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## APPENDIX D: PROBE & DIPOLE CALIBRATION DATA

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



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

Accreditation No.: **SCS 108**

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

Certificate No: **ES3-3225\_Jan12**

## CALIBRATION CERTIFICATE

Object: **ES3DV3 - SN-3225**

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

Calibration date: **January 11, 2012**

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

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


Calibration Equipment used (M&PE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	5841290874	31-Mar-11 (No. 217-01372)	Apr-12
Power sensor E4412A	5N41408087	31-Mar-11 (No. 217-01372)	Apr-12
Reference 3 dB Attenuator	SN: 05094 (3x)	29-Mar-11 (No. 217-01368)	Apr-12
Reference 20 dB Attenuator	SN: 05096 (20x)	29-Mar-11 (No. 217-01367)	Apr-12
Reference 30 dB Attenuator	SN: 05129 (30x)	29-Mar-11 (No. 217-01370)	Apr-12
Reference Probe E530V2	SN: 3013	29-Dec-11 (No. E53-3013_Dec11)	Dec-12
CAL-4	SN: 604	3-May-11 (No. DAB4-604_May11)	May-12
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8640C	US3040201700	4-Aug-09 (in house check Apr-11)	In house check Apr-13
Network Analyser HP 8753B	US37360555	18-Oct-01 (in house check Oct-11)	In house check Oct-12

Calibrated by:	Name <b>Jelco Kasrell</b>	Function <b>Laboratory Technician</b>	Signature 
Approved by:	Name <b>Katja Pitschke</b>	Function <b>Technical Manager</b>	Signature 

Issued: January 12, 2012

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 106**

#### Glossary:


TSL	Issue simulating liquid
NORM <sub>x,y,z</sub>	sensitivity in free space
ConcF	sensitivity in TSL / NORM <sub>x,y,z</sub>
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C	modulation dependent linearization parameters
Polarization $\phi$	$\phi$ rotation around probe axis
Polarization $\beta$	$\beta$ 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<sub>x,y,z</sub>: Assessed for E-field polarization  $\beta = 0$  ( $f \leq 900$  MHz in TEM-cell;  $f > 1800$  MHz: R22 waveguide). NORM<sub>x,y,z</sub> are only intermediate values, i.e., the uncertainties of NORM<sub>x,y,z</sub> does not affect the E-field uncertainty inside TSL (see below ConcF).
- NORM<sub>eff</sub>(<sub>x,y,z</sub>) = NORM<sub>x,y,z</sub> \* frequency\_response (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConcF.
- DCP<sub>x,y,z</sub>: 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<sub>x,y,z</sub>, B<sub>x,y,z</sub>, C<sub>x,y,z</sub>, VR<sub>x,y,z</sub>: 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.
- ConcF 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<sub>x,y,z</sub> \* ConcF whereby the uncertainty corresponds to that given for ConcF. A frequency dependent ConcF is used in DASY version 4.4 and higher which allows extending the validity from  $\pm 50$  MHz to  $\pm 100$  MHz.
- Spherical isotropy (3D deviation from isotropy): In a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.

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ES3DV3 – SN:3225


January 11, 2012

# Probe ES3DV3

## SN:3225

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

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

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ES3DV3– SN:3225

January 11, 2012

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

### Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ( $\mu V/\sqrt{V_{mV}^2}$ ) <sup>a</sup>	1.26	1.26	1.30	± 10.1 %
DCP (mV) <sup>b</sup>	101.2	100.8	101.2	

### Modulation Calibration Parameters


usb	Communication System Name	PAR		A dB	B dB	C dB	VR mV	Unc <sup>c</sup> (k=2)
10000	CW	0.00	X	0.00	0.00	1.00	103.9	±1.3 %
			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%.

<sup>a</sup> The uncertainties of NormX,Y,Z do not affect the E<sup>2</sup>-field uncertainty inside TSL (see Pages 8 and 9).

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

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

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ES3DV3- SN:3225

January 11, 2012


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

### Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) <sup>1</sup>	Relative Permittivity <sup>2</sup>	Conductivity (S/m) <sup>2</sup>	Coef X	Coef Y	Coef Z	Alpha	Depth (mm)	Unct. (k=2)
750	41.9	0.89	6.42	6.42	6.42	0.27	2.04	± 12.0 %
900	41.5	0.97	6.06	6.06	6.06	0.35	1.74	± 12.0 %
1810	40.0	1.40	5.23	5.23	5.23	0.73	1.21	± 12.0 %
1950	40.0	1.40	4.98	4.98	4.98	0.58	1.41	± 12.0 %
2450	39.2	1.80	4.50	4.50	4.50	0.79	1.26	± 12.0 %
2600	39.0	1.95	4.32	4.32	4.32	0.77	1.32	± 12.0 %

<sup>1</sup> 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 RSS of the Coef uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

<sup>2</sup> 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 Coef uncertainty for indicated target tissue parameters.

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ES3DV3- SN:3225

January 11, 2012


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

### Calibration Parameter Determined in Body Tissue Simulating Media

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

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

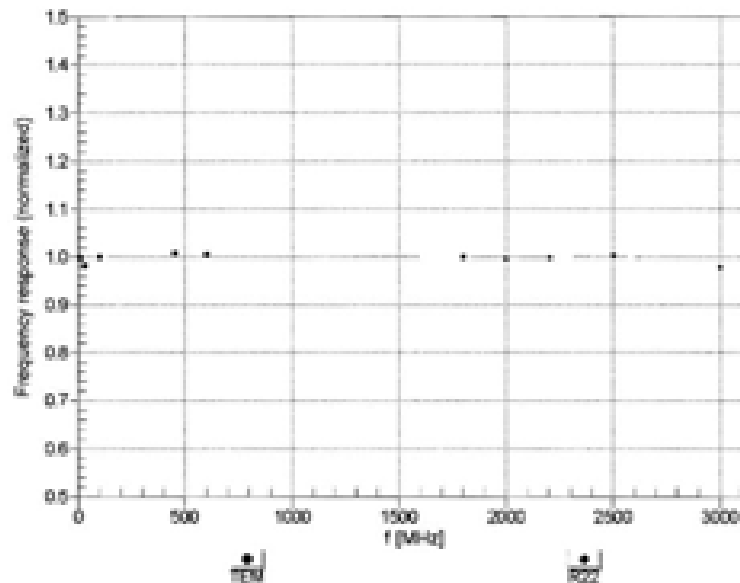
<sup>a</sup> At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the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

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ES3043- SM-3225

January 11, 2012

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


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



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**Andrew Becker**

Dates of Test  
**Nov 22, 2012 – Feb 28, 2013**

Test Report No  
**RTS-6026-1303-02**

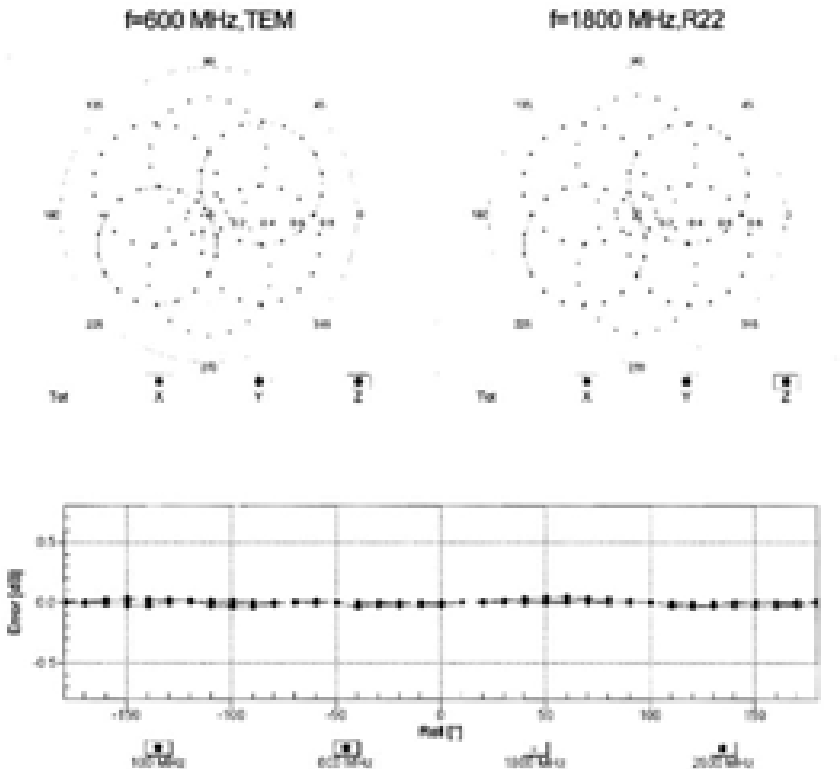
FCC ID:  
**L6ARFL110LW  
L6ARFP120LW**

IC  
**2503A-RFL110LW  
2503A-RFP120LW**

ES3073- 3M3225

January 11, 2012

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



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

Author Data  
**Andrew Becker**

Dates of Test  
**Nov 22, 2012 – Feb 28, 2013**

Test Report No  
**RTS-6026-1303-02**

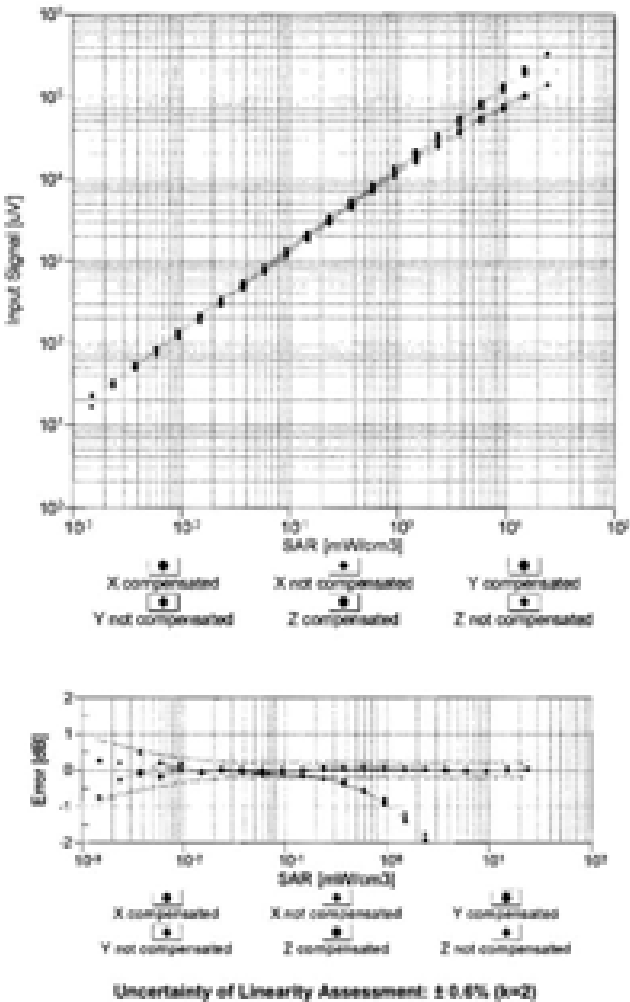
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**L6ARFL110LW  
L6ARFP120LW**

IC  
**2503A-RFL110LW  
2503A-RFP120LW**

E530V3- SN-3225

January 11, 2012

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



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Test Report No  
**RTS-6026-1303-02**

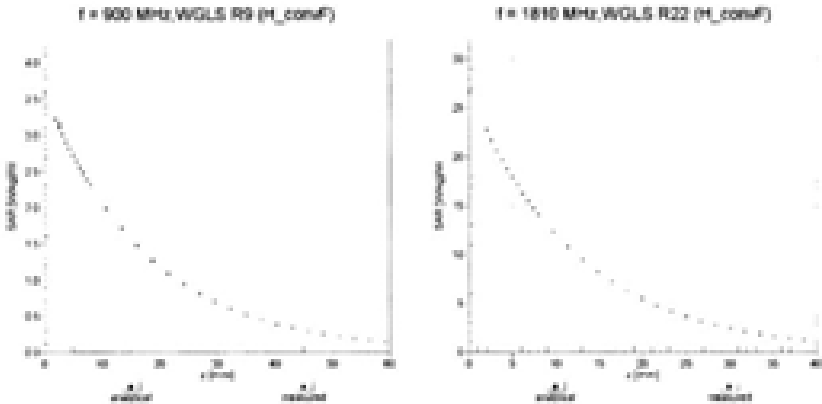
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**L6ARFL110LW  
L6ARFP120LW**

IC  
**2503A-RFL110LW  
2503A-RFP120LW**

ES33DV3- SN:3225

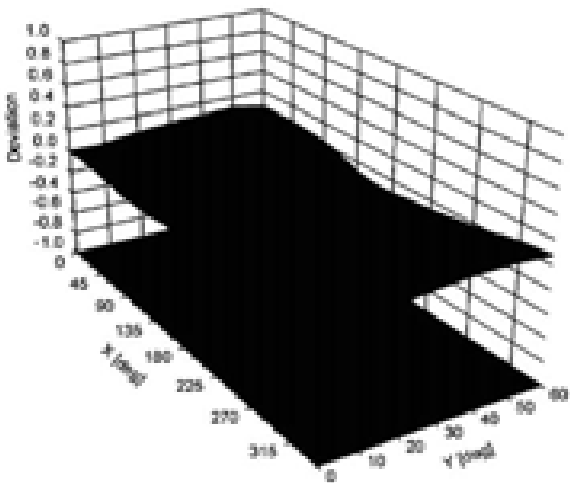
January 11, 2012

### Conversion Factor Assessment




### Deviation from Isotropy in Liquid

Error (a, b), f = 900 MHz



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

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ES3DV3- SN:3225

January 11, 2012

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

### Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	Not applicable
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	332 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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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SIC 108**

Client **RTS (RIM Testing Services)**

Certificate No: **ES3-3225\_Jan13**

## CALIBRATION CERTIFICATE

Object **ES3DV3 - SN:3225**

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



Calibration date: **January 10, 2013**


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

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

Calibration Equipment used (M&E critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter F44196	0841760874	28-Mar-12 (No. 217-01008)	Apr-12
Power sensor E44134	8714149087	28-Mar-12 (No. 217-01008)	Apr-12
Reference 1-dB Attenuator	SN: 85054 (70)	27-Mar-12 (No. 217-01001)	Apr-12
Reference 20-dB Attenuator	SN: 85086 (206)	27-Mar-12 (No. 217-01009)	Apr-12
Reference 30-dB Attenuator	SN: 85129 (306)	27-Mar-12 (No. 217-01023)	Apr-12
Reference Probe E53DV2	SN: 3213	28-Dec-12 (No. 833-3013, Dec12)	Dec-12
DAF4	SN: 660	20-Jun-12 (No. DAF4-660, Jun12)	Jun-12
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8448C	US2642UC1700	4-Aug-99 (in house check Apr-11)	In house check: Apr-12
Network Analyzer HP 8713B	US33730040	18-Oct-01 (in house check Oct-12)	In house check: Oct-12

	Name	Function	Signature
Calibrated by:	Jeton Kaspari	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	
Issued: January 14, 2013 This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			

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ConvF	sensitivity in TSL / NORM <sub>x,y,z</sub>
DCP	diode compression point
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A, B, C, D	modulation dependent linearization parameters
Polarization $\varphi$	$\varphi$ rotation around probe axis
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#### Methods Applied and Interpretation of Parameters:

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- NORM(f)<sub>x,y,z</sub> = NORM<sub>x,y,z</sub> \* frequency\_response (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- DCP<sub>x,y,z</sub>: 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<sub>k,j,z</sub>, B<sub>k,j,z</sub>, C<sub>k,j,z</sub>, D<sub>k,j,z</sub>, VR<sub>k,j,z</sub>: A, B, C, D are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- 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<sub>x,y,z</sub> \* ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from  $\pm 50$  MHz to  $\pm 100$  MHz.
- Spherical isotropy (3D deviation from isotropy): in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.

