

# SAR TEST REPORT

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

**Equipment Under Test of Host** Juno T41/5  
**Marketing Name** RH42G  
**Brand Name** Trimble  
**Model No. of Host** JUNO/T41/5-BWCRF, JUNO/T41/5-BWCRFG,  
JUNO/T41/5-BWRF  
**Company Name** Trimble Navigation Limited  
**Company Address** 1 Merrill Street, Woburn, Massachusetts 01801 United States  
**Standards** IEEE/ANSI C95.1,C95.3,IEEE1528,KDB447498D01v06,  
KDB248227D01v02r02,KDB941225D01v03r01,KDB648  
474D04v01r03,KDB865664D01v01r04,  
KDB865664D02v01r02  
**FCC ID** QV5MERCURY6E-M  
**Date of Receipt** Apr. 08, 2013  
**Date of Test(s)** Jun. 02, 2013 ~ Nov. 19, 2015  
**Date of Issue** Dec. 03, 2015

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

## Remarks:

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

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## Signed on behalf of SGS

**Sr. Engineer**

John Teh

**John Yeh**

**Date: Dec. 03, 2015**

**Supervisor**

Ricky Huang

**Ricky Huang**

**Date: Dec. 03, 2015**

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## Version

Report Number	Revision	Date	Memo
ES/2013/B0001-02	00	2015/11/26	Initial creation of test report.
ES/2013/B0001-02	01	2015/12/03	1 <sup>st</sup> modification

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

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# 1. General Information

## 1.1 Testing Laboratory

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Wuku District, New Taipei City, Taiwan	
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Internet	<a href="http://www.tw.sgs.com/">http://www.tw.sgs.com/</a>

## 1.2 Details of Applicant

Company Name	Trimble Navigation Limited
Company Address	1 Merrill Street, Woburn, Massachusetts 01801 United States

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### 1.3 Description of EUT

EUT Name of Host	Juno T41/5	
Marketing Name	RH42G	
Brand Name	Trimble	
Model No. of Host	JUNO/T41/5-BWCRF, JUNO/T41/5-BWCRFG, JUNO/T41/5-BWRF	
Model Difference	JUNO/T41/5-BWCRF is 2-4M GPS, JUNO/T41/5-BWCRFG is 1M GPS, JUNO/T41/5-BWRF without WWAN function	
FCC ID	QV5MERCURY6E-M	
Mode of Operation	<input checked="" type="checkbox"/> GSM <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) <input checked="" type="checkbox"/> Bluetooth <input checked="" type="checkbox"/> RFID	
Duty Cycle	GSM	1/8.3
	GPRS (support multi class 12 max)	1/2 (1Dn4UP) 1/2.76 (1Dn3UP) 1/4.1 (1Dn2UP) 1/8.3 (1Dn1UP)
	EDGE (support multi class 12 max)	1/2 (1Dn4UP) 1/2.76 (1Dn3UP) 1/4.1 (1Dn2UP) 1/8.3 (1Dn1UP)
	WCDMA	1
	WLAN 802.11 b/g/n(20M)	1
	Bluetooth	1
	RFID	1

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TX Frequency Range (MHz)	GSM850	824.2	—	848.8
	GSM1900	1850.2	—	1909.8
	WCDMA Band II	1852.4	—	1907.6
	WCDMA Band V	826.4	—	846.6
	WLAN 802.11 b/g/n(20M)	2412	—	2462
	Bluetooth	2402	—	2480
	RFID	917.5	—	922.5
Channel Number (ARFCN)	GSM850	128	—	251
	GSM1900	512	—	810
	WCDMA Band II	9262	—	9538
	WCDMA Band V	4132	—	4233
	WLAN 802.11 b/g/n(20M)	1	—	11
	Bluetooth	0	—	78
	RFID	Low	—	High
Max. SAR (1 g) (Unit: W/Kg)				
Mode	Band	Measured	Reported	Position / Channel
Head	GSM 850	0.427	0.437	<input type="checkbox"/> Left <input checked="" type="checkbox"/> Right <input checked="" type="checkbox"/> Cheek <input type="checkbox"/> Tilt 251 Channel
	GSM 1900	0.417	0.617	<input type="checkbox"/> Left <input checked="" type="checkbox"/> Right <input checked="" type="checkbox"/> Cheek <input type="checkbox"/> Tilt 810 Channel
	WCDMA Band II	0.78	1.064	<input type="checkbox"/> Left <input checked="" type="checkbox"/> Right <input checked="" type="checkbox"/> Cheek <input type="checkbox"/> Tilt 9538 Channel
	WCDMA Band V	0.528	0.530	<input checked="" type="checkbox"/> Left <input type="checkbox"/> Right <input checked="" type="checkbox"/> Cheek <input type="checkbox"/> Tilt 4183 Channel

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Max. SAR (1 g) (Unit: W/Kg)				
Mode	Band	Measured	Reported	Position / Channel
Body worn	GPRS 850 1Dn1UP	0.613	0.627	<input type="checkbox"/> Front <input checked="" type="checkbox"/> Back 190 Channel
	GPRS 1900 1Dn1UP	0.237	0.254	<input type="checkbox"/> Front <input checked="" type="checkbox"/> Back 512 Channel
	WCDMA Band II	0.605	0.744	<input type="checkbox"/> Front <input checked="" type="checkbox"/> Back 9262 Channel
	WCDMA Band V	0.743	0.746	<input type="checkbox"/> Front <input checked="" type="checkbox"/> Back 4183 Channel
	WLAN802.11 b	0.028	0.034	<input type="checkbox"/> Front <input checked="" type="checkbox"/> Back 1 Channel -with Memory card
	RFID	0.00197	0.0022	<input checked="" type="checkbox"/> Front <input type="checkbox"/> Back Low Channel

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# #. GSM/GPRS/EDGE conducted power table:

EUT mode	Frequency (MHz)	CH	Max. Rated Avg. Power + Max. Tolerance (dBm)	Burst average power	Source-based time average power
				Avg.(dBm)	Avg.(dBm)
GSM 850 (GMSK)	824.2	128	33	32.80	23.77
	836.6	190	33	32.90	23.87
	848.8	251	33	32.90	23.87
The division factor compared to the number of TX time slot					
Division factor				1 TX time slot	
				-9.03	

Burst average power						
Max. Rated Avg. Power + Max. Tolerance (dBm)			33	30	28.5	27
			1Dn1UP	1Dn2UP	1Dn3UP	1Dn4UP
EUT mode	Frequency (MHz)	CH	Avg. (dBm)	Avg. (dBm)	Avg. (dBm)	Avg. (dBm)
GPRS 850 (GMSK)	824.2	128	32.80	29.80	27.90	26.60
	836.6	190	32.90	29.80	27.90	26.60
	848.8	251	32.90	29.70	27.90	26.50
Source-based time average power						
GPRS 850 (GMSK)	824.2	128	23.77	23.78	23.64	23.59
	836.6	190	23.87	23.78	23.64	23.59
	848.8	251	23.87	23.68	23.64	23.49
The division factor compared to the number of TX time slot						
Division factor			1 TX time slot	2 TX time slot	3 TX time slot	4 TX time slot
			-9.03	-6.02	-4.26	-3.01

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Burst average power						
Max. Rated Avg. Power + Max. Tolerance (dBm)			27	24	22.5	21
			1Dn1UP	1Dn2UP	1Dn3UP	1Dn4UP
EUT mode	Frequency (MHz)	CH	Avg. (dBm)	Avg. (dBm)	Avg. (dBm)	Avg. (dBm)
EDGE 850 (MCS 5)	824.2	128	27.00	24.00	22.10	21.00
	836.6	190	27.00	23.90	22.00	20.90
	848.8	251	27.00	23.90	22.00	20.90
Source-based time average power						
EDGE 850 (MCS 5)	824.2	128	17.97	17.98	17.84	17.99
	836.6	190	17.97	17.88	17.74	17.89
	848.8	251	17.97	17.88	17.74	17.89
The division factor compared to the number of TX time slot						
Division factor			1 TX time slot	2 TX time slot	3 TX time slot	4 TX time slot
			-9.03	-6.02	-4.26	-3.01

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EUT mode	Frequency (MHz)	CH	Max. Rated Avg. Power + Max. Tolerance (dBm)	Burst average power	Source-based time average power
				Avg.(dBm)	Avg.(dBm)
GSM 1900 (GMSK)	1850.2	512	29.5	29.20	20.17
	1880	661	29.5	28.40	19.37
	1909.8	810	29.5	27.80	18.77
The division factor compared to the number of TX time slot					
Division factor				1 TX time slot	
				-9.03	

Burst average power						
Max. Rated Avg. Power + Max. Tolerance (dBm)			29.5	26	24	22
			1Dn1UP	1Dn2UP	1Dn3UP	1Dn4UP
EUT mode	Frequency (MHz)	CH	Avg. (dBm)	Avg. (dBm)	Avg. (dBm)	Avg. (dBm)
GPRS 1900 (GMSK)	1850.2	512	29.20	25.70	23.50	22.00
	1880	661	28.40	24.80	22.70	21.20
	1909.8	810	27.80	24.30	22.10	20.80
Source-based time average power						
GPRS 1900 (GMSK)	1850.2	512	20.17	19.68	19.24	18.99
	1880	661	19.37	18.78	18.44	18.19
	1909.8	810	18.77	18.28	17.84	17.79
The division factor compared to the number of TX time slot						
Division factor			1 TX time slot	2 TX time slot	3 TX time slot	4 TX time slot
			-9.03	-6.02	-4.26	-3.01

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Burst average power						
Max. Rated Avg. Power + Max. Tolerance (dBm)			25	22	20	19
			1Dn1UP	1Dn2UP	1Dn3UP	1Dn4UP
EUT mode	Frequency (MHz)	CH	Avg. (dBm)	Avg. (dBm)	Avg. (dBm)	Avg. (dBm)
EDGE 1900 (MCS 5)	1850.2	512	24.60	21.50	19.90	18.70
	1880	661	23.80	20.70	19.00	17.60
	1909.8	810	23.20	20.00	18.50	17.10
Source-based time average power						
EDGE 1900 (MCS 5)	1850.2	512	15.57	15.48	15.64	15.69
	1880	661	14.77	14.68	14.74	14.59
	1909.8	810	14.17	13.98	14.24	14.09
The division factor compared to the number of TX time slot						
Division factor			1 TX time slot	2 TX time slot	3 TX time slot	4 TX time slot
			-9.03	-6.02	-4.26	-3.01

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

Band	CH	Max. Rated Avg. Power + Max. Tolerance (dBm)	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 II	9262	24	23.10	23.27	22.98	22.79	22.86	23.02	21.07	22.08	21.2	22.91
	9400	24	23.02	22.91	22.88	22.46	22.47	23.00	21.07	22.02	21.12	22.86
	9538	24	22.65	22.51	22.50	21.98	22.1	22.59	20.63	21.67	20.67	22.5
WCDMA Band V	4132	24	23.94	23.73	23.87	23.27	23.32	23.90	21.96	22.94	22.01	23.76
	4183	24	23.98	23.84	23.87	23.36	23.4	23.91	21.99	22.97	22.05	23.74
	4233	24	23.88	24.00	23.75	23.51	23.57	23.80	21.84	22.88	21.92	23.69

## HSDPA

SUB-TEST	$\beta_c$	$\beta_d$	$\beta_d$ (SF)	$\beta_c/\beta_d$	$\beta_{HS}$ (Note 1, Note 2)	CM (dB) (Note 3)	MPR (dB) (Note 3)
1	2/15	15/15	64	2/15	4/15	0.0	0.0
2	12/15	15/15	64	12/15	24/15	1.0	0.0
3	15/15	8/15	64	15/8	30/15	1.5	0.5
4	15/15	4/15	64	15/4	30/15	1.5	0.5

## HSUPA

SUB-TEST	$\beta_c$	$\beta_d$	$\beta_d$ (SF)	$\beta_c/\beta_d$	$\beta_{HS}$ (Note 1)	$\beta_{ec}$	$\beta_{ed}$ (Note 5) (Note 6)	$\beta_{ed}$ (SF)	$\beta_{ed}$ (Codes)	CM (dB) (Note 2)	MPR (dB) (Note 2)	AG Index (Note 6)	E-TFCI
1	11/15	15/15	64	11/15	22/15	209/225	1309/225	4	1	1.0	0.0	20	75
2	6/15	15/15	64	6/15	12/15	12/15	94/75	4	1	3.0	2.0	12	67
3	15/15	9/15	64	15/9	30/15	30/15	$\beta_{ed1}$ : 47/15 $\beta_{ed2}$ : 47/15	4 4	2	2.0	1.0	15	92
4	2/15	15/15	64	2/15	4/15	2/15	56/75	4	1	3.0	2.0	17	71
5	15/15	15/15	64	15/15	30/15	24/15	134/15	4	1	1.0	0.0	21	81

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

WLAN802.11 b		Max. Rated Avg. Power + Max. Tolerance (dBm)	Average Power Output (dBm)			
CH	Frequency (MHz)		Data Rate (Mbps)			
			1	2	5.5	11
1	2412	16	15.15	15.13	15.11	15.09
6	2437	16	14.92	14.90	14.88	14.85
11	2462	16	14.54	14.53	14.52	14.51

WLAN802.11 g		Max. Rated Avg. Power + Max. Tolerance (dBm)	Average Power Output (dBm)							
CH	Frequency (MHz)		Data Rate (Mbps)							
			6	9	12	18	24	36	48	54
1	2412	13	12.987	12.747	12.487	12.227	11.967	11.707	11.447	11.197
6	2437	13	12.767	12.507	12.247	11.987	11.727	11.467	11.207	10.967
11	2462	13	12.467	12.227	11.987	11.747	11.507	11.267	11.027	10.797

WLAN802.11 n (20M)		Max. Rated Avg. Power + Max. Tolerance (dBm)	Average Power Output (dBm)							
CH	Frequency (MHz)		Data Rate (Mbps)							
			6.5	13	19.5	26	39	52	58.5	65
1	2412	14	13.551	13.221	12.891	12.561	12.231	11.901	11.571	11.221
6	2437	14	13.391	13.031	12.671	12.311	11.951	11.591	11.231	10.901
11	2462	14	13.001	12.671	12.341	12.011	11.681	11.351	11.021	10.701

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### #. Bluetooth conducted power table:

Frequency (MHz)	Peak Power (dBm)		
	GFSK	$\pi/4$ DQPSK	8DPSK
2402	4.04	4.42	4.47
2441	4.2	4.6	4.63
2480	4.82	4.98	5.13

### #. RFID conducted power table:

Frequency (MHz)	Max. Rated Avg. Power + Max. Tolerance (dBm)	Average Power (dBm)
902.75	28.5	28.09
915.25	28.5	28.06
927.25	28.5	28.07

## 1.4 Test Environment

Ambient Temperature: 22±2° C

Tissue Simulating Liquid: 22±2° C

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## 1.5 Operation Description

### General:

1. 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.
2. Measurements are performed respectively on the lowest, middle and highest channels of the operating band(s). The EUT is set to maximum power level during all tests, and at the beginning of each test the battery is fully charged.
3. During the SAR testing, the DASY 5 system checks power drift by comparing the e-field strength of one specific location measured at the beginning with that measured at the end of the SAR testing.
4. Testing Head SAR at lowest, middle and highest channel for all bands with LET/LEC/RET/REC conditions.
5. Testing body-worn SAR by separating the EUT and the phantom 10mm.
6. The SAR test of GPRS was performed on the maximum sourced-based time-averaged power.
7. The SAR measurement is not required for HSDPA/HSPA since its maximum output power is less than ¼ dB higher than RMC without HSDPA/HSPA.

### 802.11b DSSS SAR Test Requirements:

8. SAR is measured for 2.4 GHz 802.11b DSSS mode using the highest measured maximum output power channel, when the reported SAR of the highest measured maximum output power channel for the exposure configuration is  $\leq 0.8$  W/kg, no further SAR testing is required for 802.11b DSSS in that exposure configuration.
9. When the reported SAR is  $> 0.8$  W/kg, SAR is required for that exposure configuration using the next highest measured output power channel. When any reported SAR is  $> 1.2$  W/kg, SAR is required for the third channel; i.e., all channels require testing.

### 802.11g/n OFDM SAR Test Exclusion Requirements:

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

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adjusted SAR is  $\leq 1.2$  W/kg.

11. According to **KDB447498D01v06** – The 1-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances  $\leq 50$  mm are determined by: [(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] ·  $[\sqrt{f(\text{GHz})}] \leq 3.0$  for 1-g SAR, SAR evaluation is not required.

Mode	Maximum power (dBm)	Maximum power (mW)	body-worn exposure		
			min. test separation distance (mm)	Exclusion threshold	Require SAR testing?
BT	5.13	3.258	10	0.513	NO

12. For head exposure, the highest SAR configuration is repeated with external Memory card inside.
13. For body exposure, the highest SAR configuration is repeated with external Memory card inside.
14. According to KDB447498D01v05r02, testing of other required channels is not required when the reported 1-g SAR for the highest output channel is  $\leq 0.8$  W/kg, when the transmission band is  $\leq 100$  MHz.
15. According to KDB865664D01v01r04, SAR measurement variability must be assessed for each frequency band. When the original highest measured SAR is  $\geq 0.8$  W/kg, repeated that measurement once. Perform a second repeated measurement only if the ratio of largest to smallest SAR for the original and first repeated measurements is  $> 1.20$  or when the original or repeated measurement is  $\geq 1.45$  W/kg (~ 10% from the 1-g SAR limit)

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## 1.6 The SAR Measurement System

A block diagram of the SAR measurement System is given in Fig. a. This SAR Measurement System uses a Computer-controlled 3-D stepper motor system (SPEAG DASY 5 professional system). A Model ES3DV4/EX3DV4 field probe is used to determine the internal electric fields. The SAR can be obtained from the equation  $SAR = \sigma (|E_i|^2) / \rho$  where  $\sigma$  and  $\rho$  are the conductivity and mass density of the tissue-simulant.

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

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

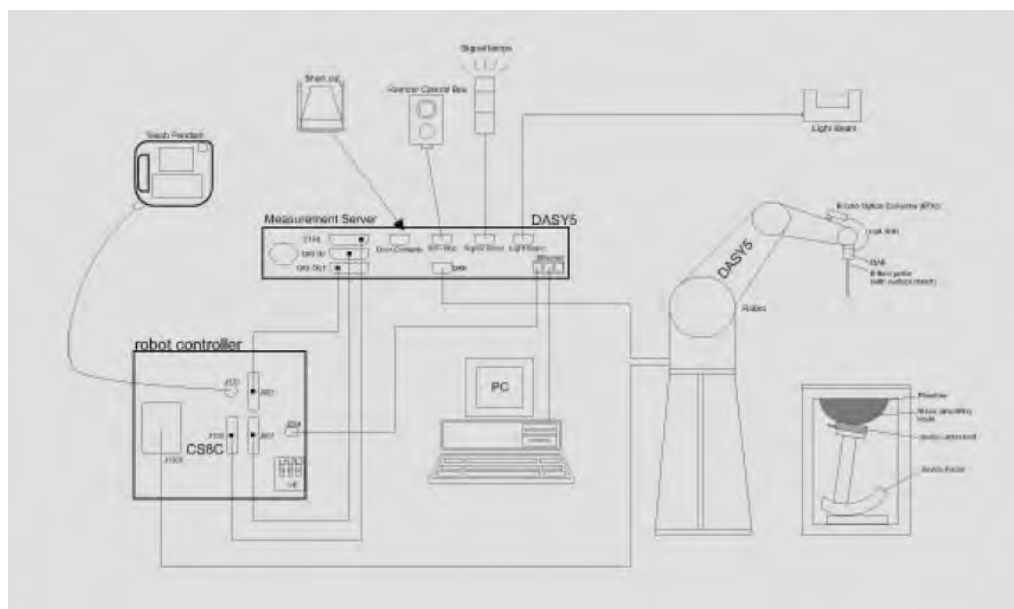


Fig. a The block diagram of SAR system

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

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## 1.7 System Components

### ES3DV3 / EX3DV4 E-Field Probe

Construction	Symmetrical design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)	
Calibration	Basic Broad Band Calibration in air Conversion Factors (CF) for HSL 835/900/1900/2450 MHz Additional CF for other liquids and frequencies upon request	
Frequency	10 MHz to > 6 GHz	
Directivity	± 0.3 dB in HSL (rotation around probe axis) ± 0.5 dB in tissue matrrial (rotation normal to probe axis)	
Dynamic Range	10 µW/g to > 100 mW/g Linearity: ± 0.2 dB (noise: typically < 1 µW/g)	
Dimensions	Tip diameter: 2.5 mm	
Application	High precision dosimetric measurements in any exposure scenario (e.g., very strong gradient fields). Only probe which enables compliance testing for frequencies up to 6 GHz with precision of better 30%.	

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## SAM PHANTOM V4.0C

Construction	<p>The shell corresponds to the specifications of the Specific Anthropomorphic Mannequin (SAM) phantom defined in IEEE 1528 and IEC 62209.</p> <p>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.</p>	
Shell Thickness	2 ± 0.2 mm	
Filling Volume	Approx. 25 liters	
Dimensions	Height: 210 mm; Length: 1000 mm; Width: 500 mm	

## DEVICE HOLDER

Construction	<p>In combination with the Twin SAM Phantom V4.0/V4.0C or Twin SAM, the Mounting Device (made from POM) enables the rotation of the mounted transmitter in spherical coordinates, whereby the rotation point is the ear opening. The devices can be easily and accurately positioned according to IEC, IEEE, CENELEC, FCC or other specifications. The device holder can be locked at different phantom locations (left head, right head, flat phantom).</p>	 <p>Device Holder</p>
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## 1.8 SAR System Verification

The microwave circuit arrangement for system verification is sketched in Fig. b. The daily system accuracy verification occurs within the flat section of the SAM phantom. A SAR measurement was performed to see if the measured SAR was within  $\pm 10\%$  from the target SAR values. These tests were done at 835/900/1900/2450 MHz. The tests were conducted on the same days as the measurement of the DUT. The obtained results from the system accuracy verification are displayed in the table 1 (SAR values are normalized to 1W forward power delivered to the dipole). During the tests, the ambient temperature of the laboratory was  $21.7^{\circ}\text{C}$ , 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.

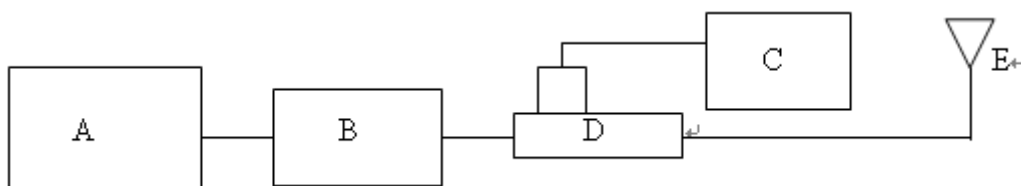


Fig. b The block diagram of system verification

- 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)	Deviation (%)	Measured Date
D835V2	4d120	835	Head	2.31	2.39	-3.46%	Jun. 02, 2013
			Body	2.43	2.42	0.41%	
D900V2	178	900	Body	2.66	2.75	-3.38%	Nov. 04, 2015
D1900V2	5d027	1900	Head	9.71	9.94	-2.37%	Jun. 03, 2013
			Body	10.1	9.91	1.88%	
D2450V2	727	2450	Body	13.2	12.9	2.27%	Jun. 02, 2013
D2450V2	727	2450	Body	13.2	12.7	3.79%	Jun. 27, 2013

Table 1. Results of system validation

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## 1.9 Tissue Simulant Fluid for the Frequency Band

The dielectric properties for this body-simulant fluid were measured by using the Agilent Model 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 at least 15cm during all tests. (Fig. 2)

Measured Frequency (MHz)	Tissue Type	Target Dielectric Constant, $\epsilon_r$	Target Conductivity, $\sigma$ (S/m)	Measured Dielectric Constant, $\epsilon_r$	Measured Conductivity, $\sigma$ (S/m)	% dev $\epsilon_r$	% dev $\sigma$	Measurement Date
824.2	Head	41.556	0.899	42.322	0.911	-1.84%	-1.32%	Jun. 02, 2013
826.4		41.545	0.899	42.314	0.915	-1.85%	-1.74%	
835		41.5	0.9	42.159	0.919	-1.59%	-2.11%	
836.6		41.500	0.902	42.134	0.924	-1.53%	-2.47%	
846.6		41.500	0.912	41.899	0.929	-0.96%	-1.81%	
848.8		41.500	0.915	41.879	0.944	-0.91%	-3.19%	
835	Body	55.2	0.97	55.856	0.958	-1.19%	1.24%	Jun. 02, 2013
836.6		55.195	0.972	55.849	0.963	-1.18%	0.92%	
900	Body	55	1.05	54.683	1.071	0.58%	-2.00%	Nov. 19, 2015
927		54.978	1.065	54.225	1.095	1.37%	-2.82%	Nov. 04, 2015
1850.2	Head	40.000	1.400	40.56	1.376	-1.40%	1.71%	Jun. 03, 2013
1852.4		40.000	1.400	40.517	1.382	-1.29%	1.29%	
1880		40.000	1.400	40.469	1.409	-1.17%	-0.64%	
1900		40.000	1.400	40.453	1.429	-1.13%	-2.07%	
1907.6		40.000	1.400	40.445	1.439	-1.11%	-2.79%	
1909.8		40.000	1.400	40.431	1.449	-1.08%	-3.50%	
1850.2	Body	53.300	1.520	53.374	1.515	-0.14%	0.33%	Jun. 02, 2013
1852.4		53.300	1.520	53.358	1.523	-0.11%	-0.20%	
1900		53.300	1.520	53.041	1.57	0.49%	-3.29%	
2412	Body	52.751	1.914	51.083	1.989	3.16%	-3.94%	Jun. 02, 2013
2450		52.7	1.95	50.89	2.035	3.43%	-4.36%	

Table 2. Dielectric Parameters of Tissue Simulant Fluid

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The composition of the brain tissue simulating liquid:

Frequency (MHz)	Mode	Ingredient						Total amount
		DGMBE	Water	Salt	Preventol D-7	Cellulose	Sugar	
850	Head	—	532.98 g	18.3 g	2.4 g	3.2 g	766 g	1.0L(Kg)
	Body	—	631.68 g	11.72 g	1.2 g	—	600 g	1.0L(Kg)
900	Body	—	631.68 g	11.72 g	1.2 g	—	600 g	1.0L(Kg)
1900	Head	444.52 g	552.42 g	3.06 g	—	—	—	1.0L(Kg)
	Body	300.67 g	716.56 g	4.0 g	—	—	—	1.0L(Kg)
2450	Body	301.7ml	698.3ml	—	—	—	—	1.0L(Kg)

Table 3. Recipes for Tissue Simulating Liquid

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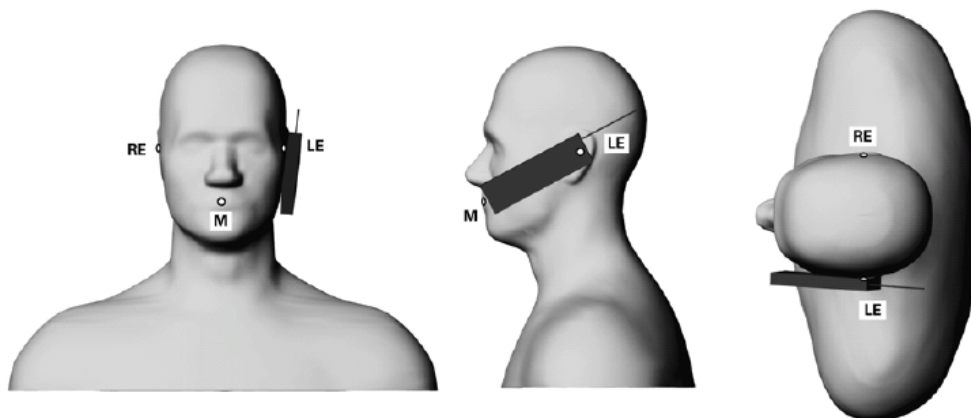
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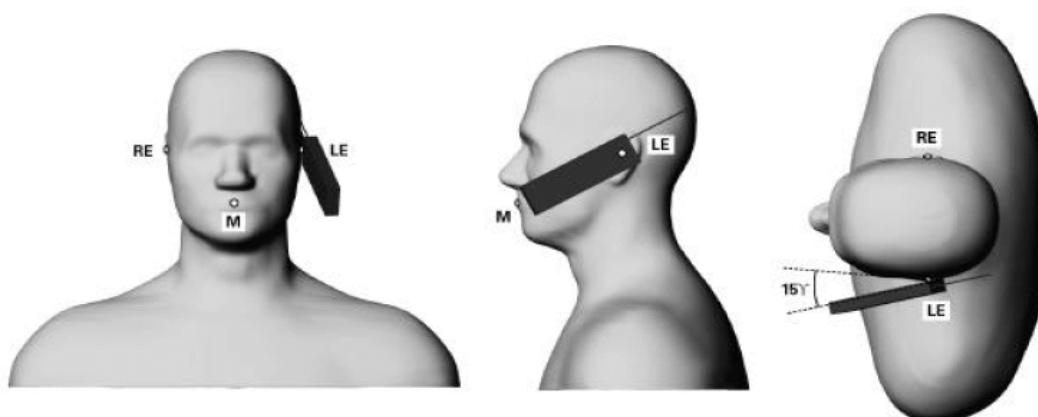
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## 1.10 Positioning Procedure



Phone position 1, "cheek" or "touch" position. The reference points for the right ear (RE), left ear (LE) and mouth (M), which define the reference plane for phone positioning.



