

# RF Exposure Lab

802 N. Twin Oaks Valley Road, Suite 105 • San Marcos, CA 92069 • U.S.A.

TEL (760) 471-2100 • FAX (760) 471-2121

<http://www.rfexposurelab.com>

## CERTIFICATE OF COMPLIANCE SAR EVALUATION

Novatel Wireless  
9645 Scranton Road, Suite 205  
San Diego, CA 92121

Dates of Test:  
Test Report Number:

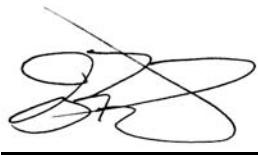
April 22-23, 2011  
SAR.20110410  
Revision J

FCC ID:	PKRNVWE362-H
Model(s):	HSTNN-F05C Containing E362 Module
Test Sample:	Engineering Unit Same as Production
Serial No.:	CAT000193015
Module Serial No.:	LE210910600413
Equipment Type:	Wireless Laptop
Classification:	PCS Licensed Transmitter (PCB)
TX Frequency Range:	824.7–848.3 MHz, 1851.25–1908.75 MHz, 779.5 – 784.5 MHz
Frequency Tolerance:	± 2.5 ppm
Maximum RF Output:	835 MHz (CDMA) – 24.76 dB, 835 MHz (WCDMA) – 23.32 dB, 835 MHz (GSM) – 31.40 dB, 1900 MHz (CDMA) – 24.19 dB , 1900 MHz (WCDMA) – 23.78 dB, 1900 MHz (GSM) – 30.21 dB , 750 MHz – 24.10 dB dB Conducted
Signal Modulation:	CDMA, WCDMA, GMSK, 8PSK, QPSK, 16QAM
Antenna Type (Length):	Internal
Application Type:	Certification
FCC Rule Parts:	Part 2, 22, 24, 27
KDB Issued for Test:	KDB Inquiry 459226

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 is subject to a denial of Federal benefits that includes 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



Certificate # 2387.01

## 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 .....	5
3.	Robot Specifications .....	7
4.	Probe and Dipole Calibration .....	8
5.	Phantom & Simulating Tissue Specifications.....	9
	SAM Phantom.....	9
	Head & Body Simulating Mixture Characterization .....	9
	Device Holder .....	9
6.	ANSI/IEEE C95.1 – 1992 RF Exposure Limits [2].....	10
	Uncontrolled Environment.....	10
	Controlled Environment .....	10
7.	Measurement Uncertainty .....	11
8.	System Validation .....	12
	Tissue Verification.....	12
	Test System Verification .....	12
9.	SAR Test Data Summary.....	14
	Procedures Used To Establish Test Signal.....	14
	Device Test Condition .....	14
10.	FCC 3G Measurement Procedures.....	15
	10.1 Procedures Used to Establish RF Signal for SAR.....	15
	10.2 SAR Measurement Conditions for CDMA2000, 1xEV-DO .....	15
	10.3 SAR Measurement Conditions for WCDMA/HSDPA/HSUPA .....	17
	10.4 SAR Measurement Conditions for GSM.....	18
	10.5 SAR Measurement Conditions for LTE Band 13.....	20
	SAR Data Summary – 835 MHz Body .....	24
	SAR Data Summary – 1900 MHz Body .....	25
	SAR Data Summary – 750 MHz Body – LTE Band 13 10 MHz QPSK.....	26
	SAR Data Summary – 750 MHz Body – LTE Band 13 10 MHz 16QAM.....	27
11.	Simultaneous Transmission Evaluation .....	28
12.	Test Equipment List .....	31
13.	Conclusion .....	32
14.	References.....	33
	Appendix A – System Validation Plots and Data .....	34
	Appendix B – SAR Test Data Plots.....	52
	Appendix C – SAR Test Setup Photos .....	81
	Appendix D – Probe Calibration Data Sheets.....	84
	Appendix E – Dipole Calibration Data Sheets .....	105
	Appendix F – Phantom Calibration Data Sheets .....	136

## 1. Introduction

This measurement report shows compliance of the Novatel Wireless Model E362 Installed in HP Model HSTNN-F05C FCC ID: PKRNVWE362-H with FCC Part 2, 1093, ET Docket 93-62 Rules for mobile and portable devices. The FCC have 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], [6]

The test procedures, as described in ANSI C95.1 – 1999 Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz [2], ANSI C95.3 – 2002 Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields [3], FCC OET Bulletin 65 Supp. C – 2001 [4], IEEE Std.1528 – 2003 Recommended Practice [5], and Industry Canada Safety Code 6 Limits of Human Exposure to Radiofrequency Electromagnetic Fields in the Frequency Range from 3kHz to 300 GHz 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).

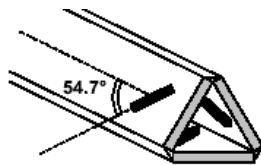
The overall uncertainty for the methodology and algorithms the ALSAS-10-U used during the SAR calculation was evaluated using the data from IEEE 1528 f3 algorithm:

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

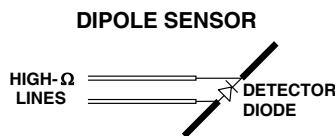
The probe used during the measurement process has been assessed to provide values for diode compression. These values are calculated during the probe calibration exercise and are used in the mathematical calculations for the assessment of SAR.

## E-Field Probe

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 4mm 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 4mm 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).

The manufacturer specified precision of the robot is  $\pm 0.05$  mm and the precision of the APREL bottom detection device is  $\pm 0.1$  mm. These precisions are calibrated and tested in the manufacturing process of the bottom detection device. A constant distance is maintained because the surface of the phantom is dynamically detected for each point. The surface detection algorithm corrects the position of the robot so that the probe rests on the surface of the phantom. The probe is then moved to the measurement location 2.44 mm above the phantom surface resulting in the probe center location to be at 4.0 mm above the phantom surface. Therefore, the probe sensor will be at 4.0 mm above the phantom surface  $\pm 0.1$  mm for each SAR location for frequencies below 3 GHz. The probe is moved to the measurement location 1.44 mm above the phantom surface resulting in the probe center location to be at 2.0 mm above the phantom surface. Therefore, the probe sensor will be at 2.0 mm above the phantom surface  $\pm 0.1$  mm for each SAR location for frequencies above 3 GHz.

The probe boundary effect compensation cannot be disabled in the ALSAS-10U testing system. The probe tip will always be at least half a probe tip diameter from the phantom surface. For frequencies up to 3 GHz, the probe diameter is 5 mm. With the sensor offset set at 1.54 mm (default setting), the sensor to phantom gap will be 4.0 mm which is greater than half the probe tip diameter. For frequencies greater than 3 GHz, the probe diameter is 3 mm. With the sensor offset set at 0.56 mm (default setting), the sensor to phantom gap will be 3.0 mm which is greater than half the probe tip diameter.

The separation of the first 2 measurement points in the zoom scan is specified in the test setup software. For frequencies below 3 GHz, the user must specify a zoom scan resolution of less than 6 mm in the z-axis to have the first two measurements within 1 cm of the surface. The z-axis is set to 4 mm as shown on each of the data sheets in Appendix B. For frequencies above 3 GHz, the user must specify a zoom scan resolution of less than 3 mm in the z-axis to have the first two measurements within 5 mm of the surface. The z-axis is set to 2 mm as shown on each of the data sheets in Appendix B.

The zoom scan volume for devices  $\leq 3$  GHz with a cube scan of 5x5x8 yields a volume of 32x32x28 mm<sup>3</sup>. For devices  $>3$  GHz and  $<4.5$  GHz, the cube scan of 9x9x9 yields a volume of 32x32x24 mm<sup>3</sup>. For devices  $\geq 4.5$  GHz, the cube scan of 7x7x12 yields a volume of 24x24x22 mm<sup>3</sup>.



### 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: Various See Probe Calibration Sheet  
Serial Number: Various See Probe Calibration Sheet  
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 and E.**



## 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]. The Uni-Phantom is used to conduct body measurements and held to face measurements. The depth of the phantom allows for 15 cm of tissue material to be filled within the phantom. See photos in Appendix C.

### Head & Body Simulating Mixture Characterization

The head and body mixtures consist of the material based on the table listed below. The mixture is calibrated to obtain proper dielectric constant (permittivity) and conductivity of the desired tissue. Body tissue parameters that have not been specified in P1528 are derived from the tissue dielectric parameters computed from the 4-Cole-Cole equations.

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

Ingredients		Simulating Tissue		
		835 MHz Body	1900 MHz Body	782 MHz Body
Mixing Percentage				
Water		52.50	69.91	52.50
Sugar		45.00	0.00	45.00
Salt		1.40	0.13	1.40
HEC		1.00	0.00	1.00
Bactericide		0.10	0.00	0.10
DGBE		0.00	29.96	0.00
Dielectric Constant	Target	55.20	53.30	55.41
Conductivity (S/m)	Target	0.97	1.52	0.97

### Device Holder



In combination with the SAM phantom, the scissor jack mounting device with 6 inches of Styrofoam enables the ability to mount the device under test to the uni-phantom. The devices can easily, accurately, and repeatably be positioned according to the FCC specifications.

## 6. 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 ENVIROMENT Professional Population (W/kg) or (mW/g)
SPATIAL PEAK SAR <sup>1</sup> Head	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.

## 7. 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) %	$v_i$
Measurement System								
Probe Calibration	10.0	normal	1	1	1	10.0	10.0	$\infty$
Axial Isotropy	3.7	rectangular	$\sqrt{3}$	0.7	0.7	1.5	1.5	$\infty$
Hemispherical Isotropy	10.9	rectangular	$\sqrt{3}$	0.7	0.7	4.4	4.4	$\infty$
Boundary Effect	1.0	rectangular	$\sqrt{3}$	1	1	0.6	0.6	$\infty$
Linearity	4.7	rectangular	$\sqrt{3}$	1	1	2.7	2.7	$\infty$
Detection Limit	1.0	rectangular	$\sqrt{3}$	1	1	0.6	0.6	$\infty$
Readout Electronics	1.0	normal	1	1	1	1.0	1.0	$\infty$
Response Time	0.8	rectangular	$\sqrt{3}$	1	1	0.5	0.5	$\infty$
Integration Time	1.7	rectangular	$\sqrt{3}$	1	1	1.0	1.0	$\infty$
RF Ambient Condition	3.0	rectangular	$\sqrt{3}$	1	1	1.7	1.7	$\infty$
Probe Positioner Mech. Restriction	0.4	rectangular	$\sqrt{3}$	1	1	0.2	0.2	$\infty$
Probe Positioning with respect to Phantom Shell	2.9	rectangular	$\sqrt{3}$	1	1	1.7	1.7	$\infty$
Extrapolation and Integration	3.7	rectangular	$\sqrt{3}$	1	1	2.1	2.1	$\infty$
Test Sample Positioning	4.0	normal	1	1	1	4.0	4.0	7
Device Holder Uncertainty	2.0	normal	1	1	1	2.0	2.0	2
Drift of Output Power	4.2	rectangular	$\sqrt{3}$	1	1	2.4	2.4	$\infty$
Phantom and Setup								
Phantom Uncertainty (shape & thickness tolerance)	3.4	rectangular	$\sqrt{3}$	1	1	2.0	2.0	$\infty$
Liquid Conductivity (target)	5.0	rectangular	$\sqrt{3}$	0.7	0.5	2.0	1.4	$\infty$
Liquid Conductivity (meas.)	0.5	normal	1	0.7	0.5	0.4	0.3	5
Liquid Permittivity (target)	5.0	rectangular	$\sqrt{3}$	0.6	0.5	1.7	1.4	$\infty$
Liquid Permittivity (meas.)	1.0	normal	1	0.6	0.5	0.6	0.5	5
Combined Uncertainty		RSS				12.8	12.7	>500
Combined Uncertainty (coverage factor=2)		Normal (k=2)				25.5	25.4	>500

## 8. System Validation

### Tissue Verification

**Table 8.1 Measured Tissue Parameters**

		835 MHz Body		1900 MHz Body		782 MHz Body	
Date(s)		Apr. 19, 2011		Apr. 19, 2011		Apr. 20, 2011	
Liquid Temperature (°C)	20.0	Target	Measured	Target	Measured	Target	Measured
Dielectric Constant: $\epsilon$		55.20	55.02	53.30	52.97	55.41	55.22
Conductivity: $\sigma$		0.97	0.98	1.52	1.54	0.97	0.98
		835 MHz Body		1900 MHz Body			
Date(s)		May 17, 2011		May 17, 2011			
Liquid Temperature (°C)	20.0	Target	Measured	Target	Measured		
Dielectric Constant: $\epsilon$		55.20	55.59	53.30	52.56		
Conductivity: $\sigma$		0.97	0.99	1.52	1.54		

See Appendix A for data printout.

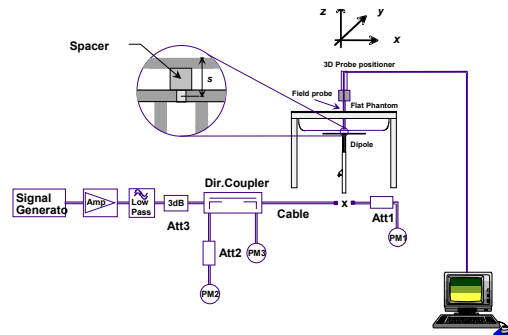
### Test System Verification

Prior to assessment, the system is verified to the  $\pm 10\%$  of the specifications at the test frequency by using the system kit. Power is normalized to 1 watt. (Graphic Plots Attached)

**Table 8.2 System Dipole Validation Target & Measured**

	Test Frequency	Targeted SAR <sub>1g</sub> (W/kg)	Measure SAR <sub>1g</sub> (W/kg)	Tissue Used for Verification	Deviation (%)
19-Apr-2011	835 MHz	9.81	9.42	Body	- 3.98
19-Apr-2011	1900 MHz	40.90	39.91	Body	- 2.42
20-Apr-2011	750 MHz	8.70	9.05	Body	+ 4.02
17-May-2011	835 MHz	9.81	9.58	Body	- 2.34
17-May-2011	1900 MHz	40.90	40.01	Body	- 2.18

See Appendix A for data plots.



**Figure 8.1 Dipole Validation Test Setup**

Note: KDB 450824 was applied for probe calibration frequencies greater than or equal to 50 MHz of the DUT frequencies.

Per KDB 450824, when the actual tissue dielectric parameters used for probe calibration are available, the differences for  $\epsilon_r$  and  $\sigma$ , between probe calibration and routine measurements should each be 5% while satisfying the required  $\pm 5\%$  tolerances in target dielectric parameters. The actual probe calibration tissue parameters are  $\epsilon_r = 53.7$  and  $\sigma = 0.96$ . The tissue parameters for the routine SAR evaluation of the 750 MHz band are  $\epsilon_r = 55.22$  and  $\sigma = 0.98$ . The 750 MHz target values for  $\epsilon_r$  is 55.41 and for  $\sigma$  is 0.97. The  $\epsilon_r$  variance of the 750 MHz tissue to the 835 MHz probe calibration is +2.83% and the  $\epsilon_r$  variance of the 750 MHz tissue to the target is -0.34%. The  $\sigma$  variance of the 750 MHz tissue to the 835 MHz probe calibration is +2.08% and the  $\sigma$  variance of the 750 MHz tissue to the target is +1.03%. Therefore, the extended bandwidth of  $\pm 100$  MHz for the 835 MHz probe calibration is valid for this application. The fact that the differences between the probe calibration tissue parameters and the routine measurement tissue parameters are less than 5% (actual 2.08%) and the routine measurement tissue parameters are still within the  $\pm 5\%$  tolerances of the target dielectric parameters indicates that the probe is valid for the range of  $\pm 100$  MHz around the 835 MHz calibration point for this test report.

## **9. 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 either placed into simulated transmit mode using the manufacturer's test codes or 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**

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 unless otherwise noted. If a conducted power deviation of more than 5% occurred, the test was repeated. The power drift of each test is measured at the start of the test and again at the end of the test. The drift percentage is calculated by the formula  $((\text{end/start})-1)*100$  and rounded to three decimal places. The drift percentage is calculated into the resultant SAR value on the data sheet for each test.

The device is a netbook with a viewable diagonal size of 10 inches. The device contains the Novatel Wireless E362 module. See figure 10.1 on page 22.

The testing was conducted on the bottom of the device with the LCD screen perpendicular to the phantom. All testing was conducted per KDB 447498, KDB 616217 D03 and OET Bulletin 65. See the photo in Appendix C for a pictorial of the setup and labeling of the antenna locations and distances.

The 1xRTT testing was conducted in RC3 with the device configured using TDSO/SO32 with FCH transmitting at full rate. The power control was set to "All Bits Up." 1xRTT did not require SAR testing due to the measured power being less than ¼ dB higher than the conducted power of Rev. 0.

The Rev. 0 testing was conducted with the Reverse Data Channel rate of 153.6 kbps. The Forward Traffic Channel data rate is set to the 2-slot version of 307.2 kbps with the ACK Channel transmitting in all slots. The power control was set to "All Bits Up."

The Rev. A Subtype 2 testing was conducted with the Reverse Data Channel payload size of 4096 bits and Termination Target of 16 slots. The Forward Traffic Channel data rate is set to the 2-slot version of 307.2 kbps with the ACK Channel transmitting in all slots. The power control was set to "All Bits Up." Rev. A did not require SAR testing due to the measured power being less than ¼ dB higher than the conducted power of Rev. 0.

## 10. FCC 3G Measurement Procedures

Power measurements were performed using a base station simulator under average power.

### 10.1 Procedures Used to Establish RF Signal for SAR

The device was placed into a simulated call using a base station simulator in a screen room. Such test signals offer a consistent means for testing SAR and recommended for evaluating SAR. The SAR measurement software calculates a reference point at the start and end of the test to check for power drifts. If conducted power deviations of more than 5% occurred, the tests were repeated.

### 10.2 SAR Measurement Conditions for CDMA2000, 1xEV-DO

#### 10.2.1 Output Power Verification 1xRTT

Use CDMA2000 Rev 6 protocol in the call box.

- 1) Test for RC 3 Reverse FCH, RC3 Reverse SCH0 and demodulation of RC 3, 4 and 5.
  - a. Set up a call using Supplemental Channel Test Mode 3 (RC 3, SO 32) with 9600 bps Fundamental Channel and 9600 bps SCH0 data rate.
  - b. As per C.S0011 or TIA/EIA-98-F Table 4.4.5.2-2, set the test parameters.
  - c. Send alternating '0' and '1' power control bit to the device
  - d. Determine the active channel configuration. If the desired channel configuration is not the active channel configuration, increase  $\hat{\rho}$  by 1 dB and repeat the verification. Repeat this step until the desired channel configuration becomes active.
  - e. Measure the output power at the device antenna connector.
  - f. Decrease  $\hat{\rho}$  by 0.5 dB.
  - g. Determine the active channel configuration. If the active channel configuration is the desired channel configuration, measure the output power at the device antenna connector.
  - h. Repeat step f and g until the output power no longer increases or the desired channel configuration is no longer active. Record the highest output power achieved with the desired channel configuration active.
  - i. Repeat step a through h ten times and average the result.

#### 10.2.2 Output Power Verification 1xEvDo

- 1) Use 1xEV-DO Rel 0 protocol in the call box 8960.
  - a. FTAP
    - Select Test Application Protocol to FTAP
    - Set FTAP Rate to 307.2 kbps (2 Slot, QPSK)
    - Generator Info -> Termination Parameters -> Max Forward Packet Duration -> 16 Slots
    - Set  $\hat{\rho}$  to -60 dBm/1.23 MHz
    - Send continuously '0' power control bits
    - Measure the power at device antenna connector
  - b. RTAP
    - Select Test Application Protocol to RTAP
    - Set RTAP Rate to 9.6 kbps



- Generator Info -> Termination Parameters -> Max Forward Packet Duration -> 16 Slots
  - Set  $\hat{I}$ or to -60 dBm/1.23 MHz
  - Send continuously '0' power control bits
  - Measure the power at device antenna connector
  - Repeat above steps for RTAP Rate = 19.2 kbps, 38.4 kbps, 76.8 kbps and 153.6 kbps respectively
- 2) Use 1xEV-DO Rev A protocol in the call box 8960
- a. FETAP
    - Select Test Application Protocol to FETAP
    - Set FETAP Rate to 307.2 kbps (2 Slot, QPSK)
    - Generator Info -> Termination Parameters -> Max Forward Packet Duration -> 16 Slots
    - Set  $\hat{I}$ or to -60 dBm/1.23 MHz
    - Send continuously '0' power control bits
    - Measure the power at device antenna connector
  - b. RETAP
    - Select Test Application Protocol to RETAP
    - F-Traffic Format -> 4 (1024, 2, 128) Canonical (307.2k, QPSK) • Set R-Data Pkt Size to 128
    - Protocol Subtype Config -> Release A Physical Layer Subtype -> Subtype 2 -> PL Subtype 2 Access Channel MAC Subtype -> Default (Subtype 0)
    - Generator Info -> Termination Parameters -> Max Forward Packet Duration -> 16 Slots ->ACK R-Data After -> Subpacket 0 (All ACK)
    - Set  $\hat{I}$ or to -60 dBm/1.23 MHz
    - Send continuously '0' power control bits
    - Measure the power at device antenna connector
    - Repeat above steps for R-Data Pkt Size = 256, 512, 768, 1024, 1536, 2048, 3072, 4096, 6144, 8192, 12288 respectively.

### 10.3 SAR Measurement Conditions for WCDMA/HSDPA/HSUPA

Configure the call box 8960 to support all WCDMA tests in respect to the 3GPP 34.121 (listed in Table below). Measure the power at Ch4132, 4182 and 4233 for US cell; Ch9262, 9400 and 9538 for US PCS band.

For Rel99

- Set a Test Mode 1 loop back with a 12.2kbps Reference Measurement Channel (RMC).
- Set and send continuously Up power control commands to the device
- Measure the power at the device antenna connector using the power meter with average detector.

For HSDPA Rel 6

- Establish a Test Mode 1 loop back with both 1 12.2kbps RMC channel and a H-Set Fixed Reference Channel (FRC). With the 8960 this is accomplished by setting the signal Channel Coding to “Fixed Reference Channel” and configuring for H-SET QPSK.
- Set beta values and HSDPA settings for HSDPA Subtest1 according to Table below.
- Send continuously Up power control commands to the device
- Measure the power at the device antenna connector using the power meter with modulated average detector.
- Repeat the measurement for the HSDPA Subtest2, 3 and 4 as given in Table below.

For HSUPA Rel 6

- Use UL RMC 12.2kbps and FRC H-Set QPSK, Test Mode 1 loop back. With the 8960 this is accomplished by setting the signal Channel Coding to “E-DCH Test Channel” and configuring the equipment category to Cat5\_10ms.
- Set the Absolute Grant for HSUPA Subtest1 according to Table below.
- Set the device power to be at least 5dB lower than the Maximum output power
- Send power control bits to give one TPC\_cmd = +1 command to the device. If device doesn't send any E-DPCH data with decreased E-TFCI within 500ms, then repeat this process until the decreased E-TFCI is reported.
- Confirm that the E-TFCI transmitted by the device is equal to the target E-TFCI in Table below. If the E-TFCI transmitted by the device is not equal to the target E-TFCI, then send power control bits to give one TPC\_cmd = -1 command to the UE. If UE sends any E-DPCH data with decreased E-TFCI within 500 ms, send new power control bits to give one TPC\_cmd = -1 command to the UE. Then confirm that the E-TFCI transmitted by the UE is equal to the target E-TFCI in Table below.
- Measure the power using the power meter with modulated average detector.
- Repeat the measurement for the HSUPA Subtest2, 3, 4 and 5 as given in Table below.

## 10.4 SAR Measurement Conditions for GSM

Configure the 8960 box to support GMSK and 8PSK call respectively, and set one timeslot and two timeslot transmission GMSK modulation MCS4 for GSM/GPRS and 8PSK modulation MCS9 for EDGE. Measure and record power outputs for both modulations.

### CDMA Power Measurements

IS-2000	Channel	TDSO SO32 [dBm]	TDSO SO32 [dBm]	1x EvDo Rev. 0 [dBm]	1x EvDo Rev. A [dBm]
	F-RC	FCH+SCH	FCH	RTAP	RETAP
Band	Vocoder Rate	Full	Full	Full	Full
Cellular	1013	24.51	24.52	24.55	24.53
	384	24.52	24.52	24.53	24.51
	777	24.53	24.51	24.52	24.53
PCS	25	23.59	23.56	24.10	23.59
	600	23.57	23.42	24.19	23.68
	1175	23.56	23.42	24.16	23.75

Power Control was set in "All Bits Up" for all measurements.

3GPP Release Version	Mode	Cellular Band [dBm]			Sub-Test (See Table Below)	MPR
		4132	5183	4233		
99	WCDMA	23.32	23.31	23.28	-	-
6	HSDPA	23.29	23.24	23.24	1	0
6		23.27	23.28	23.26	2	0
6		22.75	22.77	22.79	3	0.5
6		22.73	22.75	22.71	4	0.5
6	HSUPA	23.30	23.29	23.22	1	0
6		21.36	21.39	21.42	2	2
6		22.41	22.46	22.49	3	1
6		21.38	21.42	21.40	4	2
6		23.28	23.25	23.22	5	0
3GPP Release Version	Mode	PCS Band [dBm]			Sub-Test (See Table Below)	MPR
		9262	9400	9538		
99	WCDMA	23.78	23.71	23.78	-	-
6	HSDPA	23.68	23.64	23.74	1	0
6		23.62	23.62	23.72	2	0
6		23.25	23.22	23.31	3	0.5
6		23.29	23.29	23.21	4	0.5
6	HSUPA	23.64	23.60	23.69	1	0
6		21.81	21.89	21.74	2	2
6		22.85	22.86	22.86	3	1
6		21.93	21.96	21.92	4	2
6		23.66	23.63	23.76	5	0

**Sub-Test Setup for Release 6 HSDPA**

Sub-Test	$\beta_c$	$\beta_d$	$B_c/\beta_d$	$\beta_{hs}$
1	2/15	15/15	2/15	4/15
2	12/15	15/15	15/15	24/15
3	15/15	8/15	15/8	30/15
4	15/15	4/15	15/4	30/15

$\Delta_{ack}, \Delta_{nack}$  and  $\Delta_{cqi} = 8$

**Sub-Test Setup for Release 6 HSUPA**

Sub-Test	$\beta_c$	$\beta_d$	$B_c/\beta_d$	$\beta_{hs}$	$B_{ec}$	$B_{ed}$	MPR	AG Index	E-TFCI
1	11/15	15/15	11/15	22/15	209/225	1039/225	0.0	20	75
2	6/15	15/15	6/15	12/15	12/15	94/75	2.0	12	67
3	15/15	9/15	15/9	30/15	30/15	47/15	1.0	15	92
4	2/15	15/15	2/15	4/15	2/15	56/15	2.0	17	71
5	15/15	15/15	15/15	30/15	24/15	134/15	0.0	21	81

$\Delta_{ack}, \Delta_{nack}$  and  $\Delta_{cqi} = 8$

**RF Conducted Power Table**

		GPRS Data							
Band	Channel	GPRS [dBm]	GPRS [dBm]	GPRS [dBm]	GPRS [dBm]	GPRS [dBm]	GPRS [dBm]	GPRS [dBm]	GPRS [dBm]
		1 TX	1 TX	2 TX	2 TX	3 TX	3 TX	4 TX	4 TX
		Slot(Peak)	Slot(Avg.)	Slot(Peak)	Slot(Avg.)	Slot(Peak)	Slot(Avg.)	Slot(Peak)	Slot(Avg.)
Cellular	128	31.1	22.1	29.4	23.4	27.4	23.1	26.0	23.0
	190	31.4	22.4	29.3	23.3	27.4	23.1	26.0	23.0
	251	31.2	22.2	29.4	23.4	27.3	23.0	25.8	22.8
PCS	512	28.7	19.7	26.5	20.5	24.5	20.2	23.1	20.1
	661	29.1	20.1	26.6	20.6	24.0	19.7	22.9	19.9
	810	29.2	20.2	26.8	20.8	24.1	19.8	22.9	19.9

**RF Conducted Power Table**

		EDGE Data							
Band	Channel	EDGE [dBm]	EDGE [dBm]	EDGE [dBm]	EDGE [dBm]	EDGE [dBm]	EDGE [dBm]	EDGE [dBm]	EDGE [dBm]
		1 TX	1 TX	2 TX	2 TX	3 TX	3 TX	4 TX	4 TX
		Slot(Peak)	Slot(Avg)	Slot(Peak)	Slot(Avg)	Slot(Peak)	Slot(Avg)	Slot(Peak)	Slot(Avg)
Cellular	128	26.3	17.3	24.7	18.7	22.6	18.3	21.3	18.3
	190	26.3	17.3	24.7	18.7	22.4	18.1	21.1	18.1
	251	26.2	17.2	24.7	18.7	22.4	18.1	21.1	18.1
PCS	512	25.5	16.5	23.5	17.5	21.6	17.3	20.4	17.4
	661	25.6	16.6	23.7	17.7	21.8	17.5	20.4	17.4
	810	25.7	16.7	23.6	17.6	21.8	17.5	20.4	17.4

## 10.5 SAR Measurement Conditions for LTE Band 13

### 10.5.1 LTE Functionality

This device supports 5 MHz and 10 MHz bandwidths. At the 5 MHz bandwidth operation, there are two channels of operation. At the 10 MHz bandwidth, there is one channel of operation.

