

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

Ricoh Company, Ltd.
810 Shimoimaizumi
Ebina-Shi, Kanagawa-ken, 243-0460
Japan

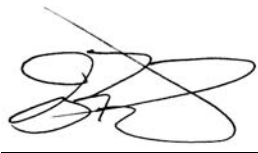
Dates of Test: July 19-22, 2011
Test Report Number: SAR.20110704
Revision A

FCC ID:	BBP-W3GEWS101
Model(s):	eQ101
Test Sample:	Engineering Unit Same as Production
Serial Number:	1097975400047
Equipment Type:	Electric Writing Tablet Computer
Classification:	Portable Transmitter Next to Body
TX Frequency Range:	824 – 848 MHz, 1851 – 1910 MHz, 2412 – 2462 MHz
Frequency Tolerance:	± 2.5 ppm
Maximum RF Output:	835 MHz (CDMA) – 25.47 dB, 1900 MHz (CDMA) – 24.68 dB, 2450 MHz (b) – 18.02 dB, 2450 MHz (g) – 14.98 dB, 2450 MHz (n20) – 13.95 dB Conducted
Signal Modulation:	CDMA, DSSS, OFDM
Antenna Type:	WWAN Antenna – Monopole; WLAN Antenna – Inv-F
Application Type:	Certification
FCC Rule Parts:	Part 2, 15C, 22H, 24E
KDB Test Methodology:	KDB 447498, KDB 248227, KDB 616217, KDB 941225 D01
Maximum SAR Value:	1.451 W/kg
Separation Distance:	0 mm

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

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1. Introduction

This measurement report shows compliance of the Ricoh Company Ltd. Model eQ101 FCC ID: BBP-W3GEWS101 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 (ρ).

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

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:

σ = conductivity of the tissue (S/m)

ρ = mass density of the tissue (kg/m³)

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).

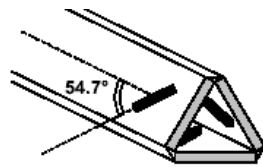
The overall uncertainty for the methodology and algorithms the ALSAS-10-U used during the SAR calculation was evaluated using the data from IEEE 1528 f3 algorithm:

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

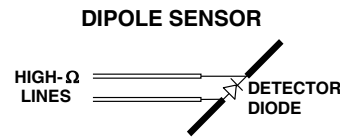
The probe used during the measurement process has been assessed to provide values for diode compression. These values are calculated during the probe calibration exercise and are used in the mathematical calculations for the assessment of SAR.

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 ± 0.05 mm and the precision of the APREL bottom detection device is ± 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 ± 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 ± 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 ≤ 3 GHz with a cube scan of 5x5x8 yields a volume of 32x32x28 mm³. For devices >3 GHz and <4.5 GHz, the cube scan of 9x9x9 yields a volume of 32x32x24 mm³. For devices ≥ 4.5 GHz, the cube scan of 7x7x12 yields a volume of 24x24x22 mm³.

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 90th 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	2450 MHz Muscle	
Mixing Percentage				
Water	52.50	69.91	73.20	
Sugar	45.00	0.00	0.00	
Salt	1.40	0.13	0.04	
HEC	1.00	0.00	0.00	
Bactericide	0.10	0.00	0.00	
DGBE	0.00	29.96	26.70	
Dielectric Constant	Target	55.20	53.30	52.70
Conductivity (S/m)	Target	0.97	1.52	1.95

Device Holder



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

6. 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 ¹ Head	1.60	8.00
SPATIAL AVERAGE SAR ² Whole Body	0.08	0.40
SPATIAL PEAK SAR ³ Hands, Feet, Ankles, Wrists	4.00	20.00

¹ 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.

² The Spatial Average value of the SAR averaged over the whole body.

³ 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	3.5	normal	1	1	1	3.5	3.5	∞
Axial Isotropy	3.7	rectangular	$\sqrt{3}$	0.7	0.7	1.5	1.5	∞
Hemispherical Isotropy	10.9	rectangular	$\sqrt{3}$	0.7	0.7	4.4	4.4	∞
Boundary Effect	1.0	rectangular	$\sqrt{3}$	1	1	0.6	0.6	∞
Linearity	4.7	rectangular	$\sqrt{3}$	1	1	2.7	2.7	∞
Detection Limit	1.0	rectangular	$\sqrt{3}$	1	1	0.6	0.6	∞
Readout Electronics	1.0	normal	1	1	1	1.0	1.0	∞
Response Time	0.8	rectangular	$\sqrt{3}$	1	1	0.5	0.5	∞
Integration Time	1.7	rectangular	$\sqrt{3}$	1	1	1.0	1.0	∞
RF Ambient Condition	3.0	rectangular	$\sqrt{3}$	1	1	1.7	1.7	∞
Probe Positioner Mech. Restriction	0.4	rectangular	$\sqrt{3}$	1	1	0.2	0.2	∞
Probe Positioning with respect to Phantom Shell	2.9	rectangular	$\sqrt{3}$	1	1	1.7	1.7	∞
Extrapolation and Integration	3.7	rectangular	$\sqrt{3}$	1	1	2.1	2.1	∞
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	∞
Phantom and Setup								
Phantom Uncertainty (shape & thickness tolerance)	3.4	rectangular	$\sqrt{3}$	1	1	2.0	2.0	∞
Liquid Conductivity (target)	5.0	rectangular	$\sqrt{3}$	0.7	0.5	2.0	1.4	∞
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	∞
Liquid Permittivity (meas.)	1.0	normal	1	0.6	0.5	0.6	0.5	5
Combined Uncertainty		RSS				9.6	9.4	>500
Combined Uncertainty (coverage factor=2)		Normal (k=2)				19.1	18.8	>500

8. System Validation

Tissue Verification

Table 8.1 Measured Tissue Parameters

		835 MHz Body		1900 MHz Body		2450 MHz Body	
Date(s)		Jul. 19, 2011		Jul. 19, 2011		Jul. 22, 2011	
Liquid Temperature (°C)	20.0	Target	Measured	Target	Measured	Target	Measured
Dielectric Constant: ϵ		55.20	54.98	53.30	53.11	52.70	52.38
Conductivity: σ		0.97	0.97	1.52	1.55	1.95	1.97

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 _{1g} (W/kg)	Measure SAR _{1g} (W/kg)	Tissue Used for Verification	Deviation (%)
19-Jul-2011	835 MHz	9.81	10.04	Body	+ 2.34
19-Jul-2011	1900 MHz	40.90	40.12	Body	- 1.91
22-Jul-2011	2450 MHz	51.50	51.24	Body	- 0.51

See Appendix A for data plots.

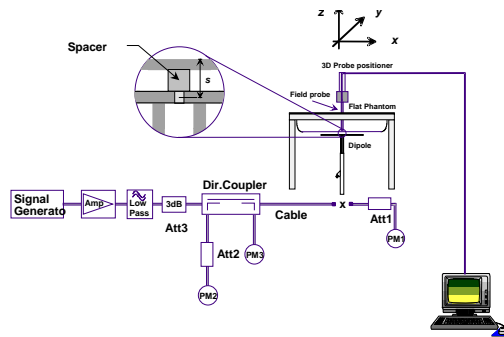


Figure 8.1 Dipole Validation Test Setup

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

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 $((\text{end}/\text{start})-1)*100$ and rounded to three decimal places. The drift percentage is calculated into the resultant SAR value on the data sheet for each test.

The EUT was test on the back of the device. None of the sides were tested as the LCD screen does not rotate. The antenna is always away from the body (24 cm) in normal use on any side. The back of the device does come within 10 mm of the body during normal use. The device was used to continuously transmit at a maximum output power on the channel specified in the test data for WLAN configurations.

The data rates used when evaluating the WiFi transmitter were the lowest data rates for each mode. The device was operating at its maximum output power at the lowest data rate for all measurements in WLAN configurations. Bluetooth operation was not evaluated as the power level of the BT transmitter was less than $60/f_{\text{GHz}}$.

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 $\frac{1}{4}$ 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 $\frac{1}{4}$ 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

CDMA Power Measurements

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

		IS-2000	1Xev-Do Rev. 0		1Xev-Do Rev. A Subtype 0/1		1Xev-Do Rev. A Subtype 2	
	Channel	TDSO SO32 RC3	FTAP [dBm]	RTAP [dBm]	FTAP [dBm]	RTAP [dBm]	FETAP [dBm]	RETAP [dBm]
Cellular	1013	25.32	24.73	25.30	24.78	25.12	24.91	25.16
	384	25.45	24.36	25.47	24.41	25.37	24.62	25.03
	777	24.65	23.68	24.63	23.78	24.64	23.22	24.30
PCS	25	24.38	24.24	24.59	24.21	24.55	24.62	24.51
	600	24.59	24.23	24.66	24.20	24.68	24.56	24.59
	1175	24.60	23.61	24.68	23.51	24.58	23.70	24.42


802.11b					2450 GHz n HT20				
Freq	Channel	Data Rate	Antenna	Power	Freq	Channel	Data Rate	Antenna	Power
2412	1	1	Main	17.95	2412	1	6	Main	13.86
2437	6	1	Main	18.02	2437	6	6	Main	13.89
2462	11	1	Main	17.98	2462	11	6	Main	13.95
802.11g									
Freq	Channel	Data Rate	Antenna	Power					
2412	1	6	Main	14.87					
2437	6	6	Main	14.98					
2462	11	6	Main	14.93					

All 802.11 measurements are Maximum Average Power Levels

SAR Data Summary – 835 MHz Body

MEASUREMENT RESULTS								
Gap	Frequency		Rev Level/ Modulation	End Power (dBm)	Drift (%)	Reverse Channel	Forward Channel	SAR (W/kg)
	MHz	Ch.						
0 mm	824.7	1013	Rev 0	25.30	- 1.264	153.6 kbps	2 Slot 307.2 kbps	0.917
	836.6	384	Rev 0	25.47	+ 1.068	153.6 kbps	2 Slot 307.2 kbps	1.227
	848.3	777	Rev 0	24.63	+ 0.299	153.6 kbps	2 Slot 307.2 kbps	1.162
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: The testing was conducted back of the device with a 0 mm gap between the phantom and the device. All testing was conducted per KDB 447498, KDB 941225 D01, KDB 616217 D03 and OET Bulletin 65. See the photos in Appendix C for a pictorial of the setup.

SAR Data Summary – 1900 MHz Body

MEASUREMENT RESULTS								
Gap	Frequency		Rev Level/ Modulation	End Power (dBm)	Drift (%)	Reverse Channel	Forward Channel	SAR (W/kg)
	MHz	Ch.						
0 mm	1851.25	25	Rev 0	24.59	+ 2.881	153.6 kbps	2 Slot 307.2 kbps	1.451
	1880.00	600	Rev 0	24.66	- 1.002	153.6 kbps	2 Slot 307.2 kbps	1.370
	1908.75	1175	Rev 0	24.68	- 2.191	153.6 kbps	2 Slot 307.2 kbps	1.034
						Body 1.6 W/kg (mW/g) <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: The testing was conducted back of the device with a 0 mm gap between the phantom and the device. All testing was conducted per KDB 447498, KDB 941225 D01, KDB 616217 D03 and OET Bulletin 65. See the photos in Appendix C for a pictorial of the setup.

SAR Data Summary – 2450 MHz Body 802.11b

MEASUREMENT RESULTS						
Gap	Frequency		Modulation	Drift	End Power (dBm)	SAR (W/kg)
	MHz	Ch.				
0 mm	2412	1	DSSS	- 2.412	17.95	0.780
	2437	6	DSSS	+ 4.863	18.02	0.899
	2462	11	DSSS	+ 0.231	17.98	0.876

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: The testing was conducted back of the device with a 0 mm gap between the phantom and the device. SAR is not required for 802.11g/HT20 channels when the maximum average output power is less than ¼ dB higher than that measured in the 802.11b. All testing was conducted per KDB 447498, KDB 248227, KDB 616217 D03 and OET Bulletin 65. See the photos in Appendix C for a pictorial of the setup.

Simultaneous Evaluation

The WWAN and WiFi can transmit simultaneously. Per KDB 616217 D03 section 4 b) if the equation $5 * [(SAR_1 + SAR_2) / 1.6]^{1.5}$ cm apart from each peak rounded to the nearest cm, simultaneous evaluation is not required. The location of the WWAN peak is 25 mm from the top of the device and 150 mm from the left of the device. The WiFi peak is 55 mm from the top of the device and 0 mm from the left side of the device. All positions are measured with the LCD facing down. Using algebraic calculations, the diagonal distance between the WWAN peak and the WiFi peak is 15.3 cm. The calculated distance required is $5 * [(1.451 + 0.899) / 1.6]^{1.5}$ cm = 9 cm. The distance between the peaks is 15.3 cm; therefore, simultaneous evaluation is not required.

11. 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-E020	06/17/2012	06/17/2011	RFE-217
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
Anritsu MT8820C	03/23/2012	03/23/2011	6200837710
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

12. 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.

13. 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

Tue 19/Jul/2011 01:52:51

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	55.11	0.92
0.8150	55.28	0.97	55.06	0.93
0.8250	55.24	0.97	55.02	0.95
0.8350	55.20	0.97	54.98	0.97
0.8450	55.17	0.98	54.94	0.98
0.8550	55.14	0.99	54.90	1.00
0.8650	55.11	1.01	54.87	1.01

Test Result for UIM Dielectric Parameter

Tue 19/Jul/2011 07:36:11

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	53.19	1.50
1.8800	53.30	1.52	53.16	1.52
1.8900	53.30	1.52	53.14	1.53
1.9000	53.30	1.52	53.11	1.55
1.9100	53.30	1.52	53.09	1.56
1.9200	53.30	1.52	53.06	1.58
1.9300	53.30	1.52	53.03	1.59

Test Result for UIM Dielectric Parameter

Fri 22/Jul/2011 01:26:24

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
2.4100	52.75	1.91	52.45	1.93
2.4200	52.74	1.92	52.43	1.95
2.4300	52.73	1.93	52.41	1.96
2.4400	52.71	1.94	52.38	1.97
2.4500	52.70	1.95	52.36	1.98
2.4600	52.69	1.96	52.34	1.99
2.4700	52.67	1.98	52.32	2.01

SAR Test Report

By Operator : Jay
Measurement Date : 19-Jul-2011
Starting Time : 19-Jul-2011 01:55:41 PM
End Time : 19-Jul-2011 02:10:52 PM
Scanning Time : 911 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 : 1.216 W/kg
Power Drift-Finish: 1.178 W/kg
Power Drift (%) : -3.128

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-Jul-2011
Temperature : 20.00 °C
Ambient Temp. : 23.00 °C
Humidity : 49.00 RH%
Epsilon : 54.98 F/m
Sigma : 0.97 S/m
Density : 1000.00 kg/cu. m

Probe Data

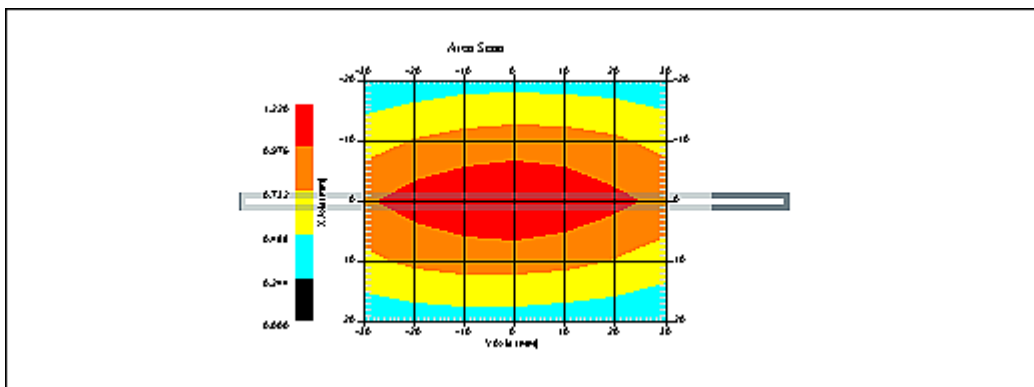
Name : Probe 215 - RFEL
Model : E020
Type : E-Field Triangle
Serial No. : 215
Last Calib. Date : 22-Sep-2010
Frequency : 835.00 MHz
Duty Cycle Factor: 1
Conversion Factor: 6.3
Probe Sensitivity: 1.20 1.20 1.20 $\mu\text{V}/(\text{V}/\text{m})^2$
Compression Point: 95.00 mV
Offset : 1.56 mm

Measurement Data

Crest Factor : 1
Scan Type : Complete
Tissue Temp. : 20.00 °C
Ambient Temp. : 25.00 °C
Set-up Date : 19-Jul-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

