Justification of the extended calibration of Dipole D1750V2 SN:1123

Per KDB 865664, we have measured the Impedance and Return Loss as below.

- 1) The most recent return-loss result, measured at least annually, deviates by no more than 20% from the previous measurement.
- 2) The most recent measurement of the real or imaginary parts of the impedance, measured at least annually is within 5 ohm from the previous measurement.

Dipole 835 Head TST	Target Value	Measured Value	Difference
Impedance transformed to feed point	50.6Ω-0.8j Ω	49.93Ω-1.83j Ω	R=-0.67Ω,X=-1.03j Ω
Return Loss	-40.2dB	-39.17 dB	-2.56%
Dipole 835 Body TST	Target Value	Measured Value	Difference
Impedance transformed to feed point	46.9Ω-1.0j Ω	46.05Ω+2.83j Ω	R=-0.85Ω,X=3.83j Ω
Return Loss	-29.5 dB	-28.05 dB	-4.92%
Measured Date	2017-07-27	2018-07-17	

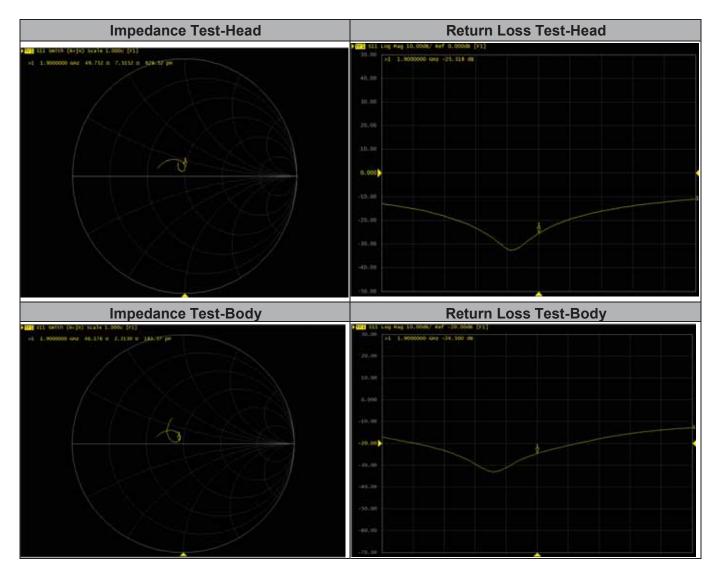
Impedance Test-Head	Return Loss Test-Head
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Justification of the extended calibration of Dipole D1900V2 SN:5d143

Per KDB 865664, we have measured the Impedance and Return Loss as below.

- 1) The most recent return-loss result, measured at least annually, deviates by no more than 20% from the previous measurement.
- 2) The most recent measurement of the real or imaginary parts of the impedance, measured at least annually is within 5 ohm from the previous measurement.

Dipole 1900 Head TST	Target Value	Measured Value	Difference
Impedance transformed to feed point	53.4Ω+4.3j Ω	49.75Ω+7.52j Ω	R=-3.65Ω,X=3.22Ω
Return Loss	-25.6dB	-25.32 dB	-1.09%
Dipole 1900 Body TST	Target Value	Measured Value	Difference
Impedance transformed to feed point	49.1Ω+5.9j Ω	46.18Ω+2.21j Ω	R=-2.92Ω,X=-3.69Ω
Return Loss	-24.4 dB	-24.5 dB	0.41%
Measured Date	2017-09-20	2018-09-20	



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Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS) The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates Accreditation No.: SCS 0108

Huawei-SZ (Auden) Client

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CALIBRATION CERTIFICATE

Object	D835V2 - SN:4d126
Calibration procedure(s)	QA CAL-05.v10 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	July 24, 2018