### 10.5.2 Test Conditions

All SAR measurements for LTE were performed using the R&S CMW500. A closed loop power control setting allowed the UE to transmit at the maximum output power during the SAR measurements. The 5 MHz bandwidth was not tested due to the maximum conducted measured output power was within 0.5 dB of the 10 MHz bandwidth maximum conducted output power measurement and the SAR was less than 1.45 W/kg per KDB 941225 D05.

MPR was enabled for this device. A-MPR was disabled for all SAR test measurements.

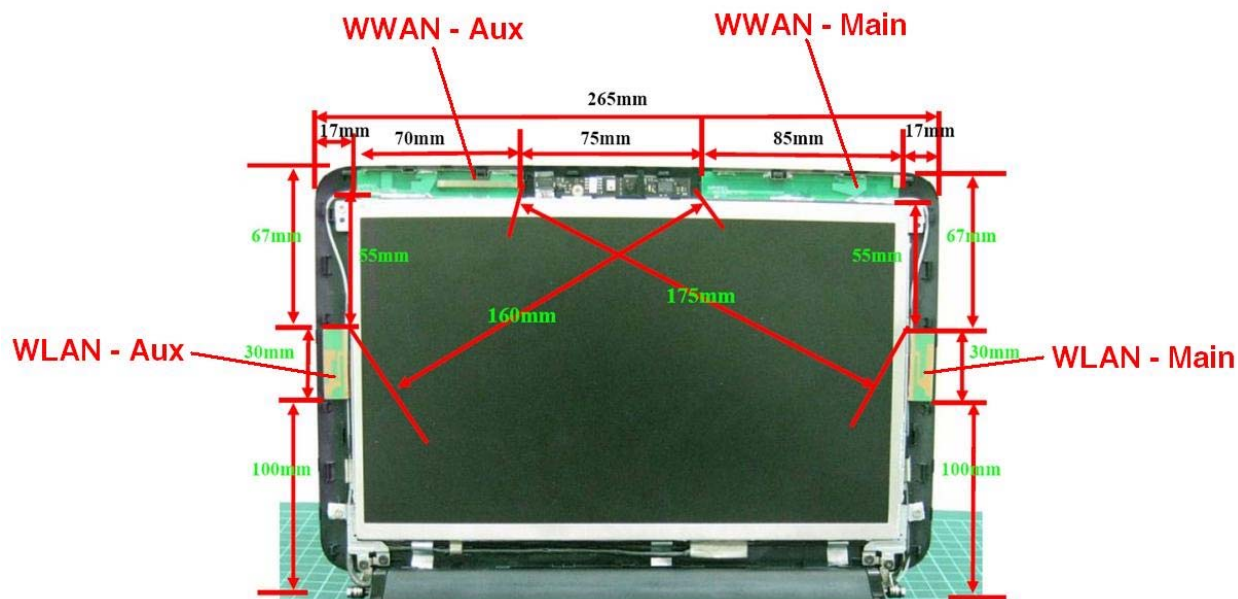
**Band 13 LTE Power Measurements**

Frequency [MHz]	Modulation	Channel Bandwidth [MHz]	RB Size	RB Offset	Maximum Avg. Power [dBm]	MPR Target Backoff (dB)
779.5	QPSK	5	1	0	23.9	0
	16QAM	5	1	0	23.2	1
	QPSK	5	1	24	24.0	0
	16QAM	5	1	24	23.2	1
	QPSK	5	12	6	23.3	1
	16QAM	5	12	6	22.6	2
	QPSK	5	25	0	23.3	1
	16QAM	5	25	0	22.5	2
784.5	QPSK	5	1	0	23.9	0
	16QAM	5	1	0	23.2	1
	QPSK	5	1	24	24.0	0
	16QAM	5	1	24	23.1	1
	QPSK	5	12	6	23.1	1
	16QAM	5	12	6	22.5	2
	QPSK	5	25	0	23.1	1
	16QAM	5	25	0	22.7	2
782	QPSK	10	1	0	23.9	0
	16QAM	10	1	0	23.3	1
	QPSK	10	1	49	24.1	0
	16QAM	10	1	49	23.3	1
	QPSK	10	25	13	23.3	1
	16QAM	10	25	13	22.6	2
	QPSK	10	50	0	23.3	1
	16QAM	10	50	0	22.5	2

**Band 13 LTE MPR Target Values**

Modulation	Channel bandwidth/Transmission bandwidth configuration (RB)		MPR (dB)
	5 MHz	10 MHz	
QPSK	> 8	> 12	≤ 1
16QAM	≤ 8	≤ 12	≤ 1
16QAM	> 8	> 12	≤ 2

**SAR Antenna Distance Diagram**  
(All measurements in mm)



	GSM		HSPA		Ev-Do		LTE		GPS
E362 Antenna	TX	RX	TX	RX	TX	RX	TX	RX	RX
WWAN – Main	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
WWAN – Aux	No	Yes	No	Yes	No	Yes	No	Yes	Yes

**WWAN Antenna Transmission Chart**

The WLAN Main and the WLAN Aux antennas both transmit and receive on each antenna.



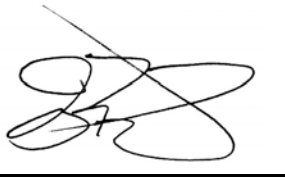


**Figure 10.1**

**SAR Data Summary – 835 MHz Body**

MEASUREMENT RESULTS										
Gap	Position	Frequency		Rev Level/ Modulation	Antenna	End Power (dBm)	Drift (%)	Reverse Channel/ RMC / TX Level	Forward Channel/ Test Set Up/ Multislot Configuration	SAR (W/kg)
		MHz	Ch.							
0 mm	Bottom	836.6	384	Rev 0	Main	24.76	+0.696	153.6 kbps	2 Slot 307.2 kbps	0.256
		836.6	4183	WCDMA	Main	23.07	+1.915	12.2 kbps	Test Loop 1	0.187
		836.6	190	GMSK MCS4	Main	29.30	-0.260	0	2 Slot	0.169
<b>Body</b> <b>1.6 W/kg (mW/g)</b> <small>averaged over 1 gram</small>										

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 Belt Clip  Without Belt Clip  N/A
5. Tissue Depth is at least 15.0 cm



Jay M. Moulton  
 Vice President

Note: When the mid channel is 3 dB or more below the limit the remaining channels are not required to be tested per KDB 447498 section 1) e). The testing was conducted on the bottom of the device with the LCD screen perpendicular to the phantom. All testing was conducted per KDB 447498, KDB 616217 D03 and OET Bulletin 65. See the photo in Appendix C for a pictorial of the setup and labeling of the antenna locations and distances.


**SAR Data Summary – 1900 MHz Body**

**MEASUREMENT RESULTS**

Gap	Position	Frequency		Rev Level/ Modulation	Antenna	End Power (dBm)	Drift (%)	Reverse Channel/ RMC / TX Level	Forward Channel/ Test Set Up/ Multislot Configuration	SAR (W/kg)
		MHz	Ch.							
0 mm	Bottom	1880.0	600	Rev 0	Main	23.69	+2.494	153.6 kbps	2 Slot 307.2 kbps	0.347
		1880.0	9400	WCDMA	Main	23.31	-3.253	12.2 kbps	Test Loop 1	0.287
		1880.0	661	GMSK MCS4	Main	26.60	-4.820	0	2 Slot	0.183

**Body**  
**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 Belt Clip  Without Belt Clip  N/A
5. Tissue Depth is at least 15.0 cm



Jay M. Moulton  
 Vice President

Note: When the mid channel is 3 dB or more below the limit the remaining channels are not required to be tested per KDB 447498 section 1) e). The testing was conducted on the bottom of the device with the LCD screen perpendicular to the phantom. All testing was conducted per KDB 447498, KDB 616217 D03 and OET Bulletin 65. See the photo in Appendix C for a pictorial of the setup and labeling of the antenna locations and distances.

**SAR Data Summary – 750 MHz Body – LTE Band 13 10 MHz QPSK**

**MEASUREMENT RESULTS**

Gap	Position	Frequency		Modulation	RB Size	RB Offset	End Power (dBm)	Drift (%)	SAR (W/kg)
		MHz	Ch.						
0 mm	Bottom	782.0	23230	QPSK	25	13	23.3	+2.725	0.197
		782.0	23230	QPSK	1	0	23.9	-2.539	0.226
		782.0	23230	QPSK	1	49	24.1	+0.283	<b>0.233</b>

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

- Battery is fully charged for all tests.  
 Power Measured  Conducted  ERP  EIRP
- SAR Measurement  
 Phantom Configuration  Left Head  Uniphantom  Right Head  
 SAR Configuration  Head  Body
- Test Signal Call Mode  Test Code  Base Station Simulator
- Test Configuration  With Belt Clip  Without Belt Clip  N/A
- Tissue Depth is at least 15.0 cm



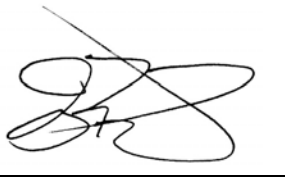
Jay M. Moulton  
 Vice President

Note: When the highest conducted power channel is 3 dB or more below the limit the remaining channels are not required to be tested per KDB 941225. Test reduction was based on KDB941225 D05. The testing was conducted on the bottom of the device with the LCD perpendicular to the phantom. The 5 MHz bandwidth was not tested due to the maximum conducted measured output power was within 0.5 dB of the 10 MHz bandwidth maximum conducted output power measurement and the SAR was less than 1.45 W/kg per KDB 941225 D05. MPR was enabled for this device. A-MPR was disabled for all SAR test measurements. All testing was conducted per KDB 941225 D05, KDB 447498, KDB 616217 D03 and OET Bulletin 65. See the photo in Appendix C for a pictorial of the setup and labeling of antenna locations and distances.

**SAR Data Summary – 750 MHz Body – LTE Band 13 10 MHz 16QAM**

MEASUREMENT RESULTS									
Gap	Position	Frequency		Modulation	RB Size	RB Offset	End Power (dBm)	Drift (%)	SAR (W/kg)
		MHz	Ch.						
0 mm	Bottom	782.0	23230	16QAM	25	13	22.6	-0.244	0.184
		782.0	23230	16QAM	1	0	23.3	+4.379	0.189
		782.0	23230	16QAM	1	49	23.3	-4.346	<b>0.201</b>
					<b>Body</b> <b>1.6 W/kg (mW/g)</b> <small>averaged over 1 gram</small>				

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 Belt Clip  Without Belt Clip  N/A
5. Tissue Depth is at least 15.0 cm



Jay M. Moulton  
 Vice President

Note: When the highest conducted power channel is 3 dB or more below the limit the remaining channels are not required to be tested per KDB 941225. Test reduction was based on KDB941225 D05. The testing was conducted on the bottom of the device with the LCD perpendicular to the phantom. The 5 MHz bandwidth was not tested due to the maximum conducted measured output power was within 0.5 dB of the 10 MHz bandwidth maximum conducted output power measurement and the SAR was less than 1.45 W/kg per KDB 941225 D05. MPR was enabled for this device. A-MPR was disabled for all SAR test measurements. All testing was conducted per KDB 941225 D05, KDB 447498, KDB 616217 D03 and OET Bulletin 65. See the photo in Appendix C for a pictorial of the setup and labeling of antenna locations and distances.

## 11. Simultaneous Transmission Evaluation

This report addresses the SAR testing of the E362 module and antenna. The individual WLAN SAR evaluation is provided by the module manufactures in a separate SAR test report. The potential collocated module FCC ID's are shown below.

Simultaneous transmission is not required according to KDB 616217 D03 section 3) and 4).

### **KDB 616217 D03 section 3) Collocated transmitters:**

The HP HSTNN-F05C is capable of operating with the E362 and one of the following modules.

FCC ID	Radio Type	Frequency (GHz)	Max. Conducted Power (dBm)	Max. Conducted Power (mW)	Mobile Antenna Gain Information (dBi)
QDS-BRCM1050	802.11b/g/n	2.4	25.59	362.24	3.9
PPD-AR5B95-H	802.11b/g/n	2.4	25.28	337.30	3.62
QDS-BRCM1051	802.11b/g/n Bluetooth	2.4	26.15	412.10	3.9
VQF-RT3090BC4	802.11b/g/n Bluetooth	2.4	21.93	155.95	2.95

Antenna type: WLAN PIFA, Bluetooth PIFA

Antenna separation distances (See photos A, B, and C):

Antenna	Distance (cm)
WLAN-to-user	7.5
WLAN AUX-to-User	7.5
WWAN main-to-user	18.5
WLAN AUX-to-WWAN main	16.0
WLAN main-to-WWAN main	5.5



Antenna locations:

Photo A – Antenna locations and identifications

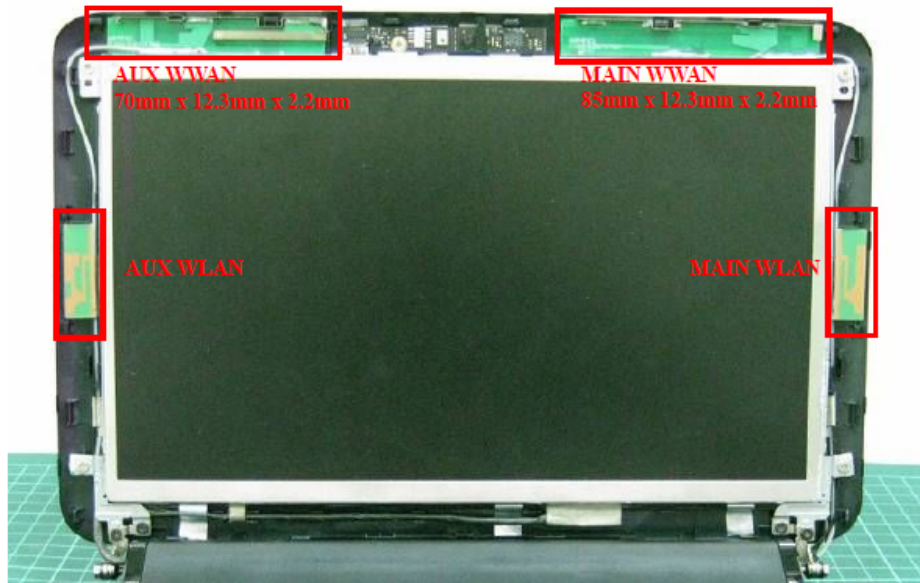
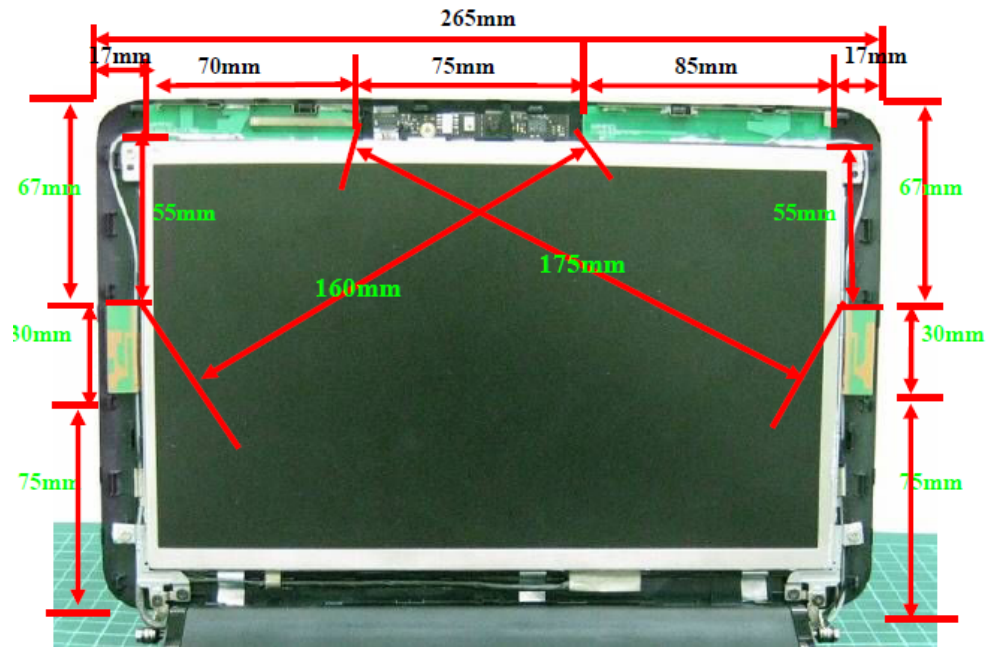
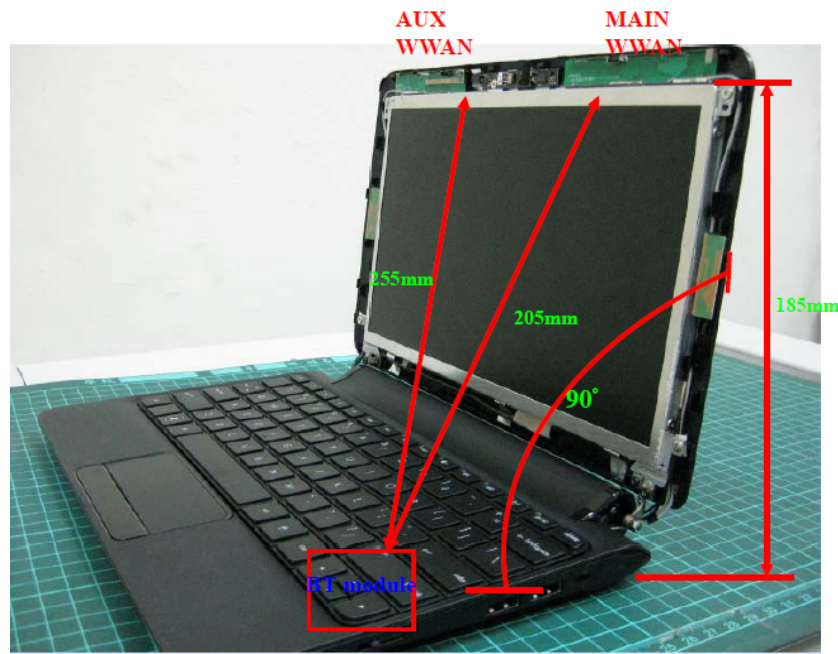


Photo B – Antenna separation distances





**Photo C – Antenna separation distances – continued**



**KDB 616217 D03 section 4) a) Simultaneous SAR exclusion**

The worst case recorded SAR for the WLAN (QDS-BRCM1051) measured at 1.8cm\* with an SAR value of 0.3. (Class II permissive change dated November 17, 2010, RF Exposure compliance history)

\*This is the worst case recorded in a notebook device with a distance less than the application presented here.

$$\begin{aligned}
 \text{SAR}_{\text{Collocated}} &= \frac{\sum \text{Highest measured 1G SAR WWAN} + \text{Highest measured 1g SAR WLAN}}{1.6\text{W/kg}} \\
 &= \frac{\sum 0.347\text{W/kg} + 0.3\text{W/kg}}{1.6\text{W/kg}} \\
 &= \frac{0.647\text{W/kg}}{1.6\text{W/kg}} \\
 \text{SAR}_{\text{Collocated}} &= 0.404
 \end{aligned}$$

If the SAR<sub>collocated</sub> < 1 simultaneous SAR is not required

## 12. Test Equipment List

**Table 11.1 Equipment Specifications**

Type	Calibration Due Date	Calibration Done Date	Serial Number
ThermoCRS Robot	N/A	N/A	RAF0338198
ThermoCRS Controller	N/A	N/A	RCF0338224
ThermoCRS Teach Pendant (Joystick)	N/A	N/A	STP0334405
IBM Computer, 2.66 MHz P4	N/A	N/A	8189D8U KCPR08N
Aprel E-Field Probe ALS-E020	09/22/2011	09/22/2010	RFE-215
Aprel E-Field Probe ALS-E030	07/14/2011	07/14/2010	E030-001
Aprel Dummy Probe	N/A	N/A	023
Aprel Left Phantom	N/A	N/A	RFE-267
Aprel Right Phantom	N/A	N/A	RFE-268
Aprel UniPhantom	N/A	N/A	RFE-273
Aprel Validation Dipole ALS-D-450-S-2 Head	01/12/2012	01/12/2010	RFE-362
Aprel Validation Dipole ALS-D-450-S-2 Body	01/19/2012	01/19/2011	RFE-362
Aprel Validation Dipole ALS-D-750-S-2 Head	01/14/2012	01/14/2010	177-00501
Aprel Validation Dipole ALS-D-750-S-2 Body	11/15/2011	11/15/2010	177-00501
Aprel Validation Dipole ALS-D-835-S-2 Head	01/14/2012	01/14/2010	180-00561
Aprel Validation Dipole ALS-D-835-S-2 Body	11/16/2011	11/16/2010	180-00561
Aprel Validation Dipole ALS-D-900-S-2 Head	01/12/2012	01/12/2010	RFE-275
Aprel Validation Dipole ALS-D-900-S-2 Body	11/19/2011	11/19/2010	RFE-275
Aprel Validation Dipole ALS-D-1900-S-2 Head	01/15/2012	01/15/2010	210-00713
Aprel Validation Dipole ALS-D-1900-S-2 Body	11/16/2011	11/16/2010	210-00713
Aprel Validation Dipole ALS-D-2450-S-2 Head	01/12/2012	01/12/2010	RFE-278
Aprel Validation Dipole ALS-D-2450-S-2 Body	11/18/2011	11/18/2010	RFE-278
Aprel Validation Dipole RFE-D-2600-S-2 Body	01/18/2012	01/18/2010	RFE-121
Aprel Validation Dipole RFE-D-BB-S-2 Head	01/12/2012	01/12/2010	235-00801
Aprel Validation Dipole RFE-D-BB-S-2 Body	02/09/2012	02/09/2011	235-00801
Agilent (HP) 437B Power Meter	03/30/2012	03/30/2011	3125U08837
Agilent (HP) 8481B Power Sensor	03/30/2012	03/30/2011	3318A05384
Agilent N1911A Power Meter	03/30/2012	03/30/2011	GB45100254
Agilent N1922A Power Sensor	03/30/2012	03/30/2011	MY45240464
Advantest R3261A Spectrum Analyzer	03/30/2012	03/30/2011	31720068
Agilent (HP) 8350B Signal Generator	03/31/2012	03/31/2011	2749A10226
Agilent (HP) 83525A RF Plug-In	03/31/2012	03/31/2011	2647A01172
Agilent (HP) 8753C Vector Network Analyzer	03/30/2012	03/30/2011	3135A01724
Agilent (HP) 85047A S-Parameter Test Set	03/31/2012	03/31/2011	2904A00595
Agilent (HP) 8960 Base Station Sim.	03/25/2012	03/25/2011	MY48360364
R&S CMW500 Wideband Radio Comm. Box	08/14/2011	08/14/2010	101383
Aprel Dielectric Probe Assembly	N/A	N/A	0011
Head Equivalent Matter (450 MHz)	N/A	N/A	N/A
Head Equivalent Matter (835/900 MHz)	N/A	N/A	N/A
Head Equivalent Matter (1900 MHz)	N/A	N/A	N/A
Head Equivalent Matter (2450 MHz)	N/A	N/A	N/A
Body Equivalent Matter (450 MHz)	N/A	N/A	N/A
Body Equivalent Matter (750 MHz)	N/A	N/A	N/A
Body Equivalent Matter (835/900 MHz)	N/A	N/A	N/A
Body Equivalent Matter (1900 MHz)	N/A	N/A	N/A
Body Equivalent Matter (2450 MHz)	N/A	N/A	N/A
Body Equivalent Matter (2600 MHz)	N/A	N/A	N/A
Body Equivalent Matter (5200 MHz)	N/A	N/A	N/A
Body Equivalent Matter (5800 MHz)	N/A	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.

## 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 – 1992, 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 – 1992, 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, June 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.
  
- [6] Industry Canada, RSS – 102e, Radio Frequency Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands), March 2010.
  
- [7] Health Canada, Safety Code 6, Limits of Human Exposure to Radiofrequency Electromagnetic Fields in the Frequency Range from 3kHz to 300 GHz, 2009.

## Appendix A – System Validation Plots and Data

```

*****
Test Result for UIM Dielectric Parameter
Wed 20/Apr/2011 06:58:32
Freq Frequency(GHz)
FCC_eH      FCC Bulletin 65 Supplement C ( June 2001) Limits for Head Epsilon
FCC_sH      FCC Bulletin 65 Supplement C (June 2001) Limits for Head Sigma
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
0.7520    55.52      0.96      55.55      0.94
0.7620    55.48      0.96      55.51      0.96
0.7720    55.45      0.97      55.47      0.97
0.7820    55.41      0.97      55.22      0.98
0.7920    55.37      0.97      55.18      0.99
0.8020    55.33      0.97      55.13      1.00
0.8120    55.29      0.97      55.08      1.02

```

```

*****
Test Result for UIM Dielectric Parameter
Tue 19/Apr/2011 05:497:23
Freq Frequency(GHz)
FCC_eH      FCC Bulletin 65 Supplement C ( June 2001) Limits for Head Epsilon
FCC_sH      FCC Bulletin 65 Supplement C (June 2001) Limits for Head Sigma
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
0.8050    55.32      0.97      55.17      0.94
0.8150    55.28      0.97      55.12      0.96
0.8250    55.24      0.97      55.06      0.97
0.8350    55.20      0.97      55.02      0.98
0.8450    55.17      0.98      54.98      1.00
0.8550    55.14      0.99      54.95      1.02
0.8650    55.11      1.01      54.91      1.03

```

\*\*\*\*\*

Test Result for UIM Dielectric Parameter

Tue 19/Apr/2011 07:01:38

Freq Frequency(GHz)

FCC\_eH FCC Bulletin 65 Supplement C ( June 2001) Limits for Head Epsilon

FCC\_sH FCC Bulletin 65 Supplement C (June 2001) Limits for Head Sigma

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
1.8700	53.30	1.52	53.03	1.50
1.8800	53.30	1.52	53.02	1.51
1.8900	53.30	1.52	53.00	1.52
1.9000	53.30	1.52	52.97	1.54
1.9100	53.30	1.52	52.94	1.56
1.9200	53.30	1.52	52.92	1.58
1.9300	53.30	1.52	52.90	1.60

\*\*\*\*\*

Test Result for UIM Dielectric Parameter

Tue 17/May/2011 01:17:43

Freq Frequency(GHz)

FCC\_eH FCC Bulletin 65 Supplement C ( June 2001) Limits for Head Epsilon

FCC\_sH FCC Bulletin 65 Supplement C (June 2001) Limits for Head Sigma

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
0.8050	55.32	0.97	55.73	0.95
0.8150	55.28	0.97	55.68	0.97
0.8250	55.24	0.97	55.64	0.98
0.8350	55.20	0.97	55.59	0.99
0.8450	55.17	0.98	55.55	1.01
0.8550	55.14	0.99	55.52	1.03
0.8650	55.11	1.01	55.48	1.05

\*\*\*\*\*

Test Result for UIM Dielectric Parameter

Tue 17/May/2011 11:51:38

Freq Frequency(GHz)

FCC\_eH FCC Bulletin 65 Supplement C ( June 2001) Limits for Head Epsilon

FCC\_sH FCC Bulletin 65 Supplement C (June 2001) Limits for Head Sigma

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
1.8700	53.30	1.52	52.61	1.49
1.8800	53.30	1.52	52.60	1.51
1.8900	53.30	1.52	52.58	1.53
1.9000	53.30	1.52	52.56	1.54
1.9100	53.30	1.52	52.55	1.55
1.9200	53.30	1.52	52.53	1.57
1.9300	53.30	1.52	52.50	1.60

**SAR Test Report**

By Operator : Jay  
Measurement Date : 20-Apr-2011  
Starting Time : 20-Apr-2011 07:09:30 AM  
End Time : 20-Apr-2011 07:24:35 AM  
Scanning Time : 905 secs

## Product Data

Device Name : Validation  
Serial No. : 750  
Type : Dipole  
Model : ALS-D-750-S-2  
Frequency : 750.00 MHz  
Max. Transmit Pwr : 0.1 W  
Drift Time : 0 min(s)  
Length : 180.2 mm  
Width : 3.6 mm  
Depth : 97 mm  
Antenna Type : Internal  
Orientation : Touch  
Power Drift-Start : 0.986 W/kg  
Power Drift-Finish: 0.995 W/kg  
Power Drift (%) : 0.911

## Phantom Data

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

## Tissue Data

Type : BODY  
Serial No. : 750  
Frequency : 750.00 MHz  
Last Calib. Date : 20-Apr-2011  
Temperature : 20.00 °C  
Ambient Temp. : 23.00 °C  
Humidity : 49.00 RH%  
Epsilon : 55.22 F/m  
Sigma : 0.98 S/m  
Density : 1000.00 kg/cu. m

## Probe Data

Name : Probe 215 - RFEL  
Model : E020  
Type : E-Field Triangle  
Serial No. : 215  
Last Calib. Date : 22-Sep-2010  
Frequency : 835.00 MHz  
Duty Cycle Factor: 1  
Conversion Factor: 6.3  
Probe Sensitivity: 1.20 1.20 1.20  $\mu\text{V}/(\text{V}/\text{m})^2$   
Compression Point: 95.00 mV  
Offset : 1.56 mm

