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





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Accreditation No.: SCS 108

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Client PC Test

Certificate No: D750V3-1054_Feb12

CALIBRATION CERTIFICATE

Object	D750V3 - SN: 1054		
Calibration procedure(s)	QA CAL-05.v8 Calibration procedure for dipole validation kits above 700 MHz		
Calibration date:	February 09, 201	2	A tek min
This calibration certificate docume The measurements and the uncer All calibrations have been conduc	ents the traceability to nati rtainties with confidence p ted in the closed laborator	onal standards, which realize the physical uni robability are given on the following pages an ry facility: environment temperature (22 \pm 3)°C	its of measurements (SI). Id are part of the certificate. C and humidity < 70%.
Calibration Equipment used (M&T	E critical for calibration)		
Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	05-Oct-11 (No. 217-01451)	Oct-12
Power sensor HP 8481A	US37292783	05-Oct-11 (No. 217-01451)	Oct-12
Reference 20 dB Attenuator	SN: 5086 (20g)	29-Mar-11 (No. 217-01368)	Apr-12
Type-N mismatch combination	SN: 5047.2 / 06327	29-Mar-11 (No. 217-01371)	Apr-12
Reference Probe ES3DV3	SN: 3205	30-Dec-11 (No. ES3-3205_Dec11)	Dec-12
DAE4	SN: 601	04-Jul-11 (No. DAE4-601_Jul11)	Jul-12
Secondary Standards	1D #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-11)	In house check: Oct-12
	Name	Function	Signature
Calibrated by:	Israe El-Naouq	Laboratory Technician	Jorea anaony
Approved by:	Kalja Pokovic	Technical Manager	Letter,
This calibration certificate shall no	of be reproduced except in	full without written approval of the laboratory	Issued: February 9, 2012

Calibration Laboratory of

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





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Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

Accreditation No.: SCS 108

Measurement Conditions

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

DASY Version	DASY5	V52.8.0
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	42.3 ± 6 %	0.92 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.18 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	8.52 mW /g ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.42 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	5.57 mW /g ± 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.5	0.96 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	55.6 ± 6 %	0.96 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C		

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.21 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	8.84 mW / g ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.46 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	5.84 mW / g ± 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	54.0 Ω - 1.5 jΩ
Return Loss	- 27.8 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	49.6 Ω - 3.4 jΩ
Return Loss	- 29.2 dB

General Antenna Parameters and Design

Γ	Electrical Delay (one direction)	1.041 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 08, 2011

DASY5 Validation Report for Head TSL

Date: 09.02.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN: 1054

Communication System: CW; Frequency: 750 MHz Medium parameters used: f = 750 MHz; $\sigma = 0.92$ mho/m; $\epsilon_r = 42.3$; $\rho = 1000$ kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 SN3205; ConvF(6.33, 6.33, 6.33); Calibrated: 30.12.2011
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.0(692); SEMCAD X 14.6.4(4989)

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

Measurement grid: dx=5mm, dy=5mm, dz=5mmReference Value = 53.659 V/m; Power Drift = 0.02 dB Peak SAR (extrapolated) = 3.2940 SAR(1 g) = 2.18 mW/g; SAR(10 g) = 1.42 mW/g Maximum value of SAR (measured) = 2.552 mW/g



0 dB = 2.550 mW/g = 8.13 dB mW/g



DASY5 Validation Report for Body TSL

Date: 09.02.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN: 1054

Communication System: CW; Frequency: 750 MHz Medium parameters used: f = 750 MHz; $\sigma = 0.96$ mho/m; $\epsilon_r = 55.6$; $\rho = 1000$ kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 SN3205; ConvF(6.12, 6.12, 6.12); Calibrated: 30.12.2011
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.0(692); SEMCAD X 14.6.4(4989)

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

Measurement grid: dx=5mm, dy=5mm, dz=5mmReference Value = 53.016 V/m; Power Drift = 0.03 dB Peak SAR (extrapolated) = 3.2860 SAR(1 g) = 2.21 mW/g; SAR(10 g) = 1.46 mW/g Maximum value of SAR (measured) = 2.576 mW/g



0 dB = 2.580 mW/g = 8.23 dB mW/g



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Client PC Test

Certificate No: D835V2-4d026_Aug12

Accreditation No.: SCS 108

CALIBRATION CERTIFICATE

Object	D835V2 - SN: 4d	026	
Calibration procedure(s)	QA CAL-05.v8 Calibration proce	dure for dipole validation kits abo	ove 700 MHz
Calibration date:	August 23, 2012		1,6014 112 9/17/12
This calibration certificate docume The measurements and the uncer All calibrations have been conduct	ents the traceability to nati tainties with confidence p ted in the closed laborator	onal standards, which realize the physical ur robability are given on the following pages a y facility: environment temperature (22 ± 3)°	nits of measurements (SI). nd are part of the certificate. C and humidity < 70%.
Calibration Equipment used (M&T	E critical for calibration)		
Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	05-Oct-11 (No. 217-01451)	Oct-12
Power sensor HP 8481A	US37292783	05-Oct-11 (No. 217-01451)	Oct-12
Reference 20 dB Attenuator	SN: 5058 (20k)	27-Mar-12 (No. 217-01530)	Apr-13
Type-N mismatch combination	SN: 5047.2 / 06327	27-Mar-12 (No. 217-01533)	Apr-13
Reference Probe ES3DV3	SN: 3205	30-Dec-11 (No. ES3-3205_Dec11)	Dec-12
DAE4	SN: 601	27-Jun-12 (No. DAE4-601_Jun12)	Jun-13
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-11)	In house check: Oct-12
	Name	Function	Signature
Calibrated by:	Israe El-Naouq	Laboratory Technician	Wran RinDaoug
Approved by:	Katja Pokovic	Technical Manager	Jal My-
			Issued: August 23, 2012
This calibration certificate shall no	t be reproduced except in	full without written approval of the laborator	у.

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Accreditation No.: SCS 108

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Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Certificate No: D835\/2-4d026_Aug12

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Measurement Conditions

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

DASY Version	DASY5	V52.8.2
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	41.3 ± 6 %	0.90 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.35 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	9.39 mW /g ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.53 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	6.12 mW /g ± 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.2	0.97 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	53.2 ± 6 %	1.00 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C		

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.47 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	9.58 mW / g ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.62 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	6.33 mW / g ± 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.7 Ω - 3.4 jΩ
Return Loss	- 26.4 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	49.6 Ω - 4.8 jΩ
Return Loss	- 26.4 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.389 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 17, 2004

DASY5 Validation Report for Head TSL

Date: 23.08.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d026

Communication System: CW; Frequency: 835 MHz Medium parameters used: f = 835 MHz; $\sigma = 0.9$ mho/m; $\epsilon_r = 41.3$; $\rho = 1000$ kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 SN3205; ConvF(6.07, 6.07, 6.07); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.2(969); SEMCAD X 14.6.6(6824)

Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm 2/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mmReference Value = 56.824 V/m; Power Drift = 0.01 dB Peak SAR (extrapolated) = 3.482 mW/g SAR(1 g) = 2.35 mW/g; SAR(10 g) = 1.53 mW/g Maximum value of SAR (measured) = 2.72 W/kg



0 dB = 2.72 W/kg = 8.69 dB W/kg

Impedance Measurement Plot for Head TSL

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DASY5 Validation Report for Body TSL

Date: 23.08.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d026

Communication System: CW; Frequency: 835 MHz Medium parameters used: f = 835 MHz; $\sigma = 1$ mho/m; $\epsilon_r = 53.2$; $\rho = 1000$ kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 SN3205; ConvF(6.02, 6.02, 6.02); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.2(969); SEMCAD X 14.6.6(6824)

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

Measurement grid: dx=5mm, dy=5mm, dz=5mmReference Value = 55.339 V/m; Power Drift = 0.04 dB Peak SAR (extrapolated) = 3.592 mW/g SAR(1 g) = 2.47 mW/g; SAR(10 g) = 1.62 mW/g Maximum value of SAR (measured) = 2.87 W/kg



0 dB = 2.87 W/kg = 9.16 dB W/kg

Impedance Measurement Plot for Body TSL

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Certificate No: D835V2-4d047_Jan12

