TEST REPORT

of

SAR

☒ New Application; ☐ Class I PC; ☐ Class II PC

Product:	**EFTPOS**
Brand:	**CASTLES TECHNOLOGY**
Model Difference:	**N/A**
Model:	**VEGA5000M**
FCC ID:	**WIY-VEGA5000M**
Standard:	**FCC 47 CFR Part2(2.1093)** **IIEEE C95.1-1999; IEEE 1528** **FCC OET 65 Supplement C(Edition 01-10)**
Applicant:	**CASTLES TECHNOLOGY CO., LTD**
Address:	**2F, No.205, Sec.3, Beixin Rd., Xindian District, New Taipei City 23143, Taiwan (R.O.C.)**

Test Performed by:

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Report No.: **ISL-11LR091SAR**
Issue Date : **2012/02/29**

International Standards Laboratory
0997

Test results given in this report apply only to the specific sample(s) tested and are traceable to national or international standard through calibration of the equipment and evaluating measurement uncertainty herein.

VERIFICATION OF COMPLIANCE

Applicant:	CASTLES TECHNOLOGY CO., LTD
Product Description:	EFTPOS
Brand Name:	CASTLES TECHNOLOGY
Model No.:	VEGA5000M
Model Difference:	N/A
FCC ID:	WIY-VEGA5000M
Date of Receipt:	Nov. 28, 2011
Date of Test:	Dec. 2, 2011 – Dec. 05, 2011
Standard:	FCC 47 CFR Part2(2.1093) IIEEE C95.1-1999; IEEE 1528 FCC OET 65 Supplement C(Edition 01-10)

We hereby certify that:

All the tests in this report have been performed and recorded in accordance with the standards described above and performed by an independent electromagnetic compatibility consultant, International Standards Laboratory.

The test results contained in this report accurately represent the measurements of the characteristics and the energy generated by sample equipment under test at the time of the test. The sample equipment tested as described in this report is in compliance with the limits of above standards.

Test By:	Arno Hsieh ***Arno Hsieh / Supervisor***	***Date:***	2012/02/29
Prepared By:	Arno Hsieh ***Arno Hsieh / Supervisor***	***Date:***	2012/02/29
Approved By:	Vincent Su ***Vincent Su / Manager***	***Date:***	2012/02/29

Version

Version No.	Date	Description
00	2011/12/06	Initial creation of document
01	2012/02/29	Update Raw data of Z-axis

Table of Contents

1 Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) were found during testing for EUT, which are as follows (with expanded uncertainty 21.4 % for 300 MHz to 3 GHz).

Type	Position	SAR_{1g} (W/kg)
GPRS 850	Body, 1.5cm distance	1.081
GPRS 1900	Body, 1.5cm distance	0.968

They are in compliance with Specific Absorption Rate (SAR) for general population /uncontrolled exposure limits (1.6 W/kg) specified in FCC 47 CFR part 2 (2.1093) and ANSI/IEEE C95.1-1999, and had been tested in accordance with the measurement methods and procedures specified in IEEE 1528-2003 and FCC OET Bulletin 65 Supplement C (Edition 01-01).

2 General Information

2.1 Description of Device Under Test (DUT)

Product Name	EFTPOS	
Brand Name	CASTLES TECHNOLOGY	
Model Name	VEGA5000M	
Model Difference	N/A	
Power Supply	7.4Vdc re-chargeable battery or 9Vdc by AC/DC power adapter	
	Battery:	Model: NA
	Adapter:	Model No.: PA1050-090T1A500 Supplier: Powertron

WWAN:

	Operating Frequency		Rated Power
Cellular Phone Standards Frequency Range and Power	GPRS/EDGE 850, Class 10	824.2 MHz– 848.8 MHz	33 dBm
	GPRS/EDGE 900, Class 10	880.2MHz – 914.8MHz	33 dBm
	GPRS/EDGE 1800, Class 10	1710.2MHz-1784.8MHz	30 dBm
	GPRS/EDGE 1900, Class 10	1850.2MHz – 1909.8MHz	30 dBm
Type of Modulation	GMSK		
Antenna Type	PIFA Antenna		
Hardware Version	N/A		
Software Version:	N/A		

The EUT is compliance with GPRS Standard. This report is test for GPRS 850 and 1900MHz bands.

Remark: The above DUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.

2.2 DUT Photos

Please refer to Appendix B.

2.3 Applied Standards

The Specific Absorption Rate (SAR) testing specification, method and procedure for this Notebook Computer is in accordance with the following standards:

FCC 47 CFR Part 2 (2.1093)
IEEE C95.1-1999
IEEE 1528-2003
FCC OET Bulletin 65 Supplement C (Edition 01-01)
FCC KDB 447498 D01

2.4 Device Category and SAR Limits

This device belongs to **portable** device category because its radiating structure is allowed to be used within 20 centimeters of the body of the user. Limit for **General Population/Uncontrolled** exposure should be applied for this device, it is **1.6 W/kg** as averaged over any 1 gram of tissue.

Limits for General Population/Uncontrolled Exposure (W/kg)

Type Exposure	Uncontrolled Environment Limit
Spatial Peak SAR (1g cube tissue for brain or body)	1.60 W/kg
Spatial Average SAR (whole body)	0.08 W/kg
Spatial Peak SAR (10g for hands, feet, ankles and wrist)	4.00 W/kg

2.5 Test Environment

Item	Required	Actual
Temperature (°C)	18-25°C	20 to 24 °C
Humidity (%RH)	30-70 %	< 60 %

2.6 Test Configuration

The device was controlled by using a CMU200 to PCL at max continuously. Modulation type and Channel number are selected by CMU200 also.

3 Specific Absorption Rate (SAR)

3.1 Introduction

SAR is related to the rate at which energy is absorbed per unit mass in an object exposed to a radio field. The SAR distribution in a biological body is complicated and is usually carried out by experimental techniques or numerical modeling. The standard recommends limits for two tiers of groups, occupational/controlled and general population/uncontrolled, based on a person's awareness and ability to exercise control over his or her exposure. In general, occupational/controlled exposure limits are higher than the limits for general population/uncontrolled.

3.2 SAR Definition

The SAR definition is the time derivative (rate) of the incremental energy (dW) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dv) of a given density (ρ). The equation description is as below:

$$SAR = \frac{d}{dt}\left(\frac{dW}{dm}\right) = \frac{d}{dt}\left(\frac{dW}{\rho dV}\right)$$

SAR is expressed in units of Watts per kilogram (W/kg)

SAR measurement can be either related to the temperature elevation in tissue by

$$SAR = C\left(\frac{\delta T}{\delta t}\right)$$

Where: C is the specific head capacity, δT is the temperature rise and δt is the exposure duration, or related to the electrical field in the tissue by

$$SAR = \frac{\sigma |E|^2}{\rho}$$

Where: σ is the conductivity of the tissue, ρ is the mass density of the tissue and E is the RMS electrical field strength.

However for evaluating SAR of low power transmitter, electrical field measurement is typically applied.

4 SAR Measurement System

4.1 ALSAS-10U System Description

APREL Laboratories ALSAS-10U is fully optimized for the dosimetric evaluation of a broad range of wireless transceivers and antennas. Developed in line with the latest methodologies it is fully compliant with the technical and scientific requirements of IEEE 1528, IEC 62209 Part 1 & 2 (draft), 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 odeling to provide a platform which is repeatable with minimum uncertainty.

Applications

ALSAS-10U is designed to cover the frequency range from 30MHz to 6GHz as per the IEC 62209 Part II (draft) standard. There is no limiting factor to the operating RF carrier frequency range for the ALSAS-10U system other than the phantoms chosen for testing. The ALSAS-10U has been designed to be modular and phantoms are integrated onto the Universal Workstation ™ so as to allow for complete flexibility of the measurement process. This unique design allows for a fully flexible system which can be built around the exact needs of the user.

Area Scans

Area scans are defined prior to the measurement process being executed with a user defined variable spacing between each measurement point (integral) allowing low uncertainty measurements to be conducted. Scans defined for FCC applications utilize a 10mm² step integral, with 1mm interpolation used to locate the peak SAR area used for zoom scan assessments.

Where the system identifies multiple SAR peaks (which are within 25% of peak value) the system will provide the user with the option of assessing each peak location individually for zoom scan averaging.

Zoom Scan (Cube Scan Averaging)

The averaging zoom scan volume utilized in the ALSAS-10U software is in the shape of a cube and the side dimension of a 1 g or 10 g mass is dependent on the density of the liquid representing the simulated tissue. A density of 1000 kg/m³ is used to represent the head and body tissue density and not the phantom liquid density, in order to be consistent with the definition of the liquid dielectric properties, i.e. the side length of the 1 g cube is 10mm, with the side length of the 10 g cube 21,5mm.

When the cube intersects with the surface of the phantom, it is oriented so that 3 vertices touch the surface of the shell or the center of a face is tangent to the surface. The face of the cube closest to the surface is modified in order to conform to the tangent surface.

The zoom scan integer steps can be user defined so as to reduce uncertainty, but normal practice for typical test applications (including FCC) utilize a physical step of 5x5x8 (8mmx8mmx5mm) providing a volume of 32mm in the X & Y axis, and 35mm in the Z axis.

ALSAS-10U Interpolation and Extrapolation Uncertainty

The overall uncertainty for the methodology and algorithms the used during the SAR calculation was evaluated using the data from IEEE 1528 based on the example f3 algorithm:

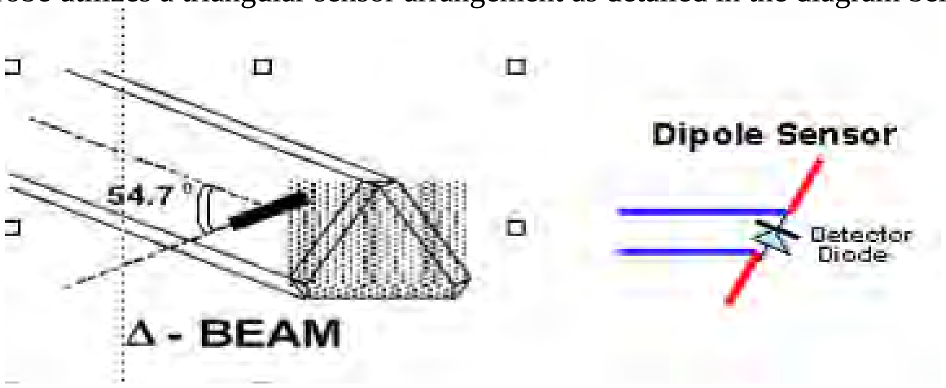
$$f_3(x,y,z) = A\frac{a^2}{\frac{a^2}{4}+x'^2+y'^2}\cdot\left(e^{-\frac{2z}{a}}+\frac{a^2}{2(a+2z)^2}\right)$$

Refer to raw data for measurement uncertainty

4.2 E-Field Probe ALS-E-020S

The isotropic E-Field probe has been fully calibrated and assessed for isotropicity, 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:

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.

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

4.2.1 E-Field Probe Specification

Model: ALS-E-020S

Compliant Standards	IEEE 1528, IEC 62209 Part 1 & 2 (draft)
Frequency Range	30 MHz ~ 6 GHz
Sensitivity	Better than 0.8 μ V/(V/m)2
Dynamic Range SAR	0. 001 W/kg to 100 W/kg
Isotropic Response Axial	Typically ± 0.1dB
Hemispherical isotropy	±0.3 dB or better
Linearity	±0.2 dB or better
Probe Tip Radius	User selectable all <5 mm
Sensor Offset	1.56 (± 0.02 mm)
Probe Length	290 mm
Video Bandwidth	@ 500 Hz: 1 dB @ 1K Hz: 3 dB
Boundary Effect	Less than 2% for distances greater than 2.4 mm
Material	Ertalyte™
Connector	6 Pin Bayonet

E-Field Probe Calibration

Each probe needs to be calibrated according to a dosimetric assessment procedure with accuracy better than ± 10%. The spherical isotropy shall be evaluated and within ± 0.25 dB. The sensitivity parameters (NormX, NormY, and NormZ), the diode compression parameter (DCP) and the conversion factor (ConvF) of the probe are tested. The calibration data can be referred to appendix C of this report.

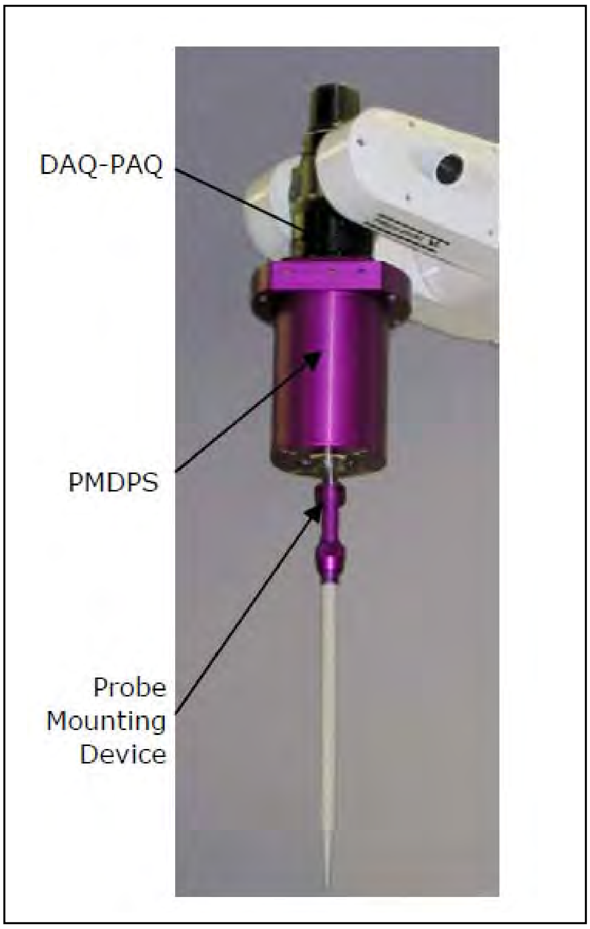
Boundary Detection Unit and Probe Mounting Device

ALSAS-10U incorporates a boundary detection unit with a sensitivity of 0.05mm for detecting all types of surfaces. The robust design allows for detection during probe tilt (probe normalize) exercises, and utilizes a second stage emergency stop. The signal electronics are fed 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 connect to an isolated probe interconnect where the output stage of the probe is fed directly into the amplifier stage of the Daq-Paq.

4.3 DAQ-PAQ (Analog to Digital Electronics) ALS-DAQ-PAQ-3 Boundary Detection Unit ALS-PMDPS-3

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 4 µV to 330 mV. 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 an RS232 communications port. Probe linearity and duty cycle compensation is carried out within the main Daq-Paq module.



PMDPS is used to hold a probe and to detect complex boundary locations (curved and flat surfaces) during a SAR or HAC assessment process. It utilizes relative movements of internal components to trigger integrated micro-sensor mechanisms in order to detect boundary(s) and consequently position the probe at the specified distance relative to a boundary in order to achieve accurate and repeatable measurements.

Amplifier Range	4 μV to 330 mV
ADC	16 Bit optically isolated
Built-in E-Stop Feature	Emergency Stop feature to prevent damage of equipment and for user safety purposes
Field Integration	Local Co-Processor utilizing proprietary integration algorithms
SAR Dynamic Range	0.001 W/kg -100 W/kg.
Ambient Noise	Below 0.001 W/kg measured with probe in tissue
LED Indication	Boundary detection and DAQ-PAQ State
Number of Input Channels	4 in total 3 dedicated and 1 spare for future upgrades (when and if needed)
Communication	Optically isolated packet data via RS232
Robot Arm Integration	DAQ-PAQ and Boundary Detection Unit are mounted directly onto joint 6 of the F3 arm utilizing joint 6 tool (ISO Standard M8 Mounting Plate) to allow easy integration and removal (no angular interface)
Supply	DC supply powered by an isolated external supply unit (no battery required)
LED Indicators	Probe status (amplifier on) and boundary detection

PMDPS Specification details

Accuracy of Positioning	Better than 10µm at 6GHz
SAR Uncertainty	Better than 0.01 W/kg SAR at 6Gz
Detection Mechanism	2 x 360° Stage Axial and Lateral Detection at 6GHz
Emergency Stop	4 Stage 360° Axial and Lateral Detection at 6GHz
Probe Mounting	6 Pin Bayonet for Fast Probe Change
Calibration	Every PMDPS is Calibrated to 0.01 W/kg SAR at 6GHz
Reliability Expectations	Better Than 10,000,000 Cycles

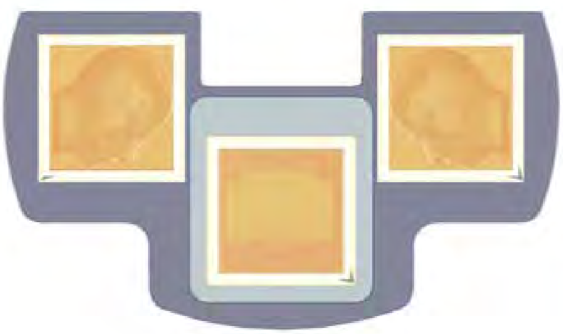
4.4 Axis Articulated Robot ALS-F3

ALSAS-10U utilizes a six axis 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 envelope. 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 Resolution	0.05mm
Controller Type	Single phase Pentium based C500C
Robot Reach	710mm
Repeatability	0.05mm or better
Communication	RS232 and LAN compatible

4.5 ALSAS Universal Workstation ALS-UWS

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



Workstation.
Top view (rendering)

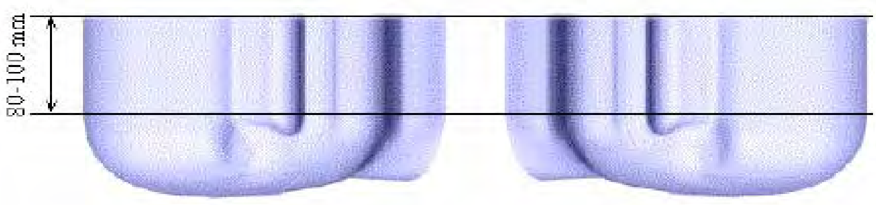
Workstation
without robot (rendering)

4.6 SAM Phantoms ALS-P-SAM-L / ALS-P-SAM-R

The ALSAS-10U allows the integration of multiple phantom types. SAM Phantoms fully compliant with IEEE 1528, Universal Phantom, and Universal Flat.

APREL SAM Phantoms

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.



Compliant Standards	IEEE-1528, IEC 62209 Part 1 & 2 (draft)
SAM	In accordance with the IEEE 1528 standard
Material	Composite urethane which allows for the device to be viewed through the phantom, resistant to DGBE
Phantom Shell Shape Tolerance	Fully calibrated to be better than ± 0.2 mm
Frame Material	Corian®
Tissue Simulation Volume	7 liter with 15.0 ± 0.5 cm tissue
Thickness	2 mm ± 0.2 mm 6 mm ± 0.2 mm at NF/MB intersection
Loss Tangent	<0.05
Relative Permittivity	<5
Resistant to Solvents	Resistant to all solvents used for tissue manufacturing detailed in IEEE 1528
Load Deflection	<1mm with sugar water compositions
Manufacturing Process	Injection Molded
Phantom Weight	Less than 10kg when filled with 15cm of simulation tissue

Universal Phantom ALS-P-UP-1

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.

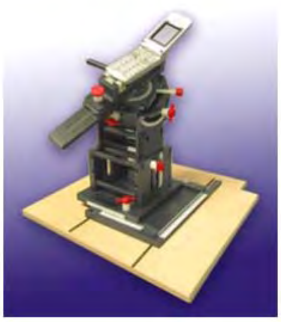
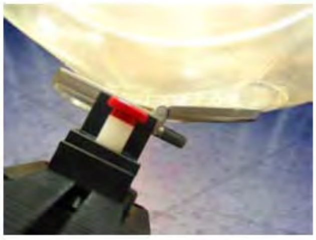
Compliant Standards	IEEE-1528, IEC 62209 Part 1 & 2 (draft), CENELEC, and others
Manufacturing Process	Injection molded
Material	Vivac
Phantom Shell Shape Tolerance	Less than ± 0.2 mm
Frame Material	Corian®
Tissue Simulation Volume	8 liter with 15.0 ± 0.5 cm tissue
Thickness	2mm ± 0.2mm 6mm at NF/MB intersection
Loss Tangent	<0.05
Relative Permittivity	<5
Resistant to Solvents	Resistant to all solvents detailed in IEEE 1528
Load Deflection	<1mm with heaviest tissue (sugar water compositions)
Dimensions	Length 220mm x breadth 170mm
Phantom Weight	Less than 10kg when filled with 15cm of simulation tissue

4.7 Universal Device Positioner

ALS-H-E-SET-2

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 indicator is included for the of aid cheek to 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.

