Table 14-27 LTE2300-FDD30 #1 AP OFF Body

LTE2300-FDD30 #1 Body				
Ambient Temperature:		22.5		22.3
Mode	Device orientation	SAR measurement	Measured SAR [W/kg]	Reported SAR [W/kg]
			27710	27710
			M	M
10MHz QPSK1RB	Tune-up		24.00	Scaling factor*
	Measured Power [dBm]		22.69	1.35
	Front 15mm	1g SAR	0.433	0.59
		10g SAR	0.24	0.32
		Deviation	0.03	0.03
	Rear 15mm	1g SAR	0.838	1.13
		10g SAR	0.45	0.61
		Deviation	0.11	0.11
Mode	Device orientation	SAR measurement	Measured SAR [W/kg]	Reported SAR [W/kg]
			27710	27710
			M	
10MHz QPSK50% RB	Tune-up		23.00	Scaling factor*
	Measured Power [dBm]		21.74	1.34
	Front 15mm	1g SAR	0.3331	0.45
		10g SAR	0.18	0.24
		Deviation	0.09	0.09
	Rear 15mm	1g SAR	0.553	0.74
		10g SAR	0.303	0.40
		Deviation	0.04	0.04
Mode	Device orientation	SAR measurement	Measured SAR [W/kg]	Reported SAR [W/kg]
			27710	27710
10MHz QPSK100% RB	Tune-up		23.00	Scaling factor*
	Measured Power [dBm]		21.70	1.35
	Front 15mm	1g SAR	0.821	1.11
		10g SAR	0.431	0.58
		Deviation	0.02	0.02

Table 14-28 LTE2300-FDD30 #2 AP ON Body

LTE2300-FDD30 #2 Body				
Ambient Temperature:		22.5		22.3
Mode	Device orientation	SAR measurement	Measured SAR [W/kg]	Reported SAR [W/kg]
			27710	27710
			H	H
10MHz QPSK1RB	Tune-up		21.50	Scaling factor*
	Measured Power [dBm]		20.93	1.14
	Front	1g SAR	0.414	0.47
		10g SAR	0.215	0.24
		Deviation	0.07	0.07
	Rear	1g SAR	0.891	1.01
		10g SAR	0.429	0.49
		Deviation	0.02	0.02
	Left edge	1g SAR	0.093	0.11
		10g SAR	0.053	0.06
		Deviation	0.15	0.15
	Right edge	1g SAR	0.061	0.07
		10g SAR	0.035	0.04
		Deviation	0.06	0.06
	Bottom edge	1g SAR	0.965	1.10
		10g SAR	0.483	0.55
		Deviation	0.08	0.08
Mode	Device orientation	SAR measurement	Measured SAR [W/kg]	Reported SAR [W/kg]
			27710	27710
			H	
10MHz QPSK50% RB	Tune-up		20.50	Scaling factor*
	Measured Power [dBm]		19.92	1.14
	Front	1g SAR	0.316	0.36
		10g SAR	0.164	0.19
		Deviation	0.14	0.14
	Rear	1g SAR	0.676	0.77
		10g SAR	0.328	0.37
		Deviation	-0.05	-0.05
	Left edge	1g SAR	0.071	0.08
		10g SAR	0.04	0.05
		Deviation	0.02	0.02
	Right edge	1g SAR	0.047	0.05
		10g SAR	0.027	0.03
		Deviation	0.07	0.07
	Bottom edge	1g SAR	0.738	0.84
		10g SAR	0.368	0.42
		Deviation	0.12	0.12
	Top edge	1g SAR		
		10g SAR		
		Deviation		
Mode	Device orientation	SAR measurement	Measured	Reported
			27710	27710
10MHz QPSK100% RB	Tune-up		20.50	Scaling factor*
	Measured Power [dBm]		19.85	1.16
	Rear	1g SAR	0.695	0.81
		10g SAR	0.332	0.39
		Deviation	-0.07	-0.07

14.2 Full SAR

Test Band	Channel	Frequency	Tune-Up	Measured Power	Test Position	Measured 10g SAR	Measured 1g SAR	Reported 10g SAR	Reported 1g SAR	Power Drift	Figure
GSM850	190	836.6 MHz	33.2	32.09	Left Cheek	0.101	0.133	0.13	0.17	0.08	Fig A.1
GSM850	128	824.2 MHz	32	30.87	Rear	0.375	0.477	0.49	0.62	-0.01	Fig A.2
PCS1900	661	1880 MHz	30	28.37	Right Cheek	0.095	0.148	0.14	0.22	0.09	Fig A.3
PCS1900	512	1850.2 MHz	28	26.81	Rear 15mm	0.378	0.663	0.50	0.87	0.11	Fig A.4
PCS1900	661	1880 MHz	22.5	21.50	Bottom edge	0.35	0.671	0.44	0.84	0.07	Fig A.5
WCDMA1900-BII	9538	1907.6 MHz	23.2	22.04	Right Cheek	0.106	0.172	0.14	0.22	0.08	Fig A.6
WCDMA1900-BII	9262	1852.4 MHz	23.2	22.02	Rear 15mm	0.407	0.719	0.53	0.94	0.1	Fig A.7
WCDMA1900-BII	9262	1852.4 MHz	20.2	18.92	Bottom edge	0.496	0.933	0.67	1.25	-0.17	Fig A.8
WCDMA1700-BIV	1513	1752.6 MHz	22.5	21.39	Right Cheek	0.086	0.135	0.11	0.17	0	Fig A.9
WCDMA1700-BIV	1513	1752.6 MHz	22.5	21.39	Rear 15mm	0.443	0.775	0.57	1.00	0.02	Fig A.10
WCDMA1700-BIV	1513	1752.6 MHz	20	19.28	Bottom edge	0.5	0.946	0.59	1.12	-0.13	Fig A.11
WCDMA850-BV	4183	836.6 MHz	25.5	24.34	Left Cheek	0.323	0.416	0.42	0.54	0.02	Fig A.12
WCDMA850-BV	4132	826.4 MHz	25.5	24.28	Rear	0.416	0.528	0.55	0.70	-0.03	Fig A.13
LTE1900-FDD2	19100	1900 MHz	24	23.61	Right Cheek	0.129	0.209	0.14	0.23	0.07	Fig A.14
LTE1900-FDD2	19100	1900 MHz	24	23.61	Rear 15mm	0.417	0.726	0.46	0.79	0.04	Fig A.15
LTE1900-FDD2	18700	1860 MHz	20	19.20	Bottom edge	0.565	1.09	0.68	1.31	-0.16	Fig A.16
LTE1700-FDD4	20050	1720 MHz	24	23.04	Right Cheek	0.111	0.172	0.14	0.21	0.04	Fig A.17
LTE1700-FDD4	20300	1745 MHz	24	22.99	Rear 15mm	0.541	0.949	0.68	1.20	0.09	Fig A.18
LTE1700-FDD4	20300	1745 MHz	20.5	19.83	Rear	0.539	0.999	0.63	1.17	-0.03	Fig A.19
LTE850-FDD5	20450	829 MHz	24.5	24.28	Left Cheek	0.266	0.34	0.28	0.36	-0.15	Fig A.20
LTE850-FDD5	20450	829 MHz	24.5	24.28	Rear	0.301	0.383	0.32	0.40	0	Fig A.21
LTE700-FDD12	23060	704 MHz	24.5	23.65	Left Cheek	0.162	0.206	0.20	0.25	0.17	Fig A.22
LTE700-FDD12	23060	704 MHz	24.5	23.65	Rear	0.345	0.436	0.42	0.53	0	Fig A.23
LTE700-FDD14	23330	793 MHz	24.5	23.37	Left Cheek	0.254	0.326	0.33	0.42	0.04	Fig A.24
LTE700-FDD14	23330	793 MHz	24.5	23.37	Rear	0.373	0.477	0.48	0.62	-0.01	Fig A.25
LTE2300-FDD30	27710	2310 MHz	24	22.69	Left Cheek	0.11	0.195	0.15	0.26	0.01	Fig A.26
LTE2300-FDD30	27710	2310 MHz	24	22.69	Rear 15mm	0.45	0.838	0.61	1.13	0.11	Fig A.27
LTE2300-FDD30	27710	2310 MHz	21.5	20.93	Bottom edge	0.483	0.965	0.55	1.10	0.08	Fig A.28

14.3 WiFi Evaluation

According to the KDB248227 D01, SAR is measured for 802.11b DSSS using the initial test position procedure.

Note1: When the reported SAR of the initial test position is > 0.4 W/kg, SAR is repeated for the 802.11 transmission mode configuration tested in the initial test position using subsequent highest estimated 1-g SAR conditions determined by area scans, on the highest maximum output power channel, until the reported SAR is ≤ 0.8 W/kg.

Note2: For all positions/configurations tested using the initial test position and subsequent test positions, when the reported SAR is > 0.8 W/kg, SAR is measured for these test positions/configurations on the subsequent next highest measured output power channel until the reported SAR is ≤ 1.2 W/kg or all required channels are tested.

Note3: According to the KDB248227 D01, The reported SAR must be scaled to 100% transmission duty factor to determine compliance at the maximum tune-up tolerance limit.

Table 14-29 WLAN2450 #1 Head Fast SAR

WLAN2450 #1 Head Fast SAR									
Ambient Temperature:	22.5					Liquid Temperature:	22.3		
Rate	Device orientation	SAR measurement	Measured SAR [W/kg]			Reported SAR [W/kg]			
			11	6	1	11	6	1	
			2462 MHz	2437 MHz	2412 MHz				
802.11b 5.5Mbps	Tune up		20	20.5	20	Scaling factor*			
	Slot Average Power [dBm]		19.70	20.29	19.60	1.07	1.05	1.10	
	Left Cheek	1g Fast SAR	1.04	0.863	0.618	1.11	0.91	0.68	
		10g SAR	0.586	0.473	0.344	0.63	0.50	0.38	
		Deviation	0.1	0.05	-0.05	0.10	0.05	-0.05	
	Left Tilt	1g Fast SAR	1.13	0.785		1.21	0.82		
		10g SAR	0.595	0.44		0.64	0.46		
		Deviation	0.07	0.07		0.07	0.07		
	Right Cheek	1g Fast SAR		0.381			0.40		
		10g SAR		0.215			0.23		
		Deviation		-0.09			-0.09		
	Right Tilt	1g Fast SAR		0.278			0.29		
		10g SAR		0.106			0.11		
		Deviation		-0.06			-0.06		

Table 14-30 WLAN2450 #1 Head Full SAR

WLAN2450 #1 Head Full SAR									
Ambient Temperature:	22.5					Liquid Temperature:	22.3		
Rate	Device orientation	SAR measurement	Measured SAR [W/kg]			Reported SAR [W/kg]			
			11	6	1	11	6	1	
			2462 MHz	2437 MHz	2412 MHz				
802.11b 5.5Mbps	Tune up		20	20.5	20	Scaling factor*			
	Slot Average Power [dBm]		19.70	20.29	19.60	1.07	1.05	1.10	
	Left Cheek	1g Full SAR	1.19	1	0.666	1.28	1.05	0.73	
		10g SAR	0.602	0.516	0.342	0.65	0.54	0.37	
		Deviation	0.1	0.05	-0.05	0.10	0.05	-0.05	
	Left Tilt	1g Full SAR	1.03	0.845		1.10	0.89		
		10g SAR	0.551	0.44		0.59	0.46		
		Deviation	0.07	0.07		0.07	0.07		
	Right Cheek	1g Full SAR		0.41			0.43		
		10g SAR		0.224			0.24		
		Deviation		-0.09			-0.09		

Table 14-31 WLAN2450 #1 Body Fast SAR

WLAN2450 #1 Body Fast SAR									
Ambient Temperature:	22.5					Liquid Temperature:	22.3		
Rate	Device orientation	SAR measurement	Measured SAR [W/kg]			Reported SAR [W/kg]			
			11	6	1	11	6	1	
			2462 MHz	2437 MHz	2412 MHz				
802.11b 5.5Mbps	Tune up		20	20.5	20	Scaling factor*			
	Slot Average Power [dBm]		19.70	20.29	19.60	1.07	1.05	1.10	
	Front	1g Fast SAR		0.288			0.30		
		10g SAR		0.161			0.17		
		Deviation		0.09			0.09		
	Rear	1g Fast SAR		0.323			0.34		
		10g SAR		0.173			0.18		
		Deviation		-0.09			-0.09		
	Top edge	1g Fast SAR		0.113			0.12		
		10g SAR		0.059			0.06		
		Deviation		0.03			0.03		
	Right edge	1g Fast SAR		0.311			0.33		
		10g SAR		0.159			0.17		
		Deviation		0.09			0.09		

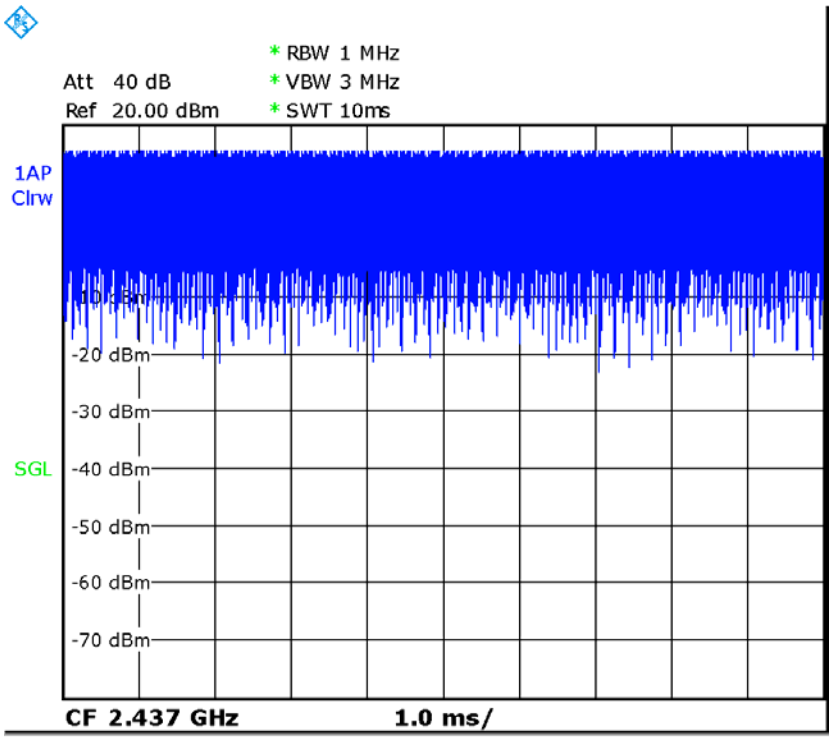
Table 14-32 WLAN2450 #1 Body Full SAR

WLAN2450 #1 Body Full SAR									
Ambient Temperature:	22.5					Liquid Temperature:	22.3		
Rate	Device orientation	SAR measurement	Measured SAR [W/kg]			Reported SAR [W/kg]			
			11	6	1	11	6	1	
			2462 MHz	2437 MHz	2412 MHz				
802.11b 5.5Mbps	Tune up		20	20.5	20	Scaling factor*			
	Slot Average Power [dBm]		19.70	20.29	19.60	1.07	1.05	1.10	
	Rear	1g Full SAR		0.322			0.34		
		10g SAR		0.172			0.18		
		Deviation		-0.09			-0.09		

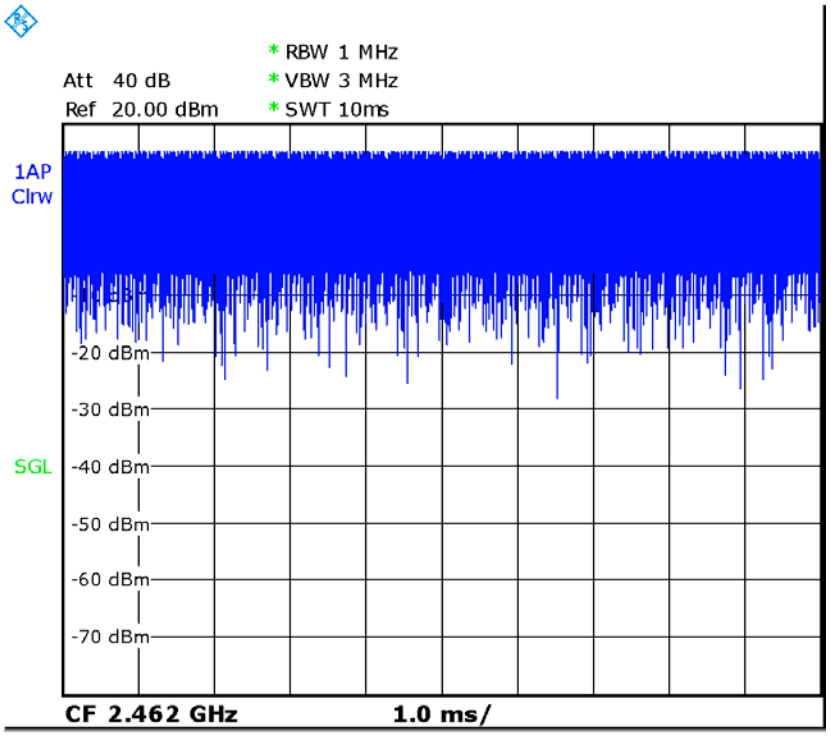
According to the KDB248227 D01, The reported SAR must be scaled to 100% transmission duty factor to determine compliance at the maximum tune-up tolerance limit. The scaled reported SAR is presented as below							
Frequency		Test Position	Actual duty factor	maximum duty factor	Reported SAR(1g)(W/kg)	Scaled reported SAR(1g)(W/kg)	Figure
MHz	Ch.						
2462 MHz	11	Left Cheek	100.00%	100%	**1.28**	**1.28**	Fig A.29

According to the KDB248227 D01, The reported SAR must be scaled to 100% transmission duty factor to determine compliance at the maximum tune-up tolerance limit. The scaled reported SAR is presented as below							
Frequency		Test Position	Actual duty factor	maximum duty factor	Reported SAR(1g)(W/kg)	Scaled reported SAR(1g)(W/kg)	Figure
MHz	Ch.						
2437	6	0	100.00%	100%	**0.34**	**0.34**	Fig A.30

SAR is not required for OFDM because the 802.11b adjusted SAR ≤ 1.2 W/kg.



Picture 14.1 Duty factor plot CH6



Picture 14.1 Duty factor plot CH11

15 SAR Measurement Variability

SAR measurement variability must be assessed for each frequency band, which is determined by the SAR probe calibration point and tissue-equivalent medium used for the device measurements. When both head and body tissue-equivalent media are required for SAR measurements in a frequency band, the variability measurement procedures should be applied to the tissue medium with the highest measured SAR, using the highest measured SAR configuration for that tissue-equivalent medium.

The following procedures are applied to determine if repeated measurements are required.

1) Repeated measurement is not required when the original highest measured SAR is < 0.80 W/kg; steps 2) through 4) do not apply.

2) When the original highest measured SAR is ≥ 0.80 W/kg, repeat that measurement once.

3) Perform a second repeated measurement only if the ratio of largest to smallest SAR for the original and first repeated measurements is > 1.20 or when the original or repeated measurement is ≥ 1.45 W/kg (~ 10% from the 1-g SAR limit).

4) Perform a third repeated measurement only if the original, first or second repeated measurement is ≥ 1.5 W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20.

Mode	CH	Freq	Test Poisition	Original SAR (W/kg)	First Repeated SAR(W/kg)	The Ratio
WCDMA1900-BII	9262	1852.4 MHz	Bottom edge	0.933	0.929	1.00
WCDMA1700-BIV	1513	1752.6 MHz	Bottom edge	0.946	0.931	1.02
LTE1900-FDD2	18700	1860 MHz	Bottom edge	1.09	1.07	1.02
LTE1700-FDD4	20300	1745 MHz	Rear 15mm	0.949	0.942	1.01
LTE1700-FDD4	20300	1745 MHz	Rear	0.999	0.989	1.01
LTE2300-FDD30	27710	2310 MHz	Rear 15mm	0.838	0.821	1.02
LTE2300-FDD30	27710	2310 MHz	Bottom edge	0.965	0.959	1.01
WLAN2450	11	2462 MHz	Left Cheek	1.19	1.15	1.03

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	6.0	N	1	1	1	6.0	6.0	∞
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	N	1	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	$u_c' = \sqrt{\sum_{i=1}^{21} c_i^2 u_i^2}$					9.55	9.43	257
Expanded uncertainty (confidence interval of 95 %)	$u_e = 2u_c$					19.1	18.9	

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	6.55	N	1	1	1	6.55	6.55	∞
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	RF ambient 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	B	5.0	R	$\sqrt{3}$	0.6	0.49	1.7	1.4	∞

	(target)									
21	Liquid permittivity (meas.)	A	1.6	N	1	0.6	0.49	1.0	0.8	521
Combined standard uncertainty		$u_c^{'} = \sqrt{\sum_{i=1}^{21} c_i^2 u_i^2}$						10.7	10.6	257
Expanded uncertainty (confidence interval of 95 %)		$u_e = 2u_c$						21.4	21.1	

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	6.0	N	1	1	1	6.0	6.0	∞
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	RF ambient 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		$u_c' = \sqrt{\sum_{i=1}^{22} c_i^2 u_i^2}$						10.4	10.3	257
Expanded uncertainty (confidence interval of 95 %)		$u_e = 2u_c$						20.8	20.6	

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	6.55	N	1	1	1	6.55	6.55	∞
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	RF ambient 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		$u_c' = \sqrt{\sum_{i=1}^{22} c_i^2 u_i^2}$						13.5	13.4	257
Expanded uncertainty (confidence interval of 95 %)		$u_e = 2u_c$						27.0	26.8	

17 MAIN TEST INSTRUMENTS

Table 17.1: List of Main Instruments

No.	Name	Type	Serial Number	Calibration Date	Valid Period
01	Network analyzer	E5071C	MY55491241	June 15, 2018	One year
02	Power meter	NRP2	101919	June 20, 2018	One year
03	Power sensor	NRP-Z91	101547		
04	Signal Generator	E4438C	MY49070393	January 4,2019	One Year
05	Amplifier	60S1G4	0331848	No Calibration Requested	
06	BTS	CMW500	159890	January 3, 2019	One year
07	E-field Probe	SPEAG EX3DV4	7514	August 27,2018	One year
08	DAE	SPEAG DAE4	1525	September 18, 2018	One year
09	Dipole Validation Kit	SPEAG D750V3	1017	July 19, 2017	Three years
10	Dipole Validation Kit	SPEAG D835V2	4d069	July 19, 2017	Three years
11	Dipole Validation Kit	SPEAG D1750V2	1003	July 21, 2017	Three years
12	Dipole Validation Kit	SPEAG D1900V2	5d101	July 26, 2017	Three years
13	Dipole Validation Kit	SPEAG D2300V2	1018	July 24, 2018	One years
14	Dipole Validation Kit	SPEAG D2450V2	853	July 21, 2017	Three years

END OF REPORT BODY

ANNEX A Graph Results

GSM850_CH190 Left Cheek
Date: 5/2/2019
Electronics: DAE4 Sn1525
Medium: head 835 MHz
Medium parameters used: f = 836.6 MHz; σ = 0.917 mho/m; εr = 41.04; ρ = 1000 kg/m^3
Ambient Temperature: 22.5°C, Liquid Temperature: 22.3°C
Communication System: GSM850 836.6 MHz Duty Cycle: 1:8.3
Probe: EX3DV4 – SN7514 ConvF(9.09,9.09,9.09)

Area Scan (71x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.143 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 4.505 V/m; Power Drift = 0.08 dB
Peak SAR (extrapolated) = 0.168 W/kg
SAR(1 g) = 0.133 W/kg; SAR(10 g) = 0.101 W/kg
Maximum value of SAR (measured) = 0.139 W/kg

