



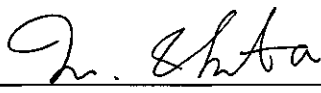
SAR EVALUATION REPORT

Report No. : 25HE0109-HO-11

Applicant : DENSO WAVE INCORPORATED
Type of Equipment : Handy Terminal
Model No. : BHT-300QWB
FCC ID : PZWBHT300WB
Test standard : FCC47CFR2.1093
FCC OET Bulletin 65, Supplement C
Test Result : Complied
Max SAR Measured : 0.206 W/kg (Body, 2412MHz)

1. This test report shall not be reproduced except full or partial, without the written approval of UL Apex Co., Ltd.
2. The results in this report apply only to the sample tested.
3. This equipment is in compliance with above regulation. We hereby certify that the data contain a true representation of the SAR profile.
4. The test results in this test report are traceable to the national or international standards.

Date of test : March 24 and June 19, 2005

Tested by : 
Miyo Ikuta
EMC Lab.Head Office

Approved by : 
Tetsuo Maeno
Site Manager of Head Office EMC Lab.

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SECTION 1 : Client information

Company Name : DENSO WAVE INCORPORATED
Brand Name : DENSO
Address : 1-1, Showa-cho, Kariyashi, Aichi-ken 448-8661 Japan
Telephone Number : +81-566-61-3816
Facsimile Number : +81-566-25-4741
Contact Person : Hiroshi Hayami

SECTION 2 : Equipment under test

2.1 Identification of E.U.T.

Applicant : DENSO WAVE INCORPORATED

Type of Equipment : Handy Terminal

Model No. : BHT-300QWB

Serial No. : 549690004450027

Country of Manufacture : Japan

Receipt Date of Sample : March 22,2005

Category Identified : Portable device

Condition of EUT : Production prototype
(Not for Sale: This sample is equivalent to mass-produced items.)

Battery option : Only one model with EUT
Type : Li-ion Battery
Model name : 496461-0450 BT-20L
V/mAh : 3.7V / 1700mAh

Photograph of EUT

Front



Back



Left side



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2.2 Product Description 1

We tested the EUT with which Wireless LAN adapter and Bluetooth module were inserted.
The shortest distance between the surface of EUT and the antenna of Wireless LAN adapter is 4.47mm.
Details of Wireless LAN adapter and Bluetooth module used while we are testing SAR is shown in the following.

2.2.1 Information of Wireless LAN adapter

Wireless LAN adapter is located beside EUT.

Type of Equipment	: Wireless LAN adapter
Model No.	: KCS
Serial No.	: 000B6B19DCED
Manufacture	: DENSO WAVE INCORPORATED
Tx Frequency	: 2412MHz – 2462MHz
Modulation	: DSSS
Rating	: DC 3.3 – 3.5V
Max.Output Power Tested	: 16.48 dBm peak Conducted
Antenna Type	: Inverted F type multi-layer antenna
Antenna Gain	: Max 2.02dBi

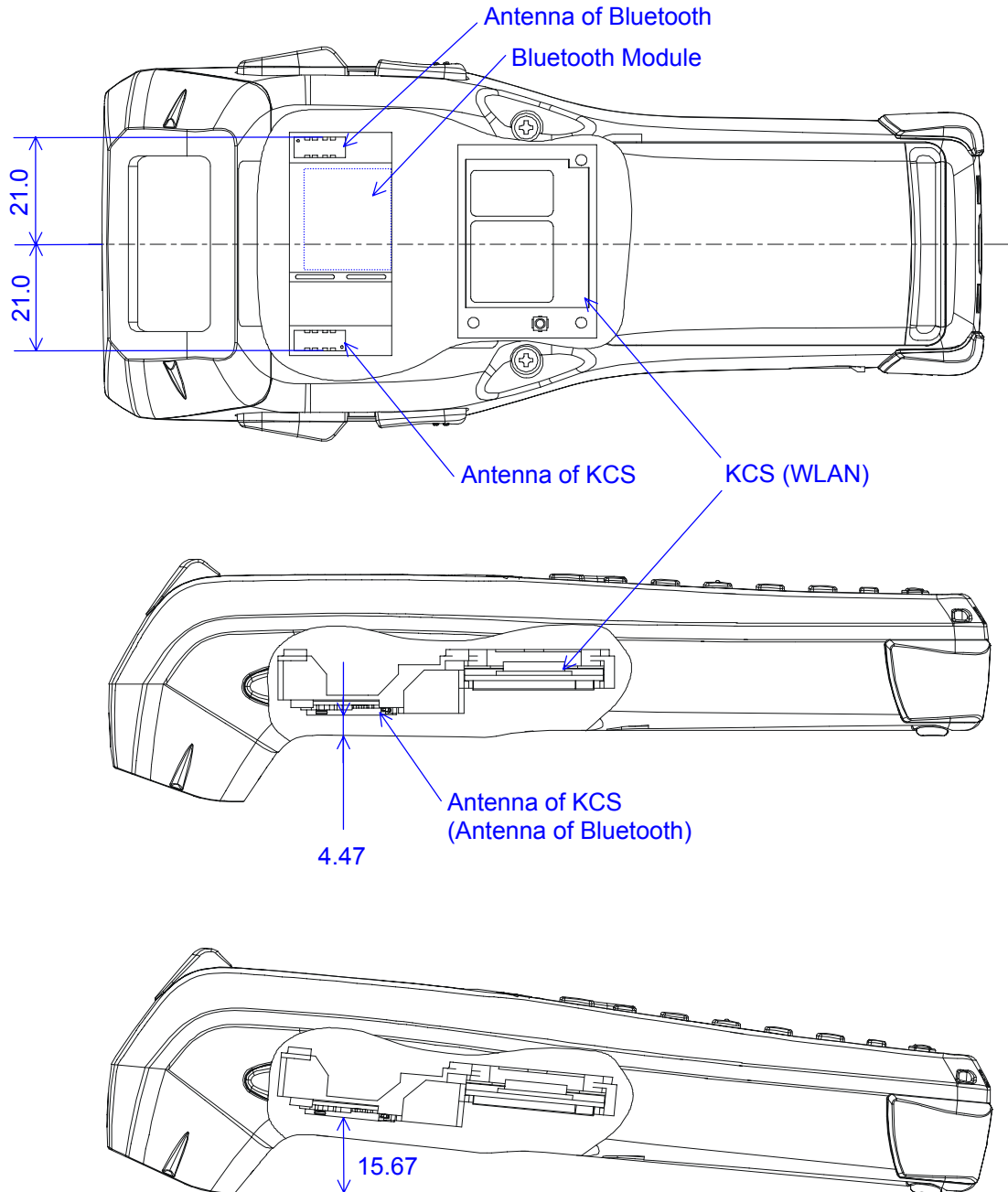
2.2.2 Information of Bluetooth module

Bluetooth module is located beside EUT.

Type of Equipment	: Bluetooth module
Model No.	: DWBT005
Serial No.	: 00037A2287D4
Manufacture	: DENSO WAVE INCORPORATED
Tx Frequency	: 2402MHz – 2480MHz
Modulation	: FHSS
Rating	: DC 3.0 – 3.6V
Max.Output Power Tested	: -0.87 dBm peak Conducted
Antenna Type	: Inverted F type multi-layer antenna
Antenna Gain	: Max 2.02dBi

2.2.3 Antenna Location

BHT-300QWB



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2.3 Product Description 2

The EUT, BHT-300QWB is the QR Code Handy Terminal and has a IEEE802.11b WLAN module (M/N: KCS) and a Bluetooth module (M/N: DWBT005) inside.

The EUT has a variant model:BHT-300BWB, which is a Barcode Handy Terminal and also have the same IEEE802.11b WLAN module (M/N: KCS) and Bluetooth module (M/N: DWBT004) inside.

The differences between BHT-300QWB and BHT-300BWB are as follows:

1. Code type (QR Code or Barcode)
2. Antenna position and length of antenna cables for WLAN/Bluetooth module.

The radio parts are same in two models.

* Reference test report : 25HE0109-HO-12

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SECTION 3 : Requirements for compliance testing defined by the FCC

The US Federal Communications Commission has released the report and order "Guidelines for Evaluating the Environmental Effects of RF Radiation", ET Docket No. 93-62 in August 1996. The order requires routine SAR evaluation prior to equipment authorization of portable transmitter devices, including portable telephones. For consumer products, the applicable limit is 1.6 mW/g for an uncontrolled environment and 8.0 mW/g for an occupational/controlled environment as recommended by the ANSI/IEEE standard C95.1-1992. According to the Supplement C of OET Bulletin 65 "Evaluating Compliance with FCC Guide-lines for Human Exposure to Radio frequency Electromagnetic Fields", released on Jun 29, 2001 by the FCC, the device should be evaluated at maximum output power (radiated from the antenna) under "worst-case" conditions for normal or intended use, incorporating normal antenna operating positions, device peak performance frequencies and positions for maximum RF energy coupling.

1 Specific Absorption Rate (SAR) is a measure of the rate of energy absorption due to exposure to an RF transmitting source (wireless portable device).

2 IEEE/ANSI Std. C95.1-1992 limits are used to determine compliance with FCC ET Docket 93-62.

SECTION 4 : Dosimetry assessment setup

These measurements were performed with the automated near-field scanning system DASY4 from Schmid & Partner Engineering AG (SPEAG). The system is based on a high precision robot (working range greater than 0.9 m), which positions the probes with a positional repeatability of better than +/- 0.02 mm. Special E- and H-field probes have been developed for measurements close to material discontinuity, the sensors of which are directly loaded with a Schottky diode and connected via highly resistive lines to the data acquisition unit. The SAR measurements were conducted with the dosimetry probe ET3DV6, SN: 1684(manufactured by SPEAG), designed in the classical triangular configuration and optimized for dosimetric evaluation. The probe has been calibrated according to the procedure described in [2] with accuracy of better than +/-10%. The spherical isotropy was evaluated with the procedure described in [3] and found to be better than +/-0.25 dB. The phantom used was the SAM Twin Phantom as described in FCC supplement C, IEEE P1528 and CENELEC EN50361.

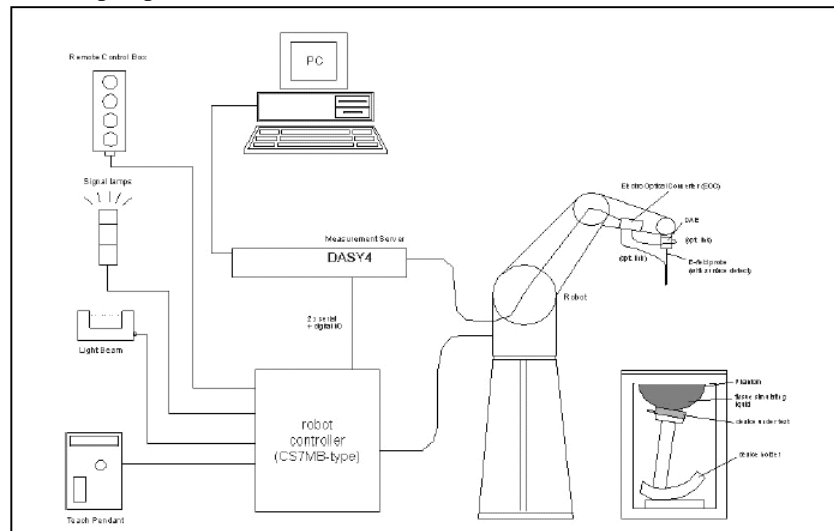
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4.1 Configuration and peripherals



The DASY4 system for performing compliance tests consist of the following items:

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

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4.2 System components

4.2.1 ET3DV6 Probe Specification

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., glycol ether)

Calibration:

Conversion Factors (CF) for
900MHz, 1800MHz and 2450MHz (Head and Body)

Frequency:

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

Directivity:

± 0.2 dB in brain tissue (rotation around probe axis)
 ± 0.4 dB in brain tissue (rotation normal probe axis)

Dynamic Range:

5 mW/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:

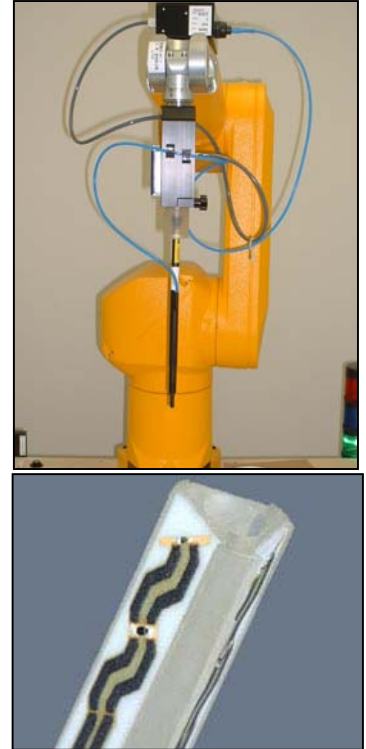
Overall length: 330 mm (Tip: 16 mm)
Tip length: 16 mm
Body diameter: 12 mm (Body: 12 mm)

Tip diameter: 6.8 mm

Distance from probe tip to dipole centers: 2.7 mm

Application:

General dosimetric up to 3 GHz
Compliance tests of mobile phones
Fast automatic scanning in arbitrary phantoms



ET3DV6 E-field Probe

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4.2.2 SAM Twin Phantom

Construction:

The shell corresponds to the specifications of the Specific Anthropomorphic Mannequin (SAM) phantom defined in IEEE 1528-200X, CENELEC EN 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:

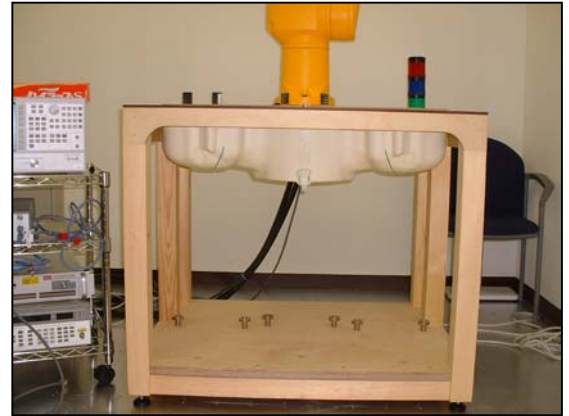
2 +/-0.2 mm

Filling Volume:

Approx. 25 liters

Dimensions:

(H x L x W): 810 x 1000 x 500 mm



SAM Phantom

4.2.3 Device Holder for Transmitters

In combination with the SAM Twin Phantom V4.0, the Mounting Device enables the rotation of the mounted transmitter

in spherical coordinates whereby the rotation points is the ear opening. The devices can be easily, accurately, and repeatedly positioned according to the FCC and CENELEC specifications. The device holder can be locked at different phantom locations (left head, right head, flat phantom).

* Note: A simulating human hand is not used due to the complex anatomical and geometrical structure of the hand that may produced infinite number of configurations.

To produce the worst-case condition (the hand absorbs antenna output power), the hand is omitted during the tests.



Device Holder

Device holder couldn't be used at this SAR measurement.

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SECTION 5 : Test system specifications**Robot RX60L**

Number of Axes	:	6
Payload	:	1.6 kg
Reach	:	800mm
Repeatability	:	+/-0.025mm
Control Unit	:	CS7M
Programming Language	:	V+
Manufacture	:	Stäubli Unimation Corp. Robot Model: RX60

DASY4 Measurement server

Features	:	166MHz low power Pentium MMX 32MB chipdisk and 64MB RAM Serial link to DAE (with watchdog supervision) 16 Bit A/D converter for surface detection system Two serial links to robot (one for real-time communication which is supervised by watchdog) Ethernet link to PC (with watchdog supervision) Emergency stop relay for robot safety chainTwo expansion slots for future applications
Manufacture	:	Schimid & Partner Engineering AG

Data Acquisition Electronic (DAE)

Features	:	Signal amplifier, multiplexer, A/D converter and control logic Serial optical link for communication with DASY4 embedded system (fully remote controlled) 2 step probe touch detector for mechanical surface detection and emergency robot stop (not in -R version)
Measurement Range	:	1 μ V to > 200 mV (16 bit resolution and two range settings: 4mV, 400mV)
Input Offset voltage	:	< 1 μ V (with auto zero)
Input Resistance	:	200 M Ω
Battery Power	:	> 10 h of operation (with two 9 V battery)
Dimension	:	60 x 60 x 68 mm
Manufacture	:	Schimid & Partner Engineering AG

Software

Item	:	Dosimetric Assesment System DASY4
Type No.	:	SD 000 401A, SD 000 402A
Software version No.	:	4.1
Manufacture / Origin	:	Schimid & Partner Engineering AG

E-Field Probe

Model	:	ET3DV6
Serial No.	:	1684
Construction	:	Triangular core fiber optic detection system
Frequency	:	10 MHz to 6 GHz
Linearity	:	+/-0.2 dB (30 MHz to 3 GHz)
Manufacture	:	Schimid & Partner Engineering AG

Phantom

Type	:	SAM Twin Phantom V4.0
Shell Material	:	Fiberglass
Thickness	:	2.0 +/-0.2 mm
Volume	:	Approx. 25 liters
Manufacture	:	Schimid & Partner Engineering AG

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SECTION 6: Test setup of EUT

6.1 Photographs of test setup

We tested the EUT with which Wireless LAN adapter and Bluetooth module were inserted.

When users operate or carry the EUT, it could be considered to touch or get close to their bodies. In order to assume this situation, we performed the test at the following positions. Please refer to "APPENDIX 1" for more details.

