Body TSL parameters at 5200 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	49.0	5.30 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	47.4 ± 6 %	5.37 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5200 MHz

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.37 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**73.2 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.08 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**20.6 W/kg ± 19.5 % (k=2)**

Body TSL parameters at 5300 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.9	5.42 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	47.2 ± 6 %	5.50 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5300 MHz

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.67 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**76.2 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.15 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**21.3 W/kg ± 19.5 % (k=2)**

Body TSL parameters at 5500 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.6	5.65 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.8 ± 6 %	5.76 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5500 MHz

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.95 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**79.0 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.22 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**22.0 W/kg ± 19.5 % (k=2)**

Body TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.5	5.77 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.7 ± 6 %	5.90 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5600 MHz

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.89 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**78.4 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.22 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**22.0 W/kg ± 19.5 % (k=2)**

Body TSL parameters at 5800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.2	6.00 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.3 ± 6 %	6.19 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5800 MHz

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.60 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**75.5 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.12 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**21.0 W/kg ± 19.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL at 5200 MHz

Impedance, transformed to feed point	49.2 Ω - 4.6 jΩ
Return Loss	- 26.5 dB

Antenna Parameters with Head TSL at 5300 MHz

Impedance, transformed to feed point	48.0 Ω - 0.4 jΩ
Return Loss	- 33.7 dB

Antenna Parameters with Head TSL at 5500 MHz

Impedance, transformed to feed point	47.2 Ω + 2.6 jΩ
Return Loss	- 28.2 dB

Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	50.5 Ω + 2.1 jΩ
Return Loss	- 33.3 dB

Antenna Parameters with Head TSL at 5800 MHz

Impedance, transformed to feed point	52.1 Ω + 2.8 jΩ
Return Loss	- 29.3 dB

Antenna Parameters with Body TSL at 5200 MHz

Impedance, transformed to feed point	49.0 Ω - 3.3 jΩ
Return Loss	- 29.1 dB

Antenna Parameters with Body TSL at 5300 MHz

Impedance, transformed to feed point	47.4 Ω + 0.2 jΩ
Return Loss	- 31.5 dB

Antenna Parameters with Body TSL at 5500 MHz

Impedance, transformed to feed point	46.8 Ω + 3.6 jΩ
Return Loss	- 26.1 dB

Antenna Parameters with Body TSL at 5600 MHz

Impedance, transformed to feed point	49.9 Ω + 4.0 jΩ
Return Loss	- 27.9 dB

Antenna Parameters with Body TSL at 5800 MHz

Impedance, transformed to feed point	52.5 Ω + 4.9 jΩ
Return Loss	- 25.3 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.192 ns

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	November 14, 2014

DASY5 Validation Report for Head TSL

Date: 14.03.2016

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1212

Communication System: UID 0 - CW; Frequency: 5200 MHz, Frequency: 5300 MHz, Frequency: 5500 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz
Medium parameters used: f = 5200 MHz; σ = 4.49 S/m; ε_r = 34.8; ρ = 1000 kg/m^3 , Medium parameters used: f = 5300 MHz; σ = 4.58 S/m; ε_r = 34.6; ρ = 1000 kg/m^3 , Medium parameters used: f = 5500 MHz; σ = 4.77 S/m; ε_r = 34.4; ρ = 1000 kg/m^3 , Medium parameters used: f = 5600 MHz; σ = 4.87 S/m; ε_r = 34.2; ρ = 1000 kg/m^3 , Medium parameters used: f = 5800 MHz; σ = 5.08 S/m; ε_r = 34; ρ = 1000 kg/m^3
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.59, 5.59, 5.59); Calibrated: 31.12.2015, ConvF(5.25, 5.25, 5.25); Calibrated: 31.12.2015, ConvF(5.18, 5.18, 5.18); Calibrated: 31.12.2015, ConvF(4.99, 4.99, 4.99); Calibrated: 31.12.2015, ConvF(4.95, 4.95, 4.95); Calibrated: 31.12.2015;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom Type: QD000P50AA
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