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ES3DV3 - SN:3225

January 10, 2013


# Probe ES3DV3

## SN:3225

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

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



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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. ( $\mu V/V/m$ ) <sup>1</sup>	1.28	1.18	1.31	$\pm 10.1\%$
DCP (mV) <sup>2</sup>	100.5	101.5	99.9	

### Modulation Calibration Parameters


US	Communication System Name		A dB	B dB- $\sqrt{\mu V}$	C	D dB	VR mV	Unc. <sup>3</sup> (k=2)
0	CW	X	0.0	0.0	1.0	0.00	107.5	$\pm 2.7\%$
		Y	0.0	0.0	1.0		108.4	
		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%.

<sup>1</sup> The uncertainties of NormX,Y,Z do not affect the E<sub>1</sub> field uncertainty inside T35, (see Pages 5 and 6).

<sup>2</sup> Numerical linearization parameter; uncertainty not required.

<sup>3</sup> 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 18, 2013


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

### Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) <sup>1</sup>	Relative Permittivity <sup>2</sup>	Conductivity (S/m) <sup>2</sup>	CorrF X	CorrF Y	CorrF Z	Alpha	Depth (mm)	Unc. (k=2)
750	41.9	0.89	6.56	6.56	6.56	0.42	1.54	± 12.0 %
900	41.5	0.97	6.19	6.19	6.19	0.43	1.52	± 12.0 %
1810	40.0	1.40	5.35	5.35	5.35	0.63	1.39	± 12.0 %
1950	40.0	1.40	5.09	5.09	5.09	0.60	1.23	± 12.0 %
2450	39.2	1.80	4.65	4.65	4.65	0.61	1.63	± 12.0 %
2600	39.0	1.96	4.43	4.43	4.43	0.60	1.32	± 12.0 %

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

<sup>2</sup> 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<sup>2</sup> 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) <sup>1</sup>	Relative Permittivity <sup>2</sup>	Conductivity (S/m) <sup>2</sup>	CorrF X	CorrF Y	CorrF Z	Alpha	Depth (mm)	Unc. (k=2)
750	55.5	0.96	6.27	6.27	6.27	0.48	1.51	± 12.0 %
900	55.0	1.05	6.12	6.12	6.12	0.73	1.25	± 12.0 %
1810	53.3	1.52	5.04	5.04	5.04	0.57	1.47	± 12.0 %
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 %

<sup>1</sup> 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 RSS of the CorrF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

<sup>2</sup> 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.

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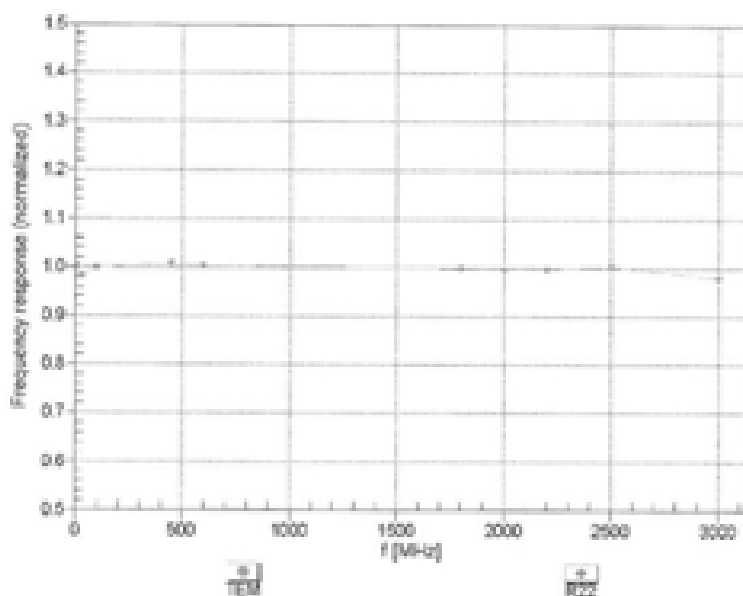
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ES330v3- Rev 3/2010

January 10, 2013

## Frequency Response of E-Field

(TEM-Cell: ifi110 EXX, Waveguide: R22)


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

Author Data  
**Andrew Becker**

Dates of Test  
**Nov 22, 2012 – Feb 28, 2013**

Test Report No  
**RTS-6026-1303-02**

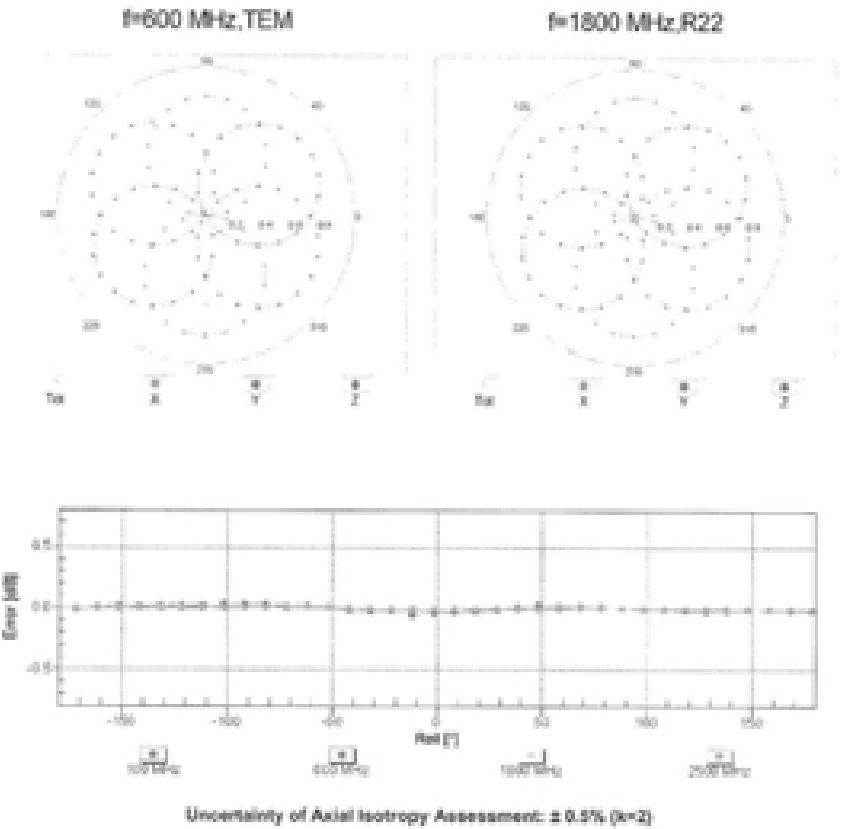
FCC ID:  
**L6ARFL110LW  
L6ARFP120LW**


IC  
**2503A-RFL110LW  
2503A-RFP120LW**

ES33DV3-5M-3225

January 10, 2013

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



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Author Data  
**Andrew Becker**

Dates of Test  
**Nov 22, 2012 – Feb 28, 2013**

Test Report No  
**RTS-6026-1303-02**

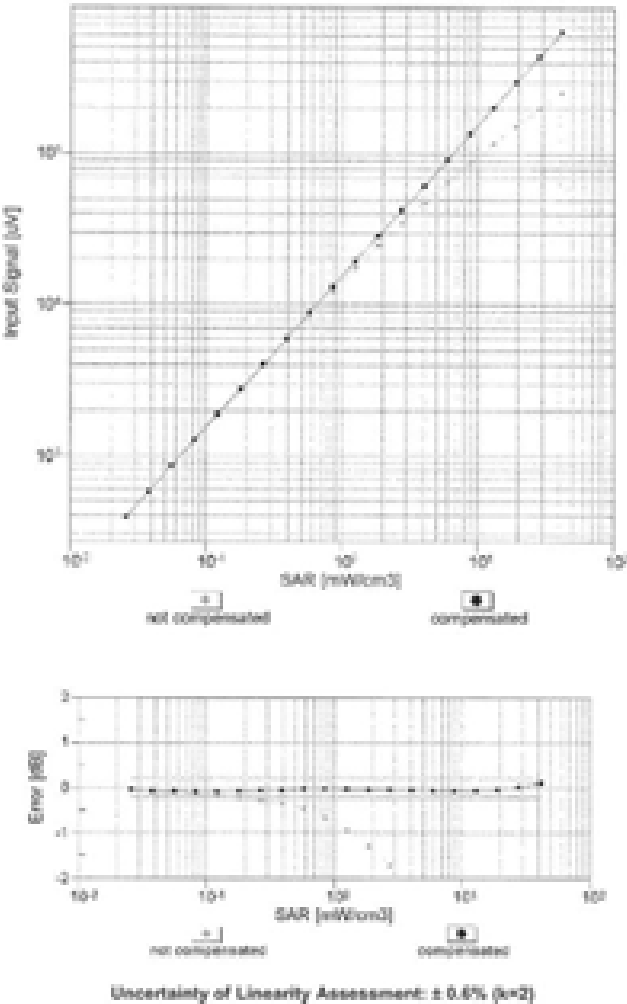
FCC ID:  
**L6ARFL110LW  
L6ARFP120LW**

IC  
**2503A-RFL110LW  
2503A-RFP120LW**

ES3-3225

January 18, 2013

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



Author Data  
**Andrew Becker**

Dates of Test  
**Nov 22, 2012 – Feb 28, 2013**

Test Report No  
**RTS-6026-1303-02**

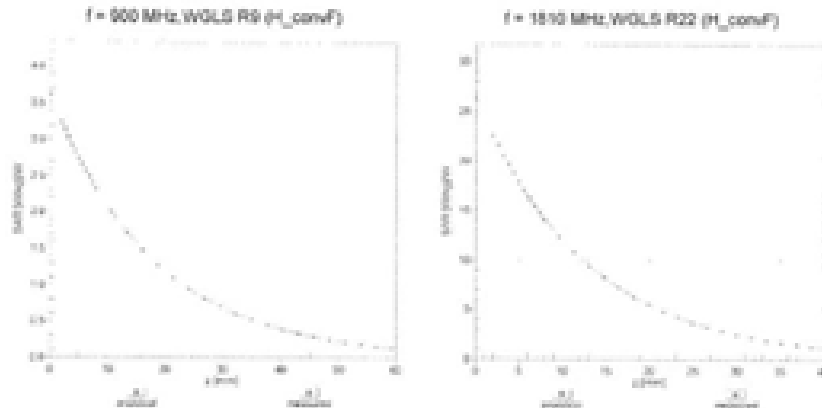
FCC ID:  
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**L6ARFP120LW**

IC  
**2503A-RFL110LW**  
**2503A-RFP120LW**

ES33225-3M3225

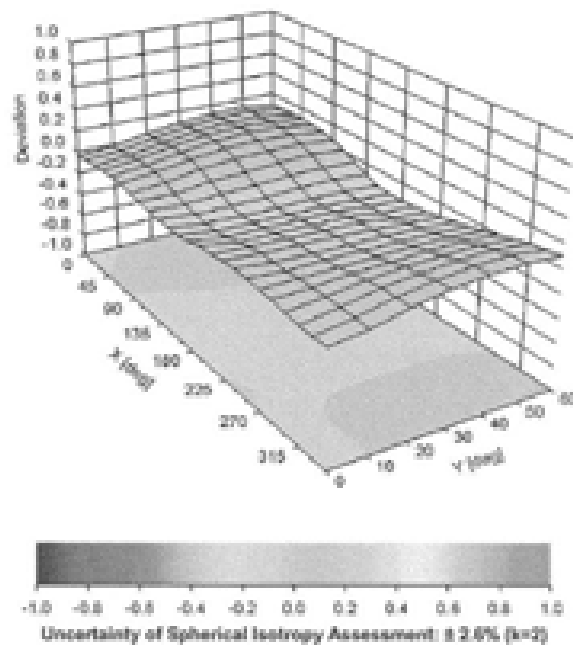
January 10, 2013


## Conversion Factor Assessment




## Deviation from Isotropy in Liquid

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



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ES3DV3- SN:3225

January 18, 2013

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

### Other Probe Parameters

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

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



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

Accreditation No.: **SCS 108**

Client **RTS (RIM Testing Services)**

Certificate No: **EX3-3592\_Nov12**

## CALIBRATION CERTIFICATE

Object: **EX3DV4 - SN 3592**

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



Calibration date: **November 14, 2012**


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

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

Calibration Equipment used (MATE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	0841293874	29-Mar-12 (No. 217-01908)	Apr-13
Power sensor E4413A	MHR1698687	29-Mar-12 (No. 217-01908)	Apr-13
Reference 3 dB Attenuator	SN: 55054 (30)	27-Mar-12 (No. 217-01537)	Apr-13
Reference 20 dB Attenuator	SN: 55085 (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 E530V2	SN: 3043	29-Dec-11 (No. E53-3013, Dec 11)	Dec-12
DA64	SN: 690	29-Jun-12 (No. DA64-690_Jun12)	Jun-13
Secondary Standards			
	ID	Check Date (in house)	Scheduled Check
RF generator HP 8640C	US3642001700	4-Aug-09 (in house check Apr-11)	In house check Apr-13
Network Analyzer HP 8753E	US37360585	18-Oct-01 (in house check Oct-02)	In house check Oct-13

