

RESEARCH DEVELOPMENT AND TESTING NATIONAL
INSTITUTE FOR ELECTRICAL ENGINEERING

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TEST REPORT

No. 15 / 12 June 2009

- 1) **Customer:** ICMET
Bvd. Decebal, no. 118A, 200746 - Craiova, ROMÂNIA
- 2) **Test product:** Mobile phone - LG KU250
- 3) **Manufacturer:** LG Electronics Inc.
LG Twin Tower 20, Yeouido-dong, Yeongdeungpo-gu,
Seul Coreea 150 - 721
- 4) **Test standard:** EN 50360
- 5) **Performed tests:** SAR measurement
- 6) **Test date:** 11 June 2009
- 7) **Tests result:** SAR_{10g} = 0.58 W/kg for GSM1800
- 8) **The report contains: 15 pages.**
- 9) **The report is edited in 2 copies, of which 1 copy for customer and 1 copy for laboratory.**

Head of High Voltage Division

Eng. Ion PĂTRU

Head of SAR laboratory:

Eng. George MIHAI

WARNINGS:

- a. The results refer only to test product mentioned on point 1;
- b. Integral reproduction of the present report is forbidden;
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- d. All signatures of the present report are original ones.



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I GENERAL INFORMATION

I.1 Test standard

EN 50360 Product standard to demonstrate the compliance of mobile phones with the basic restrictions related to human exposure to electromagnetic fields (300 MHz - 3 GHz).

I.2 Test product

I.2.1 Product identification

Mobile phone: LG KU250

IMEI: 356385-01-114391-9

Conformity statement: - / 10 April 2007 without the SAR value

Pictures: FIG. 1, FIG. 2, FIG. 3 of Chapter VII

I.2.2 Technical characteristics

Operation modes: GSM, UMTS, Bluetooth

Frequency bands: 900, 1800, 1900, 2100, 2450

Antenna type: fixed, internal

Power classes:

GSM 900 : class4 (power max. 33 dBm)

GSM 1800 : class 1 (power max. 30 dBm)

GSM 1900 : class 1 (power max. 30 dBm)

UMTS : class 3 (power max. 24 dBm)

Bluetooth : class 2

Hardware version:

Software version:

1.3 Product receipt date

10 June 2009



III TESTS DESCRIPTION

This report contains the result of the measurements performed on the tested product (DUT) described in the General Information section (I.2) in order to evaluate its compliance to the basic restrictions related to human exposure to electromagnetic fields (300 MHz - 3 GHz), according to the standard IEC EN 50360.

IEC EN 50360 standard is applied to any transmitting devices used in close proximity to the human ear. The frequency range checked is 300 MHz to 3 GHz.

The exposure limit is specified into the Council Recommendation 1999/519/EC of 12 July 1999. Alternatively the limit may be applied as stated by the International Commission on Non-Ionising Radiation Protection (ICNIRP): "Guidelines for limiting exposure in time-varying electric, magnetic and electromagnetic fields (up to 300 GHz)", April 1998.

Tested product is declared to fulfill the requirements of the standard if the SAR measured values are less than or equal to the limit.

III.1 The SAR Dosimeter Assessment System

The used dosimeter assessment system is able to determine the SAR distribution inside a SAM phantom that is conforming to the European and U.S. standards (EN 50361, IEEE 1528). It consists of a robot, a field probe calibrated for use in liquids, a "twin" phantom, an "elliptic flat" phantom, a tissue simulating liquid, a DUT holder and OpenSAR software.

The phantom is a shell made with low loss and low permittivity material integrated in a wooden table. The dosimetry assessment can be performed for the left hand and the right hand DUT usage.

The necessary liquid to fill the phantom is approximately 20 liters.

The E-field probe has a triangular transversal section. On each face there is a dipole linked to special Schottky diode with low detection thresholds. Due to the high sensitivity of the probe, its output voltage can be measured without amplification. The E-field probe fulfils CENELEC and IEEE recommendations for the measurement of electromagnetic fields radiated by mobile phones, base stations and all radiating devices.

The DUT holder is made of low-loss and low permittivity material. It allows the displacement on Ox, Oy, Oz axes or the rotation around phantom ear for a precise DUT position,

With OpenSAR software, the robot motion is commanded, the local SAR values are determined and the SAR values are averaged for 10 g and 1 g of tissue.