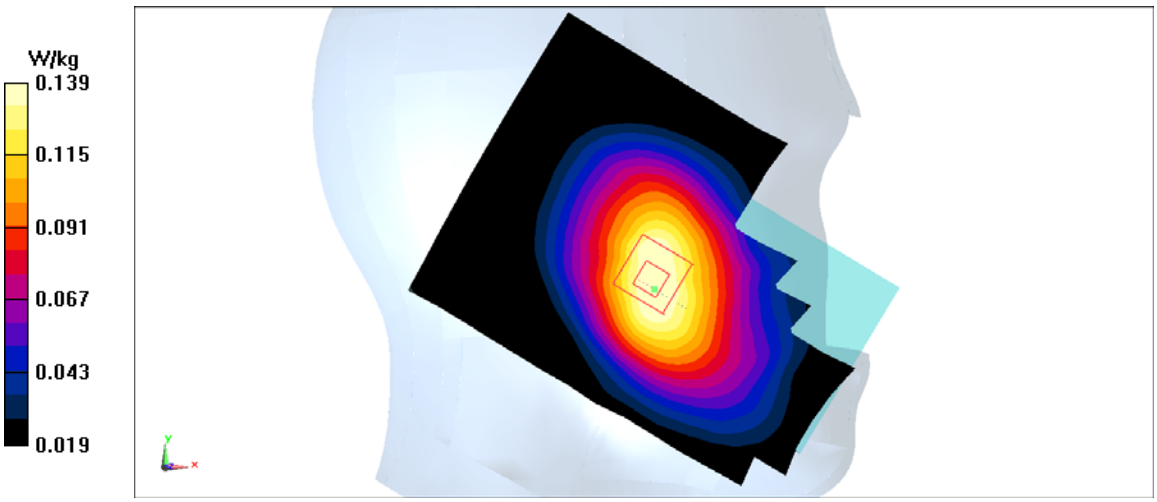


Fig A.1

GSM850_CH128 Rear
Date: 5/2/2019
Electronics: DAE4 Sn1525
Medium: body 835 MHz
Medium parameters used: f = 824.2 MHz; σ = 0.948 mho/m; εr = 55.47; ρ = 1000 kg/m^3
Ambient Temperature: 22.5ºC, Liquid Temperature: 22.3ºC
Communication System: GSM850 824.2 MHz Duty Cycle: 1:4
Probe: EX3DV4 – SN7514 ConvF(9.47,9.47,9.47)

Area Scan (71x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.566 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 22.93 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 0.617 W/kg
SAR(1 g) = 0.477 W/kg; SAR(10 g) = 0.375 W/kg
Maximum value of SAR (measured) = 0.566 W/kg

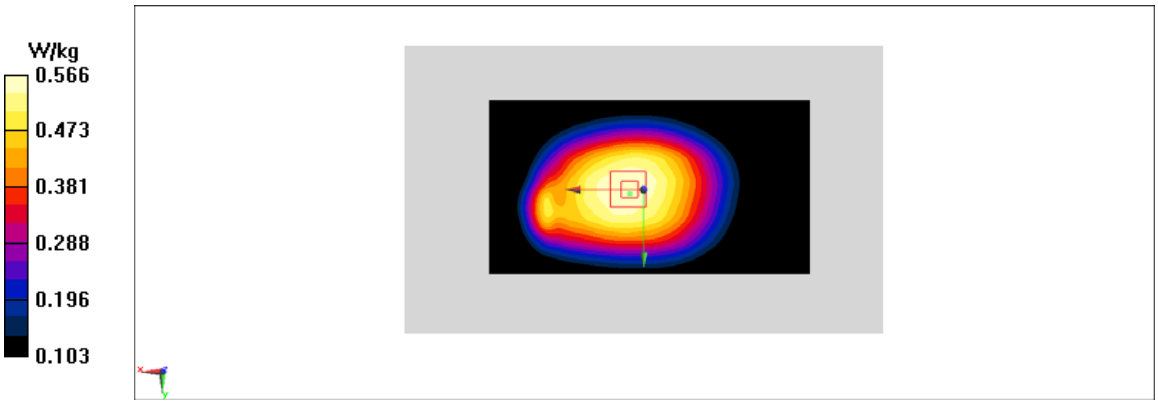


Fig A.2

PCS1900_CH661 Right Cheek
Date: 5/4/2019
Electronics: DAE4 Sn1525
Medium: head 1900 MHz
Medium parameters used: f = 1880 MHz; σ = 1.358 mho/m; εr = 39.61; ρ = 1000 kg/m^3
Ambient Temperature: 22.5ºC, Liquid Temperature: 22.3ºC
Communication System: PCS1900 1880 MHz Duty Cycle: 1:8.3
Probe: EX3DV4 – SN7514 ConvF(7.73,7.73,7.73)

Area Scan (71x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.183 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 2.898 V/m; Power Drift = 0.09 dB
Peak SAR (extrapolated) = 0.222 W/kg
SAR(1 g) = 0.148 W/kg; SAR(10 g) = 0.095 W/kg
Maximum value of SAR (measured) = 0.16 W/kg

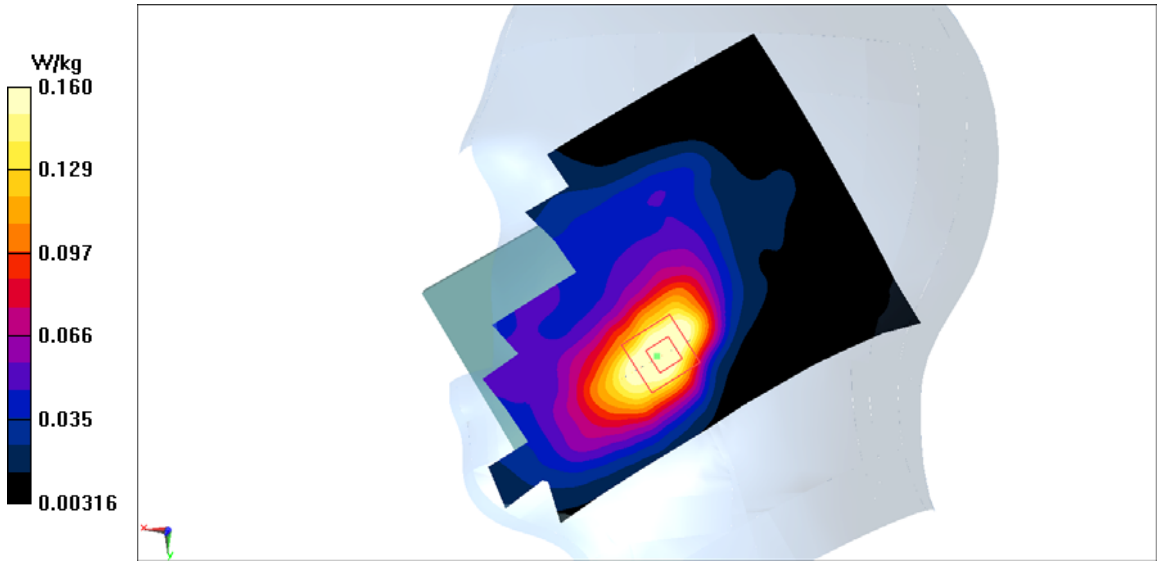


Fig A.3

PCS1900_CH512 Rear 15mm
Date: 5/4/2019
Electronics: DAE4 Sn1525
Medium: body 1900 MHz
Medium parameters used: f = 1850.2 MHz; σ = 1.448 mho/m; εr = 52.77; ρ = 1000 kg/m^3
Ambient Temperature: 22.5ºC, Liquid Temperature: 22.3ºC
Communication System: PCS1900 1850.2 MHz Duty Cycle: 1:4
Probe: EX3DV4 – SN7514 ConvF(7.53,7.53,7.53)

Area Scan (71x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.834 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 6.286 V/m; Power Drift = 0.11 dB
Peak SAR (extrapolated) = 1.14 W/kg
SAR(1 g) = 0.663 W/kg; SAR(10 g) = 0.378 W/kg
Maximum value of SAR (measured) = 0.917 W/kg

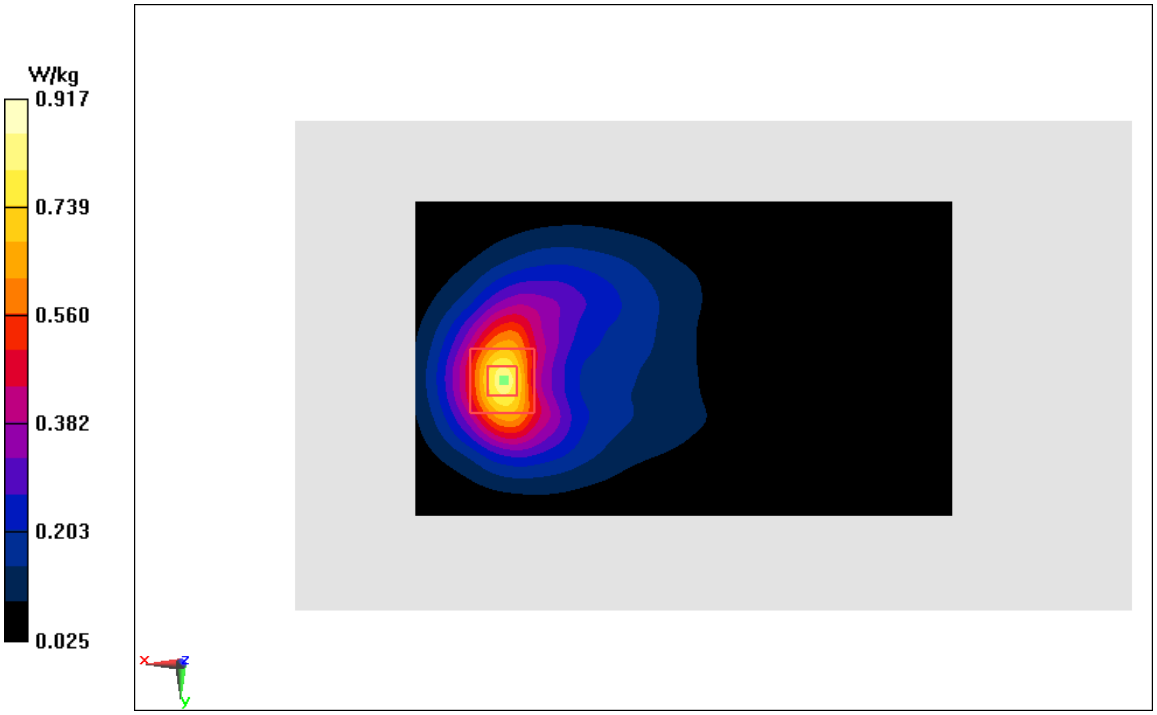


Fig A.4

PCS1900_CH661 Bottom edge
Date: 5/4/2019
Electronics: DAE4 Sn1525
Medium: body 1900 MHz
Medium parameters used: f = 1880 MHz; σ = 1.476 mho/m; εr = 52.73; ρ = 1000 kg/m^3
Ambient Temperature: 22.5ºC, Liquid Temperature: 22.3ºC
Communication System: PCS1900 1880 MHz Duty Cycle: 1:4
Probe: EX3DV4 – SN7514 ConvF(7.53,7.53,7.53)

Area Scan (71x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.86 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 21.48 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 1.2 W/kg
SAR(1 g) = 0.671 W/kg; SAR(10 g) = 0.35 W/kg
Maximum value of SAR (measured) = 0.958 W/kg

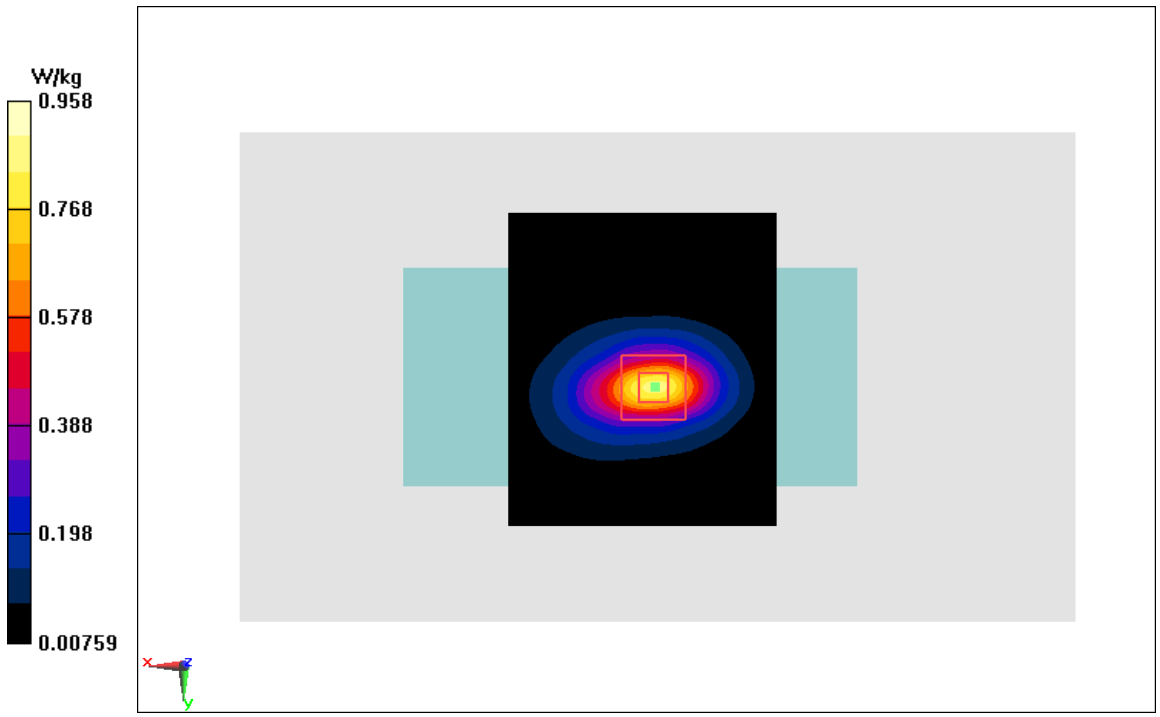


Fig A.5

WCDMA1900-BII_CH9538 Right Cheek
Date: 5/4/2019
Electronics: DAE4 Sn1525
Medium: head 1900 MHz
Medium parameters used: f = 1907.6 MHz; σ = 1.385 mho/m; εr = 39.58; ρ = 1000 kg/m^3
Ambient Temperature: 22.5ºC, Liquid Temperature: 22.3ºC
Communication System: WCDMA1900-BII 1907.6 MHz Duty Cycle: 1:1
Probe: EX3DV4 – SN7514 ConvF(7.73,7.73,7.73)

Area Scan (71x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.219 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 3.706 V/m; Power Drift = 0.08 dB
Peak SAR (extrapolated) = 0.266 W/kg
SAR(1 g) = 0.172 W/kg; SAR(10 g) = 0.106 W/kg
Maximum value of SAR (measured) = 0.187 W/kg

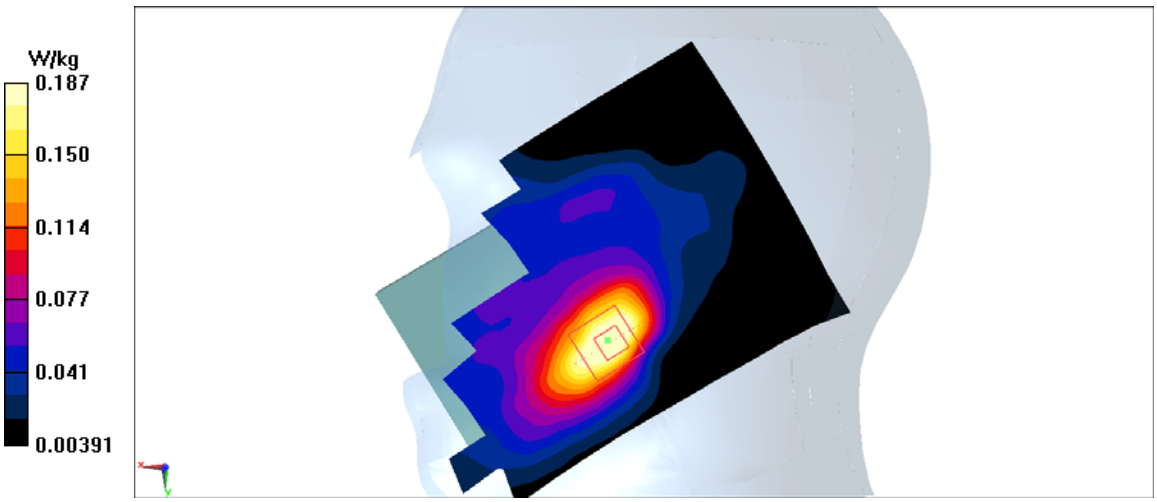


Fig A.6

WCDMA1900-BII_CH9262 Rear 15mm
Date: 5/4/2019
Electronics: DAE4 Sn1525
Medium: body 1900 MHz
Medium parameters used: f = 1852.4 MHz; σ = 1.449 mho/m; εr = 52.77; ρ = 1000 kg/m^3
Ambient Temperature: 22.5ºC, Liquid Temperature: 22.3ºC
Communication System: WCDMA1900-BII 1852.4 MHz Duty Cycle: 1:1
Probe: EX3DV4 – SN7514 ConvF(7.53,7.53,7.53)

Area Scan (71x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.835 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 4.696 V/m; Power Drift = 0.1 dB
Peak SAR (extrapolated) = 1.17 W/kg
SAR(1 g) = 0.719 W/kg; SAR(10 g) = 0.407 W/kg
Maximum value of SAR (measured) = 0.965 W/kg

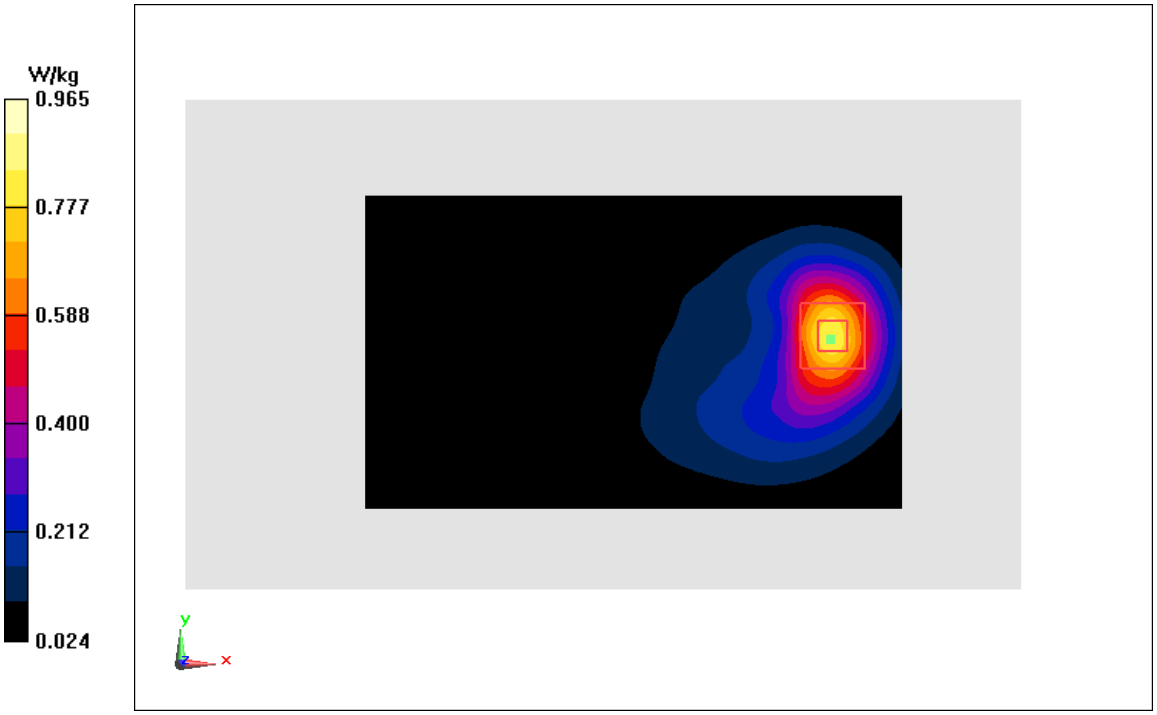


Fig A.7

WCDMA1900-BII_CH9262 Bottom edge
Date: 5/4/2019
Electronics: DAE4 Sn1525
Medium: body 1900 MHz
Medium parameters used: f = 1852.4 MHz; σ = 1.449 mho/m; εr = 52.77; ρ = 1000 kg/m^3
Ambient Temperature: 22.5ºC, Liquid Temperature: 22.3ºC
Communication System: WCDMA1900-BII 1852.4 MHz Duty Cycle: 1:1
Probe: EX3DV4 – SN7514 ConvF(7.53,7.53,7.53)

Area Scan (71x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 1.18 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 17.1 V/m; Power Drift = -0.17 dB
Peak SAR (extrapolated) = 1.58 W/kg
SAR(1 g) = 0.933 W/kg; SAR(10 g) = 0.496 W/kg
Maximum value of SAR (measured) = 1.26 W/kg

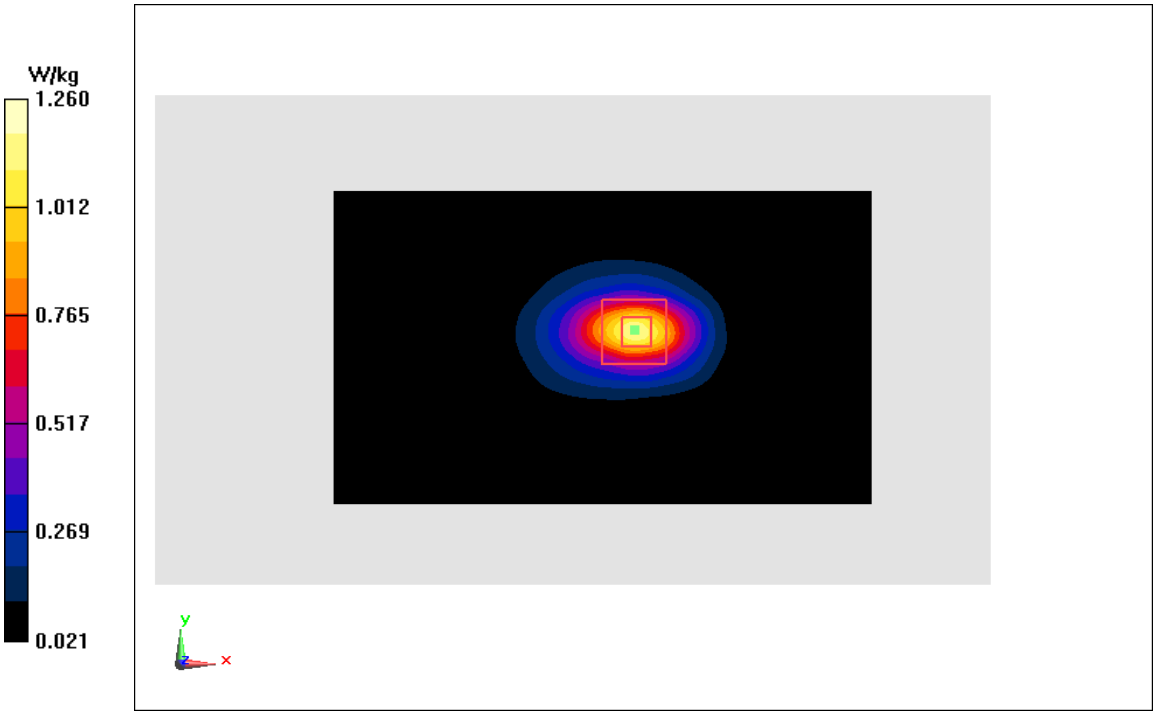


Fig A.8

WCDMA1700-BIV_CH1513 Right Cheek
Date: 5/3/2019
Electronics: DAE4 Sn1525
Medium: head 1750 MHz
Medium parameters used: f = 1752.6 MHz; σ = 1.371 mho/m; εr = 40.53; ρ = 1000 kg/m^3
Ambient Temperature: 22.5ºC, Liquid Temperature: 22.3ºC
Communication System: WCDMA1700-BIV 1752.6 MHz Duty Cycle: 1:1
Probe: EX3DV4 – SN7514 ConvF(8.10,8.10,8.10)

