SAR Evaluation Report
for
FCC OET Bulletin 65 Supplement C

Report No.: 11-08-MAS-166

Client:	Amtek system Co., Ltd.
Product:	Tablet PC
Model:	T10x (x=0~9, A~Z)
FCC ID:	R4RT10LX2AIR11
Manufacturer/supplier:	----

Date test item received:	2011/08/08
Date test campaign completed:	2011/08/12
Date of issue:	2011/08/15

Test Result: ■ Compliance ☐ Not Compliance

Statement of Compliance:
The SAR values measured for the test sample are below the maximum recommended level of 1.6 W/kg averaged over any 1g tissue according to FCC OET Bulletin 65 Supplement C (Edition 01-01).

The test result only corresponds to the tested sample. It is not permitted to copy this report, in part or in full, without the permission of the test laboratory.

Total number of pages of this test report: 66 pages

Test Engineer	Checked by	Approved by
Perry Lin	Joe Hsieh	Anson Chou
Perry Lin	Joe Hsieh	Anson Chou

The testing described in this report has been carried out to the best of our knowledge and ability, and our responsibility is limited to the exercise of reasonable care. This certification is not intended to believe the sellers from their legal and/or contractual obligations.

Applicant Information

Client	**:**	Amtek system Co., Ltd.
Address	**:**	14F-11, No. 79, Sec. 1, Hsin Tai Wu Rd., Hsi Chih City, Taipei Hsien 22101, Taiwan
Manufacturer	**:**	----
Address	**:**	----
EUT	**:**	Tablet PC
Trade name		----
Model No.	**:**	T10x (x=0~9, A~Z)
Standard Applied	**:**	FCC OET 65 Supplement C (Edition 01-01, June 2001) IEEE Standard 1528-2003 KDB: 447498 (12/02/2008)
Laboratory	**:**	CERPASS TECHNOLOGY CORP. 2F-11, No.3 Yuan Qu St (Nankang Software Park), Taipei 11560 Taiwan, R.O.C.
Test Location	**:**	No.8, Lane 29, Wenming RD., LeShan Tsuen, GuiShan Shiang, Taoyuan County 33383, Taiwan, R.O.C.
Test Result	**:**	Maximum SAR Measurement 802.11b: 0.631 W/kg(1g) 802.11g: 0.567 W/kg(1g) 802.11n HT20: 0.318 W/kg(1g) 802.11n HT40: 0.349 W/kg(1g)

The Tablet PC is in compliance with the FCC Report and Order 93-326 and Health Canada Safety Code 6, and the tests were performed according to the FCC OET65c for uncontrolled exposure.

Table of Contents

Executive Summary

The EUT is a Tablet PC operating in the 2.4GHz frequency ranges. This device contains wireless functions that are operational in IEEE 802.11b, IEEE 802.11g, IEEE 802.11n HT20 and IEEE 802.11n HT40 modes. The measurements were conducted by CERPASS and carried out with the dosimetric assessment system – DASY4.

The measurements were conducted according to FCC OET 65 Supplement C [Reference 5] for evaluating compliance with requirements of FCC Report and Order 96-326 [Reference 3].

The frequency range of the device:

IEEE 802.11b/g/n HT20		**IEEE 802.11n HT40**	
CH	**MHz**	**CH**	**MHz**
01	2412	03	2422
06	2437	06	2437
11	2462	09	2452

This device is a tablet PC and the monitor cannot rotate. The test position of SAR testing will be back site and bottom site of the tablet PC.

This device uses two antennas operate at 2.4GHz. Two antennas will be tested separately and combine at different mode.

1 General Information

1.1 Description of Equipment Under Test

EUT Type	Tablet PC
Trade Name	iTablet
Model Name	T10x (x=0~9, A~Z)
Hardware version	N/A
Software version	N/A
Tx Frequency	2412 ~ 2462 MHz
Rx Frequency	2412 ~ 2462 MHz
Antenna Type	Internal Type
Device Category	Portable Part
RF Exposure Environment	General Population / Uncontrolled
Crest Factor	1

1.2 Photograph of EUT

Front	Back
	

1.3 Characteristics of Device

The EUT is a 2.4 GHz Tablet PC. It conforms to the IEEE 802.11b/g/n protocal and operates in the unlicensed ISM Band at 2.4 GHz.

RF chain	2T2R
Frequency Range	IEEE 802.11b/g, 802.11n HT20: 2412MHz~2462MHz IEEE 802.11n HT40: 2422MHz~2452MHz
Channel Spacing	IEEE 802.11b/g/n: 5MHz
Channel Number	IEEE 802.11b/g, 802.11n HT20: 11 Channels IEEE 802.11n HT40: 7 Channels

1.4 Description of support units

No support unit for this device.

1.5 Environment Conditions

Item	Target	Measured
Ambient Temperature (°C)	18 ~ 25	22 ± 1
Temperature of Simulant (°C)	20 ~ 24	22 ± 1
Relative Humidity (% RH)	30 ~ 70	60 ~ 70

1.6 FCC Requirements for SAR Compliance Testing

According to the FCC order “Guidelines for Evaluating the Environmental Effects of RF Radiation”, for consumer products, the SAR limit is **1.6 W/kg** for an uncontrolled environment and **8.0 W/kg** for an occupational/controlled environment. Pursuant to the Supplement C of OET Bulletin 65 “Evaluating Compliance with FCC Guide-lines for Human Exposure to Radio frequency Electromagnetic Fields”, released on June 29, 2001 by FCC, the equipment under test should be evaluated at maximum output power (radiated from the antenna) under “worst-case” conditions for intended or normal operation, incorporating normal antenna operating positions, equipment undet test peak performance frequencies and positions for maximum RF power coupling.

1.6.1 RF Exposure Limits

	Whole-Body	Partial-Body	Arms and Legs
Population/Uncontrolled Environments (W/kg)	0.08	1.6	4.0
Occupational/Controlled Environments (W/kg)	0.4	8.0	20.0

Notes:

1. Population/Uncontrolled Environments: Locations where there is the exposure of individuals who have no sense or control of their exposure.
2. Occupational/Controlled Environments: Locations where there is exposure that may be incurred by people who have knowledge of the potential for exposure.
3. Whole-Body: SAR is averaged over the entire body.
4. Partial-Body: SAR is averaged over any 1g of tissue volume as defined in specification.
5. Arms and Legs: SAR is averaged over 10g of tissue volume as defined in specification.

1.7 The SAR Measurement Procudure

1.7.1 General Requirements

The test should be performance in a laboratory without influence on SAR measurements by ambient RF sources and any reflection from the environment inside. The ambient temperature should be kept in the range of 18°C to 25°C with a maximum variation within ± 2°C during the test.

1.7.2 Phantom Requirements

The phantoms used in test are simplified representations of the human head and body as a specific shaped container for the head or body simulating liquids. The physical characteristics of the phantom models should resemble the head and the body of a mobile user sice the shape is a dominant parameter for exposure. The shell of the phantom should be made of low loss and low permittivity material and the thickness tolerance should be less than 0.2 mm. In addition, the phantoms should provide simulations of both right and left hand operations.

1.7.3 Test Positions

Position	Description
A	The Tablet PC (EUT) contacted to the bottom of ELI4 phantom by the **BACK** site. The separation distance is 0mm between the **BACK** site of the EUT and the bottom of the ELI4 phantom.
B	The Tablet PC (EUT) contacted to the bottom of ELI4 phantom by the **BOTTOM** site. The separation distance is 0mm between the **BOTTOM** of the EUT and the bottom of the ELI4 phantom.

1.7.4 Test Procedures

The EUT uses the software to control the transmitter channel and transmission power. Then record the conducted power before the testing. Place the EUT to the specific test location. After the testing, must writing down the conducted power of the EUT into the report. The SAR value was calculated via the 3D spline interpolation algorithm that has been implemented in the software of DASY4 SAR measurement system manufactured and calibrated by SPEAG.

2 Description of the Test Equipment

The measurements were performed using an automated near-field scanning system, DASY4 software, manufactured by Schmid & Partner Engineering AG (SPEAG) in Switzerland. The SAR extrapolation algorithm used in all measurements on the test device was the 'worstcase extrapolation' algorithm.

2.1 Test Equipment List

Equipment	Manufacturer	Type	S/N	Calibration Expiry
Robot	Staubli	RX90B L	F03/5W16A1/A/01	(not necessary)
Robot Controller	Staubli	CS7MB	F03/5W16A1/C/01	(not necessary)
Teach Pendant	Staubli	------------	D221340061	(not necessary)
DAE4	Schmid & Partner Engineering AG	------------	629	2011-09-16
E-field Probe	Schmid & Partner Engineering AG	EX3DV4	3555	2011-09-21
Dipole Validation Kit	Schmid & Partner Engineering AG	D2450V2	764	2012-09-21
Thermo-Hygro.meter	TFA	------------	------------	2012-07-20
Directional Coupler	Amplifier Research	DC7420	310569	2011-08-22
DASY4 Software	Schmid & Partner Engineering AG	------------	Version 4.6B23	To automatically control the robot and perform the SAR measurement
SEMCAD Software	Schmid & Partner Engineering AG	------------	Version 1.8B160	Post-processing and report management
Signal Generator	Agilent	83640B	3844A01143	2011-10-04
Amplifier	Mini-Circuits	ZHL-42W	D111704-01-02	2011-08-24
Power Meter	BOONTON	4532-0102	136601	2012-06-19
Power Sensor	BOONTON	51011-EMC	32861	2012-06-19
S-Parameter Network Analyzer	Agilent	8753ES	MY40001340	2011-12-08
Calibration Kit	Agilent	85033C	2920A03287	(not necessary)
Dielectric Probe Kit	Agilent	85070E	MY44300101	(not necessary)

2.2 DASY4 Measurement System Diagram

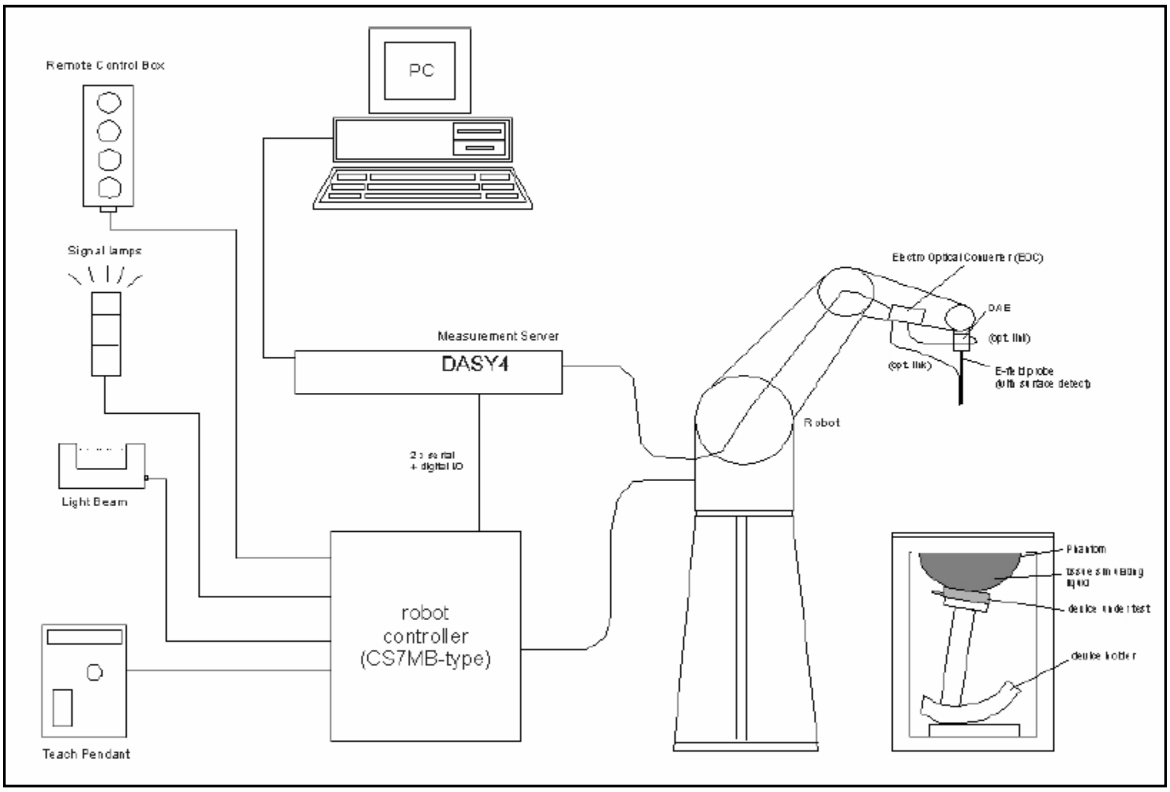


Fig. 1 The DASY4 Measurement System

Fig. 2 The DASY4 System Photo

The DASY4 system consists of the following items:

- A fixed-on-ground high precision 6-axis robot with controller and software and an arm extension for moving the Data Acquisition Electronics (DAE) and Probe.
- A dosimetric probe, an isotropic E-field probe optimized and calibrated for usage in head or body tissue simulating liquids. Some of the probes are equipped with an optical surface detector system.
- A Data Acquisition Electronic (DAE) performing the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. DAE is powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
- A unit to operate the optical surface detector which is connected to Electro-Optical Coupler (EOC).
- The EOC performs the conversion from the optical into a digital electric signal of the DAE. The EOC is connected to the DASY4 measurement server.
- The DASY4 measurement server performing all real-time data evaluation for field measurements and surface detection, controling robot movements and handling safety operation. A computer with operating Windows 2000 is used for server.
- DASY4 software and SEMCAD data evaluation software are installed in PC.
- Remote control with teach panel and additional circuitry for robot safety such as warning lamps, etc.
- The generic twin phantom enabling the testing of left-hand and right-hand usage.
- The device holder for handheld mobile phones.
- Tissue simulating liquid mixed well according to the given recipes.
- System validation dipoles is used to validate the proper functioning of the system

2.3 DASY4 Measurement Server

Fig. 3 DASY4 Measurement Server

The DASY4 measurement server is based on a PC/104 CPU board with a 166MHz low-power pentium, 32MB chipdisk and 64MB RAM. The necessary circuits for communication with either the DAE4 (or 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 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.

2.4 DAE (Data Acquisition Electronics)

Fig. 4 DAE Photo

Some probes are equipped with an optical multifiber line, ending at the front of the probe tip. This line is connected to the EOC box on the robot arm and provides automatic detection of the phantom surface. Half of the fibers are connected to a pulsed infrared transmitter, the other half to a synchronized receiver. If the probe approaches the surface, the reflection from the surface produces a coupling from the transmitting to the receiving fibers. This reflection increases during the approach, reaches a maximum and then decreases. If the probe perpendicularly touches the surface, the coupling is zero. The distance of the coupling maximum to the surface is independent of the surface reflectivity and largely independent of the surface to probe angle. The DASY4 software reads the reflection during a software approach and looks for the maximum using a 2nd order fitting. The approach is stopped upon reaching the maximum.

The optical surface detection works in transparent liquids and on di_use reflecting surfaces with a repeatability of better than ±0.1mm. The distance of the maximum depends on the fiber and the surrounding media. It is typically 1.0mm to 2.0mm in tissue simulating mixtures. The distance can be measured with the surface check job (described in the reference guide).

2.5 Phantom

SAM Twin Phantom V4.0:

The phantom used for all tests i.e. for both system performance checking and device testing, was the twinheaded "SAM Twin Phantom V4.0", manufactured by SPEAG. The phantom conforms to the requirements of IEEE 1528 - 2003.

SAM Phantom ELI4:

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 62209-2. ELI4 has been optimized regarding its performance and can be integrated into our standard phantom tables. A cover prevents evaporation of the liquid.

Fig. 5 SAM Twin Phantom and ELI4 Phantom

2.6 Device Holder

The device was placed in the device holder (illustrated below) that is supplied by SPEAG as an integrated part of the Dasy system.

Fig. 6 Device holder supplied by SPEAG

2.7 Specifications of Probes

The E-Field Probes ET3DV6 or EX3DV4, manufactured and calibrated annually by Schmid & Partner Engineering AG with following specification are used for the dosimetric measurements.

ET3DV6:

- Dynamic range: 5 μ W/g ~ 100 mW/g
- Tip diameter: 6.8 mm
- Probe linearity: ± 0.2 dB (30MHz to 3 GHz)
- Axial isotropy: ± 0.2 dB
- Spherical isotropy: ± 0.4 dB
- Distance from probe tip to dipole centers: 2.7 mm
- Calibration range: 900MHz/1750MHz/1900MHz/ /2450MHz for head and body simulating liquids.

EX3DV4:

- Dynamic range: 10 μ W/g ~ 100 mW/g
- Tip diameter: 2.5 mm
- Probe linearity: ± 0.2 dB (30MHz to 3 GHz)
- Axial isotropy: ± 0.2 dB
- Spherical isotropy: ± 0.4 dB
- Distance from probe tip to dipole centers: 1.0 mm
- Calibration range: 900MHz/1810MHz for head simulating liquid and

2.8 SAR Measurement Procedures in DASY4

Step 1 Setup a Call Connection

Establish a call in handset at the maximum power level with a base station simulator via air interface.

Step 2 Power Reference Measurement

To measure the local E-field value at a fixed location which value will be taken as a reference value for calculating a possible power drift.

Step 3 Area Scan

To measure the SAR distribution with a grid with spacing of 15 mm x 15 mm and kept with a constant distance to the inner surface of the phantom. Additional all peaks within 3 dB of the maximum SAR are searched.

Step 4 Zoom Scan

At these points (maximum number of SAR peaks is two), a cube of 32 mm x 32 mm x 30 mm is applied to and measured with 5 x 5 x 7 points. With these measured data, a peak spatial-average SAR value can be calculated by SEMCAD software.

Step 5 Power Drift Measurement

Repetition of the E-field measurement at the fixed location mentioned in Step 1 to make sure the two results differ by less than ± 0.2 dB.

2.9 Simulating Liquids

Liquid Recipes for this test report are as following:

BSL 2450MHz band (Body)

Ingredient	% by weight
Water	68.12
DGBE	31.72
Salt	0.16

2.10 System Performance Check

2.10.1 Purpose

1. To verify the simulating liquids are valid for testing.
2. To verify the performance of testing system is valid for testing.

2.10.2 System Performance Check Procedure

The DASY4 installation includes predefined files with recommended procedures for measurements and the system performance check. They are read-only document files and destined as fully defined but unmeasured masks, so the finished system performance check must be saved under a different name. The system performance check document requires the SAM Twin Phantom, so this phantom must be properly installed in your system. (User defined measurement procedures can be created by opening a new document or editing an existing document file). Before you start the system performance check, you need only to tell the system with which components (probe, medium, and device) you are performing the system performance check; the system will take care of all parameters.

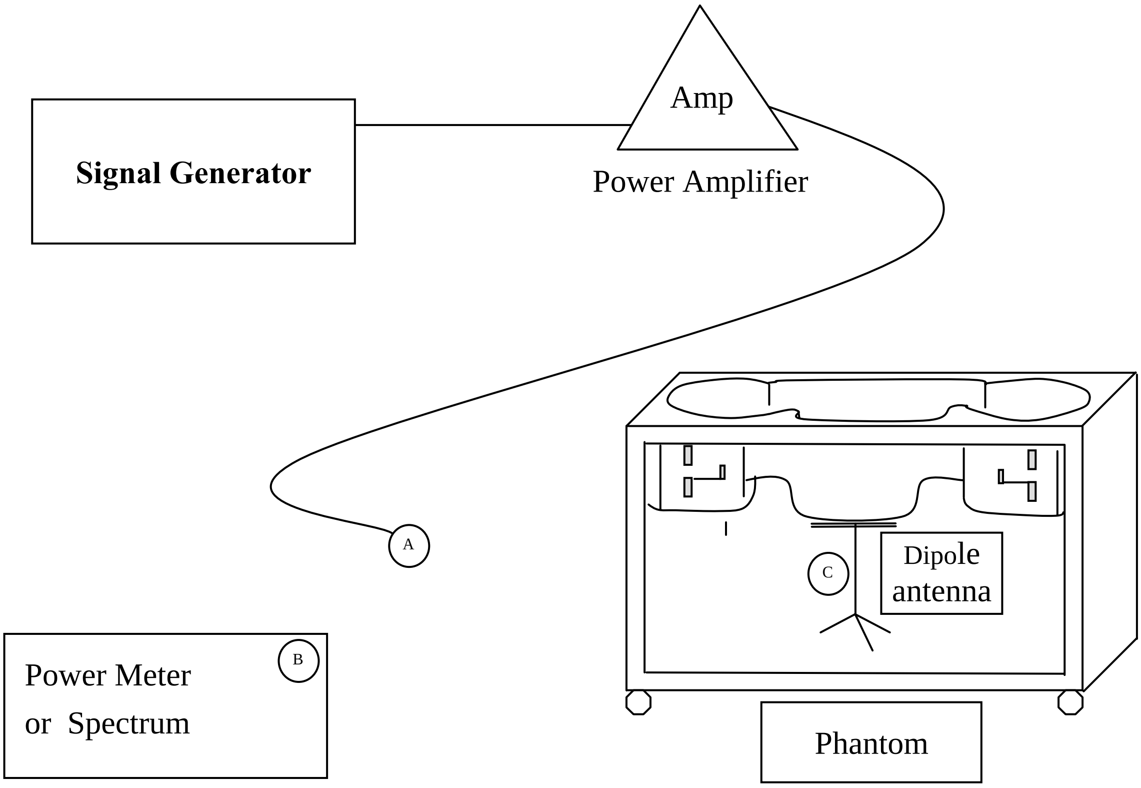
• **The Power Reference Measurement and Power Drift Measurement** jobs are located at the beginning and end of the batch process. They measure the field drift at one single point in the liquid over the complete procedure. The indicated drift is mainly the variation of the amplifier output power. If it is too high (above ±0.1 dB), the system performance check should be repeated; some amplifiers have very high drift during warm-up. A stable amplifier gives drift results in the DASY system below ±0.02 dB.

• **The Surface Check** job tests the optical surface detection system of the DASY system by repeatedly detecting the surface with the optical and mechanical surface detector and comparing the results. The output gives the detecting heights of both systems, the difference between the two systems and the standard deviation of the detection repeatability. Air bubbles or refraction in the liquid due to separation of the sugar-water mixture gives poor repeatability (above ±0.1mm). In that case it is better to abort the system performance check and stir the liquid.

• **The Area Scan** job measures the SAR above the dipole on a plane parallel to the surface. It is used to locate the approximate location of the peak SAR. The proposed scan uses large grid spacing for faster measurement; due to the symmetric field, the peak detection is reliable. Schmid & Partner Engineering AG, DASY4 Manual, February 2005 16-2 System Performance Check Application Notes If a finer graphic is desired, the grid spacing can be reduced. Grid spacing and orientation have no influence on the SAR result.

• **The Zoom Scan** job measures the field in a volume around the peak SAR value assessed in the previous Area Scan job (for more information see the application note on SAR evaluation). If the system performance check gives reasonable results, the SAR peak, 1 g and 10 g spatial average SAR values normalized to 1W dipole input power give reference data for comparisons. The next sections analyze the expected uncertainties of these values, as well as additional checks for further information or troubleshooting.

