# 1.1. D750V3 Dipole Calibration Certificate

Schmid & Partner Engineering AG teughausstrasse 43, 8004 Zurict	y of	BC-MRA BC-MRA SC S	Schweizerischer Kalibrierdie Service suisse d'étalonnage Servizio svizzero di taratura Swiss Calibration Service
Accredited by the Swiss Accredita The Swiss Accreditation Service Multilateral Agreement for the re	is one of the signatorie	s to the EA	ccreditation No.: SCS 0108
Client CCIC-HTW (Au	_		D750V3-1180_Feb18
CALIBRATION C	ERTIFICATE		
Object	D750V3 - SN:118	80	
Calibration procedure(s)	QA CAL-05.v9 Calibration proce	dure for dipole validation kits abo	ove 700 MHz
Calibration date:	February 07, 201	18	
The measurements and the unce	rtainties with confidence p	ional standards, which realize the physical ur probability are given on the following pages any facility: environment temperature $(22 \pm 3)^\circ$	nd are part of the certificate.
The measurements and the unce All calibrations have been conduc Calibration Equipment used (M& Primary Standards	rtainties with confidence p oted in the closed laborato FE critical for calibration)	probability are given on the following pages a ny facility: environment temperature (22 ± 3)° Cal Date (Certificate No.)	nd are part of the certificate. C and humidity < 70%. Scheduled Calibration
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#### 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

#### 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: D750V3-1180\_Feb18

Page 2 of 8

Swiss Calibration Service
Accreditation No.: SCS 0108

Schweizerischer Kalibrierdienst

Service suisse d'étalonnage

Servizio svizzero di taratura



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#### **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	750 MHz ± 1 MHz	

Head TSL parameters The following parameters and calculations were applied.

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

#### SAR result with Head TSL

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

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.35 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	5.39 W/kg ± 16.5 % (k=2)

Body TSL parameters The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.5	0.96 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	55.2 ± 6 %	0.96 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	2.14 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	8.55 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.42 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	5.68 W/kg ± 16.5 % (k=2)

Certificate No: D750V3-1180\_Feb18

Page 3 of 8

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

#### Antenna Parameters with Head TSL

Impedance, transformed to feed point	54.1 Ω - 0.2 jΩ	
Return Loss	- 28.1 dB	

#### Antenna Parameters with Body TSL

Impedance, transformed to feed point	49.3 Ω - 4.0 jΩ	
Return Loss	- 27.7 dB	

#### General Antenna Parameters and Design

Electrical Delay (one direction)	1.037 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	February 21, 2017

Certificate No: D750V3-1180\_Feb18

Page 4 of 8

#### DASY5 Validation Report for Head TSL

Date: 07.02.2018

Test Laboratory: SPEAG, Zurich, Switzerland

#### DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1180

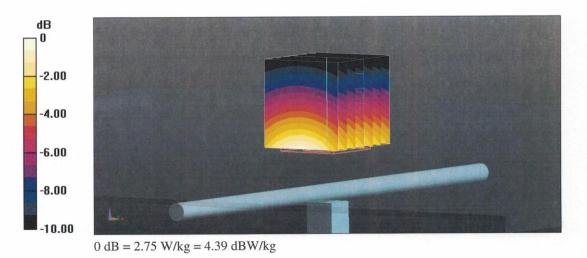
Communication System: UID 0 - CW; Frequency: 750 MHz Medium parameters used: f = 750 MHz;  $\sigma$  = 0.89 S/m;  $\epsilon_r$  = 41.4;  $\rho$  = 1000 kg/m<sup>3</sup> Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(10.22, 10.22, 10.22); 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 52.10.0(1446); SEMCAD X 14.6.10(7417)

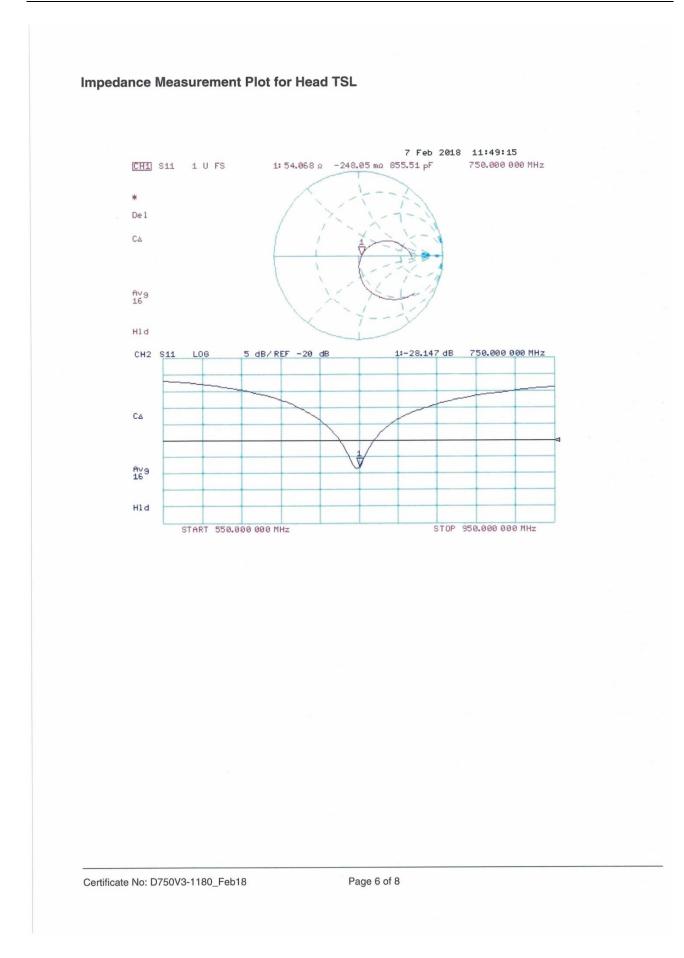
### Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 58.99 V/m; Power Drift = -0.00 dB Peak SAR (extrapolated) = 3.09 W/kg SAR(1 g) = 2.06 W/kg; SAR(10 g) = 1.35 W/kg Maximum value of SAR (measured) = 2.75 W/kg