Phone position 2, "tilted position." The reference points for the right ear (RE), left ear (LE) and mouth (M), which define the reference plane for phone positioning.

Cheek/Touch Position:

The handset was brought toward the mouth of the head phantom by pivoting against the ear reference point until any point of the mouthpiece or keypad touched the phantom.

Ear/Tilt Position:

With the phone aligned in the Cheek/Touch position, the handset was tilted away from the mouth with respect to the test device reference point by 15 degrees.

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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.

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

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

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  $\sigma$  is the conductivity,  $\rho$  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

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the liquid. With a careful setup these errors can be kept small.

- 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  $\rho$ ), there is no standard for the measurement of the conductivity. Depending on the method and liquid, the error can well exceed  $\pm 5\%$ .
- Temperature rise measurements are not very sensitive and therefore are often performed at a higher power level than the E-field measurements. The nonlinearities in the system (e.g., power measurements, different components, etc.) must be considered.

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

### 1.12.2 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:

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

## References

- [1] N. Kuster, Q. Balzano, and J.C. Lin, Eds., *Mobile Communications Safety*, Chapman & Hall, London, 1997.
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- [3] K. Jokela, P. Hyysalo, and L. Puranen, "Calibration of specific absorption rate (SAR) probes in waveguide at 900 MHz", *IEEE Transactions on Instrumentation and Measurements*, vol. 47, no. 2, pp. 432-438, Apr. 1998.

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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

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

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

### GSM 850 MHz

Mode	Position	Distance (mm)	CH	Freq. (MHz)	Max. Rated Avg. Power + Max. Tolerance (dBm)	Measured Avg. Power (dBm)	Scaling	Averaged SAR over 1g (W/kg)		Plot page
								Measured	Reported	
GSM (Head)	Re Cheek	-	128	824.2	33	32.8	4.71%	0.353	0.370	43
	Re Cheek	-	190	836.6	33	32.9	2.33%	0.378	0.387	44
	Re Cheek	-	251	848.8	33	32.9	2.33%	0.427	0.437	45
	Le Cheek	-	190	836.6	33	32.9	2.33%	0.335	0.343	46
	Re Tilt	-	190	836.6	33	32.9	2.33%	0.194	0.199	47
	Le Tilt	-	190	836.6	33	32.9	2.33%	0.165	0.169	48
GPRS (Body worn) (1Dn1UP)	Back side	10	190	836.6	33	32.9	2.33%	0.613	0.627	49

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## GSM 1900 MHz

Mode	Position	Distance (mm)	CH	Freq. (MHz)	Max. Rated Avg. Power + Max. Tolerance (dBm)	Measured Avg. Power (dBm)	Scaling	Averaged SAR over 1g (W/kg)		Plot page
								Measured	Reported	
GSM (Head)	Re Cheek	-	512	1850.2	29.5	29.2	7.15%	0.367	0.393	50
	Re Cheek	-	661	1880	29.5	28.4	28.82%	0.422	0.544	51
	Re Cheek	-	810	1909.8	29.5	27.8	47.91%	0.417	0.617	52
	Le Cheek	-	512	1850.2	29.5	29.2	7.15%	0.198	0.212	53
	Re Tilt	-	512	1850.2	29.5	29.2	7.15%	0.072	0.077	54
	Le Tilt	-	512	1850.2	29.5	29.2	7.15%	0.096	0.103	55
GPRS (Body worn) (1Dn1UP)	Back side	10	512	1850.2	29.5	29.2	7.15%	0.237	0.254	56

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## WCDMA Band II

Mode	Position	Distance (mm)	CH	Freq. (MHz)	Max. Rated Avg. Power + Max. Tolerance (dBm)	Measured Avg. Power (dBm)	Scaling	Averaged SAR over 1g (W/kg)		Plot page
								Measured	Reported	
R99 (Head)	Re Cheek	-	9262	1852.4	24	23.10	23.03%	0.761	0.936	57
	Re Cheek	-	9400	1880	24	23.20	20.23%	0.785	0.944	58
	Re Cheek	-	9538	1907.6	24	22.65	36.46%	0.77	1.051	60
	Re Cheek -with Memory card	-	9538	1907.6	24	22.65	36.46%	0.692	0.944	61
	Re Cheek*	-	9538	1907.6	24	22.65	36.46%	0.78	1.064	62
	Le Cheek	-	9262	1852.4	24	23.10	23.03%	0.417	0.513	63
	Re Tilt	-	9262	1852.4	24	23.10	23.03%	0.165	0.203	64
	Le Tilt	-	9262	1852.4	24	23.10	23.03%	0.213	0.262	65
Body worn	Back side	10	9262	1852.4	24	23.10	23.03%	0.605	0.744	66

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

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## WCDMA Band V

Mode	Position	Distance (mm)	CH	Freq. (MHz)	Max. Rated Avg. Power + Max. Tolerance (dBm)	Measured Avg. Power (dBm)	Scaling	Averaged SAR over 1g (W/kg)		Plot page
								Measured	Reported	
R99 (Head)	Re Cheek	-	4183	836.6	24	23.98	0.46%	0.525	0.527	67
	Le Cheek	-	4132	826.4	24	23.94	1.39%	0.476	0.483	68
	Le Cheek	-	4183	836.6	24	23.98	0.46%	0.528	0.530	69
	Le Cheek	-	4233	846.6	24	23.88	2.80%	0.487	0.501	70
	Re Tilt	-	4183	836.6	24	23.98	0.46%	0.263	0.264	71
	Le Tilt	-	4183	836.6	24	23.98	0.46%	0.239	0.240	72
Body worn	Front side	10	4183	836.6	24	23.98	0.46%	0.564	0.567	73
	Back side	10	4183	836.6	24	23.98	0.46%	0.743	0.746	74
	Back side -with Memory card	10	4183	836.6	24	23.98	0.46%	0.73	0.733	76

## WLAN802.11 b

Mode	Position	Distance (mm)	CH	Freq. (MHz)	Max. Rated Avg. Power + Max. Tolerance (dBm)	Measured Avg. Power (dBm)	Scaling	Averaged SAR over 1g (W/kg)		Plot page
								Measured	Reported	
Body worn	Front side	10	1	2412	16	15.15	21.62%	0.013	0.016	77
	Back side	10	1	2412	16	15.15	21.62%	0.027	0.033	78
	Back side -with Memory card	10	1	2412	16	15.15	21.62%	0.028	0.034	79

## RFID

Mode	Position	Distance (mm)	CH	Freq. (MHz)	Max. Rated Avg. Power + Max. Tolerance (dBm)	Measured Avg. Power (dBm)	Scaling	Averaged SAR over 1g (W/kg)		Plot page
								Measured	Reported	
Body worn	Front side	10	Low	917.5	28.5	28.09	9.90%	0.00197	0.0022	80
	Back side	10	Low	917.5	28.5	28.06	10.66%	0.00168	0.0019	81

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### 3. Simultaneous Transmission Analysis

Simultaneous Transmit Configurations	Head	Body-Worn
WWAN + WLAN	No	Yes
WWAN + RFID	No	Yes
WWAN + BT	No	Yes
WLAN + RFID	No	Yes
WLAN + BT	No	Yes
RFID + BT	No	Yes
<b>WWAN + WLAN + RFID + BT</b>	No	Yes
Notes:		
1. WWAN: GSM850/1900, UMTS B2/5		

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### 3.1 Estimated SAR calculation

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

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

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

Mode	Frequency (MHz)	Maximum Power (dBm)	Separation Distance (Body) (mm)	Estimated SAR 1g (Body) (W/kg)
Bluetooth	2480	5.13	10	0.068

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### 3.2 SPLSR evaluation and analysis

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

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

The ratio is determined by  $(\text{SAR1} + \text{SAR2})^{1.5}/R_i$ , rounded to two decimal digits, and must be  $\leq 0.04$  for all antenna pairs in the configuration to qualify for 1-g SAR test exclusion.

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

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

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reported SAR WWAN and WLAN DTS 2.4GHz, SAR evaluation								
Frequency band	Position		reported SAR / W/kg		RFID	Bluetooth	ΣSAR	SPLSR (≤0.04)
			WWAN	WLAN			<1.6W/kg	
GPRS 850 (1Dn1UP)	Body worn	Front	-	0.016	0.00197	0.068	-	-
		Back	0.627	0.034	0.00168	0.068	0.731	-
GPRS 1900 (1Dn1UP)	Body worn	Front	-	0.016	0.00197	0.068	-	-
		Back	0.254	0.034	0.00168	0.068	0.358	-
WCDMA Band II	Body worn	Front	-	0.016	0.00197	0.068	-	-
		Back	0.744	0.034	0.00168	0.068	0.848	-
WCDMA Band V	Body worn	Front	0.567	0.016	0.00197	0.068	0.653	-
		Back	0.746	0.034	0.00168	0.068	0.850	-

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## 4. Instruments List

Manufacturer	Device	Type	Serial number	Date of last calibration	Date of next calibration
Schmid & Partner Engineering AG	Dosimetric E-Field Probe	ES3DV3	3172	Aug.28,2012	Aug.27,2013
		EX3DV4	3938	Oct.01,2015	Sep.30,2016
Schmid & Partner Engineering AG	System Validation Dipole	D835V2	4d120	Jun.13,2012	Jun.12,2013
		D900V2	178	Apr.28,2015	Apr.27,2016
		D1900V2	5d027	May.02,2013	May01,2014
		D2450V2	727	May.02,2013	May01,2014
Schmid & Partner Engineering AG	Data acquisition Electronics	DAE4	1260	May.03,2013	May02,2014
		DAE4	1260	Sep.24,2015	Sep.23,2016
Schmid & Partner Engineering AG	Software	DASY 52 V52.8	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	8753D	3410A05547	May07,2013	May.06,2014
Agilent	Dielectric Probe Kit	85070D	US01440168	Calibration not required	Calibration not required
Agilent	Dual-directional coupler	772D	50114	Aug.16,2012 Aug.22,2013	Aug.15,2013 Aug.21,2014
		778D	50313	Aug.16,2012 Aug.28,2013	Aug.15,2013 Aug.27,2014
Agilent	RF Signal Generator	N5181A	MY50144143	Jun.16,2012 Jun.26,2013	Jun.15,2013 Jun.25,2014
Agilent	Power Meter	E4417A	MY52240003	May07,2013	May06,2014
Agilent	Power Sensor	E9301H	MY52200003	May07,2013	May06,2014
R&S	Radio Communication Test	CMU200	113505	May14,2013	May.13,2014

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Manufacturer	Device	Type	Serial number	Date of last calibration	Date of next calibration
HP	Network Analyzer	8753D	3410A05547	May.21,2015	May.20,2016
Agilent	Dual-directional coupler	772D	MY52180142	Feb.11,2015	Feb.10,2016
		778D	MY52180302	Feb.05,2015	Feb.04,2016
Agilent	RF Signal Generator	N5181A	MY50144143	Jul.16,2015	Jul.15,2016
Agilent	Power Meter	E4417A	MY52240003	Jul.15,2015	Jul.14,2016
Agilent	Power Sensor	E9301H	MY52200003	Jul.15,2015	Jul.14,2016

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## 5. Measurements

Date: 2013/6/2

### Re Cheek\_CH128

Communication System: GSM; Communication System Band: GSM850; Frequency: 824.2 MHz; Medium parameters used (interpolated):  $f = 824.2$  MHz;  $\sigma = 0.911$  S/m;  $\epsilon_r = 42.322$ ;  $\rho = 1000$  kg/m<sup>3</sup>

DASY 5 Configuration:

- Probe: ES3DV3 - SN3172; ConvF(5.85, 5.85, 5.85); Calibrated: 2012/8/28;
- Sensor-Surface: 3.4mm (Mechanical Surface Detection),
- Electronics: DAE4 Sn1260; Calibrated: 2013/5/3
- Phantom: Head;
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

**Configuration/HEAD/Area Scan (71x151x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 0.380 W/kg

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

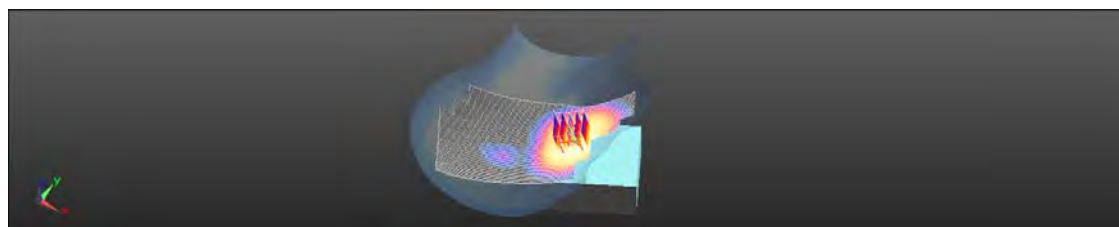
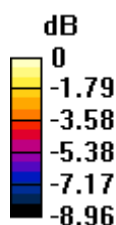
dx=8mm, dy=8mm, dz=5mm

Reference Value = 8.515 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 0.448 W/kg

**SAR(1 g) = 0.353 W/kg; SAR(10 g) = 0.272 W/kg**

Maximum value of SAR (measured) = 0.378 W/kg



0 dB = 0.378 W/kg = -4.22 dBW/kg

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Date: 2013/6/2

## Re Cheek\_CH190

Communication System: GSM; Communication System Band: GSM850; Frequency: 836.6 MHz; Medium parameters used:  $f = 837$  MHz;  $\sigma = 0.924$  S/m;  $\epsilon_r = 42.134$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
DASY 5 Configuration:

- Probe: ES3DV3 - SN3172; ConvF(5.85, 5.85, 5.85); Calibrated: 2012/8/28;
- Sensor-Surface: 3.4mm (Mechanical Surface Detection),
- Electronics: DAE4 Sn1260; Calibrated: 2013/5/3
- Phantom: Head;
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

**Configuration/HEAD/Area Scan (71x151x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm

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

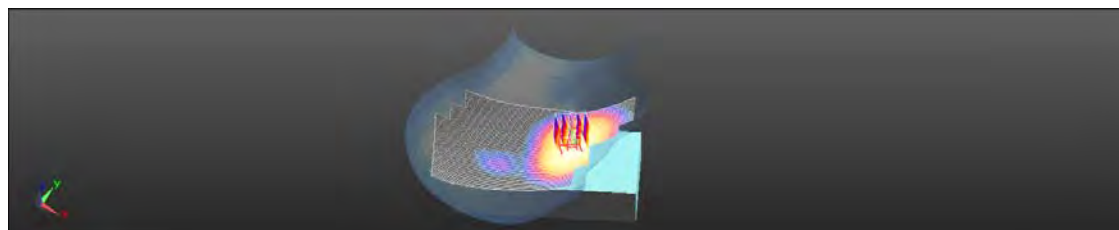
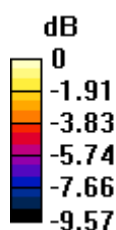
**Configuration/HEAD/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 8.178 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 0.488 W/kg

**SAR(1 g) = 0.378 W/kg; SAR(10 g) = 0.287 W/kg**

Maximum value of SAR (measured) = 0.405 W/kg



0 dB = 0.405 W/kg = -3.93 dBW/kg

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Date: 2013/6/2

## Re Cheek\_CH251

Communication System: GSM; Communication System Band: GSM850; Frequency: 848.8 MHz; Medium parameters used:  $f = 849$  MHz;  $\sigma = 0.944$  S/m;  $\epsilon_r = 41.879$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
DASY 5 Configuration:

- Probe: ES3DV3 - SN3172; ConvF(5.85, 5.85, 5.85); Calibrated: 2012/8/28;
- Sensor-Surface: 3.4mm (Mechanical Surface Detection),
- Electronics: DAE4 Sn1260; Calibrated: 2013/5/3
- Phantom: Head;
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

**Configuration/HEAD/Area Scan (71x151x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 0.459 W/kg

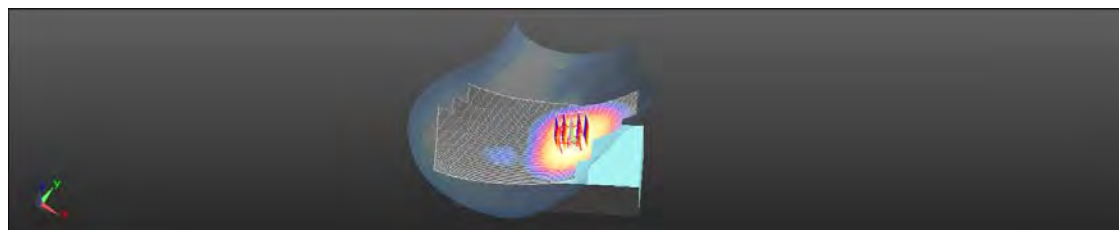
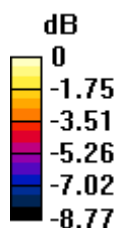
**Configuration/HEAD/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 8.723 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 0.544 W/kg

**SAR(1 g) = 0.427 W/kg; SAR(10 g) = 0.326 W/kg**

Maximum value of SAR (measured) = 0.460 W/kg



0 dB = 0.460 W/kg = -3.37 dBW/kg

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Date: 2013/6/2

## Le Cheek\_CH190

Communication System: GSM; Communication System Band: GSM850; Frequency: 836.6 MHz; Medium parameters used:  $f = 837$  MHz;  $\sigma = 0.924$  S/m;  $\epsilon_r = 42.134$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
DASY 5 Configuration:

- Probe: ES3DV3 - SN3172; ConvF(5.85, 5.85, 5.85); Calibrated: 2012/8/28;
- Sensor-Surface: 3.4mm (Mechanical Surface Detection),
- Electronics: DAE4 Sn1260; Calibrated: 2013/5/3
- Phantom: Head;
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

**Configuration/BODY/Area Scan (71x151x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 0.361 W/kg

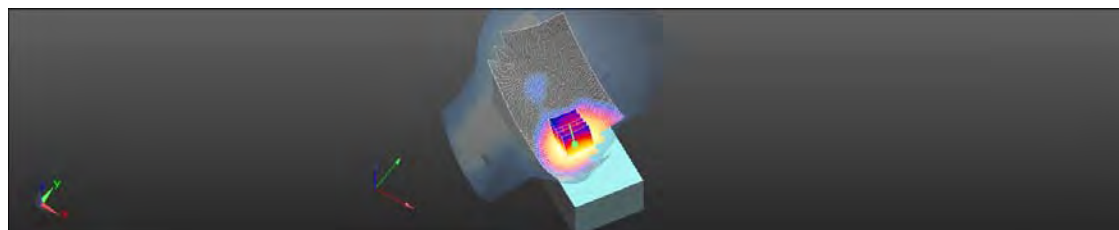
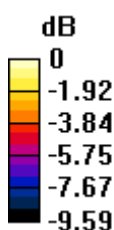
**Configuration/BODY/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 6.459 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 0.420 W/kg

**SAR(1 g) = 0.335 W/kg; SAR(10 g) = 0.255 W/kg**

Maximum value of SAR (measured) = 0.359 W/kg



0 dB = 0.359 W/kg = -4.45 dBW/kg

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Date: 2013/6/2

## Re Tilt\_CH190

Communication System: GSM; Communication System Band: GSM850; Frequency: 836.6 MHz; Medium parameters used:  $f = 837$  MHz;  $\sigma = 0.924$  S/m;  $\epsilon_r = 42.134$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
DASY 5 Configuration:

- Probe: ES3DV3 - SN3172; ConvF(5.85, 5.85, 5.85); Calibrated: 2012/8/28;
- Sensor-Surface: 3.4mm (Mechanical Surface Detection),
- Electronics: DAE4 Sn1260; Calibrated: 2013/5/3
- Phantom: Head;
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

**Configuration/HEAD/Area Scan (71x151x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 0.221 W/kg

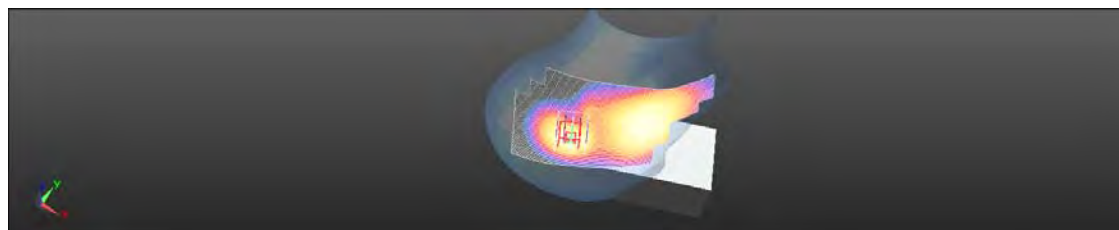
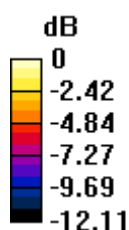
**Configuration/HEAD/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 11.527 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 0.306 W/kg

**SAR(1 g) = 0.194 W/kg; SAR(10 g) = 0.121 W/kg**

Maximum value of SAR (measured) = 0.224 W/kg



0 dB = 0.224 W/kg = -6.49 dBW/kg

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Date: 2013/6/2

## Le Tilt\_CH190

Communication System: GSM; Communication System Band: GSM850; Frequency: 836.6 MHz; Medium parameters used:  $f = 837$  MHz;  $\sigma = 0.924$  S/m;  $\epsilon_r = 42.134$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
DASY 5 Configuration:

- Probe: ES3DV3 - SN3172; ConvF(5.85, 5.85, 5.85); Calibrated: 2012/8/28;
- Sensor-Surface: 3.4mm (Mechanical Surface Detection),
- Electronics: DAE4 Sn1260; Calibrated: 2013/5/3
- Phantom: Head;
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

**Configuration/BODY/Area Scan (71x151x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 0.176 W/kg

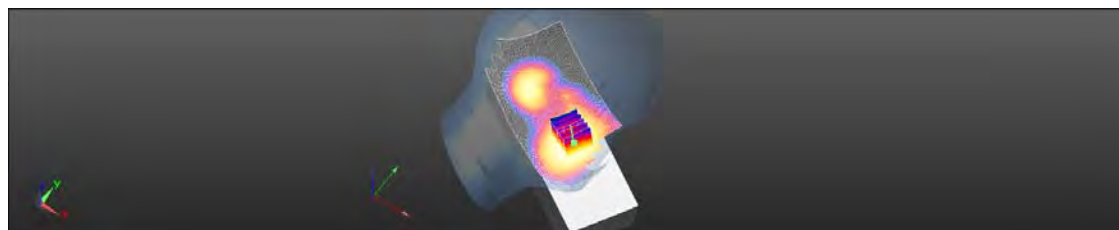
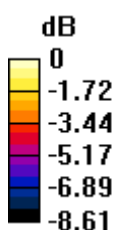
**Configuration/BODY/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 8.552 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 0.206 W/kg

**SAR(1 g) = 0.165 W/kg; SAR(10 g) = 0.128 W/kg**

Maximum value of SAR (measured) = 0.177 W/kg



0 dB = 0.177 W/kg = -7.52 dBW/kg

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## Back side\_CH190

Communication System: GPRS-8; Communication System Band: GPRS850; Frequency: 836.6 MHz; Medium parameters used:  $f = 837$  MHz;  $\sigma = 0.963$  S/m;  $\epsilon_r = 55.849$ ;  $\rho = 1000$  kg/m<sup>3</sup>

