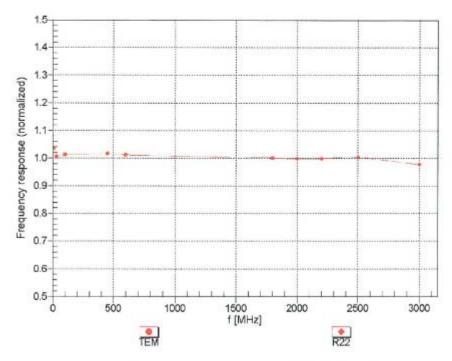


ES3DV3—SN:3327 September 2, 2015

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



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

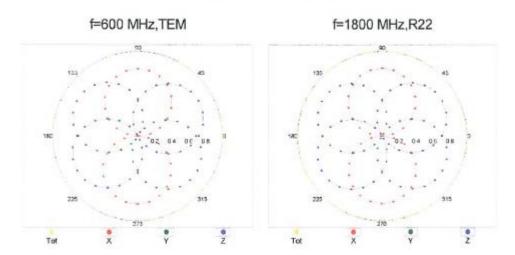
Certificate No: ES3-3327\_Sep15

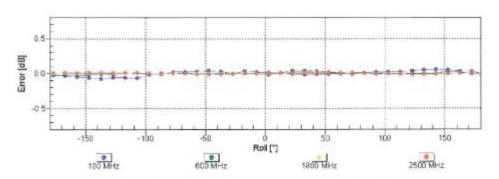
Page 7 of 11



ES3DV3—SN:3327 September 2, 2015

## Receiving Pattern (\$\phi\$), 9 = 0°





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

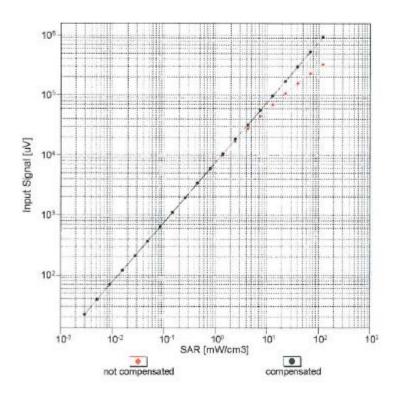
Certificate No: ES3-3327\_Sep15

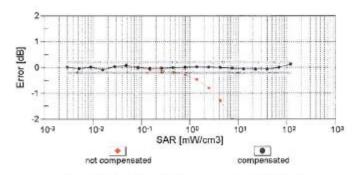
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ES3DV3- SN:3327 September 2, 2015

## Dynamic Range f(SAR<sub>head</sub>) (TEM cell , f<sub>eval</sub>= 1900 MHz)





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

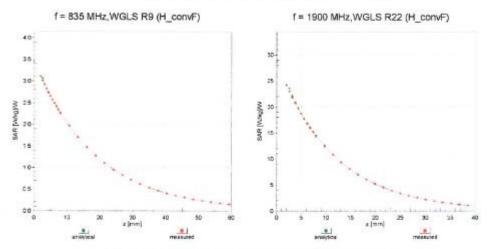
Certificate No: ES3-3327\_Sep15

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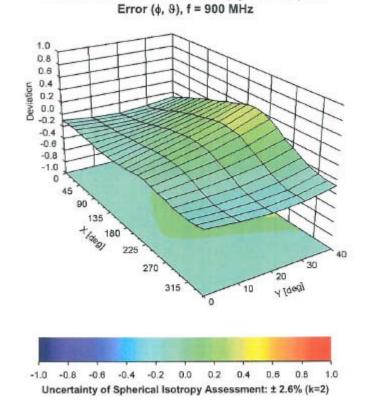


ES3DV3- SN:3327 September 2, 2015

## Conversion Factor Assessment



# Deviation from Isotropy in Liquid



Certificate No: ES3-3327\_Sep15

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ES3DV3-SN:3327

September 2, 2015

## DASY/EASY - Parameters of Probe: ES3DV3 - SN:3327

#### Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	102.8
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

Certificate No: ES3-3327\_Sep15



Pages: 120 /182

## Attachment 2. - Dipole Calibration Data



## Calibration Laboratory of

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





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Client

DT&C (Dymstec)

Accreditation No.: SCS 108

Certificate No: D750V3-1049\_Nov14

## CALIBRATION CERTIFICATE

Object D750V3 - SN: 1049

Calibration procedure(s) QA CAL-05.v9

Calibration procedure for dipole validation kits above 700 MHz

Calibration date:

November 13, 2014

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)

ID#	Cal Date (Certificate No.)	Scheduled Calibration
GB37480704	07-Oct-14 (No. 217-02020)	Oct-15
US37292783	07-Oct-14 (No. 217-02020)	Oct-15
MY41092317	07-Oct-14 (No. 217-02021)	Oct-15
SN: 5058 (20k)	03-Apr-14 (No. 217-01918)	Apr-15
SN: 5047.2 / 06327	03-Apr-14 (No. 217-01921)	Apr-15
SN: 3205	30-Dec-13 (No. ES3-3205_Dec13)	Dec-14
SN: 601	18-Aug-14 (No. DAE4-601_Aug14)	Aug-15
ID#	Check Date (in house)	Scheduled Check
100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
US37390585 S4206	18-Oct-01 (in house check Oct-14)	In house check: Oct-15
Name	Function	Signature
Jeton Kastrati	Laboratory Technician	1
	US37292783 MY41092317 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 3205 SN: 601  ID # 100005 US37390585 S4206	GB37480704 07-Oct-14 (No. 217-02020) US37292783 07-Oct-14 (No. 217-02020) MY41092317 07-Oct-14 (No. 217-02021) SN: 5058 (20k) 03-Apr-14 (No. 217-01918) SN: 5047.2 / 06327 03-Apr-14 (No. 217-01921) SN: 3205 30-Dec-13 (No. ES3-3205_Dec13) SN: 601 18-Aug-14 (No. DAE4-601_Aug14)  ID # Check Date (in house)  100005 04-Aug-99 (in house check Oct-13) US37390585 S4206 18-Oct-01 (in house check Oct-14)

Issued: November 13, 2014

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

Katja Pokovic

Certificate No: D750V3-1049\_Nov14

Approved by:

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Technical Manager



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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 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- 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) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

#### **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: D750V3-1049\_Nov14

Page 2 of 8



#### **Measurement Conditions**

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

DASY Version	DASY5	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	750 MHz ± 1 MHz	

#### **Head TSL parameters**

The following parameters and calculations were applied.

