FCC SAR TEST REPORT

Test File No : F690501/RF-SAR002462

Equipment Under Test	Module
Model Name	8265D2W
Host Device	NOTEBOOK PC
Host Device Name	NP940X5M
Applicant	Intel Mobile Communications
Address of Applicant	Intel Mobile Communications 100 Center Point Circle Suite 200 Columbia, SC 29210 USA
FCC ID	PD98265D2
Exposure Category	General Population/Uncontrolled Exposure
Standards	FCC 47 CFR Part 2 (2.1093) IEEE 1528, 2013 ANSI/IEEE C95.1, C95.3
Date of Receipt	2017-04-10
Date of Test(s)	2017-04-22 ~ 2017-04-28
Date of Issue	2017-05-02
Test Result	Refer to the Page 05

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

Remarks:

Report prepared by /
Jongho Park
Test Engineer

Approved by /
Minhyuk Han
Technical Manager

Revision history

Revision	Date of issue	Revisions	Revised By
-	May 02, 2017	Initial issue	-

Contents

1 Testing Laboratory

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2 Details of Manufacturer

Applicant	Intel Mobile Communications
Address	Intel Mobile Communications 100 Center Point Circle Suite 200 Columbia, SC 29210 USA
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3 Description of EUT(s)

EUT Type	Module			
Model Name	8265D2W			
Host Device	NOTEBOOK PC			
Host Device Name	NP940X5M			
Mode of Operation	WLAN, Bluetooth			
Crest Factor	1 (WLAN), 1.311 (Bluetooth)			
Body worn Accessory	None			
Tx Frequency Range	2412 ㎒ ~ 2462 ㎒ (WLAN_802.11b/g/n) 5180 ㎒ ~ 5240 ㎒, 5260 ㎒ ~ 5320 ㎒ (WLAN_802.11a/n/ac) 5500 ㎒ ~ 5700 ㎒ (WLAN_802.11a) 5500 ㎒ ~ 5725 ㎒(WLAN_802.11n/ac) 5745 ㎒ ~ 5825 ㎒ (WLAN_802.11a/n/ac) 2402 ㎒ ~ 2480 ㎒ (Bluetooth)			
Antenna Information	Port	Main		Aux
	Manufacturer	Galtronics		Galtronics
	Type	PIFA		PIFA
	Main Antenna Gain (dBi)		Aux Antenna Gain (dBi)	
	2.45 GHz	1.22	2.45 GHz	-0.99
	5 GHz	3.94	5 GHz	-1.73

4 The Highest Reported SAR Values

Equipment Class	Band	Highest Reported SAR 1g (W/kg)
DTS	2.4 ㎓ WLAN	0.66
UNII	5.8 ㎓ WLAN	0.70
NII	5.3 ㎓ WLAN	1.05
	5.6 ㎓ WLAN	1.08
DSS	Bluetooth	0.16
Simultaneous SAR per KDB 690783 D01v01r03		1.23

5 Test Methodology

ANSI C95.1–1999: IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz. It specifies the maximum exposure limit of 1.6 W/kg as averaged over any 1 gram of tissue for portable devices being used within 20 cm of the user in the uncontrolled environment.

Test tests documented in this report were performed in accordance with IEEE Standard 1528-2013 and the following published KDB procedures.

In additions;

☒	**KDB 865664 D01v01r04**	**SAR Measurement Requirements for 100 MHz to 6 GHz**
☒	**KDB 447498 D01v06**	**Mobile and Portable Devices RF Exposure Procedures and Equipment Authorization Policies**
☐	KDB 447498 D02v02r01	SAR Measurement Procedures for USB Dongle Transmitters
☒	**KDB 248227 D01v02r02**	**SAR Guidance For IEEE 802.11 (Wi-Fi) Transmitters**
☐	KDB 615223 D01v01r01	802.16e/WiMax SAR Measurement Guidance
☒	**KDB 616217 D04v01r02**	**SAR Evaluation Considerations for Laptop, Notebook, Netbook and Tablet Computers**
☐	KDB 643646 D01v01r03	SAR Test Reduction Considerations for Occupational PTT Radios
☐	KDB 648474 D03v01r04	Evaluation and Approval Considerations for Handsets with Specific Wireless Charging Battery Covers
☐	KDB 648474 D04v01r03	SAR Evaluation Considerations for Wireless Handsets
☐	KDB 680106 D01v02	RF Exposure Considerations for Low Power Consumer Wireless Power Transfer Applications
☐	KDB 941225 D01v03r01	3G SAR Measurement Procedures
☐	KDB 941225 D05v02r05	SAR Evaluation Considerations for LTE Devices
☐	KDB 941225 D06v02r01	SAR Evaluation Procedures for Portable Devices with Wireless Router Capabilities
☐	KDB 941225 D07v01r02	SAR Evaluation Procedures for UMPC Mini-Tablet Devices

6 Testing Environment

Ambient temperature	: 18°C ~ 25°C
Relative humidity	: 30% ~ 70%
Liquid temperature of during the test	: <± 2°C
Ambient noise & Reflection	: < 0.012 W/kg

7 Specific Absorption Rate (SAR)

7.1 Introduction

SAR is related to the rate at which energy is absorbed per unit mass in an object exposed to a radio field. The SAR distribution in a biological body is complicated and is usually carried out by experimental techniques or numerical modeling. The standard recommends limits for two tiers of groups, occupational/controlled and general population/uncontrolled, based on a person's awareness and ability to exercise control over his or her exposure. In general, occupational/controlled exposure limits are higher than the limits for general population/uncontrolled

7.2 SAR Definition

The SAR definition is the time derivative (rate) of the incremental energy (dW) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dv) of a given density (ρ). The equation description is as below:

$$\mathrm{SAR} = \frac{d}{dt}\left(\frac{dW}{dm}\right) = \frac{d}{dt}\left(\frac{dW}{\rho dv}\right)$$

SAR is expressed in units of Watts per kilogram (W/kg)

SAR measurement can be either related to the temperature elevation in tissue by

$$\mathrm{SAR} = C\left(\frac{\delta T}{\delta t}\right)$$

Where: C is the specific head capacity, δT is the temperature rise and δt is the exposure duration, or related to the electrical field in the tissue by

$$\mathrm{SAR} = \frac{\sigma |E|^2}{\rho}$$

Where: σ is the conductivity of the tissue, ρ is the mass density of the tissue and E is the RMS electrical field strength.

However for evaluating SAR of low power transmitter, electrical field measurement is typically applied.

7.3 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 ㎑ to 300 ㎓," 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 ㎑ to 6 ㎓. Portable devices that transmit at frequencies above 6 ㎓ 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 ㎓ 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.

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

1. The spatial Peak value of the SAR averaged over any 1g gram of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.
2. The spatial Average value of the SAR averaged over the whole body.
3. The Spatial Peak value of the SAR averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.

8 The SAR Measurement System

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

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

- A standard high precision 6-axis robot (Staubli TX family) with controller, teach pendant and software. An arm extension is 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.
- 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.

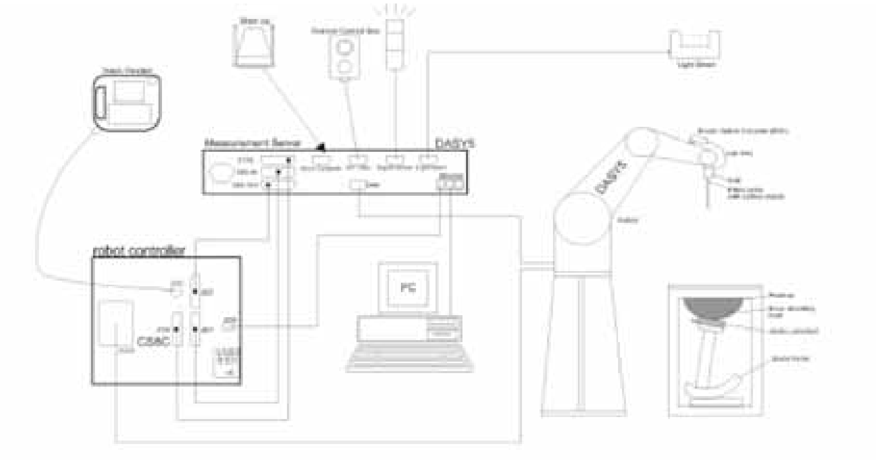


Fig a. The microwave circuit arrangement used for SAR system verification

- 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.
- DASY 5 software.
- Remote control with teach pendant and additional circuitry for robot safety such as warning lamps, etc.
- The ELI phantom enabling testing flat usage.
- Tissue simulating liquid mixed according to the given recipes.
- Validation dipole kits allowing to validate the proper functioning of the system.

9 System Components

9.1 Probe

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 and HSL1900.
Additional CF-Calibration for other liquids and frequencies upon request.

Frequency : 10 ㎒ to 6 ㎓; Linearity: ± 0.2 ㏈ (30 ㎒ to 6 ㎓)

Directivity : ± 0.3 ㏈ in HSL (rotation around probe axis)
± 0.5 ㏈ in tissue material (rotation normal to probe axis)

Dynamic Range : 10µW/g to > 100 m W/g;
Linearity: ± 0.2 ㏈(noise: typically < 1 µW/g)

Dimensions : Overall length: 337 ㎜ (Tip length: 20 ㎜)
Tip diameter: 2.5 ㎜ (Body diameter: 12 ㎜)
Distance from probe tip to dipole centers: 1 ㎜

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 ㎓ with precision of better 30%

NOTE:

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

9.2 ELI Phantom

Construction : Phantom for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30 ㎒ to 6 ㎓. ELI is fully compatible with the IEC 62209-2 standard and all known tissue simulating liquids. ELI has been optimized regarding its performance and can be integrated into our standard phantom tables. A cover prevents evaporation of the liquid. Reference markings on the phantom allow installation of the complete setup, including all predefined phantom positions and measurement grids, by teaching three points. The phantom is compatible with all SPEAG dosimetric probes and dipoles.

ELI V5.0 has the same shell geometry and is manufactured from the same material as ELI4, but has reinforced top structure

ELI Phantom

Shell Thickness : 2.0 mm ± 0.2 mm

Dimensions : Major axis: 600 ㎜
Minor axis: 400 ㎜

9.3 Device Holder

Construction: **:** Simple but effective and easy-to-use extension for Mounting Device that facilitates the testing of larger devices according to IEC 62209-2 (a.q.. laptops, Cameras, etc.). It is lightweight and fits easily on the upper part of the Mounting Device in place of the phone positioned.

Device Holder

10 SAR Measurement Procedures

10.1 Normal SAR Measurement Procedure

Step 1: Power Reference Measurement

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 1.4 ㎜. This distance cannot be smaller than the Distance of sensor calibration points to probe tip as defined in the probe properties.

Step 2 and 3: Area Scan & Zoom Scan 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 1 g and 10 g.

Step 4: Power drift measurement

The Power Drift Measurement measures the field at the same location as the most recent power reference measurement within the same procedure, and with the same settings. The Power Drift Measurement gives the field difference in dB from the reading conducted within the last Power Reference Measurement. This allows a user to monitor the power drift of the device under test within a batch process. The measurement procedure is the same as Step 1.

< Area and Zoom Scan Resolutions per FCC KDB Publication 865664 D01v01r04 >

			≤ 3 GHz	> 3 GHz
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface			5 ± 1 mm	$\frac{1}{2}\cdot\delta\cdot\ln(2) \pm 0.5$ mm
Maximum probe angle from probe axis to phantom surface normal at the measurement location			30° ± 1°	20° ± 1°
Maximum area scan spatial resolution: Δx_{Area}, Δy_{Area}			≤ 2 GHz: ≤ 15 mm 2 – 3 GHz: ≤ 12 mm	3 – 4 GHz: ≤ 12 mm 4 – 6 GHz: ≤ 10 mm
			When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be ≤ the corresponding x or y dimension of the test device with at least one measurement point on the test device.	
Maximum zoom scan spatial resolution: Δx_{Zoom}, Δy_{Zoom}			≤ 2 GHz: ≤ 8 mm 2 – 3 GHz: ≤ 5 mm*	3 – 4 GHz: ≤ 5 mm* 4 – 6 GHz: ≤ 4 mm*
Maximum zoom scan spatial resolution, normal to phantom surface	uniform grid: $\Delta z_{Zoom}(n)$		≤ 5 mm	3 – 4 GHz: ≤ 4 mm 4 – 5 GHz: ≤ 3 mm 5 – 6 GHz: ≤ 2 mm
	graded grid	$\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface	≤ 4 mm	3 – 4 GHz: ≤ 3 mm 4 – 5 GHz: ≤ 2.5 mm 5 – 6 GHz: ≤ 2 mm
		$\Delta z_{Zoom}(n>1)$: between subsequent points	$\leq 1.5\cdot\Delta z_{Zoom}(n-1)$	
Minimum zoom scan volume	x, y, z		≥ 30 mm	3 – 4 GHz: ≥ 28 mm 4 – 5 GHz: ≥ 25 mm 5 – 6 GHz: ≥ 22 mm

Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details.

* When zoom scan is required and the *reported* SAR from the area scan based *1-g SAR estimation* procedures of KDB 447498 is ≤ 1.4 W/kg, ≤ 8 mm, ≤ 7 mm and ≤ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.

11 SAR System Verification

The microwave circuit arrangement for system verification is sketched in Fig. 1. The daily system accuracy verification occurs within the flat section of the ELI phantom. A SAR measurement was performed to see if the measured SAR was within +/- 10% from the target SAR values. These tests were done at 2450 ㎒, 5300 ㎒, 5600 ㎒ and 5800 ㎒. 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 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 ≥ 15 cm ± 5 mm (frequency ≤ 3 GHz) or ≥ 10 cm ± 5 mm (frequency > 3 G Hz)in all the cases. It is seen that the system is operating within its specification, as the results are within acceptable tolerance of the reference values.

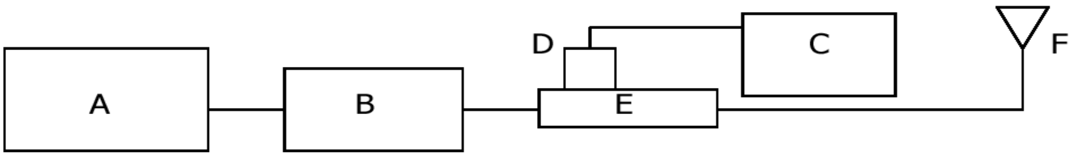


Fig. 1. The microwave circuit arrangement used for SAR system verification

A. Agilent Model E8247C Signal Generator
B. MECA Model AMP2027 Amplifier
C. Agilent Model E4419B Power Meter
D. Agilent Model E9300H Power Sensor
    Agilent Model E9327A Power Sensor
E. KEYSIGHT Model 772D Dual Directional Coupler
F. Reference dipole Antenna

Photo of the dipole Antenna

Verification Kit	Probe S/N	Tissue	Target SAR 1 g from Calibration Certificate (1 W)	Measured SAR 1 g (0.1 W)	Normalized SAR 1 g (1 W)	Deviation (%)	Date	Liquid Temp. (°C)
D2450V2 SN:734	3862	2450 Body	49.50	5.24	52.40	2.53	2017-04-22	21.7
D2450V2 SN:734	3862	2450 Body	49.50	5.25	52.50	6.06	2017-04-28	21.6
D5 ㎓ V2 SN:1130	3862	5300 Body	76.40	7.85	78.50	2.75	2017-04-24	21.7
D5 ㎓ V2 SN:1130	3862	5600 Body	78.90	8.29	82.90	2.53	2017-04-25	21.5
D5 ㎓ V2 SN:1130	3862	5800 Body	76.00	8.03	80.30	5.66	2017-04-27	21.6

Table1. Results system verification

12 Tissue Simulant Fluid for the Frequency Band

The dielectric properties for this simulant fluid were measured by using the Speag Model DAK-3.5 Dielectric Probe in conjunction with Agilent E5071C Network Analyzer(300 ㎑ - 6 ㎓) by using a procedure detailed in Section V.

f (㎒)	Tissue type	Limits / Measured	Dielectric Parameters		
			Permittivity	Conductivity	Simulated Tissue Temp(℃)
2450.0	Body	Measured, 2017-04-22	54.93	1.97	21.7
		Target Tissue Body	*52.70*	*1.95*	
		Deviation (%)	**4.23**	**1.03**	
2412.0		Measured, 2017-04-22	55.02	1.92	
		Deviation (%)	**4.40**	**-1.54**	
2462.0		Measured, 2017-04-22	54.88	1.98	
		Deviation (%)	**4.14**	**1.54**	
2450.0	Body	Measured, 2017-04-28	54.56	1.95	21.4
		Target Tissue Body	*52.70*	*1.95*	
		Deviation (%)	**3.53**	**0.00**	
2441.0		Measured, 2017-04-28	54.58	1.94	
		Deviation (%)	**3.57**	**-0.51**	
5300.0	Body	Measured, 2017-04-24	48.10	5.20	21.7
		Target Tissue Body	*48.90*	*5.42*	
		Deviation (%)	**-1.64**	**-4.06**	
5290.0		Measured, 2017-04-24	48.13	5.18	
		Deviation (%)	**-1.57**	**-4.43**	
5600.0	Body	Measured, 2017-04-25	48.05	5.71	21.5
		Target Tissue Body	*48.50*	*5.77*	
		Deviation (%)	**-0.93**	**-1.04**	
5530.0		Measured, 2017-04-25	48.22	5.61	
		Deviation (%)	**-0.58**	**-2.77**	
5610.0		Measured, 2017-04-25	48.02	5.73	
		Deviation (%)	**-0.99**	**-0.69**	
5800.0	Body	Measured, 2017-04-27	47.30	5.88	21.6
		Target Tissue Body	*48.20*	*6.00*	
		Deviation (%)	**-1.87**	**-2.00**	
5775.0		Measured, 2017-04-27	47.35	5.85	
		Deviation (%)	**-1.76**	**-2.50**	

The composition of the brain & muscle tissue simulating liquid

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 (㎒)									
	450		835		900		1900		2450	
Tissue Type	Head	Body	Head	Body	Head	Body	Head	Body	Head	Body
Water	38.91	46.21	40.29	50.75	40.29	50.75	55.24	70.17	55.00	68.64
Salt (NaCl)	3.79	2.34	1.38	0.94	1.38	0.94	0.31	0.39	-	-
Sugar	56.93	51.17	57.90	-	57.90	-	-	-	-	-
HEC	0.25	0.15	0.24	0.10	0.24	0.10	-	-	-	-
Bactericide	0.12	0.08	0.18	-	0.18	-	-	-	-	-
Triton X-100	-	-	-	-	-	-	-	-	-	-
DGBE	-	-	-	-	-	-	44.45	70.17	45.00	31.37
Dielectric Constant	43.5	56.7	41.5	55.2	41.5	55.0	40.0	53.3	39.2	52.7
Conductivity (S/m)	0.87	0.94	0.90	0.97	0.97	1.05	1.40	1.52	1.80	1.95

Salt: 99 $^{+}$% Pure Sodium Chloride

Sugar: 98 $^{+}$% Pure Sucrose

Water: De-ionized, 16 MΩ^{+} resistivity

HEC: Hydroxyethyl Cellulose

DGBE: 99 $^{+}$% 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

Simulating Liquids for 5 ㎓, Manufactured by SPEAG

Ingredients	(% by weight)
Water	78
Mineral Oil	11
Emulsifiers	9
Additives and Salt	2

13 Instruments List

Test Platform	SPEAG DASY5 Professional				
Location	SGS Korea Co., Ltd. 4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, E&E Lab				
Manufacture	SPEAG				
Description	SAR Test System (Frequency range 300 MHz – 6 GHz)				
Software Reference	DASY52: 52.8.8(1258) SEMCAD X: 14.6.10(7373)				
Hardware Reference					
Equipment	**Type**	**Serial Number**	**Cal Date**	**Cal Interval**	**Cal Due**
Robot	TX90XL	F12/5LP8A1/A/01	N/A	N/A	N/A
Phantom	ELI Phantom	TP-1244	N/A	N/A	N/A
Mounting Device	Laptop Extension Kit	N/A	N/A	N/A	N/A
Verification Dipole	D2450V2	734	2016-05-24	Biennial	2018-05-24
Verification Dipole	D5GHzV2	1130	2016-05-23	Biennial	2018-05-23
Dielectric Assessment Kit	DAK-3.5	1228	2016-11-17	Annual	2017-11-17
DAE	DAE3	1503	2016-06-27	Annual	2017-06-27
E-Field Probe	EX3DV4	3862	2016-10-06	Annual	2017-10-06
Network Analyzer	E5071C	MY46111535	2016-05-24	Annual	2017-05-24
Power Meter	E4419B	GB43311125	2016-06-20	Annual	2017-06-20
Power Meter	E4419B	GB43311715	2016-06-20	Annual	2017-06-20
Power Sensor	E9300H	MY41495307	2016-06-21	Annual	2017-06-21
Power Sensor	E9300H	MY41495314	2016-06-11	Annual	2017-06-11
Power Sensor	E9327A	US40441371	2016-12-16	Annual	2017-12-16
Signal Generator	E8247C	MY43321024	2016-06-20	Annual	2017-06-20
Power Amplifier	AMP2027	10008	2016-07-12	Annual	2017-07-12
Dual Directional Coupler	772D	MY52180226	2016-08-19	Annual	2017-08-19
LP Filter	LA-30N	N/A	2016-06-21	Annual	2017-06-21
LP Filter	LA-60N	N/A	2016-06-21	Annual	2017-06-21
Attenuator	05AS102-K03	A1	2016-12-15	Annual	2017-12-15
Attenuator	05AS102-K20	A3	2016-12-15	Annual	2017-12-15
Attenuator	05AS102-K20	A4	2016-12-15	Annual	2017-12-15
Digital Hygro-Thermometer	BJ5478	12091382-1	2016-06-21	Annual	2017-06-21
Digital Thermometer	DTM3000	3027	2016-06-22	Annual	2017-06-22
Spectrum Analyzer	E4445A	MY44020523	2016-06-20	Annual	2017-06-20

14 FCC Power Measurement Procedures

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.

