

# SAR TEST REPORT

Equipment Under Test	:	Digital Camera
Model No.	:	DV150F
Applicant	:	Samsung Electronics Co., Ltd.
Address of Applicant	:	416, Maetan-dong, Yeongtong-gu, Suwon-city, Gyeonggi-do, Korea
FCC ID	:	A3L-DV150F
IC ID	:	649E-DV150F
Device Category	:	Portable Device
Exposure Category	:	General Population /Uncontrolled Exposure
Date of Receipt	:	2012-11-13
Date of Test(s)	:	2012-11-21
Date of Issue	:	2012-11-23
Max. SAR	:	0.485W/kg (11b)

**Standards:**                    **FCC OET Bulletin 65 supplement C**  
                                       **RSS-102 (Issue 4)**  
                                       **IEEE 1528, 2003**  
                                       **ANSI/IEEE C95.1, C95.3**

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

**Remarks:**

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This report details the results of the testing carried out on one sample, the results contained in this test report do not relate to other samples of the same product. The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in this report. This report may only be reproduced and distributed in full. If the product in this report is used in any configuration other than that detailed in the report, the manufacturer must ensure the new system complies with all relevant standards. Any mention of SGS Testing Korea Co., Ltd. or testing done by SGS Testing Korea Co., Ltd. in connection with distribution or use of the product described in this report must be approved by SGS Testing Korea Co., Ltd. in writing.

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<b>Tested by</b>	:	<b>Minhyuk Han</b>		<b>2012-11-23</b>
<b>Approved by</b>	:	<b>Feel Jeong</b>		<b>2012-11-23</b>

## **Contents**

### **1. General Information**

1.1	Testing Laboratory.....	3
1.2	Details of Applicant.....	3
1.3	Version of Report.....	3
1.4	Description of EUT(s).....	3
1.5	Test Environment.....	4
1.6	Operation description.....	4
1.7	Evaluation procedures.....	4
1.8	The SAR Measurement System.....	5
1.9	System Components.....	7
1.10	SAR System Verification.....	8
1.11	Tissue Simulant Fluid for the Frequency Band.....	10
1.12	Test Standards and Limits.....	11
1.13	Justification for Extended SAR Dipole Calibrations.....	12

### **2 Instruments List.....** 13

### **3 Summary of Results .....** 14

3.1	FCC Power Measurement Procedures.....	14
3.2	RF Conducted Power.....	14
3.3	SAR Test Configuration .....	16
3.4	Still cameras and video cameras Test position .....	17

## **APPENDIX**

A. DASY5 SAR Report

B. Uncertainty Analysis

C. Calibration certificate

# 1. General Information

## 1.1 Testing Laboratory

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 Homepage : All SGS services are rendered in accordance with the applicable SGS conditions of service available on request and accessible at <http://www.sgs.com/en/Terms-and-Conditions.aspx>

## 1.2 Details of Applicant

Manufacturer : Samsung Electronics Co., Ltd.  
 Address : 416, Maetan-dong, Yeongtong-gu, Suwon-city, Gyeonggi-do, Korea  
 Contact Person : Moonki- Seok  
 Phone No. : +82 +31 277 6800  
 E-mail : mk1004.seok@samsung.com

## 1.3 Version of Report

Version Number	Date	Revision
00	2012-11-23	Initial issue

## 1.4 Description of EUT(s)

<b>EUT Type</b>	: Digital Camera
<b>Model</b>	: DV150F
<b>Serial Number</b>	: N/A
<b>H/W Version</b>	: DV 2012.10.17
<b>S/W Version</b>	: 1112
<b>Mode of Operation</b>	: WLAN
<b>Body worn Accessory</b>	: None
<b>Tx Frequency Range</b>	: 2412 MHz ~ 2462 MHz (WLAN)
<b>Max. Conducted RF Power</b>	: 12.81 dB m (WLAN)
<b>Battery Type</b>	: DC 3.7 V (Li-ion Battery)

### 1.5 Test Environment

Ambient temperature	: (22 ± 2) ° C
Tissue Simulating Liquid	: (22 ± 2) ° C
Relative Humidity	: (55 ± 5) % R.H.

### 1.6 Operation Configuration

The client provided a special driver and test program which can control the frequency and power of the WLAN module. Measurements were performed at the lowest, middle and highest channels of the operating band. The EUT was set to maximum power level during all tests and at the beginning of each test the battery was fully charged.

The DASY5 system measures power drift during SAR testing by comparing e-field in the same location at the beginning and at the end of measurement.

### 1.7 EVALUATION PROCEDURES

#### - Power Reference Measurement Procedures

The Power Reference Measurement and Power Drift Measurements are for monitoring the power drift of the device under test in the batch process. The Minimum distance of probe sensors to surface determines the closest measurement point to phantom surface. The minimum distance of probe sensors to surface is 4 mm. This distance cannot be smaller than the Distance of sensor calibration points to probe tip as defined in the probe properties (for example, 2.0 mm for an EX3DV4 probe type).

- 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 1g and 10g 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 mm to 2.0 mm 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 1g and 10g cubes, the extrapolation distance should not be larger than 5 mm.

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  $7 \times 7 \times 7$  scans. The routines are verified and optimized for the grid dimensions used in these cube measurements. The measured volume of  $30 \times 30 \times 30$  mm 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 the moved around until the highest averaged SAR is found. If the highest SAR is found at the edge of the measured volume, the system will issue a warning: higher SAR values might be found outside of the measured volume. In that case the cube measurement can be repeated, using the new interpolated maximum as the center.

## 1.8 The SAR Measurement System

A photograph 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 EX3DV4 3862 E-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 DASY5 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 for accommodating the data acquisition electronics (DAE).
- A dosimeter probe, i.e., an isotropic E-field probe optimized and calibrated for usage in tissue simulating liquid. The probe is equipped with an optical surface detector system.
- A data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery

powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.

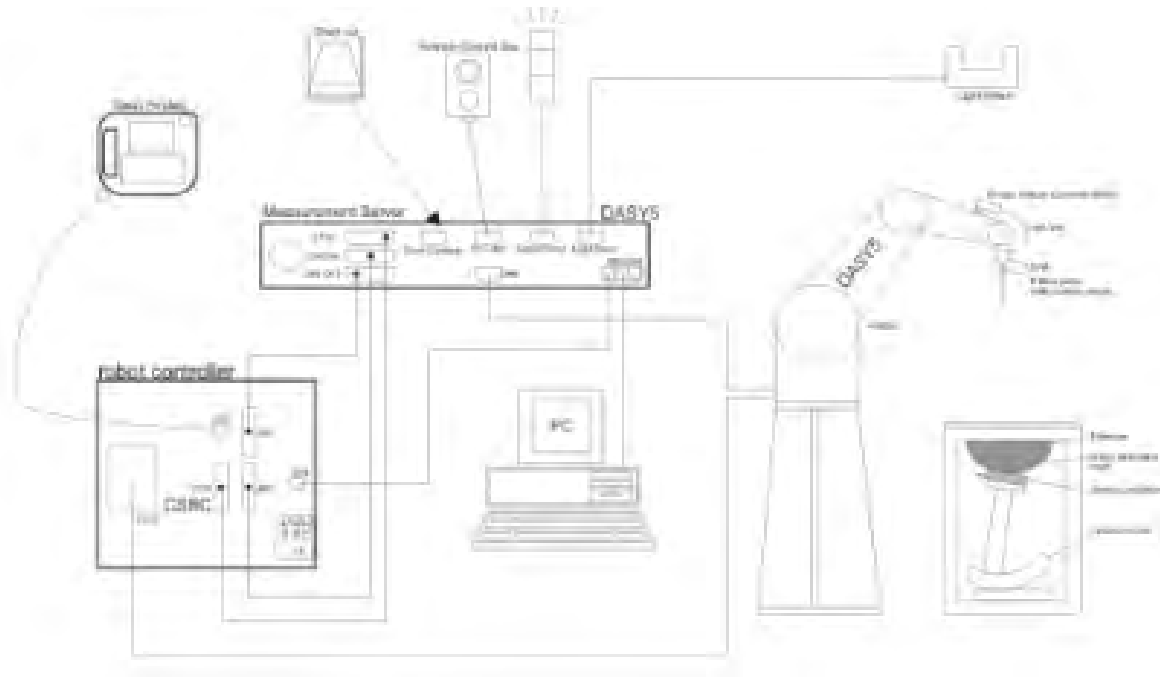


Fig a. The microwave circuit arrangement used for SAR system verification

- 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.
- DASY5 software.
- Remote control with teach pendant and additional circuitry for robot safety such as warning lamps, etc.
- The SAM twin phantom enabling testing body usage.
- The device holder for flat phantom.
- Tissue simulating liquid mixed according to the given recipes.
- Validation dipole kits allowing to validate the proper functioning of the system

## 1.9 System Components

### Isotropic E-field Probe EX3DV4



**Fig. EX3DV4 E-field Probe**

<b>Construction</b>	: Symmetrical design with triangular core. Built-in shielding against static charges. PEEK enclosure material (resistant to organic solvents, e.g., DGBE)
<b>Calibration</b>	: Basic Broad Band Calibration in air Conversion Factors (CF) for HSL 2600 and HSL5800. Additional CF-Calibration for other liquids and frequencies upon request.
<b>Frequency</b>	: 10 MHz to 6 GHz; Linearity: $\pm 0.2$ dB (30 MHz to 6 GHz)
<b>Directivity</b>	: $\pm 0.3$ dB in HSL (rotation around probe axis) $\pm 0.5$ dB in tissue material (rotation normal to probe axis)
<b>Dynamic Range</b>	: $10\mu\text{W/g}$ to $> 100\text{ m W/g}$ ; Linearity: $\pm 0.2$ dB(noise: typically $< 1\ \mu\text{W/g}$ )
<b>Dimensions</b>	: Overall length: 337 mm (Tip length: 20 mm) Tip diameter: 2.5 mm (Body diameter: 12 mm) Distance from probe tip to dipole centers: 1 mm
<b>Application</b>	: 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%
<b>Construction</b>	: Symmetrical design with triangular core. Built-in shielding against static charges. PEEK enclosure material (resistant to organic solvents, e.g., DGBE)

**NOTE:**

1. The Probe parameters have been calibrated by the SPEAG. Please reference "APPENDIX D" for the Calibration Certification Report.

### SAM Phantom

**Construction:** The SAM Phantom is constructed of a fiberglass shell integrated in a wooden table. The shape of the shell is based on data from an anatomical study designed to determine the maximum exposure in at least 90 % of all users. 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 the 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 in the robot



SAM Phantom

**Shell Thickness:** 2.0 mm ± 0.1 mm

**Filling Volume:** Approx. 25 liters

### DEVICE HOLDER

**Construction** In combination with the Twin SAM PhantomV4.0/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).



Device Holder

### 1.10 SAR System Verification

The microwave circuit arrangement for system verification is sketched in Fig. b. The daily system accuracy verification occurs within the flat section of the SAM phantom. A SAR measurement was performed to see if the measured SAR was within +/- 10% from the target SAR values. This test was done at 2450 MHz. The test for EUT was conducted within 24 hours after each validation. The obtained result from the system accuracy verification is displayed in the table 1 (SAR values are normalized to 1W forward power delivered to the dipole). During the test, the ambient temperature of the laboratory was in the range (22 ± 2) ° C, the relative humidity was in the range (55 ± 5) % R.H. 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

result is within acceptable tolerance of the reference value.