DASY 5 Configuration:

- Probe: ES3DV3 - SN3172; ConvF(5.81, 5.81, 5.81); Calibrated: 2012/8/28;
- Sensor-Surface: 3.4mm (Mechanical Surface Detection),
- Electronics: DAE4 Sn1260; Calibrated: 2013/5/3
- Phantom: Body;
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

**Configuration/Body/Area Scan (91x161x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 0.681 W/kg

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

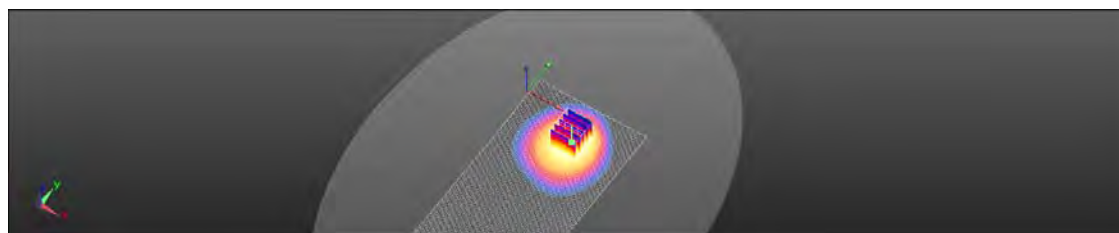
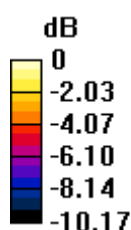
dx=8mm, dy=8mm, dz=5mm

Reference Value = 6.429 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 0.810 W/kg

**SAR(1 g) = 0.613 W/kg; SAR(10 g) = 0.445 W/kg**

Maximum value of SAR (measured) = 0.672 W/kg



0 dB = 0.672 W/kg = -1.72 dBW/kg

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## Re Cheek\_CH512

Communication System: GSM; Communication System Band: GSM1900; Frequency: 1850.2 MHz; Medium parameters used (interpolated):  $f = 1850.2$  MHz;  $\sigma = 1.376$  S/m;  $\epsilon_r = 40.56$ ;  $\rho = 1000$  kg/m<sup>3</sup>

DASY 5 Configuration:

- Probe: ES3DV3 - SN3172; ConvF(4.85, 4.85, 4.85); Calibrated: 2012/8/28;
- Sensor-Surface: 3.4mm (Mechanical Surface Detection),
- Electronics: DAE4 Sn1260; Calibrated: 2013/5/3
- Phantom: Head;
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

**Configuration/BODY/Area Scan (71x151x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 0.431 W/kg

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

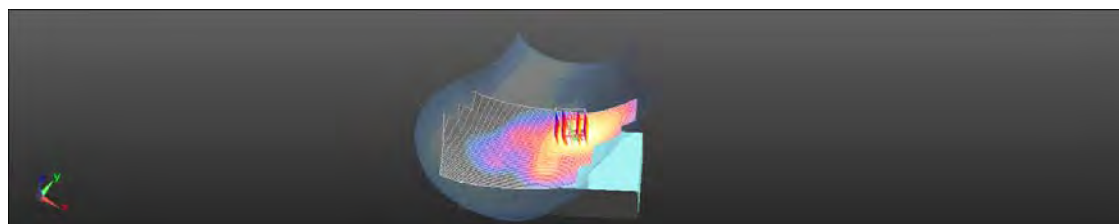
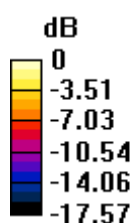
dx=8mm, dy=8mm, dz=5mm

Reference Value = 4.957 V/m; Power Drift = 0.11 dB

Peak SAR (extrapolated) = 0.549 W/kg

**SAR(1 g) = 0.367 W/kg; SAR(10 g) = 0.230 W/kg**

Maximum value of SAR (measured) = 0.411 W/kg



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

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## Re Cheek\_CH661

Communication System: GSM; Communication System Band: GSM1900; Frequency: 1880 MHz; Medium parameters used:  $f = 1880$  MHz;  $\sigma = 1.409$  S/m;  $\epsilon_r = 40.469$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
DASY 5 Configuration:

- Probe: ES3DV3 - SN3172; ConvF(4.85, 4.85, 4.85); Calibrated: 2012/8/28;
- Sensor-Surface: 3.4mm (Mechanical Surface Detection),
- Electronics: DAE4 Sn1260; Calibrated: 2013/5/3
- Phantom: Head;
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

**Configuration/BODY/Area Scan (71x151x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 0.499 W/kg

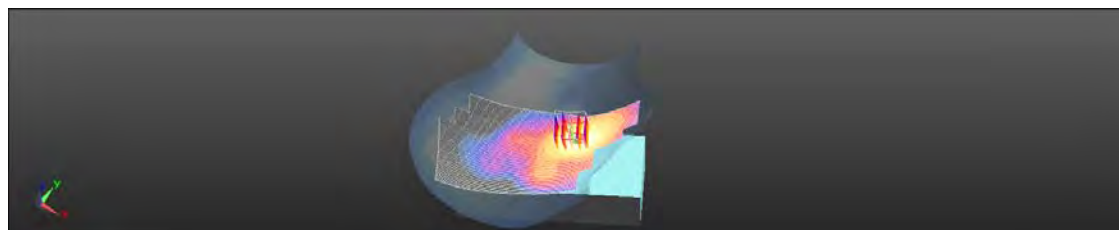
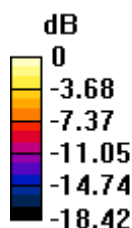
**Configuration/BODY/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 5.583 V/m; Power Drift = 0.09 dB

Peak SAR (extrapolated) = 0.638 W/kg

**SAR(1 g) = 0.422 W/kg; SAR(10 g) = 0.261 W/kg**

Maximum value of SAR (measured) = 0.479 W/kg



0 dB = 0.479 W/kg = -3.20 dBW/kg

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## Re Cheek\_CH810

Communication System: GSM; Communication System Band: GSM1900; Frequency: 1909.8 MHz; Medium parameters used:  $f = 1910$  MHz;  $\sigma = 1.449$  S/m;  $\epsilon_r = 40.431$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
DASY 5 Configuration:

- Probe: ES3DV3 - SN3172; ConvF(4.85, 4.85, 4.85); Calibrated: 2012/8/28;
- Sensor-Surface: 3.4mm (Mechanical Surface Detection),
- Electronics: DAE4 Sn1260; Calibrated: 2013/5/3
- Phantom: Head;
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

**Configuration/BODY/Area Scan (71x151x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 0.495 W/kg

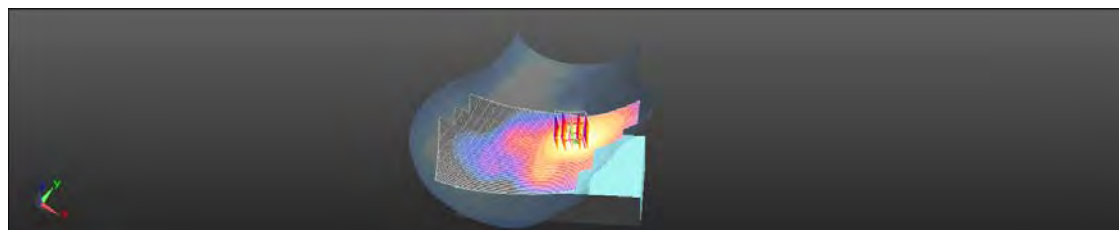
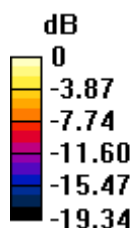
**Configuration/BODY/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 5.209 V/m; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 0.640 W/kg

**SAR(1 g) = 0.417 W/kg; SAR(10 g) = 0.255 W/kg**

Maximum value of SAR (measured) = 0.477 W/kg



0 dB = 0.477 W/kg = -3.21 dBW/kg

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## Le Cheek\_CH512

Communication System: GSM; Communication System Band: GSM1900; Frequency: 1850.2 MHz; Medium parameters used (interpolated):  $f = 1850.2$  MHz;  $\sigma = 1.376$  S/m;  $\epsilon_r = 40.56$ ;  $\rho = 1000$  kg/m<sup>3</sup>

DASY 5 Configuration:

- Probe: ES3DV3 - SN3172; ConvF(4.85, 4.85, 4.85); Calibrated: 2012/8/28;
- Sensor-Surface: 3.4mm (Mechanical Surface Detection),
- Electronics: DAE4 Sn1260; Calibrated: 2013/5/3
- Phantom: Head;
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

**Configuration/BODY/Area Scan (71x151x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 0.227 W/kg

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

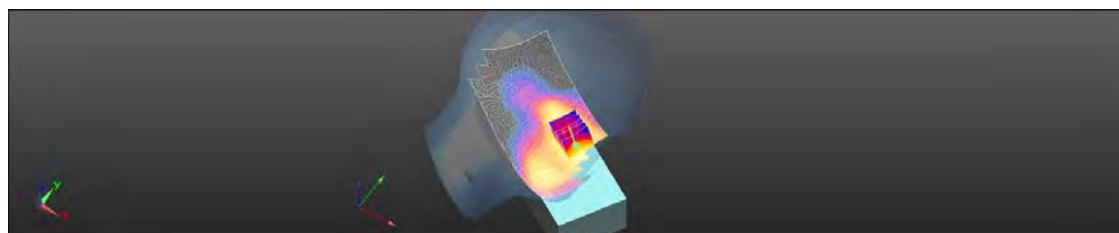
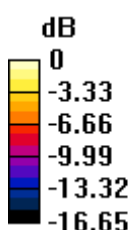
dx=8mm, dy=8mm, dz=5mm

Reference Value = 4.715 V/m; Power Drift = -0.15 dB

Peak SAR (extrapolated) = 0.298 W/kg

**SAR(1 g) = 0.198 W/kg; SAR(10 g) = 0.125 W/kg**

Maximum value of SAR (measured) = 0.224 W/kg



0 dB = 0.224 W/kg = -6.49 dBW/kg

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Date: 2013/6/3

## Re Tilt\_CH512

Communication System: GSM; Communication System Band: GSM1900; Frequency: 1850.2 MHz; Medium parameters used (interpolated):  $f = 1850.2$  MHz;  $\sigma = 1.376$  S/m;  $\epsilon_r = 40.56$ ;  $\rho = 1000$  kg/m<sup>3</sup>

DASY 5 Configuration:

- Probe: ES3DV3 - SN3172; ConvF(4.85, 4.85, 4.85); Calibrated: 2012/8/28;
- Sensor-Surface: 3.4mm (Mechanical Surface Detection),
- Electronics: DAE4 Sn1260; Calibrated: 2013/5/3
- Phantom: Head;
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

**Configuration/BODY/Area Scan (71x151x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm

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

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

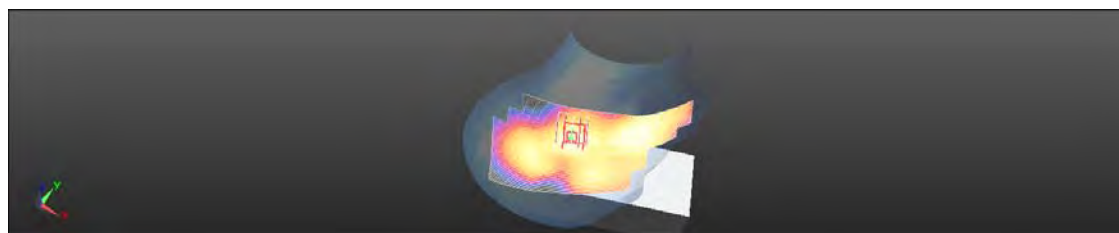
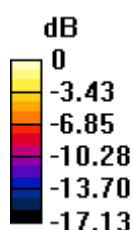
dx=8mm, dy=8mm, dz=5mm

Reference Value = 5.668 V/m; Power Drift = 0.19 dB

Peak SAR (extrapolated) = 0.109 W/kg

**SAR(1 g) = 0.072 W/kg; SAR(10 g) = 0.044 W/kg**

Maximum value of SAR (measured) = 0.0823 W/kg



0 dB = 0.0823 W/kg = -10.85 dBW/kg

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## Le Tilt\_CH512

Communication System: GSM; Communication System Band: GSM1900; Frequency: 1850.2 MHz; Medium parameters used (interpolated):  $f = 1850.2$  MHz;  $\sigma = 1.376$  S/m;  $\epsilon_r = 40.56$ ;  $\rho = 1000$  kg/m<sup>3</sup>

DASY 5 Configuration:

- Probe: ES3DV3 - SN3172; ConvF(4.85, 4.85, 4.85); Calibrated: 2012/8/28;
- Sensor-Surface: 3.4mm (Mechanical Surface Detection),
- Electronics: DAE4 Sn1260; Calibrated: 2013/5/3
- Phantom: Head;
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

**Configuration/BODY/Area Scan (71x151x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 0.112 W/kg

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

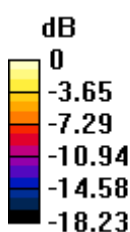
dx=8mm, dy=8mm, dz=5mm

Reference Value = 5.546 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 0.149 W/kg

**SAR(1 g) = 0.096 W/kg; SAR(10 g) = 0.059 W/kg**

Maximum value of SAR (measured) = 0.110 W/kg



0 dB = 0.110 W/kg = -9.59 dBW/kg

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## Back side\_CH512

Communication System: GPRS-8; Communication System Band: GPRS1900; Frequency: 1850.2 MHz; Medium parameters used (interpolated):  $f = 1850.2 \text{ MHz}$ ;  $\sigma = 1.515 \text{ S/m}$ ;  $\epsilon_r = 53.374$ ;  $\rho = 1000 \text{ kg/m}^3$

DASY 5 Configuration:

- Probe: ES3DV3 - SN3172; ConvF(4.44, 4.44, 4.44); Calibrated: 2012/8/28;
- Sensor-Surface: 3.4mm (Mechanical Surface Detection),
- Electronics: DAE4 Sn1260; Calibrated: 2013/5/3
- Phantom: Body;
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

**Configuration/Body/Area Scan (91x161x1):** Interpolated grid:  $dx=1.500 \text{ mm}$ ,  $dy=1.500 \text{ mm}$

Maximum value of SAR (interpolated) = 0.317 W/kg

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

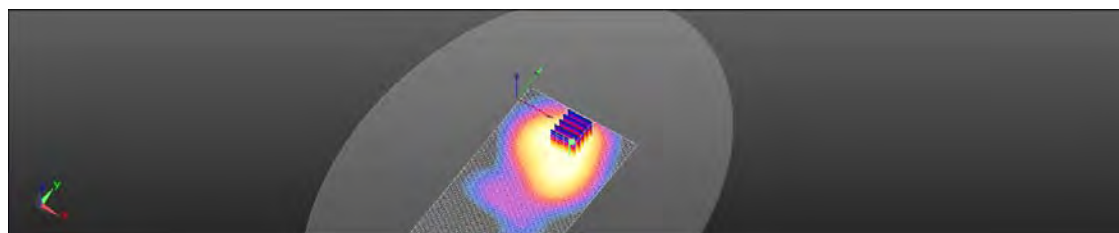
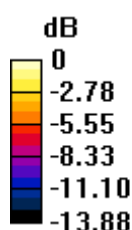
$dx=8\text{mm}$ ,  $dy=8\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 5.223 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 0.375 W/kg

**SAR(1 g) = 0.237 W/kg; SAR(10 g) = 0.150 W/kg**

Maximum value of SAR (measured) = 0.268 W/kg



0 dB = 0.268 W/kg = -5.72 dBW/kg

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## Re Cheek\_CH9262

Communication System: WCDMA; Communication System Band: WCDMA Band II;  
Frequency: 1852.4 MHz; Medium parameters used (interpolated):  $f = 1852.4 \text{ MHz}$ ;  $\sigma = 1.382 \text{ S/m}$ ;  $\epsilon_r = 40.517$ ;  $\rho = 1000 \text{ kg/m}^3$   
DASY 5 Configuration:

- Probe: ES3DV3 - SN3172; ConvF(4.85, 4.85, 4.85); Calibrated: 2012/8/28;
- Sensor-Surface: 3.4mm (Mechanical Surface Detection),
- Electronics: DAE4 Sn1260; Calibrated: 2013/5/3
- Phantom: Head;
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

**Configuration/BODY/Area Scan (71x151x1):** Interpolated grid:  $dx=1.500 \text{ mm}$ ,  $dy=1.500 \text{ mm}$

Maximum value of SAR (interpolated) =  $0.901 \text{ W/kg}$

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

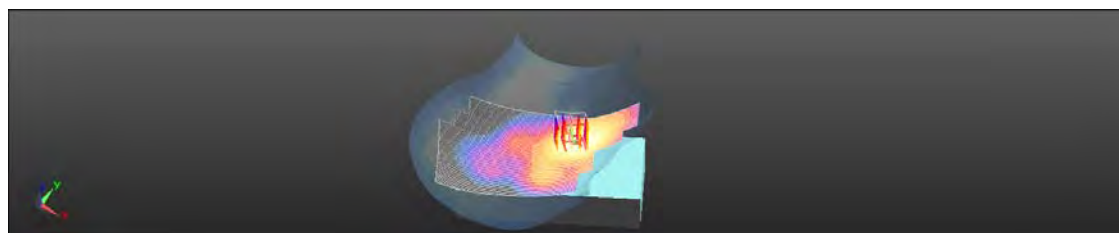
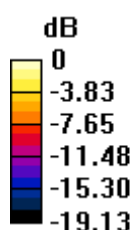
$dx=8\text{mm}$ ,  $dy=8\text{mm}$ ,  $dz=5\text{mm}$

Reference Value =  $7.716 \text{ V/m}$ ; Power Drift =  $-0.10 \text{ dB}$

Peak SAR (extrapolated) =  $1.13 \text{ W/kg}$

**SAR(1 g) =  $0.761 \text{ W/kg}$ ; SAR(10 g) =  $0.481 \text{ W/kg}$**

Maximum value of SAR (measured) =  $0.862 \text{ W/kg}$



$0 \text{ dB} = 0.862 \text{ W/kg} = -0.64 \text{ dBW/kg}$

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## Re Cheek\_CH9400

Communication System: WCDMA; Communication System Band: WCDMA Band II;  
Frequency: 1880 MHz; Medium parameters used:  $f = 1880 \text{ MHz}$ ;  $\sigma = 1.409 \text{ S/m}$ ;  $\epsilon_r = 40.469$ ;  
 $\rho = 1000 \text{ kg/m}^3$   
DASY 5 Configuration:

- Probe: ES3DV3 - SN3172; ConvF(4.85, 4.85, 4.85); Calibrated: 2012/8/28;
- Sensor-Surface: 3.4mm (Mechanical Surface Detection),
- Electronics: DAE4 Sn1260; Calibrated: 2013/5/3
- Phantom: Head;
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

**Configuration/BODY/Area Scan (71x151x1):** Interpolated grid:  $dx=1.500 \text{ mm}$ ,  
 $dy=1.500 \text{ mm}$

Maximum value of SAR (interpolated) =  $0.954 \text{ W/kg}$

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

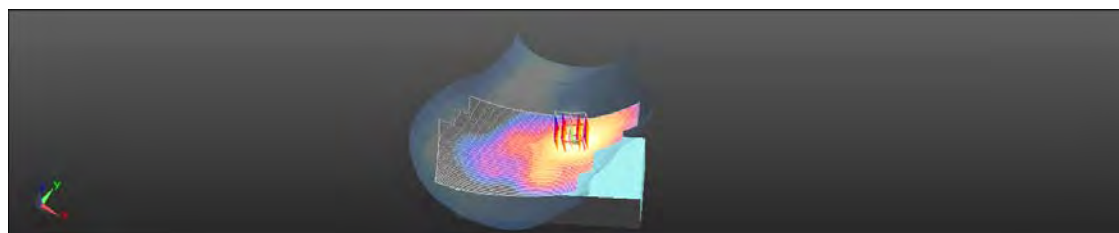
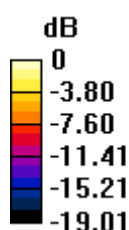
$dx=8\text{mm}$ ,  $dy=8\text{mm}$ ,  $dz=5\text{mm}$

Reference Value =  $7.963 \text{ V/m}$ ; Power Drift =  $0.05 \text{ dB}$

Peak SAR (extrapolated) =  $1.18 \text{ W/kg}$

**SAR(1 g) =  $0.785 \text{ W/kg}$ ; SAR(10 g) =  $0.493 \text{ W/kg}$**

Maximum value of SAR (measured) =  $0.890 \text{ W/kg}$



$0 \text{ dB} = 0.890 \text{ W/kg} = -0.51 \text{ dBW/kg}$

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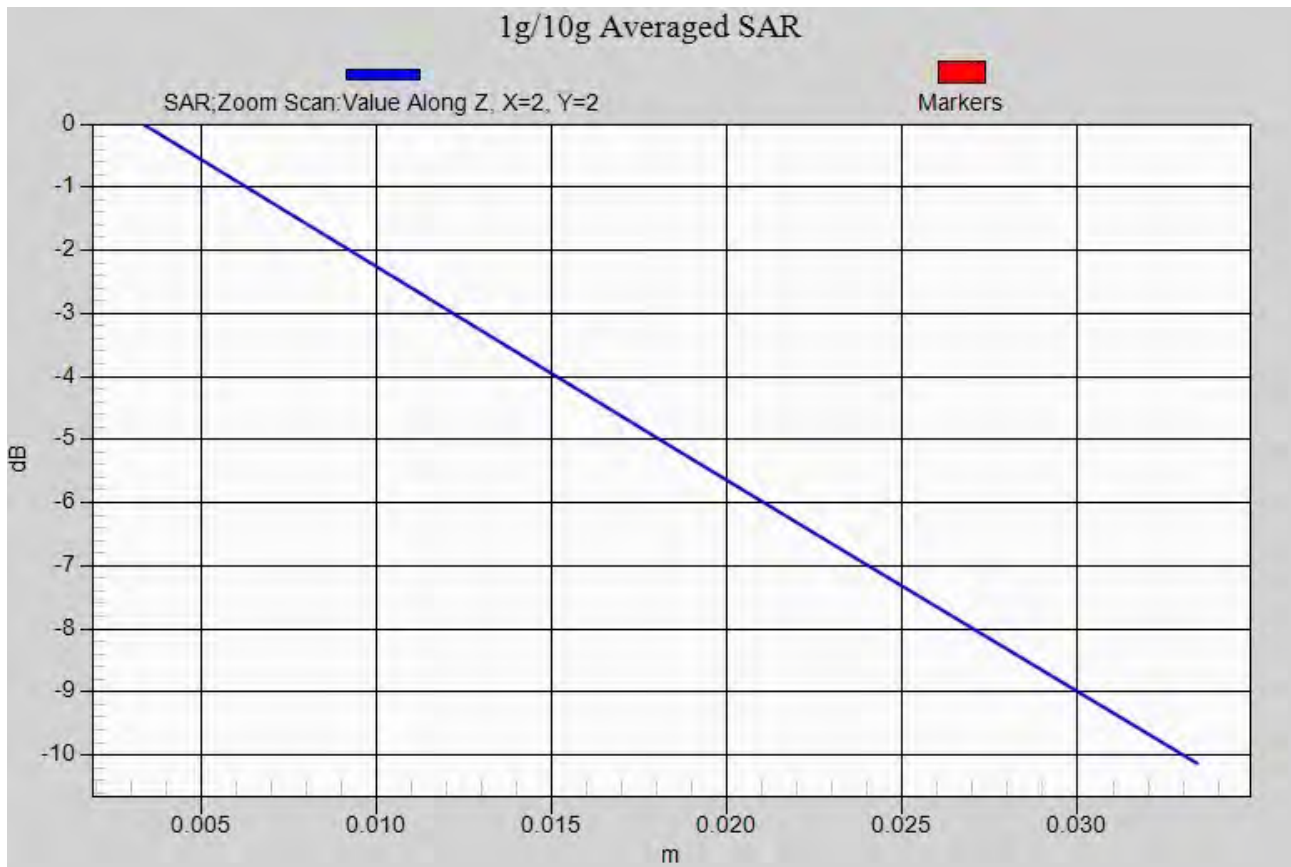
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## Re Cheek\_CH9538

Communication System: WCDMA; Communication System Band: WCDMA Band II;  
Frequency: 1907.6 MHz; Medium parameters used:  $f = 1908 \text{ MHz}$ ;  $\sigma = 1.439 \text{ S/m}$ ;  $\epsilon_r = 40.445$ ;  $\rho = 1000 \text{ kg/m}^3$   
DASY 5 Configuration:

- Probe: ES3DV3 - SN3172; ConvF(4.85, 4.85, 4.85); Calibrated: 2012/8/28;
- Sensor-Surface: 3.4mm (Mechanical Surface Detection),
- Electronics: DAE4 Sn1260; Calibrated: 2013/5/3
- Phantom: Head;
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

**Configuration/BODY/Area Scan (71x151x1):** Interpolated grid:  $dx=1.500 \text{ mm}$ ,  $dy=1.500 \text{ mm}$

Maximum value of SAR (interpolated) =  $0.913 \text{ W/kg}$

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

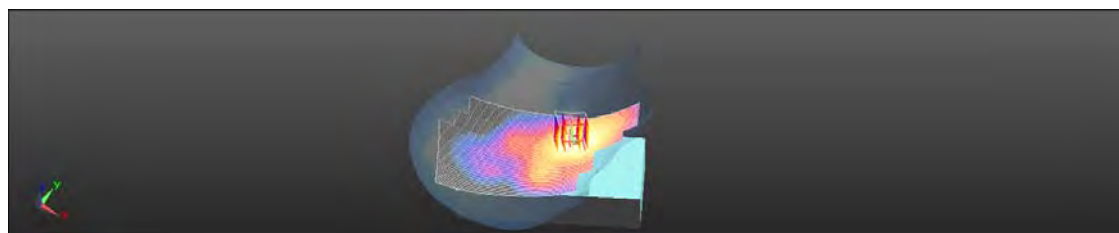
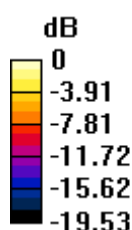
$dx=8\text{mm}$ ,  $dy=8\text{mm}$ ,  $dz=5\text{mm}$

