

SAR TEST REPORT

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

Equipment Under Test	TF600TG
Brand Name	ASUS
Model No.	TF600TG
Company Name	ASUSTeK Computer Inc.
Company Address	15, Li-Te Rd., Peitou, Taipei 112, Taiwan
Standards	FCC OET 65 supplement C, IEEE /ANSI C95.1 , C95.3, IEEE 1528
FCC ID	MSQTF600TL
Date of Receipt	Nov. 07, 2012
Date of Test(s)	Nov. 25, 2012 ~ Nov. 26, 2012
Date of Issue	Dec. 03, 2012

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 for on the behalf of SGS

Engineer

John Teh

John Yeh

Date: Dec. 03, 2012

Supervisor

Nick Hsu

Nick Hsu

Date: Dec. 03, 2012

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Version

Report Number	Revision	Date	Memo
ES/2012/B0002	00	2012/12/03	Initial creation of test report.

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

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1. General Information

1.1 Testing Laboratory

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

1.2 Details of Applicant

Company Name	ASUSTeK Computer Inc.
Company Address	15, Li-Te Rd., Peitou, Taipei 112, Taiwan
Contact Person	Claire Chen
Tel	(886) 2 2894 3447 Ext. 4253
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1.3 Description of EUT

EUT Name	TF600TG			
Brand Name	ASUS			
Model No.	TF600TG			
FCC ID	MSQTF600TL			
Mode of Operation	<input checked="" type="checkbox"/> GPRS <input checked="" type="checkbox"/> EDGE <input checked="" type="checkbox"/> WCDMA <input checked="" type="checkbox"/> HSDPA <input checked="" type="checkbox"/> HSUPA <input checked="" type="checkbox"/> WLAN802.11 b/g/n (20M) band			
Duty Cycle	GPRS (Multi-class 10)	1/4.1		
	EDGE (Multi-class 10)	1/4.1		
	WCDMA	1		
	WLAN802.11 b/g/n(20M)	1		
TX Frequency Range (MHz)	GPRS 850	824.2	—	848.8
	GPRS 1900	1850.2	—	1909.8
	WCDMA Band V	826.4	—	846.6
	WLAN802.11 b/g/n(20M)	2412	—	2462
Channel Number (ARFCN)	GPRS 850	128	—	251
	GPRS 1900	512	—	810
	WCDMA Band V	4132	—	4233
	WLAN802.11 b/g/n(20M)	1	—	11

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Max. SAR Measured(1 g) (Unit: W/Kg)	Full power	GPRS 850	0.794	<input checked="" type="checkbox"/> Lap held <input type="checkbox"/> Secondary Portrait <input type="checkbox"/> Secondary Landscape 190 Channel (test distance 10.5mm)
		GPRS 1900	1.08	<input checked="" type="checkbox"/> Lap held <input type="checkbox"/> Secondary Portrait <input type="checkbox"/> Secondary Landscape 810 Channel (test distance 10.5mm)
		WCDMA Band V	0.435	<input checked="" type="checkbox"/> Lap held <input type="checkbox"/> Secondary Portrait <input type="checkbox"/> Secondary Landscape 4183 Channel (test distance 10.5mm)
	Reduction power	GPRS 850	1.3	<input checked="" type="checkbox"/> Lap held <input type="checkbox"/> Secondary Portrait <input type="checkbox"/> Secondary Landscape 251 Channel (test distance 0mm)
		GPRS 1900	1.14	<input checked="" type="checkbox"/> Lap held <input type="checkbox"/> Secondary Portrait <input type="checkbox"/> Secondary Landscape 810 Channel (test distance 0mm)
		WCDMA Band V	1.26	<input checked="" type="checkbox"/> Lap held <input type="checkbox"/> Secondary Portrait <input type="checkbox"/> Secondary Landscape 4233 Channel (test distance 0mm)

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#. GPRS / EDGE conducted power table:

Full power				
Burst average power				
GMSK / Multi-class 10			1Dn1UP	1Dn2UP
EUT mode	Frequency (MHz)	CH	Avg. (dBm)	Avg. (dBm)
GPRS 850	824.2	128	32.3	32.3
	836.6	190	32.8	32.7
	848.8	251	32.7	32.6
Source-based time average power				
GPRS 850	824.2	128	23.27	26.28
	836.6	190	23.77	26.68
	848.8	251	23.67	26.58
The division factor compared to the number of TX time slot				
Division factor			1 TX time slot	2 TX time slot
			-9.03	-6.02

Reduced power				
Burst average power				
GMSK / Multi-class 10			1Dn1UP	1Dn2UP
EUT mode	Frequency (MHz)	CH	Avg. (dBm)	Avg. (dBm)
GPRS 850	824.2	128	27.50	27.50
	836.6	190	27.60	27.60
	848.8	251	27.30	27.30
Source-based time average power				
GPRS 850	824.2	128	18.47	21.48
	836.6	190	18.57	21.58
	848.8	251	18.27	21.28
The division factor compared to the number of TX time slot				
Division factor			1 TX time slot	2 TX time slot
			-9.03	-6.02

Full power				
Burst average power				
8PSK/ Multi-class 10			1Dn1UP	1Dn2UP
EUT mode	Frequency (MHz)	CH	Avg. (dBm)	Avg. (dBm)
EDGE 850	824.2	128	25.10	25.00
	836.6	190	25.10	24.80
	848.8	251	25.00	24.70
Source-based time average power				
EDGE 850	824.2	128	16.07	18.98
	836.6	190	16.07	18.78
	848.8	251	15.97	18.68
The division factor compared to the number of TX time slot				
Division factor			1 TX time slot	2 TX time slot
			-9.03	-6.02

Reduced power				
Burst average power				
8PSK/ Multi-class 10			1Dn1UP	1Dn2UP
EUT mode	Frequency (MHz)	CH	Avg. (dBm)	Avg. (dBm)
EDGE 850	824.2	128	22.50	22.40
	836.6	190	22.40	22.30
	848.8	251	22.30	22.10
Source-based time average power				
EDGE 850	824.2	128	13.47	16.38
	836.6	190	13.37	16.28
	848.8	251	13.27	16.08
The division factor compared to the number of TX time slot				
Division factor			1 TX time slot	2 TX time slot
			-9.03	-6.02

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Full power				
Burst average power				
GMSK / Multi-class 10			1Dn1UP	1Dn2UP
EUT mode	Frequency (MHz)	CH	Avg. (dBm)	Avg. (dBm)
GPRS 1900	1850.2	512	30.50	30.40
	1880	661	30.60	30.50
	1909.8	810	30.50	30.40
Source-based time average power				
GPRS 1900	1850.2	512	21.47	24.38
	1880	661	21.57	24.48
	1909.8	810	21.47	24.38
The division factor compared to the number of TX time slot				
Division factor			1 TX time slot	2 TX time slot
			-9.03	-6.02

Reduced power				
Burst average power				
GMSK / Multi-class 10			1Dn1UP	1Dn2UP
EUT mode	Frequency (MHz)	CH	Avg. (dBm)	Avg. (dBm)
GPRS 1900	1850.2	512	22.80	22.80
	1880	661	22.70	22.70
	1909.8	810	23.00	23.00
Source-based time average power				
GPRS 1900	1850.2	512	13.77	16.78
	1880	661	13.67	16.68
	1909.8	810	13.97	16.98
The division factor compared to the number of TX time slot				
Division factor			1 TX time slot	2 TX time slot
			-9.03	-6.02

Full power				
Burst average power				
8PSK / Multi-class 10			1Dn1UP	1Dn2UP
EUT mode	Frequency (MHz)	CH	Avg. (dBm)	Avg. (dBm)
EDGE 1900	1850.2	512	25.80	25.60
	1880	661	25.80	25.50
	1909.8	810	25.40	25.20
Source-based time average power				
EDGE 1900	1850.2	512	16.77	19.58
	1880	661	16.77	19.48
	1909.8	810	16.37	19.18
The division factor compared to the number of TX time slot				
Division factor			1 TX time slot	2 TX time slot
			-9.03	-6.02

Reduced power				
Burst average power				
8PSK / Multi-class 10			1Dn1UP	1Dn2UP
EUT mode	Frequency (MHz)	CH	Avg. (dBm)	Avg. (dBm)
EDGE 1900	1850.2	512	22.00	21.80
	1880	661	21.80	21.60
	1909.8	810	21.70	21.50
Source-based time average power				
EDGE 1900	1850.2	512	12.97	15.78
	1880	661	12.77	15.58
	1909.8	810	12.67	15.48
The division factor compared to the number of TX time slot				
Division factor			1 TX time slot	2 TX time slot
			-9.03	-6.02

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#. WCDMA Band V / HSDPA / HSUPA conducted power table:

Band	Full power										
	CH	Rel99 AV(dBm)	HSDPA mode AV(dBm)				HSUPA mode AV(dBm)				
			SUB-1	SUB-2	SUB-3	SUB-4	SUB-1	SUB-2	SUB-3	SUB-4	SUB-5
WCDMA Band V	4132	23.10	22.89	23.03	22.43	22.48	23.06	21.12	22.1	21.17	22.92
	4183	22.80	22.66	22.69	22.18	22.22	22.73	20.81	21.79	20.87	22.56
	4233	22.90	23.02	22.77	22.53	22.59	22.82	20.86	21.9	20.94	22.71
	Reduced power										
	CH	Rel99 AV(dBm)	HSDPA mode AV(dBm)				HSUPA mode AV(dBm)				
			SUB-1	SUB-2	SUB-3	SUB-4	SUB-1	SUB-2	SUB-3	SUB-4	SUB-5
	4132	20.40	20.19	20.33	19.73	19.78	20.36	18.42	19.4	18.47	20.22
	4183	19.90	19.76	19.79	19.28	19.32	19.83	17.91	18.89	17.97	19.66
	4233	20.10	20.22	19.97	19.73	19.79	20.02	18.06	19.1	18.14	19.91

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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

The EUT is controlled by using a Radio Communication Tester (R&S CMU200), and the communication between the EUT and the tester is established by air link.

Configuration 1: Lap-held mode.

Configuration 2: Primary Portrait mode.

Configuration 3: Secondary Portrait mode. (Not tested, since distance of WWAN antenna to edge is 172 mm, which is larger than 5cm)

Configuration 4: Primary Landscape mode. (Not tested, since distance of WWAN antenna to edge is 156 mm, which is larger than 5cm)

Configuration 5: Secondary Landscape mode.

- #. If the 1-g SAR for the highest output channel is less than 0.8 W/kg, where the transmission band corresponding to all channels is $\leq 100 \text{ MHz}$, testing for the other channels is not required.
- #. When the maximum transmitter and antenna output power are $\leq 60/f(\text{GHz}) \text{ (mW)}$ SAR evaluation is not required for FCC or TCB approval.
(Bluetooth average power= 10.7 dBm)
- #. Using **KDB941225 D01** to exclude SAR test requirements for HSPA modes due to the maximum average output power of HSPA active is higher than that measured without HSPA using 12.2kbps RMC but increase less than 1/4 dB.
- #. Source-Based Average power has been determined by the addition with the measured burst-average power. The GPRS/EDGE mode with GSMK modulation scheme as boldlize in red as table of data above are chosen to perform SAR testing in accordance with KDB 941225 D-03 in which highest output power in sourced-based time average mode shall be used to perform the corresponding SAR test.

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- #. The given device is pure Data-Only device at which GSM function is disabled, and since CS and PS are not co-existed while operation, DTM is not applicable to this given DUT of the application.
- #. The highest 1-g SAR for WLAN is 0.129 W/kg_ Lap-held mode(Report No. ES/2012/50006) and the highest 1-g SAR for WWAN is 1.3 W/kg_ Lap-held mode. The sum of 1-g for simultaneous transmitting WLAN and WWAN antenna pair is $0.129+1.3 = 1.429 \text{ W/kg} < 1.6 \text{ W/kg}$. According to **KDB648474/ KDB447498 /KDB248227** Simultaneous SAR evaluation is not required.(For WLAN test result refer

Configuration	Σ of SAR		Note
	Lap-held Mode	Secondary Landscape	
GPRS850 + WLAN802.11 b	0.794 + 0.129 =0.923 W/kg	0.309 + 0.015 =0.324 W/kg	Full Power
GPRS1900 + WLAN802.11 b	1.08 + 0.129 =1.209 W/kg	0.881 + 0.015 =0.896 W/kg	Full Power
WCDMA Band V + WLAN802.11 b	0.435 + 0.129 =0.564 W/kg	0.126 + 0.015 =0.141 W/kg	Full Power
GPRS850 + WLAN802.11 b	1.3 + 0.129 = 1.429 W/kg	0.629 + 0.015 =0.644 W/kg	Reduction Power
GPRS1900 + WLAN802.11 b	1.14 + 0.129 =1.269 W/kg	0.439 + 0.015 =0.454 W/kg	Reduction Power
WCDMA Band V + WLAN802.11 b	1.26 + 0.129 =1.389 W/kg	0.478 + 0.015 =0.493 W/kg	Reduction Power

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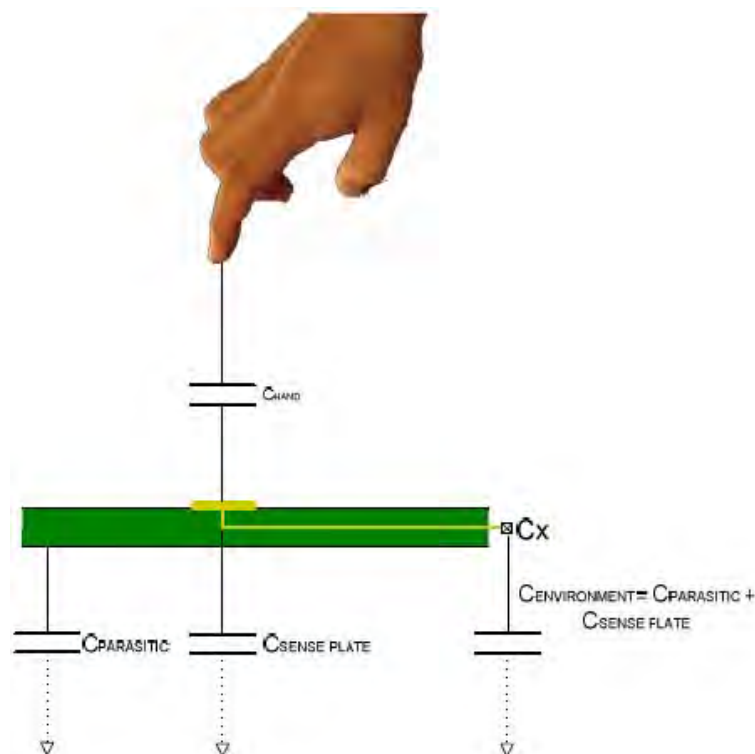
1.6 Proximity sensor operation description

This information is for a 10.1 " Tablet device which supports WWAN, WLAN, Bluetooth and wireless hotspot capabilities. This tablet PC can be used for four display orientations and it is designed with two proximity sensors beside WWAN antenna. And it can enable WWAN power reduction, and the WLAN and BT have no power reduction.

The proximity sensor itself is always available, independent of display orientation. The proximity sensors which allocates beside WWAN main antenna are implemented by sensor plates to trigger power reduction when human body approaches.

Background Information

Parasitic capacitance is the capacitance that exists between electronic components or conducting objects because of their proximity to each other. This capacitance is undesired for any proximity sensor using the surface capacitance method of sensing. This parasitic capacitance ($C_{PARASITIC}$) gets added to the capacitance of the sense plate (C_{SENSE_PLATE}), increasing the total capacitance of the sense plate environment ($C_{ENVIRONMENT}$) as depicted in Figure 1.6.1.



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Figure 1.6.1: Illustration of environmental capacitance

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The capacitance to an approaching hand (CHAND) increases as the hand comes closer to the sense plate. CHAND gets compared to CENVIRONMENT to determine if a proximity or touch condition exists. A smaller CENVIRONMENT will yield a more sensitive sensor. The ATI algorithm controls CENVIRONMENT and the proximity sensing distance can be increased considerably as depicted in Figure 1.6.3.

As mentioned above, ground planes, PCB traces or large metal objects such as device enclosures increases the parasitic capacitance which in turn considerably decreases the device sensitivity. The ATI feature counters this undesirable effect, ensuring optimum proximity detecting distance under all circumstances as illustrated by Figure 1.6.2 and Figure 1.6.3 respectively.

Present capacitive sensing solutions in the market require the designer to change the size of the external sampling capacitor. This has limited benefit and may increase the noise susceptibility. With the ATI feature, this need no longer exists.

The advantages of ATI can be summarised as follows:

- Increased sensitivity
- Automatic sensitivity adjustment for various sense pads
- Easier to integrate into new designs
- Excellent proximity detection
- No external components or programming to adjust sensitivity

No 'tuning' of components, settings or layouts to achieve optimum sensitivity.

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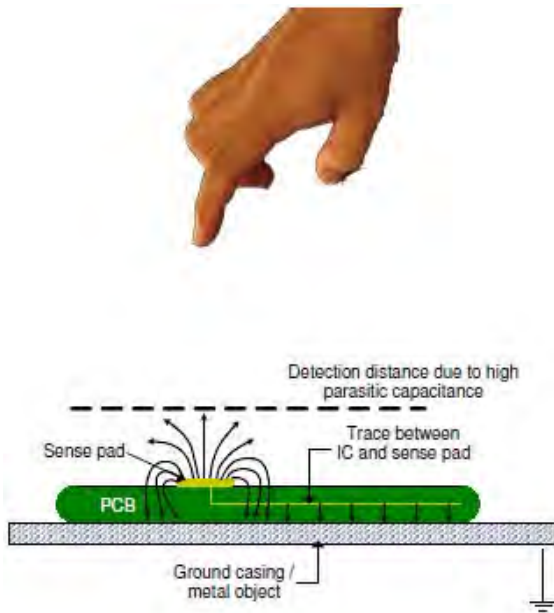


Figure 1.6.2: Electrical propagation from a sense plate with a high CP due to a grounded metal object in close range of the sense plate

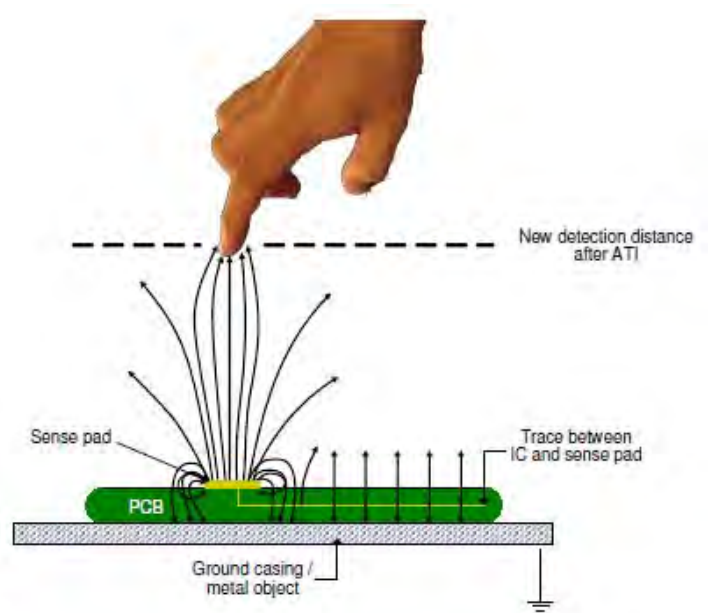


Figure 1.6.3: Electrical propagation from a sense plate with a high CP with AT1 implemented to increase the sensitivity

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Proximity sensor activation / power reduction conditions
(Manual tool for sensor forced activated and in-activated has been implemented as well. This tool is only for manufacturer internal use, publics will not have this tool.)