1. Front : The test was performed in touch with Front surface of EUT to the flat section of SAM Twin Phantom.
2. Back : The test was performed in touch* and distanced 5mm, 10mm and 15mm with Back surface of EUT to the flat section of SAM Twin Phantom.
*The distance from the antenna of Wireless LAN to SAM Twin Phantom is 15.67mm.
3. Right side : The test was performed in touch with Right side of EUT to the flat section of SAM Twin phantom.
4. Left side : The test was performed in touch with Left side of EUT to the flat section of SAM Twin phantom.
5. Top : The test was performed in touch with Top of EUT to the flat section of SAM Twin Phantom.

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1. Front



2. Back



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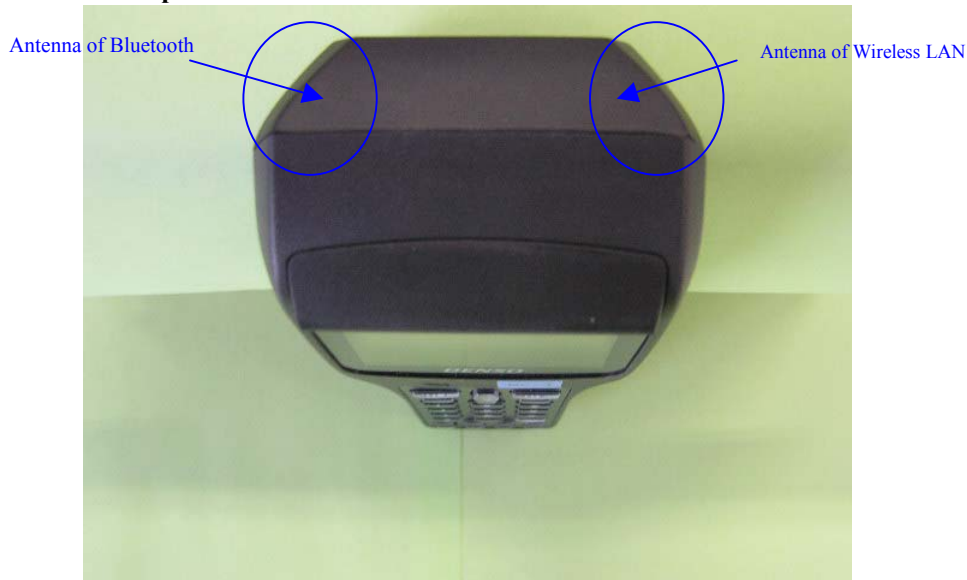
3. Right Side



4. Left Side



5. Top



6.2 EUT Tune-up procedure

The EUT has Wireless LAN and Bluetooth. This Wireless LAN adapter has IEEE.802.11b.
The frequency range and the modulation were used in the testing of each mode are shown as the following.

1. Wireless LAN adapter

IEEE802.11b

Tx Frequency : 2412 – 2462MHz

Channel : 1ch(2412MHz, Low ch),6ch(2437MHz, Mid ch),11ch(2462MHz, High ch)

Modulation : DSSS [CCK]

Crest factor : 1

2. Bluetooth module

Bluetooth

Tx Frequency : 2402 – 2480MHz

Modulation : FHSS Hopping ON/OFF [DH5]

6.3 Methode of measurement

1. IEEE 802.11b + Bluetooth (Hopping ON)

The 11b (DSSS) mode test was performed on the CCK[11Mbps] modulation, because it was the highest peak power and data rate.

Step1. The searching of the worst position.

Step2. The changing to the Low and High channels.

This test was performed at the worst position of Step1.

2. Distance change between EUT Terminal and SAM Twin Phantom

The position for the highest SAR value of this EUT was at “Back” position.

The measurement was performed with the distance,5mm,10mm and 15mm to check if the shortest distance (0mm) may not have the worst value at the conditions of the highest SAR value. As a result, the shortest distance (0mm) had the worst value.

3. Transmission of only IEEE 802.11b (Bluetooth Hopping OFF)

This test was performed at the worst condition.

SECTION 7 : Measurement uncertainty

The uncertainty budget has been determined for the DASY4 measurement system according to the SPEAG [6] documents and is given in the following Table.

Error Description	Uncertainty value $\pm$ %	Probability distribution	divisor	(ci) 1g	Standard Uncertainty (1g)	vi or v _{eff}
Measurement System						
Probe calibration	± 4.8	Normal	1	1	± 4.8	∞
Axial isotropy of the probe	± 4.7	Rectangular	$\sqrt{3}$	$(1-c_p)^{1/2}$	± 1.9	∞
Spherical isotropy of the probe	± 9.6	Rectangular	$\sqrt{3}$	$(c_p)^{1/2}$	± 3.9	∞
Boundary effects	± 1.0	Rectangular	$\sqrt{3}$	1	± 0.6	∞
Probe linearity	± 4.7	Rectangular	$\sqrt{3}$	1	± 2.7	∞
Detection limit	± 1.0	Rectangular	$\sqrt{3}$	1	± 0.6	∞
Readout electronics	± 1.0	Normal	1	1	± 1.0	∞
Response time	± 0.8	Rectangular	$\sqrt{3}$	1	± 0.5	∞
Integration time	± 2.6	Rectangular	$\sqrt{3}$	1	± 1.5	∞
RF ambient conditions	± 3.0	Rectangular	$\sqrt{3}$	1	± 1.7	∞
Mech. constraints of robot	± 0.4	Rectangular	$\sqrt{3}$	1	± 0.2	∞
Probe positioning	± 2.9	Rectangular	$\sqrt{3}$	1	± 1.7	∞
Extrap. and integration	± 1.0	Rectangular	$\sqrt{3}$	1	± 0.6	∞
Test Sample Related						
Device positioning	± 2.9	Rectangular	$\sqrt{3}$	1	± 2.9	10
Device holder uncertainty	± 3.6	Rectangular	$\sqrt{3}$	1	± 3.6	9
Power drift	± 10.0	Rectangular	$\sqrt{3}$	1	± 5.8	∞
Phantom and Setup						
Phantom uncertainty	± 4.0	Rectangular	$\sqrt{3}$	1	± 2.3	∞
Liquid conductivity (target)	± 5.0	Rectangular	$\sqrt{3}$	0.64	± 1.8	∞
Liquid conductivity (meas.)	± 5.0	Normal	1	0.64	± 3.2	∞
Liquid permittivity (target)	± 5.0	Rectangular	$\sqrt{3}$	0.6	± 1.7	∞
Liquid permittivity (meas.)	± 5.0	Normal	1	0.6	± 3.0	∞
Combined Standard Uncertainty					± 12.057	
Expanded Uncertainty (k=2)					± 24.1	

The result of some tests showed that the power drift has exceeded $\pm 5\%$. Therefore, the uncertainty of power drift expanded to $\pm 10\%$. However, the extended uncertainty ($k = 2$) of a test is less than $\pm 30\%$.

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SECTION 8 : Simulated tissue liquid parameter**8.1 Simulated Tissue Liquid Parameter confirmation**

The dielectric parameters were checked prior to assessment using the HP85070D dielectric probe kit.
The dielectric parameters measurement are reported in each correspondent section.

8.2 Head 2450 MHz

Type of liquid : **Head 2450 MHz**
Ambient temperature (deg.c.) : **24.5**
Relative Humidity (%) : **40**
Liquid depth (cm) : **15.2**

Measured By : Miyo Ikuta

DIELECTRIC PARAMETERS MEASUREMENT RESULTS								
Date	Frequency	Liquid Temp [deg.c]		Parameters	Target Value	Measured	Deviation [%]	Limit [%]
		Before	After					
24-Mar	2450	23.2	23.2	Relative Permittivity ϵ_r	39.2	37.3	-4.8	+/-5
				Conductivity σ [mho/m]	1.80	1.87	3.9	+/-5

8.3 Muscle 2450 MHz

Type of liquid : **Muscle 2450 MHz**
Ambient temperature (deg.c.) : **24.5**
Relative Humidity (%) : **40**
Liquid depth (cm) : **15.2**

Measured By : Miyo Ikuta

DIELECTRIC PARAMETERS MEASUREMENT RESULTS								
Date	Frequency	Liquid Temp [deg.c]		Parameters	Target Value	Measured	Deviation [%]	Limit [%]
		Before	After					
24-Mar	2450	22.6	22.6	Relative Permittivity ϵ_r	52.7	50.3	-4.6	+/-5
				Conductivity σ [mho/m]	1.95	2.01	3.1	+/-5

8.4 Simulated Tissues Composition of 2450MHz

Ingredient	MiXTURE(%)	
	Head 2450MHz	Muscle 2450MHz
Water	45.0	69.83
DGMBE	55.0	30.2

Note:DGMBE(Diethylenglycol-monobuthyl ether)

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SECTION 9 : System validation data

Prior to the assessment, the system validation kit was used to test whether the system was operating within its specifications of +/-10%. The validation results are tabulated below. Please refer to APPENDIX 3.

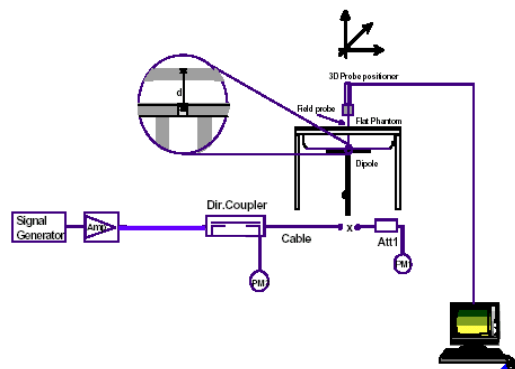
9.1 System validation of 2450MHz

Type of liquid : **HEAD 2450MHz**
Frequency : **2450MHz**
Ambient temperature (deg.c.) : **24.5**
Relative Humidity (%) : **40**
Dipole : **D2450V2 SN:713**
Power : **250mW**

Measured By : Miyo Ikuta

SYSTEM PERFORMANCE CHECK										
Date	Liquid (HEAD 2450MHz)						System dipole validation target & measured			
	Liquid Temp [deg.c.]		Relative Permittivity		Conductivity		SAR 1g [W/kg]		Deviation [%]	Limit [%]
	Before	After	Target	Measured	Target	Measured	Target	Measured		
24-Mar	23.2	23.2	39.2	37.3	1.80	1.87	13.1	14.3	9.2	+/-10

Note: Please refer to Attachment for the result representation in plot format



2450MHz System
performance check
setup

Test system for the system performance check setup diagram

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SECTION 10 : Evaluation procedure

The evaluation was performed with the following procedure:

Step 1: Measurement of the E-field at a fixed location above the ear point or central position of flat phantom was used as a reference value for assessing the power drop.

Step 2: The SAR distribution at the exposed side of head or body position was measured at a distance of each device from the inner surface of the shell. The area covered the entire dimension of the wireless LAN antenna and the horizontal grid spacing was 20 mm x 20 mm . Based on these data, the area of the maximum absorption was determined by spline interpolation.

Step 3: Around this point found in the Step 2 (area scan) , a volume of 32 mm x 32 mm x 30 mm was assessed by measuring 5 x 5 x 7 points. And for any secondary peaks found in the Step2 which are within 2dB of maximum peak and not with this Step3 (Zoom scan) is repeated. On the basis of this data set, the spatial peak SAR value was evaluated under the following procedure:

1. The data at the surface were extrapolated, since the center of the dipoles is 2.7 mm away from the tip of the probe and the distance between the surface and the lowest measuring point is 1.3 mm. The extrapolation was based on a least square algorithm [4]. A polynomial of the fourth order was calculated through the points in z-axes. This polynomial was then used to evaluate the points between the surface and the probe tip.
2. The maximum interpolated value was searched with a straightforward algorithm. Around this maximum the SAR values averaged over the spatial volumes (1 g or 10 g) were computed by the 3D-Spline interpolation algorithm. The 3D-Spline is composed of three one-dimensional splines with the "Not a knot"-condition (in x, y and z-directions) [4], [5]. The volume was integrated with the trapezoidal-algorithm. One thousand points (10 x 10 x 10) were interpolated to calculate the average.
3. All neighboring volumes were evaluated until no neighboring volume with a higher average value was found.

Step 4: Re-measurement of the E-field at the same location as in Step 1.

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SECTION 11 : Exposure limit

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

Spatial Average (averaged over the whole body)	Spatial Peak (averaged over any 1g of tissue)	Spatial Peak (hands/wrists/feet/ankles averaged over 10g)
0.4	8.0	20.0

(B) Limits for General population/Uncontrolled Exposure (W/kg)

Spatial Average (averaged over the whole body)	Spatial Peak (averaged over any 1g of tissue)	Spatial Peak (hands/wrists/feet/ankles averaged over 10g)
0.08	1.6	4.0

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

General Population/Uncontrolled Environments: are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure.

NOTE:GENERAL POPULATION/UNCONTROLLED EXPOSURE SPATIAL PEAK(averaged over any 1g of tissue) LIMIT 1.6 W/kg

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SECTION 12 : SAR Measurement results**12.1 Conducted peak power measurement result**

[IEEE802.11b : 11Mbps]						
Ch	Freq. [MHz]	P/A Reading [dBm]	Cable Loss [dB]	Atten. [dB]	Result [dBm]	Converted [mW]
Low	2412.0	5.60	0.88	10.00	16.48	44.46
Mid	2437.0	5.10	1.06	10.00	16.16	41.30
High	2462.0	4.50	1.23	10.00	15.73	37.41

Sample Calculation:

Result = Reading + Cable Loss (supplied by customer) + Attenuator

[Bluetooth]						
Ch	Freq. [MHz]	S/A Reading [dBm]	Cable Loss [dB]	Atten. [dB]	Result [dBm]	Converted [mW]
Low	2402.0	-7.32	0.45	6.00	-0.87	0.82
Mid	2441.0	-8.04	0.46	5.90	-1.68	0.68
High	2480.0	-8.47	0.46	5.90	-2.11	0.62

Sample Calculation:

Result = Reading + Cable Loss (supplied by customer)+ Attenuator

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12.2 Body 2450MHz SAR

Liquid Depth (cm)	: 15.2	Model	: BHT-300QWB
Parameters	: $\epsilon_r = 50.3$, $\sigma = 2.01$	Serial No.	: 549690004450027
Ambient temperature (deg.c.)	: 24.5	Modulation	: DSSS [CCK, 11Mbps]
Relative Humidity (%)	: 40	Crest factor	: 1

Date : March 24, 2005

Measured By : Miyo Ikuta

1. IEEE 802.11b + Bluetooth (Hopping ON)

BODY SAR MEASUREMENT RESULTS									
Frequency		Bluetooth Hopping	Phantom Section	EUT Set-up Conditions			Liquid Temp.[deg.c]		SAR(1g) [W/kg]
Channel	[MHz]			Antenna	Position	Separation [mm]	Before	After	Maximum value of multi-peak
Step1. Worst position searching.									
Mid	2437	ON	Flat	Fixed	Front	0	23.3	23.3	0.00864
Mid	2437	ON	Flat	Fixed	Back	0	23.3	23.4	0.185
Mid	2437	ON	Flat	Fixed	Right side	0	23.3	23.2	0.0487
Mid	2437	ON	Flat	Fixed	Left side	0	23.2	23.2	0.00838
Mid	2437	ON	Flat	Fixed	Top	0	23.3	23.3	0.0192
Step2. Channel change.									
Low	2412	ON	Flat	Fixed	Back	0	23.3	23.4	0.190
High	2462	ON	Flat	Fixed	Back	0	23.4	23.4	0.101
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure / General Population							Body SAR: 1.6 W/kg (averaged over 1 gram)		

2. Distance change between EUT Terminal and SAM Twin Phantom

BODY SAR MEASUREMENT RESULTS									
Frequency		Bluetooth Hopping	Phantom Section	EUT Set-up Conditions			Liquid Temp.[deg.c]		SAR(1g) [W/kg]
Channel	[MHz]			Antenna	Position	Separation [mm]	Before	After	Maximum value of multi-peak
Distance change.									
Low	2412	ON	Flat	Fixed	Back	5	23.4	23.4	0.0910
Low	2412	ON	Flat	Fixed	Back	10	23.3	23.3	0.0594
Low	2412	ON	Flat	Fixed	Back	15	23.2	23.2	0.0434
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure / General Population							Body SAR: 1.6 W/kg (averaged over 1 gram)		

3. Transmission of only IEEE 802.11b (Bluetooth Hopping OFF)

BODY SAR MEASUREMENT RESULTS									
Frequency		Bluetooth Hopping	Phantom Section	EUT Set-up Conditions			Liquid Temp.[deg.c]		SAR(1g) [W/kg]
Channel	[MHz]			Antenna	Position	Separation [mm]	Before	After	Maximum value of multi-peak
Bluetooth Hopping OFF.									
Low	2412	OFF	Flat	Fixed	Back	0	23.2	23.2	0.206
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure / General Population							Body SAR: 1.6 W/kg (averaged over 1 gram)		

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SECTION 13 : Equipment & calibration information

Equipment used on March 24

Name of Equipment	Manufacture	Model number	Serial number	Calibration	
				Last Cal	due date
Power Meter	Agilent	E4417A	GB41290639	2004/11/9	2005/11/8
Power Sensor	Agilent	E9300B	US40010300	2004/11/15	2005/11/14
Power Sensor	Agilent	E9327A	US40440576	2004/11/23	2005/11/22
S-Parameter Network Analyzer	Agilent	8753ES	US39174808	2003/10/23	2006/10/22
Signal Generator	Rohde&Schwarz	SML40	100023	2005/1/5	2006/1/4
RF Amplifier	TSJ	CBP02063033	-	2005/2/24	2006/2/23
Dosimetric E-Field Probe	Schmid&Partner Engineering AG	ET3DV6	1684	2004/9/2	2005/9/1
*Data Acquisition Electronics	Schmid&Partner Engineering AG	DAE3 V1	509	2004/4/22	2005/4/21
Robot, SAM Twin Phantom	Schmid&Partner Engineering AG	DASY4	I021834	N/A	N/A
Attenuator	Agilent	US40010300	08498-60012	2004/12/16	2005/12/15
2450MHz System Validation Dipole	Schmid&Partner Engineering AG	D2450V2	713	2004/12/13	2006/12/12
Dual Directional Coupler	N/A	Narda	3702	N/A	N/A
Head 2450MHz	N/A	N/A	N/A	N/A	N/A
Body 2450MHz	N/A	N/A	N/A	N/A	N/A
Ambient Noise <0.012W/kg	SAR room	-	-	2005/3/24	-

Equipment used on June 19

Name of Equipment	Manufacture	Model number	Serial number	Calibration	
				Last Cal	due date
Power Meter	Agilent	E4416A	GB41290974	2005/3/16	2006/3/15
Power Sensor	Agilent	E9327A	US40440545	2005/3/29	2006/3/28
Attenuator	HIROSE ELECTRIC CO.,LTD.	AT-110	-	2005/1/11	2006/1/10

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SECTION 14 : References

- [1]ANSI, ANSI/IEEE C95.1-1992: IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz, The Institute of Electrical and Electronics Engineers, Inc., New York, NY 10017, 1992.
- [2] Katja Pokovic, Thomas Schmid, and Niels Kuster, “Robust setup for precise calibration of E-field probes in tissue simulating liquids at mobile communications frequencies”, in ICECOM ‘97, Dubrovnik, October 15-17, 1997, pp. 120-124.
- [3] Katja Pokovic, Thomas Schmid, and Niels Kuster, “E- _field probe with improved isotropy in brain simulating liquids”, in Proceedings of the ELMAR, Zadar, Croatia, 23-25 June, 1996, pp.172-175.
- [4] W. Gander, Computermathematik, Birkhaeuser, Basel, 1992.
- [5] W. H. Press, S. A. Teukolsky, W. T. Vetterling, and B. P. Flannery, Numerical Recepies in C, The Art of Scientific Computing, Second Edition, Cambridge University Press, 1992.
- [6] SPEAG documents Unsertainty document for DAZY 4 System from SPEAG (Shimid & Partner Engineering AG).

