SAR TEST REPORT

REPORT NO.: SA920526R01
MODEL NO.: AWU2000b
RECEIVED: June 9 2003
TESTED: June 9 2003

APPLICANT: AIN COMM. TECHNOLOGY

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1. CERTIFICATION

PRODUCT : 2.4GHz WLAN USB Stick
MODEL NO. : AWU2000b
BRAND NAME : AIN
APPLICANT : AIN COMM. TECHNOLOGY
STANDARDS : 47 CFR Part 2 (Section 2.1093), FCC OET Bulletin 65, Supplement C (01-01), RSS-102

We, **Advance Data Technology Corporation**, hereby certify that one sample of the designation has been tested in our facility on 09th June 2003. The test record, data evaluation and Equipment Under Test (EUT) configurations represented herein are true and accurate, and it was tested according to the standards listed above. This device was found to be in compliance with the Specific Absorption Rate (SAR) requirement specified in FCC part 2.1093 under General Population / Uncontrolled Exposure condition.

PREPARED BY : Bunny Yao , **DATE** : June 11 2003
Bunny Yao

APPROVED BY : for , **DATE** : June 11 2003
Dr. Alan Lane,
Junior Vice Presidnet

2. GENERAL INFORMATION

2.1 GENERAL DESCRIPTION OF EUT

PRODUCT	2.4GHz WLAN USB Stick
MODEL NO.	AWU2000b
POWER SUPPLY	3.3VDC powered by host equipment
CLASSIFICATION	Portable device, production unit
MODULATION TYPE	BPSK, QPSK, CCK
RADIO TECHNOLOGY	DSSS
TRANSFER RATE	1/2/5.5/11Mbps
FREQUENCY RANGE	2412MHz ~ 2462MHz
NUMBER OF CHANNEL	11
CONDUCTED OUTPUT POWER	33.11 mW
ANTENNA TYPE	Internal Antenna
PEAK SAR	1.26W/kg
DATA CABLE	NA
I/O PORTS	USB
ASSOCIATED DEVICES	NA

NOTE

1. The normal operating condition is taken while this EUT has been plugged into the laptop.
2. For more detailed features description, please refer to the manufacturer's specifications or User's Manual.
3. The device is an IEEE 802.11b transceiver.

2.2 GENERAL DESCRIPTION OF APPLIED STANDARDS

According to the specifications of the manufacturer, this product must comply with the requirements of the following standards:

FCC 47 CFR Part 2 (2.1093)
FCC OET Bulletin 65, Supplement C (01- 01)
RSS-102
IEEE 1528-200X

All tests have been performed and recorded as per the above standards.

2.3 GENERAL INOFRMATION OF THE SAR SYSTEM

DASY4 (software 4.1d) consists of high precision robot, probe alignment sensor, phantom, robot controller, controlled measurement server and near-field probe. The robot includes six axes that can move to the precision position of the DASY4 software defined. The DASY4 software can define the area that is detected by the probe. The robot is connected to controlled box. Controlled measurement server is connected to the controlled robot box. The DAE includes amplifier, signal multiplexing, AD converter, offset measurement and surface detection. It is connected to the Electro-optical coupler (ECO). The ECO performs the conversion form the optical into digital electric signal of the DAE and transfers data to the PC.

ET3DV6 ISOTROPIC E-FIELD PROBE

Construction	Symmetrical design with triangular core. Built-in optical fiber for surface detection system. Built-in shielding against static charges. PEEK enclosure material (resistant to organic solvents, e.g., glycolether).
Calibration	Basic Broad Band Calibration in air: 10-2500 MHz Conversion Factors (CF) for HSL 900, HSL 1800, HSL2450, MSL 900, MSL 1800 and MSL2450. CF-Calibration for other liquids and frequencies upon request
Frequency	10 MHz to 3 GHz; Linearity: ± 0.2 dB (30 MHz to 3 GHz)
Directivity	± 0.2 dB in HSL (rotation around probe axis) ± 0.4 db in HSL (rotation normal to probe axis)
Dynamic Range	5 µW/g to > 100 mW/g; Linearity: ± 0.2 dB
Optical Surface Detection	± 0.2 mm repeatability in air and clear liquids over diffuse reflecting surfaces

Dimensions	Overall length: 330 mm (Tip Length: 16 mm) Tip diameter: 6.8 mm (Body diameter: 12 mm) Distance from probe tip to dipole centers: 2.7 mm
Application	General dosimetric measurements up to 3 GHz Compliance tests of mobile phones Fast automatic scanning in arbitrary phantoms (ET3DV6)
Sensitivity	X axis :1.81 μV ; Y axis : 1.82 μV ; Z axis : 1.61 μV
Diode compression point	X axis : 95 mV ; Y axis : 95 mV ; Z axis : 95mV

Conversion Factor

Frequency range (MHz)	X axis	Y axis	Z axis
800~950 (Head)	6.5	6.5	6.5
800~950 (Body)	6.3	6.3	6.3
1700~1910 (Head)	5.3	5.3	5.3
1700~1910 (Body)	5.1	5.1	5.1
2400~2500 (Head)	4.9	4.9	4.9
2400~2500 (Body)	4.4	4.4	4.4

Boundary effect

Frequency range (MHz)	Alpha	Depth
800~950 (Head)	0.35	2.60
800~950 (Body)	0.37	2.61
1700~1910 (Head)	0.51	2.37
1700~1910 (Body)	0.57	2.40
2400~2500 (Head)	1.00	1.70
2400~2500 (Body)	1.00	1.65

NOTE

1. The Probe parameters have been calibrated by the SPEAG. Please reference “APPENDIX D” for the Calibration Certification Report.
2. For frequencies above 800 MHz, calibration in a rectangular wave-guide is used, because wave-guide size is manageable.
3. For frequencies below 800 MHz, temperature transfer calibration is used because the wave-guide size becomes relatively large.

TWIN SAM V4.0

Construction	The shell corresponds to the specifications of the Specific Anthropomorphic Mannequin (SAM) phantom defined in IEEE 1528-200X, 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: 810 mm; Length: 1000 mm; Width: 500 mm

SYSTEM VALIDATION KITS: D900V2 – D2450V2

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
Calibration	Calibrated SAR value for specified position and input power at the flat phantom in brain simulating solutions
Frequency	900, 1800, 1900, 2450 MHz
Return Loss	> 20 dB at specified validation position
Power Capability	> 100 W (f < 1GHz); > 40 W (f > 1GHz)
Options	Dipoles for other frequencies or solutions and other calibration conditions upon request
Dimensions	D900V2: dipole length: 149 mm; overall height: 83.3mm D1800V2: dipole length: 72 mm; overall height: 41.2 mm D1900V2: dipole length: 68 mm; overall height: 39.5 mm D2450V2: dipole length: 51.5 mm; overall height: 30.6 mm

Construction

The device holder for the mobile phone device is designed to cope with different positions given in the standard. It has two scales for the device rotation (with respect to the body axis) and the device inclination (with respect to the line between the ear reference points). The rotation centers for both scales is the ear reference point (ERP). Thus the device needs no repositioning when changing the angles. The holder has been made out of low-loss POM material having the following dielectric parameters: relative permittivity ε =3 and loss tangent δ =0.02. The amount of dielectric material has been reduced in the closest vicinity of the device, since measurements have suggested that the influence of the clamp on the test results could thus be lowered. The device holder for the portable device makes up of the polyethylene foam. The dielectric parameters of material close to the dielectric parameters of the air. The holder of the portable device could support the EUT in the specific testing position.

DATA ACQUISITION ELECTRONICS

Construction

The data acquisition electronics (DAE3) consists of a highly sensitive electrometer grade preamplifier with auto-zeroing, a channel and gain-switching multiplex, 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 is 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 DAE3 box is 200MOhm; the inputs are symmetrical and floating. Common mode rejection is above 80 dB.

2.4 GENERAL DESCRIPTION OF THE SPATIAL PEAK SAR EVALUATION AND PROBE SCAN

The DASY4 post-processing software (SEMCAD) automatically executes the following procedures to calculate the field units from the micro-volt 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

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:

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

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-fieldprobes : $$E_i = \sqrt{\frac{V_1}{Norm_i \cdot ConvF}}$$

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

V_i =compensated signal of channel I (i = x, y, z)
$Norm_i$ =sensor sensitivity of channel i µV/(V/m)2 for E-field Probes (i = x, y, z)
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.

$$SAR = E_{tot}^2 \cdot \frac{o}{p \cdot 1'000}$$

SAR = local specific absorption rate in mW/g
E_{tot} = total field strength in V/m
o = conductivity in [mho/m] or [Siemens/m]
p = equivalent tissue density in g/cm3

Note that the density is set to 1, to account for actual head tissue density rather than the density of the tissue simulating liquid. The entire evaluation of the spatial peak values is performed within the Post-processing engine (SEMCAD). The system always gives the maximum values for the 1 g and 10 g cubes. The algorithm to find the cube with highest averaged SAR is divided into the following stages:

1. The extraction of the measured data (grid and values) from the Zoom Scan
2. The calculation of the SAR value at every measurement point based on all stored data (A/D values and measurement parameters)
3. The generation of a high-resolution mesh within the measured volume
4. The interpolation of all measured values from the measurement grid to the high-resolution grid
5. The extrapolation of the entire 3-D field distribution to the phantom surface over the distance from sensor to surface
6. The calculation of the averaged SAR within masses of 1g and 10g.

The probe is calibrated at the center of the dipole sensors that is located 1 to 2.7mm away from the probe tip. During measurements, the probe stops shortly above the phantom surface, depending on the probe and the surface detecting system. Both distances are included as parameters in the probe configuration file. The software always knows exactly how far away the measured point is from the surface. As the probe cannot directly measure at the surface, the values between the deepest measured point and the surface must be extrapolated. The angle between the probe axis and the surface normal line is less than 30 degree.

In the Area Scan, the gradient of the interpolation function is evaluated to find all the extreme of the SAR distribution. The uncertainty on the locations of the extreme is less than 1/20 of the grid size. Only local maximum within -2 dB of the global maximum are searched and passed for the Cube Scan measurement. In the Cube Scan, the interpolation function is used to extrapolate the Peak SAR from the lowest measurement points to the inner phantom surface (the extrapolation distance). The uncertainty increases with the extrapolation distance. To keep the uncertainty within 1% for the 1 g and 10 g cubes, the extrapolation distance should not be larger than 5mm.

The maximum search is automatically performed after each area scan measurement. It is based on splines in two or three dimensions. The procedure can find the maximum for most SAR distributions even with relatively large grid spacing. After the area scanning measurement, the probe is automatically moved to a position at the interpolated maximum. The following scan can directly use this position for reference, e.g., for a finer resolution grid or the cube evaluations. The 1g and 10g peak evaluations are only available for the predefined cube 7x7x7 scans. The routines are verified and optimized for the grid dimensions used in these cube measurements. The measured volume of 30x30x30mm contains about 30g of tissue. The first procedure is an extrapolation (incl. boundary correction) to get the points between the lowest measured plane and the surface. The next step uses 3D interpolation to get all points within the measured volume in a 1mm grid (42875 points). In the last step, a 1g cube is placed numerically into the volume and its averaged SAR is calculated. This cube is the moved around until the highest averaged SAR is found. If the highest SAR is found at the edge of the measured volume, the system will issue a warning: higher SAR values might be found outside of the measured volume. In that case the cube measurement can be repeated, using the new interpolated maximum as the center.

3. DESCRIPTION OF TEST MODES AND CONFIGURATIONS

CARRIER MODULATION UNDER TEST	CCK
CREST FACTOR	1.0
CHANNEL FREQUENCIES UNDER TEST AND ITS CONDUCTED OUTPUT POWER	33.11mW / Ch1: 2412MHz 31.19mW / Ch6: 2437MHz 30.20mW / Ch11: 2462MH
ANTENNA CONFIGURATION	Internal Antenna
EUT POWER SOURCE	From Host Notebook
HOST POWER SOURCE	Fully Charged Battery

The following test configurations have been applied in this test report:

Mode 1: The EUT is plugged in the USB slot of the notebook, the bottom of the notebook contact the bottom of the flat phantom with 0mm separation distance. Therefore the bottom of the EUT face to the phantom and the separation distance is 6mm. The area scan size is 5 x 7 points.

Mode 2: The EUT is plugged in the PCMCIA slot of the notebook, the keyboard face of the notebook is perpendicular to the bottom of the flat phantom and the EUT is located between notebook and phantom. The separation distance is 1.5cm between the tip of the EUT and the bottom of the flat phantom. The area scan size is 5 x 6 points.

Mode 3: The EUT is plugged in the PCMCIA slot of the notebook, the keyboard face of the notebook is perpendicular to the bottom of the flat phantom and the EUT is located between notebook and phantom. The separation distance is 0cm between the tip of the EUT and the bottom of the flat phantom. The area scan size is 5 x 6 points.

NOTE:

1. Please reference “APPENDIX A” for the photos of test configuration.
2. All test modes have been complied with the body worn configuration.
3. The notebook has been installed the controlling software that could control the EUT transmitted channel and power. But that software is just for test software, not for normal user.
4. The EUT has the maximum output power under the CCK modulation

4. DESCRIPTION OF SUPPORT UNITS

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

NO.	PRODUCT	BRAND	MODEL NO.	SERIAL NO.	FCC ID
1	NB	COMPAQ	N800C	470048-515	FCC DoC APPROVED

NO.	SIGNAL CABLE DESCRIPTION OF THE ABOVE SUPPORT UNITS
1	NA

5. TEST RESULTS

5.1 TEST PROCEDURES

The EUT (2.4GHz WLAN USB Stick) plugged into the notebook. Use the software to control the EUT 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. According to the IEEE P1528 draft standards, the recommended procedure for assessing the peak spatial-average SAR value consists of the following steps:

- Power reference measurement
- Area scan
- Zoom scan
- Power reference measurement

The area scan with 20mm x 20mm grid was performed for the highest spatial SAR location. Consist of 7 x 5 points while the scan size is the 120mm x 60mm. The zoon scan with 30mm x 30mm x 30mm volume was performed for SAR value averaged over 1g and 10g spatial volumes.

In the zoon scan, the distance between the measurement point at the probe sensor location (geometric center behind the probe tip) and the phantom surface is 4.0 mm and maintained at a constant distance of ±1.0 mm during a zoon scan to determine peak SAR locations. The distance is 4mm between the first measurement point and the bottom surface of the phantom. The secondary measurement point to the bottom surface of the phantom is with 9mm separation distance. The cube size is 7 x 7 x 7points consist of 343 points and the grid space is 5mm.

The measurement time is 0.5 s at each point of the zoon scan. The probe boundary effect compensation shall be applied during the SAR test. Because of the tip of the probe to the Phantom surface separated distances are longer than half a tip probe diameter.

In the area scan, the separation distance is 4mm between the each measurement point and the phantom surface. The scan size shall be included the transmission portion of the EUT. The measurement time is the same as the zoon scan. At last the reference power drift shall be less than ±5%.

