



# RF EXPOSURE LAB, LLC

2867 Progress Place, Suite 4D • Escondido, CA 92029 • U.S.A.

TEL (760) 737-3131 • FAX (760) 737-9131

<http://www.rfexposurelab.com>

## CERTIFICATE OF COMPLIANCE SAR EVALUATION

Vitelcom Mobile Technology U.S.A.  
2480 Irvine Blvd., #172  
Tustin, CA 92782

Dates of Test: August 5, 2004  
Test Report Number: SAR.20040802

FCC ID:	SELTSM1
Model(s):	TSM1-VTL101
Serial No.:	Identical Prototype #43
Equipment Type:	Single Band CDMA Cellular Phone
Classification:	Part 22 Licensed Portable Transmitter Held to Ear
TX Frequency Range:	824.7 – 848.31 MHz (CDMA)
RX Frequency Range:	869.7 – 893.31 MHz (CDMA)
Maximum RF Output:	24.91 dBm Conducted
Signal Modulation:	CDMA
Antenna Type (Length):	Internal
Application Type:	Certification
FCC Rule Parts:	Part 22H

This wireless mobile and/or portable device has been shown to be compliant for localized specific absorption rate (SAR) for uncontrolled environment/general exposure limits specified in ANSI/IEEE Std. C95.1-1992 and had been tested in accordance with the measurement procedures specified in IEEE 1528-2003 and OET Bulletin 65 Supp. C (See test report).

I attest to the accuracy of the data. All measurements were performed by myself or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

RF Exposure Lab, LLC certifies that no party to this application has been denied FCC benefits pursuant to Section 5301 of the Anti-Drug Abuse Act of 1988, 21 U.S.C. 853(a).

Jay M. Moulton  
Vice President



## Table of Contents

1.	Introduction .....	3
	SAR Definition [5].....	3
2.	SAR Measurement Setup .....	4
	Robotic System.....	4
	System Hardware .....	4
	System Description .....	4
	E-Field Probe ALS-E-020 .....	5
3.	Robot Specifications .....	7
4.	Probe and Dipole Calibration .....	8
5.	Phantom & Simulating Tissue Specifications.....	9
	SAM Phantom.....	9
	Brain & Muscle Simulating Mixture Characterization .....	9
	Device Holder .....	10
6.	Definition of Reference Points.....	11
	Ear Reference Point.....	11
	Device Reference Points .....	11
7.	Test Configuration Positions .....	12
	Positioning for Cheek/Touch [5].....	12
	Positioning for Ear / 15° Tilt [5].....	13
	Body Worn Configurations .....	13
8.	ANSI/IEEE C95.1 – 1992 RF Exposure Limits [2].....	15
	Uncontrolled Environment.....	15
	Controlled Environment .....	15
9.	Measurement Uncertainty .....	16
10.	System Validation .....	17
	Tissue Verification.....	17
	Test System Verification .....	17
11.	SAR Test Data Summary .....	18
	See Measurement Result Data Pages.....	18
	Procedures Used To Establish Test Signal.....	18
	Device Test Condition.....	18
	SAR Data Summary – 835 MHz Brain .....	19
	SAR Data Summary – 835 MHz Brain .....	20
	SAR Data Summary – 835 MHz Body .....	21
12.	Test Equipment List .....	22
13.	Conclusion .....	23
14.	References.....	24
	Appendix A – System Validation Plots and Data .....	25
	Appendix B – SAR Test Data Plots.....	30
	Appendix C – SAR Test Setup Photos .....	61
	Appendix D – Probe Calibration Data Sheets.....	65
	Appendix E – Dipole Calibration Data Sheets .....	66
	Appendix F – Phantom Calibration Data Sheets .....	67

## 1. Introduction

This measurement report shows compliance of the Vitelcom Mobile Technology U.S.A. Model TSM1 FCC ID: SELTSM1 with FCC Part 2, 1093, ET Docket 93-62 Rules for mobile and portable devices. The FCC has adopted the guidelines for evaluating the environmental effects of radio frequency radiation in ET Docket 93-62 on August 6, 1996 to protect the public and workers from the potential hazards of RF emissions due to FCC regulated portable devices. [1]

The test procedures, as described in ANSI C95.1 – 1992 Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz [2], ANSI C95.3 – 1992 Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields [3], FCC OET Bulletin 65 Supp. C – 2001 [4], and IEEE Std.1528 – 2003 Recommended Practice [5] were employed.

### SAR Definition [5]

Specific Absorption Rate is defined as 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 ( $\rho$ ).

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

SAR is expressed in units of watts per kilogram (W/kg). SAR can be related to the electric field at a point by

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

where:

$\sigma$  = conductivity of the tissue (S/m)

$\rho$  = mass density of the tissue (kg/m<sup>3</sup>)

$E$  = rms electric field strength (V/m)

## 2. SAR Measurement Setup

### Robotic System

The measurements are conducted utilizing the ALSAS-10-U automated dosimetric assessment system. The ALSAS-10-U is designed and manufactured by Aprel Laboratories in Nepean, Ontario, Canada. The system utilizes a Robcomm 3 robot manufactured by ThermoCRS located in Michigan USA.

### System Hardware

The system consists of a six axis articulated arm, controller for precise probe positioning (0.05 mm repeatability), a power supply, a teach pendant for teaching area scans, near field probe, an IBM Pentium 4™ 2.66 GHz PC with Windows XP Pro™, and custom software developed to enable communications between the robot controller software and the host operating system.

An amplifier is located on the articulated arm, which is isolated from the custom designed end effector and robot arm. The end effector provides the mechanical touch detection functionality and probe connection interface. The amplifier is functionally validated within the manufacturer's site and calibrated at NCL Calibration Laboratories. A Data Acquisition Card (DAC) is used to collect the signal as detected by the isotropic e-field probe. The DAC manufacturer calibrates the DAC to NIST standards. A formal validation is executed using all mechanical and electronic components to prove conformity of the measurement platform as a whole.

### System Description

The ALSAS-10-U has been designed to measure devices within the compliance environment to meet all recognized standards. The system also conforms to standards, which are currently being developed by the scientific and manufacturing community.

The course scan resolution is defined by the operator and reflects the requirements of the standard to which the device is being tested. Precise measurements are made within the predefined course scan area and the values are logged.

The user predefines the sample rate for which the measurements are made so as to ensure that the full duty-cycle of a pulse modulation device is covered during the sample. The following algorithm is an example of the function used by the system for linearization of the output for the probe.

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



The April E-Field probe is evaluated to establish the diode compression point.

A complex algorithm is then used to calculate the values within the measured points down to a resolution of 1mm. The data from this process is then used to provide the co-ordinates from which the cube scan is created for the determination of the 1 g and 10 g averages.

Cube scan averaging consists of a number of complex algorithms, which are used to calculate the one, and ten gram averages. The basis for the cube scan process is centered on the location where the maximum measured SAR value was found. When a secondary peak value is found which is within 60% of the initial peak value, the system will report this back to the operator who can then assess the need for further analysis of both the peak values prior to the one and ten-gram cube scan averaging process. The algorithm consists of 3D cubic Spline, and Lagrange extrapolation to the surface, which form the matrix for calculating the measurement output for the one and ten gram average values. The resolution for the physical scan integral is user defined with a final calculated resolution down to 1mm.

In-depth analysis for the differential of the physical scanning resolution for the cube scan analysis has been carried out, to identify the optimum setting for the probe positioning steps, and this has been determined at 8mm increments on the X, & Y planes. The reduction of the physical step increment increased the time taken for analysis but did not provide a better uncertainty or return on measured values.

The final output from the system provides data for the area scan measurements, physical and splined (1mm resolution) cube scan with physical and calculated values (1mm resolution).

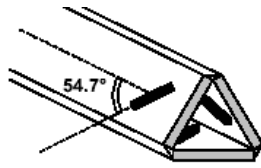
The overall uncertainty for the methodology and algorithms the ALSAS-10-U used during the SAR calculation was evaluated using the data from IEEE 1528 f3 algorithm:

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

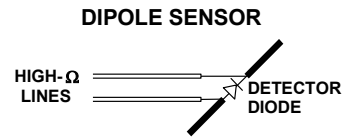
The probe used during the measurement process has been assessed to provide values for diode compression. These values are calculated during the probe calibration exercise and are used in the mathematical calculations for the assessment of SAR.

### **E-Field Probe ALS-E-020**

The E-field probe used by RF Exposure Lab, LLC, has been fully calibrated and assessed for isotropic, and boundary effect. The probe utilizes a triangular sensor arrangement as detailed in the diagram below right.



**Δ-BEAM**



The SAR is assessed with the 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 (Z height). The diagram above right shows how the center of the sensor is defined with the location of the diode placed at the center of the dipole. The 5mm default in the Z axis is the optimum height for assessing SAR where the boundary effect is at its least, with the probe located closest to the phantom surface (boundary).

### 3. Robot Specifications

#### Specifications

Positioner: ThermoCRS, Robot Model: Robocomm 3  
Repeatability: 0.05 mm  
No. of axis: 6

#### Data Acquisition Card (DAC) System

##### Cell Controller

Processor: Pentium 4™  
Clock Speed: 2.66 GHz  
Operating System: Windows XP Pro™

##### Data Converter

Features: Signal Amplifier, End Effector, DAC  
Software: ALSAS 10-U Software

#### E-Field Probe

Model: ALS-E-020  
Serial Number: RFE-217  
Construction: Triangular Core Touch Detection System  
Frequency: 10MHz to 6GHz

#### Phantom

Phantom: Uniphantom, Right Phantom, Left Phantom



## **4. Probe and Dipole Calibration**

See Appendix D.



## 5. Phantom & Simulating Tissue Specifications

### SAM Phantom



The Aprel system utilizes three separate phantoms. Each phantom for SAR assessment testing is a low loss dielectric shell, with shape and dimensions derived from the anthropomorphic data of the 90<sup>th</sup> percentile adult male head dimensions as tabulated by the US Army. The SAM phantom shell is bisected along the mid sagittal plane into right and left halves. The perimeter sidewalls of each phantom half is extended to allow filling with liquid to a depth of 15 cm that is sufficient to minimize reflections from the upper surface [5]. See photos in Appendix C.

### Brain & Muscle Simulating Mixture Characterization

The brain and muscle mixtures consist of a viscous gel using hydroxethylcellulose (HEC) gelling agent and saline solution. Preservation with a bacteriacide is added and visual inspection is made to make sure air bubbles are not trapped during the mixing process. The mixture is calibrated to obtain proper dielectric constant (permittivity) and conductivity of the desired tissue. The head tissue dielectric parameters recommended by the IEEE SCC-34/SC-2 have been incorporated in the following tables. Other head and body tissue parameters that have not been specified in P1528 are derived from the issue dielectric parameters computed from the 4-Cole-Cole equations.

**Table 5.1 Typical Composition of Ingredients for Tissue**

Ingredients		Simulating Tissue			
		835 MHz Brain	835 MHz Muscle	1900 MHz Brain	1900 MHz Muscle
Mixing Percentage					
Water		40.45	52.40	54.90	40.50
DGBE		0.00	0.00	44.92	0.00
Sugar		57.60	45.00	0.00	58.00
Salt		1.45	1.40	0.18	0.50
Bacteriacide		0.10	0.10	0.00	0.50
HEC		0.40	1.00	0.00	0.50
Dielectric Constant	Target	41.50	56.10	40.00	54.00
Conductivity (S/m)	Target	0.90	0.95	1.40	1.45

## Device Holder

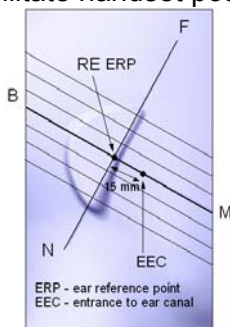


In combination with the SAM phantom, the mounting device enables the rotation of the mounted transmitter in spherical coordinates whereby the rotation point is the ear opening. The devices can easily, accurately, and repeatably be positioned according to the FCC specifications. The device holder can be locked at different phantom locations (left head, right head, and uni-phantom).

## 6. Definition of Reference Points

### Ear Reference Point

Figure 6.2 shows the front, back and side views of the SAM Phantom. The point “M” is the reference point for the center of the mouth, “LE” is the left ear reference point (ERP), and “RE” is the right ERP. The ERPs are 15mm posterior to the entrance to the ear canal (EEC) along the B-M line (Back-Mouth), as shown in Figure 6.1. The plane passing through the two ear canals and M is defined as the Reference Plane. The line N-F (Neck-Front) is perpendicular to the reference plane and passing through the RE (or LE) is called the Reference Pivoting Line (see Figure 6.1). Line B-M is perpendicular to the N-F line. Both N-F and B-M lines are marked on the external phantom shell to facilitate handset positioning [5].



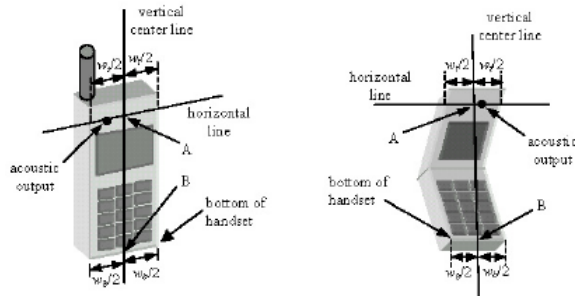
**Figure 6.1 Close-up side view of ERP's**



**Figure 6.2 Front, back and side view of SAM**

### Device Reference Points

Two imaginary lines on the device need to be established: the vertical centerline and the horizontal line. The test device is placed in a normal operating position with the “test device reference point” located along the “vertical centerline” on the front of the device aligned to the “ear reference point” (See Fig. 6.3). The “test device reference point” is then located at the same level as the center of the ear reference point. The test device is positioned so that the “vertical centerline” is bisecting the front surface of the device at it’s top and bottom edges, positioning the “ear reference point” on the outer surface of both the left and right head phantoms on the ear reference point [5].

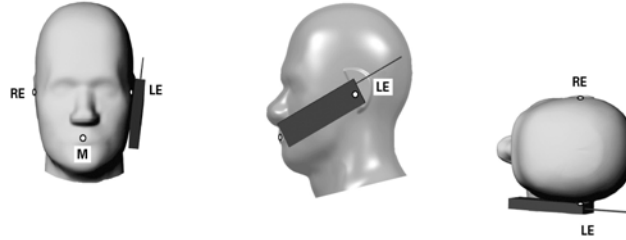


**Figure 6.3 Handset Vertical Center & Horizontal Line Reference Points**

## 7. Test Configuration Positions

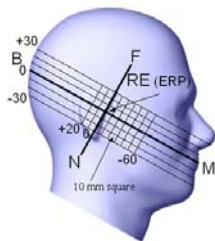
### Positioning for Cheek/Touch [5]

1. Position the device 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 7.1), such that the plane defined by the vertical center line and the horizontal line of the device is approximately parallel to the sagittal plane of the phantom.



**Figure 7.1 Front, Side and Top View of Cheek/Touch Position**

2. Translate the device towards the phantom along the line passing through RE and LE until the device touches the ear.
3. While maintaining the device 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).
4. Rotate the device around the vertical centerline until the device (horizontal line) is symmetrical with respect to the line NF.
5. While maintaining the vertical centerline in the reference plane, keeping point A on the line passing through RE and LE and maintaining the device contact with the ear, rotate the device about the line NF until any point on the device is in contact with a phantom point below the ear (cheek). See Figure 7.2.

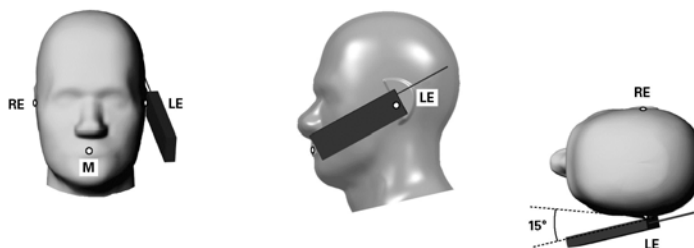


**Figure 7.2 Side view w/ relevant markings**

## Positioning for Ear / 15° Tilt [5]

With the test device aligned in the Cheek/Touch Position”:

1. While maintaining the orientation of the device, retracted the device parallel to the reference plane far enough to enable a rotation of the device by 15 degrees.
2. Rotate the device around the horizontal line by 15 degrees.
3. While maintaining the orientation of the device, move the device parallel to the reference plane until any part of the device touches the head. (In this position, point A is located on the line RE-LE). The tilted position is obtained when the contact is on the pinna. If the contact is at any location other than the pinna, the angle of the device shall be reduced. The tilted position is obtained when any part of the device is in contact with the ear as well as a second part of the device is in contact with the head (see Figure 7.3).



**Figure 7.3 Front, Side and Top View of Ear/15° Tilt Position**

## Body Worn Configurations

Body-worn operating configurations are tested with the accessories attached to the device and positioned against a flat phantom in a normal use configuration. A device with a headset output is tested with a headset connected to the device. Body dielectric parameters are used.

Accessories for Body-worn operation configurations are divided into two categories: those that do not contain metallic components and those that do contain metallic components. When multiple accessories that do not contain metallic components are supplied with the device, the device is tested with only the accessory that dictates the closest spacing to the body. Then, when multiple accessories that contain metallic components are supplied with the device, the device is tested with each accessory that contains a unique metallic component. If multiple accessories share an identical metallic component (i.e. the same metallic belt-clip used with different holsters with no other metallic components) only the accessory that dictates the closest spacing to the body is tested.

Body-worn accessories may not always be supplied or available as options for some devices intended to be authorized for body-worn use. In this case, a test configuration

where a separation distance between the back of the device and the flat phantom is used. All test position spacings are documented.

Transmitters that are designed to operate in front of a person's face, as in push-to-talk configurations, are tested for SAR compliance with the front of the device positioned to face the flat phantom. For devices that are carried next to the body such as a shoulder, waist or chest-worn transmitters, SAR compliance is tested with the accessory(ies), including headsets and microphones, attached to the device and positioned against a flat phantom in a normal use configuration.

In all cases SAR measurements are performed to investigate the worst-case positioning. Worst-case positioning is then documented and used to perform Body SAR testing.

In order for users to be aware of the body-worn operating requirements for meeting RF exposure compliance, operating instructions and cautions statements are included in the user's manual.

For this report, no accessories were provided for testing. Therefore, the device was test with an air gap of 20 mm to simulate a body worn device.

## 8. ANSI/IEEE C95.1 – 1992 RF Exposure Limits [2]

### Uncontrolled Environment

Uncontrolled Environments are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure. The general population/uncontrolled exposure limits are applicable to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Members of the general public would come under this category when exposure is not employment-related; for example, in the case of a wireless transmitter that exposes persons in its vicinity.

### Controlled Environment

Controlled Environments are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e. as a result of employment or occupation). In general, occupational/controlled exposure limits are applicable to situations in which persons are exposed as a consequence of their employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure. This exposure category is also applicable when the exposure is of a transient nature due to incidental passage through a location where the exposure levels may be higher than the general population/uncontrolled limits, but the exposed person is fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means.

**Table 8.1 Human Exposure Limits**

	UNCONTROLLED ENVIRONMENT General Population (W/kg) or (mW/g)	CONTROLLED ENVIRONMENT Professional Population (W/kg) or (mW/g)
SPATIAL PEAK SAR <sup>1</sup> Brain	1.60	8.00
SPATIAL AVERAGE SAR <sup>2</sup> Whole Body	0.08	0.40
SPATIAL PEAK SAR <sup>3</sup> Hands, Feet, Ankles, Wrists	4.00	20.00

<sup>1</sup> The Spatial Peak value of the SAR averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.

<sup>2</sup> The Spatial Average value of the SAR averaged over the whole body.

<sup>3</sup> The Spatial Peak value of the SAR averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.

## 9. Measurement Uncertainty

### 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	$(1-cp)^{1/2}$	$(1-cp)^{1/2}$	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 Postioning with respect to Phantom Shell	2.9	rectangular	•3	1	1	2.1	2.1
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	0.2	rectangular	•3	1	1	0.1	0.1
Phantom and Setup							
Phantom Uncertainty(shape & thickness tolerance)	3.4	rectangular	•3	1	1	2.0	2.0
Liquid Conductivity(target)	13.0	rectangular	•3	0.7	0.5	5.3	3.8
Liquid Conductivity(meas.)	0.1	rectangular	•3	0.7	0.5	0.0	0.0
Liquid Permittivity(target)	2.0	rectangular	•3	0.6	0.5	0.8	0.6
Liquid Permittivity(meas.)	4.4	rectangular	•3	0.6	0.5	1.5	1.3
Combined Uncertainty		RSS				10.3	9.5
Combined Uncertainty (coverage factor=2)		Normal (k=2)				20.6	19.1



# 10. System Validation

## Tissue Verification

**Table 10.1 Measured Tissue Parameters**

Date(s)	5/7/2004	835 MHz Brain		835 MHz Muscle		1900 MHz Brain		1900 MHz Muscle	
Liquid Temperature (°C)	23.0	Target	Measured	Target	Measured	Target	Measured	Target	Measured
Dielectric Constant: $\epsilon$		41.50	43.01	55.20	56.44	40.00	N/A	53.30	N/A
Conductivity: $\sigma$		0.900	0.860	0.970	0.930	1.400	N/A	1.520	N/A

See Appendix A for data printout.

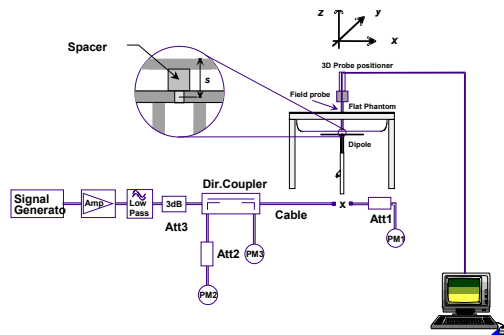
## Test System Verification

Prior to assessment, the system is verified to the  $\pm 10\%$  of the specifications at 835 MHz by using the system kit. (Graphic Plots Attached)

**Table 10.2 System Dipole Validation Target & Measured**

System Validation Kit: ALS-D-835-S-2 S/N: RFE-274	835 MHz Brain	Targeted SAR <sub>1g</sub> (W/kg) 9.5	Measure SAR <sub>1g</sub> (W/kg) 9.25	Deviation (%) - 2.6
---	------------------	--	--	------------------------

See Appendix A for data plots.



**Figure 10.1 Dipole Validation Test Setup**

## **11. SAR Test Data Summary**

### **See Measurement Result Data Pages**

See Appendix B for SAR Test Data Plots.  
See Appendix C for SAR Test Setup Photos.

### **Procedures Used To Establish Test Signal**

The device was placed into simulated transmit mode using the manufacturer's test codes. Such test signals offer a consistent means for testing SAR and are recommended for evaluating SAR. When test modes are not available or inappropriate for testing a device, the actual transmission is activated through a base station simulator or similar equipment. See data pages for actual procedure used in measurement.