Certificate No: D750V3-1180\_Feb18

Page 5 of 8



#### DASY5 Validation Report for Body TSL

Date: 07.02.2018

Test Laboratory: SPEAG, Zurich, Switzerland

#### DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1180

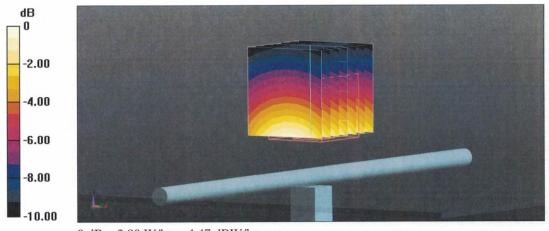
Communication System: UID 0 - CW; Frequency: 750 MHz Medium parameters used: f = 750 MHz;  $\sigma$  = 0.96 S/m;  $\epsilon_r$  = 55.2;  $\rho$  = 1000 kg/m<sup>3</sup> Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(10.19, 10.19, 10.19); 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 52.10.0(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 = 57.48 V/m; Power Drift = -0.03 dB

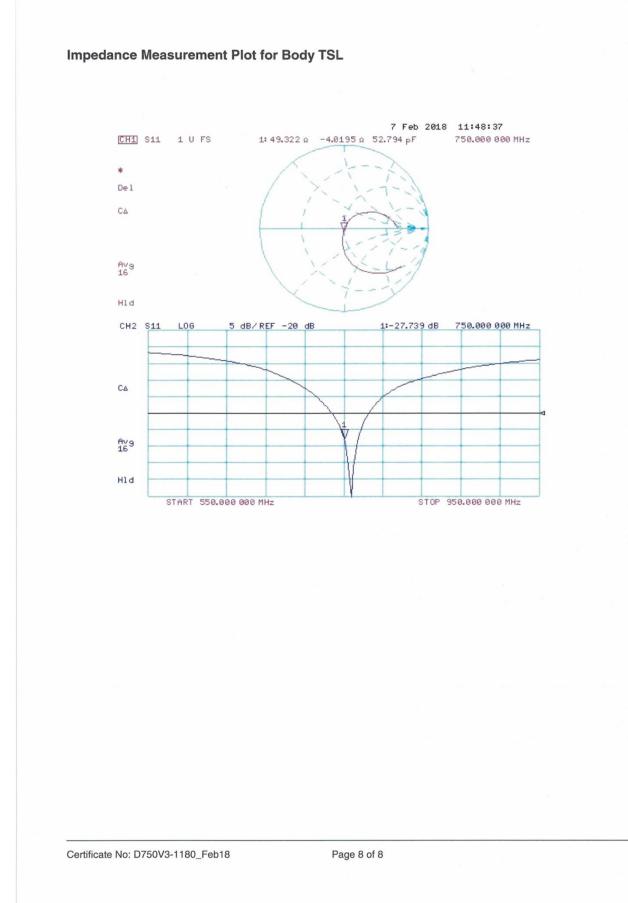
Peak SAR (extrapolated) = 3.15 W/kg SAR(1 g) = 2.14 W/kg; SAR(10 g) = 1.42 W/kg Maximum value of SAR (measured) = 2.80 W/kg



0 dB = 2.80 W/kg = 4.47 dBW/kg

Certificate No: D750V3-1180\_Feb18

Page 7 of 8



# **Extended Dipole Calibrations**

Referring to KDB865664 D01, if dipoles are verified in return loss (<-20dB, within 20% of prior calibration), and in impedance (within 5 ohm of prior calibration), the annual calibration is not necessary and the calibration interval can be extended.

Head-750						
Date of	Poturn loop (dP)	Dolto (9/)	Real Impedance	Delta	Imaginary	Delta
measurement	Return-loss (dB)	Delta (%)	(ohm)	(ohm)	impedance (ohm)	(ohm)
2018/2/7	-28.1		54.1		-0.2	
2019/2/3	-27.5	-2.14%	53.5	0.6	-0.5	0.3

			Body-750			
Date of	Return-loss (dB)	Delta (%)	Real Impedance	Delta	Imaginary	Delta
measurement	Return-1055 (ub)	Della (%)	(ohm)	(ohm)	impedance (ohm)	(ohm)
2018/2/7	-27.7		49.3		-4.0	
2019/2/3	-27.3	-1.44%	48.7	0.6	-4.5	0.5

The return loss is <-20dB, within 20% of prior calibration; the impedance is within 50hm of prior calibration. Therefore the verification result should support extended calibration.

