Table 13.4: SAR Values (GSM 1900 - Head)

Ambient Temperature: 22.8°C Liquid Temperature: 22.3°C									
Frequency		Test Mode	Test Position	Figure No. / Note	Conducted Power (dBm)	Max. tune-up Power (dBm)	Measured SAR(1g) (W/kg)	Reported SAR(1g) (W/kg)	Power Drift(dB)
MHz	Ch.								
1880	661	Speech	Left Touch	/	29.74	30.8	0.040	**0.051**	0.07
1880	661	Speech	Left Tilt	/	29.74	30.8	0.048	**0.061**	0.03
1880	661	Speech	Right Touch	/	29.74	30.8	0.057	**0.073**	0.09
1880	661	Speech	Right Tilt	/	29.74	30.8	0.034	**0.043**	0.05
1880	661	Speech	Right Touch	EUT2	29.74	30.8	0.040	**0.051**	-0.06
1880	661	Speech	Right Touch	EUT3	29.74	30.8	0.069	**0.088**	-0.03
1880	661	Speech	Right Touch	EUT4	29.74	30.8	0.059	**0.075**	0.04
1880	661	Speech	Right Touch	EUT5	29.74	30.8	0.095	**0.121**	-0.08
1880	661	Speech	Right Touch	**Fig.3** EUT6	29.74	30.8	0.106	**0.135**	-0.01

Table 13.5: SAR Values (GSM 1900 - Body)

Ambient Temperature: 22.8°C Liquid Temperature: 22.3°C									
Frequency		Test Mode	Test Position	Figure No. / Note	Conducted Power (dBm)	Max. tune-up Power (dBm)	Measured SAR(1g) (W/kg)	Reported SAR(1g) (W/kg)	Power Drift(dB)
MHz	Ch.								
Hotspot Test Data (10mm)									
1880	661	GPRS	Front	/	26.36	26.8	0.239	**0.264**	0.01
1880	661	GPRS	Rear	/	26.36	26.8	0.690	**0.764**	0.09
1880	661	GPRS	Left	/	26.36	26.8	0.048	**0.053**	0.08
1880	661	GPRS	Right	/	26.36	26.8	0.051	**0.056**	0.06
1880	661	GPRS	Bottom	/	26.36	26.8	0.656	**0.726**	-0.01
1880	661	GPRS	Rear	EUT2	26.36	26.8	0.548	**0.606**	0.04
1880	661	GPRS	Rear	**Fig.4** EUT3	26.36	26.8	**0.696**	**0.770**	0.04
1880	661	GPRS	Rear	EUT4	26.36	26.8	0.546	**0.604**	0.01
1880	661	GPRS	Rear	EUT5	26.36	26.8	0.415	**0.459**	0.08
1880	661	GPRS	Rear	EUT6	26.36	26.8	0.314	**0.347**	0.03
Body Worn Test Data (15mm)									
1880	661	GPRS	Front	/	25.45	26.5	0.234	**0.298**	0.04
1880	661	GPRS	Rear	/	25.45	26.5	0.416	**0.530**	0.07
Sensor on Test Data									
1880	661	GPRS	Rear(13mm)	/	26.36	26.8	0.430	**0.467**	0.01
1880	661	GPRS	Bottom(11mm)	/	26.36	26.8	0.585	**0.647**	-0.02

Table 13.6: SAR Values (WCDMA 850 - Head)

Ambient Temperature: 22.6°C Liquid Temperature: 22.1°C									
Frequency		Test Mode	Test Position	Figure No. / Note	Conducted Power (dBm)	Max. tune-up Power (dBm)	Measured SAR(1g) (W/kg)	Reported SAR(1g) (W/kg)	Power Drift(dB)
MHz	Ch.								
836.4	4082	RMC	Left Touch	/	23.4	25	0.143	**0.207**	0.09
836.4	4082	RMC	Left Tilt	/	23.4	25	0.094	**0.136**	0.06
836.4	4082	RMC	Right Touch	/	23.4	25	0.134	**0.194**	0.05
836.4	4082	RMC	Right Tilt	/	23.4	25	0.081	**0.117**	0.02
836.4	4082	RMC	Left Touch	EUT2	23.4	25	0.074	**0.107**	-0.03
836.4	4082	RMC	Left Touch	EUT3	23.4	25	0.161	**0.233**	0.02
836.4	4082	RMC	Left Touch	EUT4	23.4	25	0.158	**0.228**	0.11
836.4	4082	RMC	Left Touch	**Fig.5** EUT5	23.4	25	**0.178**	**0.257**	0.01
836.4	4082	RMC	Left Touch	EUT6	23.4	25	0.103	**0.149**	-0.03

Table 13.7: SAR Values (WCDMA 850 -Body)

Ambient Temperature: 22.7°C Liquid Temperature: 22.2°C									
Frequency		Test Mode	Test Position	Figure No. / Note	Conducted Power (dBm)	Max. tune-up Power (dBm)	Measured SAR(1g) (W/kg)	Reported SAR(1g) (W/kg)	Power Drift(dB)
MHz	Ch.								
Hotspot Test Data (10mm)									
836.4	4082	RMC	Front	/	23.4	25	0.122	**0.176**	-0.04
836.4	4082	RMC	Rear	/	23.4	25	0.225	**0.325**	0.09
836.4	4082	RMC	Left	/	23.4	25	0.128	**0.185**	-0.02
836.4	4082	RMC	Right	/	23.4	25	0.090	**0.130**	0.01
836.4	4082	RMC	Bottom	/	23.4	25	0.056	**0.081**	0.01
836.4	4082	RMC	Rear	EUT2	23.4	25	0.195	**0.282**	0.09
836.4	4082	RMC	Rear	EUT3	23.4	25	0.185	**0.267**	0.08
836.4	4082	RMC	Rear	**Fig.6** EUT4	23.4	25	**0.276**	**0.399**	0.02
836.4	4082	RMC	Rear	EUT5	23.4	25	0.172	**0.249**	0.03
836.4	4082	RMC	Rear	EUT6	23.4	25	0.114	**0.165**	0.05
Body Worn Test Data (15mm)									
836.4	4082	RMC	Front	/	23.4	25	0.109	**0.158**	0.04
836.4	4082	RMC	Rear	/	23.4	25	0.192	**0.278**	-0.06

Table 13.8: SAR Values (WCDMA1900 - Head)

Ambient Temperature: 22.8°C Liquid Temperature: 22.3°C									
Frequency		Test Mode	Test Position	Figure No. / Note	Conducted Power (dBm)	Max. tune-up Power (dBm)	Measured SAR(1g) (W/kg)	Reported SAR(1g) (W/kg)	Power Drift(dB)
MHz	Ch.								
1880	9400	RMC	Left Touch	/	22.8	23.6	0.044	**0.053**	0.06
1880	9400	RMC	Left Tilt	/	22.8	23.6	0.056	**0.067**	0.02
1880	9400	RMC	Right Touch	/	22.8	23.6	0.077	**0.093**	0.09
1880	9400	RMC	Right Tilt	/	22.8	23.6	0.037	**0.044**	0.02
1880	9400	RMC	Right Touch	EUT2	22.8	23.6	0.062	**0.075**	0.05
1880	9400	RMC	Right Touch	EUT3	22.8	23.6	0.055	**0.066**	0.09
1880	9400	RMC	Right Touch	**Fig.7** EUT4	22.8	23.6	**0.102**	**0.123**	0.03
1880	9400	RMC	Right Touch	EUT5	22.8	23.6	0.099	**0.119**	0.09
1880	9400	RMC	Right Touch	EUT6	22.8	23.6	0.089	**0.107**	0.03

Table 13.9: SAR Values (WCDMA1900 - Body)

Ambient Temperature: 22.8°C Liquid Temperature: 22.3°C									
Frequency		Test Mode	Test Position	Figure No. / Note	Conducted Power (dBm)	Max. tune-up Power (dBm)	Measured SAR(1g) (W/kg)	Reported SAR(1g) (W/kg)	Power Drift(dB)
MHz	Ch.								
Hotspot Test Data (10mm)									
1880	9400	RMC	Front	/	19.7	21.5	0.142	**0.215**	0.02
1880	9400	RMC	Rear	**Fig.8**	19.7	21.5	**0.472**	**0.714**	0.16
1880	9400	RMC	Left	/	19.7	21.5	0.048	**0.073**	-0.08
1880	9400	RMC	Right	/	19.7	21.5	0.013	**0.020**	0.07
1880	9400	RMC	Bottom	/	19.7	21.5	0.459	**0.695**	-0.06
1880	9400	RMC	Rear	EUT2	19.7	21.5	0.418	**0.633**	0.08
1880	9400	RMC	Rear	EUT3	19.7	21.5	0.396	**0.599**	0.08
1880	9400	RMC	Rear	EUT4	19.7	21.5	0.393	**0.595**	0.05
1880	9400	RMC	Rear	EUT5	19.7	21.5	0.338	**0.512**	0.08
1880	9400	RMC	Rear	EUT6	19.7	21.5	0.266	**0.403**	0.07
Body Worn Test Data (15mm)									
1880	9400	RMC	Front	/	22.8	23.6	0.192	**0.231**	0.04
1880	9400	RMC	Rear	/	22.8	23.6	0.464	**0.558**	0.05
Sensor on Test Data									
1880	9400	RMC	Rear(13mm)	/	19.7	21.5	0.372	**0.563**	0.01
1880	9400	RMC	Bottom(11mm)	/	19.7	21.5	0.443	**0.671**	0.06

Table 13.10: SAR Values (LTE Band 5 - Head)

Ambient Temperature: 22.5°C Liquid Temperature: 22 °C									
Frequency		Test Mode	Test Position	Figure No. / Note	Conducted Power (dBm)	Max. tune-up Power (dBm)	Measured SAR(1g) (W/kg)	Reported SAR(1g) (W/kg)	Power Drift(dB)
MHz	Ch.								
836.5	20525	1RB_Mid	Left Touch	/	23.31	24	0.072	**0.084**	0.02
836.5	20525	25RB_Mid	Left Touch	/	22.25	23	0.058	**0.069**	0.05
836.5	20525	1RB_Mid	Left Tilt	/	23.31	24	0.063	**0.074**	0.02
836.5	20525	25RB_Mid	Left Tilt	/	22.25	23	0.048	**0.057**	0.05
836.5	20525	1RB_Mid	Right Touch	/	23.31	24	0.093	**0.109**	-0.02
836.5	20525	25RB_Mid	Right Touch	/	22.25	23	0.071	**0.084**	0.04
836.5	20525	1RB_Mid	Right Tilt	/	23.31	24	0.108	**0.127**	0.10
836.5	20525	25RB_Mid	Right Tilt	/	22.25	23	0.084	**0.100**	0.12
836.5	20525	1RB_Mid	Right Tilt	EUT2	23.31	24	0.068	**0.080**	0.02
836.5	20525	1RB_Mid	Right Tilt	EUT3	23.31	24	0.075	**0.088**	-0.05
836.5	20525	1RB_Mid	Right Tilt	**Fig.9** EUT4	23.31	24	**0.111**	**0.130**	0.09
836.5	20525	1RB_Mid	Right Tilt	EUT5	23.31	24	0.094	**0.110**	-0.06
836.5	20525	1RB_Mid	Right Tilt	EUT6	23.31	24	0.035	**0.041**	0.02

Table 13.11: SAR Values (LTE Band 5 - Body)

Ambient Temperature: 22.5°C Liquid Temperature: 22 °C									
Frequency		Test Mode	Test Position	Figure No. / Note	Conducted Power (dBm)	Max. tune-up Power (dBm)	Measured SAR(1g) (W/kg)	Reported SAR(1g) (W/kg)	Power Drift(dB)
MHz	Ch.								
Hotspot Test Data (10mm)									
836.5	20525	1RB_Mid	Front	/	23.31	24	0.077	**0.090**	-0.09
836.5	20525	25RB_Mid	Front	/	22.25	23	0.065	**0.077**	0.02
836.5	20525	1RB_Mid	Rear	/	23.31	24	0.152	**0.178**	-0.03
836.5	20525	25RB_Mid	Rear	/	22.25	23	0.121	**0.144**	-0.09
836.5	20525	1RB_Mid	Left	/	23.31	24	0.073	**0.086**	-0.05
836.5	20525	25RB_Mid	Left	/	22.25	23	0.058	**0.069**	0.07
836.5	20525	1RB_Mid	Right	/	23.31	24	0.107	**0.125**	-0.06
836.5	20525	25RB_Mid	Right	/	22.25	23	0.086	**0.102**	-0.09
836.5	20525	1RB_Mid	Bottom	/	23.31	24	0.055	**0.064**	0.06
836.5	20525	25RB_Mid	Bottom	/	22.25	23	0.044	**0.052**	-0.07
836.5	20525	1RB_Mid	Rear	EUT2	23.31	24	0.145	**0.170**	0.05
836.5	20525	1RB_Mid	Rear	EUT3	23.31	24	0.171	**0.200**	0.04
836.5	20525	1RB_Mid	Rear	EUT4	23.31	24	0.203	**0.238**	0.02
836.5	20525	1RB_Mid	Rear	**Fig.10** EUT5	23.31	24	**0.175**	**0.205**	0.02
836.5	20525	1RB_Mid	Rear	EUT6	23.31	24	0.090	**0.105**	-0.08

Body Worn Test Data (15mm)									
836.5	20525	1RB_Mid	Front	/	23.31	24	0.121	**0.142**	-0.09
836.5	20525	25RB_Mid	Front	/	22.25	23	0.103	**0.122**	-0.06
836.5	20525	1RB_Mid	Rear	/	23.31	24	0.074	**0.087**	-0.08
836.5	20525	25RB_Mid	Rear	/	22.25	23	0.069	**0.082**	0.04

Table 13.12: SAR Values (LTE Band 7 - Head)

