SAR TEST REPORT

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

Equipment Under Test	Mobile POS
Marketing Name	G10
Brand Name	iRUGGY
Model No.	G10
Company Name	iRUGGY Systems Corporate Ltd.
Company Address	6F.,No.30,Xingzhong Rd.,Neihu Dist.,Taipei City 114,Taiwan.
Standards	IEEE/ANSI C95.1-1992, IEEE 1528-2013, KDB248227D01v02r02,KDB865664D01v01r04, KDB865664D02v01r02,KDB447498D01v06, KDB616217D04v01r02,KDB941225D01v03r01
FCC ID	XHM-PB63D3X
Date of Receipt	Oct. 04, 2016
Date of Test(s)	Oct. 20, 2016 ~ Oct. 28, 2016
Date of Issue	Dec. 12, 2016

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.

This report may only be reproduced and distributed in full. If the product in this report is used in any configuration other than that detailed in the report, the manufacturer must ensure the new system complies with all relevant standards. Any mention of SGS Taiwan Electronic & Communication Laboratory or testing done by SGS Taiwan Electronic & Communication Laboratory in connection with distribution or use of the product described in this report must be approved by SGS Taiwan Electronic & Communication Laboratory in writing.

Signed on behalf of SGS

Engineer	**Supervisor**
Bond Tsai Bond Tsai	**John Yeh** John Yeh
Date: Dec. 12, 2016	**Date: Dec. 12, 2016**

Revision History

Report Number	Revision	Description	Issue Date
E5/2016/A0004	Rev.00	Initial creation of document	Nov. 18, 2016
E5/2016/A0004	Rev.01	1st modification	Dec. 08, 2016
E5/2016/A0004	Rev.02	2nd modification	Dec. 12, 2016

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Contents

1. General Information

1.1 Testing Laboratory

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1.2 Details of Applicant

Company Name	iRUGGY Systems Corporate Ltd.
Company Address	6F.,No.30,Xingzhong Rd.,Neihu Dist.,Taipei City 114,Taiwan.

1.3 Description of EUT

Equipment Under Test	Mobile POS	
Marketing Name	G10	
Brand Name	iRUGGY	
Model No.	G10	
WWAN FCC ID	XHM-H38FL31	
WLAN FCC ID	XHM-PB63D31	
Host FCC ID	XHM-PB63D3X	
Mode of Operation	☒WCDMA ☒HSDPA ☒HSUPA ☒HSPA+ ☒WLAN802.11 a/b/g/n/ac(20M/40M/80M) ☒Bluetooth	
Duty Cycle	WCDMA (HSDPA Category 14) (HSUPA Category 7)	1
	WLAN802.11 a/b/g/n/ac(20M/40M/80M)	1
	Bluetooth	1
TX Frequency Range (MHz)	WCDMA Band II	1850 – 1910
	WCDMA Band V	824 – 849
	WLAN802.11 b/g/n(20M)	2412 – 2462
	WLAN802.11 n(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/ac(20M) 5.6G	5500 – 5720
	WLAN802.11 n/ac(40M) 5.6G	5510 – 5710

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TX Frequency Range (MHz)	WLAN802.11 ac(80M) 5.6G	5530	—	5690
	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		
	Bluetooth	2402	—	2480
Channel Number (ARFCN)	WCDMA Band II	9262	—	9538
	WCDMA Band V	4132	—	4233
	WLAN802.11 b/g/n(20M)	1	—	11
	WLAN802.11 n(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/ac(20M) 5.6G	100	—	144
	WLAN802.11 n/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		
	Bluetooth	0	—	78

Max. SAR (1 g) (Unit: W/Kg)				
Band	Measured	Reported	Channel	Position
WCDMA Band II	0.625	0.650	9400	Left side
WCDMA Band V	0.230	0.336	4183	Left side

Max. SAR (1 g) (Unit: W/Kg)					
Antenna	Band	Measured	Reported	Channel	Position
Main	WLAN802.11b	0.801	0.847	1	Left side
	Bluetooth (8DPSK)	0.049	0.053	39	Left side
	WLAN802.11 a 5.2G	0.364	0.399	40	Left side
	WLAN802.11 a 5.3G	0.326	0.353	52	Left side
	WLAN802.11 a 5.6G	0.140	0.152	120	Left side
	WLAN802.11 a 5.8G	0.165	0.180	165	Left side
Aux	WLAN802.11b	0.624	0.676	6	Top side
	Bluetooth (8DPSK)	0.042	0.051	0	Top side
	WLAN802.11 a 5.2G	0.275	0.278	36	Top side
	WLAN802.11 a 5.3G	0.205	0.208	52	Top side
	WLAN802.11 a 5.6G	0.173	0.175	120	Top side
	WLAN802.11 a 5.8G	0.242	0.245	165	Top side

WCDMA Band II / Band V - HSDPA / HSUPA / HSPA+ conducted power table (Full power):

Band		WCDMA II		
TX Channel		9262	9400	9538
Frequency (MHz)		1852.4	1880	1907.6
Max. Rated Avg. Power+Max. Tolerance (dBm)		24.00		
3GPP Rel 99	RMC 12.2Kbps	22.99	22.83	22.98
3GPP Rel 5	HSDPA Subtest-1	22.97	22.76	22.96
	HSDPA Subtest-2	22.84	22.71	22.89
	HSDPA Subtest-3	22.79	22.70	22.81
	HSDPA Subtest-4	22.31	22.22	22.14
3GPP Rel 6	HSUPA Subtest-1	22.83	22.74	22.58
	HSUPA Subtest-2	22.81	22.79	22.60
	HSUPA Subtest-3	22.33	22.24	22.15
	HSUPA Subtest-4	22.85	22.71	22.61
	HSUPA Subtest-5	22.94	22.76	22.66
3GPP Rel 7	HSPA+ Subtest-1	22.93	22.71	22.59

Band		WCDMA V		
TX Channel		4132	4183	4233
Frequency (MHz)		826.4	836.6	846.6
Max. Rated Avg. Power+Max. Tolerance (dBm)		24.00		
3GPP Rel 99	RMC 12.2Kbps	22.24	22.36	22.24
3GPP Rel 5	HSDPA Subtest-1	22.22	22.28	22.11
	HSDPA Subtest-2	22.14	22.27	22.04
	HSDPA Subtest-3	22.11	22.21	22.01
	HSDPA Subtest-4	21.65	21.82	22.09
3GPP Rel 6	HSUPA Subtest-1	22.19	22.22	22.08
	HSUPA Subtest-2	22.14	22.21	22.15
	HSUPA Subtest-3	21.63	21.74	21.60
	HSUPA Subtest-4	22.15	22.28	22.11
	HSUPA Subtest-5	22.21	22.34	22.16
3GPP Rel 7	HSPA+ Subtest-1	22.18	22.32	22.10

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WCDMA Band II_HSDPA / HSUPA / HSPA+ conducted power table (Reduced power) :

Band		WCDMA II		
TX Channel		9262	9400	9538
Frequency (MHz)		1852.4	1880	1907.6
Max. Rated Avg. Power+Max. Tolerance (dBm)		15.00		
3GPP Rel 99	RMC 12.2Kbps	14.69	14.83	15.00
3GPP Rel 5	HSDPA Subtest-1	14.55	14.77	14.99
	HSDPA Subtest-2	14.54	14.68	14.96
	HSDPA Subtest-3	14.53	14.69	14.98
	HSDPA Subtest-4	14.53	14.68	14.95
3GPP Rel 6	HSUPA Subtest-1	14.53	14.79	14.94
	HSUPA Subtest-2	14.52	14.78	14.95
	HSUPA Subtest-3	14.50	14.69	14.96
	HSUPA Subtest-4	14.51	14.77	14.94
	HSUPA Subtest-5	14.54	14.80	14.97
3GPP Rel 7	HSPA+ Subtest-1	14.46	14.62	14.90

Sub-test for HSDPA

SUB-TEST	β_c	β_d	β_d *(SF)*	β_c/β_d	β_{HS} *(Note1, Note 2)*	CM (dB) *(Note 3)*	MPR (dB) *(Note 3)*
1	2/15	15/15	64	2/15	4/15	0.0	0.0
2	12/15	15/15	64	12/15	24/15	1.0	0.0
3	15/15	8/15	64	15/8	30/15	1.5	0.5
4	15/15	4/15	64	15/4	30/15	1.5	0.5

Sub-test for HSUPA

SUB-TEST	β_c	β_d	β_d *(SF)*	β_c/β_d	β_{HS} *(Note1)*	β_{ec}	β_{ed} *(Note 5) (Note 6)*	β_{ed} *(SF)*	β_{ed} *(Codes)*	CM *(dB) (Note 2)*	MPR *(dB) (Note 2)*	*AG Index (Note 6)*	*E-TFCI*
1	11/15	15/15	64	11/15	22/15	209/225	1309/225	4	1	1.0	0.0	20	75
2	6/15	15/15	64	6/15	12/15	12/15	94/75	4	1	3.0	2.0	12	67
3	15/15	9/15	64	15/9	30/15	30/15	β_{ed}1: 47/15 β_{ed}2: 47/15	4 4	2	2.0	1.0	15	92
4	2/15	15/15	64	2/15	4/15	2/15	56/75	4	1	3.0	2.0	17	71
5	15/15	15/15	64	15/15	30/15	24/15	134/15	4	1	1.0	0.0	21	81

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

Main antenna

802.11 b		Max. Rated Avg. Power + Max. Tolerance (dBm)	Average conducted output power (dBm)
CH	Frequency (MHz)		Data Rate (Mbps)
			1
1	2412	17.5	17.26
6	2437	17.5	17.31
11	2462	17.5	17.21

802.11 g		Max. Rated Avg. Power + Max. Tolerance (dBm)	Average conducted output power (dBm)
CH	Frequency (MHz)		Data Rate (Mbps)
			6
1	2412	16.5	16.25
6	2437	16.5	16.21
11	2462	16.5	16.20

802.11 n(20M)		Max. Rated Avg. Power + Max. Tolerance (dBm)	Average conducted output power (dBm)
CH	Frequency (MHz)		Data Rate (Mbps)
			6.5
1	2412	15	14.61
6	2437	15	14.56
11	2462	15	14.73

802.11 n(40M)		Max. Rated Avg. Power + Max. Tolerance (dBm)	Average conducted output power (dBm)
CH	Frequency (MHz)		Data Rate (Mbps)
			13.5
3	2422	14.5	14.13
6	2437	14.5	14.11
9	2452	14.5	14.39

Main antenna

802.11 a		Max. Rated Avg. Power + Max. Tolerance (dBm)	Average conducted output power (dBm)
5.2/5.3/5.6/5.8G			Data Rate (Mbps)
CH	Frequency (MHz)		6
36	5180	13	12.57
40	5200	13	12.60
44	5220	13	12.57
48	5240	13	12.44
52	5260	13	12.65
56	5280	13	12.62
60	5300	13	12.57
64	5320	13	12.56
100	5500	13	12.58
120	5600	13	12.65
124	5620	13	12.57
128	5640	13	12.55
140	5700	13	12.61
149	5745	13	12.61
157	5785	13	12.62
165	5825	13	12.63

Main antenna

802.11 n(20M) 5.2/5.3/5.6/5.8G		Max. Rated Avg. Power + Max. Tolerance (dBm)	Average conducted output power (dBm)
CH	Frequency (MHz)		Data Rate (Mbps) 6.5
36	5180	12	11.54
40	5200	12	11.61
44	5220	12	11.62
48	5240	12	11.59
52	5260	12	11.53
56	5280	12	11.55
60	5300	12	11.59
64	5320	12	11.50
100	5500	12	11.56
120	5600	12	11.62
124	5620	12	11.55
128	5640	12	11.51
140	5700	12	11.61
149	5745	12	11.60
157	5785	12	11.52
165	5825	12	11.57

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Main antenna

802.11 n(40M)		Max. Rated Avg. Power + Max. Tolerance (dBm)	Average conducted output power (dBm)
5.2/5.3/5.6/5.8G			Data Rate (Mbps)
CH	Frequency (MHz)		13.5
38	5190	12	11.58
46	5230	12	11.56
54	5270	12	11.63
62	5310	12	11.39
102	5510	12	11.55
118	5590	12	11.61
126	5630	12	11.58
134	5670	12	11.62
151	5755	12	11.57
159	5795	12	11.58

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Main antenna

802.11 ac(20M)		Max. Rated Avg. Power + Max. Tolerance (dBm)	Average conducted output power (dBm)
5.2/5.3/5.6/5.8G			Data Rate (Mbps)
CH	Frequency (MHz)		6.5
36	5180	12	11.23
40	5200	12	11.42
44	5220	12	11.44
48	5240	12	11.41
52	5260	12	11.32
56	5280	12	11.48
60	5300	12	11.45
64	5320	12	11.32
100	5500	12	11.46
120	5600	12	11.42
124	5620	12	11.41
128	5640	12	11.39
140	5700	12	11.43
144	5720	12	11.53
149	5745	12	11.51
157	5785	12	11.34
165	5825	12	11.39

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Main antenna

802.11 ac(40M)		Max. Rated Avg. Power + Max. Tolerance (dBm)	Average conducted output power (dBm)
5.2/5.3/5.6/5.8G			
CH	Frequency (MHz)		Data Rate (Mbps)
			13.5
38	5190	12	11.37
46	5230	12	11.36
54	5270	12	11.38
62	5310	12	11.22
102	5510	12	11.45
118	5590	12	11.45
126	5630	12	11.40
134	5670	12	11.45
142	5710	12	11.55
151	5755	12	11.42
159	5795	12	11.44

802.11 ac(80M)		Max. Rated Avg. Power + Max. Tolerance (dBm)	Average conducted output power (dBm)
5.2/5.3/5.6/5.8G			
CH	Frequency (MHz)		Data Rate (Mbps)
			29.3
42	5210	10	9.56
58	5290	10	9.58
106	5530	10	9.51
122	5610	10	9.57
138	5690	10	9.68
155	5775	10	9.52

Aux antenna

802.11 b		Max. Rated Avg. Power + Max. Tolerance (dBm)	Average conducted output power (dBm)
			Data Rate (Mbps)
CH	Frequency (MHz)		1
1	2412	17.5	17.01
6	2437	17.5	17.15
11	2462	17.5	16.94

802.11 g		Max. Rated Avg. Power + Max. Tolerance (dBm)	Average conducted output power (dBm)
			Data Rate (Mbps)
CH	Frequency (MHz)		6
1	2412	16.5	16.19
6	2437	16.5	16.01
11	2462	16.5	15.95

802.11 n(20M)		Max. Rated Avg. Power + Max. Tolerance (dBm)	Average conducted output power (dBm)
			Data Rate (Mbps)
CH	Frequency (MHz)		6.5
1	2412	15	14.16
6	2437	15	14.24
11	2462	15	14.26

802.11 n(40M)		Max. Rated Avg. Power + Max. Tolerance (dBm)	Average conducted output power (dBm)
			Data Rate (Mbps)
CH	Frequency (MHz)		13.5
3	2422	14.5	13.93
6	2437	14.5	14.05
9	2452	14.5	14.16

Aux antenna

802.11 a		Max. Rated Avg. Power + Max. Tolerance (dBm)	Average conducted output power (dBm)
5.2/5.3/5.6/5.8G			Data Rate (Mbps)
CH	Frequency (MHz)		6
36	5180	13	12.96
40	5200	13	12.94
44	5220	13	12.91
48	5240	13	12.81
52	5260	13	12.93
56	5280	13	12.91
60	5300	13	12.90
64	5320	13	12.87
100	5500	13	12.94
120	5600	13	12.95
124	5620	13	12.82
128	5640	13	12.83
140	5700	13	12.93
149	5745	13	12.91
157	5785	13	12.91
165	5825	13	12.95

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Aux antenna

802.11 n(20M)		Max. Rated Avg. Power + Max. Tolerance (dBm)	Average conducted output power (dBm)
5.2/5.3/5.6/5.8G			Data Rate (Mbps)
CH	Frequency (MHz)		6.5
36	5180	12	11.75
40	5200	12	11.76
44	5220	12	11.71
48	5240	12	11.59
52	5260	12	11.73
56	5280	12	11.71
60	5300	12	11.72
64	5320	12	11.66
100	5500	12	11.70
120	5600	12	11.73
124	5620	12	11.66
128	5640	12	11.61
140	5700	12	11.76
149	5745	12	11.70
157	5785	12	11.71
165	5825	12	11.73

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Aux antenna

802.11 n(40M)		Max. Rated Avg. Power + Max. Tolerance (dBm)	Average conducted output power (dBm)
5.2/5.3/5.6/5.8G			
CH	Frequency (MHz)		Data Rate (Mbps)
			13.5
38	5190	12	11.92
46	5230	12	11.91
54	5270	12	11.94
62	5310	12	11.65
102	5510	12	11.93
118	5590	12	11.92
126	5630	12	11.83
134	5670	12	11.94
151	5755	12	11.91
159	5795	12	11.89

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802.11 ac(20M)		Max. Rated Avg. Power + Max. Tolerance (dBm)	Average conducted output power (dBm)
5.2/5.3/5.6/5.8G			Data Rate (Mbps)
CH	Frequency (MHz)		6.5
36	5180	12	11.52
40	5200	12	11.64
44	5220	12	11.64
48	5240	12	11.66
52	5260	12	11.63
56	5280	12	11.67
60	5300	12	11.64
64	5320	12	11.54
100	5500	12	11.63
120	5600	12	11.62
124	5620	12	11.52
128	5640	12	11.60
140	5700	12	11.62
144	5720	12	11.61
149	5745	12	11.68
157	5785	12	11.59
165	5825	12	11.64

Aux antenna

802.11 ac(40M) 5.2/5.3/5.6/5.8G		Max. Rated Avg. Power + Max. Tolerance (dBm)	Average conducted output power (dBm)
CH	Frequency (MHz)		Data Rate (Mbps) 13.5
38	5190	12	11.58
46	5230	12	11.68
54	5270	12	11.63
62	5310	12	11.50
102	5510	12	11.64
118	5590	12	11.64
126	5630	12	11.52
134	5670	12	11.66
142	5710	12	11.60
151	5755	12	11.62
159	5795	12	11.66

802.11 ac(80M) 5.2/5.3/5.6/5.8G		Max. Rated Avg. Power + Max. Tolerance (dBm)	Average conducted output power (dBm)
CH	Frequency (MHz)		Data Rate (Mbps) 29.3
42	5210	10	9.92
58	5290	10	9.91
106	5530	10	9.82
122	5610	10	9.90
138	5690	10	9.89
155	5775	10	9.75

Bluetooth conducted power table:

Main antenna

Frequency (MHz)	Data Rate	Max. Rated Avg. Power + Max. Tolerance (dBm)	Avg. Output Power (dBm)	
			dBm	mW
2402	1	5.5	-0.99	0.796
2441	1	5.5	-1.23	0.753
2480	1	5.5	-1.46	0.714
2402	2	5.5	4.58	2.871
2441	2	5.5	4.45	2.786
2480	2	5.5	4.40	2.754
2402	3	5.5	4.62	2.897
2441	3	5.5	4.60	2.884
2480	3	5.5	4.47	2.799

Frequency (MHz)	Max. Rated Avg. Power + Max. Tolerance (dBm)	Avg. Output Power (dBm)	
		BT4.0	
		dBm	mW
2402	5.5	4.51	2.825
2442	5.5	4.15	2.600
2480	5.5	4.52	2.831

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Aux antenna

Frequency (MHz)	Data Rate	Max. Rated Avg. Power + Max. Tolerance (dBm)	Avg. Output Power (dBm)	
			dBm	mW
2402	1	5.5	-0.91	0.811
2441	1	5.5	-0.95	0.804
2480	1	5.5	-0.99	0.796
2402	2	5.5	5.11	3.243
2441	2	5.5	5.08	3.221
2480	2	5.5	4.89	3.083
2402	3	5.5	5.13	3.258
2441	3	5.5	5.15	3.273
2480	3	5.5	4.91	3.097

Frequency (MHz)	Max. Rated Avg. Power + Max. Tolerance (dBm)	Avg. Output Power (dBm)	
		BT4.0	
		dBm	mW
2402	5.5	4.66	2.924
2442	5.5	4.31	2.698
2480	5.5	4.80	3.020

Note:
The EUT supports the antenna with TX/RX diversity function for WLAN and Bluetooth. (Ex. Assume Main was selected to conduct transmitting function in WLAN, so Aux was selected in Bluetooth Mode. Vice versa.)
Both antenna(Main) and antenna(Aux) could be used as transmitting/receiving antenna, but only one of them could transmit/receive at the same time.

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1.4 Test Environment

Ambient Temperature: 22±2° C
Tissue Simulating Liquid: 22±2° C

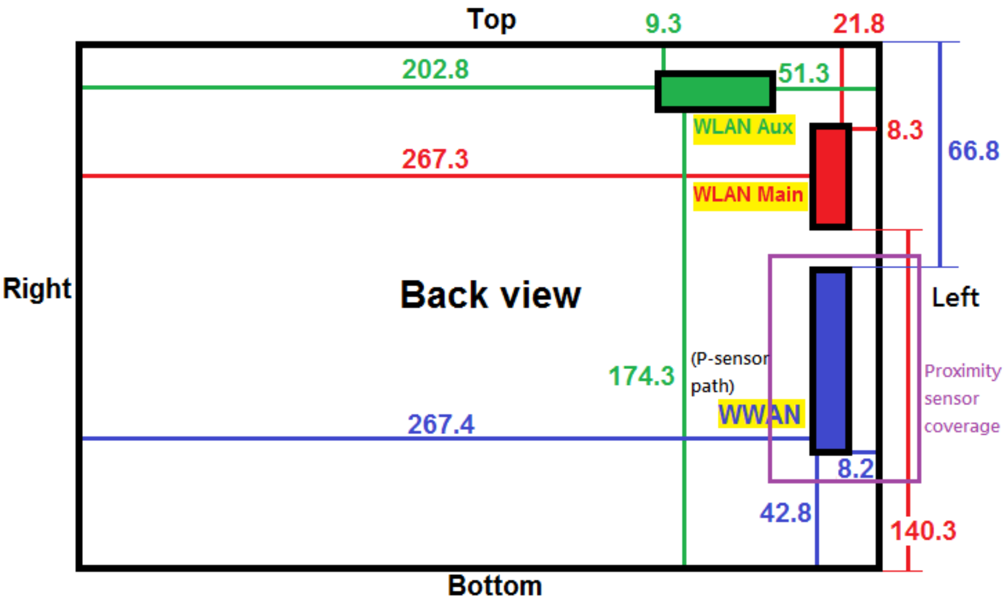
1.5 Operation Description

For WLAN, use chipset specific software to control the EUT, and makes it transmit in maximum power. The EUT is set to maximum power level during all tests, and at the beginning of each test the battery is fully charged. EUT was tested in the following configuration.

