APPENDIX K

: SAR TEST REPORT FOR WIFI

SAR Evaluation Report

FCC ID : OZ5URCMX6000

Project Reference No. : NK08R125

Product Type : Remote controller

Brand Name : URC.INC

Model : MX-6000

Tested According to : IEEE Standard C95.1 / OET Bulletin 65 Supplement C

Tested Period : May. 28. 2008 to May. 29. 2008

Tested by	Minchul.Shin		date	: June. 04. 2008
Verified by	Seonteag.Jin		date	: June. 04. 2008

This test results are only related to the item tested.
This test report is only limited to the client company and the product.
This report must not be used by the client to claim product endorsement by any agency of the U.S. Government.

Lab Address : Nemko Korea Co., Ltd
300-2, Osan-Ri, Mohyeon-Myeon, Cheoin-Gu, Yongin-Si, Gyeonggi-Do, Korea
Phone : 82-31-322-2333 Fax : 82-31-322-2332

Nemko

Contents of This Report

1.General Information

1.1 Applicant

Company Name:	OH SUNG ELECTRONICS CO.,LTD
Company Address:	#181 Gongdan-Dong, Gumi, GyeongBuk, Gumi-si, Korea
Phone	Phone: 82-54-468-7262
Contact Name:	Kwang-Jae Ok

1.2 Manufacturer

Company Name:	OH SUNG ELECTRONICS CO.,LTD
Company Address:	#181 Gongdan-Dong, Gumi, GyeongBuk, Gumi-si, Korea
Phone	Phone: 82-54-468-7262
Contact Name:	Kwang-Jae Ok

1.3 Description of Device

Category	Remote controller
Model Name:	MX-6000
Brand Name:	URC.INC
Serial Number:	Prototype
Frequency of Operation	2400 MHz ~ 2483.5 MHz
Power Output (Conducted Power)	802.11b: 16.71dBm 802.11g: 16.93dBm
Type of Oscillation	133MHz, 48MHz, 12MHz, 32.768kHz, 8MHz on Main Board 13.0625MHz on RF module board
Modulation Method	DSSS(DQPSK / CCK), OFDM(QPSK / 16QAM / 64QAM)
Modulation	DSSS for IEEE 802.11b, OFDM for IEEE 802.11g
Operating Condition	-20°C ~ +55°C , 85% at 50°C
Power Supply	DC 3.7 V
Antenna Type	Internal
Dimensions	(W)19.05mm x (D) 12.95 mm x (H) 3.30 mm
Weight	Approx. 425.25g

2. General Test Condition

2.1 Location

Nemko Korea
300-2, Osan-Ri, Mohyeon-Myeon, Cheoin-Gu, Yongin-Si, Gyeonggi-Do, Korea
Phone : 82-31-322-2333 , Fax : 82-31-322-2332

2.2 Operating Environment

Parameters	Recording during test	Accepted deviation
Ambient temperature	20 ± 2℃	15 ~ 30℃
Relative humidity	42 ± 15%	20 ~ 75%

2.3 Test Frequency

802.11b		802.11g	
Test Channel	Test Frequency (MHz)	Test Channel	Test Frequency (MHz)
1	2412	1	2412
6	2437	6	2437
11	2462	11	2462

2.4 Test Configuration

The data rates for SAR testing are 11Mbps for 802.11b and 54Mbps for 802.11g. Engineering testing software installed on the EUT can provide continuous transmitting RF signal. This RF signal utilized in SAR measurement has almost 100% duty cycle and its crest factor is 1.
The measurements were performed on the lowest, middle, and hightest channel, i.e. channel 1, channel 6, and channel 11 for each testing position.

2.5 Position Information

Top Position : key-pad side facing phantom, EUT

Bottom Position : Rear side facing phantom, EUT

Upper Edge Position : top / bottom upper side edge facing phantom, EUT

Side Edge Position : top / bottom side edge facing phantom, EUT

3. Description of Test Equipment

3.1 SAR Measurement Setup

Robotic System

Measurements are performed using the DASY4 automated dosimetric assessment system. Which is made by Schmid & Partner Engineering AG (SPEAG) in Zurich, Switzerland and consists of high precision robotics system (Stäubli), robot controller, measurement server, DELL computer, nearfield probe, probe alignment sensor, and the SAM twin phantom containing the brain equivalent material. The robot is a six-axis industrial robot performing precise movements to position the probe to the location (points) of maximum electromagnetic field (EMF) (see Fig. 3.1).

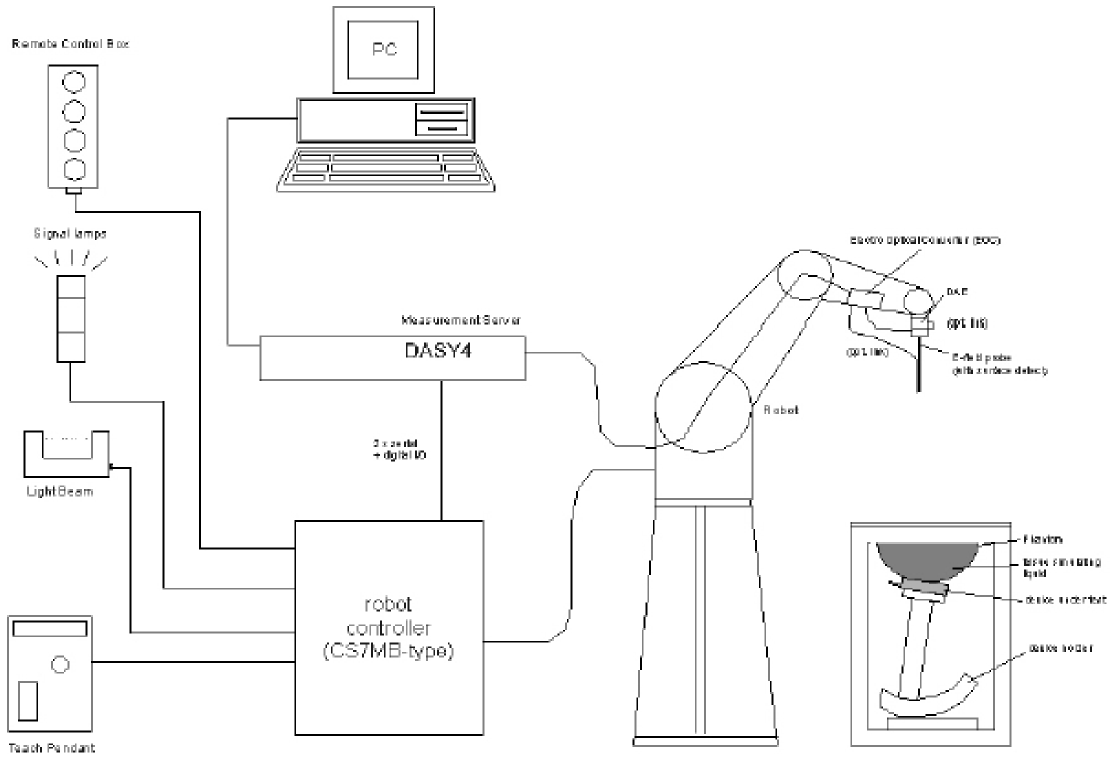


Figure 3.1 SAR Measurement System Setup

System Hardware

A cell controller system contains the power supply, robot controller, teach pendant (Joystick), and a remote control is used to drive the robot motors. The PC consists of the DELL computer with Windows XP system and SAR Measurement Software DASY4, LCD monitor, mouse and keyboard. The Stäubli Robot is connected to the cell controller to allow software manipulation of the robot.
A Data Acquisition Electronic (DAE) circuit that performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc.
This is connected to the Electro-Optical Coupler (EOC). The EOC performs the conversion from the optical into digital electric signal of the DAE and transfers data to the measurement server.

System Electronics

The DAE4 consists of a highly sensitive electrometer-grade preamplifier with autozeroing, a channel and gain-switching multiplexer, a fast 16-bit AD-converter and a command decoder and control logic unit. Transmission to the measurement server is accomplished through an optical downlink for data and status information and an optical uplink for commands and clock lines. The mechanical probe mounting device includes two different sensor systems for frontal and sidewise probe contacts. They are also used for mechanical surface detection and probe collision detection. The robot uses its own controller with a built in VME-bus computer.

3.2 E-field Probe

The SAR measurement were conducted with the dosimetric probe ES3DV3, designed in the classical triangular configuration (see Fig.3.3) and optimized for dosimetric evaluation. The probe is constructed using the thick film technique; with printed resistive lines on ceramic substrates.

The probe is equipped with an optical multi-fiber line ending at the front of the probe tip (see Fig.3.4). It is connected to the EOC box on the robot arm and provides an automatic detection of the phantom surface.

Half of the fibers are connected to a pulsed infrared transmitter, the other half to a synchronized receiver. As the probe approaches the surface, the reflection from the surface produces a coupling from the transmitting to the receiving fibers. This reflection increases first during the approach, reaches a System maximum and then decreases. If the probe is flatly touching the surface, the coupling is zero.

The distance of the coupling maximum to the surface is independent of the surface reflectivity and largely independent of the surface to probe angle. The DASY4 software reads the reflection during a software approach and looks for the maximum using a 2nd order fitting (see Fig.3.2).

The approach is stopped at reaching the maximum.

Figure3.2 DAE System

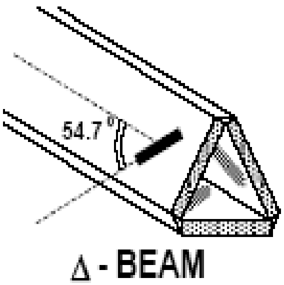


Figure 3.3 Triangular Probe Configuration

Figure 3.4 Probe Thick-Film Technique

Probe Specifications

Construction : Symmetrical design with triangular core
Interleaved sensors
Built-in shielding against static charges
PEEK enclosure material (resistant to organic DGBE)
Calibration : Basic Broad Band Calibration In air from 10 MHz to 6.0 GHz
In brain and muscle simulating tissue at Frequencies of HSL900,
HSL1800 MHz, MSL2450 Calibration certificates please find attached.
Frequency : 10 MHz to > 6 GHz; Linearity: ±0.2 dB (30 MHz to 6 GHz)
Directivity ±0.3 dB in HSL (rotation around probe axis)
±0.5 dB in HSL (rotation normal to probe axis)
Dynamic Range 10μW/g to > 100mW/g; Linearity: ±0.2dB
Dimensions Overall length: 330mm (Tip : 20mm)
Tip diameter: 2.5mm (Body : 12mm)
Distance from probe tip to dipole centers: 1.0mm
Application General dosimetry up to 6 GHz
Compliance tests of mobile phones
Fast automatic scanning in arbitrary phantoms

3.3 SAM Phantom

The SAM Twin Phantom V4.0C is constructed of a fiberglass shell Integrated in a wooden table. The shape of the shell is based on data from an anatomical study designed to determine the maximum exposure in at least 90% of all users.
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 the 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 in the robot.
(See Figure 3.5)

Figure 3.5 SAM Twin Phantom

Phantom Specification

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 teaching three points with the robot.

Shell Thickness : 2 ± 0.2 mm
Filling Volume : Approx. 25 liters
Dimensions : Height; 830 mm; Length: 1000 mm; Width: 500 mm

3.4 Device Holder for Transmitters

In combination with the SAM Twin Phantom V4.0, the Mounting Device (see Fig. 3.6) enables the rotation of the mounted transmitter in spherical coordinates whereby the rotation point is the ear opening.
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 produce infinite number of configurations .
To produce the worst-case condition (the hand absorbs antenna output power), the hand is omitted during the tests.

Figure 3.6Device Holder

4. Measurement Procedure

EUT at the maximum power level is placed by a non metallic device holder in the above described positions at a shell phantom of a human being.
The distribution of the electric field strength *E* is measured in the tissue simulating liquid within the shell phantom.
For this miniaturized field probes with high sensitivity and low field disturbance are used.
Afterwards the corresponding SAR values are calculated with the known electrical conductivity σ and the mass density *p* of the tissue in the SEMCAD software.
The software is able to determine the averaged SAR values (averaging region 1g or 10g) for compliance testing.

The measurements are done by two scans: first a coarse scan determines the region of the maximum SAR, afterwards the averaged SAR is measured in a second scan within the sharp of a cube. The measurement times takes about 20 minutes.

The following steps are used for each test position:

STEP 1

Establish a call with the maximum output power with a base station simulator.
The connection between the mobile phone and the base station simulator is established via air interface.

STEP 2

Measurement of the local E-Field value at a fixed location (P1).
This value serves as a reference value for calculating a possible power drift.

STEP 3

Measurement of the SAR distribution with a grid spacing of 15mm × 15mm and a constant distance to the inner surface of the phantom.
Since the sensors cannot directly measure at the inner surface of the phantom.
Since the sensors can not directly measure at the inner phantom surface, the values between the sensors and the inner phantom surface are extrapolated. With this values the area of the maximum SAR is calculated by a interpolation scheme (combination of a least-square fitted function and a weighted average method). Additional peaks within 3dB of the maximum SAR are searched.