Table 1.6.1 SAR test position and distance summary

Testing Face for SAR tests (Tablet)						
	Lap-held	Front side	Secondary Landscape(top)	Primary Landscape	Secondary Portrait(left)	Primary Portrait(right)
2G/UMTS	Yes (0 and 10.5mm)	X	Yes (0 and 11mm)	X	Yes (0mm)	X
WLAN/BT	Yes (0 mm)	X	Yes (0 mm)	X	X (Over 50mm)	X

Proximity Sensor Status Table – Lap-held mode in conservative Proximity Sensor Operation

Distance to Lap-held of DUT (mm)	7.5	8.5	9.5	10.5	11.5	12.5	13.5	14.5
Proximity Sensor Status	ON	ON	ON	ON	ON	OFF	OFF	OFF

Proximity Sensor Status Table –Secondary Landscape mode in conservative Proximity Sensor Operation

Distance to Secondary Landscape of DUT (mm)	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0
Proximity Sensor Status	ON	ON	ON	ON	ON	OFF	OFF	OFF

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Proximity Sensor Status Table –Back/Top in conservative Proximity Sensor Operation

Between top and back of DUT(°)	5°	10°	15°	20°	25°	30°	35°	40°	45°	50°	55°
Proximity Sensor Status	ON	ON	ON	ON	ON	ON	ON	ON	ON	OFF	OFF

Note:

1. The EUT diagonal dimension is 314.25mm, per KDB 941225 D07, the EUT diagonal > 20cm and Mini-Tablet procedure is not applied. So, SAR tests follow the Tablet Mode in KDB447498 , and the EUT does not support voice call function, therefore GSM SAR is not required.
2. The test distance is 0mm to the flat phantom, and SAR evaluation is required for back side and the edges with the antenna within 5 cm to the user.
3. The test distance **11** mm is to verify the conservative condition on Secondary landscape edge **with FULL RF power**, since EUT proximity sensor maximum activate distance is 12 mm on the Secondary landscape edge. And the test distance **10.5** mm is for verify the conservative condition on back side **with FULL RF power**, since EUT proximity sensor on back side face maximum activate distance is **11.5** mm.
4. The EUT is 4 orientations are supported; the power reduction for SAR compliance is not triggered by the screen orientation, but triggered by proximity sensor when the user is **10.5** mm or closer to the EUT. Therefore, SAR test setup and test result is conservative for real life usage.
5. The proximity sensors are designed to be triggered for back-side and Secondary-landscape exposure positions. During SAR tests for EUT other edges, the sensor is disabled via software setting.
6. According to KDB 447498 4)b)ii)2), SAR evaluation is performed for the back side and the edge with antenna with 5cm. Screen orientation is not considered in SAR evaluation, and most conservative exposure condition is considered.
7. A general composite test separation distance of **0** mm was considered for the transmitting modes of the device according to "RF Exposure Procedures Update" released by FCC / OET in October 2011. The test considerations were based on the form factor, size, operational configurations, exposure conditions and display orientations pertinent for the device.

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8. There are two sensors on the edge of the device to cover secondary landscape and back of the device. Please see below table 1.6.3 for the sensor activation/de-activation distance pre-scan (reliability) information.

Table 1.6.2 P-Sensor Trigger position summary

Testing Face for P-Sensor trigger distance tests (Tablet)						
	Lap-held	Secondary Landscape 45 degree with back side	Secondary Landscape	Primary Landscape	Secondary Portrait	Primary Portrait
WWAN	V	V	V	X	X	X
WLAN	X	X	X	X	X	X

V : Reduced maximum power applied only by activation of proximity sensors.

X : No power reduction.

Frequencies / Modes that Power reduction mechanism will activate

The following tables are the orientation which end users could be used and when the conducted power will be reduced at specific modes for all wireless modes, and frequency bands, and operating figure.

Orientation / Mode Power Limit Activation	GPRS 850 (GMSK) Class 8/ 10	EGPRS 850 (8-PSK) Class 8/10	GPRS 1900 (GMSK) Class 8/10	EGPRS 1900 (8-PSK) Class 8/10
Primary Landscape	X	X	X	X
Secondary Landscape	V	V	V	V
Primary Portrait	X	X	X	X
Secondary Portrait	X	X	X	X
Front side	X	X	X	X
Lap-held	V	V	V	V

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Orientation / Mode Power Limit Activation	WCDMA BandV	802.11b/g/n	Bluetooth
Primary Landscape	X	X	X
Secondary Landscape	V	X	X
Primary Portrait	X	X	X
Secondary Portrait	X	X	X
Front side	X	X	X
Lap-held	V	X	X

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Table 1.6.3 P-Sensor Trigger distance reliability info (tested with SPEAG DAY5 system, with Flat(body) phantom)

unit: mm	Top(secondary landscape)		Back		45° between top and back	
	P1sensor	P2sensor	P1sensor	P2sensor	P1sensor	P2sensor
1	14.5	12	13	15	12	15
2	14	14	12	15.5	14	16
3	14	16	13	15.5	14	15
4	15	15.5	15	16.5	14	14
5	15.5	16.5	20	15.5	16	14
6	15	16	14	15	16	14
7	15	16	13	15.5	15	14
8	15	16.5	13	15	16	13
9	15.5	16	13	15	15	14
10	14.5	17	12	15	15	13
11	14.5	15	12	14.5	15	14
12	15	16	11.5	15.5	14	14
13	16	14.5	14	13.5	14	15
14	15	14	14	13.5	14	15
15	16	16.5	13	12.5	12	15
16	17	16	12	13	12	15
17	16	17	13	15	14	15
18	15	15.5	13	12.5	15	16
19	15	17	13.5	13.5	16	15
20	14	15.5	13	15	17	15
21	14.5	16	13.5	15	17	14
22	14	17	14	15.5	15	13
23	13.5	15	13	15	15	15
24	14	16	14	15	14	15
25	14.5	15.5	11.5	15.5	15	16
26	15	15.5	13	15.5	16	15
27	15	15	13	14	16	15

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unit: mm	Top(secondary landscape)		Back		45° between top and back	
	P1sensor	P2sensor	P1sensor	P2sensor	P1sensor	P2sensor
28	15.5	13	14	14	17	15
29	14	15	13	14.5	16	14
30	14	13.5	13.5	14.5	15	15

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The Deficit of Power

EUT mode	Frequency (MHz)	CH	1Dn1UP (dBm)	1Dn2UP (dBm)	Sensor triggering distances	
					Lap-held	Secondary Landscape
GPRS 850 GMSK/Multi-class 10	824.2	128	4.80	4.80	11.5mm	12mm
	836.6	190	5.20	5.10		
	848.8	251	5.40	5.30		
EDGE 850 8PSK/Multi-class 10	824.2	128	2.60	2.60		
	836.6	190	2.70	2.50		
	848.8	251	2.70	2.60		
GPRS 1900 GMSK/Multi-class 10	1850.2	512	7.70	7.60	11.5mm	12mm
	1880	661	7.90	7.80		
	1909.8	810	7.50	7.40		
EDGE 1900 8PSK/Multi-class 10	1850.2	512	3.80	3.80		
	1880	661	4.00	3.90		
	1909.8	810	3.70	3.70		

Band	CH	Rel99 (dBm)	HSDPA mode (dBm)				HSUPA mode (dBm)					Sensor triggering distances	
			SUB-1	SUB-2	SUB-3	SUB-4	SUB-1	SUB-2	SUB-3	SUB-4	SUB-5	Lap-held	Secondary Landscape
WCDMA Band V	4132	2.70	2.70	2.70	2.70	2.70	2.70	2.70	2.70	2.70	2.70	11.5mm	12mm
	4183	2.90	2.90	2.90	2.90	2.90	2.90	2.90	2.90	2.90	2.90		
	4233	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80		

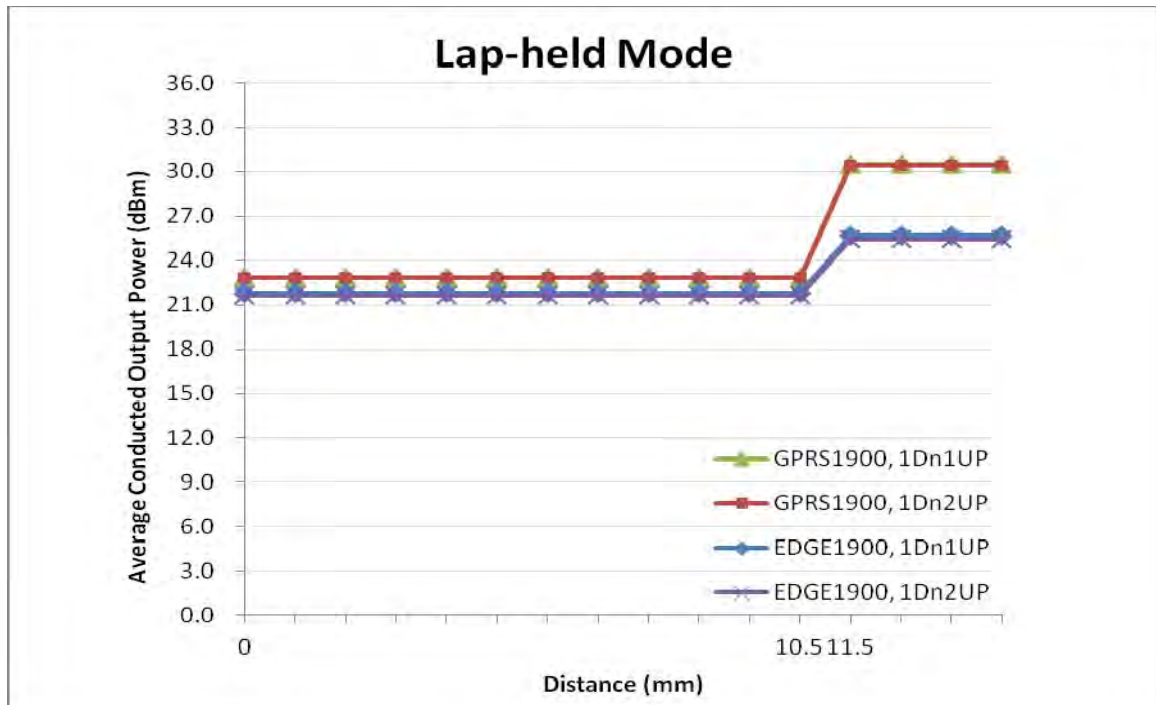
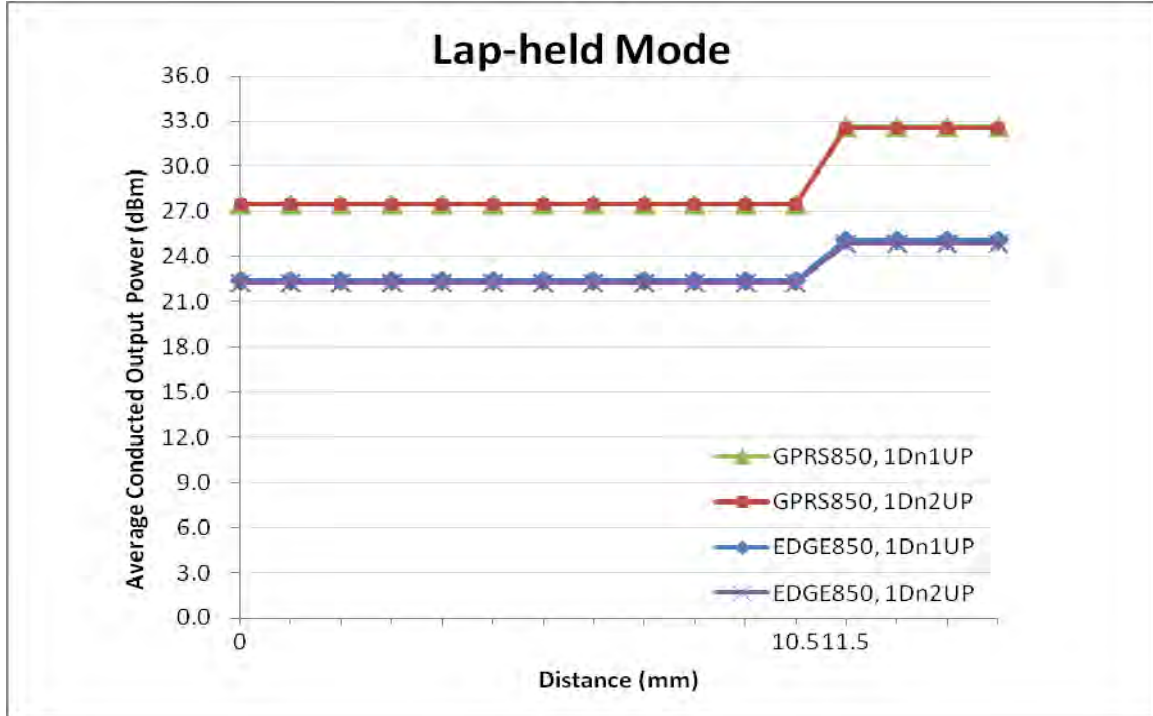
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Proximity Sensor Activation

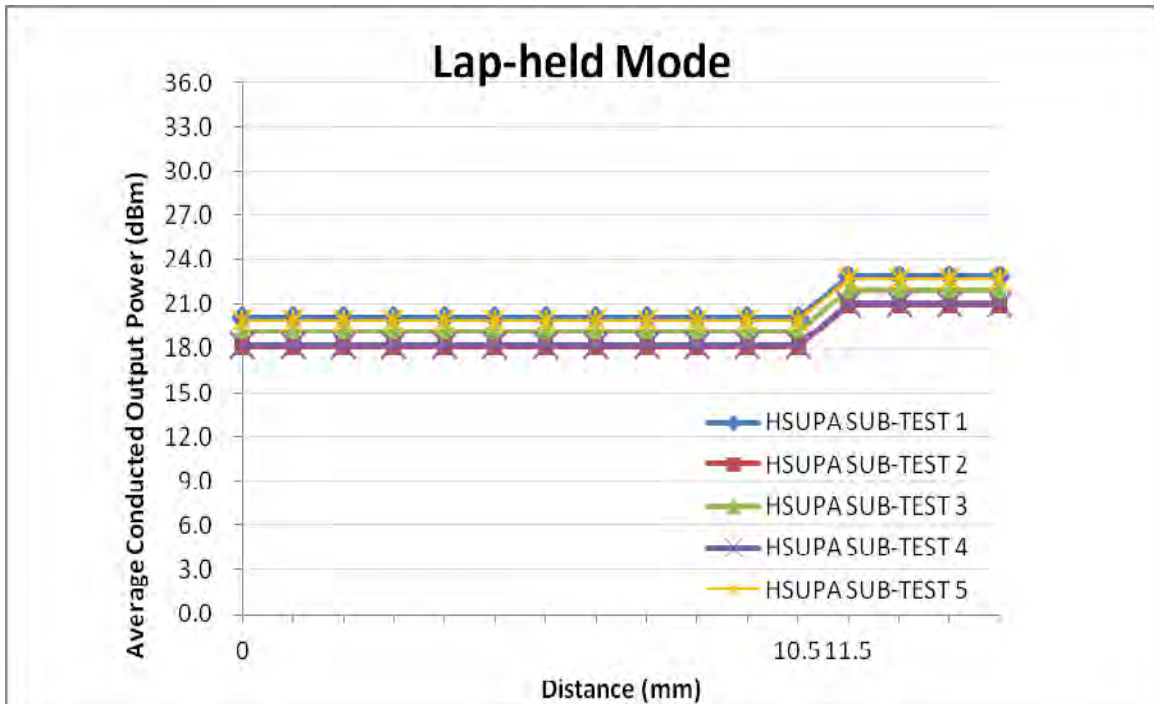
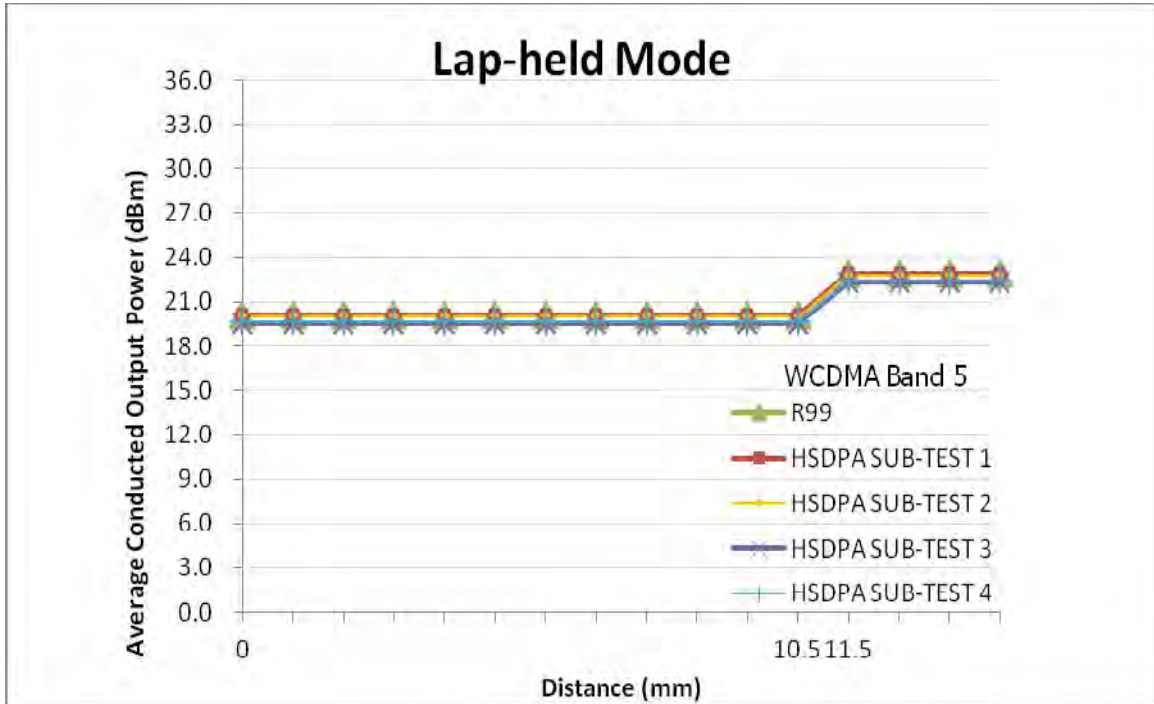
Max. Output Power vs. Distance from the body phantom