15 Measured and Reported SAR

Per FCC KDB Publication 447498 D01v06, When SAR is not measured at the maximum power level allowed for production units, the results must be scaled to the maximum tune-up tolerance limit according to the power applied to the individual channels tested to determine compliance. For simultaneous transmission, the measured aggregate SAR must be scaled according to the sum of the differences between the maximum tune-up tolerance and actual power used to test each transmitter. When SAR is measured at or scaled to the maximum tune-up tolerance limit, the results are referred to as reported SAR. Test highest reported SAR results are identified on the grant of equipment authorization according to procedures in KDB 690783 D01v01r03.

16 Maximum Output Power Specifications

This device operates using the following maximum output power specifications. SAR values were scaled to the maximum allowed power to determine compliance per KDB Publication 447498 D01v06

Average power for Production (dB m)					
Mode	**Data Rate**	**Channel**	**Normal/Maximum**	**Main**	**Aux**
802.11b	All Data Rates	All Channels	Maximum	**16.00**	**16.00**
			Normal	15.00	15.00
802.11g	All Data Rates	All Channels	Maximum	**16.00**	**16.00**
			Normal	15.00	15.00
802.11n HT20	All Data Rates	All Channels	Maximum	**16.00**	**16.00**
			Normal	15.00	15.00
802.11n HT40	All Data Rates	All Channels	Maximum	**16.00**	**16.00**
			Normal	15.00	15.00
Tune-up Tolerance: -1.0 dB / +1.0 dB					

Average power for Production (dB m)					
Mode	**Data Rate**	**Channel**	**Normal/Maximum**	**Main**	**Aux**
802.11a, n, ac HT20 / VHT20	All Data Rates	36 ~ 64 Channels	Maximum	**9.50**	**11.50**
			Normal	8.50	10.50
		100 ~ 140 Channels	Maximum	**10.50**	**12.50**
			Normal	9.50	11.50
		144 ~ 165 Channels	Maximum	**10.00**	**14.00**
			Normal	9.00	13.00
802.11n, ac HT40 / VHT40	All Data Rates	38 ~ 62 Channels	Maximum	**9.50**	**11.50**
			Normal	8.50	10.50
		102 ~ 142 Channels	Maximum	**10.50**	**12.50**
			Normal	9.50	11.50
		151 ~ 159 Channels	Maximum	**10.00**	**14.00**
			Normal	9.00	13.00
802.11ac VHT80	All Data Rates	42 ~ 58 Channels	Maximum	**9.50**	**11.50**
			Normal	8.50	10.50
		106 ~ 138 Channels	Maximum	**10.50**	**12.50**
			Normal	9.50	11.50
		155 Channels	Maximum	**10.00**	**14.00**
			Normal	9.00	13.00
Tune-up Tolerance: -1.0 dB / +1.0 dB					

16.1 Bluetooth Maximum Output Power Specifications

Average power for Production (dBm)					
Mode	**Normal/Maximum**	**GFSK**	**PI/4DQPSK**	**8DPSK**	**LE**
Bluetooth	Maximum	**11.5**	**8.0**	**7.0**	**7.0**
	Normal	9.5	6.0	5.0	5.0
Tune-up Tolerance: -2.0 dB / +2.0 dB					

17 WLAN

17.1 General Device Setup

The normal network operating configurations are not suitable for measuring the SAR of 802.11 a/b/g transmitters. Unpredictable fluctuations in network traffic and antenna diversity conditions can introduce undesirable variations in SAR results. The SAR for these devices should be measured using chipset based test mode software to ensure the results are consistent and reliable.

Chipset based test mode software is hardware dependent and generally varies among manufacturers. The device operating parameters established in test mode for SAR measurements must be identical to those programmed in production units, including output power levels, amplifier gain settings and other RF performance tuning parameters.

A periodic duty factor is required for current generation SAR systems to measure SAR. When 802.11 frame gaps are accounted for in the transmission, a maximum transmission duty factor of 92 – 96% is typically achievable in most test mode configurations. A minimum transmission duty factor of 85% is required to avoid certain hardware and device implementation issues related to wide range SAR scaling. The reported SAR is scaled to 100% transmission duty factor to determine compliance at the maximum tune-up tolerance limit.

17.2 U-NII-1 and U-NII-2A

For devices that operate in both U-NII-1 and U-NII-2A bands, when the same maximum output power is specified for both bands, SAR measurement using OFDM SAR test procedures is not required for U-NII-1 unless the highest reported SAR for U-NII-2A is > 1.2 W/kg. When different maximum output powers is not required unless the highest reported SAR for the U-NII band with the higher maximum output power, adjusted by the ratio of lower to higher specified maximum output power for the two bands, is > 1.2 W/kg.

17.3 U-NII-2C and U-NII-3

The frequency range covered by U-NII-2C and U-NII-3 is 380 MHz (5.47 – 5.85 GHz), which requires a minimum of at least two SAR probe calibration frequency points to support SAR measurements.

When Terminal Doppler Weather Radar (TDWR) restriction applies, the channels at 5.60 – 5.65 GHz in U-NII-2C band must be disabled with acceptable mechanisms and documented in the equipment certification.

Unless band gap channels are permanently disabled, SAR must be considered for these channels.

When band gap channels are disabled, each band is tested independently according to the normally required OFDM SAR measurement and probe calibration frequency point requirements.

17.4 2.4 GHz SAR Test Requirements

SAR is measured for 2.4 GHz 802.11b DSSS using either the fixed test position or, when applicable, the initial test position procedure. SAR test reduction is determined according to the following.

1) When the reported SAR of the highest measured maximum output power channel for the exposure configuration is ≤ 0.8 W/kg, no further SAR testing is required for 802.11b DSSS in that exposure configuration.
2) When the reported SAR is > 0.8 W/kg, SAR is required for that position using the next highest measured output power channel; i.e., all channels require testing.

2.4 GHz 802.11g/n OFDM are additionally evaluated for SAR if highest reported SAR for 802.11b, adjusted by the ratio of the OFDM to DSSS specified maximum output power, is > 1.2 W/kg. When SAR is required for OFDM modes in 2.4 GHz band, the Initial Test Configuration Procedures should be followed.

17.5 OFDM Transmission Mode and SAR Test Channel Selection

For the 2.4 GHz and 5 GHz band, when the same maximum output power was specified for multiple OFDM transmission mode configurations in a frequency band or aggregated band, SAR is measured using the configuration with the largest channel bandwidth, lowest order modulation and lowest data rate. When the maximum output power of a channel is the same for equivalent OFDM congigurations; for example, 802.11a, 802.11n and 802.11ac or 802.11g and 802.11n with the same channel bandwith, modulation and data rate etc., the lower order 802.11 mode i.e., 802.11a, then 802.11n and 802.11ac or 802.11g then 802.11n, is used for SAR measurement. When maximum output power are the same for multiple test channels, either according to the default or additional power measurement requirements, SAR is measured using the channel closest to the middle of the frequency band or aggregated band. When thereare multiple channels with the same maximum output power, SAR is measured using the higher number channel.

17.6 Initial Test Configuration Procedure

For OFDM, in both 2.4 and 5 GHz bands, an initial test configuration is determined for each frequency band and aggregated band, according to the transmission mode with the highest maximum output power specified for SAR measurements. When the same maximum output power is specified for multiple OFDM transmission mode configurations in a frequency band or aggregated band, SAR is measured using the configuration(s) with the largest channel bandwidth, lowest order modulation, and lowest data rate. If the average RF output powers of the highest identical transmission modes are within 0.25 dB of each other, mid channel of the transmission mode with highest average RF output power is the initial test channel. Otherwise, the channel of the transmission mode with the highest average RF output conducted power will be the initial test configuration.

When the reported SAR is ≤ 0.8 W/kg, no additional measurements on other test channels are required. Otherwise, SAR is evaluated using the subsequent highest average RF output channel until the reported SAR result is ≤ 1.2 W/kg or all channels are measured. When there are multiple untested channels having the same subsequent highest average RF output power, the channel with higher frequency from the lowest 802.11 mode is considered for SAR measurements

17.7 Subsequent Test Configuration Procedures

For OFDM configurations in each frequency band and aggregated band, SAR is evaluated for initial test configuration using the fixed test position or the initial test position procedure. When the highest reported SAR (for the initial test configuration), adjusted by the ratio of the specified maximum output power of the subsequent test configuration to initial test configuration, is ≤ 1.2 W/kg, no additional SAR tests for the subsequent test configurations are required.

18 RF Conducted Power Measurement

WLAN 2.4 ㎓

Mode	Freq. (㎒)	Ch. #	Rate	Average Power [dB m]	
				Main	AUX
802.11b	2412	1	1	15.96	16.00
	2437	6	1	15.95	15.99
	2462	11	1	15.94	15.97
802.11g	2412	1	6	-	-
	2437	6	6	-	-
	2462	11	6	-	-
802.11n HT20	2412	1	MCS0	-	-
	2437	6	MCS0	-	-
	2462	11	MCS0	-	-
802.11n HT40	2422	3	MCS0	-	-
	2437	6	MCS0	-	-
	2452	9	MCS0	-	-

WLAN 5.3 ㎓

Mode	Freq. (㎒)	Ch. #	Rate	Measured Power [dB m]	
				Main	AUX
802.11a	5180	36	6	-	-
	5200	40	6	-	-
	5220	44	6	-	-
	5240	48	6	-	-
802.11n HT20	5180	36	MCS0	-	-
	5200	40	MCS0	-	-
	5220	44	MCS0	-	-
	5240	48	MCS0	-	-
802.11n HT40	5190	38	MCS0	-	-
	5230	46	MCS0	-	-
802.11ac VHT20	5180	36	MCS0	-	-
	5200	40	MCS0	-	-
	5220	44	MCS0	-	-
	5240	48	MCS0	-	-
802.11ac VHT40	5190	38	MCS0	-	-
	5230	46	MCS0	-	-
802.11ac VHT80	5210	42	MCS0	-	-

WLAN 5.3 ㎓

Mode	Freq. (㎒)	Ch. #	Rate	Measured Power [dB m]	
				Main	AUX
802.11a	5260	52	6	-	-
	5280	56	6	-	-
	5300	60	6	-	-
	5320	64	6	-	-
802.11n HT20	5260	52	MCS0	-	-
	5280	56	MCS0	-	-
	5300	60	MCS0	-	-
	5320	64	MCS0	-	-
802.11n HT40	5270	54	MCS0	-	-
	5310	62	MCS0	-	-
802.11ac VHT20	5260	52	MCS0	-	-
	5280	56	MCS0	-	-
	5300	60	MCS0	-	-
	5320	64	MCS0	-	-
802.11ac VHT40	5270	54	MCS0	-	-
	5310	62	MCS0	-	-
802.11ac VHT80	5290	58	MCS0	9.00	11.50

WLAN 5.6 ㎓

Mode	Freq. (㎒)	Ch. #	Rate	Measured Power [dB m]	
				Main	AUX
802.11a	5500	100	6	-	-
	5580	116	6	-	-
	5660	132	6	-	-
	5700	140	6	-	-
802.11n HT20	5500	100	MCS0	-	-
	5580	116	MCS0	-	-
	5660	132	MCS0	-	-
	5700	140	MCS0	-	-
802.11n HT40	5510	102	MCS0	-	-
	5550	110	MCS0	-	-
	5670	134	MCS0	-	-
802.11ac VHT20	5500	100	MCS0	-	-
	5580	116	MCS0	-	-
	5660	132	MCS0	-	-
	5720	144	MCS0	-	-
802.11ac VHT40	5510	102	MCS0	-	-
	5550	110	MCS0	-	-
	5670	134	MCS0	-	-
	5710	142	MCS0	-	-
802.11ac VHT80	5530	106	MCS0	10.45	12.49
	5610	122	MCS0	10.47	12.50
	5690	138	MCS0	10.46	12.42

WLAN 5.8 ㎓

Mode	Freq. (㎒)	Ch. #	Rate	Measured Power [dB m]	
				Main	AUX
802.11a	5745	149	6	-	-
	5785	157	6	-	-
	5825	165	6	-	-
802.11n HT20	5745	149	MCS0	-	-
	5785	157	MCS0	-	-
	5825	165	MCS0	-	-
802.11n HT40	5755	151	MCS0	-	-
	5795	159	MCS0	-	-
802.11ac VHT20	5745	149	MCS0	-	-
	5785	157	MCS0	-	-
	5825	165	MCS0	-	-
802.11ac VHT40	5755	151	MCS0	-	-
	5795	159	MCS0	-	-
802.11ac VHT80	5775	155	MCS0	9.91	13.96

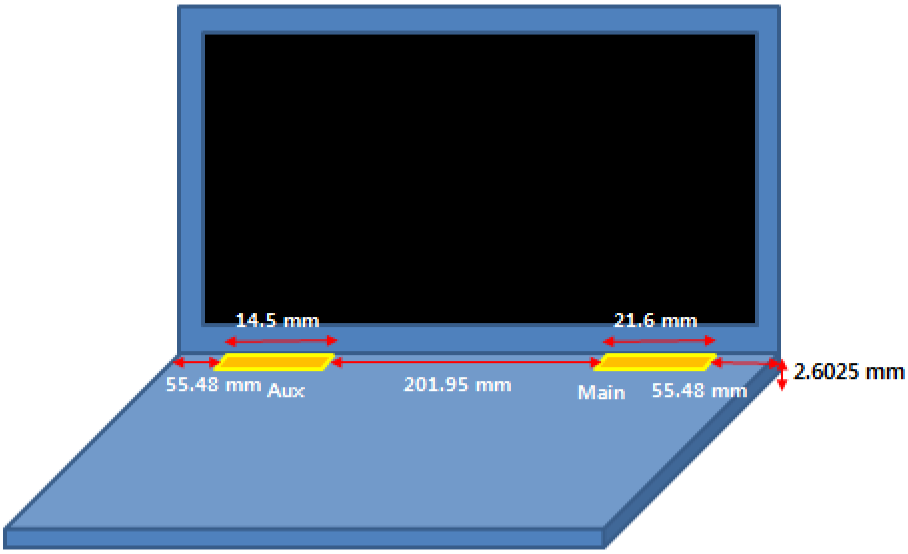
Note. Justification for test configurations for WLAN per KDB Publication 248227 D01 Wi-Fi SAR v02r02:

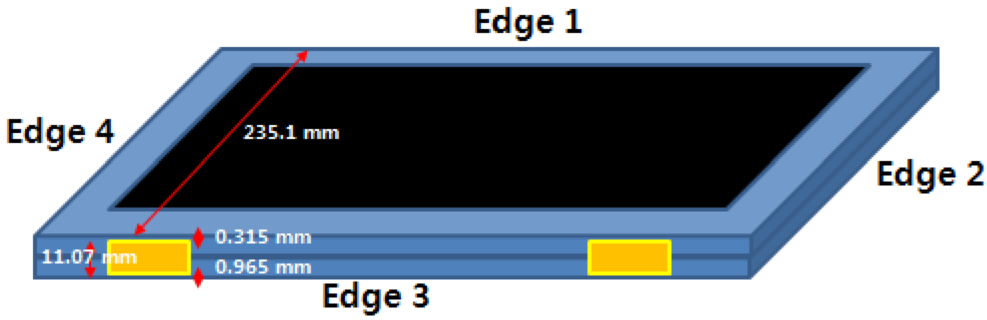
1. Power measurements were performed for the transmission mode configuration with the highest maximum output power specified for production units.
2. For transmission modes with the same maximum output power specification, powers were measured for the largest channel bandwidth, lowest order modulation and lowest data rate.
3. For transmission modes with identical maximum specified output power, channel bandwidth, modulation and data rates, power measurements were required for all identical configurations.
4. For each transmission mode configuration, powers were measured for the highest and lowest channels; and at the mid-band channel(s) when there were at least 3 channels supported. For channels were measured.

Bluetooth

Channel	Frequency (㎒)	GFSK (dB m)	4DPSK (dB m)	8DPSK (dB m)	LE (dB m)
Low	2402	8.37	5.19	4.43	4.18
Middle	2441	10.39	6.43	5.59	5.19
High	2480	9.55	5.51	4.68	4.34

19 Transmit Antenna Separation Distances





<The Distance information of Antenna to Edges of Notebook and Tablet PC>

19.1 Tablet PC Device Type

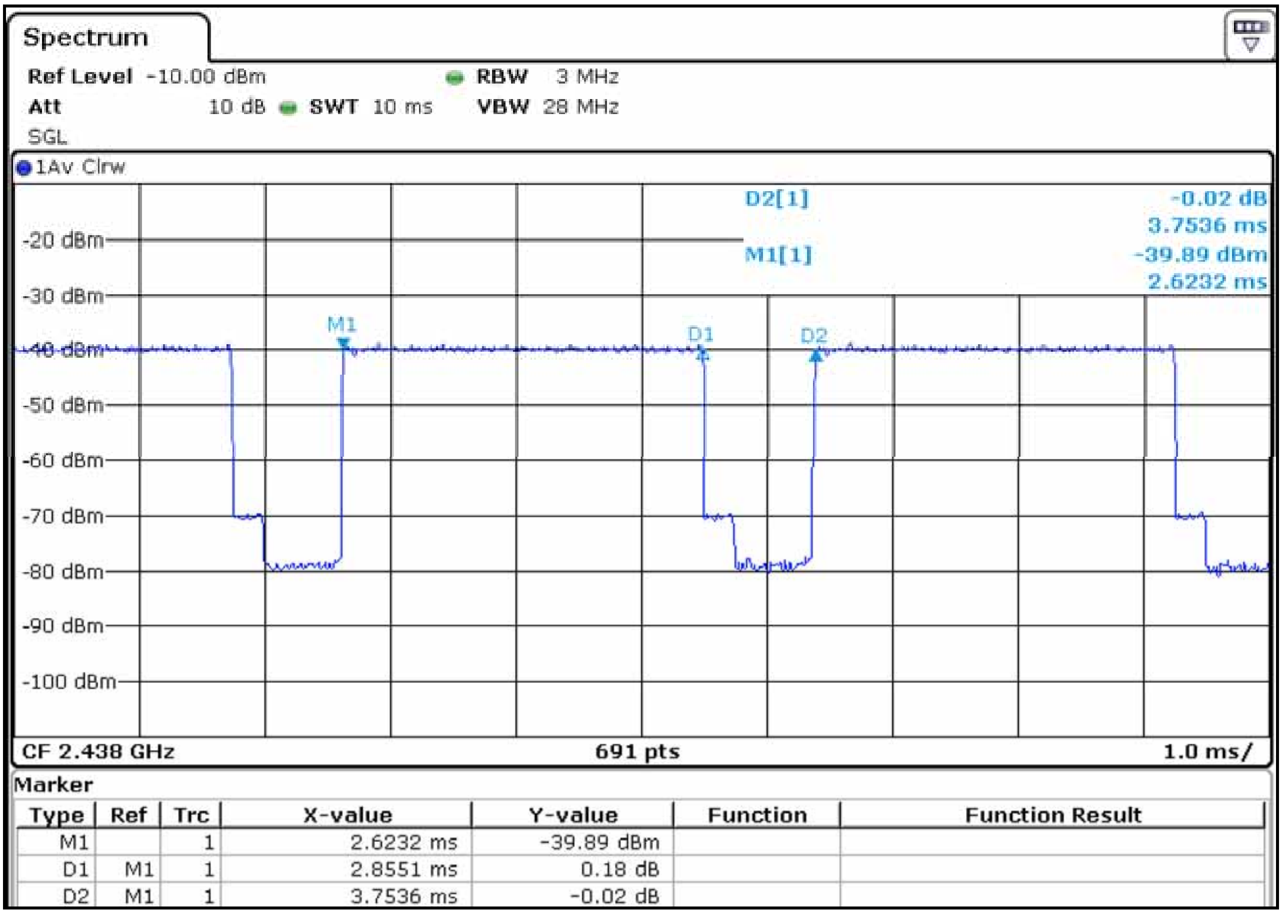
Based on the maximum tune-up tolerance limit of WLAN and Bluetooth, and the antenna to use separation distance, Table "EXEMPT" SAR was not required and Table "Measure" SAR was required.