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 NRP	SN: 104778	04-Apr-18 (No. 217-02672/02673)	Apr-19
Power sensor NRP-Z91	SN: 103244	04-Apr-18 (No. 217-02672)	Apr-19
Power sensor NRP-Z91	SN: 103245	04-Apr-18 (No. 217-02673)	Apr-19
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-18 (No. 217-02682)	Apr-19
Type-N mismatch combination	SN: 5047.2 / 06327	04-Apr-18 (No. 217-02683)	Apr-19
Reference Probe EX3DV4	SN: 7349	30-Dec-17 (No. EX3-7349_Dec17)	Dec-18
DAE4	SN: 601	26-Oct-17 (No. DAE4-601_Oct17)	Oct-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 Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-17)	In house check: Oct-18
	Name	Function	Signature
Calibrated by:	Manu Seitz	Laboratory Technician	10.1
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	 C20070202020200000000000000000000000000		
Approved by:	Katja Pokovic	Technical Manager	12111
			KK At
		222/24/252/222/222/222/222/2222/2222/22	1925-220929-229929-2092-2092-2092-2092-20
			Issued: July 24, 2018
			3 .

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





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- С 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 6 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. ۲ No uncertainty required.
- SAR measured: SAR measured at the stated antenna input power. 0
- SAR normalized: SAR as measured, normalized to an input power of 1 W at the antenna ۵ connector.
- SAR for nominal TSL parameters: The measured TSL parameters are used to calculate the 0 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%.

Measurement Conditions

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

DASY Version	DASY5	V52.10.1
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	40.7 ± 6 %	0.92 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.41 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	9.44 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.54 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	6.06 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	55.2 ± 6 %	0.99 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C		

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.45 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	9.65 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.60 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	6.32 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	49.5 Ω - 1.9 jΩ
Return Loss	- 34.3 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	45.4 Ω - 0.4 jΩ
Return Loss	- 26.3 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.395 ns

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

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	June 29, 2010

DASY5 Validation Report for Head TSL

Date: 24.07.2018

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d126

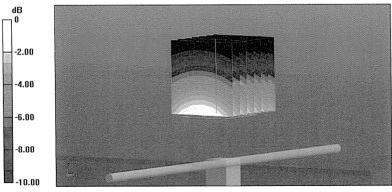
Communication System: UID 0 - CW; Frequency: 835 MHz Medium parameters used: f = 835 MHz; σ = 0.92 S/m; ϵ_r = 40.7; ρ = 1000 kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(9.9, 9.9, 9.9) @ 835 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 4.9 (front); Type: QD 00L P49 AA; Serial: 1001
- DASY52 52.10.1(1476); SEMCAD X 14.6.11(7439)

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

Measurement grid: dx=5mm, dy=5mm, dz=5mmReference Value = 62.67 V/m; Power Drift = -0.00 dB Peak SAR (extrapolated) = 3.74 W/kg SAR(1 g) = 2.41 W/kg; SAR(10 g) = 1.54 W/kg Maximum value of SAR (measured) = 3.29 W/kg



0 dB = 3.29 W/kg = 5.17 dBW/kg

Impedance Measurement Plot for Head TSL

File	⊻iew	⊆hannel	Sw <u>e</u> ep	Calibration	<u>Trace</u> <u>S</u> cale	e M <u>a</u> rker	System	<u>W</u> indow <u>I</u>	<u>H</u> elp		
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10.(5.0 -5.0 -10. -15. -20. -25. -30 -35 -40	0 - 00 - 00 - 00 - 00 - 00 - 00 - 00 -	dB S11 	20 MHz				>	1: 835			1.03500 GHz
Sta	atus	CH 1:	511		C* 1-Port		Avg=20 [Delay			LCL

DASY5 Validation Report for Body TSL

Date: 23.07.2018

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d126

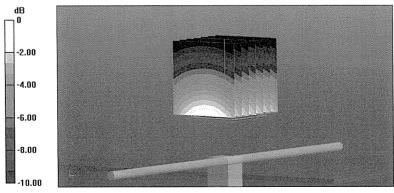
Communication System: UID 0 - CW; Frequency: 835 MHz Medium parameters used: f = 835 MHz; σ = 0.99 S/m; ϵ_r = 55.2; ρ = 1000 kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(10.05, 10.05, 10.05) @ 835 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 4.9 (Back); Type: QD 00R P49 AA; Serial: 1005
- DASY52 52.10.1(1476); SEMCAD X 14.6.11(7439)

