

DASY5 Validation Report for Head TSL

Date: 14.06.2013

Test Laboratory: The name of your organization

DUT: Dipole 450 MHz; Type: D450V3; Serial: D450V3 - SN: 1086

Communication System: UID 0 - CW; Frequency: 450 MHz

Medium parameters used: f = 450 MHz; $\sigma = 0.9 \text{ S/m}$; $\epsilon_r = 44.2$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

Probe: ET3DV6 - SN1507; ConvF(6.59, 6.59, 6.59); Calibrated: 28.12.2012;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn654; Calibrated: 10.04.2013

Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1003

DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

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

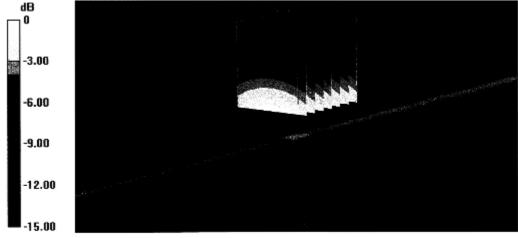
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 39.197 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 1.85 W/kg

SAR(1 g) = 1.21 W/kg; SAR(10 g) = 0.802 W/kg

Maximum value of SAR (measured) = 1.30 W/kg



0 dB = 1.30 W/kg = 1.14 dBW/kg

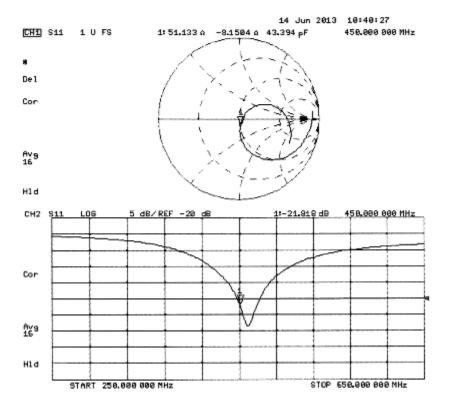
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Impedance Measurement Plot for Head TSL



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DASY5 Validation Report for Body TSL

Date: 14.06.2013

Report No.: SESF1401099

Test Laboratory: The name of your organization

DUT: Dipole 450 MHz; Type: D450V3; Serial: D450V3 - SN: 1086

Communication System: UID 0 - CW; Frequency: 450 MHz

Medium parameters used: f = 450 MHz; $\sigma = 0.96 \text{ S/m}$; $\epsilon_r = 57.1$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

Probe: ET3DV6 - SN1507; ConvF(7.03, 7.03, 7.03); Calibrated: 28.12.2012;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn654; Calibrated: 10.04.2013

Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1003

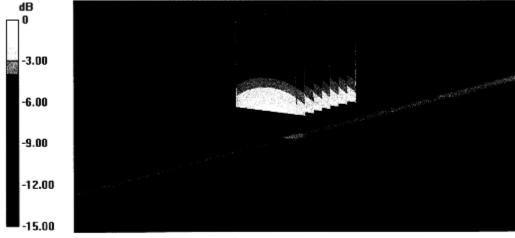
DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

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

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 39.197 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 1.81 W/kg

SAR(1 g) = 1.17 W/kg; SAR(10 g) = 0.776 W/kgMaximum value of SAR (measured) = 1.25 W/kg



0 dB = 1.25 W/kg = 0.97 dBW/kg

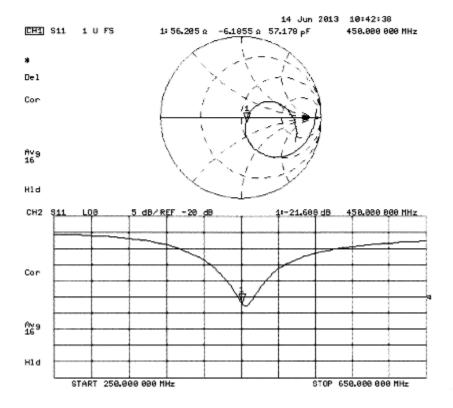
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Impedance Measurement Plot for Body TSL



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





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

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Cernass (Auden)

Confficulty Nov. DR50V2-1008 Jun 13

Client Cerpass (Aude	n)	Certificate	No: D850V2-1008_Jun13
CALIBRATION C	ERTIFICATE		Branch Commence
Object	D850V2 - SN: 10	08	
Calibration procedure(s)	QA CAL-05.v9 Calibration proce	dure for dipole validation kits a	above 700 MHz
Calibration date:	June 13, 2013		
The measurements and the unce	rtainties with confidence p	onal standards, which realize the physica robability are given on the following pages y facility: environment temperature (22 ±	s and are part of the certificate.
Calibration Equipment used (M&T	E critical for calibration)		
Primary Standards	ID#	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	01-Nov-12 (No. 217-01640)	Oct-13
Power sensor HP 8481A	US37292783	01-Nov-12 (No. 217-01640)	Oct-13
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-13 (No. 217-01736)	Apr-14
Type-N mismatch combination	SN: 5047.3 / 06327	04-Apr-13 (No. 217-01739)	Apr-14
Reference Probe ES3DV3	SN: 3205	28-Dec-12 (No. ES3-3205_Dec12)	Dec-13
DAE4	SN: 601	25-Apr-13 (No. DAE4-601_Apr13)	Apr-14
Secondary Standards	ID#	Check Date (in house)	Scheduled Check
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
Nelwork Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-12)	In house check: Oct-13
	Name	Function	Signature
Calibrated by:	Leif Klysner	Laboratory Technician	Lifty-
Approved by:	Katja Pokovio	Technical Manager	filds
		full without written approval of the labora	Issued: June 13, 2013

Certificate No: D850V2-1008_Jun13

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Accreditation No.: SCS 108

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Glossary:

TSL

tissue simulating liquid

ConvF N/A

sensitivity in TSL / NORM x,y,z

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%.