WWAN_UMTS B5: back/top/bottom/left sides with test distance 0mm (No power reduction).

WWAN_UMTS B2: back/top/bottom sides with test distance 0mm (No power reduction). Left side with test distance 15mm (No power reduction) and 0mm (With power reduction).

WLAN: back/top/left sides with test distance 0mm.



***: mm**

Antenna location (Back view)

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Note:

1. The 3G SAR test reduction procedure is applied to HSDPA with 12.2 kbps RMC as the primary mode. Since the maximum output power in a secondary mode (HSDPA) is ≤ ¼ dB higher than the primary mode (WCDMA), SAR measurement is not required for the secondary mode (HSDPA).

2. The 3G SAR test reduction procedure is applied to HSPA (HSUPA/HSDPA with RMC) with 12.2 kbps RMC as the primary mode. Since the maximum output power in a secondary mode (HSPA) is ≤ ¼ dB higher than the primary mode (WCDMA), SAR measurement is not required for the secondary mode (HSPA).

3. The 3G SAR test reduction procedure is applied to (uplink) HSPA+ with 12.2 kbps RMC as the primary mode. Power is measured for HSPA+ that supports uplink 16 QAM according to configurations in Table C.11.1.4 of 3GPP TS 34.121-1 to determine SAR test reduction. Since the maximum output power in a secondary mode (HSPA+) is ≤ ¼ dB higher than the primary mode (WCDMA), SAR measurement is not required for the secondary mode (HSPA+).

Table C.11.1.4: β values for transmitter characteristics tests with HS-DPCCH and E-DCH with 16QAM

Sub-test	β_c (Note3)	β_d	β_{HS} (Note1)	β_{ec}	β_{ed} (2xSF2) (Note 4)	β_{ed} (2xSF4) (Note 4)	CM (dB) (Note 2)	MPR (dB) (Note 2)	AG Index (Note 4)	E-TFCI (Note 5)	E-TFCI (boost)
1	1	0	30/15	30/15	β_{ed}1: 30/15 β_{ed}2: 30/15	β_{ed}3: 24/15 β_{ed}4: 24/15	3.5	2.5	14	105	105

Note 1: Δ_{ACK}, Δ_{NACK} and Δ_{CQI} = 30/15 with β_{hs} = 30/15 * β_c .
Note 2: CM = 3.5 and the MPR is based on the relative CM difference, MPR = MAX(CM-1,0).
Note 3: DPDCH is not configured, therefore the β_c is set to 1 and β_d = 0 by default.
Note 4: β_{ed} can not be set directly; it is set by Absolute Grant Value.
Note 5: All the sub-tests require the UE to transmit 2SF2+2SF4 16QAM EDCH and they apply for UE using E-DPDCH category 7. E-DCH TTI is set to 2ms TTI and E-DCH table index = 2. To support these E-DCH configurations DPDCH is not allocated. The UE is signalled to use the extrapolation algorithm.

802.11b DSSS SAR Test Requirements:

1. SAR is measured for 2.4 GHz 802.11b DSSS mode using the highest measured maximum output power channel, when the reported SAR of the highest measured maximum output power channel for the exposure configuration is ≤ 0.8 W/kg, no further SAR testing is required for 802.11b DSSS in that exposure configuration.

2. When the reported SAR is > 0.8 W/kg, SAR is required for that exposure configuration using the next highest measured output power channel. When any reported SAR is > 1.2 W/kg, SAR is required for the third channel; i.e., all channels require testing.

802.11g/n OFDM SAR Test Exclusion Requirements:

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3. SAR is not required for 802.11g/n since the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg.

Initial Test Configuration:

4. An initial test configuration is determined for OFDM transmission modes according to the channel bandwidth, modulation and data rate combination(s) with the highest maximum output power specified for production units in each standalone and aggregated frequency band.
5. SAR is measured using the highest measured maximum output power channel. When the reported SAR of the initial test configuration is > 0.8 W/kg, SAR measurement is required for the subsequent next highest measured output power channel(s) in the initial test configuration until the reported SAR is ≤ 1.2 W/kg or all required channels are tested.
6. For WLAN, 5.2a/5.3a/5.6a/5.8a is chosen to be the initial test configuration.
7. Since the highest reported SAR for the initial test configuration is adjusted by the ratio of the subsequent test configuration to initial test configuration specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg, SAR is not required for subsequent test configuration.
8. Based on KDB447498D01,

   (1) SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances≤ 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 < 5mm, 5mm is applied to determine 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. [(Threshold at 50mm in step1) + (test separation distance-50mm)x($\frac{f(\text{MHz})}{150}$)](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.

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Mode	Max. tune-up power(dBm)	Max. tune-up power(mW)	Top side			Right side			Left side		
			antenna-to-user-separation distance (mm)	Calculation value	Require SAR testing?	antenna-to-user-separation distance (mm)	>20cm	Require SAR testing?	antenna-to-user-separation distance (mm)	Calculation value	Require SAR testing?
WCDMA Band II	24	251.189	66.8	174.939	NO	267.4	YES	NO	8.2	42.309	YES
WCDMA Band V	24	251.189	66.8	99.442	NO	267.4	YES	NO	8.2	28.185	YES

Mode	Max. tune-up power(dBm)	Max. tune-up power(mW)	Bottom side			Back side		
			antenna-to-user-separation distance (mm)	Calculation value	Require SAR testing?	antenna-to-user-separation distance (mm)	Calculation value	Require SAR testing?
WCDMA Band II	24	251.189	42.8	8.106	YES	less than 5	69.386	YES
WCDMA Band V	24	251.189	42.8	5.400	YES	less than 5	46.224	YES

Mode	Max. tune-up power(dBm)	Max. tune-up power(mW)	Top side			Right side			Left side		
			antenna-to-user-separation distance (mm)	Calculation value	Require SAR testing?	antenna-to-user-separation distance (mm)	>20cm	Require SAR testing?	antenna-to-user-separation distance (mm)	Calculation value	Require SAR testing?
WLAN Main 2.45GHz	17.5	56.234	21.8	4.048	YES	267.3	YES	NO	8.3	10.631	YES
WLAN Main 5GHz	13	19.953	21.8	2.209	NO	267.3	YES	NO	8.3	5.802	YES
Main_BT	5.5	3.548	21.8	0.256	NO	267.3	YES	NO	8.3	0.673	NO

Mode	Max. tune-up power(dBm)	Max. tune-up power(mW)	Bottom side			Back side		
			antenna-to-user-separation distance (mm)	Calculation value	Require SAR testing?	antenna-to-user-separation distance (mm)	Calculation value	Require SAR testing?
WLAN Main 2.45GHz	17.5	56.234	140.3	904.765	NO	less than 5	17.647	YES
WLAN Main 5GHz	13	19.953	140.3	903.963	NO	less than 5	9.631	YES
Main_BT	5.5	3.548	140.3	903.112	NO	less than 5	1.118	NO

Mode	Max. tune-up power(dBm)	Max. tune-up power(mW)	Top side			Right side			Left side		
			antenna-to-user-separation distance (mm)	Calculation value	Require SAR testing?	antenna-to-user-separation distance (mm)	>20cm	Require SAR testing?	antenna-to-user-separation distance (mm)	Calculation value	Require SAR testing?
WLAN Aux 2.45GHz	17.5	56.234	9.3	9.488	YES	202.8	YES	NO	51.3	14.765	NO
WLAN Aux 5GHz	13	19.953	9.3	5.178	YES	202.8	YES	NO	51.3	13.963	NO
Aux_BT	5.5	3.548	9.3	0.601	NO	202.8	YES	NO	51.3	13.112	NO

Mode	Max. tune-up power(dBm)	Max. tune-up power(mW)	Bottom side			Back side		
			antenna-to-user-separation distance (mm)	Calculation value	Require SAR testing?	antenna-to-user-separation distance (mm)	Calculation value	Require SAR testing?
WLAN Aux 2.45GHz	17.5	56.234	174.3	1244.765	NO	less than 5	17.647	YES
WLAN Aux 5GHz	13	19.953	174.3	1243.963	NO	less than 5	9.631	YES
Aux_BT	5.5	3.548	174.3	1243.112	NO	less than 5	1.118	NO

9. According to KDB447498 D01, testing of other required channels is not required when the reported 1-g SAR for the highest output channel is ≤ 0.8 W/kg, when the transmission band is ≤ 100 MHz.
10. According to KDB865664 D01, SAR measurement variability must be assessed for each frequency band. When the original highest measured SAR is ≥ 0.8 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 ≥ 1.45 W/kg (~ 10% from the 1-g SAR limit).

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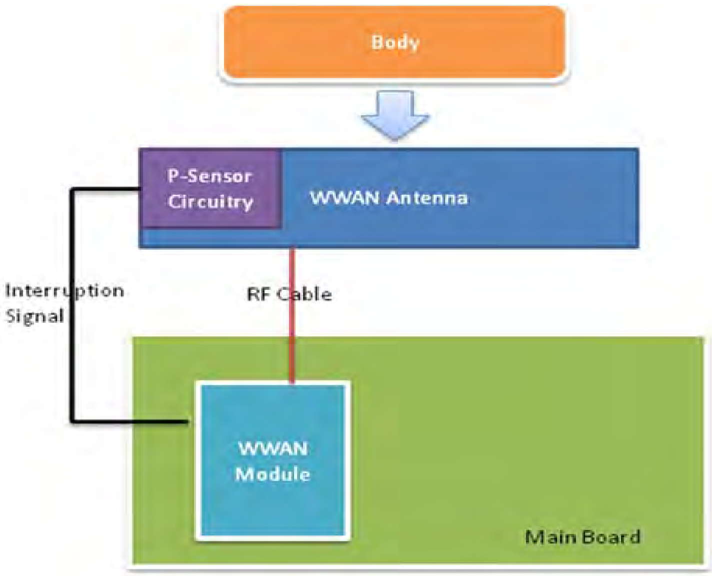
1.6 Proximity sensor operation description

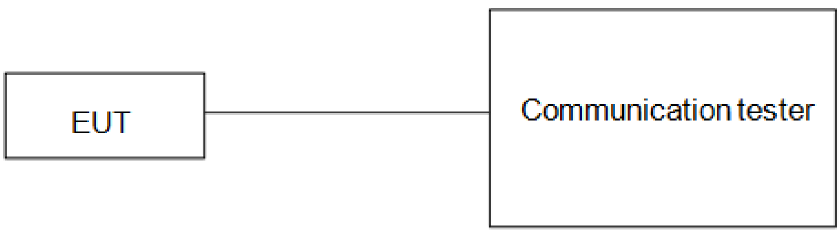
The P-sensor being used to reduce output power is capacitive in which when the object such as human body, metal or plastic is being approached, the sensing capacitance would be increased with the antenna pad. Once the capacitance is accumulated, and reached over the threshold as set in MCU of the microchip, the interruption signal is pulled low (High state without trigger) and further inform modem module of the transmitter to make power reduction.



1.6.1 Proximity sensor measurement procedure

1. The proximity sensor is collocated with WWAN antenna.

2. Output power is measured, and monitored by using the communication tester. A RF cables with sufficient length was being attached from the antenna port of the module, and used for the measurement. The appropriate loss attenuated from cable is compensated in the communication tester.



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1.6.2 Trigger distances for back/left side

Test procedure:

1. The entire back surface or edge of the tablet is positioned below a flat phantom filled with the required tissue equivalent medium and positioned at least 20 mm further than the distance that triggers power reduction.
2. The back surface or edge is moved toward the phantom in 3 mm steps until the sensor triggers.
3. The back surface or edge is then moved back (further away) from the phantom until maximum output power is returned to the normal maximum level.
4. The back surface or edge is again moved toward the phantom, but in 1 mm steps, until it is at least 5 mm past the triggering point or touching the phantom
5. If the tablet is not touching the phantom, it is moved in 3 mm steps until it touches the phantom to confirm that the sensor remains triggered and the maximum power stays reduced.
6. The process is then reversed by moving the tablet away from the phantom to determine triggering release, until it is at least 10 mm beyond the point that triggers the return of normal maximum power.
7. The measured output power within ± 5 mm of the triggering points, or until the tablet is touching the phantom, for movements to and from the phantom should be tabulated.
8. To ensure all production units are compliant, it is generally necessary to reduce the triggering distance determined from the triggering tests by 1 mm, or more if it is necessary, and use the smallest distance for movements to and from the phantom, minus 1 mm, as the sensor triggering distance for determining the SAR measurement distance.
9. For back side, the trigger distance of proximity sensor is 11mm.
10. For left side, the trigger distance of proximity sensor is 17mm, and we perform the 1.6.3 tilt angle testing in next step.

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1.6.3 Tilt angle testing

Test procedure:

1. The influence of table tilt angles to proximity sensor triggering is determined by positioning each tablet edge that contains a transmitting antenna, perpendicular to the flat phantom, at the smallest sensor triggering test distance determined in sections 1.6.2 by rotating the tablet around the edge next to the phantom in ≤ 10 deg increments until the tablet is +/- 45deg or more from the vertical position at 0 deg.

2. If sensor triggering is released and normal maximum output power is restored within the +/- 45deg range, the procedures in step 1) should be repeated by reducing the tablet to phantom separation distance by 1 mm until the proximity sensor no longer releases triggering, and maximum output power remains in the reduced mode.

3. The smallest separation distance determined in steps 1) and 2), minus 1 mm, is the sensor triggering distance for tablet tilt coverage. The smallest separation distance determined in sections 1.6.2, 1.6.3 minus 1 mm should be used in the SAR measurements.

4. The influence of tablet tilt angles to proximity sensor triggering is determined by positioning top and right sides, please refer to table 1.6.5 and 1.6.6.

5. After the tilt angle testing for left side, the sensor is not released during +/- 45deg, so 17-1=16mm, is the sensor triggering distance for tablet tilt coverage. The smallest separation distance minus 1 mm (16-1=15mm) should be used in the SAR measurements.

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1.6.4 Proximity sensor coverage

The following procedures do not apply and are not required for configurations where the antenna and sensor are collocated and the peak SAR location is overlapping with the sensor.

Test procedure:

1. The back surface or edges of the tablet is positioned at a test separation distance less than or equal to the distance required for back surface or edge triggering, with both the antenna and sensor pad located at least 20 mm laterally outside the edge (boundary) of the phantom, along the direction of maximum antenna and sensor offset.

2. The similar sequence of steps applied to determine sensor triggering distance in section 1.6.2 are used to verify back surface and edge sensor coverage by moving the tablet (sensor and antenna) horizontally toward the phantom while maintaining the same vertical separation between the back surface or edge and the phantom.

3. After the exact location where triggering of power reduction is determined, with respect to the sensor and antenna, the tablet movement should be continued, in 3 mm increments, until both the sensor and antenna(s) are fully under the phantom and at least 20 mm inside the phantom edge.

4. The process is then repeated from the other direction, at the opposite end of maximum antenna and sensor offset, by rotating the tablet 180 degrees.

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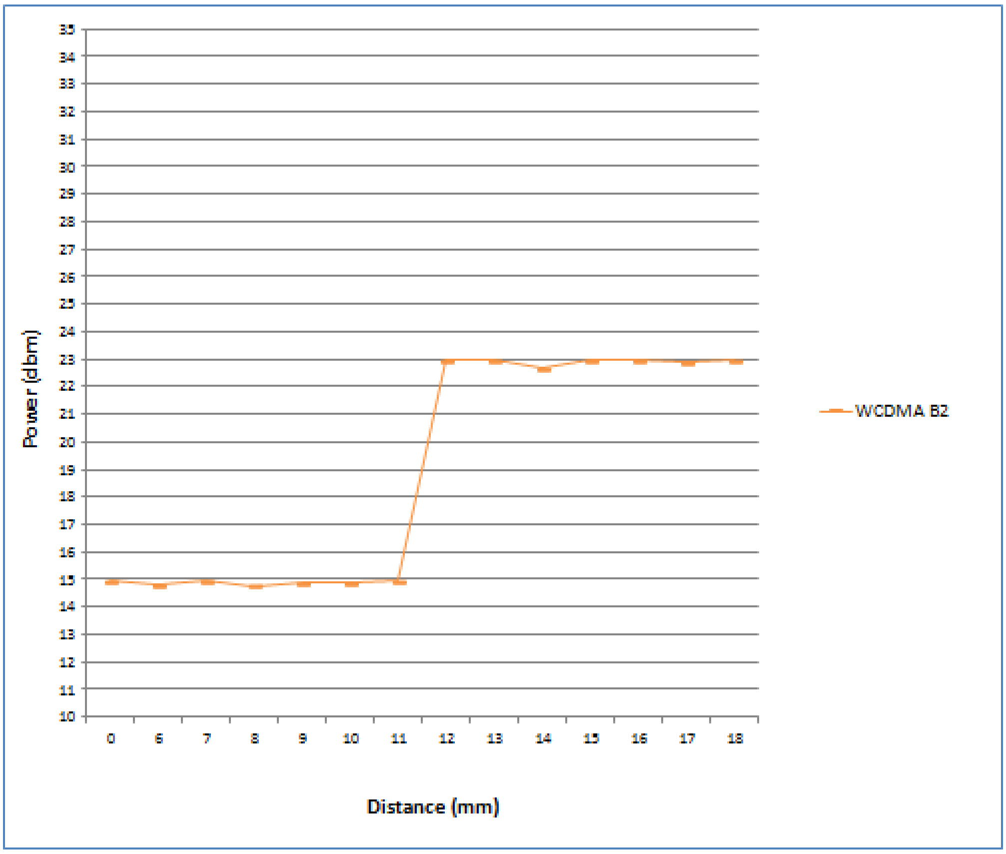
1.6.5 Results

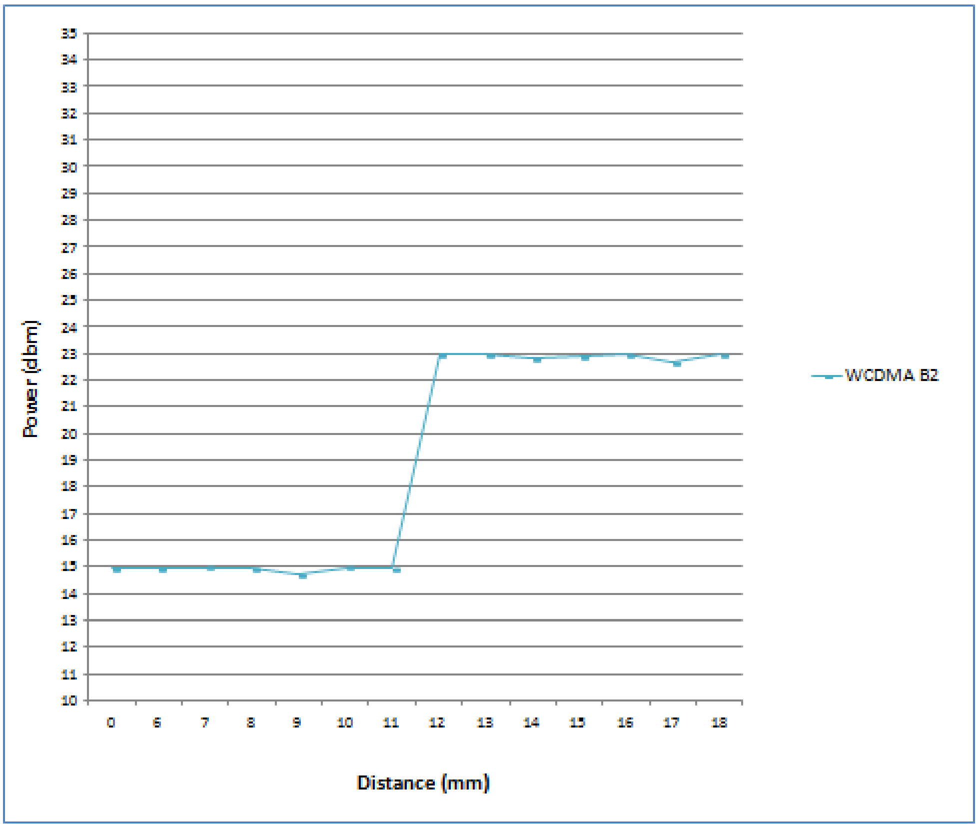
The measured output power within ± 5 mm of the triggering points, or until the tablet is touching the phantom, for movements to and from the phantom is tabulated in the following.

Back side

Moving device toward the phantom



Moving device away from the phantom



For back side, the worst trigger distance of proximity sensor is 11mm, thus we test back side SAR in 10mm without power reduction and 0mm with power reduction.