STEP 4

Around this points, a cube of 30mm×30mm×30mm is assessed by measuring 5×5×7 points. With these data, the peak spatial-average SAR value can be calculated with the SEMCAD software.

STEP 5

The used extrapolation and interpolation routines are all based on the modified Quadratic Shepard's method [DASY4].

STEP 6

Repetition of the E-Field measurement at the fixed location(P1) and repetition of the whole procedure if the two results differ by more than ±0.223dB.

4.1 Head / Muscle Simulating Mixture Characterization

The brain mixture consists of a viscous gel using hydroxethyl-cellullose (HEC) gelling agent and saline solution. Preservation with a bacteriacide is added and visual inspection is made to make sure air Bubbles are not trapped during the mixing process.
The mixture is calibrated to obtain proper dielectric constant (permittivity) and conductivity of the desired tissue. The head tissue dielectric parameters recommended by the IEEE SCC-34/SC-2 have been incorporated in the following table.

Ingredients (% by weight)	**Frequency (MHz)**									
	450		835		915		1900		2450	
Tissue Type	Head	Body	Head	Body	Head	Body	Head	Body	Head	Body
Water	38.56	51.16	41.45	52.4	41.05	56.0	54.9	40.4	62.7	73.2
Salt (NaCl)	3.95	1.49	1.45	1.4	1.35	0.76	0.18	0.5	0.5	0.04
Sugar	56.32	46.78	56.0	45.0	56.5	41.76	0.0	58.0	0.0	0.0
HEC	0.98	0.52	1.0	1.0	1.0	1.21	0.0	1.0	0.0	0.0
Bactericide	0.19	0.05	0.1	0.1	0.1	0.27	0.0	0.1	0.0	0.0
Triton X-100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36.8	0.0
DGBE	0.0	0.0	0.0	0.0	0.0	0.0	44.92	0.0	0.0	26.7
Dielectric Constant	43.50	56.70	41.50	55.2	41.50	55.00	40.00	53.30	39.2	52.5
Conductivity (S/m)	0.87	0.94	0.90	0.97	0.97	1.05	1.40	1.52	1.80	1.95

Typical Composition of Ingredients for Liquid Tissue Phantoms

4.2 Tissue Dielectric Parameters for Head and Body Phantoms

The head tissue dielectric parameters recommended by the IEEE SCC-34/SC-2 in P1528 have been incorporated in the following table.

Target Frequency	Head		Body	
(MHz)	ε_r	σ (S/m)	ε_r	σ (S/m)
150	52.3	0.76	61.9	0.80
300	45.3	0.87	58.2	0.92
450	43.5	0.87	56.7	0.94
835	41.5	0.90	55.2	0.97
900	41.5	0.97	55.0	1.05
915	41.5	0.98	55.0	1.06
1450	40.5	1.20	54.0	1.30
1610	40.3	1.29	53.8	1.40
1800 – 2000	40.0	1.40	53.3	1.52
2450	39.2	1.80	52.7	1.95
3000	38.5	2.40	52.0	2.73
5800	35.3	5.27	48.2	6.00

(ε_r = relative permittivity, σ = conductivity and ρ = 1000 kg/m^3)

4.3 FCC Limits for Specific Absorption Rate (SAR)

Limits for Occupational/Controlled Exposure (W/kg)

Whole-Body	Partial-Body	Hands, Wrists, Feet and Ankles
0.4	8.0	20.0

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

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

NOTE 1: See Section 1 for discussion of exposure categories.

NOTE 2: Whole-Body SAR is averaged over the entire body, partial-body SAR is averaged over any 1 gram of tissue defined as a tissue volume in the shape of a cube. SAR for hands, wrists, feet and ankles is averaged over any 10 grams of tissue defined as a tissue volume in the shape of a cube.

NOTE 3: At frequencies above 6.0 GHz, SAR limits are not applicable and MPE limits for power density should be applied at 5 cm or more from the transmitting device.

Note 4: The time averaging criteria for field strength and power density do not apply to general population SAR limit of 47 CFR §2.1093.

5. Definition of Reference Points

5.1 EAR Reference Point

Figure 5.1 shows the front, back and side views of SAM. The point “M” is the reference point
For the center of mouth, “LE” is the left ear reference point (ERP), and “RE” is the right ERP.
The ERPs are 15 mm posterior to the entrance to ear canal (EEC) along the B-M line (Back-Mouth), as shown in Figure 5.2.

Figure 5.1 Front, back and side view of SAM

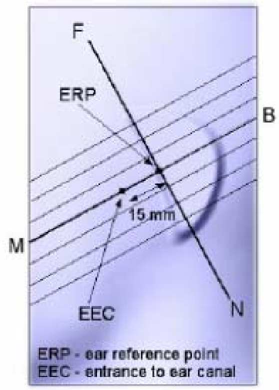


Figure 5.2 Close up side view

The plane passing through the two ear canals and M is defined as the Reference Plane. The line N-F (Neck-Front) perpendicular to the reference plane and passing through the RE(or LE) is called the Reference Pivoting Line (see Figure 5.3).
Line B-M is perpendicular to the N-F line. Both N-F and B-M Lines should be marked on the external phantom shell to Facilitate handset positioning. Posterior to the N-F line, the thickness of the phantom shell with the shape of an ear is a flat surface 6 mm thick at the ERPs.

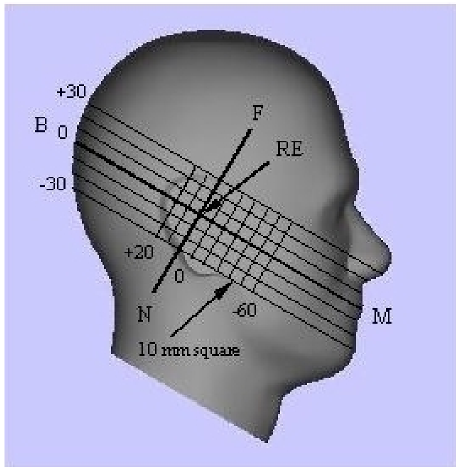


Figure 5.3 Side view of the phantom showing relevant markings

5.2 Handset Reference Points

Two imaginary lines on the handset were established: the vertical centerline and the horizontal line. The test device was placed in a normal operating position with the “test device reference point” located along the “vertical centerline” on the front of the device aligned to the “ear reference point” (see Fig. 5.4).
The “test device reference point” was than located at the same level as the center of the eat reference point. The test device was positioned so that the “vertical centerline” was bisecting the front surface of the handset at it’s tip and bottom edges, positioning the “ear reference point” on the outer surface of the both the left and right head phantoms on the ear reference point.

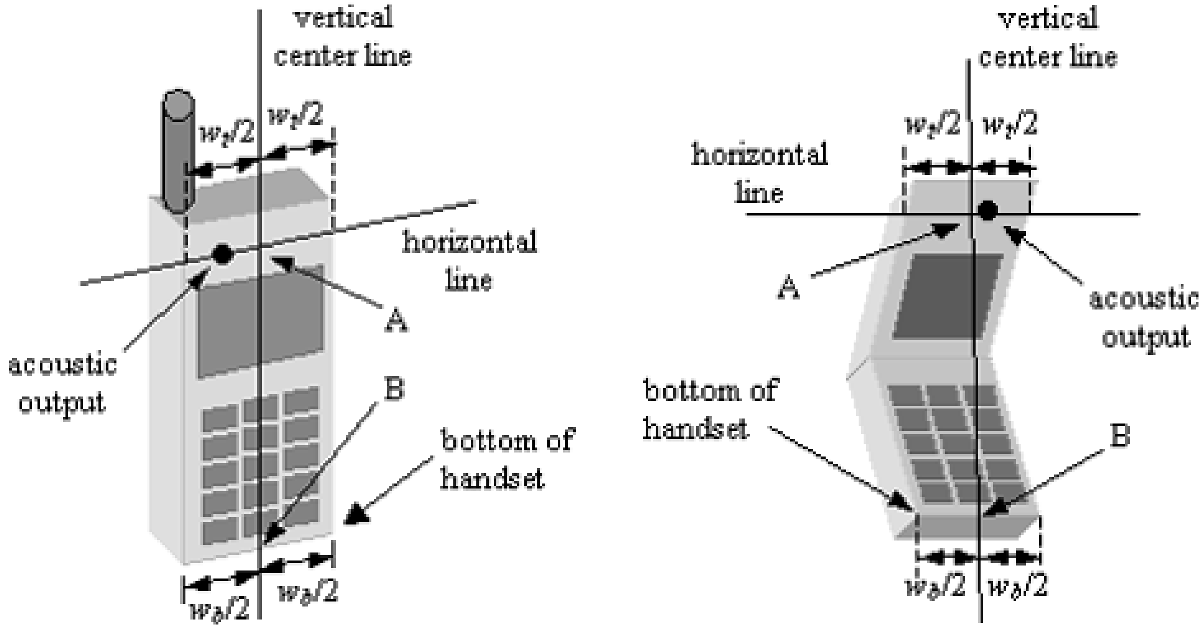


Figure 5.4 Handset vertical and horizontal reference lines

6. Test Configuration Positions

6.1 Cheek/Touch Position

Step 1
The test device was positioned with the handset close to the surface of the phantom such that point. A is on the (virtual) extension of the line passing through points RE and LE on the phantom (see Figure 6.1), such that the plane defined by the vertical center line and the horizontal line of the phone is approximately parallel to the sagittal plane of the phantom.

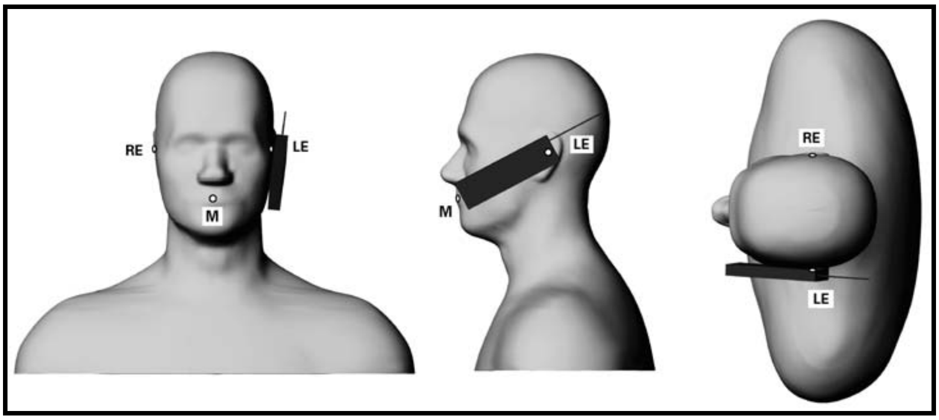


Figure 6.1 Front, Side and Top View of Cheek/Touch Position

Step 2
The handset was translated towards the phantom along the line passing through RE & LE until the handset touches the ear.

Step 3
While maintaining the handset in this plane, the handset was rotated around the LE-RE line Until the vertical centerline was in the plane normal to MB-NF including the line MB (reference plane).

Step 4
Rotate the handset around the vertical centerline until the phone (horizontal line) was symmetrical was respect to the line NF.

Step 5
While maintaining the vertical centerline in the reference plane, keeping point A on the line passing through RE and LE, and maintaining the phone contact with the ear, the handset was rotated about the line NF until any point on the handset made contact with a phantom point below the ear cheek.(See Figure 5.2)

6.2 EAR/Tilt 15° Position

With the test device aligned in the “Cheek/Touch Position”:

Step 1
Repeat steps 1 to 5 of 5.2 to place the device in the “Cheek/Touch Position”

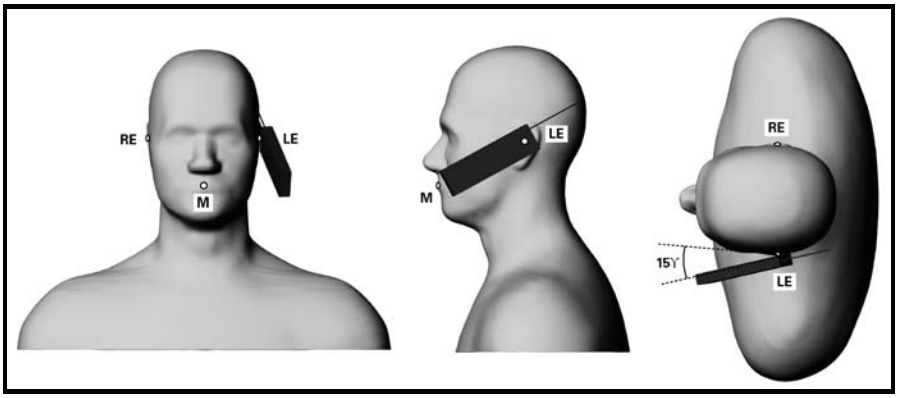


Figure 6.2 Front, side and Top View of Ear/Tilt 15° Position

Step 2
While maintaining the orientation of the phone, the phone was retracted parallel to the reference plane far enough to enable a rotation of the phone by 15 degree.