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

#### SAR result with Head TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.06 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	8.22 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.35 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	5.39 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	55.5	0.96 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	54.7 ± 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 <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.18 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	8.56 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.44 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	5.68 W/kg ± 16.5 % (k=2)

Certificate No: D750V3-1049\_Nov14



### Appendix (Additional assessments outside the scope of SCS108)

#### Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.1 Ω - 2.2 jΩ	
Return Loss	- 28.6 dB	

## Antenna Parameters with Body TSL

Impedance, transformed to feed point	47.6 Ω - 4.4 jΩ
Return Loss	- 25.8 dB

## General Antenna Parameters and Design

Electrical Delay (one direction)	1.035 ns

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

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

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

#### **Additional EUT Data**

Manufactured by	SPEAG	
Manufactured on	October 03, 2011	

Certificate No: D750V3-1049\_Nov14



#### DASY5 Validation Report for Head TSL

Date: 13.11.2014

Test Laboratory: SPEAG, Zurich, Switzerland

## DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN: 1049

Communication System: UID 0 - CW; Frequency: 750 MHz

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

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

#### DASY52 Configuration:

Probe: ES3DV3 - SN3205; ConvF(6.37, 6.37, 6.37); Calibrated: 30.12.2013;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn601; Calibrated: 18.08.2014

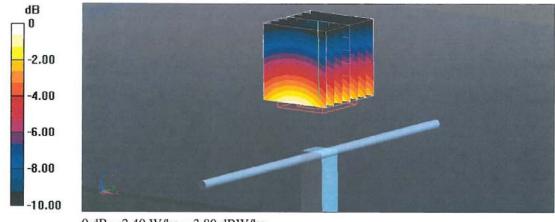
Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001

DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

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

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 53.71 V/m; Power Drift = -0.01 dB Peak SAR (extrapolated) = 3.07 W/kg SAR(1 g) = 2.06 W/kg; SAR(10 g) = 1.35 W/kg

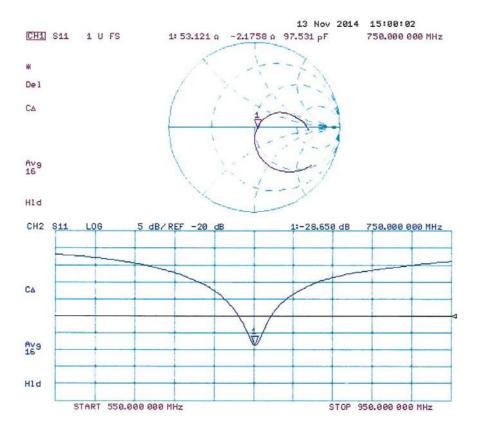
Maximum value of SAR (measured) = 2.40 W/kg



0 dB = 2.40 W/kg = 3.80 dBW/kg



## Impedance Measurement Plot for Head TSL





#### **DASY5 Validation Report for Body TSL**

Date: 13.11.2014

Test Laboratory: SPEAG, Zurich, Switzerland

#### DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN: 1049

Communication System: UID 0 - CW; Frequency: 750 MHz

Medium parameters used: f = 750 MHz;  $\sigma = 0.98 \text{ S/m}$ ;  $\varepsilon_r = 54.7$ ;  $\rho = 1000 \text{ kg/m}^3$ 

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

#### DASY52 Configuration:

Probe: ES3DV3 - SN3205; ConvF(6.13, 6.13, 6.13); Calibrated: 30.12.2013;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn601; Calibrated: 18.08.2014

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

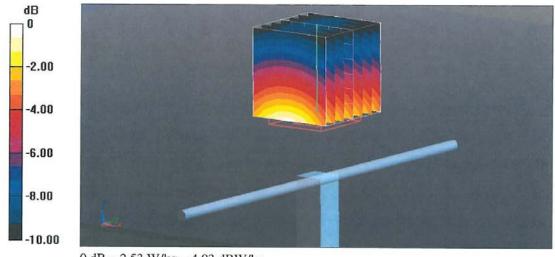
DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

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

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 52.70 V/m; Power Drift = 0.00 dB Peak SAR (extrapolated) = 3.20 W/kg

SAR(1 g) = 2.18 W/kg; SAR(10 g) = 1.44 W/kg

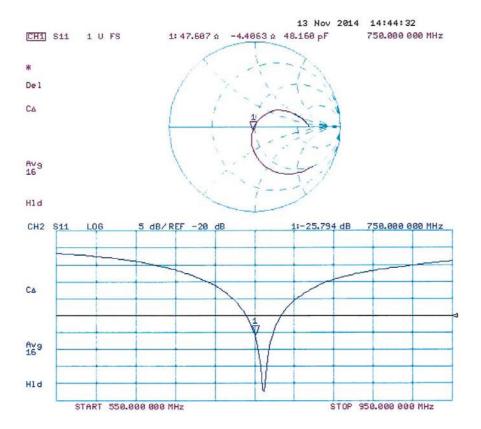
Maximum value of SAR (measured) = 2.53 W/kg



0 dB = 2.53 W/kg = 4.03 dBW/kg



## Impedance Measurement Plot for Body TSL





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Multilateral Agreement for the recognition of calibration certificates

Client DT&C (Dymstec)

Certificate No: D835V2-464\_Sep15

## CALIBRATION CERTIFICATE

Object

D835V2 - SN: 464

Calibration procedure(s)

QA CAL-05.v9

Calibration procedure for dipole validation kits above 700 MHz

Calibration date:

September 30, 2015

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	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	US37292783	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	MY41092317	07-Oct-14 (No. 217-02021)	Oct-15
Reference 20 dB Attenuator	SN: 5058 (20k)	01-Apr-15 (No. 217-02131)	Mar-16
Type-N mismatch combination	SN: 5047.2 / 06327	01-Apr-15 (No. 217-02134)	Mar-16
Reference Probe EX3DV4	SN: 7349	30-Dec-14 (No. EX3-7349_Dec14)	Dec-15
DAE4	SN: 601	17-Aug-15 (No. DAE4-601_Aug15)	Aug-16
Secondary Standards	ID#	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100972	15-Jun-15 (in house check Jun-15)	In house check: Jun-18
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-14)	In house check: Oct-15
	Name	Function	Signature
Calibrated by:	Leif Klysner	Laboratory Technician	Sef Algu-
Approved by:	Katja Pokovic	Technical Manager	Lelle.