### **Device Test Condition**


The device is battery operated. Each SAR measurement was taken with a fully charged battery. In order to verify that the device was tested at full power, conducted output power measurements were performed before and after each SAR measurement to confirm the output power. If a conducted power deviation of more than 5% occurred, the test was repeated.

**SAR Data Summary – 835 MHz Brain**

MEASUREMENT RESULTS								
EUT Position	Antenna Position	Frequency		Modulation	Begin / End Power			SAR (W/kg)
		MHz	Ch.		(dBm)		Battery	
Touch	Internal	824.70	1013	CDMA	24.3	24.2	Standard	1.51
		836.52	0384	CDMA	24.9	24.8	Standard	0.71
		848.31	0777	CDMA	24.9	24.8	Standard	1.38
15° Tilt	Internal	824.70	1013	CDMA	24.3	24.2	Standard	1.16
		836.52	0384	CDMA	24.9	24.8	Standard	0.56
		848.31	0777	CDMA	24.9	24.8	Standard	1.07

**Brain**  
**1.6 W/kg (mW/g)**  
averaged over 1 gram

1. Battery is fully charged for all tests.  
 Power Measured  Conducted  ERP  EIRP
2. SAR Measurement  
 Phantom Configuration  Left Head  Uniphantom  Right Head  
 SAR Configuration  Head  Body
3. Test Signal Call Mode  Test Code  Base Station Simulator
4. Test Configuration  With Holster  Without Holster  N/A


  
 \_\_\_\_\_  
 Jay M. Moulton  
 Vice President

**SAR Data Summary – 835 MHz Brain**

MEASUREMENT RESULTS								
EUT Position	Antenna Position	Frequency		Modulation	Begin / End Power			SAR (W/kg)
		MHz	Ch.		(dBm)		Battery	
Touch	Internal	824.70	1013	CDMA	24.3	24.2	Standard	1.58
		836.52	0384	CDMA	24.9	24.8	Standard	0.82
		848.31	0777	CDMA	24.9	24.8	Standard	1.53
15° Tilt	Internal	824.70	1013	CDMA	24.3	24.2	Standard	1.14
		836.52	0384	CDMA	24.9	24.8	Standard	0.64
		848.31	0777	CDMA	24.9	24.8	Standard	1.13

**Brain**  
**1.6 W/kg (mW/g)**  
averaged over 1 gram

- 5. Battery is fully charged for all tests.  
 Power Measured  Conducted  ERP  EIRP
- 6. SAR Measurement  
 Phantom Configuration  Left Head  Uniphantom  Right Head  
 SAR Configuration  Head  Body
- 7. Test Signal Call Mode  Test Code  Base Station Simulator
- 8. Test Configuration  With Holster  Without Holster  N/A

  
 \_\_\_\_\_  
 Jay M. Moulton  
 Vice President

## SAR Data Summary – 835 MHz Body

MEASUREMENT RESULTS								
EUT Position	Antenna Position	Frequency		Modulation	Begin / End Power			SAR (W/kg)
		MHz	Ch.		(dBm)		Battery	
20 mm Separation	Internal	824.70	1013	CDMA	24.3	24.2	Standard	0.86
		836.52	0384	CDMA	24.9	24.8	Standard	0.73
		848.31	0777	CDMA	24.9	24.8	Standard	1.00
					<b>Body</b> <b>1.6 W/kg (mW/g)</b> averaged over 1 gram			

9. Battery is fully charged for all tests.

Power Measured

Conducted

ERP

EIRP

10. SAR Measurement

Phantom Configuration

Left Head

Uniphantom

Right Head

SAR Configuration

Head

Body

11. Test Signal Call Mode

Test Code

Base Station Simulator

12. Test Configuration

With Holster

Without Holster

N/A



Jay M. Moulton  
Vice President

## 12. Test Equipment List

**Table 12.1 Equipment Specifications**

Type	Calibration Due Date	Serial Number
ThermoCRS Robot	N/A	RAF0338198
ThermoCRS Controller	N/A	RCF0338224
ThermoCRS Teach Pendant (Joystick)	N/A	STP0334405
IBM Computer, 2.66 MHz P4	N/A	8189D8U KCPR08N
Apriel E-Field Probe ALS-E020	04/20/2005	RFE-213
Apriel Dummy Probe	N/A	023
Apriel Left Phantom	N/A	RFE-267
Apriel Right Phantom	N/A	RFE-268
Apriel UniPhantom	N/A	RFE-273
Apriel Validation Dipole ALS-D-835-S-2	02/20/2005	RFE-274
Apriel Validation Dipole ALS-D-1900-S-2	02/20/2005	RFE-277
Apriel Validation Dipole ALS-D-2450-S-2	02/20/2005	RFE-278
Apriel Validation Dipole ALS-D-900-S-2	02/20/2005	RFE-275
Agilent (HP) 437B Power Meter	12/18/2005	3125U08837
Agilent (HP) 8481B Power Sensor	05/26/2005	3318A05384
Agilent (HP) 8350B Signal Generator	3/10/2005	2749A10226
Agilent (HP) 83525A RF Plug-In	03/10/2005	2647A01172
Agilent (HP) 8753C Vector Network Analyzer	02/12/2005	3135A01724
Agilent (HP) 85047A S-Parameter Test Set	02/12/2005	2904A00595
Apriel Dielectric Probe Assembly	N/A	0011
Microwave Power Devices 510-10E Amplifier	3/09/2005	6063-001
Microwave Power Devices 1020-9E Amplifier	03/09/2005	5618-1
Hughes 8010H01-000 Amplifier	03/10/2005	169
Brain Equivalent Matter (835 MHz)	N/A	N/A
Brain Equivalent Matter (1900 MHz)	N/A	N/A
Brain Equivalent Matter (900 MHz)	N/A	N/A
Muscle Equivalent Matter (835 MHz)	N/A	N/A
Muscle Equivalent Matter (1900 MHz)	N/A	N/A
Muscle Equivalent Matter (900 MHz)	N/A	N/A
Muscle Equivalent Matter (2450 MHz)	N/A	N/A
Muscle Equivalent Matter (5200 MHz)	N/A	N/A

## 13. Conclusion

The SAR measurement indicates that the EUT complies with the RF radiation exposure limits of the FCC. These measurements are taken to simulate the RF effects exposure under worst-case conditions. Precise laboratory measures were taken to assure repeatability of the tests. The tested device complies with the requirements in respect to all parameters subject to the test. The test results and statements relate only to the item(s) tested.

Please note that the absorption and distribution of electromagnetic energy in the body is a very complex phenomena that depends on the mass, shape, and size of the body; the orientation of the body with respect to the field vectors; and, the electrical properties of both the body and the environment. Other variables that may play a substantial role in possible biological effects are those that characterize the environment (e.g. ambient temperature, air velocity, relative humidity, and body insulation) and those that characterize the individual (e.g. age, gender, activity level, debilitation, or disease). Because innumerable factors may interact to determine the specific biological outcome of an exposure to electromagnetic fields, any protection guide shall consider maximal amplification of biological effects as a result of field-body interactions, environmental conditions, and physiological variables. [3]

## 14. References

- [1] Federal Communications Commission, ET Docket 93-62, Guidelines for Evaluating the Environmental Effects of Radio Frequency Radiation, August 1996
- [2] ANSI/IEEE C95.1 – 1991, American National Standard Safety Levels with respect to Human Exposure to Radio Frequency Electromagnetic Fields, 300kHz to 100GHz, New York: IEEE, 1992.
- [3] ANSI/IEEE C95.3 – 1991, IEEE Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields – RF and Microwave, New York: IEEE, 1992.
- [4] Federal Communications Commission, OET Bulletin 65 (Edition 97-01), Supplement C (Edition 01-01), Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields, July 2001.
- [5] IEEE Standard 1528 – 2003, IEEE Recommended Practice for Determining the Peak-Spatial Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communication Devices: Measurement Techniques, October 2003.



## Appendix A – System Validation Plots and Data

```

*****
Test Result for UIM Dielectric Parameter
Thu 05/Aug/2004 07:55:07
Freq  Frequency(GHz)
FCC_eH      FCC OET 65 Supplement C (June 2001) Limits for Head Epsilon
FCC_sH      FCC OET 65 Supplement C (June 2001) Limits for Head Sigma
Test_e      Epsilon of UIM
Test_s      Sigma of UIM
*****
Freq        FCC_eH      FCC_sH      Test_e      Test_s
0.6350     42.54       0.88       45.77       0.69
0.7350     42.02       0.89       44.25       0.78
0.8350     41.50       0.90       43.01       0.86
0.9350     41.46       0.99       41.85       0.94
1.0350     41.28       1.03       40.78       1.02
  
```

```

*****
Test Result for UIM Dielectric Parameter
Thu 05/Aug/2004 16:05:11
Freq  Frequency(GHz)
FCC_eB      FCC Limits for Body Epsilon
FCC_sB      FCC Limits for Body Sigma
Test_e      Epsilon of UIM
Test_s      Sigma of UIM
*****
Freq        FCC_eB      FCC_sB      Test_e      Test_s
0.6350     55.98       0.95       58.43       0.74
0.7350     55.59       0.96       57.34       0.83
0.8350     55.20       0.97       56.44       0.93
0.9350     54.96       1.07       55.78       1.02
1.0350     54.78       1.11       54.82       1.12
  
```

## SAR Test Report

Operator : Jay  
Validation Date : 05-Aug-2004  
Measurement Date : 05-Aug-2004  
Starting Time : 05-Aug-2004 08:15:16 AM  
End Time : 05-Aug-2004 08:26:14 AM  
Scanning Time : 658 secs

### Product Data

Device Name : Validation  
Serial No. : 835  
Type : Dipole  
Model : ALS-D-835-S-2  
Frequency : 835.00 MHz  
Max. Transmit Pwr : 1 W  
Drift Time : 0 min(s)  
Length : 161  
Width : 3.6  
Depth : 89.8  
Antenna Type : Internal  
Power Drift-Start : 7.57  
Power Drift-Finish : 7.39  
Power Drift : 0.18

### Phantom Data

Name : APREL-Uni  
Type : Uni-Phantom  
Size : 280 x 280 x 200  
Serial No. : System Default  
Location : Center  
Description : validation

### Tissue Data

Type : Head  
Serial No. : 835  
Frequency : 835 MHz  
Calibration Date : 05-Aug-2004  
Temperature : 23 °C  
Ambient Temp. : 24 °C  
Humidity : 50 RH%  
Epsilon : 43.01 F/m  
Sigma : 0.86 S/m  
Density : 1000 kg/cu. m

### Probe Data

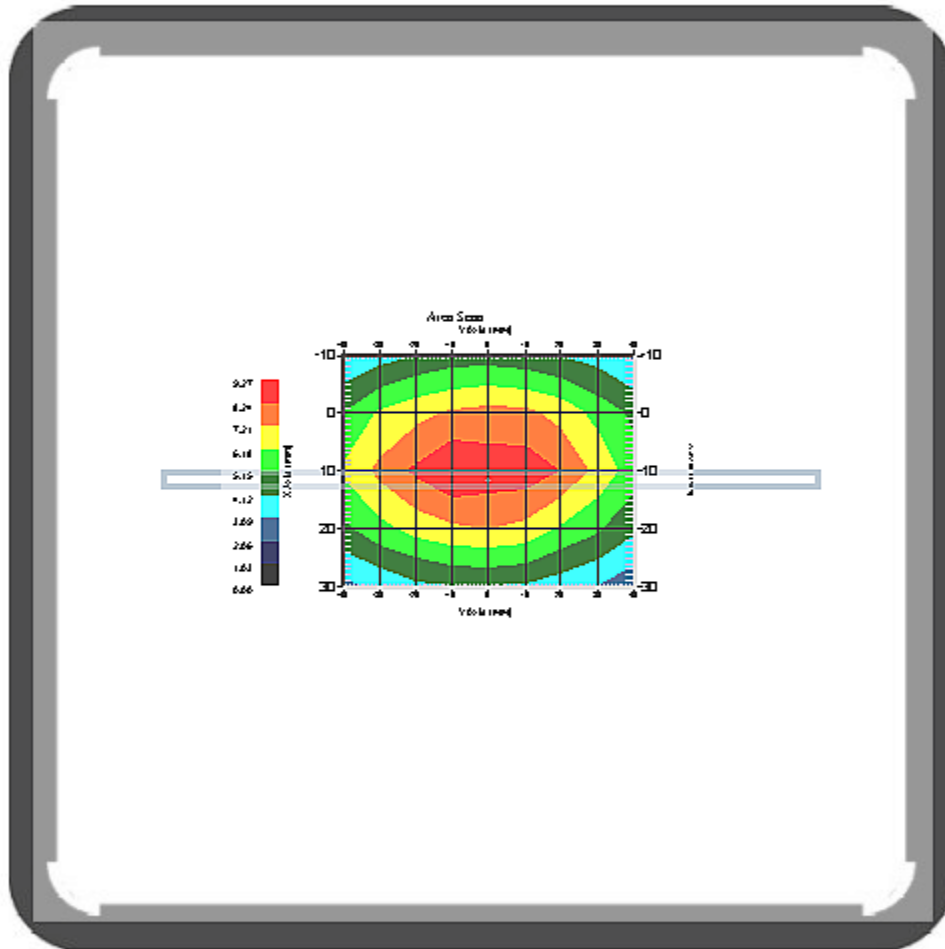
Name : RFEL 217  
Model : E020  
Type : E-Field Triangle  
Serial No. : 217  
Calibration Date : 18-Jun-2004  
Frequency : 835 MHz  
Duty Cycle Factor : 1  
Conversion Factor : 6  
Probe Sensitivity : 1.20 1.20 1.20  $\mu\text{V}/(\text{V}/\text{sq. m})$   
Compression Point : 95  
Offset : 1.56

Measurement Data

Crest Factor : 1  
Scan Type : Complete  
Set-up Date : 05-Aug-2004  
Set-up Time : 8:11:19 AM

Other Data

DUT Position : Touch  
Separation : 0  
Channel : Mid - 835



1 gram SAR value : 9.25 W/kg  
10 gram SAR value : 6.18 W/kg  
Area Scan Peak SAR : 9.25  
Zoom Scan Peak SAR : 15.20

## SAR Test Report

Operator : Jay  
Validation Date : 05-Aug-2004  
Measurement Date : 05-Aug-2004  
Starting Time : 05-Aug-2004 04:12:31 PM  
End Time : 05-Aug-2004 04:23:28 PM  
Scanning Time : 657 secs

### Product Data

Device Name : Validation  
Serial No. : 835  
Type : Dipole  
Model : ALS-D-835-S-2  
Frequency : 835.00 MHz  
Max. Transmit Pwr : 1 W  
Drift Time : 0 min(s)  
Length : 161  
Width : 3.6  
Depth : 89.8  
Antenna Type : Internal  
Power Drift-Start : 4.31  
Power Drift-Finish : 3.86  
Power Drift : 0.45

### Phantom Data

Name : APREL-Uni  
Type : Uni-Phantom  
Size : 280 x 280 x 200  
Serial No. : System Default  
Location : Center  
Description : validation

### Tissue Data

Type : Body  
Serial No. : 835  
Frequency : 835 MHz  
Calibration Date : 05-Aug-2004  
Temperature : 23 °C  
Ambient Temp. : 24 °C  
Humidity : 48 RH%  
Epsilon : 56.44 F/m  
Sigma : 0.93 S/m  
Density : 1000 kg/cu. m

### Probe Data

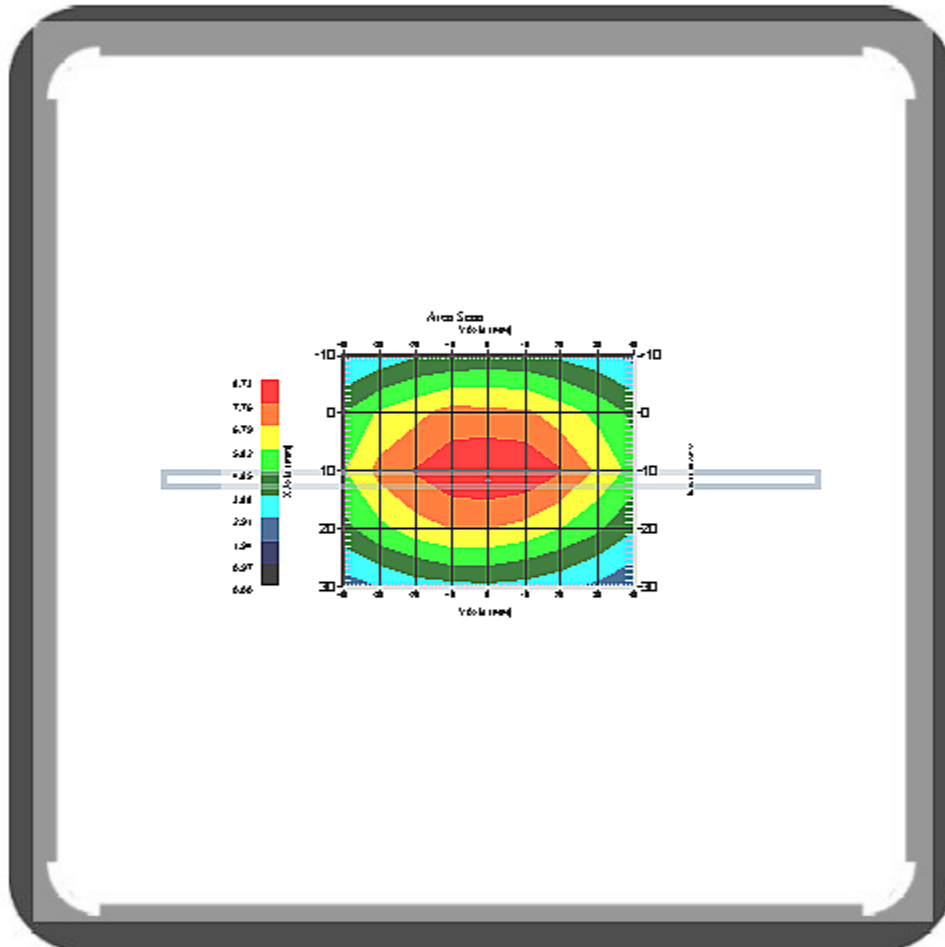
Name : RFEL 217  
Model : E020  
Type : E-Field Triangle  
Serial No. : 217  
Calibration Date : 18-Jun-2004  
Frequency : 835 MHz  
Duty Cycle Factor : 1  
Conversion Factor : 6.1  
Probe Sensitivity : 1.20 1.20 1.20  $\mu\text{V}/(\text{V}/\text{sq. m})$   
Compression Point : 95  
Offset : 1.56

Measurement Data

Crest Factor : 1  
Scan Type : Complete  
Set-up Date : 05-Aug-2004  
Set-up Time : 8:11:19 AM

Other Data

DUT Position : Touch  
Separation : 0  
Channel : Mid - 835



1 gram SAR value : 8.66 W/kg  
10 gram SAR value : 5.92 W/kg  
Area Scan Peak SAR : 8.72  
Zoom Scan Peak SAR : 13.50

## Appendix B – SAR Test Data Plots

## SAR Test Report

Operator : Jay  
Validation Date : 05-Aug-2004  
Measurement Date : 05-Aug-2004  
Starting Time : 05-Aug-2004 10:26:24 AM  
End Time : 05-Aug-2004 10:42:14 AM  
Scanning Time : 950 secs

### Product Data

Device Name : Vitelcom  
Serial No. : 43  
Type : Std Form Cell Phone  
Model : TSM1  
Frequency : 835.00 MHz  
Max. Transmit Pwr : 0.275 W  
Drift Time : 0 min(s)  
Length : 103  
Width : 45  
Depth : 20  
Antenna Type : Internal  
Power Drift-Start : 1.09  
Power Drift-Finish: 1.00  
Power Drift : 0.09

### Phantom Data

Name : APREL-SAM Right Ear  
Type : SAM-Right  
Size : 280 x 280 x 280  
Serial No. : System Default  
Location : Right  
Description : Phone

### Tissue Data

Type : Head  
Serial No. : 835  
Frequency : 835 MHz  
Calibration Date : 05-Aug-2004  
Temperature : 23 °C  
Ambient Temp. : 24 °C  
Humidity : 50 RH%  
Epsilon : 43.01 F/m  
Sigma : 0.86 S/m  
Density : 1000 kg/cu. m

### Probe Data

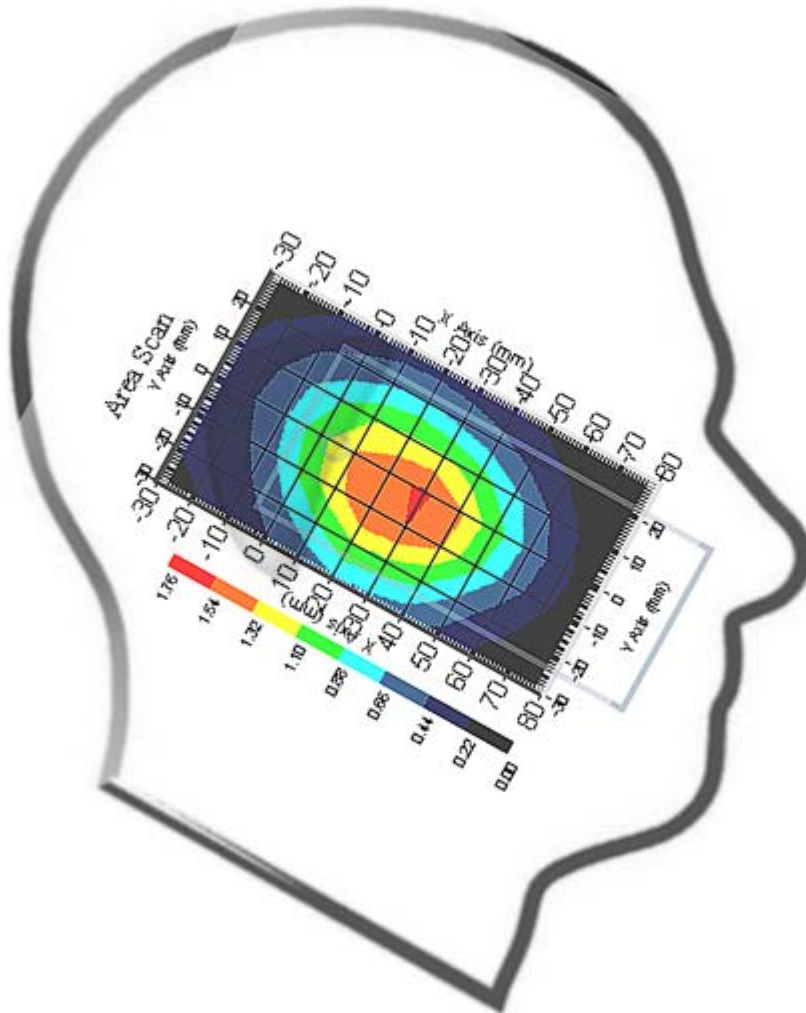
Name : RFEL 217  
Model : E020  
Type : E-Field Triangle  
Serial No. : 217  
Calibration Date : 18-Jun-2004  
Frequency : 835 MHz  
Duty Cycle Factor: 1  
Conversion Factor: 6  
Probe Sensitivity: 1.20 1.20 1.20  $\mu\text{V}/(\text{V}/\text{sq. m})$   
Compression Point: 95  
Offset : 1.56

