TABLE OF CONTENT

1 Measurement Purpose

The aim of these measurements is to test the absorption abilities of the Anti-radiation Card. The card is developed to absorb the radiation from mobile handset and hence reduce the radiated power absorbed by human tissues.

2 Measurement Condition

Report No:	SH11050016S01
Start of Testing:	2011-05-27
End of Testing:	2011-05-28
Measurement Operator:	Shi Feng

3 Test Sample

Device Under Test:	Anti-radiation Card
Size:	length:87mm width:53mm
Auxiliary Device:	Product Name: Apple iPhone 3GS 16G Brand Name: Apple Model No: A1303 Serial No: 011984006610309

NOTE:

1. Please refer to Appendix B for the photographs of the Sample.

4 SAR Measurement System

ALSAS-10-U is fully compliant with the technical and scientific requirements of IEEE 1528, IEC 62209, CENELEC, ARIB, ACA, and the Federal Communications Commission. The system comprises of a six axes articulated robot which utilizes a dedicated controller.ALSAS-10U uses the latest methodologies and FDTD order to provide a platform which is repeatable with minimum uncertainty.

Applications Predefined measurement procedures compliant with the guidelines of CENELEC, IEEE, IEC, FCC, etc are utilized during the assessment for the device. Automatic detection for all SAR maxima are embedded within the core architecture for the system, ensuring that peak locations used for centering the zoom scan are within a 1mm resolution and a 0.05mm repeatable position. System operation range currently is available up to 6 GHz in simulated tissue.

Robot system specification

ALSAS-10U utilizes a six articulated robot, which is controlled using a Pentium based real-time movement controller. The movement kinematics engine utilizes proprietary (Thermo CRS) interpolation and extrapolation algorithms, which allow full freedom of movement for each of the six joints within the working envelop. Utilization of joint 6 allows for full probe rotation with a tolerance better than 0.05mm around the central axis.

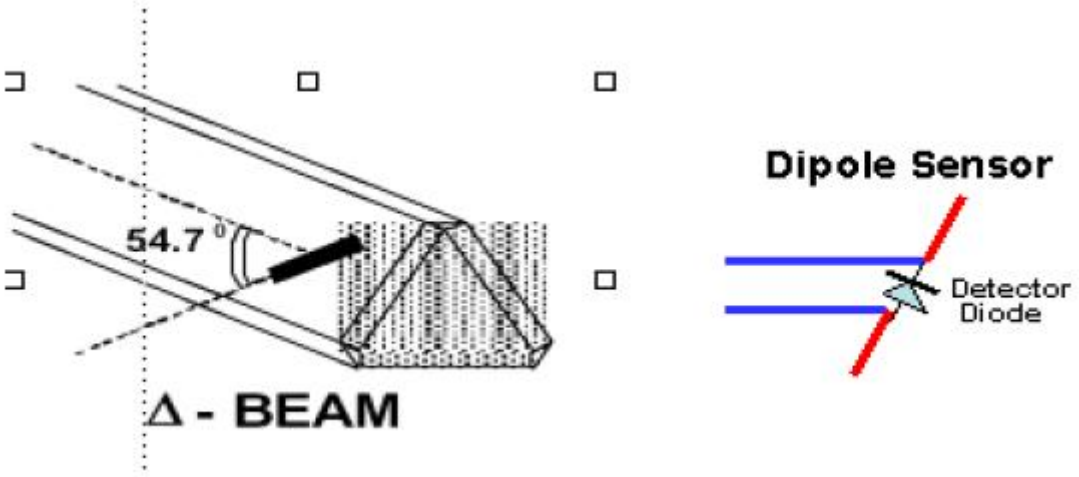
Robot/Controller Manufacturer	Thermo CRS
Number of Axis	Six independently controlled axis
Positioning Repeatability	0.05mm
Controller Type	Single phase Pentium based C500C
Robot Reach	710mm
Communication	RS232 and LAN compatible

Probe Specification

The isotropic E-Field probe has been fully calibrated and assessed for isotropic, and boundary effect within a controlled environment. Depending on the frequency for which the probe is calibrated the method utilized for calibration will change. A number of methods is used for calibrating probes, and these are outlined in the table below:

Calibration Frequency	Air Calibration	Tissue Calibration
900MHz	TEM Cell	Temperature

The E-Field probe utilizes a triangular sensor arrangement as detailed in the diagram below:



SAR is assessed with a calibrated probe which moves at a default height of 5mm from the center of the diode, which is mounted to the sensor, to the phantom surface (in the Z Axis). The 5mm offset height has been selected so as to minimize any resultant boundary effect due to the probe being in close proximity to the phantom surface.