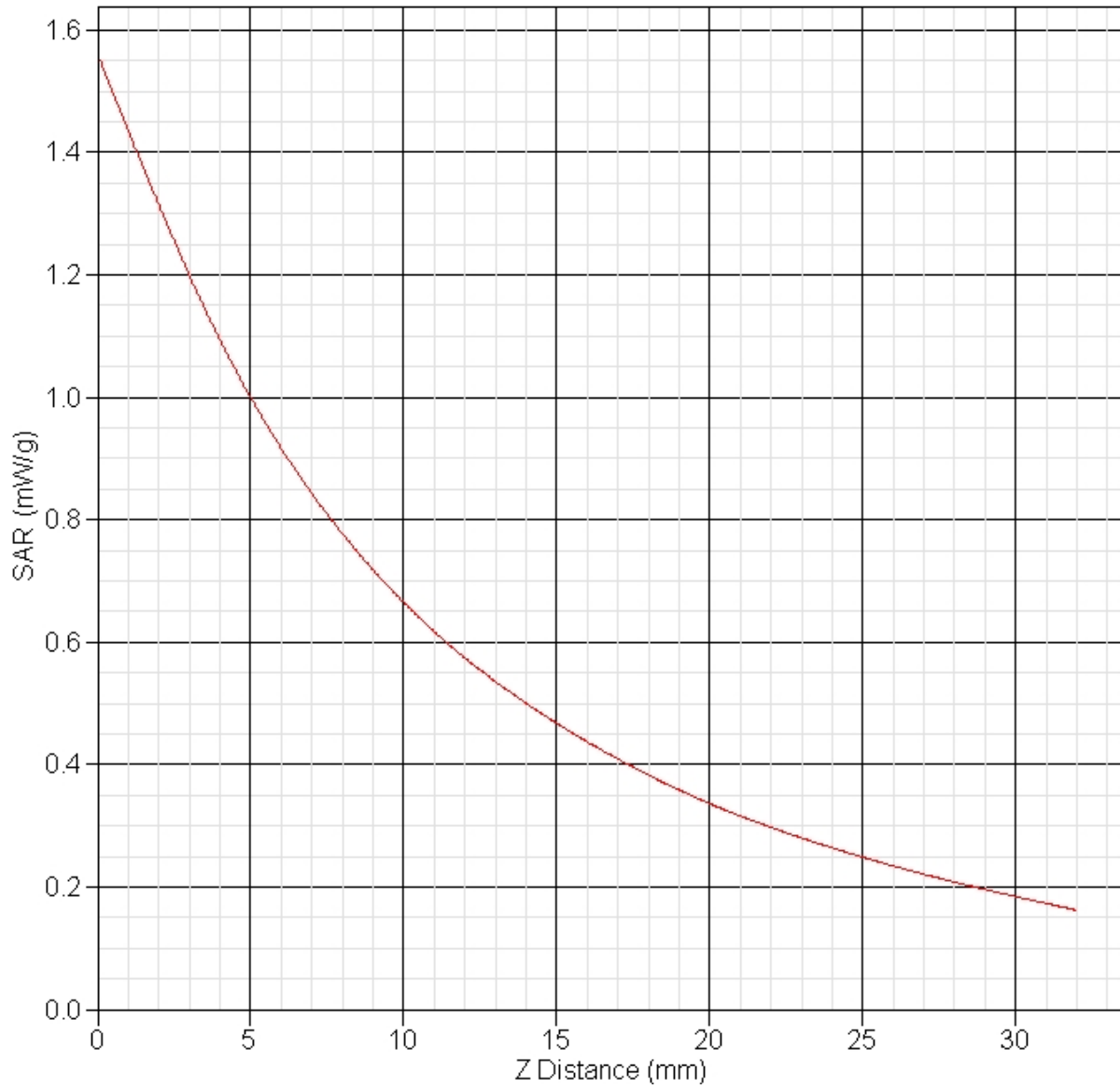
Other Data

DUT Position : Touch
Separation : 15 mm
Channel : Mid



1 gram SAR value : 1.004 W/kg
10 gram SAR value : 0.633 W/kg
Area Scan Peak SAR : 1.218 W/kg
Zoom Scan Peak SAR : 1.561 W/kg

SAR-Z Axis
at Hotspot x:0.25 y:-0.20



SAR Test Report

By Operator : Jay
Measurement Date : 19-Jul-2011
Starting Time : 19-Jul-2011 07:38:15 AM
End Time : 19-Jul-2011 07:51:18 AM
Scanning Time : 783 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 : 4.658 W/kg
Power Drift-Finish: 4.657 W/kg
Power Drift (%) : -0.024

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-Jul-2011
Temperature : 20.00 °C
Ambient Temp. : 23.00 °C
Humidity : 49.00 RH%
Epsilon : 53.11 F/m
Sigma : 1.55 S/m
Density : 1000.00 kg/cu. m

Probe Data

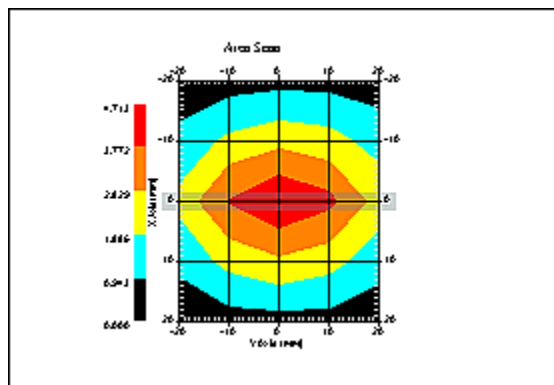
Name : RFEL 215
Model : E020
Type : E-Field Triangle
Serial No. : 215
Last Calib. Date : 22-Sep-2010
Frequency : 1900.00 MHz
Duty Cycle Factor: 1
Conversion Factor: 5
Probe Sensitivity: 1.20 1.20 1.20 $\mu\text{V}/(\text{V}/\text{m})^2$
Compression Point: 95.00 mV
Offset : 1.56 mm

Measurement Data

Crest Factor : 1
Scan Type : Complete
Tissue Temp. : 20.00 °C
Ambient Temp. : 23.00 °C
Set-up Date : 19-Jul-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

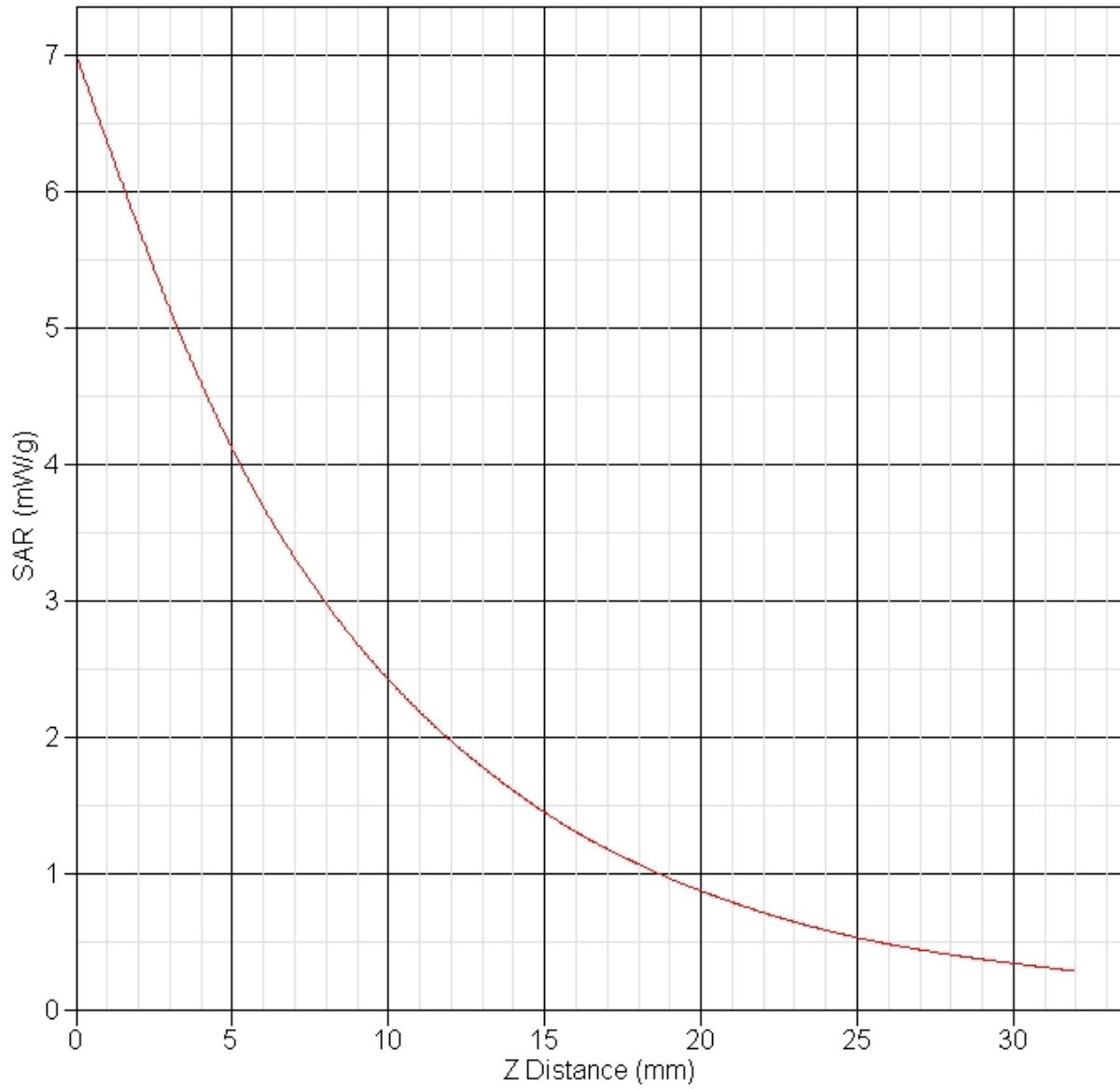
Other Data

DUT Position : Touch
Separation : 10 mm
Channel : Mid



1 gram SAR value : 4.012 W/kg
10 gram SAR value : 2.091 W/kg
Area Scan Peak SAR : 4.713 W/kg
Zoom Scan Peak SAR : 7.006 W/kg

SAR-Z Axis
at Hotspot x:0.22 y:-0.15



SAR Test Report

By Operator : Jay
Measurement Date : 22-Jul-2011
Starting Time : 22-Jul-2011 01:29:21 PM
End Time : 22-Jul-2011 01:42:20 PM
Scanning Time : 779 secs

Product Data

Device Name : Validation
Serial No. : 2450
Type : Dipole
Model : ALS-D-2450-S-2
Frequency : 2450.00 MHz
Max. Transmit Pwr : 0.1 W
Drift Time : 0 min(s)
Length : 51.5 mm
Width : 3.6 mm
Depth : 30.4 mm
Antenna Type : Internal
Orientation : Touch
Power Drift-Start : 6.280 W/kg
Power Drift-Finish: 6.193 W/kg
Power Drift (%) : -1.375

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. : 2450
Frequency : 2450.00 MHz
Last Calib. Date : 22-Jul-2011
Temperature : 20.00 °C
Ambient Temp. : 23.00 °C
Humidity : 45.00 RH%
Epsilon : 52.36 F/m
Sigma : 1.97 S/m
Density : 1000.00 kg/cu. m

Probe Data

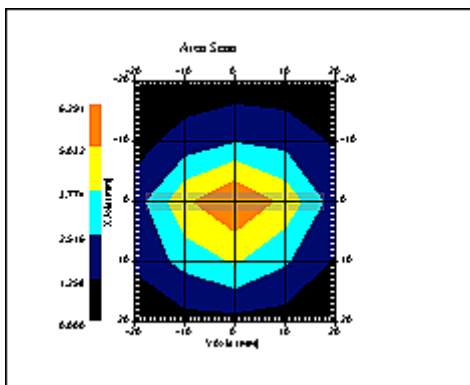
Name : Probe 215 - RFEL
Model : E020
Type : E-Field Triangle
Serial No. : 215
Last Calib. Date : 22-Sep-2010
Frequency : 2450.00 MHz
Duty Cycle Factor: 1
Conversion Factor: 4.5
Probe Sensitivity: 1.20 1.20 1.20 $\mu\text{V}/(\text{V}/\text{m})^2$
Compression Point: 95.00 mV
Offset : 1.56 mm

Measurement Data

Crest Factor : 1
Scan Type : Complete
Tissue Temp. : 20.00 °C
Ambient Temp. : 23.00 °C
Set-up Date : 22-Jul-2011
Set-up Time : 7:40:13 AM
Area Scan : 5x5x1 : Measurement x=10mm, y=10mm, z=4mm
Zoom Scan : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

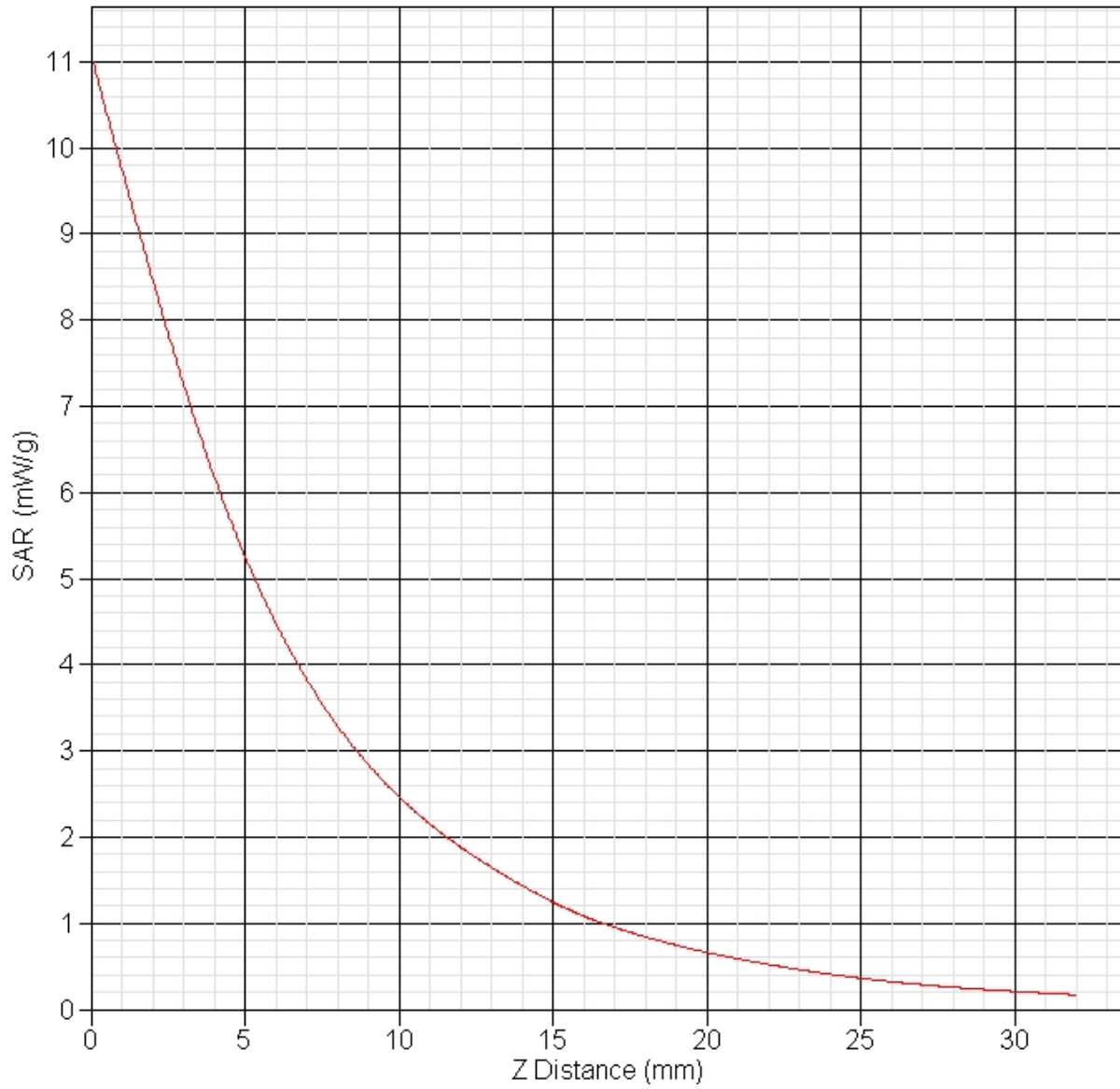
Other Data

DUT Position : Touch
Separation : 10 mm
Channel : Mid



1 gram SAR value : 5.124 W/kg
10 gram SAR value : 2.314 W/kg
Area Scan Peak SAR : 6.291 W/kg
Zoom Scan Peak SAR : 11.090 W/kg

