

# 835 MHz Dipole Calibration Certificate

Calibration procedure(s) (	Bone of the signatorie ognition of calibration BRTIFICATE D835V2 - SN:4dd QA CAL-05.v9 Calibration proce July 19, 2017	es to the EA certificates Certificate No 2069 edure for dipole validation kits abo	
Iultilateral Agreement for the reco         client       CTTL-BJ (Auden)         CALIBRATION CE         Object       I         Calibration procedure(s)       (         Calibration date:       .	pagnition of calibration ERTIFICATE D835V2 - SN:4dd QA CAL-05.v9 Calibration proces July 19, 2017 as the traceability to nat	certificates Certificate No D69 edure for dipole validation kits abo	ove 700 MHz
Calibration procedure(s)	BRTIFICATE D835V2 - SN:4dr QA CAL-05.v9 Calibration proce July 19, 2017	2069 edure for dipole validation kits abo	ove 700 MHz
Dbject [ Calibration procedure(s) ( Calibration date:	D835V2 - SN:4d QA CAL-05.v9 Calibration proce July 19, 2017 Is the traceability to nat	069 edure for dipole validation kits abo ional standards, which realize the physical un	
Calibration procedure(s) ( Calibration date:	QA CAL-05.v9 Calibration proce July 19, 2017 Is the traceability to nat	edure for dipole validation kits abo	
Calibration date:	Calibration proce July 19, 2017 Is the traceability to nat	ional standards, which realize the physical un	
This calibration certificate documents	s the traceability to nati	ional standards, which realize the physical un	its of measurements (SI).
This calibration certificate documents	s the traceability to nati	ional standards, which realize the physical un	its of measurements (SI).
Fhis calibration certificate documents The measurements and the uncertain	s the traceability to nat	ional standards, which realize the physical un	its of measurements (SI).
All calibrations have been conducted Calibration Equipment used (M&TE of		ry facility: environment temperature (22 $\pm$ 3)°(	C and humidity < 70%.
Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	04-Apr-17 (No. 217-02521/02522)	Apr-18
ower sensor NRP-Z91	SN: 103244	04-Apr-17 (No. 217-02521)	Apr-18
ower sensor NRP-Z91	SN: 103245	04-Apr-17 (No. 217-02522)	Apr-18
eference 20 dB Attenuator	SN: 5058 (20k)	07-Apr-17 (No. 217-02528)	Apr-18
ype-N mismatch combination	SN: 5047.2 / 06327	07-Apr-17 (No. 217-02529)	Apr-18
AE4	SN: 7349 SN: 601	31-May-17 (No. EX3-7349_May17) 28-Mar-17 (No. DAE4-601_Mar17)	May-18 Mar-18
econdary Standards	ID #	Check Date (in house)	Scheduled Check
ower meter EPM-442A	SN: GB37480704	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
ower sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
ower sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
IF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-16)	In house check: Oct-18
letwork Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-16)	In house check: Oct-17
	Name	Function	Signature
Calibrated by:	Johannes Kurikka	Laboratory Technician	yeu la
Approved by:	Katja Pokovic	Technical Manager	blittes
			Issued: July 20, 2017

Certificate No: D835V2-4d069\_Jul17

Page 1 of 8



# No. I19Z60553-SEM01 Page 101 of 144

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



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

Accreditation No.: SCS 0108

S

Accredited by the Swiss Accreditation Service (SAS)

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

#### Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM x,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, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
- 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: D835V2-4d069\_Jul17

Page 2 of 8



### **Measurement Conditions**

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

DASY Version	DASY5	V52.10.0
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	835 MHz ± 1 MHz	

#### Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	40.8 ± 6 %	0.91 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	2.37 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	9.37 W/kg ± 17.0 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL SAR measured	condition 250 mW input power	1.53 W/kg

#### **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	54.8 ± 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	2.43 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	9.41 W/kg ± 17.0 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL SAR measured	condition 250 mW input power	1.57 W/kg

Certificate No: D835V2-4d069\_Jul17



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

### Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.1 Ω - 1.2 jΩ	
Return Loss	- 32.4 dB	

### Antenna Parameters with Body TSL

Impedance, transformed to feed point	47.9 Ω - 3.9 jΩ
Return Loss	- 26.9 dB

## **General Antenna Parameters and Design**

Electrical Delay (one direction)	1.392 ns
----------------------------------	----------

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

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

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

#### **Additional EUT Data**

Manufactured by	SPEAG
Manufactured on	November 09, 2007

Certificate No: D835V2-4d069\_Jul17

Page 4 of 8



## DASY5 Validation Report for Head TSL

Date: 19.07.2017

Test Laboratory: SPEAG, Zurich, Switzerland

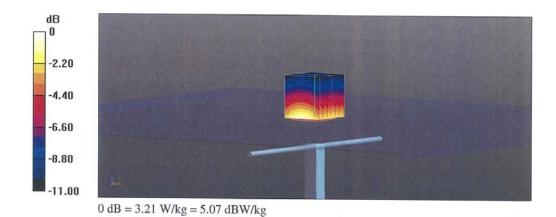
# DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d069

