

14 SAR Test Result

It is determined by user manual for the distance between the EUT and the phantom bottom. The distance is 10 mm and just applied to the condition of body worn accessory.

It is performed for all SAR measurements with area scan based 1-g SAR estimation (Fast SAR). A zoom scan measurement is added when the estimated 1-g SAR is the highest measured SAR in each exposure configuration, wireless mode and frequency band combination or more than 1.2W/kg.

The calculated SAR is obtained by the following formula:

$$\text{Reported SAR} = \text{Measured SAR} \times 10^{(P_{\text{Target}} - P_{\text{Measured}})/10}$$

Where P_{Target} is the power of manufacturing upper limit;
 P_{Measured} is the measured power in chapter 11.

Table 14.1: Duty Cycle

Mode	Duty Cycle
Speech for GSM850	1:8.3
Speech for GSM1900	1:8.3
GPRS&EGPRS for GSM850	1:2
GPRS&EGPRS for GSM1900	1:8.3
CDMA&WCDMA<E FDD	1:1
LTE TDD	1:1

14.1 Battery Check

Note:

B1: WT330 of Jiade Energy Technology (Zhuhai) Co., Ltd

B2: WT330 of Sunwoda Electronic Co.,Ltd

H1: HS-34 of New Leader Industry Co.,Ltd

We'll perform the head measurement in all bands with the primary battery and SIM card depending on the evaluation of multi-batteries and multi-SIM cards and retest on highest value point with other batteries and SIM cards. Then, repeat the measurement in the Body test.

Frequency		Mode/Band	Side	Position	BatteryType	1g SAR (W/kg)	PowerDrift
MHz	Channel						
1880	661	GSM1900	Left	Cheek	B1	0.07	0.2
1880	661	GSM1900	Left	Cheek	B2	0.06	-0.08

Note: According to the values in the above table, the battery B1 is the primary battery.

We'll perform the head measurements with this battery and retest on highest value point with others.

Frequency		Mode/Band	Position	BatteryType	1g SAR (W/kg)	PowerDrift
MHz	Channel					
836.5	20525	LTE B5	Front	B1	0.51	-0.03
836.5	20525	LTE B5	Front	B2	0.49	0.02

Note: According to the values in the above table, the battery B1 is the primary battery.

We'll perform the body measurements with this battery and retest on highest value point with others.

Frequency		Mode/Band	Position	Headset Type	1g SAR (W/kg)	PowerDrift
MHz	Channel					
826.4	4132	WCDMA850	Right Edge	SIM2	0.50	0.03
826.4	4132	WCDMA850	Right Edge	SIM1	0.44	0.05

Note: According to the values in the above table, the Headset SIM2 is the primary .

We'll perform the body measurements with this SIM2 and retest on highest value point with others.

14.2 SAR results for Fast SAR

We share the test results of I18Z62335-SEM02 and and retest on highest value point with configure1 and configure2.

Table 14.2-1: SAR Values (GSM 850 MHz Band - Head)

Ambient Temperature: 22.9 °C						Liquid Temperature: 22.5 °C					
Frequency		Side	Test Position	Figure No./Note	Conducted Power (dBm)	Max. tune-up Power (dBm)	Measured SAR(10g) (W/kg)	Reported SAR(10g) (W/kg)	Measured SAR(1g) (W/kg)	Reported SAR(1g) (W/kg)	Power Drift (dB)
Ch.	MHz										
190	836.6	Left	Cheek	/	33.50	35.00	0.174	0.25	0.218	0.31	-0.11
190	836.6	Left	Tilt	/	33.50	35.00	0.113	0.16	0.143	0.20	0.05
251	848.8	Right	Cheek	Fig.1	33.54	35.00	0.235	0.33	0.310	0.43	-0.13
190	836.6	Right	Cheek	/	33.50	35.00	0.200	0.28	0.266	0.38	0.07
128	824.2	Right	Cheek	/	33.45	35.00	0.195	0.28	0.255	0.36	0.08
190	836.6	Right	Tilt	/	33.50	35.00	0.117	0.17	0.147	0.21	-0.02
251	848.8	Right	Cheek	SIM1	33.54	35.00	0.228	0.32	0.300	0.42	0.11
251	848.8	Right	Cheek	B2	33.54	35.00	0.232	0.32	0.304	0.43	-0.08
251	848.8	Right	Cheek	configure1	33.54	35.00	0.193	0.27	0.253	0.35	-0.06
251	848.8	Right	Cheek	configure2	33.54	35.00	0.142	0.20	0.187	0.26	0.08

Table 14.2-2: SAR Values (GSM 850 MHz Band - Body)

Ambient Temperature: 22.9 °C						Liquid Temperature: 22.5 °C					
Frequency		Mode (number of timeslots)	Test Position	Figure No./ Note	Conducted Power (dBm)	Max. tune-up Power (dBm)	Measured SAR(10g) (W/kg)	Reported SAR(10g) (W/kg)	Measured SAR(1g) (W/kg)	Reported SAR(1g) (W/kg)	Power Drift (dB)
Ch.	MHz										
190	836.6	GPRS (4)	Front	/	30.77	32.00	0.137	0.18	0.226	0.30	0.11
190	836.6	GPRS (4)	Rear	/	30.77	32.00	0.122	0.16	0.200	0.26	-0.02
190	836.6	GPRS (4)	Left	/	30.77	32.00	0.096	0.13	0.140	0.19	-0.07
251	848.8	GPRS (4)	Right	/	30.71	32.00	0.225	0.30	0.340	0.46	-0.03
190	836.6	GPRS (4)	Right	/	30.77	32.00	0.207	0.27	0.302	0.40	-0.06
128	824.2	GPRS (4)	Right	Fig.2	30.75	32.00	0.263	0.35	0.387	0.52	0.03
190	836.6	GPRS (4)	Bottom	/	30.77	32.00	0.111	0.15	0.224	0.30	0.11
128	824.2	EGPRS (4)	Rear	/	30.75	32.00	0.227	0.30	0.343	0.46	-0.15
128	824.2	GPRS (4)	Rear	SIM1	30.75	32.00	0.249	0.33	0.358	0.48	-0.03
128	824.2	GPRS (4)	Rear	B2	30.75	32.00	0.251	0.33	0.374	0.50	-0.15
128	824.2	GPRS (4)	Rear	configure1	30.75	32.00	0.188	0.25	0.274	0.37	0.01
128	824.2	GPRS (4)	Rear	configure2	30.75	32.00	0.133	0.18	0.192	0.26	0.14

Note: The distance between the EUT and the phantom bottom is 10mm.

Table 14.2-3: SAR Values (GSM 1900 MHz Band - Head)

Frequency		Ambient Temperature: 22.9 °C					Liquid Temperature: 22.5 °C				
Ch.	MHz	Side	Test Position	Figure No./ Note	Conducted Power (dBm)	Max. tune-up Power (dBm)	Measured SAR(10g) (W/kg)	Reported SAR(10g) (W/kg)	Measured SAR(1g) (W/kg)	Reported SAR(1g) (W/kg)	Power Drift (dB)
810	1909.8	Left	Cheek	/	31.13	32.00	0.028	0.03	0.048	0.06	-0.11
661	1880	Left	Cheek	Fig.3	31.05	32.00	0.032	0.04	0.058	0.07	0.2
512	1850.2	Left	Cheek	/	30.87	32.00	0.029	0.04	0.049	0.06	0.06
661	1880	Left	Tilt	/	31.05	32.00	<0.01	<0.01	<0.01	<0.01	-0.15
661	1880	Right	Cheek	/	31.05	32.00	0.028	0.03	0.047	0.06	-0.06
661	1880	Right	Tilt	/	31.05	32.00	<0.01	<0.01	<0.01	<0.01	-0.04
661	1880	Left	Cheek	SIM1	31.05	32.00	0.025	0.03	0.043	0.05	-0.02
661	1880	Left	Cheek	B2	31.05	32.00	0.028	0.03	0.048	0.06	-0.08
661	1880	Left	Cheek	configure1	31.05	32.00	0.024	0.03	0.042	0.05	0.04
661	1880	Left	Cheek	configure2	31.05	32.00	0.019	0.02	0.035	0.04	-0.15

Table 14.2-4: SAR Values (GSM 1900 MHz Band - Body)

Frequency		Ambient Temperature: 22.9 °C					Liquid Temperature: 22.5 °C				
Ch.	MHz	Mode (number of timeslots)	Test Position	Figure No./ Note	Conducted Power (dBm)	Max. tune-up Power (dBm)	Measured SAR(10g) (W/kg)	Reported SAR(10g) (W/kg)	Measured SAR(1g) (W/kg)	Reported SAR(1g) (W/kg)	Power Drift (dB)
661	1880	GPRS (1)	Front	/	31.09	32.00	0.208	0.26	0.376	0.46	-0.13
661	1880	GPRS (1)	Rear	15mm	31.09	32.00	0.147	0.18	0.244	0.30	-0.14
661	1880	GPRS (1)	Left	/	31.09	32.00	0.069	0.09	0.142	0.18	-0.06
661	1880	GPRS (1)	Right	/	31.09	32.00	0.027	0.03	0.043	0.05	-0.03
661	1880	GPRS (1)	Bottom	15mm	31.09	32.00	0.193	0.24	0.332	0.41	-0.06
661	1880	GPRS (1)	Rear	/	30.76	32.00	0.307	0.41	0.531	0.71	0.07
810	1909.8	GPRS (1)	Bottom	/	30.78	32.00	0.381	0.50	0.692	0.92	-0.02
661	1880	GPRS (1)	Bottom	/	30.76	32.00	0.399	0.53	0.732	0.97	-0.09
512	1850.2	GPRS (1)	Bottom	Fig.4	30.68	32.00	0.438	0.59	0.795	1.08	-0.02
512	1850.2	EGPRS (1)	Bottom	/	30.68	32.00	0.423	0.57	0.779	1.06	-0.01
512	1850.2	GPRS (1)	Bottom	SIM1	30.68	32.00	0.417	0.57	0.768	1.04	-0.08
512	1850.2	GPRS (1)	Bottom	B2	30.68	32.00	0.430	0.58	0.788	1.07	-0.1
512	1850.2	GPRS (1)	Bottom	configure1	30.68	32.00	0.426	0.58	0.768	1.04	0.14
512	1850.2	GPRS (1)	Bottom	configure2	30.68	32.00	0.298	0.40	0.550	0.75	0.1

Note1: The distance between the EUT and the phantom bottom is 10mm.

Table 14.2-5: SAR Values (WCDMA 850 MHz Band - Head)

Frequency		Side	Test Position	Figure No./Note	Conducted Power (dBm)	Max. tune-up Power (dBm)	Measured SAR(10g) (W/kg)	Reported SAR(10g) (W/kg)	Measured SAR(1g) (W/kg)	Reported SAR(1g) (W/kg)	Power Drift (dB)
Ch.	MHz										
Ambient Temperature: 22.9 °C Liquid Temperature: 22.5 °C											
4182	836.4	Left	Cheek	/	24.92	25.00	0.231	0.24	0.302	0.31	0.07
4182	836.4	Left	Tilt	/	24.92	25.00	0.157	0.16	0.203	0.21	0.07
4233	846.6	Right	Cheek	Fig.5	24.87	25.00	0.305	0.31	0.401	0.41	0.01
4182	836.4	Right	Cheek	/	24.92	25.00	0.263	0.27	0.344	0.35	-0.14
4132	826.4	Right	Cheek	/	24.95	25.00	0.212	0.21	0.278	0.28	-0.14
4182	836.4	Right	Tilt	/	24.92	25.00	0.218	0.22	0.239	0.24	0.1
4233	846.6	Right	Cheek	SIM1	24.87	25.00	0.297	0.31	0.380	0.39	0.04
4233	846.6	Right	Cheek	B2	24.87	25.00	0.278	0.29	0.362	0.37	-0.11
4233	846.6	Right	Cheek	configure1	24.87	25.00	0.300	0.31	0.395	0.41	-0.03
4233	846.6	Right	Cheek	configure2	24.87	25.00	0.302	0.31	0.397	0.41	-0.13

Table 14.2-6: SAR Values (WCDMA 850 MHz Band - Body)

Frequency		Test Position	Figure No./Note	Conducted Power (dBm)	Max. tune-up Power (dBm)	Measured SAR(10g) (W/kg)	Reported SAR(10g) (W/kg)	Measured SAR(1g) (W/kg)	Reported SAR(1g) (W/kg)	Power Drift (dB)
Ch.	MHz									
Ambient Temperature: 22.9 °C Liquid Temperature: 22.5 °C										
4182	836.4	Front	/	24.92	25.00	0.201	0.21	0.351	0.36	0.14
4182	836.4	Rear	/	24.92	25.00	0.207	0.21	0.349	0.36	0.13
4182	836.4	Left	/	24.92	25.00	0.204	0.21	0.303	0.31	-0.14
4233	846.6	Right	/	24.87	25.00	0.318	0.33	0.469	0.48	0.12
4182	836.4	Right	/	24.92	25.00	0.286	0.29	0.425	0.43	-0.06
4132	826.4	Right	Fig.6	24.95	25.00	0.334	0.34	0.491	0.50	0.03
4182	836.4	Bottom	/	24.92	25.00	0.130	0.13	0.251	0.26	0.11
4132	826.4	Right	SIM1	24.95	25.00	0.280	0.28	0.434	0.44	0.05
4132	826.4	Right	B2	24.95	25.00	0.295	0.30	0.456	0.46	-0.05
4132	826.4	Right	configure1	24.95	25.00	0.292	0.29	0.440	0.45	0.14
4132	826.4	Right	configure2	24.95	25.00	0.260	0.26	0.389	0.39	-0.09

Note: The distance between the EUT and the phantom bottom is 10mm.

Table 14.2-7: SAR Values (LTE Band5 - Head)

Ambient Temperature: 22.9°C						Liquid Temperature: 22.5°C						
Frequency		Mode	Side	Test Position	Figure No.	Conducted Power (dBm)	Max. tune-up Power (dBm)	Measured SAR(10g) (W/kg)	Reported SAR(10g)(W/kg)	Measured SAR(1g) (W/kg)	Reported SAR(1g) (W/kg)	Power Drift (dB)
Ch.	MHz											
20525	836.5	1RB_Mid	Left	Cheek	/	24.47	25.00	0.173	0.20	0.222	0.25	0.06
20525	836.5	1RB_Mid	Left	Tilt	/	24.47	25.00	0.108	0.12	0.139	0.16	0.06
20525	836.5	1RB_Mid	Right	Cheek	Fig.7	24.47	25.00	0.219	0.25	0.290	0.33	0.15
20525	836.5	1RB_Mid	Right	Tilt	/	24.47	25.00	0.111	0.13	0.149	0.17	0.01
20450	829	25RB_Low	Left	Cheek	/	23.48	25.00	0.151	0.21	0.192	0.27	-0.09
20450	829	25RB_Low	Left	Tilt	/	23.48	25.00	0.078	0.11	0.100	0.14	-0.05
20450	829	25RB_Low	Right	Cheek	/	23.48	25.00	0.170	0.24	0.225	0.32	0.12
20450	829	25RB_Low	Right	Tilt	/	23.48	25.00	0.098	0.14	0.127	0.18	-0.03
20525	836.5	1RB_Mid	Right	Cheek	SIM1	24.47	25.00	0.201	0.23	0.277	0.31	0.03
20525	836.5	1RB_Mid	Right	Cheek	B2	24.47	25.00	0.208	0.23	0.280	0.32	-0.1
20525	836.5	1RB_Mid	Right	Cheek	configure1	24.47	25.00	0.215	0.24	0.286	0.32	-0.05
20525	836.5	1RB_Mid	Right	Cheek	configure2	24.47	25.00	0.175	0.20	0.230	0.26	0.1

Note1: The LTE mode is QPSK_10MHz.

Table 14.2-8: SAR Values (LTE Band5 - Body)

Ambient Temperature: 22.9°C						Liquid Temperature: 22.5°C					
Frequency		Mode	Test Position	Figure No.	Conducted Power (dBm)	Max. tune-up Power (dBm)	Measured SAR(10g) (W/kg)	Reported SAR(10g) (W/kg)	Measured SAR(1g) (W/kg)	Reported SAR(1g) (W/kg)	Power Drift (dB)
Ch.	MHz										
20525	836.5	1RB_Mid	Front	Fig.8	24.47	25.00	0.258	0.29	0.455	0.51	-0.03
20525	836.5	1RB_Mi	Rear	/	24.47	25.00	0.240	0.27	0.431	0.49	-0.06
20525	836.5	1RB_Mid	Left	/	24.47	25.00	0.134	0.15	0.207	0.23	-0.07
20525	836.5	1RB_Mid	Right	/	24.47	25.00	0.185	0.21	0.313	0.35	0.05
20525	836.5	1RB_Mid	Bottom	/	24.47	25.00	0.133	0.15	0.263	0.30	-0.15
20450	829	25RB_Low	Front	/	23.48	25.00	0.183	0.26	0.337	0.48	0.02
20450	829	25RB_Low	Rear	/	23.48	25.00	0.155	0.22	0.282	0.40	0.15
20450	829	25RB_Low	Left	/	23.48	25.00	0.027	0.04	0.062	0.09	-0.01
20450	829	25RB_Low	Right	/	23.48	25.00	0.084	0.12	0.133	0.19	0.03
20450	829	25RB_Low	Bottom	/	23.48	25.00	0.069	0.10	0.139	0.20	0.11
20525	836.5	1RB_Mid	Front	SIM1	24.47	25.00	0.246	0.28	0.406	0.46	0.05
20525	836.5	1RB_Mid	Front	B2	24.47	25.00	0.254	0.29	0.433	0.49	0.02
20525	836.5	1RB_Mid	Front	configure1	24.47	25.00	0.253	0.29	0.449	0.51	0.13
20525	836.5	1RB_Mid	Front	configure2	24.47	25.00	0.119	0.13	0.236	0.27	0.09

Note1: The distance between the EUT and the phantom bottom is 10mm.



Note2: The LTE mode is QPSK_10MHz.

Table 14.2-9: SAR Values (LTE Band7 - Head)

Frequency		Ambient Temperature: 22.9 °C						Liquid Temperature: 22.5 °C				
Ch.	MHz	Mode	Side	Test Position	Figure No./ Note	Conducted Power (dBm)	Max. tune-up Power (dBm)	Measured SAR(10g) (W/kg)	Reported SAR(10g) (W/kg)	Measured SAR(1g) (W/kg)	Reported SAR(1g) (W/kg)	Power Drift (dB)
21100	2535	1RB_Mid	Left	Cheek	/	23.64	24.50	0.035	0.04	0.077	0.09	0.08
21100	2535	1RB_Mid	Left	Tilt	/	23.64	24.50	0.034	0.04	0.063	0.08	-0.08
21100	2535	1RB_Mid	Right	Cheek	Fig.9	23.64	24.50	0.043	0.05	0.086	0.10	0.03
21100	2535	1RB_Mid	Right	Tilt	/	23.64	24.50	0.036	0.04	0.078	0.10	0.01
20850	2510	50RB_Mid	Left	Cheek	/	22.53	23.50	0.028	0.03	0.056	0.07	-0.11
20850	2510	50RB_Mid	Left	Tilt	/	22.53	23.50	0.020	0.02	0.038	0.05	-0.03
20850	2510	50RB_Mid	Right	Cheek	/	22.53	23.50	0.031	0.04	0.062	0.08	0.02
20850	2510	50RB_Mid	Right	Tilt	/	22.53	23.50	0.028	0.03	0.059	0.07	-0.09
21100	2535	1RB_Mid	Right	Cheek	SIM1	23.64	24.50	0.036	0.04	0.078	0.10	0.04
21100	2535	1RB_Mid	Right	Cheek	B2	23.64	24.50	0.036	0.04	0.080	0.10	-0.08
21100	2535	1RB_Mid	Right	Cheek	configure1	23.64	24.50	0.035	0.04	0.080	0.10	-0.13
21100	2535	1RB_Mid	Right	Cheek	configure2	23.64	24.50	0.033	0.04	0.083	0.10	0.12

Note1: The LTE mode is QPSK_20MHz.

Table 14.2-10: SAR Values (LTE Band7 - Body)

Frequency		Mode	Test Position	Figure No./ Note	Conducted Power (dBm)	Max. tune-up Power (dBm)	Measured SAR(10g) (W/kg)	Reported SAR(10g) (W/kg)	Measured SAR(1g) (W/kg)	Reported SAR(1g) (W/kg)	Power Drift (dB)
Ch.	MHz										
Ambient Temperature: 22.9°C Liquid Temperature: 22.5°C											
21100	2535	1RB_Mid	Front	Fig.10	23.64	24.50	0.333	0.41	0.673	0.82	-0.02
21350	2560	1RB_Mid	Front	/	23.11	24.50	0.319	0.44	0.573	0.79	-0.04
20850	2510	1RB_Mid	Front	/	23.37	24.50	0.297	0.39	0.533	0.69	0.05
21100	2535	1RB_Mid	Rear	15mm	23.64	24.50	0.224	0.27	0.413	0.50	-0.03
21100	2535	1RB_Mid	Left	/	23.64	24.50	0.140	0.17	0.286	0.35	-0.09
21100	2535	1RB_Mid	Right	/	23.64	24.50	0.084	0.10	0.151	0.18	0.13
21100	2535	1RB_Mid	Bottom	15mm	23.64	24.50	0.190	0.23	0.359	0.44	-0.15
20850	2510	1RB_Mid	Rear	/	21.74	23.00	0.250	0.33	0.489	0.65	-0.2
20850	2510	1RB_Mid	Bottom	/	21.74	23.00	0.190	0.25	0.390	0.52	0.04
20850	2510	50RB_Mid	Front	/	22.53	24.50	0.278	0.44	0.514	0.81	-0.04
21350	2560	50RB_Mid	Front	/	22.16	24.50	0.233	0.40	0.471	0.81	-0.09
21100	2535	50RB_Mid	Front	/	22.44	24.50	0.217	0.35	0.489	0.79	0.05
21100	2535	100RB_Mid	Front	/	22.53	24.50	0.220	0.35	0.394	0.62	0.09
20850	2510	50RB_Mid	Rear	15mm	22.53	24.50	0.148	0.23	0.278	0.44	-0.07
20850	2510	50RB_Mid	Left	/	22.53	24.50	0.110	0.17	0.229	0.36	0.06
20850	2510	50RB_Mid	Right	/	22.53	24.50	0.073	0.12	0.135	0.21	-0.12
20850	2510	50RB_Mid	Bottom	15mm	22.53	24.50	0.134	0.21	0.256	0.40	-0.06
20850	2510	50RB_Mid	Rear		20.68	23.00	0.187	0.32	0.379	0.65	-0.15
20850	2510	1RB_Mid	Bottom		20.68	23.00	0.146	0.25	0.301	0.51	-0.11
21100	2535	1RB_Mid	Front	SIM1	23.64	24.50	0.280	0.34	0.621	0.76	0.08
21100	2535	1RB_Mid	Front	B2	23.64	24.50	0.274	0.33	0.615	0.75	-0.02
21100	2535	1RB_Mid	Front	configure1	23.64	24.50	0.291	0.35	0.535	0.65	0.04
21100	2535	1RB_Mid	Front	configure2	23.64	24.50	0.266	0.32	0.513	0.63	-0.03

Note1: The distance between the EUT and the phantom bottom is 10mm.