The following algorithm is an example of the function used by the system for linearization of the output from the probe when measuring complex modulation schemes.

$$V_i = U_i + U_i^2 \cdot \frac{cf}{dcp_i}$$

Isotropic E-Field Probe Specification

Calibration in Air	Frequency Dependent Below 2GHz Calibration in air performed in a TEM Cell Above 2GHz Calibration in air performed in waveguide
Sensitivity	0.70 μV/(V/m)^2 to 0.85 μV/(V/m)^2
Dynamic Range	0.0005 W/kg to 100W/kg
Isotropic Response	Better than 0.2dB
Diode Compression point (DCP)	Calibration for Specific Frequency
Probe Tip Radius	< 5mm
Sensor Offset	1.56 (+/- 0.02mm)
Probe Length	290mm
Video Bandwidth	@ 500 Hz: 1dB @1.02 KHz: 3dB
Boundary Effect	Less than 2% for distance greater than 2.4mm
Spatial Resolution	Diameter less than 5mm Compliant with Standards

Boundary detection Unit and Probe Mounting Device

ALSAS-10U incorporates a boundary detection unit with a sensitivity of 0.05mm for detecting all types of surfaces. The robust design allows for detecting during probe tilt (probe normalize) exercises, and utilizes a second stage emergency stop. The signal electronics are directly into the robot controller for high accuracy surface detection in lateral and axial detection modes (X, Y, &Z). The probe is mounted directly onto the Boundary Detection unit for accurate tooling and displacement calculations controlled by the robot kinematics. The probe is connected to an isolated probe interconnect where the output stage of the probe is fed directly into the amplifier stage of the Daq-Paq.

Daq-Paq (Analog to Digital Electronics)

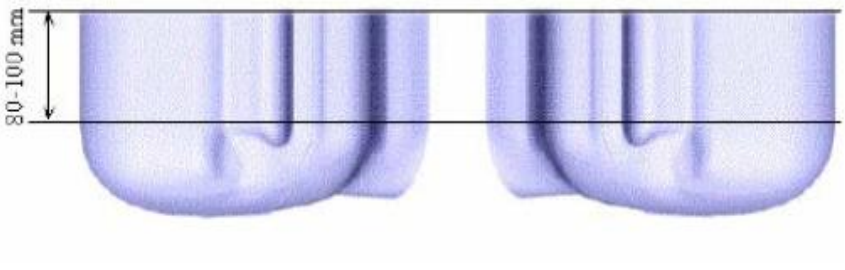
ALSAS-10U incorporates a fully calibrated Daq-Paq (analog to digital conversion system) which has a 4 channel input stage, sent via a 2 stage auto-set amplifier module. The input signal is amplified accordingly so as to offer a dynamic range from 5μ V to 800mV. Integration of the fields measured is carried out at board level utilizing a Co-Processor which then sends the measured fields down into the main computational module in digitized form via a RS232 communications port. Probe linearity and duty cycle compensation is carried out within the main Daq-Paq module.

ADC	12 Bit
Amplifier Range	20mV to 200mV and 150mV to 800mV
Field Integration	Local Co-Processor utilizing proprietary integration algorithms
Number of Input Channels	4 in total 3 dedicated and 1 spare
Communication	Packet data via RS232

Phantoms, Device Holder and Simulant Liquid

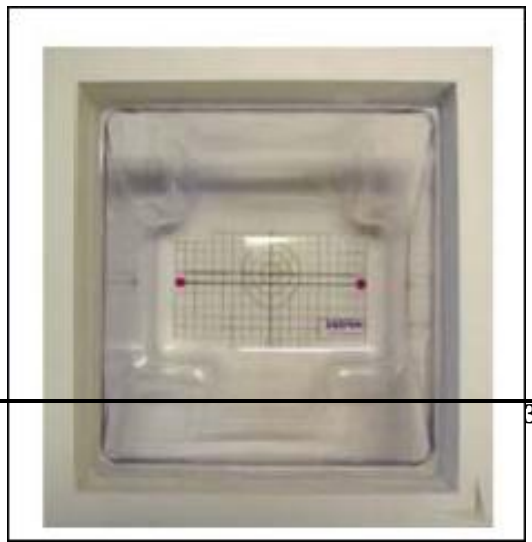
Sam Phantom

The SAM phantoms developed using the IEEE SAM CAD file. They are fully compliant with the requirements for both IEEE 1528 and FCC Supplement C. Both the left and right SAM phantoms are interchangeable, transparent and include the IEEE 1528 grid with visible NF and MB lines.



APREL Laboratories Universal Phantom

The Universal Phantom is used on the ALSAS-10U as a system validation phantom. The Universal Phantom has been fully validated both experimentally from 800MHz to 6GHz and numerically using XFDTD numerical software. The shell thickness is 2mm overall, with a 4mm spacer located at the NF/MB intersection providing an overall thickness of 6mm



in line with the requirements of IEEE-1528.

The design allows for fast and accurate measurements, of handsets , by allowing the conservative SAR to be evaluated at on frequency for both left and right head experiments in one measurement.

Device and Dipole Holder

ALSAS Universal Workstation

ALSAS Universal workstation allows for repeatability and fast adaptability. It allows users to do calibration, testing and measurement using different types of phantoms with one set up, which significantly speeds up the measurement process.

Universal Device Positioner

The universal device positioner allows complete freedom of movement of the EUT. Developed to hold a EUT in a free-space scenario any additional loading attributable to the material used in the construction of the positioner has been eliminated. Repeatability has been enhanced through the linear scales which form the design used to indicate positioning for any given test scenario in all major axes. A 15° tilt movements for head SAR analysis. Overall uncertainty for measurements has been reduced due to the design of the Universal device positioner, which allows positioning of a device in as near to a free-space scenario as possible, and by providing the means for complete repeatability.