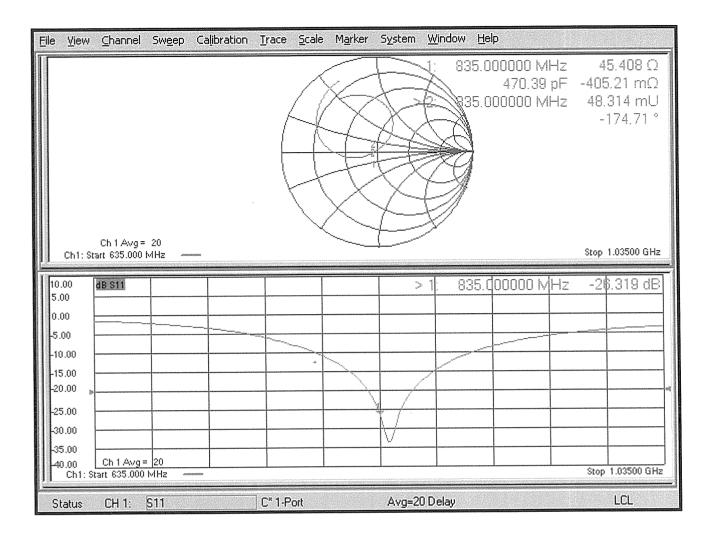
Dipole Calibration for Body Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mmReference Value = 61.39 V/m; Power Drift = -0.07 dB Peak SAR (extrapolated) = 3.66 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



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Accreditation No.: SCS 0108

Certificate No: D1750V2-1145_Feb16

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Client Huawei (Auden)

CALIBRATION C	CERTIFICATI		
Object	D1750V2 - SN: 1	145	Sector Contractor
Calibration procedure(s)	QA CAL-05.v9 Calibration proce	edure for dipole validation kits ab	ove 700 MHz
Calibration date:	February 02, 201	6	
The measurements and the unce	rtainties with confidence p	ional standards, which realize the physical ur robability are given on the following pages a ry facility: environment temperature $(22 \pm 3)^{\circ}$	nd are part of the certificate.
Calibration Equipment used (M&T	E 15 ha		
Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A Power sensor HP 8481A	GB37480704	07-Oct-15 (No. 217-02222)	Oct-16
Power sensor HP 8481A	US37292783	07-Oct-15 (No. 217-02222)	Oct-16
Reference 20 dB Attenuator	MY41092317 SN: 5058 (20k)	07-Oct-15 (No. 217-02223)	Oct-16
Type-N mismatch combination	SN: 5047.2 / 06327	01-Apr-15 (No. 217-02131) 01-Apr-15 (No. 217-02134)	Mar-16
Reference Probe EX3DV4	SN: 7349	31-Dec-15 (No. EX3-7349 Dec15)	Mar-16 Dec-16
DAE4	SN: 601	30-Dec-15 (No. DAE4-601_Dec15)	Dec-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-15)	In house check: Oct-16
	Name	Function	Signature
Calibrated by:	Michael Weber	Laboratory Technician	M.Webes
Approved by:	Katja Pokovic	Technical Manager	flit
			Issued: February 4, 2016

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Accreditation No.: SCS 0108

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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) 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%.

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	40.2 ± 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 ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	8.99 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	36.1 W/kg ± 17.0 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR averaged over 10 cm ³ (10 g) of Head TSL SAR measured	condition 250 mW input power	4.76 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	53.8 ± 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 ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	9.10 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	36.5 W/kg ± 17.0 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR averaged over 10 cm ³ (10 g) of Body TSL SAR measured	condition 250 mW input power	4.85 W/kg

Certificate No: D1750V2-1145_Feb16

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	49.5 Ω - 1.3 jΩ	
Return Loss	- 36.9 dB	

Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.5 Ω - 1.3 jΩ	
Return Loss	- 28.2 dB	

General Antenna Parameters and Design

Electrical Delay (one direction)	1.222 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	September 30, 2014	