Measurement Data

Crest Factor : 1  
Scan Type : Complete  
Set-up Date : 05-Aug-2004  
Set-up Time : 8:49:54 AM

Other Data

DUT Position : Touch  
Separation : 0  
Channel : Low - 1013



1 gram SAR value : 1.51 W/kg  
10 gram SAR value : 1.03 W/kg  
Area Scan Peak SAR : 1.57  
Zoom Scan Peak SAR : 2.25



## SAR Test Report

Operator : Jay  
Validation Date : 05-Aug-2004  
Measurement Date : 05-Aug-2004  
Starting Time : 05-Aug-2004 09:58:44 AM  
End Time : 05-Aug-2004 10:14:24 AM  
Scanning Time : 940 secs

### Product Data

Device Name : Vitelcom  
Serial No. : 43  
Type : Std Form Cell Phone  
Model : TSM1  
Frequency : 835.00 MHz  
Max. Transmit Pwr : 0.31 W  
Drift Time : 0 min(s)  
Length : 103  
Width : 45  
Depth : 20  
Antenna Type : Internal  
Power Drift-Start : 0.61  
Power Drift-Finish : 0.52  
Power Drift : 0.09

### Phantom Data

Name : APREL-SAM Right Ear  
Type : SAM-Right  
Size : 280 x 280 x 280  
Serial No. : System Default  
Location : Right  
Description : Phone

### Tissue Data

Type : Head  
Serial No. : 835  
Frequency : 835 MHz  
Calibration Date : 05-Aug-2004  
Temperature : 23 °C  
Ambient Temp. : 24 °C  
Humidity : 50 RH%  
Epsilon : 43.01 F/m  
Sigma : 0.86 S/m  
Density : 1000 kg/cu. m

### Probe Data

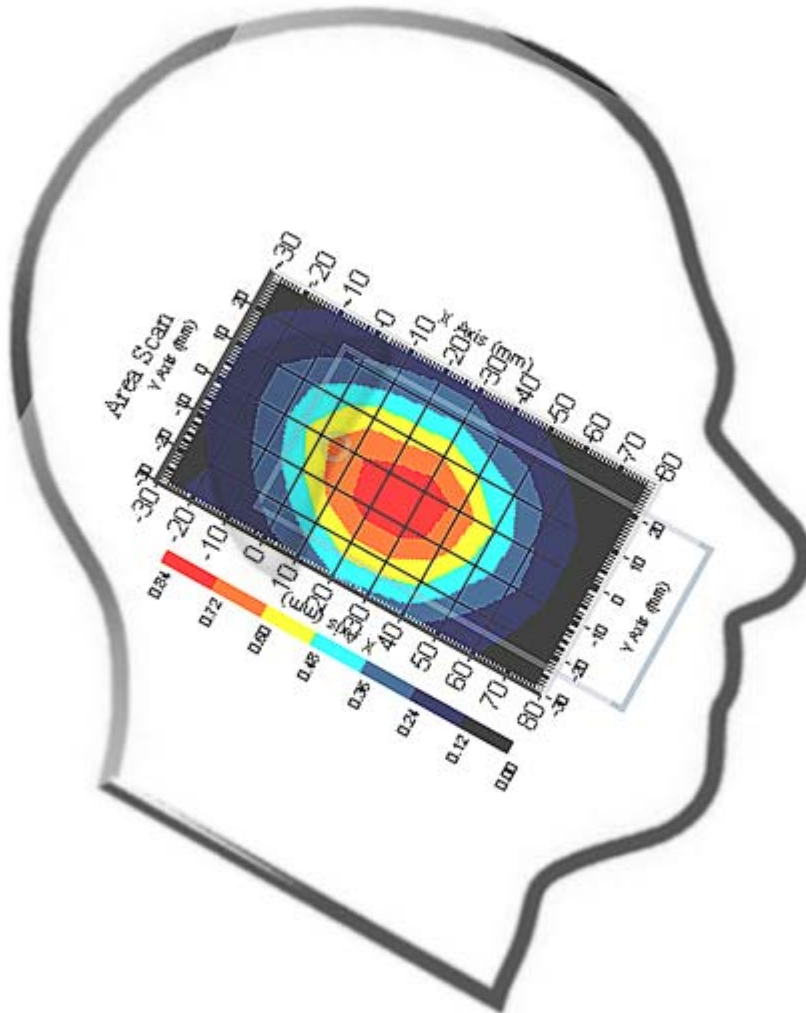
Name : RFEL 217  
Model : E020  
Type : E-Field Triangle  
Serial No. : 217  
Calibration Date : 18-Jun-2004  
Frequency : 835 MHz  
Duty Cycle Factor : 1  
Conversion Factor : 6  
Probe Sensitivity : 1.20 1.20 1.20  $\mu\text{V}/(\text{V}/\text{sq. m})$   
Compression Point : 95  
Offset : 1.56

Measurement Data

Crest Factor : 1  
Scan Type : Complete  
Set-up Date : 05-Aug-2004  
Set-up Time : 8:49:54 AM

Other Data

DUT Position : Touch  
Separation : 0  
Channel : Mid - 384



1 gram SAR value : 0.71 W/kg  
10 gram SAR value : 0.47 W/kg  
Area Scan Peak SAR : 0.81  
Zoom Scan Peak SAR : 1.27

## SAR Test Report

Operator : Jay  
Validation Date : 05-Aug-2004  
Measurement Date : 05-Aug-2004  
Starting Time : 05-Aug-2004 10:55:17 AM  
End Time : 05-Aug-2004 11:10:56 AM  
Scanning Time : 939 secs

### Product Data

Device Name : Vitelcom  
Serial No. : 43  
Type : Std Form Cell Phone  
Model : TSM1  
Frequency : 835.00 MHz  
Max. Transmit Pwr : 0.31 W  
Drift Time : 0 min(s)  
Length : 103  
Width : 45  
Depth : 20  
Antenna Type : Internal  
Power Drift-Start : 0.93  
Power Drift-Finish : 0.85  
Power Drift : 0.08

### Phantom Data

Name : APREL-SAM Right Ear  
Type : SAM-Right  
Size : 280 x 280 x 280  
Serial No. : System Default  
Location : Right  
Description : Phone

### Tissue Data

Type : Head  
Serial No. : 835  
Frequency : 835 MHz  
Calibration Date : 05-Aug-2004  
Temperature : 23 °C  
Ambient Temp. : 24 °C  
Humidity : 50 RH%  
Epsilon : 43.01 F/m  
Sigma : 0.86 S/m  
Density : 1000 kg/cu. m

### Probe Data

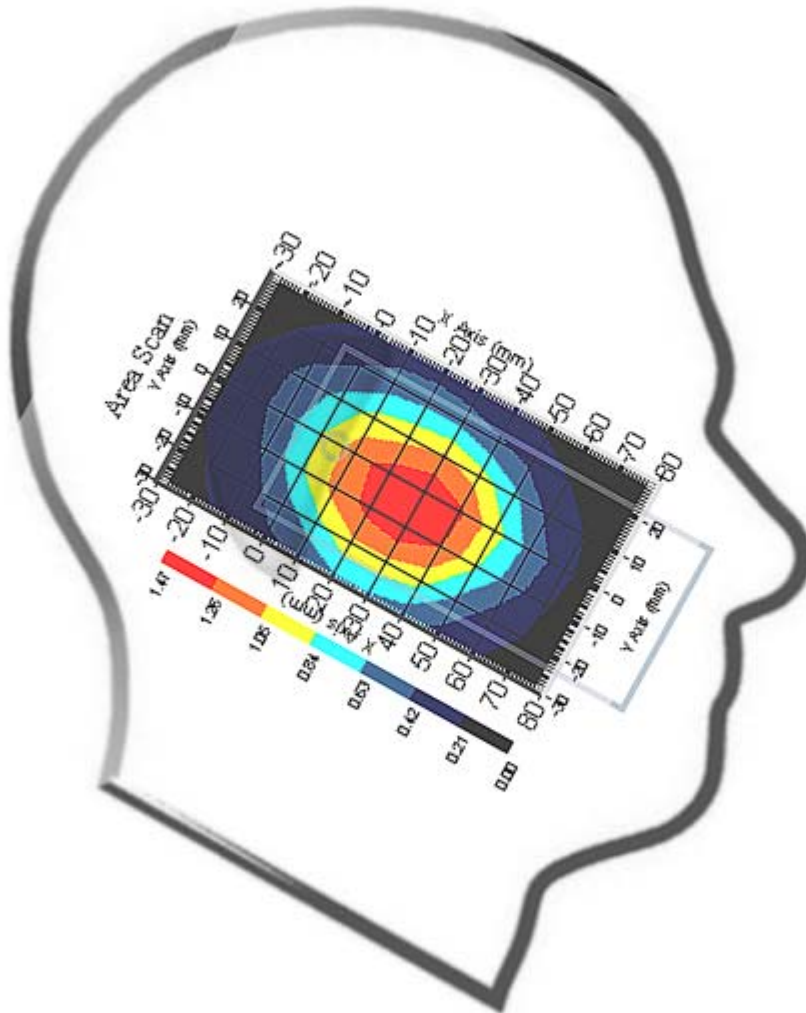
Name : RFEL 217  
Model : E020  
Type : E-Field Triangle  
Serial No. : 217  
Calibration Date : 18-Jun-2004  
Frequency : 835 MHz  
Duty Cycle Factor : 1  
Conversion Factor : 6  
Probe Sensitivity : 1.20 1.20 1.20  $\mu\text{V}/(\text{V}/\text{sq. m})$   
Compression Point : 95  
Offset : 1.56

Measurement Data

Crest Factor : 1  
Scan Type : Complete  
Set-up Date : 05-Aug-2004  
Set-up Time : 8:49:54 AM

Other Data

DUT Position : Touch  
Separation : 0  
Channel : High - 777



1 gram SAR value : 1.38 W/kg  
10 gram SAR value : 0.94 W/kg  
Area Scan Peak SAR : 1.45  
Zoom Scan Peak SAR : 2.14

## SAR Test Report

Operator : Jay  
Validation Date : 05-Aug-2004  
Measurement Date : 05-Aug-2004  
Starting Time : 05-Aug-2004 11:24:36 AM  
End Time : 05-Aug-2004 11:40:22 AM  
Scanning Time : 946 secs

### Product Data

Device Name : Vitelcom  
Serial No. : 43  
Type : Std Form Cell Phone  
Model : TSM1  
Frequency : 835.00 MHz  
Max. Transmit Pwr : 0.275 W  
Drift Time : 0 min(s)  
Length : 103  
Width : 45  
Depth : 20  
Antenna Type : Internal  
Power Drift-Start : 1.24  
Power Drift-Finish : 1.18  
Power Drift : 0.06

### Phantom Data

Name : APREL-SAM Right Ear  
Type : SAM-Right  
Size : 280 x 280 x 280  
Serial No. : System Default  
Location : Right  
Description : Phone

### Tissue Data

Type : Head  
Serial No. : 835  
Frequency : 835 MHz  
Calibration Date : 05-Aug-2004  
Temperature : 23 °C  
Ambient Temp. : 24 °C  
Humidity : 50 RH%  
Epsilon : 43.01 F/m  
Sigma : 0.86 S/m  
Density : 1000 kg/cu. m

### Probe Data

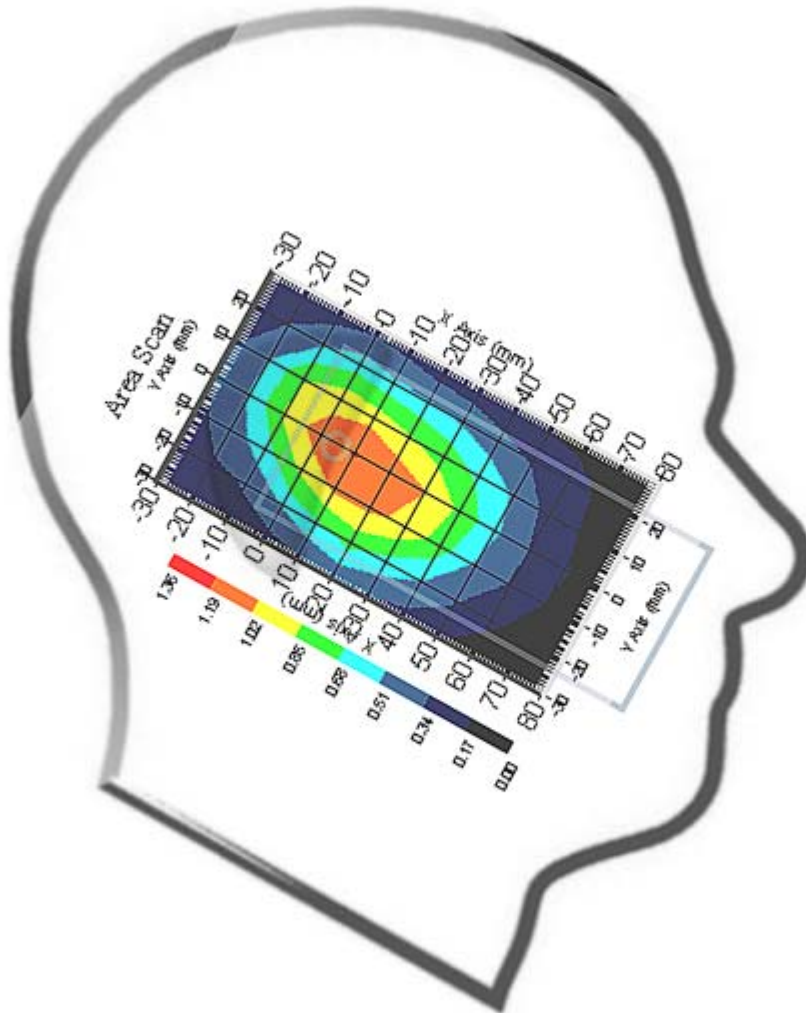
Name : RFEL 217  
Model : E020  
Type : E-Field Triangle  
Serial No. : 217  
Calibration Date : 18-Jun-2004  
Frequency : 835 MHz  
Duty Cycle Factor : 1  
Conversion Factor : 6  
Probe Sensitivity : 1.20 1.20 1.20  $\mu\text{V}/(\text{V}/\text{sq. m})$   
Compression Point : 95  
Offset : 1.56

Measurement Data

Crest Factor : 1  
Scan Type : Complete  
Set-up Date : 05-Aug-2004  
Set-up Time : 8:49:54 AM

Other Data

DUT Position : 15° Tilt  
Separation : 0  
Channel : Low - 1013



1 gram SAR value : 1.16 W/kg  
10 gram SAR value : 0.78 W/kg  
Area Scan Peak SAR : 1.20  
Zoom Scan Peak SAR : 1.94

## SAR Test Report

Operator : Jay  
Validation Date : 05-Aug-2004  
Measurement Date : 05-Aug-2004  
Starting Time : 05-Aug-2004 01:25:41 PM  
End Time : 05-Aug-2004 01:41:23 PM  
Scanning Time : 942 secs

### Product Data

Device Name : Vitelcom  
Serial No. : 43  
Type : Std Form Cell Phone  
Model : TSM1  
Frequency : 835.00 MHz  
Max. Transmit Pwr : 0.31 W  
Drift Time : 0 min(s)  
Length : 103  
Width : 45  
Depth : 20  
Antenna Type : Internal  
Power Drift-Start : 0.52  
Power Drift-Finish : 0.53  
Power Drift : 0.01

### Phantom Data

Name : APREL-SAM Right Ear  
Type : SAM-Right  
Size : 280 x 280 x 280  
Serial No. : System Default  
Location : Right  
Description : Phone

### Tissue Data

Type : Head  
Serial No. : 835  
Frequency : 835 MHz  
Calibration Date : 05-Aug-2004  
Temperature : 23 °C  
Ambient Temp. : 24 °C  
Humidity : 50 RH%  
Epsilon : 43.01 F/m  
Sigma : 0.86 S/m  
Density : 1000 kg/cu. m

### Probe Data

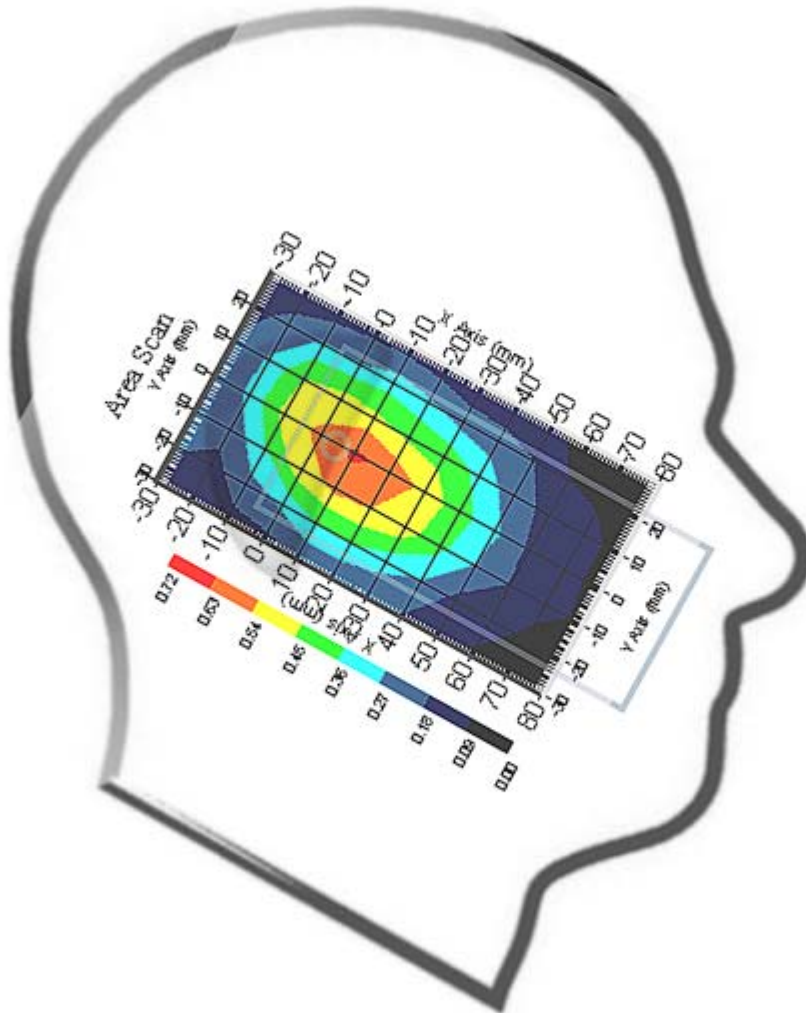
Name : RFEL 217  
Model : E020  
Type : E-Field Triangle  
Serial No. : 217  
Calibration Date : 18-Jun-2004  
Frequency : 835 MHz  
Duty Cycle Factor : 1  
Conversion Factor : 6  
Probe Sensitivity : 1.20 1.20 1.20  $\mu\text{V}/(\text{V}/\text{sq. m})$   
Compression Point : 95  
Offset : 1.56

Measurement Data

Crest Factor : 1  
Scan Type : Complete  
Set-up Date : 05-Aug-2004  
Set-up Time : 8:49:54 AM

Other Data

DUT Position : 15° Tilt  
Separation : 0  
Channel : Mid - 384



1 gram SAR value : 0.56 W/kg  
10 gram SAR value : 0.36 W/kg  
Area Scan Peak SAR : 0.65  
Zoom Scan Peak SAR : 1.08



## SAR Test Report

Operator : Jay  
Validation Date : 05-Aug-2004  
Measurement Date : 05-Aug-2004  
Starting Time : 05-Aug-2004 01:46:42 PM  
End Time : 05-Aug-2004 02:02:23 PM  
Scanning Time : 941 secs

### Product Data

Device Name : Vitelcom  
Serial No. : 43  
Type : Std Form Cell Phone  
Model : TSM1  
Frequency : 835.00 MHz  
Max. Transmit Pwr : 0.31 W  
Drift Time : 0 min(s)  
Length : 103  
Width : 45  
Depth : 20  
Antenna Type : Internal  
Power Drift-Start : 1.19  
Power Drift-Finish : 1.09  
Power Drift : 0.10

### Phantom Data

Name : APREL-SAM Right Ear  
Type : SAM-Right  
Size : 280 x 280 x 280  
Serial No. : System Default  
Location : Right  
Description : Phone

### Tissue Data

Type : Head  
Serial No. : 835  
Frequency : 835 MHz  
Calibration Date : 05-Aug-2004  
Temperature : 23 °C  
Ambient Temp. : 24 °C  
Humidity : 50 RH%  
Epsilon : 43.01 F/m  
Sigma : 0.86 S/m  
Density : 1000 kg/cu. m