Ambient Temperature: 22.6°C Liquid Temperature: 22.1°C									
Frequency		Test Mode	Test Position	Figure No. / Note	Conducted Power (dBm)	Max. tune-up Power (dBm)	Measured SAR(1g) (W/kg)	Reported SAR(1g) (W/kg)	Power Drift(dB)
MHz	Ch.								
2535	21100	1RB_Mid	Left Touch	**Fig.11**	22.85	24	**0.178**	**0.232**	0.09
2535	21100	50RB_Mid	Left Touch	/	21.92	23	0.131	**0.168**	-0.05
2535	21100	1RB_Mid	Left Tilt	/	22.85	24	0.087	**0.113**	0.05
2535	21100	50RB_Mid	Left Tilt	/	21.92	23	0.054	**0.069**	0.12
2535	21100	1RB_Mid	Right Touch	/	22.85	24	0.124	**0.162**	-0.03
2535	21100	50RB_Mid	Right Touch	/	21.92	23	0.054	**0.069**	0.03
2535	21100	1RB_Mid	Right Tilt	/	22.85	24	0.043	**0.056**	0.10
2535	21100	50RB_Mid	Right Tilt	/	21.92	23	0.031	**0.040**	0.05
2535	21100	1RB_Mid	Left Touch	EUT2	22.85	24	0.098	**0.128**	0.08
2535	21100	1RB_Mid	Left Touch	EUT3	22.85	24	0.171	**0.223**	0.11
2535	21100	1RB_Mid	Left Touch	EUT4	22.85	24	0.119	**0.155**	-0.06
2535	21100	1RB_Mid	Left Touch	EUT5	22.85	24	0.071	**0.093**	0.07
2535	21100	1RB_Mid	Left Touch	EUT6	22.85	24	0.091	**0.119**	0.03

Table 13.13: SAR Values (LTE Band 7 - Body)

Ambient Temperature: 22.6°C Liquid Temperature: 22.1°C									
Frequency		Test Mode	Test Position	Figure No. / Note	Conducted Power (dBm)	Max. tune-up Power (dBm)	Measured SAR(1g) (W/kg)	Reported SAR(1g) (W/kg)	Power Drift(dB)
MHz	Ch.								
Hotspot Test Data (10mm)									
2535	21100	1RB_Mid	Front	/	19.02	20	0.091	**0.114**	-0.06
2535	21100	50RB_Mid	Front	/	18.94	20	0.099	**0.126**	0.07
2535	21100	1RB_Mid	Rear	/	19.02	20	0.265	**0.332**	-0.05
2535	21100	50RB_Mid	Rear	**Fig.12**	18.94	20	**0.268**	**0.342**	0.02
2535	21100	1RB_Mid	Left	/	19.02	20	0.087	**0.109**	-0.02
2535	21100	50RB_Mid	Left	/	18.94	20	0.100	**0.128**	0.06
2535	21100	1RB_Mid	Right	/	19.02	20	0.047	**0.059**	0.09
2535	21100	50RB_Mid	Right	/	18.94	20	0.058	**0.074**	0.05
2535	21100	1RB_Mid	Bottom	/	19.02	20	0.231	**0.289**	0.12
2535	21100	50RB_Mid	Bottom	/	18.94	20	0.234	**0.299**	0.05
2535	21100	50RB_Mid	Rear	EUT2	18.94	20	0.215	**0.274**	-0.08
2535	21100	50RB_Mid	Rear	EUT3	18.94	20	0.215	**0.274**	0.02
2535	21100	50RB_Mid	Rear	EUT4	18.94	20	0.214	**0.273**	0.06
2535	21100	50RB_Mid	Rear	EUT5	18.94	20	0.186	**0.237**	0.04
2535	21100	50RB_Mid	Rear	EUT6	18.94	20	0.169	**0.216**	0.08
Body Worn Test Data (15mm)									
2535	21100	1RB_Mid	Front	/	22.85	24	0.147	**0.192**	0.06
2535	21100	50RB_Mid	Front	/	21.92	23	0.120	**0.154**	0.01
2535	21100	1RB_Mid	Rear	/	22.85	24	0.143	**0.186**	0.05
2535	21100	50RB_Mid	Rear	/	21.92	23	0.132	**0.169**	0.05
Sensor on Test Data									
2535	21100	1RB_Mid	Rear(13mm)	/	18.94	20	0.145	**0.185**	0.09
2535	21100	50RB_Mid	Rear(13mm)	/	18.94	20	0.152	**0.194**	0.05
2535	21100	1RB_Mid	Bottom(11mm)	/	18.94	20	0.245	**0.313**	0.09
2535	21100	50RB_Mid	Bottom(11mm)	/	18.94	20	0.245	**0.313**	0.04

13.2 WLAN Evaluation for 2.4G

According to the KDB248227 D01, SAR is measured for 2.4GHz 802.11b DSSS using the initial test position procedure.

Head Evaluation

Table 13.14: SAR Values (WLAN - Head)–802.11b 1Mbps

Ambient Temperature: 22.2°C Liquid Temperature: 21.7°C									
Frequency		Test Mode	Test Position	Figure No. / Note	Conducted Power (dBm)	Max. tune-up Power (dBm)	Measured SAR(1g) (W/kg)	Reported SAR(1g) (W/kg)	Power Drift(dB)
MHz	Ch.								
2412	1	802.11 b	Left Touch	/	12.94	14	0.399	**0.509**	-0.02
2412	1	802.11 b	Left Tilt	/	12.94	14	0.344	**0.439**	0.05
2412	1	802.11 b	Right Touch	/	12.94	14	0.152	**0.194**	0.02
2412	1	802.11 b	Right Tilt	/	12.94	14	0.214	**0.273**	0.04
2412	1	802.11 b	Left Touch	EUT2	12.94	14	0.355	**0.453**	0.06
2412	1	802.11 b	Left Touch	EUT3	12.94	14	0.377	**0.481**	0.01
2412	1	802.11 b	Left Touch	EUT4	12.94	14	0.374	**0.477**	0.07
2412	1	802.11 b	Left Touch	EUT5	12.94	14	0.325	**0.415**	0.06
2412	1	802.11 b	Left Touch	**Fig.13** EUT6	12.94	14	**0.407**	**0.520**	0.07

Note1: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.

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. A maximum transmission duty factor of 99.3% is achievable for WLAN in this project and the scaled reported SAR is presented as below.

Table 13.15: SAR Values (WLAN - Head) – 802.11b 1Mbps (Scaled Reported SAR)

Ambient Temperature: 22.2°C Liquid Temperature: 21.7°C							
Frequency		Side	Test Position	Actual duty factor	maximum duty factor	Reported SAR (1g)(W/kg)	Scaled reported SAR (1g)(W/kg)
MHz	Ch.						
2412	1	Left	Touch	99.3%	100%	0.520	**0.524**
2412	1	Right	Touch	99.3%	100%	0.203	**0.204**

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

Body Evaluation

Table 13.16: SAR Values (WLAN - Body)– 802.11b 1Mbps

Ambient Temperature: 22.2°C Liquid Temperature: 21.7°C									
Frequency		Test Mode	Test Position	Figure No. / Note	Conducted Power (dBm)	Max. tune-up Power (dBm)	Measured SAR(1g) (W/kg)	Reported SAR(1g) (W/kg)	Power Drift(dB)
MHz	Ch.								
Hotspot Test Data (10mm)									
2412	1	802.11 b	Front	/	16.85	18	0.099	**0.129**	-0.06
2412	1	802.11 b	Rear	/	16.85	18	0.080	**0.104**	0.06
2412	1	802.11 b	Right	/	16.85	18	0.019	**0.025**	0.09
2412	1	802.11 b	Top	/	16.85	18	0.095	**0.124**	-0.03
2412	1	802.11 b	Front	EUT2	16.85	18	0.106	**0.138**	0.03
2412	1	802.11 b	Front	EUT3	16.85	18	0.109	**0.142**	0.09
2412	1	802.11 b	Front	EUT4	16.85	18	0.102	**0.133**	0.07
2412	1	802.11 b	Front	EUT5	16.85	18	0.099	**0.129**	0.01
2412	1	802.11 b	Front	**Fig.14** EUT6	16.85	18	**0.116**	**0.151**	-0.05
Body Worn Test Data (15mm)									
2412	1	802.11 b	Front	/	16.85	18	0.055	**0.072**	0.03
2412	1	802.11 b	Rear	/	16.85	18	0.038	**0.050**	0.04

Note1: 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.

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. A maximum transmission duty factor of 99.3% is achievable for WLAN in this project and the scaled reported SAR is presented as below.

Table 13.17: SAR Values (WLAN - Body) – 802.11b 1Mbps (Scaled Reported SAR)

Ambient Temperature: 22.2°C Liquid Temperature: 21.7°C						
Frequency		Test Position	Actual duty factor	maximum duty factor	Reported SAR (1g)(W/kg)	Scaled reported SAR (1g)(W/kg)
MHz	Ch.					
Hotspot Test Data (10mm)						
2412	1	Front	99.3%	100%	0.151	**0.152**
2412	1	Rear	99.3%	100%	0.104	**0.105**
Body Worn Test Data (15mm)						
2412	1	Front	99.3%	100%	0.072	**0.073**
2412	1	Rear	99.3%	100%	0.050	**0.050**

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

14 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.

15 Measurement Uncertainty

15.1 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	12	N	2	1	1	6.0	6.0	∞
2	Isotropy	B	7.4	R	$\sqrt{3}$	1	1	4.3	4.3	∞
3	Boundary effect	B	1.1	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	1.0	N	1	1	1	1.0	1.0	∞
7	Response time	B	0.0	R	$\sqrt{3}$	1	1	0.0	0.0	∞
8	Integration time	B	1.7	R	$\sqrt{3}$	1	1	1.0	1.0	∞
9	RF ambient conditions-noise	B	3.0	R	$\sqrt{3}$	1	1	1.7	1.7	∞
10	RF ambient conditions-reflection	B	3.0	R	$\sqrt{3}$	1	1	1.7	1.7	∞
11	Probe positioned mech. restrictions	B	0.35	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	5
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	1.0	R	$\sqrt{3}$	1	1	0.6	0.6	∞
18	Liquid conductivity (target)	B	5.0	R	$\sqrt{3}$	0.64	0.43	1.8	1.2	∞
19	Liquid conductivity (meas.)	A	1.3	N	1	0.64	0.43	0.83	0.56	9
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	0.96	0.78	9
Combined standard uncertainty		$u_c' = \sqrt{\sum_{i=1}^{21} c_i^2 u_i^2}$						10.4	10.3	95.5
Expanded uncertainty (Confidence interval of 95 %)		$u_e = 2u_c$						20.8	20.6	

15.2 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	12	N	2	1	1	6.0	6.0	∞
2	Isotropy	B	7.4	R	$\sqrt{3}$	1	1	4.3	4.3	∞
3	Boundary effect	B	1.1	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	1.0	N	1	1	1	1.0	1.0	∞
7	Response time	B	0.0	R	$\sqrt{3}$	1	1	0.0	0.0	∞
8	Integration time	B	1.7	R	$\sqrt{3}$	1	1	1.0	1.0	∞
9	RF ambient conditions-noise	B	3.0	R	$\sqrt{3}$	1	1	1.7	1.7	∞
10	RF ambient conditions-reflection	B	3.0	R	$\sqrt{3}$	1	1	1.7	1.7	∞
11	Probe positioned mech. Restrictions	B	0.35	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	5
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	1.0	R	$\sqrt{3}$	1	1	0.6	0.6	∞
19	Liquid conductivity (target)	B	5.0	R	$\sqrt{3}$	0.64	0.43	1.8	1.2	∞
20	Liquid conductivity (meas.)	A	1.3	N	1	0.64	0.43	0.83	0.56	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	0.96	0.78	521
Combined standard uncertainty		$u_c^{'} = \sqrt{\sum_{i=1}^{22} c_i^2 u_i^2}$						11.1	11.0	257
Expanded uncertainty (Confidence interval of 95 %)		$u_e = 2u_c$						22.2	22.0	

16 MAIN TEST INSTRUMENTS

Table 16.1: List of Main Instruments

No.	Name	Type	Serial Number	Calibration Date	Valid Period
01	Network analyzer	Agilent E5071C	MY46103759	2017-11-17	One year
02	Dielectric probe	85070E	MY44300317	/	
03	Power meter	NRP	102603	2018-01-04	One year
04	Power sensor	NRP-Z51	102211		
05	Power meter	NRP	101460	2018-02-05	One year
06	Power sensor	NRP-Z91	100553		
07	Signal Generator	E8257D	MY47461211	2017-06-06	One year
08	Amplifier	VTL5400	0404	/	
09	DAE	SPEAG DAE4	786	2017-11-22	One year
10	E-field Probe	SPEAG ES3DV3	3151	2017-12-13	One year
11	Dipole Validation Kit	SPEAG D835V2	4d057	2015-10-22	Three year
12	Dipole Validation Kit	SPEAG D1900V2	5d088	2015-11-04	Three year
13	Dipole Validation Kit	SPEAG D2450V2	873	2015-10-30	Three year
14	Dipole Validation Kit	SPEAG D2550V2	1010	2015-07-24	Three year
15	BTS	E5515C	GB46110722	2018-02-19	One year
16	Radio Communication Analyzer	Anristu MT8820C	6201341853	2017-03-08	One year

END OF REPORT BODY

ANNEX A Graph Results

GSM850 Head

Date: 2018-1-10

Electronics: DAE4 Sn786

Medium: Head 835 MHz

Medium parameters used (interpolated): f = 836.6 MHz; σ = 0.917 S/m; ε_r = 40.931; ρ = 1000 kg/m^3

Ambient Temperature: 22.5^{o}C Liquid Temperature: 22.0^{o}C

Communication System: UID 0, GSM (0) Frequency: 836.6 MHz Duty Cycle: 1:8.3

Probe: ES3DV3 - SN3151 ConvF (6.47, 6.47, 6.47);

Left Cheek Mid/Area Scan (61x101x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 0.134 W/kg