Reference Value =  $7.432 \text{ V/m}$ ; Power Drift =  $0.00 \text{ dB}$

Peak SAR (extrapolated) =  $1.17 \text{ W/kg}$

**SAR(1 g) =  $0.770 \text{ W/kg}$ ; SAR(10 g) =  $0.478 \text{ W/kg}$**

Maximum value of SAR (measured) =  $0.879 \text{ W/kg}$



$0 \text{ dB} = 0.879 \text{ W/kg} = -0.56 \text{ dBW/kg}$

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## Re Cheek\_CH9538\_repeated with Memory card

Communication System: WCDMA; Communication System Band: WCDMA Band II;  
Frequency: 1907.6 MHz; Medium parameters used:  $f = 1908 \text{ MHz}$ ;  $\sigma = 1.439 \text{ S/m}$ ;  $\epsilon_r = 40.445$ ;  $\rho = 1000 \text{ kg/m}^3$   
DASY 5 Configuration:

- Probe: ES3DV3 - SN3172; ConvF(4.85, 4.85, 4.85); Calibrated: 2012/8/28;
- Sensor-Surface: 3.4mm (Mechanical Surface Detection),
- Electronics: DAE4 Sn1260; Calibrated: 2013/5/3
- Phantom: Head;
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

**Configuration/HEAD/Area Scan (71x151x1):** Interpolated grid:  $dx=1.500 \text{ mm}$ ,  $dy=1.500 \text{ mm}$

Maximum value of SAR (interpolated) = 0.821 W/kg

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

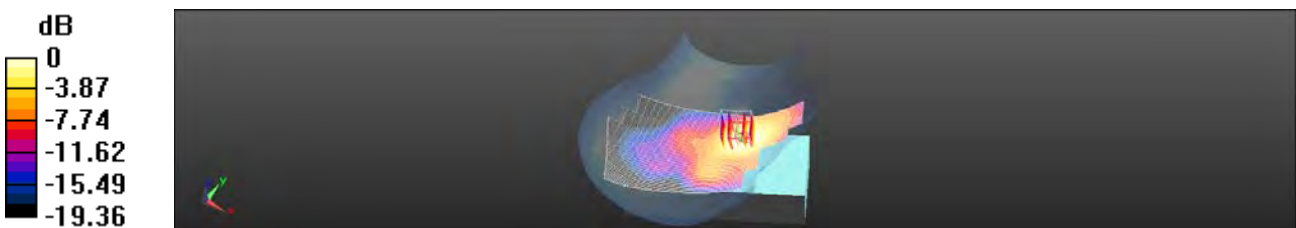
$dx=8\text{mm}$ ,  $dy=8\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 7.111 V/m; Power Drift = 0.10 dB

Peak SAR (extrapolated) = 1.05 W/kg

**SAR(1 g) = 0.692 W/kg; SAR(10 g) = 0.428 W/kg**

Maximum value of SAR (measured) = 0.786 W/kg



0 dB = 0.786 W/kg = -1.05 dBW/kg

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## Re Cheek\_CH9538\_Repeated worse case

Communication System: WCDMA; Communication System Band: WCDMA Band II;  
Frequency: 1907.6 MHz; Medium parameters used:  $f = 1908 \text{ MHz}$ ;  $\sigma = 1.439 \text{ S/m}$ ;  $\epsilon_r = 40.445$ ;  $\rho = 1000 \text{ kg/m}^3$   
DASY 5 Configuration:

- Probe: ES3DV3 - SN3172; ConvF(4.85, 4.85, 4.85); Calibrated: 2012/8/28;
- Sensor-Surface: 3.4mm (Mechanical Surface Detection),
- Electronics: DAE4 Sn1260; Calibrated: 2013/5/3
- Phantom: Head;
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

**Configuration/BODY/Area Scan (71x151x1):** Interpolated grid:  $dx=1.500 \text{ mm}$ ,  $dy=1.500 \text{ mm}$

Maximum value of SAR (interpolated) =  $0.910 \text{ W/kg}$

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

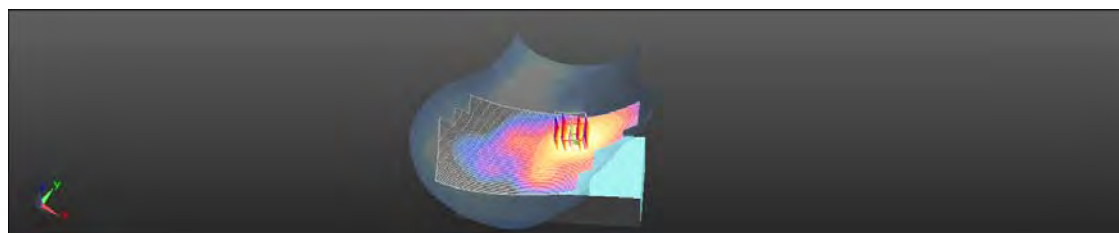
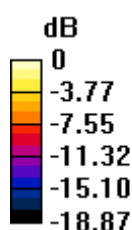
$dx=8\text{mm}$ ,  $dy=8\text{mm}$ ,  $dz=5\text{mm}$

Reference Value =  $7.484 \text{ V/m}$ ; Power Drift =  $0.01 \text{ dB}$

Peak SAR (extrapolated) =  $1.18 \text{ W/kg}$

**SAR(1 g) =  $0.780 \text{ W/kg}$ ; SAR(10 g) =  $0.483 \text{ W/kg}$**

Maximum value of SAR (measured) =  $0.888 \text{ W/kg}$



$0 \text{ dB} = 0.888 \text{ W/kg} = -0.51 \text{ dBW/kg}$

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## Le Cheek\_CH9262

Communication System: WCDMA; Communication System Band: WCDMA Band II;  
Frequency: 1852.4 MHz; Medium parameters used (interpolated):  $f = 1852.4 \text{ MHz}$ ;  $\sigma = 1.382 \text{ S/m}$ ;  $\epsilon_r = 40.517$ ;  $\rho = 1000 \text{ kg/m}^3$   
DASY 5 Configuration:

- Probe: ES3DV3 - SN3172; ConvF(4.85, 4.85, 4.85); Calibrated: 2012/8/28;
- Sensor-Surface: 3.4mm (Mechanical Surface Detection),
- Electronics: DAE4 Sn1260; Calibrated: 2013/5/3
- Phantom: Head;
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

**Configuration/BODY/Area Scan (71x151x1):** Interpolated grid:  $dx=1.500 \text{ mm}$ ,  $dy=1.500 \text{ mm}$

Maximum value of SAR (interpolated) =  $0.462 \text{ W/kg}$

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

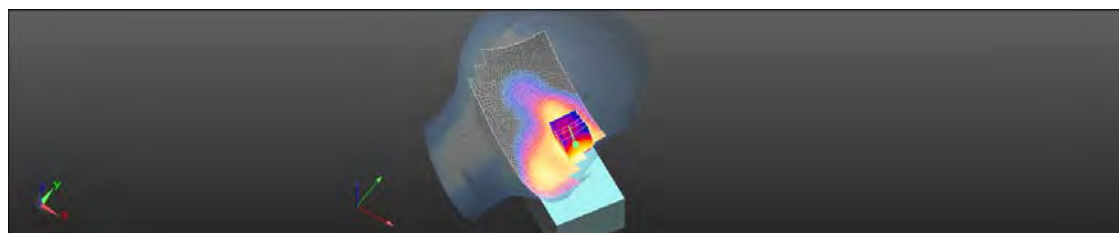
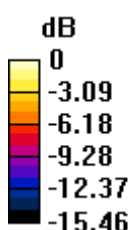
$dx=8\text{mm}$ ,  $dy=8\text{mm}$ ,  $dz=5\text{mm}$

Reference Value =  $7.205 \text{ V/m}$ ; Power Drift =  $-0.01 \text{ dB}$

Peak SAR (extrapolated) =  $0.616 \text{ W/kg}$

**SAR(1 g) =  $0.417 \text{ W/kg}$ ; SAR(10 g) =  $0.267 \text{ W/kg}$**

Maximum value of SAR (measured) =  $0.475 \text{ W/kg}$



$0 \text{ dB} = 0.475 \text{ W/kg} = -3.23 \text{ dBW/kg}$

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## Re Tilt\_CH9262

Communication System: WCDMA; Communication System Band: WCDMA Band II;  
Frequency: 1852.4 MHz; Medium parameters used (interpolated):  $f = 1852.4 \text{ MHz}$ ;  $\sigma = 1.382 \text{ S/m}$ ;  $\epsilon_r = 40.517$ ;  $\rho = 1000 \text{ kg/m}^3$   
DASY 5 Configuration:

- Probe: ES3DV3 - SN3172; ConvF(4.85, 4.85, 4.85); Calibrated: 2012/8/28;
- Sensor-Surface: 3.4mm (Mechanical Surface Detection),
- Electronics: DAE4 Sn1260; Calibrated: 2013/5/3
- Phantom: Head;
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

**Configuration/BODY/Area Scan (71x151x1):** Interpolated grid:  $dx=1.500 \text{ mm}$ ,  $dy=1.500 \text{ mm}$

Maximum value of SAR (interpolated) =  $0.193 \text{ W/kg}$

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

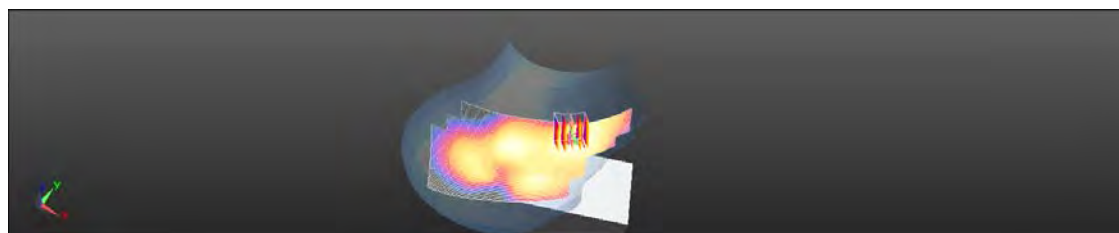
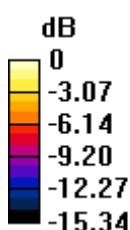
$dx=8\text{mm}$ ,  $dy=8\text{mm}$ ,  $dz=5\text{mm}$

Reference Value =  $7.608 \text{ V/m}$ ; Power Drift =  $-0.08 \text{ dB}$

Peak SAR (extrapolated) =  $0.231 \text{ W/kg}$

**SAR(1 g) =  $0.165 \text{ W/kg}$ ; SAR(10 g) =  $0.114 \text{ W/kg}$**

Maximum value of SAR (measured) =  $0.182 \text{ W/kg}$



$0 \text{ dB} = 0.182 \text{ W/kg} = -7.40 \text{ dBW/kg}$

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## Le Tilt\_CH9262

Communication System: WCDMA; Communication System Band: WCDMA Band II;  
Frequency: 1852.4 MHz; Medium parameters used (interpolated):  $f = 1852.4 \text{ MHz}$ ;  $\sigma = 1.382 \text{ S/m}$ ;  $\epsilon_r = 40.517$ ;  $\rho = 1000 \text{ kg/m}^3$   
DASY 5 Configuration:

- Probe: ES3DV3 - SN3172; ConvF(4.85, 4.85, 4.85); Calibrated: 2012/8/28;
- Sensor-Surface: 3.4mm (Mechanical Surface Detection),
- Electronics: DAE4 Sn1260; Calibrated: 2013/5/3
- Phantom: Head;
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

**Configuration/BODY/Area Scan (71x151x1):** Interpolated grid:  $dx=1.500 \text{ mm}$ ,  $dy=1.500 \text{ mm}$

Maximum value of SAR (interpolated) = 0.244 W/kg

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

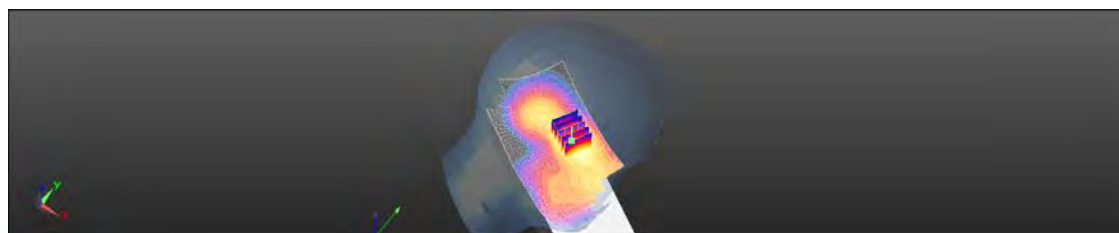
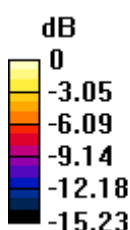
$dx=8\text{mm}$ ,  $dy=8\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 8.043 V/m; Power Drift = -0.11 dB

Peak SAR (extrapolated) = 0.325 W/kg

**SAR(1 g) = 0.213 W/kg; SAR(10 g) = 0.131 W/kg**

Maximum value of SAR (measured) = 0.243 W/kg



0 dB = 0.243 W/kg = -6.14 dBW/kg

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## Back side \_CH9262

Communication System: WCDMA; Communication System Band: WCDMA Band II;  
Frequency: 1852.4 MHz; Medium parameters used (interpolated):  $f = 1852.4 \text{ MHz}$ ;  $\sigma = 1.523 \text{ S/m}$ ;  $\epsilon_r = 53.358$ ;  $\rho = 1000 \text{ kg/m}^3$

**Configuration/Body/Area Scan (91x161x1):** Interpolated grid:  $dx=1.500 \text{ mm}$ ,  $dy=1.500 \text{ mm}$

Maximum value of SAR (interpolated) =  $0.705 \text{ W/kg}$

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

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

Reference Value =  $7.782 \text{ V/m}$ ; Power Drift =  $-0.07 \text{ dB}$

Peak SAR (extrapolated) =  $0.938 \text{ W/kg}$

**SAR(1 g) =  $0.592 \text{ W/kg}$ ; SAR(10 g) =  $0.374 \text{ W/kg}$**

Maximum value of SAR (measured) =  $0.668 \text{ W/kg}$

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

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

Reference Value =  $7.782 \text{ V/m}$ ; Power Drift =  $-0.07 \text{ dB}$

Peak SAR (extrapolated) =  $0.959 \text{ W/kg}$

**SAR(1 g) =  $0.605 \text{ W/kg}$ ; SAR(10 g) =  $0.381 \text{ W/kg}$**

Maximum value of SAR (measured) =  $0.694 \text{ W/kg}$

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

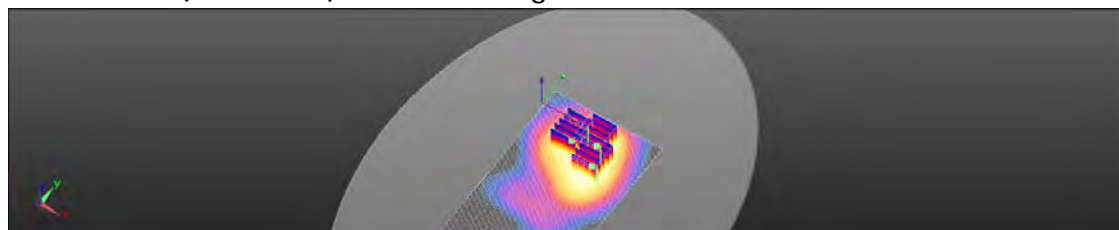
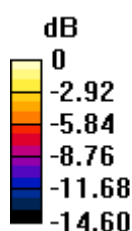
$dx=8\text{mm}$ ,  $dy=8\text{mm}$ ,  $dz=5\text{mm}$

Reference Value =  $7.782 \text{ V/m}$ ; Power Drift =  $-0.07 \text{ dB}$

Peak SAR (extrapolated) =  $0.797 \text{ W/kg}$

**SAR(1 g) =  $0.515 \text{ W/kg}$ ; SAR(10 g) =  $0.331 \text{ W/kg}$**

Maximum value of SAR (measured) =  $0.597 \text{ W/kg}$



$0 \text{ dB} = 0.597 \text{ W/kg} = -2.24 \text{ dBW/kg}$

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## Re Cheek\_CH4183

Communication System: WCDMA; Communication System Band: WCDMA Band V;  
Frequency: 836.6 MHz; Medium parameters used:  $f = 837$  MHz;  $\sigma = 0.924$  S/m;  $\epsilon_r = 42.134$ ;  
 $\rho = 1000$  kg/m<sup>3</sup>  
DASY 5 Configuration:

- Probe: ES3DV3 - SN3172; ConvF(5.85, 5.85, 5.85); Calibrated: 2012/8/28;
- Sensor-Surface: 3.4mm (Mechanical Surface Detection),
- Electronics: DAE4 Sn1260; Calibrated: 2013/5/3
- Phantom: Head;
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

**Configuration/HEAD/Area Scan (71x151x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 0.587 W/kg

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

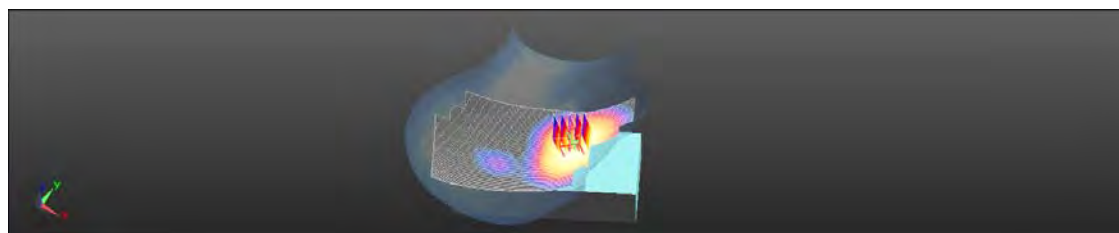
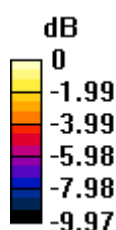
dx=8mm, dy=8mm, dz=5mm

Reference Value = 9.033 V/m; Power Drift = -0.17 dB

Peak SAR (extrapolated) = 0.679 W/kg

**SAR(1 g) = 0.525 W/kg; SAR(10 g) = 0.401 W/kg**

Maximum value of SAR (measured) = 0.563 W/kg



0 dB = 0.563 W/kg = -2.49 dBW/kg

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## Le Cheek\_CH4132

Communication System: WCDMA; Communication System Band: WCDMA Band V;  
Frequency: 826.4 MHz; Medium parameters used (interpolated):  $f = 826.4 \text{ MHz}$ ;  $\sigma = 0.915 \text{ S/m}$ ;  $\epsilon_r = 42.314$ ;  $\rho = 1000 \text{ kg/m}^3$   
DASY 5 Configuration:

- Probe: ES3DV3 - SN3172; ConvF(5.85, 5.85, 5.85); Calibrated: 2012/8/28;
- Sensor-Surface: 3.4mm (Mechanical Surface Detection),
- Electronics: DAE4 Sn1260; Calibrated: 2013/5/3
- Phantom: Head;
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

**Configuration/HEAD/Area Scan (71x151x1):** Interpolated grid:  $dx=1.500 \text{ mm}$ ,  $dy=1.500 \text{ mm}$

Maximum value of SAR (interpolated) =  $0.521 \text{ W/kg}$

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

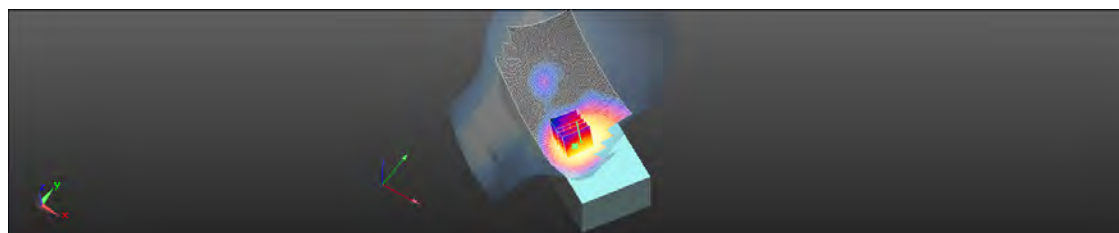
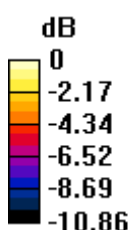
$dx=8\text{mm}$ ,  $dy=8\text{mm}$ ,  $dz=5\text{mm}$

Reference Value =  $7.475 \text{ V/m}$ ; Power Drift =  $0.03 \text{ dB}$

Peak SAR (extrapolated) =  $0.601 \text{ W/kg}$

**SAR(1 g) =  $0.476 \text{ W/kg}$ ; SAR(10 g) =  $0.361 \text{ W/kg}$**

Maximum value of SAR (measured) =  $0.508 \text{ W/kg}$



$0 \text{ dB} = 0.508 \text{ W/kg} = -2.94 \text{ dBW/kg}$

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Date: 2013/6/2

## Le Cheek\_CH4183

Communication System: WCDMA; Communication System Band: WCDMA Band V;  
Frequency: 836.6 MHz; Medium parameters used:  $f = 837$  MHz;  $\sigma = 0.924$  S/m;  $\epsilon_r = 42.134$ ;  
 $\rho = 1000$  kg/m<sup>3</sup>  
DASY 5 Configuration:

- Probe: ES3DV3 - SN3172; ConvF(5.85, 5.85, 5.85); Calibrated: 2012/8/28;
- Sensor-Surface: 3.4mm (Mechanical Surface Detection),
- Electronics: DAE4 Sn1260; Calibrated: 2013/5/3
- Phantom: Head;
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

**Configuration/HEAD/Area Scan (71x151x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm

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

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

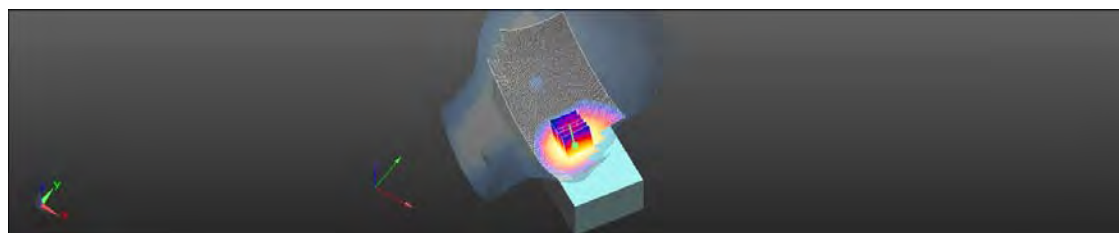
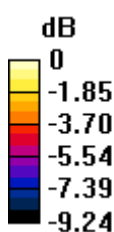
dx=8mm, dy=8mm, dz=5mm

Reference Value = 7.128 V/m; Power Drift = 0.09 dB

Peak SAR (extrapolated) = 0.660 W/kg

**SAR(1 g) = 0.528 W/kg; SAR(10 g) = 0.404 W/kg**

Maximum value of SAR (measured) = 0.568 W/kg



0 dB = 0.568 W/kg = -2.46 dBW/kg

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Date: 2013/6/2

## Le Cheek\_CH4233

Communication System: WCDMA; Communication System Band: WCDMA Band V;  
Frequency: 846.6 MHz; Medium parameters used:  $f = 847$  MHz;  $\sigma = 0.929$  S/m;  $\epsilon_r = 41.899$ ;  
 $\rho = 1000$  kg/m<sup>3</sup>  
DASY 5 Configuration:

- Probe: ES3DV3 - SN3172; ConvF(5.85, 5.85, 5.85); Calibrated: 2012/8/28;
- Sensor-Surface: 3.4mm (Mechanical Surface Detection),
- Electronics: DAE4 Sn1260; Calibrated: 2013/5/3
- Phantom: Head;
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

**Configuration/HEAD/Area Scan (71x151x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 0.533 W/kg

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

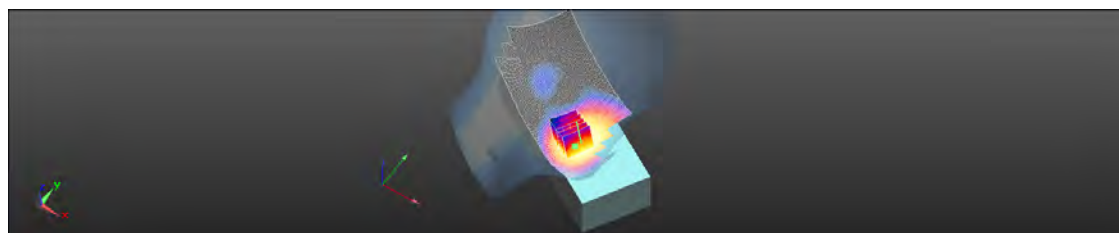
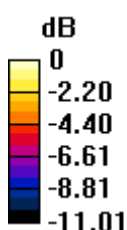
dx=8mm, dy=8mm, dz=5mm

Reference Value = 7.077 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 0.621 W/kg

**SAR(1 g) = 0.487 W/kg; SAR(10 g) = 0.366 W/kg**

Maximum value of SAR (measured) = 0.517 W/kg



0 dB = 0.517 W/kg = -2.86 dBW/kg

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## Re Tilt\_CH4183

Communication System: WCDMA; Communication System Band: WCDMA Band V;  
Frequency: 836.6 MHz; Medium parameters used:  $f = 837$  MHz;  $\sigma = 0.924$  S/m;  $\epsilon_r = 42.134$ ;  
 $\rho = 1000$  kg/m<sup>3</sup>  
DASY 5 Configuration:

- Probe: ES3DV3 - SN3172; ConvF(5.85, 5.85, 5.85); Calibrated: 2012/8/28;
- Sensor-Surface: 3.4mm (Mechanical Surface Detection),
- Electronics: DAE4 Sn1260; Calibrated: 2013/5/3
- Phantom: Head;
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

**Configuration/HEAD/Area Scan (71x151x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm

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

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

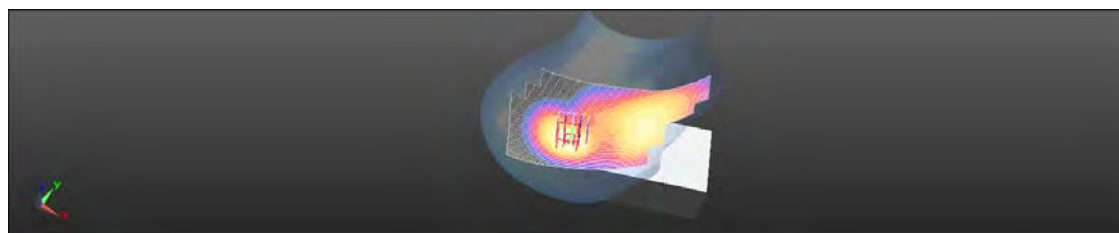
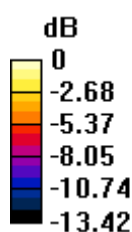
dx=8mm, dy=8mm, dz=5mm