Communication System: UID 0 - CW; Frequency: 835 MHz Medium parameters used: f = 835 MHz;  $\sigma$  = 0.91 S/m;  $\epsilon_r$  = 40.8;  $\rho$  = 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(10.07, 10.07, 10.07); Calibrated: 31.05.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 28.03.2017
- Phantom: Flat Phantom 4.9 (front); Type: QD 00L P49 AA; Serial: 1001
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

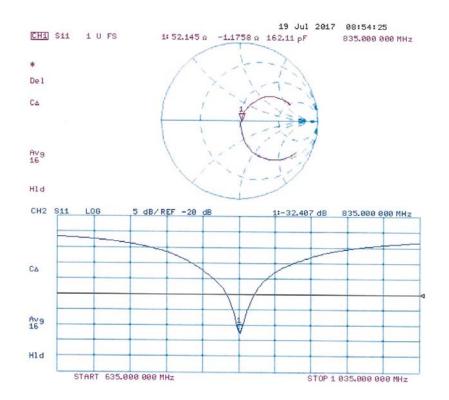
Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 62.08 V/m; Power Drift = -0.02 dB Peak SAR (extrapolated) = 3.65 W/kg SAR(1 g) = 2.37 W/kg; SAR(10 g) = 1.53 W/kg Maximum value of SAR (measured) = 3.21 W/kg



Certificate No: D835V2-4d069\_Jul17



## Impedance Measurement Plot for Head TSL



Certificate No: D835V2-4d069\_Jul17

Page 6 of 8



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

Date: 19.07.2017

Test Laboratory: SPEAG, Zurich, Switzerland

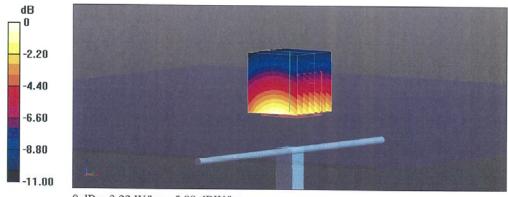
## DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d069

Communication System: UID 0 - CW; Frequency: 835 MHz Medium parameters used: f = 835 MHz;  $\sigma$  = 1.01 S/m;  $\epsilon_r$  = 54.8;  $\rho$  = 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(10.2, 10.2, 10.2); Calibrated: 31.05.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 28.03.2017
- Phantom: Flat Phantom 4.9 (Back); Type: QD 00R P49 AA; Serial: 1005
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

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 = 59.35 V/m; Power Drift = -0.03 dB Peak SAR (extrapolated) = 3.67 W/kg SAR(1 g) = 2.43 W/kg; SAR(10 g) = 1.57 W/kg Maximum value of SAR (measured) = 3.22 W/kg