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Measurement Conditions

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

DASY Version	DASY5	V52.8.7
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	850 MHz ± 1 MHz	

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Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.5	0.92 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	40.5 ± 6 %	0.95 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	2.53 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	9.83 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.63 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	6.37 W/kg ± 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	0.99 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	53.9 ± 6 %	1.03 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C		

SAR result with Body TSL

SAR averaged over 1 cm3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.49 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	9.62 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.61 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	6.27 W/kg ± 16.5 % (k=2)

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Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.2 Ω - 3.1 jΩ
Return Loss	- 28.6 dB

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Antenna Parameters with Body TSL

Impedance, transformed to feed point	47.5 Ω - 5.3 jΩ
Return Loss	- 24.4 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.382 ns

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

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	January 30, 2009

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DASY5 Validation Report for Head TSL

Date: 13.06.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 850 MHz; Type: D850V2; Serial: D850V2 - SN: 1008

Communication System: UID 0 - CW; Frequency: 850 MHz

Medium parameters used: f = 850 MHz; $\sigma = 0.95 \text{ S/m}$; $\varepsilon_r = 40.5$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

Probe: ES3DV3 - SN3205; ConvF(6.05, 6.05, 6.05); Calibrated: 28.12.2012;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn601; Calibrated: 25.04.2013

Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001

DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

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

(7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 57.472 V/m; Power Drift = -0.00 dB

Peak SAR (extrapolated) = 3.82 W/kg

SAR(1 g) = 2.53 W/kg; SAR(10 g) = 1.63 W/kgMaximum value of SAR (measured) = 2.96 W/kg



0 dB = 2.96 W/kg = 4.71 dBW/kg

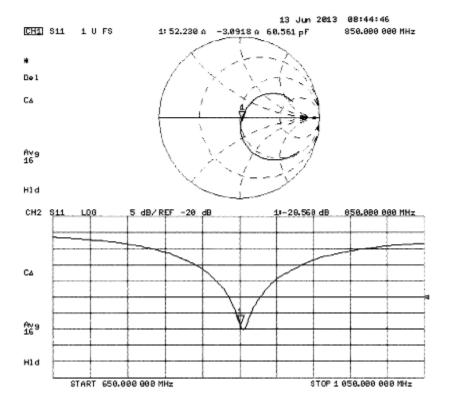
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Impedance Measurement Plot for Head TSL



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DASY5 Validation Report for Body TSL

Date: 12.06.2013

Report No.: SESF1401099

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 850 MHz; Type: D850V2; Serial: D850V2 - SN: 1008

Communication System: UID 0 - CW; Frequency: 850 MHz

Medium parameters used: f = 850 MHz; $\sigma = 1.03 \text{ S/m}$; $\varepsilon_r = 53.9$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

Probe: ES3DV3 - SN3205; ConvF(6.01, 6.01, 6.01); Calibrated: 28.12.2012;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn601; Calibrated: 25.04.2013

Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001

DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

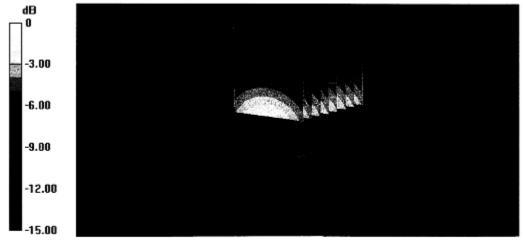
Dipole Calibration for Body Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)

(7x8x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 54.836 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 3.67 W/kg

SAR(1 g) = 2.49 W/kg; SAR(10 g) = 1.61 W/kgMaximum value of SAR (measured) = 2.91 W/kg



0 dB = 2.91 W/kg = 4.64 dBW/kg

Certificate No: D850V2-1008_Jun13

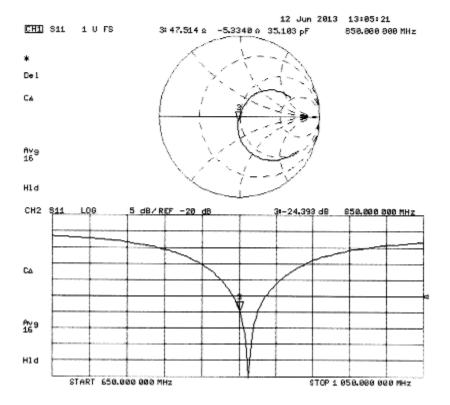
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Impedance Measurement Plot for Body TSL