### Probe Data

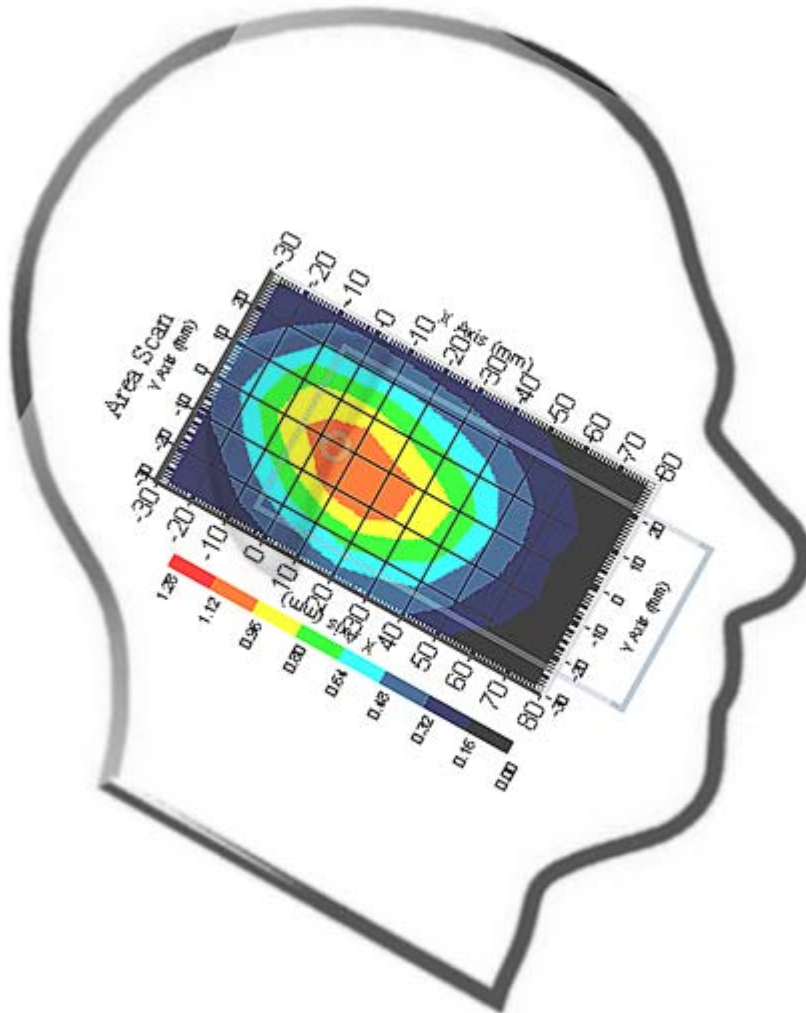
Name : RFEL 217  
Model : E020  
Type : E-Field Triangle  
Serial No. : 217  
Calibration Date : 18-Jun-2004  
Frequency : 835 MHz  
Duty Cycle Factor : 1  
Conversion Factor : 6  
Probe Sensitivity : 1.20 1.20 1.20  $\mu\text{V}/(\text{V}/\text{sq. m})$   
Compression Point : 95  
Offset : 1.56

Measurement Data

Crest Factor : 1  
Scan Type : Complete  
Set-up Date : 05-Aug-2004  
Set-up Time : 8:49:54 AM

Other Data

DUT Position : 15° Tilt  
Separation : 0  
Channel : High - 777



1 gram SAR value : 1.07 W/kg  
10 gram SAR value : 0.70 W/kg  
Area Scan Peak SAR : 1.12  
Zoom Scan Peak SAR : 1.84

## SAR Test Report

Operator : Jay  
Validation Date : 05-Aug-2004  
Measurement Date : 05-Aug-2004  
Starting Time : 05-Aug-2004 02:12:22 PM  
End Time : 05-Aug-2004 02:28:05 PM  
Scanning Time : 943 secs

### Product Data

Device Name : Vitelcom  
Serial No. : 43  
Type : Std Form Cell Phone  
Model : TSM1  
Frequency : 835.00 MHz  
Max. Transmit Pwr : 0.275 W  
Drift Time : 0 min(s)  
Length : 103  
Width : 45  
Depth : 20  
Antenna Type : Internal  
Power Drift-Start : 0.89  
Power Drift-Finish : 0.95  
Power Drift : 0.06

### Phantom Data

Name : APREL-SAM Left Ear  
Type : SAM-Left  
Size : 280 x 280 x 280  
Serial No. : System Default  
Location : Left  
Description : Left

### Tissue Data

Type : Head  
Serial No. : 835  
Frequency : 835 MHz  
Calibration Date : 05-Aug-2004  
Temperature : 23 °C  
Ambient Temp. : 24 °C  
Humidity : 50 RH%  
Epsilon : 43.01 F/m  
Sigma : 0.86 S/m  
Density : 1000 kg/cu. m

### Probe Data

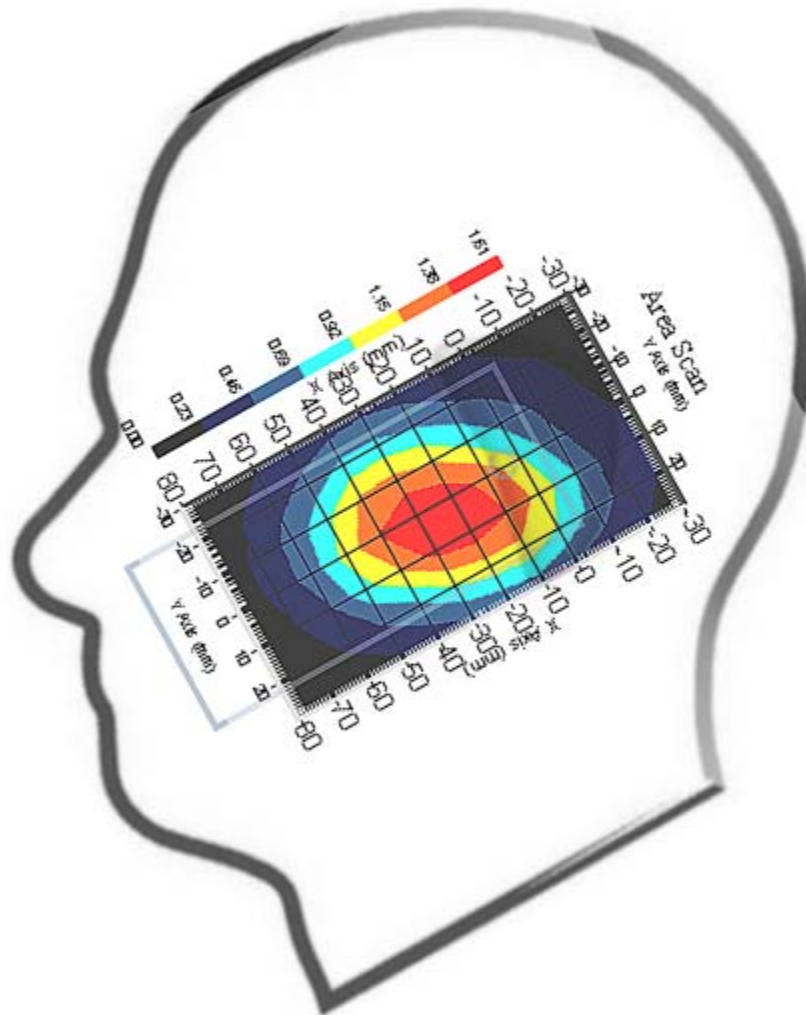
Name : RFEL 217  
Model : E020  
Type : E-Field Triangle  
Serial No. : 217  
Calibration Date : 18-Jun-2004  
Frequency : 835 MHz  
Duty Cycle Factor : 1  
Conversion Factor : 6  
Probe Sensitivity : 1.20 1.20 1.20  $\mu\text{V}/(\text{V}/\text{sq. m})$   
Compression Point : 95  
Offset : 1.56

Measurement Data

Crest Factor : 1  
Scan Type : Complete  
Set-up Date : 05-Aug-2004  
Set-up Time : 8:49:54 AM

Other Data

DUT Position : Touch  
Separation : 0  
Channel : Low - 1013



1 gram SAR value : 1.58 W/kg  
10 gram SAR value : 1.06 W/kg  
Area Scan Peak SAR : 1.58  
Zoom Scan Peak SAR : 2.38

## SAR Test Report

Operator : Jay  
Validation Date : 05-Aug-2004  
Measurement Date : 05-Aug-2004  
Starting Time : 05-Aug-2004 02:32:50 PM  
End Time : 05-Aug-2004 02:48:35 PM  
Scanning Time : 945 secs

### Product Data

Device Name : Vitelcom  
Serial No. : 43  
Type : Std Form Cell Phone  
Model : TSM1  
Frequency : 835.00 MHz  
Max. Transmit Pwr : 0.31 W  
Drift Time : 0 min(s)  
Length : 103  
Width : 45  
Depth : 20  
Antenna Type : Internal  
Power Drift-Start : 0.59  
Power Drift-Finish: 0.56  
Power Drift : 0.03

### Phantom Data

Name : APREL-SAM Left Ear  
Type : SAM-Left  
Size : 280 x 280 x 280  
Serial No. : System Default  
Location : Left  
Description : Left

### Tissue Data

Type : Head  
Serial No. : 835  
Frequency : 835 MHz  
Calibration Date : 05-Aug-2004  
Temperature : 23 °C  
Ambient Temp. : 24 °C  
Humidity : 50 RH%  
Epsilon : 43.01 F/m  
Sigma : 0.86 S/m  
Density : 1000 kg/cu. m

### Probe Data

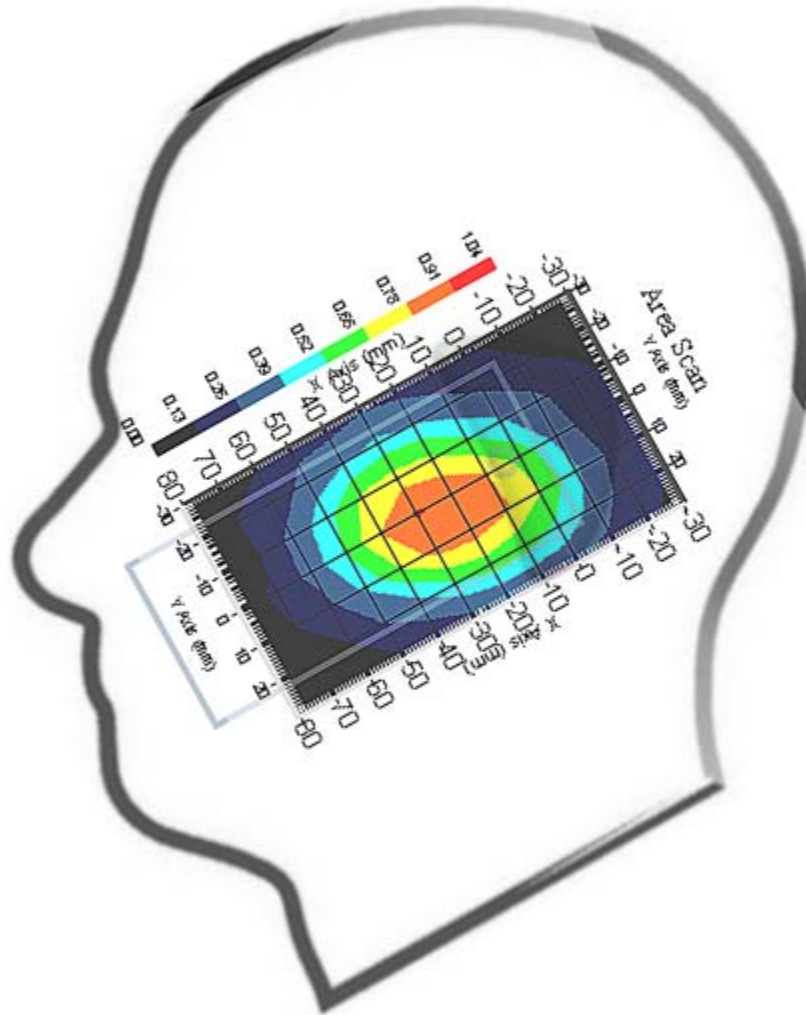
Name : RFEL 217  
Model : E020  
Type : E-Field Triangle  
Serial No. : 217  
Calibration Date : 18-Jun-2004  
Frequency : 835 MHz  
Duty Cycle Factor: 1  
Conversion Factor: 6  
Probe Sensitivity: 1.20 1.20 1.20  $\mu\text{V}/(\text{V}/\text{sq. m})$   
Compression Point: 95  
Offset : 1.56

Measurement Data

Crest Factor : 1  
Scan Type : Complete  
Set-up Date : 05-Aug-2004  
Set-up Time : 8:49:54 AM

Other Data

DUT Position : Touch  
Separation : 0  
Channel : Mid - 384



1 gram SAR value : 0.82 W/kg  
10 gram SAR value : 0.55 W/kg  
Area Scan Peak SAR : 0.92  
Zoom Scan Peak SAR : 1.36

## SAR Test Report

Operator : Jay  
Validation Date : 05-Aug-2004  
Measurement Date : 05-Aug-2004  
Starting Time : 05-Aug-2004 02:51:05 PM  
End Time : 05-Aug-2004 03:06:48 PM  
Scanning Time : 943 secs

### Product Data

Device Name : Vitelcom  
Serial No. : 43  
Type : Std Form Cell Phone  
Model : TSM1  
Frequency : 835.00 MHz  
Max. Transmit Pwr : 0.31 W  
Drift Time : 0 min(s)  
Length : 103  
Width : 45  
Depth : 20  
Antenna Type : Internal  
Power Drift-Start : 1.14  
Power Drift-Finish : 1.10  
Power Drift : 0.04

### Phantom Data

Name : APREL-SAM Left Ear  
Type : SAM-Left  
Size : 280 x 280 x 280  
Serial No. : System Default  
Location : Left  
Description : Left

### Tissue Data

Type : Head  
Serial No. : 835  
Frequency : 835 MHz  
Calibration Date : 05-Aug-2004  
Temperature : 23 °C  
Ambient Temp. : 24 °C  
Humidity : 50 RH%  
Epsilon : 43.01 F/m  
Sigma : 0.86 S/m  
Density : 1000 kg/cu. m

### Probe Data

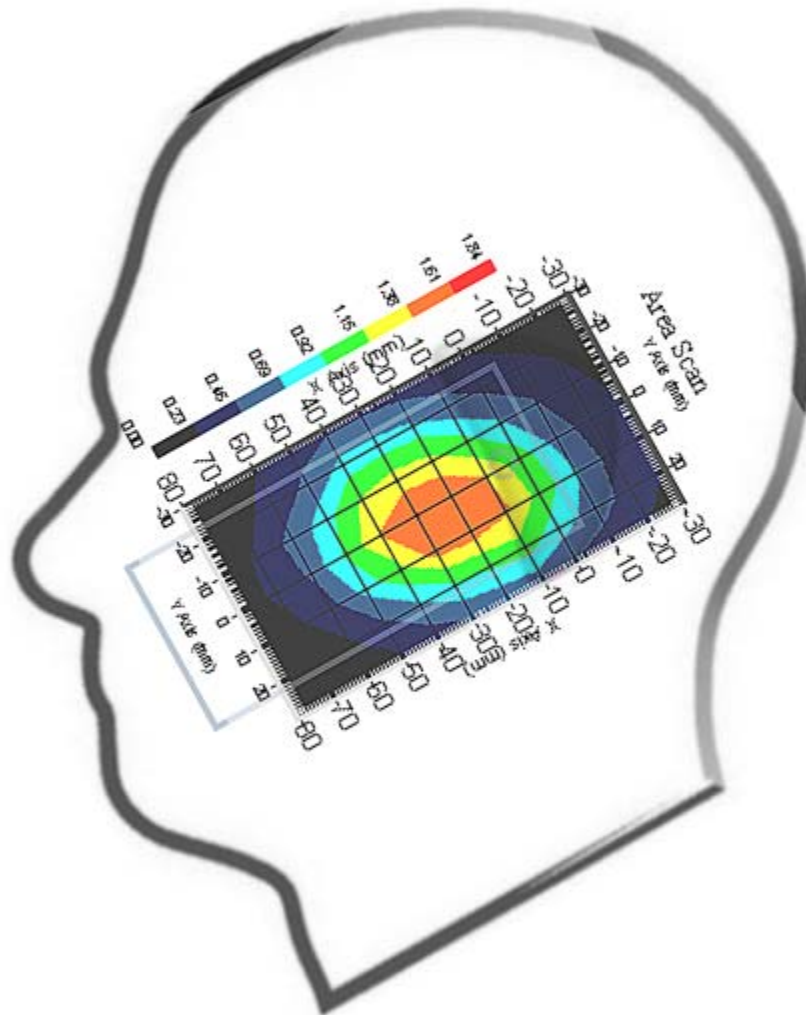
Name : RFEL 217  
Model : E020  
Type : E-Field Triangle  
Serial No. : 217  
Calibration Date : 18-Jun-2004  
Frequency : 835 MHz  
Duty Cycle Factor : 1  
Conversion Factor : 6  
Probe Sensitivity : 1.20 1.20 1.20  $\mu\text{V}/(\text{V}/\text{sq. m})$   
Compression Point : 95  
Offset : 1.56

Measurement Data

Crest Factor : 1  
Scan Type : Complete  
Set-up Date : 05-Aug-2004  
Set-up Time : 8:49:54 AM

Other Data

DUT Position : Touch  
Separation : 0  
Channel : High - 777



1 gram SAR value : 1.53 W/kg  
10 gram SAR value : 1.02 W/kg  
Area Scan Peak SAR : 1.62  
Zoom Scan Peak SAR : 2.42



## SAR Test Report

Operator : Jay  
Validation Date : 05-Aug-2004  
Measurement Date : 05-Aug-2004  
Starting Time : 05-Aug-2004 03:11:44 PM  
End Time : 05-Aug-2004 03:27:25 PM  
Scanning Time : 941 secs

### Product Data

Device Name : Vitelcom  
Serial No. : 43  
Type : Std Form Cell Phone  
Model : TSM1  
Frequency : 835.00 MHz  
Max. Transmit Pwr : 0.275 W  
Drift Time : 0 min(s)  
Length : 103  
Width : 45  
Depth : 20  
Antenna Type : Internal  
Power Drift-Start : 1.04  
Power Drift-Finish: 0.97  
Power Drift : 0.07

### Phantom Data

Name : APREL-SAM Left Ear  
Type : SAM-Left  
Size : 280 x 280 x 280  
Serial No. : System Default  
Location : Left  
Description : Left

### Tissue Data

Type : Head  
Serial No. : 835  
Frequency : 835 MHz  
Calibration Date : 05-Aug-2004  
Temperature : 23 °C  
Ambient Temp. : 24 °C  
Humidity : 50 RH%  
Epsilon : 43.01 F/m  
Sigma : 0.86 S/m  
Density : 1000 kg/cu. m

### Probe Data

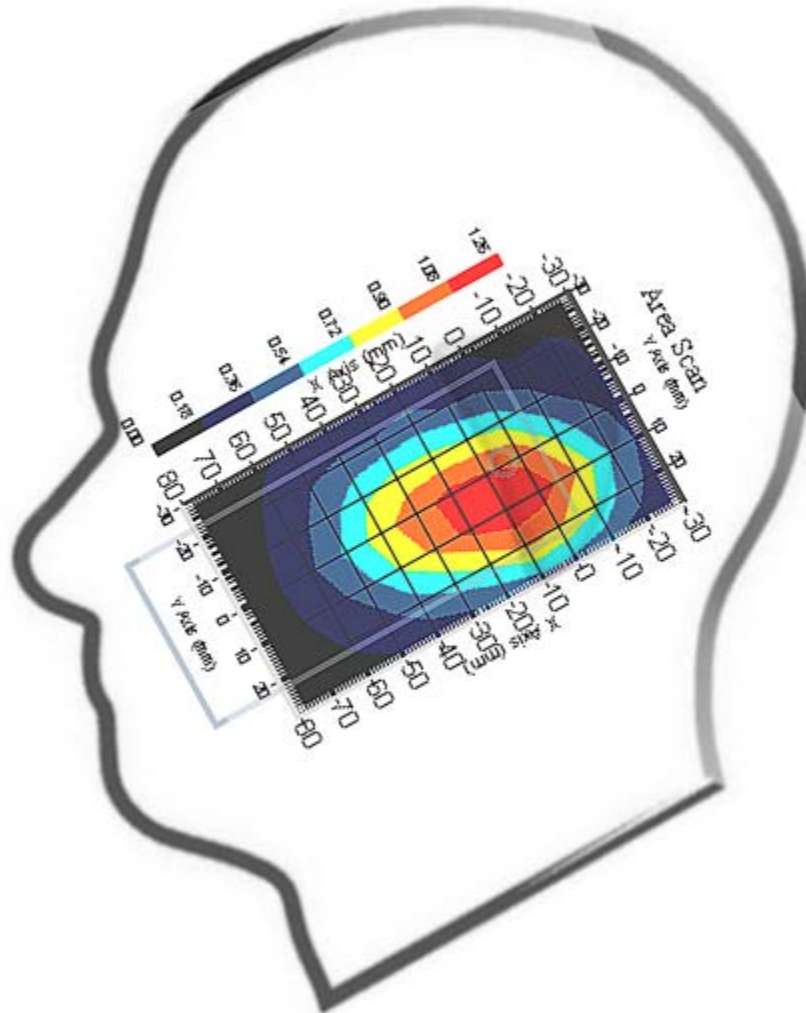
Name : RFEL 217  
Model : E020  
Type : E-Field Triangle  
Serial No. : 217  
Calibration Date : 18-Jun-2004  
Frequency : 835 MHz  
Duty Cycle Factor: 1  
Conversion Factor: 6  
Probe Sensitivity: 1.20 1.20 1.20  $\mu\text{V}/(\text{V}/\text{sq. m})$   
Compression Point: 95  
Offset : 1.56

Measurement Data

Crest Factor : 1  
Scan Type : Complete  
Set-up Date : 05-Aug-2004  
Set-up Time : 8:49:54 AM

Other Data

DUT Position : 15° Tilt  
Separation : 0  
Channel : Low - 1013



1 gram SAR value : 1.14 W/kg  
10 gram SAR value : 0.73 W/kg  
Area Scan Peak SAR : 1.23  
Zoom Scan Peak SAR : 1.86

## SAR Test Report

Operator : Jay  
Validation Date : 05-Aug-2004  
Measurement Date : 05-Aug-2004  
Starting Time : 05-Aug-2004 03:31:09 PM  
End Time : 05-Aug-2004 03:46:58 PM  
Scanning Time : 949 secs

### Product Data

Device Name : Vitelcom  
Serial No. : 43  
Type : Std Form Cell Phone  
Model : TSM1  
Frequency : 835.00 MHz  
Max. Transmit Pwr : 0.31 W  
Drift Time : 0 min(s)  
Length : 103  
Width : 45  
Depth : 20  
Antenna Type : Internal  
Power Drift-Start : 0.57  
Power Drift-Finish : 0.55  
Power Drift : 0.02

### Phantom Data

Name : APREL-SAM Left Ear  
Type : SAM-Left  
Size : 280 x 280 x 280  
Serial No. : System Default  
Location : Left  
Description : Left

### Tissue Data

Type : Head  
Serial No. : 835  
Frequency : 835 MHz  
Calibration Date : 05-Aug-2004  
Temperature : 23 °C  
Ambient Temp. : 24 °C  
Humidity : 50 RH%  
Epsilon : 43.01 F/m  
Sigma : 0.86 S/m  
Density : 1000 kg/cu. m