Accreditation No.: SCS 108

CALIBRATION CERTIFICATE

Object	D835V2 - SN: 4d	047	
Calibration procedure(s)	QA CAL-05.v8 Calibration proce	dure for dipole validation kits ab	ove 700 MHz
Calibration date:	January 25, 2012		V KOKUIZ
This calibration certificate docume The measurements and the uncer	ents the traceability to nati- tainties with confidence p	onal standards, which realize the physical ur robability are given on the following pages a	nits of measurements (SI). nd are part of the certificate.
All calibrations have been conduc	ted in the closed laborator	y facility: environment temperature (22 \pm 3)°	°C and humidity < 70%.
Calibration Equipment used (M&T	E critical for calibration)		
Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	05-Oct-11 (No. 217-01451)	Oct-12
Power sensor HP 8481A	US37292783	05-Oct-11 (No. 217-01451)	Oct-12
Reference 20 dB Attenuator	SN: 5086 (20g)	29-Mar-11 (No. 217-01368)	Apr-12
Type-N mismatch combination	SN: 5047.2 / 06327	29-Mar-11 (No. 217-01371)	Apr-12
Reference Probe ES3DV3	SN: 3205	30-Dec-11 (No. ES3-3205_Dec11)	Dec-12
DAE4	SN: 601	04-Jul-11 (No. DAE4-601_Jul11)	Jul-12
O	L.5. #	Ohanda Data (in barras)	Ontradidad Obeela
Dewer concer UD 94914	ID #	10 Oct 02 (in house shock Oct 11)	In house shealy Oct 10
POWER SENSOL THE 0401A	100005	18-Oct-02 (in house check Oct-11)	In house check. Oct-13
Notwork Applyzor HP 97525	100000	19 Oct 01 (in house check Oct-11)	In house check: Oct-13
	Name	Function	Signature
Calibrated by:	Israe El-Naouq	Laboratory Technician	Maa El-Daoug
Approved by:	Katja Pokovic	Technical Manager	AC MJ-
This solibration partificate shall be	t be reproduced event in	full without written enproved of the Joharston	Issued: January 25, 2012

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Glossarv:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

- Measurement Conditions: Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- Antenna Parameters with TSL: The dipole is mounted with the spacer to position its feed . point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- Feed Point Impedance and Return Loss: These parameters are measured with the dipole • positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- Electrical Delay: One-way delay between the SMA connector and the antenna feed point. • No uncertainty required.
- SAR measured: SAR measured at the stated antenna input power.
- SAR normalized: SAR as measured, normalized to an input power of 1 W at the antenna 0 connector.
- SAR for nominal TSL parameters: The measured TSL parameters are used to calculate the nominal SAR result.

Measurement Conditions

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

DASY Version	DASY5	V52.8.0
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	41.8 ± 6 %	0.89 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.33 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	9.41 mW /g ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.53 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	6.17 mW /g ± 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.2	0.97 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	53.3 ± 6 %	0.98 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C		~~~~

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.39 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	9.41 mW / g ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.57 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	6.21 mW / g ± 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.7 Ω - 3.0 jΩ
Return Loss	- 29.4 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	47.8 Ω - 5.0 jΩ			
Return Loss	- 25.0 dB			

General Antenna Parameters and Design

Electrical Delay (one direction)	1 386 ns
Electrical Delay (one direction)	1.000 115

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	August 16, 2006

DASY5 Validation Report for Head TSL

Date: 25.01.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d047

Communication System: CW; Frequency: 835 MHz Medium parameters used: f = 835 MHz; $\sigma = 0.89$ mho/m; $\epsilon_r = 41.8$; $\rho = 1000$ kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 SN3205; ConvF(6.07, 6.07, 6.07); Calibrated: 30.12.2011
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.0(692); SEMCAD X 14.6.4(4989)

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

Measurement grid: dx=5mm, dy=5mm, dz=5mmReference Value = 56.752 V/m; Power Drift = 0.02 dB Peak SAR (extrapolated) = 3.4130 SAR(1 g) = 2.33 mW/g; SAR(10 g) = 1.53 mW/g Maximum value of SAR (measured) = 2.709 mW/g



0 dB = 2.710 mW/g = 8.66 dB mW/g



DASY5 Validation Report for Body TSL

Date: 25.01.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d047

Communication System: CW; Frequency: 835 MHz Medium parameters used: f = 835 MHz; $\sigma = 0.98$ mho/m; $\epsilon_r = 53.3$; $\rho = 1000$ kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 SN3205; ConvF(6.02, 6.02, 6.02); Calibrated: 30.12.2011
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.0(692); SEMCAD X 14.6.4(4989)

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

Measurement grid: dx=5mm, dy=5mm, dz=5mmReference Value = 54.995 V/m; Power Drift = 0.02 dB Peak SAR (extrapolated) = 3.4790 SAR(1 g) = 2.39 mW/g; SAR(10 g) = 1.57 mW/g Maximum value of SAR (measured) = 2.767 mW/g



0 dB = 2.770 mW/g = 8.85 dB mW/g



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





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Accreditation No.: SCS 108

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PC Test Client

Certificate No: ES3-3022_Aug12

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Object	ES3DV2 - SN:3022
Calibration procedure(s)	QA CAL-01.v8, QA CAL-23.v4, QA CAL-25.v4 Calibration procedure for dosimetric E-field probes /
Calibration date:	August 28, 2012
This calibration certificate docur The measurements and the unc	nents the traceability to national standards, which realize the physical units of measurements (SI). ertainties with confidence probability are given on the following pages and are part of the certificate.
All calibrations have been condu	ucted in the closed laboratory facility: environment temperature (22 \pm 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	29-Dec-11 (No. ES3-3013_Dec11)	Dec-12
DAE4	SN: 660	20-Jun-12 (No. DAE4-660_Jun12)	Jun-13
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 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-11)	In house check: Oct-12

	Name	Function	Signature
Calibrated by:	Jeton Kastrati	Laboratory Technician	- P II
		, 	
Approved by:	Katja Pokovic	Technical Manager	
			, com second
			lanuarde Assessed 20, 2012
			Issued: August 28, 2012
This calibration certificate	e shall not be reproduced except in :	full without written approval of the lab	oratory.

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Glossary:

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	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, 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.

Accreditation No.: SCS 108

Probe ES3DV2

SN:3022

Manufactured: April 15, 2003 Calibrated:

August 28, 2012

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	1.00	1.04	0.99	± 10.1 %
DCP (mV) ^B	98.3	99.5	101.3	

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	0.00	0.00	1.00	133.3	±2.7 %
			Y	0.00	0.00	1.00	140.3	
			Z	0.00	0.00	1.00	178.9	

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

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

	V										
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	6.30	6.30	6.30	0.30	1.72	± 12.0 %			
835	41.5	0.90	6.03	6.03	6.03	0.35	1.63	± 12.0 %			
1750	40.1	1.37	5.07	5.07	5.07	0.32	1.89	± 12.0 %			
1900	40.0	1.40	4.86	4.86	4.86	0.40	1.57	± 12.0 %			
2450	39.2	1.80	4.23	4.23	4.23	0.59	1.44	± 12.0 %			
2600	39.0	1.96	4.10	4.10	4.10	0.67	1.37	± 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

^{Γ} 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	6.07	6.07	6.07	0.23	2.09	± 12.0 %
835	55.2	0.97	6.02	6.02	6.02	0.47	1.44	± 12.0 %
1750	53.4	1.49	4.70	4.70	4.70	0.46	1.55	± 12.0 %
1900	53.3	1.52	4.43	4.43	4.43	0.36	1.87	± 12.0 %
2450	52.7	1.95	3.97	3.97	3.97	0.65	1.06	± 12.0 %
2600	52.5	2.16	3.80	3.80	3.80	0.54	0.75	± 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

^r 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 (°)	98.5
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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Object	ES3DV3 - SN:3209						
Calibration procedure(s)	QA CAL-01.v8, QA CAL-12.v7, QA CAL-23.v4, QA CAL-25.v4 Calibration procedure for dosimetric E-field probes						
Calibration date:	March 16, 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%.							
A 11 A - A - A - A - A - A - A - A - A -							

Calibration Equipment used (M	<pre>//&amp;TE critical for calibration)</pre>
Calibration Equipment used (M	<pre>//&amp;TE critical for calibration)</pre>

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	31-Mar-11 (No. 217-01372)	Apr-12
Power sensor E4412A	MY41498087	31-Mar-11 (No. 217-01372)	Apr-12
Reference 3 dB Attenuator	SN: S5054 (3c)	29-Mar-11 (No. 217-01369)	Apr-12
Reference 20 dB Attenuator	SN: S5086 (20b)	29-Mar-11 (No. 217-01367)	Apr-12
Reference 30 dB Attenuator	SN: S5129 (30b)	29-Mar-11 (No. 217-01370)	Apr-12
Reference Probe ES3DV2	SN: 3013	29-Dec-11 (No. ES3-3013 Dec11)	Dec-12
DAE4	SN: 654	3-May-11 (No. DAE4-654_May11)	May-12
Secondary Standards	ID	Check Date (in house)	Scheduled Chock
RF generator HP 8648C	U\$3642U01700	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-11)	In house check: Oct-12

	Name	Function	Signature
Calibrated by:	Jeton Kastrati	Laboratory Technician	$\sim \ell$ $\ell \ell$
			- de
Approved by:	Katja Pokovic	Technical Manager	V >
			13 Chte
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<b>100</b> )			Issued: March 19, 2012
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Accreditation No.: SCS 108

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TSL	tissue simulating liquid
NORMx,y,z	sensitivity in free space
ConvF	sensitivity in TSL / NORMx.v.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	$\vartheta$ 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 θ = 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:3209

Manufactured: Calibrated:

October 14, 2008 March 16, 2012

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

#### **Basic Calibration Parameters**

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm $(\mu V/(V/m)^2)^A$	1.36	1.34	1.15	± 10.1 %
DCP (mV) [®]	98.2	97.4	98.7	

#### **Modulation Calibration Parameters**

UID	Communication System Name	PAR		A dB	B dB	C dB	VR mV	Unc ^E (k=2)
10000	CW	0.00	X	0.00	0.00	1.00	119.2	±3.5 %
			Y	0.00	0.00	1.00	89.3	······
			Z	0.00	0.00	1.00	111.5	hans

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 Numerical linearization parameter: uncertainty not required.