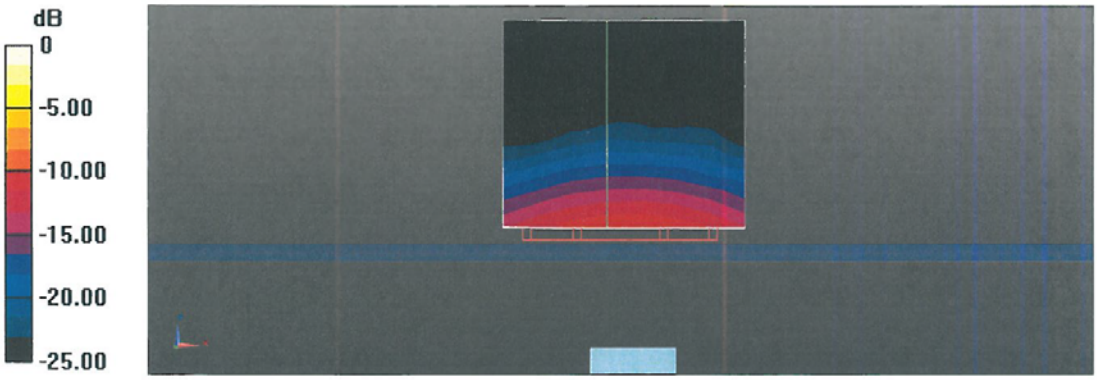
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 72.04 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 27.4 W/kg
SAR(1 g) = 7.6 W/kg; SAR(10 g) = 2.18 W/kg
Maximum value of SAR (measured) = 17.5 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5300 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 73.31 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 30.5 W/kg
SAR(1 g) = 8.19 W/kg; SAR(10 g) = 2.36 W/kg
Maximum value of SAR (measured) = 19.1 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5500 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 72.28 V/m; Power Drift = 0.06 dB
Peak SAR (extrapolated) = 31.8 W/kg
SAR(1 g) = 8.08 W/kg; SAR(10 g) = 2.31 W/kg
Maximum value of SAR (measured) = 19.2 W/kg

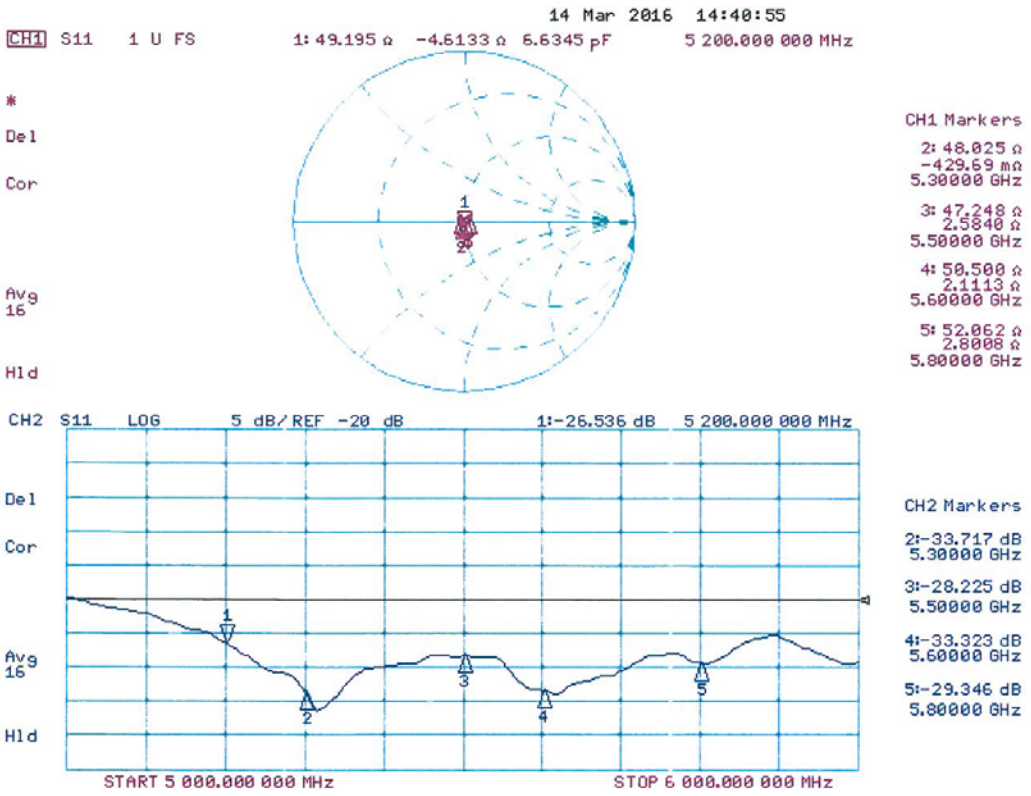
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 71.82 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 31.4 W/kg
SAR(1 g) = 7.99 W/kg; SAR(10 g) = 2.29 W/kg
Maximum value of SAR (measured) = 18.8 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 69.47 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 31.6 W/kg
SAR(1 g) = 7.66 W/kg; SAR(10 g) = 2.18 W/kg
Maximum value of SAR (measured) = 18.5 W/kg