SAR-Z Axis
at Hotspot x:0.23 y:-0.15



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-Jul-2011
Starting Time : 19-Jul-2011 02:35:40 PM
End Time : 19-Jul-2011 02:54:41 PM
Scanning Time : 1141 secs

Product Data

Device Name : Ricoh EWS
Serial No. : 1097975400047
Mode : Rev 0
Model : eQuill eQ101
Frequency : 835.00 MHz
Max. Transmit Pwr : 0.25 W
Drift Time : 0 min(s)
Length : 244 mm
Width : 190 mm
Depth : 10 mm
Antenna Type : Internal
Orientation : Back
Power Drift-Start : 1.106 W/kg
Power Drift-Finish: 1.092 W/kg
Power Drift (%) : -1.264

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-Jul-2011
Temperature : 20.00 °C
Ambient Temp. : 23.00 °C
Humidity : 40.00 RH%
Epsilon : 54.98 F/m
Sigma : 0.97 S/m
Density : 1000.00 kg/cu. m

Probe Data

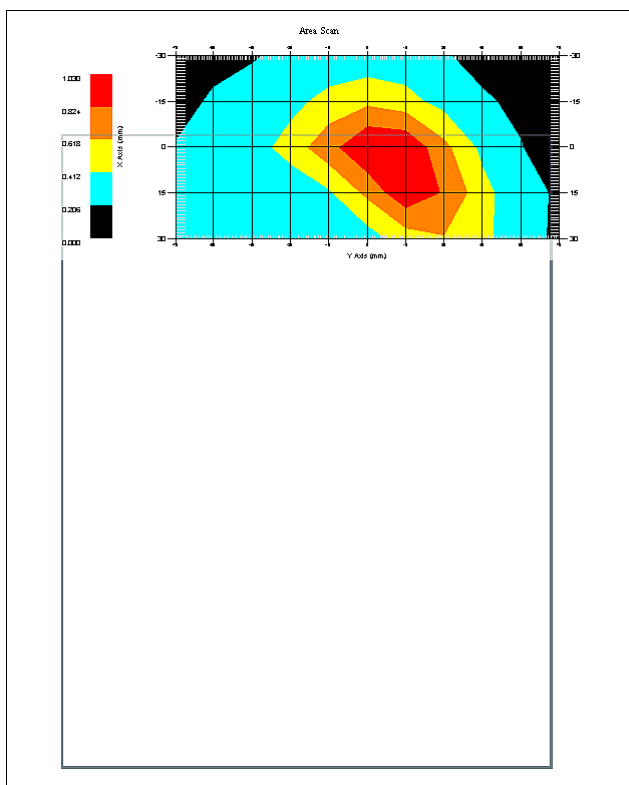
Name : Probe 215 - RFEL
Model : E020
Type : E-Field Triangle
Serial No. : 215
Last Calib. Date : 22-Sep-2010
Frequency : 835.00 MHz
Duty Cycle Factor: 1
Conversion Factor: 6.3
Probe Sensitivity: 1.20 1.20 1.20 $\mu\text{V}/(\text{V}/\text{m})^2$
Compression Point: 95.00 mV
Offset : 1.56 mm

Measurement Data

Crest Factor : 1
Scan Type : Complete
Tissue Temp. : 20.00 °C
Ambient Temp. : 23.00 °C
Set-up Date : 19-Jul-2011
Set-up Time : 2:09:54 PM
Area Scan : 5x11x1 : Measurement x=15mm, y=15mm, z=4mm
Zoom Scan : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

Other Data

DUT Position : Back
Separation : 0 mm
Channel : Low



1 gram SAR value : 0.917 W/kg
10 gram SAR value : 0.655 W/kg
Area Scan Peak SAR : 1.030 W/kg
Zoom Scan Peak SAR : 1.571 W/kg

SAR Test Report

By Operator : Jay
Measurement Date : 19-Jul-2011
Starting Time : 19-Jul-2011 03:09:44 PM
End Time : 19-Jul-2011 03:28:38 PM
Scanning Time : 1134 secs

Product Data

Device Name : Ricoh EWS
Serial No. : 1097975400047
Mode : Rev 0
Model : eQuill eQ101
Frequency : 835.00 MHz
Max. Transmit Pwr : 0.25 W
Drift Time : 0 min(s)
Length : 244 mm
Width : 190 mm
Depth : 10 mm
Antenna Type : Internal
Orientation : Back
Power Drift-Start : 1.178 W/kg
Power Drift-Finish: 1.190 W/kg
Power Drift (%) : 1.068

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-Jul-2011
Temperature : 20.00 °C
Ambient Temp. : 23.00 °C
Humidity : 40.00 RH%
Epsilon : 54.98 F/m
Sigma : 0.97 S/m
Density : 1000.00 kg/cu. m

Probe Data

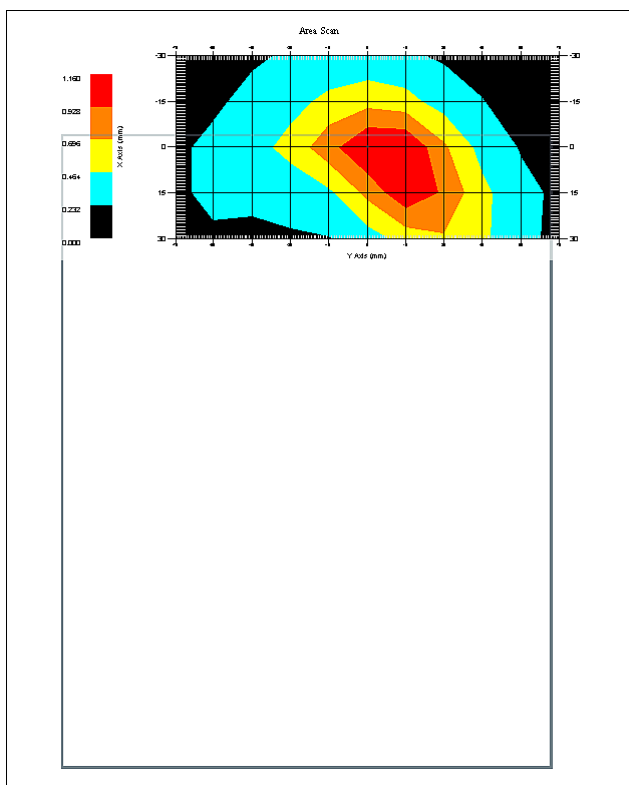
Name : Probe 215 - RFEL
Model : E020
Type : E-Field Triangle
Serial No. : 215
Last Calib. Date : 22-Sep-2010
Frequency : 835.00 MHz
Duty Cycle Factor: 1
Conversion Factor: 6.3
Probe Sensitivity: 1.20 1.20 1.20 $\mu\text{V}/(\text{V}/\text{m})^2$
Compression Point: 95.00 mV
Offset : 1.56 mm

Measurement Data

Crest Factor : 1
Scan Type : Complete
Tissue Temp. : 20.00 °C
Ambient Temp. : 23.00 °C
Set-up Date : 19-Jul-2011
Set-up Time : 2:09:54 PM
Area Scan : 5x11x1 : Measurement x=15mm, y=15mm, z=4mm
Zoom Scan : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

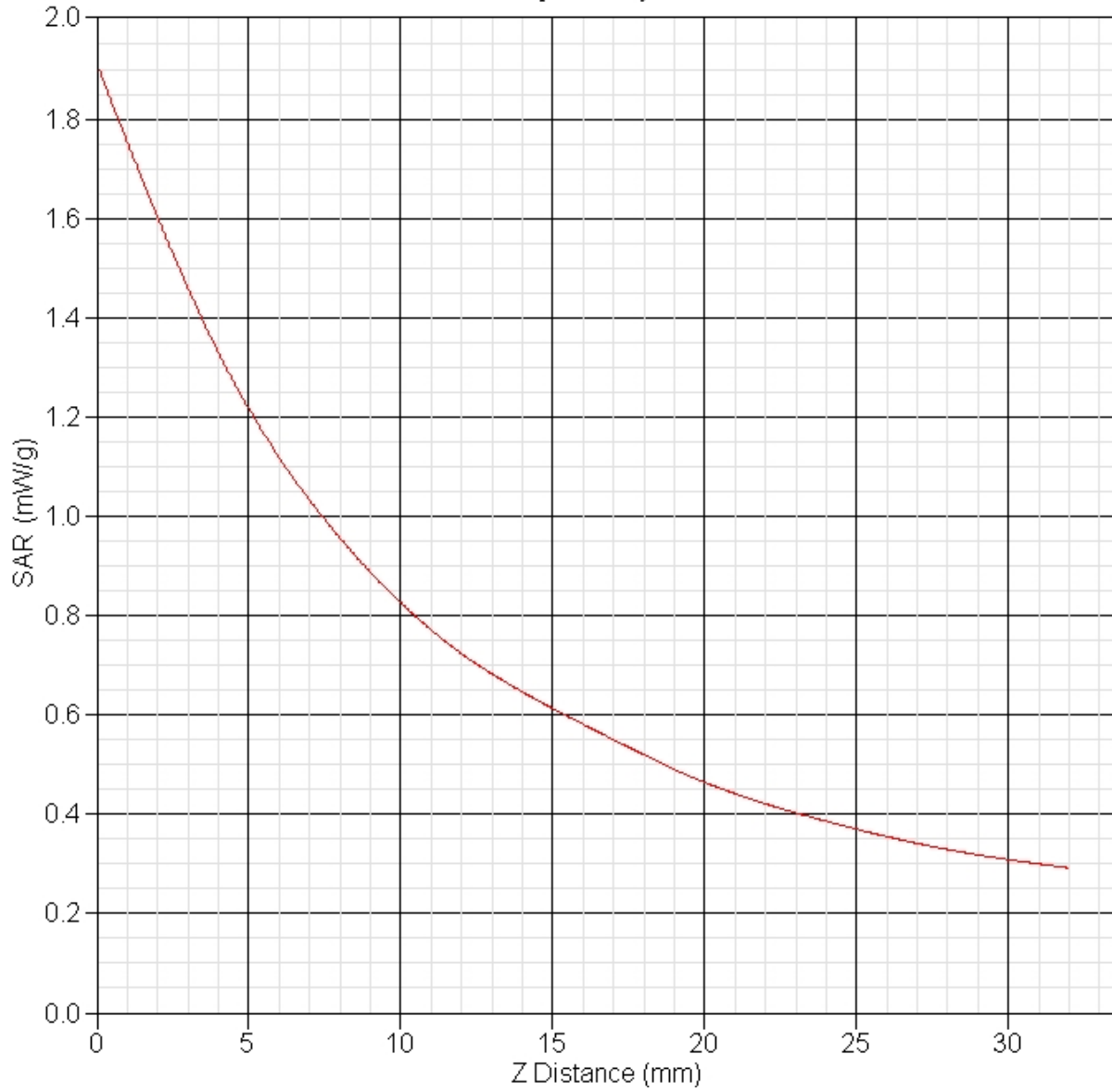
Other Data

DUT Position : Back
Separation : 0 mm
Channel : Mid



1 gram SAR value : 1.227 W/kg
10 gram SAR value : 0.779 W/kg
Area Scan Peak SAR : 1.160 W/kg
Zoom Scan Peak SAR : 1.911 W/kg

SAR-Z Axis
at Hotspot x:8.15 y:15.05



SAR Test Report

By Operator : Jay
Measurement Date : 19-Jul-2011
Starting Time : 19-Jul-2011 03:30:12 PM
End Time : 19-Jul-2011 03:49:09 PM
Scanning Time : 1137 secs

Product Data

Device Name : Ricoh EWS
Serial No. : 1097975400047
Mode : Rev 0
Model : eQuill eQ101
Frequency : 835.00 MHz
Max. Transmit Pwr : 0.25 W
Drift Time : 0 min(s)
Length : 244 mm
Width : 190 mm
Depth : 10 mm
Antenna Type : Internal
Orientation : Back
Power Drift-Start : 1.295 W/kg
Power Drift-Finish: 1.299 W/kg
Power Drift (%) : 0.299

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-Jul-2011
Temperature : 20.00 °C
Ambient Temp. : 23.00 °C
Humidity : 40.00 RH%
Epsilon : 54.98 F/m
Sigma : 0.97 S/m
Density : 1000.00 kg/cu. m

Probe Data

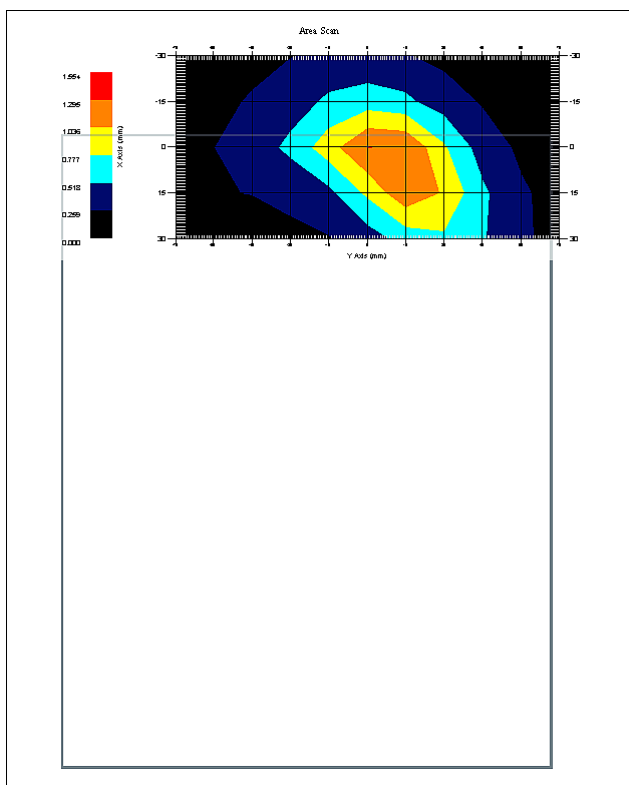
Name : Probe 215 - RFEL
Model : E020
Type : E-Field Triangle
Serial No. : 215
Last Calib. Date : 22-Sep-2010
Frequency : 835.00 MHz
Duty Cycle Factor: 1
Conversion Factor: 6.3
Probe Sensitivity: 1.20 1.20 1.20 $\mu\text{V}/(\text{V}/\text{m})^2$
Compression Point: 95.00 mV
Offset : 1.56 mm

Measurement Data

Crest Factor : 1
Scan Type : Complete
Tissue Temp. : 20.00 °C
Ambient Temp. : 23.00 °C
Set-up Date : 19-Jul-2011
Set-up Time : 2:09:54 PM
Area Scan : 5x11x1 : Measurement x=15mm, y=15mm, z=4mm
Zoom Scan : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

Other Data

DUT Position : Back
Separation : 0 mm
Channel : High



1 gram SAR value : 1.162 W/kg
10 gram SAR value : 0.807 W/kg
Area Scan Peak SAR : 1.297 W/kg
Zoom Scan Peak SAR : 2.041 W/kg

SAR Test Report

By Operator : Jay
Measurement Date : 19-Jul-2011
Starting Time : 19-Jul-2011 08:00:59 AM
End Time : 19-Jul-2011 08:19:35 AM
Scanning Time : 1116 secs

Product Data

Device Name : Ricoh EWS
Serial No. : 1097975400047
Mode : Rev 0
Model : eQuill eQ101
Frequency : 1900.00 MHz
Max. Transmit Pwr : 0.25 W
Drift Time : 0 min(s)
Length : 244 mm
Width : 190 mm
Depth : 10 mm
Antenna Type : Internal
Orientation : Back
Power Drift-Start : 0.590 W/kg
Power Drift-Finish: 0.607 W/kg
Power Drift (%) : 2.881

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-Jul-2011
Temperature : 20.00 °C
Ambient Temp. : 23.00 °C
Humidity : 36.00 RH%
Epsilon : 53.11 F/m
Sigma : 1.55 S/m
Density : 1000.00 kg/cu. m