Compliant Standards	IEEE 1528, IEC 62209 Part 1 & 2 (draft)
Dielectric constant	Less than 5.0
Loss Tangent	Less than 0.05
Number of Axis	6 axis freedom of movement (8 when utilized with ALSAS-10U Workstation
Translation Along MB Line	± 76.2 mm
Translation Along NF Line	± 38.1 mm
Translation Along Z Axis	± 25.4 mm (expandable up to 500 mm)
Rotation Around MB Line (yaw)	±10°
Rotation Around NF (pitch)	± 30°
Line Rotation (roll)	360° full circle
Maximum Grip Range	0 mm to 150 mm
Material	Resistant to DGBE and all other tissue stimulant materials as listed in IEEE 1528 Annex C.1.
Tilt Movement	Full movement with built-in 15° gauge

4.8 Test Equipment List

Equipment Type	MFR	Model No.	Serial No.	Last Cal.	Cal. Due Date
Vector Network Analyzer	Agilent	E5071B	MY42402726	09/23/2011	09/22/2012
Dielectric Probe Kit	Aglient	85070E	MY44300124	N/A	N/A
Vector Signal Generator	R&S	SMU200A	102330	01/17/2011	01/16/2012
Power Meter	Anritsu	ML2495A	1116010	03/16/2011	03/15/2012
Power Sensor	Anritsu	MA2411B	34NKF50	04/22/2011	04/21/2012
Data Acquisition Package	Aprel	ALS-DAQ-PAQ-3	110-00220	NA	NA
Aprel Laboratories Probe	Aprel	ALS-E020	266	08/08/2011	08/07/2012
Aprel Reference Dipole 835MHz	Aprel	ALS-D-835-S-2	835-180-00553	02/02/2009	02/012012
Aprel Reference Dipole 1900MHz	Aprel	ALS-D-1900-S-2	1900-210-00703	02/02/2009	02/01/2012
Boundary Detection Sensor System	Aprel	ALS-PMDPS-3	120-00266	N/A	N/A
Universal Work Station	Aprel	ALS-UWS	100-00153	N/A	N/A
Device Holder 2.0	Aprel	ALS-H-E-SET-2	170-00503	N/A	N/A
Left Ear SAM Phantom	Aprel	ALS-P-SAM-L	130-00305	N/A	N/A
Right Ear SAM Phantom	Aprel	ALS-P-SAM-R	140-00359	N/A	N/A
Universal Phantom	Aprel	ALS-P-UP-1	150-00405	N/A	N/A
Aprel Dipole Spacer	Aprel	ALS-DS-U	250-00903	N/A	N/A
SAR Software	Aprel	ALSAS-10U Ver.2.2.0	B0D5F-112FE	N/A	N/A
CRS C500C Controller	Thermo	ALS-C500	RCF0440278	N/A	N/A
CRF F3 Robot	Thermo	ALS-F3	RAF0440252	N/A	N/A
Power Amplifier	Mini-Circuit	ZVE-8G	D030305	N/A	N/A

Note: All equipment upon which need to be calibrated are with calibration period of 1 year.
Other than Dipole is according FCC KDB number 50824 D02 Dipoles must be recalibrated at least once every three years;

5 Tissue Simulating Liquids

Tissue Dielectric Parameters for Head and Body Phantoms

The head tissue dielectric parameters recommended by the IEEE SCC-34/SC-2 in P1528 have been incorporated in the following table. These head parameters are derived from planar layer models simulating the highest expected SAR for the dielectric properties and tissue thickness variations in a human head. Other head and body tissue parameters that have not been specified in P1528 are derived from the tissue dielectric parameters computed from the 4-Cole-Cole equations described in Reference [12] and extrapolated according to the head parameters specified in P1528.

Target Frequency	Parameters(Body) IEEE1528 OTE 65		Parameters(Head) 62209-1/-2 IEEE1528 OET65	
(MHz)	ε_r	σ (S/m)	ε_r	σ (S/m)
835	55.2	0.97	41.5	0.90
900	55.0	1.05	41.5	0.97
1800 – 2000	53.3	1.52	40.0	1.4
2450	52.7	1.95	39.2	1.8
5800	48.2	6.00	35.3	5.27

(ε_r = relative permittivity, σ = conductivity and ρ = 1000 kg/m^3)

Tissue Calibration Result

The dielectric parameters of the liquids were verified prior to the SAR evaluation using Agilent Dielectric Probe Kit 85070E and Agilent E5071B Vector Network Analyzer

Body Tissue Simulant Measurement				
Frequency [MHz]	Description	Dielectric Parameters		Tissue Temp. [°C]
		ε_r	σ [s/m]	
835MHz	Reference result ± 5% window	55.2 52.44 to 57.96	0.97 0.92 to 1.04	N/A
	Nov 15, 2011	54.05	0.94	22

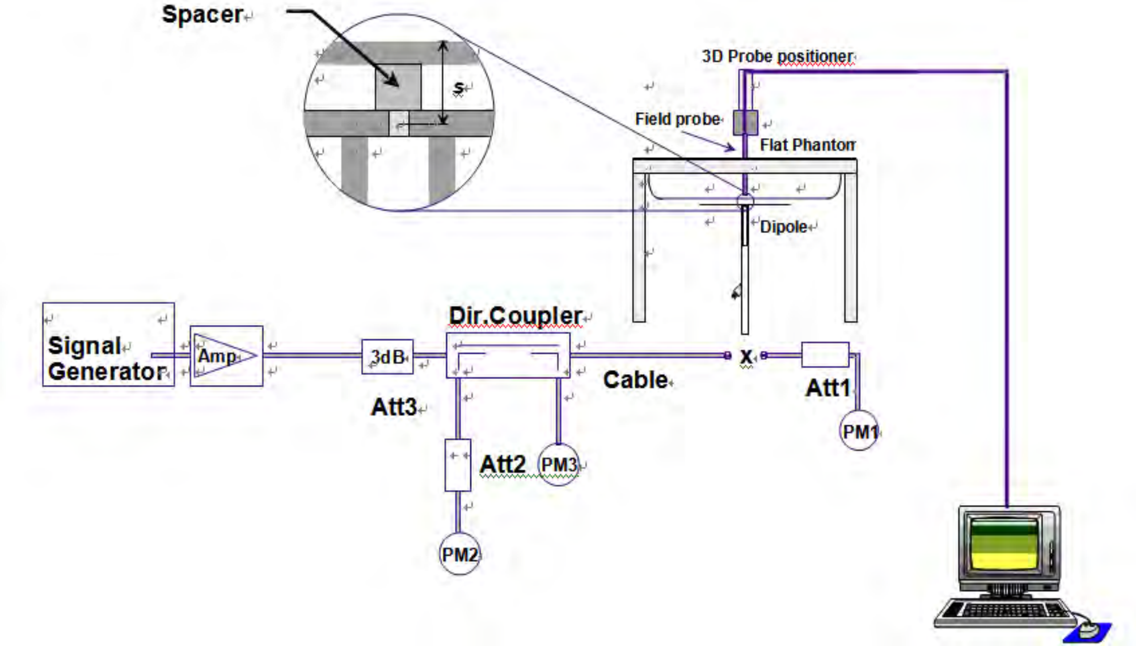
Body Tissue Simulant Measurement				
Frequency [MHz]	Description	Dielectric Parameters		Tissue Temp. [°C]
		ε_r	σ [s/m]	
1900MHz	Reference result ± 5% window	53.3 50.63 to 55.96	1.52 1.44 to 1.59	N/A
	Nov 15, 2011	51.17	1.57	22

6 SAR Measurement Evaluation

Each system is equipped with one or more system validation kits. These units, together with the predefined measurement procedures within the APREL SAR software, enable the user to conduct the system performance check and system validation. System validation kit includes a dipole, tripod holder to fix it underneath the flat phantom and a corresponding distance holder.

System Setup

In the simplified setup for system evaluation, the DUT is replaced by a calibrated dipole and the power source is replaced by a continuous wave that comes from a signal generator. The calibrated dipole must be placed beneath the flat phantom section of the SAM twin phantom with the correct distance holder. The distance holder should touch the phantom surface with a light pressure at the reference marking and be oriented parallel to the long side of the phantom. The equipment setup is shown below:



1. Signal Generator
2. Amplifier
3. Directional Coupler
4. Power Meter
5. Calibrated Dipole

Validation Dipoles

The dipoles used is based on the IEEE-1528 standard, and is complied with mechanical and electrical specifications in line with the requirements of both IEEE and FCC Supplement C. the table below provides details for the mechanical and electrical specifications for the dipoles.

*	Frequency	L (mm)	h (mm)	d (mm)
v	835MHz	161.0	89.8	3.6
	900MHz	149.0	83.3	3.6
	1800MHz	72.0	41.7	3.6
v	1900MHz	68.0	39.5	3.6
	2450MHz	51.5	30.4	3.6
	5200MHz	23.6	14.0	3.6
	5800MHz	21.6	12.6	3.6

*Note: “V” indicates Frequency used of EUT

The output power on dipole port must be calibrated to 30 dBm (1W) before dipole is connected.

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Validation Result

Comparing to the original SAR value provided by APREL, the validation data should be within its specification of 10 %. Table 8.1 shows the target SAR and measured SAR after normalized to 1W input power. The table below indicates the system performance check can meet the variation criterion and the plots can be referred to Appendix E of this report.

Frequency [MHz]	Description	SAR [w/kg] 1g	SAR [w/kg] 10g	Tissue Temp. [°C]
835 MHz	Reference result ± 5% window	9.49 9.025 to 9.975	6.2 5.89 to 6.51	N/A
	Dec. 05,2011	9.831	6.252	21.7

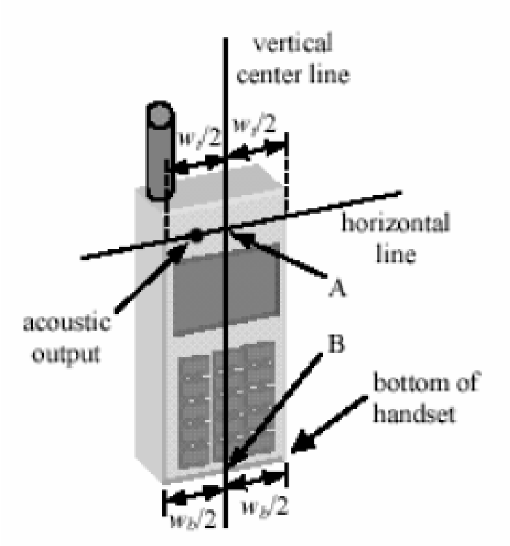
Frequency [MHz]	Description	SAR [w/kg] 1g	SAR [w/kg] 10g	Tissue Temp. [°C]
1900 MHz	Reference result ± 5% window	40.3 37.71 to 41.68	20.5 19.47 to 21.52	N/A
	Dec. 05,2011	41.24	21.20	21.7

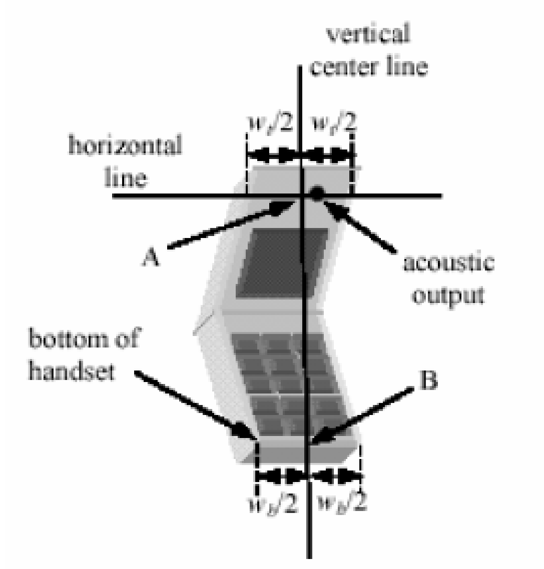
Note: All SAR values are normalized 1W.

7 DUT Testing Position

Test Positions of Device Relative to Head

This specifies exactly two test positions for the handset against the head phantom, the “cheek” position and the “tilted” position. The handset should be tested in both positions on the left and right sides of the SAM phantom. If the handset construction is such that it cannot be positioned using the handset positioning procedures described in 4.2.2.1 and 4.2.2.2 to represent normal use conditions (e.g., asymmetric handset), alternative alignment procedures should be considered with details provided in the test report.





Definition of the “Cheek” Position

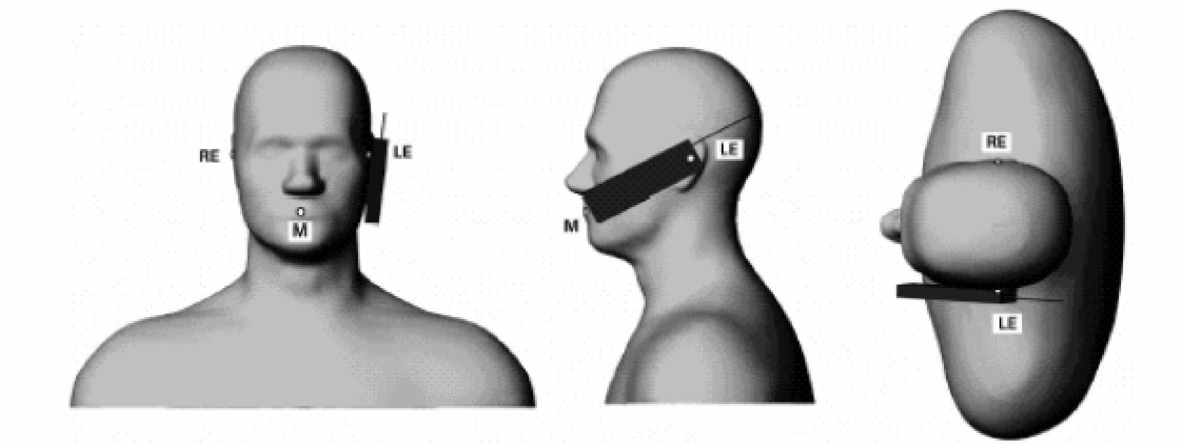
The “cheek” position is defined as follows:

a. Ready the handset for talk operation, if necessary. For example, for handsets with a cover piece, open the cover. (If the handset can also be used with the cover closed both configurations must be tested.)

b. Define two imaginary lines on the handset: the vertical centerline and the horizontal line. The vertical centerline passes through two points on the front side of the handset: the midpoint of the width wt of the handset at the level of the acoustic output (point A on Figures 4.1a and 4.1b), and the midpoint of the width wb of the bottom of the handset (point B). The horizontal line is perpendicular to the vertical centerline and passes through the center of the acoustic output (see Figure 4.1a). The two lines intersect at point A. Note that for many handsets, point A coincides with the center of the acoustic output. However, the acoustic output may be located elsewhere on the horizontal line. Also note that the vertical centerline is not necessarily parallel to the front face of the handset (see Figure 4.1b), especially for clamshell handsets, handsets with flip pieces, and other irregularly-shaped handsets.

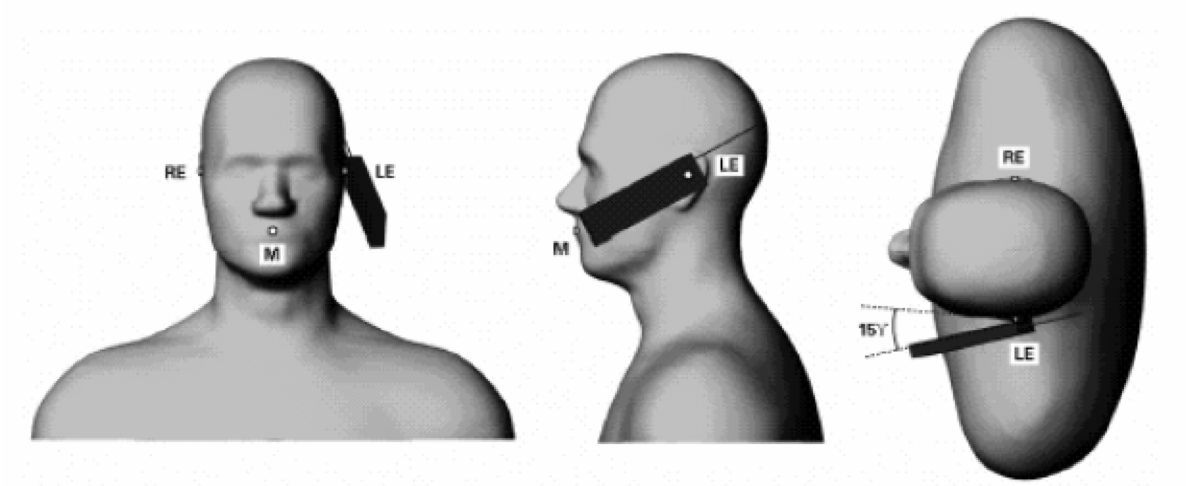
c. Position the handset close to the surface of the phantom such that point A is on the (virtual) extension of the line passing through points RE and LE on the phantom (see Figure 4.2), such that the plane defined by the vertical center line and the horizontal line of the handset is approximately parallel to the sagittal plane of the phantom.

d. Translate the handset towards the phantom along the line passing through RE and LE until the handset touches the pinna.
e. While maintaining the handset in this plane, rotate it around the LE-RE line until the vertical centerline is in the plane normal to MB-NF including the line MB (called the reference plane).
f. Rotate the handset around the vertical centerline until the handset (horizontal line) is symmetrical with respect to the line NF.
g. While maintaining the vertical centerline in the reference plane, keeping point A on the line passing through RE and LE and maintaining the handset contact with the pinna, rotate the handset about the line NF until any point on the handset is in contact with a phantom point below the pinna (cheek). See Figure 4.2 the physical angles of rotation should be noted.



Definition of the "Tilted" Position

The "tilted" position is defined as follows:
a. Repeat steps (a) – (g) of 4.2.1.1 to place the device in the "cheek position."
b. While maintaining the orientation of the handset move the handset away from the pinna along the line passing through RE and LE in order to enable a rotation of the handset by 15 degrees.
c. Rotate the handset around the horizontal line by 15 degrees.
d. While maintaining the orientation of the handset, move the handset towards the phantom on a line passing through RE and LE until any part of the handset touches the ear. The tilted position is obtained when the contact is on the pinna. If the contact is at any location other than the pinna (e.g., the antenna with the back of the phantom head), the angle of the handset should be reduced. In this case, the tilted position is obtained if any part of the handset is in contact with the pinna as well as a second part of the handset is contact with the phantom (e.g., the antenna with the back of the head).



Test Positions for body-worn

Body-worn operating configurations should be tested with the belt-clips and holsters attached to the device and positioned against a flat phantom in normal use configurations. A separation distance of **1.5 cm** between the back of the device and a flat phantom is recommended for testing body-worn SAR compliance under such circumstances. Other separation distance may be use, but not exceed 2.5 cm.

Test Positions for body

This DUT was only tested position in back ,the separation distance of phantom is 1.5cm

Please refer to Appendix B for the test setup photos.

8 SAR Measurement Procedures

The measurement procedures are as follows:

(a) through software control to continuous transmit

(b) Set CMU200 PCL to maximum output power

(c) Measure output power through RF cable and power meter

(d) Place the DUT in the positions described in the last section

(e) Set scan area, grid size and other setting on the APREL software

According to the test standard, the recommended procedure for assessing the peak spatial-average SAR value consists of the following steps:

(a) Power reference measurement

(b) Area scan

(c) Zoom scan

(d) Power drift measurement

Spatial Peak SAR Evaluation

The procedure for spatial peak SAR evaluation has been implemented according to the test standard. It can be conducted for 1g and 10g, as well as for user-specific masses. The APREL SAR software includes all numerical procedures necessary to evaluate the spatial peak SAR value.

