16 Measurement Uncertainty

16.1 Measurement Uncertainty for Normal SAR Tests (300MHz~3GHz)

No.	Error Description	Type	Uncertainty value	Probably Distribution	Div.	(Ci) 1g	(Ci) 10g	Std. Unc. (1g)	Std. Unc. (10g)	Degree of freedom
Measurement system										
1	Probe calibration	B	5.5	N	1	1	1	5.5	5.5	∞
2	Isotropy	B	4.7	R	$\sqrt{3}$	0.7	0.7	1.9	1.9	∞
3	Boundary effect	B	1.0	R	$\sqrt{3}$	1	1	0.6	0.6	∞
4	Linearity	B	4.7	R	$\sqrt{3}$	1	1	2.7	2.7	∞
5	Detection limit	B	1.0	R	$\sqrt{3}$	1	1	0.6	0.6	∞
6	Readout electronics	B	0.3	R	$\sqrt{3}$	1	1	0.3	0.3	∞
7	Response time	B	0.8	R	$\sqrt{3}$	1	1	0.5	0.5	∞
8	Integration time	B	2.6	R	$\sqrt{3}$	1	1	1.5	1.5	∞
9	RF ambient conditions-noise	B	0	R	$\sqrt{3}$	1	1	0	0	∞
10	RFambient conditions-reflection	B	0	R	$\sqrt{3}$	1	1	0	0	∞
11	Probe positioned mech. restrictions	B	0.4	R	$\sqrt{3}$	1	1	0.2	0.2	∞
12	Probe positioning with respect to phantom shell	B	2.9	R	$\sqrt{3}$	1	1	1.7	1.7	∞
13	Post-processing	B	1.0	R	$\sqrt{3}$	1	1	0.6	0.6	∞
Test sample related										
14	Test sample positioning	A	3.3	N	1	1	1	3.3	3.3	71
15	Device holder uncertainty	A	3.4	N	1	1	1	3.4	3.4	5
16	Drift of output power	B	5.0	R	$\sqrt{3}$	1	1	2.9	2.9	∞
Phantom and set-up										
17	Phantom uncertainty	B	4.0	R	$\sqrt{3}$	1	1	2.3	2.3	∞
18	Liquid conductivity (target)	B	5.0	R	$\sqrt{3}$	0.64	0.43	1.8	1.2	∞
19	Liquid conductivity (meas.)	A	2.06	N	1	0.64	0.43	1.32	0.89	43
20	Liquid permittivity (target)	B	5.0	R	$\sqrt{3}$	0.6	0.49	1.7	1.4	∞
21	Liquid permittivity (meas.)	A	1.6	N	1	0.6	0.49	1.0	0.8	521

Combined standard uncertainty		$u_c' = \sqrt{\sum_{i=1}^{21} c_i^2 u_i^2}$						9.25	9.12	257
Expanded uncertainty (confidence interval of 95 %)		$u_e = 2u_c$						18.5	18.2	

16.2 Measurement Uncertainty for Normal SAR Tests (3~6GHz)

No.	Error Description	Type	Uncertainty value	Probably Distribution	Div.	(Ci) 1g	(Ci) 10g	Std. Unc. (1g)	Std. Unc. (10g)	Degree of freedom
Measurement system										
1	Probe calibration	B	6.5	N	1	1	1	6.5	6.5	∞
2	Isotropy	B	4.7	R	$\sqrt{3}$	0.7	0.7	1.9	1.9	∞
3	Boundary effect	B	2.0	R	$\sqrt{3}$	1	1	1.2	1.2	∞
4	Linearity	B	4.7	R	$\sqrt{3}$	1	1	2.7	2.7	∞
5	Detection limit	B	1.0	R	$\sqrt{3}$	1	1	0.6	0.6	∞
6	Readout electronics	B	0.3	R	$\sqrt{3}$	1	1	0.3	0.3	∞
7	Response time	B	0.8	R	$\sqrt{3}$	1	1	0.5	0.5	∞
8	Integration time	B	2.6	R	$\sqrt{3}$	1	1	1.5	1.5	∞
9	RF ambient conditions-noise	B	0	R	$\sqrt{3}$	1	1	0	0	∞
10	RFambient conditions-reflection	B	0	R	$\sqrt{3}$	1	1	0	0	∞
11	Probe positioned mech. restrictions	B	0.8	R	$\sqrt{3}$	1	1	0.5	0.5	∞
12	Probe positioning with respect to phantom shell	B	6.7	R	$\sqrt{3}$	1	1	3.9	3.9	∞
13	Post-processing	B	4.0	R	$\sqrt{3}$	1	1	2.3	2.3	∞
Test sample related										
14	Test sample positioning	A	3.3	N	1	1	1	3.3	3.3	71
15	Device holder uncertainty	A	3.4	N	1	1	1	3.4	3.4	5
16	Drift of output power	B	5.0	R	$\sqrt{3}$	1	1	2.9	2.9	∞
Phantom and set-up										
17	Phantom uncertainty	B	4.0	R	$\sqrt{3}$	1	1	2.3	2.3	∞
18	Liquid conductivity (target)	B	5.0	R	$\sqrt{3}$	0.64	0.43	1.8	1.2	∞
19	Liquid conductivity (meas.)	A	2.06	N	1	0.64	0.43	1.32	0.89	43

20	Liquid permittivity (target)	B	5.0	R	$\sqrt{3}$	0.6	0.49	1.7	1.4	∞
21	Liquid permittivity (meas.)	A	1.6	N	1	0.6	0.49	1.0	0.8	521
Combined standard uncertainty		$u_c' = \sqrt{\sum_{i=1}^{21} c_i^2 u_i^2}$						10.8	10.7	257
Expanded uncertainty (confidence interval of 95 %)		$u_e = 2u_c$						21.6	21.4	

16.3 Measurement Uncertainty for Fast SAR Tests (300MHz~3GHz)

No.	Error Description	Type	Uncertainty value	Probably Distribution	Div.	(Ci) 1g	(Ci) 10g	Std. Unc. (1g)	Std. Unc. (10g)	Degree of freedom
Measurement system										
1	Probe calibration	B	5.5	N	1	1	1	5.5	5.5	∞
2	Isotropy	B	4.7	R	$\sqrt{3}$	0.7	0.7	1.9	1.9	∞
3	Boundary effect	B	1.0	R	$\sqrt{3}$	1	1	0.6	0.6	∞
4	Linearity	B	4.7	R	$\sqrt{3}$	1	1	2.7	2.7	∞
5	Detection limit	B	1.0	R	$\sqrt{3}$	1	1	0.6	0.6	∞
6	Readout electronics	B	0.3	R	$\sqrt{3}$	1	1	0.3	0.3	∞
7	Response time	B	0.8	R	$\sqrt{3}$	1	1	0.5	0.5	∞
8	Integration time	B	2.6	R	$\sqrt{3}$	1	1	1.5	1.5	∞
9	RF ambient conditions-noise	B	0	R	$\sqrt{3}$	1	1	0	0	∞
10	RFambient conditions-reflection	B	0	R	$\sqrt{3}$	1	1	0	0	∞
11	Probe positioned mech. Restrictions	B	0.4	R	$\sqrt{3}$	1	1	0.2	0.2	∞
12	Probe positioning with respect to phantom shell	B	2.9	R	$\sqrt{3}$	1	1	1.7	1.7	∞
13	Post-processing	B	1.0	R	$\sqrt{3}$	1	1	0.6	0.6	∞
14	Fast SAR z-Approximation	B	7.0	R	$\sqrt{3}$	1	1	4.0	4.0	∞
Test sample related										
15	Test sample positioning	A	3.3	N	1	1	1	3.3	3.3	71
16	Device holder uncertainty	A	3.4	N	1	1	1	3.4	3.4	5
17	Drift of output power	B	5.0	R	$\sqrt{3}$	1	1	2.9	2.9	∞

Phantom and set-up										
18	Phantom uncertainty	B	4.0	R	$\sqrt{3}$	1	1	2.3	2.3	∞
19	Liquid conductivity (target)	B	5.0	R	$\sqrt{3}$	0.64	0.43	1.8	1.2	∞
20	Liquid conductivity (meas.)	A	2.06	N	1	0.64	0.43	1.32	0.89	43
21	Liquid permittivity (target)	B	5.0	R	$\sqrt{3}$	0.6	0.49	1.7	1.4	∞
22	Liquid permittivity (meas.)	A	1.6	N	1	0.6	0.49	1.0	0.8	521
Combined standard uncertainty		$u_c' = \sqrt{\sum_{i=1}^{22} c_i^2 u_i^2}$						10.1	9.95	257
Expanded uncertainty (confidence interval of 95 %)		$u_e = 2u_c$						20.2	19.9	

16.4 Measurement Uncertainty for Fast SAR Tests (3~6GHz)

No.	Error Description	Type	Uncertainty value	Probably Distribution	Div.	(Ci) 1g	(Ci) 10g	Std. Unc. (1g)	Std. Unc. (10g)	Degree of freedom
Measurement system										
1	Probe calibration	B	6.5	N	1	1	1	6.5	6.5	∞
2	Isotropy	B	4.7	R	$\sqrt{3}$	0.7	0.7	1.9	1.9	∞
3	Boundary effect	B	2.0	R	$\sqrt{3}$	1	1	1.2	1.2	∞
4	Linearity	B	4.7	R	$\sqrt{3}$	1	1	2.7	2.7	∞
5	Detection limit	B	1.0	R	$\sqrt{3}$	1	1	0.6	0.6	∞
6	Readout electronics	B	0.3	R	$\sqrt{3}$	1	1	0.3	0.3	∞
7	Response time	B	0.8	R	$\sqrt{3}$	1	1	0.5	0.5	∞
8	Integration time	B	2.6	R	$\sqrt{3}$	1	1	1.5	1.5	∞
9	RF ambient conditions-noise	B	0	R	$\sqrt{3}$	1	1	0	0	∞
10	RFambient conditions-reflection	B	0	R	$\sqrt{3}$	1	1	0	0	∞
11	Probe positioned mech. Restrictions	B	0.8	R	$\sqrt{3}$	1	1	0.5	0.5	∞
12	Probe positioning with respect to phantom shell	B	6.7	R	$\sqrt{3}$	1	1	3.9	3.9	∞
13	Post-processing	B	1.0	R	$\sqrt{3}$	1	1	0.6	0.6	∞
14	Fast SAR z-Approximation	B	14.0	R	$\sqrt{3}$	1	1	8.1	8.1	∞
Test sample related										

15	Test sample positioning	A	3.3	N	1	1	1	3.3	3.3	71
16	Device holder uncertainty	A	3.4	N	1	1	1	3.4	3.4	5
17	Drift of output power	B	5.0	R	$\sqrt{3}$	1	1	2.9	2.9	∞
Phantom and set-up										
18	Phantom uncertainty	B	4.0	R	$\sqrt{3}$	1	1	2.3	2.3	∞
19	Liquid conductivity (target)	B	5.0	R	$\sqrt{3}$	0.64	0.43	1.8	1.2	∞
20	Liquid conductivity (meas.)	A	2.06	N	1	0.64	0.43	1.32	0.89	43
21	Liquid permittivity (target)	B	5.0	R	$\sqrt{3}$	0.6	0.49	1.7	1.4	∞
22	Liquid permittivity (meas.)	A	1.6	N	1	0.6	0.49	1.0	0.8	521
Combined standard uncertainty		$u_c^{'} = \sqrt{\sum_{i=1}^{22} c_i^2 u_i^2}$						13.3	13.2	257
Expanded uncertainty (confidence interval of 95 %)		$u_e = 2u_c$						26.6	26.4	

17 MAIN TEST INSTRUMENTS

Table 17.1: List of Main Instruments

No.	Name	Type	Serial Number	Calibration Date	Valid Period
01	Network analyzer	E5071C	MY46110673	February 03, 2015	One year
02	Power meter	NRVD	102196	March 03, 2015	One year
03	Power sensor	NRV-Z5	100596		
04	Signal Generator	E4438C	MY49071430	February 02, 2015	One Year
05	Amplifier	60S1G4	0331848	No Calibration Requested	
06	BTS	E5515C	MY50263375	January 30, 2015	One year
07	E-field Probe	SPEAG EX3DV4	3617	August 26, 2015	One year
08	DAE	SPEAG DAE4	777	August 26, 2015	One year
09	Dipole Validation Kit	SPEAG D835V2	4d069	July 23, 2015	One year
10	Dipole Validation Kit	SPEAG D1900V2	5d101	July 23, 2015	One year
11	Dipole Validation Kit	SPEAG D2450V2	853	July 24, 2015	One year

END OF REPORT BODY

ANNEX A Graph Results

850 Left Cheek Middle

Date: 2016-01-01
Electronics: DAE4 Sn777
Medium: Head 850 MHz
Medium parameters used (interpolated): f = 836.6 MHz; σ = 0.903 mho/m; εr = 39.476; ρ = 1000 kg/m^3
Ambient Temperature: 23.0^{o}C Liquid Temperature: 22.5^{o}C
Communication System: GSM 850 Frequency: 836.6 MHz Duty Cycle: 1:8.3
Probe: EX3DV4 - SN3617 ConvF(9.56, 9.56, 9.56)

Area Scan (71x111x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.975 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 10.00 V/m; Power Drift = -0.17 dB
Peak SAR (extrapolated) = 1.10 W/kg
SAR(1 g) = 0.876 W/kg; SAR(10 g) = 0.657 W/kg
Maximum value of SAR (measured) = 0.971 W/kg