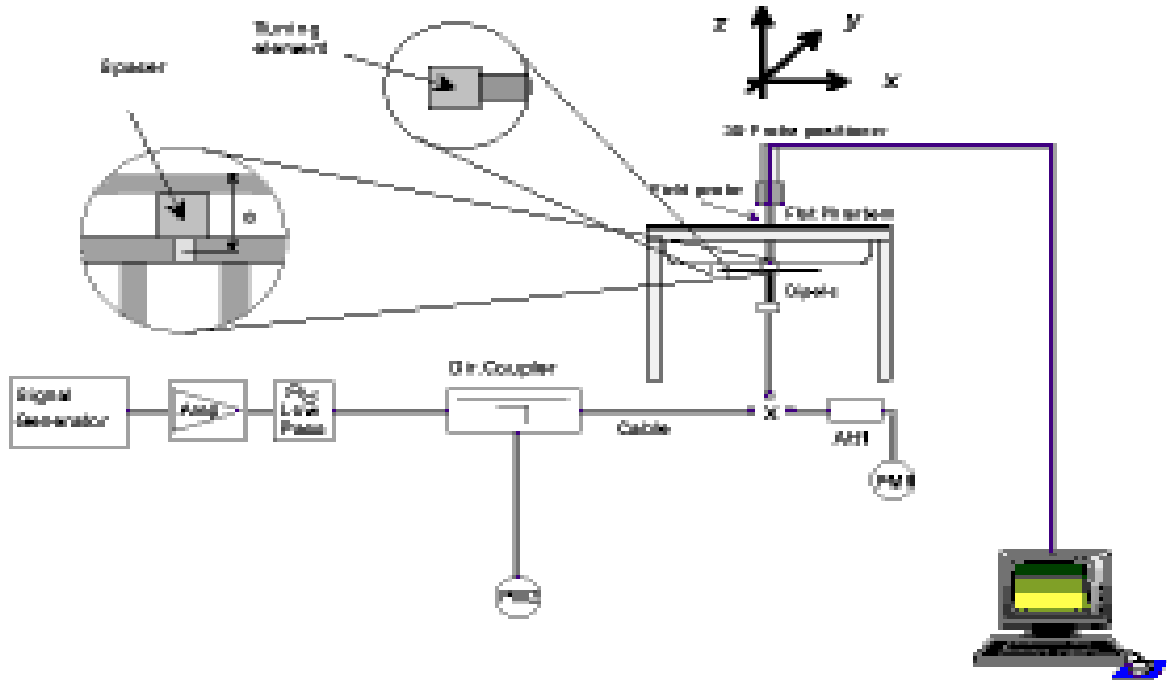


Fig b. The microwave circuit arrangement used for SAR system verification

- A. Agilent Model E4421B Signal Generator
- B. EMPOWER Model 2001-BBS3Q7ECK Amplifier
- C. Agilent Model E4419B Power Meter
- D. Agilent Model 9300H Power Sensor
- E. Agilent Model 777D/778D Dual directional coupling
- F. Reference dipole Antenna



Fig c. Photo of the dipole Antenna

### System Validation Results

Validation Kit	Tissue	Input Power (W)	Measured SAR 1g	Target SAR 1 g (Normalized to 1 W)	Measured SAR 1 g (Normalized to 1 W)	Deviation (%)	Date	Liquid Temp. (°C)
D2450V2 S/N: 734	2450 MHz Body	0.1	5.23	50.20 W/kg	<b>52.3W/kg</b>	<b>4.18</b>	2012/11/21	22.5

Table 1. Results system validation

### 1.11 Tissue Simulant Fluid for the Frequency Band

The dielectric properties for this simulant fluid were measured by using the Agilent Model 85070D Dielectric Probe (rates frequency band 200 MHz to 20 GHz) in conjunction with Agilent E5070B Network Analyzer(300 kHz-3000 MHz ) by using a procedure detailed in Section V.

f (MHz)	Tissue type	Limits / Measured	Dielectric Parameters		
			Permittivity	Conductivity	Simulated Tissue Temp( °C)
2450	Body	Measured, 2012-11-21	52.26	1.935	<b>22.5</b>
		Recommended Limits	52.7	1.95	21.0 ~ 23.0
		Deviation(%)	<b>-0.83</b>	<b>-0.77</b>	-
2412		Measured, 2012-11-21	52.28	1.89	22.5
Deviation(%)		<b>-0.80</b>	<b>-3.08</b>	-	
2437		Measured, 2012-11-21	52.28	1.921	22.5
Deviation(%)		<b>-0.80</b>	<b>-1.49</b>	-	
2462		Measured, 2012-11-21	52.26	1.946	22.5
Deviation(%)	<b>-0.83</b>	<b>-0.21</b>	-		

Typical composition of ingredients for liquid liquid tissue phantoms

The following tissue formulations are provided for reference only as some of the parameters have not been thoroughly verified. The composition of ingredients may be modified accordingly to achieve the desired target tissue parameters required for routine SAR evaluation.

Ingredients (% by weight)	Frequency (MHz)									
	450		835		915		1900		2450	
Tissue Type	Head	Body	Head	Body	Head	Body	Head	Body	Head	Body
Water	38.56	51.16	41.45	52.4	41.05	56.0	54.9	40.4	62.7	73.2
Salt (NaCl)	3.95	1.49	1.45	1.4	1.35	0.76	0.18	0.5	0.5	0.04
Sugar	56.32	46.78	56.0	45.0	56.5	41.76	0.0	58.0	0.0	0.0
HEC	0.98	0.52	1.0	1.0	1.0	1.21	0.0	1.0	0.0	0.0
Bactericide	0.19	0.05	0.1	0.1	0.1	0.27	0.0	0.1	0.0	0.0
Triton X-100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36.8	0.0
DGBE	0.0	0.0	0.0	0.0	0.0	0.0	44.92	0.0	0.0	26.7
Dielectric Constant	43.5	56.7	41.5	55.2	42.0	56.8	40.0	53.3	39.2	52.7
Conductivity (S/m)	0.87	0.94	0.90	0.97	1.0	1.07	1.40	1.52	1.80	1.95

Salt: 99<sup>+</sup> Pure Sodium Chloride

Sugar: 98<sup>+</sup> Pure Sucrose

Water: De-ionized, 16 MΩ<sup>+</sup> resistivity

HEC: Hydroxyethyl Cellulose

DGBE: 99<sup>+</sup> Di(ethylene glycol) butyl ether, [2-(2-butoxyethoxy)ethanol]

Triton X-100 (ultra pure): Polyethylene glycol mono [4-(1,1, 3, 3-tetramethylbutyl)phenyl]ether

## 1.12 Test Standards and Limits

According to FCC 47CFR §2.1093(d) The limits to be used for evaluation are based generally on criteria published by the American National Standards Institute (ANSI) for localized specific absorption rate (“SAR”) in Section 4.2 of “IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz,” ANSI/IEEE C95.3–2003, Copyright 2003 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). 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.

(2) Limits for General Population/Uncontrolled exposure: 0.08 W/kg as averaged over the whole-body and spatial peak SAR not exceeding 1.6 W/kg as averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube). Exceptions are the hands, wrists, feet and ankles where the spatial peak SAR shall not exceed 4 W/kg, as averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube). General Population/Uncontrolled limits apply when the general public may be exposed, or when persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or do not exercise control over their exposure. Warning labels placed on consumer devices such as cellular telephones will not be sufficient reason to allow these devices to be evaluated subject to limits for occupational/controlled exposure in paragraph (d)(1) of this section.(Table .4)

<b>Human Exposure</b>	<b>Uncontrolled Environment General Population</b>	<b>Controlled Environment Occupational</b>
<b>Partial Peak SAR</b> (Partial)	1.60 mW/g	8.00 mW/g
<b>Partial Average SAR</b> (Whole Body)	0.08 mW/g	0.40 mW/g
<b>Partial Peak SAR</b> (Hands/Feet/Ankle/Wrist)	4.00 mW/g	20.00 mW/g

Table .2 RF exposure limits

### 1.13 Justification for Extended SAR Dipole Calibrations

Usage of SAR dipoles calibrated less than 2 years ago but more than 1 year ago were confirmed in maintaining return loss (< -20 dB, within 20 % of prior calibration) and impedance (within 5 ohm from prior calibration) requirements per extended calibrations in KDB publication 450824:

## 2. Instruments List

Maunfacturer	Device	Type	Serial Number	Due date of Calibration
Stäubli	Robot	RX90BL	F12/5LP8A1/01	N/A
Schmid & Partner Engineering AG	Dosimetric E-Field Probe	EX3DV4	3862	July 19, 2013
Schmid & Partner Engineering AG	2450 MHz System Validation Dipole	D2450V2	734	January 17, 2014
Schmid & Partner Engineering AG	Data acquisition Electronics	DAE4	1340	July 10, 2013
Schmid & Partner Engineering AG	Software	DASY5: V52.8.1	-	N/A
Schmid & Partner Engineering AG	Phantom	SAM Phantom V5.0	TP-1721	N/A
Agilent	Network Analyzer	E5070B	MY42100282	January 03, 2013
Agilent	Dielectric Probe Kit	85070D	2184	N/A
Agilent	Power Meter	E4419B	GB43311125	July 01, 2013
Agilent	Power Sensor	E9300H	MY41495314	September 18, 2013
			MY41495307	September 18, 2013
Agilent	Signal Generator	E4421B	MY43350132	July 03, 2013
Empower RF Systems	Power Amplifier	2001-BBS3Q7ECK	1032 D/C 0336	March 31, 2013
Agilent	Dual Directional Coupler	778D	50454	April 03, 2013
Microlab	LP Filter	LA-30N	N/A	September 14, 2013
R & S	Spectrum Analyzer	FSV30	100768	March 29, 2013
Agilent	Attenuator	8491B	50566	September 14, 2013

### 3.Summary of Results

#### 3.1 FCC Power Measurement Procedures

Power measurements were performed using a base station simulator under digital average power.

The handset was placed into a simulated call using a base station simulator in shielded chamber. SAR measurements were taken with a fully charged battery. In order to verify that the device was tested and maintained at full power, this was configured with the base station simulator. The SAR measurement Software calculates a reference point at the start and end of the test to check for power drifts. If conducted power deviations of more than 5 % occurred, the tests were repeated.

