SECTION 7 : Measurement uncertainty

7.1 Uncertainty of 802.11b/g modes testing

The uncertainty budget has been determined for the DASY4 measurement system in the following Table.

Error Description	Uncertainty value ± %	Probability distribution	divisor	(ci)1 1g	Standard Uncertainty (1g)	vi or veff
Measurement System						
Probe calibration	±4.8	Normal	1	1	±4.8	∞
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	±1.0	Rectangular	√3	1	±0.6	∞
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	±0.4	Rectangular	√3	1	±0.2	∞
Probe positioning	±2.9	Rectangular	√3	1	±1.7	∞
Extrap. and integration	±1.0	Rectangular	√3	1	±0.6	∞
Test Sample Related						
Device positioning	±2.9	Rectangular	√3	1	±2.9	37
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	Rectangular	√3	0.64	±1.8	∞
Liquid permittivity (target)	±5.0	Rectangular	√3	0.6	±1.7	∞
Liquid permittivity (meas.)	±5.0	Rectangular	√3	0.6	±1.7	∞
Combined Standard Uncertainty					**±11.51**	
Expanded Uncertainty (k=2)					**±23.0**	

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

SECTION 8 : Simulated tissue liquid parameter

8.1 Simulated Tissue Liquid Parameter confirmation

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

8.2 Head 2450 MHz

Type of liquid : **Head 2450 MHz**
Ambient temperature (deg.c.) : **25.0(March 25 and 28)**
Relative Humidity (%) : **45(March 25), 56(March 28)**
Lquid depth (cm) : **15.2**

DIELECTRIC PARAMETERS MEASUREMENT RESULTS								
Date	Frequency	Liquid Temp [deg.c]		Parameters	Target Value	Measured	Deviation [%]	Limit [%]
		Before	After					
25-Mar	2450	24.5	24.5	Relative Permittivity εr	39.2	37.7	-3.8	+/-5
				Coductivity σ [mho/m]	1.80	1.88	4.4	+/-5
28-Mar	2450	24.5	24.5	Relative Permittivity εr	39.2	37.7	-3.8	+/-5
				Coductivity σ [mho/m]	1.80	1.87	3.9	+/-5

8.3 Muscle 2450 MHz

Type of liquid : **Muscle 2450 MHz**
Ambient temperature (deg.c.) : **25.0(March 25 and 28)**
Relative Humidity (%) : **45(March 25), 56(March 28)**
Liquid depth (cm) : **15.2**

DIELECTRIC PARAMETERS MEASUREMENT RESULTS								
Date	Frequency	Liquid Temp [deg.c]		Parameters	Target Value	Measured	Deviation [%]	Limit [%]
		Before	After					
25-Mar	2450	24.0	24.0	Relative Permittivity εr	52.7	50.1	-4.9	+/-5
				Coductivity σ [mho/m]	1.95	1.99	2.1	+/-5
28-Mar	2450	24.5	24.5	Relative Permittivity εr	52.7	50.1	-4.9	+/-5
				Coductivity σ [mho/m]	1.95	1.97	1.0	+/-5

8.4 Simulated Tissues Composition of 2450MHz

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

Note:DGMBE(Diethylenglycol-monobuthyl ether)

SECTION 9 : System validation data

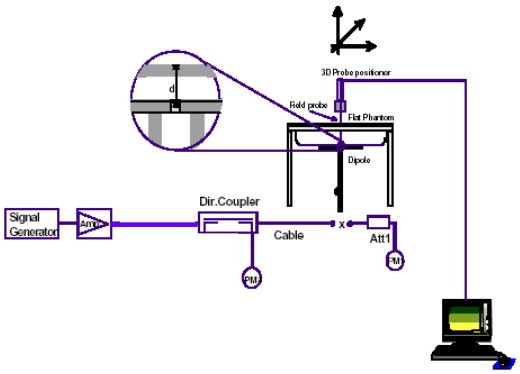
Prior to the assessment, the system validation kit was used to test whether the system was operating within its specifications of +/-10%.