Area Scan (71x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.161 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 4.299 V/m; Power Drift = 0 dB
Peak SAR (extrapolated) = 0.203 W/kg
SAR(1 g) = 0.135 W/kg; SAR(10 g) = 0.086 W/kg
Maximum value of SAR (measured) = 0.145 W/kg

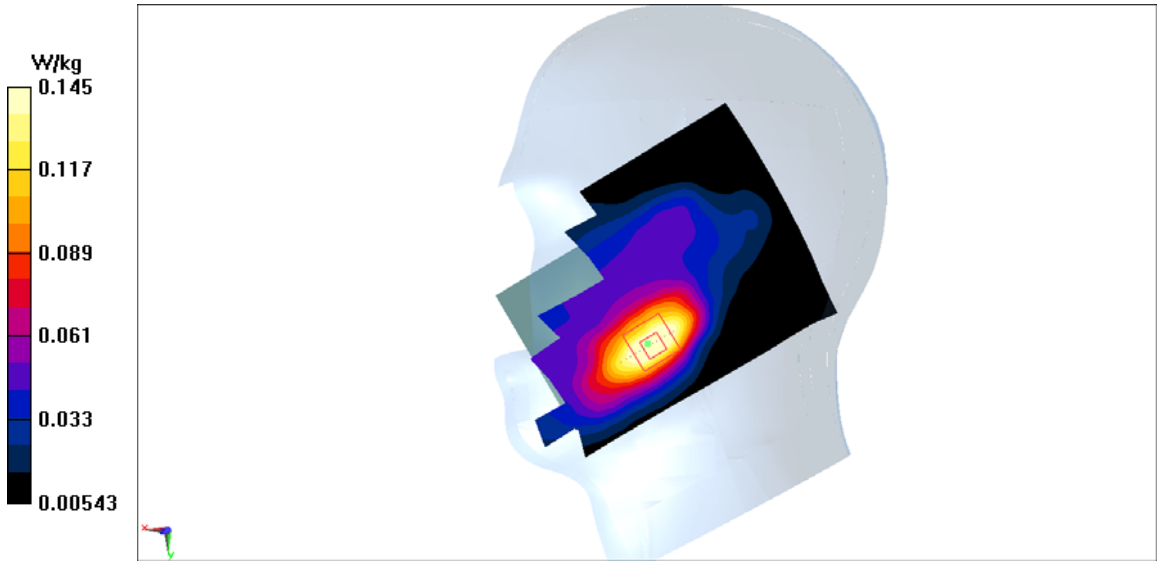


Fig A.9

WCDMA1700-BIV_CH1513 Rear 15mm
Date: 5/3/2019
Electronics: DAE4 Sn1525
Medium: body 1750 MHz
Medium parameters used: f = 1752.6 MHz; σ = 1.475 mho/m; εr = 52.72; ρ = 1000 kg/m^3
Ambient Temperature: 22.5ºC, Liquid Temperature: 22.3ºC
Communication System: WCDMA1700-BIV 1752.6 MHz Duty Cycle: 1:1
Probe: EX3DV4 – SN7514 ConvF(7.82,7.82,7.82)

Area Scan (71x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.909 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 4.861 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 1.25 W/kg
SAR(1 g) = 0.775 W/kg; SAR(10 g) = 0.443 W/kg
Maximum value of SAR (measured) = 1.03 W/kg

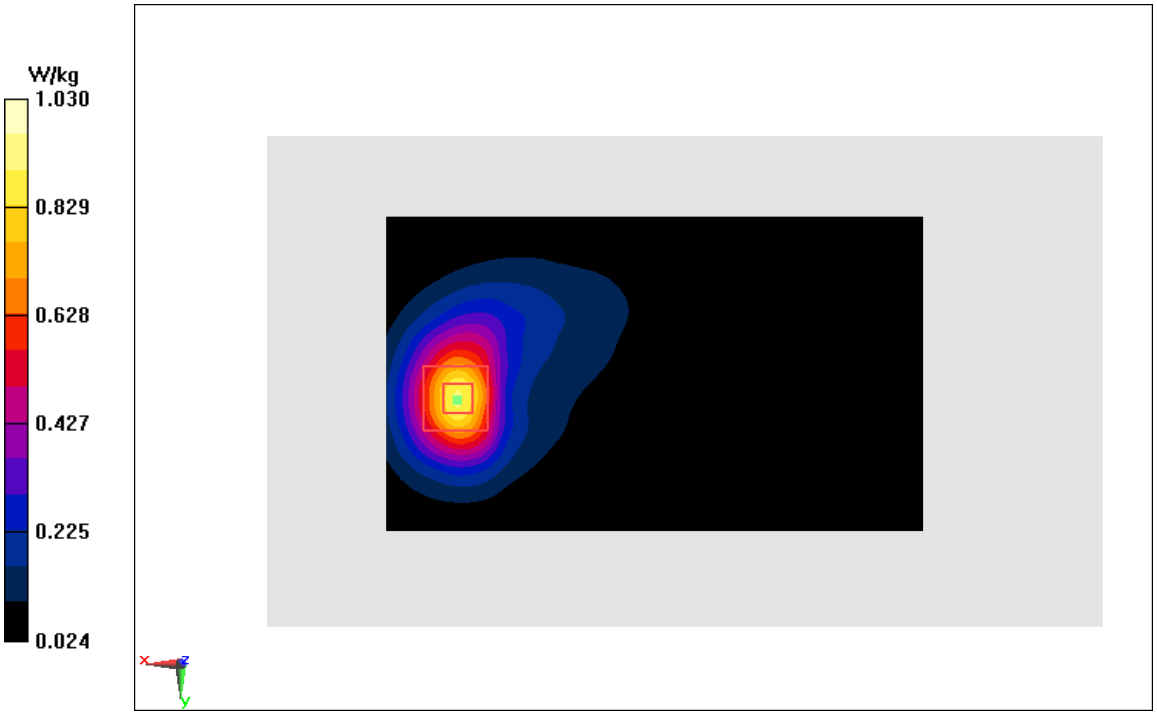


Fig A.10

WCDMA1700-BIV_CH1513 Bottom edge
Date: 5/3/2019
Electronics: DAE4 Sn1525
Medium: body 1750 MHz
Medium parameters used: f = 1752.6 MHz; σ = 1.475 mho/m; εr = 52.72; ρ = 1000 kg/m^3
Ambient Temperature: 22.5ºC, Liquid Temperature: 22.3ºC
Communication System: WCDMA1700-BIV 1752.6 MHz Duty Cycle: 1:1
Probe: EX3DV4 – SN7514 ConvF(7.82,7.82,7.82)

Area Scan (71x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 1.22 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 17.74 V/m; Power Drift = -0.13 dB
Peak SAR (extrapolated) = 1.6 W/kg
SAR(1 g) = 0.946 W/kg; SAR(10 g) = 0.5 W/kg
Maximum value of SAR (measured) = 1.29 W/kg

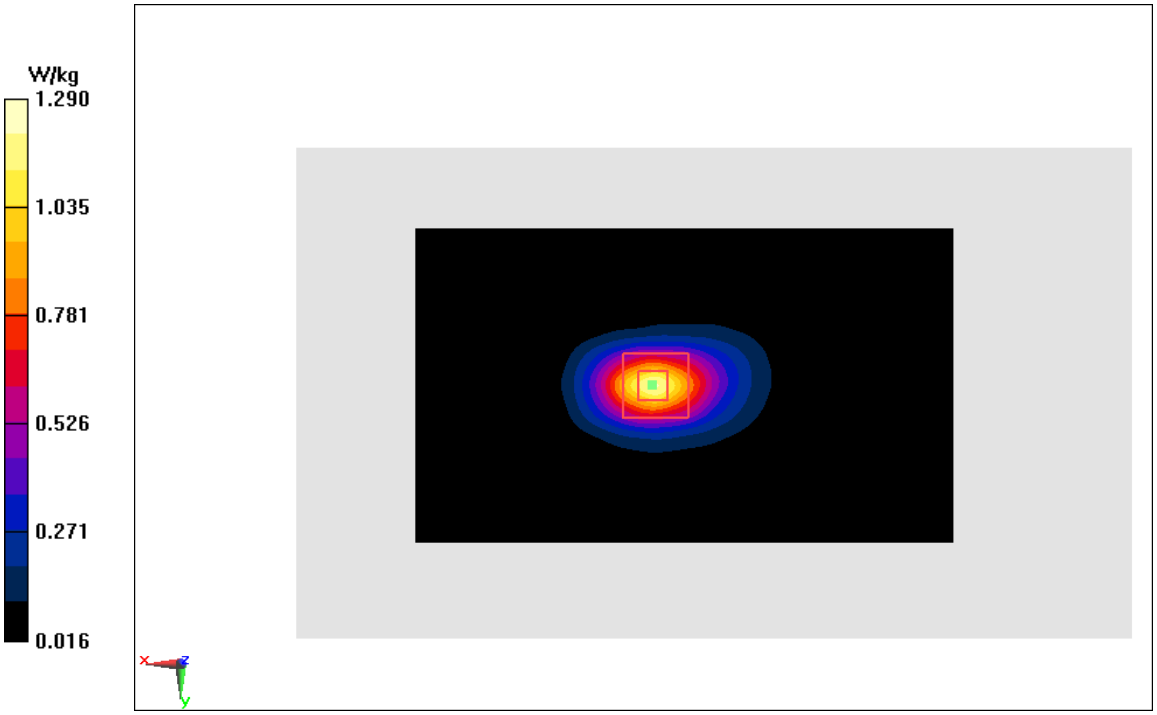


Fig A.11

WCDMA850-BV_CH4183 Left Cheek
Date: 5/2/2019
Electronics: DAE4 Sn1525
Medium: head 835 MHz
Medium parameters used: f = 836.6 MHz; σ = 0.917 mho/m; εr = 41.04; ρ = 1000 kg/m^3
Ambient Temperature: 22.5ºC, Liquid Temperature: 22.3ºC
Communication System: WCDMA850-BV 836.6 MHz Duty Cycle: 1:1
Probe: EX3DV4 – SN7514 ConvF(9.09,9.09,9.09)

Area Scan (71x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.455 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 7.492 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 0.513 W/kg
SAR(1 g) = 0.416 W/kg; SAR(10 g) = 0.323 W/kg
Maximum value of SAR (measured) = 0.436 W/kg

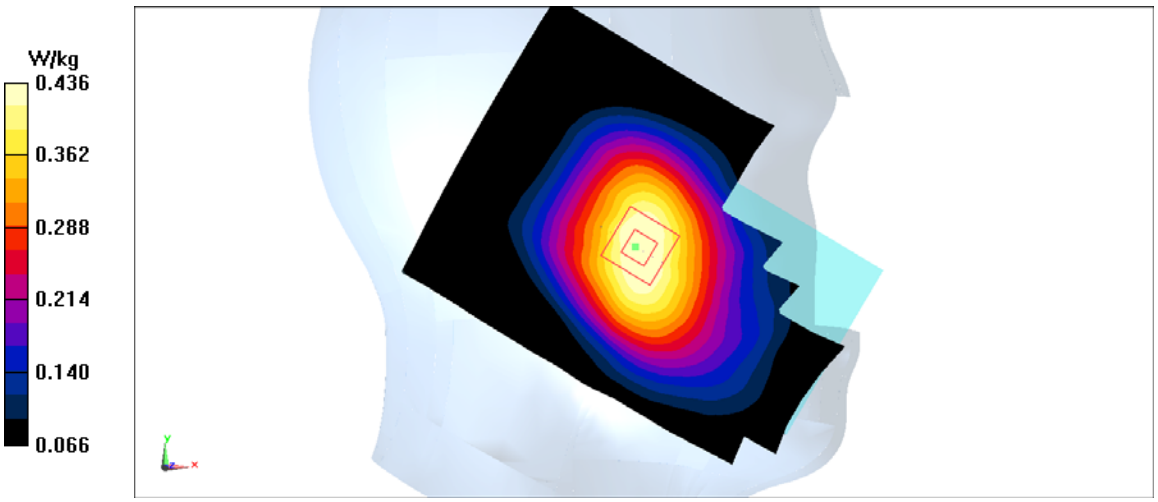


Fig A.12

WCDMA850-BV_CH4132 Rear
Date: 5/2/2019
Electronics: DAE4 Sn1525
Medium: body 835 MHz
Medium parameters used: f = 826.4 MHz; σ = 0.949 mho/m; εr = 55.47; ρ = 1000 kg/m^3
Ambient Temperature: 22.5ºC, Liquid Temperature: 22.3ºC
Communication System: WCDMA850-BV 826.4 MHz Duty Cycle: 1:1
Probe: EX3DV4 – SN7514 ConvF(9.47,9.47,9.47)

Area Scan (71x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.635 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 23.71 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 0.692 W/kg
SAR(1 g) = 0.528 W/kg; SAR(10 g) = 0.416 W/kg
Maximum value of SAR (measured) = 0.633 W/kg

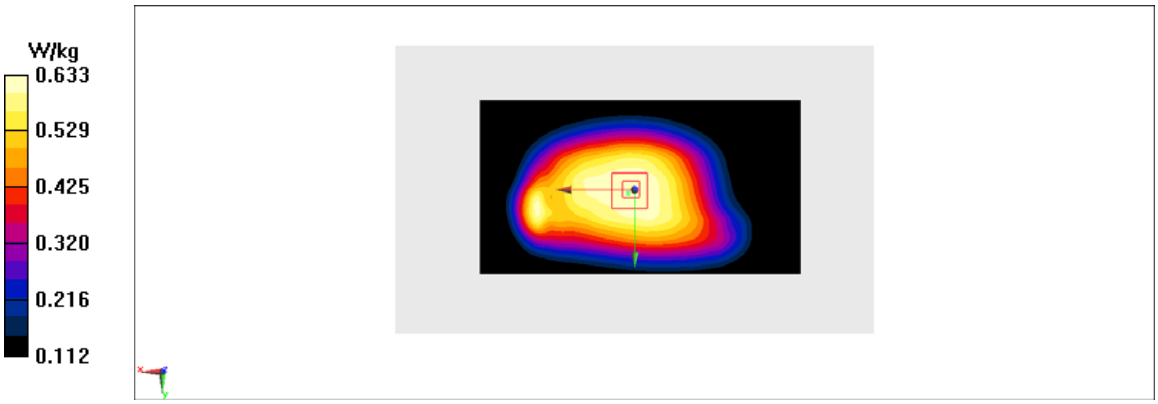


Fig A.13

LTE1900-FDD2_CH19100 Right Cheek
Date: 5/4/2019
Electronics: DAE4 Sn1525
Medium: head 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.377 mho/m; εr = 39.59; ρ = 1000 kg/m^3
Ambient Temperature: 22.5ºC, Liquid Temperature: 22.3ºC
Communication System: LTE1900-FDD2 1900 MHz Duty Cycle: 1:1
Probe: EX3DV4 – SN7514 ConvF(7.73,7.73,7.73)

Area Scan (71x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.263 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 3.963 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 0.324 W/kg
SAR(1 g) = 0.209 W/kg; SAR(10 g) = 0.129 W/kg
Maximum value of SAR (measured) = 0.224 W/kg

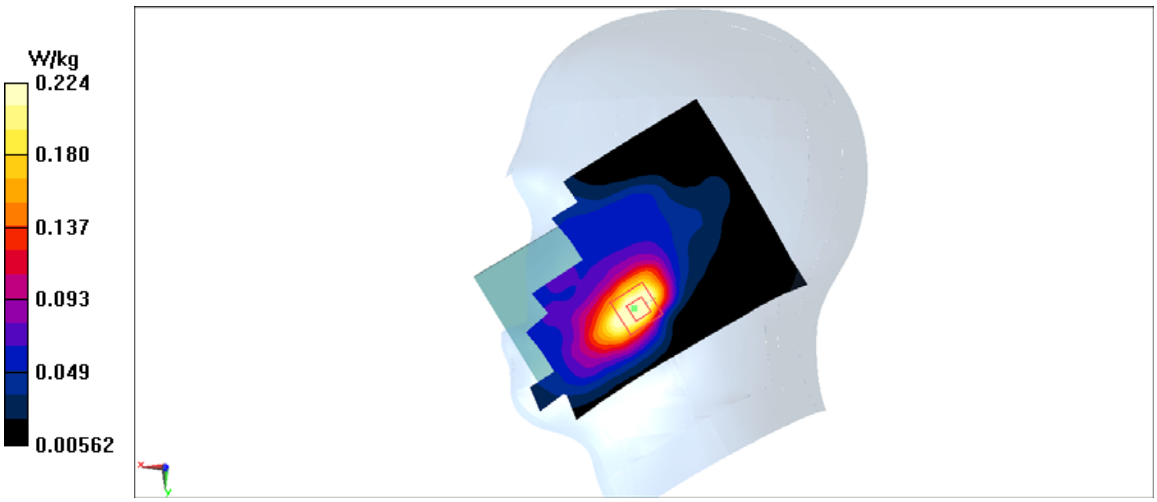


Fig A.14

LTE1900-FDD2_CH19100 Rear 15mm
Date: 5/4/2019
Electronics: DAE4 Sn1525
Medium: body 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.495 mho/m; εr = 52.71; ρ = 1000 kg/m^3
Ambient Temperature: 22.5ºC, Liquid Temperature: 22.3ºC
Communication System: LTE1900-FDD2 1900 MHz Duty Cycle: 1:1
Probe: EX3DV4 – SN7514 ConvF(7.53,7.53,7.53)

Area Scan (71x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 1.07 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 4.073 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 1.49 W/kg
SAR(1 g) = 0.726 W/kg; SAR(10 g) = 0.417 W/kg
Maximum value of SAR (measured) = 1.22 W/kg

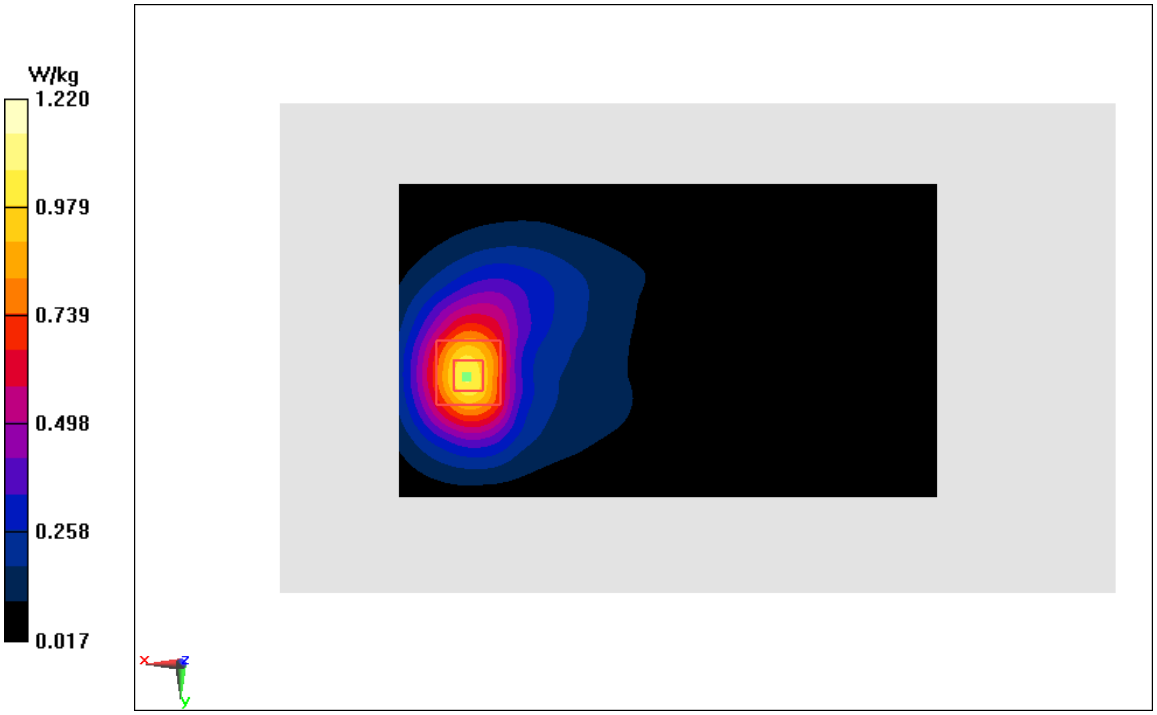


Fig A.15

LTE1900-FDD2_CH18700 Bottom edge
Date: 5/4/2019
Electronics: DAE4 Sn1525
Medium: body 1900 MHz
Medium parameters used: f = 1860 MHz; σ = 1.457 mho/m; εr = 52.76; ρ = 1000 kg/m^3
Ambient Temperature: 22.5ºC, Liquid Temperature: 22.3ºC
Communication System: LTE1900-FDD2 1860 MHz Duty Cycle: 1:1
Probe: EX3DV4 – SN7514 ConvF(7.53,7.53,7.53)

Area Scan (71x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 1.34 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 24.37 V/m; Power Drift = -0.16 dB
Peak SAR (extrapolated) = 1.93 W/kg
SAR(1 g) = 1.09 W/kg; SAR(10 g) = 0.565 W/kg
Maximum value of SAR (measured) = 1.57 W/kg

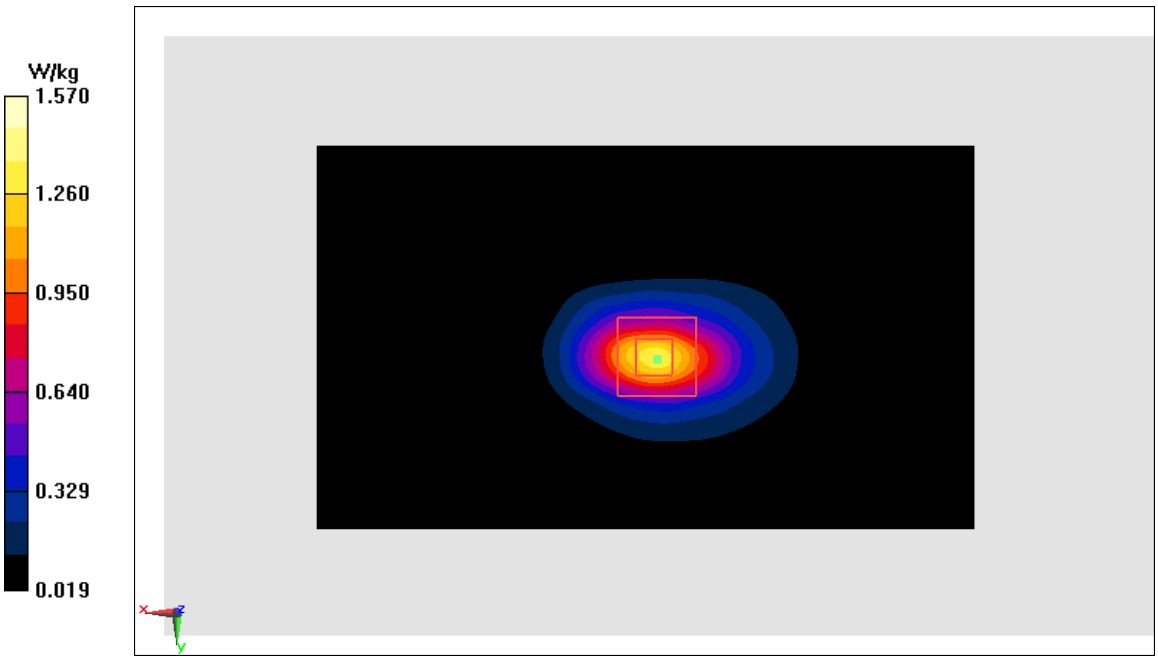


Fig A.16

LTE1700-FDD4_CH20050 Right Cheek
Date: 5/3/2019
Electronics: DAE4 Sn1525
Medium: head 1750 MHz
Medium parameters used: f = 1720 MHz; σ = 1.34 mho/m; εr = 40.57; ρ = 1000 kg/m^3
Ambient Temperature: 22.5ºC, Liquid Temperature: 22.3ºC
Communication System: LTE1700-FDD4 1720 MHz Duty Cycle: 1:1
Probe: EX3DV4 – SN7514 ConvF(8.10,8.10,8.10)