2.10.3 System Performance Check Setup



Note：

1. A connected to B is used to make sure whether the input power is 250mW for target frequency..
2. A connected to C is used to input the measured power to dipole antenna

2.10.4 Result of System Performance Check: Valid Result

2450MHz band - Diepole Antenna: D2450V2 (S/N: 764)

Date of Measurement And Reference Value	SAR@1g [W/kg]	Dielectric Parameters		Temperature [℃]
		ε r	σ [S/m]	
Body 2450MHz Recommended Value	12.9±10% [11.61 ~14.19]	52.7 ±10% [47.43 ~ 57.97]	1.95 ± 5% [1.8525 ~ 2.0475]	22.0 ± 2 [20 ~ 24]
2011-08-12	13.5	51.47	1.941	22

3 Results

3.1 Summary of Test Results

No deviations from the technical specification(s) were ascertained in the course of the tests performed.	■
The deviations as specified in this chapter were ascertained in the course of the tests Performed.	□

3.2 Conducted Output Power

Band	Mode	Frequency (MHz)	CH	Data Rate (Mbps)	Conducted Power (dBm)		Note
					ANT_A	ANT_B	
2.4GHz	IEEE 802.11b	2412	1	11	18.96	19.05	
		2437	6	11	19.63	16.61	
		2462	11	11	19.80	20.79	
	IEEE 802.11g	2412	1	54	20.80	20.92	
		2437	6	54	23.32	23.04	
		2462	11	54	21.78	21.32	
	IEEE 802.11n HT20	2412	1	HT15	17.16	17.83	
		2437	6	HT15	20.25	20.85	
		2462	11	HT15	18.52	19.00	
	IEEE 802.11n HT40	2422	3	HT15	19.06	18.69	
		2437	6	HT15	21.61	21.15	
		2452	9	HT15	19.63	19.61	

3.3 Position A (Back site)

3.3.1 ANT_A

Frequency Mode	CH	MHz	Position	Conducted Power (dBm) Before	After	Drift	SAR@1g [W/kg]	Power Drift (dB)	Note
IEEE 802.11b	1	2412	A	-	-	-	-	-	-
	6	2437		19.63	19.50	0.13	0.304	0.109	-
	11	2462		-	-	-	-	-	-
IEEE 802.11g	1	2412	A	-	-	-	-	-	-
	6	2437		23.32	23.20	0.12	0.262	0.169	-
	11	2462		-	-	-	-	-	-

3.3.2 ANT_B

Frequency Mode	CH	MHz	Position	Conducted Power (dBm) Before	After	Drift	SAR@1g [W/kg]	Power Drift (dB)	Note
IEEE 802.11b	1	2412	A	-	-	-	-	-	-
	6	2437		16.61	16.53	0.08	0.631	-0.139	Worst
	11	2462		-	-	-	-	-	-
IEEE 802.11g	1	2412	A	-	-	-	-	-	-
	6	2437		23.04	22.9	0.05	0.567	-0.158	-
	11	2462		-	-	-	-	-	-

3.3.2 ANT_A+B

Frequency Mode	CH	MHz	Position	Conducted Power (dBm) Before	After	Drift	SAR@1g [W/kg]	Power Drift (dB)	Note
IEEE 802.11n HT20	1	2412	A	-	-	-	-	-	-
	6	2437		20.85	20.75	0.10	0.318	-0.175	-
	11	2462		-	-	-	-	-	-
IEEE 802.11n HT40	1	2412	A	-	-	-	-	-	-
	6	2437		21.61	21.51	0.01	0.349	-0.187	-
	11	2462		-	-	-	-	-	-

3.4 Position B (Bottom site)

3.3.1 ANT_B

Frequency			Position	Conducted Power (dBm)			SAR@1g	Power	Note
Mode	CH	MHz		Before	After	Drift	[W/kg]	Drift (dB)	
IEEE 802.11b	1	2412	B	-	-	-	-	-	-
	6	2437		16.58	16.60	0.02	0.0012	0.115	
	11	2462		-	-	-	-	-	-

Note: The test position B (Bottom site) is far away to the operate antennas. This position is not the must conservative exposure condition. Choose the worse mode of position A to confirm.

The Max Body SAR@2450MHz@1g was 0.631 W/kg, less than limitation of 1.6W/kg.

3.5 Measurement Position

3.5.1 EUT Position A

The Back site of the EUT to the ELI4 phantom distance: 0 mm

3.5.2 EUT Position B

The Bottom site of the EUT to the ELI4 phantom distance: 0 mm.

4 The Description of Test Procedure for FCC

4.1 Scan Procedure

First coarse scans were used for determination of the field distribution. Next a cube scan, 5x5x7 points covering a volume of 32x32x30mm was performed around the highest E-field value to determine the averaged SAR value. Drift was determined by measuring the same point at the start of the coarse scan and again at the end of the cube scan.

4.2 SAR Averaging Methods

The maximum SAR value was averaged over a cube of tissue using interpolation and extrapolation. The interpolation, extrapolation and maximum search routines within Dasy4 are all based on the modified Quadratic Shepard's method (Robert J. Renka, "Multivariate Interpolation Of Lagre Sets Of Scattered Data", University of North Texas ACM Transactions on Mathematical Software, vol. 14, no. 2, June 1988, pp. 139-148).

The interpolation scheme combines a least-square fitted function method with a weighted average method. A trivariate 3-D / bivariate 2-D quadratic function is computed for each measurement point and fitted to neighbouring points by a least-square method. For the cube scan, inverse distance weighting is incorporated to fit distant points more accurately. The interpolating function is finally calculated as a weighted average of the quadratics. In the cube scan, the interpolation function is used to extrapolate the Peak SAR from the deepest measurement points to the inner surface of the phantom.

4.3 Data Storage

The DASY4 software stores the assessed data from the data acquisition electronics as raw data (in microvolt readings from the probe sensors), together with all the necessary software parameters for the data evaluation (probe calibration data, liquid parameters and device frequency and modulation data) in measurement files with the extension .DA4. The postprocessing software evaluates the desired unit and format for output each time the data is visualized or exported. This allows verification of the complete software setup even after the measurement and allows correction of erroneous parameter settings.

The measured data can be visualized or exported in different units or formats, depending on the selected probe type (e.g., [V/m], [A/m] or [W/kg]). Some of these units are not available in certain situations or give meaningless results, e.g., a SAR-output in a lossless media will always be zero. Raw data can also be exported to perform the evaluation with other software packages.

4.4 Data Evaluation

The DASY4 postprocessing 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 they can be imported into the software from the configuration files issued for the DASY components. In the direct measuring mode of the multimeter 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:

$$\text{E} - \text{fieldprobes :} \qquad E_i = \sqrt{\frac{V_i}{Norm_i \cdot ConvF}}$$

$$\text{H} - \text{fieldprobes :} \qquad H_i = \sqrt{V_i} \cdot \frac{a_{i0} + a_{i1} f + a_{i2} f^2}{f}$$

with V_i = compensated signal of channel i (i = x, y, z)
$Norm_i$ = sensor sensitivity of channel i (i = x, y, z)
$\mu V/(V/m)^2$ for E-field Probes
$ConvF$ = sensitivity enhancement in solution
a_{ij} = sensor sensitivity factors for H-field probes
f = carrier frequency [GHz]
E_i = electric field strength of channel i in V/m
H_i = 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.

$$SAR = E_{tot}^2 \cdot \frac{\sigma}{\rho \cdot 1'000}$$

with SAR = local specific absorption rate in mW/g
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 set to 1, to account for actual head tissue density rather than the density of the tissue simulating liquid.

5 Measurement Uncertainty

Frequency Band: 300MHz~3GHz

Error Description	Unc. value ±%	Prob. Dist.	Div.	C_i (1g)	C_i (10g)	Std. Unc. ±% (1g)	Std. Unc. ±% (10g)	$v_i(v_{eff})$
Measurement System								
Probe Calibration	±6.6	N	1	1	1	±6.6	±6.6	∞
Axial Isotropy	±0.3	R	$\sqrt{3}$	0.7	0.7	±0.1	±0.1	∞
Hemispherical Isotropy	±1.3	R	$\sqrt{3}$	0.7	0.7	±0.5	±0.5	∞
Boundary Effects	±0.5	R	$\sqrt{3}$	1	1	±0.3	±0.3	∞
Linearity	±0.3	R	$\sqrt{3}$	1	1	±0.2	±0.2	∞
System Detection Limits	±1.0	R	$\sqrt{3}$	1	1	±0.6	±0.6	∞
Readout Electronics	±0.3	N	1	1	1	±0.3	±0.3	∞
Response Time	±0.8	R	$\sqrt{3}$	1	1	±0.5	±0.5	∞
Integration Time	±2.6	R	$\sqrt{3}$	1	1	±1.5	±1.5	∞
RF Ambient Conditions	±3.0	R	$\sqrt{3}$	1	1	±1.7	±1,7	∞
Probe Positioner	±0.4	R	$\sqrt{3}$	1	1	±0.2	±0.2	∞
Probe Positioning	±2.9	R	$\sqrt{3}$	1	1	±1.7	±1.7	∞
Max. SAR Evaluation	±1.0	R	$\sqrt{3}$	1	1	±0.6	±0.6	∞
Test Sample Related								
Test Sample Positioning	±2.9	N	1	1	1	±2.9	±2.9	145
Device Holder Uncertainty	±3.6	N	1	1	1	±3.6	±3.6	5
SAR Drift Measurement	±5.0	R	$\sqrt{3}$	1	1	±2.9	±2.9	∞
Phantom and Setup								
Phantom Uncertainty	±4.0	R	$\sqrt{3}$	1	1	±2.3	±2.3	∞
Liquid Conductivity(target)	±5.0	R	$\sqrt{3}$	0.64	0.43	±1.8	±1.2	∞
Liquid Conductivity(meas.)	±2.5	N	1	0.64	0.43	±1.6	±1.1	∞
Liquid Permittivity(target)	±5.0	R	$\sqrt{3}$	0.6	0.49	±1.7	±1.4	∞
Liquid Permittivity(meas.)	±2.5	N	1	0.6	0.49	±1.5	±1.2	∞
Combined Std. Uncertainty						±10.0	±9.7	330
Expanded STD Uncertainty (k=2)						±19.9	±19.4	

6 References

1. [ANSI/IEEE C95.1-1992]

Safety Levels with Respect to Human Exposure to Radio Frrequency Electromagnetic Fields, 3 kHz to 300 GHz. The Institute of Electrical and Electronics Engineers, Inc. (IEEE), 1992.

2. [ANSI/IEEE C95.3-1992]

Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave". The Institute of Electrical and Electronics Engineers, Inc. (IEEE), 1992.

3. [FCC Report and Order 96-326]

Federal Communications Commission, \Report and order: Guidelines for evaluating the environmental effects of radiofrequency radiation", Tech. Rep. FCC 96-326, 1996.

4. [FCC OET Bulletin 65]

Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields. OET Bulletin 65 Edition 97-01, August 1997. Federal Communications Commission (FCC), Office of Engineering & Technology. (OET)

5. [FCC OET Bulletin 65 Supplement C]

Additional Information for Evaluating Compliance of Mobile and Portable Device with FCC Limits for Human Exposure to Radiofrequency Emissions. Supplement C (Edition 01-01) to OET Bulletin 65, June 2001. Federal Communications Commission (FCC), Office of Engineering & Technology. (OET)

6. [DASY 4]

Schmid & Partner Engineering AG: DASY 4 Manual, September 2005.

7. [IEEE 1528-2003]

IEEE Std 1528-2003: IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wirless Communications Devices: Measurement Techniques. 1528-2003, 19th December, 2003, The Institute of Electrical and Electronics Engineers, Inc. (IEEE).