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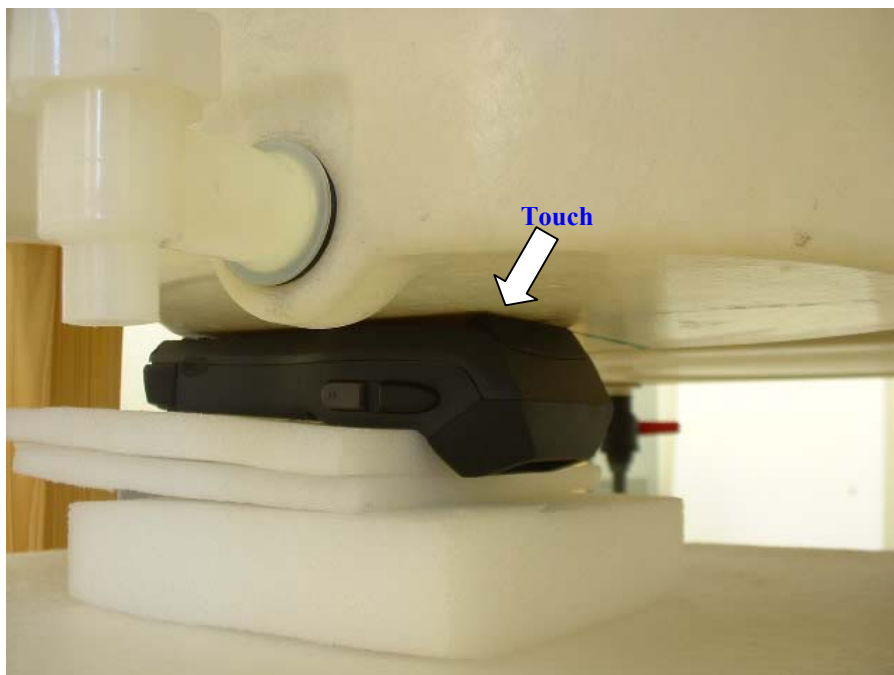
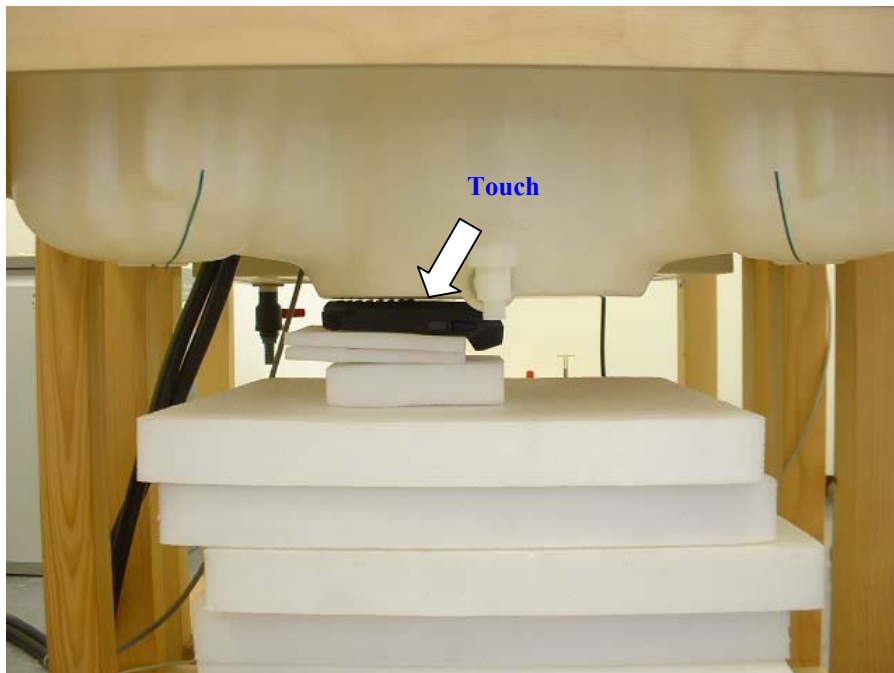
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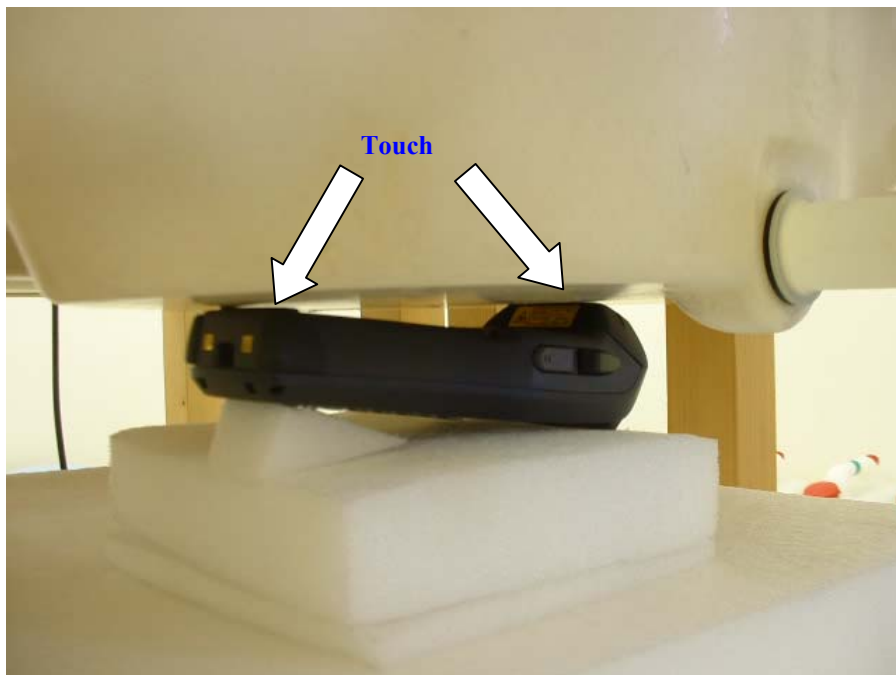
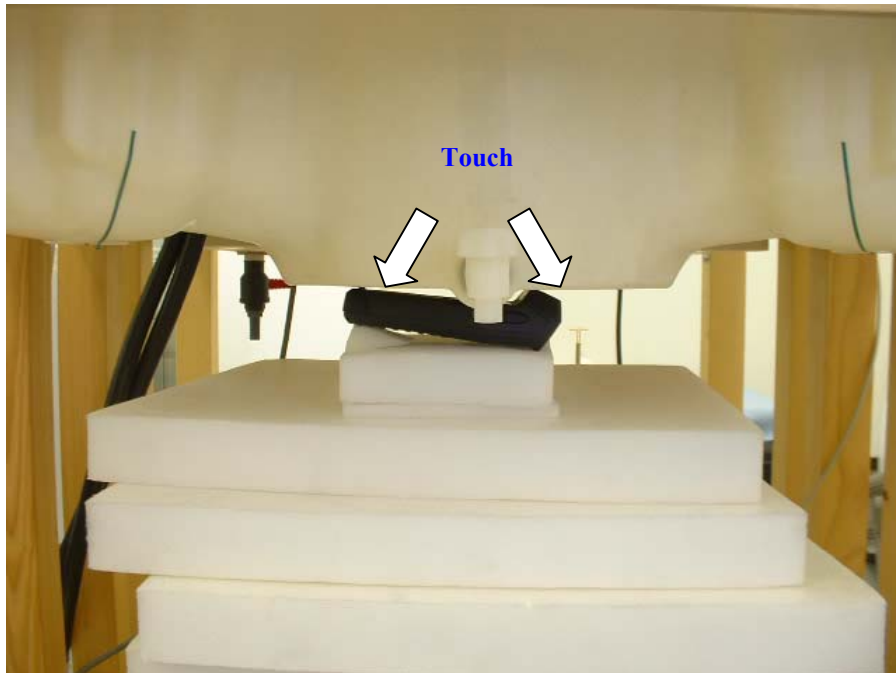
Facsimile: +81 596 24 8124