### Probe Data

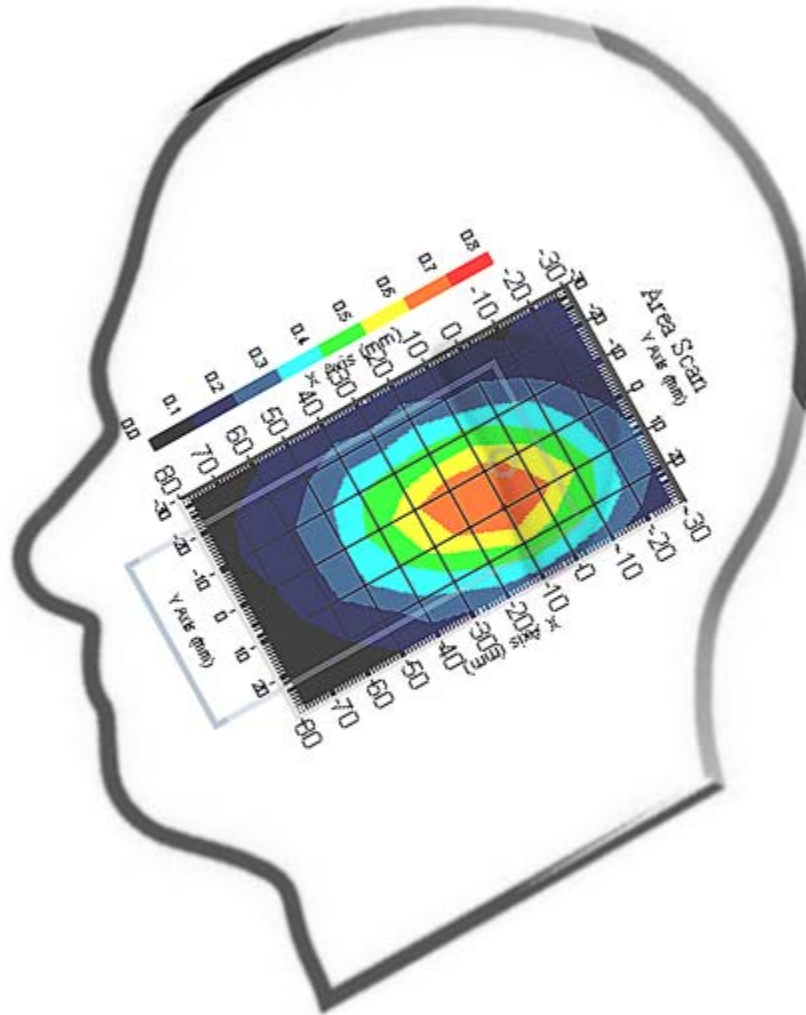
Name : RFEL 217  
Model : E020  
Type : E-Field Triangle  
Serial No. : 217  
Calibration Date : 18-Jun-2004  
Frequency : 835 MHz  
Duty Cycle Factor : 1  
Conversion Factor : 6  
Probe Sensitivity : 1.20 1.20 1.20  $\mu\text{V}/(\text{V}/\text{sq. m})$   
Compression Point : 95  
Offset : 1.56

Measurement Data

Crest Factor : 1  
Scan Type : Complete  
Set-up Date : 05-Aug-2004  
Set-up Time : 8:49:54 AM

Other Data

DUT Position : 15° Tilt  
Separation : 0  
Channel : Mid - 384



1 gram SAR value : 0.64 W/kg  
10 gram SAR value : 0.42 W/kg  
Area Scan Peak SAR : 0.71  
Zoom Scan Peak SAR : 1.20

## SAR Test Report

Operator : Jay  
Validation Date : 05-Aug-2004  
Measurement Date : 05-Aug-2004  
Starting Time : 05-Aug-2004 03:49:22 PM  
End Time : 05-Aug-2004 04:06:40 PM  
Scanning Time : 1038 secs

### Product Data

Device Name : Vitelcom  
Serial No. : 43  
Type : Std Form Cell Phone  
Model : TSM1  
Frequency : 835.00 MHz  
Max. Transmit Pwr : 0.31 W  
Drift Time : 0 min(s)  
Length : 103  
Width : 45  
Depth : 20  
Antenna Type : Internal  
Power Drift-Start : 1.07  
Power Drift-Finish : 1.00  
Power Drift : 0.07

### Phantom Data

Name : APREL-SAM Left Ear  
Type : SAM-Left  
Size : 280 x 280 x 280  
Serial No. : System Default  
Location : Left  
Description : Left

### Tissue Data

Type : Head  
Serial No. : 835  
Frequency : 835 MHz  
Calibration Date : 05-Aug-2004  
Temperature : 23 °C  
Ambient Temp. : 24 °C  
Humidity : 50 RH%  
Epsilon : 43.01 F/m  
Sigma : 0.86 S/m  
Density : 1000 kg/cu. m

### Probe Data

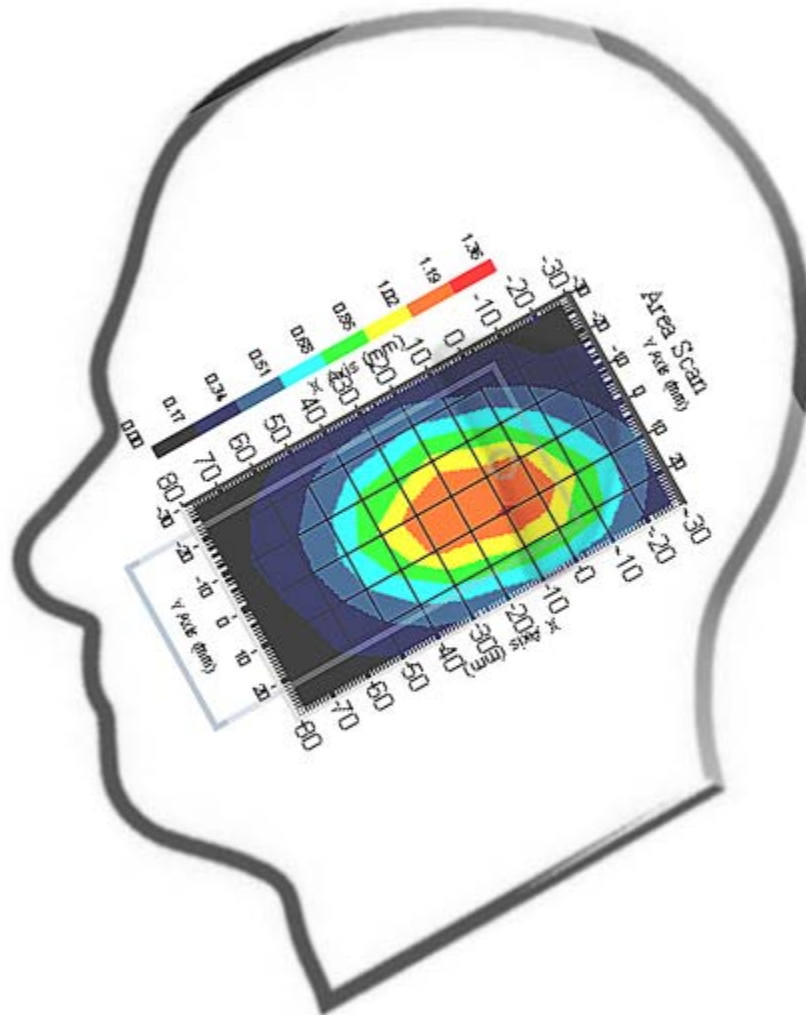
Name : RFEL 217  
Model : E020  
Type : E-Field Triangle  
Serial No. : 217  
Calibration Date : 18-Jun-2004  
Frequency : 835 MHz  
Duty Cycle Factor : 1  
Conversion Factor : 6  
Probe Sensitivity : 1.20 1.20 1.20  $\mu\text{V}/(\text{V}/\text{sq. m})$   
Compression Point : 95  
Offset : 1.56

Measurement Data

Crest Factor : 1  
Scan Type : Complete  
Set-up Date : 05-Aug-2004  
Set-up Time : 8:49:54 AM

Other Data

DUT Position : 15° Tilt  
Separation : 0  
Channel : High - 1013



1 gram SAR value : 1.13 W/kg  
10 gram SAR value : 0.71 W/kg  
Area Scan Peak SAR : 1.21  
Zoom Scan Peak SAR : 2.07

## SAR Test Report

Operator : Jay  
Validation Date : 05-Aug-2004  
Measurement Date : 05-Aug-2004  
Starting Time : 05-Aug-2004 05:00:43 PM  
End Time : 05-Aug-2004 05:16:15 PM  
Scanning Time : 932 secs

### Product Data

Device Name : Vitelcom  
Serial No. : 43  
Type : Std Form Cell Phone  
Model : TSM1  
Frequency : 835.00 MHz  
Max. Transmit Pwr : 0.275 W  
Drift Time : 0 min(s)  
Length : 103  
Width : 45  
Depth : 20  
Antenna Type : Internal  
Power Drift-Start : 0.80  
Power Drift-Finish : 0.78  
Power Drift : 0.02

### Phantom Data

Name : APREL-Uni  
Type : Uni-Phantom  
Size : 280 x 280 x 200  
Serial No. : System Default  
Location : Center  
Description : validation

### Tissue Data

Type : Body  
Serial No. : 835  
Frequency : 835 MHz  
Calibration Date : 05-Aug-2004  
Temperature : 23 °C  
Ambient Temp. : 24 °C  
Humidity : 48 RH%  
Epsilon : 56.44 F/m  
Sigma : 0.93 S/m  
Density : 1000 kg/cu. m

### Probe Data

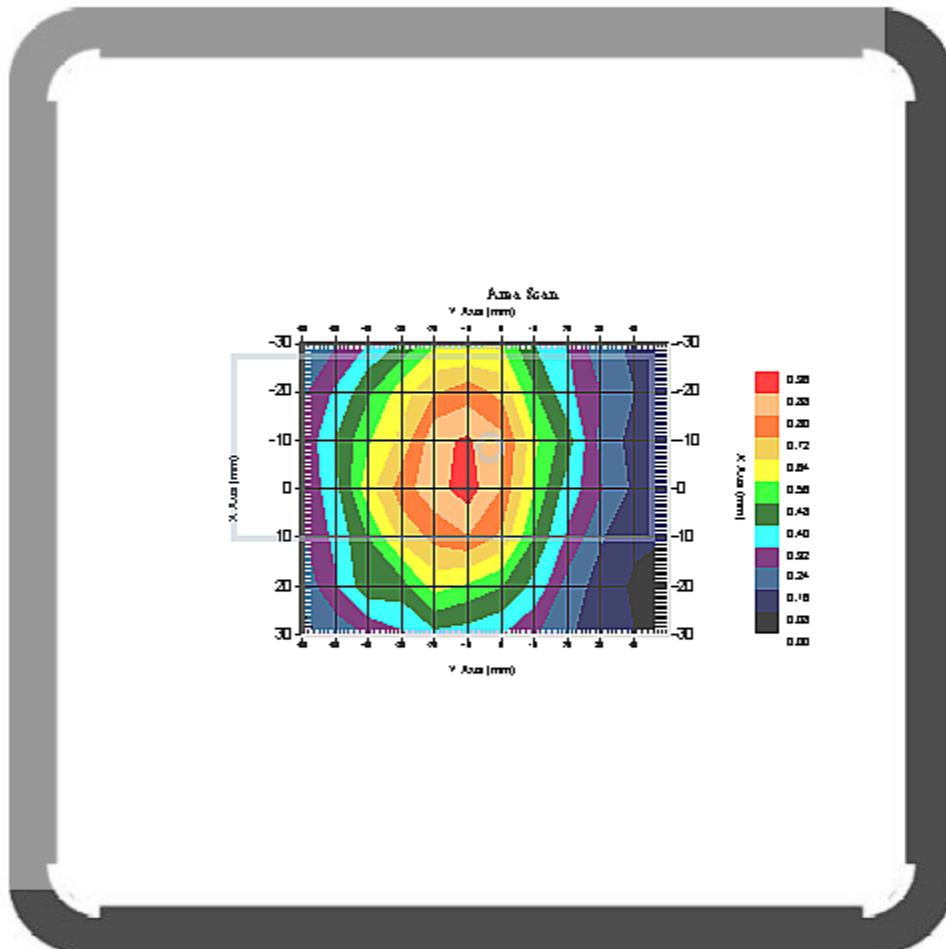
Name : RFEL 217  
Model : E020  
Type : E-Field Triangle  
Serial No. : 217  
Calibration Date : 18-Jun-2004  
Frequency : 835 MHz  
Duty Cycle Factor : 1  
Conversion Factor : 6.1  
Probe Sensitivity : 1.20 1.20 1.20  $\mu\text{V}/(\text{V}/\text{sq. m})$   
Compression Point : 95  
Offset : 1.56

Measurement Data

Crest Factor : 1  
Scan Type : Complete  
Set-up Date : 05-Aug-2004  
Set-up Time : 8:49:54 AM

Other Data

DUT Position : Rotated Left 90°  
Separation : 20 mm  
Channel : Low - 1013



1 gram SAR value : 0.86 W/kg  
10 gram SAR value : 0.59 W/kg  
Area Scan Peak SAR : 0.92  
Zoom Scan Peak SAR : 1.47



## SAR Test Report

Operator : Jay  
Validation Date : 05-Aug-2004  
Measurement Date : 05-Aug-2004  
Starting Time : 05-Aug-2004 05:18:53 PM  
End Time : 05-Aug-2004 05:34:23 PM  
Scanning Time : 930 secs

### Product Data

Device Name : Vitelcom  
Serial No. : 43  
Type : Std Form Cell Phone  
Model : TSM1  
Frequency : 835.00 MHz  
Max. Transmit Pwr : 0.31 W  
Drift Time : 0 min(s)  
Length : 103  
Width : 45  
Depth : 20  
Antenna Type : Internal  
Power Drift-Start : 0.67  
Power Drift-Finish : 0.59  
Power Drift : 0.08

### Phantom Data

Name : APREL-Uni  
Type : Uni-Phantom  
Size : 280 x 280 x 200  
Serial No. : System Default  
Location : Center  
Description : validation

### Tissue Data

Type : Body  
Serial No. : 835  
Frequency : 835 MHz  
Calibration Date : 05-Aug-2004  
Temperature : 23 °C  
Ambient Temp. : 24 °C  
Humidity : 48 RH%  
Epsilon : 56.44 F/m  
Sigma : 0.93 S/m  
Density : 1000 kg/cu. m

### Probe Data

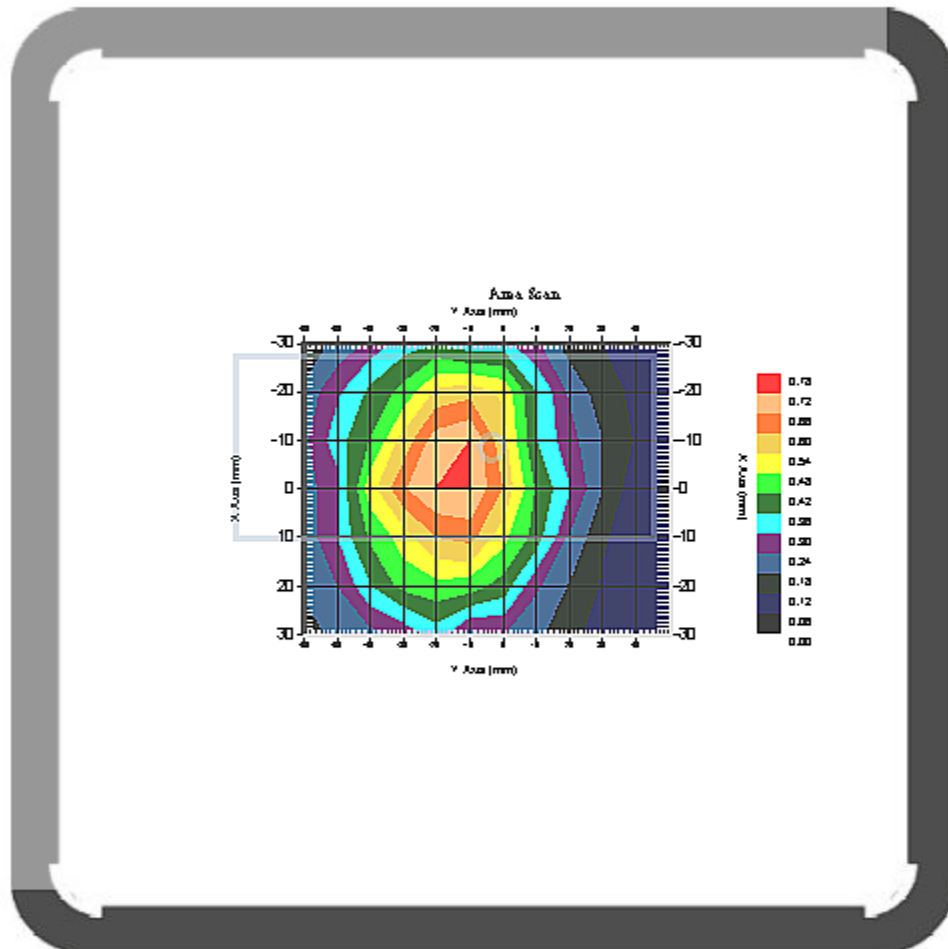
Name : RFEL 217  
Model : E020  
Type : E-Field Triangle  
Serial No. : 217  
Calibration Date : 18-Jun-2004  
Frequency : 835 MHz  
Duty Cycle Factor : 1  
Conversion Factor : 6.1  
Probe Sensitivity : 1.20 1.20 1.20  $\mu\text{V}/(\text{V}/\text{sq. m})$   
Compression Point : 95  
Offset : 1.56

Measurement Data

Crest Factor : 1  
Scan Type : Complete  
Set-up Date : 05-Aug-2004  
Set-up Time : 8:49:54 AM

Other Data

DUT Position : Rotated Left 90°  
Separation : 20 mm  
Channel : Mid - 384



1 gram SAR value : 0.73 W/kg  
10 gram SAR value : 0.50 W/kg  
Area Scan Peak SAR : 0.72  
Zoom Scan Peak SAR : 1.30

## SAR Test Report

Operator : Jay  
Validation Date : 05-Aug-2004  
Measurement Date : 05-Aug-2004  
Starting Time : 05-Aug-2004 05:37:27 PM  
End Time : 05-Aug-2004 05:52:56 PM  
Scanning Time : 929 secs

### Product Data

Device Name : Vitelcom  
Serial No. : 43  
Type : Std Form Cell Phone  
Model : TSM1  
Frequency : 835.00 MHz  
Max. Transmit Pwr : 0.31 W  
Drift Time : 0 min(s)  
Length : 103  
Width : 45  
Depth : 20  
Antenna Type : Internal  
Power Drift-Start : 0.93  
Power Drift-Finish: 0.89  
Power Drift : 0.04

### Phantom Data

Name : APREL-Uni  
Type : Uni-Phantom  
Size : 280 x 280 x 200  
Serial No. : System Default  
Location : Center  
Description : validation

### Tissue Data

Type : Body  
Serial No. : 835  
Frequency : 835 MHz  
Calibration Date : 05-Aug-2004  
Temperature : 23 °C  
Ambient Temp. : 24 °C  
Humidity : 48 RH%  
Epsilon : 56.44 F/m  
Sigma : 0.93 S/m  
Density : 1000 kg/cu. m

### Probe Data

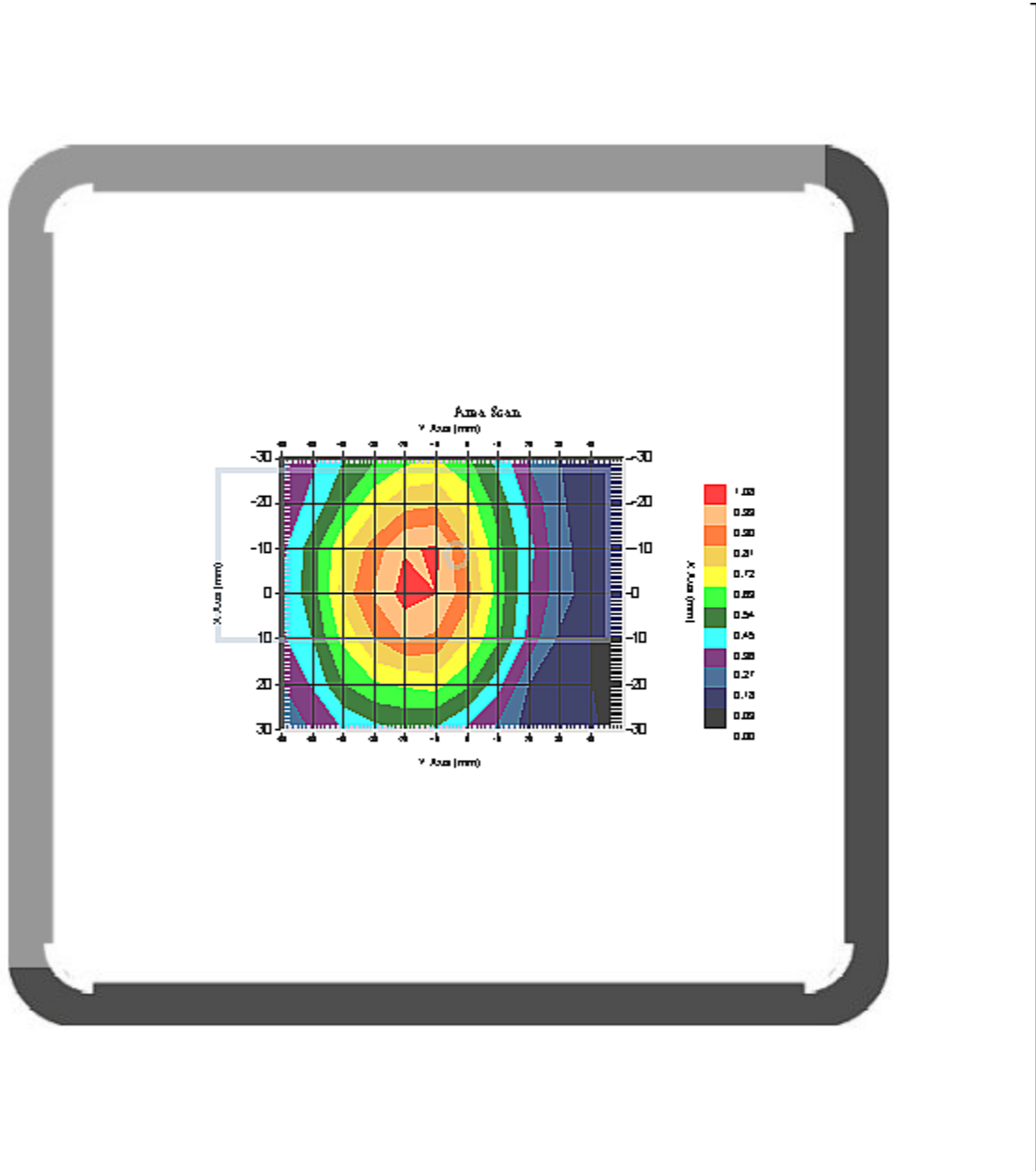
Name : RFEL 217  
Model : E020  
Type : E-Field Triangle  
Serial No. : 217  
Calibration Date : 18-Jun-2004  
Frequency : 835 MHz  
Duty Cycle Factor: 1  
Conversion Factor: 6.1  
Probe Sensitivity: 1.20 1.20 1.20  $\mu\text{V}/(\text{V}/\text{sq. m})$   
Compression Point: 95  
Offset : 1.56