Issued: October 1, 2015

Certificate No: D835V2-464\_Sep15

Page 1 of 8

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Multilateral Agreement for the recognition of calibration certificates

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 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- 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) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

#### Additional Documentation:

e) 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: D835V2-464\_Sep15

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#### **Measurement Conditions**

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

DASY Version	DASY5	V52.8.8
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 %	0.94 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	****	****

#### SAR result with Head T\$L

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.40 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	9.31 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.55 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	6.05 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	0.97 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	53.8 ± 6 %	1.00 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C		1 2222

## SAR result with Body TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.45 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	9.52 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.60 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	6.26 W/kg ± 16.5 % (k=2)



#### Appendix (Additional assessments outside the scope of SCS 0108)

#### Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.7 Ω - 1.7 jΩ	
Return Loss	- 34.7 dB	

### Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.3 Ω - 4.0 jΩ	
Return Loss	- 25.0 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	March 27, 2002



#### **DASY5 Validation Report for Head TSL**

Date: 30.09.2015

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 464

Communication System: UID 0 - CW; Frequency: 835 MHz

Medium parameters used: f = 835 MHz;  $\sigma = 0.94 \text{ S/m}$ ;  $\varepsilon_r = 41.8$ ;  $\rho = 1000 \text{ kg/m}^3$ 

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

#### DASY52 Configuration:

Probe: EX3DV4 - SN7349; ConvF(9.77, 9.77, 9.77); Calibrated: 30.12.2014;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn601; Calibrated: 17.08.2015

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

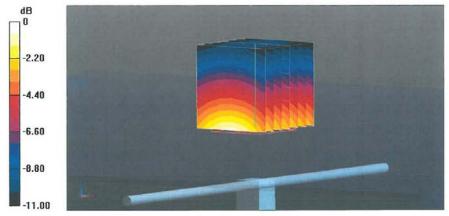
DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

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

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 61.63 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 3.62 W/kg

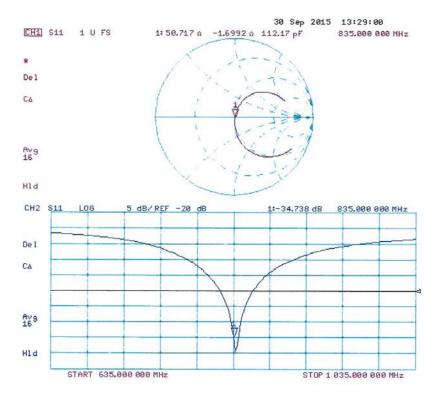
SAR(1 g) = 2.4 W/kg; SAR(10 g) = 1.55 W/kgMaximum value of SAR (measured) = 3.22 W/kg



0 dB = 3.22 W/kg = 5.08 dBW/kg



## Impedance Measurement Plot for Head TSL





## **DASY5 Validation Report for Body TSL**

Date: 30.09.2015

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 464

Communication System: UID 0 - CW; Frequency: 835 MHz

Medium parameters used: f = 835 MHz;  $\sigma = 1$  S/m;  $\varepsilon_r = 53.8$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

#### DASY52 Configuration:

Probe: EX3DV4 - SN7349; ConvF(9.72, 9.72, 9.72); Calibrated: 30.12.2014;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn601; Calibrated: 17.08.2015

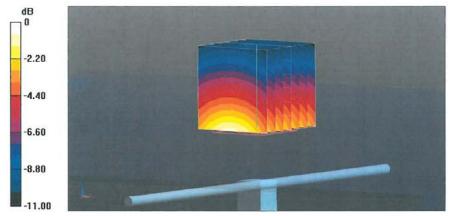
Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001

DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

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

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 59.96 V/m; Power Drift = -0.01 dB Peak SAR (extrapolated) = 3.65 W/kg SAR(1 g) = 2.45 W/kg; SAR(10 g) = 1.6 W/kg

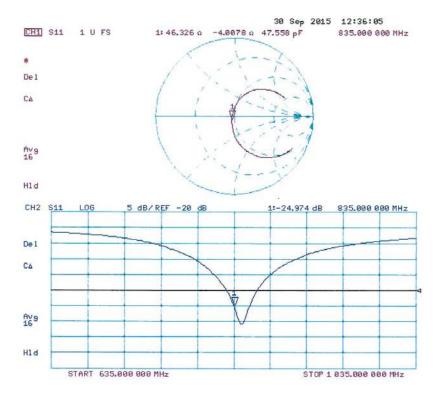
Maximum value of SAR (measured) = 3.26 W/kg



0 dB = 3.26 W/kg = 5.13 dBW/kg



## Impedance Measurement Plot for Body TSL





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 Calibration Service

Accreditation No.: SCS 0108

Accredited by the Swiss Accreditation Service (SAS)

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

Multilateral Agreement for the recognition of calibration certificates

Client DT&C (Dymstec)

Certificate No: D1800V2-2d047\_Jul15

## CALIBRATION CERTIFICATE

Object D1800V2 - SN: 2d047

Calibration procedure(s) QA CAL-05.v9

Calibration procedure for dipole validation kits above 700 MHz

Calibration date: July 16, 2015

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)

Discourse Considerate			
Primary Standards	ID#	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	US37292783	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	MY41092317	07-Oct-14 (No. 217-02021)	Oct-15
Reference 20 dB Attenuator	SN: 5058 (20k)	01-Apr-15 (No. 217-02131)	Mar-16
Type-N mismatch combination	SN: 5047.2 / 06327	01-Apr-15 (No. 217-02134)	Mar-16
Reference Probe ES3DV3	SN: 3205	30-Dec-14 (No. ES3-3205_Dec14)	Dec-15
DAE4	SN: 601	18-Aug-14 (No. DAE4-601_Aug14)	Aug-15
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
	US37390585 S4208	18-Oct-01 (in house check Oct-14)	In house check: Oct-15

Calibrated by: Israe Elnaouq Laboratory Technician

Approved by: Katja Pokovic Technical Manager

Issued: July 16, 2015

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

Certificate No: D1800V2-2d047\_Jul15

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## Calibration Laboratory of

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





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

Accreditation No.: SCS 0108

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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 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- 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
- iEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

#### Additional Documentation:

e) 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: D1800V2-2d047\_Jul15

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#### Measurement Conditions

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

DASY Version	DASY5	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	$dx_* dy, dz = 5 mm$	
Frequency	1800 MHz ± 1 MHz	

### Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	38.6 ± 6 %	1.42 mha/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

## SAR result with Head TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.78 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	38.5 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.16 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	20.4 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	52.0 ± 6 %	1.52 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	9.36 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	37.2 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR measured	250 mW input power	4.94 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	19.7 W/kg ± 16.5 % (k=2)

Certificate No: D1800V2-2d047\_Jul15



#### Appendix (Additional assessments outside the scope of SCS 0108)

#### Antenna Parameters with Head TSL

Impedance, transformed to feed point	49.1 Ω - 4.2 jΩ
Return Loss	- 27.3 dB

#### Antenna Parameters with Body TSL

Impedance, transformed to feed point	44.3 Ω - 4.5 jΩ
Return Loss	- 22.3 dB

### General Antenna Parameters and Design

1.211 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, 2002

Certificate No: D1800V2-2d047\_Jul15



#### DASY5 Validation Report for Head TSL

Date: 16.07.2015

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1800 MHz; Type: D1800V2; Serial: D1800V2 - SN: 2d047

Communication System: UID 0 - CW; Frequency: 1800 MHz

Medium parameters used: f = 1800 MHz;  $\sigma = 1.42 \text{ S/m}$ ;  $\varepsilon_r = 38.6$ ;  $\rho = 1000 \text{ kg/m}^3$ 