Calibrated by:	Name <b>David Loubser</b>	Function <b>Laboratory Technician</b>	Signature 
Approved by:	Name <b>Keljo Petrovic</b>	Technical Manager	
Issued: November 14, 2012			
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			

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



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

Accreditation No.: **SCS 108**

#### Glossary:


TSL	tissue simulating liquid
NORM <sub>x,y,z</sub>	sensitivity in free space
ConvF	sensitivity in TSL / NORM <sub>x,y,z</sub>
DCP	diode compression point
CF	crest factor (V <sub>duty_cycle</sub> ) of the RF signal
A, B, C	modulation dependent linearization parameters
Polarization $\phi$	$\phi$ rotation around probe axis
Polarization $\beta$	$\beta$ 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<sub>x,y,z</sub>: Assessed for E-field polarization  $\beta = 0$  ( $f \leq 900$  MHz: TEM-cell;  $f > 1800$  MHz: R22 waveguide). NORM<sub>x,y,z</sub> are only intermediate values, i.e., the uncertainties of NORM<sub>x,y,z</sub> does not affect the E<sup>2</sup>-field uncertainty inside TSL (see below ConvF).
- NORM<sub>f</sub>( $x,y,z$ ) = NORM<sub>x,y,z</sub> \* frequency\_response (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- DCP<sub>x,y,z</sub>: 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<sub>x,y,z</sub>; B<sub>x,y,z</sub>; C<sub>x,y,z</sub>; VR<sub>x,y,z</sub>: A, B, C are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters: Assessed in flat phantom using E-field (or Temperature Transfer Standard for  $f \leq 800$  MHz) and inside waveguide using analytical field distributions based on power measurements for  $f > 800$  MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM<sub>x,y,z</sub> \* ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from  $\pm 50$  MHz to  $\pm 100$  MHz.
- Spherical isotropy (3D deviation from isotropy): in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.

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EX3DV4 - SN:3592

November 14, 2012


# Probe EX3DV4

## SN:3592

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

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



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EX3DV4– SN:3592

November 14, 2012

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

### Basic Calibration Parameters

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

### Modulation Calibration Parameters


UID	Communication System Name	PAR		A dB	B dB	C dB	VR mV	Unc <sup>C</sup> (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%.

<sup>A</sup> The uncertainties of Norm.X,Y,Z do not affect the E<sub>1</sub> field uncertainty inside TSL (see Pages 5 and 6).

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

<sup>C</sup> Uncertainty is determined using the rms. 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) <sup>1</sup>	Relative Permittivity <sup>2</sup>	Conductivity (S/m) <sup>2</sup>	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unc. (k=2)
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 %

<sup>1</sup> Frequency validity of ± 100 kHz only applies for DASY v4.4 and higher (see Page 23), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

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

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				IC <b>2503A-RFL110LW</b> <b>2503A-RFP120LW</b>

EX3DV4-- SN:3592

November 14, 2012


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

### Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) <sup>a</sup>	Relative Permittivity <sup>b</sup>	Conductivity (S/m) <sup>c</sup>	CorrF X	CorrF Y	CorrF Z	Alpha	Depth (mm)	Unc. (k=2)
2600	52.5	2.16	6.59	6.59	6.59	0.60	0.50	± 12.0 %
5200	49.0	5.30	4.02	4.02	4.02	0.48	1.00	± 13.1 %
5500	48.6	5.65	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 %

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

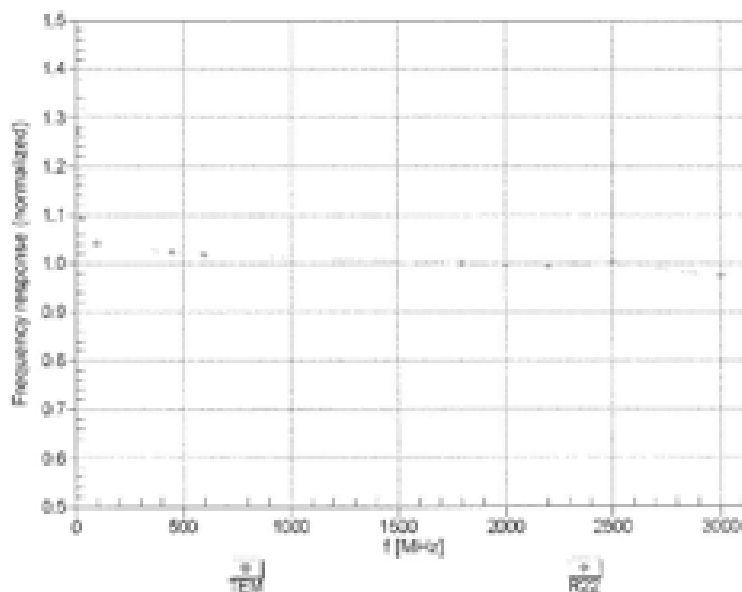
<sup>b</sup> At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the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

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

EDGDM--SN 3592

November 14, 2012

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


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

Author Data  
**Andrew Becker**

Dates of Test  
**Nov 22, 2012 – Feb 28, 2013**

Test Report No  
**RTS-6026-1303-02**

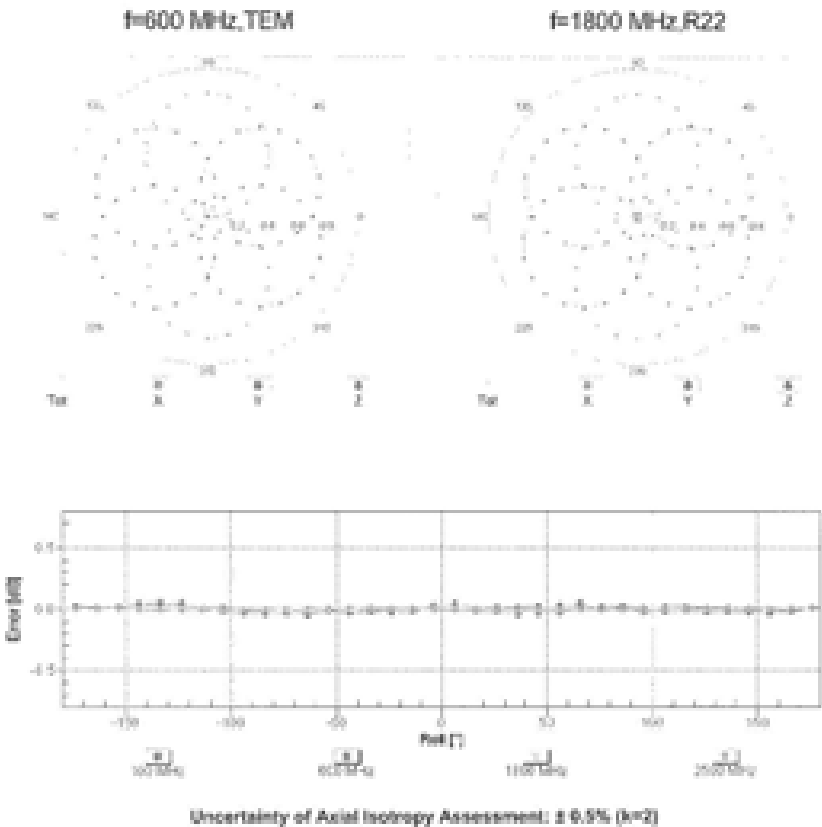
FCC ID:  
**L6ARFL110LW  
L6ARFP120LW**


IC  
**2503A-RFL110LW  
2503A-RFP120LW**

EX00V4-SN3092

November 14, 2012

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



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Author Data  
**Andrew Becker**

Dates of Test  
**Nov 22, 2012 – Feb 28, 2013**

Test Report No  
**RTS-6026-1303-02**

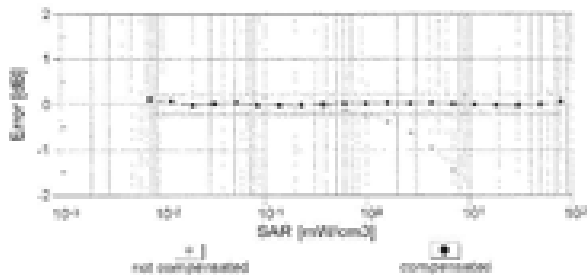
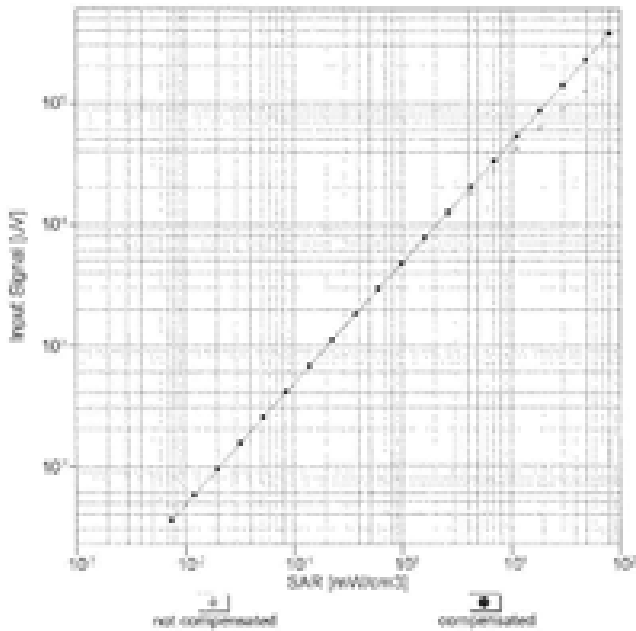
FCC ID:  
**L6ARFL110LW**  
**L6ARFP120LW**

IC  
**2503A-RFL110LW**  
**2503A-RFP120LW**

E00044-EN-3592

November 14, 2012

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



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

Author Data  
**Andrew Becker**

Dates of Test  
**Nov 22, 2012 – Feb 28, 2013**

Test Report No  
**RTS-6026-1303-02**

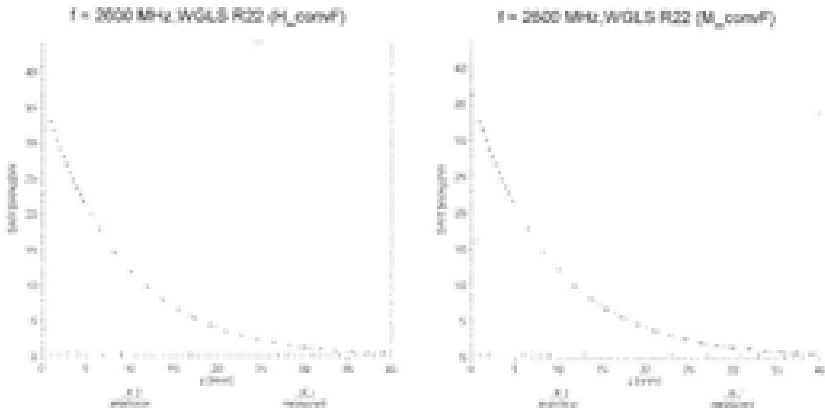
FCC ID:  
**L6ARFL110LW  
L6ARFP120LW**

IC  
**2503A-RFL110LW  
2503A-RFP120LW**

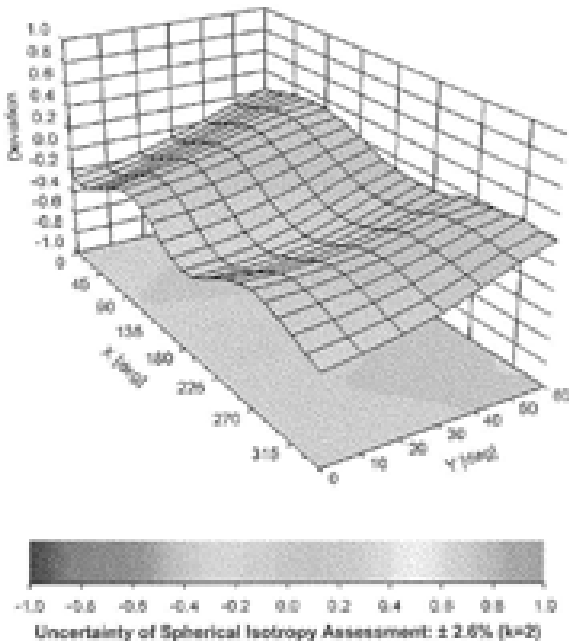
EX03D44- 0M-3592


November 14, 2012


### Conversion Factor Assessment



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



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


EX3DV4 – SN:3592

November 14, 2012

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

### Other Probe Parameters

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

	Document <b>Appendix D for the BlackBerry® Smartphone Model RFP121LW SAR Report</b>			Page <b>45(134)</b>
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**Calibration Laboratory of  
Schmid & Partner  
Engineering AG**  
Zeughausstrasse 43, 8004 Zurich, Switzerland



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

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

Accreditation No.: **SCS 108**

Client **RTS (RIM Testing Services)**

Certificate No: **ET3-1644\_Nov12**

## CALIBRATION CERTIFICATE

Object **ET3DV8 - SN:1644**

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



Calibration date: **November 13, 2012**


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

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

Calibration Equipment used (M&PE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E44199	GB4128074	29-Mar-12 (No. 217-01508)	Apr-13
Power sensor E4413A	MF41498097	29-Mar-12 (No. 217-01508)	Apr-13
Reference 3 dB Attenuator	SN: 55054 (30)	27-Mar-12 (No. 217-01520)	Apr-13
Reference 20 dB Attenuator	SN: 55086 (20)	27-Mar-12 (No. 217-01528)	Apr-13
Reference 30 dB Attenuator	SN: 55179 (30)	27-Mar-12 (No. 217-01532)	Apr-13
Reference Probe ES30V2	SN: 3013	29-Dec-11 (No. 853-3013, Dec-11)	Dec-12
DAE4	SN: 699	20-Jun-12 (No. 0A1-6460 Jun12)	Jun-13
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	U52642U1700	4-Aug-09 (in house check Apr-10)	In-house check Apr-13
Network Analyser HP 8733C	U527380595	18-Oct-01 (in house check Oct-12)	In-house check Oct-13

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

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Calibration Laboratory of  
Schmid & Partner  
Engineering AG  
Zughausstrasse 41, 8584 Zurich, Switzerland



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

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

Accreditation No.: **SCS 108**

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

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

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

#### 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.
- $A_{x,y,z}$ ;  $B_{x,y,z}$ ;  $C_{x,y,z}$ ;  $VR_{x,y,z}$ : 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  $\pm 50$  MHz to  $\pm 100$  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!)