APPENDIX 1 : Photographs of test setup

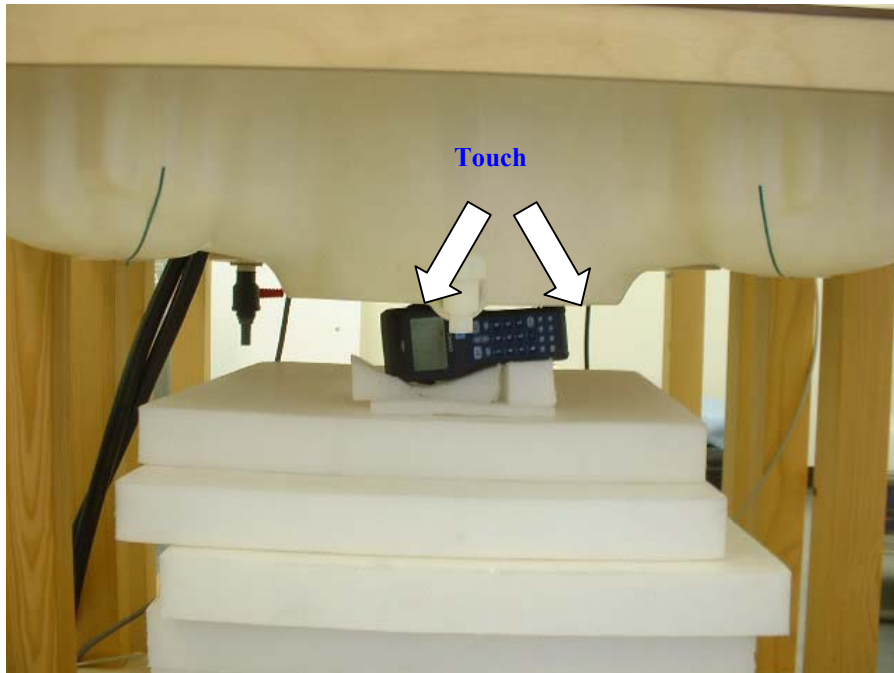
Front



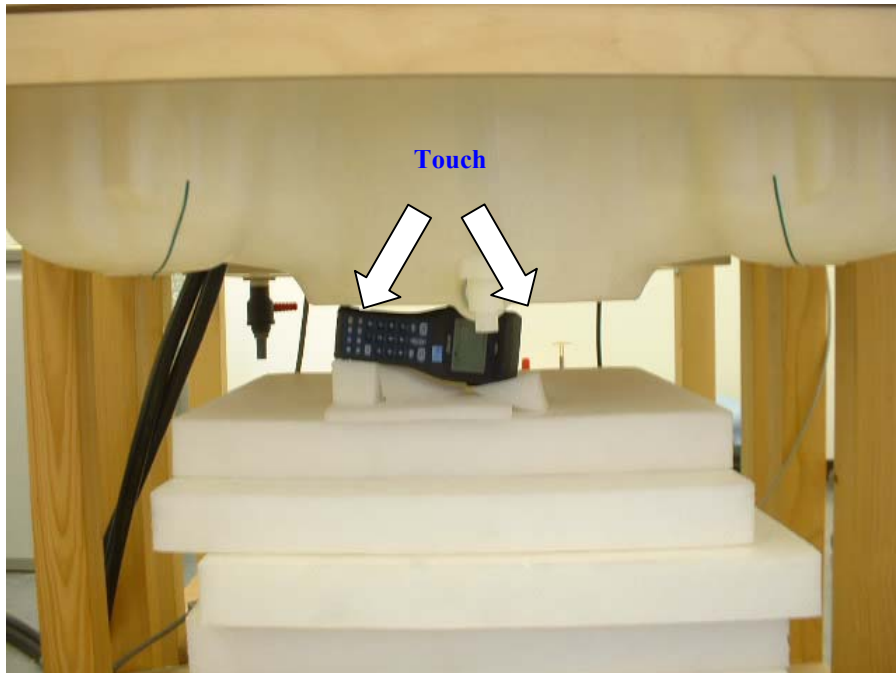
Back



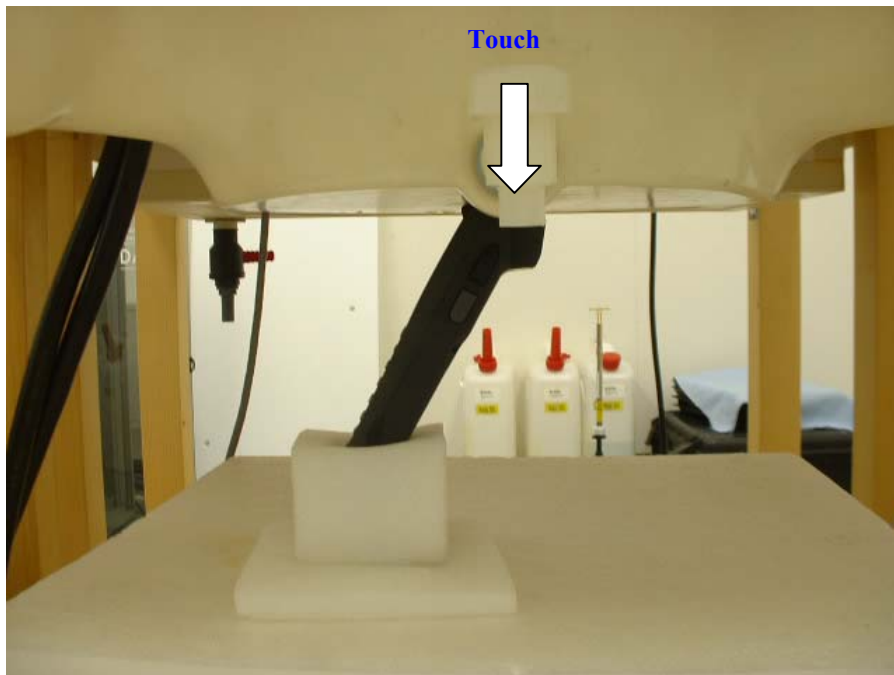
Right side



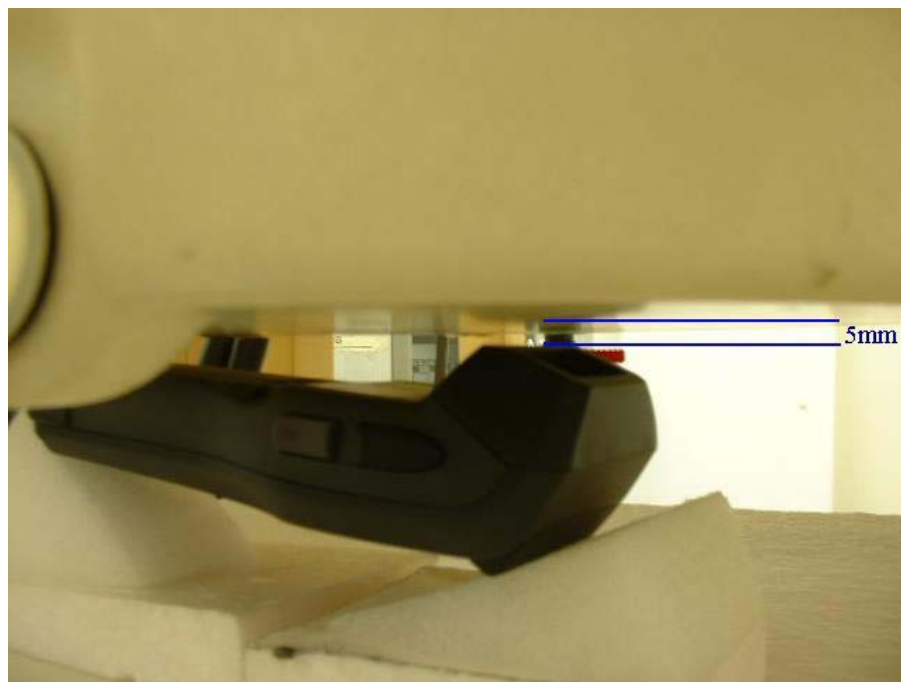
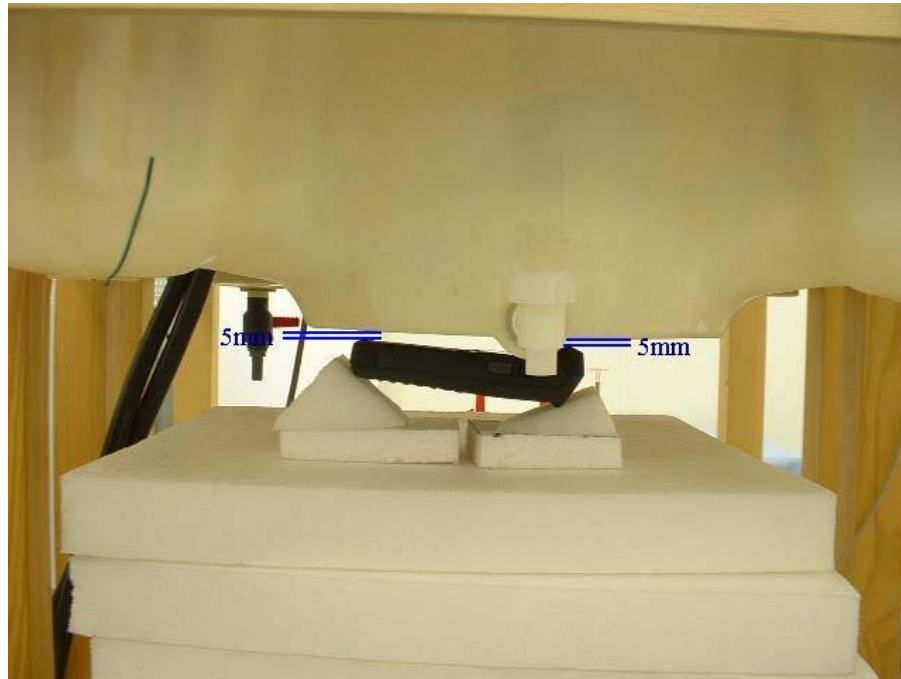
Left side

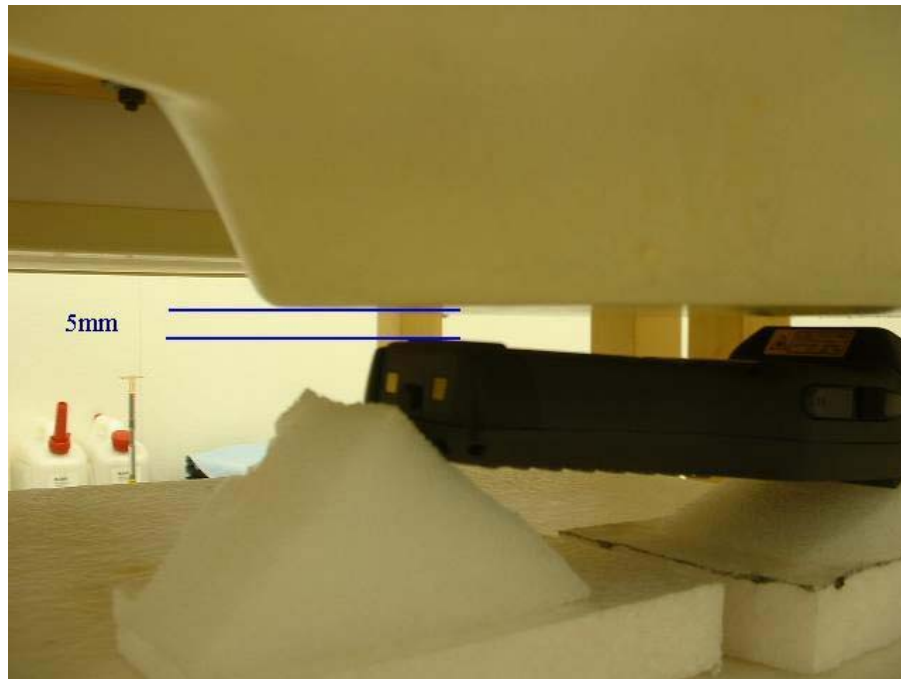


Top

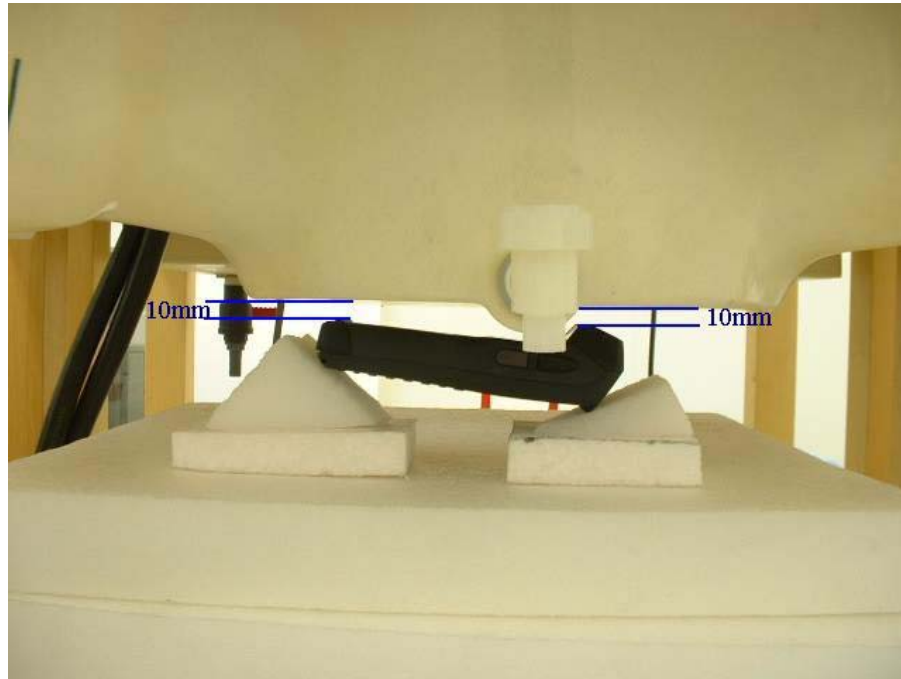


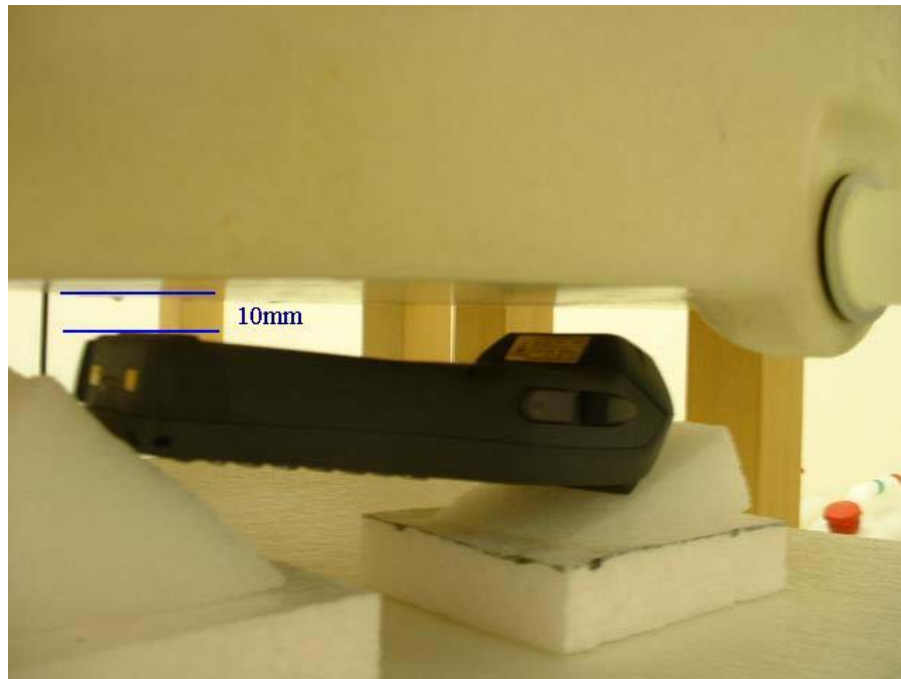
Back separated 5mm



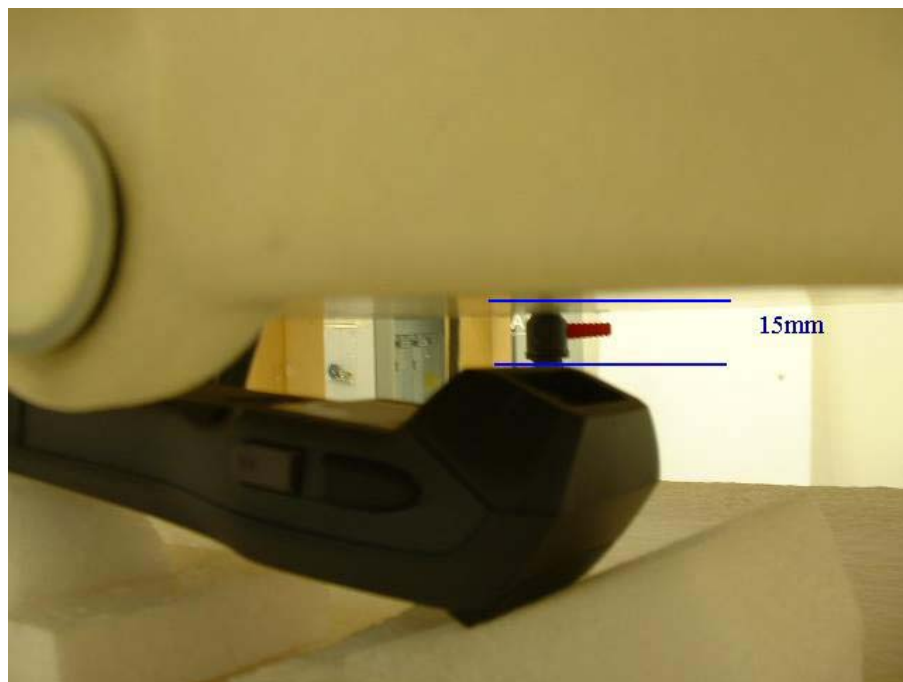


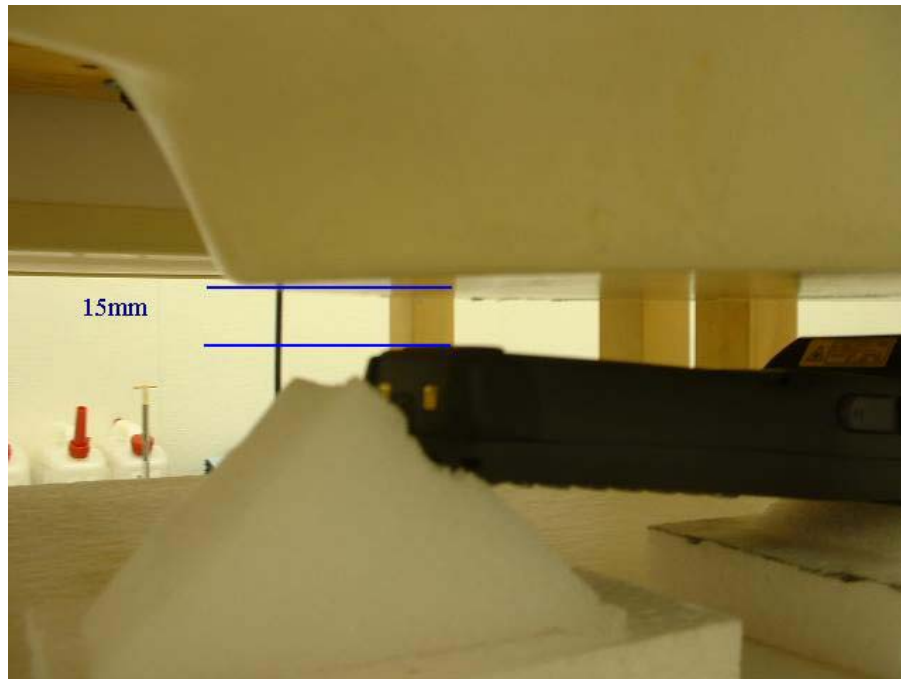
Back separated 10mm





Back separated 15mm





APPENDIX 2 : SAR Measurement data

BHT-300QWB-Body-11b-11Mbps-Mid ch(2437MHz)-Front-BT ON

Crest factor : 1

Medium: M2450 ($\sigma = 2.01$ mho/m, $\epsilon_r = 50.3$, $\rho = 1000$ kg/m³)

Phantom section: Flat Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1684; ConvF(4.14, 4.14, 4.14); Calibrated: 2004/09/02
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Phantom: SAM 1196
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 115

Area Scan (61x81x1): Measurement grid: dx=20mm, dy=20mm

Maximum value of SAR = 0.00799 mW/g

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Peak SAR (extrapolated) = 0.0219 W/kg

SAR(1 g) = 0.00864 mW/g; SAR(10 g) = 0.00419 mW/g

Maximum value of SAR = 0.00856 mW/g

Zoom Scan (5x5x7)/Cube 1: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Peak SAR (extrapolated) = 0.0119 W/kg

SAR(1 g) = 0.00534 mW/g; SAR(10 g) = 0.00285 mW/g

Maximum value of SAR = 0.00829 mW/g

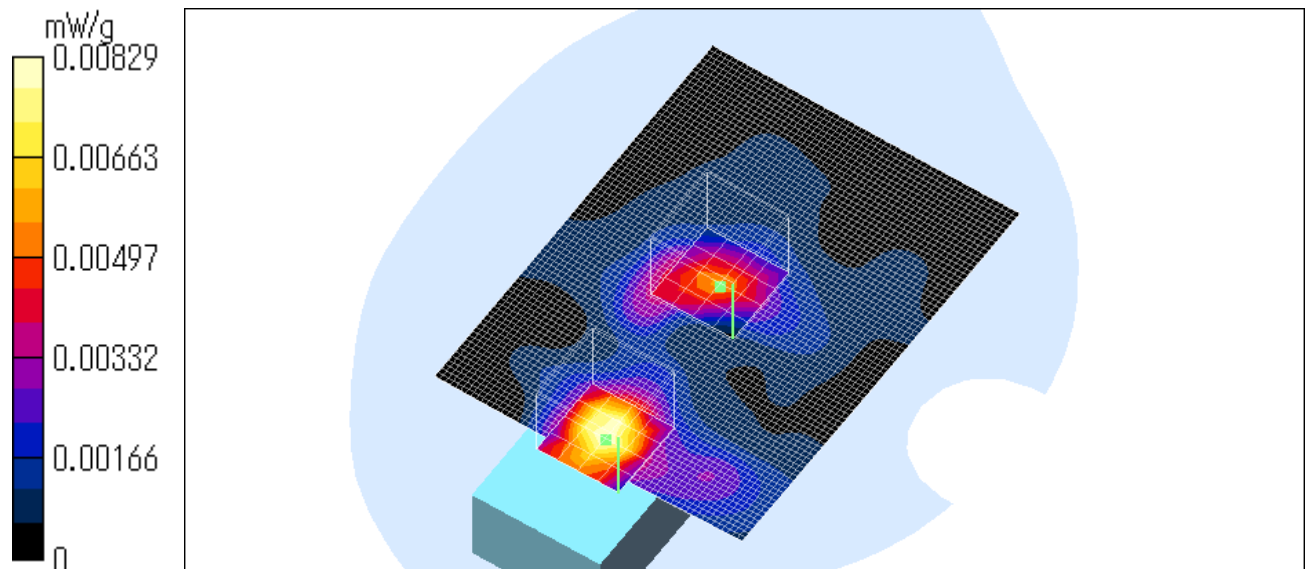
Reference Value = 1.68 V/m

Power Drift = -0.2 dB

Test Date = 03/24/05

Ambient Temperature = 24.5 degree.c

Liquid Temperature = Before 23.3 degree.C , After 23.3 degree.C



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BHT-300QWB-Body-11b-11Mbps-Mid ch(2437MHz)-Back-BT ON

Crest factor : 1

Medium: M2450 ($\sigma = 2.01$ mho/m, $\epsilon_r = 50.3$, $\rho = 1000$ kg/m³)

Phantom section: Flat Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1684; ConvF(4.14, 4.14, 4.14); Calibrated: 2004/09/02
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Phantom: SAM 1196
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 115

Area Scan (61x81x1): Measurement grid: dx=20mm, dy=20mm

Maximum value of SAR = 0.193 mW/g

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Peak SAR (extrapolated) = 0.423 W/kg