Note2: The LTE mode is QPSK_20MHz.

Table 14.2-11: SAR Values (LTE Band41 - Head)

Frequency		Ambient Temperature: 22.9 °C						Liquid Temperature: 22.5°C				
Ch.	MHz	Mode	Side	Test Position	Figure No./ Note	Conducted Power (dBm)	Max. tune-up Power (dBm)	Measured SAR(10g) (W/kg)	Reported SAR(10g)(W/kg)	Measured SAR(1g) (W/kg)	Reported SAR(1g) (W/kg)	Power Drift (dB)
41140	2645	1RB_Mid	Left	Cheek	Fig.11	24.56	25.00	0.035	0.04	0.072	0.08	0.15
41140	2645	1RB_Mid	Left	Tilt	/	24.56	25.00	0.025	0.03	0.049	0.05	0.08
41140	2645	1RB_Mid	Right	Cheek		24.56	25.00	0.032	0.04	0.068	0.08	-0.08
41140	2645	1RB_Mid	Right	Tilt	/	24.56	25.00	0.022	0.02	0.042	0.05	-0.1
41140	2645	50RB_High	Left	Cheek	/	23.24	25.00	0.027	0.04	0.056	0.08	0.02
41140	2645	50RB_High	Left	Tilt	/	23.24	25.00	0.020	0.03	0.040	0.06	0.07
41140	2645	50RB_High	Right	Cheek	/	23.24	25.00	0.028	0.04	0.055	0.08	0.14
41140	2645	50RB_High	Right	Tilt	/	23.24	25.00	0.021	0.03	0.026	0.04	-0.02
41140	2645	1RB_Mid	Left	Cheek	SIM1	24.56	25.00	0.031	0.03	0.065	0.07	-0.07
41140	2645	1RB_Mid	Left	Cheek	B2	24.56	25.00	0.032	0.04	0.068	0.08	-0.12
41140	2645	1RB_Mid	Left	Cheek	configure1	24.56	25.00	0.022	0.02	0.047	0.05	-0.12
41140	2645	1RB_Mid	Left	Cheek	configure2	24.56	25.00	0.017	0.02	0.034	0.04	-0.02

Note1: The LTE mode is QPSK_20MHz.

Table 14.1-12: SAR Values (LTE Band41 - Body)

Frequency		Ambient Temperature: 22.9 °C						Liquid Temperature: 22.5°C				
Ch.	MHz	Mode	Test Position	Figure No./ Note	Conducted Power (dBm)	Max. tune-up Power (dBm)	Measured SAR(10g) (W/kg)	Reported SAR(10g) (W/kg)	Measured SAR(1g) (W/kg)	Reported SAR(1g) (W/kg)	Power Drift (dB)	
41140	2645	1RB_Mid	Front	/	24.56	25.00	0.315	0.35	0.651	0.72	0.09	
41140	2645	1RB_Mid	Rear	Fig.12	24.56	25.00	0.468	0.52	0.911	1.01	0.13	
41140	2645	1RB_Mid	Left	/	24.56	25.00	0.206	0.23	0.439	0.49	-0.11	
41140	2645	1RB_Mid	Right	/	24.56	25.00	0.110	0.12	0.206	0.23	0.05	
41140	2645	1RB_Mid	Bottom	/	24.56	25.00	0.356	0.39	0.792	0.88	0.07	
41140	2645	50RB_High	Front	/	23.24	25.00	0.251	0.38	0.520	0.78	-0.13	
41140	2645	50RB_High	Rear	/	23.24	25.00	0.379	0.57	0.660	0.99	0.08	
41140	2645	50RB_High	Left	/	23.24	25.00	0.168	0.25	0.357	0.54	-0.12	
41140	2645	50RB_High	Right	/	23.24	25.00	0.089	0.13	0.169	0.25	0.11	
41140	2645	50RB_High	Bottom	/	23.24	25.00	0.288	0.43	0.642	0.96	0.06	
41140	2645	1RB_Mid	Rear	SIM1	24.56	25.00	0.407	0.45	0.844	0.93	0.01	
41140	2645	1RB_Mid	Rear	B2	24.56	25.00	0.442	0.49	0.875	0.97	-0.02	
41140	2645	1RB_Mid	Rear	configure1	24.56	25.00	0.360	0.40	0.700	0.77	-0.11	
41140	2645	1RB_Mid	Rear	configure2	24.56	25.00	0.222	0.25	0.453	0.50	-0.05	

Note1: The distance between the EUT and the phantom bottom is 10mm.

Note2: The LTE mode is QPSK_20MHz.

14.2 SAR results for Standard procedure

There is zoom scan measurement to be added for the highest measured SAR in each exposure configuration/band.

Test Position	Frequency Band	Channel Number	Frequency (MHz)	Test setup	EUT Measured Power (dBm)	Tune up (dBm)	Measured SAR 10g (W/kg)	Calculated SAR 10g (W/kg)	Measured SAR 1g (W/kg)	Calculated SAR 1g (W/kg)	Power Drift
Cheek	GSM850	251	848.80	Right Check	33.54	35.00	0.24	0.33	0.31	0.43	-0.13
Body	GSM850	128	824.20	Right Edge GPRS 10mm	30.75	32.00	0.26	0.35	0.39	0.52	0.03
Cheek	GSM1900	661	1880.00	Left Check	31.05	32.00	0.03	0.04	0.06	0.07	0.20
Body	GSM1900	512	1850.20	Bottom Edge GPRS 10mm	30.68	32.00	0.44	0.59	0.80	1.08	0.20
Cheek	WCDMA 850	4233	846.60	Right Check	24.87	25.00	0.31	0.31	0.40	0.41	0.01
Body	WCDMA 850	4132	826.40	Right Edge 10mm	24.95	25.00	0.33	0.34	0.49	0.50	0.03
Cheek	LTE Band5	20525	836.50	Right Check 1RB-Middle	24.47	25.00	0.22	0.25	0.29	0.33	0.15
Body	LTE Band5	20525	836.50	1RB-Middle Front 10mm	24.47	25.00	0.26	0.29	0.46	0.51	-0.03
Cheek	LTE Band7	21100	2535.00	Right Check 1RB-Middle	23.64	24.50	0.04	0.05	0.09	0.10	0.03
Body	LTE Band7	21100	2535	1RB-Middle Front 10mm	23.64	24.50	0.33	0.41	0.67	0.82	-0.02
Cheek	LTE Band41	41140	2645	Left Check 1RB-Middle	24.56	25.00	0.03	0.04	0.07	0.08	0.15
Body	LTE Band41	41140	2645	1RB-Middle Rear 10mm	24.56	25.00	0.47	0.52	0.91	1.01	0.13
Tilt	WLAN	6	2437.00	Left Tilt	17.46	18.00	0.08	0.09	0.20	0.23	-0.18
Body	WLAN	6	2437.00	Top Edge 10mm	17.46	18.00	0.03	0.03	0.05	0.06	0.12

14.3 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 14.3-1: SAR Values (WLAN - Head)– 802.11b (Fast SAR)

Frequency		Side	Test Position	Figure No./ Note	Conducte d Power (dBm)	Max. tune-up Power (dBm)	Measured SAR(10g) (W/kg)	Reported SAR(10g) (W/kg)	Measured SAR(1g) (W/kg)	Reported SAR(1g)(W/kg)	Power Drift (dB)
MHz	Ch.										
		Ambient Temperature: 22.9 °C					Liquid Temperature: 22.5°C				
2437	6	Left	Touch	/	17.46	18.00	0.1	0.11	0.217	0.25	-0.03
2437	6	Left	Tilt	/	17.46	18.00	0.103	0.12	0.247	0.28	0.05
2437	6	Right	Touch	/	17.46	18.00	0.059	0.07	0.107	0.12	0.06
2437	6	Right	Tilt	/	17.46	18.00	0.09	0.10	0.185	0.21	0.10
2437	6	Left	Tilt	SIM1	17.46	18.00	0.078	0.09	0.183	0.21	-0.14
2437	6	Left	Tilt	B2	17.46	18.00	0.073	0.08	0.165	0.19	-0.14
2437	6	Left	Tilt	SKU3	17.46	18.00	0.075	0.08	0.173	0.20	-0.01
2437	6	Left	Tilt	SKU3	17.46	18.00	0.068	0.08	0.156	0.18	-0.02

As shown above table, the initial test position for head is “Left Tilt”. So the head SAR of WLAN is presented as below:

Table 14.3-2: SAR Values (WLAN - Head)– 802.11b (Full SAR)

Frequency		Side	Test Position	Figure No./ Note	Conducte d Power (dBm)	Max. tune-up Power (dBm)	Measured SAR(10g) (W/kg)	Reported SAR(10g) (W/kg)	Measured SAR(1g) (W/kg)	Reported SAR(1g)(W/kg)	Power Drift (dB)
MHz	Ch.										
		Ambient Temperature: 22.9 °C					Liquid Temperature: 22.5°C				
2437	6	Left	Tilt	Fig.13	17.46	18.00	0.080	0.09	0.203	0.23	-0.18

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.

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.

Table 14.3-3: SAR Values (WLAN - Head) – 802.11b (Scaled Reported SAR)

Frequency		Side	Test Position	Actual duty factor	maximum duty factor	Reported SAR (1g)(W/kg)	Scaled reported SAR (1g)(W/kg)	
MHz	Ch.							
		Ambient Temperature: 22.9 °C					Liquid Temperature: 22.5°C	
2437	6	Left	Tilt	100%	100%	0.23	0.23	

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

Body Evaluation

Table 14.3-4: SAR Values (WLAN - Body)– 802.11b (Fast SAR)

Frequency		Test Position	Figure No./ Note	Conducted Power (dBm)	Max. tune-up Power (dBm)	Ambient Temperature: 22.9 °C		Liquid Temperature: 22.5°C		Power Drift (dB)
MHz	Ch.					Measured SAR(10g) (W/kg)	Reported SAR(10g) (W/kg)	Measured SAR(1g) (W/kg)	Reported SAR(1g)(W/kg)	
2437	6	Front	/	17.46	18.00	0.018	0.02	0.035	0.04	0.13
2437	6	Rear	/	17.46	18.00	0.020	0.02	0.039	0.04	-0.05
2437	6	Left	/	17.46	18.00	0.016	0.02	0.032	0.04	-0.01
2437	6	Right	/	17.46	18.00	0.015	0.02	0.03	0.03	-0.09
2437	6	Top	/	17.46	18.00	0.029	0.03	0.051	0.06	0.13
2437	6	Top	SIM1	17.46	18.00	0.019	0.02	0.041	0.05	-0.02
2437	6	Top	B2	17.46	18.00	0.022	0.03	0.043	0.05	-0.08
2437	6	Top	SKU3	17.46	18.00	0.018	0.02	0.036	0.04	-0.13
2437	6	Top	SKU3	17.46	18.00	0.016	0.02	0.032	0.04	-0.03

As shown above table, the initial test position for body is “Top”. So the body SAR of WLAN is presented as below:

Table 14.3-5: SAR Values (WLAN - Body)– 802.11b (Full SAR)

Frequency		Test Position	Figure No./ Note	Conducted Power (dBm)	Max. tune-up Power (dBm)	Ambient Temperature: 22.9 °C		Liquid Temperature: 22.5°C		Power Drift (dB)
MHz	Ch.					Measured SAR(10g) (W/kg)	Reported SAR(10g) (W/kg)	Measured SAR(1g) (W/kg)	Reported SAR(1g)(W/kg)	
2437	6	Top	Fig.14	17.46	18.00	0.029	0.03	0.053	0.06	0.12

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.

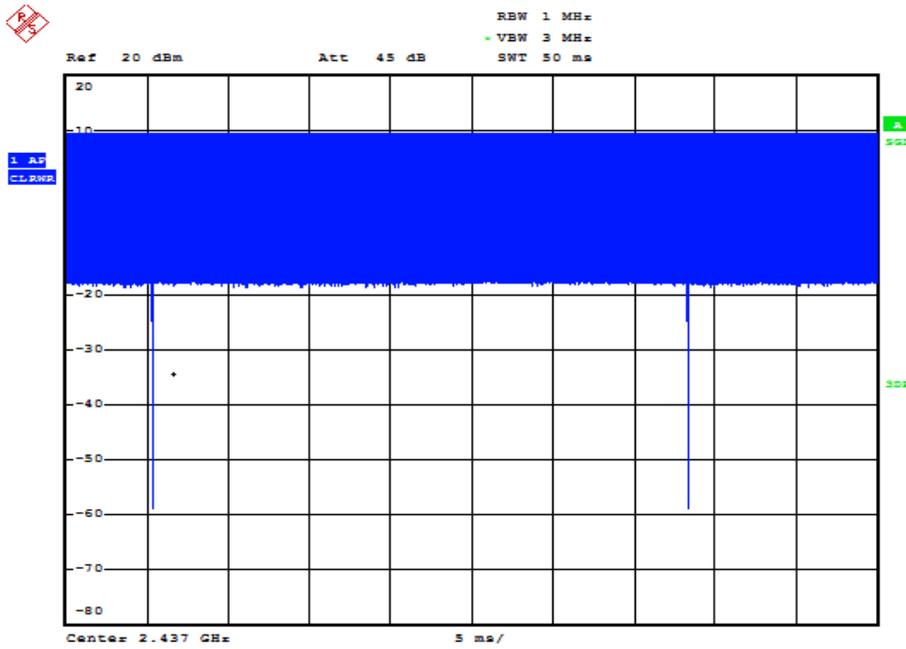
Note2: For all positions/configurations tested using the initial test position and subsequent test positions, when the reported SAR is > 0.8 W/kg, SAR is measured for these test positions/configurations on the subsequent next highest measured output power channel until the reported SAR is ≤ 1.2 W/kg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

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.

Table 14.3-6: SAR Values (WLAN - Body) – 802.11b (Scaled Reported SAR)

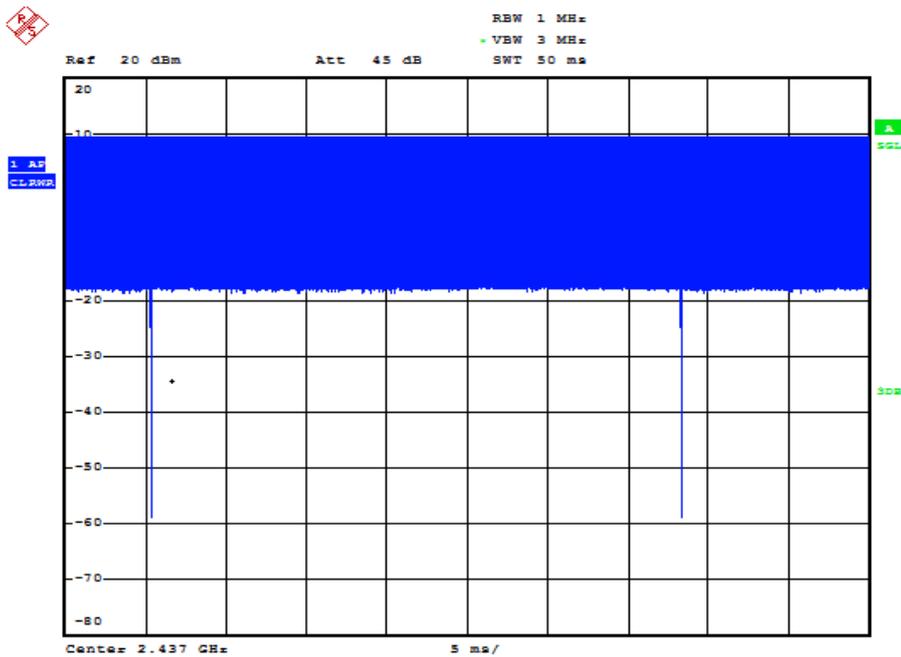
Frequency		Test Position	Ambient Temperature: 22.9 °C		Liquid Temperature: 22.5°C	
MHz	Ch.		Actual duty factor	maximum duty factor	Reported SAR (1g)(W/kg)	Scaled reported SAR (1g)(W/kg)
2412	1	Top	100%	100%	0.06	0.06

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



Date: 15. JAN. 2019 16:10:49

Picture 14.1 Duty factor plot for head



Date: 15. JAN. 2019 16:10:49

Picture 14.2 Duty factor plot for Body

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 ($\sim 10\%$ 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 .

Table 15.1: SAR Measurement Variability for Body LTE B41 (1g)

Frequency		Mode	Test Position	Spacing (mm)	Original SAR (W/kg)	First Repeated SAR (W/kg)	The Ratio	Second Repeated SAR (W/kg)
Ch.	MHz							
41140	2645	1RB_Middle	Rear	10	0.911	0.905	1.006	/

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	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	∞
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	RFambient conditions-reflection	B	0	R	$\sqrt{3}$	1	1	0	0	∞
11	Probe positioned mech. restrictions	B	0.8	R	$\sqrt{3}$	1	1	0.5	0.5	∞
12	Probe positioning with respect to phantom shell	B	6.7	R	$\sqrt{3}$	1	1	3.9	3.9	∞
13	Post-processing	B	4.0	R	$\sqrt{3}$	1	1	2.3	2.3	∞
Test sample related										
14	Test sample positioning	A	3.3	N	1	1	1	3.3	3.3	71
15	Device holder uncertainty	A	3.4	N	1	1	1	3.4	3.4	5
16	Drift of output power	B	5.0	R	$\sqrt{3}$	1	1	2.9	2.9	∞
Phantom and set-up										
17	Phantom uncertainty	B	4.0	R	$\sqrt{3}$	1	1	2.3	2.3	∞
18	Liquid conductivity (target)	B	5.0	R	$\sqrt{3}$	0.64	0.43	1.8	1.2	∞
19	Liquid conductivity (meas.)	A	2.06	N	1	0.64	0.43	1.32	0.89	43
20	Liquid permittivity (target)	B	5.0	R	$\sqrt{3}$	0.6	0.49	1.7	1.4	∞

21	Liquid permittivity (meas.)	A	1.6	N	1	0.6	0.49	1.0	0.8	521
Combined standard uncertainty		$u_c' = \sqrt{\sum_{i=1}^{21} c_i^2 u_i^2}$						10.7	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	RFambient conditions-reflection	B	0	R	$\sqrt{3}$	1	1	0	0	∞
11	Probe positioned mech. Restrictions	B	0.4	R	$\sqrt{3}$	1	1	0.2	0.2	∞
12	Probe positioning with respect to phantom shell	B	2.9	R	$\sqrt{3}$	1	1	1.7	1.7	∞
13	Post-processing	B	1.0	R	$\sqrt{3}$	1	1	0.6	0.6	∞
14	Fast SAR z-Approximation	B	7.0	R	$\sqrt{3}$	1	1	4.0	4.0	∞
Test sample related										
15	Test sample positioning	A	3.3	N	1	1	1	3.3	3.3	71
16	Device holder uncertainty	A	3.4	N	1	1	1	3.4	3.4	5
17	Drift of output power	B	5.0	R	$\sqrt{3}$	1	1	2.9	2.9	∞
Phantom and set-up										
18	Phantom uncertainty	B	4.0	R	$\sqrt{3}$	1	1	2.3	2.3	∞
19	Liquid conductivity (target)	B	5.0	R	$\sqrt{3}$	0.64	0.43	1.8	1.2	∞

20	Liquid conductivity (meas.)	A	2.06	N	1	0.64	0.43	1.32	0.89	43
21	Liquid permittivity (target)	B	5.0	R	$\sqrt{3}$	0.6	0.49	1.7	1.4	∞
22	Liquid permittivity (meas.)	A	1.6	N	1	0.6	0.49	1.0	0.8	521
Combined standard uncertainty		$u_c = \sqrt{\sum_{i=1}^{22} c_i^2 u_i^2}$						10.4	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	RFambient conditions-reflection	B	0	R	$\sqrt{3}$	1	1	0	0	∞
11	Probe positioned mech. Restrictions	B	0.8	R	$\sqrt{3}$	1	1	0.5	0.5	∞
12	Probe positioning with respect to phantom shell	B	6.7	R	$\sqrt{3}$	1	1	3.9	3.9	∞
13	Post-processing	B	1.0	R	$\sqrt{3}$	1	1	0.6	0.6	∞
14	Fast SAR z-Approximation	B	14.0	R	$\sqrt{3}$	1	1	8.1	8.1	∞
Test sample related										
15	Test sample positioning	A	3.3	N	1	1	1	3.3	3.3	71
16	Device holder uncertainty	A	3.4	N	1	1	1	3.4	3.4	5
17	Drift of output power	B	5.0	R	$\sqrt{3}$	1	1	2.9	2.9	∞