III.2 SAR measurement procedure

The dielectric properties of the tissue equivalent liquids are measured prior to the SAR measurements and at the same temperature. The measured values are the permittivity ϵ and the electric conductivity σ and their measured values they shall comply with $\pm 5\%$ tolerance as the values specified in standard.

A performance check is made before the DUT SAR measurements in order to verify that the system operates according to the technical specification. It is a SAR measurement using a set-up where the signal comes from generator and is emitted with a dipole antenna. The components and the procedure for performance checking are the same as those used for the compliance tests. The result of this check shall be within the limits $\pm 10\%$ of the target value, determined during the system validation check.

The DUT was tested using its internal transmitter; the antenna(s), battery and accessories provided by the manufacturer. The battery was fully charged before each measurement and there where no external connections.

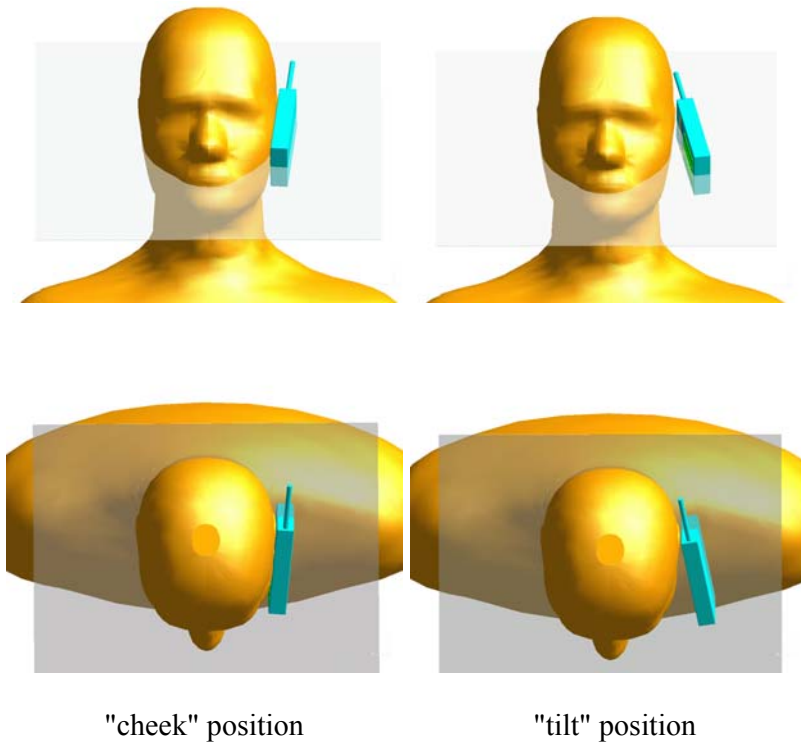
The output power and frequency were controlled using a base station emulator.



The following steps are used for each position of DUT:

- establish a radio connection at maximum DUT power using base station emulator;
- measurement of the SAR values in a grid of equidistant points on a surface situated at constant distance to the inner phantom surface;
- measurement of the SAR values in equidistant points into a cube;
- calculation of the average SAR values and comparison against the limit.

The product is laid on the "cheek" and "tilt" positions, on the left and right sides of the phantom and it is tested at the frequencies of each emission band, in the requested testing conditions.



III.3 Description of interpolation/extrapolation method

The probe tip must not be in contact with the phantom inner surface in order to minimise measurements errors.

The highest local SAR values are at the inner surface of the phantom and for their evaluation is applied an extrapolation method.

The extrapolation is based on a fourth-order least-square polynomial fit of measured data. The local SAR values are extrapolated from the liquid surface with a 1 mm step.

The measurements have to be performed over a limited time due to the operating time of the DUT battery. To reduce the measurement time, the measurement step should be high. It could vary between 5 and 8 mm. But, to obtain an accurate assessment of the maximum SAR values averaged over 10 grams and 1 gram is necessary a very fine resolution of the three dimensional scan.

An interpolation is used to obtain a sufficient resolution. The measured and extrapolated SAR values are interpolated on a 1 mm grid with a three-dimensional thin-plate spline algorithm.



