Variant FCC SAR Test Report

Report No.	:	**SA120522E09B**
Applicant	:	**Motorola Solutions, Inc.**
Address	:	**One Motorola Plaza Holtsville NY 11742-1300 USA**
Product	:	**Mobile Computer**
FCC ID	:	**UZ7MC92N0**
Brand	:	**MOTOROLA**
Model No.	:	**MC92N0**
Standards	:	**FCC 47 CFR Part 2 (2.1093) / IEEE C95.1:1991 / IEEE 1528:2003** **FCC OET Bulletin 65 Supplement C (Edition 01-01)** **KDB 248227 D01 v01r02 / KDB 447498 D01 v05**
Date of Testing	:	**Jul. 06, 2012 ~ Feb. 27, 2013**

CERTIFICATION: The above equipment have been tested by **Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch - Taiwan HwaYa Lab**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's SAR characteristics under the conditions specified in this report. It should not be reproduced except in full, without the written approval of our laboratory. The client should not use it to claim product certification, approval, or endorsement by TAF or any government agencies.

This report is issued as a supplementary report of BV ADT report no.: SA120522E09. This report is prepared for FCC class II permissive change. The difference compared with the original SAR report is adding 3 new scanner, 3 new keypad, 1 new headset, condensation resistant design, and loud speaker position shifting.

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Testing Laboratory
2021

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Release Control Record

Issue No.	Reason for Change	Date Issued
R01	Initial release	Apr. 01, 2013

1. Summary of Maximum SAR Value

Equipment Class	Mode	Highest Reported Body-Worn SAR_{1g} (0 cm Gap) (W/kg)
DTS	2.4G WLAN	0.77
	5.8G WLAN	0.72
NII	5.2G WLAN	0.63
	5.3G WLAN	0.68
	5.6G WLAN	0.79
DSS	Bluetooth	N/A
Highest Simultaneous Transmission SAR		Body-Worn (W/kg)
DTS+DSS		0.87
NII+DSS		0.89

Note:

1. The SAR limit **(Head & Body: SAR_{1g} 1.6 W/kg, Extremity: SAR_{10g} 4.0 W/kg)** for general population / uncontrolled exposure is specified in FCC 47 CFR part 2 (2.1093) and ANSI/IEEE C95.1-1991.

2. Description of Equipment Under Test

EUT Type	Mobile Computer
FCC ID	UZ7MC92N0
Brand Name	MOTOROLA
Model Name	MC92N0
Tx Frequency Bands (Unit: MHz)	WLAN : 2412 ~ 2472, 5180 ~ 5240, 5260 ~ 5320, 5500 ~ 5700, 5745 ~ 5825 Bluetooth : 2402 ~ 2480
Uplink Modulations	802.11b : DSSS 802.11a/g/n : OFDM Bluetooth : GFSK
Maximum Tune-up Conducted Power (Unit: dBm)	WLAN 2.4G : 21.8 WLAN 5.2G : 13.9 WLAN 5.3G : 18.2 WLAN 5.6G : 18.3 WLAN 5.8G : 17.3 Bluetooth : 4.7
Antenna Type	Fixed Internal Antenna
EUT Stage	Identical Prototype

Note:

1. The EUT's information list as below.

Mobile Computer	OS Version	07.00.2806
	OEM Name	MOTOROLA MC92N0G
	OEM Version	00.20.0005
Wireless (Fusion)	Part Number	31-FUSION-X2.00
	Version	X_2.00.0.0.040E
XW2DMT	Version	X_2.00.0.0.28
	Fusion	X_2.00.0.0.040E
BTRegTest Ver4.1	Version	4.1

2. The above EUT information is declared by manufacturer and for more detailed features description please refer to the manufacturer's specifications or User's Manual.

List of Accessory:

AC Adapter	**Brand Name**	HIPRO
	Model Name	HP-A0502R3D
	P/N	PWRS-14000-148R
	Power Rating	I/P:100-240Vac, 50-60Hz, 2.4A; O/P: 12Vdc, 4.16A
	AC Line Cord Type	2.2 meter unshielded cable without ferrite core
Battery	**Brand Name**	SYMBOL
	P/N	21-65587-03
	Power Rating	7.4Vdc, 2200mAh, 16.3Wh
	Type	Li-ion
Headset 1	**Brand Name**	VXI
	Model Name	VR10
	P/N	50-11300-050R
Headset 2	**Brand Name**	MOTOROLA
	Model Name	RCH50
	P/N	RCH50
USB Cable	**P/N**	25-62166-01r
	Signal Line Type	1.8 meter unshielded cable with one core
Direct Charging	**Brand Name**	SYMBOL
	Model Name	ADP9000-110R
	I/O Port	RSS232 Port*1, RJ45 Port*2
Scanner 1	**Model Name**	SE4500
Scanner 2	**Model Name**	SE965
Scanner 3	**Model Name**	SE4600
Scanner 4	**Model Name**	SE1524
Keypad 1 (53 Key)	**Model Name**	KYPD-MC9XMS000-01R
	S/N	40B63U43F
Keypad 2 (28 Key)	**Model Name**	KYPD-MC9XMR000-01R
	S/N	40A11W40H
Keypad 3 (33 Key)	**Model Name**	KYPD-MC9XMX000-01R
	S/N	40B52K50A
Keypad 4 (43 Key)	**Model Name**	KYPD-MC9XMT000-01R
	S/N	40A11R93G
Holster 1	**P/N**	SG-MC9024242-01R
Holster 2	**P/N**	SG-MC9121112-01R

Note: The EUT configuration in original SAR report is Scanner 1 (SE4500) + Keypad 1 (53 Key) + Headset 1 (VR10).

3. SAR Measurement System

3.1 Definition of Specific Absorption Rate (SAR)

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.

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:

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

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

SAR measurement can be related to the electrical field in the tissue by

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

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

3.2 SPEAG DASY System

DASY system consists of high precision robot, probe alignment sensor, phantom, robot controller, controlled measurement server and near-field probe. The robot includes six axes that can move to the precision position of the DASY4/5 software defined. The DASY software can define the area that is detected by the probe. The robot is connected to controlled box. Controlled measurement server is connected to the controlled robot box. The DAE includes amplifier, signal multiplexing, AD converter, offset measurement and surface detection. It is connected to the Electro-optical coupler (ECO). The ECO performs the conversion form the optical into digital electric signal of the DAE and transfers data to the PC.

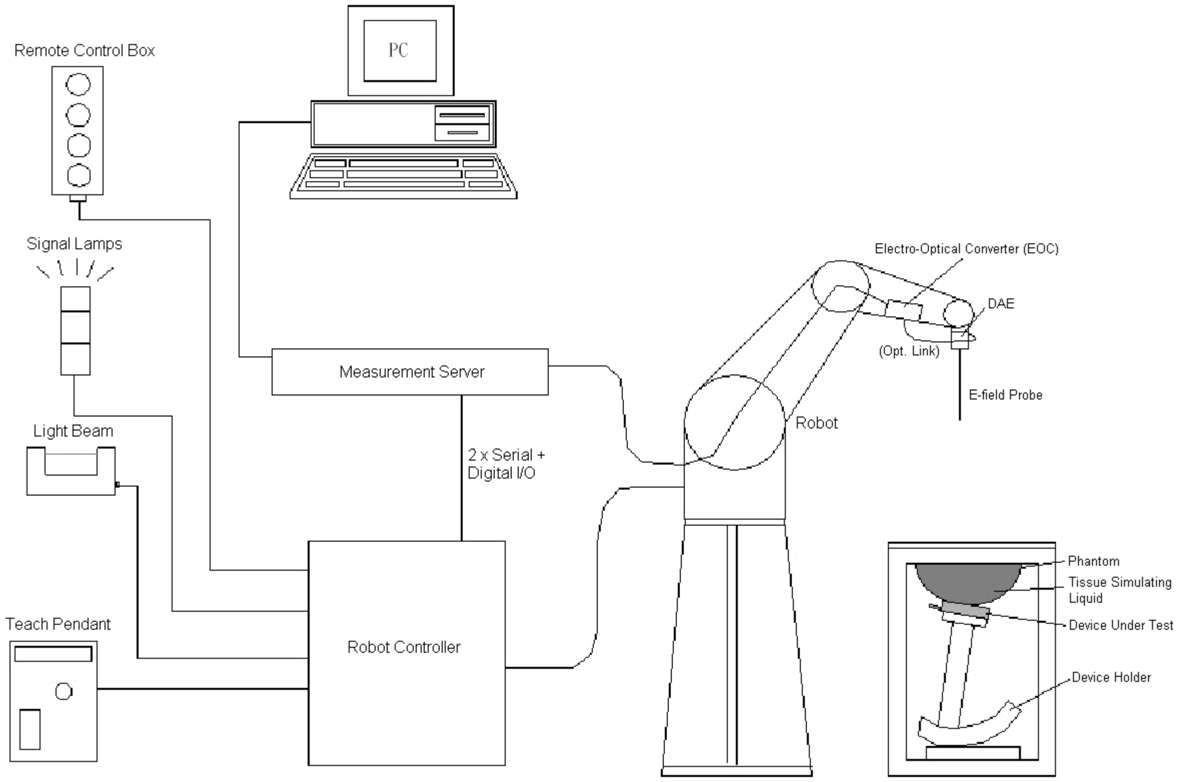


Fig-3.1 DASY System Setup

3.2.1 Robot

The DASY system uses the high precision robots from Stäubli SA (France). For the 6-axis controller system, the robot controller version (DASY4: CS7MB; DASY5: CS8c) from Stäubli is used. The Stäubli robot series have many features that are important for our application:

- High precision (repeatability ±0.035 mm)
- High reliability (industrial design)
- Jerk-free straight movements
- Low ELF interference (the closed metallic construction shields against motor control fields)

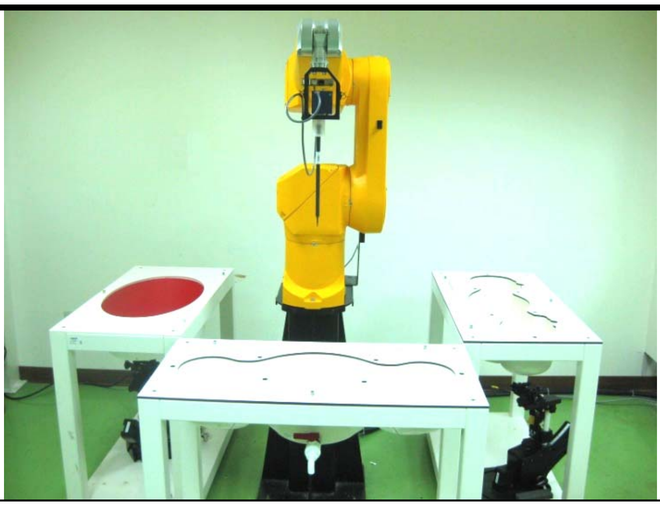


Fig-3.2 DASY4

Fig-3.3 DASY5

3.2.2 Probes

The SAR measurement is conducted with the dosimetric probe. The probe is specially designed and calibrated for use in liquid with high permittivity. The dosimetric probe has special calibration in liquid at different frequency.

Model	EX3DV4	
Construction	Symmetrical design with triangular core. Built-in shielding against static charges. PEEK enclosure material (resistant to organic solvents, e.g., DGBE).	
Frequency	10 MHz to 6 GHz Linearity: ± 0.2 dB	
Directivity	± 0.3 dB in HSL (rotation around probe axis) ± 0.5 dB in tissue material (rotation normal to probe axis)	
Dynamic Range	10 μW/g to 100 mW/g Linearity: ± 0.2 dB (noise: typically < 1 μW/g)	
Dimensions	Overall length: 337 mm (Tip: 20 mm) Tip diameter: 2.5 mm (Body: 12 mm) Typical distance from probe tip to dipole centers: 1 mm	

Model	ES3DV3	
Construction	Symmetrical design with triangular core. Interleaved sensors. Built-in shielding against static charges. PEEK enclosure material (resistant to organic solvents, e.g., DGBE).	
Frequency	10 MHz to 4 GHz Linearity: ± 0.2 dB	
Directivity	± 0.2 dB in HSL (rotation around probe axis) ± 0.3 dB in tissue material (rotation normal to probe axis)	
Dynamic Range	5 μW/g to 100 mW/g Linearity: ± 0.2 dB	
Dimensions	Overall length: 337 mm (Tip: 20 mm) Tip diameter: 3.9 mm (Body: 12 mm) Distance from probe tip to dipole centers: 2.0 mm	

3.2.3 Data Acquisition Electronics (DAE)

Model	DAE3, DAE4	
Construction	Signal amplifier, multiplexer, A/D converter and control logic. Serial optical link for communication with DASY4/5 embedded system (fully remote controlled). Two step probe touch detector for mechanical surface detection and emergency robot stop.	
Measurement Range	-100 to +300 mV (16 bit resolution and two range settings: 4mV, 400mV)	
Input Offset Voltage	< 5μV (with auto zero)	
Input Bias Current	< 50 fA	
Dimensions	60 x 60 x 68 mm	

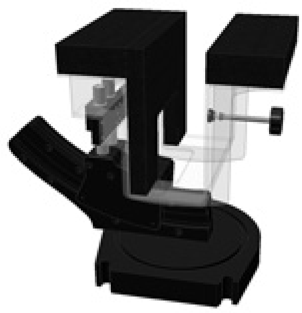
3.2.4 Phantoms

Model	Twin SAM	
Construction	The shell corresponds to the specifications of the Specific Anthropomorphic Mannequin (SAM) phantom defined in IEEE 1528 and IEC 62209-1. It enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. A cover prevents evaporation of the liquid. Reference markings on the phantom allow the complete setup of all predefined phantom positions and measurement grids by teaching three points with the robot.	
Material	Vinylester, glass fiber reinforced (VE-GF)	
Shell Thickness	2 ± 0.2 mm (6 ± 0.2 mm at ear point)	
Dimensions	Length: 1000 mm Width: 500 mm Height: adjustable feet	
Filling Volume	approx. 25 liters	

Model	ELI	
Construction	Phantom for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30 MHz to 6 GHz. 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.	
Material	Vinylester, glass fiber reinforced (VE-GF)	
Shell Thickness	2.0 ± 0.2 mm (bottom plate)	
Dimensions	Major axis: 600 mm Minor axis: 400 mm	
Filling Volume	approx. 30 liters	

3.2.5 Device Holder

Model	Mounting Device	
Construction	In combination with the Twin SAM Phantom or ELI4, the Mounting Device enables the rotation of the mounted transmitter device in spherical coordinates. Rotation point is the ear opening point. Transmitter devices can be easily and accurately positioned according to IEC, IEEE, FCC or other specifications. The device holder can be locked for positioning at different phantom sections (left head, right head, flat).	
Material	POM	

Model	Laptop Extensions Kit	
Construction	Simple but effective and easy-to-use extension for Mounting Device that facilitates the testing of larger devices according to IEC 62209-2 (e.g., laptops, cameras, etc.). It is lightweight and fits easily on the upper part of the Mounting Device in place of the phone positioner.	
Material	POM, Acrylic glass, Foam	

3.2.6 System Validation Dipoles

Model	D-Serial	
Construction	Symmetrical dipole with l/4 balun. Enables measurement of feed point impedance with NWA. Matched for use near flat phantoms filled with tissue simulating solutions.	
Frequency	750 MHz to 5800 MHz	
Return Loss	> 20 dB	
Power Capability	> 100 W (f < 1GHz), > 40 W (f > 1GHz)	

3.2.7 Tissue Simulating Liquids

For SAR measurement of the field distribution inside the phantom, the phantom must be filled with homogeneous tissue simulating liquid to a depth of at least 15 cm. For head SAR testing, the liquid height from the ear reference point (ERP) of the phantom to the liquid top surface is larger than 15 cm. For body SAR testing, the liquid height from the center of the flat phantom to the liquid top surface is larger than 15 cm. The nominal dielectric values of the tissue simulating liquids in the phantom and the tolerance of 5% are listed in Table-3.1.

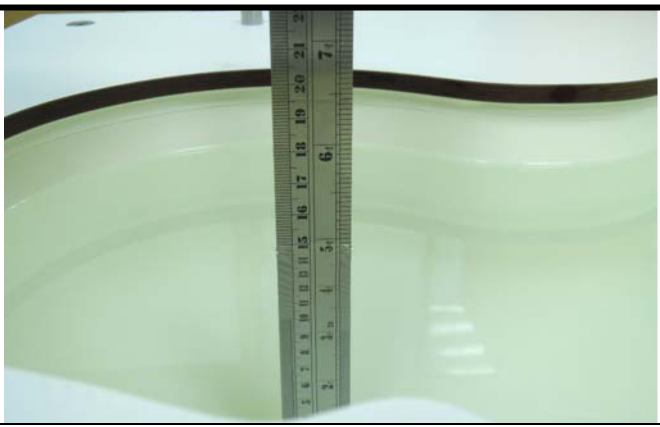


Photo of Liquid Height for Head Position

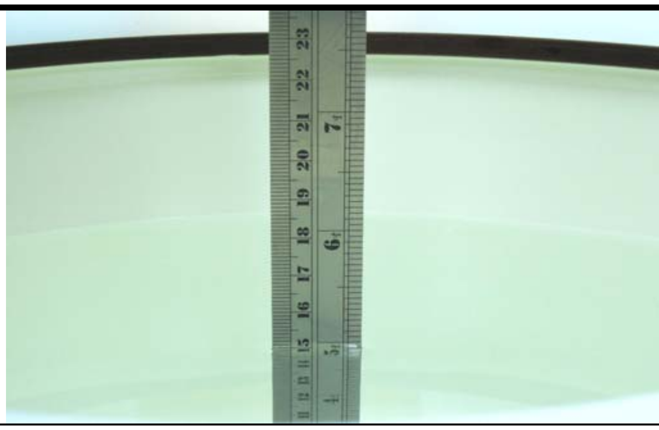


Photo of Liquid Height for Body Position

The dielectric properties of the head tissue simulating liquids are defined in IEEE 1528 and FCC OET 65 Supplement C Appendix C. For the body tissue simulating liquids, the dielectric properties are defined in FCC OET 65 Supplement C Appendix C. The dielectric properties of the tissue simulating liquids were verified prior to the SAR evaluation using an Agilent 85070D Dielectric Probe Kit and an Agilent Network Analyzer.