8. [RSS-102, Issue 2]

Radio Standards Specification 102, Radio Frequency Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands) sets out the requirements and measurement techniques used to evaluate radio frequency (RF) exposure compliance of radiocommunication apparatus designed to be used within the vicinity of the human body. November, 2005. Industry Canada.

9. [Health Canada Safety Code 6]

Canada's Safety Code 6: Limits of Human Exposure to Radiofrequency Electromagnetic Fields in the Frequency Range from 3 kHz to 300 GHz (99-EHD-237)

7 Annex：Test Results of DASY4 (Refer to ANNEX)

ANNEX
Index of Annex

ANNEX A: SAR RESULTS

System Performance Check

Body

Date/Time: 8/12/2011 9:48:42 AM

Test Laboratory: Electronics Testing Center, Taiwan

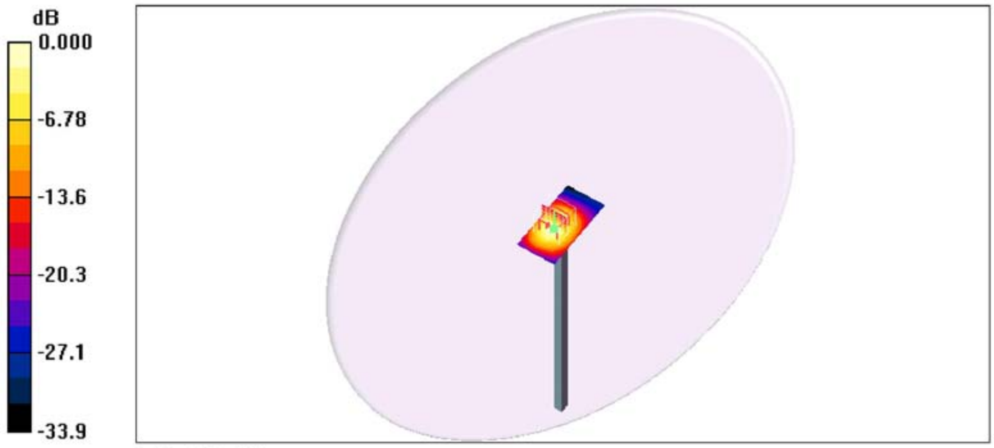
DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:764

Communication System: CW; Frequency: 2450 MHz;Duty Cycle: 1:1
Medium parameters used: f = 2450 MHz; σ = 1.941 mho/m; ε_r = 51.47; ρ = 1000 kg/m^3
Air temperature:23 degC; Liquid temperature:22 degC;
Phantom section: Flat Section

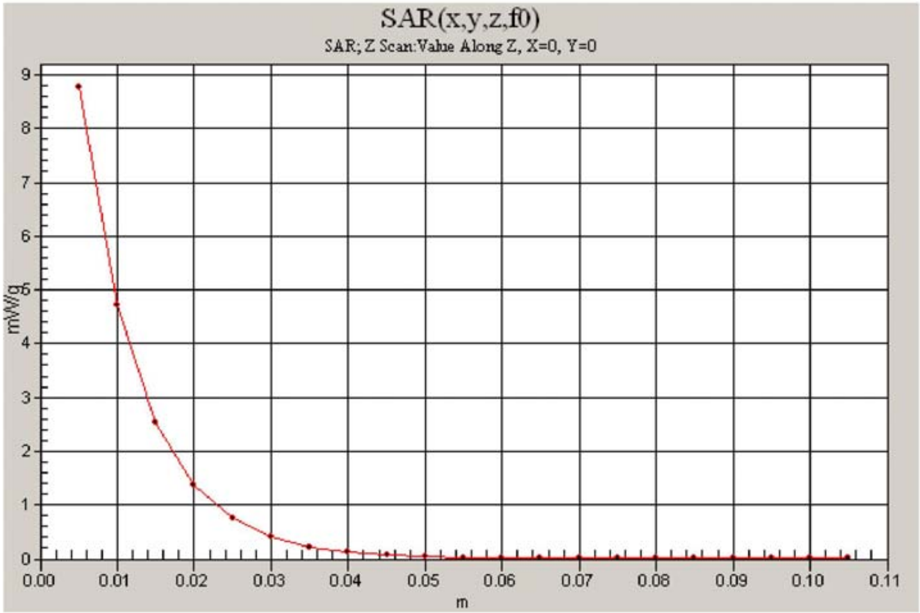
DASY4 Configuration:
- Probe: EX3DV4 - SN3665; ConvF(7.14, 7.14, 7.14); Calibrated: 4/19/2011
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn629; Calibrated: 9/17/2010
- Phantom: Flat Phantom ELI4.0; Type: QDOVA001BA; Serial: SN:1055
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

SPC/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 82.6 V/m; Power Drift = -0.070 dB
Peak SAR (extrapolated) = 27.3 W/kg
SAR(1 g) = 13.5 mW/g; SAR(10 g) = 6.24 mW/g
Maximum value of SAR (measured) = 15.6 mW/g

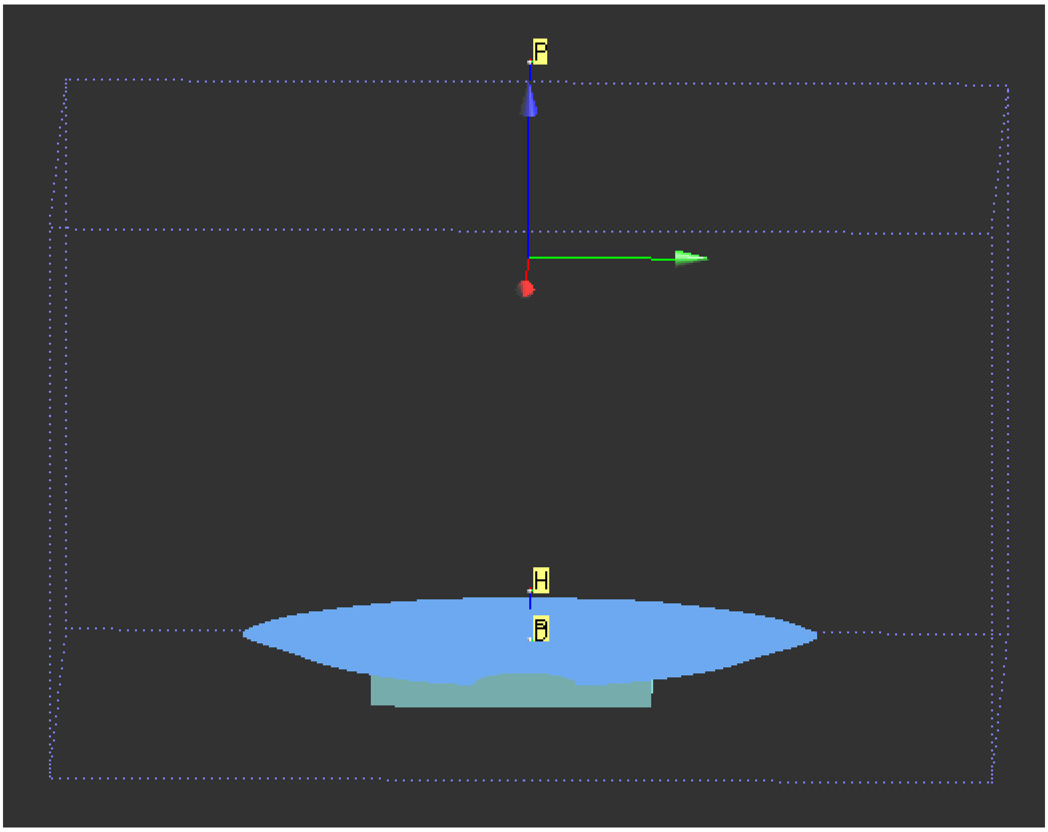
SPC/Area Scan (31x61x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 17.9 mW/g



0 dB = 17.9mW/g


SAR(x,y,z,f0)
SAR; Z Scan:Value Along Z, X=0, Y=0
mW/g
9
8
7
6
5
4
3
2
1
0
0.00
0.01
0.02
0.03
0.04
0.05
0.06
0.07
0.08
0.09
0.10
0.11
m

Body



Date/Time: 8/12/2011 4:51:26 PM

Test Laboratory: Electronics Testing Center, Taiwan

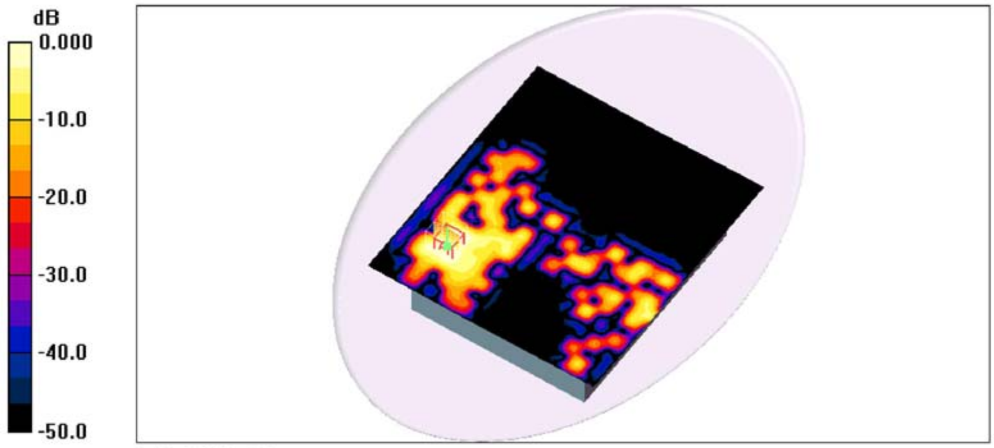
DUT: Tablet; Type: Not Specified; Serial: N/A

Communication System: IEEE 802.11b/g/n; Frequency: 2437 MHz;Duty Cycle: 1:1
Medium parameters used: f = 2437 MHz; σ = 1.92 mho/m; ε_r = 51.5; ρ = 1000 kg/m^3
Air temperature:23 degC; Liquid temperature:22 degC;
Phantom section: Flat Section

DASY4 Configuration:
- Probe: EX3DV4 - SN3665; ConvF(7.47, 7.47, 7.47); Calibrated: 4/19/2011
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn629; Calibrated: 9/17/2010
- Phantom: Flat Phantom ELI4.0; Type: QDOVA001BA; Serial: SN:1055
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

802.11B_CH06_A_Side_ANT_A/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 0.744 V/m; Power Drift = 0.109 dB
Peak SAR (extrapolated) = 0.584 W/kg
SAR(1 g) = 0.304 mW/g; SAR(10 g) = 0.153 mW/g
Maximum value of SAR (measured) = 0.357 mW/g

802.11B_CH06_A_Side_ANT_A/Area Scan (181x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.378 mW/g



0 dB = 0.378mW/g

Date/Time: 8/12/2011 1:03:59 PM

Test Laboratory: Electronics Testing Center, Taiwan

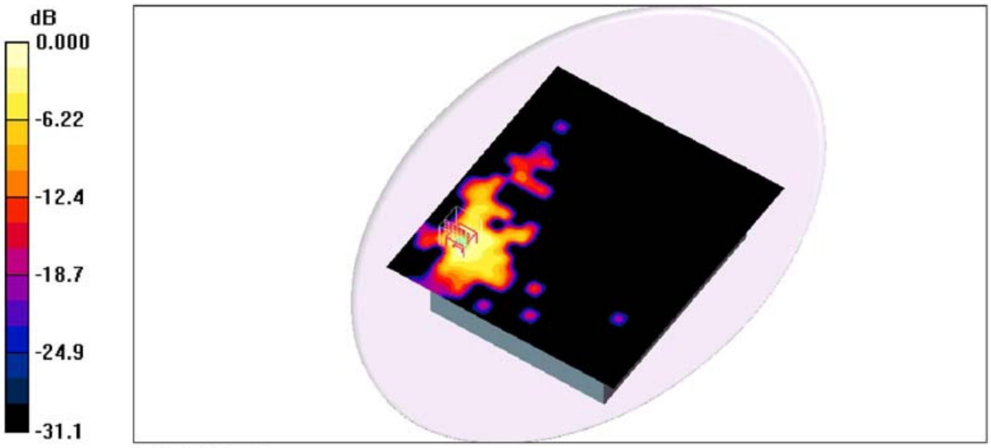
DUT: Tablet; Type: Not Specified; Serial: N/A