9.1 System validation of 2450MHz

Type of liquid	:	**HEAD 2450MHz**
Frequency	:	**2450MHz**
Ambient temperature (deg.c.)	:	**25.0(March 25 and 28)**
Relative Humidity (%)	:	**45(March 25), 56(March 28)**
Dipole	:	**D2450V2 SN:713**
Power	:	**250mW**

SYSTEM PERFORMANCE CHECK										
Date	Liquid (HEAD 2450MHz)						System dipole validation target & measured			
	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		
25-Mar	24.5	24.5	39.2	37.7	1.80	1.88	13.1	13.8	5.3	+/-10
28-Mar	24.5	24.5	39.2	37.7	1.80	1.87	13.1	14.3	9.2	+/-10

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



2450MHz System performance check setup

Test system for the system performance check setup diagram

SECTION 10 : Evaluation procedure

The evaluation was performed with the following procedure:

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

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

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

1. The data at the surface were extrapolated, since the center of the dipoles is 2.7 mm away from the tip of the probe and the distance between the surface and the lowest measuring point is 1.3 mm. The extrapolation was based on a least square algorithm [4]. A polynomial of the fourth order was calculated through the points in z-axes.
This polynomial was then used to evaluate the points between the surface and the probe tip.

2. The maximum interpolated value was searched with a straightforward algorithm. Around this maximum the SAR values averaged over the spatial volumes (1 g or 10 g) were computed by the 3D-Spline interpolation algorithm. The 3D-Spline is composed of three one-dimensional splines with the “Not a knot"-condition (in x, y and z-directions) [4], [5]. The volume was integrated with the trapezoidal-algorithm. One thousand points (10 x 10 x 10) were interpolated to calculate the average.

3. All neighboring volumes were evaluated until no neighboring volume with a higher average value was found.

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

SECTION 11 : Exposure limit

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

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

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

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

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

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

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

SECTION 12 : SAR Measurement results

12.1 Conducted power of Right Antenna (ANT.0)

	[MHz]	Reading [dBm]	Loss [dB]	[dB]	[dBm]	[mW]
Low	2412.0	6.30	1.02	10.00	17.32	53.95
Mid	2437.0	5.21	1.00	10.00	16.21	41.78
High	2462.0	4.95	0.97	10.00	15.92	39.08

[IEEE802.11g : Right Antenna (ANT.0) (by the data rate) Ch: Mid 2437MHz]						
Modulation	Data rate [bps]	S/A Reading [dBm]	Cable Loss [dB]	Atten. [dB]	Result [dBm]	Converted [mW]
BPSK	6	5.39	1.00	10.00	16.39	43.55
	9	5.44	1.00	10.00	16.44	44.06
QPSK	12	5.46	1.00	10.00	16.46	44.26
	18	5.39	1.00	10.00	16.39	43.55
16QAM	24	4.71	1.00	10.00	15.71	37.24
	36	5.23	1.00	10.00	16.23	41.98
64QAM	48	5.18	1.00	10.00	16.18	41.50
	54	6.23	1.00	10.00	17.23	52.84

[IEEE802.11g : BPSK/6Mbps : Right Antenna (ANT.0)]						
Ch	Freq. [MHz]	S/A Reading [dBm]	Cable Loss [dB]	Atten. [dB]	Result [dBm]	Converted [mW]
Low	2412.0	5.82	1.02	10.00	16.84	48.31
Mid	2437.0	5.39	1.00	10.00	16.39	43.55
High	2462.0	5.28	0.97	10.00	16.25	42.17

[IEEE802.11g : 64QAM/54Mbps : Right Antenna (ANT.0)]						
Ch	Freq. [MHz]	S/A Reading [dBm]	Cable Loss [dB]	Atten. [dB]	Result [dBm]	Converted [mW]
Low	2412.0	6.73	1.02	10.00	17.75	59.57
Mid	2437.0	6.23	1.00	10.00	17.23	52.84
High	2462.0	6.08	0.97	10.00	17.05	50.70