DASY5 Validation Report for Head TSL

Date: 02.02.2016

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN: 1145

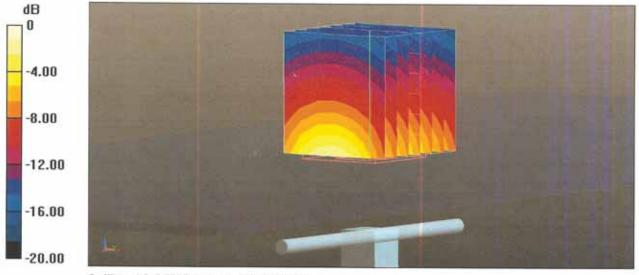
Communication System: UID 0 - CW; Frequency: 1750 MHz Medium parameters used: f = 1750 MHz; σ = 1.36 S/m; ϵ_r = 40.2; ρ = 1000 kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(8.54, 8.54, 8.54); Calibrated: 31.12.2015;
- 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)

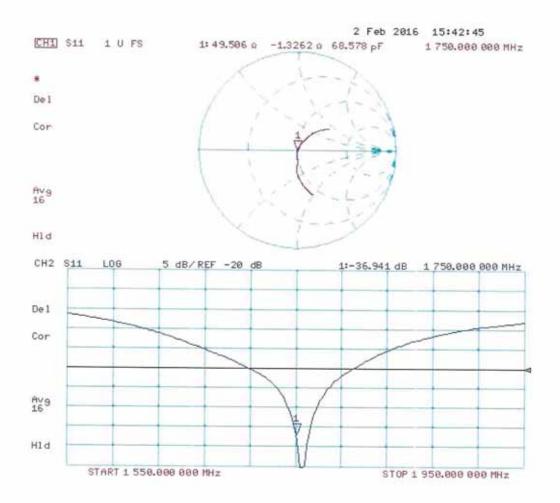
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 104.3 V/m; Power Drift = 0.04 dB Peak SAR (extrapolated) = 16.7 W/kg SAR(1 g) = 8.99 W/kg; SAR(10 g) = 4.76 W/kg Maximum value of SAR (measured) = 13.8 W/kg



0 dB = 13.8 W/kg = 11.40 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 02.02.2016

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN: 1145

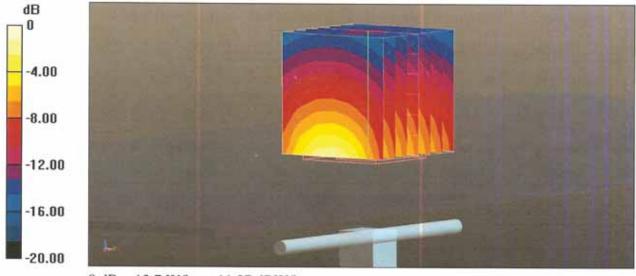
Communication System: UID 0 - CW; Frequency: 1750 MHz Medium parameters used: f = 1750 MHz; $\sigma = 1.49$ S/m; $\epsilon_r = 53.8$; $\rho = 1000$ kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

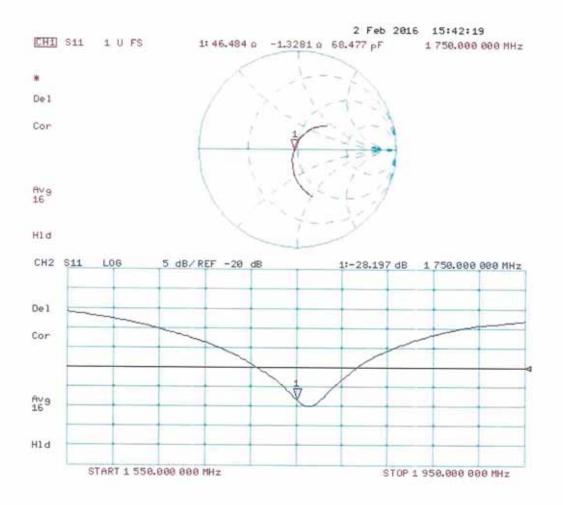
- Probe: EX3DV4 SN7349; ConvF(8.25, 8.25, 8.25); Calibrated: 31.12.2015;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

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 = 100.1 V/m; Power Drift = 0.02 dB Peak SAR (extrapolated) = 16.2 W/kg SAR(1 g) = 9.1 W/kg; SAR(10 g) = 4.85 W/kg Maximum value of SAR (measured) = 13.7 W/kg



