ANSI/IEEE Std. C95.1-1992

in accordance with the requirements of
FCC Report and Order: ET Docket 93-62

FCC TEST REPORT

For

Tablet Computer

Trade Name: TOSHIBA

Model: WT8-B

Issued to

Pegatron Corporation
5F, NO. 76, LIGONG ST., BEITOU DISTRICT,
TAIPEI CITY 112, TAIWAN (R.O.C.)

Issued by

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Issued Date: 2014/05/08

Revision History

Rev.	Issue Date	Revisions	Effect Page	Revised By
00	2014/05/08	Initial Issue	ALL	Scott Hsu

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1 Certificate of Compliance (SAR Evaluation)

Applicant	Pegatron Corporation 5F, NO. 76, LIGONG ST., BEITOU DISTRICT, TAIPEI CITY 112, TAIWAN (R.O.C.)
Equipment Under Test:	Tablet Computer
Trade Name:	TOSHIBA
Model Number:	WT8-B
Date of Test:	April 30, 2014
Device Category:	PORTABLE DEVICES
Exposure Category:	GENERAL POPULATION/UNCONTROLLED EXPOSURE

Applicable Standards	
FCC	● IEEE 1528 2003 ● KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r03 ● KDB 447498 D01 General RF Exposure Guidance v05r02 ● KDB 616217 D04 SAR for laptop and tablets v01r01 ● KDB 248227 D01 SAR measurement for 802 11 a b g v01r02
Limit	
1.6 W/kg	
Test Result	
Pass	

The test results in this report apply only to the tested sample of the stated device/equipment. Other similar device/equipment will not necessarily produce the same results due to production tolerance and measurement uncertainties.

Approved by:

Alex Wu
Section Manager
Compliance Certification Services Inc.

Tested by:

Scott Hsu
SAR Engineer
Compliance Certification Services Inc.

2 Description of Equipment Under Test

Product		Tablet Computer		
Trade Name		TOSHIBA		
Model Number		WT8-B		
Transmitters		Wi-Fi & Bluetooth		
Modulation Technique		Bluetooth: GFSK for 1Mbps;π/4-DQPSK for 2Mbps;8DPSK for 3Mbps		
		802.11b: Direct Sequence Spread Spectrum(DSSS)		
		802.11g: Orthogonal Frequency Division Multiplexing (OFDM)		
		802.11n: Orthogonal Frequency Division Multiplexing (OFDM)		
Antenna Specification		WLAN	Brand name	ACXC
			Parts Number	AT5020-B2R8HAAT/LF
			Type	Chip Antenna
FCC Rule Parts	Band	Frequency Range		Highest Reported 1-g SAR
15.247	2.4GHz	2412 - 2462 MHz		0.951 W/kg (Rear)
Rechargeable Li-polymer Battery–alternate		Brand: TOSHIBA Model: PA5203U-1BRS Rating: 3.78V 14Wh 3788mAh		

Remark: The sample selected for test was prototype that approximated to production product and was provided by manufacturer

3 Requirements for Compliance Testing Defined

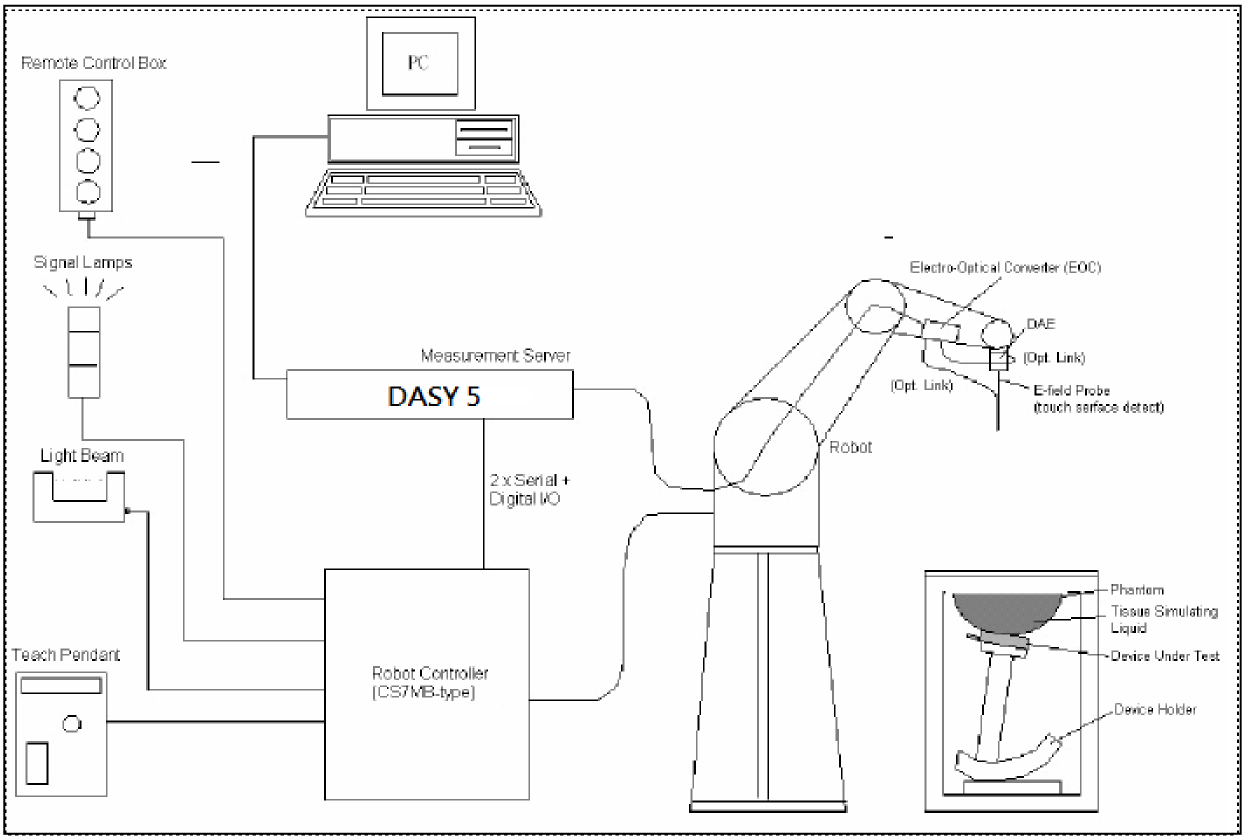
3.1 Requirements for Compliance Testing Defined by the FCC

The US Federal Communications Commission has released the report and order “Guidelines for Evaluating the Environmental Effects of RF Radiation", ET Docket No. 93-62 in August 1996 [1]. The order requires routine SAR evaluation prior to equipment authorization of portable transmitter devices, including portable telephones. For consumer products, the applicable limit is 1.6 W/kg for an uncontrolled environment and 8.0 mW/g for an occupational/controlled environment as recommended by the ANSI/IEEE standard C95.1-1992 [6].

4 Dosimetric Assessment System

These measurements were performed with the automated near-field scanning system DASY4/DAST5 from Schmid & Partner Engineering AG (SPEAG). The system is based on a high precision robot (working range greater than 0.9 m) which positions the probes with a positional repeatability of better than ± 0.02 mm. Special E- and H-field probes have been developed for measurements close to material discontinuity, the sensors of which are directly loaded with a Schottky diode and connected via highly resistive lines to the data acquisition unit. The SAR measurements were conducted with the dosimetric probe EX3DV4-SN: 3665 (manufactured by SPEAG), designed in the classical triangular configuration and optimized for dosimetric evaluation. The probe has been calibrated according to the procedure with accuracy of better than ±10%. The spherical isotropy was evaluated with the procedure and found to be better than ±0.25 dB. The phantom used was the SAM Twin Phantom as described in FCC supplement C, IEEE 1528 2003.

4.1 Measurement System Diagram



The DASY4/DASY5 system for performing compliance tests consists of the following items:

- A standard high precision 6-axis robot (St¨aubli RX family) with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
- A dosimetric probe, i.e., an isotropic E-field probe optimized and calibrated for usage in tissue simulating liquid. The probe is equipped with an optical surface detector system.
- A data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
- The Electro-optical converter (EOC) performs the conversion between optical and electrical of the signals for the digital communication to the DAE and for the analog signal from the optical surface detection. The EOC is connected to the measurement server.
- The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- A probe alignment unit which improves the (absolute) accuracy of the probe positioning.
- A computer operating Windows 2000 or Windows XP.
- DASY4/DASY5 software.
- Remote control with teach pendant and additional circuitry for robot safety such as warning lamps, etc.
- The SAM twin phantom enabling testing left-hand and right-hand usage.
- The device holder for handheld mobile phones.
- Tissue simulating liquid mixed according to the given recipes.
- Validation dipole kits allowing validating the proper functioning of the system.

4.2 System Components

DASY4/DASY5 Measurement Server

The DASY4/DASY5 measurement server is based on a PC/104 CPU board with a 166MHz low-power Pentium, 32MB chip disk and 64MB RAM. The necessary circuits for communication with either the DAE3 electronic box as well as the 16-bit AD-converter system for optical detection and digital I/O interface are contained on the DASY4/DASY5 I/O-board, which is directly connected to the PC/104 bus of the CPU board.

The measurement server performs all real-time data evaluation for field measurements and surface detection, controls robot movements and handles safety operation.

The PC-operating system cannot interfere with these time critical processes. All connections are supervised by a watchdog, and disconnection of any of the cables to the measurement server will automatically disarm the robot and disable all program-controlled robot movements. Furthermore, the measurement server is equipped with two expansion slots which are reserved for future applications. Please note that the expansion slots do not have a standardized pinout and therefore only the expansion cards provided by SPEAG can be inserted. Expansion cards from any other supplier could seriously damage the measurement server. Calibration: No calibration required.

Data Acquisition Electronics (DAE)

The data acquisition electronics (DAE4) consists of a highly sensitive electrometer grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD converter and a command decoder and control logic unit. Transmission to the measurement server is accomplished through an optical downlink for data and status information as well as an optical uplink for commands and the clock. The mechanical probe mounting device includes two different sensor systems for frontal and sideways probe contacts. They are used for mechanical surface detection and probe collision detection. The input impedance of the DAE4 box is 200MOhm; the inputs are symmetrical and floating. Common mode rejection is above 80 dB.

EX3DV4 Isotropic E-Field Probe for Dosimetric Measurements

Construction: Symmetrical design with triangular core
Built-in shielding against static charges
PEEK enclosure material (resistant to organic solvents, e.g., DGBE)

Calibration: Basic Broad Band Calibration in air: 10-3000 MHz.
Conversion Factors (CF) for HSL 900 and HSL 1800
CF-Calibration for other liquids and frequencies upon request.

Frequency: 10 MHz to > 6 GHz; Linearity: ± 0.2 dB (30 MHz to 3 GHz)

Directivity: ± 0.3 dB in HSL (rotation around probe axis)
± 0.5 dB in HSL (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: 330 mm (Tip: 20 mm)
Tip diameter: 2.5 mm (Body: 12 mm)
Distance from probe tip to dipole centers: 1 mm

Application: High precision dosimetric measurements in any exposure scenario (e.g., very strong gradient fields). Only probe which enables compliance testing for frequencies up to 6 GHz with precision of better 30%.

Interior of probe

SAM Phantom (V4.0)

Construction: The shell corresponds to the specifications of the Specific Anthropomorphic Mannequin (SAM) phantom defined in IEEE 1528-2003, CENELEC 50361 and IEC 62209. It enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. A cover prevents evaporation of the liquid. Reference markings on the phantom allow the complete setup of all predefined phantom positions and measurement grids by manually teaching three points with the robot.

Shell Thickness: 2 ±0.2 mm

Filling Volume: Approx. 25 liters

Dimensions: Height: 810mm; Length: 1000mm; Width: 500mm

SAM Phantom (ELI4)

Construction: Phantom for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30 MHz to 6 GHz. ELI4 is fully compatible with the latest draft of the standard IEC 62209 Part II and all known tissue simulating liquids. ELI4 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 supported by software version DASY4/DASY5 and higher and is compatible with all SPEAG dosimetric probes and dipoles

Shell Thickness: 2.0 ± 0.2 mm (sagging: <1%)

Filling Volume: Approx. 25 liters

Dimensions: Major ellipse axis: 600 mm

Minor axis: 400 mm 500mm

Device Holder for SAM Twin Phantom

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

System Validation Kits for SAM Phantom (V4.0)

Construction: Symmetrical dipole with l/4 balun Enables measurement of feedpoint impedance with NWA Matched for use near flat phantoms filled with brain simulating solutions Includes distance holder and tripod adaptor.

Frequency: 2450 MHz

Return loss: > 20 dB at specified validation position

Power capability: > 100 W (f < 1GHz); > 40 W (f > 1GHz)

Dimensions: D2450V2: dipole length: 51.5 mm; overall height: 290 mm

System Validation Kits for ELI4 phantom

Construction: Symmetrical dipole with l/4 balun Enables measurement of feedpoint impedance with NWA Matched for use near flat phantoms filled with brain simulating solutions Includes distance holder and tripod adaptor.

Frequency: 2450 MHz

Return loss: > 20 dB at specified validation position

Power capability: > 100 W (f < 1GHz); > 40 W (f > 1GHz)

Dimensions: D2450V2: dipole length: 51.5 mm; overall height: 290 mm

5 Evaluation Procedures

Data Evaluation

The DASY4/DASY5 post processing software (SEMCAD) automatically executes the following procedures to calculate the field units from the microvolt readings at the probe connector. The parameters used in the evaluation are stored in the configuration modules of the software:

Probe parameters:	- Sensitivity	$Norm_i$, a_{i0}, a_{i1}, a_{i2}
	- Conversion factor	$ConvF_i$
	- Diode compression point	dcp_i
Device parameters:	- Frequency	f
	- Crest factor	cf
Media parameters:	- Conductivity	σ
	- Density	ρ

These parameters must be set correctly in the software. They can be found in the component documents or be imported into the software from the configuration files issued for the DASY components. In the direct measuring mode of the multi-meter option, the parameters of the actual system setup are used. In the scan visualization and export modes, the parameters stored in the corresponding document files are used.

The first step of the evaluation is a linearization of the filtered input signal to account for the compression characteristics of the detector diode. The compensation depends on the input signal, the diode type and the DC-transmission factor from the diode to the evaluation electronics. If the exciting field is pulsed, the crest factor of the signal must be known to correctly compensate for peak power. The formula for each channel can be given as:

$$V_i = U_i + U_i^2 \cdot \frac{cf}{dcp_i}$$

with	V_i	= Compensated signal of channel i	(i = x, y, z)
	U_i	= Input signal of channel i	(i = x, y, z)
	cf	= Crest factor of exciting field	(DASY parameter)
	dcp_i	= Diode compression point	(DASY parameter)

From the compensated input signals the primary field data for each channel can be evaluated:

E-field probes:
$$E_i = \sqrt{\frac{V_i}{Norm_i \bullet ConvF}}$$

H-field probes:
$$H_i = \sqrt{Vi} \cdot \frac{a_{i10} + a_{i11} f + a_{i12} f^2}{f}$$

with	V_i	= Compensated signal of channel i	(i = x, y, z)
	$Norm_i$	= Sensor sensitivity of channel i	(i = x, y, z)

μV/(V/m)^2 for E0field Probes

	$ConvF$	= Sensitivity enhancement in solution
	aij	= Sensor sensitivity factors for H-field probes
	f	= Carrier frequency (GHz)
	Ei	= Electric field strength of channel i in V/m
	Hi	= Magnetic field strength of channel i in A/m

The RSS value of the field components gives the total field strength (Hermitian magnitude):

$$E_{tot} = \sqrt{E_x^2 + E_y^2 + E_z^2}$$

The primary field data are used to calculate the derived field units.

$$SAR = E_{tot}^2 \cdot \frac{\sigma}{\rho \cdot 1000}$$

with	*SAR*	= local specific absorption rate in W/kg
	E_{tot}	= total field strength in V/m
	σ	= conductivity in [mho/m] or [Siemens/m]
	ρ	= equivalent tissue density in g/cm^3

Note that the density is normally set to 1 (or 1.06), to account for actual brain density rather than the density of the simulation liquid.