Probe Data

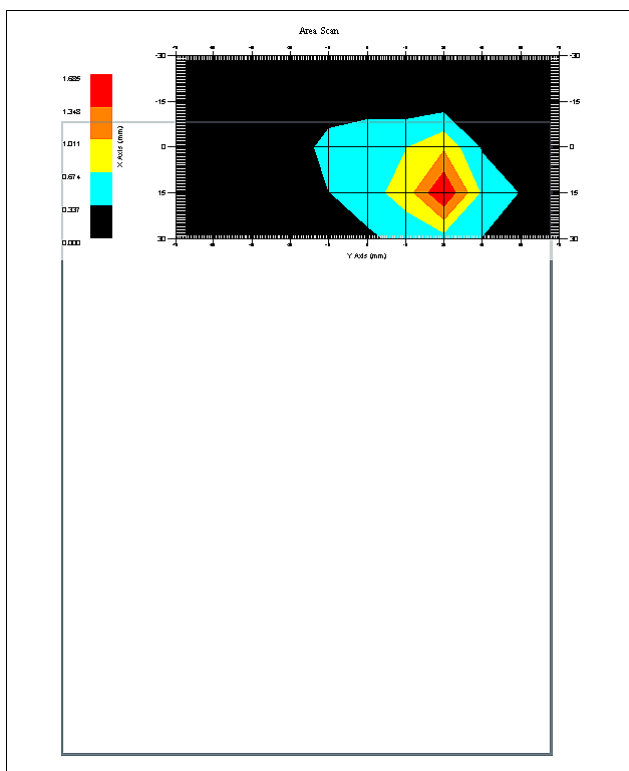
Name : Probe 215 - RFEL
Model : E020
Type : E-Field Triangle
Serial No. : 215
Last Calib. Date : 22-Sep-2010
Frequency : 1900.00 MHz
Duty Cycle Factor: 1
Conversion Factor: 5
Probe Sensitivity: 1.20 1.20 1.20 $\mu\text{V}/(\text{V}/\text{m})^2$
Compression Point: 95.00 mV
Offset : 1.56 mm

Measurement Data

Crest Factor : 1
Scan Type : Complete
Tissue Temp. : 20.00 °C
Ambient Temp. : 23.00 °C
Set-up Date : 19-Jul-2011
Set-up Time : 3:00:27 PM
Area Scan : 5x11x1 : Measurement x=15mm, y=15mm, z=4mm
Zoom Scan : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

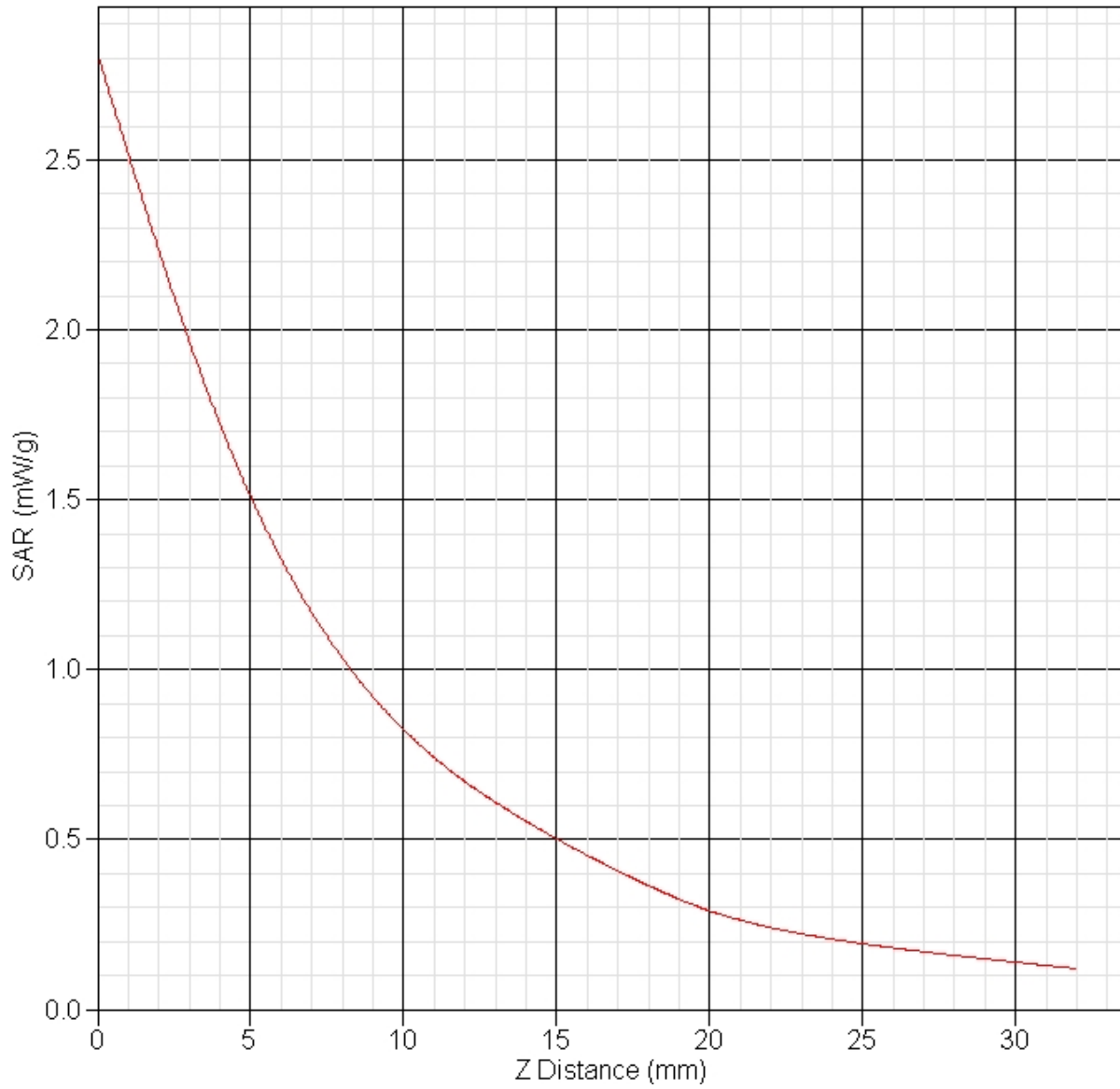
Other Data

DUT Position : Back
Separation : 0 mm
Channel : Low



1 gram SAR value : 1.451 W/kg
10 gram SAR value : 0.736 W/kg
Area Scan Peak SAR : 1.685 W/kg
Zoom Scan Peak SAR : 2.812 W/kg

SAR-Z Axis
at Hotspot x:15.18 y:30.06



SAR Test Report

By Operator : Jay
Measurement Date : 19-Jul-2011
Starting Time : 19-Jul-2011 08:26:31 AM
End Time : 19-Jul-2011 08:45:17 AM
Scanning Time : 1126 secs

Product Data

Device Name : Ricoh EWS
Serial No. : 1097975400047
Mode : Rev 0
Model : eQuill eQ101
Frequency : 1900.00 MHz
Max. Transmit Pwr : 0.25 W
Drift Time : 0 min(s)
Length : 244 mm
Width : 190 mm
Depth : 10 mm
Antenna Type : Internal
Orientation : Back
Power Drift-Start : 0.631 W/kg
Power Drift-Finish: 0.625 W/kg
Power Drift (%) : -1.002

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-Jul-2011
Temperature : 20.00 °C
Ambient Temp. : 23.00 °C
Humidity : 36.00 RH%
Epsilon : 53.11 F/m
Sigma : 1.55 S/m
Density : 1000.00 kg/cu. m

Probe Data

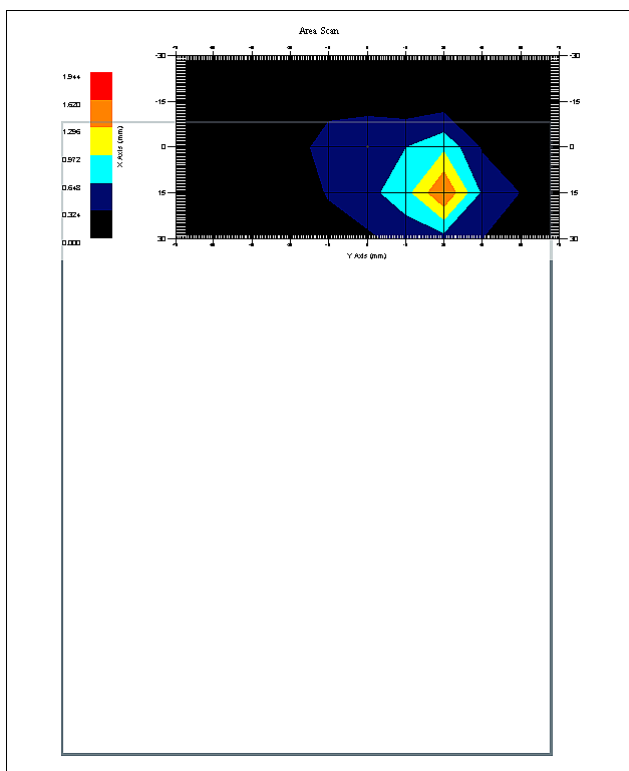
Name : Probe 215 - RFEL
Model : E020
Type : E-Field Triangle
Serial No. : 215
Last Calib. Date : 22-Sep-2010
Frequency : 1900.00 MHz
Duty Cycle Factor: 1
Conversion Factor: 5
Probe Sensitivity: 1.20 1.20 1.20 $\mu\text{V}/(\text{V}/\text{m})^2$
Compression Point: 95.00 mV
Offset : 1.56 mm

Measurement Data

Crest Factor : 1
Scan Type : Complete
Tissue Temp. : 20.00 °C
Ambient Temp. : 23.00 °C
Set-up Date : 19-Jul-2011
Set-up Time : 3:00:27 PM
Area Scan : 5x11x1 : Measurement x=15mm, y=15mm, z=4mm
Zoom Scan : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

Other Data

DUT Position : Back
Separation : 0 mm
Channel : Mid



1 gram SAR value : 1.370 W/kg
10 gram SAR value : 0.693 W/kg
Area Scan Peak SAR : 1.622 W/kg
Zoom Scan Peak SAR : 2.642 W/kg

SAR Test Report

By Operator : Jay
Measurement Date : 19-Jul-2011
Starting Time : 19-Jul-2011 01:48:08 PM
End Time : 19-Jul-2011 02:06:57 PM
Scanning Time : 1129 secs

Product Data

Device Name : Ricoh EWS
Serial No. : 1097975400047
Mode : Rev 0
Model : eQuill eQ101
Frequency : 1900.00 MHz
Max. Transmit Pwr : 0.25 W
Drift Time : 0 min(s)
Length : 244 mm
Width : 190 mm
Depth : 10 mm
Antenna Type : Internal
Orientation : Back
Power Drift-Start : 0.911 W/kg
Power Drift-Finish: 0.891 W/kg
Power Drift (%) : -2.191

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-Jul-2011
Temperature : 20.00 °C
Ambient Temp. : 23.00 °C
Humidity : 36.00 RH%
Epsilon : 53.11 F/m
Sigma : 1.55 S/m
Density : 1000.00 kg/cu. m

Probe Data

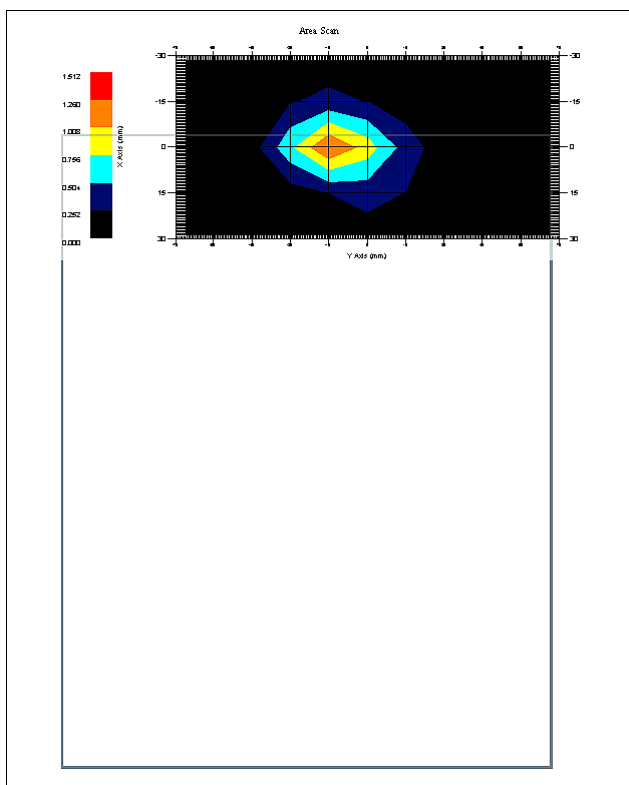
Name : Probe 215 - RFEL
Model : E020
Type : E-Field Triangle
Serial No. : 215
Last Calib. Date : 22-Sep-2010
Frequency : 1900.00 MHz
Duty Cycle Factor: 1
Conversion Factor: 5
Probe Sensitivity: 1.20 1.20 1.20 $\mu\text{V}/(\text{V}/\text{m})^2$
Compression Point: 95.00 mV
Offset : 1.56 mm

Measurement Data

Crest Factor : 1
Scan Type : Complete
Tissue Temp. : 20.00 °C
Ambient Temp. : 23.00 °C
Set-up Date : 19-Jul-2011
Set-up Time : 6:46:02 AM
Area Scan : 5x11x1 : Measurement x=15mm, y=15mm, z=4mm
Zoom Scan : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

Other Data

DUT Position : Back
Separation : 0 mm
Channel : High



1 gram SAR value : 1.034 W/kg
10 gram SAR value : 0.515 W/kg
Area Scan Peak SAR : 1.261 W/kg
Zoom Scan Peak SAR : 2.031 W/kg

SAR Test Report

By Operator : Jay
Measurement Date : 22-Jul-2011
Starting Time : 22-Jul-2011 02:51:52 PM
End Time : 22-Jul-2011 03:09:28 PM
Scanning Time : 1056 secs

Product Data

Device Name : Ricoh EWS
Serial No. : 1097975400047
Mode : 802.11b
Model : eQuill eQ101 & eQ102
Frequency : 2450.00 MHz
Max. Transmit Pwr : 0.063 W
Drift Time : 0 min(s)
Length : 244 mm
Width : 190 mm
Depth : 10 mm
Antenna Type : Internal
Orientation : Back
Power Drift-Start : 0.143 W/kg
Power Drift-Finish: 0.139 W/kg
Power Drift (%) : -2.412

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. : 2450
Frequency : 2450.00 MHz
Last Calib. Date : 22-Jul-2011
Temperature : 20.00 °C
Ambient Temp. : 23.00 °C
Humidity : 46.00 RH%
Epsilon : 52.38 F/m
Sigma : 1.97 S/m
Density : 1000.00 kg/cu. m

Probe Data

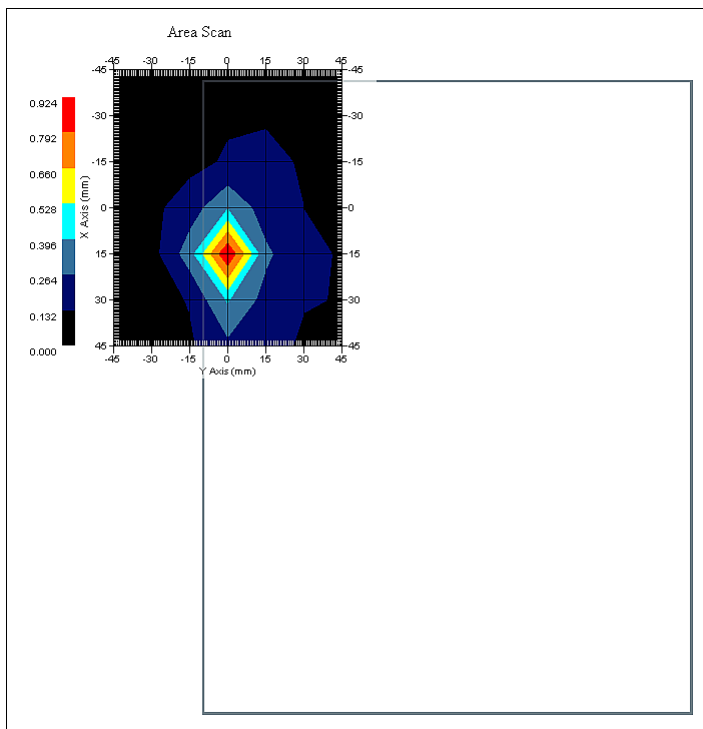
Name : Probe 215 - RFEL
Model : E020
Type : E-Field Triangle
Serial No. : 215
Last Calib. Date : 22-Sep-2010
Frequency : 2450.00 MHz
Duty Cycle Factor: 1
Conversion Factor: 4.5
Probe Sensitivity: 1.20 1.20 1.20 $\mu\text{V}/(\text{V}/\text{m})^2$
Compression Point: 95.00 mV
Offset : 1.56 mm

Measurement Data

Crest Factor : 1
Scan Type : Complete
Tissue Temp. : 20.00 °C
Ambient Temp. : 23.00 °C
Set-up Date : 22-Jul-2011
Set-up Time : 2:26:36 PM
Area Scan : 7x7x1 : Measurement x=15mm, y=15mm, z=4mm
Zoom Scan : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