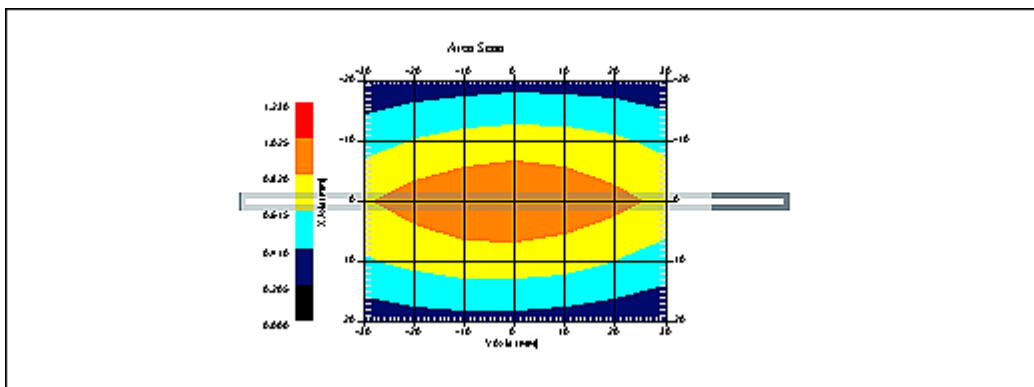


Measurement Data

Crest Factor : 1  
Scan Type : Complete  
Tissue Temp. : 20.00 °C  
Ambient Temp. : 25.00 °C  
Set-up Date : 20-Apr-2011  
Set-up Time : 9:21:48 AM  
Area Scan : 5x7x1 : Measurement x=10mm, y=10mm, z=4mm  
Zoom Scan : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

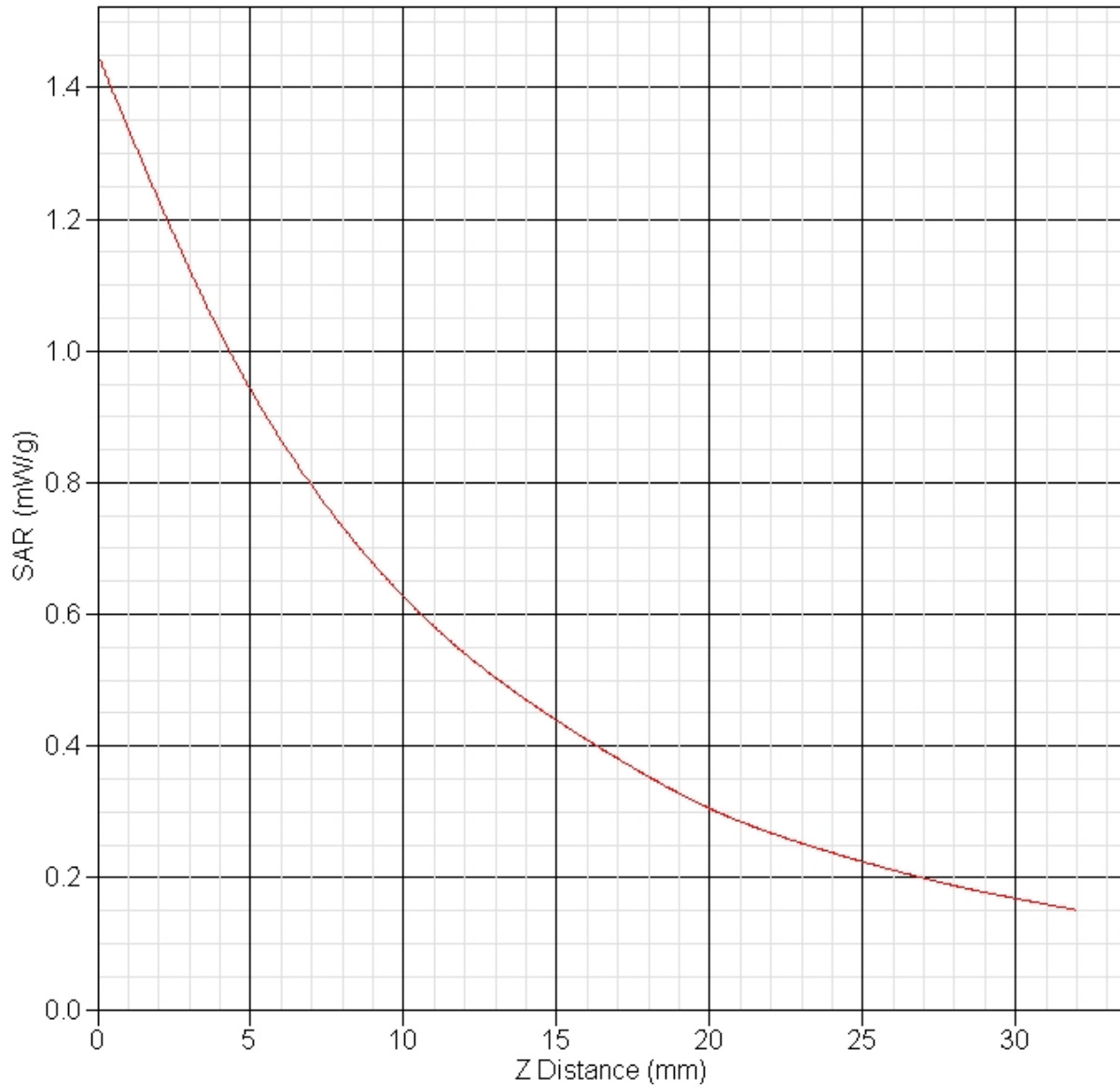
Other Data

DUT Position : Touch  
Separation : 15 mm  
Channel : Mid



1 gram SAR value : 0.905 W/kg  
10 gram SAR value : 0.588 W/kg  
Area Scan Peak SAR : 1.026 W/kg  
Zoom Scan Peak SAR : 1.451 W/kg

**SAR-Z Axis**  
at Hotspot x:0.25 y:-0.13



**SAR Test Report**

By Operator : Jay  
Measurement Date : 19-Apr-2011  
Starting Time : 19-Apr-2011 06:01:49 AM  
End Time : 19-Apr-2011 06:17:03 AM  
Scanning Time : 914 secs

## Product Data

Device Name : Validation  
Serial No. : 835  
Type : Dipole  
Model : ALS-D-835-S-2  
Frequency : 835.00 MHz  
Max. Transmit Pwr : 0.1 W  
Drift Time : 0 min(s)  
Length : 161 mm  
Width : 3.6 mm  
Depth : 89.8 mm  
Antenna Type : Internal  
Orientation : Touch  
Power Drift-Start : 1.029 W/kg  
Power Drift-Finish: 1.034 W/kg  
Power Drift (%) : 0.487

## Phantom Data

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

## Tissue Data

Type : BODY  
Serial No. : 835  
Frequency : 835.00 MHz  
Last Calib. Date : 19-Apr-2011  
Temperature : 20.00 °C  
Ambient Temp. : 23.00 °C  
Humidity : 49.00 RH%  
Epsilon : 55.02 F/m  
Sigma : 0.98 S/m  
Density : 1000.00 kg/cu. m

## Probe Data

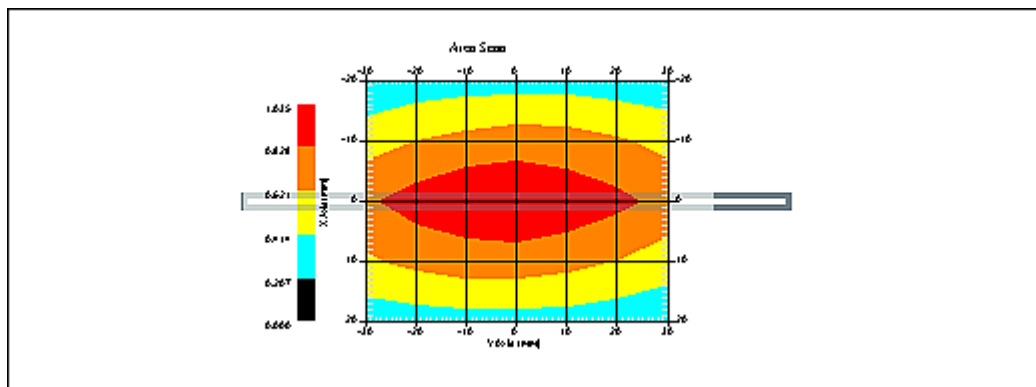
Name : Probe 215 - RFEL  
Model : E020  
Type : E-Field Triangle  
Serial No. : 215  
Last Calib. Date : 22-Sep-2010  
Frequency : 835.00 MHz  
Duty Cycle Factor: 1  
Conversion Factor: 6.3  
Probe Sensitivity: 1.20 1.20 1.20  $\mu\text{V}/(\text{V}/\text{m})^2$   
Compression Point: 95.00 mV  
Offset : 1.56 mm

### Measurement Data

Crest Factor : 1  
Scan Type : Complete  
Tissue Temp. : 20.00 °C  
Ambient Temp. : 25.00 °C  
Set-up Date : 19-Apr-2011  
Set-up Time : 9:21:48 AM  
Area Scan : 5x7x1 : Measurement x=10mm, y=10mm, z=4mm  
Zoom Scan : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

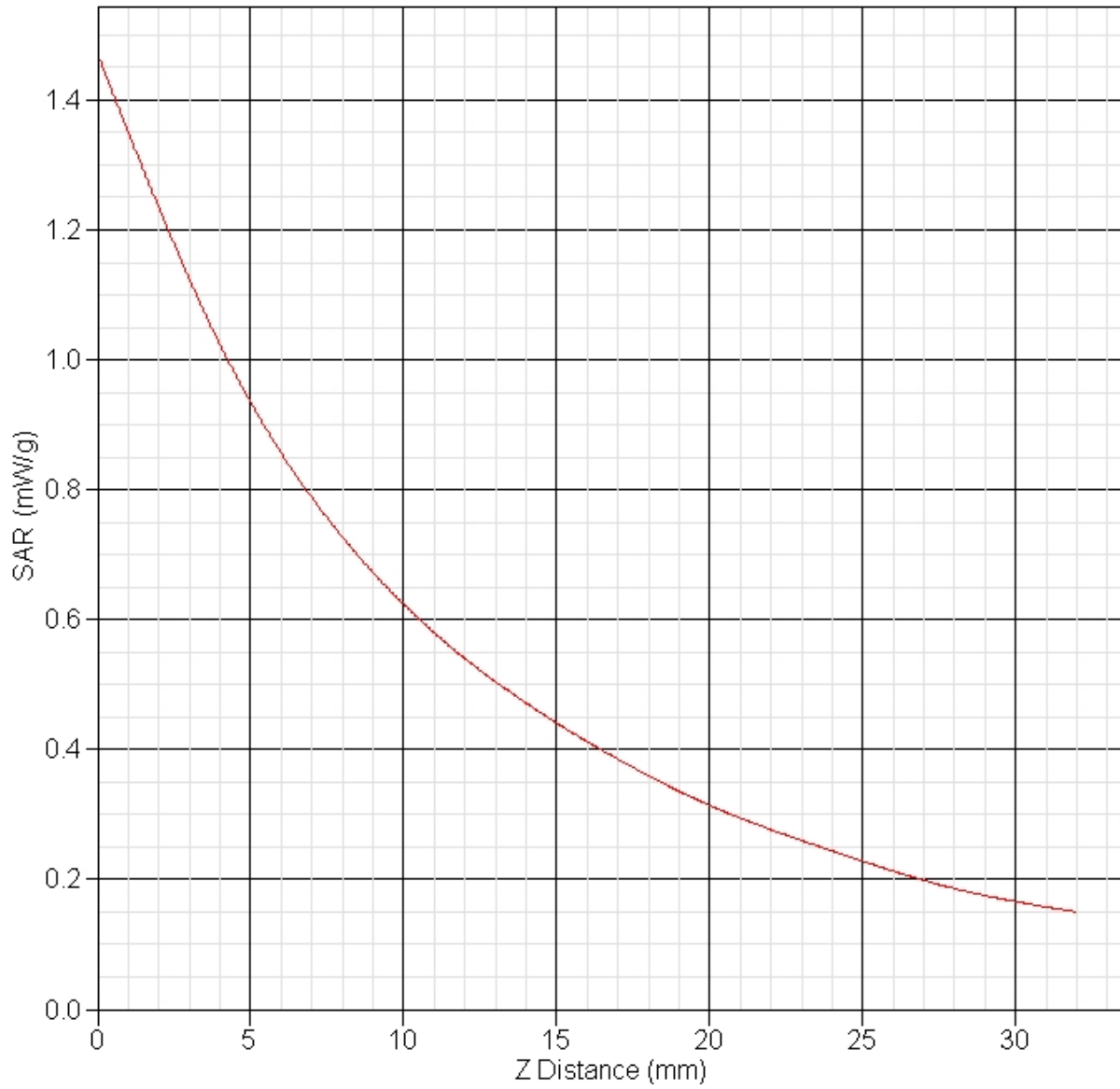
### Other Data

DUT Position : Touch  
Separation : 15 mm  
Channel : Mid



1 gram SAR value : 0.942 W/kg  
10 gram SAR value : 0.595 W/kg  
Area Scan Peak SAR : 1.035 W/kg  
Zoom Scan Peak SAR : 1.471 W/kg

**SAR-Z Axis**  
at Hotspot x:0.20 y:-0.15



**SAR Test Report**

By Operator : Jay  
Measurement Date : 19-Apr-2011  
Starting Time : 19-Apr-2011 07:26:43 AM  
End Time : 19-Apr-2011 07:39:47 AM  
Scanning Time : 784 secs

## Product Data

Device Name : Validation  
Serial No. : 1900  
Type : Dipole  
Model : ALS-D-1900-S-2  
Frequency : 1900.00 MHz  
Max. Transmit Pwr : 0.1 W  
Drift Time : 0 min(s)  
Length : 68 mm  
Width : 3.6 mm  
Depth : 39.5 mm  
Antenna Type : Internal  
Orientation : Touch  
Power Drift-Start : 4.458 W/kg  
Power Drift-Finish: 4.423 W/kg  
Power Drift (%) : -0.792

## Phantom Data

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

## Tissue Data

Type : BODY  
Serial No. : 1900  
Frequency : 1900.00 MHz  
Last Calib. Date : 19-Apr-2011  
Temperature : 20.00 °C  
Ambient Temp. : 23.00 °C  
Humidity : 49.00 RH%  
Epsilon : 52.97 F/m  
Sigma : 1.54 S/m  
Density : 1000.00 kg/cu. m

## Probe Data

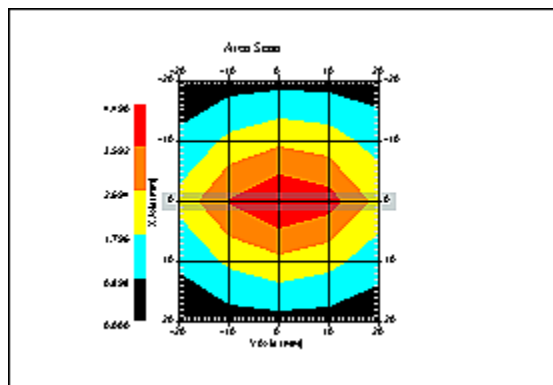
Name : Probe 215 - RFEL  
Model : E020  
Type : E-Field Triangle  
Serial No. : 215  
Last Calib. Date : 22-Sep-2010  
Frequency : 1900.00 MHz  
Duty Cycle Factor: 1  
Conversion Factor: 5  
Probe Sensitivity: 1.20 1.20 1.20  $\mu\text{V}/(\text{V}/\text{m})^2$   
Compression Point: 95.00 mV  
Offset : 1.56 mm

Measurement Data

Crest Factor : 1  
Scan Type : Complete  
Tissue Temp. : 20.00 °C  
Ambient Temp. : 23.00 °C  
Set-up Date : 19-Apr-2011  
Set-up Time : 8:03:12 AM  
Area Scan : 5x5x1 : Measurement x=10mm, y=10mm, z=4mm  
Zoom Scan : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

Other Data

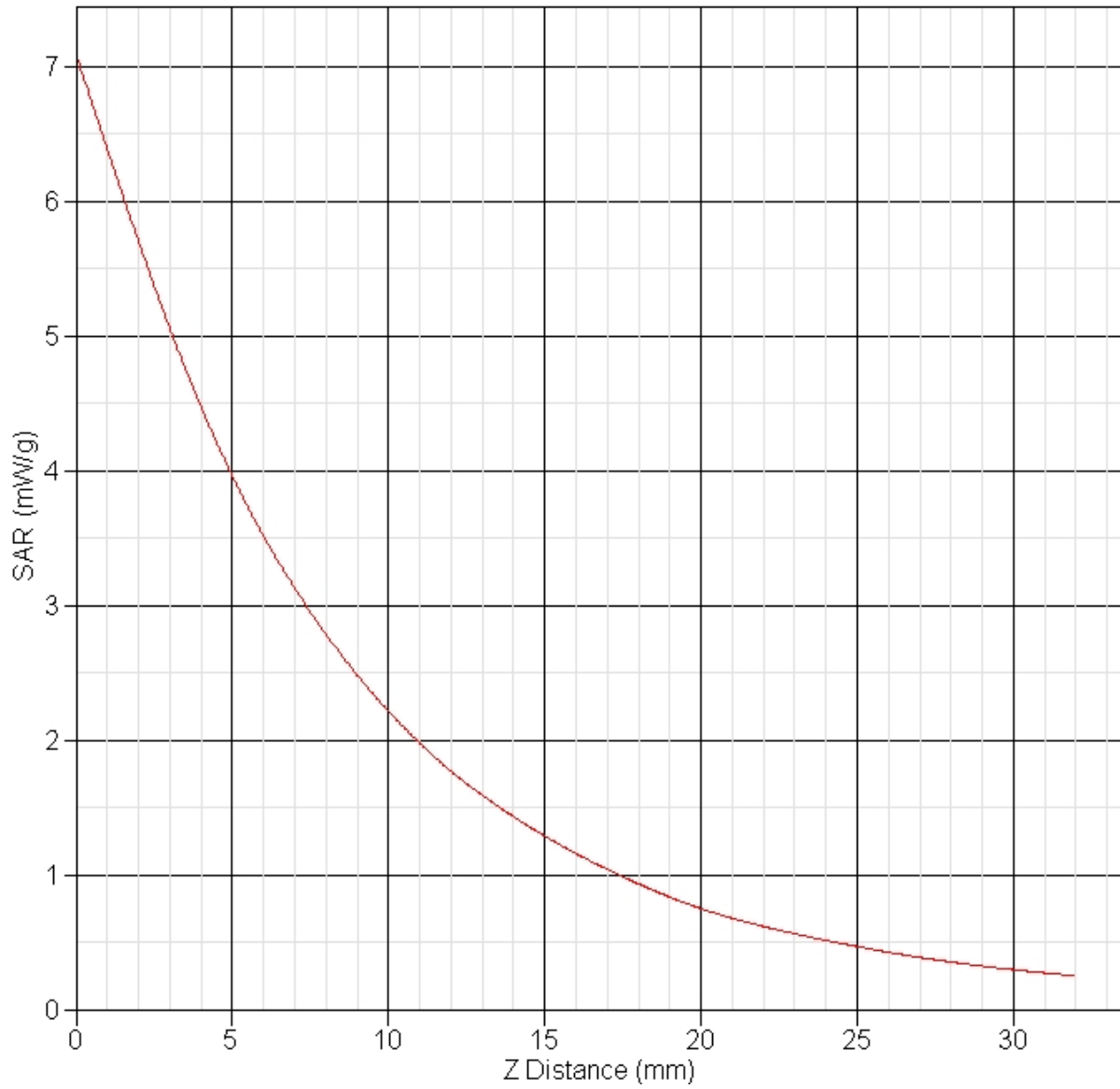
DUT Position : Touch  
Separation : 10 mm  
Channel : Mid



1 gram SAR value : 3.991 W/kg  
10 gram SAR value : 1.987 W/kg  
Area Scan Peak SAR : 4.490 W/kg  
Zoom Scan Peak SAR : 7.096 W/kg



**SAR-Z Axis**  
at Hotspot x:0.25 y:-0.15



**SAR Test Report**

By Operator : Jay  
Measurement Date : 17-May-2011  
Starting Time : 17-May-2011 01:27:43 PM  
End Time : 17-May-2011 01:42:55 PM  
Scanning Time : 912 secs

## Product Data

Device Name : Validation  
Serial No. : 835  
Type : Dipole  
Model : ALS-D-835-S-2  
Frequency : 835.00 MHz  
Max. Transmit Pwr : 0.1 W  
Drift Time : 0 min(s)  
Length : 161 mm  
Width : 3.6 mm  
Depth : 89.8 mm  
Antenna Type : Internal  
Orientation : Touch  
Power Drift-Start : 1.040 W/kg  
Power Drift-Finish: 1.039 W/kg  
Power Drift (%) : -0.129

## Phantom Data

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

## Tissue Data

Type : BODY  
Serial No. : 835  
Frequency : 835.00 MHz  
Last Calib. Date : 17-May-2011  
Temperature : 20.00 °C  
Ambient Temp. : 23.00 °C  
Humidity : 49.00 RH%  
Epsilon : 55.59 F/m  
Sigma : 0.99 S/m  
Density : 1000.00 kg/cu. m

## Probe Data

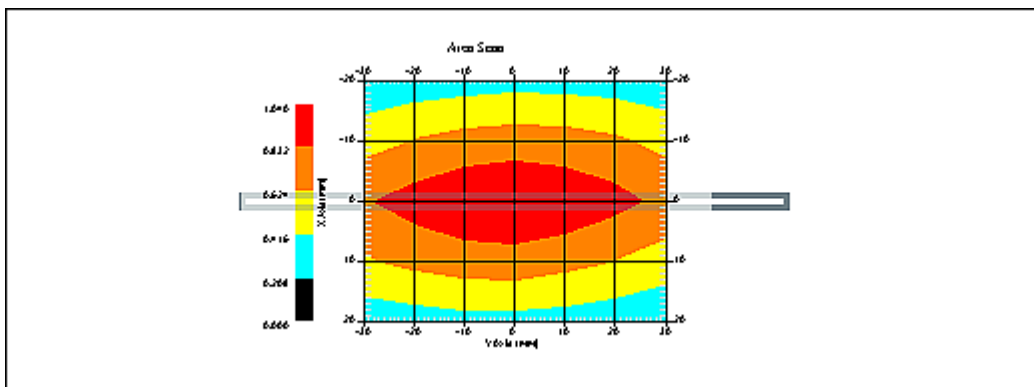
Name : Probe 215 - RFEL  
Model : E020  
Type : E-Field Triangle  
Serial No. : 215  
Last Calib. Date : 22-Sep-2010  
Frequency : 835.00 MHz  
Duty Cycle Factor: 1  
Conversion Factor: 6.3  
Probe Sensitivity: 1.20 1.20 1.20  $\mu\text{V}/(\text{V}/\text{m})^2$   
Compression Point: 95.00 mV  
Offset : 1.56 mm

### Measurement Data

Crest Factor : 1  
Scan Type : Complete  
Tissue Temp. : 20.00 °C  
Ambient Temp. : 25.00 °C  
Set-up Date : 17-May-2011  
Set-up Time : 9:21:48 AM  
Area Scan : 5x7x1 : Measurement x=10mm, y=10mm, z=4mm  
Zoom Scan : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

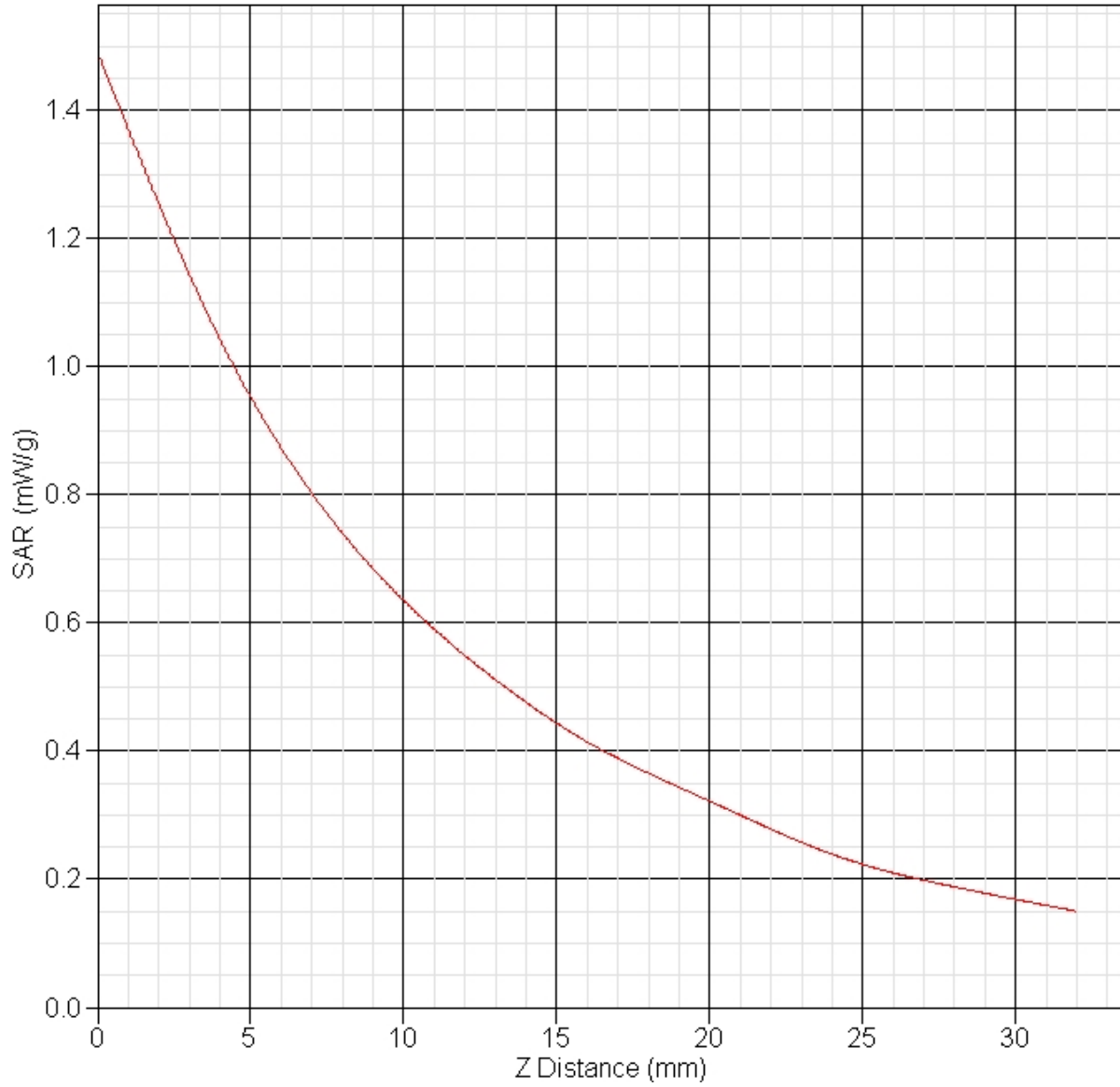
### Other Data

DUT Position : Touch  
Separation : 15 mm  
Channel : Mid



1 gram SAR value : 0.958 W/kg  
10 gram SAR value : 0.604 W/kg  
Area Scan Peak SAR : 1.038 W/kg  
Zoom Scan Peak SAR : 1.491 W/kg

**SAR-Z Axis**  
at Hotspot x:0.23 y:-0.18



**SAR Test Report**

By Operator : Jay  
Measurement Date : 17-May-2011  
Starting Time : 17-May-2011 12:02:33 PM  
End Time : 17-May-2011 12:15:43 PM  
Scanning Time : 790 secs

## Product Data

Device Name : Validation  
Serial No. : 1900  
Type : Dipole  
Model : ALS-D-1900-S-2  
Frequency : 1900.00 MHz  
Max. Transmit Pwr : 0.1 W  
Drift Time : 0 min(s)  
Length : 68 mm  
Width : 3.6 mm  
Depth : 39.5 mm  
Antenna Type : Internal  
Orientation : Touch  
Power Drift-Start : 4.597 W/kg  
Power Drift-Finish: 4.622 W/kg  
Power Drift (%) : 0.544

## Phantom Data

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

## Tissue Data

Type : BODY  
Serial No. : 1900  
Frequency : 1900.00 MHz  
Last Calib. Date : 17-May-2011  
Temperature : 20.00 °C  
Ambient Temp. : 23.00 °C  
Humidity : 49.00 RH%  
Epsilon : 52.56 F/m  
Sigma : 1.54 S/m  
Density : 1000.00 kg/cu. m

## Probe Data

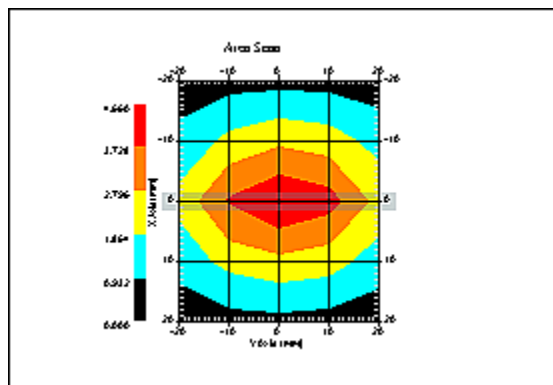
Name : Probe 215 - RFEL  
Model : E020  
Type : E-Field Triangle  
Serial No. : 215  
Last Calib. Date : 22-Sep-2010  
Frequency : 1900.00 MHz  
Duty Cycle Factor: 1  
Conversion Factor: 5  
Probe Sensitivity: 1.20 1.20 1.20  $\mu\text{V}/(\text{V}/\text{m})^2$   
Compression Point: 95.00 mV  
Offset : 1.56 mm