Table-3.1 Targets of Tissue Simulating Liquid

Frequency (MHz)	Target Permittivity	Range of ±5%	Target Conductivity	Range of ±5%
2450	52.7	50.1 ~ 55.3	1.95	1.85 ~ 2.05
5200	49.0	46.6 ~ 51.5	5.30	5.04 ~ 5.57
5300	48.9	46.5 ~ 51.3	5.42	5.15 ~ 5.69
5600	48.5	46.1 ~ 50.9	5.77	5.48 ~ 6.06
5800	48.2	45.8 ~ 50.6	6.00	5.70 ~ 6.30

The following table gives the recipes for tissue simulating liquids.

Table-3.2 Recipes of Tissue Simulating Liquid

Tissue Type	Bactericide	DGBE	HEC	NaCl	Sucrose	Triton X-100	Water	Diethylene Glycol Mono-hexylether
B2450	-	31.4	-	0.1	-	-	68.5	-
B5G	-	-	-	-	-	10.7	78.6	10.7

3.3 SAR System Verification

The system check verifies that the system operates within its specifications. It is performed daily or before every SAR measurement. The system check uses normal SAR measurements in the flat section of the phantom with a matched dipole at a specified distance. The system verification setup is shown as below.

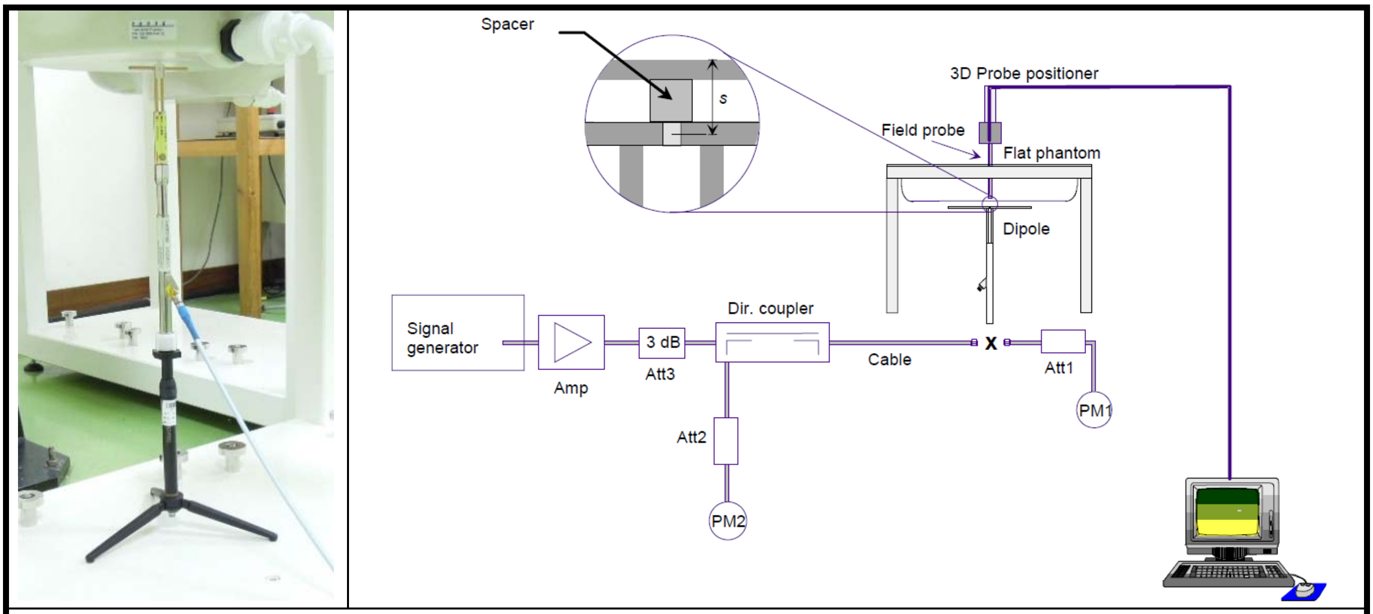


Fig-3.4 System Verification Setup

The validation dipole is placed beneath the flat phantom with the specific spacer in place. The distance spacer is touch the phantom surface with a light pressure at the reference marking and be oriented parallel to the long side of the phantom. The power meter PM1 measures the forward power at the location of the system check dipole connector. The signal generator is adjusted for the desired forward power (250 mW is used for 700 MHz to 3 GHz, 100 mW is used for 3.5 GHz to 6 GHz) at the dipole connector and the power meter PM2 is read at that level. After connecting the cable to the dipole, the signal generator is readjusted for the same reading at power meter PM2.

After system check testing, the SAR result will be normalized to 1W forward input power and compared with the reference SAR value derived from validation dipole certificate report. The deviation of system check should be within 10 %.

3.4 SAR Measurement Procedure

According to the SAR test standard, the recommended procedure for assessing the peak spatial-average SAR value consists of the following steps:

(a) Power reference measurement
(b) Area scan
(c) Zoom scan
(d) Power drift measurement

The SAR measurement procedures for each of test conditions are as follows:

(a) Make EUT to transmit maximum output power
(b) Measure conducted output power through RF cable
(c) Place the EUT in the specific position of phantom
(d) Perform SAR testing steps on the DASY system
(e) Record the SAR value

3.4.1 Area & Zoom Scan Procedure

First Area Scan is used to locate the approximate location(s) of the local peak SAR value(s). The measurement grid within an Area Scan is defined by the grid extent, grid step size and grid offset. Next, in order to determine the EM field distribution in a three-dimensional spatial extension, Zoom Scan is required. The Zoom Scan is performed around the highest E-field value to determine the averaged SAR-distribution over 10 g. According to KDB 865664D01v01, the resolution for Area and Zoom scan is specified in the table below.

Items	<= 2 GHz	2-3 GHz	3-4 GHz	4-5 GHz	5-6 GHz
Area Scan (Δx, Δy)	<= 15 mm	<= 12 mm	<= 12 mm	<= 10 mm	<= 10 mm
Zoom Scan (Δx, Δy)	<= 8 mm	<= 5 mm	<= 5 mm	<= 4 mm	<= 4 mm
Zoom Scan (Δz)	<= 5 mm	<= 5 mm	<= 4 mm	<= 3 mm	<= 2 mm
Zoom Scan Volume	>= 30 mm	>= 30 mm	>= 28 mm	>= 25 mm	>= 22 mm

Note:

When zoom scan is required and report SAR is <= 1.4 W/kg, the zoom scan resolution of Δx / Δy (2-3GHz: <= 8 mm, 3-4GHz: <= 7 mm, 4-6GHz: <= 5 mm) may be applied.

3.4.2 Volume Scan Procedure

The volume scan is used for assess overlapping SAR distributions for antennas transmitting in different frequency bands. It is equivalent to an oversized zoom scan used in standalone measurements. The measurement volume will be used to enclose all the simultaneous transmitting antennas. For antennas transmitting simultaneously in different frequency bands, the volume scan is measured separately in each frequency band. In order to sum correctly to compute the 1g aggregate SAR, the EUT remain in the same test position for all measurements and all volume scan use the same spatial resolution and grid spacing. When all volume scan were completed, the software, SEMCAD postprocessor can combine and subsequently superpose these measurement data to calculating the multiband SAR.

3.4.3 Power Drift Monitoring

All SAR testing is under the EUT install full charged battery and transmit maximum output power. In DASY measurement software, the power reference measurement and power drift measurement procedures are used for monitoring the power drift of EUT during SAR test. Both these procedures measure the field at a specified reference position before and after the SAR testing. The software will calculate the field difference in dB. If the power drift more than 5%, the SAR will be retested.

3.4.4 Spatial Peak SAR Evaluation

The procedure for spatial peak SAR evaluation has been implemented according to the test standard. It can be conducted for 1g and 10g, as well as for user-specific masses. The DASY software includes all numerical procedures necessary to evaluate the spatial peak SAR value.

The base for the evaluation is a "cube" measurement. The measured volume must include the 1g and 10g cubes with the highest averaged SAR values. For that purpose, the center of the measured volume is aligned to the interpolated peak SAR value of a previously performed area scan.

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

(a) Extraction of the measured data (grid and values) from the Zoom Scan
(b) Calculation of the SAR value at every measurement point based on all stored data (A/D values and measurement parameters)
(c) Generation of a high-resolution mesh within the measured volume
(d) Interpolation of all measured values form the measurement grid to the high-resolution grid
(e) Extrapolation of the entire 3-D field distribution to the phantom surface over the distance from sensor to surface
(f) Calculation of the averaged SAR within masses of 1g and 10g

3.4.5 SAR Averaged Methods

In DASY, the interpolation and extrapolation are both based on the modified Quadratic Shepard's method. The interpolation scheme combines a least-square fitted function method and a weighted average method which are the two basic types of computational interpolation and approximation.

Extrapolation routines are used to obtain SAR values between the lowest measurement points and the inner phantom surface. The extrapolation distance is determined by the surface detection distance and the probe sensor offset. The uncertainty increases with the extrapolation distance. To keep the uncertainty within 1% for the 1 g and 10 g cubes, the extrapolation distance should not be larger than 5 mm.

4. SAR Measurement Evaluation

4.1 EUT Configuration and Setting

For WLAN SAR testing, the EUT has installed WLAN engineering testing software which can provide continuous transmitting RF signal. According to KDB 248227 D01, WLAN SAR should tested at the lowest data rate, and testing at higher data rate is not required when the maximum average output power is less than 1/4 dB higher than those measured at the lowest data rate. Since the WLAN power at lowest data rate has highest output power, WLAN SAR for this device was performed at the lowest data rate as set in 1 Mbps for 802.11b, and 6 Mbps for 802.11a. This RF signal utilized in SAR measurement has almost 100% duty cycle, and the duty factor is 1 for WLAN SAR testing.

4.2 EUT Testing Position

The SAR test reduction for this device has been approved by FCC and the complete copy of response noted as below. Based on the worst case of original SAR report, this EUT was installed in holster and verified in **Left Side**, and **Right Side** positions with 0 cm air gap.

FCC Response on 03/29/2013:

Thanks for patience. Test plan is acceptable for preparing SAR report then submission to TCB for processing without TCB using full PBA process; however please include the records of this pre-TCB inquiry along with submission for TCB review, AND request TCB please insert this pre-TCB KDB tracking number into the form-731 as associated (but non-PBA) KDB.

4.2.1 SAR Test Exclusions

According to KDB 447498 D01v05, the SAR test exclusion condition is based on source-based time-averaged maximum conducted output power, adjusted for tune-up tolerance, and the minimum test separation distance required for the exposure conditions. The SAR exclusion threshold is determined by the following formula.

$$\frac{\text{Max. Tune up Power}_{(\text{mW})}}{\text{Min. Test Separation Distance}_{(\text{mm})}} \times \sqrt{f_{(\text{GHz})}} \leq 3.0$$

When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion.

Mode	Frequency (GHz)	Max. Tune-up Power (dBm)	Max. Tune-up Power (mW)	Body-Worn		
				Ant. to Surface (mm)	Exclusion Threshold (mW)	SAR Tested?
BT	2.48	4.7	3	5	10	No

4.3 Tissue Verification

The measuring results for tissue simulating liquid are shown as below.

Test Date	Tissue Type	Frequency (MHz)	Liquid Temp. (℃)	Measured Conductivity (σ)	Measured Permittivity (ε_r)	Target Conductivity (σ)	Target Permittivity (ε_r)	Conductivity Deviation (%)	Permittivity Deviation (%)
Jul. 11, 2012	Body	2450	20.8	2.022	53.095	1.95	52.7	3.69	0.75
Feb. 22, 2013	Body	2450	20.4	1.967	54.087	1.95	52.7	0.87	2.63
Feb. 24, 2013	Body	2450	20.2	1.966	54.662	1.95	52.7	0.82	3.72
Feb. 27, 2013	Body	2450	20.2	1.945	50.906	1.95	52.7	-0.26	-3.40
Jul. 06, 2012	Body	5200	20.9	5.278	48.936	5.30	49.0	-0.42	-0.13
Jul. 07, 2012	Body	5200	20.8	5.233	49.383	5.30	49.0	-1.26	0.78
Jul. 08, 2012	Body	5200	21.2	5.185	50.911	5.30	49.0	-2.17	3.90
Jul. 09, 2012	Body	5200	20.8	5.244	49.381	5.30	49.0	-1.06	0.78
Jul. 10, 2012	Body	5200	20.5	5.279	49.196	5.30	49.0	-0.40	0.40
Jul. 11, 2012	Body	5200	20.4	5.243	49.431	5.30	49.0	-1.08	0.88
Feb. 22, 2013	Body	5200	20.3	5.339	47.479	5.30	49.0	0.74	-3.10
Feb. 23, 2013	Body	5200	20.2	5.35	47.721	5.30	49.0	0.94	-2.61
Feb. 27, 2013	Body	5200	20.6	5.321	47.346	5.30	49.0	0.40	-3.38
Feb. 22, 2013	Body	5300	20.3	5.473	47.306	5.42	48.9	0.98	-3.26
Feb. 23, 2013	Body	5300	20.2	5.484	47.547	5.42	48.9	1.18	-2.77
Feb. 27, 2013	Body	5300	20.6	5.454	47.175	5.42	48.9	0.63	-3.53
Jul. 06, 2012	Body	5500	20.9	5.717	48.431	5.65	48.6	1.19	-0.35
Jul. 07, 2012	Body	5500	20.8	5.685	48.893	5.65	48.6	0.62	0.60
Jul. 08, 2012	Body	5500	21.2	5.686	50.476	5.65	48.6	0.64	3.86
Jul. 10, 2012	Body	5500	20.5	5.727	48.708	5.65	48.6	1.36	0.22
Jul. 11, 2012	Body	5500	20.4	5.693	48.944	5.65	48.6	0.76	0.71
Jul. 21, 2012	Body	5500	21.1	5.712	48.722	5.65	48.6	1.10	0.25
Feb. 22, 2013	Body	5600	20.3	5.903	46.754	5.77	48.5	2.31	-3.60
Feb. 27, 2013	Body	5600	20.6	5.889	46.629	5.77	48.5	2.06	-3.86
Jul. 06, 2012	Body	5800	20.9	6.123	47.668	6.00	48.2	2.05	-1.10
Jul. 07, 2012	Body	5800	20.8	6.104	48.141	6.00	48.2	1.73	-0.12
Jul. 08, 2012	Body	5800	21.2	6.153	49.738	6.00	48.2	2.55	3.19
Jul. 10, 2012	Body	5800	20.5	6.141	47.955	6.00	48.2	2.35	-0.51
Jul. 11, 2012	Body	5800	20.2	6.111	48.187	6.00	48.2	1.85	-0.03
Feb. 22, 2013	Body	5800	20.3	6.19	46.373	6.00	48.2	3.17	-3.79
Feb. 27, 2013	Body	5800	20.3	6.176	46.237	6.00	48.24	2.93	-4.15

Note:

The dielectric properties of the tissue simulating liquid must be measured within 24 hours before the SAR testing and within ±5% of the target values. Liquid temperature during the SAR testing must be within ±2 ℃.

4.4 System Verification

The measuring result for system verification is tabulated as below.

Test Date	Mode	Frequency (MHz)	1W Target SAR-1g (W/kg)	Measured SAR-1g (W/kg)	Normalized to 1W SAR-1g (W/kg)	Deviation (%)	Dipole S/N	Probe S/N	DAE S/N
Jul. 11, 2012	Body	2450	50.00	12.60	50.40	0.80	737	3650	910
Feb. 22, 2013	Body	2450	49.60	12.10	48.40	-2.42	737	3661	679
Feb. 24, 2013	Body	2450	49.60	12.20	48.80	-1.61	737	3864	1277
Feb. 27, 2013	Body	2450	49.60	12.40	49.60	0.00	737	3650	579
Jul. 06, 2012	Body	5200	72.70	7.58	75.80	4.26	1018	3650	910
Jul. 07, 2012	Body	5200	72.70	7.41	74.10	1.93	1018	3650	910
Jul. 08, 2012	Body	5200	72.70	6.99	69.90	-3.85	1018	3650	910
Jul. 09, 2012	Body	5200	72.70	7.53	75.30	3.58	1018	3650	910
Jul. 10, 2012	Body	5200	72.70	7.58	75.80	4.26	1018	3650	910
Jul. 11, 2012	Body	5200	72.70	7.43	74.30	2.20	1018	3650	910
Feb. 22, 2013	Body	5200	73.00	7.17	71.70	-1.78	1019	3661	679
Feb. 23, 2013	Body	5200	73.00	7.59	75.90	3.97	1019	3650	579
Feb. 27, 2013	Body	5200	73.00	7.26	72.60	-0.55	1019	3650	5790
Feb. 22, 2013	Body	5300	74.60	7.33	73.30	-1.74	1019	3661	679
Feb. 23, 2013	Body	5300	74.60	7.66	76.60	2.68	1019	3650	579
Feb. 27, 2013	Body	5300	74.60	7.62	76.20	2.14	1019	3650	579
Jul. 06, 2012	Body	5500	78.30	7.77	77.70	-0.77	1018	3650	910
Jul. 07, 2012	Body	5500	78.30	8.16	81.60	4.21	1018	3650	910
Jul. 08, 2012	Body	5500	78.30	8.09	80.90	3.32	1018	3650	910
Jul. 10, 2012	Body	5500	78.30	8.15	81.50	4.09	1018	3650	910
Jul. 11, 2012	Body	5500	78.30	7.86	78.60	0.38	1018	3650	910
Jul. 21, 2012	Body	5500	78.30	8.45	84.50	7.92	1018	3820	579
Feb. 22, 2013	Body	5600	79.90	7.76	77.60	-2.88	1019	3661	679
Feb. 27, 2013	Body	5600	79.90	8.01	80.10	0.25	1019	3650	579
Jul. 06, 2012	Body	5800	73.40	7.16	71.60	-2.45	1018	3650	910
Jul. 07, 2012	Body	5800	73.40	6.80	68.00	-7.36	1018	3650	910
Jul. 08, 2012	Body	5800	73.40	7.19	71.90	-2.04	1018	3650	910
Jul. 10, 2012	Body	5800	73.40	6.94	69.40	-5.45	1018	3650	910
Jul. 11, 2012	Body	5800	73.40	7.15	71.50	-2.59	1018	3650	910
Feb. 22, 2013	Body	5800	73.40	7.39	73.90	0.68	1019	3661	679
Feb. 27, 2013	Body	5800	73.40	7.73	77.30	5.31	1019	3650	579

Note:

Comparing to the reference SAR value provided by SPEAG, the validation data should be within its specification of 10 %. The result indicates the system check can meet the variation criterion and the plots can be referred to Appendix A of this report.