Left Cheek Mid/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 7.930 V/m; Power Drift = 0.08 dB

Peak SAR (extrapolated) = 0.158 W/kg

SAR(1 g) = 0.127 W/kg; SAR(10 g) = 0.097 W/kg

Maximum value of SAR (measured) = 0.134 W/kg

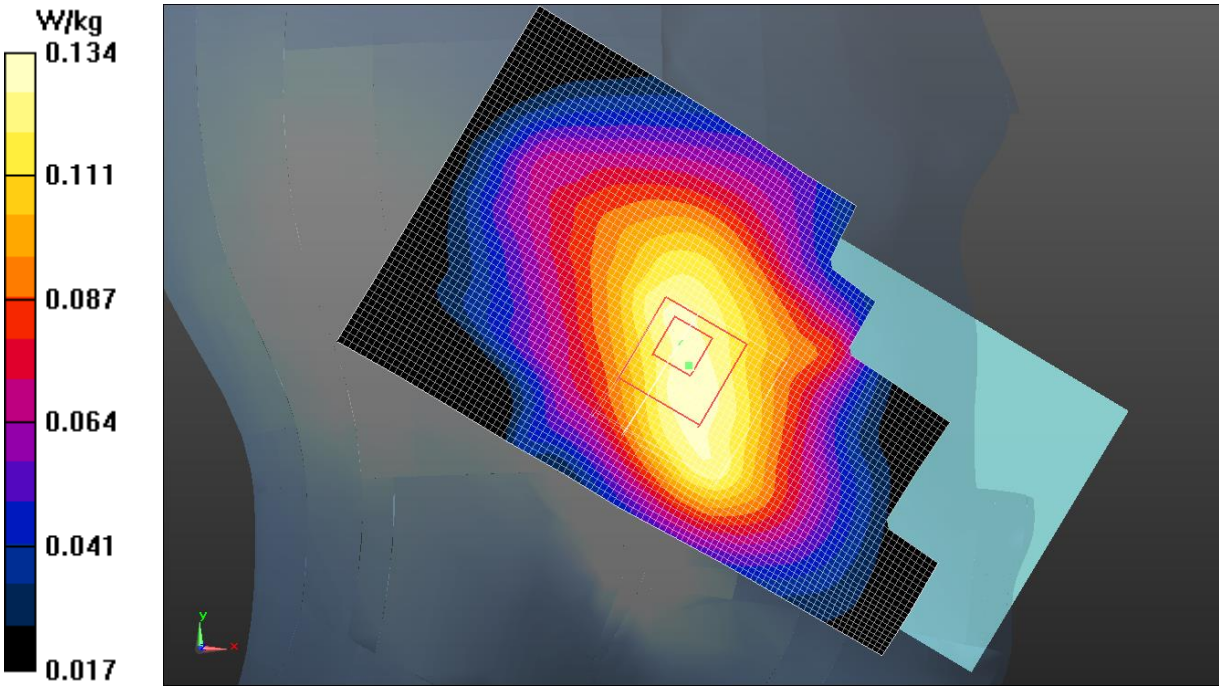


Fig.1 GSM 850MHz

GSM850 Body

Date: 2018-1-12

Electronics: DAE4 Sn786

Medium: Body 835 MHz

Medium parameters used (interpolated): f = 836.6 MHz; σ = 0.986 S/m; εr = 53.871; ρ = 1000 kg/m^3

Ambient Temperature: 22.6^{o}C Liquid Temperature: 22.1^{o}C

Communication System: UID 0, GPRS 4 Txslot (0) Frequency: 836.6 MHz Duty Cycle: 1:2

Probe: ES3DV3 - SN3151 ConvF (6.38, 6.38, 6.38);

Rear Side Mid/Area Scan (61x101x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 0.296 W/kg

Rear Side Middle/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 14.38 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 0.351 W/kg

SAR(1 g) = 0.279 W/kg; SAR(10 g) = 0.214 W/kg

Maximum value of SAR (measured) = 0.292 W/kg

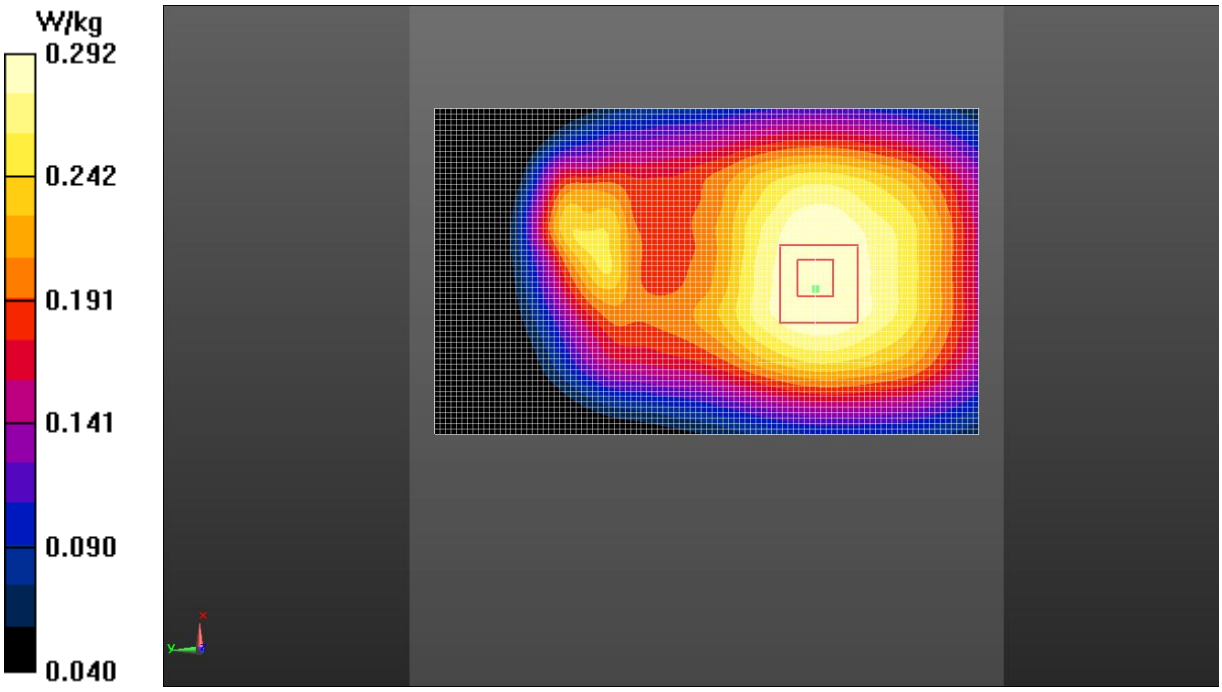


Fig.2 GSM 850 MHz

GSM1900 Head

Date: 2018-2-6
Electronics: DAE4 Sn786
Medium: Head 1900 MHz
Medium parameters used f = 1880 MHz; σ = 1.398 S/m; εr = 38.986; ρ = 1000 kg/m^3
Ambient Temperature: 22.2^{o}C Liquid Temperature: 21.7^{o}C
Communication System: UID 0, GSM (0) Frequency: 1880 MHz Duty Cycle: 1:8.3
Probe: ES3DV3 - SN3151 ConvF (5.09, 5.09, 5.09);

Right Cheek Mid/Area Scan (61x101x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.157 W/kg

Right Cheek Mid/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 10.69 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 0.0950 W/kg
SAR(1 g) = 0.106 W/kg; SAR(10 g) = 0.050 W/kg
Maximum value of SAR (measured) = 0.147 W/kg

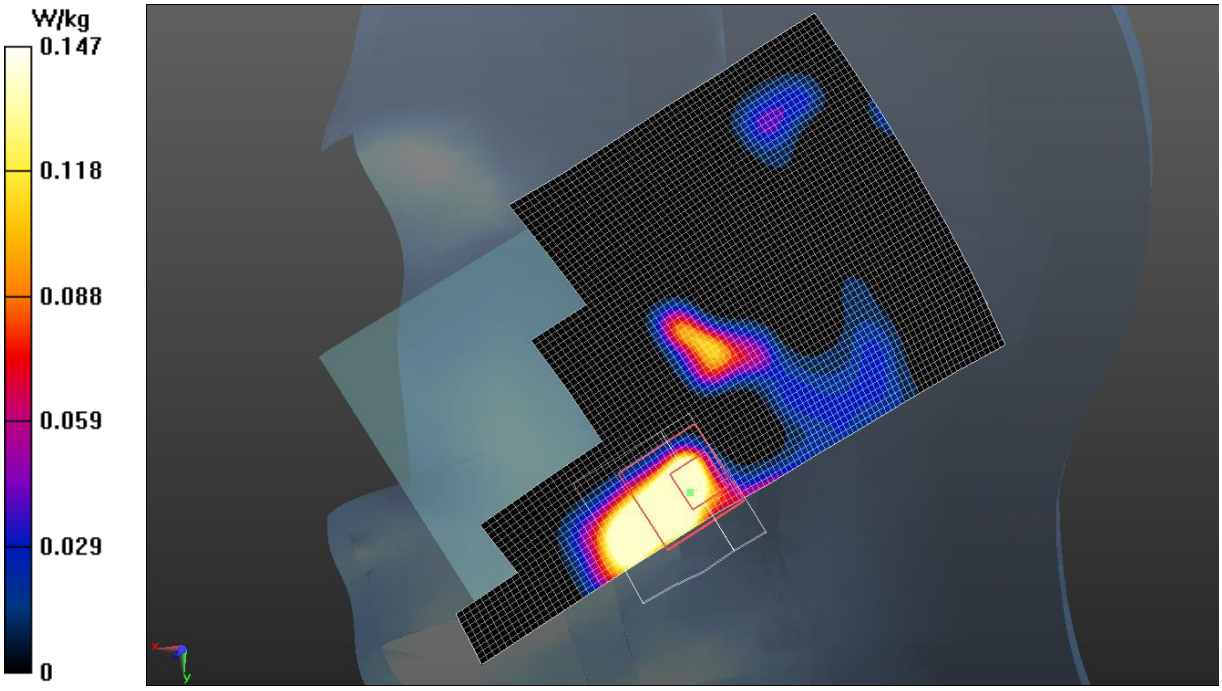


Fig.3 GSM 1900 MHz

GSM1900 Body

Date: 2018-2-6
Electronics: DAE4 Sn786
Medium: Body 1900 MHz
Medium parameters used: f = 1880 MHz; σ = 1.542 S/m; εr = 52.992; ρ = 1000 kg/m^3
Ambient Temperature: 22.2^{o}C Liquid Temperature: 21.7^{o}C
Communication System: UID 0, GPRS 4 Txslot (0) Frequency: 1880 MHz Duty Cycle: 1:2.67
Probe: ES3DV3 - SN3151 ConvF (4.89, 4.89, 4.89);

Rear Side Mid/Area Scan (51x101x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 1.14 W/kg

Rear Side Mid/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 3.282 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 1.75 W/kg
SAR(1 g) = 0.696 W/kg; SAR(10 g) = 0.358 W/kg
Maximum value of SAR (measured) = 1.07 W/kg

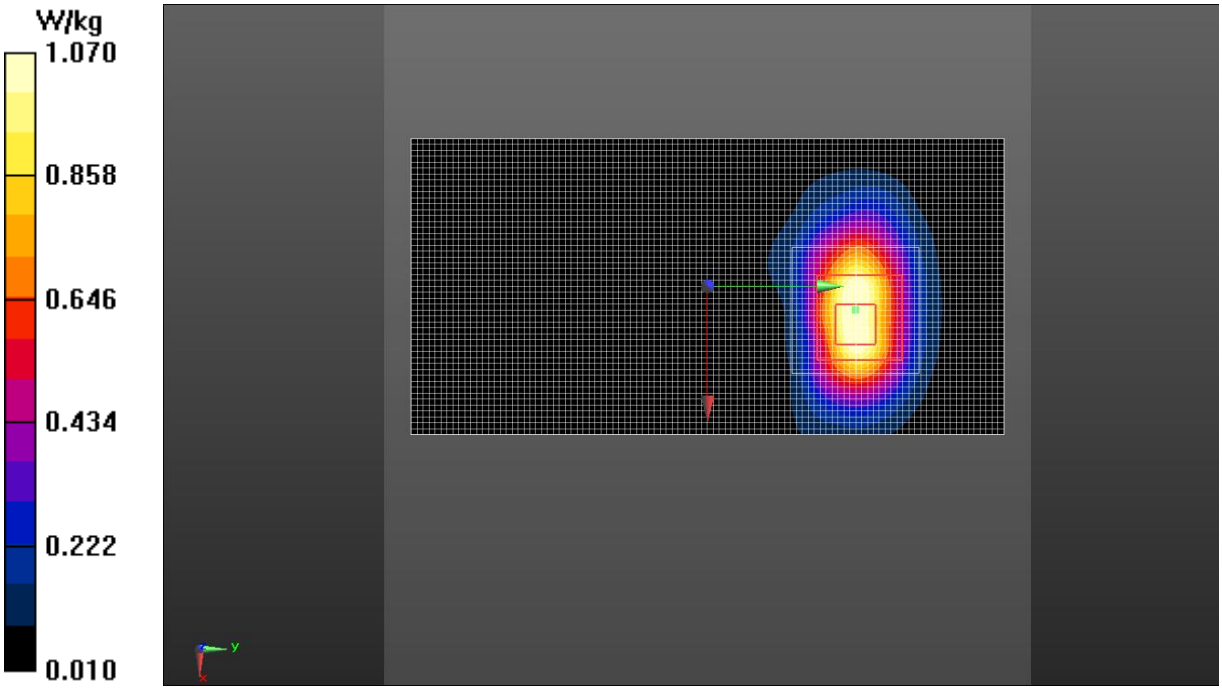


Fig.4 GSM 1900 MHz

WCDMA 850 Head

Date: 2018-1-10

Electronics: DAE4 Sn786

Medium: Head 835 MHz

Medium parameters used (interpolated): f = 836.4 MHz; σ = 0.917 S/m; ε_r = 40.933; ρ = 1000 kg/m^3