Measurement Data

Crest Factor : 1  
Scan Type : Complete  
Tissue Temp. : 20.00 °C  
Ambient Temp. : 23.00 °C  
Set-up Date : 17-May-2011  
Set-up Time : 8:39:41 AM  
Area Scan : 5x5x1 : Measurement x=10mm, y=10mm, z=4mm  
Zoom Scan : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

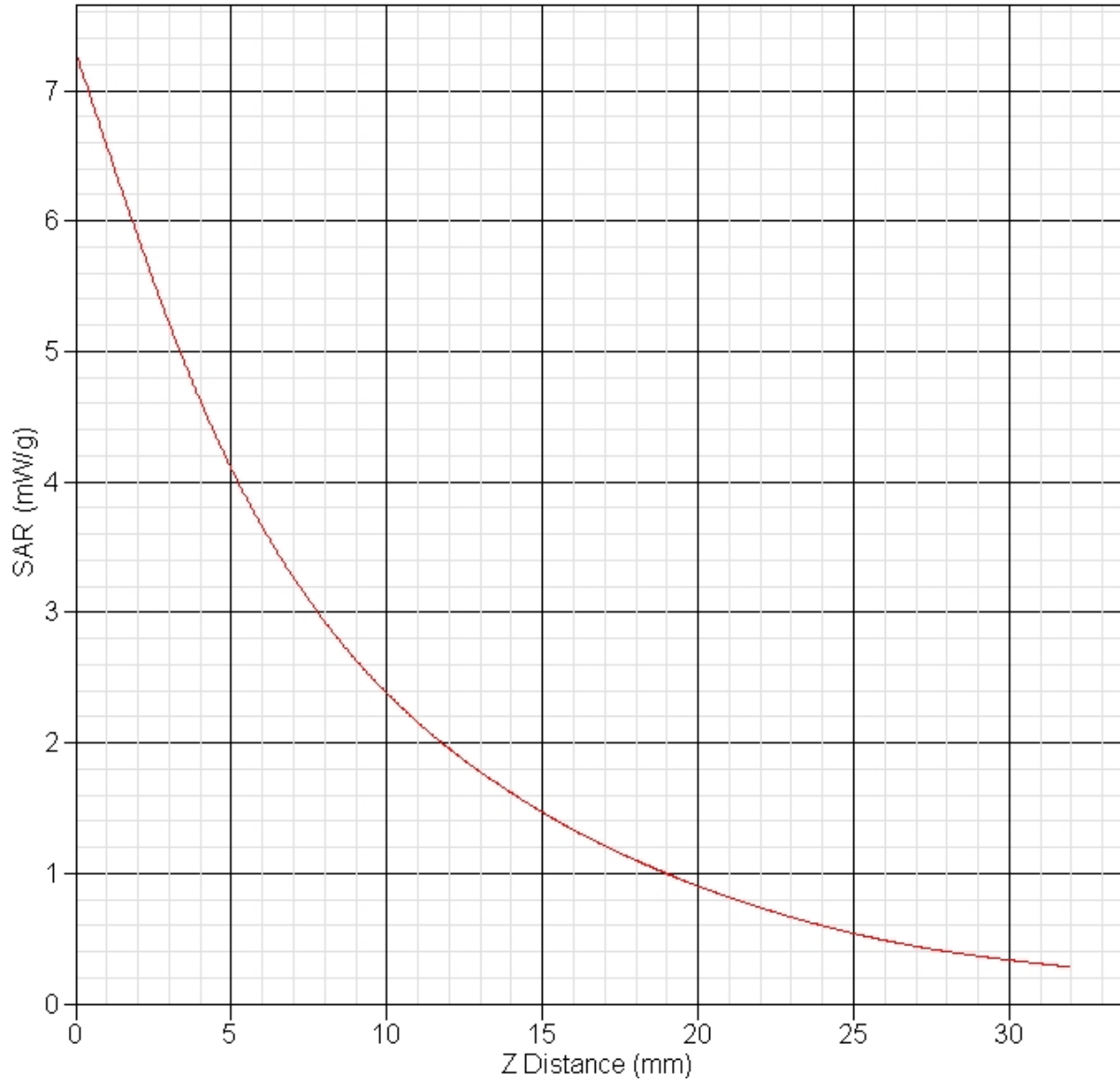
Other Data

DUT Position : Touch  
Separation : 10 mm  
Channel : Mid



1 gram SAR value : 4.001 W/kg  
10 gram SAR value : 2.082 W/kg  
Area Scan Peak SAR : 4.660 W/kg  
Zoom Scan Peak SAR : 7.296 W/kg

**SAR-Z Axis**  
at Hotspot x:0.22 y:-0.14





## Appendix B – SAR Test Data Plots

**Note:** In all data sheets in Appendix B, the frequency noted in the ‘Product Data’ section is the frequency band which the device was transmitting. This frequency does not refer to the actual frequency and channel of the test. The channel is listed in the ‘Other Data’ section of the data sheet as Low, Mid or High. The actual test frequency is listed in Section 10 in each of the data summary sheets.

**SAR Test Report**

By Operator : Jay  
Measurement Date : 19-Apr-2011  
Starting Time : 19-Apr-2011 03:12:36 PM  
End Time : 19-Apr-2011 03:35:32 PM  
Scanning Time : 1376 secs

## Product Data

Device Name : Novatel Wireless  
Serial No. : CAT000193015  
Mode : Rev 0  
Model : HSTNN-F05C containing E362  
Frequency : 850.00 MHz  
Max. Transmit Pwr : 0.299 W  
Drift Time : 0 min(s)  
Length : 269 mm  
Width : 173 mm  
Depth : 10 mm  
Antenna Type : Internal  
Orientation : Bottom  
Power Drift-Start : 0.177 W/kg  
Power Drift-Finish: 0.178 W/kg  
Power Drift (%) : 0.696

## Phantom Data

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

## Tissue Data

Type : BODY  
Serial No. : 835  
Frequency : 835.00 MHz  
Last Calib. Date : 19-Apr-2011  
Temperature : 20.00 °C  
Ambient Temp. : 23.00 °C  
Humidity : 40.00 RH%  
Epsilon : 55.03 F/m  
Sigma : 0.98 S/m  
Density : 1000.00 kg/cu. m

## Probe Data

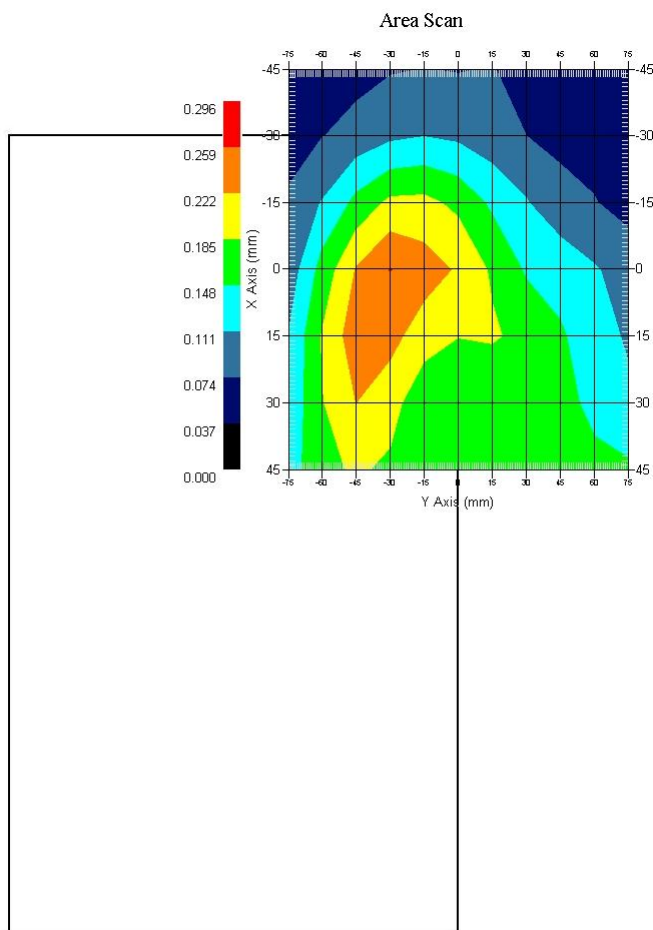
Name : Probe 215 - RFEL  
Model : E020  
Type : E-Field Triangle  
Serial No. : 215  
Last Calib. Date : 22-Sep-2010  
Frequency : 835.00 MHz  
Duty Cycle Factor: 1  
Conversion Factor: 6.3  
Probe Sensitivity: 1.20 1.20 1.20  $\mu\text{V}/(\text{V}/\text{m})^2$   
Compression Point: 95.00 mV  
Offset : 1.56 mm

### Measurement Data

Crest Factor : 1  
Scan Type : Complete  
Tissue Temp. : 20.00 °C  
Ambient Temp. : 23.00 °C  
Set-up Date : 19-Apr-2011  
Set-up Time : 11:59:44 AM  
Area Scan : 7x11x1 : Measurement x=15mm, y=15mm, z=4mm  
Zoom Scan : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

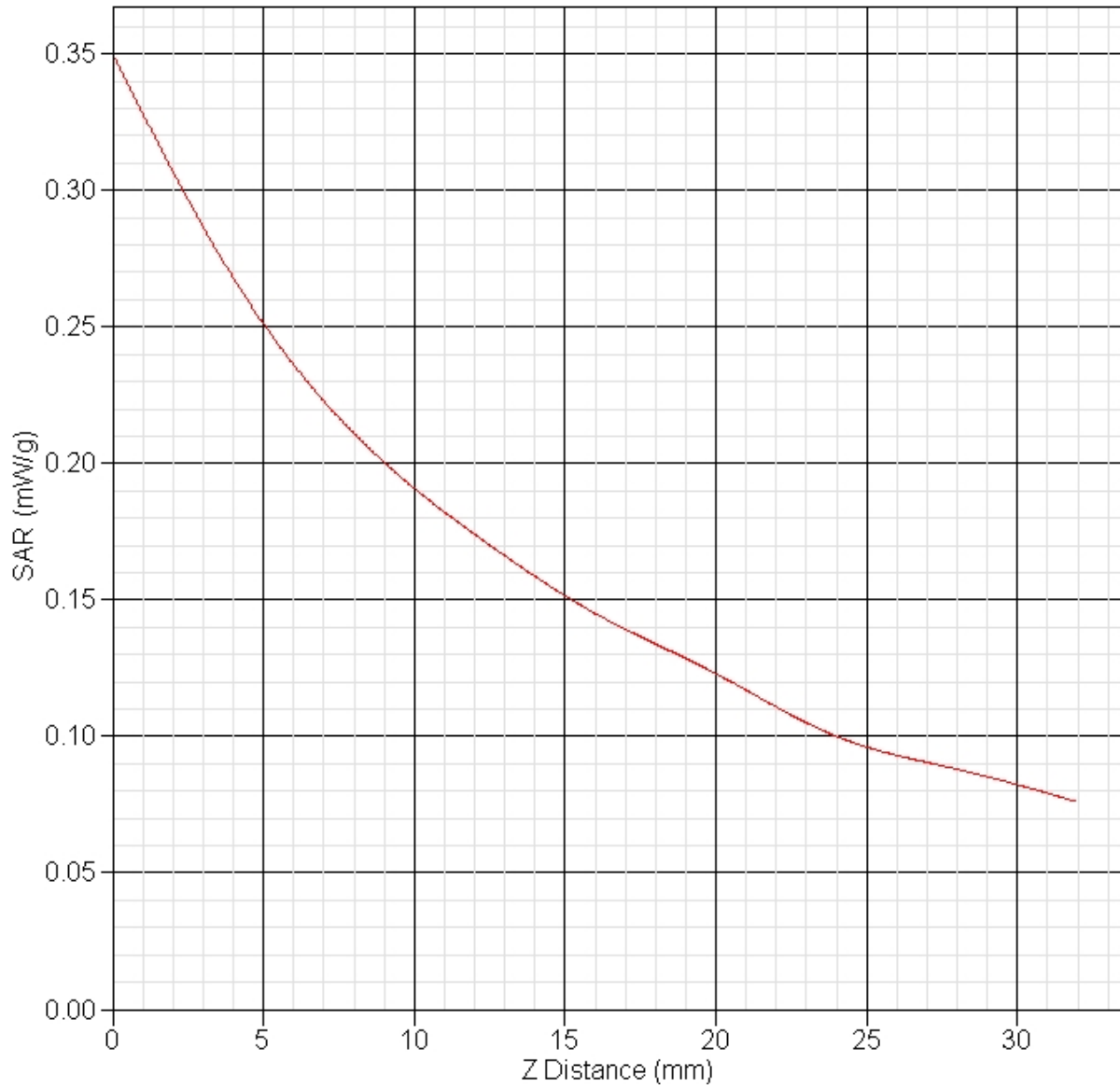
### Other Data

DUT Position : Bottom  
Separation : 0 mm  
Channel : Mid



1 gram SAR value : 0.256 W/kg  
10 gram SAR value : 0.189 W/kg  
Area Scan Peak SAR : 0.260 W/kg  
Zoom Scan Peak SAR : 0.350 W/kg

**SAR-Z Axis**  
at Hotspot x:15.15 y:-29.95



**SAR Test Report**

By Operator : Jay  
Measurement Date : 19-Apr-2011  
Starting Time : 19-Apr-2011 02:41:11 PM  
End Time : 19-Apr-2011 03:04:04 PM  
Scanning Time : 1373 secs

## Product Data

Device Name : Novatel Wireless  
Serial No. : CAT000193015  
Mode : WCDMA  
Model : HSTNN-F05C containing E362  
Frequency : 850.00 MHz  
Max. Transmit Pwr : 0.202 W  
Drift Time : 0 min(s)  
Length : 269 mm  
Width : 173 mm  
Depth : 10 mm  
Antenna Type : Internal  
Orientation : Bottom  
Power Drift-Start : 0.136 W/kg  
Power Drift-Finish: 0.139 W/kg  
Power Drift (%) : 1.915

## Phantom Data

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

## Tissue Data

Type : BODY  
Serial No. : 835  
Frequency : 835.00 MHz  
Last Calib. Date : 19-Apr-2011  
Temperature : 20.00 °C  
Ambient Temp. : 23.00 °C  
Humidity : 40.00 RH%  
Epsilon : 55.03 F/m  
Sigma : 0.98 S/m  
Density : 1000.00 kg/cu. m

## Probe Data

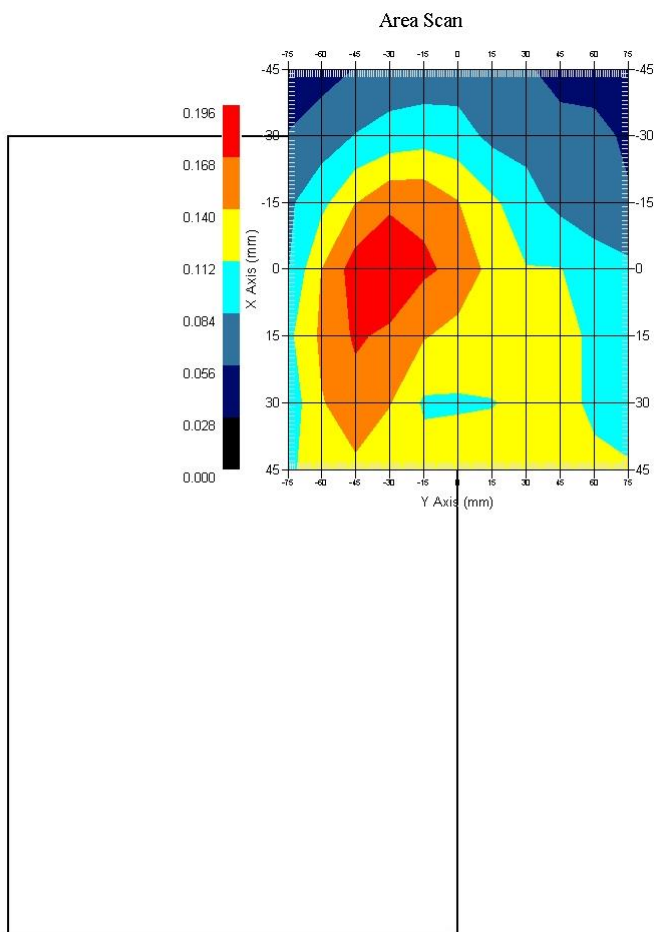
Name : Probe 215 - RFEL  
Model : E020  
Type : E-Field Triangle  
Serial No. : 215  
Last Calib. Date : 22-Sep-2010  
Frequency : 835.00 MHz  
Duty Cycle Factor: 1  
Conversion Factor: 6.3  
Probe Sensitivity: 1.20 1.20 1.20  $\mu\text{V}/(\text{V}/\text{m})^2$   
Compression Point: 95.00 mV  
Offset : 1.56 mm

### Measurement Data

Crest Factor : 1  
Scan Type : Complete  
Tissue Temp. : 20.00 °C  
Ambient Temp. : 23.00 °C  
Set-up Date : 19-Apr-2011  
Set-up Time : 11:59:44 AM  
Area Scan : 7x11x1 : Measurement x=15mm, y=15mm, z=4mm  
Zoom Scan : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

### Other Data

DUT Position : Bottom  
Separation : 0 mm  
Channel : Mid



1 gram SAR value : 0.187 W/kg  
10 gram SAR value : 0.138 W/kg  
Area Scan Peak SAR : 0.196 W/kg  
Zoom Scan Peak SAR : 0.250 W/kg

**SAR Test Report**

By Operator : Jay  
Measurement Date : 17-May-2011  
Starting Time : 17-May-2011 02:17:13 PM  
End Time : 17-May-2011 02:47:55 PM  
Scanning Time : 1842 secs

## Product Data

Device Name : Novatel Wireless  
Serial No. : CAT000193015  
Mode : GPRS 2-Slot  
Model : HSTNN-F05C containing E362  
Frequency : 850.00 MHz  
Max. Transmit Pwr : 0.851 W  
Drift Time : 0 min(s)  
Length : 269 mm  
Width : 173 mm  
Depth : 10 mm  
Antenna Type : Internal  
Orientation : Bottom  
Power Drift-Start : 0.228 W/kg  
Power Drift-Finish: 0.228 W/kg  
Power Drift (%) : -0.260

## Phantom Data

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

## Tissue Data

Type : BODY  
Serial No. : 835  
Frequency : 835.00 MHz  
Last Calib. Date : 17-May-2011  
Temperature : 20.00 °C  
Ambient Temp. : 23.00 °C  
Humidity : 40.00 RH%  
Epsilon : 55.59 F/m  
Sigma : 0.99 S/m  
Density : 1000.00 kg/cu. m

## Probe Data

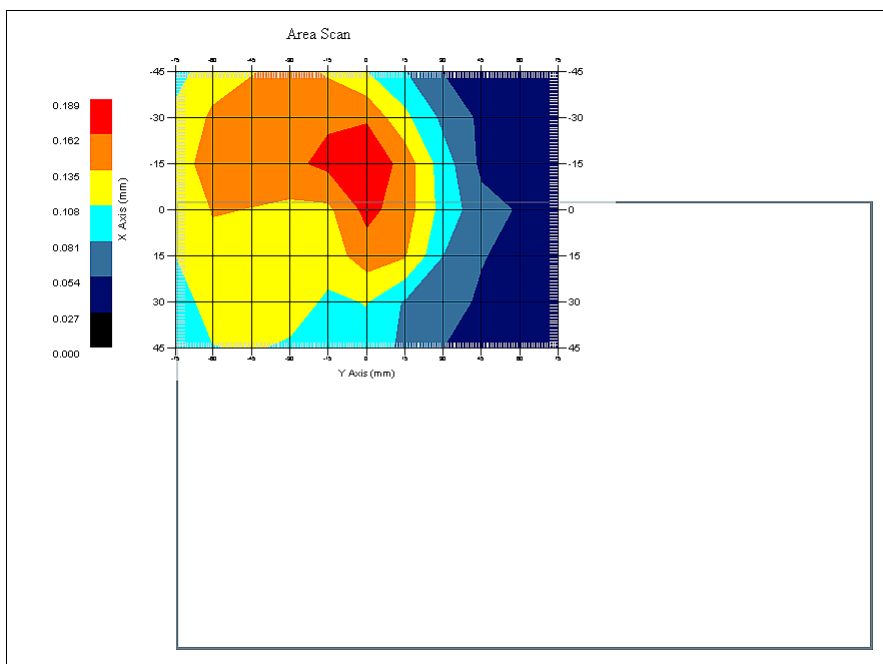
Name : Probe 215 - RFEL  
Model : E020  
Type : E-Field Triangle  
Serial No. : 215  
Last Calib. Date : 22-Sep-2010  
Frequency : 835.00 MHz  
Duty Cycle Factor: 4  
Conversion Factor: 6.3  
Probe Sensitivity: 1.20 1.20 1.20  $\mu\text{V}/(\text{V}/\text{m})^2$   
Compression Point: 95.00 mV  
Offset : 1.56 mm

Measurement Data

Crest Factor : 4  
Scan Type : Complete  
Tissue Temp. : 20.00 °C  
Ambient Temp. : 23.00 °C  
Set-up Date : 17-May-2011  
Set-up Time : 9:15:14 AM  
Area Scan : 7x11x1 : Measurement x=15mm, y=15mm, z=4mm  
Zoom Scan : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

Other Data

DUT Position : Bottom  
Separation : 0 mm  
Channel : Mid



1 gram SAR value : 0.169 W/kg  
10 gram SAR value : 0.126 W/kg  
Area Scan Peak SAR : 0.187 W/kg  
Zoom Scan Peak SAR : 0.230 W/kg



**SAR Test Report**

By Operator : Jay  
Measurement Date : 19-Apr-2011  
Starting Time : 19-Apr-2011 09:52:18 AM  
End Time : 19-Apr-2011 10:15:47 AM  
Scanning Time : 1409 secs

## Product Data

Device Name : Novatel Wireless  
Serial No. : CAT000193015  
Mode : Rev 0  
Model : HSTNN-F05C containing E362  
Frequency : 1900.00 MHz  
Max. Transmit Pwr : 0.234 W  
Drift Time : 0 min(s)  
Length : 269 mm  
Width : 173 mm  
Depth : 10 mm  
Antenna Type : Internal  
Orientation : Bottom  
Power Drift-Start : 0.317 W/kg  
Power Drift-Finish: 0.325 W/kg  
Power Drift (%) : 2.494

## Phantom Data

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

## Tissue Data

Type : BODY  
Serial No. : 1900  
Frequency : 1900.00 MHz  
Last Calib. Date : 19-Apr-2011  
Temperature : 20.00 °C  
Ambient Temp. : 23.00 °C  
Humidity : 36.00 RH%  
Epsilon : 52.97 F/m  
Sigma : 1.54 S/m  
Density : 1000.00 kg/cu. m

## Probe Data

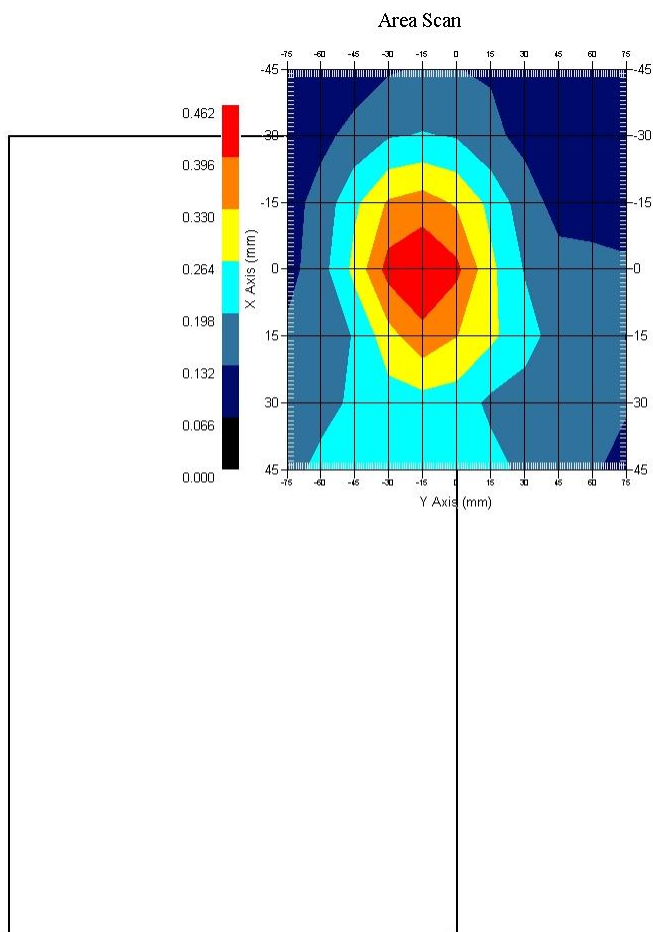
Name : Probe 215 - RFEL  
Model : E020  
Type : E-Field Triangle  
Serial No. : 215  
Last Calib. Date : 22-Sep-2010  
Frequency : 1900.00 MHz  
Duty Cycle Factor: 1  
Conversion Factor: 5  
Probe Sensitivity: 1.20 1.20 1.20  $\mu\text{V}/(\text{V}/\text{m})^2$   
Compression Point: 95.00 mV  
Offset : 1.56 mm

### Measurement Data

Crest Factor : 1  
Scan Type : Complete  
Tissue Temp. : 20.00 °C  
Ambient Temp. : 23.00 °C  
Set-up Date : 19-Apr-2011  
Set-up Time : 9:15:14 AM  
Area Scan : 7x11x1 : Measurement x=15mm, y=15mm, z=4mm  
Zoom Scan : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

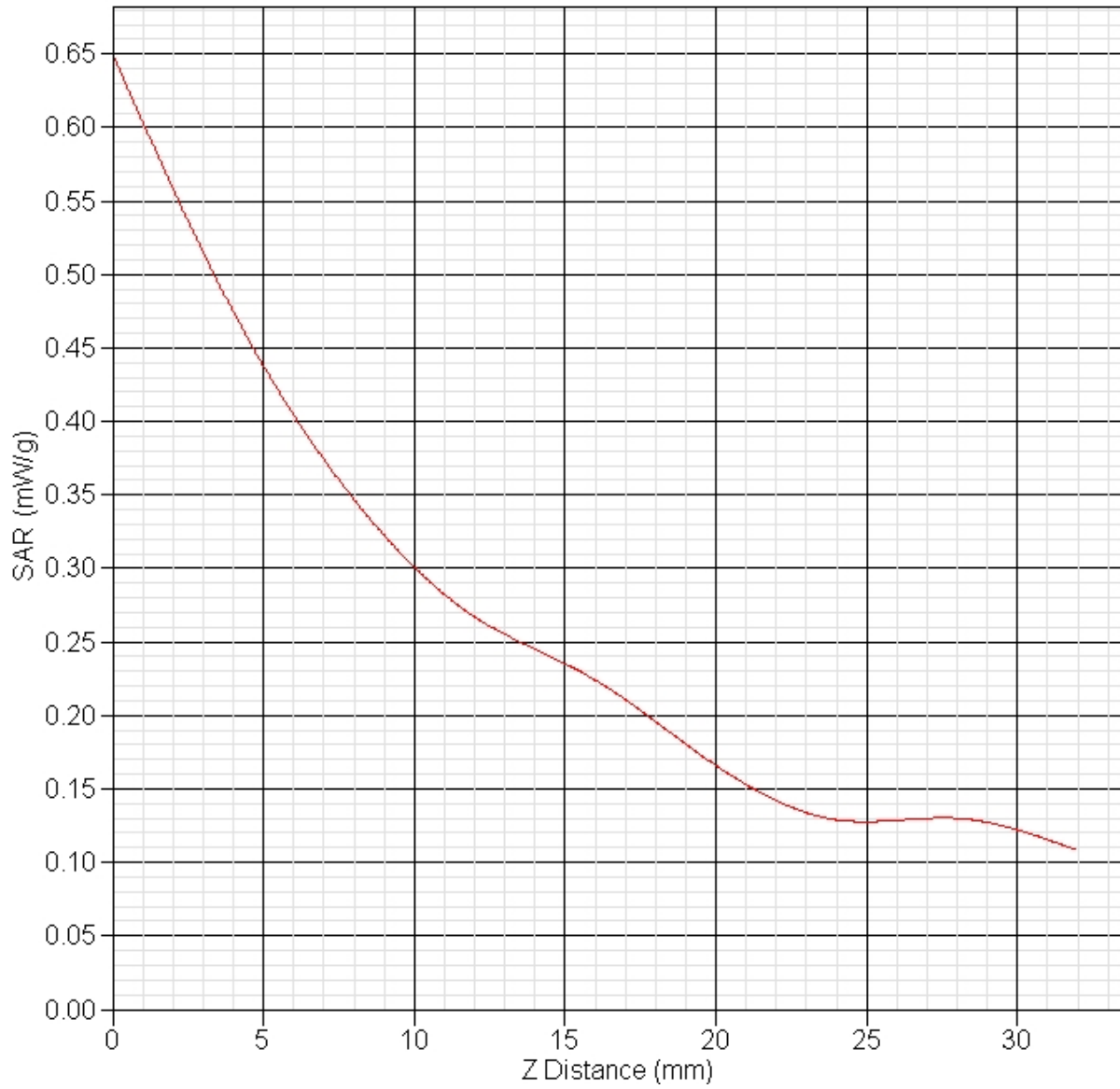
### Other Data

DUT Position : Bottom  
Separation : 0 mm  
Channel : Mid



1 gram SAR value : 0.347 W/kg  
10 gram SAR value : 0.254 W/kg  
Area Scan Peak SAR : 0.462 W/kg  
Zoom Scan Peak SAR : 0.650 W/kg