### 1.2. D835V2 Dipole Calibration Certificate

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



Schweizerischer Kalibrierdienst S Service suisse d'étalonnage С

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

CCIC-HTW (Auden) Client

Certificate No: D835V2-4d238\_Feb18

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ject	D835V2 - SN:4d23	38	
alibration procedure(s)	QA CAL-05.v9 Calibration procee	lure for dipole validation kits abov	e 700 MHz
alibration date:	February 19, 2018	3	
The measurements and the unce	rtainties with confidence pr	onal standards, which realize the physical unit obability are given on the following pages and y facility: environment temperature $(22 \pm 3)^{\circ}$ C	
Calibration Equipment used (M&	Language and	Cal Date (Certificate No.)	Scheduled Calibration
Primary Standards	ID #	04-Apr-17 (No. 217-02521/02522)	Apr-18
Power meter NRP	SN: 104778		Apr-18
Power sensor NRP-Z91	SN: 103244	04-Apr-17 (No. 217-02521) 04-Apr-17 (No. 217-02522)	Apr-18
Power sensor NRP-Z91	SN: 103245	07-Apr-17 (No. 217-02522)	Apr-18
Reference 20 dB Attenuator	SN: 5058 (20k)	07-Apr-17 (No. 217-02529) 07-Apr-17 (No. 217-02529)	Apr-18
Type-N mismatch combination	SN: 5047.2 / 06327	30-Dec-17 (No. EX3-7349_Dec17)	Dec-18
Reference Probe EX3DV4	SN: 7349	26-Oct-17 (No. DAE4-601_Oct17)	Oct-18
DAE4	SN: 601	26-001-17 (NO. DAL+001_00007)	
	l in ii	Check Date (in house)	Scheduled Check
Secondary Standards	ID #	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
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	15-Jun-15 (in house check Oct-16)	In house check: Oct-18
RF generator R&S SMT-06	SN: 100972	18-Oct-01 (in house check Oct-17)	In house check: Oct-18
Network Analyzer HP 8753E	SN: US37390585		
	Neme	Function	Signature
Calibrated by:	Name Michael Weber	Laboratory Technician	Milleber
Approved by:	Katja Pokovic	Technical Manager	fol the
			Issued: February 19, 2018
1		and the second of the laborato	rv.
This calibration certificate shall	Il not be reproduced except	in full without written approval of the laborate	

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



Schweizerischer Kalibrierdienst

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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: D835V2-4d238\_Feb18

Page 2 of 8

Measurement Conditions D

SY system configuration, as fair as not given on page 1		V52.10.0
DASY Version	DASY5	
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
	835 MHz ± 1 MHz	
Frequency		

### Head TSL parameters

e following parameters and calculations were appli	Temperature	Permittivity	Conductivity
	22.0 °C	41.5	0.90 mho/m
Nominal Head TSL parameters	(22.0 ± 0.2) °C	41.2 ± 6 %	0.92 mho/m ± 6 %
Measured Head TSL parameters	(22.0 ± 0.2) 0		
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	
	250 mW input power	2.42 W/kg
SAR measured		9.51 W/kg ± 17.0 % (k=2)
SAR for nominal Head TSL parameters	normalized to 1W	5.61 11.19 - 11.1
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		1.56 W/kg
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL SAR measured SAR for nominal Head TSL parameters	condition 250 mW input power normalized to 1W	1.56 W/kg 6.15 W/kg ± 16.5 % (k=2)

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Body TSL parameters and calculations were applied.

ne following parameters and calculations were appri-	Temperature	Permittivity	Conductivity
	22.0 °C	55.2	0.97 mho/m
Nominal Body TSL parameters	(22.0 ± 0.2) °C	55.0 ± 6 %	0.99 mho/m ± 6 %
Measured Body TSL parameters 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	
	250 mW input power	2.45 W/kg
SAR measured	normalized to 1W	9.64 W/kg ± 17.0 % (k=2)
SAR for nominal Body TSL parameters	normalized to TW	
	dillor	
SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
	250 mW input power	1.60 W/kg
		6.32 W/kg ± 16.5 % (k=2)
SAR measured SAR for nominal Body TSL parameters	normalized to 1W	6.32 W/kg ± 10.5 /0 (k-2)

Certificate No: D835V2-4d238\_Feb18

Page 3 of 8

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

## Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.8 Ω - 4.0 jΩ
Impedance, transformed to feed point	- 27.8 dB
Return Loss	- 27.0 dB

### Antenna Parameters with Body TSL

Impedance, transformed to feed point	47.6 Ω - 6.0 jΩ
Impedance, transionned to reed point	- 23.6 dB
Return Loss	- 20.0 48

# General Antenna Parameters and Design

	1.391 ns
Electrical Delay (one direction)	