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

#### DASY52 Configuration:

Probe: ES3DV3 - SN3205; ConvF(5.06, 5.06, 5.06); Calibrated: 30.12.2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

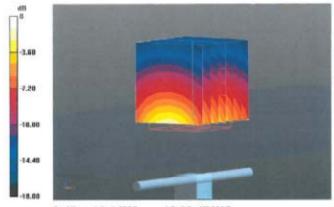
Electronics: DAE4 Sn601; Calibrated: 18.08.2014

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

DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

#### 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 = 96.55 V/m; Power Drift = 0.01 dB Peak SAR (extrapolated) = 17.8 W/kg SAR(1 g) = 9.78 W/kg; SAR(10 g) = 5.16 W/kg Maximum value of SAR (measured) = 12.4 W/kg

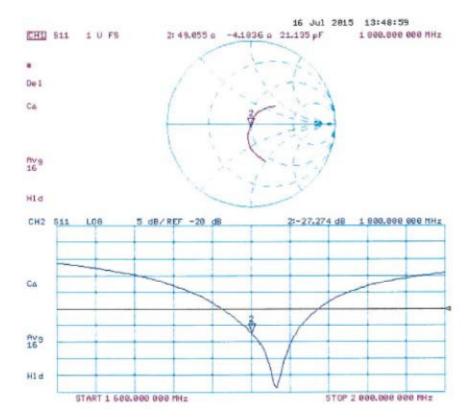


0 dB = 12.4 W/kg = 10.93 dBW/kg

Certificate No: D1800V2-2d047\_Jul15



## Impedance Measurement Plot for Head TSL





#### DASY5 Validation Report for Body TSL

Date: 16.07.2015

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1800 MHz; Type: D1800V2; Serial: D1800V2 - SN: 2d047

Communication System: UID 0 - CW; Frequency: 1800 MHz

Medium parameters used: f = 1800 MHz;  $\sigma = 1.52 \text{ S/m}$ ;  $\varepsilon_r = 52$ ;  $\rho = 1000 \text{ kg/m}^3$ 

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

#### DASY52 Configuration:

Probe: ES3DV3 - SN3205; ConvF(4.77, 4.77, 4.77); Calibrated: 30.12.2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn601; Calibrated: 18.08.2014

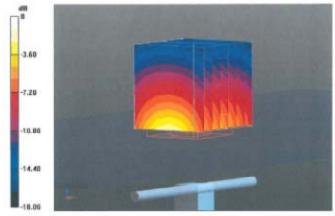
Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002

DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

#### 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 = 90.97 V/m; Power Drift = 0.02 dB Peak SAR (extrapolated) = 16.9 W/kg SAR(1 g) = 9.36 W/kg; SAR(10 g) = 4.94 W/kg

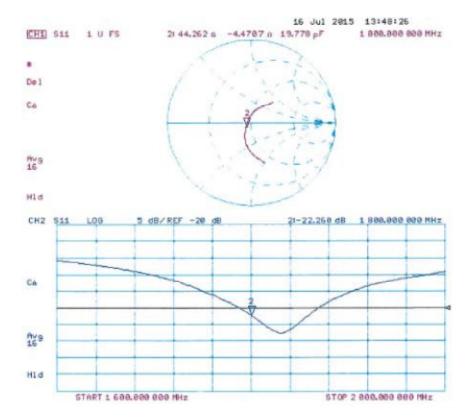
Maximum value of SAR (measured) = 11.8 W/kg



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



## Impedance Measurement Plot for Body TSL



Certificate No: D1800V2-2d047\_Jul15

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Accreditation No.: SCS 0108

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Multilateral Agreement for the recognition of calibration certificates

Client DT&C (Dymstec)