12.2 Body 2450MHz SAR of Right Antenna (ANT.0)

Liquid Depth (cm)	:	**15.2**	Model	:	**S1596-01**
Parameters	:	ε_r =**50.1**, σ =**1.99**	Serial No.	:	**524006A**
Ambient temperature (deg.c.)	:	**25.0**	Modulation	:	**DSSS,OFDM**
Relative Humidity (%)	:	**45**			

Date : March 25, 2005
Measured By : Miyo Ikuta

BODY SAR MEASUREMENT RESULTS OF ANT.0 (RIGHT ANTENNA)

W-LAN			Bluetooth	Modulation	Phantom Section	EUT Set-up Conditions			Liquid Temp.[deg.c]		SAR(1g) [W/kg]
Mode	Channel	Frequency [MHz]	Hopping			Antenna	Position	Separation [mm]	Before	After	Maximum value of multi-peak
IEEE 802.11b + Bluetooth ON	**Step1.**	**Modulation search**									
	6	2437	ON	DBPSK（1M）	Flat	Fixed	Right Back	0	23.2	23.3	**0.509**
	6	2437	ON	DQPSK(2M)	Flat	Fixed	Right Back	0	23.3	23.4	**0.267**
	6	2437	ON	CCK(5.5M)	Flat	Fixed	Right Back	0	23.4	23.4	**0.123**
	6	2437	ON	CCK(11M)	Flat	Fixed	Right Back	0	23.8	24.0	**0.0569**
	Step2.	**Position search**									
	6	2437	ON	DBPSK（1M）	Flat	Fixed	Right Front	0	24.0	24.0	**0.0154**
	6	2437	ON	DBPSK（1M）	Flat	Fixed	Right Top	0	24.0	24.0	**0.0307**
	6	2437	ON	DBPSK（1M）	Flat	Fixed	Right Side	0	24.0	24.0	**0.0342**
	Step3.	**Channel change**									
	1	2412	ON	DBPSK（1M）	Flat	Fixed	Right Back	0	23.9	23.9	**0.608**
	11	2462	ON	DBPSK（1M）	Flat	Fixed	Right Back	0	24.0	24.0	**0.268**
IEEE 802.11g + Bluetooth ON	**Step1.**	**Modulation search**									
	6	2437	ON	BPSK（6M）	Flat	Fixed	Right Back	0	24.0	24.0	**0.0458**
	6	2437	ON	QPSK （18M）	Flat	Fixed	Right Back	0	24.0	24.0	**0.0311**
	6	2437	ON	16QAM（36M）	Flat	Fixed	Right Back	0	24.0	24.0	**0.0163**
	6	2437	ON	64QAM（54M）	Flat	Fixed	Right Back	0	24.0	24.0	**0.0148**
	Step2.	**Position search**									
	6	2437	ON	BPSK（6M）	Flat	Fixed	Right Front	0	23.6	23.4	**0.0101**
	6	2437	ON	BPSK（6M）	Flat	Fixed	Right Top	0	23.8	23.7	**0.0104**
	6	2437	ON	BPSK（6M）	Flat	Fixed	Right Side	0	23.7	23.7	**0.305**
	Step3.	**Channel change**									
	1	2412	ON	BPSK（6M）	Flat	Fixed	Right Back	0	24.1	24.2	**0.0303**
	11	2462	ON	BPSK（6M）	Flat	Fixed	Right Back	0	24.2	24.0	**0.0419**
IEEE 802.11b	**Transmission of only W-LAN at worst condition of ANT.0 (Right Antenna)**										
	1	2412	OFF	DBPSK（1M）	Flat	Fixed	Right Back	0	24.0	24.0	**0.498**
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure / General Population									**Body SAR: 1.6 W/kg (averaged over 1 gram)**		

