Calibration Laboratory of

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

Accredited by the Swiss Accreditation Service (SAS)

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Client **PC** Test Certificate No: ES3-3209 Mar13

CALIBRATION CERTIFICATE

Object	ES3DV3 - SN:3209	
Calibration procedure(s)	QA CAL-01.v8, QA CAL-23.v4, QA CAL-25.v4 Calibration procedure for dosimetric E-field probes	
Calibration date:	March 15, 2013	
	ments the traceability to national standards, which realize the physical units of measurements (SI). certainties with confidence probability are given on the following pages and are part of the certificat	
All calibrations have been cond	ucted in the closed laboratory facility: environment temperature (22 \pm 3)°C and humidity < 70%.	1.8 5
Calibration Equipment used (M	&TE critical for calibration)	Y WYW

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	29-Mar-12 (No. 217-01508)	Apr-13
Power sensor E4412A	MY41498087	29-Mar-12 (No. 217-01508)	Apr-13
Reference 3 dB Attenuator	SN: S5054 (3c)	27-Mar-12 (No. 217-01531)	Apr-13
Reference 20 dB Attenuator	SN: S5086 (20b)	27-Mar-12 (No. 217-01529)	Арг-13
Reference 30 dB Attenuator	SN: S5129 (30b)	27-Mar-12 (No. 217-01532)	Apr-13
Reference Probe ES3DV2	SN: 3013	28-Dec-12 (No. ES3-3013_Dec12)	Dec-13
DAE4	SN: 660	31-Jan-13 (No. DAE4-660_Jan13)	Jan-14
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-11)	In house check: Apr-13
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

	Name	Function	Signature
Calibrated by:	Israe El-Naouq	Laboratory Technician	Asrae Arnaeerg
Approved by:	Katja Pokovic	Technical Manager	Letter 1
			Issued: March 15, 2013
This calibration certificate	e shall not be reproduced except in ful	without written approval of the lat	poratory.



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Certificate No: ES3-3209_Mar13

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Calibration Laboratory of

Glossary

Schmid & Partner Engineering AG Zeughausstrasse 43, 8004 Zurich, Switzerland





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Servizio svizzero di taratura

Swiss Calibration Service

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Giussary.	
TSL	tissue simulating liquid
NORMx,y,z	sensitivity in free space
ConvF	sensitivity in TSL / NORMx,y,z
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C, D	modulation dependent linearization parameters
Polarization φ	φ rotation around probe axis
Polarization 9	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\vartheta = 0$ is normal to probe axis

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

- NORMx, y, z: Assessed for E-field polarization 9 = 0 (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx, y, z are only intermediate values, i.e., the uncertainties of NORMx, y, z does not affect the E²-field uncertainty inside TSL (see below ConvF).
- NORM(f)x,y,z = NORMx,y,z * frequency_response (see Frequency Response Chart). This linearization is
 implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included
 in the stated uncertainty of ConvF.
- DCPx,y,z: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- Ax,y,z; Bx,y,z; Cx,y,z; Dx,y,z; VRx,y,z: A, B, C, D are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters: Assessed in flat phantom using E-field (or Temperature Transfer Standard for f ≤ 800 MHz) and inside waveguide using analytical field distributions based on power measurements for f > 800 MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORMx,y,z * ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical isotropy (3D deviation from isotropy): in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.

Accreditation No.: SCS 108

Probe ES3DV3

SN:3209

Manufactured: Calibrated:

October 14, 2008 March 15, 2013

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

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm $(\mu V/(V/m)^2)^A$	1.35	1.33	1.14	± 10.1 %
DCP (mV) ^B	99.2	97.8	98.3	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB√μV	С	D dB	VR mV	Unc ^E (k=2)
0	CW	X	0.0	0.0	1.0	0.00	163.6	±3.5 %
		Y	0.0	0.0	1.0		170.3	
		Z	0.0	0.0	1.0		158.7	

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%.

 ⁸ Numerical linearization parameter: uncertainty not required.
 ⁶ Uncertainty is determined using the max, deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

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

f (MHz) ^c	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	41.9	0.89	6.74	6.74	6.74	0.76	1.18	± 12.0 %
835	41.5	0.90	6.46	6.46	6.46	0.31	1.81	± 12.0 %
1750	40.1	1.37	5.39	5.39	5.39	0.80	1.21	± 12.0 %
1900	40.0	1.40	5.21	5.21	5.21	0.78	1.26	± 12.0 %
2450	39.2	1.80	4.57	4.57	4.57	0.65	1.43	± 12.0 %
2600	39.0	1.96	4.43	4.43	4.43	0.75	1.36	± 12.0 %

Calibration Parameter Determined in Head Tissue Simulating Media

^c Frequency validity of \pm 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to \pm 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. ^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to \pm 10% if liquid compensation formula is applied to

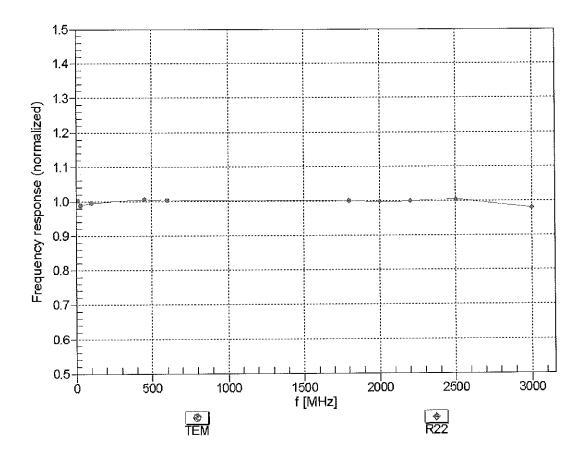
^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty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

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	55.5	0.96	6.38	6.38	6.38	0.80	1.16	± 12.0 %
835	55.2	0.97	6.28	6.28	6.28	0.52	1.45	± 12.0 %
1750	53.4	1.49	5.03	5.03	5.03	0.58	1.45	± 12.0 %
1900	53.3	1.52	4.77	4.77	4.77	0.70	1.36	± 12.0 %
2450	52.7	1.95	4.34	4.34	4.34	0.80	1.15	± 12.0 %
2600	52.5	2.16	4.11	4.11	4.11	0.80	1.00	± 12.0 %

Calibration Parameter Determined in Body Tissue Simulating Media

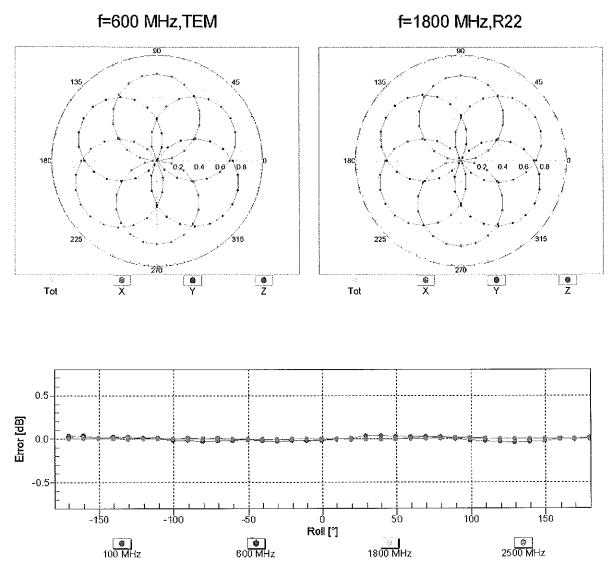
^c Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. ^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to

^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to \pm 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 \pm 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.



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

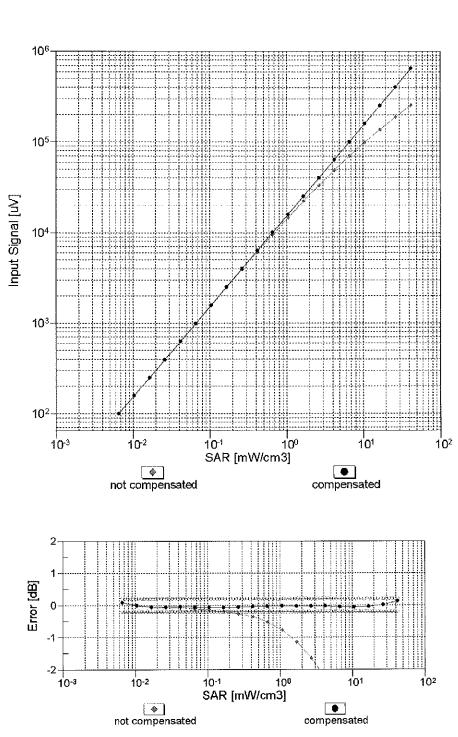
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)



Receiving Pattern (ϕ), $\vartheta = 0^{\circ}$

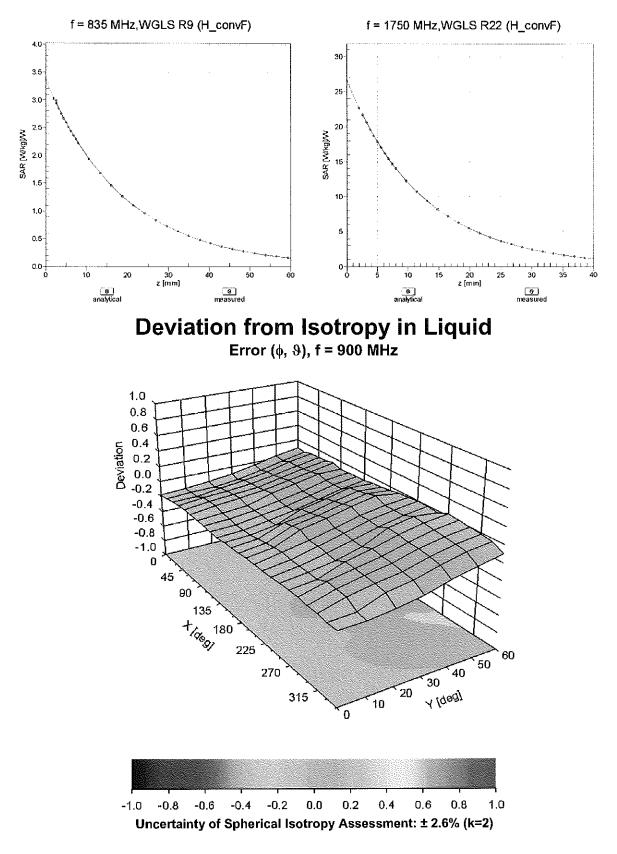
Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

March 15, 2013



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

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



Conversion Factor Assessment

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-40.6
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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Client PC Test

Certificate No: ES3-3213_Apr13

Accreditation No.: SCS 108

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CALIBRATION CERTIFICATE

Object	ES3DV3 - SN:3213				
Calibration procedure(s)	QA CAL-01.v8, QA CAL-23.v4, QA CAL-25.v4 Calibration procedure for dosimetric E-field probes				
Calibration date:	April 29, 2013				
This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.					
All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.					

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	04-Apr-13 (No. 217-01733)	Apr-14
Power sensor E4412A	MY41498087	04-Apr-13 (No. 217-01733)	Арг-14
Reference 3 dB Attenuator	SN: S5054 (3c)	04-Apr-13 (No. 217-01737)	Apr-14
Reference 20 dB Attenuator	SN: S5277 (20x)	04-Apr-13 (No. 217-01735)	Apr-14
Reference 30 dB Attenuator	SN: S5129 (30b)	04-Apr-13 (No. 217-01738)	Apr-14
Reference Probe ES3DV2	SN: 3013	28-Dec-12 (No. ES3-3013_Dec12)	Dec-13
DAE4	SN: 660	31-Jan-13 (No. DAE4-660_Jan13)	Jan-14
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-13)	In house check: Apr-15
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

	Name	Function	Signature
Calibrated by:	Dimce Iliev	Laboratory Technician	$A \mathcal{N}_{\mathcal{M}}$
			W. XIW
Approved by:	Katja Pokovic	Technical Manager	17 W
Арргомеа ву.	Rayan Orovio	이는 것 같아요? 것 같아? 것 같아요? 안 안 가 다.	Job Kor
			Issued: April 29, 2013
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This calibration certificat	e shall not be reproduced except in ful	without written approval of the labo	ratory.

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Glossary: TSL tissue simulating liquid NORMx,y,z sensitivity in free space sensitivity in TSL / NORMx,y,z ConvF DCP diode compression point CF crest factor (1/duty_cycle) of the RF signal modulation dependent linearization parameters A, B, C, D Polarization () φ rotation around probe axis 9 rotation around an axis that is in the plane normal to probe axis (at measurement center), Polarization 9 i.e., $\vartheta = 0$ is normal to probe axis

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

- NORMx,y,z: Assessed for E-field polarization 9 = 0 (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not affect the E²-field uncertainty inside TSL (see below ConvF).
- NORM(f)x,y,z = NORMx,y,z * frequency_response (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- *DCPx,y,z*: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- *PAR*: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- Ax,y,z; Bx,y,z; Cx,y,z; Dx,y,z; VRx,y,z: A, B, C, D are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters: Assessed in flat phantom using E-field (or Temperature Transfer Standard for f ≤ 800 MHz) and inside waveguide using analytical field distributions based on power measurements for f > 800 MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORMx,y,z * ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical isotropy (3D deviation from isotropy): in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.