Certificate No: D1900V2-5d029\_Sep15

Object	D1900V2 - SN:5	d029	
Calibration procedure(s)	QA CAL-05.v9 Calibration proce	edure for dipole validation kits ab	ove 700 MHz
Calibration date:	September 29, 2	015	
		ional standards, which realize the physical ur robability are given on the following pages a	nd are part of the certificate.
		ry facility: environment temperature (22 $\pm$ 3) $^{\circ}$	C and humidity < 70%.
Calibration Equipment used (M&		ry facility: environment temperature $(22 \pm 3)^{\circ}$ Cal Date (Certificate No.)	C and humidity < 70%.  Scheduled Calibration
Calibration Equipment used (M&	TE critical for calibration)		
Calibration Equipment used (M& Primary Standards Power meter EPM-442A Power sensor HP 8481A	TE critical for calibration)	Cal Date (Certificate No.)	Scheduled Calibration
Calibration Equipment used (M& Primary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A	TE critical for calibration)  ID #  GB37480704  US37292783  MY41092317	Cal Date (Certificate No.) 07-Oct-14 (No. 217-02020)	Scheduled Calibration Oct-15
Calibration Equipment used (M& Primary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A Reference 20 dB Attenuator	TE critical for calibration)  ID #  GB37480704  US37292783  MY41092317  SN: 5058 (20k)	Cal Date (Certificate No.) 07-Oct-14 (No. 217-02020) 07-Oct-14 (No. 217-02020) 07-Oct-14 (No. 217-02021) 01-Apr-15 (No. 217-02131)	Scheduled Calibration Oct-15 Oct-15 Oct-15 Mar-16
Calibration Equipment used (M& Primary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination	TE critical for calibration)  ID #  GB37480704  US37292783  MY41092317  SN: 5058 (20k)  SN: 5047.2 / 06327	Cal Date (Certificate No.) 07-Oct-14 (No. 217-02020) 07-Oct-14 (No. 217-02020) 07-Oct-14 (No. 217-02021) 01-Apr-15 (No. 217-02131) 01-Apr-15 (No. 217-02134)	Scheduled Calibration Oct-15 Oct-15 Oct-15 Mar-16 Mar-16
Calibration Equipment used (M& Primary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4	TE critical for calibration)  ID #  GB37480704  US37292783  MY41092317  SN: 5058 (20k)  SN: 5047.2 / 06327  SN: 7349	Cal Date (Certificate No.)  07-Oct-14 (No. 217-02020)  07-Oct-14 (No. 217-02020)  07-Oct-14 (No. 217-02021)  01-Apr-15 (No. 217-02131)  01-Apr-15 (No. 217-02134)  30-Dec-14 (No. EX3-7349_Dec14)	Scheduled Calibration Oct-15 Oct-15 Oct-15 Mar-16 Mar-16 Dec-15
Calibration Equipment used (M& Primary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4	TE critical for calibration)  ID #  GB37480704  US37292783  MY41092317  SN: 5058 (20k)  SN: 5047.2 / 06327	Cal Date (Certificate No.) 07-Oct-14 (No. 217-02020) 07-Oct-14 (No. 217-02020) 07-Oct-14 (No. 217-02021) 01-Apr-15 (No. 217-02131) 01-Apr-15 (No. 217-02134)	Scheduled Calibration Oct-15 Oct-15 Oct-15 Mar-16 Mar-16
Calibration Equipment used (M& Primary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4	TE critical for calibration)  ID #  GB37480704  US37292783  MY41092317  SN: 5058 (20k)  SN: 5047.2 / 06327  SN: 7349	Cal Date (Certificate No.) 07-Oct-14 (No. 217-02020) 07-Oct-14 (No. 217-02020) 07-Oct-14 (No. 217-02021) 01-Apr-15 (No. 217-02131) 01-Apr-15 (No. 217-02134) 30-Dec-14 (No. EX3-7349_Dec14) 17-Aug-15 (No. DAE4-601_Aug15)	Scheduled Calibration Oct-15 Oct-15 Oct-15 Mar-16 Mar-16 Dec-15
Calibration Equipment used (M& Primary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4	TE critical for calibration)  ID #  GB37480704  US37292783  MY41092317  SN: 5058 (20k)  SN: 5047.2 / 06327  SN: 7349  SN: 601	Cal Date (Certificate No.)  07-Oct-14 (No. 217-02020)  07-Oct-14 (No. 217-02020)  07-Oct-14 (No. 217-02021)  01-Apr-15 (No. 217-02131)  01-Apr-15 (No. 217-02134)  30-Dec-14 (No. EX3-7349_Dec14)	Scheduled Calibration Oct-15 Oct-15 Oct-15 Mar-16 Mar-16 Dec-15 Aug-16
Calibration Equipment used (M& Primary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards RF generator R&S SMT-06	TE critical for calibration)  ID #  GB37480704 US37292783 MY41092317 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601  ID #	Cal Date (Certificate No.) 07-Oct-14 (No. 217-02020) 07-Oct-14 (No. 217-02020) 07-Oct-14 (No. 217-02021) 01-Apr-15 (No. 217-02131) 01-Apr-15 (No. 217-02134) 30-Dec-14 (No. EX3-7349_Dec14) 17-Aug-15 (No. DAE4-601_Aug15) Check Date (in house)	Scheduled Calibration Oct-15 Oct-15 Oct-15 Mar-16 Mar-16 Dec-15 Aug-16 Scheduled Check
All calibrations have been conducted Calibration Equipment used (M& Primary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4  Secondary Standards RF generator R&S SMT-06 Network Analyzer HP 8753E	TE critical for calibration)  ID #  GB37480704  US37292783  MY41092317  SN: 5058 (20k)  SN: 5047.2 / 06327  SN: 7349  SN: 601  ID #  100972	Cal Date (Certificate No.)  07-Oct-14 (No. 217-02020)  07-Oct-14 (No. 217-02020)  07-Oct-14 (No. 217-02021)  01-Apr-15 (No. 217-02131)  01-Apr-15 (No. 217-02134)  30-Dec-14 (No. EX3-7349_Dec14)  17-Aug-15 (No. DAE4-601_Aug15)  Check Date (in house)  15-Jun-15 (in house check Jun-15)	Scheduled Calibration Oct-15 Oct-15 Oct-15 Mar-16 Mar-16 Dec-15 Aug-16 Scheduled Check In house check: Jun-18
Calibration Equipment used (M& Primary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards RF generator R&S SMT-06 Network Analyzer HP 8753E	TE critical for calibration)  ID #  GB37480704 US37292783 MY41092317 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601  ID #  100972 US37390585 S4206	Cal Date (Certificate No.)  07-Oct-14 (No. 217-02020)  07-Oct-14 (No. 217-02020)  07-Oct-14 (No. 217-02021)  01-Apr-15 (No. 217-02131)  01-Apr-15 (No. 217-02134)  30-Dec-14 (No. EX3-7349_Dec14)  17-Aug-15 (No. DAE4-601_Aug15)  Check Date (in house)  15-Jun-15 (in house check Jun-15)  18-Oct-01 (in house check Oct-14)	Scheduled Calibration Oct-15 Oct-15 Oct-15 Mar-16 Mar-16 Dec-15 Aug-16 Scheduled Check In house check: Jun-18 In house check: Oct-15 Signature
Calibration Equipment used (M& Primary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards RF generator R&S SMT-06	TE critical for calibration)  ID #  GB37480704 US37292783 MY41092317 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601  ID #  100972 US37390585 S4206  Name	Cal Date (Certificate No.)  07-Oct-14 (No. 217-02020)  07-Oct-14 (No. 217-02020)  07-Oct-14 (No. 217-02021)  01-Apr-15 (No. 217-02131)  01-Apr-15 (No. 217-02134)  30-Dec-14 (No. EX3-7349_Dec14)  17-Aug-15 (No. DAE4-601_Aug15)  Check Date (in house)  15-Jun-15 (in house check Jun-15)  18-Oct-01 (in house check Oct-14)	Scheduled Calibration Oct-15 Oct-15 Oct-15 Mar-16 Mar-16 Dec-15 Aug-16 Scheduled Check In house check: Jun-18 In house check: Oct-15

Certificate No: D1900V2-5d029\_Sep15

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#### Calibration Laboratory of

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





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Accreditation No.: SCS 0108

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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 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- 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) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

#### Additional Documentation:

e) 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: D1900V2-5d029\_Sep15

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#### **Measurement Conditions**

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

DASY Version	DASY5	V52.8.8
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.

7	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 %	1.38 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

#### SAR result with Head TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	10.1 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	40.6 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.24 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	21.0 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	52.6 ± 6 %	1.52 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C		

#### SAR result with Body TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	10.2 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	40.7 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.35 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.4 W/kg ± 16.5 % (k=2)

Certificate No: D1900V2-5d029\_Sep15

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## Appendix (Additional assessments outside the scope of SCS 0108)

#### Antenna Parameters with Head TSL

Impedance, transformed to feed point	$51.9 \Omega + 4.8 j\Omega$	
Return Loss	- 26.0 dB	

#### Antenna Parameters with Body TSL

Impedance, transformed to feed point	$48.3 \Omega + 5.7 j\Omega$	
Return Loss	- 24.4 dB	

## General Antenna Parameters and Design

Electrical Delay (one direction)	1.197 ns
CAST CONTROL A SECURE AND A SE	

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, 2002	

Certificate No: D1900V2-5d029\_Sep15

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#### **DASY5 Validation Report for Head TSL**

Date: 29.09.2015

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d029

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

Medium parameters used: f = 1900 MHz;  $\sigma = 1.38$  S/m;  $\epsilon_r = 39.3$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

#### DASY52 Configuration:

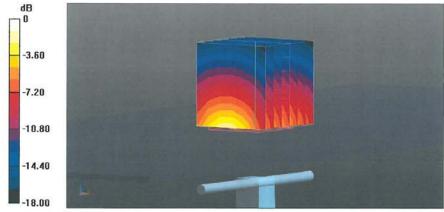
- Probe: EX3DV4 SN7349; ConvF(8.14, 8.14, 8.14); Calibrated: 30.12.2014;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 17.08.2015
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