Tissue Simulating Liquids

There is no simulating liquids that can cover all frequency bands. Therefore, our system is using different liquids for the measured band as explained bellows.

The parameters of the simulating solution strongly influence the SAR values. The different normalization organizations have defined adapted solutions for the each mobile system.

5 LABORATORY ENVIRONMENT

The Ambient Conditions during SAR Test

Temperature	Min. =15 ℃, Max. =30 ℃
Relative humidity	Min. =30%, Max. =70%
Ground system resistance	<0.5Ω
Ambient noise is checked and found very low and in compliance with requirement of standards. Reflection of surrounding objects is minimized and in compliance with requirement of standards.	

6 TEST RESULTS

6.1 Dielectric Performance

Dielectric Performance of Head Tissue Simulating Liquid

Temperature: 23.0~23.8 ℃, humidity: 54~60%.			
/	**Frequency**	**Permittivity ε**	**Conductivity σ (S/m)**
Target value	900 MHz	41.5	0.97
Validation value	900 MHz	41.684	0.972

6.2 Summary of Measurement Results

Cellular Handset Name	**Test Configuration**	**Measurement Result (W/kg)**		
		Group 1st	**Group 2nd**	**Average**
Apple iPhone 3GS 16G	**Cellular Handset only**	0.354	0.397	0.376
	Anti-radiation Card on rear surface	0.121	0.117	0.119
Compare		65.82%	70.53%	68.35%

Remark:

1. Please refer to Appendix A for the photographs of the test setup.
2. Please refer to Appendix C for the plots of the values.

6.3 Conclusion

Compare the cellular handset without the card attached at its operation situation; the Anti-radiation Card can successfully reduce the radiated power from the mobile power to the human head by at most 70.53％ at the frequencies of 900MHz.

7 MAIN TEST INSTRUMENTS

Instrument	Manufacture	Model No.	Serial No.	Last Calibration
Universal Work Station	Aprel	ALS-UWS	100-00154	Jun.2010
Data Acquisition Package	Aprel	ALS-DAQ-PAQ-3	110-00215	Jun.2010
Probe Mounting Device and Boundary Detection Sensor System	Aprel	ALS-PMDPS-3	120-00265	Jun.2010
Miniature E-Field Probe	Aprel	E-020	273-B	Sep.2010
Left ear SAM Phontom	Aprel	ALS-P-SAM-L	130-00312	N/A
Reference Validation Dipole 835MHz	Aprel	ALS-D-835-S-2	180-00565	Feb.2011
Dielectric Probe Kit	Aprel	ALS-PR-DIEL	260-00955	N/A
Device Holder 2.0	Aprel	ALS-H-E-SET-2	170-00506	N/A
SAR software	Aprel	ALS-SAR-AL-10	Ver.2.3.6	N/A
CRS C500C Controller	Thermo	ALS-C500	RCF0504291	N/A
CRS F3 Robot	Aprel	ALS-F3-SW	N/A	N/A
Power Amplifier	Mini-Circuit	SN0974	040306	N/A
Directional Coupler	Agilent	778D-012	N/A	N/A
Universal Radio Communication Tester	Rohde&Schwarz	CMU200	104845	Jan.2011
Vector Network	Anritsu	MS4623B	N/A	Nov.2010
Signal Generator	Agilent	E8257D	N/A	Jan.2011
Power Meter	Rohde&Schwarz	NRP	N/A	Jan.2011