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

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

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	6.47	6.47	6.47	0.37	1.61	± 12.0 %
835	41.5	0.90	6.22	6.22	6.22	0.24	2.24	± 12.0 %
1640	40.3	1.29	5.38	5.38	5.38	0.41	1.56	± 12.0 %
1750	40.1 1.37		5.26	5.26 5.26		0.41	1.60	± 12.0 %
1900	40.0	1.40	5.15	5.15	5.15	0.80	1.16	± 12.0 %
2450	39.2	1.80	4.46	4.46	4.46	0.64	1.39	± 12.0 %
2600	39.0	1.96	4.30	4.30	4.30	0.69	1.42	± 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. At frequencies below 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) can be relaxed to  $\pm$  10% if liquid compensation formula is applied to

The requercises below 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) 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 ( $\epsilon$  and  $\sigma$ ) 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)
450	56.7	0.94	7.11	7.11	7.11	0.07	1.00	± 13.4 %
750	55.5	0.96	6.23	6.23	6.23	0.54	1.40	± 12.0 %
835	55.2	0.97	6.13	6.13	6.13	0.24	2.27	± 12.0 %
1640	53.8	1.40	5.21	5.21	5.21	0.72	1.29	± 12.0 %
1750	53.4	1.49	4.83	4.83	4.83	0.59	1.44	± 12.0 %
1900	53.3	1.52	4.63	4.63	4.63	0.57	1.50	± 12.0 %
2450	52.7	1.95	4.23	4.23	4.23	0.80	1.00	± 12.0 %
2600	52.5	2.16	4.02	4.02	4.02	0.62	0.90	± 12.0 %

Calibration	Parameter	Determined	in Bo	dy 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 ( $\epsilon$  and  $\sigma$ ) 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 ( $\epsilon$  and  $\sigma$ ) is restricted to  $\pm$  5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters. 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 ( $\phi$ ), $\vartheta = 0^{\circ}$

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

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Accreditation No.: SCS 108

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Object

Client

ES3DV3 - SN:3213

Calibration procedure(s)

**PC** Test

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

Calibration date:

April 24, 2012

Fot SIZIT 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	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	29-Dec-11 (No. ES3-3013_Dec11)	Dec-12
DAE4	SN: 660	10-Jan-12 (No. DAE4-660_Jan12)	Jan-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-11)	In house check: Oct-12

	Name	Function	Signature
Calibrated by:	Dimce Illev	Laboratory Technician	APRIL
			NINN
Approved by:	Katja Pokovic	Technical Manager	00 IL
		6	x
			locued: April 25, 2012
			Issued: April 25, 2012
This calibration certificate shall	not be reproduced except in full without v	written approval of the laboratory.	

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#### Glossary: TSL tissue simulating liquid sensitivity in free space NORMx,y,z sensitivity in TSL / NORMx,y,z ConvF DCP diode compression point crest factor (1/duty_cycle) of the RF signal CF modulation dependent linearization parameters A, B, C φ rotation around probe axis Polarization $\phi$ Polarization & 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  $\vartheta = 0$  (f  $\leq 900$  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 ٠ 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  $f \le 800$  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

Manufactured: Calibrated:

October 14, 2008 April 24, 2012

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	1.48	1.36	1.33	± 10.1 %
DCP (mV) ^B	97.8	101.0	99.1	

#### **Modulation Calibration Parameters**

UID	Communication System Name	PAR		Α	В	С	VR	Unc ^E
				dB	dB	dB	mv	(k=2)
0	CW	0.00	Х	0.00	0.00	1.00	125.2	±2.5 %
			Y	0.00	0.00	1.00	127.5	
			Z	0.00	0.00	1.00	169.0	

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

 ^A The uncertainties of NormX,Y,Z do not affect the E²-field uncertainty inside TSL (see Pages 5 and 6).
 ^B Numerical linearization parameter: uncertainty not required.
 ^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	6.32	6.32	6.32	0.50	1.38	± 12.0 %
835	41.5	0.90	6.07	6.07	6.07	0.41	1.57	± 12.0 %
1640	40.3	1.29	5.36	5.36	5.36	0.64	1.24	± 12.0 %
1750	40.1	1.37	5.22	5.22	5.22	0.57	1.39	± 12.0 %
1900	40.0	1.40	5.02	5.02	5.02	0.63	1.32	± 12.0 %
2450	39.2	1.80	4.43	4.43	4.43	0.80	1.22	± 12.0 %
2600	39.0	1.96	4.26	4.26	4.26	0.72	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 ( $\epsilon$  and  $\sigma$ ) 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 ( $\epsilon$  and  $\sigma$ ) is restricted to  $\pm$  5%. The uncertainty is the RSS of the ConvF uncertainty is the ConvF uncertainty is the RSS of the ConvF uncertai 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	6.19	6.19	6.19	0.31	1.96	± 12.0 %
835	55.2	0.97	6.07	6.07	6.07	0.38	1.73	± 12.0 %
1640	53.8	1.40	5.13	5.13	5.13	0.35	2.07	± 12.0 %
1750	53.4	1.49	4.68	4.68	4.68	0.54	1.56	± 12.0 %
1900	53.3	1.52	4.50	4.50	4.50	0.69	1.37	± 12.0 %
2450	52.7	1.95	4.11	4.11	4.11	0.80	1.04	± 12.0 %
2600	52.5	2.16	3.91	3.91	3.91	0.63	0.92	± 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 ( $\epsilon$  and  $\sigma$ ) 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 ( $\epsilon$  and  $\sigma$ ) is restricted to  $\pm$  5%. The uncertainty is the RSS of the ConvF uncertainty is decretable ( $\epsilon$  independence) and  $\epsilon$  and  $\sigma$ ) is restricted to  $\pm$  5%. The uncertainty is the RSS of the ConvF uncertainty is 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 ( $\phi$ ), $\vartheta = 0^{\circ}$

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 (°)	140.1
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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Certificate No: ES3-3263_May12

## CALIBRATION CERTIFICATE

Object

Client

ES3DV3 - SN:3263

Calibration procedure(s)

**PC** Test

QA CAL-01.v8, QA CAL-12.v7, QA CAL-23.v4, QA CAL-25.v4 Calibration procedure for dosimetric E-field probes

Calibration date:

May 18, 2012

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E44198	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	29-Dec-11 (No. ES3-3013_Dec11)	Dec-12
DAE4	SN: 660	10-Jan-12 (No. DAE4-660_Jan12)	Jan-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-11)	In house check: Oct-12

	Name	Function	Signature
Calibrated by:	Jeton Kastrati	Laboratory Technician	Adu
Approved by:	Kalja Pokovic	Technical Manager	IC 14
This calibration certificate	shall not be reproduced except in t	full without written approval of the lab	Issued: May 21, 2012

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#### Accreditation No.: SCS 108

Glossary:	
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 8	9 rotation around an axis that is in the plane normal to probe axis (at measurement center),
	i.e., $9 = 0$ 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  $\vartheta = 0$  (f  $\leq 900$  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:3263

Manufactured: Calibrated: January 25, 2010 May 18, 2012

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	1.23	1.12	± 10.1 %
DCP (mV) ^B	100.1	99.6	104.5	

#### **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	0.00	0.00	1.00	153.9	±4.4 %
			Y	0.00	0.00	1.00	159.2	
			Z	0.00	0.00	1.00	150.3	

