

SAR TEST REPORT

The following samples were submitted and identified on behalf of the client as:

Equipment Under Test of Host	Notebook
Brand Name of Host	
Model No. of Host	MS2391
Model No. of Module	QCNFA34AC
Company Name	Acer Incorporated
Company Address	8F., No.88, Sec. 1, Hsintai 5th Rd., Hsichih, New Taipei City 22181, Taiwan (R.O.C.)
Standards	IEEE /ANSI C95.1 , C95.3, IEEE 1528, KDB447498D01, KDB616217D04, KDB248227D01, KDB865664D01, KDB865664D02
Module FCC ID	PPD-QCNFA34AC
Date of Receipt	Sep. 09, 2014
Date of Test(s)	Sep. 20, 2014 ~ Sep. 23, 2014
Date of Issue	Oct. 21, 2014

In the configuration tested, the EUT complied with the standards specified above.

Remarks:

This report details the results of the testing carried out on one sample, the results contained in this test report do not relate to other samples of the same product. The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in this report.

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Signed on behalf of SGS

Sr. Engineer

Kevin Li



Date: Oct. 21, 2014

Supervisor

Ricky Huang



Date: Oct. 21, 2014

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Version

Report Number	Revision	Date	Memo
EN/2014/90005	00	2014/10/1	Initial creation of test report.
EN/2014/90005	01	2014/10/21	1 st modification

This test report contains a reference to the previous version test report that it replaces.

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1. General Information

1.1 Testing Laboratory

SGS Taiwan Ltd. Electronics & Communication Laboratory	
No.134, Wu Kung Road, New Taipei Industrial Park, Wuku District, New Taipei City, Taiwan	
Tel	+886-2-2299-3279
Fax	+886-2-2298-0488
Internet	http://www.tw.sgs.com/

1.2 Details of Applicant

Company Name	Acer Incorporated
Company Address	8F., No.88, Sec. 1, Hsintai 5th Rd., Hsichih, New Taipei City 22181, Taiwan (R.O.C.)

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1.3 Description of EUT

EUT of Host	Notebook		
Brand Name of Host	acer		
Model No. of Host	MS2391		
Model No. of Module	QCNFA34AC		
Module FCC ID	PPD-QCNFA34AC		
Antenna Designation (Maximum Gain)	PIFA Antenna 1. Antenna Main: 2.4GHz: -3.01dBi / 5GHz: 2.54dBi 2. Antenna Aux: 2.4GHz: -1.67dBi / 5GHz: 1.37dBi		
Mode of Operation	<input checked="" type="checkbox"/> WLAN802.11 a/b/g/n(20M/40M)/ac(20M/40M/80M) band <input checked="" type="checkbox"/> Bluetooth		
Duty Cycle	WLAN802.11 a/b/g/n(20M/40M)/ac(20M/40M/80M)		1
	Bluetooth		1
TX Frequency Range (MHz)	WLAN802.11 b/g/n(20M)/ac(20M)		2412 — 2462
	WLAN802.11 n(40M)/ac(40M)		2422 — 2452
	WLAN802.11 a/n(20M)/ac(20M) 5.2G		5180 — 5240
	WLAN802.11 n(40M)/ac(40M) 5.2G		5190 — 5230
	WLAN802.11 ac(80M) 5.2G		5210
	WLAN802.11 a/n(20M)/ac(20M) 5.3G		5260 — 5320
	WLAN802.11 n(40M)/ac(40M) 5.3G		5270 — 5310
	WLAN802.11 ac(80M) 5.3G		5290
	WLAN802.11 a/n(20M) 5.6G		5500 — 5700
	WLAN802.11 ac(20M) 5.6G		5500 — 5720
	WLAN802.11 n(40M) 5.6G		5510 — 5670
	WLAN802.11 ac(40M) 5.6G		5510 — 5710
	WLAN802.11 ac(80M) 5.6G		5530 — 5690

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TX Frequency Range (MHz)	WLAN802.11 a/n(20M)/ac(20M) 5.8G	5745	—	5825
	WLAN802.11 n(40M)/ac(40M) 5.8G	5755	—	5795
	WLAN802.11 ac(80M) 5.8G		5775	
Channel Number (ARFCN)	WLAN802.11 b/g/n(20M)/ac(20M)	1	—	11
	WLAN802.11 n(40M)/ac(40M)	3	—	9
	WLAN802.11 a/n(20M)/ac(20M) 5.2G	36	—	48
	WLAN802.11 n(40M)/ac(40M) 5.2G	38	—	46
	WLAN802.11 ac(80M) 5.2G		42	
	WLAN802.11 a/n(20M)/ac(20M) 5.3G	52	—	64
	WLAN802.11 n(40M)/ac(40M) 5.3G	54	—	62
	WLAN802.11 ac(80M) 5.3G		58	
	WLAN802.11 a/n(20M) 5.6G	100	—	140
	WLAN802.11 ac(20M) 5.6G	100	—	144
	WLAN802.11 n(40M) 5.6G	102	—	134
	WLAN802.11 ac(40M) 5.6G	102	—	142
	WLAN802.11 ac(80M) 5.6G	106	—	138
	WLAN802.11 a/n(20M)/ac(20M) 5.8G	149	—	165
	WLAN802.11 n(40M)/ac(40M) 5.8G	151	—	159
	WLAN802.11 ac(80M) 5.8G		155	

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Max. SAR (1 g) (Unit: W/Kg)					
Antenna	Band	Measured	Reported	Channel	Position
2Tx CDD	WLAN802.11b	1.35	1.366	11	Lap-held
MIMO	WLAN802.11ac (20M)	1.02	1.106	6	Lap-held
MIMO	WLAN802.11ac (40M)	0.551	0.568	6	Lap-held
2Tx CDD	WLAN802.11a 5.2G	0.374	0.385	48	Lap-held
MIMO	WLAN802.11ac (20M) 5.2G	0.339	0.342	40	Lap-held
MIMO	WLAN802.11ac (40M) 5.2G	0.123	0.124	46	Lap-held
MIMO	WLAN802.11ac (80M) 5.2G	0.101	0.109	42	Lap-held
2Tx CDD	WLAN802.11a 5.3G	0.309	0.324	52	Lap-held
MIMO	WLAN802.11n (20M) 5.3G	0.076	0.077	60	Lap-held
MIMO	WLAN802.11n (40M) 5.3G	0.059	0.06	54	Lap-held
MIMO	WLAN802.11ac (20M) 5.3G	0.103	0.104	52	Lap-held
MIMO	WLAN802.11ac (40M) 5.3G	0.08	0.081	54	Lap-held
MIMO	WLAN802.11ac (80M) 5.3G	0.053	0.054	58	Lap-held
2Tx CDD	WLAN802.11a 5.6G	0.282	0.292	112	Lap-held
MIMO	WLAN802.11ac (20M) 5.6G	0.347	0.353	144	Lap-held
MIMO	WLAN802.11ac (40M) 5.6G	0.327	0.342	134	Lap-held
MIMO	WLAN802.11ac (80M) 5.6G	0.225	0.226	106	Lap-held
2Tx CDD	WLAN802.11a 5.8G	0.427	0.441	157	Lap-held
MIMO	WLAN802.11ac (20M) 5.8G	0.47	0.474	149	Lap-held
MIMO	WLAN802.11ac (40M) 5.8G	0.388	0.398	151	Lap-held
MIMO	WLAN802.11ac (80M) 5.8G	0.072	0.083	155	Lap-held

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#. WLAN802.11 a/b/g/n(20M/40M)/ ac(20M/40M/80M) conducted power table:

Band	Antenna	2Tx CDD
	Chain0+1	
WLAN802.11b		✓
WLAN802.11g		✓
WLAN802.11a		✓

Band	Antenna	MIMO
	Chain0+1	
WLAN802.11n(20M)		✓
WLAN802.11n(40M)		✓
WLAN802.11ac(20M)		✓
WLAN802.11ac(40M)		✓
WLAN802.11n(20M) 5G		✓
WLAN802.11n(40M) 5G		✓
WLAN802.11ac(20M) 5G		✓
WLAN802.11ac(40M) 5G		✓
WLAN802.11ac(80M) 5G		✓

2Tx CDD (CH0+CH1)

802.11 b		CH	Frequency (MHz)	Average Power Output(dBm)													
CH	Max. Rated Avg. Power + Max. Tolerance (dBm)			Data Rate (Mbps)													
				1			2			5.5			11				
				ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1		
1	2412	23.5	20.31	20.35	23.34	20.29	20.15	23.23	20.25	19.99	23.13	20.03	19.85	22.95			
6	2437	23.5	20.31	20.46	23.40	20.05	20.49	23.29	19.82	20.30	23.08	19.77	20.14	22.97			
11	2462	23.5	20.45	20.48	23.48	20.11	20.45	23.29	19.77	20.41	23.11	19.67	20.17	22.94			

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2Tx CDD (CH0+CH1)

802.11 g		CH	Frequency (MHz)	Average Power Output(dBm)													
Data Rate (Mbps)																	
6				9			12			18							
ch 0	ch 1	ch 0+1		ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1		
1	2412	19	15.75	15.80	18.79	15.53	15.72	18.64	15.51	15.69	18.61	15.29	15.51	18.41			
2	2417	20	16.66	16.72	19.70	16.61	16.64	19.64	16.54	15.61	19.11	15.22	15.42	18.33			
6	2437	22.5	19.42	19.51	22.48	19.17	19.41	22.30	18.95	19.16	22.07	18.81	19.02	21.93			
10	2457	21	17.58	17.85	20.73	17.51	17.77	20.65	17.46	17.71	20.60	17.41	17.63	20.53			
11	2462	18.5	14.63	15.98	18.37	14.56	15.74	18.20	14.51	15.68	18.14	14.48	15.43	17.99			

802.11 g		CH	Frequency (MHz)	Average Power Output(dBm)													
Data Rate (Mbps)																	
24				36			48			54							
ch 0	ch 1	ch 0+1		ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1		
1	2412	19	15.08	15.42	18.26	15.01	15.29	18.16	14.99	15.19	18.10	14.96	15.13	18.06			
2	2417	20	15.36	15.38	18.38	15.31	15.29	18.31	15.22	15.21	18.23	15.16	15.14	18.16			
6	2437	22.5	18.69	18.92	21.82	18.61	18.72	21.68	18.58	18.49	21.55	18.45	18.36	21.42			
10	2457	21	17.32	17.56	20.45	17.21	17.51	20.37	17.16	17.44	20.31	17.09	17.35	20.23			
11	2462	18.5	14.47	15.20	17.86	14.40	15.09	17.77	14.33	15.04	17.71	14.14	15.03	17.62			

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MIMO (CH0+CH1)

802.11 n(20M)		CH	Frequency (MHz)	Max. Rated Avg. Power + Max. Tolerance (dBm)	Average Power Output(dBm)											
Data Rate (Mbps)																
13					26			39			52					
ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	ch 0	ch 1			
1	2412	17	13.58	13.71	16.66	13.34	13.58	16.47	13.13	13.42	16.29	13.06	13.31	16.20		
2	2417	20	16.51	16.63	19.58	16.47	16.58	19.54	16.41	16.51	19.47	16.36	16.48	19.43		
6	2437	22.5	19.43	19.48	22.47	19.26	19.41	22.35	18.93	19.29	22.12	18.73	19.16	21.96		
10	2457	20	16.57	16.71	19.65	16.51	16.66	19.60	16.46	16.59	19.54	16.41	16.51	19.47		
11	2462	17	13.64	14.00	16.83	13.62	13.79	16.72	13.60	13.59	16.61	13.57	13.53	16.56		

802.11 n(20M)		CH	Frequency (MHz)	Max. Rated Avg. Power + Max. Tolerance (dBm)	Average Power Output(dBm)											
Data Rate (Mbps)																
78					104			117			130					
ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	ch 0	ch 1			
1	2412	17	12.90	13.23	16.08	12.85	13.14	16.01	12.63	13.08	15.87	12.57	12.93	15.76		
2	2417	20	16.31	16.41	19.37	16.21	16.35	19.29	16.15	16.31	19.24	16.08	16.24	19.17		
6	2437	22.5	18.57	19.02	21.81	18.57	18.98	21.79	18.45	18.91	21.70	18.40	18.73	21.58		
10	2457	20	16.34	16.42	19.39	16.28	16.34	19.32	16.21	16.29	19.26	16.15	16.21	19.19		
11	2462	17	13.43	13.30	16.38	13.20	13.24	16.23	13.12	13.04	16.09	12.93	12.89	15.92		

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MIMO (CHO+CH1)

802.11 n(40M)		Max. Rated Avg. Power + Max. Tolerance (dBm)	Average Power Output(dBm)												
CH	Frequency (MHz)		Data Rate (Mbps)												
			27			54			81			108			
			ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	
3	2422	15.5	12.24	12.55	15.41	12.05	12.38	15.23	11.83	12.34	15.10	11.77	12.12	14.96	
6	2437	20.5	17.39	17.44	20.43	17.36	17.28	20.33	17.22	17.25	20.25	17.20	17.04	20.13	
9	2452	14.5	11.26	11.48	14.38	11.03	11.39	14.22	10.95	11.25	14.11	10.87	11.19	14.04	

802.11 n(40M)		Max. Rated Avg. Power + Max. Tolerance (dBm)	Average Power Output(dBm)												
CH	Frequency (MHz)		Data Rate (Mbps)												
			162			216			243			270			
			ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	
3	2422	15.5	11.75	11.98	14.88	11.73	11.95	14.85	11.60	11.89	14.76	11.52	11.69	14.62	
6	2437	20.5	16.97	17.04	20.02	16.93	16.86	19.91	16.86	16.71	19.80	16.83	16.67	19.76	
9	2452	14.5	10.65	10.97	13.82	10.58	10.90	13.75	10.39	10.90	13.66	10.21	10.82	13.54	

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MIMO (CH0+CH1)

802.11 ac(20M)		Max. Rated Avg. Power + Max. Tolerance (dBm)	Average Power Output(dBm)												
CH	Frequency (MHz)		Data Rate (Mbps)												
			13			26			39			52			
			ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	
1	2412	17	13.95	13.92	16.95	13.89	13.75	16.83	13.92	13.48	16.72	13.99	12.96	16.52	
2	2417	20	16.91	16.64	19.79	16.85	16.58	19.73	16.85	16.54	19.71	16.78	16.48	19.64	
6	2437	22.5	19.44	19.15	22.31	19.38	18.83	22.12	19.21	18.61	21.93	19.15	18.53	21.86	
10	2457	20	16.93	16.58	19.77	16.87	16.51	19.70	16.81	16.43	19.63	16.74	16.36	19.56	
11	2462	17	13.55	13.83	16.70	13.30	13.70	16.51	13.10	13.61	16.37	13.01	13.58	16.31	

802.11 ac(20M)		Max. Rated Avg. Power + Max. Tolerance (dBm)	Average Power Output(dBm)												
CH	Frequency (MHz)		Data Rate (Mbps)												
			78			104			117			130			
			ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	
1	2412	17	13.82	12.91	16.40	13.78	12.84	16.35	13.69	12.74	16.25	13.51	12.55	16.07	
2	2417	20	16.71	16.41	19.57	16.63	16.35	19.50	16.57	16.31	19.45	16.52	16.24	19.39	
6	2437	22.5	19.11	18.29	21.73	18.88	18.04	21.49	18.63	18.01	21.34	18.40	17.93	21.18	
10	2457	20	16.66	16.31	19.50	16.62	16.25	19.45	16.53	16.14	19.35	16.44	16.11	19.29	
11	2462	17	12.87	13.50	16.21	12.82	13.34	16.10	12.60	13.13	15.88	12.40	12.95	15.69	

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MIMO (CH0+CH1)

802.11 ac(20M)		Max. Rated Avg. Power + Max. Tolerance (dBm)	Average Power Output(dBm)			
CH	Frequency (MHz)		Data Rate (Mbps)			
			156			
			ch 0	ch 1	ch 0+1	
1	2412	17	13.39	12.42	15.94	
2	2417	20	16.43	16.18	19.32	
6	2437	22.5	18.29	17.85	21.09	
10	2457	20	16.32	16.08	19.21	
11	2462	17	12.31	12.88	15.61	

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MIMO (CH0+CH1)

802.11 ac(40M)		Max. Rated Avg. Power + Max. Tolerance (dBm)	Average Power Output(dBm)												
CH	Frequency (MHz)		Data Rate (Mbps)												
			27			54			81			108			
			ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	
3	2422	15.5	12.51	11.68	15.13	12.28	11.47	14.90	12.07	11.38	14.75	11.83	11.28	14.57	
6	2437	20.5	17.37	17.43	20.41	17.18	17.22	20.21	17.01	17.20	20.12	16.99	17.17	20.09	
9	2452	14.5	11.09	11.41	14.26	10.86	11.20	14.04	10.64	11.13	13.90	10.59	10.96	13.79	

802.11 ac(40M)		Max. Rated Avg. Power + Max. Tolerance (dBm)	Average Power Output(dBm)												
CH	Frequency (MHz)		Data Rate (Mbps)												
			162			216			243			270			
			ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	
3	2422	15.5	11.65	11.08	14.38	11.59	10.96	14.30	11.41	10.84	14.14	11.20	10.66	13.95	
6	2437	20.5	16.95	17.01	19.99	16.83	16.93	19.89	16.82	16.93	19.89	16.77	16.87	19.83	
9	2452	14.5	10.44	10.74	13.60	10.21	10.56	13.40	10.07	10.36	13.23	9.93	10.17	13.06	

802.11 ac(40M)		Max. Rated Avg. Power + Max. Tolerance (dBm)	Average Power Output(dBm)						
CH	Frequency (MHz)		Data Rate (Mbps)						
			324			360			
			ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	
3	2422	15.5	11.11	10.52	13.84	11.03	10.39	13.73	
6	2437	20.5	16.64	16.75	19.71	16.53	16.64	19.60	
9	2452	14.5	9.82	10.03	12.94	9.69	10.05	12.88	

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2Tx CDD (CH0+CH1)

802.11 a			Max. Rated Avg. Power + Max. Tolerance (dBm)	Average Power Output(dBm)												
5.2/5.3/5.6/5.8G		CH		Data Rate (Mbps)												
Frequency (MHz)				6			9			12			18			
ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1		
36	5180	15.5	11.98	12.42	15.22	11.93	12.32	15.14	11.88	12.09	15.00	11.85	11.87	14.87		
40	5200	18	14.88	14.92	17.91	14.75	14.78	17.78	14.56	14.66	17.62	14.37	14.48	17.44		
44	5220	18	14.74	14.85	17.81	14.59	14.77	17.69	14.51	14.59	17.56	14.48	14.50	17.50		
48	5240	18	14.87	14.98	17.94	14.83	14.79	17.82	14.75	14.69	17.73	14.55	14.55	17.56		
52	5260	18	14.79	14.91	17.86	14.70	14.84	17.78	14.50	14.72	17.62	14.48	14.60	17.55		
56	5280	15	11.89	11.99	14.95	11.84	11.91	14.89	11.78	11.88	14.84	11.71	11.82	14.78		
60	5300	18	14.84	14.73	17.80	14.79	14.51	17.66	14.54	14.47	17.52	14.31	14.35	17.34		
64	5320	13	9.83	9.55	12.70	9.77	9.34	12.57	9.53	9.22	12.39	9.51	9.22	12.38		
100	5500	13	9.88	9.51	12.71	9.67	9.49	12.59	9.57	9.26	12.43	9.38	9.10	12.25		
104	5520	18	14.92	14.7	17.82	14.89	14.65	17.78	14.69	14.52	17.62	14.51	14.46	17.50		
108	5540	18	14.81	14.63	17.73	14.68	14.53	17.62	14.46	14.45	17.47	14.25	14.44	17.36		
112	5560	18	14.91	14.85	17.89	14.80	14.64	17.73	14.76	14.55	17.67	14.74	14.47	17.62		
116	5580	18	14.95	14.74	17.86	14.92	14.53	17.74	14.79	14.48	17.65	14.78	14.45	17.63		
132	5660	18	14.82	14.76	17.80	14.60	14.63	17.63	14.39	14.50	17.46	14.34	14.35	17.36		
136	5680	18	14.7	14.94	17.83	14.58	14.75	17.68	14.46	14.64	17.56	14.28	14.46	17.38		
140	5700	12	9.15	8.78	11.98	8.94	8.67	11.82	8.80	8.51	11.67	8.79	8.39	11.60		
149	5745	18	14.83	14.97	17.91	14.58	14.85	17.73	14.56	14.81	17.70	14.36	14.68	17.53		
153	5765	18	14.8	14.86	17.84	14.57	14.77	17.68	14.51	14.56	17.55	14.45	14.40	17.44		
157	5785	18	14.86	14.97	17.93	14.75	14.95	17.86	14.60	14.83	17.73	14.50	14.70	17.61		
161	5805	18	14.72	14.87	17.81	14.69	14.86	17.79	14.67	14.80	17.75	14.45	14.71	17.59		
165	5825	18	14.63	14.74	17.70	14.42	14.67	17.56	14.29	14.64	17.48	14.21	14.63	17.44		

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2Tx CDD (CH0+CH1)

802.11 a		Max. Rated Avg. Power + Max. Tolerance (dBm)	Average Power Output(dBm)												
5.2/5.3/5.6/5.8G			Data Rate (Mbps)												
CH	Frequency (MHz)		24			36			48			54			
			ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	
36	5180	15.5	11.70	11.66	14.69	11.61	11.60	14.62	11.57	11.56	14.58	11.51	11.37	14.45	
40	5200	18	14.21	14.29	17.26	14.01	14.28	17.16	14.00	14.06	17.04	13.93	13.91	16.93	
44	5220	18	14.47	14.26	17.38	14.43	14.23	17.34	14.38	14.07	17.24	14.29	13.87	17.10	
48	5240	18	14.47	14.52	17.51	14.24	14.35	17.31	14.11	14.28	17.21	14.05	14.26	17.17	
52	5260	18	14.28	14.46	17.38	14.24	14.35	17.31	14.05	14.15	17.11	13.86	14.01	16.95	
56	5280	15	11.62	11.74	14.69	11.57	11.63	14.61	11.44	11.56	14.51	11.38	11.49	14.45	
60	5300	18	14.26	14.15	17.22	14.09	14.08	17.10	13.99	13.93	16.97	13.88	13.88	16.89	
64	5320	13	9.39	9.08	12.25	9.17	9.06	12.13	9.04	8.98	12.02	8.92	8.76	11.85	
100	5500	13	9.20	8.93	12.08	9.16	8.84	12.01	9.15	8.69	11.94	9.12	8.45	11.81	
104	5520	18	14.43	14.32	17.39	14.18	14.23	17.22	14.05	14.11	17.09	13.98	13.90	16.95	
108	5540	18	14.02	14.42	17.23	13.99	14.21	17.11	13.98	14.15	17.08	13.86	14.08	16.98	
112	5560	18	14.62	14.30	17.47	14.57	14.28	17.44	14.49	14.12	17.32	14.27	13.92	17.11	
116	5580	18	14.68	14.29	17.50	14.45	14.14	17.31	14.45	14.13	17.30	14.32	14.12	17.23	
132	5660	18	14.33	14.20	17.28	14.28	13.98	17.14	14.19	13.98	17.10	14.17	13.79	16.99	
136	5680	18	14.25	14.33	17.30	14.11	14.22	17.18	13.96	14.05	17.02	13.93	13.96	16.96	
140	5700	12	8.68	8.19	11.45	8.57	8.10	11.35	8.48	8.06	11.29	8.26	8.00	11.14	
149	5745	18	14.15	14.59	17.39	14.11	14.34	17.24	14.05	14.29	17.18	14.04	14.11	17.09	
153	5765	18	14.43	14.27	17.36	14.22	14.05	17.15	14.14	13.99	17.08	14.06	13.81	16.95	
157	5785	18	14.29	14.68	17.50	14.13	14.63	17.40	14.09	14.56	17.34	13.90	14.41	17.17	
161	5805	18	14.38	14.62	17.51	14.33	14.46	17.41	14.30	14.23	17.28	14.21	14.21	17.22	
165	5825	18	14.04	14.44	17.25	13.83	14.36	17.11	13.73	14.23	17.00	13.71	14.02	16.88	

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MIMO (CHO+CH1)