Other Data

DUT Position : Back
Separation : 0 mm
Channel : Low



1 gram SAR value : 0.780 W/kg
10 gram SAR value : 0.399 W/kg
Area Scan Peak SAR : 0.921 W/kg
Zoom Scan Peak SAR : 1.591 W/kg

SAR Test Report

By Operator : Jay
Measurement Date : 22-Jul-2011
Starting Time : 22-Jul-2011 02:28:10 PM
End Time : 22-Jul-2011 02:46:07 PM
Scanning Time : 1077 secs

Product Data

Device Name : Ricoh EWS
Serial No. : 1097975400047
Mode : 802.11b
Model : eQuill eQ101 & eQ102
Frequency : 2450.00 MHz
Max. Transmit Pwr : 0.063 W
Drift Time : 0 min(s)
Length : 244 mm
Width : 190 mm
Depth : 10 mm
Antenna Type : Internal
Orientation : Back
Power Drift-Start : 0.162 W/kg
Power Drift-Finish: 0.170 W/kg
Power Drift (%) : 4.863

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. : 2450
Frequency : 2450.00 MHz
Last Calib. Date : 22-Jul-2011
Temperature : 20.00 °C
Ambient Temp. : 23.00 °C
Humidity : 46.00 RH%
Epsilon : 52.38 F/m
Sigma : 1.97 S/m
Density : 1000.00 kg/cu. m

Probe Data

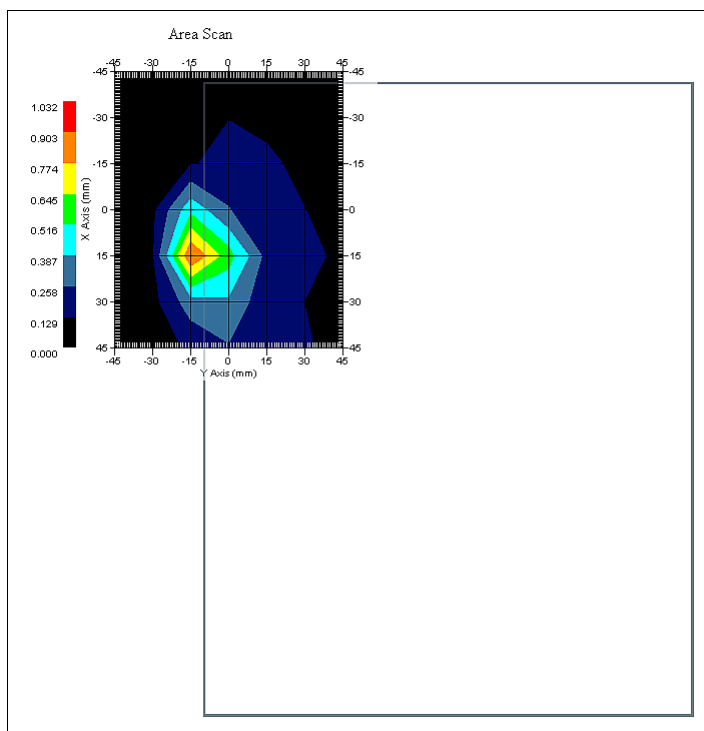
Name : Probe 215 - RFEL
Model : E020
Type : E-Field Triangle
Serial No. : 215
Last Calib. Date : 22-Sep-2010
Frequency : 2450.00 MHz
Duty Cycle Factor: 1
Conversion Factor: 4.5
Probe Sensitivity: 1.20 1.20 1.20 $\mu\text{V}/(\text{V}/\text{m})^2$
Compression Point: 95.00 mV
Offset : 1.56 mm

Measurement Data

Crest Factor : 1
Scan Type : Complete
Tissue Temp. : 20.00 °C
Ambient Temp. : 23.00 °C
Set-up Date : 22-Jul-2011
Set-up Time : 2:26:36 PM
Area Scan : 7x7x1 : Measurement x=15mm, y=15mm, z=4mm
Zoom Scan : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

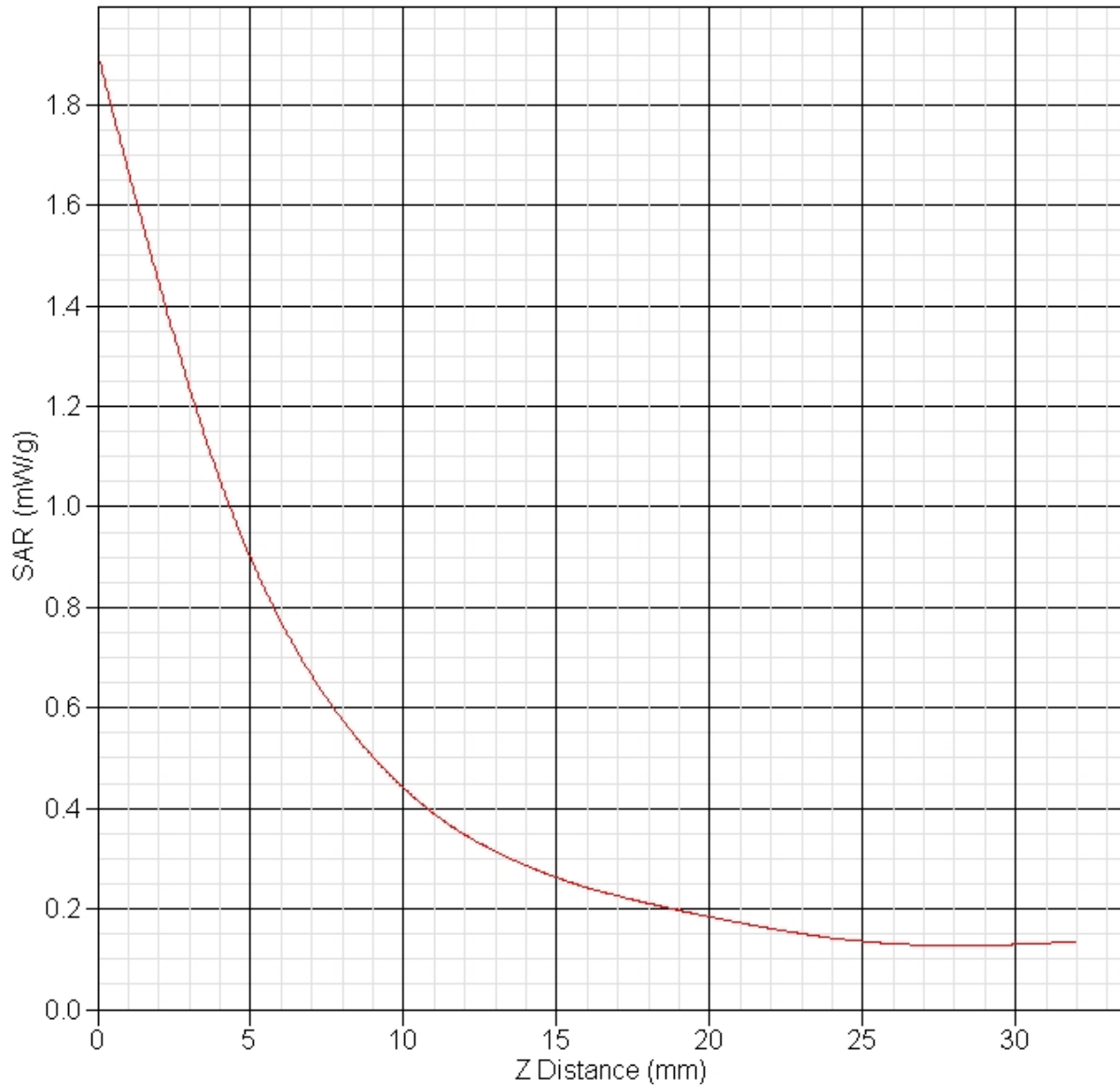
Other Data

DUT Position : Back
Separation : 0 mm
Channel : Mid



1 gram SAR value : 0.899 W/kg
10 gram SAR value : 0.423 W/kg
Area Scan Peak SAR : 0.905 W/kg
Zoom Scan Peak SAR : 1.901 W/kg

SAR-Z Axis
at Hotspot x:30.21 y:-6.94



SAR Test Report

By Operator : Jay
Measurement Date : 22-Jul-2011
Starting Time : 22-Jul-2011 03:11:43 PM
End Time : 22-Jul-2011 03:29:23 PM
Scanning Time : 1060 secs

Product Data

Device Name : Ricoh EWS
Serial No. : 1097975400047
Mode : 802.11b
Model : eQuill eQ101 & eQ102
Frequency : 2450.00 MHz
Max. Transmit Pwr : 0.063 W
Drift Time : 0 min(s)
Length : 244 mm
Width : 190 mm
Depth : 10 mm
Antenna Type : Internal
Orientation : Back
Power Drift-Start : 0.186 W/kg
Power Drift-Finish: 0.187 W/kg
Power Drift (%) : 0.231

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. : 2450
Frequency : 2450.00 MHz
Last Calib. Date : 22-Jul-2011
Temperature : 20.00 °C
Ambient Temp. : 23.00 °C
Humidity : 46.00 RH%
Epsilon : 52.38 F/m
Sigma : 1.97 S/m
Density : 1000.00 kg/cu. m

Probe Data

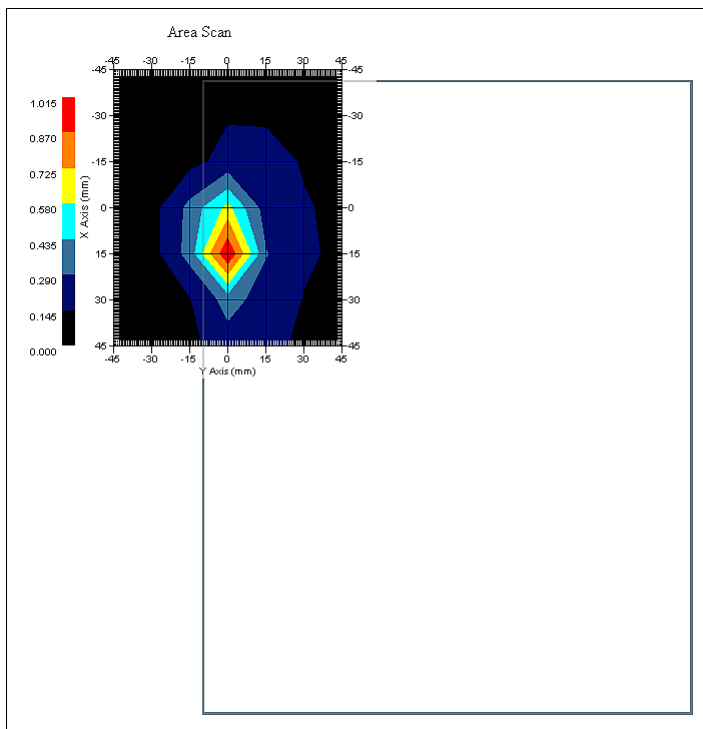
Name : Probe 215 - RFEL
Model : E020
Type : E-Field Triangle
Serial No. : 215
Last Calib. Date : 22-Sep-2010
Frequency : 2450.00 MHz
Duty Cycle Factor: 1
Conversion Factor: 4.5
Probe Sensitivity: 1.20 1.20 1.20 $\mu\text{V}/(\text{V}/\text{m})^2$
Compression Point: 95.00 mV
Offset : 1.56 mm

Measurement Data

Crest Factor : 1
Scan Type : Complete
Tissue Temp. : 20.00 °C
Ambient Temp. : 23.00 °C
Set-up Date : 22-Jul-2011
Set-up Time : 2:26:36 PM
Area Scan : 7x7x1 : Measurement x=15mm, y=15mm, z=4mm
Zoom Scan : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

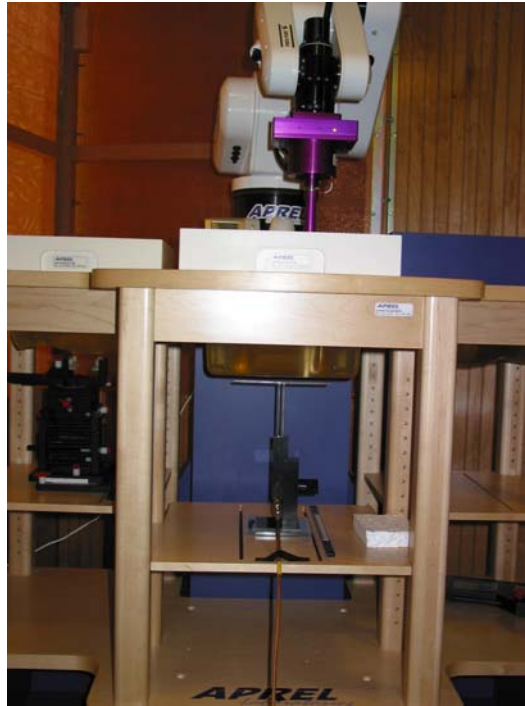
Other Data

DUT Position : Back
Separation : 0 mm
Channel : High

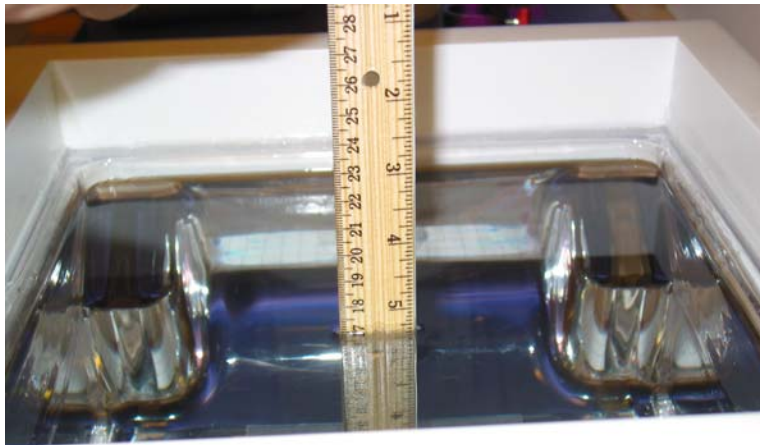


1 gram SAR value : 0.876 W/kg
10 gram SAR value : 0.413 W/kg
Area Scan Peak SAR : 1.015 W/kg
Zoom Scan Peak SAR : 1.901 W/kg