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	6.40	6.40	6.40	0.32	1.73	± 12.0 %
835	41.5	0.90	6.16	6.16	6.16	0.40	1.54	± 12.0 %
1640	40.3	1.29	5.46	5.46	5.46	0.53	1.37	± 12.0 %
1750	40.1	1.37	5.30	5.30	5.30	0.47	1.50	± 12.0 %
1900	40.0	1.40	5.09	5.09	5.09	0.55	1.35	± 12.0 %
2450	39.2	1.80	4.45	4.45	4.45	0.77	1.27	± 12.0 %
2600	39.0	1.96	4.34	4.34	4.34	0.76	1.34	± 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 ( $\varepsilon$  and  $\sigma$ ) can be relaxed to ± 10% if liquid compensation formula is applied to

^r At frequencies below 3 GHz, the validity of tissue parameters ( $\varepsilon$  and  $\sigma$ ) 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 ( $\varepsilon$  and  $\sigma$ ) 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)
450	56.7	0.94	7.05	7.05	7.05	0.08	1.15	± 13.4 %
750	55.5	0.96	6.26	6.26	6.26	0.68	1.24	± 12.0 %
835	55.2	0.97	6.15	6.15	6.15	0.40	1.65	± 12.0 %
1640	53.8	1.40	5.33	5.33	5.33	0.74	1.27	± 12.0 %
1750	53.4	1.49	4.96	4.96	4.96	0.62	1.41	± 12.0 %
1900	53.3	1.52	4.76	4.76	4.76	0.54	1.48	± 12.0 %
2450	52.7	1.95	4.35	4.35	4.35	0.80	1.15	± 12.0 %
2600	52.5	2.16	4.16	4.16	4.16	0.80	1.00	± 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 ( $\epsilon$  and  $\sigma$ ) can be relaxed to  $\pm$  10% if liquid compensation formula is applied to

⁺ At frequencies below 3 GHz, the validity of tissue parameters ( $\varepsilon$  and  $\sigma$ ) 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 ( $\varepsilon$  and  $\sigma$ ) 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 ( $\phi$ ), $\vartheta = 0^{\circ}$

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 (°)	63.9
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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Certificate No: ES3-3288_Sep12

CALIBRATION	CERTIFICATI	5						
Object	ES3DV3 - SN:3288							
Calibration procedure(s)	QA CAL-01.v8, QA CAL-23.v4, QA CAL-25.v4 Calibration procedure for dosimetric E-field probes							
Calibration date:	September 20, 2012							
This calibration certificate docur The measurements and the unc All calibrations have been condu Calibration Equipment used (M8	nents the traceability to nation ertainties with confidence produced in the closed laborator NTE critical for calibration)	onal standards, which realize the physical units robability are given on the following pages and y facility: environment temperature $(22 \pm 3)^{\circ}$ C	s of measurements (SI). are part of the certificate. and humidity < 70%.					
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	29-Dec-11 (No. ES3-3013_Dec11)	Dec-12					
DAE4	SN: 660	20-Jun-12 (No. DAE4-660_Jun12)	Jun-13					
Secondary Standards	ID	Check Date (in house)	Scheduled Check					
RF generator HP 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-11)	In house check: Oct-12					
	Name	Function	Signature					
Jallbrated by:	Jeton Kastrati		X-10					
Approved by:	Katja Pokovic	covic Technical Manager						
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#### **Calibration Laboratory of**

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





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#### 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 &	$\vartheta$ 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:3288

Manufactured: July 6, 2010 Calibrated:

September 20, 2012

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

#### **Basic Calibration Parameters**

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm $(\mu V/(V/m)^2)^A$	0.87	0.97	0.75	± 10.1 %
DCP (mV) ^B	101.3	102.4	103.9	

#### Modulation Calibration Parameters

UID	Communication System Name	PAR		A dB	B dB	C dB	VR mV	Unc [±] (k=2)
0	CW	0.00	X	0.00	0.00	1.00	168.6	±3.3 %
			Y	0.00	0.00	1.00	132.2	
			Z	0.00	0.00	1.00	156.8	

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.
## DASY/EASY - Parameters of Probe: ES3DV3 - SN:3288

					<u> </u>			
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	6.67	6.67	6.67	0.80	1.14	± 12.0 %
835	41.5	0.90	6.41	6.41	6.41	0.76	1.18	± 12.0 %
1750	40.1	1.37	5.51	5.51	5.51	0.70	1.28	± 12.0 %
1900	40.0	1.40	5.28	5.28	5.28	0.80	1.22	± 12.0 %
2450	39.2	1.80	4.61	4.61	4.61	0.80	1.26	± 12.0 %
2600	39.0	1.96	4.45	4.45	4.45	0.80	1.31	± 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 ( $\epsilon$  and  $\sigma$ ) can be relaxed to  $\pm$  10% if liquid compensation formula is applied to

^{$\Gamma$} At frequencies below 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) 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 ( $\epsilon$  and  $\sigma$ ) is restricted to  $\pm$  5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

## DASY/EASY - Parameters of Probe: ES3DV3 - SN:3288

			-		~			
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	6.44	6.44	6.44	0.62	1.31	± 12.0 %
835	55.2	0.97	6.31	6.31	6.31	0.38	1.78	± 12.0 %
1750	53.4	1.49	5.18	5.18	5.18	0.64	1.43	± 12.0 %
1900	53.3	1.52	4.89	4.89	4.89	0.50	1.64	± 12.0 %
2450	52.7	1.95	4.35	4.35	4.35	0.74	1.23	± 12.0 %
2600	52.5	2.16	4.09	4.09	4.09	0.80	1.07	± 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 ( $\epsilon$  and  $\sigma$ ) can be relaxed to  $\pm$  10% if liquid compensation formula is applied to

^F At frequencies below 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) 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 ( $\epsilon$  and  $\sigma$ ) 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 ( $\phi$ ), $\vartheta = 0^{\circ}$







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

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



## **Conversion Factor Assessment**

## DASY/EASY - Parameters of Probe: ES3DV3 - SN:3288

## **Other Probe Parameters**

Sensor Arrangement	Triangular
Connector Angle (°)	54.3
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

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

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## Certificate No: EX3-3561_Jul12