802.11 n(20M)			Max. Rated Avg. Power + Max. Tolerance (dBm)	Average Power Output(dBm)												
CH	Frequency (MHz)	Data Rate (Mbps)														
		13			26			39			52					
		ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	ch 0	ch 1	
36	5180	15	11.89	12.07	14.99	11.89	12.01	14.96	11.86	11.90	14.89	11.82	11.74	14.79		
40	5200	17.5	14.41	14.27	17.35	14.25	14.16	17.22	14.19	14.04	17.13	14.05	14.00	17.04		
44	5220	17.5	14.46	14.38	17.43	14.30	14.26	17.29	14.10	14.11	17.12	14.00	14.08	17.05		
48	5240	17.5	14.42	14.39	17.42	14.29	14.30	17.31	14.25	14.10	17.19	14.19	14.07	17.14		
52	5260	17.5	14.4	14.52	17.47	14.37	14.49	17.44	14.25	14.42	17.35	14.16	14.23	17.21		
56	5280	15.5	12.11	12.31	15.22	12.06	12.27	15.18	12.01	12.19	15.11	11.95	12.14	15.06		
60	5300	17.5	14.49	14.46	17.49	14.38	14.21	17.31	14.25	14.19	17.23	14.19	14.17	17.19		
64	5320	12	9.28	8.63	11.98	9.17	8.58	11.90	8.99	8.43	11.73	8.83	8.27	11.57		
100	5500	12	9.11	8.85	11.99	9.10	8.72	11.92	8.96	8.54	11.77	8.84	8.49	11.68		
104	5520	17.5	14.57	14.34	17.47	14.35	14.22	17.30	14.19	13.99	17.10	14.04	13.93	17.00		
108	5540	17.5	14.4	14.26	17.34	14.22	14.14	17.19	14.16	14.06	17.12	14.14	13.95	17.06		
112	5560	17.5	14.75	14.15	17.47	14.65	13.97	17.33	14.64	13.90	17.30	14.41	13.66	17.06		
116	5580	17.5	14.47	14.48	17.49	14.32	14.34	17.34	14.30	14.11	17.22	14.05	13.87	16.97		
132	5660	17.5	14.28	14.5	17.40	14.04	14.48	17.28	13.82	14.35	17.10	13.77	14.35	17.08		
136	5680	17.5	14.49	14.43	17.47	14.49	14.29	17.40	14.43	14.11	17.28	14.29	14.07	17.19		
140	5700	12	8.9	8.85	11.89	8.83	8.73	11.79	8.72	8.69	11.72	8.50	8.53	11.53		
149	5745	17.5	14.35	14.55	17.46	14.11	14.38	17.26	13.98	14.37	17.19	13.76	14.27	17.03		
153	5765	17.5	14.42	14.48	17.46	14.22	14.38	17.31	14.06	14.32	17.20	13.85	14.19	17.03		
157	5785	17.5	14.47	14.48	17.49	14.30	14.43	17.38	14.24	14.29	17.28	14.04	14.28	17.17		
161	5805	17.5	14.36	14.58	17.48	14.20	14.52	17.37	13.97	14.37	17.18	13.90	14.27	17.10		
165	5825	17.5	14.25	14.1	17.19	14.04	14.09	17.08	14.03	13.86	16.96	13.90	13.69	16.81		

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MIMO (CHO+CH1)

802.11 n(20M)			Max. Rated Avg. Power + Max. Tolerance (dBm)	Average Power Output(dBm)												
5.2/5.3/5.6/5.8G		CH		Data Rate (Mbps)												
Frequency (MHz)	78			104			117			130			ch 0	ch 1	ch 0+1	
	CH	ch 0		ch 1	ch 0+1	ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1		
36	5180	15	11.79	11.65	14.73	11.66	11.46	14.57	11.63	11.24	14.45	11.54	11.04	14.31		
40	5200	17.5	13.87	13.96	16.93	13.67	13.84	16.77	13.52	13.64	16.59	13.36	13.58	16.48		
44	5220	17.5	13.86	14.06	16.97	13.80	13.86	16.84	13.69	13.81	16.76	13.57	13.67	16.63		
48	5240	17.5	13.98	13.96	16.98	13.87	13.78	16.84	13.65	13.72	16.70	13.62	13.64	16.64		
52	5260	17.5	14.08	14.04	17.07	13.92	13.94	16.94	13.68	13.78	16.74	13.61	13.60	16.62		
56	5280	15.5	11.89	12.09	15.00	11.81	12.01	14.92	11.76	11.92	14.85	11.71	11.86	14.80		
60	5300	17.5	14.12	14.08	17.11	14.06	14.06	17.07	13.85	14.00	16.94	13.64	13.81	16.74		
64	5320	12	8.77	8.13	11.47	8.62	8.02	11.34	8.42	7.91	11.18	8.24	7.89	11.08		
100	5500	12	8.73	8.43	11.59	8.48	8.34	11.42	8.42	8.19	11.32	8.19	8.05	11.13		
104	5520	17.5	14.02	13.91	16.98	13.81	13.86	16.85	13.64	13.80	16.73	13.49	13.59	16.55		
108	5540	17.5	14.11	13.86	17.00	13.90	13.62	16.77	13.80	13.51	16.67	13.75	13.35	16.56		
112	5560	17.5	14.35	13.66	17.03	14.23	13.44	16.86	14.01	13.35	16.70	13.83	13.14	16.51		
116	5580	17.5	14.02	13.86	16.95	13.82	13.77	16.81	13.62	13.62	16.63	13.45	13.51	16.49		
132	5660	17.5	13.57	14.15	16.88	13.41	14.07	16.76	13.32	13.97	16.67	13.18	13.78	16.50		
136	5680	17.5	14.04	13.97	17.02	14.04	13.77	16.92	13.88	13.67	16.79	13.74	13.45	16.61		
140	5700	12	8.34	8.38	11.37	8.32	8.24	11.29	8.11	8.14	11.14	7.93	7.90	10.93		
149	5745	17.5	13.55	14.11	16.85	13.49	13.90	16.71	13.31	13.68	16.51	13.21	13.58	16.41		
153	5765	17.5	13.65	14.01	16.84	13.61	13.83	16.73	13.52	13.79	16.67	13.33	13.77	16.57		
157	5785	17.5	13.82	14.05	16.95	13.72	13.84	16.79	13.52	13.66	16.60	13.32	13.51	16.43		
161	5805	17.5	13.72	14.11	16.93	13.66	13.95	16.82	13.65	13.85	16.76	13.47	13.82	16.66		
165	5825	17.5	13.70	13.58	16.65	13.50	13.43	16.48	13.41	13.24	16.34	13.41	13.02	16.23		

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MIMO (CHO+CH1)

802.11 n(40M)		Max. Rated Avg. Power + Max. Tolerance (dBm)	Average Power Output(dBm)												
5.2/5.3/5.6/5.8G			Data Rate (Mbps)												
CH	Frequency (MHz)		27			54			81			108			
			ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	
38	5190	15	11.91	12.02	14.98	11.75	12.01	14.89	11.56	11.88	14.73	11.35	11.65	14.51	
46	5230	16.5	13.47	13.48	16.49	13.46	13.47	16.48	13.15	13.41	16.29	12.84	13.43	16.16	
54	5270	16.5	13.48	13.46	16.48	13.41	13.21	16.32	13.22	13.14	16.19	13.11	12.94	16.04	
62	5310	14.5	11.46	11.41	14.45	11.41	11.36	14.40	11.35	11.31	14.34	11.29	11.26	14.29	
102	5510	12.5	9.63	9.33	12.49	9.54	9.27	12.42	9.43	9.18	12.32	9.18	9.15	12.18	
110	5550	16.5	13.48	13.48	16.49	13.39	13.31	16.36	13.40	13.03	16.23	13.28	12.87	16.09	
134	5670	16.5	13.46	13.47	16.48	13.41	13.39	16.41	13.33	13.15	16.25	13.25	13.05	16.16	
151	5755	16.5	13.49	13.47	16.49	13.41	13.37	16.40	13.43	13.06	16.26	13.27	12.90	16.10	
159	5795	16.5	13.40	13.27	16.35	13.25	13.18	16.23	13.22	13.02	16.13	13.05	12.95	16.01	

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MIMO (CHO+CH1)

802.11 n(40M)			Max. Rated Avg. Power + Max. Tolerance (dBm)	Average Power Output(dBm)										
5.2/5.3/5.6/5.8G				Data Rate (Mbps)										
CH	Frequency (MHz)	162		216			243			270				
				ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	ch 0	ch 1
38	5190	15	11.33	11.46	14.41	11.09	11.23	14.17	11.03	11.08	14.07	10.86	10.98	13.93
46	5230	16.5	12.63	13.41	16.05	12.58	13.28	15.95	12.43	13.08	15.78	12.27	13.00	15.66
54	5270	16.5	12.87	12.78	15.84	12.68	12.65	15.68	12.47	12.49	15.49	12.38	12.35	15.38
62	5310	14.5	11.22	11.19	14.22	11.18	11.11	14.16	11.12	11.03	14.09	11.06	10.97	14.03
102	5510	12.5	9.04	9.12	12.09	8.96	8.94	11.96	8.88	8.74	11.82	8.68	8.53	11.62
110	5550	16.5	13.13	12.71	15.94	12.93	12.58	15.77	12.81	12.52	15.68	12.59	12.36	15.49
134	5670	16.5	13.18	12.97	16.09	13.15	12.61	15.90	13.13	12.32	15.75	12.91	12.14	15.55
151	5755	16.5	13.19	12.69	15.96	12.95	12.54	15.76	12.94	12.46	15.72	12.72	12.34	15.54
159	5795	16.5	12.99	12.94	15.98	12.96	12.74	15.86	12.86	12.50	15.69	12.71	12.27	15.51

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MIMO (CHO+CH1)

802.11 ac(20M)			Max. Rated Avg. Power + Max. Tolerance (dBm)	Average Power Output(dBm)										
CH	Frequency (MHz)	Data Rate (Mbps)												
		13			26			39			52			
		ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	
36	5180	15	11.65	12.1	14.89	11.58	12.08	14.85	11.54	12.01	14.79	11.45	11.95	14.72
40	5200	17.5	14.46	14.49	17.49	14.24	14.38	17.32	13.93	14.49	17.23	13.84	14.38	17.13
44	5220	17.5	14.33	14.57	17.46	14.12	14.46	17.30	13.99	14.45	17.24	13.80	14.22	17.03
48	5240	17.5	14.29	14.18	17.25	14.19	14.15	17.18	14.11	14.08	17.11	14.02	14.05	17.05
52	5260	17.5	14.49	14.46	17.49	14.45	14.34	17.41	14.32	14.05	17.20	14.31	13.81	17.08
56	5280	15.5	12.31	12.13	15.23	12.27	12.08	15.19	12.19	12.01	15.11	12.11	11.94	15.04
60	5300	17.5	14.68	14.23	17.47	14.63	14.22	17.44	14.55	14.19	17.38	14.50	14.06	17.30
64	5320	12	9.25	8.67	11.98	9.05	8.52	11.80	8.90	8.40	11.67	8.89	8.20	11.57
100	5500	12	9.11	8.8	11.97	9.03	8.70	11.88	8.97	8.67	11.83	8.90	8.54	11.73
104	5520	17.5	14.48	14.47	17.49	14.45	14.27	17.37	14.31	14.16	17.25	14.29	14.08	17.20
108	5540	17.5	14.64	14.28	17.47	14.53	14.12	17.34	14.47	14.01	17.26	14.44	13.96	17.22
112	5560	17.5	14.48	14.16	17.33	14.41	14.07	17.25	14.16	13.93	17.06	14.10	13.83	16.98
116	5580	17.5	14.55	14.39	17.48	14.38	14.17	17.29	14.33	14.02	17.19	14.30	13.99	17.16
132	5660	17.5	14.56	14.19	17.39	14.37	14.14	17.27	14.30	14.10	17.21	14.28	13.91	17.11
136	5680	17.5	14.36	14.58	17.48	14.19	14.33	17.27	14.13	14.22	17.19	14.05	14.05	17.06
140	5700	12	8.9	9.06	11.99	8.66	8.95	11.82	8.59	8.85	11.73	8.44	8.64	11.55
149	5745	17.5	14.46	14.5	17.49	14.26	14.29	17.29	14.10	14.09	17.11	13.92	13.98	16.96
153	5765	17.5	14.37	14.43	17.41	14.35	14.38	17.38	14.24	14.33	17.30	14.13	14.29	17.22
157	5785	17.5	14.35	14.29	17.33	14.30	14.22	17.27	14.21	13.97	17.10	13.97	13.93	16.96
161	5805	17.5	14.26	14.61	17.45	14.17	14.46	17.33	14.15	14.40	17.29	14.04	14.21	17.14
165	5825	17.5	14.3	14.01	17.17	14.20	13.94	17.08	14.16	13.81	17.00	14.07	13.61	16.86

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MIMO (CHO+CH1)

802.11 ac(20M)			Max. Rated Avg. Power + Max. Tolerance (dBm)	Average Power Output(dBm)												
CH	Frequency (MHz)	Data Rate (Mbps)														
		78			104			117			130			ch 0	ch 1	
		ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	ch 0	ch 1	
36	5180	15	11.42	11.81	14.63	11.40	11.72	14.57	11.33	11.59	14.47	11.27	11.42	14.36		
40	5200	17.5	13.64	14.16	16.92	13.39	13.98	16.71	13.20	13.84	16.54	13.00	13.83	16.45		
44	5220	17.5	13.73	14.19	16.98	13.55	14.06	16.82	13.36	14.00	16.70	13.22	13.87	16.57		
48	5240	17.5	13.84	14.00	16.93	13.65	13.84	16.76	13.43	13.62	16.54	13.32	13.61	16.48		
52	5260	17.5	14.22	13.80	17.03	14.15	13.69	16.94	13.94	13.61	16.79	13.77	13.38	16.59		
56	5280	15.5	12.06	11.91	15.00	12.02	11.82	14.93	11.94	11.75	14.86	11.83	11.67	14.76		
60	5300	17.5	14.28	14.04	17.17	14.05	13.91	16.99	13.88	13.74	16.82	13.84	13.72	16.79		
64	5320	12	8.67	8.02	11.37	8.52	7.85	11.21	8.44	7.83	11.16	8.31	7.74	11.04		
100	5500	12	8.72	8.49	11.62	8.57	8.25	11.42	8.39	8.22	11.32	8.28	8.09	11.20		
104	5520	17.5	14.07	13.90	17.00	13.87	13.67	16.78	13.75	13.54	16.66	13.57	13.31	16.45		
108	5540	17.5	14.38	13.86	17.14	14.16	13.75	16.97	14.01	13.70	16.87	13.81	13.67	16.75		
112	5560	17.5	14.00	13.67	16.85	13.93	13.60	16.78	13.77	13.43	16.61	13.75	13.31	16.55		
116	5580	17.5	14.14	13.83	17.00	14.02	13.81	16.93	13.99	13.77	16.89	13.92	13.71	16.83		
132	5660	17.5	14.17	13.87	17.03	13.94	13.86	16.91	13.86	13.62	16.75	13.71	13.44	16.59		
136	5680	17.5	13.98	13.98	16.99	13.74	13.89	16.83	13.70	13.75	16.74	13.51	13.59	16.56		
140	5700	12	8.36	8.64	11.51	8.25	8.40	11.34	8.18	8.33	11.27	8.18	8.12	11.16		
149	5745	17.5	13.70	13.94	16.83	13.61	13.80	16.72	13.46	13.78	16.63	13.21	13.59	16.41		
153	5765	17.5	13.89	14.05	16.98	13.66	14.02	16.85	13.64	13.84	16.75	13.48	13.84	16.67		
157	5785	17.5	13.80	13.69	16.76	13.75	13.48	16.63	13.57	13.33	16.46	13.35	13.21	16.29		
161	5805	17.5	13.88	14.19	17.05	13.81	13.97	16.90	13.71	13.88	16.81	13.55	13.75	16.66		
165	5825	17.5	14.01	13.54	16.79	13.92	13.36	16.66	13.78	13.17	16.50	13.70	13.13	16.43		

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MIMO (CH0+CH1)

802.11 ac(20M)		Max. Rated Avg. Power + Max. Tolerance (dBm)	Average Power Output(dBm)			
5.2/5.3/5.6/5.8G			Data Rate (Mbps)			
CH	Frequency (MHz)		156			
			ch 0	ch 1	ch 0+1	
36	5180	15	11.21	11.33	14.28	
40	5200	17.5	12.85	13.71	16.31	
44	5220	17.5	13.11	13.76	16.46	
48	5240	17.5	13.21	13.53	16.38	
52	5260	17.5	13.64	13.31	16.49	
56	5280	15.5	11.73	11.62	14.69	
60	5300	17.5	13.77	13.61	16.70	
64	5320	12	8.19	7.64	10.93	
100	5500	12	8.21	7.95	11.09	
104	5520	17.5	13.44	13.19	16.33	
108	5540	17.5	13.72	13.57	16.66	
112	5560	17.5	13.66	13.21	16.45	
116	5580	17.5	13.81	13.57	16.70	
132	5660	17.5	13.56	13.36	16.47	
136	5680	17.5	13.43	13.41	16.43	
140	5700	12	8.02	7.94	10.99	
149	5745	17.5	13.13	13.41	16.28	
153	5765	17.5	13.41	13.75	16.59	
157	5785	17.5	13.21	13.14	16.19	
161	5805	17.5	13.44	13.71	16.59	
165	5825	17.5	13.66	13.01	16.36	

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MIMO (CH0+CH1)

802.11 ac(20M)		Max. Rated Avg. Power + Max. Tolerance (dBm)	Average Power Output(dBm)												
5.2/5.3/5.6/5.8G			Data Rate (Mbps)												
CH	Frequency (MHz)		13			26			39			52			
			ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	
144	5720	17.5	14.43	14.48	17.47	14.28	14.48	17.39	14.16	14.49	17.34	13.95	14.36	17.17	

802.11 ac(20M)		Max. Rated Avg. Power + Max. Tolerance (dBm)	Average Power Output(dBm)												
5.2/5.3/5.6/5.8G			Data Rate (Mbps)												
CH	Frequency (MHz)		78			104			117			130			
			ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	
144	5720	17.5	13.90	14.16	17.04	13.81	13.98	16.91	13.78	13.78	16.79	13.71	13.67	16.70	

802.11 ac(20M)		Max. Rated Avg. Power + Max. Tolerance (dBm)	Average Power Output(dBm)			
5.2/5.3/5.6/5.8G			Data Rate (Mbps)			
CH	Frequency (MHz)		156			
			ch 0	ch 1	ch 0+1	
144	5720	17.5	13.66	13.51	16.60	

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MIMO (CHO+CH1)

802.11 ac(40M)			Max. Rated Avg. Power + Max. Tolerance (dBm)	Average Power Output(dBm)										
CH	Frequency (MHz)	Data Rate (Mbps)										27		
		27			54			81			108			
		ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	
38	5190	15	11.45	11.68	14.58	11.21	11.66	14.45	11.01	11.62	14.34	10.88	11.44	14.18
46	5230	16.5	13.47	13.48	16.49	13.44	13.46	16.46	13.18	13.45	16.33	12.97	13.35	16.17
54	5270	16.5	13.48	13.47	16.49	13.41	13.35	16.39	13.50	13.09	16.31	13.27	13.02	16.16
62	5310	14.5	11.23	11.15	14.20	11.18	11.08	14.14	11.09	11.01	14.06	11.01	10.92	13.98
102	5510	12.5	9.37	9.44	12.42	9.24	9.42	12.34	9.11	9.41	12.27	9.10	9.33	12.23
110	5550	16.5	13.52	13.20	16.37	13.33	13.07	16.21	13.32	13.03	16.19	13.31	12.83	16.09
134	5670	16.5	13.44	13.30	16.38	13.25	13.22	16.25	13.04	13.07	16.07	12.82	13.01	15.93
151	5755	16.5	13.48	13.39	16.45	13.48	13.24	16.37	13.41	13.19	16.31	13.40	12.98	16.21
159	5795	16.5	13.40	13.36	16.39	13.21	13.21	16.22	13.02	13.19	16.12	12.94	13.11	16.04

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MIMO (CHO+CH1)

802.11 ac(40M)			Max. Rated Avg. Power + Max. Tolerance (dBm)	Average Power Output(dBm)													
CH	Frequency (MHz)	Data Rate (Mbps)															
		162			216			243			270			ch 0	ch 1		
		ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	
38	5190	15	10.80	11.36	14.10	10.57	11.13	13.87	10.45	10.91	13.70	10.37	10.79	13.60			
46	5230	16.5	12.91	13.30	16.12	12.88	13.23	16.07	12.81	13.20	16.02	12.59	13.02	15.82			
54	5270	16.5	13.12	13.01	16.08	13.07	12.97	16.03	12.90	12.81	15.87	12.76	12.59	15.69			
62	5310	14.5	10.94	10.84	13.90	10.91	10.76	13.85	10.87	10.71	13.80	10.81	10.64	13.74			
102	5510	12.5	9.05	9.21	12.14	8.92	8.97	11.96	8.90	8.95	11.94	8.90	8.86	11.89			
110	5550	16.5	13.09	12.60	15.86	12.90	12.41	15.67	12.84	12.30	15.59	12.83	12.07	15.48			
134	5670	16.5	12.58	12.90	15.75	12.33	12.79	15.58	12.09	12.59	15.36	12.01	12.42	15.23			
151	5755	16.5	13.39	12.83	16.13	13.34	12.62	16.01	13.32	12.59	15.98	13.26	12.51	15.91			
159	5795	16.5	12.80	13.01	15.92	12.76	12.89	15.84	12.71	12.86	15.80	12.57	12.84	15.72			

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MIMO (CH0+CH1)

802.11 ac(40M)		Max. Rated Avg. Power + Max. Tolerance (dBm)	Average Power Output(dBm)						
5.2/5.3/5.6/5.8G			Data Rate (Mbps)						
CH	Frequency (MHz)		324			360			
			ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	
38	5190	15	10.23	10.71	13.49	10.11	10.63	13.39	
46	5230	16.5	12.51	12.94	15.74	12.39	12.81	15.62	
54	5270	16.5	12.63	12.51	15.58	12.51	12.37	15.45	
62	5310	14.5	10.74	10.57	13.67	10.67	10.51	13.60	
102	5510	12.5	8.81	8.74	11.79	8.64	8.61	11.64	
110	5550	16.5	12.71	11.94	15.35	12.63	11.85	15.27	
134	5670	16.5	11.93	12.33	15.14	11.81	12.25	15.05	
151	5755	16.5	13.18	12.44	15.84	13.11	12.35	15.76	
159	5795	16.5	12.41	12.76	15.60	12.35	12.71	15.54	

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MIMO (CH0+CH1)

802.11 ac(40M)		Max. Rated Avg. Power + Max. Tolerance (dBm)	Average Power Output(dBm)												
5.2/5.3/5.6/5.8G			Data Rate (Mbps)												
CH	Frequency (MHz)		27			54			81			108			
			ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	
142	5710	16.5	13.11	13.46	16.30	12.99	13.31	16.16	12.93	13.25	16.10	12.77	13.24	16.02	

802.11 ac(40M)		Max. Rated Avg. Power + Max. Tolerance (dBm)	Average Power Output(dBm)												
5.2/5.3/5.6/5.8G			Data Rate (Mbps)												
CH	Frequency (MHz)		162			216			243			270			
			ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	
142	5710	16.5	12.54	13.07	15.82	12.46	12.90	15.70	12.23	12.71	15.49	12.10	12.52	15.33	

802.11 ac(40M)		Max. Rated Avg. Power + Max. Tolerance (dBm)	Average Power Output(dBm)						
5.2/5.3/5.6/5.8G			Data Rate (Mbps)						
CH	Frequency (MHz)		324			360			
			ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	
142	5710	16.5	11.95	12.43	15.21	11.84	12.36	15.12	

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MIMO (CH0+CH1)

802.11 ac(80M)		Max. Rated Avg. Power + Max. Tolerance (dBm)	Average Power Output(dBm)												
5.2/5.3/5.6/5.8G			Data Rate (Mbps)												
CH	Frequency (MHz)		58.5			117			175.5			234			
			ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	
42	5210	14	10.68	10.81	13.76	10.62	10.58	13.61	10.52	10.39	13.47	10.28	10.18	13.24	
58	5290	14.5	11.43	11.48	14.47	11.24	11.51	14.39	11.10	11.46	14.29	11.03	11.35	14.20	
106	5530	15.5	12.48	12.48	15.49	12.43	12.40	15.43	12.41	12.06	15.25	12.19	11.87	15.04	
138	5690	15.5	12.55	12.26	15.42	12.43	12.21	15.33	12.27	12.14	15.22	12.24	11.97	15.12	
155	5775	15.5	12.49	11.90	15.22	12.49	11.62	15.09	12.43	11.50	15.00	12.37	11.34	14.90	

802.11 ac(80M)		Max. Rated Avg. Power + Max. Tolerance (dBm)	Average Power Output(dBm)												
5.2/5.3/5.6/5.8G			Data Rate (Mbps)												
CH	Frequency (MHz)		351			468			526.5			585			
			ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	
42	5210	14	10.09	10.15	13.13	9.86	9.90	12.89	9.69	9.83	12.77	9.57	9.62	12.61	
58	5290	14.5	11.00	11.19	14.11	10.86	11.09	13.99	10.86	10.96	13.92	10.62	10.93	13.79	
106	5530	15.5	12.15	11.79	14.98	12.00	11.67	14.85	11.78	11.54	14.67	11.55	11.51	14.54	
138	5690	15.5	12.21	11.82	15.03	12.00	11.72	14.87	11.83	11.61	14.73	11.73	11.38	14.57	
155	5775	15.5	12.27	11.31	14.83	12.07	11.20	14.67	11.85	10.97	14.44	11.63	10.79	14.24	

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MIMO (CH0+CH1)

802.11 ac(80M)		Max. Rated Avg. Power + Max. Tolerance (dBm)	Average Power Output(dBm)						
5.2/5.3/5.6/5.8G			Data Rate (Mbps)						
CH	Frequency (MHz)		702			780			
			ch 0	ch 1	ch 0+1	ch 0	ch 1	ch 0+1	
42	5210	14	9.41	9.52	12.48	9.36	9.44	12.41	
58	5290	14.5	10.55	10.83	13.70	10.41	10.72	13.58	
106	5530	15.5	11.42	11.36	14.40	11.31	11.25	14.29	
138	5690	15.5	11.65	11.26	14.47	11.44	11.21	14.34	
155	5775	15.5	11.54	10.71	14.16	11.41	10.63	14.05	

#. The maximum tune-up power of CH0 and CH1 is minus 3dBm from the maximum tune-up power of CH0+CH1.