Probe ES3DV3

SN:3213

Calibrated:

Manufactured: October 14, 2008 April 29, 2013

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

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm $(\mu V/(V/m)^2)^A$	1.47	1.36	1.33	± 10.1 %
DCP (mV) ^B	103.0	100.8	100.7	

Modulation Calibration Parameters

UID	Communication System Name		Α	В	С	D	VR	Unc [⊨]
			dB	dBõV		dB	mV	(k=2)
0	CW	X	0.0	0.0	1.0	0.00	171.2	±2.7 %
		Y	0.0	0.0	1.0		172.4	
		Z	0.0	0.0	1.0		169.5	

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

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

^B Numerical linearization parameter: uncertainty not required.

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

					-			
f (MHz) ^c	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	41.9	0.89	6.54	6.54	6.54	0.45	1.49	± 12.0 %
835	41.5	0.90	6.30	6.30	6.30	0.31	1.77	± 12.0 %
1450	40.5	1.20	5.41	5.41	5.41	0.26	2.35	± 12.0 %
1750	40.1	1.37	5.22	5.22	5.22	0.79	1.18	± 12.0 %
1900	40.0	1.40	5.08	5.08	5.08	0.80	1.20	± 12.0 %
2450	39.2	1.80	4.49	4.49	4.49	0.79	1.28	± 12.0 %
2600	39.0	1.96	4.36	4.36	4.36	0.79	1.24	± 12.0 %

Calibration Parameter Determined in Head Tissue Simulating Media

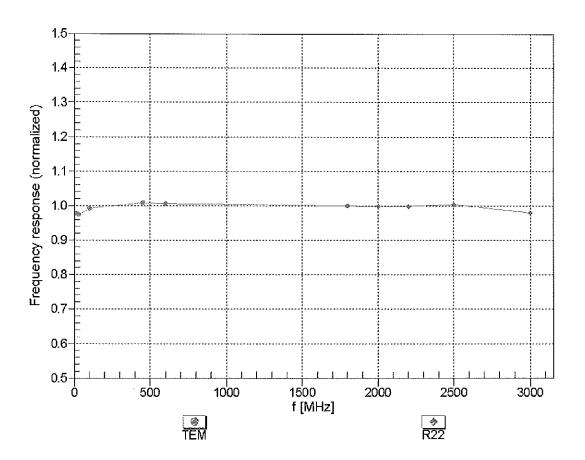
^c Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. ^F At frequencies below 3 GHz, the validity of tissue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

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	55.5	0.96	6.32	6.32	6.32	0.44	1.54	± 12.0 %
835	55.2	0.97	6.25	6.25	6.25	0.37	1.77	± 12.0 %
1450	54.0	1.30	5.28	5.28	5.28	0.57	1.42	± 12.0 %
1750	53.4	1.49	4.95	4.95	4.95	0.66	1.34	± 12.0 %
1900	53.3	1.52	4.73	4.73	4.73	0.55	1.51	± 12.0 %
2450	52.7	1.95	4.29	4.29	4.29	0.65	1.18	± 12.0 %
2600	52.5	2.16	4.11	4.11	4.11	0.60	0,87	± 12.0 %

Calibration Parameter Determined in Body Tissue Simulating Media

^C Frequency validity of \pm 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to \pm 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. ^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to \pm 10% if liquid compensation formula is applied to

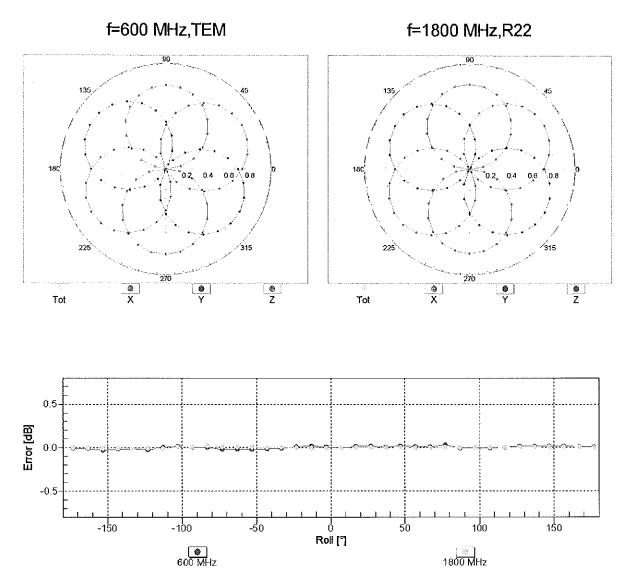
^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to \pm 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to \pm 5%. The uncertainty is the RSS of the ConvF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



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

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

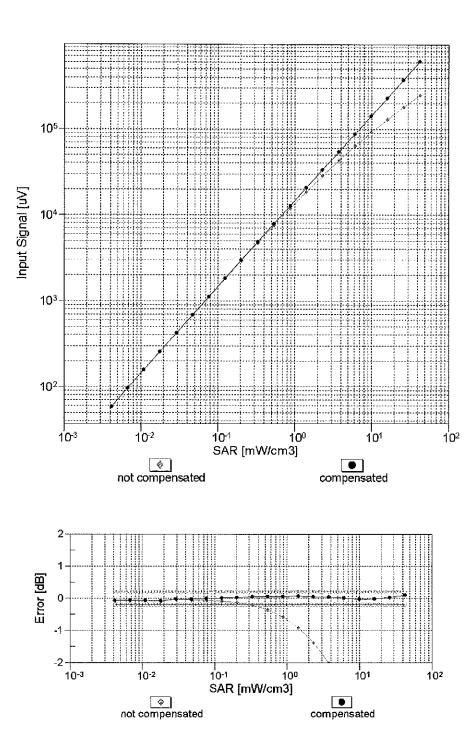
Certificate No: ES3-3213_Apr13



Receiving Pattern (ϕ), $\vartheta = 0^{\circ}$

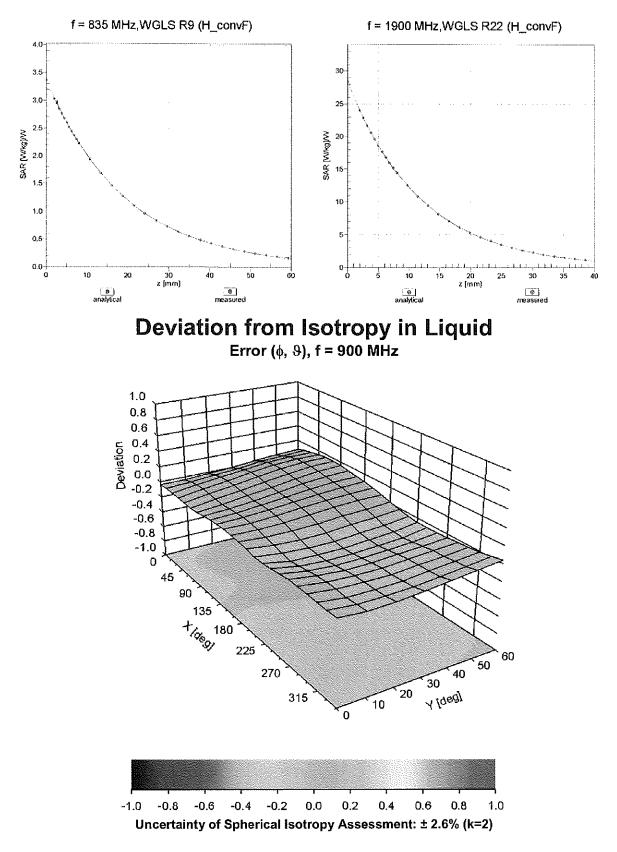
Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

April 29, 2013



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

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



Conversion Factor Assessment

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-33.1
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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Client PC Test

Certificate No: ES3-3263_May13

Accreditation No.: SCS 108

CALIBRATION CERTIFICATE

Object	ES3DV3 - SN:3263
Calibration procedure(s)	QA CAL-01.v8, QA CAL-23.v4, QA CAL-25.v4 Calibration procedure for dosimetric E-field probes
	Viet all's
Calibration date:	May 16, 2013
	nts the traceability to national standards, which realize the physical units of measurements (SI). tainties with confidence probability are given on the following pages and are part of the certificate.

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	04-Apr-13 (No. 217-01733)	Apr-14
Power sensor E4412A	MY41498087	04-Apr-13 (No. 217-01733)	Apr-14
Reference 3 dB Attenuator	SN: S5054 (3c)	04-Apr-13 (No. 217-01737)	Apr-14
Reference 20 dB Attenuator	SN: S5277 (20x)	04-Apr-13 (No. 217-01735)	Apr-14
Reference 30 dB Attenuator	SN: S5129 (30b)	04-Apr-13 (No. 217-01738)	Apr-14
Reference Probe ES3DV2	SN: 3013	28-Dec-12 (No. ES3-3013_Dec12)	Dec-13
DAE4	SN: 660	31-Jan-13 (No. DAE4-660_Jan13)	Jan-14
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-13)	In house check: Apr-15
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

	Name	Function	Signature
Calibrated by:	Leif Klysner	Laboratory Technician	£:1411
			all ships
Approved by:	Katja Pokovic	Technical Manager	Jably
			Issued: May 17, 2013
This calibration certificate	e shall not be reproduced except in f	ull without written approval of the lab	oratory.

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Accreditation No.: SCS 108

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Glossary: TSL tissue simulating liquid NORMx,y,z sensitivity in free space sensitivity in TSL / NORMx,y,z ConvF diode compression point DCP crest factor (1/duty_cycle) of the RF signal CF modulation dependent linearization parameters A, B, C, D Polarization ϕ φ rotation around probe axis 9 rotation around an axis that is in the plane normal to probe axis (at measurement center), Polarization 9 i.e., $\vartheta = 0$ is normal to probe axis

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

- NORMx, y, z: Assessed for E-field polarization 9 = 0 (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx, y, z are only intermediate values, i.e., the uncertainties of NORMx, y, z does not affect the E²-field uncertainty inside TSL (see below ConvF).
- NORM(f)x,y,z = NORMx,y,z * frequency_response (see Frequency Response Chart). This linearization is
 implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included
 in the stated uncertainty of ConvF.
- *DCPx,y,z*: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- *Ax*,*y*,*z*; *Bx*,*y*,*z*; *Cx*,*y*,*z*; *Dx*,*y*,*z*; *VRx*,*y*,*z*: *A*, *B*, *C*, *D* are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. *VR* is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters: Assessed in flat phantom using E-field (or Temperature Transfer Standard for f ≤ 800 MHz) and inside waveguide using analytical field distributions based on power measurements for f > 800 MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORMx,y,z * ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical isotropy (3D deviation from isotropy): in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.

Probe ES3DV3

SN:3263

Manufactured: Calibrated:

January 25, 2010 May 16, 2013

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

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm $(\mu V/(V/m)^2)^A$	1.21	1.25	1.12	± 10.1 %
DCP (mV) ^B	101.2	100.2	103.7	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB√μV	С	D dB	VR mV	Unc ^E (k≕2)
0	CW	X	0.0	0.0	1.0	0.00	156.5	±2.5 %
		Y	0.0	0.0	1.0		153.2	
		Z	0.0	0.0	1.0		147.2	

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

 ^A The uncertainties of NormX,Y,Z do not affect the E²-field uncertainty inside TSL (see Pages 5 and 6).
 ^B Numerical linearization parameter: uncertainty not required.
 ^E Uncertainty is determined using the max, deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	41.9	0.89	6.51	6.51	6.51	0.21	2.29	± 12.0 %
835	41.5	0.90	6.29	6.29	6.29	0.50	1.38	± 12.0 %
1750	40.1	1.37	5.30	5.30	5.30	0.45	1.54	± 12.0 %
1900	40.0	1.40	5.11	5.11	5.11	0.57	1.38	± 12.0 %
2450	39.2	1.80	4.47	4.47	4.47	0.59	1.49	± 12.0 %
2600	39.0	1.96	4.31	4.31	4.31	0.80	1.28	± 12.0 %

Calibration Parameter Determined in Head Tissue Simulating Media

^c Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS

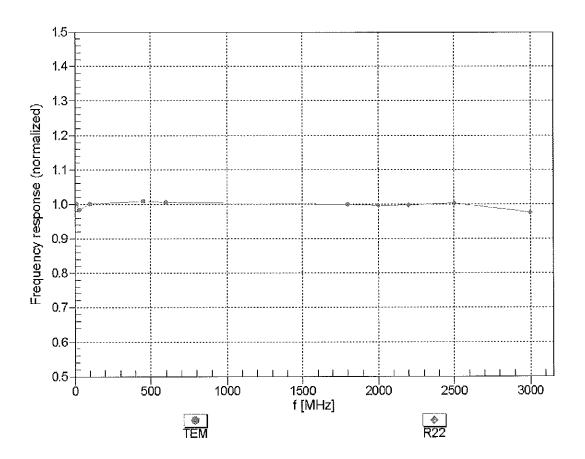
of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. ^F At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to \pm 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the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

