

#### 835 MHz Dipole Calibration Certificate

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

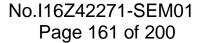
Accreditation No.: SCS 0108

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

ALIBRATION	en) CERTIFICATE		
Dbject	D835V2 - SN:4d0	069	
Calibration procedure(s)	QA CAL-05.v9		
	Calibration proce	edure for dipole validation kits abo	ove 700 MHz
Calibration date:	July 20, 2016		
alibration date:	July 20, 2016		
alibration Equipment used (M&T	ΓE critical for calibration)		
rimary Standards	ID#	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	06-Apr-16 (No. 217-02288/02289)	Apr-17
ower sensor NRP-Z91	SN: 103244	06-Apr-16 (No. 217-02288)	Apr-17
	SN: 103245	06-Apr-16 (No. 217-02289)	Apr-17
	SN: 5058 (20k)	05-Apr-16 (No. 217-02292)	
Reference 20 dB Attenuator	A STATE OF THE PARTY OF THE PAR		Apr-17
Reference 20 dB Attenuator Type-N mismatch combination	SN: 5047.2 / 06327	05-Apr-16 (No. 217-02295)	Apr-17
Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4	SN: 5047.2 / 06327 SN: 7349	05-Apr-16 (No. 217-02295) 15-Jun-16 (No. EX3-7349_Jun16)	Apr-17 Jun-17
Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4	SN: 5047.2 / 06327	05-Apr-16 (No. 217-02295)	Apr-17
Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4	SN: 5047.2 / 06327 SN: 7349	05-Apr-16 (No. 217-02295) 15-Jun-16 (No. EX3-7349_Jun16)	Apr-17 Jun-17
Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4	SN: 5047.2 / 06327 SN: 7349 SN: 601	05-Apr-16 (No. 217-02295) 15-Jun-16 (No. EX3-7349_Jun16) 30-Dec-15 (No. DAE4-601_Dec15)	Apr-17 Jun-17 Dec-16
Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter EPM-442A	SN: 5047.2 / 06327 SN: 7349 SN: 601	05-Apr-16 (No. 217-02295) 15-Jun-16 (No. EX3-7349_Jun16) 30-Dec-15 (No. DAE4-601_Dec15) Check Date (in house)	Apr-17 Jun-17 Dec-16  Scheduled Check In house check: Oct-16 In house check: Oct-16
Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter EPM-442A Power sensor HP 8481A	SN: 5047.2 / 06327 SN: 7349 SN: 601 ID # SN: GB37480704 SN: US37292783 SN: MY41092317	05-Apr-16 (No. 217-02295) 15-Jun-16 (No. EX3-7349_Jun16) 30-Dec-15 (No. DAE4-601_Dec15)  Check Date (in house) 07-Oct-15 (No. 217-02222) 07-Oct-15 (No. 217-02222) 07-Oct-15 (No. 217-02223)	Apr-17 Jun-17 Dec-16  Scheduled Check In house check: Oct-16 In house check: Oct-16 In house check: Oct-16
Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4  Secondary Standards Power meter EPM-442A Power sensor HP 8481A RF generator R&S SMT-06	SN: 5047.2 / 06327 SN: 7349 SN: 601 ID # SN: GB37480704 SN: US37292783 SN: MY41092317 SN: 100972	05-Apr-16 (No. 217-02295) 15-Jun-16 (No. EX3-7349_Jun16) 30-Dec-15 (No. DAE4-601_Dec15)  Check Date (in house) 07-Oct-15 (No. 217-02222) 07-Oct-15 (No. 217-02222) 07-Oct-15 (No. 217-02223) 15-Jun-15 (in house check Jun-15)	Apr-17 Jun-17 Dec-16  Scheduled Check In house check: Oct-16 In house check: Oct-16 In house check: Oct-16 In house check: Oct-16
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Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer HP 8753E	SN: 5047.2 / 06327 SN: 7349 SN: 601 ID # SN: GB37480704 SN: US37292783 SN: MY41092317 SN: 100972	05-Apr-16 (No. 217-02295) 15-Jun-16 (No. EX3-7349_Jun16) 30-Dec-15 (No. DAE4-601_Dec15)  Check Date (in house) 07-Oct-15 (No. 217-02222) 07-Oct-15 (No. 217-02222) 07-Oct-15 (No. 217-02223) 15-Jun-15 (in house check Jun-15)	Apr-17 Jun-17 Dec-16  Scheduled Check In house check: Oct-16 In house check: Oct-16 In house check: Oct-16 In house check: Oct-16
Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Recondary Standards Rec	SN: 5047.2 / 06327 SN: 7349 SN: 601 ID # SN: GB37480704 SN: US37292783 SN: MY41092317 SN: 100972 SN: US37390585	05-Apr-16 (No. 217-02295) 15-Jun-16 (No. EX3-7349_Jun16) 30-Dec-15 (No. DAE4-601_Dec15)  Check Date (in house) 07-Oct-15 (No. 217-02222) 07-Oct-15 (No. 217-02222) 07-Oct-15 (No. 217-02223) 15-Jun-15 (in house check Jun-15) 18-Oct-01 (in house check Oct-15)	Apr-17 Jun-17 Dec-16  Scheduled Check In house check: Oct-16
Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Recondary Standards Rec	SN: 5047.2 / 06327 SN: 7349 SN: 601 ID # SN: GB37480704 SN: US37292783 SN: MY41092317 SN: 100972 SN: US37390585 Name	05-Apr-16 (No. 217-02295) 15-Jun-16 (No. EX3-7349_Jun16) 30-Dec-15 (No. DAE4-601_Dec15)  Check Date (in house) 07-Oct-15 (No. 217-02222) 07-Oct-15 (No. 217-02222) 07-Oct-15 (No. 217-02223) 15-Jun-15 (in house check Jun-15) 18-Oct-01 (in house check Oct-15)  Function	Apr-17 Jun-17 Dec-16  Scheduled Check In house check: Oct-16
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Certificate No: D835V2-4d069\_Jul16

