

SAR TEST REPORT

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

Equipment Under Test	Tablet
Marketing Name	HP 7 Plus G2
Brand Name	HP
Model No.	HSTNH-B407D
Company Name	Hewlett-Packard Company
Company Address	1501 Page Mill Road, Palo Alto, CA 94304, United States
Standards	IEEE /ANSI C95.1 , C95.3, IEEE 1528, KDB248227 D01, KDB616217 D04, KDB865664 D01, KDB865664D02, KDB941225 D01, KDB941225 D02, KDB941225 D03, B94HHB407D
FCC ID	B94HHB407D
Date of Receipt	Jul. 24, 2014
Date of Test(s)	Aug. 13, 2014 ~ Aug. 19, 2014
Date of Issue	Aug. 27, 2014

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

Remarks:

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

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Signed on behalf of SGS

Engineer

Sam Kuo

Date: Aug. 27, 2014

Sr. Engineer

John Yeh

Date: Aug. 27, 2014

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Version

Report Number	Revision	Date	Memo
ES/2014/70006	00	2014/8/27	Initial creation of test report.

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

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Contents

1. General Information	4
1.1 Testing Laboratory	4
1.2 Details of Applicant	4
1.3 Description of EUT	5
1.4 Test Environment	14
1.5 Operation Description	14
1.6 Proximity sensor operation description	19
1.7 The SAR Measurement System	26
1.8 System Components	28
1.9 SAR System Verification	30
1.10 Tissue Simulant Fluid for the Frequency Band	32
1.11 Evaluation Procedures	34
1.12 Probe Calibration Procedures	35
1.13 Test Standards and Limits	38
2. Summary of Results	40
3. Simultaneous Transmission Analysis	45
3.1 Estimated SAR calculation	46
3.2 SPLSR evaluation and analysis	47
4. Instruments List	60
5. Measurements	62
6. SAR System Performance Verification	73
7. DAE & Probe Calibration Certificate	77
8. Uncertainty Budget	109
9. Phantom Description	110
10. System Validation from Original Equipment Supplier	111

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1. General Information

1.1 Testing Laboratory

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Fax	+886-2-2298-0488
Internet	http://www.tw.sgs.com/

1.2 Details of Applicant

Company Name	Hewlett-Packard Company
Company Address	1501 Page Mill Road, Palo Alto, CA 94304, United States

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1.3 Description of EUT

Equipment Under Test	Tablet	
Marketing Name	HP 7 Plus G2	
Brand Name	HP	
Model No.	HSTNH-B407D	
FCC ID	B94HHB407D	
Mode of Operation	☒ GPRS ☒ EDGE ☒ WCDMA ☒ HSDPA ☒ HSUPA ☒ HSUPA+ ☒ WLAN802.11 b/g/n (20M) ☒ Bluetooth	
Duty Cycle	GPRS	1/2 (1Dn4UP) 1/2.76 (1Dn3UP) 1/4.1 (1Dn2UP) 1/8.3 (1Dn1UP)
	EDGE	1/2 (1Dn4UP) 1/2.76 (1Dn3UP) 1/4.1 (1Dn2UP) 1/8.3 (1Dn1UP)
	WCDMA	1
	WLAN802.11 b/g/n (20M)	1
	Bluetooth	1

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TX Frequency Range (MHz)	GPRS850	824.2	—	848.8	
	GPRS1900	1850.2	—	1909.8	
	WCDMA Band II	1852.4	—	1907.6	
	WCDMA Band IV	1712.4	—	1752.6	
	WCDMA Band V	826.4	—	846.6	
	WLAN802.11 b/g/n(20M)	2412	—	2462	
	Bluetooth	2402	—	2480	
Channel Number (ARFCN)	GPRS850	128	—	251	
	GPRS1900	512	—	810	
	WCDMA Band II	9262	—	9538	
	WCDMA Band IV	1312	—	1513	
	WCDMA Band V	4132	—	4233	
	WLAN802.11 b/g/n(20M)	1	—	11	
	Bluetooth	0	—	78	
Max. SAR (1 g) (Unit: W/Kg)					
Band		Measured	Reported	Channel	Position
GPRS 850		1.03	1.21	251	Back side
GRPS 1900		1.26	1.35	661	Back side
WCDMA Band II		0.626	0.682	9262	Back side
WCDMA Band IV		0.986	1.127	1412	Back side
WCDMA Band V		0.999	1.134	4183	Back side
WLAN802.11b		1.23	1.23	2437	Back side*

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

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GPRS/EDGE conducted power table:

Burst average power						
Max. Rated Avg. Power + Max. Tolerance (dBm)			33.5	31	29.5	28
			1Dn1UP	1Dn2UP	1Dn3UP	1Dn4UP
EUT mode	Frequency (MHz)	CH	Avg. (dBm)	Avg. (dBm)	Avg. (dBm)	Avg. (dBm)
GPRS 850 (GMSK)	824.2	128	32.20	30.00	28.50	27.10
	836.6	190	32.40	30.00	28.50	27.10
	848.8	251	32.50	30.10	28.60	27.20
Source-based time average power						
GPRS 850 (GMSK)	824.2	128	23.17	23.98	24.24	24.09
	836.6	190	23.37	23.98	24.24	24.09
	848.8	251	23.47	24.08	24.34	24.19
The division factor compared to the number of TX time slot						
Division factor			1 TX time slot	2 TX time slot	3 TX time slot	4 TX time slot
			-9.03	-6.02	-4.26	-3.01

Burst average power						
Max. Rated Avg. Power + Max. Tolerance (dBm)			28	25.5	24	22.5
			1Dn1UP	1Dn2UP	1Dn3UP	1Dn4UP
EUT mode	Frequency (MHz)	CH	Avg. (dBm)	Avg. (dBm)	Avg. (dBm)	Avg. (dBm)
EDGE 850	824.2	128	26.30	23.80	22.30	20.70
	836.6	190	26.30	23.90	22.40	20.80
	848.8	251	26.40	24.00	22.40	20.90
Source-based time average power						
EDGE 850	824.2	128	17.27	17.78	18.04	17.69
	836.6	190	17.27	17.88	18.14	17.79
	848.8	251	17.37	17.98	18.14	17.89
The division factor compared to the number of TX time slot						
Division factor			1 TX time slot	2 TX time slot	3 TX time slot	4 TX time slot
			-9.03	-6.02	-4.26	-3.01

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Burst average power						
Max. Rated Avg. Power + Max. Tolerance (dBm)			30.5	28	26.5	25
			1Dn1UP	1Dn2UP	1Dn3UP	1Dn4UP
EUT mode	Frequency (MHz)	CH	Avg. (dBm)	Avg. (dBm)	Avg. (dBm)	Avg. (dBm)
GPRS 1900 (GMSK)	1850.2	512	30.00	27.30	25.80	24.40
	1880	661	30.00	27.20	25.80	24.40
	1909.8	810	30.00	27.20	25.80	24.30
Source-based time average power						
GPRS 1900 (GMSK)	1850.2	512	20.97	21.28	21.54	21.39
	1880	661	20.97	21.18	21.54	21.39
	1909.8	810	20.97	21.18	21.54	21.29
The division factor compared to the number of TX time slot						
Division factor			1 TX time slot	2 TX time slot	3 TX time slot	4 TX time slot
			-9.03	-6.02	-4.26	-3.01

Burst average power						
Max. Rated Avg. Power + Max. Tolerance (dBm)			27	24.5	23	21.5
			1Dn1UP	1Dn2UP	1Dn3UP	1Dn4UP
EUT mode	Frequency (MHz)	CH	Avg. (dBm)	Avg. (dBm)	Avg. (dBm)	Avg. (dBm)
EDGE 1900	1850.2	512	25.80	23.50	21.90	20.40
	1880	661	25.80	23.30	22.00	20.50
	1909.8	810	25.80	23.40	21.90	20.50
Source-based time average power						
EDGE 1900	1850.2	512	16.77	17.48	17.64	17.39
	1880	661	16.77	17.28	17.74	17.49
	1909.8	810	16.77	17.38	17.64	17.49
The division factor compared to the number of TX time slot						
Division factor			1 TX time slot	2 TX time slot	3 TX time slot	4 TX time slot
			-9.03	-6.02	-4.26	-3.01

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GPRS 850 / GPRS 1900 / EDGE 1900 conducted power table (Reduced power):

Burst average power						
Max. Rated Avg. Power + Max. Tolerance (dBm)			30.5	28	26.5	25
			1Dn1UP	1Dn2UP	1Dn3UP	1Dn4UP
EUT mode	Frequency (MHz)	CH	Avg. (dBm)	Avg. (dBm)	Avg. (dBm)	Avg. (dBm)
GPRS 850 (GMSK)	824.2	128	30.30	27.40	25.70	24.40
	836.6	190	30.20	27.40	25.70	24.40
	848.8	251	30.50	27.50	25.80	24.50
Source-based time average power						
GPRS 850 (GMSK)	824.2	128	21.27	21.38	21.44	21.39
	836.6	190	21.17	21.38	21.44	21.39
	848.8	251	21.47	21.48	21.54	21.49
The division factor compared to the number of TX time slot						
Division factor			1 TX time slot	2 TX time slot	3 TX time slot	4 TX time slot
			-9.03	-6.02	-4.26	-3.01

Burst average power						
Max. Rated Avg. Power + Max. Tolerance (dBm)			24.5	22	20.5	19
			1Dn1UP	1Dn2UP	1Dn3UP	1Dn4UP
EUT mode	Frequency (MHz)	CH	Avg. (dBm)	Avg. (dBm)	Avg. (dBm)	Avg. (dBm)
GPRS 1900 (GMSK)	1850.2	512	24.80	21.90	20.10	18.80
	1880	661	24.80	21.90	20.20	18.80
	1909.8	810	24.80	21.80	20.20	18.80
Source-based time average power						
GPRS 1900 (GMSK)	1850.2	512	15.77	15.88	15.84	15.79
	1880	661	15.77	15.88	15.94	15.79
	1909.8	810	15.77	15.78	15.94	15.79
The division factor compared to the number of TX time slot						
Division factor			1 TX time slot	2 TX time slot	3 TX time slot	4 TX time slot
			-9.03	-6.02	-4.26	-3.01

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Burst average power						
Max. Rated Avg. Power + Max. Tolerance (dBm)			24	21.5	20	18.5
			1Dn1UP	1Dn2UP	1Dn3UP	1Dn4UP
EUT mode	Frequency (MHz)	CH	Avg. (dBm)	Avg. (dBm)	Avg. (dBm)	Avg. (dBm)
EDGE 1900	1850.2	512	23.50	20.70	18.90	17.60
	1880	661	23.50	20.60	18.80	17.60
	1909.8	810	23.40	20.60	18.80	17.50
Source-based time average power						
EDGE 1900	1850.2	512	14.47	14.68	14.64	14.59
	1880	661	14.47	14.58	14.54	14.59
	1909.8	810	14.37	14.58	14.54	14.49
The division factor compared to the number of TX time slot						
Division factor			1 TX time slot	2 TX time slot	3 TX time slot	4 TX time slot
			-9.03	-6.02	-4.26	-3.01

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WCDMA Band II / Band IV / Band V - HSDPA / HSUPA / HSDPA+ conducted power table:

Band	CH	Max. Rated Avg. Power + Max. Tolerance (dBm)	Rel99 AV(dBm)	HSDPA mode AV(dBm)				HSUPA mode AV(dBm)					HSPA+ mode AV(dBm)				
				SUB-1	SUB-2	SUB-3	SUB-4	SUB-1	SUB-2	SUB-3	SUB-4	SUB-5	SUB-1	SUB-2	SUB-3	SUB-4	SUB-5
WCDMA Band II Rel 7	9262	24.5	24.38	22.01	24.26	21.53	21.6	24.30	22.27	23.28	22.40	21.65	24.31	22.29	23.28	22.40	24.11
	9400	24.5	24.23	22.20	24.09	21.64	21.65	24.21	22.26	23.21	22.31	21.59	24.20	22.24	23.19	22.28	24.05
	9538	24.5	24.18	22.02	24.03	21.35	21.47	24.12	22.10	23.14	22.14	21.51	24.13	22.12	23.14	22.16	23.99
WCDMA Band IV Rel 7	1312	24.5	23.26	22.07	23.14	21.59	21.66	23.18	21.15	22.16	21.28	21.75	23.19	21.17	22.16	21.28	22.99
	1412	24.5	23.12	22.03	22.98	21.47	21.48	23.10	21.15	22.10	21.20	21.71	23.09	21.13	22.08	21.17	22.94
	1513	24.5	23.28	22.21	23.13	21.54	21.66	23.22	21.20	22.24	21.24	21.92	23.23	21.22	22.24	21.26	23.09
WCDMA Band V Rel 7	4132	24.5	23.64	22.73	23.57	22.06	22.11	23.60	21.62	22.60	21.67	22.38	23.61	21.64	22.59	21.67	23.42
	4183	24.5	23.59	22.66	23.48	22.04	22.08	23.52	21.53	22.51	21.59	22.28	23.51	21.53	22.51	21.59	23.28
	4233	24.5	23.78	22.91	23.65	22.54	22.60	23.70	21.66	22.70	21.72	22.51	23.69	21.66	22.68	21.72	23.51

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

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_{ed1} : 47/15 β_{ed2} : 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

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WCDMA Band IV - HSDPA / HSUPA / HSPA+ conducted power table (Reduced power) :

Band	CH	Max. Rated Avg. Power + Max. Tolerance (dBm)	Rel99 AV(dBm)	HSDPA mode AV(dBm)				HSUPA mode AV(dBm)					HSPA+ mode AV(dBm)				
				SUB-1	SUB-2	SUB-3	SUB-4	SUB-1	SUB-2	SUB-3	SUB-4	SUB-5	SUB-1	SUB-2	SUB-3	SUB-4	SUB-5
WCDMA Band II Rel 7	9262	13	12.63	12.56	12.51	12.08	12.15	12.55	10.52	11.53	10.65	12.60	12.56	10.54	11.53	10.65	12.36
	9400	13	12.55	12.38	12.41	11.82	11.83	12.53	10.58	11.53	10.63	12.49	12.52	10.56	11.51	10.60	12.37
	9538	13	12.34	12.22	12.19	11.55	11.67	12.28	10.26	11.30	10.30	12.44	12.29	10.28	11.30	10.32	12.15
WCDMA Band IV Rel 7	1312	14	13.75	13.33	13.63	12.85	12.92	13.67	11.64	12.65	11.77	13.42	13.68	11.66	12.65	11.77	13.48
	1412	14	13.42	13.09	13.28	12.53	12.54	13.40	11.45	12.40	11.50	13.06	13.39	11.43	12.38	11.47	13.24
	1513	14	13.78	13.41	13.63	12.74	12.86	13.72	11.70	12.74	11.74	13.37	13.73	11.72	12.74	11.76	13.59
WCDMA Band V Rel 7	4132	21	20.48	20.38	20.41	19.71	19.76	20.44	18.46	19.44	18.51	20.52	20.45	18.48	19.43	18.51	20.26
	4183	21	20.45	20.37	20.34	19.75	19.79	20.38	18.39	19.37	18.45	20.44	20.37	18.39	19.37	18.45	20.14
	4233	21	20.63	20.52	20.50	20.15	20.21	20.55	18.51	19.55	18.57	20.50	20.54	18.51	19.53	18.57	20.36

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

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_{ed1} : 47/15 β_{ed2} : 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

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

802.11 b		Max. Rated Avg. Power + Max. Tolerance (dBm)	Average Power Output (dBm)			
CH	Frequency (MHz)		Data Rate (Mbps)			
			1	2	5.5	11
1	2412	11.0	10.68	10.55	10.29	9.71
6	2437	11.0	11.00	10.87	10.78	10.22
11	2462	11.0	10.28	10.18	9.90	9.59

802.11 g		Max. Rated Avg. Power + Max. Tolerance (dBm)	Average Power Output(dBm)							
CH	Frequency (MHz)		Data Rate (Mbps)							
			6	9	12	18	24	36	48	54
1	2412	11.0	10.59	10.31	10.10	9.54	9.14	8.54	8.09	8.01
6	2437	11.0	10.91	10.62	10.41	9.90	9.48	8.86	8.35	8.28
11	2462	11.0	10.19	9.88	9.70	9.17	8.73	8.12	7.41	7.25

802.11 n (20M)		Max. Rated Avg. Power + Max. Tolerance (dBm)	Average Power Output(dBm)							
CH	Frequency (MHz)		Data Rate (Mbps)							
			6.5	13	19.5	26	39	52	58.5	65
1	2412	11.0	10.47	9.86	9.44	8.92	8.36	7.88	7.74	7.34
6	2437	11.0	10.82	10.24	9.83	9.33	8.81	8.39	8.09	8.02
11	2462	11.0	10.90	10.52	10.13	9.63	9.06	8.59	8.38	8.11

#. Bluetooth maximum power table:

Mode	Max. tune-up power(dBm)	Max. tune-up power(mW)
All	4	2.512

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1.4 Test Environment

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

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

1.5 Operation Description

1. WWAN (GPRS/EDGE/WCDMA/HSDPA/HSUPA):

The EUT is controlled by using Radio Communication Testers (R&S CMU200), and the communication between the EUT and the testers is established by air link. The EUT is tested in four configurations:

Configuration 1: Back side_0mm with power reduction and_17mm without power reduction.

Configuration 2: Bottom side_0mm with power reduction and_16mm without power reduction.

Configuration 3: Right side_0mm without power reduction.

Configuration 4: Left side_0mm without power reduction.

Configuration 5: Top side. (Not required to be tested because the SAR test exclusion threshold in FCC KDB447498 D01 is applied to this side.)

Band	Power Reduction
GPRS850	YES
EDGE850	NO
GPRS1900	YES
EDGE1900	YES
WCDMA B2	YES
WCDMA B4	YES
WCDMA B5	YES
WLAN	NO
BT	NO

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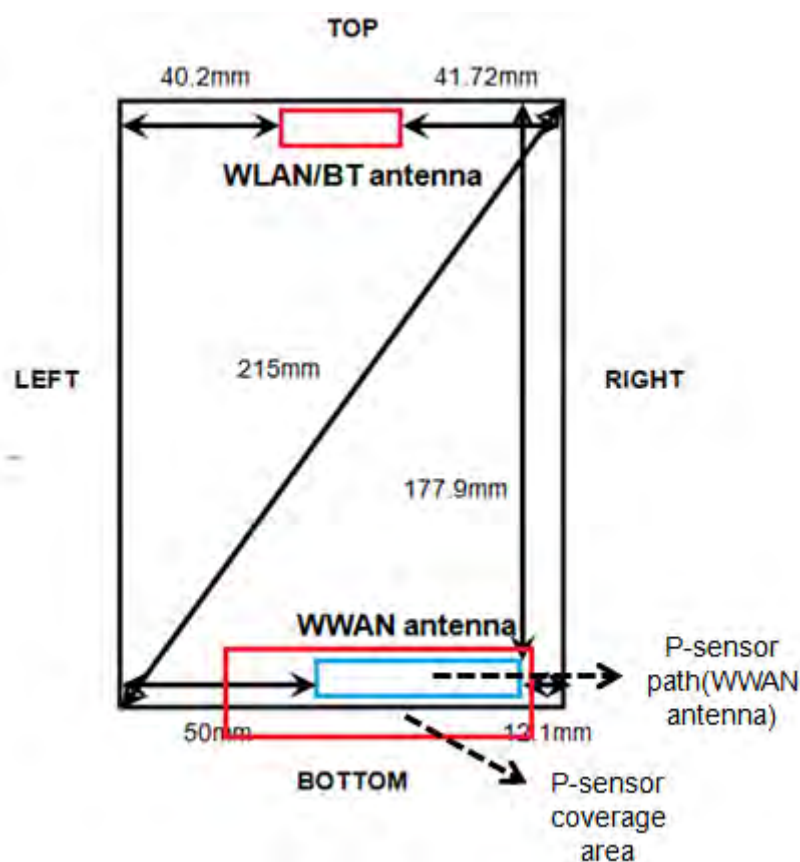
2. WLAN (802.11 b/g/n):

Use chipset specific software to control the EUT, and makes it transmit in maximum power. The EUT is tested in two configurations:

Configuration 1: Back side_0mm without power reduction.

Configuration 2: Top side_0mm without power reduction.

Configuration 3: Left/Right/Bottom sides (Not required to be tested since the SAR test exclusion threshold in FCC KDB447498 D01 is applied to these sides.)



Front view of the tablet

(Note: The proximity sensor is collocated with WWAN antenna.)