#. Per FCC KDB443999, transmission on channels which overlap the 5600-5650 MHz is prohibited as a client.

#. Bluetooth maximum power table:

Mode	Max. tune-up power(dBm)	Max. tune-up power(mW)
all	9	7.943

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1.4 Test Environment

Ambient Temperature: $22 \pm 2^\circ \text{C}$

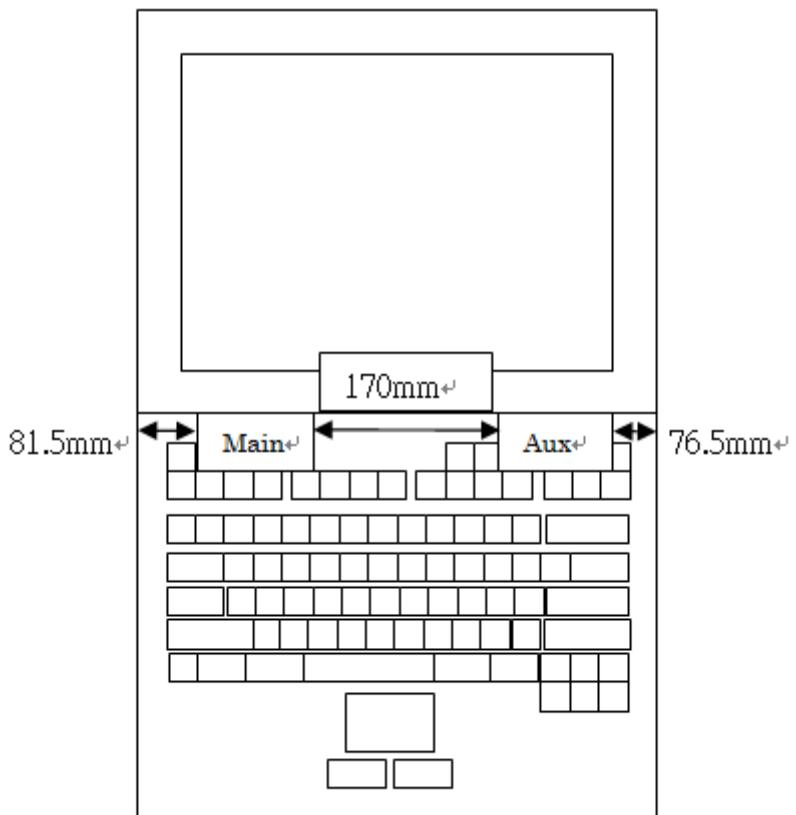
Tissue Simulating Liquid: $22 \pm 2^\circ \text{C}$

1.5 Operation Description

Use chipset specific software to control the EUT, and makes it transmit in maximum power. Measurements are performed respectively on the lowest, middle and highest channels of the operating band(s). The EUT is set to maximum power level during all tests, and at the beginning of each test the battery is fully charged.

The EUT was tested in one configuration:

Configuration 1: Lap-held mode with test separation distance 0mm. (The screen portion of the laptop is in an open position at a 90° angle, and the laptop is positioned with its bottom of keyboard against the flat phantom.)



Front view of the laptop

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Note:

1. The EUT only supports 2Tx CDD in 802.11a/b/g, and the SAR test of 2Tx was measured in these modes.
2. The EUT only supports 2Tx MIMO in 802.11n/ac, and the SAR test of 2Tx MIMO was measured in these modes.
3. The maximum output power of 802.11g/n(20) is reduced for channel 1/11, and the highest output channels closest to each of these channels are tested instead.
4. The scaling factor of MIMO SAR is the worst case between the difference in measured output power and maximum output power for Main antenna and Aux antenna.
5. The screen portion of the laptop is in an open position at a 90° angle, and the laptop is positioned with its bottom of keyboard against the flat phantom to test lap-held SAR.
6. SAR testing for 802.11g/n is not required since its maximum power is less than 1/4 dB higher than 802.11b.
7. SAR testing for 802.11n 5GHz is not required when its maximum power is less than 1/4 dB higher than 802.11a.
8. SAR testing for 802.11ac is required for the worst position of 802.11a when the maximum power of 802.11ac is less than 1/4 dB higher than 802.11a.
9. Testing at higher data rates is not required since the maximum power is less than 1/4 dB higher than those measured at the lowest data rate except for 802.11b. Testing at 5.5Mbps data rates of 802.11b is required since the maximum measured power is higher than 1/4 dB higher than those measured at the lowest data rate
10. For Bluetooth operational modes the transmission is at Main output. Bluetooth can only be transmitted simultaneously with 5GHz WLAN (Main+Aux) according to client's operation description.
11. According to KDB447498 D01,

- (1) The SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances \leq 50 mm are determined by:

$$\frac{\text{Max. tune up power(mW)}}{\text{Min. test separation distance(mm)}} \times \sqrt{f(\text{GHz})} \leq 3$$

When the minimum test separation distance is $< 5\text{mm}$, 5mm is applied to determine

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SAR test exclusion.

(2) For test separation distances > 50 mm, and the frequency at 100 MHz to 1500MHz, the SAR test exclusion threshold is determined according to the following, and as illustrated in Appendix B of KDB447498 D01.

$$[(\text{Threshold at 50mm in step1}) + (\text{test separation distance}-50\text{mm}) \times \frac{10\text{MHz}}{150\text{MHz}}](\text{mW}),$$

(3) For test separation distances > 50 mm, and the frequency at >1500MHz to 6GHz, the SAR test exclusion threshold is determined according to the following, and as illustrated in Appendix B of KDB447498 D01.

$$[(\text{Threshold at 50mm in step1}) + (\text{test separation distance}-50\text{mm}) \times 10](\text{mW}),$$

Mode	Maximum tune-up power(dBm)	Maximum tune-up power(mW)	Lap-held		
			Ant. to surface (mm)	Exclusion threshold (mW)	Require SAR testing?
BT	9	7.943	less than 5	2.502	NO

12. According to KDB447498 D01, testing of other required channels is not required when the reported 1-g SAR for the highest output channel is $\leq 0.8 \text{ W/kg}$, when the transmission band is $\leq 100 \text{ MHz}$.
13. According to KDB447498 D01, testing of other required channels is not required when the reported 1-g SAR for the highest output channel is $\leq 0.6 \text{ W/kg}$, when the transmission band is between 100 MHz and 200MHz.
14. According to KDB447498 D01, testing of other required channels is not required when the reported 1-g SAR for the highest output channel is $\leq 0.4 \text{ W/kg}$, when the transmission band is $\geq 200\text{MHz}$.
15. According to KDB865664 D01, SAR measurement variability must be assessed for each frequency band. When the original highest measured SAR is $\geq 0.8 \text{ W/kg}$, repeated that measurement once. 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 $\geq 1.45 \text{ W/kg}$ ($\sim 10\%$ from the 1-g SAR limit)

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1.6 The SAR Measurement System

A block diagram of the SAR measurement System is given in Fig. a. This SAR Measurement System uses a Computer-controlled 3-D stepper motor system (SPEAG DASY 5 professional system). The model EX3DV4 field probe is used to determine the internal electric fields. The SAR can be obtained from the equation $SAR = \sigma (|E|^2) / \rho$ where σ and ρ are the conductivity and mass density of the tissue-simulant.

The DASY 5 system for performing compliance tests consists of the following items:

- A standard high precision 6-axis robot (Staubli RX family) with controller, teach pendant and software. An arm extension is for accommodating the data acquisition electronics (DAE).
- A dosimetric probe, i.e., an isotropic E-field probe optimized and calibrated for usage intissue simulating liquid. The probe is equipped with an optical surface detector system.
- 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.

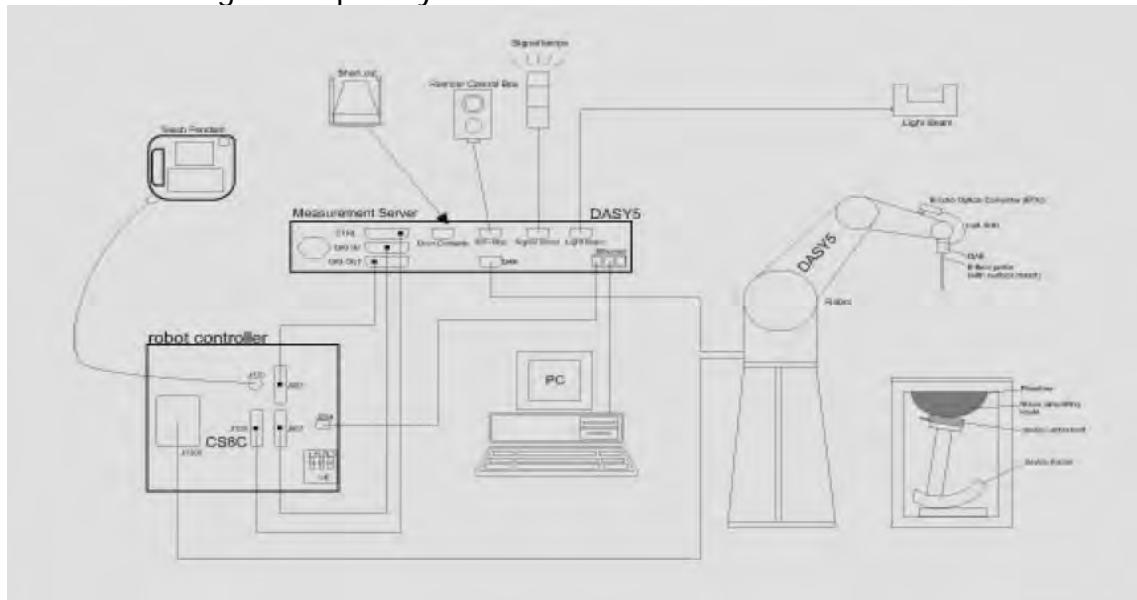


Fig. a The block diagram of SAR system

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- The Electro-optical converter (EOC) performs the conversion between optical and electrical of the signals for the digital communication to the DAE and for the analog signal from the optical surface detection. The EOC is connected 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.
- A probe alignment unit which improves the (absolute) accuracy of the probe positioning.
- A computer operating Windows 7.
- DASY 5 software.
- Remote control with teach pendant and additional circuitry for robot safety such as warning lamps, etc.
- The SAM twin phantom enabling testing left-hand and right-hand usage.
- The device holder for handheld mobile phones.
- Tissue simulating liquid mixed according to the given recipes.
- Validation dipole kits allowing to validate the proper functioning of the system.

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1.7 System Components

EX3DV4 E-Field Probe

Construction	Symmetrical design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)	
Calibration	Basic Broad Band Calibration in air Conversion Factors (CF) for HSL 2450/5200/5300/5600/5800 MHz Additional CF for other liquids and frequencies upon request	
Frequency	10 MHz to > 6 GHz	
Directivity	± 0.3 dB in HSL (rotation around probe axis) ± 0.5 dB in tissue material (rotation normal to probe axis)	
Dynamic Range	10 µW/g to > 100 mW/g Linearity: ± 0.2 dB (noise: typically < 1 µW/g)	
Dimensions	Tip diameter: 2.5 mm	
Application	High precision dosimetric measurements in any exposure scenario (e.g., very strong gradient fields). Only probe which enables compliance testing for frequencies up to 6 GHz with precision of better 30%.	

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SAM PHANTOM V4.0C

Construction	The shell corresponds to the specifications of the Specific Anthropomorphic Mannequin (SAM) phantom defined in IEEE 1528-200X and IEC 62209. It enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. A cover prevents evaporation of the liquid. Reference markings on the phantom allow the complete setup of all predefined phantom positions and measurement grids by manually teaching three points with the robot.
Shell Thickness	2 ± 0.2 mm
Filling Volume	Approx. 25 liters
Dimensions	Height: 850 mm; Length: 1000 mm; Width: 500 mm

**DEVICE HOLDER**

Construction	The device holder (Supporter) for Notebook is made by POM (polyoxymethylene resin) , which is non-metal and non-conductive. The height can be adjusted to fit varies kind of notebooks.	
Device Holder		

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1.8 SAR System Verification

The microwave circuit arrangement for system verification is sketched in Fig. b. The daily system accuracy verification occurs within the flat section of the SAM phantom. A SAR measurement was performed to see if the measured SAR was within +/- 10% from the target SAR values. These tests were done at 2450/5200/5300/5600/5800 MHz. The tests were conducted on the same days as the measurement of the DUT. The obtained results from the system accuracy verification are displayed in the table 1 (SAR values are normalized to 1W forward power delivered to the dipole). During the tests, the ambient temperature of the laboratory was 21.7°C, the relative humidity was 62% and the liquid depth above the ear reference points was $\geq 15 \text{ cm} \pm 5 \text{ mm}$ (frequency $\leq 3 \text{ GHz}$) or $\geq 10 \text{ cm} \pm 5 \text{ mm}$ (frequency $> 3 \text{ GHz}$) in all the cases. It is seen that the system is operating within its specification, as the results are within acceptable tolerance of the reference values.

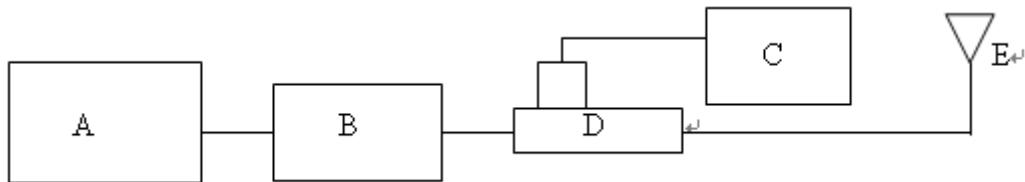


Fig. b The block diagram of system verification

- A. Signal generator
- B. Amplifier
- C. Power meter
- D. Dual directional coupling
- E. Reference dipole antenna



Photograph of the dipole Antenna

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Validation Kit	S/N	Frequency (MHz)		Target SAR (1g) (mW/g)	Measured SAR (1g)(mW/g)	Deviation (%)	Measured Date
D2450V2	922	2450	Body	12.9	12.9	0.00%	Sep. 20, 2014
D5GHzV2	1023	5200	Body	7.39	7.29	1.35%	Sep. 21, 2014
		5300	Body	7.62	7.71	-1.18%	Sep. 21, 2014
		5600	Body	8.04	8.08	-0.50%	Sep. 22, 2014
		5800	Body	7.44	7.51	-0.94%	Sep. 23, 2014

Table 1. Results of system validation

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1.9 Tissue Simulant Fluid for the Frequency Band

The dielectric properties for this body-simulant fluid were measured by using the Agilent Model 85070E Dielectric Probe (rates frequency band 200 MHz to 20 GHz) in conjunction with Network Analyzer (30 KHz-6000 MHz).

All dielectric parameters of tissue simulates were measured within 24 hours of SAR measurements. The depth of the tissue simulant in the flat section of the phantom was $\geq 15 \text{ cm} \pm 5 \text{ mm}$ (Frequency $\leq 3\text{G}$) or $\geq 10 \text{ cm} \pm 5 \text{ mm}$ (Frequency $> 3\text{G}$) during all tests. (Fig. 2)

Tissue Type	Measurement Date	Measured Frequency (MHz)	Target Dielectric Constant, ϵ_r	Target Conductivity, σ (S/m)	Measured Dielectric Constant, ϵ_r	Measured Conductivity, σ (S/m)	% dev ϵ_r	% dev σ
Body	Sep. 20, 2014	2412	52.751	1.914	51.962	1.881	1.50%	1.72%
		2417	52.744	1.918	51.943	1.892	1.52%	1.36%
		2437	52.717	1.938	51.904	1.914	1.54%	1.22%
		2450	52.700	1.950	51.879	1.929	1.56%	1.08%
		2457	52.691	1.960	51.866	1.944	1.57%	0.82%
		2462	52.685	1.967	51.842	1.952	1.60%	0.76%
	Sep. 21, 2014	5200	49.014	5.299	47.583	5.223	2.92%	1.43%
		5210	49.001	5.311	47.544	5.242	2.97%	1.30%
		5230	48.974	5.334	47.489	5.271	3.03%	1.18%
		5240	48.960	5.346	47.481	5.280	3.02%	1.23%
		5260	48.933	5.369	47.439	5.306	3.05%	1.17%
		5270	48.919	5.381	47.406	5.322	3.09%	1.10%
		5290	48.892	5.404	47.379	5.359	3.09%	0.83%
		5300	48.879	5.416	47.358	5.364	3.11%	0.96%
	Sep. 22, 2014	5520	48.580	5.673	47.498	5.491	2.23%	3.21%
		5530	48.566	5.685	47.479	5.509	2.24%	3.09%
		5560	48.526	5.720	47.440	5.553	2.24%	2.91%
		5600	48.471	5.766	47.385	5.601	2.24%	2.87%
		5670	48.376	5.848	47.202	5.716	2.43%	2.26%
		5710	48.322	5.895	47.123	5.773	2.48%	2.07%
		5720	48.309	5.907	47.106	5.788	2.49%	2.01%

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Tissue Type	Measurement Date	Measured Frequency (MHz)	Target Dielectric Constant, ϵ_r	Target Conductivity, σ (S/m)	Measured Dielectric Constant, ϵ_r	Measured Conductivity, σ (S/m)	% dev ϵ_r	% dev σ
Body	Sep. 23, 2014	5745	48.275	5.936	46.555	5.877	3.56%	0.99%
		5755	48.261	5.947	46.540	5.896	3.57%	0.86%
		5775	48.234	5.971	46.514	5.919	3.57%	0.87%
		5785	48.220	5.982	46.478	5.935	3.61%	0.79%
		5800	48.200	6.000	46.469	5.961	3.59%	0.65%

Table 2. Dielectric Parameters of Tissue Simulant Fluid

The composition of the tissue simulating liquid:

Frequency (MHz)	Mode	Ingredient						Total amount
		DGMBE	Water	Salt	Preventol D-7	Cellulose	Sugar	
2450	Body	301.7ml	698.3ml	—	—	—	—	1.0L(Kg)

Body Simulating Liquids for 5 GHz, Manufactured by SPEAG:

Ingredients (% by weight)	Water	Esters, Emulsifiers, Inhibitors	Sodium and Salt
	60-80	20-40	0-1.5

Table 3. Recipes for Tissue Simulating Liquid

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1.10 Evaluation Procedures

The entire evaluation of the spatial peak values is performed within the Post-processing engine (SEMCAD). The system always gives the maximum values for the 1 g and 10 g cubes. The algorithm to find the cube with highest averaged SAR is divided into the following stages:

1. The extraction of the measured data (grid and values) from the Zoom Scan.
2. The calculation of the SAR value at every measurement point based on all stored data (A/D values and measurement parameters)
3. The generation of a high-resolution mesh within the measured volume
4. The interpolation of all measured values from the measurement grid to the high-resolution grid
5. The extrapolation of the entire 3-D field distribution to the phantom surface over the distance from sensor to surface
6. The calculation of the averaged SAR within masses of 1g and 10g.

The probe is calibrated at the center of the dipole sensors that is located 1 to 2.7mm away from the probe tip. During measurements, the probe stops shortly above the phantom surface, depending on the probe and the surface detecting system. Both distances are included as parameters in the probe configuration file. The software always knows exactly how far away the measured point is from the surface. As the probe cannot directly measure at the surface, the values between the deepest measured point and the surface must be extrapolated. The angle between the probe axis and the surface normal line is less than 30 degree.

In the Area Scan, the gradient of the interpolation function is evaluated to find all the extreme of the SAR distribution. The uncertainty on the locations of the extreme is less than 1/20 of the grid size. Only local maximum within -2 dB of the global maximum are searched and passed for the Cube Scan measurement. In the Cube Scan, the interpolation function is used to extrapolate the Peak SAR from the lowest measurement points to the inner phantom surface (the extrapolation distance). The uncertainty increases with the extrapolation distance. To keep the uncertainty within 1% for the 1 g and 10 g cubes, the extrapolation distance should not be larger than 5mm.

The maximum search is automatically performed after each area scan measurement. It is based on splines in two or three dimensions. The procedure can find the maximum for most SAR distributions even with relatively large grid spacing. After the area scanning measurement, the probe is automatically moved to a position at the interpolated maximum. The following scan can directly use this position for reference, e.g., for a finer resolution grid or the cube evaluations. The 1g and 10g peak evaluations are only available for the predefined cube 7x7x7 scans. The routines are verified and optimized for the grid dimensions used in these cube measurements.

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The measured volume of 30x30x30mm contains about 30g of tissue.

The first procedure is an extrapolation (incl. Boundary correction) to get the points between the lowest measured plane and the surface. The next step uses 3D interpolation to get all points within the measured volume. In the last step, a 1g cube is placed numerically into the volume and its averaged SAR is calculated. This cube is moved around until the highest averaged SAR is found. If the highest SAR is found at the edge of the measured volume, the system will issue a warning: higher SAR values might be found outside of the measured volume. In that case the cube measurement can be repeated, using the new interpolated maximum as the center.

1.11 Probe Calibration Procedures

For the calibration of E-field probes in lossy liquids, an electric field with an accurately known field strength must be produced within the measured liquid. For standardization purposes it would be desirable if all measurements which are necessary to assess the correct field strength would be traceable to standardized measurement procedures. In the following two different calibration techniques are summarized:

1.11.1 Transfer Calibration with Temperature Probes

In lossy liquids the specific absorption rate (SAR) is related both to the electric field (E) and the temperature gradient ($\delta T / \delta t$) in the liquid.

$$SAR = \frac{\sigma}{\rho} |E|^2 = c \frac{\delta T}{\delta t}$$

whereby σ is the conductivity, ρ the density and c the heat capacity of the liquid.