Appendix C – SAR Test Setup Photos



System Body Configuration



Body Tissue Depth



Test Position WWAN Antenna 0 mm Gap



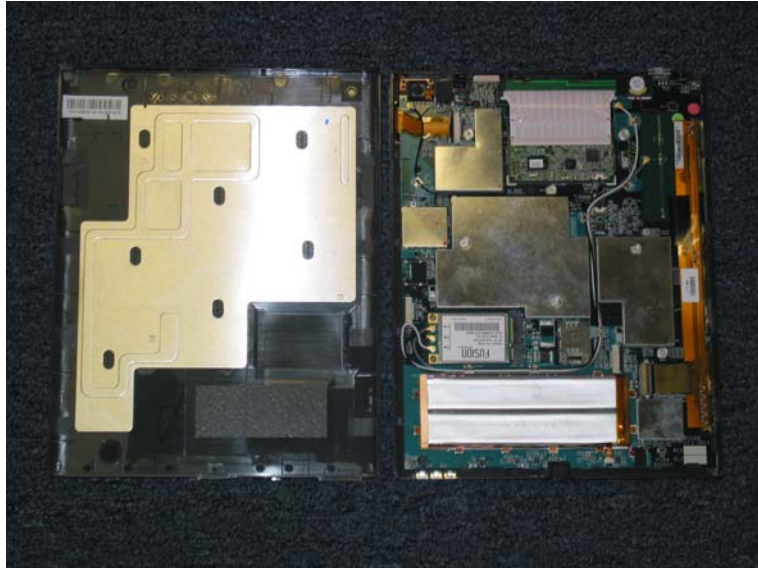
Test Position WiFi Antenna 0 mm Gap



Front of Device



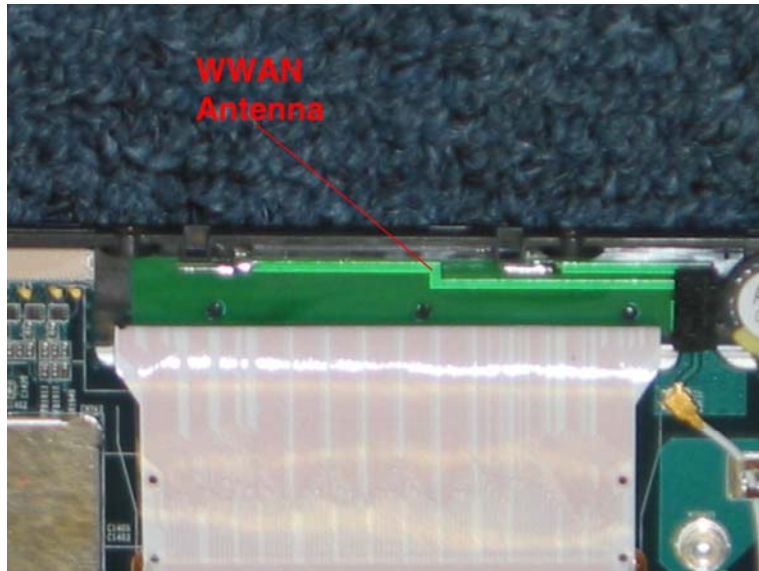
Back of Device



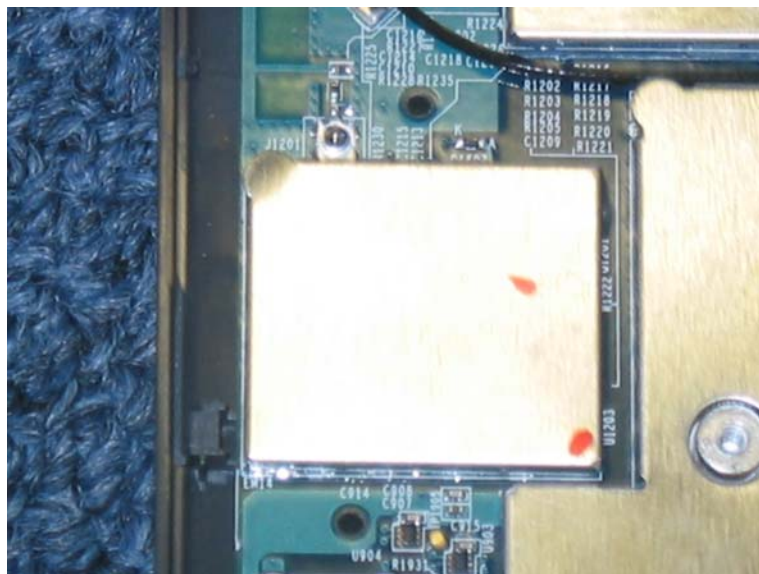
Back Cover Removed



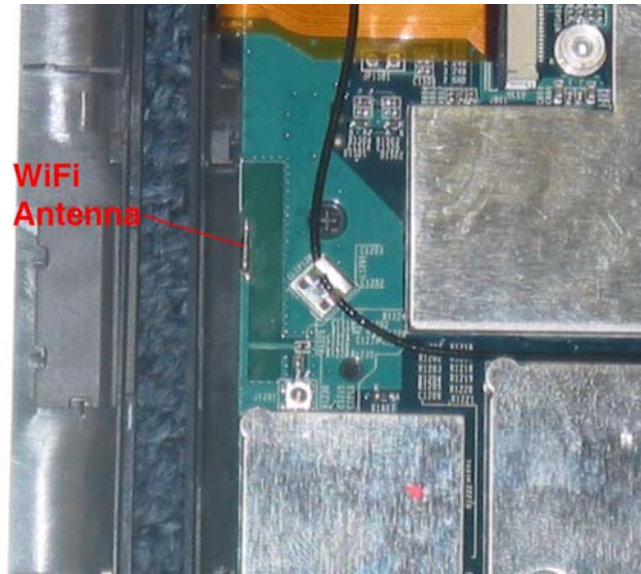
WWAN Module



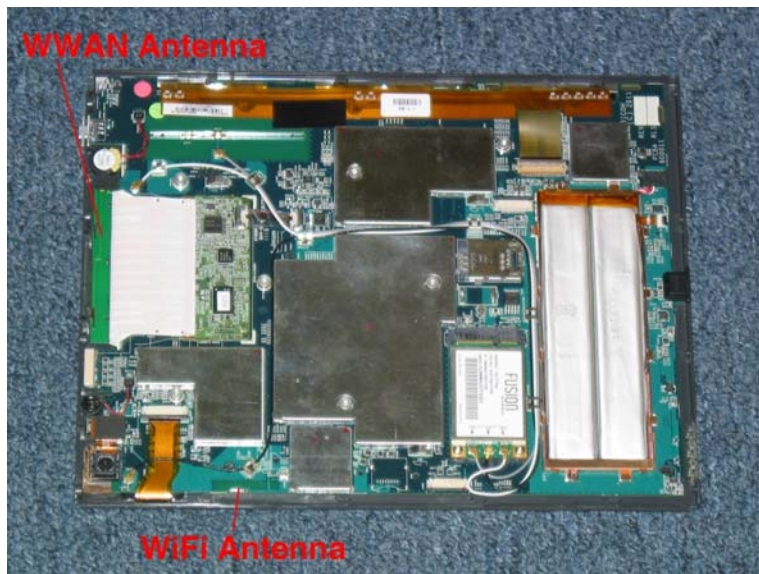
WWAN Antenna



WiFi Module Located Under Shield Can



WiFi Antenna



Antenna Locations

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

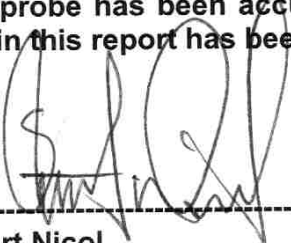
SSI/DRB-TP-D01-032-E020-V2 E-Field Probe Calibration Procedure
IEEE 1528 "Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques"
IEEE 1309 "IEEE Standard for Calibration of Electromagnetic 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

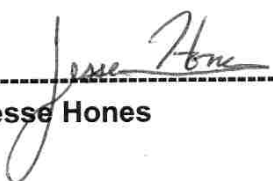
Probe 215 was a re-calibration.

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

Probe Type:	E-Field Probe E-020
Serial Number:	215
Frequency:	835 MHz
Sensor Offset:	1.56 mm
Sensor Length:	2.5 mm
Tip Enclosure:	Ertalyte*
Tip Diameter:	<5 mm
Tip Length:	60 mm
Total Length:	290 mm

*Resistive to recommended tissue recipes per IEEE-1528

Sensitivity in Air

Channel X:	1.2 $\mu\text{V}/(\text{V}/\text{m})^2$
Channel Y:	1.2 $\mu\text{V}/(\text{V}/\text{m})^2$
Channel Z:	1.2 $\mu\text{V}/(\text{V}/\text{m})^2$
Diode Compression Point:	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.

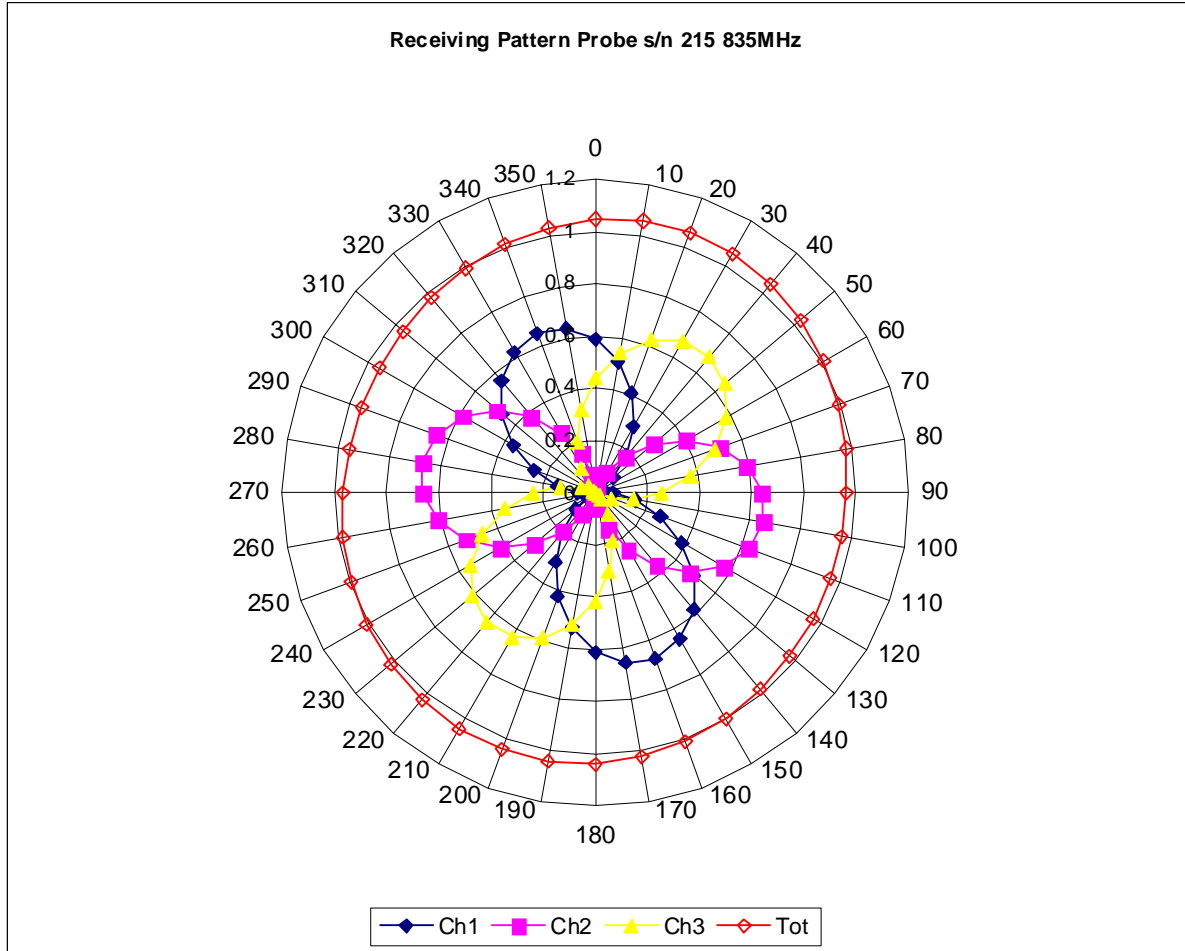
Boundary Effect:

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.

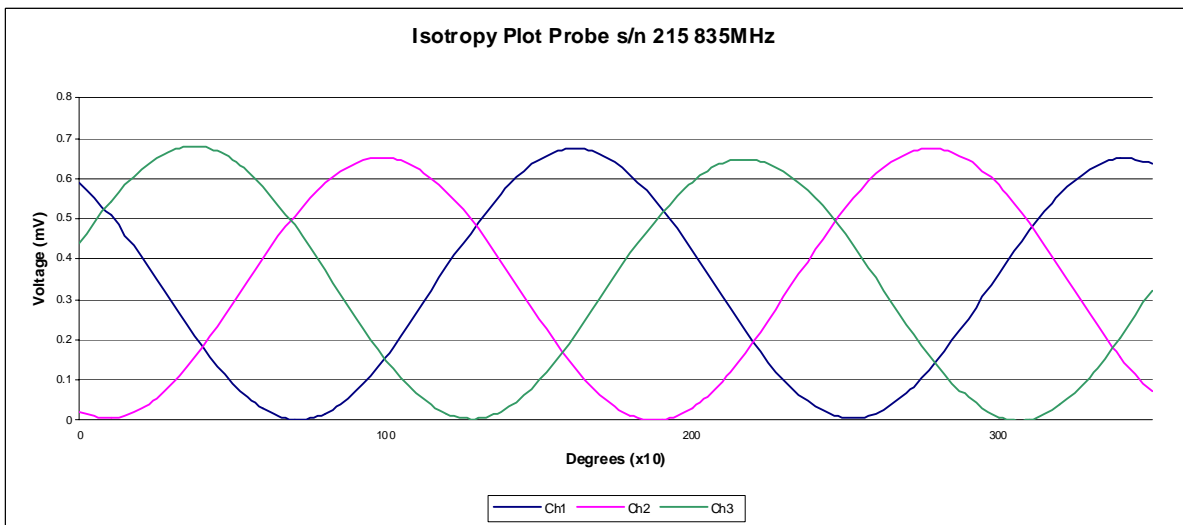
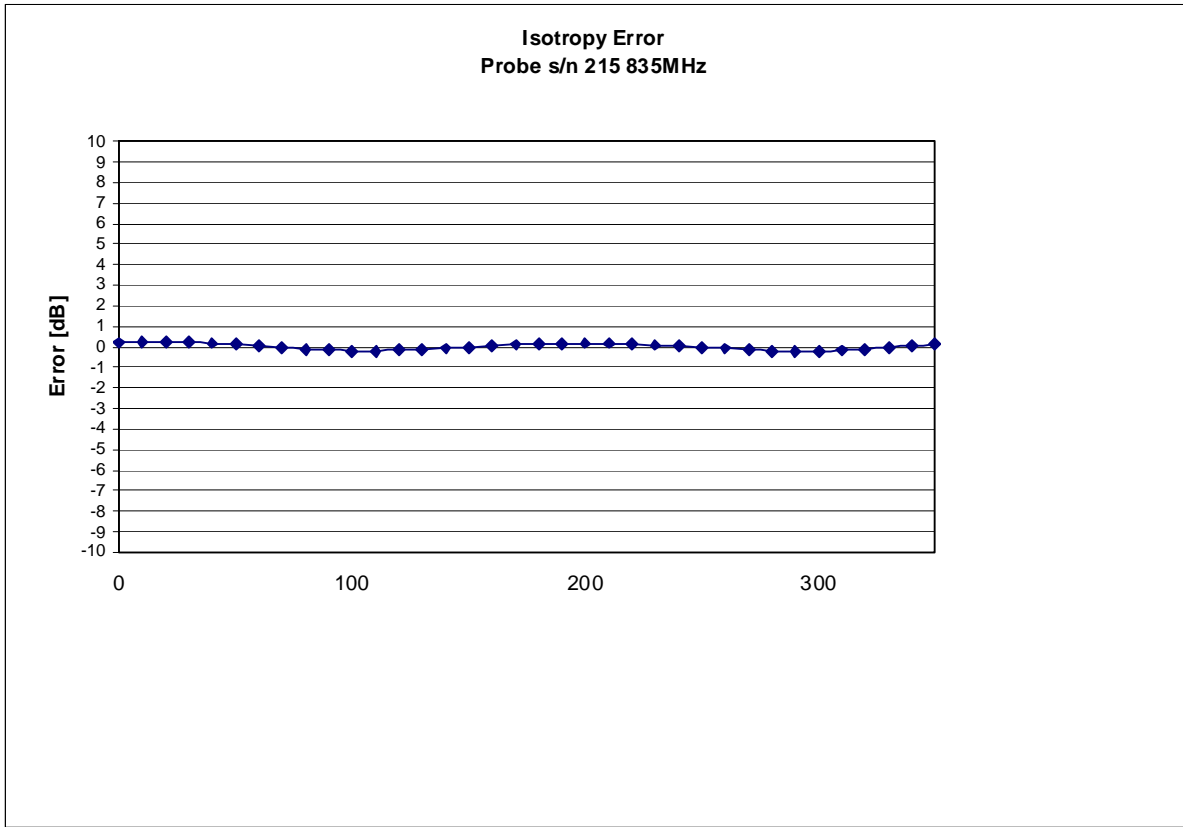
Spatial Resolution:

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)



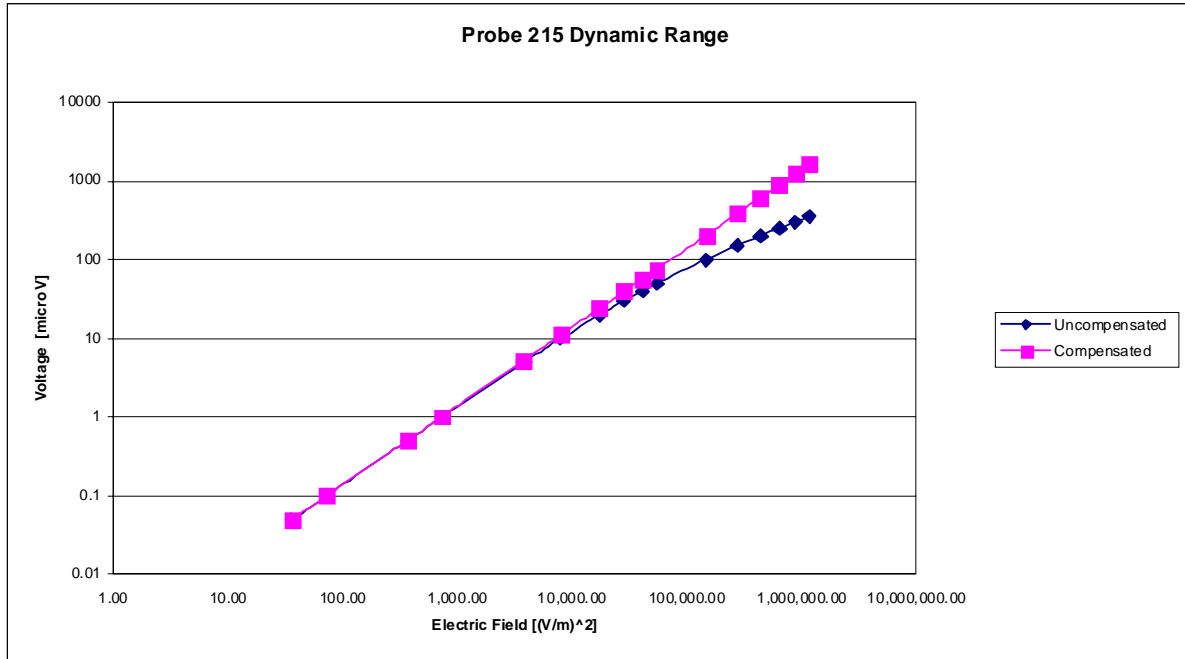
Isotropy Error 835 MHz (Air)



