# SAR EVALUATION REPORT

## Report No. : 25IE0245-HO-6

| | | |
|---|---|---|
| **Applicant** | : | **Sony Corporation** |
| **Type of Equipment** | : | **Wireless LAN Module** |
| **Model No.** | : | **IRF303JU** |
| **FCC ID** | : | **AK8IRF303** |
| **Test standard** | : | **FCC47CFR 2.1093** |
| | : | **FCC OET Bulletin 65, Supplement C** |
| **Test Result** | : | **Complied (IEEE 802.11a)** |
| **Max. SAR Measured** | : | **0.445W/kg (Body 5320MHz)** |

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** : June 13, 15 and 16, 2005

**Tested by** : M. Ikuta

Miyo Ikuta
EMC Lab.Head Office

**Approved by** : T. Maeno

Tetsuo Maeno
Site Manager of Head Office EMC Lab.

**UL Apex Co., Ltd.**
**Head Office EMC Lab.**
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN
Telephone: +81 596 24 8116
Facsimile: +81 596 24 8124

**CONTENTS** **PAGE**

## SECTION 1 : Client information

| | | |
|---|---|---|
| Company Name | : | Sony Corporation |
| Brand Name | : | SONY |
| Address | : | Gate City Osaki West Tower Osaki East Tec.<br>1-11-1 Osaki Shinagawa-ku, Tokyo, 141-0032 Japan |
| Telephone Number | : | +81-3-5435-3977 |
| Facsimile Number | : | +81-3-5435-3963 |
| Contact Person | : | Masaki Nishimura |

## SECTION 2 : Equipment under test

### 2.1 Identification of EUT

| | | |
|---|---|---|
| Type of Equipment | : | Wireless LAN Module |
| Model No. | : | IRF303JU |
| Serial No. | : | 003 |
| Country of Manufacture | : | Japan |
| Condition of EUT | : | Engineering prototype<br>(Not for Sale: This sample is equivalent to mass-produced items.) |
| Rating | : | DC3.3V, 0.81A |
| Receipt Date of Sample | : | June 13, 2005 |
| Category Identified | : | Portable device |

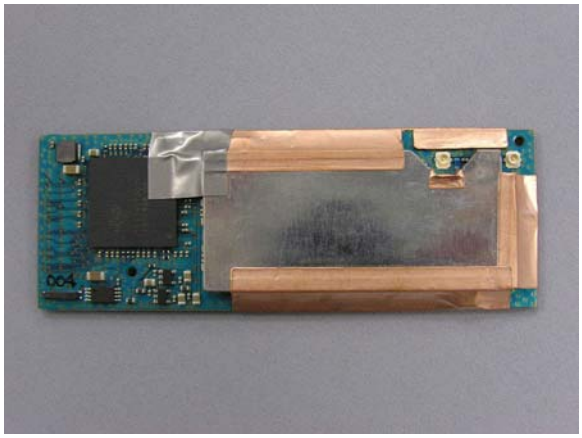
## 2.2 Product Description of EUT

This EUT has IEEE.802.11a/b/g.
The description only of the IEEE.802.11a mode is shown below.

Frequency of operation : 5180-5320MHz (IEEE802.11a)

Modulation : OFDM

Max.Output Power Tested
(5180MHz, Antenna Port 2) : 12.64 dBm Peak Conducted

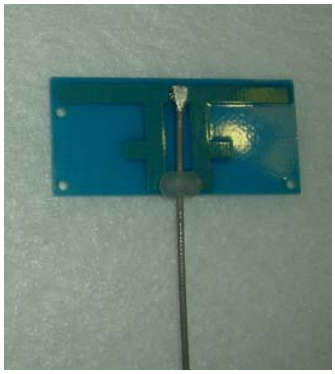


## 2.3 Product description of Antenna

Antenna Type : Pattern Antenna (M/N : LFANT103)

Antenna Gain (LFANT103 ) : 2.93dBi (MAX)

Antenna Connector Type : U.FL



## SECTION 3 : Requirements for compliance testing defined by the FCC

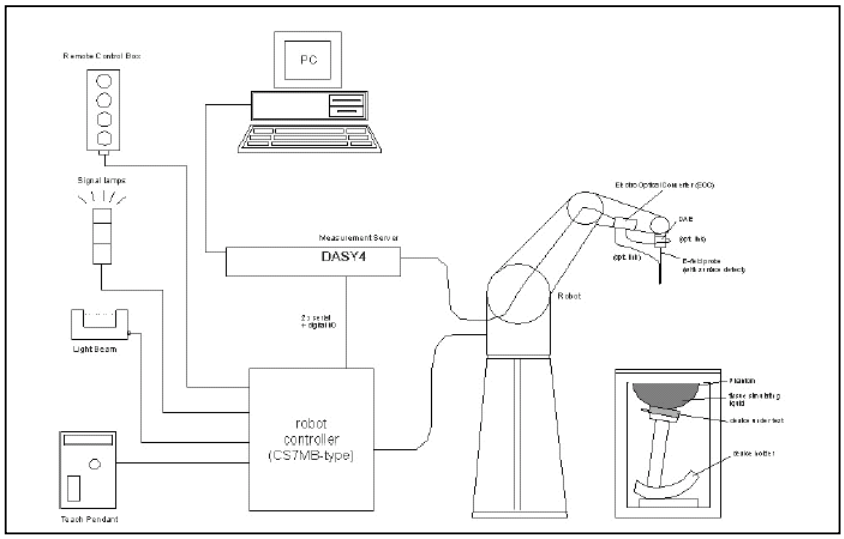
The US Federal Communications Commission has released the report and order “Guidelines for Evaluating the Environmental Effects of RF Radiation", ET Docket No. 93-62 in August 1996. The order requires routine SAR evaluation prior to equipment authorization of portable transmitter devices, including portable 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 EX3DV3, SN: 3507 (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.

## 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.

## 4.2 System components

### 4.2.1 EX3DV3 Probe Specification

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

**Calibration:**
Conversion Factors (CF) for
900MHz, 1800MHz, 2400MHz, 5200MHz, 5800MHz (Head and Body)

**Frequency:**
10 MHz to > 6GHz; Linearity: +/-0.2 dB(30 MHz to 3 GHz)

**Directivity:**
+/-0.3 dB in HSL (rotation around probe axis)
+/-0.5 dB in tissue material (rotation normal probe axis)

**Dynamic Range:**
10uW/g to > 100 mW/g;Linearity: +/-0.2 dB(noise: typically < 1uW/g)

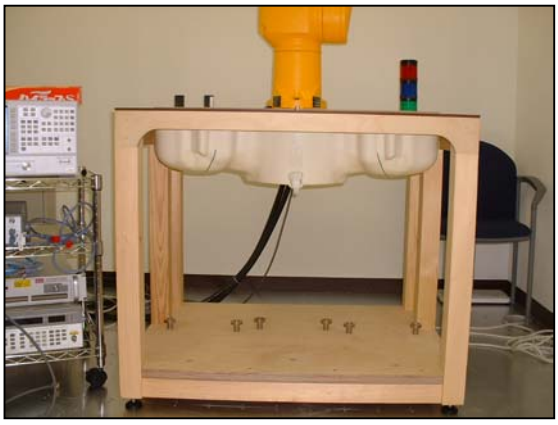
**Dimensions:**
Overall length: 330 mm (Tip: 20 mm)
Tip diameter: 2.5mm (Body: 12 mm)
Typical distance from probe tip to dipole centers: 1 mm

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

**EX3DV3 E-field Probe**

### 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 Twin 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 couldn't be used at this SAR measurement.