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





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

Accreditation No.: SCS 108

CALIBRATION (ERTIFICATI		Access to the control of the control
Object	D1750V2 - SN: 1	097	
Calibration procedure(s)	QA CAL-05.v9 Calibration proce	dure for dipole validation kits abo	ove 700 MHz
Calibration date:	June 11, 2013		
This calibration certificate docum	ents the traceability to nat entainties with confidence p	ional standards, which realize the physical un robability are given on the following pages ar	ils of measurements (SI). Id are part of the certificate.
		ry facility: environment temperature (22 ± 3)**	
Calibration Equipment used (M&		,	
Primary Standards	1D #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	01-Nov-12 (No. 217-01640)	Oct-13
Power sensor HP 8481A	US37292783	01-Nov-12 (No. 217-01640)	Oct-13
Reference 20 dB Attenuator	SN: 5068 (20k)	04-Apr-13 (No. 217-01736)	Apr-14
ype-N mismatch combination	SN: 5047.3 / 06327	04-Apr-13 (No. 217-01739)	Apr-14
Reference Probe ES3DV3	SN: 3205	28-Dec-12 (No. ES3-3205_Dec12)	Dec-13
	SN: 601	25-Apr-13 (No. DAE4-601_Apr13)	Apr-14
DAE4	10.11.00.	20 741 10 (140: DAL4-001_Apr 10)	Apr-14
		-, ,	
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Secondary Standards Power sensor HP 8481A	ID # MY41092317	Check Date (in house) 18-Oct-02 (in house check Oct-11)	Scheduled Check In house check: Oct-13
DAE4 Secondary Standards Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer HP 8753E	ID #	Check Date (in house)	Scheduled Check
Secondary Standards Power sensor HP 8481A RF generator R&S SMT-06	ID # MY41092317 100005	Check Date (in house) 18-Oct-02 (in house check Oct-11) 04-Aug-99 (in house check Oct-11)	Scheduled Check In house check: Oct-13 In house check: Oct-13
Secondary Standards Power sensor HP 8481A RF generator R&S SMT-06	ID # MY41092317 100005	Check Date (in house) 18-Oct-02 (in house check Oct-11) 04-Aug-99 (in house check Oct-11) 18-Oct-01 (in house check Oct-12) Function	Scheduled Check In house check: Oct-13 In house check: Oct-13
Secondary Standards Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer HP 8753E	ID # MY41092317 100005 US37390585 S4206	Check Date (in house) 18-Oct-02 (in house check Oct-11) 04-Aug-99 (in house check Oct-11) 18-Oct-01 (in house check Oct-12)	Scheduled Check In house check: Oct-13 In house check: Oct-13 In house check: Oct-13
Secondary Standards Power sensor HP 8481A RF generator R&S SMT-06	ID # MY41092317 100005 US37390585 S4206 Name	Check Date (in house) 18-Oct-02 (in house check Oct-11) 04-Aug-99 (in house check Oct-11) 18-Oct-01 (in house check Oct-12) Function	Scheduled Check In house check: Oct-13 In house check: Oct-13 In house check: Oct-13
Secondary Standards Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer HP 8753E Calibrated by:	ID # MY41092317 100005 US37390585 S4206 Name Jeton Kastrati	Check Date (in house) 18-Oct-02 (in house check Oct-11) 04-Aug-99 (in house check Oct-11) 18-Oct-01 (in house check Oct-12) Function Laboratory Technician	Scheduled Check In house check: Oct-13 In house check: Oct-13 In house check: Oct-13
Secondary Standards Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer HP 8753E	ID # MY41092317 100005 US37390585 S4206 Name	Check Date (in house) 18-Oct-02 (in house check Oct-11) 04-Aug-99 (in house check Oct-11) 18-Oct-01 (in house check Oct-12) Function	Scheduled Check In house check: Oct-13 In house check: Oct-13 In house check: Oct-13
Secondary Standards Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer HP 8753E Calibrated by:	ID # MY41092317 100005 US37390585 S4206 Name Jeton Kastrati	Check Date (in house) 18-Oct-02 (in house check Oct-11) 04-Aug-99 (in house check Oct-11) 18-Oct-01 (in house check Oct-12) Function Laboratory Technician	Scheduled Check In house check: Oct-13 In house check: Oct-13 In house check: Oct-13

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Swiss Calibration Service

Accreditation No.: SCS 108

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

Glossary:

TSL tissue simulating liquid

ConvF sensitivity in TSL / NORM x,v,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
- 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
- SAR for nominal TSL parameters: The measured TSL parameters are used to calculate the nominal SAR result.

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

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Measurement Conditions

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

DASY Version	DASY5	V52.8.7
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1750 MHz ± 1 MHz	

Report No.: SESF1401099

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.1	1.37 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	39.1 ± 6 %	1.32 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.07 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	36.9 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	4.85 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	19.6 W/kg ± 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.4	1.49 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	51.7 ± 6 %	1.51 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	9.46 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	37.2 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.08 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	20.1 W/kg ± 16.5 % (k=2)

Certificate No: D1750V2-1097_Jun13

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Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.0 Ω + 0.5 jΩ
Return Loss	- 38.8 dB

Report No.: SESF1401099

Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.6 Ω + 0.2 jΩ
Return Loss	- 29.2 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.218 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	May 16, 2013

Certificate No: D1750V2-1097_Jun13

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DASY5 Validation Report for Head TSL

Date: 10.06.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN: 1097

Communication System: UID 0 - CW; Frequency: 1750 MHz

Medium parameters used: f = 1750 MHz; $\sigma = 1.32$ S/m; $\epsilon_c = 39.1$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

Probe: ES3DV3 - SN3205; ConvF(5.18, 5.18, 5.18); Calibrated: 28.12.2012;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn601; Calibrated: 25.04.2013

Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002

DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

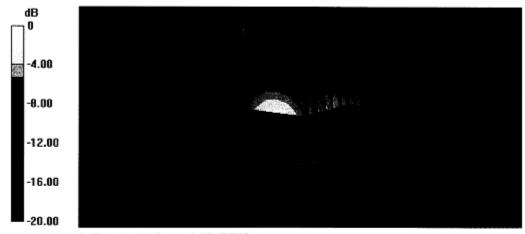
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

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

Reference Value = 95.679 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 16.2 W/kg

SAR(1 g) = 9.07 W/kg; SAR(10 g) = 4.85 W/kgMaximum value of SAR (measured) = 11.4 W/kg