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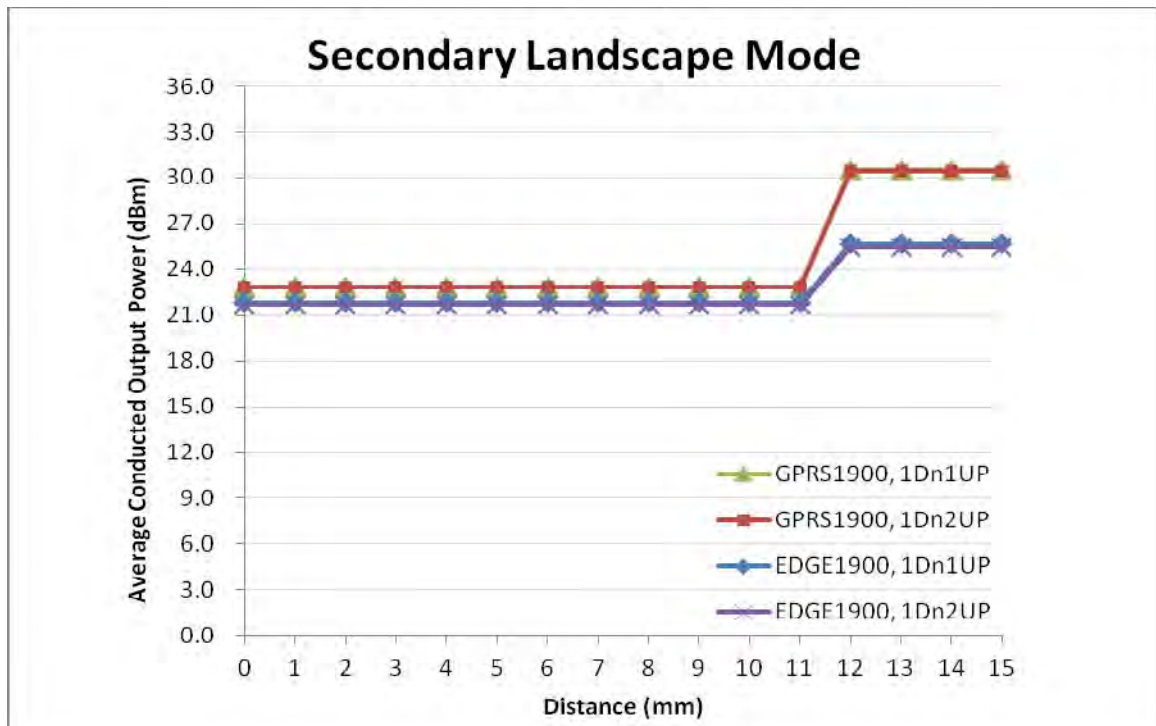
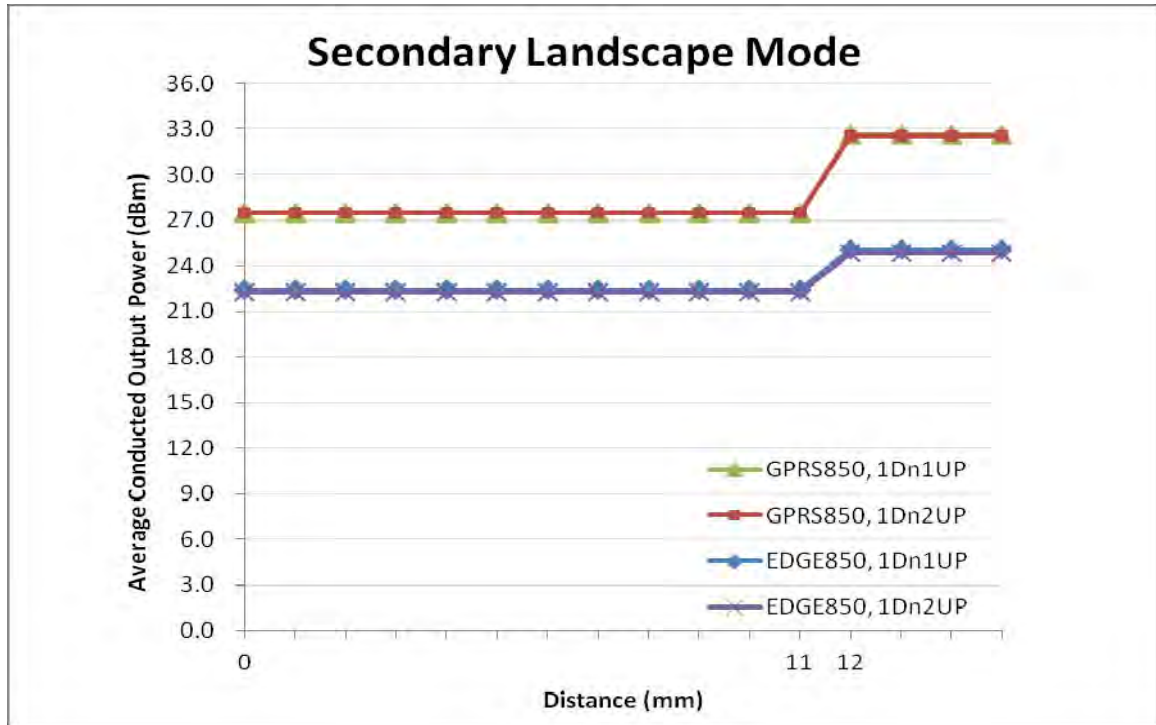
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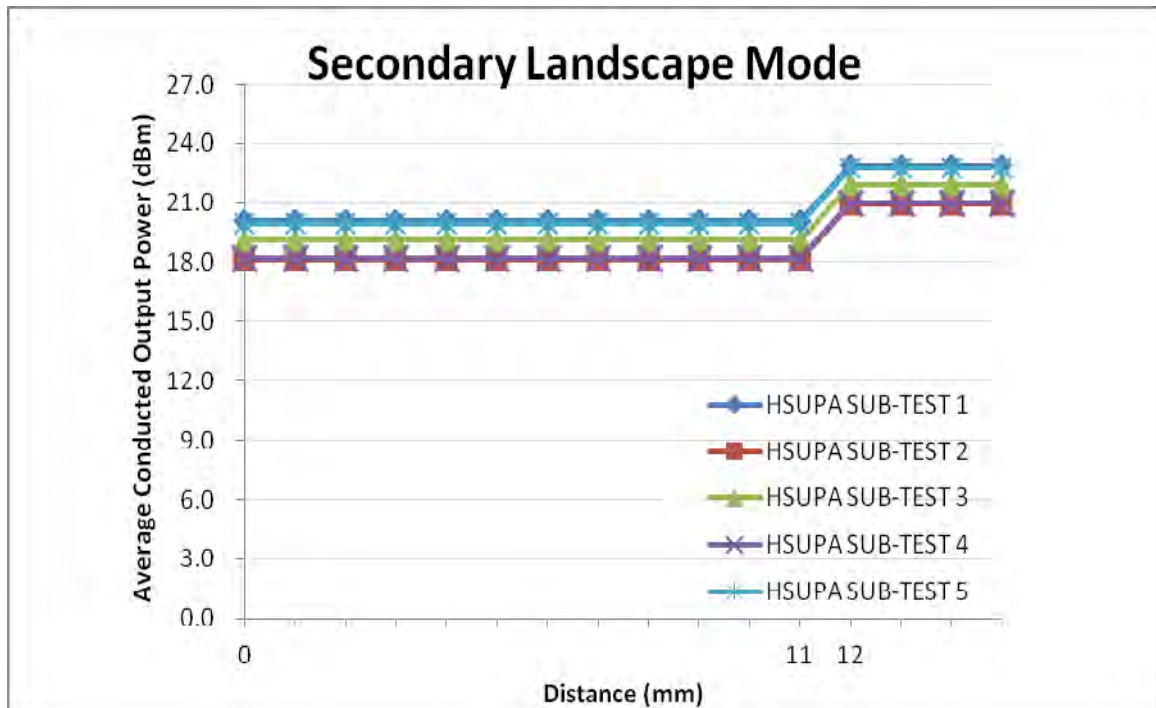
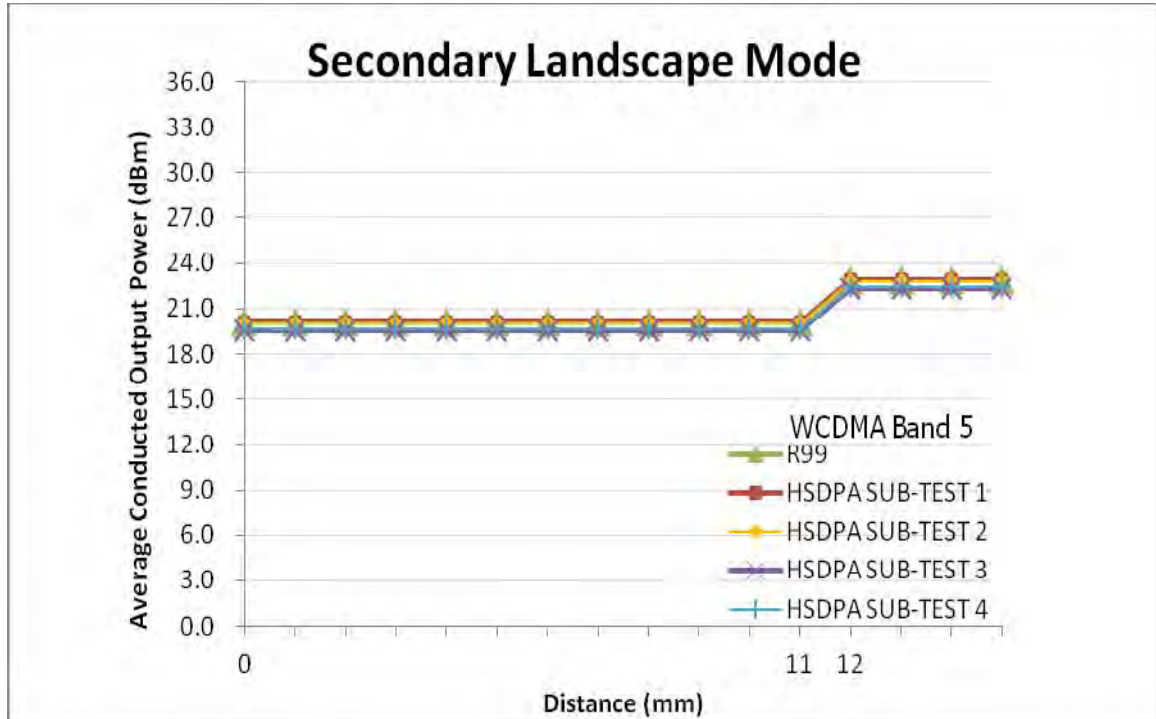
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1.7 The SAR Measurement System

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 4 professional system). A Model ES3DV3 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 4 system for performing compliance tests consists of the following items:

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

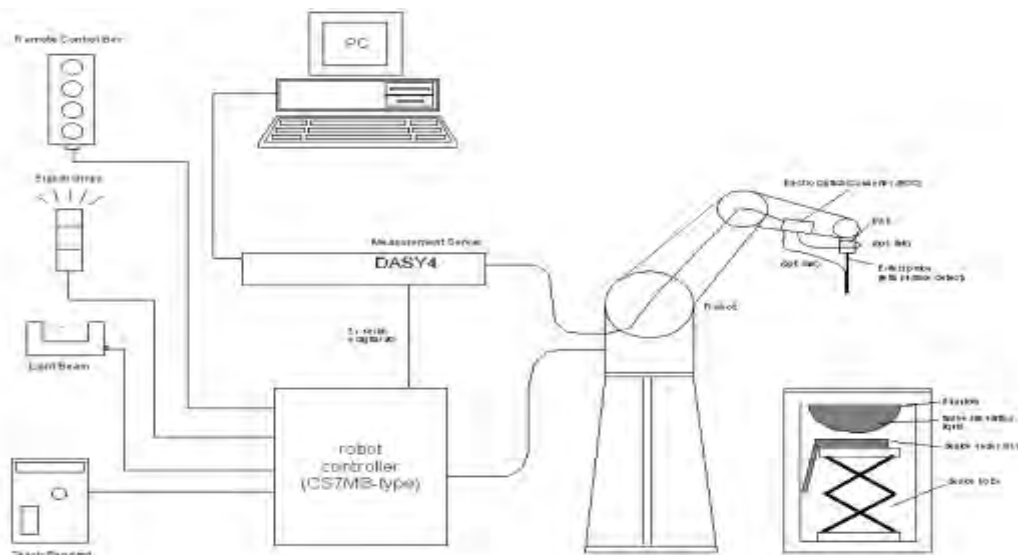


Fig. a The block diagram of SAR system

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- The Electro-optical converter (EOC) performs the conversion between optical and electrical of the signals for the digital communication to the DAE and for the analog signal from the optical surface detection. The EOC is connected to the measurement server.
- The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- A probe alignment unit which improves the (absolute) accuracy of the probe positioning.
- A computer operating Windows 2000 or Windows XP.
- DASY 4 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

ES3DV3 E-Field Probe


Construction	Symmetrical design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)	
Calibration	Basic Broad Band Calibration in air Conversion Factors (CF) for HSL 835/1900 MHz Additional CF for other liquids and frequencies upon request	
Frequency	10 MHz to > 4 GHz, Linearity: ± 0.6 dB (30 MHz to 4 GHz)	
Directivity	± 0.3 dB in HSL (rotation around probe axis) ± 0.5 dB in tissue material (rotation normal to probe axis)	
Dynamic Range	10 μ W/g to > 100 mW/g Linearity: ± 0.2 dB (noise: typically < 1 μ W/g)	
Dimensions	Overall length: 337 mm (Tip: 10 mm) Tip diameter: 4 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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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: 810 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.	 <p style="text-align: center;">Device Holder</p>
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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 +/- 5% from the target SAR values. These tests were done at 835/1900 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 above 15 cm 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.

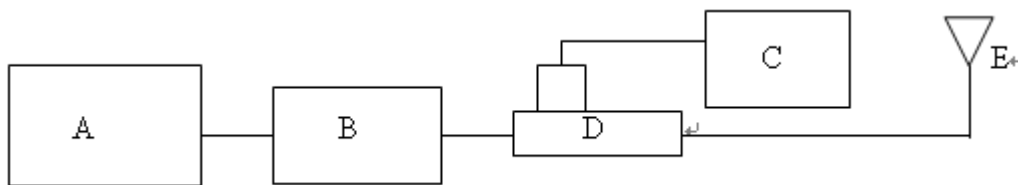


Fig. b The block diagram of system verification

- 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/g)	Measured SAR (1g)(mW/g)	Measured Date
D835V2	4d063	835	2.46	2.48	Nov. 25, 2012
D1900V2	5d027	1900	10	9.95	Nov. 26, 2012

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 85070D 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 15cm±5mm during all tests. (Fig. 2)

Frequency (MHz)	Dielectric Parameters		Recommended Limits	Measured	Measurement Date
835	ϵ_r	Verification	51.59-57.02	53.3	Nov. 25, 2012
		Test CH 128		53.3	
		Test CH 190		53.2	
		Test CH 251		53	
		Test CH 4132		53.4	
		Test CH 4183		53.2	
		Test CH 4233		53.2	
	σ (S/m)	Verification	0.95-1.05	0.984	
		Test CH 128		0.965	
		Test CH 190		0.985	
		Test CH 251		0.997	
		Test CH 4132		0.972	
		Test CH 4183		0.985	
		Test CH 4233		0.993	
Simulated Tissue Temp.(°C)		20-24	21.7		

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Frequency (MHz)	Dielectric Parameters		Recommended Limits	Measured	Measurement Date	
1900	ϵ_r	Verification	50.64-55.97	51.9	Nov. 26, 2012	
		Test CH 512		51.9		
		Test CH 661		51.8		
		Test CH 810		51.8		
	σ (S/m)	Verification	1.43-1.59	1.57		
		Test CH 512		1.51		
		Test CH 661		1.54		
		Test CH 810		1.58		
	Simulated Tissue Temp.(°C)		20-24	21.7		

Table 2. Dielectric Parameters of Tissue Simulant Fluid

The composition of the brain tissue simulating liquid:

Frequency (MHz)	Mode	Ingredient						Total amount
		DGMBE	Water	Salt	Preventol D-7	Cellulose	Sugar	
850M	Body	—	631.68 g	11.72 g	1.2 g	—	600 g	1.0L(Kg)
1900M	Body	300.67 g	716.56 g	4 g	—	—	—	1.0L(Kg)

Table 3. Recipes for Tissue Simulating Liquid

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1.11 Evaluation Procedures

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

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

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

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

The maximum search is automatically performed after each area scan measurement. It

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

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

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.

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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.

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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.

References

- [1] N. Kuster, Q. Balzano, and J.C. Lin, Eds., Mobile Communications Safety, Chapman & Hall, London, 1997.
- [2] K. Meier, M. Burkhardt, T. Schmid, and N. Kuster, "Broadband calibration of E-field probes in lossy media", IEEE Transactions on Microwave Theory and Techniques, vol. 44, no. 10, pp. 1954-1962, Oct. 1996.
- [3] K. Jokela, P. Hyysalo, and L. Puranen, "Calibration of specific absorption rate (SAR) probes in waveguide at 900 MHz", IEEE Transactions on Instrumentation and Measurements, vol. 47, no. 2, pp. 432-438, Apr. 1998.

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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

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the hands, wrists, feet and ankles where the spatial peak SAR shall not exceed 4 W/kg, as averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube). General Population/Uncontrolled limits apply when the general public may be exposed, or when persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or do not exercise control over their exposure. Warning labels placed on consumer devices such as cellular telephones will not be sufficient reason to allow these devices to be evaluated subject to limits for occupational/controlled exposure in paragraph (d)(1) of this section.(Table 4.)

Human Exposure	Uncontrolled Environment General Population	Controlled Environment Occupational
Spatial Peak SAR (Brain)	1.60 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

GSM850

Band	Mode	EUT Position	Power	Test Distance (mm)	Test Configuration	Averaged SAR over 1g (W/kg)			SAR Limit 1g (W/kg)
						CH 128	CH 190	CH 251	
						824.20 MHz	836.60 MHz	848.80 MHz	
GSM 850	GPRS 1Dn2UP	Body Worn	Full	0	Primary Portrait	—	0.23	—	1.6
				10.5	Lap-held	—	0.794	—	1.6
				11	Secondary Landscape	—	0.309	—	1.6
			Reduction	0	Lap-held	1.06	1.25	1.3	1.6
					Secondary Landscape	—	0.629	—	1.6

GSM1900

Band	Mode	EUT Position	Power	Test Distance (mm)	Test Configuration	Averaged SAR over 1g (W/kg)			SAR Limit 1g (W/kg)
						CH 512	CH 661	CH 810	
						1850.20 MHz	1880.00 MHz	1909.80 MHz	
GSM 1900	GPRS 1Dn2UP	Body Worn	Full	0	Primary Portrait	—	0.377	—	1.6
				10.5	Lap-held	0.893	1.04	1.08	1.6
				11	Secondary Landscape	0.841	0.83	0.881	1.6
			Reduction	0	Lap-held	0.954	1	1.14	1.6
					Secondary Landscape	—	0.439	—	1.6

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WCDMA Band V

Band	Mode	EUT Position	Power	Test Distance (mm)	Test Configuration	Averaged SAR over 1g (W/kg)			SAR Limit 1g (W/kg)
						CH 4132	CH 4183	CH 4233	
						826.40 MHz	836.60 MHz	846.60 MHz	
WCDMA Band V	R99	Body Worn	Full	0	Primary Portrait	—	0.099	—	1.6
				10.5	Lap-held	—	0.435	—	1.6
				11	Secondary Landscape	—	0.126	—	1.6
			Reduction	0	Lap-held	1.11	0.876	1.26	1.6
					Secondary Landscape	—	0.478	—	1.6

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3. Instruments List

Manufacturer	Device	Type	Serial number	Date of last calibration	Date of next calibration
Schmid & Partner Engineering AG	Dosimetric E-Field Probe	ES3DV3	3172	Aug.28,2012	Aug.27,2013
Schmid & Partner Engineering AG	835/1900 MHz System Validation Dipole	D835V2 D1900V2	4d063 5d027	May25.2012 Apr.26.2012	May24.2013 Apr.25.2013
Schmid & Partner Engineering AG	Data acquisition Electronics	DAE4	547	Jun.01,2012	May.31,2013
Schmid & Partner Engineering AG	Software	DASY 4 V4.7	N/A	Calibration not required	Calibration not required
Schmid & Partner Engineering AG	Phantom	SAM	N/A	Calibration not required	Calibration not required
HP	Network Analyzer	E5071C	MY46107530	Feb.16,2012	Feb.15,2013
Agilent	Dielectric Probe Kit	85070D	US01440168	Calibration not required	Calibration not required
Agilent	Dual-directional coupler	778D	50313	Aug.16.2012	Aug.15.2013
Agilent	RF Signal Generator	8648D	3847M00432	Jun.04,2012	Jun.03,2013
Agilent	Power Meter	U2001B	MY48100169	May12,2012	May11,2013
R&S	Radio Communication Test	CMU200	113505	May11,2012	May10,2013

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4. Measurements

Date: 2012/11/25

Primary Portrait_full power_GPRS 850_CH190_Test distance is 0mm

Communication System: GSM 850; Frequency: 836.6 MHz; Duty Cycle: 1:4.1

Medium: Muscle 900 MHz Medium parameters used: $f = 837 \text{ MHz}$; $\sigma = 0.985 \text{ mho/m}$; $\epsilon_r = 53.2$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3172; ConvF(5.81, 5.81, 5.81); Calibrated: 2012/8/28
- Sensor-Surface: 3.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2012/6/1
- Phantom: Body; ;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

BODY/Area Scan (61x141x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$
Maximum value of SAR (interpolated) = 0.258 mW/g

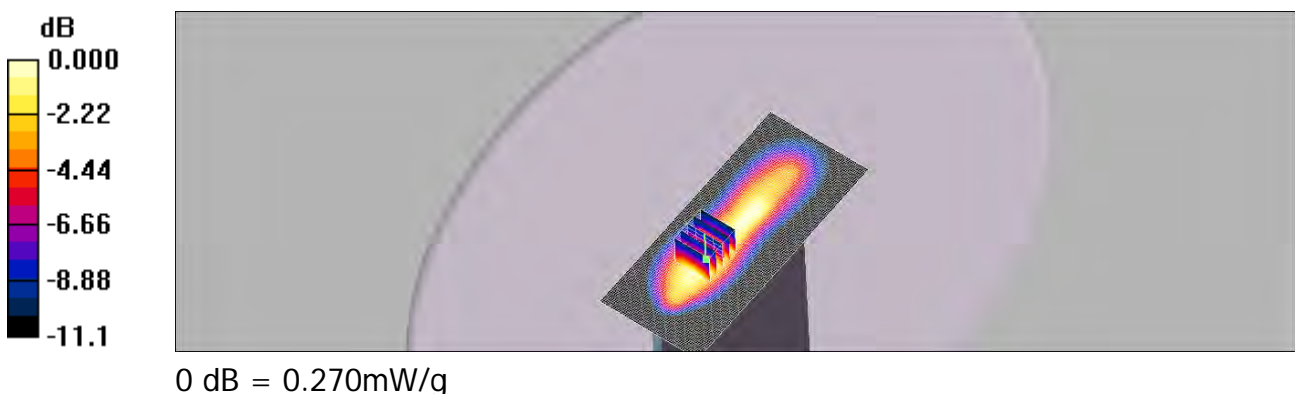
BODY/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$,
 $dz=5\text{mm}$

Reference Value = 15.7 V/m; Power Drift = 0.092 dB

Peak SAR (extrapolated) = 0.377 W/kg

SAR(1 g) = 0.230 mW/g; SAR(10 g) = 0.143 mW/g

Maximum value of SAR (measured) = 0.270 mW/g



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Date: 2012/11/25

Lap-held_full power_GPRS 850_CH190_Test distance is 10.5mm

Communication System: GSM 850; Frequency: 836.6 MHz; Duty Cycle: 1:4.1

Medium: Muscle 900 MHz Medium parameters used: $f = 837 \text{ MHz}$; $\sigma = 0.985 \text{ mho/m}$; $\epsilon_r = 53.2$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3172; ConvF(5.81, 5.81, 5.81); Calibrated: 2012/8/28
- Sensor-Surface: 3.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2012/6/1
- Phantom: Body; ;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