The power flow density is calculated assuming the excitation field as a free space field.

$$P_{pwe} = \frac{E_{tot}^2}{377} \quad \text{or} \quad P_{pwe} = H_{tot}^2 \cdot 37.7$$

with	P_{pwe}	= Equivalent power density of a plane wave in mW/cm^2
	E_{tot}	= total electric field strength in V/m
	H_{tot}	= total magnetic field strength in A/m

6 SAR Measurement Procedures

6.1 Normal SAR Test Procedure

- **Power Reference Measurement**

The reference and drift jobs are useful jobs for monitoring the power drift of the device under test in the batch process. Both jobs measure the field at a specified reference position, at a selectable distance from the phantom surface. The reference position can be either the selected section's grid reference point or a user point in this section. The reference job projects the selected point onto the phantom surface, orients the probe perpendicularly to the surface, and approaches the surface using the selected detection method.

- **Area Scan**

The area scan is used as a fast scan in two dimensions to find the area of high field values, before doing a finer measurement around the hot spot. The sophisticated interpolation routines implemented in DASY4/DASY5 software can find the maximum locations even in relatively coarse grids. The scan area is defined by an editable grid. This grid is anchored at the grid reference point of the selected section in the phantom. When the area scan's property sheet is brought-up, the grid resolution has to less than 15 mm by 15 mm at frequency ≤2GHz; the grid resolution has to less than 12mm by 12 mm at frequency between 2GHz to 4GHz; grid resolution has to less than 10 mm by 10 mm at frequency between 4GHz to 6GHz.

According to KDB 865664 D01 SAR measurement 100 MHz to 6 GHz v01r01

	≤ 3 GHz	> 3 GHz
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface	5 ± 1 mm	½·δ·ln(2) ± 0.5 mm
Maximum probe abgle from probe axis to phantom surface normal at the measurement location	30° ± 1°	20° ± 1°
Maximum area scan spatial resolution: Δx_{Zoom}, Δy_{Zoom}	≤ 2 GHz: ≤ 15 mm 2 – 3 GHz: ≤ 12 mm	3 – 4 GHz: ≤ 12 mm 4 – 6 GHz: ≤ 10 mm
	When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be ≤ the corresponding x or y dimension of the test device with at least one measurement point on the test device.	

- **Zoom Scan**

Zoom scans are used to assess the peak spatial SAR values within a cubic averaging volume containing 1 g and 10 g of simulated tissue. The default zoom scan measures points in accordance with the frequency can be divided into three parts. (1)The zoom scan volume was set to 5x5x7 points at frequency ≤ 2GHz. (2) The zoom scan volume was set to 7x7x7 points at frequency between 2GHz to 4GHz (3) The zoom scan volume was set to 7x7x12 points at frequency between 4GHz to 6GHz. The measures points within a cube whose base faces are centered around the maximum found in a preceding area scan job within the same procedure. If the preceding Area Scan job indicates more then one maximum, the number of Zoom Scans has to be enlarged accordingly.

According to KDB 865664 D01 SAR measurement 100 MHz to 6 GHz v01r01

<table>
<tr><td colspan="3"></td><td>≤ 3 GHz</td><td>> 3 GHz</td></tr>
<tr><td colspan="3">Maximum zoom scan spatial resolution: Δx_{Zoom}, Δy_{Zoom}</td><td>≤ 2 GHz: ≤ 8 mm
2 – 3 GHz: ≤ 5 mm</td><td>3 – 4 GHz: ≤ 5 mm
4 – 6 GHz: ≤ 4 mm</td></tr>
<tr><td rowspan="3">Maximum zoom scan spatial resolution, normal to phantom surface</td><td colspan="2">Uniform grid: $\Delta z_{Zoom}(n)$</td><td>≤ 5 mm</td><td>3 – 4 GHz: ≤ 4 mm
4 – 5 GHz: ≤ 3 mm
5 – 6 GHz: ≤ 2 mm</td></tr>
<tr><td rowspan="2">graded grid</td><td>$\Delta z_{Zoom}(1)$:between 1st two points losest to phantom surface</td><td>≤ 4 mm</td><td>3 – 4 GHz: ≤ 3 mm
4 – 5 GHz: ≤ 2.5 mm
5 – 6 GHz: ≤ 2 mm</td></tr>
<tr><td>$\Delta z_{Zoom}(n>1)$: between subsequent points</td><td colspan="2">≤ 1.5·$\Delta z_{Zoom}(n-1)$</td></tr>
<tr><td>Maximum zoom scan volume</td><td>x, y, z</td><td>≥ 30 mm</td><td colspan="2">3 – 4 GHz: ≥ 28 mm
4 – 5 GHz: ≥ 25 mm
5 – 6 GHz: ≥ 22 mm</td></tr>
</table>

- **Power Drift Measurement**

The drift job measures the field at the same location as the most recent reference job within the same procedure, and with the same settings. The drift measurement gives the field difference in dB from the reading conducted within the last reference measurement. Several drift measurements are possible for one reference measurement. This allows a user to monitor the power drift of the device under test within a batch process. In the properties of the Drift job, the user can specify a limit for the drift and have DASY4/DASY5 software stop the measurements if this limit is exceeded.

- **Z-Scan**

The Z Scan job measures points along a vertical straight line. The line runs along the Z-axis of a one-dimensional grid. A user can anchor the grid to the current probe location. As with any other grids, the local Z-axis of the anchor location establishes the Z-axis of the grid.

7 Device Under Test

7.1 Band Interface

Tx Frequency Bands	• 802.11 b/g/n: 2412 - 2462 MHz
Mode	• 802.11 b/g/n HT20/HT40

7.2 Simultaneous Transmission

No.	Conditions	Body SAR	Hotspot
1	WiFi 2.4GHz + Bluetooth	☒	☒

☑: The Product can simultaneously transmit

☒: The Product can't simultaneously transmit

8 Summary of SAR Test Exclusion Configurations

8.1 Standalone SAR Test Exclusion Calculations

Since the Dedicated Host Approach is applied, the standalone SAR test exclusion procedure in KDB 447498 section4.3.1 is applied in conjunction with KDB 616217 section 4.3 to determine the minimum test separation distance:

1. According to KDB 447498 Section 4.1 5) if the antenna is at close proximity to user then the outer surface of the DUT should be treated as the radiating surface. The test separation distance is then determined by the smallest distance between the outer surface of the device and the user. For the purposes of this report close proximity has been defined as closer than 50 mm. For antennas <50 mm from the rear or edge the separation distance used for the estimated SAR calculations is 0 mm.
2. When the minimum test separation distance is < 5mm, a distance of 5mm is applied to determine SAR test exclusion.
3. When the separation distance from the antenna to an adjacent edge is > 5 mm, the actual antenna-to-edge separation distance is applied to determine SAR test exclusion.
4. If the antenna to DUT adjacent edge or bottom separation distance >50mm the actual antenna to user separation distance is used to determine SAR exclusion and estimated SAR value.

Refer to Appendix for the specific details on the antenna-to-antenna and antenna-to-edge distances used for test exclusion calculations.

8.1.1 SAR Exclusion Calculations for Wi-Fi Antenna < 50mm from the User

According to KDB 447498 v05 r02 in section 4.3.1, if the calculated threshold value is > 3 then SAR testing is required.

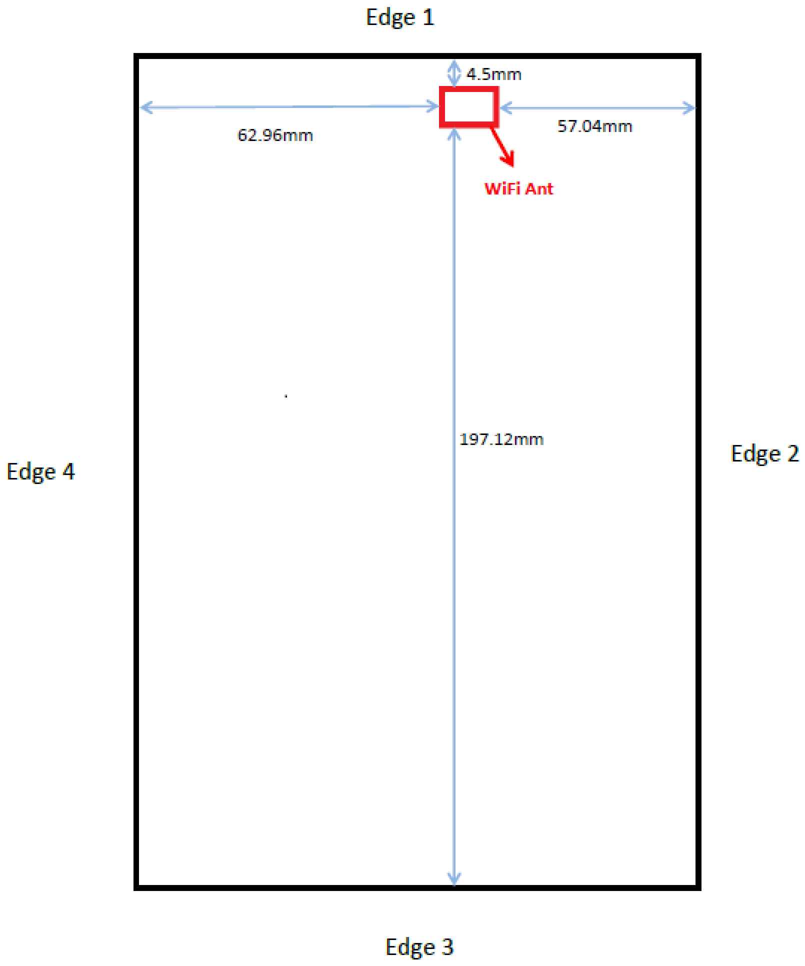
Antenna	Band	Mode	Frequency (MHz)	Output Power		Separation Distances(mm)						Calculated Threshold Value					
				dBm	mW	Rear	Edge1	Edge2	Edge3	Edge4	Front	Rear	Edge1	Edge2	Edge3	Edge4	Front
Wi-Fi Main	2.4GHz	802.11b	2437	15	32	3	5	57	197	63		10.0	10.0	>50mm	>50mm	>50mm	N/A
Wi-Fi Main	2.4GHz	802.11g	2437	14	25	3	5	57	197	63		7.8	7.8	>50mm	>50mm	>50mm	N/A
Wi-Fi Main	2.4GHz	802.11n HT20	2437	14	25	3	5	57	197	63		7.8	7.8	>50mm	>50mm	>50mm	N/A
Wi-Fi Main	2.4GHz	802.11n HT40	2437	14	25	3	5	57	197	63		7.8	7.8	>50mm	>50mm	>50mm	N/A
Wi-Fi Main	Bluetooth	Bluetooth	2480	6	4	3	5	57	197	63		1.3	1.3	>50mm	>50mm	>50mm	N/A

8.1.2 SAR Exclusion Calculations for Wi-Fi Antenna > 50mm from the User

According to KDB 447498 v05 r02, if the calculated Power threshold is less than the output power then SAR testing is required.

Antenna	Band	Mode	Frequency (MHz)	Output Power		Separation Distances(mm)						Calculated Threshold Value					
				dBm	mW	Rear	Edge1	Edge2	Edge3	Edge4	Front	Rear	Edge1	Edge2	Edge3	Edge4	Front
Wi-Fi Main	2.4GHz	802.11b	2437	15	32	3	5	57	197	63		<50mm	<50mm	71.7	1472.5	130.9	N/A
Wi-Fi Main	2.4GHz	802.11g	2437	14	25	10	6	225	77	205		<50mm	<50mm	1751.2	271.2	1551.2	N/A
Wi-Fi Main	2.4GHz	802.11n HT20	2437	14	25	10	6	225	77	205		<50mm	<50mm	1751.2	271.2	1551.2	N/A
Wi-Fi Main	2.4GHz	802.11n HT40	2437	14	25	10	6	225	77	205		<50mm	<50mm	1751.2	271.2	1551.2	N/A
Wi-Fi Main	Bluetooth	Bluetooth	2480	6	4	10	6	225	77	205		<50mm	<50mm	1751.0	271.0	1551.0	N/A

8.2 Required Test Configuration



Separation Distance (mm)	Wi-Fi Antenna (Main)
Top-Edge (Edge1)	4.5
Right-Edge (Edge2)	57.04
Bottom-Edge (Edge3)	197.12
Left-Edge (Edge4)	62.96
Rear Surface	3.25

8.2.1 For WiFi and Bluetooth

Test Configurations	Rear	Edge1	Edge2	Edge3	Edge4
802.11 b/g/n 1TX	Yes	Yes	No	No	No
Bluetooth 1TX	No	No	No	No	No

Yes = SAR is required.

