Head TSL parameters at 5800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.3	5.27 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.1 ± 6 %	5.11 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5800 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.23 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**81.6 mW / g ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.35 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**23.3 mW / g ± 19.5 % (k=2)**

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	47.0 ± 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 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.37 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**73.1 mW / g ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.07 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**20.5 mW / g ± 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	46.5 ± 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 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.87 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**78.1 mW / g ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.19 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**21.7 mW / g ± 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	46.0 ± 6 %	6.16 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5800 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.44 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**73.8 mW / g ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.06 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**20.4 mW / g ± 19.5 % (k=2)**

Appendix

Antenna Parameters with Head TSL at 5200 MHz

Impedance, transformed to feed point	49.2 Ω - 7.1 jΩ
Return Loss	- 22.8 dB

Antenna Parameters with Head TSL at 5500 MHz

Impedance, transformed to feed point	51.5 Ω - 4.4 jΩ
Return Loss	- 26.8 dB

Antenna Parameters with Head TSL at 5800 MHz

Impedance, transformed to feed point	55.3 Ω - 2.7 jΩ
Return Loss	- 24.9 dB

Antenna Parameters with Body TSL at 5200 MHz

Impedance, transformed to feed point	49.6 Ω - 5.5 jΩ
Return Loss	- 25.2 dB

Antenna Parameters with Body TSL at 5500 MHz

Impedance, transformed to feed point	52.5 Ω - 3.2 jΩ
Return Loss	- 28.1 dB

Antenna Parameters with Body TSL at 5800 MHz

Impedance, transformed to feed point	56.6 Ω - 1.3 jΩ
Return Loss	- 24.0 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.202 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	December 30, 2005

DASY5 Validation Report for Head TSL

Date: 19.06.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1040

Communication System: CW; Frequency: 5200 MHz, Frequency: 5500 MHz, Frequency: 5800 MHz
Medium parameters used: f = 5200 MHz; σ = 4.52 mho/m; ε_r = 35; ρ = 1000 kg/m^3 , Medium parameters used: f = 5500 MHz; σ = 4.8 mho/m; ε_r = 34.6; ρ = 1000 kg/m^3 , Medium parameters used: f = 5800 MHz; σ = 5.11 mho/m; ε_r = 34.1; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

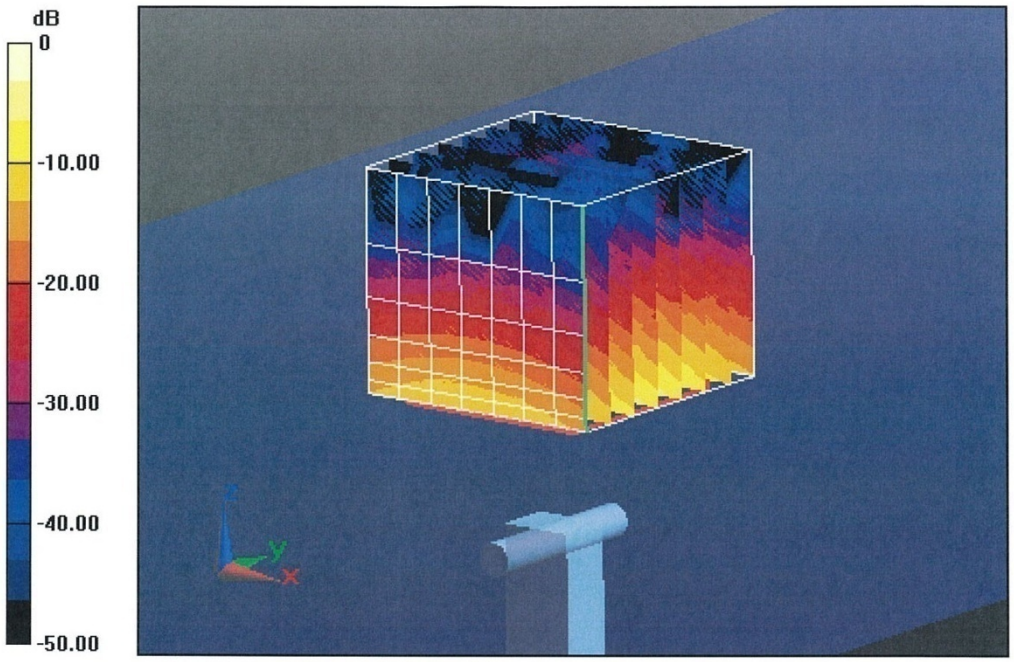
DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.41, 5.41, 5.41); Calibrated: 30.12.2011, ConvF(4.91, 4.91, 4.91); Calibrated: 30.12.2011, ConvF(4.81, 4.81, 4.81); Calibrated: 30.12.2011;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.1(838); SEMCAD X 14.6.5(6469)