BODY/Area Scan (141x201x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$
Maximum value of SAR (interpolated) = 0.891 mW/g

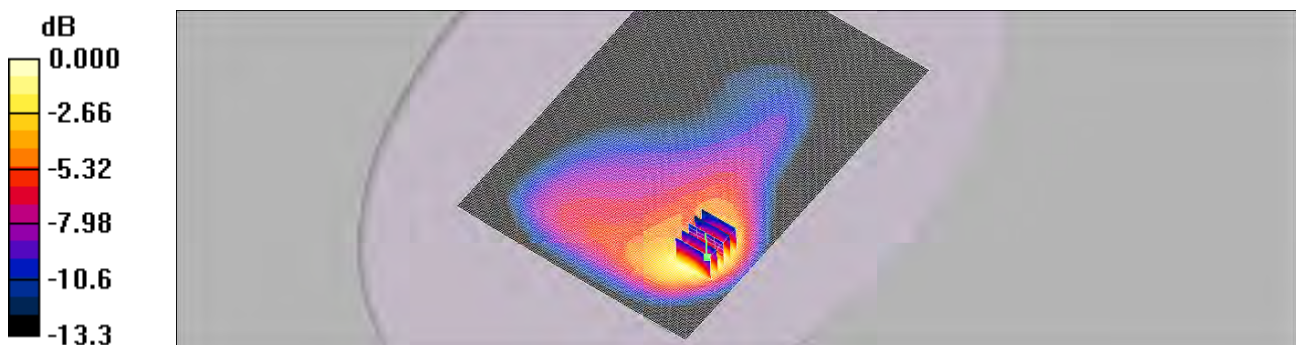
BODY/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$,
 $dz=5\text{mm}$

Reference Value = 8.61 V/m; Power Drift = 0.050 dB

Peak SAR (extrapolated) = 1.23 W/kg

SAR(1 g) = 0.794 mW/g; SAR(10 g) = 0.488 mW/g

Maximum value of SAR (measured) = 0.918 mW/g



0 dB = 0.918mW/g

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Date: 2012/11/25

Secondary Landscape_full power_GPRS 850_CH190_Test distance is 11mm

Communication System: GSM 850; Frequency: 836.6 MHz; Duty Cycle: 1:4.1

Medium: Muscle 900 MHz Medium parameters used: $f = 837 \text{ MHz}$; $\sigma = 0.985 \text{ mho/m}$; $\epsilon_r = 53.2$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3172; ConvF(5.81, 5.81, 5.81); Calibrated: 2012/8/28
- Sensor-Surface: 3.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2012/6/1
- Phantom: Body; ;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

BODY/Area Scan (61x191x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$
Maximum value of SAR (interpolated) = 0.361 mW/g

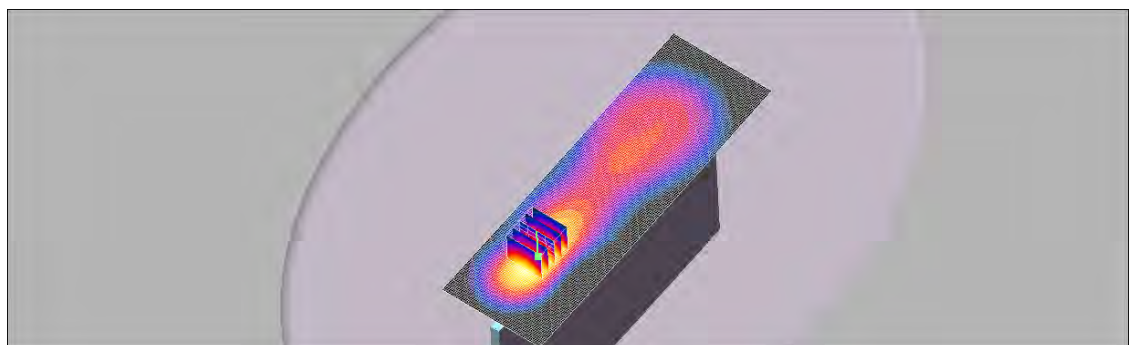
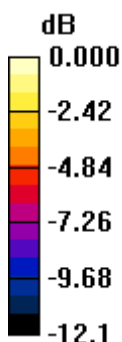
BODY/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 9.48 V/m; Power Drift = 0.082 dB

Peak SAR (extrapolated) = 0.455 W/kg

SAR(1 g) = 0.309 mW/g; SAR(10 g) = 0.193 mW/g

Maximum value of SAR (measured) = 0.352 mW/g



0 dB = 0.352mW/g

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Date: 2012/11/25

Lap-held_reduction power_GPRS 850_CH128_Test distance is 0mm

Communication System: GSM 850; Frequency: 824.2 MHz; Duty Cycle: 1:4.1
Medium: Muscle 900 MHz Medium parameters used (interpolated): $f = 824.2 \text{ MHz}$; $\sigma = 0.965 \text{ mho/m}$; $\epsilon_r = 53.3$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3172; ConvF(5.81, 5.81, 5.81); Calibrated: 2012/8/28
- Sensor-Surface: 3.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2012/6/1
- Phantom: Body; ;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

BODY/Area Scan (141x201x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$
Maximum value of SAR (interpolated) = 1.15 mW/g

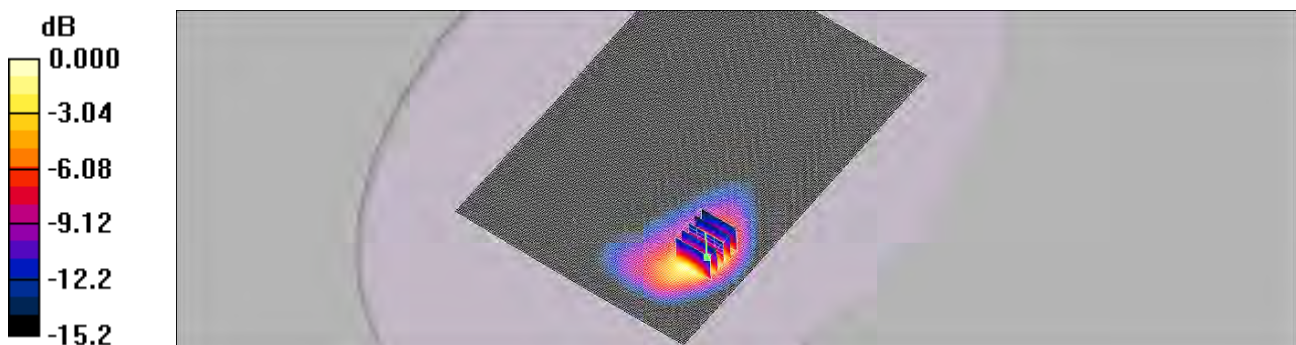
BODY/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$,
 $dz=5\text{mm}$

Reference Value = 1.76 V/m; Power Drift = 0.172 dB

Peak SAR (extrapolated) = 2.02 W/kg

SAR(1 g) = 1.06 mW/g; SAR(10 g) = 0.558 mW/g

Maximum value of SAR (measured) = 1.28 mW/g



0 dB = 1.28mW/g

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Date: 2012/11/25

Lap-held_reduction power_GPRS 850_CH190_Test distance is 0mm

Communication System: GSM 850; Frequency: 836.6 MHz; Duty Cycle: 1:4.1

Medium: Muscle 900 MHz Medium parameters used: $f = 837 \text{ MHz}$; $\sigma = 0.985 \text{ mho/m}$; $\epsilon_r = 53.2$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3172; ConvF(5.81, 5.81, 5.81); Calibrated: 2012/8/28
- Sensor-Surface: 3.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2012/6/1
- Phantom: Body; ;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

BODY/Area Scan (141x201x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$
Maximum value of SAR (interpolated) = 1.33 mW/g

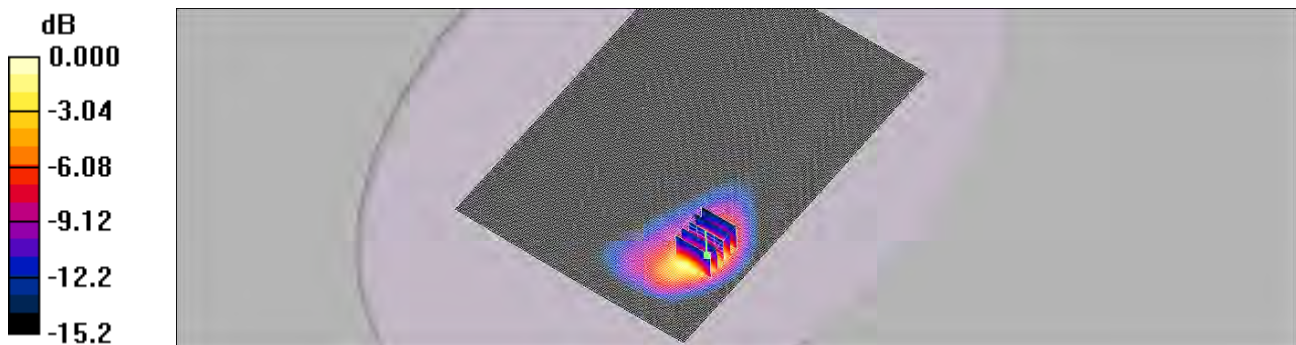
BODY/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$,
 $dz=5\text{mm}$

Reference Value = 2.08 V/m; Power Drift = -0.127 dB

Peak SAR (extrapolated) = 2.45 W/kg

SAR(1 g) = 1.25 mW/g; SAR(10 g) = 0.652 mW/g

Maximum value of SAR (measured) = 1.52 mW/g



0 dB = 1.52mW/g

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Date: 2012/11/25

Lap-held_reduction power_GPRS 850_CH251_Test distance is 0mm

Communication System: GSM 850; Frequency: 848.8 MHz; Duty Cycle: 1:4.1

Medium: Muscle 900 MHz Medium parameters used: $f = 849 \text{ MHz}$; $\sigma = 0.997 \text{ mho/m}$; $\epsilon_r = 53$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3172; ConvF(5.81, 5.81, 5.81); Calibrated: 2012/8/28
- Sensor-Surface: 3.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2012/6/1
- Phantom: Body; ;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

BODY/Area Scan (141x201x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$
Maximum value of SAR (interpolated) = 1.36 mW/g

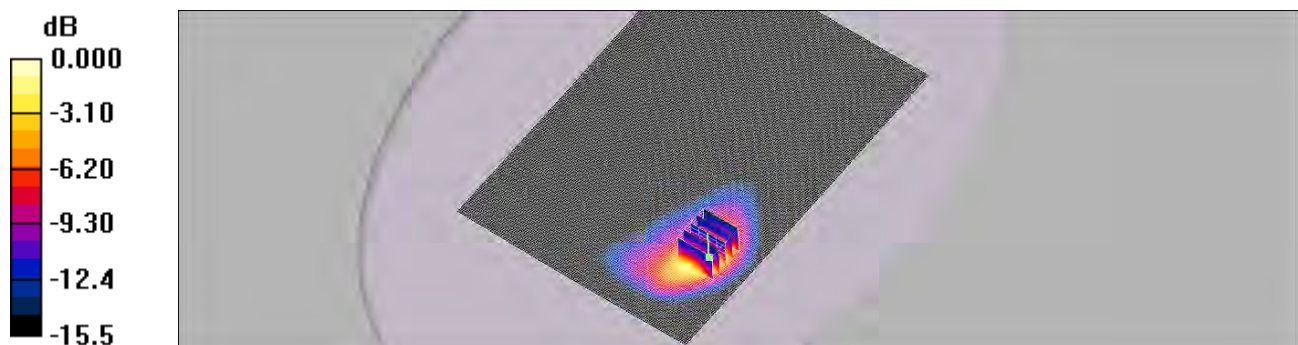
BODY/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$,
 $dz=5\text{mm}$

Reference Value = 2.30 V/m; Power Drift = 0.145 dB

Peak SAR (extrapolated) = 2.57 W/kg

SAR(1 g) = 1.3 mW/g; SAR(10 g) = 0.675 mW/g

Maximum value of SAR (measured) = 1.60 mW/g



0 dB = 1.60mW/g

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Date: 2012/11/25

Secondary Landscape_reduction power_GPRS 850_CH190_Test distance is 0mm

Communication System: GSM 850; Frequency: 836.6 MHz; Duty Cycle: 1:4.1

Medium: Muscle 900 MHz Medium parameters used: $f = 837 \text{ MHz}$; $\sigma = 0.985 \text{ mho/m}$; $\epsilon_r = 53.2$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3172; ConvF(5.81, 5.81, 5.81); Calibrated: 2012/8/28
- Sensor-Surface: 3.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2012/6/1
- Phantom: Body; ;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

BODY/Area Scan (61x191x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$
Maximum value of SAR (interpolated) = 0.759 mW/g

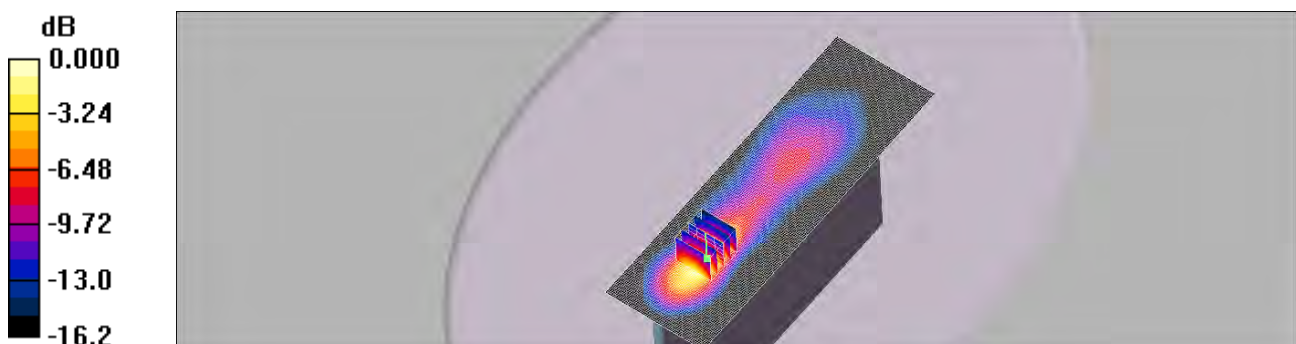
BODY/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 10.8 V/m; Power Drift = 0.128 dB

Peak SAR (extrapolated) = 1.23 W/kg

SAR(1 g) = 0.629 mW/g; SAR(10 g) = 0.324 mW/g

Maximum value of SAR (measured) = 0.795 mW/g



0 dB = 0.795mW/g

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Date: 2012/11/26

Primary Portrait_full power_GPRS 1900_CH661_Test distance is 0mm

Communication System: GSM1900; Frequency: 1880 MHz; Duty Cycle: 1:4.1

Medium: M1800 & 1900 Medium parameters used: $f = 1880 \text{ MHz}$; $\sigma = 1.54 \text{ mho/m}$; $\epsilon_r = 51.8$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3172; ConvF(4.44, 4.44, 4.44); Calibrated: 2012/8/28
- Sensor-Surface: 3.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2012/6/1
- Phantom: Body; ;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

BODY/Area Scan (61x141x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$
Maximum value of SAR (interpolated) = 0.403 mW/g

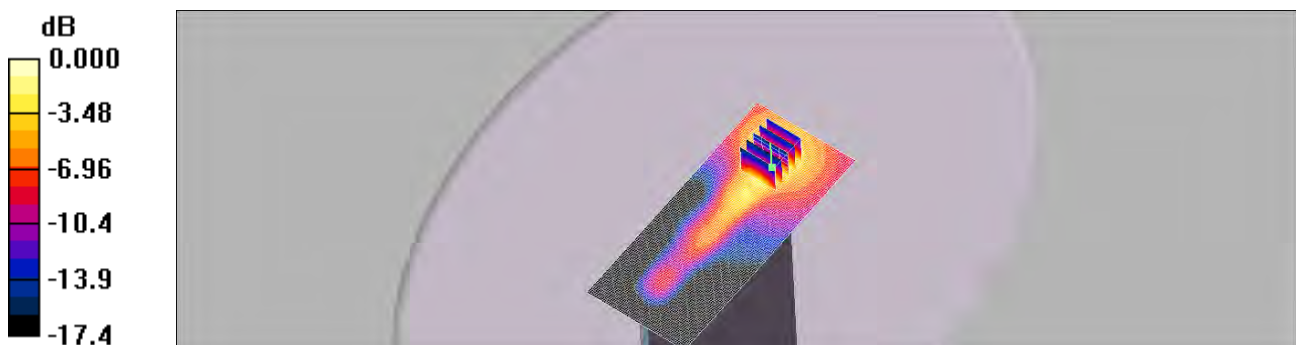
BODY/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$,
 $dz=5\text{mm}$

Reference Value = 9.11 V/m; Power Drift = 0.021 dB

Peak SAR (extrapolated) = 0.796 W/kg

SAR(1 g) = 0.377 mW/g; SAR(10 g) = 0.194 mW/g

Maximum value of SAR (measured) = 0.501 mW/g



0 dB = 0.501mW/g

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Lap-held_full power_GPRS 1900_CH512_Test distance is 10.5mm

Communication System: GSM1900; Frequency: 1850.2 MHz; Duty Cycle: 1:4.1

Medium: M1800 & 1900 Medium parameters used (interpolated): $f = 1850.2 \text{ MHz}$; $\sigma = 1.51 \text{ mho/m}$; $\epsilon_r = 51.9$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3172; ConvF(4.44, 4.44, 4.44); Calibrated: 2012/8/28
- Sensor-Surface: 3.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2012/6/1
- Phantom: Body; ;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

BODY/Area Scan (141x201x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$
Maximum value of SAR (interpolated) = 1.04 mW/g

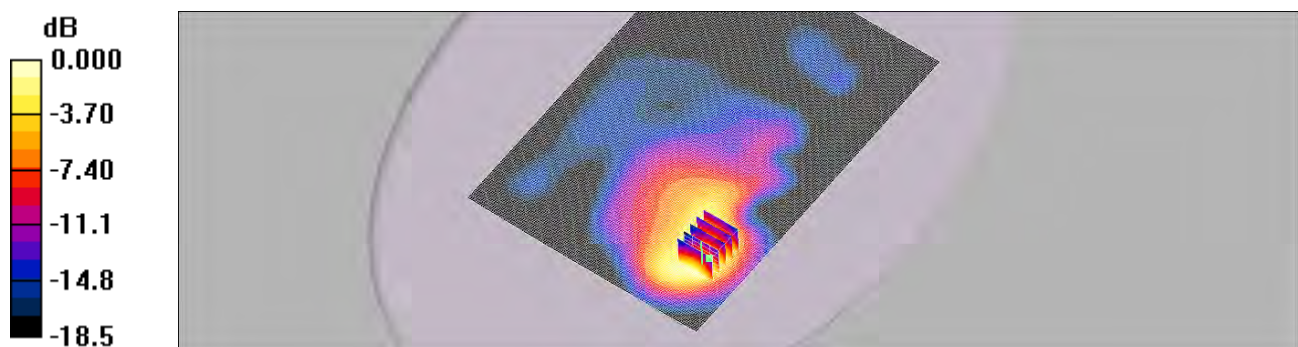
BODY/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 5.24 V/m; Power Drift = -0.121 dB

Peak SAR (extrapolated) = 1.46 W/kg

SAR(1 g) = 0.893 mW/g; SAR(10 g) = 0.520 mW/g

Maximum value of SAR (measured) = 1.08 mW/g



0 dB = 1.08mW/g

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Date: 2012/11/26

Lap-held_full power_GPRS 1900_CH661_Test distance is 10.5mm

Communication System: GSM1900; Frequency: 1880 MHz; Duty Cycle: 1:4.1
Medium: M1800 & 1900 Medium parameters used: $f = 1880 \text{ MHz}$; $\sigma = 1.54 \text{ mho/m}$; $\epsilon_r = 51.8$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3172; ConvF(4.44, 4.44, 4.44); Calibrated: 2012/8/28
- Sensor-Surface: 3.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2012/6/1
- Phantom: Body; ;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

BODY/Area Scan (141x201x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$
Maximum value of SAR (interpolated) = 1.21 mW/g

BODY/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 5.09 V/m; Power Drift = 0.189 dB