Measurement Data

Crest Factor : 1  
Scan Type : Complete  
Set-up Date : 05-Aug-2004  
Set-up Time : 8:49:54 AM

Other Data

DUT Position : Rotated Left 90°  
Separation : 20 mm  
Channel : High - 777

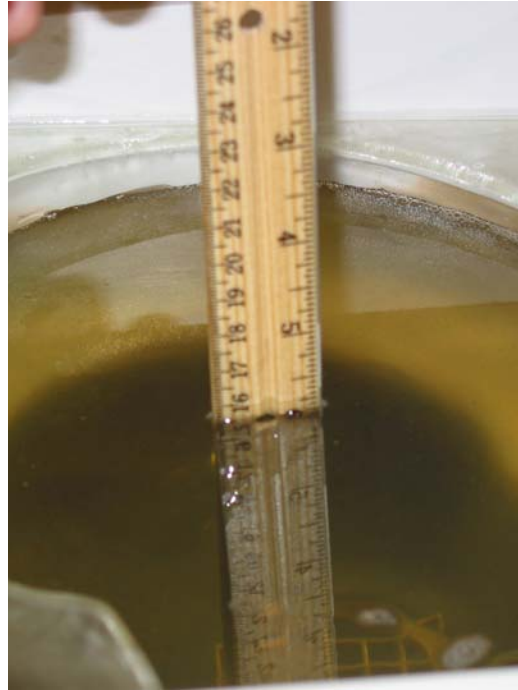


1 gram SAR value : 1.00 W/kg  
10 gram SAR value : 0.70 W/kg  
Area Scan Peak SAR : 1.03  
Zoom Scan Peak SAR : 1.55

## Appendix C – SAR Test Setup Photos



**System Head Configuration**



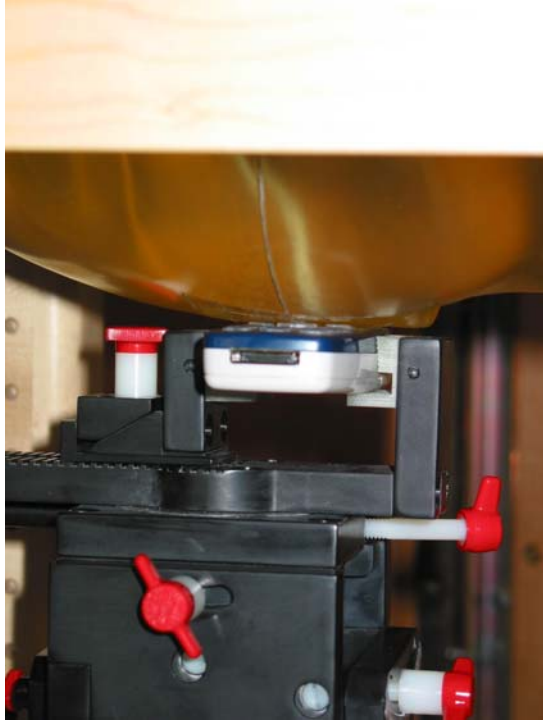
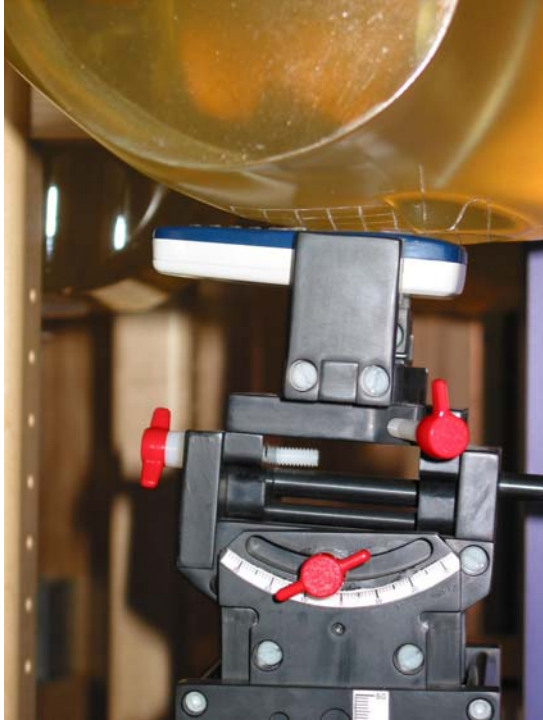
**Right Head Tissue Depth**



**Left Head Tissue Depth**



**Body Tissue Depth**



**Right Head Touch Position**

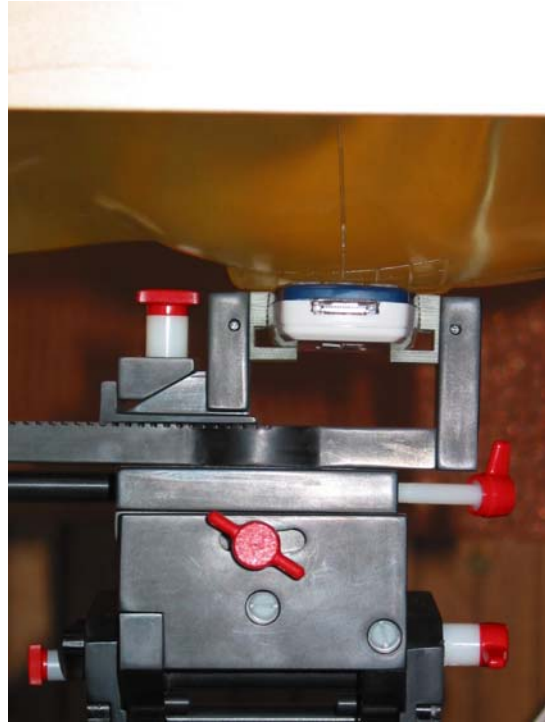


**Right Head Tilt Position**

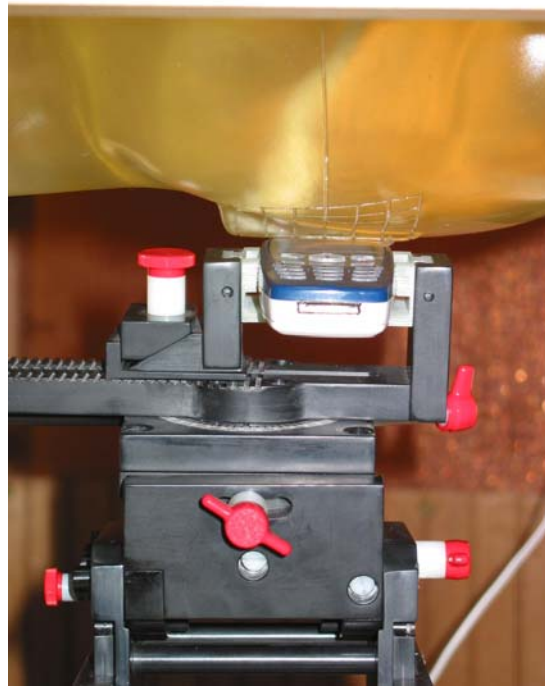


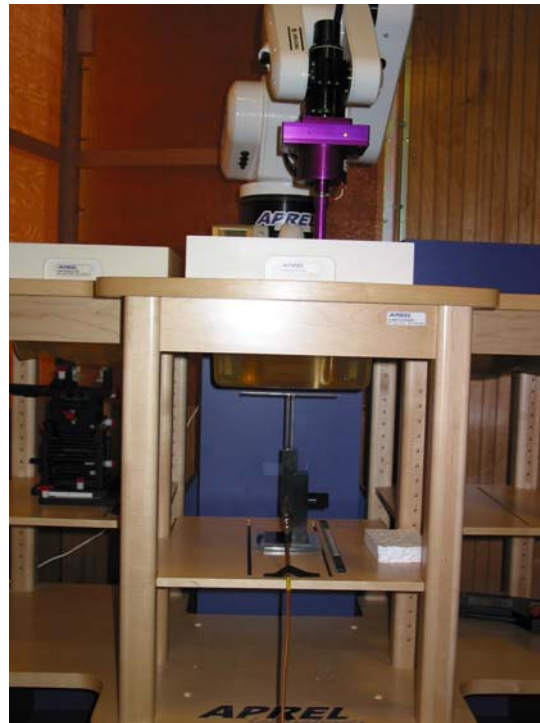


**Left Head Touch Position**

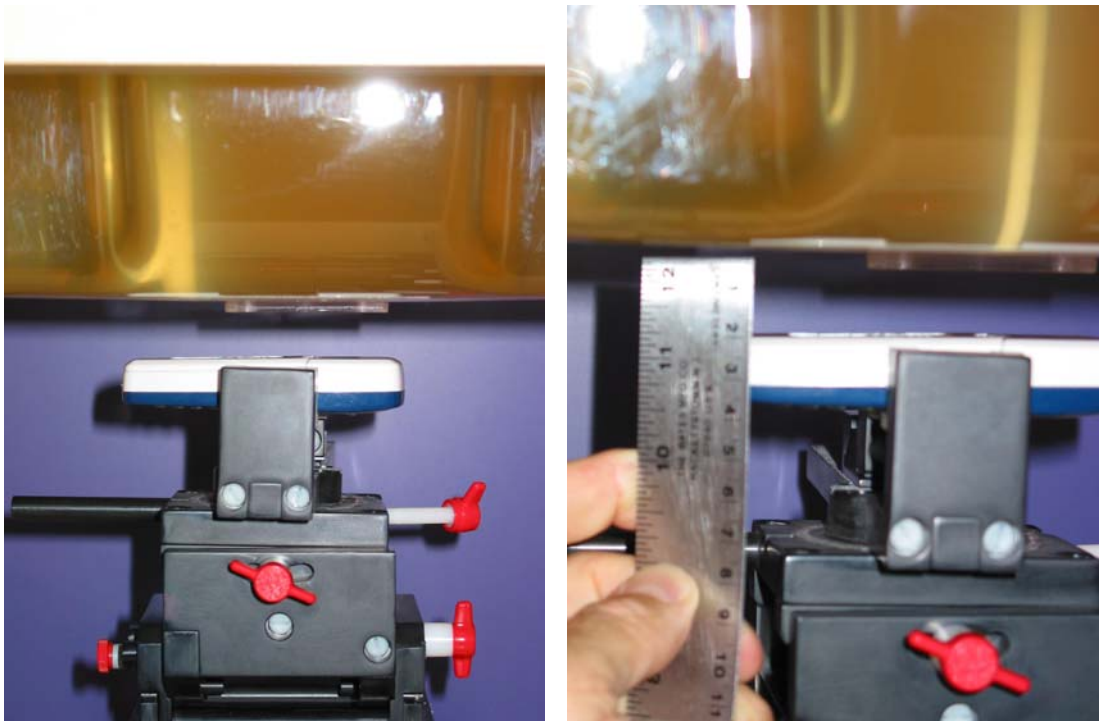


**Left Head Tilt Position**





**System Body Configuration**



**Body Position w/20 mm Separation**



## Appendix D – Probe Calibration Data Sheets

# NCL CALIBRATION LABORATORIES

Calibration File No.: CP-392

Client.: RFEL

## 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 835 MHz

Manufacturer: APREL Laboratories

Model No.: E-020

Serial No.: 217

Calibration Procedure: SSI/DRB-TP-D01-032-E020-V2

Project No: RFEB-ALSAS-10U-4087

Calibrated: 10<sup>th</sup> June 2004

Released on: 11<sup>th</sup> June 2004

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) 820-4161

## **Introduction**

This Calibration Report reproduces the results of the calibration performed in line with the SSI/DRB-TP-D01-032-E020-V2 E-Field Probe Calibration Procedure. The results contained within this report are for APREL E-Field Probe E-020 217.

## **References**

SSI/DRB-TP-D01-032-E020-V2 E-Field Probe 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"  
SSI-TP-011 Tissue Calibration Procedure

## **Conditions**

Probe 217 was a new probe 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

## Calibration Results Summary

<b>Probe Type:</b>	E-Field Probe E-020
<b>Serial Number:</b>	217
<b>Frequency:</b>	835 MHz
<b>Sensor Offset:</b>	1.56 mm
<b>Sensor Length:</b>	2.5 mm
<b>Tip Enclosure:</b>	Ertalyte*
<b>Tip Diameter:</b>	<5 mm
<b>Tip Length:</b>	60 mm
<b>Total Length:</b>	290 mm

\*Resistive to recommended tissue recipes per IEEE-1528

## Sensitivity in Air

<b>Channel X:</b>	$1.2 \mu\text{V}/(\text{V}/\text{m})^2$
<b>Channel Y:</b>	$1.2 \mu\text{V}/(\text{V}/\text{m})^2$
<b>Channel Z:</b>	$1.2 \mu\text{V}/(\text{V}/\text{m})^2$
<b>Diode Compression Point:</b>	95 mV

## **Sensitivity in Head Tissue**

**Frequency:** 835 MHz

**Epsilon:** 42.5 (+/-5%)

**Sigma:** 0.91 (+/-10%)

### **ConvF**

**Channel X:** 6.0

**Channel Y:** 6.0

**Channel Z:** 6.0

Tissue sensitivity values were calculated using the load impedance of the APREL Laboratories Daq-Paq.

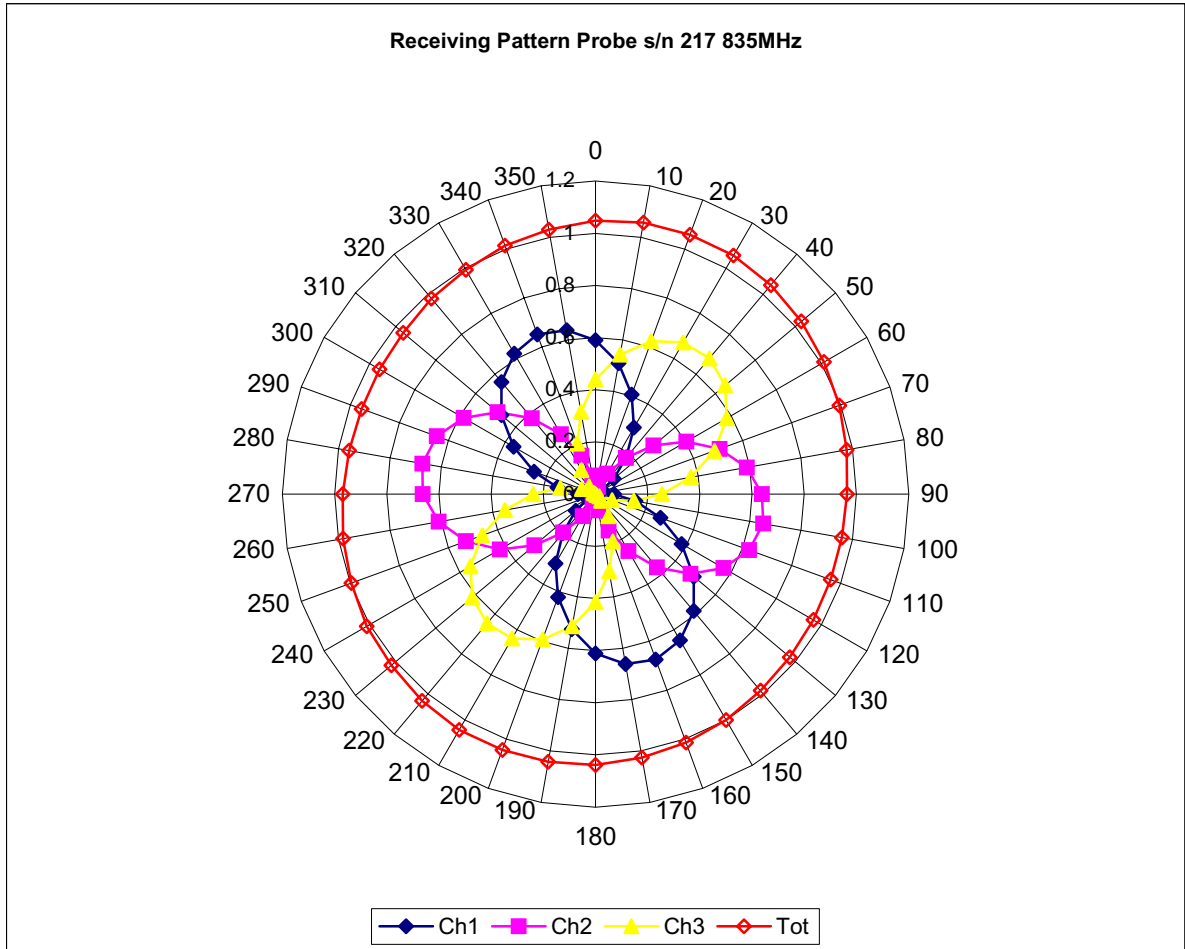
### **Boundary Effect:**

Uncertainty resulting from the boundary effect is less than 2% for the distance between the tip of the probe and the tissue boundary, when less than 2.54mm.

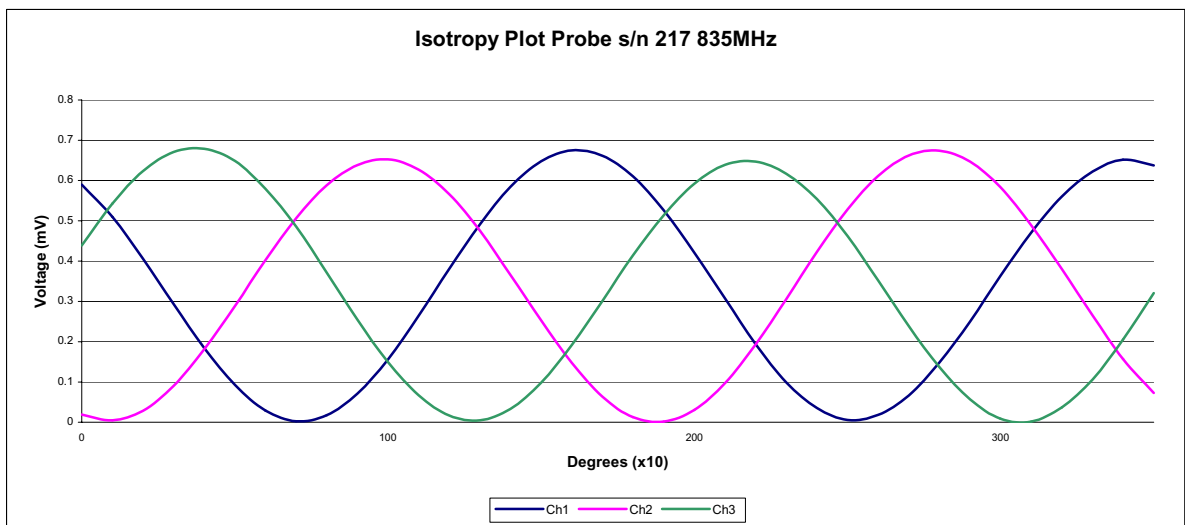
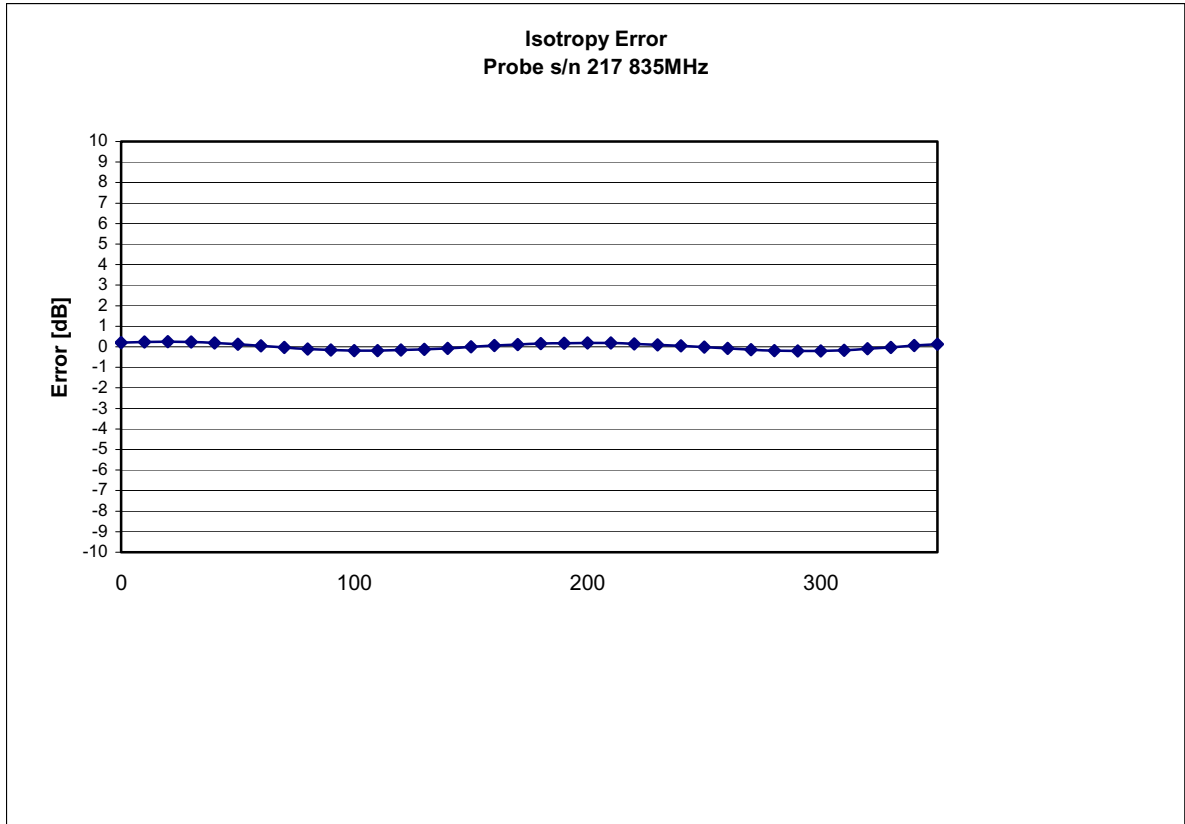
### **Spatial Resolution:**

The measured probe tip diameter is 5 mm (+/- 0.01 mm) and therefore meets the requirements of SSI/DRB-TP-D01-032 for spatial resolution.