Ambient Temperature: 22.5^{o}C Liquid Temperature: 22.0^{o}C

Communication System: UID 0, WCDMA (0) Frequency: 836.4 MHz Duty Cycle: 1:1

Probe: ES3DV3 - SN3151 ConvF (6.47, 6.47, 6.47);

Left Cheek Mid/Area Scan (61x101x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 0.332 W/kg

Left Cheek Mid/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 5.976 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 0.474 W/kg

SAR(1 g) = 0.178 W/kg; SAR(10 g) = 0.131 W/kg

Maximum value of SAR (measured) = 0.368 W/kg

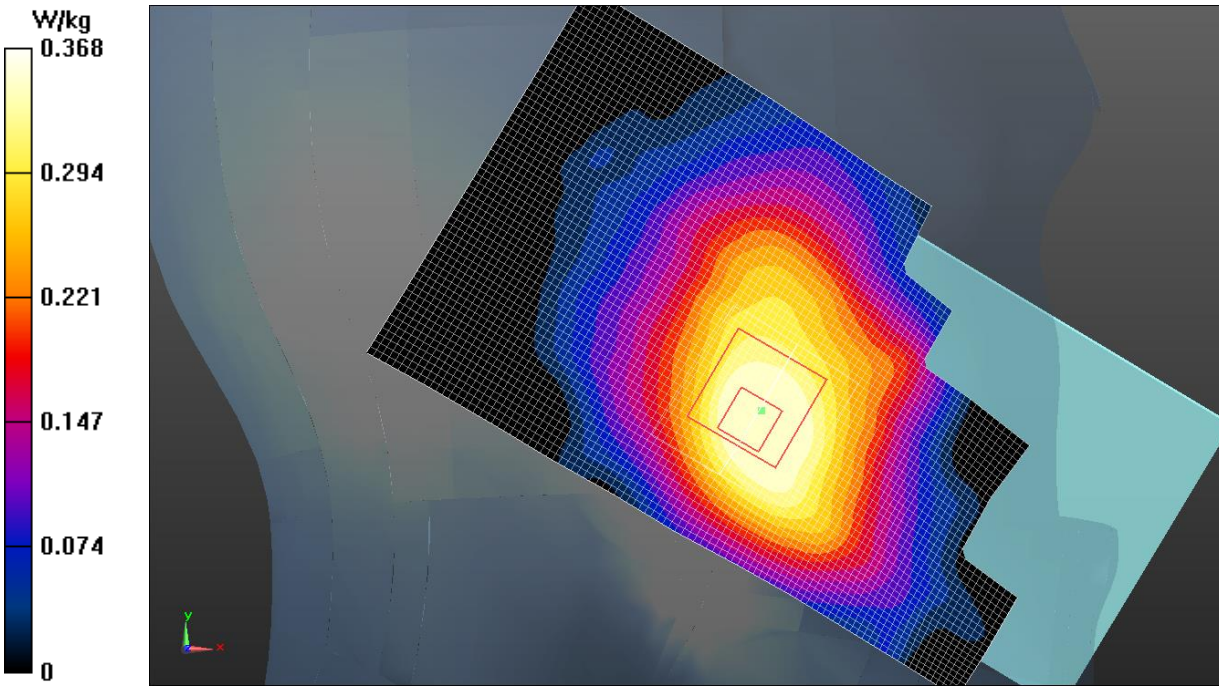


Fig.5 WCDMA 850

WCDMA 850 Body

Date: 2018-1-12

Electronics: DAE4 Sn786

Medium: Body 835 MHz

Medium parameters used (interpolated): f = 836.4 MHz; σ = 0.986 S/m; εr = 53.868; ρ = 1000 kg/m^3

Ambient Temperature: 22.5^{o}C Liquid Temperature: 22.0^{o}C

Communication System: UID 0, WCDMA (0) Frequency: 836.4 MHz Duty Cycle: 1:1

Probe: ES3DV3 - SN3151 ConvF (6.38, 6.38, 6.38);

Rear Side Mid/Area Scan (61x101x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 0.340 W/kg

Rear Side Mid/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 14.37 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 0.482 W/kg

SAR(1 g) = 0.276 W/kg; SAR(10 g) = 0.196 W/kg

Maximum value of SAR (measured) = 0.324 W/kg

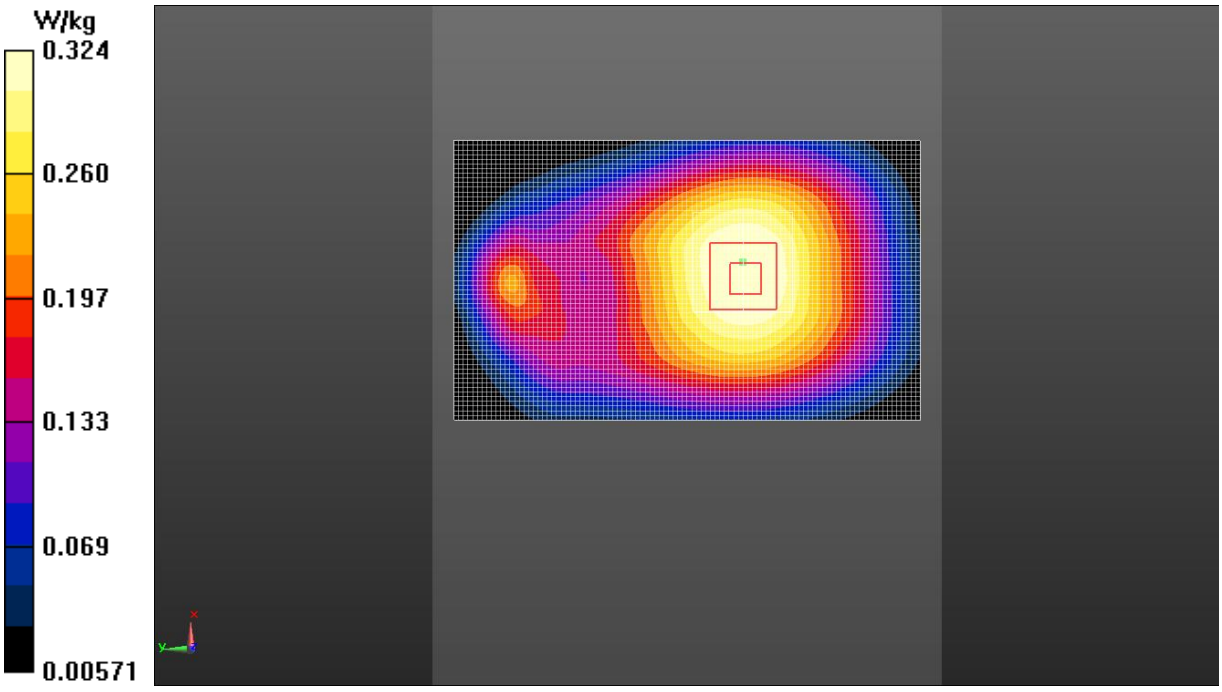


Fig.6 WCDMA 850

WCDMA 1900 Head

Date: 2018-2-6
Electronics: DAE4 Sn786
Medium: Head 1900 MHz
Medium parameters used f = 1880 MHz; σ = 1.398 S/m; εr = 38.986; ρ = 1000 kg/m^3
Ambient Temperature: 21.8^{o}C Liquid Temperature: 21.3^{o}C
Communication System: UID 0, WCDMA (0) Frequency: 1880 MHz Duty Cycle: 1:1
Probe: ES3DV3 - SN3151 ConvF (5.09, 5.09, 5.09);

Right cheek Mid/Area Scan (71x101x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.121 W/kg

Right cheek Mid/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 2.764 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 0.179 W/kg
SAR(1 g) = 0.102 W/kg; SAR(10 g) = 0.059 W/kg
Maximum value of SAR (measured) = 0.132 W/kg

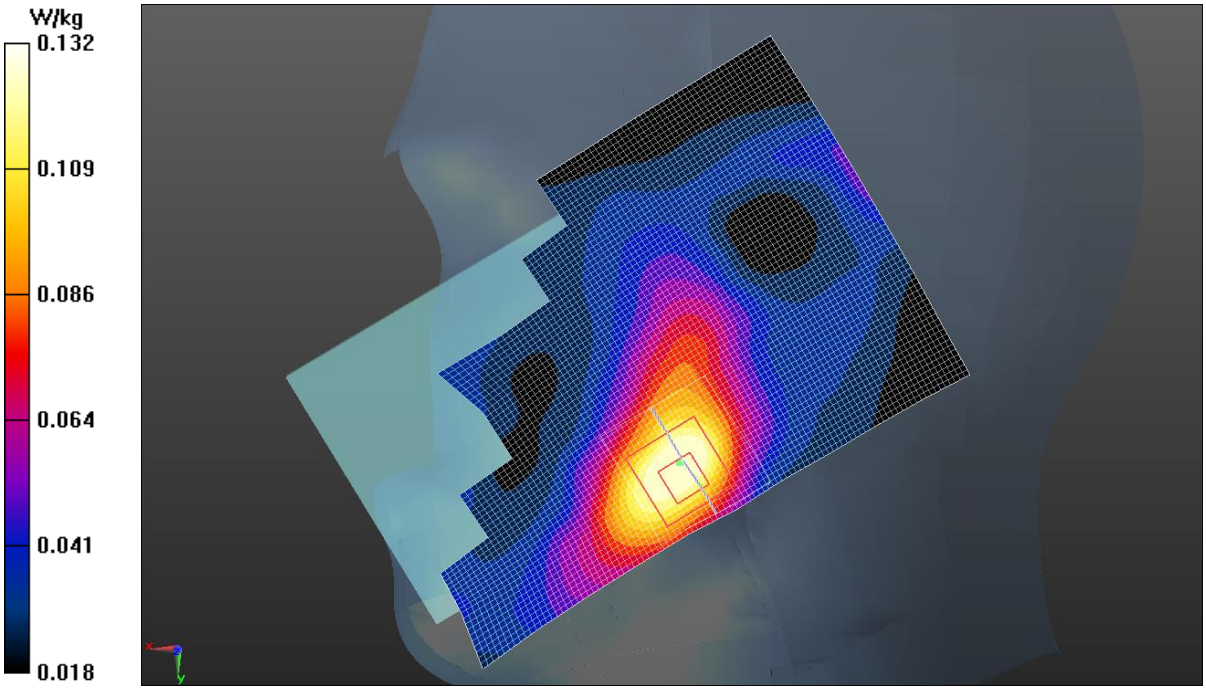


Fig.7 WCDMA 1900

WCDMA 1900 Body

Date: 2018-2-6
Electronics: DAE4 Sn786
Medium: Body 1900 MHz
Medium parameters used: f = 1880 MHz; σ = 1.542 S/m; εr = 52.992; ρ = 1000 kg/m^3
Ambient Temperature: 22.3^{o}C Liquid Temperature: 21.8^{o}C
Communication System: UID 0, WCDMA (0) Frequency: 1880 MHz Duty Cycle: 1:1
Probe: ES3DV3 - SN3151 ConvF (4.89, 4.89, 4.89);

Rear Side Mid/Area Scan (61x101x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.697 W/kg

Rear Side Mid/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 5.508 V/m; Power Drift = 0.16 dB
Peak SAR (extrapolated) = 1.10 W/kg
SAR(1 g) = 0.472 W/kg; SAR(10 g) = 0.227 W/kg
Maximum value of SAR (measured) = 0.679 W/kg

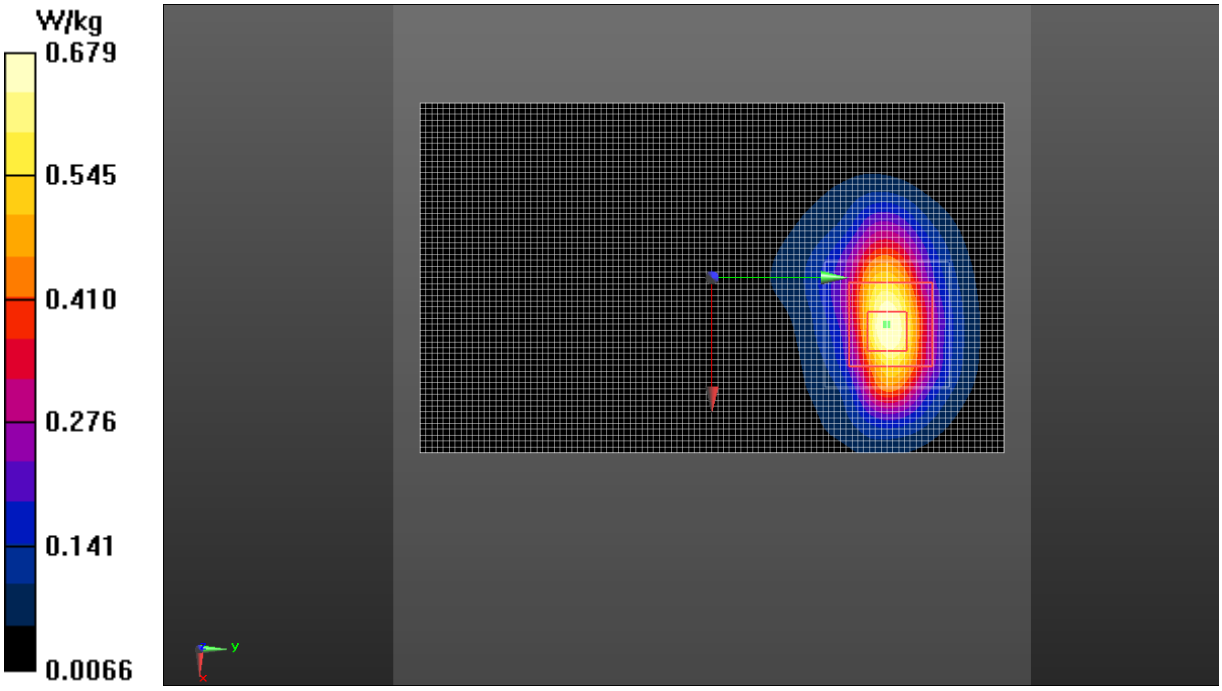


Fig.8 WCDMA 1900

LTE Band 5 Head

Date: 2018-1-10
Electronics: DAE4 Sn786
Medium: Head 835 MHz
Medium parameters used (interpolated): f = 836.5 MHz; σ = 0.917 S/m; ε_r = 40.932; ρ = 1000 kg/m^3
Ambient Temperature: 22.0^{o}C Liquid Temperature: 21.5^{o}C
Communication System: UID 0, LTE_FDD (0) Frequency: 836.5 MHz Duty Cycle: 1:1
Probe: ES3DV3 - SN3151 ConvF (6.47, 6.47, 6.47);