Peak SAR (extrapolated) = 1.73 W/kg

SAR(1 g) = 1.04 mW/g; SAR(10 g) = 0.577 mW/g

Maximum value of SAR (measured) = 1.27 mW/g

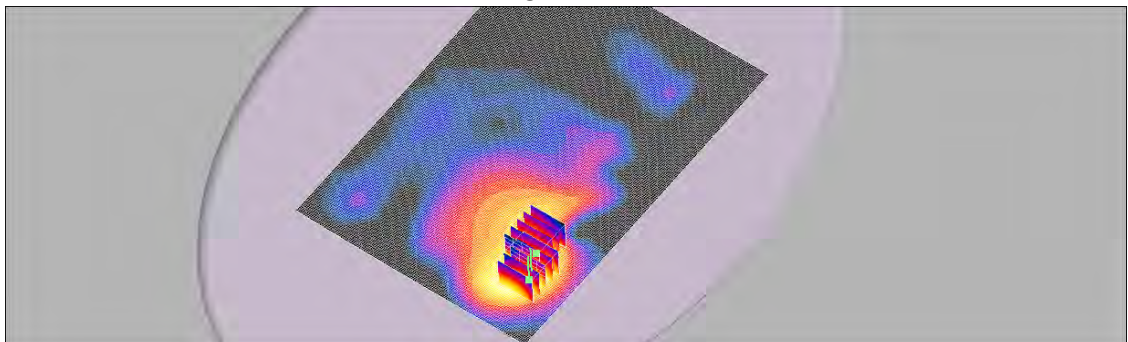
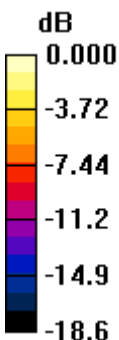
BODY/Zoom Scan (5x5x7)/Cube 1: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 5.09 V/m; Power Drift = 0.189 dB

Peak SAR (extrapolated) = 1.67 W/kg

SAR(1 g) = 0.984 mW/g; SAR(10 g) = 0.569 mW/g

Maximum value of SAR (measured) = 1.14 mW/g



0 dB = 1.14mW/g

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Date: 2012/11/26

Lap-held_full power_GPRS 1900_CH810_Test distance is 10.5mm

Communication System: GSM1900; Frequency: 1909.8 MHz; Duty Cycle: 1:4.1

Medium: M1800 & 1900 Medium parameters used: $f = 1910 \text{ MHz}$; $\sigma = 1.58 \text{ mho/m}$; $\epsilon_r = 51.8$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3172; ConvF(4.44, 4.44, 4.44); Calibrated: 2012/8/28
- Sensor-Surface: 3.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2012/6/1
- Phantom: Body; ;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

BODY/Area Scan (141x201x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

Maximum value of SAR (interpolated) = 1.21 mW/g

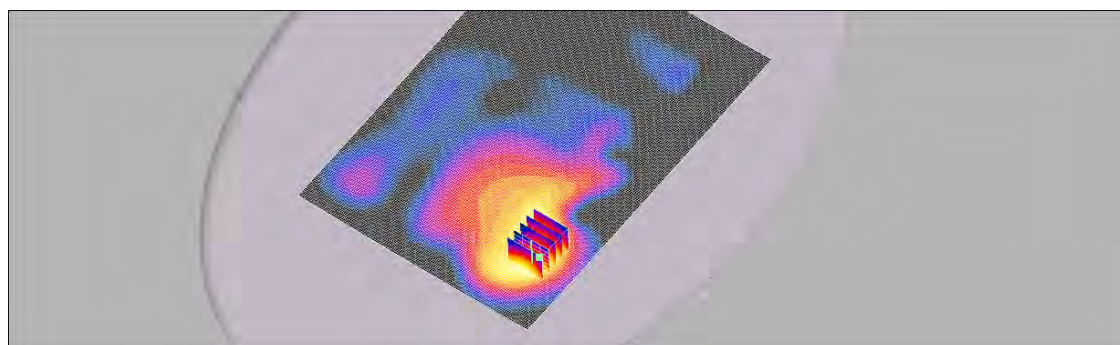
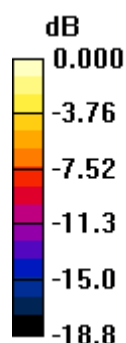
BODY/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 5.22 V/m; Power Drift = -0.122 dB

Peak SAR (extrapolated) = 1.85 W/kg

SAR(1 g) = 1.08 mW/g; SAR(10 g) = 0.587 mW/g

Maximum value of SAR (measured) = 1.33 mW/g



0 dB = 1.33mW/g

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Date: 2012/11/26

Secondary Landscape_full power_GPRS 1900_CH512_Test distance is 11mm

Communication System: GSM1900; Frequency: 1850.2 MHz; Duty Cycle: 1:4.1
Medium: M1800 & 1900 Medium parameters used (interpolated): $f = 1850.2 \text{ MHz}$; $\sigma = 1.51 \text{ mho/m}$; $\epsilon_r = 51.9$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3172; ConvF(4.44, 4.44, 4.44); Calibrated: 2012/8/28
- Sensor-Surface: 3.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2012/6/1
- Phantom: Body; ;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

BODY/Area Scan (61x191x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$
Maximum value of SAR (interpolated) = 0.934 mW/g

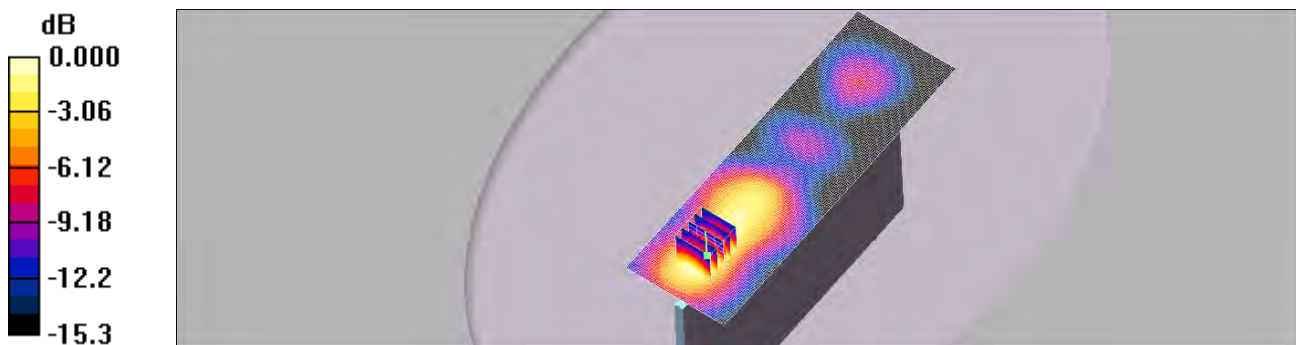
BODY/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 6.97 V/m ; Power Drift = -0.108 dB

Peak SAR (extrapolated) = 1.31 W/kg

SAR(1 g) = 0.841 mW/g ; SAR(10 g) = 0.498 mW/g

Maximum value of SAR (measured) = 0.973 mW/g



0 dB = 0.973 mW/g

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Date: 2012/11/26

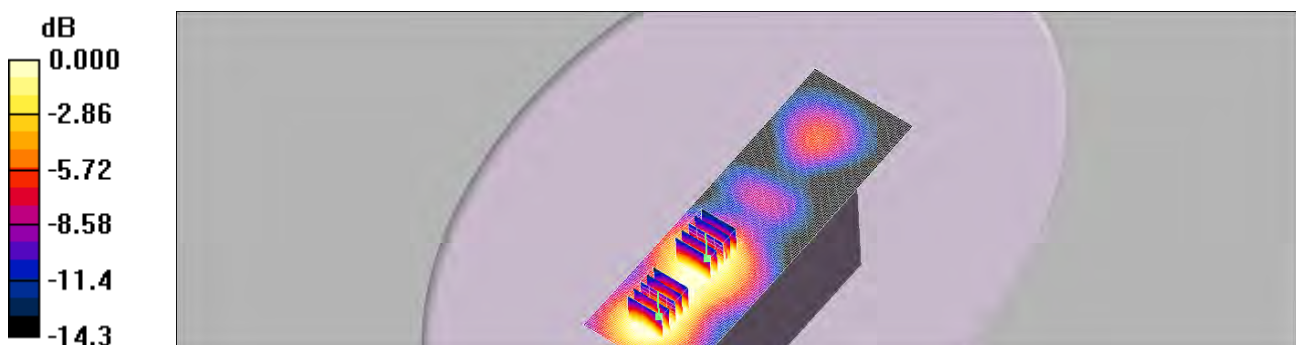
Secondary Landscape_full power_GPRS 1900_CH661_Test distance is 11mm

Communication System: GSM1900; Frequency: 1880 MHz; Duty Cycle: 1:4.1
Medium: M1800 & 1900 Medium parameters used: $f = 1880 \text{ MHz}$; $\sigma = 1.54 \text{ mho/m}$; $\epsilon_r = 51.8$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Flat Section

BODY/Area Scan (61x191x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$
Maximum value of SAR (interpolated) = 0.920 mW/g

BODY/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$
Reference Value = 7.41 V/m; Power Drift = -0.184 dB
Peak SAR (extrapolated) = 1.31 W/kg
SAR(1 g) = 0.830 mW/g; SAR(10 g) = 0.488 mW/g
Maximum value of SAR (measured) = 0.969 mW/g

BODY/Zoom Scan (5x5x7)/Cube 1: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$
Reference Value = 7.41 V/m; Power Drift = -0.184 dB
Peak SAR (extrapolated) = 0.819 W/kg
SAR(1 g) = 0.550 mW/g; SAR(10 g) = 0.354 mW/g
Maximum value of SAR (measured) = 0.620 mW/g



0 dB = 0.620mW/g

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Date: 2012/11/26

Secondary Landscape_full power_GPRS 1900_CH810_Test distance is 11mm

Communication System: GSM1900; Frequency: 1909.8 MHz; Duty Cycle: 1:4.1
Medium: M1800 & 1900 Medium parameters used: $f = 1910 \text{ MHz}$; $\sigma = 1.58 \text{ mho/m}$; $\epsilon_r = 51.8$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Flat Section

BODY/Area Scan (61x191x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$
Maximum value of SAR (interpolated) = 0.973 mW/g

BODY/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 7.92 V/m; Power Drift = -0.027 dB

Peak SAR (extrapolated) = 1.39 W/kg

SAR(1 g) = 0.881 mW/g; SAR(10 g) = 0.513 mW/g

Maximum value of SAR (measured) = 1.03 mW/g

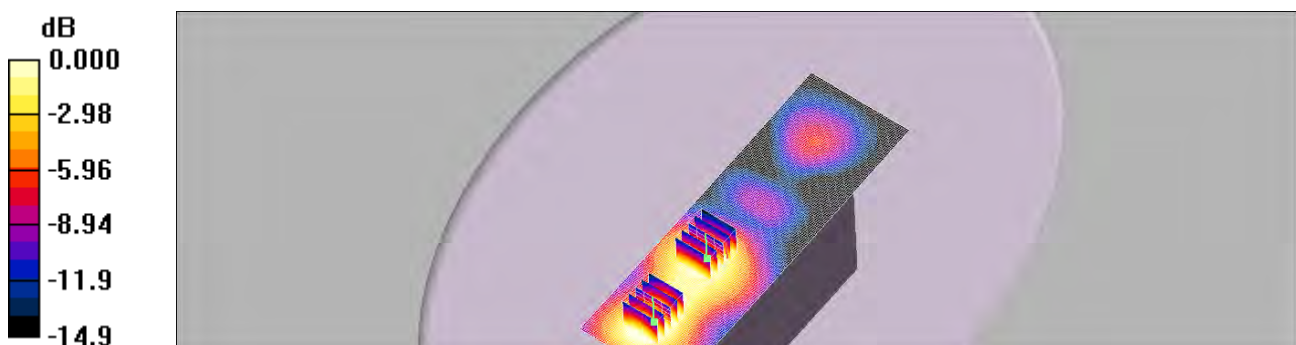
BODY/Zoom Scan (5x5x7)/Cube 1: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 7.92 V/m; Power Drift = -0.027 dB

Peak SAR (extrapolated) = 0.855 W/kg

SAR(1 g) = 0.568 mW/g; SAR(10 g) = 0.359 mW/g

Maximum value of SAR (measured) = 0.645 mW/g



0 dB = 0.645mW/g

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Date: 2012/11/26

Lap-held_reduction power_GPRS 1900_CH512_Test distance is 0mm

Communication System: GSM1900; Frequency: 1850.2 MHz; Duty Cycle: 1:4.1
Medium: M1800 & 1900 Medium parameters used (interpolated): $f = 1850.2 \text{ MHz}$; $\sigma = 1.51 \text{ mho/m}$; $\epsilon_r = 51.9$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3172; ConvF(4.44, 4.44, 4.44); Calibrated: 2012/8/28
- Sensor-Surface: 3.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2012/6/1
- Phantom: Body; ;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

BODY/Area Scan (141x201x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$
Maximum value of SAR (interpolated) = 1.02 mW/g

BODY/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 1.83 V/m; Power Drift = -0.190 dB

Peak SAR (extrapolated) = 2.00 W/kg

SAR(1 g) = 0.954 mW/g; SAR(10 g) = 0.434 mW/g

Maximum value of SAR (measured) = 1.29 mW/g

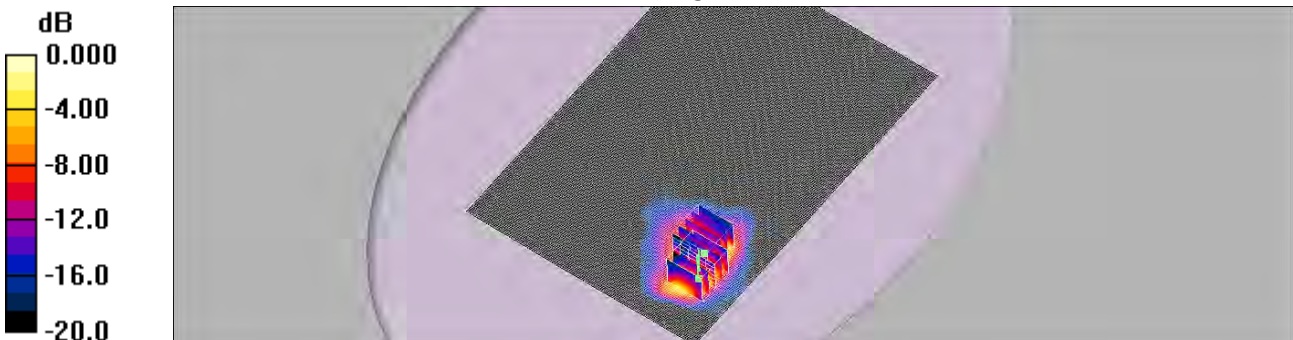
BODY/Zoom Scan (5x5x7)/Cube 1: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 1.83 V/m; Power Drift = -0.190 dB

Peak SAR (extrapolated) = 1.73 W/kg

SAR(1 g) = 0.787 mW/g; SAR(10 g) = 0.409 mW/g

Maximum value of SAR (measured) = 1.09 mW/g



0 dB = 1.09mW/g

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Date: 2012/11/26

Lap-held_reduction power_GPRS 1900_CH661_Test distance is 0mm

Communication System: GSM1900; Frequency: 1880 MHz; Duty Cycle: 1:4.1
Medium: M1800 & 1900 Medium parameters used: $f = 1880 \text{ MHz}$; $\sigma = 1.54 \text{ mho/m}$; $\epsilon_r = 51.8$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3172; ConvF(4.44, 4.44, 4.44); Calibrated: 2012/8/28
- Sensor-Surface: 3.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2012/6/1
- Phantom: Body; ;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

BODY/Area Scan (141x201x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$
Maximum value of SAR (interpolated) = 1.10 mW/g

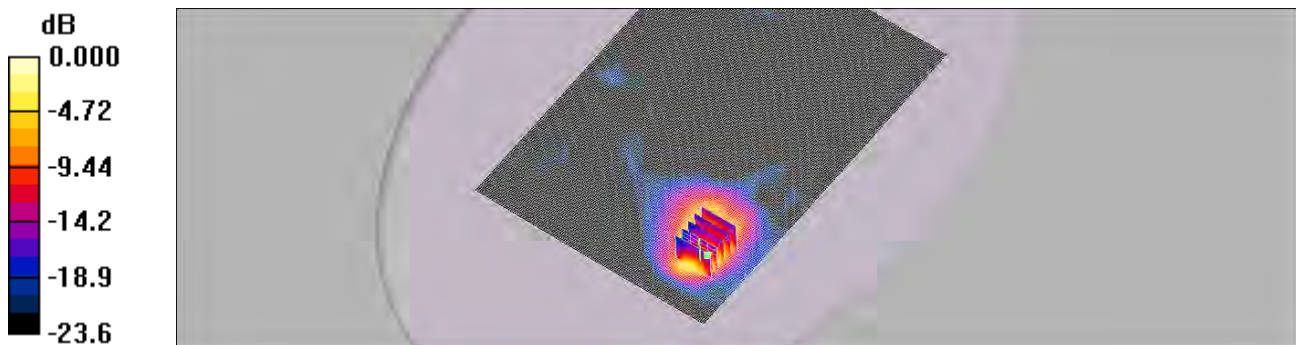
BODY/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$,
 $dz=5\text{mm}$

Reference Value = 1.70 V/m; Power Drift = 0.158 dB

Peak SAR (extrapolated) = 2.16 W/kg

SAR(1 g) = 1 mW/g; SAR(10 g) = 0.448 mW/g

Maximum value of SAR (measured) = 1.36 mW/g



0 dB = 1.36mW/g

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Date: 2012/11/26

Lap-held_reduction power_GPRS 1900_CH810_Test distance is 0mm

Communication System: GSM1900; Frequency: 1909.8 MHz; Duty Cycle: 1:4.1
Medium: M1800 & 1900 Medium parameters used: $f = 1910 \text{ MHz}$; $\sigma = 1.58 \text{ mho/m}$; $\epsilon_r = 51.8$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3172; ConvF(4.44, 4.44, 4.44); Calibrated: 2012/8/28
- Sensor-Surface: 3.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2012/6/1
- Phantom: Body; ;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

BODY/Area Scan (141x201x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$
Maximum value of SAR (interpolated) = 1.25 mW/g

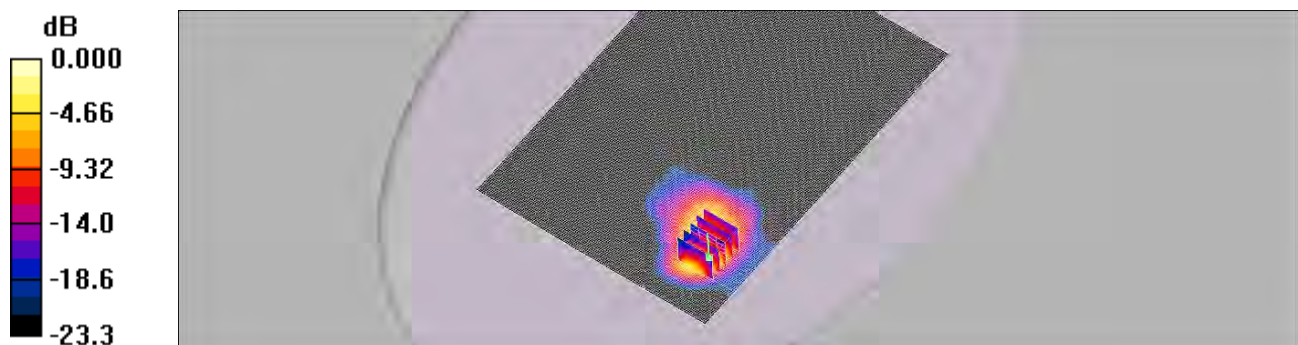
BODY/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$,
 $dz=5\text{mm}$

Reference Value = 2.43 V/m; Power Drift = -0.165 dB

Peak SAR (extrapolated) = 2.52 W/kg

SAR(1 g) = 1.14 mW/g; SAR(10 g) = 0.518 mW/g

Maximum value of SAR (measured) = 1.54 mW/g



0 dB = 1.54mW/g

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Date: 2012/11/26

Secondary Landscape_reduction power_GPRS 1900_CH661_Test distance is 0mm

Communication System: GSM1900; Frequency: 1880 MHz; Duty Cycle: 1:4.1
Medium: M1800 & 1900 Medium parameters used: $f = 1880 \text{ MHz}$; $\sigma = 1.54 \text{ mho/m}$; $\epsilon_r = 51.8$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3172; ConvF(4.44, 4.44, 4.44); Calibrated: 2012/8/28
- Sensor-Surface: 3.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2012/6/1
- Phantom: Body; ;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

BODY/Area Scan (61x191x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$
Maximum value of SAR (interpolated) = 0.404 mW/g