Reference Value = 12.094 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 0.424 W/kg

**SAR(1 g) = 0.263 W/kg; SAR(10 g) = 0.162 W/kg**

Maximum value of SAR (measured) = 0.306 W/kg



0 dB = 0.306 W/kg = -5.14 dBW/kg

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Date: 2013/6/2

## Le Tilt\_CH4183

Communication System: WCDMA; Communication System Band: WCDMA Band V;  
Frequency: 836.6 MHz; Medium parameters used:  $f = 837$  MHz;  $\sigma = 0.924$  S/m;  $\epsilon_r = 42.134$ ;  
 $\rho = 1000$  kg/m<sup>3</sup>  
DASY 5 Configuration:

- Probe: ES3DV3 - SN3172; ConvF(5.85, 5.85, 5.85); Calibrated: 2012/8/28;
- Sensor-Surface: 3.4mm (Mechanical Surface Detection),
- Electronics: DAE4 Sn1260; Calibrated: 2013/5/3
- Phantom: Head;
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

**Configuration/HEAD/Area Scan (71x151x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 0.253 W/kg

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

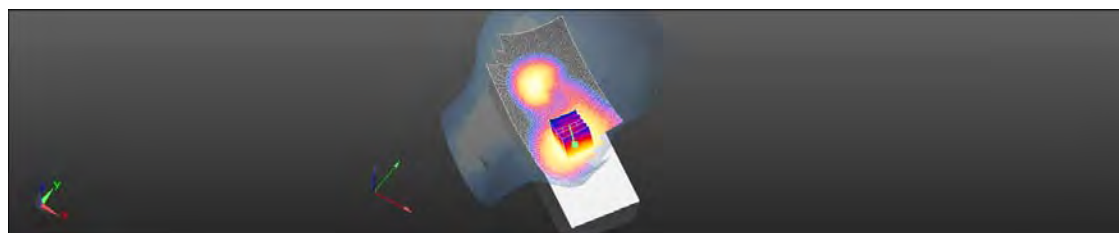
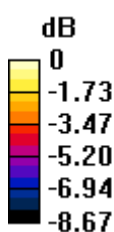
dx=8mm, dy=8mm, dz=5mm

Reference Value = 11.155 V/m; Power Drift = -0.11 dB

Peak SAR (extrapolated) = 0.300 W/kg

**SAR(1 g) = 0.239 W/kg; SAR(10 g) = 0.185 W/kg**

Maximum value of SAR (measured) = 0.256 W/kg



0 dB = 0.256 W/kg = -5.92 dBW/kg

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## Front side \_CH4183

Communication System: WCDMA; Communication System Band: WCDMA Band V;  
Frequency: 836.6 MHz; Medium parameters used:  $f = 837$  MHz;  $\sigma = 0.963$  S/m;  $\epsilon_r = 55.849$ ;  
 $\rho = 1000$  kg/m<sup>3</sup>  
DASY 5 Configuration:

- Probe: ES3DV3 - SN3172; ConvF(5.81, 5.81, 5.81); Calibrated: 2012/8/28;
- Sensor-Surface: 3.4mm (Mechanical Surface Detection),
- Electronics: DAE4 Sn1260; Calibrated: 2013/5/3
- Phantom: Body;
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

**Configuration/Body/Area Scan (91x161x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 0.609 W/kg

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

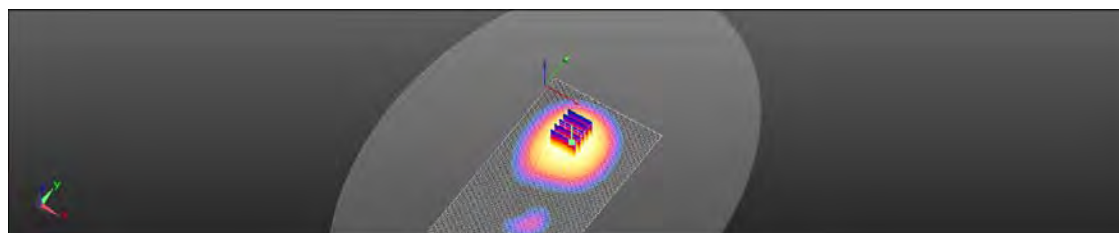
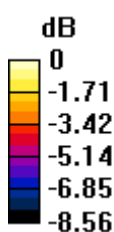
dx=8mm, dy=8mm, dz=5mm

Reference Value = 12.487 V/m; Power Drift = -0.11 dB

Peak SAR (extrapolated) = 0.704 W/kg

**SAR(1 g) = 0.564 W/kg; SAR(10 g) = 0.430 W/kg**

Maximum value of SAR (measured) = 0.608 W/kg



0 dB = 0.608 W/kg = -2.16 dBW/kg

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## Back side \_CH4183

Communication System: WCDMA; Communication System Band: WCDMA Band V;  
Frequency: 836.6 MHz; Medium parameters used:  $f = 837$  MHz;  $\sigma = 0.963$  S/m;  $\epsilon_r = 55.849$ ;  
 $\rho = 1000$  kg/m<sup>3</sup>  
DASY 5 Configuration:

- Probe: ES3DV3 - SN3172; ConvF(5.81, 5.81, 5.81); Calibrated: 2012/8/28;
- Sensor-Surface: 3.4mm (Mechanical Surface Detection),
- Electronics: DAE4 Sn1260; Calibrated: 2013/5/3
- Phantom: Body;
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

**Configuration/Body/Area Scan (91x161x1):** Interpolated grid: dx=1.500 mm,  
dy=1.500 mm

Maximum value of SAR (interpolated) = 0.819 W/kg

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

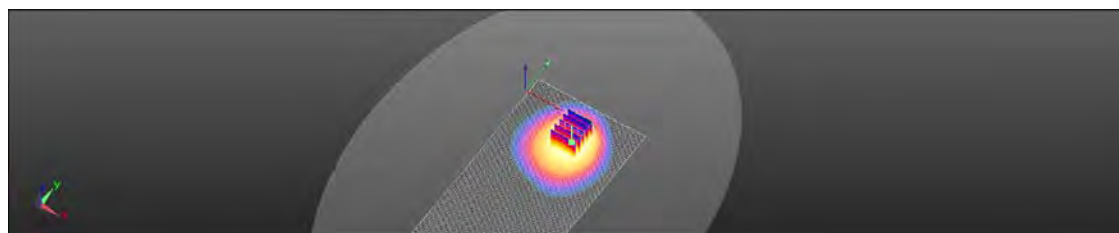
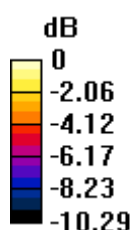
dx=8mm, dy=8mm, dz=5mm

Reference Value = 7.184 V/m; Power Drift = -0.14 dB

Peak SAR (extrapolated) = 0.977 W/kg

**SAR(1 g) = 0.743 W/kg; SAR(10 g) = 0.540 W/kg**

Maximum value of SAR (measured) = 0.812 W/kg



0 dB = 0.812 W/kg = -0.90 dBW/kg

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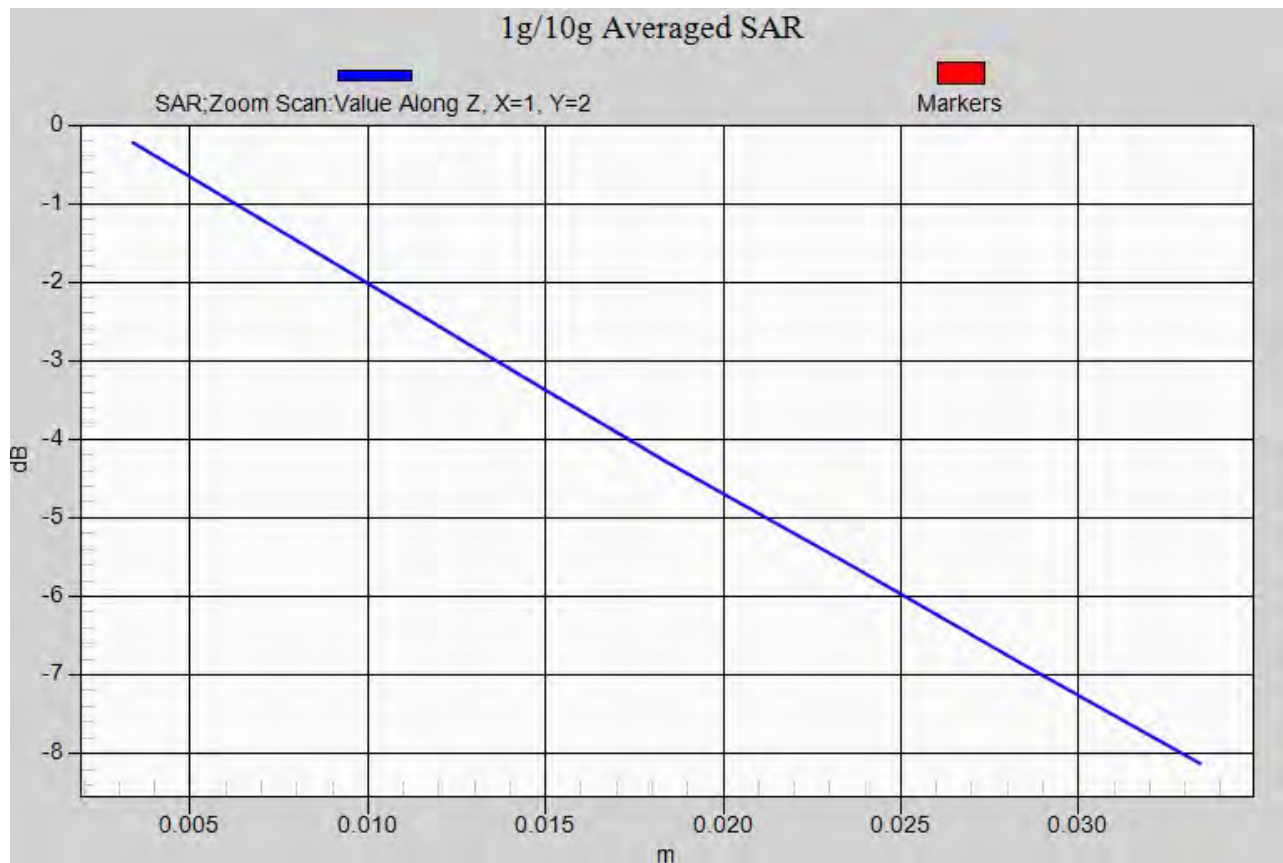
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Date: 2013/6/2

## Back side \_CH4183\_repeated with Memory card

Communication System: WCDMA; Communication System Band: WCDMA Band V;  
Frequency: 836.6 MHz; Medium parameters used:  $f = 837$  MHz;  $\sigma = 0.963$  S/m;  $\epsilon_r = 55.849$ ;  
 $\rho = 1000$  kg/m<sup>3</sup>  
DASY 5 Configuration:

- Probe: ES3DV3 - SN3172; ConvF(5.81, 5.81, 5.81); Calibrated: 2012/8/28;
- Sensor-Surface: 3.4mm (Mechanical Surface Detection),
- Electronics: DAE4 Sn1260; Calibrated: 2013/5/3
- Phantom: Body;
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

**Configuration/Body/Area Scan (91x161x1):** Interpolated grid: dx=1.500 mm,  
dy=1.500 mm

Maximum value of SAR (interpolated) = 0.820 W/kg

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

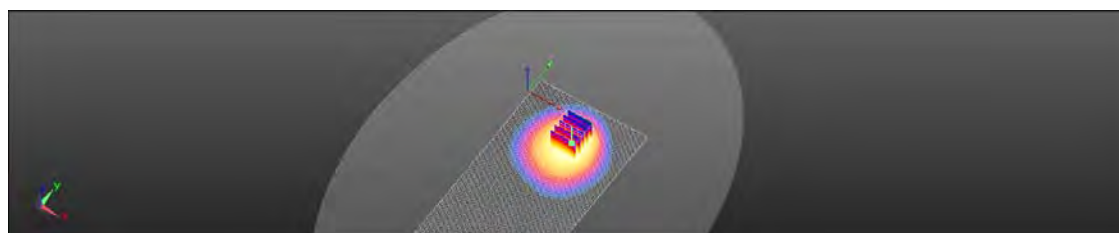
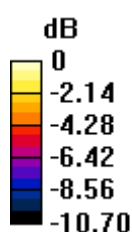
dx=8mm, dy=8mm, dz=5mm

Reference Value = 7.950 V/m; Power Drift = 0.12 dB

Peak SAR (extrapolated) = 0.978 W/kg

**SAR(1 g) = 0.730 W/kg; SAR(10 g) = 0.528 W/kg**

Maximum value of SAR (measured) = 0.797 W/kg



0 dB = 0.797 W/kg = -0.98 dBW/kg

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Date: 2013/6/2

## Front side\_WLAN802.11 b\_CH1

Communication System: WLAN(2.45G); Communication System Band: WLAN802.11 b\_FCC;  
Frequency: 2412 MHz; Medium parameters used:  $f = 2412 \text{ MHz}$ ;  $\sigma = 1.989 \text{ S/m}$ ;  $\epsilon_r = 51.083$ ;  
 $\rho = 1000 \text{ kg/m}^3$

DASY 5 Configuration:

- Probe: ES3DV3 - SN3172; ConvF(3.88, 3.88, 3.88); Calibrated: 2012/8/28;
- Sensor-Surface: 3.4mm (Mechanical Surface Detection),
- Electronics: DAE4 Sn1260; Calibrated: 2013/5/3
- Phantom: Body;
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

**Configuration/Body/Area Scan (111x201x1):** Interpolated grid:  $dx=1.200 \text{ mm}$ ,  
 $dy=1.200 \text{ mm}$

Maximum value of SAR (interpolated) =  $0.0164 \text{ W/kg}$

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

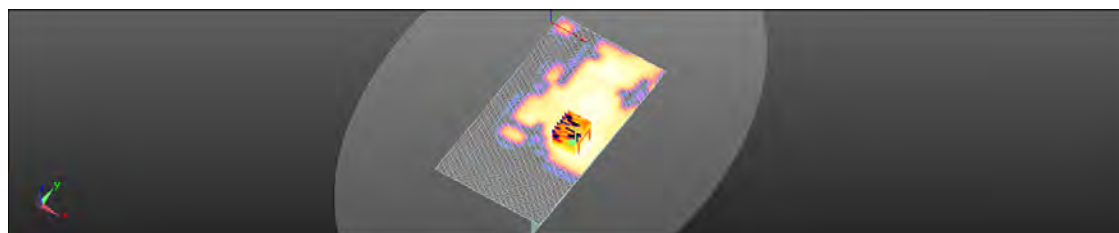
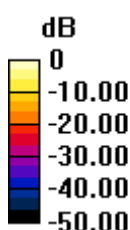
$dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Reference Value =  $2.002 \text{ V/m}$ ; Power Drift =  $-0.05 \text{ dB}$

Peak SAR (extrapolated) =  $0.0240 \text{ W/kg}$

**SAR(1 g) =  $0.013 \text{ W/kg}$ ; SAR(10 g) =  $0.0066 \text{ W/kg}$**

Maximum value of SAR (measured) =  $0.0163 \text{ W/kg}$



$0 \text{ dB} = 0.0163 \text{ W/kg} = -17.89 \text{ dBW/kg}$

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Date: 2013/6/2

## Back side\_WLAN802.11 b\_CH1

Communication System: WLAN(2.45G); Communication System Band: WLAN802.11 b\_FCC;  
Frequency: 2412 MHz; Medium parameters used:  $f = 2412$  MHz;  $\sigma = 1.989$  S/m;  $\epsilon_r = 51.083$ ;  
 $\rho = 1000$  kg/m<sup>3</sup>

DASY 5 Configuration:

- Probe: ES3DV3 - SN3172; ConvF(3.88, 3.88, 3.88); Calibrated: 2012/8/28;
- Sensor-Surface: 3.4mm (Mechanical Surface Detection),
- Electronics: DAE4 Sn1260; Calibrated: 2013/5/3
- Phantom: Body;
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

**Configuration/Body/Area Scan (111x201x1):** Interpolated grid: dx=1.200 mm, dy=1.200 mm

Maximum value of SAR (interpolated) = 0.0316 W/kg

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

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

Reference Value = 2.544 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 0.0510 W/kg

**SAR(1 g) = 0.027 W/kg; SAR(10 g) = 0.015 W/kg**

Maximum value of SAR (measured) = 0.0316 W/kg



0 dB = 0.0316 W/kg = -15.00 dBW/kg

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Date: 2013/6/2

## Back side\_WLAN802.11 b\_CH1\_repeated with Memory card

Communication System: WLAN(2.45G); Communication System Band: WLAN802.11 b\_FCC;  
Frequency: 2412 MHz; Medium parameters used:  $f = 2412 \text{ MHz}$ ;  $\sigma = 1.989 \text{ S/m}$ ;  $\epsilon_r = 51.083$ ;  
 $\rho = 1000 \text{ kg/m}^3$

DASY 5 Configuration:

- Probe: ES3DV3 - SN3172; ConvF(3.88, 3.88, 3.88); Calibrated: 2012/8/28;
- Sensor-Surface: 3.4mm (Mechanical Surface Detection),
- Electronics: DAE4 Sn1260; Calibrated: 2013/5/3
- Phantom: Body;
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

**Configuration/Body/Area Scan (111x201x1):** Interpolated grid:  $dx=1.200 \text{ mm}$ ,  
 $dy=1.200 \text{ mm}$

Maximum value of SAR (interpolated) =  $0.0320 \text{ W/kg}$

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

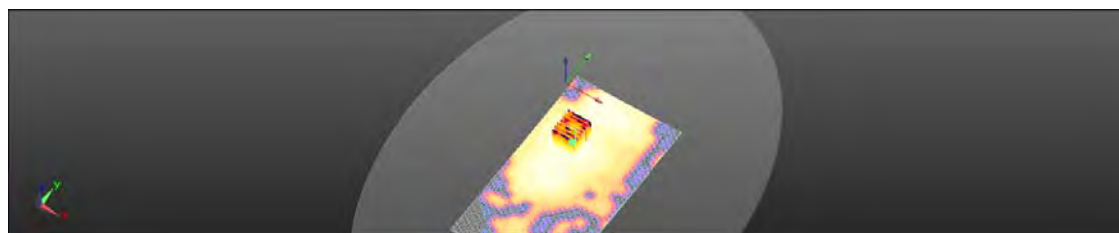
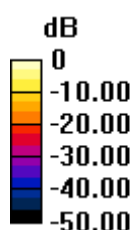
$dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Reference Value =  $2.455 \text{ V/m}$ ; Power Drift =  $0.08 \text{ dB}$

Peak SAR (extrapolated) =  $0.0490 \text{ W/kg}$

**SAR(1 g) =  $0.028 \text{ W/kg}$ ; SAR(10 g) =  $0.016 \text{ W/kg}$**

Maximum value of SAR (measured) =  $0.0322 \text{ W/kg}$



$0 \text{ dB} = 0.0322 \text{ W/kg} = -14.92 \text{ dBW/kg}$

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Date: 2015/11/19

## RFID\_Body-worn\_Frint side\_CH 917.5\_10mm

Communication System: RFID; Frequency: 917.5 MHz

Medium parameters used:  $f = 917.5 \text{ MHz}$ ;  $\sigma = 1.081 \text{ S/m}$ ;  $\epsilon_r = 53.237$ ;  $\rho = 1000 \text{ kg/m}^3$ 

Phantom section: Flat Section

### DASY5 Configuration:

- Probe: EX3DV4 - SN3938; ConvF(9.22, 9.22, 9.22); Calibrated: 2015/10/1;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1260; Calibrated: 2015/9/24
- Phantom: Body;
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

**Configuration/Body/Area Scan (101x191x1):** Interpolated grid:  $dx=15 \text{ mm}$ ,  $dy=15 \text{ mm}$

Maximum value of SAR (interpolated) = 0.00480 W/kg

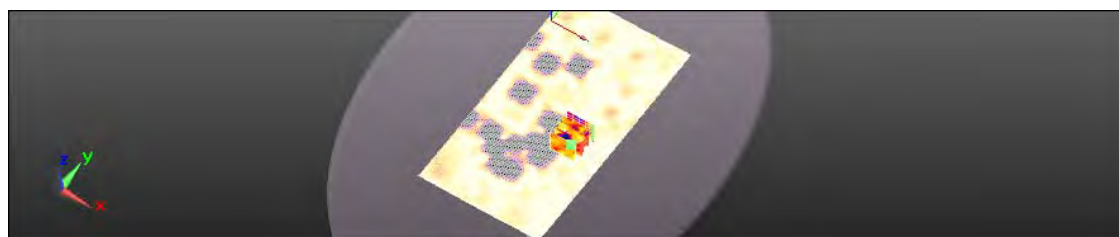
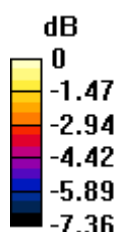
**Configuration/Body/Zoom Scan (5x5x7)/Cube 0:** Measurement grid:  $dx=8\text{mm}$ ,  $dy=8\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 1.212 V/m; Power Drift = -0.18 dB

Peak SAR (extrapolated) = 0.00345 W/kg

**SAR(1 g) = 0.00197 W/kg; SAR(10 g) = 0.00139 W/kg**

Maximum value of SAR (measured) = 0.00253 W/kg



0 dB = 0.00253 W/kg = -25.97 dBW/kg

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Date: 2015/11/19

## RFID\_Body-worn\_Back side\_CH 917.5\_10mm

Communication System: RFID; Frequency: 917.5 MHz

Medium parameters used:  $f = 917.5 \text{ MHz}$ ;  $\sigma = 1.081 \text{ S/m}$ ;  $\epsilon_r = 53.237$ ;  $\rho = 1000 \text{ kg/m}^3$ 

Phantom section: Flat Section

### DASY5 Configuration:

- Probe: EX3DV4 - SN3938; ConvF(9.22, 9.22, 9.22); Calibrated: 2015/10/1;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1260; Calibrated: 2015/9/24
- Phantom: Body;
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

**Configuration/Body/Area Scan (101x191x1):** Interpolated grid:  $dx=15 \text{ mm}$ ,  $dy=15 \text{ mm}$

Maximum value of SAR (interpolated) = 0.00365 W/kg

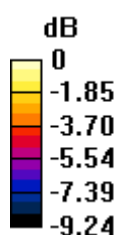
**Configuration/Body/Zoom Scan (5x5x7)/Cube 0:** Measurement grid:  $dx=8\text{mm}$ ,  $dy=8\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 1.536 V/m; Power Drift = -0.14 dB

Peak SAR (extrapolated) = 0.00368 W/kg

**SAR(1 g) = 0.00168 W/kg; SAR(10 g) = 0.00108 W/kg**

Maximum value of SAR (measured) = 0.00257 W/kg



0 dB = 0.00257 W/kg = -25.90 dBW/kg

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## 6. SAR System Performance Verification

Date: 2013/6/2

### DUT: Dipole 835 MHz (Head)

Communication System: CW; Communication System Band: D835 (835.0 MHz); Frequency: 835 MHz; Medium parameters used:  $f = 835$  MHz;  $\sigma = 0.919$  S/m;  $\epsilon_r = 42.159$ ;  $\rho = 1000$  kg/m<sup>3</sup>

DASY 5 Configuration:

- Probe: ES3DV3 - SN3172; ConvF(5.85, 5.85, 5.85); Calibrated: 2012/8/28;
- Sensor-Surface: 3.4mm (Mechanical Surface Detection),
- Electronics: DAE4 Sn1260; Calibrated: 2013/5/3
- Phantom: Head;
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

### Configuration/Pin=250mW/Area Scan (41x101x1): Interpolated grid:

dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 2.74 W/kg

### Configuration/Pin=250mW/Zoom Scan (5x5x7)/Cube 0: Measurement grid:

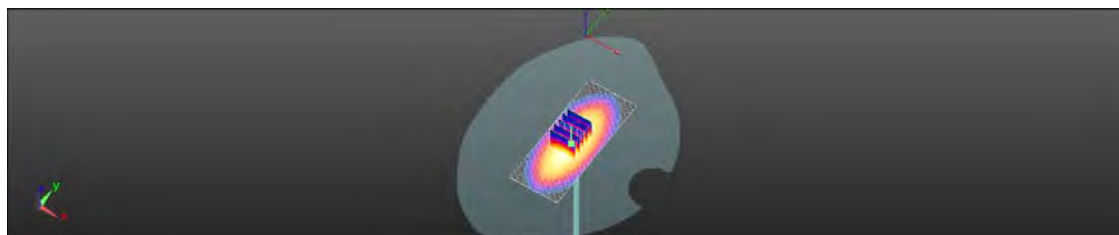
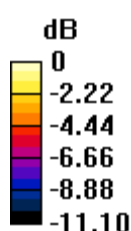
dx=8mm, dy=8mm, dz=5mm

Reference Value = 55.314 V/m; Power Drift = -0.00 dB

Peak SAR (extrapolated) = 3.65 W/kg

**SAR(1 g) = 2.39 W/kg; SAR(10 g) = 1.58 W/kg**

Maximum value of SAR (measured) = 2.73 W/kg



0 dB = 2.73 W/kg = 4.36 dBW/kg

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Date: 2013/6/2

## DUT: Dipole 835 MHz (Body)

Communication System: CW; Communication System Band: D835 (835.0 MHz); Frequency: 835 MHz; Medium parameters used:  $f = 835 \text{ MHz}$ ;  $\sigma = 0.958 \text{ S/m}$ ;  $\epsilon_r = 55.856$ ;  $\rho = 1000 \text{ kg/m}^3$

DASY 5 Configuration:

- Probe: ES3DV3 - SN3172; ConvF(5.81, 5.81, 5.81); Calibrated: 2012/8/28;
- Sensor-Surface: 3.4mm (Mechanical Surface Detection),
- Electronics: DAE4 Sn1260; Calibrated: 2013/5/3
- Phantom: Body;
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