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Note:

1. The SAR test was performed on the maximum sourced-based time-averaged power (GPRS multi-class 11).
2. SAR for HSPA is not required since its power is less than ¼ dB higher than RMC without HSPA and SAR for 12.2 kbps RMC without HSPA is ≤ 75% of the SAR limit(1.2 W/kg)
3. SAR for HSPA+ is not required since its power is less than ¼ dB higher than RMC without HSPA or SAR for 12.2 kbps RMC without HSPA+ is ≤ 75% of the SAR limit(1.2 W/kg)
4. The SAR test of 802.11g/n is not required since its maximum power is less than 1/4 dB higher than 802.11b.
5. Testing at higher data rates is not required since the maximum power is less than 1/4 dB higher than those measured at the lowest data rate.
6. BT and WLAN share the same antenna path and BT can not be transmitted simultaneously with WLAN antenna according to client's description.
7. According to KDB447498 D01,

- (1) The 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.

$$[(\text{Threshold at 50mm in step1}) + (\text{test separation distance}-50\text{mm}) \times (\frac{f(\text{MHz})-100}{150})](\text{mW}),$$

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

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

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Mode	Max. tune-up power(dBm)	Max. tune-up power(mW)	Top side			Right side			Left side		
			Ant. to surface (mm)	Exclusion threshold (mW)	Require SAR testing?	Ant. to surface (mm)	Exclusion threshold (mW)	Require SAR testing?	Ant. to surface (mm)	Exclusion threshold (mW)	Require SAR testing?
GPRS850 class11	25.24 (frame averaged)	334.195	177.9	729.901	NO	12.1	25.446	YES	50	6.158	YES
GPRS1900 class11	22.24 (frame averaged)	167.494	177.9	1283.629	NO	12.1	19.13	YES	50	4.629	YES
WCDMA B2	24.5	281.838	177.9	1286.785	NO	12.1	32.171	YES	50	7.785	YES
WCDMA B4	24.5	281.838	177.9	1286.462	NO	12.1	30.386	YES	50	7.462	YES
WCDMA B5	24.5	281.838	177.9	727.054	NO	12.1	21.432	YES	50	5.186	YES
WLAN	11	12.589	less than 5	3.951	YES	41.72	0.473	NO	40.2	0.491	NO
BT	4	2.512	less than 5	0.791	NO	41.72	0.095	NO	40.2	0.098	NO

Mode	Max. tune-up power(dBm)	Max. tune-up power(mW)	Bottom side			Back side		
			Ant. to surface (mm)	Exclusion threshold (mW)	Require SAR testing?	Ant. to surface (mm)	Exclusion threshold (mW)	Require SAR testing?
GPRS850 class11	25.24 (frame averaged)	334.195	less than 5	61.579	YES	5	61.579	YES
GPRS1900 class11	22.24 (frame averaged)	167.494	less than 5	46.294	YES	5	46.294	YES
WCDMA B2	24.5	281.838	less than 5	77.853	YES	5	77.853	YES
WCDMA B4	24.5	281.838	less than 5	74.623	YES	5	74.623	YES
WCDMA B5	24.5	281.838	less than 5	51.864	YES	5	51.864	YES
WLAN	11	12.589	171	1210.395	NO	5	3.951	YES
BT	4	2.512	171	1210.079	NO	5	0.791	NO

8. 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.

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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 ≤ 0.6 W/kg, when the transmission band is between 100 MHz and 200MHz.
10. According to KDB447498 D01, testing of other required channels is not required when the reported 1-g SAR for the highest output channel is ≤ 0.4 W/kg, when the transmission band is ≥ 200 MHz.
11. 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 ($\sim 10\%$ 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 of back side and bottom 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 18mm.
- 10) For bottom side, the trigger distance of proximity sensor is 19mm, 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 ± 45 deg or more from the vertical position at 0 deg.
- 2) If sensor triggering is released and normal maximum output power is restored within the ± 45 deg 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) After the tilt angle testing, the sensor is released during ± 45 deg until the separation distance be reduced to 18mm, so $18-1=17$ mm, is the sensor triggering distance for tablet tilt coverage. The smallest separation distance minus 1 mm($17-1=16$ mm) should be used in the SAR measurements.

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 edge 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.

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- 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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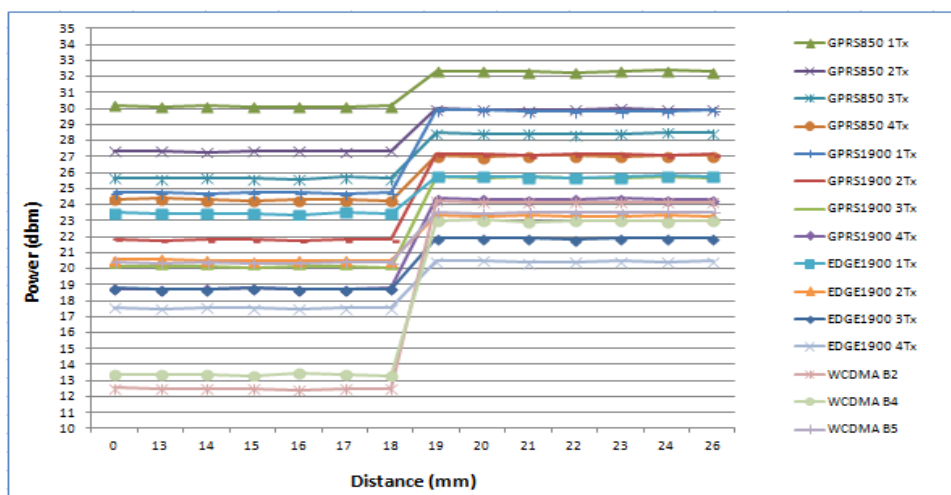
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1.6.5 Results

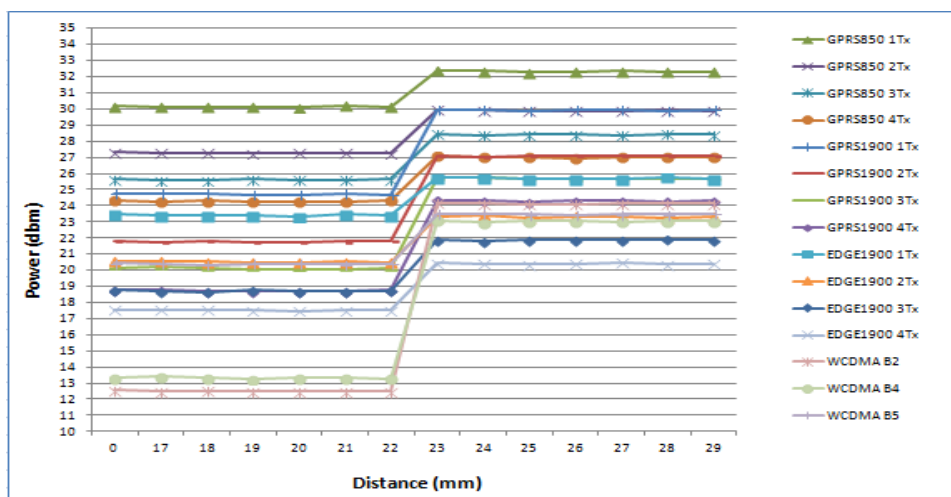
The measured output power within ± 5 mm of the triggering points, or until the tablet is touching the phantom, for movements to and from the phantom is tabulated in the following.

Back side

Moving device toward the phantom



Moving device away from the phantom



For back side, the worst trigger distance of proximity sensor is 18mm, thus we test back side SAR in 17mm without power reduction and 0mm with power reduction.

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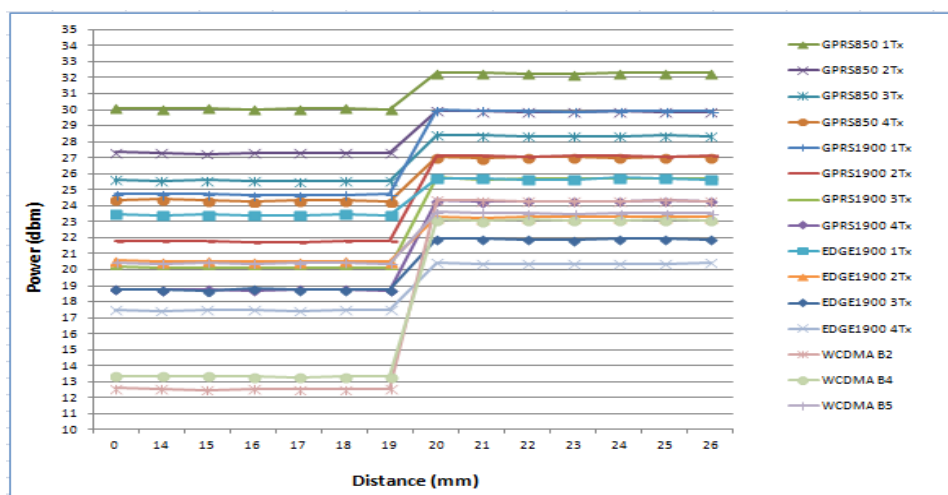
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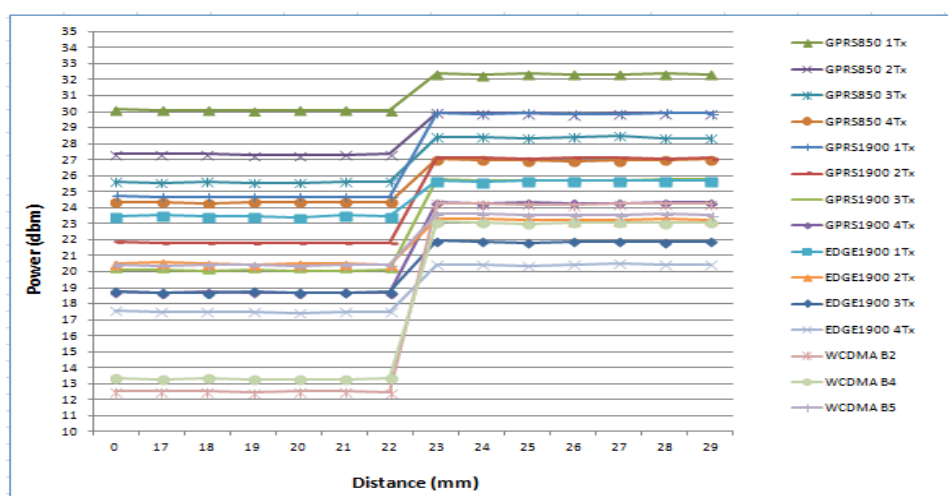
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Bottom side

Moving device toward the phantom



Moving device away from the phantom



For bottom side, the worst trigger distance of proximity sensor is 19mm, so next we perform the tilt angle testing.

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Table 1.6.5 Tilt angle test results

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
18mm	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
19mm	OFF	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON	OFF	OFF

During the tilt angle testing, the sensor will be released during $\pm 45^\circ$ until the separation distance be reduced to 18mm, so $18-1=17\text{mm}$, is the sensor triggering distance for tablet tilt coverage. The smallest separation distance minus 1 mm($17-1=16\text{mm}$) should be used in the SAR measurements.

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 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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1.7 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 $SAR = \sigma (|E_i|^2) / \rho$ where σ and ρ are the conductivity and mass density of the tissue-simulant.

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

- A standard high precision 6-axis robot (Staubli RX family) with controller, teach pendant and software. An arm extension is for accommodating the data acquisition electronics (DAE).
- A dosimetric probe, i.e., an isotropic E-field probe optimized and calibrated for usage in tissue simulating liquid. The probe is equipped with an optical surface detector system.
- A data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.

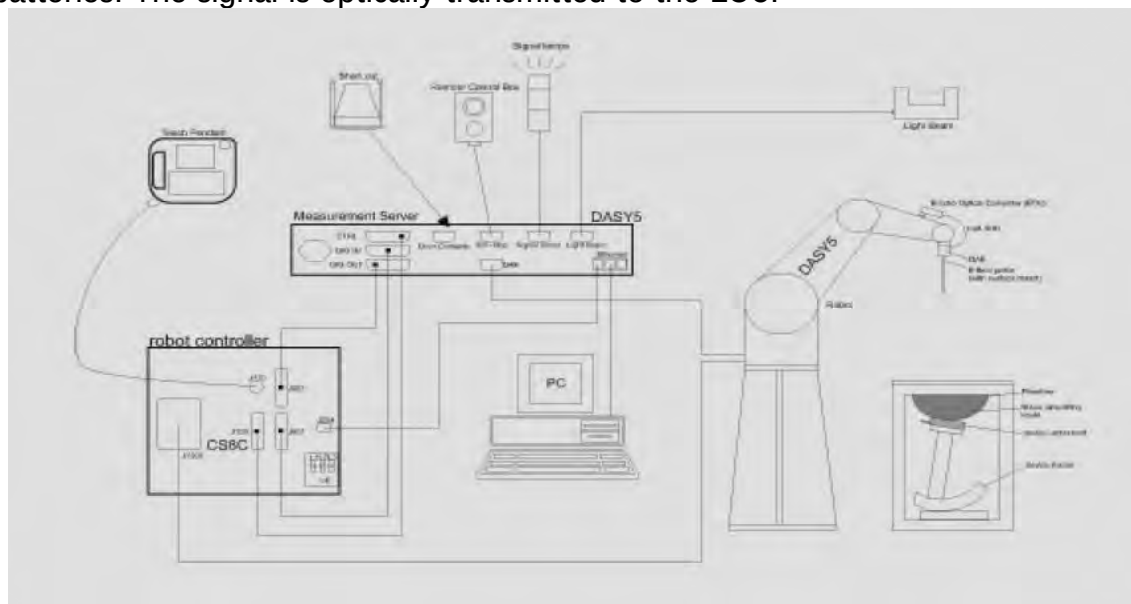


Fig. a The block diagram of SAR system

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

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1.8 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 835/1750/1900/2450 MHz Additional CF for other liquids and frequencies upon request		
Frequency	10 MHz to > 6 GHz, Linearity: ± 0.6 dB		
Directivity	± 0.3 dB in HSL (rotation around probe axis) ± 0.5 dB in tissue material (rotation normal to probe axis)		
Dynamic Range	10 μ W/g to > 100 mW/g Linearity: ± 0.2 dB (noise: typically < 1 μ W/g)		
Dimensions	Overall length: 337 mm (Tip: 9 mm) Tip diameter: 2.5 mm (Body: 10 mm) Typical distance from probe tip to dipole centers: 1 mm		
Application	High precision dosimetric measurements in any exposure scenario (e.g., very strong gradient fields). Only probe which enables compliance testing for frequencies up to 6 GHz with precision of better 30%.		

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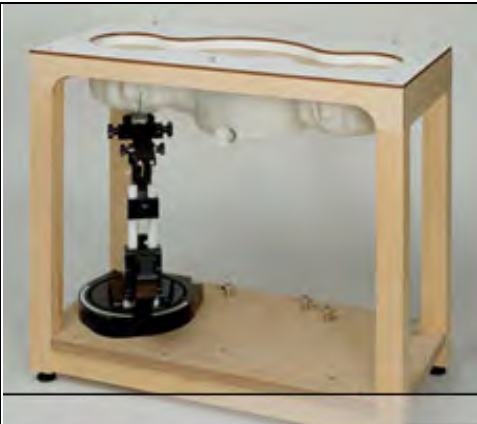
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SAM PHANTOM V4.0C

Construction	The shell corresponds to the specifications of the Specific Anthropomorphic Mannequin (SAM) phantom defined in IEEE 1528-200X, CENELEC 50361 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 $\pm 10\%$ from the target SAR values. These tests were done at 835/1750/1900/2450 MHz. The tests were conducted on the same days as the measurement of the DUT. The obtained results from the system accuracy verification are displayed in the table 1 (SAR values are normalized to 1W forward power delivered to the dipole). During the tests, the ambient temperature of the laboratory was 21.7°C, the relative humidity was 62% and the liquid depth above the ear reference points was $\geq 15 \text{ cm} \pm 5 \text{ mm}$ (frequency $\leq 3 \text{ GHz}$) or $\geq 10 \text{ cm} \pm 5 \text{ mm}$ (frequency $> 3 \text{ GHz}$) in all the cases. It is seen that the system is operating within its specification, as the results are within acceptable tolerance of the reference values.

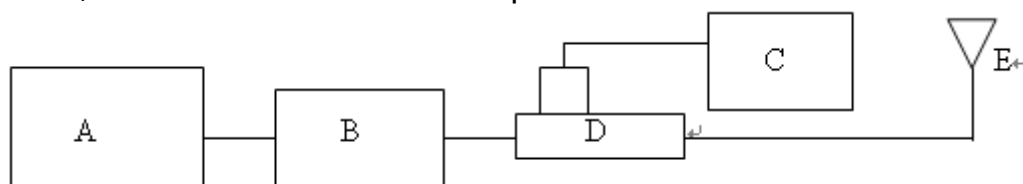


Fig. b The block diagram of system verification

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



Photograph of the dipole Antenna

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Validation Kit	S/N	Frequency (MHz)		Target SAR (1g) (Pin=250mW) (mW/kg)	Measured SAR (1g)(mW/g)	Deviation (%)	Measured Date
D835V2	4d161	835	Body	2.4	2.33	2.92%	Aug. 18,2014
D1750V2	1105	1750	Body	9.38	8.97	4.37%	Aug. 19,2014
D1900V2	5d027	1900	Body	9.87	9.47	4.05%	Aug. 19,2014
D2450V2	922	2450	Body	12.9	12.5	3.10%	Aug. 13,2014

Table 1. Results of system validation

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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 $\geq 15 \text{ cm} \pm 5 \text{ mm}$ (Frequency $\leq 3\text{G}$) or $\geq 10 \text{ cm} \pm 5 \text{ mm}$ (Frequency $> 3\text{G}$) during all tests. (Fig. 2)

Tissue Type	Measurement Date	Measured Frequency (MHz)	Target Dielectric Constant, ϵ_r	Target Conductivity, σ (S/m)	Measured Dielectric Constant, ϵ_r	Measured Conductivity, σ (S/m)	% dev ϵ_r	% dev σ
Body	Aug. 18, 2014	824.2	55.242	0.969	55.572	0.965	-0.60%	0.43%
		826.4	55.234	0.969	55.445	0.972	-0.38%	-0.31%
		835	55.2	0.97	55.615	0.97	-0.75%	0.00%
		836.6	55.195	0.972	55.268	0.98	-0.13%	-0.82%
		846.6	55.164	0.984	55.156	0.988	0.01%	-0.41%
		848.8	55.158	0.987	55.077	0.995	0.15%	-0.81%
	Aug. 19, 2014	1712.4	53.531	1.465	55.419	1.427	-3.53%	2.59%
		1732.4	53.478	1.477	55.45	1.456	-3.69%	1.42%
		1750	55.432	1.488	55.41	1.464	0.04%	1.61%
		1752.6	53.425	1.49	55.397	1.466	-3.69%	1.61%
		1850.2	53.300	1.520	54.203	1.57	-1.69%	-3.29%
		1852.4	53.300	1.520	54.19	1.571	-1.67%	-3.36%
		1880	53.300	1.520	54.117	1.572	-1.53%	-3.42%
		1900	53.300	1.520	54.057	1.573	-1.42%	-3.49%
		1909.8	53.300	1.520	54.052	1.574	-1.41%	-3.55%
	Aug. 13, 2014	2412	52.751	1.914	54.564	1.932	-3.44%	-0.94%
		2437	52.717	1.938	54.566	1.960	-3.51%	-1.16%
		2450	52.700	1.950	54.531	1.978	-3.47%	-1.44%
		2462	52.685	1.967	54.464	1.992	-3.38%	-1.27%

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)

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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.

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

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

1.12 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.

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

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

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

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

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

Considering these problems, the possible accuracy of the calibration of E-field probes with temperature gradient measurements in a carefully designed setup is about $\pm 10\%$ (RSS) [2]. Recently, a setup which is a combination of the waveguide techniques and the thermal measurements was presented in [3]. The estimated uncertainty of the setup is $\pm 5\%$ (RSS) when the same liquid is used for the calibration and for actual measurements and $\pm 7-9\%$ (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:

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

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

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

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of this section. (Table 4.)