Right Tilt Mid 1RB_Mid/Area Scan (61x101x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.136 W/kg

Right Tilt Mid 1RB_Mid/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 10.58 V/m; Power Drift = 0.09 dB
Peak SAR (extrapolated) = 0.191 W/kg
SAR(1 g) = 0.111 W/kg; SAR(10 g) = 0.071 W/kg
Maximum value of SAR (measured) = 0.117 W/kg

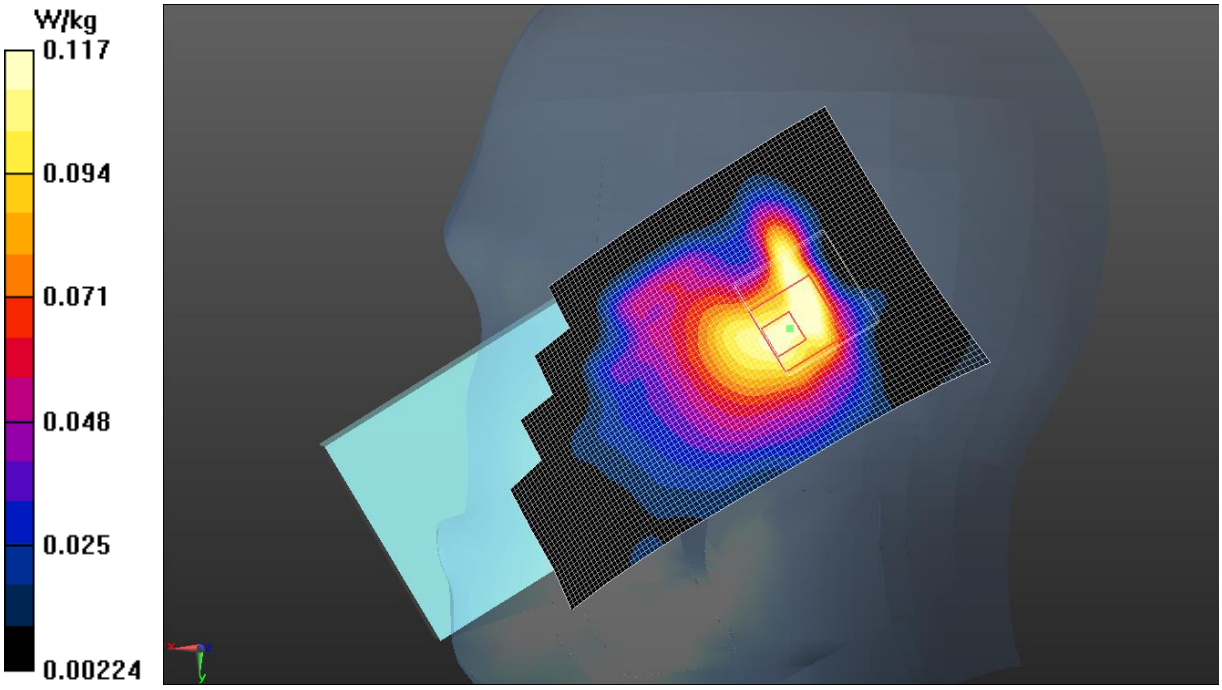


Fig.9 LTE Band 5

LTE Band 5 Body

Date: 2018-1-12
Electronics: DAE4 Sn786
Medium: Body 835 MHz
Medium parameters used (interpolated): f = 836.5 MHz; σ = 0.986 S/m; εr = 53.869; ρ = 1000 kg/m^3
Ambient Temperature: 22.4^{o}C Liquid Temperature: 21.9^{o}C
Communication System: UID 0, LTE_FDD (0) Frequency: 836.5 MHz Duty Cycle: 1:1
Probe: ES3DV3 - SN3151 ConvF (6.38, 6.38, 6.38);

Rear Side Mid 1RB_Mid /Area Scan (61x101x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.237 W/kg

Rear Side Mid 1RB_Mid /Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 10.39 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 0.297 W/kg
SAR(1 g) = 0.175 W/kg; SAR(10 g) = 0.104 W/kg
Maximum value of SAR (measured) = 0.246 W/kg

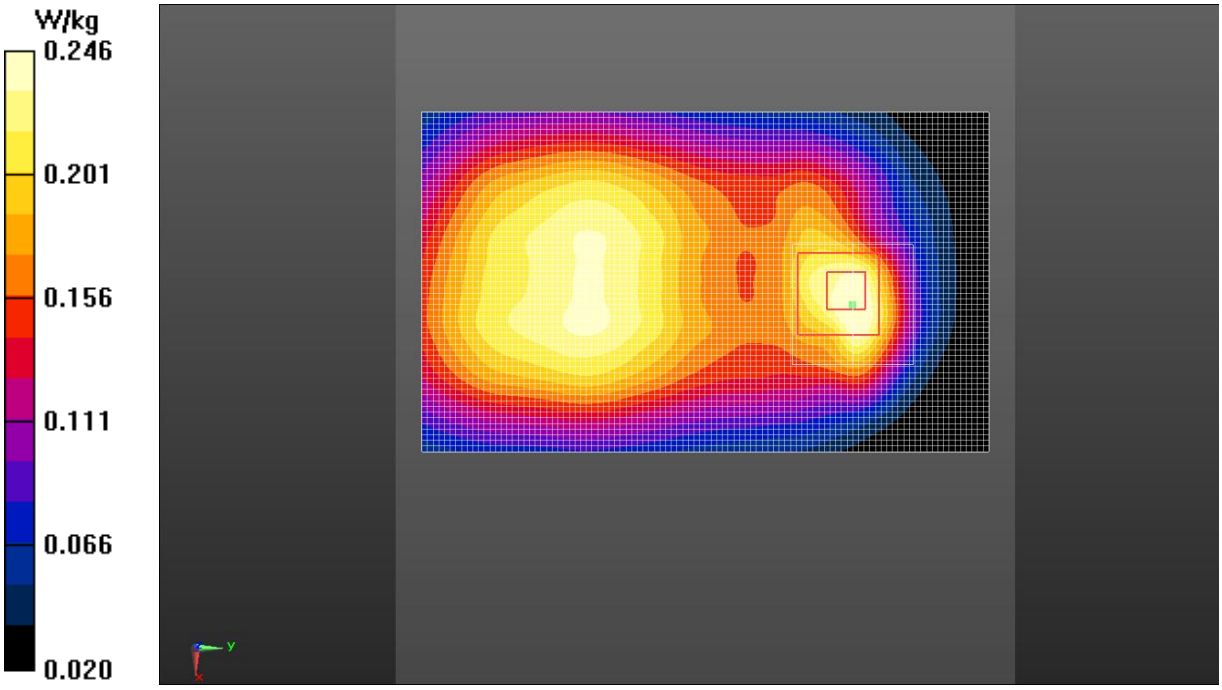


Fig.10 LTE Band 5

LTE Band 7 Head

Date: 2018-1-24
Electronics: DAE4 Sn786
Medium: Head 2550 MHz
Medium parameters used (interpolated): f = 2535 MHz; σ = 1.913 S/m; εr = 38.417; ρ = 1000 kg/m^3
Ambient Temperature: 22.3^{o}C Liquid Temperature: 21.8^{o}C
Communication System: UID 0, LTE_FDD (0) Frequency: 2535 MHz Duty Cycle: 1:1
Probe: ES3DV3 - SN3151 ConvF (4.53, 4.53, 4.53);

Left Cheek Mid 1RB_Mid/Area Scan (61x101x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.260 W/kg

Left Cheek Mid 1RB_Mid/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 1.838 V/m; Power Drift = 0.09 dB
Peak SAR (extrapolated) = 0.480 W/kg
SAR(1 g) = 0.178 W/kg; SAR(10 g) = 0.073 W/kg
Maximum value of SAR (measured) = 0.180 W/kg

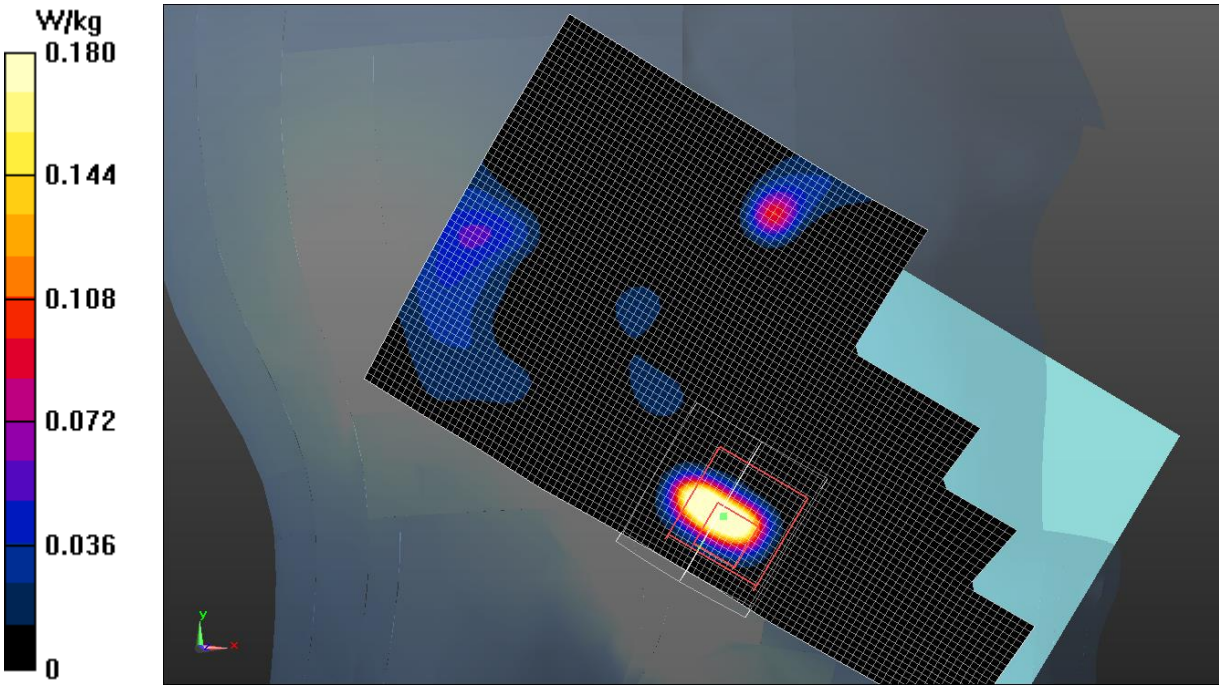


Fig.11 LTE Band 7

LTE Band 7 Body

Date: 2018-1-25

Electronics: DAE4 Sn786

Medium: Body 2550 MHz

Medium parameters used (interpolated): f = 2535 MHz; σ = 2.037 S/m; εr = 53.265; ρ = 1000 kg/m^3

Ambient Temperature: 22.7°C Liquid Temperature: 22.2°C

Communication System: UID 0, 4G_LTE_FDD (0) Frequency: 2535 MHz Duty Cycle: 1:1

Probe: ES3DV3 - SN3151 ConvF (4.24, 4.24, 4.24);

Rear Side Mid 50RB_Mid/Area Scan (61x101x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 0.331 W/kg

Rear Side Mid 50RB_Mid/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 4.958 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 0.477 W/kg

SAR(1 g) = 0.268 W/kg; SAR(10 g) = 0.140 W/kg

Maximum value of SAR (measured) = 0.286 W/kg

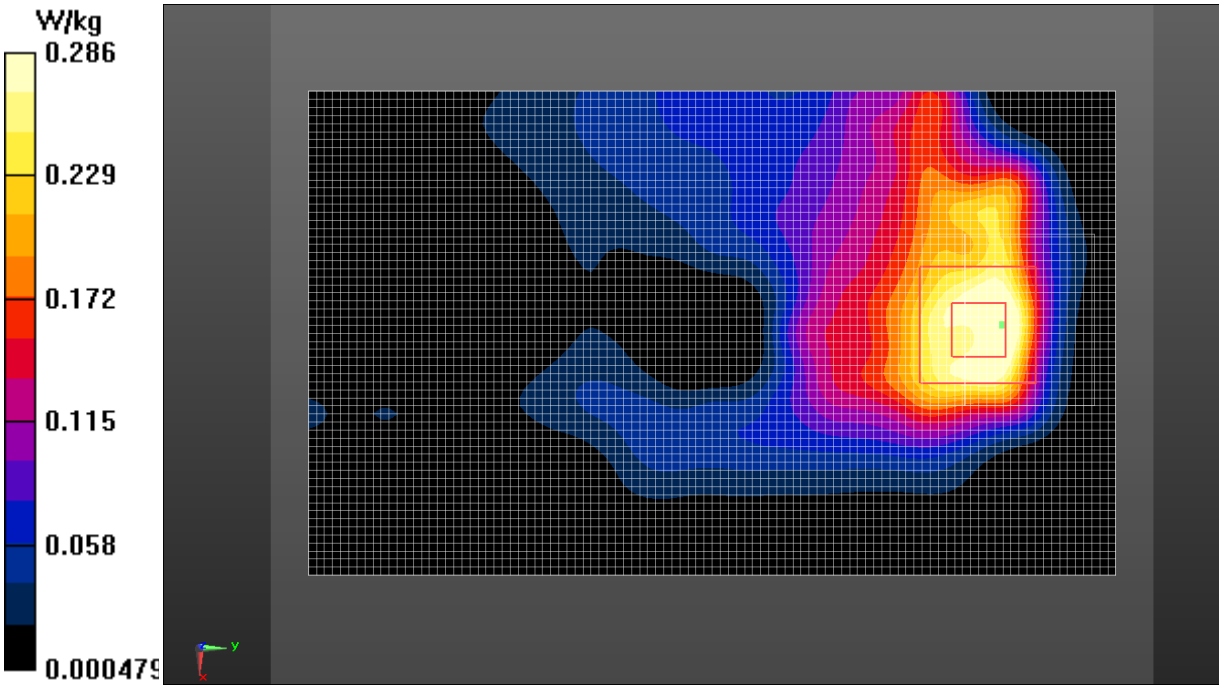


Fig.12 LTE Band 7

Wi-Fi 2.4G Head

Date: 2018-2-4
Electronics: DAE4 Sn786
Medium: Head 2450 MHz
Medium parameters used: f = 2412 MHz; σ = 1.811 S/m; εr = 39.628; ρ = 1000 kg/m^3
Ambient Temperature: 22.2^{o}C Liquid Temperature: 21.7^{o}C
Communication System: UID 0, WiFi (0) Frequency: 2412 MHz Duty Cycle: 1:1
Probe: ES3DV3 - SN3151 ConvF (4.57, 4.57, 4.57);