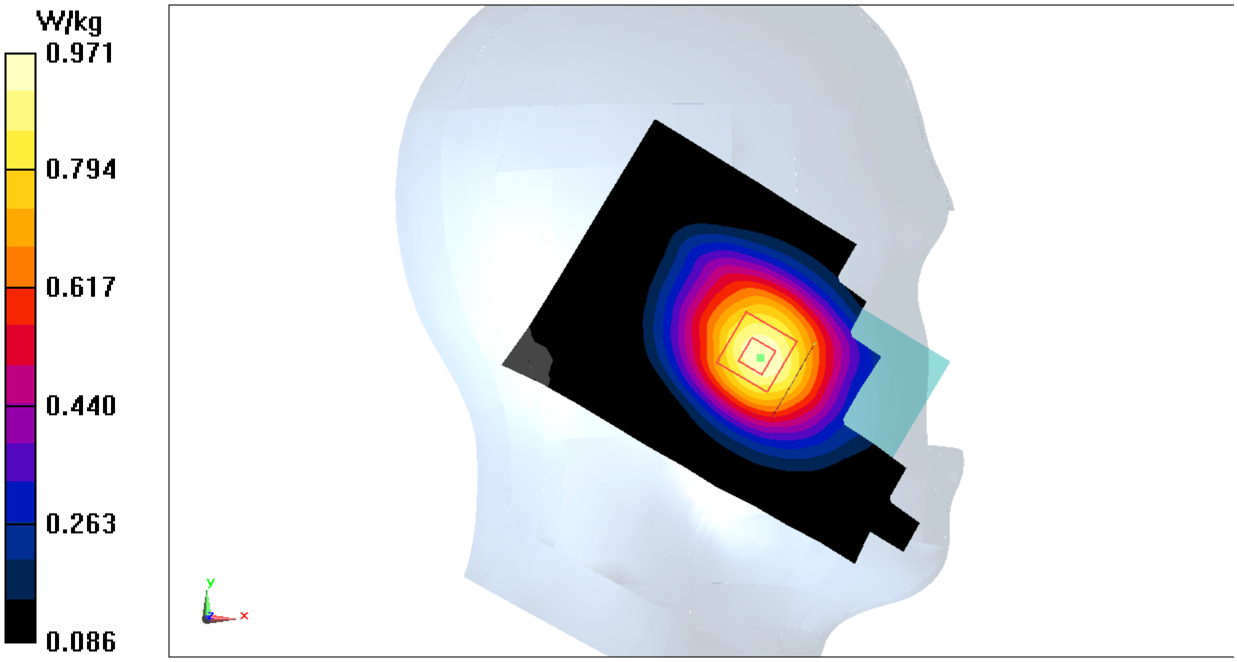


Fig.1 850MHz

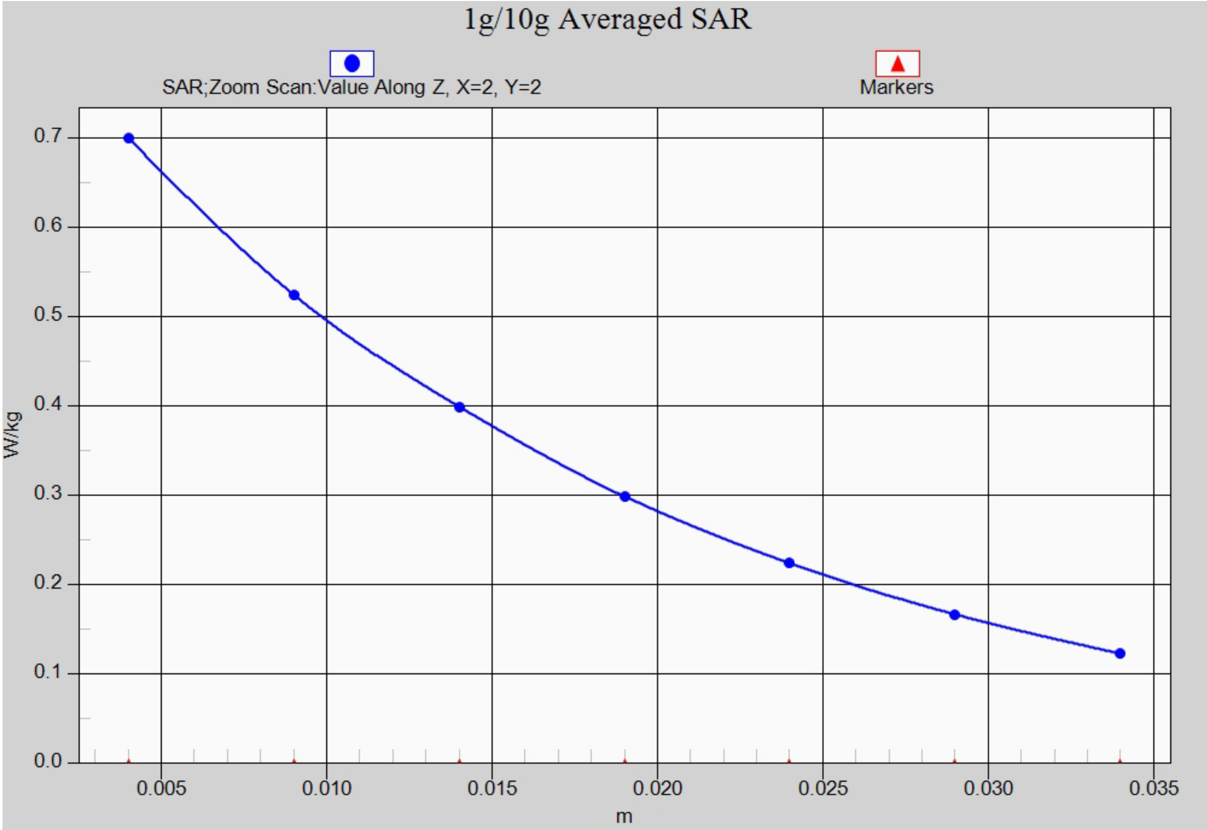


Fig. 1-1 Z-Scan at power reference point (850 MHz)

850 Body Front Middle

Date: 2016-01-01

Electronics: DAE4 Sn777

Medium: Body 850 MHz

Medium parameters used (interpolated): f = 836.6 MHz; σ = 1.215 mho/m; εr = 58.504; ρ = 1000 kg/m^3

Ambient Temperature: 23.0°C Liquid Temperature: 22.5°C

Communication System: GSM 850 GPRS Frequency: 836.6 MHz Duty Cycle: 1:1

Probe: EX3DV4 - SN3617 ConvF(9.71, 9.71, 9.71)

Area Scan (111x71x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 0.837 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 26.88 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 0.932 W/kg

SAR(1 g) = 0.739 W/kg; SAR(10 g) = 0.511 W/kg

Maximum value of SAR (measured) = 0.816 W/kg

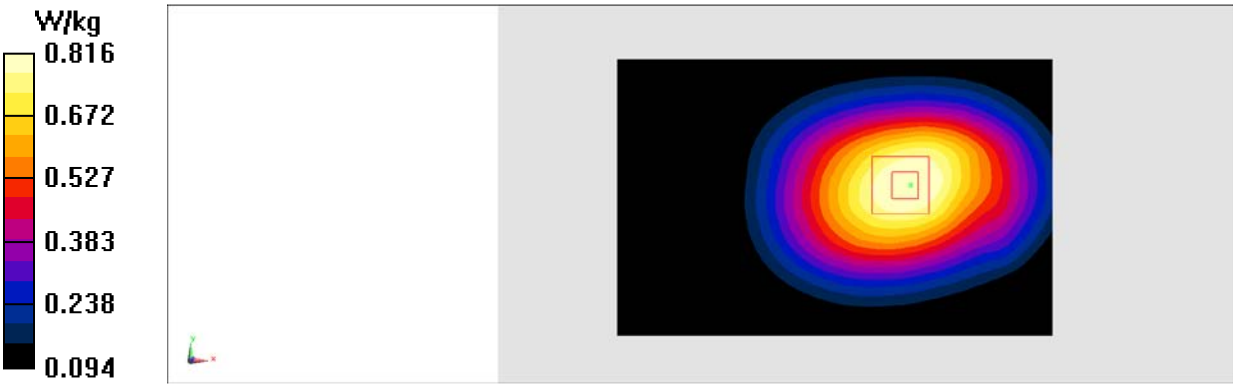


Fig.2 850 MHz

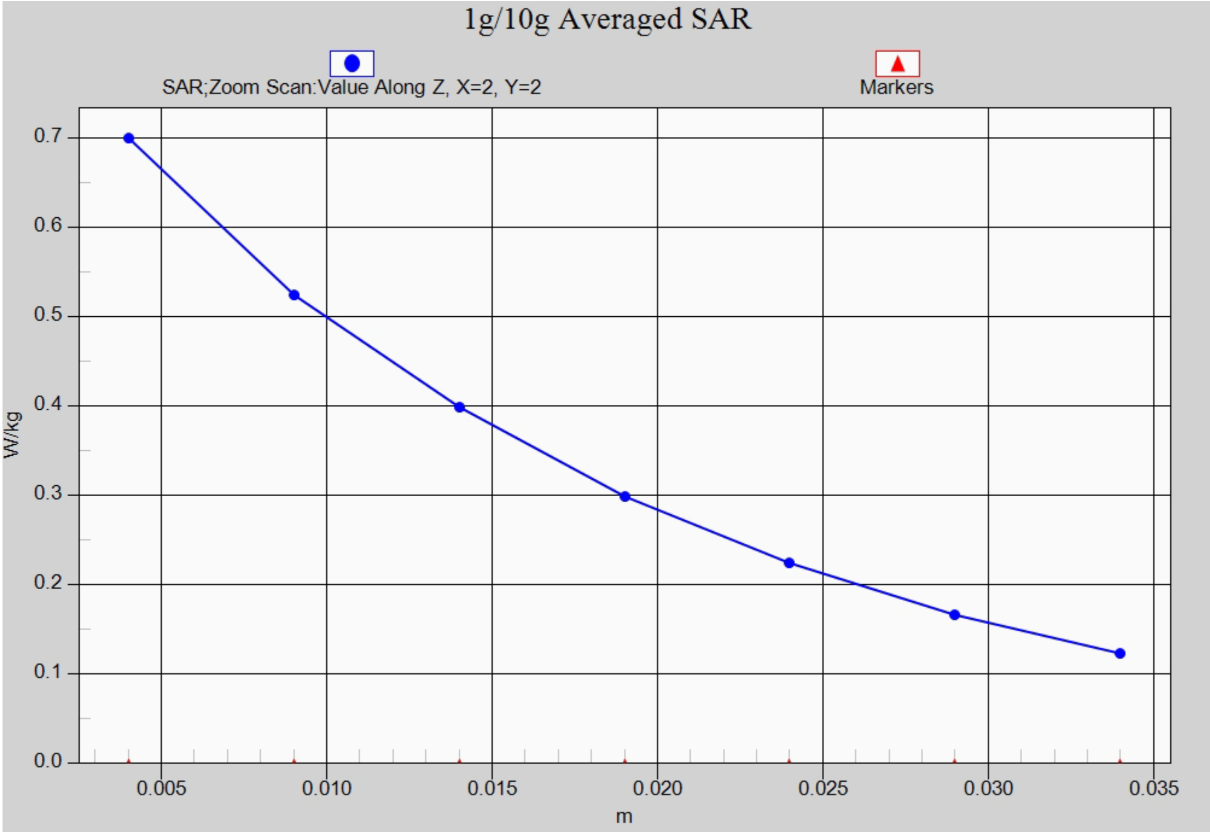


Fig. 2-1 Z-Scan at power reference point (850 MHz)

1900 Left Cheek High

Date: 2016-01-02
Electronics: DAE4 Sn777
Medium: Head 1900 MHz
Medium parameters use (interpolated): f = 1909.8 MHz; σ = 1.241 mho/m; εr = 38.122; ρ = 1000 kg/m^3
Ambient Temperature: 23.0^{o}C Liquid Temperature: 22.5^{o}C
Communication System: GSM 1900MHz Frequency: 1909.8 MHz Duty Cycle: 1:8.3
Probe: EX3DV4 - SN3617 ConvF(8.07, 8.07, 8.07)

Area Scan (71x101x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.481 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 4.979 V/m; Power Drift = -0.12 dB
Peak SAR (extrapolated) = 0.635 W/kg
SAR(1 g) = 0.398 W/kg; SAR(10 g) = 0.232 W/kg
Maximum value of SAR (measured) = 0.479 W/kg