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	55.5	0.96	6.37	6.37	6.37	0.34	1.82	± 12.0 %
835	55.2	0.97	6.29	6.29	6.29	0.54	1.39	± 12.0 %
1750	53.4	1.49	5.01	5.01	5.01	0.72	1.27	± 12.0 %
1900	53.3	1.52	4.78	4.78	4.78	0.53	1.56	± 12.0 %
2450	52.7	1.95	4.33	4.33	4.33	0.80	1.14	± 12.0 %
2600	52.5	2.16	4.14	4.14	4.14	0.80	1.02	± 12.0 %

Calibration Parameter Determined in Body Tissue Simulating Media

^c Frequency validity of \pm 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to \pm 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. ^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to \pm 10% if liquid compensation formula is applied to

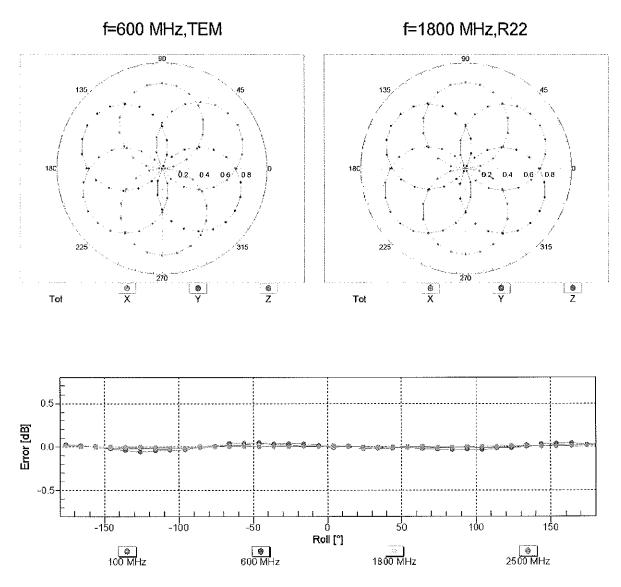
^F At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty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



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

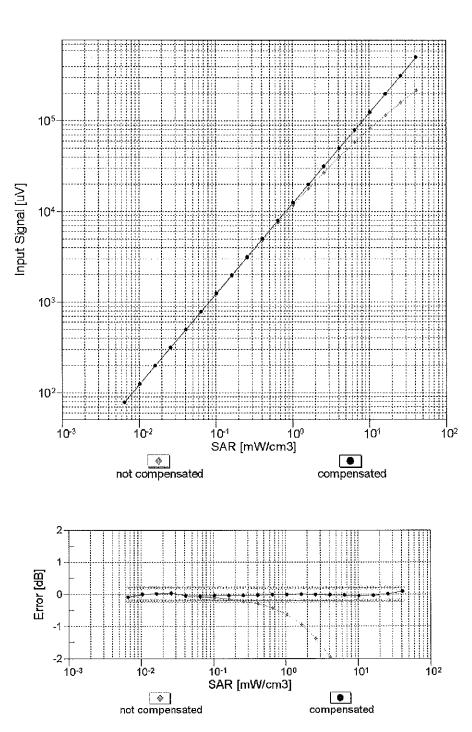
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

Certificate No: ES3-3263_May13



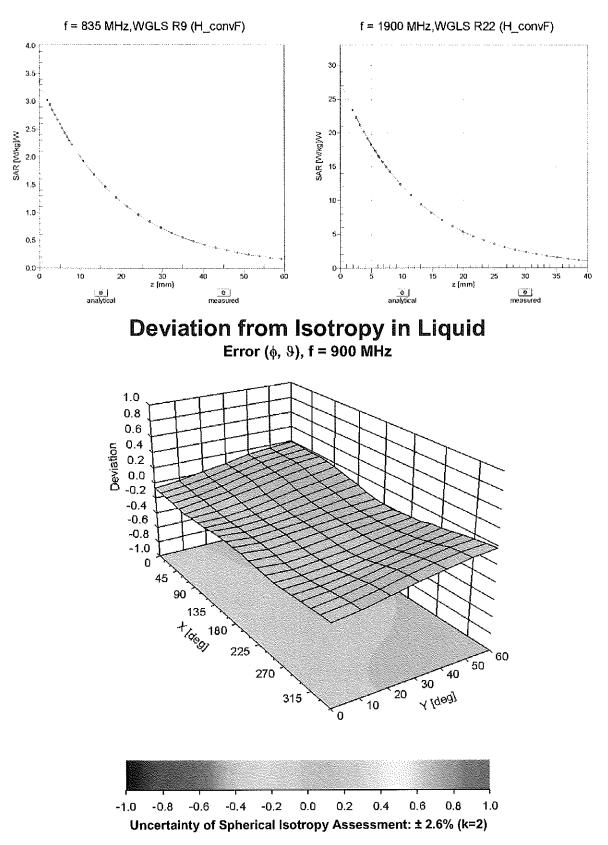
Receiving Pattern (ϕ), $\vartheta = 0^{\circ}$

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



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

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



Conversion Factor Assessment

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-116
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

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





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Swiss Calibration Service

Accreditation No.: SCS 108

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Certificate No: ES3-3287_Nov12

Client	PC Test
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na an a	CERTIFICATE		
Object	ES3DV3 - SN:328	17	
Calibration procedure(s)		A CAL-23.v4, QA CAL-25.v4 lure for dosimetric E-field probes	
Calibration date:	November 15, 20'	, 12	143,3
		nal standards, which realize the physical units obability are given on the following pages and	of measurements (SI).
All calibrations have been cond	ucted in the closed laboratory	r facility: environment temperature (22 ± 3)°C a	and humidity < 70%.
Calibration Equipment used (Ma	TE critical for calibration)		
Primary Standards	ID A	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	29-Mar-12 (No. 217-01508)	Арг-13
Power sensor E4412A	MY41498087	29-Mar-12 (No.,217-01508)	Apr-13
Reference 3 dB Attenuator	SN: S5054 (3c)	27-Mar-12 (No. 217-01531)	Apr-13
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Reference 20 dB Attenuator	SN: S5086 (20b)	27-Mar-12 (No. 217-01529)	Apr-13
Reference 20 dB Attenuator Reference 30 dB Attenuator	SN: S5086 (20b) SN: S5129 (30b)	27-Mar-12 (No. 217-01529) 27-Mar-12 (No. 217-01532)	
		······································	Apr-13
Reference 30 dB Attenuator	SN: S5129 (30b)	27-Mar-12 (No. 217-01532)	Apr-13 Apr-13
Reference 30 dB Attenuator Reference Probe ES3DV2	SN: S5129 (30b) SN: 3013	27-Mar-12 (No. 217-01532) 29-Dec-11 (No. ES3-3013_Dec11)	Apr-13 Apr-13 Dec-12
Reference 30 dB Attenuator Reference Probe ES3DV2 DAE4	SN: S5129 (30b) SN: 3013 SN: 660	27-Mar-12 (No. 217-01532) 29-Dec-11 (No. ES3-3013_Dec11) 20-Jun-12 (No. DAE4-660_Jun12)	Apr-13 Apr-13 Dec-12 Jun-13
Reference 30 dB Attenuator Reference Probe ES3DV2 DAE4 Secondary Standards	SN: S5129 (30b) SN: 3013 SN: 660	27-Mar-12 (No. 217-01532) 29-Dec-11 (No. ES3-3013_Dec11) 20-Jun-12 (No. DAE4-660_Jun12) Check Date (in house)	Apr-13 Apr-13 Dec-12 Jun-13 Scheduled Check
Reference 30 dB Attenuator Reference Probe ES3DV2 DAE4 Secondary Standards RF generator HP 8648C	SN: S5129 (30b) SN: 3013 SN: 660 ID US3642U01700	27-Mar-12 (No. 217-01532) 29-Dec-11 (No. ES3-3013_Dec11) 20-Jun-12 (No. DAE4-660_Jun12) Check Date (in house) 4-Aug-99 (in house check Apr-11)	Apr-13 Apr-13 Dec-12 Jun-13 Scheduled Check In house check: Apr-13
Reference 30 dB Attenuator Reference Probe ES3DV2 DAE4 Secondary Standards RF generator HP 8648C	SN: S5129 (30b) SN: 3013 SN: 660 ID US3642U01700 US37390585	27-Mar-12 (No. 217-01532) 29-Dec-11 (No. ES3-3013_Dec11) 20-Jun-12 (No. DAE4-660_Jun12) Check Date (in house) 4-Aug-99 (in house check Apr-11) 18-Oct-01 (in house check Oct-12)	Apr-13 Apr-13 Dec-12 Jun-13 Scheduled Check In house check: Apr-13 In house check: Oct-13

Issued: November 16, 2012

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

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





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Multilateral Agreement for the recognition of calibration certificates

Glossary:

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TSL	tissue simulating liquid
NORMx,y,z	sensitivity in free space
ConvF	sensitivity in TSL / NORMx,y,z
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C	modulation dependent linearization parameters
Polarization ϕ	φ rotation around probe axis
Polarization 9	9 rotation around an axis that is in the plane normal to probe axis (at measurement center),
	i.e., $\vartheta = 0$ is normal to probe axis

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

- NORMx,y,z: Assessed for E-field polarization 9 = 0 (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not affect the E²-field uncertainty inside TSL (see below ConvF).
- NORM(f)x,y,z = NORMx,y,z * frequency_response (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- *DCPx,y,z*: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- *PAR:* PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- *Ax,y,z; Bx,y,z; Cx,y,z, VRx,y,z: A, B, C* are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. *VR* is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters: Assessed in flat phantom using E-field (or Temperature Transfer Standard for f ≤ 800 MHz) and inside waveguide using analytical field distributions based on power measurements for f > 800 MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy/close to the boundary. The sensitivity in TSL corresponds to NORMx, y, z * ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical isotropy (3D deviation from isotropy): in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.

Probe ES3DV3

SN:3287

Manufactured: Calibrated:

June 7, 2010 November 15, 2012

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

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Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm (μV/(V/m) ²) ^A	1.31	1.25	1.25	± 10.1 %
DCP (mV) ^B	102.9	103.6	101.6	

Modulation Calibration Parameters

UID	Communication System Name	PAR		A dB	B dB	C dB	VR mV	Unc ^E (k=2)
0	CW	0.00	X	0.0	0.0	1.0	116.8	±3.5 %
			Y	0.0	0.0	1.0	118.5	
		*	Z	0.0	0.0	1.0	154.1	

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

^A The uncertainties of NormX,Y,Z do not affect the E²-field uncertainty inside TSL (see Pages 5 and 6). ^B Numerical linearization parameter: uncertainty not required.

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

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f (MHz) ^c	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	41.9	0.89	6.40	6.40	6.40	0.20	2.54	± 12.0 %
835	41.5	0.90	6.17	6.17	6.17	0.34	1.68	± 12.0 %
1750	40.1	1.37	5.16	5.16	5.16	0.63	1.30	± 12.0 %
1900	40.0	1.40	4.96	4.96	4.96	0.48	1.55	± 12.0 %
2450	39.2	1.80	4.30	4.30	4.30	0.79	1.31	± 12.0 %
2600	39.0	1.96	4.19	4.19	4.19	0.80	1.31	± 12.0 %

Calibration Parameter Determined in Head Tissue Simulating Media

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

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f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	55.5	0.96	6.14	6.14	6.14	0.28	2.06	± 12.0 %
835	55.2	0.97	6.06	6.06	6.06	0.42	1.63	± 12.0 %
1750	53.4	1.49	4.86	4.86	4.86	0.43	1.64	± 12.0 %
1900	53.3	1.52	4.69	4.69	4.69	0.56	1.54	± 12.0 %
2450	52.7	1.95	4.29	4.29	4.29	0.80	1.02	± 12.0 %
2600	52.5	2.16	4.12	4.12	4.12	0.64	0.92	± 12.0 %

Calibration Parameter Determined in Body Tissue Simulating Media

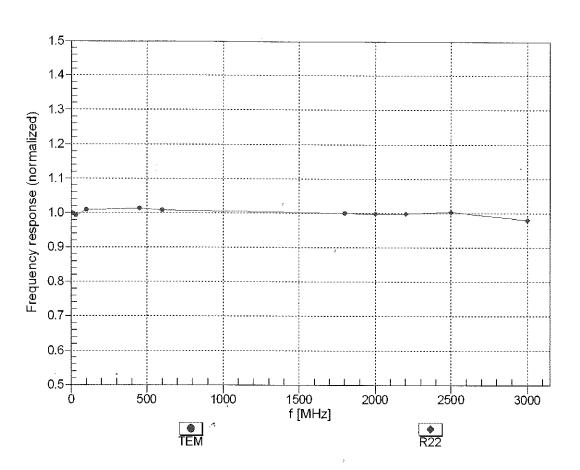
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^c Frequency validity of \pm 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to \pm 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency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