4.5 Maximum Output Power

4.5.1 Maximum Conducted Power

The maximum conducted power (Unit: dBm) including tune-up tolerance is shown as below.

WLAN Antenna-0

Mode	2.4G WLAN	5.2G WLAN	5.3G WLAN	5.6G WLAN	5.8G WLAN
802.11b	21.8	N/A	N/A	N/A	N/A
802.11g	21.1	N/A	N/A	N/A	N/A
802.11a	N/A	13.9	18.2	18.3	17.3
802.11n HT20	20.5	13.5	17.7	17.8	17.0

WLAN Antenna-1

Mode	2.4G WLAN	5.2G WLAN	5.3G WLAN	5.6G WLAN	5.8G WLAN
802.11b	21.7	N/A	N/A	N/A	N/A
802.11g	21.0	N/A	N/A	N/A	N/A
802.11a	N/A	13.8	18.1	18.2	17.1
802.11n HT20	20.1	13.4	17.6	17.7	16.8

Mode	Bluetooth
All	4.7

4.5.2 Measured Conducted Power Result

The measuring conducted power (Unit: dBm) is shown as below.

<WLAN 2.4G>

Mode	802.11b		
Channel / Frequency (MHz)	1 (2412)	6 (2437)	11 (2462)
Average Power (Ant-0)	21.50	**21.80**	19.10
Average Power (Ant-1)	21.10	**21.70**	19.00
Mode	**802.11g**		
Channel / Frequency (MHz)	**1 (2412)**	**6 (2437)**	**11 (2462)**
Average Power (Ant-0)	14.50	**21.10**	14.60
Average Power (Ant-1)	14.30	**21.00**	14.40
Mode	**802.11n (HT20)**		
Channel / Frequency (MHz)	**1 (2412)**	**6 (2437)**	**11 (2462)**
Average Power (Ant-0)	14.40	**20.50**	13.70
Average Power (Ant-1)	14.00	**20.10**	13.50

<WLAN 5.2G>

Mode	802.11a			
Channel / Frequency (MHz)	36 (5180)	40 (5200)	44 (5220)	48 (5240)
Average Power (Ant-0)	13.70	13.80	13.90	**13.90**
Average Power (Ant-1)	13.60	13.70	13.70	**13.80**
Mode	**802.11n (HT20)**			
Channel / Frequency (MHz)	**36 (5180)**	**40 (5200)**	**44 (5220)**	**48 (5240)**
Average Power (Ant-0)	13.30	13.20	13.40	**13.50**
Average Power (Ant-1)	13.20	13.10	13.30	**13.40**

<WLAN 5.3G>

Mode	802.11a			
Channel / Frequency (MHz)	52 (5260)	56 (5280)	60 (5300)	64 (5320)
Average Power (Ant-0)	**18.20**	18.00	18.10	16.00
Average Power (Ant-1)	**18.10**	17.90	18.00	15.90
Mode	802.11n (HT20)			
Channel / Frequency (MHz)	52 (5260)	56 (5280)	60 (5300)	64 (5320)
Average Power (Ant-0)	**17.70**	17.40	17.40	15.60
Average Power (Ant-1)	**17.60**	17.30	17.30	15.40

<WLAN 5.6G>

Mode	802.11a							
Channel / Frequency (MHz)	100 (5500)	104 (5520)	108 (5540)	112 (5560)	116 (5580)	132 (5660)	136 (5680)	140 (5700)
Average Power (Ant-0)	15.10	**18.30**	18.00	17.80	18.10	16.20	16.40	15.30
Average Power (Ant-1)	15.00	**18.20**	17.90	17.60	18.00	16.20	16.20	15.10
Mode	802.11n (HT20)							
Channel / Frequency (MHz)	100 (5500)	104 (5520)	108 (5540)	112 (5560)	116 (5580)	132 (5660)	136 (5680)	140 (5700)
Average Power (Ant-0)	14.70	**17.80**	17.50	17.40	17.70	15.80	15.80	14.70
Average Power (Ant-1)	14.60	**17.70**	17.40	17.20	17.60	15.60	15.60	14.50

<WLAN 5.8G>

Mode	802.11a				
Channel / Frequency (MHz)	149 (5745)	153 (5765)	157 (5785)	161 (5805)	165 (5825)
Average Power (Ant-0)	17.30	17.10	17.00	17.10	**17.30**
Average Power (Ant-1)	17.10	16.90	16.90	17.00	**17.10**
Mode	802.11n (HT20)				
Channel / Frequency (MHz)	149 (5745)	153 (5765)	157 (5785)	161 (5805)	165 (5825)
Average Power (Ant-0)	16.90	16.70	**17.00**	16.60	16.80
Average Power (Ant-1)	16.70	16.40	**16.80**	16.40	16.40

4.6 SAR Testing Results

4.6.1 SAR Results for Body-Worn (Separation Distance is 0 cm)

A) 2 WLAN Tx Antenna	B) 2 Holster	C) 4 Scanner	D) 4 Keypad	E) 2 Headset	F) CR	G) Speaker Shifting	H) KDB 865664
0) WLAN Ant-0	1) SG-MC9024242-01R	1) SE4500 (Main Source)	1) 53 Key (Main Source)	1) VR10 (Main Source)	1) without CR	1) No	1) Old Version (r1.1)
1) WLAN Ant-1	2) SG-MC9121112-01R	2) SE965	2) 28 Key	2) RCH50	2) with CR	2) Yes	2) New Version (D01v01)
		3) SE4600	3) 33 Key				
		4) SE1524	4) 43 Key				

Plot No.	Band	Test Position	Ch.	Tx Ant.	Holster	Scanner	Keypad	Headset	CR	Speaker Shift	KDB 865664	Max. Tune-up Power (dBm)	Measured Conducted Power (dBm)	Scaling Factor	Measured SAR-1g (W/kg)	Scaled SAR-1g (W/kg)
*	802.11b	Left	6	1	1	1	1	w/o	1	1	1	21.7	21.7	1.00	0.537	0.54
01	802.11b	Left	6	1	1	2	1	w/o	1	1	1	21.7	21.7	1.00	0.774	**0.77**
02	802.11b	Left	6	1	1	3	1	w/o	1	1	1	21.7	21.7	1.00	0.747	0.75
03	802.11b	Left	6	1	1	2	1	w/o	2	1	1	21.7	21.7	1.00	0.556	0.56
04	802.11b	Left	6	1	1	2	2	w/o	1	1	1	21.7	21.7	1.00	0.756	0.76
05	802.11b	Left	6	1	1	2	3	w/o	1	1	1	21.7	21.7	1.00	0.77	0.77
06	802.11b	Left	6	1	1	2	4	w/o	1	1	1	21.7	21.7	1.00	0.756	0.76
*	802.11b	Left	6	1	2	1	1	1	1	1	1	21.7	21.7	1.00	0.401	0.40
07	802.11b	Left	6	1	2	2	1	1	1	1	1	21.7	21.7	1.00	0.505	0.51
08	802.11b	Left	6	1	2	3	1	1	1	1	1	21.7	21.7	1.00	0.569	0.57
09	802.11b	Left	6	1	2	3	1	1	2	1	1	21.7	21.7	1.00	0.429	0.43
10	802.11b	Left	6	1	2	3	2	1	1	1	1	21.7	21.7	1.00	0.573	0.57
11	802.11b	Left	6	1	2	3	3	1	1	1	1	21.7	21.7	1.00	0.606	0.61
12	802.11b	Left	6	1	2	3	4	1	1	1	1	21.7	21.7	1.00	0.615	0.62
13	802.11b	Left	6	1	2	3	4	2	1	1	1	21.7	21.7	1.00	0.604	0.60
14	802.11b	Left	6	1	1	2	1	w/o	1	2	1	21.7	21.7	1.00	0.733	0.73
15	802.11b	Left	6	1	1	2	1	w/o	1	2	2	21.7	21.7	1.00	0.735	0.74
16	802.11b	Left	6	1	1	4	1	w/o	1	2	2	21.7	21.7	1.00	0.381	0.38
*	802.11a	Left	48	1	1	1	1	w/o	1	1	1	13.8	13.8	1.00	0.099	0.10
21	802.11a	Left	48	1	1	2	1	w/o	1	1	1	13.8	13.8	1.00	0.041	0.04
22	802.11a	Left	48	1	1	3	1	w/o	1	1	1	13.8	13.8	1.00	0.026	0.03
23	802.11a	Left	48	1	1	1	1	w/o	2	1	1	13.8	13.8	1.00	0.0000678	0.00
24	802.11a	Left	48	1	1	1	2	w/o	1	1	1	13.8	13.8	1.00	0.074	0.07
25	802.11a	Left	48	1	1	1	3	w/o	1	1	1	13.8	13.8	1.00	0.104	0.10
26	802.11a	Left	48	1	1	1	4	w/o	1	1	1	13.8	13.8	1.00	0.08	0.08
*	802.11a	Right	48	0	2	1	1	1	1	1	1	13.9	13.9	1.00	0.394	0.39
27	802.11a	Right	48	0	2	2	1	1	1	1	1	13.9	13.9	1.00	0.437	0.44
28	802.11a	Right	48	0	2	3	1	1	1	1	1	13.9	13.9	1.00	0.318	0.32
29	802.11a	Right	48	0	2	2	1	1	2	1	1	13.9	13.9	1.00	0.625	**0.63**
30	802.11a	Right	48	0	2	2	2	1	2	1	1	13.9	13.9	1.00	0.227	0.23
31	802.11a	Right	48	0	2	2	3	1	2	1	1	13.9	13.9	1.00	0.16	0.16
32	802.11a	Right	48	0	2	2	4	1	2	1	1	13.9	13.9	1.00	0.252	0.25
33	802.11a	Right	48	0	2	2	1	2	2	1	1	13.9	13.9	1.00	0.27	0.27
34	802.11a	Right	48	0	2	2	1	1	2	2	1	13.9	13.9	1.00	0.606	0.61
35	802.11a	Right	48	0	2	2	1	1	2	2	2	13.9	13.9	1.00	0.605	0.61
36	802.11a	Right	48	0	2	4	1	1	2	2	2	13.9	13.9	1.00	0.27	0.27

Plot No.	Band	Test Position	Ch.	Tx Ant.	Holster	Scanner	Keypad	Headset	CR	Speaker Shift	KDB 865664	Max. Tune-up Power (dBm)	Measured Conducted Power (dBm)	Scaling Factor	Measured SAR-1g (W/kg)	Scaled SAR-1g (W/kg)
*	802.11a	Left	52	1	1	1	1	w/o	1	1	1	18.1	18.1	1.00	0.314	0.31
41	802.11a	Left	52	1	1	2	1	w/o	1	1	1	18.1	18.1	1.00	0.25	0.25
42	802.11a	Left	52	1	1	3	1	w/o	1	1	1	18.1	18.1	1.00	0.097	0.10
43	802.11a	Left	52	1	1	1	1	w/o	2	1	1	18.1	18.1	1.00	0.122	0.12
44	802.11a	Left	52	1	1	1	2	w/o	1	1	1	18.1	18.1	1.00	0.23	0.23
45	802.11a	Left	52	1	1	1	3	w/o	1	1	1	18.1	18.1	1.00	0.227	0.23
46	802.11a	Left	52	1	1	1	4	w/o	1	1	1	18.1	18.1	1.00	0.246	0.25
*	802.11a	Left	52	1	2	1	1	1	1	1	1	18.1	18.1	1.00	0.678	**0.68**
47	802.11a	Left	52	1	2	2	1	1	1	1	1	18.1	18.1	1.00	0.525	0.53
48	802.11a	Left	52	1	2	3	1	1	1	1	1	18.1	18.1	1.00	0.35	0.35
49	802.11a	Left	52	1	2	1	1	1	2	1	1	18.1	18.1	1.00	0.285	0.29
50	802.11a	Left	52	1	2	1	2	1	1	1	1	18.1	18.1	1.00	0.509	0.51
51	802.11a	Left	52	1	2	1	3	1	1	1	1	18.1	18.1	1.00	0.477	0.48
52	802.11a	Left	52	1	2	1	4	1	1	1	1	18.1	18.1	1.00	0.509	0.51
53	802.11a	Left	52	1	2	1	1	2	1	1	1	18.1	18.1	1.00	0.513	0.51
54	802.11a	Left	52	1	2	1	1	1	1	2	1	18.1	18.1	1.00	0.507	0.51
55	802.11a	Left	52	1	2	1	1	1	1	2	2	18.1	18.1	1.00	0.501	0.50
56	802.11a	Left	52	1	2	4	1	1	1	2	2	18.1	18.1	1.00	0.489	0.49
*	802.11a	Left	104	0	1	1	1	w/o	1	1	1	18.3	18.3	1.00	0.282	0.28
61	802.11a	Left	104	0	1	2	1	w/o	1	1	1	18.3	18.3	1.00	0.098	0.10
62	802.11a	Left	104	0	1	3	1	w/o	1	1	1	18.3	18.3	1.00	0.358	0.36
63	802.11a	Left	104	0	1	3	1	w/o	2	1	1	18.3	18.3	1.00	0.068	0.07
64	802.11a	Left	104	0	1	3	2	w/o	1	1	1	18.3	18.3	1.00	0.087	0.09
65	802.11a	Left	104	0	1	3	3	w/o	1	1	1	18.3	18.3	1.00	0.047	0.05
66	802.11a	Left	104	0	1	3	4	w/o	1	1	1	18.3	18.3	1.00	0.066	0.07
*	802.11a	Left	104	1	2	1	1	1	1	1	1	18.2	18.2	1.00	0.547	0.55
67	802.11a	Left	104	1	2	2	1	1	1	1	1	18.2	18.2	1.00	0.144	0.14
68	802.11a	Left	104	1	2	3	1	1	1	1	1	18.2	18.2	1.00	0.384	0.38
69	802.11a	Left	104	1	2	1	1	1	2	1	1	18.2	18.2	1.00	0.444	0.44
70	802.11a	Left	104	1	2	1	2	1	1	1	1	18.2	18.2	1.00	0.675	0.68
71	802.11a	Left	104	1	2	1	3	1	1	1	1	18.2	18.2	1.00	0.717	0.72
72	802.11a	Left	104	1	2	1	4	1	1	1	1	18.2	18.2	1.00	0.701	0.70
73	802.11a	Left	104	1	2	1	3	2	1	1	1	18.2	18.2	1.00	0.712	0.71
74	802.11a	Left	104	1	2	1	3	1	1	2	1	18.2	18.2	1.00	0.793	**0.79**
75	802.11a	Left	104	1	2	1	3	1	1	2	2	18.2	18.2	1.00	0.783	0.78
76	802.11a	Left	104	1	2	4	3	1	1	2	2	18.2	18.2	1.00	0.476	0.48

Plot No.	Band	Test Position	Ch.	Tx Ant.	Holster	Scanner	Keypad	Headset	CR	Speaker Shift	KDB 865664	Max. Tune-up Power (dBm)	Measured Conducted Power (dBm)	Scaling Factor	Measured SAR-1g (W/kg)	Scaled SAR-1g (W/kg)
*	802.11a	Left	165	0	1	1	1	w/o	1	1	1	17.3	17.3	1.00	0.193	0.19
81	802.11a	Left	165	0	1	2	1	w/o	1	1	1	17.3	17.3	1.00	0.083	0.08
82	802.11a	Left	165	0	1	3	1	w/o	1	1	1	17.3	17.3	1.00	0.042	0.04
83	802.11a	Left	165	0	1	1	1	w/o	2	1	1	17.3	17.3	1.00	0.113	0.11
84	802.11a	Left	165	0	1	1	2	w/o	1	1	1	17.3	17.3	1.00	0.055	0.06
85	802.11a	Left	165	0	1	1	3	w/o	1	1	1	17.3	17.3	1.00	0.097	0.10
86	802.11a	Left	165	0	1	1	4	w/o	1	1	1	17.3	17.3	1.00	0.122	0.12
*	802.11a	Left	165	1	2	1	1	1	1	1	1	17.1	17.1	1.00	0.474	0.47
87	802.11a	Left	165	1	2	2	1	1	1	1	1	17.1	17.1	1.00	0.341	0.34
88	802.11a	Left	165	1	2	3	1	1	1	1	1	17.1	17.1	1.00	0.471	0.47
89	802.11a	Left	165	1	2	1	1	1	2	1	1	17.1	17.1	1.00	0.708	0.71
90	802.11a	Left	165	1	2	1	2	1	2	1	1	17.1	17.1	1.00	0.621	0.62
91	802.11a	Left	165	1	2	1	3	1	2	1	1	17.1	17.1	1.00	0.574	0.57
92	802.11a	Left	165	1	2	1	4	1	2	1	1	17.1	17.1	1.00	0.712	0.71
93	802.11a	Left	165	1	2	1	4	2	2	1	1	17.1	17.1	1.00	0.723	**0.72**
94	802.11a	Left	165	1	2	1	4	2	2	2	1	17.1	17.1	1.00	0.723	0.72
95	802.11a	Left	165	1	2	1	4	2	2	2	2	17.1	17.1	1.00	0.717	0.72
96	802.11a	Left	165	1	2	4	4	2	2	2	2	17.1	17.1	1.00	0.338	0.34

Note:

1. SAR was verified on the worst condition of original report.
2. Note "*" is means that is worst SAR of original report.
3. The EUT cannot connect the headset when this EUT be installed in holster 1. Therefore, SAR testing with headset is only performed on the holster 2.
4. According to KDB 248227, when the extrapolated maximum peak SAR for the maximum output power channel is <= 1.6 W/kg and the 1g averaged SAR is <= 0.8 W/kg, WLAN SAR testing for other channels is not required.
5. SAR testing for 802.11g/n is not required because its maximum power is less than 1/4 dB higher than 802.11b.
6. SAR testing for 802.11n is not required when its maximum power is less than 1/4 dB higher than 802.11a.