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

$dx=1.500 \text{ mm}$ ,  $dy=1.500 \text{ mm}$

Maximum value of SAR (interpolated) = 2.72 W/kg

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

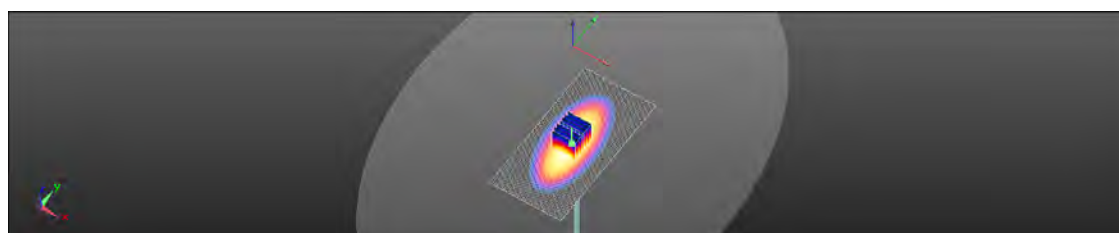
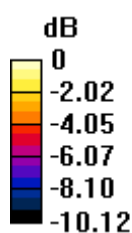
$dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 54.481 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 3.48 W/kg

**SAR(1 g) = 2.42 W/kg; SAR(10 g) = 1.6 W/kg**

Maximum value of SAR (measured) = 2.74 W/kg



0 dB = 2.74 W/kg = 4.38 dBW/kg

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Date: 2015/11/19

## DUT: Dipole 900 MHz\_SN:178\_Body

Communication System: CW; Frequency: 900 MHz

Medium parameters used:  $f = 900 \text{ MHz}$ ;  $\sigma = 1.071 \text{ S/m}$ ;  $\epsilon_r = 54.683$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3938; ConvF(9.22, 9.22, 9.22); Calibrated: 2015/10/1;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1260; Calibrated: 2015/9/24
- Phantom: Body
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

**Configuration/Pin=250mW/Area Scan (41x101x1):** Interpolated grid:

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

Maximum value of SAR (interpolated) = 3.58 W/kg

**Configuration/Pin=250mW/Zoom Scan (5x5x7)/Cube 0:** Measurement

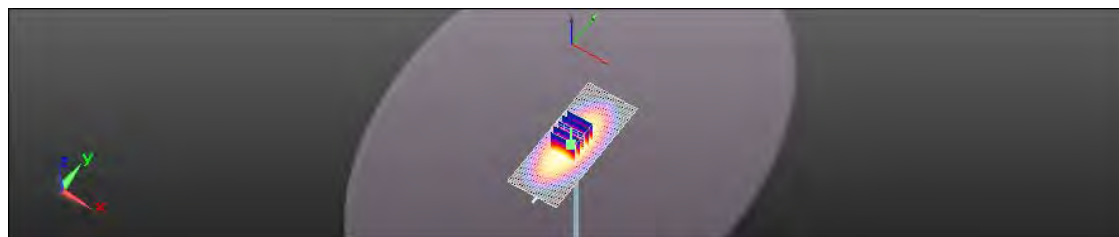
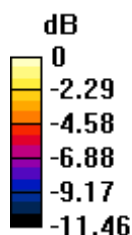
grid:  $dx=8\text{mm}$ ,  $dy=8\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 58.15 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 4.33 W/kg

**SAR(1 g) = 2.75 W/kg; SAR(10 g) = 1.76 W/kg**

Maximum value of SAR (measured) = 3.57 W/kg



0 dB = 3.57 W/kg = 5.53 dBW/kg

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Date: 2013/6/3

## DUT: Dipole 1900 MHz (Head)

Communication System: CW; Communication System Band: D1900 (1900.0 MHz);  
Frequency: 1900 MHz; Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.429$  S/m;  $\epsilon_r = 40.453$ ;  
 $\rho = 1000$  kg/m<sup>3</sup>  
DASY 5 Configuration:

- Probe: ES3DV3 - SN3172; ConvF(4.85, 4.85, 4.85); Calibrated: 2012/8/28;
- Sensor-Surface: 3.4mm (Mechanical Surface Detection),
- Electronics: DAE4 Sn1260; Calibrated: 2013/5/3
- Phantom: Head;
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

### Configuration/Pin=250mW/Area Scan (41x101x1): Interpolated grid:

dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 11.1 W/kg

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

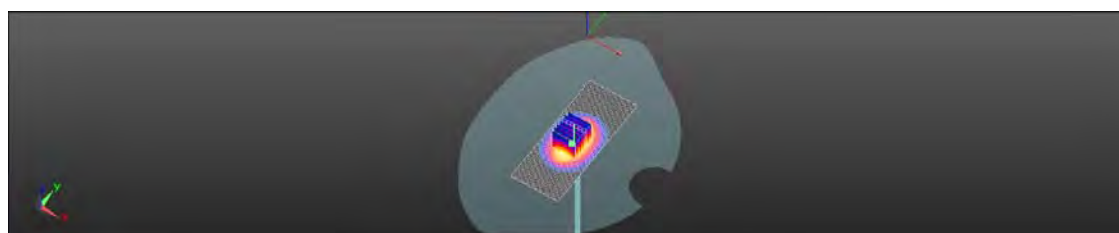
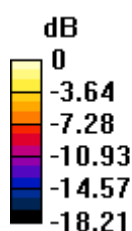
dx=5mm, dy=5mm, dz=5mm

Reference Value = 92.260 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 17.0 W/kg

**SAR(1 g) = 9.94 W/kg; SAR(10 g) = 5.15 W/kg**

Maximum value of SAR (measured) = 11.0 W/kg



0 dB = 11.0 W/kg = 10.40 dBW/kg

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Date: 2013/6/3

## DUT: Dipole 1900 MHz (Body)

Communication System: CW; Communication System Band: D1900 (1900.0 MHz);  
Frequency: 1900 MHz; Medium parameters used:  $f = 1900 \text{ MHz}$ ;  $\sigma = 1.57 \text{ S/m}$ ;  $\epsilon_r = 53.041$ ;  
 $\rho = 1000 \text{ kg/m}^3$   
DASY 5 Configuration:

- Probe: ES3DV3 - SN3172; ConvF(4.44, 4.44, 4.44); Calibrated: 2012/8/28;
- Sensor-Surface: 3.4mm (Mechanical Surface Detection),
- Electronics: DAE4 Sn1260; Calibrated: 2013/5/3
- Phantom: Body;
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

### Configuration/Pin=250mW/Area Scan (41x61x1): Interpolated grid:

$dx=1.500 \text{ mm}$ ,  $dy=1.500 \text{ mm}$

Maximum value of SAR (interpolated) = 13.2 W/kg

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

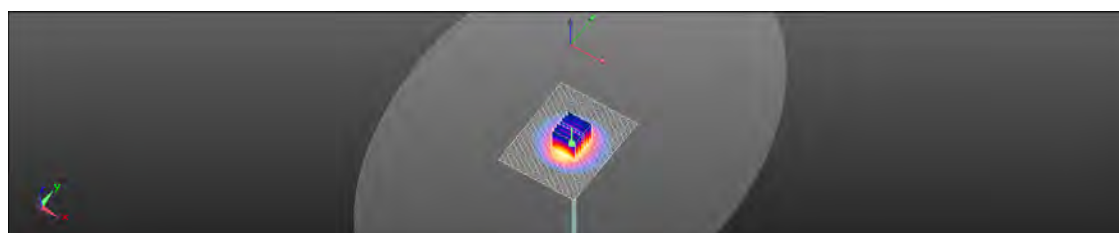
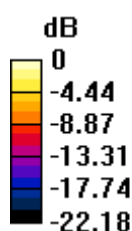
$dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 89.742 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 17.6 W/kg

**SAR(1 g) = 9.91 W/kg; SAR(10 g) = 5.18 W/kg**

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



0 dB = 11.8 W/kg = 10.73 dBW/kg

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Date: 2013/6/2

## DUT: Dipole 2450 MHz (Body)

Communication System: CW; Communication System Band: D2450 (2450.0 MHz);  
Frequency: 2450 MHz; Medium parameters used:  $f = 2450$  MHz;  $\sigma = 2.035$  S/m;  $\epsilon_r = 50.89$ ;  
 $\rho = 1000$  kg/m<sup>3</sup>  
DASY 5 Configuration:

- Probe: ES3DV3 - SN3172; ConvF(3.88, 3.88, 3.88); Calibrated: 2012/8/28;
- Sensor-Surface: 3.4mm (Mechanical Surface Detection),
- Electronics: DAE4 Sn1260; Calibrated: 2013/5/3
- Phantom: Body;
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

### Configuration/Pin=250mW/Area Scan (81x151x1): Interpolated grid:

dx=1.200 mm, dy=1.200 mm

Maximum value of SAR (interpolated) = 14.7 W/kg

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

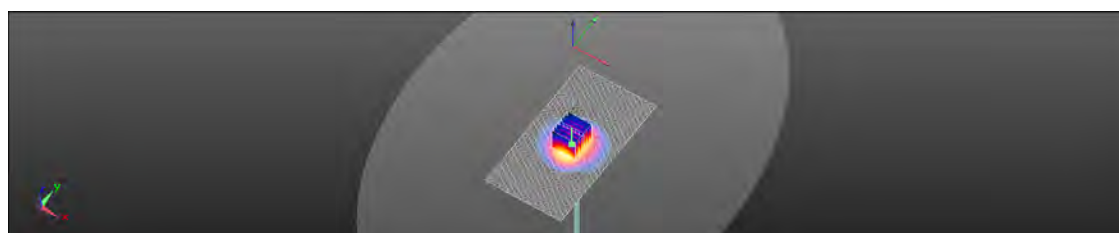
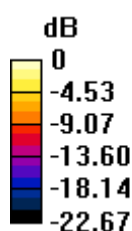
dx=5mm, dy=5mm, dz=5mm

Reference Value = 89.234 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 28.4 W/kg

**SAR(1 g) = 12.9 W/kg; SAR(10 g) = 5.81 W/kg**

Maximum value of SAR (measured) = 15.4 W/kg



0 dB = 15.4 W/kg = 11.87 dBW/kg

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Date: 2013/6/27

## DUT: Dipole 2450 MHz (Body)

Communication System: CW; Communication System Band: D2450 (2450.0 MHz);  
Frequency: 2450 MHz; Medium parameters used:  $f = 2450$  MHz;  $\sigma = 2.023$  S/m;  $\epsilon_r = 50.89$ ;  
 $\rho = 1000$  kg/m<sup>3</sup>

DASY 5 Configuration:

- Probe: ES3DV3 - SN3172; ConvF(3.88, 3.88, 3.88); Calibrated: 2012/8/28;
- Sensor-Surface: 3.4mm (Mechanical Surface Detection),
- Electronics: DAE4 Sn1260; Calibrated: 2013/5/3
- Phantom: Head;
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

## Configuration/Pin=250mW/Area Scan (51x61x1): Interpolated grid:

$dx=1.500$  mm,  $dy=1.500$  mm

Maximum value of SAR (interpolated) = 18.4 W/kg

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

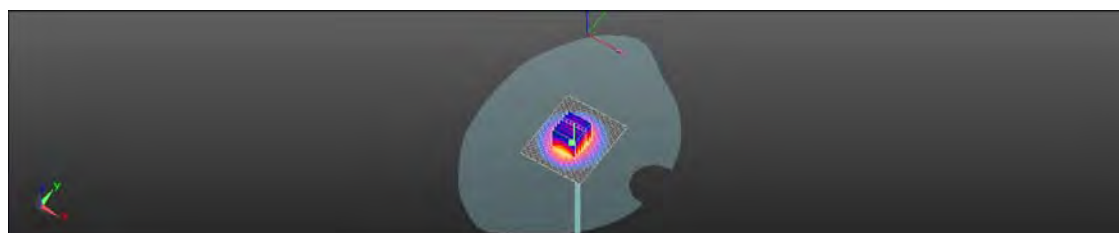
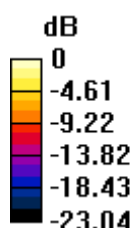
grid:  $dx=5$ mm,  $dy=5$ mm,  $dz=5$ mm

Reference Value = 90.451 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 27.7 W/kg

**SAR(1 g) = 12.7 W/kg; SAR(10 g) = 5.79 W/kg**

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



0 dB = 15.8 W/kg = 11.98 dBW/kg

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## 7. 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: DAE4-1260\_May13

### CALIBRATION CERTIFICATE

Object DAE4 - SD 000 D04 BM - SN: 1260

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

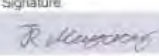
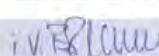
Calibration date: May 03, 2013

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

All calibrations have been conducted in the closed laboratory facility: environment temperature  $(22 \pm 3)^{\circ}\text{C}$  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	02-Oct-12 (No:12728)	Oct-13
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Auto DAE Calibration Unit	SE UWS 053 AA 1001	07-Jan-13 (in house check)	In house check: Jan-14
Calibrator Box V2.1	SE UMS 006 AA 1002	07-Jan-13 (in house check)	In house check: Jan-14

Calibrated by:	Name R. Mayraz	Function Technician	Signature 
Approved by:	Frit Bomholt	Deputy Technical Manager	

issued: May 3, 2013

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

Certificate No: DAE4-1260\_May13

Page 1 of 5

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

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

## Glossary

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

## Methods Applied and Interpretation of Parameters

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

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### DC Voltage Measurement

A/D - Converter Resolution nominal

High Range: 1LSB = 6.1μV , full range = -100...+300 mV  
Low Range: 1LSB = 61nV , full range = -1.....+3mV

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

Calibration Factors	X	Y	Z
High Range	406.022 ± 0.02% (k=2)	404.988 ± 0.02% (k=2)	405.575 ± 0.02% (k=2)
Low Range	3.95574 ± 1.50% (k=2)	4.01997 ± 1.50% (k=2)	4.00367 ± 1.50% (k=2)

### Connector Angle

Connector Angle to be used in DASY system	85.5 ° ± 1 °
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## Appendix

### 1. DC Voltage Linearity

High Range	Reading ( $\mu\text{V}$ )	Difference ( $\mu\text{V}$ )	Error (%)
Channel X + Input	199995.25	-0.61	-0.00
Channel X + Input	20002.51	2.55	0.01
Channel X - Input	-19997.65	3.41	-0.02
Channel Y + Input	199996.90	1.29	0.00
Channel Y + Input	19999.21	-0.82	-0.00
Channel Y - Input	-20002.81	-1.72	0.01
Channel Z + Input	199996.08	0.05	0.00
Channel Z + Input	20000.21	0.24	0.00
Channel Z - Input	-20002.01	-0.82	0.00

Low Range	Reading ( $\mu\text{V}$ )	Difference ( $\mu\text{V}$ )	Error (%)
Channel X + Input	2000.32	0.08	0.00
Channel X + Input	201.12	0.32	0.16
Channel X - Input	-198.54	0.64	-0.32
Channel Y + Input	1999.87	-0.37	-0.02
Channel Y + Input	199.82	-0.86	-0.43
Channel Y - Input	-199.99	-0.69	0.35
Channel Z + Input	1999.72	-0.47	-0.02
Channel Z + Input	199.92	-0.73	-0.37
Channel Z - Input	-199.77	-0.46	0.23

### 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 ( $\mu\text{V}$ )	Low Range Average Reading ( $\mu\text{V}$ )
Channel X	200	0.30	-1.55
	- 200	3.24	1.37
Channel Y	200	12.54	11.97
	- 200	-14.60	-14.70
Channel Z	200	-0.92	-0.66
	- 200	-0.59	-0.63

### 3. Channel separation

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

	Input Voltage (mV)	Channel X ( $\mu\text{V}$ )	Channel Y ( $\mu\text{V}$ )	Channel Z ( $\mu\text{V}$ )
Channel X	200	-	5.57	-1.95
Channel Y	200	9.87	-	7.47
Channel Z	200	10.03	6.92	-

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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	15916	15135
Channel Y	15816	15911
Channel Z	16041	16099

#### 5. Input Offset Measurement

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

Input 10M $\Omega$ 

	Average ( $\mu$ V)	min. Offset ( $\mu$ V)	max. Offset ( $\mu$ V)	Std. Deviation ( $\mu$ V)
Channel X	-1.40	-2.24	0.17	0.43
Channel Y	-2.03	-3.15	0.29	0.50
Channel Z	-1.12	-2.10	-0.02	0.45

#### 6. Input Offset Current

Nominal Input circuitry offset current on all channels: &lt;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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**C** Service suisse d'étalonnage  
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The Swiss Accreditation Service is one of the signatories to the EA  
Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

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

Certificate No: **DAE4-1260\_Sep15**

## CALIBRATION CERTIFICATE

Object: **DAE4 - SD 000 D04 BM - SN: 1260**

Calibration procedure(s): **QA CAL-06.v29**  
**Calibration procedure for the data acquisition electronics (DAE)**

Calibration date: **September 24, 2015**

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

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

Calibration Equipment used (MPE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Kathley Multimeter Type 2001	SN: 0910278	09-Sep-15 (No: 17153)	Sep-15
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Auto DAE Calibration Unit	SE UWS 059 AA 1001	06-Jan-15 (in house check)	In house check Jan-16
Calibrator Box V2.1	SE UMS 006 AA 1002	06-Jan-15 (in house check)	In house check Jan-16

Calibrated by:	Name Eric Hainfeld	Function Technician	Signature 
Approved by:	Fin Bonhof	Deputy Technical Manager	

Issued: September 24, 2015

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

Certificate No: **DAE4-1260\_Sep15**

Page 1 of 5

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 0108

## Glossary

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

## Methods Applied and Interpretation of Parameters

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

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### DC Voltage Measurement

A/D - Converter Resolution nominal

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

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

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

Calibration Factors	X	Y	Z
High Range	406.043 ± 0.02% (k=2)	405.010 ± 0.02% (k=2)	405.577 ± 0.02% (k=2)
Low Range	3.95755 ± 1.50% (k=2)	4.01958 ± 1.50% (k=2)	4.00483 ± 1.50% (k=2)

### Connector Angle

Connector Angle to be used in DASY system	84.5 ° ± 1 °
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## Appendix (Additional assessments outside the scope of SCS0108)

### 1. DC Voltage Linearity

High Range	Reading ( $\mu\text{V}$ )	Difference ( $\mu\text{V}$ )	Error (%)
Channel X + Input	199996.71	-0.71	-0.00
Channel X + Input	20003.42	1.97	0.01
Channel X - Input	-19997.29	3.64	-0.02
Channel Y + Input	199997.03	-0.74	-0.00
Channel Y + Input	20002.19	0.75	0.00
Channel Y - Input	-20000.85	-0.08	0.00
Channel Z + Input	199995.02	-2.52	-0.00
Channel Z + Input	20000.79	-0.63	-0.00
Channel Z - Input	-20001.97	-1.09	0.01

Low Range	Reading ( $\mu\text{V}$ )	Difference ( $\mu\text{V}$ )	Error (%)
Channel X + Input	2001.31	0.02	0.00
Channel X + Input	201.74	0.05	0.03
Channel X - Input	-197.79	0.49	-0.25
Channel Y + Input	2001.47	0.11	0.01
Channel Y + Input	201.57	-0.09	-0.04
Channel Y - Input	-198.16	0.02	-0.01
Channel Z + Input	2001.06	-0.19	-0.01
Channel Z + Input	200.35	-1.16	-0.58
Channel Z - Input	-199.72	-1.47	0.74

### 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 ( $\mu\text{V}$ )	Low Range Average Reading ( $\mu\text{V}$ )
Channel X	200	1.97	-0.02
	-200	0.99	-1.30
Channel Y	200	13.29	13.11
	-200	-13.69	-13.98
Channel Z	200	-0.48	-0.25
	-200	-1.06	-1.87

### 3. Channel separation

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

	Input Voltage (mV)	Channel X ( $\mu\text{V}$ )	Channel Y ( $\mu\text{V}$ )	Channel Z ( $\mu\text{V}$ )
Channel X	200	-	5.95	-2.35
Channel Y	200	9.12	-	6.99
Channel Z	200	9.45	7.26	-

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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	15911	14818
Channel Y	15818	16372
Channel Z	16044	16664

#### 5. Input Offset Measurement

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

Input 10M $\Omega$

	Average ( $\mu$ V)	min. Offset ( $\mu$ V)	max. Offset ( $\mu$ V)	Std. Deviation ( $\mu$ V)
Channel X	-0.60	-1.69	0.60	0.44
Channel Y	-0.89	-3.18	0.27	0.50
Channel Z	-1.05	-1.97	0.26	0.49

#### 6. Input Offset Current

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

#### 7. Input Resistance (Typical values for information)

	Zeroing (k $\Omega$ m)	Measuring (M $\Omega$ m)
Channel X	200	200
Channel Y	200	200
Channel Z	200	200

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

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

#### 9. Power Consumption (Typical values for information)

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

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Accreditation No.: **SCS 108**

Client **SGS-TW (Auden)**

Certificate No: **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  $(22 \pm 3)^\circ\text{C}$  and humidity  $< 70\%$ .

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293574	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	15-Oct-01 (in house check Oct-11)	In house check: Oct-12

	Name	Function	Signature
Calibrated by:	Jeton Kastrati	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	
issued: August 28, 2012			

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Certificate No: ES3-3172\_Aug12

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**C** Service suisse d'étalonnage  
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Accreditation No.: **SCS 108**

## Glossary:

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

## 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

## Methods Applied and Interpretation of Parameters:

- NORM<sub>x,y,z</sub>**: Assessed for E-field polarization  $\theta = 0$  ( $f \leq 900$  MHz in TEM-cell;  $f > 1800$  MHz; R22 waveguide). NORM<sub>x,y,z</sub> are only intermediate values, i.e., the uncertainties of NORM<sub>x,y,z</sub> does not affect the E<sup>2</sup>-field uncertainty inside TSL (see below ConvF).
- NORM(f)<sub>x,y,z</sub> = NORM<sub>x,y,z</sub> \* 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<sub>x,y,z</sub>**: 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<sub>x,y,z</sub>; B<sub>x,y,z</sub>; C<sub>x,y,z</sub>; VR<sub>x,y,z</sub>; 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<sub>x,y,z</sub> \* 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  $\pm 50$  MHz to  $\pm 100$  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

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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 ( $\mu V/(V/m)^2$ ) <sup>A</sup>	1.37	1.14	0.98	± 10.1 %
DCP (mV) <sup>B</sup>	102.0	102.8	94.6	

### Modulation Calibration Parameters

UID	Communication System Name	PAR		A dB	B dB	C dB	VR mV	Unc <sup>C</sup> (k=2)
0	CW	0.00	X	0.00	0.00	1.00	166.6	±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%.

<sup>A</sup> The uncertainties of NormX,Y,Z do not affect the E<sup>2</sup>-field uncertainty inside TSL (see Pages 5 and 6).

<sup>B</sup> Numerical linearization parameter; uncertainty not required.

<sup>C</sup> 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) <sup>C</sup>	Relative Permittivity <sup>F</sup>	Conductivity (S/m) <sup>F</sup>	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 %

<sup>C</sup> 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.

<sup>F</sup> At frequencies below 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) 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 ( $\epsilon$  and  $\sigma$ ) is restricted to ± 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) <sup>c</sup>	Relative Permittivity <sup>d</sup>	Conductivity (S/m) <sup>d</sup>	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 %

<sup>c</sup> 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.