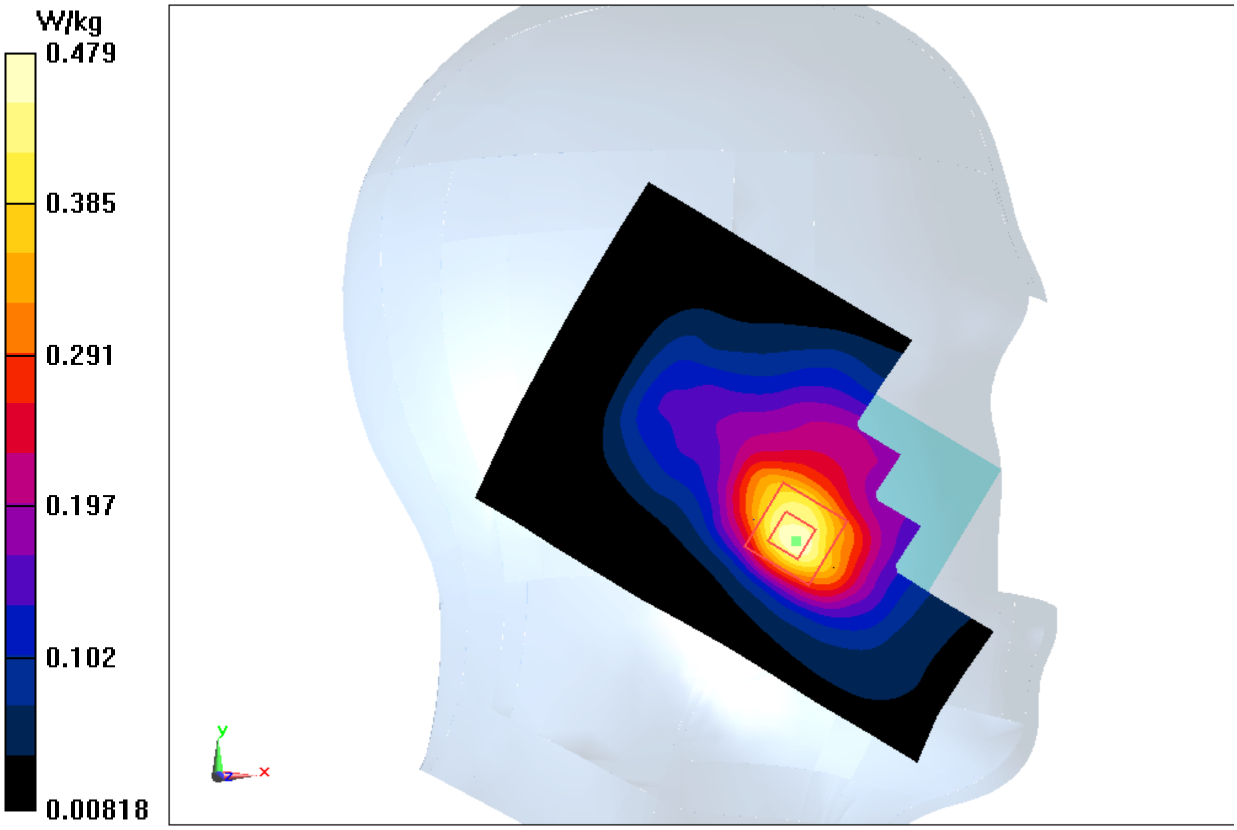


Fig.3 1900 MHz

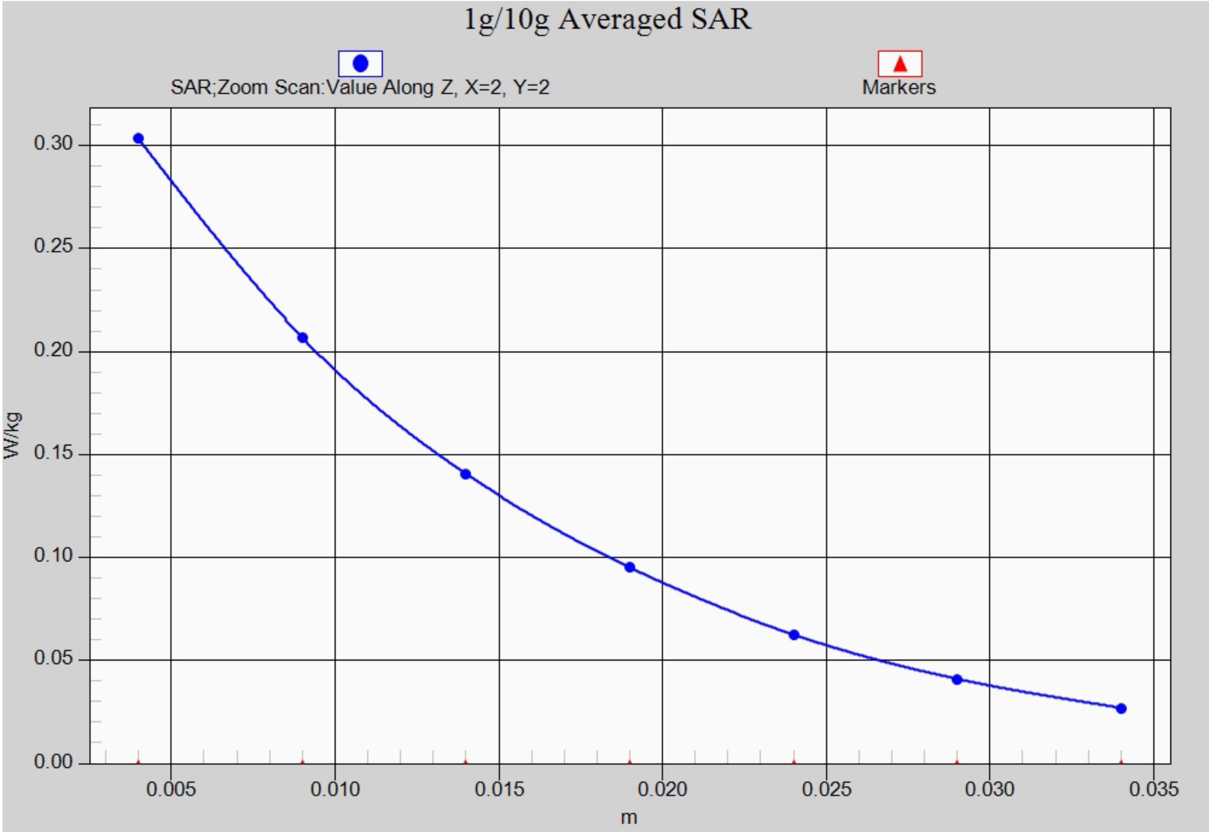


Fig. 3-1 Z-Scan at power reference point (1900 MHz)

1900 Body Rear High
Date: 2016-01-02
Electronics: DAE4 Sn777
Medium: Body 1900 MHz
Medium parameters used (interpolated): f = 1850.2 MHz; σ = 1.649 mho/m; εr = 55.04; ρ = 1000 kg/m^3
Ambient Temperature: 23.0°C Liquid Temperature: 22.5°C
Communication System: GSM 1900MHz GPRS Frequency: 1850.2 MHz Duty Cycle: 1:4
Probe: EX3DV4 – SN3617 ConvF(7.74, 7.74, 7.74)

Area Scan (111x71x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.850 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 8.362 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 1.15 W/kg
SAR(1 g) = 0.674 W/kg; SAR(10 g) = 0.395 W/kg
Maximum value of SAR (measured) = 0.720 W/kg

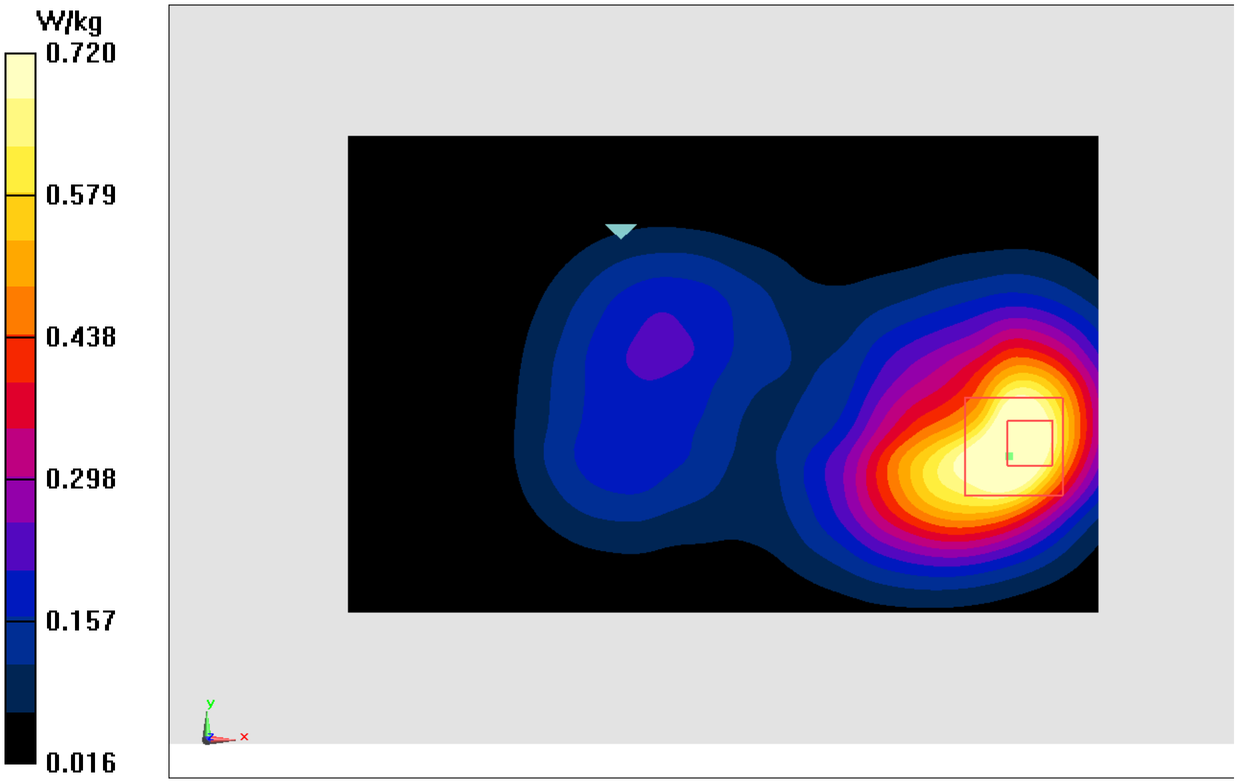


Fig.4 1900 MHz

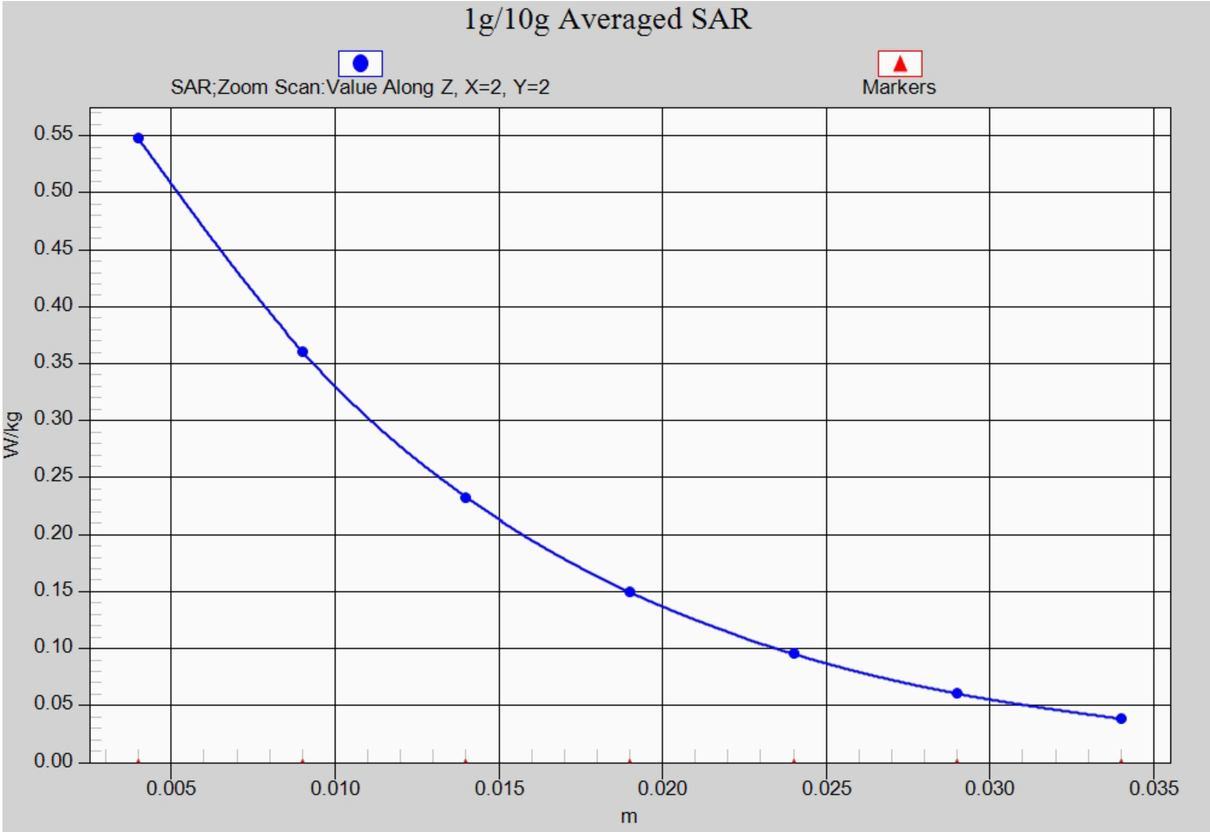


Fig.4-1 Z-Scan at power reference point (1900 MHz)

WCDMA 850 Left Cheek Middle
Date: 2016-01-01
Electronics: DAE4 Sn777
Medium: Head 850 MHz
Medium parameters used (interpolated): f = 836.4 MHz; σ = 0.912 mho/m; εr = 40.01; ρ = 1000 kg/m^3
Ambient Temperature: 23.0°C Liquid Temperature: 22.5°C
Communication System: WCDMA; Frequency: 836.4 MHz; Duty Cycle: 1:1
Probe: EX3DV4 - SN3617 ConvF(9.56, 9.56, 9.56)

Area Scan (71x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.947 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 9.942 V/m; Power Drift = -0.12 dB
Peak SAR (extrapolated) = 1.06 W/kg
SAR(1 g) = 0.865 W/kg; SAR(10 g) = 0.659 W/kg
Maximum value of SAR (measured) = 0.945 W/kg