ANNEX A- Test Layout

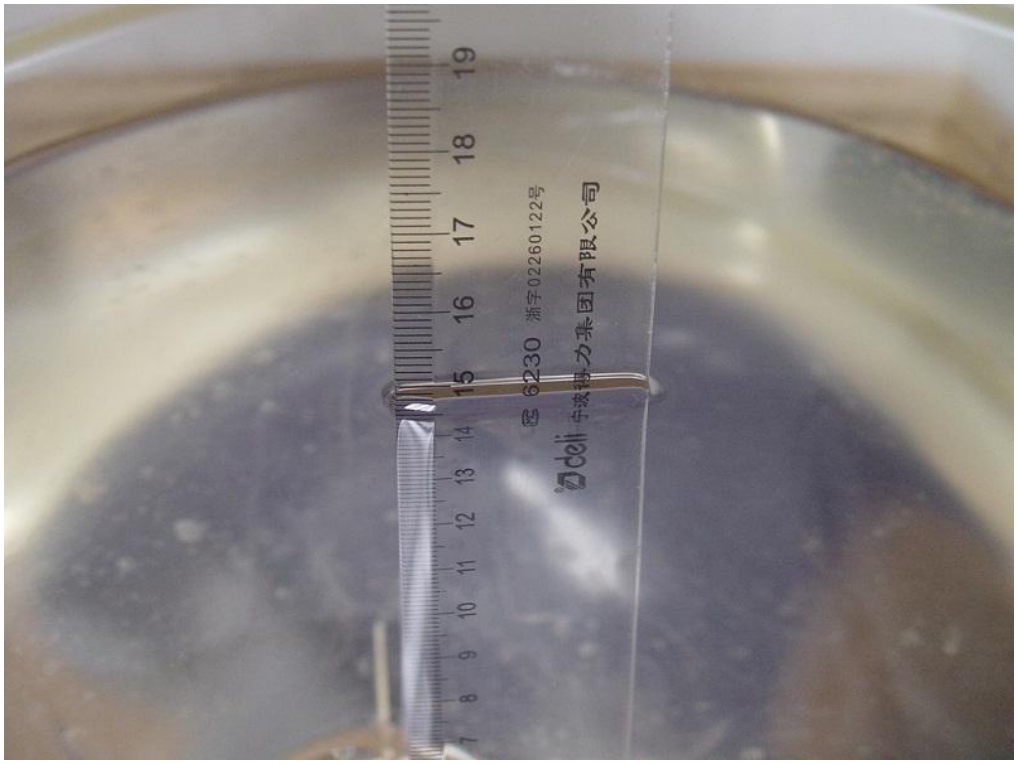


Figure B.1 Depth of Simulating Liquid in SAM Head Phantom

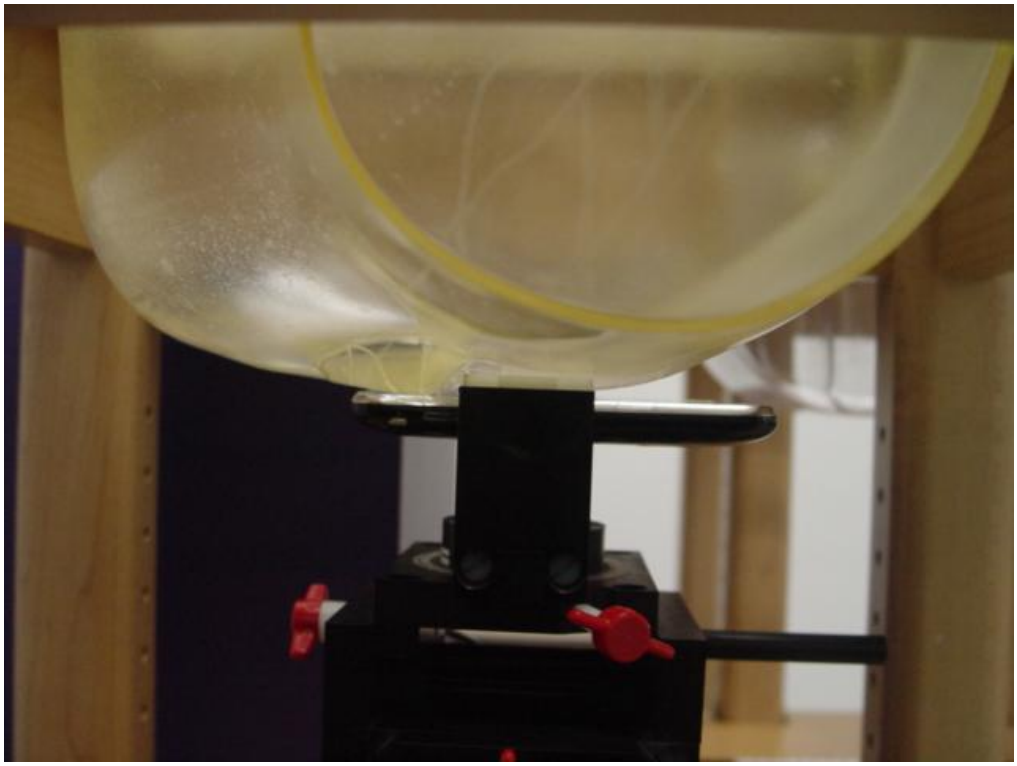


Figure B.2 Cellular Handset only

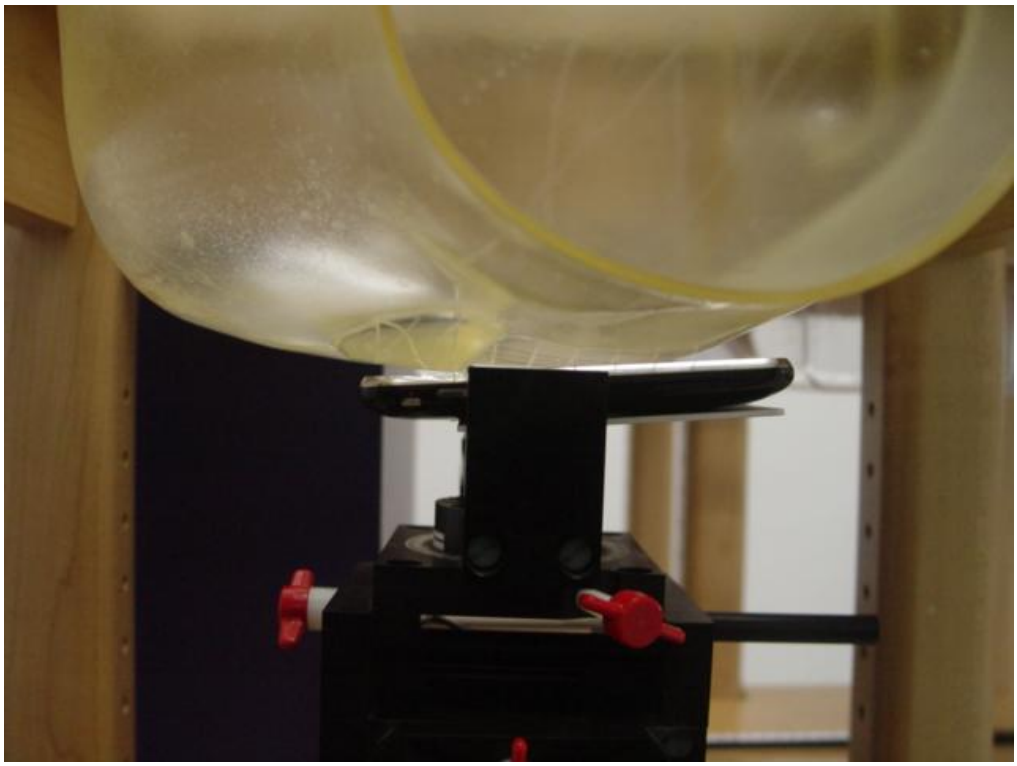


Figure B.3 Anti-radiation Card on rear surface

ANNEX B- Sample Photographs

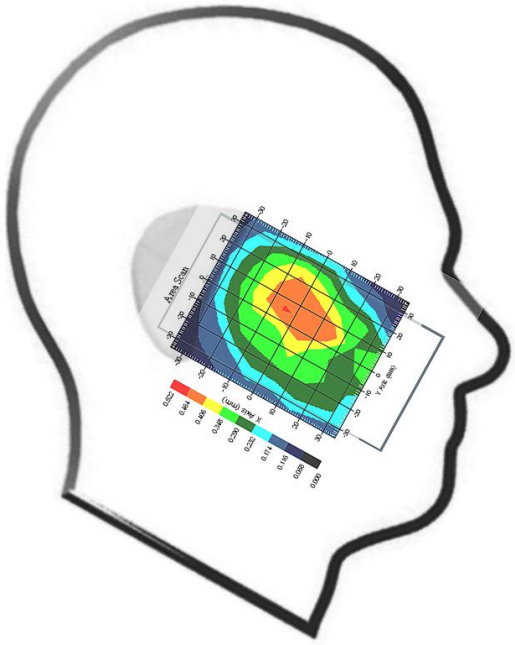
Photograph of the Device under Test

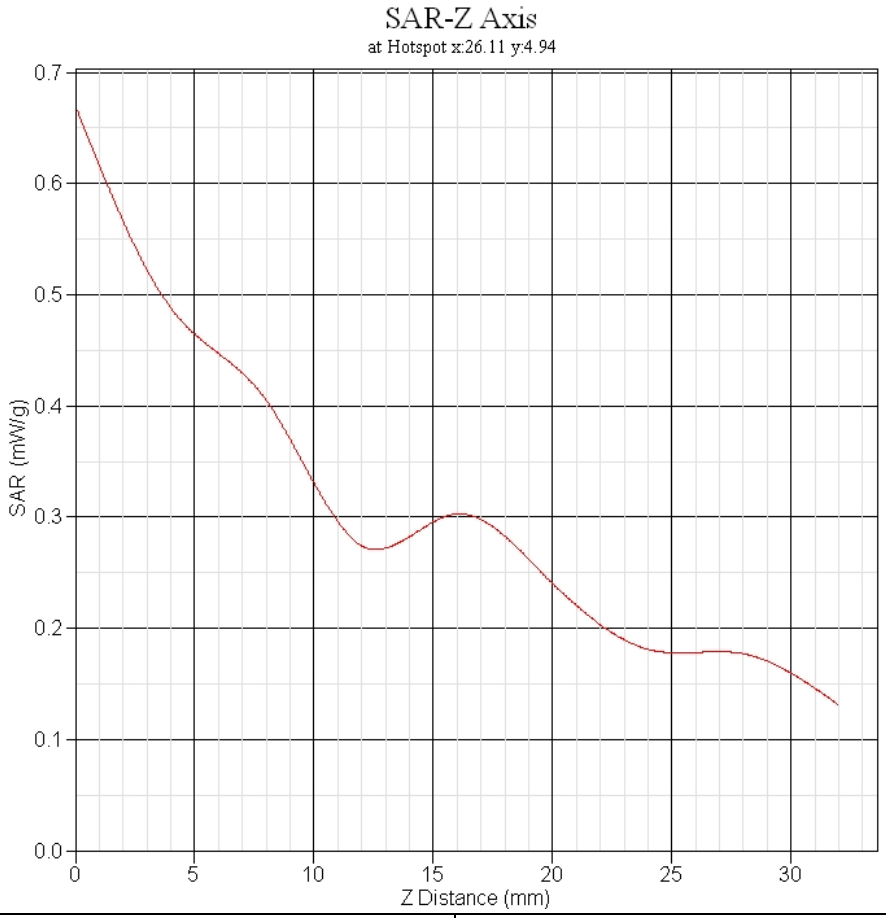
Photograph of the Auxiliary Device

ANNEX C- Graph Test Results

GSM900 Cellular Handset only 1st

Frequency (MHz)	**902.400**
Relative permitivity (real part)	**41.684**
Conductivity (S/m)	**0.972**
Variation (%)	**-0.844**
Duty Cycle Factor	**1**
Crest Factor	**8.3**
Conversion Factor	**5.7**
Probe Sensitivity	**1.20 1.20 1.20 μV/(V/m)2**
Temperature	**Ambient:22.1℃** **Liqiud:20.7℃**
Data	**2011-5-27**