Area Scan (71x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.208 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 4.218 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 0.259 W/kg
SAR(1 g) = 0.172 W/kg; SAR(10 g) = 0.111 W/kg
Maximum value of SAR (measured) = 0.186 W/kg

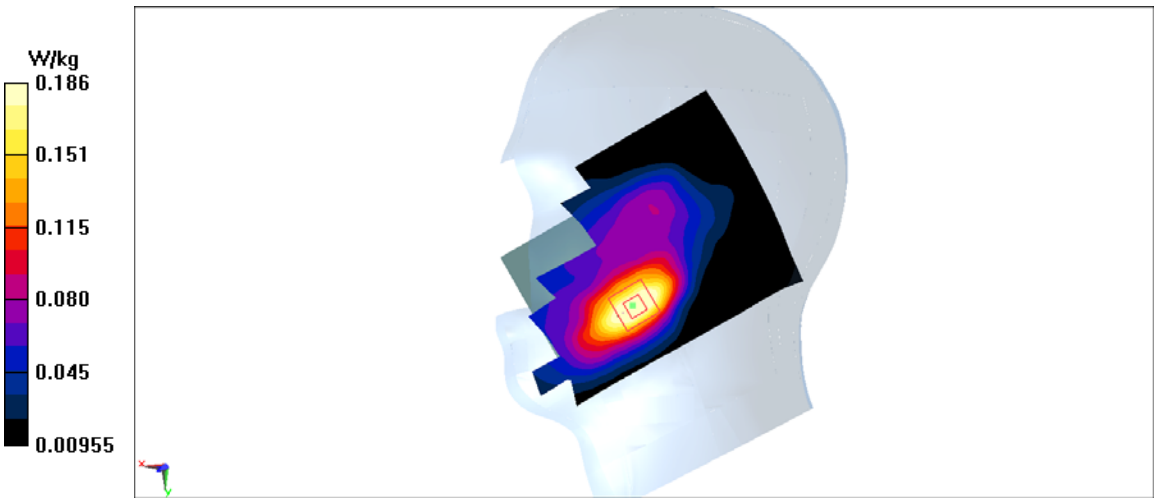


Fig A.17

LTE1700-FDD4_CH20300 Rear 15mm
Date: 5/3/2019
Electronics: DAE4 Sn1525
Medium: body 1750 MHz
Medium parameters used: f = 1745 MHz; σ = 1.467 mho/m; εr = 52.73; ρ = 1000 kg/m^3
Ambient Temperature: 22.5ºC, Liquid Temperature: 22.3ºC
Communication System: LTE1700-FDD4 1745 MHz Duty Cycle: 1:1
Probe: EX3DV4 – SN7514 ConvF(7.82,7.82,7.82)

Area Scan (71x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 1.13 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 5.292 V/m; Power Drift = 0.09 dB
Peak SAR (extrapolated) = 1.53 W/kg
SAR(1 g) = 0.949 W/kg; SAR(10 g) = 0.541 W/kg
Maximum value of SAR (measured) = 1.25 W/kg

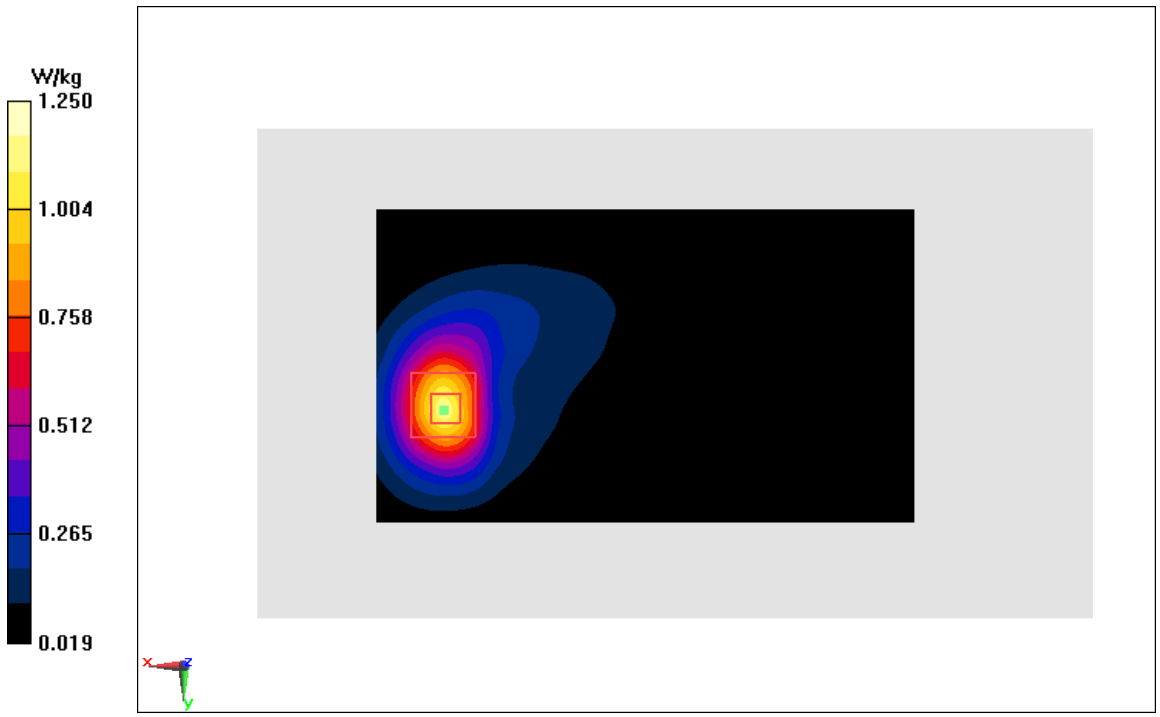


Fig A.18

LTE1700-FDD4_CH20300 Rear
Date: 5/3/2019
Electronics: DAE4 Sn1525
Medium: body 1750 MHz
Medium parameters used: f = 1745 MHz; σ = 1.467 mho/m; εr = 52.73; ρ = 1000 kg/m^3
Ambient Temperature: 22.5ºC, Liquid Temperature: 22.3ºC
Communication System: LTE1700-FDD4 1745 MHz Duty Cycle: 1:1
Probe: EX3DV4 – SN7514 ConvF(7.82,7.82,7.82)

Area Scan (71x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 1.43 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 13.21 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 1.64 W/kg
SAR(1 g) = 0.999 W/kg; SAR(10 g) = 0.539 W/kg
Maximum value of SAR (measured) = 1.32 W/kg

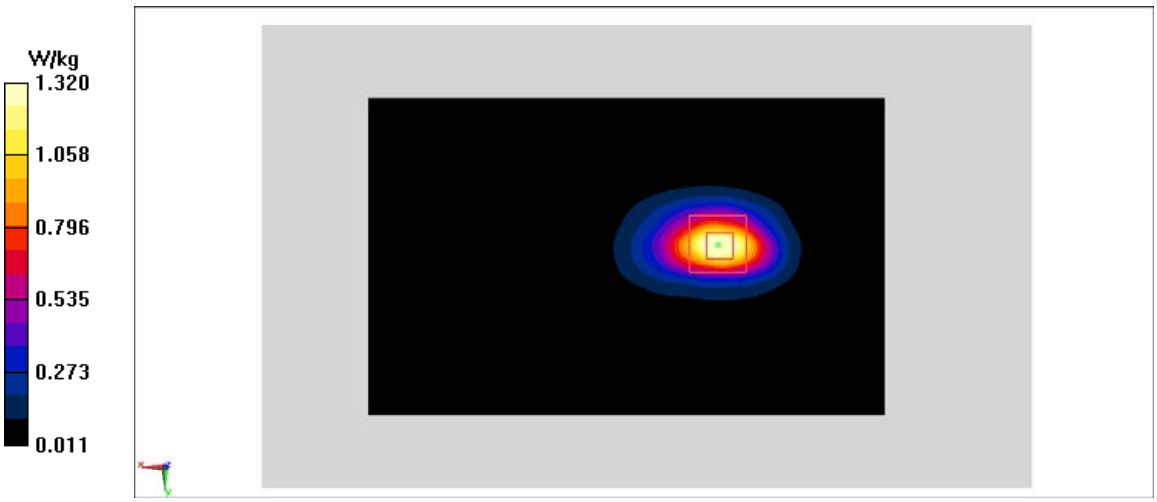


Fig A.19

LTE850-FDD5_CH20450 Left Cheek
Date: 5/2/2019
Electronics: DAE4 Sn1525
Medium: head 835 MHz
Medium parameters used: f = 829 MHz; σ = 0.909 mho/m; εr = 41.05; ρ = 1000 kg/m^3
Ambient Temperature: 22.5ºC, Liquid Temperature: 22.3ºC
Communication System: LTE850-FDD5 829 MHz Duty Cycle: 1:1
Probe: EX3DV4 – SN7514 ConvF(9.09,9.09,9.09)

Area Scan (71x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.379 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 7.619 V/m; Power Drift = -0.15 dB
Peak SAR (extrapolated) = 0.416 W/kg
SAR(1 g) = 0.34 W/kg; SAR(10 g) = 0.266 W/kg
Maximum value of SAR (measured) = 0.358 W/kg

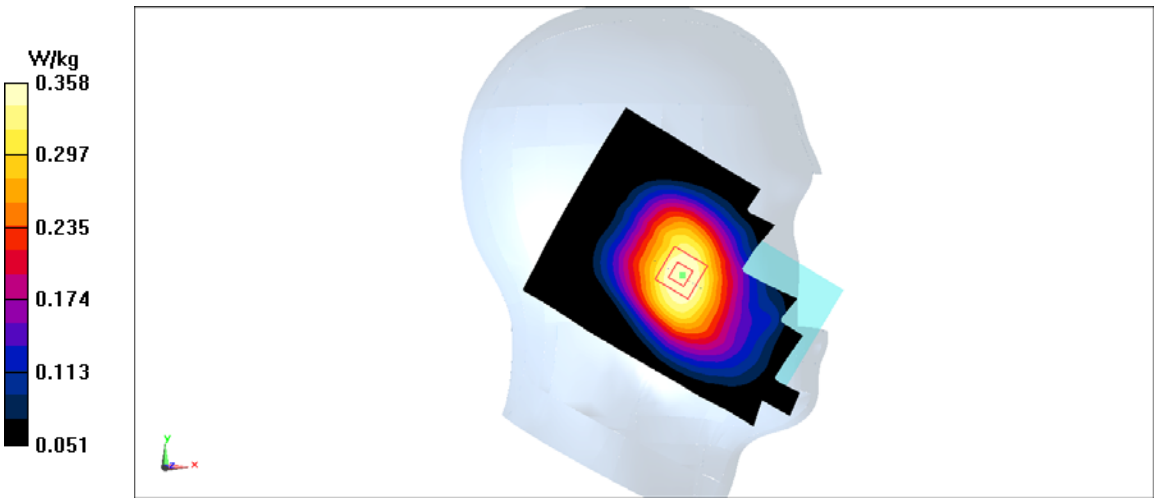


Fig A.20

LTE850-FDD5_CH20450 Rear
Date: 5/2/2019
Electronics: DAE4 Sn1525
Medium: body 835 MHz
Medium parameters used: f = 829 MHz; σ = 0.952 mho/m; εr = 55.47; ρ = 1000 kg/m^3
Ambient Temperature: 22.5ºC, Liquid Temperature: 22.3ºC
Communication System: LTE850-FDD5 829 MHz Duty Cycle: 1:1
Probe: EX3DV4 – SN7514 ConvF(9.47,9.47,9.47)

Area Scan (71x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.458 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 19.52 V/m; Power Drift = 0 dB
Peak SAR (extrapolated) = 0.501 W/kg
SAR(1 g) = 0.383 W/kg; SAR(10 g) = 0.301 W/kg
Maximum value of SAR (measured) = 0.458 W/kg

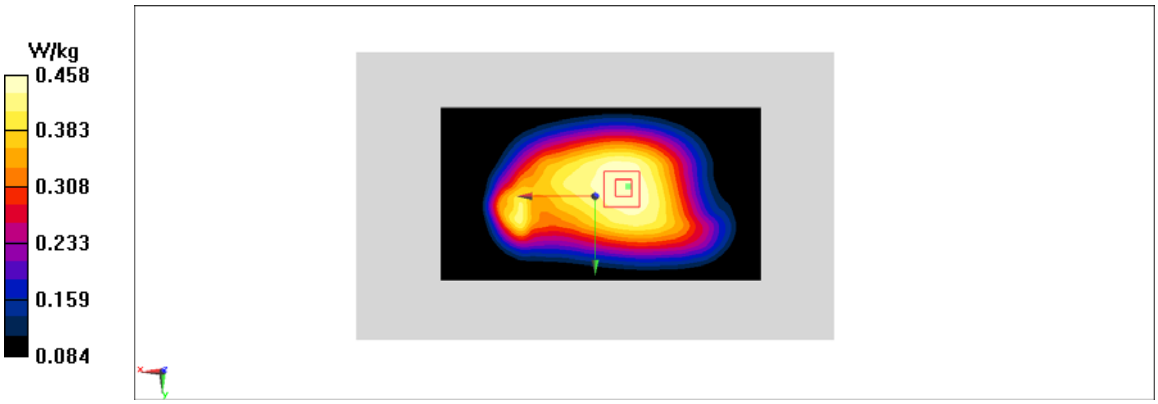


Fig A.21

LTE700-FDD12_CH23060 Left Cheek
Date: 5/1/2019
Electronics: DAE4 Sn1525
Medium: head 750 MHz
Medium parameters used: f = 704 MHz; σ = 0.844 mho/m; εr = 41.59; ρ = 1000 kg/m^3
Ambient Temperature: 22.5ºC, Liquid Temperature: 22.3ºC
Communication System: LTE700-FDD12 704 MHz Duty Cycle: 1:1
Probe: EX3DV4 – SN7514 ConvF(9.47,9.47,9.47)

Area Scan (71x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.224 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 6.432 V/m; Power Drift = 0.17 dB
Peak SAR (extrapolated) = 0.252 W/kg
SAR(1 g) = 0.206 W/kg; SAR(10 g) = 0.162 W/kg
Maximum value of SAR (measured) = 0.216 W/kg

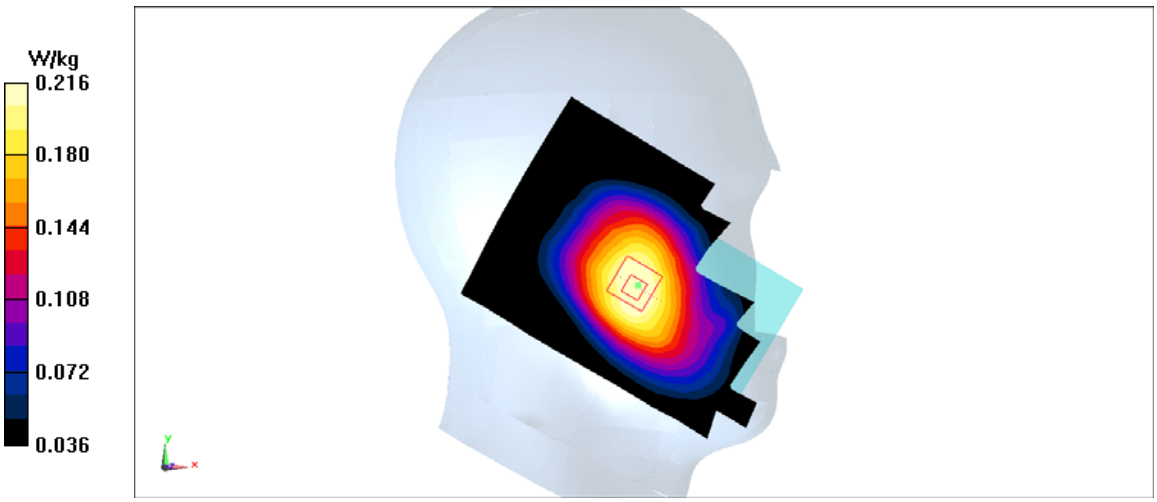


Fig A.22

LTE700-FDD12_CH23060 Rear
Date: 5/1/2019
Electronics: DAE4 Sn1525
Medium: body 750 MHz
Medium parameters used: f = 704 MHz; σ = 0.917 mho/m; εr = 55.89; ρ = 1000 kg/m^3
Ambient Temperature: 22.5ºC, Liquid Temperature: 22.3ºC
Communication System: LTE700-FDD12 704 MHz Duty Cycle: 1:1
Probe: EX3DV4 – SN7514 ConvF(9.68,9.68,9.68)

Area Scan (71x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.518 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 21.83 V/m; Power Drift = 0 dB
Peak SAR (extrapolated) = 0.563 W/kg
SAR(1 g) = 0.436 W/kg; SAR(10 g) = 0.345 W/kg
Maximum value of SAR (measured) = 0.517 W/kg

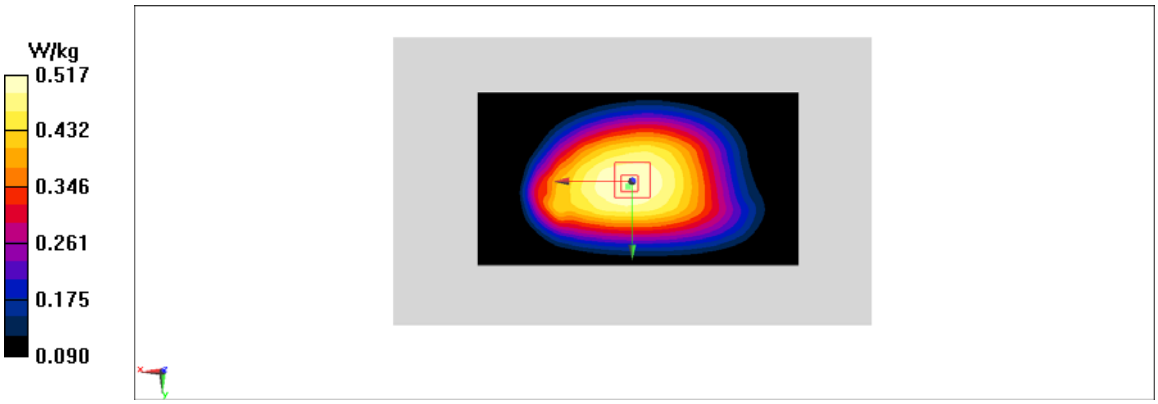


Fig A.23

LTE700-FDD14_CH23330 Left Cheek
Date: 5/1/2019
Electronics: DAE4 Sn1525
Medium: head 750 MHz
Medium parameters used: f = 793 MHz; σ = 0.929 mho/m; εr = 41.48; ρ = 1000 kg/m^3
Ambient Temperature: 22.5ºC, Liquid Temperature: 22.3ºC
Communication System: LTE700-FDD14 793 MHz Duty Cycle: 1:1
Probe: EX3DV4 – SN7514 ConvF(9.47,9.47,9.47)

Area Scan (71x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.351 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 6.463 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 0.4 W/kg
SAR(1 g) = 0.326 W/kg; SAR(10 g) = 0.254 W/kg
Maximum value of SAR (measured) = 0.34 W/kg

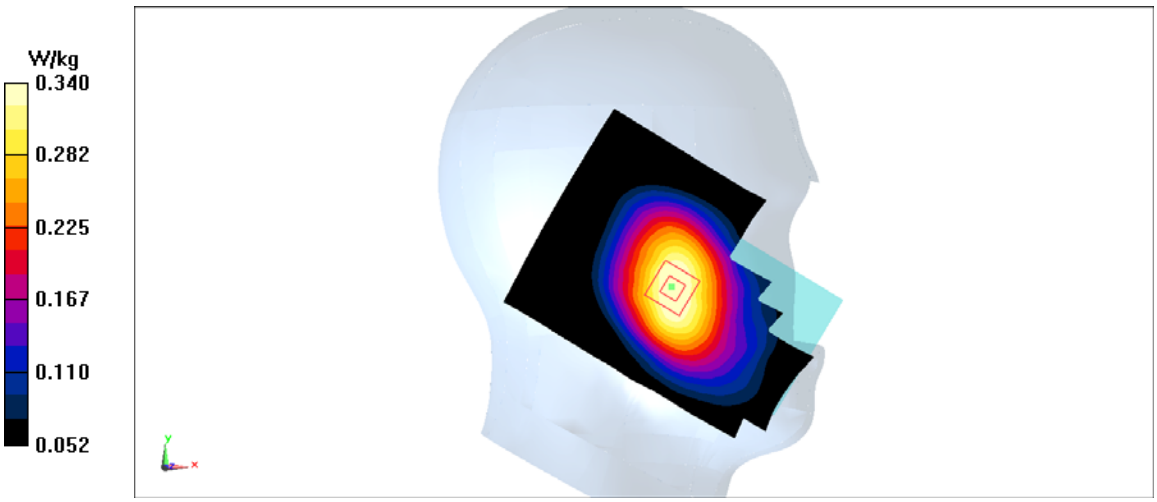


Fig A.24

LTE700-FDD14_CH23330 Rear
Date: 5/1/2019
Electronics: DAE4 Sn1525
Medium: body 750 MHz
Medium parameters used: f = 793 MHz; σ = 1.002 mho/m; εr = 55.78; ρ = 1000 kg/m^3
Ambient Temperature: 22.5ºC, Liquid Temperature: 22.3ºC
Communication System: LTE700-FDD14 793 MHz Duty Cycle: 1:1
Probe: EX3DV4 – SN7514 ConvF(9.68,9.68,9.68)

Area Scan (71x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.569 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 22.38 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 0.624 W/kg
SAR(1 g) = 0.477 W/kg; SAR(10 g) = 0.373 W/kg
Maximum value of SAR (measured) = 0.569 W/kg

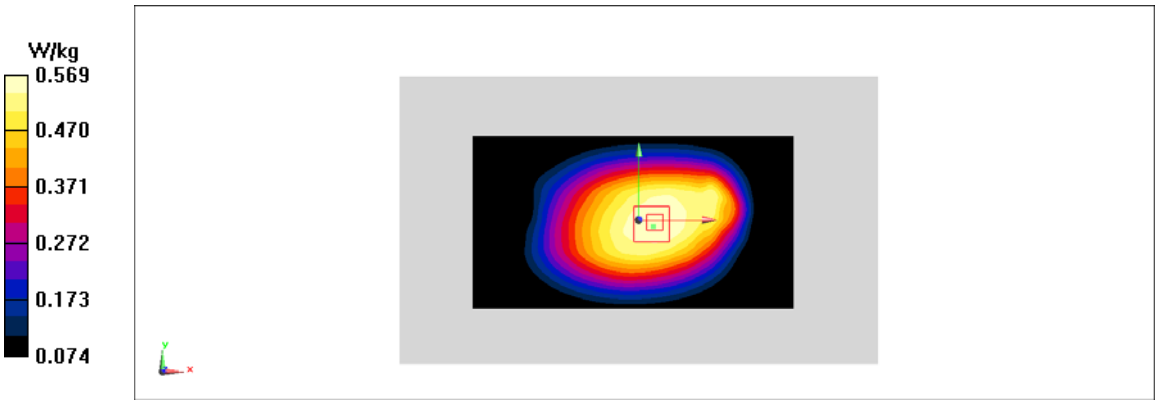


Fig A.25

LTE2300-FDD30_CH27710 Left Cheek
Date: 5/5/2019
Electronics: DAE4 Sn1525
Medium: head 2300 MHz
Medium parameters used: f = 2310 MHz; σ = 1.698 mho/m; εr = 39.07; ρ = 1000 kg/m^3
Ambient Temperature: 22.5ºC, Liquid Temperature: 22.3ºC
Communication System: LTE2300-FDD30 2310 MHz Duty Cycle: 1:1
Probe: EX3DV4 – SN7514 ConvF(7.42,7.42,7.42)

Area Scan (71x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.238 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 2.816 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 0.341 W/kg
SAR(1 g) = 0.195 W/kg; SAR(10 g) = 0.11 W/kg
Maximum value of SAR (measured) = 0.216 W/kg