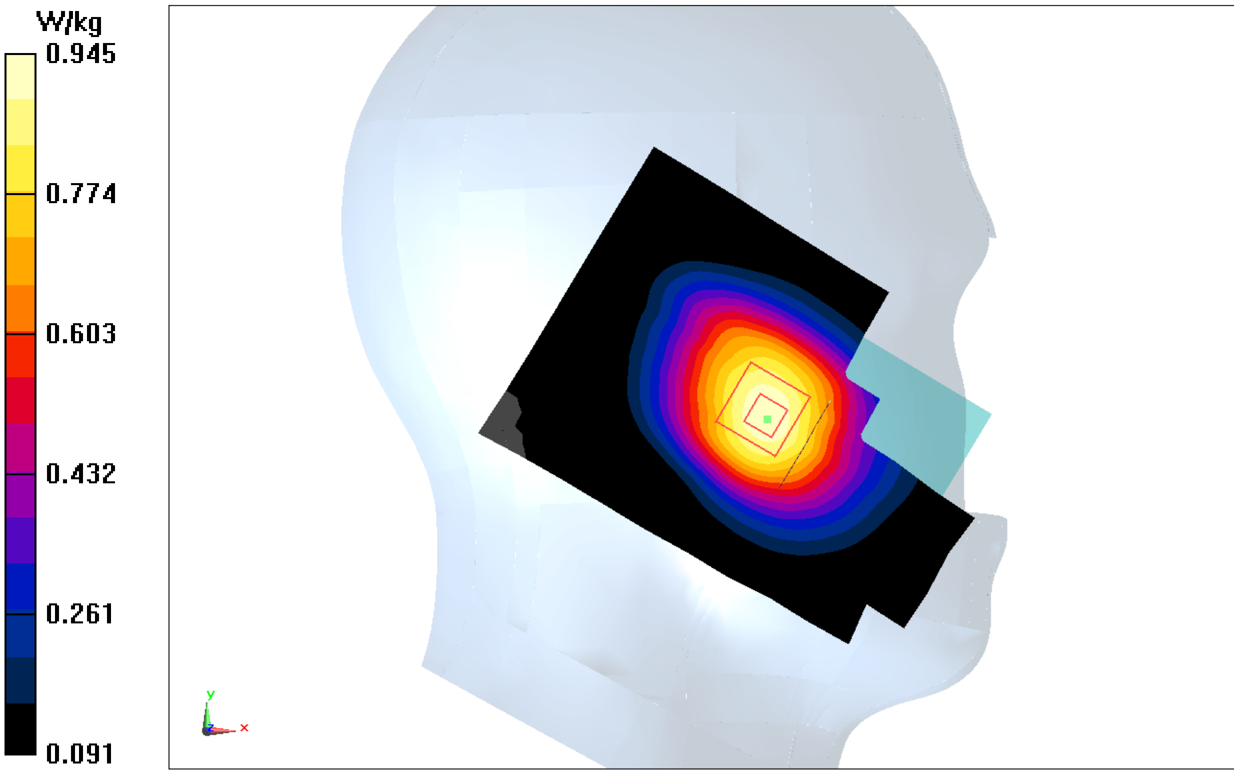


Fig.5 WCDMA 850

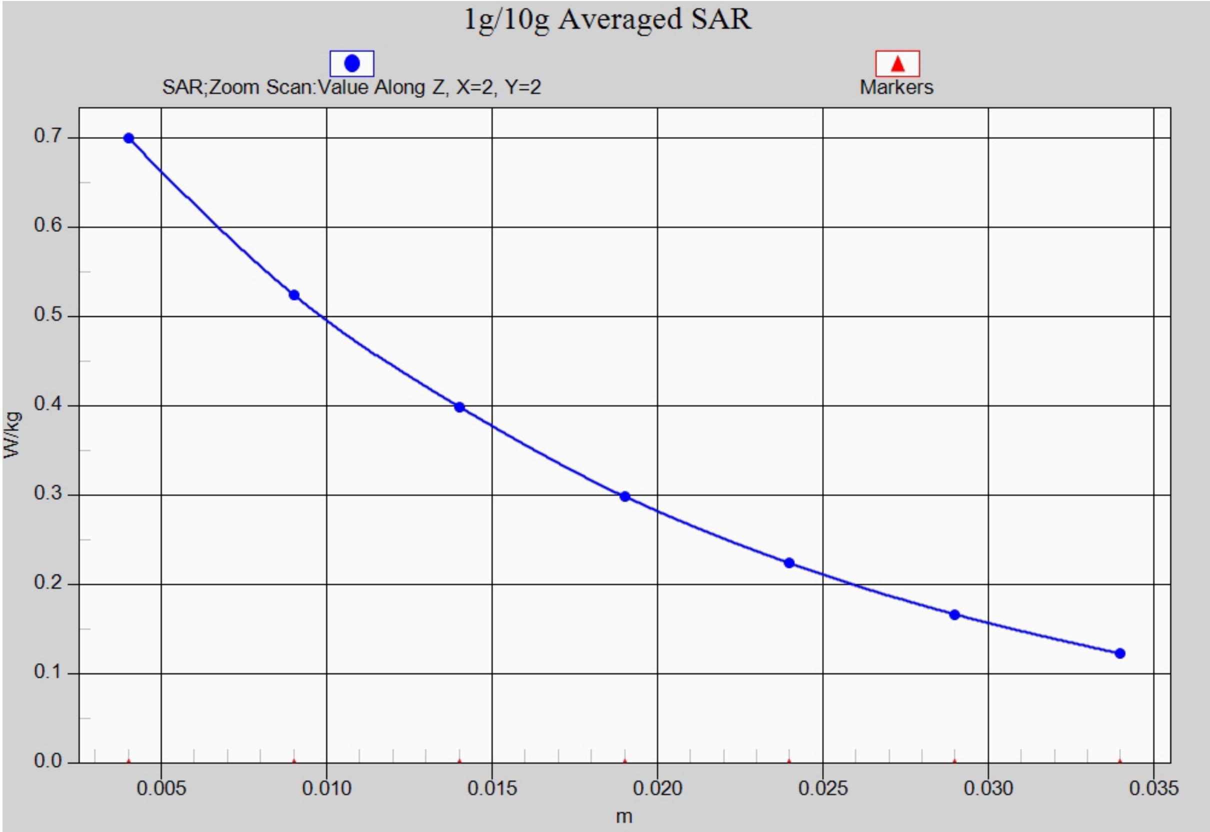


Fig. 5-1 Z-Scan at power reference point (WCDMA 850)

WCDMA 850 Body Rear Middle

Date: 2016-01-01

Electronics: DAE4 Sn777

Medium: Body 850 MHz

Medium parameters used (interpolated): f = 836.4 MHz; σ = 0.831 mho/m; εr = 54.461; ρ = 1000 kg/m^3

Ambient Temperature: 23.0^{o}C Liquid Temperature: 22.5^{o}C

Communication System: WCDMA; Frequency: 836.4 MHz; Duty Cycle: 1:1

Probe: EX3DV4 - SN3617 ConvF(9.71, 9.71, 9.71)

Area Scan (121x71x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 1.02 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 27.59 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 1.18 W/kg

SAR(1 g) = 0.927 W/kg; SAR(10 g) = 0.689 W/kg

Maximum value of SAR (measured) = 1.02 W/kg

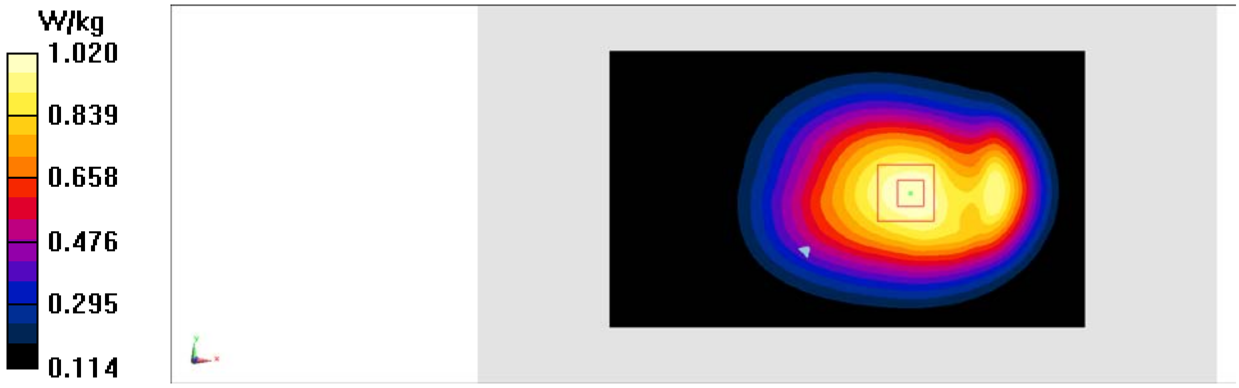


Fig.6 WCDMA 850

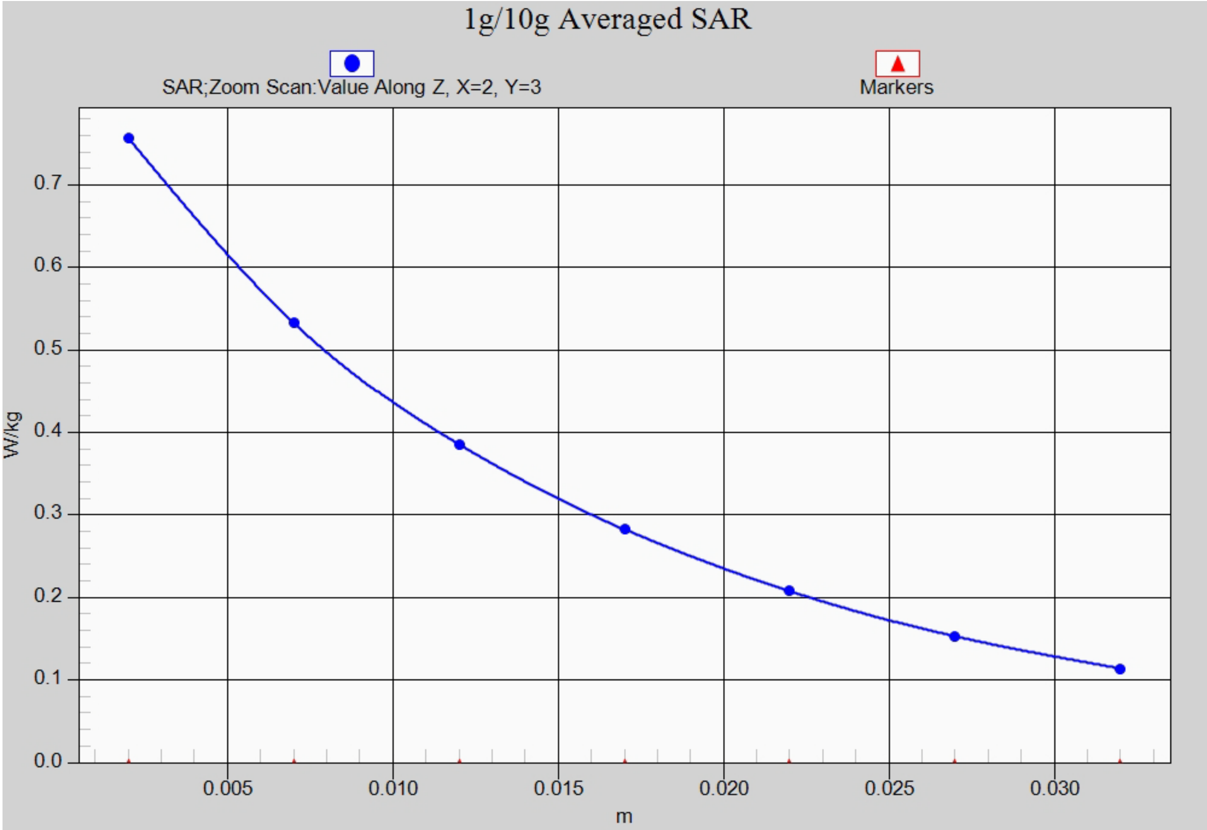


Fig. 6-1 Z-Scan at power reference point (WCDMA850)

WCDMA 1900 Left Cheek Middle

Date: 2016-01-02

Electronics: DAE4 Sn777

Medium: Head 1900 MHz

Medium parameters used (interpolated): f = 1880 MHz; σ = 1.168 mho/m; εr = 38.147; ρ = 1000 kg/m^3

Ambient Temperature: 23.0°C   Liquid Temperature: 22.5°C

Communication System: WCDMA 1900 Frequency: 1880 MHz Duty Cycle: 1:1

Probe: EX3DV4 - SN3617ConvF(8.07, 8.07, 8.07)

Area Scan (71x101x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 0.582 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 4.895 V/m; Power Drift = -0.11 dB