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ET3DV6- SN:1644

November 13, 2012

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

### Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm $(\mu W/V/m)^2$ <sup>2</sup>	1.71	1.97	1.98	$\pm 10.1\%$
DCP $(mV)^2$	99.5	98.7	97.5	

### Modulation Calibration Parameters

URD	Communication System Name	FAR		A dB	B dB	C dB	VR mV	Unc <sup>3</sup> (k=2)
0	Cel	0.00	X	0.0	0.0	1.0	193.5	$\pm 3.5\%$
			Y	0.0	0.0	1.0	212.0	
			Z	0.0	0.0	1.0	201.7	


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

<sup>2</sup> The uncertainties of NormX,Y,Z do not affect the E<sup>2</sup> field uncertainty inside T3a (see Pages 5 and 6).

<sup>3</sup> Numerical linearization parameter; uncertainty not required.

<sup>4</sup> 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

November 13, 2012


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

### Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) <sup>a</sup>	Relative Permittivity <sup>b</sup>	Conductivity (S/m) <sup>c</sup>	CorrF X	CorrF Y	CorrF Z	Alpha	Depth (mm)	Uncl. (k=2)
750	41.9	0.89	6.57	6.57	6.57	0.44	2.25	± 12.0 %
900	41.5	0.97	6.24	6.24	6.24	0.38	2.52	± 12.0 %
1810	40.0	1.40	5.21	5.21	5.21	0.60	2.19	± 12.0 %
1950	40.0	1.40	5.16	5.16	5.16	0.60	2.09	± 12.0 %
3450	39.2	1.60	4.60	4.60	4.60	0.65	2.00	± 12.0 %

<sup>a</sup> Frequency validity of a 100 MHz only applies for DASY v4.4 and higher (see Page 2), also 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.

<sup>b</sup> At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be related 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.

	Document			Page
	Appendix D for the BlackBerry® Smartphone Model RFP121LW SAR Report			50(134)
Author Data Andrew Becker	Dates of Test Nov 22, 2012 – Feb 28, 2013	Test Report No RTS-6026-1303-02	FCC ID: L6ARFL110LW L6ARFP120LW	IC 2503A-RFL110LW 2503A-RFP120LW

ET3DV6- SN:1644

November 13, 2012


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

### Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) <sup>c</sup>	Relative Permittivity <sup>d</sup>	Conductivity (S/m) <sup>e</sup>	Coeff X	Coeff Y	Coeff Z	Alpha	Depth (mm)	Unc. (k=2)
750	55.5	0.86	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 %
1950	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 %

<sup>c</sup> Frequency validity of ± 150 MHz only applies for EASY 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.

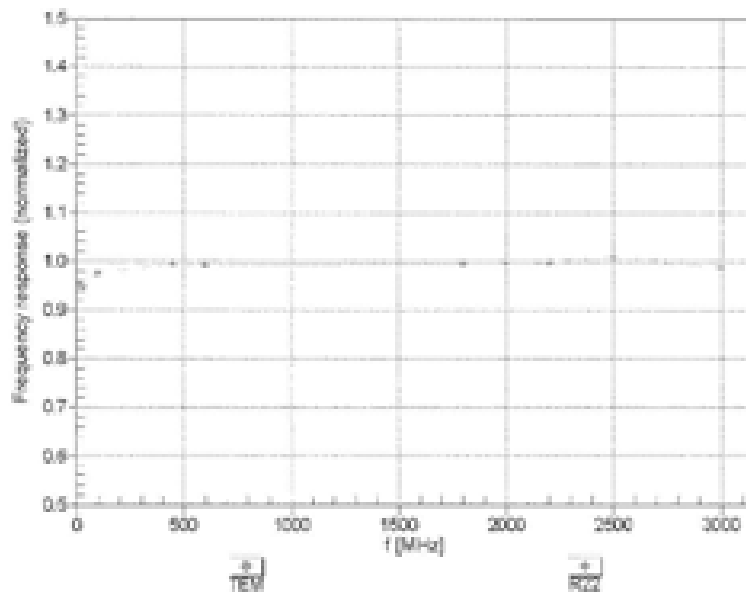
<sup>d</sup> At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the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

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ET30V6- SR-1644

November 13, 2012

### Frequency Response of E-Field (TEM-Cell: R110 EOX, Waveguide: R22)


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

Author Data  
**Andrew Becker**

Dates of Test  
**Nov 22, 2012 – Feb 28, 2013**

Test Report No  
**RTS-6026-1303-02**

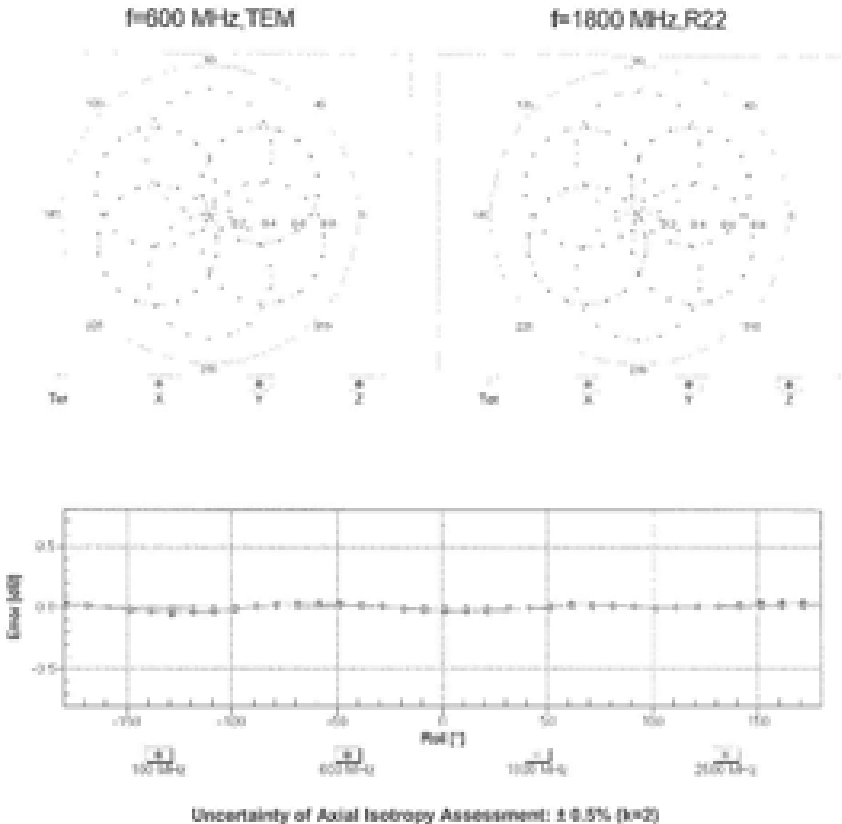
FCC ID:  
**L6ARFL110LW  
L6ARFP120LW**

IC  
**2503A-RFL110LW  
2503A-RFP120LW**

ET307V6- 3N1544

November 13, 2012

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



Author Data  
**Andrew Becker**

Dates of Test  
**Nov 22, 2012 – Feb 28, 2013**

Test Report No  
**RTS-6026-1303-02**

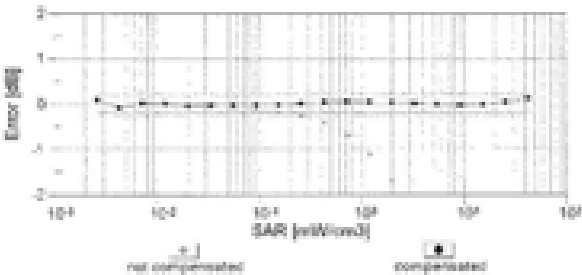
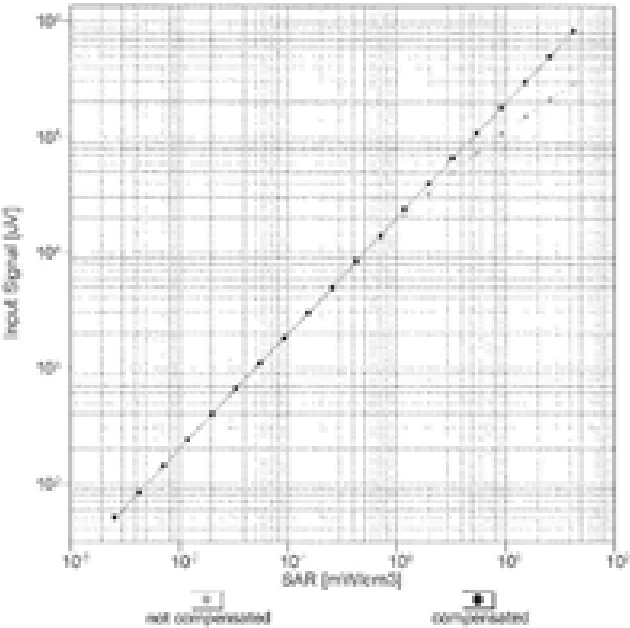
FCC ID:  
**L6ARFL110LW**  
**L6ARFP120LW**

IC  
**2503A-RFL110LW**  
**2503A-RFP120LW**

ET30146- 3N1644

November 13, 2012

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



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

Author Data  
**Andrew Becker**

Dates of Test  
**Nov 22, 2012 – Feb 28, 2013**

Test Report No  
**RTS-6026-1303-02**

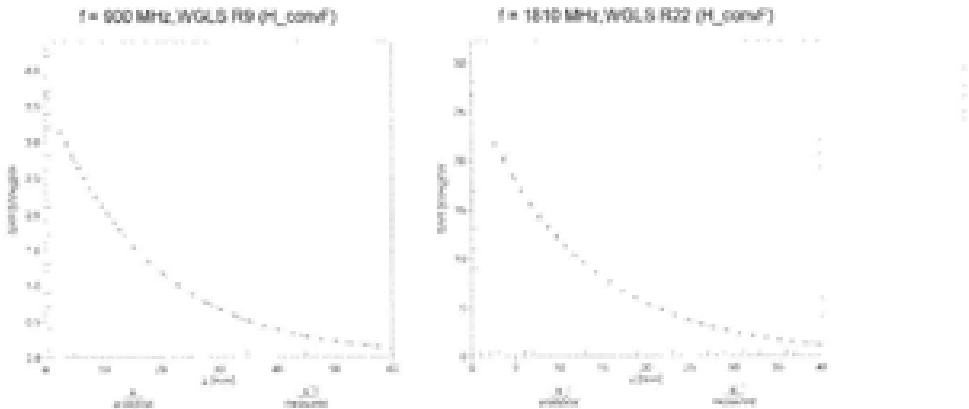
FCC ID:  
**L6ARFL110LW  
L6ARFP120LW**

IC  
**2503A-RFL110LW  
2503A-RFP120LW**

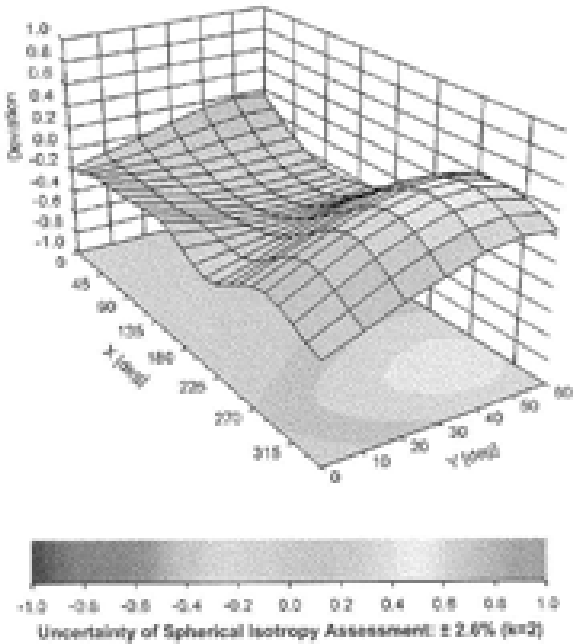
ET30V6-5N1644


November 13, 2012

### Conversion Factor Assessment



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



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


ET3DV6 - SN:1644

November 13, 2012


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

### Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	41.5
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

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



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



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

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

Accreditation No.: **SCS 108**

Client **RIM**

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

## CALIBRATION CERTIFICATE

Object **D750V3 - SN: 1021**

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

Calibration date: **January 05, 2011**

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

All calibrations have been conducted in the closed laboratory facility: environment temperature (23 ± 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	G857480704	06-Oct-10 (No. 217-01288)	Oct-11
Power sensor HP 8481A	US37282783	06-Oct-10 (No. 217-01288)	Oct-11
Reference 20 dB Attenuator	SN: 5086 (20g)	30-Mar-10 (No. 217-01158)	Mar-11
Type-N mismatch combination	SN: 5047.2 / 06327	30-Mar-10 (No. 217-01162)	Mar-11
Reference Probe ES30V3	SN: 3205	30-Apr-10 (No. ES3-3205_Apr10)	Apr-11
DAE4	SN: 601	10-Jun-10 (No. DAE4-601_Jun10)	Jun-11
Secondary Standards	ID #	Check Date (in-house)	Scheduled Check
Power sensor HP 8481A	MY41062317	18-Oct-02 (in house check Oct-08)	In-house check: Oct-11
RF generator RLS SMT-06	100005	4-Aug-09 (in house check Oct-09)	In-house check: Oct-11
Network Analyzer HP 8733E	US37390585 54205	18-Oct-01 (in house check Oct-10)	In-house check: Oct-11

Calibrated by: **Name: Jaron Kaspar** Function: **Laboratory Technician**

Approved by: **Katja Pokorski** Technical Manager

Signature




Issued: January 6, 2011

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

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

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

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

Accreditation No.: **SCS 108**

#### 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 8.

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	$750 \text{ MHz} \pm 1 \text{ MHz}$	

#### Head TSL parameters


The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.9	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 <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.12 mW / g
SAR normalized	normalized to 1W	8.48 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	$8.38 \text{ mW / g} \pm 17.0 \%$ (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.38 mW / g
SAR normalized	normalized to 1W	5.52 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	$5.45 \text{ mW / g} \pm 16.5 \%$ (k=2)

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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 warming of the dipole near the feedpoint can be measured.