SAR(1 g) = 0.185 mW/g; SAR(10 g) = 0.083 mW/g

Maximum value of SAR = 0.195 mW/g

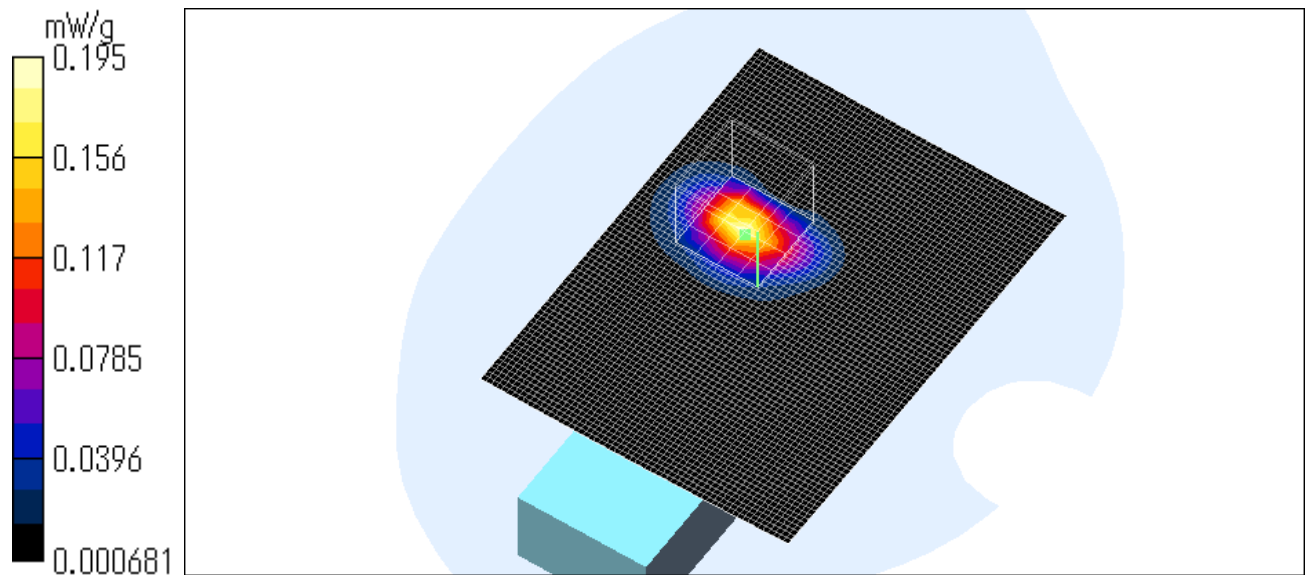
Reference Value = 2.91 V/m

Power Drift = -0.07 dB

Test Date = 03/24/05

Ambient Temperature = 24.5 degree.c

Liquid Temperature = Before 23.3 degree.C , After 23.4 degree.C



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BHT-300QWB-Body-11b-11Mbps-Mid ch(2437MHz)-Right side-BT ON

Crest factor : 1

Medium: M2450 ($\sigma = 2.01$ mho/m, $\epsilon_r = 50.3$, $\rho = 1000$ kg/m³)

Phantom section: Flat Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1684; ConvF(4.14, 4.14, 4.14); Calibrated: 2004/09/02
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Phantom: SAM 1196
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 115

Area Scan (61x91x1): Measurement grid: dx=20mm, dy=20mm

Maximum value of SAR = 0.0444 mW/g

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Peak SAR (extrapolated) = 0.1 W/kg

SAR(1 g) = 0.0487 mW/g; SAR(10 g) = 0.0251 mW/g

Maximum value of SAR = 0.0513 mW/g

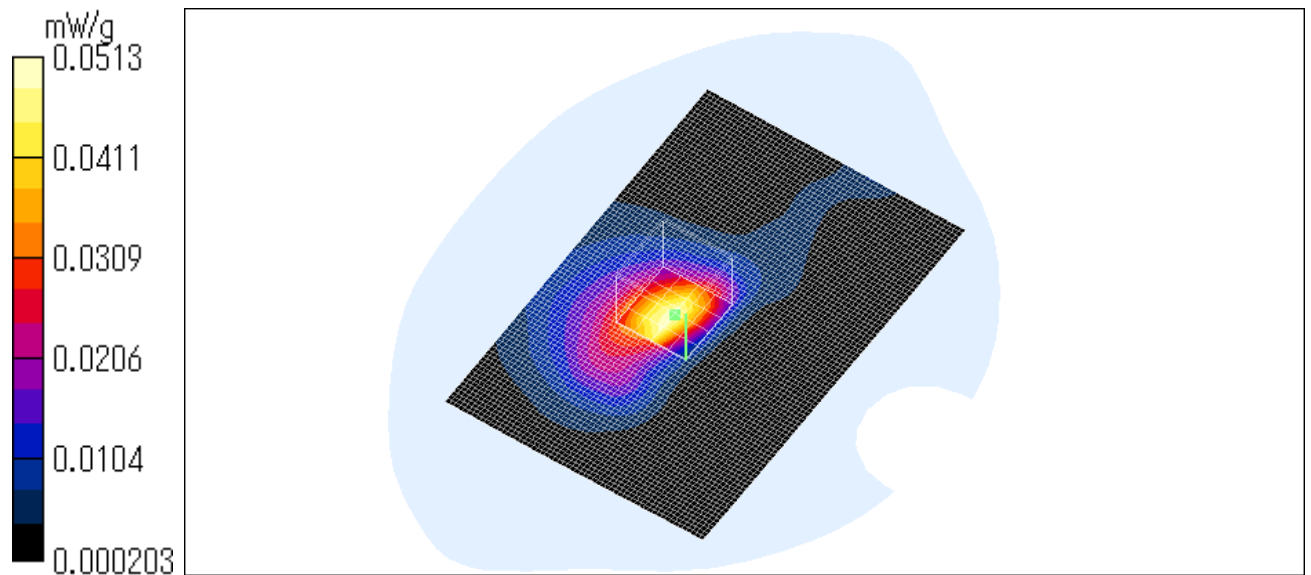
Reference Value = 4.21 V/m

Power Drift = -0.2 dB

Test Date = 03/24/05

Ambient Temperature = 24.5 degree.c

Liquid Temperature = Before 23.3 degree.C , After 23.2 degree.C



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BHT-300QWB-Body-11b-11Mbps-Mid ch(2437MHz)-Left side-BT ON

Crest factor : 1

Medium: M2450 ($\sigma = 2.01$ mho/m, $\epsilon_r = 50.3$, $\rho = 1000$ kg/m³)

Phantom section: Flat Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1684; ConvF(4.14, 4.14, 4.14); Calibrated: 2004/09/02
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Phantom: SAM 1196
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 115

Area Scan (61x91x1): Measurement grid: dx=20mm, dy=20mm

Maximum value of SAR = 0.00881 mW/g

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Peak SAR (extrapolated) = 0.0191 W/kg

SAR(1 g) = 0.00838 mW/g; SAR(10 g) = 0.004 mW/g

Maximum value of SAR = 0.00868 mW/g

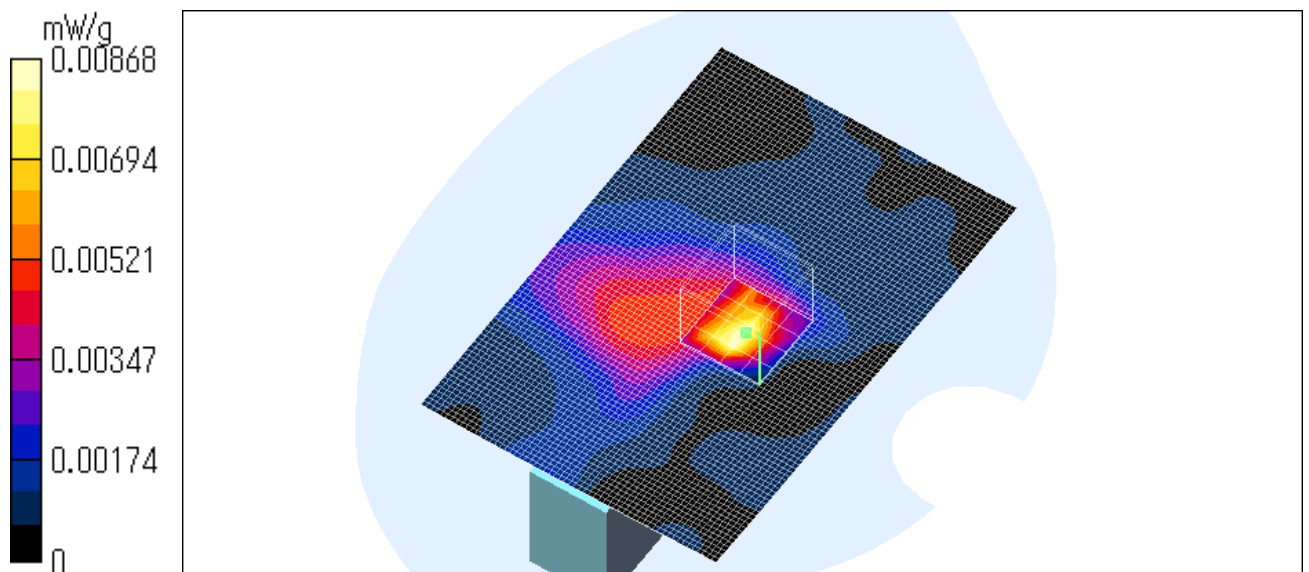
Reference Value = 1.42 V/m

Power Drift = -0.02 dB

Test Date = 03/24/05

Ambient Temperature = 24.5 degree.c

Liquid Temperature = Before 23.2 degree.C , After 23.2 degree.C



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BHT-300QWB-Body-11b-11Mbps-Mid ch(2437MHz)-Top-BT ON

Crest factor : 1

Medium: M2450 ($\sigma = 2.01$ mho/m, $\epsilon_r = 50.3$, $\rho = 1000$ kg/m³)

Phantom section: Flat Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1684; ConvF(4.14, 4.14, 4.14); Calibrated: 2004/09/02
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Phantom: SAM 1196
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 115

Area Scan (61x81x1): Measurement grid: dx=20mm, dy=20mm

Maximum value of SAR = 0.0225 mW/g

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Peak SAR (extrapolated) = 0.0358 W/kg

SAR(1 g) = 0.0192 mW/g; SAR(10 g) = 0.0099 mW/g

Maximum value of SAR = 0.0207 mW/g

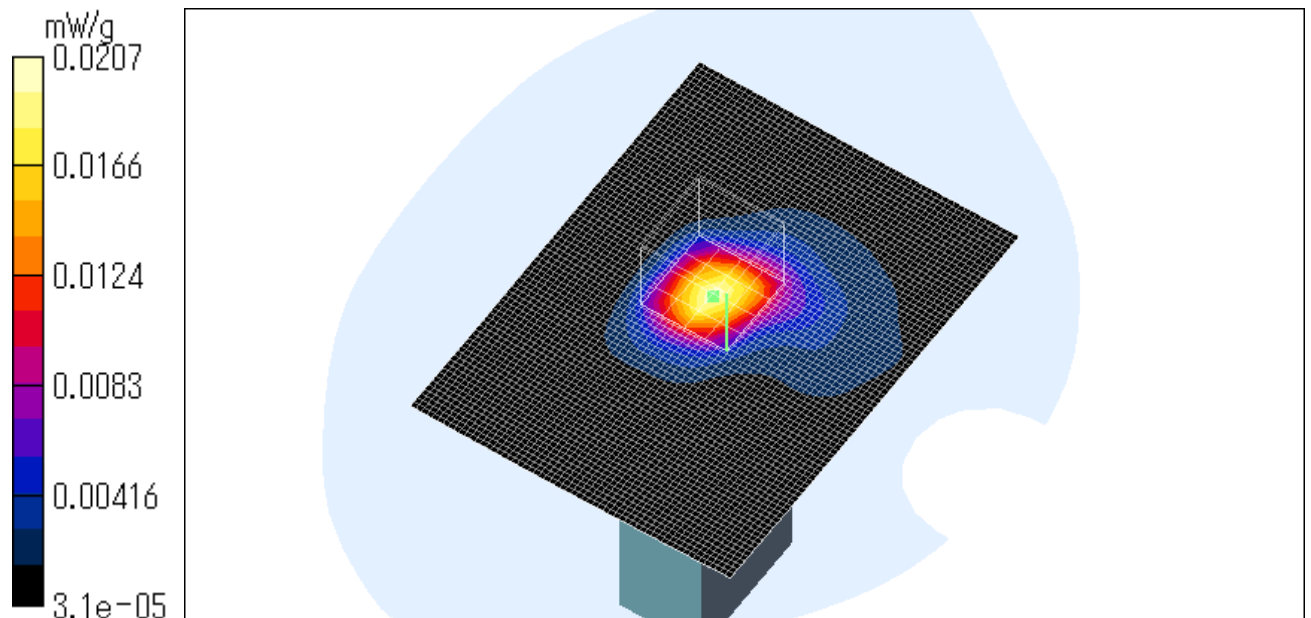
Reference Value = 3.05 V/m

Power Drift = -0.3 dB

Test Date = 03/24/05

Ambient Temperature = 24.5 degree.c

Liquid Temperature = Before 23.3 degree.C , After 23.3 degree.C



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BHT-300QWB-Body-11b-11Mbps-Low ch(2412MHz)-Back-BT ON

Crest factor : 1

Medium: M2450 ($\sigma = 2.01$ mho/m, $\epsilon_r = 50.3$, $\rho = 1000$ kg/m³)

Phantom section: Flat Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1684; ConvF(4.14, 4.14, 4.14); Calibrated: 2004/09/02
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Phantom: SAM 1196
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 115

Area Scan (61x91x1): Measurement grid: dx=20mm, dy=20mm

Maximum value of SAR = 0.174 mW/g

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Peak SAR (extrapolated) = 0.418 W/kg

SAR(1 g) = 0.19 mW/g; SAR(10 g) = 0.0874 mW/g

Maximum value of SAR = 0.198 mW/g

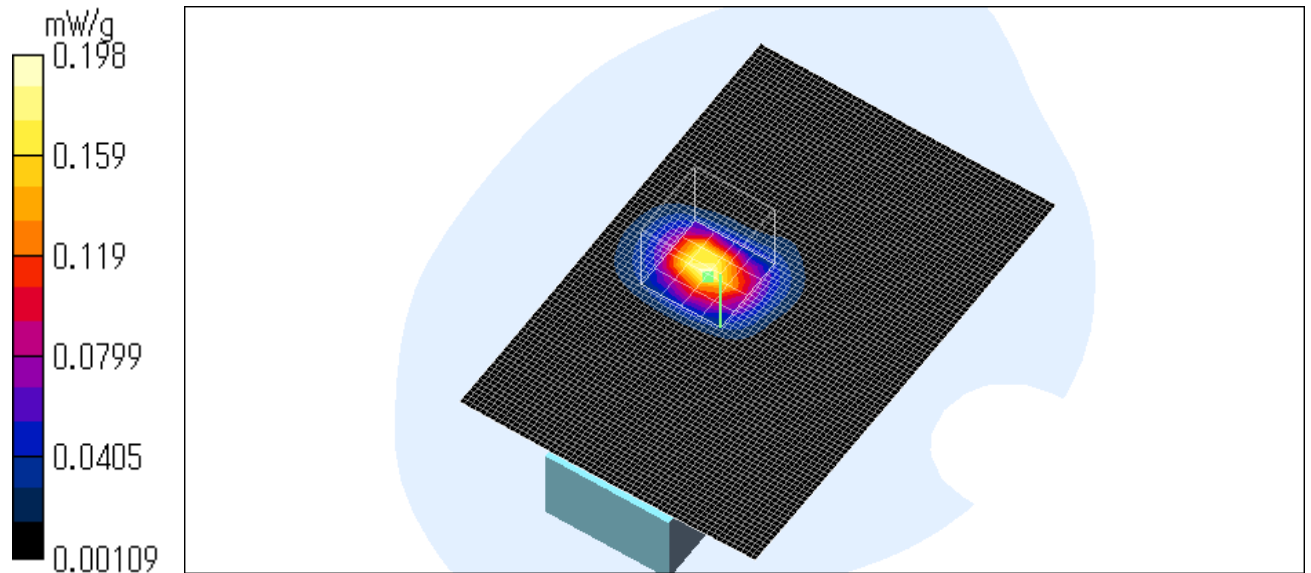
Reference Value = 5.89 V/m

Power Drift = -0.1 dB

Test Date = 03/24/05

Ambient Temperature = 24.5 degree.c

Liquid Temperature = Before 23.3 degree.C , After 23.4 degree.C



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BHT-300QWB-Body-11b-11Mbps-High ch(2462MHz)-Back-BT ON

Crest factor : 1

Medium: M2450 ($\sigma = 2.01$ mho/m, $\epsilon_r = 50.3$, $\rho = 1000$ kg/m³)

Phantom section: Flat Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1684; ConvF(4.14, 4.14, 4.14); Calibrated: 2004/09/02
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Phantom: SAM 1196
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 115

Area Scan (61x91x1): Measurement grid: dx=20mm, dy=20mm

Maximum value of SAR = 0.0909 mW/g

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Peak SAR (extrapolated) = 0.227 W/kg