0 dB = 11.4 W/kg = 10.57 dBW/kg

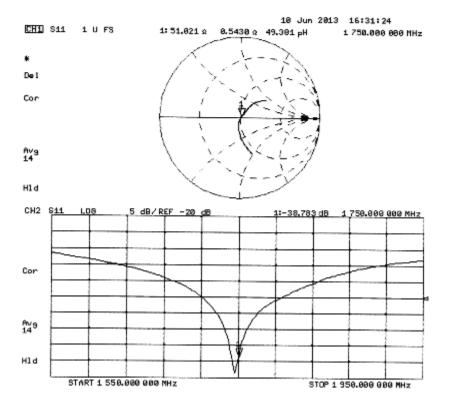
Certificate No: D1750V2-1097_Jun13

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Impedance Measurement Plot for Head TSL



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DASY5 Validation Report for Body TSL

Date: 11.06.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN: 1097

Communication System: UID 0 - CW; Frequency: 1750 MHz

Medium parameters used: f = 1750 MHz; $\sigma = 1.51 \text{ S/m}$; $\varepsilon_r = 51.7$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

Probe: ES3DV3 - SN3205; ConvF(4.83, 4.83, 4.83); Calibrated: 28.12.2012;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn601; Calibrated: 25.04.2013

Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002

DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

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

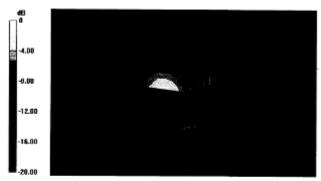
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 91.830 V/m; Power Drift = 0.08 dB

Peak SAR (extrapolated) = 16.3 W/kg

SAR(1 g) = 9.46 W/kg; SAR(10 g) = 5.08 W/kg

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



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

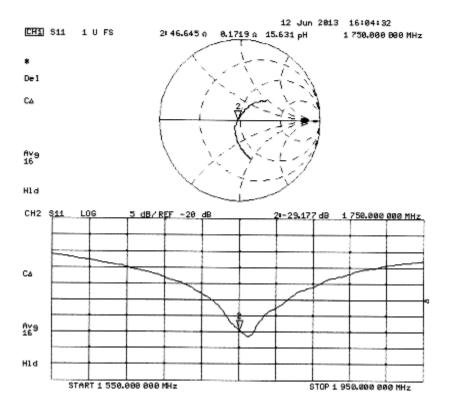
Certificate No: D1750V2-1097_Jun13

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Impedance Measurement Plot for Body TSL



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CERPASS TECHNOLOGY CORP. Report No.: SESF1401099

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





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

Issued Date : February 07,2014

Accredited by the Swiss Accreditation Service (SAS)

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

Certificate No: D1900V2-5d174_Jun13

Accreditation No.: SCS 108

Cerpass (Auden) CALIBRATION CERTIFICATE D1900V2 - SN: 5d174 Object QA CAL-05.v9 Calibration procedure(s) Calibration procedure for dipole validation kits above 700 MHz June 10, 2013 Calibration date: 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 Cal Date (Certificate No.) Scheduled Calibration Power meter EPM-442A GB37480704 01-Nov-12 (No. 217-01640) Oct-13 Power sensor HP 8481A US37292783 01-Nov-12 (No. 217-01640) Oct-13 SN: 5058 (20k) 04-Apr-13 (No. 217-01736) Apr-14 Reference 20 dB Attenuator 04-Apr-13 (No. 217-01739) Apr-14 Type-N mismatch combination SN: 5047.3 / 06327 SN: 3205 28-Dec-12 (No. ES3-3205_Dec12) Dec-13 Reference Probe ES3DV3 SN: 601 25-Apr-13 (No. DAE4-601_Apr13) Apr-14 DAE4 Check Date (in house) Scheduled Check ID# Secondary Standards Power sensor HP 8481A MY41092317 18-Oct-02 (in house check Oct-11) In house check: Oct-13 100005 04-Aug-99 (in house check Oct-11) In house check: Oct-13 RF generator R&S SMT-06 In house check: Oct-13 Network Analyzer HP 8753E US37390585 S4206 18-Oct-01 (in house check Oct-12) Function Name Laboratory Technician Calibrated by: Technical Manager Approved by: Katja Pokovic Issued: June 11, 2013

Certificate No: D1900V2-5d174_Jun13

Cerpass Technology Corp.

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Calibration Laboratory of

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





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Accreditation No.: SCS 108

s Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)

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

Glossary:

TSL

tissue simulating liquid

ConvF N/A

sensitivity in TSL / NORM x,y,z 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
- 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
- SAR for nominal TSL parameters: The measured TSL parameters are used to calculate the nominal SAR result.

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

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Measurement Conditions

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

DASY Version	DASY5	V52.8.7
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	39.3 ± 6 %	1.34 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.76 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	39.9 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.15 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	20.9 W/kg ± 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	53.7 ± 6 %	1.50 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	10.00 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	40.4 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.34 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.5 W/kg ± 16.5 % (k=2)

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Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.2 Ω + 3.9 jΩ	
Return Loss	- 26.2 dB	

Antenna Parameters with Body TSL

Impedance, transformed to feed point	48.3 Ω + 5.0 jΩ
Return Loss	- 25.4 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.202 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	June 08, 2012

Certificate No: D1900V2-5d174_Jun13

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DASY5 Validation Report for Head TSL

Date: 10.06.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d174

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

Medium parameters used: f = 1900 MHz; $\sigma = 1.34 \text{ S/m}$; $\epsilon_r = 39.3$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