The base for the evaluation is a "cube" measurement. The measured volume must include the 1g and 10g cubes with the highest averaged SAR values. For that purpose, the center of the measured volume is aligned to the interpolated peak SAR value of a previously performed area scan.

The entire evaluation of the spatial peak values is performed within the post-processing engine (SEMCAD). The system always gives the maximum values for the 1g and 10g cubes. The algorithm to find the cube with highest averaged SAR is divided into the following stages:

(a) Extraction of the measured data (grid and values) from the Zoom Scan
(b) Calculation of the SAR value at every measurement point based on all stored data (A/D values and measurement parameters)
(c) Generation of a high-resolution mesh within the measured volume
(d) Interpolation of all measured values form the measurement grid to the high-resolution grid
(e) Extrapolation of the entire 3-D field distribution to the phantom surface over the distance from sensor to surface
(f) Calculation of the averaged SAR within masses of 1g and 10g

Scan Procedures

First Area Scan is used to locate the approximate location(s) of the local peak SAR value(s). The measurement grid within an Area Scan is defined by the grid extent, grid step size and grid offset. Next, in order to determine the EM field distribution in a three-dimensional spatial extension, Zoom Scan is required. The Zoom Scan measures 5x5x7 points with step size 8, 8 and 5 mm for 300 MHz to 3 GHz. The Zoom Scan is performed around the highest E-field value to determine the averaged SAR-distribution over 10 g.

SAR Averaged Methods

In APREL, the interpolation and extrapolation are both based on the modified Quadratic Shepard's method. The interpolation scheme combines a least-square fitted function method and a weighted average method which are the two basic types of computational interpolation and approximation.

Extrapolation routines are used to obtain SAR values between the lowest measurement points and the inner phantom surface. The extrapolation distance is determined by the surface detection distance and the probe sensor offset. The uncertainty increases with the extrapolation distance. To keep the uncertainty within 1% for the 1 g and 10 g cubes, the extrapolation distance should not be larger than 5 mm.

9 SAR Test Results

9.1 Conducted power table:

Burst AVG

Band	Frequency (MHz)	CH	1 time slot	2 time slot
			AV Power (dBm)	AV Power (dBm)
GPRS 850	824.2	128	32.7	32.7
	836.6	190	32.8	32.7
	848.8	251	32.9	32.7
GPRS 1900	1850.2	512	30.8	30.9
	1880	661	30.9	30.9
	1909.8	810	31.0	30.9

Frame AVG

Band	Frequency (MHz)	CH	1 time slot	2 time slot
			AV Power (dBm)	AV Power (dBm)
GPRS 850	824.2	128	23.6	26.6
	836.6	190	23.7	26.6
	848.8	251	23.8	26.6
GPRS 1900	1850.2	512	21.7	24.8
	1880	661	21.8	24.8
	1909.8	810	21.9	24.8

Note:
Frame AVG= Burst AVG – Time Slot number
1 Time Slot = (8/1)10log= 9.03dB
2 Time Slot = (8/2)10log= 6.02dB
3 Time Slot = (8/3)10log= 4.26dB
4 Time Slot = (8/4)10log= 3.01dB

9.2 Test Records for Body SAR Test

Ambient Temperature (°C) : 21.7	*Relative Humidity (%):60*
Liquid Temperature (°C) : 22	*Depth of Liquid (cm):>15*

Dat aNo.	Band	Mode	Test Position	Separation Distance (cm)	Channel	SAR 1g(W/kg)
1	GSM 850	GPRS Slot 2	Body Back of EUT	1.5	1	0.994
2	GSM 850	GPRS Slot 2	Body Back of EUT	1.5	62	1.081
3	GSM 850	GPRS Slot 2	Body Back of EUT	1.5	124	0.976
4	GSM 1900	GPRS Slot 2	Body Back of EUT	1.5	513	0.968
5	GSM 1900	GPRS Slot 2	Body Back of EUT	1.5	698	0.828
6	GSM 1900	GPRS Slot 2	Body Back of EUT	1.5	884	0.896

10 Exposure Assessment Measurement Uncertainty

Source of Uncertainty	Tolerance Value	Probability Distribution	Divisor	c_i^1 (1-g)	c_i^1 (10-g)	Standard Uncertainty (1-g) %	Standard Uncertainty (10-g) %
Measurement System							
Probe Calibration	3.5	normal	1	1	1	3.5	3.5
Axial Isotropy	3.7	rectangular	√3	$(1\text{-cp})^{1/2}$	$(1\text{-cp})^{1/2}$	1.5	1.5
Hemispherical Isotropy	10.9	rectangular	√3	√cp	√cp	4.4	4.4
Boundary Effect	1.0	rectangular	√3	1	1	0.6	0.6
Linearity	4.7	rectangular	√3	1	1	2.7	2.7
Detection Limit	1.0	rectangular	√3	1	1	0.6	0.6
Readout Electronics	1.0	normal	1	1	1	1.0	1.0
Response Time	0.8	rectangular	√3	1	1	0.5	0.5
Integration Time	1.7	rectangular	√3	1	1	1.0	1.0
RF Ambient Condition	3.0	rectangular	√3	1	1	1.7	1.7
Probe Positioner Mech.	0.4	rectangular	√3	1	1	0.2	0.2
Restriction							
Probe Positioning with respect to Phantom Shell	2.9	rectangular	√3	1	1	1.7	1.7
Extrapolation and Integration	3.7	rectangular	√3	1	1	2.1	2.1
Test Sample Positioning	4.0	normal	1	1	1	4.0	4.0
Device Holder Uncertainty	2.0	normal	1	1	1	2.0	2.0
Drift of Output Power	1.2	rectangular	√3	1	1	0.7	0.7
Phantom and Setup							
Phantom Uncertainty(shape & thickness tolerance)	3.4	rectangular	√3	1	1	2.0	2.0
Liquid Conductivity(target)	5.0	rectangular	√3	0.7	0.5	2.0	1.4
Liquid Conductivity(meas.)	2.9	normal	1	0.7	0.5	2.0	1.4
Liquid Permittivity(target)	5.0	rectangular	√3	0.6	0.5	1.7	1.4
Liquid Permittivity(meas.)	3.3	normal	1	0.6	0.5	2.0	1.6
Combined Uncertainty		RSS				9.7	9.3
Combined Uncertainty (coverage factor=2)		Normal(k=2)				19.4	18.7

Appendix A Test Setup Photos

EUT Back test

Appendix B DUT Photos

Refer to FCC Part22/24 report

Appendix C: System Performance Check

Refer to Appendix

Appendix D: SAR Measurement Data

Refer to Appendix

Appendix E: Probe Calibration Certificate

Refer to Appendix

Appendix F: Dipole Calibration Certificate

Refer to Appendix

~ end of Report ~

Appendix C: System Performance Check

Report Date : 05-Dec-2011
By Operator : Arno Hsieh
DUT : Dipole
Frequency : 835 MHz and 1900
Max. Transmit Pwr : 1 W

APREL ALSAS-10U System Description

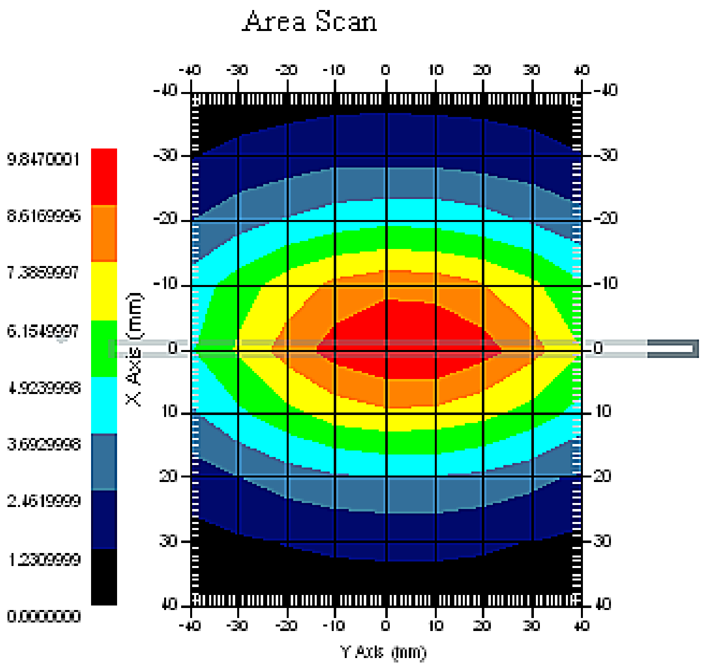
Phantom Data
Name : Universal Phantom
Type : ALS-P-UP-1

Tissue Data
Type : Body
Frequency : 835 MHz and 1900

Probe Data
Name : E-field Probe
Model : ALS-E-020
Serial No. : 266
Last Calib. Date : 08-Aug-2011

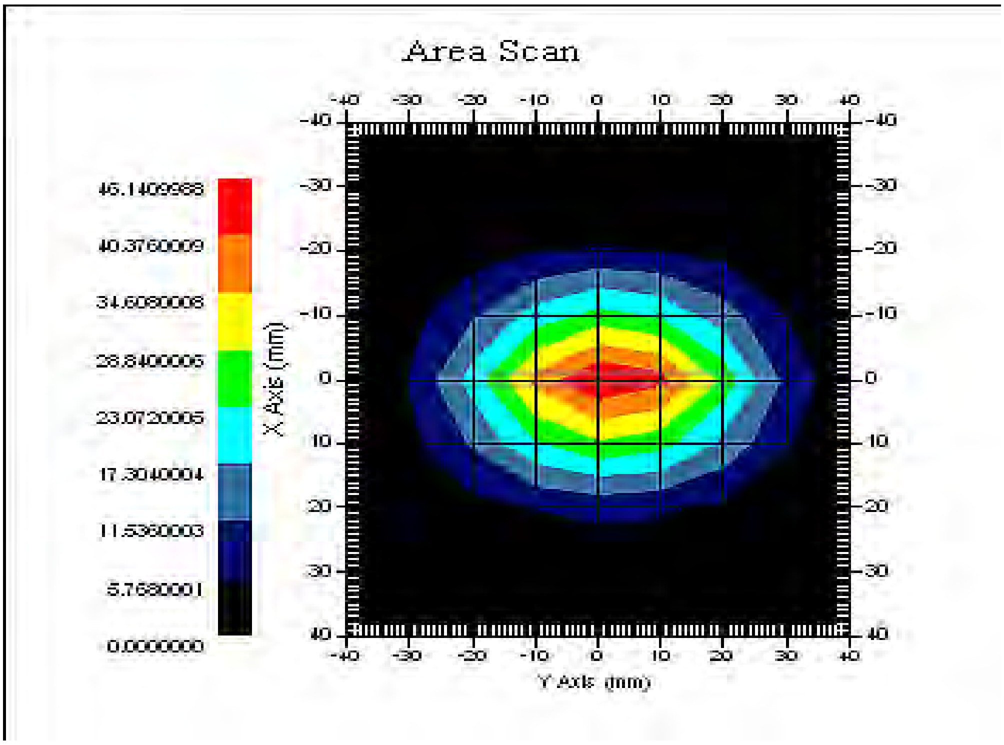
Measurement Data
Crest Factor : 1
Scan Type : Complete
Tissue Temp. : 22.00 °C
Ambient Temp. : 23.00 °C
Area Scan : 9x9x1 : Measurement x=10mm, y=10mm, z=4mm
Zoom Scan : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm
Separation : 1cm

835MHz



1 gram SAR value : 9.831 W/kg
10 gram SAR value : 6.252 W/kg
Area Scan Peak SAR : 9.847 W/kg
Zoom Scan Peak SAR : 14.112 W/kg

1900MHz



1 gram SAR value : 41.240 W/kg
10 gram SAR value : 21.203 W/kg
Area Scan Peak SAR : 46.141 W/kg
Zoom Scan Peak SAR : 71.263 W/kg

Appendix D: SAR Measurement Data

Data No.	Band	Mode	Test Position	Separation Distance (cm)	Channel	SAR 1g(W/kg)
1	GSM 850	GPRS Slot 2	Body Back of EUT	1.5	1	**0.994**
2	GSM 850	GPRS Slot 2	Body Back of EUT	1.5	62	1.081
3	GSM 850	GPRS Slot 2	Body Back of EUT	1.5	124	0.976
4	GSM 1900	GPRS Slot 2	Body Back of EUT	1.5	513	0.968
5	GSM 1900	GPRS Slot 2	Body Back of EUT	1.5	698	0.828
6	GSM 1900	GPRS Slot 2	Body Back of EUT	1.5	884	0.896

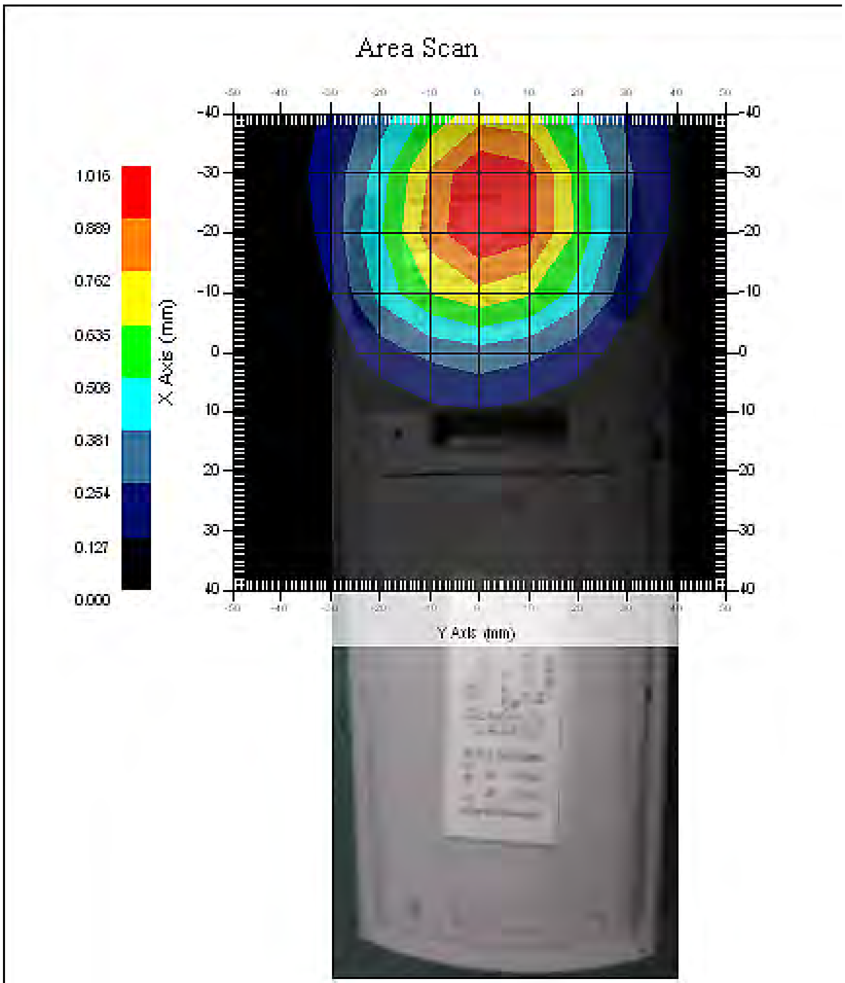
Data No. 1:

```
Report Date         : 05-Dec-2011
By Operator         : Arno Hsieh
Measurement Date    : 05-Dec-2011
Starting Time       : 05-Dec-2011  05:20:43 PM
End Time            : 05-Dec-2011  05:46:23 PM
Scanning Time       : 1540 secs

Product Data
Device Name         : EFTPOS
Serial No.          : NA
Type                : Other
Model               : VEGA5000
Frequency           : 850 MHz
Max. Transmit Pwr   : 1.86W
Drift Time          : 0 min(s)
Length              : 170 mm
Width               : 70 mm
Depth               : 60 mm
Antenna Type        : Internal
Orientation         : Touch
Power Drift-Start   : 0.732 W/kg
Power Drift-Finish  : 0.732 W/kg
Power Drift (%)     : 0.014
Picture             : C:\alsas\bitmap\S01.bmp

Phantom Data
Name               : APREL-Uni
Type               : Uni-Phantom
Size (mm)          : 280 x 280 x 200
Serial No.         : User Define
Location           : Center
Description        : Unit phantom

Tissue Data
Type               : Body
Serial No.         : 850
Frequency          : 850.00 MHz
Last Calib. Date   : 15-Nov-2011
Temperature        : 22.00 °C
Ambient Temp.      : 22.00 °C
Humidity           : 50.00 RH%
Epsilon            : 41.50 F/m
Sigma              : 0.91 S/m
Density            : 1000.00 kg/cu. m
```

Probe Data
Name : E-field Probe
Model : ALS-E-020
Type : E-Field Triangle
Serial No. : 266
Last Calib. Date : 08-Aug-2011
Frequency : 835.00 MHz
Duty Cycle Factor: 1
Conversion Factor: 6.8
Probe Sensitivity: 1.20 1.20 1.20 $\mu V/(V/m)^2$
Compression Point: 95.00 mV
Offset : 1.56 mm

Measurement Data
Crest Factor : 1
Scan Type : Complete
Tissue Temp. : 22.00 °C
Ambient Temp. : 21.70 °C
Set-up Date : 05-Dec-2011
Set-up Time : 1:05:03 PM
Area Scan : 9x11x1 : Measurement x=10mm, y=10mm, z=4mm
Zoom Scan : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

Other Data
DUT Position : Back of EUT
Separation : 1.5cm
Channel : Low




```
1 gram SAR value    : 0.994 W/kg
10 gram SAR value   : 0.589 W/kg
Area Scan Peak SAR : 1.016 W/kg
Zoom Scan Peak SAR : 1.381 W/kg
```

Data No. 2:

```
Report Date          : 05-Dec-2011
By Operator          : Arno Hsieh
Measurement Date     : 05-Dec-2011
Starting Time        : 05-Dec-2011  05:50:10 PM
End Time             : 05-Dec-2011  06:15:55 PM
Scanning Time        : 1545 secs

P Product Data
Device Name          : EFTPOS
Serial No.           : NA
Type                 : Other
Model                : VEGA5000
Frequency            : 850 MHz
Max. Transmit Pwr    : 1.90W
Drift Time           : 0 min(s)
Length               : 170 mm
Width                : 70 mm
Depth                : 60 mm
Antenna Type         : Internal
Orientation          : Touch
Power Drift-Start    : 0.844 W/kg
Power Drift-Finish: 0.827 W/kg
Power Drift (%)      : -2
Picture              : C:\alsas\bitmap\S01.bmp

Phantom Data
Name                : APREL-Uni
Type                : Uni-Phantom
Size (mm)           : 280 x 280 x 200
Serial No.          : User Define
Location            : Center
Description         : Unit phantom

Tissue Data
Type                : Body
Serial No.          : 850
Frequency           : 850.00 MHz
Last Calib. Date : 15-Nov-2011
Temperature         : 22.00 °C
Ambient Temp.       : 22.00 °C
Humidity            : 50.00 RH%
Epsilon             : 41.50 F/m
Sigma               : 0.91 S/m
Density             : 1000.00 kg/cu. m
```