#### 3.2 WLAN RF Conducted Average Power

802.11b Mode		Rated (Mbps)	Measured Average Power (dB m)
Frequency (MHz)	Channel No.		
2412	1	1	12.72
		2	12.67
		5.5	12.65
		11	12.58
2437	6	1	<b><u>12.81</u></b>
		2	12.77
		5.5	12.75
		11	12.74
2462	11	1	12.70
		2	12.67
		5.5	12.66
		11	12.63

802.11g Mode		Rated (Mbps)	Measured Average Power (dB m)
Frequency (MHz)	Channel No.		
2412	1	6	10.91
		9	10.88
		12	10.85
		18	10.78
		24	10.55
		36	10.42
		48	10.31
		54	10.16
2437	6	6	11.34
		9	11.33
		12	11.31
		18	11.25
		24	11.19
		36	11.03
		48	10.83
		54	10.78
2462	11	6	11.26
		9	11.24
		12	11.20
		18	11.14
		24	11.06
		36	10.95
		48	10.73
		54	10.63
802.11n_HT20 Mode		Rated (Mbps)	Measured Average Power (dB m)
Frequency (MHz)	Channel No.		
2412	1	MCS0	9.01
		MCS1	8.86
		MCS2	8.80
		MCS3	8.71
		MCS4	8.66
		MCS5	8.60
		MCS6	8.54
		MCS7	8.51
2437	6	MCS0	9.03
		MCS1	8.90
		MCS2	8.85
		MCS3	8.70
		MCS4	8.69
		MCS5	5.54
		MCS6	8.50
		MCS7	8.42
2462	11	MCS0	8.89
		MCS1	8.77
		MCS2	8.74
		MCS3	8.46
		MCS4	8.40
		MCS5	8.36
		MCS6	8.30
		MCS7	8.27

### 3.3 SAR Test Configuration

#### IEEE 802.11 Transmitters

802.11 a/b/g and 4.9 GHz operating modes are tested independently according to the service requirements in each frequency band. 802.11 b/g modes are tested on channel 1, 6, and 11. 802.11a is tested for UNII operations on channels 36 and 48 in the 5.15 ~ 5.25 GHz band, channels 52 and 64 in the 5.25 ~ 5.35 GHz band, channels 104, 116, 124 and 136 in the 5.470 ~ 5.725 GHz band, and channels 149 and 161 in the 5.8 GHz band. When 5.8 GHz §15.247 is also available, channels 149, 157 and 165 should be tested instead of the UNII channels. 802.11g mode was evaluated only if the output power was 0.25 dB higher than the 802.11b mode.

Mode	GHz	Channel	Radio Channel	"Default Test Channels"		UNII	§15.247
				802.11b	802.11g		
802.11 b/g	2.412	1*	1	√	∇		
	2.424	6		√	∇		
	2.436	11*		√	∇		
802.11a	5.18	36	40 (5.21 GHz)			√	
	5.20	48					•
	5.22	44					•
	5.24	40				√	
	5.26	52	80 (5.29 GHz)			√	
	5.28	58					•
	5.30	64	88 (5.37 GHz)			√	
	5.32	60					•
	5.34	66				√	
	5.36	72	Unlicensed			√	
	5.38	78					•
	5.40	84				√	
	5.42	90					•
	5.44	96				√	
	5.46	102					•
	5.48	108				√	
	5.50	114				•	
	5.52	120			√		
	5.54	126				•	
5.56	132			√			
5.58	138				•		
5.60	144			√			
5.62	150				•		
5.64	156			√			
5.66	162				•		
5.68	168			√			
5.70	174				•		
5.72	180			√			
5.74	186				•		
5.76	192			√			
5.78	198				•		
5.80	204			√			
5.82	210				•		
5.84	216			√			
5.86	222				•		
5.88	228			√			
5.90	234				•		
5.92	240			√			
5.94	246				•		
5.96	252			√			
5.98	258				•		
6.00	264			√			
6.02	270				•		
6.04	276			√			
6.06	282				•		
6.08	288			√			
6.10	294				•		
6.12	300			√			
6.14	306				•		
6.16	312			√			
6.18	318				•		
6.20	324			√			
6.22	330				•		
6.24	336			√			
6.26	342				•		
6.28	348			√			
6.30	354				•		
6.32	360			√			
6.34	366				•		
6.36	372			√			
6.38	378				•		
6.40	384			√			
6.42	390				•		
6.44	396			√			
6.46	402				•		
6.48	408			√			
6.50	414				•		
6.52	420			√			
6.54	426				•		
6.56	432			√			
6.58	438				•		
6.60	444			√			
6.62	450				•		
6.64	456			√			
6.66	462				•		
6.68	468			√			
6.70	474				•		
6.72	480			√			
6.74	486				•		
6.76	492			√			
6.78	498				•		
6.80	504			√			
6.82	510				•		
6.84	516			√			
6.86	522				•		
6.88	528			√			
6.90	534				•		
6.92	540			√			
6.94	546				•		
6.96	552			√			
6.98	558				•		
7.00	564			√			
7.02	570				•		
7.04	576			√			
7.06	582				•		
7.08	588			√			
7.10	594				•		
7.12	600			√			
7.14	606				•		
7.16	612			√			
7.18	618				•		
7.20	624			√			
7.22	630				•		
7.24	636			√			
7.26	642				•		
7.28	648			√			
7.30	654				•		
7.32	660			√			
7.34	666				•		
7.36	672			√			
7.38	678				•		
7.40	684			√			
7.42	690				•		
7.44	696			√			
7.46	702				•		
7.48	708			√			
7.50	714				•		
7.52	720			√			
7.54	726				•		
7.56	732			√			
7.58	738				•		
7.60	744			√			
7.62	750				•		
7.64	756			√			
7.66	762				•		
7.68	768			√			
7.70	774				•		
7.72	780			√			
7.74	786				•		
7.76	792			√			
7.78	798				•		
7.80	804			√			
7.82	810				•		
7.84	816			√			
7.86	822				•		
7.88	828			√			
7.90	834				•		
7.92	840			√			
7.94	846				•		
7.96	852			√			
7.98	858				•		
8.00	864			√			
8.02	870				•		
8.04	876			√			
8.06	882				•		
8.08	888			√			
8.10	894				•		
8.12	900			√			
8.14	906				•		
8.16	912			√			
8.18	918				•		
8.20	924			√			
8.22	930				•		
8.24	936			√			
8.26	942				•		
8.28	948			√			
8.30	954				•		
8.32	960			√			
8.34	966				•		
8.36	972			√			
8.38	978				•		
8.40	984			√			
8.42	990				•		
8.44	996			√			
8.46	1002				•		
8.48	1008			√			
8.50	1014				•		
8.52	1020			√			
8.54	1026				•		
8.56	1032			√			
8.58	1038				•		
8.60	1044			√			
8.62	1050				•		
8.64	1056			√			
8.66	1062				•		
8.68	1068			√			
8.70	1074				•		
8.72	1080			√			
8.74	1086				•		
8.76	1092			√			
8.78	1098				•		
8.80	1104			√			
8.82	1110				•		
8.84	1116			√			
8.86	1122				•		
8.88	1128			√			
8.90	1134				•		
8.92	1140			√			
8.94	1146				•		
8.96	1152			√			
8.98	1158				•		
9.00	1164			√			
9.02	1170				•		
9.04	1176			√			
9.06	1182				•		
9.08	1188			√			
9.10	1194				•		
9.12	1200			√			
9.14	1206				•		
9.16	1212			√			
9.18	1218				•		
9.20	1224			√			
9.22	1230				•		
9.24	1236			√			
9.26	1242				•		
9.28	1248			√			
9.30	1254				•		
9.32	1260			√			
9.34	1266				•		
9.36	1272			√			
9.38	1278				•		
9.40	1284			√			
9.42	1290				•		
9.44	1296			√			
9.46	1302				•		
9.48	1308			√			
9.50	1314				•		
9.52	1320			√			
9.54	1326				•		
9.56	1332			√			
9.58	1338				•		
9.60	1344			√			
9.62	1350				•		
9.64	1356			√			
9.66	1362				•		
9.68	1368			√			
9.70	1374				•		
9.72	1380			√			
9.74	1386				•		
9.76	1392			√			
9.78	1398				•		
9.80	1404			√			
9.82	1410				•		
9.84	1416			√			
9.86	1422				•		
9.88	1428			√			
9.90	1434				•		

### **3.4 Still cameras and video cameras Test position**

#### **FCC OET Bulletin 65 supplement C**

For purpose of determining test requirements, accessories may be divided into two categories:

Those that do not contain metallic components and those that do. For multiple accessories that do not contain metallic components, the device may be tested only with that accessory which provides the closest spacing to the body.

For multiple accessories that contain metallic components, the device must be tested with each accessory that contains a unique metallic component. If multiple accessories share an identical metallic component, only the accessory that provides the closest spacing to the body must be tested.

If the manufacturer provides none body accessories, a separation distance of 0 cm between the back of the device and the flat phantom is recommended to cover the worst-case usage scenarios. Other separation distances may be used, but they shall not exceed 2.5 cm. In these cases, the device may use body-worn accessories that provide a separation distance greater than that tested for the device provided however that the accessory contains no metallic components.

## WLAN Body SAR

Ambient Temperature (°C)	23.7
Liquid Temperature (°C)	22.5
Date	2012-11-21

Test Mode	EUT Position	Distance from Phantom (mm)	Traffic Channel		Rated (Mbps)	Power Drift (dB)	1 g SAR (W/kg)	1 g SAR Limits (W/kg)
			Frequency (MHz)	Channel				
11b	Front	0	2437	6	1	0.11	0.011	1.6
	Rear	0	2437	6	1	-0.12	0.031	
	Right Edge	0	2437	6	1	0.07	0.026	
	Left Edge	0	2437	6	1	-0.11	0.010	
	Bottom	0	2437	6	1	0.20	0.004	
	Top	0	2437	6	1	0.06	0.484	
	Top	0	2412	1	1	0.05	0.485	
	Top	0	2462	11	1	0.03	0.458	

<Note>

- The test data reported are the worst-case SAR value with the position set in a typical configuration.
- All modes of operation were investigated, and worst-case results are reported.
- Battery is fully charged for all readings and the standard batteries are the only options.
- Liquid tissue depth was at least 15 cm.
- Test procedures used were according to FCC OET Bulletin 65 supplement C
- RSS102 < Exemption from Routine Evaluation Limits – SAR Evaluation >
  - above 2.2 GHz and up to 3 GHz inclusively, and with output power (i.e. the higher of the conducted or radiated (e.i.r.p.) source-based, time-averaged output power) that is less than or equal to 20 mW for general public use and 100 mW for controlled use.
- KDB 248227 <SAR Measurement Procedures for 802.11 a/b/g Transmitters>
  - Channel 1, 6 and 11 were tested by the definition of “default test channels”.
  - Highest average RF output power channel for the lowest data rate were selected for SAR evaluation. Other mode were not tested since the average output powers were not greater than 0.25 dB than that of the corresponding channel in the lowest data rate IEEE 802.11b mode.
- WLAN transmission was verified using a spectrum analyzer.