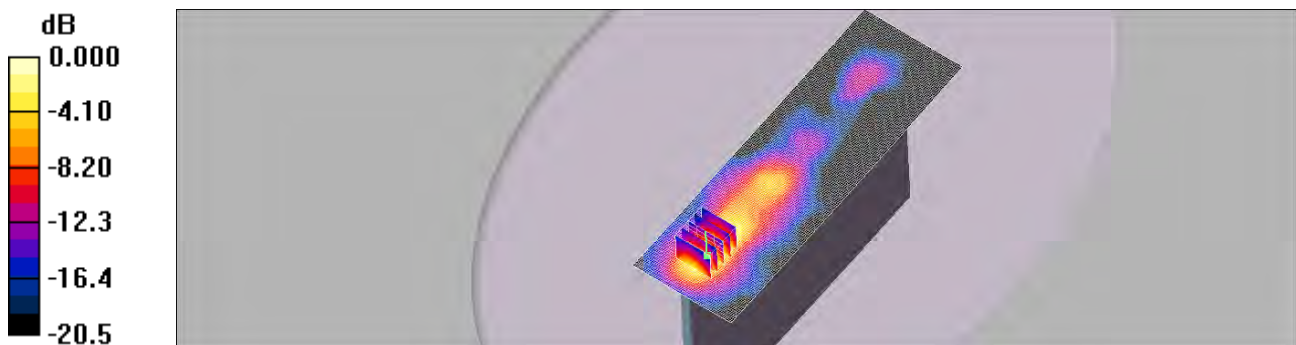
BODY/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 5.44 V/m; Power Drift = 0.191 dB

Peak SAR (extrapolated) = 0.789 W/kg

SAR(1 g) = 0.439 mW/g; SAR(10 g) = 0.218 mW/g

Maximum value of SAR (measured) = 0.569 mW/g



0 dB = 0.569mW/g

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Date: 2012/11/25

Primary Portrait_full power_WCDMA BAND V_CH4183_Test distance is 0mm

Communication System: WCDMA BAND5; Frequency: 836.6 MHz; Duty Cycle: 1:1
Medium: Muscle 900 MHz Medium parameters used: $f = 837 \text{ MHz}$; $\sigma = 0.985 \text{ mho/m}$; $\epsilon_r = 53.2$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3172; ConvF(5.81, 5.81, 5.81); Calibrated: 2012/8/28
- Sensor-Surface: 3.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2012/6/1
- Phantom: Body; ;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

BODY/Area Scan (61x141x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$
Maximum value of SAR (interpolated) = 0.110 mW/g

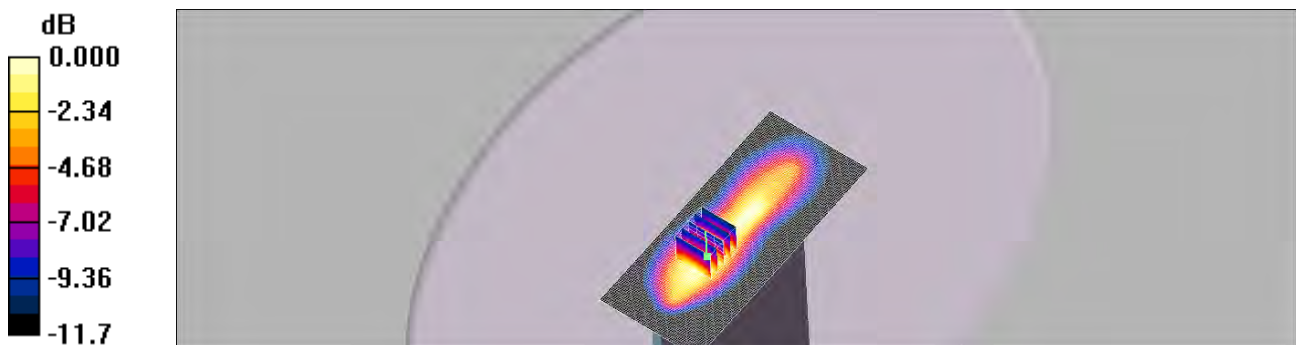
BODY/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 10.2 V/m; Power Drift = 0.091 dB

Peak SAR (extrapolated) = 0.162 W/kg

SAR(1 g) = 0.099 mW/g; SAR(10 g) = 0.061 mW/g

Maximum value of SAR (measured) = 0.116 mW/g



0 dB = 0.116mW/g

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Date: 2012/11/25

Lap-held_full power_WCDMA BAND V_CH4183_Test distance is 10.5mm

Communication System: WCDMA BAND5; Frequency: 836.6 MHz; Duty Cycle: 1:1
Medium: Muscle 900 MHz Medium parameters used: $f = 837 \text{ MHz}$; $\sigma = 0.985 \text{ mho/m}$; $\epsilon_r = 53.2$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3172; ConvF(5.81, 5.81, 5.81); Calibrated: 2012/8/28
- Sensor-Surface: 3.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2012/6/1
- Phantom: Body; ;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

BODY/Area Scan (141x201x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$
Maximum value of SAR (interpolated) = 0.492 mW/g

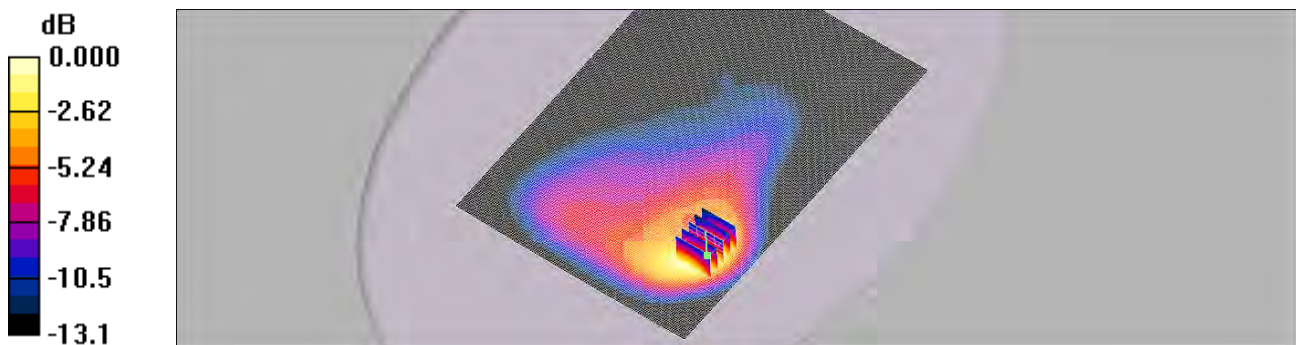
BODY/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 6.57 V/m; Power Drift = 0.122 dB

Peak SAR (extrapolated) = 0.682 W/kg

SAR(1 g) = 0.435 mW/g; SAR(10 g) = 0.267 mW/g

Maximum value of SAR (measured) = 0.499 mW/g



0 dB = 0.499mW/g

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Date: 2012/11/25

Secondary Landscape_full power_WCDMA BAND V_CH4183_Test distance is 11mm

Communication System: WCDMA BAND5; Frequency: 836.6 MHz; Duty Cycle: 1:1
Medium: Muscle 900 MHz Medium parameters used: $f = 837 \text{ MHz}$; $\sigma = 0.985 \text{ mho/m}$; $\epsilon_r = 53.2$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3172; ConvF(5.81, 5.81, 5.81); Calibrated: 2012/8/28
- Sensor-Surface: 3.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2012/6/1
- Phantom: Body; ;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

BODY/Area Scan (61x191x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$
Maximum value of SAR (interpolated) = 0.148 mW/g

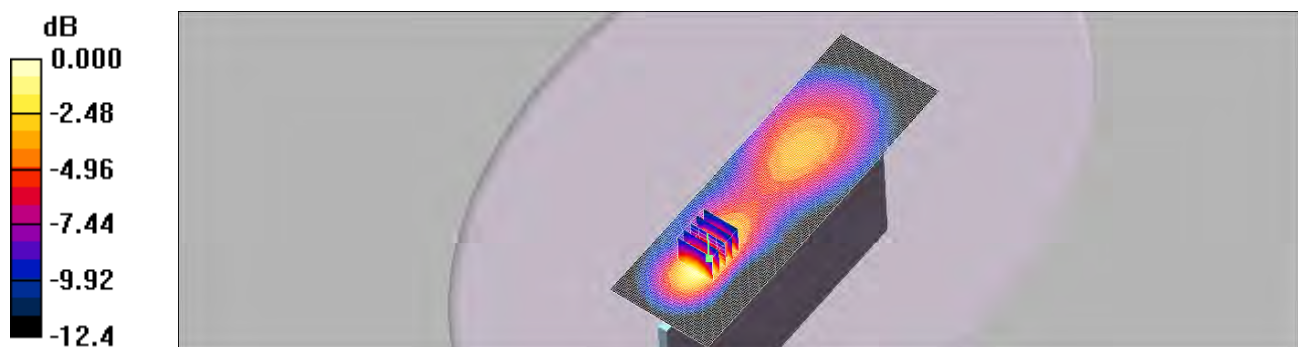
BODY/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 6.45 V/m; Power Drift = -0.055 dB

Peak SAR (extrapolated) = 0.188 W/kg

SAR(1 g) = 0.126 mW/g; SAR(10 g) = 0.078 mW/g

Maximum value of SAR (measured) = 0.145 mW/g



0 dB = 0.145mW/g

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Date: 2012/11/25

Lap-held_reduction power_WCDMA BAND V_CH4132_Test distance is 0mm

Communication System: WCDMA BAND5; Frequency: 826.4 MHz; Duty Cycle: 1:1
Medium: Muscle 900 MHz Medium parameters used (interpolated): $f = 826.4 \text{ MHz}$; $\sigma = 0.972 \text{ mho/m}$; $\epsilon_r = 53.4$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3172; ConvF(5.81, 5.81, 5.81); Calibrated: 2012/8/28
- Sensor-Surface: 3.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2012/6/1
- Phantom: Body; ;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

BODY/Area Scan (141x201x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$
Maximum value of SAR (interpolated) = 1.26 mW/g

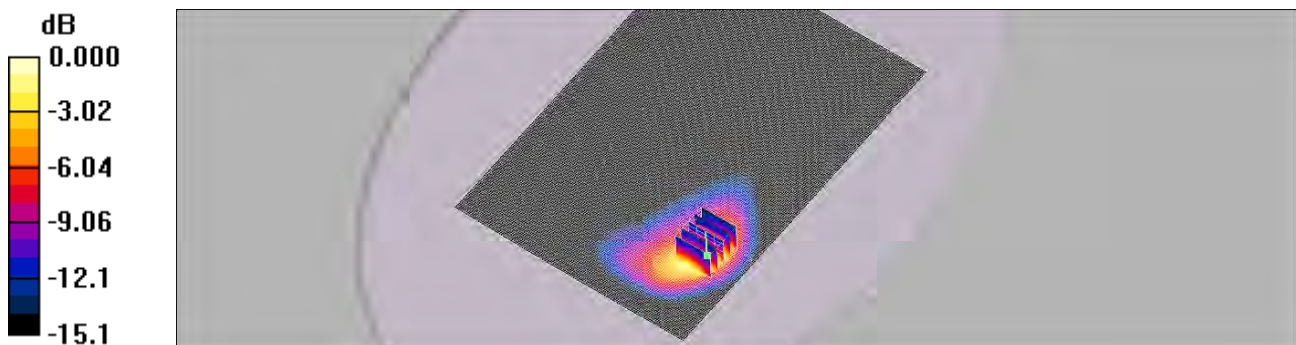
BODY/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 2.35 V/m; Power Drift = -0.185 dB

Peak SAR (extrapolated) = 2.11 W/kg

SAR(1 g) = 1.11 mW/g; SAR(10 g) = 0.590 mW/g

Maximum value of SAR (measured) = 1.35 mW/g



0 dB = 1.35mW/g

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Date: 2012/11/25

Lap-held_reduction power_WCDMA BAND V_CH4183_Test distance is 0mm

Communication System: WCDMA BAND5; Frequency: 836.6 MHz; Duty Cycle: 1:1
Medium: Muscle 900 MHz Medium parameters used: $f = 837 \text{ MHz}$; $\sigma = 0.985 \text{ mho/m}$; $\epsilon_r = 53.2$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3172; ConvF(5.81, 5.81, 5.81); Calibrated: 2012/8/28
- Sensor-Surface: 3.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2012/6/1
- Phantom: Body; ;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

BODY/Area Scan (141x201x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$
Maximum value of SAR (interpolated) = 0.971 mW/g

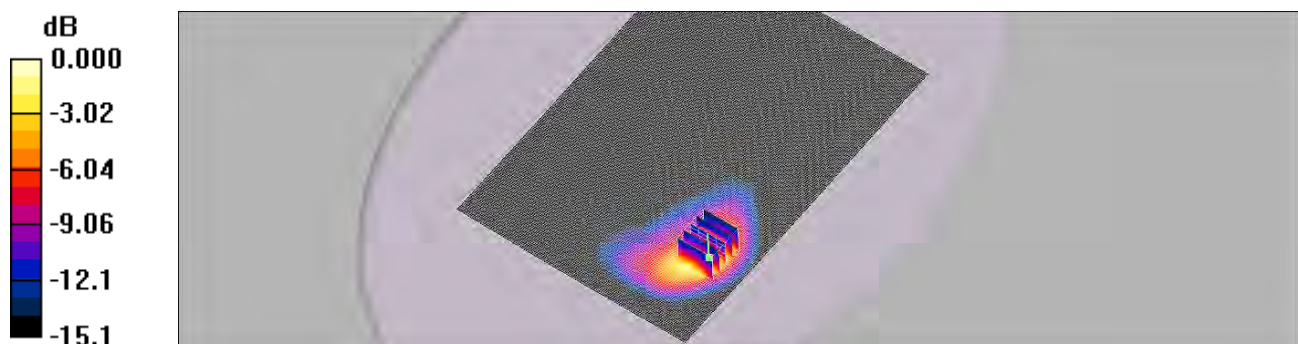
BODY/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 1.88 V/m; Power Drift = -0.127 dB

Peak SAR (extrapolated) = 1.68 W/kg

SAR(1 g) = 0.876 mW/g; SAR(10 g) = 0.463 mW/g

Maximum value of SAR (measured) = 1.07 mW/g



0 dB = 1.07mW/g

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Date: 2012/11/25

Lap-held_reduction power_WCDMA BAND V_CH4233_Test distance is 0mm

Communication System: WCDMA BAND5; Frequency: 846.6 MHz; Duty Cycle: 1:1
Medium: Muscle 900 MHz Medium parameters used: $f = 847 \text{ MHz}$; $\sigma = 0.993 \text{ mho/m}$; $\epsilon_r = 53.2$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3172; ConvF(5.81, 5.81, 5.81); Calibrated: 2012/8/28
- Sensor-Surface: 3.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2012/6/1
- Phantom: Body; ;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

BODY/Area Scan (141x201x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$
Maximum value of SAR (interpolated) = 1.39 mW/g

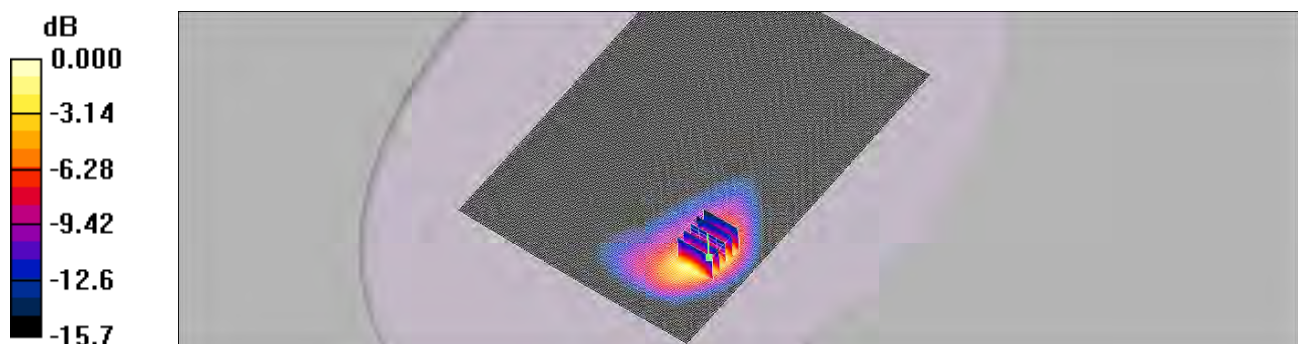
BODY/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 2.10 V/m; Power Drift = 0.168 dB

Peak SAR (extrapolated) = 2.42 W/kg

SAR(1 g) = 1.26 mW/g; SAR(10 g) = 0.657 mW/g

Maximum value of SAR (measured) = 1.56 mW/g

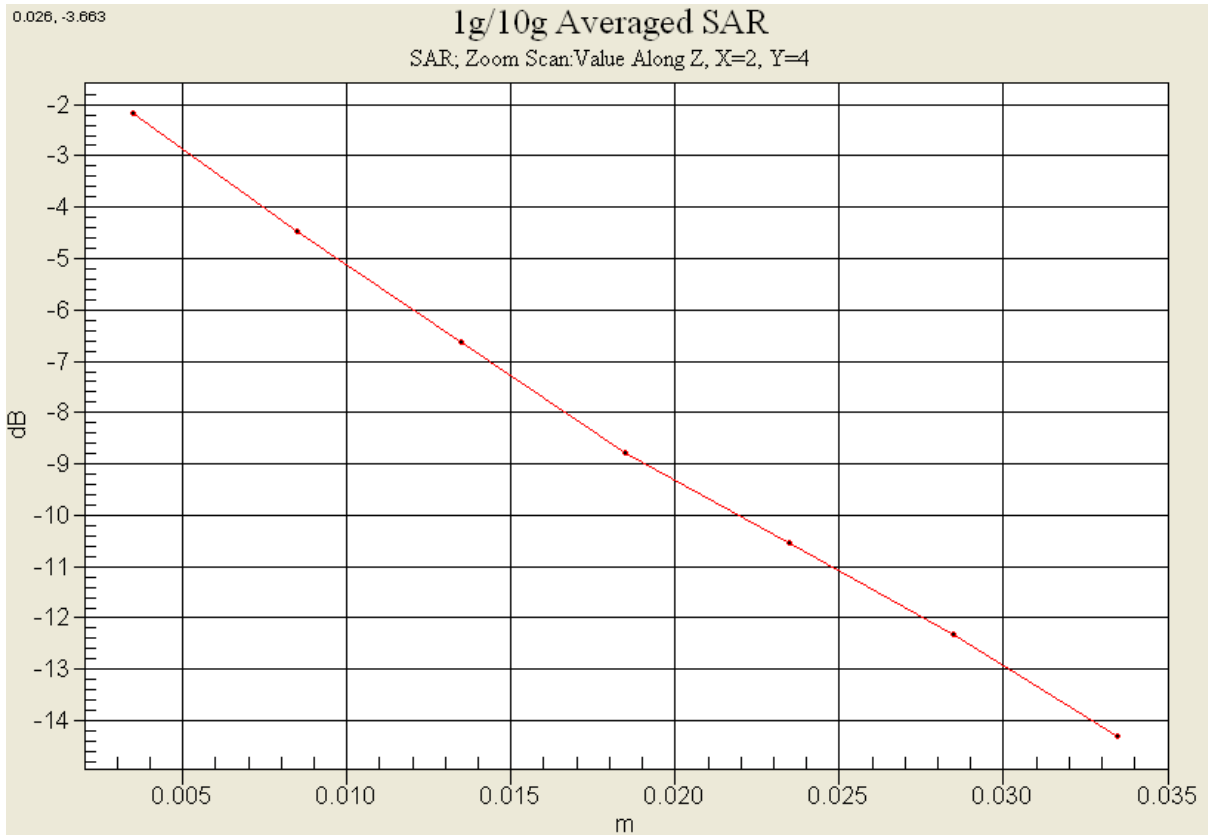


0 dB = 1.56mW/g

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Date: 2012/11/25

Secondary Landscape_reduction power_WCDMA BAND V_CH4183 _Test distance is 0mm

Communication System: WCDMA BAND5; Frequency: 836.6 MHz; Duty Cycle: 1:1
Medium: Muscle 900 MHz Medium parameters used: $f = 837 \text{ MHz}$; $\sigma = 0.985 \text{ mho/m}$; $\epsilon_r = 53.2$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3172; ConvF(5.81, 5.81, 5.81); Calibrated: 2012/8/28
- Sensor-Surface: 3.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2012/6/1
- Phantom: Body; ;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

BODY/Area Scan (61x191x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$
Maximum value of SAR (interpolated) = 0.601 mW/g