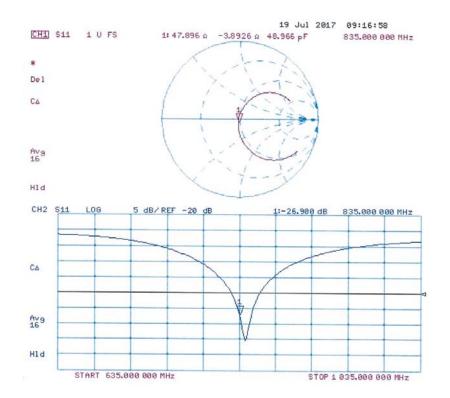


0 dB = 3.22 W/kg = 5.08 dBW/kg

Certificate No: D835V2-4d069\_Jul17



## Impedance Measurement Plot for Body TSL



Certificate No: D835V2-4d069\_Jul17

Page 8 of 8



# 1750 MHz Dipole Calibration Certificate

The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates	chweizerischer Kalibrierdienst ervice suisse d'étalonnage ervizio svizzero di taratura wiss Calibration Service	C Serv			bration Laboratory mid & Partner ngineering AG nausstrasse 43, 8004 Zurich	Schm Eng
Clinit       CTTL-BJ (Auden)       Certificate No: D         CALLIBRATION CERTIFICATE         Object       D1750V2 - SN:1003         Calibration procedure(s)       QA CAL-05.v9 Calibration procedure for dipole validation kits above 5         Calibration date:       July 21, 2017         This calibration certificate documents the traceability to national standards, which realize the physical units of The measurements and the uncertainties with confidence probability are given on the following pages and are All calibrations have been conducted in the closed laboratory facility: environment temperature (22 $\pm$ 3)°C and Calibration Equipment used (M&TE critical for calibration)         Primary Standards       D#       Cal Date (Certificate No.)         Power meter NRP       SN: 104778       04 -Apr-17 (No. 217-02521)         Power sensor NRP-291       SN: 103244       04 -Apr-17 (No. 217-02521)         Power sensor NRP-291       SN: 103245       04 -Apr-17 (No. 217-02521)         Power sensor NRP-291       SN: 103245       04 -Apr-17 (No. 217-02522)         Power sensor NRP-291       SN: 103245       04 -Apr-17 (No. 217-02521)         Power meter NRP       SN: 6047.2 / 06327       07 -Apr-17 (No. 217-02529)         Reference 20 dB Attenuator       SN: 5058 (20k)       07 -Apr-17 (No. 217-02529)         SN: 601       28 -Mar-17 (No. 217-02529)       SN: 5053 (20k)       07 -Apr-17 (No. 217-02528)	ditation No.: SCS 0108	Accredit	ries to the EA	is one of the signatori	wiss Accreditation Service	The Swi
CALIBRATION CERTIFICATE         Object       D1750V2 - SN:1003         Calibration procedure(s)       QA CAL-05.v9 Calibration procedure for dipole validation kits above 7 Calibration procedure for dipole validation kits above 7 Calibration date:         Calibration certificate documents the traceability to national standards, which realize the physical units of The measurements and the uncertainties with confidence probability are given on the following pages and are All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and Calibration Equipment used (M&TE critical for calibration)         Primary Standards       D#       Cal Date (Certificate No.) Power meter NPP Power sensor NRP-291         Power sensor NRP-291       SN: 104778       04-Apr-17 (No. 217-02521/02522) SN: 103244         Power sensor NRP-291       SN: 103245       04-Apr-17 (No. 217-02521)         Power sensor NRP-291       SN: 103245       04-Apr-17 (No. 217-02529)         SN: 103245       04-Apr-17 (No. 217-02529)         SN: 5047.2 / 05327       07-Apr-17 (No. 217-02529)         SN: 5047.2 / 05327       07-Apr-17 (No. 217-02529)         SN: 601       28-Mar-17 (No. DAE4-601_Mar17)         DAE4       SN: US37292783       07-Oct-15 (in house check Oct-16)         Power sensor HP 8481A       SN: US37292783       07-Oct-15 (in house check Oct-16)         Power sensor HP 8481A       SN: US37292783       07-Oct-15 (in house check Oc			on certificates	cognition of calibration	ateral Agreement for the re	Nultilate
Object         D1750V2 - SN:1003           Calibration procedure(s)         QA CAL-05.v9 Calibration procedure for dipole validation kits above 7 Calibration date:           Calibration date:         July 21, 2017           This calibration certificate documents the traceability to national standards, which realize the physical units of The measurements and the uncertainties with confidence probability are given on the following pages and are All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and Calibration Equipment used (M&TE critical for calibration)           Primary Standards         ID #         Cal Date (Certificate No.)           Power sensor NRP-291         SN: 103245         04-Apr-17 (No. 217-02521)           Power sensor NRP-291         SN: 103245         04-Apr-17 (No. 217-02522)           Power sensor NRP-291         SN: 103245         04-Apr-17 (No. 217-02522)           Power sensor NRP-291         SN: 103245         04-Apr-17 (No. 217-02529)           Paterence 20 dB Attenuator         SN: 5058 (20k)         07-Apr-17 (No. 217-02529)           SN: 5047.2 / 05827         07-Apr-17 (No. 217-02529)         SN: 5047.2 / 05827           SN: 601         28-Mar-17 (No. 217-02529)         SN: 5047.2 / 05827           SN: 601         28-Mar-17 (No. 217-02529)         SN: 5047.2 / 05827           Power meter EPM-442A         SN: 6B37480704         07-Oct-15 (in house check Oct-16) </td <td>01750V2-1003_Jul17</td> <td>Certificate No: D1</td> <td></td> <td>n)</td> <td>t CTTL-BJ (Aude</td> <td>Client</td>	01750V2-1003_Jul17	Certificate No: D1		n)	t CTTL-BJ (Aude	Client
Calibration procedure(s)       QA CAL-05.v9 Calibration procedure for dipole validation kits above 7 Calibration procedure for dipole validation kits above 7 Calibration date:         Calibration date:       July 21, 2017         This calibration certificate documents the traceability to national standards, which realize the physical units of The measurements and the uncertainties with confidence probability are given on the following pages and are All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and Calibration Equipment used (M&TE critical for calibration)         Primary Standards       ID #       Cal Date (Certificate No.)         Power sensor NRP-Z91       SN: 104778       04-Apr-17 (No. 217-02521/02522)         Power sensor NRP-Z91       SN: 103244       04-Apr-17 (No. 217-02528)         Power sensor NRP-Z91       SN: 5058 (20k)       07-Apr-17 (No. 217-02529)         SN: 5047.2 / 06327       07-Apr-17 (No. 217-02529)         SN: 5047.2 / 06327       07-Apr-17 (No. 217-02529)         SN: 601       28-Mar-17 (No. DAE4-601_Mar17)         SN: 6037280764       07-Oct-15 (in house check Oct-16)         Power sensor HP 8481A       SN: US37390585       18-Oc			Έ	ERTIFICAT	LIBRATION C	CAL