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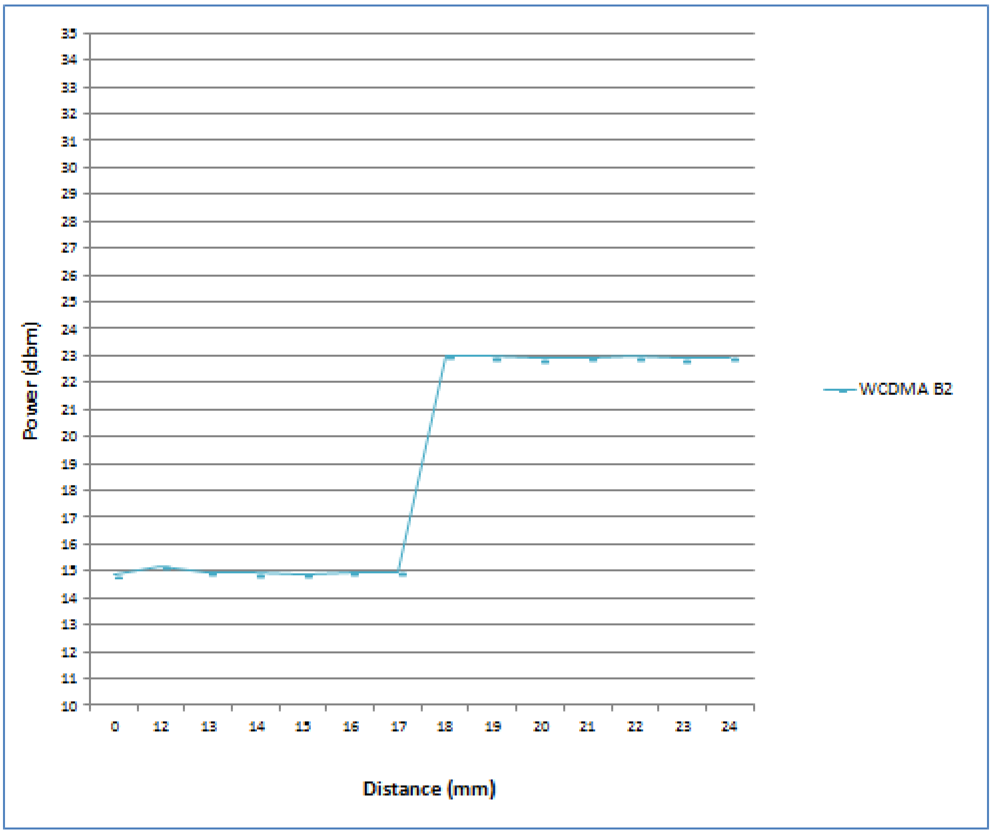
Left side

Moving device toward the phantom



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Moving device away from the phantom

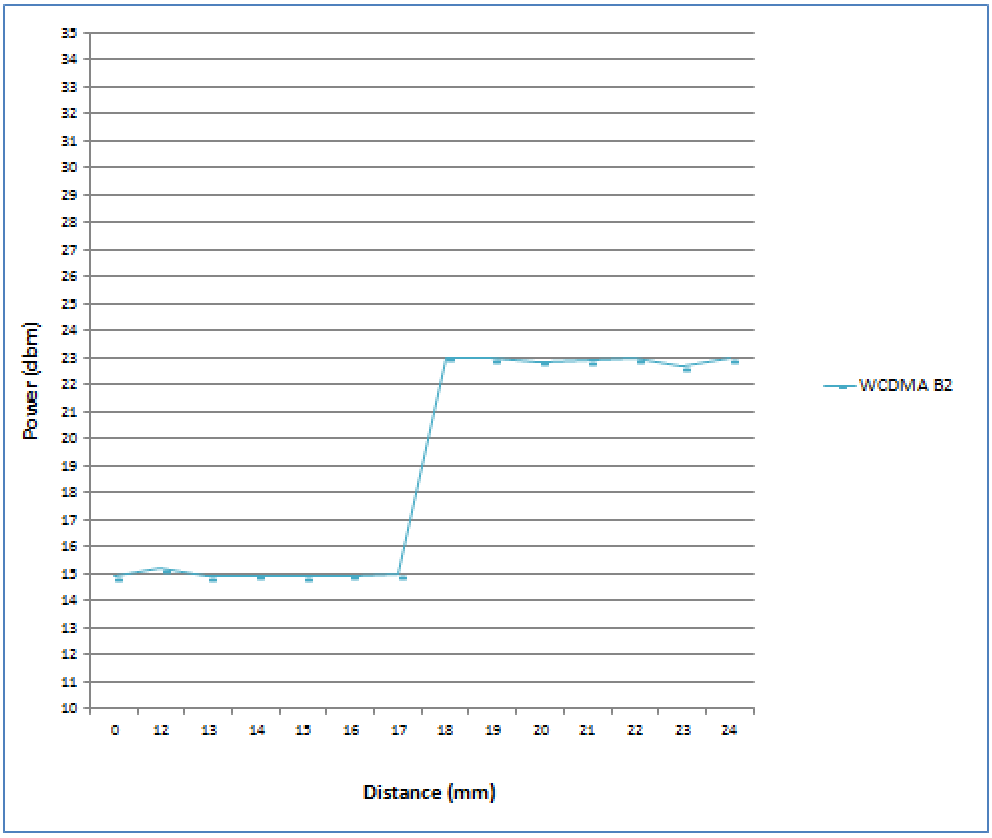

Table 1.6.5 Tilt angle test results for left side

P-sensor ON/OFF	-50 deg	-45 deg	-40 deg	-30 deg	-20 deg	-10 deg	0 deg	10 deg	20 deg	30 deg	40 deg	45 deg	50 deg
17mm	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON

During the tilt angle testing for top side, the sensor is not released in 17mm, so 17-1=16mm, is the sensor triggering distance for tablet tilt coverage. The smallest separation distance minus 1mm (16-1=15mm) should be used in the SAR measurements for left side.

Note:

1. The triggering variations and hysteresis effect has been evaluated separately according to the tissue-equivalent medium required for each frequency band, and sensor triggering does not change with different tissue-equivalent media.
2. The default power level for sensor failure and malfunctioning, including all compliance concerns, has been addressed in the client's operation description (1.6.6) for the proximity sensor implementation to be acceptable.
3. Conducted power is monitored qualitatively to identify the general triggering characteristics and recorded quantitatively, versus spacing.

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1.6.6 Operation description for P-sensor

Power Reduction Design Specification (for P-sensor)
The mechanism of power reduction is used only for WWAN, not for Wi-Fi and Bluetooth. The reduced power for each technology/band is defined in Table1-1. With P-sensor mechanism, the WCDMA default power when P-sensor failure or malfunction are show in Table1-2 as below.

Table1-1：The power reduction scenario table

Band	Power Reduction
WCDMA B2	YES
WLAN	NO
BT	NO

Table1-2：The default maximum power when p-sensor failure or malfunction

Technology / Band	Mode	Default Maximum Power (dBm)
UMTS B2	RMC 12.2K data	15
	HSDPA case 1	15
	HSDPA case 2	15
	HSDPA case 3	15
	HSDPA case 4	15
	HSUPA case 1	15
	HSUPA case 2	15
	HSUPA case 3	15
	HSUPA case 4	15
	HSUPA case 5	15
	HSPA+ case 1	15

1.7 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= σ ($|Ei|^2$)/ ρ 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:

1. 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).
2. 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.
3. 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.

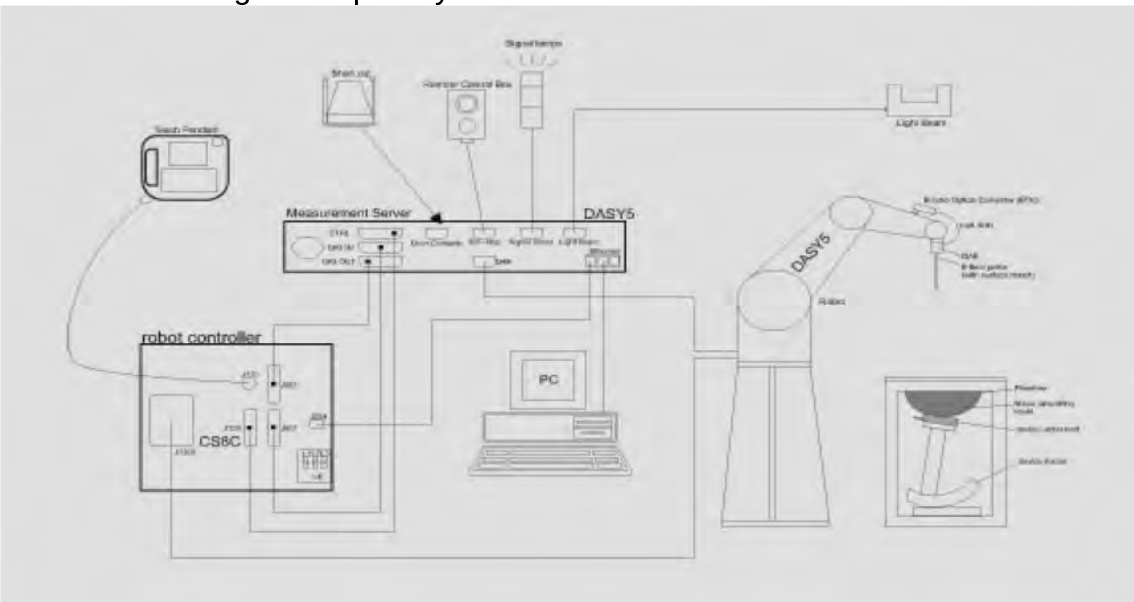

Fig. a The block diagram of SAR system

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4. 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.
5. 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.
6. A probe alignment unit which improves the (absolute) accuracy of the probe positioning.
7. A computer operating Windows 7.
8. DASY 5 software.
9. Remote control with teach pendant and additional circuitry for robot safety such as warning lamps, etc.
10. The SAM twin phantom enabling testing left-hand and right-hand usage.
11. The device holder for handheld mobile phones.
12. Tissue simulating liquid mixed according to the given recipes.
13. Validation dipole kits allowing to validate the proper functioning of the system.

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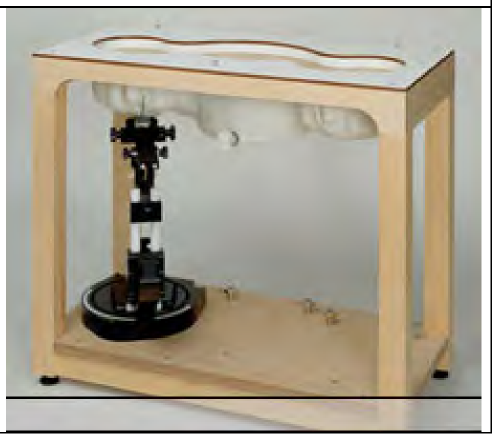
1.8 System Components

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 835/1900/2450/5200/5300/5600/5800 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%.	

SAM PHANTOM V4.0C

Construction	The shell corresponds to the specifications of the Specific Anthropomorphic Mannequin (SAM) phantom defined in IEEE 1528 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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1.9 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 835/1900/2450/5200/5300/ 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 ≥ 15 cm ± 5 mm (frequency ≤ 3 GHz) or ≥ 10 cm ± 5 mm (frequency > 3 G Hz) 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.

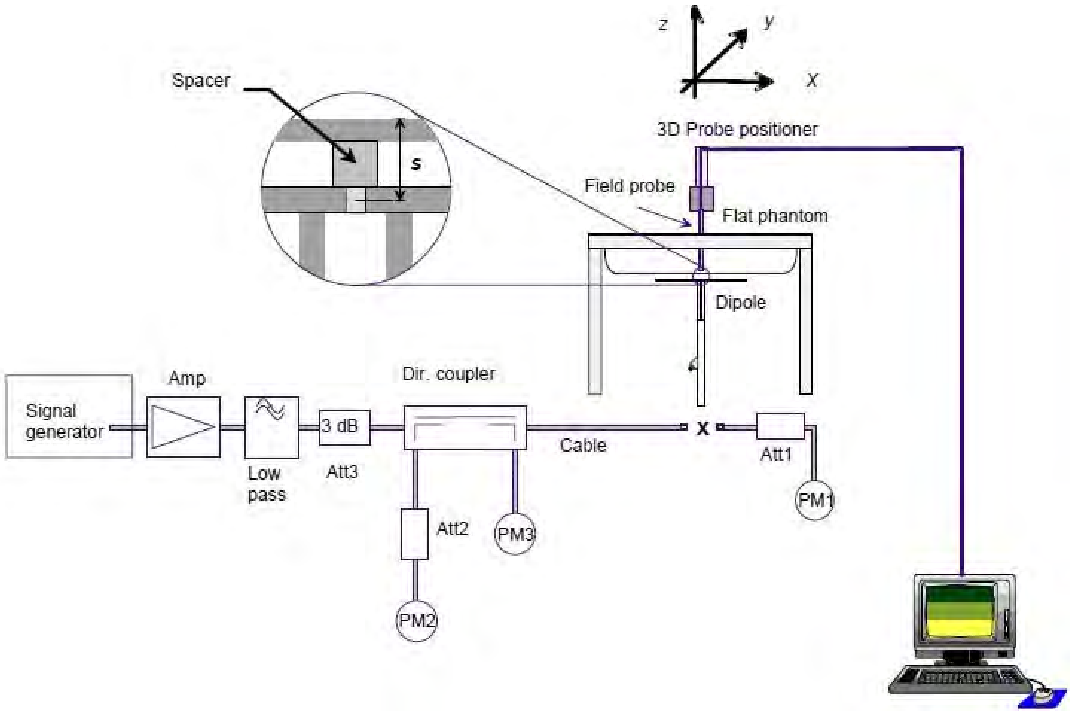

Fig. b The block diagram of system verification

Validation Kit	S/N	Frequency (MHz)		1W Target SAR-1g (mW/g)	Measured SAR-1g (mW/g)	Measured SAR-1g normalized to 1W	Deviation (%)	Measured Date
D835V2	4d063	835	Body	9.57	2.45	9.8	2.40%	Oct. 20, 2016
D1900V2	5d027	1900	Body	39.7	9.98	39.92	0.55%	Oct. 20, 2016
D2450V2	727	2450	Body	49.6	12.6	50.4	1.61%	Oct. 27, 2016
D5GHzV2	1023	5200	Body	71.9	7.22	72.2	0.42%	Oct. 27, 2016
		5300	Body	75.1	7.32	73.2	-2.53%	Oct. 27, 2016
		5600	Body	78.3	7.77	77.7	-0.77%	Oct. 28, 2016
		5800	Body	75.3	7.49	74.9	-0.53%	Oct. 28, 2016

Table 1. Results of system validation

1.10 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 ≥ 15 cm ± 5 mm (Frequency ≤3G) or ≥ 10 cm ± 5 mm (Frequency >3G) during all tests. (Fig. 2)

Tissue Type	Measurement Date	Measured Frequency (MHz)	Target Dielectric Constant, εr	Target Conductivity, σ (S/m)	Measured Dielectric Constant, εr	Measured Conductivity, σ (S/m)	% dev εr	% dev σ
Body	Oct. 20, 2016	835	55.200	0.970	53.018	1.009	3.95%	-4.02%
		836.6	55.195	0.972	53.012	1.012	3.96%	-4.12%
		1852.4	53.300	1.520	52.185	1.551	2.09%	-2.04%
		1880	53.300	1.520	51.988	1.574	2.46%	-3.55%
		1900	53.300	1.520	51.848	1.583	2.72%	-4.14%
	Oct. 27, 2016	2402	52.764	1.904	52.642	1.979	0.23%	-3.93%
		2412	52.751	1.914	52.639	1.991	0.21%	-4.04%
		2437	52.717	1.938	52.578	2.011	0.26%	-3.79%
		2441	52.712	1.941	52.551	2.012	0.31%	-3.64%
		2450	52.700	1.950	52.545	2.022	0.29%	-3.69%
		5180	49.041	5.276	49.256	5.446	-0.44%	-3.22%
		5200	49.014	5.299	49.214	5.477	-0.41%	-3.35%
		5260	48.933	5.369	49.081	5.557	-0.30%	-3.49%
		5300	48.879	5.416	48.997	5.618	-0.24%	-3.73%
	Oct. 28, 2016	5600	48.471	5.766	48.846	5.854	-0.77%	-1.52%
		5800	48.200	6.000	48.645	6.114	-0.92%	-1.90%
		5825	48.166	6.029	48.639	6.138	-0.98%	-1.80%

Table 2. Dielectric Parameters of Tissue Simulant Fluid

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The composition of the body tissue simulating liquid:

Frequency (MHz)	Mode	Ingredient						Total amount
		DGMBE	Water	Salt	Preventol D-7	Cellulose	Sugar	
850	Body	—	631.68 g	11.72 g	1.2 g	—	600 g	1.0L(Kg)
1900	Body	300.67 g	716.56 g	4.0 g	—	—	—	1.0L(Kg)
2450	Body	301.7ml	698.3ml	—	—	—	—	1.0L(Kg)

Simulating Liquids for 5 GHz, Manufactured by SPEAG:

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

Table 3. Recipes for Tissue Simulating Liquid

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1.11 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.

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

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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 the 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.

1.12 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:

1.12.1 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.

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

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:

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1. 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.
2. 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.
3. 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 ±5%.
4. 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 ±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 ±5% (RSS) when the same liquid is used for the calibration and for actual measurements and ±7-9% (RSS) when not, which is in good agreement with the estimates given in [2].

1.12.2 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:

1. The setup must enable accurate determination of the incident power.
2. The accuracy of the calculated field strength will depend on the assessment of the dielectric parameters of the liquid.

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3. 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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3. K. Jokela, P. Hyysalo, and L. Puranen, \Calibration of specific absorption rate (SAR) probes in waveguide at 900 MHz", *IEEE Transactions on Instrumentation and Measurements*, vol. 47, no. 2, pp. 432{438, Apr. 1998.

1.13 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, 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) of this section. (Table 4.)

Human Exposure	Uncontrolled Environment General Population	Controlled Environment Occupational
Spatial Peak SAR (Brain)	1.60 W/kg	8.00 W/kg
Spatial Average SAR (Whole Body)	0.08 W/kg	0.40 W/kg
Spatial Peak SAR (Hands/Feet/Ankle/Wrist)	4.00 W/kg	20.00 W/kg

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.

2. Summary of Results

WCDMA Band II (without power reduction)

Mode	Position	Distance (mm)	CH	Freq. (MHz)	Max. Rated Avg. Power + Max. Tolerance (dBm)	Measured Avg. Power (dBm)	Scaling	Averaged SAR over 1g (W/kg)		Plot page
								Measured	Reported	
WCDMA Band II	Back side	10	9262	1852.4	24	22.99	26.18%	0.325	0.410	-
	Top side	0	9262	1852.4	24	22.99	26.18%	0.046	0.058	-
	Bottom side	0	9262	1852.4	24	22.99	26.18%	0.074	0.093	-
	Left side	15	9262	1852.4	24	22.99	26.18%	0.380	0.479	-

WCDMA Band II (with power reduction)

Mode	Position	Distance (mm)	CH	Freq. (MHz)	Max. Rated Avg. Power + Max. Tolerance (dBm)	Measured Avg. Power (dBm)	Scaling	Averaged SAR over 1g (W/kg)		Plot page
								Measured	Reported	
WCDMA Band II	Back side	0	9400	1880	15	14.83	3.99%	0.366	0.381	-
	Left side	0	9400	1880	15	14.83	3.99%	0.625	0.650	64

WCDMA Band V

Mode	Position	Distance (mm)	CH	Freq. (MHz)	Max. Rated Avg. Power + Max. Tolerance (dBm)	Measured Avg. Power (dBm)	Scaling	Averaged SAR over 1g (W/kg)		Plot page
								Measured	Reported	
WCDMA Band V	Back side	0	4183	836.6	24	22.36	45.88%	0.085	0.124	-
	Top side	0	4183	836.6	24	22.36	45.88%	0.014	0.020	-
	Bottom side	0	4183	836.6	24	22.36	45.88%	0.019	0.028	-
	Left side	0	4183	836.6	24	22.36	45.88%	0.230	0.336	65

WLAN Main Antenna

Antenna	Mode	Position	Distance (mm)	CH	Freq. (MHz)	Max. Rated Avg. Power + Max. Tolerance	Measured Avg. Power (dBm)	Scaling	Averaged SAR over 1g (W/kg)		Plot page
									Measured	Reported	
Main	WLAN802.11 b	Back sdie	0	6	2437	17.5	17.31	4.47%	0.176	0.184	-
		Top side	0	6	2437	17.5	17.31	4.47%	0.050	0.052	-
		Left side	0	1	2412	17.5	17.26	5.68%	0.801	0.847	66
		Left side*	0	1	2412	17.5	17.26	5.68%	0.800	0.845	-
		Left side	0	6	2437	17.5	17.31	4.47%	0.788	0.823	-
	Bluetooth (8DPSK)	Back side	0	39	2441	5.5	5.15	8.39%	0.011	0.012	-
		Top side	0	39	2441	5.5	5.15	8.39%	0.003	0.003	-
		Left side	0	39	2441	5.5	5.15	8.39%	0.049	0.053	67
	WLAN802.11 a 5.2G	Back side	0	40	5200	13	12.60	9.65%	0.120	0.132	-
		Top side	0	40	5200	13	12.60	9.65%	0.063	0.069	-
		Left side	0	40	5200	13	12.60	9.65%	0.364	0.399	68
	WLAN802.11 a 5.3G	Back side	0	52	5260	13	12.65	8.39%	0.141	0.153	-
		Top side	0	52	5260	13	12.65	8.39%	0.058	0.063	-
		Left side	0	52	5260	13	12.65	8.39%	0.326	0.353	69
	WLAN802.11 a 5.6G	Back side	0	120	5600	13	12.65	8.39%	0.102	0.111	-
		Top side	0	120	5600	13	12.65	8.39%	0.036	0.039	-
		Left side	0	120	5600	13	12.65	8.39%	0.140	0.152	70
	WLAN802.11 a 5.8G	Back side	0	165	5825	13	12.63	8.89%	0.104	0.113	-
		Top side	0	165	5825	13	12.63	8.89%	0.058	0.063	-
		Left side	0	165	5825	13	12.63	8.89%	0.165	0.180	71

* - repeated at the highest SAR measurement according to the KDB 865664 D01

WLAN Aux Antenna

Antenna	Mode	Position	Distance (mm)	CH	Freq. (MHz)	Max. Rated Avg. Power + Max. Tolerance	Measured Avg. Power (dBm)	Scaling	Averaged SAR over 1g (W/kg)		Plot page
									Measured	Reported	
Aux	WLAN802.11 b	Back side	0	6	2437	17.5	17.15	8.39%	0.256	0.277	-
		Top side	0	6	2437	17.5	17.15	8.39%	0.624	0.676	72
		Left side	0	6	2437	17.5	17.15	8.39%	0.071	0.077	-
	Bluetooth (8DPSK)	Back side	0	0	2402	5.5	4.62	22.46%	0.018	0.022	-
		Top side	0	0	2402	5.5	4.62	22.46%	0.042	0.051	73
		Left side	0	0	2402	5.5	4.62	22.46%	0.004	0.005	-
	WLAN802.11 a 5.2G	Back side	0	36	5180	13	12.96	0.93%	0.100	0.101	-
		Top side	0	36	5180	13	12.96	0.93%	0.275	0.278	74
		Left side	0	36	5180	13	12.96	0.93%	0.015	0.015	-
	WLAN802.11 a 5.3G	Back side	0	52	5260	13	12.93	1.62%	0.098	0.100	-
		Top side	0	52	5260	13	12.93	1.62%	0.205	0.208	75
		Left side	0	52	5260	13	12.93	1.62%	0.023	0.023	-
	WLAN802.11 a 5.6G	Back side	0	120	5600	13	12.95	1.16%	0.085	0.086	-
		Top side	0	120	5600	13	12.95	1.16%	0.173	0.175	76
		Left side	0	120	5600	13	12.95	1.16%	0.015	0.015	-
	WLAN802.11 a 5.8G	Back side	0	165	5825	13	12.95	1.16%	0.103	0.104	-
		Top side	0	165	5825	13	12.95	1.16%	0.242	0.245	77
		Left side	0	165	5825	13	12.95	1.16%	0.017	0.017	-

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3. Simultaneous Transmission Analysis

Simultaneous Transmission Scenarios:

Simultaneous Transmit Configurations	Body
WCDMA + 2.4/5GHz WLAN Main	Yes
WCDMA + 2.4/5GHz WLAN Aux	Yes
WCDMA + BT Main + 2.4/5GHz WLAN Aux	Yes
WCDMA + 2.4/5GHz WLAN Main + BT Aux	Yes

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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:

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

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	antenna	position	distance (mm)	Estimated SAR
WLAN 2.4G	Main/Aux	bottom	> 50	0.4 (1g)
WLAN 5G	Main/Aux	bottom	> 50	0.4 (1g)
BT	Main/Aux	bottom	>50	0.4 (1g)

3.2 SPLSR evaluation and 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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WCDMA Band II + 2.4 GHz WLAN Main

No.	Conditions	Position	Distance (mm)	Max. WWAN	Max. WLAN Main	SAR Sum	SPLSR
1	WCDMA Band II	Back side	0	0.381	0.184	0.565	ΣSAR<1.6, Not required
		Top side	0	0.058	0.052	0.110	ΣSAR<1.6, Not required
		Bottom side	0	0.093	0.400	0.493	ΣSAR<1.6, Not required
		Left side	0	0.650	0.847	1.497	ΣSAR<1.6, Not required

WCDMA Band V + 2.4 GHz WLAN Main

No.	Conditions	Position	Distance (mm)	Max. WWAN	Max. WLAN Main	SAR Sum	SPLSR
2	WCDMA Band V	Back side	0	0.124	0.184	0.308	ΣSAR<1.6, Not required
		Top side	0	0.020	0.052	0.072	ΣSAR<1.6, Not required
		Bottom side	0	0.028	0.400	0.428	ΣSAR<1.6, Not required
		Left side	0	0.336	0.847	1.183	ΣSAR<1.6, Not required

WCDMA Band II + 2.4 GHz WLAN Aux

No.	Conditions	Position	Distance (mm)	Max. WWAN	Max. WLAN Aux	SAR Sum	SPLSR
3	WCDMA Band II	Back side	0	0.381	0.277	0.658	ΣSAR<1.6, Not required
		Top side	0	0.058	0.676	0.734	ΣSAR<1.6, Not required
		Bottom side	0	0.093	0.400	0.493	ΣSAR<1.6, Not required
		Left side	0	0.650	0.077	0.727	ΣSAR<1.6, Not required

WCDMA Band V + 2.4 GHz WLAN Aux

No.	Conditions	Position	Distance (mm)	Max. WWAN	Max. WLAN Aux	SAR Sum	SPLSR
4	WCDMA Band V	Back side	0	0.124	0.277	0.401	ΣSAR<1.6, Not required
		Top side	0	0.020	0.676	0.696	ΣSAR<1.6, Not required
		Bottom side	0	0.028	0.400	0.428	ΣSAR<1.6, Not required
		Left side	0	0.336	0.077	0.413	ΣSAR<1.6, Not required

WCDMA Band II + 5 GHz WLAN Main

No.	Conditions	Position	Distance (mm)	Max. WWAN	Max. WLAN Main	SAR Sum	SPLSR
5	WCDMA Band II	Back side	0	0.381	0.153	0.534	ΣSAR<1.6, Not required
		Top side	0	0.058	0.069	0.127	ΣSAR<1.6, Not required
		Bottom side	0	0.093	0.400	0.493	ΣSAR<1.6, Not required
		Left side	0	0.650	0.399	1.049	ΣSAR<1.6, Not required

WCDMA Band V + 5 GHz WLAN Main

No.	Conditions	Position	Distance (mm)	Max. WWAN	Max. WLAN Main	SAR Sum	SPLSR
6	WCDMA Band V	Back side	0	0.124	0.153	0.277	ΣSAR<1.6, Not required
		Top side	0	0.020	0.069	0.089	ΣSAR<1.6, Not required
		Bottom side	0	0.028	0.400	0.428	ΣSAR<1.6, Not required
		Left side	0	0.336	0.399	0.735	ΣSAR<1.6, Not required

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WCDMA Band II + 5 GHz WLAN Aux

No.	Conditions	Position	Distance (mm)	Max. WWAN	Max. WLAN Aux	SAR Sum	SPLSR
7	WCDMA Band II	Back side	0	0.381	0.104	0.485	ΣSAR<1.6, Not required
		Top side	0	0.058	0.278	0.336	ΣSAR<1.6, Not required
		Bottom side	0	0.093	0.400	0.493	ΣSAR<1.6, Not required
		Left side	0	0.650	0.023	0.673	ΣSAR<1.6, Not required

WCDMA Band V + 5 GHz WLAN Aux

No.	Conditions	Position	Distance (mm)	Max. WWAN	Max. WLAN Aux	SAR Sum	SPLSR
8	WCDMA Band V	Back side	0	0.124	0.104	0.228	ΣSAR<1.6, Not required
		Top side	0	0.020	0.278	0.298	ΣSAR<1.6, Not required
		Bottom side	0	0.028	0.400	0.428	ΣSAR<1.6, Not required
		Left side	0	0.336	0.023	0.359	ΣSAR<1.6, Not required

WCDMA Band II + 2.4 GHz WLAN Main + BT Aux

No.	Conditions	Position	Distance (mm)	Max. WWAN	Max. WLAN Main	BT	SAR Sum	SPLSR
9	WCDMA Band II	Back side	0	0.381	0.184	0.022	0.587	ΣSAR<1.6, Not required
		Top side	0	0.058	0.052	0.051	0.161	ΣSAR<1.6, Not required
		Bottom side	0	0.093	0.400	0.400	0.893	ΣSAR<1.6, Not required
		Left side	0	0.650	0.847	0.005	1.502	ΣSAR<1.6, Not required

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WCDMA Band V + 2.4 GHz WLAN Main + BT Aux

No.	Conditions	Position	Distance (mm)	Max. WWAN	Max. WLAN Main	BT	SAR Sum	SPLSR
10	WCDMA Band V	Back side	0	0.124	0.184	0.022	0.330	ΣSAR<1.6, Not required
		Top side	0	0.020	0.052	0.051	0.123	ΣSAR<1.6, Not required
		Bottom side	0	0.028	0.400	0.400	0.828	ΣSAR<1.6, Not required
		Left side	0	0.336	0.847	0.005	1.188	ΣSAR<1.6, Not required

WCDMA Band II + 2.4 GHz WLAN Aux + BT Main

No.	Conditions	Position	Distance (mm)	Max. WWAN	Max. WLAN Aux	BT	SAR Sum	SPLSR
11	WCDMA Band II	Back side	0	0.381	0.277	0.012	0.670	ΣSAR<1.6, Not required
		Top side	0	0.058	0.676	0.003	0.737	ΣSAR<1.6, Not required
		Bottom side	0	0.093	0.400	0.400	0.893	ΣSAR<1.6, Not required
		Left side	0	0.650	0.077	0.053	0.780	ΣSAR<1.6, Not required

WCDMA Band V + 2.4 GHz WLAN Aux + BT Main

No.	Conditions	Position	Distance (mm)	Max. WWAN	Max. WLAN Aux	BT	SAR Sum	SPLSR
12	WCDMA Band V	Back side	0	0.124	0.277	0.012	0.413	ΣSAR<1.6, Not required
		Top side	0	0.020	0.676	0.003	0.699	ΣSAR<1.6, Not required
		Bottom side	0	0.028	0.400	0.400	0.828	ΣSAR<1.6, Not required
		Left side	0	0.336	0.077	0.053	0.466	ΣSAR<1.6, Not required

WCDMA Band II + 5 GHz WLAN Main + BT Aux

No.	Conditions	Position	Distance (mm)	Max. WWAN	Max. WLAN Main	BT	SAR Sum	SPLSR
13	WCDMA Band II	Back side	0	0.381	0.153	0.022	0.556	ΣSAR<1.6, Not required
		Top side	0	0.058	0.069	0.051	0.178	ΣSAR<1.6, Not required
		Bottom side	0	0.093	0.400	0.400	0.893	ΣSAR<1.6, Not required
		Left side	0	0.650	0.399	0.005	1.054	ΣSAR<1.6, Not required

WCDMA Band V + 5 GHz WLAN Main + BT Aux

No.	Conditions	Position	Distance (mm)	Max. WWAN	Max. WLAN Main	BT	SAR Sum	SPLSR
14	WCDMA Band V	Back side	0	0.124	0.153	0.022	0.299	ΣSAR<1.6, Not required
		Top side	0	0.020	0.069	0.051	0.140	ΣSAR<1.6, Not required
		Bottom side	0	0.028	0.400	0.400	0.828	ΣSAR<1.6, Not required
		Left side	0	0.336	0.399	0.005	0.740	ΣSAR<1.6, Not required

WCDMA Band II + 5 GHz WLAN Aux + BT Main

No.	Conditions	Position	Distance (mm)	Max. WWAN	Max. WLAN Aux	BT	SAR Sum	SPLSR
15	WCDMA Band II	Back side	0	0.381	0.104	0.012	0.497	ΣSAR<1.6, Not required
		Top side	0	0.058	0.278	0.003	0.339	ΣSAR<1.6, Not required
		Bottom side	0	0.093	0.400	0.400	0.893	ΣSAR<1.6, Not required
		Left side	0	0.650	0.023	0.053	0.726	ΣSAR<1.6, Not required

WCDMA Band V + 5 GHz WLAN Aux + BT Main

No.	Conditions	Position	Distance (mm)	Max. WWAN	Max. WLAN Aux	BT	SAR Sum	SPLSR
16	WCDMA Band V	Back side	0	0.124	0.104	0.012	0.240	ΣSAR<1.6, Not required
		Top side	0	0.020	0.278	0.003	0.301	ΣSAR<1.6, Not required
		Bottom side	0	0.028	0.400	0.400	0.828	ΣSAR<1.6, Not required
		Left side	0	0.336	0.023	0.053	0.412	ΣSAR<1.6, 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	Dosimetric E-Field Probe	EX3DV4	3923	Sep.02,2016	Sep.01,2017
Schmid & Partner Engineering AG	System Validation Dipole	D835V2	4d063	Aug.25,2016	Aug.24,2017
		D1900V2	5d027	Apr.25,2016	Apr.24,2017
		D2450V2	727	Apr.19,2016	Apr.18,2017
		D5GHzV2	1023	Jan.26,2016	Jan.25,2017
Schmid & Partner Engineering AG	Data acquisition Electronics	DAE4	1374	Aug.23,2016	Aug.22,2017
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	Jan.07,2016	Jan.06,2017
Agilent	Dielectric Probe Kit	85070E	MY44300677	Calibration not required	Calibration not required
Agilent	Dual-directional coupler	772D	MY46151242	Jul.11,2016	Jul.10,2017
		778D	MY48220468	Jul.06,2016	Jul.05,2017
Agilent	RF Signal Generator	N5181A	MY50145142	Feb.19,2016	Feb.18,2017
Agilent	Power Meter	E4417A	MY51410006	Jan.07,2016	Jan.06,2017
Agilent	Power Sensor	E9301H	MY51470001	Jan.07,2016	Jan.06,2017
			MY51470002	Jan.07,2016	Jan.06,2017
TECPEL	Digital thermometer	DTM-303A	TP130073	Feb.26,2016	Feb.25,2017
LKM	Temperature Probe	DTM-3000	EC14010603	Feb.19,2016	Feb.18,2017
Anritsu	Radio Communication Test	MT8820C	6201061049	Apr.08,2016	Apr.07,2017

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5. Measurements

Date: 2016/10/20

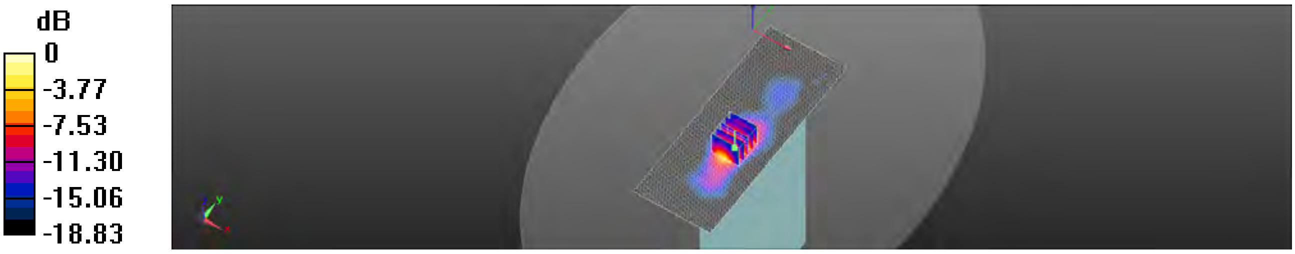
WCDMA Band II_Body_Left side_CH 9400_0mm
Communication System: WCDMA; Frequency: 1880 MHz, Duty Factor: 1:1
Medium parameters used: f = 1880 MHz; σ = 1.574 S/m; ε_r = 51.988; ρ = 1000 kg/m^3
Phantom section: Flat Section
Ambient temperature: 22.0° C ; Liquid temperature: 21.9° C

DASY5 Configuration:

- Probe: EX3DV4 - SN3923; ConvF(8.47, 8.47, 8.47); Calibrated: 2016/9/2;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1374; Calibrated: 2016/8/23
- Phantom: Body
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

Configuration/Body/Area Scan (61x161x1): Interpolated grid: dx=15 mm, dy=15 mm
Maximum value of SAR (interpolated) = 1.07 W/kg

Configuration/Body/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 11.90 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 1.24 W/kg
SAR(1 g) = 0.625 W/kg; SAR(10 g) = 0.316 W/kg
Maximum value of SAR (measured) = 0.944 W/kg



0 dB = 0.944 W/kg = -0.25 dBW/kg

Date: 2016/10/20

WCDMA Band V_Body_Left side_CH 4183_0mm

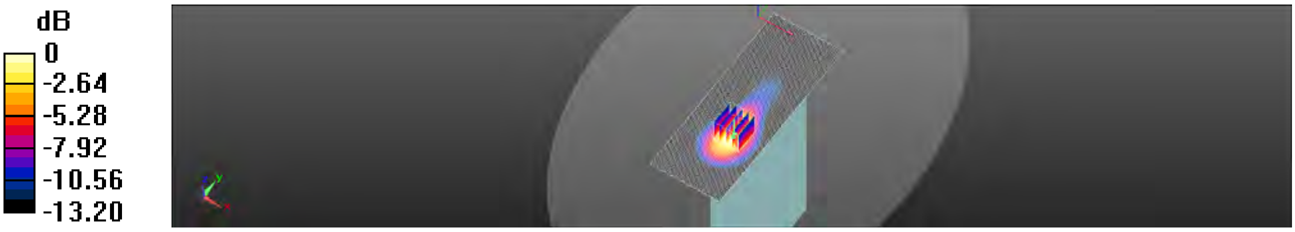
Communication System: WCDMA; Frequency: 836.6 MHz, Duty Factor: 1:1
Medium parameters used: f = 837 MHz; σ = 1.012 S/m; ε_r = 53.012; ρ = 1000 kg/m^3
Phantom section: Flat Section
Ambient temperature: 22.1° C ; Liquid temperature: 22.0° C

DASY5 Configuration:

- Probe: EX3DV4 - SN3923; ConvF(10.67, 10.67, 10.67); Calibrated: 2016/9/2;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1374; Calibrated: 2016/8/23
- Phantom: Body
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

Configuration/Body/Area Scan (61x161x1): Interpolated grid: dx=15 mm, dy=15 mm
Maximum value of SAR (interpolated) = 0.297 W/kg

Configuration/Body/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 7.008 V/m; Power Drift = 0.13 dB
Peak SAR (extrapolated) = 0.388 W/kg
SAR(1 g) = 0.230 W/kg; SAR(10 g) = 0.135 W/kg
Maximum value of SAR (measured) = 0.317 W/kg



0 dB = 0.317 W/kg = -5.00 dBW/kg

Date: 2016/10/27

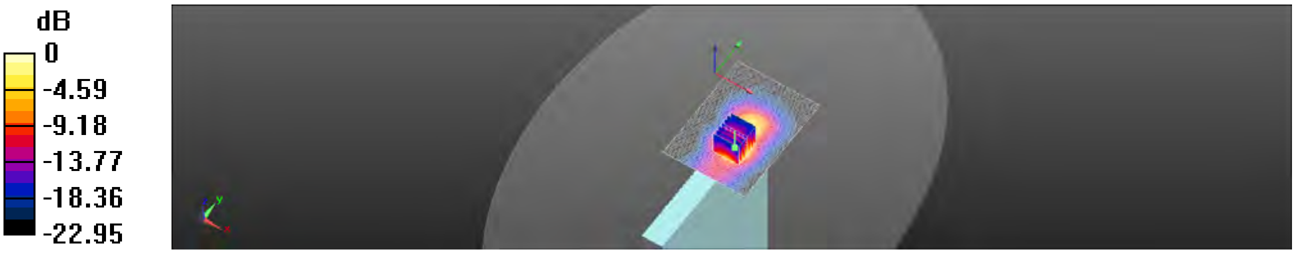
WLAN 802.11b_Body_Left side_CH 1_Main_0mm
Communication System: WLAN(2.45G); Frequency: 2412 MHz, Duty Factor: 1:1
Medium parameters used: f = 2412 MHz; σ = 1.991 S/m; ε_r = 52.639; ρ = 1000 kg/m^3
Phantom section: Flat Section
Ambient temperature: 22.2° C ; Liquid temperature: 21.8° C

DASY5 Configuration:

- Probe: EX3DV4 - SN3923; ConvF(8.06, 8.06, 8.06); Calibrated: 2016/9/2;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1374; Calibrated: 2016/8/23
- Phantom: Body
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

Configuration/Body/Area Scan (81x111x1): Interpolated grid: dx=12 mm, dy=12 mm
Maximum value of SAR (interpolated) = 1.33 W/kg

Configuration/Body/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 5.429 V/m; Power Drift = 0.12 dB
Peak SAR (extrapolated) = 1.60 W/kg
SAR(1 g) = 0.801 W/kg; SAR(10 g) = 0.354 W/kg
Maximum value of SAR (measured) = 1.20 W/kg



0 dB = 1.20 W/kg = 0.80 dBW/kg

Date: 2016/10/27

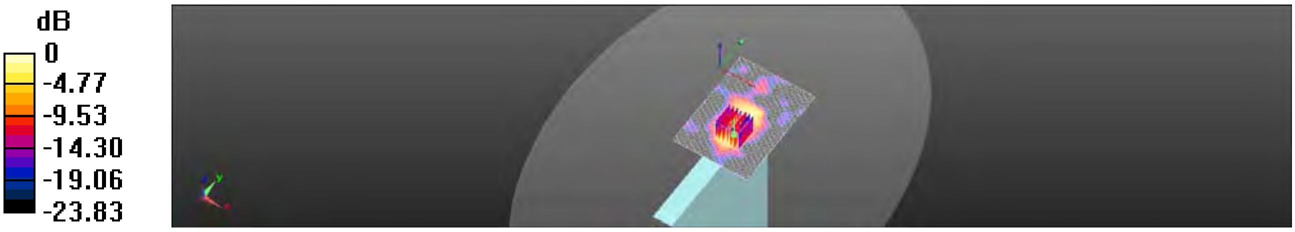
Bluetooth(8DPSK)_Body_Left side_CH 39_Main_0mm
Communication System: Bluetooth; Frequency: 2441 MHz, Duty Factor: 1:1
Medium parameters used: f = 2441 MHz; σ = 2.012 S/m; ε_r = 52.551; ρ = 1000 kg/m^3
Phantom section: Flat Section
Ambient temperature: 22.2° C ; Liquid temperature: 21.8° C

DASY5 Configuration:

- Probe: EX3DV4 - SN3923; ConvF(8.06, 8.06, 8.06); Calibrated: 2016/9/2;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1374; Calibrated: 2016/8/23
- Phantom: Body
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

Configuration/Body/Area Scan (81x111x1): Interpolated grid: dx=12 mm, dy=12 mm
Maximum value of SAR (interpolated) = 0.0685 W/kg

Configuration/Body/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 1.757 V/m; Power Drift = 0.10 dB
Peak SAR (extrapolated) = 0.0770 W/kg
SAR(1 g) = 0.049 W/kg; SAR(10 g) = 0.021 W/kg
Maximum value of SAR (measured) = 0.0589 W/kg



0 dB = 0.0589 W/kg = -12.30 dBW/kg

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Date: 2016/10/27

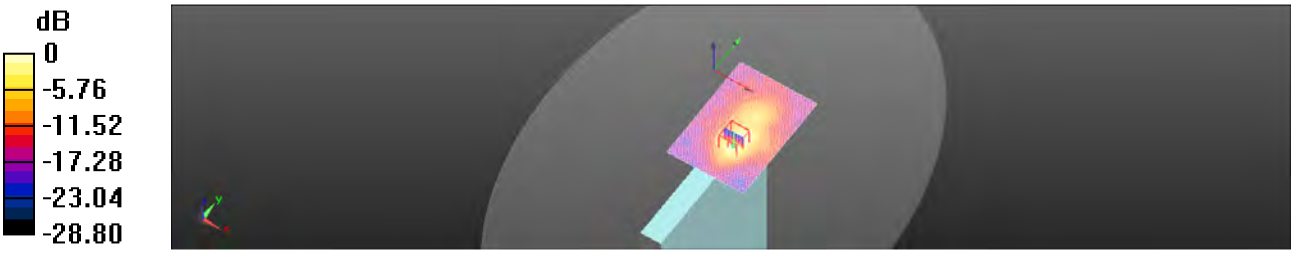
WLAN 802.11a 5.2G_Body_Left side_CH 40_Main_0mm
Communication System: WLAN(5G); Frequency: 5200 MHz, Duty Factor: 1:1
Medium parameters used: f = 5200 MHz; σ = 5.477 S/m; ε_r = 49.214; ρ = 1000 kg/m^3
Phantom section: Flat Section
Ambient temperature: 22.5° C ; Liquid temperature: 22.2° C

DASY5 Configuration:

- Probe: EX3DV4 - SN3923; ConvF(4.58, 4.58, 4.58); Calibrated: 2016/9/2;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1374; Calibrated: 2016/8/23
- Phantom: Body
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

Configuration/Body/Area Scan (91x131x1): Interpolated grid: dx=10 mm, dy=10 mm
Maximum value of SAR (interpolated) = 0.746 W/kg

Configuration/Body/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 1.757 V/m; Power Drift = 0.12 dB
Peak SAR (extrapolated) = 1.32 W/kg
SAR(1 g) = 0.364 W/kg; SAR(10 g) = 0.116 W/kg
Maximum value of SAR (measured) = 0.733 W/kg