Step 3
The phone was then rotated around the horizontal line by 15 degree.

Step 4
While maintaining the orientation of the phone, the phone was moved parallel to the reference plane until any part of the phone touches the head.
(In this position, point A was located on the line RE-LE). The tilted position is obtained when the contact is on the pinna. If the contact was at any location other than the pinna, the angle of the phone would then be reduced.
The tilted position was obtained when any part of the phone was in contact of the ear as well as a second part of the phone was in contact with the head. (See Figure 6.2)

6.3 Body-worn and Other Configurations

6.3.1 Phantom Requirements

For body-worn and other configurations a flat phantom shall be used which is comprised of material with electrical properties similar to the corresponding tissues.

6.3.2 Test Position

The body-worn configurations shall be tested with the supplied accessories (belt-clips, holsters, etc.) attached to the device in normal use configuration. Devices with a headset output shall be tested with a connected headset. Since the Supplement C to OET Bulletin 65 was mainly issued for mobile phones it is only a guideline and therefore some requirements are not usable or practical for devices other than mobile phones.

6.3.3 Test to be Performed

For purpose of determining test requirements, accessories may be divided into two categories: those that do not contain metallic components and those that do. For multiple accessories that do not contain metallic components, the device may be tested only with that accessory which provides the closet spacing to the body.
For multiple accessories that contain metallic components, the device must be tested with each accessory that contains a unique metallic component. If multiple accessories share an identical metallic component, only the accessory that provides the closet spacing to the body must be tested.
If the manufacturer provides none body accessories, a separation distance of 1.5 cm between the back of the device and the flat phantom is recommended. Other separation distances may be used, but they shall not exceed 2.5cm. In these cases, the device may use body-worn accessories that provide a separation distance greater than that tested for the device provided however that the accessory contains no metallic components.
For devices with retractable antenna, the SAR test shall be performed with the antenna fully extended and fully retracted. Other factors that may affect the exposure shall also be tested. For example, optional antennas or optional battery packs which may significantly change the volume, lengths, flip open/closed, etc. of the device or any other accessories which might have the potential to considerably increase the peak spatial-average SAR value.
The SAR test shall be performed at the high, middle and low frequency channels of each operating mode. If the SAR measured at the middle channel for each test configuration is at least 3.0dB lower than the SAR limit, testing at the high and low channel is optional.

7. Measurement Uncertainty

DASY4 Uncertainty Budget According to IEEE 1528 [1]								
Error Description	Uncertainty value	Prob. Dist.	Div.	(c_i) 1g	(c_i) 10g	Std. Unc. (1g)	Std. Unc. (10g)	(v_i) v_{eff}
Measurement System								
Probe Calibration	±5.9 %	N	1	1	1	±5.9 %	±5.9 %	∞
Axial Isotropy	±4.7 %	R	$\sqrt{3}$	0.7	0.7	±1.9 %	±1.9 %	∞
Hemispherical Isotropy	±9.6 %	R	$\sqrt{3}$	0.7	0.7	±3.9 %	±3.9 %	∞
Boundary Effects	±1.0 %	R	$\sqrt{3}$	1	1	±0.6 %	±0.6 %	∞
Linearity	±4.7 %	R	$\sqrt{3}$	1	1	±2.7 %	±2.7 %	∞
System Detection Limits	±1.0 %	R	$\sqrt{3}$	1	1	±0.6 %	±0.6 %	∞
Readout Electronics	±0.3 %	N	1	1	1	±0.3 %	±0.3 %	∞
Response Time	±0.8 %	R	$\sqrt{3}$	1	1	±0.5 %	±0.5 %	∞
Integration Time	±2.6 %	R	$\sqrt{3}$	1	1	±1.5 %	±1.5 %	∞
RF Ambient Conditions	±3.0 %	R	$\sqrt{3}$	1	1	±1.7 %	±1.7 %	∞
Probe Positioner	±0.4 %	R	$\sqrt{3}$	1	1	±0.2 %	±0.2 %	∞
Probe Positioning	±2.9 %	R	$\sqrt{3}$	1	1	±1.7 %	±1.7 %	∞
Max. SAR Eval.	±1.0 %	R	$\sqrt{3}$	1	1	±0.6 %	±0.6 %	∞
Test Sample Related								
Device Positioning	±2.9 %	N	1	1	1	±2.9 %	±2.9 %	145
Device Holder	±3.6 %	N	1	1	1	±3.6 %	±3.6 %	5
Power Drift	±5.0 %	R	$\sqrt{3}$	1	1	±2.9 %	±2.9 %	∞
Phantom and Setup								
Phantom Uncertainty	±4.0 %	R	$\sqrt{3}$	1	1	±2.3 %	±2.3 %	∞
Liquid Conductivity (target)	±5.0 %	R	$\sqrt{3}$	0.64	0.43	±1.8 %	±1.2 %	∞
Liquid Conductivity (meas.)	±2.5 %	N	1	0.64	0.43	±1.6 %	±1.1 %	∞
Liquid Permittivity (target)	±5.0 %	R	$\sqrt{3}$	0.6	0.49	±1.7 %	±1.4 %	∞
Liquid Permittivity (meas.)	±2.5 %	N	1	0.6	0.49	±1.5 %	±1.2 %	∞
Combined Std. Uncertainty						±10.8 %	±10.6 %	330
Expanded STD Uncertainty						**±21.6 %**	**±21.1 %**	

DASY4 Uncertainty Budget

According to CENELEC EN 50361 [2]

Error Description	Uncertainty value	Prob. Dist.	Div.	(c_i) 1g	(c_i) 10g	Std. Unc. (1g)	Std. Unc. (10g)	(v_i) v_{eff}
Measurement Equipment								
Probe Calibration	±5.9%	N	1	1	1	±5.9%	±5.9%	∞
Axial Isotropy	±4.7%	R	$\sqrt{3}$	0.7	0.7	±1.9%	±1.9%	∞
Spherical Isotropy	±9.6%	R	$\sqrt{3}$	0.7	0.7	±3.9%	±3.9%	∞
Probe Linearity	±4.7%	R	$\sqrt{3}$	1	1	±2.7%	±2.7%	∞
Detection Limit	±1.0%	R	$\sqrt{3}$	1	1	±0.6%	±0.6%	∞
Boundary Effects	±1.0%	R	$\sqrt{3}$	1	1	±0.6%	±0.6%	∞
Readout Electronics	±0.3%	N	1	1	1	±0.3%	±0.3%	∞
Response Time	±0.8%	N	1	1	1	±0.8%	±0.8%	∞
Noise	±0%	N	1	1	1	±0%	±0%	∞
Integration Time	±2.6%	N	1	1	1	±2.6%	±2.6,%	∞
Mechanical Constraints								
Scanning System	±0.4%	R	$\sqrt{3}$	1	1	±0.2%	±0.2%	∞
Phantom Shell	±4.0%	R	$\sqrt{3}$	1	1	±2.3%	±2.3%	∞
Probe Positioning	±2.9%	R	$\sqrt{3}$	1	1	±1.7%	±1.7%	∞
Device Positioning	±2.9%	N	1	1	1	±2.9,%	±2.9%	145
Physical Parameters								
Liquid Conductivity (target)	±5.0%	R	$\sqrt{3}$	0.7	0.5	±2.0%	±1.4%	∞
Liquid Conductivity (meas.)	±4.3%	R	$\sqrt{3}$	0.7	0.5	±1.7%	±1.2%	∞
Liquid Permittivity (target)	±5.0%	R	$\sqrt{3}$	0.6	0.5	±1.7%	±1.4%	∞
Liquid Permittivity (meas.)	±4.3%	R	$\sqrt{3}$	0.6	0.5	±1.5%	±1.2%	∞
Power Drift	±5.0%	R	$\sqrt{3}$	1	1	±2.9%	±2.9%	∞
RF Ambient Conditions	±3.0%	R	$\sqrt{3}$	1	1	±1.7%	±1.7%	∞
Post-Processing								
Extrap. and Integration	±1.0%	R	$\sqrt{3}$	1	1	±0.6%	±0.6%	∞
Combined Std. Uncertainty						± 10.9%	± 10.6%	18125
Expanded Std. Uncertainty						±21.7%	±12.1%	

8. System Verification

8.1 Tissue Verification

For the measurement of the following parameters the HP 85070E dielectric probe kit is used, representing the open-ended slim form probe measurement procedure.
The measured values should be within ±5% of the recommended values given by the IEEE Standard C95.1 / OET Bulletin 65 Supplement C.

Table 8.1 Measured Tissue Parameters

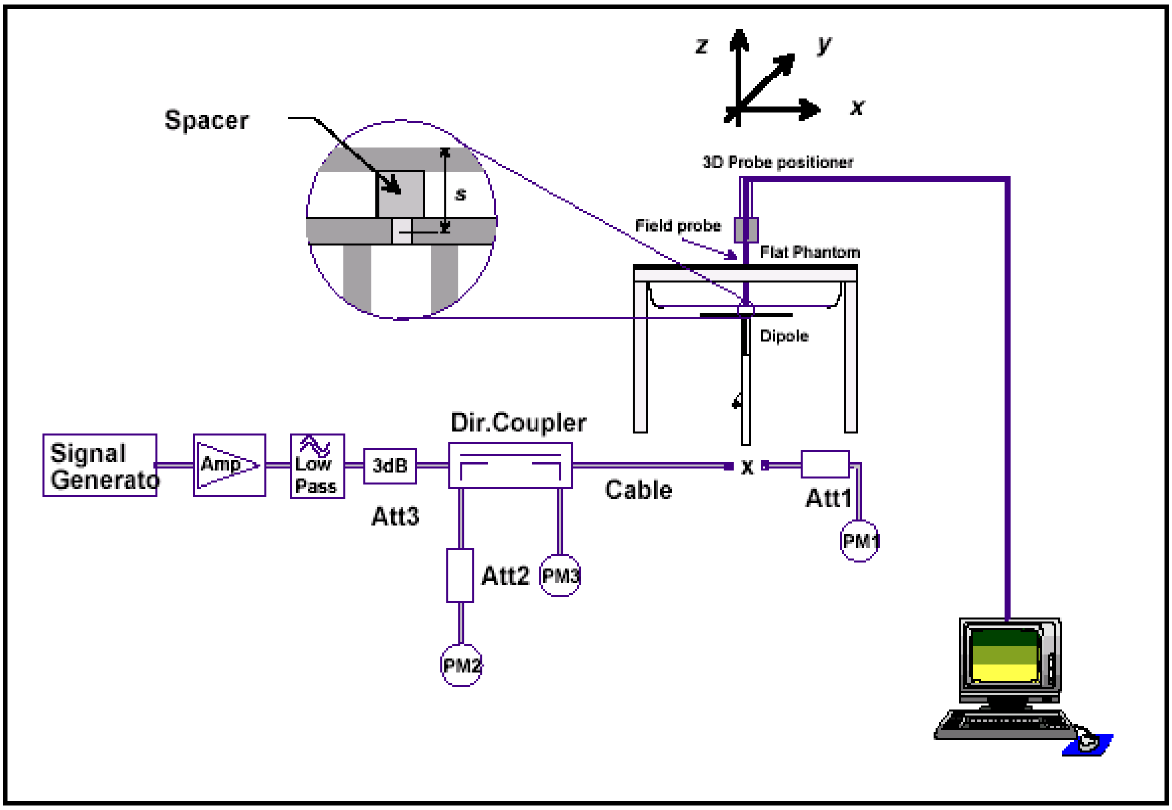
	2450MHz Muscle	
Date	May 28, 2008	
Liquid Temperature(°C)	21.5°C	
	Recommended Value	Measured Value
Dielectric Constant (ε)	52.7±2.635	**52.2**
Conductivity(σ)	1.95 ±0.0975	**1.99**

8.2 Test System Validation

The simplified performance check was realized using the dipole validation kits.
The input power of the dipole antennas were 250mW and they were placed under the flat Part of the SAM phantoms.
The target and measured results are listed in the table 8.2

Table 8.2 System Validation Results

Tissue	Date		Targeted SAR (mW/g)	Measured SAR (mW/g)	Deviation (%)
2450MHz Muscle	May 29, 2008	SAR (1g)	13.1	**14.3**	**9.16**



Dipole Validation Test Setup

8.3 Measurement Result of Test Data (2450MHz Validation)

Date/Time: 2008-05-29 12:48:37

Test Laboratory: Nemko Korea File Name: MX-6000 Validation.da4

DUT: Dipole 2450 MHz Type: D2450V2 Serial: D2450V2 - SN:774 Applicant Name: Ohsung Electronics Co.,Ltd

Communication System: CW Frequency: 2450 MHz

Duty Cycle: 1:1 Phantom section: Flat Section

Medium parameters used (interpolated): f = 2450 MHz; σ = 1.99 mho/m; ε_r = 52.2; ρ = 1000 kg/m^3

DASY4 Configuration:

Probe: EX3DV4 - SN3635; ConvF(7.27, 7.27, 7.27); Calibrated: 2008-03-21

Sensor-Surface: 2.5mm (Mechanical Surface Detection)

Electronics: DAE4 Sn672; Calibrated: 2008-03-17

Phantom: SAM Phantom; Type: SAM; Serial: TP-1358

Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

MX-6000 Validation/Area Scan (7x7x1): Measurement grid: dx=15mm, dy=15mm

Info: Interpolated medium parameters used for SAR evaluation.