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

Table 4. RF exposure limits

Notes:

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

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2. Summary of Results

GPRS 850 MHz (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	
GPRS (1D3UP)	Back side	17mm	251	848.8	29.5	28.6	23.03%	0.323	0.397	62
	Right side	0mm	251	848.8	29.5	28.6	23.03%	0.175	0.215	-
	Bottom side	16mm	251	848.8	29.5	28.6	23.03%	0.195	0.240	-
	Left side	0mm	251	848.8	29.5	28.6	23.03%	0.09	0.111	-

GPRS 850 MHz (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	
GPRS (1D3UP)	Back side	0mm	128	824.2	26.5	25.7	20.23%	0.799	0.961	-
	Back side	0mm	190	836.6	26.5	25.7	20.23%	0.829	0.997	-
	Back side	0mm	251	848.8	26.5	25.8	17.49%	1.03	1.210	63
	Back side*	0mm	251	848.8	26.5	25.8	17.49%	0.928	1.090	-
	Bottom side	0mm	128	824.2	26.5	25.7	20.23%	0.74	0.890	-
	Bottom side	0mm	190	836.6	26.5	25.7	20.23%	0.772	0.928	-
	Bottom side	0mm	251	848.8	26.5	25.8	17.49%	0.8	0.940	-

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

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GPRS 1900 MHz (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	
GPRS (1Dn3UP)	Back side	17mm	661	1880	26.5	25.8	17.49%	0.289	0.340	-
	Right side	0mm	661	1880	26.5	25.8	17.49%	0.403	0.473	64
	Bottom side	16mm	661	1880	26.5	25.8	17.49%	0.261	0.307	-
	Left side	0mm	661	1880	26.5	25.8	17.49%	0.174	0.204	-

GPRS 1900 MHz (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	
GPRS (1Dn3UP)	Back side	0mm	512	1850.2	20.5	20.1	9.65%	0.881	0.966	-
	Back side	0mm	661	1880	20.5	20.2	7.15%	1.26	1.350	65
	Back side	0mm	810	1909.8	20.5	20.2	7.15%	0.829	0.888	-
	Back side*	0mm	661	1880	20.5	20.2	7.15%	1.19	1.275	-
	Bottom side	0mm	512	1850.2	20.5	20.1	9.65%	1.01	1.107	-
	Bottom side	0mm	661	1880	20.5	20.2	7.15%	0.978	1.048	-
	Bottom side	0mm	810	1909.8	20.5	20.2	7.15%	1.03	1.104	-

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

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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	17mm	9262	1852.4	24.5	24.38	2.80%	0.496	0.510	-
	Right side	0mm	9262	1852.4	24.5	24.38	2.80%	0.66	0.678	66
	Bottom side	16mm	9262	1852.4	24.5	24.38	2.80%	0.515	0.529	-
	Left side	0mm	9262	1852.4	24.5	24.38	2.80%	0.309	0.318	-

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	0mm	9262	1852.4	13	12.63	8.89%	0.626	0.682	67
	Bottom side	0mm	9262	1852.4	13	12.63	8.89%	0.539	0.587	-

WCDMA Band IV (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 IV	Back side	17mm	1513	1752.6	24.5	23.28	32.43%	0.318	0.421	68
	Right side	0mm	1513	1752.6	24.5	23.28	32.43%	0.316	0.418	-
	Bottom side	16mm	1513	1752.6	24.5	23.28	32.43%	0.299	0.396	-
	Left side	0mm	1513	1752.6	24.5	23.28	32.43%	0.218	0.289	-

WCDMA Band IV (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 IV	Back side	0mm	1312	1712.4	14	13.75	5.93%	0.836	0.886	-
	Back side	0mm	1412	1732.4	14	13.42	14.29%	0.986	1.127	69
	Back side	0mm	1513	1752.6	14	13.78	5.20%	0.863	0.908	-
	Back side*	0mm	1412	1732.4	14	13.42	14.29%	0.864	0.987	-
	Bottom side	0mm	1513	1752.6	14	13.78	5.20%	0.543	0.571	-

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

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WCDMA Band V (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 V	Back side	17mm	4233	846.6	24.5	23.78	18.03%	0.321	0.379	70
	Right side	0mm	4233	846.6	24.5	23.78	18.03%	0.193	0.228	-
	Bottom side	16mm	4233	846.6	24.5	23.78	18.03%	0.156	0.184	-
	Left side	0mm	4233	846.6	24.5	23.78	18.03%	0.067	0.079	-

WCDMA Band V (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 V	Back side	0mm	4132	826.4	21	20.48	12.72%	0.865	0.975	-
	Back side	0mm	4183	836.6	21	20.45	13.50%	0.999	1.134	-
	Back side	0mm	4233	846.6	21	20.63	8.89%	1.03	1.122	71
	Back side*	0mm	4233	846.6	21	20.63	8.89%	0.986	1.074	-
	Bottom side	0mm	4132	826.4	21	20.48	12.72%	0.732	0.825	-
	Bottom side	0mm	4183	836.6	21	20.45	13.50%	0.773	0.877	-
	Bottom side	0mm	4233	846.6	21	20.63	8.89%	0.795	0.866	-

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

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WLAN802.11b

Band	Position	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	
WLAN802.11b	Back side	1	2412	11.00	10.68	7.65%	1.04	1.120	-
	Back side	6	2437	11.00	11.00	0.00%	1.13	1.130	-
	Back side	11	2462	11.00	10.28	18.03%	0.927	1.094	-
	Back side*	6	2437	11.00	11.00	0.00%	1.23	1.230	72
	Top side	6	2437	11.00	11.00	0.00%	0.644	0.644	-

Test distance is 0mm.

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

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3. Simultaneous Transmission Analysis

Simultaneous Transmission Scenarios:

Simultaneous Transmit Configurations	Body
GPRS850/1900 + 2.4GHz WLAN	Yes
WCDMA B2/4/5 + 2.4GHz WLAN	Yes
GPRS850/1900 + BT	Yes
WCDMA B2/4/5 + BT	Yes

Note:

1. WWAN and WLAN antennas may transmit simultaneously.
2. Bluetooth and WLAN share the same antenna path and cannot transmit simultaneously.
3. This device doesn't support voice transmission capability.

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3.1 Estimated SAR calculation

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

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

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

Mode / Band	frequency(GHz)	Max. tune-up power(dBm)	Test position	test separation distance(mm)	Estimated SAR(W/kg)
GPRS 850 (class 11)	0.8488	25.2(max. frame- averaged power)	top side	177.91	0.4
GPRS 1900 (class 11)	1.9098	22.2(max. frame- averaged power)	top side	177.91	0.4
WCDMA B2	1.9076	24.5	top side	177.91	0.4
WCDMA B4	1.7526	24.5	top side	177.91	0.4
WCDMA B5	0.8466	24.5	top side	177.91	0.4
WLAN	2.462	11	bottom side	171	0.4
WLAN	2.462	11	right side	41.72	0.063
WLAN	2.462	11	left side	40.2	0.066
BT	2.48	4	top side / back side	0	0.105
BT	2.48	4	right side	41.72	0.013
BT	2.48	4	left side	40.2	0.013
BT	2.48	4	bottom side	171	0.4

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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 $(\text{SAR1} + \text{SAR2})^{1.5} / R_i$, 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 R_i 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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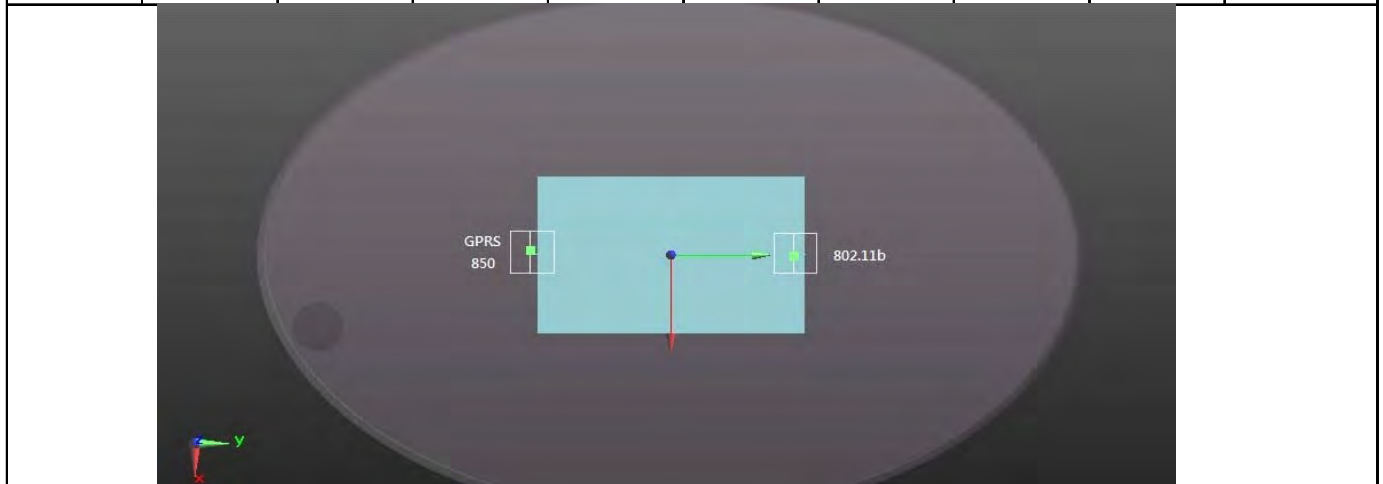
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GPRS 850 + 2.4GHz WLAN

No.	Conditions (SAR1+SAR2)	Exposure Condition	Position	Distance (mm)	Max. SAR1	Max. SAR2	SAR Summation	SPLSR Analysis
1	GPRS850 + 2.4GHz WLAN	Body	Back side	0	1.21	1.23	2.44	Analyzed as below
			Back side	17	0.397	Less than 1.23	Less than 1.627	Analyzed as below
			Top side	0	0.4 (estimated SAR)	0.644	1.044	Σ SAR<1.6, Not required
			Right side	0	0.215	0.063 (estimated SAR)	0.278	Σ SAR<1.6, Not required
			Bottom side	0	0.94	0.4 (estimated SAR)	1.34	Σ SAR<1.6, Not required
			Bottom side	16	0.24	Less than 0.4 (estimated SAR)	Less than 0.64	Σ SAR<1.6, Not required
			Left side	0	0.111	0.066 (estimated SAR)	0.177	Σ SAR<1.6, Not required

Conditions	Exposure Condition	Position	SAR Value (W/kg)	Coordinates (cm)			Peak Location Separation Distance (mm)	SPLSR	Simultaneous Transmission SAR Test
				x	y	z			
GPRS850 CH 251	Body	Back side	1.21	-0.36	-10.16	-0.23	198	0.019	SPLSR<0.04, Not required
802.11b CH 6			1.23	0.08	8.9	0.48			



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Conditions	Exposure Condition	Position	SAR Value (W/kg)	Coordinates (cm)			Peak Location Separation Distance (mm)	SPLSR	Simultaneous Transmission SAR Test
				x	y	z			
GPRS850 CH 251	Body	Back side	0.397	-0.36	-10.16	-0.23	198	0.010	SPLSR<0.04, Not required
802.11b CH 6			1.23	0.08	8.9	0.48			

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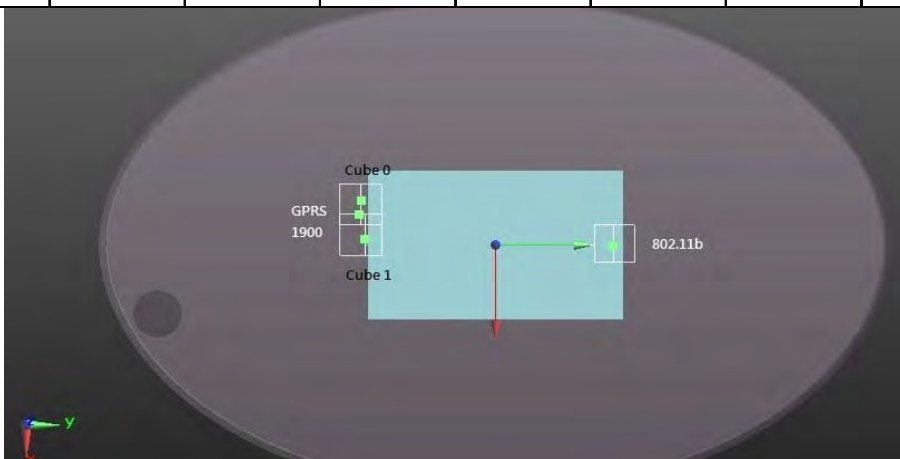
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GPRS 1900 + 2.4GHz WLAN

No.	Conditions (SAR1+SAR2)	Exposure Condition	Position	Distance (mm)	Max. SAR1	Max. SAR2	SAR Summation	SPLSR Analysis
2	GPRS1900 + 2.4GHz WLAN	Body	Back side	0	1.35	1.23	2.58	Analyzed as below
			Back side	17	0.34	Less than 1.23	Less than 1.57	Σ SAR<1.6, Not required
			Top side	0	0.4 (estimated SAR)	0.644	1.044	Σ SAR<1.6, Not required
			Right side	0	0.473	0.063 (estimated SAR)	0.536	Σ SAR<1.6, Not required
			Bottom side	0	1.107	0.4 (estimated SAR)	1.507	Σ SAR<1.6, Not required
			Bottom side	16	0.307	Less than 0.4 (estimated SAR)	Less than 0.707	Σ SAR<1.6, Not required
			Left side	0	0.204	0.066 (estimated SAR)	0.27	Σ SAR<1.6, Not required

Conditions	Exposure Condition	Position	SAR Value (W/kg)	Coordinates (cm)			Peak Location Separation Distance (mm)	SPLSR	Simultaneous Transmission SAR Test
				x	y	z			
GPRS1900 CH 661	Body	Back side	1.35	-3.52	-10.15	-0.16	194	0.021	SPLSR<0.04, Not required
802.11b CH 6			1.23	0.08	8.9	0.48			



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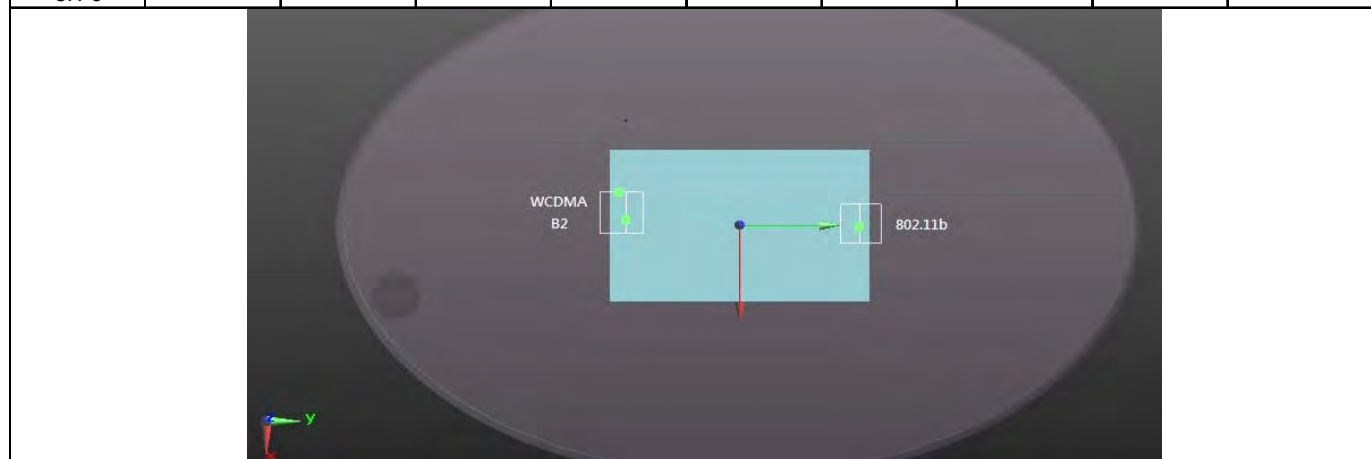
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WCDMA Band II + 2.4GHz WLAN

No.	Conditions (SAR1+SAR2)	Exposure Condition	Position	Distance (mm)	Max. SAR1	Max. SAR2	SAR Summation	SPLSR Analysis
3	WCDMA Band 2 + 2.4GHz WLAN	Body	Back side	0	0.682	1.23	1.912	Analyzed as below
			Back side	17	0.51	Less than 1.23	Less than 1.74	Analyzed as below
			Top side	0	0.4 (estimated SAR)	0.644	1.044	Σ SAR<1.6, Not required
			Right side	0	0.678	0.063 (estimated SAR)	0.741	Σ SAR<1.6, Not required
			Bottom side	0	0.587	0.4 (estimated SAR)	0.987	Σ SAR<1.6, Not required
			Bottom side	16	0.529	Less than 0.4 (estimated SAR)	Less than 0.929	Σ SAR<1.6, Not required
			Left side	0	0.318	0.066 (estimated SAR)	0.384	Σ SAR<1.6, Not required

Conditions	Exposure Condition	Position	SAR Value (W/kg)	Coordinates (cm)			Peak Location Separation Distance (mm)	SPLSR	Simultaneous Transmission SAR Test
				x	y	z			
WCDMA B2 CH 9262	Body	Back side	0.682	-0.47	-8.43	-0.17	173.5	0.015	SPLSR<0.04, Not required
802.11b CH 6			1.23	0.08	8.9	0.48			



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Conditions	Exposure Condition	Position	SAR Value (W/kg)	Coordinates (cm)			Peak Location Separation Distance (mm)	SPLSR	Simultaneous Transmission SAR Test
				x	y	z			
WCDMA B2 CH 9262	Body	Back side	0.51	-0.35	-9.55	-0.2	184.7	0.012	SPLSR<0.04, Not required
802.11b CH 6			1.23	0.08	8.9	0.48			

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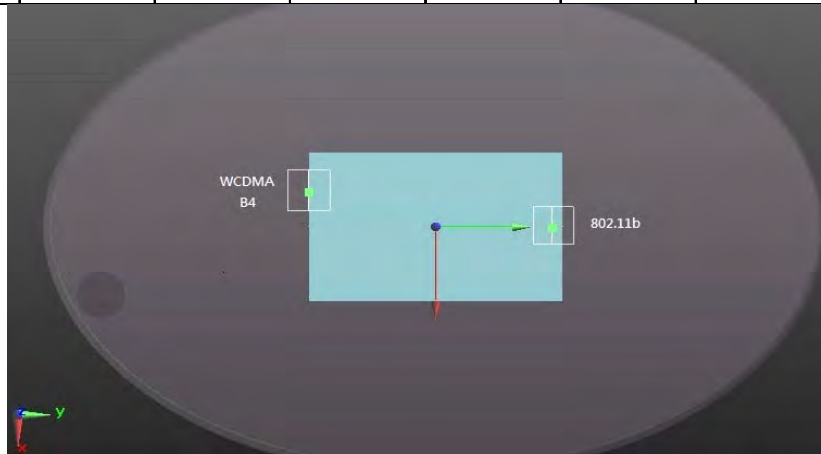
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WCDMA Band IV + 2.4GHz WLAN

No.	Conditions (SAR1+SAR2)	Exposure Condition	Position	Distance (mm)	Max. SAR1	Max. SAR2	SAR Summation	SPLSR Analysis
4	WCDMA Band 4 + 2.4GHz WLAN	Body	Back side	0	1.127	1.23	2.357	Analyzed as below
			Back side	17	0.421	Less than 1.23	Less than 1.651	Analyzed as below
			Top side	0	0.4 (estimated SAR)	0.644	1.044	Σ SAR<1.6, Not required
			Right side	0	0.418	0.063 (estimated SAR)	0.481	Σ SAR<1.6, Not required
			Bottom side	0	0.571	0.4 (estimated SAR)	0.971	Σ SAR<1.6, Not required
			Bottom side	16	0.396	Less than 0.4 (estimated SAR)	Less than 0.796	Σ SAR<1.6, Not required
			Left side	0	0.289	0.066 (estimated SAR)	0.355	Σ SAR<1.6, Not required

Conditions	Exposure Condition	Position	SAR Value (W/kg)	Coordinates (cm)			Peak Location Separation Distance (mm)	SPLSR	Simultaneous Transmission SAR Test
				x	y	z			
WCDMA B4 CH 1412	Body	Back side	1.127	-2.74	-9.65	-0.16	187.7	0.019	SPLSR<0.04, Not required
802.11b CH 6			1.23	0.08	8.9	0.48			



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Conditions	Exposure Condition	Position	SAR Value (W/kg)	Coordinates (cm)			Peak Location Separation Distance (mm)	SPLSR	Simultaneous Transmission SAR Test
				x	y	z			
WCDMA B4 CH 1513	Body	Back side	0.421	0.1	-9.41	-0.2	183.2	0.012	SPLSR<0.04, Not required
802.11b CH 6			1.23	0.08	8.9	0.48			

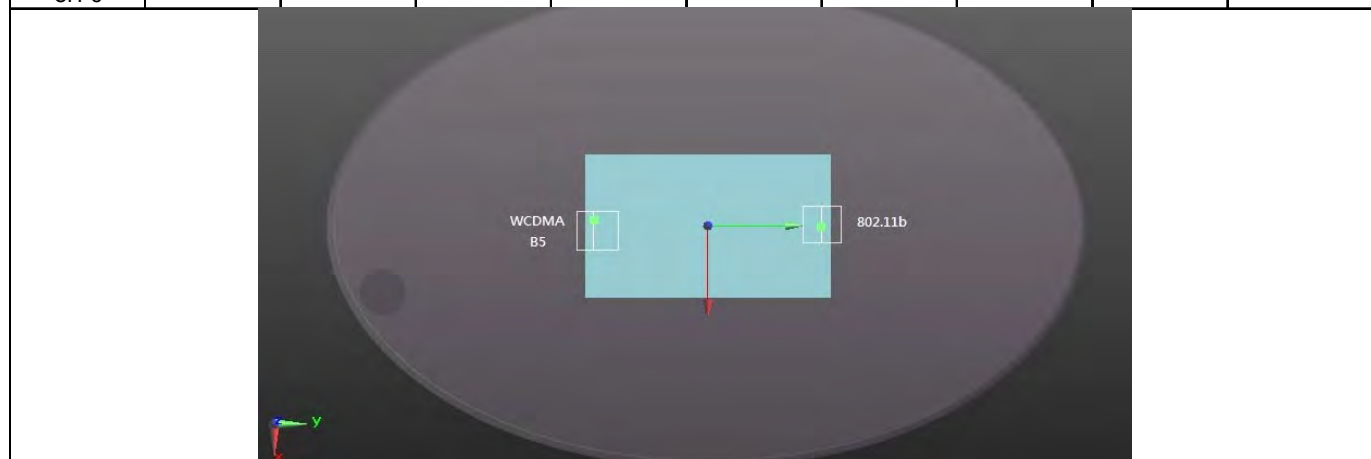
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WCDMA Band V + 2.4GHz WLAN