No = SAR is not required

9 Measurement Uncertainty

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

Uncertainty Component	Uncertainty	Prob.	Div.	$c_{i\,(10g)}$	Std. Unc.(1-g)	v_i or V_{eff}
Measurement System						
Probe Calibration (k=1)	6.00	Normal	1	1	6.00	∞
Probe Isotropy	7.60	Rectangular	$\sqrt{3}$	0.7	3.07	∞
Boundary Effect	0.65	Rectangular	$\sqrt{3}$	1	0.38	∞
Linearity	4.70	Rectangular	$\sqrt{3}$	1	2.71	∞
System Detection Limit	1.00	Rectangular	$\sqrt{3}$	1	0.58	∞
Readout Electronics	0.30	Normal	1	1	0.30	∞
Response Time	0.80	Rectangular	$\sqrt{3}$	1	0.46	∞
Integration Time	2.60	Rectangular	$\sqrt{3}$	1	1.50	∞
RF Ambient Conditions	3.00	Rectangular	$\sqrt{3}$	1	1.73	∞
RF Ambient Reflections	3.00	Rectangular	$\sqrt{3}$	1	1.73	∞
Probe Positioner Mechanical Tolerance	0.40	Rectangular	$\sqrt{3}$	1	0.23	∞
Probe Positioning with respect to Phantom Shell	2.90	Rectangular	$\sqrt{3}$	1	1.67	∞
Extrapolation, interpolation and integration Algorithms for Max. SAR Evaluation	2.00	Rectangular	$\sqrt{3}$	1	1.15	∞
Test sample Related						
Test sample Positioning	3.70	Normal	1	1	3.7	89
Device Holder Uncertainty	3.40	Normal	1	1	3.4	5
Output Power Variation - SAR drift measurement	5.00	Rectangular	$\sqrt{3}$	1	2.89	∞
Phantom and Tissue Parameters						
Phantom Uncertainty (shape and thickness tolerances)	7.50	Rectangular	$\sqrt{3}$	1	4.33	∞
Liquid Conductivity - deviation from target values	4.14	Rectangular	$\sqrt{3}$	0.64	1.53	∞
Liquid Conductivity - measurement uncertainty	-4.23	Normal	1	0.64	-2.71	39
Liquid Permittivity - deviation from target values	3.92	Rectangular	$\sqrt{3}$	0.6	1.36	∞
Liquid Permittivity - measurement uncertainty	-2.62	Normal	1	0.6	-1.57	39
		RSS			11.50	611
Expanded Uncertainty U, Coverage Factor = 2, > 95 % Confidence =		k=2			23.01%	
Expanded Uncertainty U, Coverage Factor = 2, > 95 % Confidence =		k=2			1.80dB	

10 Exposure Limit

(A). Limits for Occupational/Controlled Exposure (W/kg)

Whole-Body	Partial-Body	Hands, Wrists, Feet and Ankles
0.4	8.0	2.0

(B). Limits for General Population/Uncontrolled Exposure (W/kg)

Whole-Body	Partial-Body	Hands, Wrists, Feet and Ankles
0.08	1.6	4.0

NOTE: **Whole-Body SAR** is averaged over the entire body, **partial-body SAR** is averaged over any 1 gram of tissue defined as a tissue volume in the shape of a cube. **SAR for hands, wrists, feet and ankles** is averaged over any 10 grams of tissue defined as a tissue volume in the shape of a cube.

Population/Uncontrolled Environments:

are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure.

Occupational/Controlled Environments:

are defined as locations where there is exposure that may be incurred by people who are aware of the potential for exposure, (i.e. as a result of employment or occupation).

NOTE GENERAL POPULATION/UNCONTROLLED EXPOSURE PARTIAL BODY LIMIT 1.6 W/kg

11 Tissue Dielectric Properties

11.1 Test Liquid Confirmation

Simulating Liquids Parameter Check

The simulating liquids should be checked at the beginning of a series of SAR measurements to determine of the dielectric parameters are within the tolerances of the specified target values

The relative permittivity and conductivity of the tissue material should be within ± 5% of the values given in the table below 5% may not be easily achieved at certain frequencies.

The head tissue dielectric parameters recommended by the IEEE SCC-34/SC-2 in IEEE 1528 2003 have been incorporated in the following table. These head parameters are derived from planar layer models simulating the highest expected SAR for the dielectric properties and tissue thickness variations in a human head. Other head and body tissue parameters that have not been specified in IEEE 1528 2003 are derived from the tissue dielectric parameters computed from the 4-Cole-Cole equations and extrapolated according to the head parameters specified in IEEE 1528 2003

Target Frequency (MHz)	Head		Body	
	ε_r	σ (S/m)	ε_r	σ (S/m)
150	52.3	0.76	61.9	0.80
300	45.3	0.87	58.2	0.92
450	43.5	0.87	56.7	0.94
835	41.5	0.90	55.2	0.97
900	41.5	0.97	55.0	1.05
915	41.5	0.98	55.0	1.06
1450	40.5	1.20	54.0	1.30
1610	40.3	1.29	53.8	1.40
1800 – 2000	40.0	1.40	53.3	1.52
2450	39.2	1.80	52.7	1.95
3000	38.5	2.40	52.0	2.73
5000	36.2	4.45	49.3	5.07
5100	36.1	4.55	49.1	5.18
5200	36.0	4.66	49.0	5.30
5300	35.9	4.76	48.9	5.42
5400	35.8	4.86	48.7	5.53
5500	35.6	4.96	48.6	5.65
5600	35.5	5.07	48.5	5.77
5700	35.4	5.17	48.3	5.88
5800	35.3	5.27	48.2	6.00

11.2 Typical Composition of Ingredients for Liquid Tissue Phantoms

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

Ingredients (% by weight)	Frequency (MHz)									
	450		835		915		1900		2450	
Tissue Type	Head	Body	Head	Body	Head	Body	Head	Body	Head	Body
Water	38.56	51.16	41.45	52.4	41.05	56.0	54.9	40.4	62.7	73.2
Salt (NaCl)	3.95	1.49	1.45	1.4	1.35	0.76	0.18	0.5	0.5	0.04
Sugar	56.32	46.78	56.0	45.0	56.5	41.76	0.0	58.0	0.0	0.0
HEC	0.98	0.52	1.0	1.0	1.0	1.21	0.0	1.0	0.0	0.0
Bactericide	0.19	0.05	0.1	0.1	0.1	0.27	0.0	0.1	0.0	0.0
Triton X-100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36.8	0.0
DGBE	0.0	0.0	0.0	0.0	0.0	0.0	44.92	0.0	0.0	26.7
Dielectric Constant	43.42	58.0	42.54	56.1	42.0	56.8	39.9	54.0	39.8	52.5
Conductivity (S/m)	0.85	0.83	0.91	0.95	1.0	1.07	1.42	1.45	1.88	1.78

alt: 99^{+}% Pure Sodium Chloride Sugar: 98^{+}% Pure Sucrose
Water: De-ionized, 16 $M\Omega^{+}$ resistivity HEC: Hydroxy thyl Cellulose
DGBE: 99^{+}% Di(ethylene glycol) butyl ether, [2-(2-butoxyethoxy)ethanol]
Triton X-100 (ultra-pure): Polyethylene glycol mono [4-(1, 1, 3, 3-tetramethylbutyl)phenyl]ether

Simulating Liquids for 5 GHz, Manufactured by SPEAG

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

11.3 Simulating Liquids Parameter Check Results

Date	Band	Freq(MHz)	Measured			Standard		Δ		Limit
			e' (εr)	e''	σ	e' (εr)	σ	e' (εr)	σ	±5
2014/04/30	Body 2450	2412	51.48	13.68	1.83	52.75	1.91	-2.42%	-4.23%	±5
		2437	51.39	13.79	1.87	52.72	1.94	-2.51%	-3.64%	±5
		2442	51.38	13.80	1.87	52.71	1.94	-2.52%	-3.58%	±5
		2462	51.33	13.88	1.90	52.68	1.97	-2.58%	-3.48%	±5
		2472	51.29	13.92	1.91	52.67	1.98	-2.62%	-3.54%	±5

12 System Performance Check

The system performance check is performed prior to any usage of the system in order to guarantee reproducible results. The system performance check verifies that the system operates within its specifications. The system performance check results are tabulated below. And also the corresponding SAR plot is attached as well in the SAR plots files.

System Performance Check Measurement Conditions

- The measurements were performed in the flat section of the SAM twin phantom filled with Body simulating liquid of the following parameters.
- The DASY4/DASY5 system with an E-field probe EX3DV4 SN:3665 was used for the measurements.
- The dipole was mounted on the small tripod so that the dipole feed point was positioned below the center marking of the flat phantom section and the dipole was oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 15 mm (below 1 GHz) and 10 mm (above 1 GHz) from dipole center to the simulating liquid surface.
- The coarse grid with a grid spacing of 10mm was aligned with the dipole.
- Special 7x7x7 fine cube was chosen for cube integration (dx=dy= 5 mm, dz= 5 mm).
- Distance between probe sensors and phantom surface was set to 3.0 mm.
- The dipole input power (forward power) was 100 mW±3%.
- The results are normalized to 1 W input power.

Reference SAR Values for System Performance Check

The reference SAR values can be obtained from the calibration certificate of system validation dipoles

System Dipole	Serial No.	Cal. Date	Freq. (MHz)	Target SAR Values (W/kg)		
				1g/10g	Head	Body
D2450V2	728	2013/5/2	2450	1g	53.5	51.1
				10g	25.0	23.9

12.1 System Performance Check Results

Date	System Dipole			Parameters	Target	Measured	Deviation[%]	Limited[%]
	Type	Serial No.	Liquid					
2014/04/30	D2450V2	728	Body	1g SAR:	51.10	50.90	-0.39	± 5
				10g SAR:	23.90	24.10	0.84	± 5

13 RF Output Power Measurement

13.1 Wi-Fi (2.4 GHz Band)

Required Test Channels per KDB 248227 D01

Mode	Band (GHz)	Freq. (MHz)	Ch #	Default Test Channels	
				802.11b	802.11g
802.11 b/g	2.4	2412	1#	✓	∇
		2437	6	✓	∇
		2462	11#	✓	∇

Notes
✓ = "default test channels"
∇ = possible 802.11g channels with maximum average output ¼ dB the "default test channels"
= when output power is reduced for channel 1 and /or 11 to meet restricted band requirements the highest output channels closest to each of these channels should be tested.

The indicated Wi-Fi target powers in the following table are absolute maximums.

Output power table

Band (GHz)	Mode	Data rate (Mbps)	Ch #	Freq. (MHz)	Target Pwr (dBm)			Tune-up Tolerance (dB)	Maximum Tune-up Pwr (dBm)	Avg. Pwr (dBm)		
					Main	Aux	Total			Main	Aux	Total
2.4	802.11b	1	1	2412	14.0			±1.0	15.0	14.9		
			6	2437	14.0			±1.0	15.0	15.0		
			11	2462	14.0			±1.0	15.0	14.8		
	802.11g	6	1	2412	13.0			±1.0	14.0	13.9		
			6	2437	13.0			±1.0	14.0	14.0		
			11	2462	13.0			±1.0	14.0	14.0		
	802.11n HT20	MCS0	1	2412	13.0			±1.0	14.0	14.0		
			6	2437	13.0			±1.0	14.0	14.0		
			11	2462	13.0			±1.0	14.0	13.7		
	802.11n HT40	MCS0	3	2422	13.0			±1.0	14.0	14.0		
			6	2437	13.0			±1.0	14.0	14.0		
			9	2452	13.0			±1.0	14.0	13.7		

Note(s):
SAR is not required for 802.11g/HT20/HT40 channels when the maximum average output power is less than 1/4 dB higher than that measured on the corresponding 802.11b channels per KDB 248227 D01

13.2 Bluetooth

Output power table

Band (GHz)	Mode	Ch #	Freq. (MHz)	Target Pwr (dBm)			Tune-up Tolerance (dB)	Maximum Tune-up Pwr (dBm)	Measured Avg. Pwr (dBm)		
				Main	Aux	Total			Main	Aux	Total
Bluetooth	DH5	0	2402	2.0			± 2.0	4.0	3.4		
		39	2441	2.0			± 2.0	4.0	3.0		
		78	2480	2.0			± 2.0	4.0	2.8		
Bluetooth	3DH5	0	2402	2.0			± 2.0	4.0	2.6		
		39	2441	2.0			± 2.0	4.0	2.3		
		78	2480	2.0			± 2.0	4.0	1.9		
Bluetooth	BLE	0	2402	4.0			± 2.0	6.0	5.6		
		19	2440	4.0			± 2.0	6.0	5.5		
		39	2480	4.0			± 2.0	6.0	5.4		

14 SAR Measurements Results

Wi-Fi (2.4GHz Band):

Mode	Test Position	Channel	Freq. (MHz)	Chain	Dist. (mm)	Power (dBm)		Measured 1g SAR (W/kg)	Reported SAR(W/kg)	Note
						Tune up limit	Measured			
802.11b	Rear	6	2437	0	0	15.0	15.0	0.932	0.932	
	Rear	1	2412	0	0	15.0	14.9	0.889	0.910	
	Rear	11	2462	0	0	15.0	14.8	0.822	0.861	
	Rear	6	2437	0	0	15.0	15.0	0.951	0.951	2
	Edge1	6	2437	0	0	15.0	15.0	0.498	0.498	
802.11n (HT20)	Rear	6	2437	0	0	14.0	14.0	0.892	0.892	
	Rear	1	2412	0	0	14.0	14.0	0.773	0.773	
	Rear	11	2462	0	0	14.0	13.7	0.790	0.847	
	Edge1	1	2437	0	0	14.0	14.0	0.463	0.463	

Note(s):

1. Testing of other required channels within the operating mode of a frequency band is required when the reported 1-g SAR for the mid-band or highest output power channel. ≥ 0.8 W/kg and transmission band ≤ 100 MHz (Per KDB 447498 D01 v05r02 section 4.3.3)
2. Repeated measurements are required only when the measured SAR is ≥0.80 W/kg. If the measured SAR values are < 1.45 W/kg with ≤20% variation, only one repeated measurement is required to reaffirm that the results are not expected to have substantial variations, which may introduce significant compliance concerns. (Per KDB 865664 D01 SAR measurement 100 MHz to 6 GHz v01r01)

   2.1 Tablet Mode

   Original SAR = 0.932 W/kg, therefore two times repeat SAR is required.
   Repeat SAR = 0.951 W/kg < 1.45W/kg
   SAR variation= 1.9% < 20%

14.1 Summary of Highest SAR Values

Results for highest reported SAR values for each frequency band and mode

Technology/Band	Test configuration	Mode	Highest Reported 1g-SAR (W/kg)
WiFi 2.4 GHz	Rear	802.11b	0.951

15 Equipment List & Calibration Status

Name of Equipment	Manufacturer	Type/Model	Serial Number	Calibration Cycle(year)	Calibration Due
S-Parameter Network Analyzer	Agilent	E8358A	MY46213916	1	2014/6/3
Electronic Probe kit	Hewlett Packard	85070D	N/A	N/A	N/A
Power Meter	Agilent	4416	GB41291611	1	2014/9/10
Power Sensor	Agilent	8481H	MY41091956	1	2014/9/11
Data Acquisition Electronics (DAE)	SPEAG	DAE4	877	1	2015/3/25
Dosimetric E-Field Probe	SPEAG	EX3DV4	3665	1	2014/5/6
2450 MHz System Validation Dipole	SPEAG	D2450V2	728	1	2014/5/1
Robot	Staubli	RX90L	F02/5T69A1/A/01	N/A	N/A
Amplifier	Mini-Circuit	ZVE-8G	665500309	N/A	N/A
Amplifier	Mini-Circuit	ZHL-1724HLN	D072602#2	N/A	N/A

16 Facilities

All measurement facilities used to collect the measurement data are located at

☐ No. 81-1, Lane 210, Bade Rd. 2, Luchu Hsiang, Taoyuan Hsien, Taiwan, R.O.C.

☒ No.11, Wugong 6th Rd., Wugu Dist., New Taipei City 24891, Taiwan. (R.O.C.)

☐ No. 199, Chunghsen Road, Hsintien City, Taipei Hsien, Taiwan, R.O.C.