0 dB = 13.7 W/kg = 11.37 dBW/kg



Calibration Laboratory of Schmid & Partner Engineering AG

Zeughausstrasse 43, 8004 Zurich, Switzerland

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

Huawei (Auden) Client

Object	D2450V2 - SN: 9	78	
Calibration procedure(s)	QA CAL-05.v9 Calibration proce	dure for dipole validation kits abo	ove 700 MHz
Calibration date:	February 08, 201	6	
The measurements and the unce	rtainties with confidence p	ional standards, which realize the physical un robability are given on the following pages an ry facility: environment temperature $(22 \pm 3)^{\circ}$	d are part of the certificate.
Calibration Equipment used (M&T	E critical for calibration)		
	E critical for calibration)	Cal Date (Certificate No.)	Scheduled Calibration
rimary Standards	THE R. L.	Cal Date (Certificate No.) 07-Oct-15 (No. 217-02222)	Scheduled Calibration Oct-16
rimary Standards ower meter EPM-442A	ID #		
rimary Standards ower meter EPM-442A ower sensor HP 8481A	ID # GB37480704	07-Oct-15 (No. 217-02222)	Oct-16
rimary Standards ower meter EPM-442A ower sensor HP 8481A ower sensor HP 8481A	ID # GB37480704 US37292783	07-Oct-15 (No. 217-02222) 07-Oct-15 (No. 217-02222)	Oct-16 Oct-16
rimary Standards ower meter EPM-442A ower sensor HP 8481A ower sensor HP 8481A eference 20 dB Attenuator	ID # GB37480704 US37292783 MY41092317	07-Oct-15 (No. 217-02222) 07-Oct-15 (No. 217-02222) 07-Oct-15 (No. 217-02223)	Oct-16 Oct-16 Oct-16
rimary Standards ower meter EPM-442A ower sensor HP 8481A ower sensor HP 8481A reference 20 dB Attenuator ype-N mismatch combination	ID # GB37480704 US37292783 MY41092317 SN: 5058 (20k)	07-Oct-15 (No. 217-02222) 07-Oct-15 (No. 217-02222) 07-Oct-15 (No. 217-02223) 01-Apr-15 (No. 217-02131)	Oct-16 Oct-16 Oct-16 Mar-16
Primary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A Reference 20 dB Attenuator ype-N mismatch combination Reference Probe EX3DV4	ID # GB37480704 US37292783 MY41092317 SN: 5058 (20k) SN: 5047.2 / 06327	07-Oct-15 (No. 217-02222) 07-Oct-15 (No. 217-02222) 07-Oct-15 (No. 217-02223) 01-Apr-15 (No. 217-02131) 01-Apr-15 (No. 217-02134)	Oct-16 Oct-16 Oct-16 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-15 (No. 217-02222) 07-Oct-15 (No. 217-02222) 07-Oct-15 (No. 217-02223) 01-Apr-15 (No. 217-02131) 01-Apr-15 (No. 217-02134) 31-Dec-15 (No. EX3-7349_Dec15)	Oct-16 Oct-16 Oct-16 Mar-16 Mar-16 Dec-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 SN: 601	07-Oct-15 (No. 217-02222) 07-Oct-15 (No. 217-02222) 07-Oct-15 (No. 217-02223) 01-Apr-15 (No. 217-02131) 01-Apr-15 (No. 217-02134) 31-Dec-15 (No. EX3-7349_Dec15) 30-Dec-15 (No. DAE4-601_Dec15)	Oct-16 Oct-16 Oct-16 Mar-16 Mar-16 Dec-16 Dec-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-15 (No. 217-02222) 07-Oct-15 (No. 217-02222) 07-Oct-15 (No. 217-02223) 01-Apr-15 (No. 217-02131) 01-Apr-15 (No. 217-02134) 31-Dec-15 (No. EX3-7349_Dec15) 30-Dec-15 (No. DAE4-601_Dec15) Check Date (in house)	Oct-16 Oct-16 Oct-16 Mar-16 Mar-16 Dec-16 Dec-16 Scheduled Check