**SAR-Z Axis**  
at Hotspot x:15.20 y:-14.96



**SAR Test Report**

By Operator : Jay  
Measurement Date : 19-Apr-2011  
Starting Time : 19-Apr-2011 10:44:39 AM  
End Time : 19-Apr-2011 11:07:55 AM  
Scanning Time : 1396 secs

## Product Data

Device Name : Novatel Wireless  
Serial No. : CAT000193015  
Mode : WCDMA  
Model : HSTNN-F05C containing E362  
Frequency : 1900.00 MHz  
Max. Transmit Pwr : 0.214 W  
Drift Time : 0 min(s)  
Length : 269 mm  
Width : 173 mm  
Depth : 10 mm  
Antenna Type : Internal  
Orientation : Bottom  
Power Drift-Start : 0.242 W/kg  
Power Drift-Finish: 0.235 W/kg  
Power Drift (%) : -3.253

## Phantom Data

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

## Tissue Data

Type : BODY  
Serial No. : 1900  
Frequency : 1900.00 MHz  
Last Calib. Date : 19-Apr-2011  
Temperature : 20.00 °C  
Ambient Temp. : 23.00 °C  
Humidity : 36.00 RH%  
Epsilon : 52.97 F/m  
Sigma : 1.54 S/m  
Density : 1000.00 kg/cu. m

## Probe Data

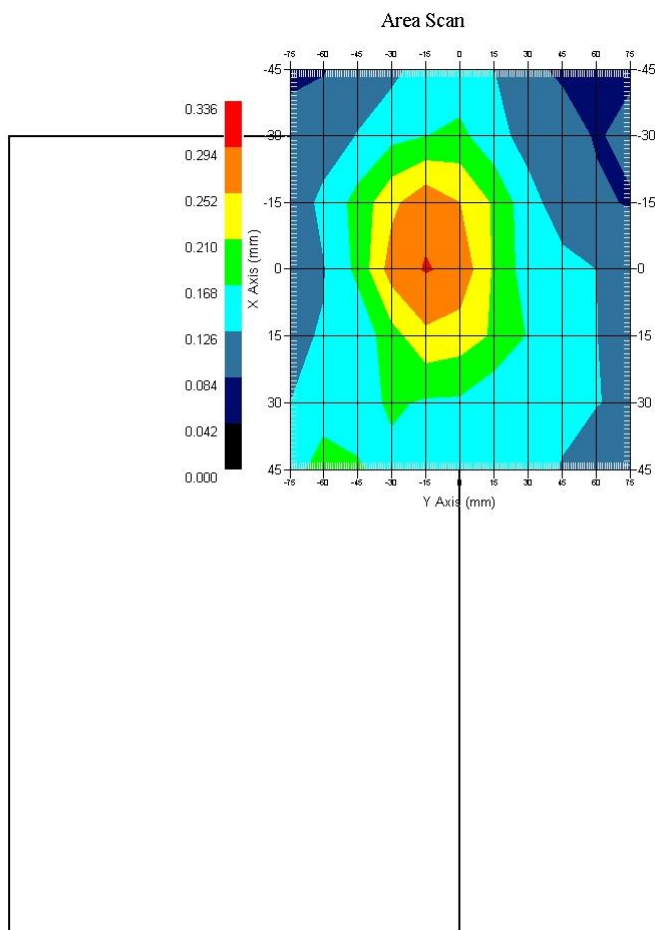
Name : Probe 215 - RFEL  
Model : E020  
Type : E-Field Triangle  
Serial No. : 215  
Last Calib. Date : 22-Sep-2010  
Frequency : 1900.00 MHz  
Duty Cycle Factor: 1  
Conversion Factor: 5  
Probe Sensitivity: 1.20 1.20 1.20  $\mu\text{V}/(\text{V}/\text{m})^2$   
Compression Point: 95.00 mV  
Offset : 1.56 mm

### Measurement Data

Crest Factor : 1  
Scan Type : Complete  
Tissue Temp. : 20.00 °C  
Ambient Temp. : 23.00 °C  
Set-up Date : 19-Apr-2011  
Set-up Time : 9:15:14 AM  
Area Scan : 7x11x1 : Measurement x=15mm, y=15mm, z=4mm  
Zoom Scan : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

### Other Data

DUT Position : Bottom  
Separation : 0 mm  
Channel : Mid



1 gram SAR value : 0.287 W/kg  
10 gram SAR value : 0.196 W/kg  
Area Scan Peak SAR : 0.297 W/kg  
Zoom Scan Peak SAR : 0.420 W/kg

**SAR Test Report**

By Operator : Jay  
Measurement Date : 17-May-2011  
Starting Time : 17-May-2011 12:35:05 PM  
End Time : 17-May-2011 01:04:42 PM  
Scanning Time : 1777 secs

## Product Data

Device Name : Novatel Wireless  
Serial No. : CAT000193015  
Mode : GPRS 2-Slot  
Model : HSTNN-F05C containing E362  
Frequency : 1900.00 MHz  
Max. Transmit Pwr : 0.457 W  
Drift Time : 0 min(s)  
Length : 269 mm  
Width : 173 mm  
Depth : 10 mm  
Antenna Type : Internal  
Orientation : Bottom  
Power Drift-Start : 0.228 W/kg  
Power Drift-Finish: 0.217 W/kg  
Power Drift (%) : -4.820

## Phantom Data

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

## Tissue Data

Type : BODY  
Serial No. : 1900  
Frequency : 1900.00 MHz  
Last Calib. Date : 17-May-2011  
Temperature : 20.00 °C  
Ambient Temp. : 23.00 °C  
Humidity : 36.00 RH%  
Epsilon : 52.56 F/m  
Sigma : 1.54 S/m  
Density : 1000.00 kg/cu. m

## Probe Data

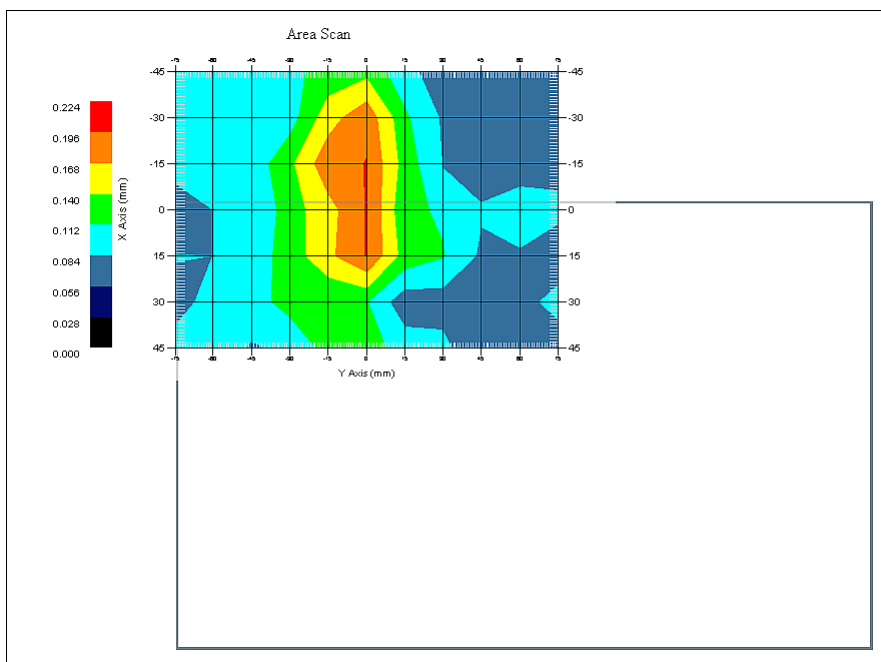
Name : Probe 215 - RFEL  
Model : E020  
Type : E-Field Triangle  
Serial No. : 215  
Last Calib. Date : 22-Sep-2010  
Frequency : 1900.00 MHz  
Duty Cycle Factor: 4  
Conversion Factor: 5  
Probe Sensitivity: 1.20 1.20 1.20  $\mu\text{V}/(\text{V}/\text{m})^2$   
Compression Point: 95.00 mV  
Offset : 1.56 mm

### Measurement Data

Crest Factor : 4  
Scan Type : Complete  
Tissue Temp. : 20.00 °C  
Ambient Temp. : 23.00 °C  
Set-up Date : 17-May-2011  
Set-up Time : 9:15:14 AM  
Area Scan : 7x11x1 : Measurement x=15mm, y=15mm, z=4mm  
Zoom Scan : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

### Other Data

DUT Position : Bottom  
Separation : 0 mm  
Channel : Mid



1 gram SAR value : 0.183 W/kg  
10 gram SAR value : 0.129 W/kg  
Area Scan Peak SAR : 0.197 W/kg  
Zoom Scan Peak SAR : 0.280 W/kg

**SAR Test Report**

By Operator : Jay  
Measurement Date : 20-Apr-2011  
Starting Time : 20-Apr-2011 01:51:55 PM  
End Time : 20-Apr-2011 02:18:18 PM  
Scanning Time : 1583 secs

## Product Data

Device Name : Novatel Wireless  
Serial No. : CAT000193015  
Mode : QPSK  
Model : HSTNN-F05C containing E362  
Frequency : 782.00 MHz  
Max. Transmit Pwr : 0.214 W  
Drift Time : 0 min(s)  
Length : 269 mm  
Width : 173 mm  
Depth : 10 mm  
Antenna Type : Internal  
Orientation : Bottom RB Size - 25 RB Offset - 13  
Power Drift-Start : 0.147 W/kg  
Power Drift-Finish: 0.151 W/kg  
Power Drift (%) : 2.725

## Phantom Data

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

## Tissue Data

Type : BODY  
Serial No. : 782  
Frequency : 782.00 MHz  
Last Calib. Date : 20-Apr-2011  
Temperature : 20.00 °C  
Ambient Temp. : 23.00 °C  
Humidity : 41.00 RH%  
Epsilon : 55.22 F/m  
Sigma : 0.98 S/m  
Density : 1000.00 kg/cu. m

## Probe Data

Name : Probe 215 - RFEL  
Model : E020  
Type : E-Field Triangle  
Serial No. : 215  
Last Calib. Date : 22-Sep-2010  
Frequency : 835.00 MHz  
Duty Cycle Factor: 1  
Conversion Factor: 6.3  
Probe Sensitivity: 1.20 1.20 1.20  $\mu\text{V}/(\text{V}/\text{m})^2$   
Compression Point: 95.00 mV  
Offset : 1.56 mm

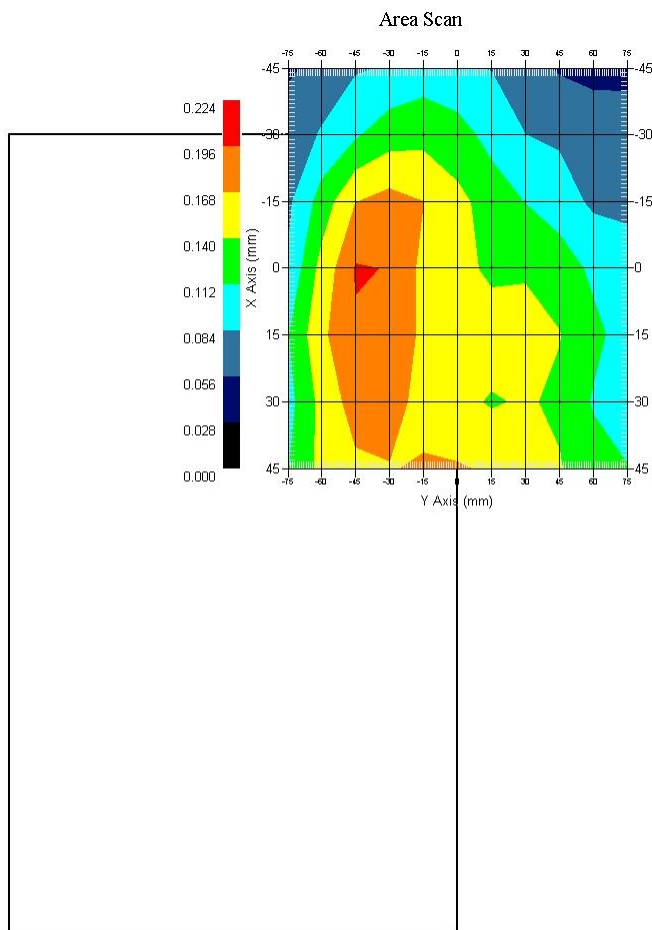


### Measurement Data

Crest Factor : 1  
Scan Type : Complete  
Tissue Temp. : 20.00 °C  
Ambient Temp. : 23.00 °C  
Set-up Date : 20-Apr-2011  
Set-up Time : 12:56:16 PM  
Area Scan : 7x11x1 : Measurement x=15mm, y=15mm, z=4mm  
Zoom Scan : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

### Other Data

DUT Position : Bottom RB Size - 25 RB Offset - 13  
Separation : 0 mm  
Channel : Mid



1 gram SAR value : 0.197 W/kg  
10 gram SAR value : 0.160 W/kg  
Area Scan Peak SAR : 0.198 W/kg  
Zoom Scan Peak SAR : 0.240 W/kg

**SAR Test Report**

By Operator : Jay  
Measurement Date : 20-Apr-2011  
Starting Time : 20-Apr-2011 02:48:28 PM  
End Time : 20-Apr-2011 03:14:40 PM  
Scanning Time : 1572 secs

## Product Data

Device Name : Novatel Wireless  
Serial No. : CAT000193015  
Mode : QPSK  
Model : HSTNN-F05C containing E362  
Frequency : 782.00 MHz  
Max. Transmit Pwr : 0.245 W  
Drift Time : 0 min(s)  
Length : 269 mm  
Width : 173 mm  
Depth : 10 mm  
Antenna Type : Internal  
Orientation : Bottom RB Size - 1 RB Offset - 0  
Power Drift-Start : 0.168 W/kg  
Power Drift-Finish: 0.163 W/kg  
Power Drift (%) : -2.539

## Phantom Data

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

## Tissue Data

Type : BODY  
Serial No. : 782  
Frequency : 782.00 MHz  
Last Calib. Date : 20-Apr-2011  
Temperature : 20.00 °C  
Ambient Temp. : 23.00 °C  
Humidity : 41.00 RH%  
Epsilon : 55.22 F/m  
Sigma : 0.98 S/m  
Density : 1000.00 kg/cu. m

## Probe Data

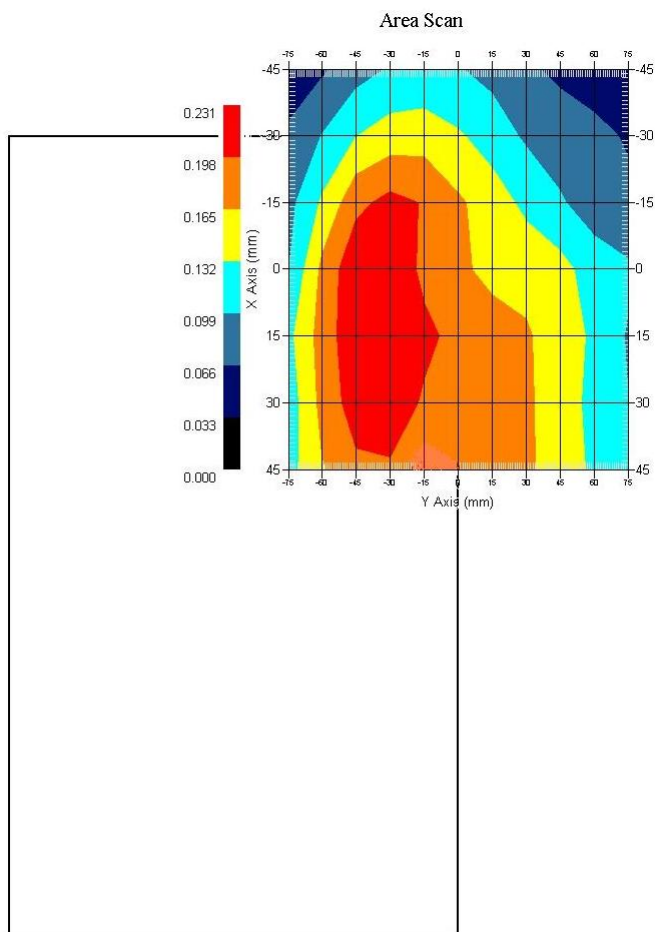
Name : Probe 215 - RFEL  
Model : E020  
Type : E-Field Triangle  
Serial No. : 215  
Last Calib. Date : 22-Sep-2010  
Frequency : 835.00 MHz  
Duty Cycle Factor: 1  
Conversion Factor: 6.3  
Probe Sensitivity: 1.20 1.20 1.20  $\mu\text{V}/(\text{V}/\text{m})^2$   
Compression Point: 95.00 mV  
Offset : 1.56 mm

Measurement Data

Crest Factor : 1  
Scan Type : Complete  
Tissue Temp. : 20.00 °C  
Ambient Temp. : 23.00 °C  
Set-up Date : 20-Apr-2011  
Set-up Time : 12:56:16 PM  
Area Scan : 7x11x1 : Measurement x=15mm, y=15mm, z=4mm  
Zoom Scan : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

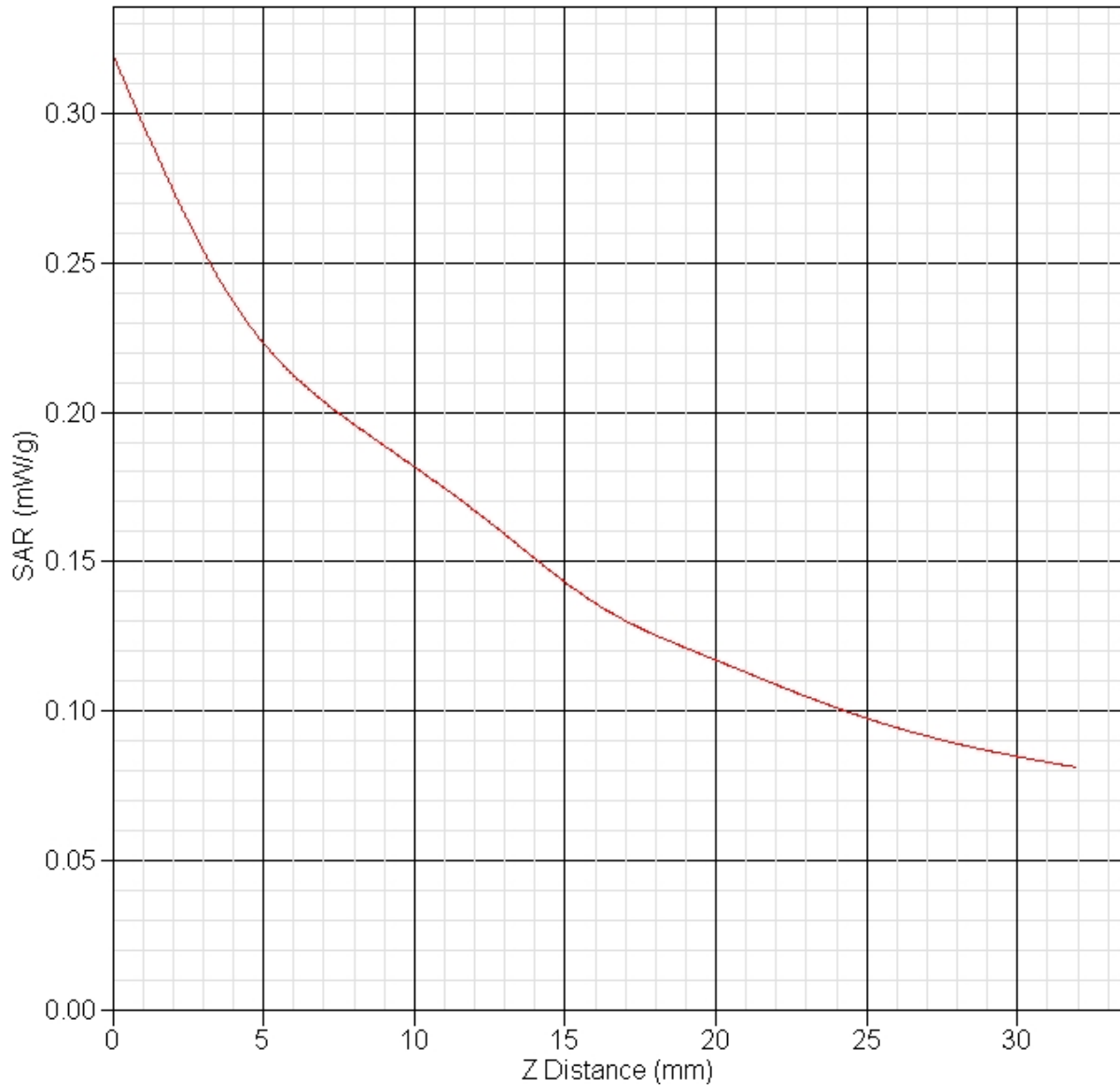
Other Data

DUT Position : Bottom RB Size - 1 RB Offset - 0  
Separation : 0 mm  
Channel : Mid



1 gram SAR value : 0.233 W/kg  
10 gram SAR value : 0.176 W/kg  
Area Scan Peak SAR : 0.228 W/kg  
Zoom Scan Peak SAR : 0.320 W/kg

**SAR-Z Axis**  
at Hotspot x:15.15 y:-37.94



**SAR Test Report**

By Operator : Jay  
Measurement Date : 20-Apr-2011  
Starting Time : 20-Apr-2011 02:20:33 PM  
End Time : 20-Apr-2011 02:46:58 PM  
Scanning Time : 1585 secs

## Product Data

Device Name : Novatel Wireless  
Serial No. : CAT000193015  
Mode : QPSK  
Model : HSTNN-F05C containing E362  
Frequency : 782.00 MHz  
Max. Transmit Pwr : 0.257 W  
Drift Time : 0 min(s)  
Length : 269 mm  
Width : 173 mm  
Depth : 10 mm  
Antenna Type : Internal  
Orientation : Bottom RB Size - 1 RB Offset - 49  
Power Drift-Start : 0.171 W/kg  
Power Drift-Finish: 0.172 W/kg  
Power Drift (%) : 0.283

## Phantom Data

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

## Tissue Data

Type : BODY  
Serial No. : 782  
Frequency : 782.00 MHz  
Last Calib. Date : 20-Apr-2011  
Temperature : 20.00 °C  
Ambient Temp. : 23.00 °C  
Humidity : 41.00 RH%  
Epsilon : 55.22 F/m  
Sigma : 0.98 S/m  
Density : 1000.00 kg/cu. m

## Probe Data

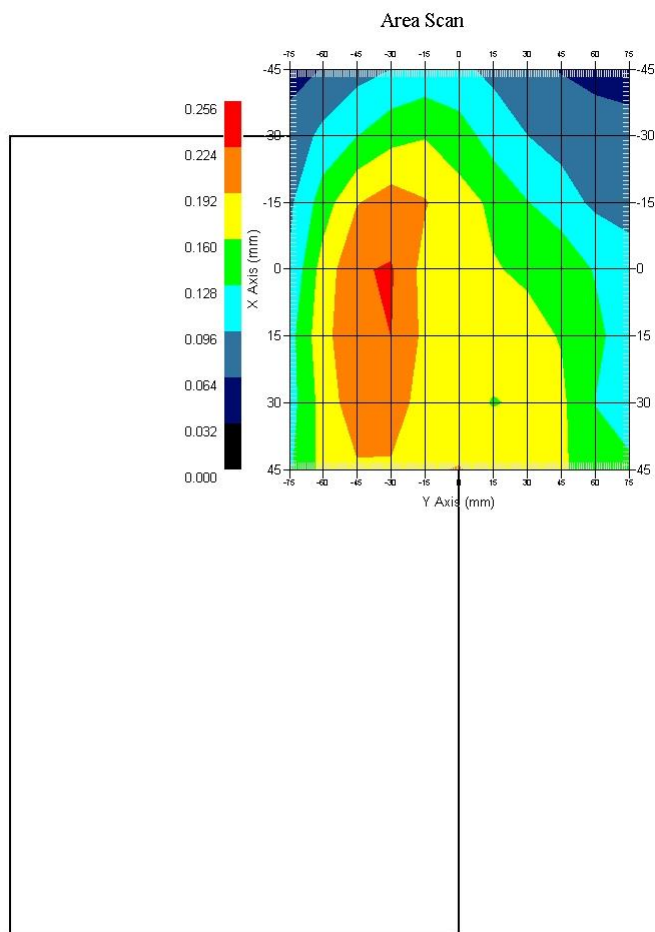
Name : Probe 215 - RFEL  
Model : E020  
Type : E-Field Triangle  
Serial No. : 215  
Last Calib. Date : 22-Sep-2010  
Frequency : 835.00 MHz  
Duty Cycle Factor: 1  
Conversion Factor: 6.3  
Probe Sensitivity: 1.20 1.20 1.20  $\mu\text{V}/(\text{V}/\text{m})^2$   
Compression Point: 95.00 mV  
Offset : 1.56 mm

### Measurement Data

Crest Factor : 1  
Scan Type : Complete  
Tissue Temp. : 20.00 °C  
Ambient Temp. : 23.00 °C  
Set-up Date : 20-Apr-2011  
Set-up Time : 12:56:16 PM  
Area Scan : 7x11x1 : Measurement x=15mm, y=15mm, z=4mm  
Zoom Scan : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

### Other Data

DUT Position : Bottom RB Size - 1 RB Offset - 49  
Separation : 0 mm  
Channel : Mid



1 gram SAR value : 0.226 W/kg  
10 gram SAR value : 0.171 W/kg  
Area Scan Peak SAR : 0.226 W/kg  
Zoom Scan Peak SAR : 0.300 W/kg

**SAR Test Report**

By Operator : Jay  
Measurement Date : 20-Apr-2011  
Starting Time : 20-Apr-2011 03:20:01 PM  
End Time : 20-Apr-2011 03:46:27 PM  
Scanning Time : 1586 secs

## Product Data

Device Name : Novatel Wireless  
Serial No. : CAT000193015  
Mode : 16QAM  
Model : HSTNN-F05C containing E362  
Frequency : 782.00 MHz  
Max. Transmit Pwr : 0.182 W  
Drift Time : 0 min(s)  
Length : 269 mm  
Width : 173 mm  
Depth : 10 mm  
Antenna Type : Internal  
Orientation : Bottom RB Size - 25 RB Offset - 13  
Power Drift-Start : 0.129 W/kg  
Power Drift-Finish: 0.129 W/kg  
Power Drift (%) : -0.244

## Phantom Data

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

## Tissue Data

Type : BODY  
Serial No. : 782  
Frequency : 782.00 MHz  
Last Calib. Date : 20-Apr-2011  
Temperature : 20.00 °C  
Ambient Temp. : 23.00 °C  
Humidity : 41.00 RH%  
Epsilon : 55.22 F/m  
Sigma : 0.98 S/m  
Density : 1000.00 kg/cu. m

## Probe Data

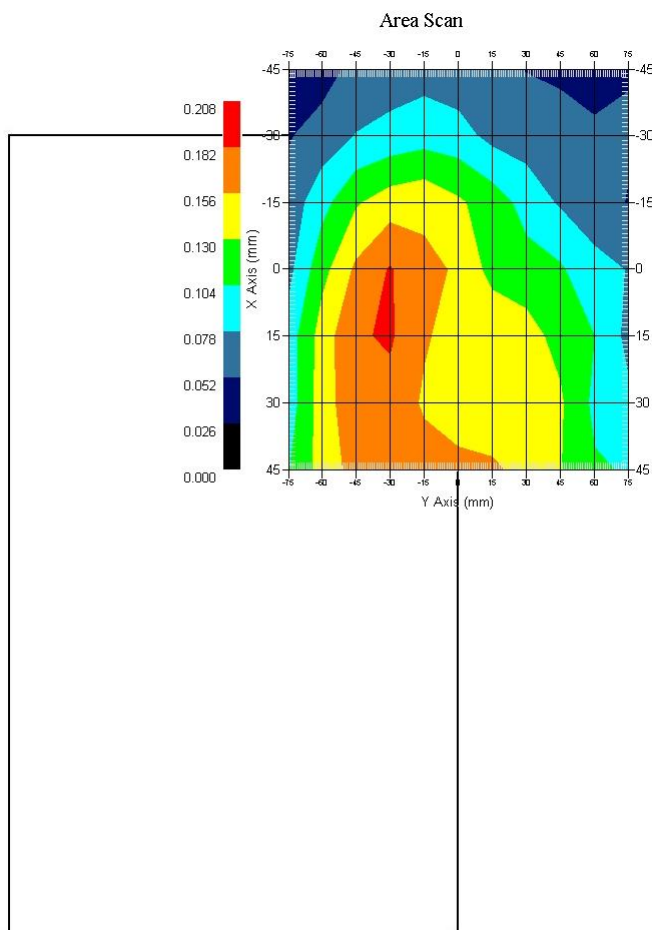
Name : Probe 215 - RFEL  
Model : E020  
Type : E-Field Triangle  
Serial No. : 215  
Last Calib. Date : 22-Sep-2010  
Frequency : 835.00 MHz  
Duty Cycle Factor: 1  
Conversion Factor: 6.3  
Probe Sensitivity: 1.20 1.20 1.20  $\mu\text{V}/(\text{V}/\text{m})^2$   
Compression Point: 95.00 mV  
Offset : 1.56 mm