Left Cheek Low /Area Scan (61x101x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.410 W/kg

Left Cheek Low /Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 6.526 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 0.765 W/kg
SAR(1 g) = 0.407 W/kg; SAR(10 g) = 0.205 W/kg
Maximum value of SAR (measured) = 0.478 W/kg

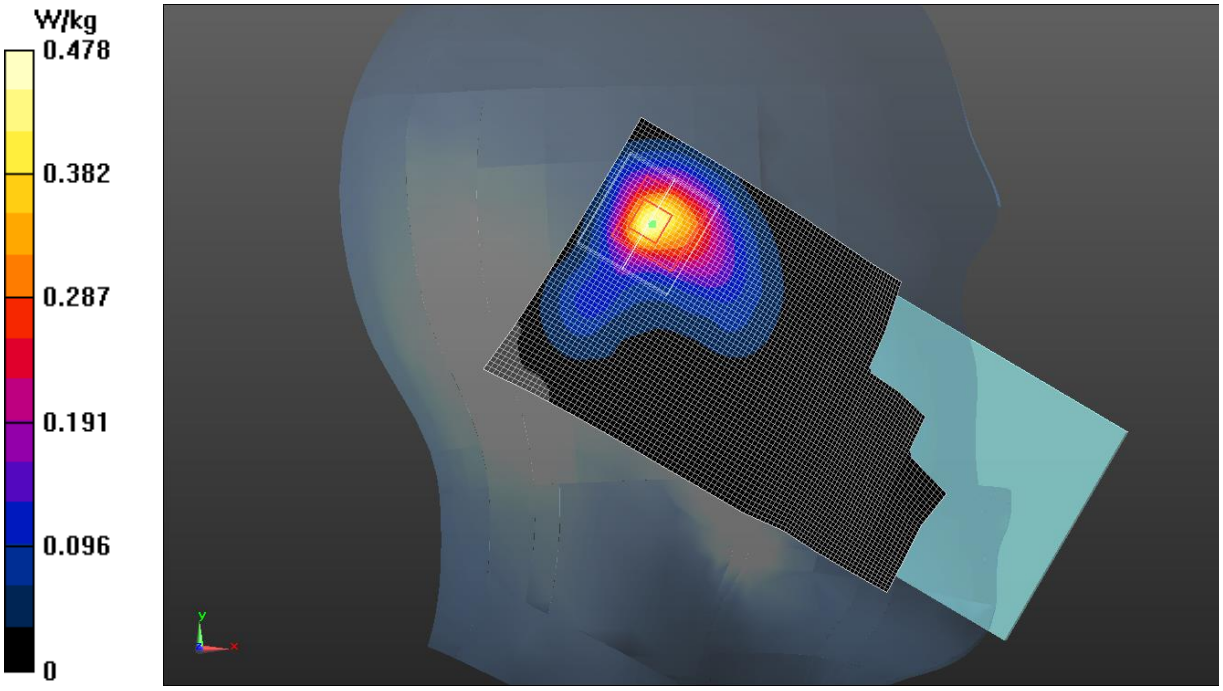


Fig.13 Wi-Fi 2.4G

Wi-Fi 2.4G Body

Date: 2018-2-4
Electronics: DAE4 Sn786
Medium: Body 2450 MHz
Medium parameters used: f = 2412 MHz; σ = 1.871 S/m; εr = 51.736; ρ = 1000 kg/m^3
Ambient Temperature: 22.3^{o}C Liquid Temperature: 21.8^{o}C
Communication System: UID 0, WiFi (0) Frequency: 2412 MHz Duty Cycle: 1:1
Probe: ES3DV3 - SN3151 ConvF (4.46, 4.46, 4.46);

Front side Low /Area Scan (111x61x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.117 W/kg

Front side Low /Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 3.353 V/m; Power Drift = -0.05 dB
Peak SAR (extrapolated) = 0.172 W/kg
SAR(1 g) = 0.116 W/kg; SAR(10 g) = 0.065 W/kg
Maximum value of SAR (measured) = 0.155 W/kg

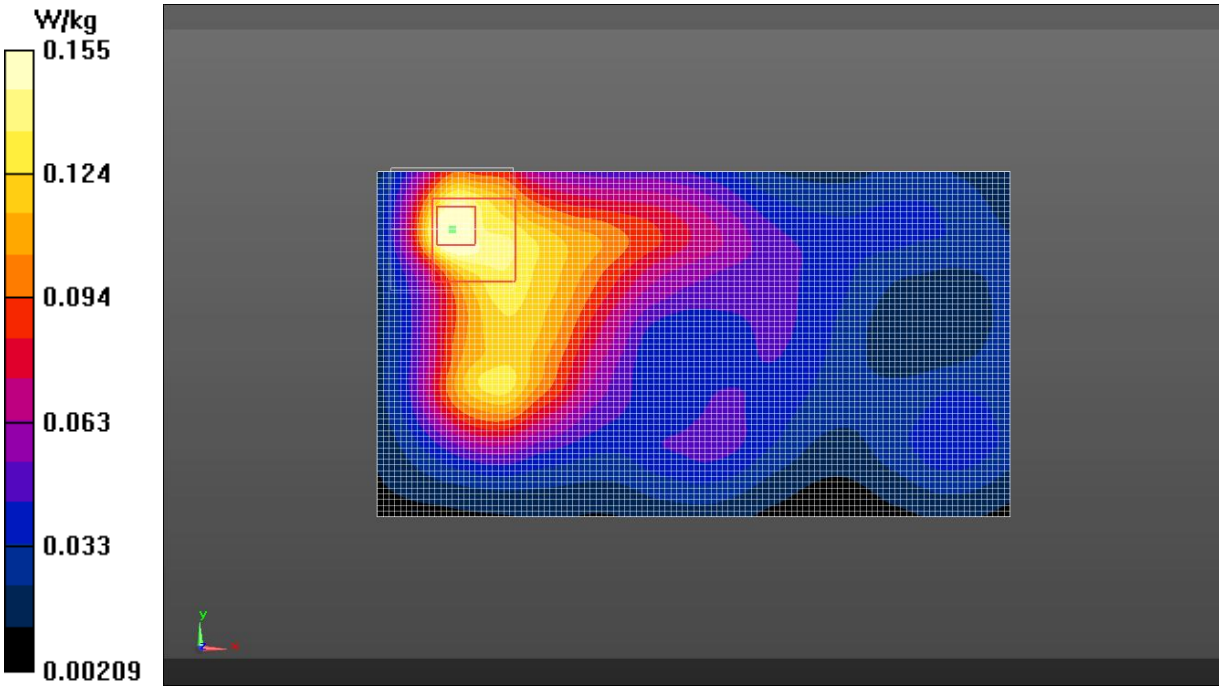


Fig.14 Wi-Fi 2.4G

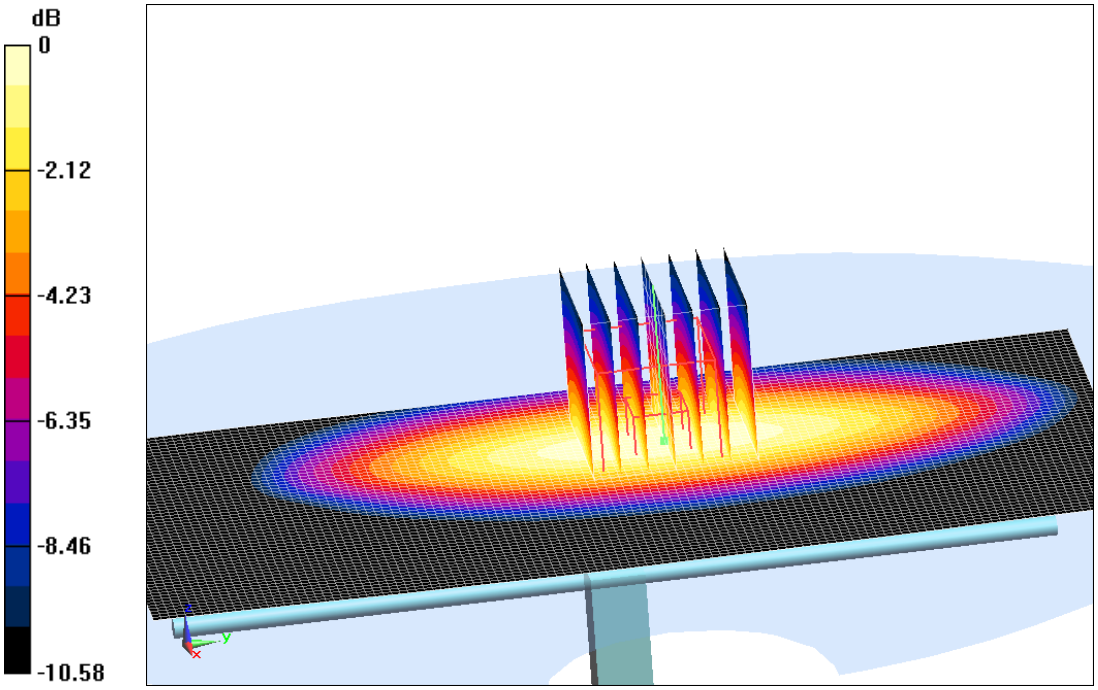
ANNEX B SystemVerification Results

835MHz

Date: 2018-1-10
Electronics: DAE4 Sn786
Medium: Head 835 MHz
Medium parameters used: f = 835 MHz; σ = 0.916 S/m; εr = 40.953; ρ = 1000 kg/m^3
Ambient Temperature: 22.9°C Liquid Temperature: 22.5°C
Communication System: CW Frequency: 835 MHz Duty Cycle: 1:1
Probe: ES3DV3 - SN3151 ConvF (6.47, 6.47, 6.47);

System Validation/Area Scan (81x161x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Reference Value = 53.964 V/m; Power Drift = 0.07 dB
Fast SAR: SAR(1 g) = 2.20 W/kg; SAR(10 g) = 1.45 W/kg
Maximum value of SAR (interpolated) = 2.48 W/kg

System Validation/Zoom Scan (7x7x7)/Cube0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 53.964 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 3.45 W/kg
SAR(1 g) = 2.22 W/kg; SAR(10 g) = 1.48 W/kg
Maximum value of SAR (measured) = 2.51 W/kg



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

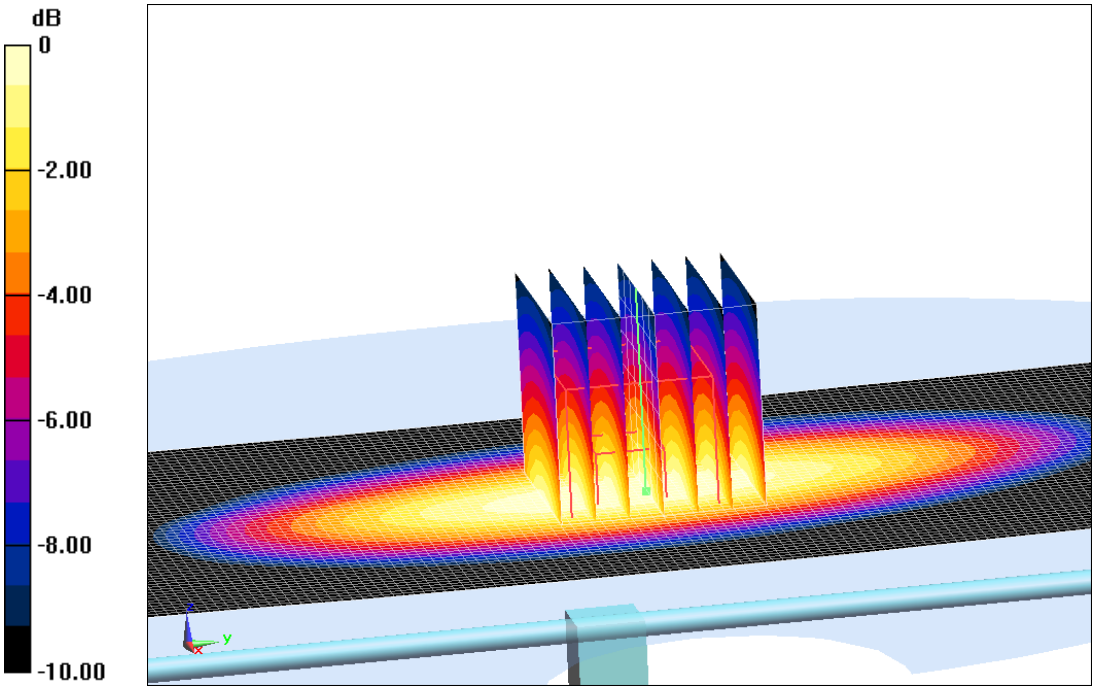
Fig.B.1. Validation 835MHz 250mW

835MHz

Date: 2018-1-12
Electronics: DAE4 Sn786
Medium: Body 835 MHz
Medium parameters used: f = 835 MHz; σ = 0.985 S/m; ε_r = 53.881; ρ = 1000 kg/m^3
Ambient Temperature: 22.9°C Liquid Temperature: 22.5°C
Communication System: CW Frequency: 835 MHz Duty Cycle: 1:1
Probe: ES3DV3 - SN3151 ConvF (6.38, 6.38, 6.38);