**Device Holder**

## 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+ |
| **Manuafacture** | : | Stäubli Unimation Corp. Robot Model: RX60 |

### DASY4 Measurement server

| | | |
|---|---|---|
| **Features** | : | 166MHz low power Pentium MMX<br>32MB chipdisk and 64MB RAM Serial link to DAE (with watchdog supervision)<br>16 Bit A/D converter for surface detection system<br>Two serial links to robot (one for real-time communication which is supervised by watchdog)<br>Ethernet link to PC (with watchdog supervision)<br>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<br>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 µV to > 200 mV (16 bit resolution and two range settings: 4mV, 400mV) |
| **Input Offset voltage** | : | < 1 µV (with auto zero) |
| **Input Resistance** | : | 200 MΩ |
| **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.** | : | 4.5 |
| **Manufacture / Origin** | : | Schimid & Partner Engineering AG |

### E-Field Probe

| | | |
|---|---|---|
| **Model** | : | EX3DV3 |
| **Serial No.** | : | 3507 |
| **Construction** | : | Symmetrical design with triangular core |
| **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 |

## SECTION 6 : Measurement outline

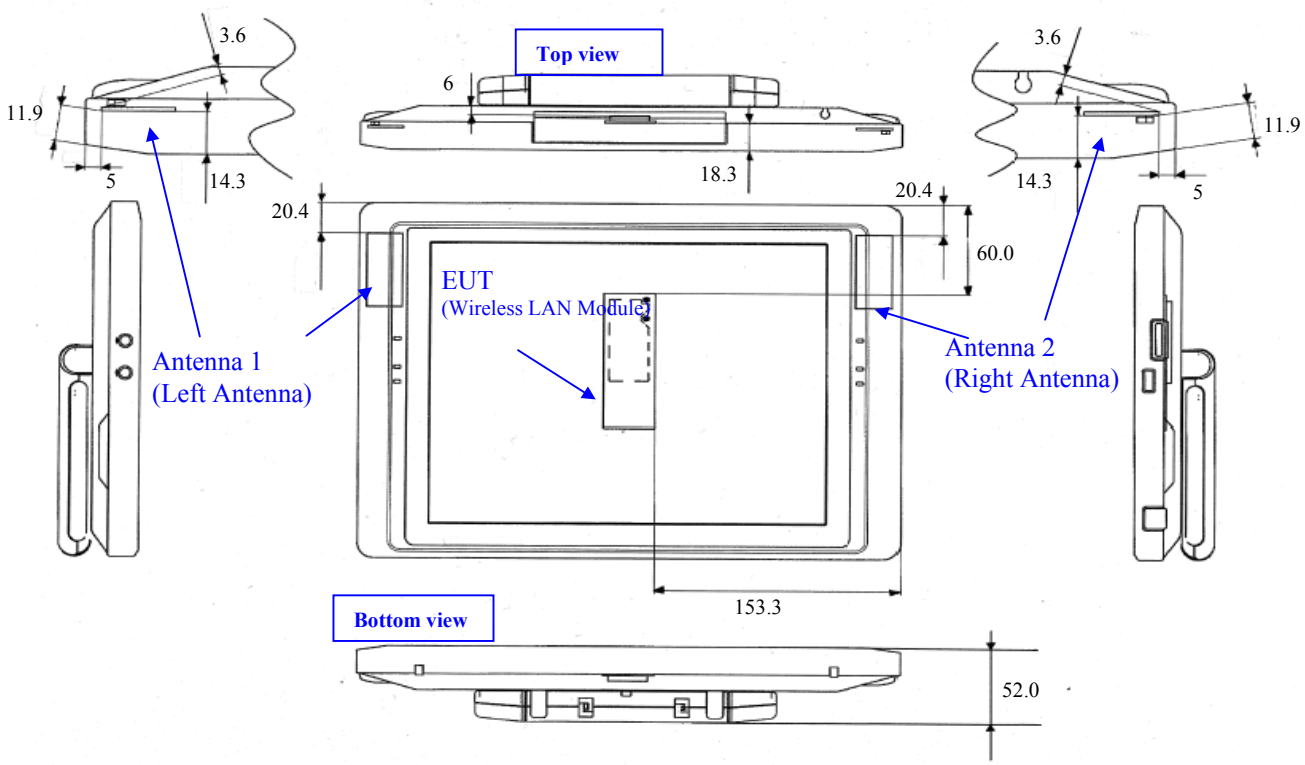
We tested with this EUT was inserted into the limited host device. (Location Free TV, model : LF-X11)
The test operation of the EUT was controlled by the PC. Therefore, we tested connecting the PC and the Location Free TV which inserted in the EUT.

The detail of the Location Free TV that we used for SAR testing is showing in the following.
The shortest distance between the surface of this Location Free TV and antenna is 3.6 mm.