No.	Conditions (SAR1+SAR2)	Exposure Condition	Position	Distance (mm)	Max. SAR1	Max. SAR2	SAR Summation	SPLSR Analysis
5	WCDMA Band 5 + 2.4GHz WLAN	Body	Back side	0	1.122	1.23	2.352	Analyzed as below
			Back side	17	0.379	Less than 1.23	Less than 1.609	Analyzed as below
			Top side	0	0.4 (estimated SAR)	0.644	1.044	Σ SAR<1.6, Not required
			Right side	0	0.228	0.063 (estimated SAR)	0.291	Σ SAR<1.6, Not required
			Bottom side	0	0.877	0.4 (estimated SAR)	1.277	Σ SAR<1.6, Not required
			Bottom side	16	0.184	Less than 0.4 (estimated SAR)	Less than 0.584	Σ SAR<1.6, Not required
			Left side	0	0.079	0.066 (estimated SAR)	0.145	Σ SAR<1.6, Not required

Conditions	Exposure Condition	Position	SAR Value (W/kg)	Coordinates (cm)			Peak Location Separation Distance (mm)	SPLSR	Simultaneous Transmission SAR Test
				x	y	z			
WCDMA B5 CH 4233	Body	Back side	1.122	-0.4	-8.97	-0.26	178.9	0.020	SPLSR<0.04, Not required
802.11b CH 6			1.23	0.08	8.9	0.48			



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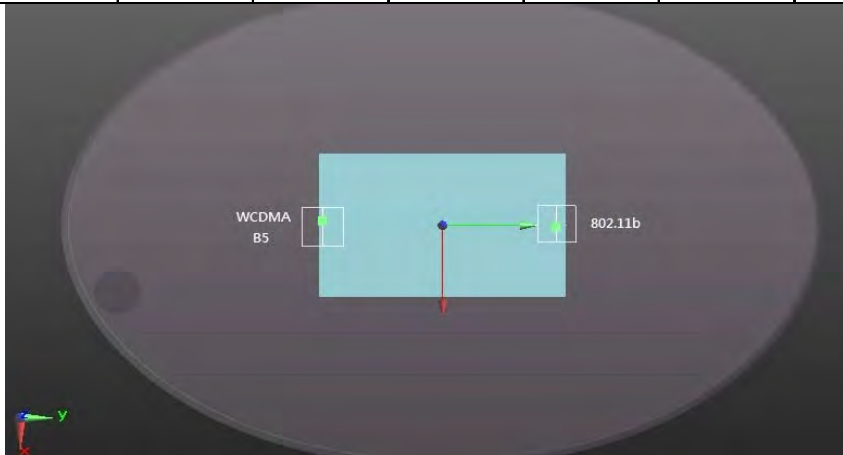
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Conditions	Exposure Condition	Position	SAR Value (W/kg)	Coordinates (cm)			Peak Location Separation Distance (mm)	SPLSR	Simultaneous Transmission SAR Test
				x	y	z			
WCDMA B5 CH 4233	Body	Back side	0.379	-0.38	-9.4	-0.26	183.2	0.011	SPLSR<0.04, Not required
802.11b CH 6			1.23	0.08	8.9	0.48			



The diagram illustrates the SAR measurement setup on a human body model. A light blue rectangular area is centered on the back of the model. Two green dots, each enclosed in a small white square, represent the locations of the WCDMA B5 and 802.11b signal sources. A green double-headed arrow connects these two dots, indicating the separation distance. A red arrow points downwards from the center of the blue rectangle. A 3D coordinate system (x, y, z) is shown in the bottom left corner of the diagram.

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GPRS 850 + BT

No.	Conditions (SAR1+SAR2)	Exposure Condition	Position	Distance (mm)	Max. SAR1	Max. SAR2	SAR Summation	SPLSR Analysis
6	GPRS850 + BT	Body	Back side	0	1.21	0.105 (estimated SAR)	1.315	Σ SAR<1.6, Not required
			Back side	17	0.397	Less than 0.105 (estimated SAR)	Less than 0.502	Σ SAR<1.6, Not required
			Top side	0	0.4 (estimated SAR)	0.105 (estimated SAR)	0.505	Σ SAR<1.6, Not required
			Right side	0	0.215	0.013 (estimated SAR)	0.228	Σ SAR<1.6, Not required
			Bottom side	0	0.94	0.4 (estimated SAR)	1.34	Σ SAR<1.6, Not required
			Bottom side	16	0.24	Less than 0.4 (estimated SAR)	Less than 0.64	Σ SAR<1.6, Not required
			Left side	0	0.111	0.013 (estimated SAR)	0.124	Σ SAR<1.6, Not required

GPRS 1900 + BT

No.	Conditions (SAR1+SAR2)	Exposure Condition	Position	Distance (mm)	Max. SAR1	Max. SAR2	SAR Summation	SPLSR Analysis
7	GPRS1900 + BT	Body	Back side	0	1.35	0.105 (estimated SAR)	1.455	Σ SAR<1.6, Not required
			Back side	17	0.34	Less than 0.105 (estimated SAR)	Less than 0.445	Σ SAR<1.6, Not required
			Top side	0	0.4 (estimated SAR)	0.105 (estimated SAR)	0.505	Σ SAR<1.6, Not required
			Right side	0	0.473	0.013 (estimated SAR)	0.486	Σ SAR<1.6, Not required
			Bottom side	0	1.107	0.4 (estimated SAR)	1.507	Σ SAR<1.6, Not required
			Bottom side	16	0.307	Less than 0.4 (estimated SAR)	Less than 0.707	Σ SAR<1.6, Not required
			Left side	0	0.204	0.013 (estimated SAR)	0.217	Σ SAR<1.6, Not required

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WCDMA Band II + BT

No.	Conditions (SAR1+SAR2)	Exposure Condition	Position	Distance (mm)	Max. SAR1	Max. SAR2	SAR Summation	SPLSR Analysis
8	WCDMA Band 2 + BT	Body	Back side	0	0.682	0.105 (estimated SAR)	0.787	Σ SAR<1.6, Not required
			Back side	17	0.51	Less than 0.105 (estimated SAR)	Less than 0.615	Σ SAR<1.6, Not required
			Top side	0	0.4 (estimated SAR)	0.105 (estimated SAR)	0.505	Σ SAR<1.6, Not required
			Right side	0	0.678	0.013 (estimated SAR)	0.691	Σ SAR<1.6, Not required
			Bottom side	0	0.587	0.4 (estimated SAR)	0.987	Σ SAR<1.6, Not required
			Bottom side	16	0.529	Less than 0.4 (estimated SAR)	Less than 0.929	Σ SAR<1.6, Not required
			Left side	0	0.318	0.013 (estimated SAR)	0.331	Σ SAR<1.6, Not required

WCDMA Band IV + BT

No.	Conditions (SAR1+SAR2)	Exposure Condition	Position	Distance (mm)	Max. SAR1	Max. SAR2	SAR Summation	SPLSR Analysis
9	WCDMA Band 4 + BT	Body	Back side	0	1.127	0.105 (estimated SAR)	1.232	Σ SAR<1.6, Not required
			Back side	17	0.421	Less than 0.105 (estimated SAR)	Less than 0.526	Σ SAR<1.6, Not required
			Top side	0	0.4 (estimated SAR)	0.105 (estimated SAR)	0.505	Σ SAR<1.6, Not required
			Right side	0	0.418	0.013 (estimated SAR)	0.431	Σ SAR<1.6, Not required
			Bottom side	0	0.571	0.4 (estimated SAR)	0.971	Σ SAR<1.6, Not required
			Bottom side	16	0.396	Less than 0.4 (estimated SAR)	Less than 0.796	Σ SAR<1.6, Not required
			Left side	0	0.289	0.013 (estimated SAR)	0.302	Σ SAR<1.6, Not required

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WCDMA Band V + BT

No.	Conditions (SAR1+SAR2)	Exposure Condition	Position	Distance (mm)	Max. SAR1	Max. SAR2	SAR Summation	SPLSR Analysis
10	WCDMA Band 5 + BT	Body	Back side	0	1.122	0.105 (estimated SAR)	1.227	Σ SAR<1.6, Not required
			Back side	17	0.379	Less than 0.105 (estimated SAR)	Less than 0.484	Σ SAR<1.6, Not required
			Top side	0	0.4 (estimated SAR)	0.105 (estimated SAR)	0.505	Σ SAR<1.6, Not required
			Right side	0	0.228	0.013 (estimated SAR)	0.241	Σ SAR<1.6, Not required
			Bottom side	0	0.877	0.4 (estimated SAR)	1.277	Σ SAR<1.6, Not required
			Bottom side	16	0.184	Less than 0.4 (estimated SAR)	Less than 0.584	Σ SAR<1.6, Not required
			Left side	0	0.079	0.013 (estimated SAR)	0.092	Σ SAR<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	3831	Jan.31,2014	Jan.30,2015
			3979	Mar.04,2014	Mar.03,2015
Schmid & Partner Engineering AG	835/1750/1900/2450 MHz System Validation Dipole	D835V2	4d161	Nov.01,2013	Oct.31,2014
		D1750V2	1105	Nov.05,2013	Nov.04,2014
		D1900V2	5d027	Apr.23,2014	Apr.22,2015
		D2450V2	922	Nov.05,2013	Nov.04,2014
Schmid & Partner Engineering AG	Data acquisition Electronics	DAE4	547	Mar.26,2014	Mar.25,2015
			915	Jun.18,2014	Jun.17,2015
Schmid & Partner Engineering AG	Software	DASY 52 V52.8.8	N/A	Calibration not required	Calibration not required
Schmid & Partner Engineering AG	Phantom	SAM	N/A	Calibration not required	Calibration not required
Agilent	Network Analyzer	E5071C	MY46107530	Feb.14,2014	Feb.13,2015
Agilent	Dielectric Probe Kit	85070E	MY44300677	Calibration not required	Calibration not required
Agilent	Dual-directional coupler	772D	MY46151242	Jul.14,2014	Jul.13,2015
		778D	MY48220468	Apr.01,2014	Mar.31,2015
Agilent	RF Signal Generator	N5181A	MY50144143	Jun.25,2014	Jun.24,2015
Agilent	Power Meter	E4417A	MY51410006	Oct.25,2013	Oct.24,2015
Agilent	Power Sensor	E9301H	MY51470001	Dec.16,2013	Dec.15,2014
TECPEL	Digital thermometer	DTM-303A	TP130077	Mar.17,2014	Mar.16,2015

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Manufacturer	Device	Type	Serial number	Date of last calibration	Date of next calibration
R&S	Radio Communication Test	CMU200	113505	May.08,2014	May.07,2015
Anritsu	Power Meter	ML2495A	1005007	Jan.13,2014	Jan.12,2015
Anritsu	Power Sensor	MA2411B	917032	Jan.13,2014	Jan.12,2015
Mini-Circuit	Attenuator	BW-S10W2+	002	Feb.27,2014	Feb.26,2015

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5. Measurements

Date: 2014/8/18

GPRS 850_Body_Back side_CH 251_17 mm

Communication System: GPRS (1Dn3Up); Frequency: 848.8 MHz

Medium parameters used: $f = 849$ MHz; $\sigma = 0.995$ S/m; $\epsilon_r = 55.077$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3831; ConvF(9.03, 9.03, 9.03); Calibrated: 2014/1/31;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2014/3/26
- Phantom: Body
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Configuration/BODY/Area Scan (91x61x1): Interpolated grid: dx=15 mm, dy=15 mm

Maximum value of SAR = 0.403 W/kg

Configuration/BODY/Zoom Scan (5x5x7)/Cube 0: Measurement grid:

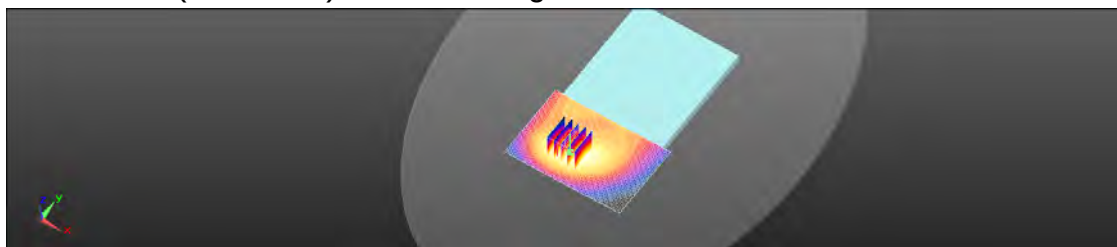
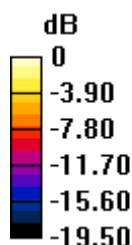
dx=8mm, dy=8mm, dz=5mm

Reference Value = 11.74 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 0.475 W/kg

SAR(1 g) = 0.323 W/kg; SAR(10 g) = 0.210 W/kg

Maximum value of SAR (measured) = 0.407 W/kg



0 dB = 0.403 W/kg = -3.95 dBW/kg

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Date: 2014/8/18

GPRS 850_Body_Back side_CH 251_0 mm

Communication System: GPRS (1Dn3Up); Frequency: 848.8 MHz

Medium parameters used: $f = 849$ MHz; $\sigma = 0.995$ S/m; $\epsilon_r = 55.077$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3831; ConvF(9.03, 9.03, 9.03); Calibrated: 2014/1/31;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2014/3/26
- Phantom: Body
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Configuration/BODY/Area Scan (91x61x1): Interpolated grid: dx=15 mm, dy=15 mm

Maximum value of SAR = 1.63 W/kg

Configuration/BODY/Zoom Scan (5x5x7)/Cube 0: Measurement grid:

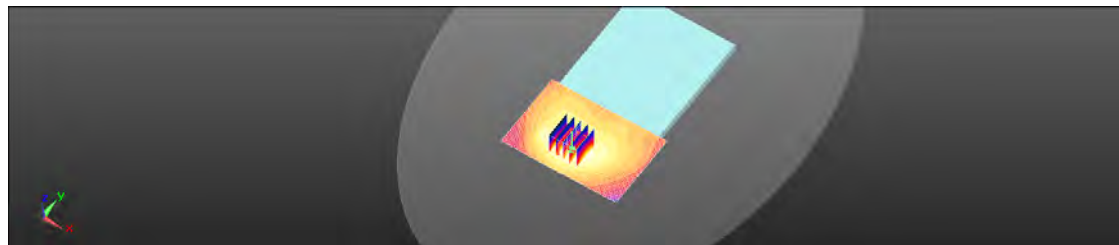
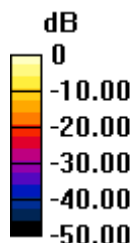
dx=8mm, dy=8mm, dz=5mm

Reference Value = 5.545 V/m; Power Drift = 0.18 dB

Peak SAR (extrapolated) = 2.18 W/kg

SAR(1 g) = 1.03 W/kg; SAR(10 g) = 0.531 W/kg

Maximum value of SAR (measured) = 1.61 W/kg



0 dB = 1.63 W/kg = 2.12 dBW/kg

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Date: 2014/8/19

GPRS 1900_Body_Right side_CH 661_0 mm

Communication System: GPRS (1Dn3Up); Frequency: 1880 MHz

Medium parameters used: $f = 1880 \text{ MHz}$; $\sigma = 1.572 \text{ S/m}$; $\epsilon_r = 54.117$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3831; ConvF(7.19, 7.19, 7.19); Calibrated: 2014/1/31;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2014/3/26
- Phantom: Body
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Configuration/BODY/Area Scan (61x171x1): Interpolated grid: $dx=15 \text{ mm}$, $dy=15 \text{ mm}$

Maximum value of SAR = 0.597 W/kg

Configuration/BODY/Zoom Scan (5x5x7)/Cube 0: Measurement grid:

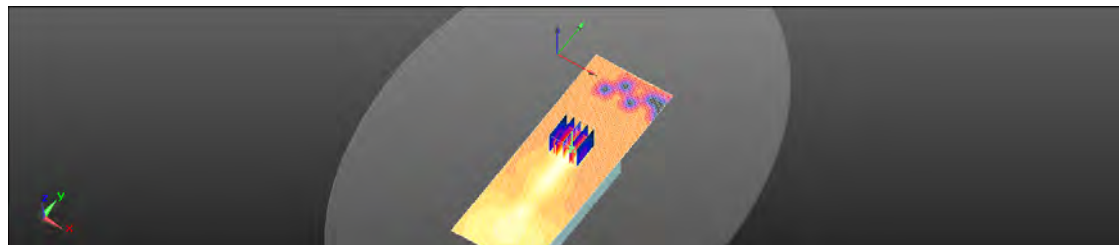
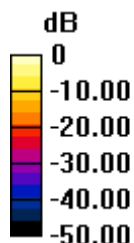
 $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 15.15 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 0.796 W/kg

SAR(1 g) = 0.403 W/kg; SAR(10 g) = 0.179 W/kg

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



0 dB = 0.597 W/kg = -2.24 dBW/kg

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Date: 2014/8/19

GPRS 1900_Body_Back side_CH 661_0 mm

Communication System: GPRS (1Dn3Up); Frequency: 1880 MHz

Medium parameters used: $f = 1880$ MHz; $\sigma = 1.572$ S/m; $\epsilon_r = 54.117$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3831; ConvF(7.19, 7.19, 7.19); Calibrated: 2014/1/31;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2014/3/26
- Phantom: Body
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Configuration/BODY/Area Scan (91x61x1): Interpolated grid: dx=15 mm, dy=15 mm

Maximum value of SAR = 2.05 W/kg

Configuration/BODY/Zoom Scan (5x5x7)/Cube 0: Measurement grid:

dx=8mm, dy=8mm, dz=5mm

Reference Value = 2.164 V/m; Power Drift = 0.14 dB

Peak SAR (extrapolated) = 2.70 W/kg

SAR(1 g) = 1.26 W/kg; SAR(10 g) = 0.551 W/kg

Maximum value of SAR (measured) = 1.99 W/kg

Configuration/BODY/Zoom Scan (5x5x7)/Cube 1: Measurement grid:

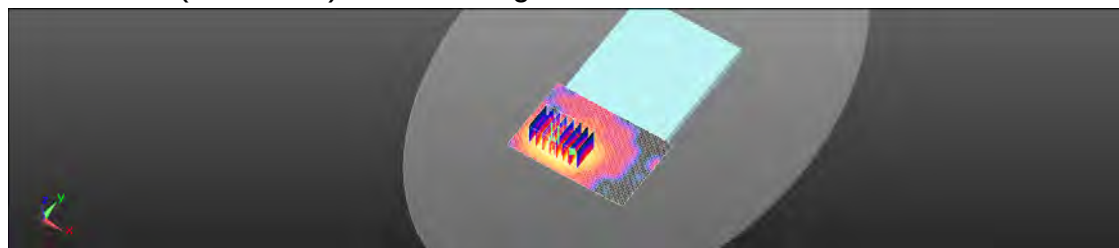
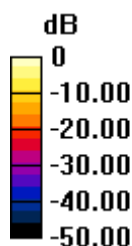
dx=8mm, dy=8mm, dz=5mm

Reference Value = 2.164 V/m; Power Drift = 0.14 dB

Peak SAR (extrapolated) = 2.24 W/kg

SAR(1 g) = 0.871 W/kg; SAR(10 g) = 0.439 W/kg

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



0 dB = 2.05 W/kg = 3.12 dBW/kg

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Date: 2014/8/19

WCDMA Band 2_Body_Right side_CH 9262_0 mm

Communication System: WCDMA; Frequency: 1852.4 MHz

Medium parameters used: $f = 1852.4 \text{ MHz}$; $\sigma = 1.571 \text{ S/m}$; $\epsilon_r = 54.19$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3831; ConvF(7.19, 7.19, 7.19); Calibrated: 2014/1/31;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2014/3/26
- Phantom: Body
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Configuration/BODY/Area Scan (61x171x1): Interpolated grid: $dx=15 \text{ mm}$, $dy=15 \text{ mm}$

Maximum value of SAR = 0.950 W/kg

Configuration/BODY/Zoom Scan (5x5x7)/Cube 0: Measurement grid:

 $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 19.94 V/m; Power Drift = -0.10 dB