Probe: ES3DV3 - SN3205; ConvF(4.98, 4.98, 4.98); Calibrated: 28.12.2012;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAF4 Sn601; Calibrated: 25.04.2013

Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001

DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

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

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 95.712 V/m; Power Drift = 0.06 dB Pcak SAR (extrapolated) = 17.6 W/kg

SAR(1 g) = 9.76 W/kg; SAR(10 g) = 5.15 W/kgMaximum value of SAR (measured) = 12.0 W/kg



0 dB = 12.0 W/kg = 10.79 dBW/kg

Certificate No: D1900V2-5d174_Jun13

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DASY5 Validation Report for Body TSL

Date: 10.06.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type; D1900V2; Serial: D1900V2 - SN: 5d174

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

Medium parameters used: f = 1900 MHz; $\sigma = 1.5 \text{ S/m}$; $\varepsilon_r = 53.7$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

Probe: ES3DV3 - SN3205; ConvF(4.6, 4.6, 4.6); Calibrated: 28.12.2012;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn601; Calibrated: 25.04,2013

Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002

DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

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

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 95.712 V/m; Power Drift = 0.01 dB Peak SAR (extrapolated) = 17.1 W/kg SAR(1 g) = 10 W/kg; SAR(10 g) = 5.34 W/kg

Maximum value of SAR (measured) = 12.7 W/kg



0 dB = 12.7 W/kg = 11.04 dBW/kg

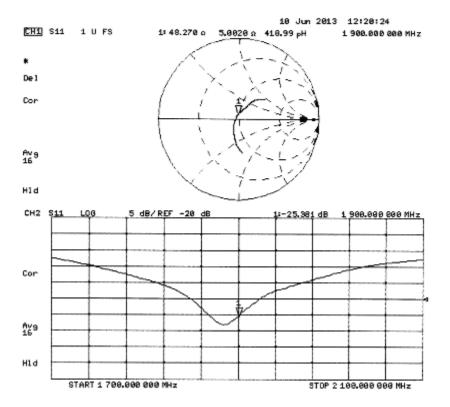
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Impedance Measurement Plot for Body TSL



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Client

Cerpass (Auden)