<sup>d</sup> At frequencies below 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) 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 ( $\epsilon$  and  $\sigma$ ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

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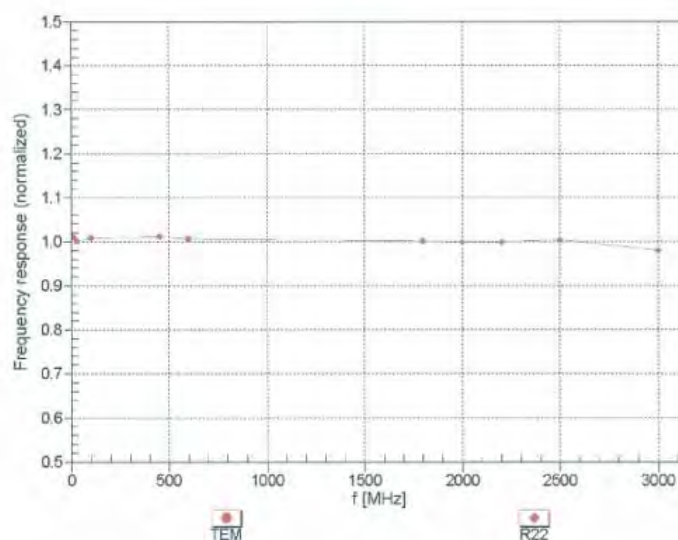
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## Frequency Response of E-Field (TEM-Cell:ifi110 EXX, Waveguide: R22)



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

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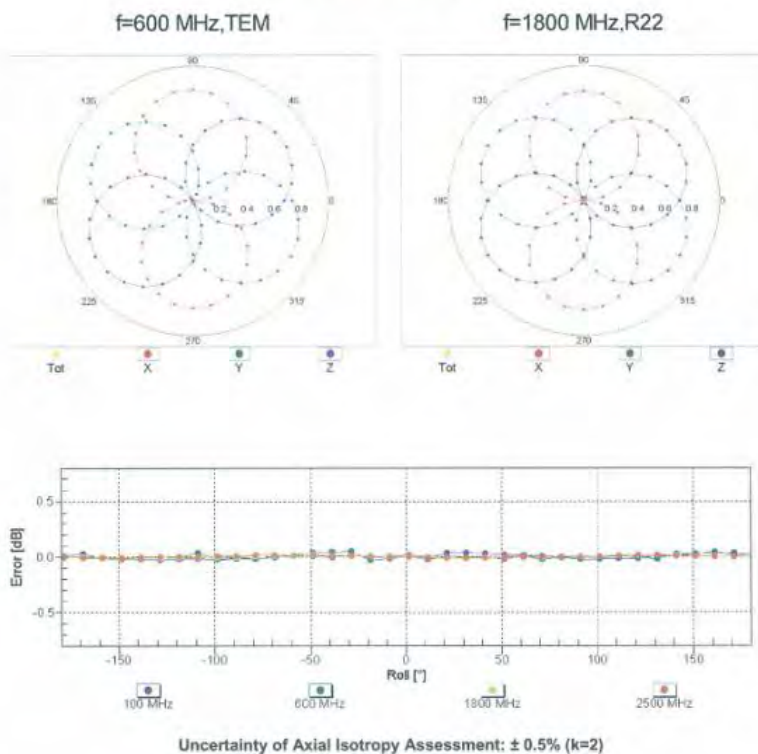
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## Receiving Pattern ( $\phi$ ), $\theta = 0^\circ$



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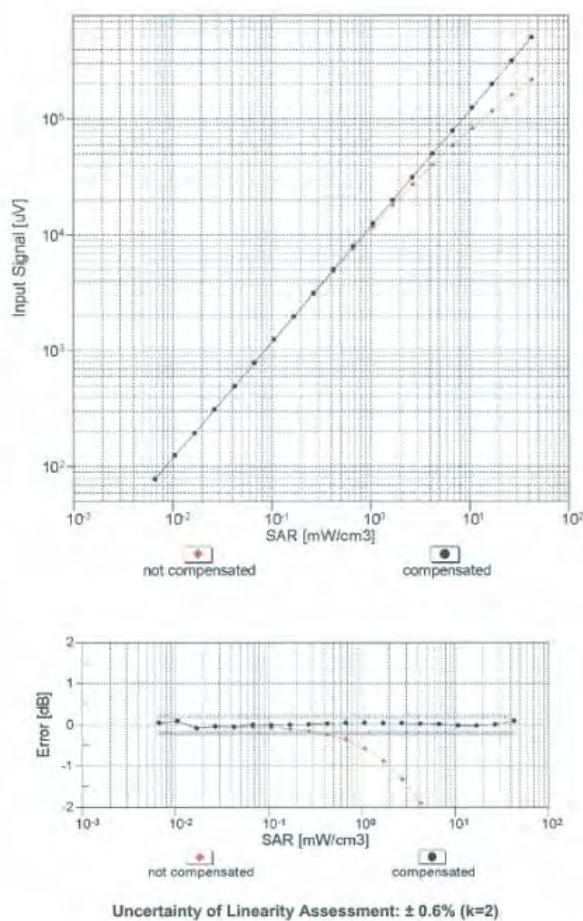
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## Dynamic Range f(SAR<sub>head</sub>) (TEM cell, f = 900 MHz)



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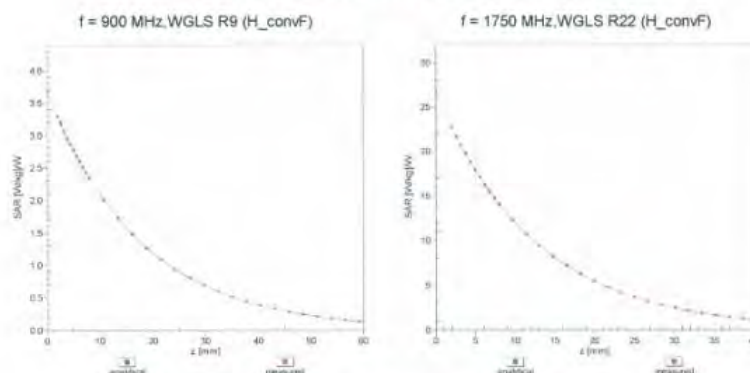
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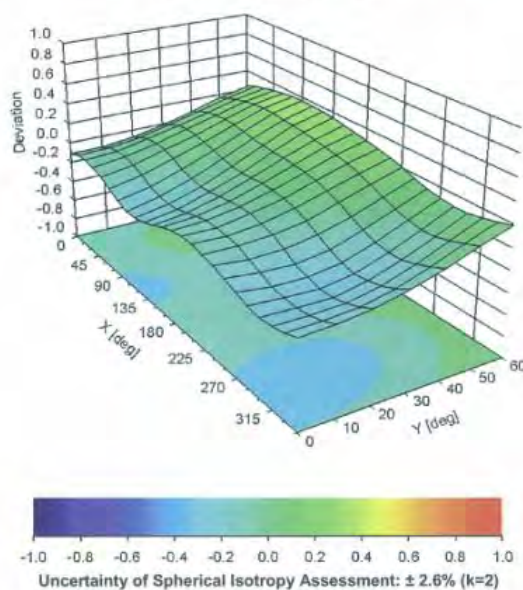
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## Conversion Factor Assessment



## Deviation from Isotropy in Liquid Error ( $\phi$ , $\theta$ ), $f = 900 \text{ MHz}$



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



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 Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **SGS-TW (Auden)**

Certificate No: **EX3-3938\_Oct15**

## CALIBRATION CERTIFICATE

Object **EX3DV4 - SN:3938**

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

Calibration date: **October 1, 2015**

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	01-Apr-15 (No. 217-02128)	Mar-16
Power sensor E4412A	MY41498087	01-Apr-15 (No. 217-02128)	Mar-16
Reference J dB Attenuator	SN: S5054 (3c)	01-Apr-15 (No. 217-02129)	Mar-16
Reference 20 dB Attenuator	SN: S5277 (20x)	01-Apr-15 (No. 217-02132)	Mar-16
Reference 30 dB Attenuator	SN: S5129 (30b)	01-Apr-15 (No. 217-02133)	Mar-16
Reference Probe ES3DV2	SN: 3013	30-Dec-14 (No. ES3-3013_Dec14)	Dec-15
D4E4	SN: 660	14-Jan-15 (No. D4E4-660_Jan15)	Jan-16
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-13)	In house check: Apr-16
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-14)	In house check: Oct-15

Calibrated by:	Name Israel Elmadug	Function Laboratory Technician	Signature 
Approved by:	Katja Pokovic	Technical Manager	
Issued: October 2, 2015			

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Certificate No: **EX3-3938\_Oct15**

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### Glossary:

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

### Calibration is Performed According to the Following Standards:

- IEEE Std 1526-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

### Methods Applied and Interpretation of Parameters:

- NORM<sub>x,y,z</sub>**: Assessed for E-field polarization  $\beta = 0$  ( $f \leq 900$  MHz in TEM-cell;  $f > 1800$  MHz: R22 waveguide). NORM<sub>x,y,z</sub> are only intermediate values, i.e., the uncertainties of NORM<sub>x,y,z</sub> does not affect the E<sup>2</sup>-field uncertainty inside TSL (see below ConvF).
- NORM(f)<sub>x,y,z</sub>** = NORM<sub>x,y,z</sub> \* 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<sub>x,y,z</sub>**: 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<sub>x,y,z</sub>; B<sub>x,y,z</sub>; C<sub>x,y,z</sub>; D<sub>x,y,z</sub>; VR<sub>x,y,z</sub>**: A, B, C, D are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters**: Assessed in flat phantom using E-field (or Temperature Transfer Standard for  $f \leq 800$  MHz) and inside waveguide using analytical field distributions based on power measurements for  $f > 800$  MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM<sub>x,y,z</sub> \* 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  $\pm 50$  MHz to  $\pm 100$  MHz.
- Spherical isotropy (3D deviation from isotropy)**: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset**: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- Connector Angle**: The angle is assessed using the information gained by determining the NORM<sub>x</sub> (no uncertainty required).

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EX3DV4 – SN:3938

October 1, 2015

# Probe EX3DV4

## SN:3938

Manufactured: May 2, 2013  
Calibrated: October 1, 2015

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

Certificate No: EX3-3938\_Oct15

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EX3DV4- SN:3938

October 1, 2015

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

### Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ( $\mu V/(V/m)^2$ ) <sup>A</sup>	0.52	0.57	0.34	± 10.1 %
DCP (mV) <sup>B</sup>	100.8	99.7	104.1	

### Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB $\sqrt{\mu V}$	C	D dB	VR mV	Unc <sup>E</sup> (k=2)
0	CW	X	0.0	0.0	1.0	0.00	141.3	±2.7 %
		Y	0.0	0.0	1.0		147.2	
		Z	0.0	0.0	1.0		128.1	

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%.

<sup>A</sup> The uncertainties of Norm X,Y,Z do not affect the E<sup>2</sup>-field uncertainty inside TSL (see Pages 5 and 6).

<sup>B</sup> Numerical linearization parameter: uncertainty not required.

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

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EX3DV4- SN:3938

October 1, 2015

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

### Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) <sup>c</sup>	Relative Permittivity <sup>f</sup>	Conductivity (S/m) <sup>f</sup>	ConvF X	ConvF Y	ConvF Z	Alpha <sup>g</sup>	Depth <sup>g</sup> (mm)	Unc (k=2)
750	41.9	0.89	9.69	9.69	9.69	0.19	1.67	± 12.0 %
835	41.5	0.90	9.35	9.35	9.35	0.26	1.23	± 12.0 %
900	41.5	0.97	9.15	9.15	9.15	0.18	1.86	± 12.0 %
1450	40.5	1.20	7.86	7.86	7.86	0.13	2.63	± 12.0 %
1750	40.1	1.37	8.17	8.17	8.17	0.36	0.80	± 12.0 %
1900	40.0	1.40	7.89	7.89	7.89	0.32	0.80	± 12.0 %
2000	40.0	1.40	7.89	7.89	7.89	0.36	0.75	± 12.0 %
2300	39.5	1.67	7.46	7.46	7.46	0.34	0.88	± 12.0 %
2450	39.2	1.80	7.11	7.11	7.11	0.32	0.94	± 12.0 %
2600	39.0	1.96	6.79	6.79	6.79	0.24	1.23	± 12.0 %
5250	35.9	4.71	4.90	4.90	4.90	0.40	1.80	± 13.1 %
5300	35.9	4.76	4.81	4.81	4.81	0.40	1.80	± 13.1 %
5600	35.5	5.07	4.28	4.28	4.28	0.50	1.80	± 13.1 %
5750	35.4	5.22	4.41	4.41	4.41	0.50	1.80	± 13.1 %

<sup>c</sup> Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 60 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

<sup>f</sup> 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.

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

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EX3DV4- SN:3938

October 1, 2015

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

### Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) <sup>C</sup>	Relative Permittivity <sup>F</sup>	Conductivity (S/m) <sup>F</sup>	ConvF X	ConvF Y	ConvF Z	Alpha <sup>G</sup>	Depth <sup>G</sup> (mm)	Unc (k=2)
750	55.5	0.96	9.50	9.50	9.50	0.31	1.13	± 12.0 %
835	55.2	0.97	9.30	9.30	9.30	0.28	1.26	± 12.0 %
900	55.0	1.05	9.22	9.22	9.22	0.34	1.05	± 12.0 %
1450	54.0	1.30	7.96	7.96	7.96	0.16	2.05	± 12.0 %
1750	53.4	1.49	7.73	7.73	7.73	0.42	0.80	± 12.0 %
1900	53.3	1.52	7.41	7.41	7.41	0.32	0.90	± 12.0 %
2000	53.3	1.52	7.55	7.55	7.55	0.26	1.05	± 12.0 %
2300	52.9	1.81	7.27	7.27	7.27	0.36	0.84	± 12.0 %
2450	52.7	1.95	7.17	7.17	7.17	0.37	0.85	± 12.0 %
2600	52.5	2.16	6.90	6.90	6.90	0.33	0.90	± 12.0 %
5250	48.9	5.36	4.19	4.19	4.19	0.50	1.90	± 13.1 %
5300	48.9	5.42	4.09	4.09	4.09	0.50	1.90	± 13.1 %
5600	48.5	5.77	3.66	3.66	3.66	0.55	1.90	± 13.1 %
5750	48.3	5.94	3.87	3.87	3.87	0.55	1.90	± 13.1 %

<sup>C</sup> Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

<sup>F</sup> At frequencies below 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) 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 ( $\epsilon$  and  $\sigma$ ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

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

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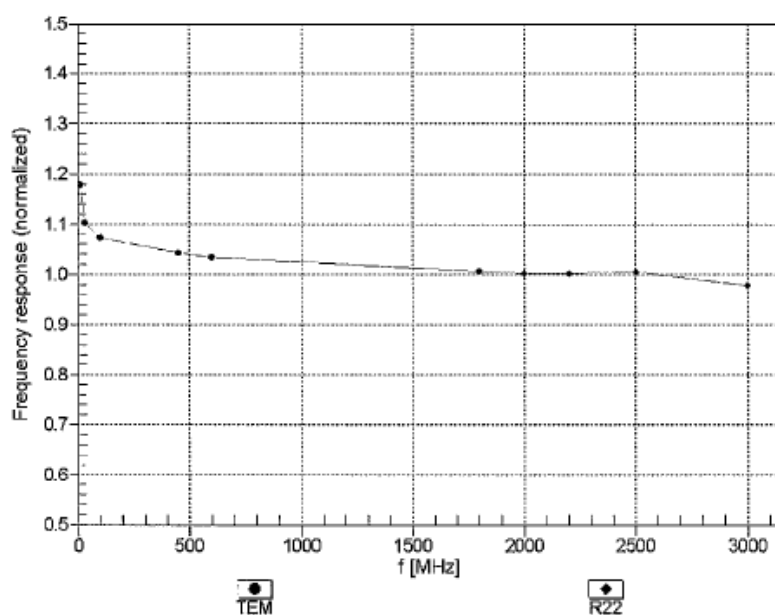
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EX3DV4- SN:3938

October 1, 2015

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



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

Certificate No: EX3-3938\_Oct15

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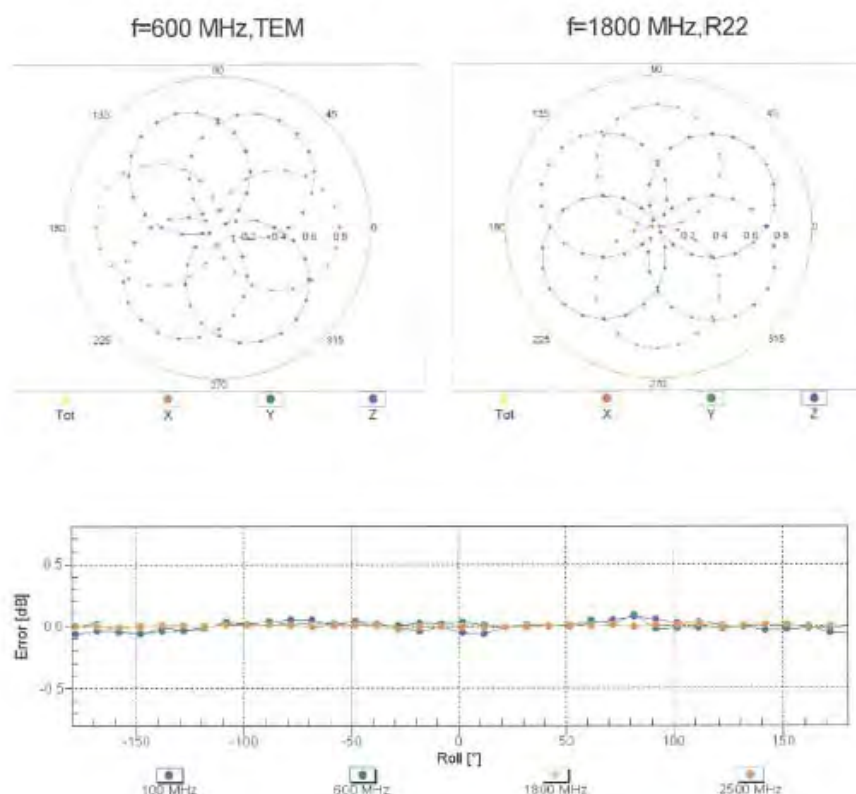
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EX3DV4- SN:3938

October 1, 2015

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



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

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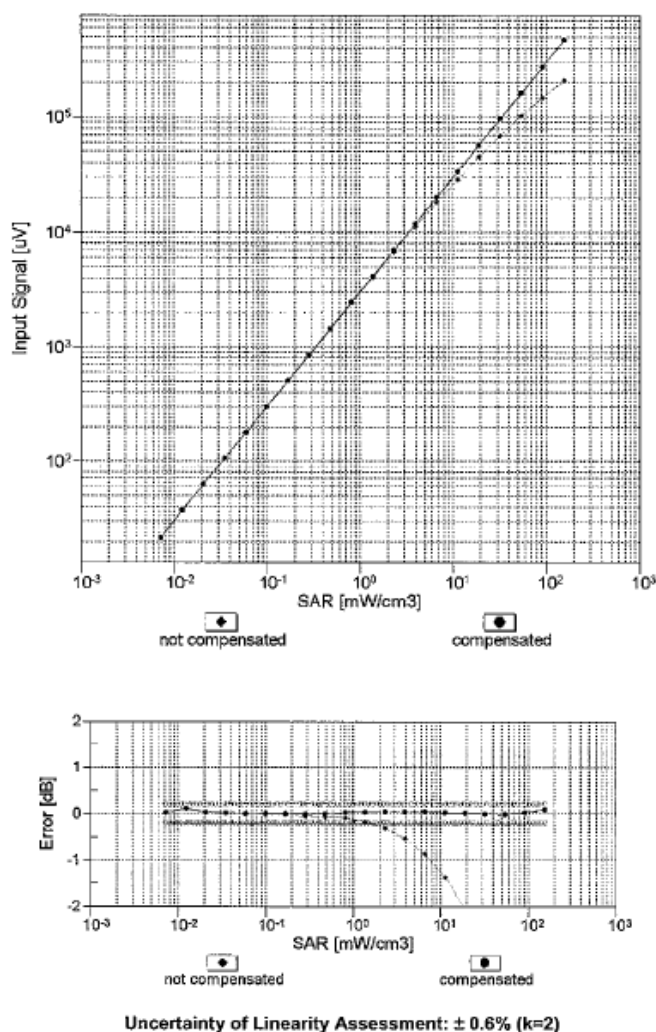
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EX3DV4- SN:3938

October 1, 2015

## Dynamic Range $f(\text{SAR}_{\text{head}})$ (TEM cell, $f_{\text{eval}} = 1900 \text{ MHz}$ )



Certificate No: EX3-3938\_Oct15

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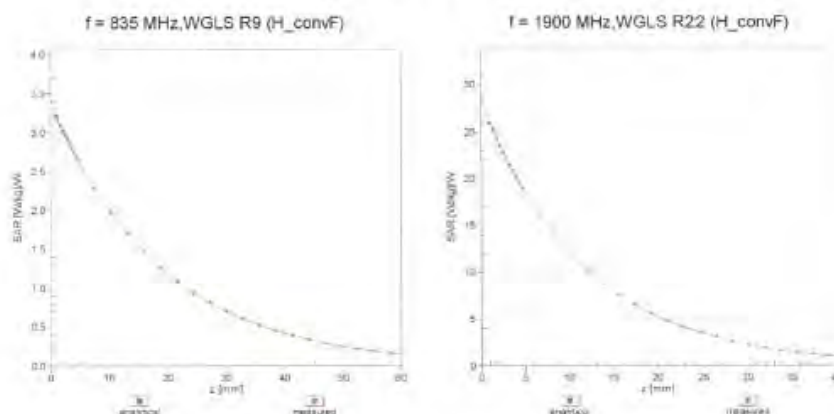
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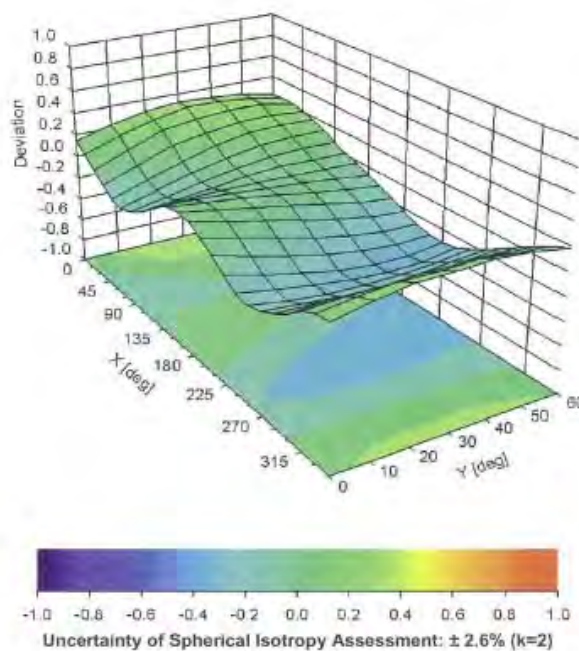
October 1, 2015

## Conversion Factor Assessment



## Deviation from Isotropy in Liquid

Error ( $\phi$ ,  $\theta$ ),  $f = 900$  MHz



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EX3DV4- SN:3938

October 1, 2015

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

### Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-28.1
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	1.4 mm

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## 8. Uncertainty Budget

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

A	c	D	e		f	g	h=c * f / e	i=c * g / e	k
Source of Uncertainty	Tolerance/ Uncertainty %	Probabilit y	Div	Div Value	ci (1g)	ci (10g)	Standard uncertainty	Standard uncertainty	vi, or Veff
<b>Measurement system</b>									
Probe calibration	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%	∞
<b>Measurement drift (class A evaluation)</b>	1.75%	R	$\sqrt{3}$	1.732	1	1	1.01%	1.01%	∞
RF ambient condition - noise	3.00%	R	$\sqrt{3}$	1.732	1	1	1.73%	1.73%	∞
RF ambient conditions - reflections	3.00%	R	$\sqrt{3}$	1.732	1	1	1.73%	1.73%	∞
Probe positioner	0.40%	R	$\sqrt{3}$	1.732	1	1	0.23%	0.23%	∞
<b>Mechanical restrictions</b>									
Probe Positioning with respect to phantom	2.90%	R	$\sqrt{3}$	1.732	1	1	1.67%	1.67%	∞
Post-processing	1.00%	R	$\sqrt{3}$	1.732	1	1	0.58%	0.58%	∞
Max SAR Eval	1.00%	R	$\sqrt{3}$	1.732	1	1	0.58%	0.58%	∞
<b>Test Sample related</b>									
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%	∞
<b>Phantom and Setup</b>									
Phantom Uncertainty	4.00%	R	$\sqrt{3}$	1.732	1	1	2.31%	2.31%	∞
Deviation from reference liquid target $\epsilon_r$ (Body)	3.43%	N	1	1	0.64	0.43	2.20%	1.47%	M
Deviation from reference liquid target $\sigma$ (Body)	4.36%	N	1	1	0.6	0.49	2.62%	2.14%	M
Combined standard uncertainty		RSS					11.83%	11.62%	
Expant uncertainty (95% confidence)							23.67%	23.23%	

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## 9. Phantom Description

**Schmid & Partner Engineering AG**

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

**s p e a g**

**Certificate of Conformity / First Article Inspection**

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

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

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

**Standards**  
 [1] CENELEC EN 50361  
 [2] IEEE Std 1528-2003  
 [3] IEC 62209 Part I  
 [4] FCC OET Bulletin 65, Supplement C, Edition 01-01  
 (\*) The IT/IS CAD file is derived from [2] and is also within the tolerance requirements of the shapes of the other documents.

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

**Date** 07.07.2005

**Signature / Stamp**

**s p e a g**

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

Doc No. 581 – QD 000 P40 C – F

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## 10. System Validation from Original Equipment Supplier

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



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

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

Accreditation No.: **SCS 108**

Client **Auden**

Certificate No: **D835V2-4d120\_Jun12**

### CALIBRATION CERTIFICATE

Object **D835V2 - SN: 4d120**

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

Calibration date: **June 13, 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 B481A	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 B481A	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 <b>Israa El-Naouq</b>	Function <b>Laboratory Technician</b>	Signature 
Approved by:	<b>Katja Pokovic</b>	<b>Technical Manager</b>	

Issued: June 15, 2012

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

Certificate No: D835V2-4d120\_Jun12

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Accreditation No.: **SCS 108**

**Glossary:**

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

**Calibration is Performed According to the Following Standards:**

- IEEE Std 1528-2003, "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 $\pm$ 1 MHz	

### Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	41.1 $\pm$ 6 %	0.89 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C		

### SAR result with Head TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.31 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	9.30 mW / g $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.51 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	6.07 mW / g $\pm$ 16.5 % (k=2)

### Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.2	0.97 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	53.6 $\pm$ 6 %	1.00 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C		

### SAR result with Body TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.43 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	9.44 mW / g $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.59 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	6.22 mW / g $\pm$ 16.5 % (k=2)

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## Appendix

### Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.9 $\Omega$ - 2.3 j $\Omega$
Return Loss	- 32.0 dB

### Antenna Parameters with Body TSL

Impedance, transformed to feed point	47.4 $\Omega$ - 3.9 j $\Omega$
Return Loss	- 26.3 dB

### General Antenna Parameters and Design

Electrical Delay (one direction)	1.397 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	June 29, 2010

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## DASY5 Validation Report for Head TSL

Date: 13.06.2012

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d120**

Communication System: CW; Frequency: 835 MHz

Medium parameters used:  $f = 835 \text{ MHz}$ ;  $\sigma = 0.89 \text{ mho/m}$ ;  $\epsilon_r = 41.1$ ;  $\rho = 1000 \text{ kg/m}^3$

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:

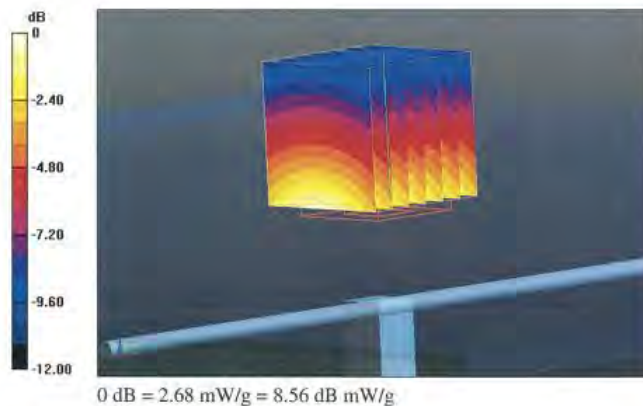
Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 56.771 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 3.388 mW/g

**SAR(1 g) = 2.31 mW/g; SAR(10 g) = 1.51 mW/g**

Maximum value of SAR (measured) = 2.68 mW/g

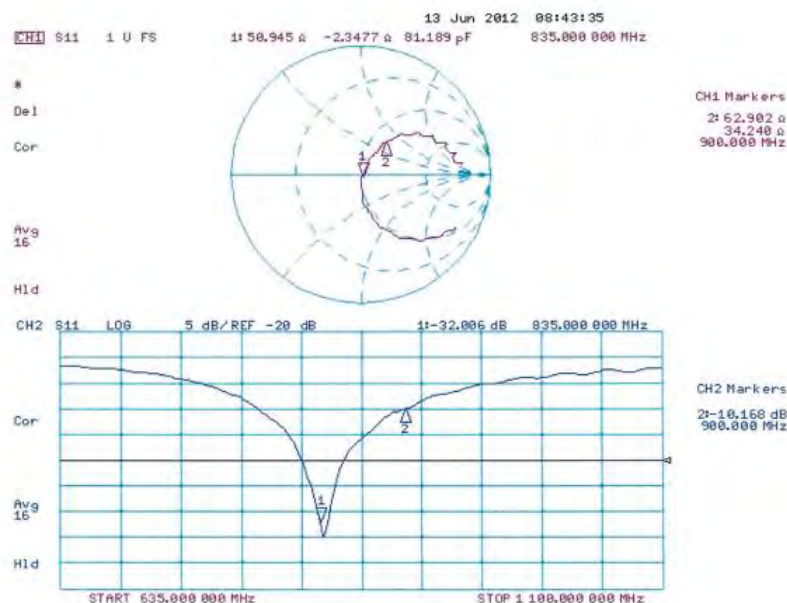


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## Impedance Measurement Plot for Head TSL