Hence, the electric field in lossy liquid can be measured indirectly by measuring the temperature gradient in the liquid. Non-disturbing temperature probes (optical probes or thermistor probes with resistive lines) with high spatial resolution (<1-2 mm) and fast reaction time (<1 s) are available and can be easily calibrated with high precision [1]. The setup and the exciting source have no influence on the calibration; only the relative positioning uncertainties of the standard temperature probe and the E-field probe to be calibrated must be considered. However, several problems limit the available accuracy of probe calibrations with temperature probes:

- The temperature gradient is not directly measurable but must be evaluated from temperature measurements at different time steps. Special precaution is necessary to avoid measurement errors caused by temperature gradients due to energy equalizing effects or convection currents in the liquid. Such effects cannot be completely avoided, as the measured field itself destroys the thermal equilibrium in the liquid. With a careful setup these errors can be kept small.

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- The measured volume around the temperature probe is not well defined. It is difficult to calculate the energy transfer from a surrounding gradient temperature field into the probe. These effects must be considered, since temperature probes are calibrated in liquid with homogeneous temperatures. There is no traceable standard for temperature rise measurements.
- The calibration depends on the assessment of the specific density, the heat capacity and the conductivity of the medium. While the specific density and heat capacity can be measured accurately with standardized procedures (~ 2% for c ; much better for ρ), there is no standard for the measurement of the conductivity. Depending on the method and liquid, the error can well exceed $\pm 5\%$.
- Temperature rise measurements are not very sensitive and therefore are often performed at a higher power level than the E-field measurements. The nonlinearities in the system (e.g., power measurements, different components, etc.) must be considered.

Considering these problems, the possible accuracy of the calibration of E-field probes with temperature gradient measurements in a carefully designed setup is about $\pm 10\%$ (RSS) [2]. Recently, a setup which is a combination of the waveguide techniques and the thermal measurements was presented in [3]. The estimated uncertainty of the setup is $\pm 5\%$ (RSS) when the same liquid is used for the calibration and for actual measurements and $\pm 7\text{--}9\%$ (RSS) when not, which is in good agreement with the estimates given in [2].

1.11.2 Calibration with Analytical Fields

In this method a technical setup is used in which the field can be calculated analytically from measurements of other physical magnitudes (e.g., input power). This corresponds to the standard field method for probe calibration in air; however, there is no standard defined for fields in lossy liquids.

When using calculated fields in lossy liquids for probe calibration, several points must be considered in the assessment of the uncertainty:

- The setup must enable accurate determination of the incident power.
- The accuracy of the calculated field strength will depend on the assessment of the dielectric parameters of the liquid.
- Due to the small wavelength in liquids with high permittivity, even small setups might be above the resonant cutoff frequencies. The field distribution in the setup must be carefully checked for conformity with the theoretical field distribution.

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1.12 Test Standards and Limits

According to FCC 47CFR §2.1093(d) The limits to be used for evaluation are based generally on criteria published by the American National Standards Institute (ANSI) for localized specific absorption rate ("SAR") in Section 4.2 of "IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz," ANSI/IEEE C95.1–1992, Copyright 1992 by the Institute of Electrical and Electronics Engineers, Inc., New York, New York 10017. These criteria for SAR evaluation are similar to those recommended by the National Council on Radiation Protection and Measurements (NCRP) in "Biological Effects and Exposure Criteria for Radio frequency Electromagnetic Fields," NCRP Report No. 86, Section 17.4.5. Copyright NCRP, 1986, Bethesda, Maryland 20814. SAR is a measure of the rate of energy absorption due to exposure to an RF transmitting source. SAR values have been related to threshold levels for potential biological hazards. The criteria to be used are specified in paragraphs (d)(1) and (d)(2) of this section and shall apply for portable devices transmitting in the frequency range from 100 kHz to 6 GHz. Portable devices that transmit at frequencies above 6 GHz are to be evaluated in terms of the MPE limits specified in § 1.1310 of this chapter. Measurements and calculations to demonstrate compliance with MPE field strength or power density limits for devices operating above 6 GHz should be made at a minimum distance of 5 cm from the radiating source.

- (1) Limits for Occupational/Controlled exposure: 0.4 W/kg as averaged over the whole-body and spatial peak SAR not exceeding 8 W/kg as averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube). Exceptions are the hands, wrists, feet and ankles where the spatial peak SAR shall not exceed 20 W/kg, as averaged over an 10 grams of tissue (defined as a tissue volume in the shape of a cube).
- (2) Occupational/Controlled limits apply when persons are exposed as a consequence of their employment provided these persons are fully aware of and exercise control over their exposure. Awareness of exposure can be accomplished by use of warning labels or by specific training or education through appropriate means, such as an RF safety program in a work environment.
- (3) Limits for General Population/Uncontrolled exposure: 0.08 W/kg as averaged over the whole-body and spatial peak SAR not exceeding 1.6 W/kg as averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube). Exceptions are the hands, wrists, feet and ankles where the spatial peak SAR shall not exceed 4 W/kg, as averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube). General Population/Uncontrolled limits apply when the general public may be exposed, or when persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or do not exercise control over their exposure. Warning labels placed on consumer devices such as cellular telephones will not be sufficient reason to allow these devices to be evaluated subject to limits for occupational/controlled exposure in paragraph (d)(1)

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of this section. (Table 4.)

Human Exposure	Uncontrolled Environment General Population	Controlled Environment Occupational
Spatial Average SAR (Partial-body)	1.60 m W/g	8.00 m W/g
Spatial Average SAR (Whole-Body)	0.08 m W/g	0.40 m W/g
Spatial Peak SAR (Hands/Feet/Ankles/Wrists)	4.00 m W/g	20.00 m W/g

Table 4. RF exposure limits

Notes:

1. Uncontrolled environments are defined as locations where there is potential exposure of individuals who have no knowledge or control of their potential exposure.
2. Controlled environments are defined as locations where there is potential exposure of individuals who have knowledge of their potential exposure and can exercise control over their exposure.

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2. Summary of Results

Antenna	Band	Position	CH	Freq. (MHz)	Max. Rated Avg. Power + Max. Tolerance (dBm)	Measured Avg. Power (dBm)	Worst case Scaling	Averaged SAR over 1g (W/kg)		Plot page
								Measured	Reported	
2Tx CDD	WLAN802.11b	Lap-held	1	2412	20.50 (Ch 0)	20.31 (Ch 0)	4.47%	0.814	0.850	-
		Lap-held	6	2437	20.50 (Ch 0)	20.31 (Ch 0)	4.47%	1.26	1.316	-
		Lap-held	11	2462	20.50 (Ch 0)	20.45 (Ch 0)	1.16%	1.35	1.366	55
		Lap-held*	11	2462	20.50 (Ch 0)	20.45 (Ch 0)	1.16%	1.33	1.345	-
MIMO	WLAN802.11ac (20M)	Lap-held	2	2417	17.00 (Ch 1)	16.64 (Ch 1)	8.64%	0.601	0.653	-
		Lap-held	6	2437	19.50 (Ch 1)	19.15 (Ch 1)	8.39%	1.02	1.106	56
		Lap-held	10	2457	17.00 (Ch 1)	16.58 (Ch 1)	10.15%	0.544	0.599	-
	WLAN802.11ac (40M)	Lap-held	6	2437	17.50 (Ch 0)	17.37 (Ch 0)	3.04%	0.551	0.568	57
2Tx CDD	WLAN802.11a 5.2G	Lap-held	48	5240	15 (Ch 0)	14.87 (Ch 0)	3.04%	0.374	0.385	58
MIMO	WLAN802.11ac (20M) 5.2G	Lap-held	40	5200	14.5 (Ch 0)	14.46 (Ch 0)	0.93%	0.339	0.342	59
	WLAN802.11ac (40M) 5.2G	Lap-held	46	5230	13.5 (Ch 0)	13.47 (Ch 0)	0.69%	0.123	0.124	60
	WLAN802.11ac (80M) 5.2G	Lap-held	42	5210	11 (Ch 0)	10.68 (Ch 0)	7.65%	0.101	0.109	61
2Tx CDD	WLAN802.11a 5.3G	Lap-held	52	5260	15 (Ch 0)	14.79 (Ch 0)	4.95%	0.309	0.324	62
MIMO	WLAN802.11n (20M) 5.3G	Lap-held	60	5300	14.5 (Ch 1)	14.46 (Ch 1)	0.93%	0.076	0.077	63
	WLAN802.11n (40M) 5.3G	Lap-held	54	5270	13.5 (Ch 1)	13.46 (Ch 1)	0.93%	0.059	0.060	64
	WLAN802.11ac (20M) 5.3G	Lap-held	52	5260	14.5 (Ch 1)	14.46 (Ch 1)	0.93%	0.103	0.104	65
	WLAN802.11ac (40M) 5.3G	Lap-held	54	5270	13.5 (Ch 1)	13.47 (Ch 1)	0.69%	0.08	0.081	66
	WLAN802.11ac (80M) 5.3G	Lap-held	58	5290	11.5 (Ch 0)	11.43 (Ch 0)	1.62%	0.053	0.054	67

Test distance is 0mm.

*- repeated at the highest SAR measurement according to the FCC KDB 865664

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Antenna	Band	Position	CH	Freq. (MHz)	Max. Rated Avg. Power + Max. Tolerance (dBm)	Measured Avg. Power (dBm)	Worst case Scaling	Averaged SAR over 1g (W/kg)		Plot page
								Measured	Reported	
2Tx CDD	WLAN802.11a 5.6G	Lap-held	112	5560	15 (Ch 1)	14.85 (Ch 1)	3.51%	0.282	0.292	68
MIMO	WLAN802.11ac (20M) 5.6G	Lap-held	104	5520	14.5 (Ch 1)	14.47 (Ch 1)	0.69%	0.312	0.314	-
		Lap-held	144	5720	14.5 (Ch 0)	14.43 (Ch 0)	1.62%	0.347	0.353	69
	WLAN802.11ac (40M) 5.6G	Lap-held	134	5670	13.5 (Ch 1)	13.3 (Ch 1)	4.71%	0.327	0.342	70
		Lap-held	142	5710	13.5 (Ch 0)	13.11 (Ch 0)	9.40%	0.308	0.337	-
	WLAN802.11ac (80M) 5.6G	Lap-held	106	5530	12.5 (Ch 0)	12.48 (Ch 0)	0.46%	0.225	0.226	71
2Tx CDD	WLAN802.11a 5.8G	Lap-held	157	5785	15 (Ch 0)	14.86 (Ch 0)	3.28%	0.427	0.441	72
MIMO	WLAN802.11ac (20M) 5.8G	Lap-held	149	5745	14.5 (Ch 0)	14.46 (Ch 0)	0.93%	0.47	0.474	73
	WLAN802.11ac (40M) 5.8G	Lap-held	151	5755	13.5 (Ch 1)	13.39 (Ch 1)	2.57%	0.388	0.398	74
	WLAN802.11ac (80M) 5.8G	Lap-held	155	5775	12.5 (Ch 1)	11.9 (Ch 1)	14.82%	0.072	0.083	75

Test distance is 0mm.

#. The scaling factor of MIMO SAR is the worst case between the difference in measured output power and maximum output power for Main antenna and Aux antenna.

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3. Simultaneous Transmission Analysis

Simultaneous Transmission Scenarios:

Simultaneous Transmit Configurations	Body
5GHz WLAN (Main+Aux) + BT	Yes

Note:

1. 5GHz WLAN (Main+Aux) and BT antennas may transmit simultaneously.
2. Bluetooth and WLAN Main share the same antenna path.

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3.1 Estimated SAR calculation

According to KDB447498 D01v05 – When standalone SAR test exclusion applies to an antenna that transmits simultaneously with other antennas, the standalone SAR must be estimated according to following to determine simultaneous transmission SAR test exclusion:

$$\text{Estimated SAR} = \frac{\text{Max. tune up power(mW)}}{\text{Min. test separation distance(mm)}} \times \frac{\sqrt{f(\text{GHz})}}{7.5}$$

If the minimum test separation distance is < 5mm, a distance of 5mm is used for estimated SAR calculation. When the test separation distance is >50mm, the 0.4W/kg is used for SAR-1g.

Mode / Band	frequency(GHz)	Maximum tune-up power(dBm)	Test position	test separation distance(mm)	Estimated SAR(W/kg)
BT	2.48	9	Lap-held	0	0.334

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3.2 Simultaneous Transmission analysis

Per KDB447498D01, when the sum of SAR is larger than the limit, SAR test exclusion is determined by the SAR sum to peak location separation ratio(SPLSR).

The simultaneous transmitting antennas in each operating mode and exposure condition combination must be considered one pair at a time to determine the SAR to peak location separation ratio to qualify for test exclusion.

The ratio is determined by **(SAR1 + SAR2)^1.5/Ri**, rounded to two decimal digits, and must be **≤ 0.04** for all antenna pairs in the configuration to qualify for 1-g SAR test exclusion.

SAR1 and SAR2 are the highest reported or estimated SAR for each antenna in the pair, and Ri is the separation distance between the peak SAR locations for the antenna pair in mm.

When standalone test exclusion applies, SAR is estimated; the peak location is assumed to be at the feed-point or geometric center of the antenna.

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5GHz WLAN (Main+Aux) DTS + BT

No.	Conditions	Exposure Condition	Position	Distance (mm)	Max. Main+Aux 5G	Max. BT	SAR Summation	SPLSR Analysis
1	Main+Aux 5G + BT	Body	Lap-held	0	0.474	0.334	0.808	Σ SAR<1.6, Not required

5GHz WLAN (Main+Aux) NII + BT

No.	Conditions	Exposure Condition	Position	Distance (mm)	Max. Main+Aux 5G	Max. BT	SAR Summation	SPLSR Analysis
2	Main+Aux 5G + BT	Body	Lap-held	0	0.385	0.334	0.719	Σ SAR<1.6, Not required

Note:

1. Since the SAR summation is less than the limit, the SAR test of simultaneous transmission is not required.

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4. Instruments List

Manufacturer	Device	Type	Serial number	Date of last calibration	Date of next calibration
Schmid & Partner Engineering AG	E-Field Probe	EX3DV4	3938	Jul.25,2014	Jul.24,2015
Schmid & Partner Engineering AG	2450 / 5G System Validation Dipole	D2450V2	922	Nov.05,2013	Nov.04,2014
		D5GHzV2	1023	Jan.30,2014	Jan.29,2015
Schmid & Partner Engineering AG	Data acquisition Electronics	DAE4	547	Mar.26,2014	Mar.25,2015
Schmid & Partner Engineering AG	Software	DASY 52 V52.8.8	N/A	Calibration not required	Calibration not required
Schmid & Partner Engineering AG	Phantom	SAM	N/A	Calibration not required	Calibration not required
Agilent	Network Analyzer	E5071C	MY46107530	Feb.14,2014	Feb.13,2015
Agilent	Dielectric Probe Kit	85070E	MY44300677	Calibration not required	Calibration not required
Agilent	Dual-directional coupler	772D	MY46151242	Jul.14,2014	Jul.13,2015
Agilent	RF Signal Generator	N5181A	MY50144143	Jun.25.2014	Jun.24.2015
Agilent	Power Meter	E4417A	MY51410006	Oct.25,2013	Oct.24,2015
Agilent	Power Sensor	E9301H	MY51470001	Dec.16,2013	Dec.15,2014
TECPYL	Digital thermometer	DTM-303A	TP130077	Mar.17,2014	Mar.16,2015

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5. Measurements

Date: 2014/9/20

WLAN 802.11b_Body-worn_Lap-held_CH 11_MIMO

Communication System: WLAN(2.45G); Frequency: 2462 MHz

Medium parameters used: $f = 2462$ MHz; $\sigma = 1.952$ S/m; $\epsilon_r = 51.842$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3938; ConvF(6.69, 6.69, 6.69); Calibrated: 2014/7/25;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2014/3/26
- Phantom: Body
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Configuration/BODY/Area Scan (81x271x1): Interpolated grid: dx=12 mm, dy=12 mm

Maximum value of SAR (interpolated) = 2.01 W/kg

Configuration/BODY/Zoom Scan (7x7x7)/Cube 0: Measurement grid:

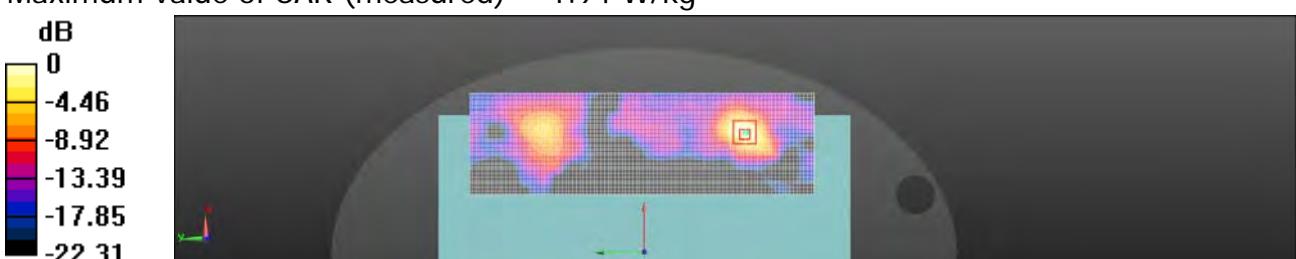
dx=5mm, dy=5mm, dz=5mm

Reference Value = 1.204 V/m; Power Drift = 0.17 dB

Peak SAR (extrapolated) = 2.80 W/kg

SAR(1 g) = 1.35 W/kg; SAR(10 g) = 0.592 W/kg

Maximum value of SAR (measured) = 1.94 W/kg



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Date: 2014/9/20

WLAN 802.11ac(20M)_Body-worn_Lap-held_CH 6_MIMO

Communication System: WLAN(2.45G); Frequency: 2437 MHz

Medium parameters used: $f = 2437$ MHz; $\sigma = 1.914$ S/m; $\epsilon_r = 51.904$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3938; ConvF(6.69, 6.69, 6.69); Calibrated: 2014/7/25;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2014/3/26
- Phantom: Body
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Configuration/BODY/Area Scan (81x271x1): Interpolated grid: $dx=12$ mm, $dy=12$ mm

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

Configuration/BODY/Zoom Scan (7x7x7)/Cube 0: Measurement grid:

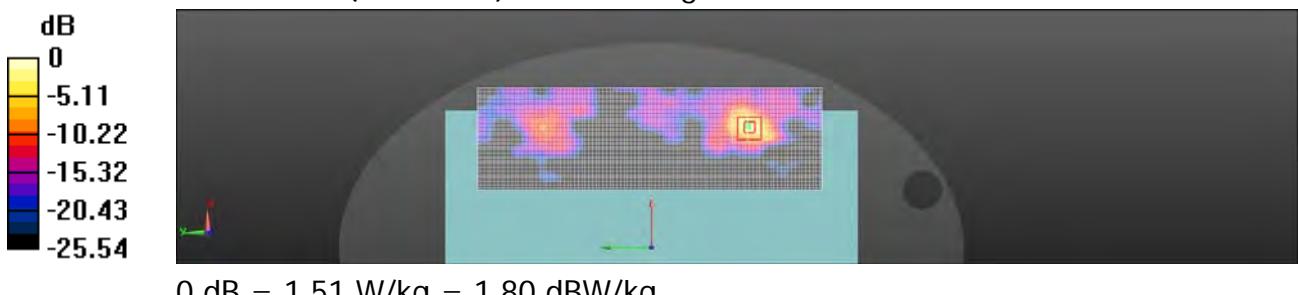
$dx=5$ mm, $dy=5$ mm, $dz=5$ mm

Reference Value = 0.6840 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 2.13 W/kg

SAR(1 g) = 1.02 W/kg; SAR(10 g) = 0.408 W/kg

Maximum value of SAR (measured) = 1.51 W/kg



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Date: 2014/9/20

WLAN 802.11ac(40M)_Body-worn_Lap-held_CH 6_MIMO

Communication System: WLAN(2.45G); Frequency: 2437 MHz

Medium parameters used: $f = 2437$ MHz; $\sigma = 1.914$ S/m; $\epsilon_r = 51.904$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3938; ConvF(6.69, 6.69, 6.69); Calibrated: 2014/7/25;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2014/3/26
- Phantom: Body
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Configuration/BODY/Area Scan (81x271x1): Interpolated grid: $dx=12$ mm,

$dy=12$ mm

Maximum value of SAR (interpolated) = 0.896 W/kg

Configuration/BODY/Zoom Scan (7x7x7)/Cube 0: Measurement grid:

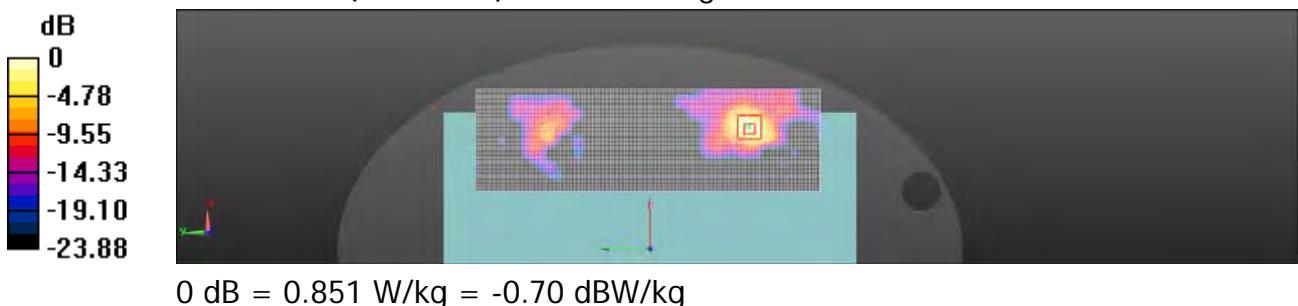
$dx=5$ mm, $dy=5$ mm, $dz=5$ mm

Reference Value = 0.6190 V/m; Power Drift = 0.07 dB

Peak SAR (extrapolated) = 1.22 W/kg

SAR(1 g) = 0.551 W/kg; SAR(10 g) = 0.226 W/kg

Maximum value of SAR (measured) = 0.851 W/kg



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Date: 2014/9/21

WLAN 802.11a 5.2G_Body-worn_Lap-held_CH 48_MIMO

Communication System: WLAN(5G); Frequency: 5240 MHz

Medium parameters used: $f = 5240$ MHz; $\sigma = 5.28$ S/m; $\epsilon_r = 47.481$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3938; ConvF(4.27, 4.27, 4.27); Calibrated: 2014/7/25;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2014/3/26
- Phantom: Body
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Configuration/BODY/Area Scan (91x321x1): Interpolated grid: $dx=10$ mm, $dy=10$ mm

Maximum value of SAR (interpolated) = 0.692 W/kg

Configuration/BODY/Zoom Scan (7x7x12)/Cube 0: Measurement grid:

$dx=4$ mm, $dy=4$ mm, $dz=2$ mm

Reference Value = 0.4725 V/m; Power Drift = 0.09 dB

Peak SAR (extrapolated) = 4.42 W/kg

SAR(1 g) = 0.374 W/kg; SAR(10 g) = 0.076 W/kg

Maximum value of SAR (measured) = 0.719 W/kg

Configuration/BODY/Zoom Scan (7x7x12)/Cube 1: Measurement grid:

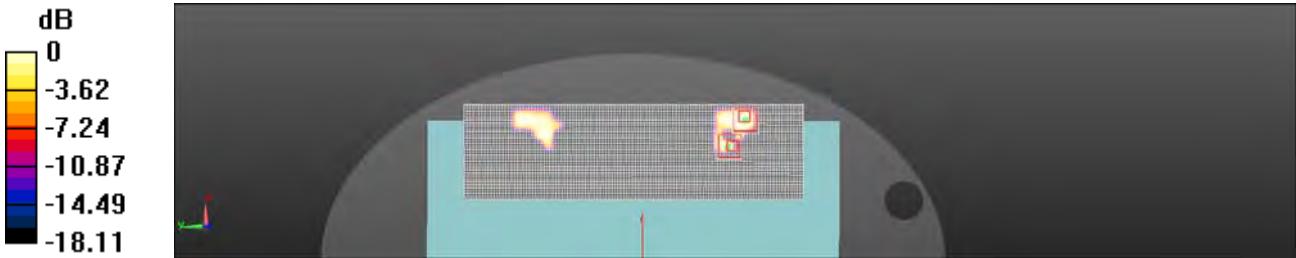
$dx=4$ mm, $dy=4$ mm, $dz=2$ mm

Reference Value = 0.4725 V/m; Power Drift = 0.09 dB

Peak SAR (extrapolated) = 2.09 W/kg

SAR(1 g) = 0.177 W/kg; SAR(10 g) = 0.058 W/kg

Maximum value of SAR (measured) = 0.299 W/kg



0 dB = 0.299 W/kg = -5.25 dBW/kg

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Date: 2014/9/21

WLAN 802.11ac(20M) 5.2G_Body-worn_Lap-held_CH 40_MIMO

Communication System: WLAN(5G); Frequency: 5200 MHz

Medium parameters used: $f = 5200$ MHz; $\sigma = 5.223$ S/m; $\epsilon_r = 47.583$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3938; ConvF(4.27, 4.27, 4.27); Calibrated: 2014/7/25;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2014/3/26
- Phantom: Body
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Configuration/BODY/Area Scan (91x321x1): Interpolated grid: $dx=10$ mm,