4.6.2 SAR Measurement Variability

According to KDB 865664 D01v01, SAR measurement variability was assessed for each frequency band, which is determined by the SAR probe calibration point and tissue-equivalent medium used for the device measurements. When both head and body tissue-equivalent media are required for SAR measurements in a frequency band, the variability measurement procedures should be applied to the tissue medium with the highest measured SAR, using the highest measured SAR configuration for that tissue-equivalent medium. Alternatively, if the highest measured SAR for both head and body tissue-equivalent media are ≤ 1.45 W/kg and the ratio of these highest SAR values, i.e., largest divided by smallest value, is ≤ 1.10, the highest SAR configuration for either head or body tissue-equivalent medium may be used to perform the repeated measurement. These additional measurements are repeated after the completion of all measurements requiring the same head or body tissue-equivalent medium in a frequency band. The test device should be returned to ambient conditions (normal room temperature) with the battery fully charged before it is re-mounted on the device holder for the repeated measurement(s) to minimize any unexpected variations in the repeated results.

Since all the measured SAR are less than 0.8 W/kg, the repeated measurement is not required.

4.6.3 Simultaneous Multi-band Transmission Evaluation

<Estimated SAR Calculation>

According to KDB 447498 D01v05, when standalone SAR test exclusion applies to an antenna that transmits simultaneously with other antennas, the standalone SAR was estimated according to following formula to result in substantially conservative SAR values of <= 0.4 W/kg to determine simultaneous transmission SAR test exclusion.

$$\text{Estimated SAR} = \frac{\text{Max. Tune up Power}_{(\text{mW})}}{\text{Min. Test Separation Distance}_{(\text{mm})}} \times \frac{\sqrt{f_{(\text{GHz})}}}{7.5}$$

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

Mode / Band	Frequency (GHz)	Max. Tune-up Power (dBm)	Test Position	Separation Distance (mm)	Estimated SAR (W/kg)
BT (DSS)	2.48	4.7	Body-Worn	5	0.1

Note:

1. When standalone SAR testing is not required, an estimated SAR can be applied to determine simultaneous transmission SAR test exclusion.

<SAR Summation Analysis>

Simultaneous transmission SAR test exclusion is determined for each operating configuration and exposure condition according to the reported standalone SAR of each applicable simultaneous transmitting antenna. When the sum of SAR_{1g} of all simultaneously transmitting antennas in an operating mode and exposure condition combination is within the SAR limit (SAR_{1g} 1.6 W/kg), the simultaneous transmission SAR is not required. When the sum of SAR_{1g} is greater than the SAR limit (SAR_{1g} 1.6 W/kg), SAR test exclusion is determined by the SPLSR.

No.	Conditions (SAR1 + SAR2)	Exposure Condition	Max. SAR1	Max. SAR2	SAR Summation	SPLSR Analysis
1	**WLAN (DTS) + BT (DSS)**	Body-Worn	0.77	0.1 (Estimated SAR)	0.87	ΣSAR < 1.6, Not required
2	**WLAN (NII) + BT (DSS)**	Body-Worn	0.79	0.1 (Estimated SAR)	0.89	ΣSAR < 1.6, Not required

Test Engineer： Sam Onn, and Eli Hsu

5. Calibration of Test Equipment

Equipment	Manufacturer	Model	SN	Cal. Date	Cal. Interval
System Validation Kit	SPEAG	D2450V2	737	Jan. 24, 2012	Annual
System Validation Kit	SPEAG	D2450V2	737	Jan. 21, 2013	Annual
System Validation Kit	SPEAG	D5GHzV2	1018	Jan. 18, 2012	Annual
System Validation Kit	SPEAG	D5GHzV2	1019	Nov. 16, 2012	Annual
Dosimetric E-Field Probe	SPEAG	EX3DV4	3650	Oct. 26, 2011	Annual
Dosimetric E-Field Probe	SPEAG	EX3DV4	3650	Oct. 26, 2012	Annual
Dosimetric E-Field Probe	SPEAG	EX3DV4	3661	Jan. 15, 2013	Annual
Dosimetric E-Field Probe	SPEAG	EX3DV4	3820	Dec. 16, 2011	Annual
Dosimetric E-Field Probe	SPEAG	EX3DV4	3864	Jul. 19, 2012	Annual
Data Acquisition Electronics	SPEAG	DAE3	579	Apr. 27, 2012	Annual
Data Acquisition Electronics	SPEAG	DAE4	679	Jan. 16, 2013	Annual
Data Acquisition Electronics	SPEAG	DAE4	910	Dec. 07, 2011	Annual
Data Acquisition Electronics	SPEAG	DAE4	910	Dec. 05, 2012	Annual
Data Acquisition Electronics	SPEAG	DAE4	1277	Jul. 19, 2012	Annual
SAM Phantom	SPEAG	QD000P40CD	TP-1127	N/A	N/A
SAM Phantom	SPEAG	QD000P40CD	TP-1202	N/A	N/A
SAM Phantom	SPEAG	QD000P40CD	TP-1485	N/A	N/A
ELI Phantom	SPEAG	QDOVA001B	TP-1039	N/A	N/A
ELI Phantom	SPEAG	QDOVA001B	TP-1043	N/A	N/A
ENA Series Network Analyzer	Agilent	E5071C	MY46214281	May 14, 2012	Annual
MXG Analog Signal Generator	Agilent	N5181A	MY50143868	May 06, 2012	Annual
Power Meter	Anritsu	ML2495A	1218009	May 07, 2012	Annual
Power Sensor	Anritsu	MA2411B	1207252	May 07, 2012	Annual
EXA Spectrum Analyzer	Agilent	N9010A	MY52100136	Apr. 23, 2012	Annual
Dielectric Probe Kit	Agilent	85070D	E2-020018	May 14, 2012	Annual
Thermometer	YFE	YF-160A	110600361	Feb. 20, 2013	Annual
Directional Coupler	Woken	0110A05602O-10	11122702	Apr. 19, 2012	Annual
Power Amplifier	AR	5S1G4	0339656	Apr. 23, 2012	Annual
Power Amplifier	Mini-Circuit	ZVE-8G	001000422	Apr. 23, 2012	Annual
Attenuator	Woken	00800A1G01L-03	N/A	Apr. 19, 2012	Annual

6. Measurement Uncertainty

Error Description	Uncertainty Value (±%)	Probability Distribution	Divisor	Ci (1g)	Standard Uncertainty (1g)	Vi
Measurement System						
Probe Calibration	6.0	Normal	1	1	± 6.0 %	∞
Axial Isotropy	4.7	Rectangular	√3	0.7	± 1.9 %	∞
Hemispherical Isotropy	9.6	Rectangular	√3	0.7	± 3.9 %	∞
Boundary Effects	1.0	Rectangular	√3	1	± 0.6 %	∞
Linearity	4.7	Rectangular	√3	1	± 2.7 %	∞
System Detection Limits	1.0	Rectangular	√3	1	± 0.6 %	∞
Readout Electronics	0.6	Normal	1	1	± 0.6 %	∞
Response Time	0.0	Rectangular	√3	1	± 0.0 %	∞
Integration Time	1.7	Rectangular	√3	1	± 1.0 %	∞
RF Ambient Noise	3.0	Rectangular	√3	1	± 1.7 %	∞
RF Ambient Reflections	3.0	Rectangular	√3	1	± 1.7 %	∞
Probe Positioner	0.5	Rectangular	√3	1	± 0.3 %	∞
Probe Positioning	2.9	Rectangular	√3	1	± 1.7 %	∞
Max. SAR Eval.	2.3	Rectangular	√3	1	± 1.3 %	∞
Test Sample Related						
Device Positioning	3.9	Normal	1	1	± 3.9 %	31
Device Holder	2.7	Normal	1	1	± 2.7 %	19
Power Drift	5.0	Rectangular	√3	1	± 2.9 %	∞
Phantom and Setup						
Phantom Uncertainty	4.0	Rectangular	√3	1	± 2.3 %	∞
Liquid Conductivity (Target)	5.0	Rectangular	√3	0.64	± 1.8 %	∞
Liquid Conductivity (Meas.)	5.0	Normal	1	0.64	± 3.2 %	29
Liquid Permittivity (Target)	5.0	Rectangular	√3	0.6	± 1.7 %	∞
Liquid Permittivity (Meas.)	5.0	Normal	1	0.6	± 3.0 %	29
Combined Standard Uncertainty					± 11.7 %	
Expanded Uncertainty (K=2)					**± 23.4 %**	

Uncertainty budget for frequency range 300 MHz to 3 GHz

Error Description	Uncertainty Value (±%)	Probability Distribution	Divisor	Ci (1g)	Standard Uncertainty (1g)	Vi
Measurement System						
Probe Calibration	6.55	Normal	1	1	± 6.55 %	∞
Axial Isotropy	4.7	Rectangular	√3	0.7	± 1.9 %	∞
Hemispherical Isotropy	9.6	Rectangular	√3	0.7	± 3.9 %	∞
Boundary Effects	2.0	Rectangular	√3	1	± 1.2 %	∞
Linearity	4.7	Rectangular	√3	1	± 2.7 %	∞
System Detection Limits	1.0	Rectangular	√3	1	± 0.6 %	∞
Readout Electronics	0.3	Normal	1	1	± 0.3 %	∞
Response Time	0.8	Rectangular	√3	1	± 0.5 %	∞
Integration Time	2.6	Rectangular	√3	1	± 1.5 %	∞
RF Ambient Noise	3.0	Rectangular	√3	1	± 1.7 %	∞
RF Ambient Reflections	3.0	Rectangular	√3	1	± 1.7 %	∞
Probe Positioner	0.8	Rectangular	√3	1	± 0.5 %	∞
Probe Positioning	9.9	Rectangular	√3	1	± 5.7 %	∞
Max. SAR Eval.	4.0	Rectangular	√3	1	± 2.3 %	∞
Test Sample Related						
Device Positioning	3.9	Normal	1	1	± 3.9 %	31
Device Holder	2.7	Normal	1	1	± 2.7 %	19
Power Drift	5.0	Rectangular	√3	1	± 2.9 %	∞
Phantom and Setup						
Phantom Uncertainty	4.0	Rectangular	√3	1	± 2.3 %	∞
Liquid Conductivity (Target)	5.0	Rectangular	√3	0.64	± 1.8 %	∞
Liquid Conductivity (Meas.)	5.0	Normal	1	0.64	± 3.2 %	30
Liquid Permittivity (Target)	5.0	Rectangular	√3	0.6	± 1.7 %	∞
Liquid Permittivity (Meas.)	5.0	Normal	1	0.6	± 3.0 %	30
Combined Standard Uncertainty					± 13.4 %	
Expanded Uncertainty (K=2)					**± 26.8 %**	

Uncertainty budget for frequency range 3 GHz to 6 GHz

7. Information on the Testing Laboratories

We, Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch, were founded in 1988 to provide our best service in EMC, Radio, Telecom and Safety consultation. Our laboratories are accredited and approved according to ISO/IEC 17025.

If you have any comments, please feel free to contact us at the following:

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The road map of all our labs can be found in our web site also.

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Appendix A. SAR Plots of System Verification

The plots for system verification are shown as follows.

System Check_B2450_120711

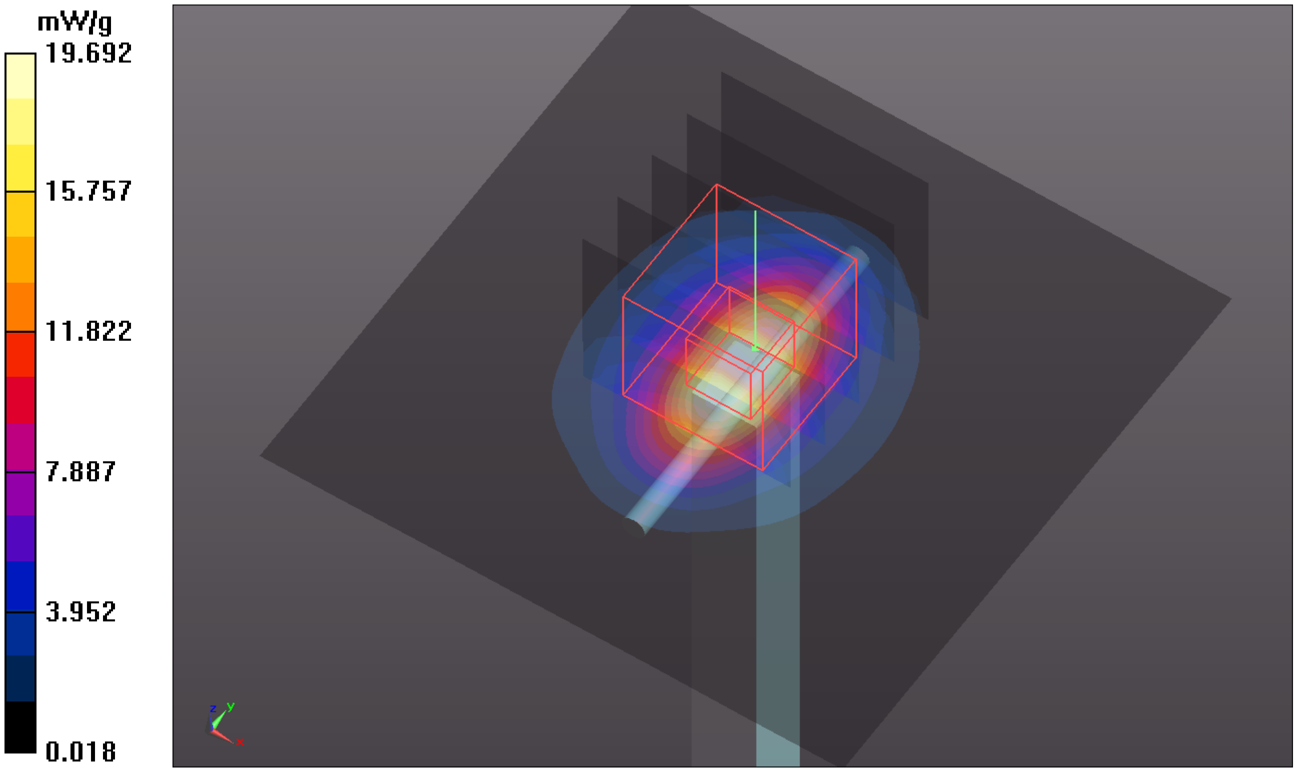
DUT: Dipole 2450 MHz; Type: D2450V2; SN: 737

Communication System: CW; Frequency: 2450 MHz;Duty Cycle: 1:1
Medium: B2450_0711 Medium parameters used: f = 2450 MHz; σ = 2.022 mho/m; ε_r = 53.095; ρ = 1000 kg/m^3
Ambient Temperature：21.9 ℃; Liquid Temperature：20.8 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3650; ConvF(6.89, 6.89, 6.89); Calibrated: 2011/10/26;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn910; Calibrated: 2011/12/07
- Phantom: ELI v4.0; Type: QDOVA001BA; Serial: TP:1043
- Measurement SW: DASY52, Version 52.8 (1); SEMCAD X Version 14.6.5 (6469)

Pin=250mW/Area Scan (61x61x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 19.7 mW/g

Pin=250mW/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 98.490 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 26.069 mW/g
SAR(1 g) = 12.6 mW/g; SAR(10 g) = 5.84 mW/g
Maximum value of SAR (measured) = 18.7 mW/g