Object	EX3DV4 - SN:35	61	
Calibration procedure(s)	QA CAL-01.v8, C Calibration proce	A CAL-14.v3, QA CAL-23.v4, QA dure for dosimetric E-field probes	CAL-25.v4
Calibration date:	July 26, 2012		Yed
This calibration certificate docu	ments the traceability to natio	onal standards, which realize the physical units	of measurements (SI).
he measurements and the un	certainties with confidence pr	obability are given on the following pages and	are part of the certificate.
The measurements and the un	certainties with confidence pr	obability are given on the following pages and	are part of the certificate.
The measurements and the un All calibrations have been cond	certainties with confidence pr lucted in the closed laborator	obability are given on the following pages and y facility: environment temperature (22 $\pm$ 3)°C a	are part of the certificate.
The measurements and the un All calibrations have been cond Calibration Equipment used (M	certainties with confidence pr lucted in the closed laborator &TE critical for calibration)	obability are given on the following pages and y facility: environment temperature (22 ± 3)°C a	are part of the certificate.
The measurements and the un All calibrations have been cond Calibration Equipment used (M	certainties with confidence pr lucted in the closed laborator &TE critical for calibration)	obability are given on the following pages and y facility: environment temperature (22 ± 3)°C a	are part of the certificate.
The measurements and the un- NI calibrations have been cond Calibration Equipment used (M Primary Standards	certainties with confidence pr lucted in the closed laborator &TE critical for calibration)	obability are given on the following pages and y facility: environment temperature (22 ± 3)°C a Cal Date (Certificate No.)	are part of the certificate. and humidity < 70%. Scheduled Calibration
The measurements and the un- all calibrations have been cond calibration Equipment used (M Primary Standards Power meter E4419B	certainties with confidence pr lucted in the closed laborator &TE critical for calibration) ID GB41293874	obability are given on the following pages and y facility: environment temperature (22 ± 3)°C a Cal Date (Certificate No.) 29-Mar-12 (No. 217-01508)	are part of the certificate. and humidity < 70%. Scheduled Calibration Apr-13
The measurements and the un- all calibrations have been cond calibration Equipment used (M Primary Standards Power meter E4419B Power sensor E4412A	certainties with confidence pr lucted in the closed laborator &TE critical for calibration) ID GB41293874 MY41498087	obability are given on the following pages and         y facility: environment temperature (22 ± 3)°C a         Cal Date (Certificate No.)         29-Mar-12 (No. 217-01508)         29-Mar-12 (No. 217-01508)	are part of the certificate. and humidity < 70%. Scheduled Calibration Apr-13 Apr-13
The measurements and the united in a calibrations have been conceptible calibration Equipment used (M Primary Standards Power meter E4419B Power sensor E4412A Reference 3 dB Attenuator	certainties with confidence pr lucted in the closed laborator &TE critical for calibration) ID GB41293874 MY41498087 SN: S5054 (3c)	obability are given on the following pages and         y facility: environment temperature (22 ± 3)°C a         Cal Date (Certificate No.)         29-Mar-12 (No. 217-01508)         29-Mar-12 (No. 217-01508)         27-Mar-12 (No. 217-01531)	are part of the certificate. and humidity < 70%. Scheduled Calibration Apr-13 Apr-13 Apr-13
The measurements and the unit of calibrations have been cond calibration Equipment used (M Primary Standards Power meter E4419B Power sensor E4412A Reference 3 dB Attenuator Reference 20 dB Attenuator	certainties with confidence pr lucted in the closed laborator &TE critical for calibration) ID GB41293874 MY41498087 SN: S5054 (3c) SN: S5086 (20b)	obability are given on the following pages and         y facility: environment temperature (22 ± 3)°C a         Cal Date (Certificate No.)         29-Mar-12 (No. 217-01508)         29-Mar-12 (No. 217-01508)         27-Mar-12 (No. 217-01531)         27-Mar-12 (No. 217-01529)	are part of the certificate. and humidity < 70%. Scheduled Calibration Apr-13 Apr-13 Apr-13 Apr-13
The measurements and the unit of calibrations have been cond Calibration Equipment used (M Primary Standards Power meter E4419B Power sensor E4412A Reference 3 dB Attenuator Reference 20 dB Attenuator Reference 30 dB Attenuator	certainties with confidence pr lucted in the closed laborator &TE critical for calibration) ID GB41293874 MY41498087 SN: S5054 (3c) SN: S5086 (20b) SN: S5129 (30b)	obability are given on the following pages and         y facility: environment temperature (22 ± 3)°C a         Cal Date (Certificate No.)         29-Mar-12 (No. 217-01508)         29-Mar-12 (No. 217-01508)         27-Mar-12 (No. 217-01531)         27-Mar-12 (No. 217-01532)	are part or the certificate.         and humidity < 70%.
The measurements and the unital calibrations have been conceptions calibration Equipment used (Mean of the conception of	certainties with confidence pr lucted in the closed laborator &TE critical for calibration) ID GB41293874 MY41498087 SN: S5054 (3c) SN: S5086 (20b) SN: S5129 (30b) SN: 3013	obability are given on the following pages and         y facility: environment temperature (22 ± 3)°C a         Cal Date (Certificate No.)         29-Mar-12 (No. 217-01508)         29-Mar-12 (No. 217-01508)         27-Mar-12 (No. 217-01531)         27-Mar-12 (No. 217-01529)         27-Mar-12 (No. 217-01532)         29-Dec-11 (No. ES3-3013_Dec11)	are part of the certificate. and humidity < 70%. Scheduled Calibration Apr-13 Apr-13 Apr-13 Apr-13 Apr-13 Dec-12
The measurements and the un- All calibrations have been cond Calibration Equipment used (M Primary Standards Power meter E4419B Power sensor E4412A Reference 3 dB Attenuator Reference 20 dB Attenuator Reference 30 dB Attenuator Reference Probe ES3DV2 DAE4	certainties with confidence pr lucted in the closed laborator &TE critical for calibration) ID GB41293874 MY41498087 SN: S5054 (3c) SN: S5086 (20b) SN: S5129 (30b) SN: 3013 SN: 660	cobability are given on the following pages and         y facility: environment temperature (22 ± 3)°C a         Cal Date (Certificate No.)         29-Mar-12 (No. 217-01508)         29-Mar-12 (No. 217-01508)         27-Mar-12 (No. 217-01531)         27-Mar-12 (No. 217-01529)         27-Mar-12 (No. 217-01529)         27-Mar-12 (No. 217-01529)         27-Mar-12 (No. 217-01532)         29-Dec-11 (No. ES3-3013_Dec11)         20-Jun-12 (No. DAE4-660_Jun12)	are part or the certificate.         and humidity < 70%.
The measurements and the un- All calibrations have been conc Calibration Equipment used (M Primary Standards Power meter E4419B Power sensor E4412A Reference 3 dB Attenuator Reference 20 dB Attenuator Reference 90 dB Attenuator Reference Probe ES3DV2 DAE4 Secondary Standards	certainties with confidence pr lucted in the closed laborator &TE critical for calibration) ID GB41293874 MY41498087 SN: S5054 (3c) SN: S5086 (20b) SN: S5129 (30b) SN: 3013 SN: 660	obability are given on the following pages and         y facility: environment temperature (22 ± 3)°C a         Cal Date (Certificate No.)         29-Mar-12 (No. 217-01508)         29-Mar-12 (No. 217-01508)         27-Mar-12 (No. 217-01531)         27-Mar-12 (No. 217-01532)         29-Dec-11 (No. ES3-3013_Dec11)         20-Jun-12 (No. DAE4-660_Jun12)         Check Date (in house)	are part of the certificate. and humidity < 70%. Scheduled Calibration Apr-13 Apr-13 Apr-13 Apr-13 Dec-12 Jun-13 Scheduled Check
The measurements and the un All calibrations have been conc Calibration Equipment used (M Primary Standards Power meter E4419B Power sensor E4412A Reference 3 dB Attenuator Reference 20 dB Attenuator Reference 20 dB Attenuator Reference Probe ES3DV2 DAE4 Secondary Standards RF generator HP 8648C	certainties with confidence pr lucted in the closed laborator &TE critical for calibration) ID GB41293874 MY41498087 SN: S5054 (3c) SN: S5054 (3c) SN: S5056 (20b) SN: S5129 (30b) SN: 3013 SN: 660 ID US3642U01700	cobability are given on the following pages and         y facility: environment temperature (22 ± 3)°C a         Cal Date (Certificate No.)         29-Mar-12 (No. 217-01508)         29-Mar-12 (No. 217-01508)         27-Mar-12 (No. 217-01531)         27-Mar-12 (No. 217-01529)         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)	are part of the certificate. and humidity < 70%. Scheduled Calibration Apr-13 Apr-13 Apr-13 Apr-13 Dec-12 Jun-13 Scheduled Check In house check: Apr-13

	Name	Function	_ oldusine	
Calibrated by:	Jeton Kastrati	Laboratory Techniciar	fle	
Approved by:	Katja Pokovic	Technical Manager	Letter	
			Issued: July 26, 2012	
This calibration certificate	shall not be reproduced except in fu	ill without written approval of the lal	horatory	

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





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Accreditation No.: SCS 108

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## 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 o	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:

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- 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 EX3DV4

## SN:3561

Calibrated:

Manufactured: February 14, 2005 July 26, 2012

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

## DASY/EASY - Parameters of Probe: EX3DV4 - SN:3561

### **Basic Calibration Parameters**

,	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm $(\mu V/(V/m)^2)^A$	0.43	0.48	0.43	± 10.1 %
$DCP (mV)^{B}$	95.3	100.0	98.1	

## **Modulation Calibration Parameters**

UID	Communication System Name	PAR		A dB	B dB	C dB	VR mV	Unc [⊭] (k=2)
0	CW	0.00	X	0.00	0.00	1.00	147.3	±1.7 %
			Y	0.00	0.00	1.00	112.4	
			Z	0.00	0.00	1.00	109.9	

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

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

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

## DASY/EASY - Parameters of Probe: EX3DV4 - SN:3561

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	8.41	8.41	8.41	0.65	0.69	± 12.0 %
835	41.5	0.90	7.98	7.98	7.98	0.22	1.34	± 12.0 %
1750	40.1	1.37	7.27	7.27	7.27	0.60	0.73	± 12.0 %
1900	40.0	1.40	6.95	6.95	6.95	0.47	0.81	± 12.0 %
2450	39.2	1.80	6.23	6.23	6.23	0.50	0.81	± 12.0 %
2600	39.0	1.96	6.12	6.12	6.12	0.54	0.79	± 12.0 %
4950	36.3	4.40	4.66	4.66	4.66	0.35	1.80	± 13.1 %
5200	36.0	4.66	4.45	4.45	4.45	0.35	1.80	± 13.1 %
5300	35.9	4.76	4.16	4.16	4.16	0.40	1.80	± 13.1 %
5500	35.6	4.96	4.18	4.18	4.18	0.43	1.80	± 13.1 %
5600	35.5	5.07	4.00	4.00	4.00	0.40	1.80	± 13.1 %
5800	35.3	5.27	3.92	3.92	3.92	0.45	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. ^c At frequencies below 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) can be relaxed to  $\pm$  10% if liquid compensation formula is applied to