Communication System: IEEE 802.11b/g/n; Frequency: 2437 MHz;Duty Cycle: 1:1
Medium parameters used: f = 2437 MHz; σ = 1.92 mho/m; ε_r = 51.5; ρ = 1000 kg/m^3
Air temperature:23 degC; Liquid temperature:22 degC;
Phantom section: Flat Section

DASY4 Configuration:
- Probe: EX3DV4 - SN3665; ConvF(7.47, 7.47, 7.47); Calibrated: 4/19/2011
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn629; Calibrated: 9/17/2010
- Phantom: Flat Phantom ELI4.0; Type: QDOVA001BA; Serial: SN:1055
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

802.1G_CH06_A_Side_ANT_A/Area Scan (181x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.349 mW/g

802.1G_CH06_A_Side_ANT_A/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 1.52 V/m; Power Drift = 0.169 dB
Peak SAR (extrapolated) = 0.476 W/kg
SAR(1 g) = 0.262 mW/g; SAR(10 g) = 0.139 mW/g
Maximum value of SAR (measured) = 0.288 mW/g



0 dB = 0.349mW/g

Date/Time: 8/12/2011 3:39:05 PM

Test Laboratory: Electronics Testing Center, Taiwan

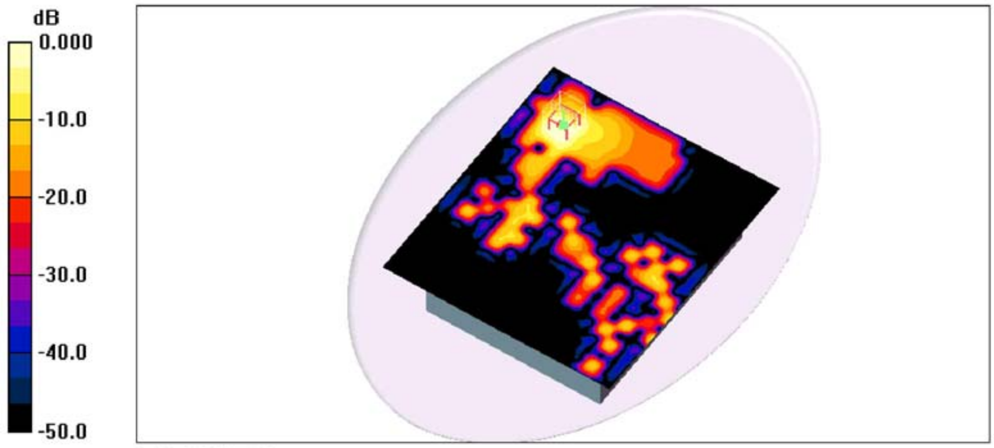
DUT: Tablet; Type: Not Specified; Serial: N/A

Communication System: IEEE 802.11b/g/n; Frequency: 2437 MHz;Duty Cycle: 1:1
Medium parameters used: f = 2437 MHz; σ = 1.92 mho/m; ε_r = 51.5; ρ = 1000 kg/m^3
Air temperature:23 degC; Liquid temperature:22 degC;
Phantom section: Flat Section

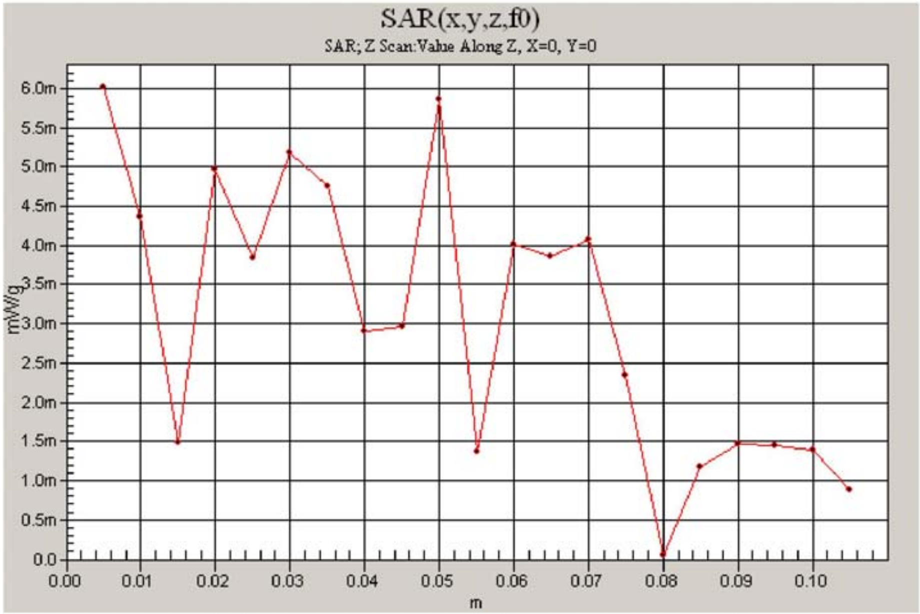
DASY4 Configuration:
- Probe: EX3DV4 - SN3665; ConvF(7.47, 7.47, 7.47); Calibrated: 4/19/2011
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn629; Calibrated: 9/17/2010
- Phantom: Flat Phantom ELI4.0; Type: QDOVA001BA; Serial: SN:1055
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

802.11B_CH06_A_Side_ANT_B/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 2.04 V/m; Power Drift = -0.139 dB
Peak SAR (extrapolated) = 1.18 W/kg
SAR(1 g) = 0.631 mW/g; SAR(10 g) = 0.314 mW/g
Maximum value of SAR (measured) = 0.707 mW/g

802.11B_CH06_A_Side_ANT_B/Area Scan (181x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.687 mW/g



0 dB = 0.687mW/g


SAR(x,y,z,f0)
SAR; Z Scan:Value Along Z, X=0, Y=0
6.0m
5.5m
5.0m
4.5m
4.0m
3.5m
3.0m
2.5m
2.0m
1.5m
1.0m
0.5m
0.0
mW/g
0.00
0.01
0.02
0.03
0.04
0.05
0.06
0.07
0.08
0.09
0.10
m

Date/Time: 8/12/2011 1:59:32 PM

Test Laboratory: Electronics Testing Center, Taiwan

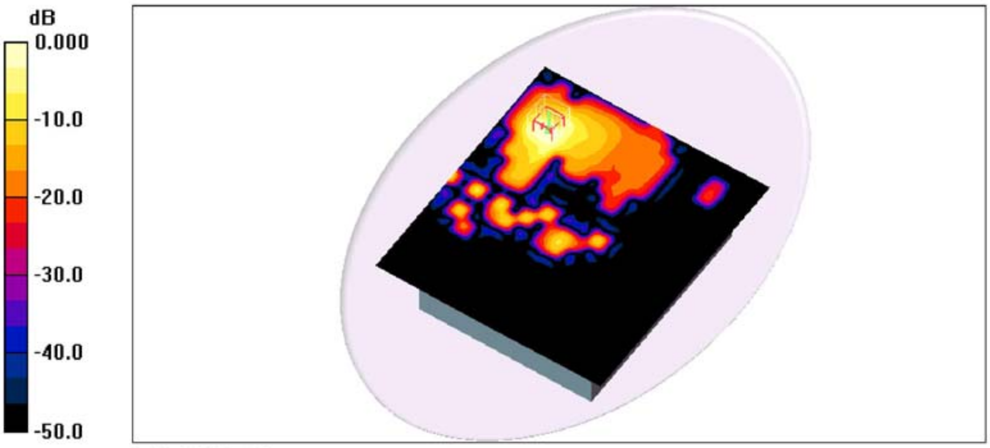
DUT: Tablet; Type: Not Specified; Serial: N/A

Communication System: IEEE 802.11b/g/n; Frequency: 2437 MHz;Duty Cycle: 1:1
Medium parameters used: f = 2437 MHz; σ = 1.92 mho/m; ε_r = 51.5; ρ = 1000 kg/m^3
Air temperature:23 degC; Liquid temperature:22 degC;
Phantom section: Flat Section

DASY4 Configuration:
- Probe: EX3DV4 - SN3665; ConvF(7.47, 7.47, 7.47); Calibrated: 4/19/2011
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn629; Calibrated: 9/17/2010
- Phantom: Flat Phantom ELI4.0; Type: QDOVA001BA; Serial: SN:1055
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

802.1G_CH06_A_Side_ANT_B/Area Scan (181x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.680 mW/g

802.1G_CH06_A_Side_ANT_B/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 1.79 V/m; Power Drift = -0.158 dB
Peak SAR (extrapolated) = 1.02 W/kg
SAR(1 g) = 0.567 mW/g; SAR(10 g) = 0.297 mW/g
Maximum value of SAR (measured) = 0.663 mW/g



0 dB = 0.680mW/g

Date/Time: 8/12/2011 5:53:18 PM

Test Laboratory: Electronics Testing Center, Taiwan

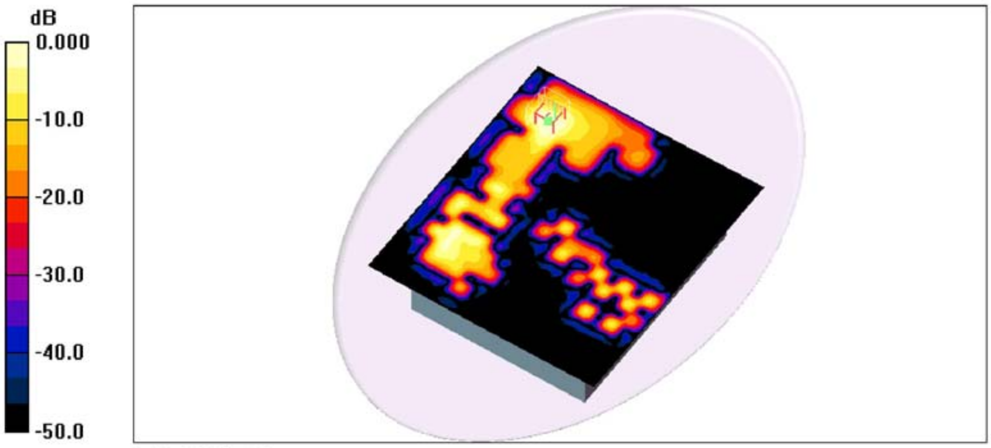
DUT: Tablet; Type: Not Specified; Serial: N/A

Communication System: IEEE 802.11b/g/n; Frequency: 2437 MHz;Duty Cycle: 1:1
Medium parameters used: f = 2437 MHz; σ = 1.92 mho/m; ε_r = 51.5; ρ = 1000 kg/m^3
Air temperature:23 degC; Liquid temperature:22 degC;
Phantom section: Flat Section

DASY4 Configuration:
- Probe: EX3DV4 - SN3665; ConvF(7.47, 7.47, 7.47); Calibrated: 4/19/2011
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn629; Calibrated: 9/17/2010
- Phantom: Flat Phantom ELI4.0; Type: QDOVA001BA; Serial: SN:1055
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

802.1GN20_CH06_A_Side_ANT_A+B/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 1.97 V/m; Power Drift = -0.175 dB
Peak SAR (extrapolated) = 0.595 W/kg
SAR(1 g) = 0.318 mW/g; SAR(10 g) = 0.160 mW/g
Maximum value of SAR (measured) = 0.347 mW/g