Probe Data

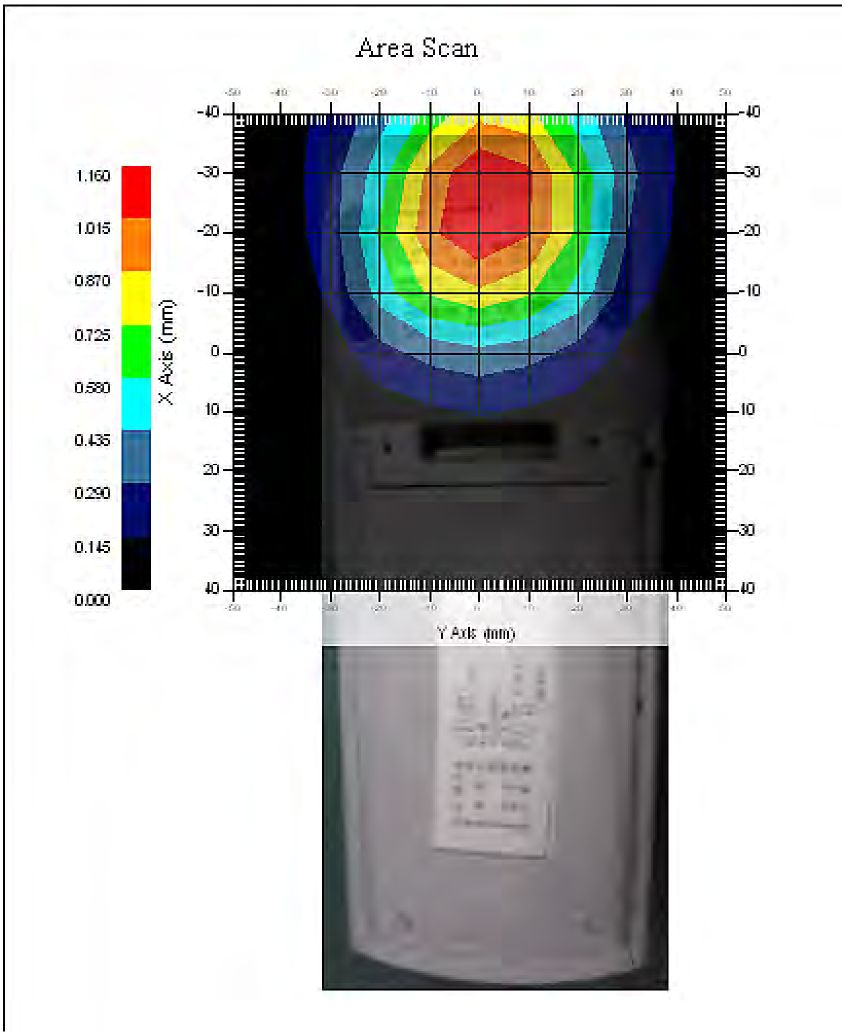
Name	:	E-field Probe
Model	:	ALS-E-020
Type	:	E-Field Triangle
Serial No.	:	266
Last Calib. Date	:	08-Aug-2011
Frequency	:	835.00 MHz
Duty Cycle Factor	:	1
Conversion Factor	:	6.8
Probe Sensitivity	:	1.20 1.20 1.20 $\mu V/(V/m)^2$
Compression Point	:	95.00 mV
Offset	:	1.56 mm

Measurement Data

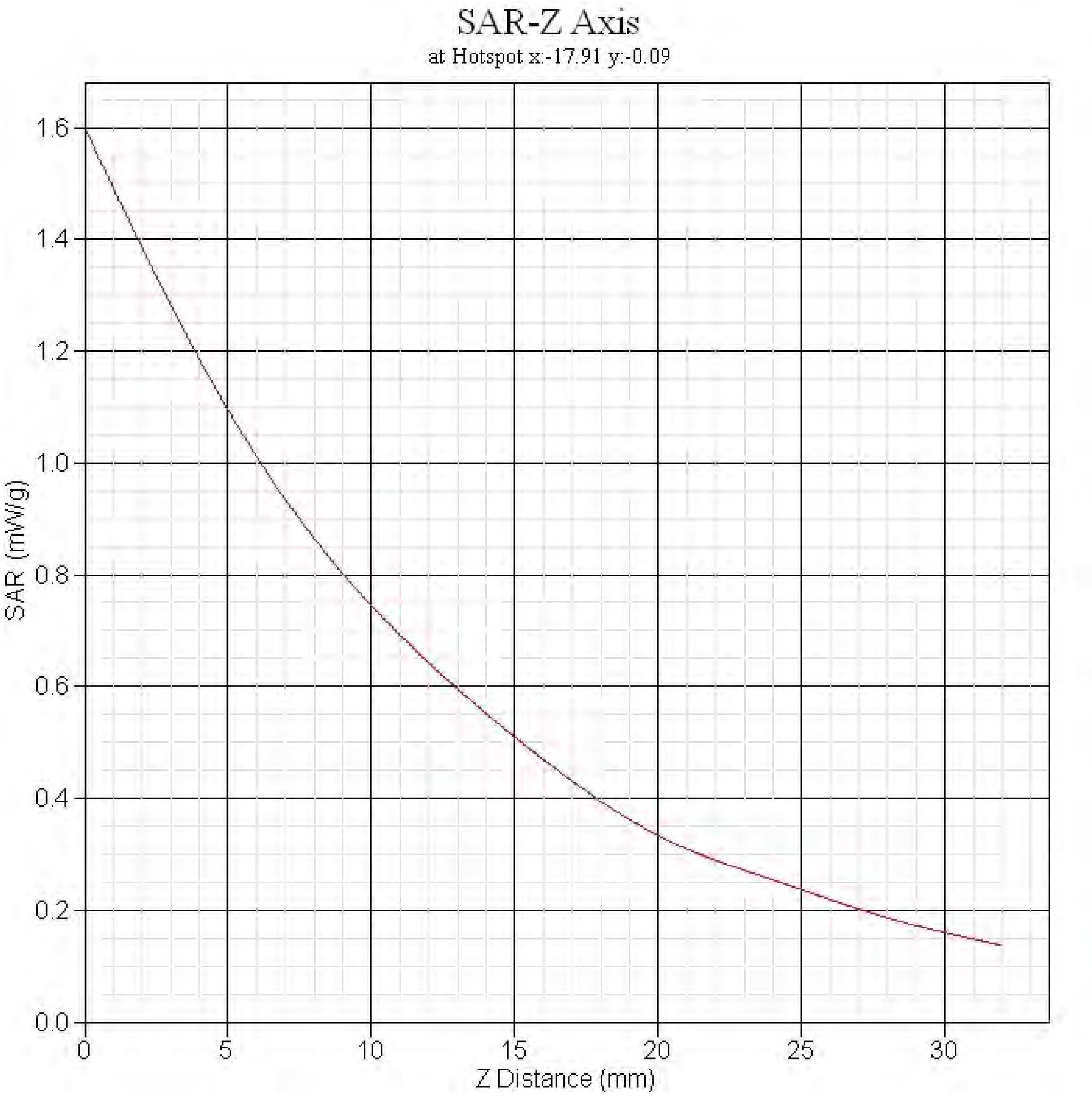
Crest Factor	:	1
Scan Type	:	Complete
Tissue Temp.	:	22.00 °C
Ambient Temp.	:	21.70 °C
Set-up Date	:	05-Dec-2011
Set-up Time	:	1:05:03 PM
Area Scan	:	9x11x1 : Measurement x=10mm, y=10mm, z=4mm
Zoom Scan	:	5x5x8 : Measurement x=8mm, y=8mm, z=4mm

Other Data

DUT Position	:	Back of EUT
Separation	:	1.5cm
Channel	:	Mid



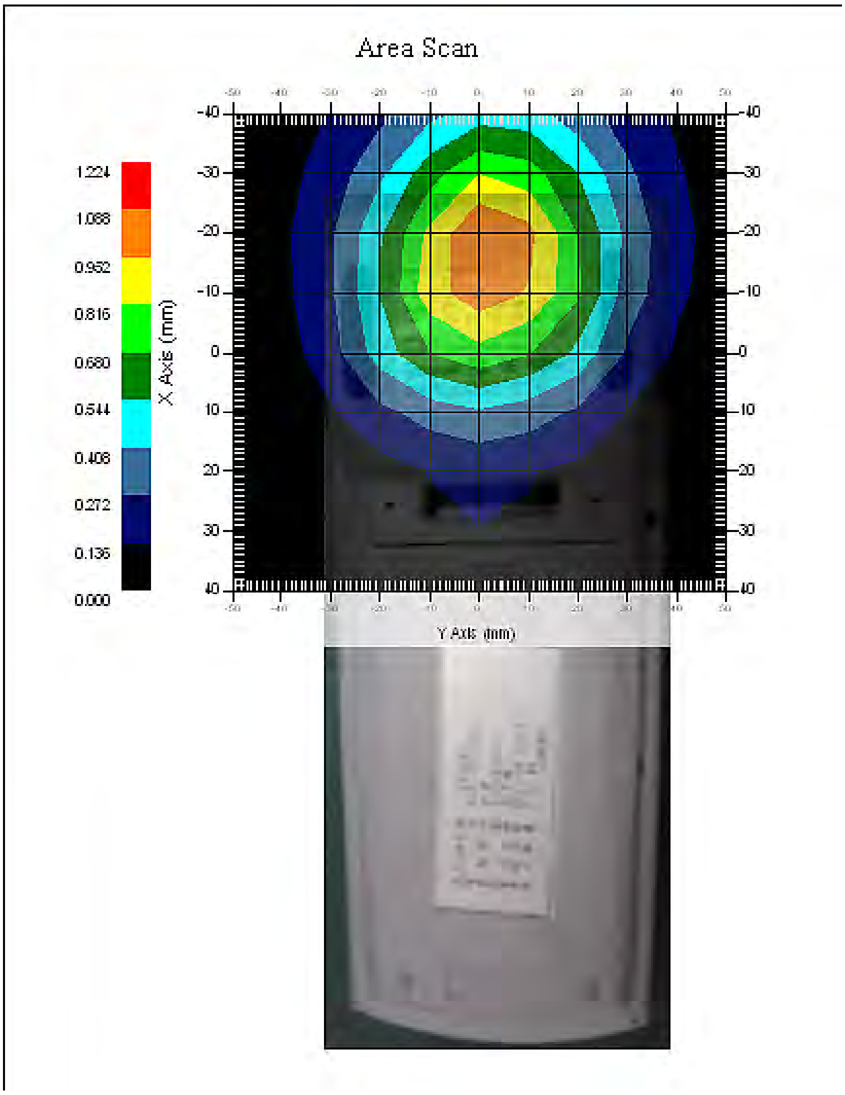

```
1 gram SAR value    : 1.081 W/kg
10 gram SAR value   : 0.660 W/kg
Area Scan Peak SAR : 1.158 W/kg
Zoom Scan Peak SAR : 1.601 W/kg
```


SAR-Z Axis
at Hotspot x:-17.91 y:-0.09
SAR (mW/g)
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0
5
10
15
20
25
30
Z Distance (mm)

Data No. 3:

```
Report Date          : 05-Dec-2011
By Operator          : Arno Hsieh
Measurement Date     : 05-Dec-2011
Starting Time        : 05-Dec-2011  09:12:00 AM
End Time             : 05-Dec-2011  09:37:37 AM
Scanning Time        : 1537 secs

Product Data
Device Name          : EFTPOS
Serial No.           : NA
Type                 : Other
Model                : VEGA5000
Frequency            : 850 MHz
Max. Transmit Pwr    : 1.94W
Drift Time           : 0 min(s)
Length               : 170 mm
Width                : 70 mm
Depth                : 60 mm
Antenna Type         : Internal
Orientation          : Touch
Power Drift-Start    : 1.069 W/kg
Power Drift-Finish: 1.079 W/kg
Power Drift (%)      : 1
Picture              : C:\alsas\bitmap\S01.bmp

Phantom Data
Name                : APREL-Uni
Type                : Uni-Phantom
Size (mm)           : 280 x 280 x 200
Serial No.          : User Define
Location            : Center
Description         : Unit phantom

Tissue Data
Type                : Body
Serial No.          : 850
Frequency           : 850.00 MHz
Last Calib. Date : 15-Nov-2011
Temperature         : 22.00 °C
Ambient Temp.       : 22.00 °C
Humidity            : 50.00 RH%
Epsilon             : 41.50 F/m
Sigma               : 0.91 S/m
Density             : 1000.00 kg/cu. m
```

```
Probe Data
Name              : E-field Probe
Model             : ALS-E-020
Type              : E-Field Triangle
Serial No.        : 266
Last Calib. Date : 08-Aug-2011
Frequency         : 835.00 MHz
Duty Cycle Factor: 1
Conversion Factor: 6.8
Probe Sensitivity: 1.20  1.20  1.20   μV/(V/m)²
Compression Point: 95.00 mV
Offset            : 1.56 mm

Measurement Data
Crest Factor      : 1
Scan Type         : Complete
Tissue Temp.      : 22.00 °C
Ambient Temp.     : 21.70 °C
Set-up Date       : 05-Dec-2011
Set-up Time       : 1:05:03 PM
Area Scan         : 9x11x1 : Measurement x=10mm, y=10mm, z=4mm
Zoom Scan         : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

Other Data
DUT Position      : Back of EUT
Separation        : 1.5cm
Channel           : High
```

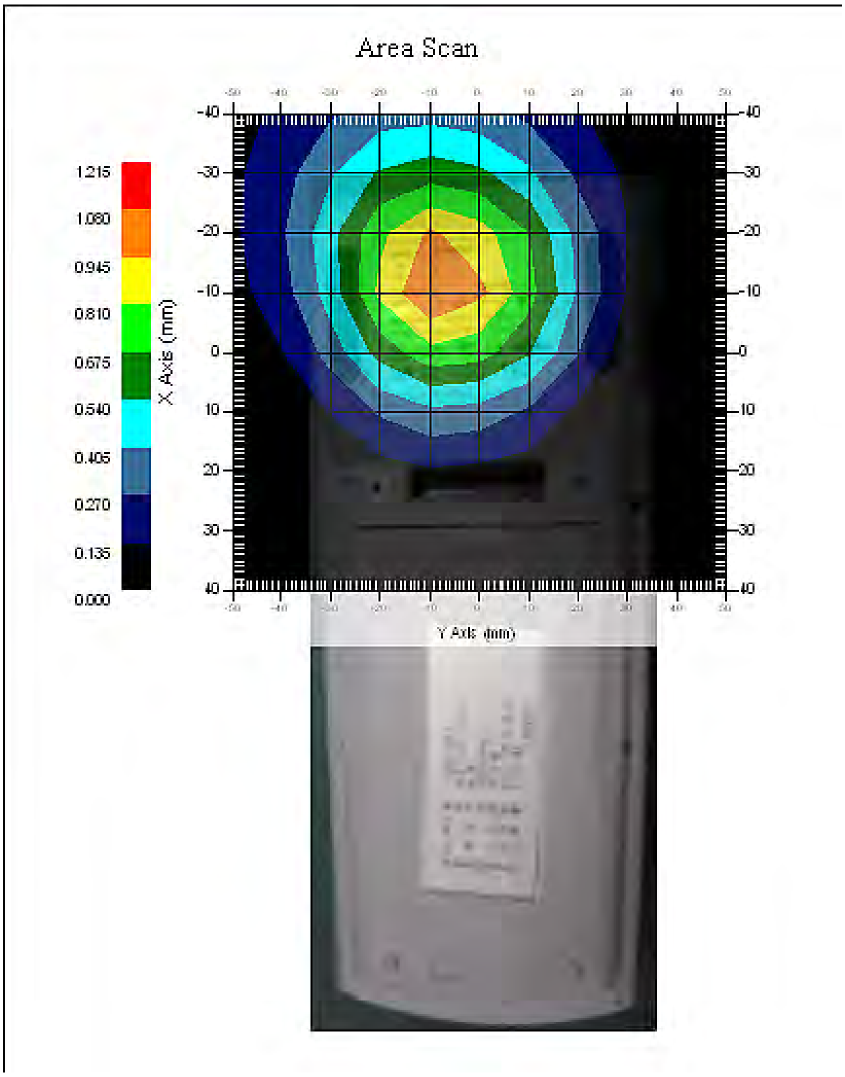



```
1 gram SAR value    : 0.976 W/kg
10 gram SAR value   : 0.622 W/kg
Area Scan Peak SAR : 1.089 W/kg
Zoom Scan Peak SAR : 1.471 W/kg
```

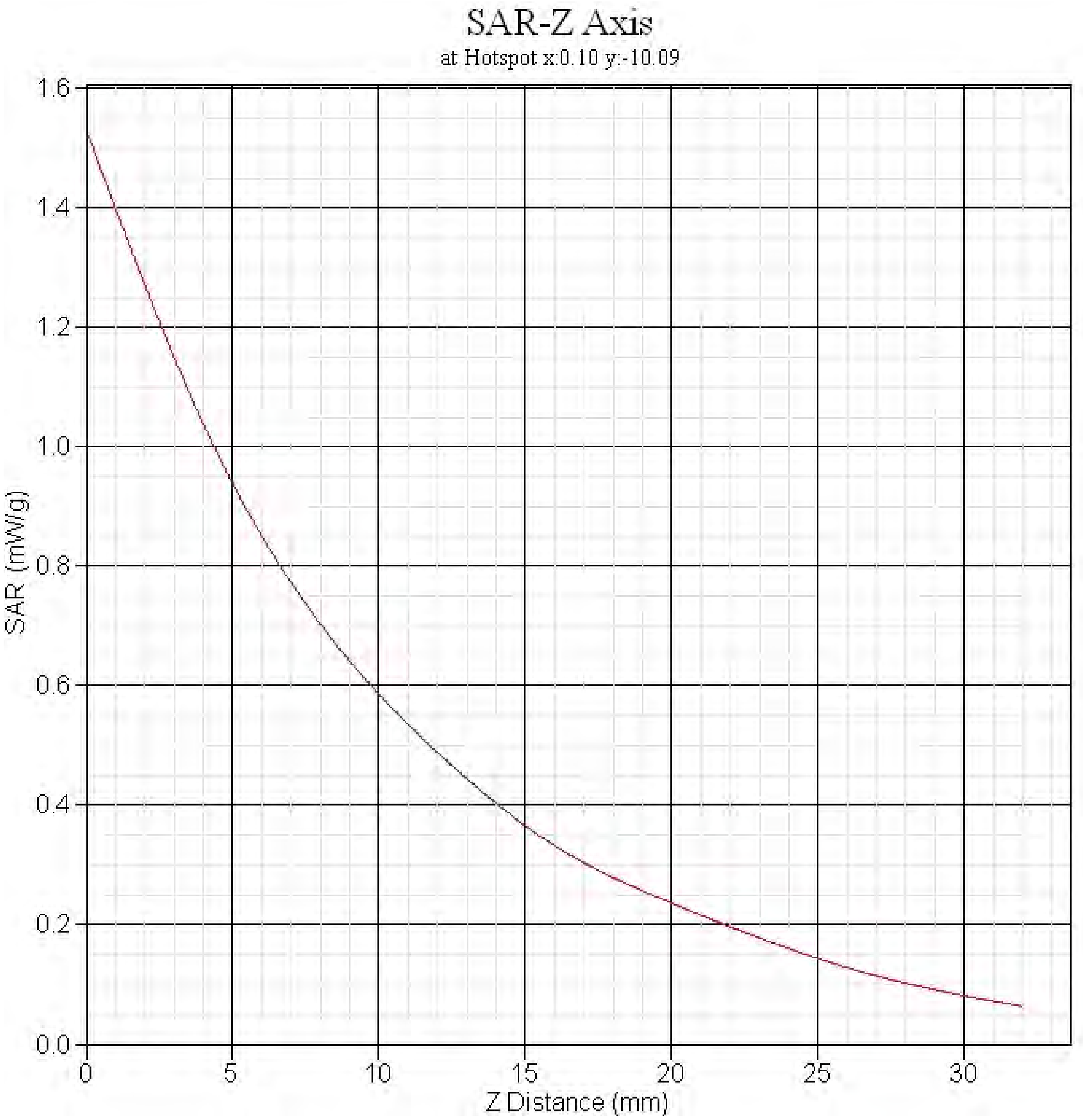
Data No. 4:

```
Report Date         : 05-Dec-2011
By Operator         : Arno Hsieh
Measurement Date    : 05-Dec-2011
Starting Time       : 05-Dec-2011  03:39:08 PM
End Time            : 05-Dec-2011  04:04:42 PM
Scanning Time       : 1534 secs

Product Data
Device Name         : EFTPOS
Serial No.          : NA
Type                : Other
Model               : VEGA5000
Frequency           : 1900 MHz
Max. Transmit Pwr   : 1.12W
Drift Time          : 0 min(s)
Length              : 170 mm
Width               : 70 mm
Depth               : 60 mm
Antenna Type        : Internal
Orientation         : Touch
Power Drift-Start   : 0.994 W/kg
Power Drift-Finish  : 0.979 W/kg
Power Drift (%)     : -1.5
Picture             : C:\alsas\bitmap\S01.bmp

Phantom Data
Name               : APREL-Uni
Type               : Uni-Phantom
Size (mm)          : 280 x 280 x 200
Serial No.         : User Define
Location           : Center
Description        : Unit phantom

Tissue Data
Type               : BODY
Serial No.         : 1900_Body
Frequency          : 1900.00 MHz
Last Calib. Date   : 16-May-2011
Temperature        : 22.10 °C
Ambient Temp.      : 21.50 °C
Humidity           : 51.00 RH%
Epsilon            : 51.80 F/m
Sigma              : 1.57 S/m
Density            : 1000.00 kg/cu. m
```

```
Probe Data
Name                : E-field Probe
Model               : ALS-E-020
Type                : E-Field Triangle
Serial No.          : 266
Last Calib. Date    : 08-Aug-2011
Frequency           : 1900.00 MHz
Duty Cycle Factor   : 1
Conversion Factor   : 5.3
Probe Sensitivity   : 1.20  1.20  1.20   μV/(V/m)²
Compression Point   : 95.00 mV
Offset              : 1.56 mm

Measurement Data
Crest Factor        : 1
Scan Type           : Complete
Tissue Temp.        : 22.00 °C
Ambient Temp.       : 21.70 °C
Set-up Date         : 05-Dec-2011
Set-up Time         : 1:05:03 PM
Area Scan           : 9x11x1 : Measurement x=10mm, y=10mm, z=4mm
Zoom Scan           : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

Other Data
DUT Position        : Back of EUT
Separation          : 1.5cm
Channel             : Low
```