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

Man factured by	SPEAG
Manufactured by	June 02, 2017
Manufactured on	

Certificate No: D835V2-4d238\_Feb18

Page 4 of 8

## DASY5 Validation Report for Head TSL

Date: 19.02.2018

Test Laboratory: SPEAG, Zurich, Switzerland

# DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d238

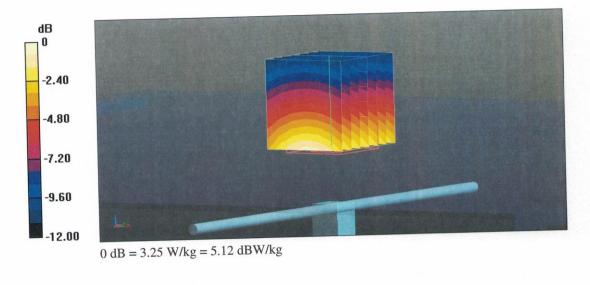
Communication System: UID 0 - CW; Frequency: 835 MHz Medium parameters used: f = 835 MHz;  $\sigma$  = 0.92 S/m;  $\epsilon_r$  = 41.2;  $\rho$  = 1000 kg/m<sup>3</sup> Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(9.9, 9.9, 9.9); 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 52.10.0(1446); SEMCAD X 14.6.10(7417)

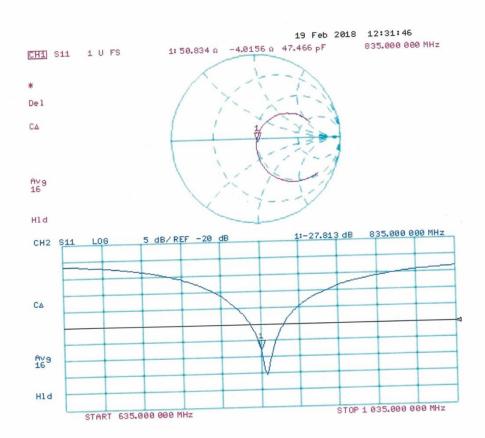
# Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 62.44 V/m; Power Drift = -0.03 dB Peak SAR (extrapolated) = 3.69 W/kg SAR(1 g) = 2.42 W/kg; SAR(10 g) = 1.56 W/kg Maximum value of SAR (measured) = 3.25 W/kg



Certificate No: D835V2-4d238\_Feb18

Page 5 of 8



Impedance Measurement Plot for Head TSL

Certificate No: D835V2-4d238\_Feb18

Page 6 of 8

# DASY5 Validation Report for Body TSL

Date: 19.02.2018

Test Laboratory: SPEAG, Zurich, Switzerland

# DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d238

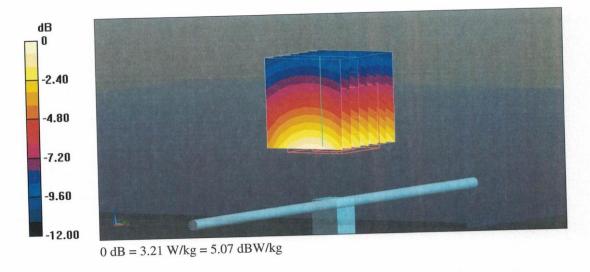
Communication System: UID 0 - CW; Frequency: 835 MHz Medium parameters used: f = 835 MHz;  $\sigma$  = 0.99 S/m;  $\epsilon_r$  = 55;  $\rho$  = 1000 kg/m<sup>3</sup> Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(10.05, 10.05, 10.05); 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 52.10.0(1446); SEMCAD X 14.6.10(7417)

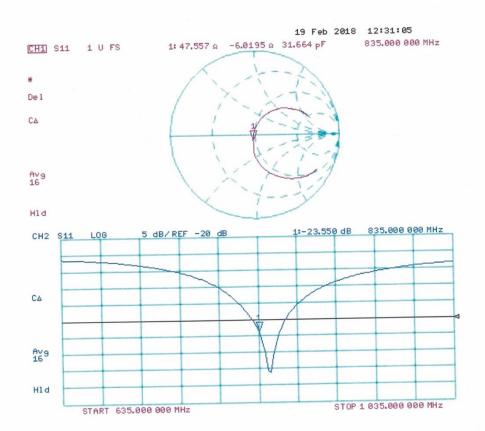
# Dipole Calibration for Body Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 60.24 V/m; Power Drift = -0.01 dB Peak SAR (extrapolated) = 3.70 W/kg SAR(1 g) = 2.45 W/kg; SAR(10 g) = 1.6 W/kg Maximum value of SAR (measured) = 3.21 W/kg



Certificate No: D835V2-4d238\_Feb18

Page 7 of 8



Impedance Measurement Plot for Body TSL

Certificate No: D835V2-4d238\_Feb18

Page 8 of 8

# **Extended Dipole Calibrations**

Referring to KDB865664 D01, if dipoles are verified in return loss (<-20dB, within 20% of prior calibration), and in impedance (within 5 ohm of prior calibration), the annual calibration is not necessary and the calibration interval can be extended.

			Head-835			
Date of	Poturn loop (dP)	Dolto (9/)	Real Impedance	Delta	Imaginary	Delta
measurement	Return-loss (dB)	Delta (%)	(ohm)	(ohm)	impedance (ohm)	(ohm)
2018/2/19	-27.8		50.8		-4.0	
2019/2/3	-27.1	-2.52%	49.9	0.9	-3.6	0.4

			Body-835			
Date of	Return-loss (dB)	Delta (%)	Real Impedance	Delta	Imaginary	Delta
measurement	Return-1055 (ub)	Della (%)	(ohm)	(ohm)	impedance (ohm)	(ohm)
2018/2/19	-23.6		47.6		-6.0	
2019/2/3	-24.2	2.54%	47.1	0.5	-6.2	0.2

The return loss is <-20dB, within 20% of prior calibration; the impedance is within 50hm of prior calibration. Therefore the verification result should support extended calibration.