IV TEST EQUIPMENT DESCRIPTION

Type: SAR Dosimetric Assessment System
Manufacturer: Satimo
Model: Comosar Twins

Comosar Twin system contains the following components:

- PC to control the entire system
 - o CPU: Pentium 4 @ 2.8 GHz / MEMORIE: 512 MB DDR SDRAM
 - o SOFTWARE: Windows XP + MS Office + OpenSAR V3.2
 - o INTERFAȚĂ: GPIB NSI card
 - o Manufacturer: Dell
- Robot 6 – axes
 - o Model: KR5 sixx R850
 - o sn: 948707
 - o Manufacturer: Kuka
- Robot controller
 - o Model: KRC2sr
 - o sn: 1712
 - o Manufacturer: Kuka
- Data acquisition system
 - o Model: Digital multimeter Keithley 2000
 - o sn: P1231041
 - o Manufacturer: Keithley
- Electric field probe
 - o sn: SN_0408_EP96
 - o Manufacturer: Satimo
- Phantom
 - o sn: SN_2708_SAM56
 - o Manufacturer: Satimo
- Phone holding device
 - o sn: SN_27/08 MSH52
 - o Manufacturer: Satimo
- Simulating liquid, type "head"
 - o sn: SN 02/08 HLF148
 - o Manufacturer: Satimo
- Base station simulator
 - o Model: Universal radio communication tester CMU200
 - o sn: P1231234
 - o Manufacturer: Rohde & Schwarz
- Power meter
 - o Model: MA24106A
 - o sn: 0849006
 - o Manufacturer: Anritsu
- Vector network analyzer
 - o Model: VNA Master MS2024A
 - o sn: 0850134
 - o Manufacturer: Anritsu



V MEASUREMENTS RESULT

Performed tests:

Band	Description
GSM 1800	Performance check of SAR Dosimetric Assessment System
GSM 1800	SAR measurement mobile phone in "cheek" position
GSM 1800	SAR measurement mobile phone in "tilt" position

Person in charge: Eng. Cătălin VĂRGATU

V.1 Performance check of SAR Dosimetric Assessment System

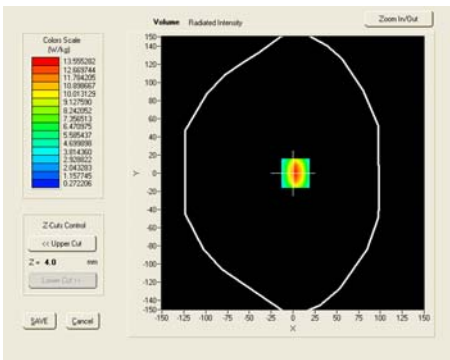
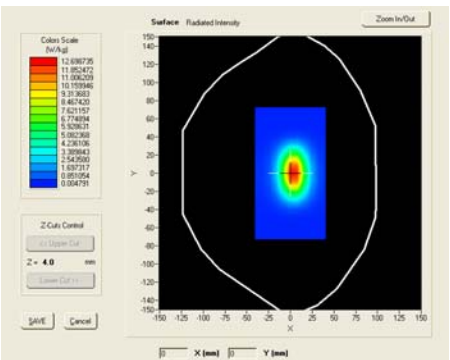
Test data: 11 June 2009

Environment temperature: 18 - 21 °C

A) Experimental conditions

Phantom	"Twins"
DUT	Dipole
DUT position	Validation plane
Band	GSM1800
Channel	Middle
Signal	CW

B) SAR measurements result

Frequency (MHz)	1747.400024
Relative permittivity - real part	39.903999
Relative permittivity - imaginary part	13.566000
Conductivity (S/m)	1.316957
SURFACE SAR	VOLUME SAR
	