## Appendix

### List

Appendix A	DASY5 Report (Plots of the SAR Measurements)	- 2450 MHz Validation Test - Body Test
Appendix B	Uncertainty Analysis	
Appendix C	Calibration Certificate	- PROBE - DAE4 - DIPOLE



Report File No. : F690501/RF-SAR002034  
Date of Issue : 2012-11-23  
Page : 20 / 60

## **Appendix A**

### **Test Plot - DASY5 Report**

## 2450 MHz Body Validation Test

Date: 2012-11-21

Test Laboratory : SGS Korea (Gunpo Laboratory)  
 File Name: 2450MHz Validation sla53.0

Input Power : 100 mW

Ambient Temp : 23.7 °C Tissue Temp : 22.5 °C

DUT: Dipole 2450 MHz D2450V2; Type: D2450V2; Serial: 734

Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1  
 Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.935$  mho/m;  $\epsilon_r = 52.264$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
 Phantom section: Flat Section

DASY52 Configuration:

- Probe: EX3DV4 - SN3862; ConvF(7.32, 7.32, 7.32); Calibrated: 19.07.2012;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1340; Calibrated: 10.07.2012
- Phantom: SAM with CRP v5.0; Type: QD000P40CD; Serial: TP:1721
- DASY52 52.8.2(969)SEMCAD X 14.6.6(6824)

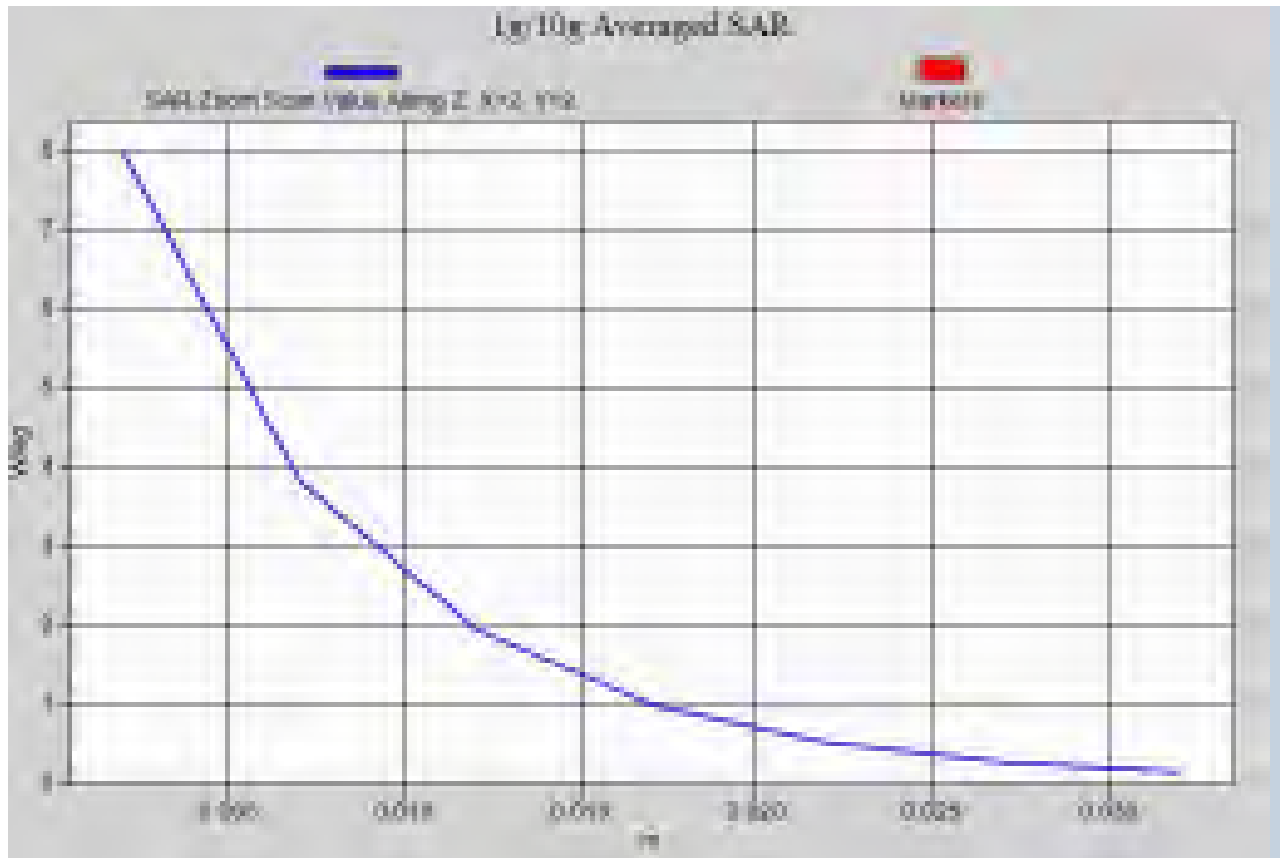
**2450MHz Validation/2450MHz Validation/Area Scan (61x61x1):** Interpolated grid:  
 $dx=1.500$  mm,  $dy=1.500$  mm  
 Maximum value of SAR (interpolated) = 7.90 W/kg

**2450MHz Validation/2450MHz Validation/Zoom Scan (5x5x7)/Cube 0:** Measurement grid:  $dx=8$ mm,  $dy=8$ mm,  $dz=5$ mm  
 Reference Value = 63.055 V/m; Power Drift = -0.01 dB  
 Peak SAR (extrapolated) = 11.040 mW/g  
**SAR(1 g) = 5.23 mW/g; SAR(10 g) = 2.38 mW/g**  
 Maximum value of SAR (measured) = 7.98 W/kg



0 dB - 7.98 W/kg - 18.04 dB W/kg

## Z Scan





**SAR Test Plot**

Report File No. : F690501/RF-SAR002034  
Date of Issue : 2012-11-23  
Page : 23 / 60

Date: 2012-11-21

Test Laboratory : SGS Korea (Gunpo Laboratory)  
 File Name: 2.45GHz WLAN\_Front\_CH6.das52.0

Ambient Temp : 23.7 °C Tissue Temp : 22.5 °C

**DUT: DV150F; Type: Digital Camera; Serial: N/A**

Communication System: WLAN 2.45GHz; Frequency: 2437 MHz; Duty Cycle: 1:1  
 Medium parameters used:  $f = 2437 \text{ MHz}$ ;  $\sigma = 1.921 \text{ mho/m}$ ;  $\epsilon_r = 52.281$ ;  $\rho = 1000 \text{ kg/m}^3$   
 Phantom section: Flat Section

DASY52 Configuration:

- Probe: EX3DV4 - SN3862; ConvF(7.32, 7.32, 7.32); Calibrated: 19.07.2012;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1340; Calibrated: 10.07.2012
- Phantom: SAM with CRP v5.0; Type: QD000P40CD; Serial: TP:1721
- DASY52 52.8.2(969)SEMCAD X 14.6.6(6824)

**2.45GHz/2.45GHz WLAN\_Front\_CH6/Area Scan (61x81x1):** Interpolated grid:  $dx=1.500 \text{ mm}$ ,  $dy=1.500 \text{ mm}$   
 Maximum value of SAR (interpolated) = 0.0326 W/kg

**2.45GHz/2.45GHz WLAN\_Front\_CH6/Zoom Scan (5x5x7)/Cube 0:** Measurement grid:  
 $dx=8\text{mm}$ ,  $dy=8\text{mm}$ ,  $dz=5\text{mm}$   
 Reference Value = 3.000 V/m; Power Drift = 0.11 dB  
 Peak SAR (extrapolated) = 0.066 mW/g  
**SAR(1 g) = 0.011 mW/g; SAR(10 g) = 0.00212 mW/g**  
 Maximum value of SAR (measured) = 0.0304 W/kg



0 dB = 0.0304 W/kg = -30.34 dB W/kg

Date: 2012-11-21

Test Laboratory : SGS Korea (Gunpo Laboratory)  
 File Name: 2.45GHz WLAN\_Rear\_CH6.du53.0

Ambient Temp : 23.7 °C Tissue Temp : 22.5 °C

DUT: DV150F; Type: Digital Camera; Serial: N/A

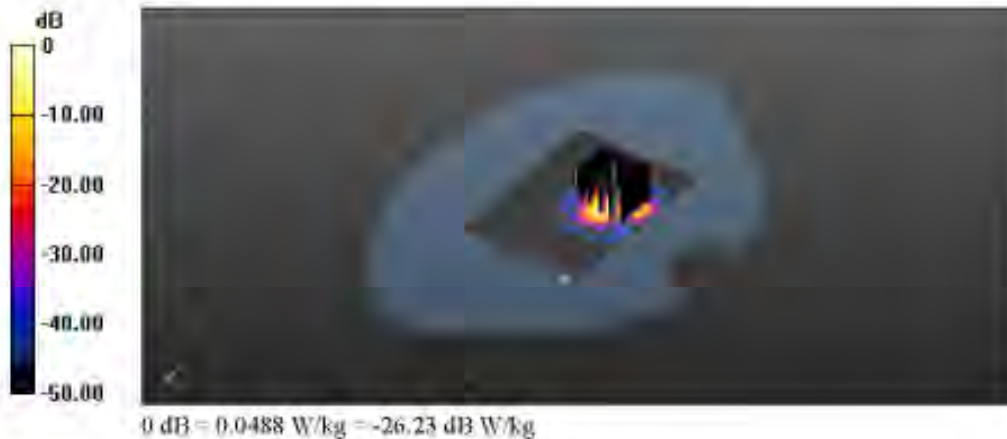
Communication System: WLAN 2.45GHz; Frequency: 2437 MHz; Duty Cycle: 1:1  
 Medium parameters used:  $f = 2437$  MHz;  $\sigma = 1.921$  mho/m;  $\epsilon_r = 52.281$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
 Phantom section: Flat Section

DASY52 Configuration:

- Probe: EX3DV4 - SN3862; ConvF(7.32, 7.32, 7.32); Calibrated: 19.07.2012;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1340; Calibrated: 10.07.2012
- Phantom: SAM with CRP v5.0; Type: QD000P40CD; Serial: TP:1721
- DASY52 52.8.2(969)SEMCAD X 14.6.6(6824)

**2.45GHz/2.45GHz WLAN\_Rear\_CH6/Area Scan (61x81x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm  
 Maximum value of SAR (interpolated) = 0.0563 W/kg

**2.45GHz/2.45GHz WLAN\_Rear\_CH6/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm  
 Reference Value = 0.762 V/m; Power Drift = -0.12 dB  
 Peak SAR (extrapolated) = 0.094 mW/g  
**SAR(1 g) = 0.031 mW/g; SAR(10 g) = 0.00661 mW/g**  
 Maximum value of SAR (measured) = 0.0488 W/kg



Date: 2012-11-21

Test Laboratory : SGS Korea (Gunpo Laboratory)  
 File Name: 2.45GHz WLAN\_Right Edge\_CH6.da53.0

Ambient Temp : 23.7 °C Tissue Temp : 22.5 °C

**DUT: DV150F; Type: Digital Camera; Serial: N/A**

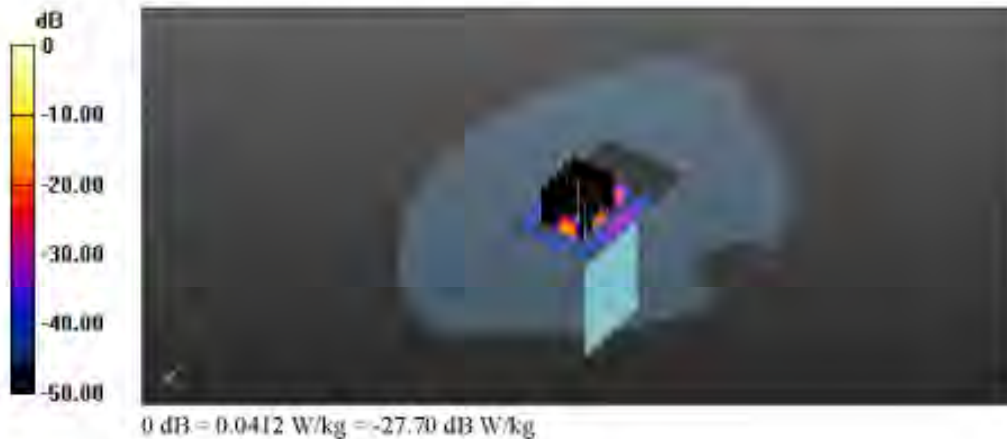
Communication System: WLAN 2.45GHz; Frequency: 2437 MHz; Duty Cycle: 1:1  
 Medium parameters used:  $f = 2437$  MHz;  $\sigma = 1.921$  mho/m;  $\epsilon_r = 52.281$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
 Phantom section: Flat Section

DASY52 Configuration:

- Probe: EX3DV4 - SN3862; ConvF(7.32, 7.32, 7.32); Calibrated: 19.07.2012;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1340; Calibrated: 10.07.2012
- Phantom: SAM with CRP v5.0; Type: QD000P40CD; Serial: TP:1721
- DASY52 52.8.2(969)SEMCAD X 14.6.6(6824)

**2.45GHz/2.45GHz WLAN\_Right Edge\_CH6/Area Scan (41x71x1):** Interpolated grid:  
 dx=1.500 mm, dy=1.500 mm  
 Maximum value of SAR (interpolated) = 0.0355 W/kg

**2.45GHz/2.45GHz WLAN\_Right Edge\_CH6/Zoom Scan (5x5x7)/Cube 0:** Measurement  
 grid: dx=8mm, dy=8mm, dz=5mm  
 Reference Value = 1.908 V/m; Power Drift = 0.07 dB  
 Peak SAR (extrapolated) = 0.103 mW/g  
**SAR(1 g) = 0.026 mW/g; SAR(10 g) = 0.0048 mW/g**  
 Maximum value of SAR (measured) = 0.0412 W/kg



Date: 2012-11-21

Test Laboratory : SGS Korea (Gunpo Laboratory)  
 File Name: 2.45GHz WLAN\_Left Edge\_CH6.std53.d

Ambient Temp : 23.7 °C Tissue Temp : 22.5 °C

**DUT: DV150F; Type: Digital Camera; Serial: N/A**

Communication System: WLAN 2.45GHz; Frequency: 2437 MHz; Duty Cycle: 1:1  
 Medium parameters used:  $f = 2437$  MHz;  $\sigma = 1.921$  mho/m;  $\epsilon_r = 52.281$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
 Phantom section: Flat Section

DASY52 Configuration:

- Probe: EX3DV4 - SN3862; ConvF(7.32, 7.32, 7.32); Calibrated: 19.07.2012;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1340; Calibrated: 10.07.2012
- Phantom: SAM with CRP v5.0; Type: QD000P40CD; Serial: TP:1721
- DASY52 52.8.2(969)SEMCAD X 14.6.6(6824)

**2.45GHz/2.45GHz WLAN\_Left Edge\_CH6/Area Scan (41x71x1):** Interpolated grid:

dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 0.0208 W/kg

**2.45GHz/2.45GHz WLAN\_Left Edge\_CH6/Zoom Scan (5x5x7)/Cube 0:** Measurement

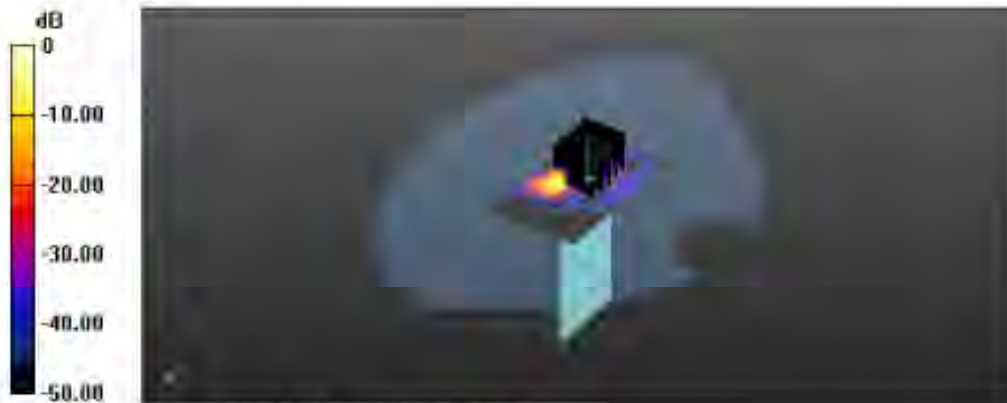
grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 1.205 V/m; Power Drift = -0.11 dB

Peak SAR (extrapolated) = 0.047 mW/g

**SAR(1 g) = 0.010 mW/g; SAR(10 g) = 0.00267 mW/g**

Maximum value of SAR (measured) = 0.0262 W/kg



0 dB = 0.0262 W/kg = -31.63 dB W/kg

Date: 2012-11-21

Test Laboratory : SGS Korea (Gunpo Laboratory)  
 File Name: 2.45GHz WLAN\_Bottom\_CH6.dic310

Ambient Temp : 23.7 °C Tissue Temp : 22.5 °C

**DUT: DV150F; Type: Digital Camera; Serial: N/A**

Communication System: WLAN 2.45GHz; Frequency: 2437 MHz; Duty Cycle: 1:1  
 Medium parameters used:  $f = 2437$  MHz;  $\sigma = 1.921$  mho/m;  $\epsilon_2 = 52.281$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
 Phantom section: Flat Section

DASY52 Configuration:

- Probe: EX3DV4 - SN3862; ConvF(7.32, 7.32, 7.32); Calibrated: 19.07.2012;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1340; Calibrated: 10.07.2012
- Phantom: SAM with CRP v5.0; Type: QD000P40CD; Serial: TP:1721
- DASY52 52.8.2(969)SEMCAD X 14.6.6(6824)

**2.45GHz/2.45GHz WLAN\_Bottom\_CH6/Area Scan (61x91x1):** Interpolated grid:

dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 0.0106 W/kg

**2.45GHz/2.45GHz WLAN\_Bottom\_CH6/Zoom Scan (5x5x7)/Cube 0:** Measurement

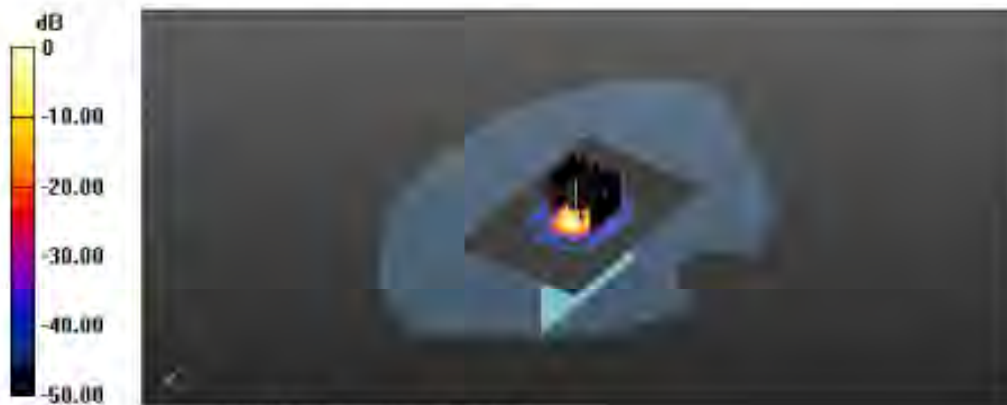
grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 2.446 V/m; Power Drift = 0.20 dB

Peak SAR (extrapolated) = 0.025 mW/g

**SAR(1 g) = 0.00423 mW/g; SAR(10 g) = 0.00115 mW/g**

Maximum value of SAR (measured) = 0.0102 W/kg



0 dB = 0.0102 W/kg = -39.83 dB W/kg

Date: 2012-11-21

Test Laboratory : SGS Korea (Gunpo Laboratory)  
 File Name: 2.45GHz WLAN\_Top\_CH6.d053.0

Ambient Temp : 23.7 °C Tissue Temp : 22.5 °C

DUT: DV150F; Type: Digital Camera; Serial: N/A

Communication System: WLAN 2.45GHZ; Frequency: 2437 MHz; Duty Cycle: 1:1  
 Medium parameters used:  $f = 2437$  MHz;  $\sigma = 1.921$  mho/m;  $\epsilon_r = 52.281$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
 Phantom section: Flat Section

DASY52 Configuration:

- Probe: EX3DV4 - SN3862; ConvF(7.32, 7.32, 7.32); Calibrated: 19.07.2012;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1340; Calibrated: 10.07.2012
- Phantom: SAM with CRP v5.0; Type: QD000P40CD; Serial: TP:1721
- DASY52 52.8.2(969)SEMCAD X 14.6.6(6824)

**2.45GHz/2.45GHz WLAN\_Top\_CH6/Area Scan (51x81x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm  
 Maximum value of SAR (interpolated) = 0.863 W/kg

**2.45GHz/2.45GHz WLAN\_Top\_CH6/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm  
 Reference Value = 14.357 V/m; Power Drift = 0.06 dB  
 Peak SAR (extrapolated) = 1.393 mW/g  
**SAR(1 g) = 0.484 mW/g; SAR(10 g) = 0.176 mW/g**  
 Maximum value of SAR (measured) = 0.767 W/kg



0 dB = 0.767 W/kg = -2.30 dB W/kg

Date: 2012-11-21

Test Laboratory : SGS Korea (Gunpo Laboratory)  
 File Name: 2.45GHz WLAN\_Top\_CH1.d053.0

Ambient Temp : 23.7 °C Tissue Temp : 22.5 °C

DUT: DV150F; Type: Digital Camera; Serial: N/A

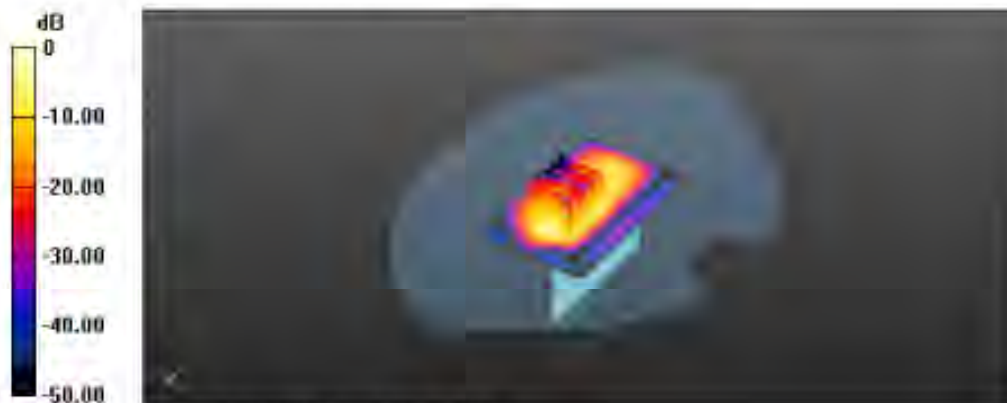
Communication System: WLAN 2.45GHz; Frequency: 2412 MHz; Duty Cycle: 1:1  
 Medium parameters used:  $f = 2412$  MHz;  $\sigma = 1.89$  mho/m;  $\epsilon_r = 52.28$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
 Phantom section: Flat Section

DASY52 Configuration:

- Probe: EX3DV4 - SN3862; ConvF(7.32, 7.32, 7.32); Calibrated: 19.07.2012;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1340; Calibrated: 10.07.2012
- Phantom: SAM with CRP v5.0; Type: QD000P40CD; Serial: TP:1721
- DASY52 52.8.2(969)SEMCAD X 14.6.6(6824)