System Check_B5200_120711

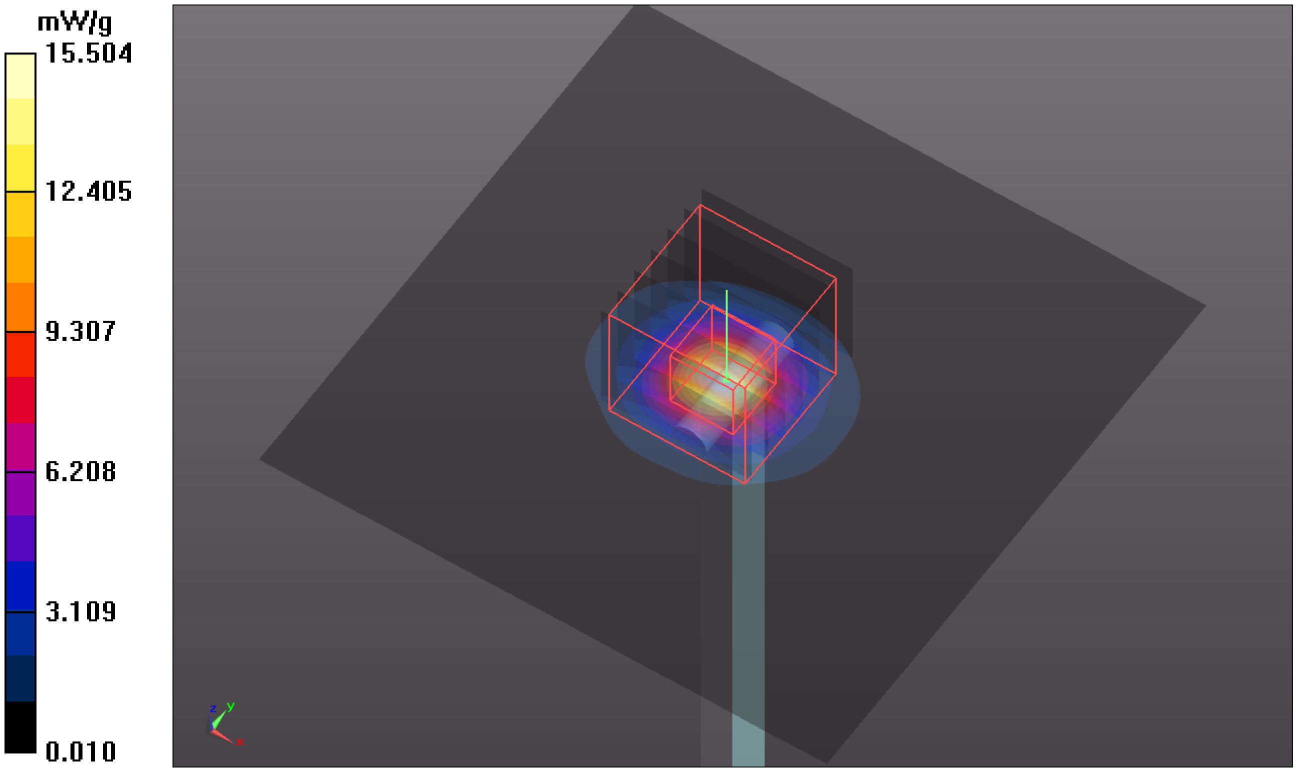
DUT: Dipole 5 GHz; Type: D5GHzV2; SN: 1018

Communication System: CW; Frequency: 5200 MHz;Duty Cycle: 1:1
Medium: B5G_0711 Medium parameters used: f = 5200 MHz; σ = 5.243 mho/m; ε_r = 49.431; ρ = 1000 kg/m^3
Ambient Temperature：21.5 ℃; Liquid Temperature：20.4 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3650; ConvF(4.28, 4.28, 4.28); Calibrated: 2011/10/26;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn910; Calibrated: 2011/12/07
- Phantom: ELI v4.0; Type: QDOVA001BA; Serial: TP:1043
- Measurement SW: DASY52, Version 52.8 (1); SEMCAD X Version 14.6.5 (6469)

Pin=100mW, f=5200 MHz/Area Scan (91x91x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 15.5 mW/g

Pin=100mW, f=5200 MHz/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 59.332 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 28.319 mW/g
SAR(1 g) = 7.43 mW/g; SAR(10 g) = 2.08 mW/g
Maximum value of SAR (measured) = 15.5 mW/g



System Check_B5800_120711

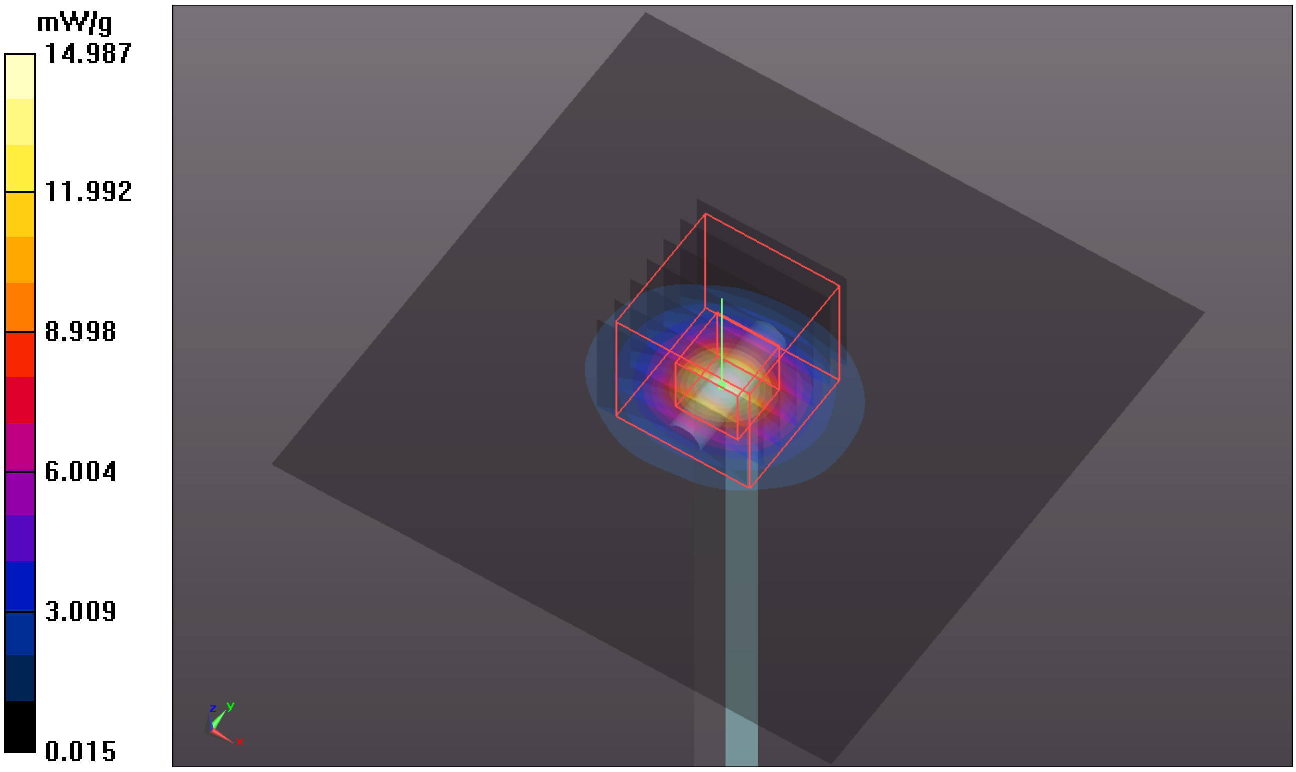
DUT: Dipole 5 GHz; Type: D5GHzV2; SN: 1018

Communication System: CW; Frequency: 5800 MHz;Duty Cycle: 1:1
Medium: B5G_0711 Medium parameters used: f = 5800 MHz; σ = 6.111 mho/m; ε_r = 48.187; ρ = 1000 kg/m^3
Ambient Temperature：21.7 ℃; Liquid Temperature：20.2 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3650; ConvF(3.81, 3.81, 3.81); Calibrated: 2011/10/26;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn910; Calibrated: 2011/12/07
- Phantom: ELI v4.0; Type: QDOVA001BA; Serial: TP:1043
- Measurement SW: DASY52, Version 52.8 (1); SEMCAD X Version 14.6.5 (6469)

Pin=100mW, f=5800 MHz/Area Scan (91x91x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 15.0 mW/g

Pin=100mW, f=5800 MHz/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 55.908 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 28.897 mW/g
SAR(1 g) = 7.15 mW/g; SAR(10 g) = 1.99 mW/g
Maximum value of SAR (measured) = 15.6 mW/g



Appendix B. SAR Plots of SAR Measurement

The SAR plots for highest measured SAR and measured SAR > 1.5 W/kg are shown as follows.

P01 802.11b_Left Side_0 cm_Ch6_ANT1_Holster1+Scanner2+Keypad1

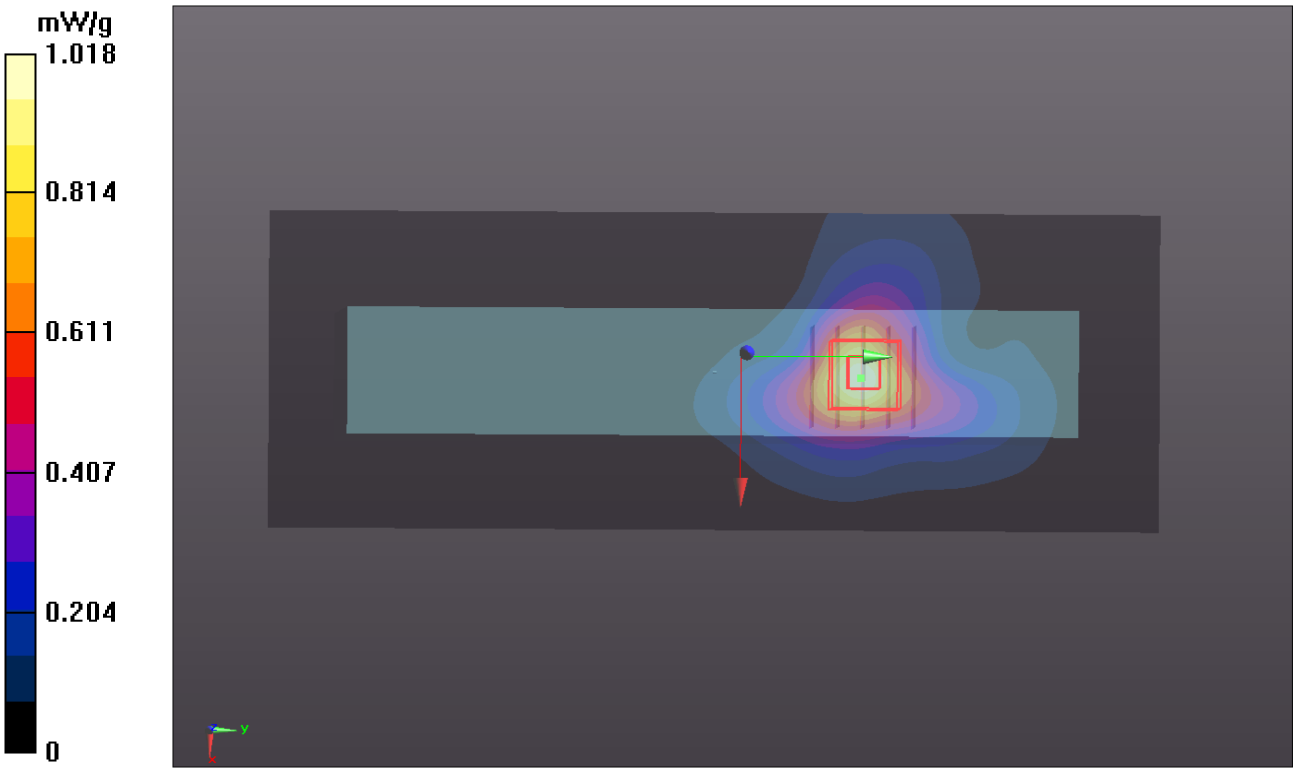
DUT: 120522E09

Communication System: WLAN_2.4G; Frequency: 2437 MHz;Duty Cycle: 1:1
Medium: B2450_0711 Medium parameters used: f = 2437 MHz; σ = 2.003 mho/m; ε_r = 53.145; ρ = 1000 kg/m^3
Ambient Temperature：21.9 ℃; Liquid Temperature：20.8 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3650; ConvF(6.89, 6.89, 6.89); Calibrated: 2011/10/26;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn910; Calibrated: 2011/12/07
- Phantom: ELI v4.0; Type: QDOVA001BA; Serial: TP:1043
- Measurement SW: DASY52, Version 52.8 (1); SEMCAD X Version 14.6.5 (6469)

Ch6/Area Scan (51x141x1): Measurement grid: dx=20mm, dy=20mm
Maximum value of SAR (interpolated) = 1.02 mW/g

Ch6/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 7.832 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 1.448 mW/g
SAR(1 g) = 0.774 mW/g; SAR(10 g) = 0.408 mW/g
Maximum value of SAR (measured) = 1.10 mW/g



P29 802.11a_Right Side_0 cm_Ch48_ANT0_Holster2+Scanner2+Keypad1 +Headset1+CR

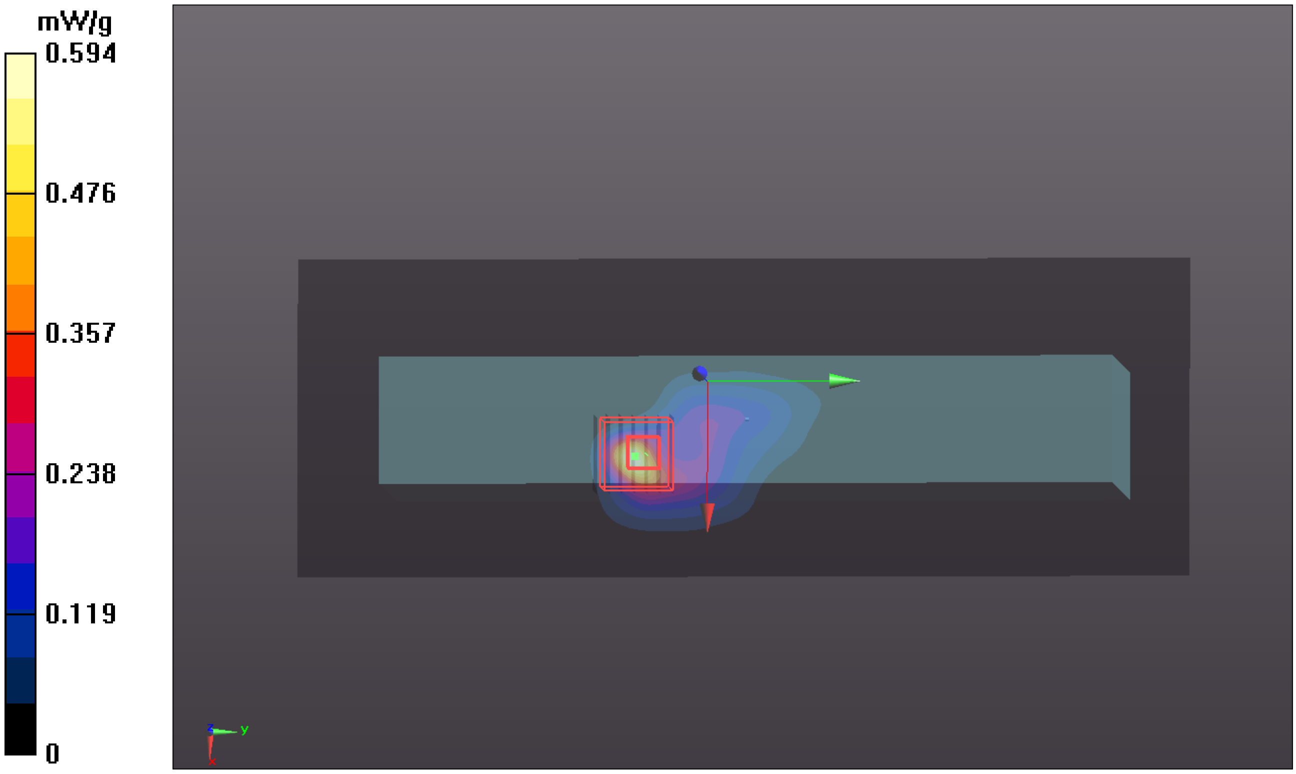
DUT: 120522E09

Communication System: WLAN_5G; Frequency: 5240 MHz;Duty Cycle: 1:1
Medium: B5G_0709 Medium parameters used: f = 5240 MHz; σ = 5.326 mho/m; ε_r = 49.306; ρ = 1000 kg/m^3
Ambient Temperature：22.0 ℃; Liquid Temperature：20.8 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3650; ConvF(4.28, 4.28, 4.28); Calibrated: 2011/10/26;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn910; Calibrated: 2011/12/07
- Phantom: ELI v4.0; Type: QDOVA001BA; Serial: TP:1043
- Measurement SW: DASY52, Version 52.8 (1); SEMCAD X Version 14.6.5 (6469)

Ch48/Area Scan (101x281x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 0.594 mW/g

Ch48/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 5.888 V/m; Power Drift = -0.15 dB
Peak SAR (extrapolated) = 2.489 mW/g
SAR(1 g) = 0.625 mW/g; SAR(10 g) = 0.134 mW/g
Maximum value of SAR (measured) = 1.37 mW/g