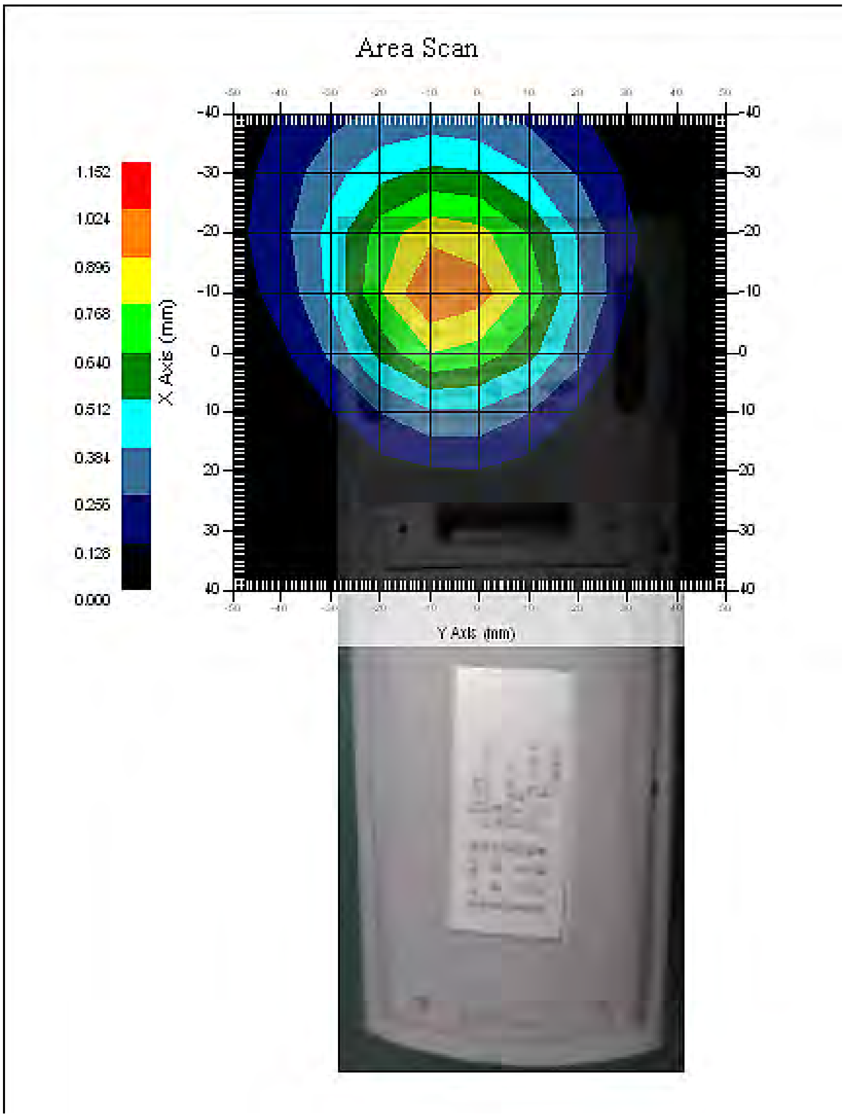

```
1 gram SAR value    : 0.968 W/kg
10 gram SAR value   : 0.567 W/kg
Area Scan Peak SAR  : 1.081 W/kg
Zoom Scan Peak SAR  : 1.531 W/kg
```


SAR-Z Axis
at Hotspot x:0.10 y:-10.09
SAR (mW/g)
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0
5
10
15
20
25
30
Z Distance (mm)

Data No. 5:

```
Report Date          : 05-Dec-2011
By Operator          : Arno Hsieh
Measurement Date     : 05-Dec-2011
Starting Time        : 05-Dec-2011  04:10:27 PM
End Time             : 05-Dec-2011  04:36:13 PM
Scanning Time        : 1546 secs

Product Data
Device Name          : EFTPOS
Serial No.           : NA
Type                 : Other
Model                : VEGA5000
Frequency            : 1900 MHz
Max. Transmit Pwr    : 1.23W
Drift Time           : 0 min(s)
Length               : 170 mm
Width                : 70 mm
Depth                : 60 mm
Antenna Type         : Internal
Orientation          : Touch
Power Drift-Start    : 0.954 W/kg
Power Drift-Finish   : 0.942 W/kg
Power Drift (%)      : -1.2
Picture              : C:\alsas\bitmap\S01.bmp

Phantom Data
Name                : APREL-Uni
Type                : Uni-Phantom
Size (mm)           : 280 x 280 x 200
Serial No.          : User Define
Location            : Center
Description         : Unit phantom

Tissue Data
Type                : BODY
Serial No.          : 900-boby
Frequency           : 900.00 MHz
Last Calib. Date    : 02-Dec-2011
Temperature         : 22.00 °C
Ambient Temp.       : 21.80 °C
Humidity            : 51.00 RH%
Epsilon             : 57.22 F/m
Sigma               : 1.08 S/m
Density             : 1000.00 kg/cu. m
```

```
Probe Data
Name                : E-field Probe
Model               : ALS-E-020
Type                : E-Field Triangle
Serial No.          : 266
Last Calib. Date : 08-Aug-2011
Frequency           : 1900.00 MHz
Duty Cycle Factor: 1
Conversion Factor: 5.3
Probe Sensitivity: 1.20  1.20  1.20   μV/(V/m)²
Compression Point: 95.00 mV
Offset              : 1.56 mm

Measurement Data
Crest Factor        : 1
Scan Type           : Complete
Tissue Temp.        : 22.00 °C
Ambient Temp.       : 21.70 °C
Set-up Date         : 05-Dec-2011
Set-up Time         : 1:05:03 PM
Area Scan           : 9x11x1 : Measurement x=10mm, y=10mm, z=4mm
Zoom Scan           : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

Other Data
DUT Position        : Back of EUT
Separation          : 1.5cm
Channel             : Mid
```

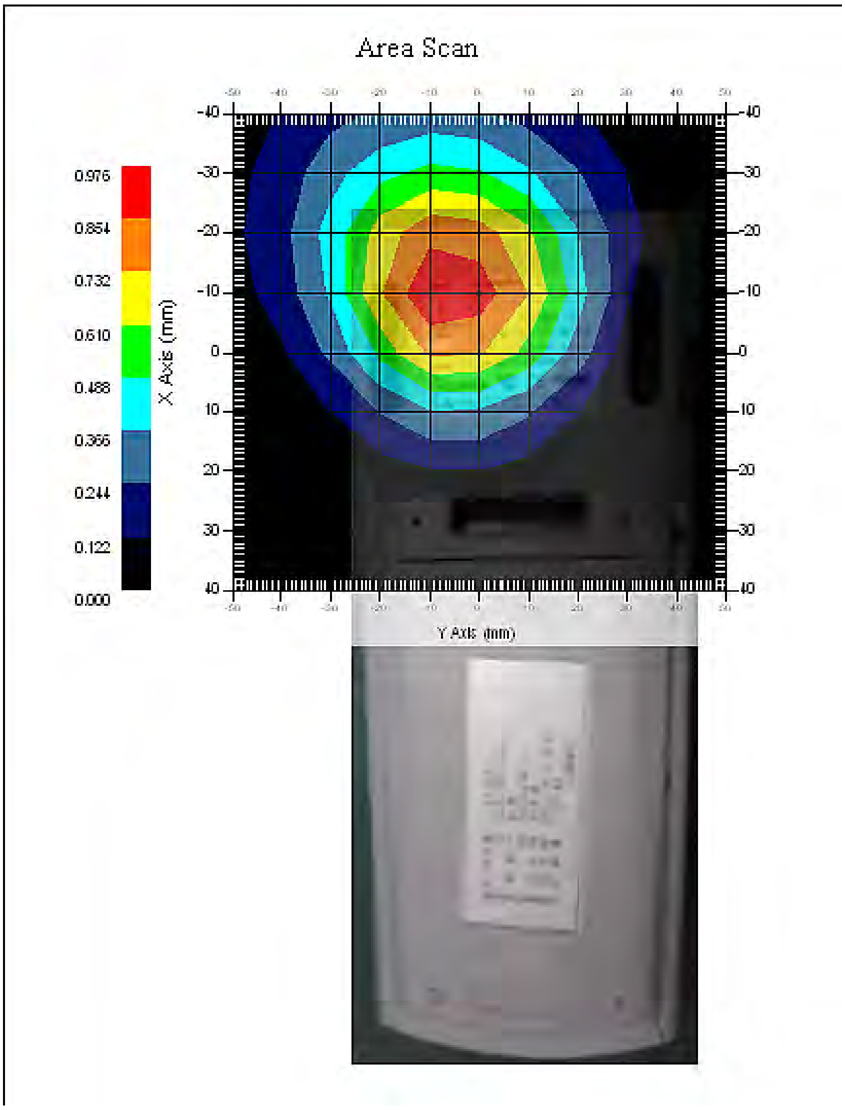



```
1 gram SAR value    : 0.828 W/kg
10 gram SAR value   : 0.535 W/kg
Area Scan Peak SAR : 1.056 W/kg
Zoom Scan Peak SAR : 1.230 W/kg
```

Data No. 6:

```
Report Date        : 05-Dec-2011
By Operator        : Arno Hsieh
Measurement Date   : 05-Dec-2011
Starting Time      : 05-Dec-2011  04:46:25 PM
End Time           : 05-Dec-2011  05:12:23 PM
Scanning Time      : 1558 secs

Product Data
Device Name        : EFTPOS
Serial No.         : NA
Type               : Other
Model              : VEGA5000
Frequency          : 1900 MHz
Max. Transmit Pwr  : 1.25W
Drift Time         : 0 min(s)
Length             : 170 mm
Width              : 70 mm
Depth              : 60 mm
Antenna Type       : Internal
Orientation        : Touch
Power Drift-Start  : 0.968 W/kg
Power Drift-Finish: 0.945 W/kg
Power Drift (%)    : -2.3
Picture            : C:\alsas\bitmap\S01.bmp

Phantom Data
Name              : APREL-Uni
Type              : Uni-Phantom
Size (mm)         : 280 x 280 x 200
Serial No.        : User Define
Location          : Center
Description       : Unit phantom

Tissue Data
Type              : BODY
Serial No.        : 1900_Body
Frequency         : 1900.00 MHz
Last Calib. Date  : 15-Nov-2011
Temperature       : 22.10 °C
Ambient Temp.     : 21.50 °C
Humidity          : 51.00 RH%
Epsilon           : 51.80 F/m
Sigma             : 1.57 S/m
Density           : 1000.00 kg/cu. m
```

```
Probe Data
Name                : E-field Probe
Model               : ALS-E-020
Type                : E-Field Triangle
Serial No.          : 266
Last Calib. Date    : 08-Aug-2011
Frequency           : 1900.00 MHz
Duty Cycle Factor: 1
Conversion Factor: 5.3
Probe Sensitivity: 1.20  1.20  1.20   μV/(V/m)²
Compression Point: 95.00 mV
Offset              : 1.56 mm

Measurement Data
Crest Factor        : 1
Scan Type           : Complete
Tissue Temp.        : 22.00 °C
Ambient Temp.       : 21.70 °C
Set-up Date         : 05-Dec-2011
Set-up Time         : 1:05:03 PM
Area Scan           : 9x11x1 : Measurement x=10mm, y=10mm, z=4mm
Zoom Scan           : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

Other Data
DUT Position        : Back of EUT
Separation          : 1.5cm
Channel             : High
```




```
1 gram SAR value    : 0.896 W/kg
10 gram SAR value   : 0.505 W/kg
Area Scan Peak SAR : 0.972 W/kg
Zoom Scan Peak SAR : 1.441 W/kg
```

NCL CALIBRATION LABORATORIES

Calibration File No.: 1289-1298

Client.: ISL

CERTIFICATE OF CALIBRATION

It is certified that the equipment identified below has been calibrated in the **NCL CALIBRATION LABORATORIES** by qualified personnel following recognized procedures and using transfer standards traceable to NRC/NIST.

Equipment: Miniature Isotropic RF Probe
Record of Calibration
Head and Body
Manufacturer: APREL Laboratories
Model No.: E-020
Serial No.: 266

Calibration Procedure: D01-032-E020-V2, D22-012-Tissue, D28-002-Dipole
Project No: ISL-E020-5612

Calibrated: 8th August 2011
Released on: 15th August 2011

Approved By: Stuart Nicol

This Calibration Certificate is Incomplete Unless Accompanied with the Calibration Results Summary

Released By: ______________________

NCL CALIBRATION LABORATORIES

303 Terry Fox Drive, Suite 102
Kanata, Ontario
CANADA K2K 3J1

Division of APREL
TEL: (613) 435-8300
FAX: (613) 435-8306

Introduction

This Calibration Report reproduces the results of the calibration performed in line with the references listed below. Calibration is performed using accepted methodologies as per the references listed below. Probes are calibrated for air, and tissue and the values reported are the results from the physical quantification of the probe through meteorgical practices.

Calibration Method

Probes are calibrated using the following methods.

<1000MHz
TEM Cell for sensitivity in air
Standard phantom using temperature transfer method for sensitivity in tissue

>1000MHz
Waveguide* method to determine sensitivity in air and tissue
*Waveguide is numerically (simulation) assessed to determine the field distribution and power

The boundary effect for the probe is assessed using a standard flat phantom where the probe output is compared against a numerically simulated series of data points

References

- IEEE Standard 1528 (2003) including Amendment 1
  IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques
- EN 62209-1 (2006)
  Human Exposure to RF Fields from hand-held and body-mounted wireless communication devices - Human models. instrumentation, and procedures-Part 1: Procedure to measure the Specific Absorption Rate (SAR) for hand-held mobile wireless devices
- IEC 62209-2 Ed. 1.0 (2010-03)
  Human exposure to RF fields from hand-held and body-mounted wireless devices - Human models, instrumentation, and procedures - Part 2: specific absorption rate (SAR) for wireless communication devices (30 MHz - 6 GHz)
- TP-D01-032-E020-V2 E-Field probe calibration procedure
- D22-012-Tissue dielectric tissue calibration procedure
- D28-002-Dipole procedure for validation of SAR system using a dipole
- IEEE 1309 Draft Standard for Calibration of Electromagnetic Field Sensors and Probes, Excluding Antennas, from 9kHz to 40GHz

Conditions

Probe 266 was a recalibration.
The probe was received in good working order, although at 1900MHz the uncertainty was higher than our standard (see note)

Ambient Temperature of the Laboratory:	22 °C +/- 1.5°C
Temperature of the Tissue:	21 °C +/- 1.5°C
Relative Humidity:	< 60%

Primary Measurement Standards

Instrument	Serial Number	Cal due date
Power meter Anritsu MA2408A	90025437	Nov.4, 2011
Power Sensor Anritsu MA2481D	103555	Nov 4, 2011
Attenuator HP 8495A (70dB)	1944A10711	Sept. 14, 2011
Network Analyzer Anritsu MT8801C	MB11855	Feb. 8, 2012

Secondary Measurement Standards

Signal Generator Agilent E4438C -506	MY55182336	June 7, 2012

Attestation

The below named signatories have conducted the calibration and review of the data which is presented in this calibration report.

We the undersigned attest that to the best of our knowledge the calibration of this probe has been accurately conducted and that all information contained within this report has been reviewed for accuracy.

Stuart Nicol

Jesse Hones

Probe Summary

Probe Type:	E-Field Probe E020
Serial Number:	266
Frequency:	As presented on page 5
Sensor Offset:	1.56
Sensor Length:	2.5
Tip Enclosure:	Composite*
Tip Diameter:	< 2.9 mm
Tip Length:	55 mm
Total Length:	289 mm

*Resistive to recommended tissue recipes per IEEE-1528

Sensitivity in Air

Channel X:	1.2 µV/(V/m)^2
Channel Y:	1.2 µV/(V/m)^2
Channel Z:	1.2 µV/(V/m)^2

Diode Compression Point: 95 mV

Calibration for Tissue (Head H, Body B)

Frequency	Tissue Type	Measured Epsilon	Measured Sigma	Calibration Uncertainty	Tolerance Uncertainty for 5%*	Conversion Factor
450 H	Head	X	X	X	X	X
450 B	Body	X	X	X	X	X
750 H	Head	X	X	X	X	X
750 B	Body	X	X	X	X	X
835 H	**Head**	**42.35**	**0.94**	**3.5**	**3.4**	**6.6**
835 B	**Body**	**56.65**	**1.018**	**3.5**	**3.4**	**6.8**
900 H	**Head**	**41.35**	**0.98**	**3.5**	**3.4**	**6.4**
900 B	**Body**	**56.08**	**1.05**	**3.5**	**3.4**	**6.7**
1450 H	Head	X	X	X	X	X
1450 B	Body	X	X	X	X	X
1500 H	Head	X	X	X	X	X
1500 B	Body	X	X	X	X	X
1640 H	Head	X	X	X	X	X
1640 B	Body	X	X	X	X	X
1750 H	Head	X	X	X	X	X
1750 B	Body	X	X	X	X	X
1800 H	**Head**	**40.56**	**1.37**	**3.5**	**2.7**	**5.4**
1800 B	**Body**	**52.16**	**1.56**	**3.5**	**2.7**	**5.5**
1900 H	**Head**	**38.19**	**1.43**	**3.5**	**2.7**	**5.5**
1900 B	**Body**	**51.87**	**1.59**	**3.5**	**2.7**	**5.3**
2000 H	Head	X	X	X	X	X
2000 B	Body	X	X	X	X	X
2100 H	Head	X	X	X	X	X
2100 B	Body	X	X	X	X	X
2300 H	Head	X	X	X	X	X
2300 B	Body	X	X	X	X	X
2450 H	**Head**	**38.06**	**1.87**	**3.5**	**3.5**	**5**
2450B	**Body**	**50.52**	**2.04**	**3.5**	**3.5**	**4.55**
2600 H	Head	X	X	X	X	X
2600 B	Body	X	X	X	X	X
3000 H	Head	X	X	X	X	X
3000 B	Body	X	X	X	X	X
3600 H	Head	X	X	X	X	X
3600 B	Body	X	X	X	X	X
5200 H	Head	X	X	X	X	X
5200 B	Body	X	X	X	X	X
5600 H	Head	X	X	X	X	X
5600 B	Body	X	X	X	X	X
5800 H	Head	X	X	X	X	X
5800 B	Body	X	X	X	X	X

Boundary Effect:

Uncertainty resulting from the boundary effect is less than 2.1% for the distance between the tip of the probe and the tissue boundary, when less than 0.58mm.