17 Reference

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18 Attachments

Exhibit	Content
1	System Performance Check Plots
2	SAR test plots for Wi-Fi 2.4GHz Band
3	SAR_Probe_EX3DV4_sn3665
4	SAR_DAE4_sn877
5	SAR_Dipole_D2450v2_sn728
6	T140421W03-SF PHOTOs

END OF REPORT

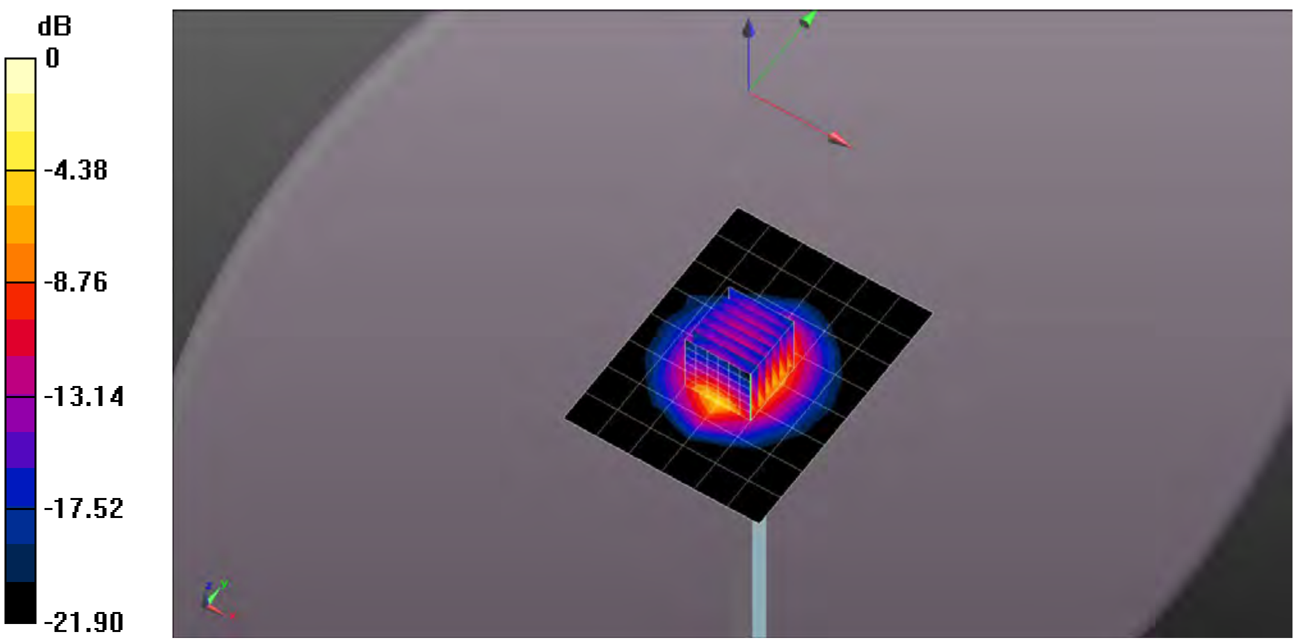
Test Laboratory: Compliance Certification Service Inc. SAR Lab 01 Date: 2014/04/30

20140430_System check_Diple2450v2 SN728

Frequency: 2450 MHz; Duty Cycle: 1:1; Room Ambient Temperature: 24.0°C; Liquid Temperature: 23.5°C
Medium parameters used (interpolated): f = 2450 MHz; σ = 1.886 S/m; ε_r = 51.359; ρ = 1000 kg/m^3
DASY5 Configuration:
- Area Scan Setting - Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Electronics: DAE4 Sn877; Calibrated: 2014/03/26
- Probe: EX3DV4 - SN3665; ConvF(7.4, 7.4, 7.4); Calibrated: 2013/05/07;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1056

Body/Pin=100mW, d=10mm/Area Scan (7x9x1): Measurement grid: dx=15mm, dy=15mm
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 8.30 W/kg

Body/Pin=100mW, d=10mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 67.855 V/m; Power Drift = 0.10 dB
Peak SAR (extrapolated) = 10.4 W/kg
SAR(1 g) = 5.09 W/kg; SAR(10 g) = 2.41 W/kg
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 8.34 W/kg



0 dB = 8.34 W/kg = 9.21 dBW/kg

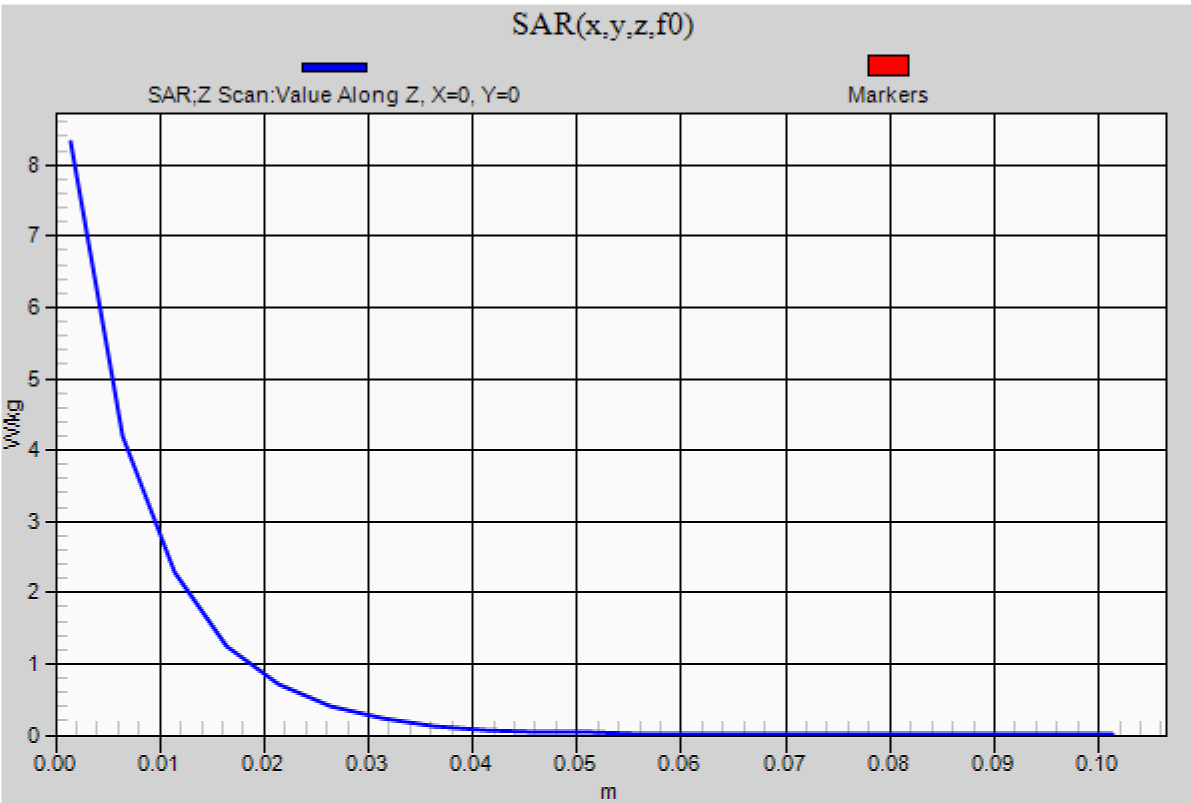
Test Laboratory: Compliance Certification Service Inc. SAR Lab 01 Date: 2014/04/30

20140430_System check_Diple2450v2 SN728

Frequency: 2450 MHz; Duty Cycle: 1:1

Body/Pin=100mW, d=10mm/Z Scan (1x1x21): Measurement grid: dx=20mm, dy=20mm, dz=5mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 8.32 W/kg



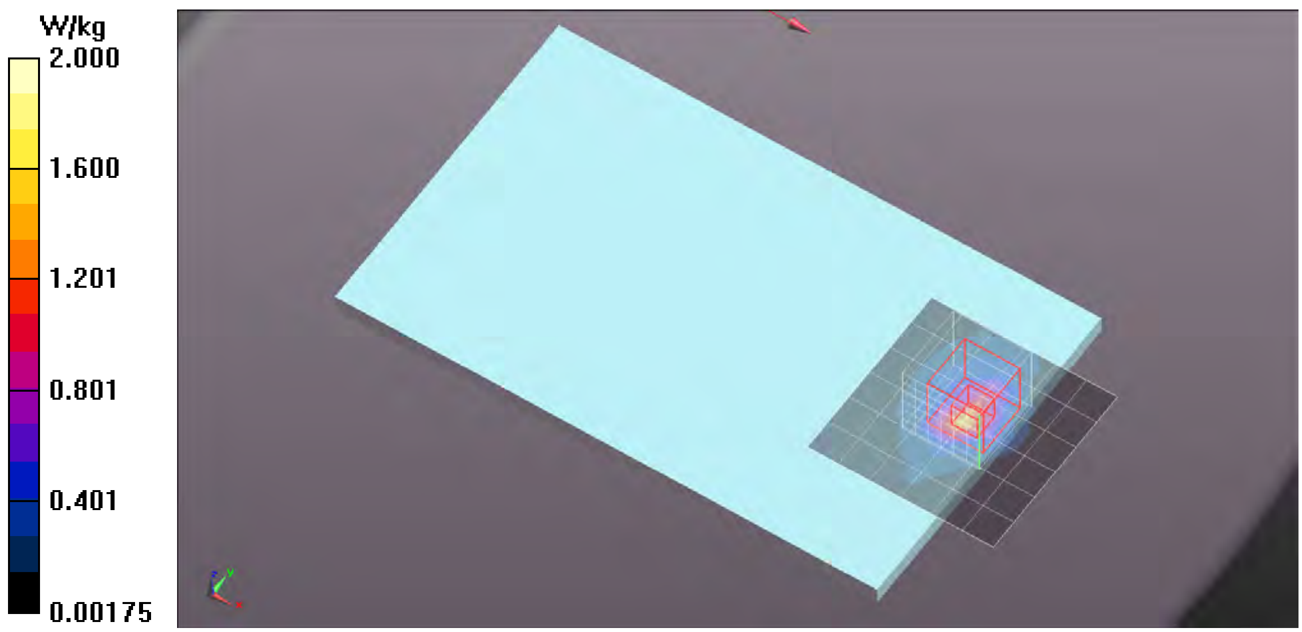
Test Laboratory: Compliance Certification Service Inc. SAR Lab 01 Date: 2014/04/30

2.4GHz Band

Frequency: 2437 MHz; Duty Cycle: 1:1; Room Ambient Temperature: 24.0°C; Liquid Temperature: 23.5°C
Medium parameters used (interpolated): f = 2437 MHz; σ = 1.868 S/m; ε_r = 51.399; ρ = 1000 kg/m^3
DASY5 Configuration:
- Area Scan Setting - Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Electronics: DAE4 Sn877; Calibrated: 2014/03/26
- Probe: EX3DV4 - SN3665; ConvF(7.4, 7.4, 7.4); Calibrated: 2013/05/07;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1056

Rear/Rear/802.11b/Main Ant/Ch6/Area Scan (7x7x1): Measurement grid: dx=12mm, dy=12mm
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 1.52 W/kg

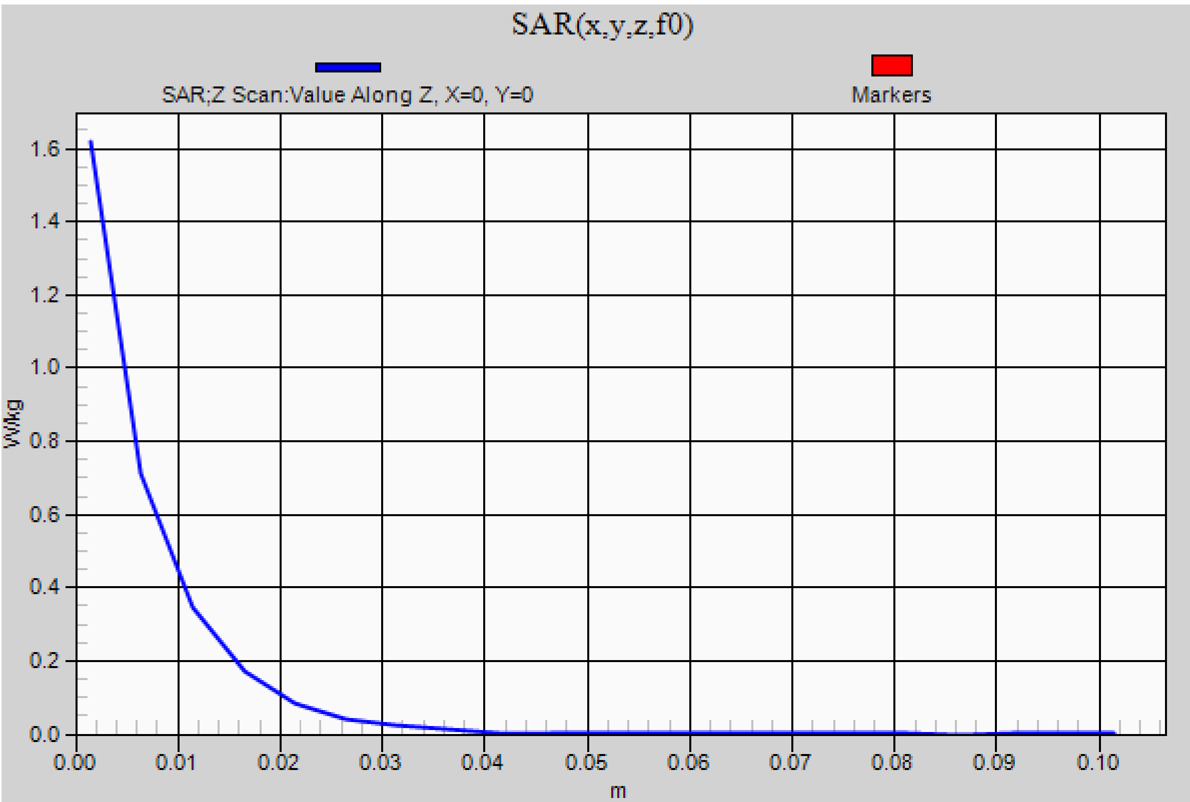
Rear/Rear/802.11b/Main Ant/Ch6/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 17.494 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 2.40 W/kg
SAR(1 g) = 0.932 W/kg; SAR(10 g) = 0.368 W/kg
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 1.67 W/kg



2.4GHz Band

Frequency: 2437 MHz; Duty Cycle: 1:1

Rear/Rear/802.11b/Main Ant/Ch6/Z Scan (1x1x21): Measurement grid: dx=20mm, dy=20mm, dz=5mm
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 1.62 W/kg