# 1.3. D1750V2 Dipole Calibration Certificate

Schmid & Partner Engineering AG eughausstrasse 43, 8004 Zurich,	of Switzerland	S C S	Schweizerischer Kalibrierdienst Service suisse d'étalonnage Servizio svizzero di taratura Swiss Calibration Service
Accredited by the Swiss Accreditation The Swiss Accreditation Service Multilateral Agreement for the reco	is one of the signatories	s to the EA	creditation No.: SCS 0108
Client CCIC-HTW (Aud	len)	Certificate No	: D1750V2-1164_Feb18
CALIBRATION C	ERTIFICATE		
Object	D1750V2 - SN:11	64	
Calibration procedure(s)	QA CAL-05.v9 Calibration proces	dure for dipole validation kits abo	ove 700 MHz
Calibration date:	February 06, 201	8	
Calibration Equipment used (M&T Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator	ID # SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k)	Cal Date (Certificate No.) 04-Apr-17 (No. 217-02521/02522) 04-Apr-17 (No. 217-02521) 04-Apr-17 (No. 217-02522) 07-Apr-17 (No. 217-02528)	Scheduled Calibration Apr-18 Apr-18 Apr-18 Apr-18 Apr-18
Type-N mismatch combination Reference Probe EX3DV4 DAE4	SN: 5047.2 / 06327 SN: 7349 SN: 601	07-Apr-17 (No. 217-02529) 30-Dec-17 (No. EX3-7349_Dec17) 26-Oct-17 (No. DAE4-601_Oct17)	Apr-18
	011.001		Dec-18 Oct-18
Secondary Standards	ID #	Check Date (in house)	Oct-18 Scheduled Check
Secondary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer HP 8753E	ID # SN: GB37480704 SN: US37292783 SN: MY41092317 SN: 100972 SN: US37390585		Oct-18
Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06	SN: GB37480704 SN: US37292783 SN: MY41092317 SN: 100972	Check Date (in house) 07-Oct-15 (in house check Oct-16) 07-Oct-15 (in house check Oct-16) 07-Oct-15 (in house check Oct-16) 15-Jun-15 (in house check Oct-16)	Oct-18 Scheduled Check In house check: Oct-18 In house check: Oct-18 In house check: Oct-18 In house check: Oct-18
Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer HP 8753E	SN: GB37480704 SN: US37292783 SN: MY41092317 SN: 100972 SN: US37390585 Name	Check Date (in house) 07-Oct-15 (in house check Oct-16) 07-Oct-15 (in house check Oct-16) 07-Oct-15 (in house check Oct-16) 15-Jun-15 (in house check Oct-16) 18-Oct-01 (in house check Oct-17) Function	Oct-18 Scheduled Check In house check: Oct-18 In house check: Oct-18 In house check: Oct-18 In house check: Oct-18 In house check: Oct-18

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





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

#### Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM x,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: D1750V2-1164\_Feb18

Page 2 of 8

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Accreditation No.: SCS 0108

#### **Measurement Conditions**

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

DASY5	V52.10.0
Advanced Extrapolation	
Modular Flat Phantom	
10 mm	with Spacer
dx, dy, dz = 5 mm	
1750 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	40.1	1.37 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	39.4 ± 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	9.11 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	36.6 W/kg ± 17.0 % (k=2)
SAP overend over 10 cm <sup>3</sup> (10 c) - (11 c 1 TO)		
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	4.83 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	53.5 ± 6 %	1.46 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	9.06 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	36.7 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR measured	250 mW input power	4.84 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	19.5 W/kg ± 16.5 % (k=2)

Certificate No: D1750V2-1164\_Feb18

Page 3 of 8

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

#### Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.1 Ω - 0.1 jΩ	
Return Loss	- 39.2 dB	

#### Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.2 Ω - 1.3 jΩ	
Return Loss	- 27.6 dB	

#### General Antenna Parameters and Design

Electrical Delay (one direction)	1.216 ns
----------------------------------	----------

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

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

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

#### **Additional EUT Data**

Manufactured by	SPEAG	
Manufactured on	March 07, 2016	

Certificate No: D1750V2-1164\_Feb18

Page 4 of 8

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

Date: 06.02.2018

Test Laboratory: SPEAG, Zurich, Switzerland

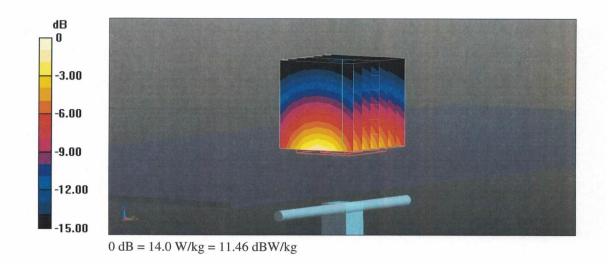
#### DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN:1164

Communication System: UID 0 - CW; Frequency: 1750 MHz Medium parameters used: f = 1750 MHz;  $\sigma$  = 1.35 S/m;  $\epsilon_r$  = 39.4;  $\rho$  = 1000 kg/m<sup>3</sup> Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