$dy=10$ mm

Maximum value of SAR (interpolated) = 0.849 W/kg

Configuration/BODY/Zoom Scan (7x7x12)/Cube 0: Measurement grid:

$dx=4$ mm, $dy=4$ mm, $dz=2$ mm

Reference Value = 2.554 V/m; Power Drift = -0.13 dB

Peak SAR (extrapolated) = 3.55 W/kg

SAR(1 g) = 0.339 W/kg; SAR(10 g) = 0.073 W/kg

Maximum value of SAR (measured) = 0.692 W/kg

Configuration/BODY/Zoom Scan (7x7x12)/Cube 1: Measurement grid:

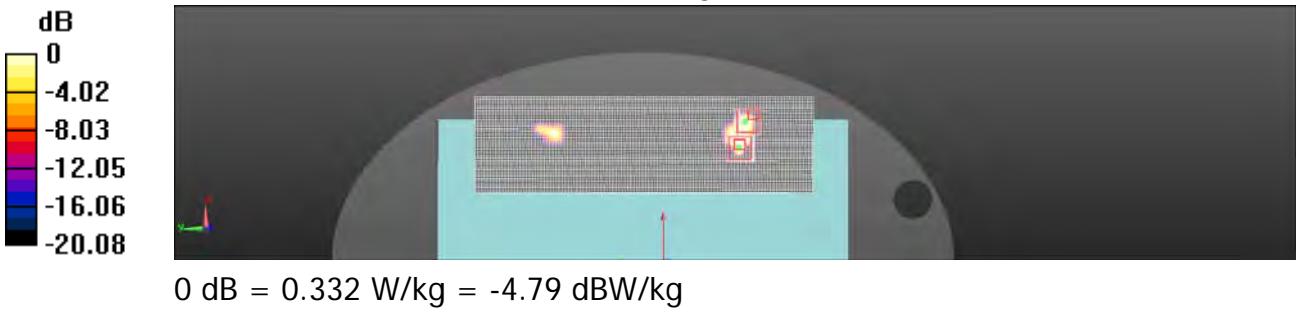
$dx=4$ mm, $dy=4$ mm, $dz=2$ mm

Reference Value = 2.554 V/m; Power Drift = -0.13 dB

Peak SAR (extrapolated) = 1.66 W/kg

SAR(1 g) = 0.145 W/kg; SAR(10 g) = 0.052 W/kg

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



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Date: 2014/9/21

WLAN 802.11ac(40M) 5.2G_Body-worn_Lap-held_CH 46_MIMO

Communication System: WLAN(5G); Frequency: 5230 MHz

Medium parameters used: $f = 5230$ MHz; $\sigma = 5.271$ S/m; $\epsilon_r = 47.489$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3938; ConvF(4.27, 4.27, 4.27); Calibrated: 2014/7/25;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2014/3/26
- Phantom: Body
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Configuration/BODY/Area Scan (91x321x1): Interpolated grid: $dx=10$ mm,

$dy=10$ mm

Maximum value of SAR (interpolated) = 0.234 W/kg

Configuration/BODY/Zoom Scan (7x7x12)/Cube 0: Measurement grid:

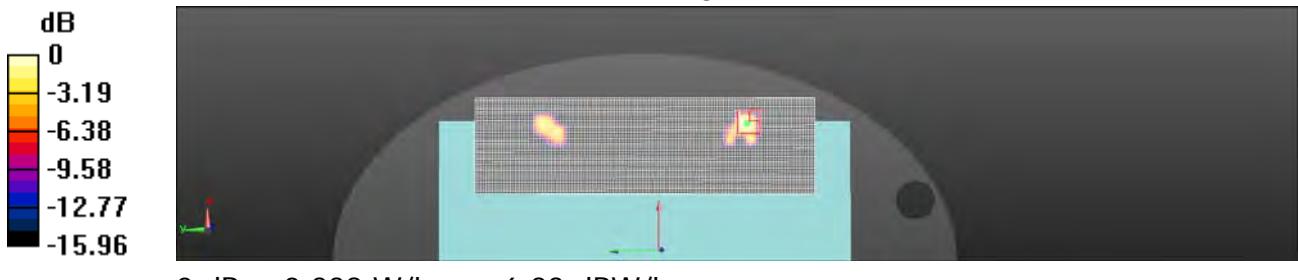
$dx=4$ mm, $dy=4$ mm, $dz=2$ mm

Reference Value = 1.423 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 1.42 W/kg

SAR(1 g) = 0.123 W/kg; SAR(10 g) = 0.040 W/kg

Maximum value of SAR (measured) = 0.238 W/kg



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Date: 2014/9/21

WLAN 802.11ac(80M) 5.2G_Body-worn_Lap-held_CH 42_MIMO

Communication System: WLAN(5G); Frequency: 5210 MHz

Medium parameters used: $f = 5210$ MHz; $\sigma = 5.242$ S/m; $\epsilon_r = 47.544$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3938; ConvF(4.27, 4.27, 4.27); Calibrated: 2014/7/25;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2014/3/26
- Phantom: Body
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Configuration/BODY/Area Scan (91x321x1): Interpolated grid: $dx=10$ mm,

$dy=10$ mm

Maximum value of SAR (interpolated) = 0.638 W/kg

Configuration/BODY/Zoom Scan (7x7x12)/Cube 0: Measurement grid:

$dx=4$ mm, $dy=4$ mm, $dz=2$ mm

Reference Value = 1.896 V/m; Power Drift = 0.11 dB

Peak SAR (extrapolated) = 1.22 W/kg

SAR(1 g) = 0.101 W/kg; SAR(10 g) = 0.035 W/kg

Maximum value of SAR (measured) = 0.150 W/kg



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Date: 2014/9/21

WLAN 802.11a 5.3G_Body-worn_Lap-held_CH 52_MIMO

Communication System: WLAN(5G); Frequency: 5260 MHz

Medium parameters used: $f = 5260$ MHz; $\sigma = 5.306$ S/m; $\epsilon_r = 47.439$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3938; ConvF(4.11, 4.11, 4.11); Calibrated: 2014/7/25;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2014/3/26
- Phantom: Body
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Configuration/BODY/Area Scan (91x321x1): Interpolated grid: $dx=10$ mm, $dy=10$ mm

Maximum value of SAR (interpolated) = 0.799 W/kg

Configuration/BODY/Zoom Scan (7x7x12)/Cube 0: Measurement grid:

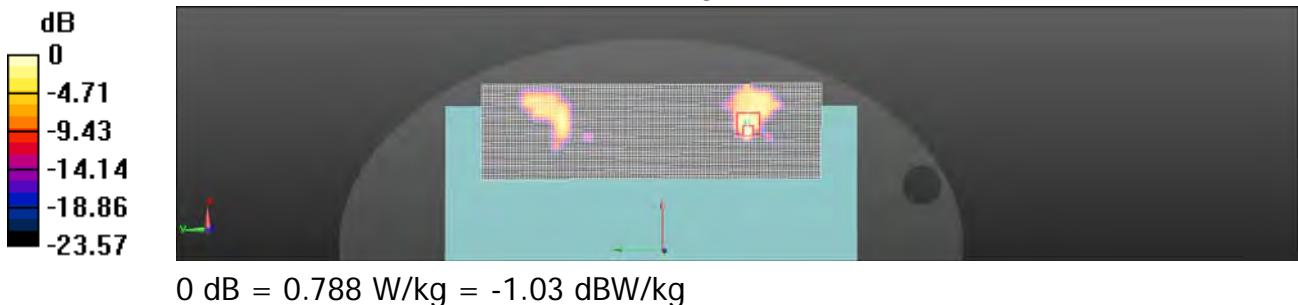
$dx=4$ mm, $dy=4$ mm, $dz=2$ mm

Reference Value = 0.5714 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 2.15 W/kg

SAR(1 g) = 0.309 W/kg; SAR(10 g) = 0.089 W/kg

Maximum value of SAR (measured) = 0.788 W/kg



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Date: 2014/9/21

WLAN 802.11n(20M) 5.3G_Body-worn_Lap-held_CH 60_MIMO

Communication System: WLAN(5G); Frequency: 5300 MHz

Medium parameters used: $f = 5300$ MHz; $\sigma = 5.364$ S/m; $\epsilon_r = 47.358$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3938; ConvF(4.11, 4.11, 4.11); Calibrated: 2014/7/25;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2014/3/26
- Phantom: Body
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Configuration/BODY/Area Scan (91x321x1): Interpolated grid: $dx=10$ mm, $dy=10$ mm

Maximum value of SAR (interpolated) = 0.302 W/kg

Configuration/BODY/Zoom Scan (7x7x12)/Cube 0: Measurement grid:

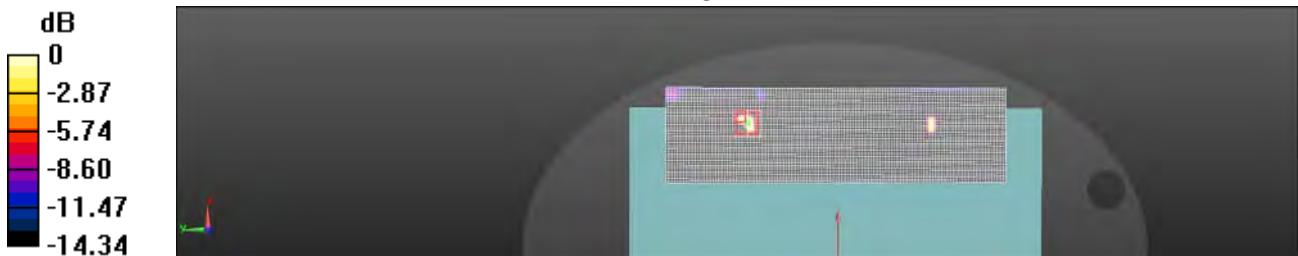
$dx=4$ mm, $dy=4$ mm, $dz=2$ mm

Reference Value = 0.6830 V/m; Power Drift = 0.11 dB

Peak SAR (extrapolated) = 0.877 W/kg

SAR(1 g) = 0.076 W/kg; SAR(10 g) = 0.023 W/kg

Maximum value of SAR (measured) = 0.161 W/kg



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Date: 2014/9/21

WLAN 802.11n(40M) 5.3G_Body-worn_Lap-held_CH 54_MIMO

Communication System: WLAN(5G); Frequency: 5270 MHz

Medium parameters used: $f = 5270$ MHz; $\sigma = 5.322$ S/m; $\epsilon_r = 47.406$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3938; ConvF(4.11, 4.11, 4.11); Calibrated: 2014/7/25;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2014/3/26
- Phantom: Body
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Configuration/BODY/Area Scan (91x321x1): Interpolated grid: $dx=10$ mm, $dy=10$ mm

Maximum value of SAR (interpolated) = 0.172 W/kg

Configuration/BODY/Zoom Scan (7x7x12)/Cube 0: Measurement grid:

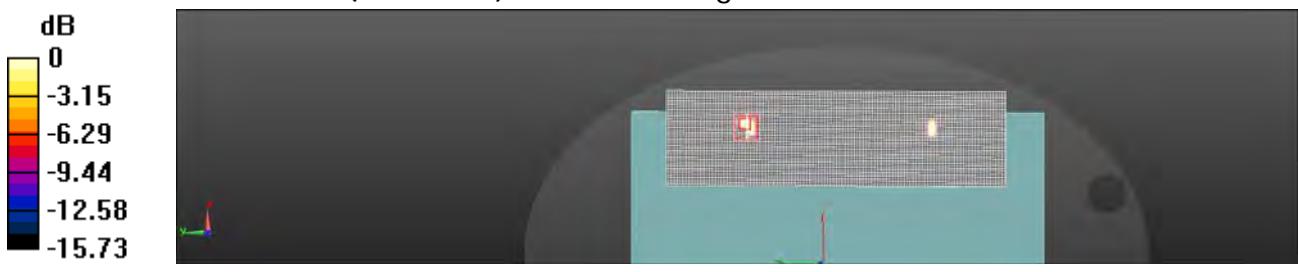
$dx=4$ mm, $dy=4$ mm, $dz=2$ mm

Reference Value = 0.9245 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 0.713 W/kg

SAR(1 g) = 0.059 W/kg; SAR(10 g) = 0.016 W/kg

Maximum value of SAR (measured) = 0.0985 W/kg



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Date: 2014/9/21

WLAN 802.11ac(20M) 5.3G_Body-worn_Lap-held_CH 52_MIMO

Communication System: WLAN(5G); Frequency: 5260 MHz

Medium parameters used: $f = 5260$ MHz; $\sigma = 5.306$ S/m; $\epsilon_r = 47.439$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3938; ConvF(4.11, 4.11, 4.11); Calibrated: 2014/7/25;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2014/3/26
- Phantom: Body
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Configuration/BODY/Area Scan (91x321x1): Interpolated grid: $dx=10$ mm,

$dy=10$ mm

Maximum value of SAR (interpolated) = 0.202 W/kg

Configuration/BODY/Zoom Scan (7x7x12)/Cube 0: Measurement grid:

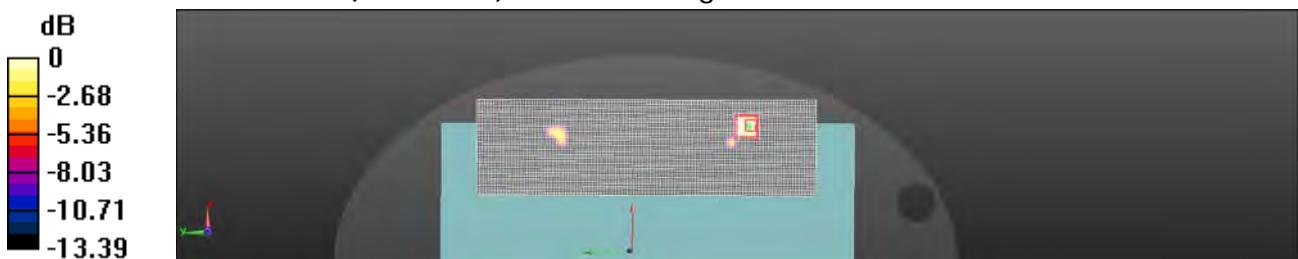
$dx=4$ mm, $dy=4$ mm, $dz=2$ mm

Reference Value = 0.8421 V/m; Power Drift = 0.07 dB

Peak SAR (extrapolated) = 1.31 W/kg

SAR(1 g) = 0.103 W/kg; SAR(10 g) = 0.030 W/kg

Maximum value of SAR (measured) = 0.148 W/kg



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Date: 2014/9/21

WLAN 802.11ac(40M) 5.3G_Body-worn_Lap-held_CH 54_MIMO

Communication System: WLAN(5G); Frequency: 5270 MHz

Medium parameters used: $f = 5270$ MHz; $\sigma = 5.322$ S/m; $\epsilon_r = 47.406$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3938; ConvF(4.11, 4.11, 4.11); Calibrated: 2014/7/25;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2014/3/26
- Phantom: Body
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Configuration/BODY/Area Scan (91x321x1): Interpolated grid: $dx=10$ mm, $dy=10$ mm

Maximum value of SAR (interpolated) = 0.194 W/kg

Configuration/BODY/Zoom Scan (7x7x12)/Cube 0: Measurement grid:

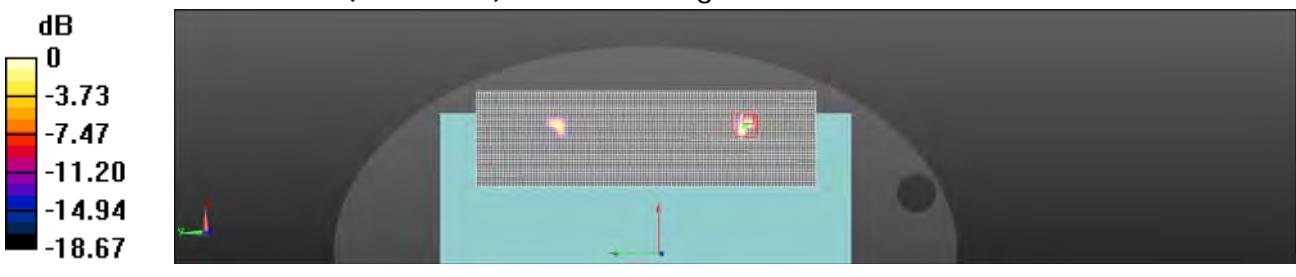
$dx=4$ mm, $dy=4$ mm, $dz=2$ mm

Reference Value = 0.5123 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 0.938 W/kg

SAR(1 g) = 0.080 W/kg; SAR(10 g) = 0.023 W/kg

Maximum value of SAR (measured) = 0.201 W/kg



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Date: 2014/9/21

WLAN 802.11ac(80M) 5.3G_Body-worn_Lap-held_CH 58_MIMO

Communication System: WLAN(5G); Frequency: 5290 MHz

Medium parameters used: $f = 5290$ MHz; $\sigma = 5.359$ S/m; $\epsilon_r = 47.379$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3938; ConvF(4.11, 4.11, 4.11); Calibrated: 2014/7/25;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2014/3/26
- Phantom: Body
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Configuration/BODY/Area Scan (91x321x1): Interpolated grid: dx=10 mm, dy=10 mm

Maximum value of SAR (interpolated) = 0.0850 W/kg

Configuration/BODY/Zoom Scan (7x7x12)/Cube 0: Measurement grid:

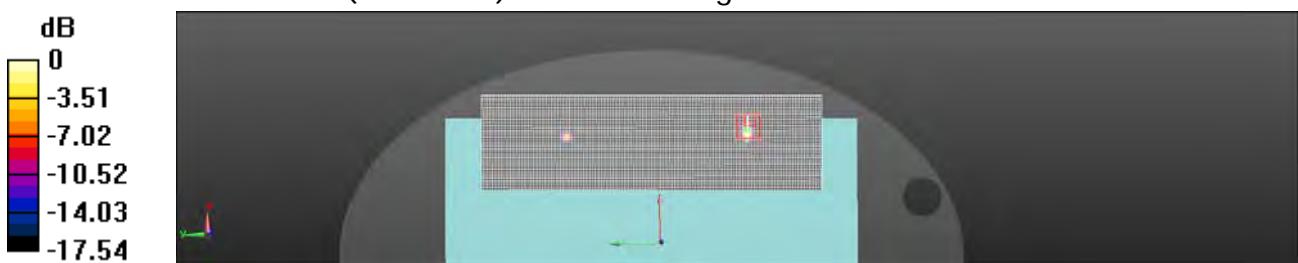
dx=4mm, dy=4mm, dz=2mm

Reference Value = 0.1574 V/m; Power Drift = 0.18 dB

Peak SAR (extrapolated) = 0.746 W/kg

SAR(1 g) = 0.053 W/kg; SAR(10 g) = 0.00965 W/kg

Maximum value of SAR (measured) = 0.0879 W/kg



0 dB = 0.0879 W/kg = -10.56 dBW/kg

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Date: 2014/9/22

WLAN 802.11a 5.6G_Body-worn_Lap-held_CH 112_MIMO

Communication System: WLAN(5G); Frequency: 5560 MHz

Medium parameters used: $f = 5560$ MHz; $\sigma = 5.553$ S/m; $\epsilon_r = 47.44$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3938; ConvF(3.7, 3.7, 3.7); Calibrated: 2014/7/25;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2014/3/26
- Phantom: Body
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Configuration/BODY/Area Scan (91x321x1): Interpolated grid: $dx=10$ mm,

$dy=10$ mm

Maximum value of SAR (interpolated) = 0.720 W/kg

Configuration/BODY/Zoom Scan (7x7x12)/Cube 0: Measurement grid:

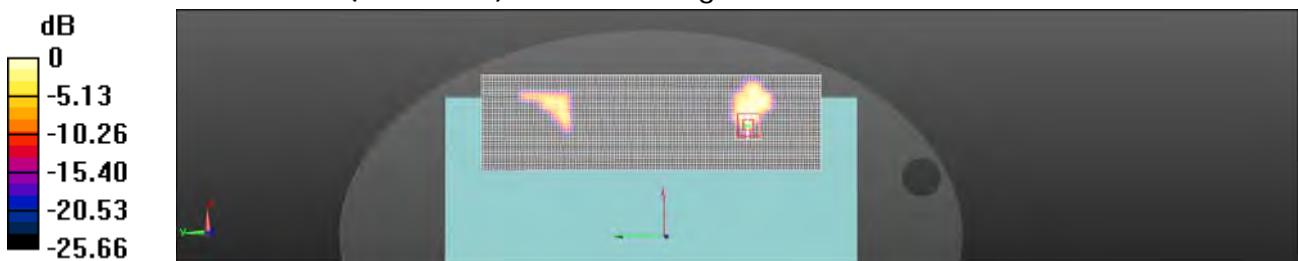
$dx=4$ mm, $dy=4$ mm, $dz=2$ mm

Reference Value = 1.054 V/m; Power Drift = 0.17 dB

Peak SAR (extrapolated) = 3.07 W/kg

SAR(1 g) = 0.282 W/kg; SAR(10 g) = 0.073 W/kg

Maximum value of SAR (measured) = 0.569 W/kg



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Date: 2014/9/22

WLAN 802.11ac(20M) 5.6G_Body-worn_Lap-held_CH 144_MIMO

Communication System: WLAN(5G); Frequency: 5720 MHz

Medium parameters used (extrapolated): $f = 5720$ MHz; $\sigma = 5.788$ S/m; $\epsilon_r = 47.106$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3938; ConvF(3.7, 3.7, 3.7); Calibrated: 2014/7/25;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2014/3/26
- Phantom: Body
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Configuration/BODY/Area Scan (91x321x1): Interpolated grid: dx=10 mm, dy=10 mm

Maximum value of SAR (interpolated) = 0.904 W/kg

Configuration/BODY/Zoom Scan (7x7x12)/Cube 0: Measurement grid:

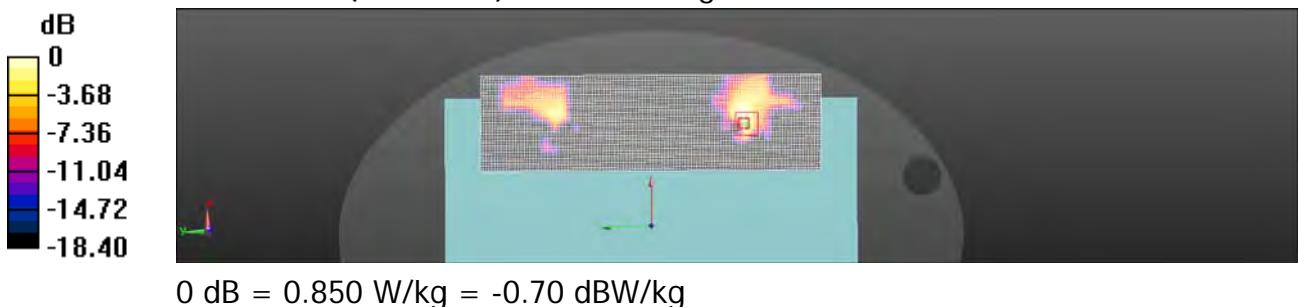
dx=4mm, dy=4mm, dz=2mm

Reference Value = 0.9625 V/m; Power Drift = 0.14 dB

Peak SAR (extrapolated) = 1.58 W/kg

SAR(1 g) = 0.347 W/kg; SAR(10 g) = 0.108 W/kg

Maximum value of SAR (measured) = 0.850 W/kg



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Date: 2014/9/22

WLAN 802.11ac(40M) 5.6G_Body-worn_Lap-held_CH 134_MIMO

Communication System: WLAN(5G); Frequency: 5670 MHz

Medium parameters used: $f = 5670$ MHz; $\sigma = 5.716$ S/m; $\epsilon_r = 47.202$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3938; ConvF(3.7, 3.7, 3.7); Calibrated: 2014/7/25;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2014/3/26
- Phantom: Body
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Configuration/BODY/Area Scan (91x321x1): Interpolated grid: $dx=10$ mm, $dy=10$ mm