Maximum value of SAR (measured) = 19.8 mW/g

MX-6000 Validation/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

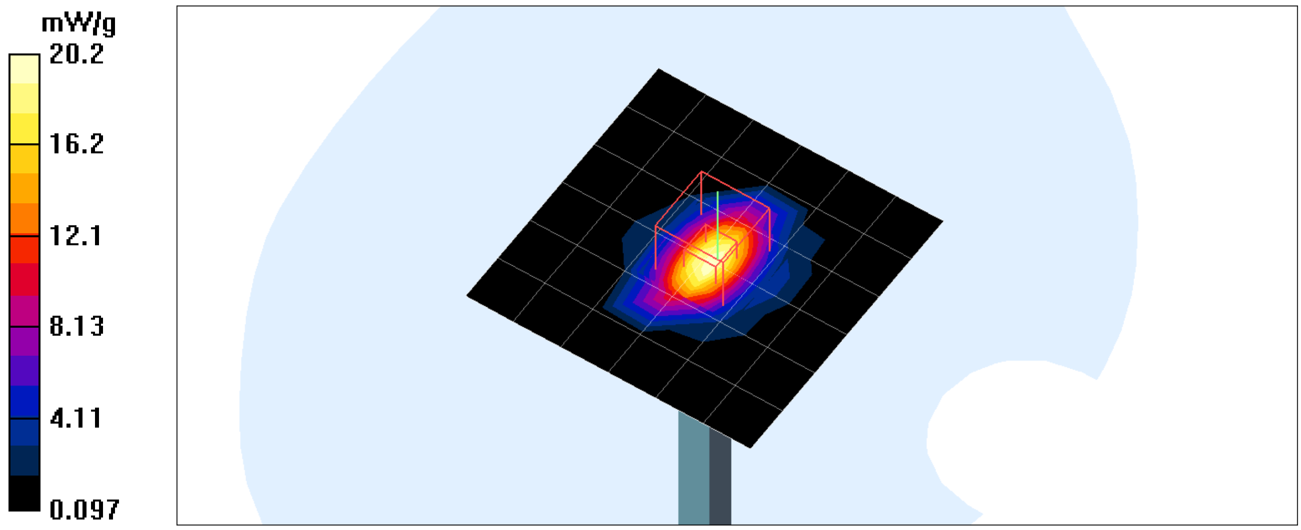
Reference Value = 101.6 V/m; Power Drift = -0.001 dB

Peak SAR (extrapolated) = 30.3 W/kg

SAR(1 g) = 14.3 mW/g; SAR(10 g) = 6.47 mW/g

Info: Interpolated medium parameters used for SAR evaluation.

Maximum value of SAR (measured) = 20.2 mW/g



9. SAR Measurement Results

Procedures Used To Establish Test Signal

Engineering testing software installed on the EUT can provide continuous transmitting RF signal. This RF signal utilized in SAR measurement is Continuous wave.

♦ Maximum SAR

Mode	CH	Frequency (MHz)	Position	SAR Limit (W/kg)	Measured SAR (W/kg)	Result
802.11b	1	2412	Bottom	1.6	**0.406**	**Passed**

9.1 SAR Data Summary

Date of Test : May 29.2008
Mixture Type: 2450MHz Muscle
Tissue Depth: 15.1 Cm

Mode	Frequency		Power Drift (dB)	Antenna Position	SAR (W/kg)
	CH	(MHz)			
802.11b	6	2437	**0.145**	Bottom	**0.352**
	6	2437	**0.123**	Upper edge	**0.269**
	6	2437	**-0.034**	Side edge	**0.155**
802.11g	6	2437	**-0.079**	Bottom	**0.081**
802.11b	**1**	**2412**	**-0.189**	**Bottom**	**0.406**
	1	2412	**0.018**	Top	**0.201**
	1	2412	**-0.155**	Bottom (With 418 MHz)	**0.335**
	11	2462	**-0.142**	Bottom	**0.286**

Notes:
1. The test data reported are the worst-case SAR value with the antenna-head position set in a typical configuration.
2. All modes of operation were investigated, and worst-case results are reported.
3. SAR Measurement System ■ DASY4
4. Phantom Configuration □ Left Head ■ Flat Phantom □ Right Head
5. SAR Configuration □ Head ■ Body □ Hand
6. Test Signal Call Mode ■ Manu. Test Codes □ Base Station Simulator

Measurement Result of Test Data (802.11b Bottom Position_Ch6)

Date/Time: 2008-05-29 3:21:40

Test Laboratory: Nemko Korea File Name: MX-6000 CH6 b-mode.da4

DUT: MX-6000 Type: Bar Type Serial: 00000001 Applicant Name: Ohsung Electronics Co.,Ltd

Communication System: Wifi Frequency: 2437 MHz

Duty Cycle: 1:1 Phantom section: Flat Section

Medium parameters used (interpolated): f = 2437 MHz; σ = 1.98 mho/m; ε_r = 52.2; ρ = 1000 kg/m^3

DASY4 Configuration:

Probe: EX3DV4 - SN3635; ConvF(7.27, 7.27, 7.27); Calibrated: 2008-03-21

Sensor-Surface: 2.5mm (Mechanical Surface Detection)

Electronics: DAE4 Sn672; Calibrated: 2008-03-17

Phantom: SAM Phantom; Type: SAM; Serial: TP-1358

Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

MX-6000 CH6 b-mode/Area Scan (9x9x1): Measurement grid: dx=15mm, dy=15mm

Info: Interpolated medium parameters used for SAR evaluation.

Maximum value of SAR (measured) = 0.388 mW/g

MX-6000 CH6 b-mode/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

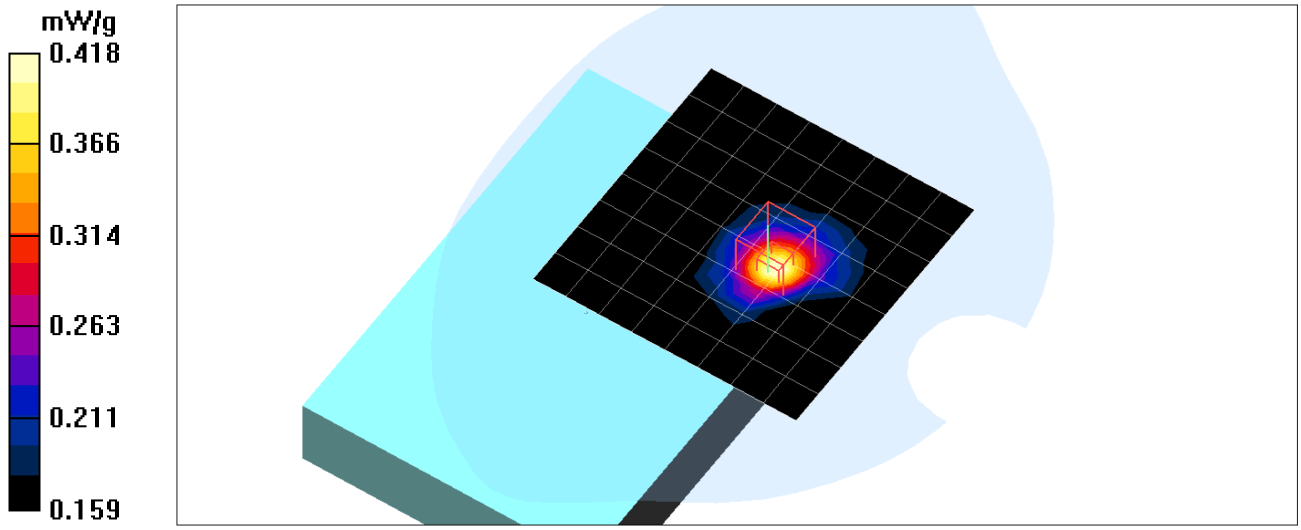
Reference Value = 11.7 V/m; Power Drift = 0.145 dB

Peak SAR (extrapolated) = 0.599 W/kg

SAR(1 g) = 0.352 mW/g; SAR(10 g) = 0.255 mW/g

Info: Interpolated medium parameters used for SAR evaluation.

Maximum value of SAR (measured) = 0.418 mW/g



Measurement Result of Test Data (802.11b Upper edge Position_Ch6)

Date/Time: 2008-05-29 3:58:19

Test Laboratory: Nemko Korea File Name: MX-6000 CH6 b-mode upper.da4

DUT: MX-6000 Type: Bar Type Serial: 00000001 Applicant Name: Ohsung Electronics Co.,Ltd

Communication System: Wifi Frequency: 2437 MHz

Duty Cycle: 1:1 Phantom section: Flat Section

Medium parameters used (interpolated): f = 2437 MHz; σ = 1.98 mho/m; ε_r = 52.2; ρ = 1000 kg/m^3

DASY4 Configuration:

Probe: EX3DV4 - SN3635; ConvF(7.27, 7.27, 7.27); Calibrated: 2008-03-21

Sensor-Surface: 2.5mm (Mechanical Surface Detection)

Electronics: DAE4 Sn672; Calibrated: 2008-03-17

Phantom: SAM Phantom; Type: SAM; Serial: TP-1358

Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

MX-6000 CH6 b-mode Upper/Area Scan (9x9x1): Measurement grid: dx=15mm, dy=15mm

Info: Interpolated medium parameters used for SAR evaluation.

Maximum value of SAR (measured) = 0.271 mW/g

MX-6000 CH6 b-mode Upper/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

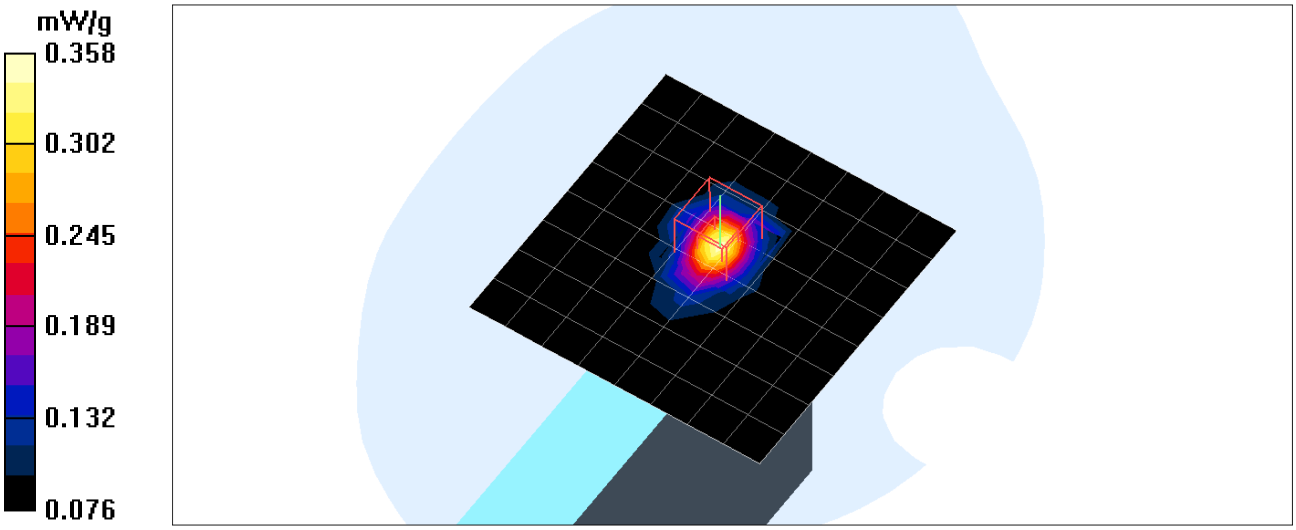
Reference Value = 11.6 V/m; Power Drift = 0.123 dB

Peak SAR (extrapolated) = 0.525 W/kg

SAR(1 g) = 0.269 mW/g; SAR(10 g) = 0.156 mW/g

Info: Interpolated medium parameters used for SAR evaluation.

Maximum value of SAR (measured) = 0.358 mW/g



Measurement Result of Test Data (802.11b Side edge Position_Ch6)

Date/Time: 2008-05-29 4:29:45

Test Laboratory: Nemko Korea File Name: MX-6000 CH6 b-mode side.da4

DUT: MX-6000 Type: Bar Type Serial: 00000001 Applicant Name: Ohsung Electronics Co.,Ltd

Communication System: Wifi Frequency: 2437 MHz

Duty Cycle: 1:1 Phantom section: Flat Section

Medium parameters used (interpolated): f = 2437 MHz; σ = 1.98 mho/m; ε_r = 52.2; ρ = 1000 kg/m^3

DASY4 Configuration:

Probe: EX3DV4 - SN3635; ConvF(7.27, 7.27, 7.27); Calibrated: 2008-03-21

Sensor-Surface: 2.5mm (Mechanical Surface Detection)

Electronics: DAE4 Sn672; Calibrated: 2008-03-17

Phantom: SAM Phantom; Type: SAM; Serial: TP-1358

Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

MX-6000 CH6 b-mode Side/Area Scan (9x9x1): Measurement grid: dx=15mm, dy=15mm

Info: Interpolated medium parameters used for SAR evaluation.