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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 Recondary Standards RF generator R&S SMT-06 Retwork Analyzer HP 8753E	ID # GB37480704 US37292783 MY41092317 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601 ID # 100972 US37390585 S4206	07-Oct-15 (No. 217-02222) 07-Oct-15 (No. 217-02222) 07-Oct-15 (No. 217-02223) 01-Apr-15 (No. 217-02131) 01-Apr-15 (No. 217-02134) 31-Dec-15 (No. 217-02134) 31-Dec-15 (No. EX3-7349_Dec15) 30-Dec-15 (No. DAE4-601_Dec15) Check Date (in house) 15-Jun-15 (in house check Jun-15) 18-Oct-01 (in house check Oct-15)	Oct-16 Oct-16 Oct-16 Mar-16 Dec-16 Dec-16 Scheduled Check In house check: Jun-18 In house check: Oct-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 Recondary Standards RF generator R&S SMT-06 Retwork Analyzer HP 8753E	ID # GB37480704 US37292783 MY41092317 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601 ID # 100972 US37390585 S4206 Name Jeton Kastrati	07-Oct-15 (No. 217-02222) 07-Oct-15 (No. 217-02222) 07-Oct-15 (No. 217-02223) 01-Apr-15 (No. 217-02131) 01-Apr-15 (No. 217-02134) 31-Dec-15 (No. 217-02134) 31-Dec-15 (No. 217-02134) 31-Dec-15 (No. 217-02134) 30-Dec-15 (No. 217-02134) 30-Dec-15 (No. 217-02134) 31-Dec-15 (No. 217	Oct-16 Oct-16 Oct-16 Mar-16 Dec-16 Dec-16 Scheduled Check In house check: Jun-18 In house check: Oct-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 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-15 (No. 217-02222) 07-Oct-15 (No. 217-02222) 07-Oct-15 (No. 217-02223) 01-Apr-15 (No. 217-02131) 01-Apr-15 (No. 217-02134) 31-Dec-15 (No. 217-02134) 31-Dec-15 (No. 217-02134) 30-Dec-15 (No. 217-02134) 30-Dec-15 (No. 217-02134) 30-Dec-15 (No. 217-02134) 30-Dec-15 (No. 217-02134) 30-Dec-15 (No. 217-02134) 31-Dec-15 (No. 217	Oct-16 Oct-16 Oct-16 Mar-16 Dec-16 Dec-16 Scheduled Check In house check: Jun-18 In house check: Oct-16
Calibration Equipment used (M&T Primary Standards Power meter EPM-442A Power sensor HP 8481A 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: Approved by:	ID # GB37480704 US37292783 MY41092317 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601 ID # 100972 US37390585 S4206 Name Jeton Kastrati	07-Oct-15 (No. 217-02222) 07-Oct-15 (No. 217-02222) 07-Oct-15 (No. 217-02223) 01-Apr-15 (No. 217-02131) 01-Apr-15 (No. 217-02134) 31-Dec-15 (No. 217-02134) 31-Dec-15 (No. 217-02134) 31-Dec-15 (No. 217-02134) 30-Dec-15 (No. 217-02134) 30-Dec-15 (No. 217-02134) 31-Dec-15 (No. 217	Oct-16 Oct-16 Oct-16 Mar-16 Dec-16 Dec-16 Scheduled Check In house check: Jun-18 In house check: Oct-16