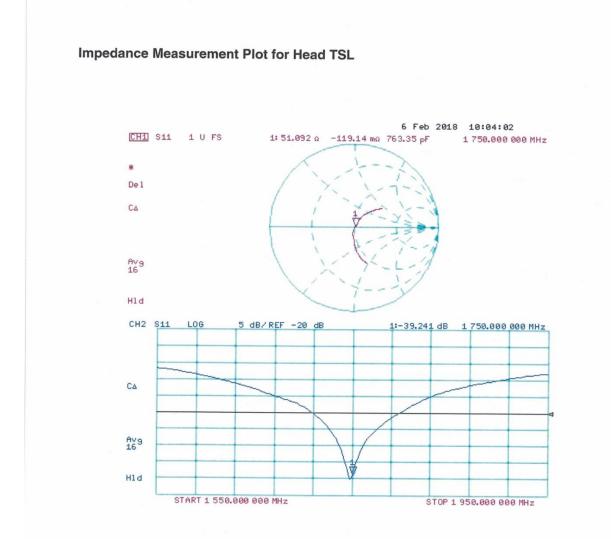
- Probe: EX3DV4 SN7349; ConvF(8.5, 8.5, 8.5); Calibrated: 30.12.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

#### 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 = 106.4 V/m; Power Drift = -0.09 dB Peak SAR (extrapolated) = 16.8 W/kg SAR(1 g) = 9.11 W/kg; SAR(10 g) = 4.83 W/kg Maximum value of SAR (measured) = 14.0 W/kg



Certificate No: D1750V2-1164\_Feb18

Page 5 of 8



Certificate No: D1750V2-1164\_Feb18

Page 6 of 8

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

Date: 06.02.2018

Test Laboratory: SPEAG, Zurich, Switzerland

### DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN:1164

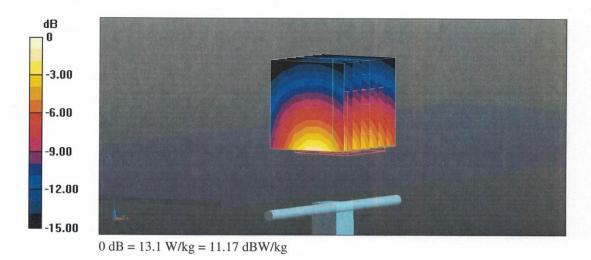
Communication System: UID 0 - CW; Frequency: 1750 MHz Medium parameters used: f = 1750 MHz;  $\sigma$  = 1.46 S/m;  $\epsilon_r$  = 53.5;  $\rho$  = 1000 kg/m<sup>3</sup> Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(8.35, 8.35, 8.35); Calibrated: 30.12.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

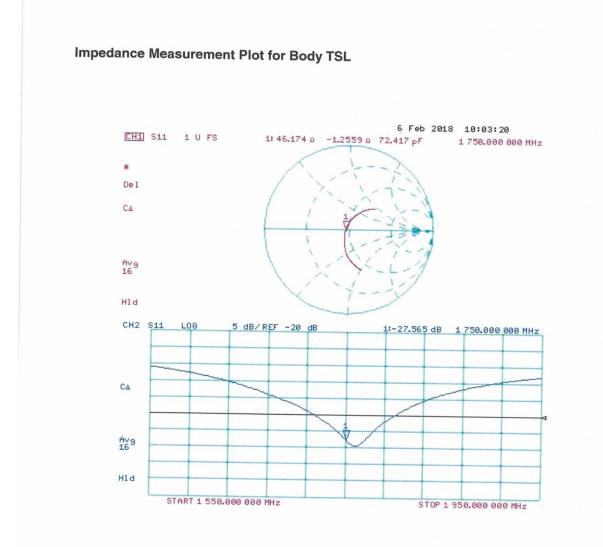
#### Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 99.62 V/m; Power Drift = -0.02 dB Peak SAR (extrapolated) = 16.0 W/kg SAR(1 g) = 9.06 W/kg; SAR(10 g) = 4.84 W/kgMaximum value of SAR (measured) = 13.1 W/kg



Certificate No: D1750V2-1164\_Feb18

Page 7 of 8



Certificate No: D1750V2-1164\_Feb18

Page 8 of 8

# **Extended Dipole Calibrations**

Referring to KDB865664 D01, if dipoles are verified in return loss (<-20dB, within 20% of prior calibration), and in impedance (within 5 ohm of prior calibration), the annual calibration is not necessary and the calibration interval can be extended.

			Head-1750			
Date of	Poturn loop (dP)	Dolto (9/)	Real Impedance	Delta	Imaginary	Delta
measurement	Return-loss (dB)	Delta (%)	(ohm)	(ohm)	impedance (ohm)	(ohm)
2018/2/6	-39.2		51.1		-0.1	
2019/2/3	-38.6	-1.53%	50.7	0.4	-0.8	0.7

			Body-1750			
Date of	Return-loss (dB)	Delta (%)	Real Impedance	Delta	Imaginary	Delta
measurement	Return-1055 (ub)	Della (%)	(ohm)	(ohm)	impedance (ohm)	(ohm)
2018/2/6	-27.6		46.2		-1.3	
2019/2/3	-27.1	-1.81%	46.9	0.7	-0.5	0.8

The return loss is <-20dB, within 20% of prior calibration; the impedance is within 50hm of prior calibration. Therefore the verification result should support extended calibration.