Calibration procedure for dipole validation kits above 7         Calibration date:       July 21, 2017         This calibration certificate documents the traceability to national standards, which realize the physical units of The measurements and the uncertainties with confidence probability are given on the following pages and are All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and Calibration Equipment used (M&TE critical for calibration)         Primary Standards       ID #       Cal Date (Certificate No.)         Power meter NRP       SN: 104778       04-Apr-17 (No. 217-02521/02522)         Power sensor NRP-291       SN: 103244       04-Apr-17 (No. 217-02521)         Power sensor NRP-291       SN: 103245       04-Apr-17 (No. 217-02522)         Power sensor NRP-291       SN: 103245       04-Apr-17 (No. 217-02529)         SN: 5058 (20k)       07-Apr-17 (No. 217-02529)         SN: 5058 (20k)       07-Apr-17 (No. 217-02529)         SN: 5058 (20k)       07-Apr-17 (No. 217-02529)         SN: 601       28-Mar-17 (No. DAE4-601_Mar17)         Secondary Standards       ID #       Check Date (in house)         Power meter FPM-442A       SN: GB37480704       07-Oct-15 (in house check Oct			1003	D1750V2 - SN:1	ct	Object
This calibration certificate documents the traceability to national standards, which realize the physical units of         The measurements and the uncertainties with confidence probability are given on the following pages and are         All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and         Calibration Equipment used (M&TE critical for calibration)         Primary Standards       ID #         Cal Date (Certificate No.)         Power meter NRP       SN: 104778         Power sensor NRP-Z91       SN: 103244         SN: 103245       04-Apr-17 (No. 217-02521)         Power sensor NRP-Z91       SN: 103245         SN: 103245       04-Apr-17 (No. 217-02528)         Power sensor NRP-Z91       SN: 5058 (20k)         SN: 5058 (20k)       07-Apr-17 (No. 217-02529)         Reference Probe EX3DV4       SN: 5047.2 / 06327         SN: 601       28-Mar-17 (No. EX3-7349_May17)         DAE4       SN: 601       28-Mar-17 (No. DAE4-601_Mar17)         Secondary Standards       ID #       Check Date (in house)         Power sensor HP 8481A       SN: US37292783       07-Oct-15 (in house check Oct-16)         SN: 00972       15-Jun-15 (in house check Oct-16)       SN: US37390585         SN: US37390585       18-Oct-01 (in house check Oct-16)       SN: US37390585	700 MHz	lidation kits above 70	edure for c		ration procedure(s)	Calibrat
The measurements and the uncertainties with confidence probability are given on the following pages and are         All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and         Calibration Equipment used (M&TE critical for calibration)         Primary Standards       ID #       Cal Date (Certificate No.)         Power meter NRP       SN: 104778       04-Apr-17 (No. 217-02521/02522)         Power sensor NRP-Z91       SN: 103244       04-Apr-17 (No. 217-02521)         Power sensor NRP-Z91       SN: 103245       04-Apr-17 (No. 217-02528)         Power sensor NRP-Z91       SN: 5058 (20k)       07-Apr-17 (No. 217-02529)         Reference 20 dB Attenuator       SN: 5047.2 / 06327       07-Apr-17 (No. 217-02529)         Reference Probe EX3DV4       SN: 7349       31-May-17 (No. 217-02529)         DAE4       SN: 601       28-Mar-17 (No. 217-02529)         SN: 601       28-Mar-17 (No. DAE4-601_Mar17)         DAE4       SN: 601       28-Mar-17 (No. DAE4-601_Mar17)         Secondary Standards       ID #       Check Date (in house)         Power sensor HP 8481A       SN: US37292783       07-Oct-15 (in house check Oct-16)         Power sensor HP 8481A       SN: US37390585       18-Oct-01 (in house check Oct-16)         SN: 10972       15-Jun-15 (in house check Oct-16)       SN: US37390585 </td <td></td> <td></td> <td></td> <td>July 21, 2017</td> <td>ration date:</td> <td>Calibrati</td>				July 21, 2017	ration date:	Calibrati
Power meter NRP         SN: 104778         04-Apr-17 (No. 217-02521/02522)           Power sensor NRP-Z91         SN: 103244         04-Apr-17 (No. 217-02521)           Power sensor NRP-Z91         SN: 103245         04-Apr-17 (No. 217-02522)           Reference 20 dB Attenuator         SN: 5058 (20k)         07-Apr-17 (No. 217-02528)           Type-N mismatch combination         SN: 5047.2 / 06327         07-Apr-17 (No. 217-02529)           Reference Probe EX3DV4         SN: 7349         31-May-17 (No. 217-02529)           Secondary Standards         ID #         Check Date (in house)           Power sensor HP 8481A         SN: US37292783         07-Oct-15 (in house check Oct-16)           Power sensor HP 8481A         SN: 100372         15-Jun-15 (in house check Oct-16)           Power sensor HP 8481A         SN: 100372         15-Jun-15 (in house check Oct-16)           Power sensor HP 8453E         SN: 100372         15-Jun-15 (in house check Oct-16)           Power sensor HP 8453E         SN: US37390585         18-Oct-01 (in house check Oct-16)           Reference PA: SMT-06         SN: US37390585         18-Oct-01 (in house check Oct-16)           Name         Function         Michael Weber         Laboratory Technician	Scheduled Calibration			E critical for calibration)	ration Equipment used (M&T	Calibrati
Power sensor NRP-Z91         SN: 103244         04-Apr-17 (No. 217-02521)           Power sensor NRP-Z91         SN: 103245         04-Apr-17 (No. 217-02522)           Version Sensor NRP-Z91         SN: 103245         04-Apr-17 (No. 217-02522)           Version Sensor NRP-Z91         SN: 103245         04-Apr-17 (No. 217-02522)           Version Sensor NRP-Z91         SN: 5058 (20k)         07-Apr-17 (No. 217-02528)           Version Sensor NRP-Z91         SN: 5047.2 / 06327         07-Apr-17 (No. 217-02529)           Version Sensor NRP-Z91         SN: 5047.2 / 06327         07-Apr-17 (No. 217-02529)           Version Sensor NRP-Z91         SN: 5047.2 / 06327         07-Apr-17 (No. 217-02529)           Version Sensor NRP-Z91         SN: 5047.2 / 06327         07-Apr-17 (No. 217-02529)           Version Sensor NRP-Z91         SN: 5047.2 / 06327         07-Apr-17 (No. EX3-7349_May17)           Version Sensor H2 Standards         ID #         Check Date (in house)           Version Sensor H2 8481A         SN: US37292783         07-Oct-15 (in house check Oct-16)           Version Sensor H2 8481A         SN: 100972         15-Jun-15 (in house check Oct-16)           Version R&S SMT-06         SN: US37390585         18-Oct-01 (in house check Oct-16)           Version K Analyzer HP 8753E         Name         Function           Name <td< td=""><td>Apr-18</td><td></td><td></td><td></td><td></td><td></td></td<>	Apr-18					