Phantom and set-up										
18	Phantom uncertainty	B	4.0	R	$\sqrt{3}$	1	1	2.3	2.3	∞
19	Liquid conductivity (target)	B	5.0	R	$\sqrt{3}$	0.64	0.43	1.8	1.2	∞
20	Liquid conductivity (meas.)	A	2.06	N	1	0.64	0.43	1.32	0.89	43
21	Liquid permittivity (target)	B	5.0	R	$\sqrt{3}$	0.6	0.49	1.7	1.4	∞
22	Liquid permittivity (meas.)	A	1.6	N	1	0.6	0.49	1.0	0.8	521
Combined standard uncertainty		$u_c = \sqrt{\sum_{i=1}^{22} c_i^2 u_i^2}$						13.5	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	MY46110673	January 24, 2018	One year
02	Power meter	NRVD	102083	October 24, 2018	One year
03	Power sensor	NRV-Z5	100542		
04	Signal Generator	E4438C	MY49071430	January 2, 2018	One Year
05	Amplifier	60S1G4	0331848	No Calibration Requested	
06	BTS	E5515C	MY50263375	January 23, 2018	One year
07	BTS	CMW500	149646	October 22, 2018	One year
08	E-field Probe	SPEAG EX3DV4	7514	August 27, 2018	One year
09	DAE	SPEAG DAE4	1555	August 20, 2018	One year
10	Dipole Validation Kit	SPEAG D835V2	4d069	July 23, 2018	One year
11	Dipole Validation Kit	SPEAG D1900V2	5d101	July 24, 2018	One year
12	Dipole Validation Kit	SPEAG D2450V2	853	July 24, 2018	One year
13	Dipole Validation Kit	SPEAG D2600V2	1012	July 26, 2018	One year

END OF REPORT BODY

ANNEX A Graph Results

GSM 850 Right Cheek High

Date: 2019-1-9

Electronics: DAE4 Sn1555

Medium: Head 850 MHz

Medium parameters used: $f = 848.8$ MHz; $\sigma = 0.911$ mho/m; $\epsilon_r = 41.71$; $\rho = 1000$ kg/m³

Ambient Temperature: 22.9°C Liquid Temperature: 22.5°C

Communication System: GSM 850 GPRS Frequency: 848.8 MHz Duty Cycle: 1:8.3

Probe: EX3DV4 – SN7514 ConvF(9.09, 9.09, 9.09)

Area Scan (71x131x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 0.364 W/kg

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

Reference Value = 4.232 V/m; Power Drift = -0.13 dB

Peak SAR (extrapolated) = 0.396 W/kg

SAR(1 g) = 0.310 W/kg; SAR(10 g) = 0.235 W/kg

Maximum value of SAR (measured) = 0.357 W/kg

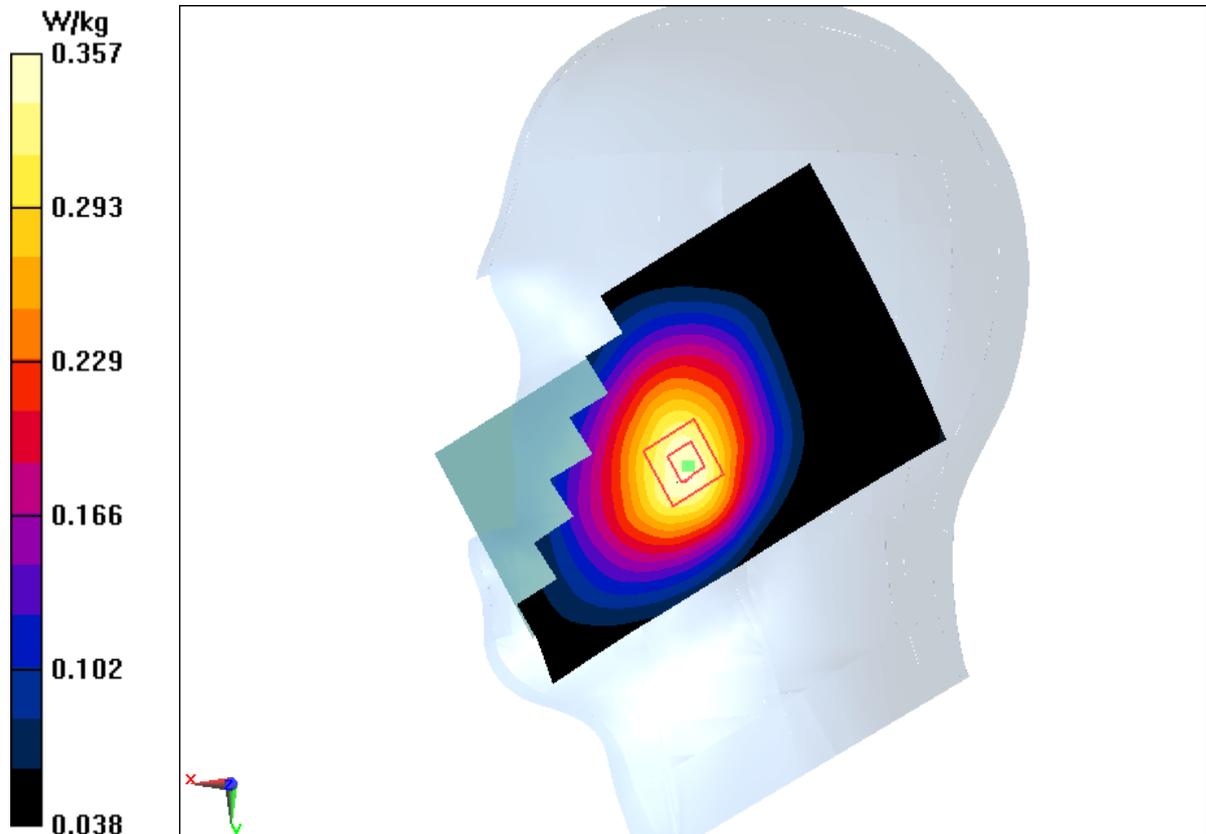


Fig.1 850MHz

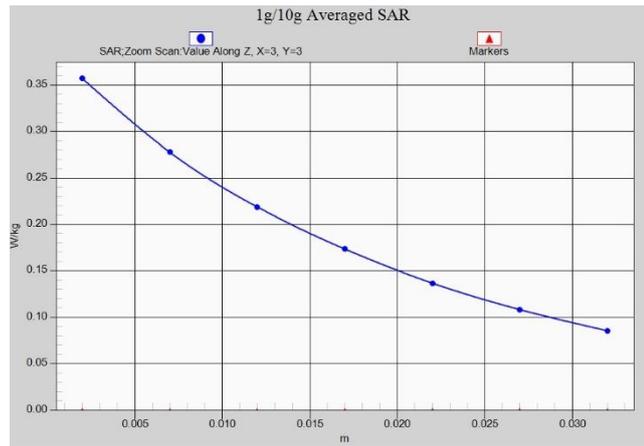


Fig. 1-1 Z-Scan at power reference point (850 MHz)

GSM 850 Body Right Edge Low

Date: 2019-1-9

Electronics: DAE4 Sn1555

Medium: Body 850 MHz

Medium parameters used: $f = 848.8$ MHz; $\sigma = 0.989$ mho/m; $\epsilon_r = 55.77$; $\rho = 1000$ kg/m³

Ambient Temperature: 22.9°C Liquid Temperature: 22.5°C

Communication System: GSM 850 GPRS Frequency: 848.8 MHz Duty Cycle: 1:2

Probe: EX3DV4 – SN7514 ConvF(9.47, 9.47, 9.47)

Area Scan (31x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 0.481 W/kg

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

Reference Value = 20.60 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 0.569 W/kg

SAR(1 g) = 0.387 W/kg; SAR(10 g) = 0.263 W/kg

Maximum value of SAR (measured) = 0.484 W/kg

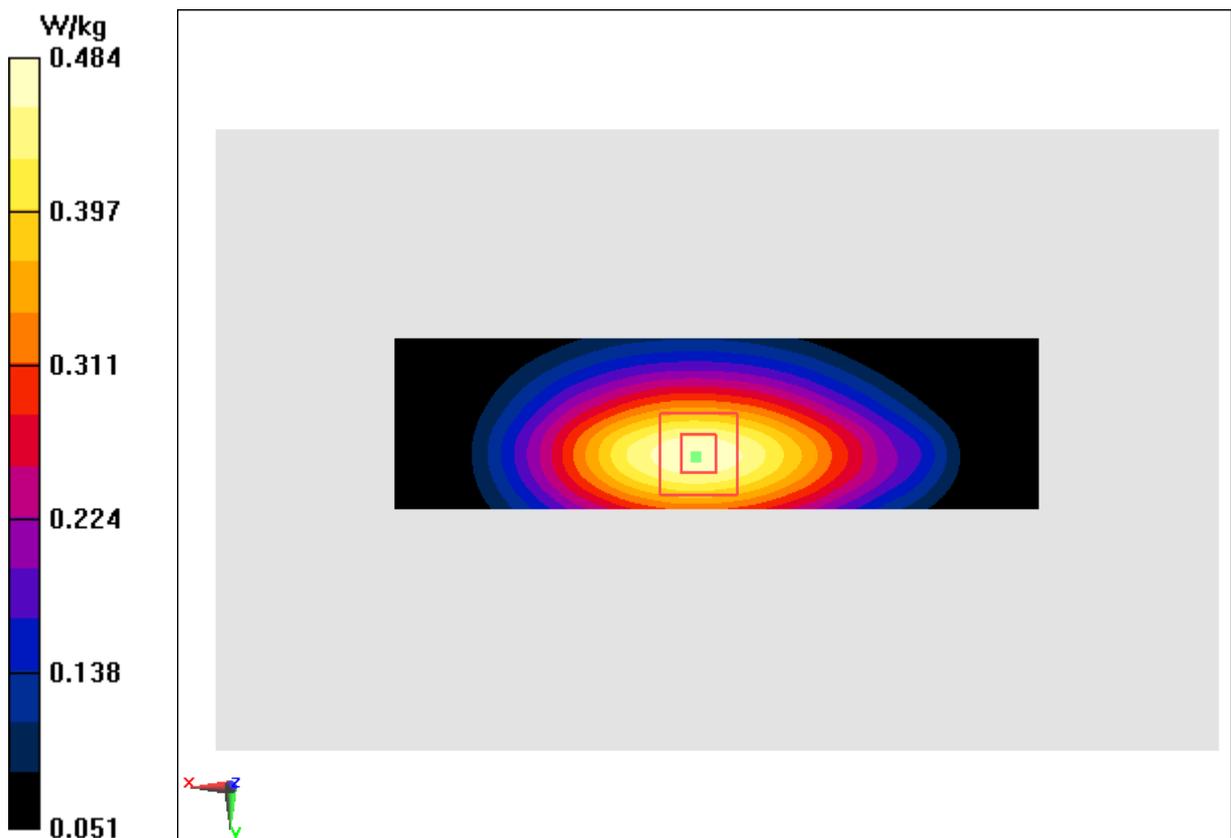


Fig.2 850 MHz

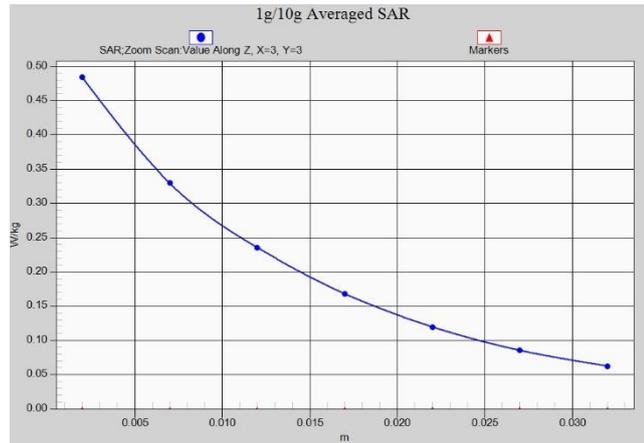


Fig. 2-1 Z-Scan at power reference point (850 MHz)

GSM 1900 Left Cheek Middle

Date: 2019-1-11

Electronics: DAE4 Sn1555

Medium: Head 1900 MHz

Medium parameters used: $f = 1850.2$ MHz; $\sigma = 1.389$ mho/m; $\epsilon_r = 40.64$; $\rho = 1000$ kg/m³

Ambient Temperature: 22.9°C Liquid Temperature: 22.5°C

Communication System: GSM 1900MHz Frequency: 1850.2 MHz Duty Cycle: 1:8.3

Probe: EX3DV4– SN7514 ConvF(7.73, 7.73, 7.73)

Area Scan (71x131x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 0.0727 W/kg

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

Reference Value = 2.899 V/m; Power Drift = 0.20 dB

Peak SAR (extrapolated) = 0.0980 W/kg

SAR(1 g) = 0.058 W/kg; SAR(10 g) = 0.032 W/kg

Maximum value of SAR (measured) = 0.0786 W/kg

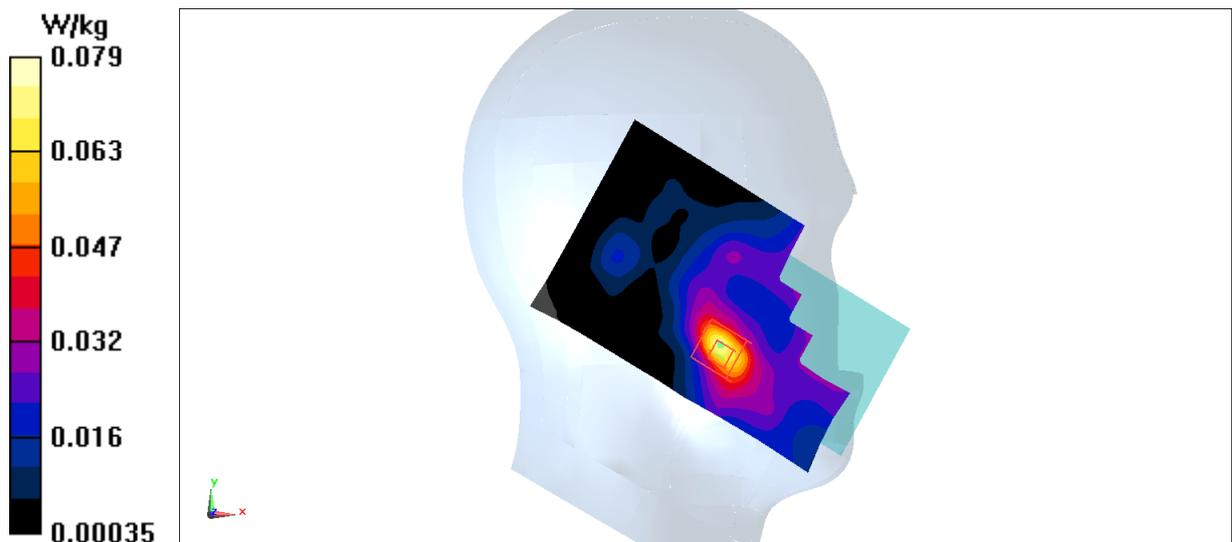


Fig.3 1900 MHz

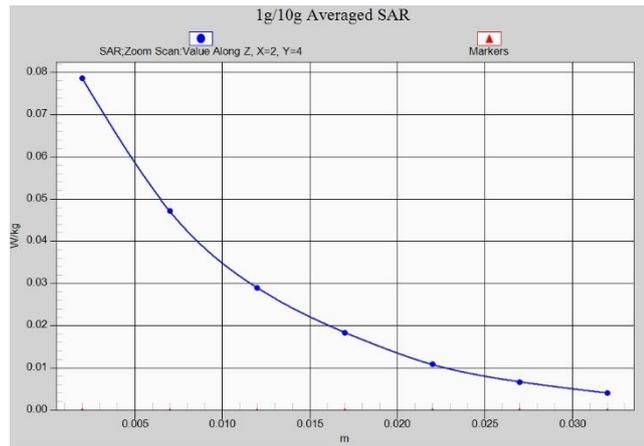


Fig. 3-1 Z-Scan at power reference point (1900 MHz)

GMS 1900 Body Bottom Low

Date: 2019-1-11

Electronics: DAE4 Sn1555

Medium: Body 1900 MHz

Medium parameters used (interpolated): $f = 1850.2$ MHz; $\sigma = 1.520$ mho/m; $\epsilon_r = 52.72$; $\rho = 1000$ kg/m³

Ambient Temperature: 22.9°C Liquid Temperature: 22.5°C

Communication System: GSM 1900MHz GPRS Frequency: 1850.2 MHz Duty Cycle: 1:8.3

Probe: EX3DV4– SN7514 ConvF(7.53, 7.53, 7.53)

Area Scan (31x81x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 1.19 W/kg

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

Reference Value = 24.46 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 1.33 W/kg

SAR(1 g) = 0.795 W/kg; SAR(10 g) = 0.438 W/kg

Maximum value of SAR (measured) = 1.10 W/kg

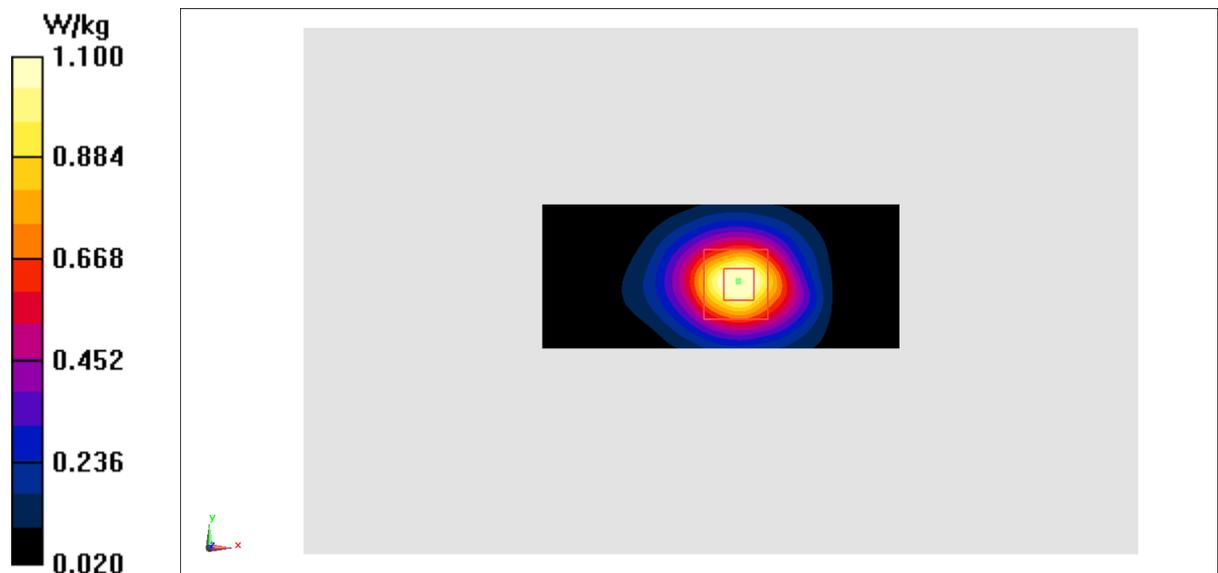


Fig.4 1900 MHz

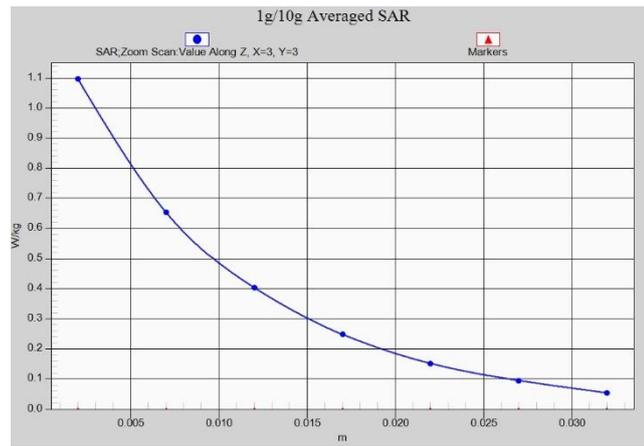


Fig. 4-1 Z-Scan at power reference point (1900 MHz)

WCDMA 850 Right Cheek High

Date: 2019-1-9

Electronics: DAE4 Sn1555

Medium: Head 850 MHz

Medium parameters used (interpolated): $f = 846.6$ MHz; $\sigma = 0.908$ mho/m; $\epsilon_r = 41.715$; $\rho = 1000$ kg/m³

Ambient Temperature: 22.9°C Liquid Temperature: 22.5°C

Communication System: WCDMA; Frequency: 846.6 MHz; Duty Cycle: 1:1

Probe: EX3DV4 – SN7514 ConvF(9.09, 9.09, 9.09)

Area Scan (71x131x1): Interpolated grid: $dx=1.000$ mm, $dy=1.000$ mm

Maximum value of SAR (interpolated) = 0.472 W/kg

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

Reference Value = 4.663 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 0.515 W/kg