System Validation/Area Scan (81x171x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Reference Value = 53.244 V/m; Power Drift = 0.05 dB
Fast SAR: SAR(1 g) = 2.25 W/kg; SAR(10 g) = 1.51 W/kg
Maximum value of SAR (interpolated) = 2.52 W/kg

System Validation/Zoom Scan (7x7x7)/Cube0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 53.244 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 3.56 W/kg
SAR(1 g) = 2.29 W/kg; SAR(10 g) = 1.54 W/kg
Maximum value of SAR (measured) = 2.58 W/kg



0 dB = 2.58 W/kg = 4.12 dBW/kg

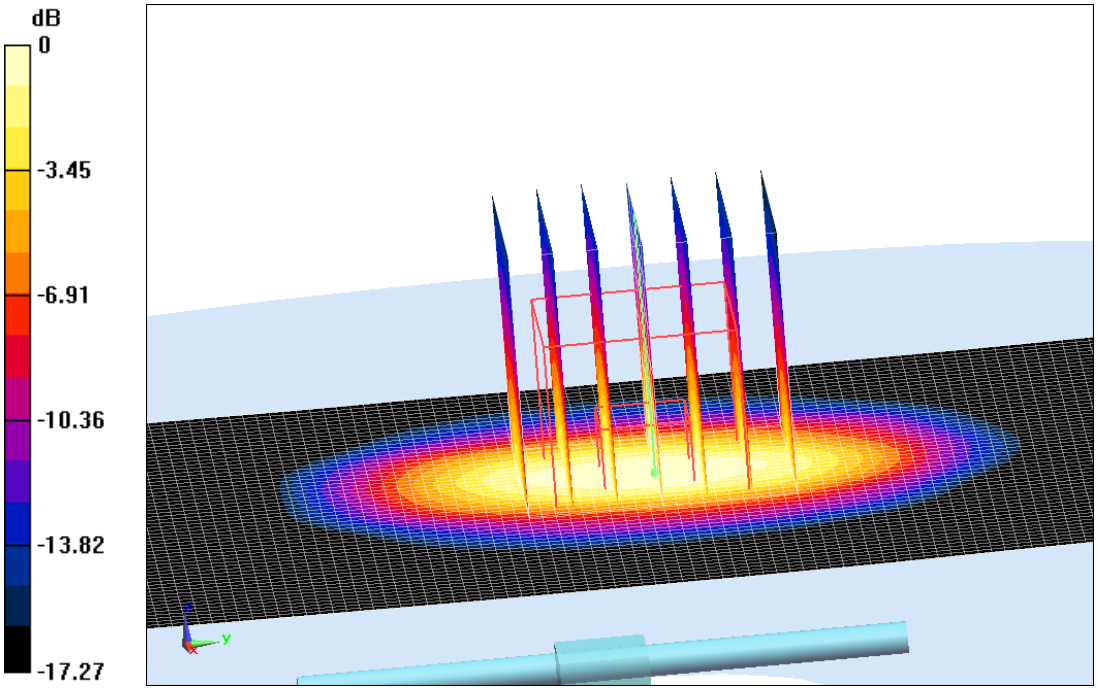
Fig.B.2. Validation 835MHz 250mW

1900MHz

Date: 2018-2-6
Electronics: DAE4 Sn786
Medium: Head 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.416 S/m; ε_r = 38.907; ρ = 1000 kg/m^3
Ambient Temperature: 22.9°C Liquid Temperature: 22.5°C
Communication System: CW Frequency: 1900 MHz Duty Cycle: 1:1
Probe: ES3DV3 - SN3151 ConvF (5.09, 5.09, 5.09);

System Validation/Area Scan (81x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Reference Value = 92.685 V/m; Power Drift = 0.11 dB
Fast SAR: SAR(1 g) = 10.2 W/kg; SAR(10 g) = 5.27 W/kg
Maximum value of SAR (interpolated) = 12.5 W/kg

System Validation/Zoom Scan (7x7x7)/Cube0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 92.685 V/m; Power Drift = 0.11 dB
Peak SAR (extrapolated) = 18.3 W/kg
SAR(1 g) = 10.4 W/kg; SAR(10 g) = 5.31 W/kg
Maximum value of SAR (measured) = 13.2 W/kg



0 dB = 13.2 W/kg = 11.21 dBW/kg

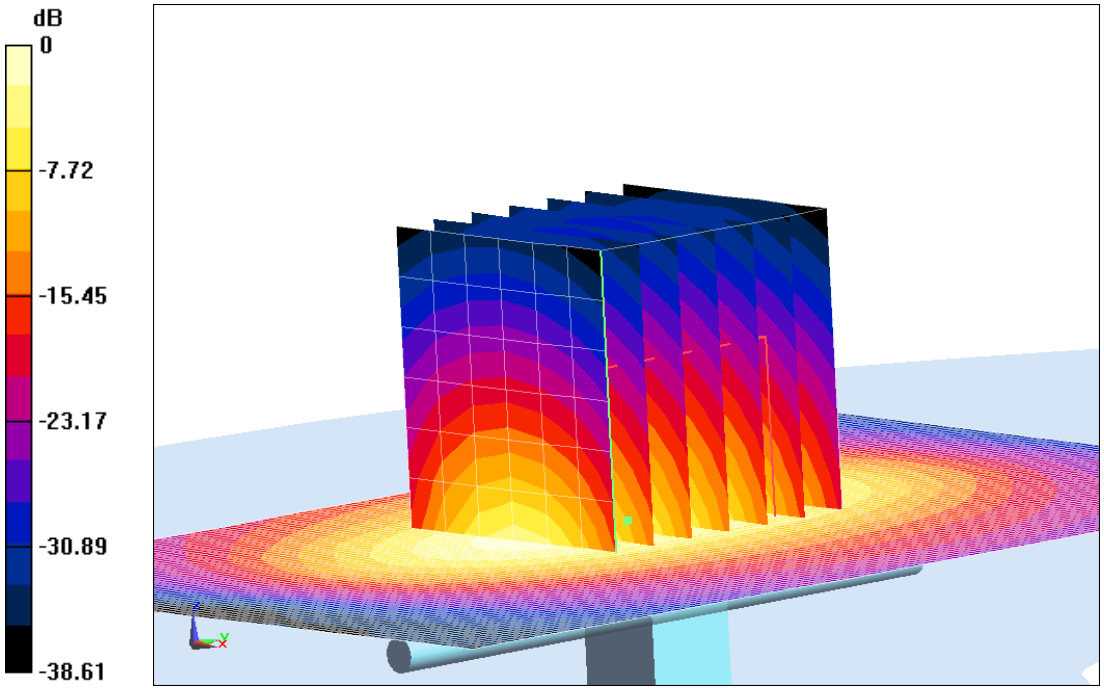
Fig.B.3. Validation 1900MHz 250mW

1900MHz

Date: 2018-2-6
Electronics: DAE4 Sn786
Medium: Body 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.559 S/m; ε_r = 52.95; ρ = 1000 kg/m^3
Ambient Temperature: 22.9°C Liquid Temperature: 22.5°C
Communication System: CW Frequency: 1900 MHz Duty Cycle: 1:1
Probe: ES3DV3 - SN3151 ConvF (4.89, 4.89, 4.89);

System validation/Area Scan (81x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Reference Value = 65.802 V/m; Power Drift = -0.06 dB
Fast SAR: SAR(1 g) = 10.2 W/kg; SAR(10 g) = 5.30 W/kg
Maximum value of SAR (interpolated) = 12.7 W/kg

System validation /Zoom Scan (7x7x7)/Cube0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 65.802 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 18.3 W/kg
SAR(1 g) = 9.95 W/kg; SAR(10 g) = 5.24 W/kg
Maximum value of SAR (measured) = 12.0 W/kg



0 dB = 12.0 W/kg = 10.79 dBW/kg

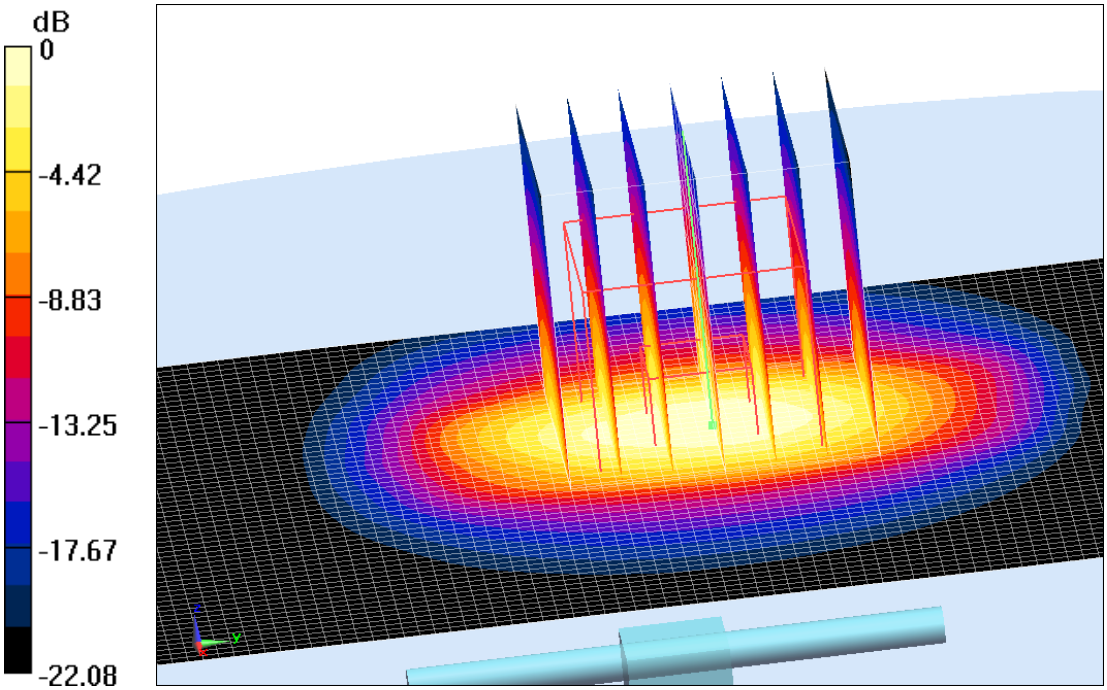
Fig.B.4. Validation 1900MHz 250mW

2450MHz

Date: 2018-2-4
Electronics: DAE4 Sn786
Medium: Head 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 1.859 S/m; ε_r = 39.50; ρ = 1000 kg/m^3
Ambient Temperature: 22.0°C Liquid Temperature: 21.6°C
Communication System: CW Frequency: 2450 MHz Duty Cycle: 1:1
Probe: ES3DV3 - SN3151 ConvF (4.57, 4.57, 4.57);

System Validation/Area Scan (61x81x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Reference Value = 86.467 V/m; Power Drift = 0.03 dB
Fast SAR: SAR(1 g) = 13.5 W/kg; SAR(10 g) = 6.12 W/kg
Maximum value of SAR (interpolated) = 16.1 W/kg

System Validation/Zoom Scan (7x7x7)/Cube0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 86.467 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 23.4 W/kg
SAR(1 g) = 13.6 W/kg; SAR(10 g) = 6.15 W/kg
Maximum value of SAR (measured) = 16.7 W/kg



0 dB = 16.7 W/kg = 12.23 dBW/kg

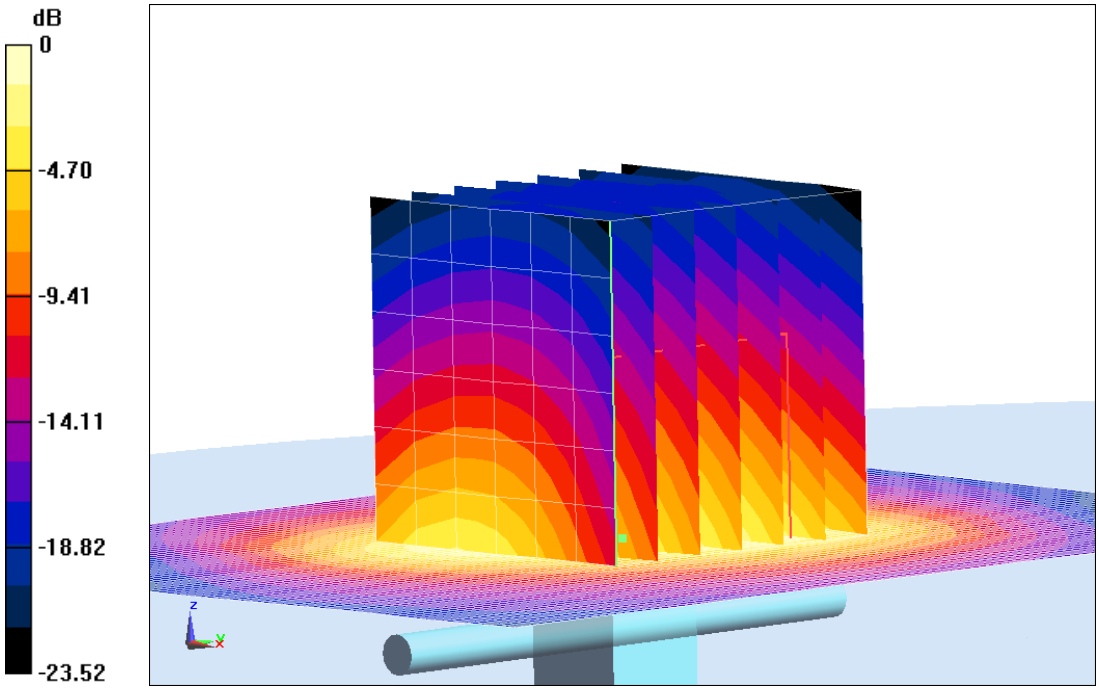
Fig.B.5. Validation 2450MHz 250mW

2450MHz

Date: 2018-2-4
Electronics: DAE4 Sn786
Medium: Body 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 1.912 S/m; ε_r = 51.648; ρ = 1000 kg/m^3
Ambient Temperature: 22.0°C Liquid Temperature: 21.6°C
Communication System: CW Frequency: 2450 MHz Duty Cycle: 1:1
Probe: ES3DV3 - SN3151 ConvF (4.46, 4.46, 4.46);