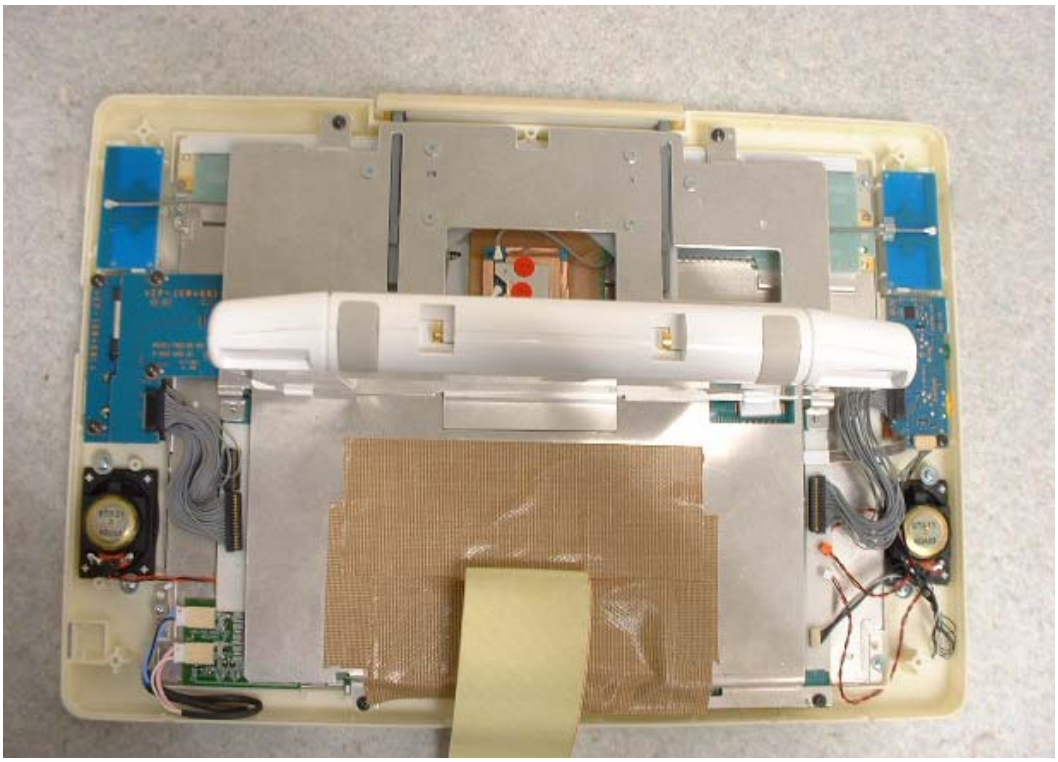
### 6.1 Information of host device

| | | |
|---|---|---|
| Type of Equipment | : | Location Free TV |
| Model name | : | LF-X11 |
| Manufacture | : | SONY |
| Battery | : | Only one type<br>Model name : BP-LX1A<br>V / mAh : 10.8V / 4400mAh |
| Position of Antenna | : | See figure and photograph of berrow |

Note : There are no accessories attached to this EUT.

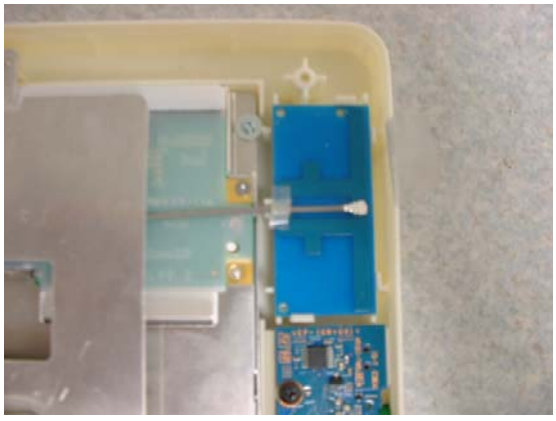


**Back view**



**Antenna 2 (Right Antenna)**

**Antenna 1 (Left Antenna)**



**UL Apex Co., Ltd.**
**Head Office EMC Lab.**
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN
Telephone: +81 596 24 8116
Facsimile: +81 596 24 8124

## SECTION 7 : Test setup of EUT

### 7.1 Photographs of test setup

This EUT is inserted into the Location Free TV.(model : LF-X11).
When users operate or carry the Location Free TV, 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.Left Front : The test was performed in touch with left front surface (ANT.1) of the Location Free TV to the flat section of SAM phantom.

2.Right Front : The test was performed in touch with right front surface (ANT.2) of the Location Free TV to the flat section of SAM phantom.

3.Left Side : The test was performed in touch with left side (ANT.1) of the Location Free TV to the flat section of SAM phantom.

4.Right Side : The test was performed in touch with right side (ANT.2) of the Location Free TV to the flat section of SAM phantom.

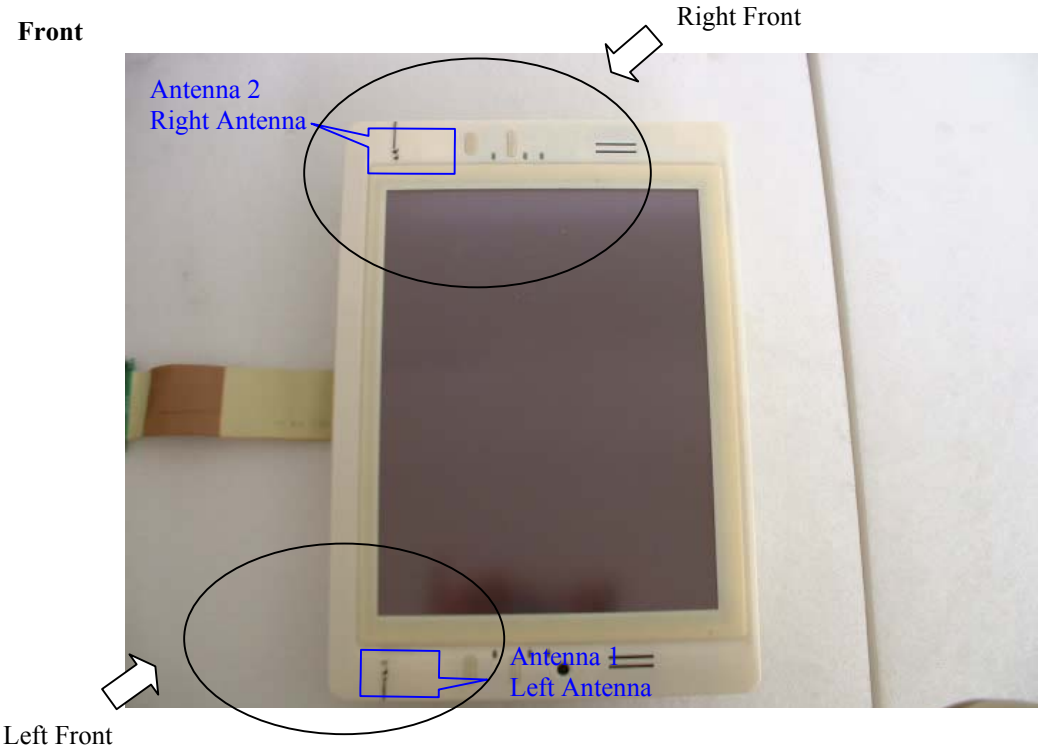
5.Left Back : The test was performed in touch with left back surface (ANT.1) of the Location Free TV to the flat section of SAM phantom

6.Right Back : The test was performed in touch with right back surface (ANT.2) of the Location Free TV to the flat section of SAM phantom.