⁶ At frequencies below 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) 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 ( $\epsilon$  and  $\sigma$ ) 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	8.18	8.18	8.18	0.37	0.97	± 12.0 %
835	55.2	0.97	8.11	8.11	8.11	0.48	0.81	± 12.0 %
1750	53.4	1.49	6.78	6.78	6.78	0.35	0.96	± 12.0 %
1900	53.3	1.52	6.51	6.51	6.51	0.31	1.01	± 12.0 %
2450	52.7	1.95	6.22	6.22	6.22	0.80	0.60	± 12.0 %
2600	52.5	2.16	6.09	6.09	6.09	0.80	0.50	± 12.0 %
4950	49.4	5.01	3.91	3.91	3.91	0.45	1.90	± 13.1 %
5200	49.0	5.30	3.76	3.76	3.76	0.50	1.90	± 13.1 %
5300	48.9	5.42	3.54	3.54	3.54	0.52	1.90	± 13.1 %
5500	48.6	5.65	3.33	3.33	3.33	0.55	1.90	± 13.1 %
5600	48.5	5.77	3.17	3.17	3.17	0.50	1.90	± 13.1 %
5800	48.2	6.00	3.42	3.42	3.42	0.55	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 ( $\epsilon$  and  $\sigma$ ) can be relaxed to  $\pm$  10% if liquid compensation formula is applied to

^F At frequencies below 3 GHz, the validity of tissue parameters ( $\varepsilon$  and  $\sigma$ ) 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 ( $\varepsilon$  and  $\sigma$ ) 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)

July 26, 2012



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

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**

## DASY/EASY - Parameters of Probe: EX3DV4 - SN:3561

Other	Probe	Paramet	ers

Sensor Arrangement	Triangular
Connector Angle (°)	77.1
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,  $r^2 = \rho^2 + {\rho'}^2 - 2\rho\rho'\cos\phi'$ ,  $\omega$  is the angular frequency, and  $j = \sqrt{-1}$ .

Table D-I
<b>Composition of the Tissue Equivalent Matter</b>

	001	positic		2 1100000	Equitu	icitt mat				
Frequency (MHz)	750	750	835	835	1900	1900	2450	2450	5200- 5800	5200- 5800
Tissue	Head	Brain	Head	Body	Head	Body	Head	Body	Head	Body
Ingredients (% by weight)										
Bactericide			0.1	0.1						
DGBE					44.92	29.44	]	26.7	] [	
HEC	See Next	See Next	1	1			See Next		See Nevt	
NaCl	Page	Page	1.45	0.94	0.18	0.39	Page	0.1	Page	
Sucrose	1 ugo	1 uge	57	44.9			1 ugo		i ugo	
Polysorbate (Tween) 80										20
Water			40.45	53.06	54.9	70.17		73.2		80

FCC ID: ZNFVS870		SAR EVALUATION REPORT	🕒 LG	Reviewed by: Quality Manager
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#### 2 Composition / Information on ingredients

	Element D 4
	Relevant for safety; Refer to the respective Safety Data Sheet*.
	0.1 – 0.7%
	5-chloro-2-methyl-3(2H)-isothiazolone and 2-methyyl-3(2H)-isothiazolone,
Preventol-D7	Preservative: aqueous preparation, (CAS# 55965-84-9), containing
lydroxyethyl-cellulose	Medium Viscosity (CAS# 9004-62-0), <0.3%
laCl	Sodium Chloride, 0 – 6%
Sucrose	Sugar, white, refined, 40 – 60%
1 ₂ O	Water, 35 – 58%
he Item is composed o	f the following ingredients:

#### 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 (MSL 750) Product No. SL AAM 075 AA (Charge: 110606-1) Manufacturer SPEAG

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.

F

Test Condition

Ambient Condition 22°C ; 30% humidity TSL Temperature 22°C Test Date 8-Jun-11

#### Additional Information

TSL Density 1.212 g/cm³ TSL Heat-capacity 3.006 kJ/(kg*K)



Figure D-2 750MHz Body Tissue Equivalent Matter

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#### Measurement Certificate / Material Test

Item Name	Head Tissue Simulating Liquid (HSL 750)
Product No.	SL AAH 075 (Charge: 110601-1)
Manufacturer	SPEAG

#### 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.

#### Test Condition

Ambient Condition	22°C ; 30% humidity			
TSL Temperature	22°C			
Test Date	8-Jun-11	 	 	

#### Additional Information

			 	-	
TSL	Density	1.284 g/cm ³			
TSL	Heat-capacity	2.701 kJ/(kg*K)	 	 	 

#### Results



Figure D-3 750MHz Head Tissue Equivalent Matter

Frequency MHz

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				Quality Manager
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## 2 Composition / Information on ingredients

The Item is c	composed 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

ILCHT NUMBER	Head Tissue Simulating Liquid (HSL 2450)
Product No.	SL AAH 245 BA (Charge: 110718-3)
Manufacturer	SPEAG
Measurement M	lethod
TSL dielectric pa	rameters measured using calibrated OCP probe (type DAK).
	20
<b>-</b>	
Towners Concerns	
Target Paramet	ors
Target Paramete	rs as defined in the IEEE 1528 and IEC 62209 compliance standards.
Target Paramete	rs as defined in the IEEE 1528 and IEC 62209 compliance standards.
Target paramete	rs as defined in the IEEE 1528 and IEC 62209 compliance standards.
Target paramete	rs as defined in the IEEE 1528 and IEC 62209 compliance standards.
Target Parameter Target parameter Test Condition Ambient Condition	n 22°C ; 30% humidity
Target Paramete Target paramete Test Condition Ambient Conditio TSL Temperatur	n 22°C ; 30% humidity
Target Paramete Target paramete Test Condition Ambient Conditio TSL Temperatur Test Date	rs as defined in the IEEE 1528 and IEC 62209 compliance standards.
Target Paramete Target paramete Test Condition Ambient Condition TSL Temperatur Test Date Additional Infor	rs as defined in the IEEE 1528 and IEC 62209 compliance standards.
Target Parameter Target parameter Test Condition Ambient Condition TSL Temperatur Test Date Additional Infor TSL Density	rs as defined in the IEEE 1528 and IEC 62209 compliance standards.
Target Parameter Target parameter Test Condition Ambient Condition TSL Temperatur Test Date Additional Infor TSL Density TSL Density TSL Heat-capac	n 22°C ; 30% humidity a 23°C 20-Jul-11 mation 0.988 g/cm ³ N 3 680 k //km ⁴ K)

10000	Measu	ured	12.044	Targe	t	Diff.to T	arget [%]
f (MHz)	HP-e'	HP-e"	sigma	eps	sigma	∆-eps	∆-sigma
1900	40.5	11.75	1,24	40.0	1.40	1.3	-11.3
1925	40.4	11.84	1.27	40.0	1.40	1.1	-9.4
1950	40.3	11.93	1.29	40.0	1.40	0.8	-7.6
1975	40.2	12.01	1.32	40.0	1.40	0.6	-5.7
2000	40.1	12.10	1.35	40.0	1.40	0.3	-3.8
2025	40.0	12.19	1.37	40.0	1.42	0.2	-3.4
2050	40.0	12.29	1.40	39.9	1.44	0.1	-3.0
2075	39.9	12.39	1.43	39.9	1.47	0.0	-2.5
2100	39.8	12.48	1.46	39.8	1.49	-0.1	-2.0
2125	39.7	12.59	1.49	39.8	1.51	-0.3	-1.5
2150	39.5	12.69	1.52	39.7	1.53	-0.5	-1.0
2175	-39.4	12,77	1.55	39.7	1.56	-0.6	-0.6
2200	39.3	12.86	1.57	39.6	1.58	-0.8	-0.3
2225	39.2	12.94	1.60	39.6	1.60	-1.0	0.1
2250	39.1	13.03	1.63	39.6	1.62	-1.1	0.5
2275	39.0	13.10	1.66	39.5	1.64	-1.3	0.9
2300	38.9	13.18	1.69	39.5	1.67	-1.4	1.2
2325	38.8	13.25	1.71	39.4	1.69	-1.6	1.4
2350	38.7	13.31	1.74	39.4	1.71	-1.7	1.7
2375	38.6	13.39	1.77	39.3	1.73	-1.9	2.1
2400	38.5	13.47	1.80	39.3	1.76	-2.0	2.5
2425	38.4	13.54	1.83	39,2	1.78	-2.1	2.8
2450	38.3	13.61	1.86	39.2	1.80	-2.3	3.1
2475	38.2	13.69	1.89	39.2	1.83	-2.5	3.2
2500	38.1	13,78	1.92	39.1	1.85	-2.7	3.3
2525	38.0	13.85	1.95	39.1	1.88	-2.8	3.4
2550	37.9	13.92	1.97	39.1	1.91	-3.0	3.4
2575	37.8	13.99	2.00	39.0	1.94	-3.2	3.5
2600	37.7	14.06	2.03	39.0	1,96	-3.5	3.6
2625	37.6	14.14	2.06	39.0	1.99	-3.6	3.7
2650	37.4	14.21	2.10	38.9	2.02	-3.8	3.8
2675	37.3	14.26	2.12	38.9	2.05	-4.0	3.8