Frequency (MHz)	Output power		Separation distances (mm)						SAR Exemption					
	dBm	mW	Rear	Edge 1	Edge 2	Edge 3	Edge 4	Front	Rear	Edge 1	Edge 2	Edge 3	Edge 4	Front
WLAN Main Antenna														
2462	16.00	40	5	> 200	55.48	5	55.48	N/A	12.55 Measure	N/A	EXEMPT	12.55 Measure	EXEMPT	N/A
5240	9.50	9	5	> 200	55.48	5	55.48	N/A	4.12 Measure	N/A	EXEMPT	4.12 Measure	EXEMPT	N/A
5320	9.50	9	5	> 200	55.48	5	55.48	N/A	4.15 Measure	N/A	EXEMPT	4.15 Measure	EXEMPT	N/A
5720	10.00	10	5	> 200	55.48	5	55.48	N/A	4.78 Measure	N/A	EXEMPT	4.78 Measure	EXEMPT	N/A
5825	10.00	10	5	> 200	55.48	5	55.48	N/A	4.83 Measure	N/A	EXEMPT	4.83 Measure	EXEMPT	N/A
WLAN Aux Antenna														
2462	16.00	40	5	> 200	55.48	5	55.48	N/A	12.55 Measure	N/A	EXEMPT	12.55 Measure	EXEMPT	N/A
5240	11.50	14	5	> 200	55.48	5	55.48	N/A	6.41 Measure	N/A	EXEMPT	6.41 Measure	EXEMPT	N/A
5320	11.50	14	5	> 200	55.48	5	55.48	N/A	6.46 Measure	N/A	EXEMPT	6.46 Measure	EXEMPT	N/A
5720	12.50	18	5	> 200	55.48	5	55.48	N/A	8.61 Measure	N/A	EXEMPT	8.61 Measure	EXEMPT	N/A
5825	14.00	25	5	> 200	55.48	5	55.48	N/A	12.07 Measure	N/A	EXEMPT	12.07 Measure	EXEMPT	N/A
Bluetooth Antenna														
2480	11.50	14	5	> 200	55.48	5	55.48	N/A	4.41 Measure	N/A	EXEMPT	4.41 Measure	EXEMPT	N/A

Note

1. Maximum power is the source-based time-average power and represents the maximum RF output power among production units.
2. For distances < 5mm, a distance of 5mm is used to determine SAR exclusion and estimated SAR value.
3. Output power is the maximum rated power (including tune-up or manufacturing tolerances).
4. If the antenna separation distance is > 50mm then the value listed is the output power threshold, above which SAR measurement is required. For separation ≤ 50mm the value is the KDB 447498 D01v06 calculated value and must be less than 3 for SAR exemption.
5. Formulas round separation distance to nearest mm and power to nearest ㎽ before calculating thresholds or exemption values.
6. SAR evaluation for the front surface of tablet display screens is generally not necessary according to 4.3 section of KDB 616217 D04 v01r02.

20 Bluetooth Duty Cycle used for SAR Testing



Bluetooth Duty cycle measurement

T_{on} = 2.86 ms

T_{on}+ T_{off} = 3.75 ms

Duty Cycle = (T_{on} / T_{on}+ T_{off}) x 100

76.3 % = (2.86 / 3.75) x 100

Bluetooth Duty cycle: **76.3 %**

SAR Crest Factor = 100 / 76.3 = 1.311

21 SAR Data Summary

21.1 Notebook Device Type

WLAN 2.45 GHz Body SAR

EUT Position	Mode	Traffic Channel		Power(dBm)			Peak SAR of Area Scan(W/kg)	Cube	1-g SAR (W/kg))		Scaling Factor (Power)		Scaling Factor (Duty cycle)	1-g Scaled SAR (W/kg)		Plot No
		Frequency (MHz)	Channel	Conducted Power Main	Conducted Power Aux	Tune-Up Limit			Main	Aux	Main	Aux		Main	Aux	
Base	802.11b	2412	1	15.96	-	16.00	1.180	0	0.611	-	1.009	-	1.013	**0.661**	-	A5
								1	0.505					0.546		
Base		2412	1	-	16.00	16.00	0.355	-	-	0.266	-	1.000	1.013	-	**0.269**	A6

WLAN 5.3 GHz Body SAR

EUT Position	Mode	Traffic Channel		Power(dBm)			Peak SAR of Area Scan(W/kg)	1-g SAR (W/kg))		Scaling Factor (Power)		Scaling Factor (Duty cycle)	1-g Scaled SAR (W/kg)		Plot No
		Frequency (MHz)	Channel	Conducted Power Main	Conducted Power Aux	Tune-Up Limit		Main	Aux	Main	Aux		Main	Aux	
Base	802.11ac VHT80	5290	58	9.00	-	9.50	1.640	0.662	-	1.122	-	1.072	**0.796**	-	A7
Base	802.11ac VHT80	5290	58	-	11.50	11.50	0.948	-	0.337	-	1.000	1.072	-	**0.361**	A8

WLAN 5.6 GHz Body SAR

EUT Position	Mode	Traffic Channel		Power(dBm)			Peak SAR of Area Scan(W/kg)	1-g SAR (W/kg))		Scaling Factor (Power)		Scaling Factor (Duty cycle)	1-g Scaled SAR (W/kg)		Plot No
		Frequency (MHz)	Channel	Conducted Power Main	Conducted Power Aux	Tune-Up Limit		Main	Aux	Main	Aux		Main	Aux	
Base	802.11ac VHT80	5610	122	10.47	-	10.50	1.600	0.614	-	1.007	-	1.072	0.663	-	-
Base	802.11ac VHT80	5690	138	10.46	-	10.50	1.400	0.578	-	1.009	-	1.072	0.625	-	-
Base	802.11ac VHT80	5530	106	10.45	-	10.50	1.870	0.710	-	1.012	-	1.072	**0.770**	-	A9
Base	802.11ac VHT80	5610	122	-	12.50	12.50	0.653	-	0.282	-	1.000	1.072	-	**0.302**	A10

WLAN 5.8 GHz Body SAR

EUT Position	Mode	Traffic Channel		Power(dBm)			Peak SAR of Area Scan(W/kg)	1-g SAR (W/kg))		Scaling Factor (Power)		Scaling Factor (Duty cycle)	1-g Scaled SAR (W/kg)		Plot No
		Frequency (MHz)	Channel	Conducted Power Main	Conducted Power Aux	Tune-Up Limit		Main	Aux	Main	Aux		Main	Aux	
Base	802.11ac VHT80	5775	155	9.91	-	10.00	0.883	0.238	-	1.021	-	1.072	**0.260**	-	A11
Base	802.11ac VHT80	5775	155	-	13.96	14.00	1.060	-	0.358	-	1.009	1.072	-	**0.387**	A12

Bluetooth Body SAR

EUT Position	Mode	Traffic Channel		Power(dBm)		Peak SAR of Area Scan(W/kg)	1-g SAR (W/kg)	Scaling Factor (Power)	1-g Scaled SAR (W/kg)	Plot No
		Frequency (MHz)	Channel	Conducted Power	Tune-Up Limit					
Base	DH5	2441.0	39	10.39	11.50	0.117	0.039	1.291	**0.050**	A13

21.2 Tablet PC Device Type

WLAN 2.45 GHz Body SAR

EUT Position	Mode	Traffic Channel		Power(dBm)			Peak SAR of Area Scan(W/kg)	Cube	1-g SAR (W/kg))		Scaling Factor (Power)		Scaling Factor (Duty cycle)	1-g Scaled SAR (W/kg)		Plot No
		Frequency (MHz)	Channel	Conducted Power Main	Conducted Power Aux	Tune-Up Limit			Main	Aux	Main	Aux		Main	Aux	
Rear	802.11b	2412	1	15.96	-	16.00	0.406	-	0.225	-	1.009	-	1.013	0.230	-	-
Rear	802.11b	2412	1	-	16.00	16.00	0.651	-	-	0.382	-	1.000	1.013	-	0.387	-
Edge3	802.11b	2412	1	15.96	-	16.00	0.934	0	0.486	-	1.009	-	1.013	**0.497**	-	A14
								1	0.463					0.473		
Edge3	802.11b	2412	1	-	16.00	16.00	0.906	0	-	0.514	-	1.000	1.013	-	**0.521**	A15
								1		0.447					0.453	

WLAN 5.3 GHz Body SAR

EUT Position	Mode	Traffic Channel		Power(dBm)			Peak SAR of Area Scan(W/kg)	1-g SAR (W/kg))		Scaling Factor (Power)		Scaling Factor (Duty cycle)	1-g Scaled SAR (W/kg)		Plot No
		Frequency (MHz)	Channel	Conducted Power Main	Conducted Power Aux	Tune-Up Limit		Main	Aux	Main	Aux		Main	Aux	
Rear	802.11ac VHT80	5290	58	9.00	-	9.50	0.588	0.162	-	1.122	-	1.072	0.195	-	-
Rear	802.11ac VHT80	5290	58	-	11.50	11.50	0.548	-	0.242	-	1.000	1.072	-	0.259	-
Edge3	802.11ac VHT80	5290	58	9.00	-	9.50	2.240	0.816	-	1.122	-	1.072	0.981	-	-
Edge3	802.11ac VHT80	5290	58	-	11.50	11.50	2.280	-	0.641	-	1.000	1.072	-	**0.689**	A17
Repeated Test															
Edge3	802.11ac VHT80	5290	58	9.00	-	9.50	2.380	0.869	-	1.122	-	1.072	**1.045**	-	A16

WLAN 5.6 GHz Body SAR

EUT Position	Mode	Traffic Channel		Power(dBm)			Peak SAR of Area Scan(W/kg)	1-g SAR (W/kg))		Scaling Factor (Power)		Scaling Factor (Duty cycle)	1-g Scaled SAR (W/kg)		Plot No
		Frequency (MHz)	Channel	Conducted Power Main	Conducted Power Aux	Tune-Up Limit		Main	Aux	Main	Aux		Main	Aux	
Rear	802.11ac VHT80	5610	122	10.47	-	10.50	0.648	0.198	-	1.007	-	1.072	0.214	-	-
Rear	802.11ac VHT80	5610	122	-	12.50	12.50.	0.575	-	0.199	-	1.000	1.072	-	0.213	-
Edge3	802.11ac VHT80	5610	122	10.47	-	10.50	2.730	0.999	-	1.007	-	1.072	**1.078**	-	A18
Edge3	802.11ac VHT80	5690	138	10.46	-	10.50	2.350	0.927	-	1.009	-	1.072	1.003	-	-
Edge3	802.11ac VHT80	5530	106	10.45	-	10.50	2.480	0.993	-	1.012	-	1.072	1.077	-	-
Edge3	802.11ac VHT80	5610	122	-	12.50	12.50.	2.000	-	0.615	-	1.000	1.072	-	0.659	-
Edge3	802.11ac VHT80	5690	138	-	12.42	12.50.	1.510	-	0.425	-	1.019	1.072	-	0.464	-
Edge3	802.11ac VHT80	5530	106	-	12.49	12.50	2.440	-	0.798	-	1.002	1.072	-	**0.857**	A19
Repeated Test															
Edge3	802.11ac VHT80	5610	122	10.47	-	10.50	3.220	0.912	-	1.007	-	1.072	0.984	-	-

WLAN 5.8 GHz Body SAR

EUT Position	Mode	Traffic Channel		Power(dBm)			Peak SAR of Area Scan(W/kg)	1-g SAR (W/kg))		Scaling Factor (Power)		Scaling Factor (Duty cycle)	1-g Scaled SAR (W/kg)		Plot No
		Frequency (MHz)	Channel	Conducted Power		Tune-Up Limit									
				Main	Aux			Main	Aux	Main	Aux		Main	Aux	
Rear	802.11ac VHT80	5775	155	9.91	-	10.00	0.119	0.056	-	1.021	-	1.072	0.061	-	-
Rear	802.11ac VHT80	5775	155	-	13.96	14.00	0.683	-	0.290	-	1.009	1.072	-	0.314	-
Edge3	802.11ac VHT80	5775	155	9.91	-	10.00	1.440	0.491	-	1.021	-	1.072	**0.537**	-	A20
Edge3	802.11ac VHT80	5775	155	-	13.96	14.00	1.750	-	0.643	-	1.009	1.072	-	**0.696**	A21

Bluetooth Body SAR

EUT Position	Mode	Traffic Channel		Power(dBm)		Peak SAR of Area Scan(W/kg)	1-g SAR (W/kg)	Scaling Factor (Power)	1-g Scaled SAR (W/kg)	Plot No
		Frequency (MHz)	Channel	Conducted Power	Tune-Up Limit					
Rear	DH5	2441.0	39	10.39	11.50	0.009	0.006	1.291	0.008	-
Edge3	DH5	2441.0	39	10.39	11.50	0.263	0.130	1.291	**0.155**	A22

General Notes:

1. The test data reported are the worst-case SAR values according to test procedures specified in FCC KDB Publication 616217 D04v01r02 and FCC KDB Publication 447498 D01v06.
2. Liquid tissue depth was at least 15 cm for all frequencies.
3. All modes of operation were investigated, and worst-case results are reported.
4. The EUT is tested 2nd hot-spot peak, if it is less than 2 dB below the highest peak.
5. The manufacturer has confirmed that the device(s) tested have the same physical, mechanical and thermal characteristics and are within operational tolerances expected for production units.
6. SAR results were scaled to the maximum allowed power to demonstrate compliance per FCC KDB Publication 447498 D01v06.
7. Per FCC KDB 616217 D04v01r02 Section 4.3, SAR tests are required for the back surface and edges of the tablet with the tablet touching the phantom. The SAR Exclusion Threshold in FCC KDB 447498 D01v06 was applied to determined SAR test exclusion for adjacent edge configurations.

WLAN Notes:

1. Justification for test configurations for WLAN per KDB Publication 248227 D01v02r02 for 2.4GHz WIFI operations, the highest measured maximum output power channel for DSSS was selected for SAR measurement. SAR for OFDM modes (2.4GHz 802.11g/n) was not required due to the maximum allowed powers and the highest reported DSSS SAR.
2. Justification for test configurations for WLAN per KDB Publication 248227 D01v02r02 for 5GHz WIFI operations, the initial test configuration was selected according to the transmission mode with the highest maximum allowed powers. Other transmission modes were not investigated since the highest reported SAR for initial test configuration adjusted by the ratio of maximum output powers is less than 1.2W/kg.
3. When the maximum reported 1g averaged SAR is ≤ 0.8 W/kg, SAR testing on additional channels was not required. Otherwise, SAR for the next highest output power channel was required until the reported SAR result was ≤ 1.20 W/kg or all test channels were measured.
4. The device was configured to transmit continuously at the required data rate, channel bandwidth and signal modulation, using the highest transmission duty factor supported by the test mode tools. The reported SAR was scaled to the 100% transmission duty factor to determine compliance.
5. WLAN transmission was verified using a spectrum analyzer.
6. When the same transmission mode configurations have the same maximum output power on the same channel for the 802.11 a/g/n/ac modes, the channel in the lower order/sequence 802.11 mode (i.e. a,g, n then ac) is selected.
7. When the specified maximum output power is the same for both UNII Band1 and UNII Band 2A, begin SAR measurement in UNII band 2A; and if the highest reported SAR for UNII band 2A is ≤ 1.2W/kg, SAR is not required for UNII band1 > 1.2W/kg, both bands should be tested independently for SAR. When different maximum output powers is not required unless the highest reported SAR for the U-NII band with the higher maximum output power, adjusted by the ratio of lower to higher specified maximum output power for the two bands, is > 1.2 W/kg.

22. SAR Measurement Variability

22.1 Measurement Variability

Per FCC KDB Publication 865664 D01v01r04, SAR measurement variability was assessed for each frequency band, which was determined by the SAR probe calibration point and tissue-equivalent medium used for the device measurements. When both head and body tissue-equivalent media were required for SAR measurements in a frequency band, the variability measurement procedures were applied to the tissue medium with the highest measured SAR, using the highest measured SAR configuration for that tissue-equivalent medium. These additional measurements were repeated after the completion of all measurements requiring the same head or body tissue-equivalent medium in a frequency band. The test device was returned to ambient conditions (normal room temperature) with the battery fully charged before it was re-mounted on the device holder for the repeated measurement(s) to minimize any unexpected variations in the repeated results.

SAR Measurement Variability was assessed using the following procedures for each frequency band:

1. When the original highest measured SAR is ≥ 0.80 W/kg, the measurement was repeated once.

2. A second repeated measurement was preformed only if the ratio of largest to smallest SAR for the original and first repeated measurements was > 1.20 or when the original or repeated measurement was ≥ 1.45 W/kg (~ 10% from the 1-g SAR limit).

3. A third repeated measurement was performed only if the original, first or second repeated measurement was ≥ 1.5 W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20.

4. Repeated measurements are not required when the original highest measured SAR is < 0.80 W/kg

EUT Position	Mode	Traffic Channel		Separation Distance (mm)	Measured 1g SAR (W/kg)	1st Repeated 1g SAR(W/kg)	Ratio
		Frequency (MHz)	Channel				
Edge3	WLAN 5GHz	5290	58	0	0.826	0.869	1.05
Edge3	WLAN 5GHz	5610	122	0	0.999	0.912	0.91

22.2 Measurement Uncertainty

The measured SAR was < 1.5 W/kg for all frequency bands. Therefore, per KDB Publication 865664 D01v01r04, the extended measurement uncertainty analysis per IEEE 1528-2013 was not required.

23 Simultaneous Multi-band Transmission Evaluation

23.1 Introduction

The following procedures adopted from FCC KDB Publication 447498 D01v06 are applicable to handsets with built-in unlicensed transmitters such as Bluetooth devices which may simultaneously transmit with the licensed transmitter.

23.2 The Simultaneous Transmission possibilities are listed as below

No	Capable TX Configuration	Operation
1	WLAN Main + WLAN Aux	Yes
2	WLAN 2.45 GHz Main Ant + Bluetooth Aux Ant	Yes
3	WLAN 5 GHz Main Ant + Bluetooth Aux Ant	Yes

Note:

- The simultaneous transmission possibilities are listed as below.
- WLAN Aux Ant and Bluetooth Aux Ant share the same antenna and cannot transmit simultaneously.

23.3 Simultaneous Transmission Procedures

23.3.1 Notebook Body SAR Simultaneous Transmission Analysis

Simultaneous TX	configuration	Main Ant SAR(W/kg)	Aux Ant SAR(W/kg)	∑SAR (W/kg)
WLAN 2.4 GHz	Base	0.661	0.269	0.930
WLAN 5.3 GHz	Base	0.796	0.361	1.157
WLAN 5.6 GHz	Base	0.770	0.302	1.072
WLAN 5.8 GHz	Base	0.260	0.387	0.647
WLAN + Bluetooth	configuration	2.4 GHz Main Ant SAR(W/kg)	Bluetooth Aux Ant SAR (W/kg)	∑SAR (W/kg)
	Base	0.661	0.050	0.711
	configuration	5 GHz Main Ant SAR(W/kg)	Bluetooth Aux Ant SAR (W/kg)	∑SAR (W/kg)
	Base	0.796	0.050	0.846

23.3.2 Tablet PC Body SAR Simultaneous Transmission Analysis

Simultaneous TX	configuration	Main Ant SAR(W/kg)	Aux Ant SAR(W/kg)	∑SAR (W/kg)
2.4 GHz WLAN Tablet Mode	Rear	0.230	0.387	0.617
	Edge3	0.497	0.521	1.018
5.3 GHz WLAN Tablet Mode	Rear	0.195	0.259	0.454
	Edge3	1.045	0.689	1.734
5.6 GHz WLAN Tablet Mode	Rear	0.214	0.213	0.427
	Edge3	1.078	0.857	1.935
5.8 GHz WLAN Tablet Mode	Rear	0.061	0.314	0.375
	Edge3	0.537	0.696	1.233
WLAN + Bluetooth	configuration	2.4 GHz Main Ant SAR(W/kg)	Bluetooth Aux Ant SAR (W/kg)	∑SAR (W/kg)
	Rear	0.230	0.008	0.238
	Edge 3	0.497	0.155	0.652
	configuration	5 GHz Main Ant SAR(W/kg)	Bluetooth Aux Ant SAR (W/kg)	∑SAR (W/kg)
	Rear	0.214	0.008	0.222
	Edge3	1.078	0.155	1.233

23.4 SPLSR Evaluation and Analysis

FCC KDB Publication 447498 D01v06, when the sum of the standalone transmitters is more than 1.6 W/kg, the SAR sum to peak locations can be analyzed to determine SAR distribution overlaps. When the SAR peak to location ratio for each pair of antennas is ≤ 0.04, simultaneous SAR evaluation is not required. The distance between the transmitters was calculated using the following formal.