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

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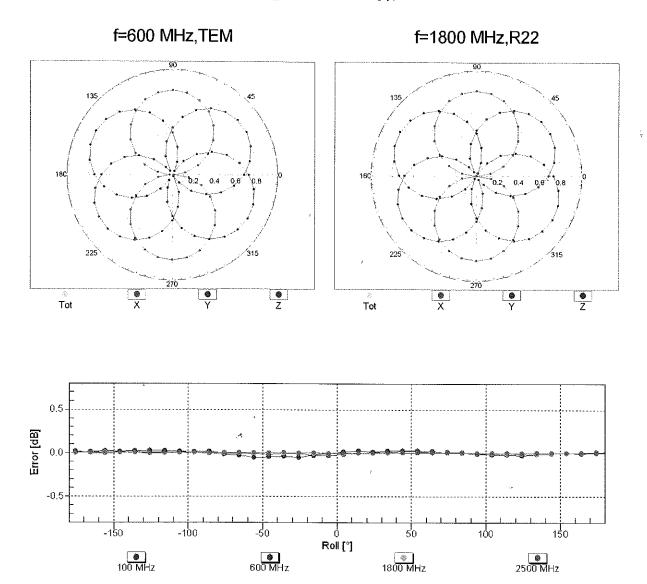


Frequency Response of E-Field (TEM-Cell:ifi110 EXX, Waveguide: R22)

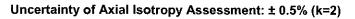
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

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Certificate No: ES3-3287_Nov12

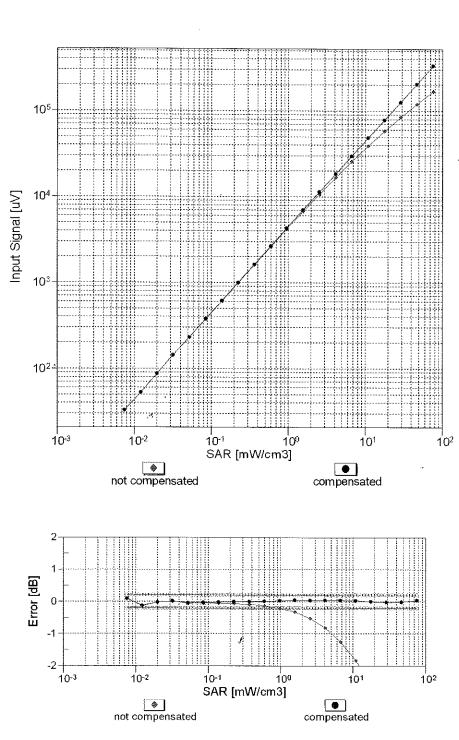


Receiving Pattern (ϕ), $\vartheta = 0^{\circ}$



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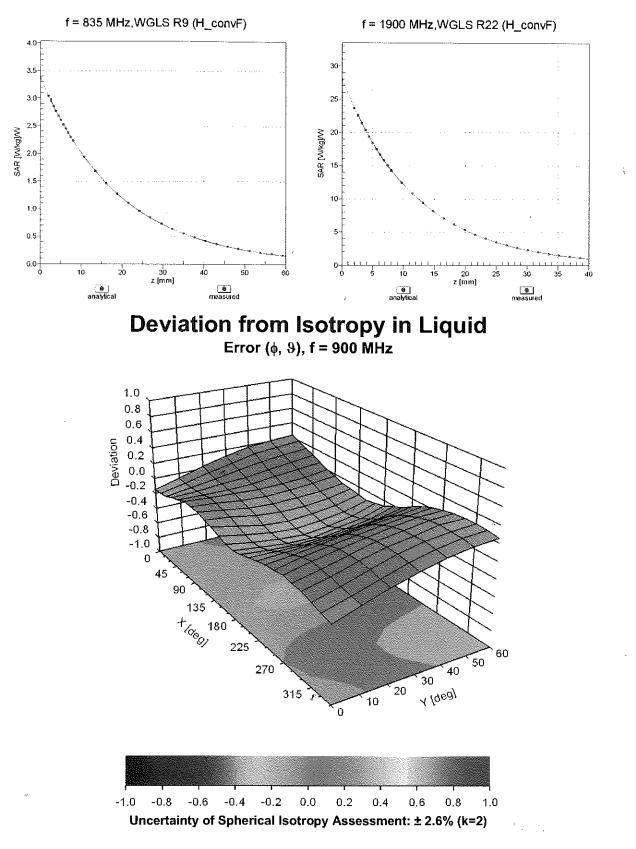
Certificate No: ES3-3287_Nov12



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

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

Certificate No: ES3-3287_Nov12



Conversion Factor Assessment

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3287

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-15.9
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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Client **PC Test**

Certificate No: EX3-3920_Feb13/2

Accreditation No.: SCS 108

CALIBRATION CERTIFICATE (Replacement of No: EX3-3920_Feb13)

Object	EX3DV4 - SN:3920
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:	February 27, 2013
	nts the traceability to national standards, which realize the physical units of measurements (SI). ainties with confidence probability are given on the following pages and are part of the certificate.
All calibrations have been conduct	ed in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	29-Mar-12 (No. 217-01508)	Apr-13
Power sensor E4412A	MY41498087	29-Mar-12 (No. 217-01508)	Apr-13
Reference 3 dB Attenuator	SN: S5054 (3c)	27-Mar-12 (No. 217-01531)	Apr-13
Reference 20 dB Attenuator	SN: S5086 (20b)	27-Mar-12 (No. 217-01529)	Apr-13
Reference 30 dB Attenuator	SN: S5129 (30b)	27-Mar-12 (No. 217-01532)	Apr-13
Reference Probe ES3DV2	SN: 3013	28-Dec-12 (No. ES3-3013_Dec12)	Dec-13
DAE4	SN: 660	31-Jan-13 (No. DAE4-660_Jan13)	Jan-14
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-11)	In house check: Apr-13
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

	Name	Function	Signature
Calibrated by:	Claudio Leubler	Laboratory Technician	
			UCK
Approved by:	Katja Pokovic	Technical Manager	72 101
			per dag
			issued: March 5, 2013
This calibration certificate	shall not be reproduced except in full	without written approval of the lab	oratory.

Calibration Laboratory of Schmid & Partner

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Engineering AG Zeughausstrasse 43, 8004 Zurich, Switzerland





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Accreditation No.: SCS 108

Polarization φ rotation around probe axis		tissue simulating liquid z sensitivity in free space sensitivity in TSL / NORMx,y,z diode compression point crest factor (1/duty_cycle) of the RF signal modulation dependent linearization parameters n φ φ rotation around probe axis n θ θ rotation around an axis that is in the plane normal to probe axis (at measurement center),
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Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

- NORMx,y,z: Assessed for E-field polarization 9 = 0 (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not affect the E²-field uncertainty inside TSL (see below ConvF).
- NORM(f)x,y,z = NORMx,y,z * frequency_response (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- *DCPx,y,z*: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- *Ax,y,z; Bx,y,z; Cx,y,z; Dx,y,z; VRx,y,z: A, B, C, D* are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. *VR* is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters: Assessed in flat phantom using E-field (or Temperature Transfer Standard for f ≤ 800 MHz) and inside waveguide using analytical field distributions based on power measurements for f > 800 MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORMx,y,z * ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical isotropy (3D deviation from isotropy): in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.

Probe EX3DV4

SN:3920

Manufactured: Calibrated:

December 18, 2012 February 27, 2013

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

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm $(\mu V/(V/m)^2)^A$	0.34	0.50	0.50	± 10.1 %
DCP (mV) ^B	101.2	101.0	99.1	

Modulation Calibration Parameters

UID	Communication System Name		А	В	С	D	VR	Unc ^E
			dB	dB√μV		dB	mV	(k=2)
0	CW	X	0.0	0.0	1.0	0.00	134.3	±3.3 %
		Y	0.0	0.0	1.0		164.7	
		Z	0.0	0.0	1.0		161.4	

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

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

^e Uncertainties of NormA, 1,2 do not anot the E-field uncertainty inside 1 of (soc), ages of all 2 //. ^e Numerical linearization parameter: uncertainty not required. ^e Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

f (MHz) ^c	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	41.9	0.89	9.86	9.86	9.86	0.19	1.39	± 12.0 %
835	41.5	0.90	9.58	9.58	9.58	0.77	0.54	± 12.0 %
1750	40.1	1.37	7.97	7.97	7.97	0.57	0.69	± 12.0 %
1900	40.0	1.40	7.73	7.73	7.73	0.54	0.73	± 12.0 %
2450	39.2	1.80	7.04	7.04	7.04	0.40	0.82	± 12.0 %
2600	39.0	1.96	6.80	6.80	6.80	0.49	0.76	± 12.0 %
5200	36.0	4.66	4.87	4.87	4.87	0.35	1.80	± 13.1 %
5300	35.9	4.76	4.73	4.73	4.73	0.37	1.80	± 13.1 %
5500	35.6	4.96	4.52	4.52	4.52	0.39	1.80	± 13.1 %
5600	35.5	5.07	4.17	4.17	4.17	0.50	1.80	± 13.1 %
5800	35.3	5.27	4.02	4.02	4.02	0.45	1.80	± 13.1 %

Calibration Parameter Determined in Head Tissue Simulating Media

^C Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. ^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to

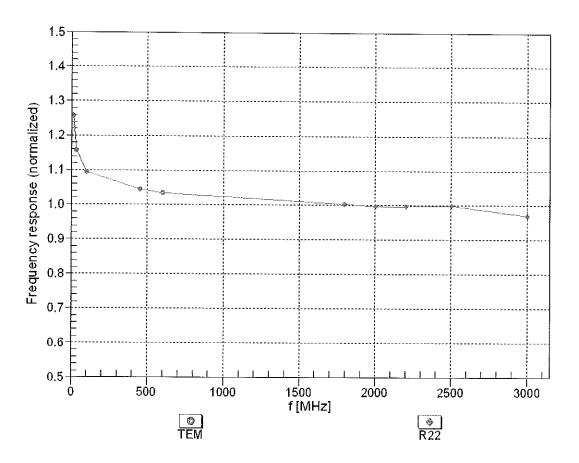
measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to \pm 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

f (MHz) ^c	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	55.5	0.96	9.57	9.57	9.57	0.43	0.83	± 12.0 %
835	55.2	0.97	9.42	9.42	9.42	0.36	0.98	± 12.0 %
1750	53.4	1.49	7.59	7.59	7.59	0.43	0.78	± 12.0 %
1900	53.3	1.52	7.38	7.38	7.38	0.33	0.91	± 12.0 %
2450	52.7	1.95	7.07	7.07	7.07	0.80	0.55	± 12.0 %
2600	52.5	2.16	6.73	6.73	6.73	0.80	0.56	± 12.0 %
5200	49.0	5.30	4.23	4.23	4.23	0.51	1.90	± 13.1 %
5300	48.9	5.42	4.13	4.13	4.13	0.49	1.90	± 13.1 %
5500	48.6	5.65	3.63	3.63	3.63	0.52	1.90	± 13.1 %
5600	48.5	5.77	3.62	3.62	3.62	0.49	1.90	± 13.1 %
5800	48.2	6.00	3.91	3.91	3.91	0.54	1.90	± 13.1 %

Calibration Parameter Determined in Body Tissue Simulating Media

^C Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. ^F At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to

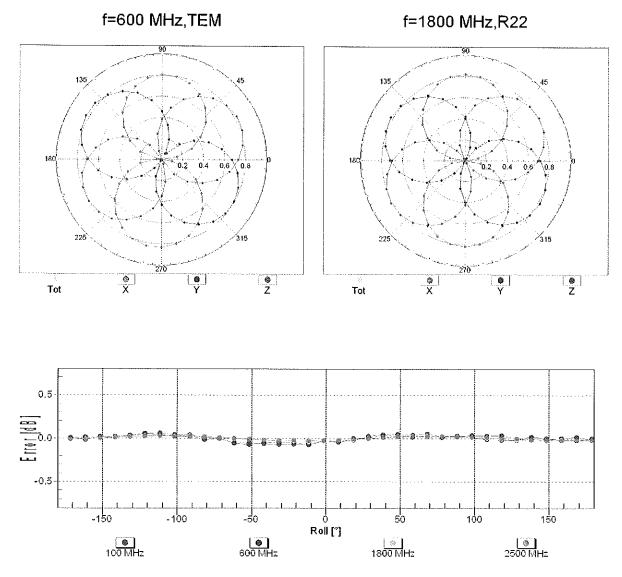
⁷ At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.