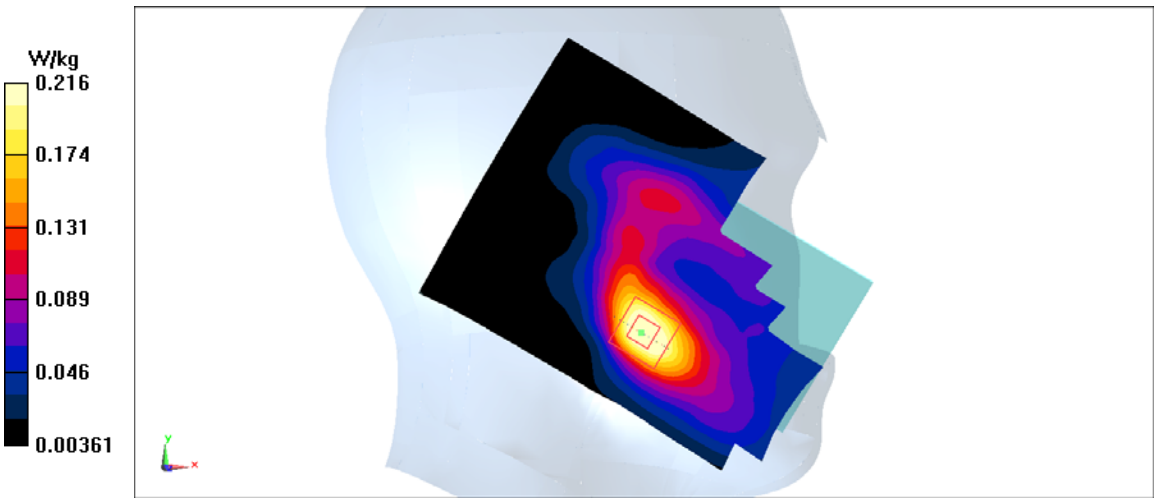


Fig A.26

LTE2300-FDD30_CH27710 Rear 15mm
Date: 5/5/2019
Electronics: DAE4 Sn1525
Medium: body 2300 MHz
Medium parameters used: f = 2310 MHz; σ = 1.792 mho/m; εr = 53.53; ρ = 1000 kg/m^3
Ambient Temperature: 22.5ºC, Liquid Temperature: 22.3ºC
Communication System: LTE2300-FDD30 2310 MHz Duty Cycle: 1:1
Probe: EX3DV4 – SN7514 ConvF(7.25,7.25,7.25)

Area Scan (71x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 1.01 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 7.381 V/m; Power Drift = 0.11 dB
Peak SAR (extrapolated) = 1.5 W/kg
SAR(1 g) = 0.838 W/kg; SAR(10 g) = 0.45 W/kg
Maximum value of SAR (measured) = 1.17 W/kg

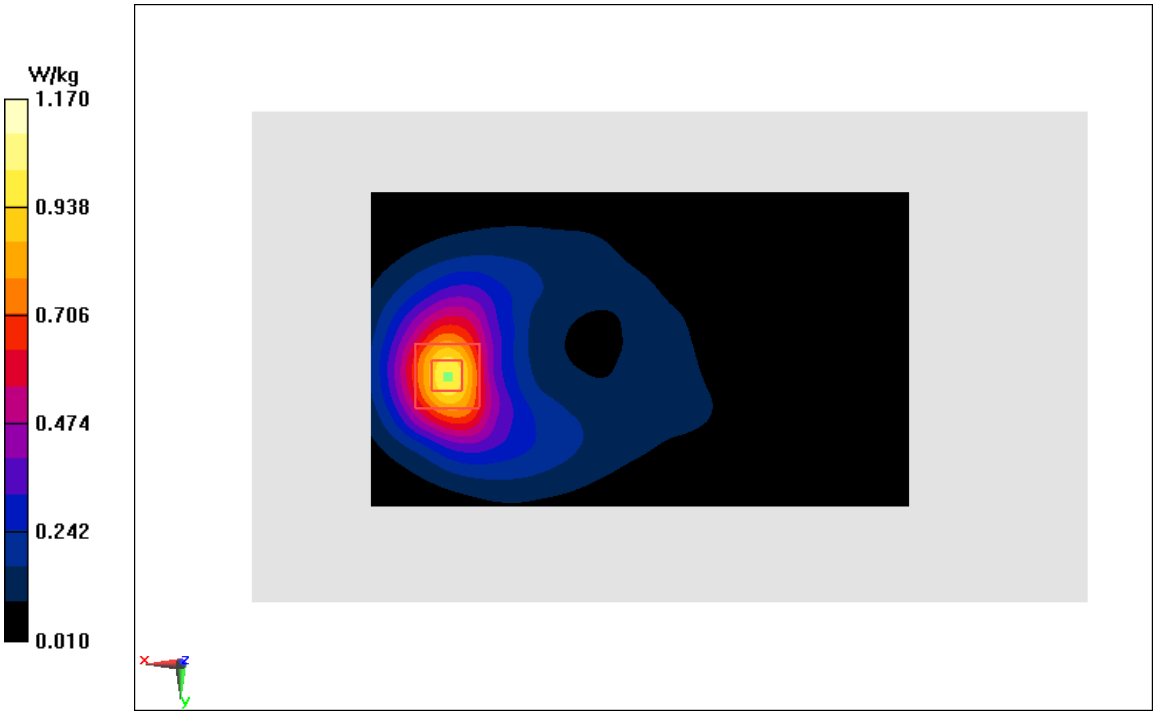


Fig A.27

LTE2300-FDD30_CH27710 Bottom edge
Date: 5/5/2019
Electronics: DAE4 Sn1525
Medium: body 2300 MHz
Medium parameters used: f = 2310 MHz; σ = 1.792 mho/m; εr = 53.53; ρ = 1000 kg/m^3
Ambient Temperature: 22.5ºC, Liquid Temperature: 22.3ºC
Communication System: LTE2300-FDD30 2310 MHz Duty Cycle: 1:1
Probe: EX3DV4 – SN7514 ConvF(7.25,7.25,7.25)

Area Scan (71x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 1.38 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 6.307 V/m; Power Drift = 0.08 dB
Peak SAR (extrapolated) = 1.77 W/kg
SAR(1 g) = 0.965 W/kg; SAR(10 g) = 0.483 W/kg
Maximum value of SAR (measured) = 1.39 W/kg

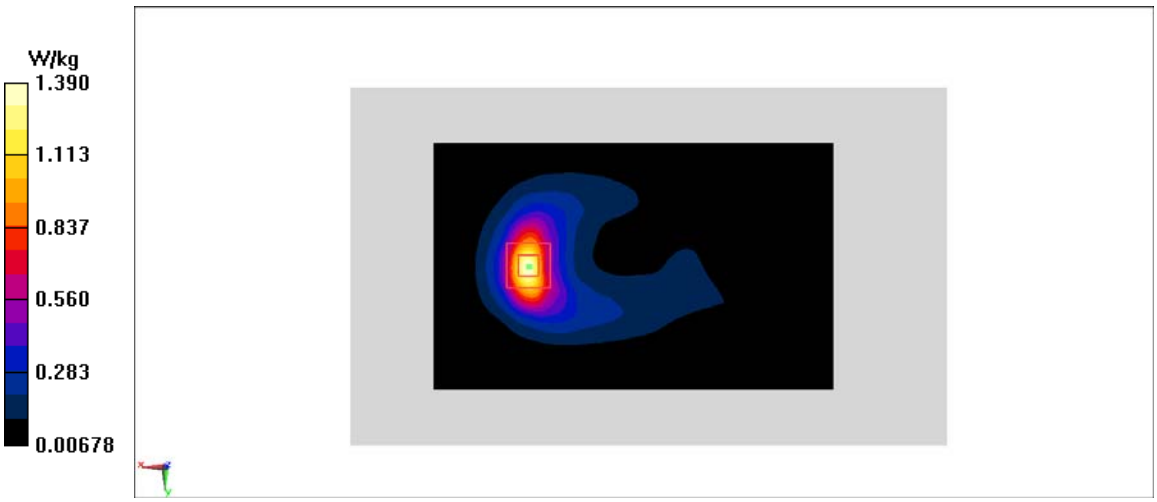


Fig A.28

WLAN2450_CH11 Left Cheek
Date: 5/6/2019
Electronics: DAE4 Sn1525
Medium: head 2450 MHz
Medium parameters used: f = 2462 MHz; σ = 1.799 mho/m; εr = 39.2; ρ = 1000 kg/m^3
Ambient Temperature: 22.5ºC, Liquid Temperature: 22.3ºC
Communication System: WLAN2450 2462 MHz Duty Cycle: 1:1
Probe: EX3DV4 – SN7514 ConvF(6.95,6.95,6.95)

Area Scan (71x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 1.53 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 13.8 V/m; Power Drift = 0.1 dB
Peak SAR (extrapolated) = 2.36 W/kg
SAR(1 g) = 1.19 W/kg; SAR(10 g) = 0.602 W/kg
Maximum value of SAR (measured) = 1.54 W/kg

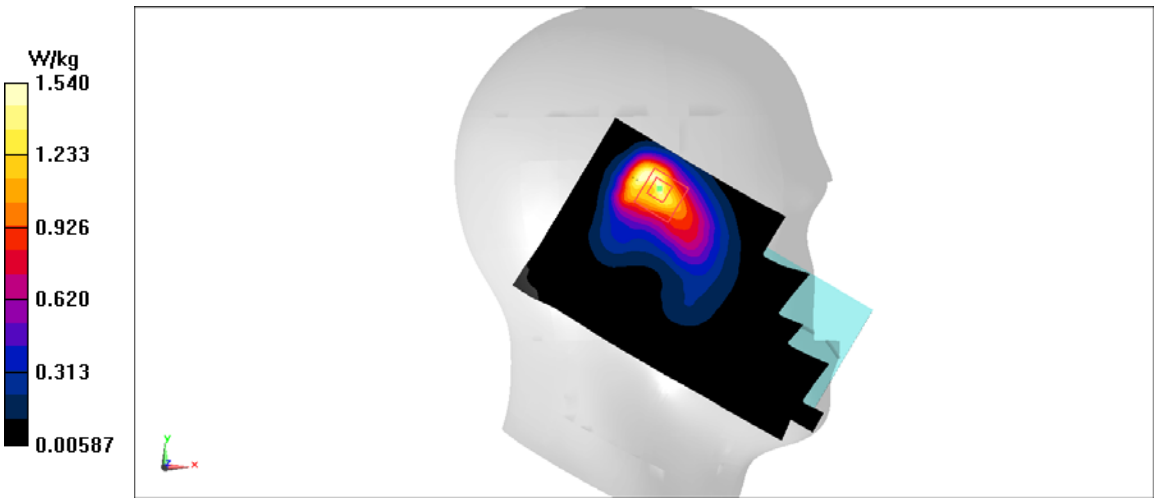


Fig A.29

WLAN2450_CH6 Rear
Date: 5/6/2019
Electronics: DAE4 Sn1525
Medium: body 2450 MHz
Medium parameters used: f = 2437 MHz; σ = 1.908 mho/m; εr = 51.85; ρ = 1000 kg/m^3
Ambient Temperature: 22.5ºC, Liquid Temperature: 22.3ºC
Communication System: WLAN2450 2437 MHz Duty Cycle: 1:1
Probe: EX3DV4 – SN7514 ConvF(7.13,7.13,7.13)

Area Scan (71x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.415 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 7.027 V/m; Power Drift = -0.09 dB
Peak SAR (extrapolated) = 0.619 W/kg
SAR(1 g) = 0.322 W/kg; SAR(10 g) = 0.172 W/kg
Maximum value of SAR (measured) = 0.466 W/kg

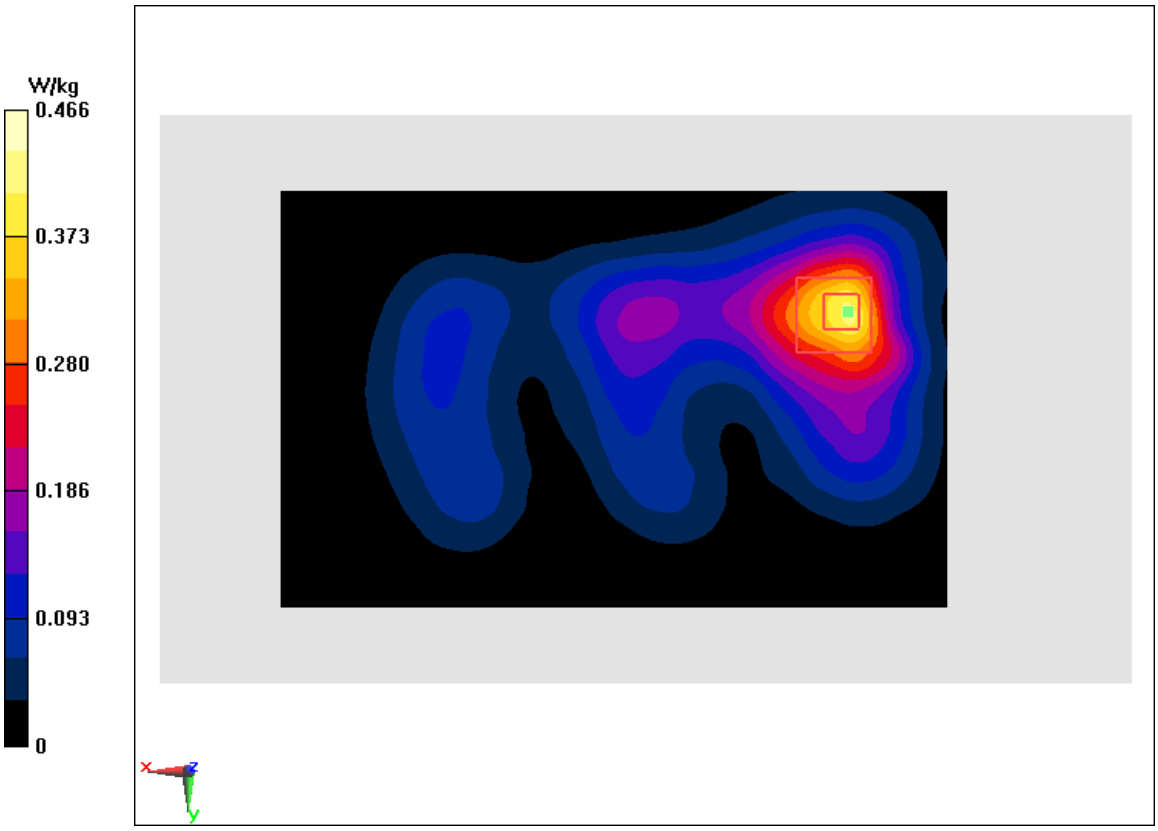


Fig A.30

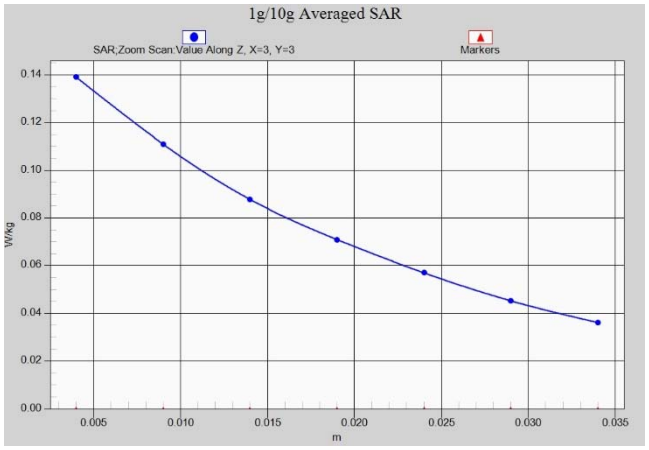


Fig.A.1- 1 Z-Scan at power reference point (GSM850)

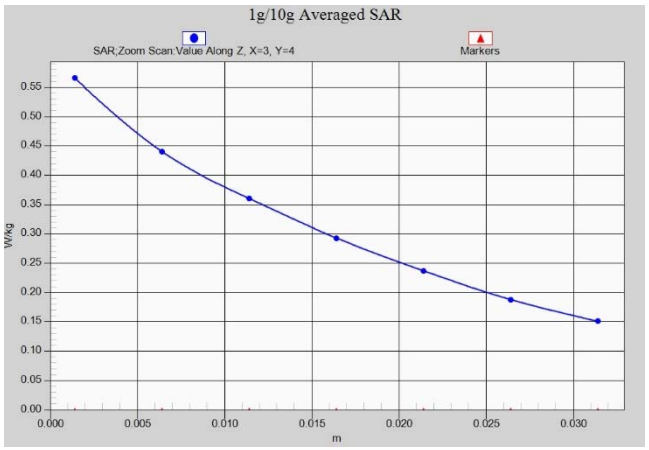


Fig.A.1- 2 Z-Scan at power reference point (GSM850)

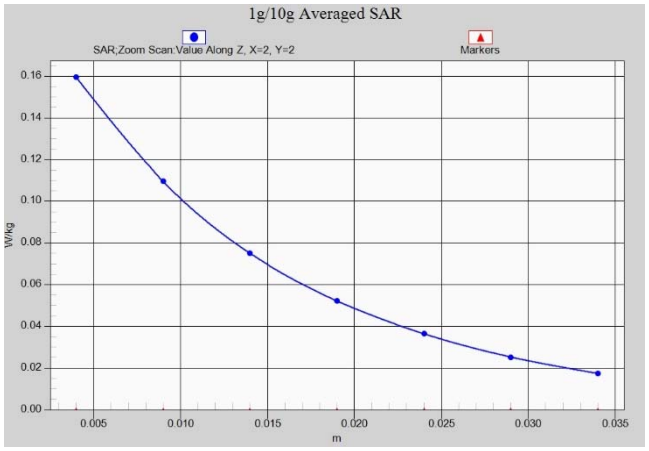


Fig.A.1- 3 Z-Scan at power reference point (PCS1900)

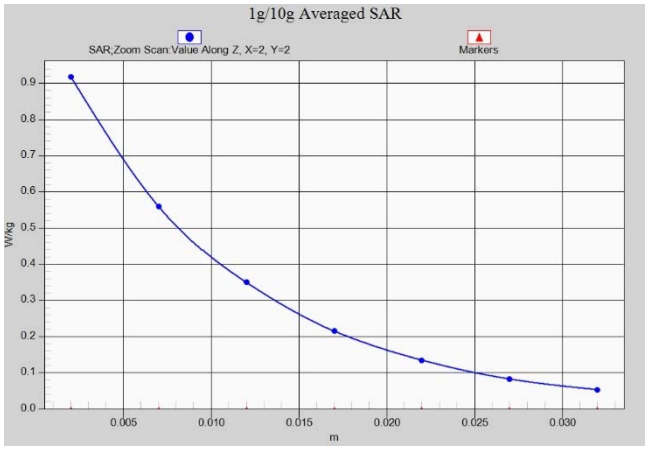


Fig.A.1- 4 Z-Scan at power reference point (PCS1900) 15mm

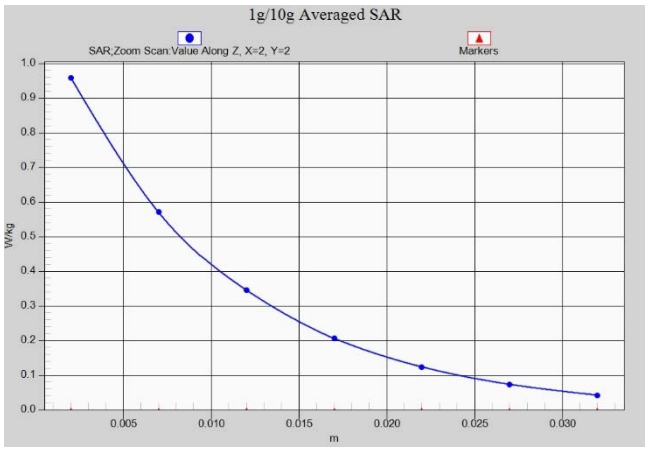


Fig.A.1- 5 Z-Scan at power reference point (PCS1900) 10mm

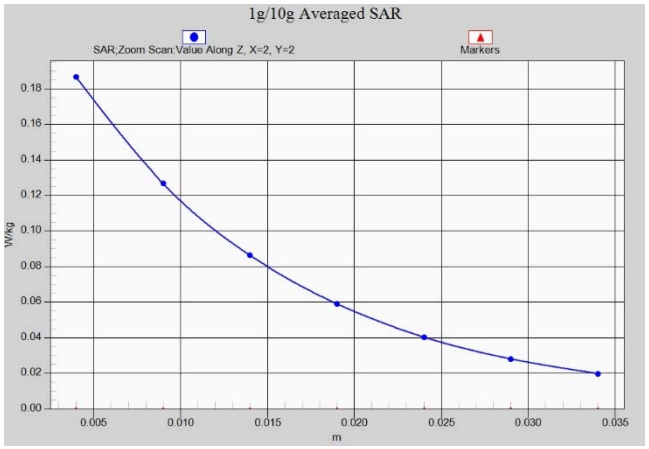


Fig.A.1- 6 Z-Scan at power reference point (W1900)

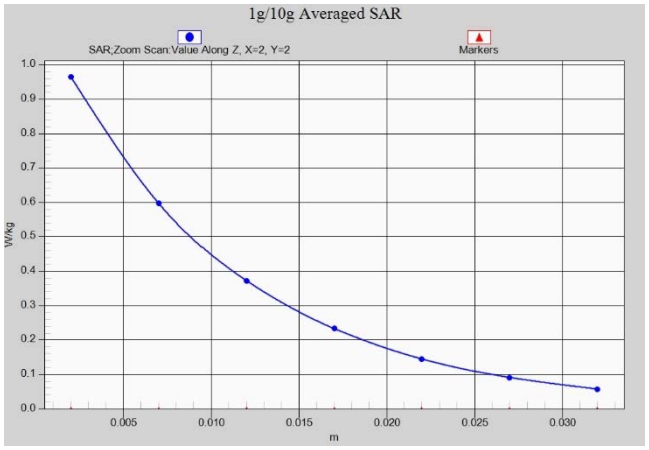


Fig.A.1- 7 Z-Scan at power reference point (W1900) 15mm

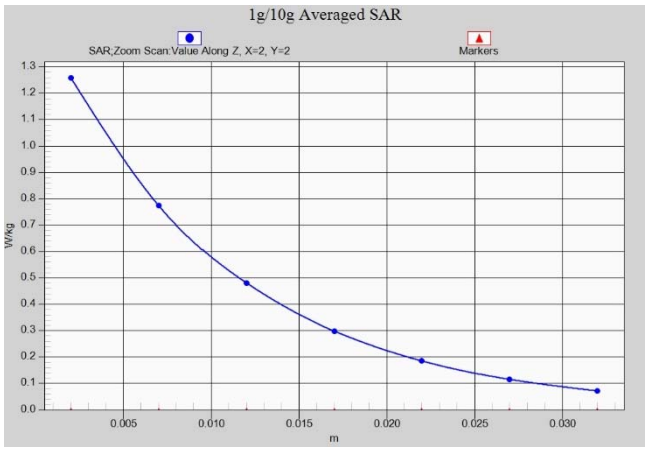


Fig.A.1- 8 Z-Scan at power reference point (W1900) 10mm

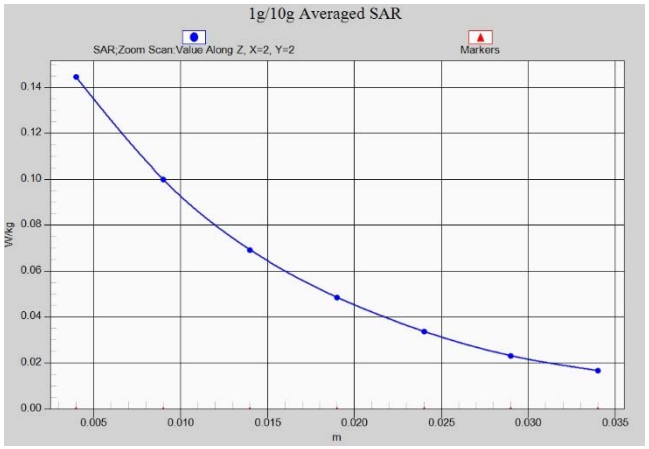


Fig.A.1- 9 Z-Scan at power reference point (W1700)