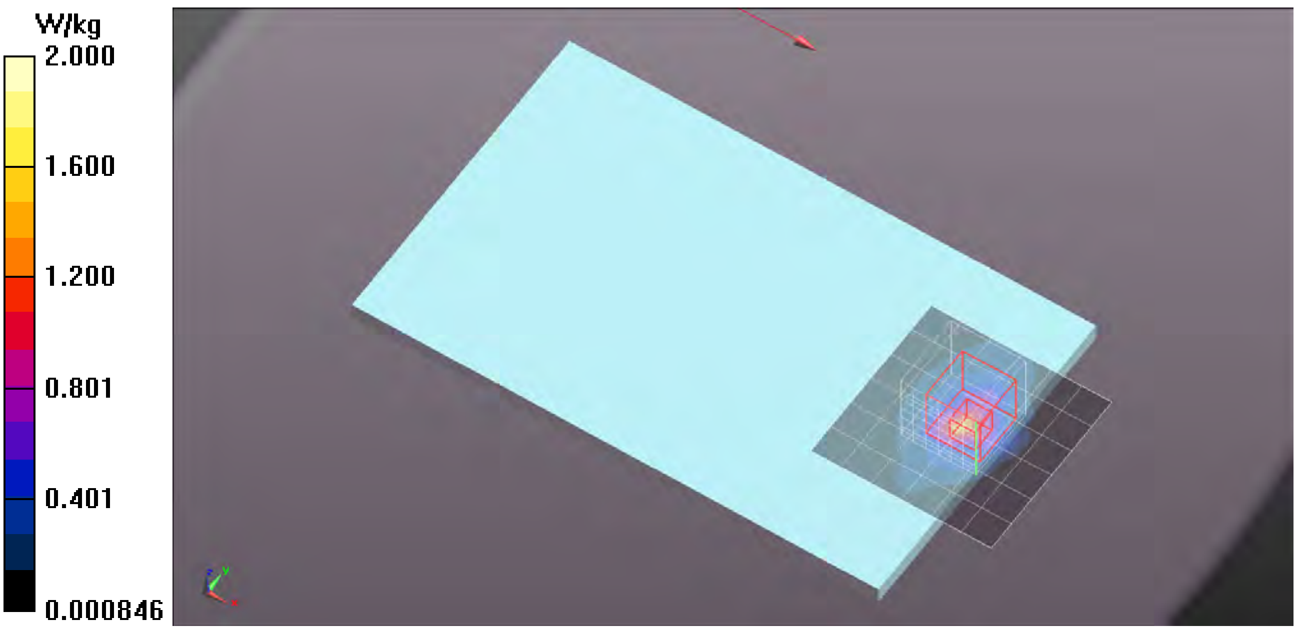
Test Laboratory: Compliance Certification Service Inc. SAR Lab 01 Date: 2014/04/30

2.4GHz Band

Frequency: 2412 MHz; Duty Cycle: 1:1; Room Ambient Temperature: 24.0°C; Liquid Temperature: 23.5°C
Medium parameters used: f = 2412.7 MHz; σ = 1.836 S/m; ε_r = 51.477; ρ = 1000 kg/m^3
DASY5 Configuration:
- Area Scan Setting - Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Electronics: DAE4 Sn877; Calibrated: 2014/03/26
- Probe: EX3DV4 - SN3665; ConvF(7.4, 7.4, 7.4); Calibrated: 2013/05/07;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1056

Rear/Rear/802.11b/Main Ant/Ch1/Area Scan (7x7x1): Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (measured) = 1.48 W/kg

Rear/Rear/802.11b/Main Ant/Ch1/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 0 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 2.27 W/kg
SAR(1 g) = 0.889 W/kg; SAR(10 g) = 0.347 W/kg
Maximum value of SAR (measured) = 1.61 W/kg

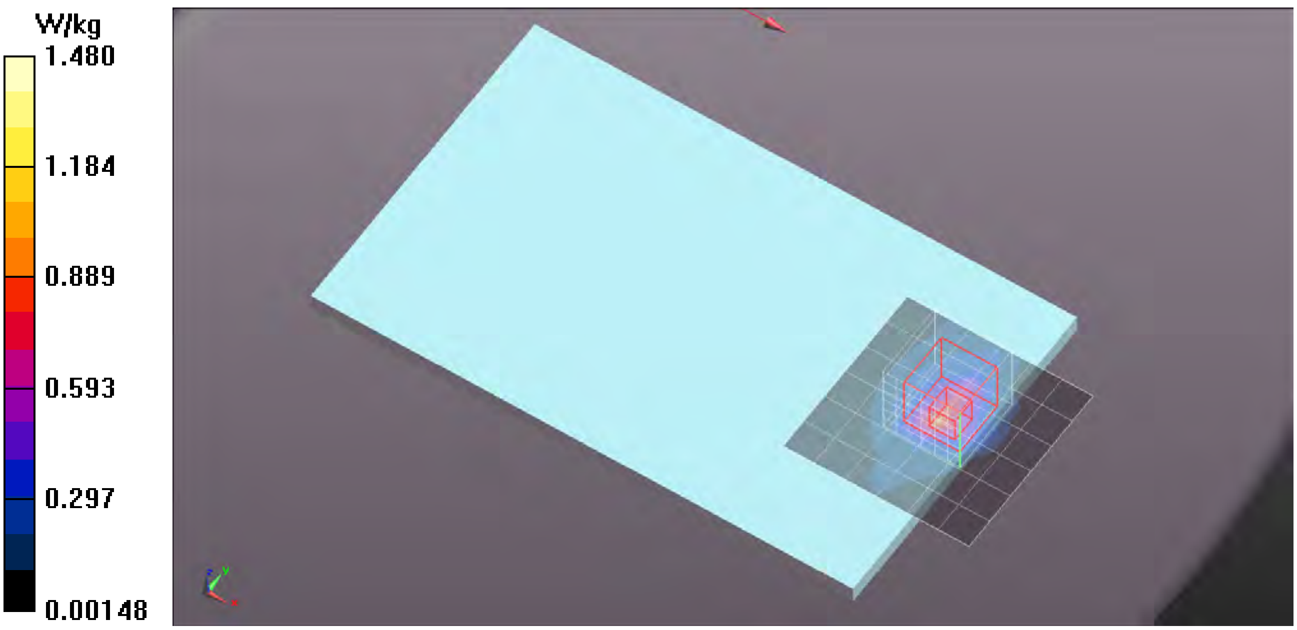


2.4GHz Band

Frequency: 2462 MHz; Duty Cycle: 1:1; Room Ambient Temperature: 24.0°C; Liquid Temperature: 23.5°C
Medium parameters used: f = 2462.2 MHz; σ = 1.901 S/m; ε_r = 51.325; ρ = 1000 kg/m^3
DASY5 Configuration:
- Area Scan Setting - Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Electronics: DAE4 Sn877; Calibrated: 2014/03/26
- Probe: EX3DV4 - SN3665; ConvF(7.4, 7.4, 7.4); Calibrated: 2013/05/07;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1056

Rear/Rear/802.11b/Main Ant/Ch11/Area Scan (7x7x1): Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (measured) = 0.929 W/kg

Rear/Rear/802.11b/Main Ant/Ch11/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 0 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 2.06 W/kg
SAR(1 g) = 0.822 W/kg; SAR(10 g) = 0.333 W/kg
Maximum value of SAR (measured) = 1.48 W/kg

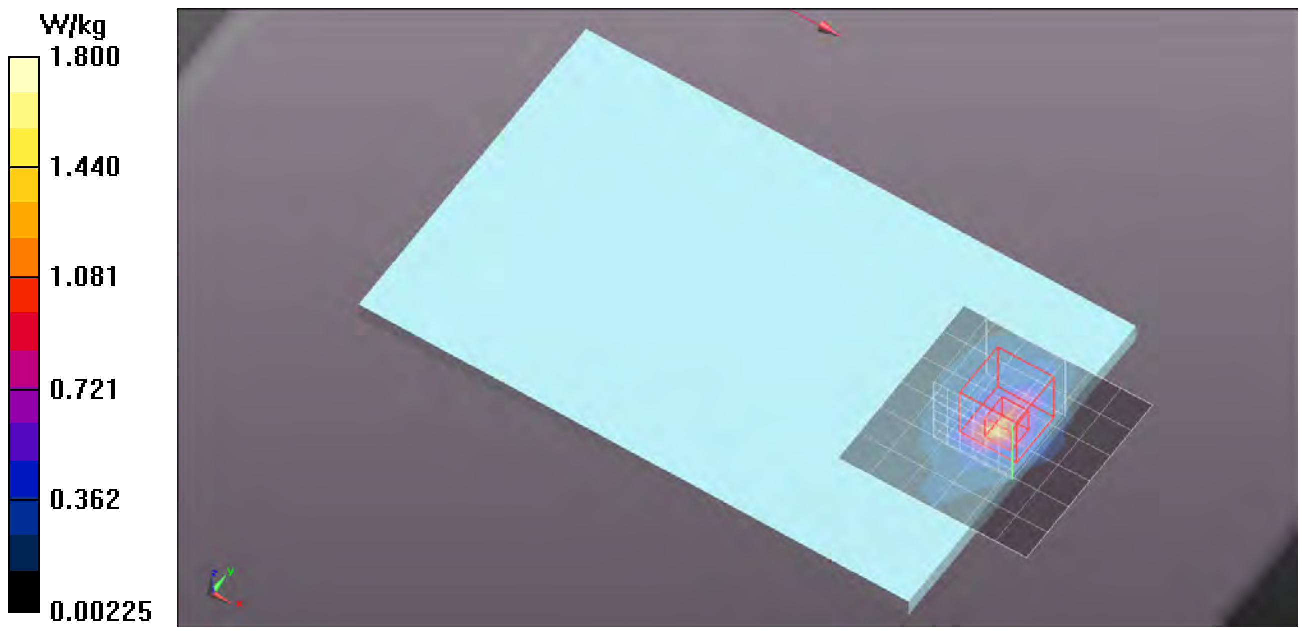


2.4GHz Band

Frequency: 2437 MHz; Duty Cycle: 1:1; Room Ambient Temperature: 24.0°C; Liquid Temperature: 23.5°C
Medium parameters used (interpolated): f = 2437 MHz; σ = 1.868 S/m; ε_r = 51.399; ρ = 1000 kg/m^3
DASY5 Configuration:
- Area Scan Setting - Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Electronics: DAE4 Sn877; Calibrated: 2014/03/26
- Probe: EX3DV4 - SN3665; ConvF(7.4, 7.4, 7.4); Calibrated: 2013/05/07;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1056

Rear/Rear/802.11b/Main Ant/Ch6_Repeat/Area Scan (7x7x1): Measurement grid: dx=12mm, dy=12mm
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 1.33 W/kg

Rear/Rear/802.11b/Main Ant/Ch6_Repeat/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 0.835 V/m; Power Drift = -0.17 dB
Peak SAR (extrapolated) = 0.15 W/kg
SAR(1 g) = 0.951 W/kg; SAR(10 g) = 0.376 W/kg
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 1.67 W/kg

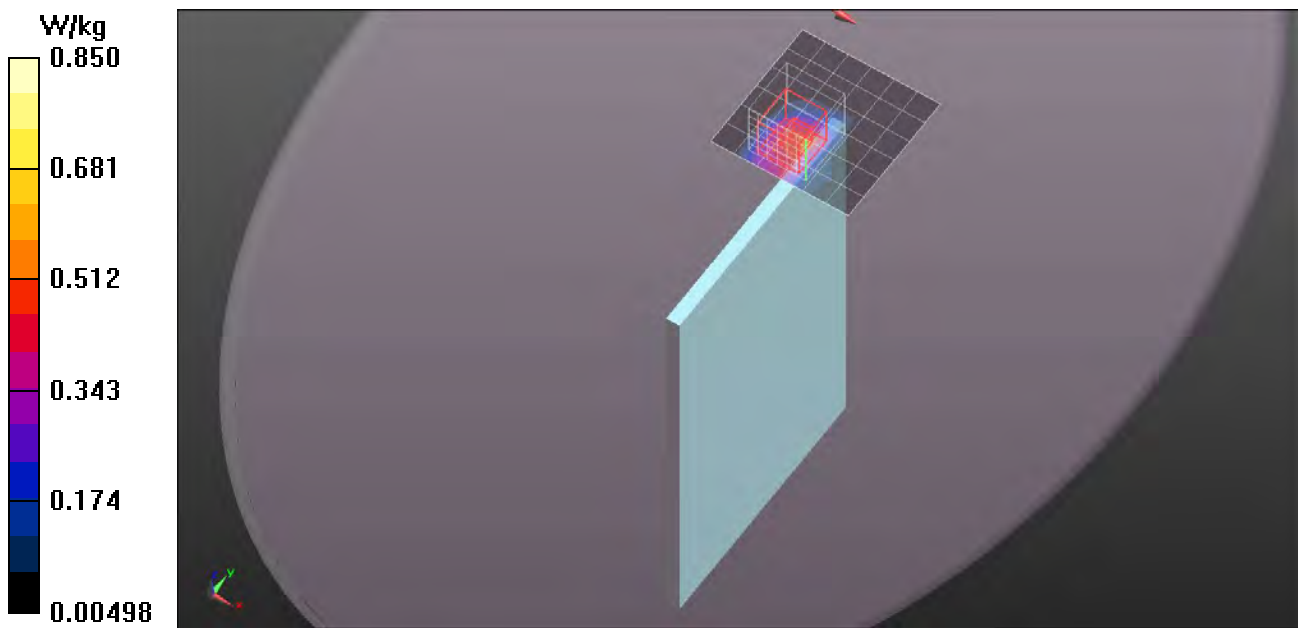


2.4GHz Band

Frequency: 2437 MHz; Duty Cycle: 1:1; Room Ambient Temperature: 24.0°C; Liquid Temperature: 23.5°C
Medium parameters used (interpolated): f = 2437 MHz; σ = 1.868 S/m; ε_r = 51.399; ρ = 1000 kg/m^3
DASY5 Configuration:
- Area Scan Setting - Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Electronics: DAE4 Sn877; Calibrated: 2014/03/26
- Probe: EX3DV4 - SN3665; ConvF(7.4, 7.4, 7.4); Calibrated: 2013/05/07;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1056

Edge/Rear/802.11b/Main Ant/Ch6/Area Scan (7x7x1): Measurement grid: dx=12mm, dy=12mm
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.560 W/kg

Edge/Rear/802.11b/Main Ant/Ch6/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 17.494 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 1.07 W/kg
SAR(1 g) = 0.498 W/kg; SAR(10 g) = 0.226 W/kg
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.856 W/kg