5.2 MEASURED SAR RESULT

EUT			2.4GHz WLAN USB Stick		**MODEL**		AWU2000b		
ENVIRONMENTAL CONDITION			Air Temperature：21.0°C, Liquid Temperature：20.1°C Humidity：60%RH						
TESTED BY			Cody Chang						
Chan.	**Freq. (MHz)**	**Modulate type**	**Conducted Power (mW)**		**Power Drift (%)**	**Device Use Power**	**Device Test Position Mode**	**Antenna Position**	**Measured 1g SAR (W/kg)**
			egin Test	**fter Test**					
1	**2412 (Low)**	**CCK**	33.11	33.07	-0.12	Standard Battery from host	1	Internal Fixed	0.0126
6	**2437 (Mid.)**	**CCK**	31.19	31.0	-0.61	Standard Battery from host	1	Internal Fixed	0.0133
11	**2462 (High)**	**CCK**	30.2	30.07	-0.43	Standard Battery from host	1	Internal Fixed	0.0124
1	**2412 (Low)**	**CCK**	33.02	32.97	-0.15	Standard Battery from host	2	Internal Fixed	0.188
6	**2437 (Mid.)**	**CCK**	31.16	31.18	0.06	Standard Battery from host	2	Internal Fixed	0.159
11	**2462 (High)**	**CCK**	30.13	30.18	0.17	Standard Battery from host	2	Internal Fixed	0.162

NOTE:

1. Test configuration of each mode is described in section 3.
2. In this testing, the limit for General Population Spatial Peak averaged over 1g, **1.6 W/kg**, is applied.
3. Please see the Appendix A for the photo of the test configuration and also the data.
4. The variation of the EUT conducted power measured before and after SAR testing should not over 5%

EUT	2.4GHz WLAN USB Stick	MODEL	AWU2000b
ENVIRONMENTAL CONDITION	Air Temperature：21.0°C, Liquid Temperature：20.1°C Humidity：60%RH		
TESTED BY	Cody Chang		

Chan.	Freq. (MHz)	Modulate type	Conducted Power (mW)		Power Drift (%)	Device Use Power	Device Test Position Mode	Antenna Position	Measured 1g SAR (W/kg)
			Begin Test	After Test					
1	2412 (Low)	CCK	33.09	33.0	-0.27	Standard Battery from host	3	Internal Fixed	1.26
6	2437 (Mid.)	CCK	31.08	30.96	-0.39	Standard Battery from host	3	Internal Fixed	1.21
11	2462 (High)	CCK	30.09	30.17	0.27	Standard Battery from host	3	Internal Fixed	1.17

NOTE:

1. Test configuration of each mode is described in section 3.
2. In this testing, the limit for General Population Spatial Peak averaged over 1g, **1.6 W/kg**, is applied.
3. Please see the Appendix A for the photo of the test configuration and also the data.
4. The variation of the EUT conducted power measured before and after SAR testing should not over 5%

5.3 SAR LIMITS

HUMAN EXPOSURE	SAR (W/kg)	
	(General Population / Uncontrolled Exposure Environment)	(Occupational / controlled Exposure Environment)
Spatial Average (whole body)	0.08	0.4
Spatial Peak (averaged over 1 g)	**1.6**	8.0
Spatial Peak (hands/wrists/feet/ankles averaged over 10 g)	4.0	20.0

NOTE

1. This limits accord to ANSI/IEEE C95.1 1992 – Safety Limit.
2. The EUT property been complied with the partial body exposure limit under the general population environment.

5.4 RECIPES FOR TISSUE SIMULATING LIQUIDS

For the measurement of the field distribution inside the SAM phantom, the phantom must be filled with 25 litters of tissue simulation liquid.

The following ingredients are used：

- Water- Deionized water (pure H20), resistivity _16 M - as basis for the liquid
- Sugar- Refined sugar in crystals, as available in food shops - to reduce relative permittivity
- Salt- Pure NaCl - to increase conductivity
- Cellulose- Hydroxyethyl-cellulose, medium viscosity (75-125 mPa.s, 2% in water, 20_C),CAS # 54290 - to increase viscosity and to keep sugar in solution
- Preservative- Preventol D-7 Bayer AG, D-51368 Leverkusen, CAS # 55965-84-9 - to prevent the spread of bacteria and molds
- DGMBE- Diethylenglycol-monobuthyl ether (DGMBE), Fluka Chemie GmbH, CAS # 112-34-5 - to reduce relative permittivity

The Recipes For 2450MHz Simulating Liquid Table

Ingredient	Head Simulating Liquid 2450MHz(HSL-2450)	Muscle Simulating Liquid 2450MHz(MSL-2450)
Water	45%	69.83%
DGMBE	55%	30.17%
Salt	NA	NA
Dielectric Parameters at 22℃	f=2450MHz ε=39.2±5% σ= 1.80±5% S/m	f=2450MHz ε=52.7±5% σ= 1.95±5% S/m

The liquid nature is tested by Agilent Network Analyzer E8358A and Agilent Dielectric Probe Kit 85070D.Here are the procedure.

1. Turn Network Analyzer on and allow at least 30 min. warm up.
2. Mount dielectric probe kit so that interconnecting cable to Network Analyzer will not be moved during measurements or calibration.
3. Pour de-ionized water and measure water temperature (±1°).
4. Set water temperature in Agilent-Software (Calibration Setup).
5. Perform calibration.
6. Validate calibration with dielectric material of known properties (e.g. polished ceramic slab with >8mm thickness ε'=10.0, ε''=0.0). If measured parameters do not fit within tolerance, repeat calibration (±0.2 for ε': ±0.1 for ε'').
7. Conductivity can be calculated from ε'' by $\sigma = \omega \varepsilon_0 \varepsilon'' = \varepsilon'' f$ [GHz] / 18.
8. Measure liquid shortly after calibration. Repeat calibration every hour.
9. Stir the liquid to be measured. Take a sample (~50ml) with a syringe from the center of the liquid container.
10. Pour the liquid into a small glass flask. Hold the syringe at the bottom of the flask to avoid air bubbles.
11. Put the dielectric probe in the glass flask. Check that there are no air bubbles in front of the opening in the dielectric probe kit.
12. Perform measurements.
13. Adjust medium parameters in DASY4 for the frequencies necessary for the measurements (‘Setup Config’, select medium (e.g. Brain 900 MHz) and press ‘Option’-button.
14. Select the current medium for the frequency of the validation (e.g. Setup Medium Brain 900 MHz).

For 802.11g Band Simulating Liquid

Liquid Type		HSL-2450	MSL-2450
Simulating Liquid Temp.		NA	20.1
Test Date		NA	2003/06/09
Tested By		NA	Cody Chang
Freq. (MHz)	**Liquid Parameter**	**Value**	**Value**
2412	Permitivity (ε)	NA	51.97
2437		NA	51.95
2450		NA	51.89
2462		NA	51.86
2412	Conductivity (σ) S/m	NA	1.897
2437		NA	1.931
2450		NA	1.937
2462		NA	1.933
Dielectric Parameters Required at 22℃		f=2450MHz ε=39.2±5% σ= 1.80±5% S/m	f=2450MHz ε=52.7±5% σ= 1.95±5% S/m

5.5 TEST EQUIPMENT FOR TISSUE PROPERTY

Item	Name	Band	Type	Series No.	Calibrated Until
1	Network Analyzer	Agilent	E8358A	US41480539	May 6, 2004
2	Dielectric Probe	Agilent	85070D	US01440176	NA

NOTE

1. Before starting, all test equipment shall be warmed up for 30min.
2. The tolerance (k=1) specified by Agilent for general dielectric measurements, deriving from inaccuracies in the calibration data, analyzer drift, and random errors, are usually ±2.5% and ±5% for measured permittivity and conductivity, respectively. However, the tolerances for the conductivity is smaller for material with large loss tangents, i.e., less than ±2.5% (k=1) . It can be substantially smaller if more accurate methods are applied.

6. SYSTEM VALIDATION

The system validation was performed in the flat phantom with equipment listed in the following table. Since the SAR value is calculated from the measured electric field, dielectric constant and conductivity of the body tissue, and the SAR is proportional to the square of the electric field. So, the SAR value will be also proportional to the RF power input to the system validation dipole under the same test environment. In our system validation test, 50mW RF input power was used instead of 250mW used by Schmid & Partner, then the measured SAR will be linearly extrapolated to that of 250mW RF power.

6.1 TEST EQUIPMENT

Item	Name	Band	Type	Series No.	Calibrated Until
1	SAM Phantom	S & P	QD000 P40 CA	PT-1150	NA
2	Signal Generator	R & S	SMP04	10001	May 5, 2004
3	E-Field Probe	S & P	ET3DV6	1687	Sept. 27, 2003
4	DAE	S & P	DAE3 V1	510	April 10, 2004
5	Robot Positioner	Staubli Unimation	NA	NA	NA
6	Validation Dipole	S & P	D900V2	156	May 14, 2004
7	Validation Dipole	S & P	D1800V2	2d041	May 15, 2004

NOTE: Before starting the measurement, all test equipment shall be warmed up for 30min.

6.2 TEST PROCEDURE

Before the system performance check, we need only to tell the system which components (probe, medium, and device) are used for the system performance check; the system will take care of all parameters. The dipole must be placed beneath the flat section of the SAM Twin Phantom with the correct distance holder in place. The distance holder should touch the phantom surface with a light pressure at the reference marking (little cross) and be oriented parallel to the long side of the phantom. Accurate positioning is not necessary, since the system will search for the peak SAR location, except that the dipole arms should be parallel to the surface. The device holder for mobile phones can be left in place but should be rotated away from the dipole.

1.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.

2.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 difference between the optical surface detection and the actual surface depends on the probe and is specified with each probe. (It does not depend on the surface reflectivity or the probe angle to the surface within ±30°.) However, varying breaking indices of different liquid compositions might also influence the distance. If the indicated difference varies from the actual setting, the probe parameter ”optical surface

3. 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. If a finer graphic is desired, the grid spacing can be reduced. Grid spacing and orientation have no influence on the SAR result.

4. 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).

About the validation dipole positioning uncertainty, the constant and low loss dielectric spacer is used to establish the correct distance between the top surface of the dipole and the bottom surface of the phantom, the error component introduced by the uncertainty of the distance between the liquid (i.e., phantom shell) and the validation dipole in the DASY4 system is less than ±0.1mm.

$$SAR_{tolerance}[\%] = 100 \times (\frac{(a+d)^2}{a^2} - 1)$$

As the closest distance is 10mm, the resulting tolerance $SAR_{tolerance}$[%] is <2%.

6.3 VALIDATION RESULT

ENVIRONMENTAL CONDITION	Temperature：21.0°C, Humidity：60%RH		
TESTED BY	Cody Chang		
TEST DATE	2003/06/09		
2450MHz System Validation Test in the Muscle Simulating Liquid			
Required SAR (mW/g)	**Measured SAR (mW/g)**	**Deviation (%)**	**Separation Distance**
12.9 (1g)	11.9	-7.75	10mm
6.26 (10g)	5.85	-6.54	10mm

NOTE: Please see Appendix for the photo of system validation test.

6.4 SYSTEM VALIDATION UNCERTAINTIES

In the table below, the system validation uncertainty with respect to the analytically assessed SAR value of a dipole source as given in the P1528 standard is given. This uncertainty is smaller than the expected uncertainty for mobile phone measurements due to the simplified setup and the symmetric field distribution.

Error Description	Tolerance (±%)	Probability Distribution	Divisor	(C_i)		Standard Uncertainty (±%)		(v_i)
				(1g)	(10g)	(1g)	(10g)	
Measurement System								
Probe Calibration	4.8	Normal	1	1	1	4.8	4.8	∞
Axial Isotropy	4.7	Rectangular	$\sqrt{3}$	1	1	2.7	2.7	∞
Hemispherical Isotropy	0	Rectangular	$\sqrt{3}$	1	1	0	0	∞
Boundary effect	1.0	Rectangular	$\sqrt{3}$	1	1	0.6	0.6	∞
Linearity	4.7	Rectangular	$\sqrt{3}$	1	1	2.7	2.7	∞
System Detection Limit	1.0	Rectangular	$\sqrt{3}$	1	1	0.6	0.6	∞
Readout Electronics	1.0	Normal	1	1	1	1.0	1.0	∞
Response Time	0	Rectangular	$\sqrt{3}$	1	1	0	0	∞
Integration Time	0	Rectangular	$\sqrt{3}$	1	1	0	0	∞
RF Ambient Conditions	3.0	Rectangular	$\sqrt{3}$	1	1	1.7	1.7	∞
Probe Positioner	0.4	Rectangular	$\sqrt{3}$	1	1	0.2	0.2	∞
Probe positioning	2.9	Rectangular	$\sqrt{3}$	1	1	1.7	1.7	∞
Algorithms for Max. SAR Evaluation	1.0	Rectangular	$\sqrt{3}$	1	1	0.6	0.6	∞
Dipole								
Dipole Axis to Liquid Distance	2.0	Rectangular	$\sqrt{3}$	1	1	1.2	1.2	∞
Input power and SAR drift measurement	4.7	Rectangular	$\sqrt{3}$	1	1	2.7	2.7	∞
Phantom and Tissue Parameters								
Phantom Uncertainty	4.0	Rectangular	$\sqrt{3}$	1	1	2.3	2.3	∞
Liquid Conductivity (target)	5.0	Rectangular	$\sqrt{3}$	0.64	0.43	1.8	1.2	∞
Liquid Conductivity (measurement)	2.5	Normal	1	0.64	0.43	1.6	1.1	∞
Liquid Permittivity (target)	5.0	Rectangular	$\sqrt{3}$	0.6	0.49	1.7	1.4	∞
Liquid Permittivity (measurement)	2.5	Normal	1	0.6	0.49	1.5	1.2	∞
Combined Standard Uncertainty						8.4	8.1	∞
Coverage Factor for 95%						kp=2		
Expanded Uncertainty (K=2)						16.8	16.2	

NOTE: About the system validation uncertainty assessment, please reference the section 7.

7. MEASUREMENT SAR PROCEDURE UNCERTAINTIES

The assessment of spatial peak SAR of the hand handheld devices is according to IEEE 1528. All testing situation shall be met below these requirement.

- The system is used by an experienced engineer who follows the manual and the guidelines taught during the training provided by SPEAG.
- The probe has been calibrated within the requested period and the stated uncertainty for the relevant frequency bands does not exceed 4.8% (k=1).
- The validation dipole has been calibrated within the requested period and the system performance check has been successful.
- The DAE unit has been calibrated within the within the requested period.
- The minimum distance between the probe sensor and inner phantom shell is selected to be between 4 and 5mm.
- The operational mode of the DUT is CW, CDMA, FDMA or TDMA (GSM, DCS, PCS, IS136 and PDC) and the measurement/integration time per point is >500 ms.
- The dielectric parameters of the liquid have been assessed using Agilent 85070D dielectric probe kit or a more accurate method.
- The dielectric parameters are within 5% of the target values.
- The DUT has been positioned as described in section 3.

7.1 PROBE CALIBRATION UNCERTAINTY

SPEAG conducts the probe calibration in compliance with international and national standards (e.g. IEEE 1528, EN50361, IEC 62209, etc.) under ISO17025. The uncertainties are stated on the calibration certificate. For the most relevant frequency bands, these values do not exceed 4.8% (k=1). If evaluations of other bands are performed for which the uncertainty exceeds these values, the uncertainty tables given in the summary have to be revised accordingly.