P* 802.11a_Left Side_0 cm_Ch52_ANT1_Holster2+Scanner1+Keypad1+Headset1

DUT: 120522E09

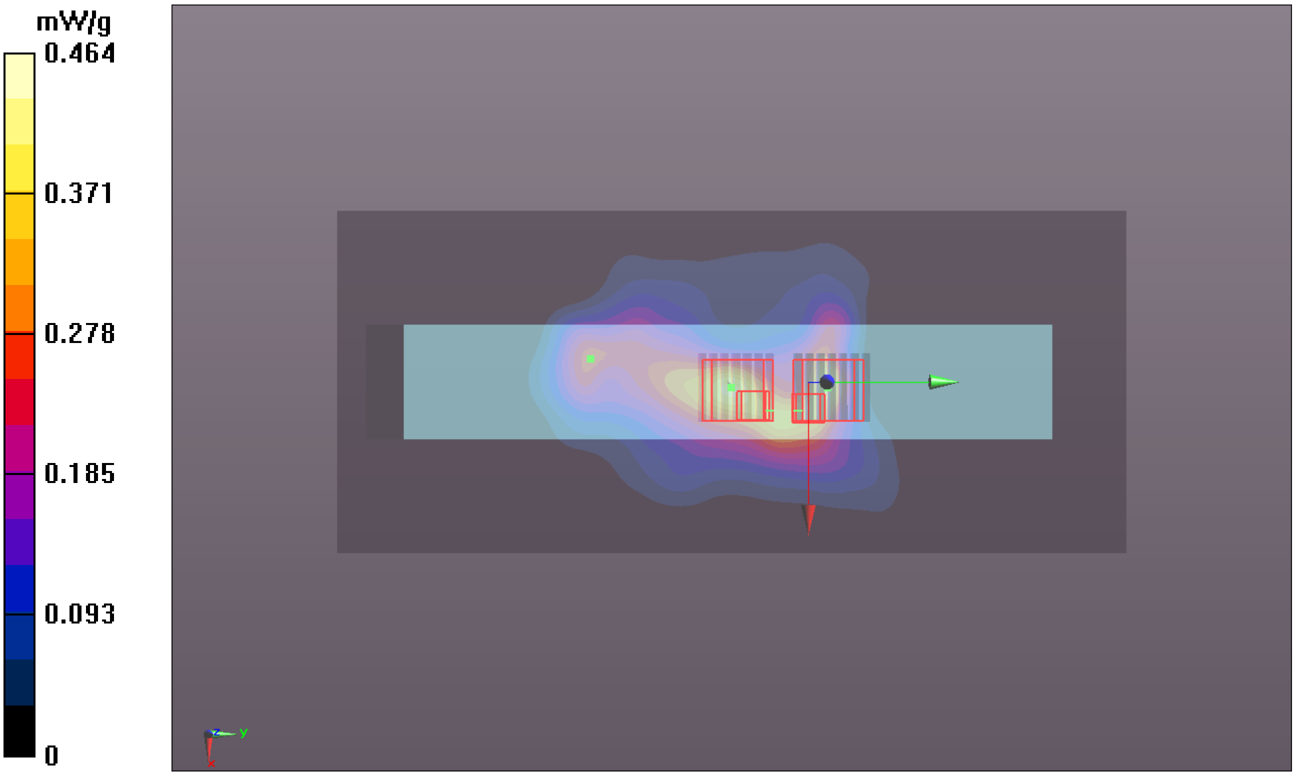
Communication System: WLAN_5G; Frequency: 5260 MHz;Duty Cycle: 1:1
Medium: B5G_0629 Medium parameters used: f = 5260 MHz; σ = 5.383 mho/m; ε_r = 49.236; ρ = 1000 kg/m^3
Ambient Temperature：22.0 ℃; Liquid Temperature：21.1 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3650; ConvF(4.11, 4.11, 4.11); Calibrated: 2011/10/26;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1277; Calibrated: 2011/07/29
- Phantom: ELI v4.0; Type: QDOVA001BA; Serial: TP:1043
- Measurement SW: DASY52, Version 52.8 (1); SEMCAD X Version 14.6.5 (6469)

Ch52/Area Scan (121x281x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 0.414 mW/g

Ch52/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 9.479 V/m; Power Drift = -0.08 dB
Peak SAR (extrapolated) = 3.934 mW/g
SAR(1 g) = 0.678 mW/g; SAR(10 g) = 0.151 mW/g
Maximum value of SAR (measured) = 2.19 mW/g

Ch52/Zoom Scan (7x7x9)/Cube 1: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 9.479 V/m; Power Drift = -0.08 dB
Peak SAR (extrapolated) = 0.757 mW/g
SAR(1 g) = 0.169 mW/g; SAR(10 g) = 0.061 mW/g
Maximum value of SAR (measured) = 0.464 mW/g



Test Laboratory: Bureau Veritas ADT SAR/HAC Testing Lab   Date: 2013/02/22

P74 802.11a_Left Side_0 cm_Ch104_ANT1_Holster2+Scanner1+Keypad3+Headset1

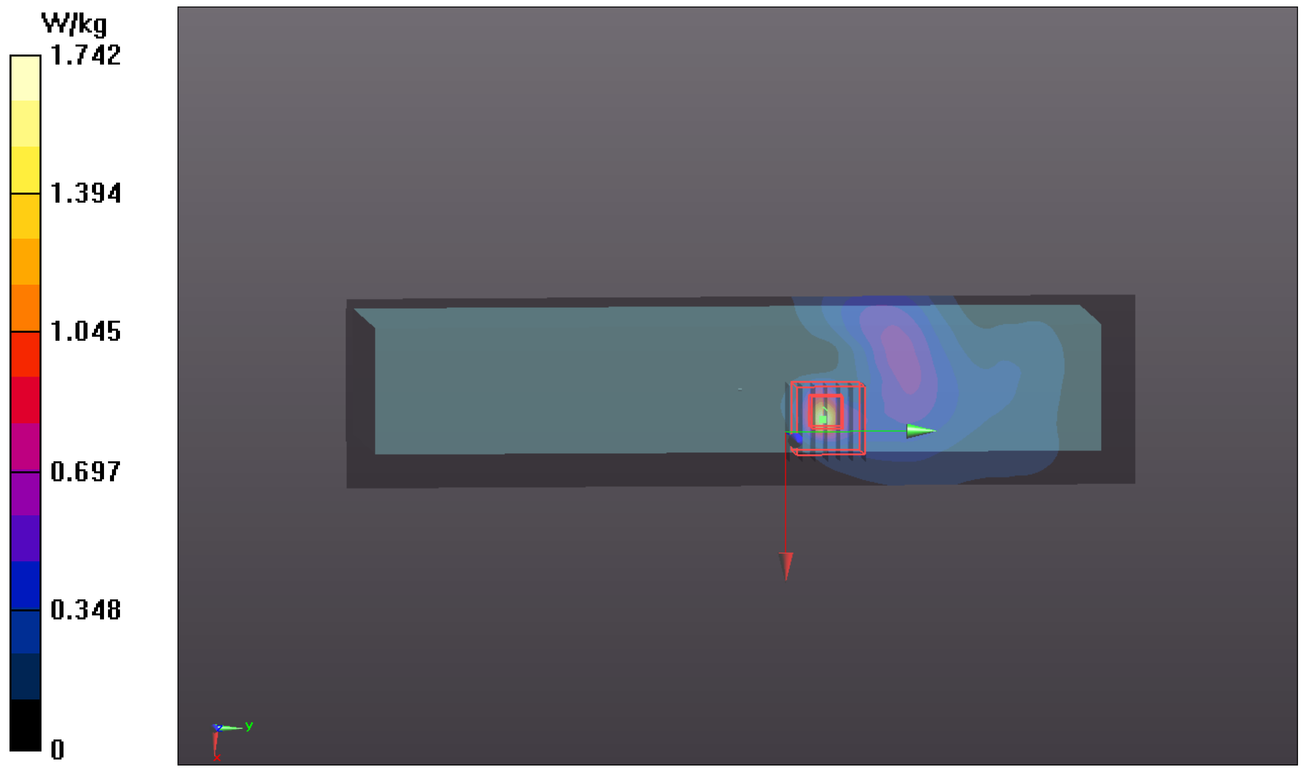
DUT: 120522E09

Communication System: WLAN_5G; Frequency: 5520 MHz;Duty Cycle: 1:1
Medium: B5G_0222 Medium parameters used: f = 5520 MHz; σ = 5.778 S/m; ε_r = 46.861; ρ = 1000 kg/m^3
Ambient Temperature：21.3 ℃; Liquid Temperature：20.3 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3661; ConvF(4.16, 4.16, 4.16); Calibrated: 2013/01/15;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn679; Calibrated: 2013/01/16
- Phantom: ELI v4.0; Type: QDOVA001BA; Serial: TP:1043
- Measurement SW: DASY52, Version 52.8 (4); SEMCAD X Version 14.6.8 (7028)

Ch104/Area Scan (61x251x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 1.74 W/kg

Ch104/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 2.623 V/m; Power Drift = -0.19 dB
Peak SAR (extrapolated) = 3.73 W/kg
SAR(1 g) = 0.793 W/kg; SAR(10 g) = 0.174 W/kg
Maximum value of SAR (measured) = 1.84 W/kg



P93 802.11a_Left Side_0 cm_Ch165_ANT1_Holster2+Scanner1+Keypad4 +Headset2+CR

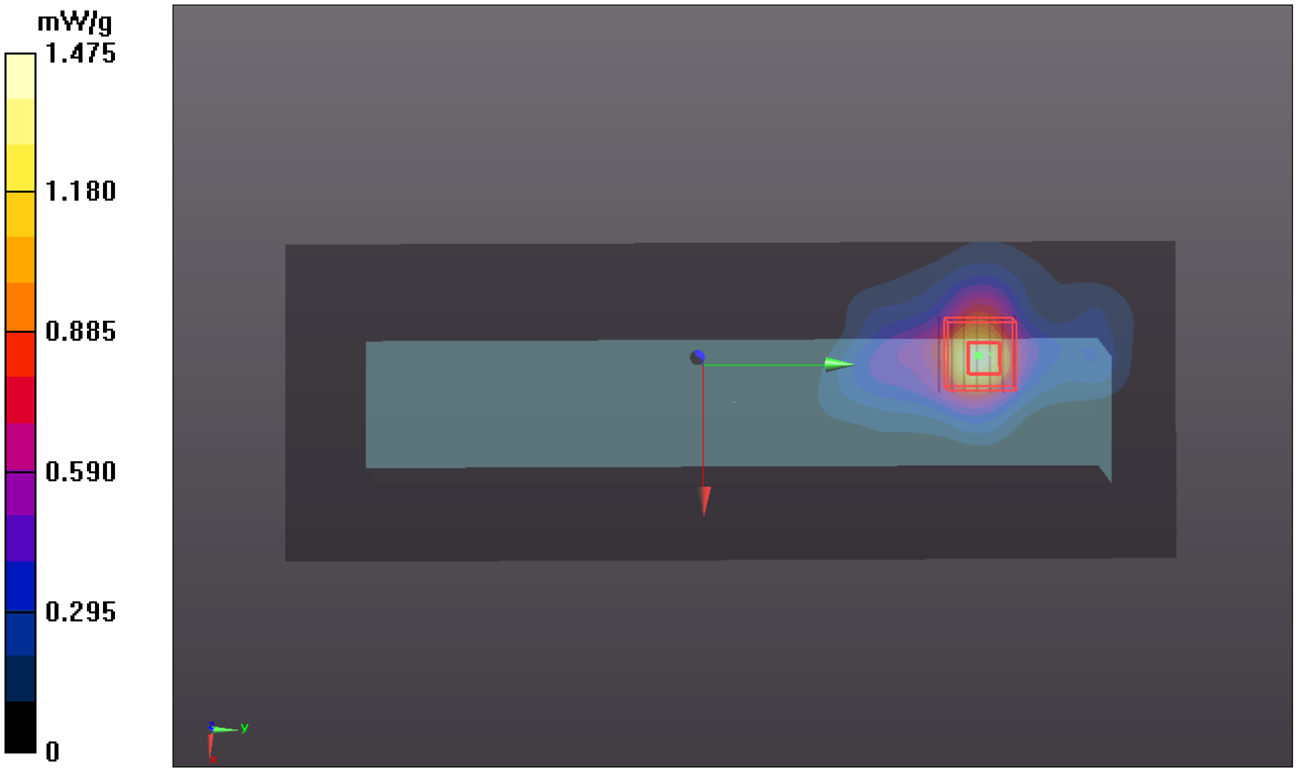
DUT: 120522E09

Communication System: WLAN_5G; Frequency: 5825 MHz;Duty Cycle: 1:1
Medium: B5G_0711 Medium parameters used: f = 5825 MHz; σ = 6.187 mho/m; ε_r = 48.265; ρ = 1000 kg/m^3
Ambient Temperature：21.5 ℃; Liquid Temperature：20.4 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3650; ConvF(3.81, 3.81, 3.81); Calibrated: 2011/10/26;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn910; Calibrated: 2011/12/07
- Phantom: ELI v4.0; Type: QDOVA001BA; Serial: TP:1043
- Measurement SW: DASY52, Version 52.8 (1); SEMCAD X Version 14.6.5 (6469)

Ch165/Area Scan (101x281x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 1.48 mW/g

Ch165/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 2.364 V/m; Power Drift = 0.15 dB
Peak SAR (extrapolated) = 2.482 mW/g
SAR(1 g) = 0.723 mW/g; SAR(10 g) = 0.281 mW/g
Maximum value of SAR (measured) = 1.34 mW/g



Appendix C. Calibration Certificate for Probe and Dipole

The SPEAG calibration certificates are shown as follows.

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

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

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

Accreditation No.: SCS 108

Client **B.V.ADT (Auden)**

Certificate No: D2450V2-737_Jan12

CALIBRATION CERTIFICATE

Object	D2450V2 - SN: 737
Calibration procedure(s)	QA CAL-05.v8 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	January 24, 2012

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	05-Oct-11 (No. 217-01451)	Oct-12
Power sensor HP 8481A	US37292783	05-Oct-11 (No. 217-01451)	Oct-12
Reference 20 dB Attenuator	SN: 5086 (20g)	29-Mar-11 (No. 217-01368)	Apr-12
Type-N mismatch combination	SN: 5047.2 / 06327	29-Mar-11 (No. 217-01371)	Apr-12
Reference Probe ES3DV3	SN: 3205	30-Dec-11 (No. ES3-3205_Dec11)	Dec-12
DAE4	SN: 601	04-Jul-11 (No. DAE4-601_Jul11)	Jul-12

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-11)	In house check: Oct-12

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

Issued: January 24, 2012

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

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.0
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	39.2 ± 6 %	1.85 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	13.4 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**52.9 mW /g ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.18 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**24.5 mW /g ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	50.6 ± 6 %	2.01 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	12.8 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**50.0 mW / g ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.91 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**23.3 mW / g ± 16.5 % (k=2)**

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	54.3 Ω + 4.3 jΩ
Return Loss	- 24.7 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	50.6 Ω + 5.3 jΩ
Return Loss	- 25.6 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.161 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	August 26, 2003

DASY5 Validation Report for Head TSL

Date: 24.01.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 737

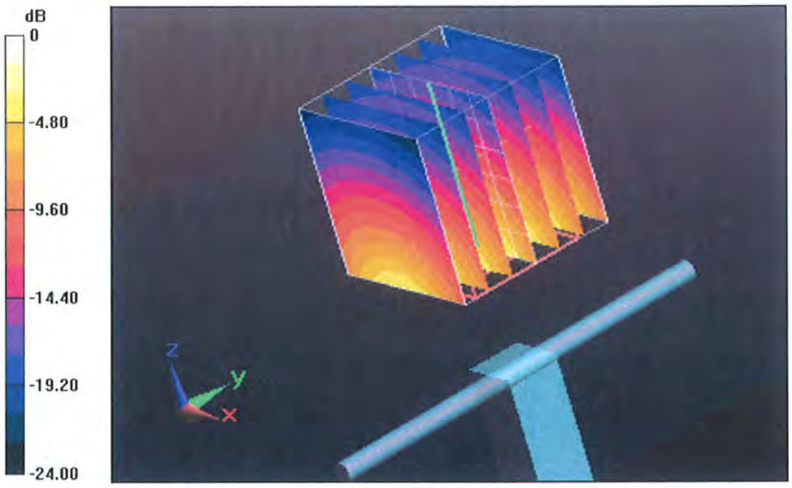
Communication System: CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; $\sigma = 1.85$ mho/m; $\varepsilon_r = 39.2$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.45, 4.45, 4.45); Calibrated: 30.12.2011
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.0(692); SEMCAD X 14.6.4(4989)

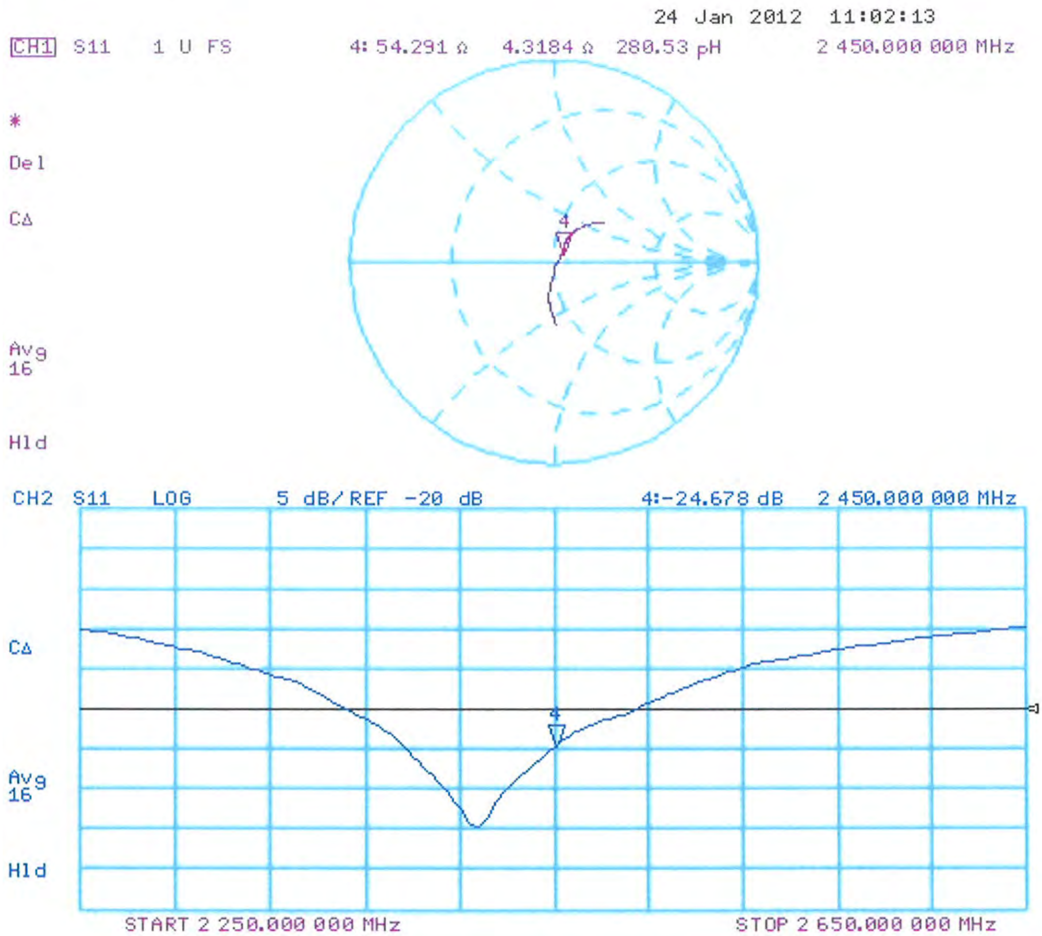
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 99.933 V/m; Power Drift = 0.08 dB
Peak SAR (extrapolated) = 27.6400
SAR(1 g) = 13.4 mW/g; SAR(10 g) = 6.18 mW/g
Maximum value of SAR (measured) = 17.183 mW/g