0 dB = 18.5 W/kg = 12.67 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 15.03.2016

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1212

Communication System: UID 0 - CW; Frequency: 5200 MHz, Frequency: 5300 MHz, Frequency: 5500 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz
Medium parameters used: f = 5200 MHz; σ = 5.37 S/m; ε_r = 47.4; ρ = 1000 kg/m^3 , Medium parameters used: f = 5300 MHz; σ = 5.5 S/m; ε_r = 47.2; ρ = 1000 kg/m^3 , Medium parameters used: f = 5500 MHz; σ = 5.76 S/m; ε_r = 46.8; ρ = 1000 kg/m^3 , Medium parameters used: f = 5600 MHz; σ = 5.9 S/m; ε_r = 46.7; ρ = 1000 kg/m^3 , Medium parameters used: f = 5800 MHz; σ = 6.19 S/m; ε_r = 46.3; ρ = 1000 kg/m^3
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(4.99, 4.99, 4.99); Calibrated: 31.12.2015, ConvF(4.75, 4.75, 4.75); Calibrated: 31.12.2015, ConvF(4.4, 4.4, 4.4); Calibrated: 31.12.2015, ConvF(4.35, 4.35, 4.35); Calibrated: 31.12.2015, ConvF(4.27, 4.27, 4.27); Calibrated: 31.12.2015;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom Type: QD000P50AA
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

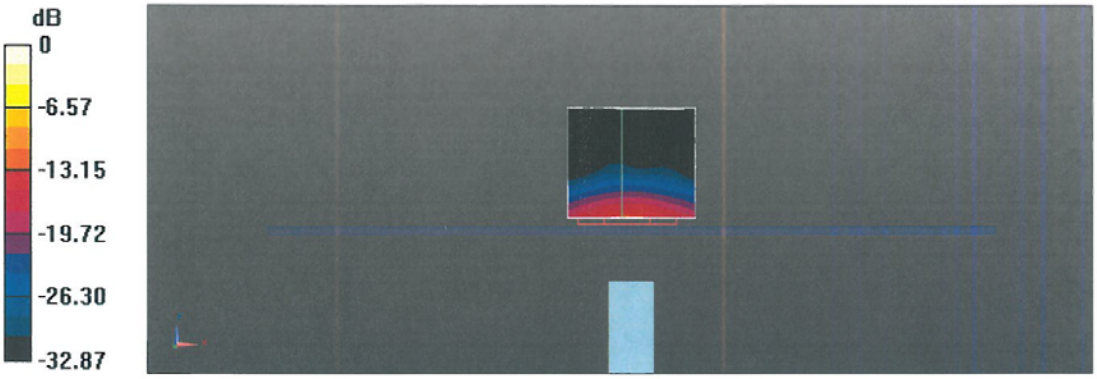
Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 66.69 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 27.3 W/kg
SAR(1 g) = 7.37 W/kg; SAR(10 g) = 2.08 W/kg
Maximum value of SAR (measured) = 17.3 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5300 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 67.48 V/m; Power Drift = -0.00 dB
Peak SAR (extrapolated) = 29.1 W/kg
SAR(1 g) = 7.67 W/kg; SAR(10 g) = 2.15 W/kg
Maximum value of SAR (measured) = 18.2 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5500 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 67.62 V/m; Power Drift = -0.00 dB
Peak SAR (extrapolated) = 31.8 W/kg
SAR(1 g) = 7.95 W/kg; SAR(10 g) = 2.22 W/kg
Maximum value of SAR (measured) = 19.2 W/kg