7.2 ISOTROPY UNCERTAINTY

The axial isotropy tolerance accounts for probe rotation around its axis while the hemispherical isotropy error includes all probe orientations and field polarizations. These parameters are assessed by SPEAG during initial calibration. In 2001, SPEAG further tightened its quality controls and warrants that the maximal deviation from axial isotropy is ±0.20 dB, while the maximum deviation of hemispherical isotropy is ±0.40 dB, corresponding to ±4.7% and ±9.6%, respectively. A weighting factor of cp equal to 0.5 can be applied, since the axis of the probe deviates less than 30 degrees from the normal surface orientation.

7.3 BOUNDARY EFFECT UNCERTAINTY

The effect can be estimated according to the following error approximation formula

$$SAR_{tolerance}[\%] = SAR_{be}[\%] \times \frac{(d_{be} + d_{step})^2}{2d_{step}} \frac{e^{-\frac{d_{be}}{\delta/2}}}{\delta/2}$$

$$d_{be} + d_{step} < 10mm$$

The parameter d_{be} is the distance in mm between the surface and the closest measurement point used in the averaging process; d_{step} is the separation distance in mm between the first and second measurement points; δ is the minimum penetration depth in mm within the head tissue equivalent liquids (i.e., δ= 13.95 mm at 3GHz); SAR_{be} is the deviation between the measured SAR value at the distance d_{be} from the boundary and the wave-guide analytical value SAR_{ref}.DASY4 applies a boundary effect compensation algorithm according to IEEE 1528, which is possible since the axis of the probe never deviates more than 30 degrees from the normal surface orientation. SAR_{be}[%] is assessed during the calibration process and SPEAG warrants that the uncertainty at distances larger than 4mm is always less than 1%.In summary, the worst case boundary effect SAR tolerance[%] for scanning distances larger than 4mm is < ± 0.8%.

7.4 PROBE LINEARITY UNCERTAINTY

Field probe linearity uncertainty includes errors from the assessment and compensation of the diode compression effects for CW and pulsed signals with known duty cycles. This error is assessed using the procedure described in IEEE 1528. For SPEAG field probes, the measured difference between CW and pulsed signals, with pulse frequencies between 10 Hz and 1 kHz and duty cycles between 1 and 100, is < ±0.20 dB (< ±4.7%).

7.5 READOUT ELECTRONICS UNCERTAINTY

All uncertainties related to the probe readout electronics (DAE unit), including the gain and linearity of the instrumentation amplifier, its loading effect on the probe, and accuracy of the signal conversion algorithm, have been assessed accordingly to IEEE 1528.The combination (root-sum-square RSS method) of these components results in an overall maximum error of ±1.0%.

7.6 RESPONSE TIME UNCERTAINTY

The time response of the field probes is assessed by exposing the probe to a well-controlled electric field producing SAR larger than 2.0 W/kg at the tissue medium surface. The signal response time is evaluated as the time required by the system to reach 90% of the expected final value after an on/of switch of the power source. Analytically, it can be expressed as:

$$SAR_{tolerance}[\%] = 100 \times \left(\frac{T_m}{T_m + Te^{-T_m/T} - T} - 1\right)$$

where Tm is 500 ms, i.e., the time between measurement samples, and $_T$ the time constant. The response time $_T$ of SPEAG's probes is <5 ms. In the current implementation, DASY4 waits longer than 100 ms after having reached the grid point before starting a measurement, i.e., the response time uncertainty is negligible.

7.7 INTEGRATION TIME UNCERTAINTY

If the device under test does not emit a CW signal, the integration time applied to measure the electric field at a specific point may introduce additional uncertainties due to the discretization and can be assessed as follows

$$SAR_{tolerance}[\%] = 100 \times \sum_{allsub-frames} \frac{t_{frame}}{t_{integration}} \frac{slot_{idle}}{slot_{total}}$$

The tolerances for the different systems are given in Table 7.1, whereby the worst-case $SAR_{tolerance}$ is 2.6%.

System	$SAR_{tolerance}$ %
CW	0
CDMA*	0
WCDMA*	0
FDMA	0
IS-136	2.6
PDC	2.6
GSM/DCS/PCS	1.7
DECT	1.9
Worst-Case	2.6

Table 7.1

7.8 PROBE POSITIONER MECHANICAL TOLERANCE

The mechanical tolerance of the field probe positioner can introduce probe positioning uncertainties. The resulting SAR uncertainty is assessed by comparing the SAR obtained according to the specifications of the probe positioner with respect to the actual position defined by the geometric enter of the probe sensors. The tolerance is determined as:

$$SAR_{tolerance}[\%] = 100 \times \frac{d_{ss}}{\delta/2}$$

The specified repeatability of the RX robot family used in DASY4 systems is ±25 µm. The absolute accuracy for short distance movements is better than ±0.1mm, i.e., the $SAR_{tolerance}$[%] is better than 1.5% (rectangular).

7.9 PROBE POSITIONING

The probe positioning procedures affect the tolerance of the separation distance between the probe tip and the phantom surface as:

$$SAR_{tolerance}[\%] = 100 \times \frac{d_{ph}}{\delta/2}$$

where d_{ph} is the maximum deviation of the distance between the probe tip and the phantom surface. The optical surface detection has a precision of better than 0.2 mm, resulting in an $SAR_{tolerance}$[%] of <2.9% (rectangular distribution). Since the mechanical detection provides better accuracy, 2.9% is a worst-case figure for DASY4 system.

7.10 PHANTOM UNCERTAINTY

The SAR measurement uncertainty due to SPEAG phantom shell production tolerances has been evaluated using

$$SAR_{tolerance}[\%] \cong 100 \times \frac{2d}{a}, \qquad d << a$$

For a maximum deviation d of the inner and outer shell of the phantom from that specified in the CAD file of ±0.2 mm, and a 10mm spacing a between source and tissue liquid, the calculated phantom uncertainty is ±4.0%.

7.11 DASY4 UNCERTAINTY BUDGET

Error Description	Tolerance (±%)	Probability Distribution	Divisor	(C_i)		Standard Uncertainty (±%)		(v_i)
				(1g)	(10g)	(1g)	(10g)	
Measurement System								
Probe Calibration	4.8	Normal	1	1	1	4.8	4.8	∞
Axial Isotropy	4.7	Rectangular	$\sqrt{3}$	1	1	1.9	1.9	∞
Hemispherical Isotropy	9.6	Rectangular	$\sqrt{3}$	1	1	3.9	3.9	∞
Boundary effect	1.0	Rectangular	$\sqrt{3}$	1	1	0.6	0.6	∞
Linearity	4.7	Rectangular	$\sqrt{3}$	1	1	2.7	2.7	∞
System Detection Limit	1.0	Rectangular	$\sqrt{3}$	1	1	0.6	0.6	∞
Readout Electronics	1.0	Normal	1	1	1	1.0	1.0	∞
Response Time	0.8	Rectangular	$\sqrt{3}$	1	1	0.5	0.5	∞
Integration Time	2.6	Rectangular	$\sqrt{3}$	1	1	1.5	1.5	∞
RF Ambient Conditions	3.0	Rectangular	$\sqrt{3}$	1	1	1.7	1.7	∞
Probe Positioner	0.4	Rectangular	$\sqrt{3}$	1	1	0.2	0.2	∞
Probe positioning	2.9	Rectangular	$\sqrt{3}$	1	1	1.7	1.7	∞
Algorithms for Max. SAR Evaluation	1.0	Rectangular	$\sqrt{3}$	1	1	0.6	0.6	∞
Test EUT Related								
Device Positioning	2.9	Normal	1	1	1	2.9	2.9	875
Device Holder	3.6	Normal	1	1	1	3.6	3.6	5
Power Drift	5	Rectangular	$\sqrt{3}$	1	1	2.9	2.9	∞
Phantom and Tissue Parameters								
Phantom Uncertainty	4.0	Rectangular	$\sqrt{3}$	1	1	2.3	2.3	∞
Liquid Conductivity (target)	5.0	Rectangular	$\sqrt{3}$	0.64	0.43	1.8	1.2	∞
Liquid Conductivity (measurement)	2.5	Normal	1	0.64	0.43	1.6	1.1	∞
Liquid Permittivity (target)	5.0	Rectangular	$\sqrt{3}$	0.6	0.49	1.7	1.4	∞
Liquid Permittivity (measurement)	2.5	Normal	1	0.6	0.49	1.5	1.2	∞
Combined Standard Uncertainty						**10.3**	**10**	331
Coverage Factor for 95%						**kp=2**		
Expanded Uncertainty (K=2)						20.6	20.1	

Table 7.2

The table 7.2: Worst-Case uncertainty budget for DASY4 assessed according to IEEE P1528. The budget is valid for the frequency range 300MHz ~ 3 GHz and represents a worst-case analysis. For specific tests and configurations, the uncertainty could be considerable smaller.

8. INFORMATION ON THE TESTING LABORATORIES

We, ADT Corp., were founded in 1988 to provide our best service in EMC and Safety consultation. Our laboratories are accredited and approved by the following approval agencies according to ISO/IEC 17025, Guide 25 or EN 45001:

USA	FCC, NVLAP
Germany	TUV Rheinland
Japan	VCCI
New Zealand	MoC
Norway	NEMKO
R.O.C.	BSMI, DGT, CNLA

Copies of accreditation certificates of our laboratories obtained from approval agencies can be downloaded from our web site: www.adt.com.tw/index.5/phtml.

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

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Fax: 886-2-26052943

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Web Site: www.adt.com.tw

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

APPENDIX A: TEST CONFIGURATIONS AND TEST DATA

A1: TEST CONFIGURATION

Mode 1

Mode 2

Mode 3

EUT Photo

Liquid Level Photo

2450MHz D=152mm

A2 : TEST DATA

Date/Time: 06/09/03 17:58:26

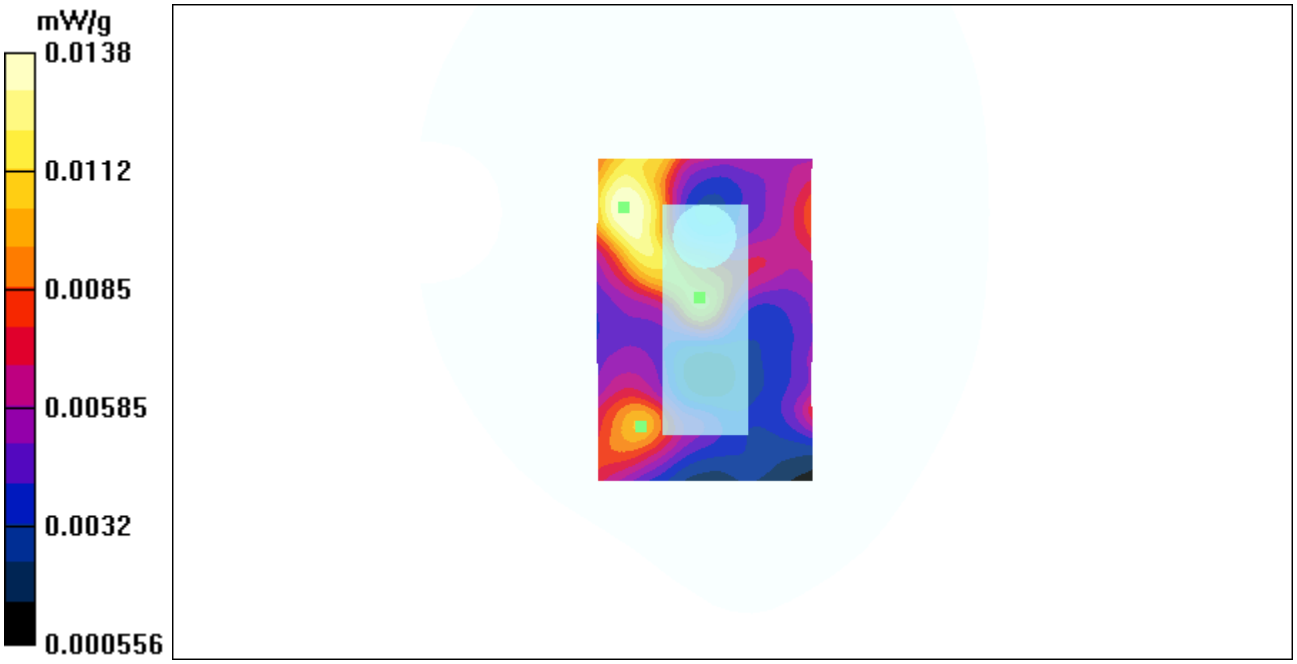
Test Laboratory: Advance Data Technology

AWU2000b Mode 1 channel 1

DUT: 2.4GHz WLAN USB Stick ; Type: AWU2000b ; Test Channel Frequency: 2412 MHz

Communication System: 802.11b ; Frequency: 2412 MHz; Duty Cycle: 1:1; Modulation type: CCK
Medium: MSL2450 (σ = 1.897 mho/m, ε_r = 51.97, ρ = 1000 kg/m^3) ; Liquid level : 152mm
Phantom section: Flat Section ; Separation distance : 6mm(The bottom of the EUT to the Phantom)
Antenna type : Internal Antenna ; Air temp. : 21 degrees ; Liquid temp. : 20.1 degrees
DASY4 Configuration:
- Probe: ET3DV6 - SN1687; ConvF(4.4, 4.4, 4.4); Calibrated: 2002/9/28
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn541; Calibrated: 2003/1/14
- Phantom: SAM Twin Phantom V4.0; Type: QD 000 P40 CA; Serial: TP-1150
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 115

Channel 1/Area Scan (5x7x1): Measurement grid: dx=20mm, dy=20mm
Channel 1/Zoon Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Peak SAR (extrapolated) = 0.0221 W/kg
SAR(1 g) = 0.0126 mW/g; SAR(10 g) = 0.00802 mW/g
Reference Value = 1.29 V/m
Power Drift = -0.2 dB
Maximum value of SAR = 0.0138 mW/g