### Receiving Pattern 835 MHz (Air)

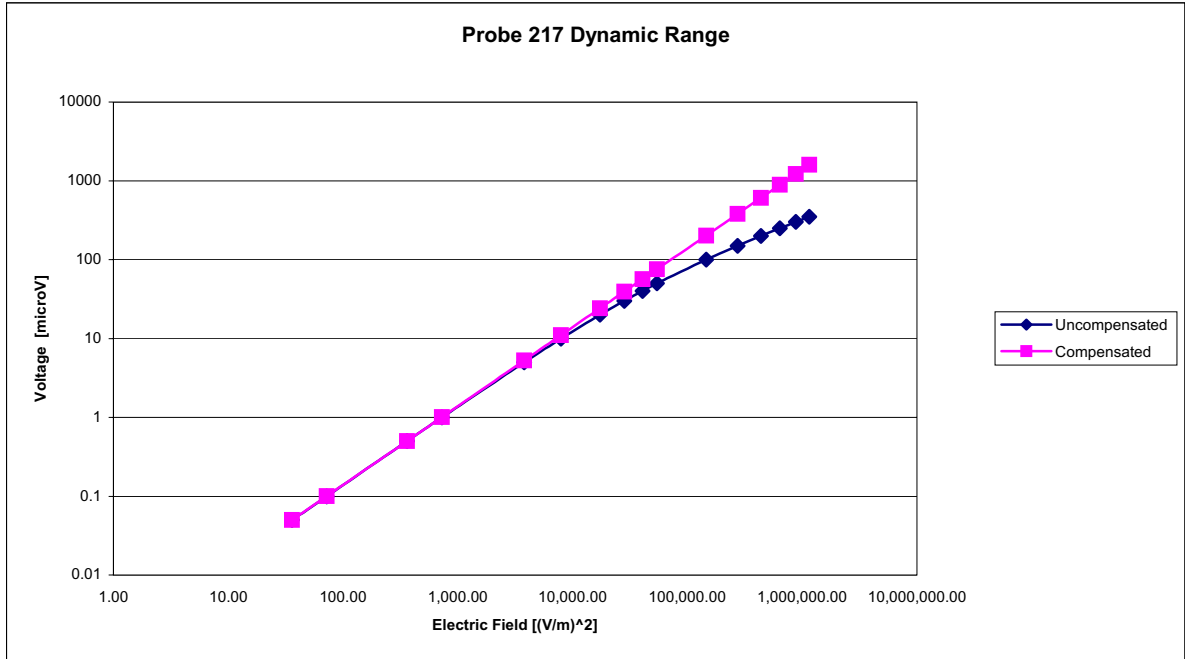


### Isotropy Error 835 MHz (Air)



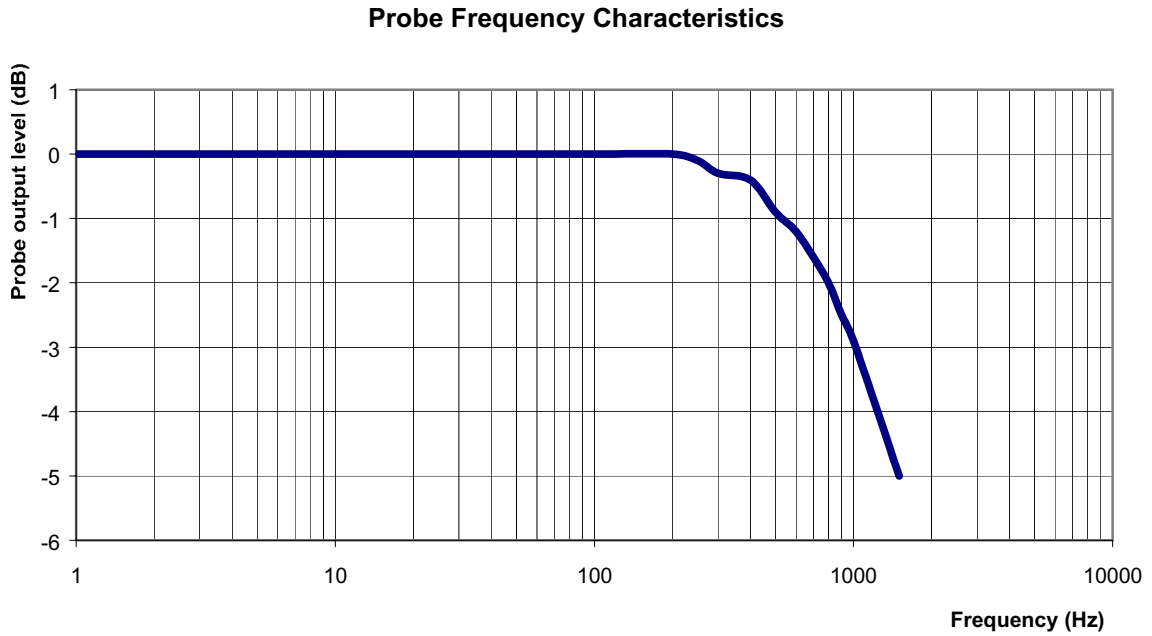
Isotropicity: 0.10 dB

## Dynamic Range





## Video Bandwidth



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

## **Conversion Factor Uncertainty Assessment**

**Frequency:** 835MHz  
**Epsilon:** 42.5 (+/-5%)      **Sigma:** 0.91 S/m (+/-10%)

### **ConvF**

**Channel X:** 6.0      7%(K=2)  
**Channel Y:** 6.0      7%(K=2)  
**Channel Z:** 6.0      7%(K=2)

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

### **Boundary Effect:**

For a distance of 2.4mm the evaluated uncertainty (increase in the probe sensitivity) is less than 2%.

## **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 2004.

# NCL CALIBRATION LABORATORIES

Calibration File No.: CP-396

Client.: RFEL

## 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 835 MHz BODY

Manufacturer: APREL Laboratories

Model No.: E-020

Serial No.: 217

Calibration Procedure: SSI/DRB-TP-D01-032-E020-V2

Project No: RFEB-ALSAS-10U-4087

Calibrated: 10<sup>th</sup> June 2004  
Released on: 11<sup>th</sup> June 2004

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) 820-4161

## **Introduction**

This Calibration Report reproduces the results of the calibration performed in line with the SSI/DRB-TP-D01-032-E020-V2 E-Field Probe Calibration Procedure. The results contained within this report are for APREL E-Field Probe E-020 217.

## **References**

SSI/DRB-TP-D01-032-E020-V2 E-Field Probe 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"  
SSI-TP-011 Tissue Calibration Procedure

## **Conditions**

Probe 217 was a new probe 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

## Calibration Results Summary

<b>Probe Type:</b>	E-Field Probe E-020
<b>Serial Number:</b>	217
<b>Frequency:</b>	835 MHz
<b>Sensor Offset:</b>	1.56 mm
<b>Sensor Length:</b>	2.5 mm
<b>Tip Enclosure:</b>	Ertalyte*
<b>Tip Diameter:</b>	<5 mm
<b>Tip Length:</b>	60 mm
<b>Total Length:</b>	290 mm

\*Resistive to recommended tissue recipes per IEEE-1528

## Sensitivity in Air

<b>Channel X:</b>	$1.2 \mu\text{V}/(\text{V}/\text{m})^2$
<b>Channel Y:</b>	$1.2 \mu\text{V}/(\text{V}/\text{m})^2$
<b>Channel Z:</b>	$1.2 \mu\text{V}/(\text{V}/\text{m})^2$
<b>Diode Compression Point:</b>	95 mV

## **Sensitivity in Body Tissue**

**Frequency:** 835 MHz

**Epsilon:** 55.2 (+/-5%)

**Sigma:** 0.97 (+/-10%)

### **ConvF**

**Channel X:** 6.1

**Channel Y:** 6.1

**Channel Z:** 6.1

Tissue sensitivity values were calculated using the load impedance of the APREL Laboratories Daq-Paq.

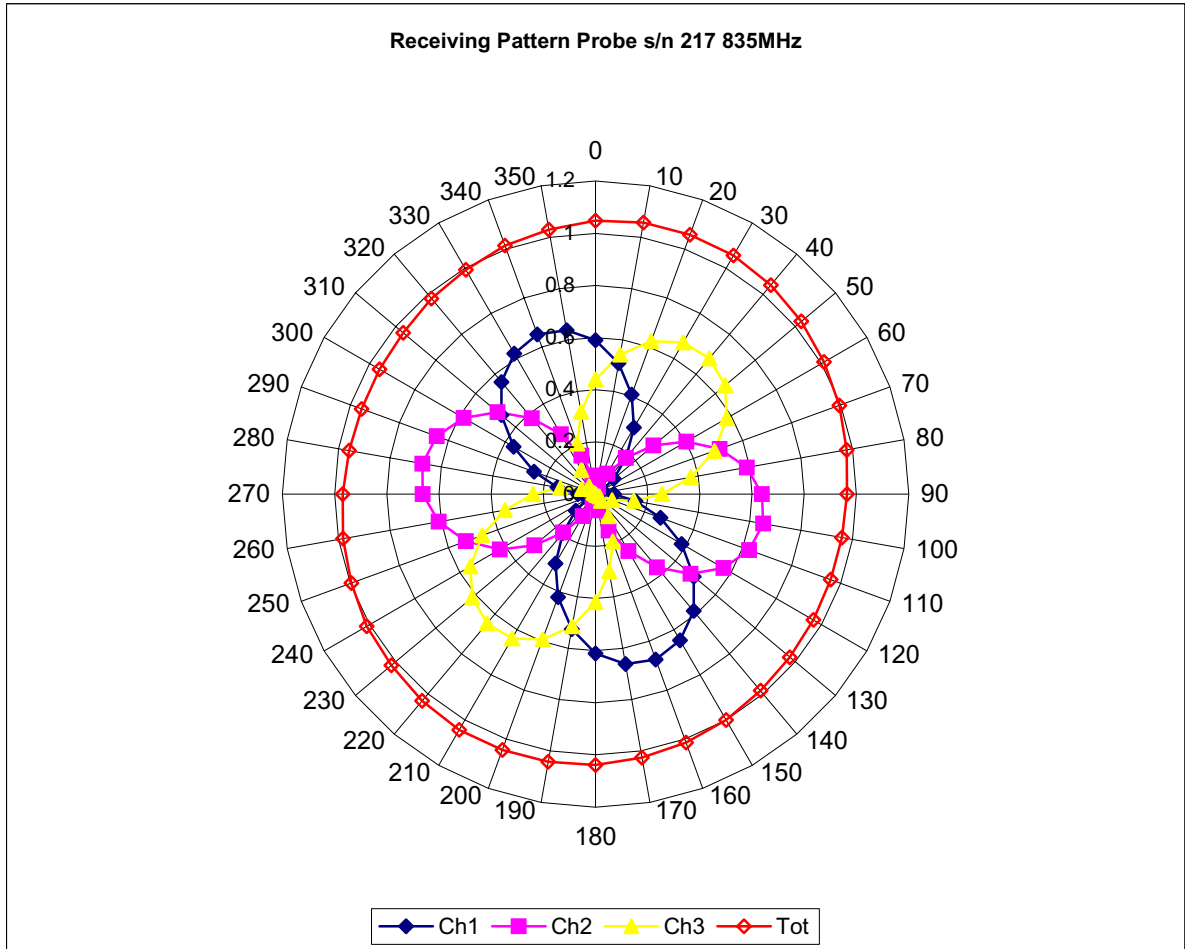
### **Boundary Effect:**

Uncertainty resulting from the boundary effect is less than 2% for the distance between the tip of the probe and the tissue boundary, when less than 2.54mm.

### **Spatial Resolution:**

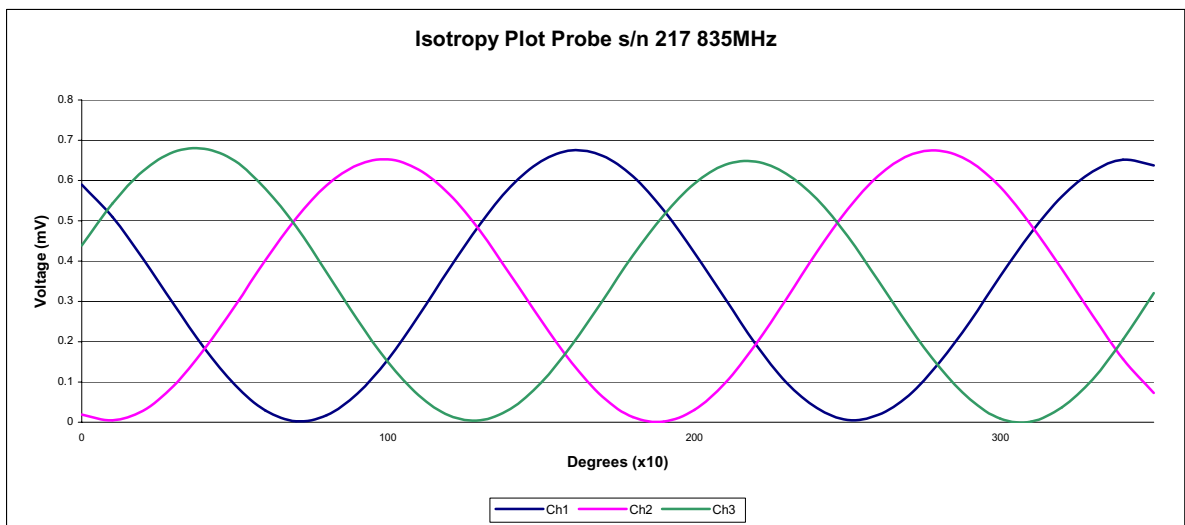
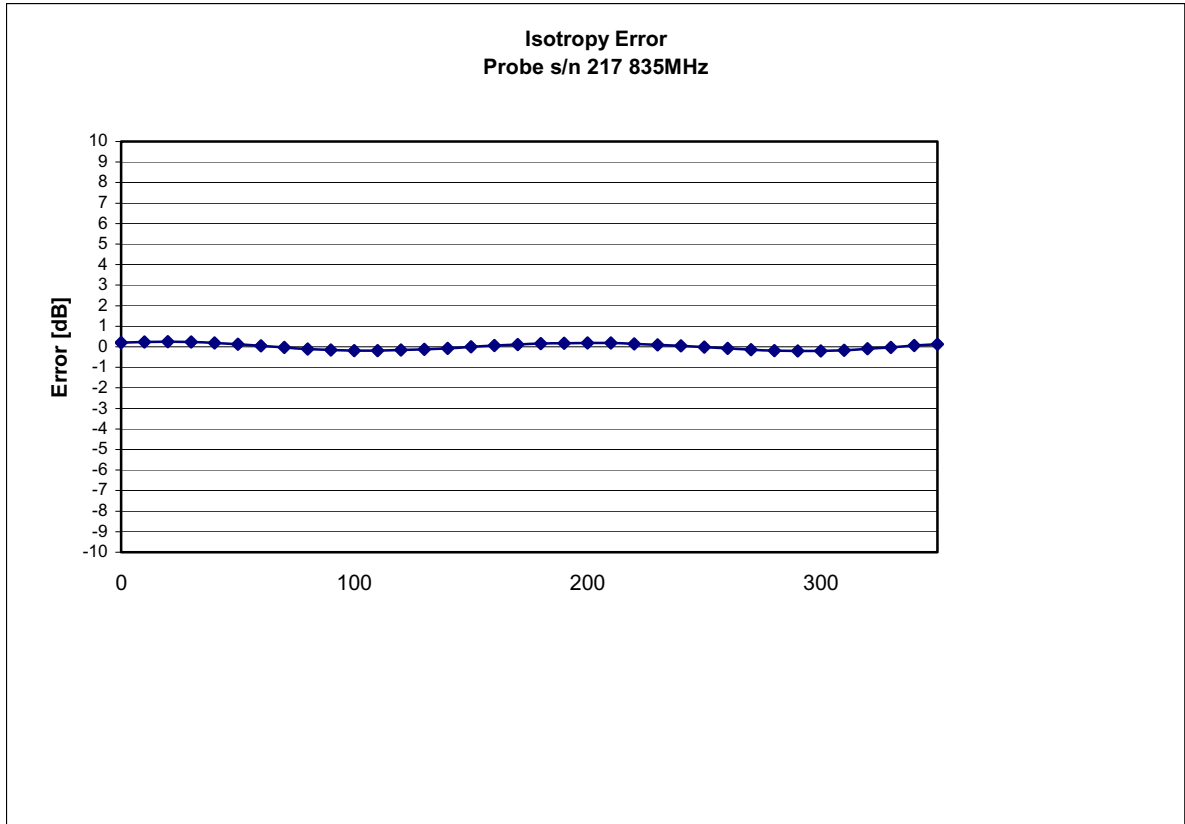
The measured probe tip diameter is 5 mm (+/- 0.01 mm) and therefore meets the requirements of SSI/DRB-TP-D01-032 for spatial resolution.

### Receiving Pattern 835 MHz (Air)



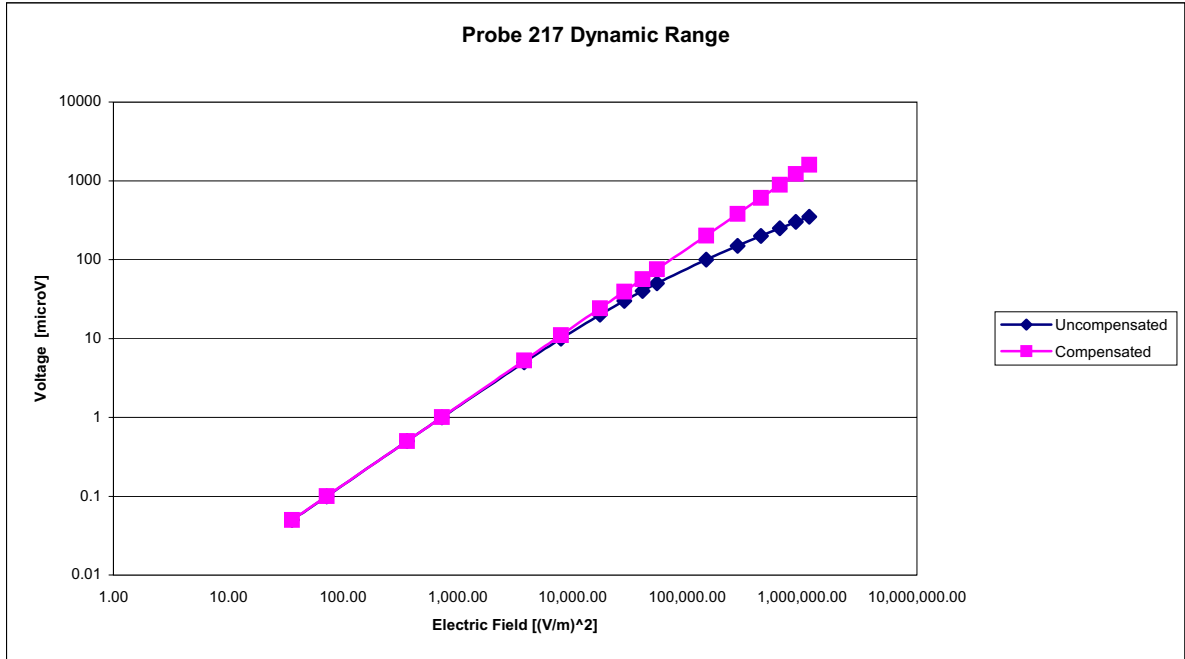


### Isotropy Error 835 MHz (Air)

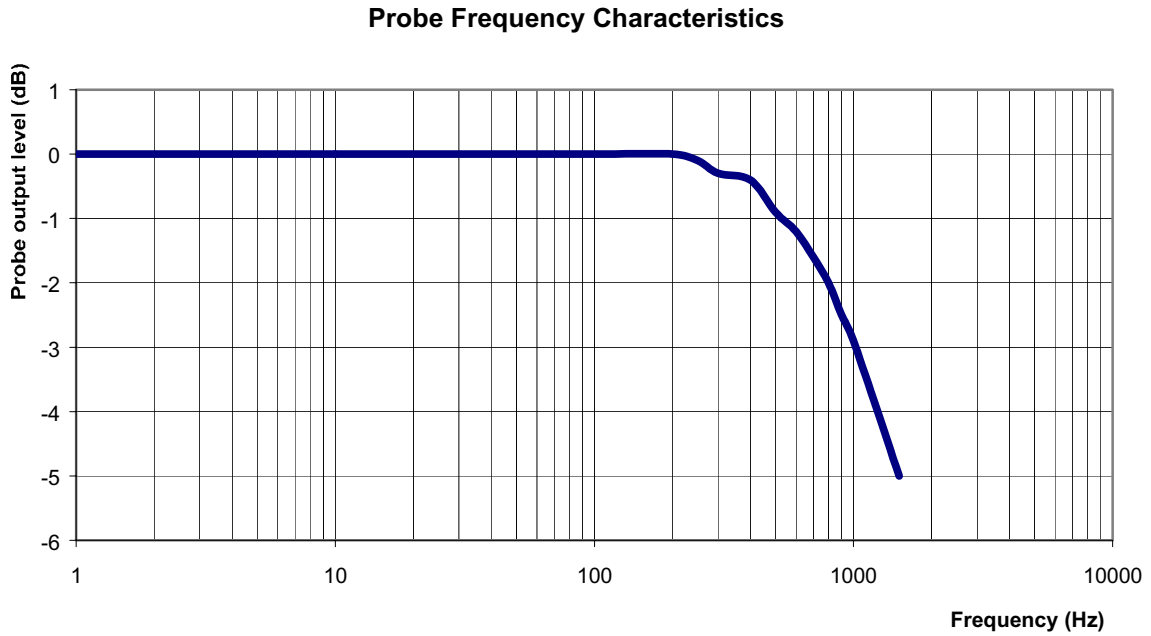


Isotropicity: 0.10 dB

## Dynamic Range



## Video Bandwidth



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

## **Conversion Factor Uncertainty Assessment**

**Frequency:** 835MHz  
**Epsilon:** 55.2 (+/-5%)      **Sigma:** 0.97 S/m (+/-10%)

### **ConvF**

**Channel X:** 6.1      7%(K=2)  
**Channel Y:** 6.1      7%(K=2)  
**Channel Z:** 6.1      7%(K=2)

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

### **Boundary Effect:**

For a distance of 2.4mm the evaluated uncertainty (increase in the probe sensitivity) is less than 2%.