SAR(1 g) = 0.101 mW/g; SAR(10 g) = 0.0458 mW/g

Maximum value of SAR = 0.0976 mW/g

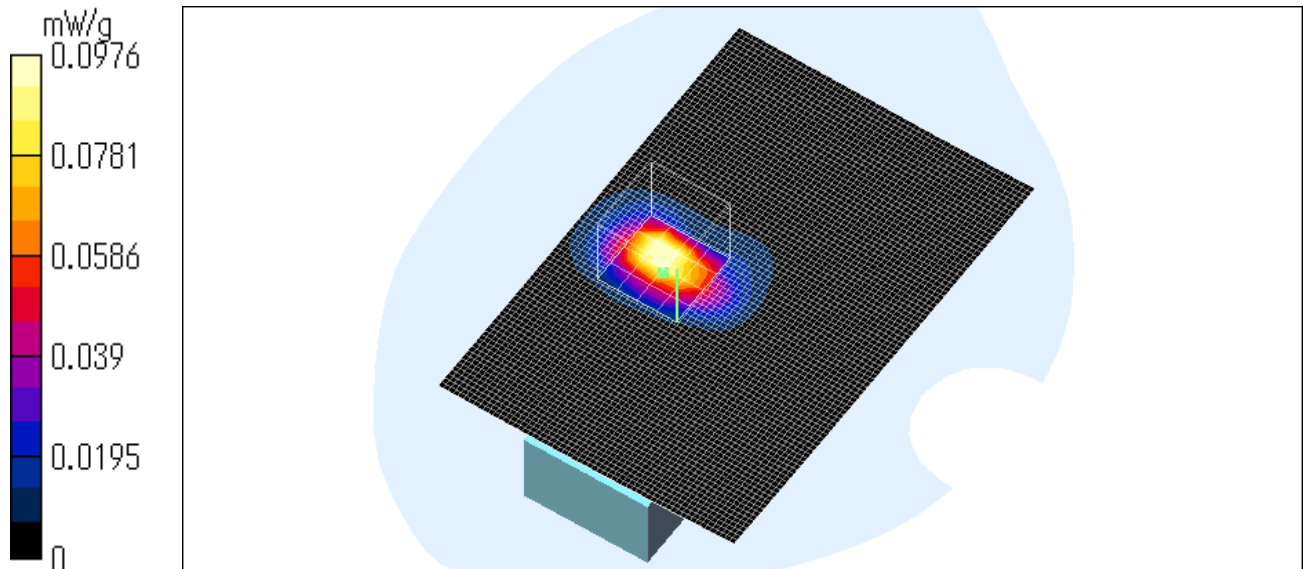
Reference Value = 4.4 V/m

Power Drift = -0.3 dB

Test Date = 03/24/05

Ambient Temperature = 24.5 degree.c

Liquid Temperature = Before 23.4 degree.C , After 23.4 degree.C



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BHT-300QWB-Body-11b-11Mbps-Low ch(2412MHz)-Back-BT ON-Separation: 5mm

Crest factor : 1

Medium: M2450 ($\sigma = 2.01$ mho/m, $\epsilon_r = 50.3$, $\rho = 1000$ kg/m³)

Phantom section: Flat Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1684; ConvF(4.14, 4.14, 4.14); Calibrated: 2004/09/02
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Phantom: SAM 1196
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 115

Area Scan (61x91x1): Measurement grid: dx=20mm, dy=20mm

Maximum value of SAR = 0.0898 mW/g

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Peak SAR (extrapolated) = 0.184 W/kg

SAR(1 g) = 0.091 mW/g; SAR(10 g) = 0.0452 mW/g

Maximum value of SAR = 0.0962 mW/g

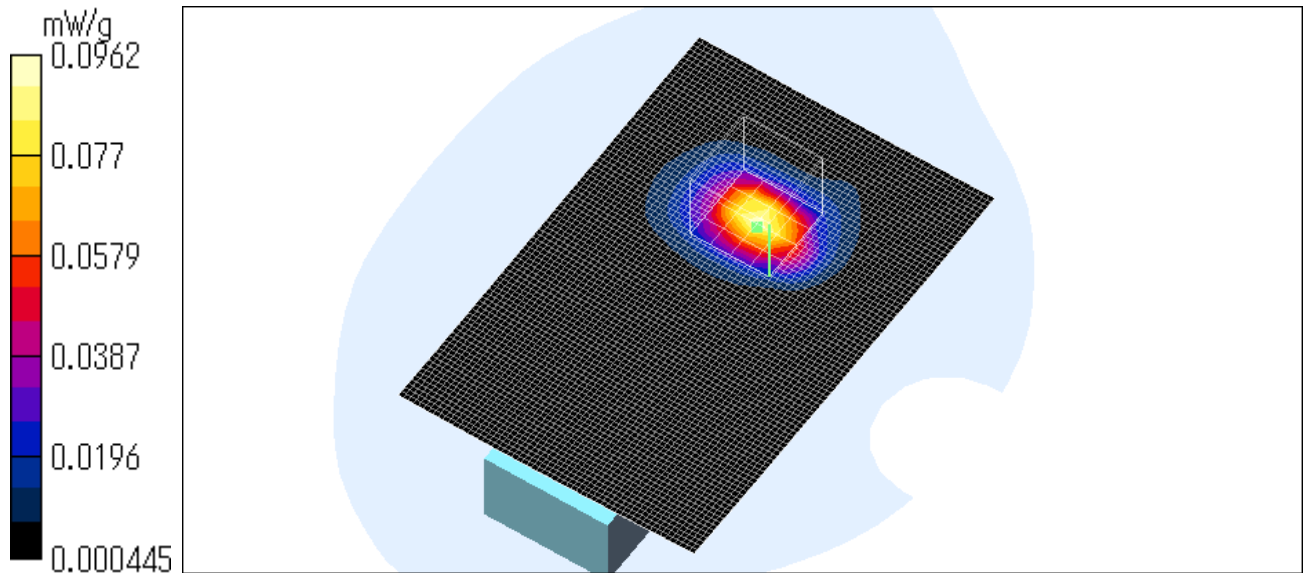
Reference Value = 0.552 V/m

Power Drift = 0.3 dB

Test Date = 03/24/05

Ambient Temperature = 24.5 degree.c

Liquid Temperature = Before 23.4 degree.C , After 23.4 degree.C



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BHT-300QWB-Body-11b-11Mbps-Low ch(2412MHz)-Back-BT ON-Separation: 10mm

Crest factor : 1

Medium: M2450 ($\sigma = 2.01$ mho/m, $\epsilon_r = 50.3$, $\rho = 1000$ kg/m³)

Phantom section: Flat Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1684; ConvF(4.14, 4.14, 4.14); Calibrated: 2004/09/02
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Phantom: SAM 1196
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 115

Area Scan (61x91x1): Measurement grid: dx=20mm, dy=20mm

Maximum value of SAR = 0.0599 mW/g

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Peak SAR (extrapolated) = 0.123 W/kg

SAR(1 g) = 0.0594 mW/g; SAR(10 g) = 0.0302 mW/g

Maximum value of SAR = 0.0621 mW/g

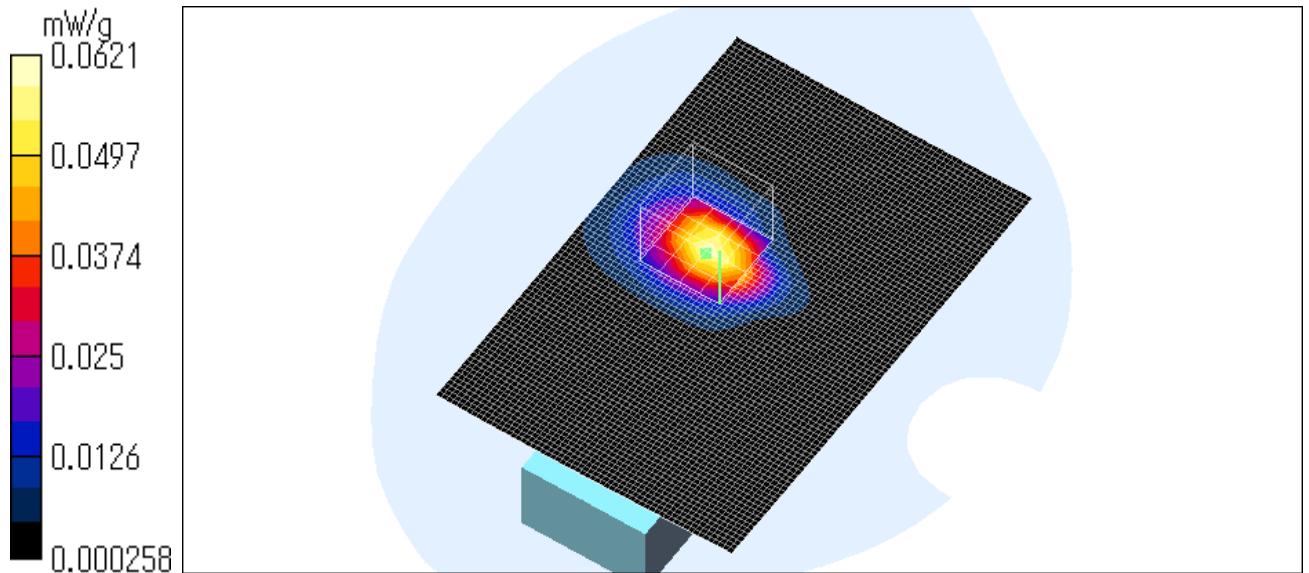
Reference Value = 3.71 V/m

Power Drift = -0.05 dB

Test Date = 03/24/05

Ambient Temperature = 24.5 degree.c

Liquid Temperature = Before 23.3 degree.C , After 23.3 degree.C



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BHT-300QWB-Body-11b-11Mbps-Low ch(2412MHz)-Back-BT ON-Separation: 15mm

Crest factor : 1

Medium: M2450 ($\sigma = 2.01$ mho/m, $\epsilon_r = 50.3$, $\rho = 1000$ kg/m³)

Phantom section: Flat Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1684; ConvF(4.14, 4.14, 4.14); Calibrated: 2004/09/02
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Phantom: SAM 1196
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 115

Area Scan (61x91x1): Measurement grid: dx=20mm, dy=20mm

Maximum value of SAR = 0.0459 mW/g

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Peak SAR (extrapolated) = 0.0862 W/kg

SAR(1 g) = 0.0434 mW/g; SAR(10 g) = 0.0228 mW/g

Maximum value of SAR = 0.0459 mW/g

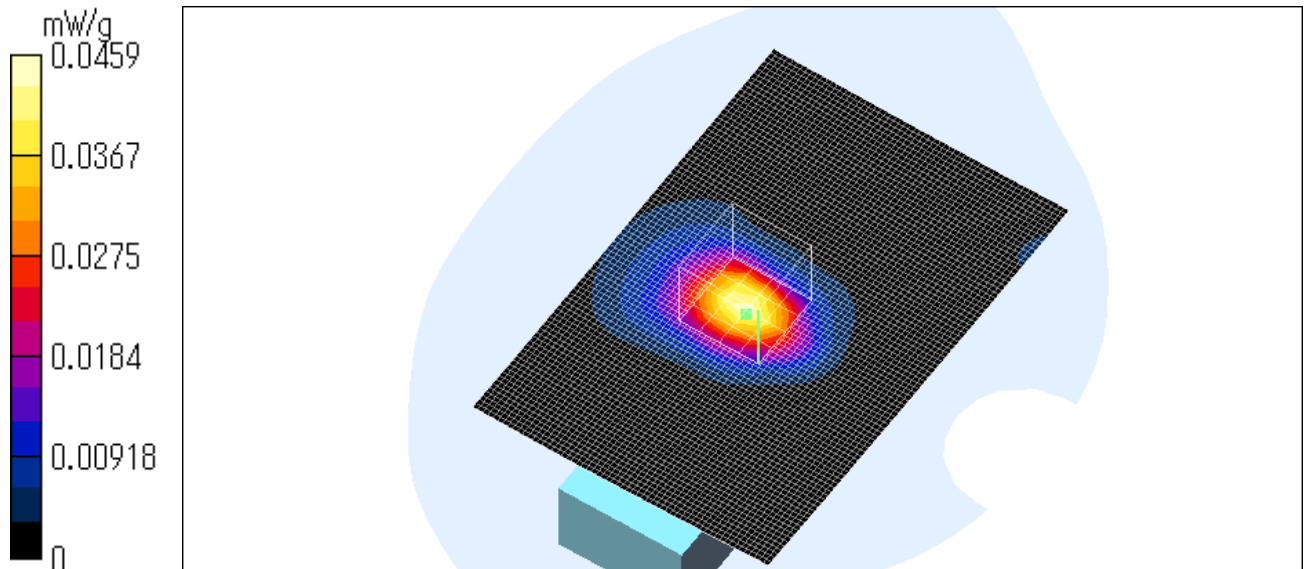
Reference Value = 4.59 V/m

Power Drift = -0.09 dB

Test Date = 03/24/05

Ambient Temperature = 24.5 degree.c

Liquid Temperature = Before 23.2degree.C , After 23.2degree.C



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BHT-300QWB-Body-11b-11Mbps-Low ch(2412MHz)-Back-BT OFF

Crest factor : 1

Medium: M2450 ($\sigma = 2.01$ mho/m, $\epsilon_r = 50.3$, $\rho = 1000$ kg/m³)

Phantom section: Flat Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1684; ConvF(4.14, 4.14, 4.14); Calibrated: 2004/09/02
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Phantom: SAM 1196
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 115

Area Scan (61x91x1): Measurement grid: dx=20mm, dy=20mm

Maximum value of SAR = 0.196 mW/g

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Peak SAR (extrapolated) = 0.458 W/kg

SAR(1 g) = 0.206 mW/g; SAR(10 g) = 0.0945 mW/g

Maximum value of SAR = 0.221 mW/g

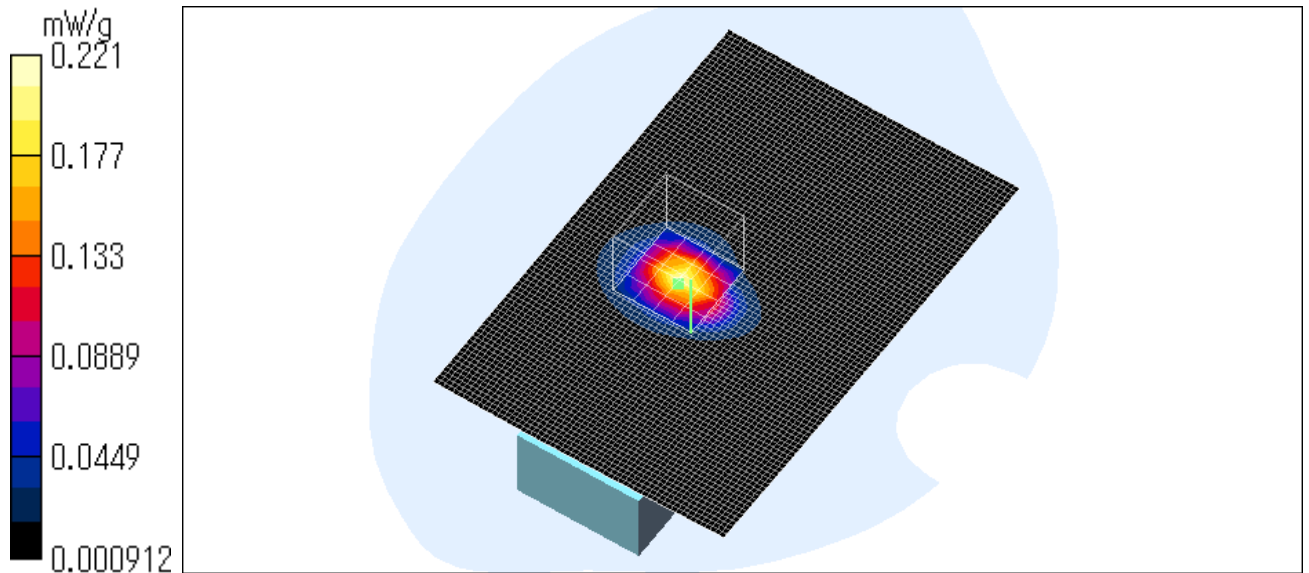
Reference Value = 7.1 V/m

Power Drift = -0.08 dB

Test Date = 03/24/05

Ambient Temperature = 24.5 degree.c

Liquid Temperature = Before 23.2degree.C , After 23.2degree.C



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Z-axis at maximum SAR location

BHT-300QWB-Body-11b-11Mbps-Low ch(2412MHz)-Back-BT OFF

Crest factor: 1

Medium: M2450 ($\sigma = 2.01$ mho/m, $\epsilon_r = 50.3$, $\rho = 1000$ kg/m³)