Spatial Resolution:

The spatial resolution uncertainty is less than 1.5% for 4.9mm diameter probe.
The spatial resolution uncertainty is less than 1.0% for 2.5mm diameter probe.

DAQ-PAQ Contribution

To minimize the uncertainty calculation all tissue sensitivity values were calculated using a load impedance of 5 MΩ.

Boundary Effect:

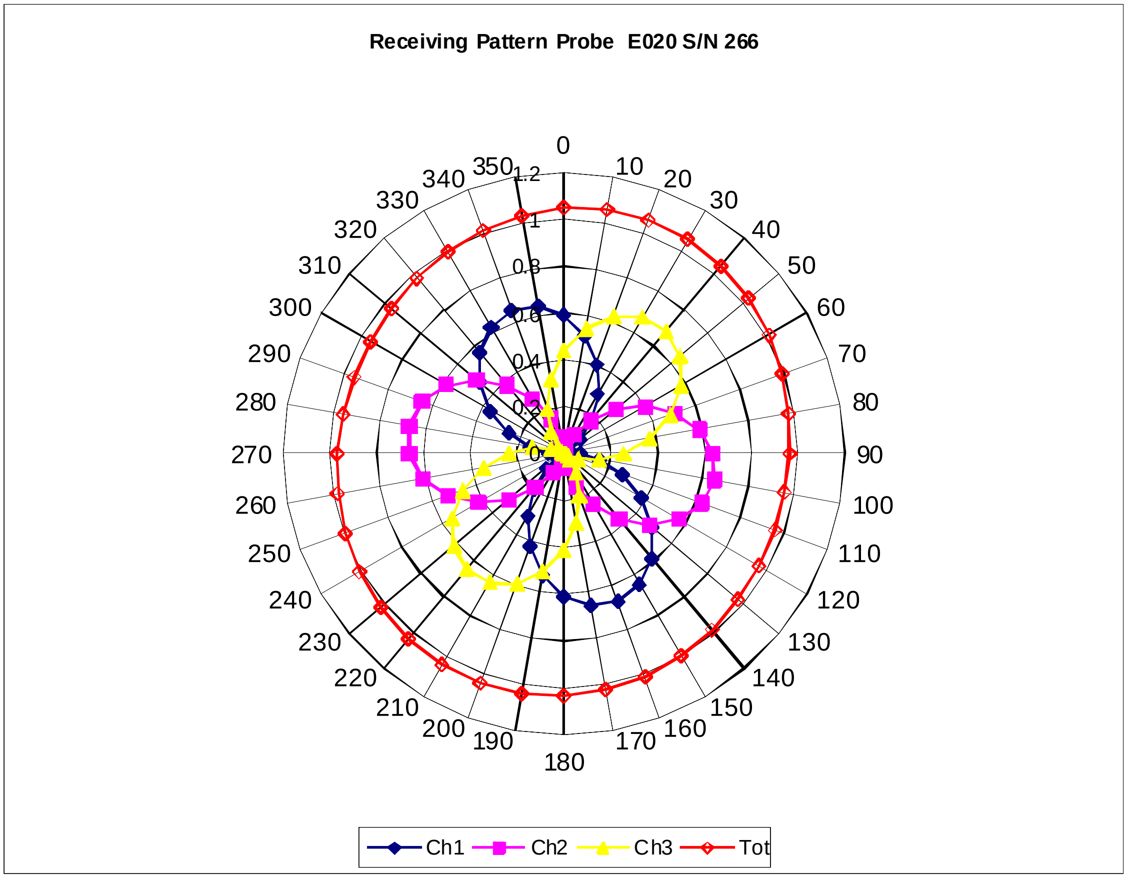
For a distance of 0.58mm the worst case evaluated uncertainty (increase in the probe sensitivity) is less than 2.1%.

NOTES:

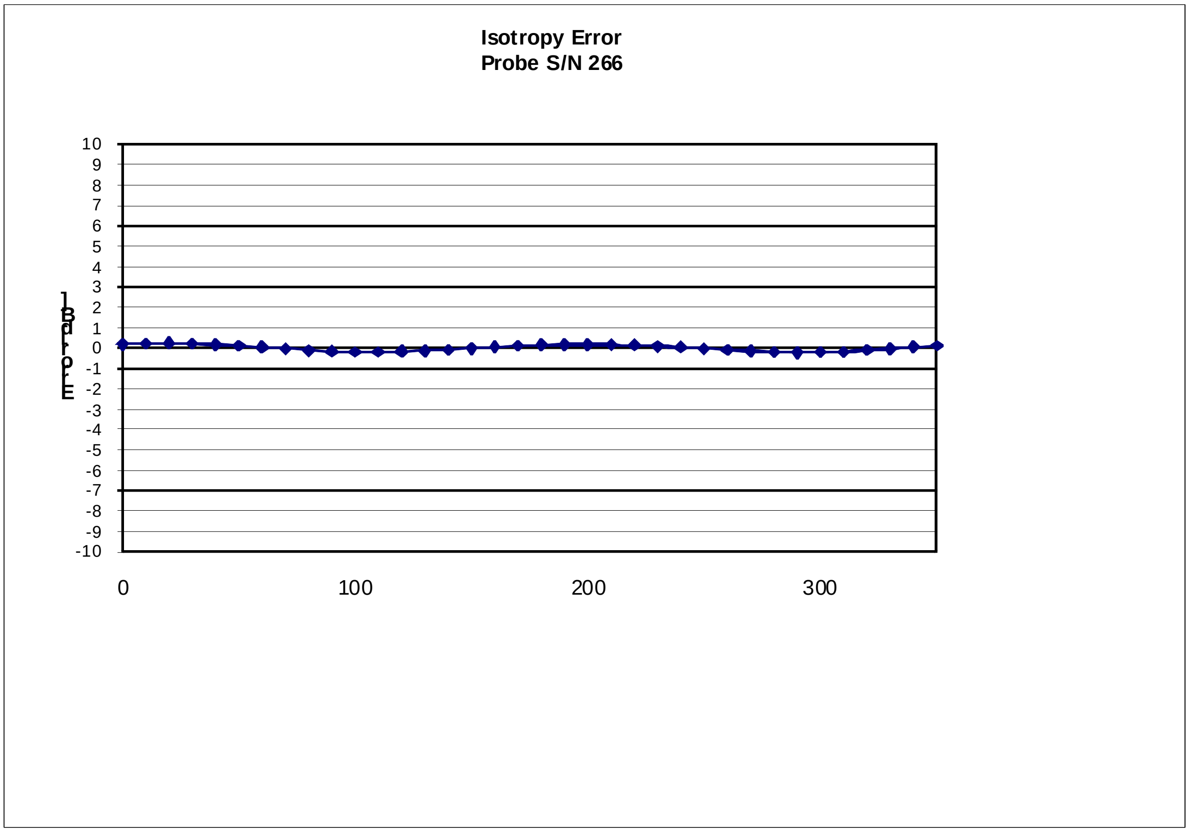
*The maximum deviation from the centre frequency when comparing the lower to upper range is listed.

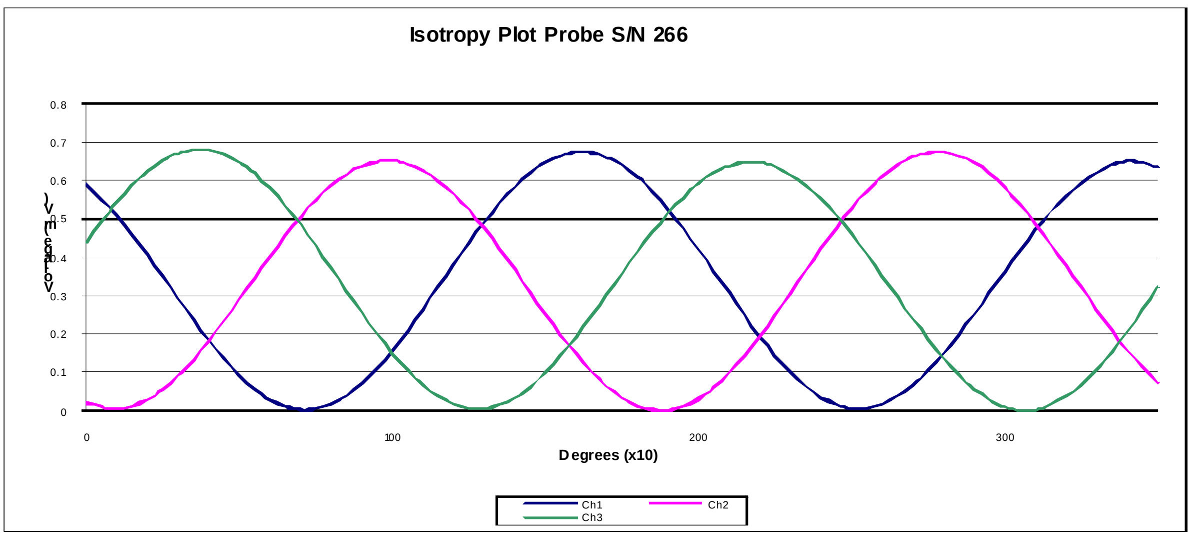
**The 1900MHz body calibration had an assessed deviation of +8.52%. This value has been normalized to be within 1.4% assessed deviation. As the deviation measured would have contributed to a higher SAR value APREL can conclude that SAR measurements made with this probe will have been within typical uncertainty of 10% and that this would not contribute to SAR value which if corrected would yield a higher than reported value.

Receiving Pattern Air



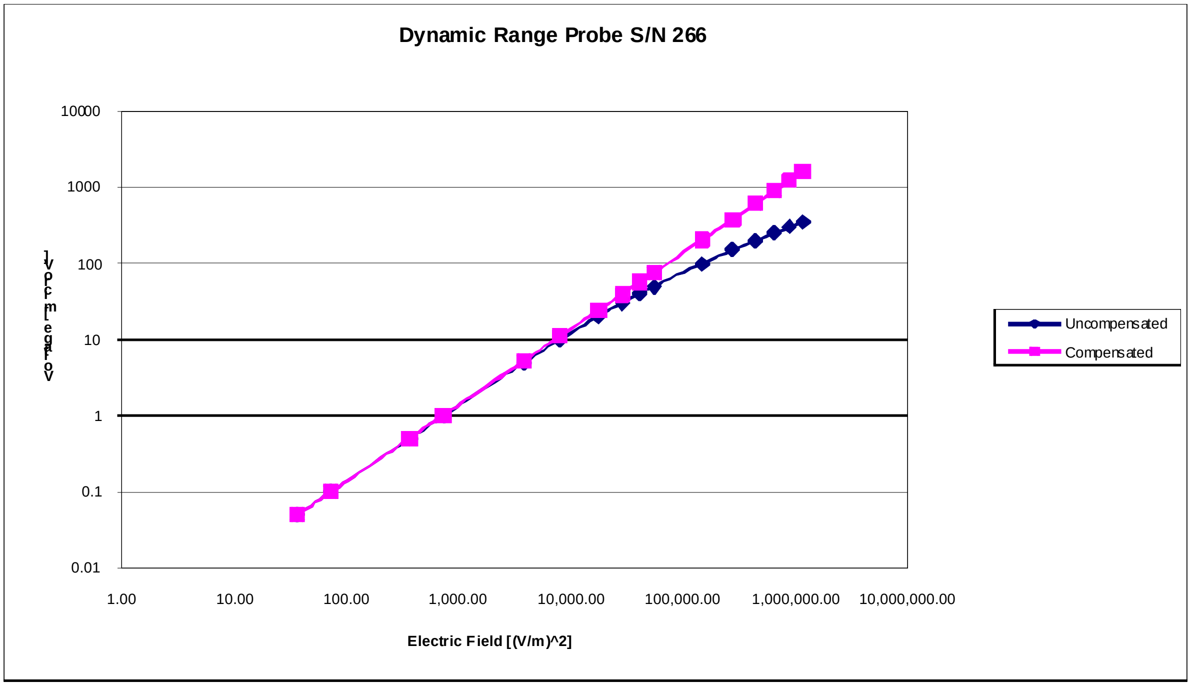
Isotropy Error Air



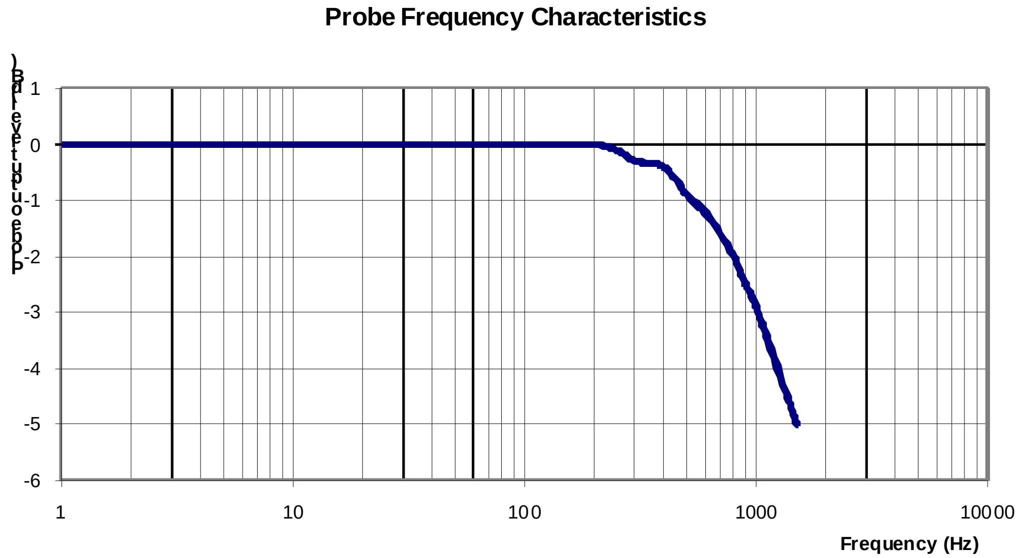


Isotropicity Tissue: 0.10 dB

Dynamic Range



Video Bandwidth



Video Bandwidth at 500 Hz 1 dB
Video Bandwidth at 1.02 KHz: 3 dB

Test Equipment

The test equipment used during Probe Calibration, manufacturer, model number and, current calibration status are listed and located on the main APREL server R:\NCL\Calibration Equipment\Instrument List May 2011.

NCL CALIBRATION LABORATORIES

Calibration File No: DC-956
Project Number: ISLB-D-835S2-5414

CERTIFICATE OF CALIBRATION

It is certified that the equipment identified below has been calibrated in the **NCL CALIBRATION LABORATORIES** by qualified personnel following recognized procedures and using transfer standards traceable to NRC/NIST.

WISB Validation Dipole

Manufacturer: APREL Laboratories
Part number: ALS-D-835-S-2
Frequency: 835 MHz
Serial No: 835-180-00553

Customer: WISB

Calibrated: 2nd February 2009
Released on: 5th February 2009

This Calibration Certificate is Incomplete Unless Accompanied with the Calibration Results Summary

Released By: ____________________

NCL CALIBRATION LABORATORIES

51 SPECTRUM WAY
NEPEAN, ONTARIO
CANADA K2R 1E6

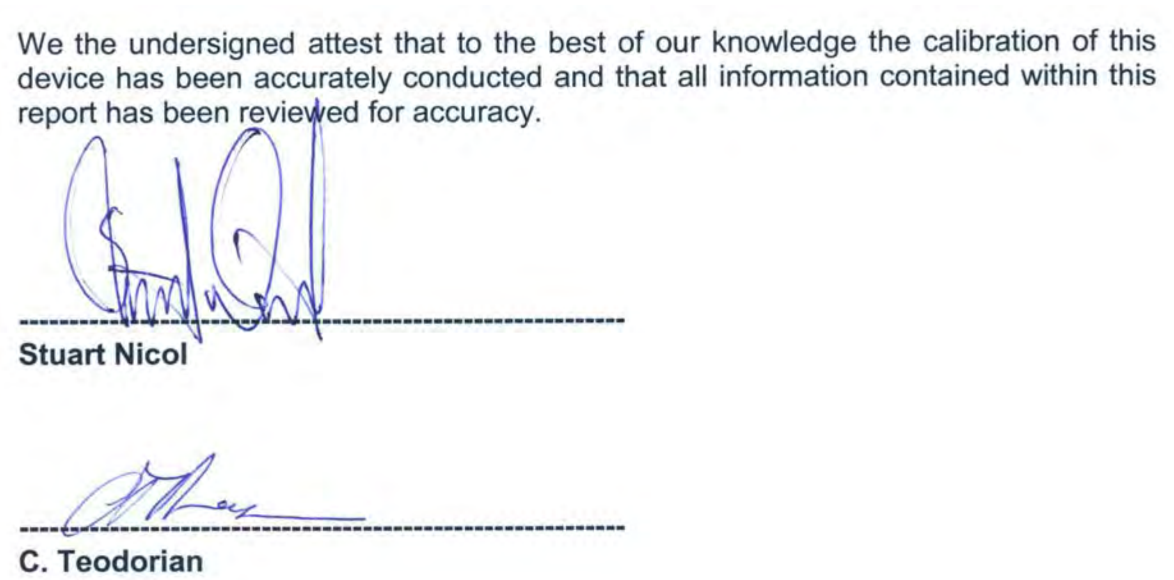
Division of APREL Lab.
TEL: (613) 820-4988
FAX: (613) 820-4162

Conditions

Dipole 835-180-00553 was a re-calibration.

Ambient Temperature of the Laboratory: 22 °C +/- 0.5°C
Temperature of the Tissue: 21 °C +/- 0.5°C

We the undersigned attest that to the best of our knowledge the calibration of this device has been accurately conducted and that all information contained within this report has been reviewed for accuracy.


We the undersigned attest that to the best of our knowledge the calibration of this device has been accurately conducted and that all information contained within this report has been reviewed for accuracy.

Stuart Nicol

C. Teodorian

Calibration Results Summary

The following results relate the Calibrated Dipole and should be used as a quick reference for the user.

Mechanical Dimensions

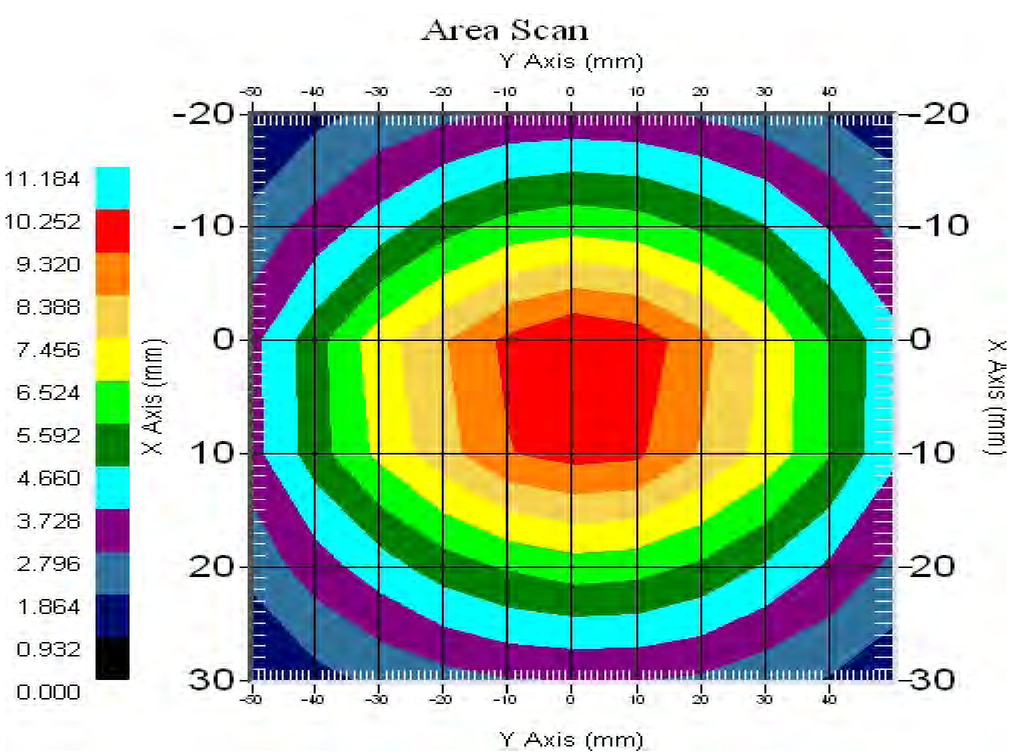
Length: 161.0 mm
Height: 89.8 mm

Electrical Specification

SWR: 1.02 U
Return Loss: -39.6 dB
Impedance: 49.6 Ω

System Validation Results

Frequency	1 Gram	10 Gram	Peak
835 MHz	9.49	6.1	14.21



This page has been reviewed for content and attested to by signature within this document.