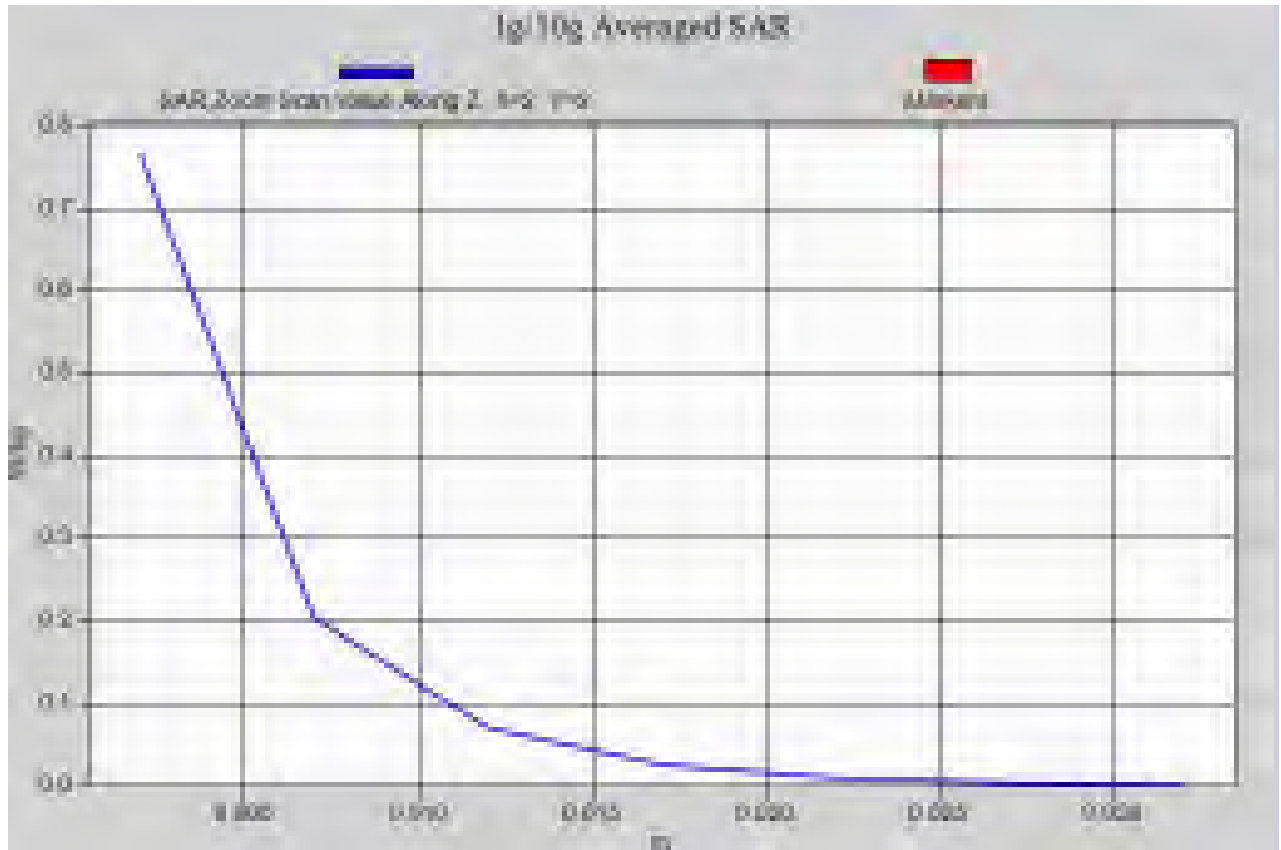
**2.45GHz/2.45GHz WLAN\_Top\_CH1/Area Scan (51x81x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm  
 Maximum value of SAR (interpolated) = 0.809 W/kg

**2.45GHz/2.45GHz WLAN\_Top\_CH1/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm  
 Reference Value = 11.578 V/m; Power Drift = 0.05 dB  
 Peak SAR (extrapolated) = 1.377 mW/g  
**SAR(1 g) = 0.485 mW/g; SAR(10 g) = 0.181 mW/g**  
 Maximum value of SAR (measured) = 0.846 W/kg



0 dB = 0.846 W/kg = -1.45 dB W/kg

## Z-Scan



Date: 2012-11-21

Test Laboratory : SGS Korea (Gunpo Laboratory)  
 File Name: 2.45GHz WLAN\_Top\_CH11/da5310

Ambient Temp : 23.7 °C Tissue Temp : 22.5 °C

DUT: DV150F; Type: Digital Camera; Serial: N/A

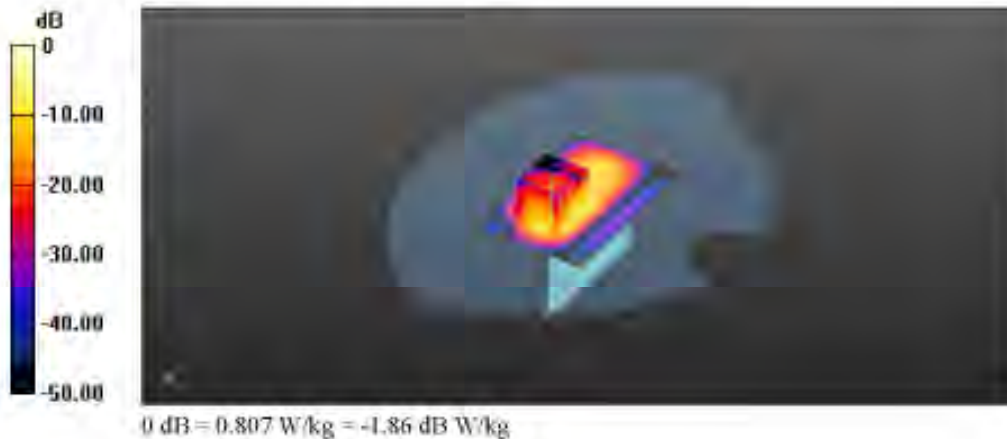
Communication System: WLAN 2.45GHz; Frequency: 2462 MHz; Duty Cycle: 1:1  
 Medium parameters used:  $f = 2462$  MHz;  $\sigma = 1.946$  mho/m;  $\epsilon_r = 52.257$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
 Phantom section: Flat Section

DASY52 Configuration:

- Probe: EX3DV4 - SN3862; ConvF(7.32, 7.32, 7.32); Calibrated: 19.07.2012;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1340; Calibrated: 10.07.2012
- Phantom: SAM with CRP v5.0; Type: QD000P40CD; Serial: TP:1721
- DASY52 52.8.2(969)SEMCAD X 14.6.6(6824)

**2.45GHz/2.45GHz WLAN\_Top\_CH11/Area Scan (51x81x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm  
 Maximum value of SAR (interpolated) = 0.796 W/kg

**2.45GHz/2.45GHz WLAN\_Top\_CH11/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm  
 Reference Value = 9.441 V/m; Power Drift = 0.03 dB  
 Peak SAR (extrapolated) = 1.278 mW/g  
**SAR(1 g) = 0.458 mW/g; SAR(10 g) = 0.166 mW/g**  
 Maximum value of SAR (measured) = 0.807 W/kg





Report File No. : F690501/RF-SAR002034  
Date of Issue : 2012-11-23  
Page : 33 / 60



Report File No. : F690501/RF-SAR002034  
Date of Issue : 2012-11-23  
Page : 34 / 60

## Appendix B

### Uncertainty Analysis

Measurement uncertainty for 300 MHz to 3 GHz averaged over 1 gram

a	b	c	d	e = f(d,k)	g	i = cxg/e	k
Uncertainty Component	Section in P1528	Tol (%)	Prob . Dist.	Div.	Ci (1g)	1g ui (%)	Vi (Veff)
Probe calibration	E.2.1	6.0	N	1	1	6.0	∞
Axial isotropy	E.2.2	0.5	R	1.73	0.71	0.20	∞
hemispherical isotropy	E.2.2	2.6	R	1.73	0.71	1.06	∞
Boundary effect	E.2.3	0.8	R	1.73	1	0.46	∞
Linearity	E.2.4	0.6	R	1.73	1	0.35	∞
System detection limit	E.2.5	0.25	R	1.73	1	0.14	∞
Readout electronics	E.2.6	0.3	N	1	1	0.30	∞
Response time	E.2.7	0	R	1.73	1	0.00	∞
Integration time	E.2.8	2.6	R	1.73	1	1.50	∞
RF ambient Condition –Noise	E.6.1	3	R	1.73	1	1.73	∞
RF ambient Condition – reflections	E.6.1	3	R	1.73	1	1.73	∞
Probe positioning– mechanical tolerance	E.6.2	1.5	R	1.73	1	0.87	∞
Probe positioning– with respect to phantom	E.6.3	2.9	R	1.73	1	1.67	∞
Max. SAR evaluation	E.5.2	1	R	1.73	1	0.58	∞
Test sample positioning	E.4.2	5.84	N	1	1	5.84	9
Device holder uncertainty	E.4.1	3.6	N	1	1	3.60	∞
Output power variation–SAR drift measurement	6.62	5	R	1.73	1	2.89	∞
Phantom uncertainty (shape and thickness tolerances)	E.3.1	4	R	1.73	1	2.31	∞
Liquid conductivity – deviation from target values	E.3.2	5	R	1.73	0.64	1.85	∞
Liquid conductivity – measurement uncertainty	E.3.2	0.7	N	1	0.64	0.45	5
Liquid permittivity – deviation from target values	E.3.3	5	R	1.73	0.6	1.73	∞
Liquid permittivity – measurement uncertainty	E.3.3	0.56	N	1	0.6	0.34	5
Combined standard uncertainty				RSS		10.83	∞
Expanded uncertainty (95% CONFIDENCE INTERVAL)				K=2		21.65	

## **Appendix C**

### **Calibration Certificate**

**- PROBE**

**- DAE4**

**- 2450 MHz Dipole**

## - PROBE Calibration Certificate

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



**S** Schweizerischer Kalibrierdienst  
**C** Service suisse d'alignement  
**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 (Dymstec)**

Certificate No. **EX3-3862\_Jul12**

### CALIBRATION CERTIFICATE

Object **EX3DV4 - SN:3862**

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

Calibration date: **July 19, 2012**

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

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

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

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GBF1263874	28-Mar-12 (No. 217-01508)	Apr-13
Power sensor E4412A	NY41498087	28-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 S5085 (20g)	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
DAEA	SN 680	20-Jun-12 (No. DAEA-680_Jun12)	Jun-13
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3842U01700	6-Aug-98 (in house check Apr-11)	In house check: Apr-13
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-11)	In house check: Oct-12

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

issued: July 23, 2012

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

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

Accreditation No.: **SCS 108**

**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 $\vartheta$	$\vartheta$ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\vartheta = 0$ is normal to probe axis

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

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

**Methods Applied and Interpretation of Parameters:**

- **NORM<sub>x,y,z</sub>**: Assessed for E-field polarization  $\vartheta = 0$  ( $f \leq 900$  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.

EX3DV4 - SN:3862

July 19, 2012

# Probe EX3DV4

## SN:3862

Manufactured: February 2, 2012  
Calibrated: July 19, 2012

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

EX3DV4- SN:3862

July 19, 2012

**DASY/EASY - Parameters of Probe: EX3DV4 - SN:3862**

**Basic Calibration Parameters**

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ( $\mu V / (V/m)^2$ ) <sup>A</sup>	0.42	0.43	0.37	± 10.1 %
DCP (mV) <sup>B</sup>	106.7	94.8	101.9	

**Modulation Calibration Parameters**

UID	Communication System Name	PAR		A dB	B dB	C dB	VR mV	Unc <sup>E</sup> (k=2)
0	CW	0.00	X	0.00	0.00	1.00	149.3	±3.8 %
			Y	0.00	0.00	1.00	146.9	
			Z	0.00	0.00	1.00	196.2	

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

<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.

