Bâtiment le Ponant Avenue de la PEROUSE 29280 PLOUZANÉ France Tél. : 02.98.05.13.34 Fax : 02.98.05.53.87	**SAR MEASUREMENT REPORT**
	Project name :
	KS070608A01

I. INFORMATIONS ON THE TESTING

I. INFORMATIONS ON THE TESTING

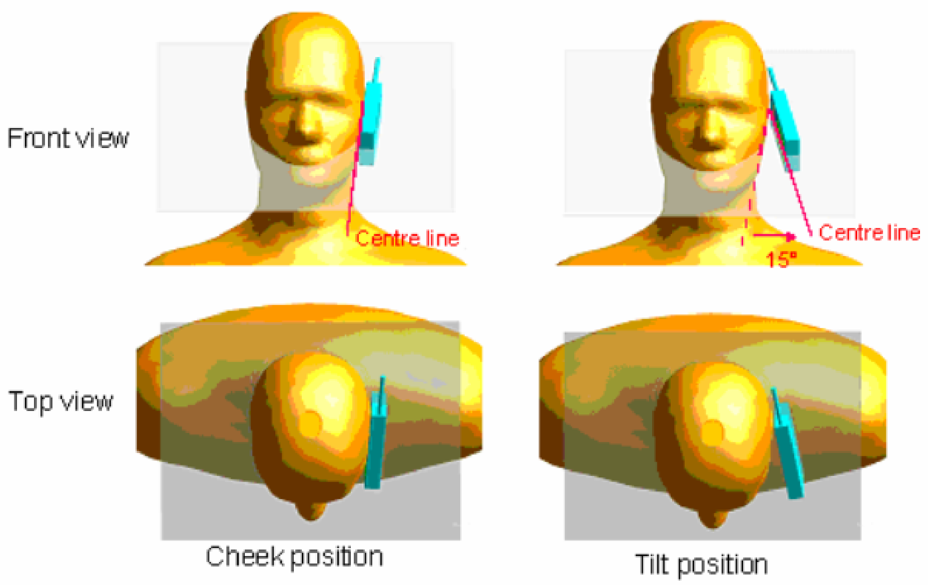
I.1. Normative reference

IEEE 1528: Recommended Practice for determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques. Institute of Electrical and Electronics Engineers, INC., 2003.

I.3. Positions and test conditions of the mobile phone under test

The mobile phone antenna and battery are those specified by the manufacturer. The battery is fully charged before each measurement. The output power and frequency are controlled using a base station simulator. The mobile phone is set to transmit at its highest output peak power level.

The mobile phone is test in the "cheek" and "tilted" positions on the left and right sides of the phantom. The mobile phone is placed with the vertical centre line of the body of the mobile phone and the horizontal line crossing the centre of the earpiece in a plane parallel to the sagittal plane of the phantom.



Description of the « cheek » position:

The mobile phone is well placed in the reference plane and the earpiece is in contact with the ear. Then the mobile phone is moved until any point on the front side get in contact with the cheek of the phantom or until contact with the ear is lost.

Description of the « tilted » position:

The mobile phone is well place in the “cheek” position as described above. Then the mobile phone is moved outward away from the mouth by an angle of 15 degrees or until contact with the ear lost.

II. THE MEASUREMENT SYSTEM

Comosar is a system that is able to determine the SAR distribution inside a phantom of human being according to different standards. The Comosar system consists of the following items:

- Main computer to control all the system
- 6 axis robot
- Data acquisition system
- Miniature E-field probe
- Phone holder
- Head simulating tissue

The following figure shows the system.

COMOSAR bench

The mobile phone under test operating at the maximum power level is placed in the phone holder, under the phantom, which is filled with head simulating liquid. The E-Field probe measures the electric field inside the phantom. The OpenSAR software computes the results to give a SAR value in a 1g or 10 g mass.

II.1. Phantom

For the measurements the Specific Anthropomorphic Mannequin (SAM) defined by the IEEE SCC-34/SC2 group is used. The phantom is a polyurethane shell integrated in a wooden table. The thickness of the phantom amounts to 2 mm +/- 0,2 mm. It enables the dosimetric evaluation of left and right hand phone usage and includes an additional flat phantom part for the simplified performance check. The phantom set-up includes a cover, which prevents the evaporation of the liquid.

II.2. Probe

For the measurements the Specific Dosimetric E-Field Probe SSE5 with following specifications is used.