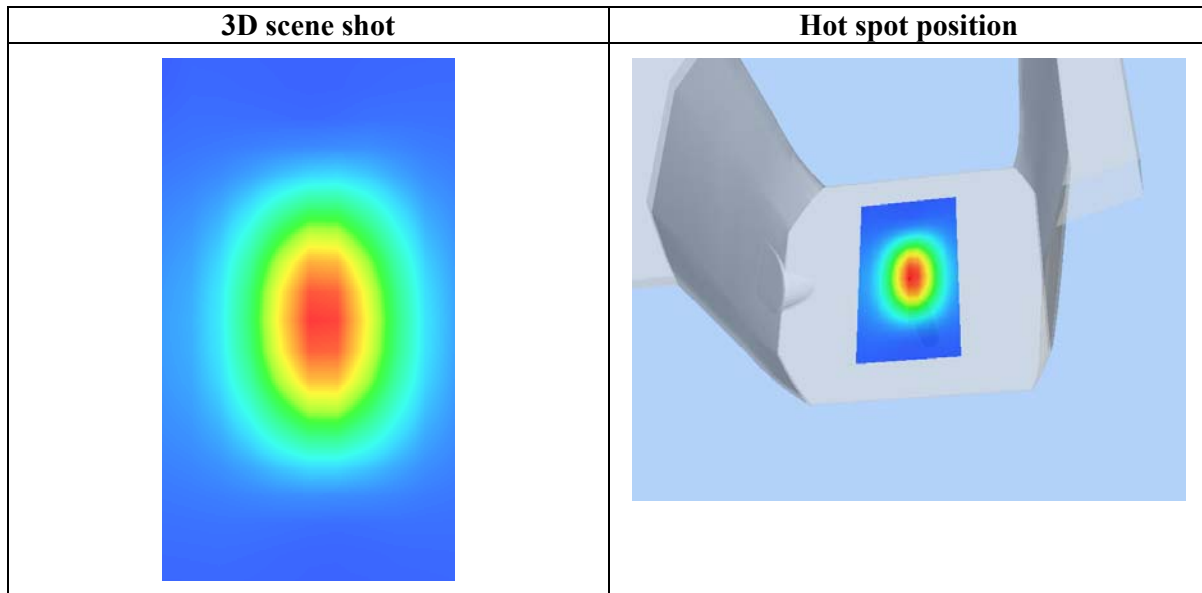
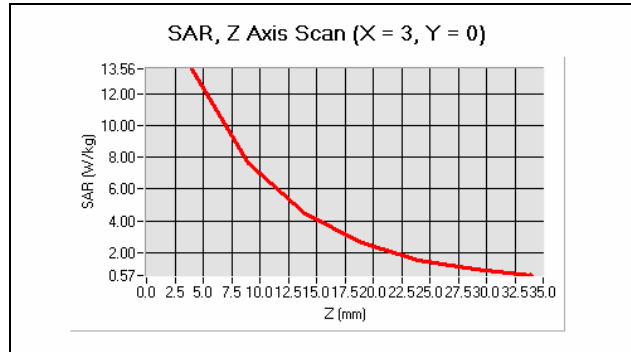
Maximum position: X=3.00, Y=0.00

	SAR (W/Kg)	SAR (W/Kg) Reference	Variation (%)
SAR 10g	6.697259	6.67	0.41
SAR 1g	12.515631	12.5	0.13



Z axis scan

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	0.0000	13.5553	7.5922	4.4304	2.6125	1.5607	0.9408



V.2 SAR measurement mobile phone in "cheek" position

Test data: 11 June 2009

Environment temperature: 18 - 21 °C

A) Experimental conditions

Phantom	"Twins"
DUT	LG KU250
DUT position	Cheek, Left head
Band	GSM1800
Channel	Middle
Signal	TDMA

B) SAR measurements result

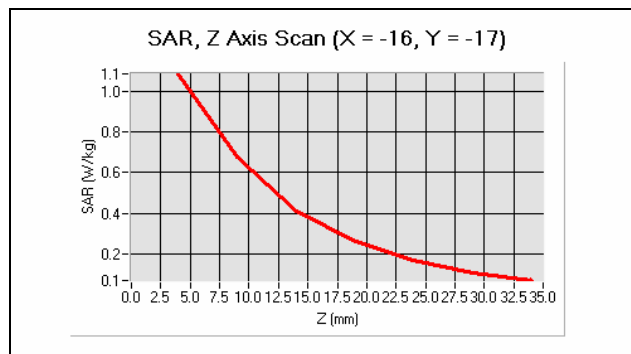
Frequency (MHz)	1747.400024
Relative permittivity - real part	39.903999
Relative permittivity - imaginary part	13.566000
Conductivity (S/m)	1.316957
SURFACE SAR	VOLUME SAR