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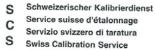


## Calibration Laboratory of

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







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
- 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%.

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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	40.6 ± 6 %	0.94 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	2.45 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	9.44 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	1.59 W/kg	
SAR for nominal Head TSL parameters	normalized to 1W	6.18 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	54.9 ± 6 %	1.01 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	2.50 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	9.69 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	ALC 9 (800 A 100 A
SAR measured	250 mW input power	1.63 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	6.36 W/kg ± 16.5 % (k=2)

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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 Ω - 2.1 jΩ	
Return Loss	- 31.1 dB	-

#### Antenna Parameters with Body TSL

Impedance, transformed to feed point	48.8 Ω - 2.5 jΩ	
Return Loss	- 31.0 dB	

## General Antenna Parameters and Design

Electrical Delay (one direction)	1.394 ns
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After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

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

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

#### **Additional EUT Data**

Manufactured by	SPEAG
Manufactured on	November 09, 2007

Certificate No: D835V2-4d069\_Jul16



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

Date: 20.07.2016

Test Laboratory: SPEAG, Zurich, Switzerland

# DUT: Dipole 835 MHz D835V2; Type: D835V2; Serial: D835V2 - SN:4d069

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

Medium parameters used: f = 835 MHz;  $\sigma = 0.94$  S/m;  $\epsilon_r = 40.6$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

## DASY52 Configuration:

Probe: EX3DV4 - SN7349; ConvF(9.72, 9.72, 9.72); Calibrated: 15.06.2016;

• Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn601; Calibrated: 30.12.2015

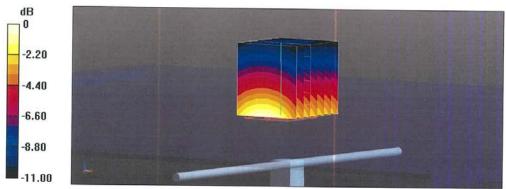
Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001

DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

# 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 = 62.09 V/m; Power Drift = 0.02 dB Peak SAR (extrapolated) = 3.70 W/kg

SAR(1 g) = 2.45 W/kg; SAR(10 g) = 1.59 W/kgMaximum value of SAR (measured) = 3.26 W/kg

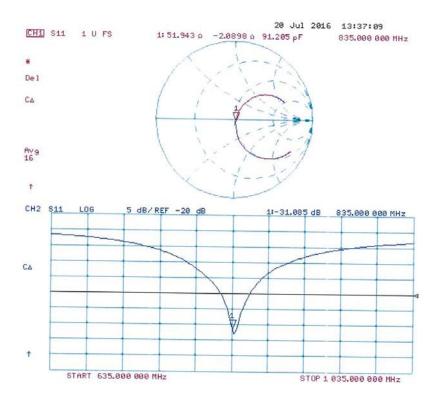


0 dB = 3.26 W/kg = 5.13 dBW/kg

Certificate No: D835V2-4d069\_Jul16



## Impedance Measurement Plot for Head TSL



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

Date: 20.07.2016

Test Laboratory: SPEAG, Zurich, Switzerland

## DUT: Dipole 835 MHz D835V2; Type: D835V2; Serial: D835V2 - SN: 4d069

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

Medium parameters used: f = 835 MHz;  $\sigma = 1.01$  S/m;  $\epsilon_r = 54.9$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