- Dynamic range: 0.01-100 W/kg
- Tip Diameter : 5 mm

- Distance between probe tip and sensor center : 2.5 mm
- Distance between sensor center and the inner phantom surface: 4 mm (repeatability better than +/- 1mm).
- Probe linearity : <0.25 dB
- Axial Isotropy : <0.25 dB
- Spherical Isotropy : <0.50 dB
- Calibration range : 835 to 2500 MHz for head & body simulating liquid
- Angle between probe axis (evaluation axis) and suface normal line : less than 30°

II.3. Measurement procedure

The following steps are used for each test position

- Establish a call with the maximum output power with a base station simulator. The connection between the mobile and the base station simulator is established via air interface
- Measurement of the local E-field value at a fixed location. This value serves as a reference value for calculating a possible power drift.
- Measurement of the SAR distribution with a grid of 8 to 16 mm * 8 to 16 mm and a constant distance to 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 these values the area of the maximum SAR is calculated by an interpolation scheme.
- Around this point, a cube of 30 * 30 * 30 mm or 32 * 32 * 32 mm is assessed by measuring 5 or 8 * 5 or 8 * 4 or 5 mm. With these data, the peak spatial-average SAR value can be calculated.

II.4 Description of interpolation/extrapolation scheme

The local SAR inside the phantom is measured using small dipole sensing elements inside a probe body. The probe tip must not be in contact with the phantom surface in order to minimise measurements errors, but the highest local SAR will occur at the surface of the phantom.

An extrapolation is using to determinate this highest local SAR values.
The extrapolation is based on a fourth-order least-square polynomial fit of measured data. The local SAR value is then extrapolated from the liquid surface with a 1 mm step.

The measurements have to be performed over a limited time (due to the duration of the battery) so the step of measurement is high. It could vary between 5 and 8 mm. To obtain an accurate assessment of the maximum SAR averaged over 10 grams and 1 gram requires a very fine resolution in the three dimensional scanned data array.

II.5. UNCERTAINTY ASSESSMENT

The following table includes the uncertainty table of the IEEE 1528. The values are determined by Antennessa.

UNCERTAINTY EVALUATION FOR HANDSET SAR TEST

a	b	c	d	e= f(d,k)	f	g	h= c*f/e	i= c*g/e	k
Uncertainty Component	Sec.	Tol (+-%)	Prob. Dist.	Div.	Ci (1g)	Ci (10g)	1g Ui (+-%)	10g Ui (+-%)	Vi
Measurement System									
Probe calibration	E.2.1	6.0	N	1	1	1	6.0	6.0	∞
Axial Isotropy	E.2.2	3.0	R	$\sqrt{3}$	$(1-Cp)^{1/2}$	$(1-Cp)^{1/2}$	1.2	1.2	∞
Hemispherical Isotropy	E.2.2	5.4	R	$\sqrt{3}$	$\sqrt{Cp}$	$\sqrt{Cp}$	2.2	2.2	∞
Boundary effect	E.2.3	1.0	R	$\sqrt{3}$	1	1	0.6	0.6	∞
Linearity	E.2.4	3.9	R	$\sqrt{3}$	1	1	2.3	2.3	∞
System detection limits	E.2.5	1.0	R	$\sqrt{3}$	1	1	0.6	0.6	∞
Readout Electronics	E.2.6	0.5	N	1	1	1	0.5	0.5	∞
Reponse Time	E.2.7	0.2	R	$\sqrt{3}$	1	1	0.1	0.1	∞
Integration Time	E.2.8	2.0	R	$\sqrt{3}$	1	1	1.2	1.2	∞
RF ambient Conditions	E.6.1	3.0	R	$\sqrt{3}$	1	1	1.7	1.7	∞
Probe positioner Mechanical Tolerance	E.6.2	2.0	R	$\sqrt{3}$	1	1	1.2	1.2	∞
Probe positioning with respect to Phantom Shell	E.6.3	1.0	R	$\sqrt{3}$	1	1	0.6	0.6	∞
Extrapolation, interpolation and integration Algoritms for Max. SAR Evaluation	E.5.2	1.5	R	$\sqrt{3}$	1	1	0.9	0.9	∞
Test sample Related									
Test sample positioning	E.4.2.1	1.5	N	1	1	1	1.5	1.5	N-1
Device Holder Uncertainty	E.4.1.1	5.0	N	1	1	1	5.0	5.0	
Output power Variation - SAR drift measurement	6.6.2	0.5	R	$\sqrt{3}$	1	1	0.3	0.3	∞
Phantom and Tissue Parameters									
Phantom Uncertainty (Shape and thickness tolerances)	E.3.1	4.0	R	$\sqrt{3}$	1	1	2.3	2.3	∞

