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

#### Antenna Parameters with Head TSL at 5250 MHz

Impedance, transformed to feed point	49.7 Ω - 9.8 jΩ	
Return Loss	- 20.1 dB	

#### Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	57.2 Ω - 6.4 jΩ	
Return Loss	- 21.0 dB	

### Antenna Parameters with Head TSL at 5750 MHz

Impedance, transformed to feed point	56.4 Ω - 6.7 jΩ	
Return Loss	- 21.2 dB	

## Antenna Parameters with Body TSL at 5250 MHz

Impedance, transformed to feed point	51.2 Ω - 8.3 jΩ	
Return Loss	- 21.6 dB	

### Antenna Parameters with Body TSL at 5600 MHz

Impedance, transformed to feed point	59.9 Ω - 3.0 jΩ	
Return Loss	- 20.5 dB	

## Antenna Parameters with Body TSL at 5750 MHz

Impedance, transformed to feed point	58.2 Ω - 4.5 jΩ	
Return Loss	- 21.3 dB	

# **General Antenna Parameters and Design**

Electrical Delay (one direction)	1.206 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	September 20, 2012	

Certificate No: D5GHzV2-1155\_Apr17

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

Date: 25.04.2017

Test Laboratory: SPEAG, Zurich, Switzerland

# DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1155

Communication System: UID 0 - CW; Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz

Medium parameters used: f = 5250 MHz;  $\sigma = 4.52$  S/m;  $\epsilon_r = 34.6$ ;  $\rho = 1000$  kg/m³, Medium parameters used: f = 5600 MHz;  $\sigma = 4.86$  S/m;  $\epsilon_r = 34.2$ ;  $\rho = 1000$  kg/m³, Medium parameters used: f = 5750 MHz;  $\sigma = 5.06$  S/m;  $\epsilon_r = 33.9$ ;  $\rho = 1000$  kg/m³

Phantom section: Flat Section

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

### DASY52 Configuration:

- Probe: EX3DV4 SN3503; ConvF(5.58, 5.58, 5.58); Calibrated: 31.12.2016, ConvF(5.09, 5.09, 5.09); Calibrated: 31.12.2016, ConvF(5.02, 5.02, 5.02); Calibrated: 31.12.2016;
- 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(1442); SEMCAD X 14.6.10(7413)

# Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5250 MHz/Zoom Scan,

dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 71.22 V/m; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 29.0 W/kg

SAR(1 g) = 7.88 W/kg; SAR(10 g) = 2.25 W/kg

Maximum value of SAR (measured) = 18.0 W/kg

# Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan,

dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 71.31 V/m; Power Drift = -0.07 dB

Peak SAR (extrapolated) = 32.2 W/kg

SAR(1 g) = 8.19 W/kg; SAR(10 g) = 2.33 W/kg

Maximum value of SAR (measured) = 19.3 W/kg

# Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5750 MHz/Zoom Scan,

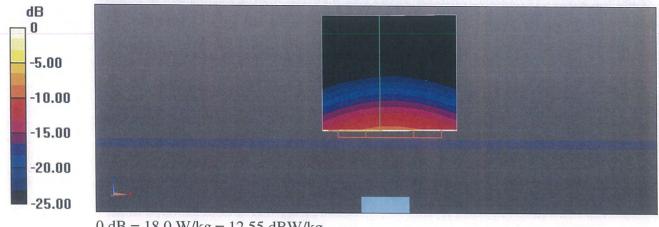
dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 69.08 V/m; Power Drift = -0.09 dB

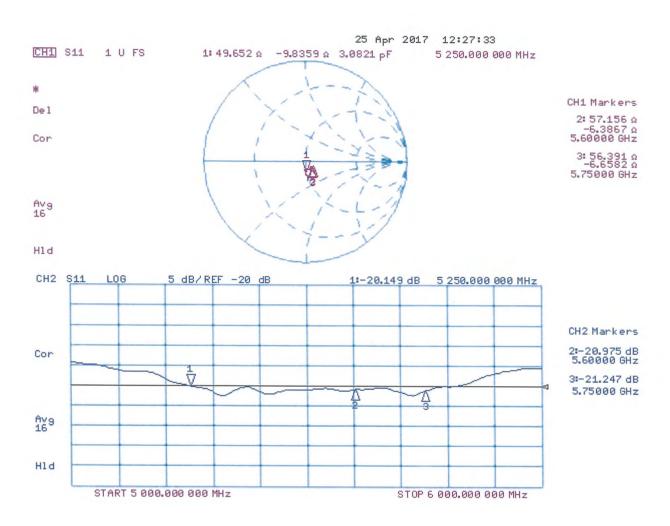
Peak SAR (extrapolated) = 31.5 W/kg

SAR(1 g) = 7.8 W/kg; SAR(10 g) = 2.22 W/kg

Maximum value of SAR (measured) = 18.7 W/kg



0 dB = 18.0 W/kg = 12.55 dBW/kg



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

Date: 26.04.2017

Test Laboratory: SPEAG, Zurich, Switzerland

### DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1155

Communication System: UID 0 - CW; Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz