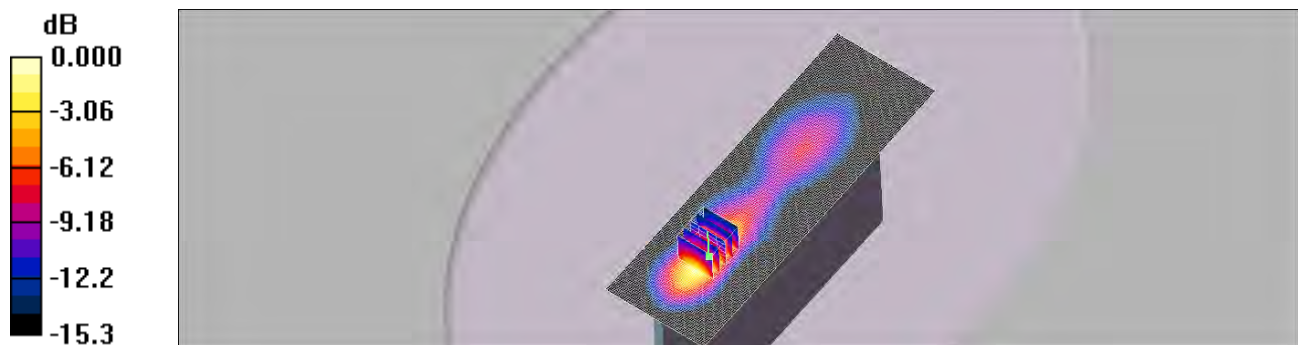
BODY/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$,
 $dz=5\text{mm}$

Reference Value = 9.25 V/m; Power Drift = 0.046 dB

Peak SAR (extrapolated) = 0.926 W/kg

SAR(1 g) = 0.478 mW/g; SAR(10 g) = 0.249 mW/g

Maximum value of SAR (measured) = 0.607 mW/g



0 dB = 0.607mW/g

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5. SAR System Performance Verification

Date: 2012/11/25

DUT: Dipole 835 MHz

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

Medium: Muscle 900 MHz Medium parameters used: $f = 835 \text{ MHz}$; $\sigma = 0.984 \text{ mho/m}$; $\epsilon_r = 53.3$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3172; ConvF(5.81, 5.81, 5.81); Calibrated: 2012/8/28
- Sensor-Surface: 3.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2012/6/1
- Phantom: Body; ;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Pin=250mW/Area Scan (61x121x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$
Maximum value of SAR (interpolated) = 2.80 mW/g

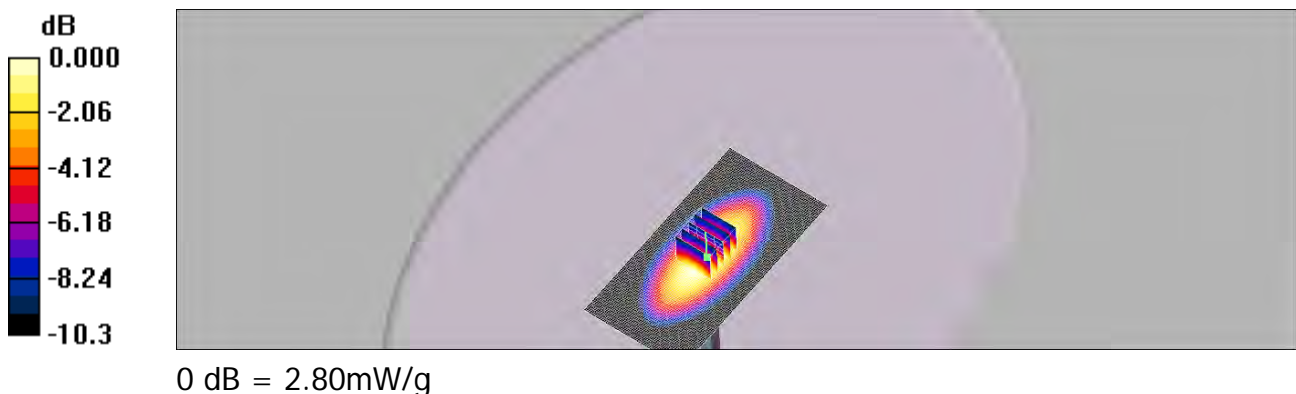
Pin=250mW/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$,
 $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 54.9 V/m; Power Drift = 0.002 dB

Peak SAR (extrapolated) = 3.54 W/kg

SAR(1 g) = 2.48 mW/g; SAR(10 g) = 1.64 mW/g

Maximum value of SAR (measured) = 2.80 mW/g



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Date: 2012/11/26

DUT: Dipole 1900 MHz

Communication System: CW; Frequency: 1900 MHz; Duty Cycle: 1:1
Medium: M1800 & 1900 Medium parameters used: $f = 1900 \text{ MHz}$; $\sigma = 1.57 \text{ mho/m}$; $\epsilon_r = 51.9$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3172; ConvF(4.44, 4.44, 4.44); Calibrated: 2012/8/28
- Sensor-Surface: 3.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2012/6/1
- Phantom: Body; ;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Pin=250mW/Area Scan (51x61x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$
Maximum value of SAR (interpolated) = 13.5 mW/g

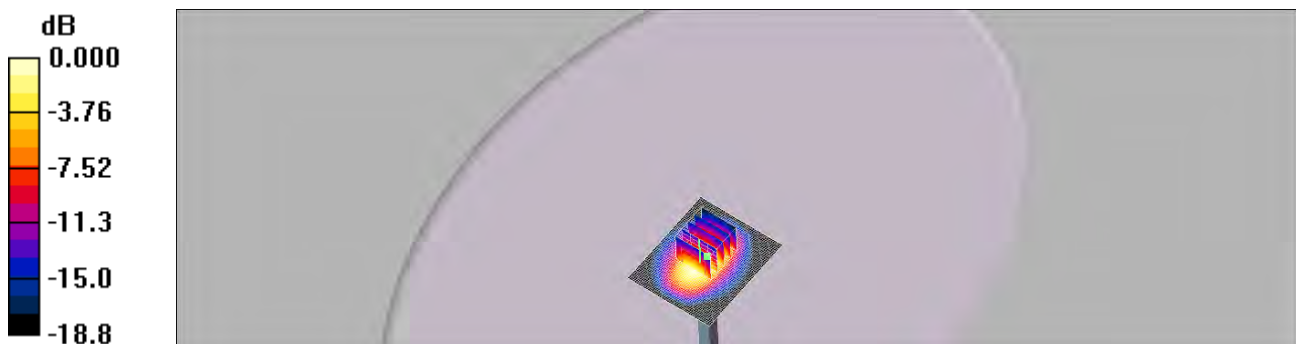
Pin=250mW/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$,
 $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 90.6 V/m; Power Drift = -0.013 dB

Peak SAR (extrapolated) = 17.6 W/kg

SAR(1 g) = 9.95 mW/g; SAR(10 g) = 5.21 mW/g

Maximum value of SAR (measured) = 12.0 mW/g



0 dB = 12.0mW/g

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6. DAE & Probe Calibration Certificate

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: **DAE4-547_Jun12**

CALIBRATION CERTIFICATE

Object **DAE4 - SD 000 D04 BJ - SN: 547**

Calibration procedure(s) **QA CAL-06.v24
Calibration procedure for the data acquisition electronics (DAE)**

Calibration date: **June 01, 2012**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Keithley Multimeter Type 2001	SN: 0810278	28-Sep-11 (No:11450)	Sep-12

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Calibrator Box V2.1	SE UWS 053 AA 1001	05-Jan-12 (in house check)	In house check: Jan-13

Calibrated by:	Name	Function	Signature
	Dominique Steffen	Technician	
Approved by:	Fin Bomholt	R&D Director	

Issued: June 1, 2012

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

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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 = 8.1μV , full range = -100...+300 mV

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

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

Calibration Factors	X	Y	Z
High Range	403.991 ± 0.1% (k=2)	404.021 ± 0.1% (k=2)	404.165 ± 0.1% (k=2)
Low Range	3.95833 ± 0.7% (k=2)	3.96044 ± 0.7% (k=2)	3.97334 ± 0.7% (k=2)

Connector Angle

Connector Angle to be used in DASY system	188.5 ° ± 1 °
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Appendix
1. DC Voltage Linearity

High Range	Reading (μV)	Difference (μV)	Error (%)
Channel X + Input	199998.35	2.97	0.00
Channel X + Input	20003.01	3.40	0.02
Channel X - Input	-19999.79	1.72	-0.01
Channel Y + Input	199995.78	0.56	0.00
Channel Y + Input	19997.80	-1.85	-0.01
Channel Y - Input	-20002.86	-1.29	0.01
Channel Z + Input	199994.37	-1.29	-0.00
Channel Z + Input	19999.89	0.33	0.00
Channel Z - Input	-20004.55	-3.05	0.02

Low Range	Reading (μV)	Difference (μV)	Error (%)
Channel X + Input	2000.42	0.22	0.01
Channel X + Input	200.58	0.05	0.03
Channel X - Input	-200.36	-0.95	0.47
Channel Y + Input	2000.13	0.09	0.00
Channel Y + Input	200.21	-0.28	-0.14
Channel Y - Input	-200.21	-0.72	0.36
Channel Z + Input	2000.48	0.50	0.02
Channel Z + Input	200.00	-0.35	-0.18
Channel Z - Input	-200.24	-0.72	0.36

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	2.44	0.42
	-200	-1.09	-2.58
Channel Y	200	-12.58	-13.15
	-200	12.53	12.88
Channel Z	200	20.17	19.90
	-200	-20.96	-21.63

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	-	2.91	-1.28
Channel Y	200	9.12	-	4.48
Channel Z	200	5.56	7.61	-

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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	16136	15101
Channel Y	16450	16073
Channel Z	15981	16890

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	1.92	0.96	3.04	0.39
Channel Y	-0.95	-1.86	0.27	0.40
Channel Z	-2.66	-3.84	-1.65	0.45

6. Input Offset Current

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

7. Input Resistance (Typical values for information)

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

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

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

9. Power Consumption (Typical values for information)

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

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



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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **SGS-TW (Auden)**

Certificate No: **ES3-3172_Aug12**

CALIBRATION CERTIFICATE

Object: **ES3DV3 - SN:3172**

Calibration procedure(s): **QA CAL-01.v8, QA CAL-23.v4, QA CAL-25.v4
Calibration procedure for dosimetric E-field probes**

Calibration date: **August 28, 2012**

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 E4419B	GB41293874	29-Mar-12 (No. 217-01508)	Apr-13
Power sensor E4412A	MY41498087	29-Mar-12 (No. 217-01508)	Apr-13
Reference 3 dB Attenuator	SN: S5054 (3c)	27-Mar-12 (No. 217-01531)	Apr-13
Reference 20 dB Attenuator	SN: S5086 (20b)	27-Mar-12 (No. 217-01529)	Apr-13
Reference 30 dB Attenuator	SN: S5129 (30b)	27-Mar-12 (No. 217-01532)	Apr-13
Reference Probe ES3DV2	SN: 3013	29-Dec-11 (No. ES3-3013_Dec11)	Dec-12
DAE4	SN: 660	20-Jun-12 (No. DAE4-660_Jun12)	Jun-13
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-11)	In house check: Apr-13
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-11)	In house check: Oct-12

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

Issued: August 28, 2012

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Glossary:

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

Calibration is Performed According to the Following Standards:

- a) IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

Methods Applied and Interpretation of Parameters:

- **NORM_{x,y,z}**: Assessed for E-field polarization $\vartheta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORM_{x,y,z} are only intermediate values, i.e., the uncertainties of NORM_{x,y,z} does not affect the E²-field uncertainty inside TSL (see below ConvF).
- **NORM(f)_{x,y,z} = NORM_{x,y,z} * frequency_response** (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- **DCP_{x,y,z}**: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- **PAR**: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- **A_{x,y,z}; B_{x,y,z}; C_{x,y,z}; VR_{x,y,z}; A, B, C** 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.

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ES3DV3 – SN:3172

August 28, 2012

Probe ES3DV3

SN:3172

Manufactured: January 23, 2008
Calibrated: August 28, 2012

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

Certificate No: ES3-3172_Aug12

Page 3 of 11

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ES3DV3-SN:3172

August 28, 2012

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3172

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	1.37	1.14	0.98	$\pm 10.1\%$
DCP (mV) ^B	102.0	102.8	94.6	

Modulation Calibration Parameters

UID	Communication System Name	PAR		A dB	B dB	C dB	VR mV	Unc ^C (k=2)
0	CW	0.00	X	0.00	0.00	1.00	166.6	$\pm 2.5\%$
			Y	0.00	0.00	1.00	151.1	
			Z	0.00	0.00	1.00	138.5	

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

^A The uncertainties of NormX,Y,Z do not affect the E^2 -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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ES3DV3- SN:3172

August 28, 2012

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3172

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	Depth (mm)	Unct. (k=2)
750	41.9	0.89	6.07	6.07	6.07	0.32	1.78	± 12.0 %
835	41.5	0.90	5.85	5.85	5.85	0.80	1.09	± 12.0 %
900	41.5	0.97	5.76	5.76	5.76	0.43	1.49	± 12.0 %
1750	40.1	1.37	5.03	5.03	5.03	0.80	1.15	± 12.0 %
1900	40.0	1.40	4.85	4.85	4.85	0.63	1.32	± 12.0 %
2000	40.0	1.40	4.79	4.79	4.79	0.61	1.35	± 12.0 %
2300	39.5	1.67	4.50	4.50	4.50	0.73	1.26	± 12.0 %
2450	39.2	1.80	4.21	4.21	4.21	0.80	1.19	± 12.0 %

^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 $\pm 10\%$ 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 $\pm 5\%$. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

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ES3DV3- SN:3172

August 28, 2012

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3172

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	55.5	0.96	5.90	5.90	5.90	0.30	1.96	± 12.0 %
835	55.2	0.97	5.81	5.81	5.81	0.36	1.80	± 12.0 %
900	55.0	1.05	5.82	5.82	5.82	0.80	1.17	± 12.0 %
1750	53.4	1.49	4.71	4.71	4.71	0.36	2.09	± 12.0 %
1900	53.3	1.52	4.44	4.44	4.44	0.44	1.76	± 12.0 %
2000	53.3	1.52	4.40	4.40	4.40	0.57	1.59	± 12.0 %
2300	52.9	1.81	4.07	4.07	4.07	0.65	1.38	± 12.0 %
2450	52.7	1.95	3.88	3.88	3.88	0.80	1.01	± 12.0 %

^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.

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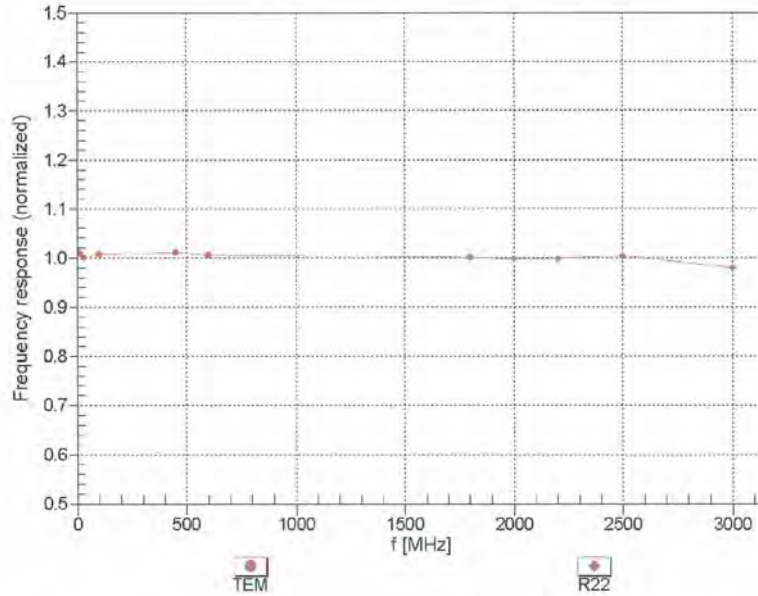
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ES3DV3-SN:3172

August 28, 2012

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



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

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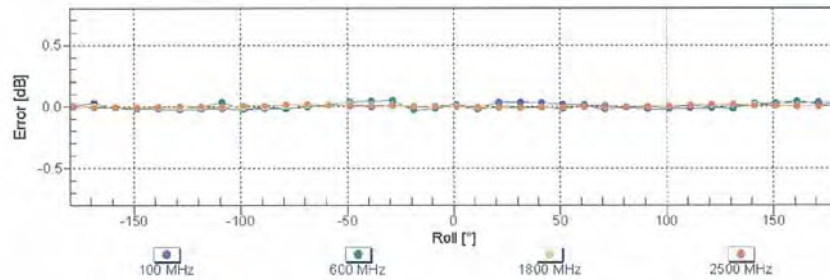
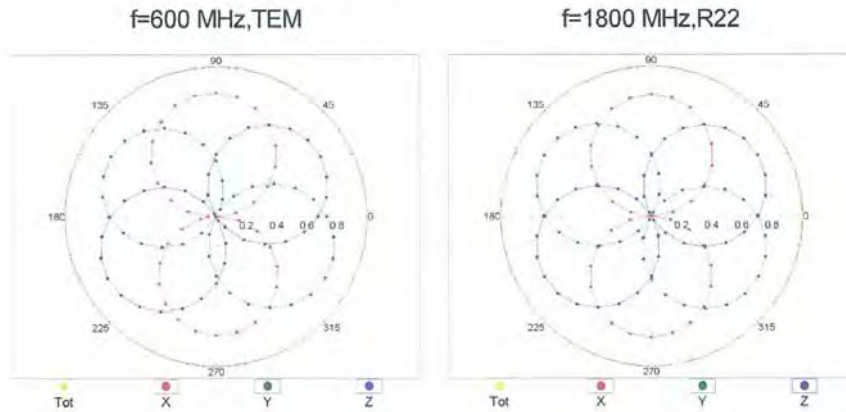
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ES3DV3- SN:3172

August 28, 2012

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



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

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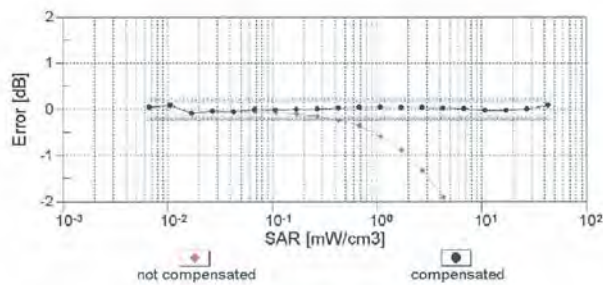
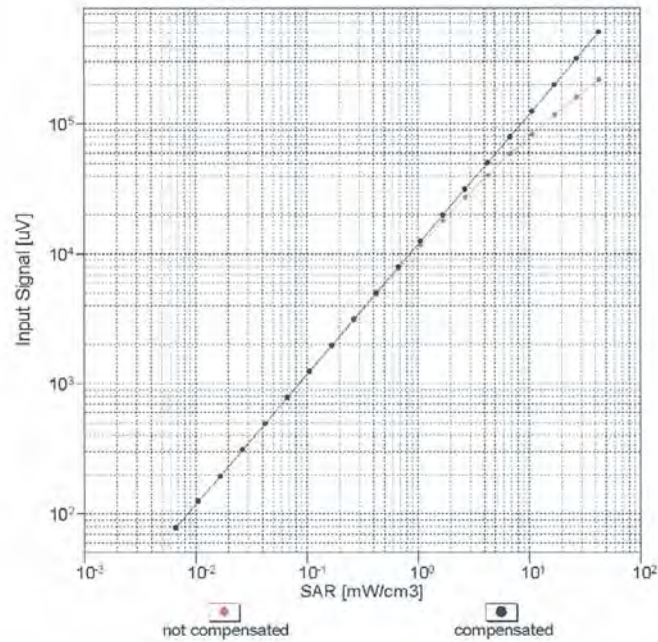
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ES3DV3-SN:3172

August 28, 2012

Dynamic Range $f(SAR_{head})$ (TEM cell, $f = 900$ MHz)



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

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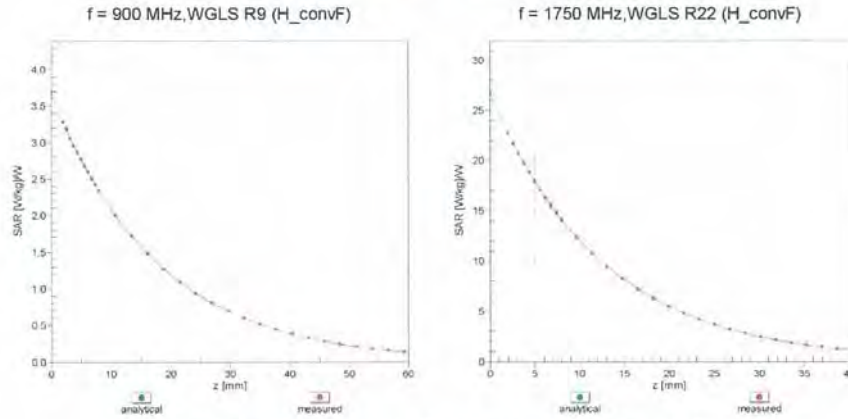
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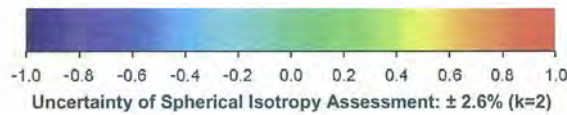
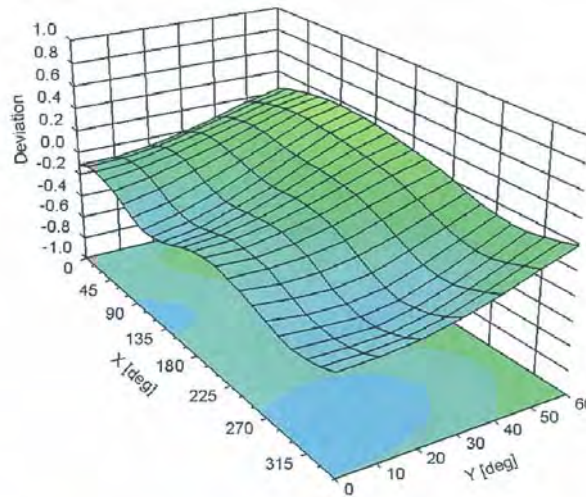
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August 28, 2012