efference 20 dB Attenuator       SN: 5058 (20k)       07-Apr-17 (No. 217-02528)         ype-N mismatch combination       SN: 5058 (20k)       07-Apr-17 (No. 217-02528)         secondary Standards       SN: 5057 (2 / 06327)       07-Apr-17 (No. 217-02529)         SN: 5058 (20k)       SN: 5047.2 / 06327       07-Apr-17 (No. 217-02529)         SN: 5047.2 / 06327       07-Apr-17 (No. 217-02529)         SN: 601       28-Mar-17 (No. DAE4-601_Mar17)         econdary Standards       ID #       Check Date (in house)         ower meter EPM-442A       SN: GB37480704       07-Oct-15 (in house check Oct-16)         ower sensor HP 8481A       SN: US37292783       07-Oct-15 (in house check Oct-16)         SN: US37292783       07-Oct-15 (in house check Oct-16)       SN: 100972         F generator R&S SMT-06       SN: US37390585       18-Oct-01 (in house check Oct-16)         etwork Analyzer HP 8753E       Name       Function         Alibrated by:       Michael Weber       Laboratory Technician	Apr-18			SN: 103244	r sensor NRP-Z91	ower s
eference 20 dB Attenuator       SN: 5058 (20k)       07-Apr-17 (No. 217-02528)         ype-N mismatch combination       SN: 5047.2 / 06327       07-Apr-17 (No. 217-02529)         eference Probe EX3DV4       SN: 5047.2 / 06327       07-Apr-17 (No. 217-02529)         SN: 5047.2 / 06327       07-Apr-17 (No. 217-02529)         SN: 5047.2 / 06327       07-Apr-17 (No. EX3-7349_May17)         AE4       SN: 601       28-Mar-17 (No. DAE4-601_Mar17)         econdary Standards       ID #       Check Date (in house)         ower meter EPM-442A       SN: GB37480704       07-Oct-15 (in house check Oct-16)         ower sensor HP 8481A       SN: US37292783       07-Oct-15 (in house check Oct-16)         ower sensor HP 8481A       SN: WY41092317       07-Oct-15 (in house check Oct-16)         SN: US37390585       18-Oct-01 (in house check Oct-16)       SN: US37390585         etwork Analyzer HP 8753E       Name       Function         allibrated by:       Name       Function	Apr-18		04-Apr-17	SN: 103245	r sensor NRP-Z91	ower s
eference Probe EX3DV4     SN: 7349     31-May-17 (No. EX3-7349_May17)       AE4     SN: 601     28-Mar-17 (No. DAE4-601_Mar17)       econdary Standards     ID #     Check Date (in house)       ower meter EPM-442A     SN: GB37480704     07-Oct-15 (in house check Oct-16)       ower sensor HP 8481A     SN: US37292783     07-Oct-15 (in house check Oct-16)       SN: generator R&S SMT-06     SN: 100972     15-Jun-15 (in house check Oct-16)       stwork Analyzer HP 8753E     SN: US37390585     18-Oct-01 (in house check Oct-16)       Name     Function       Michael Weber     Laboratory Technician	Apr-18			SN: 5058 (20k)	ence 20 dB Attenuator	eferen
AE4     SN: 601     28-Mar-17 (No. DAE4-601_Mar17)       econdary Standards     ID #     Check Date (in house)       ower meter EPM-442A     SN: GB37480704     07-Oct-15 (in house check Oct-16)       ower sensor HP 8481A     SN: US37292783     07-Oct-15 (in house check Oct-16)       ower sensor HP 8481A     SN: MY41092317     07-Oct-15 (in house check Oct-16)       SN: 100972     15-Jun-15 (in house check Oct-16)       SN: US37390585     18-Oct-01 (in house check Oct-16)       SN: US37390585     18-Oct-01 (in house check Oct-16)       Name     Function       Michael Weber     Laboratory Technician	Apr-18	2529)	07-Apr-17	SN: 5047.2 / 06327		
econdary Standards       ID #       Check Date (in house)         ower meter EPM-442A       SN: GB37480704       07-Oct-15 (in house check Oct-16)         ower sensor HP 8481A       SN: US37292783       07-Oct-15 (in house check Oct-16)         ower sensor HP 8481A       SN: MY41092317       07-Oct-15 (in house check Oct-16)         F generator R&S SMT-06       SN: 100972       15-Jun-15 (in house check Oct-16)         etwork Analyzer HP 8753E       SN: US37390585       18-Oct-01 (in house check Oct-16)         Name       Function         Alibrated by:       Michael Weber       Laboratory Technician	May-18	7349_May17)	31-May-17			
ower meter EPM-442A     SN: GB37480704     07-Oct-15 (in house check Oct-16)       ower sensor HP 8481A     SN: US37292783     07-Oct-15 (in house check Oct-16)       ower sensor HP 8481A     SN: WY41092317     07-Oct-15 (in house check Oct-16)       iF generator R&S SMT-06     SN: 100972     15-Jun-15 (in house check Oct-16)       ietwork Analyzer HP 8753E     SN: US37390585     18-Oct-01 (in house check Oct-16)       Name     Function       alibrated by:     Michael Weber     Laboratory Technician	Mar-18	-601_Mar17)	28-Mar-17	SN: 601		AE4
ower sensor HP 8481A     SN: US37292783     07-Oct-15 (in house check Oct-16)       ower sensor HP 8481A     SN: US37292783     07-Oct-15 (in house check Oct-16)       F generator R&S SMT-06     SN: 100972     15-Jun-15 (in house check Oct-16)       etwork Analyzer HP 8753E     SN: US37390585     18-Oct-01 (in house check Oct-16)       Name     Function       Alibrated by:     Michael Weber     Laboratory Technician	Scheduled Check	))	Check Dat	ID #		
ower sensor HP 8481A     SN: MY41092317     07-Oct-15 (in house check Oct-16)       F generator R&S SMT-06 etwork Analyzer HP 8753E     SN: 100972     15-Jun-15 (in house check Oct-16)       Name     Function       Alibrated by:     Michael Weber     Laboratory Technician	In house check: Oct-18	heck Oct-16)	07-Oct-15	SN: GB37480704		
IF generator R&S SMT-06     SN: 100972     15-Jun-15 (in house check Oct-16)       letwork Analyzer HP 8753E     SN: US37390585     18-Oct-01 (in house check Oct-16)       Name     Function       alibrated by:     Michael Weber     Laboratory Technician	In house check: Oct-18					
letwork Analyzer HP 8753E     SN: US37390585     18-Oct-01 (in house check Oct-16)       Name     Function       alibrated by:     Michael Weber     Laboratory Technician	In house check: Oct-18					
Alibrated by: Michael Weber Laboratory Technician	In house check: Oct-18			A TRANSPORT OF A CONTRACT OF A		
alibrated by: Michael Weber Laboratory Technician	In house check: Oct-17	heck Oct-16)	18-Oct-01	SN: US3/390585	Analyzer HP 8/53E	Retwork
	Signature				e 100	
pproved by: Katja Pokovic Technical Manager	Milles	y Technician		Michael Weber	ated by:	Calibrate
	follows	l Manager		Katja Pokovic	wed by:	pprove
	Issued: July 24, 2017	1				