### Measurement Data

Crest Factor : 1  
Scan Type : Complete  
Tissue Temp. : 20.00 °C  
Ambient Temp. : 23.00 °C  
Set-up Date : 20-Apr-2011  
Set-up Time : 12:56:16 PM  
Area Scan : 7x11x1 : Measurement x=15mm, y=15mm, z=4mm  
Zoom Scan : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

### Other Data

DUT Position : Bottom RB Size - 25 RB Offset - 13  
Separation : 0 mm  
Channel : Mid



1 gram SAR value : 0.184 W/kg  
10 gram SAR value : 0.141 W/kg  
Area Scan Peak SAR : 0.185 W/kg  
Zoom Scan Peak SAR : 0.260 W/kg



**SAR Test Report**

By Operator : Jay  
Measurement Date : 20-Apr-2011  
Starting Time : 20-Apr-2011 04:16:13 PM  
End Time : 20-Apr-2011 04:42:13 PM  
Scanning Time : 1560 secs

## Product Data

Device Name : Novatel Wireless  
Serial No. : CAT000193015  
Mode : 16QAM  
Model : HSTNN-F05C containing E362  
Frequency : 782.00 MHz  
Max. Transmit Pwr : 0.214 W  
Drift Time : 0 min(s)  
Length : 269 mm  
Width : 173 mm  
Depth : 10 mm  
Antenna Type : Internal  
Orientation : Bottom RB Size - 1 RB Offset - 0  
Power Drift-Start : 0.137 W/kg  
Power Drift-Finish: 0.143 W/kg  
Power Drift (%) : 4.379

## Phantom Data

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

## Tissue Data

Type : BODY  
Serial No. : 782  
Frequency : 782.00 MHz  
Last Calib. Date : 20-Apr-2011  
Temperature : 20.00 °C  
Ambient Temp. : 23.00 °C  
Humidity : 41.00 RH%  
Epsilon : 55.22 F/m  
Sigma : 0.98 S/m  
Density : 1000.00 kg/cu. m

## Probe Data

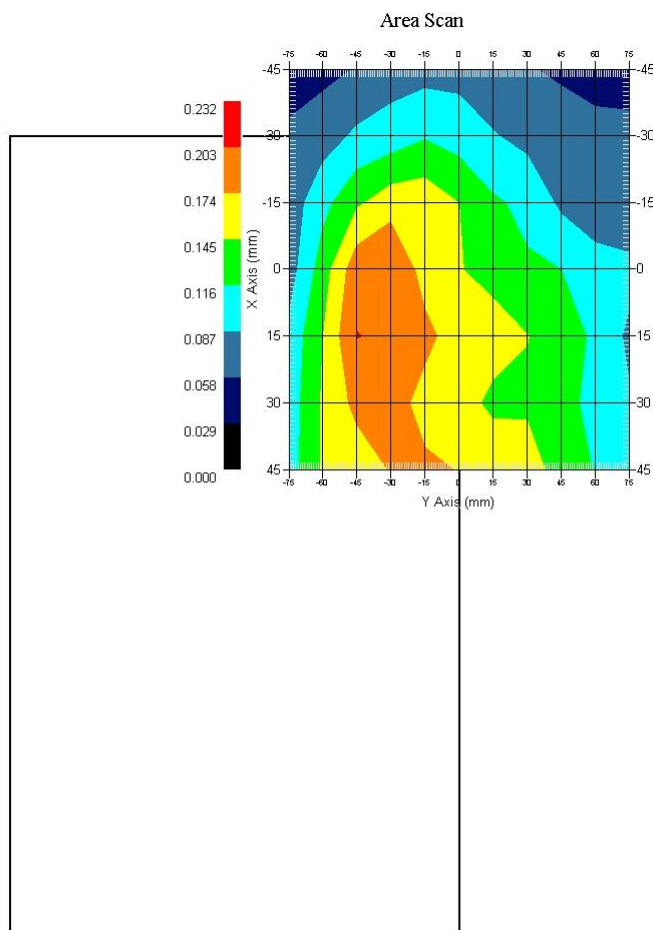
Name : Probe 215 - RFEL  
Model : E020  
Type : E-Field Triangle  
Serial No. : 215  
Last Calib. Date : 22-Sep-2010  
Frequency : 835.00 MHz  
Duty Cycle Factor: 1  
Conversion Factor: 6.3  
Probe Sensitivity: 1.20 1.20 1.20  $\mu\text{V}/(\text{V}/\text{m})^2$   
Compression Point: 95.00 mV  
Offset : 1.56 mm

### Measurement Data

Crest Factor : 1  
Scan Type : Complete  
Tissue Temp. : 20.00 °C  
Ambient Temp. : 23.00 °C  
Set-up Date : 20-Apr-2011  
Set-up Time : 12:56:16 PM  
Area Scan : 7x11x1 : Measurement x=15mm, y=15mm, z=4mm  
Zoom Scan : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

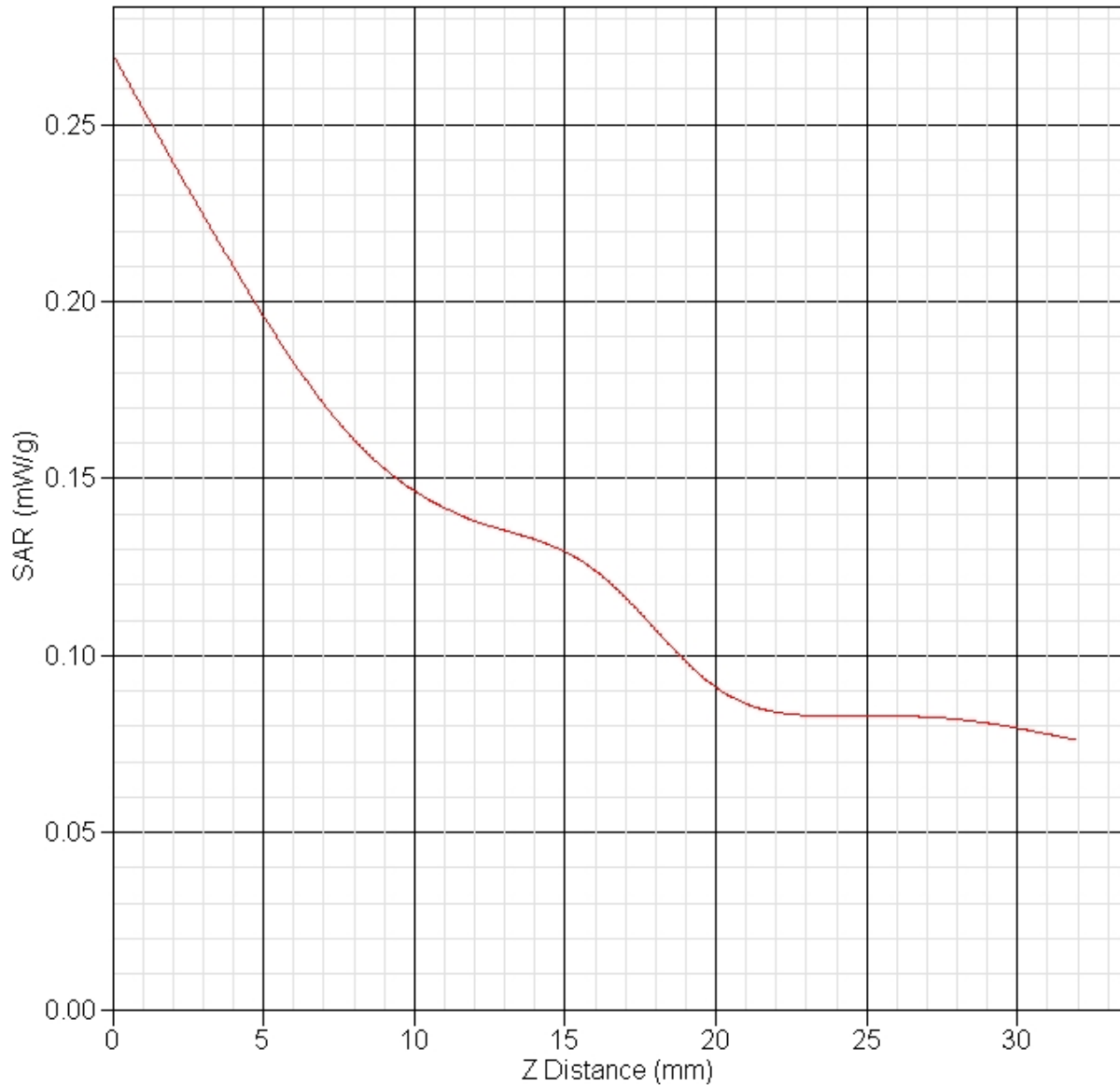
### Other Data

DUT Position : Bottom RB Size - 1 RB Offset - 0  
Separation : 0 mm  
Channel : Mid



1 gram SAR value : 0.201 W/kg  
10 gram SAR value : 0.150 W/kg  
Area Scan Peak SAR : 0.204 W/kg  
Zoom Scan Peak SAR : 0.270 W/kg

**SAR-Z Axis**  
at Hotspot x:14.07 y:-36.95



**SAR Test Report**

By Operator : Jay  
Measurement Date : 20-Apr-2011  
Starting Time : 20-Apr-2011 03:47:53 PM  
End Time : 20-Apr-2011 04:13:59 PM  
Scanning Time : 1566 secs

## Product Data

Device Name : Novatel Wireless  
Serial No. : CAT000193015  
Mode : 16QAM  
Model : HSTNN-F05C containing E362  
Frequency : 782.00 MHz  
Max. Transmit Pwr : 0.214 W  
Drift Time : 0 min(s)  
Length : 269 mm  
Width : 173 mm  
Depth : 10 mm  
Antenna Type : Internal  
Orientation : Bottom RB Size - 1 RB Offset - 49  
Power Drift-Start : 0.161 W/kg  
Power Drift-Finish: 0.154 W/kg  
Power Drift (%) : -4.346

## Phantom Data

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

## Tissue Data

Type : BODY  
Serial No. : 782  
Frequency : 782.00 MHz  
Last Calib. Date : 20-Apr-2011  
Temperature : 20.00 °C  
Ambient Temp. : 23.00 °C  
Humidity : 41.00 RH%  
Epsilon : 55.22 F/m  
Sigma : 0.98 S/m  
Density : 1000.00 kg/cu. m

## Probe Data

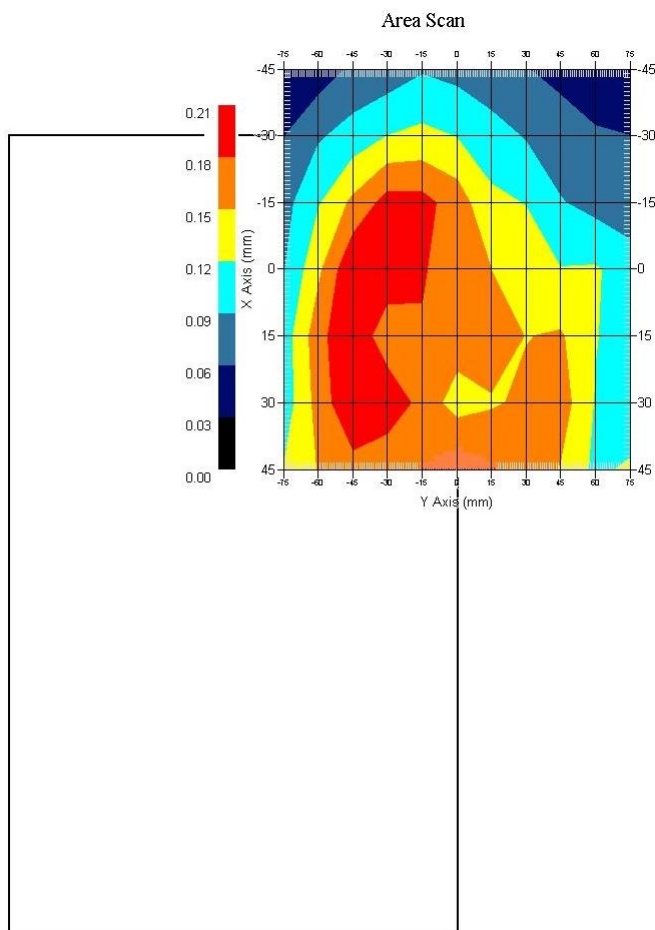
Name : Probe 215 - RFEL  
Model : E020  
Type : E-Field Triangle  
Serial No. : 215  
Last Calib. Date : 22-Sep-2010  
Frequency : 835.00 MHz  
Duty Cycle Factor: 1  
Conversion Factor: 6.3  
Probe Sensitivity: 1.20 1.20 1.20  $\mu\text{V}/(\text{V}/\text{m})^2$   
Compression Point: 95.00 mV  
Offset : 1.56 mm

### Measurement Data

Crest Factor : 1  
Scan Type : Complete  
Tissue Temp. : 20.00 °C  
Ambient Temp. : 23.00 °C  
Set-up Date : 20-Apr-2011  
Set-up Time : 12:56:16 PM  
Area Scan : 7x11x1 : Measurement x=15mm, y=15mm, z=4mm  
Zoom Scan : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

### Other Data

DUT Position : Bottom RB Size - 1 RB Offset - 49  
Separation : 0 mm  
Channel : Mid



1 gram SAR value : 0.189 W/kg  
10 gram SAR value : 0.177 W/kg  
Area Scan Peak SAR : 0.210 W/kg  
Zoom Scan Peak SAR : 0.310 W/kg

## **Appendix D – Probe Calibration Data Sheets**

# NCL CALIBRATION LABORATORIES

Calibration File No.: CP-1156

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.: 215

Body Calibration

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

Project No: RFEL-E-020-Cal-5539

Calibrated: 22 September 2010

Released on: 27 September 2010

This Calibration Certificate is Incomplete Unless Accompanied with the Calibration Results Summary  
This calibration has been conducted in line with the SCC ISO-IEC 17025 Scope of Accreditation  
Accredited Laboratory Number 48

Released By: \_\_\_\_\_

**NCL** CALIBRATION LABORATORIES

17 Bentley Ave  
NEPEAN, ONTARIO  
CANADA K2E 6T7

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-020 215.

## References

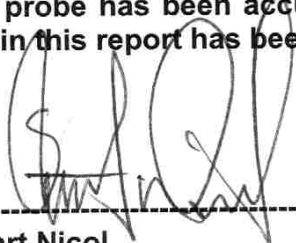
SSI/DRB-TP-D01-032-E020-V2 E-Field Probe Calibration Procedure  
IEEE 1528 "Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques"  
IEEE 1309 "IEEE Standard for Calibration of Electromagnetic Field Sensors and Probes, Excluding Antennas, from 9 KHz to 40 GHz" 2005  
SSI-TP-011 Tissue Calibration Procedure  
IEC 62209 "Human exposure to radio frequency fields from handheld and body-mounted wireless communication devices –Human models, instrumentation and procedures Part 1 & 2: Procedure to determine the Specific Absorption Rate (SAR) for handheld devices used in close proximity of the ear (frequency range of 200MHz to 3GHz)"

## Conditions

Probe 215 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 probe has been accurately conducted and that all information contained within this report has been reviewed for accuracy.**

  
-----  
**Stuart Nicol**

  
-----  
**Jesse Hones**



## Calibration Results Summary

<b>Probe Type:</b>	E-Field Probe E-020
<b>Serial Number:</b>	215
<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 Measured**

**Frequency:** 835 MHz

**Epsilon:** 53.7 (+/-5%)      **Sigma:** 0.96 S/m (+/-5%)

### **ConvF**

**Channel X:** 6.3

**Channel Y:** 6.3

**Channel Z:** 6.3

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

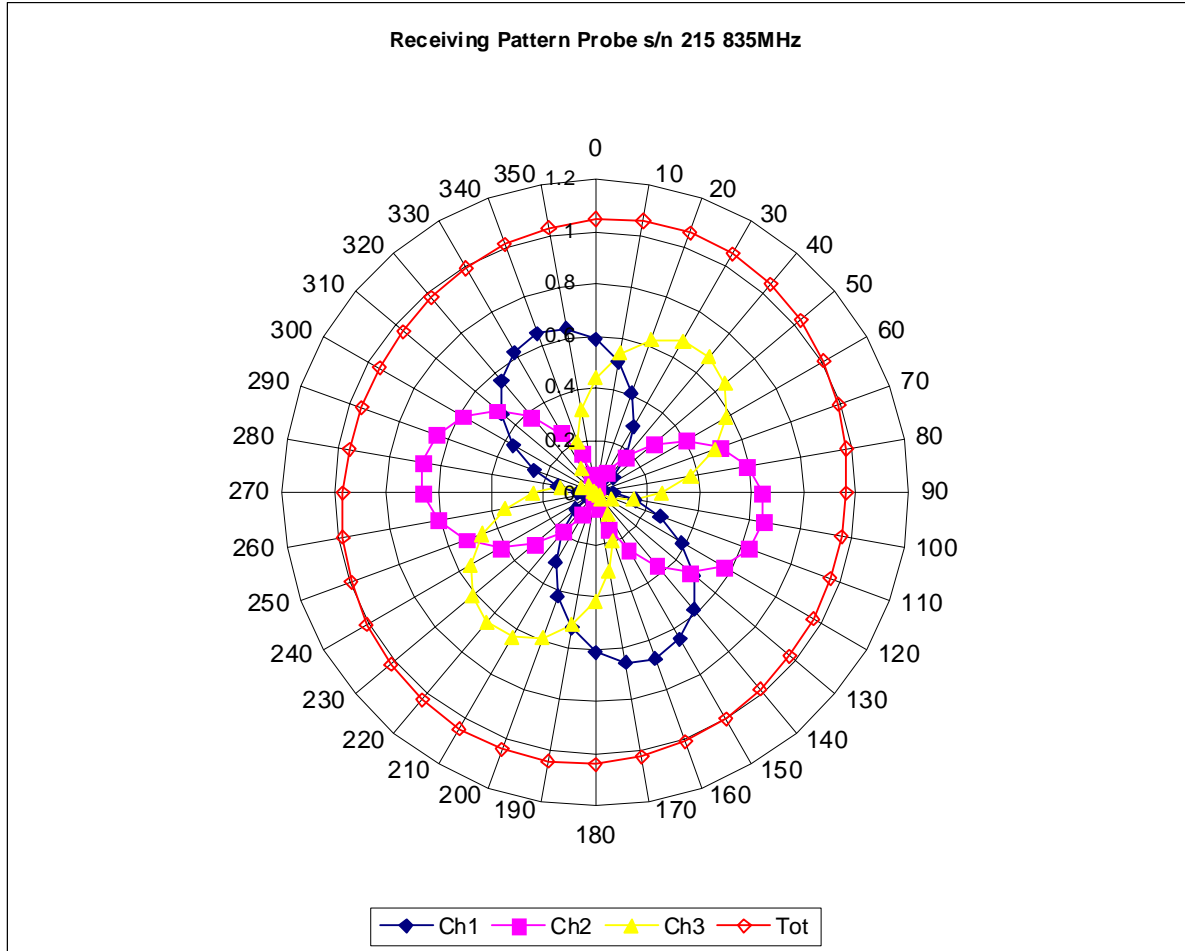
### **Boundary Effect:**

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 2.44mm.

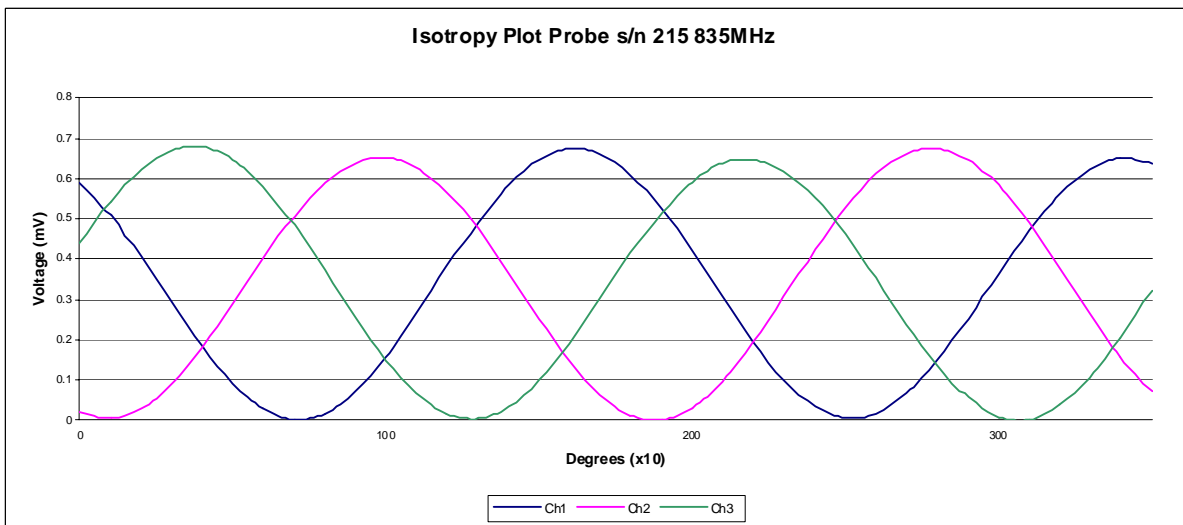
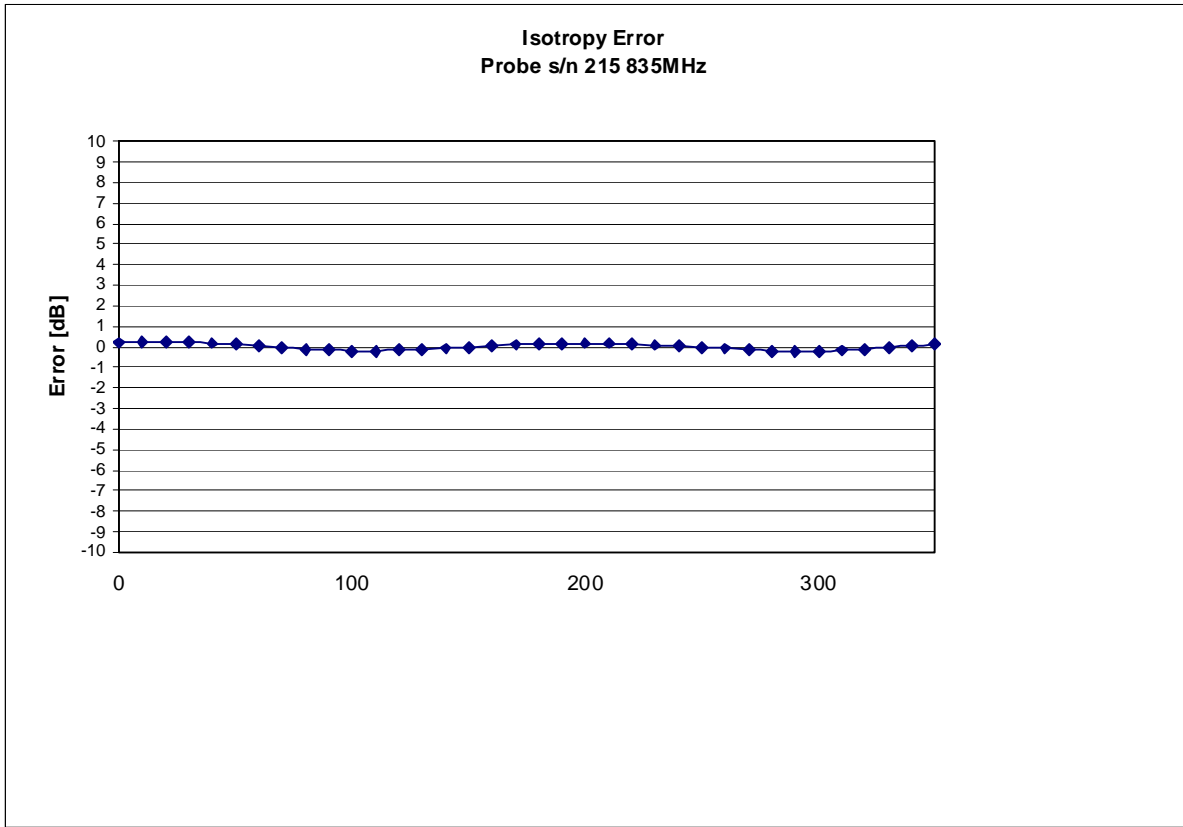
### **Spatial Resolution:**

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)



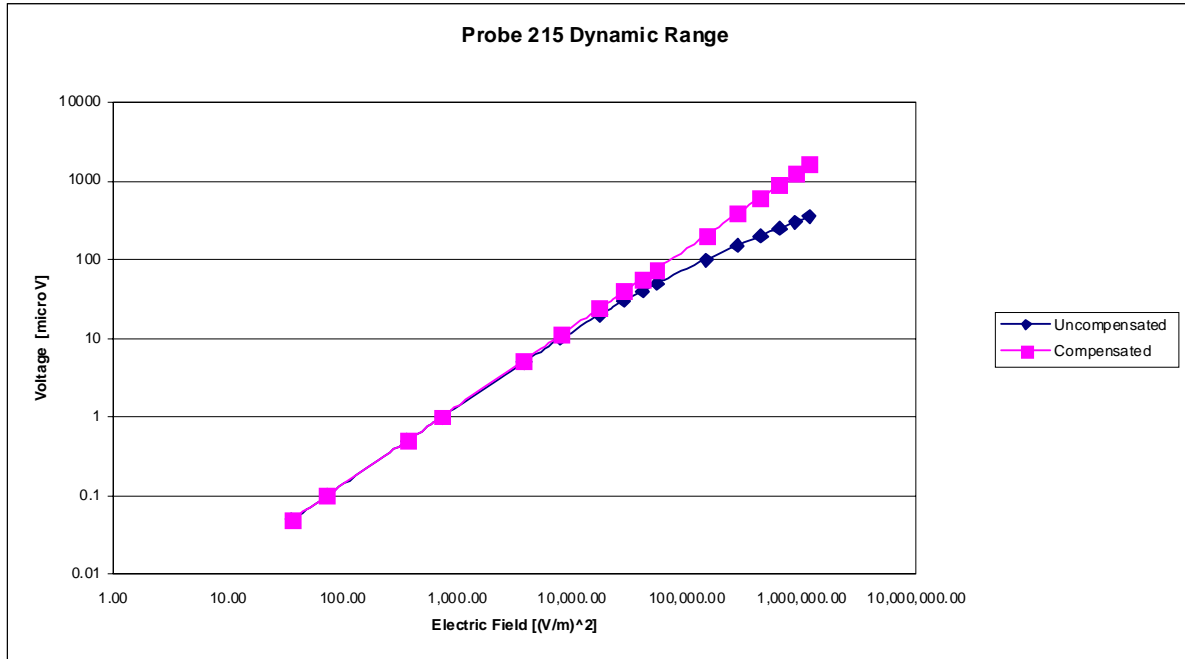
### Isotropy Error 835 MHz (Air)



Isotropicity Tissue:

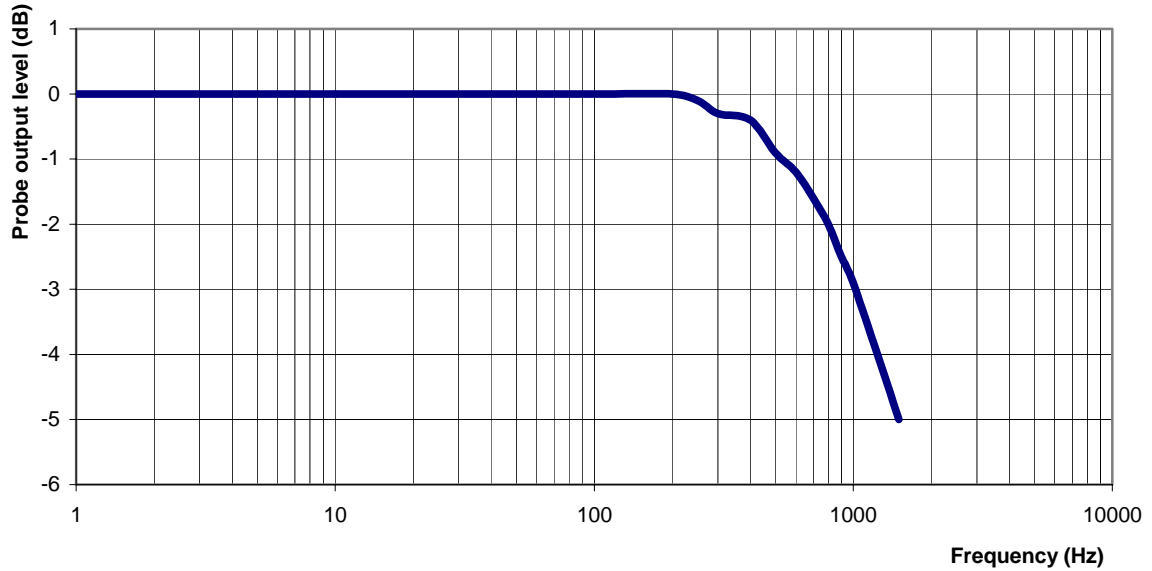
0.10 dB

## Dynamic Range



## Video Bandwidth

**Probe Frequency Characteristics**



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

## **Conversion Factor Uncertainty Assessment Measured**

### **Sensitivity in Body Tissue**

**Frequency:** 835 MHz  
**Epsilon:** 53.7 (+/-5%)      **Sigma:** 0.96 S/m (+/-5%)

#### **ConvF**

**Channel X:** 6.3      7%(K=2)  
**Channel Y:** 6.3      7%(K=2)  
**Channel Z:** 6.3      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 2.5mm 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 2010



# NCL CALIBRATION LABORATORIES

Calibration File No.: CP-1162

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 1900 MHz

Manufacturer: APREL Laboratories

Model No.: E-020

Serial No.: 215

Body Calibration

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

Project No: RFEL-E-020-Cal-5539

Calibrated: 22 September 2010

Released on: 27 September 2010

This Calibration Certificate is Incomplete Unless Accompanied with the Calibration Results Summary  
This calibration has been conducted in line with the SCC ISO-IEC 17025 Scope of Accreditation  
Accredited Laboratory Number 48

Released By: \_\_\_\_\_

**NCL** CALIBRATION LABORATORIES

17 Bentley Ave  
NEPEAN, ONTARIO  
CANADA K2E 6T7

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-020 215.