Peak SAR (extrapolated) = 0.749 W/kg

SAR(1 g) = 0.491 W/kg; SAR(10 g) = 0.296 W/kg

Maximum value of SAR (measured) = 0.589 W/kg

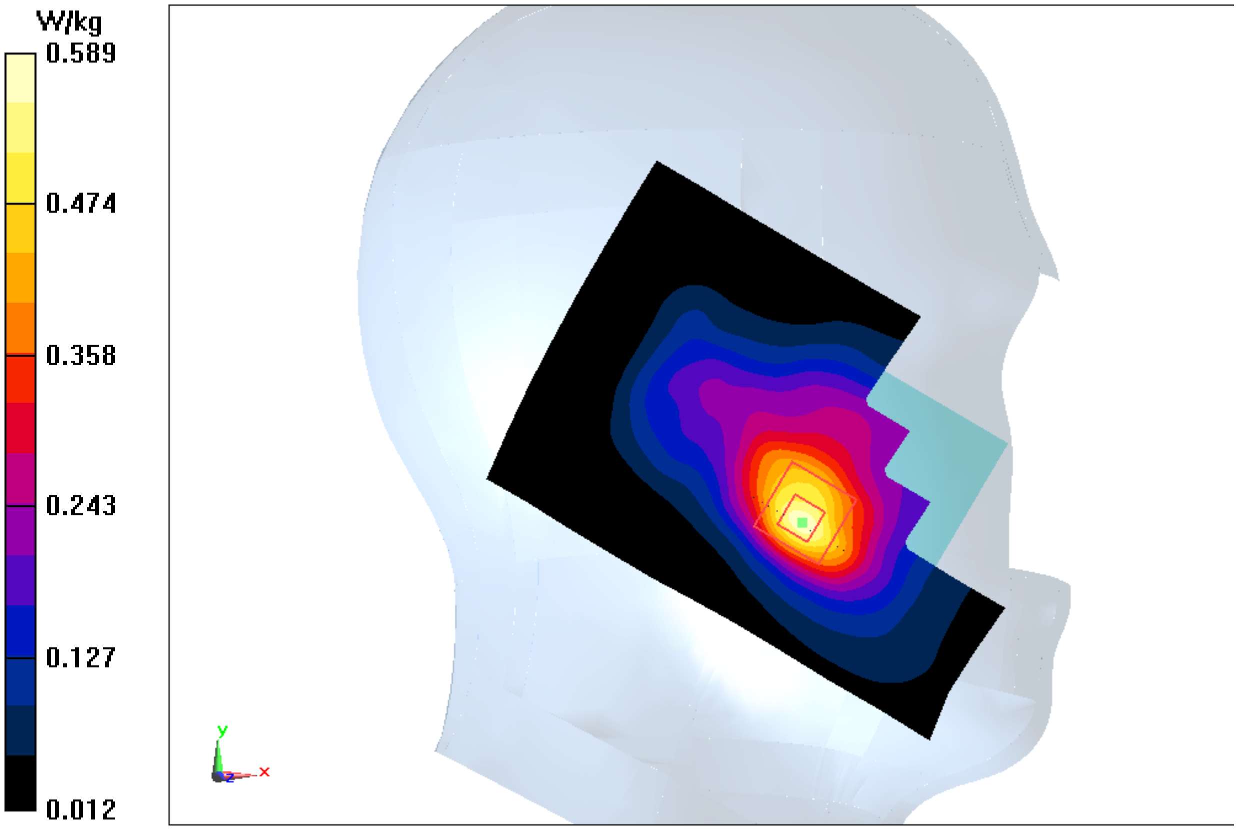


Fig.7 WCDMA1900

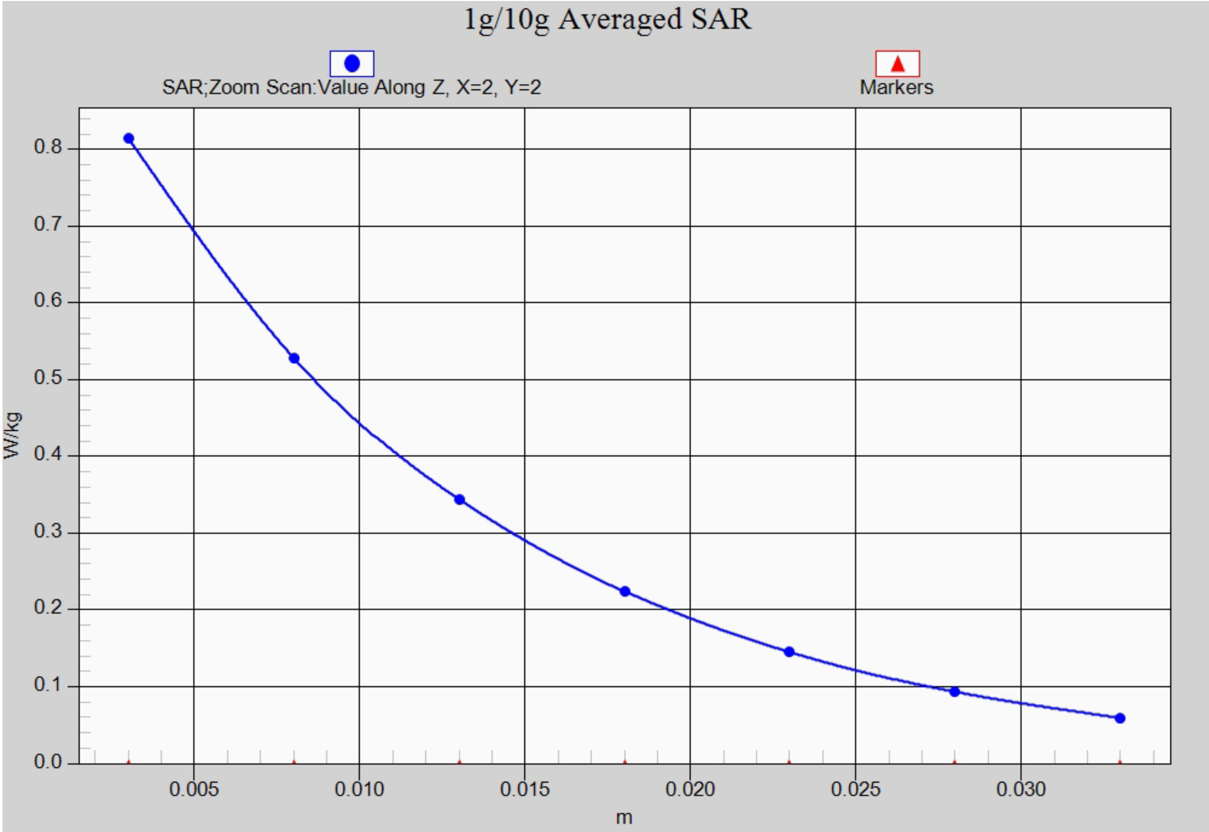


Fig. 7-1 Z-Scan at power reference point (WCDMA1900)

WCDMA 1900 Body Rear Low
Date: 2016-01-02
Electronics: DAE4 Sn777
Medium: Body 1900 MHz
Medium parameters used: f = 1880 MHz; σ = 1.257 mho/m; εr = 52.172; ρ = 1000 kg/m^3
Ambient Temperature: 23.0°C Liquid Temperature: 22.5°C
Communication System: WCDMA 1900 Frequency: 1880 MHz Duty Cycle: 1:1
Probe: EX3DV4 – SN3617 ConvF(7.74, 7.74, 7.74)

Area Scan (111x71x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.963 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 8.261 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 1.31 W/kg
SAR(1 g) = 0.779 W/kg; SAR(10 g) = 0.456 W/kg
Maximum value of SAR (measured) = 0.851 W/kg

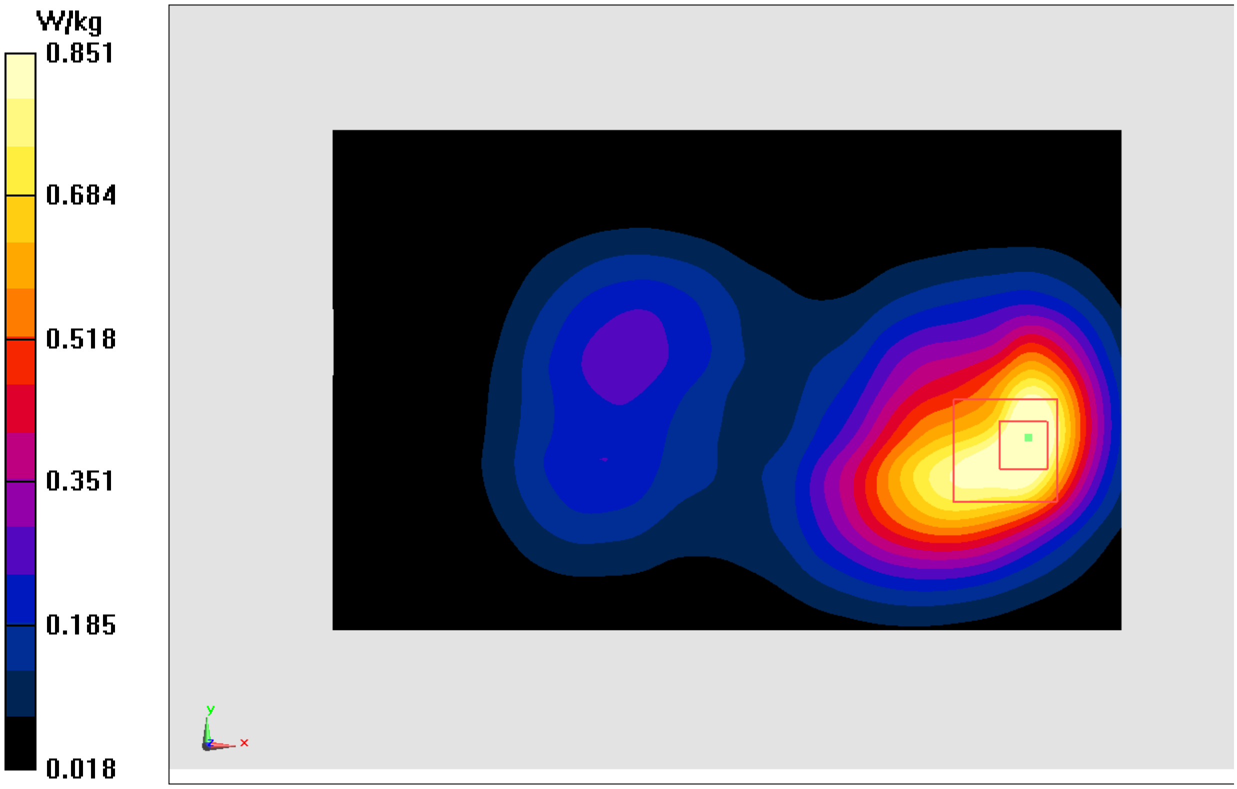


Fig.8 WCDMA1900

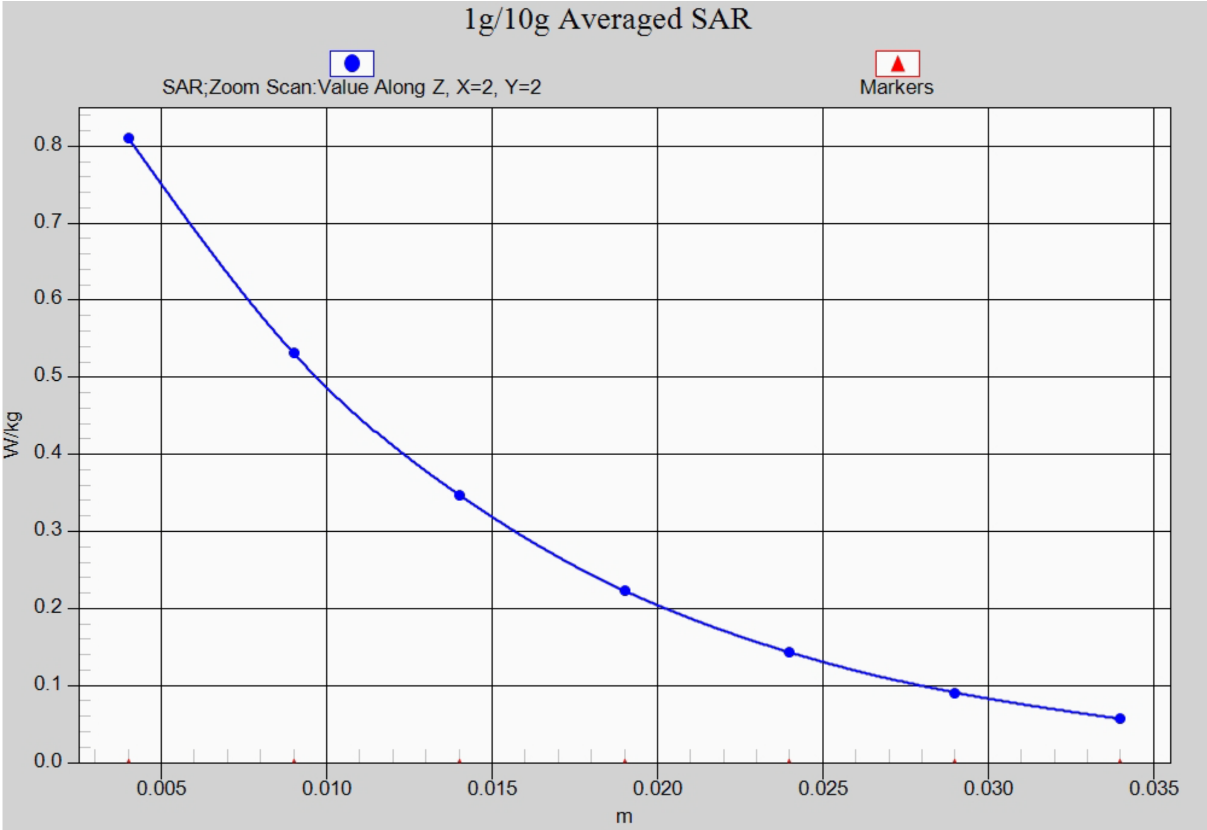


Fig. 8-1 Z-Scan at power reference point (WCDMA1900)

Wifi 802.11b Left Cheek Channel 1
Date: 2016-01-03
Electronics: DAE4 Sn777
Medium: Head 2450 MHz
Medium parameters used (interpolated): f = 2412 MHz; σ = 1.585 mho/m; ε_r = 37.843; ρ = 1000 kg/m^3
Ambient Temperature: 23.0°C Liquid Temperature: 22.5°C
Communication System: WLan 2450 Frequency: 2412 MHz Duty Cycle: 1:1
Probe: EX3DV4 - SN3617 ConvF (7.24, 7.24, 7.24)

Area Scan (71x101x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.248 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 5.068 V/m; Power Drift = 0.11 dB
Peak SAR (extrapolated) = 0.402 W/kg
SAR(1 g) = 0.189 W/kg; SAR(10 g) = 0.090 W/kg
Maximum value of SAR (measured) = 0.216 W/kg