Date/Time: 06/09/03 17:58:26

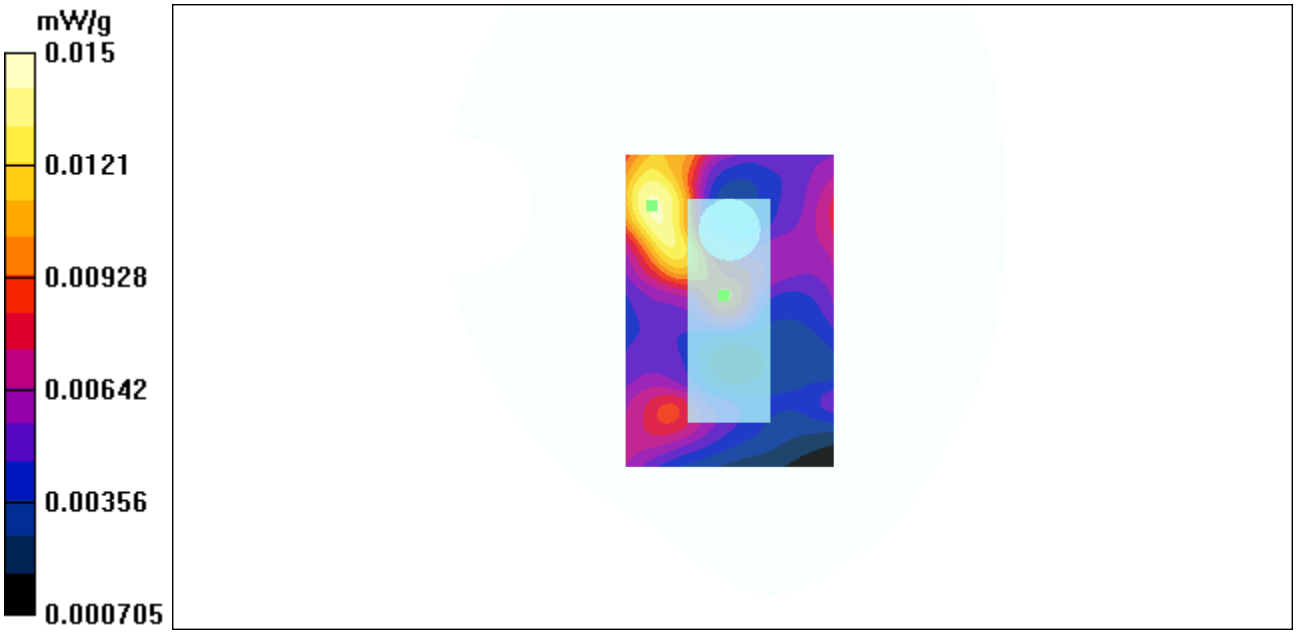
Test Laboratory: Advance Data Technology

AWU2000b Mode 1 channel 6

DUT: 2.4GHz WLAN USB Stick ; Type: AWU2000b ; Test Channel Frequency: 2437 MHz

Communication System: 802.11b ; Frequency: 2437 MHz; Duty Cycle: 1:1; Modulation type: CCK
Medium: MSL2450 (σ = 1.931 mho/m, ε_r = 51.95, ρ = 1000 kg/m^3) ; Liquid level : 152mm
Phantom section: Flat Section ; Separation distance : 6mm(The bottom of the EUT to the Phantom)
Antenna type : Internal Antenna ; Air temp. : 21 degrees ; Liquid temp. : 20.1 degrees
DASY4 Configuration:
- Probe: ET3DV6 - SN1687; ConvF(4.4, 4.4, 4.4); Calibrated: 2002/9/28
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn541; Calibrated: 2003/1/14
- Phantom: SAM Twin Phantom V4.0; Type: QD 000 P40 CA; Serial: TP-1150
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 115

Channel 6/Area Scan (5x7x1): Measurement grid: dx=20mm, dy=20mm
Channel 6/Zoon Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Peak SAR (extrapolated) = 0.0253 W/kg
SAR(1 g) = 0.0133 mW/g; SAR(10 g) = 0.00842 mW/g
Reference Value = 1.13 V/m
Power Drift = -0.1 dB
Maximum value of SAR = 0.015 mW/g



Date/Time: 06/09/03 18:19:52

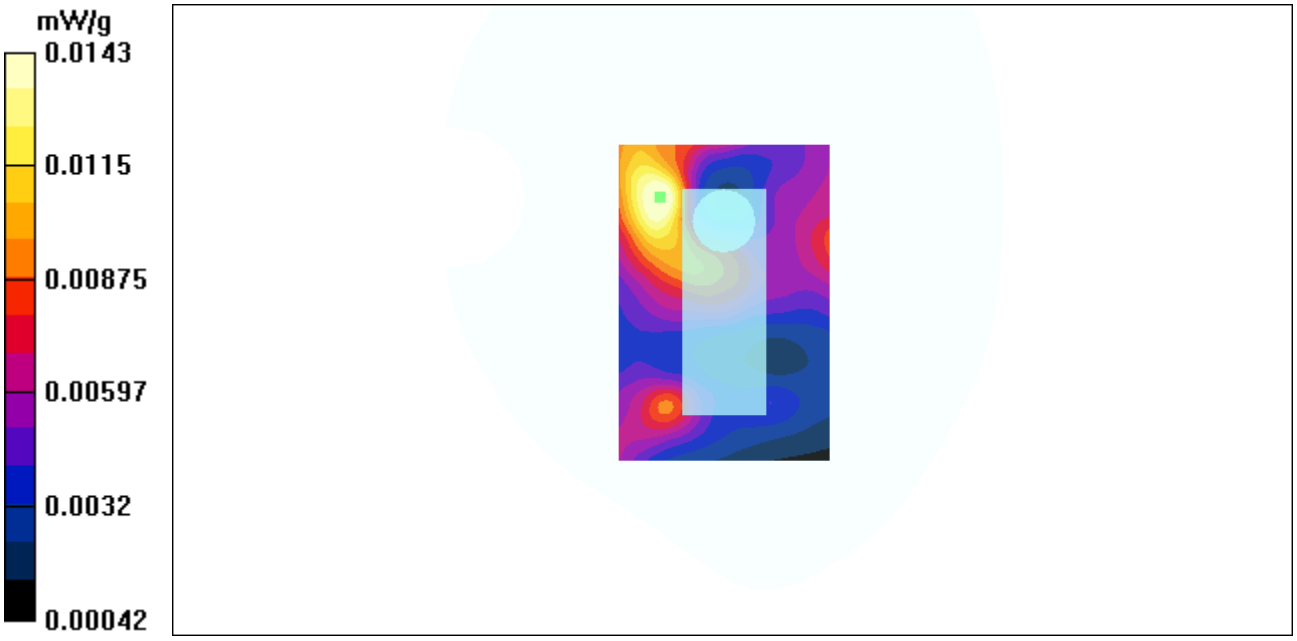
Test Laboratory: Advance Data Technology

AWU2000b Mode 1 channel 11

DUT: 2.4GHz WLAN USB Stick ; Type: AWU2000b ; Test Channel Frequency: 2462 MHz

Communication System: 802.11b ; Frequency: 2462 MHz; Duty Cycle: 1:1; Modulation type: CCK
Medium: MSL2450 (σ = 1.933 mho/m, ε_r = 51.86, ρ = 1000 kg/m^3) ; Liquid level : 152mm
Phantom section: Flat Section ; Separation distance : 6mm(The bottom of the EUT to the Phantom)
Antenna type : Internal Antenna ; Air temp. : 21 degrees ; Liquid temp. : 20.1 degrees
DASY4 Configuration:
- Probe: ET3DV6 - SN1687; ConvF(4.4, 4.4, 4.4); Calibrated: 2002/9/28
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn541; Calibrated: 2003/1/14
- Phantom: SAM Twin Phantom V4.0; Type: QD 000 P40 CA; Serial: TP-1150
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 115

Channel 11/Area Scan (5x7x1): Measurement grid: dx=20mm, dy=20mm
Channel 11/Zoon Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Peak SAR (extrapolated) = 0.0214 W/kg
SAR(1 g) = 0.0124 mW/g; SAR(10 g) = 0.00805 mW/g
Reference Value = 1.02 V/m
Power Drift = -0.04 dB
Maximum value of SAR = 0.0143 mW/g



Date/Time: 06/09/03 15:32:26

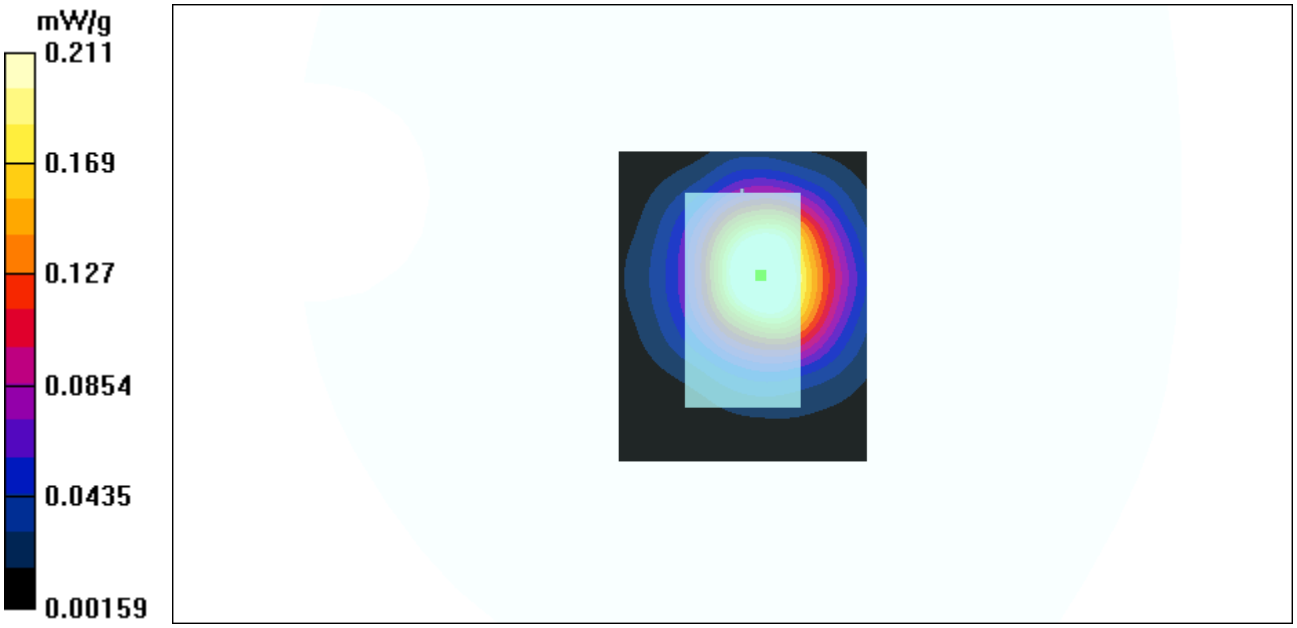
Test Laboratory: Advance Data Technology

AWU2000b Mode 2 channel 1

DUT: 2.4GHz WLAN USB Stick ; Type: AWU2000b ; Test Channel Frequency: 2412 MHz

Communication System: 802.11b ; Frequency: 2412 MHz; Duty Cycle: 1:1; Modulation type: CCK
Medium: MSL2450 (σ = 1.897 mho/m, ε_r = 51.97, ρ = 1000 kg/m^3) ; Liquid level : 152mm
Phantom section: Flat Section ; Separation distance : 15mm(The tip of the EUT to the Phantom)
Antenna type : Internal Antenna ; Air temp. : 21 degrees ; Liquid temp. : 20.1 degrees
DASY4 Configuration:
- Probe: ET3DV6 - SN1687; ConvF(4.4, 4.4, 4.4); Calibrated: 2002/9/28
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn541; Calibrated: 2003/1/14
- Phantom: SAM Twin Phantom V4.0; Type: QD 000 P40 CA; Serial: TP-1150
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 115

Channel 1/Area Scan (5x6x1): Measurement grid: dx=15mm, dy=15mm
Channel 1/Zoon Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Peak SAR (extrapolated) = 0.344 W/kg
SAR(1 g) = 0.188 mW/g; SAR(10 g) = 0.0977 mW/g
Reference Value = 7.6 V/m
Power Drift = -0.2 dB
Maximum value of SAR = 0.211 mW/g



Date/Time: 06/09/03 15:51:20

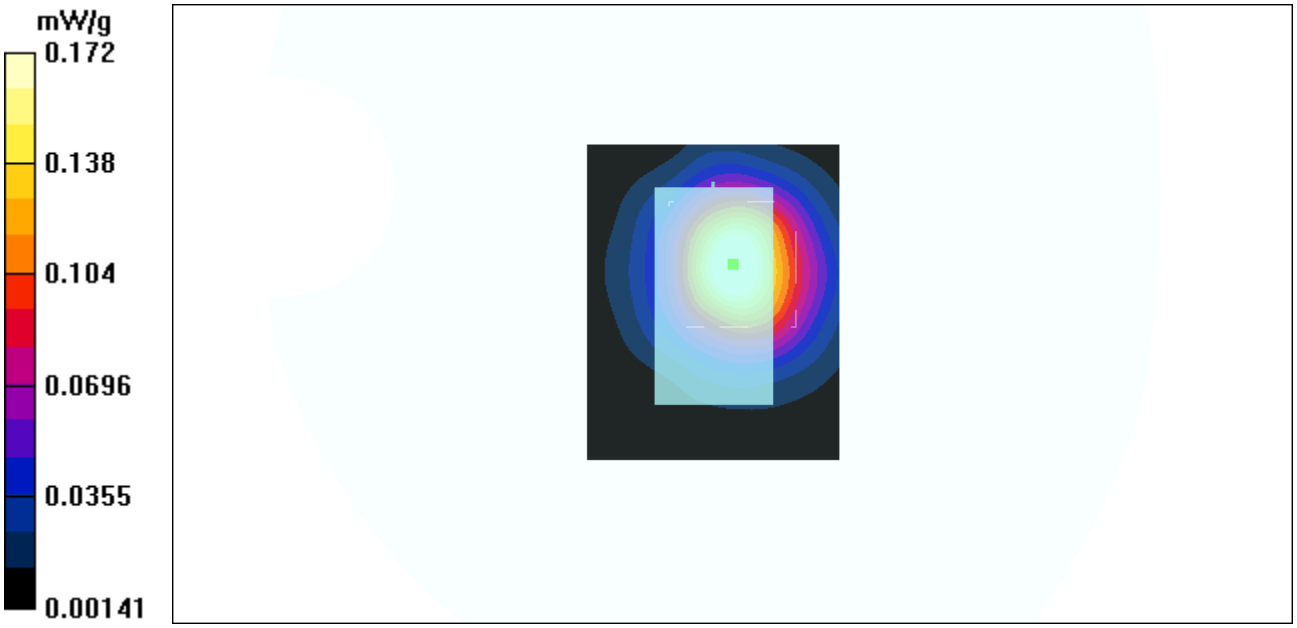
Test Laboratory: Advance Data Technology

AWU2000b Mode 2 channel 6

DUT: 2.4GHz WLAN USB Stick ; Type: AWU2000b ; Test Channel Frequency: 2437 MHz

Communication System: 802.11b ; Frequency: 2437 MHz; Duty Cycle: 1:1; Modulation type: CCK
Medium: MSL2450 (σ = 1.931 mho/m, ε_r = 51.95, ρ = 1000 kg/m^3) ; Liquid level : 152mm
Phantom section: Flat Section ; Separation distance : 15mm(The tip of the EUT to the Phantom)
Antenna type : Internal Antenna ; Air temp. : 21 degrees ; Liquid temp. : 20.1 degrees
DASY4 Configuration:
- Probe: ET3DV6 - SN1687; ConvF(4.4, 4.4, 4.4); Calibrated: 2002/9/28
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn541; Calibrated: 2003/1/14
- Phantom: SAM Twin Phantom V4.0; Type: QD 000 P40 CA; Serial: TP-1150
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 115