802.1GN20_CH06_A_Side_ANT_A+B/Area Scan (181x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.374 mW/g



0 dB = 0.374mW/g

Date/Time: 8/12/2011 6:13:14 PM

Test Laboratory: Electronics Testing Center, Taiwan

DUT: Tablet; Type: Not Specified; Serial: N/A

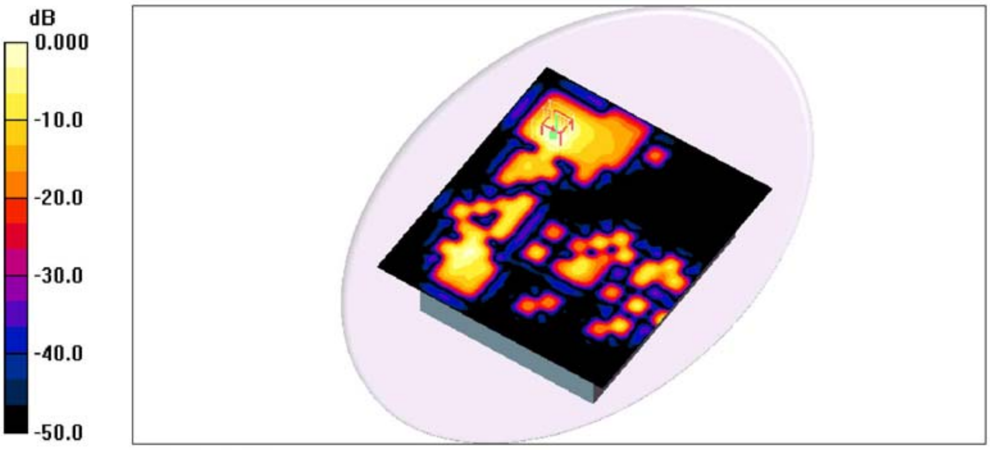
Communication System: IEEE 802.11b/g/n; Frequency: 2437 MHz;Duty Cycle: 1:1
Medium parameters used: f = 2437 MHz; σ = 1.92 mho/m; ε_r = 51.5; ρ = 1000 kg/m^3
Air temperature:23 degC; Liquid temperature:22 degC;
Phantom section: Flat Section

DASY4 Configuration:
- Probe: EX3DV4 - SN3665; ConvF(7.47, 7.47, 7.47); Calibrated: 4/19/2011
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn629; Calibrated: 9/17/2010
- Phantom: Flat Phantom ELI4.0; Type: QDOVA001BA; Serial: SN:1055
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

802.1GN40_CH06_A_Side_ANT_A+B/Area Scan (181x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.449 mW/g

802.1GN40_CH06_A_Side_ANT_A+B/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 2.34 V/m; Power Drift = -0.187 dB
Peak SAR (extrapolated) = 0.646 W/kg
SAR(1 g) = 0.349 mW/g; SAR(10 g) = 0.175 mW/g

Warning: Maximum averaged SAR over 10 g is located on the boundary of the measurement cube. This cube might not incorporate the absolute averaged SAR. Please consider a refinement of the Area Scan measurement.
Maximum value of SAR (measured) = 0.376 mW/g



0 dB = 0.449mW/g

Date/Time: 8/12/2011 7:38:43 PM

Test Laboratory: Electronics Testing Center, Taiwan

DUT: Tablet; Type: Not Specified; Serial: N/A

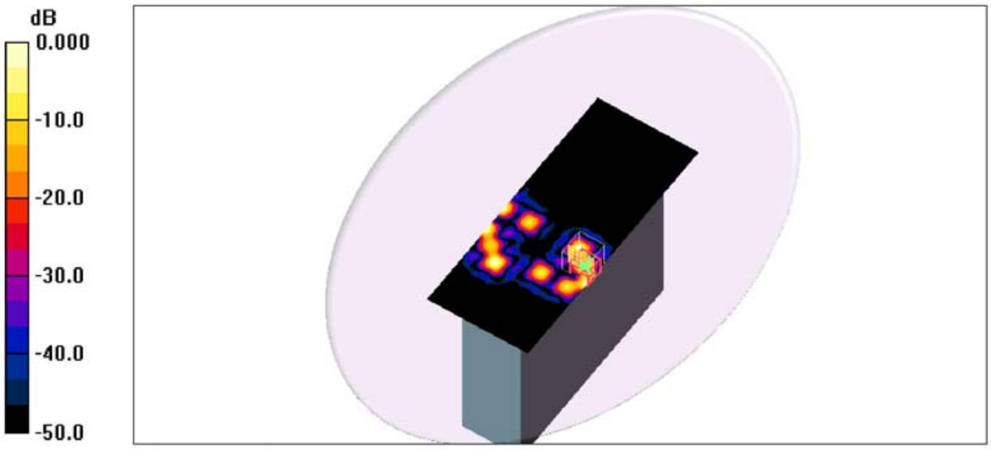
Communication System: IEEE 802.11b/g/n; Frequency: 2437 MHz;Duty Cycle: 1:1
Medium parameters used: f = 2437 MHz; σ = 1.92 mho/m; ε_r = 51.5; ρ = 1000 kg/m^3
Air temperature:23 degC; Liquid temperature:22 degC;
Phantom section: Flat Section

DASY4 Configuration:
- Probe: EX3DV4 - SN3665; ConvF(7.47, 7.47, 7.47); Calibrated: 4/19/2011
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn629; Calibrated: 9/17/2010
- Phantom: Flat Phantom ELI4.0; Type: QDOVA001BA; Serial: SN:1055
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

802.11B_CH06_B_Side_ANT_B/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 0.619 V/m; Power Drift = 0.115 dB
Peak SAR (extrapolated) = 0.088 W/kg
SAR(1 g) = 0.011 mW/g; SAR(10 g) = 0.00121 mW/g

Warning: Maximum averaged SAR over 1 g is located on the boundary of the measurement cube. This cube might not incorporate the absolute averaged SAR. Please consider a refinement of the Area Scan measurement. Maximum averaged SAR over 10 g is located on the boundary of the measurement cube. This cube might not incorporate the absolute averaged SAR. Please consider a refinement of the Area Scan measurement.
Maximum value of SAR (measured) = 0.034 mW/g

802.11B_CH06_B_Side/Area Scan (81x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.065 mW/g



0 dB = 0.065mW/g

ANNEX B: DIPOLE CERTIFICATE

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

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
S Servizio svizzero di taratura
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 **ETC (Auden)**

Certificate No: **D2450V2-764_Sep10**

CALIBRATION CERTIFICATE

Object	D2450V2 - SN: 764
Calibration procedure(s)	QA CAL-05.v7 Calibration procedure for dipole validation kits
Calibration date:	September 21, 2010

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	06-Oct-09 (No. 217-01086)	Oct-10
Power sensor HP 8481A	US37292783	06-Oct-09 (No. 217-01086)	Oct-10
Reference 20 dB Attenuator	SN: 5086 (20g)	30-Mar-10 (No. 217-01158)	Mar-11
Type-N mismatch combination	SN: 5047.2 / 06327	30-Mar-10 (No. 217-01162)	Mar-11
Reference Probe ES3DV3	SN: 3205	30-Apr-10 (No. ES3-3205_Apr10)	Apr-11
DAE4	SN: 601	10-Jun-10 (No. DAE4-601_Jun10)	Jun-11

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-09)	In house check: Oct-11
RF generator R&S SMT-06	100005	4-Aug-99 (in house check Oct-09)	In house check: Oct-11
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-09)	In house check: Oct-10

	Name	Function	Signature
Calibrated by:	Dimce Iliev	Laboratory Technician	D. Iliev
Approved by:	Katja Pokovic	Technical Manager	[signature]

Issued: September 22, 2010

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

Certificate No: D2450V2-764_Sep10 Page 1 of 9

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**

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	V52.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
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	39.0 ± 6 %	1.74 mho/m ± 6 %
Head TSL temperature during test	(21.5 ± 0.2) °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.0 mW / g
SAR normalized	normalized to 1W	52.0 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**52.8 mW /g ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.09 mW / g
SAR normalized	normalized to 1W	24.4 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	52.5 ± 6 %	1.95 mho/m ± 6 %
Body TSL temperature during test	(21.8 ± 0.2) °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	12.9 mW / g
SAR normalized	normalized to 1W	51.6 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**51.5 mW / g ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.00 mW / g
SAR normalized	normalized to 1W	24.0 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**24.0 mW / g ± 16.5 % (k=2)**

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.4 Ω + 1.5 jΩ
Return Loss	- 31.2 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	48.8 Ω + 3.3 jΩ
Return Loss	- 28.9 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.150 ns

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals.
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 10, 2004

DASY5 Validation Report for Head TSL

Date/Time: 20.09.2010 14:17:25

Test Laboratory: SPEAG, Zurich, Switzerland

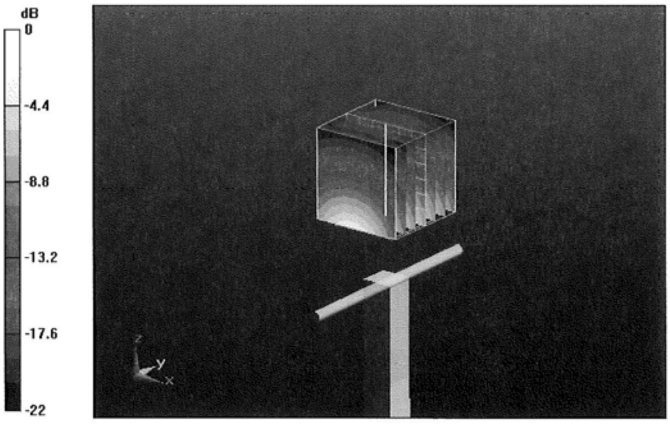
DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:764

Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1
Medium: HSL U12 BB
Medium parameters used: f = 2450 MHz; σ = 1.74 mho/m; ε_r = 39; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.53, 4.53, 4.53); Calibrated: 30.04.2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 10.06.2010
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- Measurement SW: DASY52, V52.2 Build 0, Version 52.2.0 (163)
- Postprocessing SW: SEMCAD X, V14.2 Build 2, Version 14.2.2 (1685)

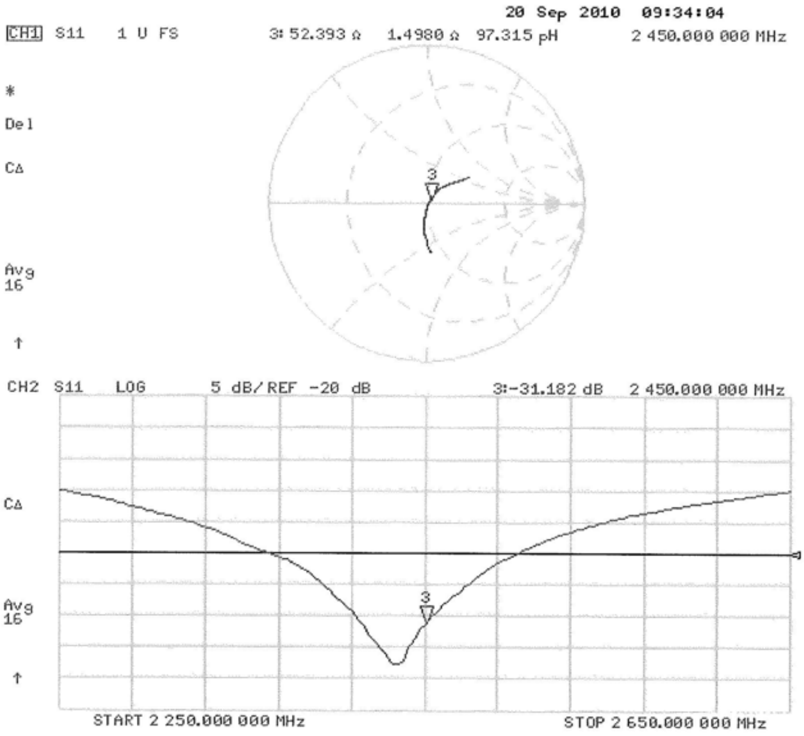
Pin=250 mW /d=10mm, dist=3.0mm (ES-Probe)/Zoom Scan (7x7x7) /Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 101.4 V/m; Power Drift = 0.044 dB
Peak SAR (extrapolated) = 26.5 W/kg
SAR(1 g) = 13 mW/g; SAR(10 g) = 6.09 mW/g
Maximum value of SAR (measured) = 16.6 mW/g