Figure D-5 2.4 GHz Head Tissue Equivalent Matter

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#### 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

Deaders	ame		Head	Tiss	ue Sin	nulating	g Liquid (	HBBL	3500-	5800	V5)									
moduo	rt No.		SL A	AH 50	2 AB (	Charge	: 120402	-2)												
Manufa	acture	r	SPEA	١G																
Measu	ireme	nt Met	hod																	
TSL di	electri	c para	meter	s mea	sured	using c	alibrated (	DCP p	robe (	type	DAI	s).								
Target	t Para	meter	s																	
Target	paran	neters	as de	fined i	in the I	EEE 15	28 and IE	C 622	09 co	molia	ince	stan	dard	5	_	_	_			
0										- aprilo		0.001	acci ai							
																				-
Test C	ondit	ion																		
Ambier	nt Cor	ndition	22°C	; 30%	humio	dity														
TSL Te	emper	ature	22°C																	
Test D	ate		4-Apr	-12																
Additi	onal li	nform	ation		-															
TSL D	ensity		0.985	i g/cm	ia .															
TSL H	eat-ca	pacity	3.383	3 kJ/(k	(g*K															
										.,										
Dooult																				
Result	S	mod (2)		Torac		Diff to 7	Contract DV 1													
Result	Measu	red	eiame	Targe	t	Diff,to T	arget [%]		10.0			1147	·							
Result	Measu HP-e'	Ired	sigma	Targe eps	t sigma	Diff,to T	arget [%] Δ-sigma	*	10.0		72						204	14.7		-
Result f [MHz] 3400	Measu HP-e ¹ 38.7	red HP-e" 14.96	sigma 2.83	Targe eps 38.0	t sigma 2.81	Diff.to T A-eps 1.8	arget [%] Δ-sigma 0.7	/t/ %	10.0 7.5 5.0											
Result f [MHz] 3400 3500	Measu HP-e ¹ 38.7 38.6 38.5	red HP-e [*] 14.96 14.91	sigma 2.83 2.90	Targe eps 38.0 37.9	t sigma 2.81 2.91	Diff.to T <u>A-eps</u> 1.8 1.7 1.7	[arget [%] Δ-sigma 0.7 -0.3	nittivity %	10.0 7.5 5.0 2.5											
Result f [MHz] 3400 3500 3600	Measu HP-e' 38.7 38.6 38.5 38.3	HP-e" 14.96 14.91 14.92 14.92	sigma 2.83 2.90 2.99	Targe eps 38.0 37.9 37.8	t sigma 2.81 2.91 3.02 3.12	Diff.to T <u>A-eps</u> 1.8 1.7 1.7 1.7	[arget [%] Δ-sigma 0.7 -0.3 -0.9	'ermittvity %	10.0 7.5 5.0 2.5 0.0											
Result f [MHz] 3400 3500 3600 3700 3800	8 Measu HP-e ¹ 38.7 38.6 38.5 38.3 38.3	red HP-e" 14.96 14.91 14.92 14.92 14.92	sigma 2.83 2.99 3.07 3.16	Targe eps 38.0 37.9 37.8 37.7 37.6	t sigma 2.81 2.91 3.02 3.12 3.22	Diff.to T A-eps 1.8 1.7 1.7 1.7 1.7 1.7	[arget [%] <u>∆-sigma</u> 0.7 -0.3 -0.9 -1.5 -1.9	iv. Permittivity %	10.0 7.5 5.0 2.5 0.0 -2.5						•				••••	
F[MHz]           3400           3500           3600           3700           3800           3900	8 Measu HP-e' 38.7 38.6 38.5 38.3 38.2 38.2 38.1	red HP-e" 14.96 14.91 14.92 14.92 14.94 14.94	sigma 2.83 2.90 2.99 3.07 3.16 3.24	Targe eps 38.0 37.9 37.8 37.7 37.6 37.5	t sigma 2.81 3.02 3.12 3.22 3.32	Diff.to T <u>A-eps</u> 1.8 1.7 1.7 1.7 1.7 1.7	[arget [%] <u>∆-sigma</u> 0.7 -0.3 -0.9 -1.5 -1.9 -2.4	Dev. Permittivity %	10.0 7.5 5.0 2.5 0.0 -2.5 -5.0											
F[MHz]           3400           3500           3600           3700           3800           3900           4000	Measu HP-e' 38.7 38.6 38.5 38.3 38.2 38.2 38.1 38.0	rred HP-e" 14.96 14.91 14.92 14.92 14.92 14.94 14.95 15.00	sigma 2.83 2.99 3.07 3.16 3.24 3.34	Targe eps 38.0 37.9 37.8 37.7 37.6 37.5 37.4	t sigma 2.81 3.02 3.12 3.22 3.32 3.43	Diff.to.T <u>∆-eps</u> 1.8 1.7 1.7 1.7 1.7 1.7 1.7 1.7 1.8	arget [%] Δ-sigma 0.7 -0.3 -0.9 -1.5 -1.9 -2.4 -2.5	Dev. Permittivity %	10.0 7.5 5.0 2.5 0.0 -2.5 -5.0											
f [MHz]           3400           3500           3600           3800           3900           4000           4100	Measi HP-e' 38.7 38.6 38.3 38.2 38.1 38.0 37.9	rred HP-e ⁹⁷ 14.96 14.91 14.92 14.92 14.94 14.95 15.00 15.04	sigma 2.83 2.99 3.07 3.16 3.24 3.34 3.43	Targe eps 38.0 37.9 37.8 37.7 37.6 37.5 37.4 37.2	t 2.81 2.91 3.02 3.12 3.22 3.32 3.43 3.53	Diff.to.T A-eps 1.8 1.7 1.7 1.7 1.7 1.7 1.7 1.8 1.8	arget [%] Δ-sigma 0.7 -0.3 -0.9 -1.5 -1.9 -2.4 -2.5 -2.5 -2.8	Dev. Permittivity %	10.0 7.5 5.0 2.5 0.0 -2.5 -5.0 -7.5											
Result f [MHz] 3400 3500 3600 3800 3900 4000 4100 4200	x Measu HP-e' 38.7 38.6 38.5 38.3 98.2 38.1 38.0 37.9 37.8	red HP-e ⁷⁷ 14.96 14.91 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	Targe eps 38.0 37.9 37.8 37.7 37.6 37.5 37.4 37.2 37.4 37.2 37.1	sigma 2.81 2.91 3.02 3.12 3.22 3.32 3.43 3.53 3.63	Diff.to.T A-eps 1.8 1.7 1.7 1.7 1.7 1.7 1.7 1.8 1.8 1.8 1.8	arget [%] <b>∆-sigma</b> 0.7 0.3 -0.9 -1.5 -1.9 -2.4 -2.5 -2.8 -2.8 -2.9	Dev. Permittvity %	10.0 7.5 5.0 2.5 -2.5 -5.0 -7.5 -10.0	400		900	44		• • •					
Presult f [MHz] 3400 3600 3600 3700 3800 3900 4000 4100 4200 4300	8 Measu HP-e' 38.7 38.6 38.5 38.3 38.2 38.1 38.0 37.9 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 37.6 37.5 37.4 37.2 37.1 87.0	sigma 2.81 2.91 3.02 3.12 3.22 3.32 3.43 3.53 3.63 3.63 3.73	Diff.to T <u>A-eps</u> 1.8 1.7 1.7 1.7 1.7 1.7 1.8 1.8 1.8 1.8 1.8	arget [%] ▲sigma 0.7 -0.3 -0.9 -1.5 -1.9 -2.4 -2.5 -2.8 -2.9 -3.0	Dev. Permittvňy %	10.0 7.5 5.0 2.5 -0.0 -2.5 -5.0 -7.5 -10.0 3	400	••	900	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	100		00	54	00		
Presult 3400 3500 3600 3700 3800 3900 4000 4100 4200 4300 4400	ts Measu HP-e' 38.7 38.6 38.3 38.2 38.3 38.2 38.1 38.0 37.9 37.8 37.7 37.5	rred HP-e ^w 14.96 14.91 14.92 14.92 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 3.52 3.62 3.62 3.71	Targe eps 38.0 37.9 37.8 37.6 37.6 37.5 37.4 37.2 37.1 37.0 36.9	t 2,81 2,91 3,02 3,12 3,22 3,43 3,53 3,63 3,63 3,73 3,84	Diff.to T <u>A-eps</u> 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	arget [%] <u>A-sigma</u> 0.7 0.9 1.5 1.9 2.4 2.5 -2.8 -2.9 -3.0 3.1	Dev. Permittvity %	10.0 7.5 5.0 2.5 -0.0 -2.5 -5.0 -7.5 -10.0 3	400	3	900	44 F	100 requen	1. 34 12 49 ccy M	00 Hz	54	00		59
Result 3400 3500 3500 3700 3900 4000 4100 4200 4300 4400 4400	Measu HP-9' 38.7 38.6 38.5 38.3 38.2 38.1 38.0 37.9 37.8 37.7 37.5 37.4	rred HP-e ^{**} 14.96 14.91 14.92 14.92 14.92 14.94 14.95 15.00 15.04 15.08 15.14 15.18 15.20	sigma 2.83 2.90 3.07 3.16 3.24 3.34 3.52 3.62 3.71 3.81	Targe eps 38.0 37.9 37.8 37.8 37.6 37.5 37.4 37.5 37.4 37.2 37.1 37.0 36.9 36.8	t 2,81 2,91 3,02 3,12 3,22 3,43 3,53 3,63 3,63 3,73 3,84 3,94	Diff.to T A-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 1.7 1.7 1.7 1.7 1.7 1.7 1.7 1.7	arget [%] ▲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	Dev. Permittvity %	10.0 7.5 5.0 2.5 -2.5 -5.0 -7.5 -10.0 3	400	3	900	44 F	100 requen		000 Hz	54	00		59
Result 3400 3500 3700 3700 4000 4100 4200 4400 4400 4400 4500	Measu HP-e' 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 37.5 37.4 37.3	HP-e" 14.91 14.92 14.92 14.92 14.92 14.94 14.95 15.00 15.04 15.08 15.14 15.18 15.29	sigma 2.83 2.99 3.07 3.16 3.24 3.43 3.43 3.52 3.62 3.71 3.81 3.91	Targe eps 38.0 37.9 37.8 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	sigma 2.81 2.91 3.02 3.12 3.22 3.43 3.53 3.63 3.63 3.63 3.73 3.84 3.94 4.04	Diff.to T A-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 1.8 1.6 1.7 1.6 1.7 1.7 1.7 1.7 1.7 1.7 1.7 1.7	arget [%] ▲sigma 0,7 0,3 1,9 -2,4 -2,5 -2,8 -2,9 -3,0 -3,1 -3,3 -3,2	Dev. Permittvity %	10.0 7.5 5.0 2.5 -2.5 -5.0 -7.5 -10.0 3	400	3	900	44 F	100 requen		000 Hz	54	00		