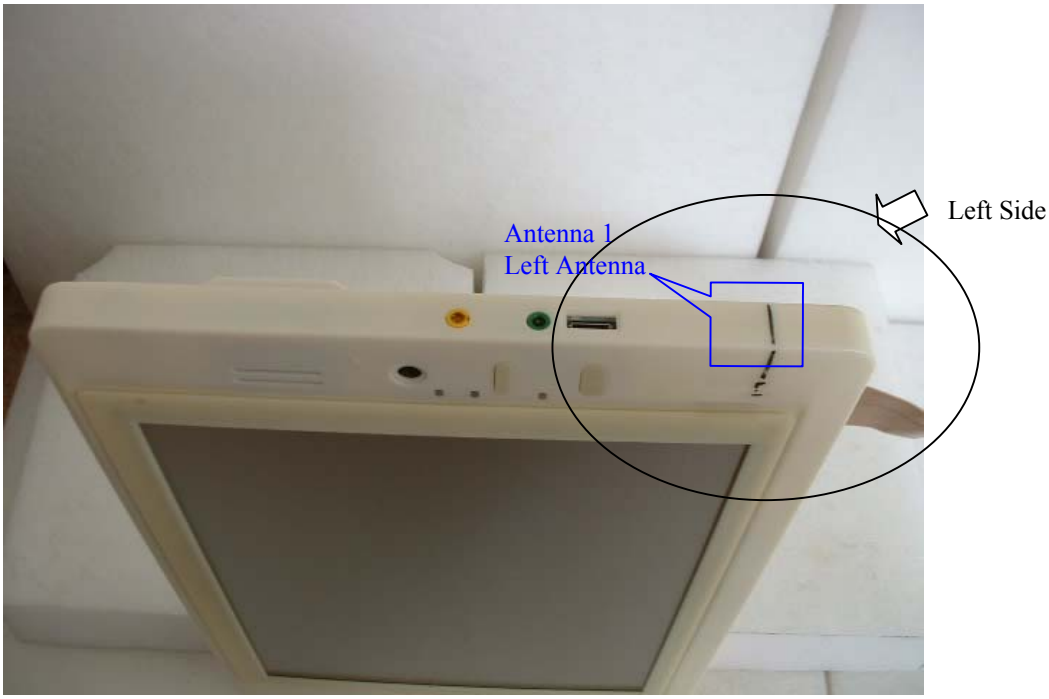
7.Left Top : The test was performed in touch with left top surface (ANT.1) of the Location Free TV to the flat section of SAM phantom

8.Right Top : The test was performed in touch with right top surface (ANT.2) of the Location Free TV to the flat section of SAM phantom