## **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 2004.

## **Appendix E – Dipole Calibration Data Sheets**

# NCL CALIBRATION LABORATORIES

Calibration File No: CD-339  
Project Number: RFEB-ALSAS-10U-4087

## 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.

RFE Validation Dipole

Manufacturer: APREL Laboratories

Part number: ALS-D-835-S-2

Frequency: 835 MHz

Serial No: RFE-274

Customer: RFE

Calibrated: 20 February 2004  
Released on: 20 February 2004

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

## Calibration Results Summary

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

### Mechanical Dimensions

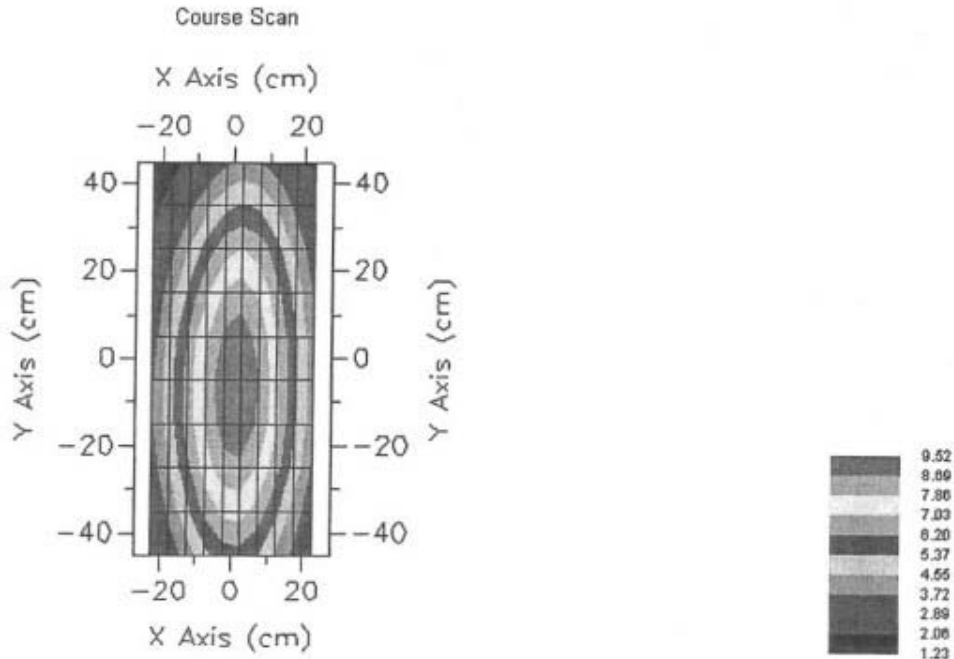
**Length:** 161.8 mm  
**Height:** 91.1 mm

### Electrical Specification

**SWR:** 1.11 U  
**Return Loss:** -26.20 dB  
**Impedance:** 52.40  $\Omega$

### System Validation Results

Frequency	1 Gram	10 Gram	Peak
835 MHz	9.33	6.42	15.0





## 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 RFE-274. The calibration routine consisted of a three-step process. Step 1 was a mechanical verification of the dipole to ensure that it meets the IEEE/APREL 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 RFE E-020 130 MHz to 26 GHz E-Field Probe Serial Number 213.

## 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 RFE-274 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

IEEE Length	IEEE Height	Measured Length	Measured Height
162.0 mm	91.0 mm	161.8 mm	91.1 mm

### Tissue Validation

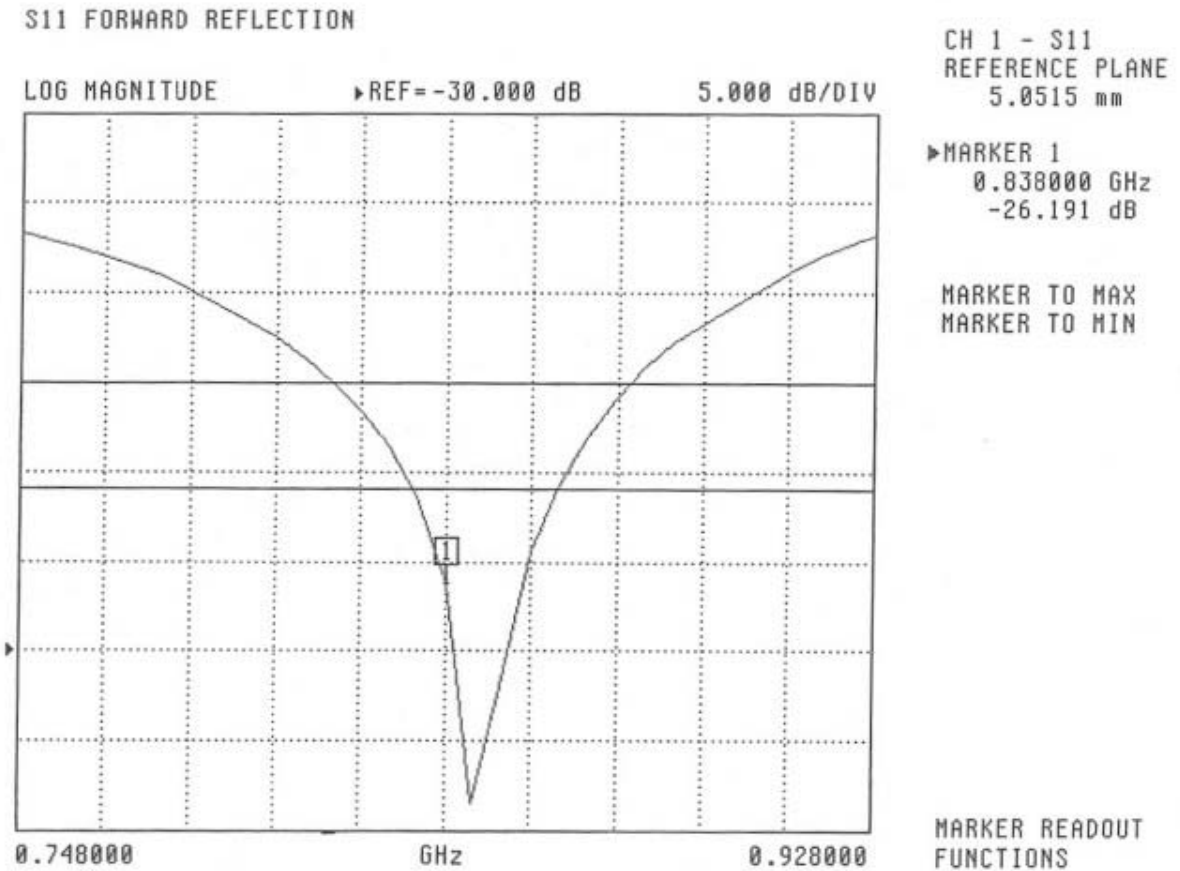
Head Tissue 835 MHz	Measured
Dielectric constant, $\epsilon_r$	42.54
Conductivity, $\sigma$ [S/m]	0.91

**Electrical Calibration**

Test	Result
S11 R/L	-26.2 dB
SWR	1.11 U
Impedance	52.4 $\Omega$

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

**S11 Parameter Return Loss**



SWR

S11 FORWARD REFLECTION

SWR

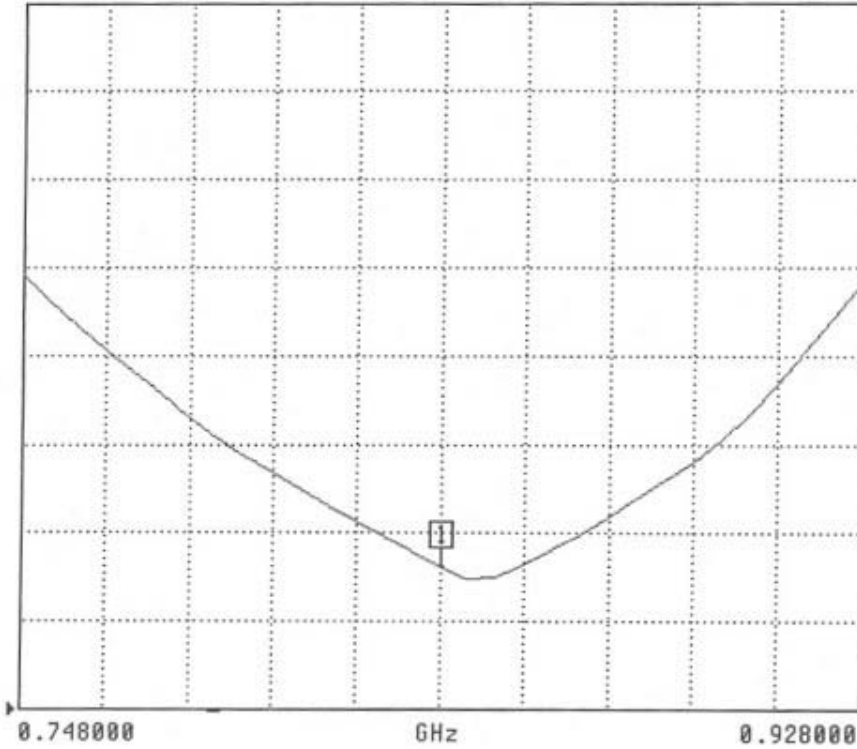
REF=294.938 mU

500.000 mU/DIV

CH 1 - S11  
REFERENCE PLANE  
5.0515 mm

MARKER 1  
0.838000 GHz  
1.108 U

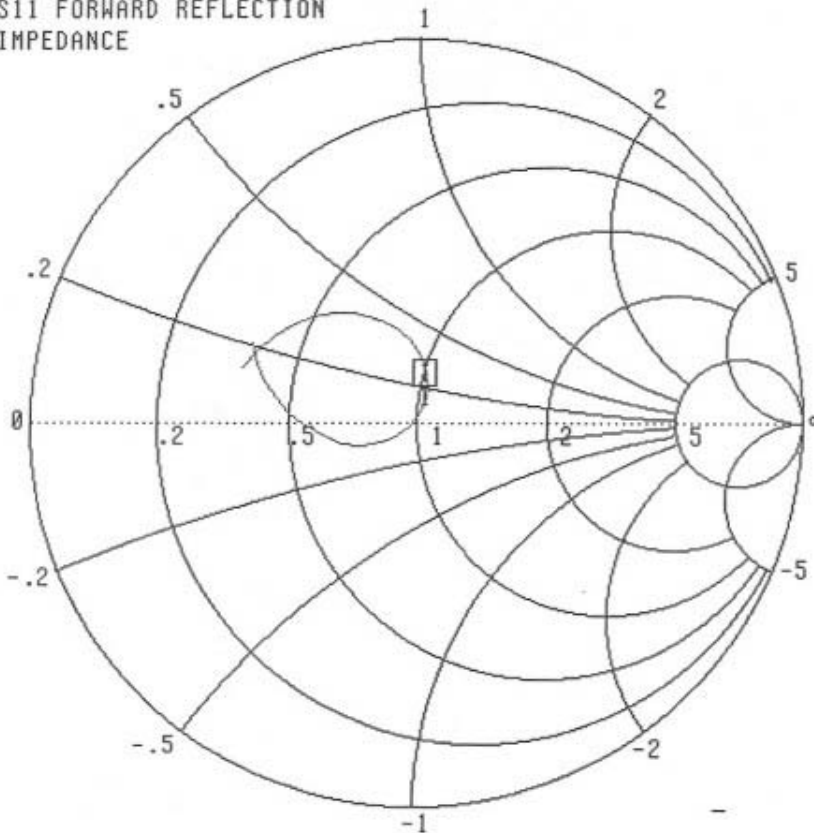
MARKER TO MAX  
MARKER TO MIN



MARKER READOUT  
FUNCTIONS

### Smith Chart Dipole Impedance

S11 FORWARD REFLECTION  
IMPEDANCE



CH 1 - S11  
REFERENCE PLANE  
5.0515 mm

▶ MARKER 1  
0.838000 GHz  
52.440 Ω  
4.834 jΩ

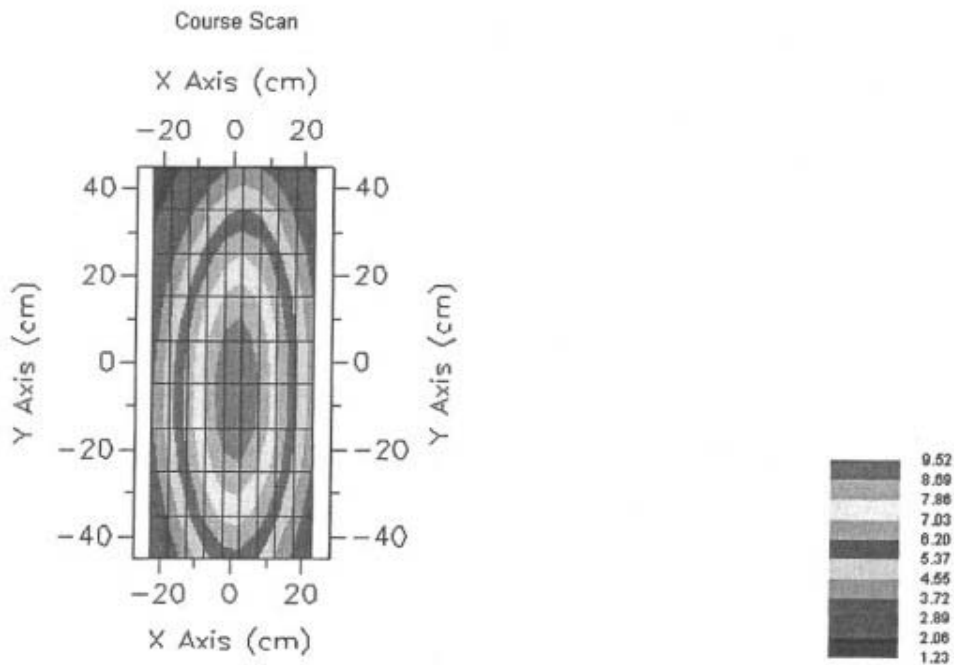
MARKER TO MAX  
MARKER TO MIN

MARKER READOUT  
FUNCTIONS

0.748000 - 0.928000 GHz

System Validation Results Using the Electrically Calibrated Dipole

Head Tissue Frequency	1 Gram	10 Gram	Peak Above Feed Point
835 MHz	9.33	6.42	15.0



## 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 2003

*[Handwritten signature]*

*[Handwritten signature]*

## Appendix F – Phantom Calibration Data Sheets



# NCL CALIBRATION LABORATORIES

Calibration File No.: RFE-267

## 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 National Standards.

Unit serial number: RFE-267

### MEASUREMENTS OF THE PINNA

#### Left SAM Head

MB0	NF6	2.00
MB0	NF8	2.01
MB -30	NF6	2.00
MB +30	NF6	1.98
MB0	NF0	5.68
MB +30	NF0	4.68
MB -30	NF0	1.52
MB0	NF -2	5.61

NOTE: Lowest value was recorded.

Calibrated By:

*Karen K*

Date:

*Feb 17/04*

### **NCL** CALIBRATION LABORATORIES

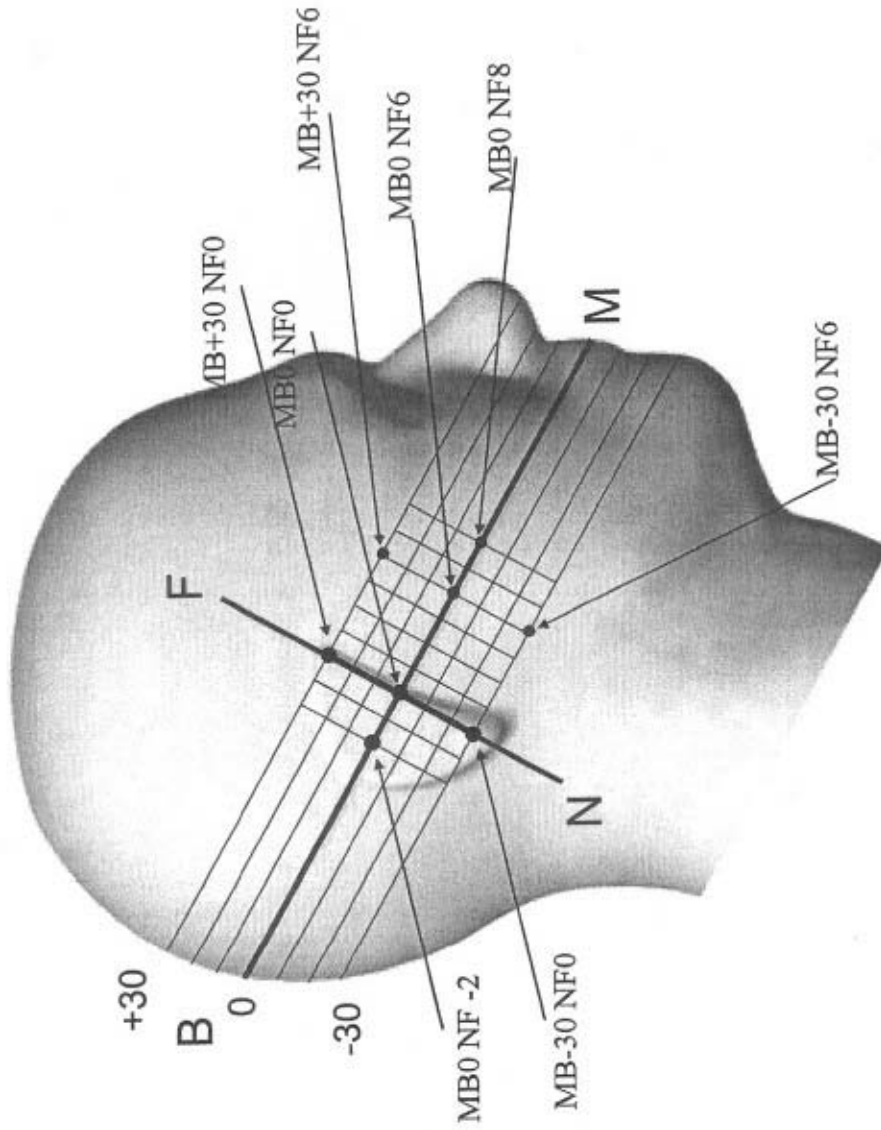
51 SPECTRUM WAY  
NEPEAN, ONTARIO  
CANADA K2R 1E6

Division of APREL Laboratories,  
TEL: (613) 820-4988  
FAX: (613) 820-4161

# NCL CALIBRATION LABORATORIES

Calibration File No.: RFE-267

## CERTIFICATE OF CALIBRATION



### **NCL** CALIBRATION LABORATORIES

51 SPECTRUM WAY  
NEPEAN, ONTARIO  
CANADA K2R 1E6

Division of APREL Lab.  
TEL: (613) 820-4988  
FAX: (613) 820-4151

# NCL CALIBRATION LABORATORIES

Calibration File No.: RFE-268

## 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 National Standards.

Unit serial number: RFE-268

### MEASUREMENTS OF THE PINNA

#### Right SAM Head

MB0	NF6	1.96
MB0	NF8	1.99
MB -30	NF6	1.98
MB +30	NF6	2.00
MB0	NF0	5.80
MB +30	NF0	4.46
MB -30	NF0	11.56
MB0	NF -2	5.6

NOTE: Lowest value was recorded.

Calibrated By: Parvati K

Date: Feb 17/04

### **NCL** CALIBRATION LABORATORIES

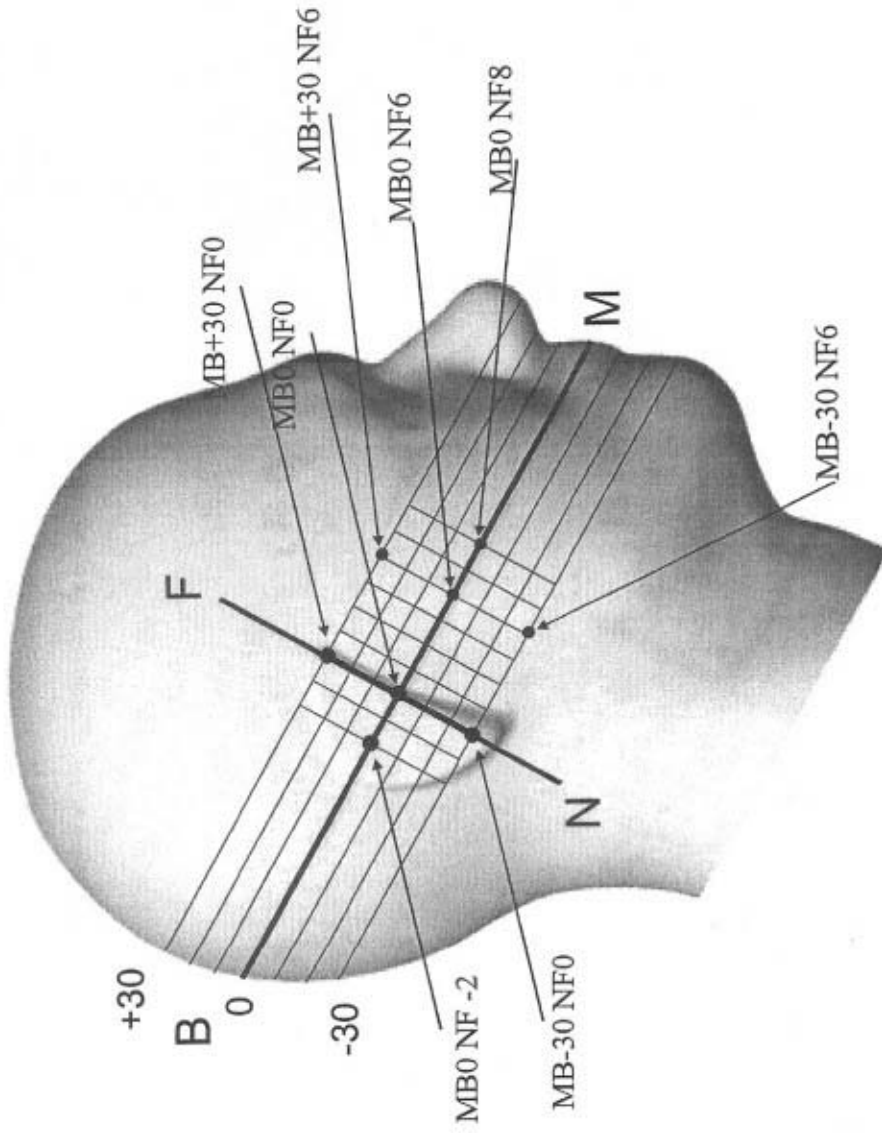
51 SPECTRUM WAY  
NEPEAN, ONTARIO  
CANADA K2R 1E6

Division of APREL Laboratories,  
TEL: (613) 820-4988  
FAX: (613) 820-4161

# NCL CALIBRATION LABORATORIES

Calibration File No.: RFE-268

## CERTIFICATE OF CALIBRATION



### **NCL** CALIBRATION LABORATORIES

51 SPECTRUM WAY  
NEPEAN, ONTARIO  
CANADA, K2R 1E6

Division of APRIL Lab.  
TEL: (613) 820-4988  
FAX: (613) 820-4161

## NCL CALIBRATION LABORATORIES

Calibration File No.: RFE-273

# 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 National Standards.

Thickness of the UniPhantom is 2 mm  $\pm$  10%  
Pinna thickness is 6 mm  $\pm$  10%

Resolution:	0.01 mm	Calibrated to:	0.0 mm
Stability:	OK	Accuracy:	< 0.1 mm

Calibrated By: Karen K. Feb 17/04.

### **NCL** CALIBRATION LABORATORIES

51 SPECTRUM WAY  
NEPEAN, ONTARIO  
CANADA K2R 1E6

Division of APREL Lab.  
TEL: (613) 820-4988  
FAX: (613) 820-4161