#### 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 = 109.5 V/m; Power Drift = 0.01 dB Peak SAR (extrapolated) = 18.9 W/kg

SAR(1 g) = 10.1 W/kg; SAR(10 g) = 5.24 W/kg

Maximum value of SAR (measured) = 15.5 W/kg



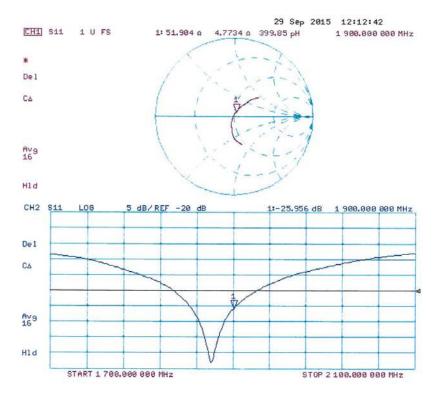
0 dB = 15.5 W/kg = 11.90 dBW/kg

Certificate No: D1900V2-5d029\_Sep15

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## Impedance Measurement Plot for Head TSL



Certificate No: D1900V2-5d029\_Sep15



#### **DASY5 Validation Report for Body TSL**

Date: 29.09.2015

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d029

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

Medium parameters used: f = 1900 MHz;  $\sigma = 1.52$  S/m;  $\epsilon_r = 52.6$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

#### DASY52 Configuration:

Probe: EX3DV4 - SN7349; ConvF(7.9, 7.9, 7.9); Calibrated: 30.12.2014;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn601; Calibrated: 17.08.2015

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

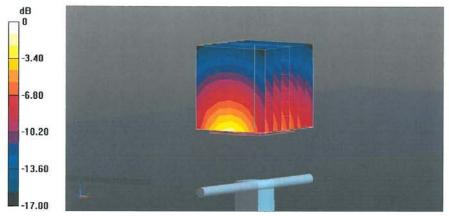
DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

## 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 = 104.7 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 18.2 W/kg

SAR(1 g) = 10.2 W/kg; SAR(10 g) = 5.35 W/kgMaximum value of SAR (measured) = 15.5 W/kg



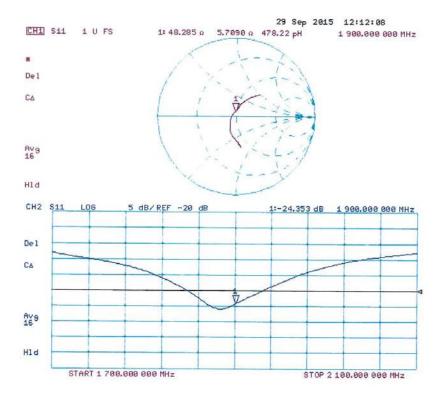
0 dB = 15.5 W/kg = 11.90 dBW/kg

Certificate No: D1900V2-5d029\_Sep15

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## Impedance Measurement Plot for Body TSL







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





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

Accreditation No.: SCS 0108

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

D0450V2 726 Con15

ALIDITATION	CERTIFICATE		
Object	D2450V2 - SN: 7	26	
Calibration procedure(s)	QA CAL-05.v9 Calibration proce	dure for dipole validation kits abo	ove 700 MHz
Calibration date:	September 28, 20	015	
		robability are given on the following pages an ry facility: environment temperature (22 $\pm$ 3)°0	
Calibration Equipment used (M&	TE critical for calibration)		
	POSSESSE CONTRACTOR CONTRACTOR CONTRACTOR	Cal Date (Certificate No.)	Scheduled Calibration
Primary Standards	ID#	Cal Date (Certificate No.)	Scheduled Calibration Oct-15
Primary Standards Power meter EPM-442A	ID # GB37480704	07-Oct-14 (No. 217-02020)	Scheduled Calibration Oct-15 Oct-15
Primary Standards Power meter EPM-442A Power sensor HP 8481A	ID # GB37480704 US37292783	07-Oct-14 (No. 217-02020) 07-Oct-14 (No. 217-02020)	Oct-15
Primary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A	ID # GB37480704 US37292783 MY41092317	07-Oct-14 (No. 217-02020) 07-Oct-14 (No. 217-02020) 07-Oct-14 (No. 217-02021)	Oct-15 Oct-15
Primary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A Reference 20 dB Attenuator	ID # GB37480704 US37292783	07-Oct-14 (No. 217-02020) 07-Oct-14 (No. 217-02020)	Oct-15 Oct-15 Oct-15
Primary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination	ID # GB37480704 US37292783 MY41092317 SN: 5058 (20k)	07-Oct-14 (No. 217-02020) 07-Oct-14 (No. 217-02020) 07-Oct-14 (No. 217-02021) 01-Apr-15 (No. 217-02131)	Oct-15 Oct-15 Oct-15 Mar-16
Primary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4	ID #  GB37480704 US37292783 MY41092317 SN: 5058 (20k) SN: 5047.2 / 06327	07-Oct-14 (No. 217-02020) 07-Oct-14 (No. 217-02020) 07-Oct-14 (No. 217-02021) 01-Apr-15 (No. 217-02131) 01-Apr-15 (No. 217-02134)	Oct-15 Oct-15 Oct-15 Mar-16 Mar-16
Primary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4	ID #  GB37480704 US37292783 MY41092317 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349	07-Oct-14 (No. 217-02020) 07-Oct-14 (No. 217-02020) 07-Oct-14 (No. 217-02021) 01-Apr-15 (No. 217-02131) 01-Apr-15 (No. 217-02134) 30-Dec-14 (No. EX3-7349_Dec14)	Oct-15 Oct-15 Oct-15 Mar-16 Mar-16 Dec-15
Primary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards	ID # GB37480704 US37292783 MY41092317 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601	07-Oct-14 (No. 217-02020) 07-Oct-14 (No. 217-02020) 07-Oct-14 (No. 217-02021) 01-Apr-15 (No. 217-02131) 01-Apr-15 (No. 217-02134) 30-Dec-14 (No. EX3-7349_Dec14) 17-Aug-15 (No. DAE4-601_Aug15)	Oct-15 Oct-15 Oct-15 Mar-16 Mar-16 Dec-15 Aug-16
Primary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards RF generator R&S SMT-06	ID # GB37480704 US37292783 MY41092317 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601 ID #	07-Oct-14 (No. 217-02020) 07-Oct-14 (No. 217-02020) 07-Oct-14 (No. 217-02021) 01-Apr-15 (No. 217-02131) 01-Apr-15 (No. 217-02134) 30-Dec-14 (No. EX3-7349_Dec14) 17-Aug-15 (No. DAE4-601_Aug15) Check Date (in house)	Oct-15 Oct-15 Oct-15 Mar-16 Mar-16 Dec-15 Aug-16 Scheduled Check
Primary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards RF generator R&S SMT-06	ID #  GB37480704 US37292783 MY41092317 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601  ID #  100972 US37390585 S4206	07-Oct-14 (No. 217-02020) 07-Oct-14 (No. 217-02020) 07-Oct-14 (No. 217-02021) 01-Apr-15 (No. 217-02131) 01-Apr-15 (No. 217-02134) 30-Dec-14 (No. EX3-7349_Dec14) 17-Aug-15 (No. DAE4-601_Aug15) Check Date (in house) 15-Jun-15 (in house check Jun-15) 18-Oct-01 (in house check Oct-14)	Oct-15 Oct-15 Oct-15 Mar-16 Mar-16 Dec-15 Aug-16 Scheduled Check In house check: Jun-18 In house check: Oct-15
Primary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards RF generator R&S SMT-06 Network Analyzer HP 8753E	ID #  GB37480704 US37292783 MY41092317 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601  ID #  100972 US37390585 S4206  Name	07-Oct-14 (No. 217-02020) 07-Oct-14 (No. 217-02020) 07-Oct-14 (No. 217-02021) 01-Apr-15 (No. 217-02131) 01-Apr-15 (No. 217-02134) 30-Dec-14 (No. EX3-7349_Dec14) 17-Aug-15 (No. DAE4-601_Aug15) Check Date (in house) 15-Jun-15 (in house check Jun-15) 18-Oct-01 (in house check Oct-14)	Oct-15 Oct-15 Oct-15 Mar-16 Mar-16 Dec-15 Aug-16 Scheduled Check In house check: Jun-18
Calibration Equipment used (M&Primary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4  Secondary Standards RF generator R&S SMT-06 Network Analyzer HP 8753E  Calibrated by:	ID #  GB37480704 US37292783 MY41092317 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601  ID #  100972 US37390585 S4206	07-Oct-14 (No. 217-02020) 07-Oct-14 (No. 217-02020) 07-Oct-14 (No. 217-02021) 01-Apr-15 (No. 217-02131) 01-Apr-15 (No. 217-02134) 30-Dec-14 (No. EX3-7349_Dec14) 17-Aug-15 (No. DAE4-601_Aug15) Check Date (in house) 15-Jun-15 (in house check Jun-15) 18-Oct-01 (in house check Oct-14)	Oct-15 Oct-15 Oct-15 Mar-16 Mar-16 Dec-15 Aug-16 Scheduled Check In house check: Jun-18 In house check: Oct-15