#### DASY52 Configuration:

Probe: EX3DV4 - SN7349; ConvF(9.73, 9.73, 9.73); Calibrated: 15.06.2016;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn601; Calibrated: 30.12.2015

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

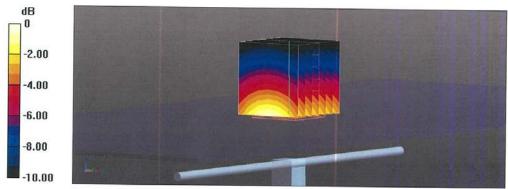
DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

## 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 = 60.64 V/m; Power Drift = -0.02 dB Peak SAR (extrapolated) = 3.68 W/kg

SAR(1 g) = 2.5 W/kg; SAR(10 g) = 1.63 W/kg

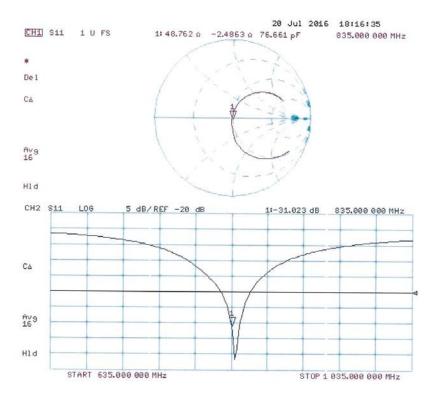
Maximum value of SAR (measured) = 3.31 W/kg



0 dB = 3.31 W/kg = 5.20 dBW/kg



## Impedance Measurement Plot for Body TSL



Certificate No: D835V2-4d069\_Jul16

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#### 1750 MHz Dipole Calibration Certificate

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

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QA CAL-05.v9

Client CTTL-BJ (Auden)

Calibration procedure(s)

Certificate No: D1750V2-1003\_Jul16

# Object D1750V2 - SN:1003

Calibration procedure for dipole validation kits above 700 MHz

Calibration date: July 21, 2016

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 ( $22 \pm 3$ )°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

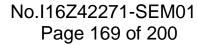
Primary Standards	ID#	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	06-Apr-16 (No. 217-02288/02289)	Apr-17
Power sensor NRP-Z91	SN: 103244	06-Apr-16 (No. 217-02288)	Apr-17
Power sensor NRP-Z91	SN: 103245	06-Apr-16 (No. 217-02289)	Apr-17
Reference 20 dB Attenuator	SN: 5058 (20k)	05-Apr-16 (No. 217-02292)	Apr-17
Type-N mismatch combination	SN: 5047.2 / 06327	05-Apr-16 (No. 217-02295)	Apr-17
Reference Probe EX3DV4	SN: 7349	15-Jun-16 (No. EX3-7349_Jun16)	Jun-17
DAE4	SN: 601	30-Dec-15 (No. DAE4-601_Dec15)	Dec-16
Secondary Characterists	1.5.		
Secondary Standards	ID#	Check Date (in house)	Scheduled Check
Power meter EPM-442A	SN: GB37480704	07-Oct-15 (No. 217-02222)	In house check: Oct-16
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (No. 217-02222)	In house check: Oct-16
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (No. 217-02223)	In house check: Oct-16
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Jun-15)	In house check: Oct-16
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-15)	In house check: Oct-16
	Name	Function	Sigflature /
Calibrated by:	CTI-642-CTION INTO THE REPORT OF THE PROPERTY OF THE PARTY OF THE PART		Signature
Calibrated by.	Claudio Leubler	Laboratory Technician	VXL
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Approved by:	Katja Pokovic	Technical Manager	60101
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Issued: July 22, 2016

Certificate No: D1750V2-1003\_Jul16

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#### Calibration Laboratory of

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





S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage

Servizio svizzero di taratura Swiss Calibration Service

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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%.