System Validation/Area Scan (81x101x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Reference Value = 85.514 V/m; Power Drift = -0.08 dB
Fast SAR: SAR(1 g) = 13.1 W/kg; SAR(10 g) = 6.10 W/kg
Maximum value of SAR (interpolated) = 15.2 W/kg

System Validation/Zoom Scan (7x7x7)/Cube0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 85.514 V/m; Power Drift = -0.08 dB
Peak SAR (extrapolated) = 29.1 W/kg
SAR(1 g) = 12.7 W/kg; SAR(10 g) = 6.01 W/kg
Maximum value of SAR (measured) = 14.4 W/kg



0 dB = 14.4 W/kg = 11.58 dB W/kg

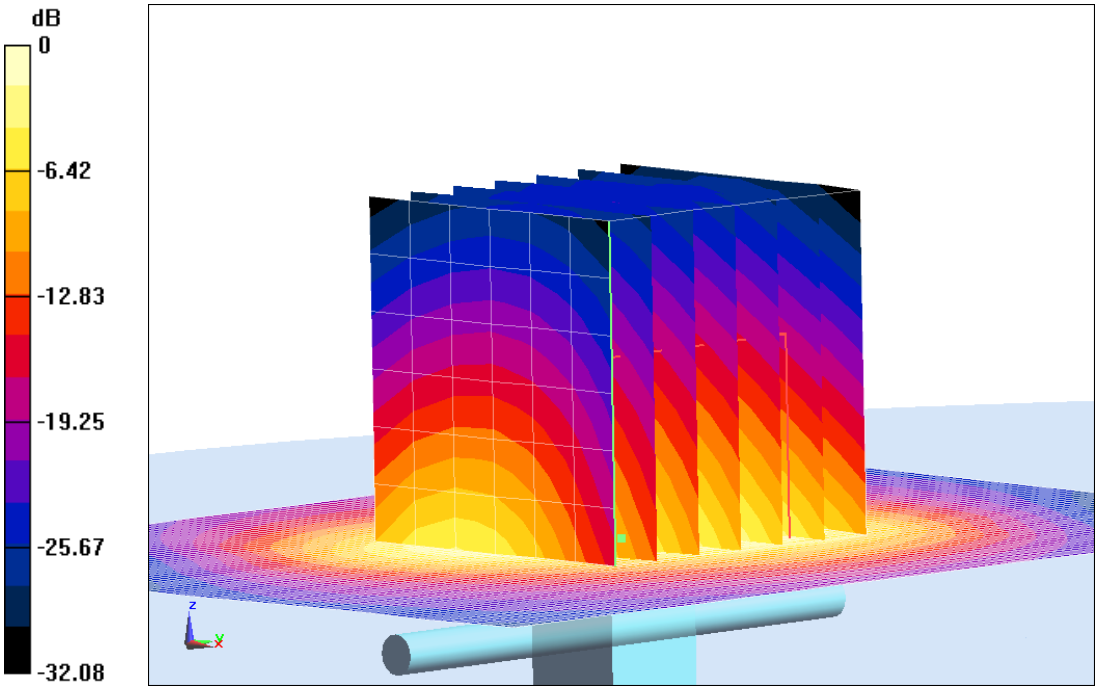
Fig.B.6. Validation 2450MHz 250mW

2550MHz

Date: 2018-1-24
Electronics: DAE4 Sn786
Medium: Head 2550 MHz
Medium parameters used: f = 2550 MHz; σ = 1.931 S/m; ε_r = 38.362; ρ = 1000 kg/m^3
Ambient Temperature: 22.0°C Liquid Temperature: 21.6°C
Communication System: CW Frequency: 2550 MHz Duty Cycle: 1:1
Probe: ES3DV3 - SN3151 ConvF (4.53, 4.53, 4.53);

System Validation/Area Scan (81x101x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Reference Value = 90.025 V/m; Power Drift = -0.10 dB
Fast SAR: SAR(1 g) = 14.2 W/kg; SAR(10 g) = 6.55 W/kg
Maximum value of SAR (interpolated) = 15.3 W/kg

System Validation/Zoom Scan (7x7x7)/Cube0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 90.025 V/m; Power Drift = -0.10 dB
Peak SAR (extrapolated) = 27.4 W/kg
SAR(1 g) = 13.9 W/kg; SAR(10 g) = 6.47 W/kg
Maximum value of SAR (measured) = 14.7 W/kg



0 dB = 14.7 W/kg = 11.67 dB W/kg

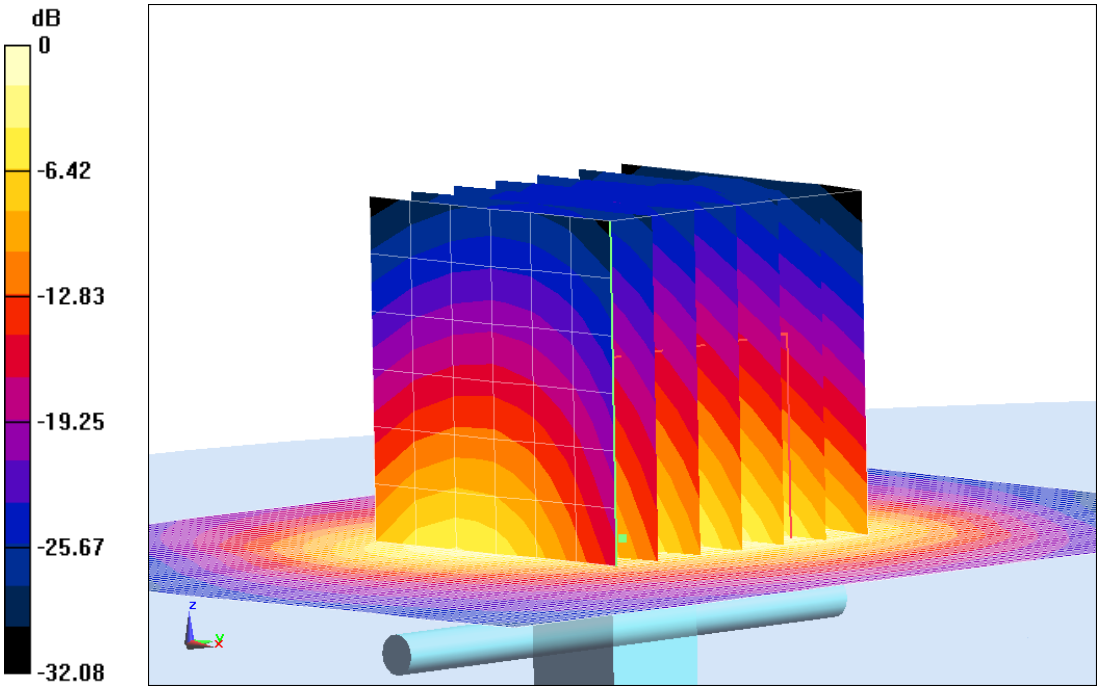
Fig.B.7. Validation 2550MHz 250mW

2550MHz

Date: 2018-1-25
Electronics: DAE4 Sn786
Medium: Body 2550 MHz
Medium parameters used: f = 2550 MHz; σ = 2.055 S/m; ε_r = 53.209; ρ = 1000 kg/m^3
Ambient Temperature: 22.0°C Liquid Temperature: 21.6°C
Communication System: CW Frequency: 2550 MHz Duty Cycle: 1:1
Probe: ES3DV3 - SN3151 ConvF (4.24, 4.24, 4.24);

System Validation/Area Scan (81x101x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Reference Value = 88.122 V/m; Power Drift = 0.05 dB
Fast SAR: SAR(1 g) = 13.8 W/kg; SAR(10 g) = 6.28 W/kg
Maximum value of SAR (interpolated) = 14.9 W/kg

System Validation/Zoom Scan (7x7x7)/Cube0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 88.122 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 27.5 W/kg
SAR(1 g) = 14.1 W/kg; SAR(10 g) = 6.36 W/kg
Maximum value of SAR (measured) = 15.4 W/kg



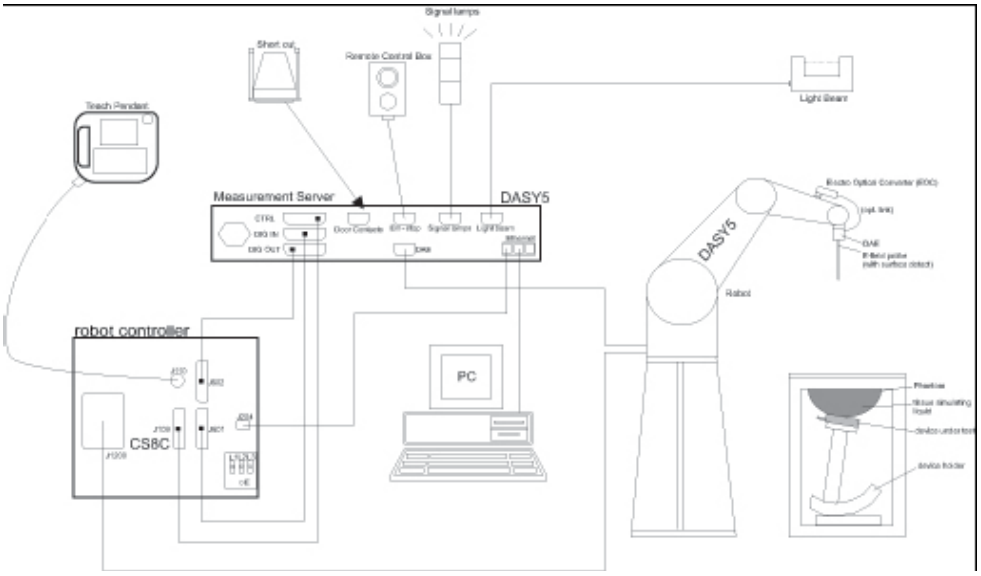
0 dB = 15.4 W/kg = 11.88 dB W/kg

Fig.B.8. Validation 2550MHz 250mW

ANNEX C SAR Measurement Setup

C.1 Measurement Set-up

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 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 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 DASY5 software reads the reflection durning a software approach and looks for the maximum using 2ndord 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 (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 5

C.4.3 Measurement Server

The Measurement server is based on a PC/104 CPU broad with CPU (DASY5: 400 MHz, Intel Celeron), chipdisk (DASY5:128MB), RAM (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.6 Server for DASY 5

C.4.4 Device Holder for Phantom

The SAR in the phantom is approximately inversely proportional to the square of the distance between the source and the liquid surface. For a source at 5mm distance, a positioning uncertainty of ±0.5mm would produce a SAR uncertainty of ±20%. Accurate device positioning is therefore crucial for accurate and repeatable measurements. The positions in which the devices must be measured are defined by the standards.

The DASY device holder is designed to cope with the different positions given in the standard. It has two scales for device rotation (with respect to the body axis) and device inclination (with respect to the line between the ear reference points). The rotation centers for both scales is the ear reference point (ERP). Thus the device needs no repositioning when changing the angles.

The DASY device holder is constructed of low-loss

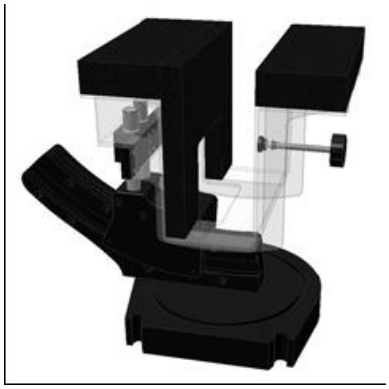
POM material having the following dielectric

parameters: relative permittivity ε=3 and loss tangent δ=0.02. The amount of dielectric material has been reduced in the closest vicinity of the device, since measurements have suggested that the influence of the clamp on the test results could thus be lowered.

<Laptop Extension Kit>

The extension is lightweight and made of POM, acrylic glass and foam. It fits easily on the upper part of the Mounting Device in place of the phone positioner. The extension is fully compatible with the Twin-SAM and ELI phantoms.

Picture C.7-1: Device Holder



Picture C.7-2: Laptop Extension Kit

C.4.5 Phantom

The SAM Twin Phantom V4.0 is constructed of a fiberglass shell integrated in a table. The shape of the shell is based on data from an anatomical study designed to

Represent the 90th percentile of the population. The phantom enables the dissymmetric evaluation of SAR for both left and right handed handset usage, as well as body-worn usage using the flat phantom region. Reference markings on the Phantom allow the complete setup of all predefined phantom positions and measurement grids by manually teaching three points in the robot. The shell phantom has a 2mm shell thickness (except the ear region where shell thickness increases to 6 mm).

Shell Thickness:	2 ± 0. 2 mm
Filling Volume:	Approx. 25 liters
Dimensions:	810 x l000 x 500 mm (H x L x W)
Available:	Special

Picture C.8: SAM Twin Phantom