# 1.4. D1900V2 Dipole Calibration Certificate

Engineering AG Zeughausstrasse 43, 8004 Zuri	ry of ch, Switzerland	COMPACT AND A STATE OF	Service suisse d'étalonnage Servizio svizzero di taratura
Accredited by the Swiss Accredit The Swiss Accreditation Servic Multilateral Agreement for the	ce is one of the signator	ies to the EA	Accreditation No.: SCS 0108
Client CCIC-HTW (Au	uden)	Certificate N	No: D1900V2-5d226_Feb18
CALIBRATION	CERTIFICAT	E	
Object	D1900V2 - SN:5	5d226	
Calibration procedure(s)	QA CAL-05.v9 Calibration proc	edure for dipole validation kits ab	ove 700 MHz
Calibration date:	February 22, 20	18	
All calibrations have been condu	cted in the closed laborate		
Calibration Equipment used (M&	TE critical for calibration)	ory facility: environment temperature (22 ± 3)°	
		Cal Date (Certificate No.)	Scheduled Calibration
Calibration Equipment used (M&	TE critical for calibration)	Cal Date (Certificate No.) 04-Apr-17 (No. 217-02521/02522)	Scheduled Calibration Apr-18
Calibration Equipment used (M& Primary Standards Power meter NRP	TE critical for calibration)	Cal Date (Certificate No.) 04-Apr-17 (No. 217-02521/02522) 04-Apr-17 (No. 217-02521)	Scheduled Calibration Apr-18 Apr-18
Calibration Equipment used (M& Primary Standards Power meter NRP Power sensor NRP-Z91	TE critical for calibration) ID # SN: 104778 SN: 103244	Cal Date (Certificate No.) 04-Apr-17 (No. 217-02521/02522)	Scheduled Calibration Apr-18 Apr-18 Apr-18
Calibration Equipment used (M& Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91	TE critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245	Cal Date (Certificate No.) 04-Apr-17 (No. 217-02521/02522) 04-Apr-17 (No. 217-02521) 04-Apr-17 (No. 217-02522)	Scheduled Calibration Apr-18 Apr-18
Calibration Equipment used (M& Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator	TE critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k)	Cal Date (Certificate No.) 04-Apr-17 (No. 217-02521/02522) 04-Apr-17 (No. 217-02521) 04-Apr-17 (No. 217-02522) 07-Apr-17 (No. 217-02528)	Scheduled Calibration Apr-18 Apr-18 Apr-18 Apr-18 Apr-18
Calibration Equipment used (M& Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4	TE critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327	Cal Date (Certificate No.) 04-Apr-17 (No. 217-02521/02522) 04-Apr-17 (No. 217-02521) 04-Apr-17 (No. 217-02522) 07-Apr-17 (No. 217-02528) 07-Apr-17 (No. 217-02529)	Scheduled Calibration Apr-18 Apr-18 Apr-18 Apr-18 Apr-18 Apr-18
Calibration Equipment used (M& Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards	TE critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349	Cal Date (Certificate No.) 04-Apr-17 (No. 217-02521/02522) 04-Apr-17 (No. 217-02521) 04-Apr-17 (No. 217-02522) 07-Apr-17 (No. 217-02528) 07-Apr-17 (No. 217-02529) 30-Dec-17 (No. EX3-7349_Dec17)	Scheduled Calibration Apr-18 Apr-18 Apr-18 Apr-18 Apr-18 Apr-18 Dec-18
Calibration Equipment used (M& Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter EPM-442A	TE critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601 ID # SN: GB37480704	Cal Date (Certificate No.) 04-Apr-17 (No. 217-02521/02522) 04-Apr-17 (No. 217-02521) 04-Apr-17 (No. 217-02522) 07-Apr-17 (No. 217-02528) 07-Apr-17 (No. 217-02529) 30-Dec-17 (No. EX3-7349_Dec17) 26-Oct-17 (No. DAE4-601_Oct17)	Scheduled Calibration Apr-18 Apr-18 Apr-18 Apr-18 Apr-18 Dec-18 Oct-18
Calibration Equipment used (M& Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter EPM-442A Power sensor HP 8481A	TE critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601 ID # SN: GB37480704 SN: US37292783	Cal Date (Certificate No.) 04-Apr-17 (No. 217-02521/02522) 04-Apr-17 (No. 217-02521) 04-Apr-17 (No. 217-02522) 07-Apr-17 (No. 217-02528) 07-Apr-17 (No. 217-02529) 30-Dec-17 (No. EX3-7349_Dec17) 26-Oct-17 (No. DAE4-601_Oct17) Check Date (in house)	Scheduled Calibration Apr-18 Apr-18 Apr-18 Apr-18 Apr-18 Dec-18 Oct-18 Scheduled Check
Calibration Equipment used (M& Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A	TE critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601 ID # SN: GB37480704 SN: US37292783 SN: MY41092317	Cal Date (Certificate No.)           04-Apr-17 (No. 217-02521/02522)           04-Apr-17 (No. 217-02521)           04-Apr-17 (No. 217-02522)           07-Apr-17 (No. 217-02528)           07-Apr-17 (No. 217-02529)           30-Dec-17 (No. EX3-7349_Dec17)           26-Oct-17 (No. DAE4-601_Oct17)           Check Date (in house)           07-Oct-15 (in house check Oct-16)           07-Oct-15 (in house check Oct-16)	Scheduled Calibration Apr-18 Apr-18 Apr-18 Apr-18 Apr-18 Dec-18 Oct-18 Scheduled Check In house check: Oct-18