Certificate No: D1750V2-1003\_Jul17

Page 1 of 8



# No. I19Z60553-SEM01 Page 109 of 144

## Calibration Laboratory of

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



CCREDITATION S Schw C Serv Serv

Schweizerischer Kalibrierdienst

- 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

## 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, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
- 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: D1750V2-1003\_Jul17

Page 2 of 8



## **Measurement Conditions**

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

DASY Version	DASY5	V52.10.0
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	39.0 ± 6 %	1.35 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	9.15 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	36.7 W/kg ± 17.0 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL SAR measured	condition 250 mW input power	4.84 W/kg

#### **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	53.3 ± 6 %	1.49 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	9.29 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	37.1 W/kg ± 17.0 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL SAR measured	condition 250 mW input power	4.94 W/kg



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

#### Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.9 Ω + 1.1 jΩ	
Return Loss	- 37.1 dB	

### Antenna Parameters with Body TSL

Impedance, transformed to feed point	47.0 Ω + 0.1 jΩ	٦
Return Loss	- 30.2 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: 21.07.2017

Test Laboratory: SPEAG, Zurich, Switzerland

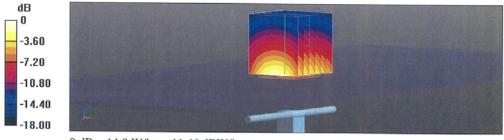
# DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN: 1003

Communication System: UID 0 - CW; Frequency: 1750 MHz Medium parameters used: f = 1750 MHz;  $\sigma$  = 1.35 S/m;  $\epsilon_r$  = 39;  $\rho$  = 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(8.73, 8.73, 8.73); Calibrated: 31.05.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 28.03.2017
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