0 dB = 0.733 W/kg = -1.35 dBW/kg

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Member of SGS Group

Date: 2016/10/27

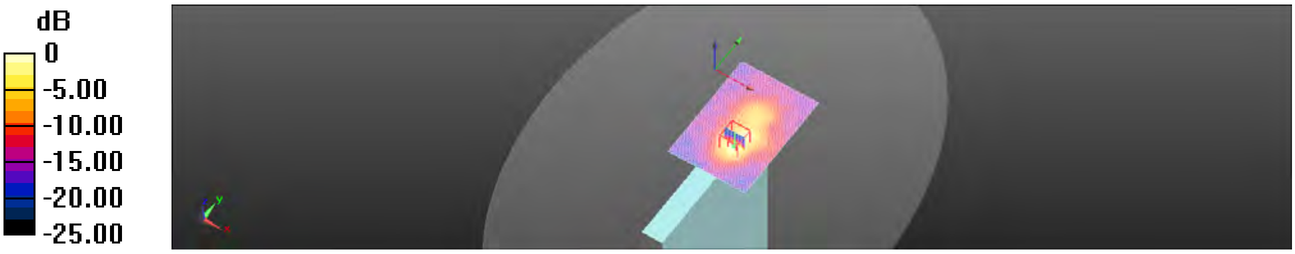
WLAN 802.11a 5.3G_Body_Left side_CH 52_Main_0mm
Communication System: WLAN(5G); Frequency: 5260 MHz, Duty Factor: 1:1
Medium parameters used: f = 5260 MHz; σ = 5.557 S/m; ε_r = 49.081; ρ = 1000 kg/m^3
Phantom section: Flat Section
Ambient temperature: 22.5° C ; Liquid temperature: 22.2° C

DASY5 Configuration:

- Probe: EX3DV4 - SN3923; ConvF(4.58, 4.58, 4.58); Calibrated: 2016/9/2;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1374; Calibrated: 2016/8/23
- Phantom: Body
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

Configuration/Body/Area Scan (91x131x1): Interpolated grid: dx=10 mm, dy=10 mm
Maximum value of SAR (interpolated) = 0.663 W/kg

Configuration/Body/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 1.692 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 1.22 W/kg
SAR(1 g) = 0.326 W/kg; SAR(10 g) = 0.104 W/kg
Maximum value of SAR (measured) = 0.653 W/kg



0 dB = 0.653 W/kg = -1.85 dBW/kg

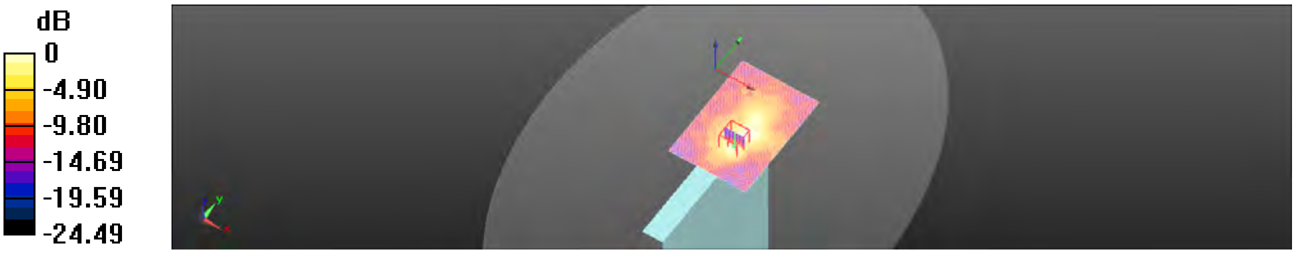
Date: 2016/10/28

WLAN 802.11a 5.6G_Body_Left side_CH 120_Main_0mm
Communication System: WLAN(5G); Frequency: 5600 MHz, Duty Factor: 1:1
Medium parameters used: f = 5600 MHz; σ = 5.854 S/m; ε_r = 48.846; ρ = 1000 kg/m^3
Phantom section: Flat Section
Ambient temperature: 22.1° C ; Liquid temperature: 22.3° C

DASY5 Configuration:
- Probe: EX3DV4 - SN3923; ConvF(4, 4, 4); Calibrated: 2016/9/2;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1374; Calibrated: 2016/8/23
- Phantom: Body
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

Configuration/Body/Area Scan (91x131x1): Interpolated grid: dx=10 mm, dy=10 mm
Maximum value of SAR (interpolated) = 0.290 W/kg

Configuration/Body/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 1.398 V/m; Power Drift = -0.14 dB
Peak SAR (extrapolated) = 0.631 W/kg
SAR(1 g) = 0.140 W/kg; SAR(10 g) = 0.047 W/kg
Maximum value of SAR (measured) = 0.287 W/kg



0 dB = 0.287 W/kg = -5.42 dBW/kg

Date: 2016/10/28

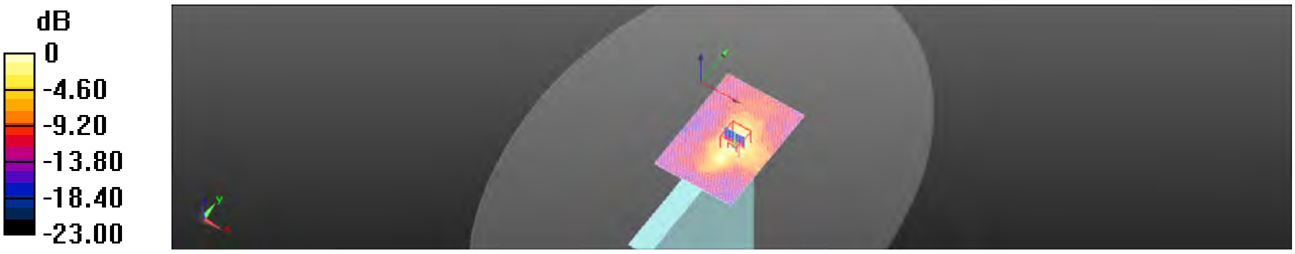
WLAN 802.11a 5.8G_Body_Left side_CH 165_Main_0mm
Communication System: WLAN(5G); Frequency: 5825 MHz, Duty Factor: 1:1
Medium parameters used: f = 5825 MHz; σ = 6.138 S/m; ε_r = 48.639; ρ = 1000 kg/m^3
Phantom section: Flat Section
Ambient temperature: 22.1° C ; Liquid temperature: 22.3° C

DASY5 Configuration:

- Probe: EX3DV4 - SN3923; ConvF(4.19, 4.19, 4.19); Calibrated: 2016/9/2;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1374; Calibrated: 2016/8/23
- Phantom: Body
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

Configuration/Body/Area Scan (91x131x1): Interpolated grid: dx=10 mm, dy=10 mm
Maximum value of SAR (interpolated) = 0.320 W/kg

Configuration/Body/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 0.7230 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 0.789 W/kg
SAR(1 g) = 0.165 W/kg; SAR(10 g) = 0.057 W/kg
Maximum value of SAR (measured) = 0.346 W/kg



0 dB = 0.346 W/kg = -4.61 dBW/kg

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Date: 2016/10/27

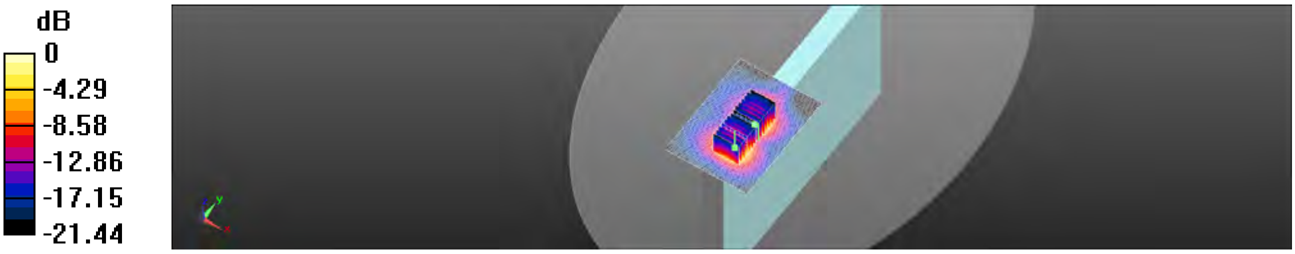
WLAN 802.11b_Body_Top side_CH 6_Aux_0mm
Communication System: WLAN(2.45G); Frequency: 2437 MHz, Duty Factor: 1:1
Medium parameters used: f = 2437 MHz; σ = 2.011 S/m; ε_r = 52.578; ρ = 1000 kg/m^3
Phantom section: Flat Section
Ambient temperature: 22.2° C ; Liquid temperature: 21.8° C

DASY5 Configuration:

- Probe: EX3DV4 - SN3923; ConvF(8.06, 8.06, 8.06); Calibrated: 2016/9/2;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1374; Calibrated: 2016/8/23
- Phantom: Body
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

Configuration/Body/Area Scan (81x111x1): Interpolated grid: dx=12 mm, dy=12 mm
Maximum value of SAR (interpolated) = 0.951 W/kg

Configuration/Body/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 1.410 V/m; Power Drift = 0.14 dB
Peak SAR (extrapolated) = 1.27 W/kg
SAR(1 g) = 0.624 W/kg; SAR(10 g) = 0.265 W/kg
Maximum value of SAR (measured) = 0.960 W/kg
Configuration/Body/Zoom Scan (7x7x7)/Cube 1: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 1.410 V/m; Power Drift = 0.14 dB
Peak SAR (extrapolated) = 1.13 W/kg
SAR(1 g) = 0.576 W/kg; SAR(10 g) = 0.262 W/kg
Maximum value of SAR (measured) = 0.857 W/kg



0 dB = 0.857 W/kg = -0.67 dBW/kg

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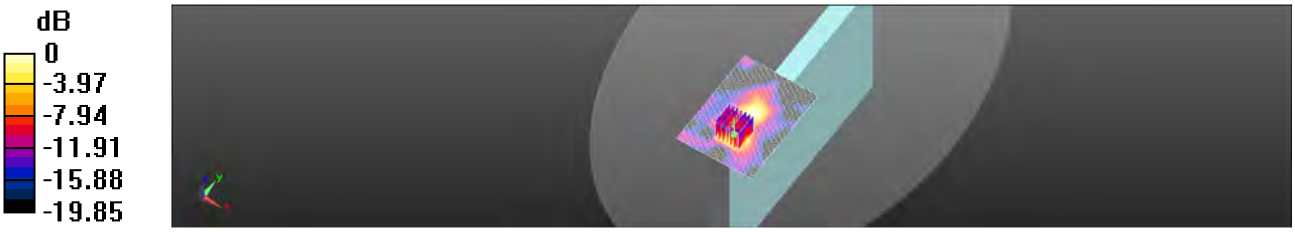
Date: 2016/10/27

Bluetooth(8DPSK)_Body_Top side_CH 0_Aux_0mm
Communication System: Bluetooth; Frequency: 2402 MHz, Duty Factor: 1:1
Medium parameters used: f = 2402 MHz; σ = 1.979 S/m; ε_r = 52.642; ρ = 1000 kg/m^3
Phantom section: Flat Section
Ambient temperature: 22.2° C ; Liquid temperature: 21.8° C

DASY5 Configuration:
- Probe: EX3DV4 - SN3923; ConvF(8.06, 8.06, 8.06); Calibrated: 2016/9/2;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1374; Calibrated: 2016/8/23
- Phantom: Body
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

Configuration/Body/Area Scan (81x111x1): Interpolated grid: dx=12 mm, dy=12 mm
Maximum value of SAR (interpolated) = 0.0710 W/kg

Configuration/Body/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 1.890 V/m; Power Drift = 0.11 dB
Peak SAR (extrapolated) = 0.0860 W/kg
SAR(1 g) = 0.042 W/kg; SAR(10 g) = 0.018 W/kg
Maximum value of SAR (measured) = 0.0692 W/kg



0 dB = 0.0692 W/kg = -11.60 dBW/kg

Date: 2016/10/27

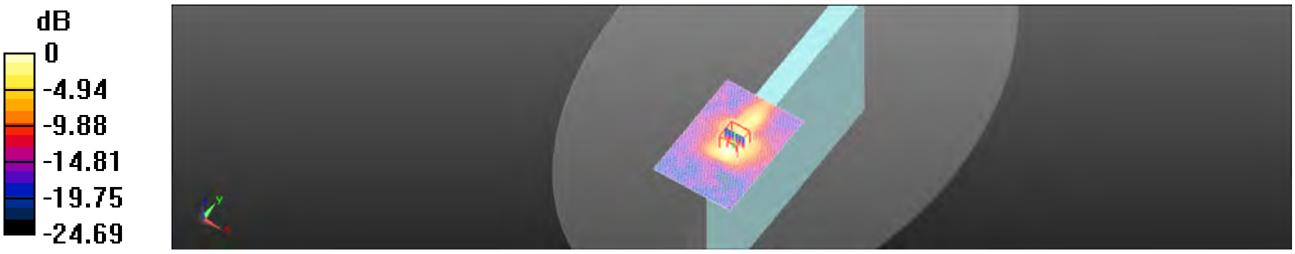
WLAN 802.11a 5.2G_Body_Top side_CH 36_Aux_0mm
Communication System: WLAN(5G); Frequency: 5180 MHz, Duty Factor: 1:1
Medium parameters used: f = 5180 MHz; σ = 5.446 S/m; ε_r = 49.256; ρ = 1000 kg/m^3
Phantom section: Flat Section
Ambient temperature: 22.5° C ; Liquid temperature: 22.2° C

DASY5 Configuration:

- Probe: EX3DV4 - SN3923; ConvF(4.58, 4.58, 4.58); Calibrated: 2016/9/2;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1374; Calibrated: 2016/8/23
- Phantom: Body
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

Configuration/Body/Area Scan (91x131x1): Interpolated grid: dx=10 mm, dy=10 mm
Maximum value of SAR (interpolated) = 0.524 W/kg

Configuration/Body/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 1.643 V/m; Power Drift = 0.11 dB
Peak SAR (extrapolated) = 1.01 W/kg
SAR(1 g) = 0.275 W/kg; SAR(10 g) = 0.098 W/kg
Maximum value of SAR (measured) = 0.528 W/kg



0 dB = 0.528 W/kg = -2.77 dBW/kg

Date: 2016/10/27

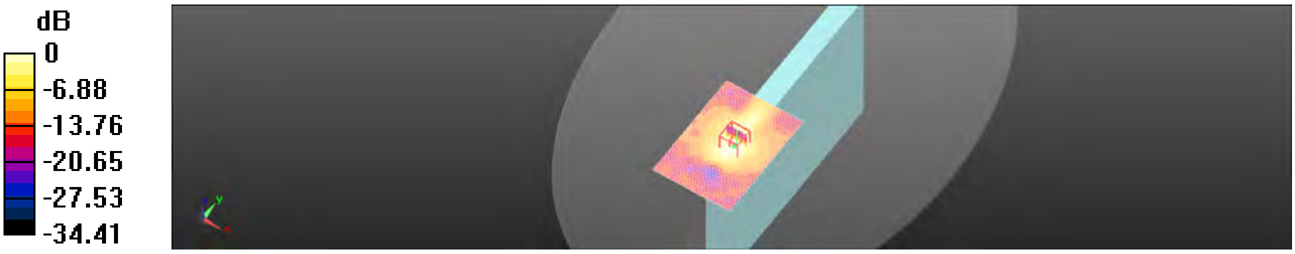
WLAN 802.11a 5.3G_Body_Top side_CH 52_Aux_0mm
Communication System: WLAN(5G); Frequency: 5260 MHz, Duty Factor: 1:1
Medium parameters used: f = 5260 MHz; σ = 5.557 S/m; ε_r = 49.081; ρ = 1000 kg/m^3
Phantom section: Flat Section
Ambient temperature: 22.5° C ; Liquid temperature: 22.2° C

DASY5 Configuration:

- Probe: EX3DV4 - SN3923; ConvF(4.58, 4.58, 4.58); Calibrated: 2016/9/2;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1374; Calibrated: 2016/8/23
- Phantom: Body
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

Configuration/Body/Area Scan (91x131x1): Interpolated grid: dx=10 mm, dy=10 mm
Maximum value of SAR (interpolated) = 0.393 W/kg

Configuration/Body/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 1.681 V/m; Power Drift = 0.08 dB
Peak SAR (extrapolated) = 0.763 W/kg
SAR(1 g) = 0.205 W/kg; SAR(10 g) = 0.075 W/kg
Maximum value of SAR (measured) = 0.391 W/kg



0 dB = 0.391 W/kg = -4.08 dBW/kg

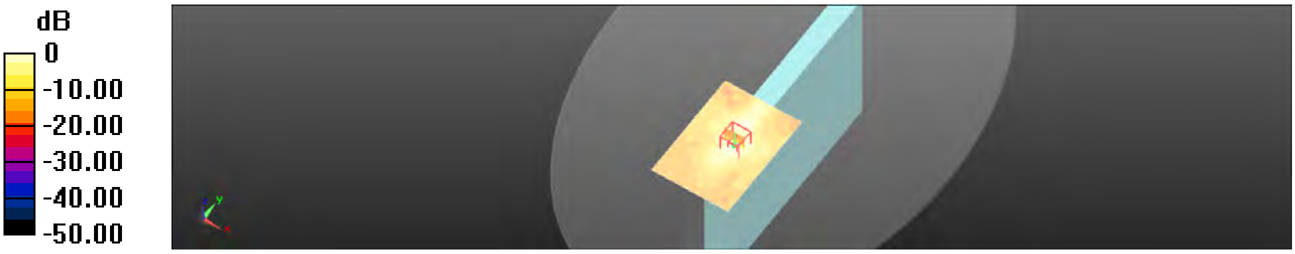
Date: 2016/10/28

WLAN 802.11a 5.6G_Body_Top side_CH 120_Aux_0mm
Communication System: WLAN(5G); Frequency: 5600 MHz, Duty Factor: 1:1
Medium parameters used: f = 5600 MHz; σ = 5.854 S/m; ε_r = 48.846; ρ = 1000 kg/m^3
Phantom section: Flat Section
Ambient temperature: 22.1° C ; Liquid temperature: 22.3° C

DASY5 Configuration:
- Probe: EX3DV4 - SN3923; ConvF(4, 4, 4); Calibrated: 2016/9/2;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1374; Calibrated: 2016/8/23
- Phantom: Body
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

Configuration/Body/Area Scan (91x131x1): Interpolated grid: dx=10 mm, dy=10 mm
Maximum value of SAR (interpolated) = 0.359 W/kg

Configuration/Body/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 2.189 V/m; Power Drift = -0.13 dB
Peak SAR (extrapolated) = 0.774 W/kg
SAR(1 g) = 0.173 W/kg; SAR(10 g) = 0.054 W/kg
Maximum value of SAR (measured) = 0.358 W/kg



0 dB = 0.358 W/kg = -4.46 dBW/kg

Date: 2016/10/28

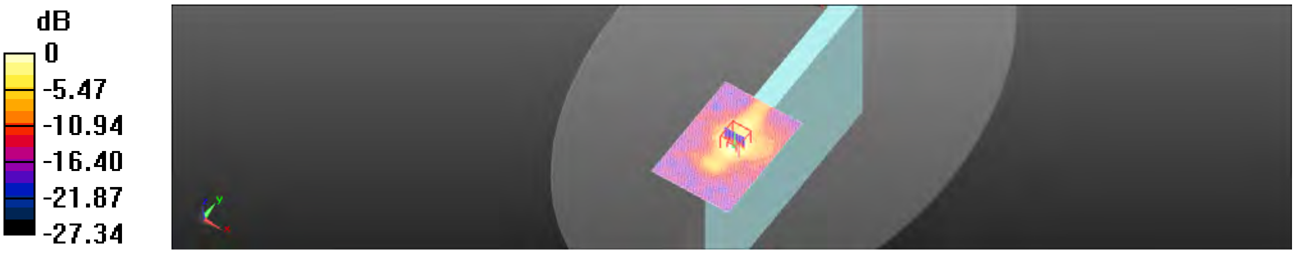
WLAN 802.11a 5.8G_Body_Top side_CH 165_Aux_0mm
Communication System: WLAN(5G); Frequency: 5825 MHz, Duty Factor: 1:1
Medium parameters used: f = 5825 MHz; σ = 6.138 S/m; ε_r = 48.639; ρ = 1000 kg/m^3
Phantom section: Flat Section
Ambient temperature: 22.1° C ; Liquid temperature: 22.3° C

DASY5 Configuration:

- Probe: EX3DV4 - SN3923; ConvF(4.19, 4.19, 4.19); Calibrated: 2016/9/2;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1374; Calibrated: 2016/8/23
- Phantom: Body
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

Configuration/Body/Area Scan (91x131x1): Interpolated grid: dx=10 mm, dy=10 mm
Maximum value of SAR (interpolated) = 0.521 W/kg

Configuration/Body/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 1.641 V/m; Power Drift = 0.15 dB
Peak SAR (extrapolated) = 1.05 W/kg
SAR(1 g) = 0.242 W/kg; SAR(10 g) = 0.079 W/kg
Maximum value of SAR (measured) = 0.508 W/kg



0 dB = 0.508 W/kg = -2.94 dBW/kg

6. SAR System Performance Verification

Date: 2016/10/20

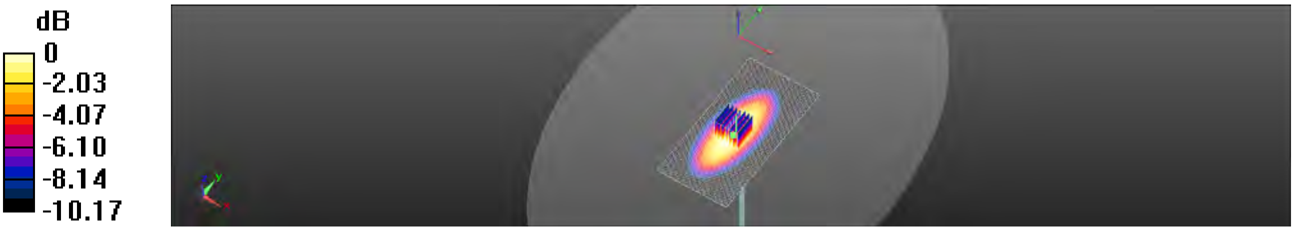
Dipole 835 MHz_SN:4d063
Communication System: CW; Frequency: 835 MHz, Duty Factor: 1:1
Medium parameters used: f = 835 MHz; σ = 1.009 S/m; ε_r = 53.018; ρ = 1000 kg/m^3
Phantom section: Flat Section
Ambient temperature: 22.1° C ; Liquid temperature: 22.0° C