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

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

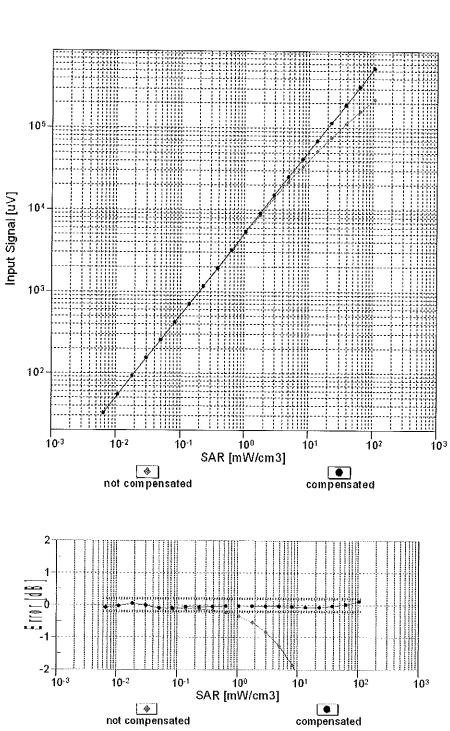
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Receiving Pattern (ϕ), $\vartheta = 0^{\circ}$

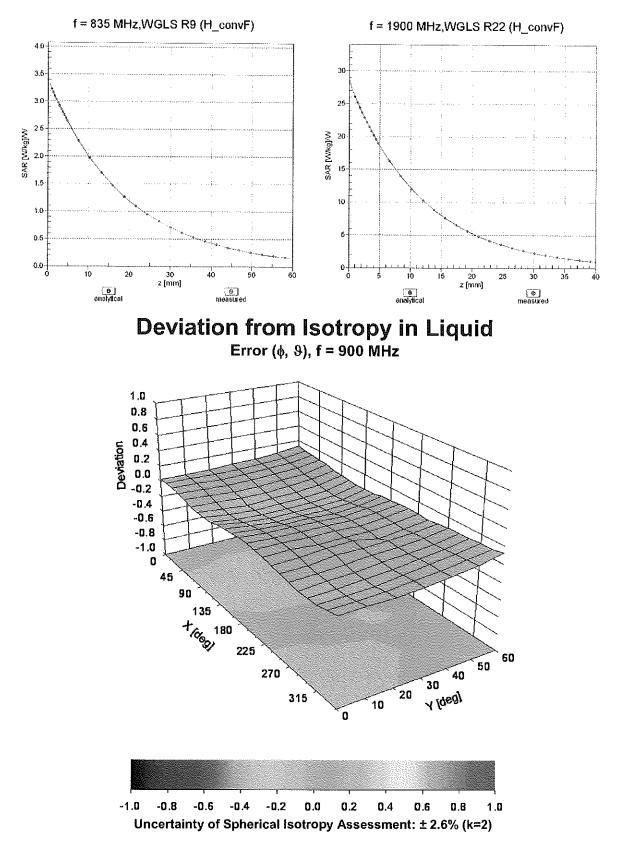
Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

February 27, 2013



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

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



Conversion Factor Assessment

Certificate No: EX3-3920_Feb13/2

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-21.6
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

Calibration Laboratory of

Schmid & Partner Engineering AG Zeughausstrasse 43, 8004 Zurich, Switzerland lac-mrA



Schweizerischer Kalibrierdienst Service suisse d'étalonnage Servizio svizzero di taratura 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

Client PC Test

Certificate No: EX3-3589_Jan13

Accreditation No.: SCS 108

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CALIBRATION CERTIFICATE

Object	EX3DV4 - SN:3589	
Calibration procedure(s)	OA CAL-01.v8, OA CAL-14,v3, OA CAL-23.v4, OA CAL-25.v4 Celloration procedure for dosimetric E-field probes	
Calibration date:	January 17, 2013	
	nts the traceability to national standards, which realize the physical units of measurements (SI). tainties with confidence probability are given on the following pages and are part of the certificate.	

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

Calibration Equipment used (M&TE critical for calibration)

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

Calibrated by: Jeton Kastrati Laboratory Technician Approved by: Katja Pokovic Technical Manager	
Approved by: Katja Pokovic Technical Manager	
Approved by: Katja Pokovic Technical Manager	
	2
Issued: January 17, 2013)13

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

Calibration Laboratory of

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S

S Schweizerischer Kalibrierdienst

- C Service suisse d'étalonnage
 - Servizio svizzero di taratura

Swiss Calibration Service

Accreditation No.: SCS 108

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

Glossary: TSL tissue simulating liquid NORMx,y,z sensitivity in free space sensitivity in TSL / NORMx,y,z ConvF diode compression point DCP crest factor (1/duty_cycle) of the RF signal CF modulation dependent linearization parameters A, B, C, D φ rotation around probe axis Polarization ϕ Polarization 9 9 rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\vartheta = 0$ is normal to probe axis

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

- NORMx, y, z: Assessed for E-field polarization 9 = 0 (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx, y, z are only intermediate values, i.e., the uncertainties of NORMx, y, z does not affect the E²-field uncertainty inside TSL (see below ConvF).
- NORM(f)x,y,z = NORMx,y,z * frequency_response (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- *DCPx,y,z*: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- *PAR*: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- *Ax,y,z; Bx,y,z; Cx,y,z; Dx,y,z; VRx,y,z: A, B, C, D* are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. *VR* is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters: Assessed in flat phantom using E-field (or Temperature Transfer Standard for f ≤ 800 MHz) and inside waveguide using analytical field distributions based on power measurements for f > 800 MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORMx,y,z * ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical isotropy (3D deviation from isotropy): in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.

Probe EX3DV4

SN:3589

Calibrated:

Manufactured: March 30, 2006 January 17, 2013

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

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm (μV/(V/m) ²) ^A	0.46	0.40	0.40	± 10.1 %
DCP (mV) ^B	100.5	103.8	99.6	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB√μV	С	D dB	VR mV	Unc [≞] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	165.8	±3.3 %
		Y	0.0	0.0	1.0		134.3	
		Z	0.0	0.0	1.0		140.5	

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

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

^B Numerical linearization parameter: uncertainty not required.

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

f (MHz) ^c	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	41.9	0.89	8.70	8.70	8.70	0.39	0.96	± 12.0 %
835	41.5	0.90	8.40	8.40	8.40	0.52	0.74	± 12.0 %
1750	40.1	1.37	7.34	7.34	7.34	0.45	0.93	± 12.0 %
1900	40.0	1.40	7.09	7.09	7.09	0.80	0.65	± 12.0 %
2450	39.2	1.80	6.37	6.37	6.37	0.39	0.97	± 12.0 %
2600	39.0	1.96	6.19	6.19	6.19	0.30	1.12	± 12.0 %
5200	36.0	4.66	4.48	4.48	4.48	0.45	1.80	± 13.1 %
5300	35.9	4.76	4.27	4.27	4.27	0.45	1.80	± 13.1 %
5500	35.6	4.96	4.14	4.14	4.14	0.50	1.80	± 13.1 %
5600	35.5	5.07	3.81	3.81	3.81	0.55	1.80	± 13.1 %
5800	35.3	5.27	3.85	3.85	3.85	0.55	1.80	± 13.1 %

Calibration Parameter Determined in Head Tissue Simulating Media

^c Frequency validity of \pm 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to \pm 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. ^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to \pm 10% if liquid compensation formula is applied to

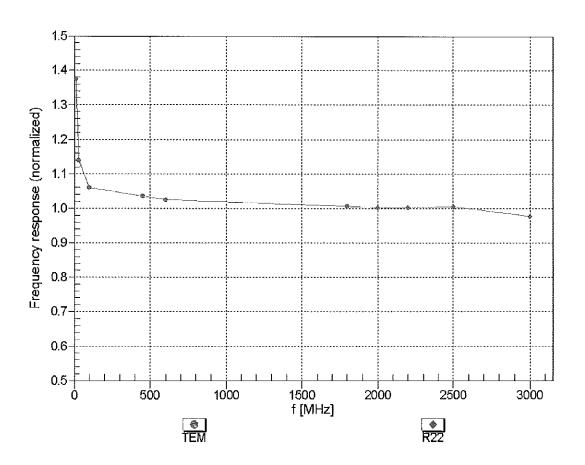
^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty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

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	55.5	0.96	8.59	8.59	8.59	0.49	0.86	± 12.0 %
835	55.2	0.97	8.43	8.43	8.43	0.38	1.05	± 12.0 %
1750	53.4	1.49	7.87	7.87	7.87	0.44	0.89	± 12.0 %
1900	53.3	1.52	7.46	7.46	7.46	0.58	0.75	± 12.0 %
2450	52.7	1.95	7.07	7.07	7.07	0.80	0.50	± 12.0 %
2600	52.5	2.16	6.68	6.68	6.68	0.80	0.50	± 12.0 %
5200	49.0	5.30	3.99	3.99	3.99	0.50	1.90	± 13.1 %
5300	48.9	5.42	3.81	3.81	3.81	0.50	1.90	± 13.1 %
5500	48.6	5.65	3.52	3.52	3.52	0.55	1.90	± 13.1 %
5600	48.5	5.77	3.32	3.32	3.32	0.60	1.90	± 13.1 %
5800	48.2	6.00	3.66	3.66	3.66	0.60	1.90	± 13.1 %

Calibration Parameter Determined in Body Tissue Simulating Media

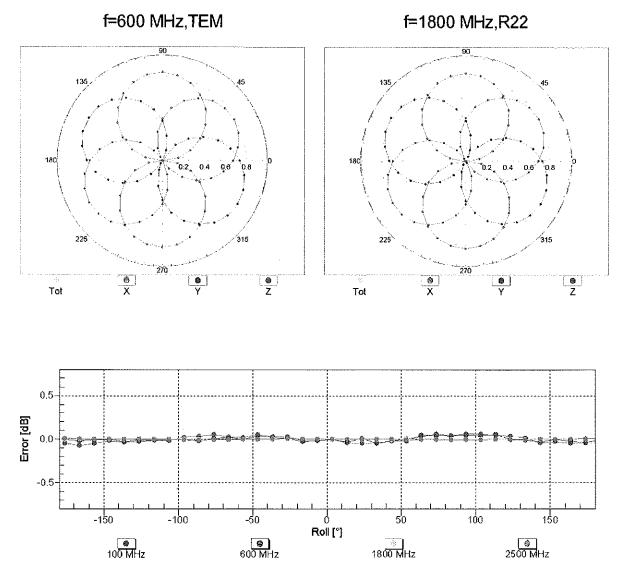
^C Frequency validity of \pm 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to \pm 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. ^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to \pm 10% if liquid compensation formula is applied to

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



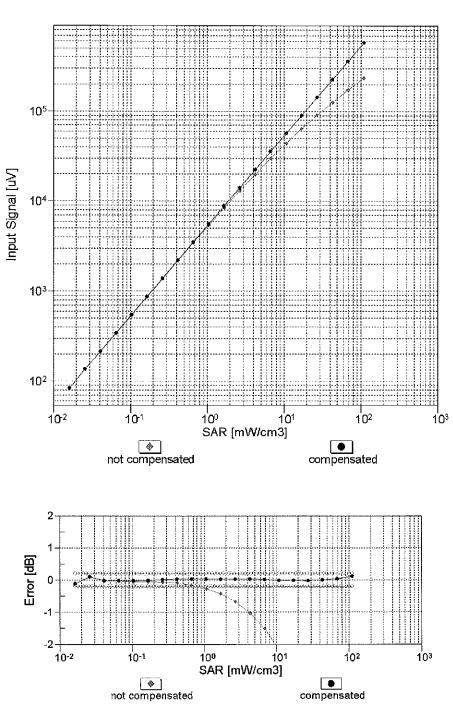
Frequency Response of E-Field (TEM-Cell:ifi110 EXX, Waveguide: R22)

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



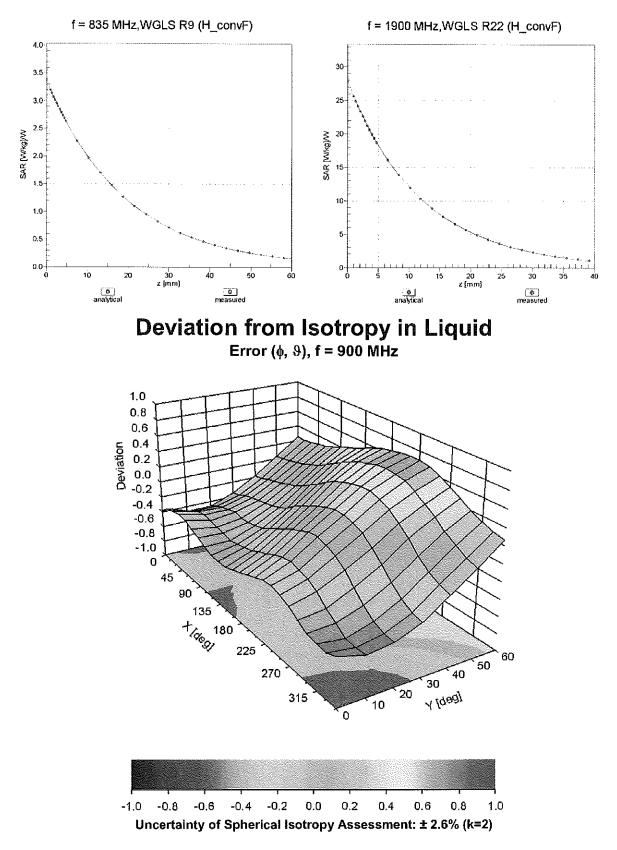
Receiving Pattern (ϕ), $\vartheta = 0^{\circ}$

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



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

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



Conversion Factor Assessment

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-26.4
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

APPENDIX 8: SAR T=GGI 9 GD97 = =75 H=CBG

APPENDIX D: SAR TISSUE SPECIFICATIONS

Measurement Procedure for Tissue verification:

- 1) The network analyzer and probe system was configured and calibrated.
- The probe was immersed in the tissue. The tissue was placed in a nonmetallic container. Trapped air bubbles beneath the flange were minimized by placing the probe at a slight angle.
- 3) The complex admittance with respect to the probe aperture was measured
- 4) The complex relative permittivity ε can be calculated from the below equation (Pournaropoulos and Misra):

$$Y = \frac{j2\omega\varepsilon_r\varepsilon_0}{\left[\ln(b/a)\right]^2} \int_a^b \int_a^b \int_0^\pi \cos\phi' \frac{\exp\left[-j\omega r(\mu_0\varepsilon_r\varepsilon_0)^{1/2}\right]}{r} d\phi' d\rho' d\rho$$

where Y is the admittance of the probe in contact with the sample, the primed and unprimed coordinates refer to source and observation points, respectively, $r^2 = \rho^2 + {\rho'}^2 - 2\rho\rho' \cos \phi'$, ω is the angular frequency, and $j = \sqrt{-1}$.