Maximum value of SAR (measured) = 0.192 mW/g

MX-6000 CH6 b-mode Side/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

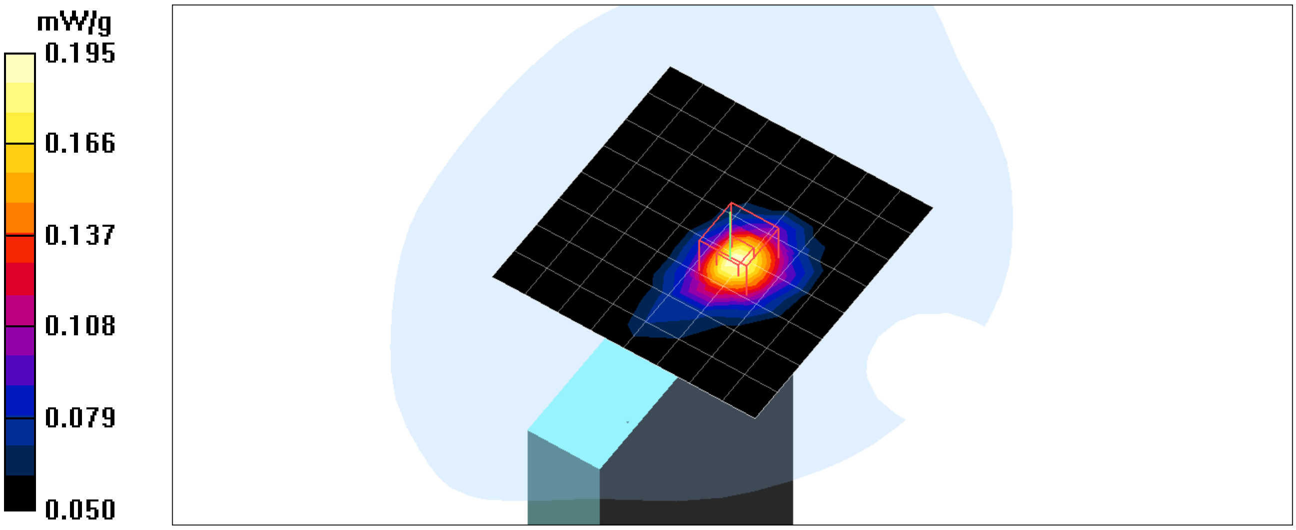
Reference Value = 7.17 V/m; Power Drift = -0.034 dB

Peak SAR (extrapolated) = 0.272 W/kg

SAR(1 g) = 0.155 mW/g; SAR(10 g) = 0.100 mW/g

Info: Interpolated medium parameters used for SAR evaluation.

Maximum value of SAR (measured) = 0.195 mW/g



Measurement Result of Test Data (802.11g Bottom Position_Ch6)

Date/Time: 2008-05-29 8:51:34

Test Laboratory: Nemko Korea File Name: MX-6000 CH6 g-mode.da4

DUT: MX-6000 Type: Bar Type Serial: 00000001 Applicant Name: Ohsung Electronics Co.,Ltd

Communication System: Wifi Frequency: 2437 MHz

Duty Cycle: 1:1 Phantom section: Flat Section

Medium parameters used (interpolated): f = 2437 MHz; σ = 1.98 mho/m; ε_r = 52.2; ρ = 1000 kg/m^3

DASY4 Configuration:

Probe: EX3DV4 - SN3635; ConvF(7.27, 7.27, 7.27); Calibrated: 2008-03-21

Sensor-Surface: 2.5mm (Mechanical Surface Detection)

Electronics: DAE4 Sn672; Calibrated: 2008-03-17

Phantom: SAM Phantom; Type: SAM; Serial: TP-1358

Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

MX-6000 CH1 g-mode/Area Scan (9x9x1): Measurement grid: dx=15mm, dy=15mm

Info: Interpolated medium parameters used for SAR evaluation.

Maximum value of SAR (measured) = 0.087 mW/g

MX-6000 CH1 g-mode/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

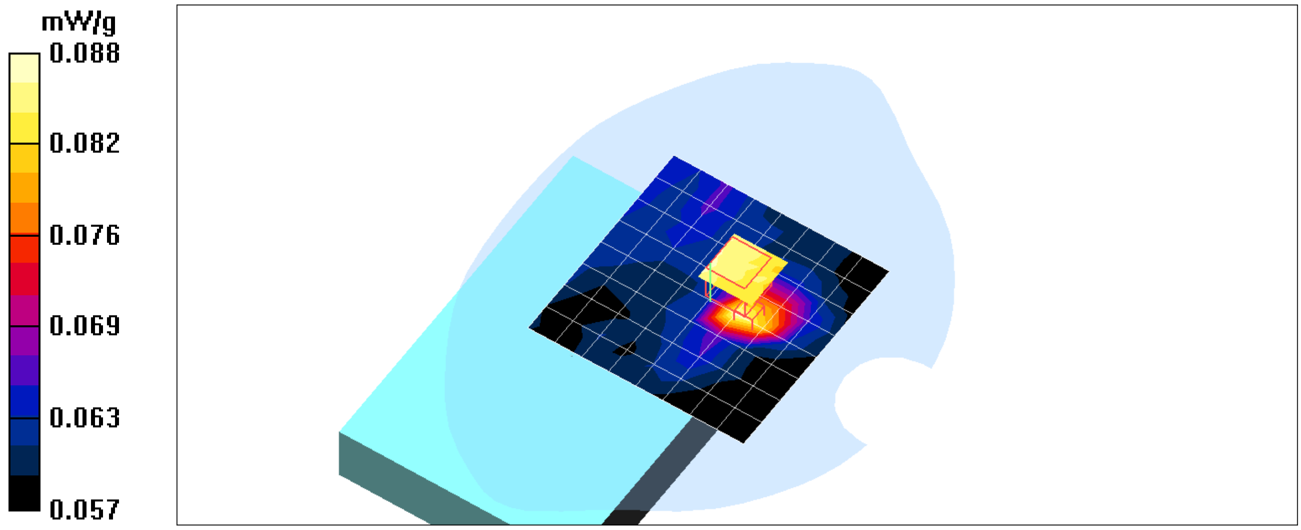
Reference Value = 5.71 V/m; Power Drift = -0.079 dB

Peak SAR (extrapolated) = 0.114 W/kg

SAR(1 g) = 0.081 mW/g; SAR(10 g) = 0.074 mW/g

Info: Interpolated medium parameters used for SAR evaluation.

Maximum value of SAR (measured) = 0.088 mW/g



Measurement Result of Test Data (802.11b Bottom Position_Ch1)

Date/Time: 2008-05-29 6:42:09

Test Laboratory: Nemko Korea File Name: MX-6000 CH1 b-mode.da4

DUT: MX-6000 Type: Bar Type Serial: 00000001 Applicant Name: Ohsung Electronics Co.,Ltd

Communication System: Wifi Frequency: 2412 MHz

Duty Cycle: 1:1 Phantom section: Flat Section

Medium parameters used: f = 2412.15 MHz; σ = 1.94 mho/m; ε_r = 52.3; ρ = 1000 kg/m^3

DASY4 Configuration:

Probe: EX3DV4 - SN3635; ConvF(7.27, 7.27, 7.27); Calibrated: 2008-03-21

Sensor-Surface: 2.5mm (Mechanical Surface Detection)

Electronics: DAE4 Sn672; Calibrated: 2008-03-17

Phantom: SAM Phantom; Type: SAM; Serial: TP-1358

Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

MX-6000 CH1 b-mode/Area Scan (9x9x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (measured) = 0.456 mW/g

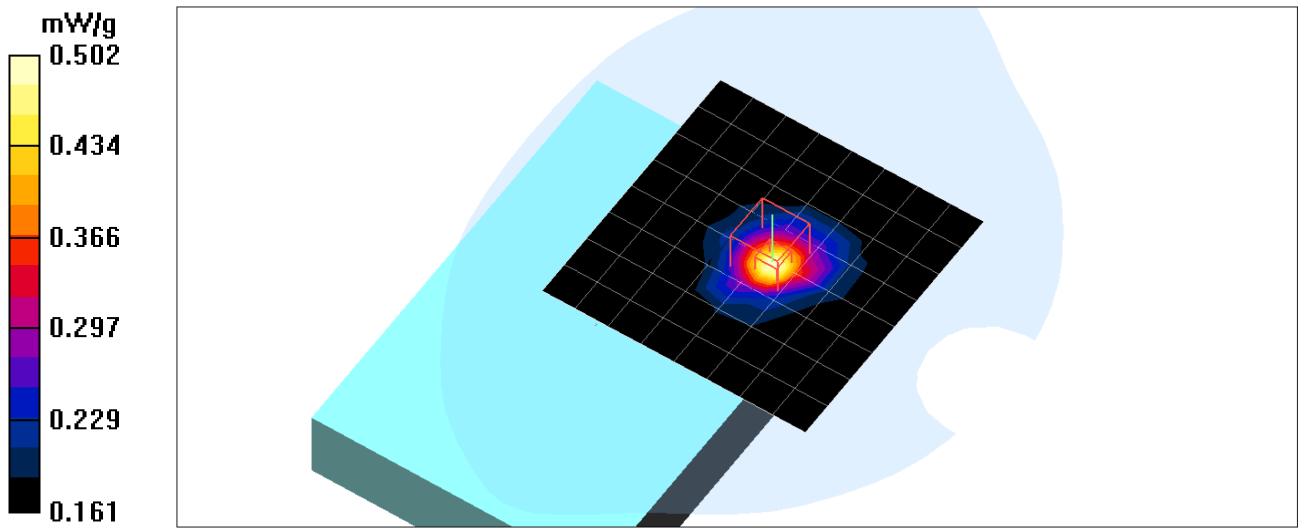
MX-6000 CH1 b-mode/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 15.6 V/m; Power Drift = -0.189 dB

Peak SAR (extrapolated) = 0.711 W/kg

SAR(1 g) = 0.406 mW/g; SAR(10 g) = 0.272 mW/g

Maximum value of SAR (measured) = 0.502 mW/g



Date/Time: 2008-05-29 6:42:09

Test Laboratory: Nemko Korea File Name: MX-6000 CH1 b-mode.da4

DUT: MX-6000 Type: Bar Type Serial: 00000001 Applicant Name: Ohsung Electronics Co.,Ltd

Communication System: Wifi Frequency: 2412 MHz

Duty Cycle: 1:1 Phantom section: Flat Section

Medium parameters used: f = 2412.15 MHz; σ = 1.94 mho/m; ε_r = 52.3; ρ = 1000 kg/m^3

DASY4 Configuration:

Probe: EX3DV4 - SN3635; ConvF(7.27, 7.27, 7.27); Calibrated: 2008-03-21

Sensor-Surface: 2.5mm (Mechanical Surface Detection)

Electronics: DAE4 Sn672; Calibrated: 2008-03-17

Phantom: SAM Phantom; Type: SAM; Serial: TP-1358

Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

MX-6000 CH1 b-mode/Area Scan (9x9x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (measured) = 0.456 mW/g

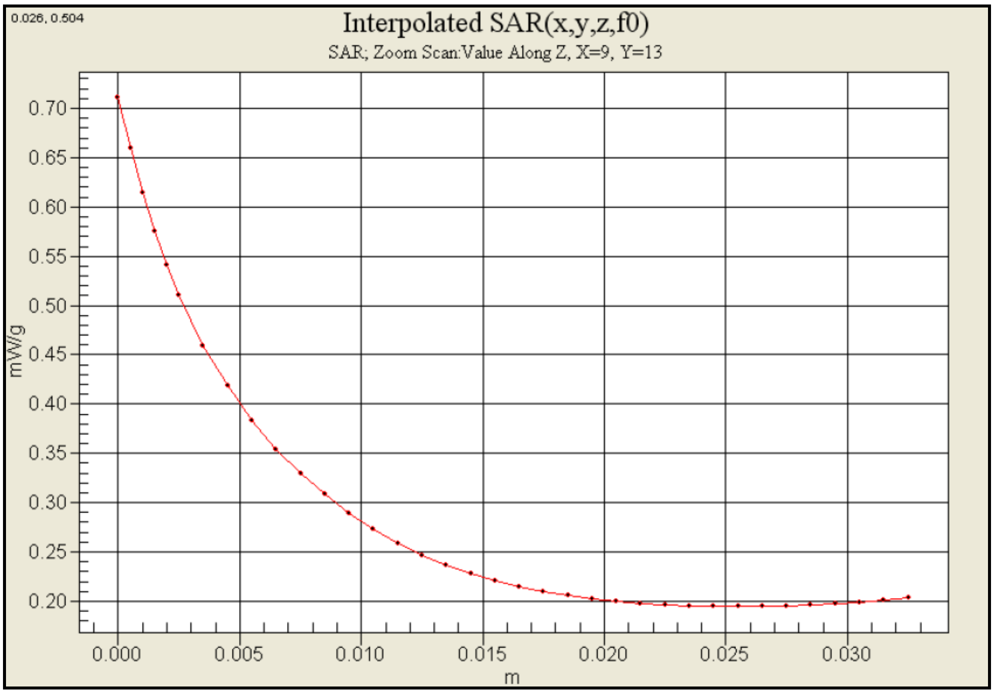
MX-6000 CH1 b-mode/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 15.6 V/m; Power Drift = -0.189 dB