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

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

### Additional EUT Data

Manufactured by	SPEAG
Manufactured on	December 04, 2010

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## DASY5 Validation Report for Head TSL

Date/Time: 05.01.2011 15:51:17

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

Medium: HSL750

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

Phantom section: Flat Section

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

### DASY5 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.37, 6.37, 6.37); Calibrated: 30.04.2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 10.06.2010
- Phantom: Flat Phantom 4.5L; Type: QD000P49AA; Serial: 1001
- Measurement SW: DASY52, V52.6 Build (401)
- Postprocessing SW: SEMCAD X, V14.4.2 Build (2595)

**P<sub>in</sub>=250mW; dip=15mm; dist=3.0mm/Zoom Scan (7x7x7)/Cube 0; Measurement grid:**

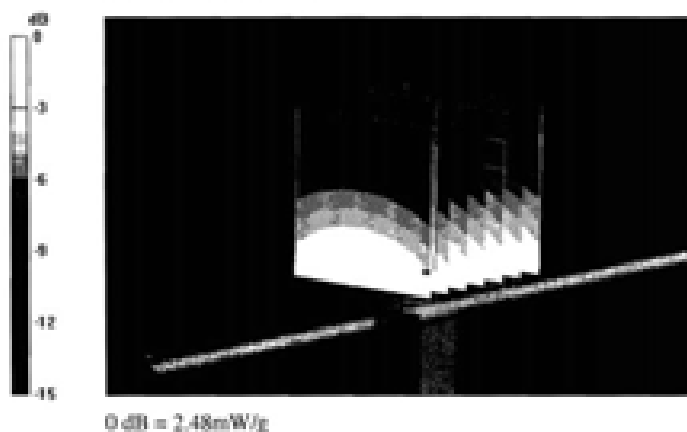
$dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

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

Peak SAR (extrapolated) = 3.24 W/kg

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

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





Author Data  
**Andrew Becker**

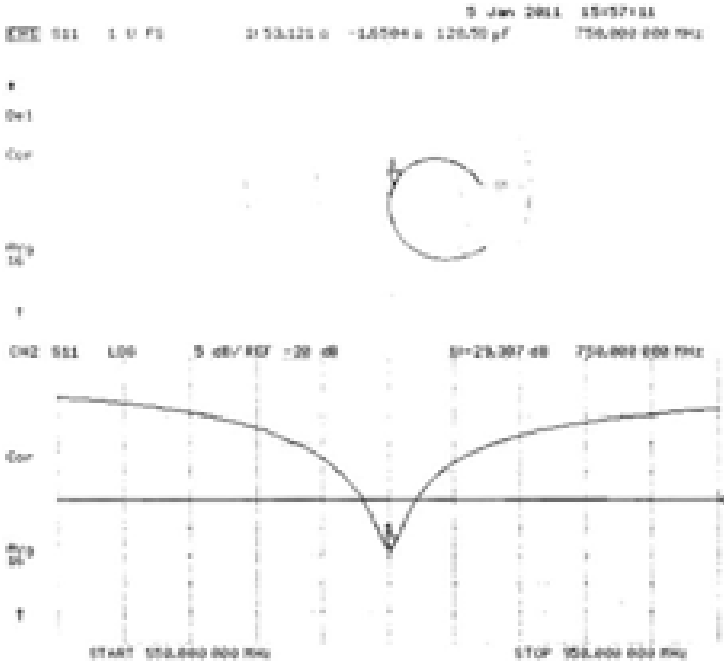
Dates of Test  
**Nov 22, 2012 – Feb 28, 2013**


Test Report No  
**RTS-6026-1303-02**

FCC ID:  
**L6ARFL110LW  
L6ARFP120LW**

IC  
**2503A-RFL110LW  
2503A-RFP120LW**

**Impedance Measurement Plot for Head TSL**



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Accreditation No.: **SCS 108**

Client **RTS (RIM Testing Services)**

Certificate No: **D750V3-1021\_Jan13**

## CALIBRATION CERTIFICATE

Object **D750V3 - SN: 1021**

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

Calibration date: **January 07, 2013**



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

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

Calibration Equipment used (MATE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter CPM-402A	04501460704	01-Nov-12 (No. 217-01640)	Oct-13
Power sensor HP 8481A	US37292783	01-Nov-12 (No. 217-01640)	Oct-13
Reference 20-dB Attenuator	SN: 3058 (30x)	27-Mar-12 (No. 217-01630)	Apr-13
Type-N mismatch combination	SN: 5047.3 / 06327	27-Mar-12 (No. 217-01630)	Apr-13
Reference Probe E530V3	SN: 3205	28-Dec-12 (No. E53-3205_Dec12)	Dec-13
DA614	SN: 601	27-Jun-12 (No. DA614-601_Jun12)	Jun-13

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MP11092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SM1-05	100005	04-Aug-09 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8713E	UC37390585 34206	18-Oct-01 (in house check Oct-12)	In house check: Oct-13


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

Issued: January 8, 2013

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Certificate No: D750V3-1021\_Jan13

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 108

#### Glossary:

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

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

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

#### Additional Documentation:


- DASY4/5 System Handbook

#### Methods Applied and Interpretation of Parameters:

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

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



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#### Measurement Conditions

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

DASY Version	DASY5	V52-6.4
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 <sup>3</sup> (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	<b>8.46 W/kg ± 17.0 % (k=2)</b>

SAR averaged over 10 cm <sup>3</sup> (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	<b>6.31 W/kg ± 16.5 % (k=2)</b>

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## Appendix

### Antenna Parameters with Head TSL

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

### General Antenna Parameters and Design

Electrical Delay (one direction)	1.000 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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## DASY5 Validation Report for Head TSL

Date: 07.01.2013

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: CW; Frequency: 750 MHz

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

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN:205; Core:R(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/ $P_{\text{in}}=250 \text{ mW}$ , $d=15\text{mm}$ /Zoom Scan (7x7x7)/Cube 0:

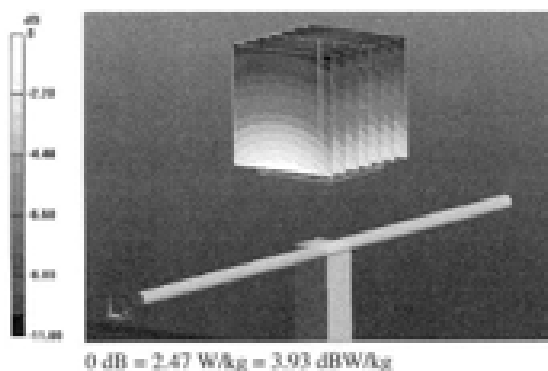
Measurement grid:  $d_x=5\text{mm}$ ,  $d_y=5\text{mm}$ ,  $d_z=5\text{mm}$

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**

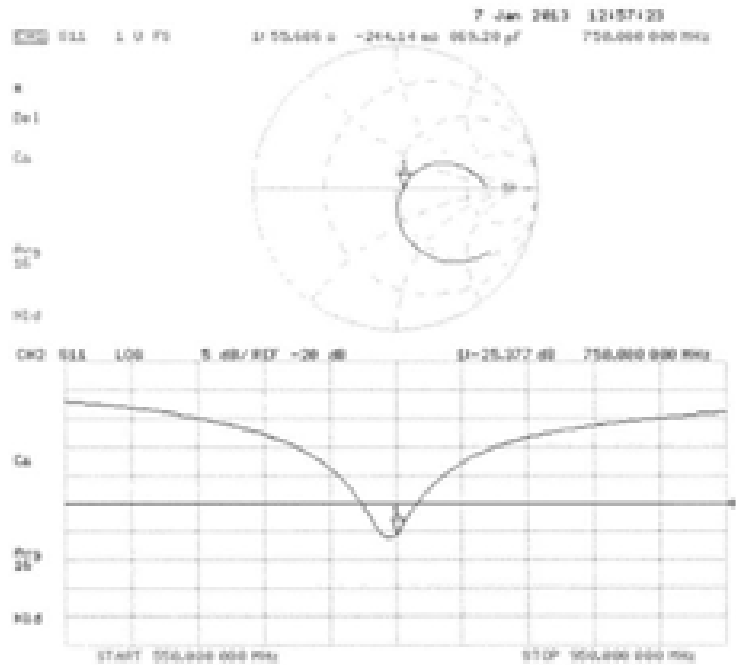
Dates of Test  
**Nov 22, 2012 – Feb 28, 2013**


Test Report No  
**RTS-6026-1303-02**


FCC ID:  
**L6ARFL110LW  
L6ARFP120LW**

IC  
**2503A-RFL110LW  
2503A-RFP120LW**

Impedance Measurement Plot for Head TSL



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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**

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

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

Calibration Equipment used (M&E critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	G837480704	06-Oct-10 (No. 217-01296)	Oct-11
Power sensor HP 8481A	US37282763	06-Oct-10 (No. 217-01296)	Oct-11
Reference 20 dB Attenuator	SN: 5086 (20g)	30-Mar-10 (No. 217-01158)	Mar-11
Type-N mismatch combination	SN: 5047.2 / 06327	30-Mar-10 (No. 217-01162)	Mar-11
Reference Probe ES30V3	SN: 3205	30-Apr-10 (No. ES3-3205_Apr10)	Apr-11
DAE4	SN: 601	10-Jun-10 (No. DAE4-601_Jun10)	Jun-11
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MH41062317	18-Oct-02 (in house check Oct-08)	In house check: Oct-11
RF generator R&S SMY-06	100005	4-Aug-99 (in house check Oct-09)	In house check: Oct-11
Network Analyser HP 8713E	US37380585 S4206	18-Oct-01 (in house check Oct-10)	In house check: Oct-11


Calibrated by:	<b>Oliver Hey</b>	Function <b>Laboratory Technician</b>	Signature 
Approved by:	<b>Katja Pokorski</b>	<b>Technical Manager</b>	

Issued: January 21, 2011

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

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

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Accreditation No.: **SCS 108**

#### Glossary:

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

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


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

#### Additional Documentation:

- DASY4/5 System Handbook

#### Methods Applied and Interpretation of Parameters:

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

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

### 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 1/4.9	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	805 MHz ± 1 MHz	

### Head TSL parameters

The following parameters and calculations were applied.


	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	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 <sup>3</sup> (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 ± 17.9 % (n=2)

SAR averaged over 10 cm <sup>3</sup> (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 % (n=2)



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## Appendix

### Antenna Parameters with Head TSL

Impedance, transformed to feed point	49.8 Ω ± 7.7 jΩ
Return Loss	~ 22.2 dB

### General Antenna Parameters and Design


Electrical Delay (one direction)	1.380 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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## DASY5 Validation Report for Head TSL

Date/Time: 21.01.2011 10:18:05

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

Medium: HSL900

Medium parameters used:  $f = 835$  MHz;  $\sigma = 0.89$  mho/m;  $\epsilon_r = 41.2$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY5 Configuration:

- Probe: ES3DV3 - SN3206; ConvF(6.03, 6.03, 6.03); Calibrated: 30.04.2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAB4 Sn601; Calibrated: 10.06.2010
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- Measurement SW: DASY52, V52.6.1 Build (408)
- Postprocessing SW: SEMCAD X, V14.4.2 Build (2595)

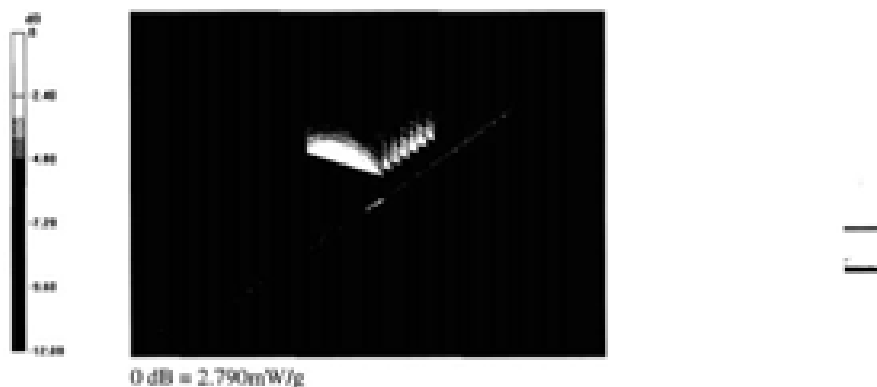
**Pin=250 mW /d=15mm, dist=3.0mm (ES-Probe)/Zoom Scan (7x7x7) /Cube 0; Measurement grid: dx=5mm, dy=5mm, dz=5mm**

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



Author Data  
**Andrew Becker**

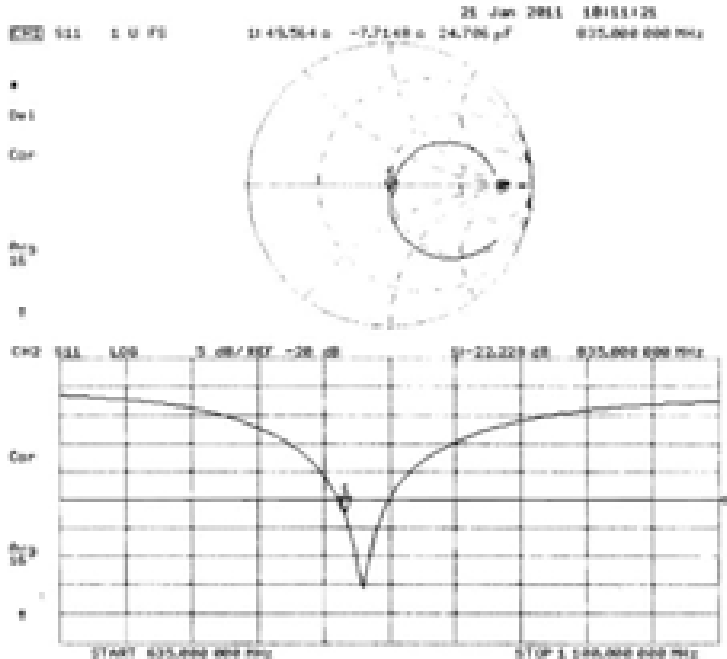
Dates of Test  
**Nov 22, 2012 – Feb 28, 2013**


Test Report No  
**RTS-6026-1303-02**

FCC ID:  
**L6ARFL110LW  
L6ARFP120LW**

IC  
**2503A-RFL110LW  
2503A-RFP120LW**

**Impedance Measurement Plot for Head TSL**



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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **RTS (RIM Testing Services)**

Certificate No: **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 ± 3°C and humidity < 70%.