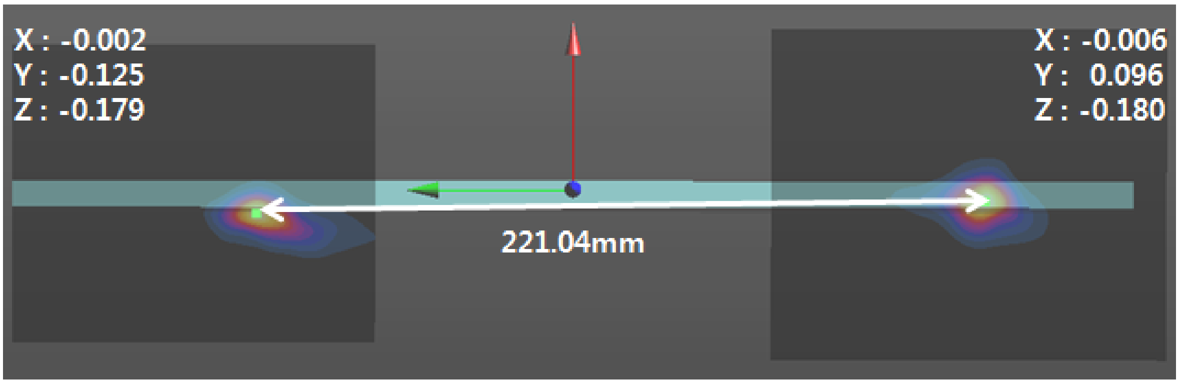
$$\text{Distance} = R_i = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2 + (z_1 - z_2)^2}$$

$$\text{SPLS Ratio} = \frac{(SAR_1 + SAR_2)^{1.5}}{R_i}$$

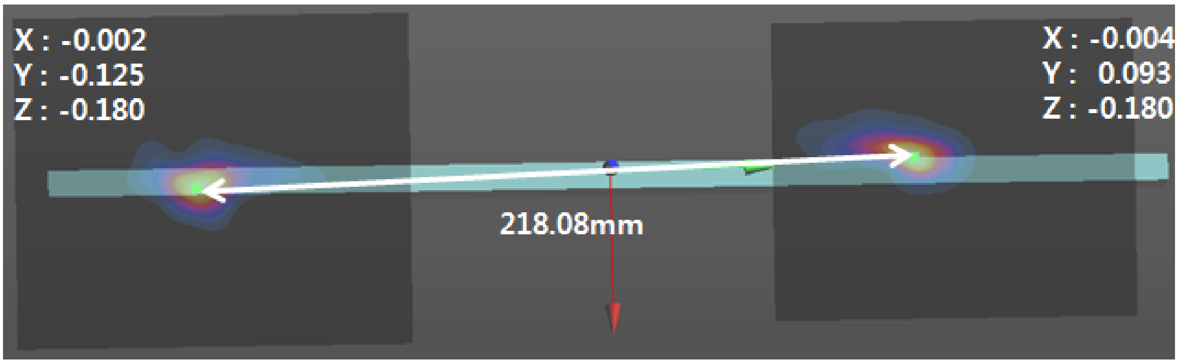
Notebook Body SAR Peak Location Separation Ratio (SPLSR)

Simultaneous Tx	Position	Man Ant	Aux Ant	∑SAR (W/kg)	Calculated Distance (mm)	SPLSR (≤0.04)	Volume Scan	Page No
WLAN 5.3 GHz	Edge3	1.045	0.689	1.734	221.04	0.012	No	37
WLAN 5.6 GHz	Edge3	1.078	0.857	1.935	218.08	0.012	No	37

Notebook (Base) 5.3 GHz (WLAN Main Ant + WLAN Aux Ant)



Notebook (Base) 5.6 GHz (WLAN Main Ant + WLAN Aux Ant)



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Appendix A.1 Verification Test Plots for 2450 MHz

Date: 2017-04-22

Test Laboratory : SGS Korea (Gunpo Laboratory)
File Name: 2450MHz Verification(1).da53:0

Input Power : 100 mW

Ambient Temp : 23.0 ℃ Tissue Temp : 21.7 ℃

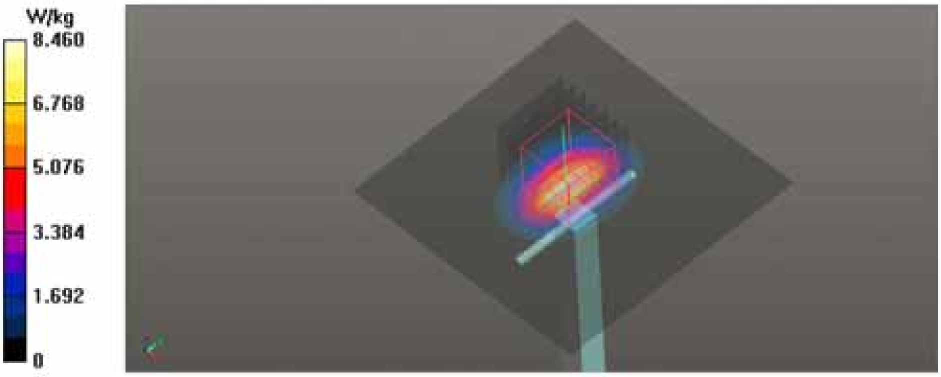
DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:734

Communication System: UID 0, CW (0); Frequency: 2450 MHz;Duty Cycle: 1:1
Medium parameters used: f = 2450 MHz; σ = 1.967 S/m; ε_r = 54.926; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY52 Configuration:
- Probe: EX3DV4 - SN3862; ConvF(7.57, 7.57, 7.57); Calibrated: 2016-10-06;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1503; Calibrated: 2016-06-27
- Phantom: ELI v5.0 1244; Type: QDOVA002AA; Serial: TP:1244
- DASY52 52.8.8(1258)SEMCAD X 14.6.10(7373)

Verification/2450MHz Verification/Area Scan (101x101x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 8.46 W/kg

Verification/2450MHz Verification/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 67.03 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 10.2 W/kg
SAR(1 g) = 5.24 W/kg; SAR(10 g) = 2.45 W/kg
Maximum value of SAR (measured) = 8.47 W/kg



Date: 2017-04-28

Test Laboratory : SGS Korea (Gunpo Laboratory)
File Name: 2450MHz Verification(2).da53:0

Input Power : 100 mW

Ambient Temp : 23.3 ℃ Tissue Temp : 21.4 ℃

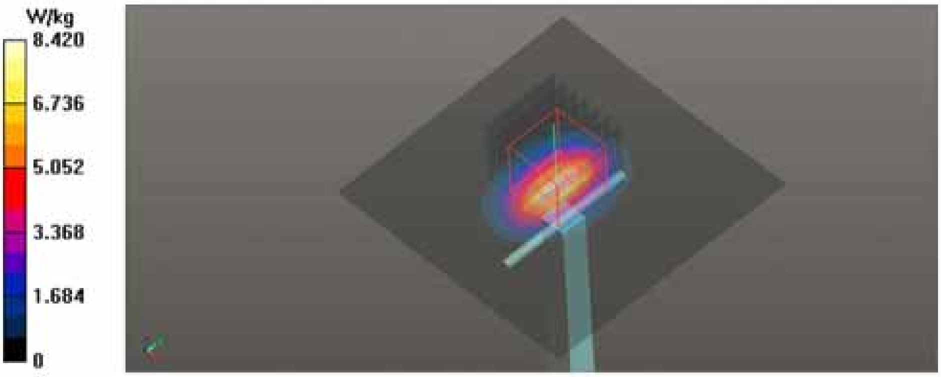
DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:734

Communication System: UID 0, CW (0); Frequency: 2450 MHz;Duty Cycle: 1:1
Medium parameters used: f = 2450 MHz; σ = 1.954 S/m; ε_r = 54.557; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY52 Configuration:
- Probe: EX3DV4 - SN3862; ConvF(7.57, 7.57, 7.57); Calibrated: 2016-10-06;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1503; Calibrated: 2016-06-27
- Phantom: ELI v5.0 1244; Type: QDOVA002AA; Serial: TP:1244
- DASY52 52.8.8(1258)SEMCAD X 14.6.10(7373)

Verification/2450MHz Verification/Area Scan (101x101x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 8.42 W/kg

Verification/2450MHz Verification/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 67.22 V/m; Power Drift = -0.00 dB
Peak SAR (extrapolated) = 10.1 W/kg
SAR(1 g) = 5.25 W/kg; SAR(10 g) = 2.45 W/kg
Maximum value of SAR (measured) = 8.44 W/kg



Appendix A.2 Verification Test Plots for 5300 MHz

Date: 2017-04-24

Test Laboratory : SGS Korea (Gunpo Laboratory)
File Name: 5300MHz Verification.da53:0

Input Power : 100 mW

Ambient Temp : 23.2 ℃ Tissue Temp : 21.7 ℃

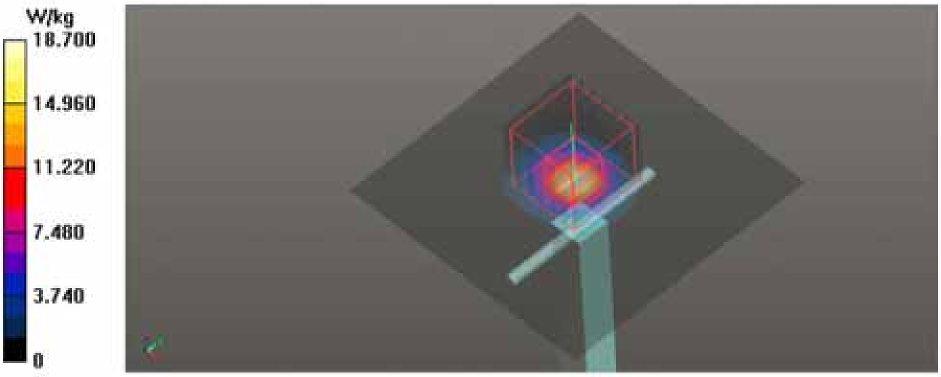
DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1130

Communication System: UID 0, CW (0); Frequency: 5300 MHz;Duty Cycle: 1:1
Medium parameters used: f = 5300 MHz; σ = 5.197 S/m; ε_r = 48.101; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY52 Configuration:
- Probe: EX3DV4 - SN3862; ConvF(4.35, 4.35, 4.35); Calibrated: 2016-10-06;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1503; Calibrated: 2016-06-27
- Phantom: ELI v5.0 1244; Type: QDOVA002AA; Serial: TP:1244
- DASY52 52.8.8(1258)SEMCAD X 14.6.10(7373)

Verification/5300MHz Verification/Area Scan (81x81x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 18.7 W/kg

Verification/5300MHz Verification/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 65.61 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 27.6 W/kg
SAR(1 g) = 7.85 W/kg; SAR(10 g) = 2.11 W/kg
Maximum value of SAR (measured) = 19.0 W/kg



Appendix A.3 Verification Test Plots for 5600 MHz

Date: 2017-04-25

Test Laboratory : SGS Korea (Gunpo Laboratory)
File Name: 5600MHz Verification.da53:0

Input Power : 100 mW

Ambient Temp : 23.0 ℃ Tissue Temp : 21.5 ℃

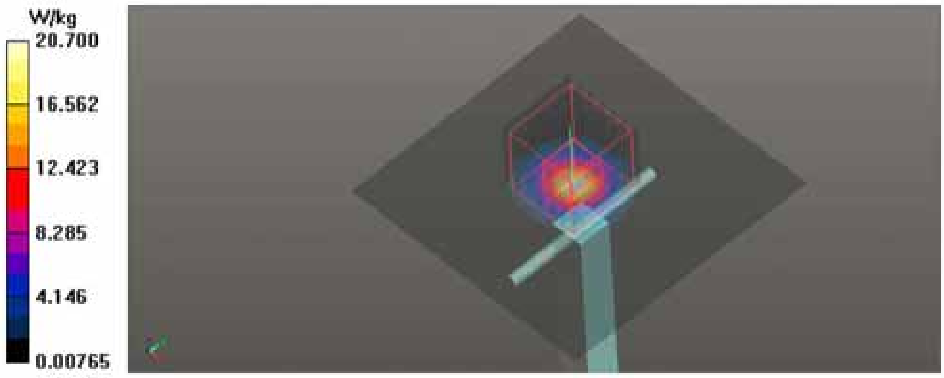
DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1130

Communication System: UID 0, CW (0); Frequency: 5600 MHz;Duty Cycle: 1:1
Medium parameters used: f = 5600 MHz; σ = 5.708 S/m; ε_r = 48.05; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY52 Configuration:
- Probe: EX3DV4 - SN3862; ConvF(3.69, 3.69, 3.69); Calibrated: 2016-10-06;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1503; Calibrated: 2016-06-27
- Phantom: ELI v5.0 1244; Type: QDOVA002AA; Serial: TP:1244
- DASY52 52.8.8(1258)SEMCAD X 14.6.10(7373)

Verification/5600MHz Verification/Area Scan (81x81x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 20.7 W/kg

Verification/5600MHz Verification/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 71.15 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 30.2 W/kg
SAR(1 g) = 8.29 W/kg; SAR(10 g) = 2.16 W/kg
Maximum value of SAR (measured) = 21.3 W/kg



Appendix A.4 Verification Test Plots for 5800 MHz

Date: 2017-04-27

Test Laboratory : SGS Korea (Gunpo Laboratory)
File Name: 5800MHz Verification.da53:0

Input Power : 100 mW

Ambient Temp : 23.3 ℃ Tissue Temp : 21.6 ℃

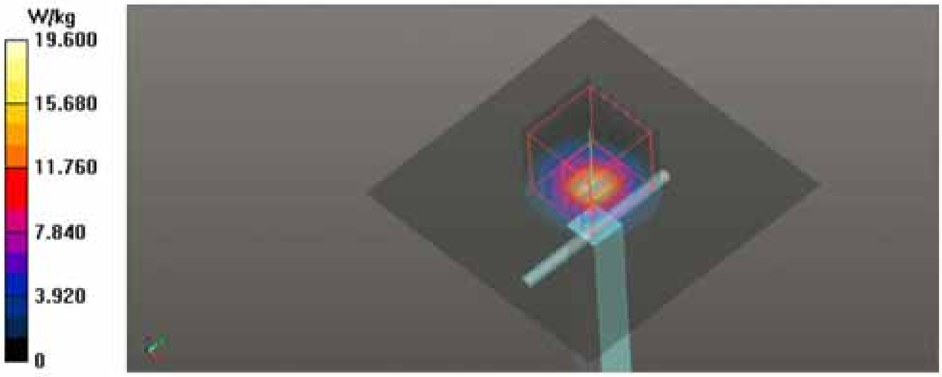
DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1130

Communication System: UID 0, CW (0); Frequency: 5800 MHz;Duty Cycle: 1:1
Medium parameters used: f = 5800 MHz; σ = 5.883 S/m; ε_r = 47.296; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY52 Configuration:
- Probe: EX3DV4 - SN3862; ConvF(3.84, 3.84, 3.84); Calibrated: 2016-10-06;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1503; Calibrated: 2016-06-27
- Phantom: ELI v5.0 1244; Type: QDOVA002AA; Serial: TP:1244
- DASY52 52.8.8(1258)SEMCAD X 14.6.10(7373)

Verification/5800MHz Verification/Area Scan (81x81x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 19.6 W/kg

Verification/5800MHz Verification/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 68.33 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 29.2 W/kg
SAR(1 g) = 8.03 W/kg; SAR(10 g) = 2.19 W/kg
Maximum value of SAR (measured) = 20.2 W/kg



Appendix A.5 SAR Test Plots for WLAN 2450 MHz Main (Notebook Mode)

Date: 2017-04-22

Test Laboratory : SGS Korea (Gunpo Laboratory)
File Name: WLAN 802.11b Base CH1 Main.da53:0

Ambient Temp : 23.0 ℃ Tissue Temp : 21.7 ℃

DUT: NP940X5M; Type: Samsung Notebook; Serial: 0RTE91ZJ300051

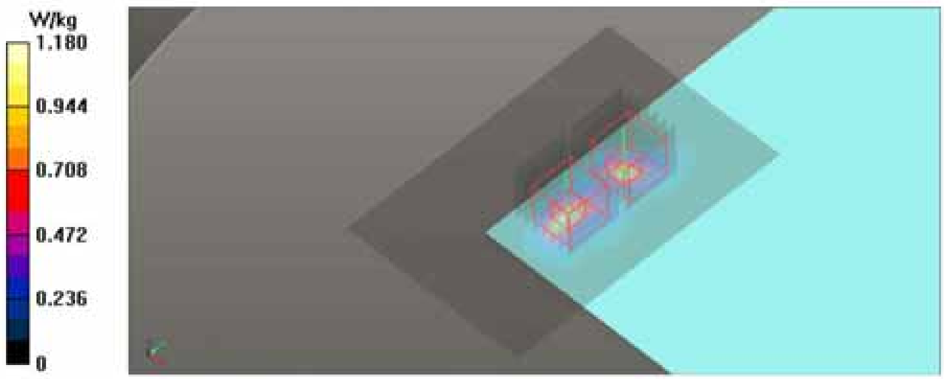
Communication System: UID 0, WLAN 2.45GHz (0); Frequency: 2412 MHz;Duty Cycle: 1:1
Medium parameters used: f = 2412 MHz; σ = 1.917 S/m; ε_r = 55.024; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY52 Configuration:
- Probe: EX3DV4 - SN3862; ConvF(7.57, 7.57, 7.57); Calibrated: 2016-10-06;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1503; Calibrated: 2016-06-27
- Phantom: ELI v5.0 1244; Type: QDOVA002AA; Serial: TP:1244
- DASY52 52.8.8(1258)SEMCAD X 14.6.10(7373)

Body/WLAN_802.11b_Base_CH1_Main/Area Scan (101x151x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 1.18 W/kg

Body/WLAN_802.11b_Base_CH1_Main/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 13.74 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 1.64 W/kg
SAR(1 g) = 0.611 W/kg; SAR(10 g) = 0.252 W/kg
Maximum value of SAR (measured) = 1.22 W/kg

Body/WLAN_802.11b_Base_CH1_Main/Zoom Scan (7x7x7)/Cube 1: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 13.74 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 1.40 W/kg
SAR(1 g) = 0.505 W/kg; SAR(10 g) = 0.193 W/kg
Maximum value of SAR (measured) = 1.09 W/kg



Appendix A.6 SAR Test Plots for WLAN 2450 MHz Aux (Notebook Mode)

Date: 2017-04-22

Test Laboratory : SGS Korea (Gunpo Laboratory)
File Name: WLAN_802.11b_Base_CH1_Aux.da53:0

Ambient Temp : 23.0 ℃ Tissue Temp : 21.7 ℃

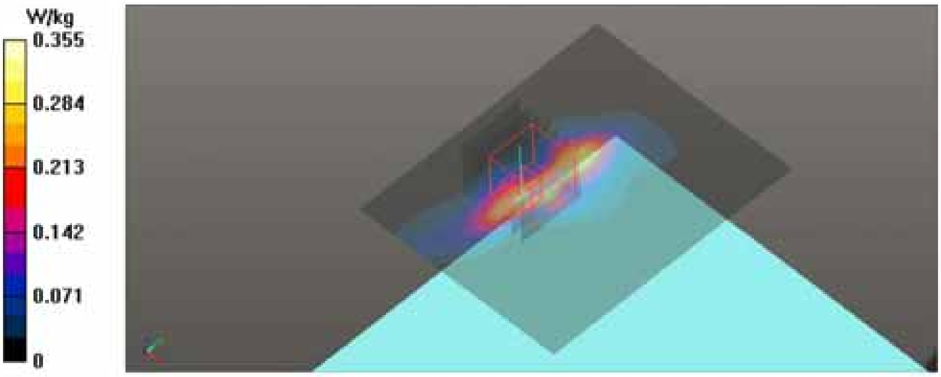
DUT: NP940X5M; Type: Samsung Notebook; Serial: 0RTE91ZJ300051

Communication System: UID 0, WLAN 2.45GHz (0); Frequency: 2412 MHz;Duty Cycle: 1:1
Medium parameters used: f = 2412 MHz; σ = 1.917 S/m; ε_r = 55.024; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY52 Configuration:
- Probe: EX3DV4 - SN3862; ConvF(7.57, 7.57, 7.57); Calibrated: 2016-10-06;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1503; Calibrated: 2016-06-27
- Phantom: ELI v5.0 1244; Type: QDOVA002AA; Serial: TP:1244
- DASY52 52.8.8(1258)SEMCAD X 14.6.10(7373)

Body/WLAN_802.11b_Base_CH1_Aux/Area Scan (101x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.355 W/kg

Body/WLAN_802.11b_Base_CH1_Aux/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 1.964 V/m; Power Drift = -0.12 dB
Peak SAR (extrapolated) = 0.816 W/kg
SAR(1 g) = 0.266 W/kg; SAR(10 g) = 0.099 W/kg
Maximum value of SAR (measured) = 0.581 W/kg



Appendix A.7 SAR Test Plots for WLAN 5300 MHz Main (Notebook Mode)

Date: 2017-04-24

Test Laboratory : SGS Korea (Gunpo Laboratory)
File Name: WLAN_802.11ac_VHT80_Base_CH58_Main.da53:0