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## DASY5 Validation Report for Body TSL

Date: 12.06.2012

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d120**

Communication System: CW; Frequency: 835 MHz

Medium parameters used:  $f = 835 \text{ MHz}$ ;  $\sigma = 1 \text{ mho/m}$ ;  $\epsilon_r = 53.6$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.02, 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:

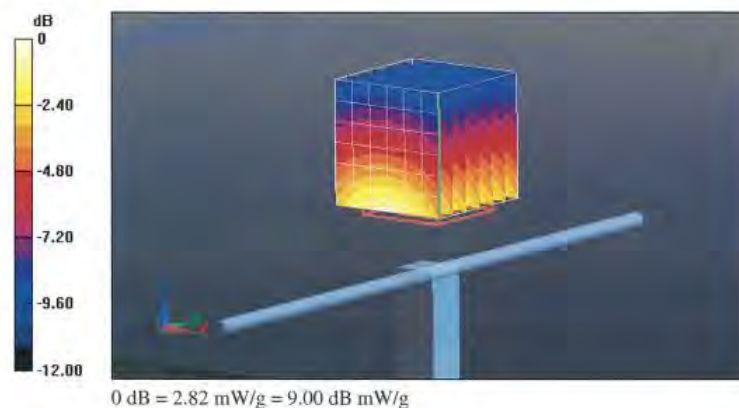
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 55.036 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 3.520 mW/g

SAR(1 g) = 2.43 mW/g; SAR(10 g) = 1.59 mW/g

Maximum value of SAR (measured) = 2.82 mW/g

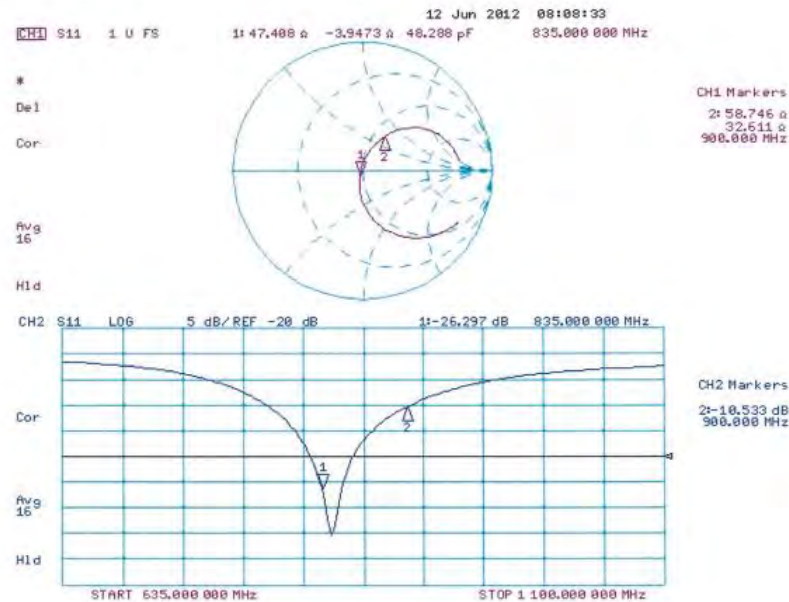


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## Impedance Measurement Plot for Body TSL



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Accreditation No.: SCS 0108

Client **SGS-TW (Auden)**

Certificate No: D900V2-178\_Apr15

## CALIBRATION CERTIFICATE

Object **D900V2 - SN: 178**

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

Calibration date: **April 28, 2015**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP B481A	US37292783	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP B481A	MY41092317	07-Oct-14 (No. 217-02021)	Oct-15
Reference 20 dB Attenuator	SN: 5058 (20k)	01-Apr-15 (No. 217-02131)	Mar-16
Type-N mismatch combination	SN: 5047.2 / 06327	01-Apr-15 (No. 217-02134)	Mar-16
Reference Probe ES3DV3	SN: 3205	30-Dec-14 (No. ES3-3205_Dec14)	Dec-15
DAE4	SN: 601	18-Aug-14 (No. DAE4-601_Aug14)	Aug-15
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP B753E	US37390585 S4206	18-Oct-01 (in house check Oct-14)	In house check: Oct-15

Calibrated by: **Michael Weber** **Michael Weber** Laboratory Technician

Approved by: **Katja Pokovic** **Katja Pokovic** Technical Manager

Signature

*M. Weber*

Issued: April 28, 2015

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

Certificate No: D900V2-178\_Apr15

Page 1 of 8

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Accreditation No.: **SCS 0108**

## Glossary:

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

## Calibration is Performed According to the Following Standards:

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

## Additional Documentation:

- DASY4/5 System Handbook

## Methods Applied and Interpretation of Parameters:

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

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

### Measurement Conditions

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

DASY Version	DASY5	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	900 MHz $\pm$ 1 MHz	

### Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.5	0.97 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	40.8 $\pm$ 6 %	0.96 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

### SAR result with Head TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.64 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	10.6 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.69 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	6.78 W/kg $\pm$ 16.5 % (k=2)

### Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.0	1.05 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	55.3 $\pm$ 6 %	1.04 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

### SAR result with Body TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.66 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	10.7 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.72 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	6.92 W/kg $\pm$ 16.5 % (k=2)

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## Appendix (Additional assessments outside the scope of SCS 0108)

### Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.3 $\Omega$ - 1.3 j $\Omega$
Return Loss	- 37.7 dB

### Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.5 $\Omega$ - 2.9 j $\Omega$
Return Loss	- 26.6 dB

### General Antenna Parameters and Design

Electrical Delay (one direction)	1.400 ns
----------------------------------	----------

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

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

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

### Additional EUT Data

Manufactured by	SPEAG
Manufactured on	January 28, 2003

## DASY5 Validation Report for Head TSL

Date: 28.04.2015

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 900 MHz; Type: D900V2; Serial: D900V2 - SN: 178**

Communication System: UID 0 - CW; Frequency: 900 MHz

Medium parameters used:  $f = 900 \text{ MHz}$ ;  $\sigma = 0.96 \text{ S/m}$ ;  $\epsilon_r = 40.8$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

### DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5.94, 5.94, 5.94); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAB4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

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

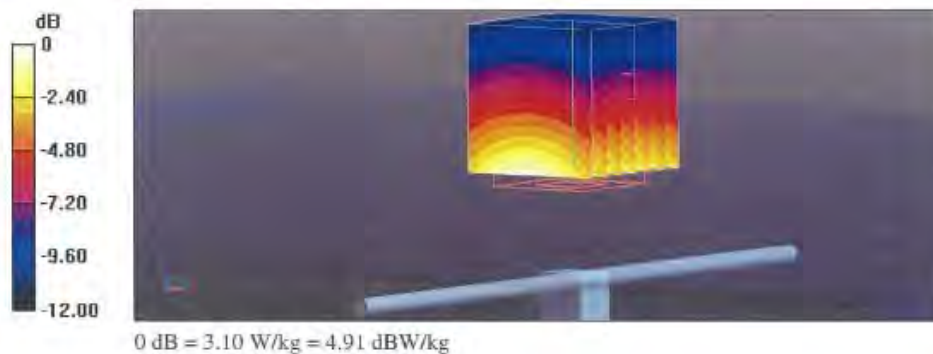
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 58.67 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 3.97 W/kg

**SAR(1 g) = 2.64 W/kg; SAR(10 g) = 1.69 W/kg**

Maximum value of SAR (measured) = 3.10 W/kg

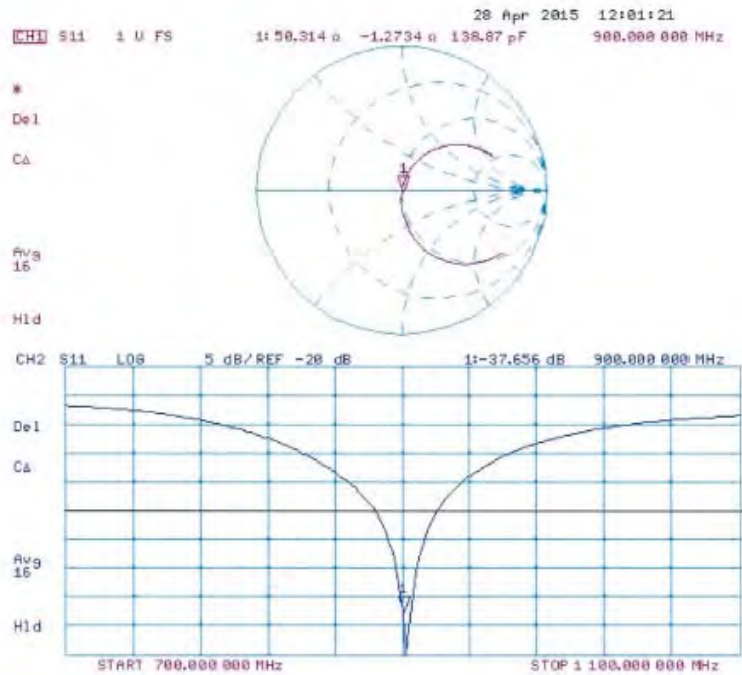


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## Impedance Measurement Plot for Head TSL



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## DASY5 Validation Report for Body TSL

Date: 24.04.2015

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 900 MHz; Type: D900V2; Serial: D900V2 - SN: 178**

Communication System: UID 0 - CW; Frequency: 900 MHz

Medium parameters used:  $f = 900$  MHz;  $\sigma = 1.04$  S/m;  $\epsilon_r = 55.3$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5.95, 5.95, 5.95); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

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

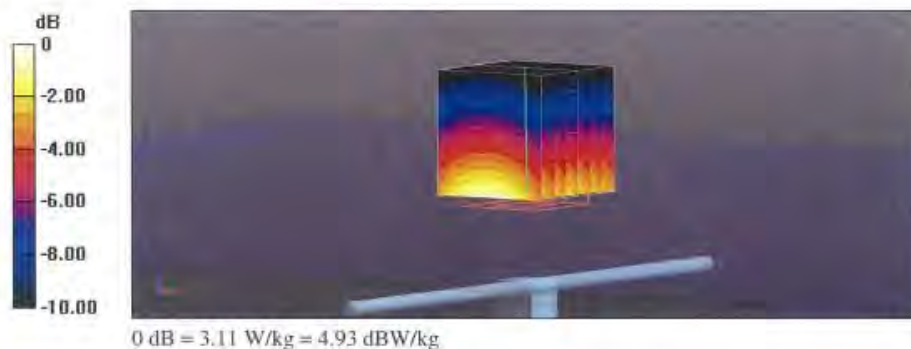
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 56.74 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 3.95 W/kg

**SAR(1 g) = 2.66 W/kg; SAR(10 g) = 1.72 W/kg**

Maximum value of SAR (measured) = 3.11 W/kg



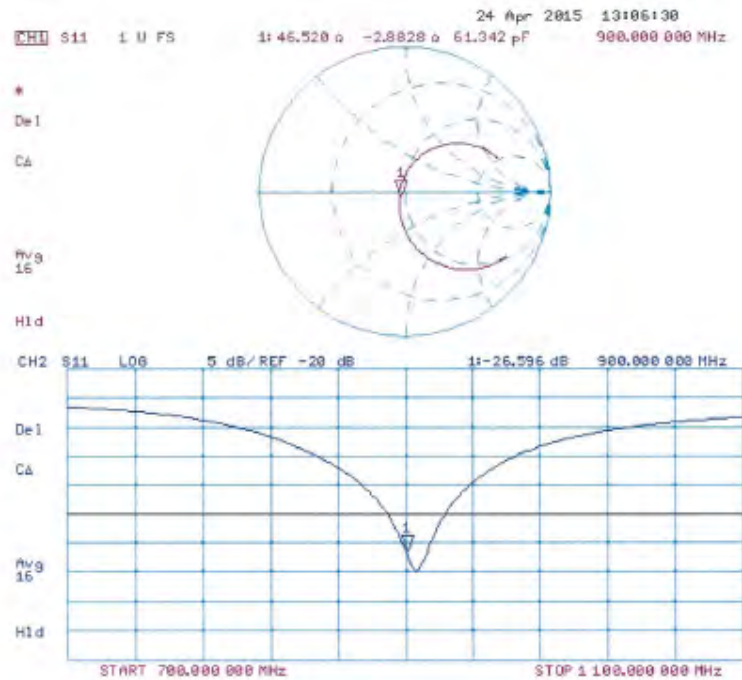
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## Impedance Measurement Plot for Body TSL



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



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

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 Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **SGS-TW (Auden)**

Certificate No: **D1900V2-5d027\_May13**

## CALIBRATION CERTIFICATE

Object **D1900V2 - SN: 5d027**

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

Calibration date: **May 02, 2013**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	01-Nov-12 (No. 217-01640)	Oct-13
Power sensor HP 8481A	US37292783	01-Nov-12 (No. 217-01640)	Oct-13
Reference 20 dB Attenuator	SN: 5058 (20K)	04-Apr-13 (No. 217-01736)	Apr-14
Type-N mismatch combination	SN: 5047.3 / 06327	04-Apr-13 (No. 217-01739)	Apr-14
Reference Probe ES3DV3	SN: 3205	26-Dec-12 (No. ES3-3205_Dec12)	Dec-13
DAE4	SN: 601	25-Apr-13 (No. DAE4-601_Apr13)	Apr-14
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41082317	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-12)	In house check: Oct-13

Calibrated by: **Claudio Laubler** **Laboratory Technician**

Signature

Approved by: **Katja Pokovic** **Technical Manager**

Issued: May 2, 2013

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

Certificate No: D1900V2-5d027\_May13

Page 1 of 8

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Accreditation No.: SCS 108

**Glossary:**

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

**Calibration is Performed According to the Following Standards:**

- IEEE Std 1528-2003, "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	V52.8.6
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz $\pm$ 1 MHz	

### Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	39.3 $\pm$ 6 %	1.37 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	—	—

### SAR result with Head TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.71 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	39.2 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.09 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	20.5 W/kg $\pm$ 16.5 % (k=2)

### Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	54.0 $\pm$ 6 %	1.51 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	—	—

### SAR result with Body TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	10.1 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	40.7 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.37 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.6 W/kg $\pm$ 16.5 % (k=2)

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## Appendix

### Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.5 $\Omega$ + 3.5 j $\Omega$
Return Loss	- 29.2 dB

### Antenna Parameters with Body TSL

Impedance, transformed to feed point	44.7 $\Omega$ + 4.8 j $\Omega$
Return Loss	- 22.4 dB

### General Antenna Parameters and Design

Electrical Delay (one direction)	1,196 ns
----------------------------------	----------

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

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

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

### Additional EUT Data

Manufactured by	SPEAG
Manufactured on	December 17, 2002

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## DASY5 Validation Report for Head TSL

Date: 02.05.2013

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.37$  S/m;  $\epsilon_r = 39.3$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.98, 4.98, 4.98); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.6(1115); SEMCAD X 14.6.9(7117)

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

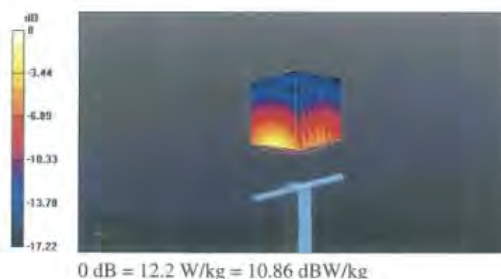
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 95.215 V/m; Power Drift = 0.08 dB

Peak SAR (extrapolated) = 17.6 W/kg

SAR(1 g) = 9.71 W/kg; SAR(10 g) = 5.09 W/kg

Maximum value of SAR (measured) = 12.2 W/kg



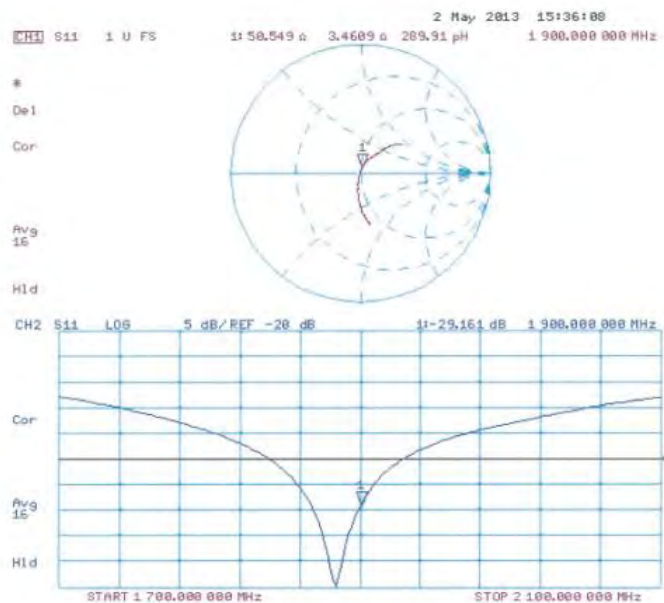
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## Impedance Measurement Plot for Head TSL



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## DASY5 Validation Report for Body TSL

Date: 02.05.2013

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.51$  S/m;  $\epsilon_r = 54$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.6, 4.6, 4.6); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.6(1115); SEMCAD X 14.6.9(7117)

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

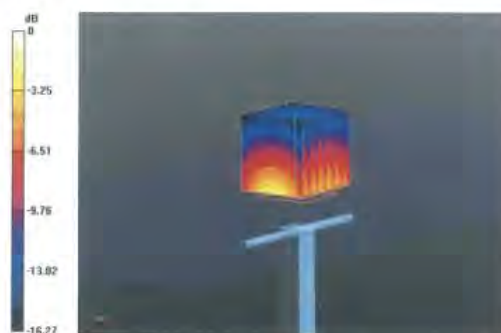
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 95.215 V/m; Power Drift = 0.07 dB

Peak SAR (extrapolated) = 17.1 W/kg

**SAR(1 g) = 10.1 W/kg; SAR(10 g) = 5.37 W/kg**

Maximum value of SAR (measured) = 12.6 W/kg



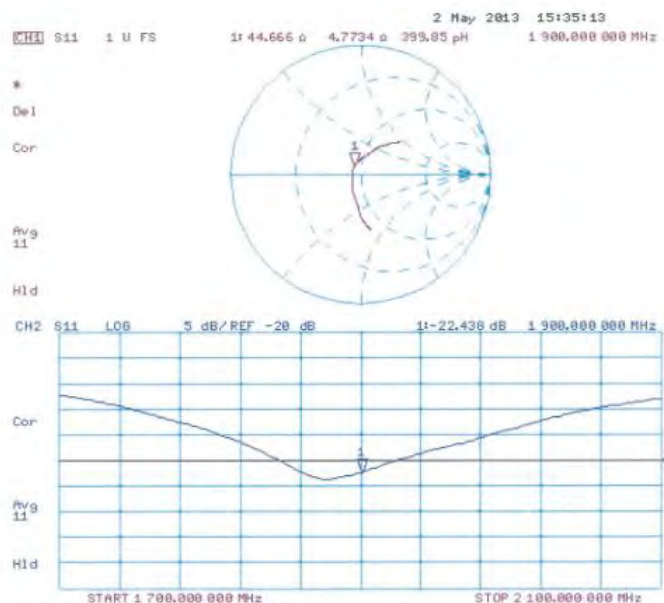
0 dB = 12.6 W/kg = 11.00 dBW/kg

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## Impedance Measurement Plot for Body TSL



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



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

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 Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **SGS-TW (Auden)**

Certificate No: **D2450V2-727\_May13**

## CALIBRATION CERTIFICATE

Object **D2450V2 - SN: 727**

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

Calibration date: **May 02, 2013**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	01-Nov-12 (No. 217-01640)	Oct-13
Power sensor HP 8481A	US37292783	01-Nov-12 (No. 217-01640)	Oct-13
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-13 (No. 217-01736)	Apr-14
Type-N mismatch combination	SN: 5047.3 / 06327	04-Apr-13 (No. 217-01736)	Apr-14
Reference Probe ES3DV3	SN: 3205	28-Dec-12 (No. ES3-3205_Dec12)	Dec-13
DAE4	SN: 601	25-Apr-13 (No. DAE4-601_Apr13)	Apr-14
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
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-12)	In house check: Oct-13

Calibrated by: **Claudio Leubler** **Laboratory Technician**

Approved by: **Katja Polovic** **Technical Manager**

Signature

Issued: May 2, 2013

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

Certificate No: D2450V2-727\_May13

Page 1 of 8

*Robert Chang*

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Accreditation No.: **SCS 108**

**Glossary:**

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

**Calibration is Performed According to the Following Standards:**

- IEEE Std 1528-2003, "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	V52.8.6
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz $\pm$ 1 MHz	

### Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	37.7 $\pm$ 6 %	1.83 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C		

### SAR result with Head TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.7 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	53.9 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.35 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	25.1 W/kg $\pm$ 16.5 % (k=2)

### Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	51.2 $\pm$ 6 %	2.03 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C		

### SAR result with Body TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	13.2 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	51.5 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.09 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	24.0 W/kg $\pm$ 16.5 % (k=2)

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## Appendix

### Antenna Parameters with Head TSL

Impedance, transformed to feed point	$55.6 \Omega + 1.9 j\Omega$
Return Loss	- 25.0 dB

### Antenna Parameters with Body TSL

Impedance, transformed to feed point	$51.9 \Omega + 4.0 j\Omega$
Return Loss	- 27.2 dB

### General Antenna Parameters and Design

Electrical Delay (one direction)	1.150 ns
----------------------------------	----------

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

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

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

### Additional EUT Data

Manufactured by	SPEAG
Manufactured on	January 09, 2003

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## DASY5 Validation Report for Head TSL

Date: 02.05.2013

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.83$  S/m;  $\epsilon_r = 37.7$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.52, 4.52, 4.52); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.6(1115); SEMCAD X 14.6.9(7117)

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

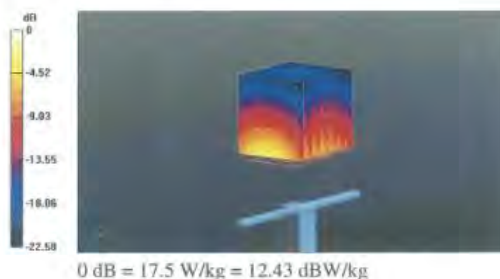
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 95.668 V/m; Power Drift = 0.09 dB

Peak SAR (extrapolated) = 28.6 W/kg

SAR(1 g) = 13.7 W/kg; SAR(10 g) = 6.35 W/kg

Maximum value of SAR (measured) = 17.5 W/kg

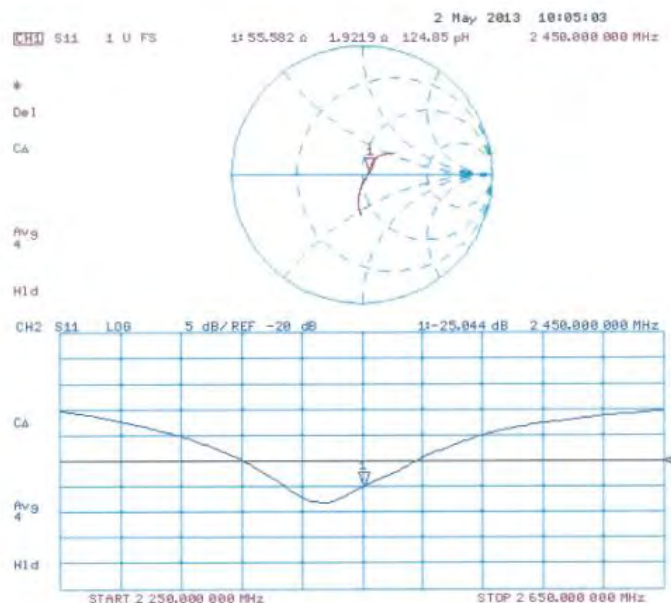


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## Impedance Measurement Plot for Head TSL



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## DASY5 Validation Report for Body TSL

Date: 02.05.2013

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 2.03$  S/m;  $\epsilon_r = 51.2$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.42, 4.42, 4.42); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.6(1|15); SEMCAD X 14.6.9(7|17)

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

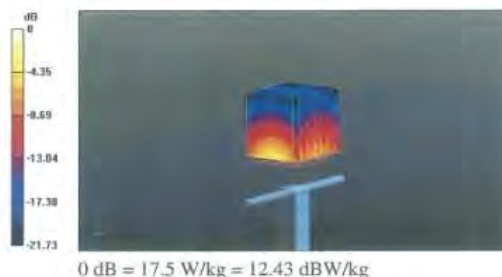
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 95.668 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 27.5 W/kg

**SAR(1 g) = 13.2 W/kg; SAR(10 g) = 6.09 W/kg**

Maximum value of SAR (measured) = 17.5 W/kg

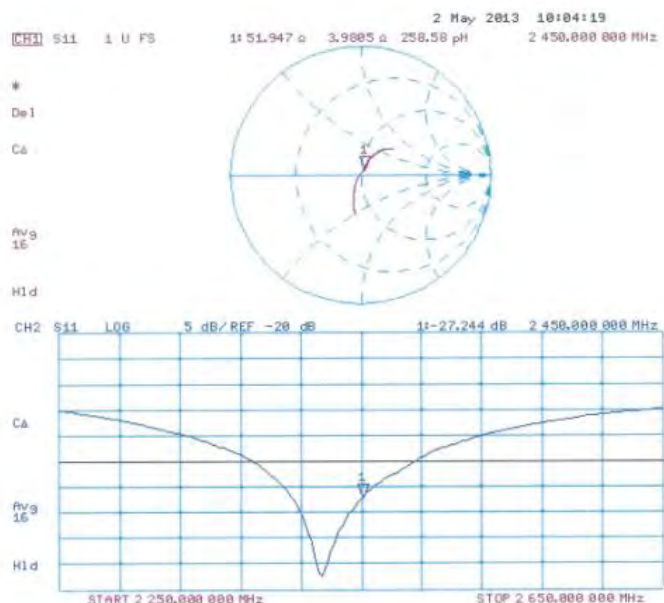


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## Impedance Measurement Plot for Body TSL



**- End of 1<sup>st</sup> part of report -**

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