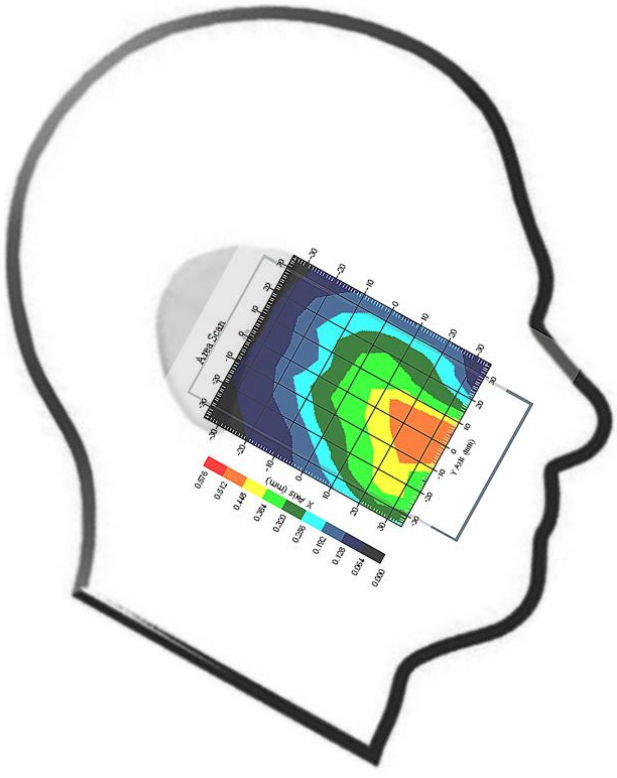


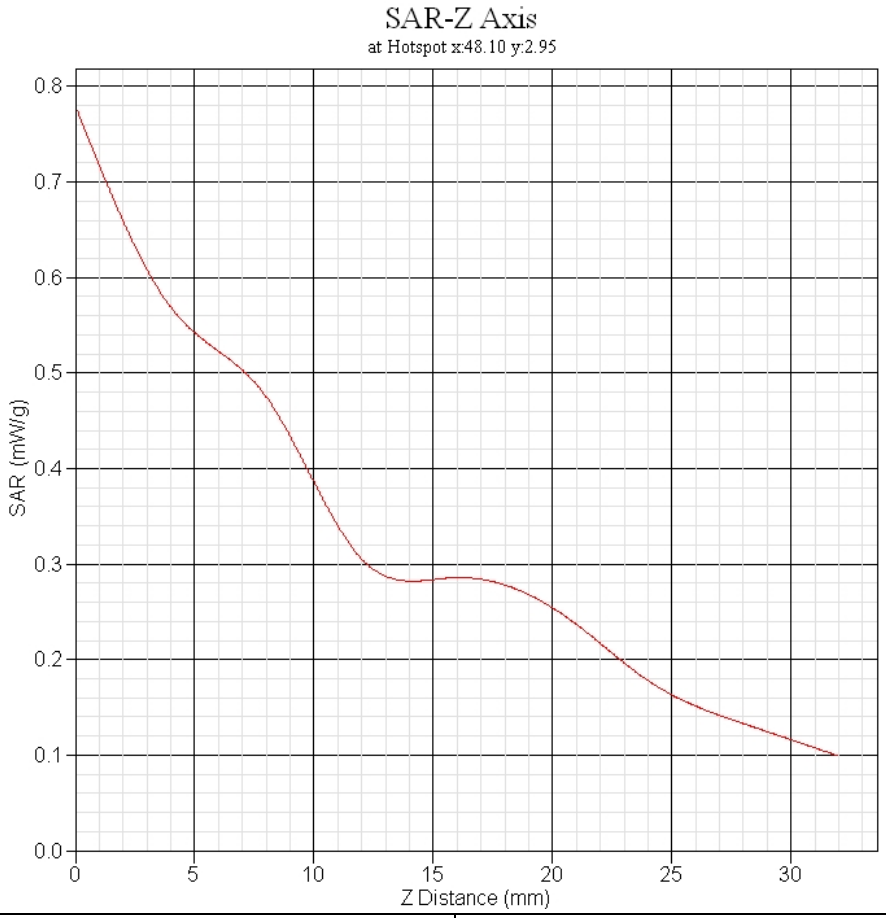


SAR 10g (W/Kg)	**0.354**

GSM900 Cellular Handset only 2nd

Frequency (MHz)	**902.400**
Relative permitivity (real part)	**41.684**
Conductivity (S/m)	**0.972**
Variation (%)	**-1.285**
Duty Cycle Factor	**1**
Crest Factor	**8.3**
Conversion Factor	**5.7**
Probe Sensitivity	**1.20 1.20 1.20 μV/(V/m)2**
Temperature	**Ambient:22.1℃** **Liqiud:20.7℃**
Data	**2011-5-27**