Accreditation No.: SCS 0108

Schweizerischer Kalibrierdienst S

Service suisse d'étalonnage C

Servizio svizzero di taratura

S Swiss Calibration Service

Certificate No: D2450V2-978_Feb16

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Certificate No: D2450V2-978_Feb16



AC-MR

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

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%.

Measurement Conditions

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

DASY5	V52.8.8
Advanced Extrapolation	
Modular Flat Phantom	
10 mm	with Spacer
dx, dy, dz = 5 mm	
2450 MHz ± 1 MHz	
	Advanced Extrapolation Modular Flat Phantom 10 mm dx, dy, dz = 5 mm

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	37.9 ± 6 %	1.88 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.7 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	53.3 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.34 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.9 W/kg ± 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	52.2 ± 6 %	2.03 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	7 <u>9599</u>	1

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition		
SAR measured	250 mW input power	13.3 W/kg	
SAR for nominal Body TSL parameters	normalized to 1W	52.1 W/kg ± 17.0 % (k=2)	
SAR averaged over 10 cm ³ (10 g) of Body TSL	condition		
SAR averaged over 10 cm ³ (10 g) of Body TSL SAR measured	condition 250 mW input power	6.26 W/kg	

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.0 Ω + 3.6 jΩ	
Return Loss	- 26.8 dB	

Antenna Parameters with Body TSL

Impedance, transformed to feed point	49.8 Ω + 5.8 jΩ
Return Loss	- 24.7 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.154 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	December 30, 2014		

DASY5 Validation Report for Head TSL

Date: 08.02.2016

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz ; Type: D2450V2; Serial: D2450V2 - SN: 978

Communication System: UID 0 - CW; Frequency: 2450 MHz Medium parameters used: f = 2450 MHz; σ = 1.88 S/m; ϵ_r = 37.9; ρ = 1000 kg/m³ 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(7372)

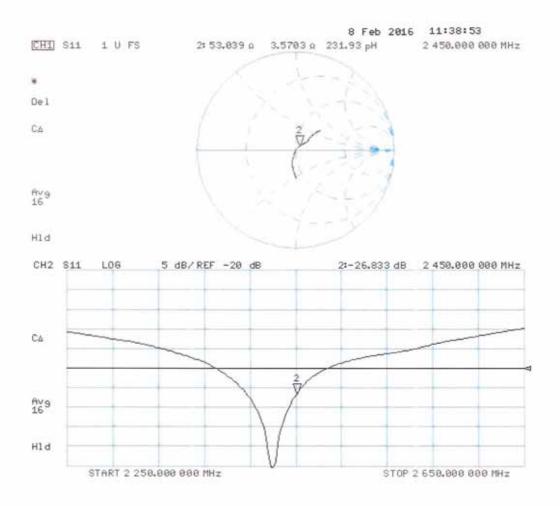
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 115.7 V/m; Power Drift = 0.00 dB Peak SAR (extrapolated) = 28.4 W/kg SAR(1 g) = 13.7 W/kg; SAR(10 g) = 6.34 W/kg Maximum value of SAR (measured) = 23.1 W/kg



0 dB = 23.1 W/kg = 13.64 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 08.02.2016

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz ; Type: D2450V2; Serial: D2450V2 - SN: 978

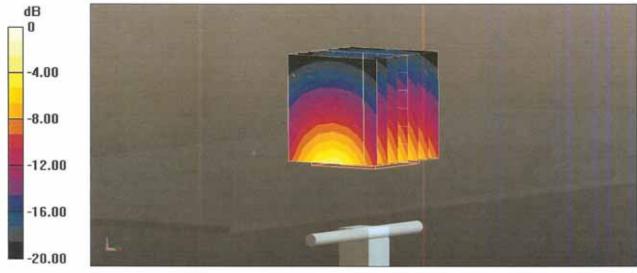
Communication System: UID 0 - CW; Frequency: 2450 MHz Medium parameters used: f = 2450 MHz; σ = 2.03 S/m; ϵ_r = 52.2; ρ = 1000 kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

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(7372)

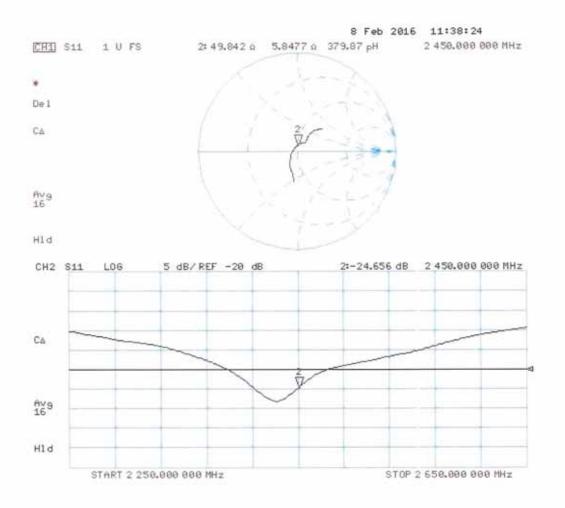
Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 108.7 V/m; Power Drift = -0.00 dB Peak SAR (extrapolated) = 26.4 W/kg SAR(1 g) = 13.3 W/kg; SAR(10 g) = 6.26 W/kg Maximum value of SAR (measured) = 21.7 W/kg



0 dB = 21.7 W/kg = 13.36 dBW/kg

Impedance Measurement Plot for Body TSL



Justification of the extended calibration of Dipole D1750V2 SN:1145

Per KDB 865664, we have measured the impedance and return loss as below.