0 dB = 16.6mW/g

Certificate No: D2450V2-764_Sep10 Page 6 of 9

Impedance Measurement Plot for Head TSL



Certificate No: D2450V2-764_Sep10 Page 7 of 9

DASY5 Validation Report for Body TSL

Date/Time: 21.09.2010 14:15:54

Test Laboratory: SPEAG, Zurich, Switzerland

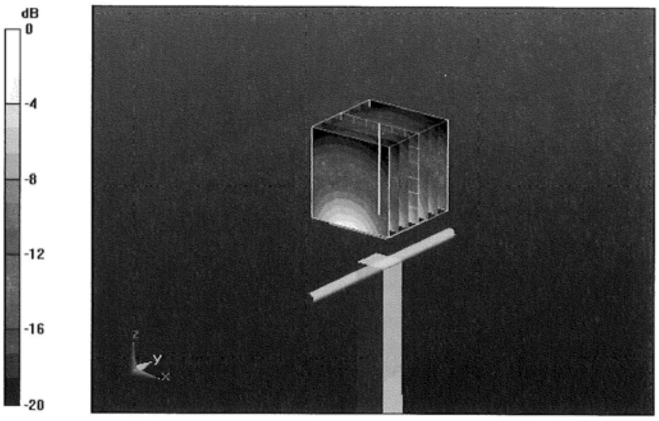
DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:764

Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1
Medium: MSL U12 BB
Medium parameters used: f = 2450 MHz; σ = 1.95 mho/m; ε_r = 52.5; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

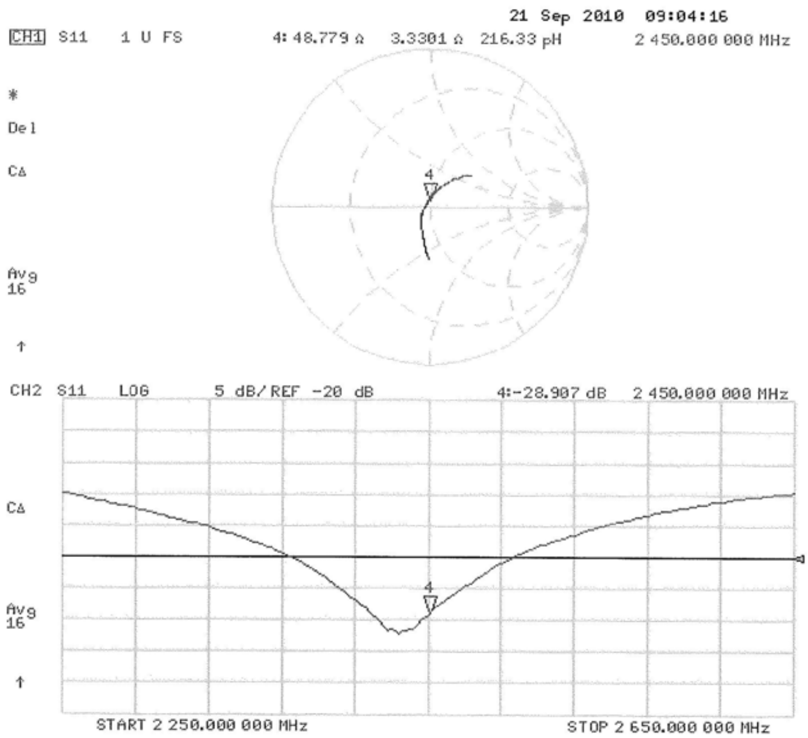
- Probe: ES3DV3 - SN3205; ConvF(4.31, 4.31, 4.31); Calibrated: 30.04.2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 10.06.2010
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- Measurement SW: DASY52, V52.2 Build 0, Version 52.2.0 (163)
- Postprocessing SW: SEMCAD X, V14.2 Build 2, Version 14.2.2 (1685)

Pin=250 mW /d=10mm, dist=3.0mm (ES-Probe)/Zoom Scan (7x7x7) /Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 96.2 V/m; Power Drift = 0.012 dB
Peak SAR (extrapolated) = 27.2 W/kg
SAR(1 g) = 12.9 mW/g; SAR(10 g) = 6 mW/g
Maximum value of SAR (measured) = 17 mW/g



0 dB = 17mW/g

Impedance Measurement Plot for Body TSL



Certificate No: D2450V2-764_Sep10 Page 9 of 9

ANNEX C: PROBE CERTIFICATE

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

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Accreditation No.: **SCS 108**

Client **ETC (Auden)**

Certificate No: **EX3-3555_Sep10**

CALIBRATION CERTIFICATE

Object: EX3DV4 - SN:3555

Calibration procedure(s): QA CAL-01.v6, QA CAL-14.v3, QA CAL-23.v3 and QA CAL-25.v2
Calibration procedure for dosimetric E-field probes

Calibration date: September 22, 2010

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	1-Apr-10 (No. 217-01136)	Apr-11
Power sensor E4412A	MY41495277	1-Apr-10 (No. 217-01136)	Apr-11
Power sensor E4412A	MY41498087	1-Apr-10 (No. 217-01136)	Apr-11
Reference 3 dB Attenuator	SN: S5054 (3c)	30-Mar-10 (No. 217-01159)	Mar-11
Reference 20 dB Attenuator	SN: S5086 (20b)	30-Mar-10 (No. 217-01161)	Mar-11
Reference 30 dB Attenuator	SN: S5129 (30b)	30-Mar-10 (No. 217-01160)	Mar-11
Reference Probe ES3DV2	SN: 3013	30-Dec-09 (No. ES3-3013_Dec09)	Dec-10
DAE4	SN: 660	20-Apr-10 (No. DAE4-660_Apr10)	Apr-11

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Oct-09)	In house check: Oct-11
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-09)	In house check: Oct10

	Name	Function	Signature
Calibrated by:	Katja Pokovic	Technical Manager	
Approved by:	Fin Bomholt	R&D Director	

Issued: September 22, 2010

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

Certificate No: EX3-3555_Sep10 Page 1 of 11

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Accreditation No.: **SCS 108**

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	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 effect 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.
- *Ax,y,z; Bx,y,z; Cx,y,z, VRx,y,z: A, B, C* are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. *VR* is the maximum calibration range expressed in RMS voltage across the diode.
- *ConvF and Boundary Effect Parameters:* Assessed in flat phantom using E-field (or Temperature Transfer Standard for f ≤ 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:3555

Manufactured:	July 13, 2004
Last calibrated:	September 22, 2009
Recalibrated:	September 22, 2010

Calibrated for DASY/EASY Systems

(Note: non-compatible with DASY2 system!)

EX3DV4 SN:3555 September 22, 2010

DASY/EASY - Parameters of Probe: EX3DV4 SN:3555

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	0.42	0.40	0.42	± 10.1%
DCP (mV)[B]	90.2	93.2	90.6	

Modulation Calibration Parameters

UID	Communication System Name	PAR		A dB	B dBuV	C	VR mV	Unc[E] (k=2)
10000	CW	0.00	X	0.00	0.00	1.00	300	± 1.5%
			Y	0.00	0.00	1.00	300	
			Z	0.00	0.00	1.00	300	

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 maximum deviation from linear response applying recatangular distribution and is expressed for the square of the field value.

EX3DV4 SN:3555 September 22, 2010

DASY/EASY - Parameters of Probe: EX3DV4 SN:3555

Calibration Parameter Determined in Head Tissue Simulating Media

f [MHz]	Validity [MHz][C]	Permittivity	Conductivity	ConvF X	ConvF Y	ConvF Z	Alpha	Depth	Unc (k=2)
900	± 50 / ± 100	41.5 ± 5%	0.97 ± 5%	7.90	7.90	7.90	0.59	0.71	± 11.0%
1750	± 50 / ± 100	40.1 ± 5%	1.37 ± 5%	7.10	7.10	7.10	0.62	0.70	± 11.0%
1950	± 50 / ± 100	40.0 ± 5%	1.40 ± 5%	6.60	6.60	6.60	0.60	0.68	± 11.0%
2450	± 50 / ± 100	39.2 ± 5%	1.80 ± 5%	6.23	6.23	6.23	0.39	0.86	± 11.0%

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

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EX3DV4 SN:3555 September 22, 2010

DASY/EASY - Parameters of Probe: EX3DV4 SN:3555

Calibration Parameter Determined in Body Tissue Simulating Media

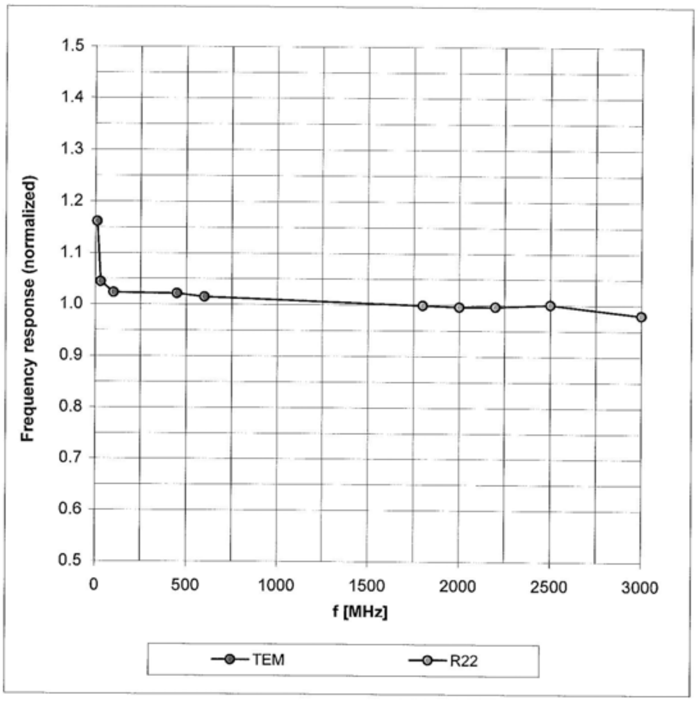
f [MHz]	Validity [MHz][C]	Permittivity	Conductivity	ConvF X	ConvF Y	ConvF Z	Alpha	Depth Unc (k=2)
900	± 50 / ± 100	55.0 ± 5%	1.05 ± 5%	8.03	8.03	8.03	0.57	0.73 ± 11.0%
1750	± 50 / ± 100	53.4 ± 5%	1.49 ± 5%	6.67	6.67	6.67	0.59	0.72 ± 11.0%
1950	± 50 / ± 100	53.3 ± 5%	1.52 ± 5%	6.66	6.66	6.66	0.62	0.70 ± 11.0%
2450	± 50 / ± 100	52.7 ± 5%	1.95 ± 5%	6.34	6.34	6.34	0.45	0.85 ± 11.0%
5200	± 50 / ± 100	49.0 ± 5%	5.30 ± 5%	3.91	3.91	3.91	0.58	1.95 ± 13.1%
5300	± 50 / ± 100	48.9 ± 5%	5.42 ± 5%	3.71	3.71	3.71	0.58	1.95 ± 13.1%
5600	± 50 / ± 100	48.5 ± 5%	5.77 ± 5%	3.17	3.17	3.17	0.65	1.95 ± 13.1%
5800	± 50 / ± 100	48.2 ± 5%	6.00 ± 5%	3.51	3.51	3.51	0.65	1.95 ± 13.1%