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

Configuration/BODY/Zoom Scan (7x7x12)/Cube 0: Measurement grid:

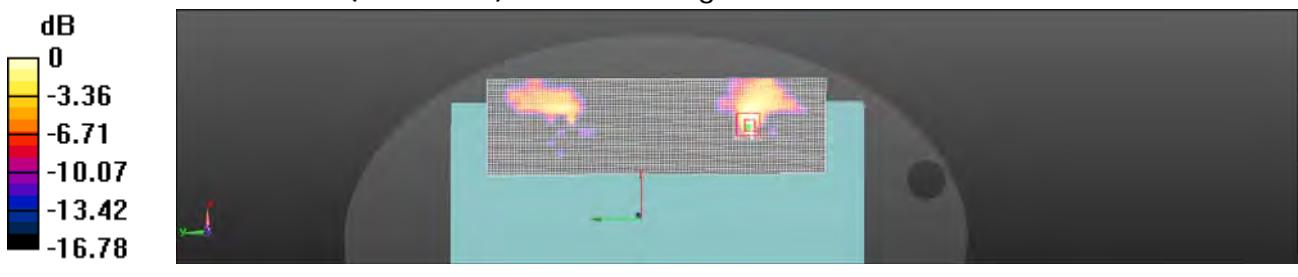
$dx=4$ mm, $dy=4$ mm, $dz=2$ mm

Reference Value = 0.7435 V/m; Power Drift = 0.17 dB

Peak SAR (extrapolated) = 2.70 W/kg

SAR(1 g) = 0.327 W/kg; SAR(10 g) = 0.100 W/kg

Maximum value of SAR (measured) = 0.676 W/kg



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Date: 2014/9/22

WLAN 802.11ac(80M) 5.6G_Body-worn_Lap-held_CH 106_MIMO

Communication System: WLAN(5G); Frequency: 5530 MHz

Medium parameters used: $f = 5530$ MHz; $\sigma = 5.509$ S/m; $\epsilon_r = 47.479$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3938; ConvF(3.7, 3.7, 3.7); Calibrated: 2014/7/25;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2014/3/26
- Phantom: Body
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Configuration/BODY/Area Scan (91x321x1): Interpolated grid: $dx=10$ mm, $dy=10$ mm

Maximum value of SAR (interpolated) = 0.824 W/kg

Configuration/BODY/Zoom Scan (7x7x12)/Cube 0: Measurement grid:

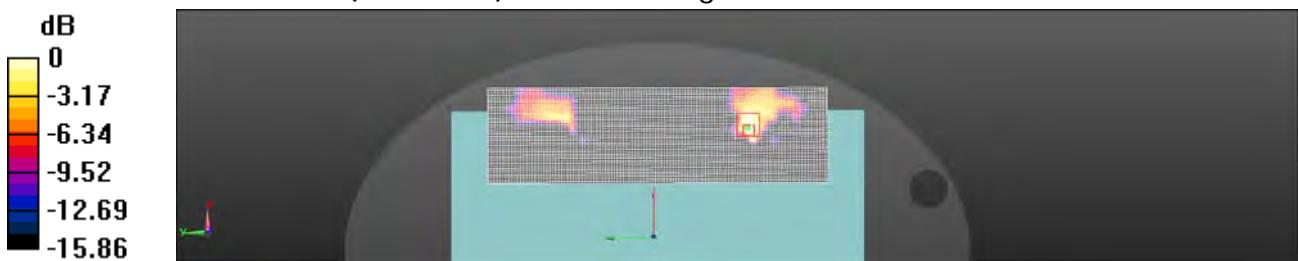
$dx=4$ mm, $dy=4$ mm, $dz=2$ mm

Reference Value = 0.8436 V/m; Power Drift = 0.11 dB

Peak SAR (extrapolated) = 1.27 W/kg

SAR(1 g) = 0.225 W/kg; SAR(10 g) = 0.078 W/kg

Maximum value of SAR (measured) = 0.525 W/kg



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Date: 2014/9/23

WLAN 802.11a 5.8G_Body-worn_Lap-held_CH 157_MIMO

Communication System: WLAN(5G); Frequency: 5785 MHz

Medium parameters used: $f = 5785$ MHz; $\sigma = 5.935$ S/m; $\epsilon_r = 46.478$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3938; ConvF(3.92, 3.92, 3.92); Calibrated: 2014/7/25;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2014/3/26
- Phantom: Body
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Configuration/BODY/Area Scan (91x321x1): Interpolated grid: $dx=10$ mm, $dy=10$ mm

Maximum value of SAR (interpolated) = 1.39 W/kg

Configuration/BODY/Zoom Scan (7x7x12)/Cube 0: Measurement grid:

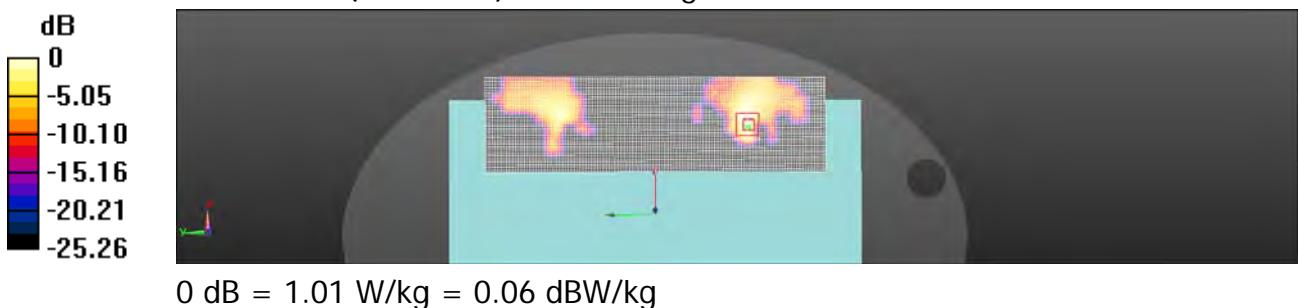
$dx=4$ mm, $dy=4$ mm, $dz=2$ mm

Reference Value = 0.8210 V/m; Power Drift = -0.19 dB

Peak SAR (extrapolated) = 1.67 W/kg

SAR(1 g) = 0.427 W/kg; SAR(10 g) = 0.131 W/kg

Maximum value of SAR (measured) = 1.01 W/kg



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Date: 2014/9/23

WLAN 802.11ac(20M) 5.8G_Body-worn_Lap-held_CH 149_MIMO

Communication System: WLAN(5G); Frequency: 5745 MHz

Medium parameters used: $f = 5745$ MHz; $\sigma = 5.877$ S/m; $\epsilon_r = 46.555$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3938; ConvF(3.92, 3.92, 3.92); Calibrated: 2014/7/25;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2014/3/26
- Phantom: Body
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Configuration/BODY/Area Scan (91x321x1): Interpolated grid: $dx=10$ mm, $dy=10$ mm

Maximum value of SAR (interpolated) = 1.41 W/kg

Configuration/BODY/Zoom Scan (7x7x12)/Cube 0: Measurement grid:

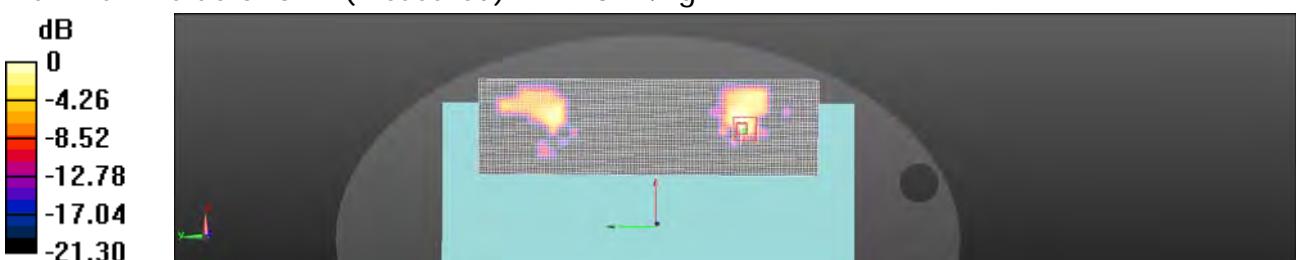
$dx=4$ mm, $dy=4$ mm, $dz=2$ mm

Reference Value = 1.157 V/m; Power Drift = 0.12 dB

Peak SAR (extrapolated) = 1.83 W/kg

SAR(1 g) = 0.470 W/kg; SAR(10 g) = 0.137 W/kg

Maximum value of SAR (measured) = 1.13 W/kg



0 dB = 1.13 W/kg = 0.53 dBW/kg

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Date: 2014/9/23

WLAN 802.11ac(40M) 5.8G_Body-worn_Lap-held_CH 151_MIMO

Communication System: WLAN(5G); Frequency: 5755 MHz

Medium parameters used: $f = 5755$ MHz; $\sigma = 5.896$ S/m; $\epsilon_r = 46.54$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3938; ConvF(3.92, 3.92, 3.92); Calibrated: 2014/7/25;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2014/3/26
- Phantom: Body
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Configuration/BODY/Area Scan (91x321x1): Interpolated grid: $dx=10$ mm, $dy=10$ mm

Maximum value of SAR (interpolated) = 1.57 W/kg

Configuration/BODY/Zoom Scan (7x7x12)/Cube 0: Measurement grid:

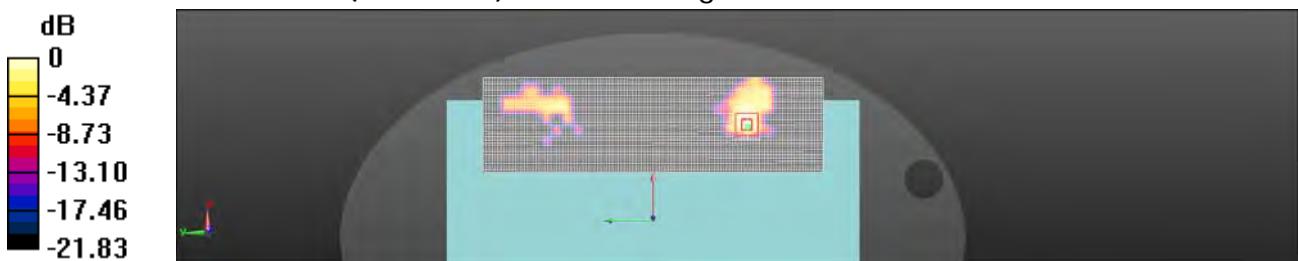
$dx=4$ mm, $dy=4$ mm, $dz=2$ mm

Reference Value = 1.569 V/m; Power Drift = 0.14 dB

Peak SAR (extrapolated) = 1.85 W/kg

SAR(1 g) = 0.388 W/kg; SAR(10 g) = 0.127 W/kg

Maximum value of SAR (measured) = 0.911 W/kg



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Date: 2014/9/23

WLAN 802.11ac(80M) 5.8G_Body-worn_Lap-held_CH 155_MIMO

Communication System: WLAN(5G); Frequency: 5775 MHz

Medium parameters used: $f = 5775$ MHz; $\sigma = 5.919$ S/m; $\epsilon_r = 46.514$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3938; ConvF(3.92, 3.92, 3.92); Calibrated: 2014/7/25;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2014/3/26
- Phantom: Body
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Configuration/BODY/Area Scan (91x321x1): Interpolated grid: $dx=10$ mm, $dy=10$ mm

Maximum value of SAR (interpolated) = 0.178 W/kg

Configuration/BODY/Zoom Scan (7x7x12)/Cube 0: Measurement grid:

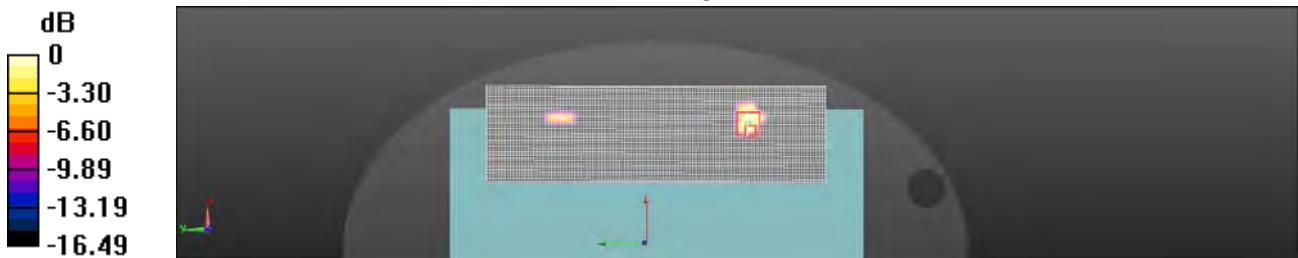
$dx=4$ mm, $dy=4$ mm, $dz=2$ mm

Reference Value = 1.024 V/m; Power Drift = 0.11 dB

Peak SAR (extrapolated) = 0.567 W/kg

SAR(1 g) = 0.072 W/kg; SAR(10 g) = 0.026 W/kg

Maximum value of SAR (measured) = 0.234 W/kg



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6. SAR System Performance Verification

Date: 2014/9/20

Dipole 2450 MHz_SN:922_Body

Communication System: CW; Frequency: 2450 MHz

Medium parameters used: $f = 2450$ MHz; $\sigma = 1.929$ S/m; $\epsilon_r = 51.879$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3938; ConvF(6.69, 6.69, 6.69); Calibrated: 2014/7/25;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2014/3/26
- Phantom: Body
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Configuration/Pin=250mW/Area Scan (61x131x1): Interpolated grid:

$dx=12$ mm, $dy=12$ mm

Maximum value of SAR (interpolated) = 19.4 W/kg

Configuration/Pin=250mW/Zoom Scan (7x7x7)/Cube 0: Measurement

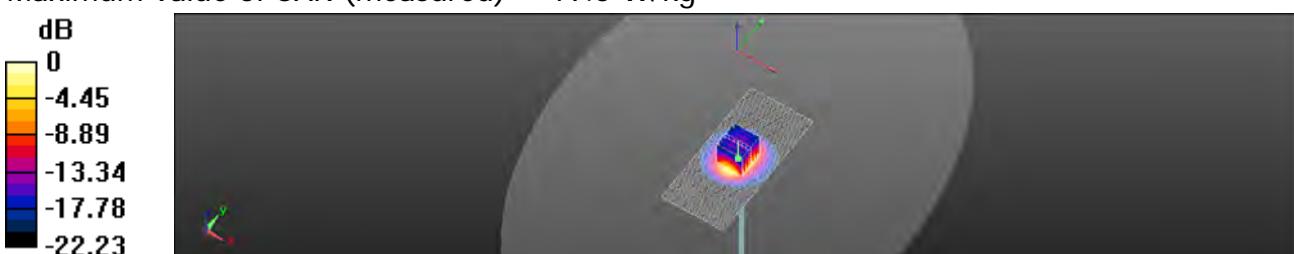
grid: $dx=5$ mm, $dy=5$ mm, $dz=5$ mm

Reference Value = 96.404 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 25.6 W/kg

SAR(1 g) = 12.9 W/kg; SAR(10 g) = 5.93 W/kg

Maximum value of SAR (measured) = 19.5 W/kg



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Date: 2014/9/21

Dipole 5GHz_SN:1023_Body

Communication System: CW; Frequency: 5200 MHz

Medium parameters used: $f = 5200$ MHz; $\sigma = 5.223$ S/m; $\epsilon_r = 47.583$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY 5 Configuration:

- Probe: EX3DV4 - SN3938; ConvF(4.27, 4.27, 4.27); Calibrated: 2014/7/25;
- Sensor-Surface: 2mm (Mechanical Surface Detection),
- Electronics: DAE4 Sn547; Calibrated: 2014/3/26
- Phantom: Body
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Configuration/Pin=100mW/Area Scan (61x101x1): Interpolated grid:

$dx=10$ mm, $dy=10$ mm

Maximum value of SAR (interpolated) = 13.9 W/kg

Configuration/Pin=100mW/Zoom Scan (7x7x12)/Cube 0: Measurement

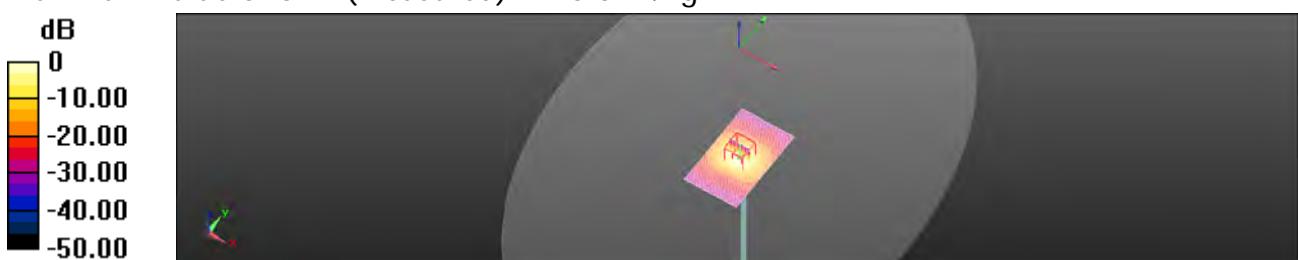
grid: $dx=4$ mm, $dy=4$ mm, $dz=2$ mm

Reference Value = 56.202 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 28.8 W/kg

SAR(1 g) = 7.29 W/kg; SAR(10 g) = 1.99 W/kg

Maximum value of SAR (measured) = 15.0 W/kg



0 dB = 15.0 W/kg = 11.76 dBW/kg

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Date: 2014/9/21

Dipole 5GHz_SN:1023_Body

Communication System: CW; Frequency: 5300 MHz

Medium parameters used: $f = 5300$ MHz; $\sigma = 5.364$ S/m; $\epsilon_r = 47.358$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY 5 Configuration:

- Probe: EX3DV4 - SN3938; ConvF(4.11, 4.11, 4.11); Calibrated: 2014/7/25;
- Sensor-Surface: 2mm (Mechanical Surface Detection),
- Electronics: DAE4 Sn547; Calibrated: 2014/3/26
- Phantom: Body
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Configuration/Pin=100mW/Area Scan (61x101x1): Interpolated grid:

$dx=10$ mm, $dy=10$ mm

Maximum value of SAR (interpolated) = 16.1 W/kg

Configuration/Pin=100mW/Zoom Scan (7x7x12)/Cube 0: Measurement

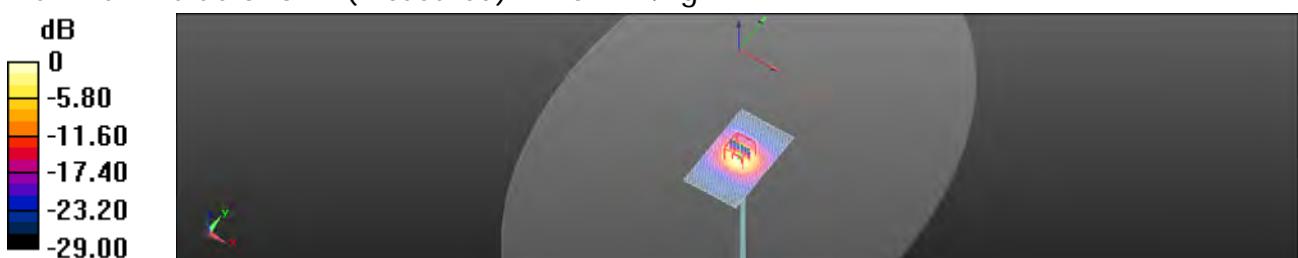
grid: $dx=4$ mm, $dy=4$ mm, $dz=2$ mm

Reference Value = 59.013 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 31.9 W/kg

SAR(1 g) = 7.71 W/kg; SAR(10 g) = 2.18 W/kg

Maximum value of SAR (measured) = 16.1 W/kg



0 dB = 16.1 W/kg = 12.07 dBW/kg

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Date: 2014/9/22

Dipole 5GHz_SN:1023_Body

Communication System: CW; Frequency: 5600 MHz

Medium parameters used: $f = 5600$ MHz; $\sigma = 5.601$ S/m; $\epsilon_r = 47.385$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY 5 Configuration:

- Probe: EX3DV4 - SN3938; ConvF(3.7, 3.7, 3.7); Calibrated: 2014/7/25;
- Sensor-Surface: 2mm (Mechanical Surface Detection),
- Electronics: DAE4 Sn547; Calibrated: 2014/3/26
- Phantom: Body
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Configuration/Pin=100mW/Area Scan (51x91x1): Interpolated grid: dx=10

mm, dy=10 mm

Maximum value of SAR (interpolated) = 18.8 W/kg

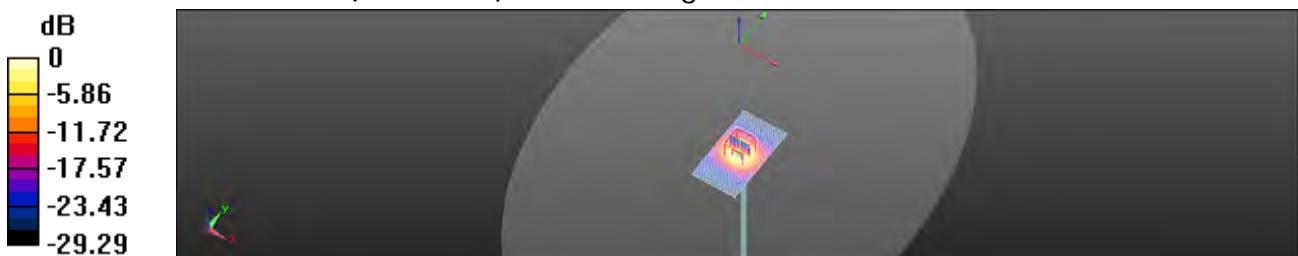
Configuration/Pin=100mW/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 57.995 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 36.2 W/kg

SAR(1 g) = 8.08 W/kg; SAR(10 g) = 2.25 W/kg

Maximum value of SAR (measured) = 16.2 W/kg



0 dB = 16.2 W/kg = 12.10 dBW/kg

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Date: 2014/9/23

Dipole 5GHz_SN:1023_Body

Communication System: CW; Frequency: 5800 MHz

Medium parameters used: $f = 5800$ MHz; $\sigma = 5.961$ S/m; $\epsilon_r = 46.469$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY 5 Configuration:

- Probe: EX3DV4 - SN3938; ConvF(3.92, 3.92, 3.92); Calibrated: 2014/7/25;
- Sensor-Surface: 2mm (Mechanical Surface Detection),
- Electronics: DAE4 Sn547; Calibrated: 2014/3/26
- Phantom: Body
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Configuration/Pin=100mW/Area Scan (61x101x1): Interpolated grid:

$dx=10$ mm, $dy=10$ mm

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

Configuration/Pin=100mW/Zoom Scan (7x7x12)/Cube 0: Measurement

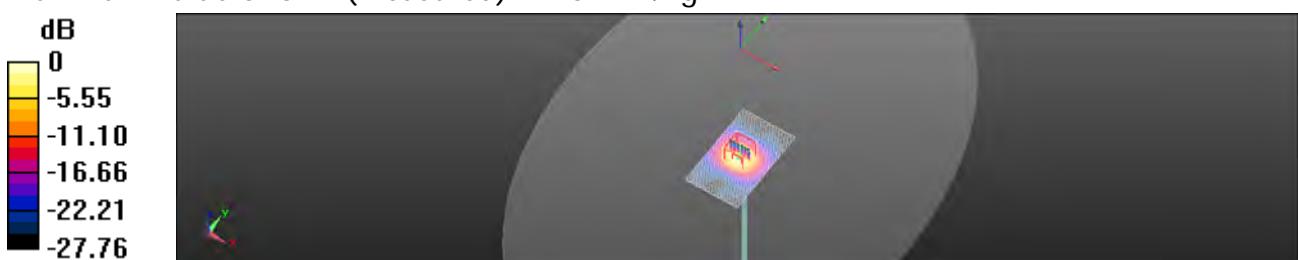
grid: $dx=4$ mm, $dy=4$ mm, $dz=2$ mm

Reference Value = 55.463 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 34.8 W/kg

SAR(1 g) = 7.51 W/kg; SAR(10 g) = 2.11 W/kg

Maximum value of SAR (measured) = 15.2 W/kg



0 dB = 15.2 W/kg = 11.82 dBW/kg

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Calibration Laboratory of
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Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland



S Schweizerischer Kalibrierdienst
Service suisse d'étalonnage
C 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 108

Client SGS - TW (Auden)

Certificate No.: DAE4-547_Mar14

CALIBRATION CERTIFICATE

Object DAE4 - SD 000 D04 BM - SN: 547

Calibration procedure(s) QA CAL-06.v26
Calibration procedure for the data acquisition electronics (DAE)

Calibration date: March 26, 2014

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 ± 1)°C and humidity < 70%.