Liquid conductivity - deviation from target value	E.3.2	4.7	R	$\sqrt{3}$	0.64	0.43	1.7	1.2	∞
Liquid conductivity - measurement uncertainty	E.3.3	2.5	N	1	0.64	0.43	1.6	1.1	M
Liquid permitivity - deviation from target value	E.3.2	0.1	R	$\sqrt{3}$	0.6	0.49	0.0	0.0	∞
Liquid permitivity - measurement uncertainty	E.3.3	2.5	N	1	0.6	0.49	1.5	1.2	M
Combined Standard Uncertainty			RSS				9.4	9.2	
Expanded Uncertainty (95% Confidence interval)			k				18.3	18.0	

UNCERTAINTY FOR SYSTEM PERFORMANCE CHECK

a	b	c	d	e= f(d,k)	f	g	h= c*f/e	i= c*g/e	k
Uncertainty Component	Sec.	Tol (+-%)	Prob. Dist.	Div.	Ci (1g)	Ci (10g)	1g Ui (+-%)	10g Ui (+-%)	Vi
Measurement System									
Probe calibration	E.2.1	6.0	N	1	1	1	6.0	6.0	∞
Axial Isotropy	E.2.2	3.0	R	$\sqrt{3}$	$(1\text{-}Cp)^{1/2}$	$(1\text{-}Cp)^{1/2}$	1.2	1.2	∞
Hemispherical Isotropy	E.2.2	5.4	R	$\sqrt{3}$	$\sqrt{Cp}$	$\sqrt{Cp}$	2.2	2.2	∞
Boundary effect	E.2.3	1.0	R	$\sqrt{3}$	1	1	0.6	0.6	∞
Linearity	E.2.4	3.9	R	$\sqrt{3}$	1	1	2.3	2.3	∞
System detection limits	E.2.5	1.0	R	$\sqrt{3}$	1	1	0.6	0.6	∞
Readout Electronics	E.2.6	0.5	N	1	1	1	0.5	0.5	∞
Reponse Time	E.2.7	0.2	R	$\sqrt{3}$	1	1	0.1	0.1	∞
Integration Time	E.2.8	2.0	R	$\sqrt{3}$	1	1	1.2	1.2	∞
RF ambient Conditions	E.6.1	3.0	R	$\sqrt{3}$	1	1	1.7	1.7	∞
Probe positioner Mechanical Tolerance	E.6.2	2.0	R	$\sqrt{3}$	1	1	1.2	1.2	∞
Probe positioning with respect to Phantom Shell	E.6.3	1.0	R	$\sqrt{3}$	1	1	0.6	0.6	∞
Extrapolation, interpolation and integration Algoritms for Max. SAR Evaluation	E.5.2	1.5	R	$\sqrt{3}$	1	1	0.9	0.9	∞
Dipole									
Dipole axis to liquid Distance	8,E.4.2	1.0	N	$\sqrt{3}$	1	1	0.6	0.6	N-1
Input power and SAR drift measurement	8,6.6.2	0.5	R	$\sqrt{3}$	1	1	0.3	0.3	∞
Phantom and Tissue Parameters									
Phantom Uncertainty (Shape and thickness tolerances)	E.3.1	4.0	R	$\sqrt{3}$	1	1	2.3	2.3	∞
Liquid conductivity - deviation from target value	E.3.2	4.7	R	$\sqrt{3}$	0.64	0.43	1.7	1.2	∞
Liquid conductivity -	E.3.3	2.5	N	1	0.64	0.43	1.6	1.1	M

measurement uncertainty									
Liquid permitivity - deviation from target value	E.3.2	0.1	R	$\sqrt{3}$	0.6	0.49	0.0	0.0	∞
Liquid permitivity - measurement uncertainty	E.3.3	2.5	N	1	0.6	0.49	1.5	1.2	M
Combined Standard Uncertainty			RSS				7.8	7.6	
Expanded Uncertainty (95% Confidence interval)			k				15.2	14.9	

-

III. RESULTS

	TYPE	PARAMETERS
GSM850	Noise	--
	Validation	--
	Phone	--
GSM900	Noise	--
	Validation	--
	Phone	--
GSM1800	Noise	--
	Validation	--
	Phone	--
GSM1900	Noise	--
	Validation	--
	Phone	--
IMT2000	Noise	--
	Validation	--
	Phone	--
CUSTOM	Noise	--
	Validation	Measurement 1: Validation Plane with Cheek device position (band bluetooth)

	Phone	--

MEASUREMENT 1

VALIDATION

Type: Validation measurement (Complete)