Certificate No: D2450V2-914 Jun 13

Calibration procedure(s) Calibration procedure(s) Calibration procedure for dipole validation kits above 700 MHz 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 tollowing 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 Primary Standards ID # Cal Date (Certificate No.) Scheduled Calibration Power melet EPM-442A QBS7480704 01-Nov-12 (No. 217-01640) Oct-13 Power enser Ph 841A SN: 5058 (20K) 04-Apr-13 (No. 217-01739) Apr-14 Reference Probe ES3DV3 SN: 5058 (20K) 04-Apr-13 (No. 217-01739) Apr-14 Reference Probe ES3DV3 SN: 5058 (20K) 04-Apr-13 (No. 217-01739) Apr-14 Reference Probe ES3DV3 SN: 5067 25-Apr-13 (No. DAE4-601-Apr13) Apr-14 Secondary Standards ID # Check Date (in house) Scheduled Check New or the P 8481A MY41092317 18-Oct-02 (in house check Oct-11) In house check: Oct-13 New ork Analyzer HP 87SIE USS7390585 S4205 18-Oct-01 (in house check Oct-12) In house check: Oct-13 Name Function Signature Lalf Klysner Lalfornical Manager In scheduled Check Potency Technicist Lalf Klysner Lalfornical Manager In scheduled Check Potency Technicist In house check: Oct-13 Name Function Signature Lalf Klysner Lalfornical Manager In scheduled Check Potency Technicist Lalfornical Manager In scheduled Check Potency Technicist In house check: Oct-13 This calibration certificate shall not be reproduced except in full without written approval of the laboratory.	Client Cerpass (Aude	(1)	C	etificate No: D2450V2-914_Jun13
Calibration procedure(s) Calibration procedure for dipole validation kits above 700 MHz Calibration procedure for dipole validation kits above 700 MHz 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 # Calibration (Mate (Confidence probability environment temperature (22 ± 3)°C and humidity < 70%. Calibration Equipment used (M&TE critical for calibration) Primary Standards ID # Calibration (Mate (Confidence probability environment temperature (22 ± 3)°C and humidity < 70%. Calibration Equipment used (M&TE critical for calibration) Primary Standards ID # Calibration (Mate (Confidence probability environment temperature (22 ± 3)°C and humidity < 70%. Calibration Equipment used (M&TE critical for calibration) Primary Standards ID # Calibration (Mate (Confidence probability environment temperature (22 ± 3)°C and humidity < 70%. Calibration Equipment used (Mate (Confidence probability environment temperature (22 ± 3)°C and humidity < 70%. Calibrated Standards ID # Calibrated (Mate (Confidence probability environment temperature (22 ± 3)°C and humidity < 70%. Calibrated (Mate (Confidence probability environment temperature (22 ± 3)°C and humidity < 70%. Calibrated (Mate (Confidence probability environment temperature (22 ± 3)°C and humidity < 70%. Calibrated (Mate (Confidence probability environment temperature (22 ± 3)°C and humidity < 70%. Calibrated (Mate (Confidence probability environment temperature (22 ± 3)°C and humidity < 70%. Calibrated (Mate (Confidence probability environment temperature (22 ± 3)°C and humidity < 70%. Calibrated (Mate (Confidence probability enviro	CALIBRATION C	ERTIFICATI	477.1	
Calibration procedure for dipole validation kits above 700 MHz Calibration date: June 97, 2013 This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate. All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%. Calibration Equipment used (M&TE critical for calibration) Primary Standards ID # Cal Date (Certificate No.) Scheduled Calibration Power meter EPM-442A GB37480704 01+Nov-12 (No. 217-01640) Oct-13 Power sensor NP 9461A US37292783 01+Nov-12 (No. 217-01640) Oct-13 Reference 20 dB Attenuator No. 5058 (20k) 04-Apr-13 (No. 217-01736) Apr-14 Reference 20 dB Attenuator SN: 5058 (20k) 04-Apr-13 (No. 217-01739) Apr-14 Reference Probe ES30V3 SN: 206327 04-Apr-13 (No. 217-01739) Apr-14 Reference Probe ES30V3 SN: 206 Dec-12 (No. ES3-3205 Dec-12) Dec-13 DAE4 SN: 601 25-Apr-13 (No. DAE4-601_Apr13) Apr-14 Secondary Standards ID # Check Date (in house) Scheduled Check Power sensor HP 8481A MY41092317 18-Oct-02 (in house check Oct-11) In house check: Oct-13 Network Analyzer HP 8753E US37390585 S4206 18-Oct-01 (in house check Oct-11) In house check: Oct-13 Name Function Signature Left Klysner Lationatory Technicism Issued: June 7, 2013	Object	D2450V2 - SN: 9	114	
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Primary Standards	All calibrations have been conduc	ted in the closed laborato	ry facility: environment temperatur	e (22 \pm 3)°C and humidity < 70%.
Power meter EPM-442A GB37480704 01-Nov-12 (No. 217-01640) Oct-13	Calibration Equipment used (M&T	E critical for calibration)		
Power sensor HP 8481A US37292783 01-Nov-12 (No. 217-01640) Oct-13 Reference 20 dB Attenuator SN: 5058 (20k) 04-Apr-13 (No. 217-01736) Apr-14 Type-N mismatch combination SN: 5047.3 / 06327 04-Apr-13 (No. 217-01739) Apr-14 Reference Probe ES3DV3 SN: 3205 28-Dec-12 (No. ES3-3205_Dec12) Dec-13 DAE4 SN: 601 25-Apr-13 (No. DAE4-601_Apr13) Apr-14 Secondary Standards ID # Check Date (in house) Scheduled Check Power sensor HP 8481A MY41092317 18-Oct-02 (in house check Oct-11) In house check: Oct-13 RF generator R&S SMT-06 100005 04-Aug-99 (in house check Oct-11) In house check: Oct-13 Network Analyzer HP 8753E US37390585 S4206 18-Oct-01 (in house check Oct-12) In house check: Oct-13 Name Function Signature Calibrated by: Katja Pokovic technical Manager Issued: June 7, 2013			Cal Date (Certificate No.)	Scheduled Calibration
Reference 20 dB Attenuator SN: 5058 (20k) 04-Apr-13 (No. 217-01736) Apr-14			01-Nov-12 (No. 217-01640)	Oct-13
Type-N mismatch combination Reference Probe ES3DV3 SN: 3205 SN: 3205 SN: 601 S		US37292783	01-Nov-12 (No. 217-01640)	Oct-13
Reference Probe ES3DV3		SN: 5058 (20k)	04-Apr-13 (No. 217-01736)	Apr-14
SN: 601 25-Apr-13 (No. DAE4-601_Apr13) Apr-14 Secondary Standards ID # Check Date (in house) Scheduled Check Power sensor HP 8481A RF generator R&S SMT-06 100005 04-Aug-99 (in house check Oct-11) In house check: Oct-13 Network Analyzer HP 8753E US37390585 S4206 18-Oct-01 (in house check Oct-12) In house check: Oct-13 Name Function Signature Calibrated by: Katje Pokovic Technical Manager Approved by: Katje Pokovic Technical Manager Issued: June 7, 2013	Type-N mismatch combination	SN: 5047.3 / 06327	04-Apr-13 (No. 217-01739)	Apr-14
Secondary Standards ID # Check Date (in house) Scheduled Check Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer HP 8753E Name Function Calibrated by: Name Function Signature Leff Klysner Liboratory Fecunician Approved by: Katja Pokovic Left Klysner Issued: June 7, 2013	Reference Probe ES3DV3	SN: 3205	28-Dec-12 (No. ES3-3205_Dec	12) Dec-13
Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer HP 8753E Name Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer HP 8753E Name Power sensor HP 8481A MY41082317 18-Oct-02 (in house check Oct-11) Network Analyzer HP 8753E Name Power sensor HP 8481A In house check: Oct-13 In house check: O	DAE4	SN: 601	25-Apr-13 (No. DAE4-601_Apr	3) Apr-14
Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer HP 8753E Name Name Function Calibrated by: Katja Pokovic Katja Pokovic Signature In house check: Oct-13 In house	Secondary Standards	ID#	Check Date (in house)	Scheduled Check
PRF generator R&S SMT-06 Network Analyzer HP 8753E Network Analyzer HP 8753E Name Signature Leif Klysner Liboratory Technical Manager Approved by: Katja Pokovic Lissued: June 7, 2013	Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-	11) In house check: Oct-13
Network Analyzer HP 8753E US3/390585 S4206 18-Oct-01 (in house check Oct-12) In house check: Oct-13 Name Function Signature Calibrated by: Leif Klysner Laboratory Technician Approved by: Katja Pokovic Technical Manager Issued: June 7, 2013	RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct	11) In house check: Oct-13
Calibrated by: Leif Klysner Liboratory Technician Approved by: Katja Pokovic technical Manager Issued: June 7, 2013	Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-	
Issued: June 7, 2013	Calibrated by:	CMS200s/detromagacamyamphophysia.co	CONTRACTOR AND	Address the course of the second seco
Issued: June 7, 2013	Approved by:	Katja Pokovic	Yachnical Manager	ory algo-
				Je 19
	This calibration certificate shall no	t be reproduced except in	full without written approval of the	

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Calibration Laboratory of

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





Schwelzerlscher Kalibrierdienst S Service suisse d'étalonnage

С Servizio svizzero di taratura

Accreditation No.: SCS 108

Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)

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

Glossary:

TSL

tissue simulating liquid

ConvF

sensitivity in TSL / NORM x,v,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
- SAR for nominal TSL parameters: The measured TSL parameters are used to calculate the nominal SAR result.