Peak SAR (extrapolated) = 0.711 W/kg

SAR(1 g) = 0.406 mW/g; SAR(10 g) = 0.272 mW/g

Maximum value of SAR (measured) = 0.502 mW/g



Measurement Result of Test Data (802.11b LCD side Position_Ch1)

Date/Time: 2008-05-29 8:23:53

Test Laboratory: Nemko Korea File Name: MX-6000 CH1 b-mode LCD side.da4

DUT: MX-6000 Type: Bar Type Serial: 00000001 Applicant Name: Ohsung Electronics Co.,Ltd

Communication System: Wifi Frequency: 2412 MHz

Duty Cycle: 1:1 Phantom section: Flat Section

Medium parameters used: f = 2412.15 MHz; σ = 1.94 mho/m; ε_r = 52.3; ρ = 1000 kg/m^3

DASY4 Configuration:

Probe: EX3DV4 - SN3635; ConvF(7.27, 7.27, 7.27); Calibrated: 2008-03-21

Sensor-Surface: 2.5mm (Mechanical Surface Detection)

Electronics: DAE4 Sn672; Calibrated: 2008-03-17

Phantom: SAM Phantom; Type: SAM; Serial: TP-1358

Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

MX-6000 CH1 b-mode LCD side/Area Scan (9x9x1): Measurement grid: dx=15mm, dy=15mm

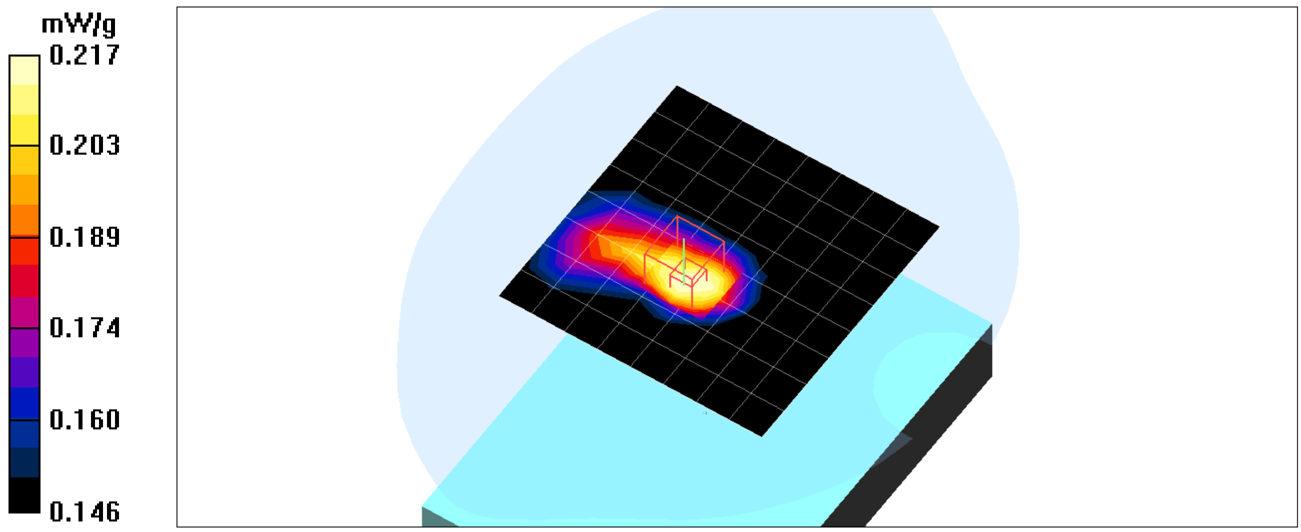
Maximum value of SAR (measured) = 0.217 mW/g

MX-6000 CH1 b-mode LCD side/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 9.87 V/m; Power Drift = 0.018 dB

Peak SAR (extrapolated) = 0.283 W/kg

SAR(1 g) = 0.201 mW/g; SAR(10 g) = 0.177 mW/g



Measurement Result of Test Data (802.11b Bottom Position (With 418 MHz)_Ch1)

Date/Time: 2008-05-29 7:53:34

Test Laboratory: Nemko Korea File Name: MX-6000 CH11 b-mode with 418MHz.da4

DUT: MX-6000 Type: Bar Type Serial: 00000001 Applicant Name: Ohsung Electronics Co.,Ltd

Communication System: Wifi Frequency: 2412 MHz

Duty Cycle: 1:1 Phantom section: Flat Section

Medium parameters used: f = 2412.15 MHz; σ = 1.94 mho/m; ε_r = 52.3; ρ = 1000 kg/m^3

DASY4 Configuration:

Probe: EX3DV4 - SN3635; ConvF(7.27, 7.27, 7.27); Calibrated: 2008-03-21

Sensor-Surface: 2.5mm (Mechanical Surface Detection)

Electronics: DAE4 Sn672; Calibrated: 2008-03-17

Phantom: SAM Phantom; Type: SAM; Serial: TP-1358

Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

MX-6000 CH1 b-mode with 418MHz/Area Scan (9x9x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (measured) = 0.356 mW/g

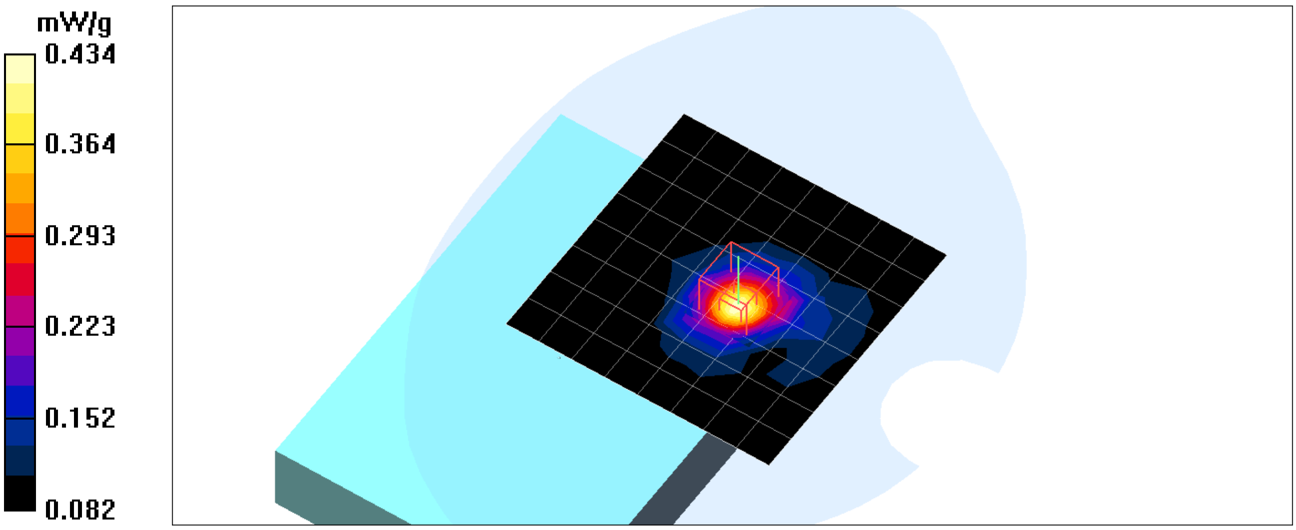
MX-6000 CH1 b-mode with 418MHz/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 13.2 V/m; Power Drift = -0.155 dB

Peak SAR (extrapolated) = 0.629 W/kg

SAR(1 g) = 0.335 mW/g; SAR(10 g) = 0.198 mW/g

Maximum value of SAR (measured) = 0.434 mW/g



Measurement Result of Test Data (802.11b Bottom Position_Ch11)

Date/Time: 2008-05-29 7:05:51

Test Laboratory: Nemko Korea File Name: MX-6000 CH11 b-mode.da4

DUT: MX-6000 Type: Bar Type Serial: 00000001 Applicant Name: Ohsung Electronics Co.,Ltd

Communication System: Wifi Frequency: 2462 MHz

Duty Cycle: 1:1 Phantom section: Flat Section

Medium parameters used: f = 2462.1 MHz; σ = 2.01 mho/m; ε_r = 52.1; ρ = 1000 kg/m^3

DASY4 Configuration:

Probe: EX3DV4 - SN3635; ConvF(7.27, 7.27, 7.27); Calibrated: 2008-03-21

Sensor-Surface: 2.5mm (Mechanical Surface Detection)

Electronics: DAE4 Sn672; Calibrated: 2008-03-17

Phantom: SAM Phantom; Type: SAM; Serial: TP-1358

Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

MX-6000 CH11 b-mode/Area Scan (9x9x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (measured) = 0.296 mW/g

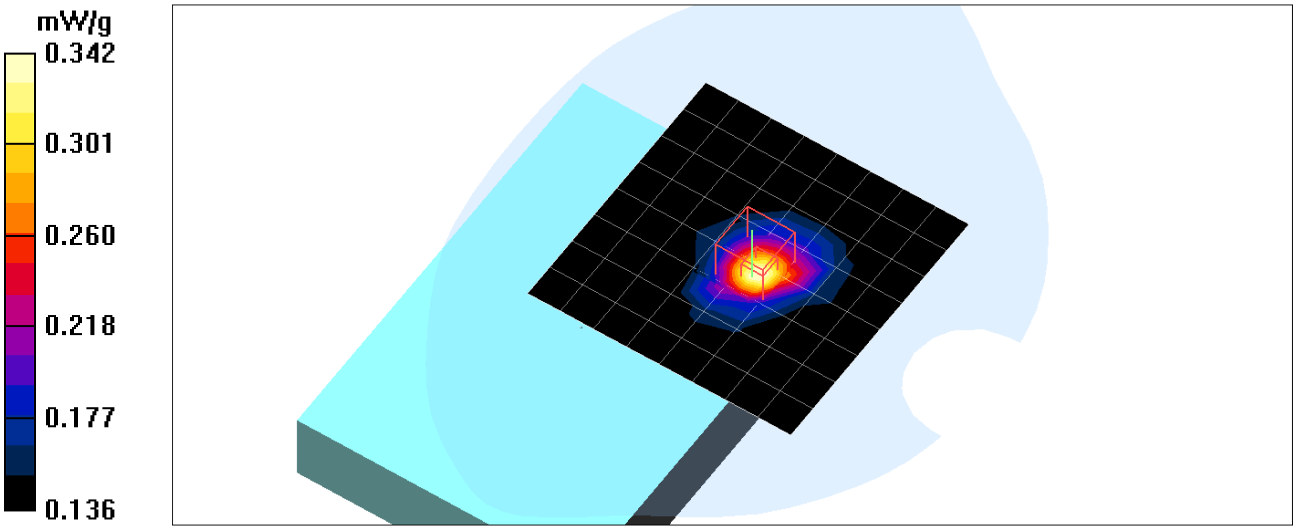
MX-6000 CH11 b-mode/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 12.3 V/m; Power Drift = -0.142 dB

Peak SAR (extrapolated) = 0.494 W/kg

SAR(1 g) = 0.286 mW/g; SAR(10 g) = 0.205 mW/g

Maximum value of SAR (measured) = 0.342 mW/g



10. SAR Test Equipment

Table 10.1 Test Equipment Calibration

Description	Model	Serial No.	Due to Calibration
Staubli Robot Unit	RX60L	F05/51E1A1/A/01	N/A
Data Acquisition Electronics	DAE4	672	March.17. 2009
E-Field Probe	EX3DV4	3635	March.21. 2009
Electro-Optical Converter	EOC3	398	N/A
SAM Twin Phantom V4.0C	TP-1358	SM 00 T02 DA	N/A
Validation Dipole Antenna	D835V2	4d017	January.28.2010
Validation Dipole Antenna	D1900V2	5d059	July.17. 2008
Validation Dipole Antenna	D2450V2	774	July.11. 2008
PSA Series Spectrum Analyzer	E4440A	MY44022567	December.04.2008
Dielectric Probe Kit	85070E	MY44300121	N/A
Network Analyzer	8753ES	US39171172	February.27.2009
Power Amplifier	5303075	509/0743	November.05.2008
Power Meter	437B	2912U01687	December.04.2008
Power Sensor	8481A	3318A83210	August.08.2008
Power Meter	NRVS	835360/002	December.04.2008
Power Sensor	NRV-Z32	836019/028	December.04.2008
Series Signal Generator	E4436B	US39260598	December.05.2008

Note:

The E-field probe was calibrated by SPEAG, by waveguide technique procedure. Dipole Validation measurement is performed by Nemkokorea Lab. before each test. The brain simulating material is calibrated by Nemkokorea using the dielectric probe system and network analyzer to determine the conductivity and permittivity (dielectric constant) of the brain-equivalent material.