## References

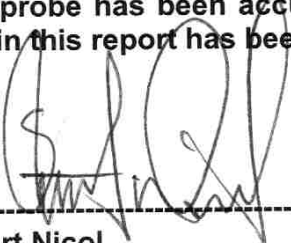
SSI/DRB-TP-D01-032-E020-V2 E-Field Probe Calibration Procedure  
IEEE 1528 "Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques"  
IEEE 1309 "IEEE Standard for Calibration of Electromagnetic Field Sensors and Probes, Excluding Antennas, from 9 KHz to 40 GHz" 2005  
SSI-TP-011 Tissue Calibration Procedure  
IEC 62209 "Human exposure to radio frequency fields from handheld and body-mounted wireless communication devices –Human models, instrumentation and procedures Part 1 & 2: Procedure to determine the Specific Absorption Rate (SAR) for handheld devices used in close proximity of the ear (frequency range of 200MHz to 3GHz)"

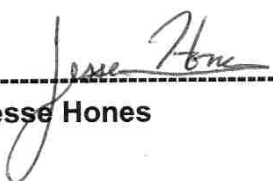
## Conditions

Probe 215 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 probe has been accurately conducted and that all information contained within this report has been reviewed for accuracy.**

  
-----  
**Stuart Nicol**

  
-----  
**Jesse Hones**

## Calibration Results Summary

<b>Probe Type:</b>	E-Field Probe E-020
<b>Serial Number:</b>	215
<b>Frequency:</b>	1900 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 Measured**

**Frequency:** 1900 MHz

**Epsilon:** 51.9 (+/-5%)                      **Sigma:** 1.56 S/m (+/-5%)

### **ConvF**

**Channel X:** 5.0

**Channel Y:** 5.0

**Channel Z:** 5.0

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

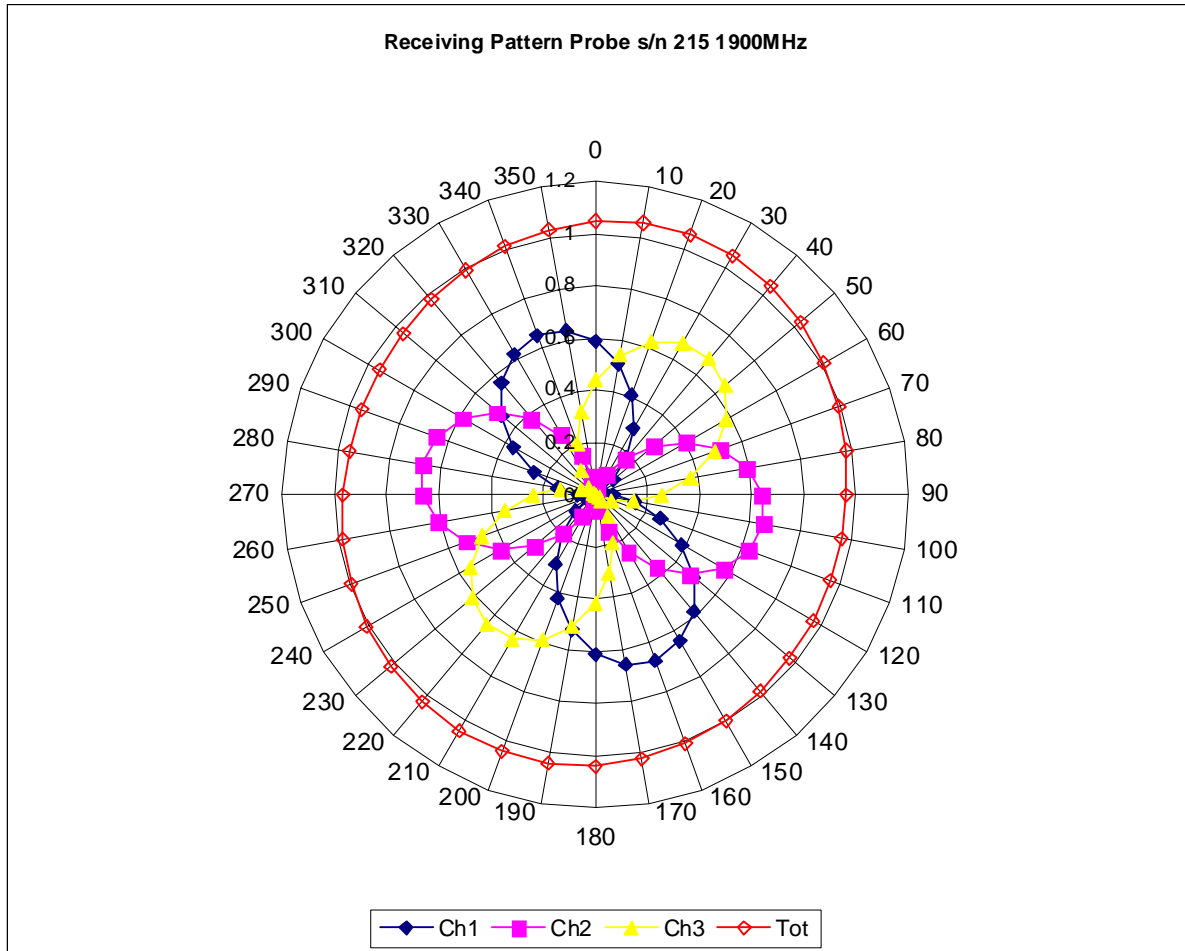
### **Boundary Effect:**

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 2.44mm.

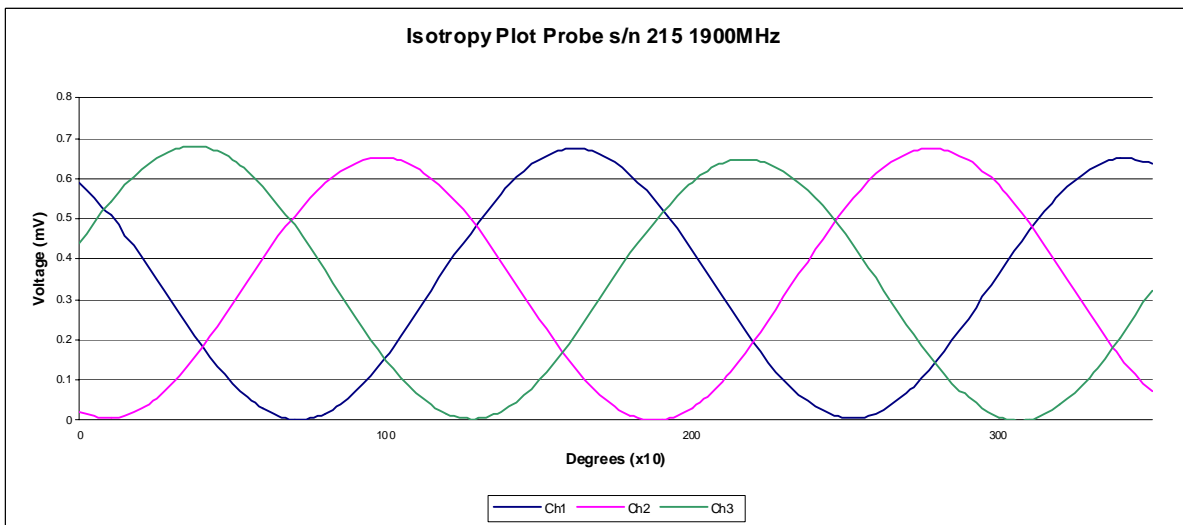
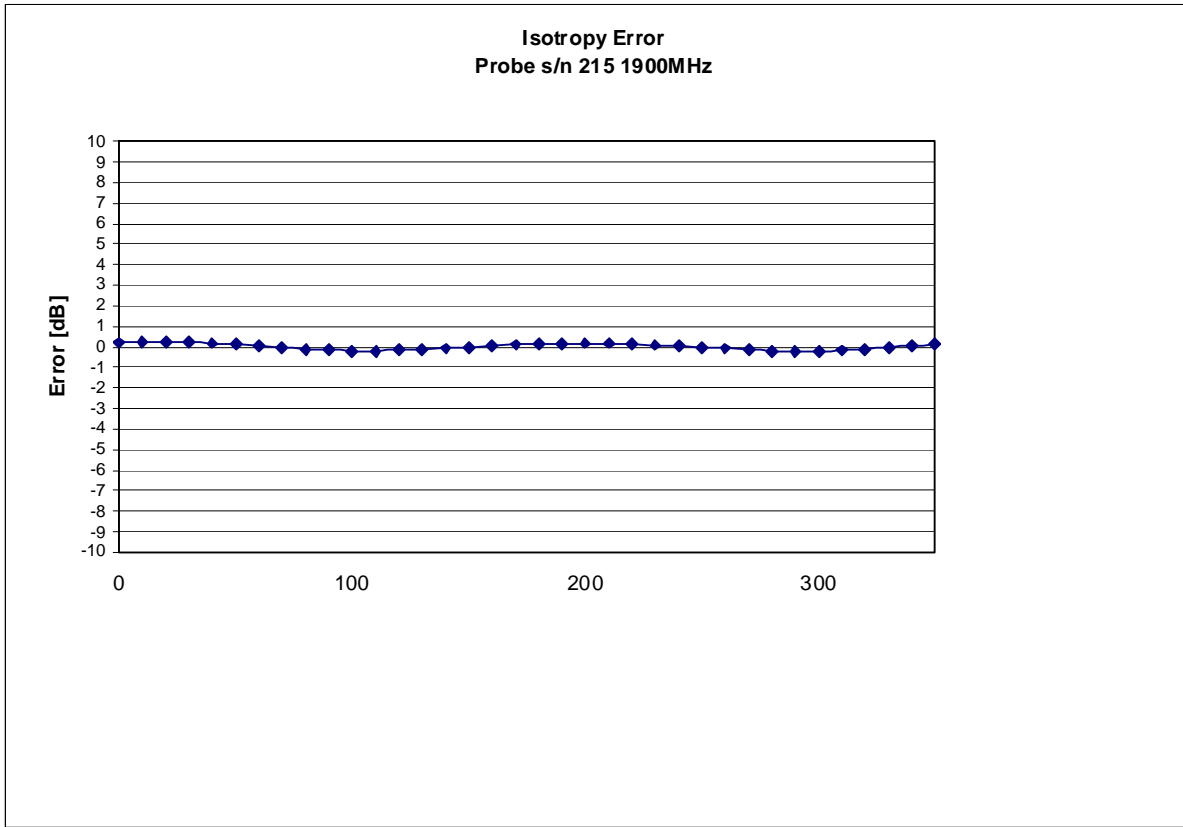
### **Spatial Resolution:**

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 1900 MHz (Air)



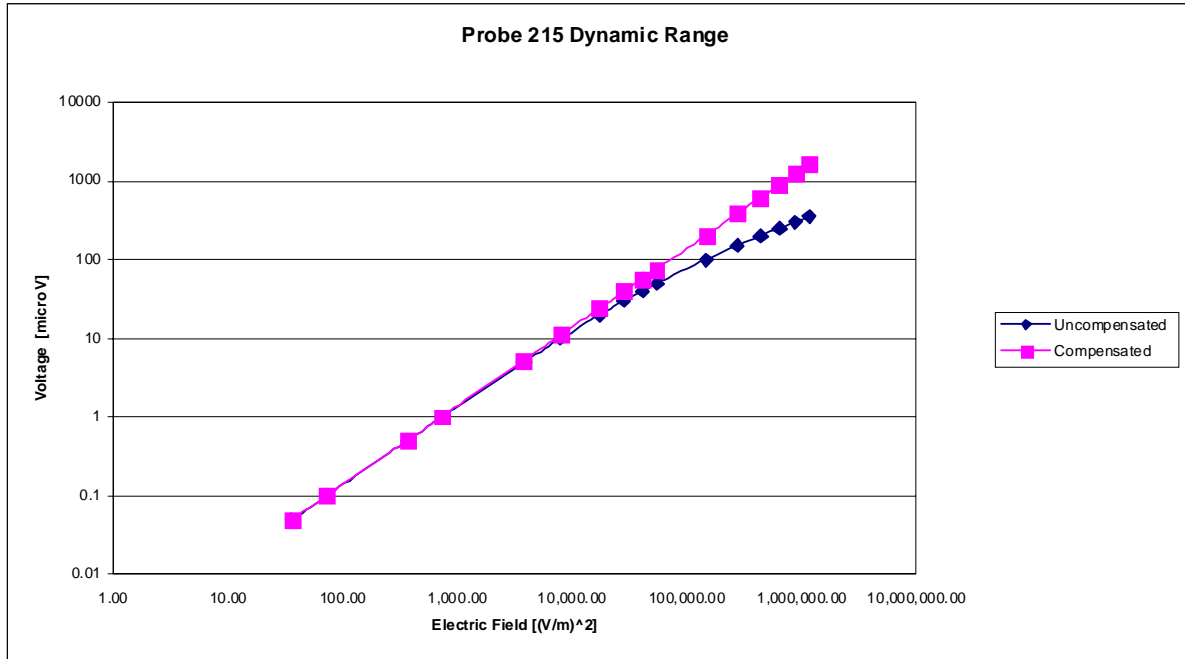
### Isotropy Error 1900 MHz (Air)



Isotropicity Tissue:

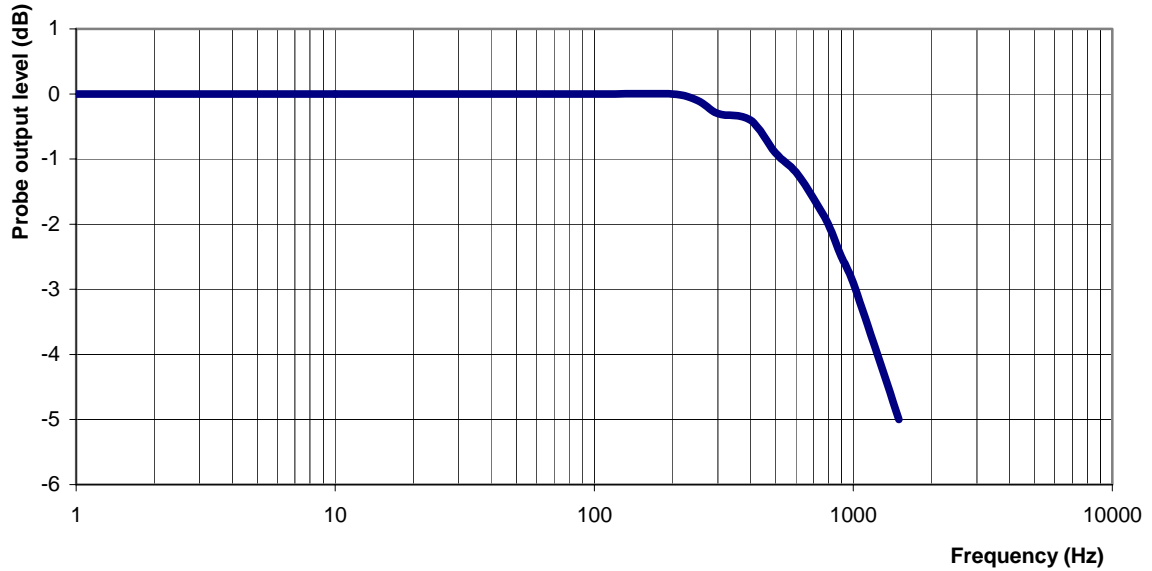
0.10 dB

## Dynamic Range



## Video Bandwidth

**Probe Frequency Characteristics**



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



## **Conversion Factor Uncertainty Assessment Measured**

### **Sensitivity in Body Tissue**

**Frequency:** 1900 MHz

**Epsilon:** 51.9 (+/-5%)      **Sigma:** 1.56 S/m (+/-5%)

#### **ConvF**

**Channel X:** 5.0      7%(K=2)

**Channel Y:** 5.0      7%(K=2)

**Channel Z:** 5.0      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 2.5mm 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 2010.

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

# NCL CALIBRATION LABORATORIES

Calibration File No: DC-1178  
Project Number: RFEL-DC-750B-5548

## 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.

Validation Dipole

Manufacturer: APREL Laboratories

Part number: ALS-D-750-S-2

Frequency: 750 MHz

Serial No: 177-00501

Customer: RFEL

Body Calibration

Calibrated: 15<sup>th</sup> November 2010  
Released on: 16<sup>th</sup> November 2010

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

## **NCL Calibration Laboratories**

---

Division of APREL Laboratories.

### **Conditions**

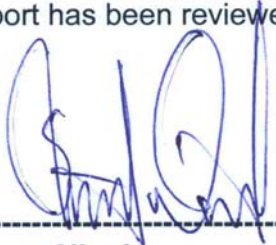
Dipole 177-00501 was a new calibration.

**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

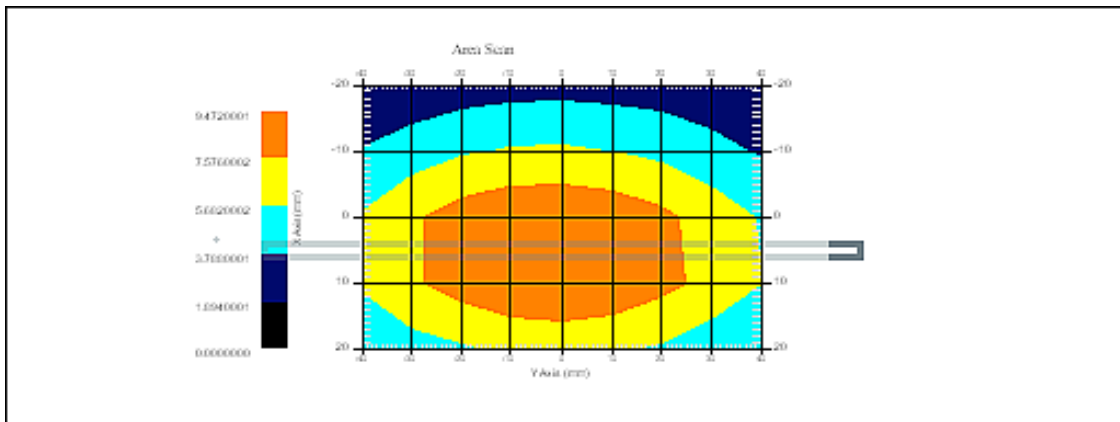
**Length:** 180.2 mm  
**Height:** 97.0 mm

### Electrical Specification

**SWR:** 1.098U  
**Return Loss:** -27.875 dB  
**Impedance:** 52.754  $\Omega$

### System Validation Results

Frequency	1 Gram	10 Gram	Peak
750 MHz	8.7	5.64	12.9



## **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 177-00501. 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 2225.

## **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 177-00501 was a new 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

<b>APREL Length</b>	<b>APREL Height</b>	<b>Measured Length</b>	<b>Measured Height</b>
180.0 mm	97.8 mm	180.2 mm	97.0 mm

### Tissue Validation

<b>Body Tissue 750MHz</b>	<b>Measured</b>
<b>Dielectric constant, <math>\epsilon_r</math></b>	57.07
<b>Conductivity, <math>\sigma</math> [S/m]</b>	1.02

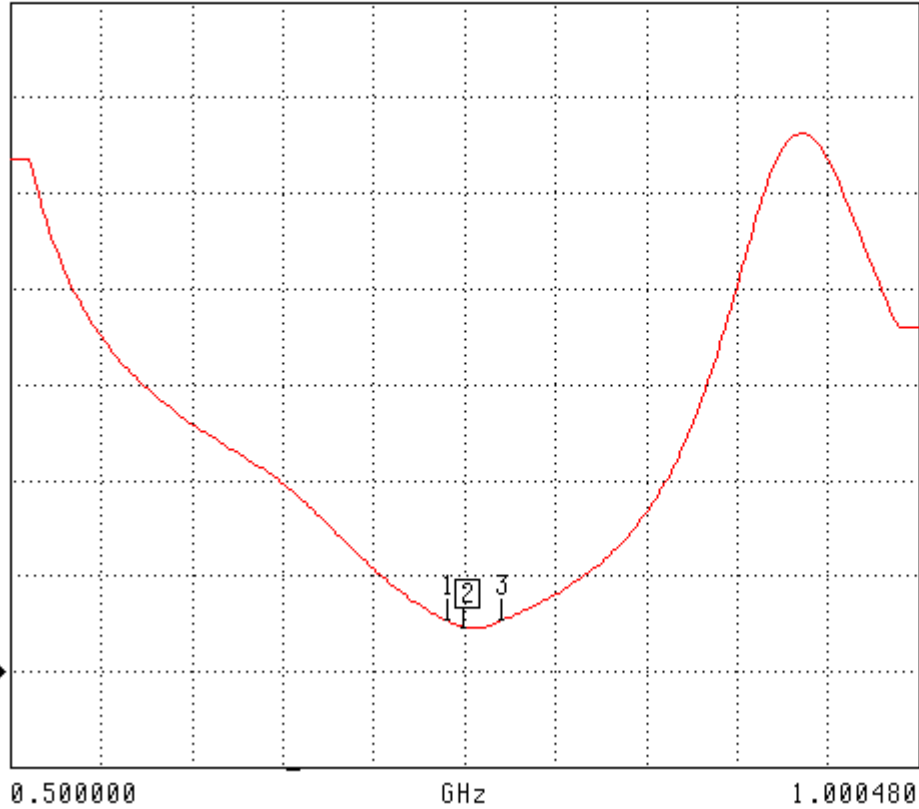




SWR

S11 FORWARD REFLECTION

SWR REF=172.168 mU 2.000 U/DIV



CH 1 - S11  
5.0584 mm REF  
0.000 dB OFFSET  
0.00° OFFSET

MARKER 2  
0.750000 GHz  
1.098 U

MARKER TO MAX  
MARKER TO MIN

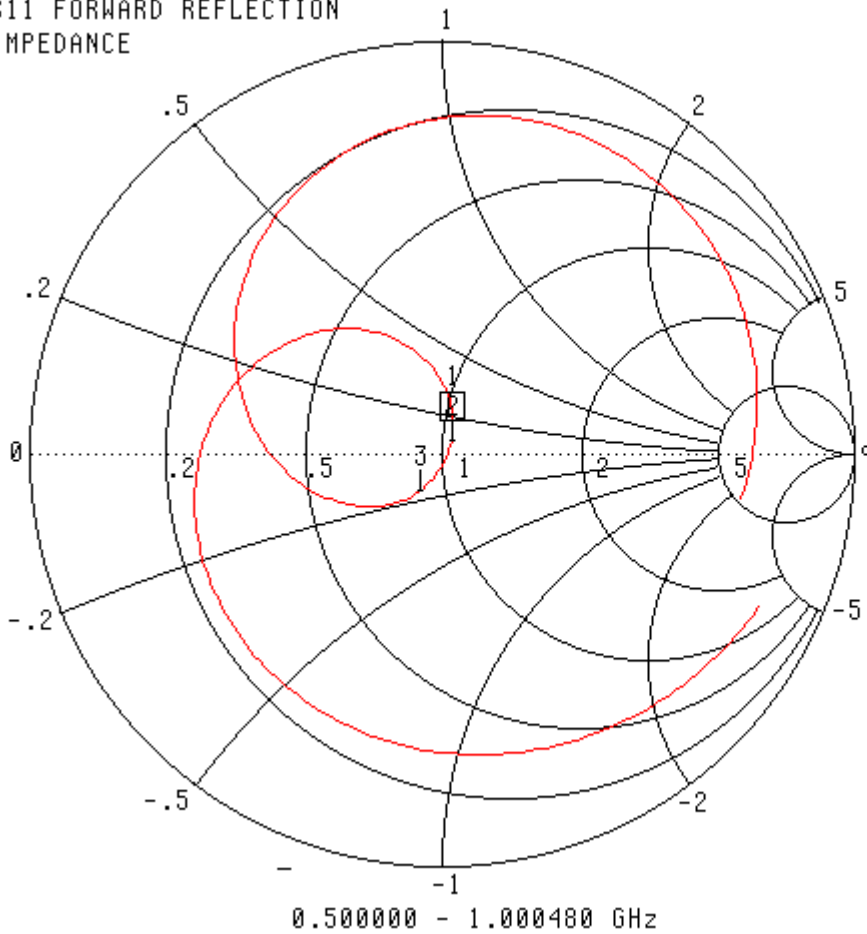
1 0.740967 GHz  
1.234 U

3 0.770480 GHz  
1.233 U

MARKER READOUT  
FUNCTIONS

### Smith Chart Dipole Impedance

S11 FORWARD REFLECTION  
IMPEDANCE



CH 1 - S11  
5.0584 mm REF  
0.000 dB OFFSET  
0.00° OFFSET

▶ MARKER 2  
0.750000 GHz  
52.754 Ω  
3.122 jΩ

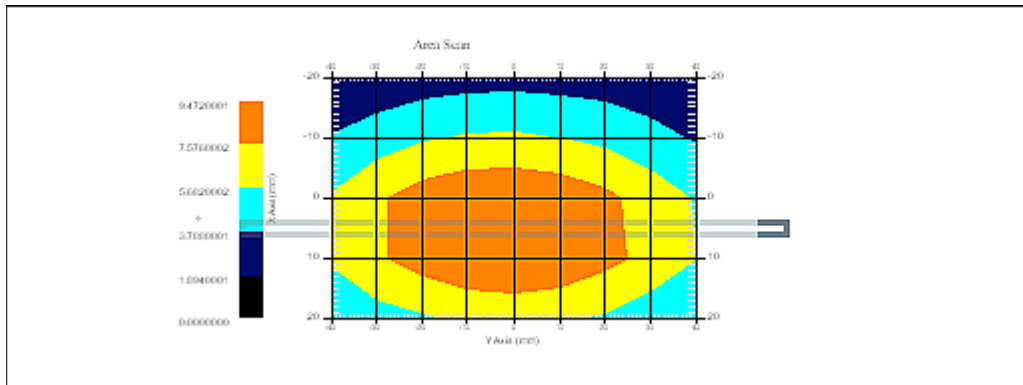
MARKER TO MAX  
MARKER TO MIN

**1** 0.740967 GHz  
51.843 Ω  
10.414 jΩ  
**3** 0.770480 GHz  
44.676 Ω  
-8.291 jΩ

MARKER READOUT  
FUNCTIONS

**System Validation Results Using the Electrically Calibrated Dipole**

<b>Body Tissue Frequency</b>	<b>1 Gram</b>	<b>10 Gram</b>	<b>Peak Above Feed Point</b>
750 MHz	8.7	5.64	12.9



## **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 2010.

# NCL CALIBRATION LABORATORIES

Calibration File No: DC-1179  
Project Number: RFEL-DC-835B-5549

## 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.

Validation Dipole

Manufacturer: APREL Laboratories

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

Frequency: 835 MHz

Serial No: 180-00561

Customer: RFEL

Body Calibration

Calibrated: 16<sup>th</sup> November 2010  
Released on: 16<sup>th</sup> November 2010

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

## NCL Calibration Laboratories

---

Division of APREL Laboratories.

### Conditions

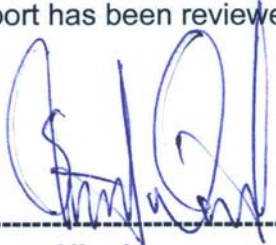
Dipole 180-00561 was a new calibration.