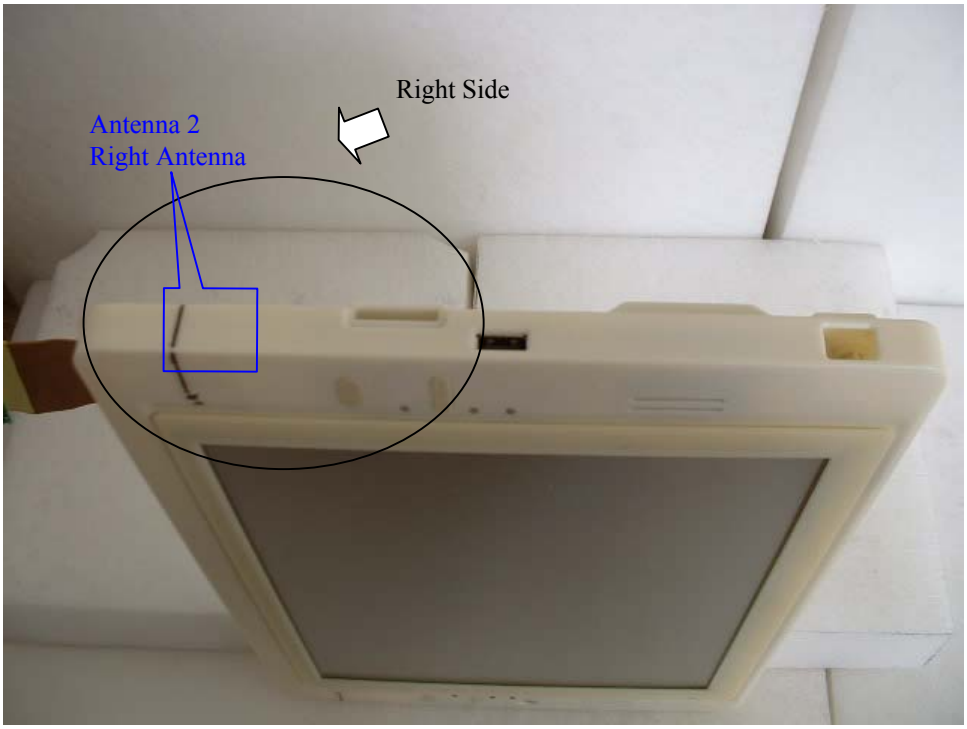
1. **Front**



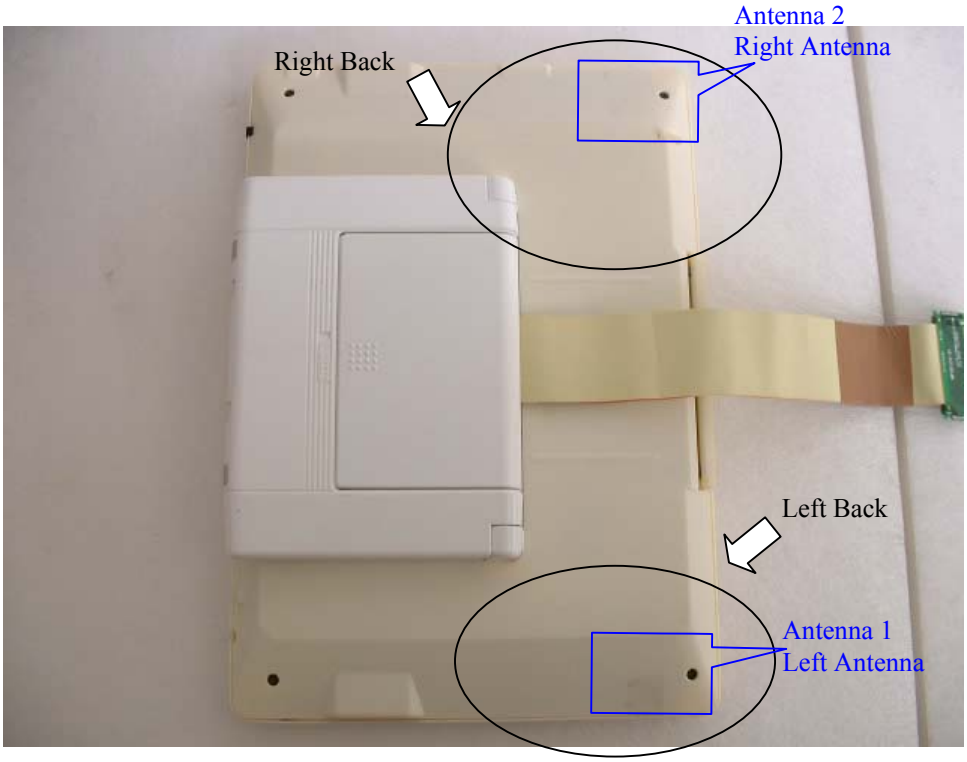

2. **Left Side**



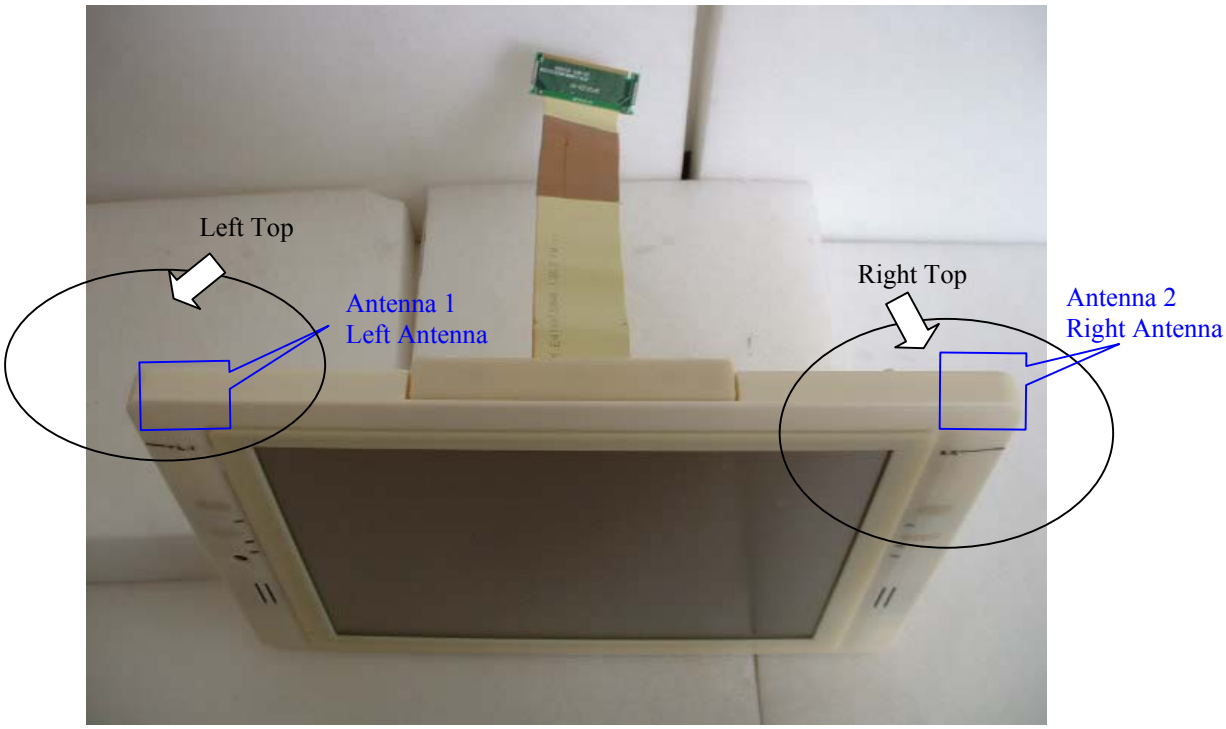
### 3. Right Side




### 4. Back



**5. Top**




## 7.2 EUT Tune-up procedure

The Wireless LAN module has IEEE.802.11a/b/g.
The frequency band and the modulation used in the testing of IEEE.802.11a are shown as a following.

1. IEEE 802.11a

| | |
|---|---|
| Frequency band | : 5150-5350MHz |
| Channel | : 36ch(5180MHz),52ch(5260MHz),64ch(5320MHz) |
| Modulation | : OFDM(BPSK,QPSK,16QAM,64QAM) |
| Crest factor | : 1 |

### 7.3 Method of measurement

Step1. The data rate in the higher peak power of each modulation was decided, then the worst modulation was searched in the SAR testing.

Step2. The searching of the worst position
This test was performed at the worst modulation of Step1.

Step3. The changing of the frequency
This test was performed at the worst conditions of Step2.

**Distance between Location Free TV and Phantom**
After we measure Antenna 1 and Antenna 2,
the measurement was performed with the distance 5mm and 10mm to check if the distance 0mm may not have the worst value at the conditions of the highest SAR value of this EUT. As result, the distance 0mm had the worst value.

## SECTION 8 : Measurement uncertainty

### 8.1 Uncertainty of 802.11a modes testing

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

| Error Description | Uncertainty value ± % | Probability distribution | divisor | (ci) 1g | Standard Uncertainty (1g) | vi or veff |
|---|---|---|---|---|---|---|
| **Measurement System** | | | | | | |
| Probe calibration | ±6.8 | Normal | 1 | 1 | ±6.8 | ∞ |
| Axial isotropy of the probe | ±4.7 | Rectangular | √3 | $(1-c_p)^{1/2}$ | ±1.9 | ∞ |
| Spherical isotropy of the probe | ±9.6 | Rectangular | √3 | $(c_p)^{1/2}$ | ±3.9 | ∞ |
| Boundary effects | ±2.0 | Rectangular | √3 | 1 | ±1.2 | ∞ |
| Probe linearity | ±4.7 | Rectangular | √3 | 1 | ±2.7 | ∞ |
| Detection limit | ±1.0 | Rectangular | √3 | 1 | ±0.6 | ∞ |
| Readout electronics | ±1.0 | Normal | 1 | 1 | ±1.0 | ∞ |
| Response time | ±0.8 | Rectangular | √3 | 1 | ±0.5 | ∞ |
| Integration time | ±2.6 | Rectangular | √3 | 1 | ±1.5 | ∞ |
| RF ambient conditions | ±3.0 | Rectangular | √3 | 1 | ±1.7 | ∞ |
| Mech. constraints of robot | ±0.8 | Rectangular | √3 | 1 | ±0.5 | ∞ |
| Probe positioning | ±5.7 | Rectangular | √3 | 1 | ±5.7 | ∞ |
| Extrap. and integration | ±4.0 | Rectangular | √3 | 1 | ±2.3 | ∞ |
| **Test Sample Related** | | | | | | |
| Device positioning | ±2.9 | Rectangular | √3 | 1 | ±2.9 | 17 |
| Device holder uncertainty | ±3.6 | Rectangular | √3 | 1 | ±3.6 | 7 |
| Power drift | ±10.0 | Rectangular | √3 | 1 | ±5.8 | ∞ |
| **Phantom and Setup** | | | | | | |
| Phantom uncertainty | ±4.0 | Rectangular | √3 | 1 | ±2.3 | ∞ |
| Liquid conductivity (target) | ±5.0 | Rectangular | √3 | 0.64 | ±1.8 | ∞ |
| Liquid conductivity (meas.) | ±5.0 | Normal | 1 | 0.64 | ±3.2 | ∞ |
| Liquid permittivity (target) | ±5.0 | Rectangular | √3 | 0.6 | ±1.7 | ∞ |
| Liquid permittivity (meas.) | ±5.0 | Normal | 1 | 0.6 | ±3.0 | ∞ |
| | | | | | | |
| **Combined Standard Uncertainty** | | | | | **±14.30** | |
| **Expanded Uncertainty (k=2)** | | | | | **±28.6** | |