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

EX3DV4 SN:3555 September 22, 2010

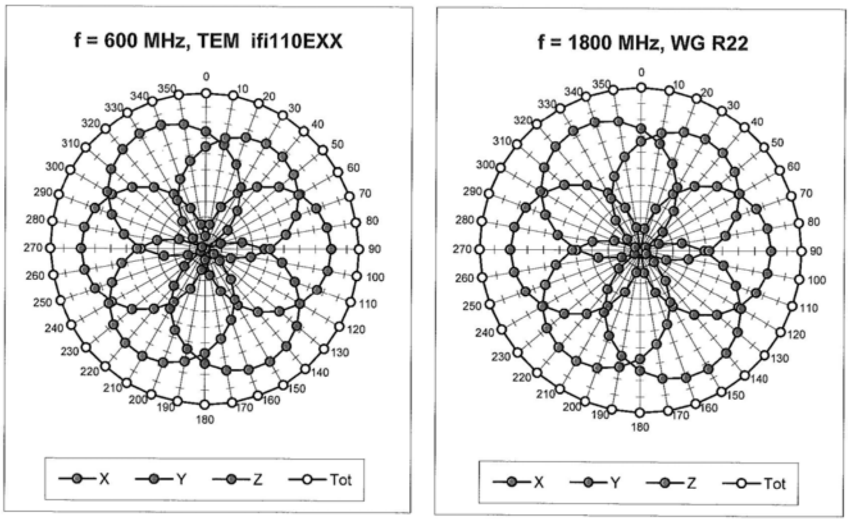
Frequency Response of E-Field

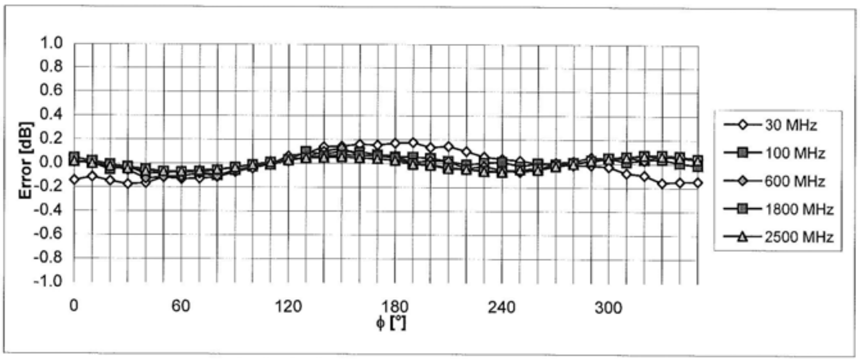
(TEM-Cell:ifi110 EXX, Waveguide: R22)



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

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



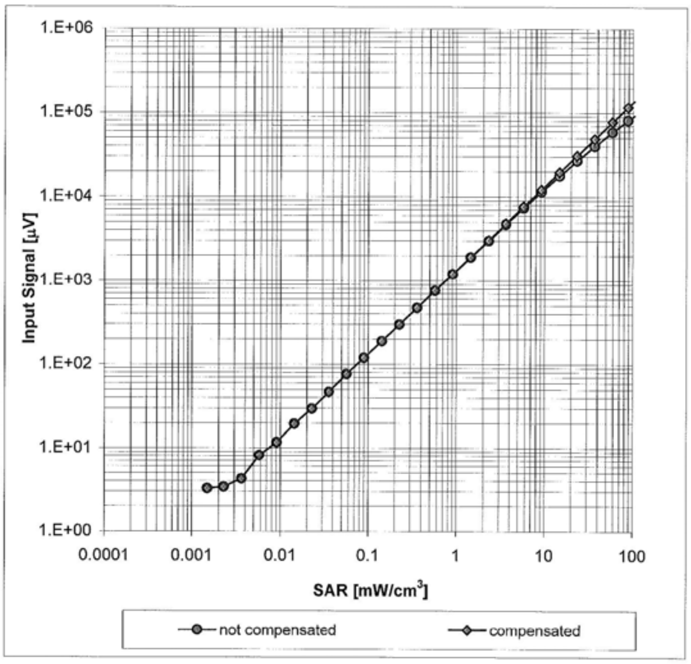


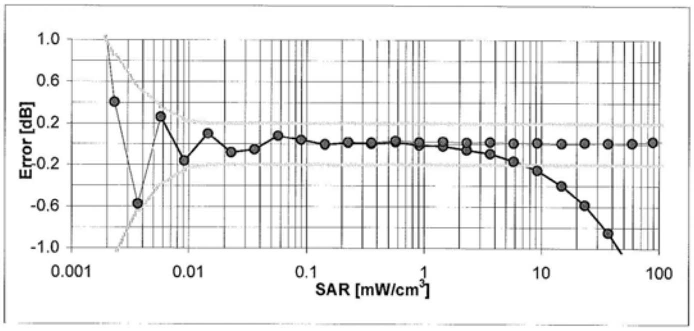
Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

EX3DV4 SN:3555 September 22, 2010

Dynamic Range f(SAR_{head})

(Waveguide R22, f = 1800 MHz)

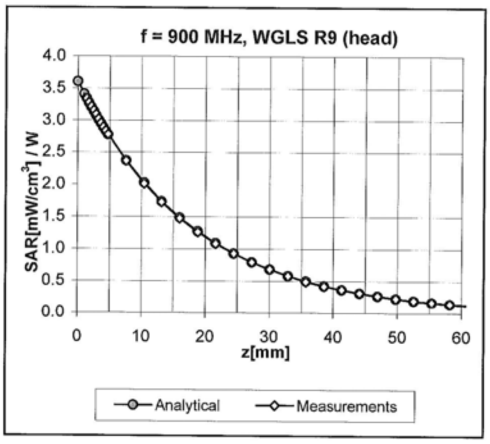


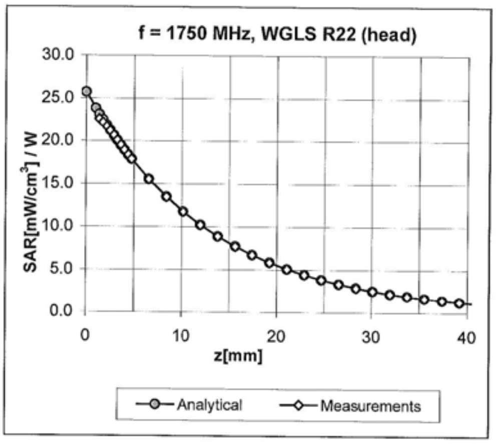


Uncertainty of Linearity Assessment: ± 0.6% (k=2)

EX3DV4 SN:3555 September 22, 2010

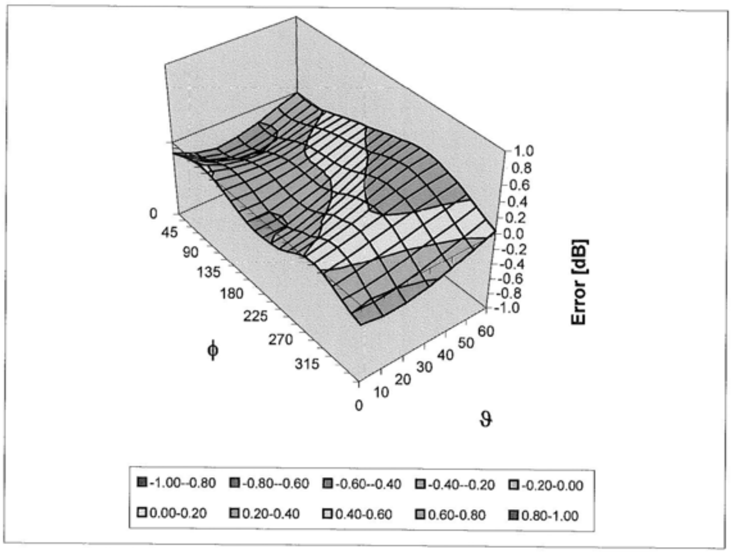
Conversion Factor Assessment





Deviation from Isotropy in HSL

Error (ϕ, ϑ), f = 900 MHz



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

Certificate No: EX3-3555_Sep10 Page 10 of 11

EX3DV4 SN:3555 September 22, 2010

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	Not applicable
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

Schmid & Partner Engineering AG

s p e a g

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info@speag.com, http://www.speag.com

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

TN_BR040315AD DAE4.doc 11.12.2009

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Accreditation No.: **SCS 108**

Client **ETC (Auden)**

Certificate No: **DAE4-629_Sep10**

CALIBRATION CERTIFICATE

Object: DAE4 - SD 000 D04 BJ - SN: 629

Calibration procedure(s): QA CAL-06.v22
Calibration procedure for the data acquisition electronics (DAE)

Calibration date: September 17, 2010

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	1-Oct-09 (No: 9055)	Oct-10
Secondary Standards	**ID #**	**Check Date (in house)**	**Scheduled Check**
Calibrator Box V1.1	SE UMS 006 AB 1004	07-Jun-10 (in house check)	In house check: Jun-11

	Name	Function	Signature
Calibrated by:	Dominique Steffen	Technician	
Approved by:	Fin Bomholt	R&D Director	F. Bomholt

Issued: September 17, 2010

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Accreditation No.: **SCS 108**

Glossary

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

Methods Applied and Interpretation of Parameters

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

DC Voltage Measurement

A/D - Converter Resolution nominal

High Range: 1LSB = 6.1μV , 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	404.336 ± 0.1% (k=2)	404.208 ± 0.1% (k=2)	404.081 ± 0.1% (k=2)
Low Range	3.98391 ± 0.7% (k=2)	3.96777 ± 0.7% (k=2)	3.97695 ± 0.7% (k=2)

Connector Angle

Connector Angle to be used in DASY system	153.0 ° ± 1 °

Appendix

1. DC Voltage Linearity

High Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	199995.7	-5.34	-0.00
Channel X	+ Input	20000.71	0.51	0.00
Channel X	- Input	-19997.58	1.72	-0.01
Channel Y	+ Input	199994.6	-1.46	-0.00
Channel Y	+ Input	19999.09	-1.01	-0.01
Channel Y	- Input	-19997.51	2.79	-0.01
Channel Z	+ Input	199994.2	-1.40	-0.00
Channel Z	+ Input	20000.77	0.67	0.00
Channel Z	- Input	-19999.11	1.29	-0.01

Low Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	1999.5	-0.55	-0.03
Channel X	+ Input	199.96	0.06	0.03
Channel X	- Input	-199.89	0.11	-0.05
Channel Y	+ Input	1997.0	-3.01	-0.15
Channel Y	+ Input	199.74	-0.06	-0.03
Channel Y	- Input	-200.51	-0.51	0.25
Channel Z	+ Input	2000.2	0.13	0.01
Channel Z	+ Input	199.28	-0.62	-0.31
Channel Z	- Input	-200.79	-0.79	0.40

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	-0.69	-1.66
	- 200	3.67	1.89
Channel Y	200	2.70	2.36
	- 200	-2.99	-3.31
Channel Z	200	0.31	1.02
	- 200	-1.97	-2.05

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	-	2.72	0.39
Channel Y	200	1.27	-	3.35
Channel Z	200	0.73	0.15	-

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4. **AD-Converter Values with inputs shorted**

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

	High Range (LSB)	Low Range (LSB)
Channel X	16029	16581
Channel Y	15984	17313
Channel Z	16305	16385

5. **Input Offset Measurement**

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

	Average (μV)	min. Offset (μV)	max. Offset (μV)	Std. Deviation (μV)
Channel X	0.63	-0.21	3.79	0.49
Channel Y	-0.71	-2.49	1.23	0.48
Channel Z	-0.65	-1.48	1.24	0.36

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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