Isotropicity Tissue:

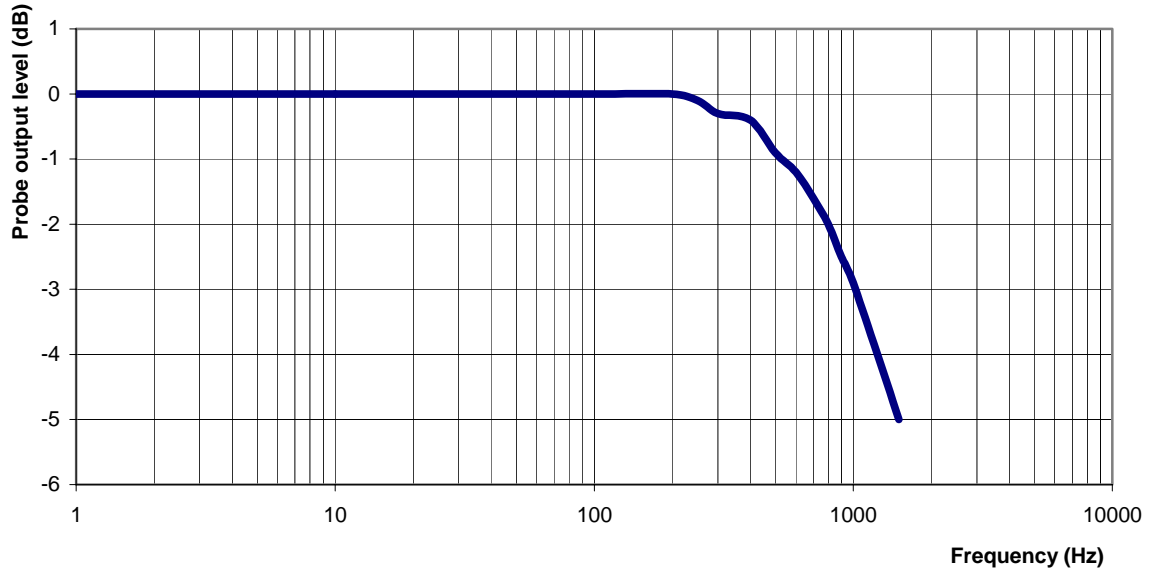
0.10 dB

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

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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

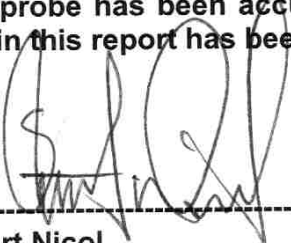
SSI/DRB-TP-D01-032-E020-V2 E-Field Probe Calibration Procedure
IEEE 1528 "Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques"
IEEE 1309 "IEEE Standard for Calibration of Electromagnetic 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

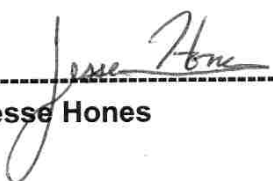
Probe 215 was a re-calibration.

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

Probe Type:	E-Field Probe E-020
Serial Number:	215
Frequency:	1900 MHz
Sensor Offset:	1.56 mm
Sensor Length:	2.5 mm
Tip Enclosure:	Ertalyte*
Tip Diameter:	<5 mm
Tip Length:	60 mm
Total Length:	290 mm

*Resistive to recommended tissue recipes per IEEE-1528

Sensitivity in Air

Channel X:	1.2 $\mu\text{V}/(\text{V}/\text{m})^2$
Channel Y:	1.2 $\mu\text{V}/(\text{V}/\text{m})^2$
Channel Z:	1.2 $\mu\text{V}/(\text{V}/\text{m})^2$
Diode Compression Point:	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.

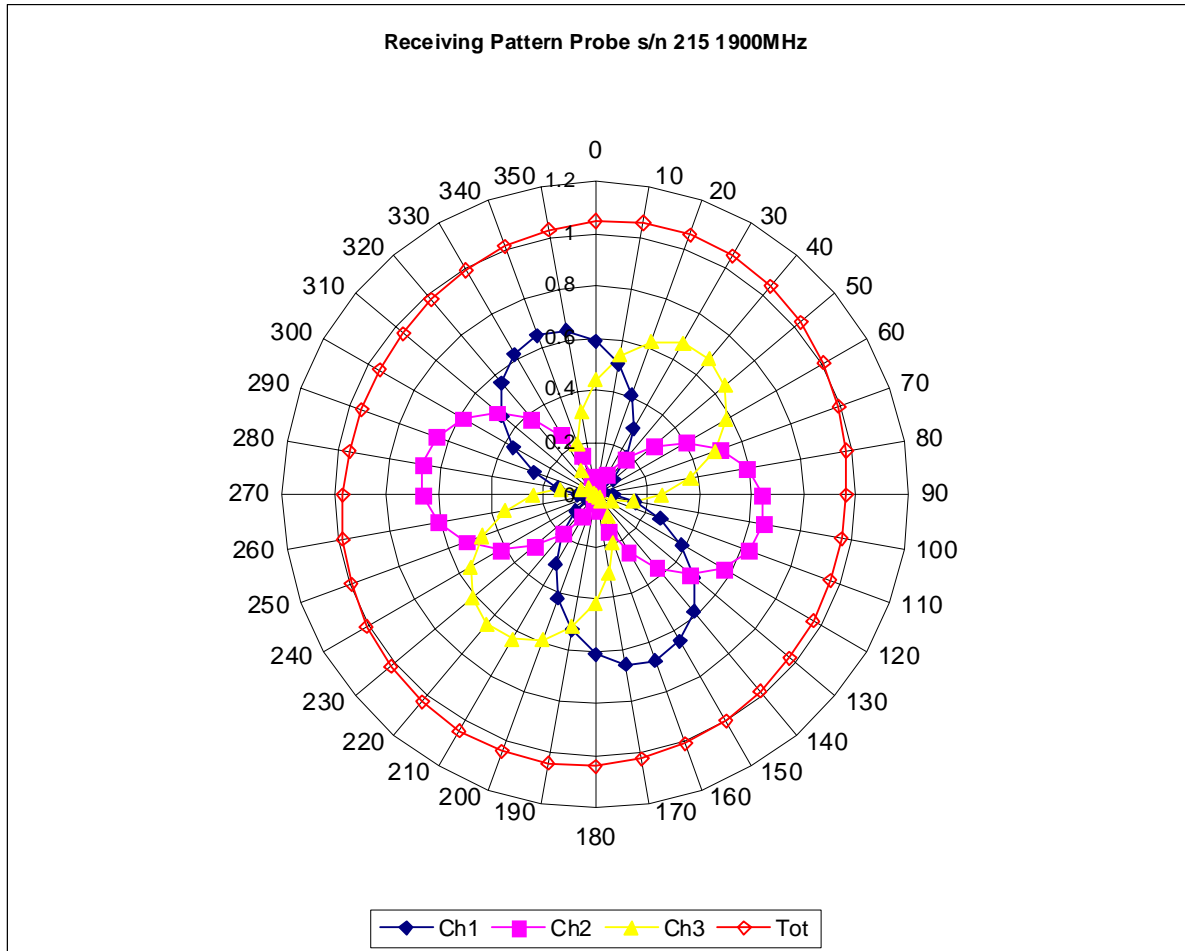
Boundary Effect:

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.

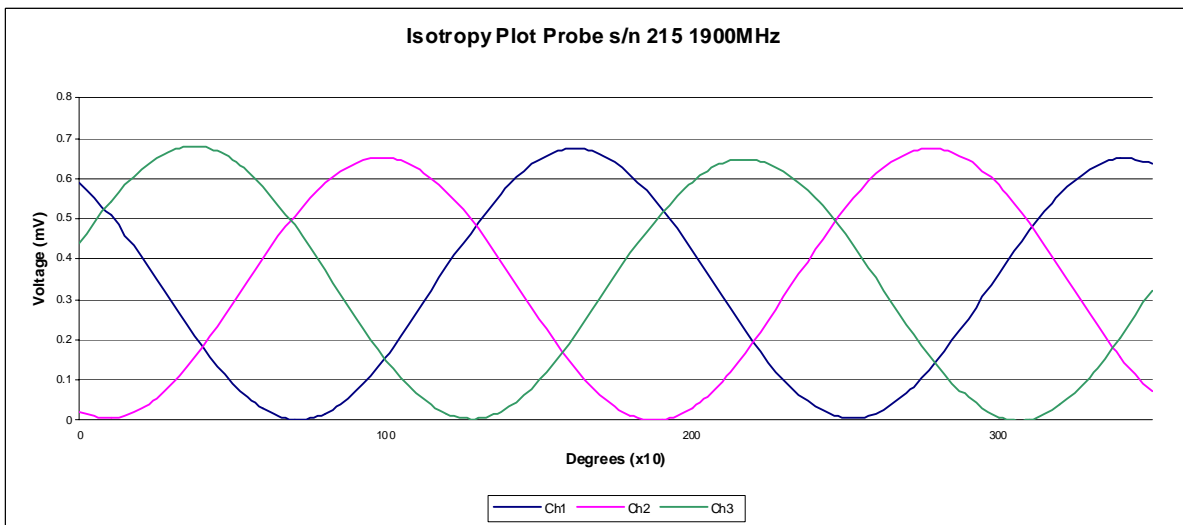
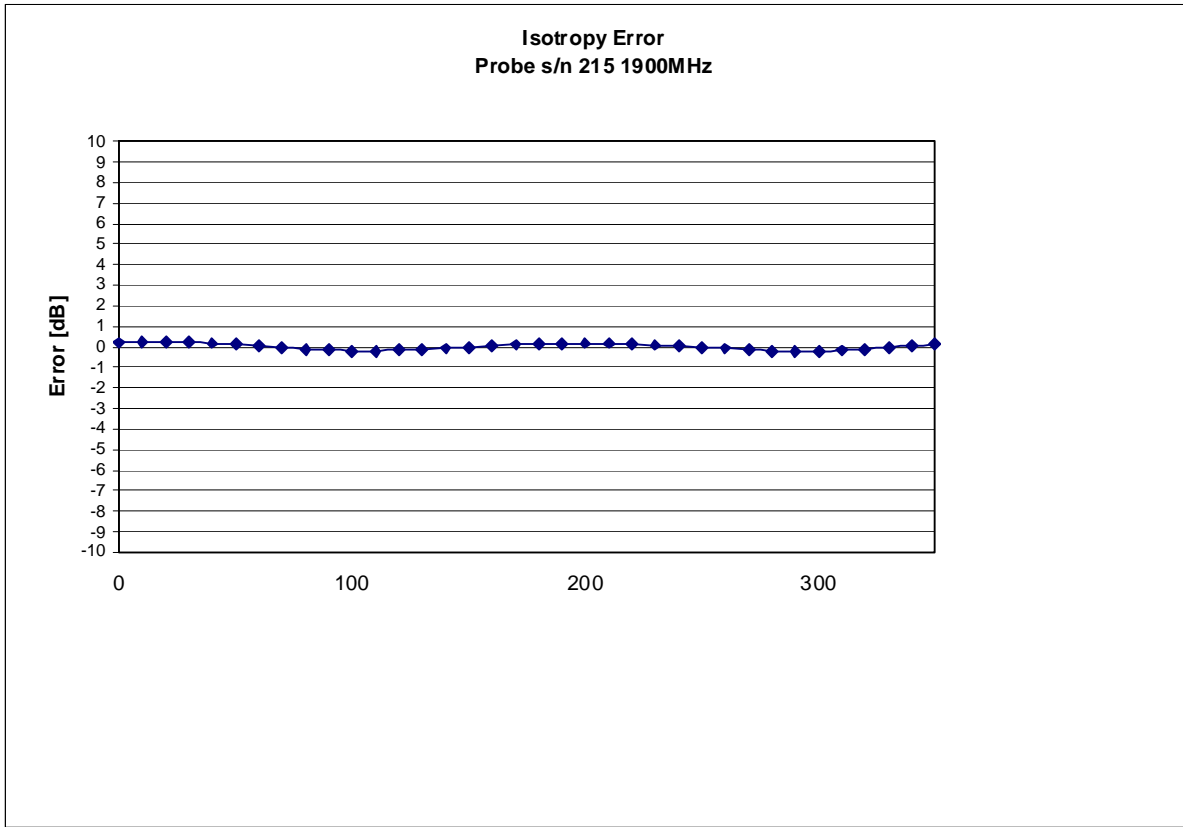
Spatial Resolution:

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)



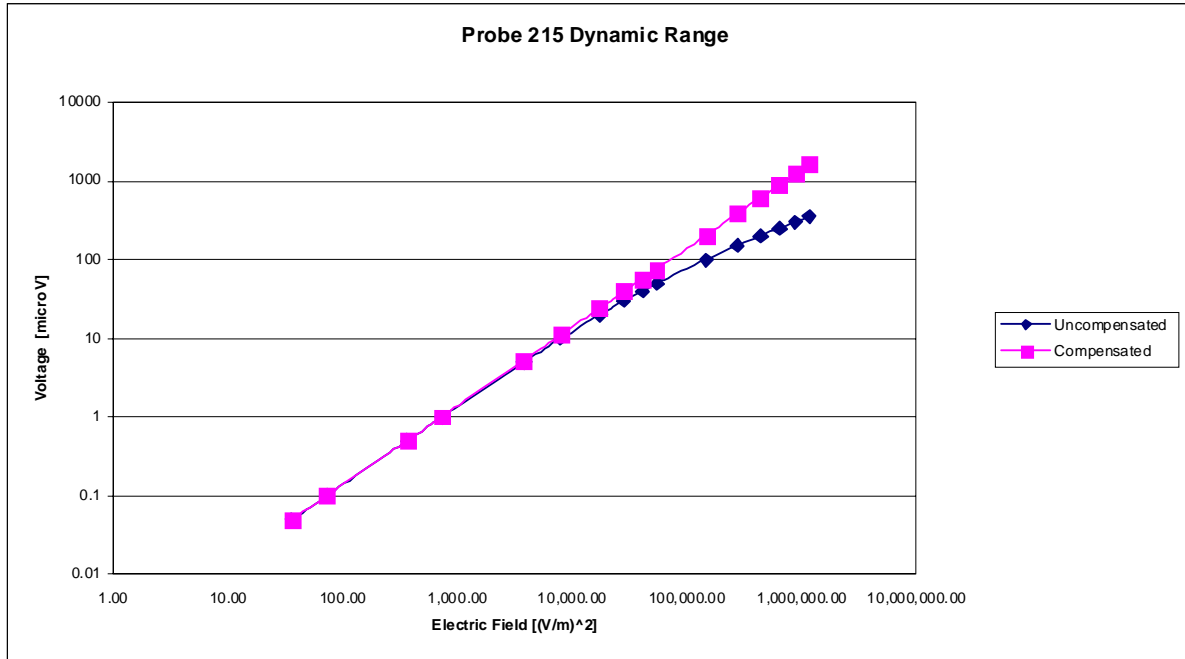
Isotropy Error 1900 MHz (Air)



Isotropicity Tissue:

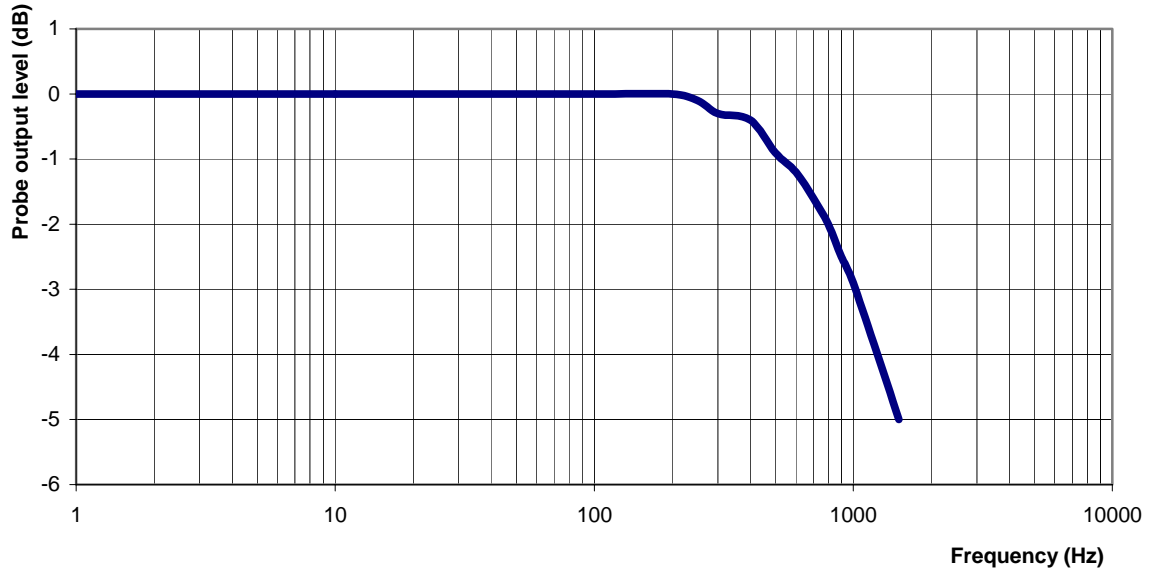
0.10 dB

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.