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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	1750 MHz ± 1 MHz	

#### **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	38.8 ± 6 %	1.36 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

#### SAR result with Head TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.22 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	36.8 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	4.88 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	19.5 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	53.4 ± 6 %	1.48 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	9.20 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	37.0 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	4.88 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	19.6 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	$50.8 \Omega + 0.9 j\Omega$
Return Loss	- 38.6 dB

#### Antenna Parameters with Body TSL

Impedance, transformed to feed point	45.8 Ω + 0.4 jΩ	
Return Loss	- 27.2 dB	

#### General Antenna Parameters and Design

Electrical Delay (one direction)	1.213 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	July 30, 2008



## DASY5 Validation Report for Head TSL

Date: 21.07.2016

Test Laboratory: SPEAG, Zurich, Switzerland

## DUT: Dipole 1750 MHz D1750V2; Type: D1750V2; Serial: D1750V2 - SN: 1003

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

Medium parameters used: f = 1750 MHz;  $\sigma = 1.36$  S/m;  $\epsilon_r = 38.8$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

#### DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(8.46, 8.46, 8.46); Calibrated: 15.06.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

## 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 = 105.6 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 17.0 W/kg

SAR(1 g) = 9.22 W/kg; SAR(10 g) = 4.88 W/kg

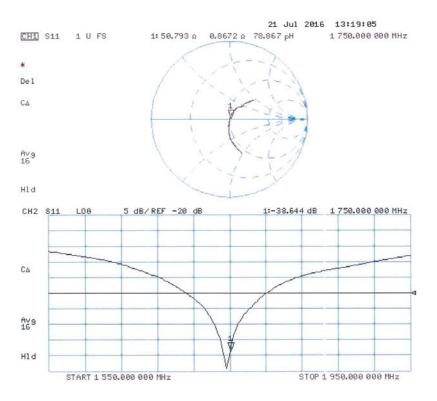
Maximum value of SAR (measured) = 14.2 W/kg



0 dB = 14.2 W/kg = 11.52 dBW/kg



#### Impedance Measurement Plot for Head TSL



Page 6 of 8



## DASY5 Validation Report for Body TSL

Date: 21.07.2016

Test Laboratory: SPEAG, Zurich, Switzerland

## DUT: Dipole 1750 MHz D1750V2; Type: D1750V2; Serial: D1750V2 - SN: 1003

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

Medium parameters used: f = 1750 MHz;  $\sigma = 1.48$  S/m;  $\epsilon_r = 53.4$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

#### DASY52 Configuration:

Probe: EX3DV4 - SN7349; ConvF(8.25, 8.25, 8.25); Calibrated: 15.06.2016;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn601; Calibrated: 30.12.2015

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

DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

## 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 = 101.3 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 16.3 W/kg

SAR(1 g) = 9.2 W/kg; SAR(10 g) = 4.88 W/kg

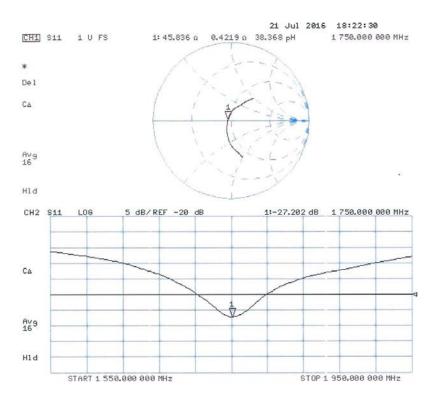
Maximum value of SAR (measured) = 13.9 W/kg



0 dB = 13.9 W/kg = 11.43 dBW/kg



## Impedance Measurement Plot for Body TSL





#### 1900 MHz Dipole Calibration Certificate

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





S Schweizerischer Kalibrierdienst
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

CTTL-BJ (Auden)