0 dB = 17.180mW/g = 24.70 dB mW/g

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 23.01.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 737

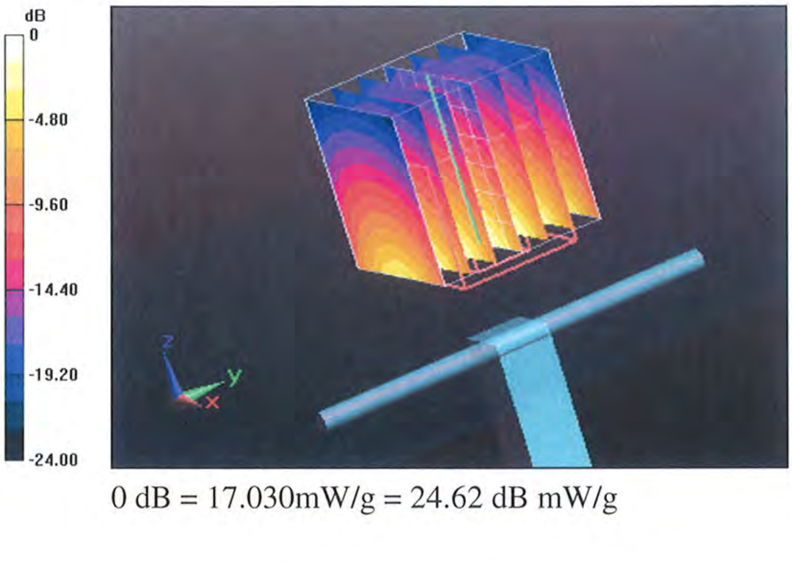
Communication System: CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; $\sigma = 2.01$ mho/m; $\varepsilon_r = 50.6$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.26, 4.26, 4.26); Calibrated: 30.12.2011
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.0(692); SEMCAD X 14.6.4(4989)

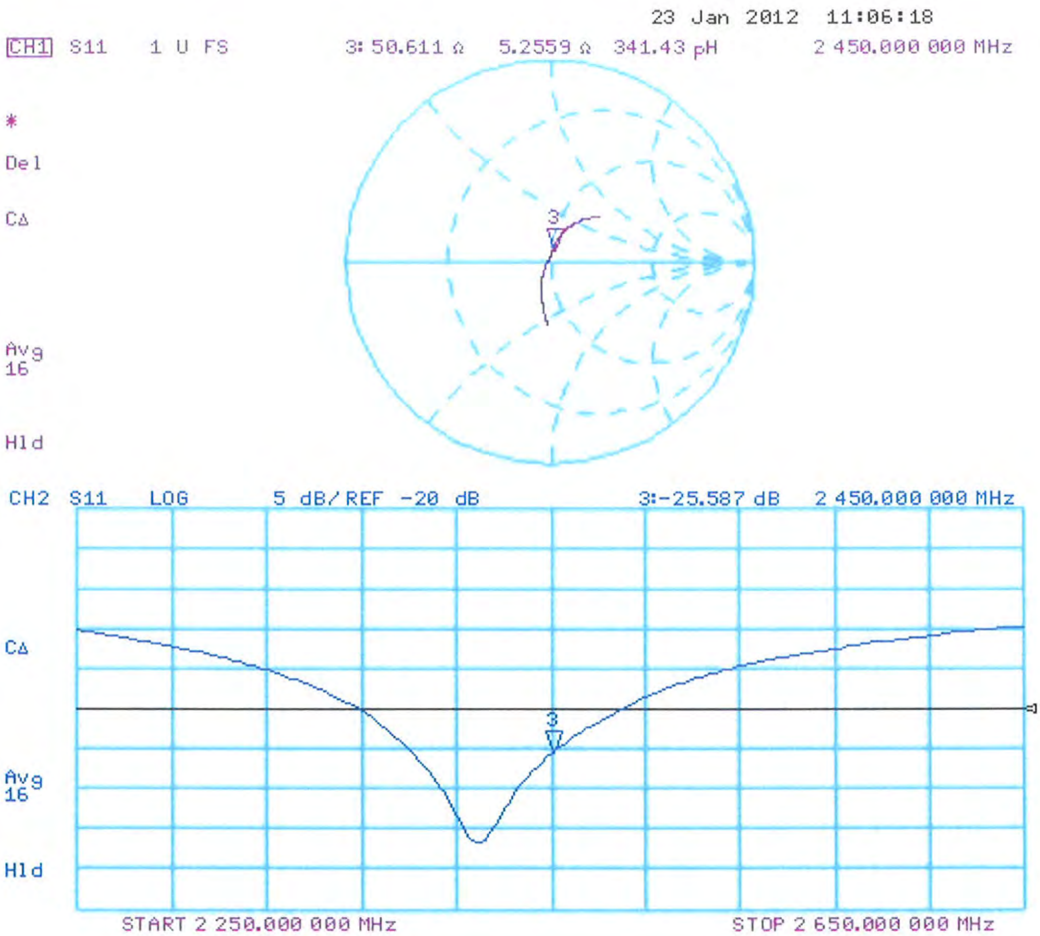
Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 94.889 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 26.6520
SAR(1 g) = 12.8 mW/g; SAR(10 g) = 5.91 mW/g
Maximum value of SAR (measured) = 17.026 mW/g



0 dB = 17.030mW/g = 24.62 dB mW/g

Impedance Measurement Plot for Body TSL



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**
Swiss Calibration Service

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

Accreditation No.: SCS 108

Client **B.V. ADT (Auden)**

Certificate No: D2450V2-737_Jan13

CALIBRATION CERTIFICATE

Object	D2450V2 - SN: 737
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	January 21, 2013

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	01-Nov-12 (No. 217-01640)	Oct-13
Power sensor HP 8481A	US37292783	01-Nov-12 (No. 217-01640)	Oct-13
Reference 20 dB Attenuator	SN: 5058 (20k)	27-Mar-12 (No. 217-01530)	Apr-13
Type-N mismatch combination	SN: 5047.3 / 06327	27-Mar-12 (No. 217-01533)	Apr-13
Reference Probe ES3DV3	SN: 3205	28-Dec-12 (No. ES3-3205_Dec12)	Dec-13
DAE4	SN: 601	27-Jun-12 (No. DAE4-601_Jun12)	Jun-13

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

	Name	Function	Signature
Calibrated by:	Leif Klysner	Laboratory Technician	Leif Klysner
Approved by:	Fin Bomholt	Deputy Technical Manager	F. Bomholt

Issued: January 21, 2013

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.5
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	37.9 ± 6 %	1.85 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	13.4 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**52.5 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.17 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**24.4 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	50.5 ± 6 %	2.01 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	12.7 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**49.6 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.86 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**23.1 W/kg ± 16.5 % (k=2)**

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.4 Ω + 3.7 jΩ
Return Loss	- 26.3 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	50.1 Ω + 5.3 jΩ
Return Loss	- 25.5 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.161 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	August 26, 2003

DASY5 Validation Report for Head TSL

Date: 21.01.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 737

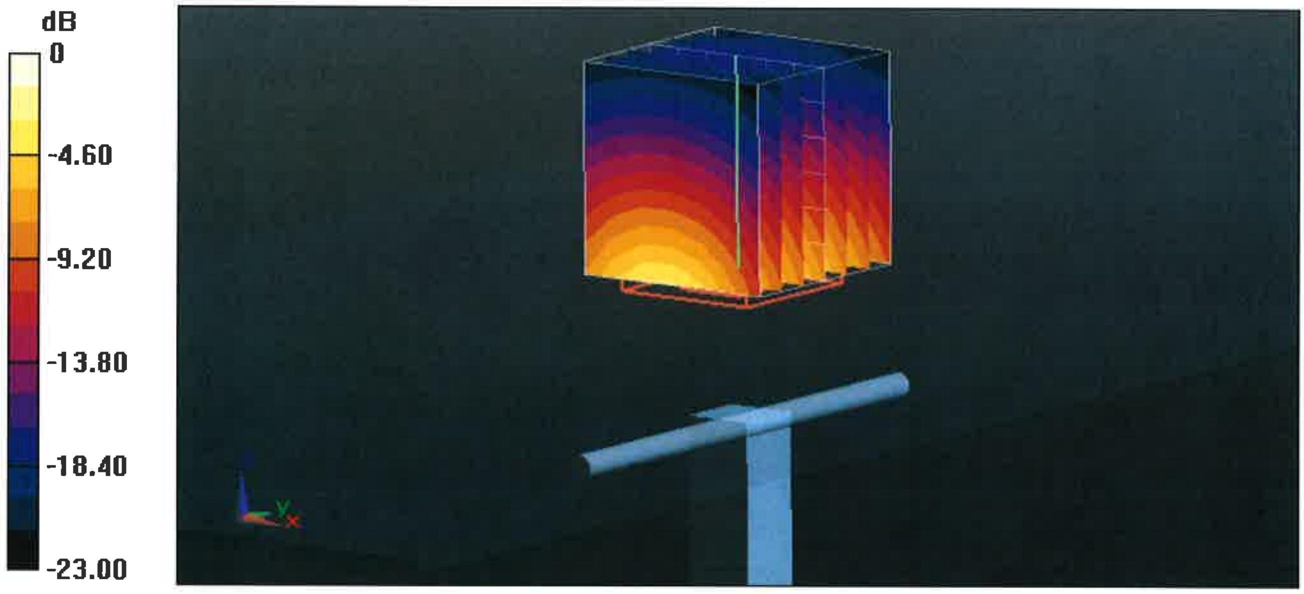
Communication System: CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; $\sigma = 1.85$ S/m; $\varepsilon_r = 37.9$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.52, 4.52, 4.52); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

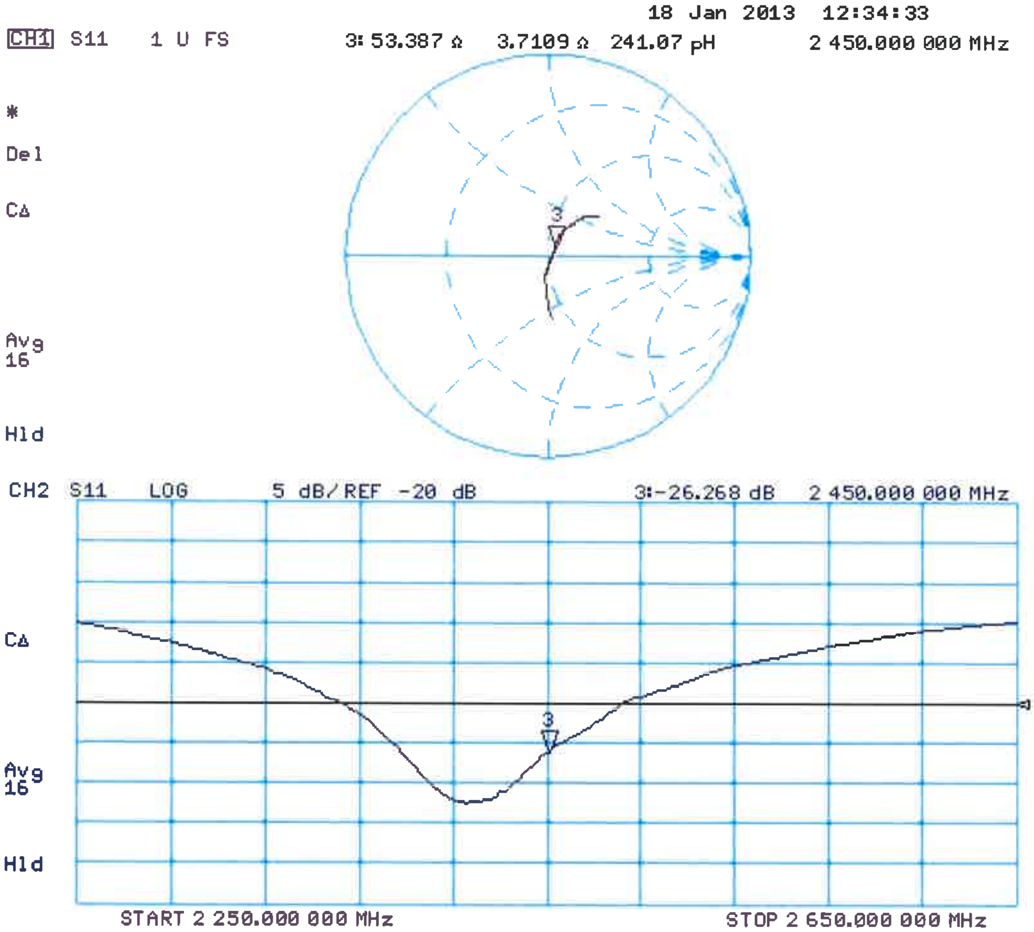
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 99.892 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 28.0 W/kg
SAR(1 g) = 13.4 W/kg; SAR(10 g) = 6.17 W/kg
Maximum value of SAR (measured) = 17.2 W/kg



0 dB = 17.2 W/kg = 12.36 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 18.01.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 737

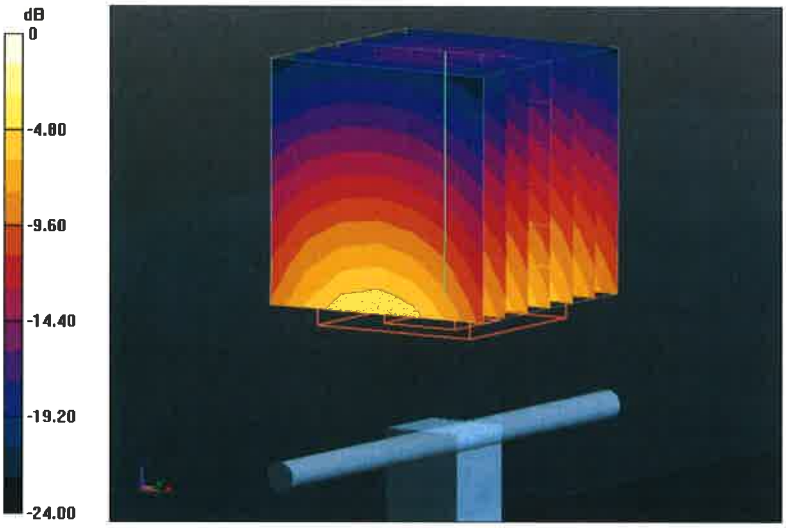
Communication System: CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 2.01 S/m; ε_r = 50.5; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.42, 4.42, 4.42); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

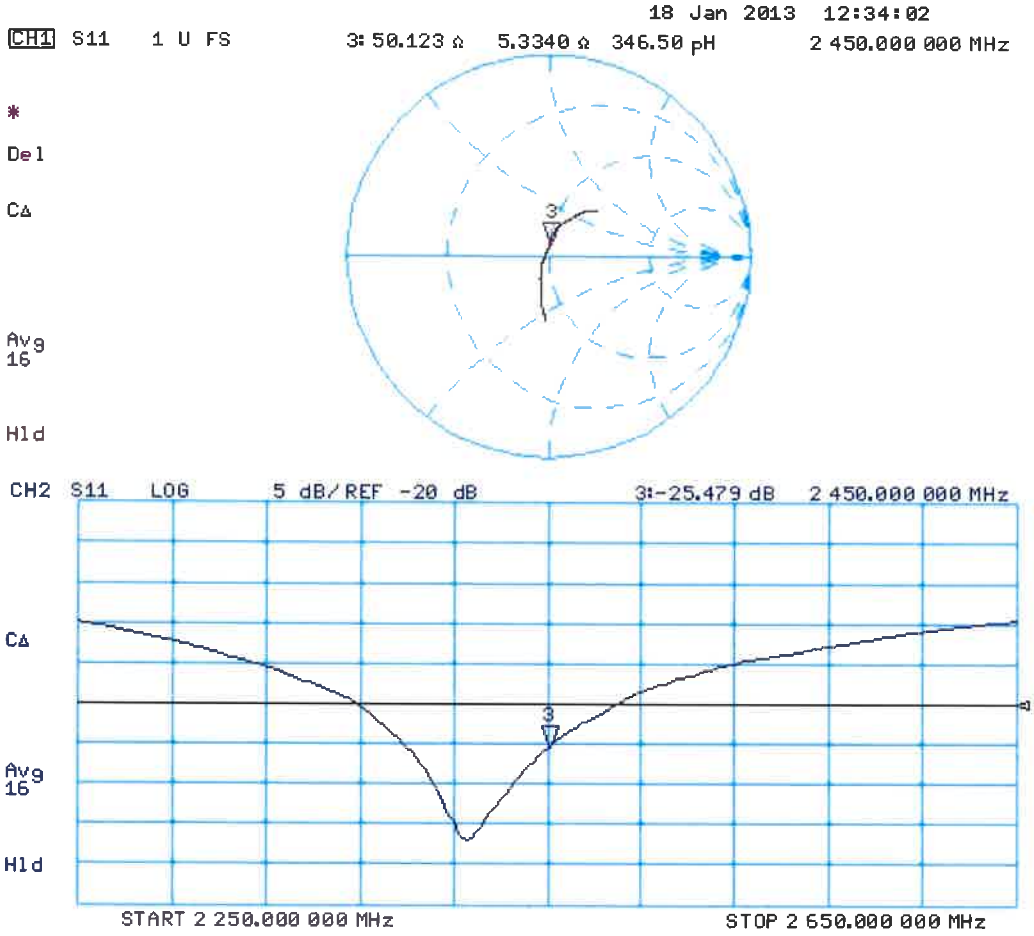
Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 94.076 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 26.9 W/kg
SAR(1 g) = 12.7 W/kg; SAR(10 g) = 5.86 W/kg
Maximum value of SAR (measured) = 16.8 W/kg