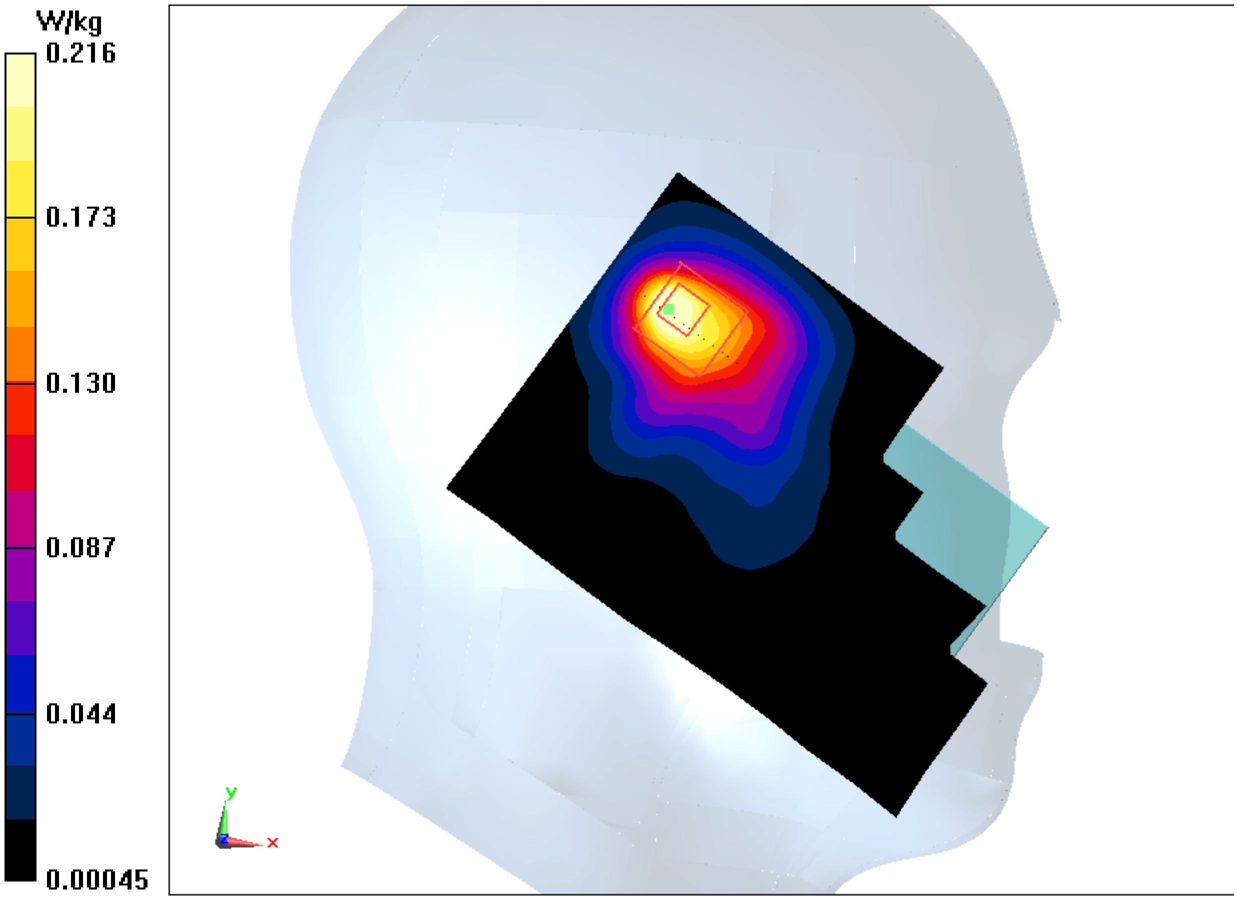


Fig.9 2450 MHz

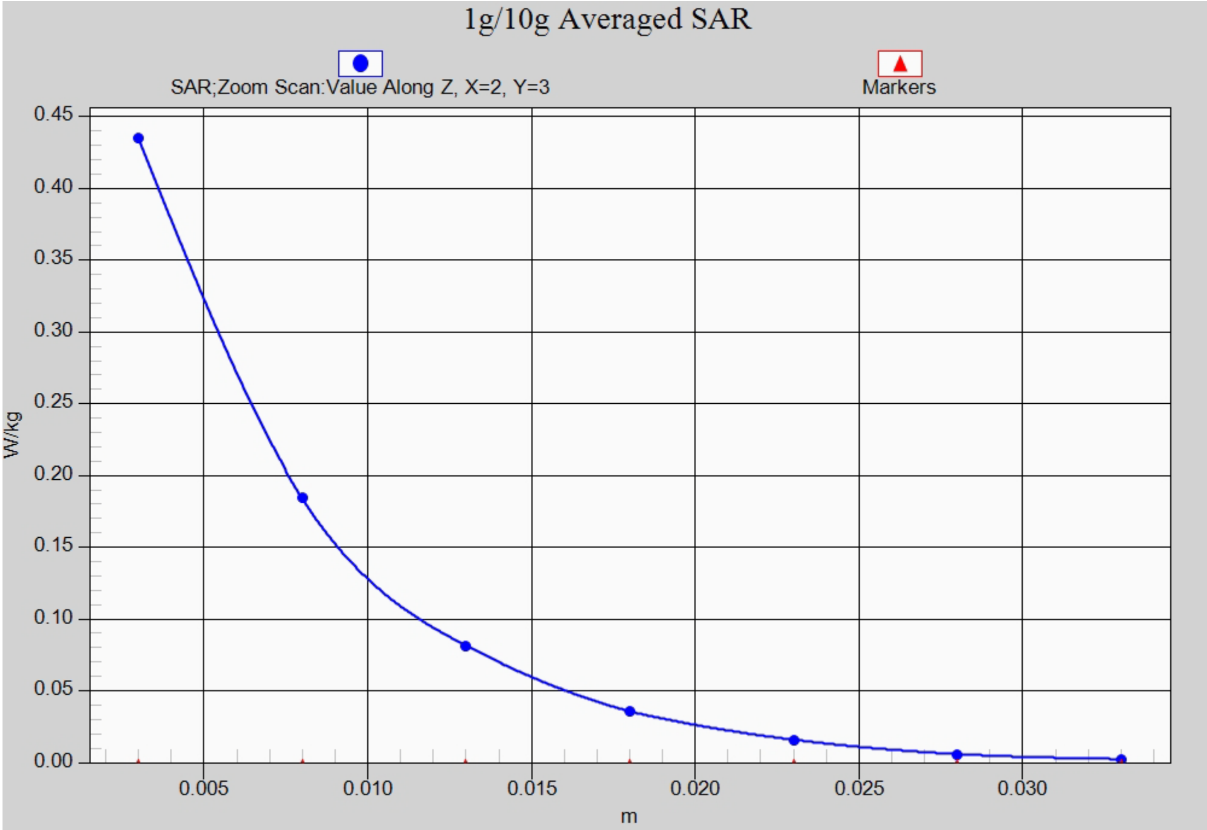


Fig. 9-1 Z-Scan at power reference point (2450 MHz)

Wifi 802.11b Body Rear Channel 1
Date: 2016-01-03
Electronics: DAE4 Sn777
Medium: Body 2450 MHz
Medium parameters used (interpolated): f = 2412 MHz; σ = 1.852 mho/m; ε_r = 50.597; ρ = 1000 kg/m^3
Ambient Temperature: 23.0^{o}C Liquid Temperature: 22.5^{o}C
Communication System: WLan 2450 Frequency: 2412 MHz Duty Cycle: 1:1
Probe: EX3DV4 - SN3617 ConvF(7.35, 7.35, 7.35)

Area Scan (101x71x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.126 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 3.539 V/m; Power Drift = 0.11 dB
Peak SAR (extrapolated) = 0.196 W/kg
SAR(1 g) = 0.091 W/kg; SAR(10 g) = 0.041 W/kg
Maximum value of SAR (measured) = 0.111 W/kg

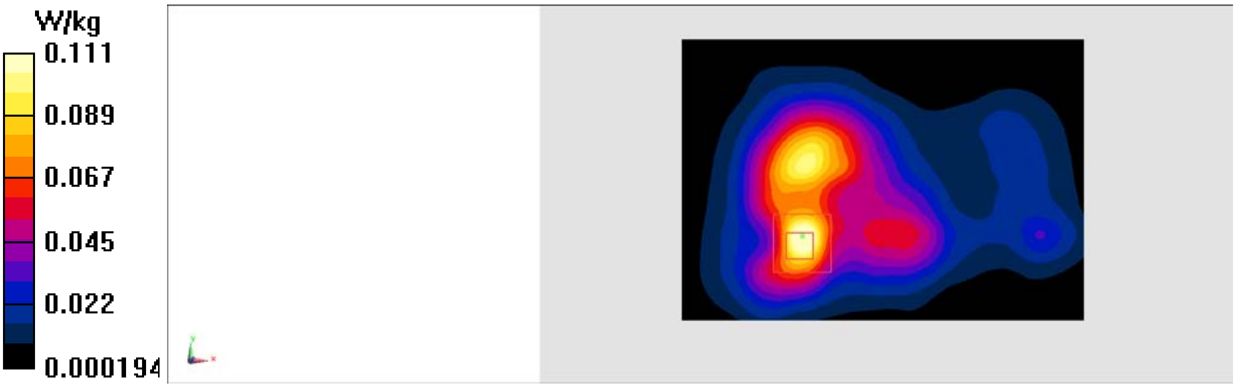


Fig.10 2450 MHz

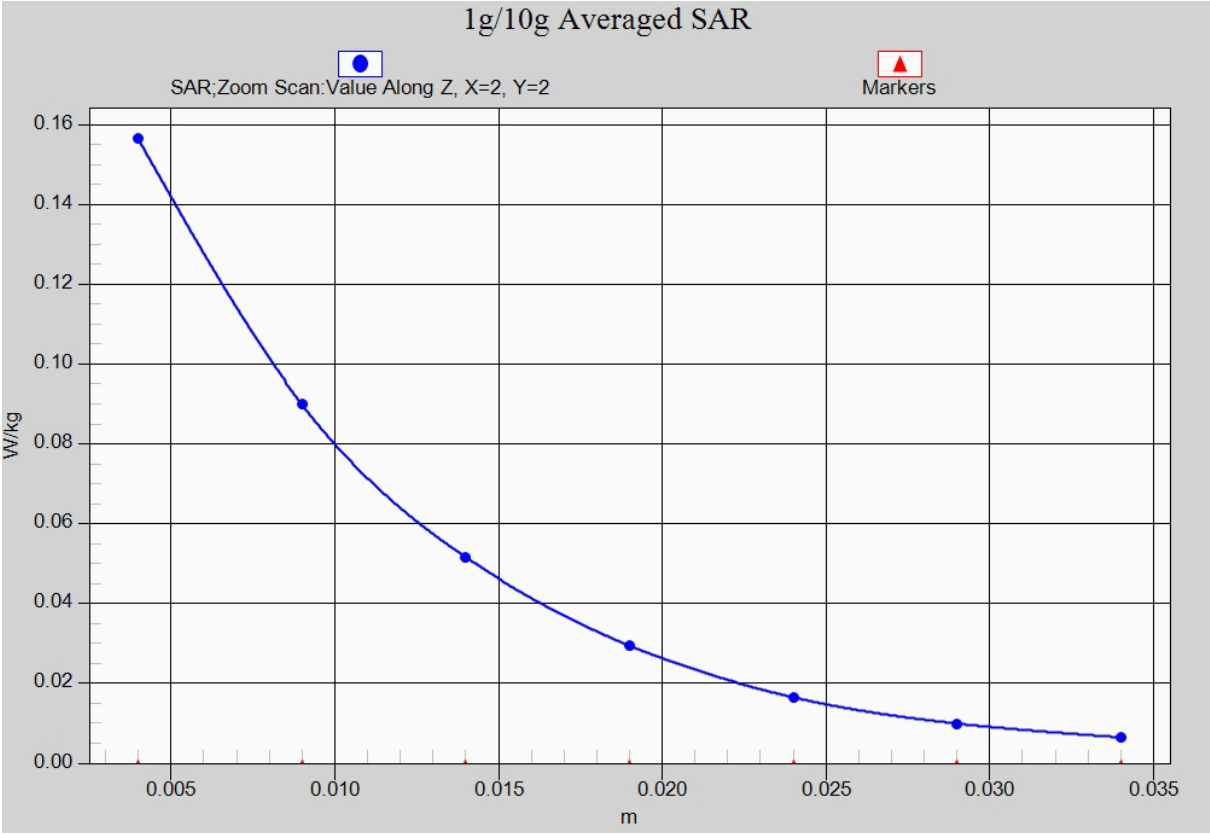


Fig. 10-1 Z-Scan at power reference point (2450 MHz)

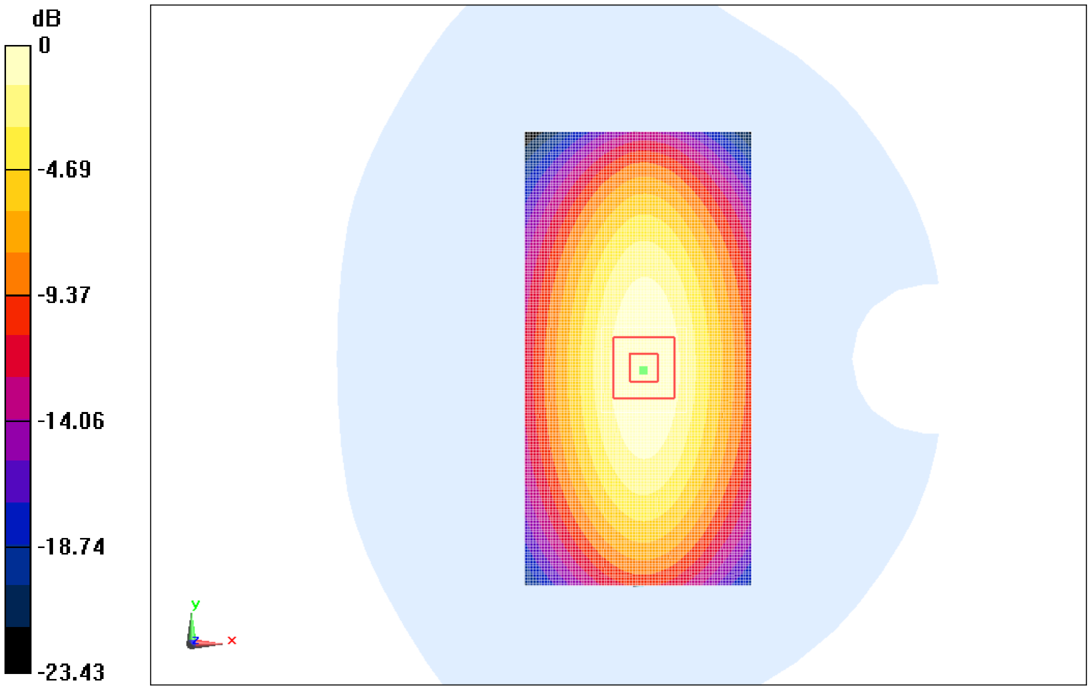
ANNEX B SystemVerification Results

835MHz

Date: 2015-01-01
Electronics: DAE4 Sn777
Medium: Head 850 MHz
Medium parameters used: f = 835 MHz; σ = 0.922 S/m; ε_r = 41.13; ρ = 1000 kg/m^3
Ambient Temperature: 23.0^{o}C Liquid Temperature: 22.5^{o}C
Communication System: CW Frequency: 835 MHz Duty Cycle: 1:1
Probe: EX3DV4 – SN3617 ConvF(9.56, 9.56, 9.56)