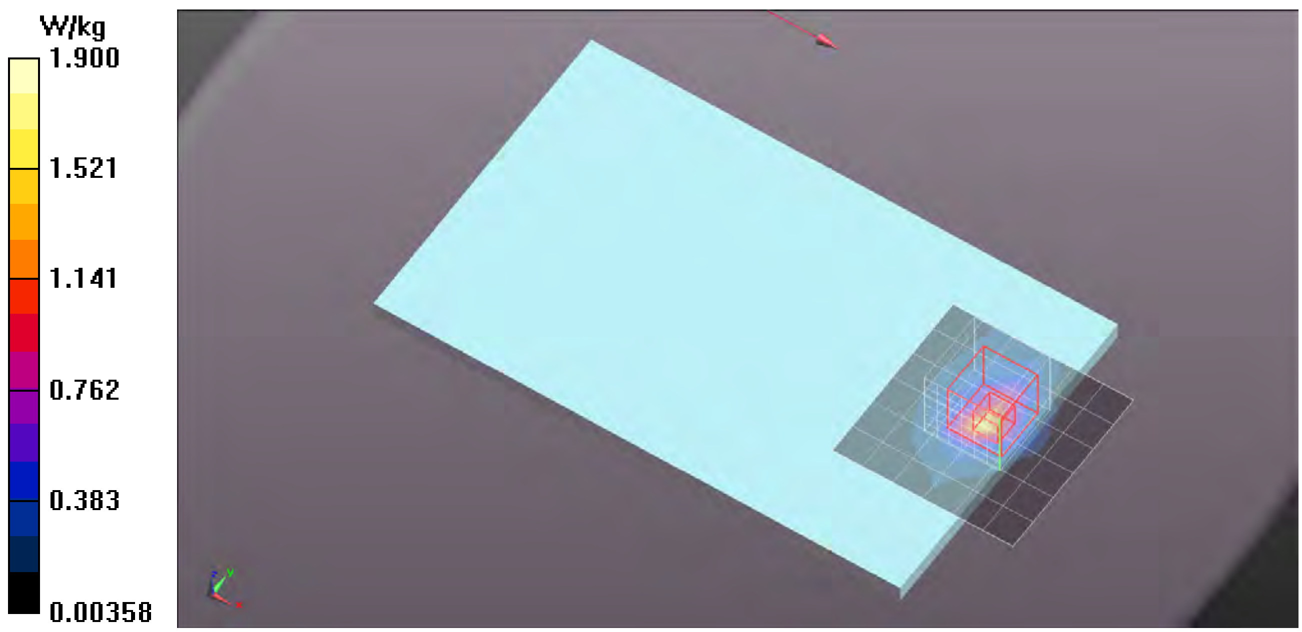


2.4GHz Band

Frequency: 2437 MHz; Duty Cycle: 1:1; Room Ambient Temperature: 24.0°C; Liquid Temperature: 23.5°C
Medium parameters used (interpolated): f = 2437 MHz; σ = 1.868 S/m; ε_r = 51.399; ρ = 1000 kg/m^3
DASY5 Configuration:
- Area Scan Setting - Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Electronics: DAE4 Sn877; Calibrated: 2014/03/26
- Probe: EX3DV4 - SN3665; ConvF(7.4, 7.4, 7.4); Calibrated: 2013/05/07;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1056

Rear/Rear/802.11n/Main Ant/Ch6/Area Scan (7x7x1): Measurement grid: dx=12mm, dy=12mm
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 1.57 W/kg

Rear/Rear/802.11n/Main Ant/Ch6/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 0.736 V/m; Power Drift = 0.10 dB
Peak SAR (extrapolated) = 2.33 W/kg
SAR(1 g) = 0.892 W/kg; SAR(10 g) = 0.356 W/kg
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 1.56 W/kg

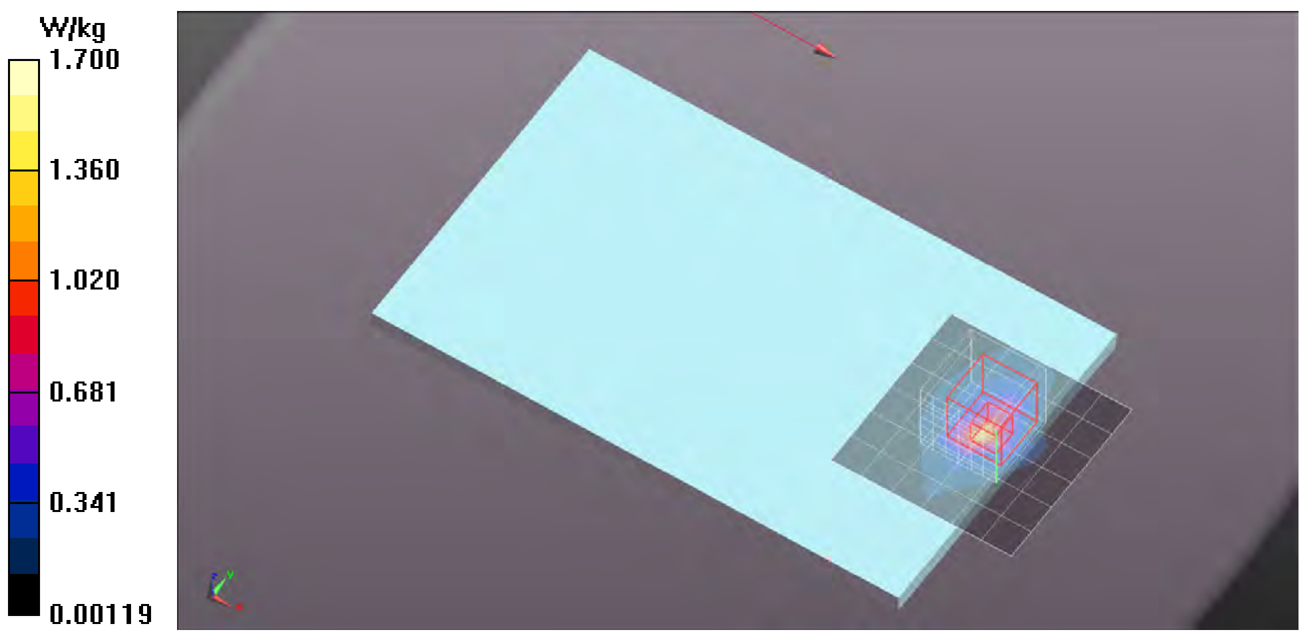


2.4GHz Band

Frequency: 2412 MHz; Duty Cycle: 1:1; Room Ambient Temperature: 24.0°C; Liquid Temperature: 23.5°C
Medium parameters used: f = 2412.7 MHz; σ = 1.836 S/m; ε_r = 51.477; ρ = 1000 kg/m^3
DASY5 Configuration:
- Area Scan Setting - Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Electronics: DAE4 Sn877; Calibrated: 2014/03/26
- Probe: EX3DV4 - SN3665; ConvF(7.4, 7.4, 7.4); Calibrated: 2013/05/07;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1056

Rear/Rear/802.11n/Main Ant/Ch1/Area Scan (7x7x1): Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (measured) = 1.27 W/kg

Rear/Rear/802.11n/Main Ant/Ch1/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 0.580 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 2.02 W/kg
SAR(1 g) = 0.773 W/kg; SAR(10 g) = 0.304 W/kg
Maximum value of SAR (measured) = 1.38 W/kg

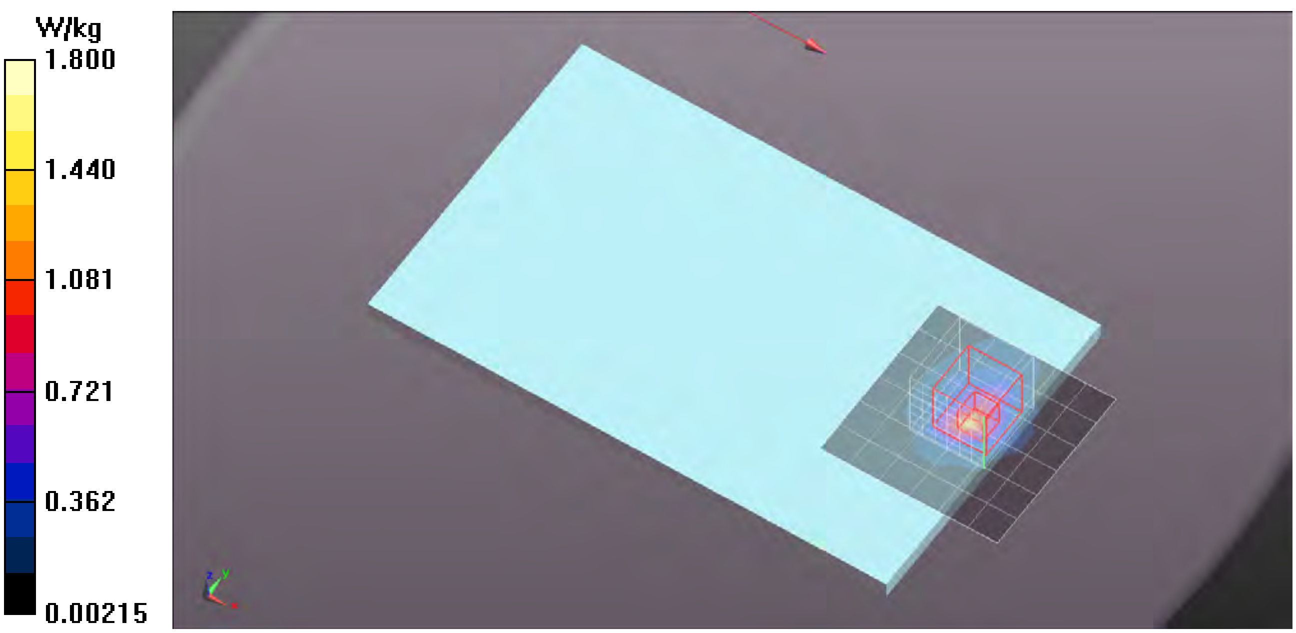


2.4GHz Band

Frequency: 2462 MHz; Duty Cycle: 1:1; Room Ambient Temperature: 24.0°C; Liquid Temperature: 23.5°C
Medium parameters used: f = 2462.2 MHz; σ = 1.901 S/m; ε_r = 51.325; ρ = 1000 kg/m^3
DASY5 Configuration:
- Area Scan Setting - Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Electronics: DAE4 Sn877; Calibrated: 2014/03/26
- Probe: EX3DV4 - SN3665; ConvF(7.4, 7.4, 7.4); Calibrated: 2013/05/07;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1056

Rear/Rear/802.11n/Main Ant/Ch11/Area Scan (7x7x1): Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (measured) = 1.32 W/kg

Rear/Rear/802.11n/Main Ant/Ch11/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 0.616 V/m; Power Drift = 0.19 dB
Peak SAR (extrapolated) = 2.05 W/kg
SAR(1 g) = 0.790 W/kg; SAR(10 g) = 0.314 W/kg
Maximum value of SAR (measured) = 1.38 W/kg

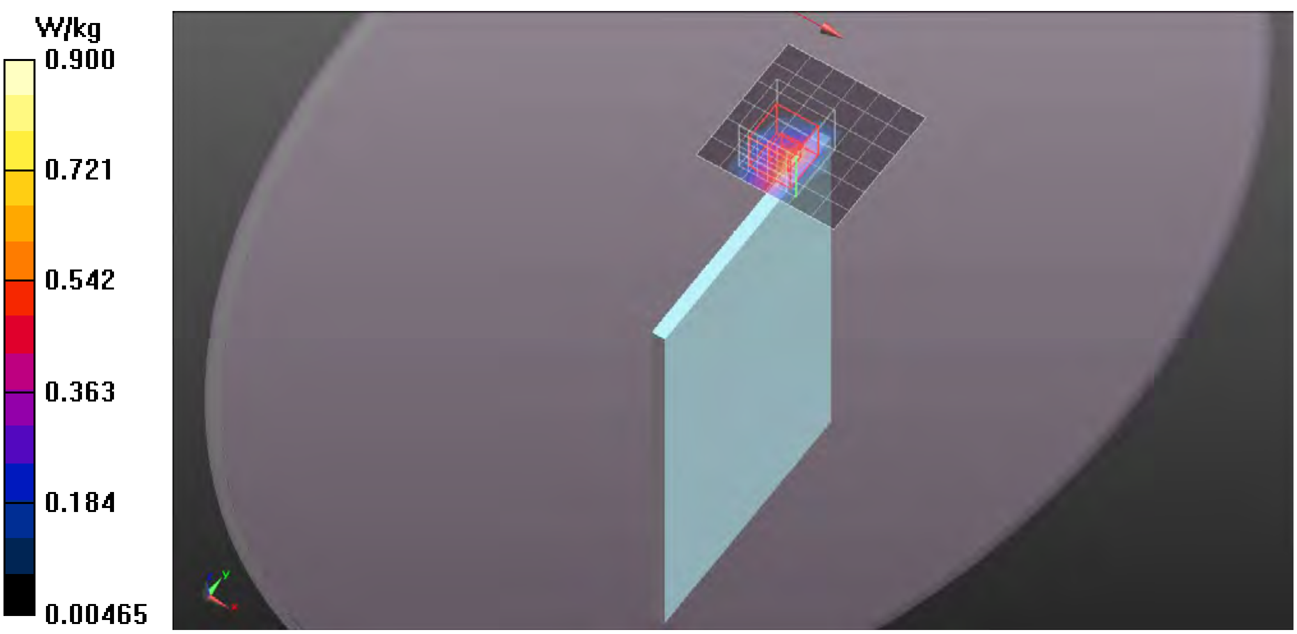


2.4GHz Band

Frequency: 2412 MHz; Duty Cycle: 1:1; Room Ambient Temperature: 24.0°C; Liquid Temperature: 23.5°C
Medium parameters used: f = 2412.7 MHz; σ = 1.836 S/m; ε_r = 51.477; ρ = 1000 kg/m^3
DASY5 Configuration:
- Area Scan Setting - Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Electronics: DAE4 Sn877; Calibrated: 2014/03/26
- Probe: EX3DV4 - SN3665; ConvF(7.4, 7.4, 7.4); Calibrated: 2013/05/07;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1056

Edge/Edge 1/802.11a/Main Ant/Ch1/Area Scan (7x7x1): Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (measured) = 0.648 W/kg

Edge/Edge 1/802.11a/Main Ant/Ch1/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 19.161 V/m; Power Drift = -0.11 dB
Peak SAR (extrapolated) = 0.977 W/kg
SAR(1 g) = 0.463 W/kg; SAR(10 g) = 0.209 W/kg
Maximum value of SAR (measured) = 0.785 W/kg



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 **CCS-TW (Auden)**

Certificate No: EX3-3665_May13

CALIBRATION CERTIFICATE

Object	EX3DV4 - SN:3665
Calibration procedure(s)	QA CAL-01.v8, QA CAL-14.v3, QA CAL-23.v4, QA CAL-25.v4 Calibration procedure for dosimetric E-field probes
Calibration date:	May 7, 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 E4419B	GB41293874	04-Apr-13 (No. 217-01733)	Apr-14
Power sensor E4412A	MY41498087	04-Apr-13 (No. 217-01733)	Apr-14
Reference 3 dB Attenuator	SN: S5054 (3c)	04-Apr-13 (No. 217-01737)	Apr-14
Reference 20 dB Attenuator	SN: S5277 (20x)	04-Apr-13 (No. 217-01735)	Apr-14
Reference 30 dB Attenuator	SN: S5129 (30b)	04-Apr-13 (No. 217-01738)	Apr-14
Reference Probe ES3DV2	SN: 3013	28-Dec-12 (No. ES3-3013_Dec12)	Dec-13
DAE4	SN: 660	31-Jan-13 (No. DAE4-660_Jan13)	Jan-14
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-13)	In house check: Apr-15
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

	Name	Function	Signature
Calibrated by:	Claudio Leubler	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: May 8, 2013

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

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

Probe EX3DV4

SN:3665

Manufactured: October 20, 2008
Calibrated: May 7, 2013

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3665

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	0.50	0.58	0.52	± 10.1 %
DCP (mV)[B]	98.8	97.7	99.8	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	173.8	±2.7 %
		Y	0.0	0.0	1.0		167.0	
		Z	0.0	0.0	1.0		166.4	