Calibration Equipment used (MPE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-642A	0820460704	01-Nov-12 (No. 217-01640)	Oct-13
Power sensor HP 8481A	US37292783	01-Nov-12 (No. 217-01640)	Oct-13
Reference 20 dB Attenuator	SN: 5056 (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 ESGDV3	SN: 3205	28-Dec-12 (No. ESG-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	MY41002017	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
HP generator N65 SMT-05	100005	04-Aug-09 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8713B	US37390585 54206	18-Oct-01 (in house check Oct-12)	In house check: Oct-13


Calibrated by:	Name	Function	Signature
	Leif Rysner	Laboratory Technician	
Approved by:	Katja Polowik	Technical Manager	

Issued: January 8, 2013

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Certificate No: **D835V2-446\_Jan13**

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 108

#### Glossary:

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

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

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


#### Additional Documentation:

- DASY4/5 System Handbook

#### Methods Applied and Interpretation of Parameters:

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

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

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#### Measurement Conditions

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

DASY Version	DASY5	V92.6.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	835 MHz ± 1 MHz	

#### Head TSL parameters

The following parameters and calculations were applied.


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

#### SAR result with Head TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.38 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	6.39 W/kg ± 17.6 % (k=2)

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

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## Appendix

### Antenna Parameters with Head TSL

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

### General Antenna Parameters and Design

Electrical Delay (one direction)	1.385 ns
----------------------------------	----------


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

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

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

### Additional EUT Data

Manufactured by	SPEAG
Manufactured on	October 24, 2001

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## DASY5 Validation Report for Head TSL

Date: 07.01.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: DR35V2; Serial: DR35V2 - SN: 446

Communication System: CW; Frequency: 835 MHz

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

Phantom section: Flat Section

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

DASY52 Configuration:

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

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

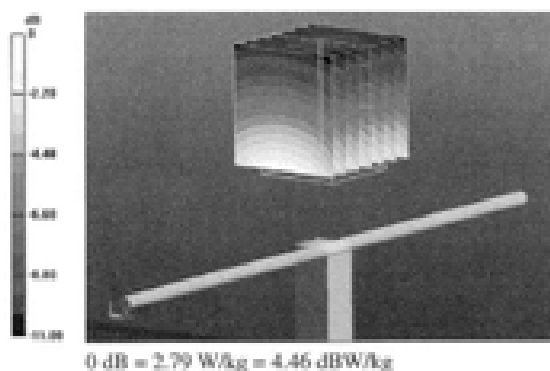
Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

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

Peak SAR (extrapolated) = 3.61 W/kg

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

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





Author Data  
**Andrew Becker**

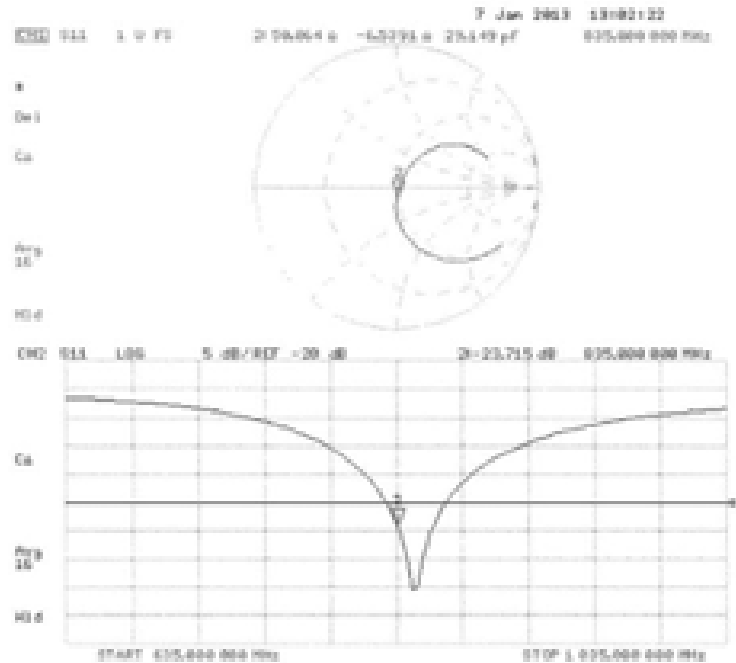
Dates of Test  
**Nov 22, 2012 – Feb 28, 2013**


Test Report No  
**RTS-6026-1303-02**


FCC ID:  
**L6ARFL110LW  
L6ARFP120LW**

IC  
**2503A-RFL110LW  
2503A-RFP120LW**

**Impedance Measurement Plot for Head TSL**



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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **RTS (RIM Testing Services)**

Certificate No: **D835V2-4d043\_Apr11**

## CALIBRATION CERTIFICATE

Object **D835V2 - SN: 4d043**

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

Calibration date: **April 07, 2011**

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

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

Calibration (Equipment used) (NISTE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-4024	0807480704	06-Oct-10 (No. 217-01060)	Oct-11
Power sensor HP 8481A	US07290780	06-Oct-10 (No. 217-01060)	Oct-11
Reference 30 dB Attenuator	SN: 3086 (P09)	29-Mar-11 (No. 217-01060)	Apr-12
Type-N mismatch combination	SN: 5047 2 / 06007	29-Mar-11 (No. 217-01071)	Apr-12
Reference Probe ES20V3	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	MPI 1060217	18-Oct-02 (in house check Oct-09)	In house check Oct-11
RF generator R&S SMF-06	100805	4-Aug-09 (in house check Oct-09)	In house check Oct-11
Network Analyzer HP 8753B	US07390585 54056	18-Oct-01 (in house check Oct-10)	In house check Oct-11

Calibrated by: **Jelena Kasirali**      Function: **Laboratory Technician**

Approved by: **Katja Polenko**      Technical Manager


Signature  
  


Issued April 7, 2011

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

Certificate No: **D835V2-4d043\_Apr11**

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

Accreditation No.: **SCS 108**

#### Glossary:

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

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


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

#### Additional Documentation:

- DASY4/5 System Handbook

#### Methods Applied and Interpretation of Parameters:

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

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

#### Measurement Conditions

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

DASY Version	DASY5	V5.2.6.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V4.9	
Distance Dipole Center - TSL	15 mm	with Specor
Zoom Scan Resolution	$dx, dy, dz = 5 \text{ mm}$	
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	0.90 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 <sup>2</sup> (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.33 mW / g
SAR normalized	normalized to 1W	9.32 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	<b>9.43 mW / g <math>\pm 17.6 \%</math> (k=2)</b>

SAR averaged over 10 cm <sup>2</sup> (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.52 mW / g
SAR normalized	normalized to 1W	6.08 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	<b>6.14 mW / g <math>\pm 16.5 \%</math> (k=2)</b>

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## Appendix

### Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.8 $\Omega$ - 3.4 j $\Omega$
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

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## DASY5 Validation Report for Head TSL

Date/Time: 07.04.2011 09:28:21

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

Medium: HSL900

Medium parameters used:  $f = 835$  MHz;  $\sigma = 0.88$  mho/m;  $\epsilon_r = 40.6$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

### DASY5 Configuration:

- Probe: ES3DV3 - SN3205; Coef F(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 4.9L; Type: QD000P49AA; Serial: 1001
- Measurement SW: DASY52, V52.6.2 Build (424)
- Postprocessing SW: SEMCAD X, V14.4.4 Build (2829)

**P<sub>in</sub>=250 mW /d=15mm/Cube 0;**

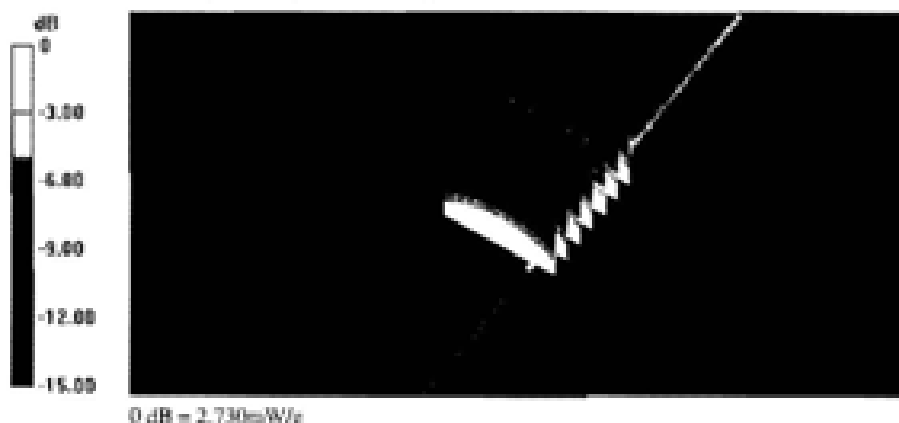
Measurement grid: d<sub>x</sub>=5mm, d<sub>y</sub>=5mm, d<sub>z</sub>=5mm

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

Peak SAR (extrapolated) = 3.504 W/kg


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

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







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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 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)


Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	0803480704	06-Oct-10 (No. 217-01266)	Oct-11
Power sensor HP 8481A	US37392763	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 E530V3	SN: 3205	30-Apr-10 (No. E53-3205_Apr10)	Apr-11
DAE4	SN: 601	10-Jun-10 (No. DAE4-601_Jun10)	Jun-11

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MPH1000317	18-Oct-02 (in house check Oct-09)	In house check: Oct-11
RF generator R&S SM7-06	100005	4-Aug-99 (in house check Oct-09)	In house check: Oct-11
Network Analyzer HP 8713E	US37390585 54206	18-Oct-01 (in house check Oct-10)	In house check: Oct-11

	Name	Function	Signature
Calibrated by:	<b>Dimos Iliev</b>	<b>Laboratory Technician</b>	
Approved by:	<b>Katja Pokorski</b>	<b>Technical Manager</b>	

Issued: January 13, 2011

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Accreditation No.: **SCS 108**

#### Glossary:

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

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


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

#### Additional Documentation:

- DASY4/5 System Handbook

#### Methods Applied and Interpretation of Parameters:

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

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#### Measurement Conditions

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

DASY Version	DASY5	V52.6
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1800 MHz ± 1 MHz	

#### Head TSL parameters


The following parameters and calculations were applied.

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

#### SAR result with Head TSL

SAR averaged over 1 cm³ (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 ± 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.13 mW / g
SAR normalized	normalized to 1W	20.5 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	20.5 mW / g ± 16.5 % (k=2)

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## Appendix

### Antenna Parameters with Head TSL

Impedance, transformed to feed point	$46.5 \Omega - 7.3 j\Omega$
Return Loss	$-21.5 \text{ dB}$

### General Antenna Parameters and Design


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

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

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

### Additional EUT Data

Manufactured by	SPEAG
Manufactured on	September 07, 2001

	Document			Page
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#### 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:  $f = 1800 \text{ MHz}$ ;  $\sigma = 1.38 \text{ mho/m}$ ;  $\epsilon_r = 38.7$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY5 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(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**

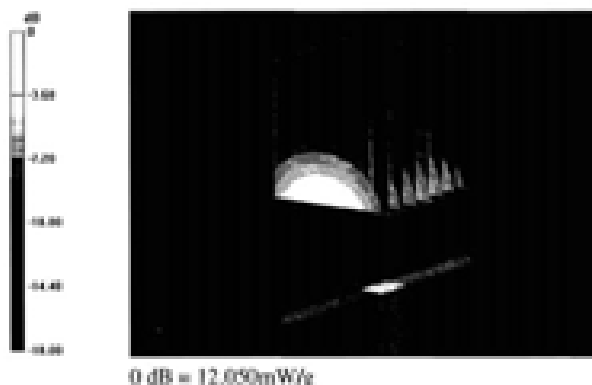
grid: dx=5mm, dy=5mm, dz=5mm

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





Author Data  
**Andrew Becker**

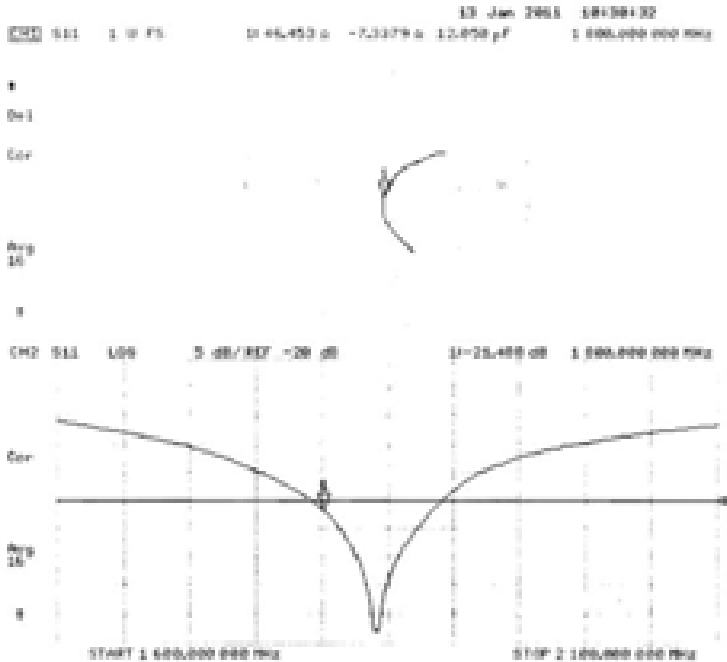
Dates of Test  
**Nov 22, 2012 – Feb 28, 2013**