Certificate No: D1900V2-5d101 Jul16

Exchange the self-term output to your China continues to the	ERTIFICATE			
Dbject	D1900V2 - SN:50	1101		
Calibration procedure(s)	QA CAL-05.v9			
	Calibration procedure for dipole validation kits above 700 MHz			
Calibration date:	July 28, 2016			
he measurements and the unce	rtainties with confidence p	ional standards, which realize the physical un robability are given on the following pages ar ry facility: environment temperature $(22 \pm 3)^{\circ}$	nd are part of the certificate.	
Calibration Equipment used (M&T				
	l.=	0.15.40.40.4	0.1.1.1.0.111.11	
rimary Standards	ID#	Cal Date (Certificate No.)	Scheduled Calibration	
	ID # SN: 104778	Cal Date (Certificate No.) 06-Apr-16 (No. 217-02288/02289)	Apr-17	
ower meter NRP				
Power meter NRP Power sensor NRP-Z91	SN: 104778	06-Apr-16 (No. 217-02288/02289)	Apr-17	
ower meter NRP lower sensor NRP-Z91 lower sensor NRP-Z91	SN: 104778 SN: 103244	06-Apr-16 (No. 217-02288/02289) 06-Apr-16 (No. 217-02288)	Apr-17 Apr-17	
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator	SN: 104778 SN: 103244 SN: 103245	06-Apr-16 (No. 217-02288/02289) 06-Apr-16 (No. 217-02288) 06-Apr-16 (No. 217-02289)	Apr-17 Apr-17 Apr-17	
ower meter NRP ower sensor NRP-Z91 ower sensor NRP-Z91 eference 20 dB Attenuator ype-N mismatch combination	SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k)	06-Apr-16 (No. 217-02288/02289) 06-Apr-16 (No. 217-02288) 06-Apr-16 (No. 217-02289) 05-Apr-16 (No. 217-02292) 05-Apr-16 (No. 217-02295) 15-Jun-16 (No. EX3-7349_Jun16)	Apr-17 Apr-17 Apr-17 Apr-17	
ower meter NRP ower sensor NRP-Z91 ower sensor NRP-Z91 deference 20 dB Attenuator type-N mismatch combination deference Probe EX3DV4	SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327	06-Apr-16 (No. 217-02288/02289) 06-Apr-16 (No. 217-02288) 06-Apr-16 (No. 217-02289) 05-Apr-16 (No. 217-02292) 05-Apr-16 (No. 217-02295)	Apr-17 Apr-17 Apr-17 Apr-17 Apr-17	
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4	SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349	06-Apr-16 (No. 217-02288/02289) 06-Apr-16 (No. 217-02288) 06-Apr-16 (No. 217-02289) 05-Apr-16 (No. 217-02292) 05-Apr-16 (No. 217-02295) 15-Jun-16 (No. EX3-7349_Jun16)	Apr-17 Apr-17 Apr-17 Apr-17 Apr-17 Jun-17	
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Reference Probe EX3DV4 RAFE4 RECORDARY Standards	SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601	06-Apr-16 (No. 217-02288/02289) 06-Apr-16 (No. 217-02288) 06-Apr-16 (No. 217-02289) 05-Apr-16 (No. 217-02292) 05-Apr-16 (No. 217-02292) 05-Apr-16 (No. 217-02295) 15-Jun-16 (No. EX3-7349_Jun16) 30-Dec-15 (No. DAE4-601_Dec15) Check Date (in house) 07-Oct-15 (No. 217-02222)	Apr-17 Apr-17 Apr-17 Apr-17 Apr-17 Jun-17 Dec-16	
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Recondary Standards Power meter EPM-442A Power sensor HP 8481A	SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601	06-Apr-16 (No. 217-02288/02289) 06-Apr-16 (No. 217-02288) 06-Apr-16 (No. 217-02289) 05-Apr-16 (No. 217-02292) 05-Apr-16 (No. 217-02295) 15-Jun-16 (No. EX3-7349_Jun16) 30-Dec-15 (No. DAE4-601_Dec15)  Check Date (in house) 07-Oct-15 (No. 217-02222) 07-Oct-15 (No. 217-02222)	Apr-17 Apr-17 Apr-17 Apr-17 Apr-17 Apr-17 Jun-17 Dec-16 Scheduled Check	
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Reference Probe EX3DV4 Power sensor NRP-Z91 Reference Probe EX3DV4 Reference	SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601  ID # SN: GB37480704 SN: US37292783 SN: MY41092317	06-Apr-16 (No. 217-02288/02289) 06-Apr-16 (No. 217-02288) 06-Apr-16 (No. 217-02289) 05-Apr-16 (No. 217-02292) 05-Apr-16 (No. 217-02295) 15-Jun-16 (No. EX3-7349_Jun16) 30-Dec-15 (No. DAE4-601_Dec15)  Check Date (in house) 07-Oct-15 (No. 217-02222) 07-Oct-15 (No. 217-02222)	Apr-17 Apr-17 Apr-17 Apr-17 Apr-17 Jun-17 Dec-16 Scheduled Check In house check: Oct-16 In house check: Oct-16	