Medium parameters used: f = 5250 MHz;  $\sigma = 5.5$  S/m;  $\epsilon_r = 47.7$ ;  $\rho = 1000$  kg/m<sup>3</sup>, Medium parameters used: f = 5600 MHz;  $\sigma = 5.97$  S/m;  $\epsilon_r = 47$ ;  $\rho = 1000$  kg/m<sup>3</sup>, Medium parameters used: f = 5750 MHz;  $\sigma = 6.18$  S/m;  $\epsilon_r = 46.8$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

### DASY52 Configuration:

- Probe: EX3DV4 SN3503; ConvF(5.14, 5.14, 5.14); Calibrated: 31.12.2016, ConvF(4.57, 4.57, 4.57); Calibrated: 31.12.2016, ConvF(4.51, 4.51, 4.51); Calibrated: 31.12.2016;
- 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(1442); SEMCAD X 14.6.10(7413)

## Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5200MHz/Zoom Scan,

dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 61.55 V/m; Power Drift = -0.09 dB

Peak SAR (extrapolated) = 28.6 W/kg

SAR(1 g) = 7.51 W/kg; SAR(10 g) = 2.1 W/kg

Maximum value of SAR (measured) = 17.4 W/kg

### Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan,

dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 62.72 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 32.9 W/kg

SAR(1 g) = 7.91 W/kg; SAR(10 g) = 2.22 W/kg

Maximum value of SAR (measured) = 19.9 W/kg

### Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5750 MHz/Zoom Scan,

dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

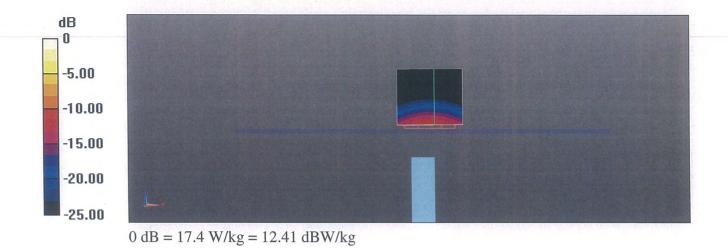
Reference Value = 60.66 V/m; Power Drift = -0.09 dB

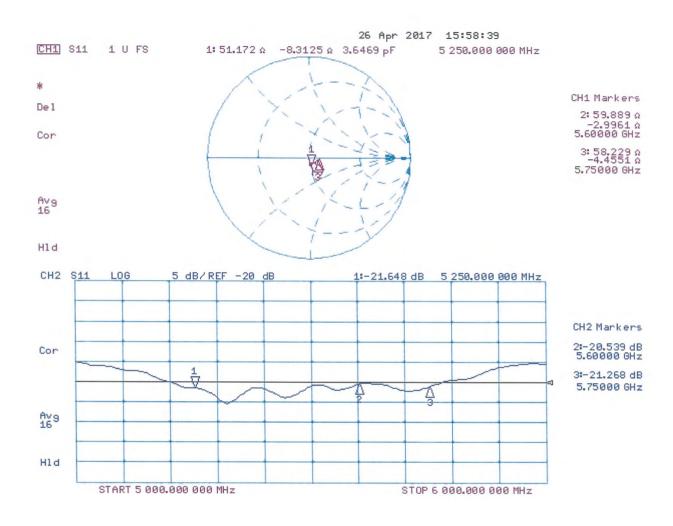
Peak SAR (extrapolated) = 32.8 W/kg

SAR(1 g) = 7.63 W/kg; SAR(10 g) = 2.13 W/kg

Maximum value of SAR (measured) = 19.4 W/kg

Certificate No: D5GHzV2-1155\_Apr17





## Justification of the extended calibration of Dipole D835V2 SN: 4d126

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 835 Head TST	Target Value	Measured Value	Difference
Impedance transformed to feed point	51.50Ω-0.7jΩ	47.62Ω-0.67jΩ	R= -3.88Ω, X= 0.03Ω
Return Loss	-35.8dB	-32.16dB	10.17%
Dipole 835 Body TST	Target Value	Measured Value	Difference
Impedance transformed to feed point	48Ω-2.5jΩ	44.09Ω-0.94jΩ	R= -3.91Ω, X= 1.56Ω
Return Loss	-29.6dB	-25.2dB	14.86%
Measured Date	2015-07-23	2017-07-19	
Impedance Tes	st-Head	Return Loss	Test-Head
>TOS 511 Seith (R-)<> Scale 1.000U [F1] >1 835.00000 MHZ 47.622 Q -667.65 mQ 287.49 pF		10.00   51 Log Mag 10.00db/ Ref -30.00db [F1]   20.00   51 835.00000 MHz -32.160 db   10.00   10.00   -32.000   -30.00	
Impedance Tes	st-Body	Return Loss	Test- Body
SIL Smith (84)%) Scale 1.0000 [F1]  >1 835,00000 MHz 44,089 0 938.31 mg 176.85 pH		10.00   51	

## 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	t-Head	Return Loss T	est-Head
		20.00 10.00 0.000 -10.00 -20.00 -30.00 -40.00	
Impedance Tes	t-Body	Return Loss Test- Body	
) 1 1.750000 GHz 45.535 0 -3.5522 0 25-607 PF		\$10.00   \$1.1.09 Mag 10.0060 Ref 0.00060 [F1]   \$50.00   \$1.1.7500600 GHZ -25.800 db   \$40.00   \$10.00	

# Justification of the extended calibration of Dipole D1900V2 SN: 5d091

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.