**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

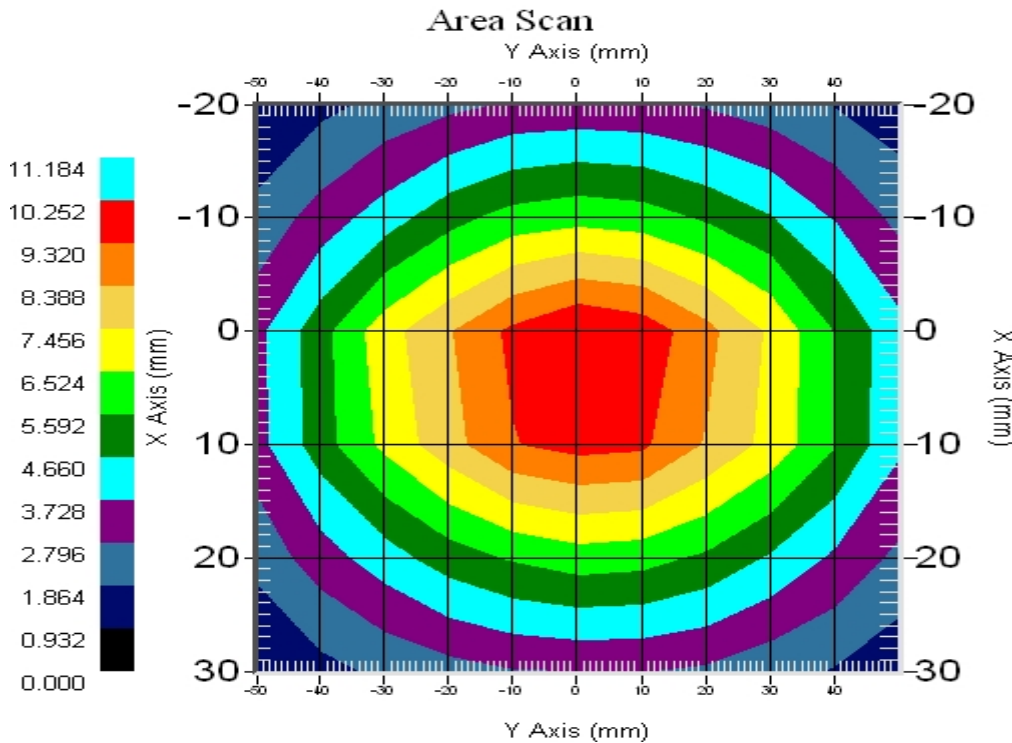
**Length:** 161.0 mm  
**Height:** 89.8 mm

### Electrical Specification

**SWR:** 1.143U  
**Return Loss:** -24.058 dB  
**Impedance:** 55.519  $\Omega$

### System Validation Results

Frequency	1 Gram	10 Gram	Peak
835 MHz	9.81	6.3	14.87





## **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 180-00561. 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 2225.

## **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 180-00561 was a new 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

<b>APREL Length</b>	<b>APREL Height</b>	<b>Measured Length</b>	<b>Measured Height</b>
161.0 mm	89.8 mm	162.1 mm	89.8 mm

### Tissue Validation

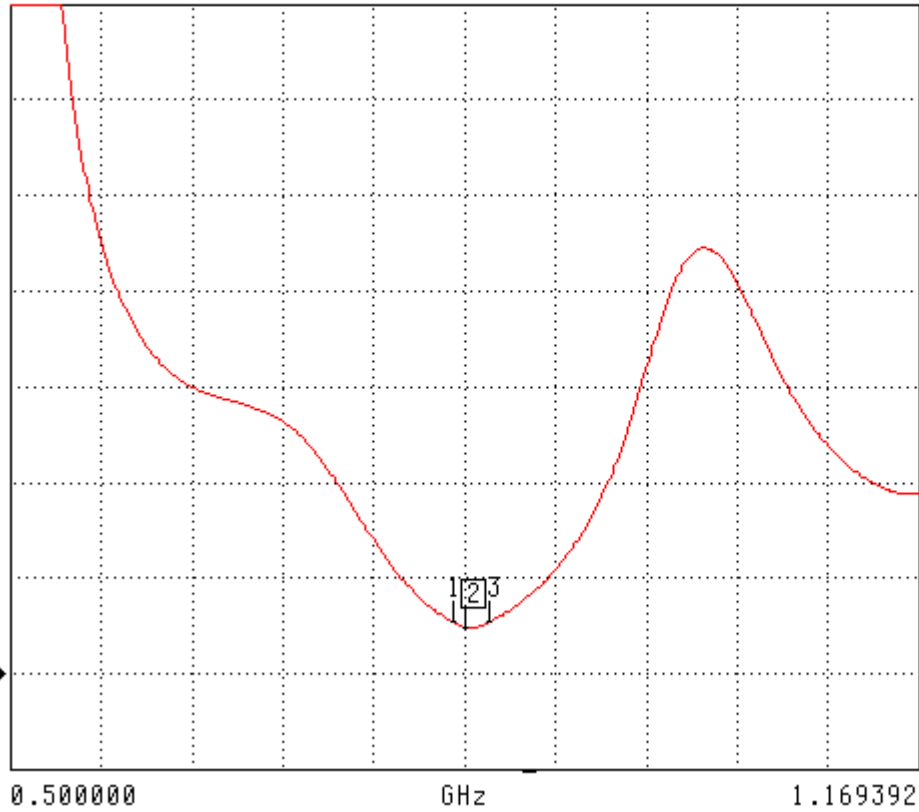
<b>Body Tissue 835MHz</b>	<b>Measured</b>
<b>Dielectric constant, <math>\epsilon_r</math></b>	57.19
<b>Conductivity, <math>\sigma</math> [S/m]</b>	0.97



SWR

S11 FORWARD REFLECTION

SWR REF=172.168 mU 2.000 U/DIV



CH 1 - S11  
5.0584 mm REF  
0.000 dB OFFSET  
0.00° OFFSET

MARKER 2  
0.835000 GHz  
1.143 U

MARKER TO MAX  
MARKER TO MIN

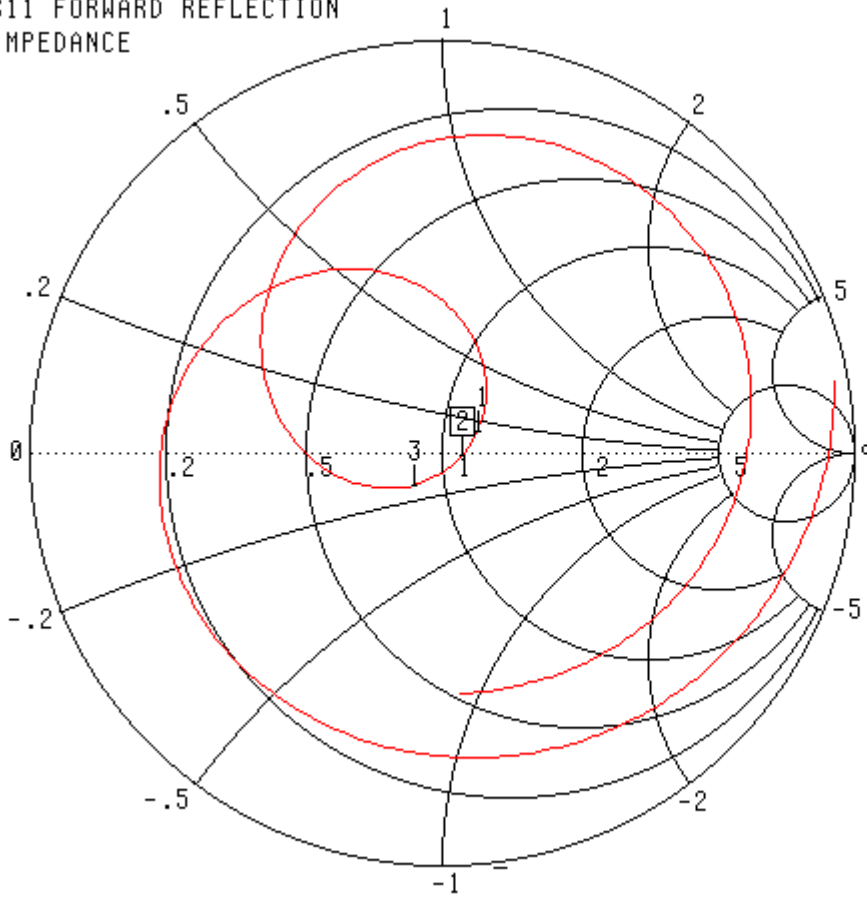
1 0.826043 GHz  
1.245 U

3 0.853304 GHz  
1.242 U

MARKER READOUT  
FUNCTIONS

### Smith Chart Dipole Impedance

S11 FORWARD REFLECTION  
IMPEDANCE



CH 1 - S11  
5.0584 mm REF  
0.000 dB OFFSET  
0.00° OFFSET

▶ MARKER 2  
0.835000 GHz  
55.519 Ω  
-1.124 jΩ

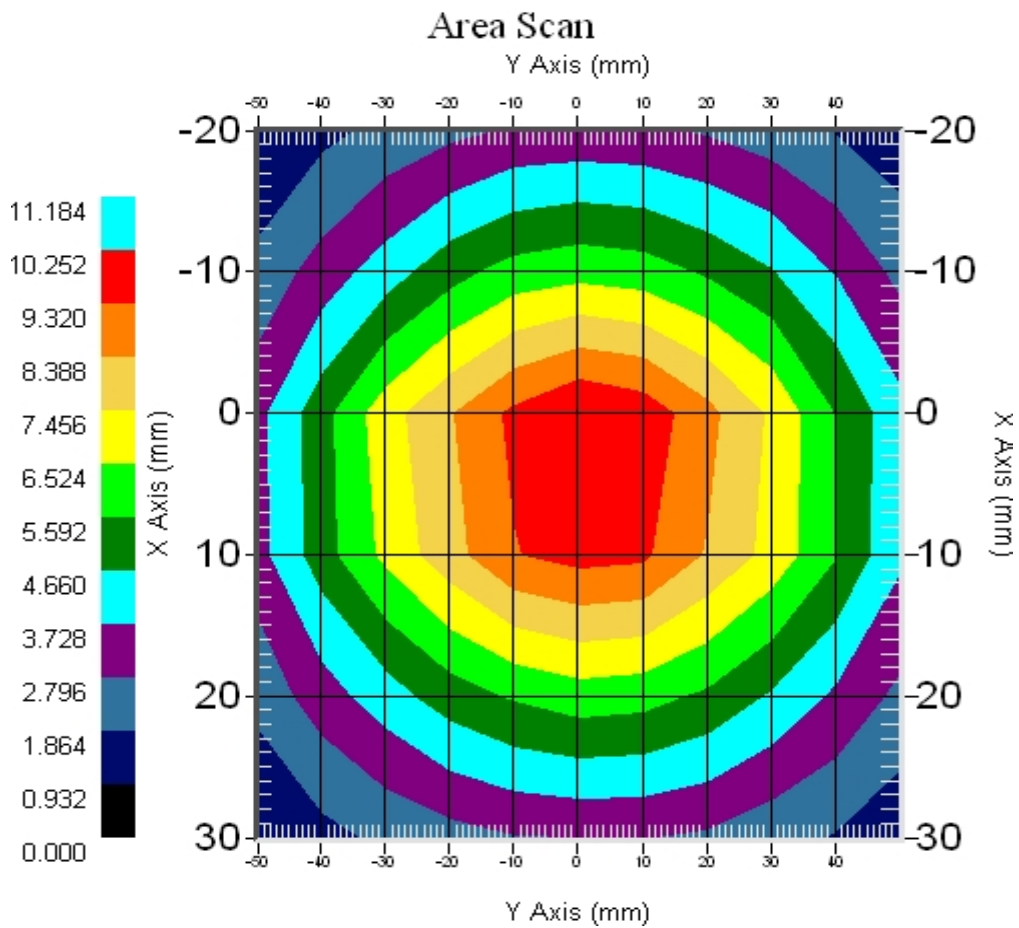
MARKER TO MAX  
MARKER TO MIN

**1** 0.826043 GHz  
59.648 Ω  
6.084 jΩ  
**3** 0.853304 GHz  
43.349 Ω  
-7.171 jΩ

MARKER READOUT  
FUNCTIONS

System Validation Results Using the Electrically Calibrated Dipole

Body Tissue Frequency	1 Gram	10 Gram	Peak Above Feed Point
835 MHz	9.81	6.3	14.87



## **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 2010.

# NCL CALIBRATION LABORATORIES

Calibration File No: DC-1180  
Project Number: RFEL-DC-1900B-5550

## 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.

Validation Dipole

Manufacturer: APREL Laboratories

Part number: ALS-D-1900-S-2

Frequency: 1900 MHz

Serial No: 210-00713

Customer: RFEL

Body Calibration

Calibrated: 16 November 2010  
Released on: 16<sup>th</sup> November 2010

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



## NCL Calibration Laboratories

---

Division of APREL Laboratories.

### Conditions

Dipole 210-00713 was new and 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.



-----  
**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

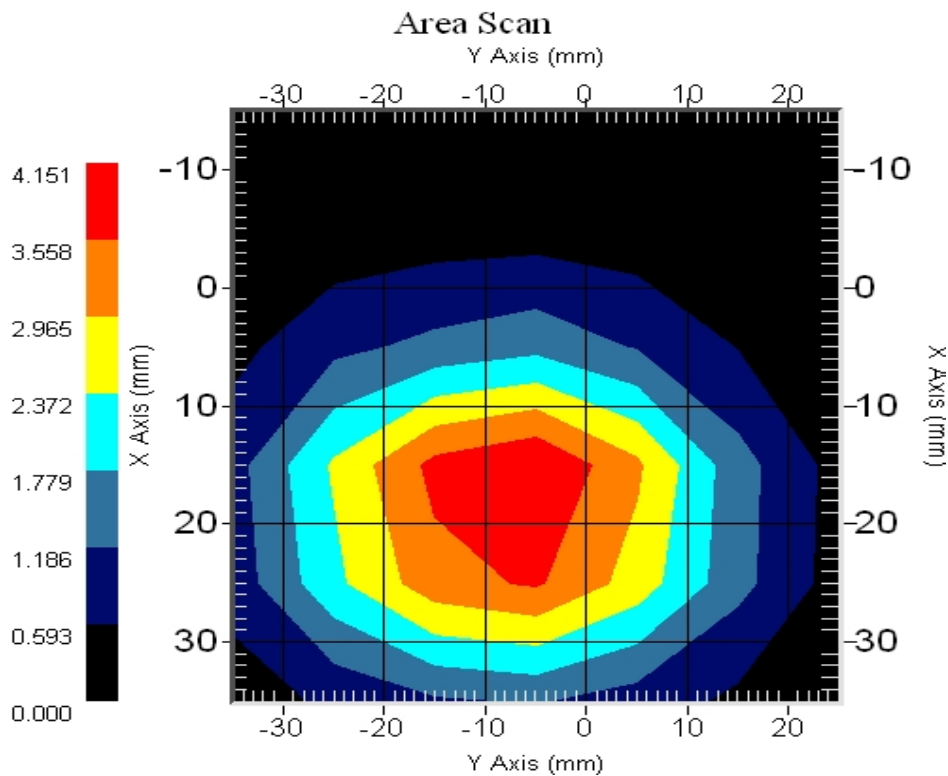
**Length:** 67.1 mm  
**Height:** 38.9 mm

### Electrical Specification

**SWR:** 1.122U  
**Return Loss:** -24.913dB  
**Impedance:** 53.469Ω

### System Validation Results

Frequency	1 Gram	10 Gram	Peak
1900 MHz	40.9	20.9	71.7



## **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 210-00713. 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 226.

## **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 210-00713 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

<b>APREL Length</b>	<b>APREL Height</b>	<b>Measured Length</b>	<b>Measured Height</b>
68.0 mm	39.5 mm	67.1mm	38.9 mm

### Tissue Validation

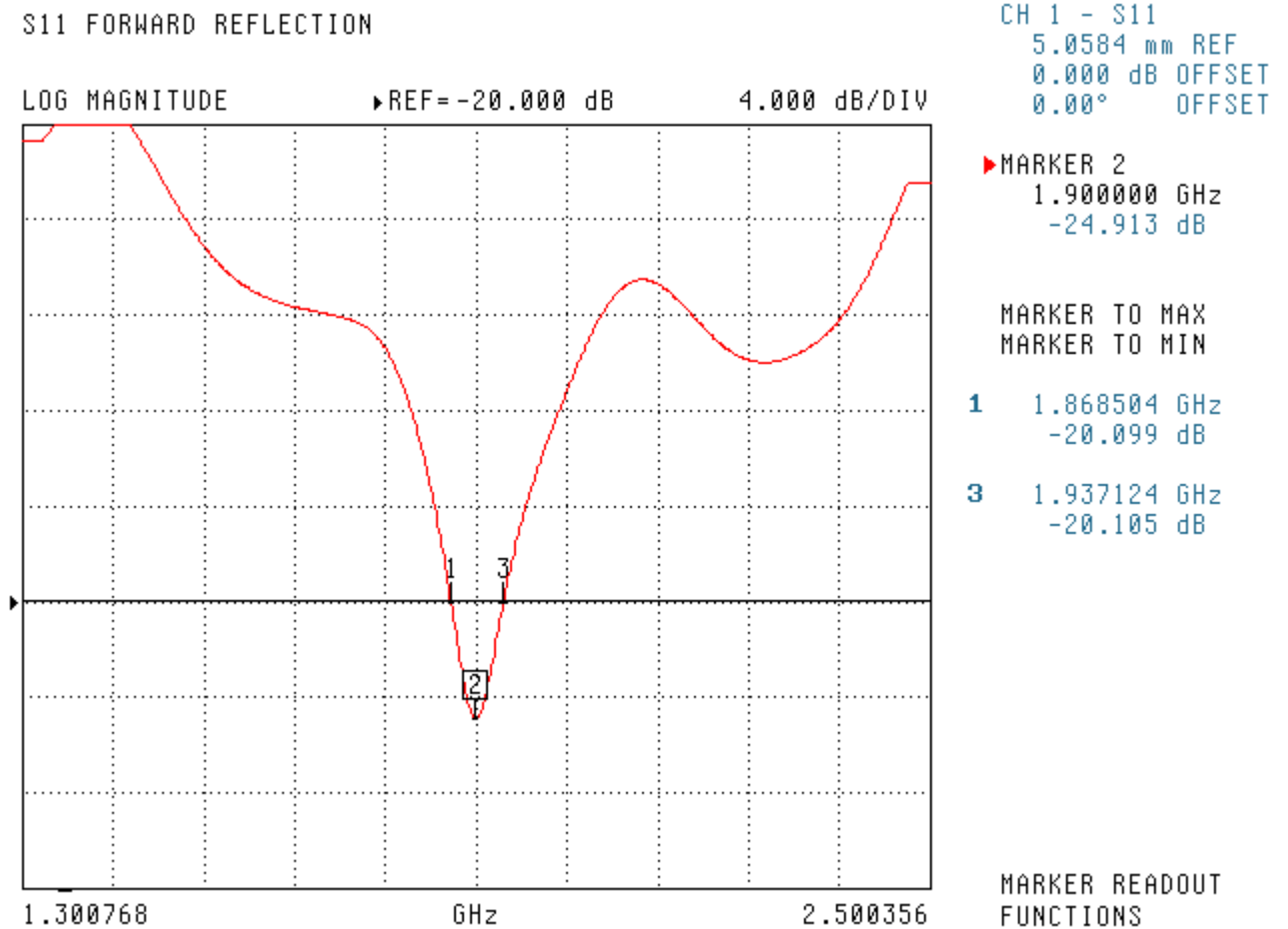
<b>Body Tissue 1900 MHz</b>	<b>Measured</b>
<b>Dielectric constant, <math>\epsilon_r</math></b>	53.87
<b>Conductivity, <math>\sigma</math> [S/m]</b>	1.55

**Electrical Calibration**

Test	Result
S11 R/L	-24.913dB
SWR	1.122U
Impedance	53.469 Ω

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

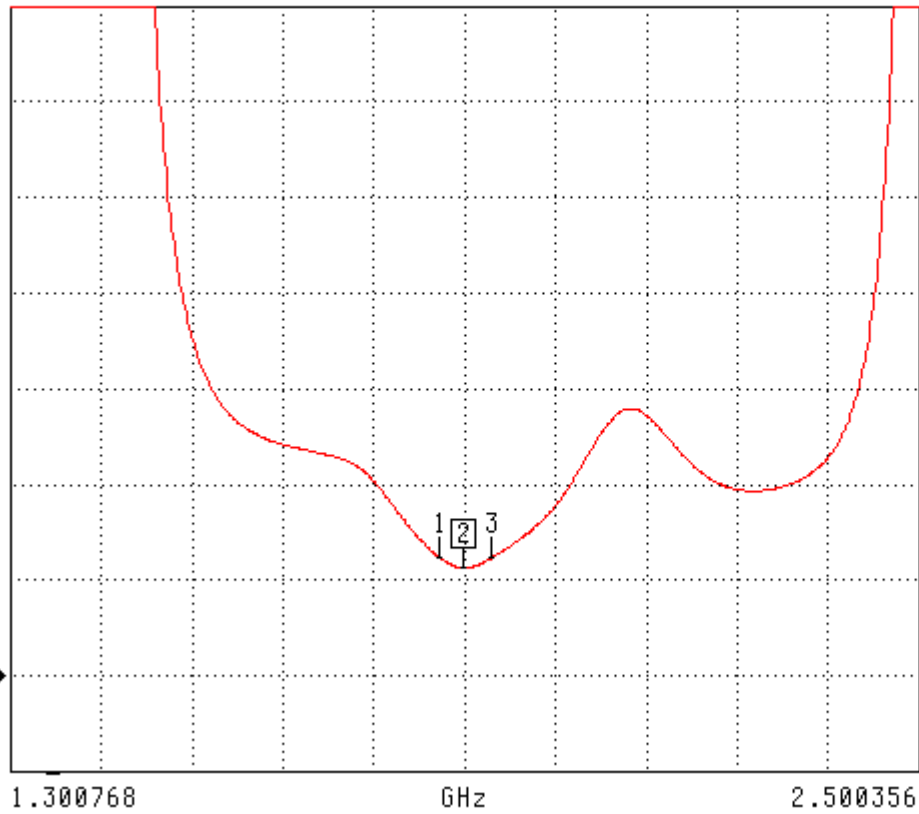
**S11 Parameter Return Loss**



SWR

S11 FORWARD REFLECTION

SWR REF=0.000 pU 1.000 U/DIV



CH 1 - S11  
5.0584 mm REF  
0.000 dB OFFSET  
0.00° OFFSET

MARKER 2  
1.900000 GHz  
1.122 U

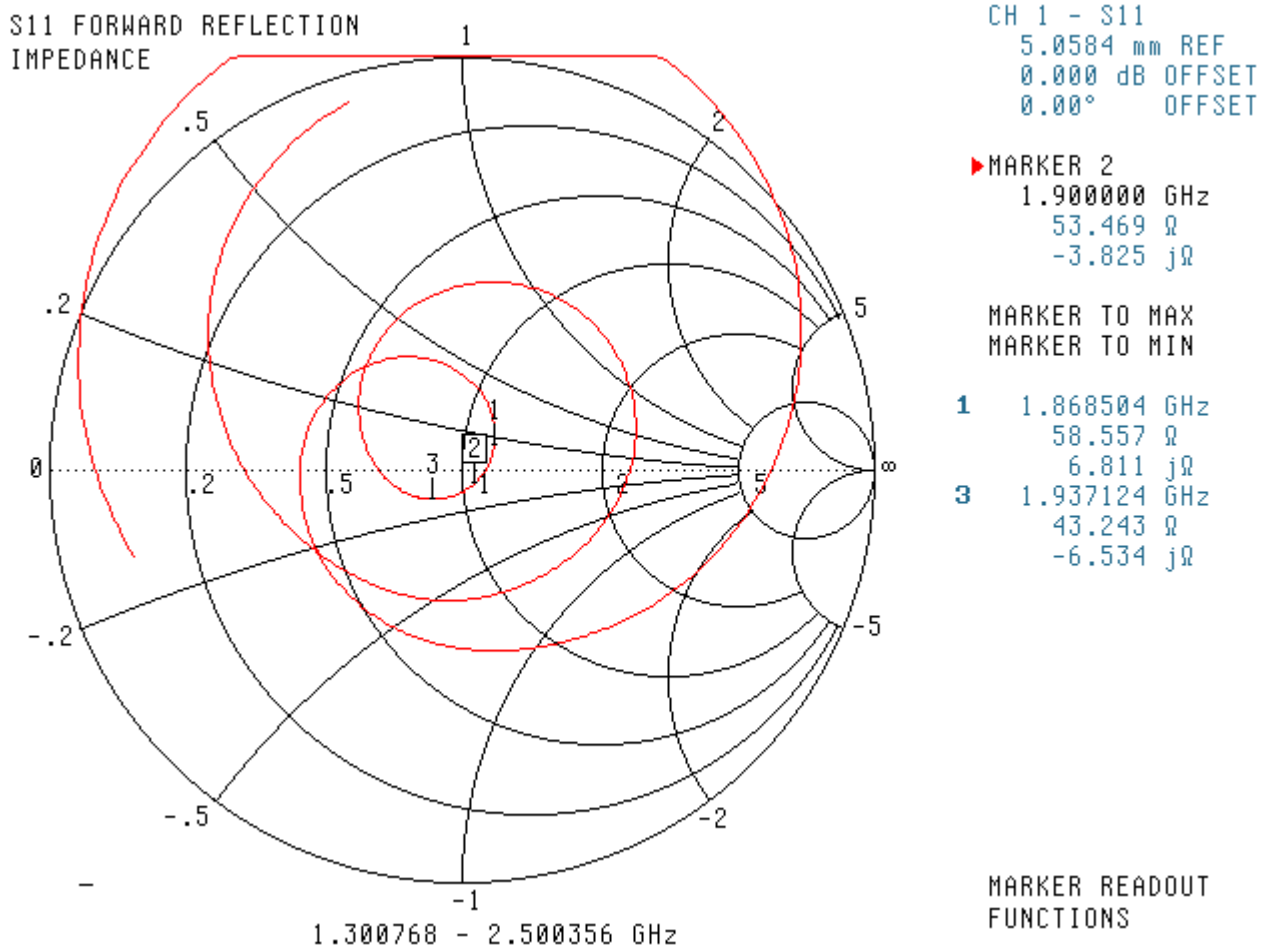
MARKER TO MAX  
MARKER TO MIN

1 1.868504 GHz  
1.231 U

3 1.937124 GHz  
1.226 U

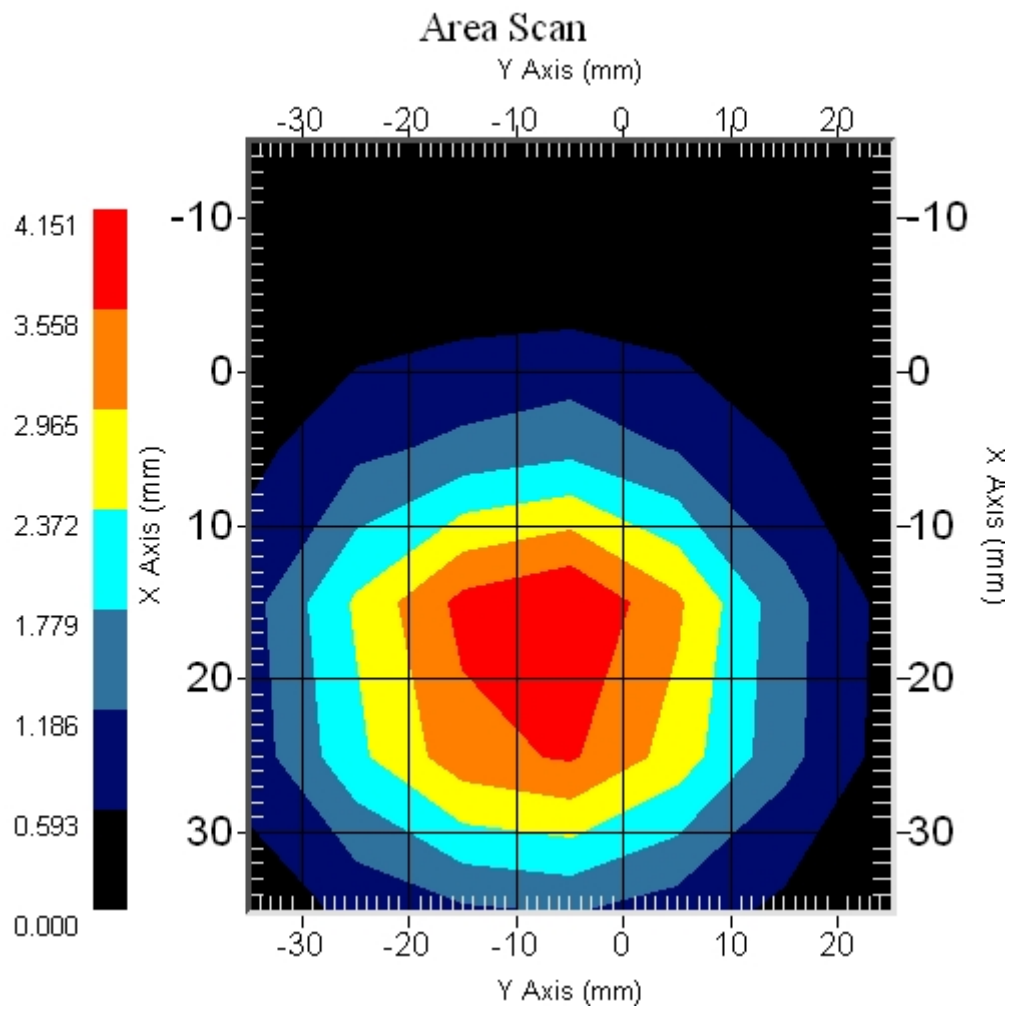
MARKER READOUT  
FUNCTIONS

### Smith Chart Dipole Impedance



**System Validation Results Using the Electrically Calibrated Dipole**

Body Tissue Frequency	1 Gram	10 Gram	Peak Above Feed Point
1900 MHz	40.9	20.9	71.7





## **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 2010.

## **Appendix F – Phantom Calibration Data Sheets**

## 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