Peak SAR (extrapolated) = 1.25 W/kg

SAR(1 g) = 0.660 W/kg; SAR(10 g) = 0.306 W/kg

Maximum value of SAR (measured) = 0.981 W/kg

Configuration/BODY/Zoom Scan (5x5x7)/Cube 1: Measurement grid:

 $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 19.94 V/m; Power Drift = -0.10 dB

Peak SAR (extrapolated) = 0.867 W/kg

SAR(1 g) = 0.454 W/kg; SAR(10 g) = 0.211 W/kg

Maximum value of SAR (measured) = 0.662 W/kg

Configuration/BODY/Zoom Scan (5x5x7)/Cube 2: Measurement grid:

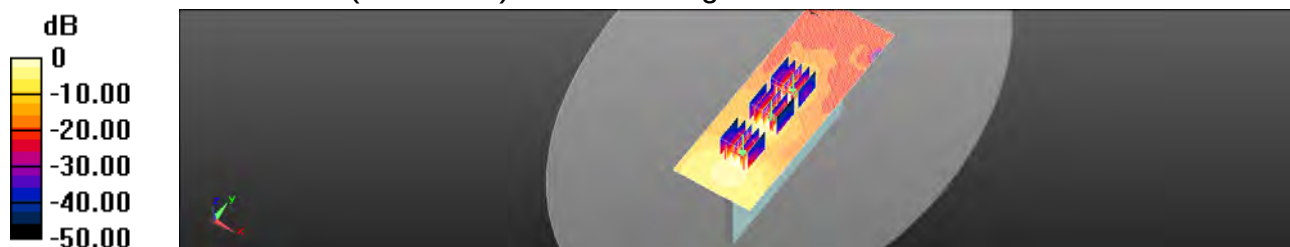
 $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 19.94 V/m; Power Drift = -0.10 dB

Peak SAR (extrapolated) = 0.839 W/kg

SAR(1 g) = 0.447 W/kg; SAR(10 g) = 0.222 W/kg

Maximum value of SAR (measured) = 0.674 W/kg



0 dB = 0.950 W/kg = -0.22 dBW/kg

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Date: 2014/8/19

WCDMA Band 2_Body_Back side_CH 9262_0 mm

Communication System: WCDMA; Frequency: 1852.4 MHz

Medium parameters used: $f = 1852.4 \text{ MHz}$; $\sigma = 1.571 \text{ S/m}$; $\epsilon_r = 54.19$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3831; ConvF(7.19, 7.19, 7.19); Calibrated: 2014/1/31;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2014/3/26
- Phantom: Body
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Configuration/BODY/Area Scan (91x61x1): Interpolated grid: $dx=15 \text{ mm}$, $dy=15 \text{ mm}$

Maximum value of SAR = 1.66 W/kg

Configuration/BODY/Zoom Scan (5x5x7)/Cube 0: Measurement grid:

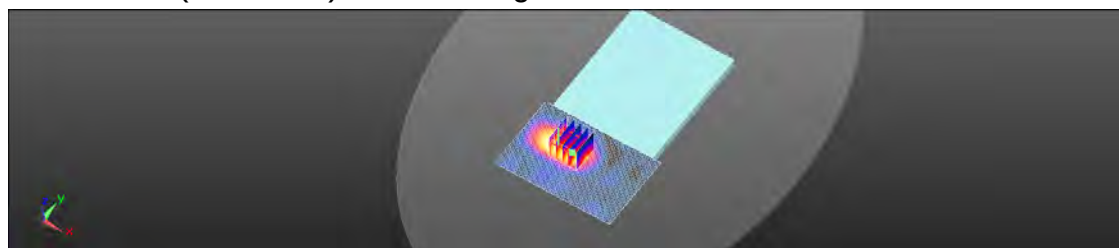
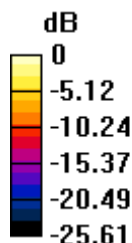
 $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 1.851 V/m; Power Drift = 0.11 dB

Peak SAR (extrapolated) = 1.82 W/kg

SAR(1 g) = 0.626 W/kg; SAR(10 g) = 0.314 W/kg

Maximum value of SAR (measured) = 1.14 W/kg



0 dB = 1.66 W/kg = 2.20 dBW/kg

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Date: 2014/8/19

WCDMA Band 4_Body_Back side_CH 1513_17 mm

Communication System: WCDMA; Frequency: 1752.6 MHz

Medium parameters used: $f = 1753 \text{ MHz}$; $\sigma = 1.466 \text{ S/m}$; $\epsilon_r = 55.397$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3831; ConvF(7.63, 7.63, 7.63); Calibrated: 2014/1/31;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2014/3/26
- Phantom: Body
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Configuration/BODY/Area Scan (91x61x1): Interpolated grid: $dx=15 \text{ mm}$, $dy=15 \text{ mm}$

Maximum value of SAR = 0.411 W/kg

Configuration/BODY/Zoom Scan (5x5x7)/Cube 0: Measurement grid:

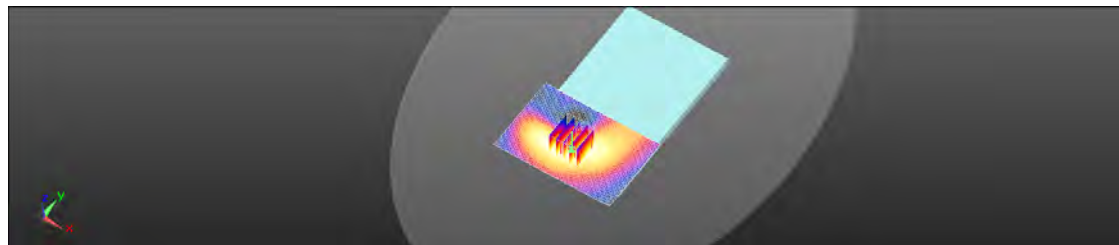
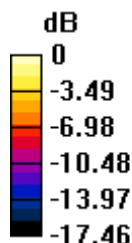
 $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 4.266 V/m; Power Drift = 0.13 dB

Peak SAR (extrapolated) = 0.474 W/kg

SAR(1 g) = 0.318 W/kg; SAR(10 g) = 0.204 W/kg

Maximum value of SAR (measured) = 0.404 W/kg



0 dB = 0.411 W/kg = -3.86 dBW/kg

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Date: 2014/8/19

WCDMA Band 4_Body_Back side_CH 1412_0 mm

Communication System: WCDMA; Frequency: 1732.4 MHz

Medium parameters used: $f = 1732.4$ MHz; $\sigma = 1.456$ S/m; $\epsilon_r = 55.45$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3831; ConvF(7.63, 7.63, 7.63); Calibrated: 2014/1/31;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2014/3/26
- Phantom: Body
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Configuration/BODY/Area Scan (91x61x1): Interpolated grid: dx=15 mm, dy=15 mm

Maximum value of SAR = 1.59 W/kg

Configuration/BODY/Zoom Scan (5x5x7)/Cube 0: Measurement grid:

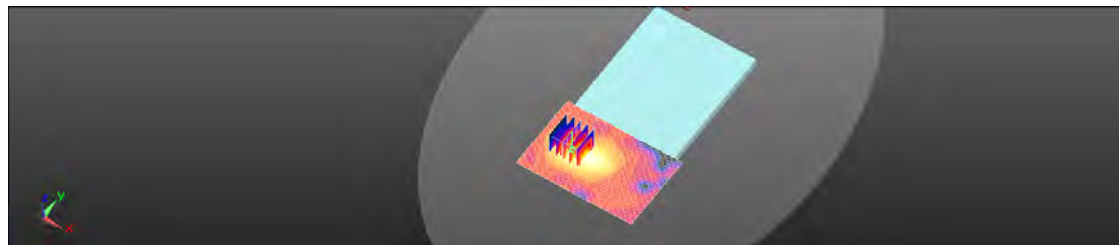
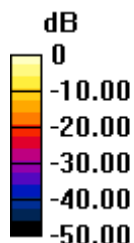
dx=8mm, dy=8mm, dz=5mm

Reference Value = 2.314 V/m; Power Drift = 0.18 dB

Peak SAR (extrapolated) = 1.98 W/kg

SAR(1 g) = 0.986 W/kg; SAR(10 g) = 0.462 W/kg

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



0 dB = 1.59 W/kg = 2.01 dBW/kg

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Date: 2014/8/18

WCDMA Band 5_Body_Back side_CH 4233_17 mm

Communication System: WCDMA; Frequency: 846.6 MHz

Medium parameters used: $f = 847$ MHz; $\sigma = 0.988$ S/m; $\epsilon_r = 55.156$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3831; ConvF(9.03, 9.03, 9.03); Calibrated: 2014/1/31;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2014/3/26
- Phantom: Body
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Configuration/BODY/Area Scan (91x61x1): Interpolated grid: dx=15 mm, dy=15 mm

Maximum value of SAR = 0.413 W/kg

Configuration/BODY/Zoom Scan (5x5x7)/Cube 0: Measurement grid:

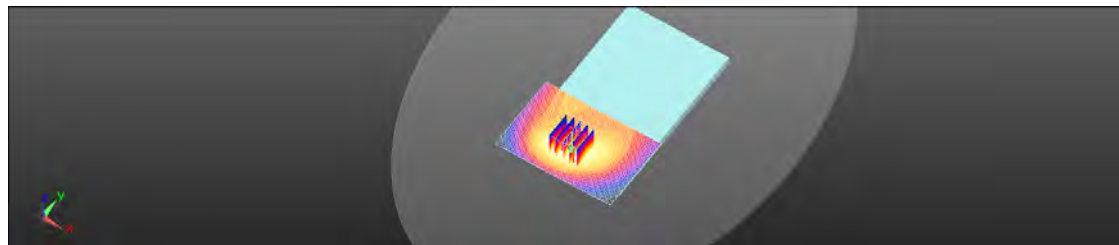
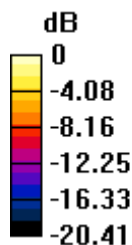
dx=8mm, dy=8mm, dz=5mm

Reference Value = 11.21 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 0.479 W/kg

SAR(1 g) = 0.321 W/kg; SAR(10 g) = 0.207 W/kg

Maximum value of SAR (measured) = 0.404 W/kg



0 dB = 0.413 W/kg = -3.84 dBW/kg

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Date: 2014/8/18

WCDMA Band 5_Body_Back side_CH 4233_0 mm

Communication System: WCDMA; Frequency: 846.6 MHz

Medium parameters used: $f = 847$ MHz; $\sigma = 0.988$ S/m; $\epsilon_r = 55.156$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3831; ConvF(9.03, 9.03, 9.03); Calibrated: 2014/1/31;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2014/3/26
- Phantom: Body
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Configuration/BODY/Area Scan (91x61x1): Interpolated grid: dx=15 mm, dy=15 mm

Maximum value of SAR = 1.45 W/kg

Configuration/BODY/Zoom Scan (5x5x7)/Cube 0: Measurement grid:

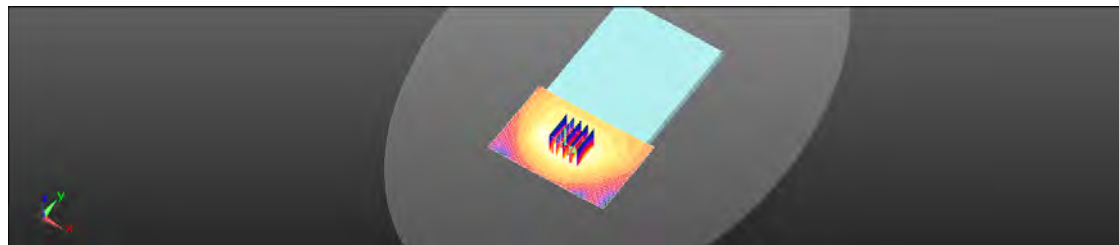
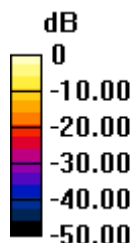
dx=8mm, dy=8mm, dz=5mm

Reference Value = 6.654 V/m; Power Drift = 0.13 dB

Peak SAR (extrapolated) = 2.04 W/kg

SAR(1 g) = 1.03 W/kg; SAR(10 g) = 0.551 W/kg

Maximum value of SAR (measured) = 1.47 W/kg



0 dB = 1.45 W/kg = 1.61 dBW/kg

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Date: 2014/8/13

WLAN 802.11b_Body_Lap-held_CH 6_0mm_repeat SAR test at the highest SAR measurement

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

Medium parameters used: $f = 2437$ MHz; $\sigma = 1.96$ S/m; $\epsilon_r = 54.566$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3979; ConvF(7.08, 7.08, 7.08); Calibrated: 2014/3/4;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn915; Calibrated: 2014/6/18
- Phantom: Body;
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Configuration/Body/Area Scan (111x81x1): Interpolated grid: dx=12 mm, dy=12 mm

Maximum value of SAR (interpolated) = 2.19 W/kg

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

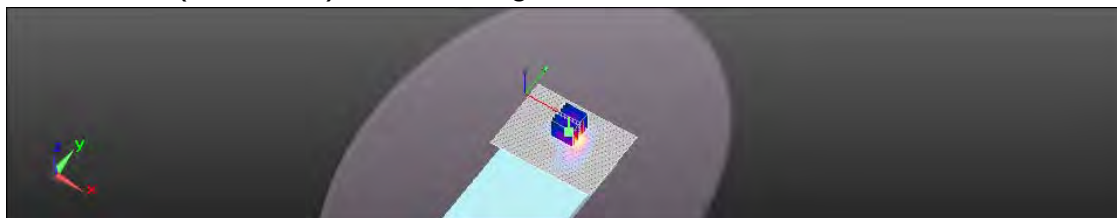
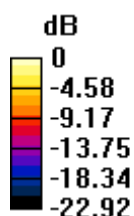
dx=5mm, dy=5mm, dz=5mm

Reference Value = 2.345 V/m; Power Drift = 0.06 dB

Peak SAR (extrapolated) = 3.33 W/kg

SAR(1 g) = 1.23 W/kg; SAR(10 g) = 0.424 W/kg

Maximum value of SAR (measured) = 2.22 W/kg



0 dB = 2.22 W/kg = 3.46 dBW/kg

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6. SAR System Performance Verification

Date: 2014/8/18

Dipole 835 MHz_SN:4d161_Body

Communication System: CW; Frequency: 835 MHz

Medium parameters used: $f = 835 \text{ MHz}$; $\sigma = 0.97 \text{ S/m}$; $\epsilon_r = 55.615$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3831; ConvF(9.03, 9.03, 9.03); Calibrated: 2014/1/31;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2014/3/26
- Phantom: Body
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Configuration/Pin=250mW/Area Scan (61x121x1): Interpolated grid:

dx=15 mm, dy=15 mm

Maximum value of SAR (interpolated) = 2.90 W/kg

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

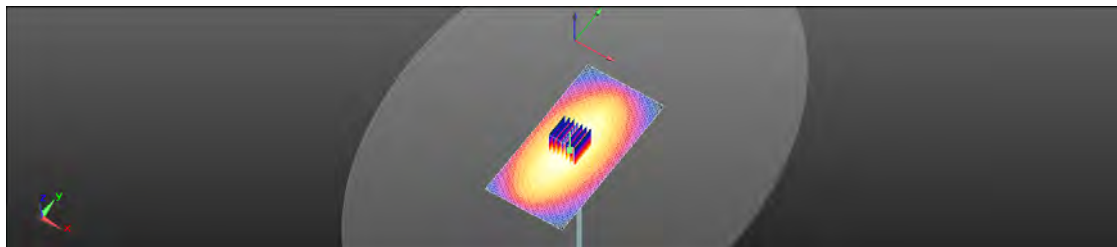
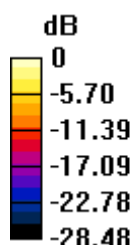
grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 55.45 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 3.39 W/kg

SAR(1 g) = 2.33 W/kg; SAR(10 g) = 1.55 W/kg

Maximum value of SAR (measured) = 2.92 W/kg



0 dB = 2.90 W/kg = 4.62 dBW/kg

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Date: 2014/8/19

Dipole 1750 MHz_SN: 1105_Body

Communication System: CW; Frequency: 1750 MHz

Medium parameters used: $f = 1750$ MHz; $\sigma = 1.464$ S/m; $\epsilon_r = 55.41$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3831; ConvF(7.63, 7.63, 7.63); Calibrated: 2014/1/31;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2014/3/26
- Phantom: Body
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Configuration/Pin=250mW/Area Scan (61x81x1): Interpolated grid: dx=15 mm, dy=15 mm

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

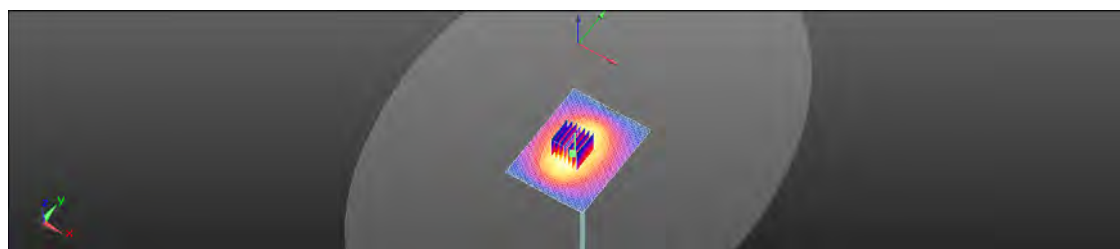
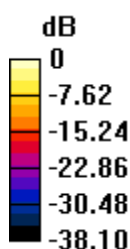
Configuration/Pin=250mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 90.21 V/m; Power Drift = -0.09 dB

Peak SAR (extrapolated) = 14.7 W/kg

SAR(1 g) = 8.97 W/kg; SAR(10 g) = 4.58 W/kg

Maximum value of SAR (measured) = 11.8 W/kg



0 dB = 12.1 W/kg = 10.82 dBW/kg

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Date: 2014/8/19

Dipole 1900 MHz_SN:5d027_Body

Communication System: CW; Frequency: 1900 MHz

Medium parameters used: $f = 1900 \text{ MHz}$; $\sigma = 1.573 \text{ S/m}$; $\epsilon_r = 54.057$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3831; ConvF(7.19, 7.19, 7.19); Calibrated: 2014/1/31;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2014/3/26
- Phantom: Body
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Configuration/Pin=250mW/Area Scan (71x121x1): Interpolated grid:

 $dx=15 \text{ mm}$, $dy=15 \text{ mm}$

Maximum value of SAR (interpolated) = 12.9 W/kg

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

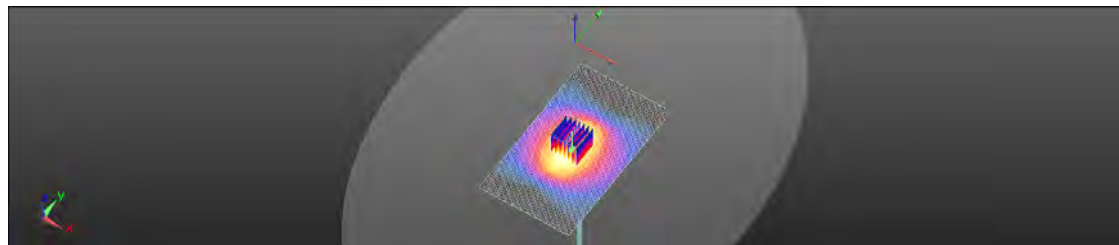
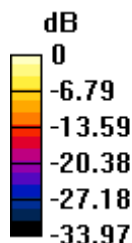
grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 88.59 V/m; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 16.6 W/kg

SAR(1 g) = 9.47 W/kg; SAR(10 g) = 5.03 W/kg

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



0 dB = 12.9 W/kg = 11.11 dBW/kg

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Date: 2014/8/13

Dipole 2450 MHz_SN:922_Body

Communication System: CW; Frequency: 2450 MHz

Medium parameters used: $f = 2450 \text{ MHz}$; $\sigma = 1.978 \text{ S/m}$; $\epsilon_r = 54.531$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3979; ConvF(7.08, 7.08, 7.08); Calibrated: 2014/3/4;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn915; Calibrated: 2014/6/18
- Phantom: Body;
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Configuration/Pin=250mW/Area Scan (51x81x1): Interpolated grid: $dx=12 \text{ mm}$, $dy=12 \text{ mm}$

Maximum value of SAR (interpolated) = 20.2 W/kg

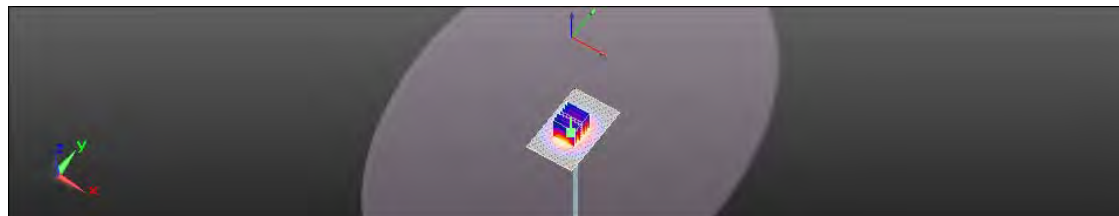
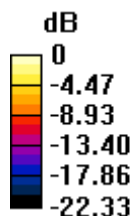
Configuration/Pin=250mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 99.25 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 25.8 W/kg

SAR(1 g) = 12.5 W/kg; SAR(10 g) = 5.77 W/kg

Maximum value of SAR (measured) = 18.9 W/kg



0 dB = 18.9 W/kg = 12.76 dBW/kg

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7. DAE & Probe Calibration Certificate

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



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

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

Accreditation No.: SCS 108

Client: SGS - TW (Auden)

Certificate No.: DAE4-547_Mar14

CALIBRATION CERTIFICATE

Object: DAE4 - SD 000 D04 BM - SN: 547

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

Calibration date: March 26, 2014

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

All calibrations have been conducted in the closed laboratory facility. Environment temperature $(22 \pm 3)^\circ\text{C}$ and humidity $< 70\%$.