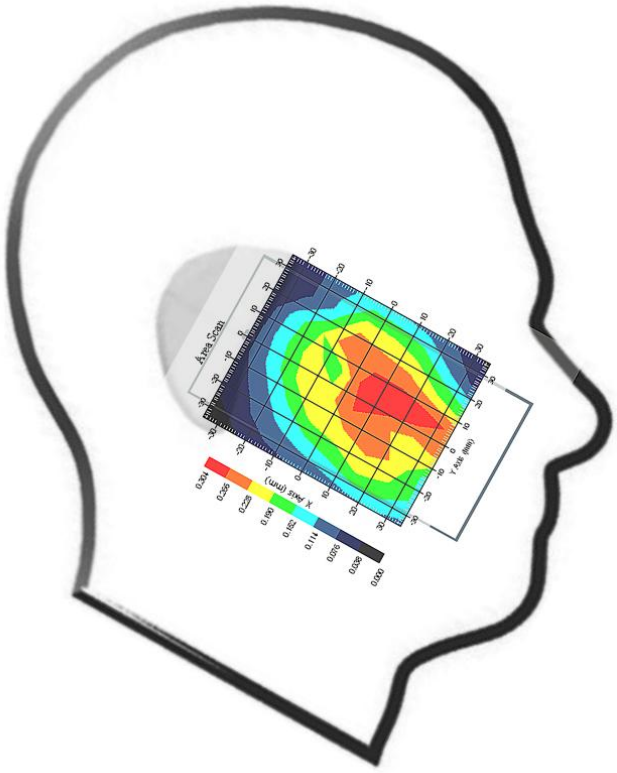


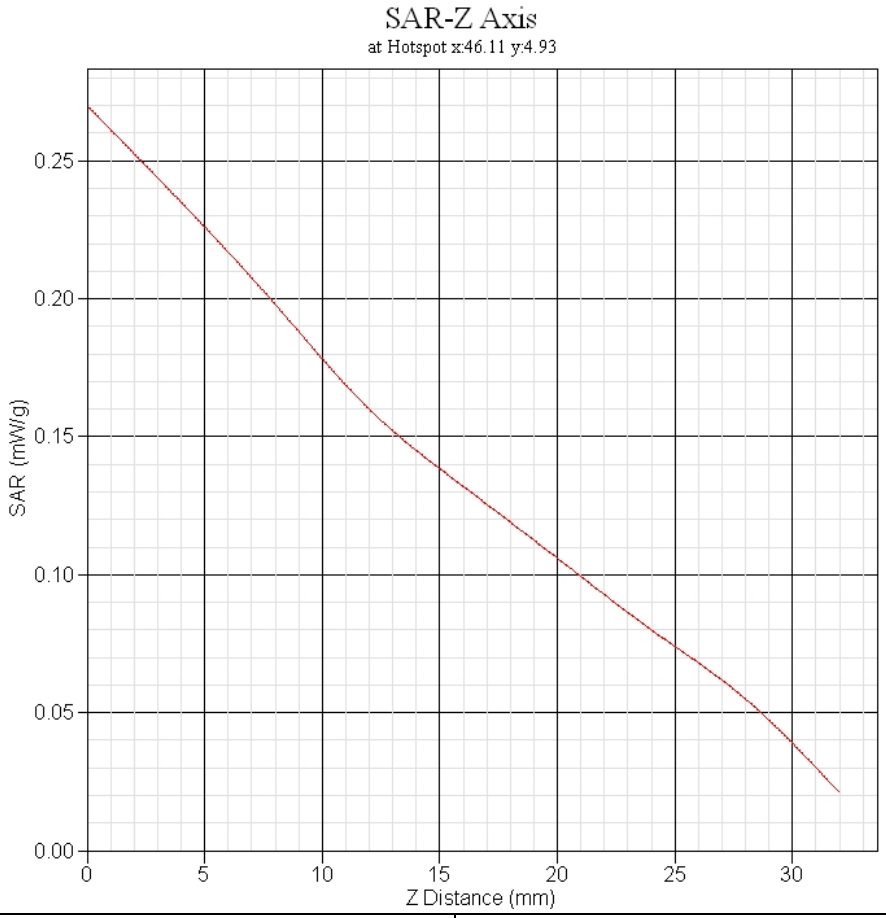


SAR 10g (W/Kg)	**0.397**

GSM900 Anti-radiation Card on rear surface 1st

Frequency (MHz)	**902.400**
Relative permitivity (real part)	**41.684**
Conductivity (S/m)	**0.972**
Variation (%)	**-0.687**
Duty Cycle Factor	**1**
Crest Factor	**8.3**
Conversion Factor	**5.7**
Probe Sensitivity	**1.20 1.20 1.20 μV/(V/m)2**
Temperature	**Ambient:22.1℃** **Liqiud:20.7℃**
Data	**2011-5-27**