ower meter NRP ower sensor NRP-Z91 ower sensor NRP-Z91 ower sensor NRP-Z91 teference 20 dB Attenuator ype-N mismatch combination teference Probe EX3DV4 AE4 tecondary Standards ower meter EPM-442A tower sensor HP 8481A	SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601  ID # SN: GB37480704 SN: US37292783	06-Apr-16 (No. 217-02288/02289) 06-Apr-16 (No. 217-02288) 06-Apr-16 (No. 217-02289) 05-Apr-16 (No. 217-02292) 05-Apr-16 (No. 217-02295) 15-Jun-16 (No. EX3-7349_Jun16) 30-Dec-15 (No. DAE4-601_Dec15)  Check Date (in house) 07-Oct-15 (No. 217-02222) 07-Oct-15 (No. 217-02222)	Apr-17 Apr-17 Apr-17 Apr-17 Apr-17 Apr-17 Jun-17 Dec-16 Scheduled Check In house check: Oct-16 In house check: Oct-16	
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter EPM-442A Power sensor HP 8481A RF generator R&S SMT-06	SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601  ID # SN: GB37480704 SN: US37292783 SN: MY41092317	06-Apr-16 (No. 217-02288/02289) 06-Apr-16 (No. 217-02288) 06-Apr-16 (No. 217-02289) 05-Apr-16 (No. 217-02292) 05-Apr-16 (No. 217-02295) 15-Jun-16 (No. EX3-7349_Jun16) 30-Dec-15 (No. DAE4-601_Dec15)  Check Date (in house) 07-Oct-15 (No. 217-02222) 07-Oct-15 (No. 217-02222)	Apr-17 Apr-17 Apr-17 Apr-17 Apr-17 Apr-17 Jun-17 Dec-16 Scheduled Check In house check: Oct-16 In house check: Oct-16 In house check: Oct-16 In house check: Oct-16	
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Recondary Standards Power meter EPM-442A Power sensor HP 8481A Ref generator R&S SMT-06	SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601  ID # SN: GB37480704 SN: US37292783 SN: MY41092317 SN: 100972	06-Apr-16 (No. 217-02288/02289) 06-Apr-16 (No. 217-02288) 06-Apr-16 (No. 217-02289) 05-Apr-16 (No. 217-02292) 05-Apr-16 (No. 217-02295) 15-Jun-16 (No. EX3-7349_Jun16) 30-Dec-15 (No. DAE4-601_Dec15)  Check Date (in house) 07-Oct-15 (No. 217-02222) 07-Oct-15 (No. 217-02222) 07-Oct-15 (No. 217-02222) 15-Jun-15 (in house check Jun-15)	Apr-17 Apr-17 Apr-17 Apr-17 Apr-17 Jun-17 Dec-16 Scheduled Check In house check: Oct-16 In house check: Oct-16	
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer HP 8753E	SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601  ID # SN: GB37480704 SN: US37292783 SN: MY41092317 SN: 100972 SN: US37390585	06-Apr-16 (No. 217-02288/02289) 06-Apr-16 (No. 217-02288) 06-Apr-16 (No. 217-02289) 05-Apr-16 (No. 217-02292) 05-Apr-16 (No. 217-02295) 15-Jun-16 (No. EX3-7349_Jun16) 30-Dec-15 (No. DAE4-601_Dec15)  Check Date (in house) 07-Oct-15 (No. 217-02222) 07-Oct-15 (No. 217-02222) 07-Oct-15 (No. 217-02222) 15-Jun-15 (in house check Jun-15) 18-Oct-01 (in house check Oct-15)	Apr-17 Apr-17 Apr-17 Apr-17 Apr-17 Jun-17 Dec-16 Scheduled Check In house check: Oct-16	
Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4  Secondary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer HP 8753E  Calibrated by:	SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601  ID # SN: GB37480704 SN: US37292783 SN: MY41092317 SN: 100972 SN: US37390585  Name	06-Apr-16 (No. 217-02288/02289) 06-Apr-16 (No. 217-02288) 06-Apr-16 (No. 217-02289) 05-Apr-16 (No. 217-02292) 05-Apr-16 (No. 217-02295) 15-Jun-16 (No. EX3-7349_Jun16) 30-Dec-15 (No. DAE4-601_Dec15)  Check Date (in house) 07-Oct-15 (No. 217-02222) 07-Oct-15 (No. 217-02222) 07-Oct-15 (No. 217-02222) 15-Jun-15 (in house check Jun-15) 18-Oct-01 (in house check Oct-15)	Apr-17 Apr-17 Apr-17 Apr-17 Apr-17 Jun-17 Dec-16 Scheduled Check In house check: Oct-16	

Certificate No: D1900V2-5d101\_Jul16

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