DASY5 Configuration:

- Probe: EX3DV4 - SN3923; ConvF(10.67, 10.67, 10.67); Calibrated: 2016/9/2;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1374; Calibrated: 2016/8/23
- Phantom: Body
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

Configuration/Pin=250mW/Area Scan (61x121x1): Interpolated grid: dx=15 mm, dy=15 mm
Maximum value of SAR (interpolated) = 2.95 W/kg

Configuration/Pin=250mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 55.30 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 3.43 W/kg
SAR(1 g) = 2.45 W/kg; SAR(10 g) = 1.56 W/kg
Maximum value of SAR (measured) = 2.95 W/kg



0 dB = 2.95 W/kg = 4.70 dBW/kg

Date: 2016/10/20

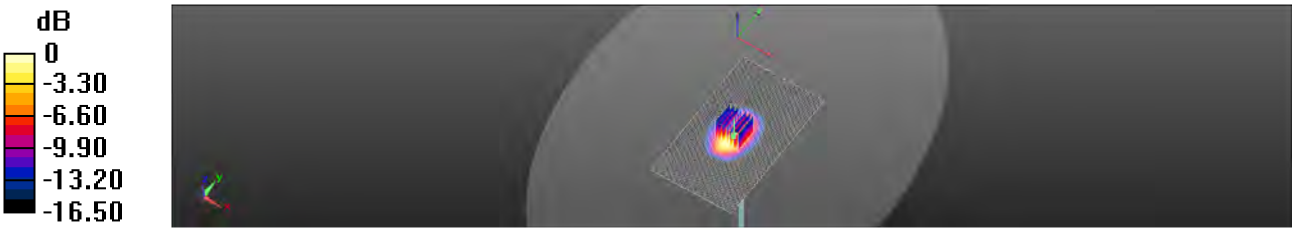
Dipole 1900 MHz_SN:5d027
Communication System: CW; Frequency: 1900 MHz, Duty Factor: 1:1
Medium parameters used: f = 1900 MHz; σ = 1.583 S/m; ε_r = 51.848; ρ = 1000 kg/m^3
Phantom section: Flat Section
Ambient temperature: 22.0° C ; Liquid temperature: 21.9° C

DASY5 Configuration:

- Probe: EX3DV4 - SN3923; ConvF(8.47, 8.47, 8.47); Calibrated: 2016/9/2;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1374; Calibrated: 2016/8/23
- Phantom: Body
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

Configuration/Pin=250mW/Area Scan (71x121x1): Interpolated grid: dx=15 mm, dy=15 mm
Maximum value of SAR (interpolated) = 13.8 W/kg

Configuration/Pin=250mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 90.37 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 17.4 W/kg
SAR(1 g) = 9.98 W/kg; SAR(10 g) = 5.32 W/kg
Maximum value of SAR (measured) = 14.0 W/kg



0 dB = 14.0 W/kg = 11.47 dBW/kg

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Date: 2016/10/27

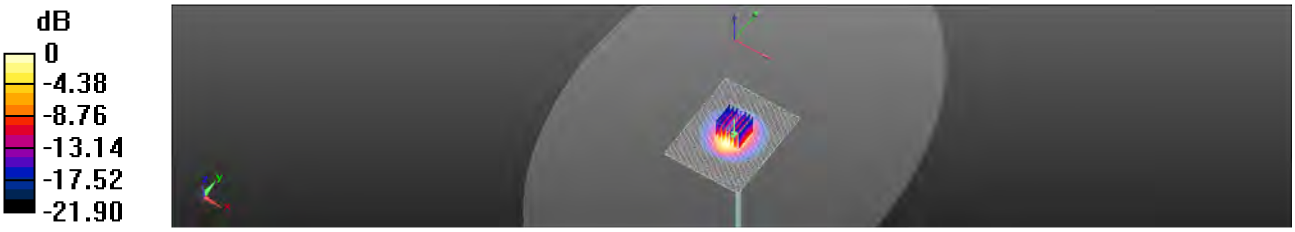
Dipole 2450 MHz_SN:727
Communication System: CW; Frequency: 2450 MHz, Duty Factor: 1:1
Medium parameters used: f = 2450 MHz; σ = 2.022 S/m; ε_r = 52.545; ρ = 1000 kg/m^3
Phantom section: Flat Section
Ambient temperature: 22.2° C ; Liquid temperature: 21.8° C

DASY5 Configuration:

- Probe: EX3DV4 - SN3923; ConvF(8.06, 8.06, 8.06); Calibrated: 2016/9/2;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1374; Calibrated: 2016/8/23
- Phantom: Body
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

Configuration/Pin=250mW/Area Scan (81x101x1): Interpolated grid: dx=12 mm, dy=12 mm
Maximum value of SAR (interpolated) = 20.7 W/kg

Configuration/Pin=250mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 101.8 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 27.9 W/kg
SAR(1 g) = 12.6 W/kg; SAR(10 g) = 6.09 W/kg
Maximum value of SAR (measured) = 20.9 W/kg



0 dB = 20.9 W/kg = 13.20 dBW/kg

Date: 2016/10/27

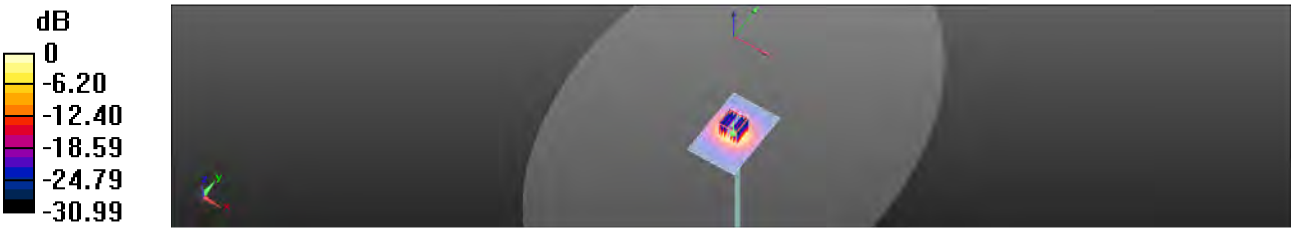
Dipole 5200 MHz_SN:1023
Communication System: CW; Frequency: 5200 MHz, Duty Factor: 1:1
Medium parameters used: f = 5200 MHz; σ = 5.477 S/m; ε_r = 49.2146; ρ = 1000 kg/m^3
Phantom section: Flat Section
Ambient temperature: 22.5° C ; Liquid temperature: 22.2° C

DASY5 Configuration:

- Probe: EX3DV4 - SN3923; ConvF(4.58, 4.58, 4.58); Calibrated: 2016/9/2;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1374; Calibrated: 2016/8/23
- Phantom: Body
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

Configuration/Pin=100mW/Area Scan (61x91x1): Interpolated grid: dx=10 mm, dy=10 mm
Maximum value of SAR (interpolated) = 14.9 W/kg

Configuration/Pin=100mW/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 55.36 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 27.9 W/kg
SAR(1 g) = 7.22 W/kg; SAR(10 g) = 2.08 W/kg
Maximum value of SAR (measured) = 15.1 W/kg



0 dB = 15.1 W/kg = 11.78 dBW/kg

Date: 2016/10/27

Dipole 5300 MHz_SN:1023

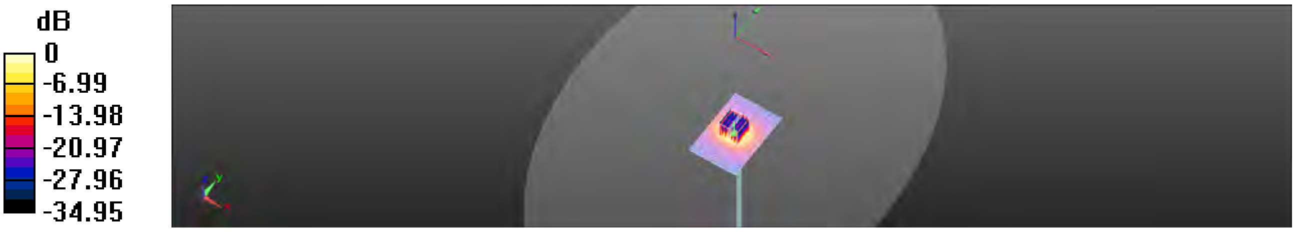
Communication System: CW; Frequency: 5300 MHz, Duty Factor: 1:1
Medium parameters used: f = 5300 MHz; σ = 5.618 S/m; ε_r = 48.997; ρ = 1000 kg/m^3
Phantom section: Flat Section
Ambient temperature: 22.5° C ; Liquid temperature: 22.2° C

DASY5 Configuration:

- Probe: EX3DV4 - SN3923; ConvF(4.58, 4.58, 4.58); Calibrated: 2016/9/2;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1374; Calibrated: 2016/8/23
- Phantom: Body
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

Configuration/Pin=100mW/Area Scan (61x91x1): 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=4mm, dy=4mm, dz=2mm
Reference Value = 55.73 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 30.0 W/kg
SAR(1 g) = 7.32 W/kg; SAR(10 g) = 2.06 W/kg
Maximum value of SAR (measured) = 15.5 W/kg



0 dB = 15.5 W/kg = 11.90 dBW/kg

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Date: 2016/10/28

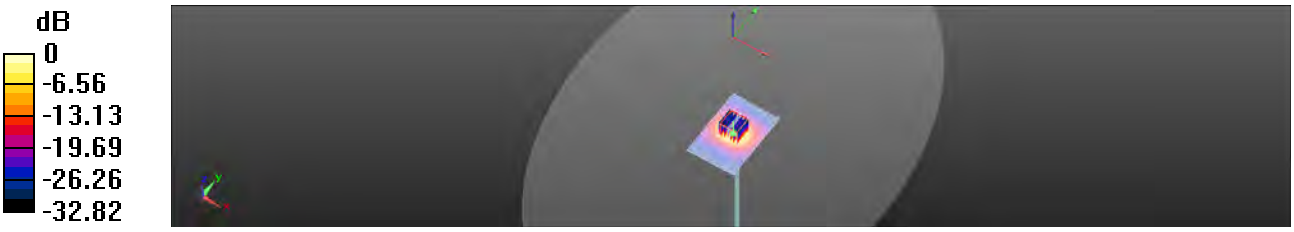
Dipole 5600 MHz_SN:1023
Communication System: CW; Frequency: 5600 MHz, Duty Factor: 1:1
Medium parameters used: f = 5600 MHz; σ = 5.854 S/m; ε_r = 48.846; ρ = 1000 kg/m^3
Phantom section: Flat Section
Ambient temperature: 22.1° C ; Liquid temperature: 22.3° C

DASY5 Configuration:

- Probe: EX3DV4 - SN3923; ConvF(4, 4, 4); Calibrated: 2016/9/2;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1374; Calibrated: 2016/8/23
- Phantom: Body
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

Configuration/Pin=100mW/Area Scan (61x91x1): Interpolated grid: dx=10 mm, dy=10 mm
Maximum value of SAR (interpolated) = 16.0 W/kg

Configuration/Pin=100mW/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 56.20 V/m; Power Drift = -0.11 dB
Peak SAR (extrapolated) = 32.1 W/kg
SAR(1 g) = 7.77 W/kg; SAR(10 g) = 2.18 W/kg
Maximum value of SAR (measured) = 16.0 W/kg



0 dB = 16.0 W/kg = 12.05 dBW/kg

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Date: 2016/10/28

Dipole 5800 MHz_SN:1023

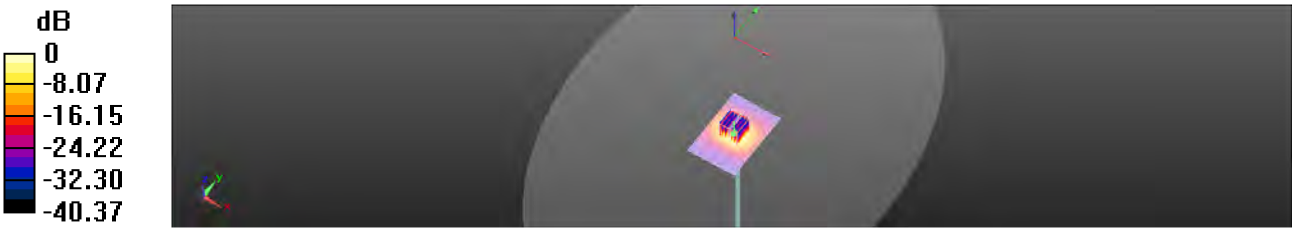
Communication System: CW; Frequency: 5800 MHz, Duty Factor: 1:1
Medium parameters used: f = 5800 MHz; σ = 6.114 S/m; ε_r = 48.645; ρ = 1000 kg/m^3
Phantom section: Flat Section
Ambient temperature: 22.1° C ; Liquid temperature: 22.3° C

DASY5 Configuration:

- Probe: EX3DV4 - SN3923; ConvF(4.19, 4.19, 4.19); Calibrated: 2016/9/2;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1374; Calibrated: 2016/8/23
- Phantom: Body
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

Configuration/Pin=100mW/Area Scan (61x91x1): Interpolated grid: dx=10 mm, dy=10 mm
Maximum value of SAR (interpolated) = 15.0 W/kg

Configuration/Pin=100mW/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 51.69 V/m; Power Drift = -0.07 dB
Peak SAR (extrapolated) = 29.4 W/kg
SAR(1 g) = 7.49 W/kg; SAR(10 g) = 2.12 W/kg
Maximum value of SAR (measured) = 14.6 W/kg



0 dB = 14.6 W/kg = 11.66 dBW/kg

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7. DAE & Probe Calibration Certificate

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Client **SGS-TW (Auden)**

Certificate No: **DAE4-1374_Aug16**

CALIBRATION CERTIFICATE

Object	DAE4 - SD 000 D04 BM - SN: 1374
Calibration procedure(s)	QA CAL-06.v29 Calibration procedure for the data acquisition electronics (DAE)
Calibration date:	August 23, 2016

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Keithley Multimeter Type 2001	SN: 0810278	09-Sep-15 (No:17153)	Sep-16
Secondary Standards	**ID #**	**Check Date (in house)**	**Scheduled Check**
Auto DAE Calibration Unit	SE UWS 053 AA 1001	05-Jan-16 (in house check)	In house check: Jan-17
Calibrator Box V2.1	SE UMS 006 AA 1002	05-Jan-16 (in house check)	In house check: Jan-17

	Name	Function	Signature
Calibrated by:	Dominique Steffen	Technician	
Approved by:	Fin Bomholt	Deputy Technical Manager	

Issued: August 23, 2016

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Certificate No: DAE4-1374_Aug16 Page 1 of 5

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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.

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DC Voltage Measurement

A/D - Converter Resolution nominal

High Range:	1LSB =	6.1μV ,	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	403.637 ± 0.02% (k=2)	403.886 ± 0.02% (k=2)	404.160 ± 0.02% (k=2)
Low Range	3.98275 ± 1.50% (k=2)	3.96719 ± 1.50% (k=2)	3.99036 ± 1.50% (k=2)

Connector Angle

Connector Angle to be used in DASY system	42.5 ° ± 1 °

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Appendix (Additional assessments outside the scope of SCS0108)

1. DC Voltage Linearity

High Range		Reading (µV)	Difference (µV)	Error (%)
Channel X	+ Input	200039.11	0.18	0.00
Channel X	+ Input	20005.23	0.57	0.00
Channel X	- Input	-20004.46	1.52	-0.01
Channel Y	+ Input	200041.10	3.98	0.00
Channel Y	+ Input	20002.96	-1.76	-0.01
Channel Y	- Input	-20007.46	-1.33	0.01
Channel Z	+ Input	200039.71	2.56	0.00
Channel Z	+ Input	20002.57	-2.04	-0.01
Channel Z	- Input	-20008.39	-2.20	0.01

Low Range		Reading (µV)	Difference (µV)	Error (%)
Channel X	+ Input	2001.14	0.37	0.02
Channel X	+ Input	200.90	0.07	0.03
Channel X	- Input	-198.75	0.41	-0.20
Channel Y	+ Input	2000.82	0.06	0.00
Channel Y	+ Input	200.17	-0.51	-0.25
Channel Y	- Input	-199.47	-0.29	0.15
Channel Z	+ Input	2000.50	-0.29	-0.01
Channel Z	+ Input	199.36	-1.24	-0.62
Channel Z	- Input	-200.79	-1.45	0.73

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	6.08	3.93
	- 200	-2.69	-4.73
Channel Y	200	7.56	7.12
	200	-8.69	-8.88
Channel Z	200	5.83	5.98
	- 200	-8.94	-9.16

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	-	-2.29	-1.91
Channel Y	200	4.85	-	-1.13
Channel Z	200	10.99	2.02	-

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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	15938	14709
Channel Y	16155	14646
Channel Z	16005	15566

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	1.17	0.20	1.90	0.33
Channel Y	0.61	-0.17	1.24	0.30
Channel Z	-1.30	-2.42	-0.33	0.37

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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Client **SGS-TW (Auden)**

Certificate No: **EX3-3923_Sep16**

CALIBRATION CERTIFICATE

Object	EX3DV4 - SN:3923
Calibration procedure(s)	QA CAL-01.v9, QA CAL-14.v4, QA CAL-23.v5, QA CAL-25.v6 Calibration procedure for dosimetric E-field probes
Calibration date	September 2, 2016

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	06-Apr-16 (No. 217-02288/02289)	Apr-17
Power sensor NRP-Z91	SN: 103244	06-Apr-16 (No. 217-02288)	Apr-17
Power sensor NRP-Z91	SN: 103245	06-Apr-16 (No. 217-02289)	Apr-17
Reference 20 dB Attenuator	SN: S5277 (20x)	05-Apr-16 (No. 217-02293)	Apr-17
Reference Probe ES3DV2	SN: 3013	31-Dec-15 (No. ES3-3013_Dec15)	Dec-16
DAE4	SN: 660	23-Dec-15 (No. DAE4-660_Dec15)	Dec-16
Secondary Standards	ID	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB41293874	06-Apr-16 (in house check Jun-16)	In house check: Jun-18
Power sensor E4412A	SN: MY41498087	06-Apr-16 (in house check Jun-16)	In house check: Jun-18
Power sensor E4412A	SN: 000110210	06-Apr-16 (in house check Jun-16)	In house check: Jun-18
RF generator HP 8648C	SN: US3642U01700	04-Aug-99 (in house check Jun-16)	In house check: Jun-18
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-15)	In house check: Oct-16

	Name	Function	Signature
Calibrated by:	Michael Weber	Laboratory Technician	M.Weber
Approved by:	Katja Pokovic	Technical Manager	

Issued: September 2, 2016

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Certificate No: EX3-3923_Sep16 Page 1 of 11

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Glossary:

TSL	tissue simulating liquid
NORMx,y,z	sensitivity in free space
ConvF	sensitivity in TSL / NORMx,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., θ = 0 is normal to probe axis
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization θ = 0 (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not affect the E^2-field uncertainty inside TSL (see below *ConvF*).
- *NORM(f)x,y,z = NORMx,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
- *Ax,y,z; Bx,y,z; Cx,y,z; Dx,y,z; VRx,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 ≤ 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 NORMx,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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Probe EX3DV4

SN:3923

Manufactured: March 8, 2013
Repaired: August 30, 2016
Calibrated: September 2, 2016

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

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DASY/EASY - Parameters of Probe: EX3DV4 - SN:3923

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	0.55	0.46	0.45	± 10.1 %
DCP (mV)[B]	101.5	102.8	106.7	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB$\sqrt{\mu V}$	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	150.8	±3.0 %
		Y	0.0	0.0	1.0		149.7	
		Z	0.0	0.0	1.0		151.5	

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

[A] The uncertainties of Norm X,Y,Z do not affect the E^2-field uncertainty inside TSL (see Pages 5 and 6).
[B] Numerical linearization parameter: uncertainty not required.
[E] Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

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DASY/EASY - Parameters of Probe: EX3DV4 - SN:3923

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unc (k=2)
750	41.9	0.89	11.01	11.01	11.01	0.53	0.80	± 12.0 %
835	41.5	0.90	10.66	10.66	10.66	0.47	0.80	± 12.0 %
900	41.5	0.97	10.40	10.40	10.40	0.36	0.93	± 12.0 %
1750	40.1	1.37	9.27	9.27	9.27	0.29	0.80	± 12.0 %
1900	40.0	1.40	8.90	8.90	8.90	0.30	0.80	± 12.0 %
2000	40.0	1.40	8.92	8.92	8.92	0.34	0.80	± 12.0 %
2450	39.2	1.80	7.95	7.95	7.95	0.33	0.85	± 12.0 %
2600	39.0	1.96	7.77	7.77	7.77	0.33	0.80	± 12.0 %
5250	35.9	4.71	5.36	5.36	5.36	0.30	1.80	± 13.1 %
5600	35.5	5.07	4.94	4.94	4.94	0.40	1.80	± 13.1 %
5750	35.4	5.22	4.96	4.96	4.96	0.40	1.80	± 13.1 %

[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 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.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

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DASY/EASY - Parameters of Probe: EX3DV4 - SN:3923

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unc (k=2)
750	55.5	0.96	10.83	10.83	10.83	0.32	0.98	± 12.0 %
835	55.2	0.97	10.67	10.67	10.67	0.37	0.96	± 12.0 %
900	55.0	1.05	10.52	10.52	10.52	0.44	0.80	± 12.0 %
1750	53.4	1.49	8.78	8.78	8.78	0.39	0.81	± 12.0 %
1900	53.3	1.52	8.47	8.47	8.47	0.37	0.80	± 12.0 %
2000	53.3	1.52	8.68	8.68	8.68	0.38	0.80	± 12.0 %
2450	52.7	1.95	8.06	8.06	8.06	0.30	0.80	± 12.0 %
2600	52.5	2.16	7.84	7.84	7.84	0.27	0.80	± 12.0 %
5250	48.9	5.36	4.58	4.58	4.58	0.50	1.90	± 13.1 %
5600	48.5	5.77	4.00	4.00	4.00	0.55	1.90	± 13.1 %
5750	48.3	5.94	4.19	4.19	4.19	0.55	1.90	± 13.1 %

[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 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.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