Composition of the Tissue Equivalent Matter												
Frequency (MHz)	750	750	835	835	1750	1750	1900	1900	2450	2450	5200-5800	5200-5800
Tissue	Head	Body	Head	Body	Head	Body	Head	Body	Head	Body	Head	Body
Ingredients (% by weight)												
Bactericide			0.1	0.1								
DGBE					47	31	44.92	29.44		26.7		
HEC	See Page		1	1								
NaCl	2-3	See Page 2	1.45	0.94	0.4	0.2	0.18	0.39	See Page 4	0.1	See Page 5	
Sucrose			57	44.9								
Polysorbate (Tween) 80												20
Water			40.45	53.06	52.6	68.8	54.9	70.17		73.2		80

Table D-I Composition of the Tissue Equivalent Matter

FCC ID: ZNFD520	CA PCTEST	SAR EVALUATION REPORT	Reviewed by:
	FROMULTING LARDWATDRY, INC.		Quality Manager
Test Dates:	DUT Type:		APPENDIX D:
10/15/13 - 10/29/13	Portable Handset		Page 1 of 5
© 2013 PCTEST Engineering	Laboratory, Inc.		REV 12.5 M 05/20/2013

2 Composition / Information on ingredients

H ₂ O	f the following ingredients: Water, 35 – 58%
Sucrose	Sugar, white, refined, 40 – 60%
NaCl	Sodium Chloride, 0 – 6%
Hydroxyethyl-cellulose	Medium Viscosity (CAS# 9004-62-0), <0.3%
Preventol-D7	Preservative: aqueous preparation, (CAS# 55965-84-9), containing
	5-chloro-2-methyl-3(2H)-isothiazolone and 2-methyyl-3(2H)-isothiazolone,
	0.1 – 0.7%
	Relevant for safety; Refer to the respective Safety Data Sheet*.

Figure D-1 Composition of 750 MHz Head and Body Tissue Equivalent Matter

Note: 750MHz liquid recipes are proprietary SPEAG. Since the composition is approximate to the actual liquids utilized, the manufacturer tissue-equivalent liquid data sheets are provided below.

Measurement Certificate / Material Test

Item Name	Body Tissue Simulating Liquid (MSL750)	
Product No.	SL AAM 075 AA (Charge: 111130-3)	
Manufacturer	SPEAG CT	-
Measurement I	Method	
TSL dielectric p	arameters measured using calibrated OCP probe (type DAK).	
		1 a 1 a 1 a 1 a 1 a 1 a 1 a 1 a 1 a 1 a
Target Parame		
	ters ers as defined in the IEEE 1528 and IEC 62209 compliance standards.	
Target paramete	ers as defined in the IEEE 1528 and IEC 62209 compliance standards.	·
Target paramete	ers as defined in the IEEE 1528 and IEC 62209 compliance standards.	
Target parameter Test Condition Ambient Conditi	ers as defined in the IEEE 1528 and IEC 62209 compliance standards.	
Target parameter Test Condition Ambient Conditi TSL Temperatu	ers as defined in the IEEE 1528 and IEC 62209 compliance standards.	
Target parameter Test Condition Ambient Conditi TSL Temperatu Test Date	ers as defined in the IEEE 1528 and IEC 62209 compliance standards. on 22°C; 30% humidity re 22°C 7-Dec-11	
Target parameter Test Condition Ambient Conditi TSL Temperatu	ers as defined in the IEEE 1528 and IEC 62209 compliance standards. on 22°C; 30% humidity re 22°C 7-Dec-11	
Target parameter Test Condition Ambient Condition TSL Temperatu Test Date Additional Info	ers as defined in the IEEE 1528 and IEC 62209 compliance standards. on 22°C; 30% humidity re 22°C 7-Dec-11	· · · · · · · · · · · · · · · · · · ·

Results Measured Target Diff.to Target [%] 10.0 7.5 5.0 2.5 0.0 1 [MHz] HP-e' HP-e' sigma eps 600 57.9 25.01 0.83 56.1 ∆-eps ∆-sigma Permittivity % 0.95 3.1 -12.3 625 650 57.6 24.66 0.86 56.0 0.95 2.9 -10.1 57.4 24.31 0.88 55.9 0.96 2.6 -8.0 675 57.1 24.02 0.90 55.8 0.96 2.3 -5.8 -2.5 -5.0 -7.5 -10.0 0.92 0.95 -3.7 -1.5 Dev. 700 56.8 23.74 55.7 0.96 2.0 23.50 55.6 72 56.6 1.7 0.96 750 56.4 23.26 0.97 55.5 0.96 1,5 0.8 650 700 800 600 750 850 900 950 775 3.0 5.2 56.1 23.06 0.99 55.4 0.97 1.2 Freq ency MHz 800 825 55.8 55.6 22.86 1.02 55.3 0.97 0.9 22.72 22.64 1.04 1.05 6.6 7.3 55.2 0.98 0.6 838 55.5 55.2 0.98 0.5 850 875 55.4 22.57 1.07 55.2 0.99 0.4 8.0 7.2 6.4 **7**.5 10.0 7.5 5.0 2.5 0.0 -2.5 •5.0 •7.5 55.1 22.44 1.09 0.1 55.1 1.02 . Conductivity % 900 54.9 22.31 1.12 55.0 1.05 -0.2 925 54.7 22.20 1.54 1717 55.0 1.06 -0.5 950 54.5 22.09 54.9 1.08 -0.9 8.5 975 54.3 21.99 1.19 54.9 1.09 -1.2 9.7 Dev. 54.1 1000 21.89 1.22 54.8 1.10 -1.4 10.9 -10.0 600 650 700 750 800 850 900 950

Figure D-2 750MHz Body Tissue Equivalent Matter

FCC ID: ZNFD520		SAR EVALUATION REPORT	🕒 LG	Reviewed by: Quality Manager
Test Dates:	DUT Type:			APPENDIX D:
10/15/13 - 10/29/13	Portable Handset			Page 2 of 5
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1000

1000

Frequency MHz

Measurement Certificate / Material Test

Item Name	Head Tissue Simulating Liquid (HSL 750)	
Product No.	SL AAH 075 (Charge: 111208-2)	
Manufacturer	SPEAG C	

Measurement Method

TSL dielectric parameters measured using calibrated OCP probe (type DAK).

Target Parameters

Target parameters as defined in the IEEE 1528 and IEC 62209 compliance standards.

s,

Test Condition

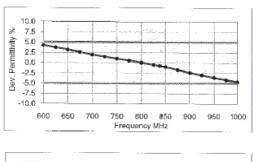
Ambient Condition 22°C ; 30% humidity TSL Temperature 22°C Test Date 14-Dec-11

Additional Information

TSL Density 1.284 g/cm³ TSL Heat-capacity 2.701 kJ/(kg*K)

Results

£	Measu	red	an e	Targe	t	Diff.to 7	farget [%]
f [MHz]	HP-e'	HP-e*	sigma	eps	sigma	∆-eps	∆-sigma
600	44.5	22.77	0.76	42.7	0.88	4.2	-13.8
62.5	44.2	22.50	0.78	42.6	0.88	3.7	-11.5
650	43.8	22,24	03:80	42.5	0.89	3.1	-9.2
675	43.4	22.03	0.83	42.3	0.89	2.5	-6.8
700	43.0	21.82	0.85	42.2	0.89	1.9	-4.5
725	42.7	21.64	0.87	42.1	0.89	1.4	-2.1
750	42.3	21.45	0.89	41.9	0.89	1.0	0.2
775	42.0	21.28	0.92	41.8	0.90	0.5	2.4
800	41.7	21.11	0.94	41.7	0.90	0.0	4.7
825	41.4	20.97	0.96	41.6	0.91	-0.5	6.1
838	41.2	20.90	0.97	41.5	0.91	-0.7	6.8
850	41.1	20.83	0.98	41.5	0.92	-1.0	7.5
875	40.8	20.69	1.01	41.5	0.94	-1.7	6.8
900	40.5	20.55	1.03	41.5	0.97	-2.4	6.1
925	40.2	20.45	1.05	41.5	0.98	-3.0	7.1
950	39.9	20.34	1.08	41.4	0.99	-3.6	8.1
975	39.7	20.24	1:10	41.4	1.00	-4.2	9.3
1000	39.4	20.14	1.12	41.3	1.01	-4.7	10.4



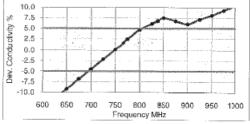


Figure D-3 750MHz Head Tissue Equivalent Matter

FCC ID: ZNFD520		SAR EVALUATION REPORT	🕒 LG	Reviewed by: Quality Manager
Test Dates:	DUT Type:			APPENDIX D:
10/15/13 - 10/29/13	Portable Handset			Page 3 of 5
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2 Composition / Information on ingredients

The Item is co	omposed of the following ingredients:
H2O	Water, 52 – 75%
C8H18O3	Diethylene glycol monobutyl ether (DGBE), 25 – 48%
	(CAS-No. 112-34-5, EC-No. 203-961-6, EC-index-No. 603-096-00-8)
	Relevant for safety; Refer to the respective Safety Data Sheet*.
NaCl	Sodium Chloride, <1.0%
	Figure D-4

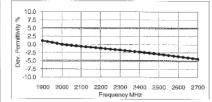
Composition of 2.4 GHz Head Tissue Equivalent Matter

Note: 2.4 GHz head liquid recipes are proprietary SPEAG. Since the composition is approximate to the actual liquids utilized, the manufacturer tissue-equivalent liquid data sheets are provided below.

Measurement Certificate / Material Test

ltem Name	Head Tissue Simulating Liquid (HSL 2450)
Product No.	SL AAH 245 BA (Charge: 120112-4)
Manufacturer	SPEAG C-
	* · · · · · · · · · · · · · · · · · · ·
Measurement Me	thod
TSL dielectric para	ameters measured using calibrated OCP probe (type DAK).
Target Paramete	
	s as defined in the IEEE 1528 and IEC 62209 compliance standards.
	3
	3
	3
Target parameters	3
Target parameters	as defined in the IEEE 1528 and IEC 62209 compliance standards.
Target parameters Test Condition Ambient Condition TSL Temperature	as defined in the IEEE 1528 and IEC 62209 compliance standards.
Target parameters Test Condition Ambient Condition TSL Temperature Test Date	as defined in the IEEE 1528 and IEC 62209 compliance standards. 22°C ; 30% humidity 23°C 18-Jan-12
Target parameters Test Condition Ambient Condition TSL Temperature	as defined in the IEEE 1528 and IEC 62209 compliance standards. 22°C ; 30% humidity 23°C 18-Jan-12
Target parameters Test Condition Ambient Condition TSL Temperature Test Date	as defined in the IEEE 1528 and IEC 62209 compliance standards. 22°C ; 30% humidity 23°C 18-Jan-12 ation