Ambient Temp : 23.2 ℃ Tissue Temp : 21.7 ℃

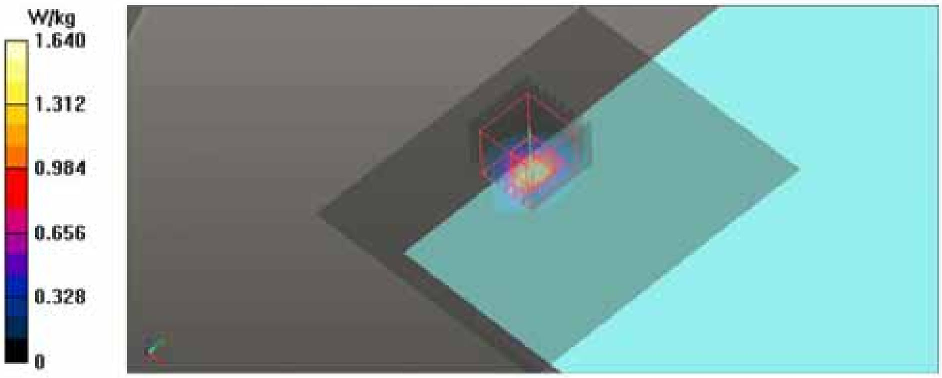
DUT: NP940X5M; Type: Samsung Notebook; Serial: 0RTE91ZJ300051

Communication System: UID 0, 5GHz WLAN (0); Frequency: 5290 MHz;Duty Cycle: 1:1
Medium parameters used: f = 5290 MHz; σ = 5.183 S/m; ε_r = 48.127; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY52 Configuration:
- Probe: EX3DV4 - SN3862; ConvF(4.35, 4.35, 4.35); Calibrated: 2016-10-06;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1503; Calibrated: 2016-06-27
- Phantom: ELI v5.0 1244; Type: QDOVA002AA; Serial: TP:1244
- DASY52 52.8.8(1258)SEMCAD X 14.6.10(7373)

Body/WLAN_802.11ac_VHT80_Base_CH58_Main/Area Scan (101x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 1.64 W/kg

Body/WLAN_802.11ac_VHT80_Base_CH58_Main/Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 1.947 V/m; Power Drift = 0.15 dB
Peak SAR (extrapolated) = 3.36 W/kg
SAR(1 g) = 0.662 W/kg; SAR(10 g) = 0.187 W/kg
Maximum value of SAR (measured) = 1.71 W/kg



Appendix A.8 SAR Test Plots for WLAN 5300 MHz Aux (Notebook Mode)

Date: 2017-04-24

Test Laboratory : SGS Korea (Gunpo Laboratory)
File Name: WLAN_802.11ac_VHT80_Base_CH58_Aux.da53:0

Ambient Temp : 23.2 ℃ Tissue Temp : 21.7 ℃

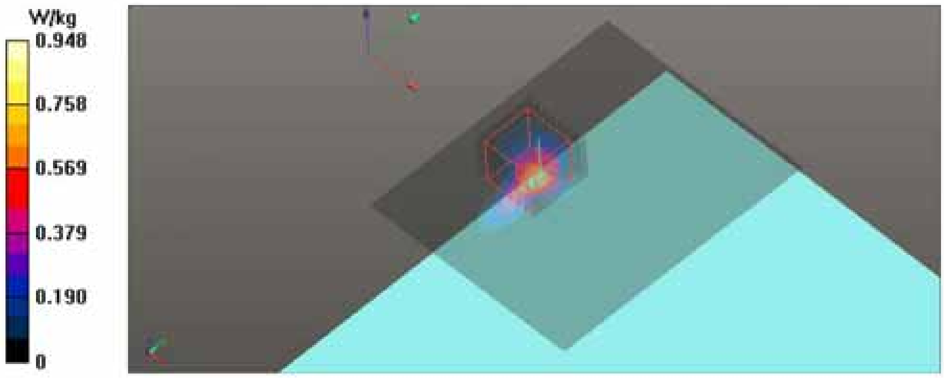
DUT: NP940X5M; Type: Samsung Notebook; Serial: 0RTE91ZJ300051

Communication System: UID 0, 5GHz WLAN (0); Frequency: 5290 MHz;Duty Cycle: 1:1
Medium parameters used: f = 5290 MHz; $\sigma = 5.183$ S/m; $\varepsilon_r = 48.127$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section

DASY52 Configuration:
- Probe: EX3DV4 - SN3862; ConvF(4.35, 4.35, 4.35); Calibrated: 2016-10-06;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1503; Calibrated: 2016-06-27
- Phantom: ELI v5.0 1244; Type: QDOVA002AA; Serial: TP:1244
- DASY52 52.8.8(1258)SEMCAD X 14.6.10(7373)

Body/WLAN_802.11ac_VHT80_Base_CH58_Aux/Area Scan (101x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.948 W/kg

Body/WLAN_802.11ac_VHT80_Base_CH58_Aux/Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 2.048 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 1.40 W/kg
SAR(1 g) = 0.337 W/kg; SAR(10 g) = 0.107 W/kg
Maximum value of SAR (measured) = 0.853 W/kg



Appendix A.9 SAR Test Plots for WLAN 5600 MHz Main (Notebook Mode)

Date: 2017-04-25

Test Laboratory : SGS Korea (Gunpo Laboratory)
File Name: WLAN_802.11ac_VHT80_Base_CH106_Main.da53:0

Ambient Temp : 23.0 ℃ Tissue Temp : 21.5 ℃

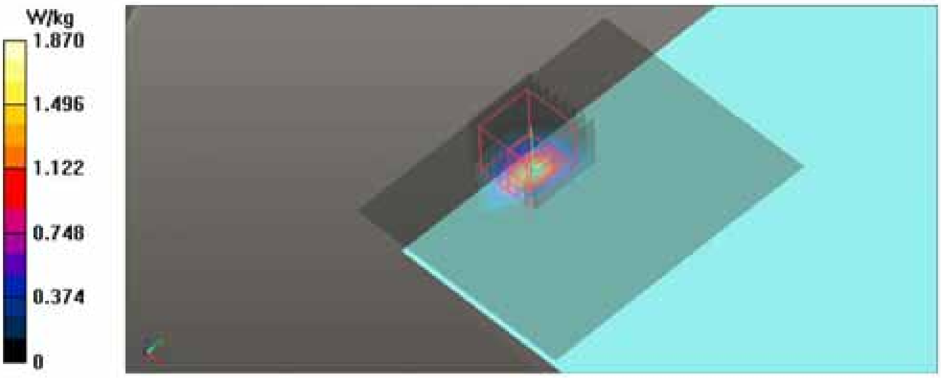
DUT: NP940X5M; Type: Samsung Notebook; Serial: 0RTE91ZJ300051

Communication System: UID 0, 5GHz WLAN (0); Frequency: 5530 MHz;Duty Cycle: 1:1
Medium parameters used: f = 5530 MHz; σ = 5.609 S/m; ε_r = 48.219; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY52 Configuration:
- Probe: EX3DV4 - SN3862; ConvF(3.69, 3.69, 3.69); Calibrated: 2016-10-06;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1503; Calibrated: 2016-06-27
- Phantom: ELI v5.0 1244; Type: QDOVA002AA; Serial: TP:1244
- DASY52 52.8.8(1258)SEMCAD X 14.6.10(7373)

Body/WLAN_802.11ac_VHT80_Base_CH106_Main/Area Scan (91x111x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 1.87 W/kg

Body/WLAN_802.11ac_VHT80_Base_CH106_Main/Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 1.951 V/m; Power Drift = -0.11 dB
Peak SAR (extrapolated) = 2.79 W/kg
SAR(1 g) = 0.710 W/kg; SAR(10 g) = 0.209 W/kg
Maximum value of SAR (measured) = 1.89 W/kg



Appendix A.10 SAR Test Plots for WLAN 5600 MHz Aux (Notebook Mode)

Date: 2017-04-25

Test Laboratory : SGS Korea (Gunpo Laboratory)
File Name: WLAN_802.11ac_VHT80_Base_CH122_Aux.da53:0

Ambient Temp : 23.0 ℃ Tissue Temp : 21.5 ℃

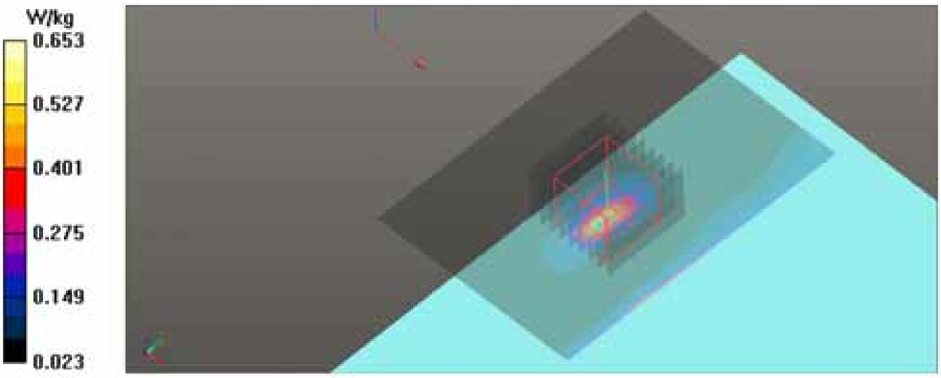
DUT: NP940X5M; Type: Samsung Notebook; Serial: 0RTE91ZJ300051

Communication System: UID 0, 5GHz WLAN (0); Frequency: 5610 MHz;Duty Cycle: 1:1
Medium parameters used: f = 5610 MHz; σ = 5.725 S/m; ϵ_r = 48.023; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY52 Configuration:
- Probe: EX3DV4 - SN3862; ConvF(3.69, 3.69, 3.69); Calibrated: 2016-10-06;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1503; Calibrated: 2016-06-27
- Phantom: ELI v5.0 1244; Type: QDOVA002AA; Serial: TP:1244
- DASY52 52.8.8(1258)SEMCAD X 14.6.10(7373)

Body/WLAN_802.11ac_VHT80_Base_CH122_Aux/Area Scan (81x111x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.653 W/kg

Body/WLAN_802.11ac_VHT80_Base_CH122_Aux/Zoom Scan (9x9x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 1.987 V/m; Power Drift = -0.18 dB
Peak SAR (extrapolated) = 1.18 W/kg
SAR(1 g) = 0.282 W/kg; SAR(10 g) = 0.104 W/kg
Maximum value of SAR (measured) = 0.659 W/kg



Appendix A.11 SAR Test Plots for WLAN 5800 MHz Main (Notebook Mode)

Date: 2017-04-27

Test Laboratory : SGS Korea (Gunpo Laboratory)
File Name: WLAN_802.11ac_VHT80_Base_CH155_Main.da53:0

Ambient Temp : 23.3 ℃ Tissue Temp : 21.6 ℃

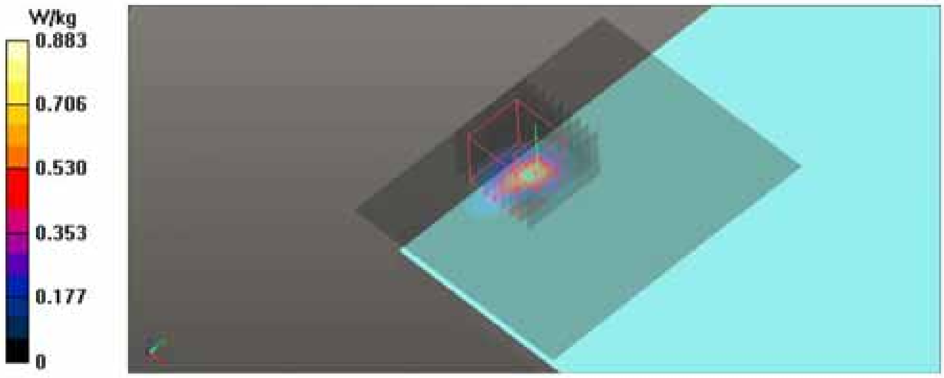
DUT: NP940X5M; Type: Samsung Notebook; Serial: 0RTE91ZJ300051

Communication System: UID 0, 5GHz WLAN (0); Frequency: 5775 MHz;Duty Cycle: 1:1
Medium parameters used: f = 5775 MHz; σ = 5.845 S/m; ε_r = 47.35; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY52 Configuration:
- Probe: EX3DV4 - SN3862; ConvF(3.84, 3.84, 3.84); Calibrated: 2016-10-06;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1503; Calibrated: 2016-06-27
- Phantom: ELI v5.0 1244; Type: QDOVA002AA; Serial: TP:1244
- DASY52 52.8.8(1258)SEMCAD X 14.6.10(7373)

Body/WLAN_802.11ac_VHT80_Base_CH155_Main/Area Scan (91x111x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.883 W/kg

Body/WLAN_802.11ac_VHT80_Base_CH155_Main/Zoom Scan (9x9x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 3.521 V/m; Power Drift = 0.16 dB
Peak SAR (extrapolated) = 2.34 W/kg
SAR(1 g) = 0.238 W/kg; SAR(10 g) = 0.073 W/kg
Maximum value of SAR (measured) = 0.836 W/kg



Appendix A.12 SAR Test Plots for WLAN 5800 MHz Aux (Notebook Mode)

Date: 2017-04-27

Test Laboratory : SGS Korea (Gunpo Laboratory)
File Name: WLAN_802.11ac_VHT80_Base_CH155_Aux.da53:0

Ambient Temp : 23.3 ℃ Tissue Temp : 21.6 ℃

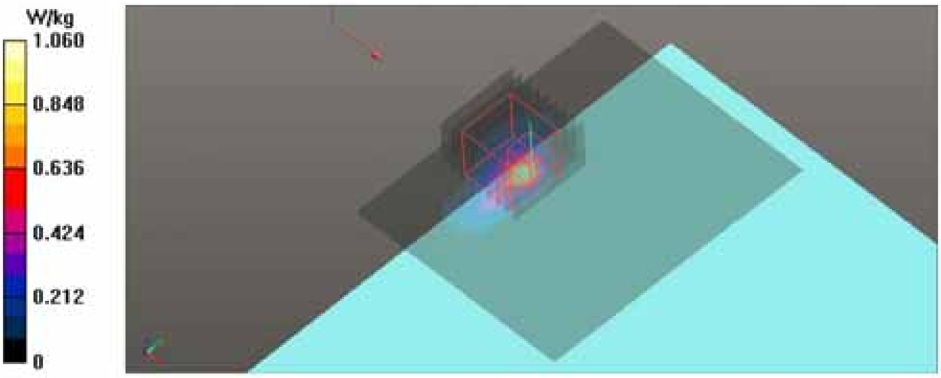
DUT: NP940X5M; Type: Samsung Notebook; Serial: 0RTE91ZJ300051

Communication System: UID 0, 5GHz WLAN (0); Frequency: 5775 MHz;Duty Cycle: 1:1
Medium parameters used: f = 5775 MHz; σ = 5.845 S/m; ε_r = 47.35; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY52 Configuration:
- Probe: EX3DV4 - SN3862; ConvF(3.84, 3.84, 3.84); Calibrated: 2016-10-06;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1503; Calibrated: 2016-06-27
- Phantom: ELI v5.0 1244; Type: QDOVA002AA; Serial: TP:1244
- DASY52 52.8.8(1258)SEMCAD X 14.6.10(7373)

Body/WLAN_802.11ac_VHT80_Base_CH155_Aux/Area Scan (91x111x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 1.06 W/kg

Body/WLAN_802.11ac_VHT80_Base_CH155_Aux/Zoom Scan (9x9x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 1.503 V/m; Power Drift = -0.12 dB
Peak SAR (extrapolated) = 2.26 W/kg
SAR(1 g) = 0.358 W/kg; SAR(10 g) = 0.103 W/kg
Maximum value of SAR (measured) = 1.32 W/kg



Appendix A.13 SAR Test Plots for Bluetooth (Notebook Mode)

Date: 2017-04-28

Test Laboratory : SGS Korea (Gunpo Laboratory)
File Name: 2.45GHz_Bluetooth_Base_Ch39.da53:0

Ambient Temp : 23.3 ℃ Tissue Temp : 21.6 ℃

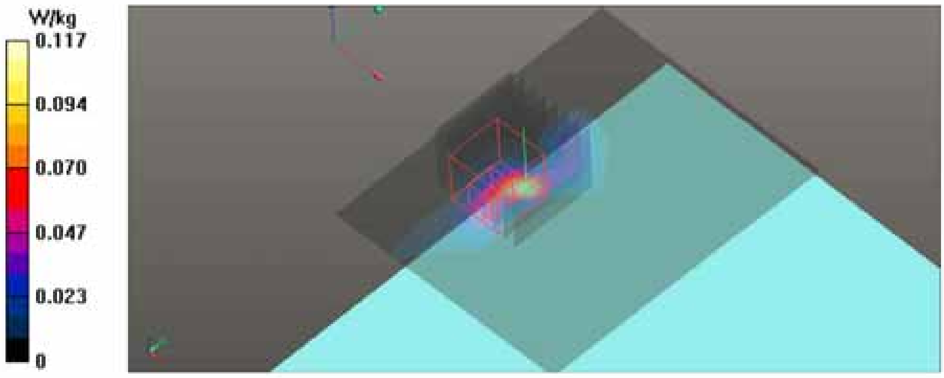
DUT: NP940X5M; Type: Samsung Notebook; Serial: 0RTE91ZJ300051

Communication System: UID 0, Bluetooth (0); Frequency: 2441 MHz;Duty Cycle: 1:1.311
Medium parameters used: f = 2441 MHz; σ = 1.942 S/m; ε_r = 54.579; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY52 Configuration:
- Probe: EX3DV4 - SN3862; ConvF(7.57, 7.57, 7.57); Calibrated: 2016-10-06;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1503; Calibrated: 2016-06-27
- Phantom: ELI v5.0 1244; Type: QDOVA002AA; Serial: TP:1244
- DASY52 52.8.8(1258)SEMCAD X 14.6.10(7373)

Body/2.45GHz_Bluetooth_Base_Ch39/Area Scan (101x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.117 W/kg

Body/2.45GHz_Bluetooth_Base_Ch39/Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 0.8950 V/m; Power Drift = -0.15 dB
Peak SAR (extrapolated) = 0.148 W/kg
SAR(1 g) = 0.039 W/kg; SAR(10 g) = 0.017 W/kg
Maximum value of SAR (measured) = 0.110 W/kg



Appendix A.14 SAR Test Plots for WLAN 2450 MHz Main (Tablet Mode)

Date: 2017-04-22

Test Laboratory : SGS Korea (Gunpo Laboratory)
File Name: WLAN_802.11b_Edge3_CH1_Main.da53:0

Ambient Temp : 23.0 ℃ Tissue Temp : 21.7 ℃

DUT: NP940X5M; Type: Samsung Notebook; Serial: 0RTE91ZJ300051

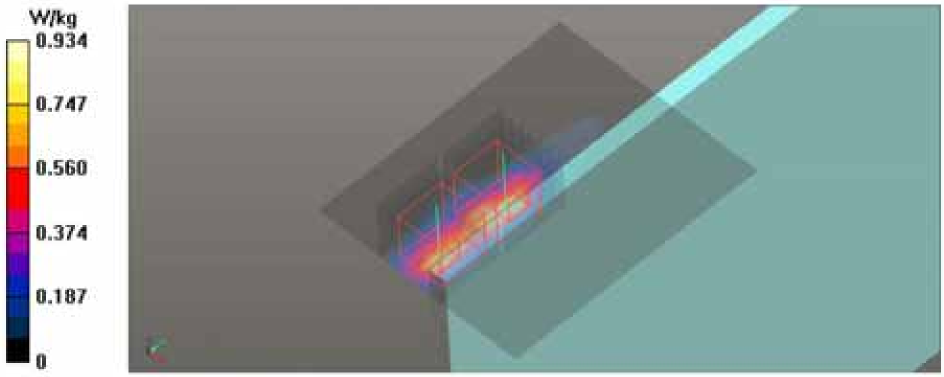
Communication System: UID 0, WLAN 2.45GHz (0); Frequency: 2412 MHz;Duty Cycle: 1:1
Medium parameters used: f = 2412 MHz; σ = 1.917 S/m; ε_r = 55.024; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY52 Configuration:
- Probe: EX3DV4 - SN3862; ConvF(7.57, 7.57, 7.57); Calibrated: 2016-10-06;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1503; Calibrated: 2016-06-27
- Phantom: ELI v5.0 1244; Type: QDOVA002AA; Serial: TP:1244
- DASY52 52.8.8(1258)SEMCAD X 14.6.10(7373)

Body/WLAN_802.11b_Edge3_CH1_Main/Area Scan (101x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.934 W/kg

Body/WLAN_802.11b_Edge3_CH1_Main/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 12.19 V/m; Power Drift = -0.20 dB
Peak SAR (extrapolated) = 1.26 W/kg
SAR(1 g) = 0.486 W/kg; SAR(10 g) = 0.199 W/kg
Maximum value of SAR (measured) = 0.922 W/kg