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

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3665

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	41.9	0.89	10.20	10.20	10.20	0.27	1.13	± 12.0 %
835	41.5	0.90	9.85	9.85	9.85	0.60	0.64	± 12.0 %
900	41.5	0.97	9.78	9.78	9.78	0.64	0.63	± 12.0 %
1750	40.1	1.37	8.38	8.38	8.38	0.36	0.83	± 12.0 %
1900	40.0	1.40	8.12	8.12	8.12	0.29	0.99	± 12.0 %
2000	40.0	1.40	8.07	8.07	8.07	0.69	0.63	± 12.0 %
2450	39.2	1.80	7.31	7.31	7.31	0.27	1.03	± 12.0 %
2600	39.0	1.96	7.15	7.15	7.15	0.38	0.89	± 12.0 %
5200	36.0	4.66	5.24	5.24	5.24	0.32	1.80	± 13.1 %
5300	35.9	4.76	5.05	5.05	5.05	0.30	1.80	± 13.1 %
5500	35.6	4.96	4.93	4.93	4.93	0.34	1.80	± 13.1 %
5600	35.5	5.07	4.81	4.81	4.81	0.30	1.80	± 13.1 %
5800	35.3	5.27	4.70	4.70	4.70	0.40	1.80	± 13.1 %

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

[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3665

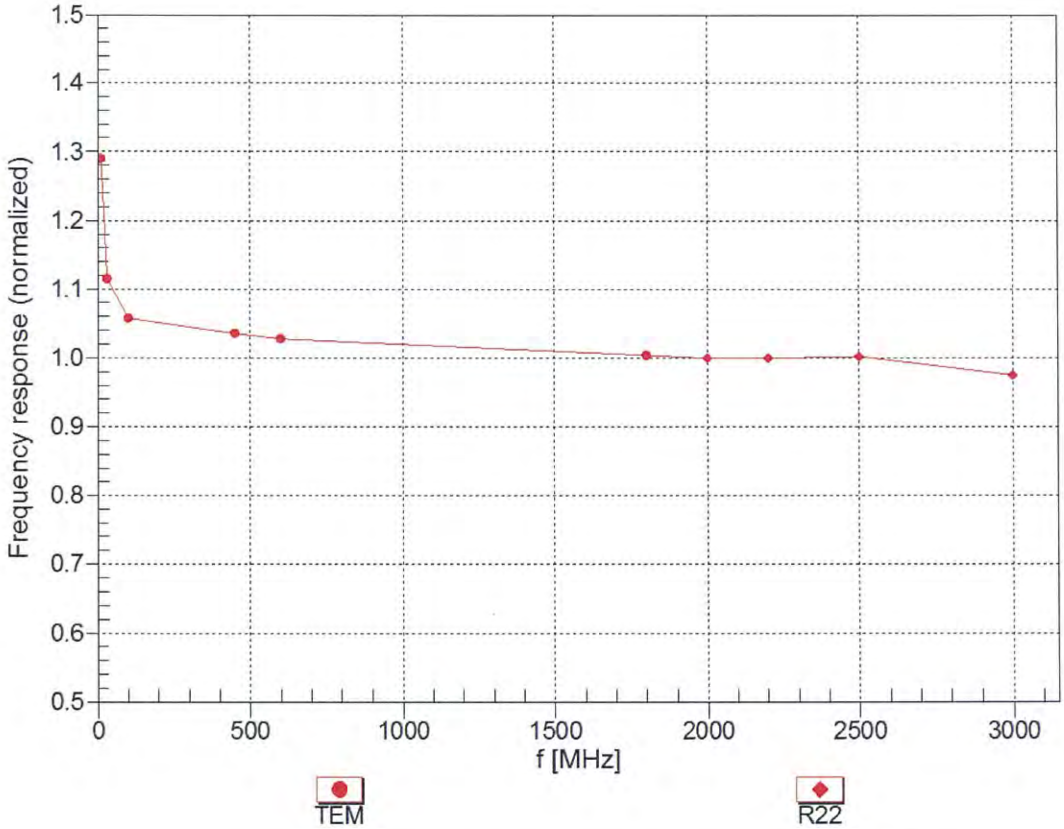
Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	55.5	0.96	9.92	9.92	9.92	0.62	0.71	± 12.0 %
835	55.2	0.97	9.82	9.82	9.82	0.69	0.66	± 12.0 %
900	55.0	1.05	9.73	9.73	9.73	0.44	0.84	± 12.0 %
1750	53.4	1.49	8.06	8.06	8.06	0.34	0.93	± 12.0 %
1900	53.3	1.52	7.75	7.75	7.75	0.20	1.33	± 12.0 %
2000	53.3	1.52	7.89	7.89	7.89	0.62	0.70	± 12.0 %
2450	52.7	1.95	7.40	7.40	7.40	0.80	0.50	± 12.0 %
2600	52.5	2.16	7.19	7.19	7.19	0.80	0.50	± 12.0 %
5200	49.0	5.30	4.44	4.44	4.44	0.43	1.90	± 13.1 %
5300	48.9	5.42	4.27	4.27	4.27	0.41	1.90	± 13.1 %
5500	48.6	5.65	4.05	4.05	4.05	0.42	1.90	± 13.1 %
5600	48.5	5.77	4.07	4.07	4.07	0.30	1.90	± 13.1 %
5800	48.2	6.00	4.38	4.38	4.38	0.44	1.90	± 13.1 %

[C] Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

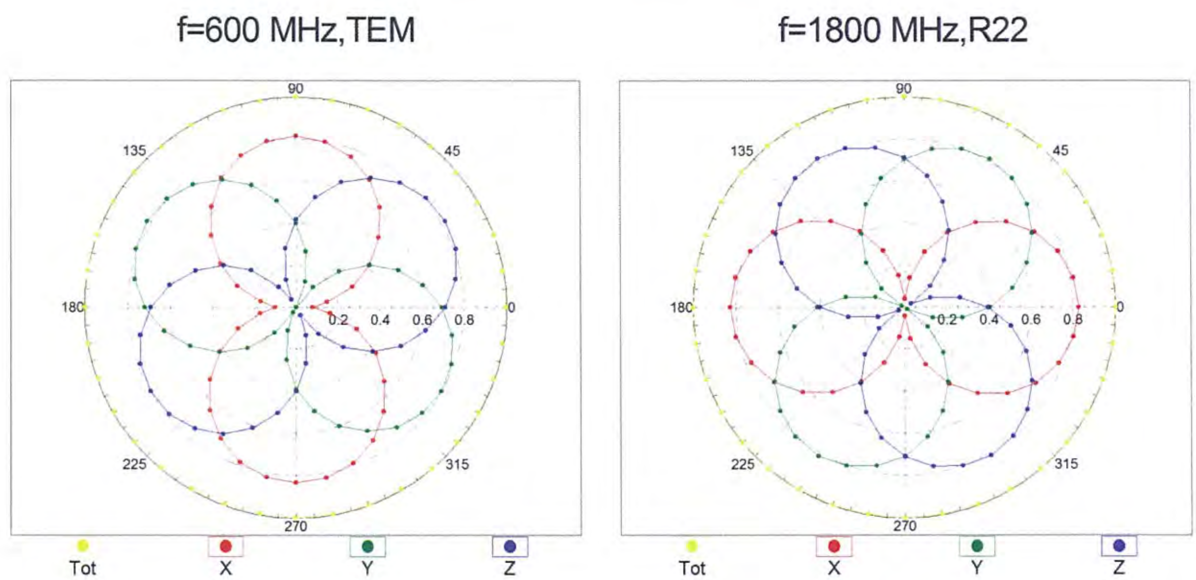
Frequency Response of E-Field

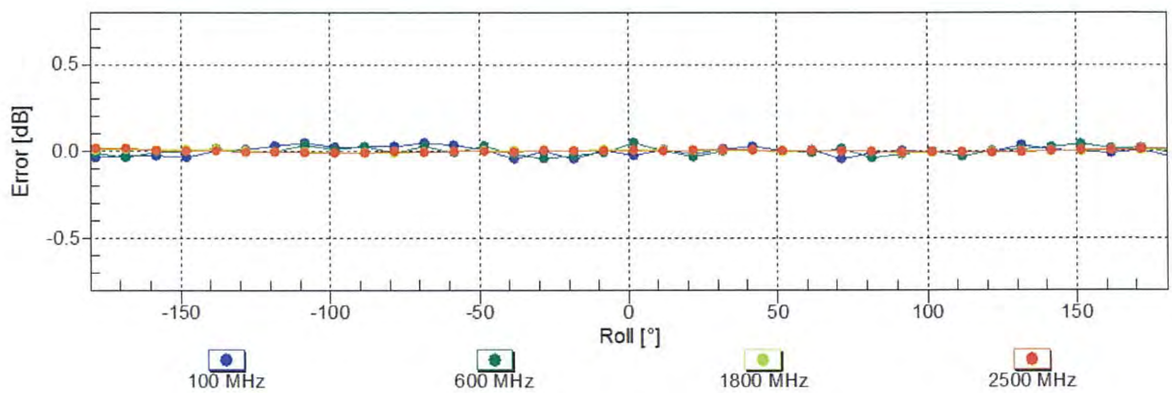
(TEM-Cell:ifi110 EXX, Waveguide: R22)



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

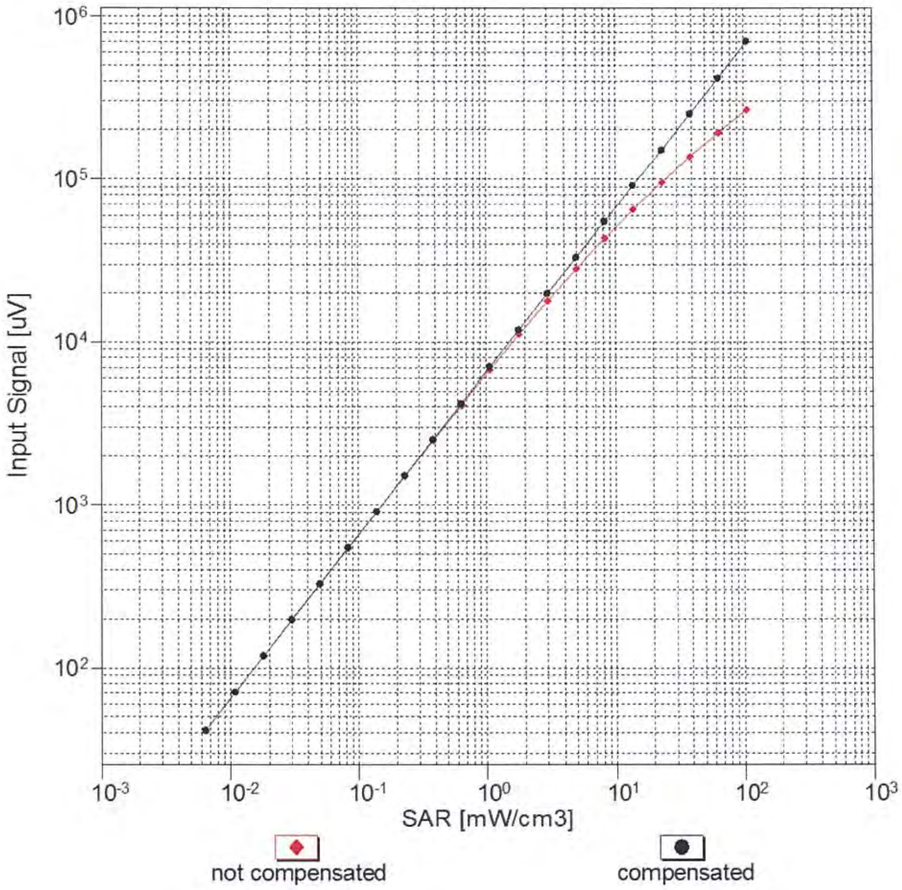
Receiving Pattern (ϕ), ϑ = 0°

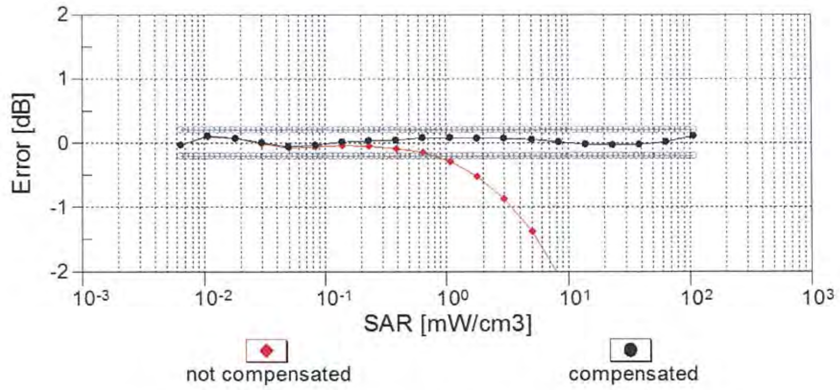




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

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

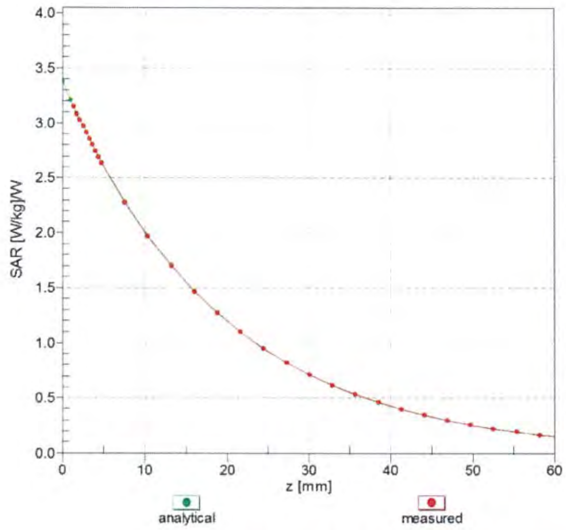




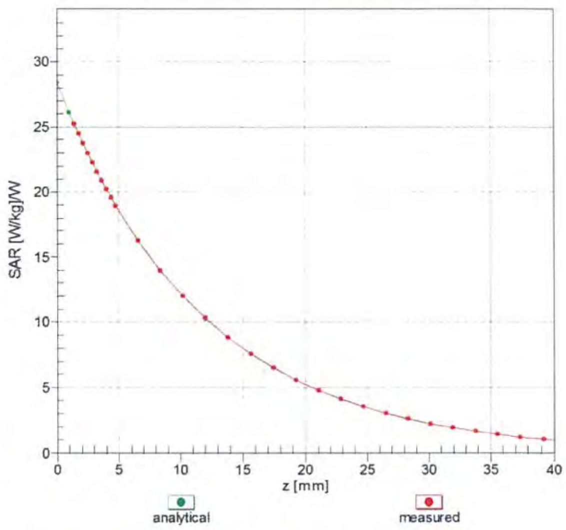
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment

f = 835 MHz,WGLS R9 (H_convF)

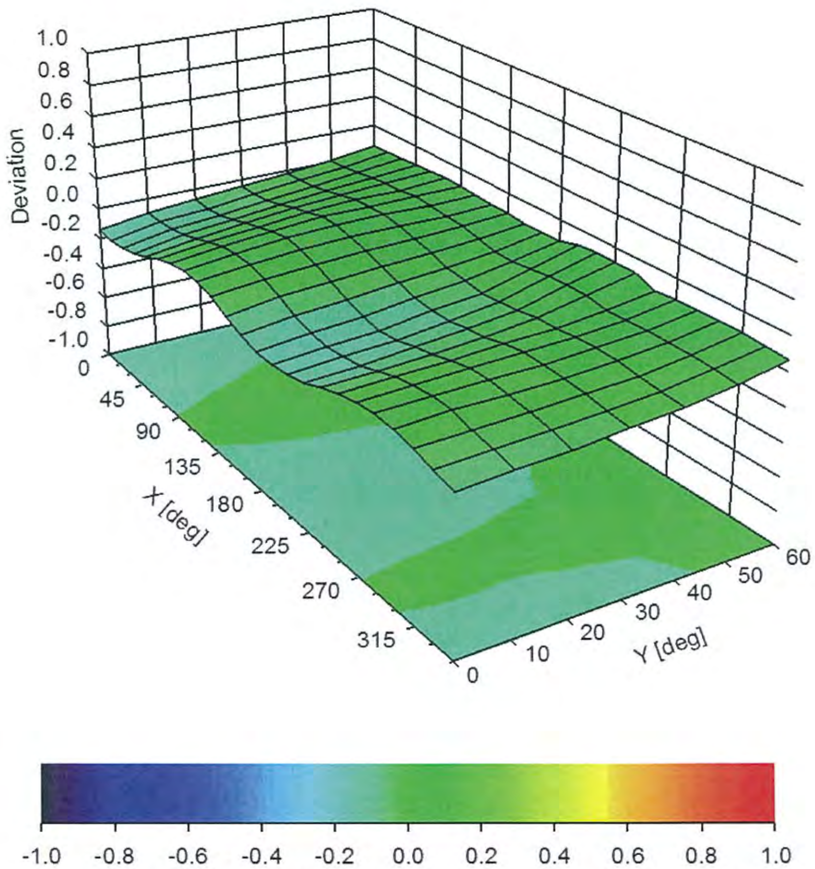


f = 1900 MHz,WGLS R22 (H_convF)



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3665

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-18.3
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	2 mm

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s p e a g

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IMPORTANT NOTICE

USAGE OF THE DAE 4

The DAE unit is a delicate, high precision instrument and requires careful treatment by the user. There are no serviceable parts inside the DAE. Special attention shall be given to the following points:

Battery Exchange: The battery cover of the DAE4 unit is closed using a screw, over tightening the screw may cause the threads inside the DAE to wear out.