Channel 6/Area Scan (5x6x1): Measurement grid: dx=15mm, dy=15mm
Channel 6/Zoon Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Peak SAR (extrapolated) = 0.3 W/kg
SAR(1 g) = 0.159 mW/g; SAR(10 g) = 0.0855 mW/g
Reference Value = 5.82 V/m
Power Drift = -0.1 dB
Maximum value of SAR = 0.172 mW/g



Date/Time: 06/09/03 16:39:32

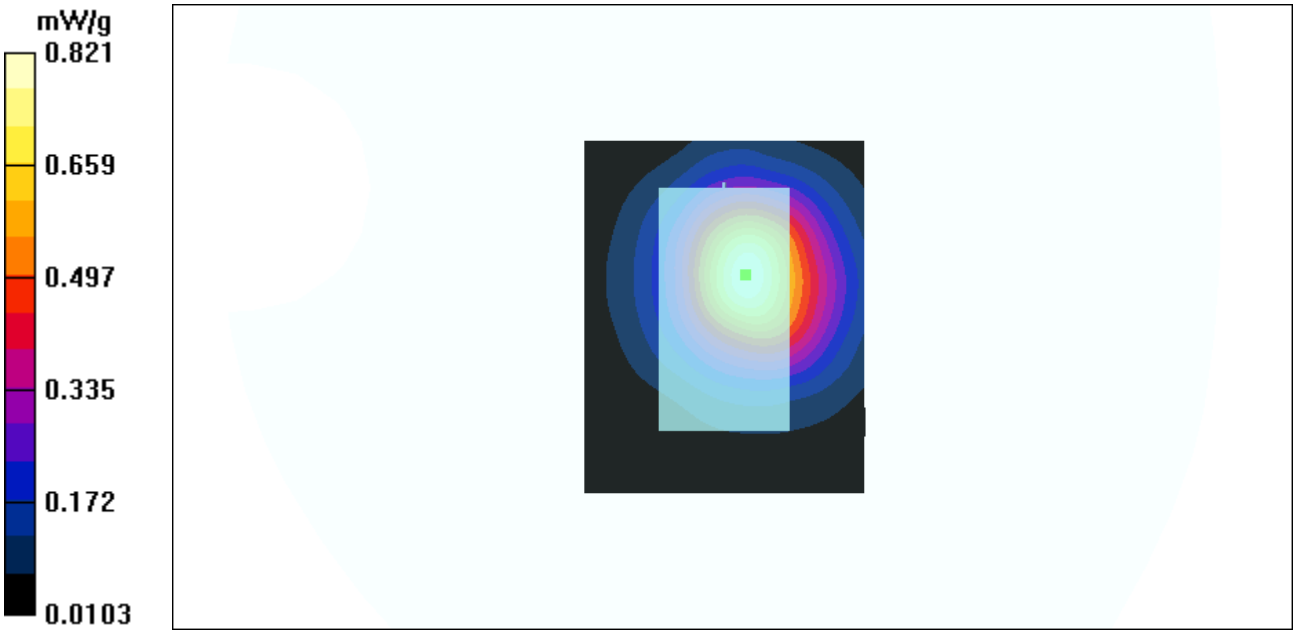
Test Laboratory: Advance Data Technology

AWU2000b Mode 2 channel 11

DUT: 2.4GHz WLAN USB Stick ; Type: AWU2000b ; Test Channel Frequency: 2462 MHz

Communication System: 802.11b ; Frequency: 2462 MHz; Duty Cycle: 1:1; Modulation type: CCK
Medium: MSL2450 (σ = 1.933 mho/m, ε_r = 51.86, ρ = 1000 kg/m^3) ; Liquid level : 152mm
Phantom section: Flat Section ; Separation distance : 15mm(The tip of the EUT to the Phantom)
Antenna type : Internal Antenna ; Air temp. : 21 degrees ; Liquid temp. : 20.1 degrees
DASY4 Configuration:
- Probe: ET3DV6 - SN1687; ConvF(4.4, 4.4, 4.4); Calibrated: 2002/9/28
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn541; Calibrated: 2003/1/14
- Phantom: SAM Twin Phantom V4.0; Type: QD 000 P40 CA; Serial: TP-1150
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 115

Channel 11/Area Scan (5x6x1): Measurement grid: dx=15mm, dy=15mm
Channel 11/Zoon Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Peak SAR (extrapolated) = 0.33 W/kg
SAR(1 g) = 0.162 mW/g; SAR(10 g) = 0.0931 mW/g
Reference Value = 5.93 V/m
Power Drift = -0.8 dB
Maximum value of SAR = 0.183 mW/g



Date/Time: 06/09/03 16:44:51

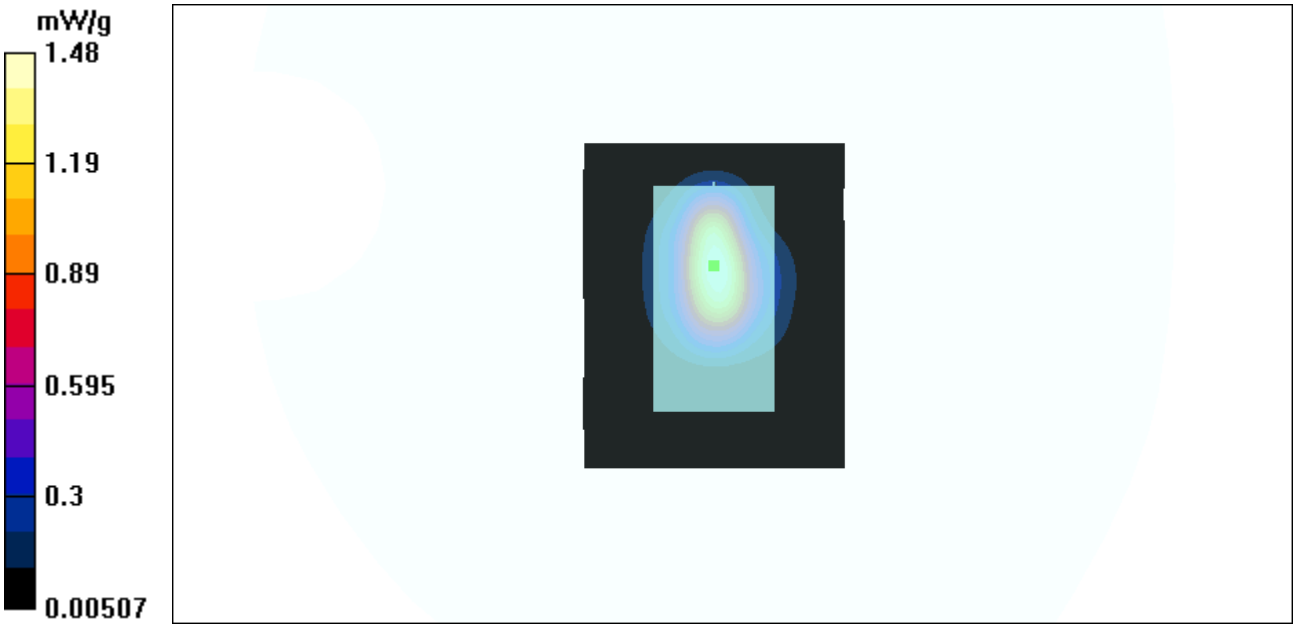
Test Laboratory: Advance Data Technology

AWU2000b Mode 3 channel 1

DUT: 2.4GHz WLAN USB Stick ; Type: AWU2000b ; Test Channel Frequency: 2412 MHz

Communication System: 802.11b ; Frequency: 2412 MHz; Duty Cycle: 1:1; Modulation type: CCK
Medium: MSL2450 (σ = 1.897 mho/m, ε_r = 51.97, ρ = 1000 kg/m^3) ; Liquid level : 152mm
Phantom section: Flat Section ; Separation distance : 0mm(The tip of the EUT to the Phantom)
Antenna type : Internal Antenna ; Air temp. : 21 degrees ; Liquid temp. : 20.1 degrees
DASY4 Configuration:
- Probe: ET3DV6 - SN1687; ConvF(4.4, 4.4, 4.4); Calibrated: 2002/9/28
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn541; Calibrated: 2003/1/14
- Phantom: SAM Twin Phantom V4.0; Type: QD 000 P40 CA; Serial: TP-1150
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 115

Channel 1/Area Scan (5x6x1): Measurement grid: dx=15mm, dy=15mm
Channel 1/Zoon Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Peak SAR (extrapolated) = 2.81 W/kg
SAR(1 g) = 1.26 mW/g; SAR(10 g) = 0.524 mW/g
Reference Value = 11.4 V/m
Power Drift = -0.12 dB
Maximum value of SAR = 1.48 mW/g



Date/Time: 06/09/03 13:47:50

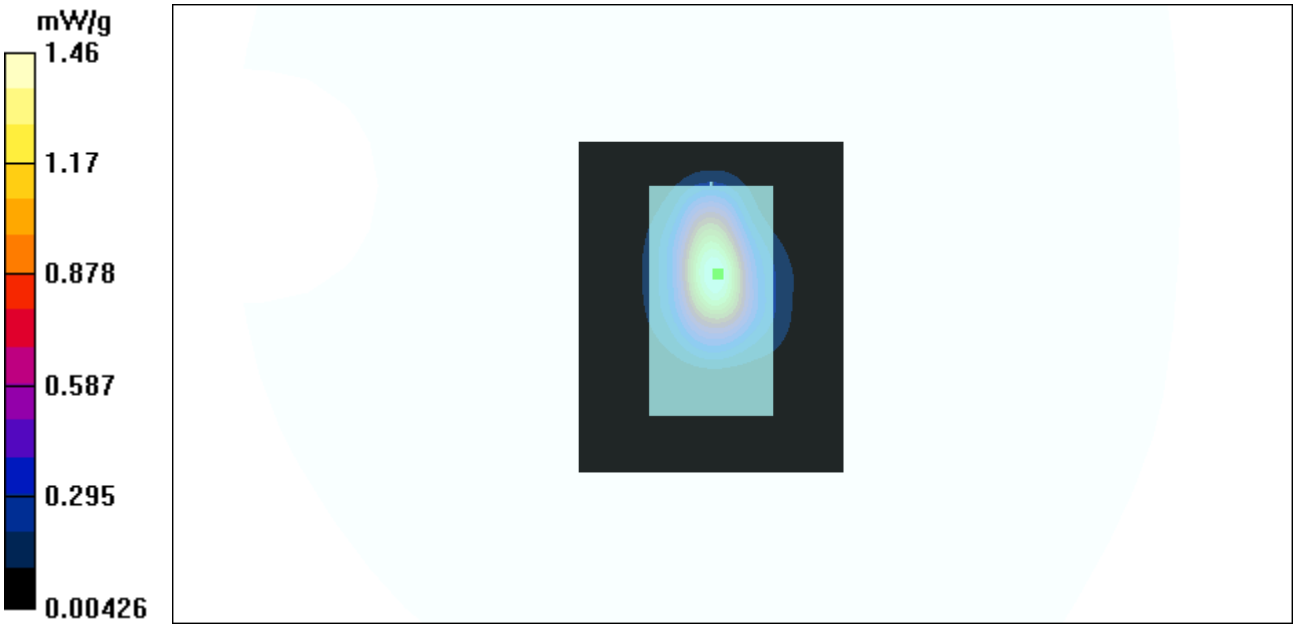
Test Laboratory: Advance Data Technology

AWU2000b Mode 3 channel 6

DUT: 2.4GHz WLAN USB Stick ; Type: AWU2000b ; Test Channel Frequency: 2437 MHz

Communication System: 802.11b ; Frequency: 2437 MHz; Duty Cycle: 1:1; Modulation type: CCK
Medium: MSL2450 (σ = 1.931 mho/m, ε_r = 51.95, ρ = 1000 kg/m^3) ; Liquid level : 152mm
Phantom section: Flat Section ; Separation distance : 0mm(The tip of the EUT to the Phantom)
Antenna type : Internal Antenna ; Air temp. : 21 degrees ; Liquid temp. : 20.1 degrees
DASY4 Configuration:
- Probe: ET3DV6 - SN1687; ConvF(4.4, 4.4, 4.4); Calibrated: 2002/9/28
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn541; Calibrated: 2003/1/14
- Phantom: SAM Twin Phantom V4.0; Type: QD 000 P40 CA; Serial: TP-1150
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 115

Channel 6/Area Scan (5x6x1): Measurement grid: dx=15mm, dy=15mm
Channel 6/Zoon Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Peak SAR (extrapolated) = 2.3 W/kg
SAR(1 g) = 1.21 mW/g; SAR(10 g) = 0.5 mW/g
Reference Value = 10.5 V/m
Power Drift = -0.14 dB
Maximum value of SAR = 1.46 mW/g



Date/Time: 06/09/03 14:07:36

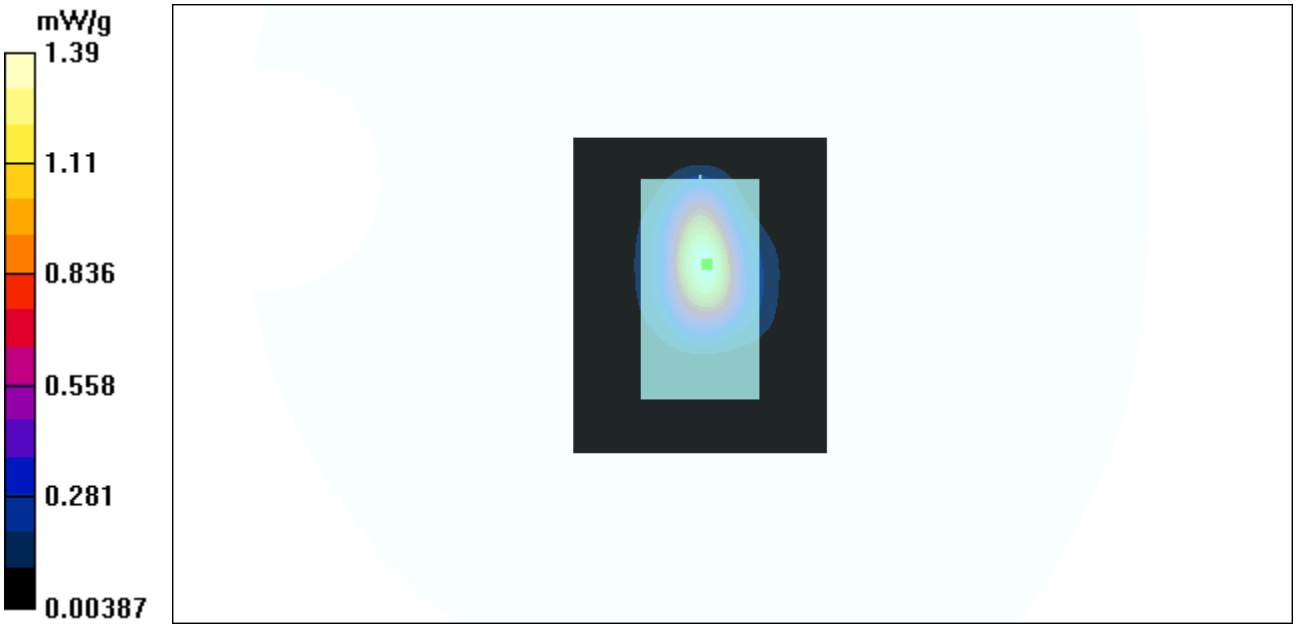
Test Laboratory: Advance Data Technology