Body/WLAN_802.11b_Edge3_CH1_Main/Zoom Scan (7x7x7)/Cube 1: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 12.19 V/m; Power Drift = -0.20 dB
Peak SAR (extrapolated) = 0.938 W/kg
SAR(1 g) = 0.463 W/kg; SAR(10 g) = 0.206 W/kg
Maximum value of SAR (measured) = 0.777 W/kg



Appendix A.15 SAR Test Plots for WLAN 2450 MHz Aux (Tablet Mode)

Date: 2017-04-22

Test Laboratory : SGS Korea (Gunpo Laboratory)
File Name: WLAN_802.11b_Edge3_CH1_Aux.da53:0

Ambient Temp : 23.0 ℃ Tissue Temp : 21.7 ℃

DUT: NP940X5M; Type: Samsung Notebook; Serial: 0RTE91ZJ300051

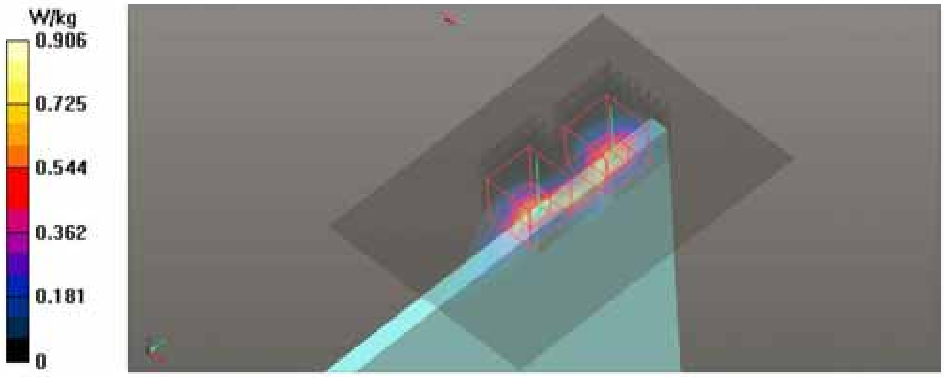
Communication System: UID 0, WLAN 2.45GHz (0); Frequency: 2412 MHz;Duty Cycle: 1:1
Medium parameters used: f = 2412 MHz; σ = 1.917 S/m; ε_r = 55.024; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY52 Configuration:
- Probe: EX3DV4 - SN3862; ConvF(7.57, 7.57, 7.57); Calibrated: 2016-10-06;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1503; Calibrated: 2016-06-27
- Phantom: ELI v5.0 1244; Type: QDOVA002AA; Serial: TP:1244
- DASY52 52.8.8(1258)SEMCAD X 14.6.10(7373)

Body/WLAN_802.11b_Edge3_CH1_Aux 2/Area Scan (101x141x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.906 W/kg

Body/WLAN_802.11b_Edge3_CH1_Aux 2/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 4.353 V/m; Power Drift = 0.14 dB
Peak SAR (extrapolated) = 1.37 W/kg
SAR(1 g) = 0.514 W/kg; SAR(10 g) = 0.191 W/kg
Maximum value of SAR (measured) = 0.894 W/kg

Body/WLAN_802.11b_Edge3_CH1_Aux 2/Zoom Scan (7x7x7)/Cube 1: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 4.353 V/m; Power Drift = 0.14 dB
Peak SAR (extrapolated) = 0.876 W/kg
SAR(1 g) = 0.447 W/kg; SAR(10 g) = 0.196 W/kg
Maximum value of SAR (measured) = 0.713 W/kg



Appendix A.16 SAR Test Plots for WLAN 5300 MHz Main (Tablet Mode)

Date: 2017-04-24

Test Laboratory : SGS Korea (Gunpo Laboratory)
File Name: WLAN_802.11ac_VHT80_Edge3_CH58_Main_Repeated Test.da53:0

Ambient Temp : 23.2 ℃ Tissue Temp : 21.7 ℃

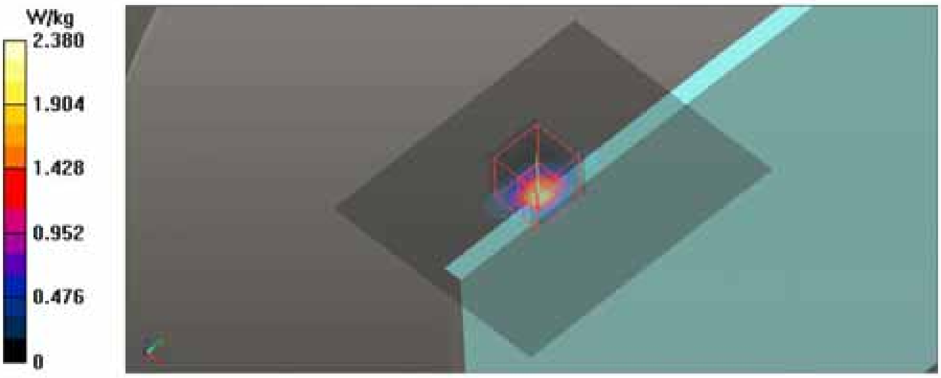
DUT: NP940X5M; Type: Samsung Notebook; Serial: 0RTE91ZJ300051

Communication System: UID 0, 5GHz WLAN (0); Frequency: 5290 MHz;Duty Cycle: 1:1
Medium parameters used: f = 5290 MHz; σ = 5.183 S/m; ε_r = 48.127; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY52 Configuration:
- Probe: EX3DV4 - SN3862; ConvF(4.35, 4.35, 4.35); Calibrated: 2016-10-06;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1503; Calibrated: 2016-06-27
- Phantom: ELI v5.0 1244; Type: QDOVA002AA; Serial: TP:1244
- DASY52 52.8.8(1258)SEMCAD X 14.6.10(7373)

Body/WLAN_802.11ac_VHT80_Edge3_CH58_Main_Repeated Test/Area Scan (101x121x1):
Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 2.38 W/kg

Body/WLAN_802.11ac_VHT80_Edge3_CH58_Main_Repeated Test/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 1.987 V/m; Power Drift = 0.17 dB
Peak SAR (extrapolated) = 3.07 W/kg
SAR(1 g) = 0.869 W/kg; SAR(10 g) = 0.231 W/kg
Maximum value of SAR (measured) = 2.07 W/kg



Appendix A.17 SAR Test Plots for WLAN 5300 MHz Aux (Tablet Mode)

Date: 2017-04-24

Test Laboratory : SGS Korea (Gunpo Laboratory)
File Name: WLAN_802.11ac_VHT80_Edge3_CH58_Aux.da53:0

Ambient Temp : 23.2 ℃ Tissue Temp : 21.7 ℃

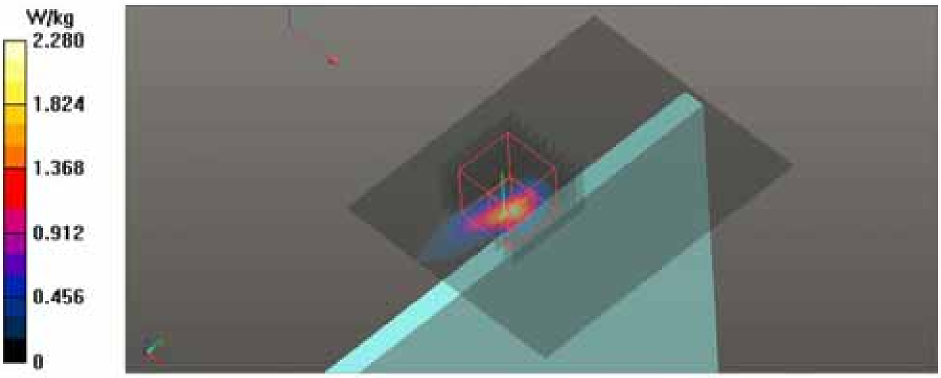
DUT: NP940X5M; Type: Samsung Notebook; Serial: 0RTE91ZJ300051

Communication System: UID 0, 5GHz WLAN (0); Frequency: 5290 MHz;Duty Cycle: 1:1
Medium parameters used: f = 5290 MHz; σ = 5.183 S/m; ε_r = 48.127; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY52 Configuration:
- Probe: EX3DV4 - SN3862; ConvF(4.35, 4.35, 4.35); Calibrated: 2016-10-06;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1503; Calibrated: 2016-06-27
- Phantom: ELI v5.0 1244; Type: QDOVA002AA; Serial: TP:1244
- DASY52 52.8.8(1258)SEMCAD X 14.6.10(7373)

Body/WLAN_802.11ac_VHT80_Edge3_CH58_Aux/Area Scan (91x111x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 2.28 W/kg

Body/WLAN_802.11ac_VHT80_Edge3_CH58_Aux/Zoom Scan (9x9x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 2.004 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 4.15 W/kg
SAR(1 g) = 0.641 W/kg; SAR(10 g) = 0.188 W/kg
Maximum value of SAR (measured) = 1.85 W/kg



Appendix A.18 SAR Test Plots for WLAN 5600 MHz Main (Tablet Mode)

Date: 2017-04-25

Test Laboratory : SGS Korea (Gunpo Laboratory)
File Name: WLAN_802.11ac_VHT80_Edge3_CH122_Main.da53:0

Ambient Temp : 23.0 ℃ Tissue Temp : 21.5 ℃

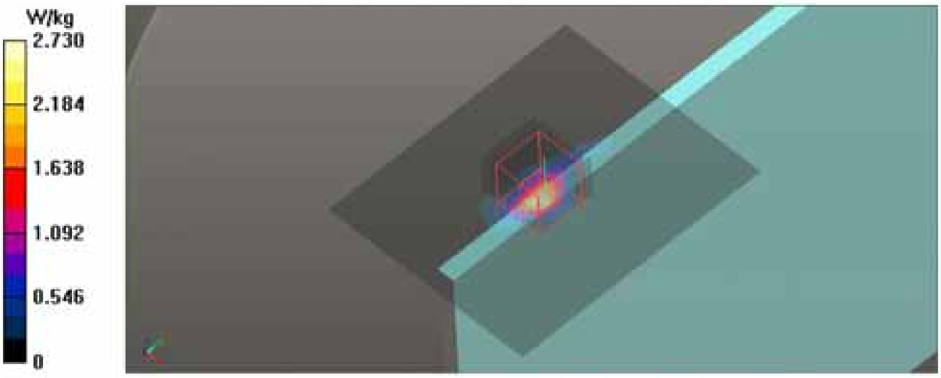
DUT: NP940X5M; Type: Samsung Notebook; Serial: 0RTE91ZJ300051

Communication System: UID 0, 5GHz WLAN (0); Frequency: 5610 MHz;Duty Cycle: 1:1
Medium parameters used: f = 5610 MHz; σ = 5.725 S/m; ε_r = 48.023; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY52 Configuration:
- Probe: EX3DV4 - SN3862; ConvF(3.69, 3.69, 3.69); Calibrated: 2016-10-06;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1503; Calibrated: 2016-06-27
- Phantom: ELI v5.0 1244; Type: QDOVA002AA; Serial: TP:1244
- DASY52 52.8.8(1258)SEMCAD X 14.6.10(7373)

Body/WLAN_802.11ac_VHT80_Edge3_CH122_Main/Area Scan (101x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 2.73 W/kg

Body/WLAN_802.11ac_VHT80_Edge3_CH122_Main/Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 2.025 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 3.98 W/kg
SAR(1 g) = 0.999 W/kg; SAR(10 g) = 0.282 W/kg
Maximum value of SAR (measured) = 2.24 W/kg



Appendix A.19 SAR Test Plots for WLAN 5600 MHz Aux (Tablet Mode)

Date: 2017-04-25

Test Laboratory : SGS Korea (Gunpo Laboratory)
File Name: WLAN_802.11ac_VHT80_Edge3_CH106_Aux.da53:0

Ambient Temp : 23.0 ℃ Tissue Temp : 21.5 ℃

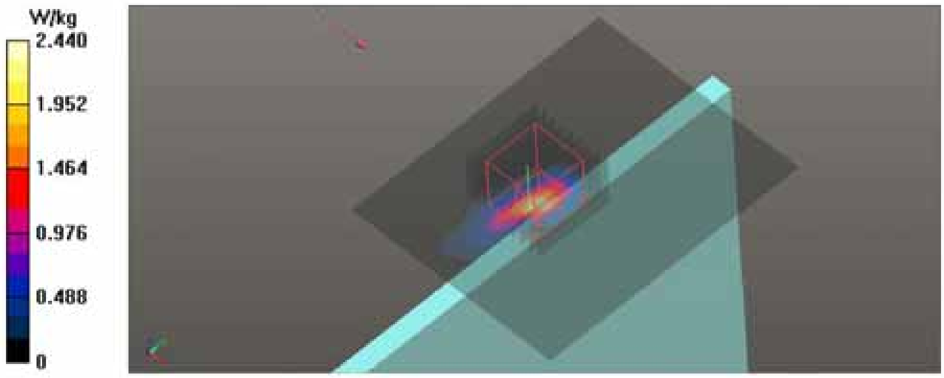
DUT: NP940X5M; Type: Samsung Notebook; Serial: 0RTE91ZJ300051

Communication System: UID 0, 5GHz WLAN (0); Frequency: 5530 MHz;Duty Cycle: 1:1
Medium parameters used: f = 5530 MHz; σ = 5.609 S/m; ε_r = 48.219; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY52 Configuration:
- Probe: EX3DV4 - SN3862; ConvF(3.69, 3.69, 3.69); Calibrated: 2016-10-06;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1503; Calibrated: 2016-06-27
- Phantom: ELI v5.0 1244; Type: QDOVA002AA; Serial: TP:1244
- DASY52 52.8.8(1258)SEMCAD X 14.6.10(7373)

Body/WLAN_802.11ac_VHT80_Edge3_CH106_Aux/Area Scan (91x111x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 2.44 W/kg

Body/WLAN_802.11ac_VHT80_Edge3_CH106_Aux/Zoom Scan (9x9x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 2.131 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 3.84 W/kg
SAR(1 g) = 0.798 W/kg; SAR(10 g) = 0.244 W/kg
Maximum value of SAR (measured) = 2.33 W/kg



Appendix A.20 SAR Test Plots for WLAN 5800 MHz Main (Tablet Mode)

Date: 2017-04-27

Test Laboratory : SGS Korea (Gunpo Laboratory)
File Name: WLAN_802.11ac_VHT80_Edge3_CH155_Main.da53:0

Ambient Temp : 23.3 ℃ Tissue Temp : 21.6 ℃

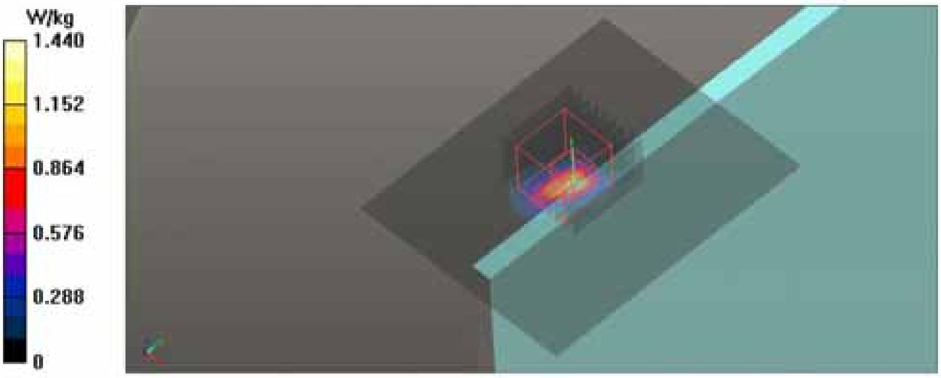
DUT: NP940X5M; Type: Samsung Notebook; Serial: 0RTE91ZJ300051

Communication System: UID 0, 5GHz WLAN (0); Frequency: 5775 MHz;Duty Cycle: 1:1
Medium parameters used: f = 5775 MHz; σ = 5.845 S/m; ε_r = 47.35; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY52 Configuration:
- Probe: EX3DV4 - SN3862; ConvF(3.84, 3.84, 3.84); Calibrated: 2016-10-06;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1503; Calibrated: 2016-06-27
- Phantom: ELI v5.0 1244; Type: QDOVA002AA; Serial: TP:1244
- DASY52 52.8.8(1258)SEMCAD X 14.6.10(7373)

Body/WLAN_802.11ac_VHT80_Edge3_CH155_Main/Area Scan (91x111x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 1.44 W/kg

Body/WLAN_802.11ac_VHT80_Edge3_CH155_Main/Zoom Scan (9x9x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 2.114 V/m; Power Drift = -0.14 dB
Peak SAR (extrapolated) = 3.88 W/kg
SAR(1 g) = 0.491 W/kg; SAR(10 g) = 0.134 W/kg
Maximum value of SAR (measured) = 1.30 W/kg



Appendix A.21 SAR Test Plots for WLAN 5800 MHz Aux (Tablet Mode)

Date: 2017-04-27

Test Laboratory : SGS Korea (Gunpo Laboratory)
File Name: WLAN_802.11ac_VHT80_Edge3_CH155_Aux.da53:0

Ambient Temp : 23.3 ℃ Tissue Temp : 21.6 ℃

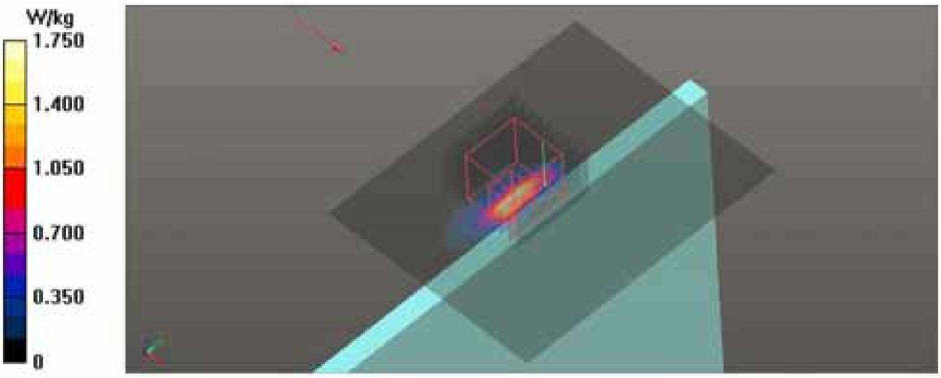
DUT: NP940X5M; Type: Samsung Notebook; Serial: 0RTE91ZJ300051

Communication System: UID 0, 5GHz WLAN (0); Frequency: 5775 MHz;Duty Cycle: 1:1
Medium parameters used: f = 5775 MHz; σ = 5.845 S/m; ε_r = 47.35; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY52 Configuration:
- Probe: EX3DV4 - SN3862; ConvF(3.84, 3.84, 3.84); Calibrated: 2016-10-06;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1503; Calibrated: 2016-06-27
- Phantom: ELI v5.0 1244; Type: QDOVA002AA; Serial: TP:1244
- DASY52 52.8.8(1258)SEMCAD X 14.6.10(7373)

Body/WLAN_802.11ac_VHT80_Edge3_CH155_Aux/Area Scan (91x111x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 1.75 W/kg

Body/WLAN_802.11ac_VHT80_Edge3_CH155_Aux/Zoom Scan (9x9x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 2.292 V/m; Power Drift = -0.15 dB
Peak SAR (extrapolated) = 3.96 W/kg
SAR(1 g) = 0.643 W/kg; SAR(10 g) = 0.184 W/kg
Maximum value of SAR (measured) = 1.96 W/kg



Appendix A.22 SAR Test Plots for Bluetooth (Tablet Mode)

Date: 2017-04-28

Test Laboratory : SGS Korea (Gunpo Laboratory)
File Name: 2.45GHz_Bluetooth_Edge3_Ch39.da53:0

Ambient Temp : 23.3 ℃ Tissue Temp : 21.6 ℃

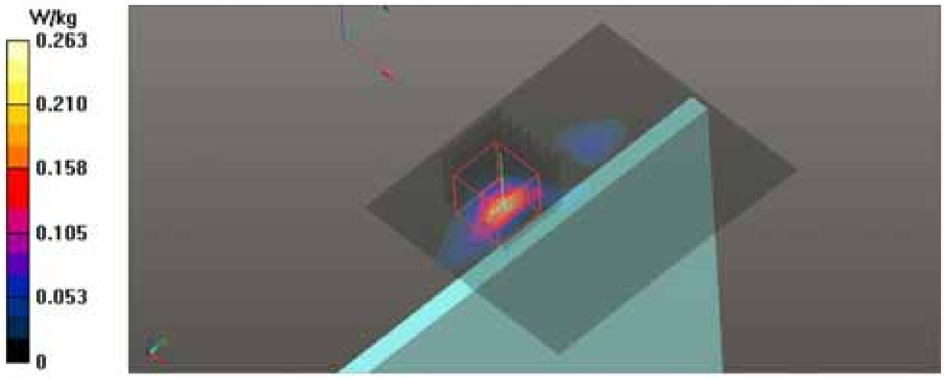
DUT: NP940X5M; Type: Samsung Notebook; Serial: 0RTE91ZJ300051