Dipole1900 Head TST	Target Value	Measured Value	Difference
Impedance transformed to feed point	52.0Ω+5.5jΩ	50.03Ω+3.15jΩ	R=-1.97Ω, X=-2.35Ω
Return Loss	-24.8dB	-29.05dB	-17.14%
Dipole1900 Body TST	Target Value	Measured Value	Difference
Impedance transformed to feed point	48.2Ω+6.0jΩ	47.44Ω+5.92jΩ	R=-0.76Ω, X=-0.08Ω
Return Loss	-24.0dB	-23.57dB	1.80%
Measured Date	2015-09-21	2017-09-19	
Impedance Tes	st-Head	Return Loss T	est-Head
1 Active Ch/Trace 2 Response 3 Stimulus 4 Mir/Analysis 5 Instr State  Trl Sil Smith (R+jx) Scale 1.000U [F1]		1 Active Ch(Trace 2 Response 3 Stimulus 4 Mkr/Analysis 5 Instr State   Tr1   S11   Log Mag 10.00d8/ Ref = 20.00d8 [F1]	
		10.00 0.000 -10.00 -20.00 -30.00 -40.00 -60.00 -70.00	
Impedance Tes	st-Body	Return Loss Test-Body	
Acthe CP(Inser 2 Response 3 Simula 4 Mis(Reslys 5 State 2 de Print 511 Smith (Reslys 5 state 1.0000 [F1]   1.9000000 GHz 47.435 G 5.9212 G 455:99 pm		1 Active Chilinace 2 Response 3 Strudus 4 MiriAnalysis 5 Indo 3 Sate   Time	

## Justification of the extended calibration of Dipole D2450V2 SN:978

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.

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Dipole 2450 Head TST	Target Value	Measured Value	Difference
Impedance transformed to feed point	53Ω+3.6jΩ	49.89Ω+0.34jΩ	R=-3.11Ω, X=-3.26Ω
Return Loss	-26.8dB	-29.17dB	8.84%
Dipole 2450 Body TST	Target Value	Measured Value	Difference
Impedance transformed to feed point	49.8Ω+5.8jΩ	50.68Ω+2.02jΩ	R=0.88Ω, X=-3.78Ω
Return Loss	-24.7dB	-23.91dB	-3.20%
Measured Date	2016-02-08	2017-01-26	
Impedance Tes	st-Head	Return Loss	Test-Head
> [F1] S11 Smith (R+jX) Scale 1.0000 [F1] >1 2.4500000 GHz 49.890 0 342.68 m0 22:261 pH		FIT S11 Log Mag 10.00d8/ Ref 0.000d8 [F1] 50.00 F1 2.4500000 GHz -29.172 d8	
		40.00 20.00 20.00 10.00 -10.00 -20.00 -40.00 -40.00	
Impedance Tes	st-Body	Return Loss	Test- Body
>1 2.4500000 GHZ 50.677 D 2.0210 D 111-29 PH		30.00 31 2.450000 GHz -23.912 db 40.00 40.00 10.	

# Justification of the extended calibration of Dipole D2600V2 SN:1119

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.

Dipole 2600 Head TST	Target Value	Measured Value	Difference
Impedance transformed to feed point	49.1Ω-7.4jΩ	48.35Ω-3.06jΩ	R=-0.75Ω, X=4.34Ω
Return Loss	-22.5dB	-24.25dB	7.78%
Dipole 2600 Body TST	Target Value	Measured Value	Difference
Impedance transformed to feed point	45.8Ω-6.0jΩ	43.94Ω-5.35jΩ	R=-1.86Ω, X=0.65Ω
Return Loss	-22.3dB	-23.41dB	4.98%
Measured Date	2016-02-03	2017-01-26	
Impedance Test-Head		Return Loss Test-Head	
FTE S11 Smith (R+jX) Scale 1.0000 [F1]		FTE 511 Log Mag 10.00ds/ Ref 0.00ds [F1] 50.00   51   2.600000 GHz   -24.249 ds	
>1 2.6000000 GHz 48.346 Ω -3.0648 Ω 19.973 PF		40,00	
		80.00	
		70.00	
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ð		0.000	
		-10.00	
		-20.00	
		-30.00	
		-40.00	
Impedance Test Padu		Poturn Loca Toot Pody	
Impedance Test-Body		Return Loss Test- Body	
51 2,6000000 GHZ 43,940 ti -5,3484 ti 11,485 pF		50.00 >1 2.6000000 GHz -23.407 dB	
		40-00	
		30.00	
*		20.00	
		10.00	
		0.000	1
		-10.00	
		-20.00	
		-30.00	
		-40.00	