Shipping of the DAE: Before shipping the DAE to SPEAG for calibration, remove the batteries and pack the DAE in an antistatic bag. This antistatic bag shall then be packed into a larger box or container which protects the DAE from impacts during transportation. The package shall be marked to indicate that a fragile instrument is inside.

E-Stop Failures: Touch detection may be malfunctioning due to broken magnets in the E-stop. Rough handling of the E-stop may lead to damage of these magnets. Touch and collision errors are often caused by dust and dirt accumulated in the E-stop. To prevent E-stop failure, the customer shall always mount the probe to the DAE carefully and keep the DAE unit in a non-dusty environment if not used for measurements.

Repair: Minor repairs are performed at no extra cost during the annual calibration. However, SPEAG reserves the right to charge for any repair especially if rough unprofessional handling caused the defect.

DASY Configuration Files: Since the exact values of the DAE input resistances, as measured during the calibration procedure of a DAE unit, are not used by the DASY software, a nominal value of 200 MOhm is given in the corresponding configuration file.

Important Note:
Warranty and calibration is void if the DAE unit is disassembled partly or fully by the Customer.

Important Note:
Never attempt to grease or oil the E-stop assembly. Cleaning and readjusting of the E-stop assembly is allowed by certified SPEAG personnel only and is part of the annual calibration procedure.

Important Note:
To prevent damage of the DAE probe connector pins, use great care when installing the probe to the DAE. Carefully connect the probe with the connector notch oriented in the mating position. Avoid any rotational movement of the probe body versus the DAE while turning the locking nut of the connector. The same care shall be used when disconnecting the probe from the DAE.

Schmid & Partner Engineering

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Accreditation No.: SCS 108

Client CCS - TW (Auden)

Certificate No: DAE4-877_Mar14

CALIBRATION CERTIFICATE

Object	DAE4 - SD 000 D04 BJ - SN: 877
Calibration procedure(s)	QA CAL-06.v26 Calibration procedure for the data acquisition electronics (DAE)
Calibration date:	March 26, 2014

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Keithley Multimeter Type 2001	SN: 0810278	01-Oct-13 (No:13976)	Oct-14
Secondary Standards	**ID #**	**Check Date (in house)**	**Scheduled Check**
Auto DAE Calibration Unit	SE UWS 053 AA 1001	07-Jan-14 (in house check)	In house check: Jan-15
Calibrator Box V2.1	SE UMS 006 AA 1002	07-Jan-14 (in house check)	In house check: Jan-15

	Name	Function	Signature
Calibrated by:	Eric Hainfeld	Technician	
Approved by:	Fin Bomholt	Deputy Technical Manager	i.V.

Issued: March 26, 2014

Glossary

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

Methods Applied and Interpretation of Parameters

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

DC Voltage Measurement

A/D - Converter Resolution nominal

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

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

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

Calibration Factors	X	Y	Z
High Range	405.049 ± 0.02% (k=2)	404.595 ± 0.02% (k=2)	405.001 ± 0.02% (k=2)
Low Range	3.99289 ± 1.50% (k=2)	3.98120 ± 1.50% (k=2)	3.97284 ± 1.50% (k=2)

Connector Angle

Connector Angle to be used in DASY system	206.0 ° ± 1 °

Appendix

1. DC Voltage Linearity

High Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	200035.90	0.81	0.00
Channel X	+ Input	20008.13	3.69	0.02
Channel X	- Input	-20002.59	2.01	-0.01
Channel Y	+ Input	200033.31	-1.83	-0.00
Channel Y	+ Input	20005.83	1.46	0.01
Channel Y	- Input	-20005.17	-0.38	0.00
Channel Z	+ Input	200037.18	1.74	0.00
Channel Z	+ Input	20004.61	0.21	0.00
Channel Z	- Input	-20004.82	-0.03	0.00

Low Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	2000.37	-0.68	-0.03
Channel X	+ Input	201.67	0.43	0.22
Channel X	- Input	-198.23	0.56	-0.28
Channel Y	+ Input	2001.86	0.91	0.05
Channel Y	+ Input	201.14	-0.07	-0.03
Channel Y	- Input	-198.43	0.49	-0.25
Channel Z	+ Input	2000.54	-0.46	-0.02
Channel Z	+ Input	199.12	-1.98	-0.99
Channel Z	- Input	-200.37	-1.43	0.72

2. Common mode sensitivity

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

	Common mode Input Voltage (mV)	High Range Average Reading (μV)	Low Range Average Reading (μV)
Channel X	200	14.54	13.31
	- 200	-11.40	-12.95
Channel Y	200	-19.84	-20.25
	- 200	19.79	19.75
Channel Z	200	19.30	19.18
	- 200	-23.23	-23.06

3. Channel separation

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

	Input Voltage (mV)	Channel X (μV)	Channel Y (μV)	Channel Z (μV)
Channel X	200	-	1.00	-3.19
Channel Y	200	6.66	-	2.09
Channel Z	200	8.79	4.53	-

4. AD-Converter Values with inputs shorted

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

	High Range (LSB)	Low Range (LSB)
Channel X	15994	17224
Channel Y	15872	16182
Channel Z	15669	15233

5. Input Offset Measurement

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

Input 10MΩ

	Average (μV)	min. Offset (μV)	max. Offset (μV)	Std. Deviation (μV)
Channel X	1.26	-0.23	2.87	0.61
Channel Y	0.20	-1.19	1.59	0.55
Channel Z	-1.09	-2.38	0.38	0.61

6. Input Offset Current

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

7. Input Resistance (Typical values for information)

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

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

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

9. Power Consumption (Typical values for information)

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

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Zeughausstrasse 43, 8004 Zurich, Switzerland

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Accreditation No.: SCS 108

Client CCS-CN (Auden)

Certificate No: D2450V2-728_May13

CALIBRATION CERTIFICATE

Object	D2450V2 - SN: 728
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	May 02, 2013

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	01-Nov-12 (No. 217-01640)	Oct-13
Power sensor HP 8481A	US37292783	01-Nov-12 (No. 217-01640)	Oct-13
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-13 (No. 217-01736)	Apr-14
Type-N mismatch combination	SN: 5047.3 / 06327	04-Apr-13 (No. 217-01739)	Apr-14
Reference Probe ES3DV3	SN: 3205	28-Dec-12 (No. ES3-3205_Dec12)	Dec-13
DAE4	SN: 601	25-Apr-13 (No. DAE4-601_Apr13)	Apr-14

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

	Name	Function	Signature
Calibrated by:	Claudio Leubler	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: May 2, 2013

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Zeughausstrasse 43, 8004 Zurich, Switzerland

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Accreditation No.: SCS 108

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.6
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz ± 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	37.7 ± 6 %	1.83 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	13.6 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**53.5 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.32 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**25.0 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	51.2 ± 6 %	2.03 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	13.1 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**51.1 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.07 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**23.9 W/kg ± 16.5 % (k=2)**

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	56.7 Ω + 5.4 jΩ
Return Loss	- 21.9 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	52.4 Ω + 7.6 jΩ
Return Loss	- 22.2 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.153 ns

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	January 09, 2003

DASY5 Validation Report for Head TSL

Date: 02.05.2013

Test Laboratory: SPEAG, Zurich, Switzerland

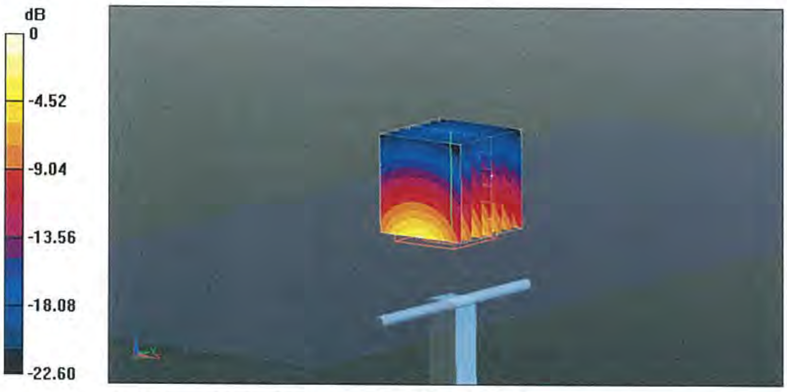
DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 728

Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 1.83 S/m; ε_r = 37.7; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

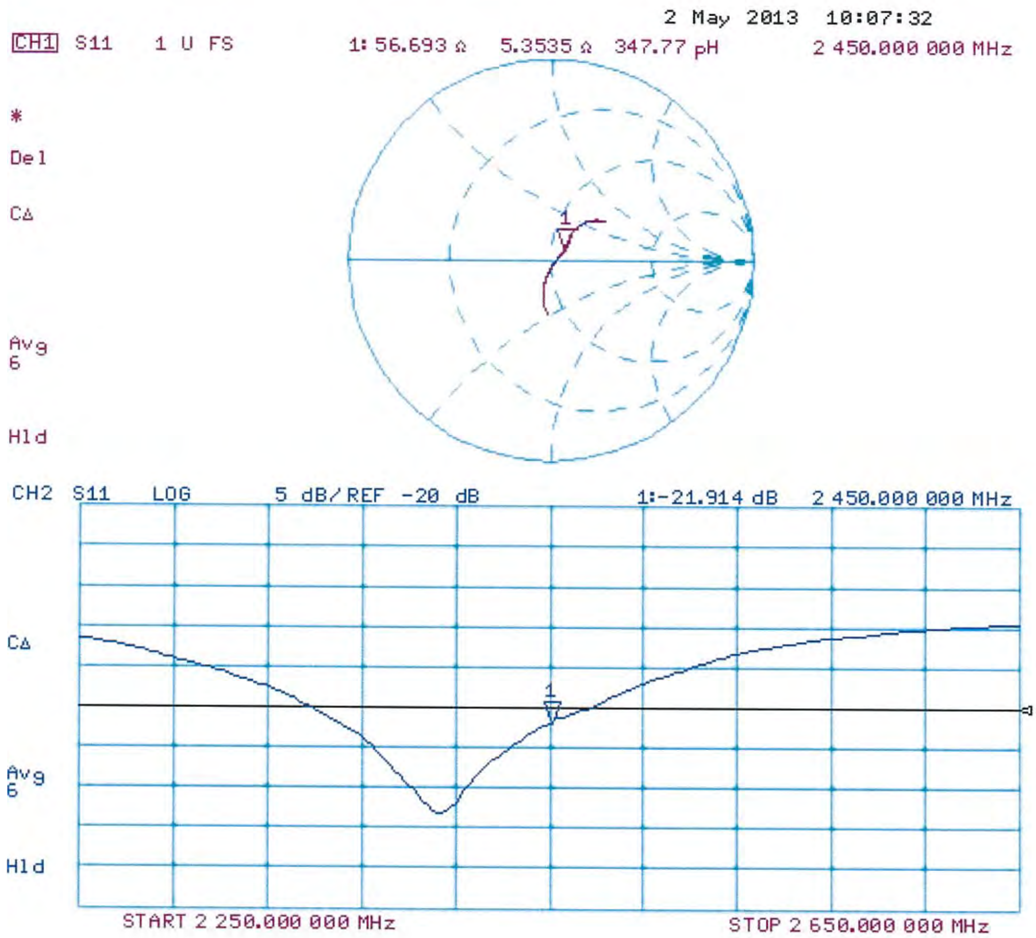
- Probe: ES3DV3 - SN3205; ConvF(4.52, 4.52, 4.52); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.6(1115); SEMCAD X 14.6.9(7117)

Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 94.919 V/m; Power Drift = 0.09 dB
Peak SAR (extrapolated) = 28.3 W/kg
SAR(1 g) = 13.6 W/kg; SAR(10 g) = 6.32 W/kg
Maximum value of SAR (measured) = 17.6 W/kg



0 dB = 17.6 W/kg = 12.46 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 02.05.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 728

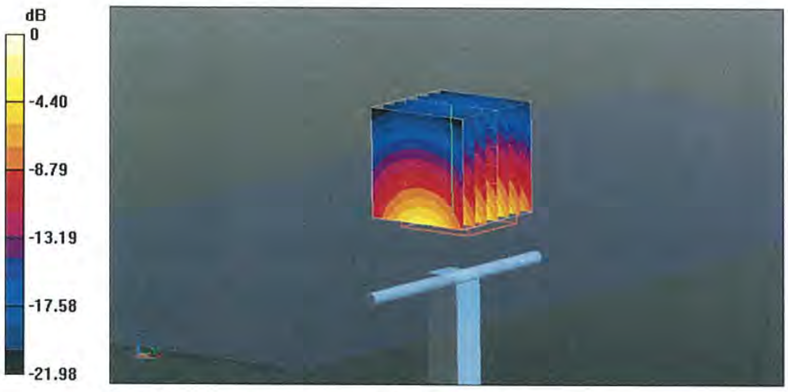
Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; $\sigma = 2.03$ S/m; $\varepsilon_r = 51.2$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.42, 4.42, 4.42); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.6(1115); SEMCAD X 14.6.9(7117)

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

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 94.919 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 27.5 W/kg
SAR(1 g) = 13.1 W/kg; SAR(10 g) = 6.07 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 Body TSL