Calibration Equipment used (M&PE critical for calibration):

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Kathley Multimeter Type 2001	SN: 081027H	01-Oct-13 (No: 13076)	Oct-14
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Auto DAE Calibration Unit	SE LWS 053 AA 1001	07-Jan-14 (in house check)	In house check: Jan-15
Calibrator Box V2.1	SE LMS 006 AA 1002	07-Jan-14 (in house check)	In house check: Jan-15

Calibrated by: Name: Eric Hamlet, Function: Technician, Signature: 

Approved by: Fr. Bommeli, Deputy Technical Manager, Signature: 

Issued: March 26, 2014

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

Certificate No.: DAE4-547_Mar14

Page 1 of 5

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Accreditation No.: SCS 108

Glossary

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

Methods Applied and Interpretation of Parameters

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

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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	404.032 ± 0.02% (k=2)	404.058 ± 0.02% (k=2)	404.202 ± 0.02% (k=2)
Low Range	3.95713 ± 1.50% (k=2)	3.96202 ± 1.50% (k=2)	3.97561 ± 1.50% (k=2)

Connector Angle

Connector Angle to be used in DASY system	158.0 ° ± 1 °
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Appendix

1. DC Voltage Linearity

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

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

2. Common mode sensitivity

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

	Common mode Input Voltage (mV)	High Range Average Reading (μV)	Low Range Average Reading (μV)
Channel X	200	19.65	17.65
	-200	-14.62	-15.76
Channel Y	200	-6.89	-7.43
	-200	3.98	4.06
Channel Z	200	20.93	20.96
	-200	-22.42	-22.42

3. Channel separation

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

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

Certificate No: DAE4-547_Mar14

Page 4 of 5

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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	16141	15478
Channel Y	16453	16523
Channel Z	15984	17120

5. Input Offset Measurement

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

Input 10MΩ

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

6. Input Offset Current

Nominal input circuitry offset current on all channels: <251A

7. Input Resistance (Typical values for information)

	Zeroing (kΩ)	Measuring (MΩ)
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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 The Swiss Accreditation Service is one of the signatories to the EA
 Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client: **Auden**

Certificate No: **DAE4-915_Jun14**

CALIBRATION CERTIFICATE

Object	DAE4 - SD 000 D04 BK - SN: 915		
Calibration procedure(s)	QA CAL-06.v26 Calibration procedure for the data acquisition electronics (DAE)		
Calibration date:	June 18, 2014		
This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate. All calibrations have been conducted in the closed laboratory facility, environment temperature (22 ± 3°C) and humidity < 70%. Calibration Equipment used (M&TE critical for calibration)			
Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Ketley Multimeter Type 2001	SN: 0810278	01-Oct-13 (No.13076)	Oct-14
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Auto DAE Calibration Unit	SE LWS 030 AA 1001	07-Jan-14 (in house check)	In house check: Jan-15
Calibrator Box V2.1	SE UMS 006 AA 1002	07-Jan-14 (in house check)	In house check: Jan-15
Calibrated by:	Name Dominique Staffen	Function Technician	Signature
Approved by:	Flo Bommert	Deputy Technical Manager	
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			Issued: June 18, 2014

Certificate No: DAE4-915_Jun14

Page 1 of 5

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Accreditation No.: **SCS 108**

Glossary

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

Methods Applied and Interpretation of Parameters

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

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DC Voltage Measurement

A/D - Converter Resolution nominal

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

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

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

Calibration Factors	X	Y	Z
High Range	404.307 $\pm$ 0.02% (k=2)	404.432 $\pm$ 0.02% (k=2)	404.778 $\pm$ 0.02% (k=2)
Low Range	3.97786 $\pm$ 1.50% (k=2)	4.00889 $\pm$ 1.50% (k=2)	3.98763 $\pm$ 1.50% (k=2)

Connector Angle

Connector Angle to be used in DASY system	115.0 $^{\circ}$ $\pm$ 1 $^{\circ}$
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Appendix (Additional assessments outside the scope of SCS108)

1. DC Voltage Linearity

High Range	Reading (μV)	Difference (μV)	Error (%)
Channel X + Input	19998.06	1.14	0.00
Channel X + Input	20000.26	-0.79	-0.00
Channel X - Input	-19999.34	1.47	-0.01
Channel Y + Input	20000.17	3.04	0.00
Channel Y + Input	19999.35	-1.60	-0.01
Channel Y - Input	-20000.40	0.40	-0.00
Channel Z + Input	199996.89	-0.05	-0.00
Channel Z + Input	19999.67	-1.07	-0.01
Channel Z - Input	-20001.83	-0.82	0.00

Low Range	Reading (μV)	Difference (μV)	Error (%)
Channel X + Input	2000.78	-0.15	-0.01
Channel X + Input	201.37	-0.01	-0.00
Channel X - Input	-198.71	-0.07	0.04
Channel Y + Input	2001.08	0.23	0.01
Channel Y + Input	201.11	-0.04	-0.02
Channel Y - Input	-198.95	-0.16	0.08
Channel Z + Input	2000.69	-0.17	-0.01
Channel Z + Input	200.66	-0.48	-0.24
Channel Z - Input	-200.04	-1.33	0.67

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	-15.73	-17.62
	- 200	17.95	16.40
Channel Y	200	-5.63	-5.61
	- 200	4.75	4.70
Channel Z	200	-0.98	-1.03
	- 200	-0.88	-0.86

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	-	4.09	-3.56
Channel Y	200	7.89	-	5.02
Channel Z	200	8.61	6.69	-

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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	16112	13093
Channel Y	15985	14777
Channel Z	15881	15729

5. Input Offset Measurement

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

Input 10M Ω

	Average (μ V)	min. Offset (μ V)	max. Offset (μ V)	Std. Deviation (μ V)
Channel X	0.08	-1.17	1.32	0.43
Channel Y	-0.58	-1.57	0.70	0.47
Channel Z	-0.51	-1.47	1.80	0.44

6. Input Offset Current

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

7. Input Resistance (Typical values for information)

	Zeroing (k Ω m)	Measuring (M Ω m)
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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Accreditation No. : **SCS 108**

Client : **SGS-TW (Auden)**

Certificate No. : **EX3-3831_Jan14**

CALIBRATION CERTIFICATE

Object: **EX3DV4 - SN:3831**

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: **January 31, 2014**

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

All calibrations have been conducted in the closed laboratory facility, environment temperature $(22 \pm 3)^{\circ}\text{C}$ and humidity $\approx 70\%$.

Calibration Equipment used (M&E series for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4410B	GB41260679	04-Apr-13 (No. 217-01732)	Apr-14
Power sensor E4412A	MY41498867	04-Apr-13 (No. 217-01732)	Apr-14
Reference 3 dB Attenuator	SN: S5054 (30)	04-Apr-13 (No. 217-01737)	Apr-14
Reference 20 dB Attenuator	SN: S5277 (20)	04-Apr-13 (No. 217-01735)	Apr-14
Reference 30 dB Attenuator	SN: S5128 (30)	04-Apr-13 (No. 217-01735)	Apr-14
Reference Probe ES3DV2	SN: 9013	30-Dec-13 (No. ES3-3013, Dec-13)	Dec-14
DAEs	SN: 660	13-Dec-13 (No. DAE4-660, Dec-13)	Dec-14
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8640C	US3642(LS1700)	4-Aug-99 (in house check Apr-13)	In house check: Apr-16
Network Analyzer HP 8730E	US37340006	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

Calibrated by: **Name** **Function** **Signature**
 (Vase B-Haus) **Laboratory Technician**

Approved by: **Name** **Technical Manager**

Issued: January 31, 2014

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Certificate No. **EX3-3831_Jan14**

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Accreditation No.: SCS 108

Glossary:

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

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

Methods Applied and Interpretation of Parameters:

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

Certificate No: EX3-3831_Jan14

Page 2 of 11

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EX3DV4 – SN:3831

January 31, 2014

Probe EX3DV4

SN:3831

Manufactured: September 6, 2011
Calibrated: January 31, 2014

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

Certificate No: EX3-3831_Jan14

Page 3 of 11

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EX3DV4--SN:3831

January 31, 2014

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3831**Basic Calibration Parameters**

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	0.45	0.42	0.43	$\pm 10.1 \%$
DCP (mV) ^B	102.4	100.1	97.7	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB $\sqrt{\mu\text{V}}$	C	D dB	VR mV	Unc ^C (k=2)
0	CW	X	0.0	0.0	1.0	0.00	153.1	$\pm 3.0 \%$
		Y	0.0	0.0	1.0		146.3	
		Z	0.0	0.0	1.0		154.8	

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

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

^B Numerical linearization parameter: uncertainty not required.

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

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EX3DV4-SN:3831

January 31, 2014

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3831

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 ^h (mm)	Unc. (k=2)
750	41.9	0.89	9.59	9.59	9.59	0.74	0.64	± 12.0 %
835	41.5	0.90	9.14	9.14	9.14	0.22	1.36	± 12.0 %
900	41.5	0.97	9.17	9.17	9.17	0.28	0.96	± 12.0 %
1750	40.1	1.37	8.00	8.00	8.00	0.26	0.99	± 12.0 %
1900	40.0	1.40	7.79	7.79	7.79	0.60	0.65	± 12.0 %
2000	40.0	1.40	7.71	7.71	7.71	0.39	0.79	± 12.0 %
2300	39.5	1.87	7.35	7.35	7.35	0.43	0.76	± 12.0 %
2450	39.2	1.80	6.99	6.99	6.99	0.37	0.85	± 12.0 %
2600	39.0	1.96	6.62	6.62	6.62	0.38	0.87	± 12.0 %
5200	36.0	4.66	4.67	4.67	4.67	0.36	1.80	± 13.1 %
5300	35.9	4.76	4.41	4.41	4.41	0.40	1.80	± 13.1 %
5600	35.5	5.07	3.99	3.99	3.99	0.50	1.80	± 13.1 %
5800	35.3	5.27	4.12	4.12	4.12	0.45	1.80	± 13.1 %

^c Frequency validity 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.

^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 ± 6%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

^g Alpha/Depth are determined during calibration. SPIAG 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.

Certificate No: EX3-3831_Jan14

Page 5 of 11

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EX3DV4-SN:3831

January 31, 2014

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3831

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) ^c	Relative Permittivity ^d	Conductivity (S/m) ^e	ConvF X	ConvF Y	ConvF Z	Alpha ^g	Depth ^h (mm)	Unct. (k=2)
750	55.5	0.96	9.10	9.10	9.10	0.50	0.80	± 12.0 %
835	55.2	0.97	9.03	9.03	9.03	0.28	1.15	± 12.0 %
900	55.0	1.05	8.84	8.84	8.84	0.29	1.08	± 12.0 %
1750	53.4	1.49	7.63	7.63	7.63	0.26	1.16	± 12.0 %
1900	53.3	1.52	7.19	7.19	7.19	0.32	1.01	± 12.0 %
2000	53.3	1.52	7.17	7.17	7.17	0.44	0.83	± 12.0 %
2300	52.9	1.81	6.90	6.90	6.90	0.52	0.75	± 12.0 %
2450	52.7	1.95	6.68	6.68	6.68	0.60	0.56	± 12.0 %
2600	52.5	2.16	6.50	6.50	6.50	0.80	0.50	± 12.0 %
5200	49.0	5.30	4.08	4.08	4.08	0.50	1.90	± 13.1 %
5300	48.9	5.42	3.87	3.87	3.87	0.50	1.90	± 13.1 %
5600	48.5	5.77	3.36	3.36	3.36	0.60	1.90	± 13.1 %
5900	48.2	6.00	3.78	3.78	3.78	0.55	1.90	± 13.1 %

^c Frequency validity 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.

^d 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.

^h 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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Page 6 of 11

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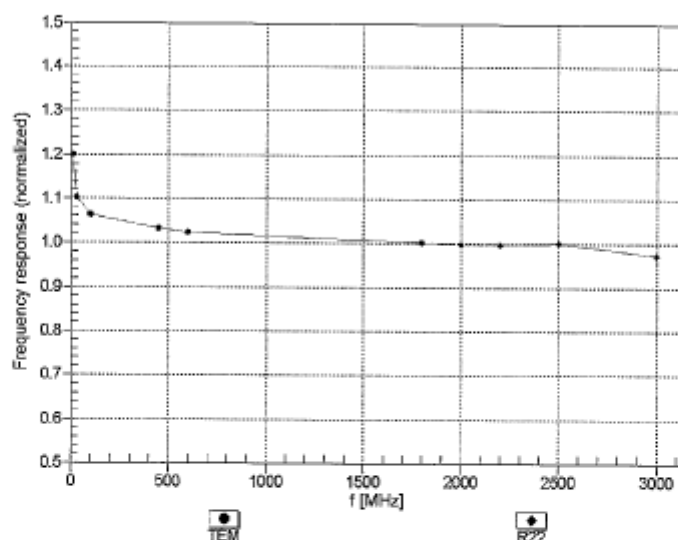
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EX3DV4-SN:3831

January 31, 2014

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



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

Certificate No: EX3-3831_Jan14

Page 7 of 11

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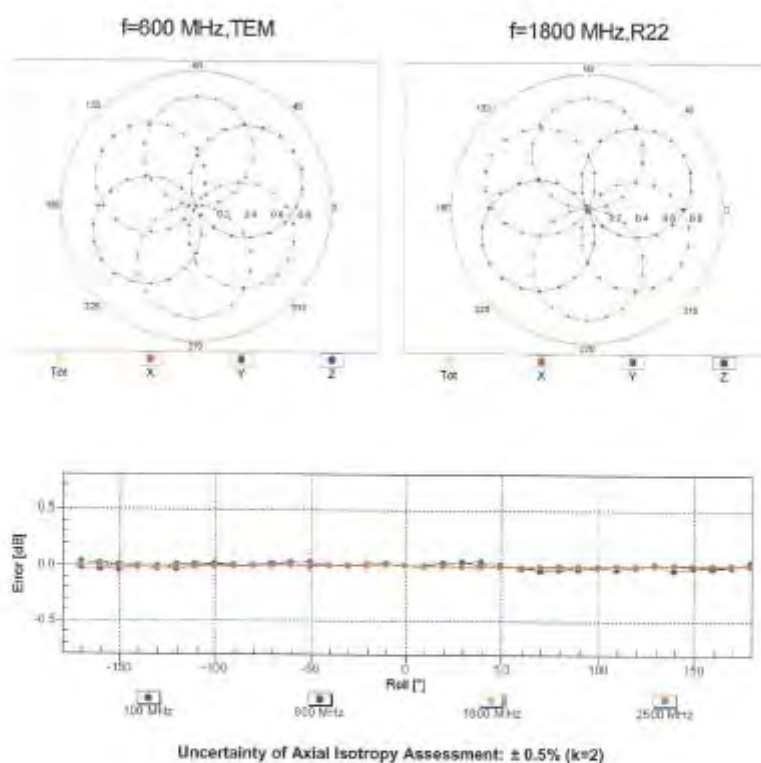
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January 31, 2014

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



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Page 8 of 11

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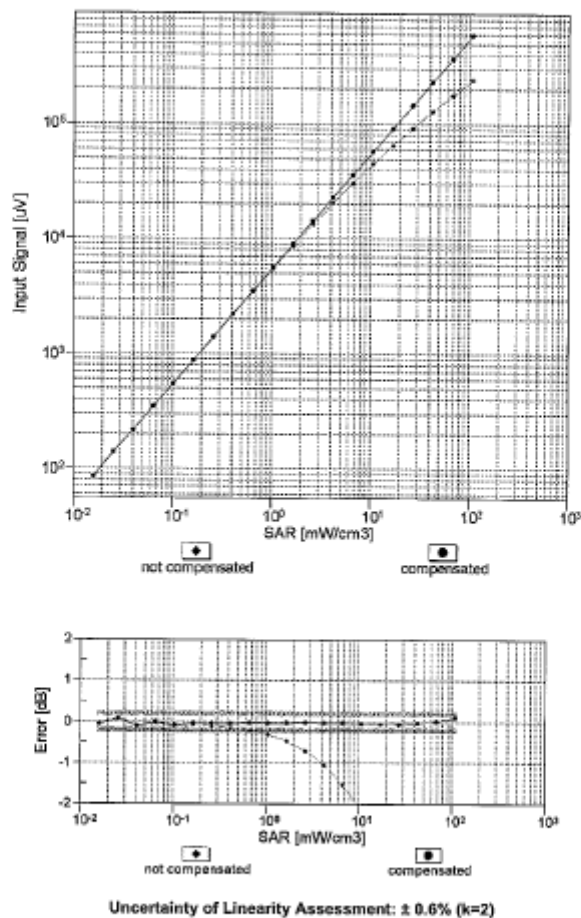
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EX3DV4-SN:3831

January 31, 2014

Dynamic Range $f(\text{SAR}_{\text{head}})$ (TEM cell, $f = 900 \text{ MHz}$)



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

Certificate No: EX3-3831_Jan14

Page 9 of 11

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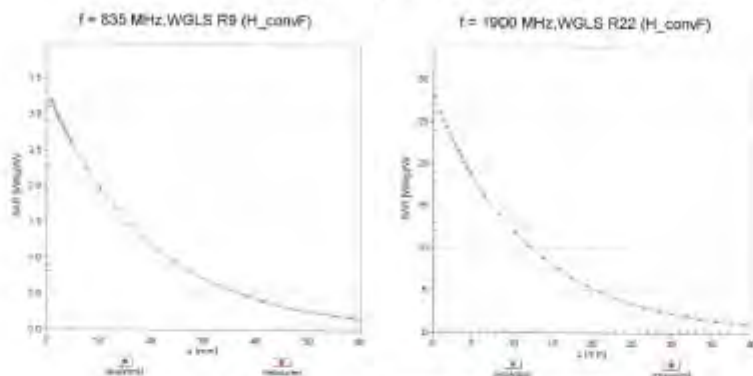
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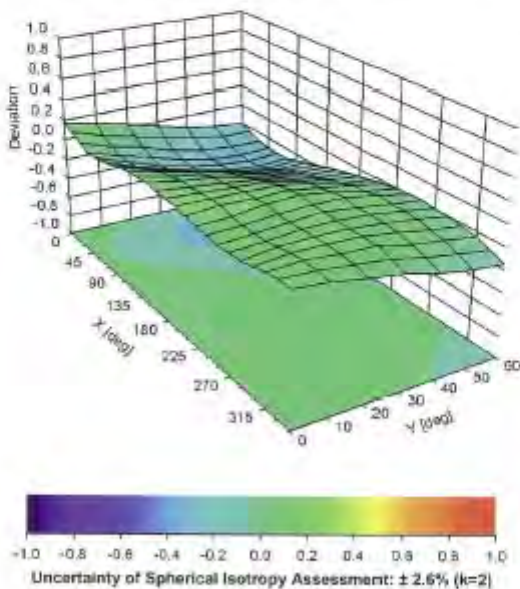
EX3DV4-SN:3831

January 31, 2014

Conversion Factor Assessment



Deviation from Isotropy in Liquid Error (ϕ , θ), f = 900 MHz



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Page 10 of 11

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EX3DV4-SN:3831

January 31, 2014

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3831

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-20.6
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	2 mm

Certificate No: EX3-3831_Jan14

Page 11 of 11

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Accreditation No.: **SCS 108**

Client **Demen SH (Auden)**

Certificate No: **EX3-3979_Mar14**

CALIBRATION CERTIFICATE

Object: **EX3DV4 - SN-3979**

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: **March 4, 2014**

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

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

Calibration Equipment used (M&E critical for calibration):

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41290874	04-Apr-13 (No. 217-01733)	Apr-14
Power sensor E4412A	MY41498087	04-Apr-13 (No. 217-01733)	Apr-14
Reference 3 dB Attenuator	BN: ES054 (3c)	04-Apr-13 (No. 217-01737)	Apr-14
Reference 20 dB Attenuator	SN: SS277 (20s)	04-Apr-13 (No. 217-01735)	Apr-14
Reference 30 dB Attenuator	SN: SS129 (30s)	04-Apr-13 (No. 217-01738)	Apr-14
Reference Probe ES3DV2	SN: 3013	30-Dec-13 (No. ES3-3013, Dec13)	Dec-14
DAF4	SN: 660	13-Dec-13 (No. DAF4-660, Dec13)	Dec-14
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8848C	US3642L01700	4-Aug-99 (in house check Apr-13)	in house check: Apr-16
Network Analyzer HP 8753E	US373K0665	18-Oct-01 (in house check Oct-13)	in house check: Oct-14

	Name	Function	Signature
Calibrated by:	Leif Kyster	Laboratory Technician	
Approved by:	Sasha Polovic	Technical Manager	
Issued: March 4, 2014			
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			

Certificate No. **EX3-3979_Mar14**

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Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

Methods Applied and Interpretation of Parameters:

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

Certificate No: EX3-3979_Mar14

Page 2 of 11

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EX3DV4 – SN:3979

March 4, 2014

Probe EX3DV4

SN:3979

Manufactured: November 5, 2013

Calibrated: March 4, 2014

Calibrated for DASY/EASY Systems

(Note: non-compatible with DASY2 system!)