	Measu	ired	e	Targe	t	Diff.to T	arget [%]
f [MHz]	HP-e'	HP-e"	sigma	eps	sigma	∆-eps	∆-sigma
1900	40.5	11.99	1.27	40.0	1.40	1.1	-9.5
1925	40.3	12.08	1.29	40.0	1.40	0.9	-7.6
1950	40.2	12.17	1.32	40.0	1.40	0.6	-5.7
1975	40.1	12.26	1.35	40.0	1.40	0.3	-3.8
2000	40.0	12.35	1.37	40.0	1.40	0.0	-1.9
2025	39.9	12.44	1.40	40.0	1.42	-0.1	-1.5
2050	39.8	12.53	1.43	39.9	1.44	-0.3	-1.1
2075	39.7	12.60	1.46	39.9	1.47	-0.4	-0.8
2100	39.6	12.68	1.48	39.8	1.49	-0.6	-0.5
2125	39.5	12.76	1.51	39.8	1.51	-0.7	-0.2
2150	39.4	12.84	1.54	39.7	1.53	-0.8	0.2
2175	39.3	12.93	1.56	39.7	1.56	-1.0	0.6
2200	39.2	13.02	1.59	39.6	1.58	-1.1	1.0
2225	39.1	13.09	1.62	39.6	1.60	-1.3	1.3
2250	39.0	13.17	1.65	39.6	1.62	-1.4	1.6
2275	38.9	13.25	1.68	39.5	1.64	-1.5	2.0
2300	38.8	13.33	1.71	39.5	1.67	-1.7	2.3
2325	38.7	13.40	1.73	39.4	1.69	-1.8	2.7
2350	38.6	13.48	1.76	39.4	1.71	-2.0	3.0
2375	38.5	13.56	1.79	39.3	1.73	-2.1	3.3
2400	38.4	13.63	1.82	39.3	1.76	-2.3	3.7
2425	38.3	13.71	1.85	39.2	1.78	-2.4	4.0
2450	38.2	13.78	1.88	39.2	1.80	-2.6	4.4
2475	38.1	13.85	1.91	39.2	1.83	-2,7	4.4
2500	38.0	13.93	1.94	39.1	1.85	-2.9	4.4
2525	37.9	13.99	1.97	39.1	1.88	-3.1	4.4
2550	37.8	14.06	1.99	39.1	1.91	-3.3	4.4
2575	37.7	14.13	2.02	39.0	1.94	-3.5	4.5
2600	37.6	14.20	2.05	39.0	1.96	-3.7	4.6
2625	37.5	14.26	2.08	39.0	1.99	-3.8	4.6
2650	37.4	14.32	2,11	38.9	2.02	-4.0	4.6
2675	37.3	14.39	2.14	38.9	2.05	-4.3	4.7
2073							



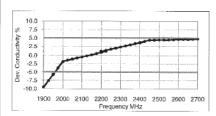


Figure D-5 2.4 GHz Head Tissue Equivalent Matter

FCC ID: ZNFD520	<u>«NPCTEST</u>	SAR EVALUATION REPORT	LG	Reviewed by:
				Quality Manager
Test Dates:	DUT Type:			APPENDIX D:
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05/20/2013

2 Composition / Information on ingredients

The Item is composed of the following ingredients: Water

	Figure D-6
Sodium salt	0 – 1.5%
Emulsifiers	8 – 25%
Mineral oil	10 – 30%
Water	50 — 65%

Composition of 5 GHz Head Tissue Equivalent Matter

Note: 5GHz head liquid recipes are proprietary SPEAG. Since the composition is approximate to the actual liquids utilized, the manufacturer tissue-equivalent liquid data sheets are provided below.

Measurement Certificate / Material Test

	lame		Head	Tissu	ue Sin	nulating	Liquid (I	HBBL	3500-58	00V5)					
Produ	ct No.						: 120402				, 					
Manuf	acture	r	SPE					-/								
Measu	ureme	nt Mei	hod													
TSL d	ielectri	ic para	meter	s mea	sured	using c	alibrated (DCP p	robe (tv	pe DA	K).					
								1.								
												~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~				
		meter														
Targe1	t parar	neters	as de	fined i	n the I	EEE 15	28 and IE	C 622	09 com	plianc	e star	ndards	s.			
	Condit															
		ndition	22%	· 30%	humic	dity										
		ature		, 00%	mannin	any										
Test D		atoro	4-Apt	-12												
. 301 0	- 410		inp	16				10./								
Additi	ional I	nform	ation													
	ensitv			a/cm	3											
		pacity														
1 31 1	ieat-ca	ipacity														
			0.000	ND/(N	y N/											
			0.000	n nu (n	y Nj		10								 	
			0.000	- NJ/(N	y Nj											
	ts					Diff to T		I								
Resul	ts Meas	ured		Targel	F ^{ree} See		arget [%]		10.0 -						 	
Resul f (MHz)	ts Meas HP-e'	ured	sigma	Targel eps	t sigma	∆-eps	∆-sigma	*	10.0		7 22				0.	
Resul (MHz) 3400	ts Mease HP-e ¹ 38.7	ured HP-e ^{**} 14.96	sigma 2.83	Targel eps 38.0	sigma 2.81	∆-eps 1.8	∆-sigma 0.7	rity %	7.5		21 <u>227</u> 21 103					
Resul f [MHz] 3400 3500	ts Meas HP-e' 38.7 38.6	ured HP-e" 14.96	sigma 2.83 2.99	Targel eps 38.0 37.9	t sigma 2.81 2.91	Δ-eps 1.8 1.7	∆-sigma 0.7 -0.3		7.5		2 2 <i>37</i> 2 53 2 53					
Resul f [MHz] 3400 3500 3600	ts Mease HP-e' 38.7 38.6 38.5	ured HP-e ⁹ 14.91 14.91 14.92	sigma 2.83 2.99 2.99	Targel eps 38.0 37.9 37.8	sigma 2.81 2.91 3.02	∆-eps 1.8 1.7 1.7	Δ-sigma 0.7 -0.3 -0.9		7.5 5.0 2.5							
Resul 3400 3500 3600 3700	ts Measi HP-e' 38.6 38.5 38.3	ured HP-e" 14.96 14.91 14.92 14.92	sigma 2.83 2.90 2.99 3.07	Targel eps 38.0 37.9 37.8 37.7	sigma 2.81 2.91 3.02 3.12	Δ-eps 1.8 1.7 1.7 1.7 1.7	∆-sigma 0.7 -0.3 -0.9 -1.5		7.5 5.0 2.5							
Resul 3400 3500 3600 3700 3800	ts Measu HP-e' 38.7 38.6 38.5 38.3 38.3	ured HP-e [®] 14.96 14.91 14.92 14.92 14.94	sigma 2.83 2.90 2.99 3.07 3.16	Targel eps 38.0 37.9 37.8 37.7 37.6	sigma 2.81 2.91 3.02 3.12 3.22	<u>∆-eps</u> 1.8 1.7 1.7 1.7 1.7 1.7	Δ-sigma 0.7 -0.3 -0.9 -1.5 -1.9	Dev. Permittivity %	7.5 5.0 2.5 0.0 -2.5							
F[MHz] 3400 3500 3600 3700 3800 3900	ts Measi HP-9' 38.7 38.6 38.5 38.3 38.2 38.2 38.1	ured HP-e" 14.96 14.91 14.92 14.92 14.94 14.95	sigma 2.83 2.90 2.99 3.07 3.16 3.24	Targel eps 38.0 37.9 37.8 37.8 37.6 37.5	sigma 2.81 2.91 3.02 3.12 3.22 3.32	Δ-eps 1.8 1.7 1.7 1.7 1.7 1.7 1.7 1.7	Δ-sigma 0.7 -0.3 -0.9 -1.5 -1.9 -2.4		7.5 5.0 2.5 0.0 -2.5 -5.0							
Resul 3400 3500 3600 3700 3800	ts Meass HP-9' 38.7 38.6 38.5 38.3 38.2 38.2 38.1 38.0	ured HP-e ²⁷ 14.96 14.91 14.92 14.92 14.94 14.95 15.00	sigma 2.83 2.90 3.07 3.16 3.24 3.34	Targel eps 38.0 37.9 37.8 37.7 37.6 37.5 37.4	sigma 2.81 2.91 3.02 3.12 3.22 3.32 3.43	<u>∆-eps</u> 1.8 1.7 1.7 1.7 1.7 1.7 1.7 1.8	Δ-sigma 0.7 -0.3 -0.9 -1.5 -1.9 -2.4 -2.5		7.5 5.0 2.5 0.0 -2.5 -5.0 -7.5							
Resul 3400 3500 3600 3700 3800 3900 4000	ts Mease HP-9' 38.7 38.6 38.5 38.3 38.2 38.1 38.0 37.9	ured HP-e ^v 14.96 14.91 14.92 14.92 14.94 14.95 15.00 15.04	sigma 2.83 2.90 3.07 3.16 3.24 3.34 3.43	Targel eps 38.0 37.9 37.8 37.8 37.8 37.6 37.5 37.4 37.2	sigma 2.81 2.91 3.02 3.12 3.22 3.32 3.43 3.53	<u>A-eps</u> 1.8 1.7 1.7 1.7 1.7 1.7 1.7 1.8 1.8 1.8	▲-sigma 0.7 -0.3 -0.9 -1.5 -1.9 -2.4 -2.5 -2.8		7.5 5.0 2.5 0.0 -2.5 -5.0 -7.5 -10.0		3900		00	-	 5400	
Result 3400 3500 3600 3800 3900 4000 4100	ts HP-e' 38.7 38.6 38.5 38.3 38.3 38.2 38.1 38.0 37.9 37.8	HP-e [®] 14.96 14.91 14.92 14.92 14.92 14.94 14.95 15.00 15.04 15.08	sigma 2.83 2.90 2.99 3.07 3.16 3.24 3.34 3.43 3.52	Targel eps 38.0 37.9 37.8 37.8 37.6 37.6 37.5 37.4 97.2 37.1	sigma 2.81 2.91 3.02 3.12 3.22 3.32 3.43 3.53 3.63	<u>A-eps</u> 1.8 1.7 1.7 1.7 1.7 1.7 1.7 1.8 1.8 1.8 1.8	▲sigma 0.7 -0.3 -0.9 -1.5 -1.9 -2.4 -2.5 -2.8 -2.8 -2.9		7.5 5.0 2.5 0.0 -2.5 -5.0 -7.5		3900		00	49 cy Mi	 5400	
Result 3400 3500 3600 3800 3900 4000 4100 4200	ts HP-9' 38.7 38.6 38.5 38.3 38.2 38.3 38.2 38.1 38.0 37.9 37.8 37.8 37.7	red HP-e" 14.96 14.91 14.92 14.92 14.94 14.95 15.00 15.04 15.08 15.14	sigma 2.83 2.90 3.07 3.16 3.24 3.34 3.43 3.52 3.62	Targe eps 38.0 37.9 37.8 37.7 37.8 37.5 37.4 37.2 37.1 37.0	sigma 2.81 2.91 3.02 3.12 3.22 3.32 3.43 3.53 3.63 3.63 3.73	Δ-eps 1.8 1.7 1.7 1.7 1.7 1.7 1.8 1.8 1.8 1.8 1.8	Δ-sigma 0.7 -0.3 -0.9 -1.5 -1.9 -2.4 -2.5 -2.8 -2.9 -3.0		7.5 5.0 2.5 0.0 -2.5 -5.0 -7.5 -10.0		3900		00 equen		 5400	590
f [MHz] 3400 3500 3800 3800 3800 4000 4100 4200 4300 4400	ts Measu HP-e' 38.7 38.6 38.5 38.3 38.2 38.1 38.0 37.9 37.8 37.7 37.5	ured HP-e ^v 14.96 14.91 14.92 14.94 14.95 15.00 15.04 15.08 15.14 15.18	sigma 2.83 2.90 3.07 3.16 3.24 3.34 3.43 3.52 3.62 3.71	Targe eps 38.0 37.9 37.8 37.7 37.8 37.5 37.4 37.2 37.1 37.0 36.9	sigma 2.81 2.91 3.02 3.12 3.22 3.32 3.43 3.53 3.63 3.63 3.73 3.64	Δ-eps 1.8 1.7 1.7 1.7 1.7 1.7 1.7 1.8 1.8 1.8 1.8 1.8 1.7 1.7 1.7 1.7 1.7 1.7 1.7 1.7	Δ-sigma 0.7 -0.3 -0.9 -1.5 -1.9 -2.4 -2.5 -2.8 -2.9 -3.0 -3.1		7.5 5.0 2.5 0.0 -2.5 -5.0 -7.5 -10.0		3900				 5400	590
Resul 3400 3500 3800 3800 3900 4000 4100 4200 4300 4400 4500	ts Measu HP-e' 38.7 38.6 38.5 38.3 38.2 38.1 38.0 37.9 37.8 37.7 37.5 37.4	ured HP-e ^v 14.96 14.91 14.92 14.94 14.95 15.00 15.04 15.08 15.14 15.18 15.20	sigma 2.83 2.99 3.07 3.16 3.24 3.34 3.43 3.52 3.62 3.71 3.81	Targel eps 38.0 37.9 37.8 37.7 37.6 37.5 37.4 37.2 37.1 37.0 36.9 36.8	sigma 2.81 2.91 3.02 3.12 3.22 3.43 3.53 3.63 3.63 3.63 3.73 3.64 3.94	Δ-eps 1.8 1.7 1.7 1.7 1.7 1.7 1.8 1.8 1.8 1.8 1.8 1.8 1.7 1.6	Δ-sigma 0.7 -0.3 -0.9 -1.5 -1.9 -2.4 -2.5 -2.5 -2.8 -2.9 -3.0 -3.1 -3.3		7.5 5.0 2.5 0.0 -2.5 -5.0 -7.5 -10.0	3	3900				 5400	590
Resul 3400 3500 3800 3800 3900 4000 4100 4100 4200 4300 4400 4500 4600	ts Meass HP-e' 38.7 38.6 38.3 38.3 38.2 38.1 38.0 37.9 37.8 37.7 37.5 37.4 37.4 37.3	Jred HP-e ⁷ 14.96 14.91 14.92 14.92 14.94 14.95 15.00 15.04 15.04 15.14 15.18 15.20 15.29	sigma 2.83 2.90 3.07 3.16 3.24 3.34 3.43 3.52 3.62 3.71 3.81 3.91	Targel eps 38.0 37.9 37.8 37.7 37.6 37.5 37.4 37.2 37.1 37.0 36.9 36.8 36.7	sigma 2.81 3.02 3.12 3.22 3.43 3.53 3.63 3.63 3.63 3.63 3.63 3.64 3.94 4.04	∆-eps 1.8 1.7 1.7 1.7 1.7 1.7 1.7 1.8 <	▲-sigma 0.7 -0.3 -0.9 -1.5 -1.9 -2.4 -2.5 -2.6 -2.9 -3.0 -3.1 -3.3 -3.2		7.5 5.0 2.5 0.0 -2.5 -5.0 -7.5 -10.0		3900				 5400	590
Resul 7 [MHz] 3400 3500 3500 3700 3800 3900 4000 4100 4100 4100 4200 4400 4200 4400 4200 4400 4200 4300 400 400 400 400 400 400	ts Meass HP-e' 38.7 38.6 38.3 38.3 38.2 38.1 38.0 37.9 37.8 37.7 37.5 37.4 37.4 37.3 37.1	14.96 14.91 14.92 14.92 14.92 14.94 14.95 15.00 15.04 15.08 15.18 15.20 15.29 15.34	sigma 2.83 2.99 3.07 3.16 3.24 3.34 3.34 3.52 3.62 3.71 3.81 3.91 4.01	Targe eps 38.0 37.9 37.8 37.7 37.6 37.5 37.4 37.5 37.4 37.2 37.1 37.0 36.9 36.8 36.7 36.6	sigma 2.81 2.91 3.02 3.12 3.22 3.43 3.53 3.63 3.63 3.73 3.84 3.94 4.04 4.14	∆-eps 1.8 1.7 1.7 1.7 1.7 1.7 1.7 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.5	A-sigma 0.7 0.3 0.9 1.5 1.9 2.4 -2.5 -2.8 -2.9 -3.0 -3.1 -3.2 -3.2		7.5 5.0 2.5 -2.5 -5.0 -7.5 -10.0 340		3900				 5400	590
Result 3400 3506 3700 3900 4000 4100 4200 4400 4400 4500 4600 4700 4800	ts Meass 38.7 38.6 38.5 38.3 38.2 38.3 38.2 38.1 38.0 37.9 37.8 37.7 37.8 37.7 37.5 37.4 37.3 37.1 37.0	HP-e ⁹ 14.96 14.92 14.92 14.92 14.92 14.94 14.95 15.00 15.04 15.08 15.14 15.18 15.20 15.29 15.34 15.39	sigma 2.83 2.99 3.07 3.16 3.24 3.34 3.43 3.52 3.62 3.62 3.62 3.62 3.81 3.81 3.91 4.01 4.11	Targel eps 38.0 37.9 37.8 37.4 37.5 37.4 37.5 37.4 37.5 37.4 37.2 37.1 37.0 36.9 36.8 36.7 36.6 36.4	sigma 2.81 3.02 3.22 3.32 3.43 3.53 3.63 3.73 3.64 3.94 4.04 4.04 4.14	∆-eps 1.8 1.7 1.7 1.7 1.7 1.7 1.8 1.8 1.8 1.8 1.8 1.5 1.4	A-sigma 0.7 0.3 0.9 1.6 1.9 2.4 2.5 -2.8 -2.9 -3.0 -3.1 -3.3 -3.2 -3.2 -3.2 -3.2		7.5 5.0 2.5 -2.5 -5.0 -7.5 -10.0 10.0 7.5		3900				 5400	590
Result 3400 3500 3800 3800 3900 4000 4100 4200 4300 4400 4500 4000 4500 4800 4800	ts Measure HP-e' 38.7 38.6 38.5 38.3 38.2 38.3 38.2 38.3 38.2 38.3 38.2 38.3 38.2 38.3 38.2 38.3 38.2 38.3 38.2 38.3 38.2 38.3 38.2 38.3 38.2 38.3 38.2 38.3 38.2 38.3 37.4	HP-e" 14.96 14.91 14.92 14.92 15.00 15.04 15.08 15.14 15.18 15.20 15.29 15.29 15.34	sigma 2.83 2.99 3.07 3.16 3.24 3.34 3.52 3.62 3.71 3.81 3.91 4.01 4.11 4.16	Targel eps 38.0 37.9 37.8 37.6 37.5 37.4 37.2 37.4 37.2 37.1 37.0 36.9 36.8 36.7 36.6 36.4 36.4	sigma 2.81 3.02 3.12 3.32 3.43 3.53 3.63 3.73 3.64 4.94 4.94 4.94 4.94 4.94 4.94	▲ eps 1.8 1.7 1.7 1.7 1.7 1.7 1.7 1.8 1.8 1.8 1.8 1.8 1.8 1.6 1.5 1.4 1.3	A-sigma 0.7 0.3 0.9 1.6 1.9 2.4 2.5 -2.6 -2.9 -3.0 -3.1 -3.3 -3.2 -3.2 -3.2 -3.2 -3.1	e. Dev. Permittvity	7.5 5.0 2.5 0.0 -2.5 -5.0 -7.5 -10.0 3400 10.0 7.5 5.0		3900				 5400	590
Result 3400 3506 3700 3900 4000 4100 4200 4400 4400 4500 4600 4700 4800	ts Meass 38.7 38.6 38.5 38.3 38.2 38.3 38.2 38.1 38.0 37.9 37.8 37.7 37.8 37.7 37.5 37.4 37.3 37.1 37.0	HP-e ⁹ 14.96 14.92 14.92 14.92 14.92 14.94 14.95 15.00 15.04 15.08 15.14 15.18 15.20 15.29 15.34 15.39	sigma 2.83 2.99 3.07 3.16 3.24 3.34 3.43 3.52 3.62 3.62 3.62 3.62 3.81 3.81 3.91 4.01 4.11	Targel eps 38.0 37.9 37.8 37.4 37.5 37.4 37.5 37.4 37.5 37.4 37.2 37.1 37.0 36.9 36.8 36.7 36.6 36.4	sigma 2.81 3.02 3.22 3.32 3.43 3.53 3.63 3.73 3.64 3.94 4.04 4.04 4.14	∆-eps 1.8 1.7 1.7 1.7 1.7 1.7 1.8 1.8 1.8 1.8 1.8 1.5 1.4	A-sigma 0.7 0.3 0.9 1.6 1.9 2.4 2.5 -2.8 -2.9 -3.0 -3.1 -3.3 -3.2 -3.2 -3.2 -3.2	Dev. Permittvity	7.5 5.0 2.5 0.0 -2.5 -5.0 -7.5 -10.0 3400 10.0 7.5 5.0		3900				 5400) 590