SAR(1 g) = 0.401 W/kg; SAR(10 g) = 0.305 W/kg

Maximum value of SAR (measured) = 0.464 W/kg

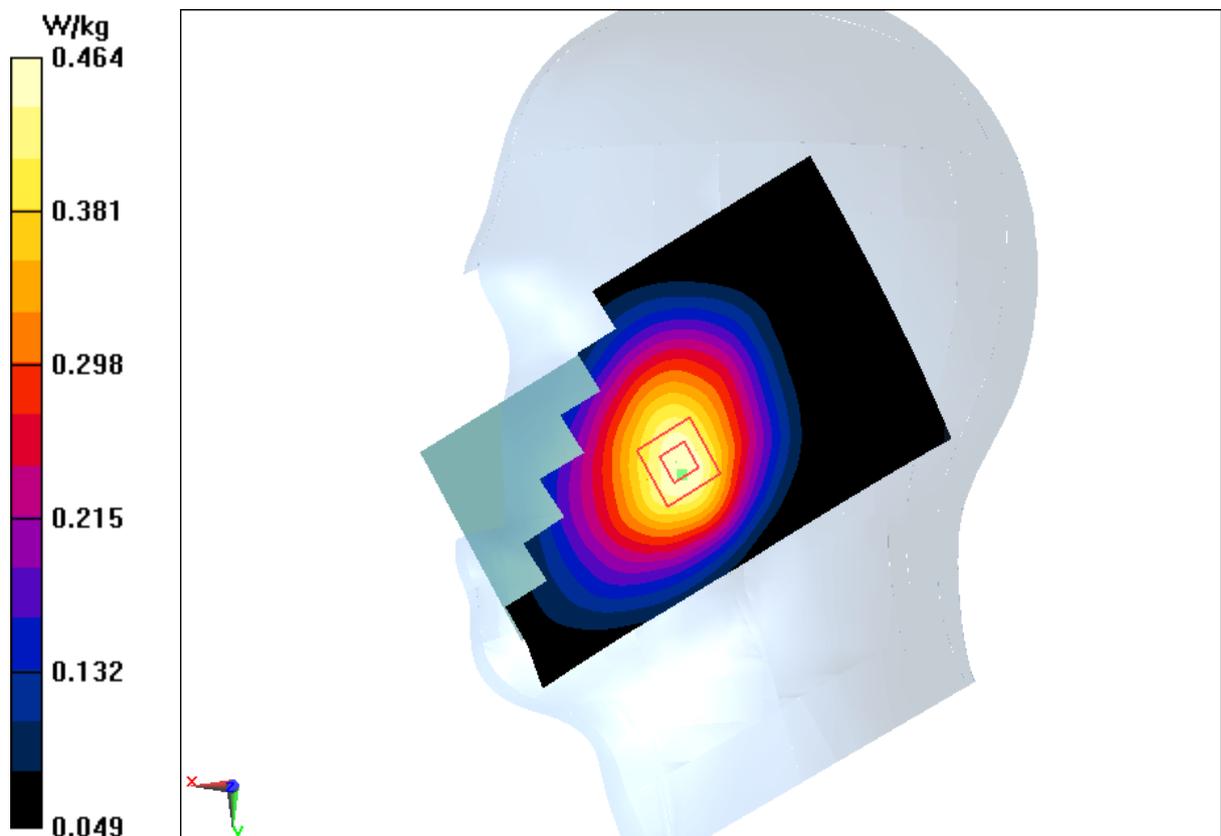


Fig.5 WCDMA 850

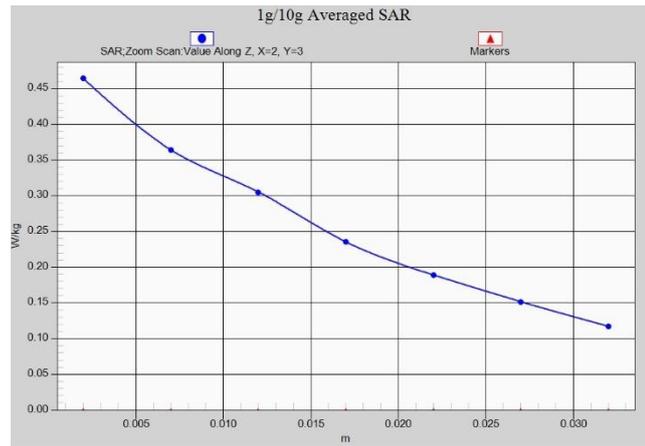


Fig. 5-1 Z-Scan at power reference point (850 MHz)

WCDMA 850 Body Right Edge Low

Date: 2019-1-9

Electronics: DAE4 Sn1555

Medium: Body 850 MHz

Medium parameters used (interpolated): $f = 846.6$ MHz; $\sigma = 0.987$ mho/m; $\epsilon_r = 55.77$; $\rho = 1000$ kg/m³

Ambient Temperature: 22.9°C Liquid Temperature: 22.5°C

Communication System: WCDMA; Frequency: 846.6 MHz; Duty Cycle: 1:1

Probe: EX3DV4 – SN7514 ConvF(9.47, 9.47, 9.47)

Area Scan (31x121x1): Interpolated grid: $dx=1.000$ mm, $dy=1.000$ mm

Maximum value of SAR (interpolated) = 0.596 W/kg

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

Reference Value = 23.35 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 0.698 W/kg

SAR(1 g) = 0.491 W/kg; SAR(10 g) = 0.334 W/kg

Maximum value of SAR (measured) = 0.526 W/kg

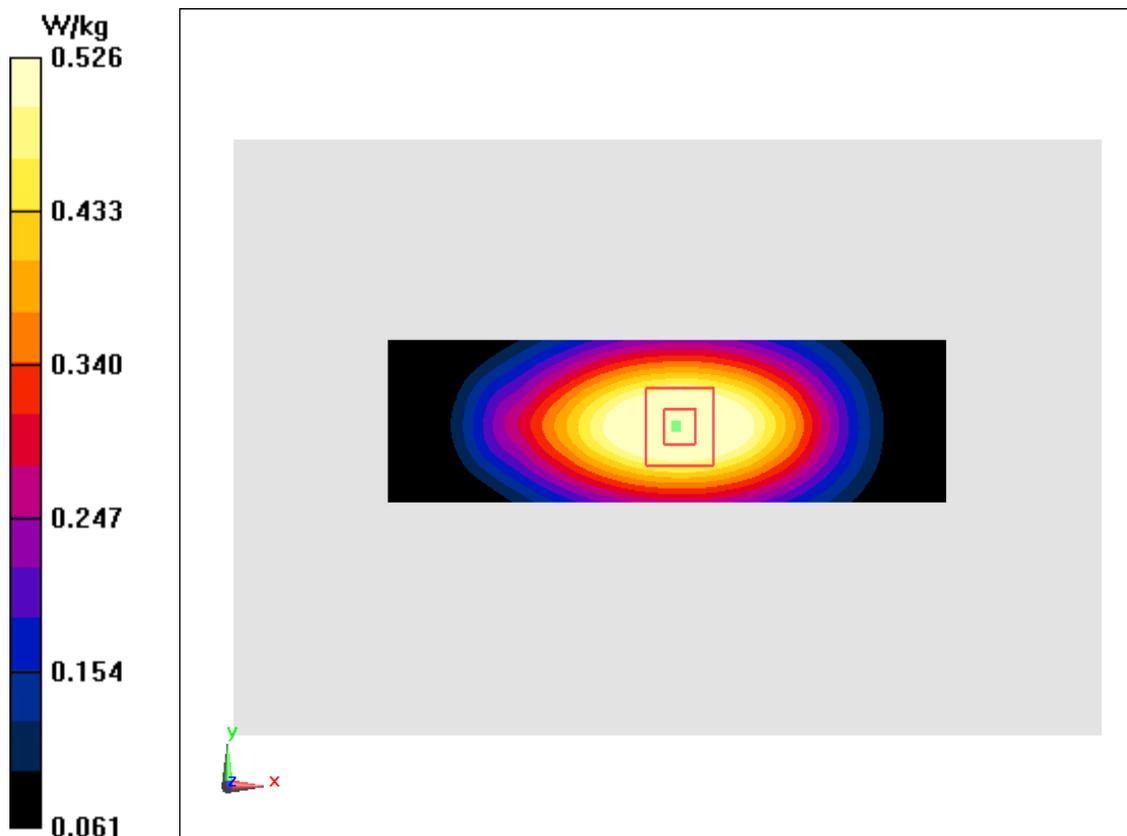


Fig.6 WCDMA 850

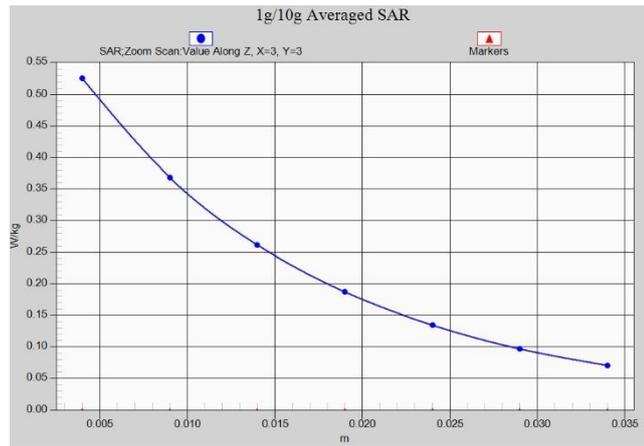


Fig. 6-1 Z-Scan at power reference point (WCDMA850)

LTE Band5 Right Cheek Middle with QPSK_10M_1RB_Middle

Date: 2019-1-9

Electronics: DAE4 Sn1555

Medium: Head 850 MHz

Medium parameters used (interpolated): $f = 836.5$ MHz; $\sigma = 0.908$ mho/m; $\epsilon_r = 41.771$; $\rho = 1000$ kg/m³

Ambient Temperature: 22.9°C Liquid Temperature: 22.5°C

Communication System: LTE Band5 Frequency: 836.5 MHz Duty Cycle: 1:1

Probe: EX3DV4 - SN7514 ConvF(9.09, 9.09, 9.09)

Area Scan (71x131x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 0.353 W/kg

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

Reference Value = 5.911 V/m; Power Drift = 0.15 dB

Peak SAR (extrapolated) = 0.373 W/kg

SAR(1 g) = 0.290 W/kg; SAR(10 g) = 0.219 W/kg

Maximum value of SAR (measured) = 0.335 W/kg

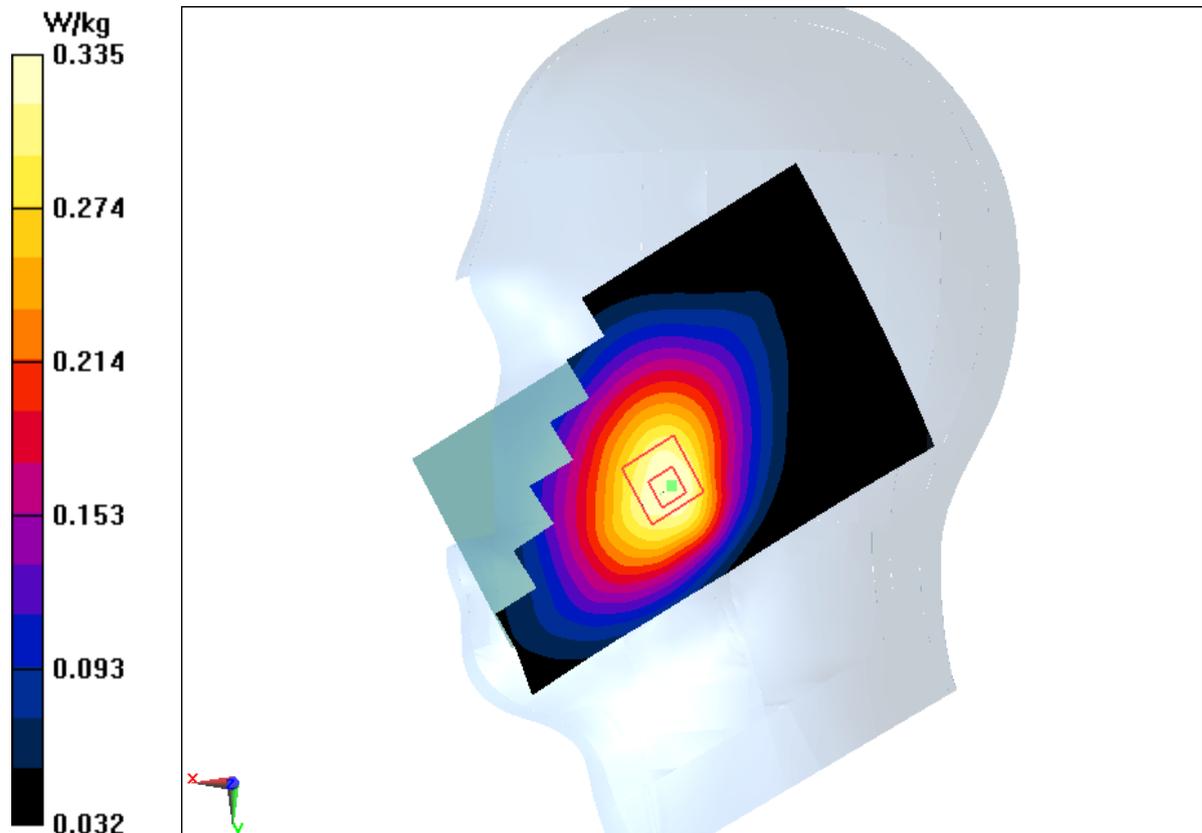


Fig.7 LTE Band5

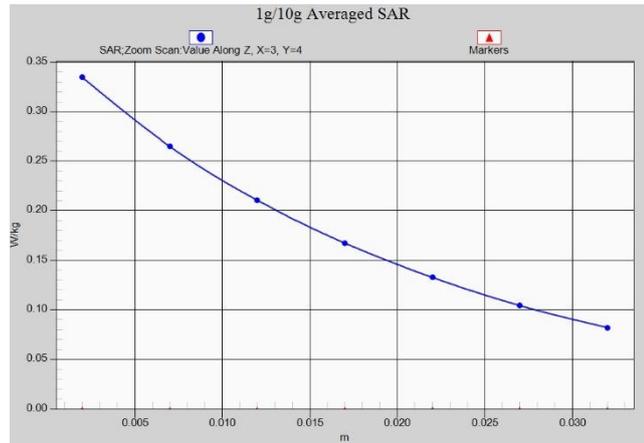


Fig. 7-1 Z-Scan at power reference point (LTE Band5)

LTE Band5 Body Front Middle with QPSK_10M_1RB_Middle

Date: 2019-1-9

Electronics: DAE4 Sn1555

Medium: Body 850 MHz

Medium parameters used (interpolated): $f = 836.5$ MHz; $\sigma = 1.013$ mho/m; $\epsilon_r = 55.544$; $\rho = 1000$ kg/m³

Ambient Temperature: 22.9°C Liquid Temperature: 22.5°C

Communication System: LTE Band5 Frequency: 836.5 MHz Duty Cycle: 1:1

Probe: EX3DV4 - SN7514 ConvF(9.47, 9.47, 9.47)

Area Scan (71x131x1): Interpolated grid: $dx=1.000$ mm, $dy=1.000$ mm

Maximum value of SAR (interpolated) = 0.557 W/kg

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

Reference Value = 19.79 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 0.806 W/kg

SAR(1 g) = 0.455 W/kg; SAR(10 g) = 0.258 W/kg

Maximum value of SAR (measured) = 0.632 W/kg

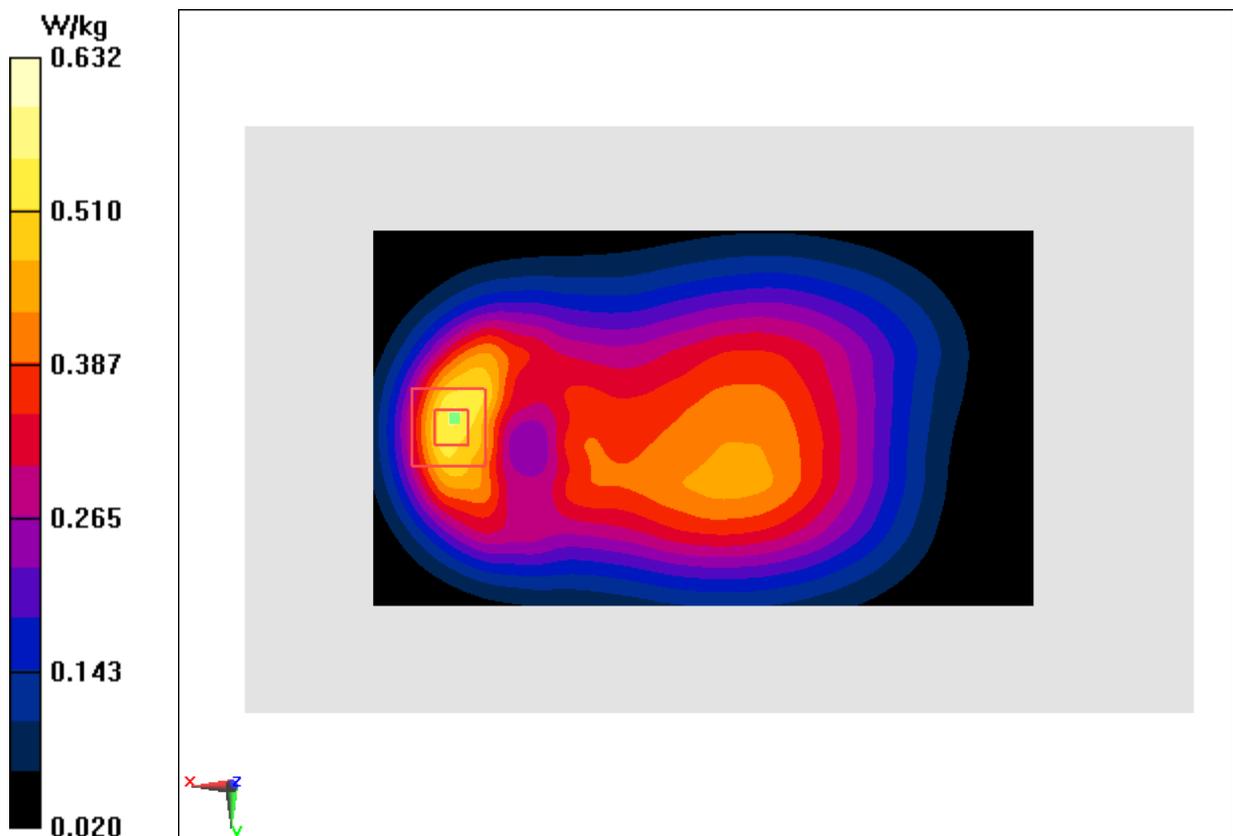


Fig.8LTE Band5

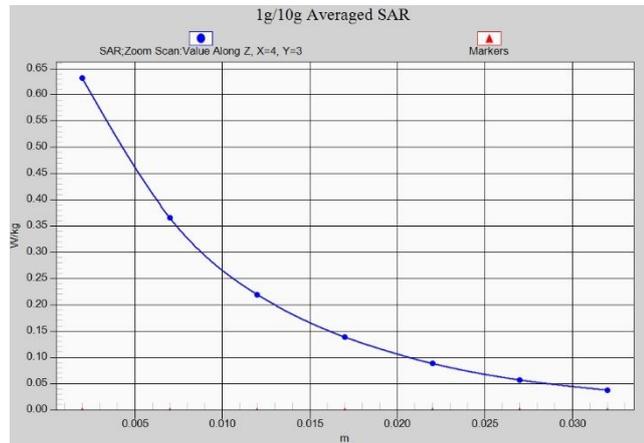


Fig. 8-1 Z-Scan at power reference point (LTE Band5)

LTE Band7 Right Cheek Middle with QPSK_20M_1RB_Middle

Date: 2019-1-11

Electronics: DAE4 Sn1555

Medium: Head 2600 MHz

Medium parameters used: $f = 2535$ MHz; $\sigma = 1.856$ mho/m; $\epsilon_r = 37.88$; $\rho = 1000$ kg/m³

Ambient Temperature: 22.9°C Liquid Temperature: 22.5°C

Communication System: LTE Band7 Frequency: 2535 MHz Duty Cycle: 1:1

Probe: EX3DV4– SN7514 ConvF(6.92, 6.92, 6.92)

Area Scan (91x151x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 0.122 W/kg

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

Reference Value = 2.517 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 0.161 W/kg

SAR(1 g) = 0.086 W/kg; SAR(10 g) = 0.043 W/kg

Maximum value of SAR (measured) = 0.109 W/kg

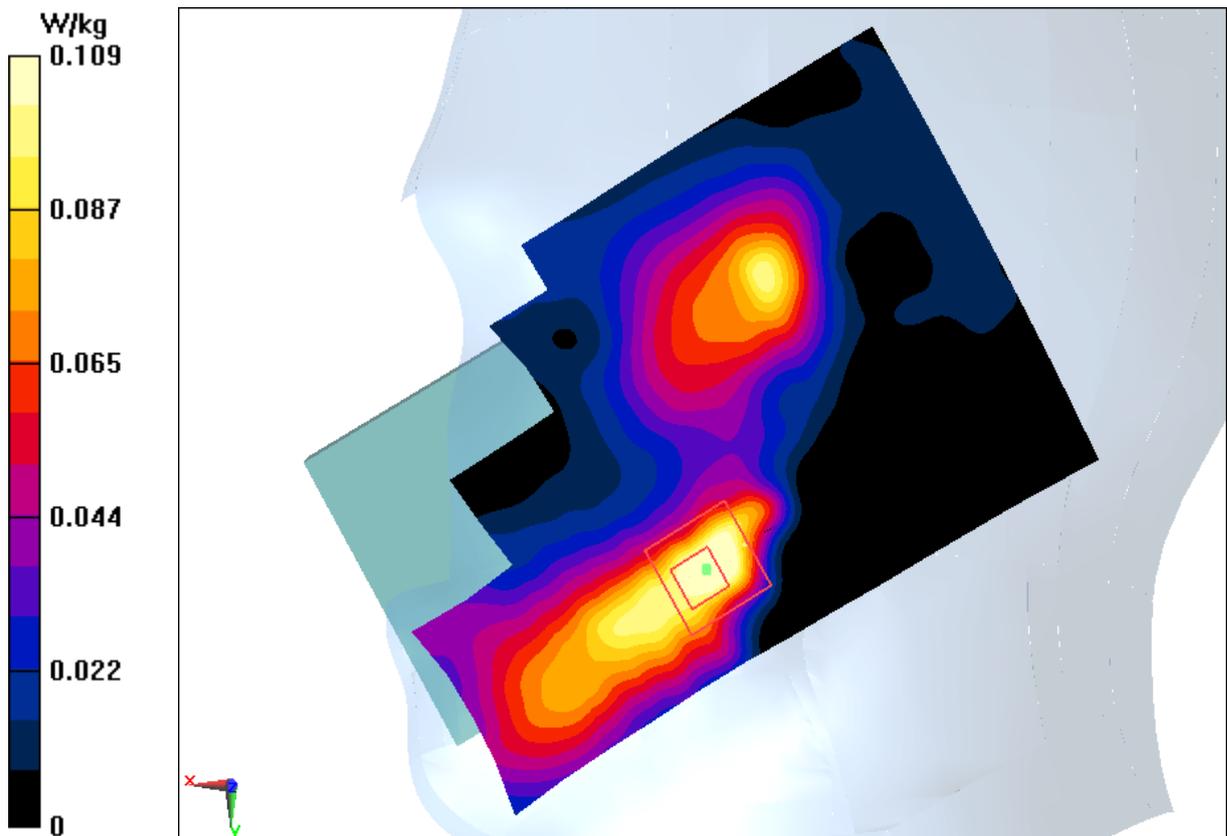


Fig.9 LTE Band7

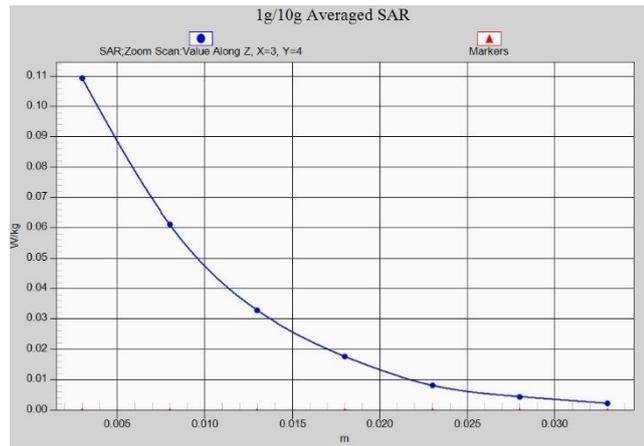


Fig. 9-1 Z-Scan at power reference point (LTE Band7)