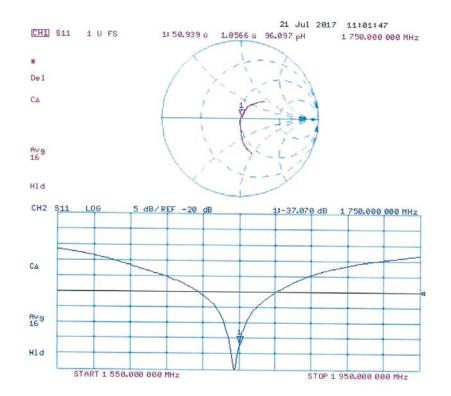
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 104.4 V/m; Power Drift = -0.05 dB Peak SAR (extrapolated) = 17.0 W/kg SAR(1 g) = 9.15 W/kg; SAR(10 g) = 4.84 W/kg Maximum value of SAR (measured) = 14.0 W/kg



0 dB = 14.0 W/kg = 11.46 dBW/kg



# Impedance Measurement Plot for Head TSL



Certificate No: D1750V2-1003\_Jul17

Page 6 of 8



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

Date: 20.07.2017

Test Laboratory: SPEAG, Zurich, Switzerland

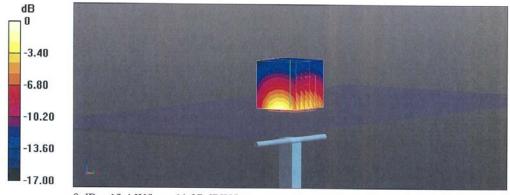
# DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN: 1003

Communication System: UID 0 - CW; Frequency: 1750 MHz Medium parameters used: f = 1750 MHz;  $\sigma$  = 1.49 S/m;  $\epsilon_r$  = 53.3;  $\rho$  = 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(8.46, 8.46, 8.46); Calibrated: 31.05.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 28.03.2017
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

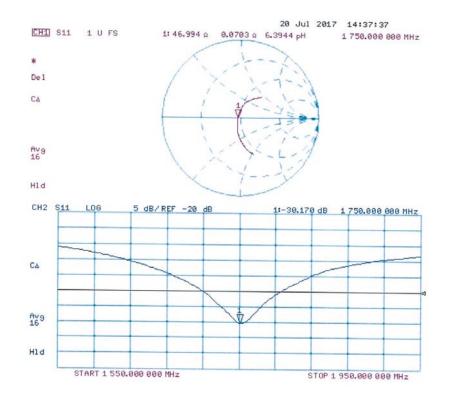
Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 99.34 V/m; Power Drift = -0.02 dB Peak SAR (extrapolated) = 16.4 W/kg SAR(1 g) = 9.29 W/kg; SAR(10 g) = 4.94 W/kg Maximum value of SAR (measured) = 13.4 W/kg



0 dB = 13.4 W/kg = 11.27 dBW/kg



## Impedance Measurement Plot for Body TSL



Certificate No: D1750V2-1003\_Jul17

Page 8 of 8



## **1900 MHz Dipole Calibration Certificate**

<b>Calibration Laboratory</b> Schmid & Partner Engineering AG <sub>Zeughausstrasse</sub> 43, 8004 Zurich		S CARDINA S C	Service suisse d'étalonnage Servizio svizzero di taratura
Accredited by the Swiss Accreditat The Swiss Accreditation Service Multilateral Agreement for the re	is one of the signatorie	s to the EA	ccreditation No.: SCS 0108
Client CTTL-BJ (Aude			o: D1900V2-5d101_Jul17
CALIBRATION C	ERTIFICATE		
Object	D1900V2 - SN:50	d101	
Calibration procedure(s)	QA CAL-05.v9 Calibration proce	dure for dipole validation kits ab	ove 700 MHz
Calibration date:	July 26, 2017		
Calibration Equipment used (M&T	FE critical for calibration)	ry facility: environment temperature (22 $\pm$ 3)	
Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	04-Apr-17 (No. 217-02521/02522)	Apr-18
Power sensor NRP-Z91 Power sensor NRP-Z91	SN: 103244 SN: 103245	04-Apr-17 (No. 217-02521)	Apr-18
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-17 (No. 217-02522) 07-Apr-17 (No. 217-02528)	Apr-18 Apr-18
Type-N mismatch combination	SN: 5047.2 / 06327	07-Apr-17 (No. 217-02529)	Apr-18
Reference Probe EX3DV4	SN: 7349	31-May-17 (No. EX3-7349_May17)	May-18
DAE4	SN: 601	28-Mar-17 (No. DAE4-601_Mar17)	Mar-18
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter EPM-442A	SN: GB37480704	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-16)	In house check: Oct-18
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-16)	In house check: Oct-17
	Name	Function	Signature
Calibrated by:	Johannes Kurikka	Laboratory Technician	Jun her
Approved by:	Katja Pokovic	Technical Manager	1/100
			bedo