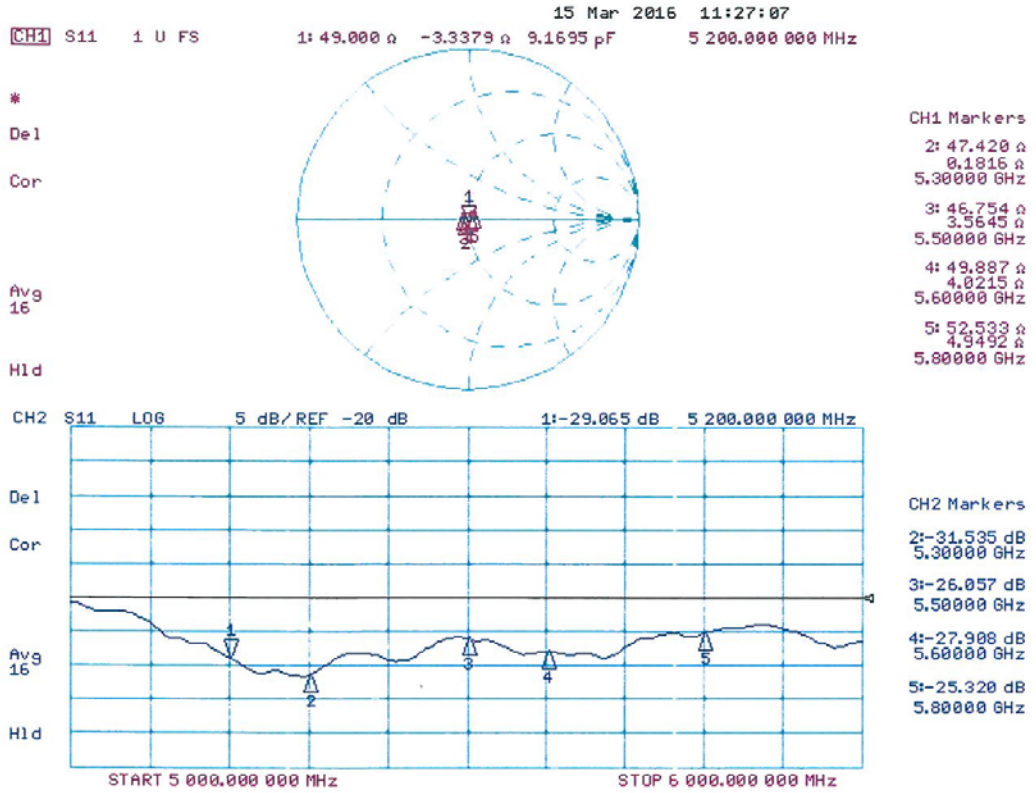
Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 67.42 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 32.4 W/kg
SAR(1 g) = 7.89 W/kg; SAR(10 g) = 2.22 W/kg
Maximum value of SAR (measured) = 19.4 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 64.97 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 33.0 W/kg
SAR(1 g) = 7.6 W/kg; SAR(10 g) = 2.12 W/kg
Maximum value of SAR (measured) = 19.0 W/kg