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

## SECTION 9: Simulated tissue liquid parameter

### 9.1 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.

### 9.1.1 Muscle 5GHz

Type of liquid : **Muscle 5GHz**
Liquid depth (cm) : **15.2**
Ambient temperature (deg.c.) : **25.0(June 15 and 16)**
Relative Humidity (%) : **58(June 15),60(June 16)**

Measured By : Miyo Ikuta

| DIELECTRIC PARAMETERS MEASUREMENT RESULTS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Date | Frequency [MHz] | Liquid Temp [deg.c] | | Parameters | Target Value | Measured | Deviation [%] | Limit [%] |
| | | Before | After | | | | | |
| 15-Jun | 5200 | 24.9 | 24.9 | Relative Permittivity εr | 49.0 | 46.8 | -4.5 | +/-5 |
| | | | | Coductivity σ [mho/m] | 5.30 | 5.41 | 2.1 | +/-5 |
| 16-Jun | 5200 | 24.9 | 24.9 | Relative Permittivity εr | 49.0 | 46.8 | -4.5 | +/-5 |
| | | | | Coductivity σ [mho/m] | 5.30 | 5.32 | 0.4 | +/-5 |

### 9.2 Simulated Tissues Composition of 5GHz

| Ingredient | MIXTURE(%) | |
|---|---|---|
| | Head 5GHz | Muscle 5GHz |
| Water | 64.0 | 78.0 |
| Mineral Oil | 18.0 | 11.0 |
| Emulsifiers | 15.0 | 9.0 |
| Additives and salt | 3.0 | 2.0 |

### 9.3 Decision on Simulated Tissues of 5200MHz

In the current standards (e.g., IEEE P1528, OET 65 Supplement C), the dielectric parameters suggested for head and body tissue simulating liquid are given at 3000MHz and 5800MHz. As an intermediate solution, dielectric parameters for the frequencies between 5000to 5800 MHz were obtained using linear interpolation.
Therefore the dielectric parameters of 5200MHz were decided as following.
(5200MHz Body Tissue/ Relative Permittivity εr: **49.0**, Conductivity σ : **5.30** )

| f (MHz) | Head Tissue | | Body Tissue | | Reference |
|---|---|---|---|---|---|
| | ε r | σ [mho/m] | ε r | σ [mho/m] | |
| 3000 | 38.5 | 2.40 | 52.0 | 2.73 | Standard |
| 5800 | 35.3 | 5.27 | 48.2 | 6.00 | Standard |
| 5000 | 36.2 | 4.45 | 49.3 | 5.07 | Interpolated |
| 5100 | 36.1 | 4.55 | 49.1 | 5.18 | Interpolated |
| 5200 | 36.0 | 4.66 | 49.0 | 5.30 | Interpolated |
| 5300 | 35.9 | 4.76 | 48.9 | 5.42 | Interpolated |
| 5400 | 35.8 | 4.86 | 48.7 | 5.53 | Interpolated |
| 5500 | 35.6 | 4.96 | 48.6 | 5.65 | Interpolated |
| 5600 | 35.5 | 5.07 | 48.5 | 5.77 | Interpolated |
| 5700 | 35.4 | 5.17 | 48.3 | 5.88 | Interpolated |

Standard and interpolated dielectric parameters for head and body tissue simulating liquidin the frequency range 3000 to 5800MHz.

## SECTION 10 : System validation data

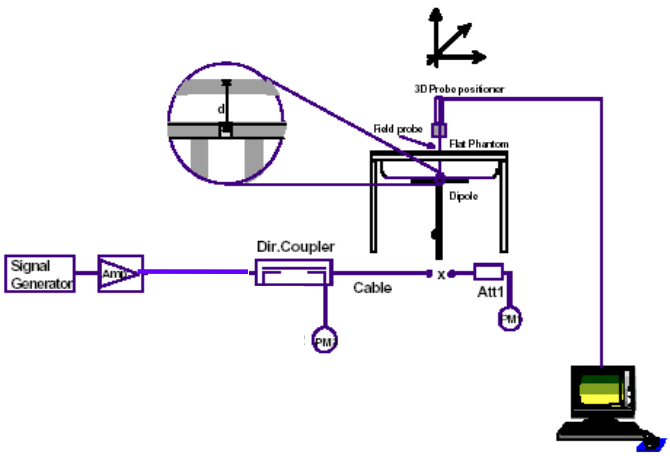
The target values of 5GHz were not defied by IEEE 1528. So, the target values were made into the calibration values of SPEAG. And each of the validation results of 5200MHz checked (Evaluation of muscle) that it was within +/-10% as compared with the calibration values of SPEAG. The validation results are in the table below. Please refer to APPENDIX5.

| | | |
|---|---|---|
| Type of liquid | : | **Muscle 5GHz** |
| Dipole | : | **D5GHzV2 SN:1020** |
| Power | : | **250mW** |
| Ambient temperature (deg.c.) | : | **25.0(June 15 and 16)** |
| Relative Humidity (%) | : | **58(June 15),60(June 16)** |

Measured By : Miyo Ikuta

| Date | Frequency | Liquid Temp [deg.c.] | | Relative Permittivity εr | | Conductivity σ [mho/m] | | SAR 1g [W/kg] | | Deviation [%] | Limit [%] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Before | After | Target | Measured | Target | Measured | Target | Measured | | |
| 15-Jun | 5200 | 24.9 | 24.9 | 49.0 | 46.8 | 5.30 | 5.41 | 20.5 | 19.3 | -5.9 | +/-10 |
| 16-Jun | 5200 | 24.9 | 24.9 | 49.0 | 46.8 | 5.30 | 5.32 | 20.5 | 19.1 | -6.8 | +/-10 |

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




**5100-5800MHz**
**Systemperformance check setup**

**Test system for the system performance check setup diagram**

## SECTION 11 : 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 10mm x 10 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 30mm x 30mm x 21mm was assessed by measuring 7 x 7 x 8 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 1 mm 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.