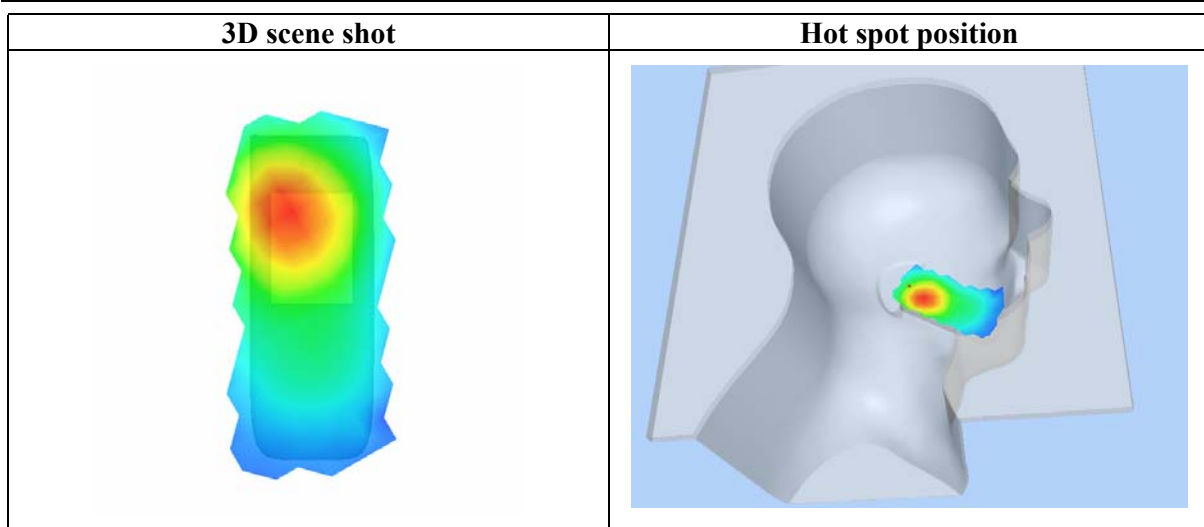
Maximum position: X = -16.00, Y=-17.00

SAR 10g (W/Kg)	0.580182
SAR 1g (W/Kg)	1.022678

Z axis scan

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	0.0000	1.0858	0.6752	0.4091	0.2650	0.1725	0.1060





Test name	Test result
SAR in GSM1800 band, DUT in "cheek" position	pass

V.3 SAR measurement mobile phone in "tilt" position

Test data: 11 June 2009

Environment temperature: 18 - 21 °C

A) Experimental conditions

Phantom	"Twins"
DUT	LG KU250
DUT position	Tilt, Left head
Band	GSM1800
Channel	Middle
Signal	TDMA

B) SAR measurements result

Frequency (MHz)	1747.400024
Relative permittivity - real part	39.903999
Relative permittivity - imaginary part	13.566000
Conductivity (S/m)	1.316957
SURFACE SAR	VOLUME SAR



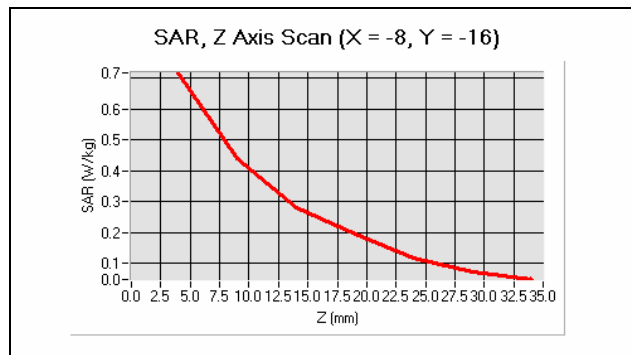


Maximum position: X=-8.00, Y=-16.00

SAR 10g (W/Kg)	0.403744
SAR 1g (W/Kg)	0.693484

Z axis scan

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	0.0000	0.7169	0.4405	0.2829	0.1937	0.1173	0.0750



3D scene shot	Hot spot position

Test name	Test result
SAR in GSM1800 band, DUT in "tilt" position	pass

VI MEASURING UNCERTAINTY

In the following tables there are the estimated values of measuring uncertainties. The values were obtained with OpenSAR software of SAR Dosimetric Assessment System Comosar Twin.



Table 1: Measuring uncertainty for performance check of SAR Dosimetric Assessment System Comosar Twin.