Communication System: UID 0, Bluetooth (0); Frequency: 2441 MHz;Duty Cycle: 1:1.311
Medium parameters used: f = 2441 MHz; σ = 1.942 S/m; ε_r = 54.579; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY52 Configuration:
- Probe: EX3DV4 - SN3862; ConvF(7.57, 7.57, 7.57); Calibrated: 2016-10-06;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1503; Calibrated: 2016-06-27
- Phantom: ELI v5.0 1244; Type: QDOVA002AA; Serial: TP:1244
- DASY52 52.8.8(1258)SEMCAD X 14.6.10(7373)

Body/2.45GHz_Bluetooth_Edge3_Ch39/Area Scan (101x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.263 W/kg

Body/2.45GHz_Bluetooth_Edge3_Ch39/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 1.077 V/m; Power Drift = 0.20 dB
Peak SAR (extrapolated) = 0.322 W/kg
SAR(1 g) = 0.130 W/kg; SAR(10 g) = 0.046 W/kg
Maximum value of SAR (measured) = 0.241 W/kg



Appendix B.1 Uncertainty Analysis DASY5 #3

Measurement uncertainty for 300 MHz to 6 GHz averaged over 1 gram

a	b	c	d	e = f(d,k)	f	g	h cxf/e	i cxg/e	k
Uncertainty Component	IEEE 1528 2013	Tol (%)	Prob . Dist.	Div.	Ci (1g)	Ci (10g)	1g ui (%)	10g ui (%)	Vi (Veff)
Probe calibration	E.2.1	6.55	N	1	1	1	6.55	6.55	∞
Axial Isotropy	E.2.2	4.7	R	1.73	0.71	0.71	1.92	1.92	∞
Hemispherical Isotropy	E.2.2	9.6	R	1.73	0.71	0.71	3.92	3.92	∞
Boundary Effects	E.2.3	1	R	1.73	1	1	0.58	0.58	∞
Modulation Response	E.2.5	2.4	R	1.73	1	1	1.39	1.39	∞
Linearity	E.2.4	4.7	R	1.73	1	1	2.71	2.71	∞
System Detection Limits	E.2.4	0.3	R	1.73	1	1	0.17	0.17	∞
Reabout Electronics	E.2.6	0.3	N	1	1	1	0.3	0.3	∞
Response Time	E.2.7	0.5	R	1.73	1	1	0.29	0.29	∞
Integration Time	E.2.8	2.6	R	1.73	1	1	1.5	1.5	∞
RF Ambient Noise	E.6.1	3	R	1.73	1	1	1.73	1.73	∞
RF Ambient Reflections	E.6.1	3	R	1.73	1	1	1.73	1.73	∞
Probe Positiones	E.6.2	1.5	R	1.73	1	1	0.87	0.87	∞
Probe Positioning	E.6.3	2.9	R	1.73	1	1	1.67	1.67	∞
Max SAR evaluation	E.5	1	R	1.73	1	1	0.58	0.58	∞
Test sample positioning	E.4.2	3.34/3.30	N	1	1	1	3.34	3.30	9
Device holder uncertainty	E.4.1	3.28	N	1	1	1	3.28	3.28	4
Output power variation -SAR drift measurement	E.2.9	5	R	1.73	1	1	2.89	2.89	∞
Phantom uncertainty	E.3.1	4	R	1.73	1	1	2.31	2.31	∞
Correcting SAR for deviations in permittivity and conductivity	E.3.2	1.2	R	1.73	1	0.84	0.69	0.58	∞
Liquid conductivity– measurement	E.3.3	1.76	N	1	0.78	0.71	1.37	1.25	5
Liquid permittivity– measurement	E.3.3	1.72	N	1	0.23	0.26	0.4	0.45	9
Liquid conductivity-temperature	E.3.4	2.86	R	1.73	0.23	0.26	0.25	0.28	∞
Liquid permittivity – temperature	E.3.4	1.86	R	1.73	0.78	0.71	1.29	1.17	∞
Combined standard uncertainty				RSS			11.12	11.08	355/357
Expanded uncertainty				k=2			22.24	22.16	

Appendix C.1 Calibration certificate for Probe

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

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

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

Accreditation No.: **SCS 0108**

Client **SGS Korea (Dymstec)**

Certificate No: **EX3-3862_Oct16**

CALIBRATION CERTIFICATE

Object: EX3DV4 - SN:3862

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 6, 2016

기술책임자
2016. 10. 1?

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

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

Calibration Equipment used (M&TE critical for calibration)

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

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

Issued: October 6, 2016

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

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Swiss Calibration Service

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

Accreditation No.: **SCS 0108**

Glossary:

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

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization ϑ = 0 (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not affect the E^2-field uncertainty inside TSL (see below *ConvF*).
- *NORM(f)x,y,z = NORMx,y,z * frequency_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of *ConvF*.
- *DCPx,y,z:* DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- *PAR:* PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- *Ax,y,z; Bx,y,z; Cx,y,z; Dx,y,z; VRx,y,z: A, B, C, D* are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. *VR* is the maximum calibration range expressed in RMS voltage across the diode.
- *ConvF and Boundary Effect Parameters:* Assessed in flat phantom using E-field (or Temperature Transfer Standard for f ≤ 800 MHz) and inside waveguide using analytical field distributions based on power measurements for f > 800 MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to *NORMx,y,z * ConvF* whereby the uncertainty corresponds to that given for *ConvF*. A frequency dependent *ConvF* is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- *Spherical isotropy (3D deviation from isotropy):* in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- *Sensor Offset:* The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- *Connector Angle:* The angle is assessed using the information gained by determining the *NORMx* (no uncertainty required).

Probe EX3DV4

SN:3862

Manufactured: February 2, 2012
Calibrated: October 6, 2016

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

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

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	0.37	0.34	0.39	± 10.1 %
DCP (mV)[B]	102.3	96.5	102.3	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB$\sqrt{\mu V}$	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	181.7	±3.3 %
		Y	0.0	0.0	1.0		195.5	
		Z	0.0	0.0	1.0		179.2	

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

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

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

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unc (k=2)
835	41.5	0.90	10.34	10.34	10.34	0.41	0.86	± 12.0 %
900	41.5	0.97	9.86	9.86	9.86	0.33	0.96	± 12.0 %
1750	40.1	1.37	8.69	8.69	8.69	0.31	0.89	± 12.0 %
1900	40.0	1.40	8.41	8.41	8.41	0.32	0.80	± 12.0 %
2300	39.5	1.67	8.01	8.01	8.01	0.25	0.99	± 12.0 %
2450	39.2	1.80	7.54	7.54	7.54	0.23	1.08	± 12.0 %
2600	39.0	1.96	7.42	7.42	7.42	0.36	0.84	± 12.0 %
5200	36.0	4.66	5.50	5.50	5.50	0.30	1.80	± 13.1 %
5300	35.9	4.76	5.17	5.17	5.17	0.35	1.80	± 13.1 %
5500	35.6	4.96	4.90	4.90	4.90	0.40	1.80	± 13.1 %
5600	35.5	5.07	4.62	4.62	4.62	0.45	1.80	± 13.1 %
5800	35.3	5.27	4.70	4.70	4.70	0.45	1.80	± 13.1 %

[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

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

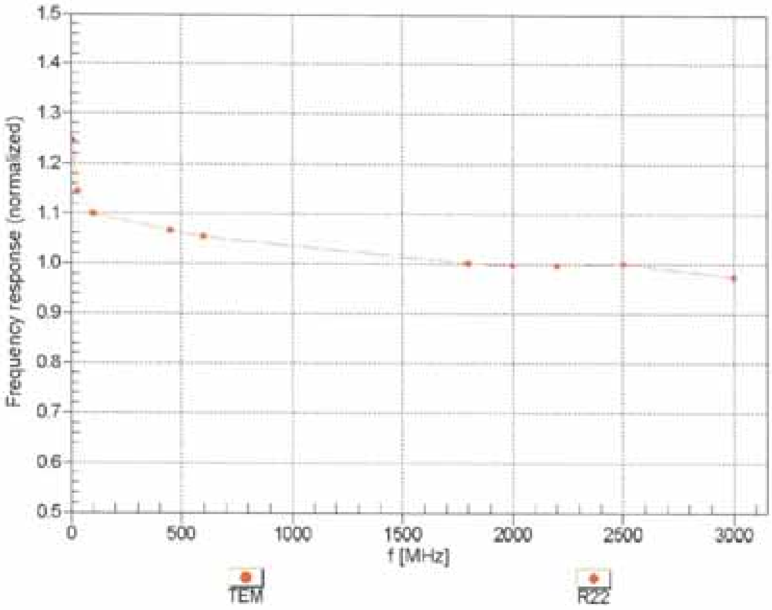
Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unc (k=2)
835	55.2	0.97	10.02	10.02	10.02	0.46	0.80	± 12.0 %
1750	53.4	1.49	8.35	8.35	8.35	0.30	0.80	± 12.0 %
1900	53.3	1.52	8.03	8.03	8.03	0.37	0.80	± 12.0 %
2450	52.7	1.95	7.57	7.57	7.57	0.34	0.80	± 12.0 %
2600	52.5	2.16	7.40	7.40	7.40	0.41	0.80	± 12.0 %
5200	49.0	5.30	4.52	4.52	4.52	0.45	1.90	± 13.1 %
5300	48.9	5.42	4.35	4.35	4.35	0.45	1.90	± 13.1 %
5600	48.5	5.77	3.69	3.69	3.69	0.60	1.90	± 13.1 %
5800	48.2	6.00	3.84	3.84	3.84	0.60	1.90	± 13.1 %

[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

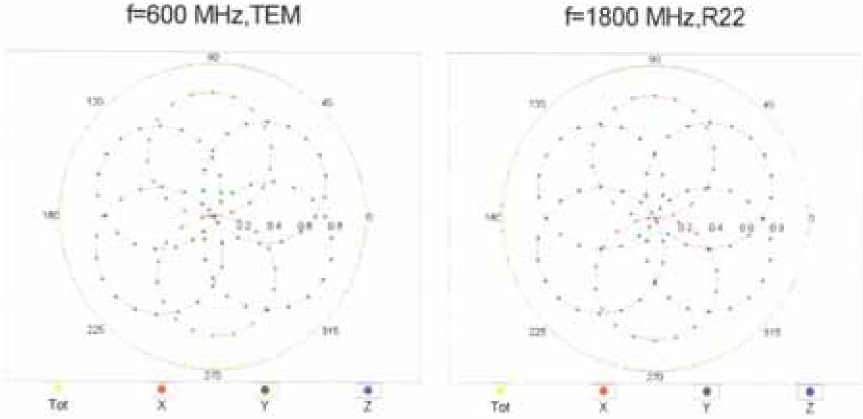
Frequency Response of E-Field

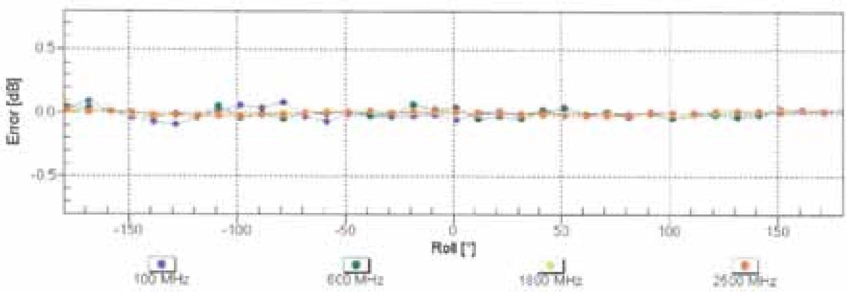
(TEM-Cell:ifi110 EXX, Waveguide: R22)



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

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





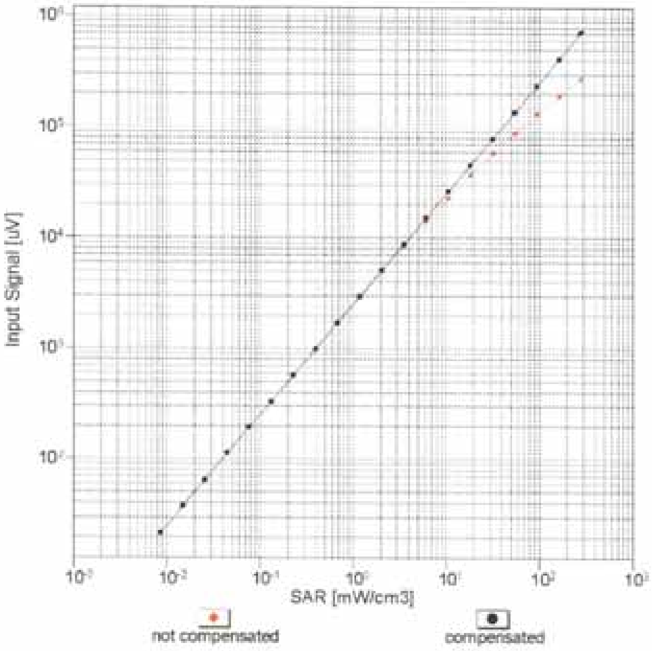
Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

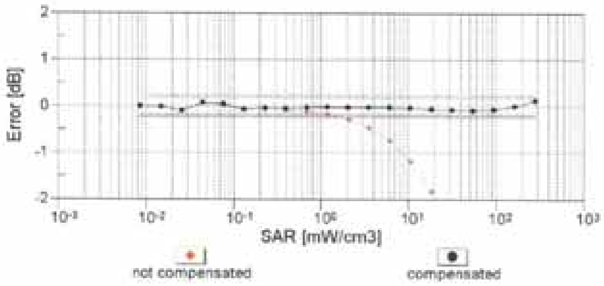
EX3DV4– SN:3862

October 6, 2016

Dynamic Range f(SAR_{head})

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



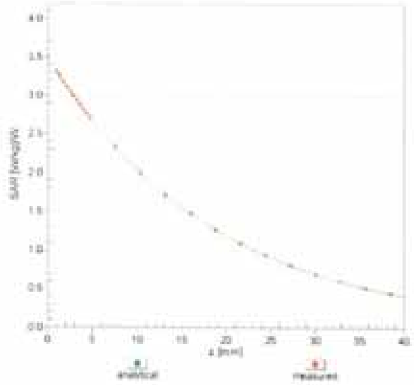


Uncertainty of Linearity Assessment: ± 0.6% (k=2)

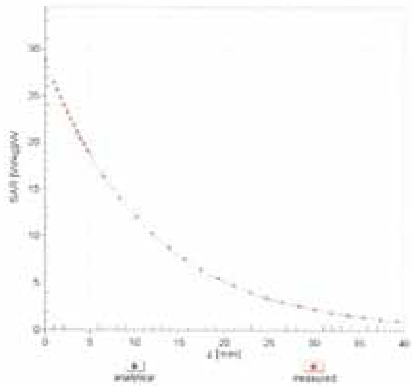
Certificate No: EX3-3862_Oct16 Page 9 of 11

Conversion Factor Assessment

f = 835 MHz,WGLS R9 (H_convF)

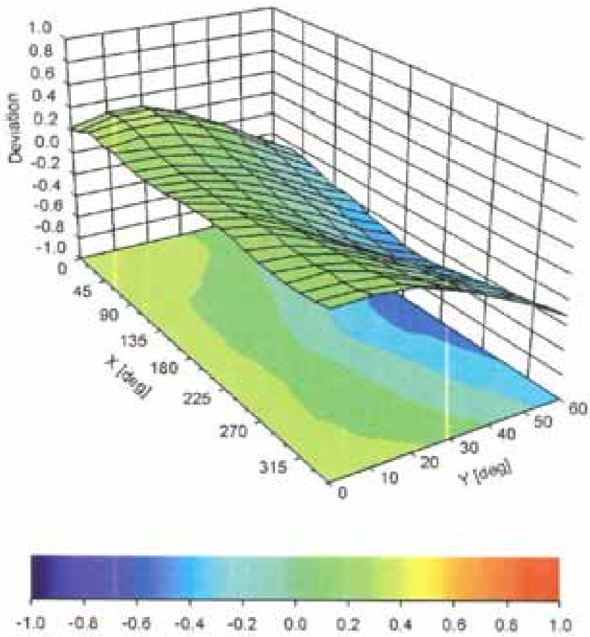


f = 1900 MHz,WGLS R22 (H_convF)



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



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

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

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-28.5
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

Appendix C.2 Calibration certificate for DAE

Appendix C.2 Calibration certificate for DAE

Calibration Laboratory of
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Zeughausstrasse 43, 8004 Zurich, Switzerland

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client: SGS Korea (Dymstec)

Certificate No: DAE4-1503_Jun16

CALIBRATION CERTIFICATE

Object	DAE4 - SD 000 D04 BM - SN: 1503
Calibration procedure(s)	QA CAL-06.v29 Calibration procedure for the data acquisition electronics (DAE)
Calibration date:	June 27, 2016

기술 책임자

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

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

Calibration Equipment used (M&TE critical for calibration)

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

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

Issued: June 27, 2016

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Certificate No: DAE4-1503_Jun16 Page 1 of 5

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Glossary

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

Methods Applied and Interpretation of Parameters

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

DC Voltage Measurement

A/D - Converter Resolution nominal

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

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

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

Calibration Factors	X	Y	Z
High Range	403.951 ± 0.02% (k=2)	404.168 ± 0.02% (k=2)	404.135 ± 0.02% (k=2)
Low Range	3.94895 ± 1.50% (k=2)	3.97690 ± 1.50% (k=2)	3.95594 ± 1.50% (k=2)

Connector Angle

Connector Angle to be used in DASY system	59.0 ° ± 1 °

Appendix (Additional assessments outside the scope of SCS0108)

1. DC Voltage Linearity

High Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	200028.83	-3.53	-0.00
Channel X	+ Input	20005.73	1.52	0.01
Channel X	- Input	-20001.37	3.65	-0.02
Channel Y	+ Input	200030.67	-1.62	-0.00
Channel Y	+ Input	20002.54	-1.59	-0.01
Channel Y	- Input	-20004.27	0.86	-0.00
Channel Z	+ Input	200032.13	-0.44	-0.00
Channel Z	+ Input	20003.27	-0.80	-0.00
Channel Z	- Input	-20002.96	2.33	-0.01

Low Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	2001.01	0.31	0.02
Channel X	+ Input	200.95	0.21	0.10
Channel X	- Input	-199.31	0.03	-0.02
Channel Y	+ Input	2000.60	0.04	0.00
Channel Y	+ Input	200.45	-0.19	-0.10
Channel Y	- Input	-199.53	-0.04	0.02
Channel Z	+ Input	2000.98	0.44	0.02
Channel Z	+ Input	199.69	-0.91	-0.45
Channel Z	- Input	-200.83	-1.35	0.67

2. Common mode sensitivity

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

	Common mode Input Voltage (mV)	High Range Average Reading (μV)	Low Range Average Reading (μV)
Channel X	200	9.87	8.36
	- 200	-7.26	-8.72
Channel Y	200	-10.69	-10.84
	- 200	9.63	9.90
Channel Z	200	-13.01	-13.44
	- 200	12.60	11.81

3. Channel separation

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

	Input Voltage (mV)	Channel X (μV)	Channel Y (μV)	Channel Z (μV)
Channel X	200	-	0.41	-3.30
Channel Y	200	7.10	-	2.58
Channel Z	200	10.37	4.97	-

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	15551	16361
Channel Y	16217	15592
Channel Z	15480	15585

5. Input Offset Measurement

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec
Input 10MΩ

	Average (μV)	min. Offset (μV)	max. Offset (μV)	Std. Deviation (μV)
Channel X	0.93	-0.00	1.98	0.43
Channel Y	-0.02	-1.06	1.11	0.37
Channel Z	0.32	-0.91	1.46	0.51

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

Appendix C.3 Calibration certificate for Dipole

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Accreditation No.: **SCS 0108**

Client **SGS Korea (Dymstec)**

Certificate No: **D2450V2-734_May16**

CALIBRATION CERTIFICATE

Object	D2450V2 - SN:734
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	May 24, 2016

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

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

Calibration Equipment used (M&TE critical for calibration)

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

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

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

Issued: May 25, 2016

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Certificate No: D2450V2-734_May16 Page 1 of 8

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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**

Glossary:

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

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	38.6 ± 6 %	1.87 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	12.8 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**50.1 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.92 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**23.4 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	52.6 ± 6 %	2.02 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	12.6 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**49.5 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.90 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**23.4 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	54.6 Ω + 5.0 jΩ
Return Loss	- 23.7 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	50.7 Ω + 7.2 jΩ
Return Loss	- 22.9 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.152 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: 24.05.2016

Test Laboratory: SPEAG, Zurich, Switzerland

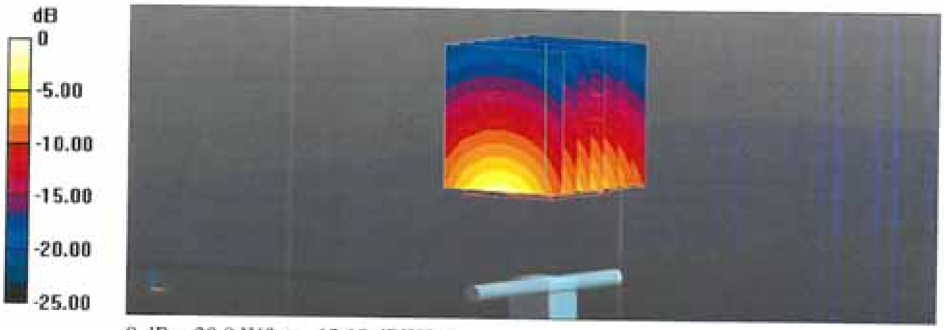
DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 734

Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 1.87 S/m; ε_r = 38.6; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

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

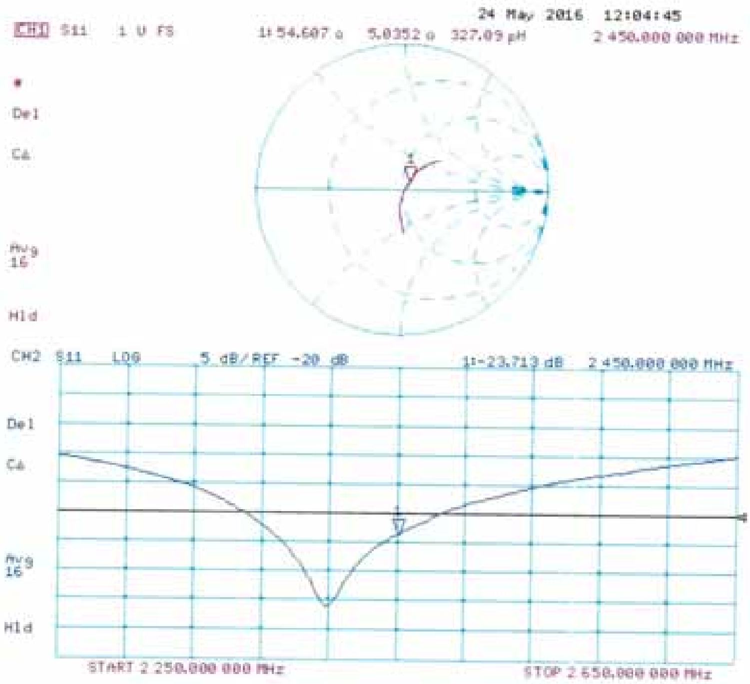
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 111.0 V/m; Power Drift = 0.06 dB
Peak SAR (extrapolated) = 25.8 W/kg
SAR(1 g) = 12.8 W/kg; SAR(10 g) = 5.92 W/kg
Maximum value of SAR (measured) = 20.8 W/kg



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

Certificate No: D2450V2-734_May16 Page 5 of 8

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 24.05.2016

Test Laboratory: SPEAG, Zurich, Switzerland

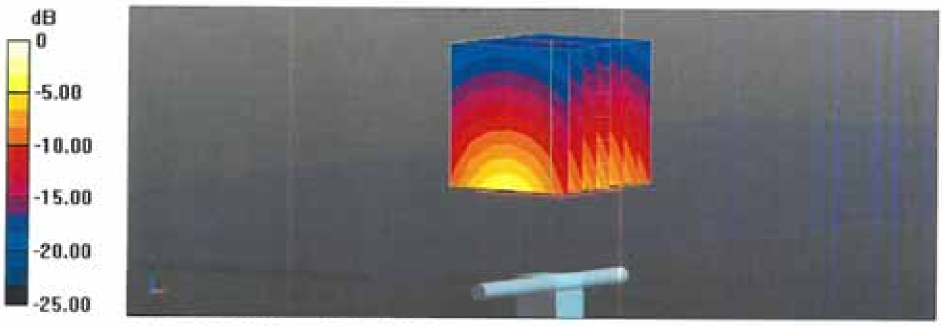
DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 734

Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 2.02 S/m; ε_r = 52.6; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

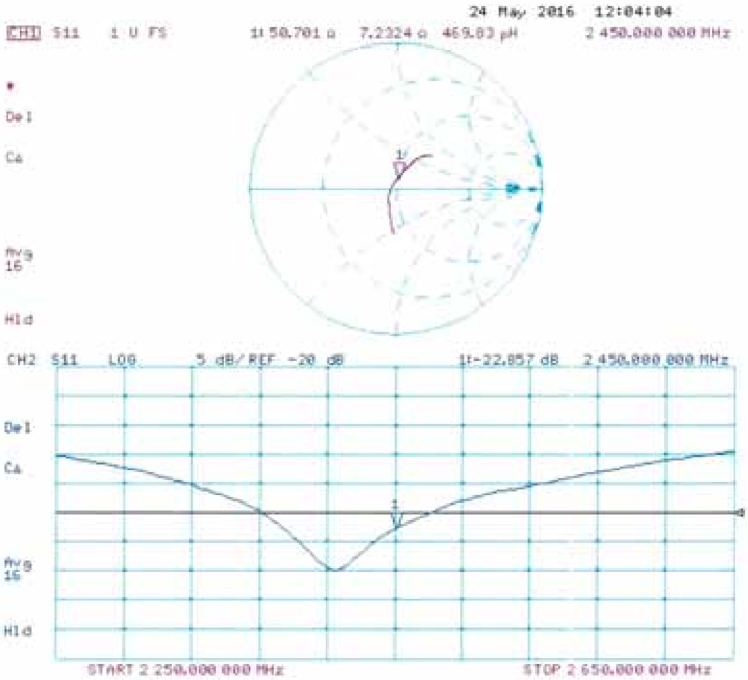
- Probe: EX3DV4 - SN7349; ConvF(7.79, 7.79, 7.79); Calibrated: 31.12.2015;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 105.2 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 25.2 W/kg
SAR(1 g) = 12.6 W/kg; SAR(10 g) = 5.9 W/kg
Maximum value of SAR (measured) = 20.6 W/kg



0 dB = 20.6 W/kg = 13.14 dBW/kg

Impedance Measurement Plot for Body TSL



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Accreditation No.: **SCS 0108**

Client **SGS Korea (Dymstec)**

Certificate No: **D5GHzV2-1130_May16**

CALIBRATION CERTIFICATE

Object	D5GHzV2 - SN: 1130
Calibration procedure(s)	QA CAL-22.v2 Calibration procedure for dipole validation kits between 3-6 GHz
Calibration date:	May 23, 2016

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	06-Apr-16 (No. 217-02288/02289)	Apr-17
Power sensor NRP-Z91	SN: 103244	06-Apr-16 (No. 217-02288)	Apr-17
Power sensor NRP-Z91	SN: 103245	06-Apr-16 (No. 217-02289)	Apr-17
Reference 20 dB Attenuator	SN: 5058 (20k)	05-Apr-16 (No. 217-02292)	Apr-17
Type-N mismatch combination	SN: 5047.2 / 06327	05-Apr-16 (No. 217-02295)	Apr-17
Reference Probe EX3DV4	SN: 3503	31-Dec-15 (No. EX3-3503_Dec15)	Dec-16
DAE4	SN: 601	30-Dec-15 (No. DAE4-601_Dec15)	Dec-16

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

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

Issued: May 25, 2016

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Accreditation No.: **SCS 0108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy = 4.0 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
Frequency	5200 MHz ± 1 MHz 5300 MHz ± 1 MHz 5500 MHz ± 1 MHz 5600 MHz ± 1 MHz 5800 MHz ± 1 MHz	

Head TSL parameters at 5200 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	36.0	4.66 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.8 ± 6 %	4.52 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5200 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.63 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**75.7 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.21 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**21.9 W/kg ± 19.5 % (k=2)**

Head TSL parameters at 5300 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.9	4.76 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.7 ± 6 %	4.61 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5300 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.05 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**79.9 W / kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.34 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**23.2 W/kg ± 19.5 % (k=2)**

Head TSL parameters at 5500 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.6	4.96 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.4 ± 6 %	4.81 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5500 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.01 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**79.4 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.31 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**22.9 W/kg ± 19.5 % (k=2)**

Head TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.5	5.07 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.3 ± 6 %	4.91 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5600 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.15 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**80.8 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.34 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**23.2 W/kg ± 19.5 % (k=2)**

Head TSL parameters at 5800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.3	5.27 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.0 ± 6 %	5.12 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5800 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.74 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**76.7 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.20 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**21.8 W/kg ± 19.5 % (k=2)**

Body TSL parameters at 5200 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	49.0	5.30 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	47.3 ± 6 %	5.43 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5200 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.40 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**73.5 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.09 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**20.7 W/kg ± 19.5 % (k=2)**

Body TSL parameters at 5300 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.9	5.42 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	47.1 ± 6 %	5.56 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5300 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.69 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**76.4 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.17 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**21.5 W/kg ± 19.5 % (k=2)**

Body TSL parameters at 5500 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.6	5.65 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.7 ± 6 %	5.83 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5500 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.93 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**78.8 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.23 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**22.1 W/kg ± 19.5 % (k=2)**

Body TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.5	5.77 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.5 ± 6 %	5.97 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5600 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.95 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**78.9 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.24 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**22.2 W/kg ± 19.5 % (k=2)**

Body TSL parameters at 5800 MHz
The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.2	6.00 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.2 ± 6 %	6.26 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5800 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.65 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**76.0 W/kg ± 19.9 % (k=2)**

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

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL at 5200 MHz

Impedance, transformed to feed point	51.5 Ω - 10.0 jΩ
Return Loss	- 20.0 dB

Antenna Parameters with Head TSL at 5300 MHz

Impedance, transformed to feed point	52.1 Ω - 4.5 jΩ
Return Loss	- 26.3 dB

Antenna Parameters with Head TSL at 5500 MHz

Impedance, transformed to feed point	51.7 Ω - 5.6 jΩ
Return Loss	- 24.8 dB

Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	56.2 Ω - 3.2 jΩ
Return Loss	- 23.7 dB

Antenna Parameters with Head TSL at 5800 MHz

Impedance, transformed to feed point	54.7 Ω - 2.6 jΩ
Return Loss	- 25.8 dB

Antenna Parameters with Body TSL at 5200 MHz

Impedance, transformed to feed point	51.4 Ω - 8.9 jΩ
Return Loss	- 21.0 dB

Antenna Parameters with Body TSL at 5300 MHz

Impedance, transformed to feed point	50.9 Ω - 3.1 jΩ
Return Loss	- 29.9 dB

Antenna Parameters with Body TSL at 5500 MHz

Impedance, transformed to feed point	52.5 Ω - 4.1 jΩ
Return Loss	- 26.6 dB

Antenna Parameters with Body TSL at 5600 MHz

Impedance, transformed to feed point	57.9 Ω - 1.4 jΩ
Return Loss	- 22.6 dB

Antenna Parameters with Body TSL at 5800 MHz

Impedance, transformed to feed point	56.5 Ω - 1.1 jΩ
Return Loss	- 24.2 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.205 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	September 08, 2011

DASY5 Validation Report for Head TSL

Date: 23.05.2016

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1130

Communication System: UID 0 - CW; Frequency: 5200 MHz, Frequency: 5300 MHz, Frequency: 5500 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz
Medium parameters used: f = 5200 MHz; σ = 4.52 S/m; ε_r = 34.8; ρ = 1000 kg/m^3 , Medium parameters used: f = 5300 MHz; σ = 4.61 S/m; ε_r = 34.7; ρ = 1000 kg/m^3 , Medium parameters used: f = 5500 MHz; σ = 4.81 S/m; ε_r = 34.4; ρ = 1000 kg/m^3 , Medium parameters used: f = 5600 MHz; σ = 4.91 S/m; ε_r = 34.3; ρ = 1000 kg/m^3 , Medium parameters used: f = 5800 MHz; σ = 5.12 S/m; ε_r = 34; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.59, 5.59, 5.59); Calibrated: 31.12.2015, ConvF(5.25, 5.25, 5.25); Calibrated: 31.12.2015, ConvF(5.18, 5.18, 5.18); Calibrated: 31.12.2015, ConvF(4.99, 4.99, 4.99); Calibrated: 31.12.2015, ConvF(4.95, 4.95, 4.95); Calibrated: 31.12.2015;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

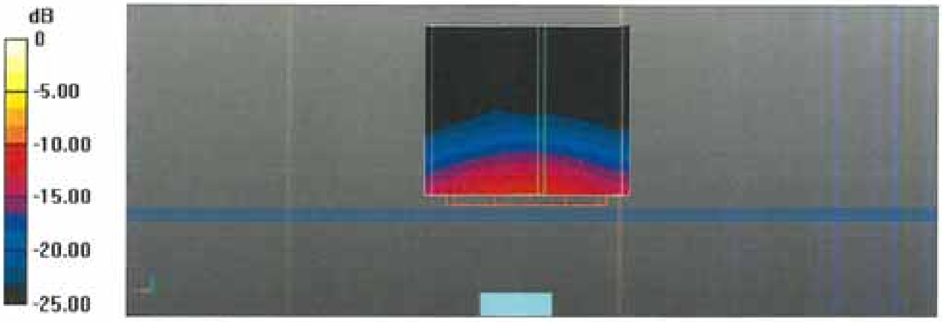
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 71.75 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 27.6 W/kg
SAR(1 g) = 7.63 W/kg; SAR(10 g) = 2.21 W/kg
Maximum value of SAR (measured) = 17.7 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5300 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 73.16 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 30.1 W/kg
SAR(1 g) = 8.05 W/kg; SAR(10 g) = 2.34 W/kg
Maximum value of SAR (measured) = 18.8 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5500 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 70.23 V/m; Power Drift = 0.09 dB
Peak SAR (extrapolated) = 31.5 W/kg
SAR(1 g) = 8.01 W/kg; SAR(10 g) = 2.31 W/kg
Maximum value of SAR (measured) = 18.9 W/kg

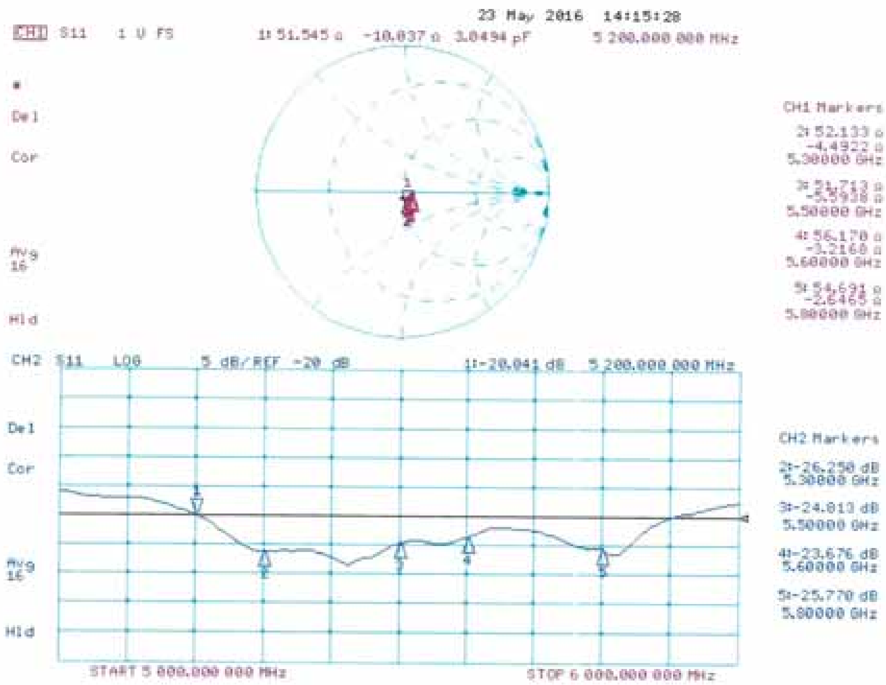
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 72.60 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 31.9 W/kg
SAR(1 g) = 8.15 W/kg; SAR(10 g) = 2.34 W/kg
Maximum value of SAR (measured) = 19.5 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 69.86 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 31.8 W/kg
SAR(1 g) = 7.74 W/kg; SAR(10 g) = 2.2 W/kg
Maximum value of SAR (measured) = 19.5 W/kg



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

Impedance Measurement Plot for Head TSL



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DASY5 Validation Report for Body TSL

Date: 20.05.2016

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1130

Communication System: UID 0 - CW; Frequency: 5200 MHz, Frequency: 5300 MHz, Frequency: 5500 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz
Medium parameters used: f = 5200 MHz; σ = 5.43 S/m; ε_r = 47.3; ρ = 1000 kg/m^3 , Medium parameters used: f = 5300 MHz; σ = 5.56 S/m; ε_r = 47.1; ρ = 1000 kg/m^3 , Medium parameters used: f = 5500 MHz; σ = 5.83 S/m; ε_r = 46.7; ρ = 1000 kg/m^3 , Medium parameters used: f = 5600 MHz; σ = 5.97 S/m; ε_r = 46.5; ρ = 1000 kg/m^3 , Medium parameters used: f = 5800 MHz; σ = 6.26 S/m; ε_r = 46.2; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(4.99, 4.99, 4.99); Calibrated: 31.12.2015, ConvF(4.75, 4.75, 4.75); Calibrated: 31.12.2015, ConvF(4.4, 4.4, 4.4); Calibrated: 31.12.2015, ConvF(4.35, 4.35, 4.35); Calibrated: 31.12.2015, ConvF(4.27, 4.27, 4.27); Calibrated: 31.12.2015;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

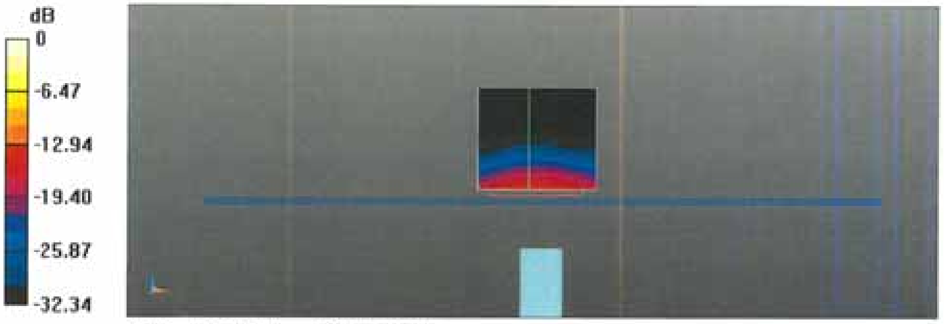
Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 66.11 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 27.3 W/kg
SAR(1 g) = 7.4 W/kg; SAR(10 g) = 2.09 W/kg
Maximum value of SAR (measured) = 16.7 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5300 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 67.08 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 29.1 W/kg
SAR(1 g) = 7.69 W/kg; SAR(10 g) = 2.17 W/kg
Maximum value of SAR (measured) = 17.6 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5500 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 67.44 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 31.9 W/kg
SAR(1 g) = 7.93 W/kg; SAR(10 g) = 2.23 W/kg
Maximum value of SAR (measured) = 18.6 W/kg

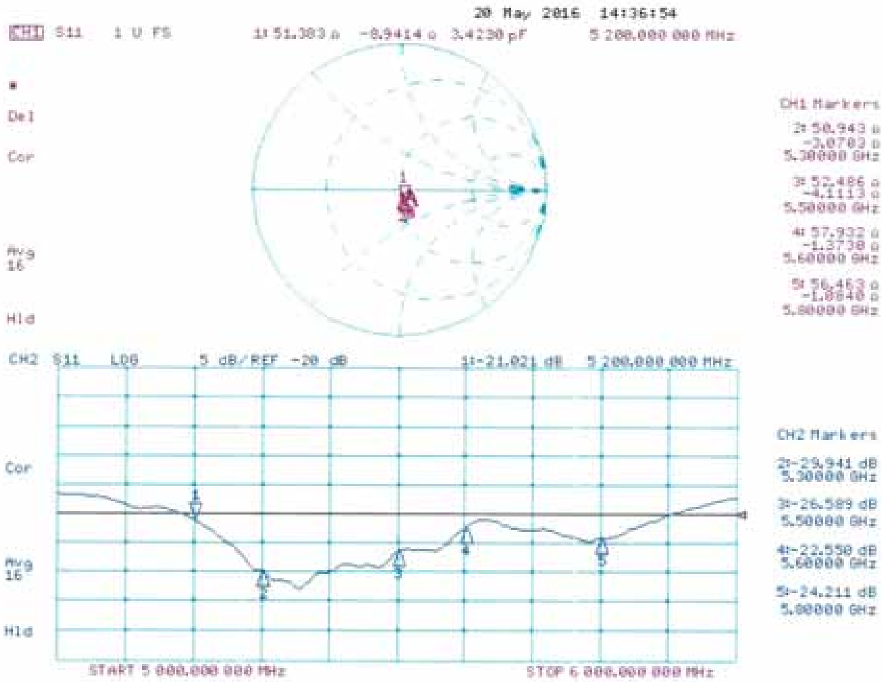
Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 67.01 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 32.6 W/kg
SAR(1 g) = 7.95 W/kg; SAR(10 g) = 2.24 W/kg
Maximum value of SAR (measured) = 18.7 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 64.61 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 33.2 W/kg
SAR(1 g) = 7.65 W/kg; SAR(10 g) = 2.14 W/kg
Maximum value of SAR (measured) = 18.3 W/kg



0 dB = 16.7 W/kg = 12.23 dBW/kg

Impedance Measurement Plot for Body TSL



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