11. References

[1] IEEE 1528-2003, “Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques, December 2003

[2] EN 50361:2001, “Basic standard fields from mobile phones (200MHz – 3 GHz)”, July 2001

[3] IEC 62209 - 1, “Specific Absorption Rate (SAR) in the frequency range of 300 MHz to 3 GHz

[4] IEC 62209 - 2, Draft Version 0.9, “Evaluation of Human Exposure to Radio Frequency Fields from Handheld and Body - Mounted Wireless Communication Devices in the Frequency Range of 30 MHz to 6 GHz: Human models, Instrumentation and Procedures
Part 2: Procedure to determine the Specific Absorption Rate (SAR) for … including accessories and multiple transmitters”, December 2004

[5] OET Bulletin 65, Supplement C, “Evaluating Compliance with FCC Guidelines for Human Exposure to Radio frequency Electromagnetic Fields”, Edition 01-01

[6] ANSI-PC63.19-2001, Draft 3.6, “American National Standard for Methods of Measurement of Compatibility between Wireless Communication Devices and Hearing Aids”, April 2005

APPENDIX A

SAR Definition

Specific Absorption Rate (SAR) is defined as the time derivative (rate) of the incremental energy (*dU*) absorbed by (dissipated in) an incremental mass (*dm*) contained in a volume element (*dV*) of a given density (*p*). It is also defined as the rate of RF energy absorption pet unit mass at a point in an absorbing body (see Fig. A.1).

$$SAR = \frac{d}{dt}\left(\frac{dU}{dm}\right) = \frac{d}{dt}\left(\frac{dU}{pdv}\right)$$

Figure A.1 SAR Mathematical Equation

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

$$SAR = \sigma E^2 / p$$

Where :

σ = conductivity of the tissue-simulant material (S/m)
p = mass density of the tissue-simulant material (kg/m3)
E = Total RMS electric field strength (V/m)

Note:
The primary factors that control rate or energy absorption were found to be the wavelength of the incident field in relations to the dimensions and geometry of the irradiated organism, the orientation of the organism in relation to the polarity of field vectors, the presence of reflecting surfaces, and whether conductive contact is made by the organism with a ground plane.

APPENDIX B : Probe Calibration

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

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Swiss Calibration Service

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Accreditation No.: **SCS 108**

Client **Nemko (Dymstec)**

Certificate No: **EX3-3635_Mar08**

CALIBRATION CERTIFICATE

Object	EX3DV4 - SN:3635
Calibration procedure(s)	QA CAL-01.v6 Calibration procedure for dosimetric E-field probes
Calibration date:	March 21, 2008
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 E4419B	GB41293874	29-Mar-07 (METAS, No. 217-00670)	Mar-08
Power sensor E4412A	MY41495277	29-Mar-07 (METAS, No. 217-00670)	Mar-08
Power sensor E4412A	MY41498087	29-Mar-07 (METAS, No. 217-00670)	Mar-08
Reference 3 dB Attenuator	SN: S5054 (3c)	8-Aug-07 (METAS, No. 217-00719)	Aug-08
Reference 20 dB Attenuator	SN: S5086 (20b)	29-Mar-07 (METAS, No. 217-00671)	Mar-08
Reference 30 dB Attenuator	SN: S5129 (30b)	8-Aug-07 (METAS, No. 217-00720)	Aug-08
Reference Probe ES3DV2	SN: 3013	2-Jan-08 (SPEAG, No. ES3-3013_Jan08)	Jan-09
DAE4	SN: 654	20-Apr-07 (SPEAG, No. DAE4-654_Apr07)	Apr-08

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (SPEAG, in house check Oct-07)	In house check: Oct-09
Network Analyzer HP 8753E	US37390585	18-Oct-01 (SPEAG, in house check Oct-07)	In house check: Oct-08

	Name	Function	Signature
Calibrated by:	Katja Pokovic	Technical Manager	
Approved by:	Niels Kuster	Quality Manager	

Issued: March 21, 2008

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Certificate No: EX3-3635_Mar08 Page 1 of 9

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Accreditation No.: **SCS 108**

Glossary:

TSL	tissue simulating liquid
NORMx,y,z	sensitivity in free space
ConvF	sensitivity in TSL / NORMx,y,z
DCP	diode compression point
Polarization φ	φ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., ϑ = 0 is normal to probe axis

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

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

Probe EX3DV4

SN:3635

Manufactured: January 11, 2007
Calibrated: March 21, 2008

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

DASY - Parameters of Probe: EX3DV4 SN:3635

Sensitivity in Free Space[A]

NormX	**0.460** ± 10.1%	$\mu V/(V/m)^2$
NormY	**0.460** ± 10.1%	$\mu V/(V/m)^2$
NormZ	**0.550** ± 10.1%	$\mu V/(V/m)^2$

Diode Compression[B]

DCP X	**87**	mV
DCP Y	**91**	mV
DCP Z	**88**	mV

Sensitivity in Tissue Simulating Liquid (Conversion Factors)

Please see Page 8.

Boundary Effect

TSL **900 MHz** **Typical SAR gradient: 5 % per mm**

Sensor Center to Phantom Surface Distance		**2.0 mm**	**3.0 mm**
SAR_{be} [%]	Without Correction Algorithm	8.8	5.1
SAR_{be} [%]	With Correction Algorithm	0.5	0.3

TSL **1810 MHz** **Typical SAR gradient: 10 % per mm**

Sensor Center to Phantom Surface Distance		**2.0 mm**	**3.0 mm**
SAR_{be} [%]	Without Correction Algorithm	7.8	4.2
SAR_{be} [%]	With Correction Algorithm	0.6	0.5

Sensor Offset

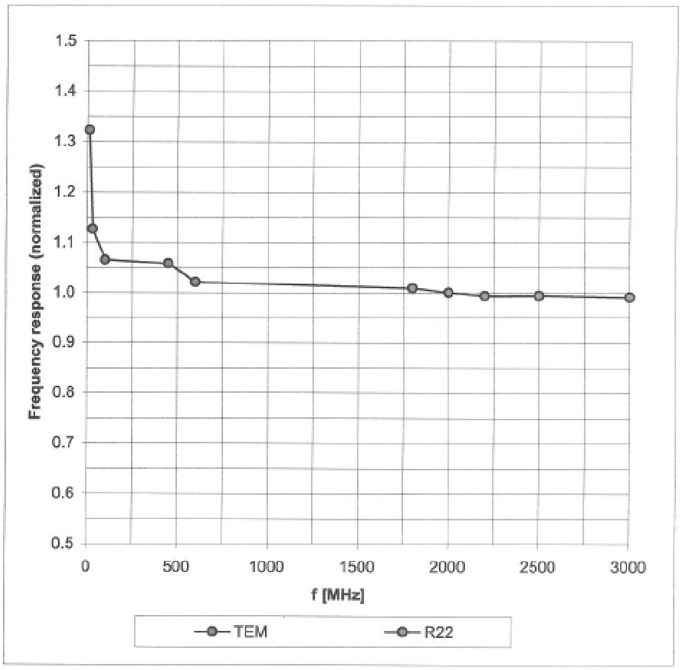
Probe Tip to Sensor Center **1.0** mm

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

[A] The uncertainties of NormX,Y,Z do not affect the E^2-field uncertainty inside TSL (see Page 8).
[B] Numerical linearization parameter: uncertainty not required.

Frequency Response of E-Field

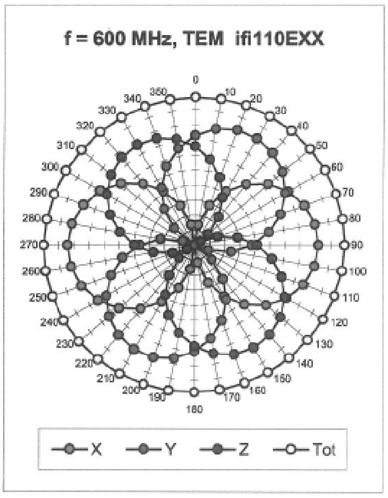
(TEM-Cell:ifi110 EXX, Waveguide: R22)

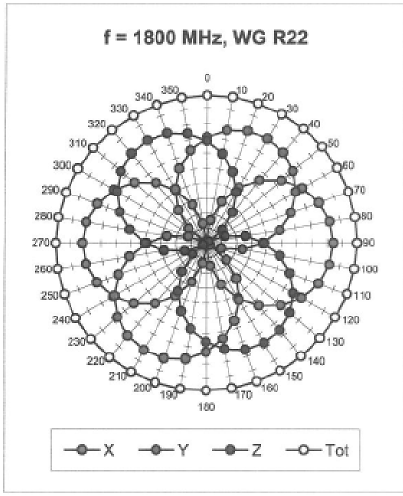


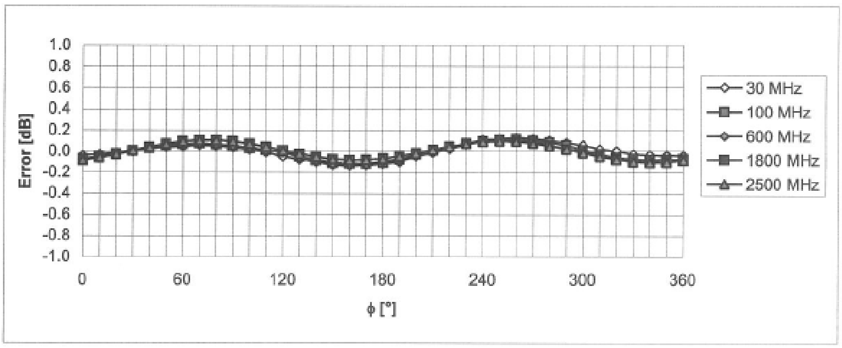
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

EX3DV4 SN:3635 March 21, 2008

Receiving Pattern (φ), ϑ = 0°



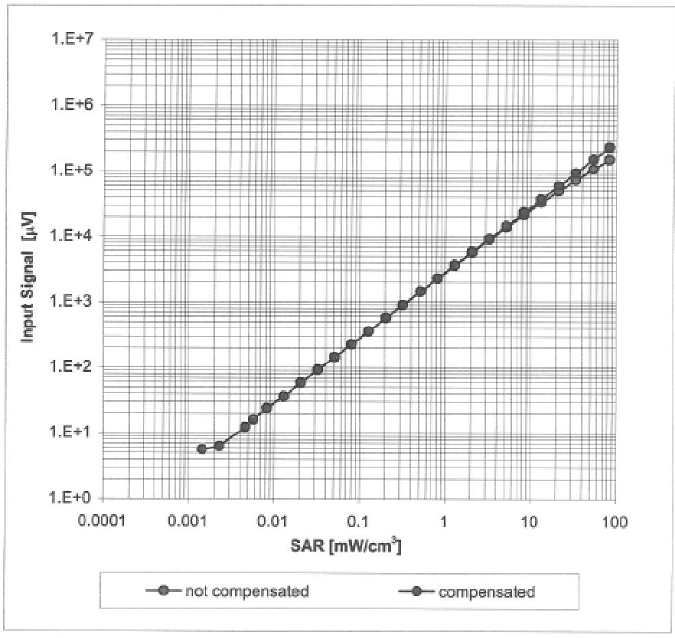


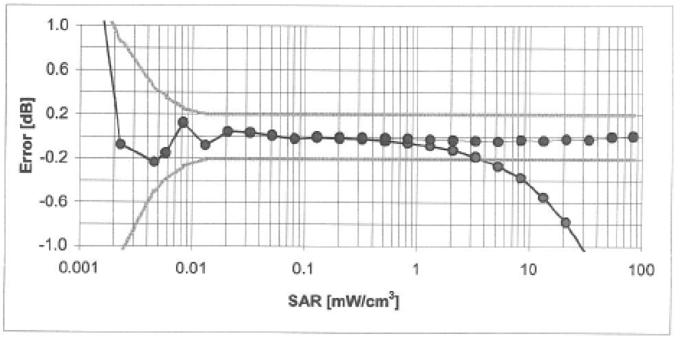


Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(SAR_{head})

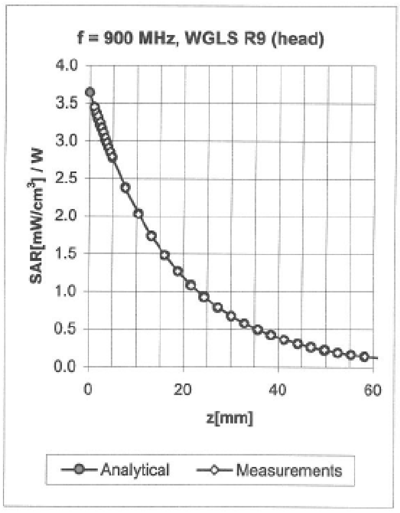
(Waveguide R22, f = 1800 MHz)