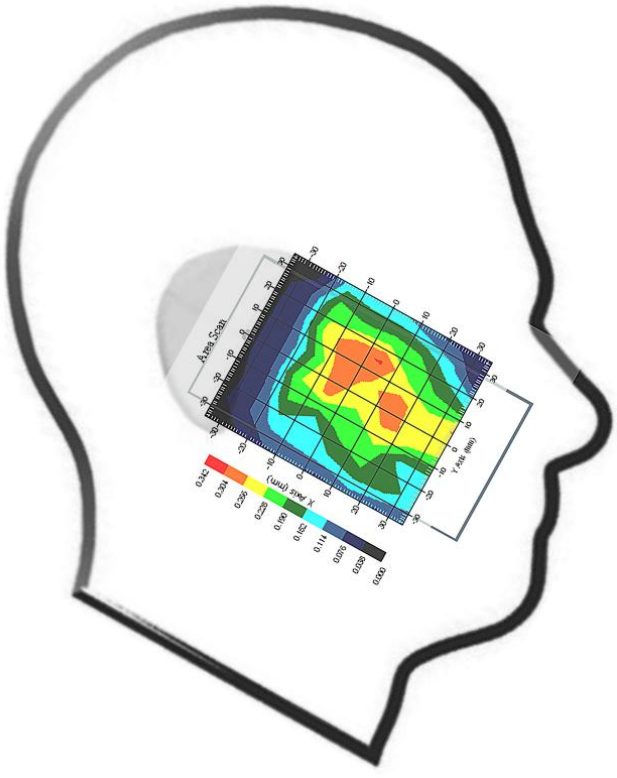


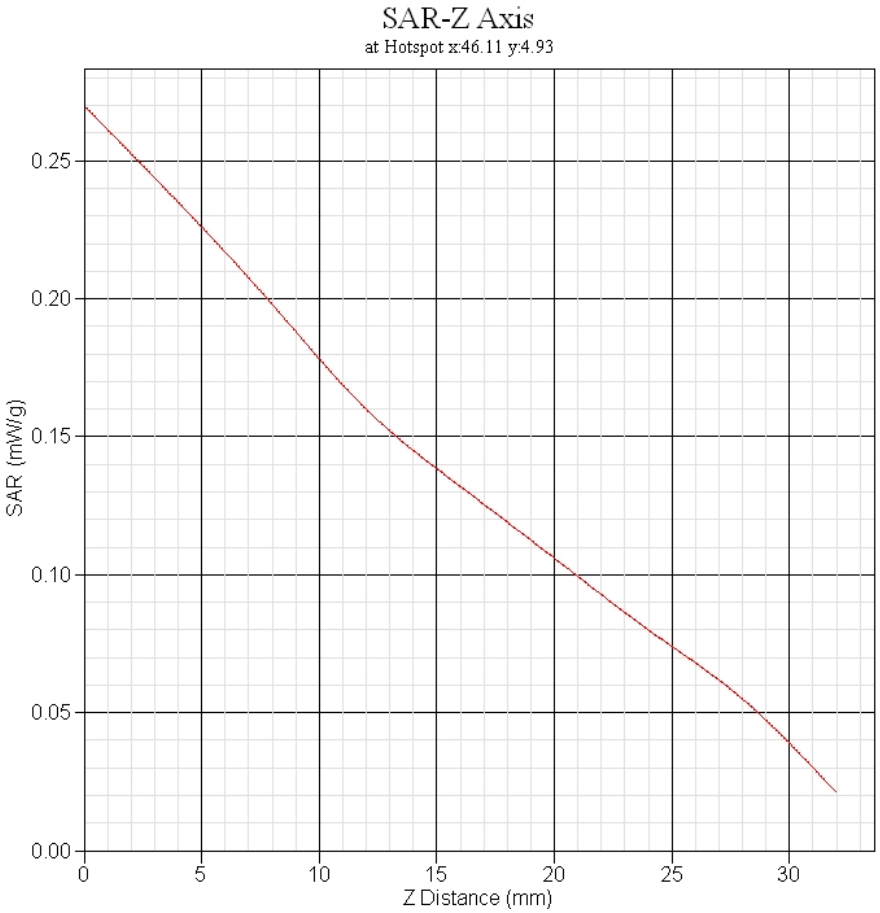


SAR 10g (W/Kg)	**0.121**

GSM900 Anti-radiation Card on rear surface 2nd

Frequency (MHz)	**902.400**
Relative permitivity (real part)	**41.684**
Conductivity (S/m)	**0.972**
Variation (%)	**-0.439**
Duty Cycle Factor	**1**
Crest Factor	**8.3**
Conversion Factor	**5.7**
Probe Sensitivity	**1.20 1.20 1.20 μV/(V/m)2**
Temperature	**Ambient:22.1℃** **Liqiud:20.7℃**
Data	**2011-5-27**





SAR 10g (W/Kg)	**0.117**

** END OF REPORT **