AWU2000b Mode 3 channel 11

DUT: 2.4GHz WLAN USB Stick ; Type: AWU2000b ; Test Channel Frequency: 2462 MHz

Communication System: 802.11b ; Frequency: 2462 MHz; Duty Cycle: 1:1; Modulation type: CCK
Medium: MSL2450 (σ = 1.933 mho/m, ε_r = 51.86, ρ = 1000 kg/m^3) ; Liquid level : 152mm
Phantom section: Flat Section ; Separation distance : 0mm(The tip of the EUT to the Phantom)
Antenna type : Internal Antenna ; Air temp. : 21 degrees ; Liquid temp. : 20.1 degrees
DASY4 Configuration:
- Probe: ET3DV6 - SN1687; ConvF(4.4, 4.4, 4.4); Calibrated: 2002/9/28
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn541; Calibrated: 2003/1/14
- Phantom: SAM Twin Phantom V4.0; Type: QD 000 P40 CA; Serial: TP-1150
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 115

Channel 11/Area Scan (5x6x1): Measurement grid: dx=15mm, dy=15mm
Channel 11/Zoon Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Peak SAR (extrapolated) = 2.35 W/kg
SAR(1 g) = 1.17 mW/g; SAR(10 g) = 0.479 mW/g
Reference Value = 10.2 V/m
Power Drift = -0.15 dB
Maximum value of SAR = 1.39 mW/g



Date/Time: 06/09/03 14:10:30

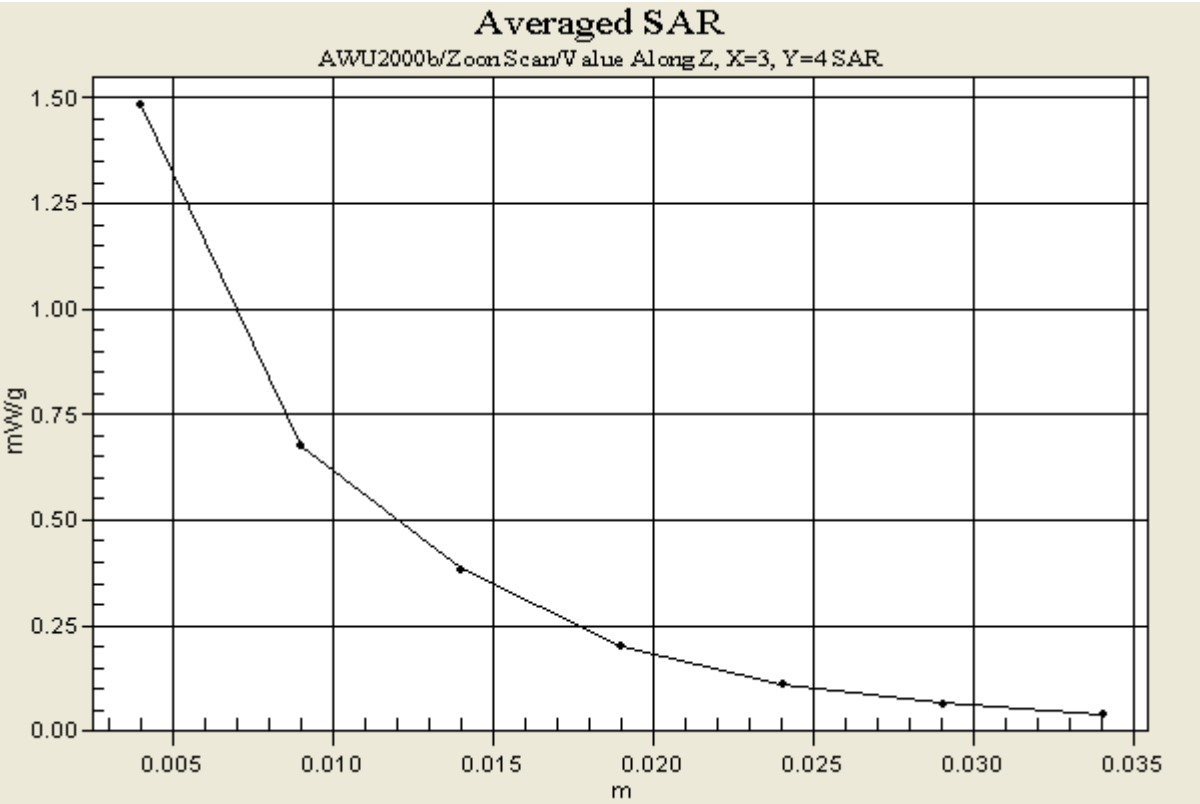
Test Laboratory: Advance Data Technology

AWU2000b Mode 3 channel 1

DUT: 2.4GHz WLAN USB Stick ; Type: AWU2000b ; Test Channel Frequency: 2412 MHz

Communication System: 802.11b ; Frequency: 2412 MHz; Duty Cycle: 1:1; Modulation type: CCK
Medium: MSL2450 (σ = 1.897 mho/m, ε_r = 51.97, ρ = 1000 kg/m^3) ; Liquid level : 152mm
Phantom section: Flat Section ; Separation distance : 0mm(The tip of the EUT to the Phantom)
Antenna type : Internal Antenna ; Air temp. : 21.0 degrees ; Liquid temp. : 20.1 degrees
DASY4 Configuration:
- Probe: ET3DV6 - SN1687; ConvF(4.4, 4.4, 4.4); Calibrated: 2002/9/28
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn541; Calibrated: 2003/1/14
- Phantom: SAM Twin Phantom V4.0; Type: QD 000 P40 CA; Serial: TP-1150
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 115

Channel 1/Area Scan (5x6x1): Measurement grid: dx=15mm, dy=15mm
Channel 1/Zoon Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Peak SAR (extrapolated) = 2.81 W/kg
SAR(1 g) = 1.26 mW/g; SAR(10 g) = 0.524 mW/g
Reference Value = 11.4 V/m
Power Drift = -0.12 dB
Maximum value of SAR = 1.48 mW/g



A3 : SYSTEM VAILDATION TEST DATA

Date/Time: 06/09/03 10:12:10

Test Laboratory: Advance Data Technology

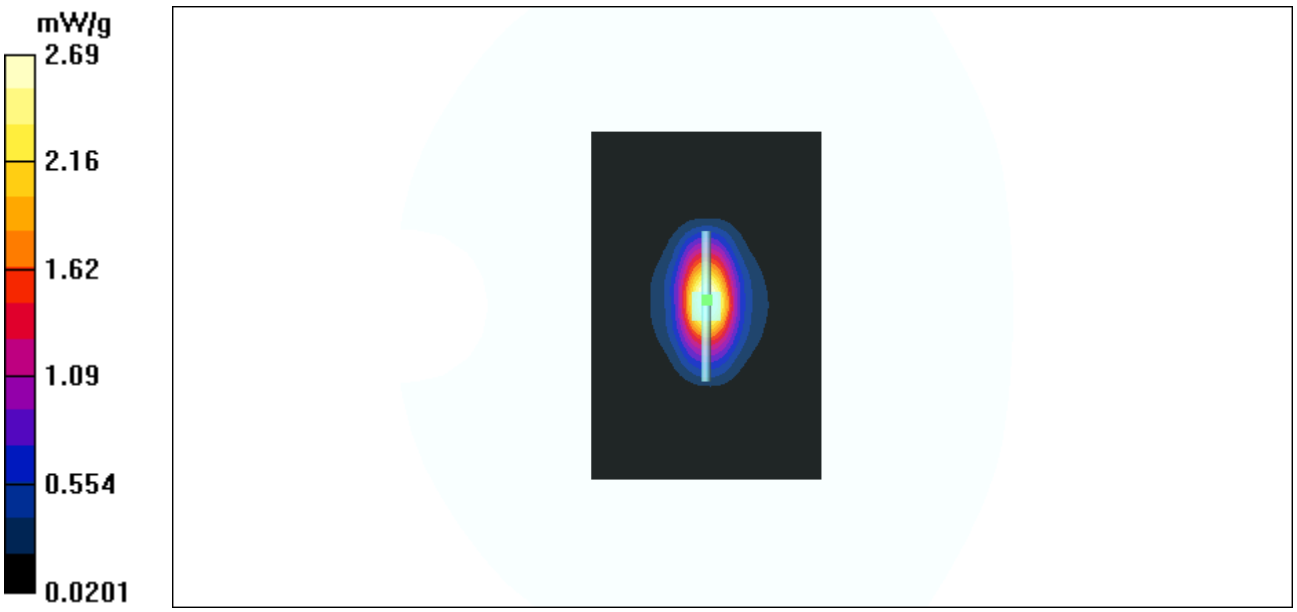
System Validation Check-MSL2450MHz

DUT: Dipole 2450 MHz ; Type: D2450V2

Communication System: CW ; Frequency: 2450 MHz; Duty Cycle: 1:1; Modulation type: CW
Medium: MSL2450 (σ = 1.937 mho/m, ε_r= 51.89, ρ = 1000 kg/m^3) ; Liquid level : 152mm
Phantom section: Flat Section ; Separation distance : 10mm(The feetpoint of the dipole to the Phantom)
Air temp. : 21 degrees ; Liquid temp. : 20.1 degrees

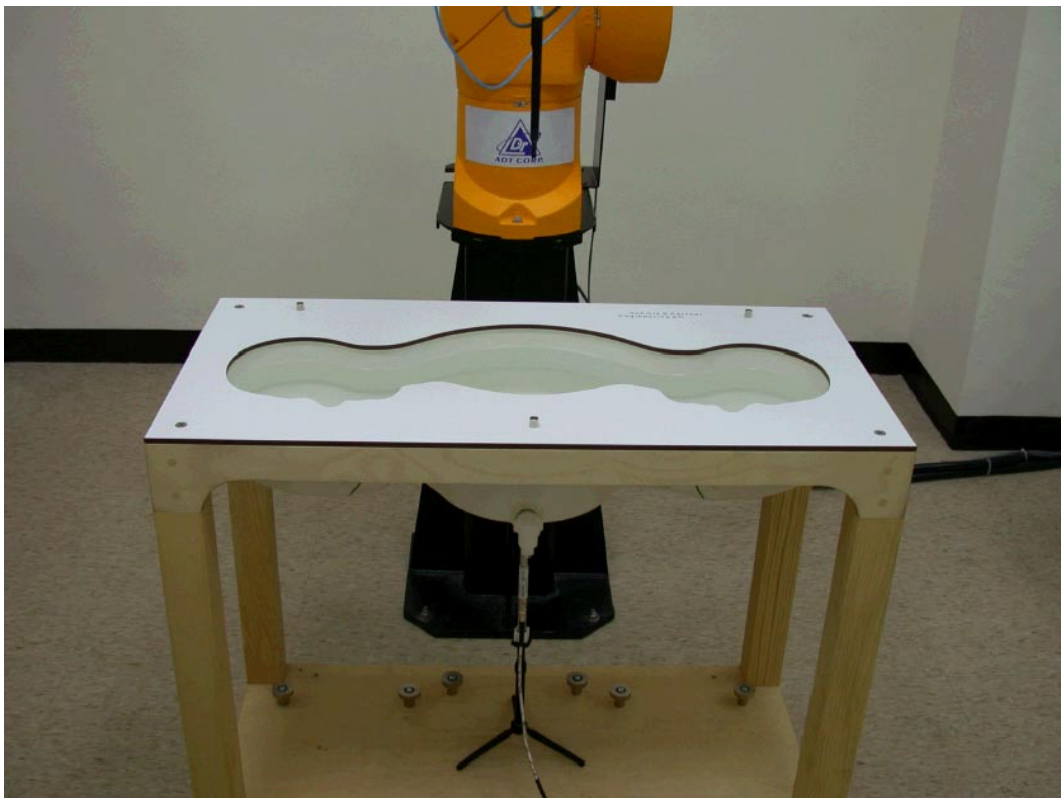
DASY4 Configuration:
- Probe: ET3DV6 - SN1687; ConvF(4.4, 4.4, 4.4); Calibrated: 2002/9/28
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn541; Calibrated: 2003/1/14
- Phantom: SAM Twin Phantom V4.0; Type: QD 000 P40 CA; Serial: TP-1150
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 115

System Validation procedure/Area Scan (5x7x1): Measurement grid: dx=20mm, dy=20mm
System Validation procedure/Zoon Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Peak SAR (extrapolated) = 4.23 W/kg
SAR(1 g) = 2.38 mW/g; SAR(10 g) = 1.17 mW/g
Reference Value = 39.6 V/m
Power Drift = -0.02 dB
Maximum value of SAR = 2.69 mW/g



APPENDIX B: ADT SAR MEASUREMENT SYSTEM

APPENDIX C: PHOTOGRAPHS OF SYSTEM VALIDATION



ADT CORP.

APPENDIX D: SYSTEM CERTIFICATE & CALIBRATION

D1: SAM PHANTOM

Schmid & Partner Engineering AG

Zeughausstrasse 43, 8004 Zurich, Switzerland, Phone +41 1 245 97 00, Fax +41 1 245 97 79

Certificate of conformity / First Article Inspection

Item	SAM Twin Phantom V4.0
Type No	QD 000 P40 CA
Series No	TP-1150 and higher
Manufacturer / Origin	Untersee Composites Hauptstr. 69 CH-8559 Fruthwilen Switzerland

Tests

The series production process used allows the limitation to test of first articles.
Complete tests were made on the pre-series Type No. QD 000 P40 AA, Serial No. TP-1001 and on the series first article Type No. QD 000 P40 BA, Serial No. TP-1006. Certain parameters have been retested using further series units (called samples).

Test	Requirement	Details	Units tested
Shape	Compliance with the geometry according to the CAD model.	IT'IS CAD File (*)	First article, Samples
Material thickness	Compliant with the requirements according to the standards	2mm +/- 0.2mm in specific areas	First article, Samples
Material parameters	Dielectric parameters for required frequencies	200 MHz – 3 GHz Relative permittivity < 5 Loss tangent < 0.05.	Material sample TP 104-5
Material resistivity	The material has been tested to be compatible with the liquids defined in the standards	Liquid type HSL 1800 and others according to the standard.	Pre-series, First article

Standards

[1] CENELEC EN 50361
[2] IEEE P1528-200x draft 6.5
[3] IEC PT 62209 draft 0.9
(*) The IT'IS CAD file is derived from [2] and is also within the tolerance requirements of the shapes of [1] and [3].

Conformity

Based on the sample tests above, we certify that this item is in compliance with the uncertainty requirements of SAR measurements specified in standard [1] and draft standards [2] and [3].

Date 28.02.2002

Signature / Stamp

F. Bomholt

Schmid & Partner
Engineering AG
Zeughausstrasse 43, CH-8004 Zurich
Tel. +41 1 245 97 00, Fax +41 1 245 97 79
Voleaić Katja

ADT CORP.