Test Report No  
**RTS-6026-1303-02**

FCC ID:  
**L6ARFL110LW  
L6ARFP120LW**

IC  
**2503A-RFL110LW  
2503A-RFP120LW**

**Impedance Measurement Plot for Head TSL**



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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **RTS (RIM Testing Services)**

Certificate No: **D1800V2-2d020\_Jan13**

## CALIBRATION CERTIFICATE

Object **D1800V2 - SN: 2d020**

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

Calibration date: **January 09, 2013**



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

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

Calibration Equipment used (MATE critical for calibration):

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	0807460704	01-Nov-12 (No. 217-01640)	Oct-13
Power sensor HP 8481A	U507292780	01-Nov-12 (No. 217-01640)	Oct-13
Reference 20 dB Attenuator	SN: 5058 (204)	27-Mar-12 (No. 217-01630)	Apr-13
Type-N mismatch combination	SN: 5047.3 / 06397	27-Mar-12 (No. 217-01630)	Apr-13
Reference Probe E530V3	SN: 5005	26-Dec-12 (No. E53-3005_Dec12)	Dec-13
DAE4	SN: 601	27-Jan-12 (No. 04E14-601_Jan12)	Jan-13

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MFV10002017	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator PLS SMT-06	100006	04-Aug-09 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8713C	U507290585 54706	18-Oct-01 (in house check Oct-12)	In house check: Oct-13


	Name	Function	Signature
Calibrated by:	Israr El-Nasouj	Laboratory Technician	
Approved by:	Katja Polovic	Technical Manager	

Issued: January 8, 2013

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Certificate No: **D1800V2-2d020\_Jan13**

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 108

#### Glossary:

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

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

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

#### Additional Documentation:


- DASY4/5 System Handbook

#### Methods Applied and Interpretation of Parameters:

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

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



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#### Measurement Conditions

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

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

#### Head TSL parameters


The following parameters and calculations were applied:

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	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 <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.61 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>38.5 W/kg ± 17.8 % (k=2)</b>

SAR averaged over 10 cm <sup>3</sup> (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	<b>20.3 W/kg ± 16.5 % (k=2)</b>

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

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

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

### Additional EUT Data

Manufactured by	SPEAG
Manufactured on	September 07, 2001

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				IC <b>2503A-RFL110LW</b> <b>2503A-RFP120LW</b>

## DASY5 Validation Report for Head TSL

Date: 09/01/2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1800 MHz; Type: D1800V2; Serial: D1800V2 - SN: 24020

Communication System: CW; Frequency: 1800 MHz

Medium parameters used:  $f = 1800$  MHz;  $\sigma = 1.38$  S/m;  $\epsilon_r = 38.9$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; CorrF(5.04, 5.04, 5.04); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.4(1052); SEMCAD X 14.6.8(7028)

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

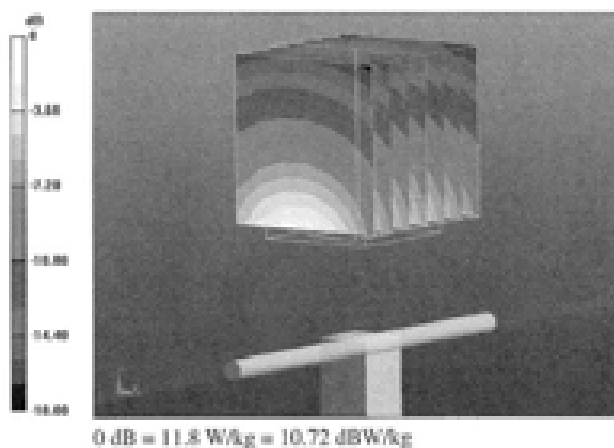
Measurement grid: dx=5mm, dy=5mm, dz=5mm

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


Peak SAR (extrapolated) = 17.5 W/kg


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

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





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**Calibration Laboratory of  
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Engineering AG**  
Zauggstrasse 43, 8034 Zurich, Switzerland



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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **RTS (RIM Testing Services)**


Certificate No: **D1900V2-545\_Jan11**

## CALIBRATION CERTIFICATE

Object	<b>D1900V2 - SN: 545</b>		
Calibration procedure(s)	<b>QA-CAL-05.v8 Calibration procedure for dipole validation kits</b>		
Calibration date:	<b>January 13, 2011</b>		
<p>This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).  The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.</p> <p>All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity &lt; 70%.</p> <p>Calibration Equipment used (MATE critical for calibration)</p>			
Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	0807480704	06-Oct-10 (No. 217-01266)	Oct-11
Power sensor HP 8481A	US37262763	06-Oct-10 (No. 217-01266)	Oct-11
Reference 20 dB Attenuator	SN: 5085 (20g)	30-Mar-10 (No. 217-01156)	Mar-11
Type-N mismatch combination	SN: 5047.2 / 06327	30-Mar-10 (No. 217-01162)	Mar-11
Reference Probe E530V3	SN: 3205	30-Apr-10 (No. E53-3205_Apr10)	Apr-11
DAE4	SN: 605	10-Jun-10 (No. 0464-601_Jun10)	Jun-11
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MFV41052317	18-Oct-02 (in house check Oct-09)	In house check: Oct-11
RF generator R&S SM1-06	100005	4-Aug-09 (in house check Oct-09)	In house check: Oct-11
Network Analyzer HP 8753E	US37260565 54206	18-Oct-01 (in house check Oct-10)	In house check: Oct-11
Calibrated by:	Name <b>Dirk Baur</b>	Function <b>Laboratory Technician</b>	Signature 
Approved by:	Name <b>Ralph Finkbein</b>	Technical Manager	
<p>This calibration certificate shall not be reproduced except in full without written approval of the laboratory.</p> <p>Issued: January 14, 2011</p>			

Certificate No: **D1900V2-545\_Jan11**

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Zughausstrasse 43, 8004 Zurich, Switzerland



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**S** Swiss Calibration Service

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

Accreditation No.: **SCS 108**

#### Glossary:

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

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


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

#### Additional Documentation:

- DASY4/5 System Handbook

#### Methods Applied and Interpretation of Parameters:

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

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#### Measurement Conditions

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

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

#### Head TSL parameters

The following parameters and calculations were applied.


	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	39.5 ± 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 <sup>3</sup> (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 ± 17.6 % (k=2)

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



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## Appendix

### Antenna Parameters with Head TSL

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

### General Antenna Parameters and Design


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

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

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

### Additional EUT Data

Manufactured by	SPEAG
Manufactured on	November 15, 2001

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## DASY5 Validation Report for Head TSL

Date/Time: 13.01.2011 14:52:49

Test Laboratory: 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/m<sup>3</sup>

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: DAB4 Sn601; Calibrated: 10.06.2010
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- Measurement SW: DASY52, V52.6.1 Build (408)
- Postprocessing SW: SEMCAD X, V14.4.2 Build (2595)

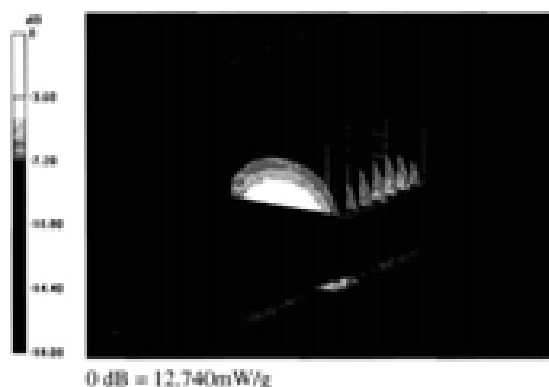
Pin=250 mW /d=10mm, dist=3.0mm (ES-Probe)/Zoom Scan (7x7x7) /Cube 0; Measurement grid: dx=5mm, dy=5mm, dz=5mm

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

Peak SAR (extrapolated) = 18.648 W/kg


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

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



0 dB = 12.740mW/g



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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		
<p>This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).  The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.</p> <p>All calibrations have been conducted in the closed laboratory facility; environment temperature (22 ± 3)°C and humidity &lt; 70%.</p> <p>Calibration Equipment used (MATE critical for calibration)</p>			
Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-400A	0807480704	01-Nov-12 (No. 217-01040)	Oct-13
Power sensor HP 8481A	US37292763	01-Nov-12 (No. 217-01040)	Oct-13
Reference 20 dB Attenuator	SN: 5056 (204)	27-Mar-12 (No. 217-01520)	Apr-13
Type-N mismatch combination	SN: 5247.3 / 98327	27-Mar-12 (No. 217-01520)	Apr-13
Reference Probe E530V3	SN: 3005	26-Dec-12 (No. E53-3005_Dec12)	Dec-13
DAE4	SN: 601	27-Jun-12 (No. DAE4-001_Jun12)	Jun-13
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MT41090317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator RMS SM7 06	100005	04-Aug-09 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37290585 54206	18-Oct-01 (in house check Oct-12)	In house check: Oct-13
Calibrated by:	Name Toris El-Nedouy	Function Laboratory Technician	Signature 
Approved by:	Name Katja Pokorski	Technical Manager	
<p>This calibration certificate shall not be reproduced except in full without written approval of the laboratory.</p> <p>Issued: January 9, 2013</p>			

Certificate No.: D1900V2-545\_Jan13

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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%.

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#### Measurement Conditions

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

DASY Version	DASY5	V52.8.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz ± 1 MHz	

#### Head TSL parameters


The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.0	1.60 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	39.4 ± 6 %	1.38 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	—	—

#### SAR result with Head TSL

SAR averaged over 1 cm <sup>2</sup> (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	10.0 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	40.2 W/kg ± 17.0 % (k=2)

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

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## Appendix

### Antenna Parameters with Head TSL

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

### 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/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; CoreF(4.98, 4.98, 4.98); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sa601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.4(1052); SEMCAD X 14.6.8(7028)

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

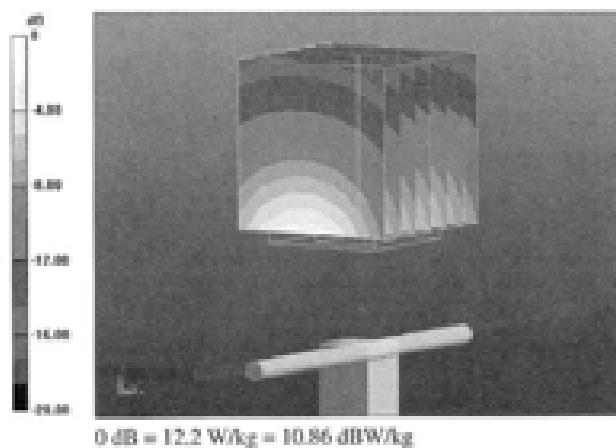
Measurement grid: dx=5mm, dy=5mm, dz=5mm

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

Peak SAR (extrapolated) = 18.1 W/kg

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

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







Author Data  
**Andrew Becker**

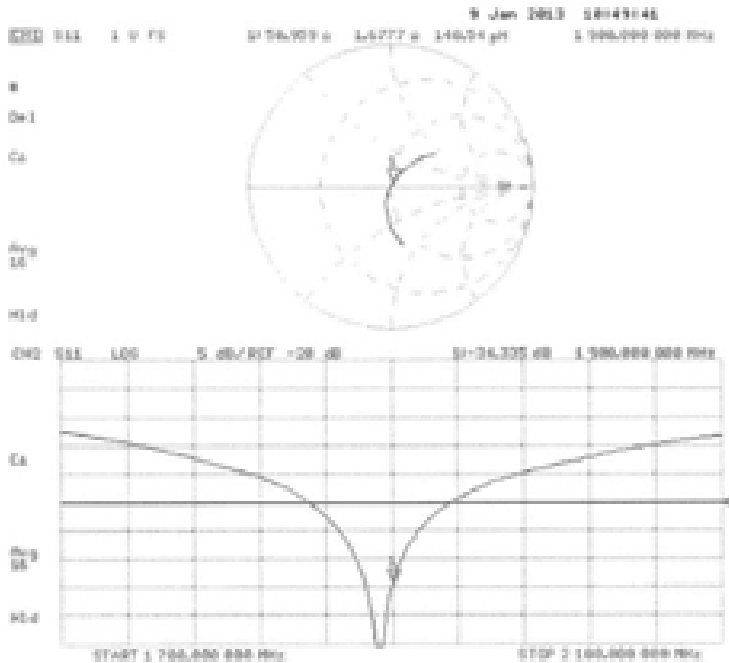
Dates of Test  
**Nov 22, 2012 – Feb 28, 2013**


Test Report No  
**RTS-6026-1303-02**


FCC ID:  
**L6ARFL110LW  
L6ARFP120LW**

IC  
**2503A-RFL110LW  
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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: **D1900V2-5d075\_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 (20 ± 3)°C and humidity < 70%.