Certificate No: D2450V2-726\_Sep15

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





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#### Calibration Laboratory of

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





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Accreditation No.: SCS 0108

Accredited by the Swiss Accreditation Service (SAS)

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Multilateral Agreement for the recognition of calibration certificates

#### 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 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- 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) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

#### Additional Documentation:

e) 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: D2450V2-726\_Sep15

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#### **Measurement Conditions**

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

DASY Version	DASY5	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, $dy$ , $dz = 5 mm$	
Frequency	2450 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	39.2 ± 6 %	1.86 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

#### SAR result with Head TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.0 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	51.2 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.01 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.8 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	53.2 ± 6 %	2.00 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	27773	

## SAR result with Body TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	12.5 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	49.5 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.84 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	23.2 W/kg ± 16.5 % (k=2)

Certificate No: D2450V2-726\_Sep15



#### Appendix (Additional assessments outside the scope of SCS 0108)

#### Antenna Parameters with Head TSL

Impedance, transformed to feed point	$53.5 \Omega + 5.0 j\Omega$	
Return Loss	- 24.6 dB	

#### Antenna Parameters with Body TSL

Impedance, transformed to feed point	$49.3 \Omega + 6.1 j\Omega$	
Return Loss	- 24.2 dB	

#### General Antenna Parameters and Design

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	January 09, 2003	

Certificate No: D2450V2-726\_Sep15

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#### **DASY5 Validation Report for Head TSL**

Date: 28.09.2015

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 726

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

Medium parameters used: f = 2450 MHz;  $\sigma = 1.86$  S/m;  $\varepsilon_r = 39.2$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

#### DASY52 Configuration:

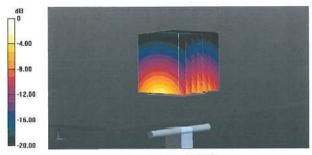
- Probe: EX3DV4 SN7349; ConvF(7.67, 7.67, 7.67); Calibrated: 30.12.2014;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 17.08.2015
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

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

Measurement grid: dx=5mm, dy=5mm, dz=5mmReference Value = 112.1 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 26.7 W/kg

SAR(1 g) = 13 W/kg; SAR(10 g) = 6.01 W/kgMaximum value of SAR (measured) = 21.5 W/kg

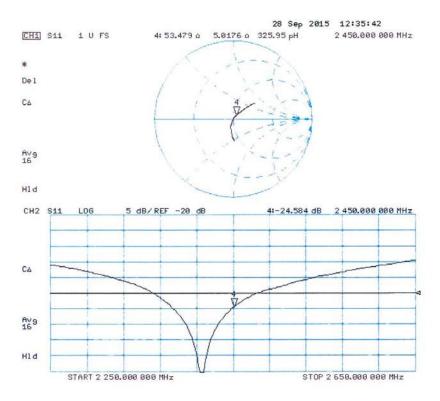


0 dB = 21.5 W/kg = 13.32 dBW/kg

Certificate No: D2450V2-726\_Sep15



## Impedance Measurement Plot for Head TSL





#### **DASY5 Validation Report for Body TSL**

Date: 28.09.2015

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 726

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

Medium parameters used: f = 2450 MHz;  $\sigma = 2$  S/m;  $\varepsilon_r = 53.2$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

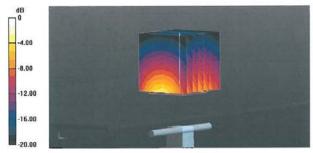
#### DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(7.53, 7.53, 7.53); Calibrated: 30.12.2014;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 17.08.2015
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

## 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 = 105.5 V/m; Power Drift = 0.02 dB Peak SAR (extrapolated) = 24.7 W/kg

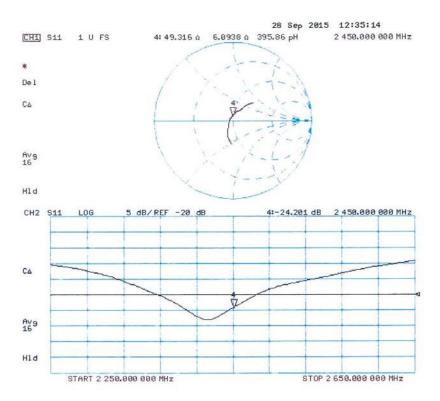
SAR(1 g) = 12.5 W/kg; SAR(10 g) = 5.84 W/kgMaximum value of SAR (measured) = 20.3 W/kg