D2: 2450MHz SYSTEM VALIDATION DIPOLE

Schmid & Partner
Engineering AG

Zeughausstrasse 43, 8004 Zurich, Switzerland, Phone +41 1 245 97 00, Fax +41 1 245 97 79

Calibration Certificate

2450 MHz System Validation Dipole

Type:	D2450V2
Serial Number:	716
Place of Calibration:	Zurich
Date of Calibration:	September 26, 2002
Calibration Interval:	24 months

Schmid & Partner Engineering AG hereby certifies, that this device has been calibrated on the date indicated above. The calibration was performed in accordance with specifications and procedures of Schmid & Partner Engineering AG.

Wherever applicable, the standards used in the calibration process are traceable to international standards. In all other cases the standards of the Laboratory for EMF and Microwave Electronics at the Swiss Federal Institute of Technology (ETH) in Zurich, Switzerland have been applied.

Calibrated by:	
Approved by:	

Schmid & Partner
Engineering AG

Zeughausstrasse 43, 8004 Zurich, Switzerland, Phone +41 1 245 97 00, Fax +41 1 245 97 79

DASY

Dipole Validation Kit

Type: D2450V2

Serial: 716

Manufactured: September 10, 2002
Calibrated: September 26, 2002

1. Measurement Conditions

The measurements were performed in the flat section of the new SAM twin phantom filled with head simulating solution of the following electrical parameters at 2450 MHz:

Relative permitivity	**37.7**	± 5%
Conductivity	**1.88 mho/m**	± 10%

The DASY System with a dosimetric E-field probe ET3DV6 (SN:1507, conversion factor 5.0 at 2450 MHz) was used for the measurements.

The dipole feedpoint was positioned below the center marking and oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 10mm from dipole center to the solution surface. The included distance holder was used during measurements for accurate distance positioning.

The coarse grid with a grid spacing of 20mm was aligned with the dipole. The 5x5x7 fine cube was chosen for cube integration. Probe isotropy errors were cancelled by measuring the SAR with normal and 90° turned probe orientations and averaging.
The dipole input power (forward power) was 250mW ± 3 %. The results are normalized to 1W input power.

2.1. SAR Measurement with DASY3 System

Standard SAR-measurements were performed according to the measurement conditions described in section 1. The results (see figure supplied) have been normalized to a dipole input power of 1W (forward power). The resulting averaged SAR-values measured with the dosimetric probe ET3DV6 SN:1507 and applying the worst-case extrapolation are:

averaged over 1 cm^3 (1 g) of tissue: **57.2 mW/g**

averaged over 10 cm^3 (10 g) of tissue: **26.4 mW/g**

2.2 SAR Measurement with DASY4 System

Standard SAR-measurements were performed according to the measurement conditions described in section 1. The results (see figure supplied) have been normalized to a dipole input power of 1W (forward power). The resulting averaged SAR-values measured with the dosimetric probe ET3DV6 SN:1507 and applying the advanced extrapolation are:

averaged over 1 cm^3 (1 g) of tissue: **54.0 mW/g**

averaged over 10 cm^3 (10 g) of tissue: **25.2 mW/g**

3. Dipole impedance and return loss

The impedance was measured at the SMA-connector with a network analyzer and numerically transformed to the dipole feedpoint. The transformation parameters from the SMA-connector to the dipole feedpoint are:

Electrical delay:	**1.148 ns**	(one direction)
Transmission factor:	**0.982**	(voltage transmission, one direction)

The dipole was positioned at the flat phantom sections according to section 1 and the distance holder was in place during impedance measurements.

Feedpoint impedance at 2450 MHz:	Re{Z} = **54.1 Ω**
	Im {Z} = **2.4 Ω**
Return Loss at 2450 MHz	**- 26.8 dB**

4. Measurement Conditions

The measurements were performed in the flat section of the new SAM twin phantom filled with body simulating solution of the following electrical parameters at 2450 MHz:

Relative permitivity	**52.4**	± 5%
Conductivity	**1.99 mho/m**	± 10%

The DASY System with a dosimetric E-field probe ET3DV6 (SN:1507, conversion factor 4.5 at 2450 MHz) was used for the measurements.

The dipole feedpoint was positioned below the center marking and oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 10mm from dipole center to the solution surface. The included distance holder was used during measurements for accurate distance positioning.

The coarse grid with a grid spacing of 20mm was aligned with the dipole. The 5x5x7 fine cube was chosen for cube integration. Probe isotropy errors were cancelled by measuring the SAR with normal and 90° turned probe orientations and averaging.
The dipole input power (forward power) was 250mW ± 3 %. The results are normalized to 1W input power.

5.1. SAR Measurement with DASY3 System

Standard SAR-measurements were performed according to the measurement conditions described in section 4. The results (see figure supplied) have been normalized to a dipole input power of 1W (forward power). The resulting averaged SAR-values measured with the dosimetric probe ET3DV6 SN:1507 and applying the worst-case extrapolation are:

averaged over 1 cm^3 (1 g) of tissue:	**57.2 mW/g**
averaged over 10 cm^3 (10 g) of tissue:	**27.0 mW/g**

5.2 SAR Measurement with DASY4 System

Standard SAR-measurements were performed according to the measurement conditions described in section 4. The results (see figure supplied) have been normalized to a dipole input power of 1W (forward power). The resulting averaged SAR-values measured with the dosimetric probe ET3DV6 SN:1507 and applying the advanced extrapolation are:

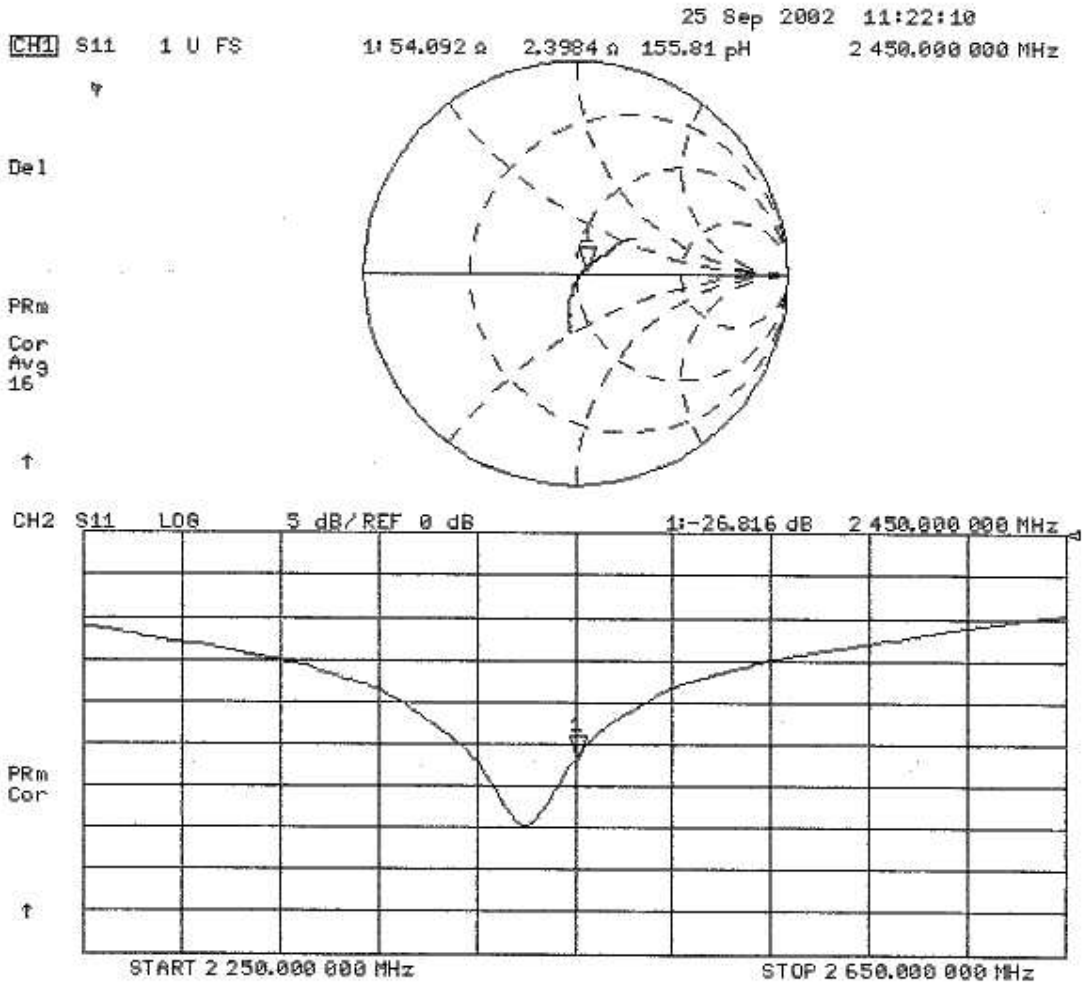
averaged over 1 cm^3 (1 g) of tissue:	**51.6 mW/g**
averaged over 10 cm^3 (10 g) of tissue:	**25.0 mW/g**

6. Dipole impedance and return loss

The dipole was positioned at the flat phantom sections according to section 4 (with body tissue inside the phantom) and the distance holder was in place during impedance measurements.

Feedpoint impedance at 2450 MHz:	Re{Z} = **49.6 Ω**
	Im {Z} = **4.2 Ω**
Return Loss at 2450 MHz	**- 27.5 dB**

ADT CORP.


25 Sep 2002 11:22:10
CH1 S11 1 U FS
1: 54.092 Ω 2.3984 Ω 155.81 pH 2 450.000 000 MHz
Del
PRm
Cor
Avg
16
CH2 S11 LOG 5 dB/ REF 0 dB
1:-26.816 dB 2 450.000 000 MHz
PRm
Cor
START 2 250.000 000 MHz
STOP 2 650.000 000 MHz

ADT CORP.

D3: DOSIMETRIC E-FILED PROBE

Schmid & Partner
Engineering AG

Zeughausstrasse 43, 8004 Zurich, Switzerland, Phone +41 1 245 97 00, Fax +41 1 245 97 79

Calibration Certificate

Dosimetric E-Field Probe

Type:	ET3DV6
Serial Number:	1687
Place of Calibration:	Zurich
Date of Calibration:	June 5, 2002
Calibration Interval:	12 months

Schmid & Partner Engineering AG hereby certifies, that this device has been calibrated on the date indicated above. The calibration was performed in accordance with specifications and procedures of Schmid & Partner Engineering AG.

Wherever applicable, the standards used in the calibration process are traceable to international standards. In all other cases the standards of the Laboratory for EMF and Microwave Electronics at the Swiss Federal Institute of Technology (ETH) in Zurich, Switzerland have been applied.

Calibrated by:	D. Velleu
Approved by:	

Schmid & Partner
Engineering AG

Zeughausstrasse 43, 8004 Zurich, Switzerland, Telephone +41 1 245 97 00, Fax +41 1 245 97 79