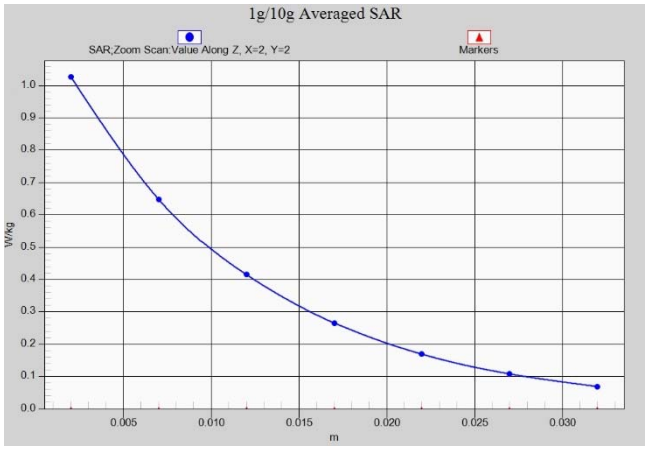


Fig.A.1- 10 Z-Scan at power reference point (W1700) 15mm

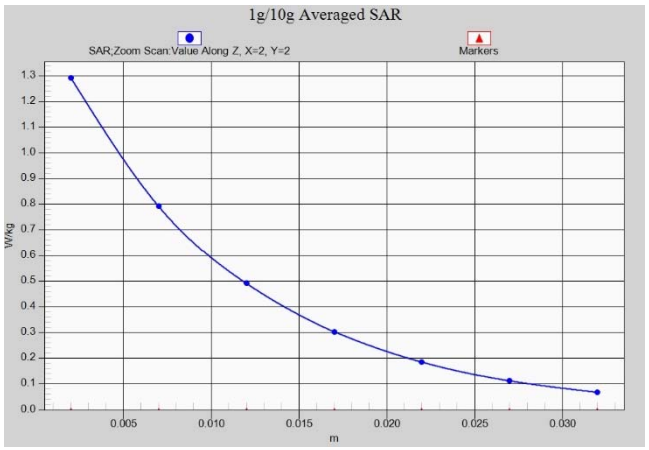


Fig.A.1- 11 Z-Scan at power reference point (W1700) 10mm

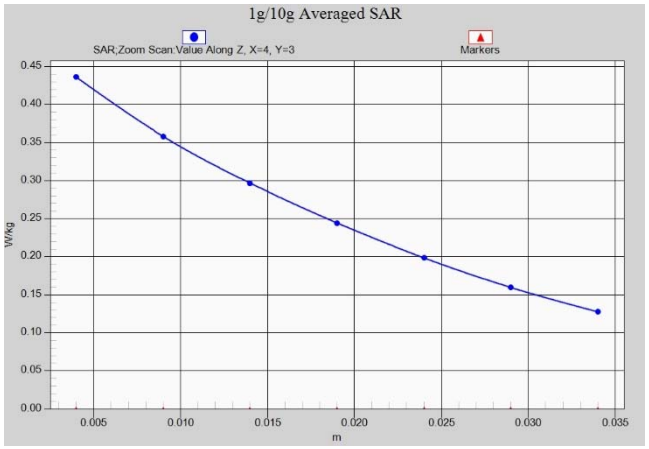


Fig.A.1- 12 Z-Scan at power reference point (W850)

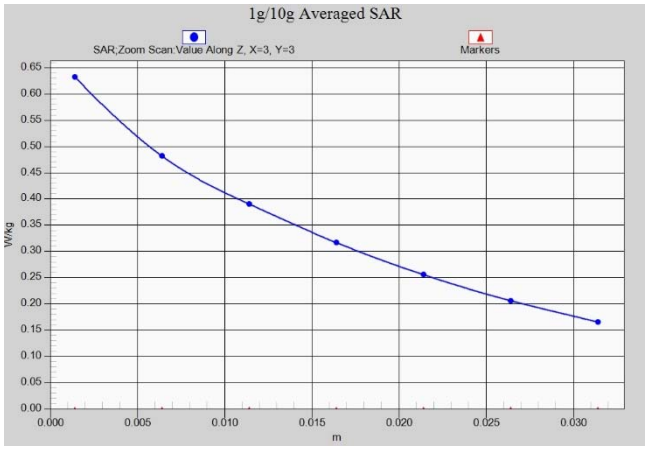


Fig.A.1- 13 Z-Scan at power reference point (W850)

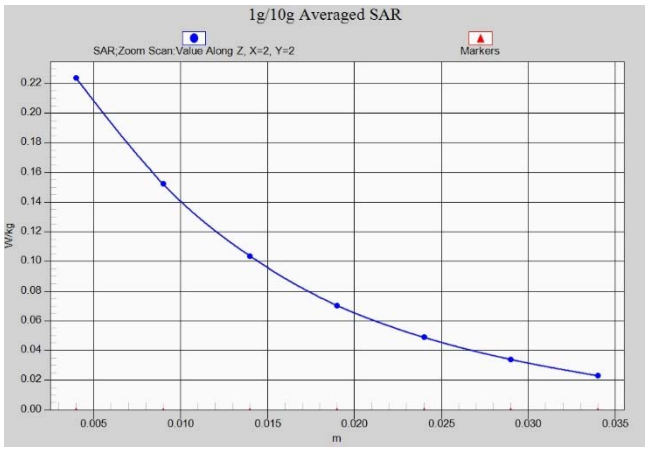


Fig.A.1- 14 Z-Scan at power reference point (LTE band2)

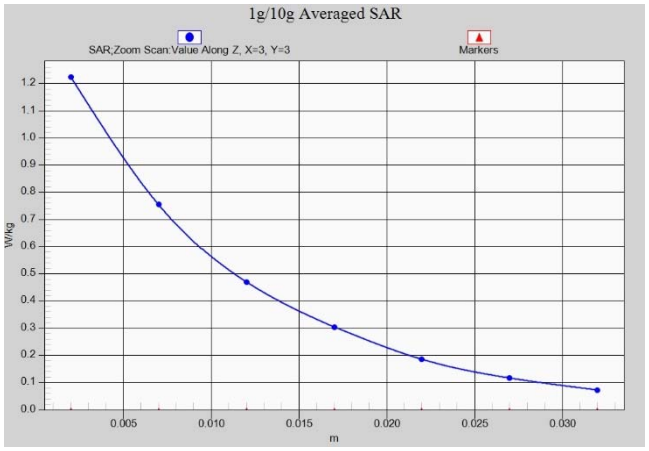


Fig.A.1- 15 Z-Scan at power reference point (LTE band2) 15mm

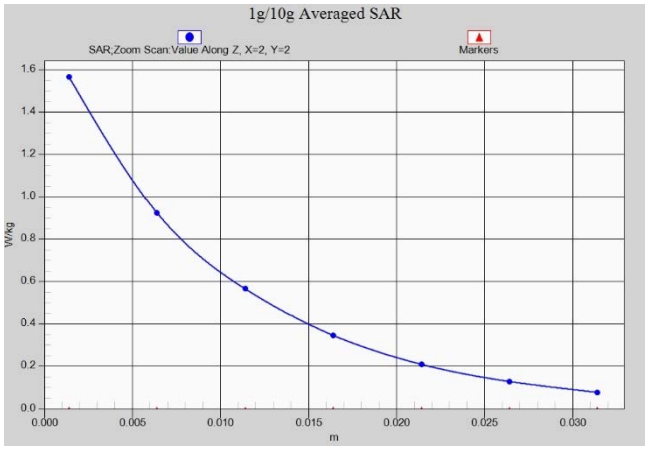


Fig.A.1- 16 Z-Scan at power reference point (LTE band2) 10mm

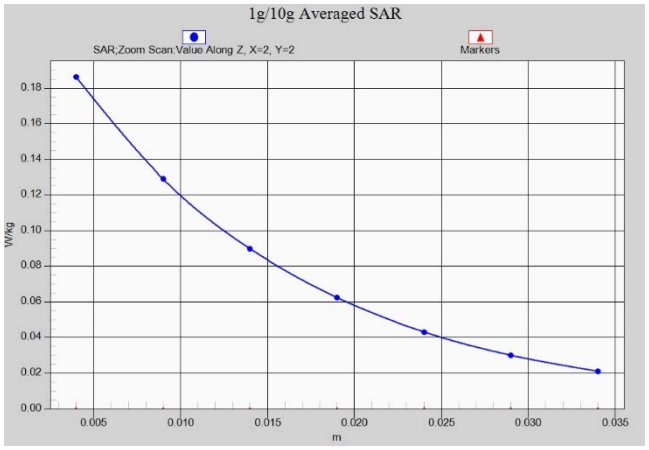


Fig.A.1- 17 Z-Scan at power reference point (LTE band4)

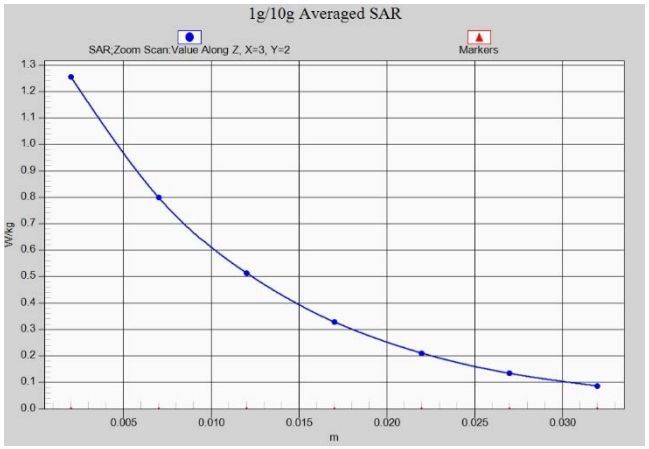


Fig.A.1- 18 Z-Scan at power reference point (LTE band4) 15mm

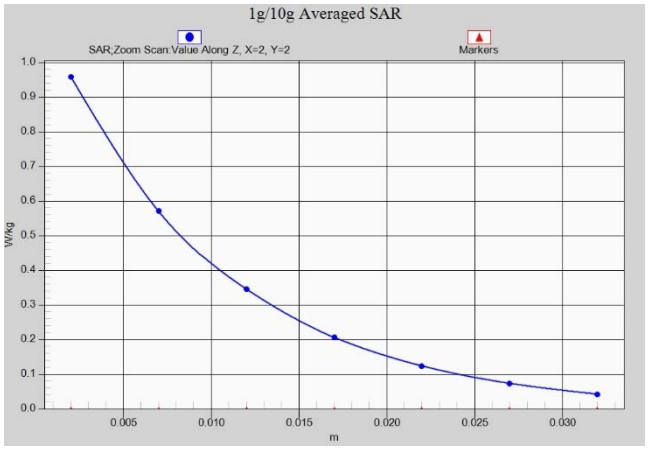


Fig.A.1- 19 Z-Scan at power reference point (LTE band4) 10mm

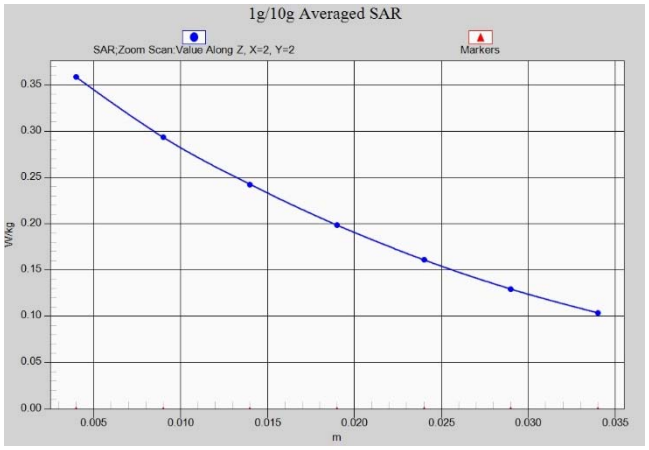


Fig.A.1- 20 Z-Scan at power reference point (LTE band5)

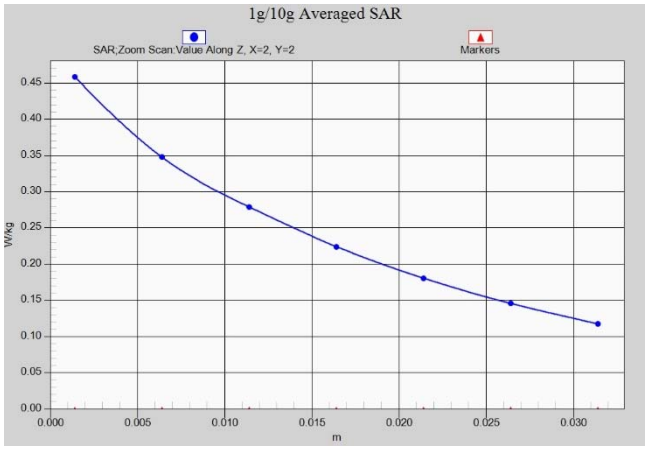


Fig.A.1- 21 Z-Scan at power reference point (LTE band5)

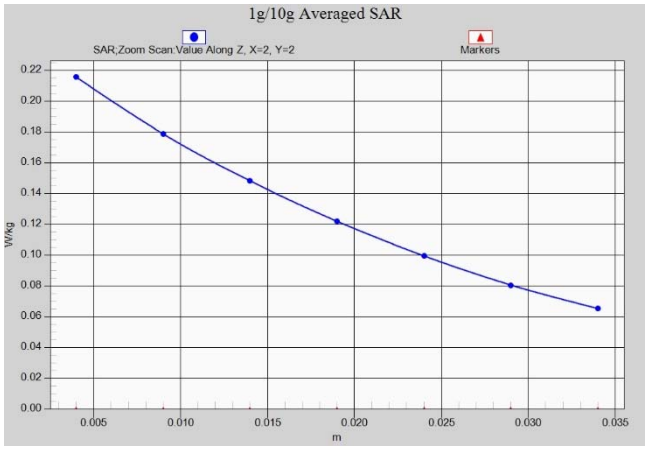


Fig.A.1- 22 Z-Scan at power reference point (LTE band12)

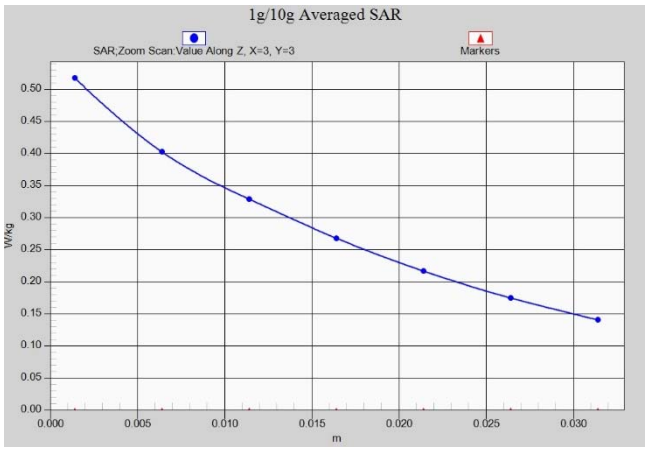


Fig.A.1- 23 Z-Scan at power reference point (LTE band12)

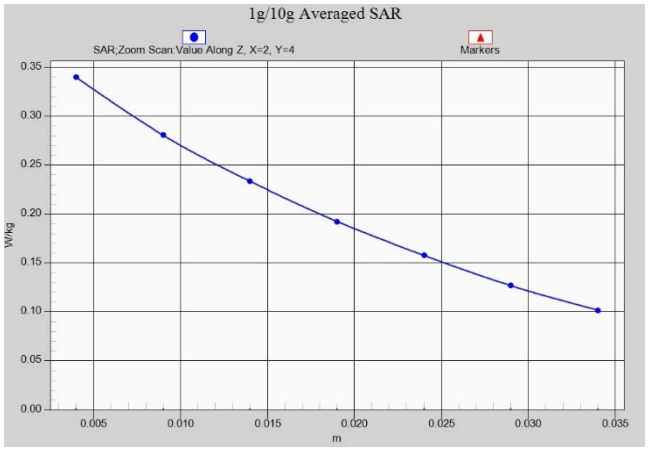


Fig.A.1- 24 Z-Scan at power reference point (LTE band14)

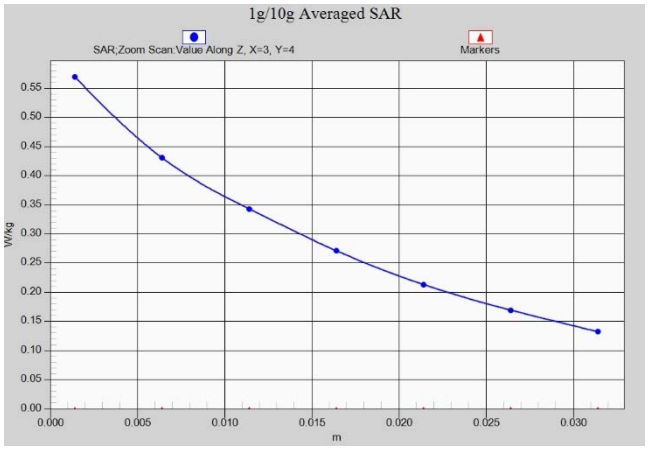


Fig.A.1- 25 Z-Scan at power reference point (LTE band14)

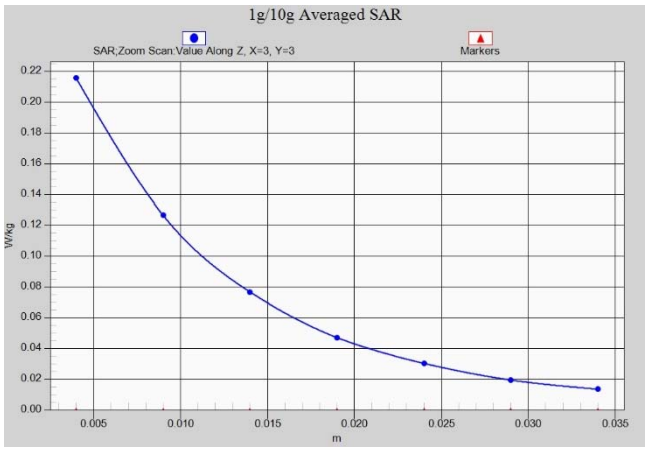


Fig.A.1- 26 Z-Scan at power reference point (LTE band30)

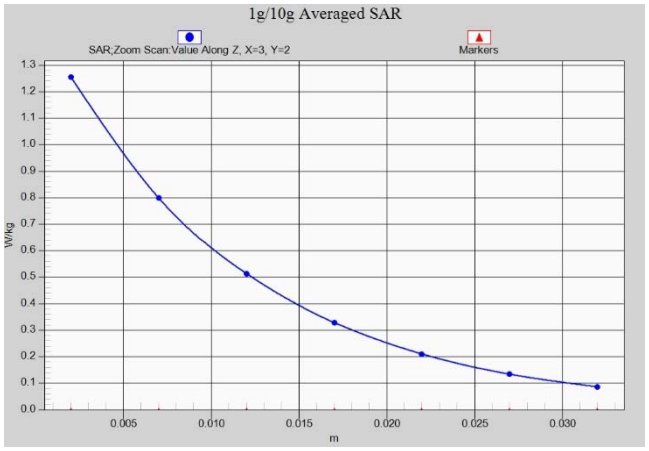


Fig.A.1- 27 Z-Scan at power reference point (LTE band30) 15mm

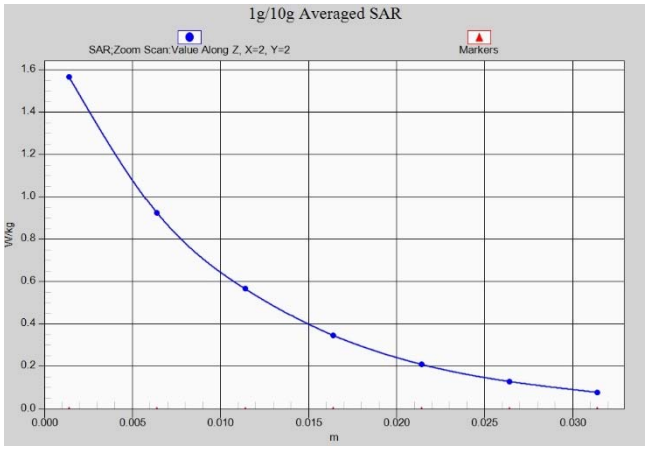


Fig.A.1- 28 Z-Scan at power reference point (LTE band30) 10mm

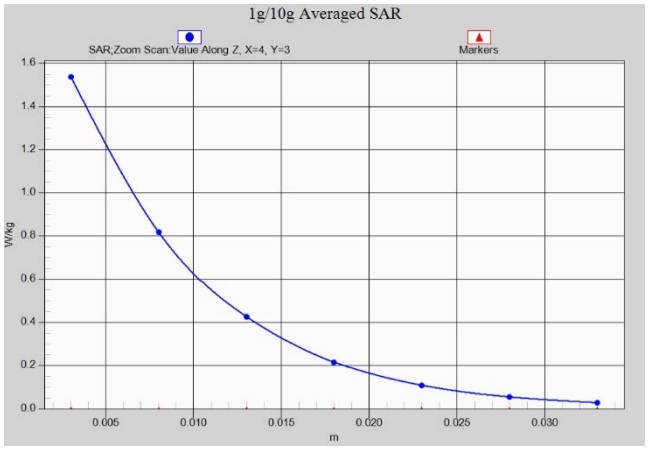


Fig.A.1- 29 Z-Scan at power reference point (Wifi2450)

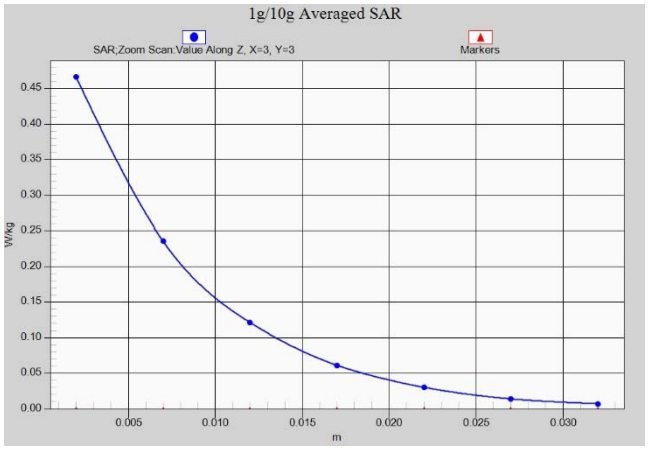


Fig.A.1- 30 Z-Scan at power reference point (Wifi2450)

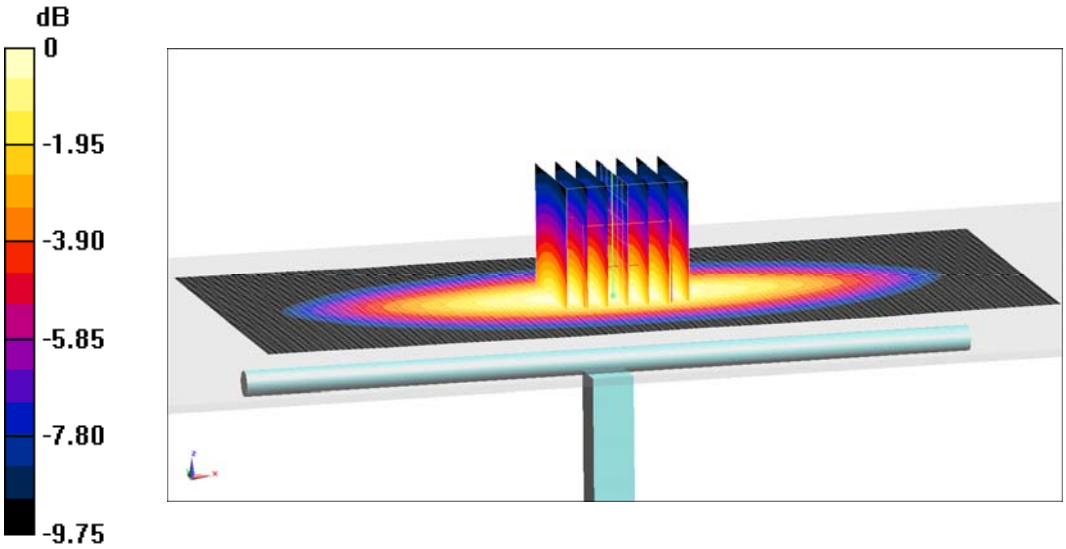
ANNEX B System Verification Results

750 MHz

Date: 5/1/2019
Electronics: DAE4 Sn1525
Medium: Head 750 MHz
Medium parameters used: f = 750 MHz; σ =0.898 mho/m; ε_r = 41.7; ρ = 1000 kg/m^3
Ambient Temperature: 22.5°C Liquid Temperature: 22.3°C
Communication System: CW Frequency: 750 MHz Duty Cycle: 1:1
Probe: EX3DV4 – SN7514 ConvF(9.47,9.47,9.47)