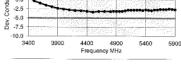


Figure D-7 **5GHz Head Tissue Equivalent Matter**

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-3.1 -3.0

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-2.8

FCC ID: ZNFD520	SAR EVALUATION REPORT		🕒 LG	Reviewed by: Quality Manager
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36.7 36.6 36.5

36.4 5.62

5000

5050

5100

5150

5600

5650

5700

5750 35.6 15.90 5.08 35.4 5.22 0.6

5850 5900 15.50 15.55

15.60 4.43 36.1 4.55

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 4.96

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 4.88
 35.6
 5.01

5800 35.5 15.94 5.14 35.3 5.27

35.4 15.98 35.4 16.02

 35.9
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 35.8
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 35.5
 5.07

 35.7
 15.86
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 5.12

 35.7
 15.86
 5.03
 35.4
 5.17

4.31

4.37

4.48

36.2 36.2

36.0 4.60 1.0

5.20 35.3 5.34 5.26 35.3 5.40

4.45

4.50

APPENDIX 9: G5 F SYSTEM V5 @=85 H=CB

APPENDIX E: SAR SYSTEM VALIDATION

Per FCC KDB 865664 D02v01r01, SAR system validation status should be documented to confirm measurement accuracy. The SAR systems (including SAR probes, system components and software versions) used for this device were validated against its performance specifications prior to the SAR measurements. Reference dipoles were used with the required tissue- equivalent media for system validation, according to the procedures outlined in IEEE 1528-2013 and FCC KDB 865664 D01v01r01. Since SAR probe calibrations are frequency dependent, each probe calibration point was validated at a frequency within the valid frequency range of the probe calibration point, using the system that normally operates with the probe for routine SAR measurements and according to the required tissue-equivalent media.

A tabulated summary of the system validation status including the validation date(s), measurement frequencies, SAR probes and tissue dielectric parameters has been included.

SAR System validation Summary														
SAR		DATE	PROBE SN	PROBE TYPE	PROBE CAL. POINT		COND.	PERM.	CW VALIDATION			MOD. VALIDATION		
SYSTEM #	STEM FREQ.						(σ)	(ɛ,)	SENSI- TIVITY	PROBE LINEARITY	PROBE ISOTROPY	MOD. TYPE	DUTY FACTOR	PAR
F	750	5/20/2013	3213	ES3DV3	750	Head	0.912	41.64	PASS	PASS	PASS	N/A	N/A	N/A
E	835	3/12/2013	3920	EX3DV4	835	Head	0.943	41.71	PASS	PASS	PASS	GMSK	PASS	N/A
В	1750	1/23/2013	3287	ES3DV3	1750	Head	1.402	38.84	PASS	PASS	PASS	N/A	N/A	N/A
G	1900	3/27/2013	3209	ES3DV3	1900	Head	1.449	39.10	PASS	PASS	PASS	GMSK	PASS	N/A
I	2450	7/3/2013	3319	ES3DV3	2450	Head	1.753	39.01	PASS	PASS	PASS	OFDM	N/A	PASS
E	5200	3/21/2013	3920	EX3DV4	5200	Head	4.529	35.64	PASS	PASS	PASS	OFDM	N/A	PASS
E	5300	3/21/2013	3920	EX3DV4	5300	Head	4.638	35.52	PASS	PASS	PASS	OFDM	N/A	PASS
E	5500	3/28/2013	3920	EX3DV4	5500	Head	4.813	34.07	PASS	PASS	PASS	OFDM	N/A	PASS
E	5600	3/22/2013	3920	EX3DV4	5600	Head	4.916	35.05	PASS	PASS	PASS	OFDM	N/A	PASS
E	5800	3/22/2013	3920	EX3DV4	5800	Head	5.108	34.76	PASS	PASS	PASS	OFDM	N/A	PASS
F	750	5/20/2013	3213	ES3DV3	750	Body	0.982	54.69	PASS	PASS	PASS	N/A	N/A	N/A
D	835	10/8/2013	3022	ES3DV3	835	Body	1.012	53.65	PASS	PASS	PASS	GMSK	PASS	N/A
D	1750	10/3/2013	3022	ES3DV3	1750	Body	1.446	51.36	PASS	PASS	PASS	N/A	N/A	N/A
E	1750	3/16/2013	3920	EX3DV4	1750	Body	1.491	52.88	PASS	PASS	PASS	N/A	N/A	N/A
С	1900	8/13/2013	3263	ES3DV3	1900	Body	1.579	51.36	PASS	PASS	PASS	GMSK	PASS	N/A
G	2450	3/29/2013	3209	ES3DV3	2450	Body	2.044	52.61	PASS	PASS	PASS	OFDM	N/A	PASS
Α	5200	1/23/2013	3589	EX3DV4	5200	Body	5.292	47.85	PASS	PASS	PASS	OFDM	N/A	PASS
Α	5300	1/23/2013	3589	EX3DV4	5300	Body	5.477	47.47	PASS	PASS	PASS	OFDM	N/A	PASS
Α	5500	1/23/2013	3589	EX3DV4	5500	Body	5.729	47.03	PASS	PASS	PASS	OFDM	N/A	PASS
Α	5600	1/23/2013	3589	EX3DV4	5600	Body	5.916	46.70	PASS	PASS	PASS	OFDM	N/A	PASS
Α	5800	1/23/2013	3589	EX3DV4	5800	Body	6.233	46.20	PASS	PASS	PASS	OFDM	N/A	PASS

Table E-I SAR System Validation Summary

NOTE: All measurements were performed using probes calibrated for CW signals only. Modulations in the table above represent test configurations for which the measurement system has been validated per FCC KDB Publication 865664 D01v01r01. SAR systems were validated for modulated signals with a periodic duty cycle, such as GMSK, or with a high peak to average ratio (>5 dB), such as OFDM according to KDB 865664.

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