LTE Band7 Body Rear Low with QPSK_20M_1RB_Middle

Date: 2019-1-11

Electronics: DAE4 Sn1555

Medium: Body 2600 MHz

Medium parameters used: $f = 2535$ MHz; $\sigma = 2.176$ mho/m; $\epsilon_r = 51.28$; $\rho = 1000$ kg/m³

Ambient Temperature: 22.9°C Liquid Temperature: 22.5°C

Communication System: LTE Band7 Frequency: 2535 MHz Duty Cycle: 1:1

Probe: EX3DV4– SN7514 ConvF(7.06, 7.06, 7.06)

Area Scan (161x91x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 0.978 W/kg

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

Reference Value = 5.222 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 1.31 W/kg

SAR(1 g) = 0.673 W/kg; SAR(10 g) = 0.333 W/kg

Maximum value of SAR (measured) = 0.989 W/kg

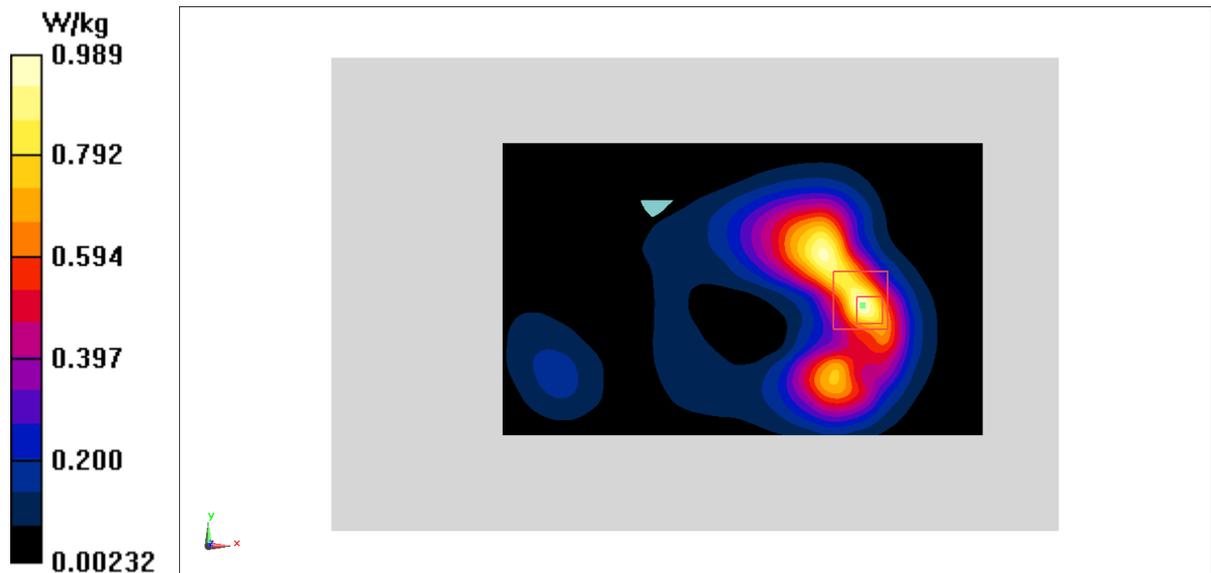


Fig.10 LTE Band7

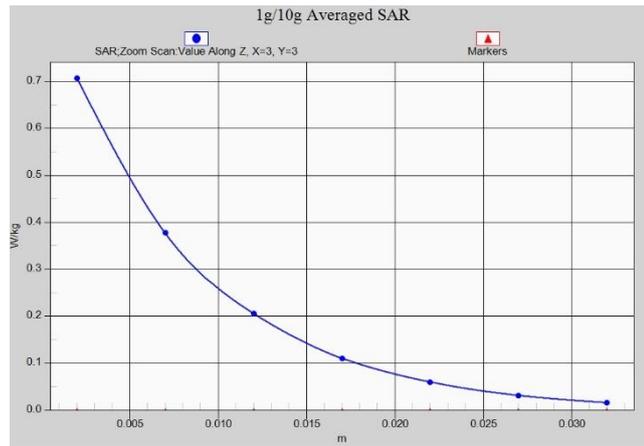


Fig. 10-1 Z-Scan at power reference point (LTE Band7)

LTE Band 41 Left Cheek High with QPSK_20M_1RB_Middle

Date: 2019-1-10

Electronics: DAE4 Sn1555

Medium: Head 2600 MHz

Medium parameters used: $f = 2612.5$ MHz; $\sigma = 1.867$ mho/m; $\epsilon_r = 37.88$; $\rho = 1000$ kg/m³

Ambient Temperature: 22.9°C Liquid Temperature: 22.5°C

Communication System: LTE Band41 Frequency: 2612.5 MHz Duty Cycle: 1:1

Probe: EX3DV4 - SN7514 ConvF(6.92, 6.92, 6.92)

Area Scan (91x161x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 0.122 W/kg

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

Reference Value = 2.419 V/m; Power Drift = 0.15 dB

Peak SAR (extrapolated) = 0.144 W/kg

SAR(1 g) = 0.072 W/kg; SAR(10 g) = 0.035 W/kg

Maximum value of SAR (measured) = 0.104 W/kg

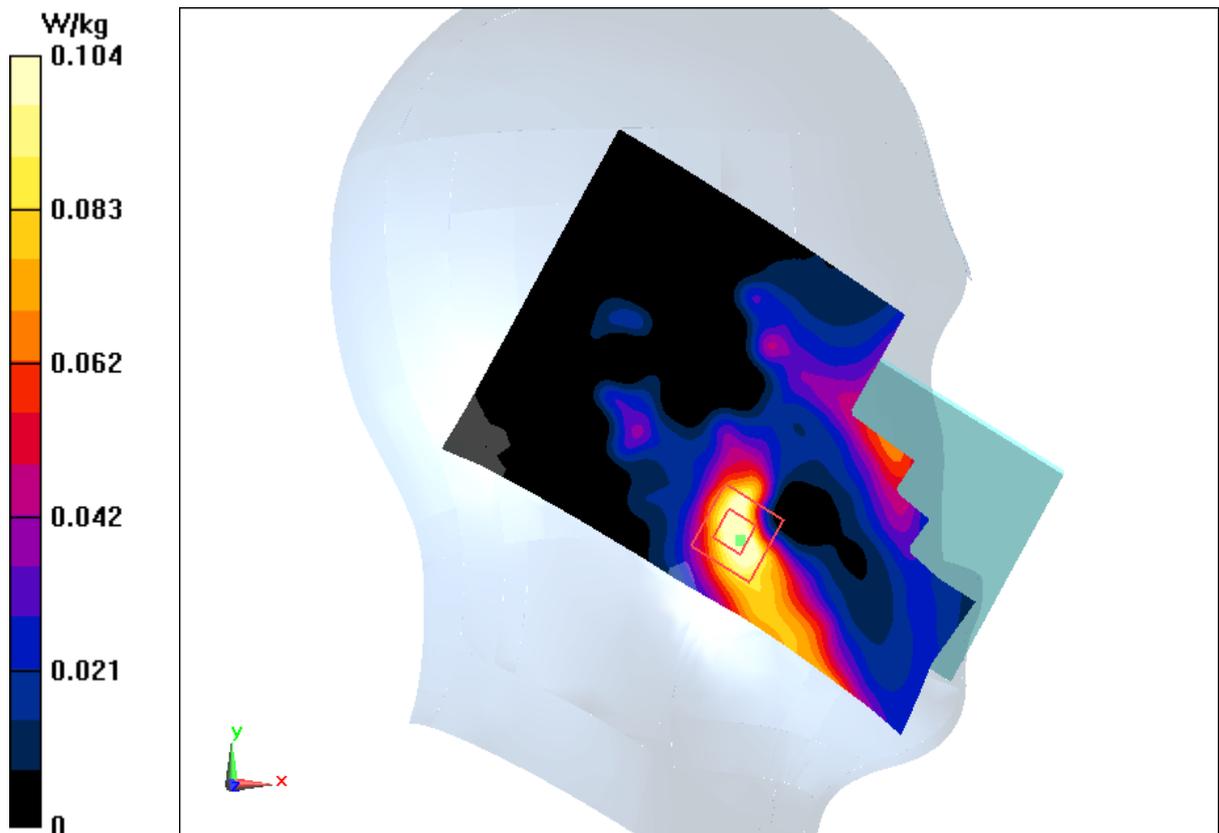


Fig.11 LTE Band 41

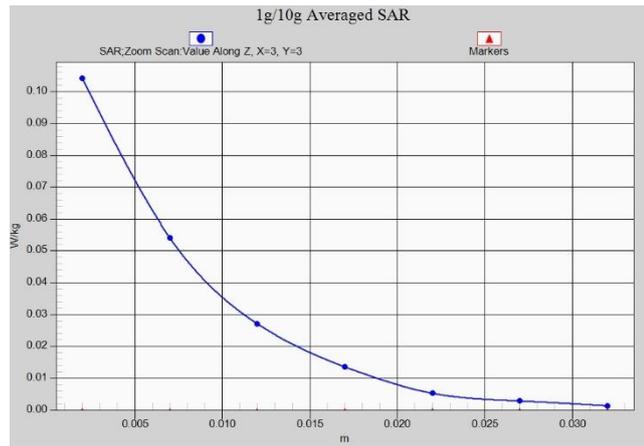


Fig. 11-1 Z-Scan at power reference point (LTE Band 41)

LTE Band 41 Body Rear High with QPSK_20M_1RB_Middle

Date: 2019-1-10

Electronics: DAE4 Sn1555

Medium: Body 2600 MHz

Medium parameters use: $f = 2612.5$ MHz; $\sigma = 2.206$ mho/m; $\epsilon_r = 51.239$; $\rho = 1000$ kg/m³

Ambient Temperature: 22.9°C Liquid Temperature: 22.5°C

Communication System: LTE Band41 Frequency: 2612.5 MHz Duty Cycle: 1:1

Probe: EX3DV4 - SN7514 ConvF(7.06, 7.06, 7.06)

Area Scan (91x161x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 1.42 W/kg

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

Reference Value = 3.435 V/m; Power Drift = 0.13 dB

Peak SAR (extrapolated) = 1.80 W/kg

SAR(1 g) = 0.911 W/kg; SAR(10 g) = 0.468 W/kg

Maximum value of SAR (measured) = 1.33 W/kg

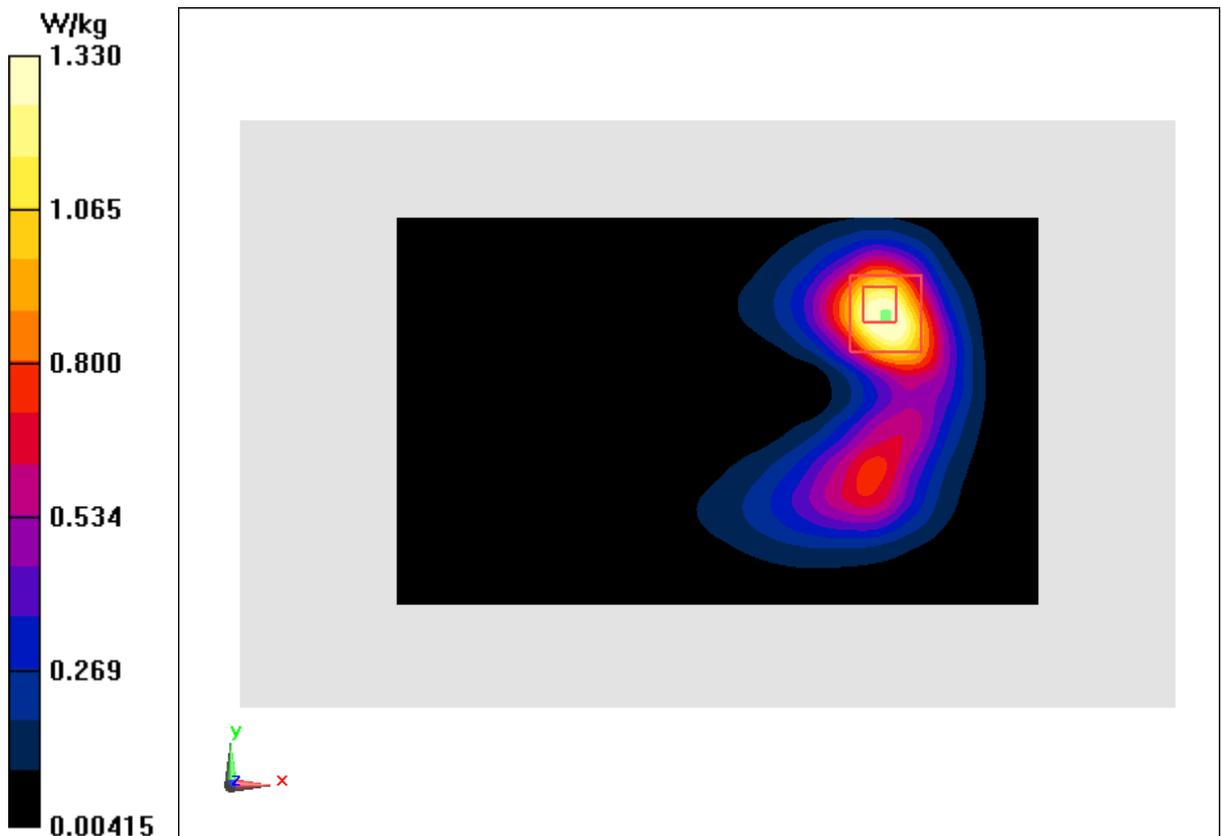


Fig.12 LTE Band 41

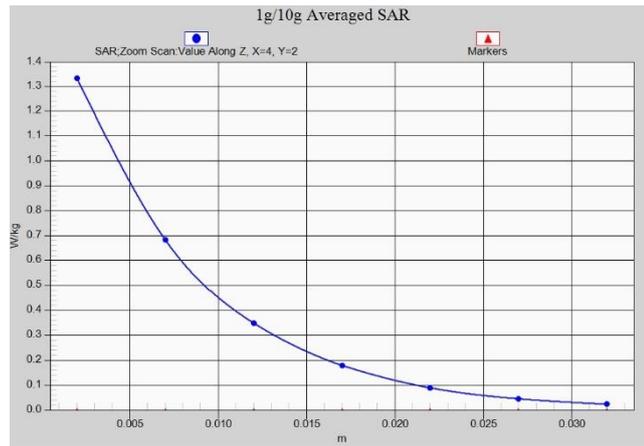


Fig. 12-1 Z-Scan at power reference point (LTE Band 41)

Wifi 802.11b Left Tilt Channel 6

Date: 2019-1-11

Electronics: DAE4 Sn1555

Medium: Head 2450 MHz

Medium parameters used (interpolated): $f = 2437$ MHz; $\sigma = 1.823$ mho/m; $\epsilon_r = 39.66$; $\rho = 1000$ kg/m³

Ambient Temperature: 22.9°C Liquid Temperature: 22.5°C

Communication System: WLAN 2450 Frequency: 2437 MHz Duty Cycle: 1:1

Probe: EX3DV4- SN7514 ConvF(6.95, 6.95, 6.95)

Area Scan (91x151x1): Interpolated grid: $dx=1.000$ mm, $dy=1.000$ mm

Maximum value of SAR (interpolated) = 0.271 W/kg

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

Reference Value = 8.513 V/m; Power Drift = -0.18 dB

Peak SAR (extrapolated) = 0.576 W/kg

SAR(1 g) = 0.203 W/kg; SAR(10 g) = 0.080 W/kg

Maximum value of SAR (measured) = 0.427 W/kg

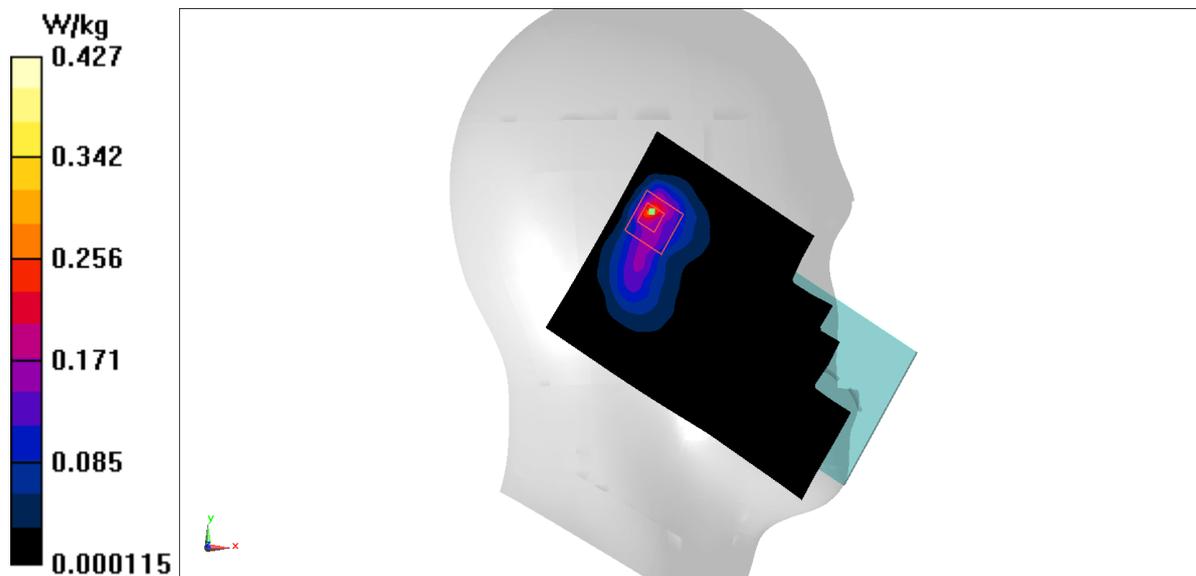


Fig.13 2450 MHz

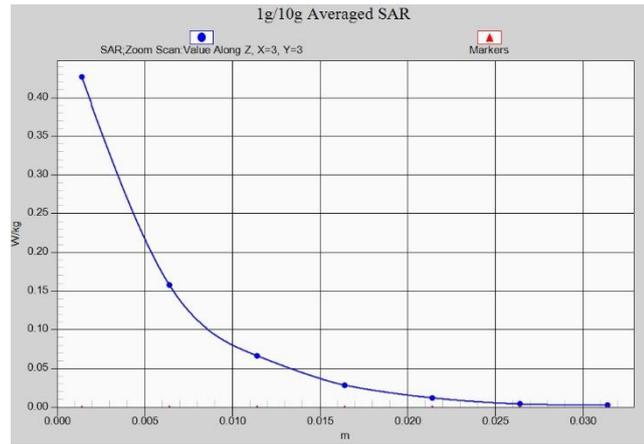


Fig. 13-1 Z-Scan at power reference point (2450 MHz)

Wifi 802.11b Body Top Edge Channe 6

Date: 2019-1-11

Electronics: DAE4 Sn1555

Medium: Body 2450 MHz

Medium parameters used (interpolated): $f = 2412$ MHz; $\sigma = 1.882$ mho/m; $\epsilon_r = 52.03$; $\rho = 1000$ kg/m³

Ambient Temperature: 22.9°C Liquid Temperature: 22.5°C

Communication System: WLAN 2450 Frequency: 2412 MHz Duty Cycle: 1:1

Probe: EX3DV4 – SN7514 ConvF(7.13, 7.13, 7.13)