Calibration Equipment used (MUST be critical for calibration):

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Kathley Memmeter Type 2001	SN: 081027II	01-Oct-14 (Int'l 10076)	Oct-14
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Auto DAE Calibration Unit Calibrator Box V2.1	SE UMS 052 AA 1001 SE UMS 006 AA 1002	07-Jan-14 (in house check) 07-Jan-14 (in house check)	In house check, Jan-15 In house check, Jan-15

Calibrated by:

Name: Eric (Hantek)

Function: Technician

Approved by:

Name: F. Bommel

Function: Deputy Technical Manager

Issued: March 26, 2014

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

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



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Accreditation No.: SCS 108

Glossary

DAE	data acquisition electronics
Connector angle	information used in DASY system to align probe sensor X to the robot coordinate system.

Methods Applied and Interpretation of Parameters

- *DC Voltage Measurement*: Calibration Factor assessed for use in DASY system by comparison with a calibrated instrument traceable to national standards. The figure given corresponds to the full scale range of the voltmeter in the respective range.
- *Connector angle*: The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required.
- The following parameters as documented in the Appendix contain technical information as a result from the performance test and require no uncertainty.
 - *DC Voltage Measurement Linearity*: Verification of the Linearity at +10% and -10% of the nominal calibration voltage. Influence of offset voltage is included in this measurement.
 - *Common mode sensitivity*: Influence of a positive or negative common mode voltage on the differential measurement.
 - *Channel separation*: Influence of a voltage on the neighbor channels not subject to an input voltage.
 - *AD Converter Values with inputs shorted*: Values on the internal AD converter corresponding to zero input voltage
 - *Input Offset Measurement*: Output voltage and statistical results over a large number of zero voltage measurements.
 - *Input Offset Current*: Typical value for information; Maximum channel input offset current, not considering the input resistance.
 - *Input resistance*: Typical value for information: DAE input resistance at the connector, during internal auto-zeroing and during measurement.
 - *Low Battery Alarm Voltage*: Typical value for information. Below this voltage, a battery alarm signal is generated.
 - *Power consumption*: Typical value for information. Supply currents in various operating modes.

DC Voltage Measurement

A/D - Converter Resolution nominal

High Range: 1LSB = 6.1 μ V, full range = -100...+300 mV

Low Range: 1LSB = 61nV, full range = -1.....+3mV

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

Calibration Factors	X	Y	Z
High Range	404.032 \pm 0.02% (k=2)	404.058 \pm 0.02% (k=2)	404.202 \pm 0.02% (k=2)
Low Range	3.95713 \pm 1.50% (k=2)	3.96202 \pm 1.50% (k=2)	3.97561 \pm 1.50% (k=2)

Connector Angle

Connector Angle to be used in DASY system	158.0 ° \pm 1 °
---	-------------------

Appendix**1. DC Voltage Linearity**

High Range	Reading (µV)	Difference (µV)	Error (%)
Channel X + Input	199995.43	-0.60	-0.00
Channel X + Input	20004.43	4.15	0.02
Channel X - Input	-19997.69	3.25	-0.02
Channel Y + Input	199994.87	-1.15	-0.00
Channel Y + Input	19998.43	-1.93	-0.01
Channel Y - Input	-20001.87	-0.85	0.00
Channel Z + Input	199997.48	1.41	0.00
Channel Z + Input	20001.10	0.79	0.00
Channel Z - Input	-20003.63	-2.53	0.01

Low Range	Reading (µV)	Difference (µV)	Error (%)
Channel X + Input	2000.64	0.17	0.01
Channel X + Input	201.77	0.85	0.42
Channel X - Input	-199.11	-0.24	0.12
Channel Y + Input	2000.97	0.62	0.03
Channel Y + Input	200.19	-0.69	-0.34
Channel Y - Input	-199.95	-0.97	0.49
Channel Z + Input	2000.53	0.21	0.01
Channel Z + Input	200.38	-0.40	-0.20
Channel Z - Input	-199.62	-0.59	0.29

2. Common mode sensitivity

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	Common mode Input Voltage (mV)	High Range Average Reading (µV)	Low Range Average Reading (µV)
Channel X	200	19.65	17.65
	-200	-14.62	-15.78
Channel Y	200	-6.89	-7.43
	-200	3.98	4.06
Channel Z	200	20.93	20.96
	-200	-22.42	-22.42

3. Channel separation

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	Input Voltage (mV)	Channel X (µV)	Channel Y (µV)	Channel Z (µV)
Channel X	200	-	2.53	-2.12
Channel Y	200	9.67	-	3.63
Channel Z	200	5.84	6.75	-

4. AD-Converter Values with inputs shorted

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	High Range (LSB)	Low Range (LSB)
Channel X	16141	15478
Channel Y	16453	16523
Channel Z	15984	17120

5. Input Offset Measurement

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

Input 10MΩ

	Average (µV)	min. Offset (µV)	max. Offset (µV)	Std. Deviation (µV)
Channel X	2.01	0.79	3.52	0.47
Channel Y	-0.51	-1.15	0.66	0.34
Channel Z	-0.87	-1.96	0.11	0.45

6. Input Offset Current

Nominal Input circuitry offset current on all channels: <25fA

7. Input Resistance (Typical values for information)

	Zeroing (kOhm)	Measuring (MOhm)
Channel X	200	200
Channel Y	200	200
Channel Z	200	200

8. Low Battery Alarm Voltage (Typical values for information)

Typical values	Alarm Level (VDC)
Supply (+ Vcc)	+7.9
Supply (- Vcc)	-7.6

9. Power Consumption (Typical values for information)

Typical values	Switched off (mA)	Stand by (mA)	Transmitting (mA)
Supply (+ Vcc)	+0.01	+6	+14
Supply (- Vcc)	-0.01	-8	-9

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



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Accreditation No.: SCS 108

Client: SGS-TW (Auden)

Certificate No: EX3-3938_Jul14

CALIBRATION CERTIFICATE

Object: EX3DV4 - SN:3938

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

Calibration date: July 26, 2014

This calibration certificate documents the traceability to national standards, which relates the physical units of measurement (B).
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&T critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	03-Apr-14 (No. 217-01911)	Apr-15
Power sensor E4412A	MB41408897	03-Apr-14 (No. 217-01911)	Apr-15
Reference 3 dB Attenuator	SN: 55954 (3c)	03-Apr-14 (No. 217-01915)	Apr-15
Reference 20 dB Attenuator	SN: 56277 (20x)	03-Apr-14 (No. 217-01919)	Apr-15
Reference 30 dB Attenuator	SN: 55179 (30x)	03-Apr-14 (No. 217-01920)	Apr-15
Reference Probe E330V2	SN: 8813	30-Dec-13 (No. E83-2013_Dec13)	Dec-14
DAE4	SN: 880	13-Dec-13 (No. DAE4-880_Dec13)	Dec-14
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HF 8848D	US3642U01780	4-Aug-09 (in house check: Apr-13)	In house check: Apr-15
Network Analyzer HP 8753E	US37399235	18-Oct-01 (in house check: Oct-13)	In house check: Oct-14

Calibrated by:	Name:	Function:	Signature:
	Ulrich El-Naschie	Laboratory Technician	
Approved by:	Karlis Povarovs	Technical Manager	

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

Issued: July 26, 2014

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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., $\theta = 0$ 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:

- 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
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

Methods Applied and Interpretation of Parameters:

- NORM_{x,y,z}:** Assessed for E-field polarization $\theta = 0$ ($f \leq 800$ 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.
- DCPx,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}:** 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 NORMx (no uncertainty required).

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EX3DV4 – SN:3938

July 25, 2014

Probe EX3DV4

SN:3938

Manufactured: May 2, 2013
Calibrated: July 25, 2014

Calibrated for DASY/EASY Systems

(Note: non-compatible with DASY2 system!)

Certificate No: EX3-3938_Jul14

Page 3 of 11

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EX3DV4- SN:3938

July 25, 2014

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3938

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm (μ V/(V/m)) ^A	0.52	0.59	0.34	\pm 10.1 %
DCP (mV) ^B	98.3	99.4	104.7	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB/ μ V	C	D dB	VR mV	Unc ^C (k=2)
0	CW	X	0.0	0.0	1.0	0.00	166.6	\pm 3.0 %
		Y	0.0	0.0	1.0		157.7	
		Z	0.0	0.0	1.0		153.7	

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 NormX,Y,Z do not affect the E²-field uncertainty inside TSL (see Pages 5 and 6).

^B Numerical linearization parameter: uncertainty not required.

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3938**Calibration Parameter Determined in Head Tissue Simulating Media**

f (MHz) ^a	Relative Permittivity ^b	Conductivity (S/m) ^c	ConvF X	ConvF Y	ConvF Z	Alpha ^d	Depth ^e (mm)	Unct. (k=2)
835	41.5	0.90	9.41	9.41	9.41	0.80	0.50	± 12.0 %
900	41.5	0.97	9.26	9.26	9.26	0.61	0.68	± 12.0 %
1750	40.1	1.37	7.91	7.91	7.91	0.59	0.66	± 12.0 %
1900	40.0	1.40	7.65	7.65	7.65	0.54	0.72	± 12.0 %
2000	40.0	1.40	7.66	7.66	7.66	0.80	0.59	± 12.0 %
2450	39.2	1.80	6.97	6.97	6.97	0.41	0.78	± 12.0 %
2600	39.0	1.96	6.83	6.83	6.83	0.38	0.86	± 12.0 %
5200	36.0	4.86	4.95	4.95	4.95	0.40	1.80	± 13.1 %
5300	35.9	4.76	4.74	4.74	4.74	0.40	1.80	± 13.1 %
5600	35.5	5.07	4.47	4.47	4.47	0.40	1.80	± 13.1 %
5800	35.3	5.27	4.49	4.49	4.49	0.40	1.80	± 13.1 %

^a 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 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

^b 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.

^c 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:3938

July 25, 2014

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3938**Calibration Parameter Determined in Body Tissue Simulating Media**

f (MHz) ^a	Relative Permittivity ^b	Conductivity (S/m) ^c	ConvF X	ConvF Y	ConvF Z	Alpha ^d	Depth ^e (mm)	Unc. (k=2)
835	55.2	0.97	9.35	9.35	9.35	0.80	0.60	± 12.0 %
900	55.0	1.05	9.24	9.24	9.24	0.80	0.50	± 12.0 %
1750	53.4	1.49	7.36	7.36	7.36	0.80	0.62	± 12.0 %
1900	53.3	1.52	7.03	7.03	7.03	0.44	0.83	± 12.0 %
2000	53.3	1.52	7.21	7.21	7.21	0.30	0.97	± 12.0 %
2450	52.7	1.95	6.69	6.69	6.69	0.75	0.57	± 12.0 %
2600	52.5	2.16	6.57	6.57	6.57	0.80	0.50	± 12.0 %
5200	49.0	5.30	4.27	4.27	4.27	0.45	1.90	± 13.1 %
5300	48.9	5.42	4.11	4.11	4.11	0.45	1.90	± 13.1 %
5600	48.5	5.77	3.70	3.70	3.70	0.50	1.90	± 13.1 %
5800	48.2	6.00	3.92	3.92	3.92	0.50	1.90	± 13.1 %

^a 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 300 MHz is ± 10, 25, 40, 55 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

^b 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.

^c 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.

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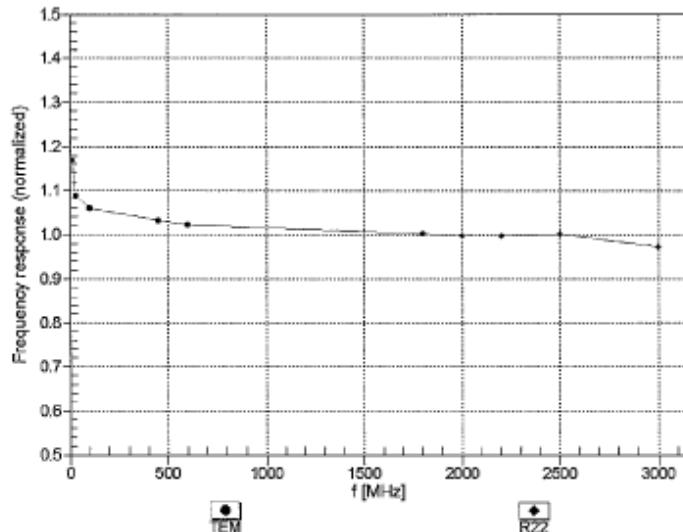
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EX3DV4-SN:3838

July 25, 2014

Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ (k=2)

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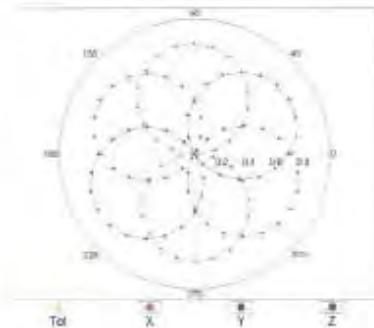
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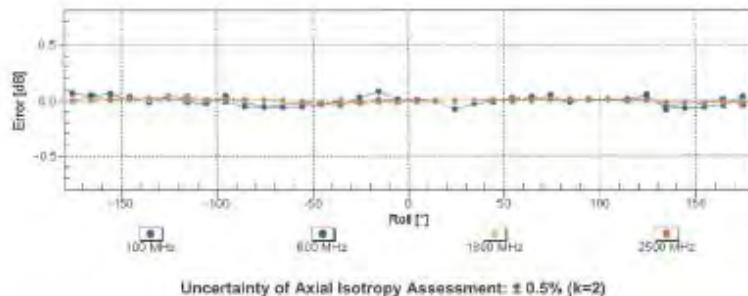
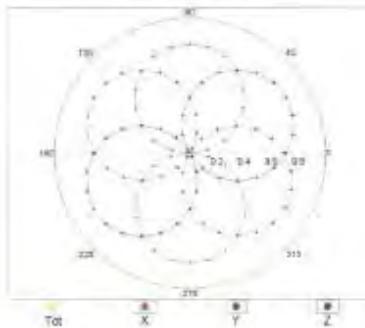
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Receiving Pattern (ϕ), $\theta = 0^\circ$

f=600 MHz, TEM



f=1800 MHz, R22

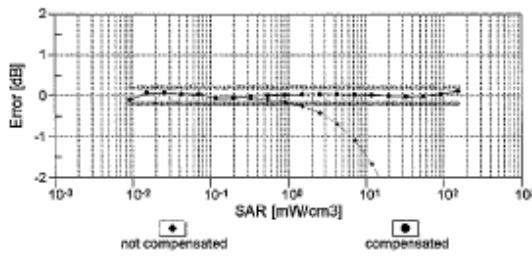
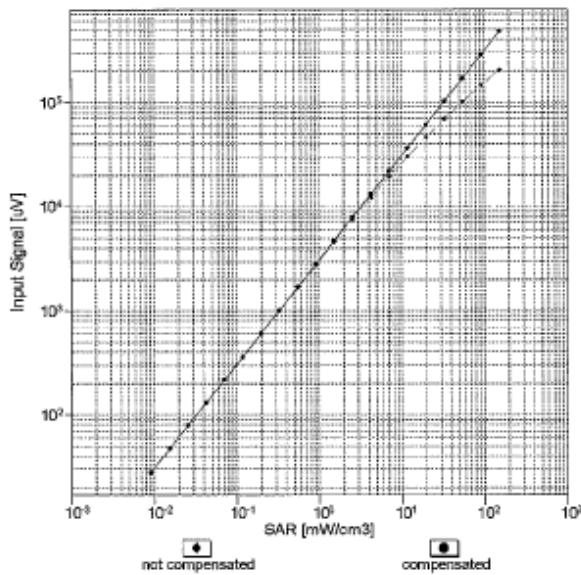
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

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Dynamic Range f(SAR_{head})
(TEM cell, f_{eval}= 1900 MHz)

Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

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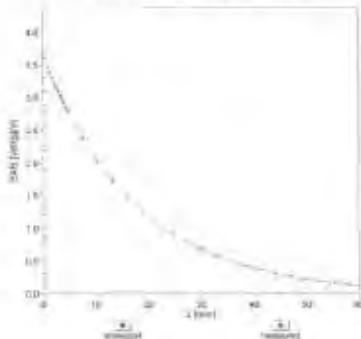
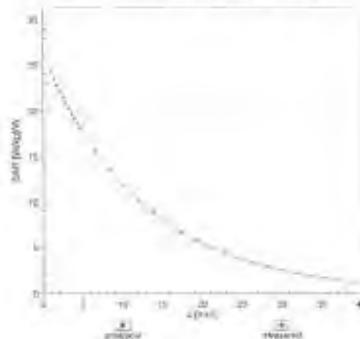
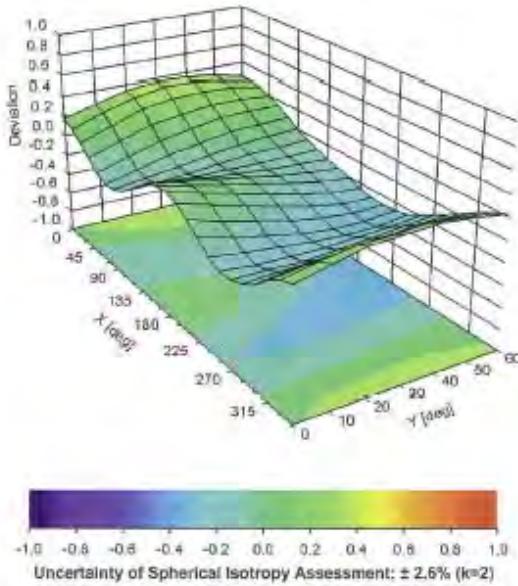
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EX3DW4-SN-3938

July 25, 2014

Conversion Factor Assessment $f = 900 \text{ MHz}, \text{WGLS R9 (H_convF)}$  $f = 1750 \text{ MHz}, \text{WGLS R22 (H_convF)}$ **Deviation from Isotropy in Liquid**Error (θ, δ), $f = 900 \text{ MHz}$ Uncertainty of Spherical Isotropy Assessment: $\pm 2.6\% (k=2)$

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EX3DV4-SN:3938

July 25, 2014

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3938

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-25.5
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	1.4 mm

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8. Uncertainty Budget

 Measurement Uncertainty evaluation template for DUT SAR test
 IEEE 1528

A	c	D	e	f	g	$h=c * f / e$	$i=c * g / e$	k	
Source of Uncertainty	Tolerance/ Uncertainty	Probabilit v	Div	Div Value	ci (1g)	ci (10g)	Standard uncertainty	Standard uncertainty	vi, or Veff
Measurement system									
Probe calibration	6.55%	N	1	1	1	1	6.55%	6.55%	∞
<i>Isotropy, Axial</i>	3.50%	R	$\sqrt{3}$	1.732	1	1	2.02%	2.02%	∞
<i>Isotropy, Hemispherical</i>	9.60%	R	$\sqrt{3}$	1.732	1	1	5.54%	5.54%	∞
Boundary Effect	1.00%	R	$\sqrt{3}$	1.732	1	1	0.58%	0.58%	∞
Linearity	4.70%	R	$\sqrt{3}$	1.732	1	1	2.71%	2.71%	∞
Detection Limits	1.00%	R	$\sqrt{3}$	1.732	1	1	0.58%	0.58%	∞
Readout Electronics	0.30%	N	1	1	1	1	0.30%	0.30%	∞
Response time	0.80%	R	$\sqrt{3}$	1.732	1	1	0.46%	0.46%	∞
Integration Time	2.60%	R	$\sqrt{3}$	1.732	1	1	1.50%	1.50%	∞
<i>Measurement drift (class A evaluation)</i>	1.75%	R	$\sqrt{3}$	1.732	1	1	1.01%	1.01%	∞
RF ambient condition - noise	3.00%	R	$\sqrt{3}$	1.732	1	1	1.73%	1.73%	∞
RF ambient conditions - reflections	3.00%	R	$\sqrt{3}$	1.732	1	1	1.73%	1.73%	∞
Probe positioner Mechanical restrictions	0.40%	R	$\sqrt{3}$	1.732	1	1	0.23%	0.23%	∞
Probe Positioning with respect to phantom	2.90%	R	$\sqrt{3}$	1.732	1	1	1.67%	1.67%	∞
Post-processing	1.00%	R	$\sqrt{3}$	1.732	1	1	0.58%	0.58%	∞
Max SAR Eval	1.00%	R	$\sqrt{3}$	1.732	1	1	0.58%	0.58%	∞
Test Sample related									
Test sample positioning	2.90%	N	1	1	1	1	2.90%	2.90%	M-1
Device Holder Uncertainty	3.60%	N	1	1	1	1	3.60%	3.60%	M-1
Drift of output power	5.00%	R	$\sqrt{3}$	1.732	1	1	2.89%	2.89%	∞
Phantom and Setup									
Phantom Uncertainty	4.00%	R	$\sqrt{3}$	1.732	1	1	2.31%	2.31%	∞
Deviation from reference	3.61%	N	1	1	0.64	0.43	2.31%	1.55%	M
Deviation from reference	3.21%	N	1	1	0.6	0.49	1.93%	1.57%	M
Combined standard uncertainty		RSS					11.96%	11.78%	
Explant uncertainty (95% confidence)							23.91%	23.56%	

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9. Phantom Description

Schmid & Partner Engineering AG

s p e a cZeughausstrasse 43, 8004 Zurich, Switzerland
Phone +41 1 245 9700, Fax +41 1 245 9779
Info@speag.com, http://www.speag.com**Certificate of Conformity / First Article Inspection**

Item	SAM Twin Phantom V4.0
Type No	QD 000 P40 C
Series No	TP-1150 and higher
Manufacturer	SPEAG Zeughausstrasse 43 CH-8004 Zürich Switzerland

Tests

The series production process used allows the limitation to test of first articles.
Complete tests were made on the pre-series Type No. QD 000 P40 AA, Serial No. TP-1001 and on the series first article Type No. QD 000 P40 BA, Serial No. TP-1006. Certain parameters have been retested using further series items (called samples) or are tested at each item.

Test	Requirement	Details	Units tested
Dimensions	Compliant with the geometry according to the CAD model.	IT'IS CAD File (*)	First article, Samples
Material thickness of shell	Compliant with the requirements according to the standards	2mm +/- 0.2mm in flat and specific areas of head section	First article, Samples, TP-1314 fl.
Material thickness at ERP	Compliant with the requirements according to the standards	8mm +/- 0.2mm at ERP	First article, All items
Material parameters	Dielectric parameters for required frequencies	300 MHz – 6 GHz: Relative permittivity < 5, Loss tangent < 0.05	Material samples
Material resistivity	The material has been tested to be compatible with the liquids defined in the standards if handled and cleaned according to the instructions. Observe technical Note for material compatibility.	DEGMME based simulating liquids	Pre-series, First article, Material samples
Sagging	Compliant with the requirements according to the standards. Sagging of the flat section when filled with tissue simulating liquid.	< 1% typical < 0.8% if filled with 155mm of HSL900 and without DUT below	Prototypes, Sample testing

Standards

- [1] CENELEC EN 50361
 - [2] IEEE Std 1528-2003
 - [3] IEC 62209 Part 1
 - [4] FCC OET Bulletin 85, Supplement C, Edition 01-01
- (*) The IT'IS CAD file is derived from [2] and is also within the tolerance requirements of the shapes of the other documents.