Conversion Factor Assessment



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



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ES3DV3- SN:3172

August 28, 2012

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3172

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-178.7
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm

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7. 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	Div	Div Value	ci (1g)	ci (10g)	Standard uncertainty	Standard uncertainty	vi, or Veff
Measurement system									
Probe calibration(under	6.00%	N	1	1	1	1	6.00%	6.00%	∞
<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)	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 -	3.00%	R	$\sqrt{3}$	1.732	1	1	1.73%	1.73%	∞
Probe positioner Mechanical	0.40%	R	$\sqrt{3}$	1.732	1	1	0.23%	0.23%	∞
Probe Positioning with respect to	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%	∞
Liquid conductivity(meas.)	4.60%	N	1	1	0.64	0.43	2.94%	1.98%	M
Liquid permittivity(meas.)	2.17%	N	1	1	0.6	0.49	1.30%	1.06%	M
Combined standard		RSS					11.72%	11.49%	
Expan uncertainty (95% confidence)							23.44%	22.98%	

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8. 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-1314 ff.
Material thickness at ERP	Compliant with the requirements according to the standards	6mm +/- 0.2mm at ERP	First article, A3 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 HSL000 and without DUT below	Prototypes, Sample testing

Standards

- [1] CENELEC EN 50381
 - [2] IEEE Std 1528-2003
 - [3] IEC 62209 Part I
 - [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: 881 - QD 000 P40 C - F

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9. 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: D835V2-4d063_May12

CALIBRATION CERTIFICATE

Object: D835V2 - SN: 4d063

Calibration procedure(s): QA CAL-05.v8
Calibration procedure for dipole validation kits above 700 MHz

Calibration date: May 25, 2012

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	05-Oct-11 (No. 217-01451)	Oct-12
Power sensor HP 8481A	US37292783	05-Oct-11 (No. 217-01451)	Oct-12
Reference 20 dB Attenuator	SN: 5058 (20k)	27-Mar-12 (No. 217-01530)	Apr-13
Type-N mismatch combination	SN: 5047.2 / 06327	27-Mar-12 (No. 217-01533)	Apr-13
Reference Probe ES3DV3	SN: 3205	30-Dec-11 (No. ES3-3205_Dec11)	Dec-12
DAE4	SN: 601	04-Jul-11 (No. DAE4-601_Jul11)	Jul-12
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP B753E	US37390585 S4206	18-Oct-01 (in house check Oct-11)	In house check: Oct-12

	Name	Function	Signature
Calibrated by:	Israe El-Naouq	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: May 25, 2012

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

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**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**

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 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- 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
- Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

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	V52.8.1
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	835 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	40.6 ± 6 %	0.89 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	---	---

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.36 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	9.47 mW / g ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.54 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	6.18 mW / g ± 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.2	0.97 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	54.3 ± 6 %	1.00 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	---	---

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.46 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	9.58 mW / g ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.62 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	6.35 mW / g ± 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.6 Ω + 0.3 $j\Omega$
Return Loss	- 29.1 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	48.0 Ω - 2.9 $j\Omega$
Return Loss	- 28.9 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.390 ns
----------------------------------	----------

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

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	November 27, 2006

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DASY5 Validation Report for Head TSL

Date: 25.05.2012

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: CW; Frequency: 835 MHz

Medium parameters used: $f = 835 \text{ MHz}$; $\sigma = 0.89 \text{ mho/m}$; $\epsilon_r = 40.6$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.07, 6.07, 6.07); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.1(838); SEMCAD X 14.6.5(6469)

Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm 2/Zoom Scan (7x7x7)/Cube 0:

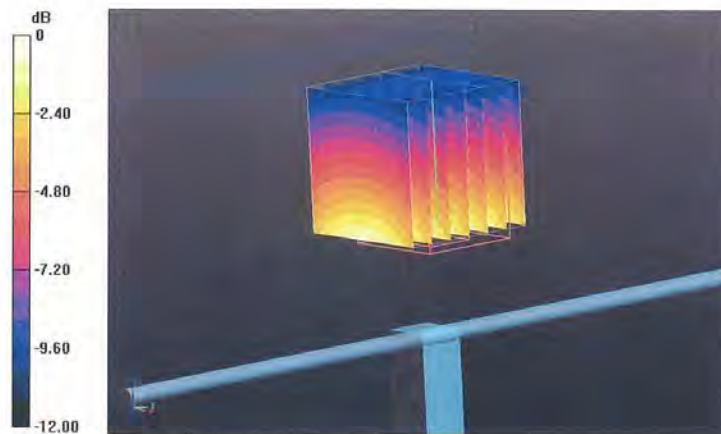
Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 57.199 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 3.481 mW/g

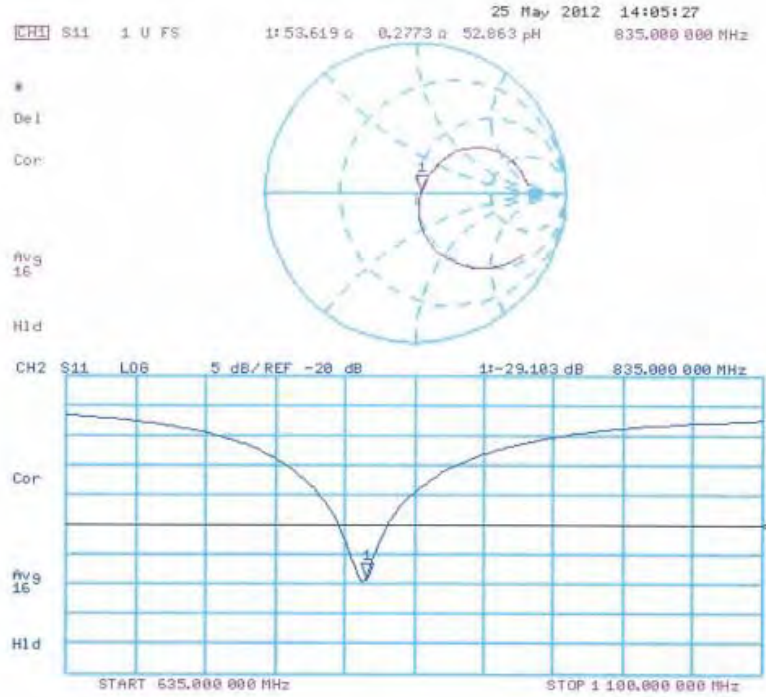
SAR(1 g) = 2.36 mW/g; SAR(10 g) = 1.54 mW/g

Maximum value of SAR (measured) = 2.75 mW/g



0 dB = 2.75 mW/g = 8.79 dB mW/g

Impedance Measurement Plot for Head TSL



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DASY5 Validation Report for Body TSL

Date: 25.05.2012

Test Laboratory: SPEAG, Zurich, Switzerland

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

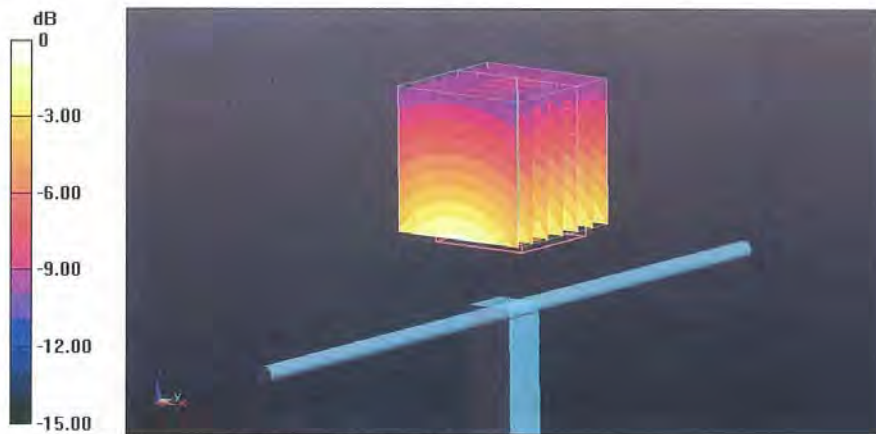
Communication System: CW; Frequency: 835 MHz
Medium parameters used: $f = 835$ MHz; $\sigma = 1$ mho/m; $\epsilon_r = 54.3$; $\rho = 1000$ kg/m³
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.02, 6.02, 6.02); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.1(838); SEMCAD X 14.6.5(6469)

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 = 55.303 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 3.569 mW/g
SAR(1 g) = 2.46 mW/g; SAR(10 g) = 1.62 mW/g
Maximum value of SAR (measured) = 2.87 mW/g



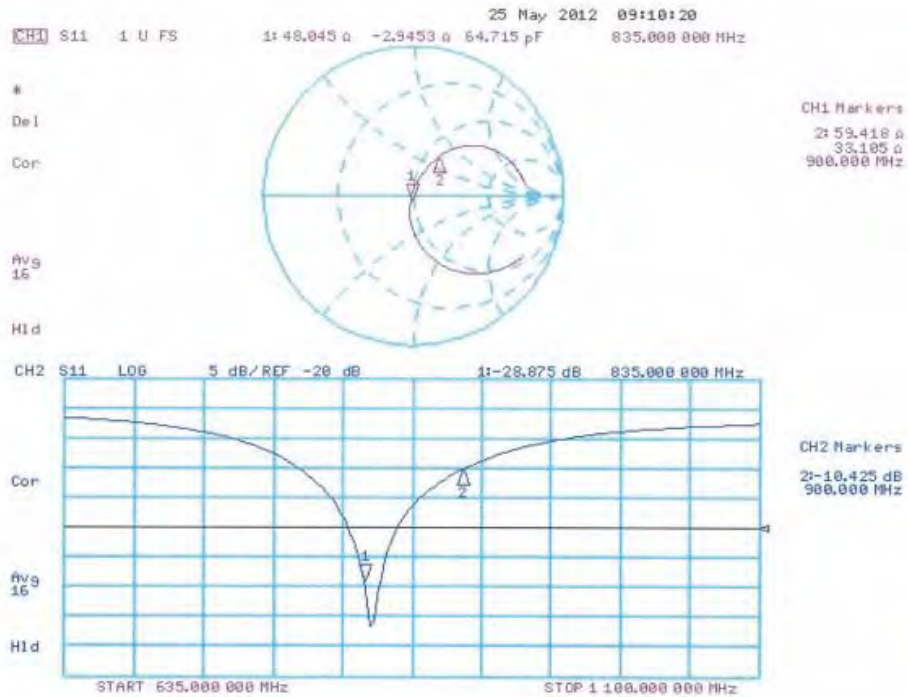
0 dB = 2.87 mW/g = 9.16 dB mW/g

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Impedance Measurement Plot for Body TSL



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



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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: **D1900V2-5d027_Apr12**

CALIBRATION CERTIFICATE

Object: **D1900V2 - SN: 5d027**

Calibration procedure(s): **QA CAL-05.v8
Calibration procedure for dipole validation kits above 700 MHz**

Calibration date: **April 26, 2012**

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	05-Oct-11 (No. 217-01451)	Oct-12
Power sensor HP 8481A	US37292783	05-Oct-11 (No. 217-01451)	Oct-12
Reference 20 dB Attenuator	SN: 5058 (20k)	27-Mar-12 (No. 217-01530)	Apr-13
Type-N mismatch combination	SN: 5047.2 / 06327	27-Mar-12 (No. 217-01533)	Apr-13
Reference Probe ES3DV3	SN: 3205	30-Dec-11 (No. ES3-3205_Dec11)	Dec-12
DAE4	SN: 601	04-Jul-11 (No. DAE4-601_Jul11)	Jul-12
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-11)	In house check: Oct-12

Calibrated by:	Name Israa El-Naouq	Function Laboratory Technician	Signature
Approved by:	Name Katja Pokovic	Function Technical Manager	Signature

Issued: April 26, 2012

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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:

- a) IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- c) Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

Additional Documentation:

- d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

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Measurement Conditions

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

DASY Version	DASY5	V52.8.1
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	40.8 ± 6 %	1.37 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	---	---

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.43 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	38.4 mW / g ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	4.96 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	20.1 mW / g ± 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	53.3 ± 6 %	1.51 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	---	---

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	10.0 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	40.2 mW / g ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.30 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	21.3 mW / g ± 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	49.5 Ω + 4.5 j Ω
Return Loss	- 26.9 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.2 Ω + 4.5 j Ω
Return Loss	- 24.3 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.197 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

DASY5 Validation Report for Head TSL

Date: 26.04.2012

Test Laboratory: SPEAG, Zurich, Switzerland

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

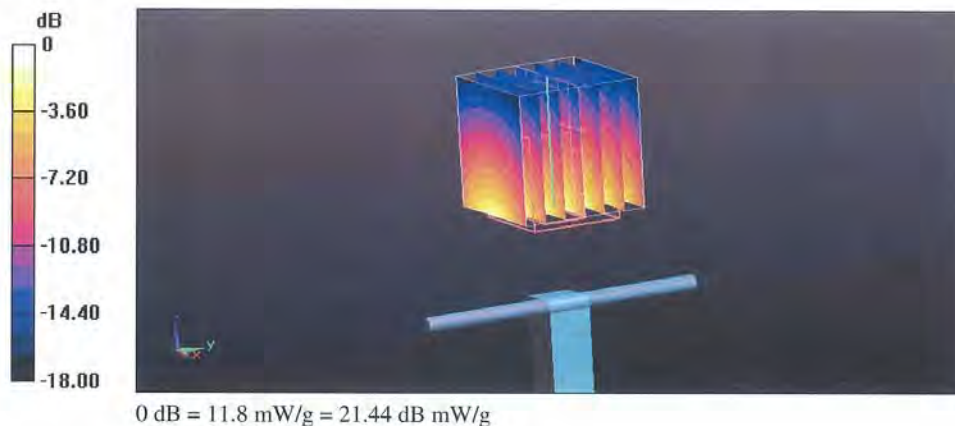
Communication System: CW; Frequency: 1900 MHz
Medium parameters used: $f = 1900$ MHz; $\sigma = 1.37$ mho/m; $\epsilon_r = 40.8$; $\rho = 1000$ kg/m³
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5.01, 5.01, 5.01); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.1(838); SEMCAD X 14.6.5(6469)

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 = 96.127 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 16.890 mW/g
SAR(1 g) = 9.43 mW/g; SAR(10 g) = 4.96 mW/g
Maximum value of SAR (measured) = 11.8 mW/g

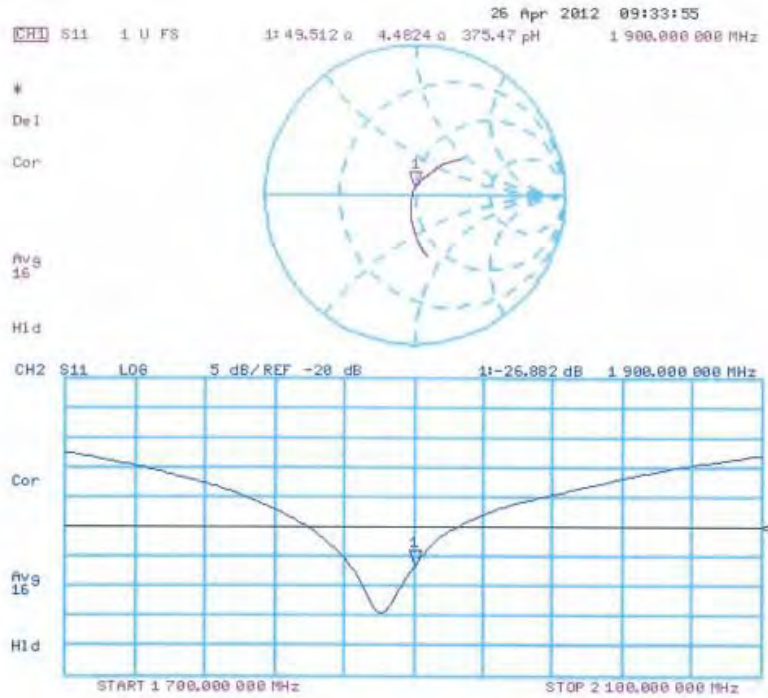


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Impedance Measurement Plot for Head TSL



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DASY5 Validation Report for Body TSL

Date: 26.04.2012

Test Laboratory: SPEAG, Zurich, Switzerland

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

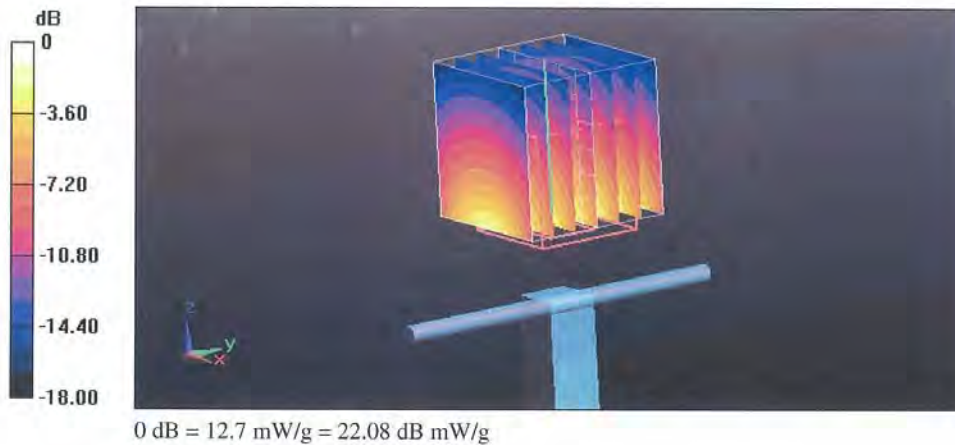
Communication System: CW; Frequency: 1900 MHz
Medium parameters used: $f = 1900$ MHz; $\sigma = 1.51$ mho/m; $\epsilon_r = 53.3$; $\rho = 1000$ kg/m³
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.62, 4.62, 4.62); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.1(838); SEMCAD X 14.6.5(6469)

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 = 95.355 V/m; Power Drift = -0.00 dB
Peak SAR (extrapolated) = 17.593 mW/g
SAR(1 g) = 10 mW/g; SAR(10 g) = 5.3 mW/g
Maximum value of SAR (measured) = 12.7 mW/g

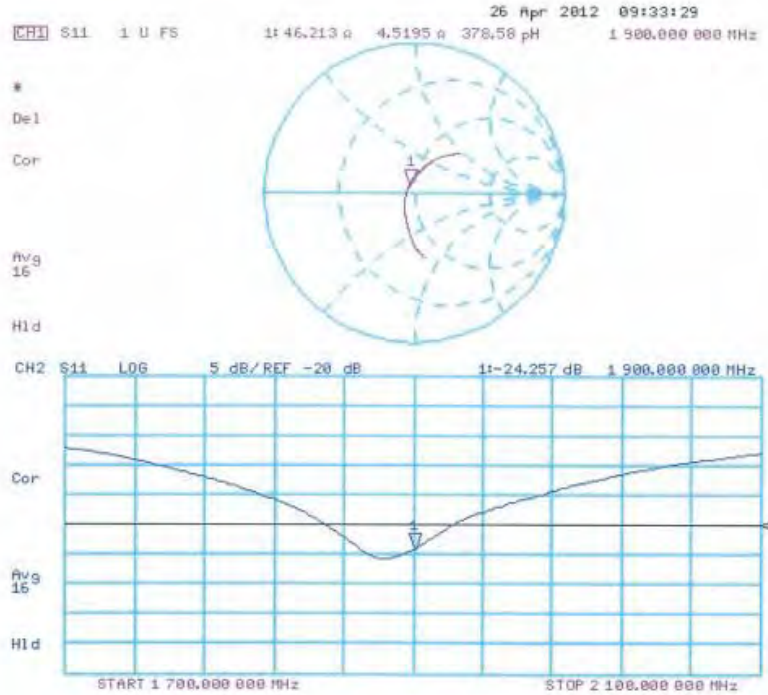


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Impedance Measurement Plot for Body TSL



- End of 1st part of report -

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