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.	c _i (1 g)	c _i (10 g)	1 g u _i (± %)	10 g u _i (± %)	v _i
Measurement System									
Probe calibration	E.2.1	7.0	N	1	1	1	7.00	7.00	∞
Axial Isotropy	E.2.2	2.5	R	$\sqrt{3}$	$(1-C_p)^{1/2}$	$(1-C_p)^{1/2}$	1.02	1.02	∞
Hemispherical Isotropy	E.2.2	4.0	R	$\sqrt{3}$	$\sqrt{C_p}$	$\sqrt{C_p}$	1.63	1.63	∞
Boundary effect	E.2.3	1.0	R	$\sqrt{3}$	1	1	0.58	0.58	∞
Linearity	E.2.4	5.0	R	$\sqrt{3}$	1	1	2.89	2.89	∞
System detection limits	E.2.5	1.0	R	$\sqrt{3}$	1	1	0.58	0.58	∞
Readout Electronics	E.2.6	0.02	N	1	1	1	0.02	0.02	∞
Response Time	E.2.7	3.0	R	$\sqrt{3}$	1	1	1.73	1.73	∞
Integration Time	E.2.8	2.0	R	$\sqrt{3}$	1	1	1.15	1.15	∞
RF ambient Conditions	E.6.1	3.0	R	$\sqrt{3}$	1	1	1.73	1.73	∞
Probe positioner Mechanical Tolerance	E.6.2	2.0	R	$\sqrt{3}$	1	1	1.15	1.15	∞
Probe positioning with respect to Phantom Shell	E.6.3	0.05	R	$\sqrt{3}$	1	1	0.03	0.03	∞
Extrapolation, interpolation and integration Algorithms for Max. SAR Evaluation	E.5.2	5.0	R	$\sqrt{3}$	1	1	2.89	2.89	∞
Test sample Related									
Test sample positioning	E.4.2. 1	0.03	N	1	1	1	0.03	0.03	N-1
Device Holder Uncertainty	E.4.1. 1	5.00	N	1	1	1	5.00	5.00	
Output power Variation - SAR drift measurement	6.6.2	0.31	R	$\sqrt{3}$	1	1	0.18	0.18	∞
Phantom and Tissue Parameters									
Phantom Uncertainty (Shape and thickness tolerances)	E.3.1	0.05	R	$\sqrt{3}$	1	1	0.03	0.03	∞
Liquid conductivity - deviation from target value	E.3.2	0.43	R	$\sqrt{3}$	0.64	0.43	0.16	0.11	∞
Liquid conductivity - measurement uncertainty	E.3.3	5.00	N	1	0.64	0.43	3.20	2.15	M
Liquid permittivity - deviation from target value	E.3.2	4.02	R	$\sqrt{3}$	0.6	0.49	1.39	1.14	∞
Liquid permittivity - measurement uncertainty	E.3.3	10.00	N	1	0.6	0.49	6.00	4.90	M
Combined Standard Uncertainty			RSS				10.94	10.43	
Expanded Uncertainty (95% Confidence interval)			k				21.34	20.34	