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

Maximum value of SAR (interpolated) = 0.0662 W/kg

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

Reference Value = 5.111 V/m; Power Drift = 0.12 dB

Peak SAR (extrapolated) = 0.0940 W/kg

SAR(1 g) = 0.053 W/kg; SAR(10 g) = 0.029 W/kg

Maximum value of SAR (measured) = 0.0746 W/kg

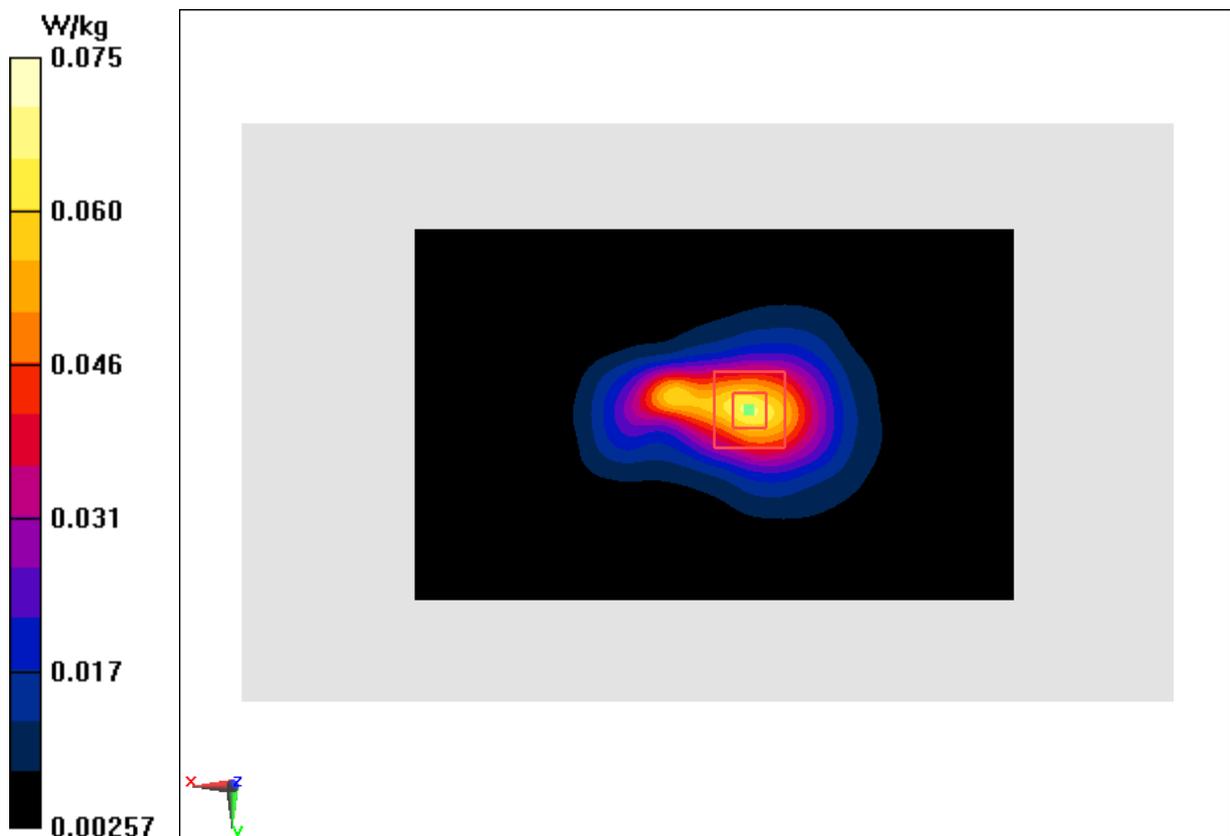


Fig.14 2450 MHz

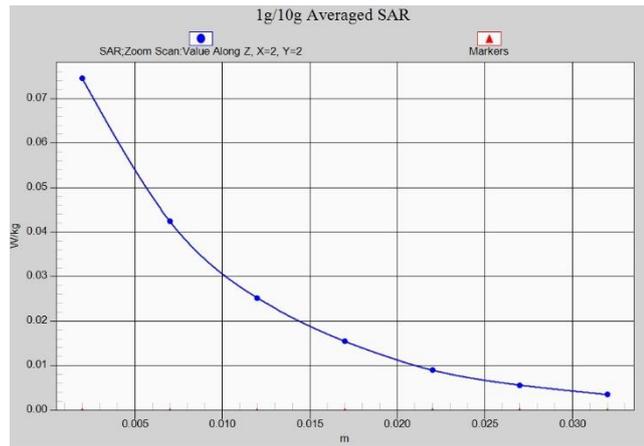


Fig. 14-1 Z-Scan at power reference point (2450 MHz)

ANNEX B System Verification Results

835MHz

Date: 2019-1-9

Electronics: DAE4 Sn1555

Medium: Head 850 MHz

Medium parameters used: $f = 835$ MHz; $\sigma = 0.907$ S/m; $\epsilon_r = 41.75$; $\rho = 1000$ kg/m³

Ambient Temperature: 22.9°C Liquid Temperature: 22.5°C

Communication System: CW Frequency: 835 MHz Duty Cycle: 1:1

Probe: EX3DV4 – SN7514 ConvF(9.09, 9.09, 9.09)

System Validation/Area Scan (61x121x1): Interpolated grid: $dx=1.000$ mm, $dy=1.000$ mm

Reference Value = 54.38 V/m; Power Drift = -0.07 dB

Fast SAR: SAR(1 g) = 2.36 W/kg; SAR(10 g) = 1.74 W/kg

Maximum value of SAR (interpolated) = 2.56 W/kg

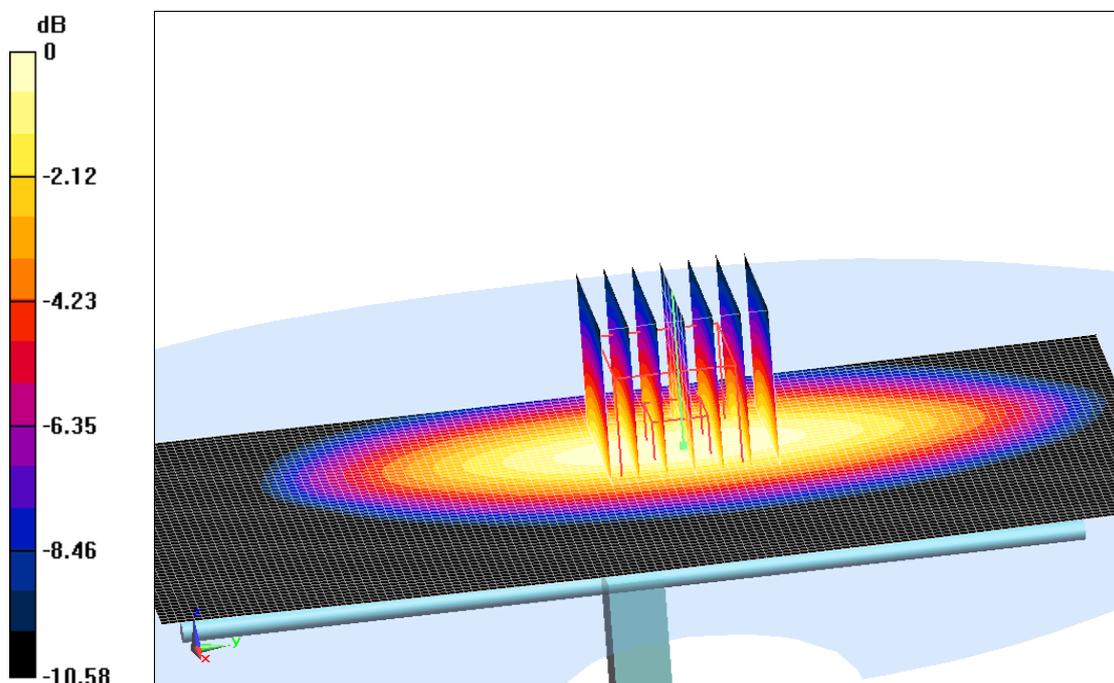
System Validation/Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5$ mm, $dy=5$ mm, $dz=5$ mm

Reference Value = 54.38 V/m; Power Drift = -0.07 dB

Peak SAR (extrapolated) = 3.05 W/kg

SAR(1 g) = 2.33 W/kg; SAR(10 g) = 1.72 W/kg

Maximum value of SAR (measured) = 2.53 W/kg



0 dB = 2.53 W/kg = 4.03 dBW/kg

Fig.B.1 validation 835MHz 250mW

835MHz

Date: 2019-1-9

Electronics: DAE4 Sn1555

Medium: Body 850 MHz

Medium parameters used: $f = 835 \text{ MHz}$; $\sigma = 0.985 \text{ S/m}$; $\epsilon_r = 55.81$; $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature: 22.9°C Liquid Temperature: 22.5°C

Communication System: CW Frequency: 835 MHz Duty Cycle: 1:1

Probe: EX3DV4 – SN7514 ConvF(9.47, 9.47, 9.47)

System Validation /Area Scan (61x121x1): Interpolated grid: $dx=1.000 \text{ mm}$, $dy=1.000 \text{ mm}$

Reference Value = 51.76 V/m ; Power Drift = 0.04 dB

Fast SAR: SAR(1 g) = 2.26 W/kg ; SAR(10 g) = 1.16 W/kg

Maximum value of SAR (interpolated) = 2.60 W/kg

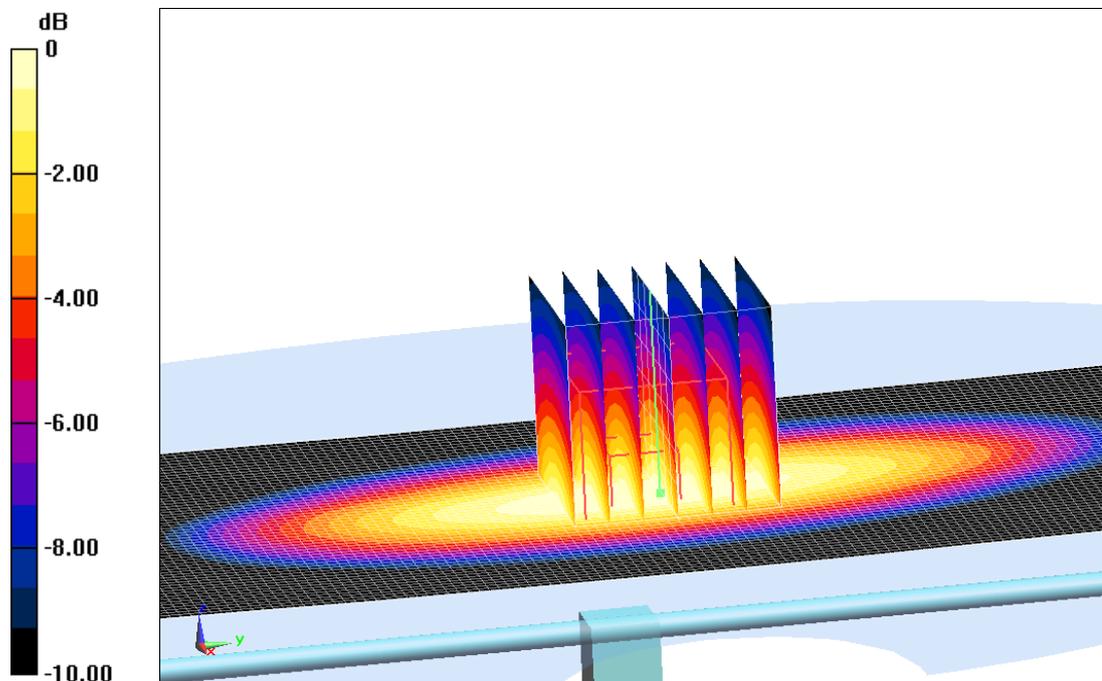
System Validation /Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 51.76 V/m ; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 3.05 W/kg

SAR(1 g) = 2.30 W/kg ; SAR(10 g) = 1.39 W/kg

Maximum value of SAR (measured) = 2.65 W/kg



0 dB = 2.65 W/kg = 4.23 dBW/kg

Fig.B.2 validation 835MHz 250mW

1900MHz

Date: 2019-1-11

Electronics: DAE4 Sn1555

Medium: Head 1900 MHz

Medium parameters used: $f = 1900 \text{ MHz}$; $\sigma = 1.410 \text{ mho/m}$; $\epsilon_r = 40.59$; $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature: 22.9°C Liquid Temperature: 22.5°C

Communication System: CW Frequency: 1900 MHz Duty Cycle: 1:1

Probe: EX3DV4 – SN7514 ConvF (7.73, 7.73, 7.73)

System Validation /Area Scan(61x81x1): Interpolated grid: $dx=1.000 \text{ mm}$, $dy=1.000 \text{ mm}$

Reference Value = 90.9 V/m ; Power Drift = -0.05 dB

SAR(1 g) = 11.3 W/kg ; SAR(10 g) = 6.11 W/kg

Maximum value of SAR (interpolated) = 13.4 W/kg

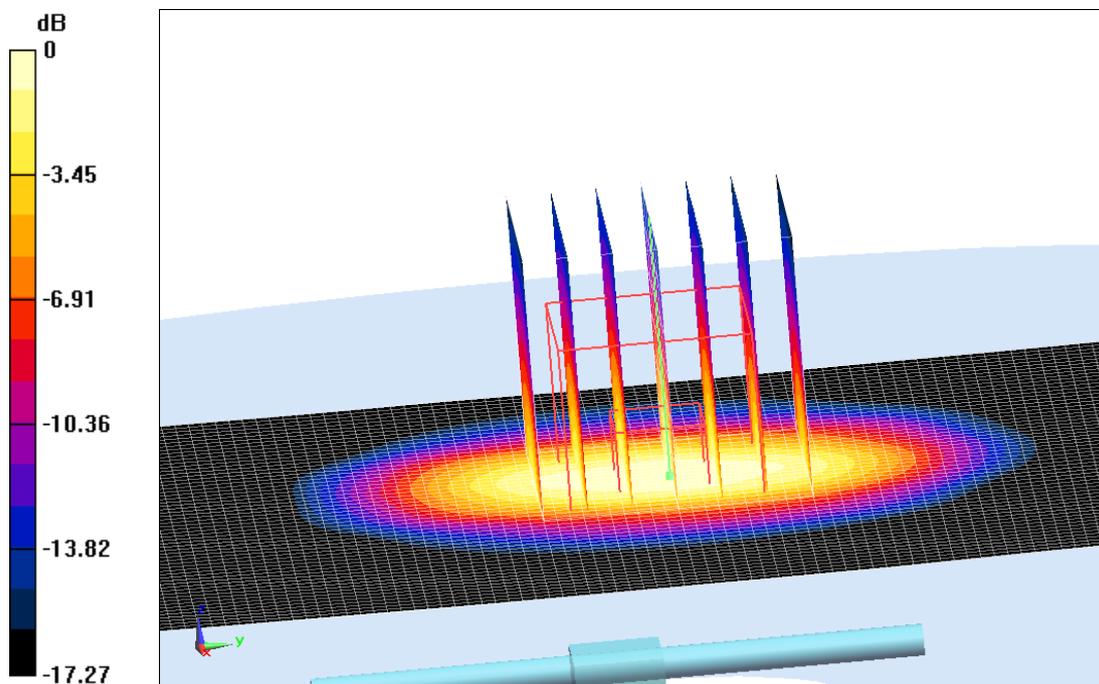
System Validation /Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 90.9 V/m ; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 18.99 W/kg

SAR(1 g) = 11.2 W/kg ; SAR(10 g) = 6.04 W/kg

Maximum value of SAR (measured) = 13.3 W/kg



0 dB = 13.3 W/kg = 11.24 dBW/kg

Fig.B.3 validation 1900MHz 250mW

1900MHz

Date: 2019-1-11

Electronics: DAE4 Sn1555

Medium: Body 1900 MHz

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.545$ S/m; $\epsilon_r = 52.60$; $\rho = 1000$ kg/m³

Ambient Temperature: 22.9°C Liquid Temperature: 22.5°C

Communication System: CW Frequency: 1900 MHz Duty Cycle: 1:1

Probe: EX3DV4 – SN7514 ConvF(7.53, 7.53, 7.53)

System Validation/Area Scan (81x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Reference Value = 91.5 V/m; Power Drift = 0.05 dB

Fast SAR: SAR(1 g) = 10.2 W/kg; SAR(10 g) = 5.26 W/kg

Maximum value of SAR (interpolated) = 12.5 W/kg

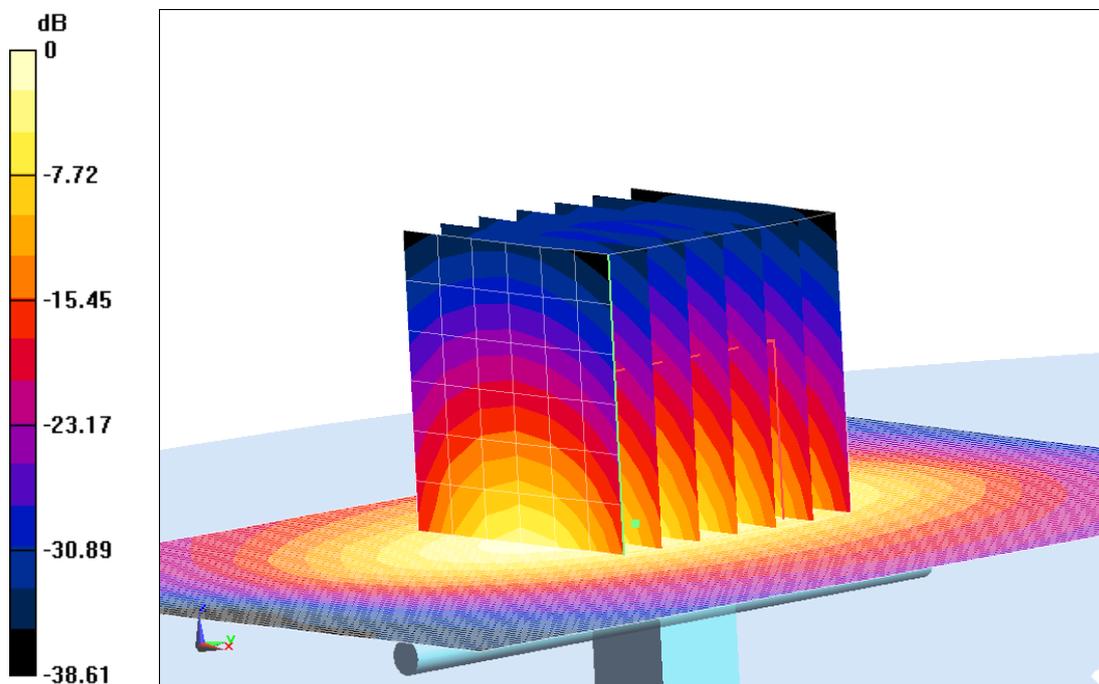
System Validation/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 91.5 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 18.65 W/kg

SAR(1 g) = 10.1 W/kg; SAR(10 g) = 5.27 W/kg

Maximum value of SAR (measured) = 12.1 W/kg



0 dB = 12.1 W/kg = 10.83 dB W/kg

Fig.B.4 validation 1900MHz 250mW

2450MHz

Date: 2019-1-11

Electronics: DAE4 Sn1555

Medium: Head 2450 MHz

Medium parameters used: $f = 2450$ MHz; $\sigma = 1.835$ mho/m; $\epsilon_r = 39.60$; $\rho = 1000$ kg/m³

Ambient Temperature: 22.9°C Liquid Temperature: 22.5°C

Communication System: CW Frequency: 2450 MHz Duty Cycle: 1:1

Probe: EX3DV4 – SN7514 ConvF(6.95, 6.95, 6.95)

System Validation /Area Scan (61x81x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Reference Value = 81.12 V/m; Power Drift = -0.07 dB

SAR(1 g) = 13.4 W/kg; SAR(10 g) = 5.94 W/kg

Maximum value of SAR (interpolated) = 15.8 W/kg

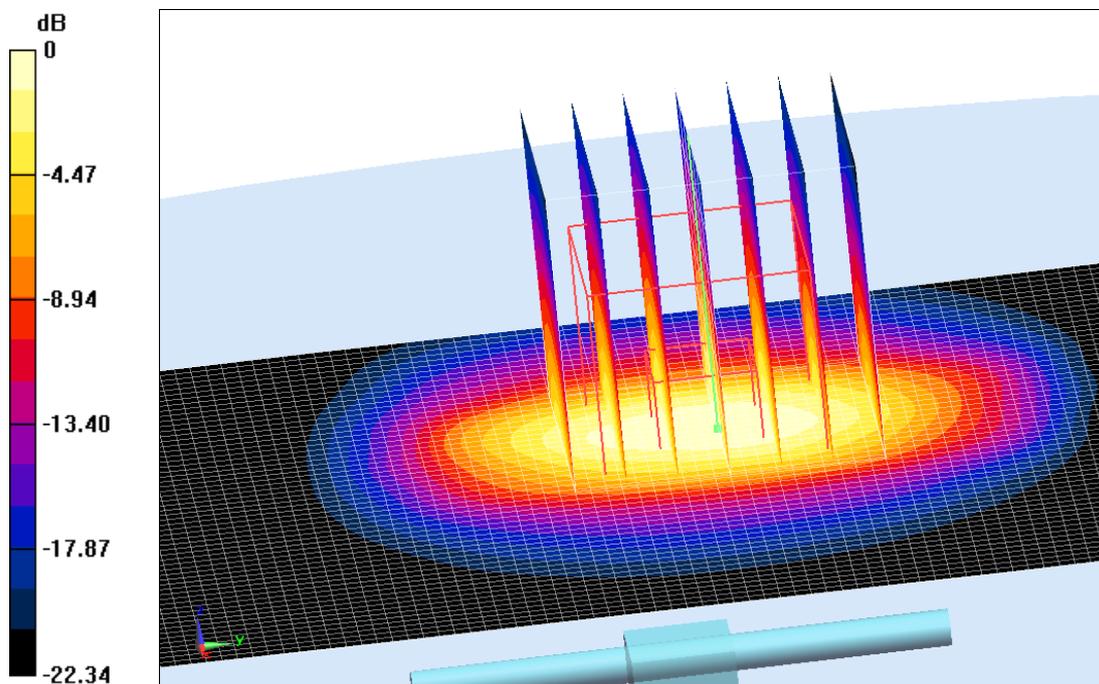
System Validation /Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 81.12 V/m; Power Drift = -0.07 dB

Peak SAR (extrapolated) = 26.45 W/kg

SAR(1 g) = 13.2 W/kg; SAR(10 g) = 5.76 W/kg

Maximum value of SAR (measured) = 15.6 W/kg



0 dB = 15.6 W/kg = 11.93 dBW/kg

Fig.B.5 validation 2450MHz 250mW

2450MHz

Date: 2019-1-11

Electronics: DAE4 Sn1555

Medium: Body 2450 MHz

Medium parameters used: $f = 2450 \text{ MHz}$; $\sigma = 1.964 \text{ S/m}$; $\epsilon_r = 53.27$; $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature: 22.9°C Liquid Temperature: 22.5°C