## SECTION 12 : 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**

## SECTION 13 : SAR Measurement results

### 13.1 Antenna 1

### 13.1.1 Conducted power of Antenna Port 1

| [IEEE802.11a 5150-5350MHz : Antenna Port 1 (by the data rate) ] | | | | | | |
|---|---|---|---|---|---|---|
| Ch | Modulation (Data rate[Mbps]) | S/A Reading [dBm] | Cable Loss [dB] | Atten. [dB] | Result [dBm] | Converted [mW] |
| 52 | BPSK(6Mbps) | 0.65 | 1.23 | 10.00 | 11.88 | 15.42 |
| 52 | BPSK(9Mbps) | 0.51 | 1.23 | 10.00 | 11.74 | 14.93 |
| 52 | QPSK(12Mbps) | 0.68 | 1.23 | 10.00 | 11.91 | 15.52 |
| 52 | QPSK(18Mbps) | 0.57 | 1.23 | 10.00 | 11.80 | 15.14 |
| 52 | 16QAM(24Mbps) | 0.68 | 1.23 | 10.00 | 11.91 | 15.52 |
| 52 | 16QAM(36Mbps) | 0.65 | 1.23 | 10.00 | 11.88 | 15.42 |
| 52 | 64QAM(48Mbps) | 0.50 | 1.23 | 10.00 | 11.73 | 14.89 |
| 52 | 64QAM(54Mbps) | 0.70 | 1.23 | 10.00 | 11.93 | 15.60 |

**[The worst data rate in SAR result]**

| [IEEE802.11a 5150-5350MHz: Antenna Port 1 (12Mbps)] | | | | | | |
|---|---|---|---|---|---|---|
| Ch | Freq. [MHz] | S/A Reading [dBm] | Cable Loss [dB] | Atten. [dB] | Result [dBm] | Converted [mW] |
| 36 | 5180 | 1.32 | 1.23 | 10.00 | 12.55 | 17.99 |
| 52 | 5260 | 0.68 | 1.23 | 10.00 | 11.91 | 15.52 |
| 64 | 5320 | 0.49 | 1.23 | 10.00 | 11.72 | 14.84 |

| [IEEE802.11a 5150-5350MHz: Antenna Port 1 (54Mbps)] | | | | | | |
|---|---|---|---|---|---|---|
| Ch | Freq. [MHz] | S/A Reading [dBm] | Cable Loss [dB] | Atten. [dB] | Result [dBm] | Converted [mW] |
| 36 | 5180 | 1.36 | 1.23 | 10.00 | 12.59 | 18.16 |
| 52 | 5260 | 0.70 | 1.23 | 10.00 | 11.93 | 15.60 |
| 64 | 5320 | 0.50 | 1.23 | 10.00 | 11.73 | 14.89 |

### 13.1.2 Body 5150-5350MHz SAR of Antenna 1

| | | | | | |
|---|---|---|---|---|---|
| Liquid Depth (cm) | : | **15.2** | Model | : | **IRF303JU** |
| Parameters | : | $\varepsilon_r$ =**46.8**, $\sigma$ =**5.41** | Serial No. | : | **003** |
| Ambient temperature (deg.c.) | : | **25.0** | Modulation | : | **OFDM** |
| Relative Humidity (%) | : | **58** | Crest factor | : | **1** |

Date : June 15,2005
Measured By : Miyo Ikuta

**BODY SAR MEASUREMENT RESULTS OF ANTENNA 1 (IEEE802.11a 5150-5350MHz)**

| Frequency | | | Modulation (Data rate [bps]) | Phantom Section | EUT Set-up Conditions | | | Liquid Temp.[deg.c] | | SAR(1g) [W/kg] |
|---|---|---|---|---|---|---|---|---|---|---|
| Band | Channel | [MHz] | | | Antenna | Position | Separation [mm] | Before | After | Maximum value of multi-peak |
| 5150-5350MHz | **Step 1 Modulation search** | | | | | | | | | |
| | 52 | 5260 | BPSK(6Mbps) | Flat | ANT.1 | Left Front | 0 | 24.0 | 24.0 | **0.216** |
| | 52 | 5260 | QPSK(12Mbps) | Flat | ANT.1 | Left Front | 0 | 24.0 | 24.0 | **0.356** |
| | 52 | 5260 | 16QAM(24Mbps) | Flat | ANT.1 | Left Front | 0 | 24.1 | 24.2 | **0.257** |
| | 52 | 5260 | 64QAM(54Mbps) | Flat | ANT.1 | Left Front | 0 | 24.2 | 24.3 | **0.336** |
| | **Step 2 Position search** | | | | | | | | | |
| | 52 | 5260 | QPSK(12Mbps) | Flat | ANT.1 | Left Side | 0 | 24.2 | 24.3 | **0.094** |
| | 52 | 5260 | QPSK(12Mbps) | Flat | ANT.1 | Left Back | 0 | 24.6 | 24.6 | **0.038** |
| | 52 | 5260 | QPSK(12Mbps) | Flat | ANT.1 | Left Top | 0 | 24.3 | 24.2 | **0.012** |
| | **Step 3 Frequency Change** | | | | | | | | | |
| | 36 | 5180 | QPSK(12Mbps) | Flat | ANT.1 | Left Front | 0 | 24.2 | 24.3 | **0.222** |
| | 64 | 5320 | QPSK(12Mbps) | Flat | ANT.1 | Left Front | 0 | 24.3 | 24.4 | **0.445** |
| **ANSI / IEEE C95.1 1992 - SAFETY LIMIT<br>Spatial Peak Uncontrolled Exposure / General Population** | | | | | | | | **Body SAR: 1.6 W/kg<br>(averaged over 1 gram)** | | |

## 13.2 Antenna 2

### 13.2.1 Conducted power of Antenna Port 2

| [IEEE802.11a 5150-5350MHz: Antenna Port 2 (by the data rate) ] | | | | | | |
|---|---|---|---|---|---|---|
| Ch | Modulation (Data rate[Mbps]) | S/A Reading [dBm] | Cable Loss [dB] | Atten. [dB] | Result [dBm] | Converted [mW] |
| 52 | BPSK(6Mbps) | 0.73 | 1.23 | 10.00 | 11.96 | 15.70 |
| 52 | BPSK(9Mbps) | 0.73 | 1.23 | 10.00 | 11.96 | 15.70 |
| 52 | QPSK(12Mbps) | 0.71 | 1.23 | 10.00 | 11.94 | 15.63 |
| 52 | QPSK(18Mbps) | 0.62 | 1.23 | 10.00 | 11.85 | 15.31 |
| 52 | 16QAM(24Mbps) | 0.61 | 1.23 | 10.00 | 11.84 | 15.28 |
| 52 | 16QAM(36Mbps) | 0.72 | 1.23 | 10.00 | 11.95 | 15.67 |
| 52 | 64QAM(48Mbps) | 0.69 | 1.23 | 10.00 | 11.92 | 15.56 |
| 52 | 64QAM(54Mbps) | 0.76 | 1.23 | 10.00 | 11.99 | 15.81 |

**[The worst data rate in SAR result]**

| [IEEE802.11a 5150-5350MHz: Antenna Port 2 (12Mbps)] | | | | | | |
|---|---|---|---|---|---|---|
| Ch | Freq. [MHz] | S/A Reading [dBm] | Cable Loss [dB] | Atten. [dB] | Result [dBm] | Converted [mW] |
| 36 | 5180 | 1.04 | 1.23 | 10.00 | 12.27 | 16.85 |
| 52 | 5260 | 0.71 | 1.23 | 10.00 | 11.94 | 15.63 |
| 64 | 5320 | 0.43 | 1.23 | 10.00 | 11.66 | 14.66 |

| [IEEE802.11a 5150-5350MHz: Antenna Port 2 (54Mbps)] | | | | | | |
|---|---|---|---|---|---|---|
| Ch | Freq. [MHz] | S/A Reading [dBm] | Cable Loss [dB] | Atten. [dB] | Result [dBm] | Converted [mW] |
| 36 | 5180 | 1.41 | 1.23 | 10.00 | 12.64 | 18.37 |
| 52 | 5260 | 0.76 | 1.23 | 10.00 | 11.99 | 15.81 |
| 64 | 5320 | 0.49 | 1.23 | 10.00 | 11.72 | 14.86 |