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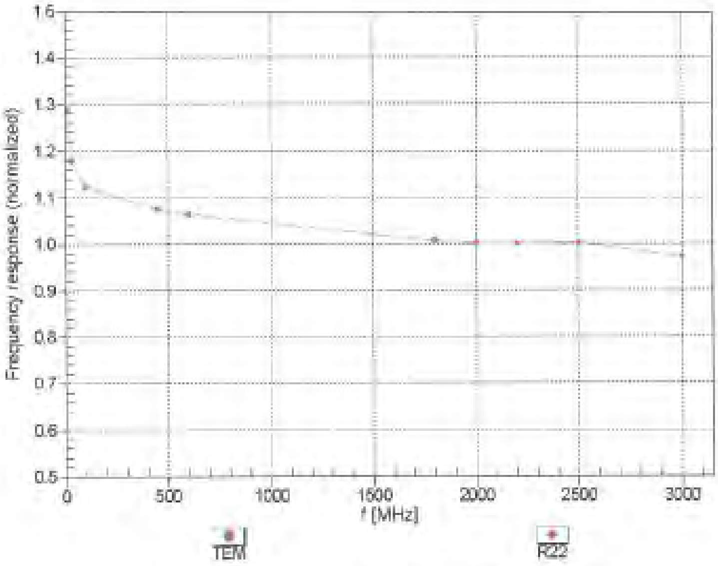
Frequency Response of E-Field

(TEM-Cell:ifi110 EXX, Waveguide: R22)



Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

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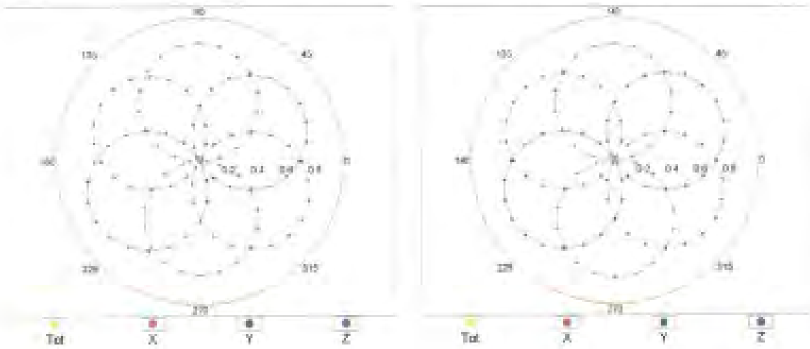
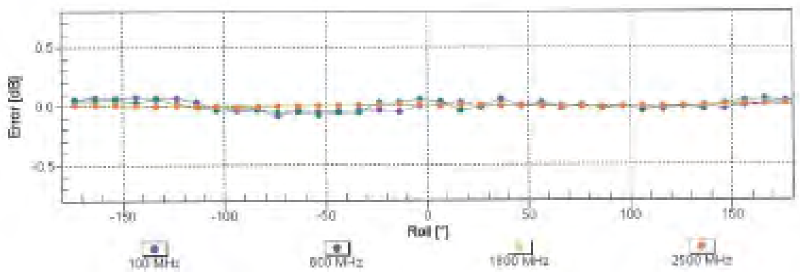
Receiving Pattern (ϕ), $\vartheta = 0°$





Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

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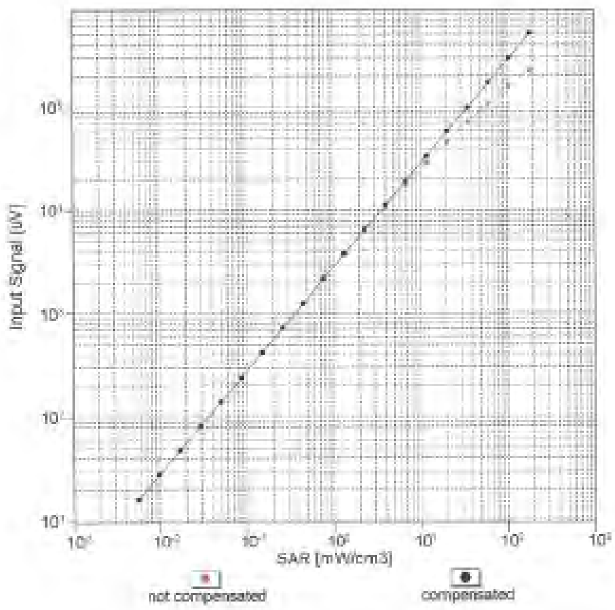
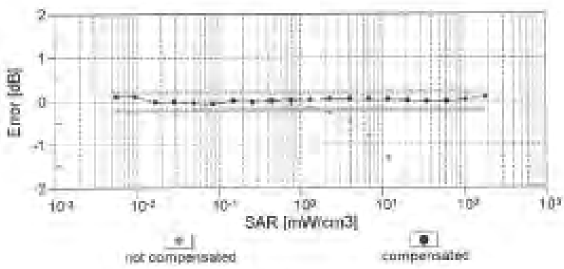
EX3DV4– SN:3923 September 2, 2016

Dynamic Range f(SAR$_{head}$)

(TEM cell , f_{eval}= 1900 MHz)





Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Certificate No: EX3-3923_Sep16 Page 9 of 11

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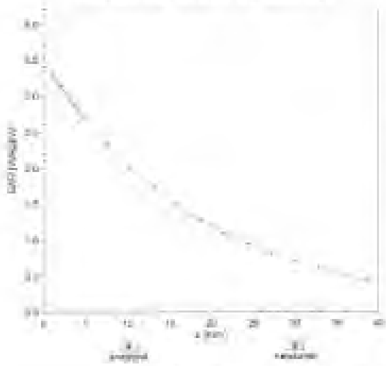
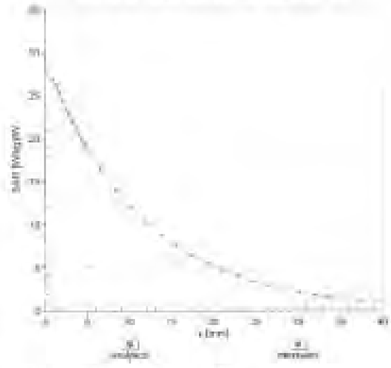
Conversion Factor Assessment

f = 835 MHz,WGLS R9 (H_convF)

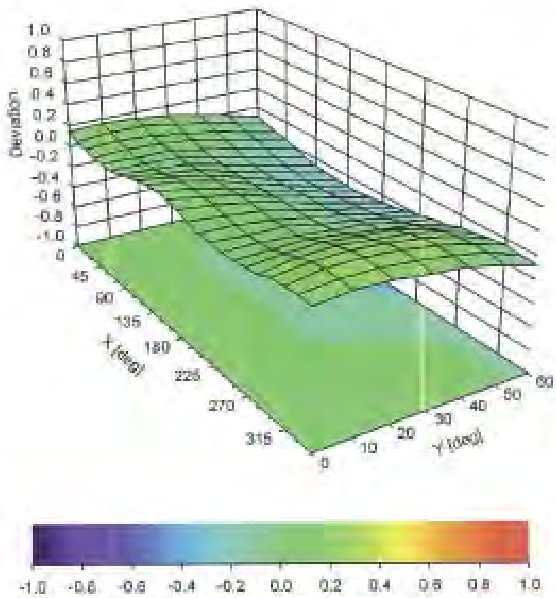


f = 1900 MHz,WGLS R22 (H_convF)



Deviation from Isotropy in Liquid

Error (φ, θ), f = 900 MHz



Uncertainty of Spherical Isotropy Assessment: ± 2.6% (k=2)

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DASY/EASY - Parameters of Probe: EX3DV4 - SN:3923

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	26.4
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 (3-6G)

A	c	D	e		f	g	h=c * f / e	i=c * g / e	k
Source of Uncertainty	Tolerance/ Uncertainty	Probability	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%	∞
Isotropy , Axial	3.50%	R	√3	1.732	1	1	2.02%	2.02%	∞
Isotropy, Hemispherical	9.60%	R	√3	1.732	1	1	5.54%	5.54%	∞
Modulation Response	2.40%	R	√3	1.732	1	1	1.40%	1.40%	∞
Boundary Effect	1.00%	R	√3	1.732	1	1	0.58%	0.58%	∞
Linearity	4.70%	R	√3	1.732	1	1	2.71%	2.71%	∞
Detection Limits	1.00%	R	√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	√3	1.732	1	1	0.46%	0.46%	∞
Integration Time	2.60%	R	√3	1.732	1	1	1.50%	1.50%	∞
Measurement drift (class A evaluation)	1.75%	R	√3	1.732	1	1	1.01%	1.01%	∞
RF ambient condition - noise	3.00%	R	√3	1.732	1	1	1.73%	1.73%	∞
RF ambient conditions - reflections	3.00%	R	√3	1.732	1	1	1.73%	1.73%	∞
Probe positioner Mechanical restrictions	0.40%	R	√3	1.732	1	1	0.23%	0.23%	∞
Probe Positioning with respect to phantom	2.90%	R	√3	1.732	1	1	1.67%	1.67%	∞
Post-processing	1.00%	R	√3	1.732	1	1	0.58%	0.58%	∞
Max SAR Eval	1.00%	R	√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	√3	1.732	1	1	2.89%	2.89%	∞
Phantom and Setup									
Phantom Uncertainty	4.00%	R	√3	1.732	1	1	2.31%	2.31%	∞
Liquid permittivity (mea.)	0.98%	N	1	1	0.64	0.43	0.63%	0.42%	M
Liquid Conductivity (mea.)	3.73%	N	1	1	0.6	0.49	2.24%	1.83%	M
Combined standard uncertainty		RSS					11.94%	11.86%	
Expant uncertainty (95% confidence							23.89%	23.71%	

Measurement Uncertainty evaluation template for DUT SAR test (0.3-3G)

A	c	D	e		f	g	h=c * f / e	i=c * g / e	k
Source of Uncertainty	Tolerance/ Uncertainty	Probability	Div	Div Value	ci (1g)	ci (10g)	Standard uncertainty	Standard uncertainty	vi, or Veff
Measurement system									
Probe calibration	6.00%	N	1	1	1	1	6.00%	6.00%	∞
Isotropy , Axial	3.50%	R	√3	1.732	1	1	2.02%	2.02%	∞
Isotropy, Hemispherical	9.60%	R	√3	1.732	1	1	5.54%	5.54%	∞
Modulation Response	2.40%	R	√3	1.732	1	1	1.40%	1.40%	∞
Boundary Effect	1.00%	R	√3	1.732	1	1	0.58%	0.58%	∞
Linearity	4.70%	R	√3	1.732	1	1	2.71%	2.71%	∞
Detection Limits	1.00%	R	√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	√3	1.732	1	1	0.46%	0.46%	∞
Integration Time	2.60%	R	√3	1.732	1	1	1.50%	1.50%	∞
Measurement drift (class A evaluation)	1.75%	R	√3	1.732	1	1	1.01%	1.01%	∞
RF ambient condition - noise	3.00%	R	√3	1.732	1	1	1.73%	1.73%	∞
RF ambient conditions - reflections	3.00%	R	√3	1.732	1	1	1.73%	1.73%	∞
Probe positioner Mechanical restrictions	0.40%	R	√3	1.732	1	1	0.23%	0.23%	∞
Probe Positioning with respect to phantom	2.90%	R	√3	1.732	1	1	1.67%	1.67%	∞
Post-processing	1.00%	R	√3	1.732	1	1	0.58%	0.58%	∞
Max SAR Eval	1.00%	R	√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	√3	1.732	1	1	2.89%	2.89%	∞
Phantom and Setup									
Phantom Uncertainty	4.00%	R	√3	1.732	1	1	2.31%	2.31%	∞
Liquid permittivity (mea.)	3.96%	N	1	1	0.64	0.43	2.53%	1.70%	M
Liquid Conductivity (mea.)	4.14%	N	1	1	0.6	0.49	2.48%	2.03%	M
Combined standard uncertainty		RSS					11.96%	11.71%	
Expant uncertainty (95% confidence							23.91%	23.42%	

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9. Phantom Description

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Phone +41 1 245 9700, Fax +41 1 245 9779
info@speag.com, http://www.speag.com

speag

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 ff.
Material thickness at ERP	Compliant with the requirements according to the standards	6mm +/- 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.	DEGMBE 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 I
[4] FCC OET Bulletin 65, 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

Signature / Stamp

speag
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info@speag.com, http://www.speag.com

Doc No 881 – QD 000 P40 C – F Page 1 (1)

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10. System Validation from Original Equipment Supplier

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

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

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

Accreditation No.: **SCS 0108**

Client **SGS-TW (Auden)**

Certificate No: **D835V2-4d063_Aug16**

CALIBRATION CERTIFICATE

Object: D835V2 - SN:4d063

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

Calibration date: August 25, 2016

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	06-Apr-16 (No. 217-02288/02289)	Apr-17
Power sensor NRP-Z91	SN: 103244	06-Apr-16 (No. 217-02288)	Apr-17
Power sensor NRP-Z91	SN: 103245	06-Apr-16 (No. 217-02289)	Apr-17
Reference 20 dB Attenuator	SN: 5058 (20k)	05-Apr-16 (No. 217-02292)	Apr-17
Type-N mismatch combination	SN: 5047.2 / 06327	05-Apr-16 (No. 217-02295)	Apr-17
Reference Probe EX3DV4	SN: 7349	15-Jun-16 (No. EX3-7349_Jun16)	Jun-17
DAE4	SN: 601	30-Dec-15 (No. DAE4-601_Dec15)	Dec-16

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter EPM-442A	SN: GB37480704	07-Oct-15 (No. 217-02222)	In house check: Oct-16
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (No. 217-02222)	In house check: Oct-16
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (No. 217-02223)	In house check: Oct-16
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Jun-15)	In house check: Oct-16
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-15)	In house check: Oct-16

	Name	Function	Signature
Calibrated by:	Michael Weber	Laboratory Technician	M.Weber
Approved by:	Katja Pokovic	Technical Manager	

Issued: August 29, 2016

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

Certificate No: D835V2-4d063_Aug16 Page 1 of 8

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

Accreditation No.: **SCS 0108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

e) 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%.

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Measurement Conditions

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

DASY Version	DASY5	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	835 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	42.1 ± 6 %	0.93 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	2.40 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**9.40 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.54 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**6.05 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	55.2	0.97 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	54.7 ± 6 %	1.01 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	2.47 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**9.57 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.61 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**6.28 W/kg ± 16.5 % (k=2)**

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Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.2 Ω - 2.8 jΩ
Return Loss	- 30.3 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	47.3 Ω - 5.5 jΩ
Return Loss	- 24.0 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.392 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	November 27, 2006

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DASY5 Validation Report for Head TSL

Date: 25.08.2016

Test Laboratory: SPEAG, Zurich, Switzerland

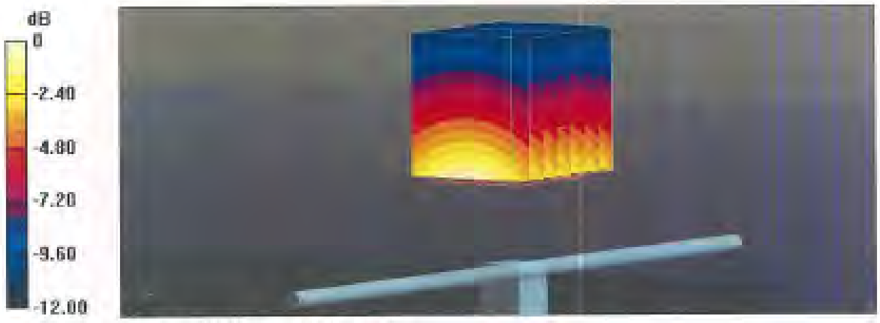
DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d063

Communication System: UID 0 - CW; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; σ = 0.93 S/m; ε_r = 42.1; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(9.72, 9.72, 9.72); Calibrated: 15.06.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

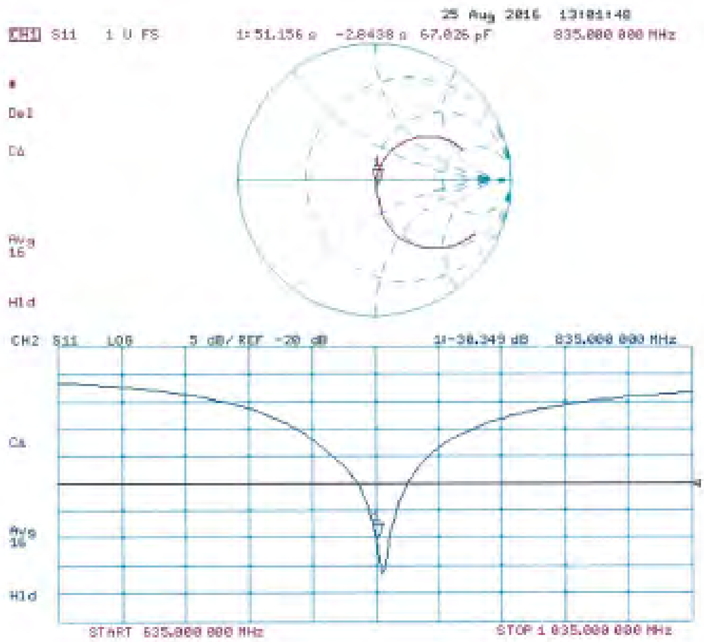
Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 61.75 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 3.65 W/kg
SAR(1 g) = 2.4 W/kg; SAR(10 g) = 1.54 W/kg
Maximum value of SAR (measured) = 3.24 W/kg



0 dB = 3.24 W/kg = 5.11 dBW/kg

Certificate No: D835V2-4d063_Aug16 Page 5 of 8

Impedance Measurement Plot for Head TSL



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DASY5 Validation Report for Body TSL

Date: 25.08.2016

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d063

Communication System: UID 0 - CW; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; σ = 1.01 S/m; ε_r = 54.7; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(9.73, 9.73, 9.73); Calibrated: 15.06.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

Dipole Calibration for Body Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 59.83 V/m; Power Drift = -0.00 dB
Peak SAR (extrapolated) = 3.63 W/kg
SAR(1 g) = 2.47 W/kg; SAR(10 g) = 1.61 W/kg
Maximum value of SAR (measured) = 3.25 W/kg

0 dB = 3.25 W/kg = 5.12 dBW/kg

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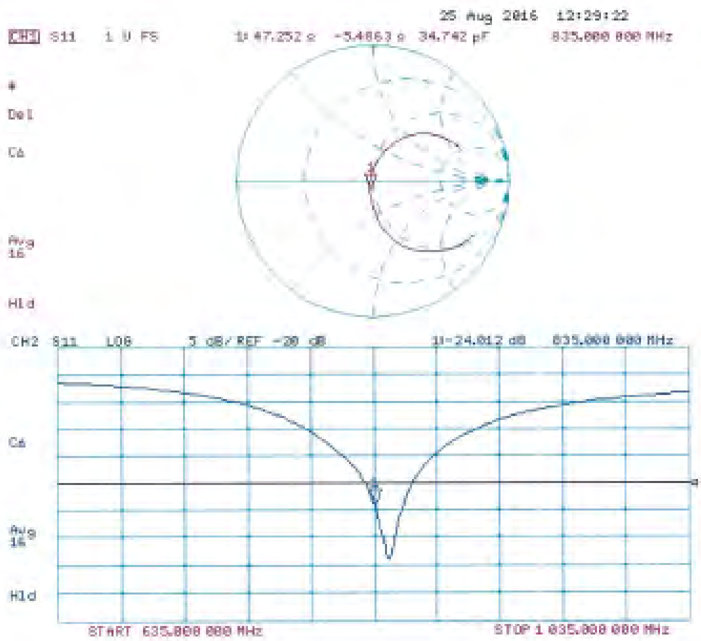
Impedance Measurement Plot for Body TSL



Certificate No: D835V2-4d063_Aug16 Page 8 of 8

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Accreditation No.: **SCS 0108**

Client **SGS-TW (Auden)**

Certificate No: **D1900V2-5d027_Apr16**

CALIBRATION CERTIFICATE

Object	D1900V2 - SN: 5d027
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date	April 25, 2016

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	06-Apr-16 (No. 217-02288/02289)	Apr-17
Power sensor NRP-Z91	SN: 103244	06-Apr-16 (No. 217-02288)	Apr-17
Power sensor NRP-Z91	SN: 103245	06-Apr-16 (No. 217-02289)	Apr-17
Reference 20 dB Attenuator	SN: 5058 (20k)	05-Apr-16 (No. 217-02292)	Apr-17
Type-N mismatch combination	SN: 5047.2 / 06327	05-Apr-16 (No. 217-02295)	Apr-17
Reference Probe EX3DV4	SN: 7349	31-Dec-15 (No. EX3-7349_Dec15)	Dec-16
DAE4	SN: 601	30-Dec-15 (No. DAE4-601_Dec15)	Dec-16
Secondary Standards	**ID #**	**Check Date (in house)**	**Scheduled Check**
Power meter EPM-442A	SN: GB37480704	07-Oct-15 (No. 217-02222)	In house check: Oct-16
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (No. 217-02222)	In house check: Oct-16
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (No. 217-02223)	In house check: Oct-16
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Jun-15)	In house check: Oct-16
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-15)	In house check: Oct-16

	Name	Function	Signature
Calibrated by:	Michael Weber	Laboratory Technician	M.Weber
Approved by:	Katja Pokovic	Technical Manager	

Issued: April 26, 2016

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Certificate No: D1900V2-5d027_Apr16 Page 1 of 8

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Accreditation No.: SCS 0108

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:

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

Additional Documentation:

e) 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%.