Certificate No: EX3-3979_Mar14

Page 3 of 11

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EX3DV4- SN:3979

March 4, 2014

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3979

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm $(\mu V/(V/m))^{1/2}$ ^A	0.48	0.50	0.48	± 10.1 %
DCP $(mV)^{1/2}$ ^B	100.3	101.1	100.0	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Unc ^C (k=2)
0	CW	X	0.0	0.0	1.0	0.00	137.1	±3.5 %
		Y	0.0	0.0	1.0		141.2	
		Z	0.0	0.0	1.0		133.2	

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

^A The uncertainties of NormX,Y,Z do not affect the E₁-field uncertainty inside TSL (see Pages 5 and 6).

^B Numerical linearization parameter: uncertainty not required.

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

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EX3DV4- SN:3979

March 4, 2014

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3979

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^c	Relative Permittivity ^f	Conductivity (Sim) ^f	ConvF X	ConvF Y	ConvF Z	Alpha ^g	Depth (mm)	Unct. (k=2)
750	41.9	0.89	9.93	9.93	9.93	0.22	1.39	± 12.0 %
900	41.5	0.97	9.42	9.42	9.42	0.46	0.80	± 12.0 %
1750	40.1	1.37	8.21	8.21	8.21	0.76	0.62	± 12.0 %
1900	40.0	1.40	8.01	8.01	8.01	0.48	0.76	± 12.0 %
2100	39.8	1.49	8.03	8.03	8.03	0.72	0.62	± 12.0 %
2450	39.2	1.80	7.02	7.02	7.02	0.32	0.92	± 12.0 %
5200	36.0	4.66	4.83	4.83	4.83	0.30	1.80	± 13.1 %
5500	35.6	4.96	4.67	4.67	4.67	0.35	1.80	± 13.1 %
5800	35.3	5.27	4.39	4.39	4.39	0.35	1.80	± 13.1 %

^c Frequency validity 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.

^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.

Certificate No: EX3-3979_Mar14

Page 5 of 11

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EX3DV4 - SN:3979

March 4, 2014

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3979

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (Sim) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth (mm) ^G	Unct. (k=2)
750	55.5	0.96	9.44	9.44	9.44	0.64	0.71	± 12.0 %
900	55.0	1.05	9.21	9.21	9.21	0.80	0.62	± 12.0 %
1750	53.4	1.49	8.12	8.12	8.12	0.44	0.88	± 12.0 %
1900	53.3	1.52	7.71	7.71	7.71	0.44	0.88	± 12.0 %
2100	53.2	1.62	7.92	7.92	7.92	0.36	0.91	± 12.0 %
2450	52.7	1.95	7.08	7.08	7.08	0.80	0.58	± 12.0 %
5200	49.0	5.30	4.61	4.61	4.61	0.40	1.90	± 13.1 %
5500	48.6	5.65	4.02	4.02	4.02	0.45	1.90	± 13.1 %
5800	48.2	6.00	4.28	4.28	4.28	0.45	1.90	± 13.1 %

^C Frequency validity 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.

^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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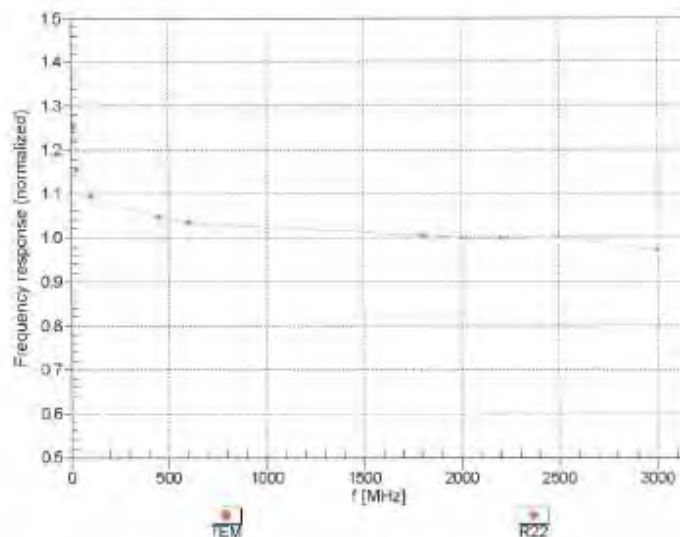
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EX3DW4- SN:3979

March 4, 2014

Frequency Response of E-Field (TEM-Cell:ifl110 EXX, Waveguide: R22)



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

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Page 7 of 11

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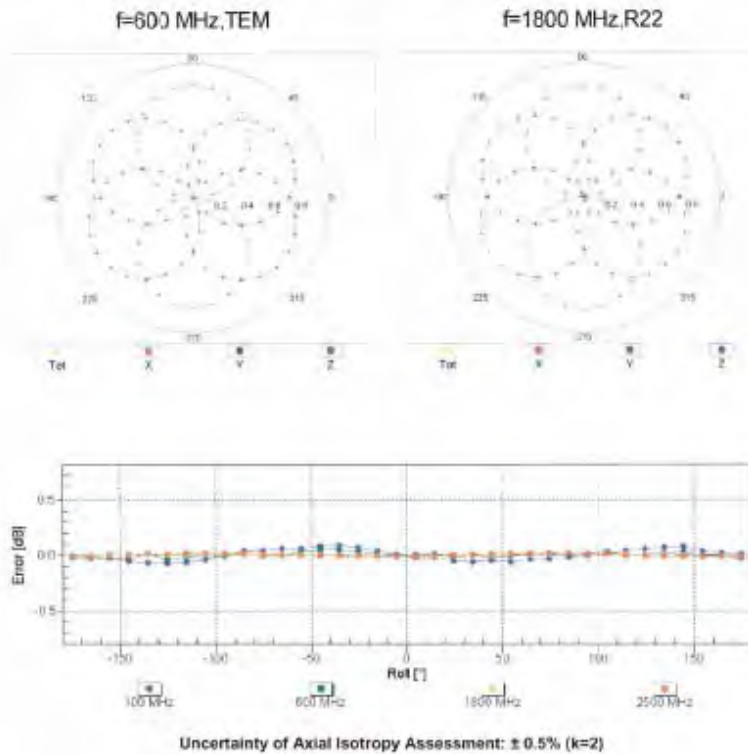
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March 4, 2014

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



Certificate No. EX3-3979, Mar14

Page 8 of 11

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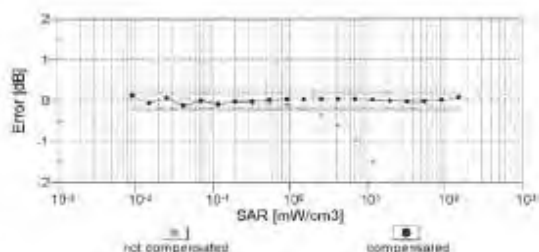
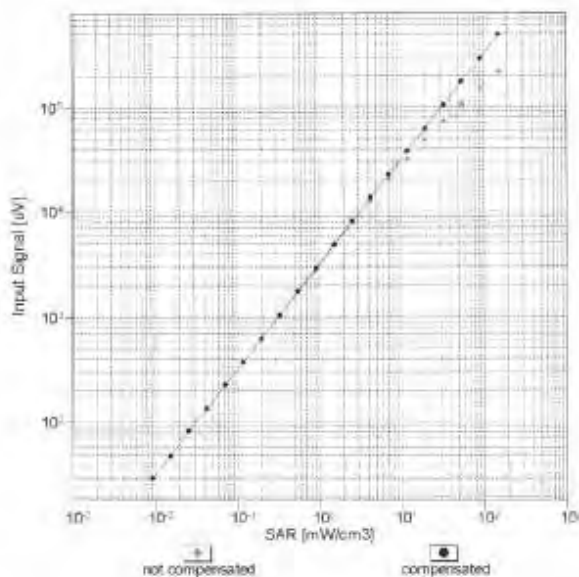
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March 4, 2014

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



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

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Page 9 of 11

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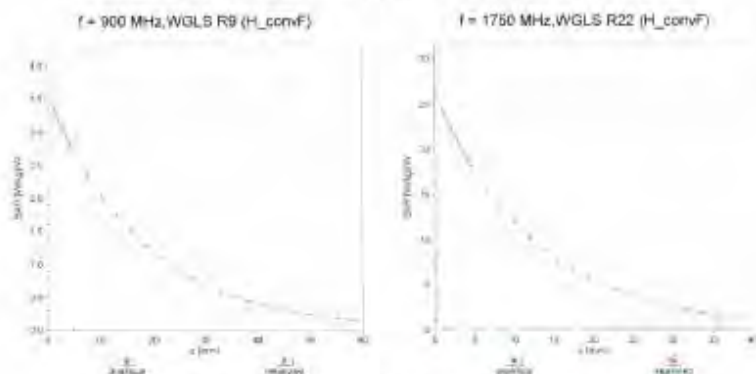
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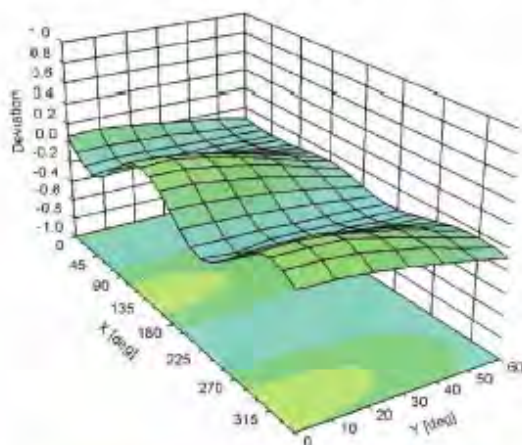
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Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (θ, ϕ), $f = 900$ MHz



Uncertainty of Spherical Isotropy Assessment: $\pm 2.6\%$ ($k=2$)

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Page 10 of 11

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EX3DV4- SN:3979

March 4, 2014

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3979

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-45.3
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	2 mm

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8. Uncertainty Budget

Measurement Uncertainty evaluation template for DUT SAR test
IEEE 1528

A	c	D	e		f	g	h=c * f / e	i=c * g / e	k
Source of Uncertainty	Tolerance/ Uncertainty	Probability Distributioi	Div	Div Value	ci (1g)	ci (10g)	Standard uncertainty	Standard uncertainty	vi, or Veff
Measurement system									
Probe calibration	6.55%	N	1	1	1	1	6.55%	6.55%	∞
<i>Isotropy , Axial</i>	3.50%	R	$\sqrt{3}$	1.732	1	1	2.02%	2.02%	∞
<i>Isotropy, Hemispherical</i>	9.60%	R	$\sqrt{3}$	1.732	1	1	5.54%	5.54%	∞
Boundary Effect	1.00%	R	$\sqrt{3}$	1.732	1	1	0.58%	0.58%	∞
Linearity	4.70%	R	$\sqrt{3}$	1.732	1	1	2.71%	2.71%	∞
Detection Limits	1.00%	R	$\sqrt{3}$	1.732	1	1	0.58%	0.58%	∞
Readout Electronics	0.30%	N	1	1	1	1	0.30%	0.30%	∞
Response time	0.80%	R	$\sqrt{3}$	1.732	1	1	0.46%	0.46%	∞
Integration Time	2.60%	R	$\sqrt{3}$	1.732	1	1	1.50%	1.50%	∞
Measurement drift (class A evaluation)	1.75%	R	$\sqrt{3}$	1.732	1	1	1.01%	1.01%	∞
RF ambient condition - noise	3.00%	R	$\sqrt{3}$	1.732	1	1	1.73%	1.73%	∞
RF ambient conditions - reflections	3.00%	R	$\sqrt{3}$	1.732	1	1	1.73%	1.73%	∞
Probe positioner Mechanical restrictions	0.40%	R	$\sqrt{3}$	1.732	1	1	0.23%	0.23%	∞
Probe Positioning with respect to phantom shell	2.90%	R	$\sqrt{3}$	1.732	1	1	1.67%	1.67%	∞
Post-processing	1.00%	R	$\sqrt{3}$	1.732	1	1	0.58%	0.58%	∞
Max SAR Eval	1.00%	R	$\sqrt{3}$	1.732	1	1	0.58%	0.58%	∞
Test Sample related									
Test sample positioning	2.90%	N	1	1	1	1	2.90%	2.90%	M-1
Device Holder Uncertainty	3.60%	N	1	1	1	1	3.60%	3.60%	M-1
Drift of output power	5.00%	R	$\sqrt{3}$	1.732	1	1	2.89%	2.89%	∞
Phantom and Setup									
Phantom Uncertainty	4.00%	R	$\sqrt{3}$	1.732	1	1	2.31%	2.31%	∞
Deviation from reference liquid target ϵ 'r(Body)	3.84%	N	1	1	0.64	0.43	2.46%	1.65%	M
Deviation from reference liquid target σ (Body)	4.85%	N	1	1	0.6	0.49	2.91%	2.38%	M
Combined standard uncertainty		RSS					12.18%	11.93%	
Expan uncertainty (95% confidence interval), K=2							24.36%	23.85%	

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9. Phantom Description

Schmid & Partner Engineering AG

s p e a g

Zeughausstrasse 43, 8004 Zürich, Switzerland
Phone +41 1 245 9700, Fax +41 1 245 9779
info@speag.com, http://www.speag.com

Certificate of Conformity / First Article Inspection

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

Tests

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

Test	Requirement	Details	Units tested
Dimensions	Compliant with the geometry according to the CAD model	IT15 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-1214 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 1
- [4] FCC OET Bulletin 65, Supplement C, Edition 01-01
- (*) The IT15 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

s p e a g

Schmid & Partner Engineering AG
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info@speag.com, http://www.speag.com

Doc No. SA1 - QD 000 P40 C - F

Page 3 (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 108

Client SGS-TW (Auden)

Certificate No: D835V2-4d161_Nov13

CALIBRATION CERTIFICATE

Object D835V2 - SN: 4d161

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

Calibration date November 01, 2013

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	GB37490704	08-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	US37292783	08-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	MY41092317	09-Oct-13 (No. 217-01828)	Oct-14
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-13 (No. 217-01736)	Apr-14
Type-N mismatch combination	SN: 5047.3 / 06327	04-Apr-13 (No. 217-01739)	Apr-14
Reference Probe ES3DV3	SN: 3205	28-Dec-12 (No. ES3-3205_Dec12)	Dec-13
DAE4	SN: 601	25-Apr-13 (No. DAE4-601_Apr13)	Apr-14
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-08	100005	04-Aug-09 (in house check Oct-13)	In house check: Oct-15
Network Analyzer HP 8753E	US37390585 S4205	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

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

Issued: November 1, 2013

Certificate No: D835V2-4d161_Nov13

Page 1 of 8

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 108

Glossary:

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

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

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Measurement Conditions

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

DASY Version	DASY5	V52.8.7
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	835 MHz $\pm$ 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 $\pm$ 0.2) °C	40.8 $\pm$ 6 %	0.94 mho/m $\pm$ 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	2.46 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	9.49 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.59 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	6.18 W/kg $\pm$ 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 $\pm$ 0.2) °C	54.7 $\pm$ 6 %	1.01 mho/m $\pm$ 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	2.40 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	9.32 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.57 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	6.13 W/kg $\pm$ 16.5 % (k=2)

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Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.9 Ω - 2.4 j Ω
Return Loss	- 27.1 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	47.7 Ω - 5.1 j Ω
Return Loss	- 24.8 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.425 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 28, 2012

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DASY5 Validation Report for Head TSL

Date: 01.11.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d161

Communication System: UID 0 - CW ; Frequency: 835 MHz

Medium parameters used: $f = 835 \text{ MHz}$; $\sigma = 0.94 \text{ S/m}$; $\epsilon_r = 40.8$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.05, 6.05, 6.05); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7)64)

Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

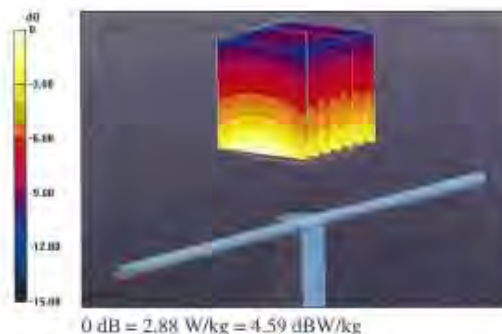
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 56,867 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 3.75 W/kg

SAR(1 g) = 2.46 W/kg; SAR(10 g) = 1.59 W/kg

Maximum value of SAR (measured) = 2.88 W/kg

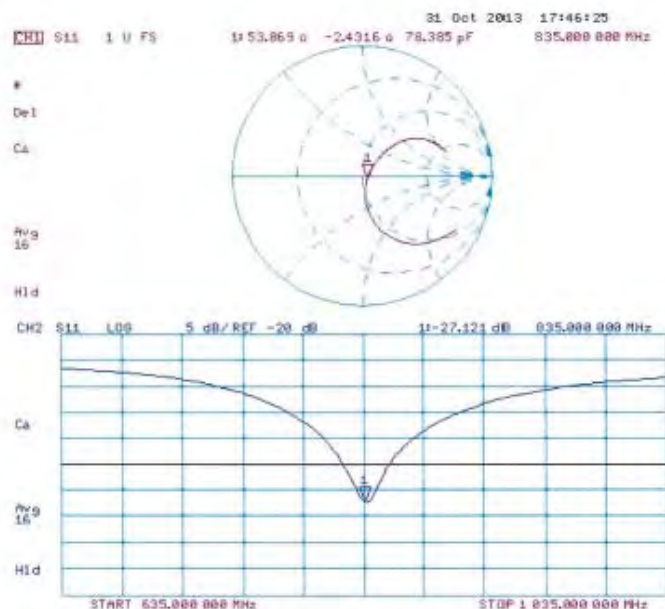


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Impedance Measurement Plot for Head TSL



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DASY5 Validation Report for Body TSL

Date: 01.11.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d161

Communication System: UID 0 - CW ; Frequency: 835 MHz

Medium parameters used: $f = 835 \text{ MHz}$; $\sigma = 1.007 \text{ S/m}$; $\epsilon_r = 54.7$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.04, 6.04, 6.04); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sa601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

Dipole Calibration for Body Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

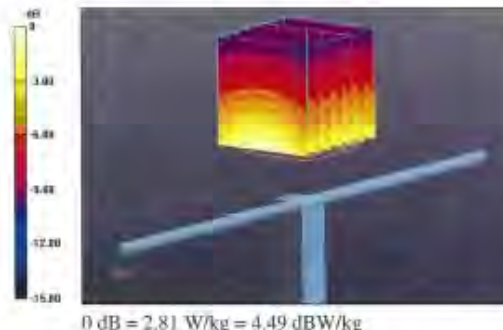
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 35.021 V/m; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 3.55 W/kg

SAR(1 g) = 2.4 W/kg; SAR(10 g) = 1.57 W/kg

Maximum value of SAR (measured) = 2.81 W/kg

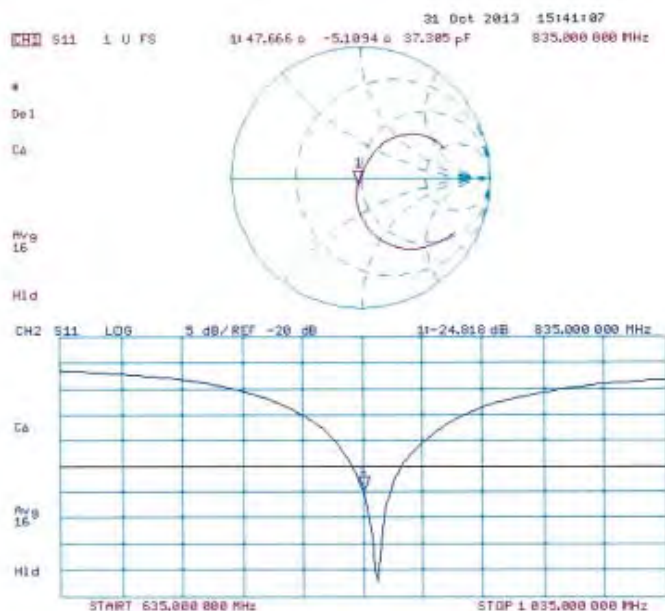


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Impedance Measurement Plot for Body TSL