System Validation /Area Scan (81x191x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Reference Value = 59.9 V/m; Power Drift = 0.03
Fast SAR: SAR(1 g) = 2.04 W/kg; SAR(10 g) = 1.38 W/kg
Maximum value of SAR (interpolated) = 2.75 W/kg

System Validation /Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value =59.9 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 3.17 W/kg
SAR(1 g) = 2.08 W/kg; SAR(10 g) = 1.34 W/kg
Maximum value of SAR (measured) = 2.82 W/kg



0 dB = 2.82 W/kg = 4.5 dB W/kg

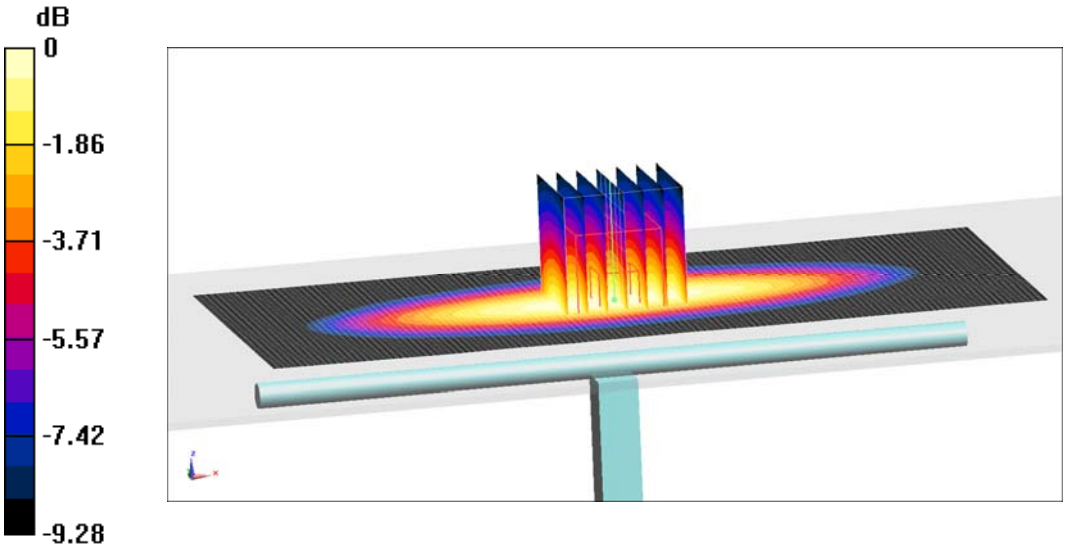
Fig.B.1 validation 750 MHz 250mW

750 MHz

Date: 5/1/2019
Electronics: DAE4 Sn1525
Medium: Body 750 MHz
Medium parameters used: f = 750 MHz; σ =0.951 mho/m; ε_r = 55.35; ρ = 1000 kg/m^3
Ambient Temperature: 22.5ºC Liquid Temperature: 22.3ºC
Communication System: CW Frequency: 750 MHz Duty Cycle: 1:1
Probe: EX3DV4 – SN7514 ConvF(9.68,9.68,9.68)

System Validation /Area Scan (81x191x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Reference Value = 56.8 V/m; Power Drift = -0.03
Fast SAR: SAR(1 g) = 2.16 W/kg; SAR(10 g) = 1.42 W/kg
Maximum value of SAR (interpolated) = 3.23 W/kg

System Validation /Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value =56.8 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 3.3 W/kg
SAR(1 g) = 2.21 W/kg; SAR(10 g) = 1.41 W/kg
Maximum value of SAR (measured) = 2.9 W/kg



0 dB = 2.9 W/kg = 4.62 dB W/kg

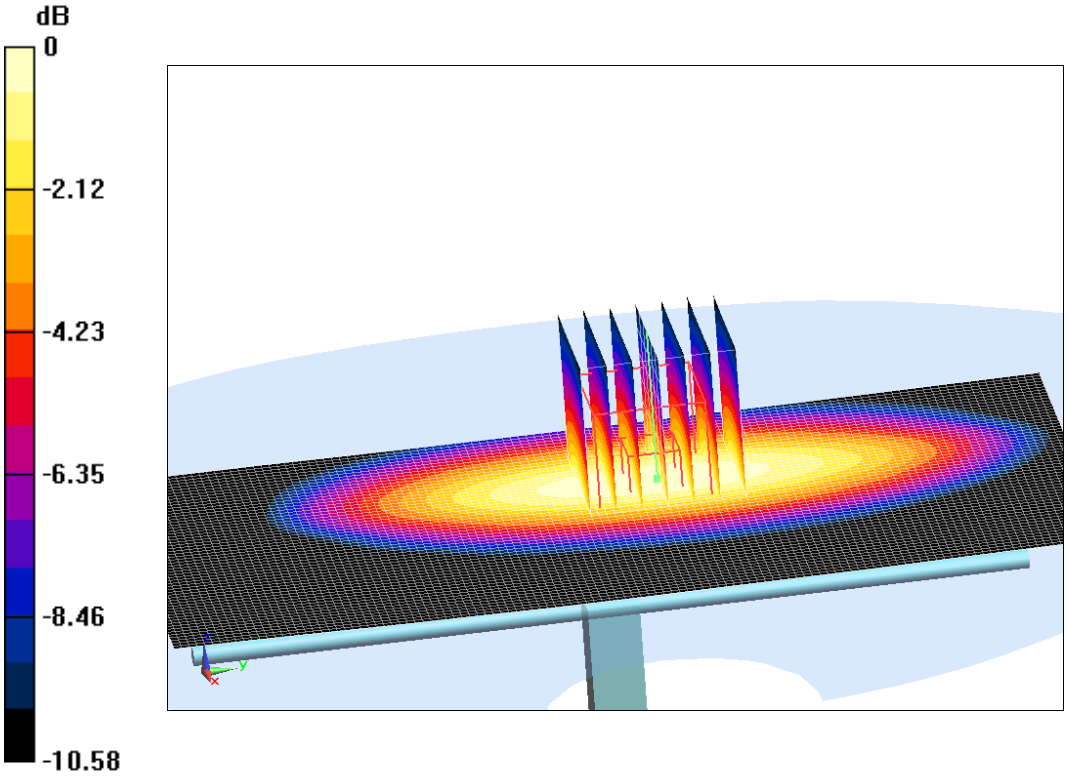
Fig.B.2 validation 750 MHz 250mW

835 MHz

Date: 5/2/2019
Electronics: DAE4 Sn1525
Medium: Head 835 MHz
Medium parameters used: f = 835 MHz; σ =0.901 mho/m; ε_r = 41.6; ρ = 1000 kg/m^3
Ambient Temperature: 22.5ºC Liquid Temperature: 22.3ºC
Communication System: CW Frequency: 835 MHz Duty Cycle: 1:1
Probe: EX3DV4 – SN7514 ConvF(9.09,9.09,9.09)

System Validation /Area Scan (81x191x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Reference Value = 64.81 V/m; Power Drift = 0.04
Fast SAR: SAR(1 g) = 2.34 W/kg; SAR(10 g) = 1.5 W/kg
Maximum value of SAR (interpolated) = 3.8 W/kg

System Validation /Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value =64.81 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 4.12 W/kg
SAR(1 g) = 2.37 W/kg; SAR(10 g) = 1.52 W/kg
Maximum value of SAR (measured) = 3.63 W/kg



0 dB = 3.63 W/kg = 5.6 dB W/kg

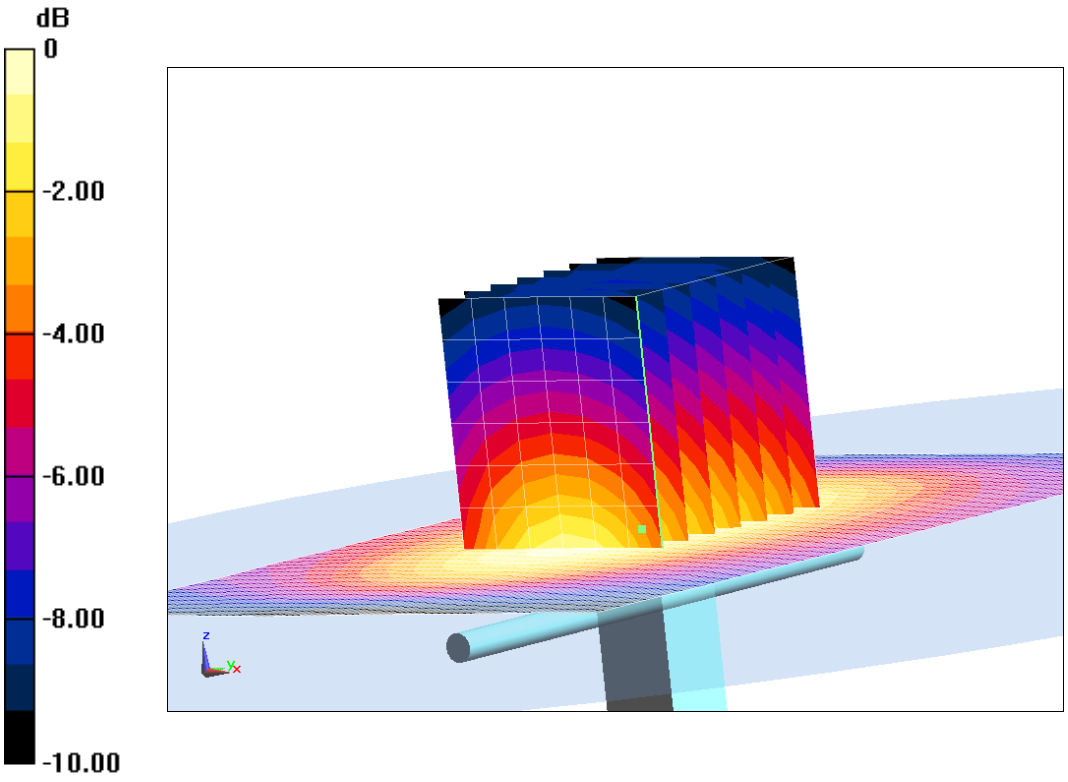
Fig.B.3 validation 835 MHz 250mW

835 MHz

Date: 5/2/2019
Electronics: DAE4 Sn1525
Medium: Body 835 MHz
Medium parameters used: f = 835 MHz; σ =0.988 mho/m; ε_r = 56.1; ρ = 1000 kg/m^3
Ambient Temperature: 22.5ºC Liquid Temperature: 22.3ºC
Communication System: CW Frequency: 835 MHz Duty Cycle: 1:1
Probe: EX3DV4 – SN7514 ConvF(9.47,9.47,9.47)

System Validation /Area Scan (81x191x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Reference Value = 59.21 V/m; Power Drift = -0.09
Fast SAR: SAR(1 g) = 2.32 W/kg; SAR(10 g) = 1.52 W/kg
Maximum value of SAR (interpolated) = 3.58 W/kg

System Validation /Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value =59.21 V/m; Power Drift = -0.09 dB
Peak SAR (extrapolated) = 3.7 W/kg
SAR(1 g) = 2.31 W/kg; SAR(10 g) = 1.55 W/kg
Maximum value of SAR (measured) = 3.2 W/kg



0 dB = 3.2 W/kg = 5.05 dB W/kg

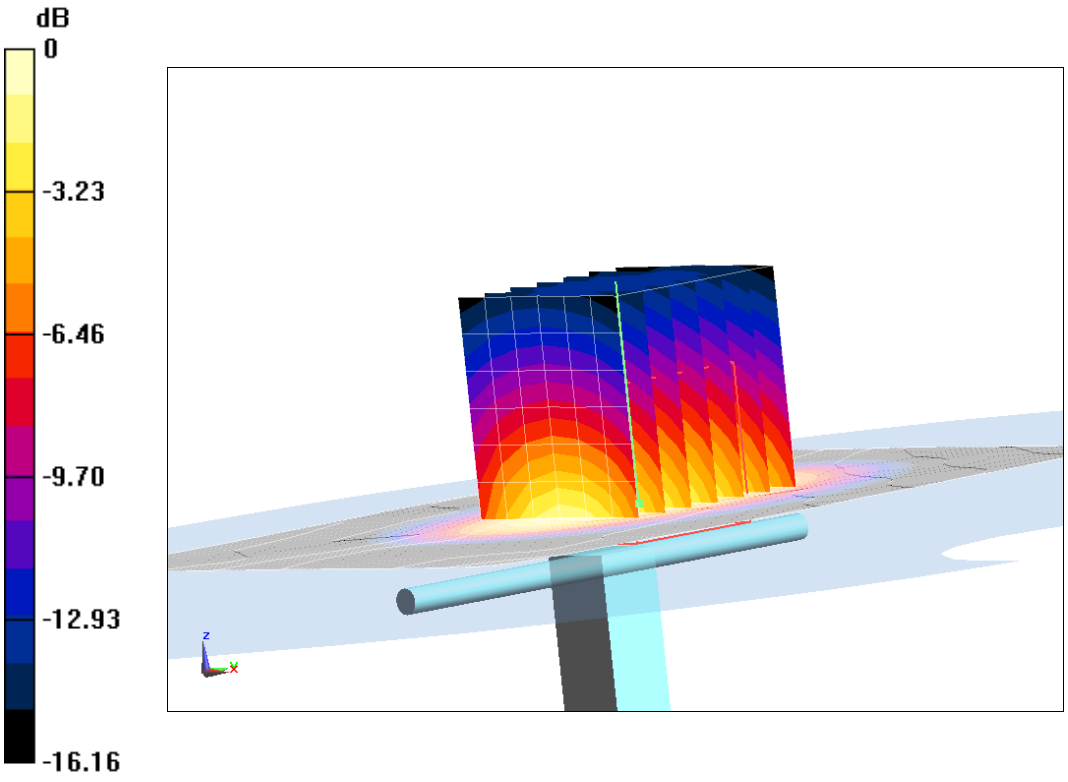
Fig.B.4 validation 835 MHz 250mW

1750 MHz

Date: 5/3/2019
Electronics: DAE4 Sn1525
Medium: Head 1750 MHz
Medium parameters used: f = 1750 MHz; σ =1.38 mho/m; ε_r = 40.68; ρ = 1000 kg/m^3
Ambient Temperature: 22.5ºC Liquid Temperature: 22.3ºC
Communication System: CW Frequency: 1750 MHz Duty Cycle: 1:1
Probe: EX3DV4 – SN7514 ConvF(8.10,8.10,8.10)

System Validation /Area Scan (81x191x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Reference Value = 104.5 V/m; Power Drift = 0.06
Fast SAR: SAR(1 g) = 9.05 W/kg; SAR(10 g) = 4.85 W/kg
Maximum value of SAR (interpolated) = 14.9 W/kg

System Validation /Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value =104.5 V/m; Power Drift = 0.06 dB
Peak SAR (extrapolated) = 17.93 W/kg
SAR(1 g) = 9.03 W/kg; SAR(10 g) = 4.88 W/kg
Maximum value of SAR (measured) = 14.5 W/kg



0 dB = 14.5 W/kg = 11.61 dB W/kg

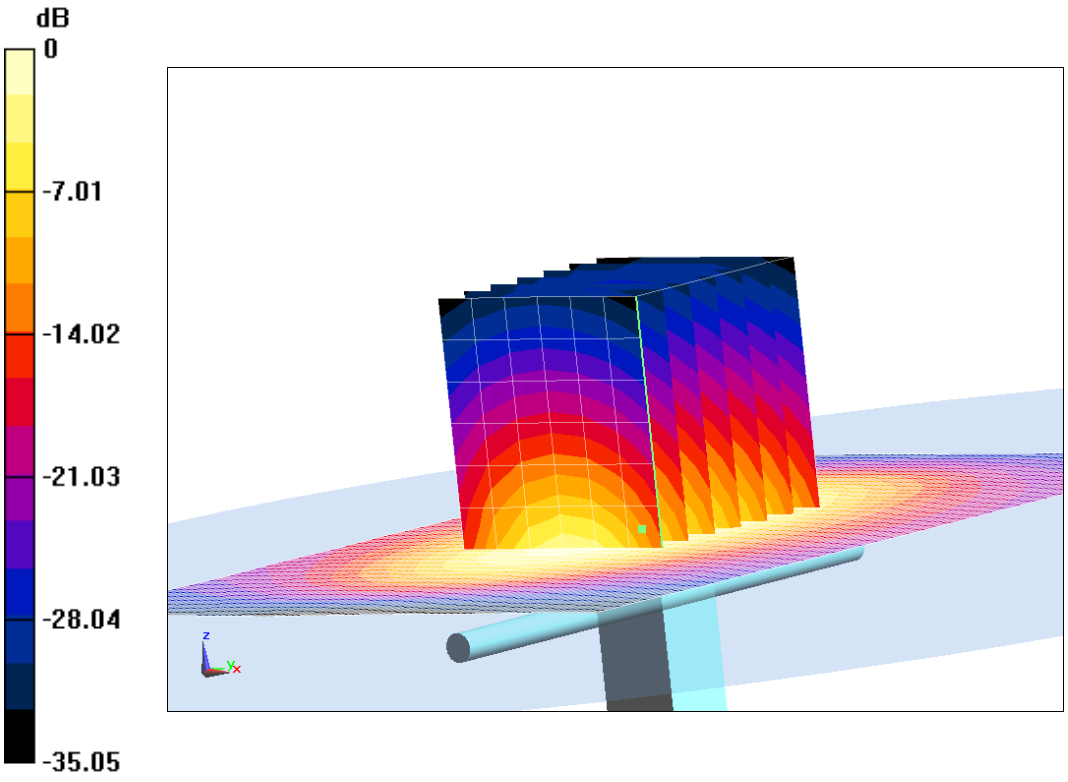
Fig.B.5 validation 1750 MHz 250mW

1750 MHz

Date: 5/3/2019
Electronics: DAE4 Sn1525
Medium: Body 1750 MHz
Medium parameters used: f = 1750 MHz; σ =1.514 mho/m; ε_r = 53.22; ρ = 1000 kg/m^3
Ambient Temperature: 22.5ºC Liquid Temperature: 22.3ºC
Communication System: CW Frequency: 1750 MHz Duty Cycle: 1:1
Probe: EX3DV4 – SN7514 ConvF(7.82,7.82,7.82)

System Validation /Area Scan (81x191x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Reference Value = 101.14 V/m; Power Drift = 0.04
Fast SAR: SAR(1 g) = 9.15 W/kg; SAR(10 g) = 4.93 W/kg
Maximum value of SAR (interpolated) = 16.23 W/kg

System Validation /Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value =101.14 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 16.08 W/kg
SAR(1 g) = 9.19 W/kg; SAR(10 g) = 5.02 W/kg
Maximum value of SAR (measured) = 13.23 W/kg



0 dB = 13.23 W/kg = 11.22 dB W/kg

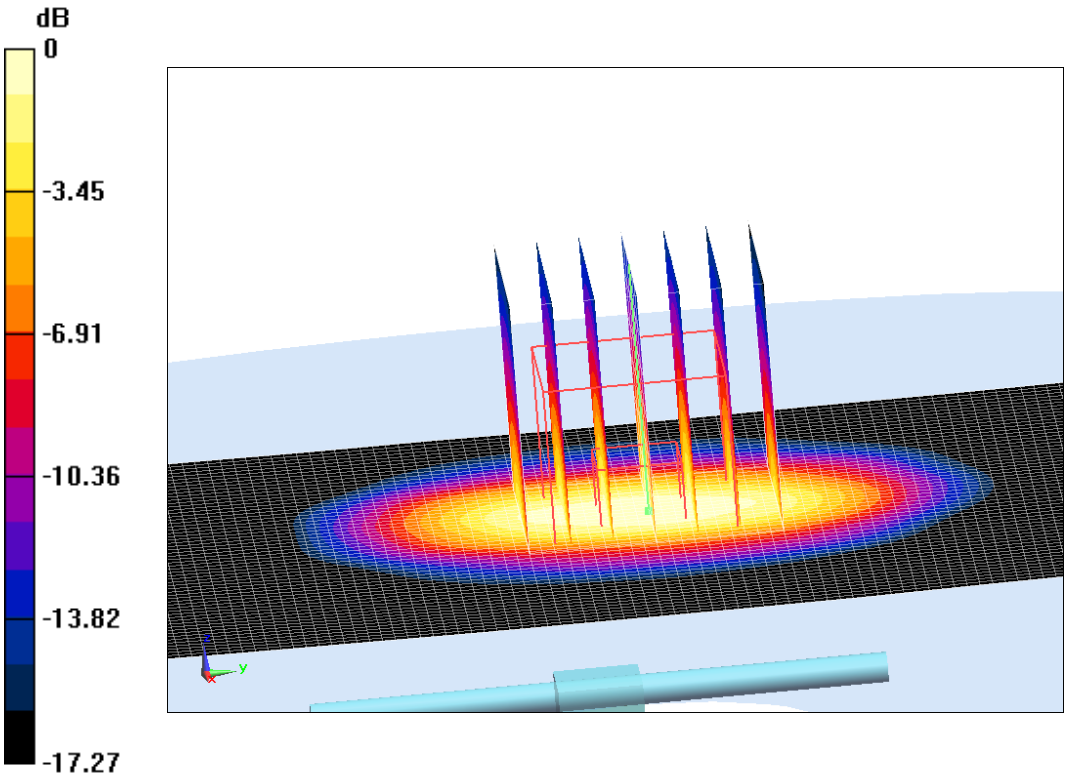
Fig.B.6 validation 1750 MHz 250mW

1900 MHz

Date: 5/4/2019
Electronics: DAE4 Sn1525
Medium: Head 1900 MHz
Medium parameters used: f = 1900 MHz; σ =1.39 mho/m; ε_r = 39.55; ρ = 1000 kg/m^3
Ambient Temperature: 22.5ºC Liquid Temperature: 22.3ºC
Communication System: CW Frequency: 1900 MHz Duty Cycle: 1:1
Probe: EX3DV4 – SN7514 ConvF(7.73,7.73,7.73)

System Validation /Area Scan (81x191x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Reference Value = 105.18 V/m; Power Drift = 0.02
Fast SAR: SAR(1 g) = 10.03 W/kg; SAR(10 g) = 5.25 W/kg
Maximum value of SAR (interpolated) = 14.95 W/kg

System Validation /Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value =105.18 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 18.32 W/kg
SAR(1 g) = 10.15 W/kg; SAR(10 g) = 5.2 W/kg
Maximum value of SAR (measured) = 14.81 W/kg