Phantom section: Flat Section

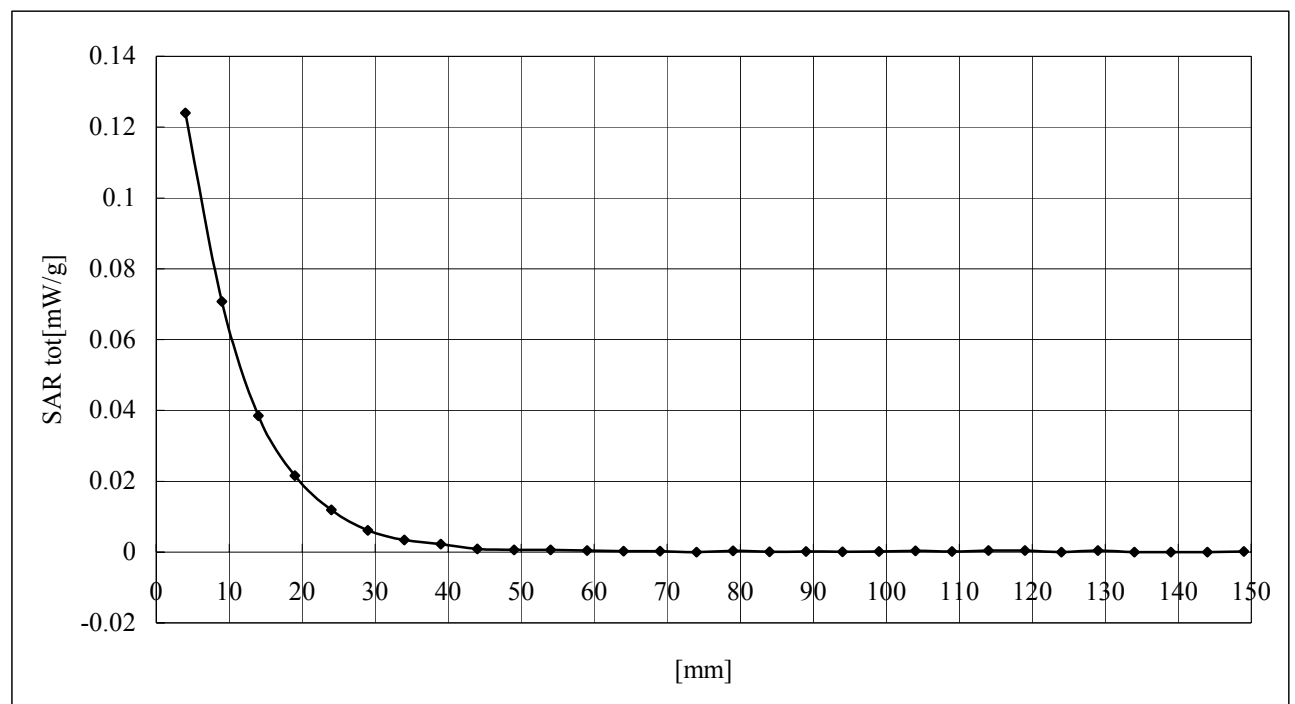
DASY4 Configuration:

- Probe: ET3DV6 - SN1684; ConvF(4.14, 4.14, 4.14); Calibrated: 2004/09/02

- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)

- Phantom: SAM 1196

- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 115



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APPENDIX 3 : Validation Measurement data

System Validation / Dipole 2450MHz / Forward Conducted Power : 250mW

Dipole 2450 MHz; Type: D2450V2; Serial: SN:713
Communication System: CW; Frequency: 2450 MHz; Crest factor: 1
Medium: HSL2450 ($\sigma = 1.87 \text{ mho/m}$, $\epsilon_r = 37.3$, $\rho = 1000 \text{ kg/m}^3$)
Phantom section: Flat Section

Dipole 2450MHz;
-Type: D2450V2; Serial: SN: 713

DASY4 Configuration:

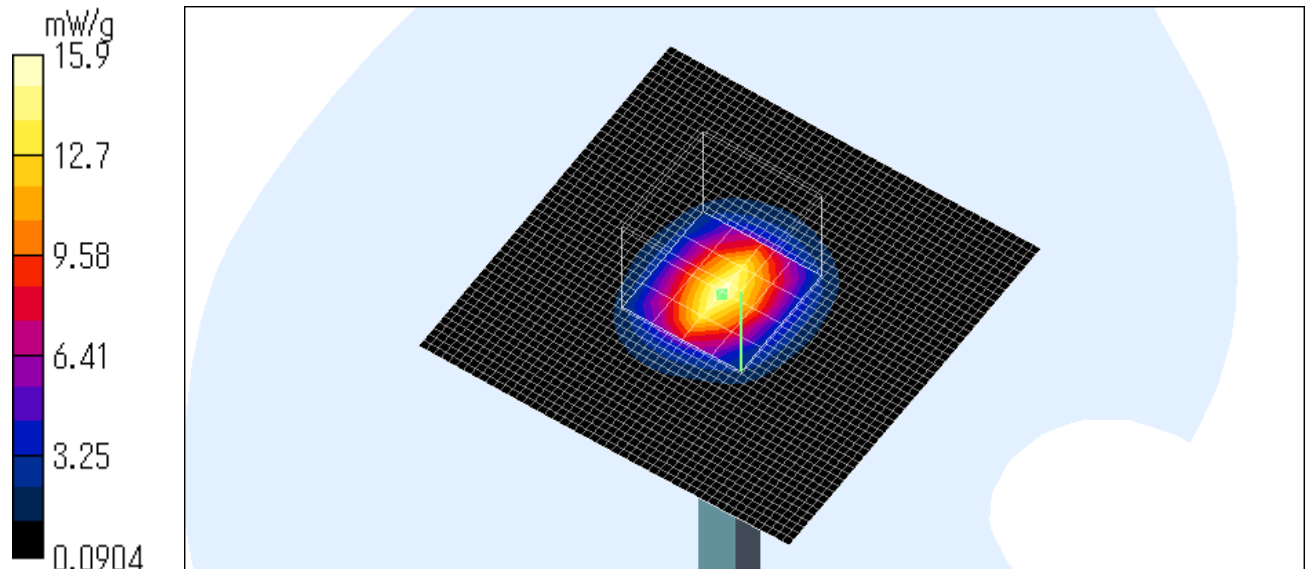
- Probe: ET3DV6 - SN1684; ConvF(4.39, 4.39, 4.39); Calibrated: 2004/09/02
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Phantom: SAM 1196
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 115

Area Scan (51x51x1): Measurement grid: dx=20mm, dy=20mm
Maximum value of SAR = 17.6 mW/g

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Peak SAR (extrapolated) = 29.4 W/kg
SAR(1 g) = 14.3 mW/g; SAR(10 g) = 6.56 mW/g
Maximum value of SAR = 15.9 mW/g

Reference Value = 96.8 V/m
Power Drift = -0.03 dB

Test Date = 03/24/05
Ambient Temperature = 24.5degree.c
Liquid Temperature = Before 23.2degree.C , After 23.2 degree.C



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APPENDIX 4 : System Validation Dipole (D2450V2,S/N: 713)

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



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

Accredited by the Swiss Federal Office of Metrology and Accreditation
 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 **UL A-Pex (MTT)**

Certificate No: **D2450V2-713_Dec04**

CALIBRATION CERTIFICATE

Object **D2450V2 - SN: 713**

Calibration procedure(s) **QA CAL-05.v6**
Calibration procedure for dipole validation kits

Calibration date: **December 13, 2004**

Condition of the calibrated item **In Tolerance**

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 (Calibrated by, Certificate No.)	Scheduled Calibration
Power meter EPM E442	GB37480704	12-Oct-04 (METAS, No. 251-00412)	Oct-05
Power sensor HP 8481A	US37292783	12-Oct-04 (METAS, No. 251-00412)	Oct-05
Reference 20 dB Attenuator	SN: 5086 (20g)	10-Aug-04 (METAS, No 251-00402)	Aug-05
Reference 10 dB Attenuator	SN: 5047.2 (10r)	10-Aug-04 (METAS, No 251-00402)	Aug-05
Reference Probe ES3DV2	SN 3025	29-Oct-04 (SPEAG, No. ES3-3025_Oct04)	Oct-05
DAE4	SN 601	22-Jul-04 (SPEAG, No. DAE4-601_Jul04)	Jul-05
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (SPEAG, in house check Oct-03)	In house check: Oct-05
RF generator R&S SML-03	100698	27-Mar-02 (SPEAG, in house check Dec-03)	In house check: Dec-05
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (SPEAG, in house check Nov-04)	In house check: Nov-05

Calibrated by: **Mike Meili** **Function** **Laboratory Technician**

Signature

Approved by: **Katja Pokovic** **Technical Manager**

Issued: December 15, 2004

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

Certificate No: D2450V2-713_Dec04

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



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

Accredited by the Swiss Federal Office of Metrology and Accreditation
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:

- 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
- CENELEC EN 50361, "Basic standard for the measurement of Specific Absorption Rate related to human exposure to electromagnetic fields from mobile phones (300 MHz - 3 GHz), July 2001
- 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:

- DASY4 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.

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Measurement Conditions

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

DASY Version	DASY4	V4.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Area Scan resolution	dx, dy = 15 mm	
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz $\pm$ 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	(23.0 $\pm$ 0.2) °C	38.3 $\pm$ 6 %	1.86 mho/m $\pm$ 6 %
Head TSL temperature during test	(23.0 $\pm$ 0.2) °C	---	---

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	condition	
SAR measured	250 mW input power	13.8 mW / g
SAR normalized	normalized to 1W	55.2 mW / g
SAR for nominal Head TSL parameters ¹	normalized to 1W	53.9 mW / g $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.29 mW / g
SAR normalized	normalized to 1W	25.2 mW / g
SAR for nominal Head TSL parameters ¹	normalized to 1W	24.6 mW / g $\pm$ 16.5 % (k=2)

¹ Correction to nominal TSL parameters according to d), chapter "SAR Sensitivities"

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	(23.0 ± 0.2) °C	51.7 ± 6 %	1.96 mho/m ± 6 %
Body TSL temperature during test	(23.0 ± 0.2) °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	condition	
SAR measured	250 mW input power	13.5 mW / g
SAR normalized	normalized to 1W	54.0 mW / g
SAR for nominal Body TSL parameters ²	normalized to 1W	53.2 mW / g ± 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.22 mW / g
SAR normalized	normalized to 1W	24.9 mW / g
SAR for nominal Body TSL parameters ¹	normalized to 1W	24.5 mW / g ± 16.5 % (k=2)

² Correction to nominal TSL parameters according to d), chapter "SAR Sensitivities"

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.8 Ω + 2.0 j Ω
Return Loss	- 31.6 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	47.8 Ω + 2.7 j Ω
Return Loss	- 29.0 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.160 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	July 5, 2002

DASY4 Validation Report for Head TSL

Date/Time: 12/13/04 21:25:09

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN713

Communication System: CW-2450; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium: HSL 2450 MHz;

Medium parameters used: $f = 2450$ MHz; $\sigma = 1.86$ mho/m; $\epsilon_r = 38.3$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ES3DV2 - SN3025; ConvF(4.4, 4.4, 4.4); Calibrated: 29.10.2004
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 22.07.2004
- Phantom: Flat Phantom quarter size -SN:1001; Type: QD000P50AA; Serial: SN:1001;
- Measurement SW: DASY4, V4.4 Build 3; Postprocessing SW: SEMCAD, V1.8 Build 130

Pin = 250 mW; d = 10 mm/Area Scan (81x81x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 15.7 mW/g

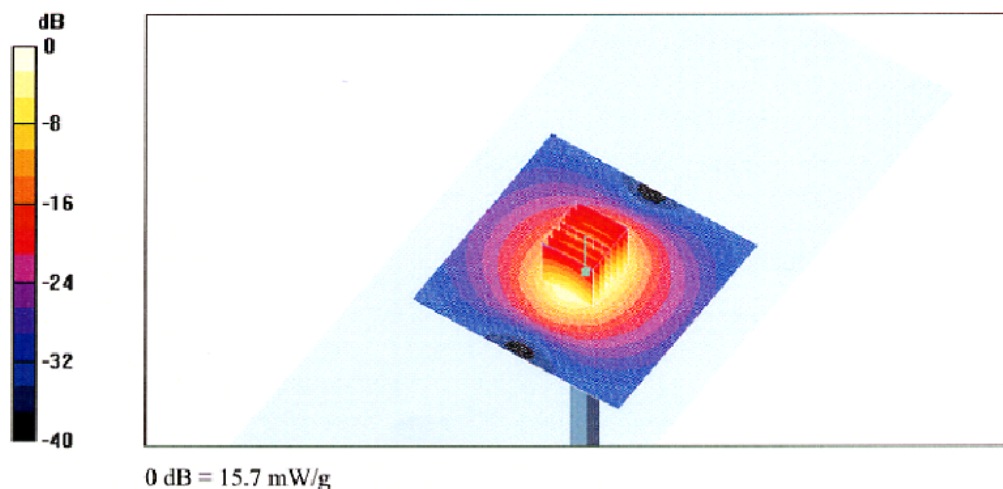
Pin = 250 mW; d = 10 mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 93.8 V/m; Power Drift = 0.0 dB

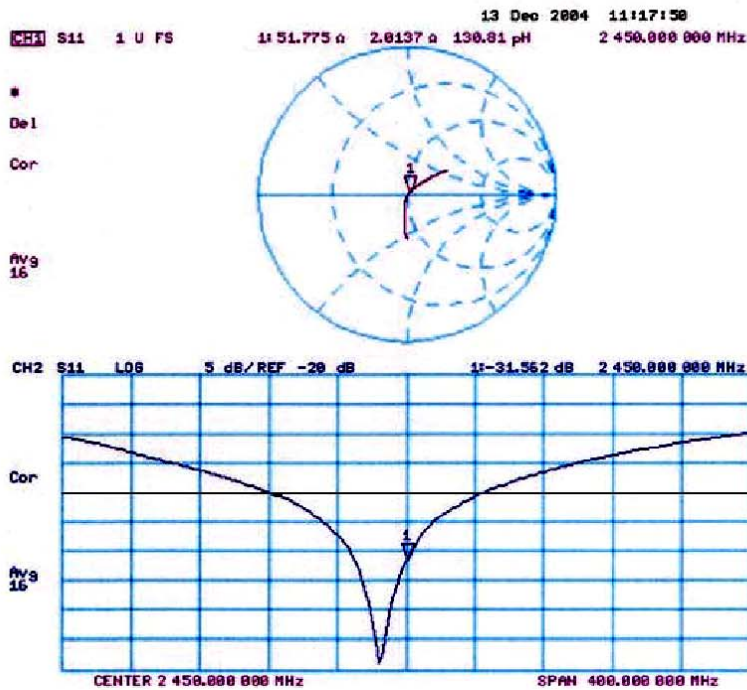
Peak SAR (extrapolated) = 29.4 W/kg

SAR(1 g) = 13.8 mW/g; SAR(10 g) = 6.29 mW/g

Maximum value of SAR (measured) = 15.7 mW/g



Impedance Measurement Plot for Head TSL



DASY4 Validation Report for Body TSL

Date/Time: 12/10/04 14:05:10

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN713

Communication System: CW-2450; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium: MSL 2450 MHz;

Medium parameters used: $f = 2450$ MHz; $\sigma = 1.96$ mho/m; $\epsilon_r = 51.7$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ES3DV2 - SN3025; ConvF(4.13, 4.13, 4.13); Calibrated: 29.10.2004
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 22.07.2004
- Phantom: Flat Phantom quarter size -SN:1001; Type: QD000P50AA; Serial: SN:1001;
- Measurement SW: DASY4, V4.4 Build 3; Postprocessing SW: SEMCAD, V1.8 Build 130

Pin = 250 mW; d = 10 mm/Area Scan (81x81x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 15.4 mW/g

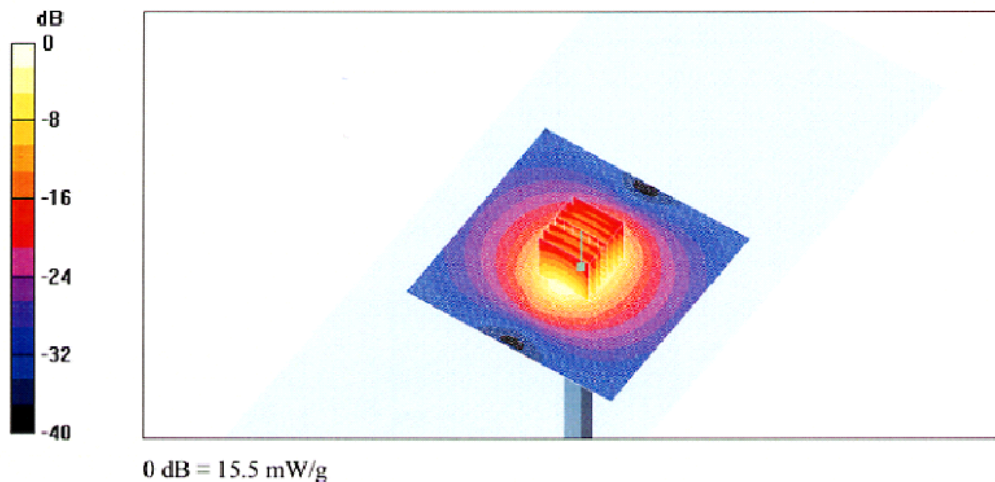
Pin = 250 mW; d = 10 mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 90 V/m; Power Drift = -0.0 dB

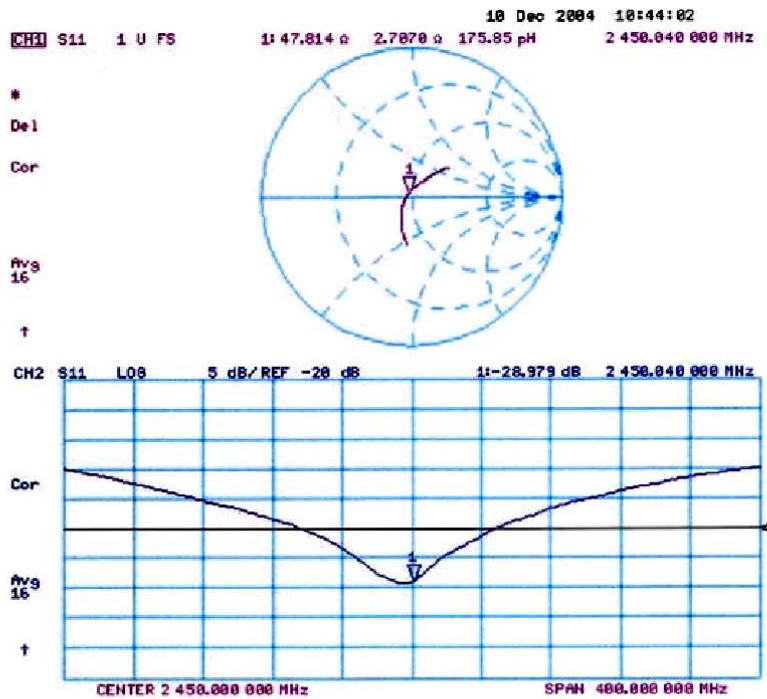
Peak SAR (extrapolated) = 27.7 W/kg

SAR(1 g) = 13.5 mW/g; SAR(10 g) = 6.22 mW/g

Maximum value of SAR (measured) = 15.5 mW/g



Impedance Measurement Plot for Body TSL



APPENDIX 5 : Dosimetric E-Field Probe Calibration (ET3DV6,S/N: 1684)

Schmid & Partner Engineering AG

s p e a g

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

IMPORTANT NOTICE

USAGE OF PROBES IN ORGANIC SOLVENTS

Diethylene Glycol Monobutyl Ether (the basis for liquids above 1 GHz), as many other organic solvents, is a very effective softener for synthetic materials. These solvents can cause irreparable damage to certain SPEAG products, except those which are explicitly declared as compliant with organic solvents.