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Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: SCS 108

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

Client: SGS-TW (Auden)

Certificate No: D1750V2-1105_Nov13

CALIBRATION CERTIFICATE

Object: D1750V2 - SN: 1105

Calibration procedure(s): QA CAL-05.V9
Calibration procedure for dipole validation kits above 700 MHz

Calibration date: November 05, 2013

This calibration certificate documents the traceability to national standards, which realize the physical units of 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	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	11537292783	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	MY41092317	09-Oct-13 (No. 217-01828)	Oct-14
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-13 (No. 217-01738)	Apr-14
Type-N mismatch combination	SN: 5047.3 / 06327	04-Apr-13 (No. 217-01739)	Apr-14
Reference Probe ES30VS	SN: 3205	28-Dec-12 (No. ES3-3205_Dec12)	Dec-13
DAE4	SN: 601	25-Apr-13 (No. DAE4-601_Apr13)	Apr-14
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-09 (in house check Oct-13)	in house check: Oct-15
Network Analyzer HP 8753E	11537390595 S4206	18-Oct-01 (in house check Oct-13)	in house check: Oct-14

Calibrated by: Name: (Lisa E-Nack) Function: Laboratory Technician Signature: *Lisa E-Nack*

Approved by: Kalja Pokovic Technical Manager Signature: *Kalja Pokovic*

Issued: November 5, 2013

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

Certificate No: D1750V2-1105_Nov13

Page 1 of 6

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

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Measurement Conditions

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

DASY Version	DASY5	V52.8.7
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1750 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.1	1.37 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	40.0 $\pm$ 6 %	1.37 mho/m $\pm$ 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	9.31 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	37.2 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	4.94 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	19.8 W/kg $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.4	1.49 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	53.0 $\pm$ 6 %	1.48 mho/m $\pm$ 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	9.38 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	37.6 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.05 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	20.2 W/kg $\pm$ 16.5 % (k=2)

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Appendix**Antenna Parameters with Head TSL**

Impedance, transformed to feed point	50.2 Ω - 1.0 j Ω
Return Loss	- 40.3 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	45.9 Ω - 0.8 j Ω
Return Loss	- 27.2 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.217 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	May 16, 2013

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DASY5 Validation Report for Head TSL

Date: 04.11.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN: 1105

Communication System: UID 0 - CW; Frequency: 1750 MHz

Medium parameters used: $f = 1750$ MHz; $\sigma = 1.37$ S/m; $\epsilon_r = 40$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5.18, 5.18, 5.18); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

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

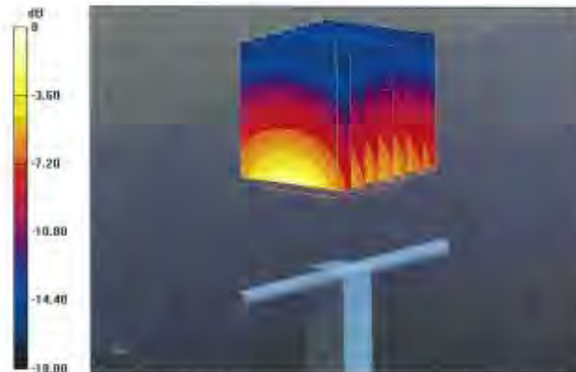
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 94,504 V/m; Power Drift = 0,03 dB

Peak SAR (extrapolated) = 16.9 W/kg

SAR(1 g) = 9.31 W/kg; SAR(10 g) = 4.94 W/kg

Maximum value of SAR (measured) = 11.5 W/kg



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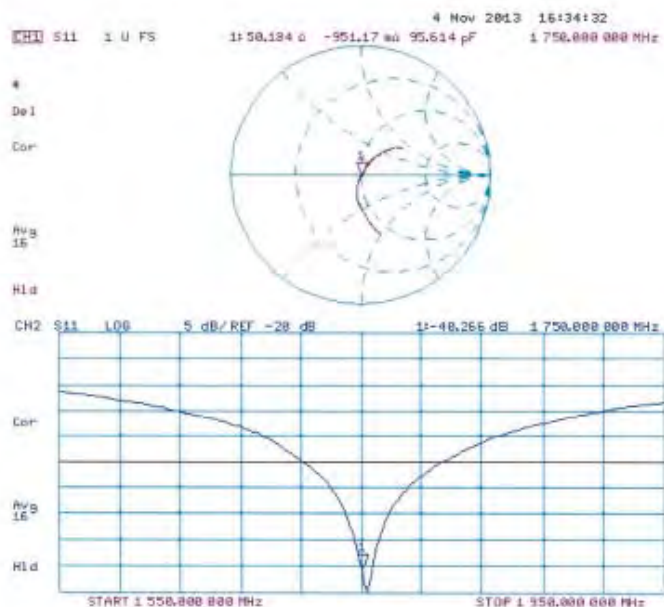
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Impedance Measurement Plot for Head TSL



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DASY5 Validation Report for Body TSL

Date: 05.11.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN: 1105

Communication System: UID 0 - CW; Frequency: 1750 MHz

Medium parameters used: $f = 1750$ MHz; $\sigma = 1.48$ S/m; $\epsilon_r = 53$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.83, 4.83, 4.83); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

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

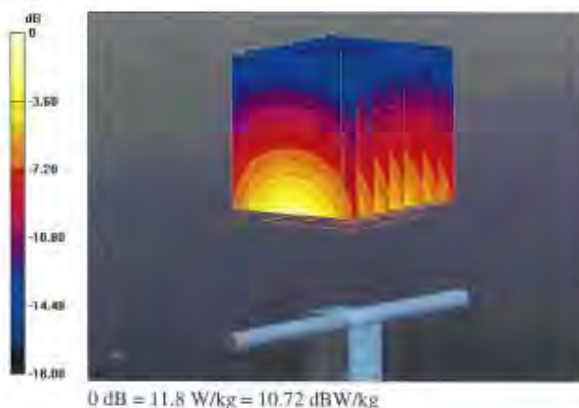
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 93.113 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 16.1 W/kg

SAR(1 g) = 9.38 W/kg; SAR(10 g) = 5.05 W/kg

Maximum value of SAR (measured) = 11.8 W/kg



Certificate No: D1750V2-1105_Nov13

Page 7 of 8

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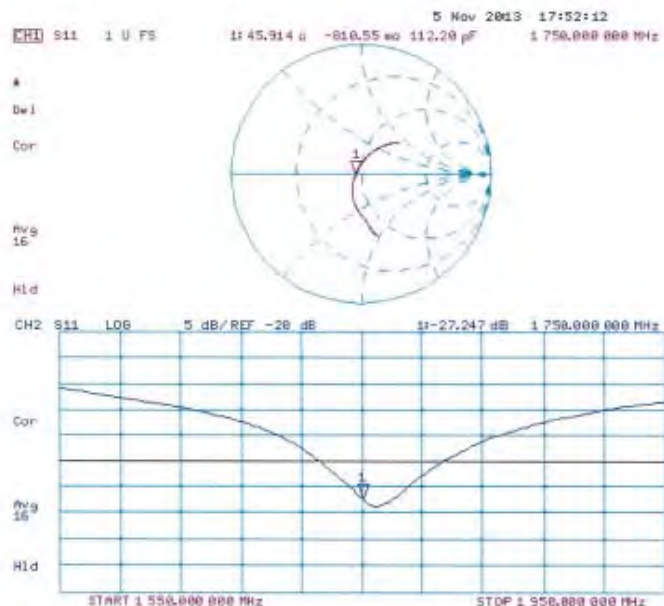
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Impedance Measurement Plot for Body TSL



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Accreditation No.: SCS 108

Client: SGS-TW (Auden)

Certificate No: D1900V2-5d027_Apr14

CALIBRATION CERTIFICATE

Object: D1900V2 - SN: 5d027

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

Calibration date: April 23, 2014

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

All calibrations have been conducted in the closed laboratory facility; environment temperature $(20 \pm 0.5)^\circ\text{C}$ and humidity $< 70\%$.

Calibration Equipment used (M&PE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	US37292783	08-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	MY41082317	08-Oct-13 (No. 217-01828)	Oct-14
Reference 20 dB Attenuator	SN: 5058 (20k)	03-Apr-14 (No. 217-01918)	Apr-15
Type-N mismatch combination	SN: 5047.2 / 06327	03-Apr-14 (No. 217-01921)	Apr-15
Reference Probe ES20V3	SN: 3208	30-Dec-13 (No. EB3-3205_Dec13)	Dec-14
DAE4	SN: 601	25-Apr-13 (No. DAE4-601_Apr13)	Apr-14
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
HF generator H&S 5MT-08	100006	04-Aug-09 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37380585 54208	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

Calibrated by:	Name: Jefen Kastral	Function: Laboratory Technician	Signature:
Approved by:	Name: Katja Pokovic	Function: Technical Manager	Signature:

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Issued: April 23, 2014

Certificate No: D1900V2-5d027_Apr14

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Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

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Measurement Conditions

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

DASY Version	DASY5	V52.8.7
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz $\pm$ 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 $\pm$ 0.2) °C	39.1 $\pm$ 6 %	1.36 mho/m $\pm$ 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	9.71 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	39.3 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.10 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	20.6 W/kg $\pm$ 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 $\pm$ 0.2) °C	52.4 $\pm$ 6 %	1.52 mho/m $\pm$ 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	9.87 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	39.3 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.22 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	20.8 W/kg $\pm$ 16.5 % (k=2)

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Appendix**Antenna Parameters with Head TSL**

Impedance, transformed to feed point	$52.5 \Omega + 6.8 j\Omega$
Return Loss	- 23.0 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	$46.3 \Omega + 2.8 j\Omega$
Return Loss	- 26.4 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	December 17, 2002

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DASY5 Validation Report for Head TSL

Date: 23.04.2014

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; $\sigma = 1.36$ S/m; $\epsilon_r = 39.1$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5.06, 5.06, 5.06); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 S2.8.7(1137); SEMCAD X 14.6.10(7164)

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

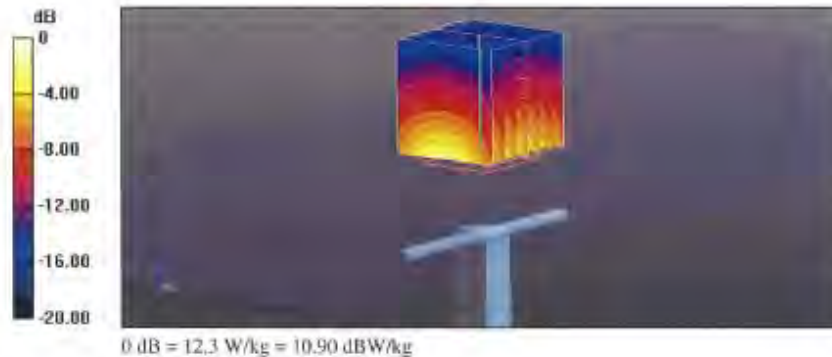
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 97.825 V/m; Power Drift = 0.06 dB

Peak SAR (extrapolated) = 17.8 W/kg

SAR(1 g) = 9.71 W/kg; SAR(10 g) = 5.1 W/kg

Maximum value of SAR (measured) = 12.3 W/kg



Certificate No: D1900V2-5d027_Apr14

Page 5 of 8

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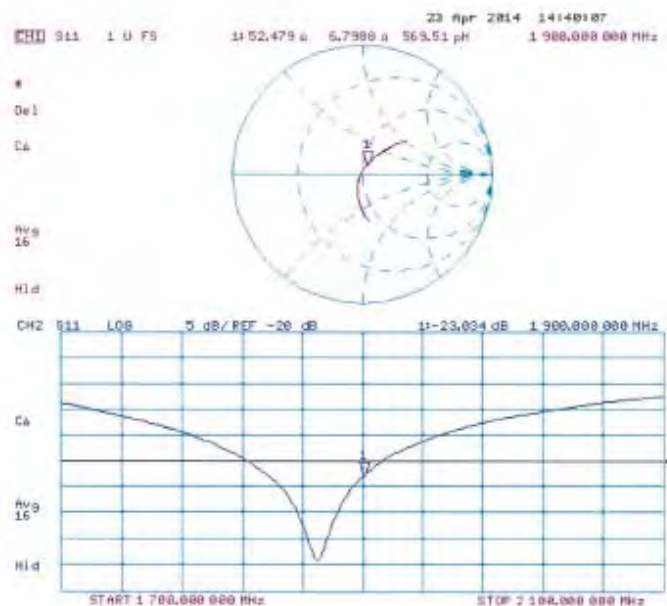
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Impedance Measurement Plot for Head TSL



Certificate No: D1900V2-5d027_Apr14

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DASY5 Validation Report for Body TSL

Date: 22.04.2014

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: UHF 0 - CW; Frequency: 1900 MHz

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.52$ S/m; $\epsilon_r = 52.4$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.76, 4.76, 4.76); Calibrated: 30.12.2013
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm 2/Zoom Scan (7x7x7)/Cube 0;

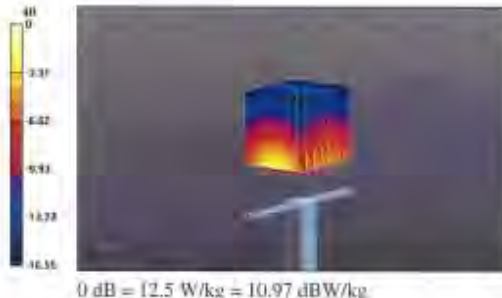
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 94.526 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 17.2 W/kg

SAR(1 g) = 9.87 W/kg; SAR(10 g) = 5.22 W/kg

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



Certificate No: D1900V2-5d027_Apr14

Page 7 of 8

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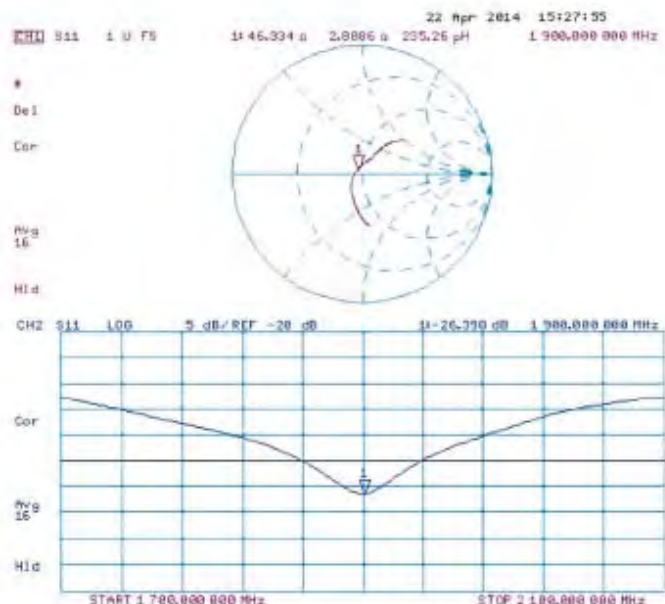
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Impedance Measurement Plot for Body TSL



Certificate No: D1900V2-5d027_Apr14

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Accreditation No.: SCS 108

Client: **SGS-TW (Auden)**

Certificate No: **D2450V2-922_Nov13**

CALIBRATION CERTIFICATE

Object: **D2450V2 - SN: 922**

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

Calibration date: **November 05, 2013**

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

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

Calibration Equipment used (MATE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37490704	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	US37282783	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	MY41092317	09-Oct-13 (No. 217-01828)	Oct-14
Reference 20 dB Attenuator	SN: 5058 (20K)	04-Apr-13 (No. 217-01736)	Apr-14
Type-N mismatch combination	SN: 5047.3 / 06327	04-Apr-13 (No. 217-01739)	Apr-14
Reference Probe ES3DV3	SN: 3205	28-Dec-12 (No. ES3-3205_Dec12)	Dec-13
DAEA	SN: 601	25-Apr-13 (No. DAEA-601_Apr13)	Apr-14

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SM1-06	100005	04-Aug-09 (in house check Oct-13)	In house check: Oct-15
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

Calibrated by:	Name: aree El-Nasouj	Function: Laboratory Technician	Signature:
Approved by:	Name: Kate Pokovic	Function: Technical Manager	Signature:

Issued: November 5, 2013

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

Certificate No: D2450V2-922_Nov13

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Accreditation No.: SCS 108

Glossary:

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

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

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Measurement Conditions

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

DASY Version	DASY5	V52.8.7
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz $\pm$ 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 $\pm$ 0.2) °C	39.7 $\pm$ 6 %	1.84 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.3 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	52.8 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.13 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.4 W/kg $\pm$ 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 $\pm$ 0.2) °C	52.1 $\pm$ 6 %	2.02 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	12.9 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	50.6 W/kg $\pm$ 17.0 % (k=2)

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

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Appendix**Antenna Parameters with Head TSL**

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

Antenna Parameters with Body TSL

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

General Antenna Parameters and Design

Electrical Delay (one direction)	1.161 ns
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After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	September 26, 2013

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DASY5 Validation Report for Head TSL

Date: 05.11.2013

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: UFD 0 - CW; Frequency: 2450 MHz

Medium parameters used: $f = 2450$ MHz; $\sigma = 1.84$ S/m; $\epsilon_r = 39.7$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

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

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

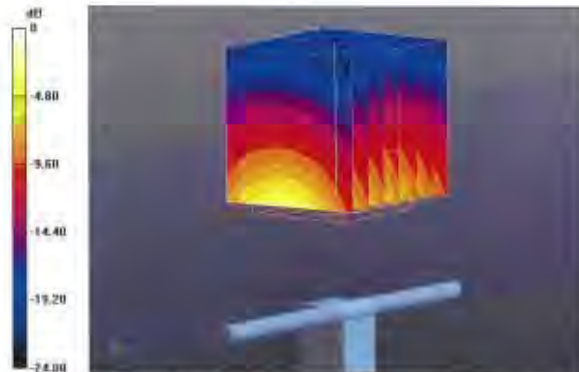
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 98.82 V/m; Power Drift = 0.07 dB

Peak SAR (extrapolated) = 27.7 W/kg

SAR(1 g) = 13.3 W/kg; SAR(10 g) = 6.13 W/kg

Maximum value of SAR (measured) = 16.8 W/kg



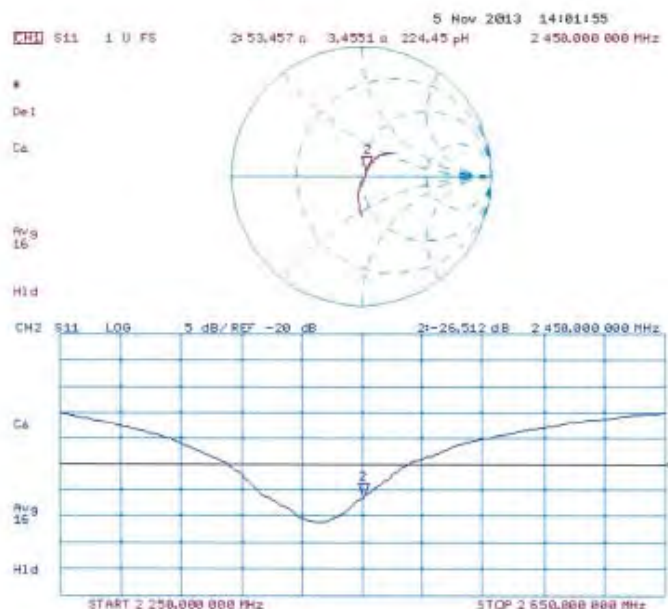
0 dB = 16.8 W/kg = 12.25 dBW/kg

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Impedance Measurement Plot for Head TSL



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DASY5 Validation Report for Body TSL

Date: 01.11.2013

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: UID 0 - CW; Frequency: 2450 MHz

Medium parameters used: $f = 2450$ MHz; $\sigma = 2.02$ S/m; $\epsilon_r = 52.1$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

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

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

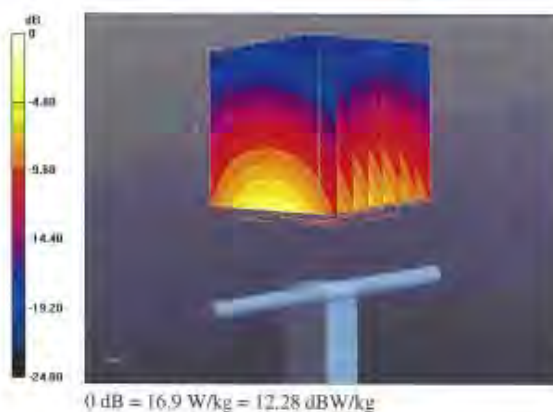
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 94.218 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 27.0 W/kg

SAR(1 g) = 12.9 W/kg; SAR(10 g) = 5.96 W/kg

Maximum value of SAR (measured) = 16.9 W/kg



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Page 8 of 8

- End of 1st part of report -

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