Calibration Equipment used (M& Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06	TE critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601 ID # SN: GB37480704 SN: US37292783 SN: MY41092317 SN: 100972	Cal Date (Certificate No.) 04-Apr-17 (No. 217-02521/02522) 04-Apr-17 (No. 217-02521) 04-Apr-17 (No. 217-02522) 07-Apr-17 (No. 217-02528) 07-Apr-17 (No. 217-02529) 30-Dec-17 (No. EX3-7349_Dec17) 26-Oct-17 (No. DAE4-601_Oct17) Check Date (in house) 07-Oct-15 (in house check Oct-16) 07-Oct-15 (in house check Oct-16) 07-Oct-15 (in house check Oct-16) 15-Jun-15 (in house check Oct-16)	Scheduled Calibration Apr-18 Apr-18 Apr-18 Apr-18 Apr-18 Dec-18 Oct-18 Scheduled Check In house check: Oct-18 In house check: Oct-18
Calibration Equipment used (M& Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06	TE critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601 ID # SN: GB37480704 SN: US37292783 SN: MY41092317	Cal Date (Certificate No.)           04-Apr-17 (No. 217-02521/02522)           04-Apr-17 (No. 217-02521)           04-Apr-17 (No. 217-02522)           07-Apr-17 (No. 217-02528)           07-Apr-17 (No. 217-02529)           30-Dec-17 (No. EX3-7349_Dec17)           26-Oct-17 (No. DAE4-601_Oct17)           Check Date (in house)           07-Oct-15 (in house check Oct-16)           07-Oct-15 (in house check Oct-16)	Scheduled Calibration Apr-18 Apr-18 Apr-18 Apr-18 Dec-18 Oct-18 Scheduled Check In house check: Oct-18 In house check: Oct-18 In house check: Oct-18
Calibration Equipment used (M& Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer HP 8753E	TE critical for calibration)           ID #           SN: 104778           SN: 103244           SN: 103245           SN: 5058 (20k)           SN: 5047.2 / 06327           SN: 7349           SN: 601           ID #           SN: 037292783           SN: 100972           SN: 0037390585           Name	Cal Date (Certificate No.)           04-Apr-17 (No. 217-02521/02522)           04-Apr-17 (No. 217-02521)           04-Apr-17 (No. 217-02522)           07-Apr-17 (No. 217-02528)           07-Apr-17 (No. 217-02529)           30-Dec-17 (No. 217-02529)           30-Dec-17 (No. DAE4-601_Oct17)           Check Date (in house)           07-Oct-15 (in house check Oct-16)           07-Oct-15 (in house check Oct-16)           15-Jun-15 (in house check Oct-16)           18-Oct-01 (in house check Oct-17)           Function	Scheduled Calibration Apr-18 Apr-18 Apr-18 Apr-18 Apr-18 Dec-18 Oct-18 Scheduled Check In house check: Oct-18 In house check: Oct-18
Calibration Equipment used (M& Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer HP 8753E	TE critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601 ID # SN: GB37480704 SN: US37292783 SN: MY41092317 SN: 100972 SN: US37390585	Cal Date (Certificate No.) 04-Apr-17 (No. 217-02521/02522) 04-Apr-17 (No. 217-02521) 04-Apr-17 (No. 217-02522) 07-Apr-17 (No. 217-02528) 07-Apr-17 (No. 217-02529) 30-Dec-17 (No. EX3-7349_Dec17) 26-Oct-17 (No. DAE4-601_Oct17) Check Date (in house) 07-Oct-15 (in house check Oct-16) 07-Oct-15 (in house check Oct-16) 15-Jun-15 (in house check Oct-16) 18-Oct-01 (in house check Oct-17)	Scheduled Calibration Apr-18 Apr-18 Apr-18 Apr-18 Apr-18 Dec-18 Oct-18 Scheduled Check In house check: Oct-18 In house check: Oct-18
Calibration Equipment used (M& Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06	TE critical for calibration)           ID #           SN: 104778           SN: 103244           SN: 103245           SN: 5058 (20k)           SN: 5047.2 / 06327           SN: 7349           SN: 601           ID #           SN: 037292783           SN: 100972           SN: 0037390585           Name	Cal Date (Certificate No.)           04-Apr-17 (No. 217-02521/02522)           04-Apr-17 (No. 217-02521)           04-Apr-17 (No. 217-02522)           07-Apr-17 (No. 217-02528)           07-Apr-17 (No. 217-02529)           30-Dec-17 (No. 217-02529)           30-Dec-17 (No. DAE4-601_Oct17)           Check Date (in house)           07-Oct-15 (in house check Oct-16)           07-Oct-15 (in house check Oct-16)           15-Jun-15 (in house check Oct-16)           18-Oct-01 (in house check Oct-17)           Function	Scheduled Calibration Apr-18 Apr-18 Apr-18 Apr-18 Apr-18 Dec-18 Oct-18 Scheduled Check In house check: Oct-18 In house check: Oct-18

Certificate No: D1900V2-5d226\_Feb18

Page 1 of 8