0 dB = 20.3 W/kg = 13.07 dBW/kg



## Impedance Measurement Plot for Body TSL



Certificate No: D2450V2-726\_Sep15

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





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Accreditation No.: SCS 0108

CALIBRATION	JEITH IOATE			
Object	D5GHzV2 - SN: 1103			
Calibration procedure(s)	QA CAL-22.v2 Calibration procedure for dipole validation kits between 3-6 GHz			
Calibration date:	March 23, 2015			
The measurements and the thou	ortantiloo witir corindonoo p	probability are given on the following pages ar	id are part of the definitiate.	
		ry facility: environment temperature (22 $\pm$ 3)°(	C and humidity < 70%.	
Calibration Equipment used (M&		by facility: environment temperature $(22 \pm 3)^{\circ}$ 0 Cal Date (Certificate No.)	C and humidity < 70%.  Scheduled Calibration	
Calibration Equipment used (M& Primary Standards	TE critical for calibration)			
calibration Equipment used (M& rrimary Standards Yower meter EPM-442A Yower sensor HP 8481A	TE critical for calibration)  ID #  GB37480704 US37292783	Cal Date (Certificate No.) 07-Oct-14 (No. 217-02020) 07-Oct-14 (No. 217-02020)	Scheduled Calibration Oct-15 Oct-15	
Calibration Equipment used (M& Primary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A	TE critical for calibration)  ID #  GB37480704 US37292783 MY41092317	Cal Date (Certificate No.) 07-Oct-14 (No. 217-02020) 07-Oct-14 (No. 217-02020) 07-Oct-14 (No. 217-02021)	Scheduled Calibration Oct-15 Oct-15 Oct-15	
Calibration Equipment used (M& Primary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A Reference 20 dB Attenuator	TE critical for calibration)  ID #  GB37480704 US37292783 MY41092317 SN: 5058 (20k)	Cal Date (Certificate No.) 07-Oct-14 (No. 217-02020) 07-Oct-14 (No. 217-02020) 07-Oct-14 (No. 217-02021) 03-Apr-14 (No. 217-01918)	Scheduled Calibration Oct-15 Oct-15 Oct-15 Apr-15	
Calibration Equipment used (M& Primary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination	TE critical for calibration)  ID #  GB37480704 US37292783 MY41092317 SN: 5058 (20k) SN: 5047.2 / 06327	Cal Date (Certificate No.) 07-Oct-14 (No. 217-02020) 07-Oct-14 (No. 217-02020) 07-Oct-14 (No. 217-02021) 03-Apr-14 (No. 217-01918) 03-Apr-14 (No. 217-01921)	Scheduled Calibration Oct-15 Oct-15 Oct-15 Apr-15 Apr-15	
Calibration Equipment used (M& Primary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4	TE critical for calibration)  ID #  GB37480704 US37292783 MY41092317 SN: 5058 (20k)	Cal Date (Certificate No.) 07-Oct-14 (No. 217-02020) 07-Oct-14 (No. 217-02020) 07-Oct-14 (No. 217-02021) 03-Apr-14 (No. 217-01918)	Scheduled Calibration Oct-15 Oct-15 Oct-15 Apr-15	
Calibration Equipment used (M& Primary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4	TE critical for calibration)  ID #  GB37480704 US37292783 MY41092317 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 3503	Cal Date (Certificate No.) 07-Oct-14 (No. 217-02020) 07-Oct-14 (No. 217-02020) 07-Oct-14 (No. 217-02021) 03-Apr-14 (No. 217-01918) 03-Apr-14 (No. 217-01921) 30-Dec-14 (No. EX3-3503_Dec14)	Scheduled Calibration Oct-15 Oct-15 Oct-15 Apr-15 Apr-15 Dec-15	
Calibration Equipment used (M& Primary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4	TE critical for calibration)  ID #  GB37480704 US37292783 MY41092317 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 3503 SN: 601	Cal Date (Certificate No.) 07-Oct-14 (No. 217-02020) 07-Oct-14 (No. 217-02020) 07-Oct-14 (No. 217-02021) 03-Apr-14 (No. 217-01918) 03-Apr-14 (No. 217-01921) 30-Dec-14 (No. EX3-3503_Dec14) 18-Aug-14 (No. DAE4-601_Aug14)	Scheduled Calibration Oct-15 Oct-15 Oct-15 Apr-15 Apr-15 Apr-15 Dec-15 Aug-15 Scheduled Check	
Calibration Equipment used (M& Primary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards	TE critical for calibration)  ID #  GB37480704 US37292783 MY41092317 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 3503 SN: 601  ID #	Cal Date (Certificate No.)  07-Oct-14 (No. 217-02020)  07-Oct-14 (No. 217-02020)  07-Oct-14 (No. 217-02021)  03-Apr-14 (No. 217-01918)  03-Apr-14 (No. 217-01921)  30-Dec-14 (No. EX3-3503_Dec14)  18-Aug-14 (No. DAE4-601_Aug14)  Check Date (in house)	Scheduled Calibration Oct-15 Oct-15 Oct-15 Apr-15 Apr-15 Apr-15 Dec-15 Aug-15 Scheduled Check In house check: Oct-16	
All calibrations have been conducted Calibration Equipment used (M&Primary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards RF generator R&S SMT-06 Network Analyzer HP 8753E	TE critical for calibration)  ID #  GB37480704 US37292783 MY41092317 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 3503 SN: 601  ID #  100005	Cal Date (Certificate No.)  07-Oct-14 (No. 217-02020)  07-Oct-14 (No. 217-02020)  07-Oct-14 (No. 217-02021)  03-Apr-14 (No. 217-01918)  03-Apr-14 (No. 217-01921)  30-Dec-14 (No. EX3-3503_Dec14)  18-Aug-14 (No. DAE4-601_Aug14)  Check Date (in house)  04-Aug-99 (in house check Oct-13)	Scheduled Calibration Oct-15 Oct-15 Oct-15 Apr-15 Apr-15 Apr-15 Dec-15 Aug-15	
Calibration Equipment used (M& Primary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards	TE critical for calibration)  ID #  GB37480704 US37292783 MY41092317 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 3503 SN: 601  ID #  100005 US37390585 S4206	Cal Date (Certificate No.)  07-Oct-14 (No. 217-02020)  07-Oct-14 (No. 217-02020)  07-Oct-14 (No. 217-02021)  03-Apr-14 (No. 217-01918)  03-Apr-14 (No. 217-01921)  30-Dec-14 (No. EX3-3503_Dec14)  18-Aug-14 (No. DAE4-601_Aug14)  Check Date (in house)  04-Aug-99 (in house check Oct-13)  18-Oct-01 (in house check Oct-14)	Scheduled Calibration Oct-15 Oct-15 Oct-15 Apr-15 Apr-15 Apr-15 Dec-15 Aug-15 Scheduled Check In house check: Oct-16 In house check: Oct-15	

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