Certificate No: D1900V2-5d101\_Jul17

Page 1 of 8



# No. I19Z60553-SEM01 Page 117 of 144

# Calibration Laboratory of Schmid & Partner

Engineering AG Zeughausstrasse 43, 8004 Zurich, Switzerland



S C S

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

## Glossarv:

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

### Calibration is Performed According to the Following Standards:

- a) IEEE Std 1528-2013, "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, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
- 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: D1900V2-5d101 Jul17

Page 2 of 8



#### **Measurement Conditions**

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

DASY Version	DASY5	V52.10.0
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz ± 1 MHz	

### **Head TSL parameters**

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	40.7 ± 6 %	1.39 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	9.93 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	40.0 W/kg ± 17.0 % (k=2)
1.11.0		
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL SAR measured	condition 250 mW input power	5.23 W/kg

#### **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	54.1 ± 6 %	1.50 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C		

#### SAR result with Body TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	10.0 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	40.5 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	5.33 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.5 W/kg ± 16.5 % (k=2)

Certificate No: D1900V2-5d101\_Jul17



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

#### Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.7 Ω + 5.8 jΩ
Return Loss	- 24.5 dB

#### Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.2 Ω + 6.6 jΩ
Return Loss	- 22.0 dB

#### General Antenna Parameters and Design

Electrical Delay (one direction)	1.203 ns
Electrical Belay (one anection)	1.200 110

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 28, 2008



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

Date: 26.07.2017

Test Laboratory: SPEAG, Zurich, Switzerland

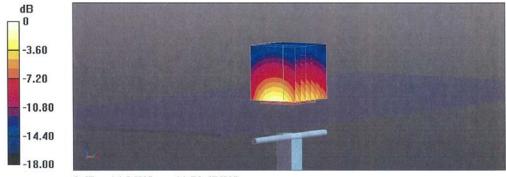
## DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d101

Communication System: UID 0 - CW; Frequency: 1900 MHz Medium parameters used: f = 1900 MHz;  $\sigma$  = 1.39 S/m;  $\epsilon_r$  = 40.7;  $\rho$  = 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(8.43, 8.43, 8.43); Calibrated: 31.05.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 28.03.2017
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

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 = 106.3 V/m; Power Drift = -0.04 dB Peak SAR (extrapolated) = 18.4 W/kg SAR(1 g) = 9.93 W/kg; SAR(10 g) = 5.23 W/kg Maximum value of SAR (measured) = 14.9 W/kg



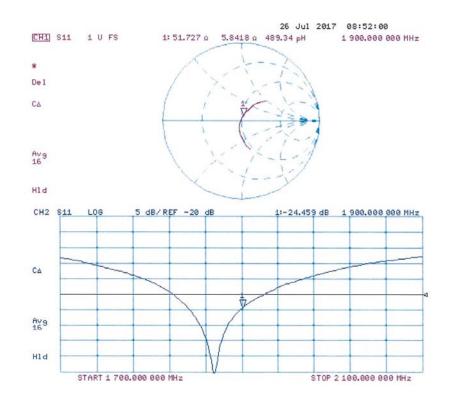
0 dB = 14.9 W/kg = 11.73 dBW/kg

Certificate No: D1900V2-5d101\_Jul17

Page 5 of 8



#### Impedance Measurement Plot for Head TSL



Certificate No: D1900V2-5d101\_Jul17

Page 6 of 8



### DASY5 Validation Report for Body TSL

Date: 26.07.2017

Test Laboratory: SPEAG, Zurich, Switzerland

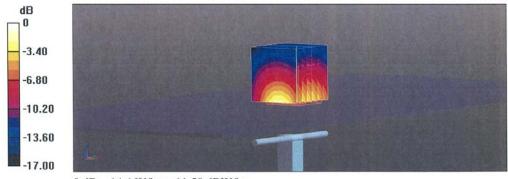
#### DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d101

Communication System: UID 0 - CW; Frequency: 1900 MHz Medium parameters used: f = 1900 MHz;  $\sigma$  = 1.5 S/m;  $\epsilon_r$  = 54.1;  $\rho$  = 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(8.2, 8.2, 8.2); Calibrated: 31.05.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 28.03.2017
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

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 = 101.8 V/m; Power Drift = -0.09 dB Peak SAR (extrapolated) = 17.6 W/kg SAR(1 g) = 10 W/kg; SAR(10 g) = 5.33 W/kg Maximum value of SAR (measured) = 14.4 W/kg



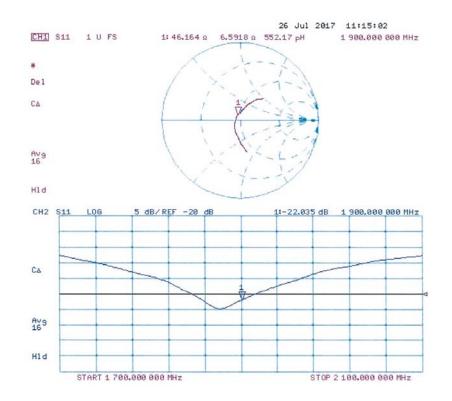
0 dB = 14.4 W/kg = 11.58 dBW/kg

Certificate No: D1900V2-5d101\_Jul17

Page 7 of 8



## Impedance Measurement Plot for Body TSL



Certificate No: D1900V2-5d101\_Jul17

Page 8 of 8