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 = 65.507 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 30.371 mW/g
SAR(1 g) = 8.2 mW/g; SAR(10 g) = 2.36 mW/g
Maximum value of SAR (measured) = 19.0 mW/g

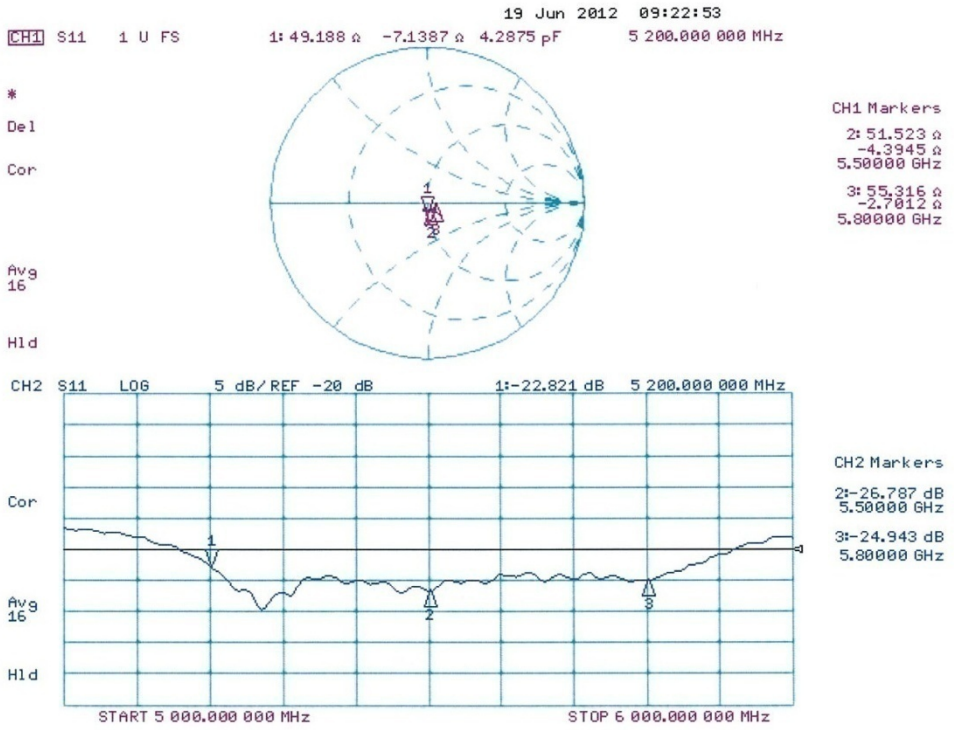
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5500 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 66.096 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 35.013 mW/g
SAR(1 g) = 8.82 mW/g; SAR(10 g) = 2.52 mW/g
Maximum value of SAR (measured) = 21.2 mW/g

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 = 62.419 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 34.147 mW/g
SAR(1 g) = 8.23 mW/g; SAR(10 g) = 2.35 mW/g
Maximum value of SAR (measured) = 20.0 mW/g



0 dB = 20.0 mW/g = 26.02 dB mW/g

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 18.06.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1040

Communication System: CW; Frequency: 5200 MHz, Frequency: 5500 MHz, Frequency: 5800 MHz
Medium parameters used: f = 5200 MHz; σ = 5.37 mho/m; ε_r = 47; ρ = 1000 kg/m^3 , Medium parameters used: f = 5500 MHz; σ = 5.76 mho/m; ε_r = 46.5; ρ = 1000 kg/m^3 , Medium parameters used: f = 5800 MHz; σ = 6.16 mho/m; ε_r = 46; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

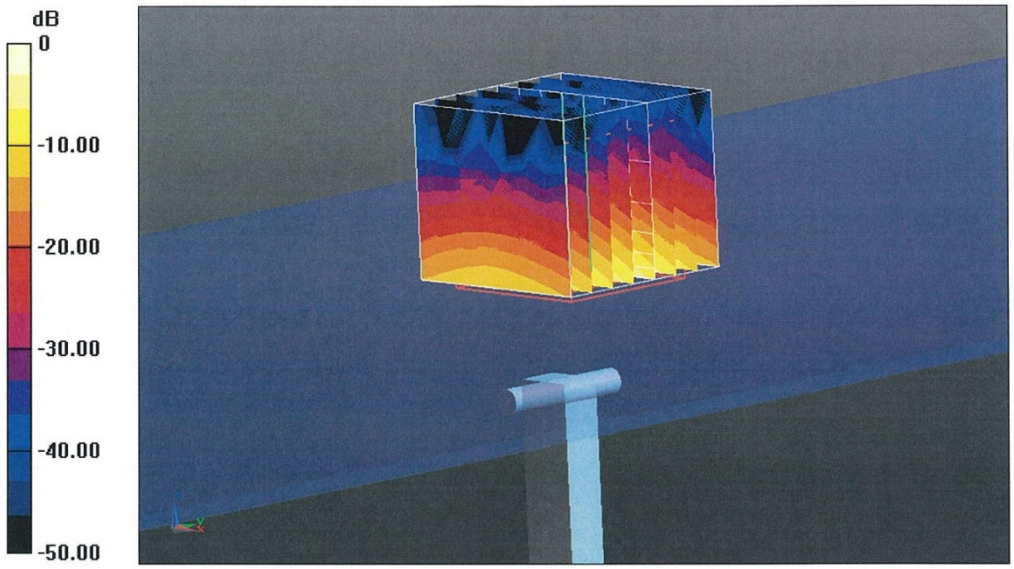
DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(4.91, 4.91, 4.91); Calibrated: 30.12.2011, ConvF(4.43, 4.43, 4.43); Calibrated: 30.12.2011, ConvF(4.38, 4.38, 4.38); Calibrated: 30.12.2011;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.1(838); SEMCAD X 14.6.5(6469)