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

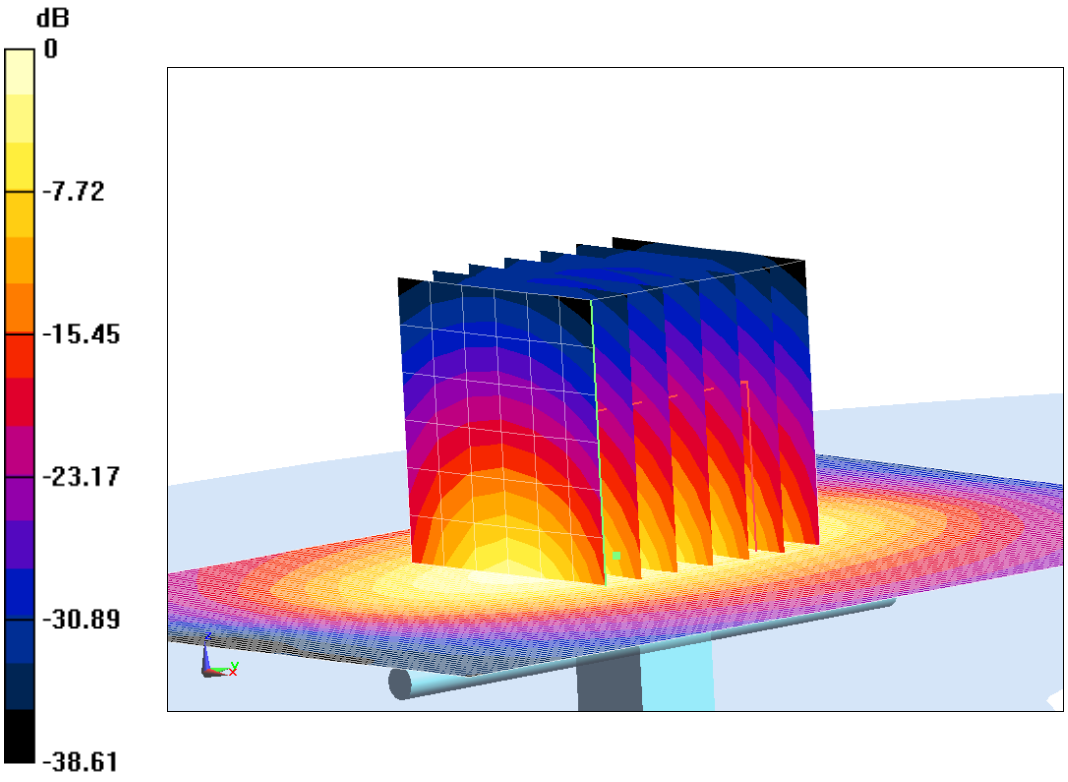
Fig.B.7 validation 1900 MHz 250mW

1900 MHz

Date: 5/4/2019
Electronics: DAE4 Sn1525
Medium: Body 1900 MHz
Medium parameters used: f = 1900 MHz; σ =1.536 mho/m; ε_r = 53.19; ρ = 1000 kg/m^3
Ambient Temperature: 22.5ºC Liquid Temperature: 22.3ºC
Communication System: CW Frequency: 1900 MHz Duty Cycle: 1:1
Probe: EX3DV4 – SN7514 ConvF(7.53,7.53,7.53)

System Validation /Area Scan (81x191x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Reference Value = 103.34 V/m; Power Drift = -0.03
Fast SAR: SAR(1 g) = 10.3 W/kg; SAR(10 g) = 5.34 W/kg
Maximum value of SAR (interpolated) = 17.78 W/kg

System Validation /Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value =103.34 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 17.85 W/kg
SAR(1 g) = 10.03 W/kg; SAR(10 g) = 5.31 W/kg
Maximum value of SAR (measured) = 14.11 W/kg



0 dB = 14.11 W/kg = 11.5 dB W/kg

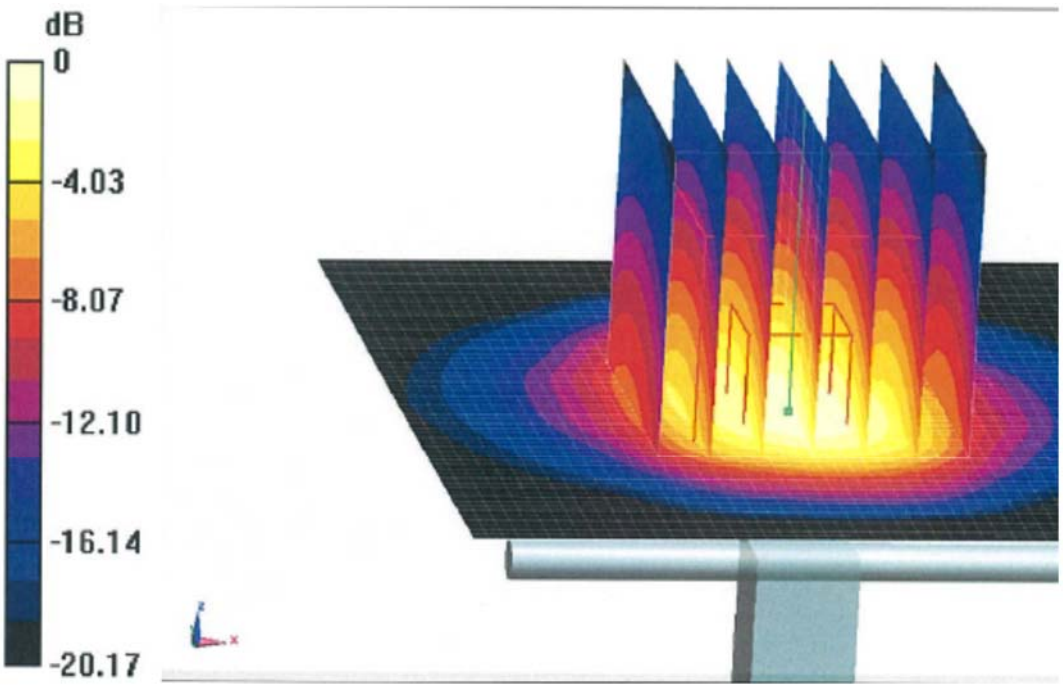
Fig.B.8 validation 1900 MHz 250mW

2300 MHz

Date: 5/5/2019
Electronics: DAE4 Sn1525
Medium: Head 2300 MHz
Medium parameters used: f = 2300 MHz; σ =1.655 mho/m; ε_r = 39.35; ρ = 1000 kg/m^3
Ambient Temperature: 22.5ºC Liquid Temperature: 22.3ºC
Communication System: CW Frequency: 2300 MHz Duty Cycle: 1:1
Probe: EX3DV4 – SN7514 ConvF(7.42,7.42,7.42)

System Validation /Area Scan (81x191x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Reference Value = 111.37 V/m; Power Drift = -0.08
Fast SAR: SAR(1 g) = 12.16 W/kg; SAR(10 g) = 5.82 W/kg
Maximum value of SAR (interpolated) = 19.15 W/kg

System Validation /Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value =111.37 V/m; Power Drift = -0.08 dB
Peak SAR (extrapolated) = 23.75 W/kg
SAR(1 g) = 12.47 W/kg; SAR(10 g) = 6 W/kg
Maximum value of SAR (measured) = 19.47 W/kg



0 dB = 19.47 W/kg = 12.89 dB W/kg

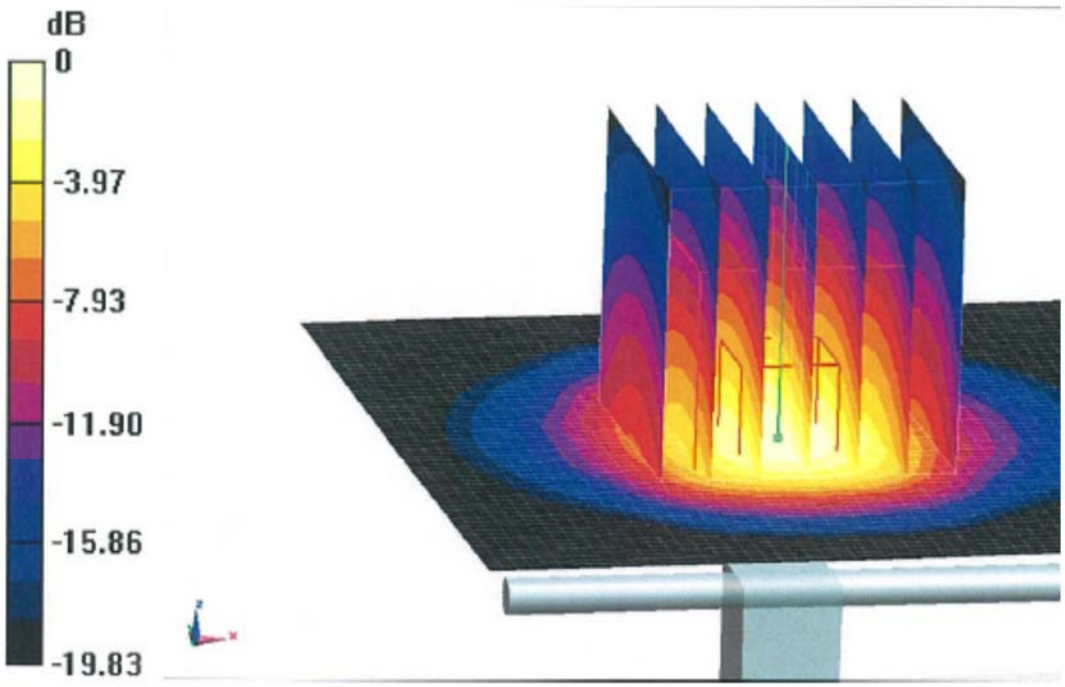
Fig.B.9 validation 2300 MHz 250mW

2300 MHz

Date: 5/5/2019
Electronics: DAE4 Sn1525
Medium: Body 2300 MHz
Medium parameters used: f = 2300 MHz; σ =1.825 mho/m; ε_r = 53.56; ρ = 1000 kg/m^3
Ambient Temperature: 22.5ºC Liquid Temperature: 22.3ºC
Communication System: CW Frequency: 2300 MHz Duty Cycle: 1:1
Probe: EX3DV4 – SN7514 ConvF(7.25,7.25,7.25)

System Validation /Area Scan (81x191x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Reference Value = 103.74 V/m; Power Drift = -0.02
Fast SAR: SAR(1 g) = 11.89 W/kg; SAR(10 g) = 5.7 W/kg
Maximum value of SAR (interpolated) = 22.56 W/kg

System Validation /Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value =103.74 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 22.69 W/kg
SAR(1 g) = 11.63 W/kg; SAR(10 g) = 5.59 W/kg
Maximum value of SAR (measured) = 18.1 W/kg



0 dB = 18.1 W/kg = 12.58 dB W/kg

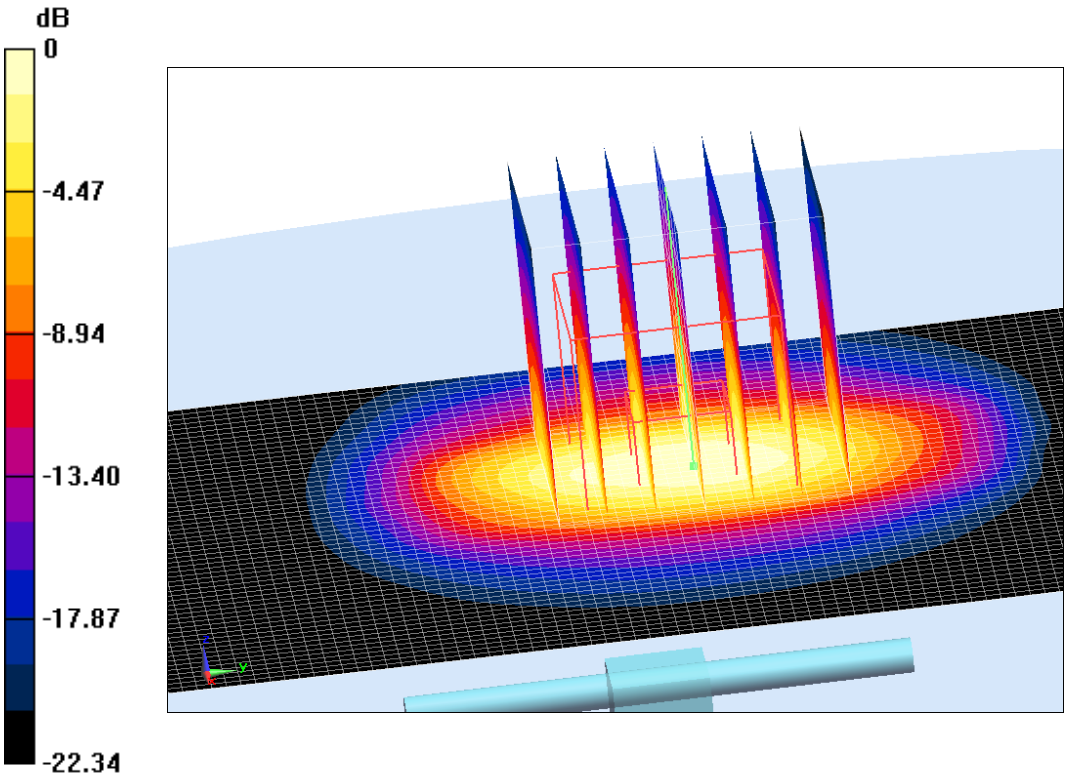
Fig.B.10 validation 2300 MHz 250mW

2450 MHz

Date: 5/6/2019
Electronics: DAE4 Sn1525
Medium: Head 2450 MHz
Medium parameters used: f = 2450 MHz; σ =1.805 mho/m; ε_r = 39.76; ρ = 1000 kg/m^3
Ambient Temperature: 22.5ºC Liquid Temperature: 22.3ºC
Communication System: CW Frequency: 2450 MHz Duty Cycle: 1:1
Probe: EX3DV4 – SN7514 ConvF(6.95,6.95,6.95)

System Validation /Area Scan (81x191x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Reference Value = 112.42 V/m; Power Drift = -0.05
Fast SAR: SAR(1 g) = 12.93 W/kg; SAR(10 g) = 6.1 W/kg
Maximum value of SAR (interpolated) = 21.62 W/kg

System Validation /Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value =112.42 V/m; Power Drift = -0.05 dB
Peak SAR (extrapolated) = 26.89 W/kg
SAR(1 g) = 13.26 W/kg; SAR(10 g) = 6.21 W/kg
Maximum value of SAR (measured) = 21.27 W/kg



0 dB = 21.27 W/kg = 13.28 dB W/kg

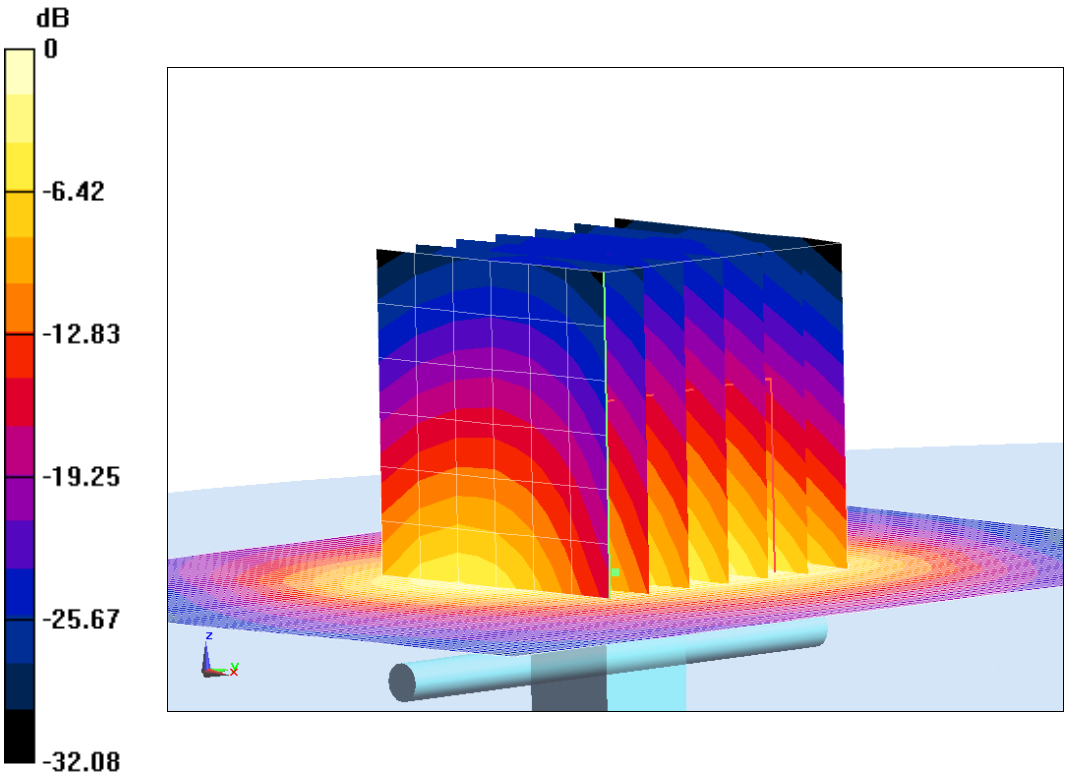
Fig.B.11 validation 2450 MHz 250mW

2450 MHz

Date: 5/6/2019
Electronics: DAE4 Sn1525
Medium: Body 2450 MHz
Medium parameters used: f = 2450 MHz; σ =1.93 mho/m; ε_r = 51.8; ρ = 1000 kg/m^3
Ambient Temperature: 22.5ºC Liquid Temperature: 22.3ºC
Communication System: CW Frequency: 2450 MHz Duty Cycle: 1:1
Probe: EX3DV4 – SN7514 ConvF(7.13,7.13,7.13)

System Validation /Area Scan (81x191x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Reference Value = 105.18 V/m; Power Drift = -0.02
Fast SAR: SAR(1 g) = 12.64 W/kg; SAR(10 g) = 5.85 W/kg
Maximum value of SAR (interpolated) = 25.41 W/kg

System Validation /Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value =105.18 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 25.53 W/kg
SAR(1 g) = 12.4 W/kg; SAR(10 g) = 6.05 W/kg
Maximum value of SAR (measured) = 20.36 W/kg



0 dB = 20.36 W/kg = 13.09 dB W/kg

Fig.B.12 validation 2450 MHz 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.

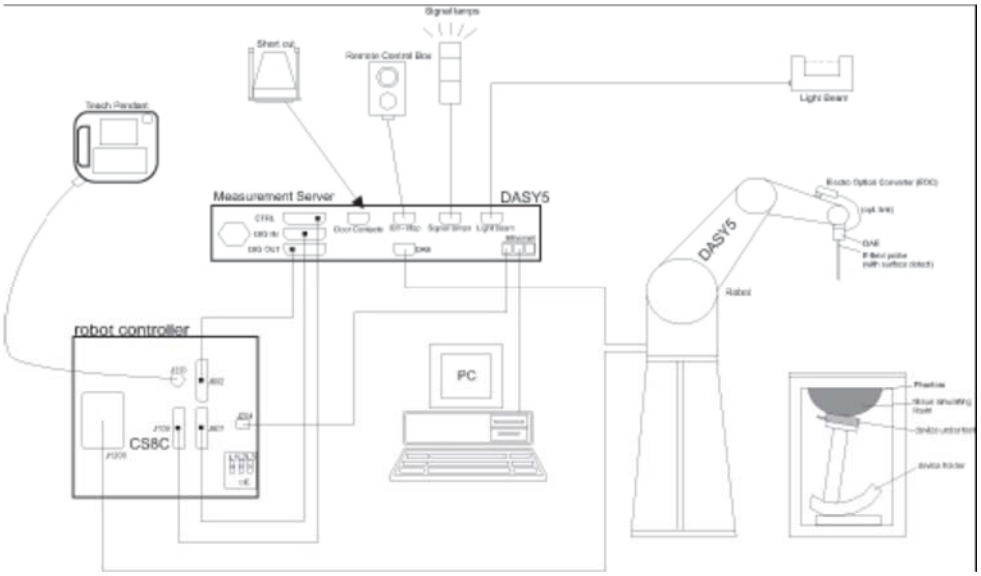
Table B.1 Comparison between area scan and zoom scan for system verification

Date	Band	Position	Area scan (1g)	Zoom scan (1g)	Drift (%)
2019/5/1	750	Head	2.04	2.08	-1.92
	750	Body	2.16	2.21	-2.26
2019/5/2	835	Head	2.34	2.37	-1.27
	835	Body	2.32	2.31	0.43
2019/5/3	1750	Head	9.05	9.03	0.22
	1750	Body	9.15	9.19	-0.44
2019/5/4	1900	Head	10.03	10.15	-1.18
	1900	Body	10.3	10.03	2.69
2019/5/5	2300	Head	12.16	12.47	-2.49
	2300	Body	11.89	11.63	2.24
2019/5/6	2450	Head	12.93	13.26	-2.49
	2450	Body	12.64	12.4	1.94

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.1 SAR Lab Test Measurement Set-up

- A standard high precision 6-axis robot (Stäubli TX=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 10MHz — 6.0GHz(EX3DV4)
Range: 10MHz — 4GHz(ES3DV3)
Calibration: In head and body simulating tissue at Frequencies from 835 up to 5800MHz
Linearity: ± 0.2 dB(30 MHz to 6 GHz) for EX3DV4
± 0.2 dB(30 MHz to 4 GHz) for ES3DV3
Dynamic Range: 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

in the volumetric center of the cavity and at the proper orientation with the field. The probe is then rotated 360 degrees until the three channels show the maximum reading. The power density readings equates to 1 mW/ cm^2.

E-field temperature correlation calibration is performed in a flat phantom filled with the appropriate simulated brain tissue. The E-field in the medium correlates with the temperature rise in the dielectric medium. For temperature correlation calibration a RF transparent thermistor-based temperature probe is used in conjunction with the E-field probe.

$$SAR = C\frac{\Delta T}{\Delta t}$$

Where:

Δt = Exposure time (30 seconds),

C = Heat capacity of tissue (brain or muscle),

ΔT = Temperature increase due to RF exposure.

$$SAR = \frac{|E|^2 \cdot \sigma}{\rho}$$

Where:

σ = Simulated tissue conductivity,

ρ = Tissue density (kg/m^3).

C.4 Other Test Equipment

C.4.1 Data Acquisition Electronics(DAE)

The data acquisition electronics consist of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converter and a command decoder with a control logic unit. Transmission to the measurement server is accomplished through an optical downlink for data and status information, as well as an optical uplink for commands and the clock.

The mechanical probe mounting device includes two different sensor systems for frontal and sideways probe contacts. They are used for mechanical surface detection and probe collision detection.

The input impedance of the DAE is 200 MOhm; the inputs are symmetrical and floating. Common mode rejection is above 80 dB.

PictureC.4: DAE

C.4.2 Robot

The SPEAG DASY system uses the high precision robots (DASY4: RX90XL; DASY5: RX160L) type from Stäubli SA (France). For the 6-axis controller system, the robot controller version from Stäubli is used. The Stäubli robot series have many features that are important for our application:

- High precision (repeatability 0.02mm)
- High reliability (industrial design)
- Low maintenance costs (virtually maintenance free due to direct drive gears; no belt drives)
- Jerk-free straight movements (brushless synchron motors; no stepper motors)
- Low ELF interference (motor control fields shielded via the closed metallic construction shields)

Picture C.5 DASY 4

Picture C.6 DASY 5

C.4.3 Measurement Server

The Measurement server is based on a PC/104 CPU broad with CPU (dasy4: 166 MHz, Intel Pentium; DASY5: 400 MHz, Intel Celeron), chipdisk (DASY4: 32 MB; DASY5: 128MB), RAM (DASY4: 64 MB, DASY5: 128MB). The necessary circuits for communication with the DAE electronic box, as well as the 16 bit AD converter system for optical detection and digital I/O interface are contained on the DASY I/O broad, which is directly connected to the PC/104 bus of the CPU broad.

The measurement server performs all real-time data evaluation of field measurements and surface detection, controls robot movements and handles safety operation. The PC operating system cannot interfere with these time critical processes. All connections are supervised by a watchdog, and disconnection of any of the cables to the measurement server will automatically disarm the robot and disable all program-controlled robot movements. Furthermore, the measurement server is equipped with an expansion port which is reserved for future applications. Please note that this expansion port does not have a standardized pinout, and therefore only devices provided by SPEAG can be connected. Devices from any other supplier could seriously damage the measurement server.

Picture C.7 Server for DASY 4

Picture C.8 Server for DASY 5