Compatible Probes:

- ET3DV6
- ET3DV6R
- ES3DVx
- ER3DV6
- H3DV6

Important Note for ET3DV6 Probes:

The ET3DV6 probes shall not be exposed to solvents longer than necessary for the measurements and shall be cleaned daily after use with warm water and stored dry.

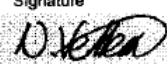
s p e a g

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Schmid & Partner Engineering AG

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

Client **UL A-Pex (MTI)**

CALIBRATION CERTIFICATE			
Object(s)	ET3DV6 - SN 1684		
Calibration procedure(s)	QA CAL-01.V2 Calibration procedure for dosimetric E-field probes		
Calibration date:	September 2, 2004		
Condition of the calibrated item	In Tolerance (according to the specific calibration document)		
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 +/- 2 degrees Celsius and humidity < 75%. Calibration Equipment used (M&TE critical for calibration)			
Model Type	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Power meter EPM E4419B	GB41293874	5-May-04 (METAS, No 251-00388)	May-05
Power sensor E4412A	MY41495277	5-May-04 (METAS, No 251-00388)	May-05
Reference 20 dB Attenuator	SN: 5086 (20b)	3-May-04 (METAS, No 251-00389)	May-05
Fluke Process Calibrator Type 702	SN: 6295803	8-Sep-03 (Sintrel SCS No. 5-030020)	Sep-04
Power sensor HP 8481A	MY41092180	18-Sep-02 (SPEAG, in house check Oct03)	In house check: Oct 05
RF generator HP 8684C	US3642U01700	4-Aug-99 (SPEAG, in house check Aug02)	In house check: Aug05
Network Analyzer HP 8753E	US37390585	18-Oct-01 (SPEAG, in house check Oct03)	In house check: Oct 05
Calibrated by:	Name Nicola Vassallo	Function Technician	Signature 
Approved by:	Name Katja Poljanec	Function Laboratory Director	Signature 
Date issued: September 2, 2004			
This calibration certificate is issued as an intermediate solution until the accreditation process (based on ISO/IEC 17025 International Standard) for Calibration Laboratory of Schmid & Partner Engineering AG is completed.			

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Probe ET3DV6

SN:1684

Manufactured:	April 3, 2002
Last calibrated:	November 20, 2002
Recalibrated:	September 2, 2004

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

ET3DV6 SN:1684

September 2, 2004

DASY - Parameters of Probe: ET3DV6 SN:1684

Sensitivity in Free Space

Diode Compression^A

NormX	1.58 $\mu\text{V}/(\text{V}/\text{m})^2$	DCP X	96	mV
NormY	1.58 $\mu\text{V}/(\text{V}/\text{m})^2$	DCP Y	96	mV
NormZ	1.62 $\mu\text{V}/(\text{V}/\text{m})^2$	DCP Z	96	mV

Sensitivity in Tissue Simulating Liquid (Conversion Factors)

Please see Page 7.

Boundary Effect

Head 900 MHz Typical SAR gradient: 5 % per mm

Sensor Center to Phantom Surface Distance		3.7 mm	4.7 mm
SAR _{be} [%]	Without Correction Algorithm	7.2	3.6
SAR _{be} [%]	With Correction Algorithm	0.0	0.1

Head 1800 MHz Typical SAR gradient: 10 % per mm

Sensor Center to Phantom Surface Distance		3.7 mm	4.7 mm
SAR _{be} [%]	Without Correction Algorithm	11.6	8.2
SAR _{be} [%]	With Correction Algorithm	0.2	0.2

Sensor Offset

Probe Tip to Sensor Center	2.7 mm
Optical Surface Detection	in tolerance

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%.

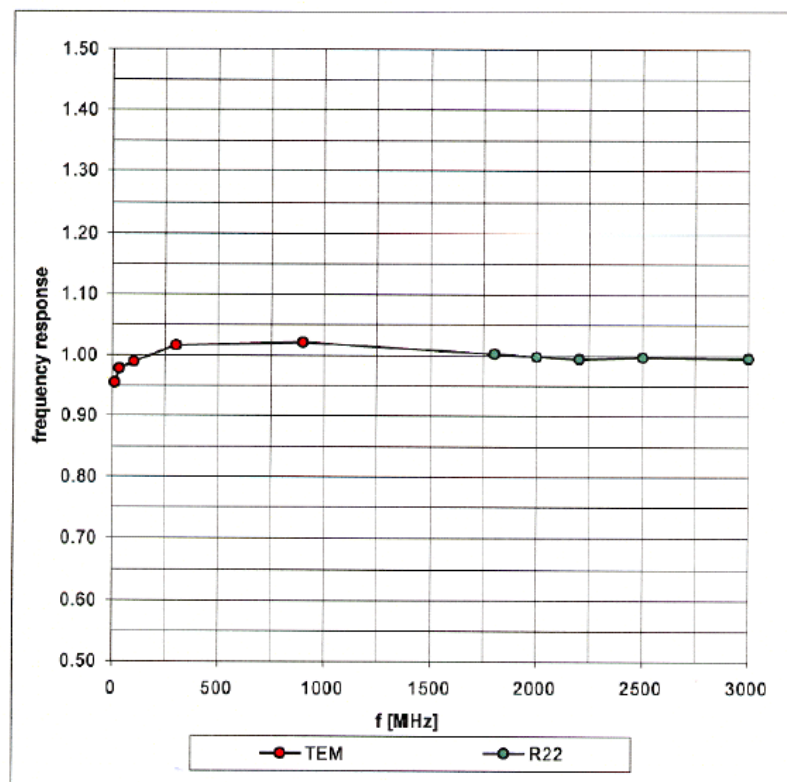
^A numerical linearization parameter: uncertainty not required

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Frequency Response of E-Field

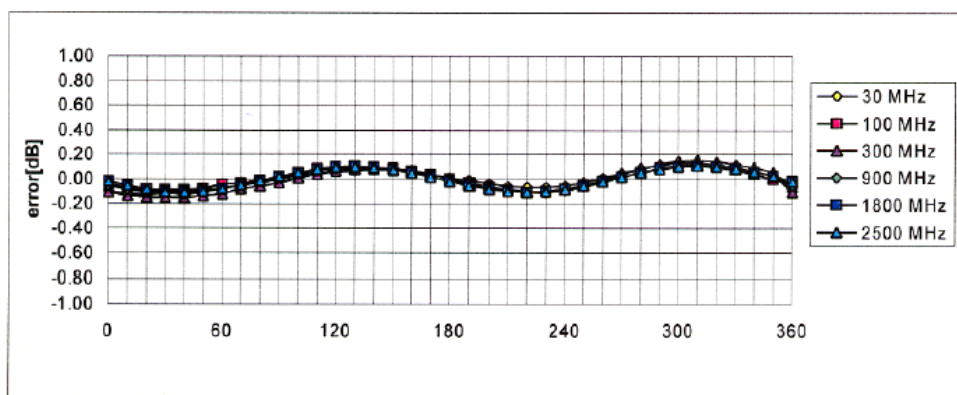
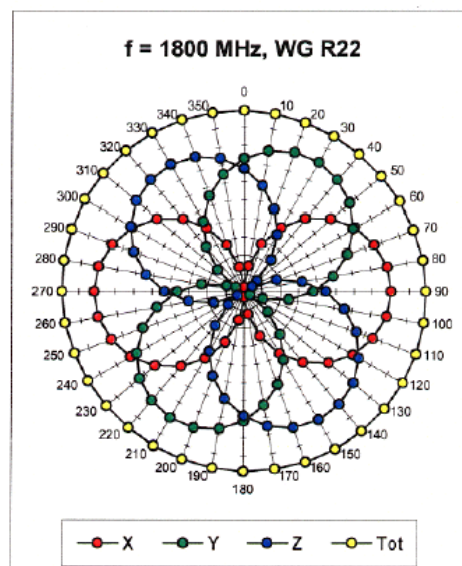
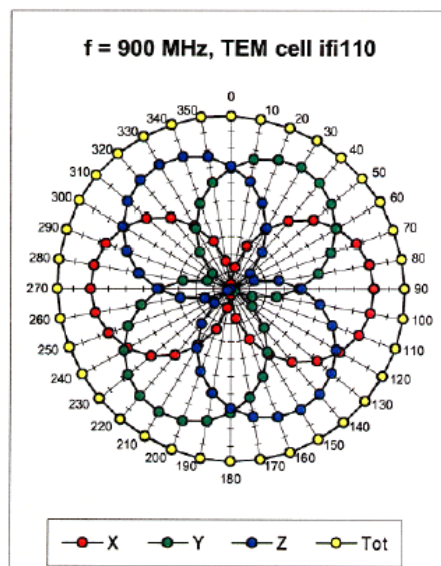
(TEM-Cell:ifi110, Waveguide R22)



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Receiving Pattern (ϕ), $\theta = 0^\circ$

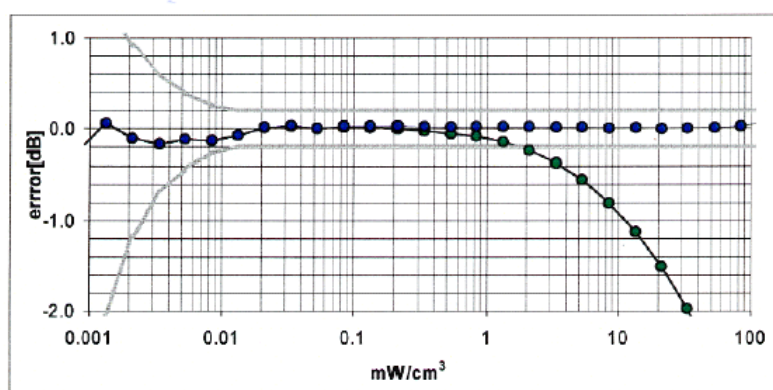
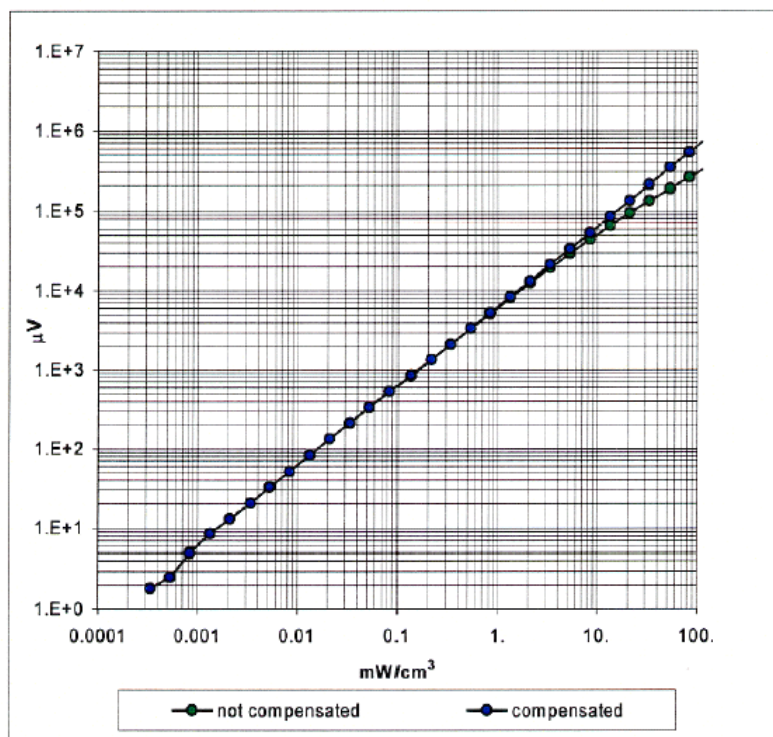


Axial Isotropy Error $< \pm 0.2$ dB

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Dynamic Range f(SAR_{head}) (Waveguide R22)

Probe Linearity Error < ± 0.2 dB**UL Apex Co., Ltd.****Head Office EMC Lab.**

4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

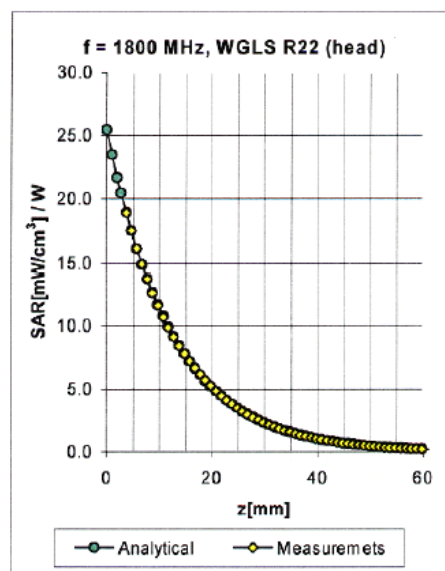
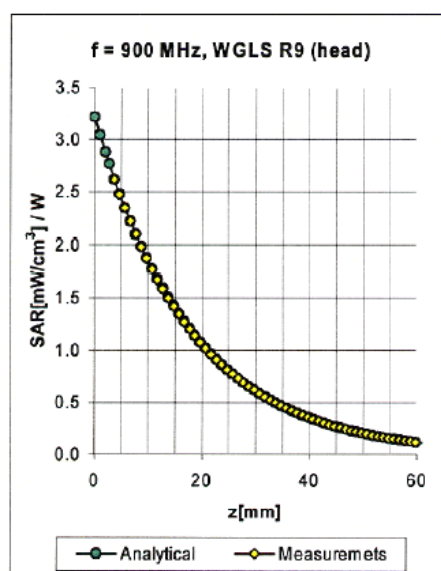
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Conversion Factor Assessment



f [MHz]	Validity [MHz] ^a	Tissue	Permittivity	Conductivity	Alpha	Depth	ConvF	Uncertainty
900	800-1000	Head	41.5 ± 5%	0.97 ± 5%	0.72	1.56	6.75 ± 11.3% (k=2)	
1800	1710-1910	Head	40.0 ± 5%	1.40 ± 5%	0.40	2.81	5.27 ± 11.7% (k=2)	
2450	2400-2500	Head	39.2 ± 5%	1.80 ± 5%	0.77	2.07	4.39 ± 9.7% (k=2)	
900	800-1000	Body	55.0 ± 5%	1.05 ± 5%	0.40	2.32	6.28 ± 11.3% (k=2)	
1800	1710-1910	Body	53.3 ± 5%	1.52 ± 5%	0.47	3.00	4.57 ± 11.7% (k=2)	
2450	2400-2500	Body	52.7 ± 5%	1.95 ± 5%	0.82	1.85	4.14 ± 9.7% (k=2)	

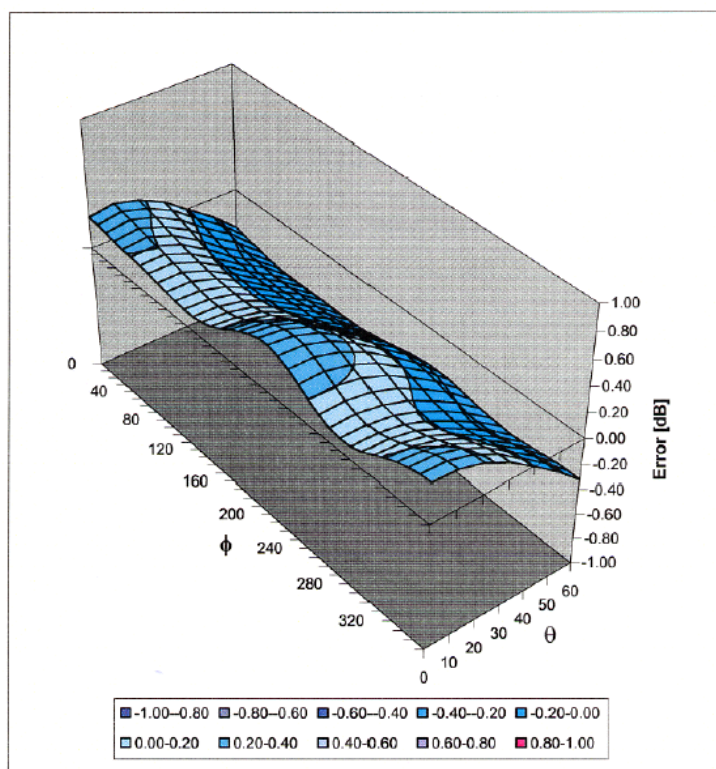
^a The total standard uncertainty is calculated as root-sum-square of standard uncertainty of the Conversion Factor at calibration frequency and the standard uncertainty for the indicated frequency band.

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Deviation from Isotropy in HSL

Error (θ, ϕ), $f = 900$ MHz



Spherical Isotropy Error $< \pm 0.4$ dB