1.2 1.1 1.1

1.0

1.0

1.0

0.9

0.8

0.9

8.0

0.8

0.7

0.5

0.4 0.2

4.25 1.4

4.30 1.3

4.45

4.50

4.11 4.16 36.4 36.4

4.31

4.37

36.2 36.2

35.9 4.76 35.8 4.81

35.8 4.86 35.7 4.91

35.6 5.01 35.5 5.07

35.5 5.12 0.7

35.4 5.17 0.7

5.20 35.3 5.34 5.26 35.3 5.40

15.43

15.45 4.21 36.3 4.35 1.3 1.2

15.47 4.26 36.3 4.40

15.50 15.55

15.60 4.43 36.1 4.55

15.62 4.48 36.0 4.60 1.0

15.74 15.75

35.9 15.80 4.88

 5200
 36.4
 15.65
 4.53
 36.0
 4.66

 5250
 36.3
 15.67
 4.58
 35.9
 4.71

15.70 4.63 15.70 4.67

5500 35.9 15.75 4.82 35.6 4.96

5800 35.5 15.94 5.14 35.3 5.27

35.4 15.98 35.4 16.02

4.73 4.77

4.93 4.98 5.03

4800 37.0 15.39

4850

4900

4950

5000

5050

5100

5150

5300

5350

5400 5450

5550

5600 35.8 15.82

5650 35,7 15.86

5700 35.7 15.88

5750 35.6 15.90 5.08 35.4 5.22 0.6

5850 5900 36.9 36.8 36.7

36.7 36.6 36.5 36.4

36.2 36.1 36.1 36.0

-3.2 -3.1 -3.1 -3.1

-3.1 -3.0

-2.8

-2.8

-2.8 -2.8 -2.7 -2.9

-2.7

-2.8

-2.9

-2.7 -2.7

-2.6

-2.6

-2.6

-2.4

-2.5 -2.6



Figure D-7							
5GHz Head Tissue Equivalent Matter							

FCC ID: ZNFVS870		SAR EVALUATION REPORT	LG	Reviewed by:		
				Quality Manager		
Test Dates:	DUT Type:			APPENDIX D:		
01/10/13 - 01/21/13	Portable Handset			Page 5 of 5		
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## APPENDIX 9: G5 F SYSTEM V5 @=85 H=CB

## APPENDIX E: SAR SYSTEM VALIDATION

Per FCC KDB 865664 D02v01, 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 1528-2003 and FCC KDB 865664 D01 v01. 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	SAR					COND.	PERM.	C	W VALIDATIO	N	MOD. VALIDATION			
SYSTEM #	FREQ. [MHz]	DATE	PROBE SN	PROBE TYPE	PROBE C	AL. POINT	(σ)	(ε _r )	SENSI- TIVITY	PROBE LINEARITY	PROBE ISOTROPY	MOD. TYPE	DUTY FACTOR	PAR
D	750	10/18/2012	3288	ES3DV3	750	Head	0.894	41.92	PASS	PASS	PASS	N/A	N/A	N/A
В	835	10/20/2012	3209	ES3DV3	835	Head	0.939	41.42	PASS	PASS	PASS	GMSK	PASS	N/A
G	1900	10/17/2012	3213	ES3DV3	1900	Head	1.562	52.56	PASS	PASS	PASS	GMSK	PASS	N/A
Α	2450	1/7/2013	3022	ES3DV2	2450	Head	1.836	37.78	PASS	PASS	PASS	OFDM	N/A	PASS
С	5200	1/3/2013	3561	EX3DV4	5200	Head	4.695	37.410	PASS	PASS	PASS	OFDM	N/A	PASS
С	5300	1/3/2013	3561	EX3DV4	5300	Head	4.839	37.060	PASS	PASS	PASS	OFDM	N/A	PASS
С	5600	1/3/2013	3561	EX3DV4	5600	Head	5.192	36.440	PASS	PASS	PASS	OFDM	N/A	PASS
С	5800	1/3/2013	3561	EX3DV4	5800	Head	5.433	35.820	PASS	PASS	PASS	OFDM	N/A	PASS
D	750	10/18/2012	3288	ES3DV3	750	Body	0.947	55.34	PASS	PASS	PASS	N/A	N/A	N/A
В	835	10/15/2012	3209	ES3DV3	835	Body	0.984	55.43	PASS	PASS	PASS	GMSK	PASS	N/A
D	835	10/19/2012	3288	ES3DV3	835	Body	0.991	55.66	PASS	PASS	PASS	GMSK	PASS	N/A
G	1900	10/17/2012	3213	ES3DV3	1900	Body	1.406	40.09	PASS	PASS	PASS	GMSK	PASS	N/A
E	1900	10/18/2012	3263	ES3DV3	1900	Body	1.578	52.61	PASS	PASS	PASS	GMSK	PASS	N/A
Α	2450	1/9/2013	3022	ES3DV2	2450	Body	1.939	50.28	PASS	PASS	PASS	OFDM	N/A	PASS
С	5200	12/26/2012	3561	EX3DV4	5200	Body	5.285	50.610	PASS	PASS	PASS	OFDM	N/A	PASS
С	5300	12/26/2012	3561	EX3DV4	5300	Body	5.493	50.080	PASS	PASS	PASS	OFDM	N/A	PASS
С	5600	12/26/2012	3561	EX3DV4	5600	Body	5.856	49.560	PASS	PASS	PASS	OFDM	N/A	PASS
С	5800	12/26/2012	3561	EX3DV4	5800	Body	6.224	48.520	PASS	PASS	PASS	OFDM	N/A	PASS

Table E-I SAR System Validation Summary

FCC ID: ZNFVS870	<u>«APCTEST</u>	SAR EVALUATION REPORT	Reviewed by:		
	SNORMERIAN LABORATORY, INC.		Quality Manager		
Test Dates:	DUT Type:		APPENDIX E:		
01/10/13 - 01/21/13	Portable Handset		Page 1 of 1		
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