Conformity

Based on the sample tests above, we certify that this item is in compliance with the uncertainty requirements of SAR measurements specified in standards [1] to [4].

Date

07.07.2005

s p e a c

Signature / Stamp

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Doc No. 841 - QD 000 P40 C - F

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10. System Validation from Original Equipment Supplier

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



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The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**Client: **SGS-TW (Auden)**Certificate No.: **D2450V2-922_Nov13**

CALIBRATION CERTIFICATE

Object: D2450V2 - SN: 922

Calibration procedure(s): QA CAL-05/v9
Calibration procedure for dipole validation kits above 700 MHz

Calibration date: November 05, 2013

This calibration certificate documents the traceability to national standards, which realize the physical units of measurement (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 Standard	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8461A	US37292783	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	MY41002317	09-Oct-13 (No. 217-01828)	Oct-14
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-13 (No. 217-01736)	Apr-14
Type-N mismatch combination	SN: 5047.3 / 06327	04-Apr-13 (No. 217-01739)	Apr-14
Reference Probe ES3DV3	SN: 3805	28-Dec-12 (No. ES3-3205_Dec12)	Dec-13
DAE4	SN: 601	25-Apr-13 (No. DAE4-601_Apr13)	Apr-14
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator RMS SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-15
Network Analyzer HP 8753E	US37390585 S4286	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

Calibrated by:	Name: Israa El-Napouq	Function: Laboratory Technician	Signature:
Approved by:	Name: Kaja Poxovic	Function: Technical Manager	

Issued: November 5, 2013

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

Certificate No: D2450V2-922_Nov13

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Calibration Laboratory of

Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland



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S Servizio svizzero di taratura
S Swiss Calibration Service

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Accreditation No.: **SCS 108****Glossary:**

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM x,y,z
N/A	not applicable or not measured

Calibration is Performed According to the Following Standards:

- 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
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

- Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- Antenna Parameters with TSL:* The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- Feed Point Impedance and Return Loss:* These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- Electrical Delay:* One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- SAR measured:* SAR measured at the stated antenna input power.
- SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

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%.

Measurement Conditions

DASY system configuration, as far as not given on page 1.

DASY Version	DASY5	V52.8.7
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	39.7 ± 6 %	1.84 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.3 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	52.8 W/kg ± 17.0 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.13 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.4 W/kg ± 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	52.1 ± 6 %	2.02 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	12.9 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	50.6 W/kg ± 17.0 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.96 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	23.6 W/kg ± 16.5 % (k=2)

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Appendix**Antenna Parameters with Head TSL**

Impedance, transformed to feed point	53.5 Ω + 3.5 $\text{j}\Omega$
Return Loss	- 26.5 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	51.0 Ω + 5.0 $\text{j}\Omega$
Return Loss	- 25.9 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.161 ns
----------------------------------	----------

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	September 26, 2013

DASY5 Validation Report for Head TSL

Date: 05.11.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 922

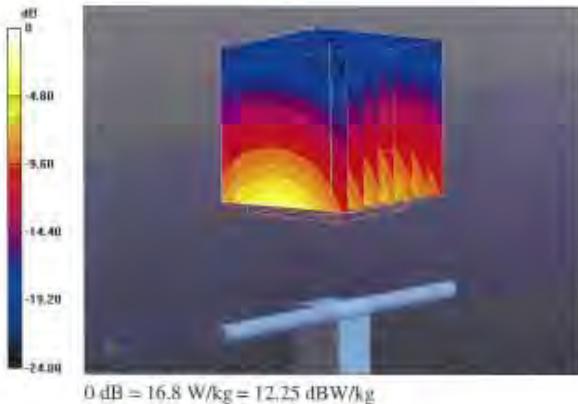
Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: $f = 2450$ MHz; $\sigma = 1.84$ S/m; $\epsilon_r = 39.7$; $\rho = 1000$ kg/m³
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.52, 4.52, 4.52); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 98.82 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 27.7 W/kg
SAR(1 g) = 13.3 W/kg; SAR(10 g) = 6.13 W/kg
Maximum value of SAR (measured) = 16.8 W/kg



Certificate No: D2450V2-922_Nov13

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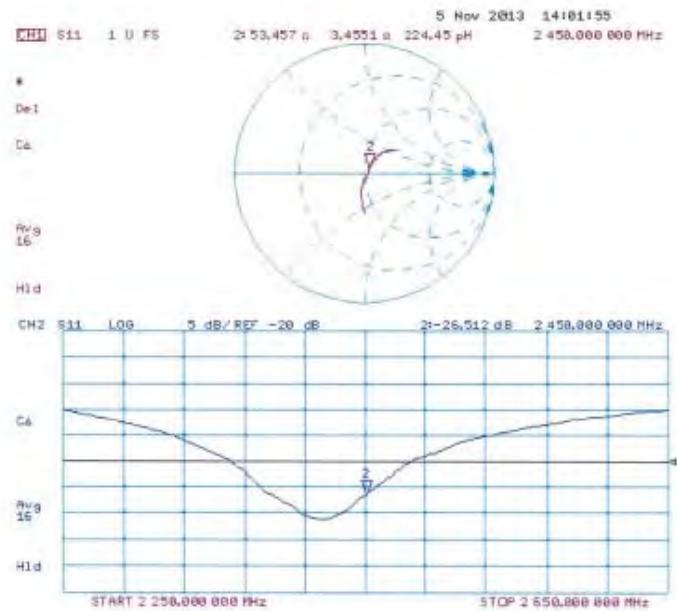
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Impedance Measurement Plot for Head TSL



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DASY5 Validation Report for Body TSL

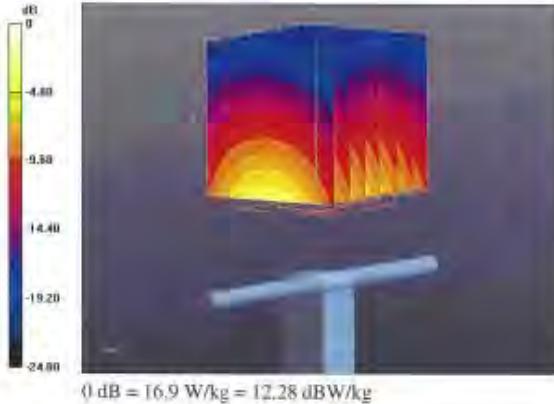
Date: 01.11.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 922Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: $f = 2450$ MHz; $\sigma = 2.02$ S/m; $\epsilon_r = 52.1$; $\rho = 1000$ kg/m³
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.42, 4.42, 4.42); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 94.218 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 27.0 W/kg
SAR(1 g) = 12.9 W/kg; SAR(10 g) = 5.96 W/kg
Maximum value of SAR (measured) = 16.9 W/kg

Certificate No: D2450V2-922_Nov13

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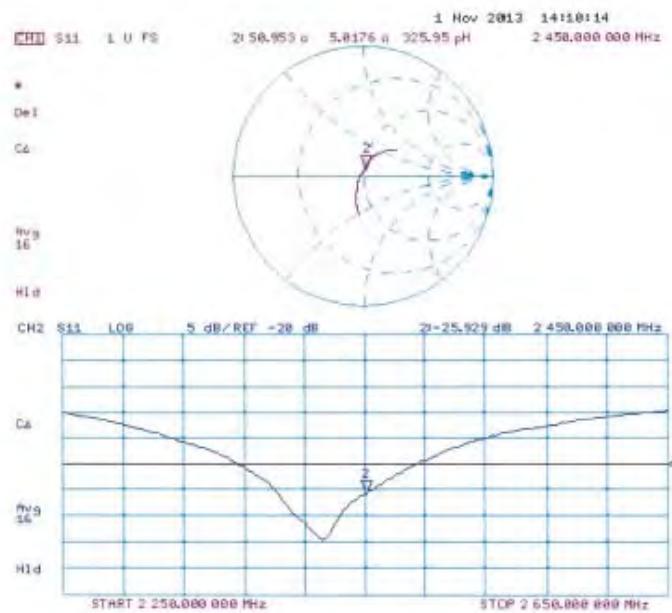
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Impedance Measurement Plot for Body TSL



Certificate No: D2450V2-B22_Nov13

Page 8 of 8

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Calibration Laboratory of
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Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland



S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
S Servizio svizzero di tamografia
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 108

Client SGS-TW (Auden)

Certificate No: D5GHzV2-1023_Jan14

CALIBRATION CERTIFICATE

Object D5GHzV2 - SN: 1023

Calibration procedure(s) QA.CAL.22.V2
Calibration procedure for dipole validation kits between 3-6 GHz

Calibration date January 30, 2014

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 this certificate.

All calibrations have been conducted in the closest 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 EPM-442A	GB37486/704	09-Oct-13 (No. 217-01627)	Oct-14
Power sensor HP 8481A	US37292753	09-Oct-13 (No. 217-01627)	Oct-14
Power sensor HP 8481A	MY41092317	09-Oct-13 (No. 217-01628)	Oct-14
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-13 (No. 217-01730)	Apr-14
Type-N mismatch combination	SN: 5047.3 / 08327	04-Apr-13 (No. 217-01739)	Apr-14
Reference Probe EX30V4	SN: 3603	30-Dec-13 (No. EX3-3603_Dec13)	Dec-14
DAE4	SN: 601	25-Apr-13 (No. DAE4-601_Apr13)	Apr-14
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SM1-00	100008	04-Aug-09 (in house check Oct-13)	in house check: Oct-16
Network Analyzer HP 8753E	US37386585 54208	18-Oct-11 (in house check Oct-13)	in house check: Oct-14

Calibrated by:	Name:	Function:	Signature:
	Jeton Kaslina	Laboratory Technician	
Approved by:	Kaja Pokorny	Technical Manager	

Issued: January 31, 2014

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

Certificate No: D5GHzV2-1023_Jan14

Page 1 of 14

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



S Schweizerischer Kalibrierdienst
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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 108

Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM x,y,z
N/A	not applicable or not measured

Calibration is Performed According to the Following Standards:

- IEC 62209-2, "Evaluation of Human Exposure to Radio Frequency Fields from Handheld and Body-Mounted Wireless Communication Devices in the Frequency Range of 30 MHz to 6 GHz: Human models, Instrumentation, and Procedures"; Part 2: "Procedure to determine the Specific Absorption Rate (SAR) for including accessories and multiple transmitters", March 2010
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"
- 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

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

- Measurement Conditions:** Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- Antenna Parameters with TSL:** The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- Feed Point Impedance and Return Loss:** These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- Electrical Delay:** One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- SAR measured:** SAR measured at the stated antenna input power.
- SAR normalized:** SAR as measured, normalized to an input power of 1 W at the antenna connector.
- SAR for nominal TSL parameters:** The measured TSL parameters are used to calculate the nominal SAR result.

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%.

Measurement Conditions

DASY system configuration, as far as not given on page 1.

DASY Version	DASY5	V52.8.7
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy = 4.0 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
Frequency	5200 MHz \pm 1 MHz 5300 MHz \pm 1 MHz 5600 MHz \pm 1 MHz 5800 MHz \pm 1 MHz	

Head TSL parameters at 5200 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	36.0	4.86 mho/m
Measured Head TSL parameters	(22.0 \pm 0.2) °C	37.2 \pm 6 %	4.54 mho/m \pm 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5200 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.67 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	77.2 W/kg \pm 19.9 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.19 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.1 W/kg \pm 19.5 % (k=2)

Head TSL parameters at 5300 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.9	4.76 mho/m
Measured Head TSL parameters	(22.0 \pm 0.2) °C	37.0 \pm 6 %	4.65 mho/m \pm 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5300 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.14 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	81.8 W / kg \pm 19.9 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.32 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.4 W/kg \pm 19.5 % (k=2)

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Head TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.5	5.07 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	36.6 ± 6 %	4.96 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	---	---

SAR result with Head TSL at 5600 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.09 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	81.3 W/kg ± 19.9 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.30 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.2 W/kg ± 19.5 % (k=2)

Head TSL parameters at 5800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.3	5.27 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	36.3 ± 6 %	5.18 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	---	---

SAR result with Head TSL at 5800 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.77 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	78.1 W/kg ± 19.9 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.20 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.1 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5200 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	49.0	5.30 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	47.8 ± 6 %	5.40 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5200 MHz

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.39 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	73.6 W/kg ± 19.9 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.06 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	20.5 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5300 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.9	5.42 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	47.8 ± 6 %	5.53 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5300 MHz

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.62 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	75.8 W/kg ± 19.9 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.13 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.2 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.6	5.77 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	47.1 ± 6 %	5.93 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	---	---

SAR result with Body TSL at 5600 MHz

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	8.04 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	80.0 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.23 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	22.2 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.2	6.00 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.8 ± 6 %	6.21 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	---	---

SAR result with Body TSL at 5800 MHz

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.44 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	74.1 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.05 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	20.4 W/kg ± 19.5 % (k=2)

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Appendix

Antenna Parameters with Head TSL at 5200 MHz

Impedance, transformed to feed point	49.9 Ω - 7.7 $j\Omega$
Return Loss	- 22.3 dB

Antenna Parameters with Head TSL at 5300 MHz

Impedance, transformed to feed point	51.2 Ω - 4.0 $j\Omega$
Return Loss	- 27.6 dB

Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	53.8 Ω - 2.5 $j\Omega$
Return Loss	- 27.1 dB

Antenna Parameters with Head TSL at 5800 MHz

Impedance, transformed to feed point	56.5 Ω + 0.5 $j\Omega$
Return Loss	- 24.3 dB

Antenna Parameters with Body TSL at 5200 MHz

Impedance, transformed to feed point	50.0 Ω - 6.1 $j\Omega$
Return Loss	- 24.3 dB

Antenna Parameters with Body TSL at 5300 MHz

Impedance, transformed to feed point	51.3 Ω - 1.9 $j\Omega$
Return Loss	- 32.7 dB

Antenna Parameters with Body TSL at 5600 MHz

Impedance, transformed to feed point	54.3 Ω - 0.4 $j\Omega$
Return Loss	- 27.6 dB

Antenna Parameters with Body TSL at 5800 MHz

Impedance, transformed to feed point	57.1 Ω + 3.3 $j\Omega$
Return Loss	- 22.7 dB

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General Antenna Parameters and Design

Electrical Delay (one direction)	1.199 ns
----------------------------------	----------

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	February 05, 2004

DASY5 Validation Report for Head TSL

Date: 30.01.2014

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 5GHz; Type: DSGHzV2; Serial: DSGHzV2 - SN: 1023

Communication System: UID 0 - CW; Frequency: 5200 MHz, Frequency: 5300 MHz, Frequency: 5500 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz

Medium parameters used: $f = 5200 \text{ MHz}$; $\sigma = 4.54 \text{ S/m}$; $\epsilon_r = 37.2$; $\rho = 1000 \text{ kg/m}^3$, Medium parameters used: $f = 5300 \text{ MHz}$; $\sigma = 4.65 \text{ S/m}$; $\epsilon_r = 37$; $\rho = 1000 \text{ kg/m}^3$, Medium parameters used: $f = 5600 \text{ MHz}$; $\sigma = 4.96 \text{ S/m}$; $\epsilon_r = 36.6$; $\rho = 1000 \text{ kg/m}^3$, Medium parameters used: $f = 5800 \text{ MHz}$; $\sigma = 5.18 \text{ S/m}$; $\epsilon_r = 36.3$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.52, 5.52, 5.52); Calibrated: 30.12.2013, ConvF(5.2, 5.2, 5.2); Calibrated: 30.12.2013, ConvF(4.86, 4.86, 4.86); Calibrated: 30.12.2013, ConvF(4.91, 4.91, 4.91); Calibrated: 30.12.2013;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 62.583 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 28.2 W/kg

SAR(1 g) = 7.67 W/kg; SAR(10 g) = 2.19 W/kg

Maximum value of SAR (measured) = 18.2 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5300 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 63.619 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 30.8 W/kg

SAR(1 g) = 8.14 W/kg; SAR(10 g) = 2.32 W/kg

Maximum value of SAR (measured) = 19.4 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 61.852 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 32.3 W/kg

SAR(1 g) = 8.09 W/kg; SAR(10 g) = 2.3 W/kg

Maximum value of SAR (measured) = 19.7 W/kg

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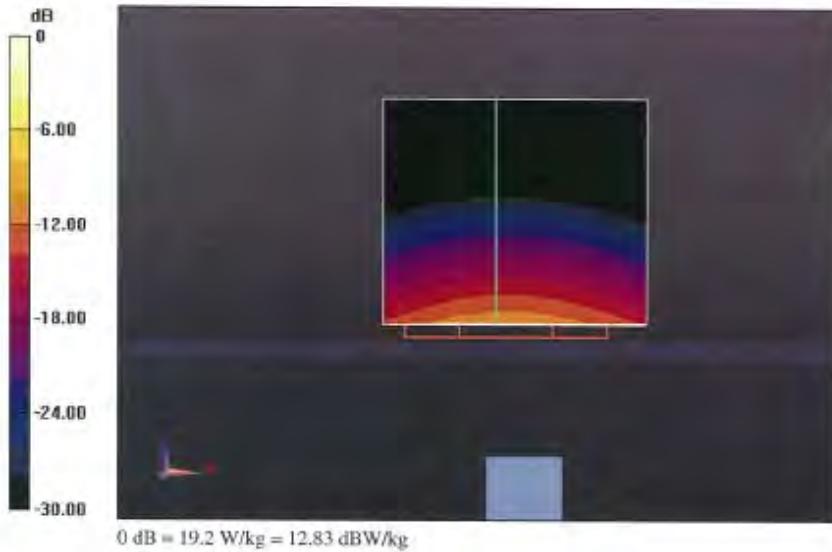
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Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 59.398 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 32.6 W/kg
SAR(1 g) = 7.77 W/kg; SAR(10 g) = 2.2 W/kg
Maximum value of SAR (measured) = 19.2 W/kg



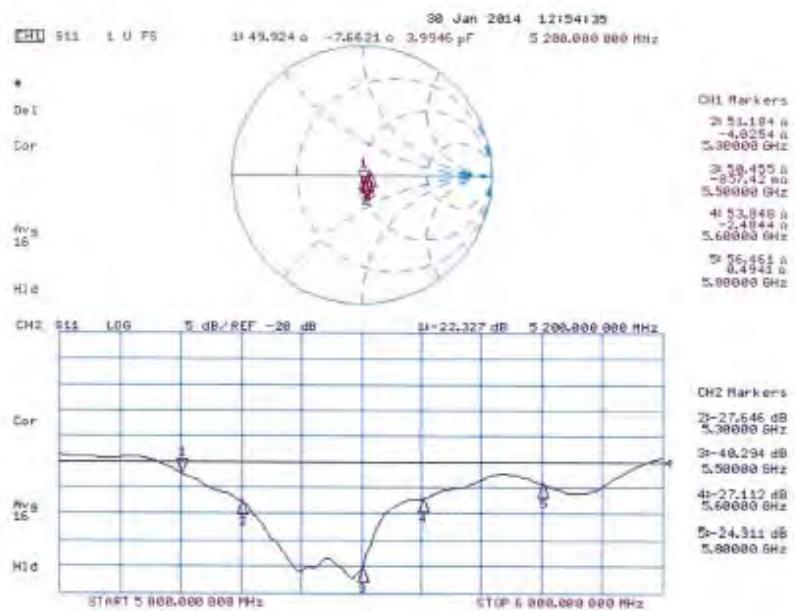
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Impedance Measurement Plot for Head TSL



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DASY5 Validation Report for Body TSL

Date: 29.01.2014

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1023

Communication System: UID 0 - CW; Frequency: 5200 MHz, Frequency: 5300 MHz, Frequency: 5500 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz

Medium parameters used: $f = 5200 \text{ MHz}$; $\sigma = 5.4 \text{ S/m}$; $\epsilon_r = 47.8$; $\rho = 1000 \text{ kg/m}^3$, Medium parameters used: $f = 5300 \text{ MHz}$; $\sigma = 5.53 \text{ S/m}$; $\epsilon_r = 47.6$; $\rho = 1000 \text{ kg/m}^3$, Medium parameters used: $f = 5600 \text{ MHz}$; $\sigma = 5.93 \text{ S/m}$; $\epsilon_r = 47.1$; $\rho = 1000 \text{ kg/m}^3$, Medium parameters used: $f = 5800 \text{ MHz}$; $\sigma = 6.21 \text{ S/m}$; $\epsilon_r = 46.8$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.01, 5.01, 5.01); Calibrated: 30.12.2013, ConvF(4.76, 4.76, 4.76); Calibrated: 30.12.2013, ConvF(4.3, 4.3, 4.3); Calibrated: 30.12.2013, ConvF(4.47, 4.47, 4.47); Calibrated: 30.12.2013;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 57.977 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 29.2 W/kg

SAR(1 g) = 7.39 W/kg; SAR(10 g) = 2.06 W/kg

Maximum value of SAR (measured) = 17.6 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5300 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 58.404 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 30.9 W/kg

SAR(1 g) = 7.62 W/kg; SAR(10 g) = 2.13 W/kg

Maximum value of SAR (measured) = 18.5 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 58.115 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 35.7 W/kg

SAR(1 g) = 8.04 W/kg; SAR(10 g) = 2.23 W/kg

Maximum value of SAR (measured) = 20.0 W/kg

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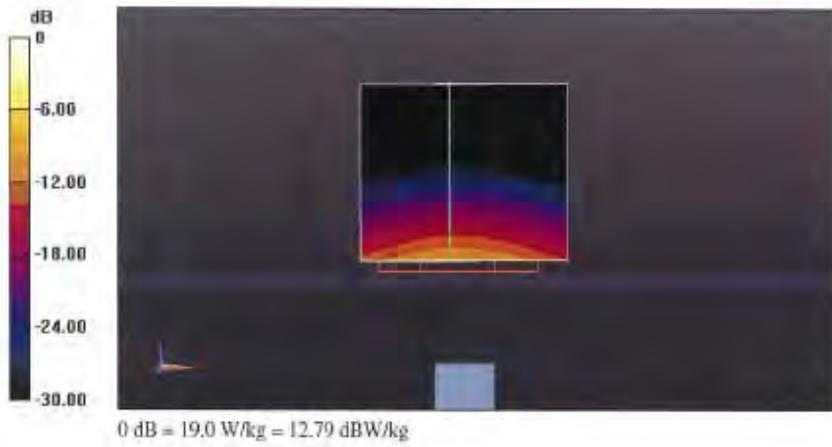
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Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 54.877 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 34.9 W/kg
SAR(1 g) = 7.44 W/kg; SAR(10 g) = 2.05 W/kg
Maximum value of SAR (measured) = 19.0 W/kg



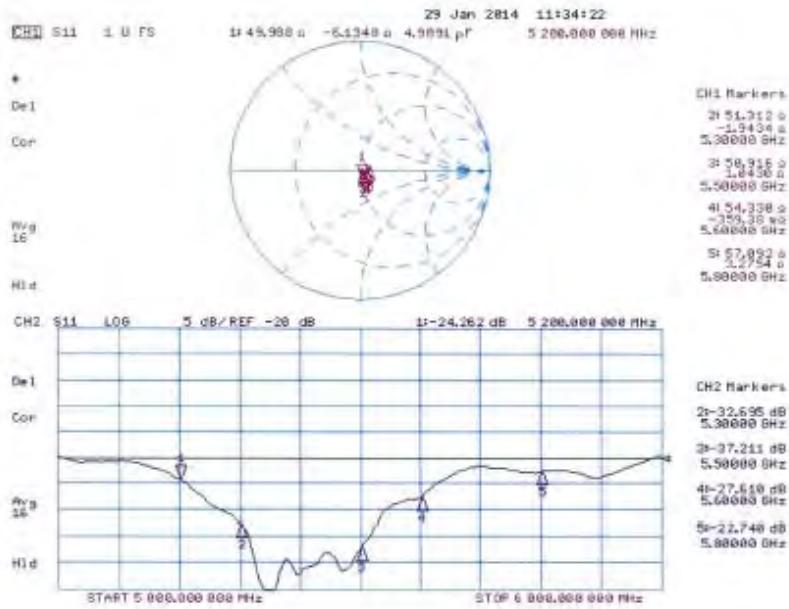
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Impedance Measurement Plot for Body TSL

**- End of 1st part of report -**

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