System Validation /Area Scan (81x161x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Reference Value = 50.281 V/m; Power Drift = 0.07 dB
Fast SAR: SAR(1 g) = 2.25 W/kg; SAR(10 g) = 1.45 W/kg
Maximum value of SAR (interpolated) = 2.48 W/kg

System Validation /Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 50.281 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 3.58 W/kg
SAR(1 g) = 2.29 W/kg; SAR(10 g) = 1.48 W/kg
Maximum value of SAR (measured) = 2.51 W/kg



0 dB = 2.51 W/kg = 4.00dBW/kg

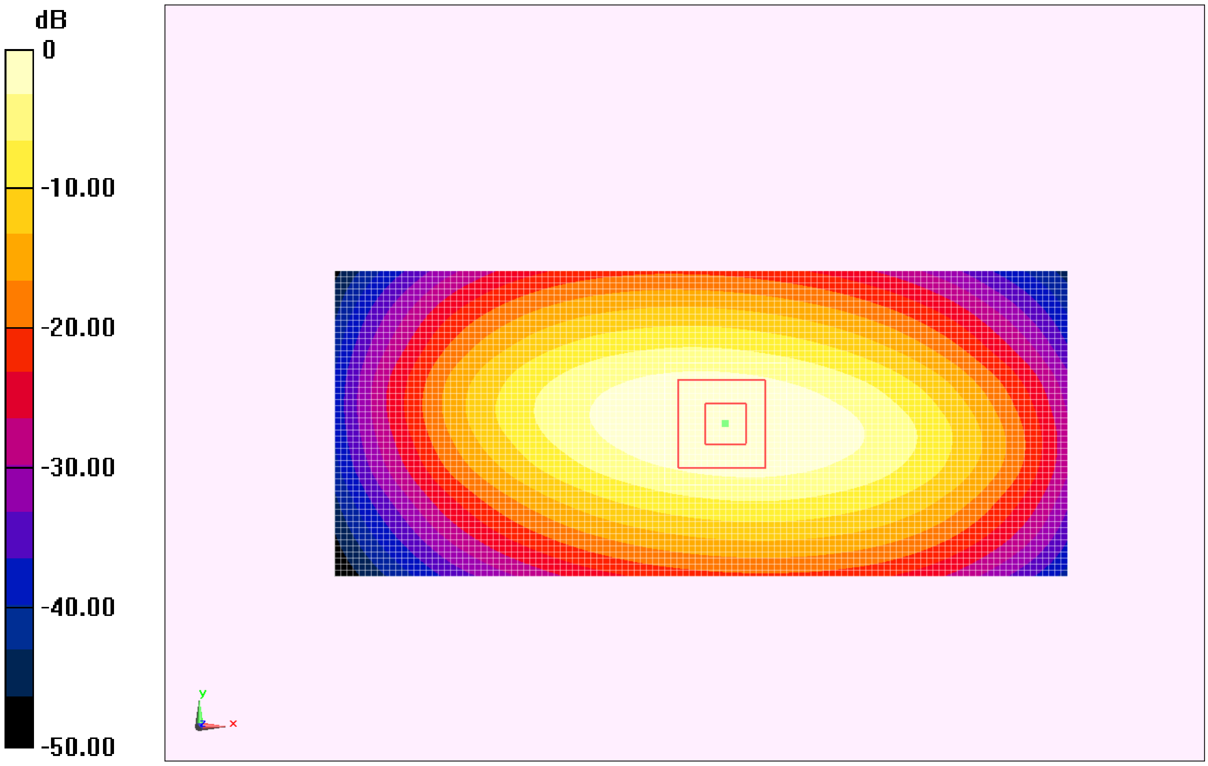
Fig.B.1 validation 835MHz 250mW

835MHz

Date: 2015-01-01
Electronics: DAE4 Sn777
Medium: Body 850 MHz
Medium parameters used: f = 835 MHz; σ =0.972 S/m; ε_r = 56.23; ρ = 1000 kg/m^3
Ambient Temperature: 23.0^{o}C Liquid Temperature: 22.5^{o}C
Communication System: CW Frequency: 835 MHz Duty Cycle: 1:1
Probe: EX3DV4 – SN3617 ConvF(9.71, 9.71, 9.71)

System Validation /Area Scan (81x171x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Reference Value = 50.697 V/m; Power Drift = 0.05 dB
Fast SAR: SAR(1 g) = 2.29 W/kg; SAR(10 g) = 1.51 W/kg
Maximum value of SAR (interpolated) = 2.49 W/kg

System Validation /Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 50.697 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 3.50 W/kg
SAR(1 g) = 2.34 W/kg; SAR(10 g) = 1.53 W/kg
Maximum value of SAR (measured) = 2.51 W/kg



0 dB = 2.51 W/kg = 4.00 dBW/kg

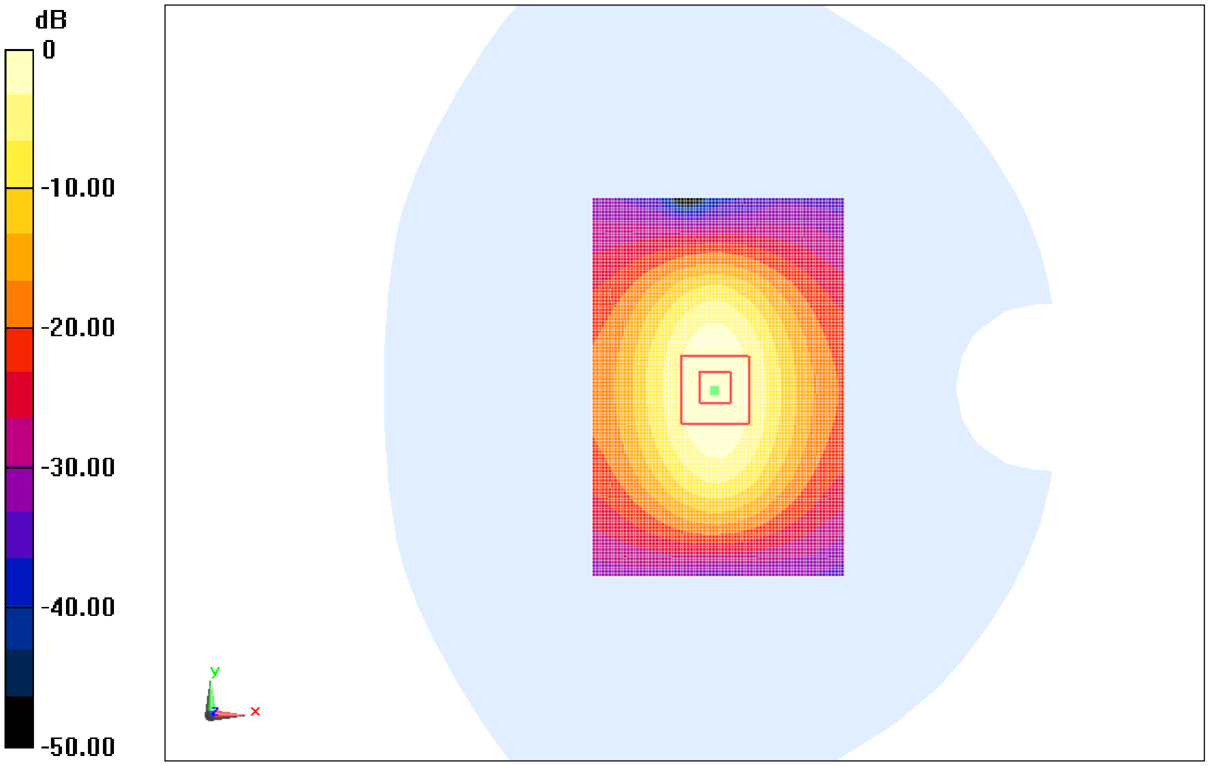
Fig.B.2 validation 835MHz 250mW

1900MHz

Date: 2015-01-02
Electronics: DAE4 Sn777
Medium: Head 1900 MHz
Medium parameters used: f = 1900 MHz; $\sigma = 1.427$ S/m; $\varepsilon_r = 39.78$; $\rho = 1000$ kg/m^3
Ambient Temperature: 23.0°C Liquid Temperature: 22.5°C
Communication System: CW Frequency: 1900 MHz Duty Cycle: 1:1
Probe: EX3DV4 - SN3617 ConvF(8.07, 8.07, 8.07)

System Validation /Area Scan (81x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Reference Value = 91.339 V/m; Power Drift = 0.05 dB
Fast SAR: SAR(1 g) = 10.59 W/kg; SAR(10 g) = 5.65 W/kg
Maximum value of SAR (interpolated) = 11.99 W/kg

System Validation /Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 91.339 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 19.02 W/kg
SAR(1 g) = 10.39 W/kg; SAR(10 g) = 5.47 W/kg
Maximum value of SAR (measured) = 11.79 W/kg



0 dB = 11.79 W/kg = 10.72 dBW/kg

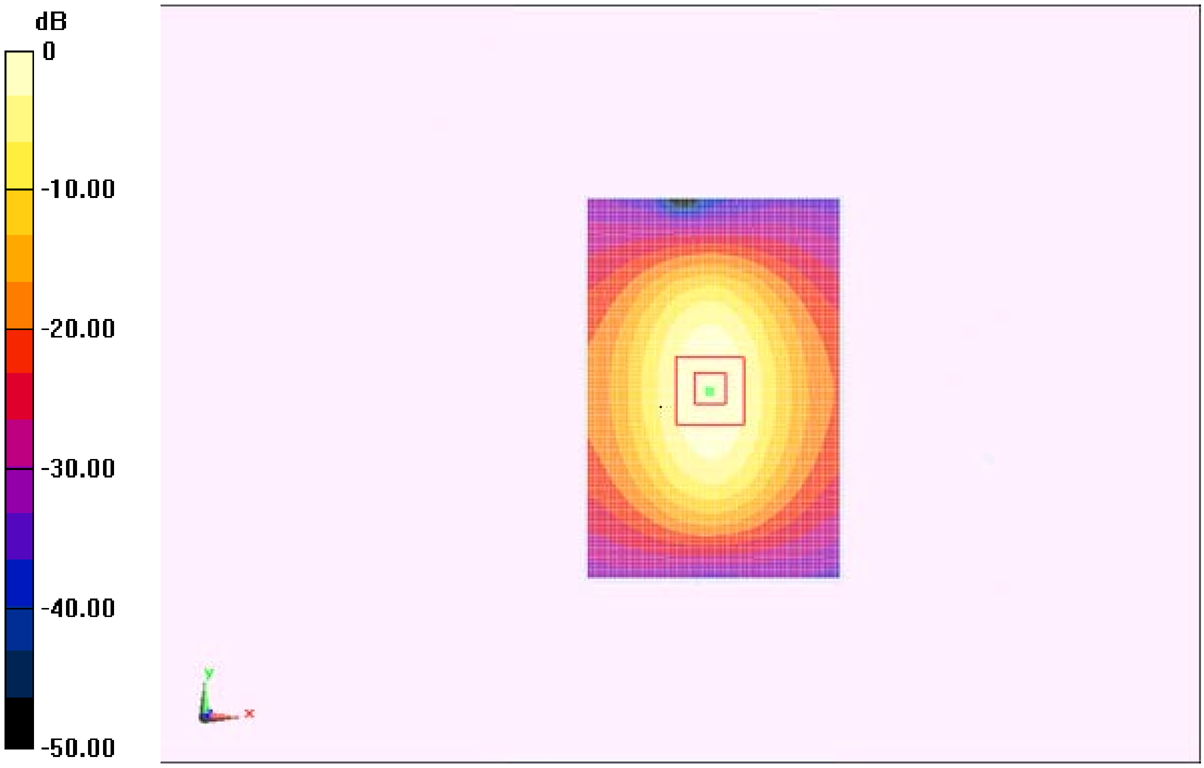
Fig.B.3 validation 1900MHz 250mW

1900MHz

Date: 2015-01-02
Electronics: DAE4 Sn777
Medium: Body 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.550 S/m; ε_r = 54.05; ρ = 1000 kg/m^3
Ambient Temperature: 23.0^{o}C Liquid Temperature: 22.5^{o}C
Communication System: CW Frequency: 1900 MHz Duty Cycle: 1:1
Probe: EX3DV4 – SN3617 ConvF(7.74, 7.74, 7.74)