Date of measurement: 16/8/2007

Measurement duration: 6 minutes 42 seconds

Mobile Phone IMEI number: --

A. Experimental conditions.

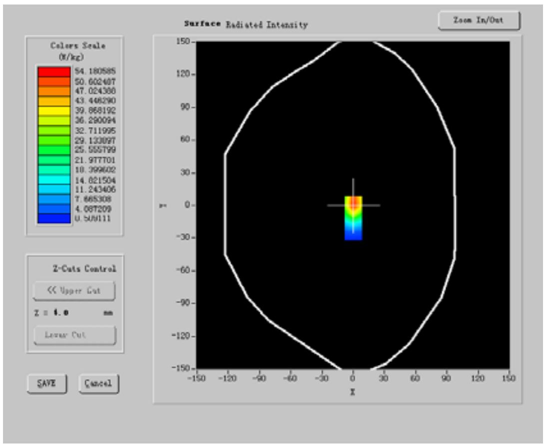
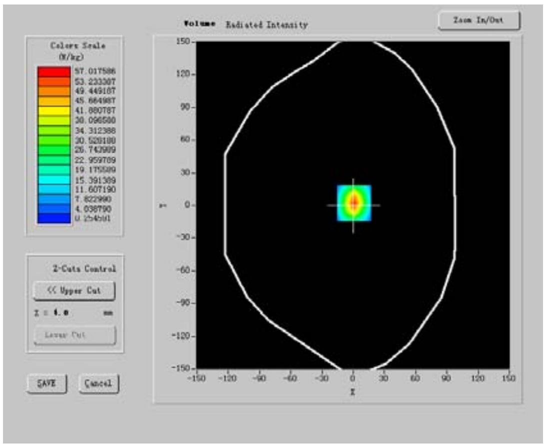
Phantom File	surf_sam_plan.txt, Adaptative 2 max
Phantom	Validation plane
Device Position	Cheek
Band	CUSTOM (bluetooth)
Channels	--
Signal	Duty Cycle: 1.00

B. Instrumentations.

PC	HP (Pentium(R) V 3.06GHz375052-AA1, SN:375052-AA1)
Network Emulator	Agilent (E5071B, SN:B23-03291)
Voltmeter	Keithley (2000, SN:1015843)
Synthetizer	Agilent (E8257C, SN:MY43321570)
Amplifier	Mini-Circuits (ZHL-42, SN:110405)
Power Meter	Agilent (E4416A, SN:QB41292714)
Probe	Antennessa (SN:SN_1205_EP_45)
Phantom	Antennessa (SN:SN41_05_SAM29)
Liquid	Antennessa (Last Calibration:02/2006)

C. SAR Measurement Results

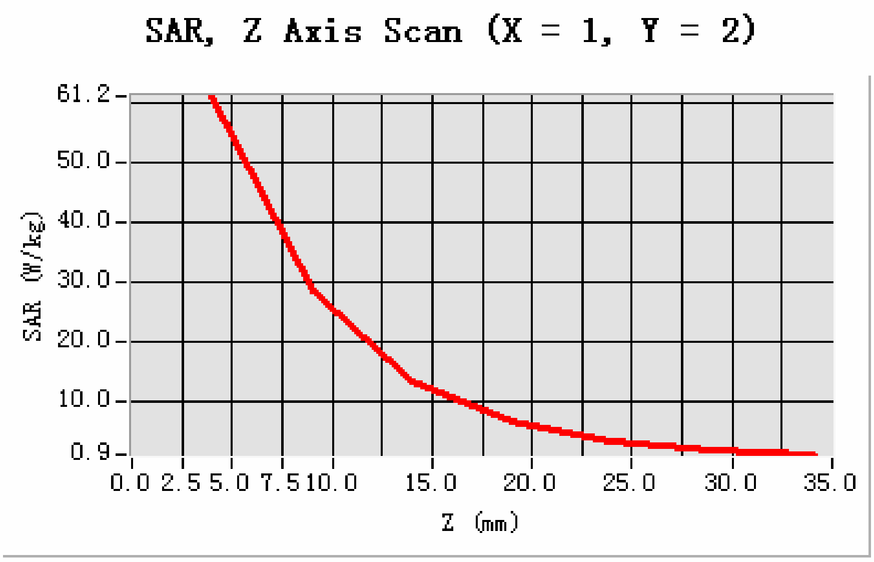
Frequency (MHz)	2437.000000
Relative permitivity (real part)	50.348000
Relative permitivity (imaginary part)	14.295750
Conductivity (S/m)	1.935486
Variation (%)	0.510000

SURFACE SAR	**VOLUME SAR**
	

Maximum location: X=1.00, Y=2.00

SAR 10g (W/Kg)	24.410086
SAR 1g (W/Kg)	54.990273

Z Axis Scan


SAR, Z Axis Scan (X = 1, Y = 2)
61.2
50.0
40.0
30.0
20.0
10.0
0.9
SAR (W/kg)
0.0 2.5 5.0 7.5 10.0 15.0 20.0 25.0 30.0 35.0
Z (mm)