Certificate No: D1900V2-5d027_Apr15 Page 2 of 8

Measurement Conditions

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

DASY Version	DASY5	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	40.0 ± 6 %	1.37 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	9.55 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**38.7 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.03 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**20.3 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	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	52.9 ± 6 %	1.49 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	9.83 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**39.7 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.21 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**21.0 W/kg ± 16.5 % (k=2)**

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Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.8 Ω + 4.4 jΩ
Return Loss	- 27.0 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.5 Ω + 5.6 jΩ
Return Loss	- 23.3 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.196 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	December 17, 2002

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DASY5 Validation Report for Head TSL

Date: 25.04.2016

Test Laboratory: SPEAG, Zurich, Switzerland

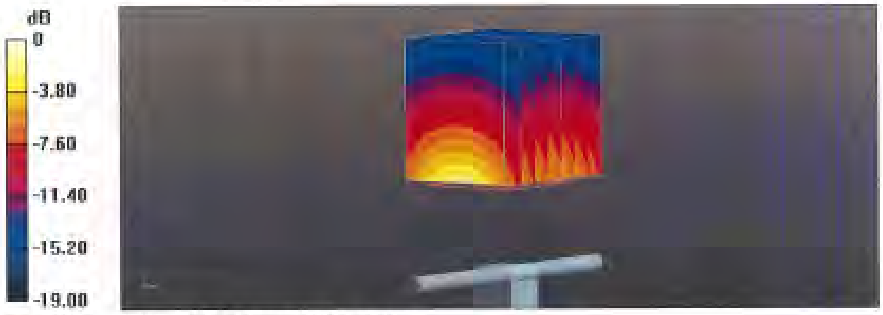
DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d027

Communication System: UID 0 - CW; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.37 S/m; ε_r = 40; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.2, 8.2, 8.2); Calibrated: 31.12.2015;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

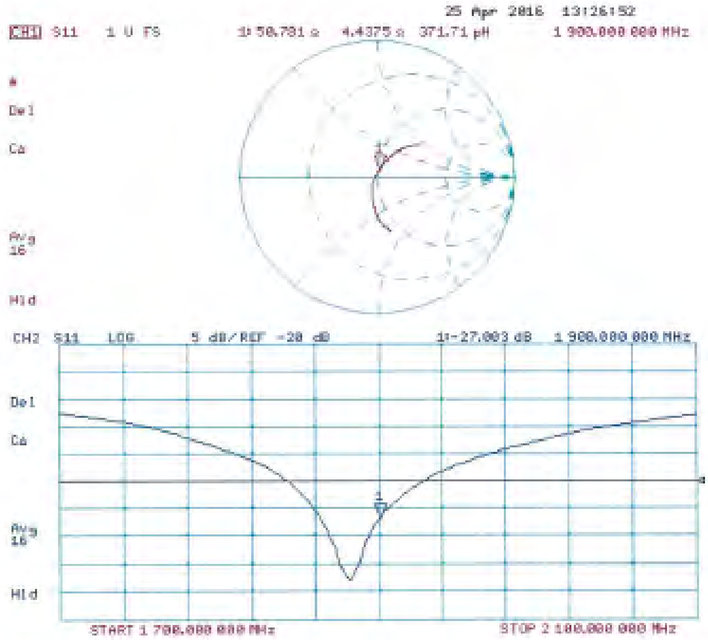
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 106.9 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 17.2 W/kg
SAR(1 g) = 9.55 W/kg; SAR(10 g) = 5.03 W/kg
Maximum value of SAR (measured) = 14.3 W/kg



0 dB = 14.3 W/kg = 11.55 dBW/kg

Certificate No: D1900V2-5d027_Apr16 Page 5 of 8

Impedance Measurement Plot for Head TSL



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DASY5 Validation Report for Body TSL

Date: 25.04.2016

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d027

Communication System: UID 0 - CW; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; $\sigma = 1.49$ S/m; $\varepsilon_r = 52.9$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.03, 8.03, 8.03); Calibrated: 31.12.2015;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

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 = 104.2 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 17.2 W/kg
SAR(1 g) = 9.83 W/kg; SAR(10 g) = 5.21 W/kg
Maximum value of SAR (measured) = 14.7 W/kg

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

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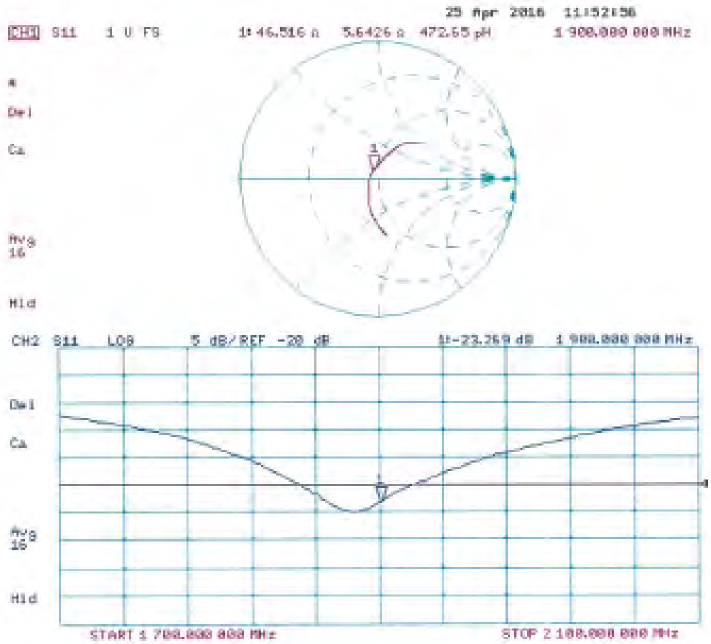
Impedance Measurement Plot for Body TSL



Certificate No: D1900V2-5d027_Apr16 Page 8 of 8

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Accreditation No.: SCS 0108

Client SGS-TW (Auden)

Certificate No: D2450V2-727_Apr16

CALIBRATION CERTIFICATE

Object	D2450V2 - SN:727
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	April 19, 2016

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	06-Apr-16 (No. 217-02288/02289)	Apr-17
Power sensor NRP-Z91	SN: 103244	06-Apr-16 (No. 217-02288)	Apr-17
Power sensor NRP-Z91	SN: 103245	06-Apr-16 (No. 217-02289)	Apr-17
Reference 20 dB Attenuator	SN: 5058 (20k)	05-Apr-16 (No. 217-02292)	Apr-17
Type-N mismatch combination	SN: 5047.2 / 06327	05-Apr-16 (No. 217-02295)	Apr-17
Reference Probe EX3DV4	SN: 7349	31-Dec-15 (No. EX3-7349_Dec15)	Dec-16
DAE4	SN: 601	30-Dec-15 (No. DAE4-601_Dec15)	Dec-16

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter EPM-442A	SN: GB37480704	07-Oct-15 (No. 217-02222)	In house check: Oct-16
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (No. 217-02222)	In house check: Oct-16
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (No. 217-02223)	In house check: Oct-16
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Jun-15)	In house check: Oct-16
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-15)	In house check: Oct-16

	Name	Function	Signature
Calibrated by:	Michael Weber	Laboratory Technician	M.Weber
Approved by:	Katja Pokovic	Technical Manager	

Issued: April 20, 2016

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Accreditation No.: SCS 0108

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:

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

Additional Documentation:

e) 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%.

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Measurement Conditions

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

DASY Version	DASY5	V52.8.8
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	40.0 ± 6 %	1.83 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	12.8 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**51.0 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.93 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**23.7 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	52.7 ± 6 %	1.98 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	12.5 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**49.6 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.86 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**23.3 W/kg ± 16.5 % (k=2)**

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Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	55.3 Ω + 2.0 jΩ
Return Loss	- 25.4 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	52.1 Ω + 4.8 jΩ
Return Loss	- 25.9 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.148 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	January 09, 2003

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DASY5 Validation Report for Head TSL

Date: 19.04.2016

Test Laboratory: SPEAG, Zurich, Switzerland

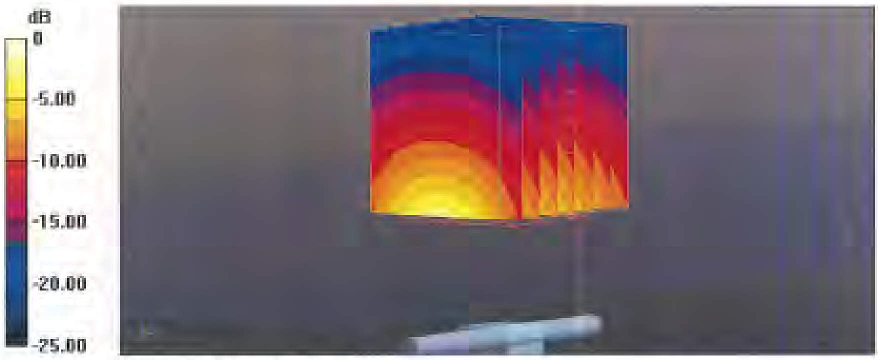
DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 727

Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 1.83 S/m; ε_r = 40; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(7.76, 7.76, 7.76); Calibrated: 31.12.2015;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

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 = 112.1 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 25.7 W/kg
SAR(1 g) = 12.8 W/kg; SAR(10 g) = 5.93 W/kg
Maximum value of SAR (measured) = 20.8 W/kg



0 dB = 20.8 W/kg = 13.18 dBW/kg

Certificate No: D2450V2-727_Apr16

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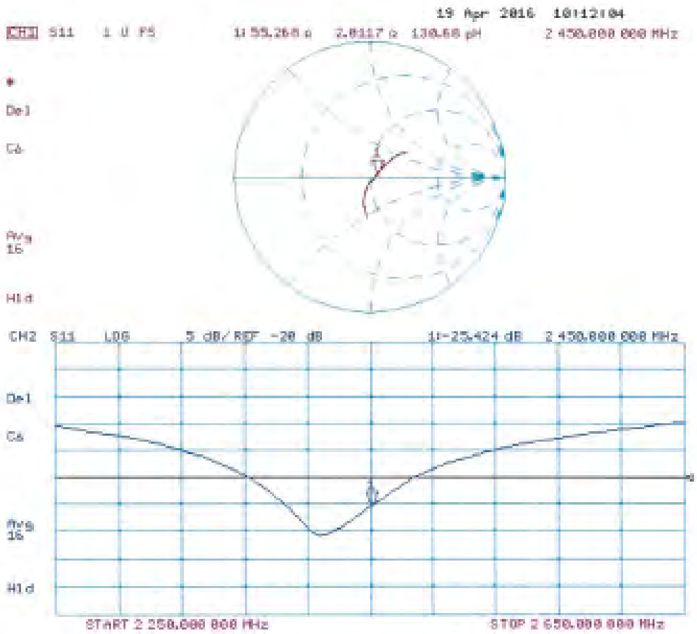
Impedance Measurement Plot for Head TSL



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Accreditation No.: **SCS 0108**

Client **SGS-TW (Auden)**

Certificate No: **D5GHzV2-1023_Jan16**

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 26, 2016

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	07-Oct-15 (No. 217-02222)	Oct-16
Power sensor HP 8481A	US37292783	07-Oct-15 (No. 217-02222)	Oct-16
Power sensor HP 8481A	MY41092317	07-Oct-15 (No. 217-02223)	Oct-16
Reference 20 dB Attenuator	SN: 5058 (20k)	01-Apr-15 (No. 217-02131)	Mar-16
Type-N mismatch combination	SN: 5047.2 / 06327	01-Apr-15 (No. 217-02134)	Mar-16
Reference Probe EX3DV4	SN: 3503	31-Dec-15 (No. EX3-3503_Dec15)	Dec-16
DAE4	SN: 601	30-Dec-15 (No. DAE4-601_Dec15)	Dec-16

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100972	15-Jun-15 (in house check Jun-15)	In house check: Jun-18
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-15)	In house check: Oct-16

	Name	Function	Signature
Calibrated by:	Michael Weber	Laboratory Technician	M.Weber
Approved by:	Katja Pokovic	Technical Manager	

Issued: January 28, 2016

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

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Accreditation No.: **SCS 0108**

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:

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

Additional Documentation:

d) 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	V52.8.8
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 ± 1 MHz 5300 MHz ± 1 MHz 5600 MHz ± 1 MHz 5800 MHz ± 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	4.66 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.2 ± 6 %	4.51 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5200 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.74 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**77.0 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.23 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**22.1 W/kg ± 19.5 % (k=2)**

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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 ± 0.2) °C	35.1 ± 6 %	4.60 mho/m ± 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	8.03 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**79.9 W / kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.33 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**23.1 W/kg ± 19.5 % (k=2)**

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	34.7 ± 6 %	4.90 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	8.31 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**82.6 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.38 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**23.6 W/kg ± 19.5 % (k=2)**

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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	34.4 ± 6 %	5.10 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	7.78 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**77.3 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.22 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**22.0 W/kg ± 19.5 % (k=2)**

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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	47.1 ± 6 %	5.37 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	7.25 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**71.9 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	**20.3 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	46.9 ± 6 %	5.50 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	7.57 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**75.1 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.14 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**21.2 W/kg ± 19.5 % (k=2)**

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Body TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.5	5.77 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.4 ± 6 %	5.91 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	7.89 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**78.3 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	**22.1 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	46.0 ± 6 %	6.19 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	7.59 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**75.3 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	**21.1 W/kg ± 19.5 % (k=2)**

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Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL at 5200 MHz

Impedance, transformed to feed point	49.1 Ω - 8.4 jΩ
Return Loss	- 21.4 dB

Antenna Parameters with Head TSL at 5300 MHz

Impedance, transformed to feed point	49.6 Ω - 4.2 jΩ
Return Loss	- 27.4 dB

Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	54.9 Ω - 1.4 jΩ
Return Loss	- 26.3 dB

Antenna Parameters with Head TSL at 5800 MHz

Impedance, transformed to feed point	55.9 Ω + 2.2 jΩ
Return Loss	- 24.5 dB

Antenna Parameters with Body TSL at 5200 MHz

Impedance, transformed to feed point	49.4 Ω - 6.8 jΩ
Return Loss	- 23.3 dB

Antenna Parameters with Body TSL at 5300 MHz

Impedance, transformed to feed point	50.9 Ω - 2.4 jΩ
Return Loss	- 31.8 dB

Antenna Parameters with Body TSL at 5600 MHz

Impedance, transformed to feed point	56.0 Ω - 0.1 jΩ
Return Loss	- 25.0 dB

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Antenna Parameters with Body TSL at 5800 MHz

Impedance, transformed to feed point	56.4 Ω + 2.4 jΩ
Return Loss	- 23.8 dB

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

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DASY5 Validation Report for Head TSL

Date: 26.01.2016

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: UID 0 - CW; Frequency: 5200 MHz, Frequency: 5300 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz
Medium parameters used: f = 5200 MHz; σ = 4.51 S/m; ε_r = 35.2; ρ = 1000 kg/m^3 , Medium parameters used: f = 5300 MHz; σ = 4.6 S/m; ε_r = 35.1; ρ = 1000 kg/m^3 , Medium parameters used: f = 5600 MHz; σ = 4.9 S/m; ε_r = 34.7; ρ = 1000 kg/m^3 , Medium parameters used: f = 5800 MHz; σ = 5.1 S/m; ε_r = 34.4; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.59, 5.59, 5.59); Calibrated: 31.12.2015, ConvF(5.25, 5.25, 5.25); Calibrated: 31.12.2015, ConvF(4.99, 4.99, 4.99); Calibrated: 31.12.2015, ConvF(4.95, 4.95, 4.95); Calibrated: 31.12.2015;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

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 = 72.68 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 28.1 W/kg
SAR(1 g) = 7.74 W/kg; SAR(10 g) = 2.23 W/kg
Maximum value of SAR (measured) = 17.8 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 = 73.14 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 30.0 W/kg
SAR(1 g) = 8.03 W/kg; SAR(10 g) = 2.33 W/kg
Maximum value of SAR (measured) = 18.7 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 = 73.32 V/m; Power Drift = 0.08 dB
Peak SAR (extrapolated) = 32.6 W/kg
SAR(1 g) = 8.31 W/kg; SAR(10 g) = 2.38 W/kg
Maximum value of SAR (measured) = 19.8 W/kg

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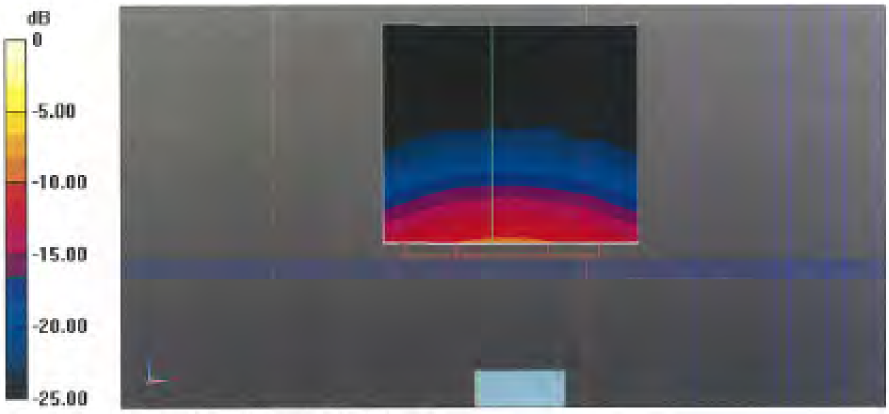
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 70.15 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 32.0 W/kg
SAR(1 g) = 7.78 W/kg; SAR(10 g) = 2.22 W/kg
Maximum value of SAR (measured) = 18.8 W/kg



0 dB = 18.8 W/kg = 12.74 dBW/kg

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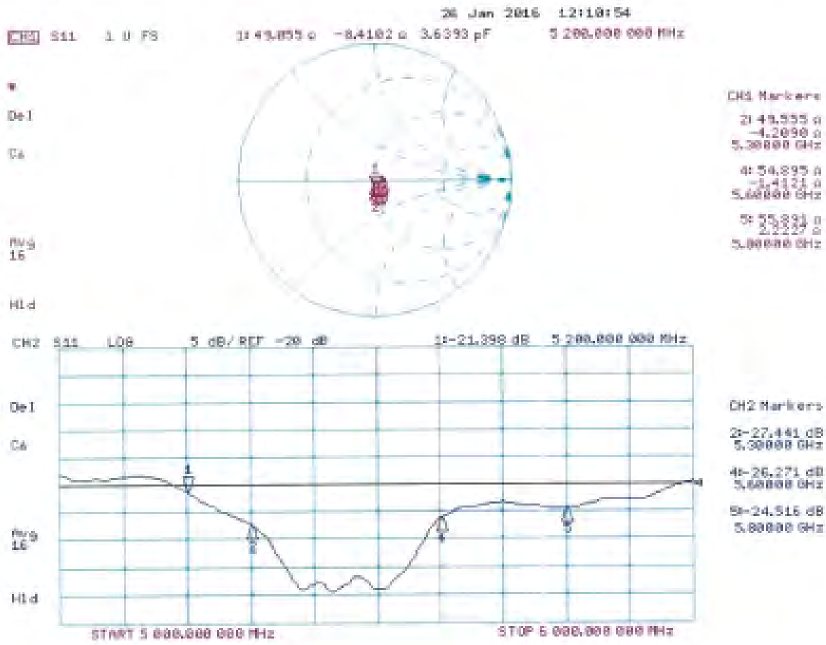
Impedance Measurement Plot for Head TSL



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DASY5 Validation Report for Body TSL

Date: 25.01.2016

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: 5600 MHz, Frequency: 5800 MHz
Medium parameters used: f = 5200 MHz; σ = 5.37 S/m; ε_r = 47.1; ρ = 1000 kg/m^3 , Medium parameters used: f = 5300 MHz; σ = 5.5 S/m; ε_r = 46.9; ρ = 1000 kg/m^3 , Medium parameters used: f = 5600 MHz; σ = 5.91 S/m; ε_r = 46.4; ρ = 1000 kg/m^3 , Medium parameters used: f = 5800 MHz; σ = 6.19 S/m; ε_r = 46; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(4.99, 4.99, 4.99); Calibrated: 31.12.2015, ConvF(4.75, 4.75, 4.75); Calibrated: 31.12.2015, ConvF(4.35, 4.35, 4.35); Calibrated: 31.12.2015, ConvF(4.27, 4.27, 4.27); Calibrated: 31.12.2015;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

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 = 66.72 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 27.1 W/kg
SAR(1 g) = 7.25 W/kg; SAR(10 g) = 2.05 W/kg
Maximum value of SAR (measured) = 16.8 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 = 67.43 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 29.1 W/kg
SAR(1 g) = 7.57 W/kg; SAR(10 g) = 2.14 W/kg
Maximum value of SAR (measured) = 17.7 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 = 67.67 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 32.6 W/kg
SAR(1 g) = 7.89 W/kg; SAR(10 g) = 2.23 W/kg
Maximum value of SAR (measured) = 19.1 W/kg

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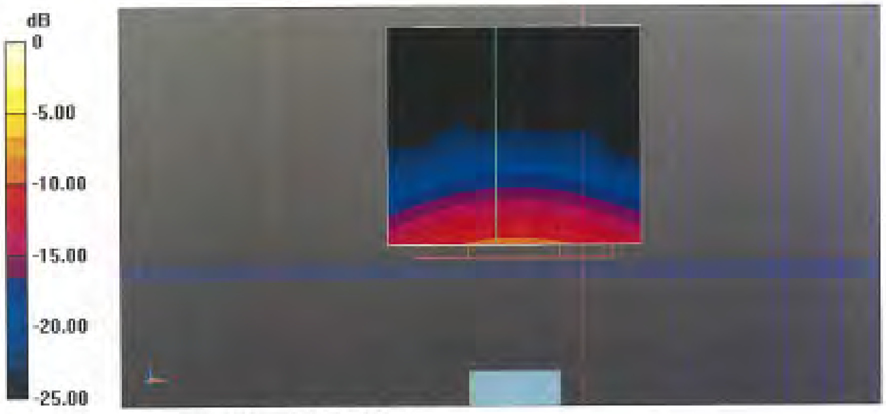
Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 65.76 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 33.0 W/kg
SAR(1 g) = 7.59 W/kg; SAR(10 g) = 2.13 W/kg
Maximum value of SAR (measured) = 18.5 W/kg



0 dB = 18.5 W/kg = 12.67 dBW/kg

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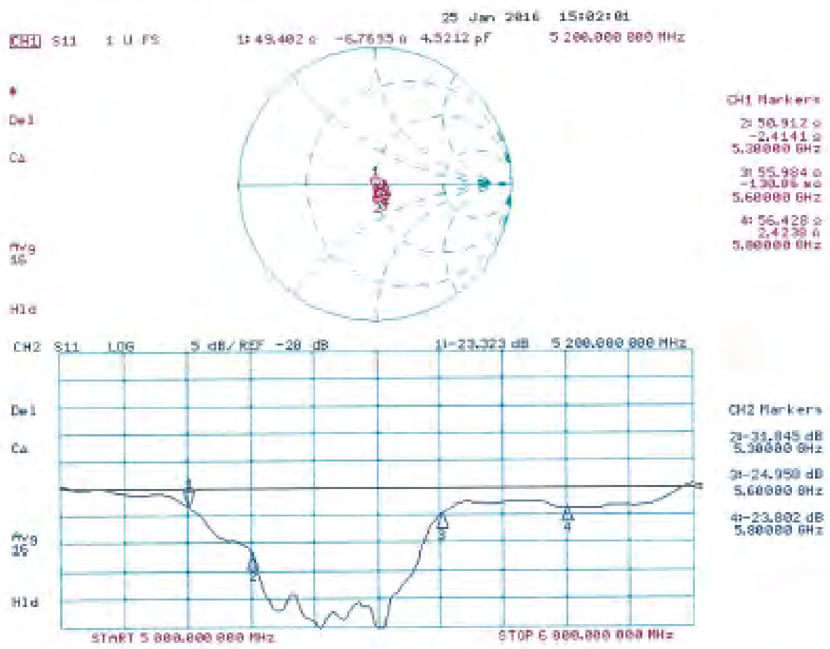
Impedance Measurement Plot for Body TSL



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- End of 1st part of report -

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