### 13.2.2 Body 5150-5350MHz SAR of Antenna 2

| | | | | | |
|---|---|---|---|---|---|
| Liquid Depth (cm) | : | **15.2** | Model | : | **IRF303JU** |
| Parameters | : | **$\varepsilon_r$ =46.8, $\sigma$ =5.32** | Serial No. | : | **003** |
| Ambient temperature (deg.c.) | : | **25.0** | Modulation | : | **OFDM** |
| Relative Humidity (%) | : | **60** | Crest factor | : | **1** |

Date : June 16,2005
Measured By : Miyo Ikuta

| BODY SAR MEASUREMENT RESULTS OF ANTENNA2 (IEEE802.11a 5150-5350MHz) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | | | Modulation (Data rate [bps]) | Phantom Section | EUT Set-up Conditions | | | Liquid Temp.[deg.c] | | SAR(1g) [W/kg] |
| Band | Channel | [MHz] | | | Antenna | Position | Separation [mm] | Before | After | Maximum value of multi-peak |
| 5150-5350MHz | **Step 1 Modulation search** | | | | | | | | | |
| | 52 | 5260 | BPSK(6Mbps) | Flat | ANT.2 | Right Front | 0 | 24.9 | 24.9 | **0.155** |
| | 52 | 5260 | QPSK(12Mbps) | Flat | ANT.2 | Right Front | 0 | 24.9 | 24.9 | **0.244** |
| | 52 | 5260 | 16QAM(36Mbps) | Flat | ANT.2 | Right Front | 0 | 24.9 | 24.8 | **0.237** |
| | 52 | 5260 | 64QAM(54Mbps) | Flat | ANT.2 | Right Front | 0 | 24.8 | 24.9 | **0.240** |
| | **Step 2 Position search** | | | | | | | | | |
| | 52 | 5260 | QPSK(12Mbps) | Flat | ANT.2 | Right Side | 0 | 25.0 | 24.9 | **0.059** |
| | 52 | 5260 | QPSK(12Mbps) | Flat | ANT.2 | Right Back | 0 | 24.8 | 24.7 | **0.062** |
| | 52 | 5260 | QPSK(12Mbps) | Flat | ANT.2 | Right Top | 0 | 24.9 | 24.8 | **0.015** |
| | **Step 3 Frequency Change** | | | | | | | | | |
| | 36 | 5180 | QPSK(12Mbps) | Flat | ANT.2 | Right Front | 0 | 24.9 | 25.0 | **0.357** |
| | 64 | 5320 | QPSK(12Mbps) | Flat | ANT.2 | Right Front | 0 | 25.0 | 25.0 | **0.226** |
| **ANSI / IEEE C95.1 1992 - SAFETY LIMIT**<br>**Spatial Peak Uncontrolled Exposure / General Population** | | | | | | | | **Body SAR: 1.6 W/kg**<br>**(averaged over 1 gram)** | | |

### 13.3 Distance between Location Free TV and Phantom

This measurement opened the distance of Location Free TV and Phantom.
This test was performed at the conditions of the highest SAR value.

Date : June 16,2005
Measured By : Miyo Ikuta

| BODY SAR MEASUREMENT RESULTS OF ANTENNA 1 (IEEE802.11a 5150-5350MHz) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | | | Modulation | Phantom Section | EUT Set-up Conditions | | | Liquid Temp.[deg.c] | | SAR(1g) [W/kg] |
| Band | Channel | [MHz] | | | Antenna | Position | Separation [mm] | Before | After | Maximum value of multi-peak |
| 5150-5350MHz | **Distance Change** | | | | | | | | | |
| | 64 | 5320 | QPSK(12Mbps) | Flat | ANT.1 | Left Front | 5 | 24.8 | 24.8 | **0.210** |
| | 64 | 5320 | QPSK(12Mbps) | Flat | ANT.1 | Left Front | 10 | 24.8 | 24.7 | **0.142** |
| **ANSI / IEEE C95.1 1992 - SAFETY LIMIT**<br>**Spatial Peak Uncontrolled Exposure / General Population** | | | | | | | | **Body SAR: 1.6 W/kg**<br>**(averaged over 1 gram)** | | |

## SECTION 14 : Equipment & calibration information

| Name of Equipment | Manufacture | Model number | Serial number | Calibration | |
|---|---|---|---|---|---|
| | | | | Last Cal | due date |
| Power Meter | Agilent | E4417A | GB41290639 | 2004/11/09 | 2005/11/08 |
| Power Sensor | Agilent | E9300B | US40010300 | 2004/11/15 | 2005/11/14 |
| Power Sensor | Agilent | E9327A | US40440545 | 2004/11/23 | 2005/11/22 |
| Spectrum Analyzer | Agilent | E4448A | MY44020357 | 2005/06/03 | 2006/06/02 |
| S-Parameter Network Analyzer | Agilent | 8753ES | US39174808 | 2003/10/23 | 2006/10/22 |
| Signal Generator | Rohde&Schwarz | SML40 | 100023 | 2005/01/05 | 2006/01/04 |
| RF Amplifier | TSJ | TCBP0206 | - | 2005/2/24 | 2006/2/23 |
| Dosimetric E-Field Probe | Schmid&Partner Engineering AG | EX3DV3 | 3507 | 2005/4/12 | 2006/4/11 |
| Data Acquisition Electronics | Schmid&Partner Engineering AG | DAE3 | 516 | 2005/3/10 | 2006/3/09 |
| Robot,SAM Phantom | Schmid&Partner Engineering AG | DASY4 | I021834 | N/A | N/A |
| Attenuator | Agilent | US40010300 | 08498-60012 | 2004/12/16 | 2005/12/15 |
| Attenuator | Orient Microwave | BX10-0476-00 | - | 2005/03/16 | 2006/03/15 |
| 5GHz System Validation Dipole | Schmid&Partner Engineering AG | D5GHzV2 | 1020 | 2004/2/23 | 2006/2/22 |
| Dual Directional Coupler | N/A | Narda | 3702 | N/A | N/A |
| Body 5800MHz | N/A | N/A | N/A | N/A | N/A |
| Ambient Noise <0.012W/kg | SAR room | - | - | 2005/6/15<br>2005/6/16 | - |

## SECTION 15 : 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] Barry N. Taylor and Christ E. Kuyatt, "Guidelines for evaluating and expressing the uncertainty of NIST measurement results", Tech. Rep., National Institute of Standards and Technology,1994.