EX3DV4- SN:3862

July 19, 2012

## DASY/EASY - Parameters of Probe: EX3DV4 - SN:3862

### 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)
835	41.5	0.90	9.34	9.34	9.34	0.21	1.30	± 12.0 %
900	41.5	0.97	9.27	9.27	9.27	0.21	1.22	± 12.0 %
1750	40.1	1.37	8.35	8.35	8.35	0.29	1.00	± 12.0 %
1810	40.0	1.40	8.02	8.02	8.02	0.33	0.83	± 12.0 %
1900	40.0	1.40	7.93	7.93	7.93	0.39	0.86	± 12.0 %
2450	39.2	1.80	7.09	7.09	7.09	0.34	0.90	± 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.

EX3DV4- SN:3862

July 19, 2012

## DASY/EASY - Parameters of Probe: EX3DV4 - SN:3862

### 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	Depth (mm)	Unct. (k=2)
835	55.2	0.97	9.37	9.37	9.37	0.30	1.00	± 12.0 %
1750	53.4	1.49	8.38	8.38	8.38	0.46	0.87	± 12.0 %
1900	53.3	1.52	7.90	7.90	7.90	0.31	0.98	± 12.0 %
2450	52.7	1.95	7.32	7.32	7.32	0.80	0.57	± 12.0 %

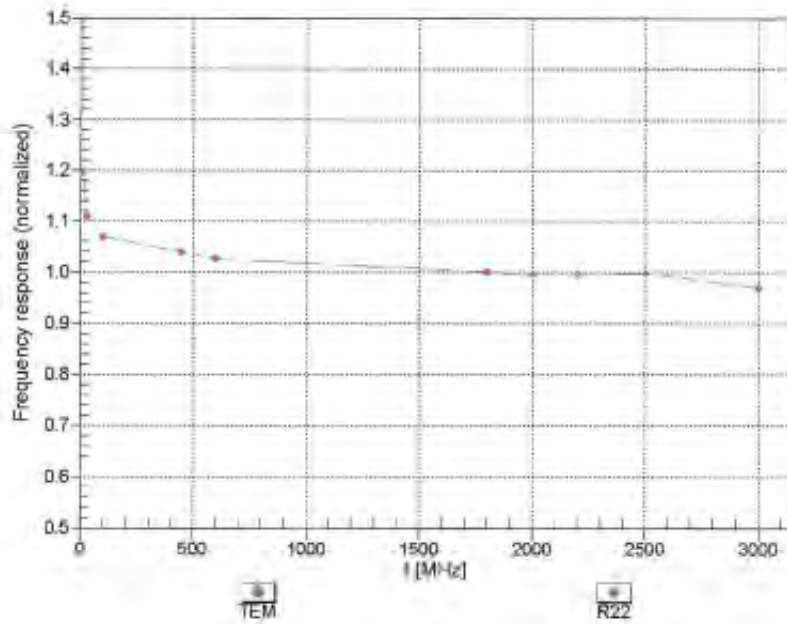
<sup>C</sup> Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

<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.

EX3DV4- SN.3862

July 19, 2012

## Frequency Response of E-Field (TEM-Cell:if1110 EXX, Waveguide: R22)

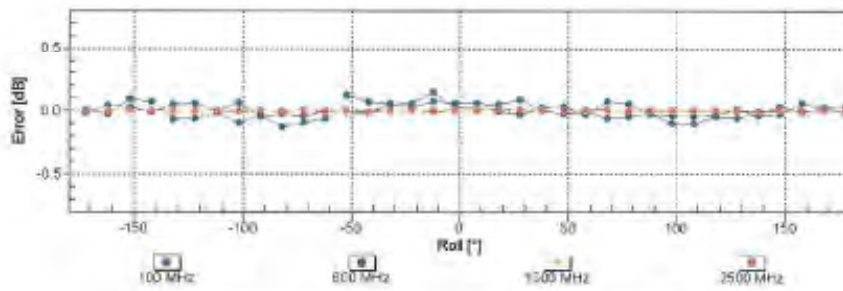
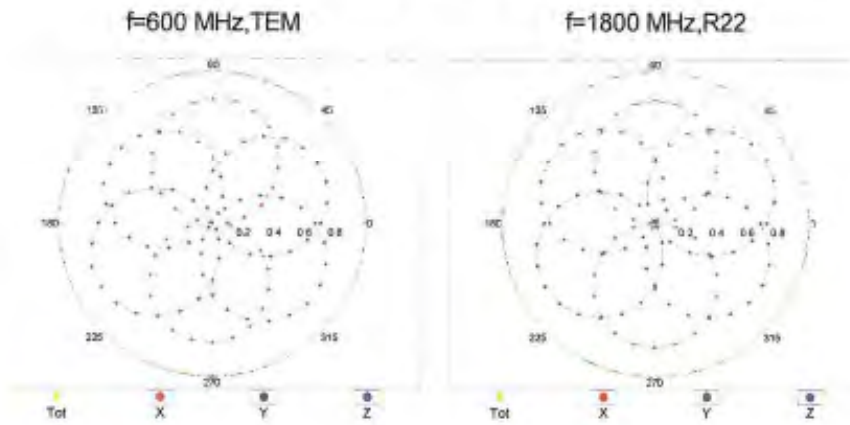


Uncertainty of Frequency Response of E-field:  $\pm 6.3\%$  ( $k=2$ )

EX30V4-SN:3862

July 19, 2012

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

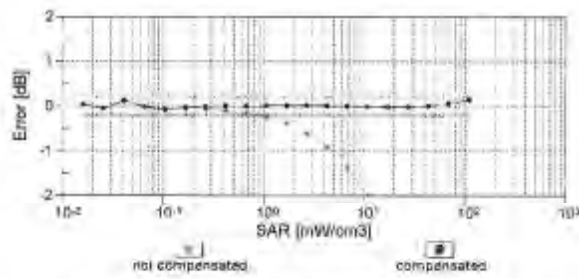
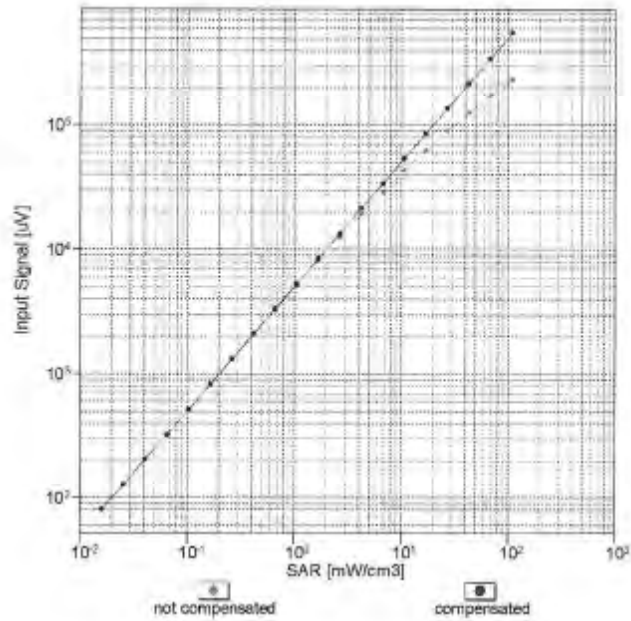


Uncertainty of Axial Isotropy Assessment:  $\pm 0.5\%$  (k=2)

EX3DV4-SN:3862

July 19, 2012

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

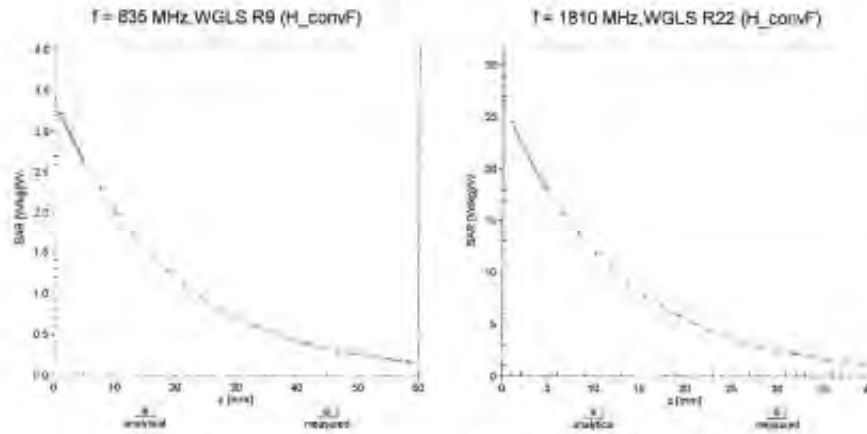


Uncertainty of Linearity Assessment:  $\pm 0.6\%$  (k=2)

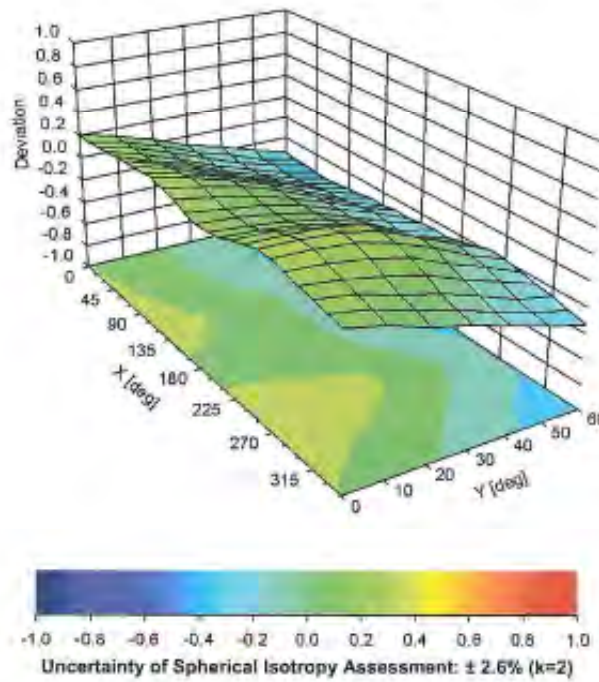
EX3DV4- SN 3862

July 19, 2012

## Conversion Factor Assessment



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



EX3DV4- SN:3862

July 19, 2012

**DASY/EASY - Parameters of Probe: EX3DV4 - SN:3862**

**Other Probe Parameters**

Sensor Arrangement	Triangular
Connector Angle (°)	107.9
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	2 mm

- **DAE Calibration certification**

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



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**S** Servizio svizzero di taratura  
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Accreditation No.: **SCS 108**

Client **SGS (Dymstec)**

Certificate No: **DAE4-1340\_Jul12**

CALIBRATION CERTIFICATE																			
Object	DAE4 - SD 000 D04 BJ - SN: 1340																		
Calibration procedure(s)	QA CAL-06 v24 Calibration procedure for the data acquisition electronics (DAE)																		
Calibration date:	July 10, 2012																		
<p>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.</p> <p>All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity &lt; 70%.</p> <p>Calibration Equipment used (M&amp;TE critical for calibration)</p> <table border="1"> <thead> <tr> <th>Primary Standards</th> <th>ID #</th> <th>Cal Date (Certificate No.)</th> <th>Scheduled Calibration</th> </tr> </thead> <tbody> <tr> <td>Keithley Multimeter Type 2001</td> <td>SN: 0810278</td> <td>28-Sep-11 (No:11450)</td> <td>Sep-12</td> </tr> <tr> <th>Secondary Standards</th> <th>ID #</th> <th>Check Date (in house)</th> <th>Scheduled Check</th> </tr> <tr> <td>Calibrator Box V2.1</td> <td>SE UWS 053 AA 1001</td> <td>05-Jan-12 (in house check)</td> <td>In house check: Jan-13</td> </tr> </tbody> </table>				Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration	Keithley Multimeter Type 2001	SN: 0810278	28-Sep-11 (No:11450)	Sep-12	Secondary Standards	ID #	Check Date (in house)	Scheduled Check	Calibrator Box V2.1	SE UWS 053 AA 1001	05-Jan-12 (in house check)	In house check: Jan-13
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Keithley Multimeter Type 2001	SN: 0810278	28-Sep-11 (No:11450)	Sep-12																
Secondary Standards	ID #	Check Date (in house)	Scheduled Check																
Calibrator Box V2.1	SE UWS 053 AA 1001	05-Jan-12 (in house check)	In house check: Jan-13																
Calibrated by:	Name Eric Hanfeld	Function Technician	Signature 																
Approved by:	Name Fin Böhnholt	Function R&D Director	Signature 																
			Issued: July 10, 2012																
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.																			