Table 2: Measuring uncertainty for mobile phone 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.	c _i (1g)	c _i (10g)	1g u _i (±%)	10g u _i (±%)	v _i
Measurement System									
Probe calibration	E.2.1	7.0	N	1	1	1	7.00	7.00	∞
Axial Isotropy	E.2.2	2.5	R	$\sqrt{3}$	$(1-C_p)^{1/2}$	$(1-C_p)^{1/2}$	1.02	1.02	∞
Hemispherical Isotropy	E.2.2	4.0	R	$\sqrt{3}$	$\sqrt{C_p}$	$\sqrt{C_p}$	1.63	1.63	∞
Boundary effect	E.2.3	1.0	R	$\sqrt{3}$	1	1	0.58	0.58	∞
Linearity	E.2.4	5.0	R	$\sqrt{3}$	1	1	2.89	2.89	∞
System detection limits	E.2.5	1.0	R	$\sqrt{3}$	1	1	0.58	0.58	∞
Readout Electronics	E.2.6	0.02	N	1	1	1	0.02	0.02	∞
Response Time	E.2.7	3.0	R	$\sqrt{3}$	1	1	1.73	1.73	∞
Integration Time	E.2.8	2.0	R	$\sqrt{3}$	1	1	1.15	1.15	∞
RF ambient Conditions	E.6.1	3.0	R	$\sqrt{3}$	1	1	1.73	1.73	∞
Probe positioner Mechanical Tolerance	E.6.2	2.0	R	$\sqrt{3}$	1	1	1.15	1.15	∞
Probe positioning with respect to Phantom Shell	E.6.3	0.05	R	$\sqrt{3}$	1	1	0.03	0.03	∞
Extrapolation, interpolation and integration Algorithms for Max. SAR Evaluation	E.5.2	5.0	R	$\sqrt{3}$	1	1	2.89	2.89	∞
Test sample Related									
Test sample positioning	E.4.2. 1	0.03	N	1	1	1	0.03	0.03	N-1
Device Holder Uncertainty	E.4.1. 1	5.00	N	1	1	1	5.00	5.00	
Output power Variation - SAR drift measurement	6.6.2	2.52	R	$\sqrt{3}$	1	1	1.45	1.45	∞
Phantom and Tissue Parameters									
Phantom Uncertainty (Shape and thickness tolerances)	E.3.1	0.05	R	$\sqrt{3}$	1	1	0.03	0.03	∞
Liquid conductivity - deviation from target value	E.3.2	0.43	R	$\sqrt{3}$	0.64	0.43	0.16	0.11	∞
Liquid conductivity - measurement uncertainty	E.3.3	5.00	N	1	0.64	0.43	3.20	2.15	M
Liquid permittivity - deviation from target value	E.3.2	4.02	R	$\sqrt{3}$	0.6	0.49	1.39	1.14	∞
Liquid permittivity - measurement uncertainty	E.3.3	10.00	N	1	0.6	0.49	6.00	4.90	M
Combined Standard Uncertainty			RSS				11.04	10.53	
Expanded Uncertainty (95% Confidence interval)			k				21.52	20.54	



VI PICTURES



FIG. 1: DUT – front view.



FIG. 2: DUT – rear view.



FIG. 3: DUT battery.



Fig 4: DUT during test.

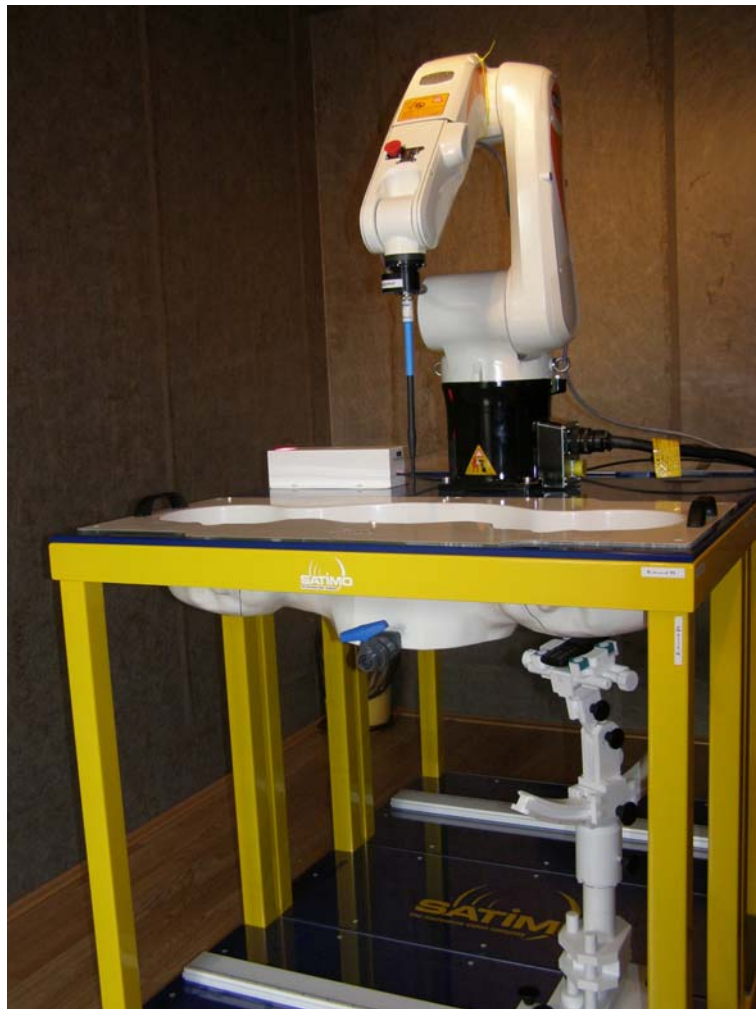


Fig. 5: DUT during test.