Introduction

This Calibration Report has been produced in line with the SSI Dipole Calibration Procedure SSI-TP-018-ALSAS. The results contained within this report are for Validation Dipole 835-180-00553. The calibration routine consisted of a three-step process. Step 1 was a mechanical verification of the dipole to ensure that it meets the mechanical specifications. Step 2 was an Electrical Calibration for the Validation Dipole, where the SWR, Impedance, and the Return loss were assessed. Step 3 involved a System Validation using the ALSAS-10U, along with APREL E-020 130 MHz to 26 GHz E-Field Probe Serial Number 212.

References

SSI-TP-018-ALSAS Dipole Calibration Procedure
SSI-TP-016 Tissue Calibration Procedure
IEEE 1528 “Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques”

Conditions

Dipole 835-180-00553 was a re-calibration.

Ambient Temperature of the Laboratory: 22 °C +/- 0.5°C
Temperature of the Tissue: 20 °C +/- 0.5°C

Dipole Calibration Results

Mechanical Verification

APREL Length	APREL Height	Measured Length	Measured Height
161.0 mm	89.8 mm	162.1 mm	89.8 mm

Tissue Validation

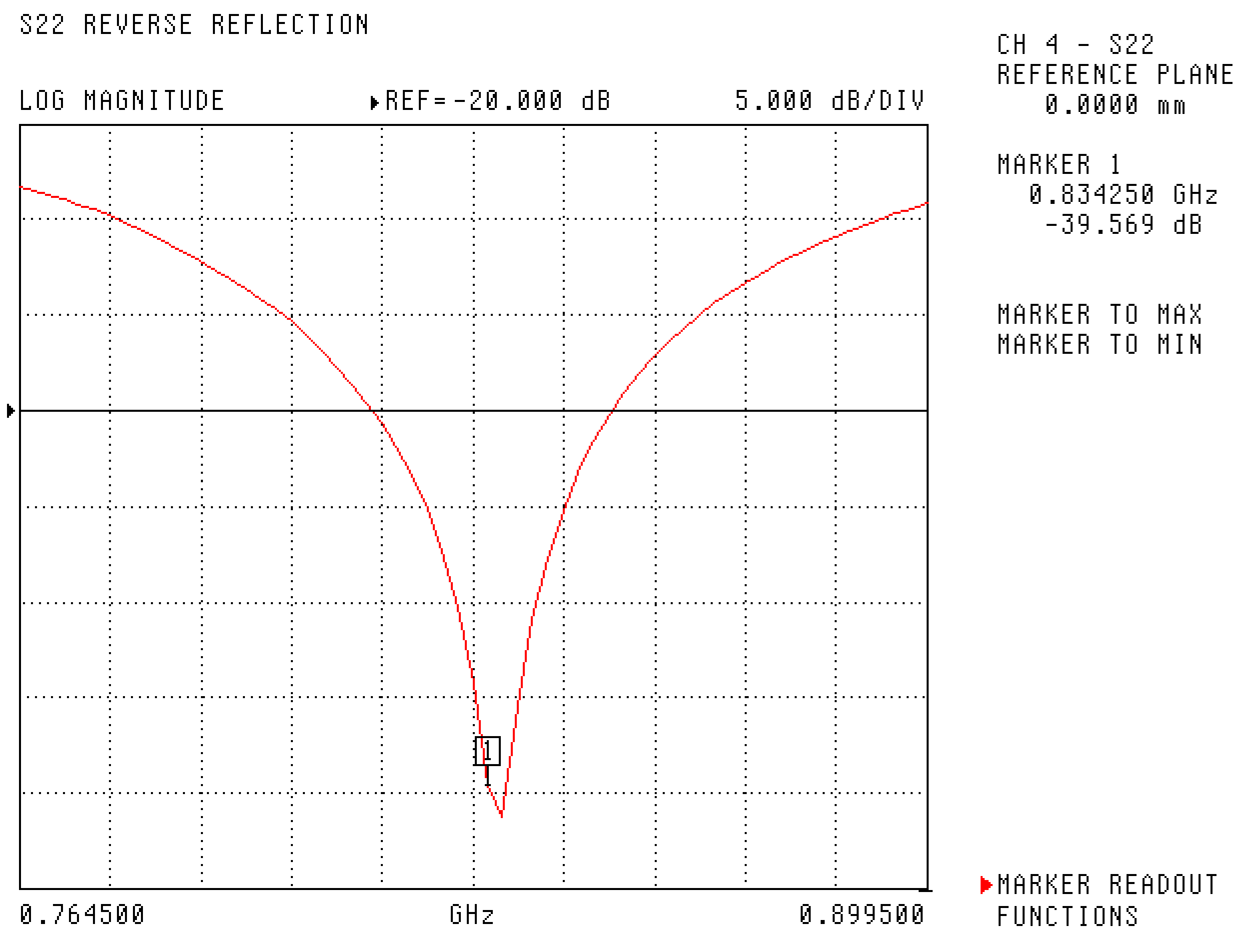
Head Tissue 835MHz	Measured
Dielectric constant, ε_r	42.54
Conductivity, σ [S/m]	0.91

Electrical Calibration

Test	Result
S11 RL	-39.6 dB
SWR	1.02 U
Impedance	49.6 Ω

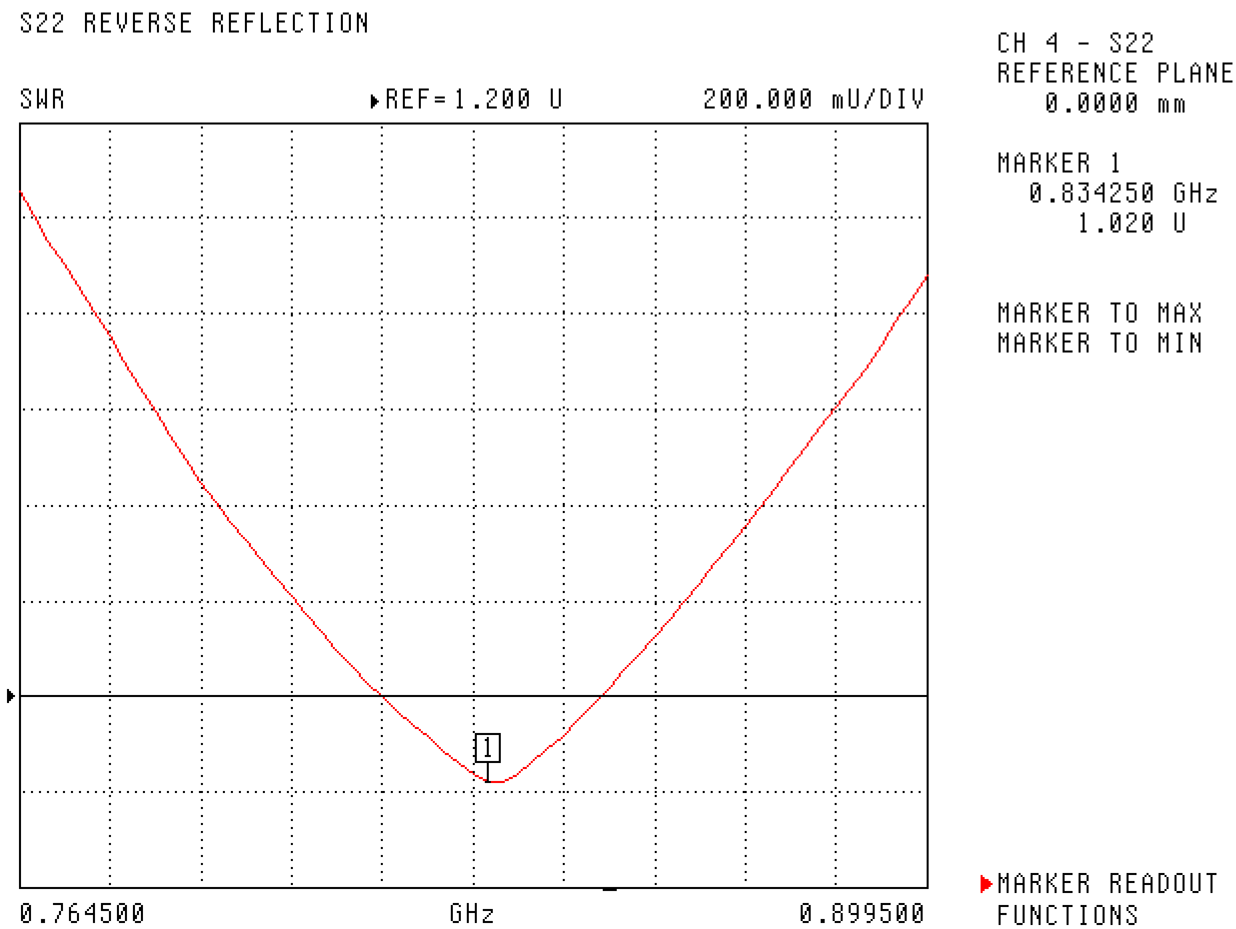
The Following Graphs are the results as displayed on the Vector Network Analyzer.

S11 Parameter Return Loss

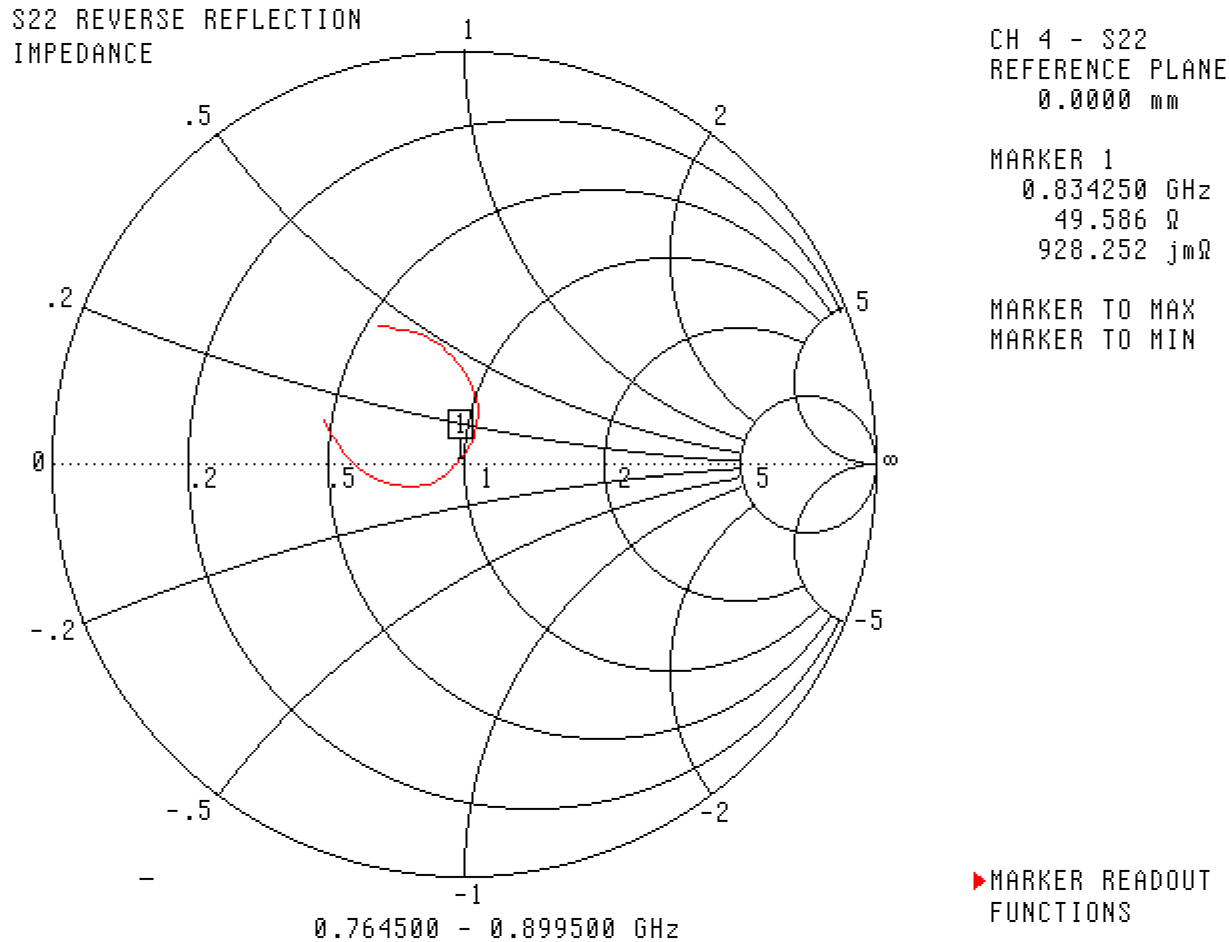


This page has been reviewed for content and attested to by signature within this document.

SWR


S22 REVERSE REFLECTION
SWR
REF= 1.200 U
200.000 mU/DIV
1
0.764500
GHz
0.899500
CH 4 - S22
REFERENCE PLANE
0.0000 mm
MARKER 1
0.834250 GHz
1.020 U
MARKER TO MAX
MARKER TO MIN
MARKER READOUT
FUNCTIONS

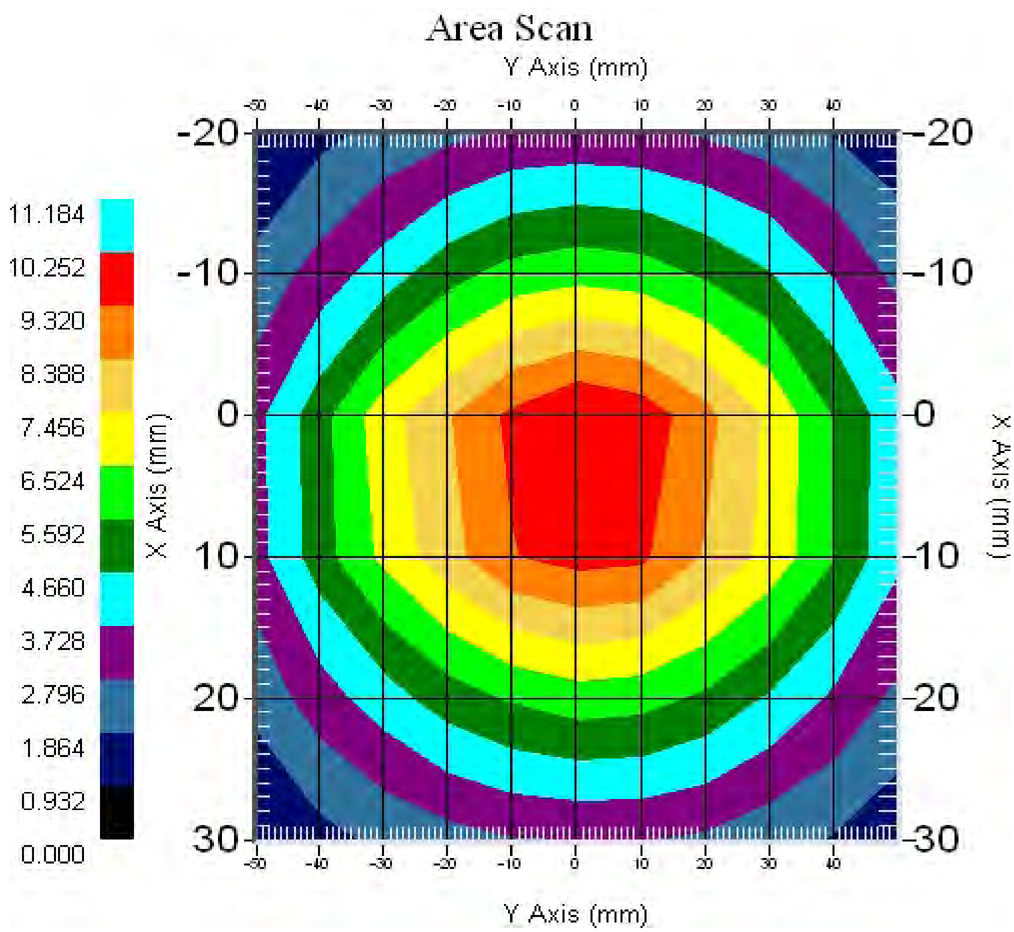
Smith Chart Dipole Impedance



This page has been reviewed for content and attested to by signature within this document.

System Validation Results Using the Electrically Calibrated Dipole

Head Tissue Frequency	1 Gram	10 Gram	Peak Above Feed Point
835 MHz	9.49	6.1	14.21



Test Equipment

The test equipment used during Probe Calibration, manufacturer, model number and, current calibration status are listed and located on the main APREL server R:\NCL\Calibration Equipment\Instrument List May 2008.

NCL CALIBRATION LABORATORIES

Calibration File No: DC-962
Project Number: ISLB-1900 Dipole Replacement-5430

CERTIFICATE OF CALIBRATION

It is certified that the equipment identified below has been calibrated in the **NCL CALIBRATION LABORATORIES** by qualified personnel following recognized procedures and using transfer standards traceable to NRC/NIST.

ISL Validation Dipole

Manufacturer: APREL Laboratories
Part number: ALS-D-1900-S-2
Frequency: 1900 MHz
Serial No: 1900-210-00703-Re-Issue

Customer: ISL

Calibrated: 16th March 2009
Released on: 23rd March 2009

This Calibration Certificate is Incomplete Unless Accompanied with the Calibration Results Summary

Released By: ____________________

NCL CALIBRATION LABORATORIES

51 SPECTRUM WAY
NEPEAN, ONTARIO
CANADA K2R 1E6

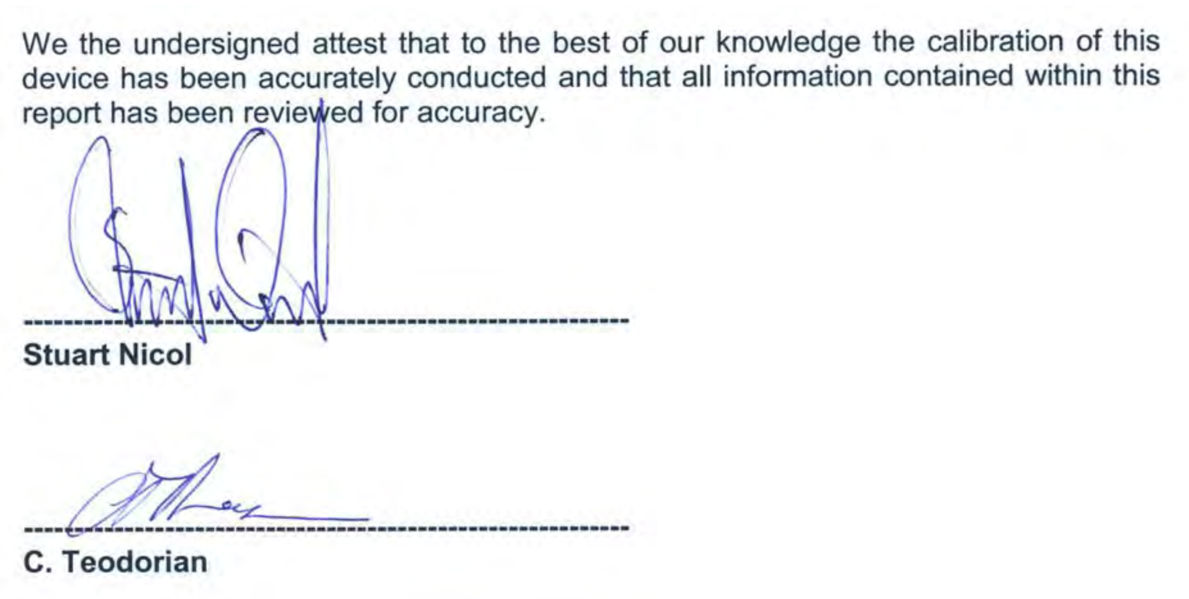
Division of APREL Lab.
TEL: (613) 820-4988
FAX: (613) 820-4162

Conditions

Dipole 1900-210-00703 was new (and reissued under the initial dipole serial number) taken from stock prior to calibration.