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 = 58.667 V/m; Power Drift = -0.05 dB
Peak SAR (extrapolated) = 29.022 mW/g
SAR(1 g) = 7.37 mW/g; SAR(10 g) = 2.07 mW/g
Maximum value of SAR (measured) = 17.2 mW/g

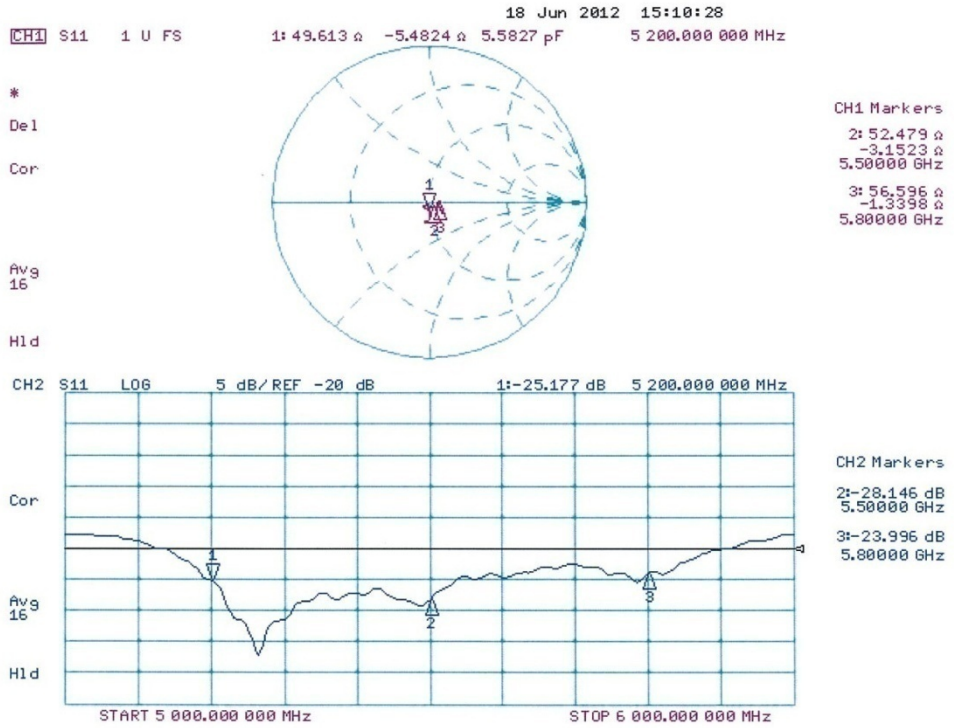
Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5500 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 58.708 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 33.769 mW/g
SAR(1 g) = 7.87 mW/g; SAR(10 g) = 2.19 mW/g
Maximum value of SAR (measured) = 19.0 mW/g

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 = 55.529 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 34.868 mW/g
SAR(1 g) = 7.44 mW/g; SAR(10 g) = 2.06 mW/g
Maximum value of SAR (measured) = 18.1 mW/g



0 dB = 18.1 mW/g = 25.15 dB mW/g

Impedance Measurement Plot for Body TSL



ANNEX I DIPOLE QUALIFICATION FOR THE EXTENDED 3-YEAR CALIBRATION INTERVAL

I1 Dipole750

The information and documentation below are provided to qualify the extended 3-year calibration interval of dipole.