**Calibration Laboratory of**  
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**C** Servizio svizzero di taratura  
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Accreditation No.: **SCS 108**

## Glossary

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

## Methods Applied and Interpretation of Parameters

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

**DC Voltage Measurement**

A/D - Converter Resolution nominal

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

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

Calibration Factors	X	Y	Z
High Range	404.816 $\pm$ 0.1% (k=2)	404.267 $\pm$ 0.1% (k=2)	404.287 $\pm$ 0.1% (k=2)
Low Range	3.98926 $\pm$ 0.7% (k=2)	3.98671 $\pm$ 0.7% (k=2)	3.98083 $\pm$ 0.7% (k=2)

**Connector Angle**

Connector Angle to be used in DASY system	256 <sup>a</sup> $\pm$ 1 <sup>o</sup>
---	---------------------------------------

## Appendix

### 1. DC Voltage Linearity

High Range	Reading ( $\mu\text{V}$ )	Difference ( $\mu\text{V}$ )	Error (%)
Channel X + Input	199990.77	-5.51	-0.00
Channel X + Input	20000.35	0.37	0.00
Channel X - Input	-19997.05	3.35	-0.02
Channel Y + Input	199991.21	-4.81	-0.00
Channel Y + Input	19997.26	-2.76	-0.01
Channel Y - Input	-20001.32	-0.88	0.00
Channel Z + Input	199990.17	-5.61	-0.00
Channel Z + Input	19999.03	-0.92	-0.00
Channel Z - Input	-20002.23	-1.65	0.01

Low Range	Reading ( $\mu\text{V}$ )	Difference ( $\mu\text{V}$ )	Error (%)
Channel X + Input	2001.07	0.18	0.01
Channel X + Input	201.34	0.01	0.01
Channel X - Input	-198.70	-0.08	0.04
Channel Y + Input	2000.62	-0.31	-0.02
Channel Y + Input	200.89	-0.39	-0.19
Channel Y - Input	-198.48	0.21	-0.10
Channel Z + Input	2000.53	-0.29	-0.01
Channel Z + Input	200.08	-1.16	-0.58
Channel Z - Input	-200.30	-1.59	0.80

### 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	-6.54	-8.70
	-200	9.80	8.18
Channel Y	200	-1.45	-1.57
	-200	0.92	0.43
Channel Z	200	2.74	2.22
	-200	-4.71	-4.88

### 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	-	0.17	-3.54
Channel Y	200	5.87	-	-0.07
Channel Z	200	9.54	4.08	-

**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	16036	14867
Channel Y	15954	14621
Channel Z	15767	15486

**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	-1.35	-2.24	-0.14	0.35
Channel Y	-1.50	-2.38	0.09	0.43
Channel Z	-3.63	-4.85	-2.65	0.42

**6. Input Offset Current**

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

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

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

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

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

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

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

## 2.45 GHz Dipole Calibration Certificate

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



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

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

Accreditation No.: **SCS 108**

Client **SGS (Dymstec)**

Certificate No. **D2450V2-734\_May12**

### CALIBRATION CERTIFICATE

Object **D2450V2 - SN: 734**

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

Calibration date: **May 17, 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 this closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

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

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	05-Oct-11 (No. 217-01451)	Oct-12
Power sensor HP 8481A	US37982763	05-Oct-11 (No. 217-01451)	Oct-12
Reference 20 dB Attenuator	SN: 5056 (20k)	27-Mar-12 (No. 217-01580)	Apr-13
Type-N mismatch combiner	SN: 5047.2 / 05327	27-Mar-12 (No. 217-01580)	Apr-13
Reference Probe ES3DV3	SN: 3205	30-Dec-11 (No. ES3-3205_Dec11)	Dec-12
DAE4	SN: 501	04-Jul-11 (No. DAE4-501_Jul11)	Jul-12
Secondary Standards	ID #	Check Date (In house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (In house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (In house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	UES3990585 84205	18-Oct-01 (In house check Oct-11)	In house check: Oct-12

Calibrated by: **Name: Claudio Leubler, Function: Laboratory Technician**

Approved by: **Name: Kata Pokovic, Function: Technical Manager**

Issued: May 17, 2012

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

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



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

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Accreditation No.: **SCS 108**

**Glossary:**

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

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

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

**Additional Documentation:**

- d) DASY4/5 System Handbook

**Methods Applied and Interpretation of Parameters:**

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

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

### Measurement Conditions

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

DASY Version	DASY5	V52.8.1
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	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	40.3 $\pm$ 6 %	1.85 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	13.3 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	<b>52.8 mW / g <math>\pm</math> 17.0 % (k=2)</b>

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.19 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	<b>24.7 mW / g <math>\pm</math> 16.5 % (k=2)</b>

### Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	52.3 $\pm$ 6 %	1.99 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	12.7 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	<b>50.2 mW / g <math>\pm</math> 17.0 % (k=2)</b>

SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.95 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	<b>23.6 mW / g <math>\pm</math> 16.5 % (k=2)</b>

**Appendix**

**Antenna Parameters with Head TSL**

Impedance, transformed to feed point	53.3 $\Omega$ + 3.6 j $\Omega$
Return Loss	- 26.4 dB

**Antenna Parameters with Body TSL**

Impedance, transformed to feed point	49.9 $\Omega$ + 5.1 j $\Omega$
Return Loss	- 25.8 dB

**General Antenna Parameters and Design**

Electrical Delay (one direction)	1.153 ns
----------------------------------	----------

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

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

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

**Additional EUT Data**

Manufactured by	SPEAG
Manufactured on	May 07, 2003

## DASY5 Validation Report for Head TSL

Date: 17.05.2012

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 734**

Communication System: CW; Frequency: 2450 MHz

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.85$  mho/m;  $\epsilon_r = 40.3$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

### DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.45, 4.45, 4.45); Calibrated: 30.12.2011
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.1(838); SEMCAD X 14.6.5(6469)

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

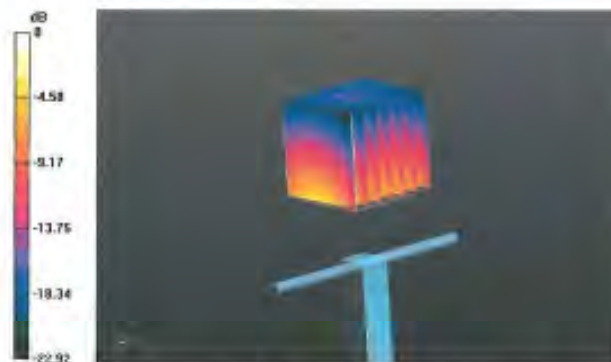
Measurement grid:  $dx=5$ mm,  $dy=5$ mm,  $dz=5$ mm

Reference Value = 97.190 V/m; Power Drift = 0.08 dB

Peak SAR (extrapolated) = 27.316 mW/g

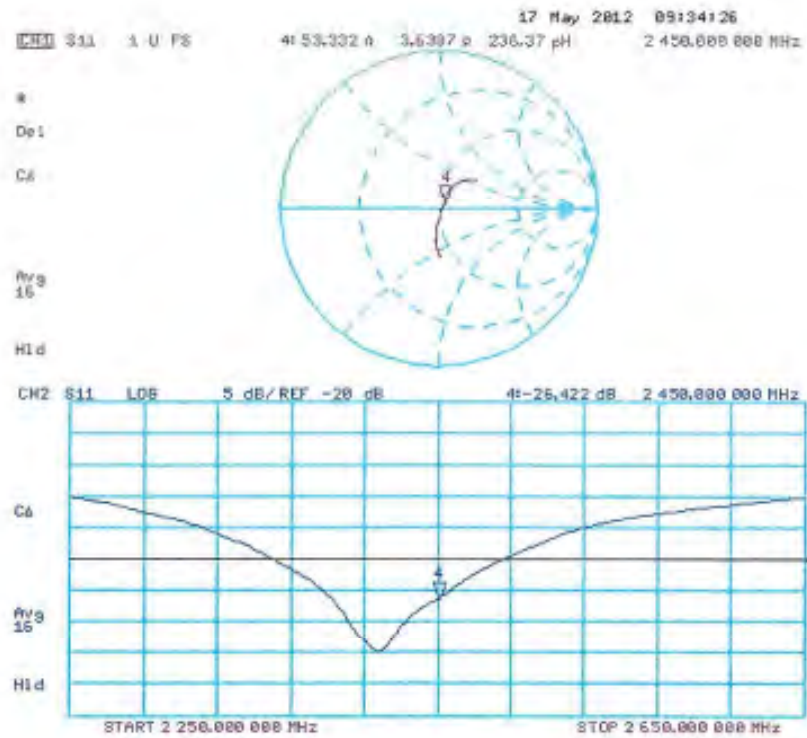
**SAR(1 g) = 13.3 mW/g; SAR(10 g) = 6.19 mW/g**

Maximum value of SAR (measured) = 16.9 mW/g



0 dB = 16.9 mW/g = 24.56 dB mW/g

## Impedance Measurement Plot for Head TSL



**DASY5 Validation Report for Body TSL**

Date: (5.05.2012)

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 734**

Communication System: CW; Frequency: 2450 MHz

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.99$  mho/m;  $\epsilon_r = 52.3$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvP(4.26, 4.26, 4.26); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: i002
- DASY52 52.8.1(838); SEMCAD X 14.6.5(6469)

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

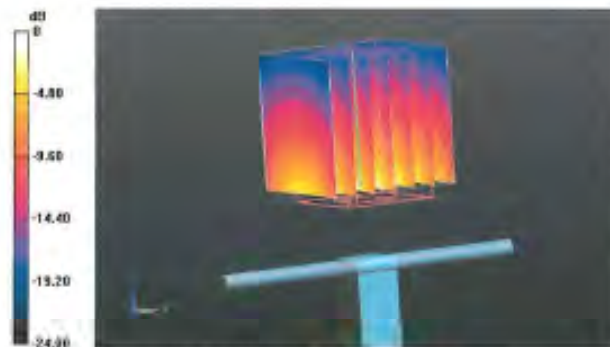
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 95.201 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 25.791 mW/g

**SAR(1 g) = 12.7 mW/g; SAR(10 g) = 5.95 mW/g**

Maximum value of SAR (measured) = 16.8 mW/g



0 dB = 16.8 mW/g = 24.51 dB mW/g

### Impedance Measurement Plot for Body TSL