Communication System: CW Frequency: 2450 MHz Duty Cycle: 1:1

Probe: EX3DV4 – SN7514 ConvF(7.13, 7.13, 7.13)

System Validation/Area Scan (81x101x1): Interpolated grid: $dx=1.000 \text{ mm}$, $dy=1.000 \text{ mm}$

Reference Value = 94.28 V/m ; Power Drift = 0.06 dB

SAR(1 g) = 13.3 W/kg ; SAR(10 g) = 6.06 W/kg

Maximum value of SAR (interpolated) = 14.9 W/kg

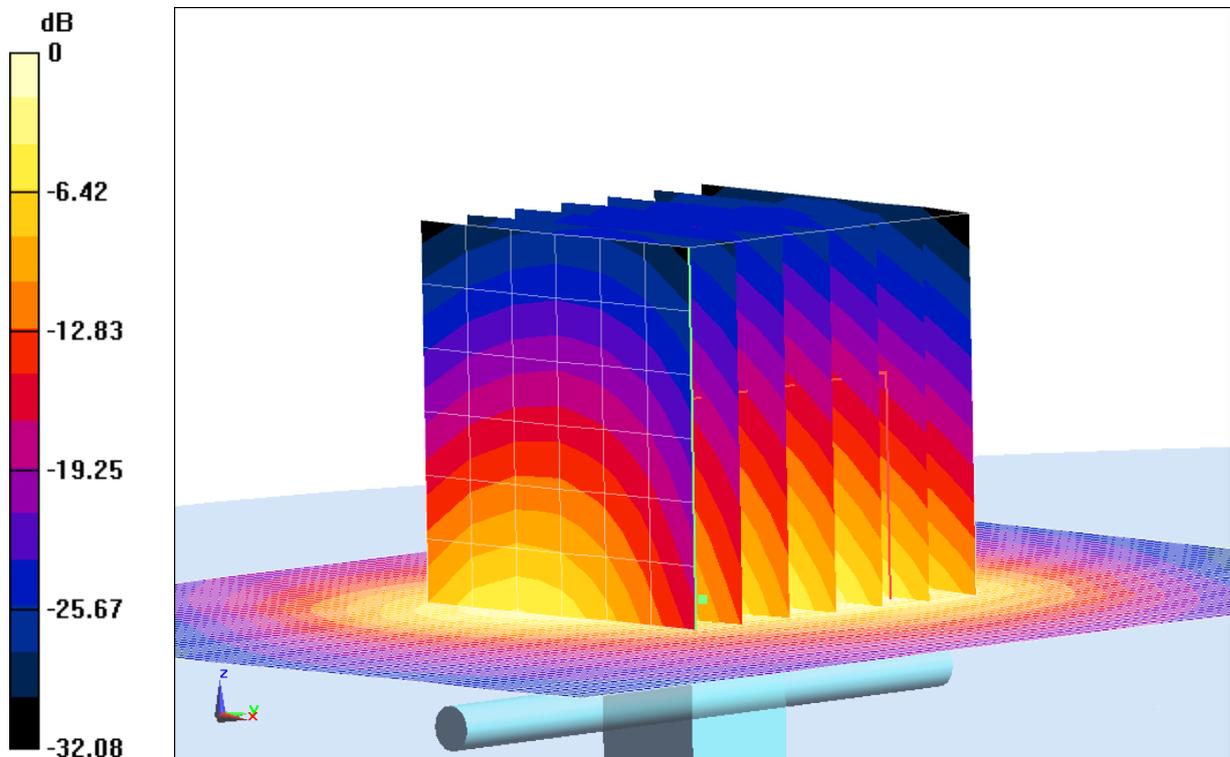
System Validation/Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 94.28 V/m ; Power Drift = 0.06 dB

Peak SAR (extrapolated) = 25.09 W/kg

SAR(1 g) = 13.5 W/kg ; SAR(10 g) = 6.24 W/kg

Maximum value of SAR (measured) = 15.1 W/kg



0 dB = 15.1 W/kg = 11.79 dB W/kg

Fig.B.6 validation 2450MHz 250mW

2600MHz

Date: 2019-1-10

Electronics: DAE4 Sn1555

Medium: Head 2600 MHz

Medium parameters used: $f = 2600$ MHz; $\sigma = 1.958$ mho/m; $\epsilon_r = 37.95$; $\rho = 1000$ kg/m³

Ambient Temperature: 22.9°C Liquid Temperature: 22.5°C

Communication System: CW Frequency: 2600 MHz Duty Cycle: 1:1

Probe: EX3DV4 – SN7514 ConvF(6.92, 6.92, 6.92)

System Validation/Area Scan(81x81x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Reference Value = 81.33 V/m; Power Drift = -0.08 dB

SAR(1 g) = 14.3 W/kg; SAR(10 g) = 6.84 W/kg

Maximum value of SAR (interpolated) = 22.1 W/kg

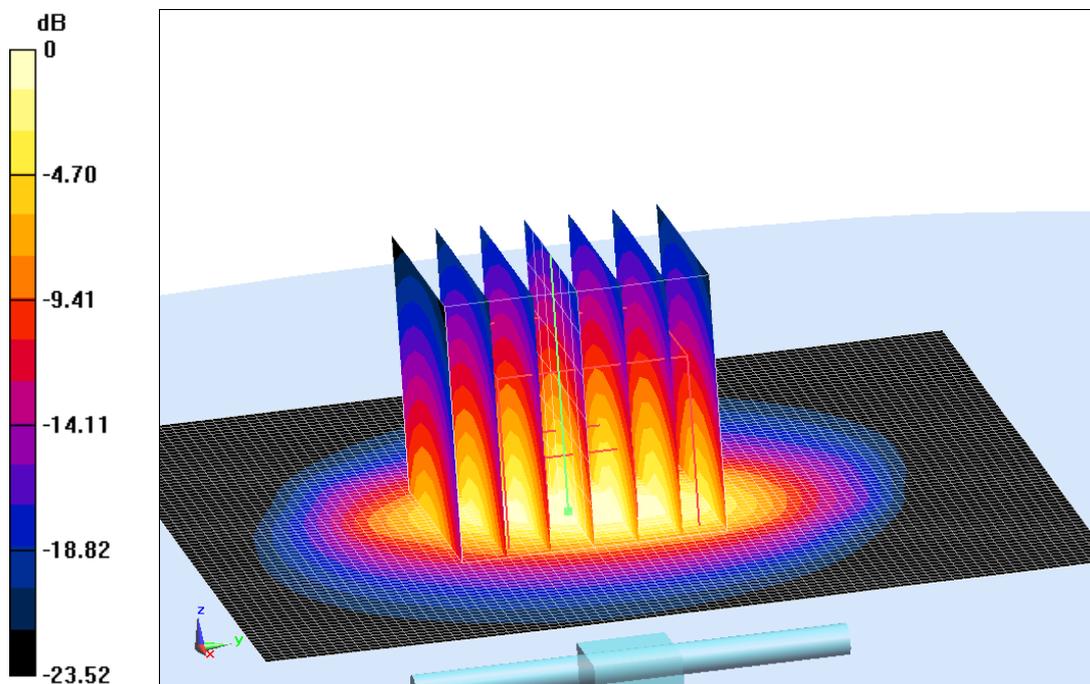
System Validation /Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 81.33 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 31.54 W/kg

SAR(1 g) = 14.1 W/kg; SAR(10 g) = 6.75 W/kg

Maximum value of SAR (measured) = 20.7 W/kg



0 dB = 20.7 W/kg = 13.16 dBW/kg

Fig.B.7 validation 2600MHz 250mW

2600MHz

Date: 2019-1-10

Electronics: DAE4 Sn1555

Medium: Body 2600 MHz

Medium parameters used: $f = 2600$ MHz; $\sigma = 2.204$ mho/m; $\epsilon_r = 51.34$; $\rho = 1000$ kg/m³

Ambient Temperature: 22.9°C Liquid Temperature: 22.5°C

Communication System: CW Frequency: 2600 MHz Duty Cycle: 1:1

Probe: EX3DV4 – SN7514 ConvF(7.06, 7.06, 7.06)

System Validation /Area Scan(81x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Reference Value = 79.75 V/m; Power Drift = -0.05 dB

Fast SAR: SAR(1 g) = 13.9 W/kg; SAR(10 g) = 6.15 W/kg

Maximum value of SAR (interpolated) = 22.2 W/kg

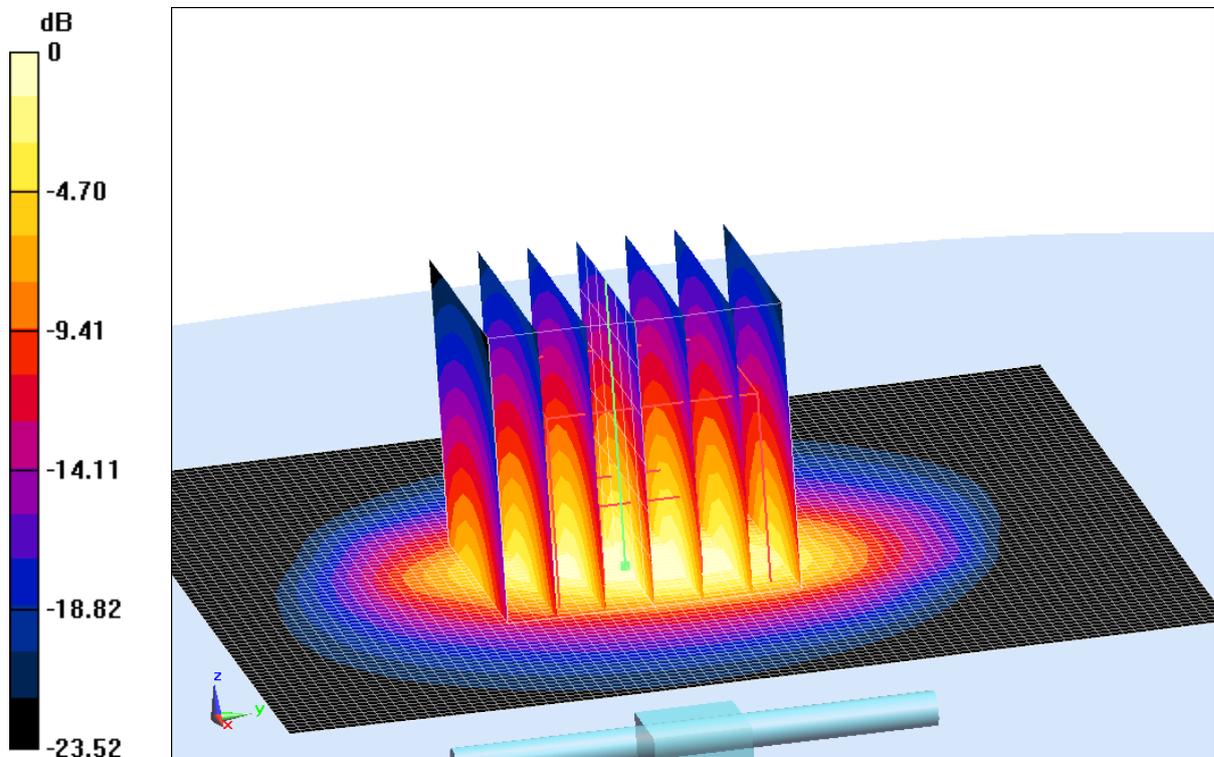
System Validation /Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 79.75 V/m; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 29.55 W/kg

SAR(1 g) = 13.8 W/kg; SAR(10 g) = 6.08W/kg

Maximum value of SAR (measured) = 21.9 W/kg



0 dB = 21.9 W/kg = 13.40 dB W/kg

Fig.B.8 validation 2600MHz 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.

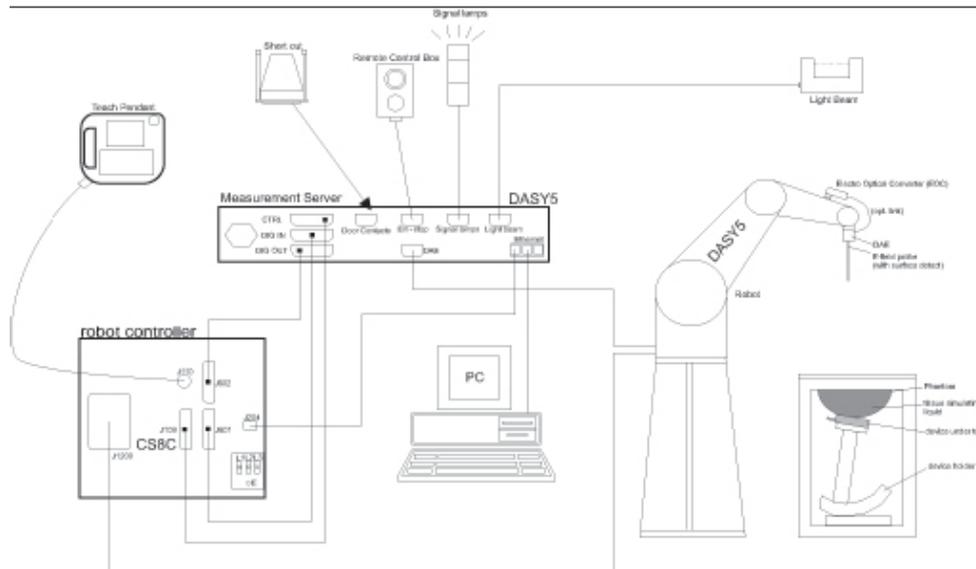
Table B.1 Comparison between area scan and zoom scan for system verification

Date	Band	Position	Area scan (1g)	Zoom scan (1g)	Drift (%)
2019-1-9	835	Head	2.36	2.33	1.29
	835	Body	2.26	2.30	-1.74
2019-1-11	1900	Head	11.3	11.2	0.89
	1900	Body	10.2	10.1	0.99
2019-1-11	2450	Head	13.4	13.2	1.52
	2450	Body	13.3	13.5	-1.48
2019-1-10	2600	Head	14.3	14.1	1.42
	2600	Body	13.9	13.8	0.72

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 during 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
DynamicRange:	10 mW/kg — 100W/kg
Probe Length:	330 mm
Probe Tip	
Length:	20 mm
Body Diameter:	12 mm
Tip Diameter:	2.5 mm (3.9 mm for ES3DV3)
Tip-Center:	1 mm (2.0mm for ES3DV3)
Application:	SAR Dosimetry Testing Compliance tests of mobile phones Dosimetry in strong gradient fields



Picture C.2Near-field Probe



Picture C.3E-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/cm²) 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 in 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/cm².

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/m³).

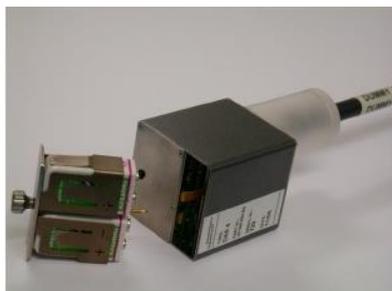
C.4 Other Test Equipment

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 board 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 board, which is directly connected to the PC/104 bus of the CPU board.

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

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 $\pm 0.5\text{mm}$ would produce a SAR uncertainty of $\pm 20\%$. 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.

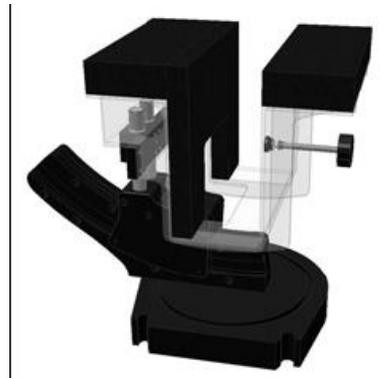
The DASY device holder is designed to cope with the different positions given in the standard. It has two scales for device rotation (with respect to the body axis) and device inclination (with respect to the line between the ear reference points). The rotation centers for both scales are the ear reference 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 $\epsilon = 3$ and loss tangent $\delta = 0.02$. 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.9-1: Device Holder



Picture C.9-2: 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 1000 x 500 mm (H x L x W)

Available: Special

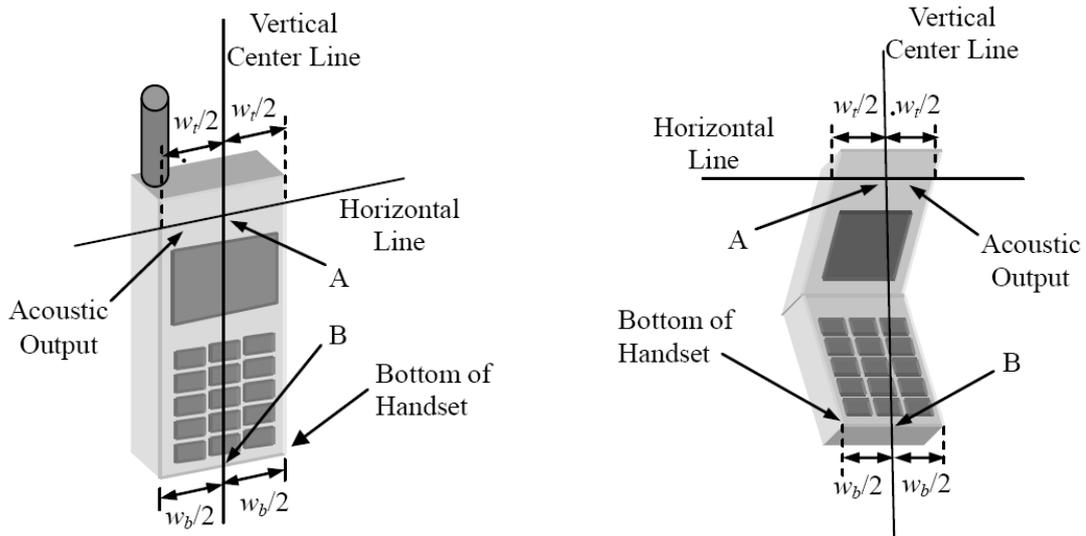


Picture C.10: SAM Twin Phantom

ANNEX D Position of the wireless device in relation to the phantom

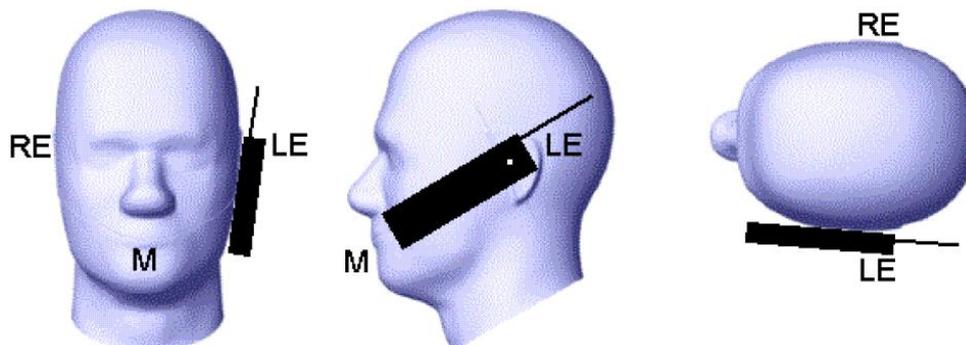
D.1 General considerations

This standard specifies two handset test positions against the head phantom – the “cheek” position and the “tilt” position.

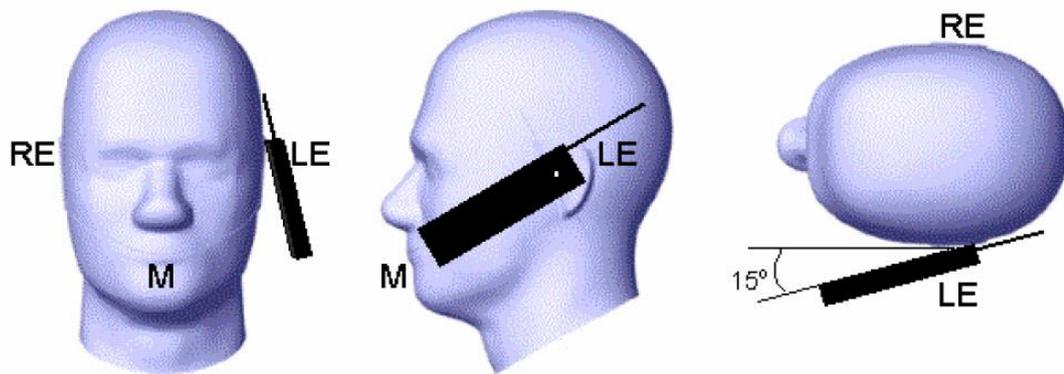


- w_t Width of the handset at the level of the acoustic
- w_b Width of the bottom of the handset
- A Midpoint of the width w_t of the handset at the level of the acoustic output
- B Midpoint of the width w_b of the bottom of the handset

Picture D.1-a Typical “fixed” case handset Picture D.1-b Typical “clam-shell” case handset



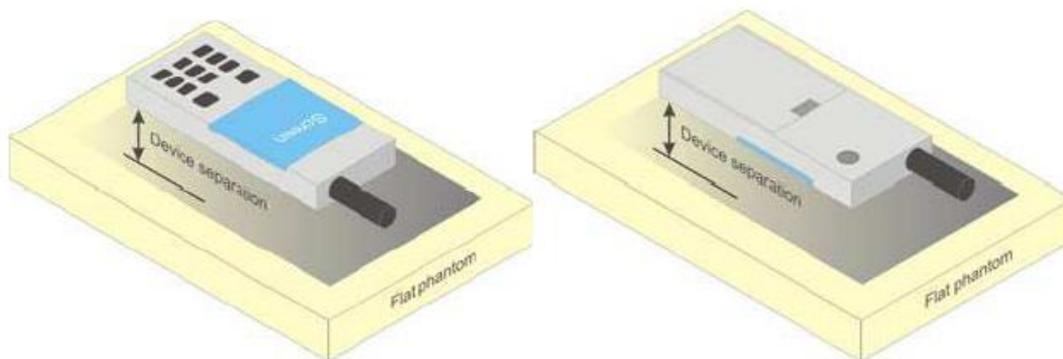
Picture D.2 Cheek position of the wireless device on the left side of SAM



Picture D.3 Tilt position of the wireless device on the left side of SAM

D.2 Body-worn device

A typical example of a body-worn device is a mobile phone, wireless enabled PDA or other battery operated wireless device with the ability to transmit while mounted on a person's body using a carry accessory approved by the wireless device manufacturer.