I1.1 List of Equipment

No.	Name	Type	Serial Number
01	Network analyzer	E5071C	MY46110673
02	Power meter	NRVD	102083
03	Power sensor	NRV-Z5	100542
04	Signal Generator	E4438C	MY49070393
05	Amplifier	60S1G4	0331848
06	E-field Probe	SPEAG ES3DV3	3149
07	DAE	SPEAG DAE4	771
08	Dipole Validation Kit	SPEAG D750V3	1045

I1.2 Results of Impedance, Return-loss and System validation

Dipole 750 - Head

		Year		Deviation	Limit
		2011	2012		
Impedance	Real (Ω)	54.2	51.7	2.5Ω	Deviation < 5Ω
	Imaginary (Ω)	-2.3	0.9	3.2Ω	Deviation < 5Ω
Return-loss (dB)		-26.8	-26.7	0.1dB	Deviate < 0.2dB
System validation	10g	1.4	1.43	2.14%	Deviation < 10%
	1g	2.14	2.21	3.27%	Deviation < 10%

Dipole 750 - Body

		Year		Deviation	Limit
		2011	2012		
Impedance	Real (Ω)	49.5	49.6	0.1Ω	Deviation < 5Ω
	Imaginary (Ω)	-4.1	0.6	4.7Ω	Deviation < 5Ω
Return-loss (dB)		-27.5	-27.6	0.1dB	Deviate < 0.2dB
System validation	10g	1.45	1.47	1.38%	Deviation < 10%
	1g	2.2	2.25	2.27%	Deviation < 10%

According to the above tables, it is not necessary to recalibration the dipoles in 2012.

I2 Dipole 835

The information and documentation below are provided to qualify the extended 3-year calibration interval of dipole.

I2.1 List of Equipment

No.	Name	Type	Serial Number
01	Network analyzer	E5071C	MY46110673
02	Power meter	NRVD	102083
03	Power sensor	NRV-Z5	100542
04	Signal Generator	E4438C	MY49070393
05	Amplifier	60S1G4	0331848
06	E-field Probe	SPEAG EX3DV4	3846
07	DAE	SPEAG DAE4	771
08	Dipole Validation Kit	SPEAG D835V2	443

I2.2 Results of Impedance, Return-loss and System validation

Dipole 835 - Head

		Year		Deviation	Limit
		2012	2013		
Impedance	Real (Ω)	50.8	53.6	2.8Ω	Deviation < 5Ω
	Imaginary (Ω)	-6.7	-2.2	4.5Ω	Deviation < 5Ω
Return-loss (dB)		-23.5	-23.3	0.2dB	Deviate < 0.2dB
System validation	10g	1.52	1.56	2.63%	Deviation < 10%
	1g	2.33	2.38	2.15%	Deviation < 10%

Dipole 835 - Body

		Year		Deviation	Limit
		2012	2013		
Impedance	Real (Ω)	46.8	49.1	2.3Ω	Deviation < 5Ω
	Imaginary (Ω)	-7.8	-3.7	4.1Ω	Deviation < 5Ω
Return-loss (dB)		-21.2	-21.4	-0.2dB	Deviate < 0.2dB
System validation	10g	1.59	1.61	1.26%	Deviation < 10%
	1g	2.42	2.42	0.00%	Deviation < 10%

According to the above tables, it is not necessary to recalibration the dipoles in 2013.

I3 Dipole 1750

The information and documentation below are provided to qualify the extended 3-year calibration interval of dipole.

I3.1 List of Equipment

No.	Name	Type	Serial Number
01	Network analyzer	E5071C	MY46110673
02	Power meter	NRVD	102083
03	Power sensor	NRV-Z5	100542
04	Signal Generator	E4438C	MY49070393
05	Amplifier	60S1G4	0331848
06	E-field Probe	SPEAG EX3DV4	3846
07	DAE	SPEAG DAE4	771
08	Dipole Validation Kit	SPEAG D1750V2	1003

I3.2 Results of Impedance, Return-loss and System validation

Dipole 1750 - Head

		Year		Deviation	Limit
		2012	2013		
Impedance	Real (Ω)	50.3	51.5	1.2 Ω	Deviation < 5 Ω
	Imaginary (Ω)	1.3	3.7	2.4 Ω	Deviation < 5 Ω
Return-loss (dB)		-37.5	-37.3	0.2dB	Deviate < 0.2dB
System validation	10g	4.77	4.91	2.94%	Deviation < 10%
	1g	8.91	9.24	3.70%	Deviation < 10%

Dipole 1750 - Body

		Year		Deviation	Limit
		2012	2013		
Impedance	Real (Ω)	45.7	48.3	2.6 Ω	Deviation < 5 Ω
	Imaginary (Ω)	1.2	2.9	1.7 Ω	Deviation < 5 Ω
Return-loss (dB)		-26.6	-26.5	0.1dB	Deviate < 0.2dB
System validation	10g	5	5.01	0.20%	Deviation < 10%
	1g	9.26	9.22	-0.43%	Deviation < 10%

According to the above tables, it is not necessary to recalibration the dipoles in 2013.