12.3 Conducted power of Left Antenna (ANT.1)

[IEEE802.11b : Left antenna (ANT.1) (by the data rate) Ch: Mid 2437MHz]						
Modulation	Data rate [bps]	S/A Reading [dBm]	Cable Loss [dB]	Atten. [dB]	Result [dBm]	Converted [mW]
DBPSK	1	4.10	1.00	10.00	15.10	32.36
DQPSK	2	3.88	1.00	10.00	14.88	30.76
CCK	5.5	4.46	1.00	10.00	15.46	35.16
	11	4.34	1.00	10.00	15.34	34.20

[IEEE802.11b : DBPSK/1Mbps : Left Antenna (ANT.1)]						
Ch	Freq. [MHz]	S/A Reading [dBm]	Cable Loss [dB]	Atten. [dB]	Result [dBm]	Converted [mW]
Low	2412.0	6.23	1.02	10.00	17.25	53.09
Mid	2437.0	5.11	1.00	10.00	16.11	40.83
High	2462.0	4.87	0.97	10.00	15.84	38.37

[IEEE802.11g : Left Antenna (ANT.1) (by the data rate) Ch: Mid 2437MHz]						
Modulation	Data rate [bps]	S/A Reading [dBm]	Cable Loss [dB]	Atten. [dB]	Result [dBm]	Converted [mW]
BPSK	6	5.39	1.00	10.00	16.39	43.55
	9	5.48	1.00	10.00	16.48	44.46
QPSK	12	5.43	1.00	10.00	16.43	43.95
	18	5.28	1.00	10.00	16.28	42.46
16QAM	24	4.65	1.00	10.00	15.65	36.73
	36	5.12	1.00	10.00	16.12	40.93
64QAM	48	5.15	1.00	10.00	16.15	41.21
	54	6.13	1.00	10.00	17.13	51.64

[IEEE802.11g : BPSK/6Mbps : Left Antenna (ANT.1)]						
Ch	Freq. [MHz]	S/A Reading [dBm]	Cable Loss [dB]	Atten. [dB]	Result [dBm]	Converted [mW]
Low	2412.0	5.78	1.02	10.00	16.80	47.86
Mid	2437.0	5.29	1.00	10.00	16.29	42.56
High	2462.0	5.17	0.97	10.00	16.14	41.11

[IEEE802.11g : 64QAM/54Mbps : Left Antenna (ANT.1)]						
Ch	Freq. [MHz]	S/A Reading [dBm]	Cable Loss [dB]	Atten. [dB]	Result [dBm]	Converted [mW]
Low	2412.0	6.49	1.02	10.00	17.51	56.36
Mid	2437.0	6.01	1.00	10.00	17.01	50.23
High	2462.0	6.04	0.97	10.00	17.01	50.23

12.4 Body 2450MHz SAR of Left Antenna (ANT.1)

Liquid Depth (cm)	:	**15.2**	Model	:	**S1596-01**
Parameters	:	**ε_r =50.1 σ =1.97**	Serial No.	:	**524006A**
Ambient temperature (deg.c.)	:	**25.0**	Modulation	:	**DSSS,OFDM**
Relative Humidity (%)	:	**56**			

Date : Mach 28, 2005
Measured By : Miyo Ikuta

BODY SAR MEASUREMENT RESULTS OF ANT.1 (LEFT ANTENNA)