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

Impedance Measurement Plot for Body TSL



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

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Servizio svizzero di taratura
S Swiss Calibration Service

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

Accreditation No.: SCS 108

Client **B.V.ADT (Auden)**

Certificate No: D5GHzV2-1018_Jan12

CALIBRATION CERTIFICATE

Object	D5GHzV2 - SN: 1018
Calibration procedure(s)	QA CAL-22.v1 Calibration procedure for dipole validation kits between 3-6 GHz
Calibration date:	January 18, 2012

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	05-Oct-11 (No. 217-01451)	Oct-12
Power sensor HP 8481A	US37292783	05-Oct-11 (No. 217-01451)	Oct-12
Reference 20 dB Attenuator	SN: 5086 (20g)	29-Mar-11 (No. 217-01368)	Apr-12
Type-N mismatch combination	SN: 5047.2 / 06327	29-Mar-11 (No. 217-01371)	Apr-12
Reference Probe EX3DV4	SN: 3503	30-Dec-11 (No. EX3-3503_Dec11)	Dec-12
DAE4	SN: 601	04-Jul-11 (No. DAE4-601_Jul11)	Jul-12

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-11)	In house check: Oct-12

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

Issued: January 18, 2012

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.0
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 5500 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	36.3 ± 6 %	4.60 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5200 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.95 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**79.6 mW /g ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.27 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**22.7 mW /g ± 16.5 % (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	35.8 ± 6 %	4.90 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	8.47 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**84.7 mW / g ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.41 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**24.1 mW / g ± 16.5 % (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	35.3 ± 6 %	5.22 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	7.86 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**78.6 mW / g ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.23 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**22.3 mW / g ± 16.5 % (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	49.2 ± 6 %	5.46 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	7.26 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**72.7 mW / g ± 18.1 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.04 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**20.5 mW / g ± 17.6 % (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	48.7 ± 6 %	5.86 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	7.82 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**78.3 mW / g ± 18.1 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.18 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**21.8 mW / g ± 17.6 % (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	48.2 ± 6 %	6.28 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	7.33 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**73.4 mW / g ± 18.1 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.03 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**20.3 mW / g ± 17.6 % (k=2)**

Appendix

Antenna Parameters with Head TSL at 5200 MHz

Impedance, transformed to feed point	53.1 Ω - 9.5 jΩ
Return Loss	- 20.3 dB

Antenna Parameters with Head TSL at 5500 MHz

Impedance, transformed to feed point	50.7 Ω - 3.8 jΩ
Return Loss	- 28.4 dB

Antenna Parameters with Head TSL at 5800 MHz

Impedance, transformed to feed point	56.4 Ω + 1.4 jΩ
Return Loss	- 24.3 dB

Antenna Parameters with Body TSL at 5200 MHz

Impedance, transformed to feed point	52.3 Ω - 8.4 jΩ
Return Loss	- 21.4 dB

Antenna Parameters with Body TSL at 5500 MHz

Impedance, transformed to feed point	49.2 Ω + 0.0 jΩ
Return Loss	- 42.3 dB

Antenna Parameters with Body TSL at 5800 MHz

Impedance, transformed to feed point	54.4 Ω - 6.9 jΩ
Return Loss	- 22.1 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.106 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	February 05, 2004

DASY5 Validation Report for Head TSL

Date: 17.01.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1018

Communication System: CW; Frequency: 5200 MHz, Frequency: 5500 MHz, Frequency: 5800 MHz
Medium parameters used: f = 5200 MHz; σ = 4.6 mho/m; ε_r = 36.3; ρ = 1000 kg/m^3 , Medium parameters used: f = 5500 MHz; σ = 4.9 mho/m; ε_r = 35.8; ρ = 1000 kg/m^3 , Medium parameters used: f = 5800 MHz; σ = 5.22 mho/m; ε_r = 35.3; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

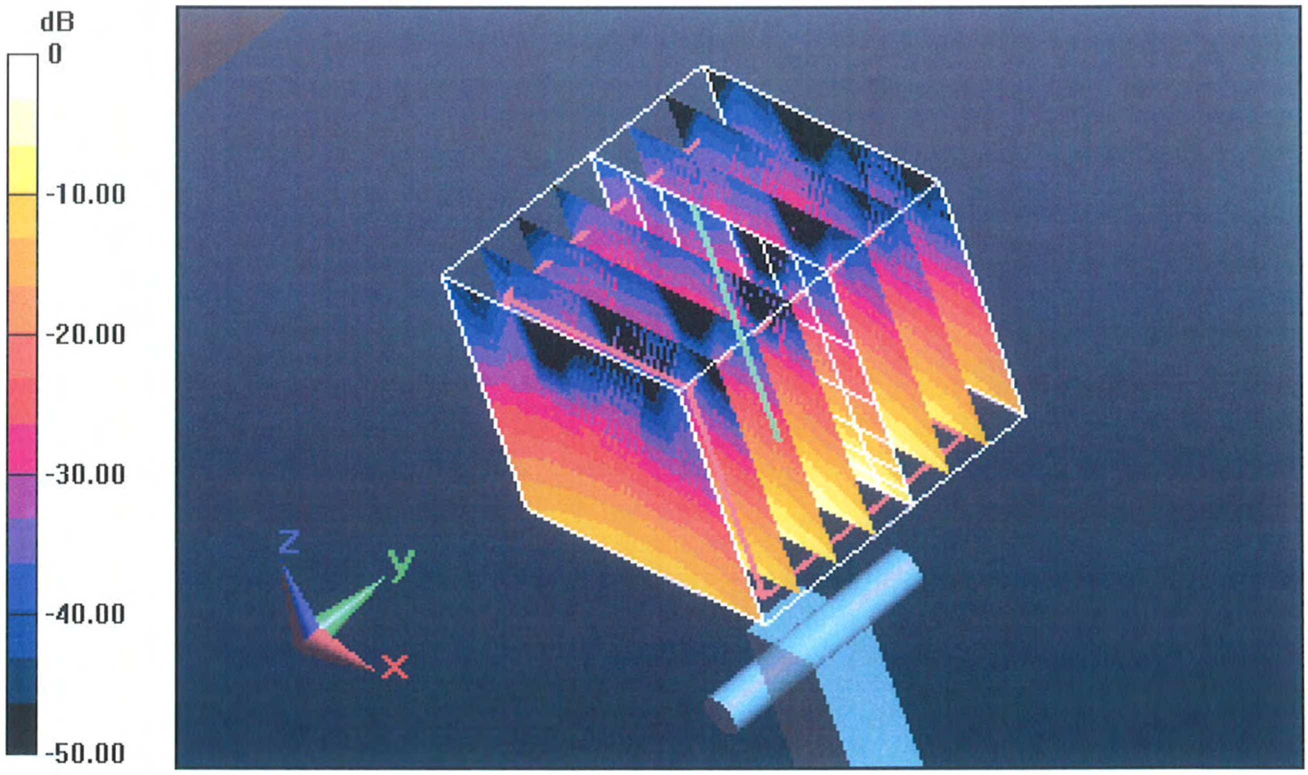
DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.41, 5.41, 5.41), ConvF(4.91, 4.91, 4.91), ConvF(4.81, 4.81, 4.81); Calibrated: 30.12.2011
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.0(692); SEMCAD X 14.6.4(4989)

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 = 63.604 V/m; Power Drift = 0.09 dB
Peak SAR (extrapolated) = 29.6500
SAR(1 g) = 7.95 mW/g; SAR(10 g) = 2.27 mW/g
Maximum value of SAR (measured) = 18.292 mW/g

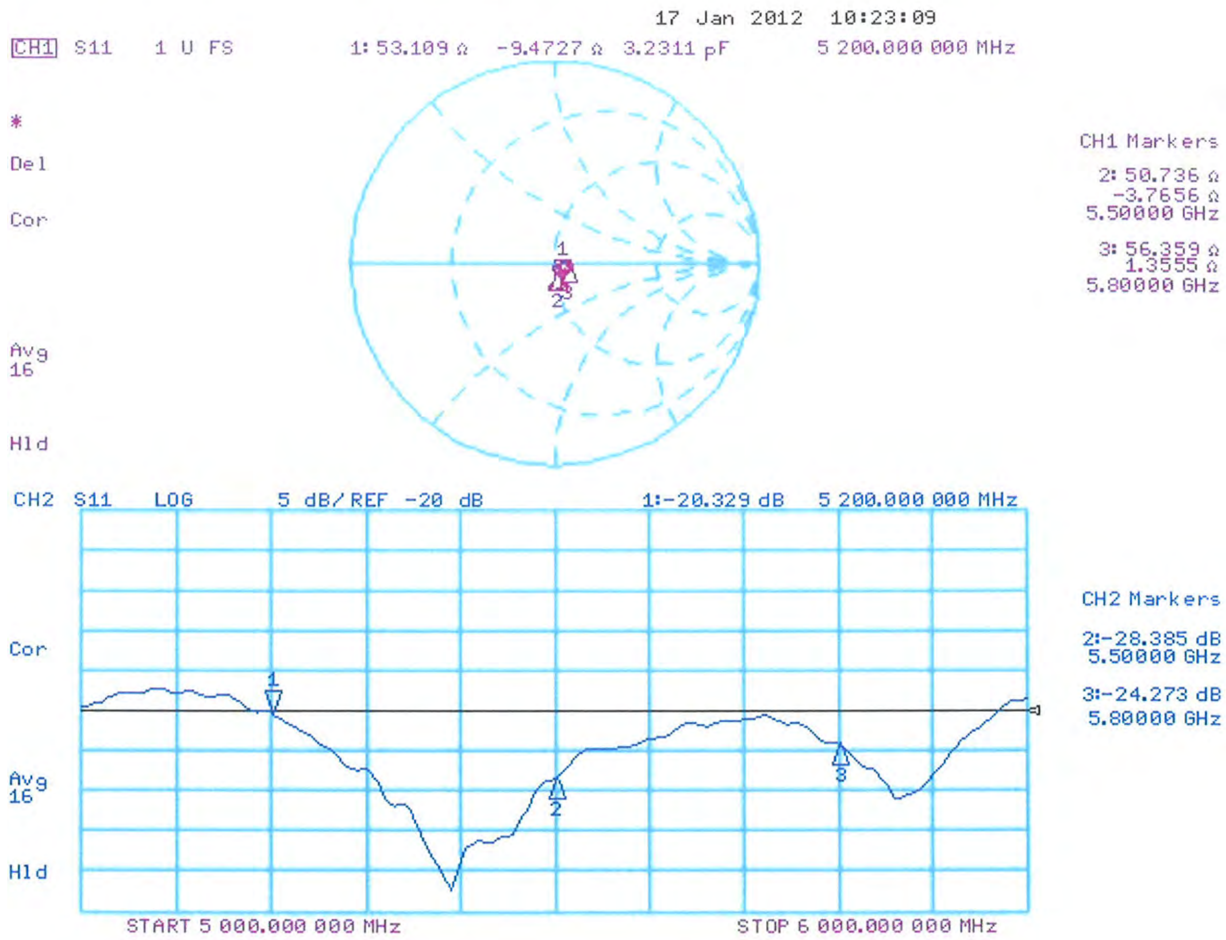
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5500 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 63.798 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 33.9410
SAR(1 g) = 8.47 mW/g; SAR(10 g) = 2.41 mW/g
Maximum value of SAR (measured) = 20.236 mW/g

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 = 60.556 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 33.2500
SAR(1 g) = 7.86 mW/g; SAR(10 g) = 2.23 mW/g
Maximum value of SAR (measured) = 19.231 mW/g



0 dB = 19.230mW/g = 25.68 dB mW/g

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 18.01.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1018

Communication System: CW; Frequency: 5200 MHz, Frequency: 5500 MHz, Frequency: 5800 MHz
Medium parameters used: f = 5200 MHz; $\sigma = 5.46$ mho/m; $\varepsilon_r = 49.2$; $\rho = 1000$ kg/m^3 , Medium parameters used: f = 5500 MHz; $\sigma = 5.86$ mho/m; $\varepsilon_r = 48.7$; $\rho = 1000$ kg/m^3 , Medium parameters used: f = 5800 MHz; $\sigma = 6.28$ mho/m; $\varepsilon_r = 48.2$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

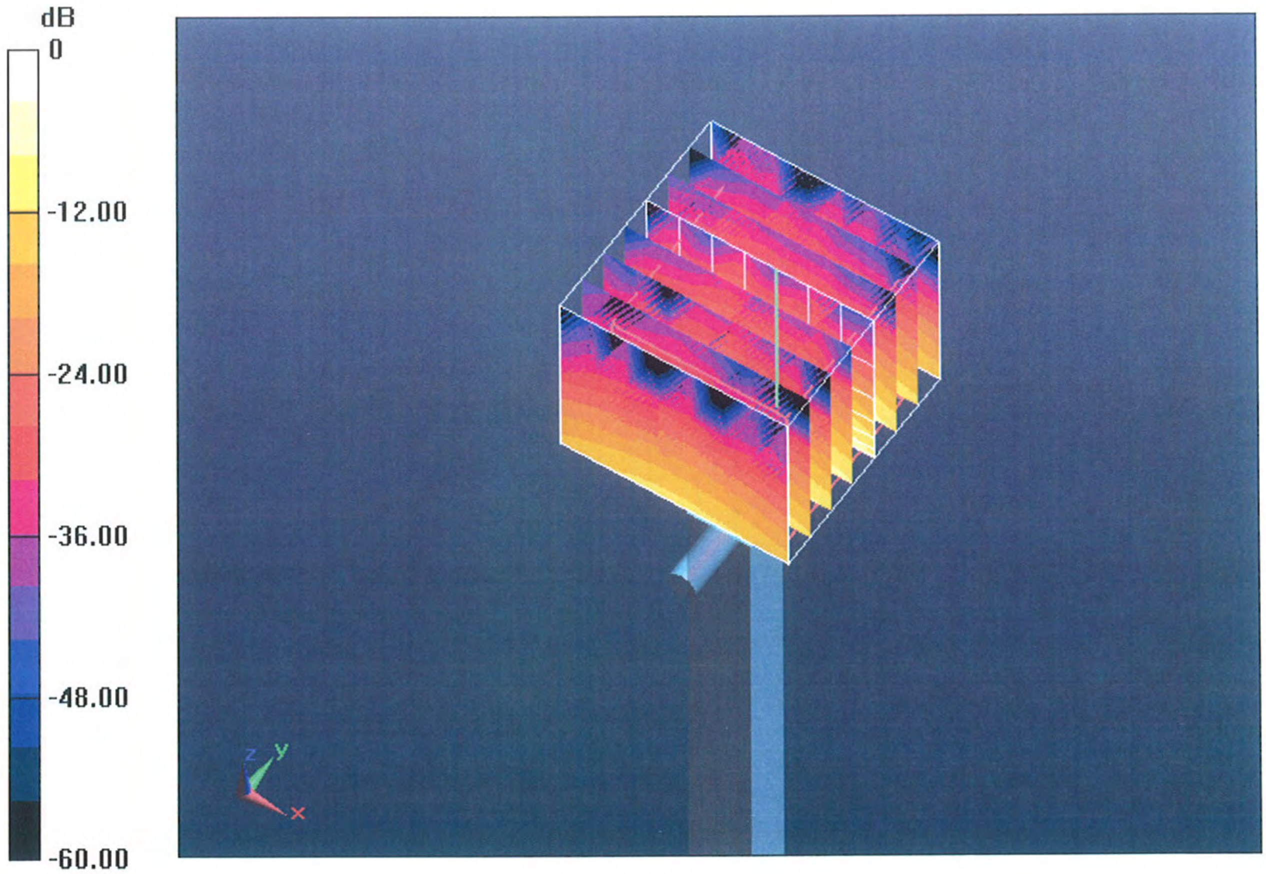
DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(4.91, 4.91, 4.91), ConvF(4.43, 4.43, 4.43), ConvF(4.38, 4.38, 4.38); Calibrated: 30.12.2011
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.0(692); SEMCAD X 14.6.4(4989)

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 = 57.349 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 28.4300
SAR(1 g) = 7.26 mW/g; SAR(10 g) = 2.04 mW/g
Maximum value of SAR (measured) = 17.187 mW/g

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 = 57.629 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 33.3620
SAR(1 g) = 7.82 mW/g; SAR(10 g) = 2.18 mW/g
Maximum value of SAR (measured) = 19.092 mW/g

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 = 54.181 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 34.3080
SAR(1 g) = 7.33 mW/g; SAR(10 g) = 2.03 mW/g
Maximum value of SAR (measured) = 18.527 mW/g



0 dB = 18.530mW/g = 25.36 dB mW/g

Impedance Measurement Plot for Body TSL