Ambient Temperature of the Laboratory: 22 °C +/- 0.5°C
Temperature of the Tissue: 21 °C +/- 0.5°C

We the undersigned attest that to the best of our knowledge the calibration of this device has been accurately conducted and that all information contained within this report has been reviewed for accuracy.


We the undersigned attest that to the best of our knowledge the calibration of this device has been accurately conducted and that all information contained within this report has been reviewed for accuracy.

Stuart Nicol

C. Teodorian

Calibration Results Summary

The following results relate the Calibrated Dipole and should be used as a quick reference for the user.

Mechanical Dimensions

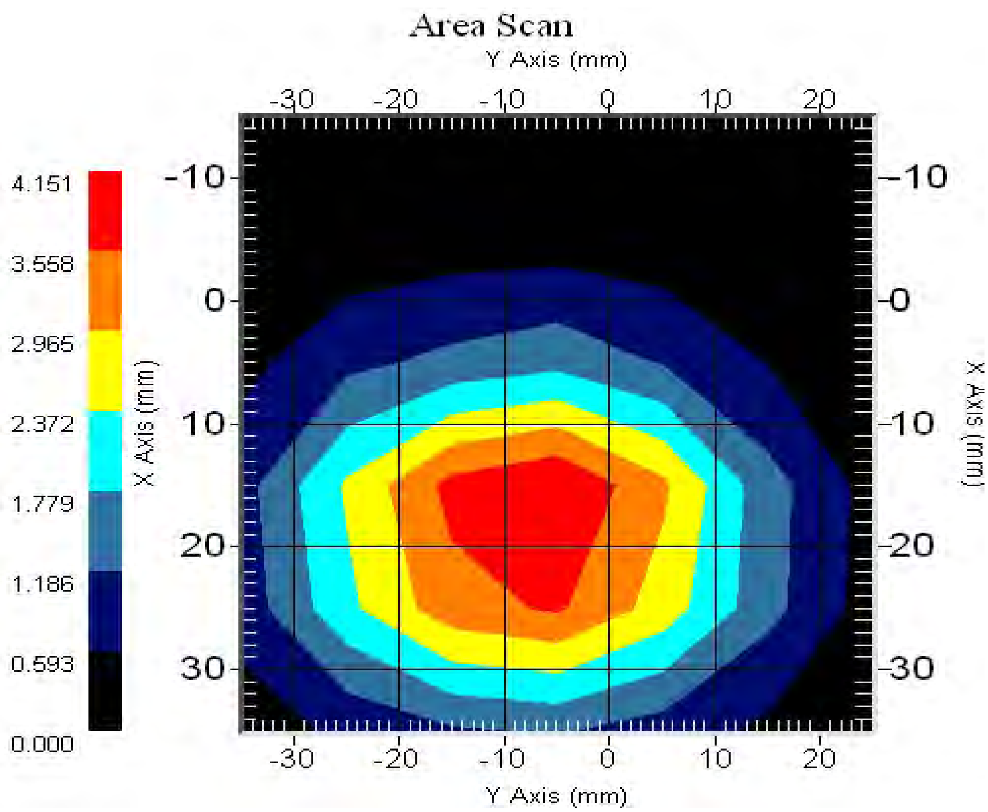
Length: 68.0 mm
Height: 39.5 mm

Electrical Specification

SWR: 1.015 U
Return Loss: -43.654 dB
Impedance: 50.076 Ω

System Validation Results

Frequency	1 Gram	10 Gram	Peak
1900 MHz	40.3	20.14	71.7



This page has been reviewed for content and attested to by signature within this document.

Introduction

This Calibration Report has been produced in line with the SSI Dipole Calibration Procedure SSI-TP-018-ALSAS. The results contained within this report are for Validation Dipole 1900-210-00703. The calibration routine consisted of a three-step process. Step 1 was a mechanical verification of the dipole to ensure that it meets the mechanical specifications. Step 2 was an Electrical Calibration for the Validation Dipole, where the SWR, Impedance, and the Return loss were assessed. Step 3 involved a System Validation using the ALSAS-10U, along with APREL E-020 130 MHz to 26 GHz E-Field Probe Serial Number 212.

References

SSI-TP-018-ALSAS Dipole Calibration Procedure
SSI-TP-016 Tissue Calibration Procedure
IEEE 1528 "Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques"

Conditions

Dipole 1900-210-00703 was new taken from stock.

Ambient Temperature of the Laboratory: 22 °C +/- 0.5°C
Temperature of the Tissue: 20 °C +/- 0.5°C

Dipole Calibration Results

Mechanical Verification

APREL Length	APREL Height	Measured Length	Measured Height
68.0 mm	39.5 mm	68.7mm	40.0 mm

Tissue Validation

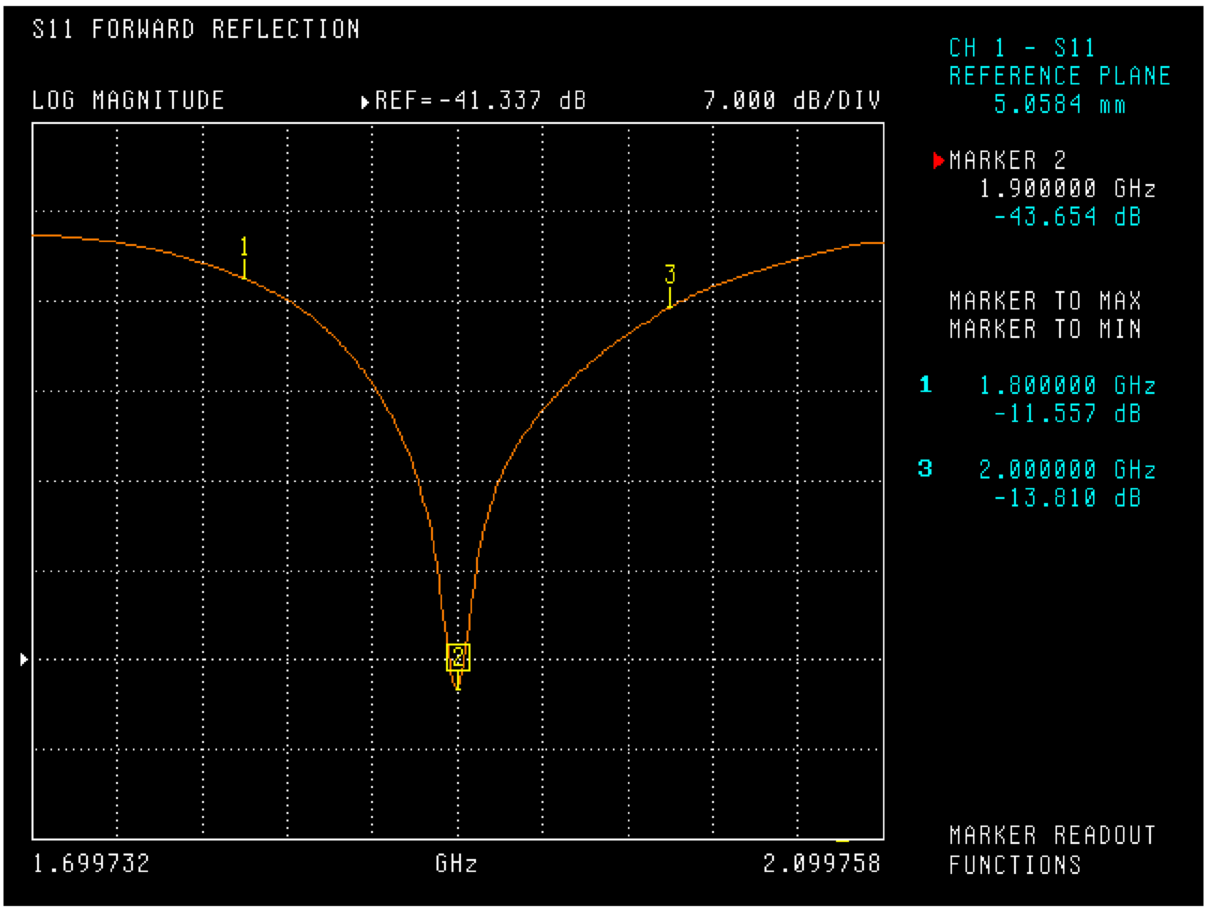
Head Tissue 1900 MHz	Measured
Dielectric constant, ε_r	40.2
Conductivity, σ [S/m]	1.43

Electrical Calibration

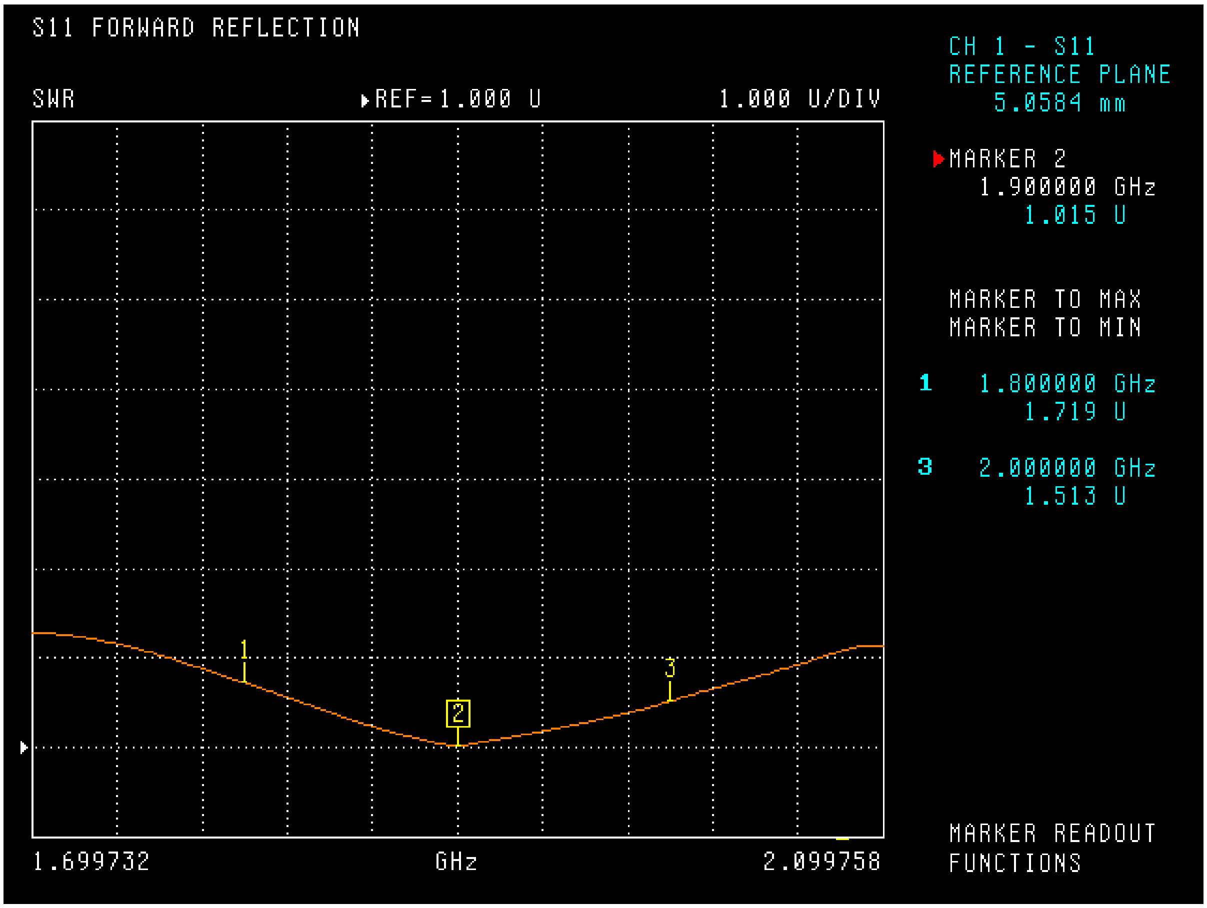
Test	Result
S11 R/L	-43.654 dB
SWR	1.015 U
Impedance	50.076 Ω

The Following Graphs are the results as displayed on the Vector Network Analyzer.

S11 Parameter Return Loss



SWR



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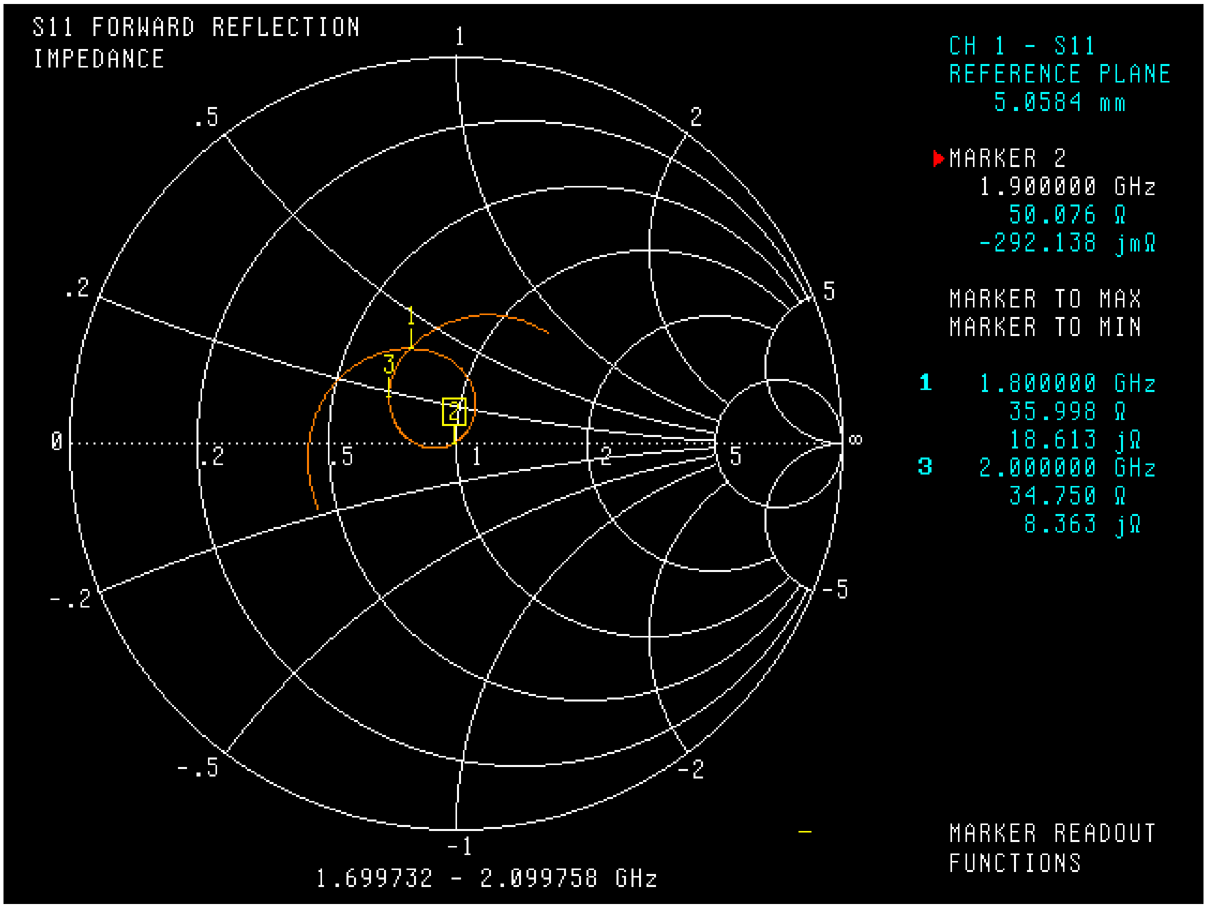
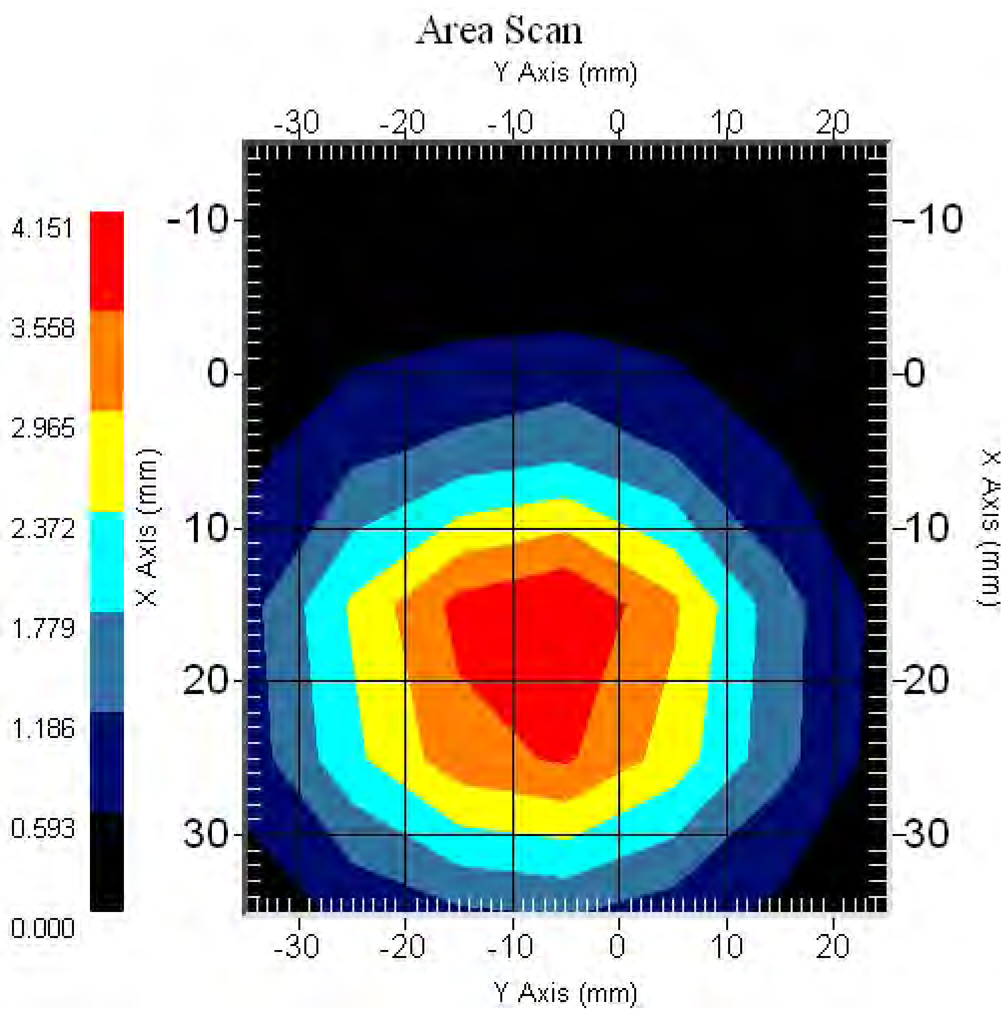
Smith Chart Dipole Impedance



System Validation Results Using the Electrically Calibrated Dipole

Head Tissue Frequency	1 Gram	10 Gram	Peak Above Feed Point
1900 MHz	40.3	20.14	71.7



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Test Equipment

The test equipment used during Probe Calibration, manufacturer, model number and, current calibration status are listed and located on the main APREL server R:\NCL\Calibration Equipment\Instrument List May 2009.