System validation /Area Scan (81x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Reference Value = 65.021 V/m; Power Drift = -0.02 dB
Fast SAR: SAR(1 g) = 10.54 W/kg; SAR(10 g) = 5.63 W/kg
Maximum value of SAR (interpolated) = 12.54 W/kg

System validation /Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 65.021 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 19.38 W/kg
SAR(1 g) = 10.34 W/kg; SAR(10 g) = 5.49 W/kg
Maximum value of SAR (measured) = 12.34 W/kg



0 dB = 12.34 W/kg = 10.91 dBW/kg

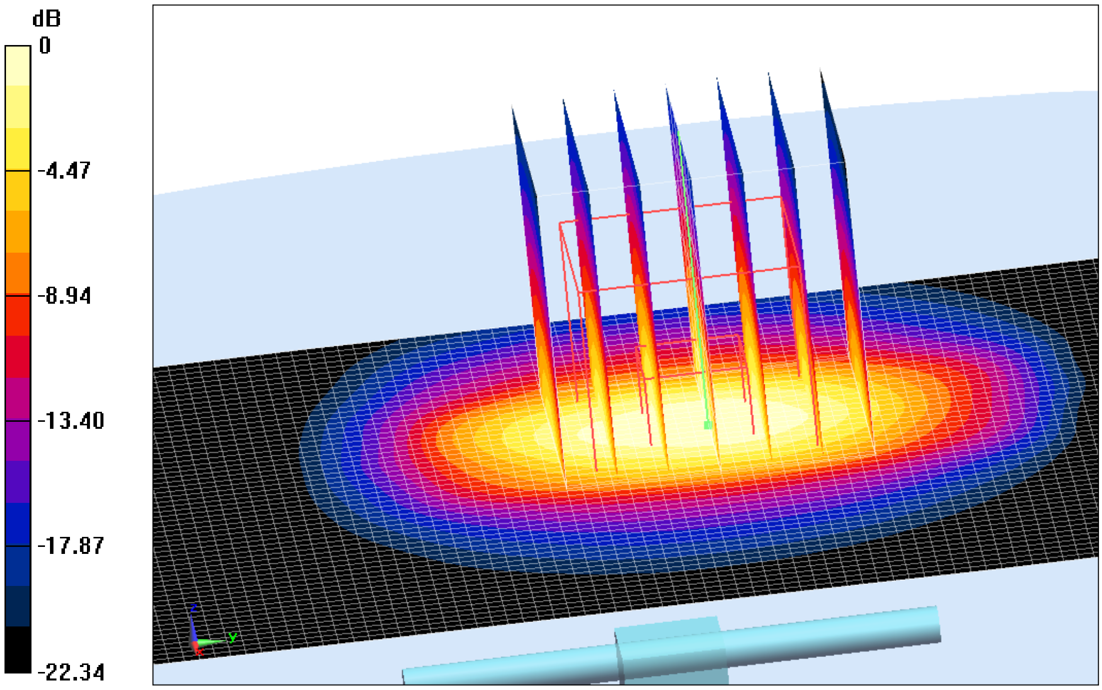
Fig.B.4 validation 1900MHz 250mW

2450MHz

Date: 2015-01-03
Electronics: DAE4 Sn777
Medium: Head 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 1.822 mho/m; ε_r = 38.01; ρ = 1000 kg/m^3
Ambient Temperature: 23.0°C   Liquid Temperature: 22.5°C
Communication System: CW Frequency: 2450 MHz Duty Cycle: 1:1
Probe: EX3DV4 - SN3617 ConvF(7.24, 7.24, 7.24)

System Validation /Area Scan (61x81x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Reference Value = 93.14 V/m; Power Drift = 0.02 dB
SAR(1 g) = 13.33 W/kg; SAR(10 g) = 6.35 W/kg
Maximum value of SAR (interpolated) = 16.63 W/kg

System Validation /Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 93.14 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 27.23 W/kg
SAR(1 g) = 13.13 W/kg; SAR(10 g) = 6.14W/kg
Maximum value of SAR (measured) = 16.43 W/kg



0 dB = 16.43W/kg = 12.16 dBW/kg

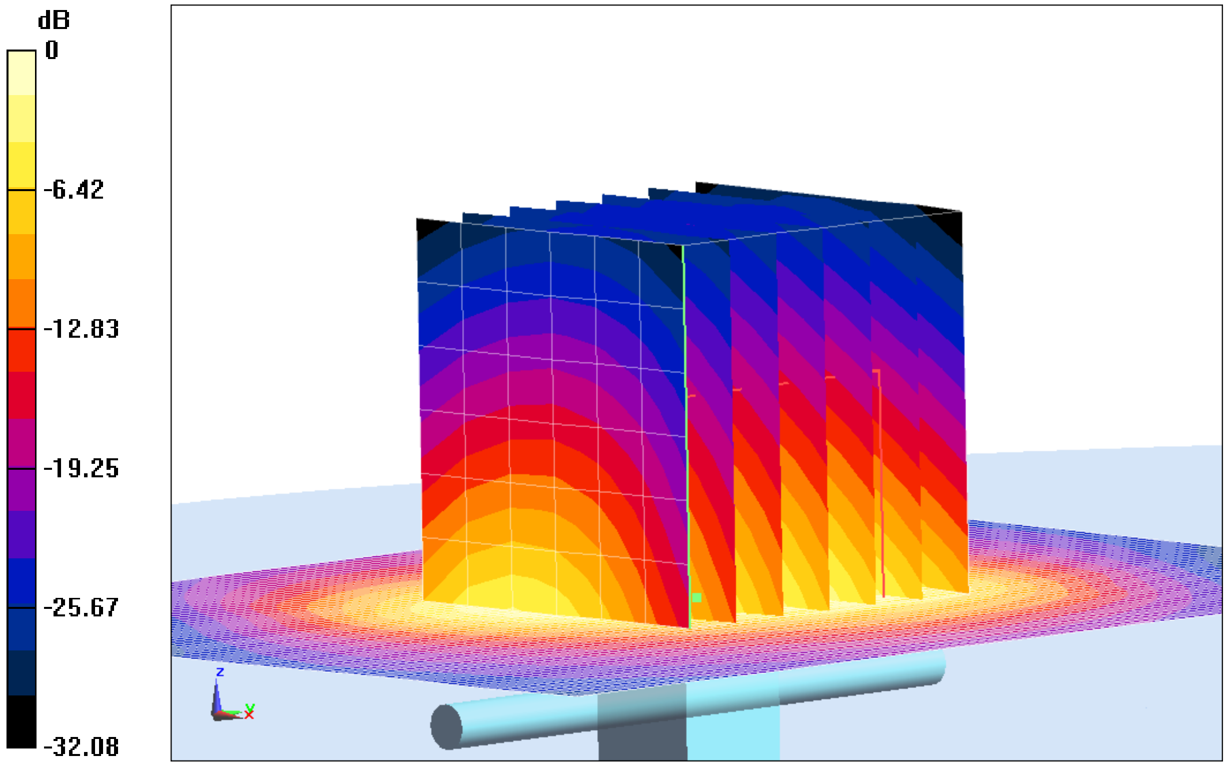
Fig.B.5 validation 2450MHz 250mW

2450MHz

Date: 2015-01-03
Electronics: DAE4 Sn777
Medium: Body 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 1.974 S/m; ε_r =51.63; ρ = 1000 kg/m^3
Ambient Temperature: 23.0°C   Liquid Temperature: 22.5°C
Communication System: CW Frequency: 2450 MHz Duty Cycle: 1:1
Probe: EX3DV4 - SN3617 ConvF(7.35, 7.35, 7.35)

System Validation/Area Scan (81x101x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Reference Value = 90.947 V/m; Power Drift = -0.03 dB
SAR(1 g) = 12.51 W/kg; SAR(10 g) = 5.82 W/kg
Maximum value of SAR (interpolated) = 14.61 W/kg

System Validation/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 90.947 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 25.00 W/kg
SAR(1 g) = 12.71 W/kg; SAR(10 g) = 5.60 W/kg
Maximum value of SAR (measured) = 14.81 W/kg



0 dB = 14.81 W/kg = 11.71 dB W/kgz

Fig.B.6 validation 2450MHz 250mW

The SAR system verification must be required that the area scan estimated 1-g SAR is within 3% of the zoom scan 1-g SAR.

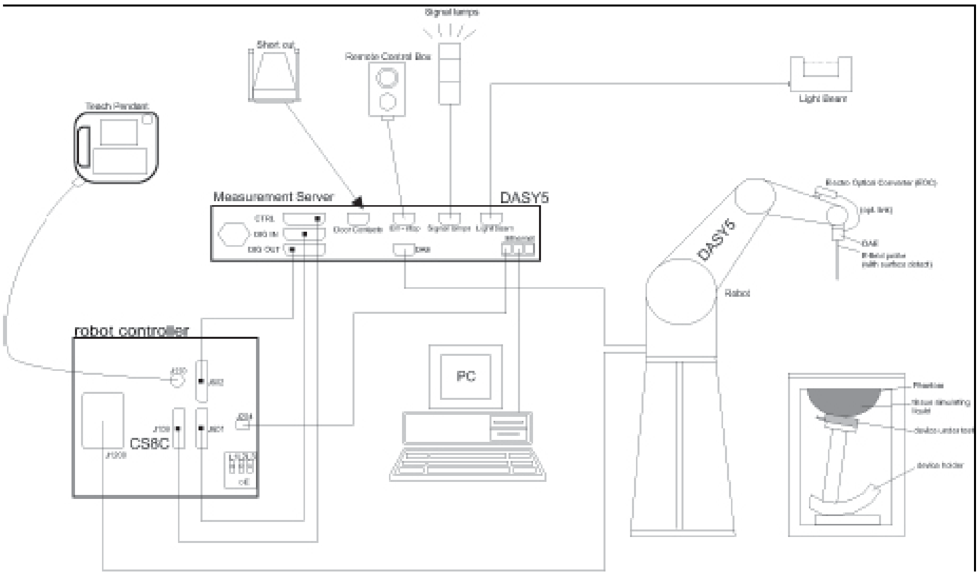
Table B.1 Comparison between area scan and zoom scan for system verification

Date	**Band**	**Position**	**Area scan (1g)**	**Zoom scan (1g)**	**Drift (%)**
2016-01-01	835	Head	2.25	2.29	-1.75
	835	Body	2.29	2.34	-2.14
2016-01-02	1900	Head	10.59	10.39	1.92
	1900	Body	10.54	10.34	1.93
2016-01-03	2450	Head	13.33	13.13	1.52
	2450	Body	12.51	12.71	-1.57

ANNEX C SAR Measurement Setup

C.1 Measurement Set-up

The Dasy4 or DASY5 system for performing compliance tests is illustrated above graphically. This system consists of the following items:



Picture C.1SAR Lab Test Measurement Set-up

- A standard high precision 6-axis robot (StäubliTX=RX family) with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
- An isotropic field probe optimized and calibrated for the targeted measurement.
- A data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
- The Electro-optical converter (EOC) performs the conversion from optical to electrical signals for the digital communication to the DAE. To use optical surface detection, a special version of the EOC is required. The EOC signal is transmitted to the measurement server.
- The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- The Light Beam used is for probe alignment. This improves the (absolute) accuracy of the probe positioning.
- A computer running WinXP and the DASY4 or DASY5 software.
- Remote control and teach pendant as well as additional circuitry for robot safety such as
- warning lamps, etc.
- The phantom, the device holder and other accessories according to the targeted measurement.

C.2 Dasy4 or DASY5 E-field Probe System

The SAR measurements were conducted with the dosimetric probe designed in the classical triangular configuration and optimized for dosimetric evaluation. The probe is constructed using the thick film technique; with printed resistive lines on ceramic substrates. The probe is equipped with an optical multifiber line ending at the front of the probe tip. It is connected to the EOC box on the robot arm and provides an automatic detection of the phantom surface. Half of the fibers are connected to a pulsed infrared transmitter, the other half to a synchronized receiver. As the probe approaches the surface, the reflection from the surface produces a coupling from the transmitting to the receiving fibers. This reflection increases first during the approach, reaches maximum and then decreases. If the probe is flatly touching the surface, the coupling is zero. The distance of the coupling maximum to the surface is independent of the surface reflectivity and largely independent of the surface to probe angle. The DASY4 or DASY5 software reads the reflection durning a software approach and looks for the maximum using 2nd ord curve fitting. The approach is stopped at reaching the maximum.

Probe Specifications:
Model: ES3DV3, EX3DV4
Frequency Range: 10MHz — 6.0GHz(EX3DV4)
10MHz — 4GHz(ES3DV3)
Calibration: In head and body simulating tissue at Frequencies from 835 up to 5800MHz
Linearity: ± 0.2dB(30 MHz to 6 GHz) for EX3DV4
± 0.2dB(30 MHz to 4 GHz) for ES3DV3
DynamicRange: 10 mW/kg — 100W/kg
Probe Length: 330 mm
Probe Tip Length: 20 mm
Body Diameter: 12 mm
Tip Diameter: 2.5 mm (3.9 mm for ES3DV3)
Tip-Center: 1 mm (2.0mm for ES3DV3)
Application: SAR Dosimetry Testing
Compliance tests of mobile phones
Dosimetry in strong gradient fields

Picture C.2 Near-field Probe

Picture C.3 E-field Probe

C.3 E-field Probe Calibration

Each E-Probe/Probe Amplifier combination has unique calibration parameters. A TEM cell calibration procedure is conducted to determine the proper amplifier settings to enter in the probe parameters. The amplifier settings are determined for a given frequency by subjecting the probe to a known E-field density (1 mW/cm^2) using an RF Signal generator, TEM cell, and RF Power Meter.

The free space E-field from amplified probe outputs is determined in a test chamber. This calibration can be performed in a TEM cell if the frequency is below 1 GHz and inn a waveguide or other methodologies above 1 GHz for free space. For the free space calibration, the probe is placed