Calibration Equipment used (MPE/E critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM 440x	45537460704	06-Oct-10 (No. 217-01266)	Oct-11
Power sensor HP 8461A	15327260763	06-Oct-10 (No. 217-01266)	Oct-11
Polyspace 20 dB Attenuator	SN: 1086 (J06)	29-Mar-11 (No. 217-01368)	Apr-12
Type-N mismatch combination	SN: 2047.2 / 06027	29-Mar-11 (No. 217-01371)	Apr-12
Reference Probe ES30V3	SN: 3205	30-Apr-10 (No. E53-3205_Apr10)	Apr-11
DA84	SN: 601	10-Jun-10 (No. DA84-601_Jun10)	Jun-11
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8461A	M141002317	18-Oct-07 (in house check Oct-08)	In house check Oct-11
RF generator R&S SMT-66	106055	4-Aug-99 (in house check Oct-09)	In house check Oct-11
Network Analyzer HP 8713E	15327300545 54094	18-Oct-01 (in house check Oct-10)	In house check Oct-11

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

Approved by: **Katja Polzella** Technical Manager

Signature 




Issued: April 6, 2011

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

Certificate No: **D1900V2-5d075\_Apr11**

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



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**S** Servizio svizzero di taratura  
**S** Swiss Calibration Service

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

Accreditation No.: **SCS 108**

#### Glossary:

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

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


- IEEE Std 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	V50.0.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz ± 1 MHz	

### Head TSL parameters


The following parameters and calculations were applied

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

### SAR result with Head TSL

SAR averaged over 1 cm <sup>3</sup> (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 <sup>3</sup> (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	$53.5 \Omega + 6.1 j\Omega$
Return Loss	-23.3 dB

### General Antenna Parameters and Design

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


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

The dipole is made of standard semirigid coaxial cable. The center conductor of the loading 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/m<sup>3</sup>

Phantom section: Flat Section

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

## DASY5 Configuration:

- Probe: ES01W3 - SNT006; Cal/H15.09, 5.09, 5.09; Calibrated: 30.04.2010
- Sensor-Surface: 3mm (Mechanical Surface Detectors)
- Electronic: DASA Sat06; Calibrated: 10.06.2010
- Phantom: Flat Phantom SAR (Front); Type: QD000P35AA; Serial: 1001
- Measurement SW: DASY52, V32.6.2 Build (424)
- Postprocessing SW: SIMCAD-X, V14.4.6 Build (2029)

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

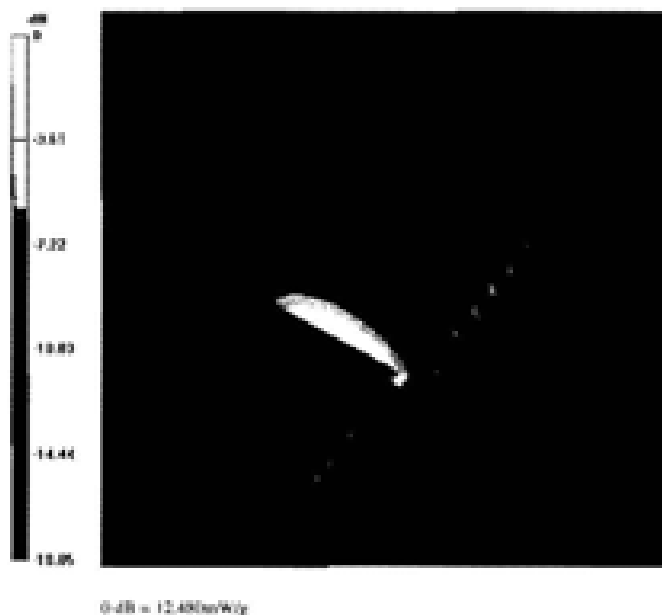
Measurement grid:  $\Delta x=5$ mm,  $\Delta y=5$ mm,  $\Delta z=5$ mm


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

Peak SAR (extrapolated) = 18.796 W/kg

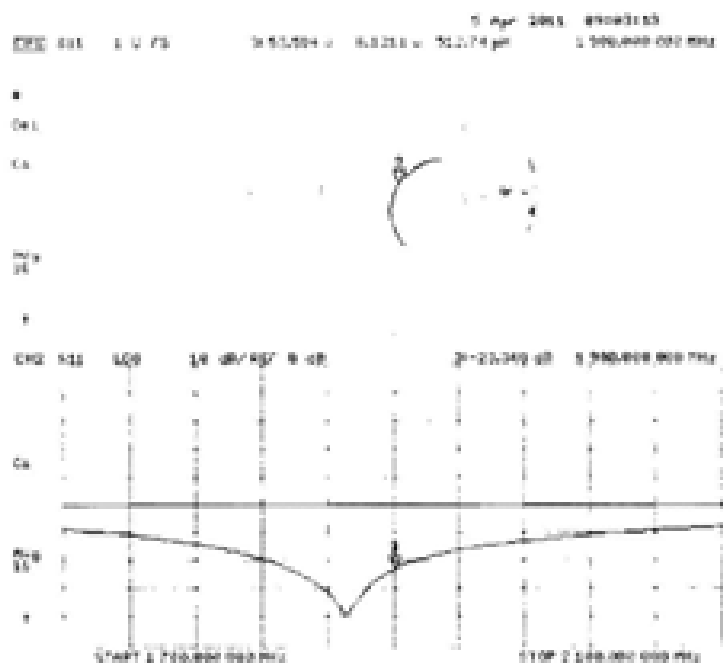
SAR(1 g) = 10.2 mW/g; SAR(10 g) = 5.29 mW/g

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




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# Impedance Measurement Plot for Head TSL





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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

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

Certificate No.: **D2450V2-747\_Nov11**

## CALIBRATION CERTIFICATE

Object: **D2450V2 - SN: 747**  
  
Calibration procedure(s): **QA CAL-05.v6**  
**Calibration procedure for dipole validation kits above 700 MHz**  
  
Calibration date: **November 09, 2011**

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

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 75%.

Calibration Equipment used (MELTE, official for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	08027482704	05-Oct-11 (No. 217-0145/1)	Oct-12
Power sensor HP 8481A	US37292785	05-Oct-11 (No. 217-0145/1)	Oct-12
Reference 20-dB Attenuator	SN: 5086 (20g)	29-Mar-11 (No. 217-01368)	Apr-12
Type-N mismatch combination	SN: 5047.2 / 06327	29-Mar-11 (No. 217-01371)	Apr-12
Reference Probe ES30V3	SN: 3205	29-Apr-11 (No. ES3-3205_Apr11)	Apr-12
DA44	SN: 601	04-Jul-11 (No. DA44-601_Jul11)	Jul-12
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41062017	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-09 (in house check Oct-11)	In house check: Oct-13
Network Analyser HP 8753E	US37390585 54206	18-Oct-01 (in house check Oct-11)	In house check: Oct-12


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

Issued: November 9, 2011

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

Certificate No: **D2450V2-747\_Nov11**

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Accreditation No.: **SCS 108**

#### Glossary:

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

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


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

#### Additional Documentation:

- DASY4/5 System Handbook

#### Methods Applied and Interpretation of Parameters:

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

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#### Measurement Conditions

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

DASY Version	DASY5	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 <sup>3</sup> (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 <sup>3</sup> (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	25.5 mW / g ± 16.5 % (k=2)

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## Appendix

### Antenna Parameters with Head TSL

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

### General Antenna Parameters and Design

Electrical Delay (one direction)	1.561 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	SPEAG
Manufactured on	December 01, 2003

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# DASY5 Validation Report for Head TSL

Date: 09.11.2011

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: CW; Frequency: 2450 MHz

Medium parameters used:  $f = 2450 \text{ MHz}$ ;  $\sigma = 1.84 \text{ mho/m}$ ;  $\epsilon_r = 37.7$ ;  $\rho = 1000 \text{ kg/m}^3$

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: QD000P50AA; Serial: 1001
- DASY52 52.6.2(482); SEMCAD X 14.4.5(3634)

Dipole Calibration for Head Tissue/ $P_{in}=250 \text{ mW}$ ,  $d=10\text{mm}$ /Zoom Scan (7x7x7)/Cube 0:

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

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





Author Data  
**Andrew Becker**

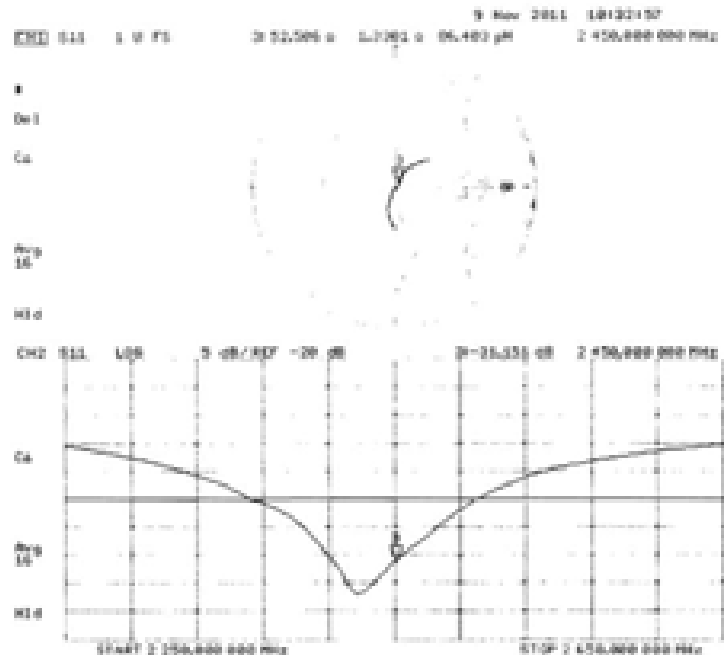
Dates of Test  
**Nov 22, 2012 – Feb 28, 2013**


Test Report No  
**RTS-6026-1303-02**

FCC ID:  
**L6ARFL110LW  
L6ARFP120LW**

IC  
**2503A-RFL110LW  
2503A-RFP120LW**

**Impedance Measurement Plot for Head TSL**



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Accreditation No.: **SGS 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  $20 \pm 2^\circ\text{C}$  and humidity  $< 70\%$ .

Calibration Equipment used (MATE critical for calibration)


Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	0607480704	05-Oct-11 (No. 217-01401)	Oct-12
Power sensor HP 8481A	U537292783	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 / 06327	29-Mar-11 (No. 217-01371)	Apr-12
Reference Probe EX3DV4	SN: 3603	04-Mar-11 (No. EX3-3603_Mar11)	Mar-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	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator RMS SMT-06	100005	04-Aug-09 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8713B	U537300585-54206	18-Oct-01 (in house check Oct-11)	In house check: Oct-12

Calibrated by:	Name <b>Dirce Bay</b>	Function <b>Laboratory Technician</b>	Signature 
Approved by:	Name <b>Rafal Polonski</b>	Technical Manager	

Issued: November 15, 2011

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Accreditation No.: **SCS 108**

#### Glossary:

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

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

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


#### Additional Documentation:

- DASY4/5 System Handbook

#### Methods Applied and Interpretation of Parameters:

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



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#### Measurement Conditions

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

DASY Version	DASY5	V52.6.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy = 4.0 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
Frequency	5200 MHz ± 1 MHz 5500 MHz ± 1 MHz 5800 MHz ± 1 MHz	

#### Head TSL parameters at 5200 MHz

The following parameters and calculations were applied.

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

#### SAR result with Head TSL at 5200 MHz

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.16 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	80.8 mW / g ± 17.0 % (k=2)

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

#### Head TSL parameters at 5500 MHz


The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.6	4.96 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.2 ± 6 %	4.75 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	---	---

#### SAR result with Head TSL at 5500 MHz

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

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

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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	36.3	5.27 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	33.7 ± 8 %	5.03 mho/m ± 8 %
Head TSL temperature change during test	< 0.5 °C	-----	-----

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

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.03 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	79.4 mW / g ± 17.8 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.28 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	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 $\Omega$ - 8.7 $\mu\Omega$
Return Loss	- 21.2 dB

### Antenna Parameters with Head TSL at 5500 MHz

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

### Antenna Parameters with Head TSL at 5800 MHz

Impedance, transformed to feed point	56.7 $\Omega$ - 4.3 $\mu\Omega$
Return Loss	- 22.6 dB

### General Antenna Parameters and Design


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

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

### Additional EUT Data

Manufactured by	SPEAG
Manufactured on	July 09, 2004

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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:  $f = 5200 \text{ MHz}$ ;  $\sigma = 4.46 \text{ mho/m}$ ;  $\epsilon_r = 34.6$ ;  $\rho = 1000 \text{ kg/m}^3$ , Medium parameters used:  $f = 5500 \text{ MHz}$ ;  $\sigma = 4.75 \text{ mho/m}$ ;  $\epsilon_r = 34.2$ ;  $\rho = 1000 \text{ kg/m}^3$ , Medium parameters used:  $f = 5800 \text{ MHz}$ ;  $\sigma = 5.03 \text{ mho/m}$ ;  $\epsilon_r = 33.7$ ;  $\rho = 1000 \text{ kg/m}^3$   
Phantom section: Flat Section  
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

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

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

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

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

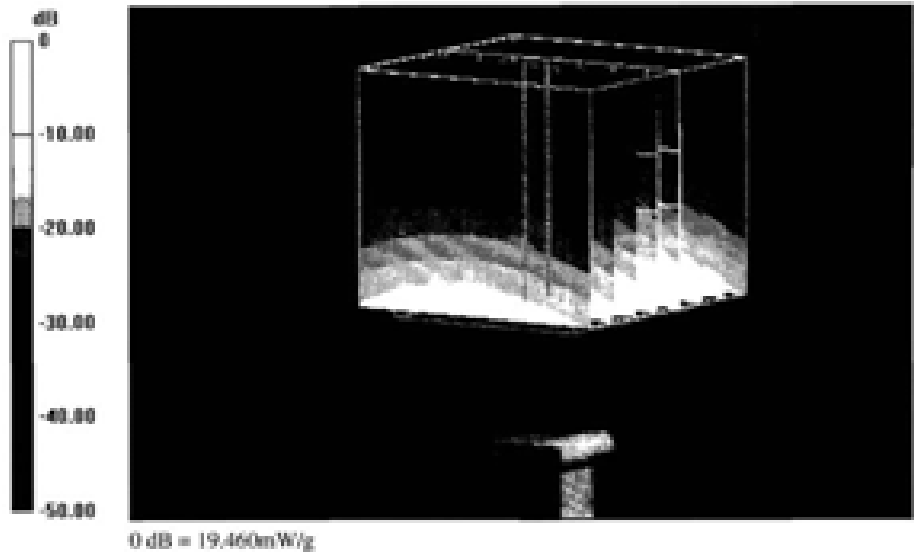
Author Data  
**Andrew Becker**

Dates of Test  
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**RTS-6026-1303-02**

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IC  
**2503A-RFL110LW  
2503A-RFP120LW**



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L6ARFP120LW**

IC  
**2503A-RFL110LW  
2503A-RFP120LW**

**Impedance Measurement Plot for Head TSL**