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

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Measurement Conditions

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

DASY Version	DASY5	V52.8.7	
Extrapolation	Advanced Extrapolation		
Phantom	Modular Flat Phantom		
Distance Dipole Center - TSL	10 mm	with Spacer	
Zoom Scan Resolution	dx, dy, dz = 5 mm		
Frequency	2450 MHz ± 1 MHz		

Report No.: SESF1401099

Head TSL parameters

The following parameters and calculations were applied

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	37.8 ± 6 %	1.81 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.5 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	53.4 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.24 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.8 W/kg ± 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	50.9 ± 6 %	2.02 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	13.2 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	51.5 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.07 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	23.9 W/kg ± 16.5 % (k=2)

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Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	57.0 Ω + 1.9 jΩ
Return Loss	- 23.3 dB

Report No.: SESF1401099

Antenna Parameters with Body TSL

Impedance, transformed to feed point	52.1 Ω + 3.5 jΩ	
Return Loss	- 28.0 dB	

General Antenna Parameters and Design

- 1		
	Electrical Delay (one direction)	1.160 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 19, 2012

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DASY5 Validation Report for Head TSL

Date: 07.06.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 914

Communication System: UID 0 - CW; Frequency: 2450 MHz

Medium parameters used: f = 2450 MHz; $\sigma = 1.81$ S/m; $\varepsilon_r = 37.8$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

Probe: ES3DV3 - SN3205; ConvF(4.52, 4.52, 4.52); Calibrated: 28.12.2012;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn601; Calibrated: 25.04.2013

Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001

DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

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

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

Reference Value = 95.695 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 28.3 W/kg

SAR(1 g) = 13.5 W/kg; SAR(10 g) = 6.24 W/kg

Maximum value of SAR (measured) = 17.6 W/kg



0 dB = 17.6 W/kg = 12.46 dBW/kg

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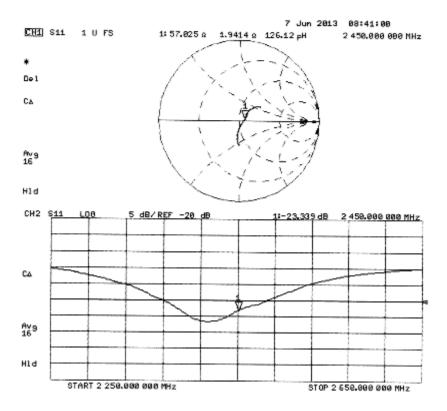
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Impedance Measurement Plot for Head TSL



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DASY5 Validation Report for Body TSL

Date: 07.06.2013

Report No.: SESF1401099

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 914

Communication System: UID 0 - CW; Frequency: 2450 MHz

Medium parameters used: f = 2450 MHz; $\sigma = 2.02$ S/m; $\epsilon_r = 50.9$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

Probe: ES3DV3 - SN3205; ConvF(4.42, 4.42, 4.42); Calibrated: 28.12.2012;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn601; Calibrated: 25.04.2013

Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002

DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

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

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

Reference Value = 95.695 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 27.6 W/kg

SAR(1 g) = 13.2 W/kg; SAR(10 g) = 6.07 W/kg

Maximum value of SAR (measured) = 17.5 W/kg



0 dB = 17.5 W/kg = 12.43 dBW/kg

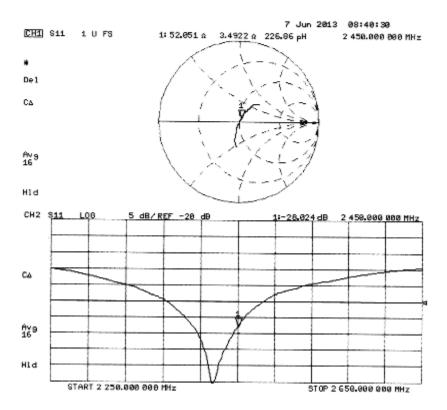
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Impedance Measurement Plot for Body TSL



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CERPASS TECHNOLOGY CORP.

11. Appendix F. DAE Calibration Data

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





С

Accreditation No.: SCS 108

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

Report No.: SESF1401099

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

Cerpass (Auden) CALIBRATION CERTI Object DAE4 SD 000 D04 BJ - SN: 1379 QA CAL-06.926 Calibration procedure(s) Calibration procedure for the data acquisition electronics (DAE) Calibration date: 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 SN: 0810278 Keithley Multimeter Type 2001 02-Oct-12 (No:12728) Oct-13 Secondary Standards ID# Check Date (in house) Scheduled Check SE UWS 053 AA 1001 07-Jan-13 (in house check) Auto DAE Calibration Unit In house check: Jan-14 Calibrator Box V2.1 SE UMS 006 AA 1002 07-Jan-13 (in house check) In house check: Jan-14 Function Signature Calibrated by: Fin Bomholt Approved by: Issued: June 14, 2013 This calibration certificate shall not be reproduced except in full without written approval of the laboratory.