0 dB = 17.3 W/kg = 12.38 dBW/kg

Impedance Measurement Plot for Body TSL



Attachment 3. – SAR SYSTEM VALIDATION

SAR System Validation

Per FCC KDB 865664 D02v01r02, SAR system validation status should be documented to confirm measurement accuracy. The SAR systems (including SAR probes, system components and software versions) used for this device were validated against its performance specifications prior to the SAR measurements. Reference dipoles were used with the required tissue- equivalent media for system validation, according to the procedures outlined in FCC KDB 865664 D01v01r04 and IEEE 1528-2013.Since SAR probe calibrations are frequency dependent, each probe calibration point was validated at a frequency within the valid frequency range of the probe calibration point, using the system that normally operates with the probe for routine SAR measurements and according to the required tissue-equivalent media.

A tabulated summary of the system validation status including the validation date(s), measurement frequencies, SAR probes and tissue dielectric parameters has been included.

Table Attachment 3.1 SAR System Validation Summary

SAR System	Freq. [MHz]	Date	Probe SN	Probe Type	Probe CAL. Point		PERM.	COND.	CW Validation			MOD. Validation		
							(εr)	(σ)	Sensi-tivity	Probe Linearity	Probe Isortopy	MOD. Type	Duty Factor	PAR
C	750	2016-10-10	3933	EX3DV4	750	Head	42.226	0.913	PASS	PASS	PASS	N/A	N/A	N/A
C	835	2016-10-11	3933	EX3DV4	835	Head	40.856	0.882	PASS	PASS	PASS	N/A	N/A	N/A
C	835	2016-10-11	3933	EX3DV4	835	Head	40.856	0.882	PASS	PASS	PASS	GMSK	PASS	N/A
C	1900	2016-10-12	3933	EX3DV4	1900	Head	41.464	1.432	PASS	PASS	PASS	GMSK	PASS	N/A
C	2450	2016-10-17	3933	EX3DV4	2450	Head	38.364	1.850	PASS	PASS	PASS	OFDM	N/A	PASS
C	5300	2016-10-18	3933	EX3DV4	5300	Head	36.702	4.860	PASS	PASS	PASS	OFDM	N/A	PASS
C	5600	2016-10-19	3933	EX3DV4	5600	Head	34.865	5.062	PASS	PASS	PASS	OFDM	N/A	PASS
C	750	2016-10-10	3933	EX3DV4	750	Body	56.715	0.975	PASS	PASS	PASS	N/A	N/A	N/A
C	835	2016-10-11	3933	EX3DV4	835	Body	54.436	0.952	PASS	PASS	PASS	N/A	N/A	N/A
C	835	2016-10-11	3933	EX3DV4	835	Body	54.436	0.952	PASS	PASS	PASS	GMSK	PASS	N/A
C	1900	2016-10-12	3933	EX3DV4	1900	Body	52.115	1.466	PASS	PASS	PASS	GMSK	PASS	N/A
C	2450	2016-10-17	3933	EX3DV4	2450	Body	50.774	1.877	PASS	PASS	PASS	OFDM	N/A	PASS
C	5300	2016-10-18	3933	EX3DV4	5300	Body	49.446	5.423	PASS	PASS	PASS	OFDM	N/A	PASS
C	5600	2016-10-19	3933	EX3DV4	5600	Body	48.158	5.725	PASS	PASS	PASS	OFDM	N/A	PASS

NOTE: While the probes have been calibrated for both a CW and modulated signals, all measurements were performed using communication systems calibrated for CW signals only. Modulations in the table above represent test configurations for which the measurement system has been validated per FCC KDB Publication 865664 D01v01r04 for scenarios when CW probe calibrations are used with other signal types. SAR systems were validated for modulated signals with a periodic duty cycle, such as GMSK, or with a high peak to average ratio (>5 dB), such as OFDM according to KDB 865664.