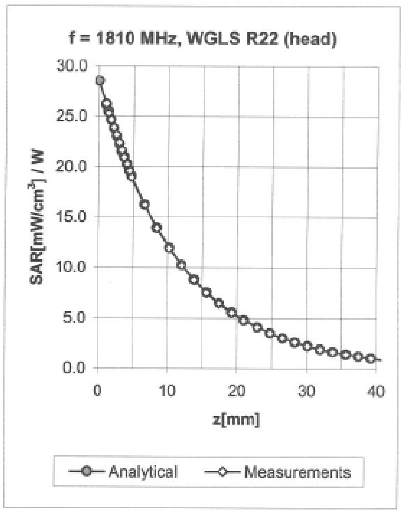




Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment





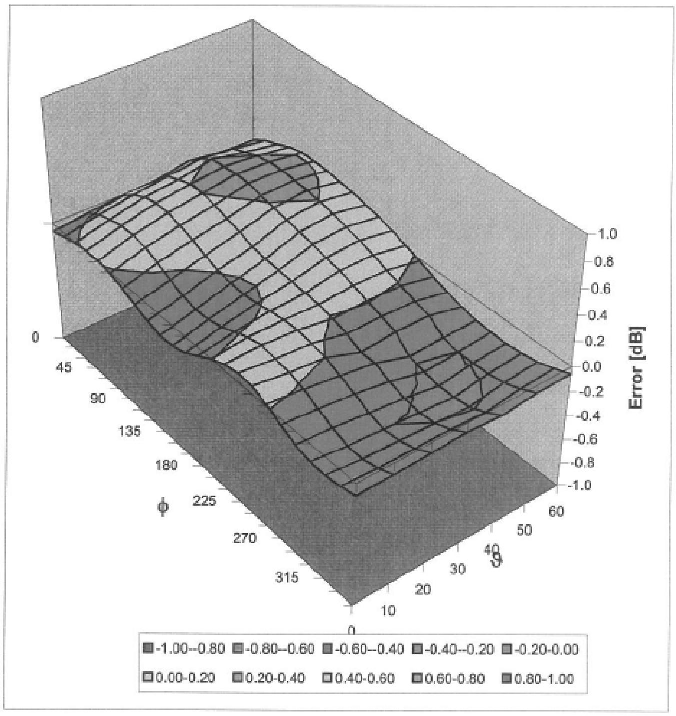
f [MHz]	Validity [MHz][C]	TSL	Permittivity	Conductivity	Alpha	Depth	ConvF	Uncertainty
900	± 50 / ± 100	Head	41.5 ± 5%	0.97 ± 5%	0.91	0.57	9.53	± 11.0% (k=2)
1810	± 50 / ± 100	Head	40.0 ± 5%	1.40 ± 5%	0.97	0.53	8.12	± 11.0% (k=2)
1950	± 50 / ± 100	Head	40.0 ± 5%	1.40 ± 5%	0.97	0.53	7.72	± 11.0% (k=2)
2450	± 50 / ± 100	Head	39.2 ± 5%	1.80 ± 5%	0.94	0.52	7.34	± 11.8% (k=2)
2600	± 50 / ± 100	Head	39.0 ± 5%	1.96 ± 5%	0.80	0.58	7.25	± 11.8% (k=2)
900	± 50 / ± 100	Body	55.0 ± 5%	1.05 ± 5%	0.95	0.58	9.05	± 11.0% (k=2)
1900	± 50 / ± 100	Body	53.3 ± 5%	1.52 ± 5%	0.59	0.76	7.80	± 11.0% (k=2)
1950	± 50 / ± 100	Body	53.3 ± 5%	1.52 ± 5%	0.99	0.54	8.08	± 11.0% (k=2)
2450	± 50 / ± 100	Body	52.7 ± 5%	1.95 ± 5%	0.75	0.65	7.27	± 11.8% (k=2)
2600	± 50 / ± 100	Body	52.5 ± 5%	2.16 ± 5%	0.73	0.65	7.04	± 11.8% (k=2)

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

EX3DV4 SN:3635 March 21, 2008

Deviation from Isotropy in HSL

Error (ϕ, ϑ), f = 900 MHz



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

Certificate No: EX3-3635_Mar08 Page 9 of 9

APPENDIX C : Dipole Calibration

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Accreditation No.: **SCS 108**

Client **Nemko (Dymstec)**

Certificate No: **D2450V2-774_Jul06**

CALIBRATION CERTIFICATE

Object	D2450V2 - SN: 774
Calibration procedure(s)	QA CAL-05.v6 Calibration procedure for dipole validation kits
Calibration date:	July 11, 2006
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-442A	GB37480704	04-Oct-05 (METAS, No. 251-00516)	Oct-06
Power sensor HP 8481A	US37292783	04-Oct-05 (METAS, No. 251-00516)	Oct-06
Reference 20 dB Attenuator	SN: 5086 (20g)	11-Aug-05 (METAS, No 251-00498)	Aug-06
Reference 10 dB Attenuator	SN: 5047.2 (10r)	11-Aug-05 (METAS, No 251-00498)	Aug-06
Reference Probe ES3DV2	SN 3025	28-Oct-05 (SPEAG, No. ES3-3025_Oct05)	Oct-06
DAE4	SN 601	15-Dec-05 (SPEAG, No. DAE4-601_Dec05)	Dec-06

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (SPEAG, in house check Oct-05)	In house check: Oct-07
RF generator Agilent E4421B	MY41000675	11-May-05 (SPEAG, in house check Nov-05)	In house check: Nov-07
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (SPEAG, in house check Nov-05)	In house check: Nov-06

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

Issued: July 11, 2006

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Certificate No: D2450V2-774_Jul06 Page 1 of 6

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Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
b) 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
c) Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

Additional Documentation:

d) DASY4 System Handbook

Methods Applied and Interpretation of Parameters:

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

Measurement Conditions

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

DASY Version	DASY4	V4.7
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	38.4 ± 6 %	1.84 mho/m ± 6 %
Head TSL temperature during test	(23.0 ± 0.2) °C	-------	------

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	condition	
SAR measured	250 mW input power	14.2 mW / g
SAR normalized	normalized to 1W	56.8 mW / g
SAR for nominal Head TSL parameters [1]	normalized to 1W	**55.7 mW / g ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.59 mW / g
SAR normalized	normalized to 1W	26.4 mW / g
SAR for nominal Head TSL parameters [1]	normalized to 1W	**26.1 mW / g ± 16.5 % (k=2)**

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

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	54.4 Ω + 4.4 jΩ
Return Loss	– 24.5 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.152 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	January 20, 2005

DASY4 Validation Report for Head TSL

Date/Time: 11.07.2006 11:15:14

Test Laboratory: SPEAG, Zurich, Switzerland

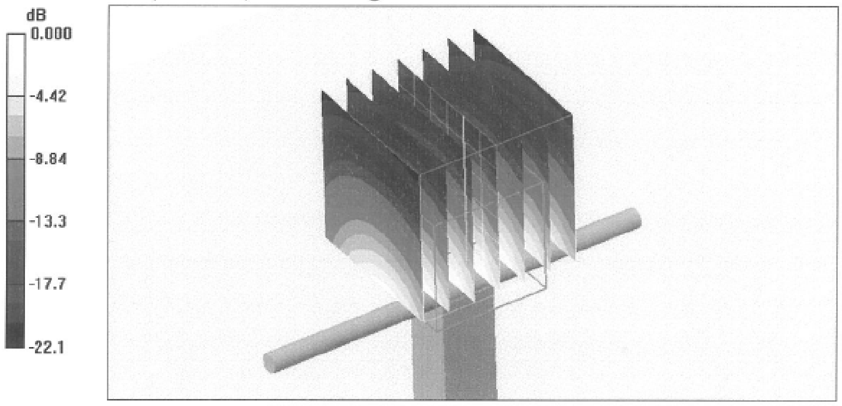
DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN774

Communication System: CW-2450; Frequency: 2450 MHz;Duty Cycle: 1:1
Medium: HSL U10 BB_060425;
Medium parameters used: f = 2450 MHz; σ = 1.84 mho/m; ε_r = 38.3; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ES3DV2 - SN3025 (HF); ConvF(4.4, 4.4, 4.4); Calibrated: 28.10.2005
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 15.12.2005
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; ;
- Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

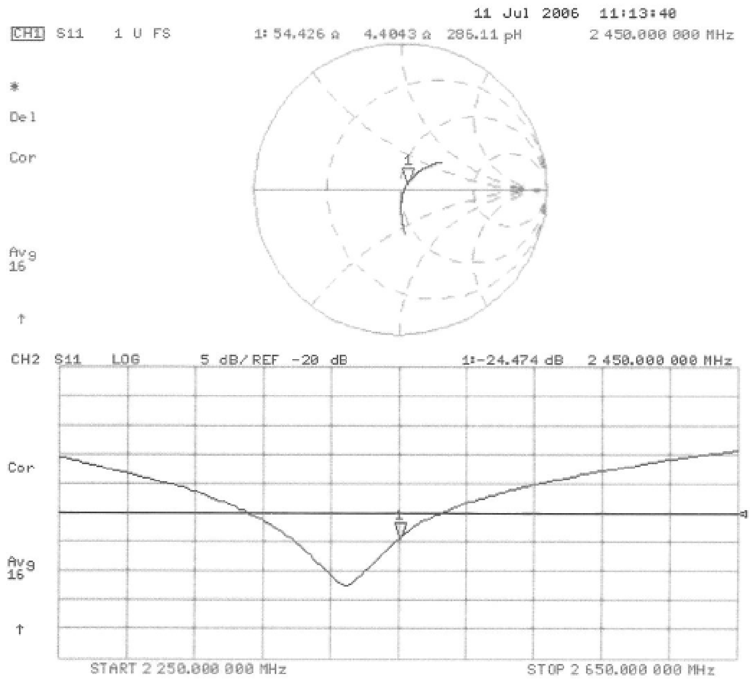
Pin = 250 mW; d = 10 mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 92.1 V/m; Power Drift = 0.039 dB
Peak SAR (extrapolated) = 29.5 W/kg
SAR(1 g) = 14.2 mW/g; SAR(10 g) = 6.59 mW/g
Maximum value of SAR (measured) = 15.5 mW/g



0 dB = 15.5mW/g

Certificate No: D2450V2-774_Jul06 Page 5 of 6

Impedance Measurement Plot for Head TSL



Certificate No: D2450V2-774_Jul06 Page 6 of 6

APPENDIX D : Photographs of EUT

Front View Of EUT

Rear View Of EUT

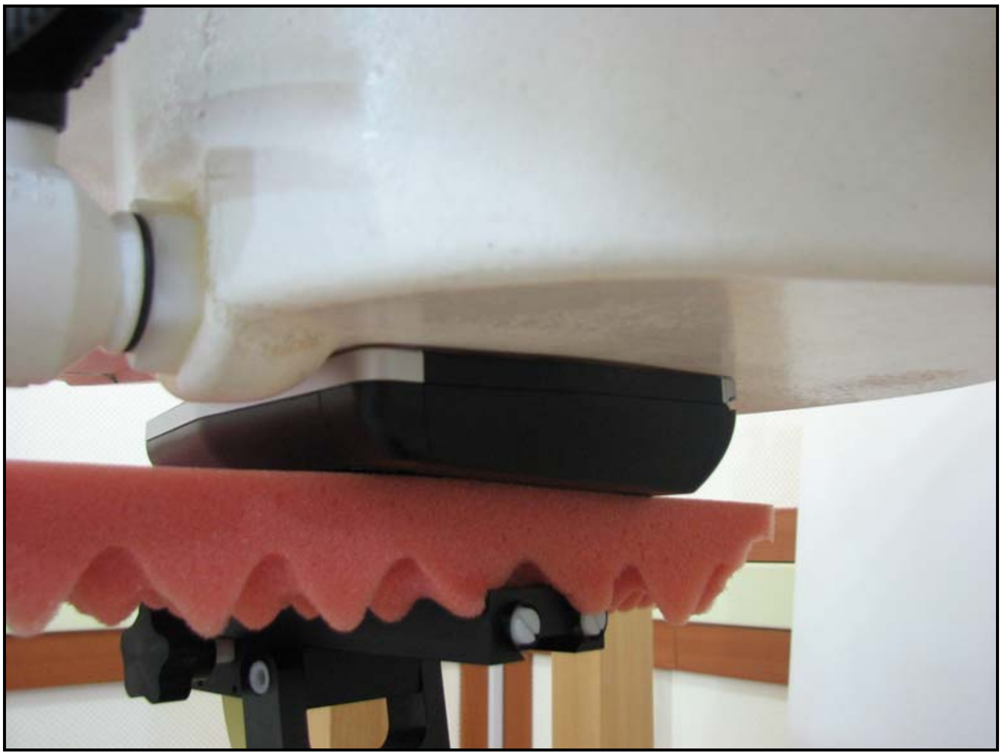
Top View Of EUT

Bottom View Of EUT

Right Side View Of EUT

Left Side View Of EUT

APPENDIX E : Test Position of EUT



Top Position

Bottom Position

Upper edge Position

Side edge Position