1) The most recent return-loss result, measured at least annually, deviates by no more than 20% from the previous measurement.

2) The most recent measurement of the real or imaginary parts of the impedance, measured at least annually is within 50hm from the previous measurement.

Dipole 1750 Head TST	Target Value	Measured Value	Difference
Impedance transformed to feed point	49.5Ω-1.3jΩ	48.84Ω-2.72jΩ	R=-0.66Ω, X=-1.42Ω
Return Loss	-36.9dB	-33.58dB	-9.00%
Dipole 1750 Body TST	Target Value	Measured Value	Difference
Impedance transformed to feed point	46.5Ω-1.3jΩ	45.54Ω-3.55jΩ	R=-0.96Ω, X=-2.25Ω
Return Loss	-28.2dB	-25.8dB	-8.51%
Measured Date	2016-02-02	2017-01-26	
Impedance Tes	st-Head	Return Loss T	est-Head
▶ Tr1 S11 Smith (R+jX) Scale 1.000U [F1] >1 1.7500000 GHZ 48.835 Ω -2.7162 Ω 33.483 pF		Trl S11 Log Mag 10.00dB/ Ref 0.000dB [F1] 50.00 >1 1.7500000 GHz -33.577 dB	
>1 1.7500000 GHZ 48.835 0 -2.7162 0 33.485 pt		40.00 30.00 20.00 10.00 -10.00 -20.00 -30.00 -40.00 -50.00	
Impedance Tes	st-Body	Return Loss T	est- Body
102 S11 Smith (RejX) Scale 1.0000 [F1] >1 1.7500000 GHz 45.535 0 -3.5522 0 25.602 pF		>11 10 Mag 10.00dB/ Ref 0.000dB [F1] 50.00 >1 1.7500000 GHZ -25.800 dB 40.00 30.00 30.00 GHZ -25.800 dB 20.00 .000 .000 .000 .000 .000 -10.00 .000 .000 .000 .000 .000 -30.00 .000 .000 .000 .000 .000 -30.00 .000 .000 .000 .000 .000 -50.00 .000 .000 .000 .000 .000	

Justification of the extended calibration of Dipole D2450V2 SN:978

Per KDB 865664, we have Measured the Impedance and Return Loss as below, and the return loss is <-20dB, with 20% of prior calibration; the real or imaginary parts of the impedance is with 5 ohm of prior calibration. Therefore the verification result should support extended calibration.

Dipole2450 Head TST	Target Value	Measured Value	Difference
Impedance transformed to feed point	53Ω+3.6jΩ	50.89Ω+0.18jΩ	R=-2.11Ω, X=-3.42Ω
Return Loss	-26.8dB	-29.84dB	-11.34%
Dipole2450 Body TST	Target Value	Measured Value	Difference
Impedance transformed to feed point	49.8Ω+5.8jΩ	50.63Ω+3.66jΩ	R=0.83Ω, X=-2.14Ω
Return Loss	-24.7dB	-28.74dB	-16.36%
Measured Date	2016-02-08	2018-01-26	
Impedance Tes	st-Head	Return Loss T	est-Head
P[r] 511 saith (8+jx) scale 1.0000 [F] >1 2.4500000 GHZ 50.885 0 175.66 m0 11-411 PH II-411 PH Image:		int log kag 10.008/r kef -30.004k [F1] 20.00 >1 2.4500000 GHz -29.839 db 10.00 -10.00 -20.00 -30.00 -40.00 -50.00 -60.00 -70.00 -80.00	
Impedance Tes	st-Body	Return Loss Test-Body	
>1 2.4500000 cmz 50.622 n 3.6550 n 237.44 pm		• End 511 Log Mag 10.000h/ Mef -20.000h (F1) 30.00 >1 2.500000 Gitz -28.742 Git 20.00	