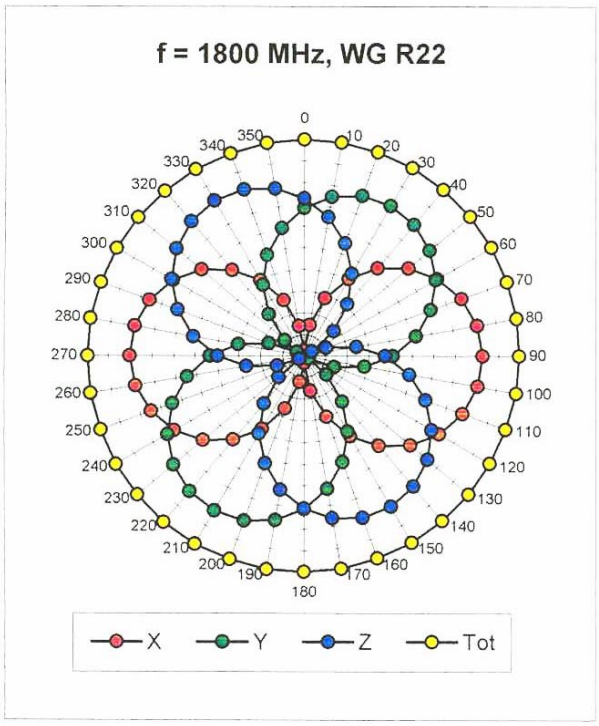
Probe ET3DV6

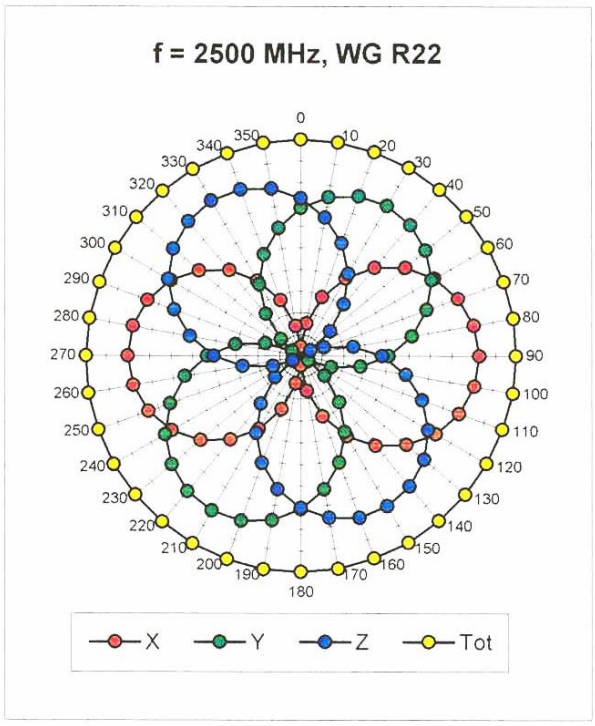
SN:1687

Manufactured: May 28, 2002
Last calibration: June 5, 2002

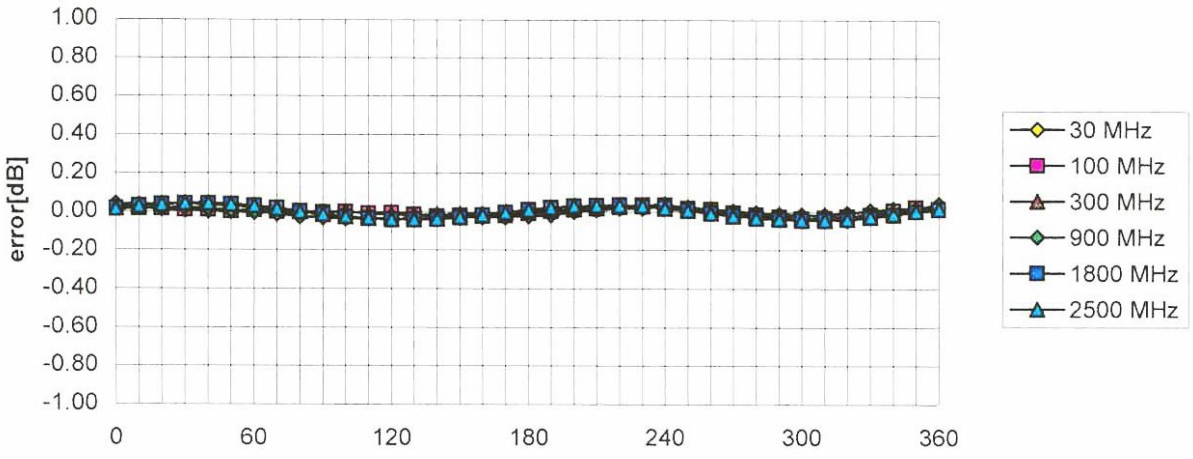
Calibrated for System DASY3

ET3DV6 SN:1687 June 5, 2002





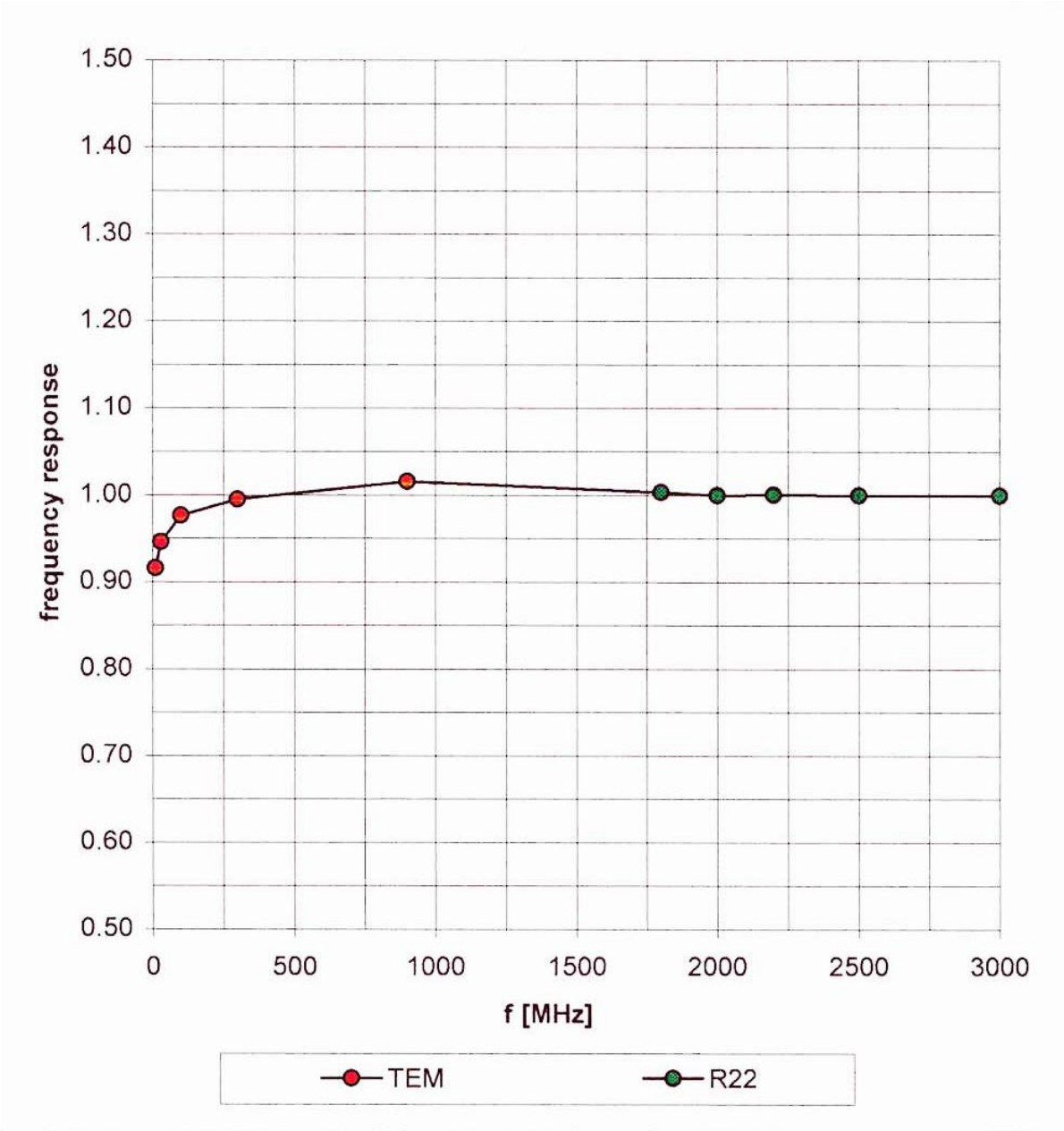
Isotropy Error (Φ), θ = 0˚



ET3DV6 SN:1687 June 5, 2002

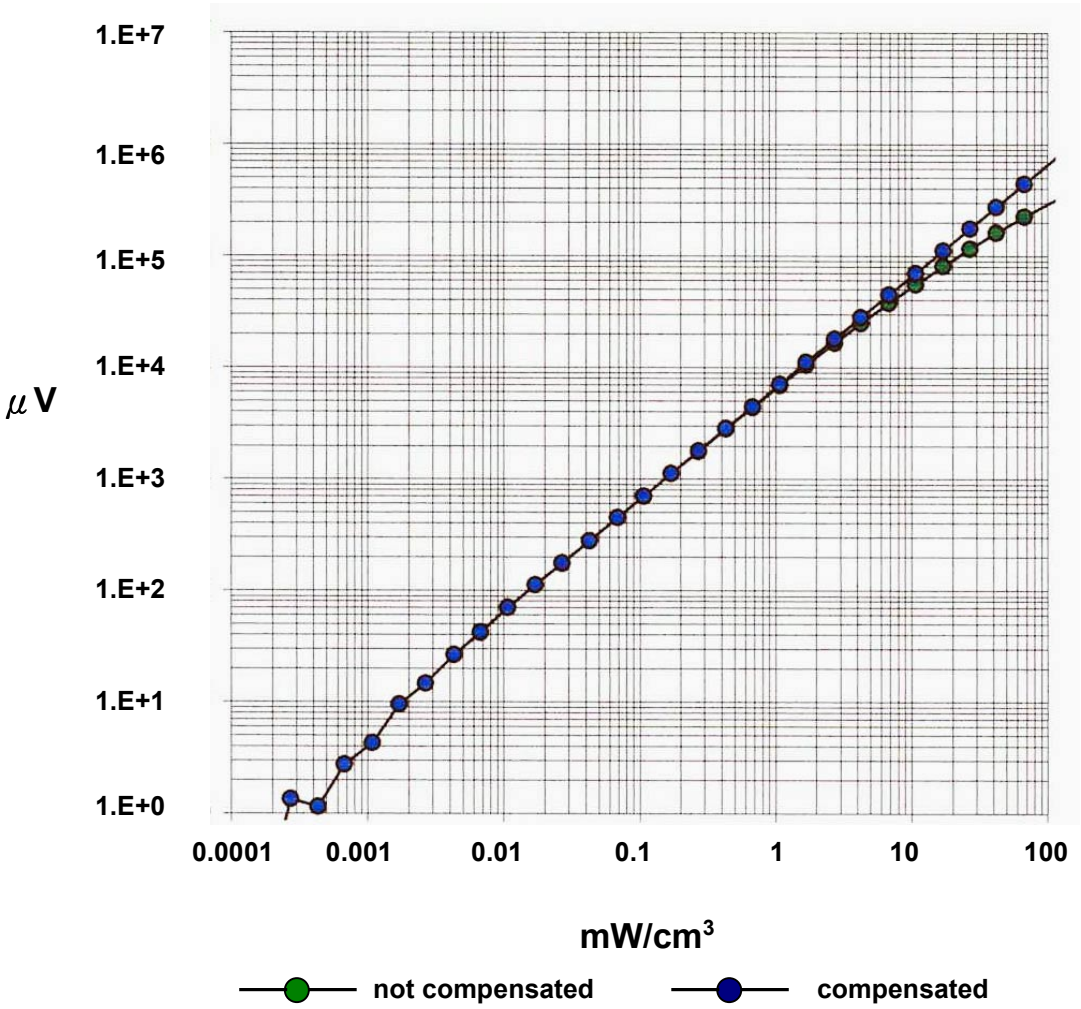
Frequency Response of E-Field

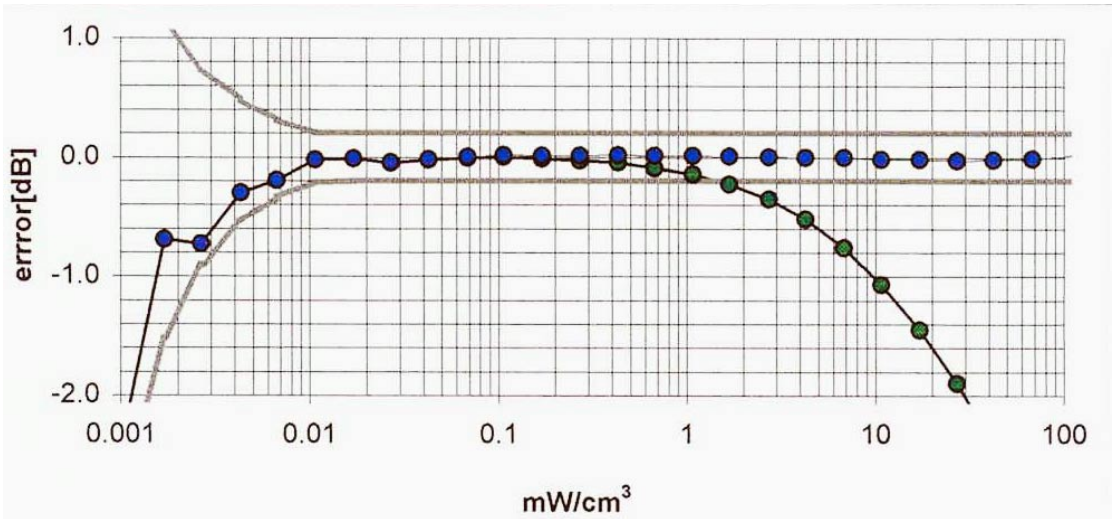
(TEM – Cell:ifi110, Waveguide R22)



Dynamic Range f (SAR $_{brain}$)

(Waveguide R22)





Schmid & Partner
Engineering AG

Zeughausstrasse 43, 8004 Zurich, Switzerland, Phone +41 1 245 97 00, Fax +41 1 245 97 79

Calibration Certificate

Dosimetric E-Field Probe

Type:	**ET3DV6**
Serial Number:	**1687**
Place of Calibration:	**Zurich**
Date of Calibration:	**September 28, 2002**
Calibration Interval:	**12 months**

Schmid & Partner Engineering AG hereby certifies, that this device has been calibrated on the date indicated above. The calibration was performed in accordance with specifications and procedures of Schmid & Partner Engineering AG.

Wherever applicable, the standards used in the calibration process are traceable to international standards. In all other cases the standards of the Laboratory for EMF and Microwave Electronics at the Swiss Federal Institute of Technology (ETH) in Zurich, Switzerland have been applied.

Calibrated by:	D. Vetter
Approved by:	[signature]

Schmid & Partner
Engineering AG

Zeughausstrasse 43, 8004 Zurich, Switzerland, Telephone +41 1 245 97 00, Fax +41 1 245 97 79

Probe ET3DV6

SN:1687

Additonal Conversion Factors

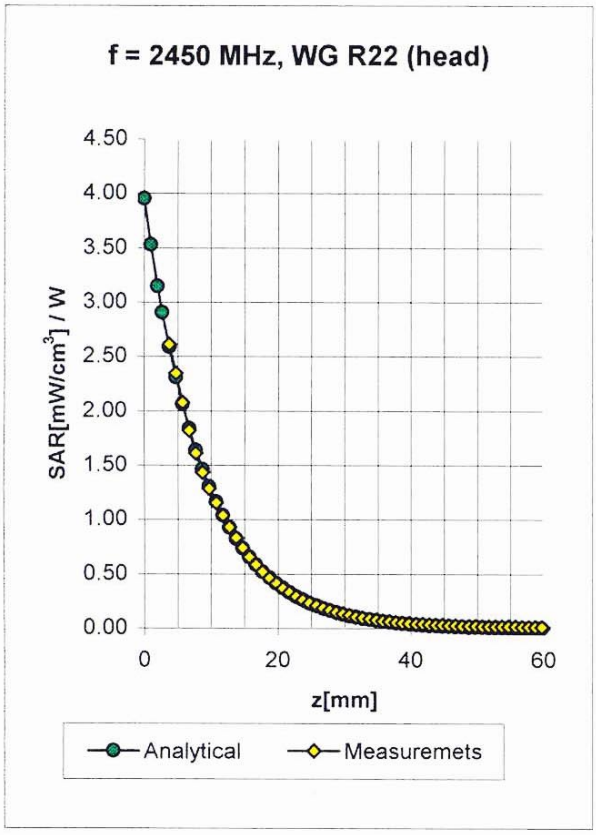
Calibrated: September 28, 2002

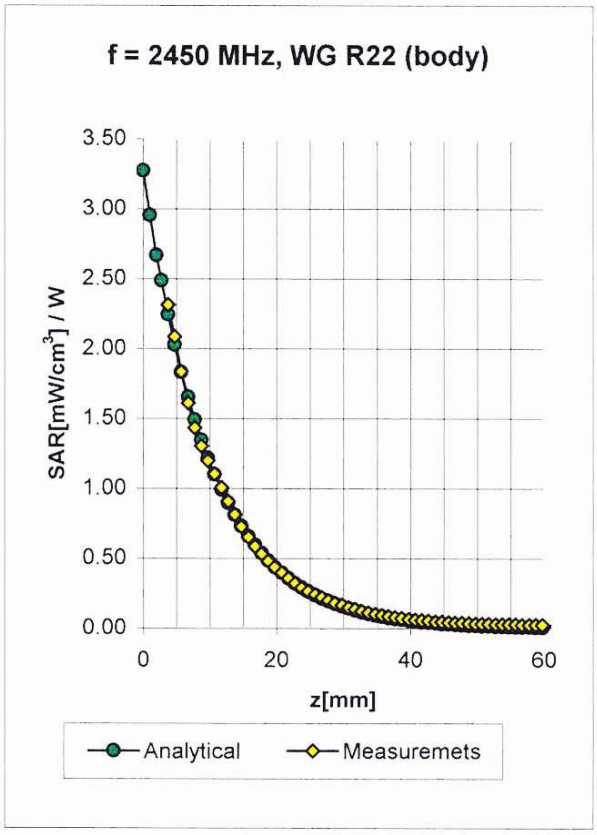
Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

ET3DV6 SN:1687 September 28, 2002

Conversion Factor Assessment





Head **2450 MHz** ε_r **= 39.2 ± 5%** σ **= 1.80 ± 5% mho/m**

ConvF X	**4.9** ± 8.9% (k=2)	Boundary effect:	
ConvF Y	**4.9** ± 8.9% (k=2)	Alpha	**1.00**
ConvF Z	**4.9** ± 8.9% (k=2)	Depth	**1.70**

Body **2450 MHz** ε_r **= 52.7 ± 5%** σ **= 1.95 ± 5% mho/m**

ConvF X	**4.4** ± 8.9% (k=2)	Boundary effect:	
ConvF Y	**4.4** ± 8.9% (k=2)	Alpha	**1.00**
ConvF Z	**4.4** ± 8.9% (k=2)	Depth	**1.65**