W-LAN			Bluetooth	Modulation	Phantom Section	EUT Set-up Conditions			Liquid Temp.[deg.c]		SAR(1g) [W/kg]
Mode	Channel	Frequency [MHz]	Hopping			Antenna	Position	Separation [mm]	Before	After	Maximum value of multi-peak
IEEE 802.11b + Bluetooth ON	**Step1.**	**Modulation search**									
	6	2437	ON	DBPSK（1M）	Flat	Fixed	Left Front	0	24.1	24.2	**0.117**
	6	2437	ON	DQPSK(2M)	Flat	Fixed	Left Front	0	24.2	24.2	**0.0604**
	6	2437	ON	CCK(5.5M)	Flat	Fixed	Left Front	0	24.2	24.3	**0.0396**
	6	2437	ON	CCK(11M)	Flat	Fixed	Left Front	0	24.2	24.2	**0.0271**
	Step2.	**Position search**									
	6	2437	ON	DBPSK（1M）	Flat	Fixed	Left Back	0	24.0	24.0	**0.0505**
	6	2437	ON	DBPSK（1M）	Flat	Fixed	Left Top	0	24.1	24.0	**0.0661**
	6	2437	ON	DBPSK（1M）	Flat	Fixed	Left Side	0	24.0	24.0	**0.0576**
	Step3.	**Channel change**									
	1	2412	ON	DBPSK（1M）	Flat	Fixed	Left Front	0	24.3	24.3	**0.107**
	11	2462	ON	DBPSK（1M）	Flat	Fixed	Left Front	0	24.3	24.3	**0.0857**
IEEE 802.11g + Bluetooth ON	**Step1.**	**Modulation search**									
	6	2437	ON	BPSK（6M）	Flat	Fixed	Left Front	0	24.5	24.5	**0.0255**
	6	2437	ON	QPSK （18M）	Flat	Fixed	Left Front	0	24.2	24.2	**0.0190**
	6	2437	ON	16QAM（36M）	Flat	Fixed	Left Front	0	24.2	24.2	**0.0183**
	6	2437	ON	64QAM（54M）	Flat	Fixed	Left Front	0	24.2	24.2	**0.0166**
	Step2.	**Position search**									
	6	2437	ON	BPSK（6M）	Flat	Fixed	Left Back	0	24.2	24.2	**0.0146**
	6	2437	ON	BPSK（6M）	Flat	Fixed	Left Top	0	24.1	24.1	**0.0198**
	6	2437	ON	BPSK（6M）	Flat	Fixed	Left Side	0	24.1	24.1	**0.0191**
	Step3.	**Channel change**									
	1	2412	ON	BPSK（6M）	Flat	Fixed	Left Front	0	24.2	24.3	**0.0331**
	11	2462	ON	BPSK（6M）	Flat	Fixed	Left Front	0	24.3	24.3	**0.0260**
IEEE 802.11b	**Transmission of only W-LAN at worst condition of ANT.1 (Left Antenna)**										
	1	2412	OFF	DBPSK（1M）	Flat	Fixed	Left Front	0	24.3	24.3	**0.143**
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure / General Population									**Body SAR: 1.6 W/kg (averaged over 1 gram)**		

SECTION 13 : 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	2004/03/11	2005/03/10
Spectrum Analyzer	Agilent	E4448A	MY44020357	2004/06/12	2005/06/11
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	-	2005/02/24	2006/02/23
Dosimetric E-Field Probe	Schmid&Partner Engineering AG	ET3DV6	1684	2004/09/02	2005/09/01
Data Acquisition Electronics	Schmid&Partner Engineering AG	DAE3 V1	509	2004/04/22	2005/04/21
Robot,SAM Twin Phantom	Schmid&Partner Engineering AG	DASY4	I021834	N/A	N/A
Attenuator	Agilent	US40010300	08498-60012	2004/12/16	2005/12/15
Attenuator	Orient Microwave	BX10-0476-00	-	2005/03/16	2006/03/15
Conducted cable	Sahner	SUCOFLFX104	-	2005/02/03	2006/02/02
2450MHz System Validation Dipole	Schmid&Partner Engineering AG	D2450V2	713	2004/12/13	2006/12/12
Dual Directional Coupler	N/A	Narda	03702	N/A	N/A
Head 2450MHz	N/A	N/A	N/A	N/A	N/A
Body 2450MHz	N/A	N/A	N/A	N/A	N/A

SECTION 14 : References

[1]ANSI, ANSI/IEEE C95.1-1992: IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz, The Institute of Electrical and Electronics Engineers, Inc., New York, NY 10017, 1992.

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