Certificate No: DAE4-1379 Jun13

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Issued Date : February 07,2014



Calibration Laboratory of

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





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C Service suisse d'étalonnage
Servizio svizzero di taratura
S Swiss Callbration Service

Accreditation No.: SCS 108

Report No.: SESF1401099

Accredited by the Swiss Accreditation Service (SAS)

The Swiss Accreditation Service is one of the signatories to the EA

Multilateral Agreement for the recognition of calibration certificates

Glossary

DAE

data acquisition electronics

Connector angle

information used in DASY system to align probe sensor X to the robot

coordinate system.

Methods Applied and Interpretation of Parameters

- DC Voltage Measurement: Calibration Factor assessed for use in DASY system by comparison with a calibrated instrument traceable to national standards. The figure given corresponds to the full scale range of the voltmeter in the respective range.
- Connector angle: The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required.
- The following parameters as documented in the Appendix contain technical information as a result from the performance test and require no uncertainty.
 - DC Voltage Measurement Linearity: Verification of the Linearity at +10% and -10% of the nominal calibration voltage. Influence of offset voltage is included in this measurement.
 - Common mode sensitivity: Influence of a positive or negative common mode voltage on the differential measurement.
 - Channel separation: Influence of a voltage on the neighbor channels not subject to an input voltage.
 - AD Converter Values with inputs shorted: Values on the internal AD converter corresponding to zero input voltage
 - Input Offset Measurement: Output voltage and statistical results over a large number of zero voltage measurements.
 - Input Offset Current: Typical value for information; Maximum channel input offset current, not considering the input resistance.
 - Input resistance: Typical value for information: DAE input resistance at the connector, during internal auto-zeroing and during measurement.
 - Low Battery Alarm Voltage: Typical value for information. Below this voltage, a battery alarm signal is generated.
 - Power consumption: Typical value for information. Supply currents in various operating modes.

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DC Voltage Measurement

A/D - Converter Resolution nominal

High Range: 1LSB = 6.1μV, full range = -100...+300 mV full range = -1......+3mV Low Range: 1LSB = 61nV, DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

Calibration Factors	x	Y	Z
High Range	403.780 ± 0.02% (k=2)	404.053 ± 0.02% (k=2)	403.989 ± 0.02% (k=2)
Low Range	3.99596 ± 1.50% (k=2)	3.99156 ± 1.50% (k=2)	3.99899 ± 1.50% (k=2)

Connector Angle

Connector Angle to be used in DASY system	149.5°±1°
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Appendix

1. DC Voltage Linearity

High Range	Reading (µV)	Difference (µV)	Error (%)
Channel X + Input	199994.77	-0.79	-0.00
Channel X + Input	19998.34	-1.48	-0.01
Channel X - Input	-19999.63	1.83	-0.01
Channel Y + Input	199996.50	0.61	0.00
Channel Y + Input	19995.46	-4.43	-0.02
Channel Y - Input	-20002.71	-1.27	0.01
Channel Z + Input	199998.27	2.81	0.00
Channel Z + Input	19997.65	-2.19	-0.01
Channel Z - Input	-20002.08	-0.49	0.00

Report No.: SESF1401099

Low Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	2000.48	0.36	0.02
Channel X	+ Input	200.15	-0.33	-0.16
Channel X	- Input	-199.65	-0.28	0.14
Channel Y	+ Input	1999.47	-0.73	-0.04
Channel Y	+ Input	200.66	0.01	0.01
Channel Y	- Input	-199.30	0.05	-0.02
Channel Z	+ Input	2000.00	-0.12	-0.01
Channel Z	+ Input	199.74	-0.81	-0.41
Channel Z	- Input	-200.31	-0.98	0.49

2. Common mode sensitivity

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	Common mode Input Voltage (mV)	High Range Average Reading (μV)	Low Range Average Reading (μV)
Channel X	200	-17.91	-19.73
	- 200	20.20	18.29
Channel Y	200	-4.93	-4.72
	- 200	3.59	3.43
Channel Z	200	-10.76	-10.75
	- 200	8.61	8.62

3. Channel separation

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	Input Voltage (mV)	Channel X (µV)	Channel Y (μV)	Channel Z (μV)
Channel X	200	-	-0.44	-5.25
Channel Y	200	7.04	-	0.32
Channel Z	200	9.23	5.34	-

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4. AD-Converter Values with inputs shorted

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	High Range (LSB)	Low Range (LSB)
Channel X	16053	15886
Channel Y	16274	14321
Channel Z	15829	15916

5. Input Offset Measurement

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec Input $10M\Omega$

	Average (μV)	min. Offset (μV)	max. Offset (μV)	Std. Deviation (µV)
Channel X	-3.67	-4.90	-2.52	0.44
Channel Y	-1.51	-2.97	-0.02	0.59
Channel Z	-0.53	-1.65	1.01	0.65

6. Input Offset Current

Nominal Input circuitry offset current on all channels: <25fA

7. Input Resistance (Typical values for information)

	Zeroing (kOhm)	Measuring (MOhm)
Channel X	200	200
Channel Y	200	200
Channel Z	200	200

8. Low Battery Alarm Voltage (Typical values for information)

Typical values	Alarm Level (VDC)	
Supply (+ Vcc)	+7.9	
Supply (- Vcc)	-7.6	

9. Power Consumption (Typical values for information)

Typical values	Switched off (mA)	Stand by (mA)	Transmitting (mA)
Supply (+ Vcc)	+0.01	+6	+14
Supply (- Vcc)	-0.01	-8	-9

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