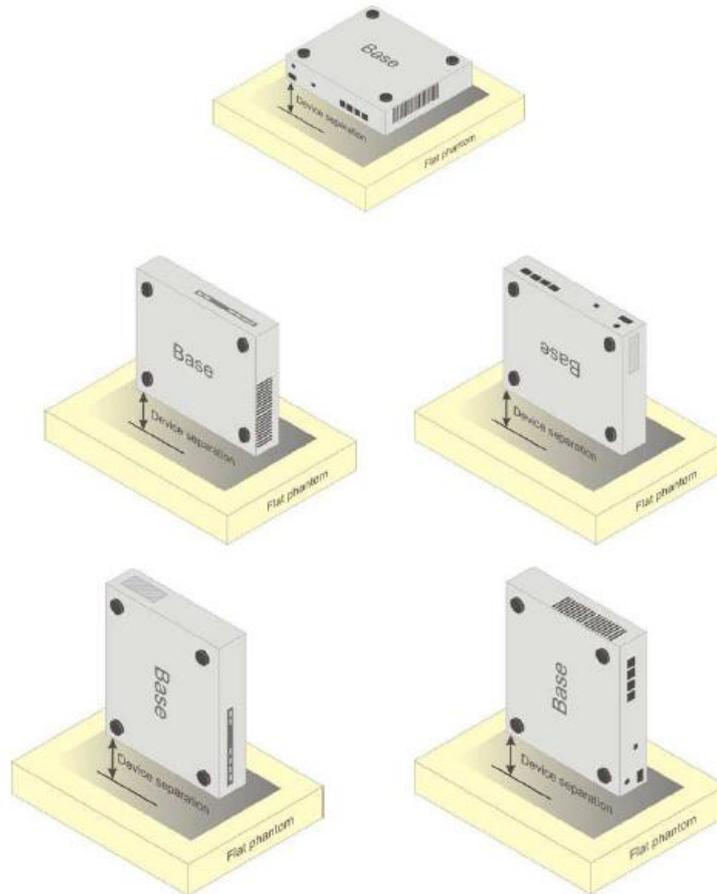


Picture D.4 Test positions for body-worn devices

D.3 Desktop device

A typical example of a desktop device is a wireless enabled desktop computer placed on a table or desk when used.

The DUT shall be positioned at the distance and in the orientation to the phantom that corresponds to the intended use as specified by the manufacturer in the user instructions. For devices that employ an external antenna with variable positions, tests shall be performed for all antenna positions specified. Picture 8.5 show positions for desktop device SAR tests. If the intended use is not specified, the device shall be tested directly against the flat phantom.



Picture D.5 Test positions for desktop devices

D.4 DUT Setup Photos



Picture D.6

ANNEX E Equivalent Media Recipes

The liquid used for the frequency range of 800-3000 MHz consisted of water, sugar, salt, preventol, glycol monobutyl and Cellulose. The liquid has been previously proven to be suited for worst-case. The Table E.1 shows the detail solution. It's satisfying the latest tissue dielectric parameters requirements proposed by the IEEE 1528 and IEC 62209.

TableE.1: Composition of the Tissue Equivalent Matter

Frequency (MHz)	835Head	835Body	1900 Head	1900 Body	2450 Head	2450 Body	5800 Head	5800 Body
Ingredients (% by weight)								
Water	41.45	52.5	55.242	69.91	58.79	72.60	65.53	65.53
Sugar	56.0	45.0	\	\	\	\	\	\
Salt	1.45	1.4	0.306	0.13	0.06	0.18	\	\
Preventol	0.1	0.1	\	\	\	\	\	\
Cellulose	1.0	1.0	\	\	\	\	\	\
Glycol Monobutyl	\	\	44.452	29.96	41.15	27.22	\	\
Diethylenglycol monohexylether	\	\	\	\	\	\	17.24	17.24
Triton X-100	\	\	\	\	\	\	17.24	17.24
Dielectric Parameters Target Value	$\epsilon=41.5$ $\sigma=0.90$	$\epsilon=55.2$ $\sigma=0.97$	$\epsilon=40.0$ $\sigma=1.40$	$\epsilon=53.3$ $\sigma=1.52$	$\epsilon=39.2$ $\sigma=1.80$	$\epsilon=52.7$ $\sigma=1.95$	$\epsilon=35.3$ $\sigma=5.27$	$\epsilon=48.2$ $\sigma=6.00$

Note: There are a little adjustment respectively for 750, 1750, 2600, 5200, 5300 and 5600 based on the recipe of closest frequency in table E.1.

ANNEX F System Validation

The SAR system must be validated against its performance specifications before it is deployed. When SAR probes, system components or software are changed, upgraded or recalibrated, these must be validated with the SAR system(s) that operates with such components.

Table F.1: System Validation for 7514

Probe SN.	Liquid name	Validation date	Frequency point	Status (OK or Not)
7514	Head 750MHz	Sep.10,2018	750 MHz	OK
7514	Head 850MHz	Sep.10,2018	835 MHz	OK
7514	Head 900MHz	Sep.10,2018	900 MHz	OK
7514	Head 1750MHz	Sep.10,2018	1750 MHz	OK
7514	Head 1810MHz	Sep.10,2018	1810 MHz	OK
7514	Head 1900MHz	Sep.11,2018	1900 MHz	OK
7514	Head 2000MHz	Sep.11,2018	2000 MHz	OK
7514	Head 2100MHz	Sep.11,2018	2100 MHz	OK
7514	Head 2300MHz	Sep.11,2018	2300 MHz	OK
7514	Head 2450MHz	Sep.11,2018	2450 MHz	OK
7514	Head 2600MHz	Sep.12,2018	2600 MHz	OK
7514	Head 3500MHz	Sep.12,2018	3500 MHz	OK
7514	Head 3700MHz	Sep.12,2018	3700 MHz	OK
7514	Head 5200MHz	Sep.12,2018	5250 MHz	OK
7514	Head 5500MHz	Sep.12,2018	5600 MHz	OK
7514	Head 5800MHz	Sep.12,2018	5800 MHz	OK
7514	Body 750MHz	Sep.12,2018	750 MHz	OK
7514	Body 850MHz	Sep.9,2018	835 MHz	OK
7514	Body 900MHz	Sep.9,2018	900 MHz	OK
7514	Body 1750MHz	Sep.9,2018	1750 MHz	OK
7514	Body 1810MHz	Sep.9,2018	1810 MHz	OK
7514	Body 1900MHz	Sep.9,2018	1900 MHz	OK
7514	Body 2000MHz	Sep.13,2018	2000 MHz	OK
7514	Body 2100MHz	Sep.13,2018	2100 MHz	OK
7514	Body 2300MHz	Sep.13,2018	2300 MHz	OK
7514	Body 2450MHz	Sep.13,2018	2450 MHz	OK
7514	Body 2600MHz	Sep.13,2018	2600 MHz	OK
7514	Body 3500MHz	Sep.8,2018	3500 MHz	OK
7514	Body 3700MHz	Sep.8,2018	3700 MHz	OK
7514	Body 5200MHz	Sep.8,2018	5250 MHz	OK
7514	Body 5500MHz	Sep.8,2018	5600 MHz	OK
7514	Body 5800MHz	Sep.8,2018	5800 MHz	OK

ANNEX G Probe Calibration Certificate

Probe 7514 Calibration Certificate

Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland



S Schweizerischer Kalibrierdienst
S Service suisse d'étalonnage
S Servizio svizzero di taratura
S Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **CTTL-BJ (Auden)**

Certificate No: **EX3-7514_Aug18**

CALIBRATION CERTIFICATE

Object **EX3DV4 - SN:7514**

Calibration procedure(s) **QA CAL-01.v9, QA CAL-12.v9, QA CAL-14.v4, QA CAL-23.v5,
QA CAL-25.v6
Calibration procedure for dosimetric E-field probes**

Calibration date: **August 27, 2018**

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	04-Apr-18 (No. 217-02672/02673)	Apr-19
Power sensor NRP-Z91	SN: 103244	04-Apr-18 (No. 217-02672)	Apr-19
Power sensor NRP-Z91	SN: 103245	04-Apr-18 (No. 217-02673)	Apr-19
Reference 20 dB Attenuator	SN: S5277 (20x)	04-Apr-18 (No. 217-02682)	Apr-19
Reference Probe ES3DV2	SN: 3013	30-Dec-17 (No. ES3-3013_Dec17)	Dec-18
DAE4	SN: 660	21-Dec-17 (No. DAE4-660_Dec17)	Dec-18
Secondary Standards	ID	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB41293874	06-Apr-16 (in house check Jun-18)	In house check: Jun-20
Power sensor E4412A	SN: MY41498087	06-Apr-16 (in house check Jun-18)	In house check: Jun-20
Power sensor E4412A	SN: 000110210	06-Apr-16 (in house check Jun-18)	In house check: Jun-20
RF generator HP 8648C	SN: US3642U01700	04-Aug-99 (in house check Jun-18)	In house check: Jun-20
Network Analyzer E8358A	SN: US41080477	31-Mar-14 (in house check Oct-17)	In house check: Oct-18

	Name	Function	Signature
Calibrated by:	Jeton Kastrati	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: August 27, 2018

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.

**Calibration Laboratory of
Schmid & Partner
Engineering AG**
Zeughausstrasse 43, 8004 Zurich, Switzerland



S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
S Servizio svizzero di taratura
S Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Glossary:

TSL	tissue simulating liquid
NORM _{x,y,z}	sensitivity in free space
ConvF	sensitivity in TSL / NORM _{x,y,z}
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C, D	modulation dependent linearization parameters
Polarization ϕ	ϕ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\vartheta = 0$ is normal to probe axis
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

- a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- b) IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
- c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Methods Applied and Interpretation of Parameters:

- **NORM_{x,y,z}:** Assessed for E-field polarization $\vartheta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORM_{x,y,z} are only intermediate values, i.e., the uncertainties of NORM_{x,y,z} does not affect the E²-field uncertainty inside TSL (see below *ConvF*).
- **NORM(*f*)_{x,y,z} = NORM_{x,y,z} * frequency_response** (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of *ConvF*.
- **DCP_{x,y,z}:** DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- **PAR:** PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- **A_{x,y,z}; B_{x,y,z}; C_{x,y,z}; D_{x,y,z}; VR_{x,y,z}:** A, B, C, D are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- **ConvF and Boundary Effect Parameters:** Assessed in flat phantom using E-field (or Temperature Transfer Standard for $f \leq 800$ MHz) and inside waveguide using analytical field distributions based on power measurements for $f > 800$ MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM_{x,y,z} * ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- **Spherical isotropy (3D deviation from isotropy):** in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- **Sensor Offset:** The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- **Connector Angle:** The angle is assessed using the information gained by determining the NORM_x (no uncertainty required).



EX3DV4 – SN:7514

August 27, 2018

Probe EX3DV4

SN:7514

Manufactured: November 13, 2017
Calibrated: August 27, 2018

Calibrated for DASY/EASY Systems
(Note: non-compatible with DASY2 system!)

EX3DV4– SN:7514

August 27, 2018

DASY/EASY - Parameters of Probe: EX3DV4 - SN:7514

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	0.46	0.44	0.39	$\pm 10.1\%$
DCP (mV) ^B	96.5	101.1	97.9	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB $\sqrt{\mu\text{V}}$	C	D dB	VR mV	Unc ^E (k=2)
0	CW	X	0.0	0.0	1.0	0.00	179.1	$\pm 3.5\%$
		Y	0.0	0.0	1.0		177.3	
		Z	0.0	0.0	1.0		158.1	

Note: For details on UID parameters see Appendix.

Sensor Model Parameters

	C1 fF	C2 fF	α V ⁻¹	T1 ms.V ⁻²	T2 ms.V ⁻¹	T3 ms	T4 V ⁻²	T5 V ⁻¹	T6
X	31.17	241.1	37.77	3.625	0.025	5.031	0.000	0.325	1.005
Y	34.86	259.7	35.41	7.412	0.000	5.026	0.323	0.291	1.002
Z	33.14	259.6	38.65	3.827	0.264	5.046	0.000	0.373	1.008

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

^A The uncertainties of Norm X,Y,Z do not affect the E²-field uncertainty inside TSL (see Pages 5 and 6).

^B Numerical linearization parameter: uncertainty not required.

^E Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.



EX3DV4- SN:7514

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DASY/EASY - Parameters of Probe: EX3DV4 - SN:7514

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth (mm) ^G	Unc (k=2)
150	52.3	0.76	12.79	12.79	12.79	0.00	1.00	± 13.3 %
300	45.3	0.87	11.57	11.57	11.57	0.07	1.20	± 13.3 %
450	43.5	0.87	10.68	10.68	10.68	0.14	1.20	± 13.3 %
750	41.9	0.89	9.47	9.47	9.47	0.45	0.89	± 12.0 %
835	41.5	0.90	9.09	9.09	9.09	0.53	0.85	± 12.0 %
900	41.5	0.97	9.03	9.03	9.03	0.49	0.85	± 12.0 %
1450	40.5	1.20	8.24	8.24	8.24	0.35	0.80	± 12.0 %
1640	40.2	1.31	8.22	8.22	8.22	0.38	0.81	± 12.0 %
1750	40.1	1.37	8.10	8.10	8.10	0.36	0.83	± 12.0 %
1810	40.0	1.40	7.82	7.82	7.82	0.35	0.81	± 12.0 %
1900	40.0	1.40	7.73	7.73	7.73	0.31	0.80	± 12.0 %
2000	40.0	1.40	7.64	7.64	7.64	0.30	0.84	± 12.0 %
2100	39.8	1.49	7.57	7.57	7.57	0.27	0.85	± 12.0 %
2300	39.5	1.67	7.42	7.42	7.42	0.31	0.80	± 12.0 %
2450	39.2	1.80	6.95	6.95	6.95	0.38	0.98	± 12.0 %
2600	39.0	1.96	6.92	6.92	6.92	0.25	1.05	± 12.0 %
3500	37.9	2.91	6.78	6.78	6.78	0.79	0.64	± 13.1 %
3700	37.7	3.12	6.61	6.61	6.61	0.42	0.93	± 13.1 %
5200	36.0	4.66	5.05	5.05	5.05	0.40	1.80	± 13.1 %
5250	35.9	4.71	5.02	5.02	5.02	0.40	1.80	± 13.1 %
5300	35.9	4.76	4.99	4.99	4.99	0.40	1.80	± 13.1 %
5500	35.6	4.96	4.59	4.59	4.59	0.40	1.80	± 13.1 %
5600	35.5	5.07	4.41	4.41	4.41	0.40	1.80	± 13.1 %
5750	35.4	5.22	4.47	4.47	4.47	0.40	1.80	± 13.1 %
5800	35.3	5.27	4.42	4.42	4.42	0.40	1.80	± 13.1 %

^C Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below at 150 MHz is ± 50 MHz. Above 5 GHz frequency validity can be extended to ± 110 MHz.

^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

^G Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.



EX3DV4– SN:7514

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DASY/EASY - Parameters of Probe: EX3DV4 - SN:7514

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unc (k=2)
150	61.9	0.80	12.43	12.43	12.43	0.00	1.00	± 13.3 %
300	58.2	0.92	11.39	11.39	11.39	0.05	1.20	± 13.3 %
450	56.7	0.94	11.34	11.34	11.34	0.08	1.20	± 13.3 %
750	55.5	0.96	9.68	9.68	9.68	0.31	1.04	± 12.0 %
835	55.2	0.97	9.47	9.47	9.47	0.46	0.80	± 12.0 %
900	55.0	1.05	9.34	9.34	9.34	0.46	0.83	± 12.0 %
1450	54.0	1.30	8.02	8.02	8.02	0.31	0.80	± 12.0 %
1640	53.7	1.42	7.85	7.85	7.85	0.42	0.81	± 12.0 %
1750	53.4	1.49	7.82	7.82	7.82	0.39	0.83	± 12.0 %
1810	53.3	1.52	7.69	7.69	7.69	0.32	0.92	± 12.0 %
1900	53.3	1.52	7.53	7.53	7.53	0.35	0.83	± 12.0 %
2000	53.3	1.52	7.45	7.45	7.45	0.39	0.80	± 12.0 %
2100	53.2	1.62	7.39	7.39	7.39	0.32	0.94	± 12.0 %
2300	52.9	1.81	7.25	7.25	7.25	0.37	0.85	± 12.0 %
2450	52.7	1.95	7.13	7.13	7.13	0.32	0.97	± 12.0 %
2600	52.5	2.16	7.06	7.06	7.06	0.24	1.10	± 12.0 %
3500	51.3	3.31	6.85	6.85	6.85	0.00	1.00	± 13.1 %
3700	51.0	3.55	6.75	6.75	6.75	0.00	1.00	± 13.1 %
5200	49.0	5.30	4.59	4.59	4.59	0.50	1.90	± 13.1 %
5250	48.9	5.36	4.54	4.54	4.54	0.50	1.90	± 13.1 %
5300	48.9	5.42	4.49	4.49	4.49	0.50	1.90	± 13.1 %
5500	48.6	5.65	4.17	4.17	4.17	0.50	1.90	± 13.1 %
5600	48.5	5.77	4.00	4.00	4.00	0.50	1.90	± 13.1 %
5750	48.3	5.94	3.98	3.98	3.98	0.50	1.90	± 13.1 %
5800	48.2	6.00	3.94	3.94	3.94	0.50	1.90	± 13.1 %

^C Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below at 150 MHz is ± 50 MHz. Above 5 GHz frequency validity can be extended to ± 110 MHz.

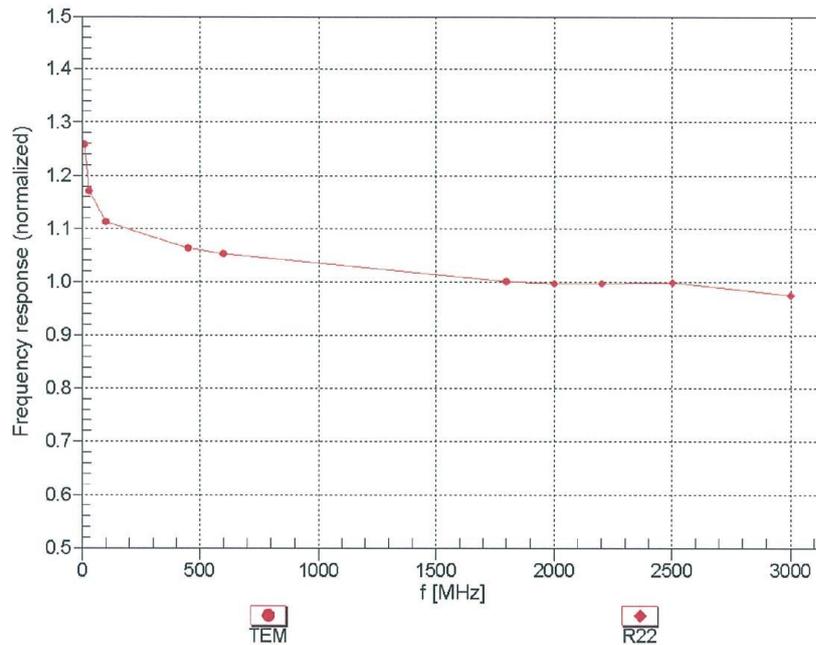
^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

^G Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

EX3DV4- SN:7514

August 27, 2018

Frequency Response of E-Field (TEM-Cell:ifi110 EXX, Waveguide: R22)

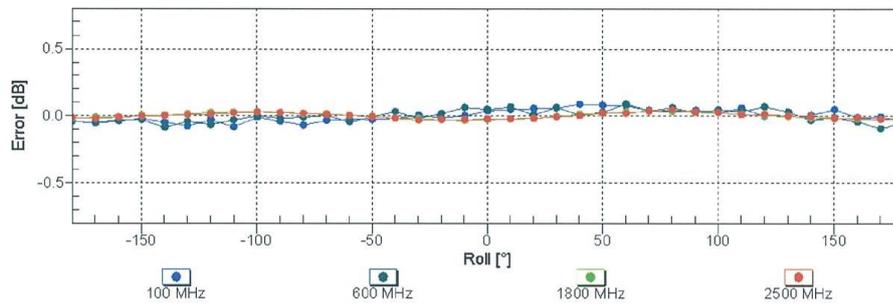
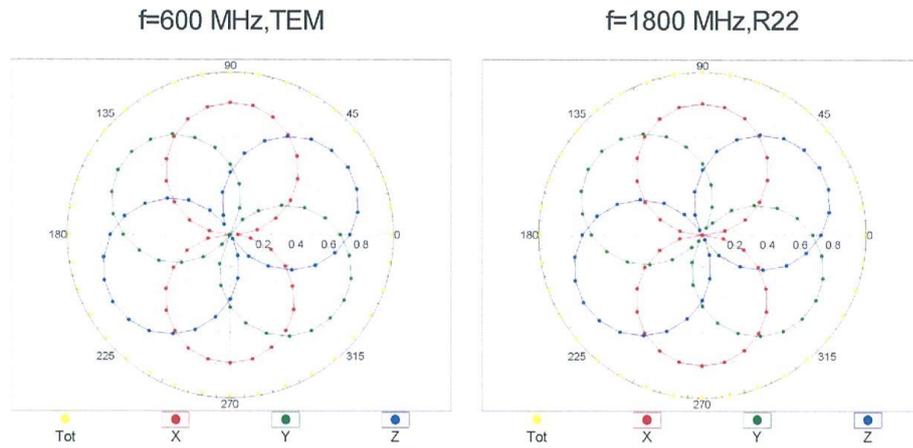


Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ (k=2)

EX3DV4- SN:7514

August 27, 2018

Receiving Pattern (ϕ), $\vartheta = 0^\circ$



Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ (k=2)