NCL CALIBRATION LABORATORIES

Calibration File No.: CP-1164

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 2450 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

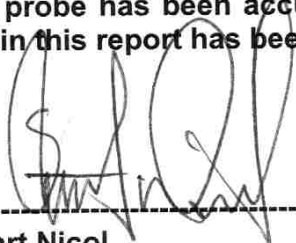
SSI/DRB-TP-D01-032-E020-V2 E-Field Probe Calibration Procedure
IEEE 1528 "Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques"
IEEE 1309 "IEEE Standard for Calibration of Electromagnetic 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

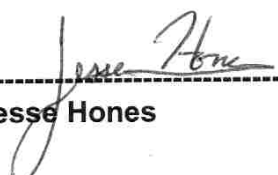
Probe 215 was a re-calibration.

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

Probe Type:	E-Field Probe E-020
Serial Number:	215
Frequency:	2450 MHz
Sensor Offset:	1.56 mm
Sensor Length:	2.5 mm
Tip Enclosure:	Ertalyte*
Tip Diameter:	<5 mm
Tip Length:	60 mm
Total Length:	290 mm

*Resistive to recommended tissue recipes per IEEE-1528

Sensitivity in Air

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

Sensitivity in Body Tissue Measured

Frequency: 2450 MHz

Epsilon: 53.0 (+/-5%) **Sigma:** 1.98 S/m (+/-5%)

ConvF

Channel X: 4.5

Channel Y: 4.5

Channel Z: 4.5

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

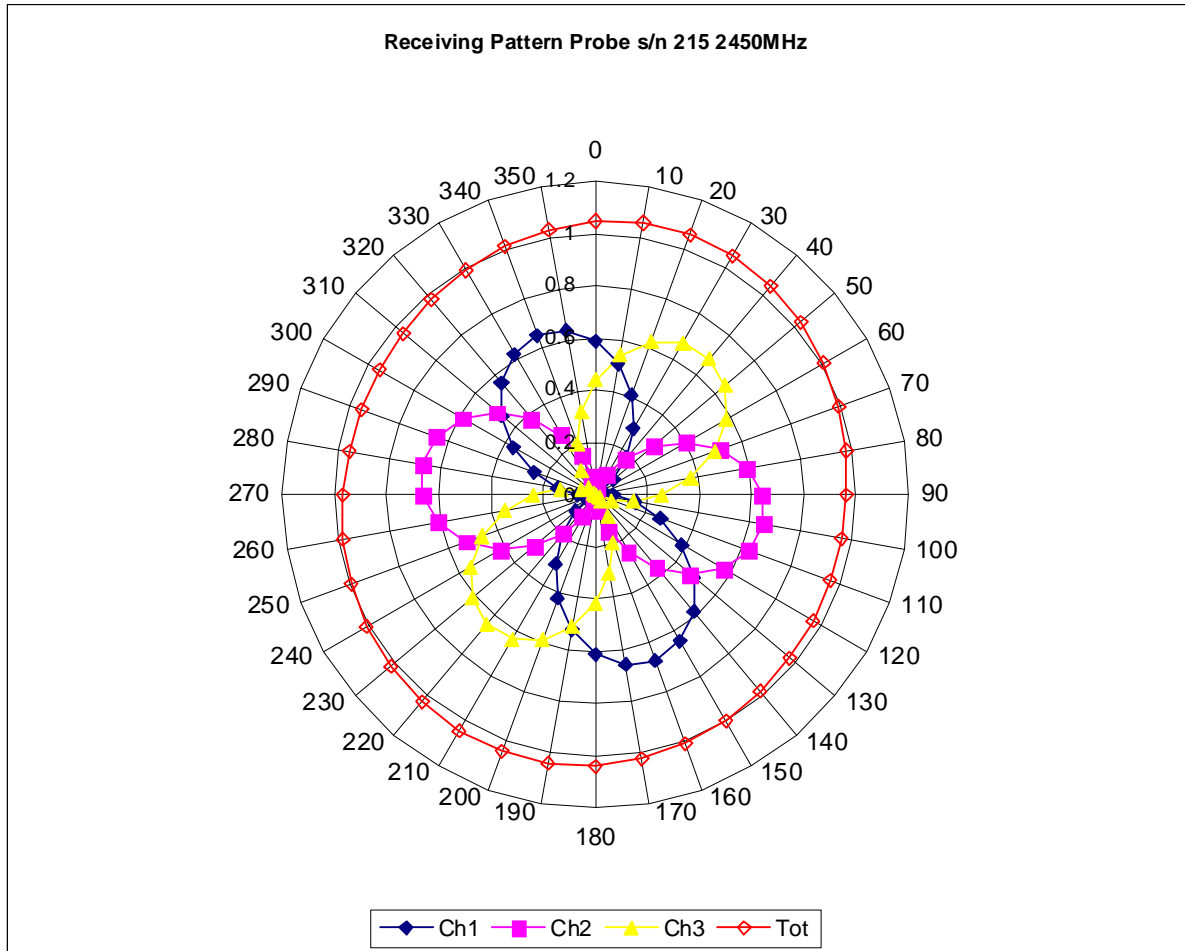
Boundary Effect:

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.

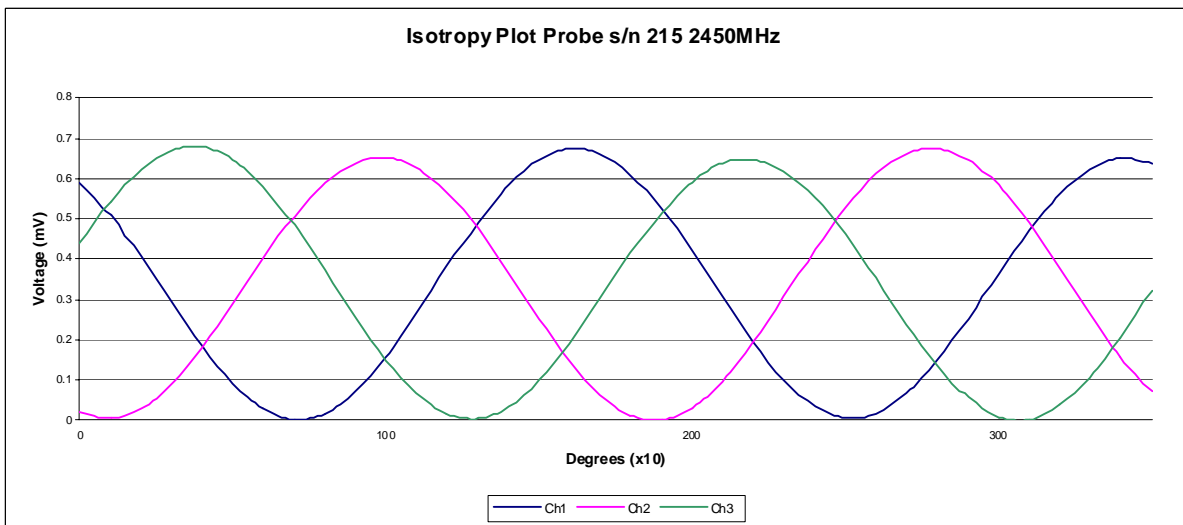
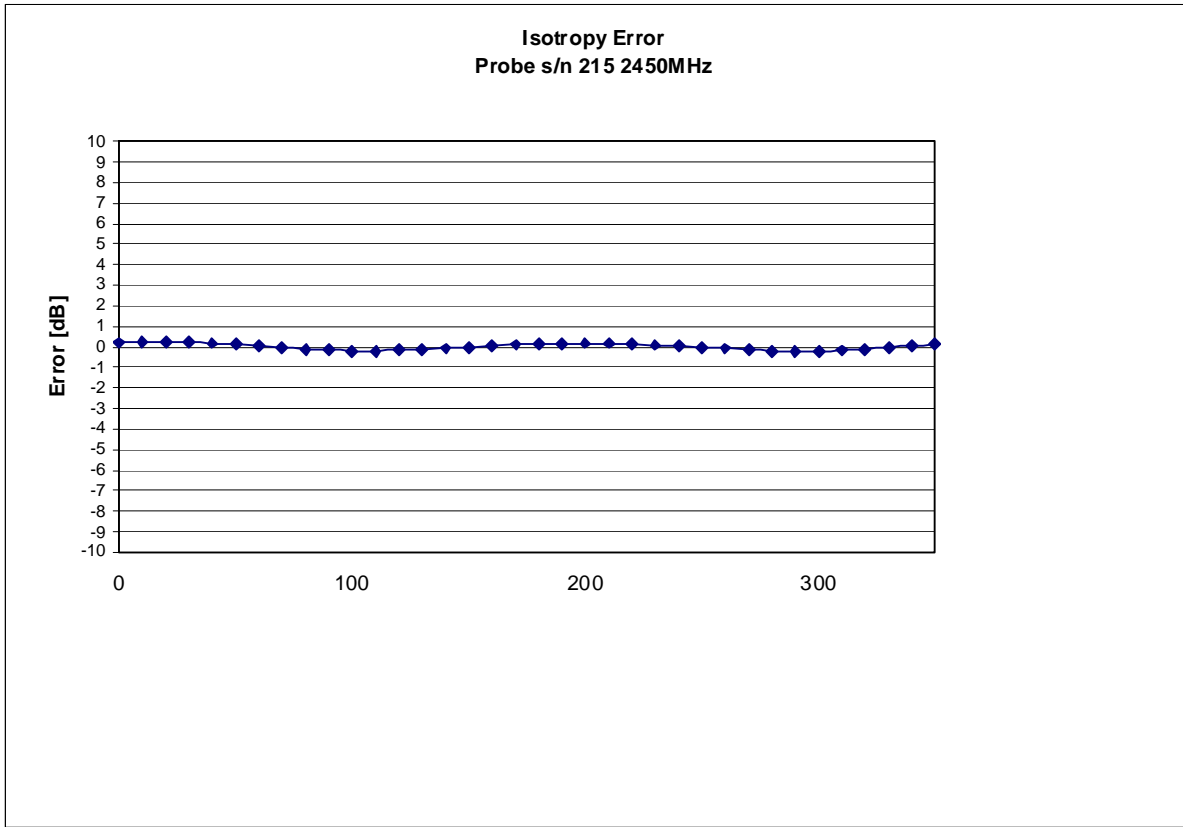
Spatial Resolution:

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 2450 MHz (Air)



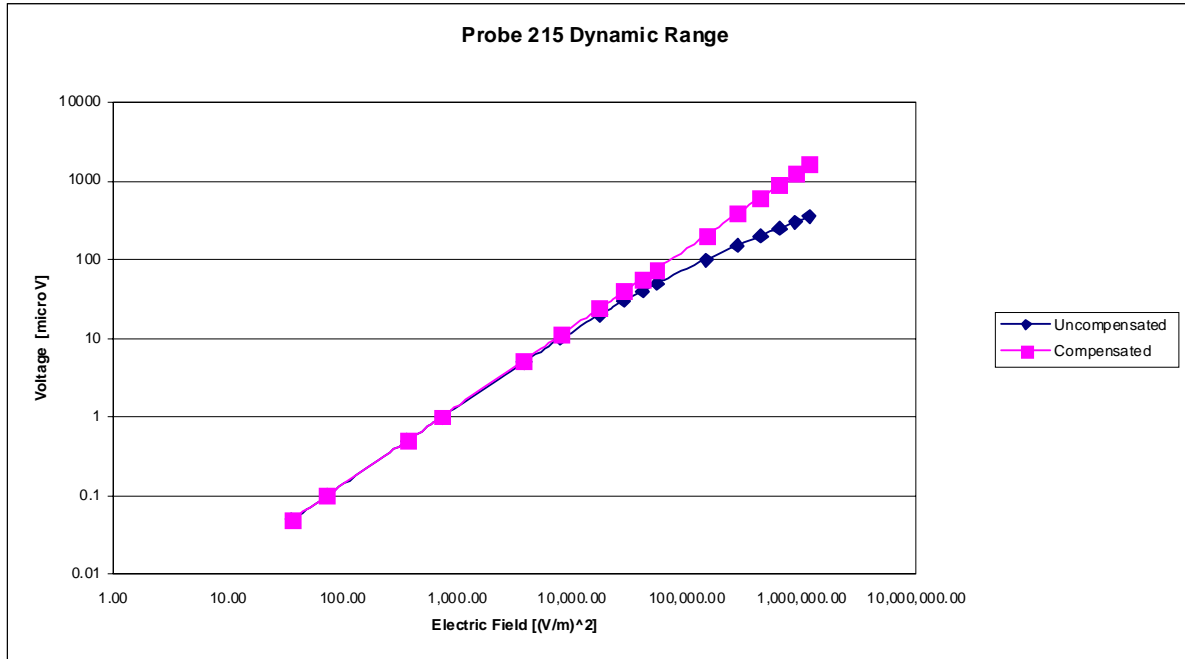
Isotropy Error 2450 MHz (Air)



Isotropicity Tissue:

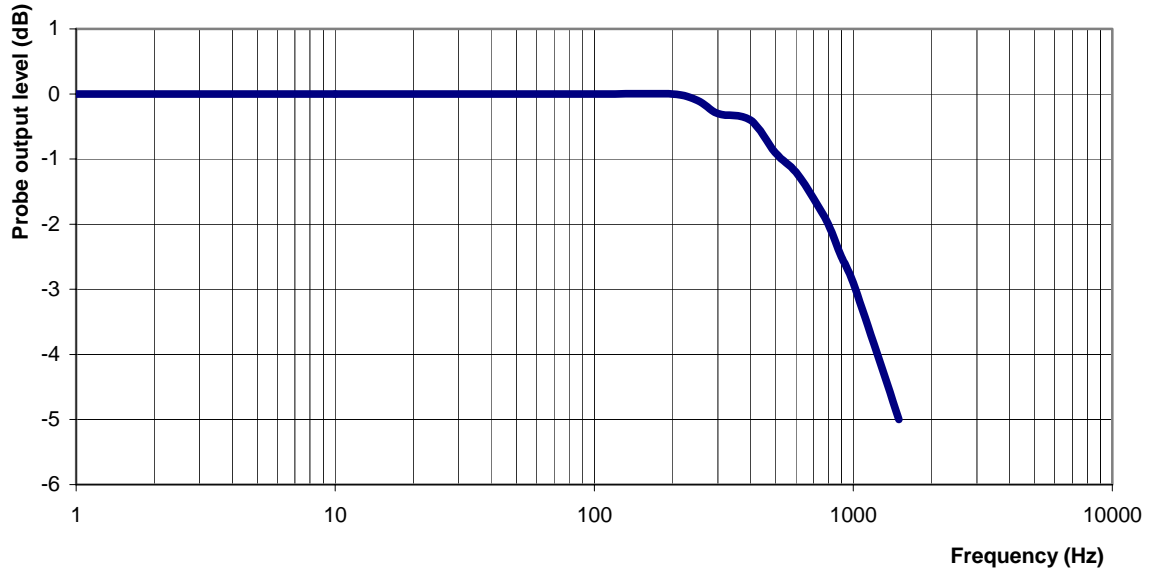
0.10 dB

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

Sensitivity in Body Tissue

Frequency: 2450 MHz
Epsilon: 53.0 (+/-5%) **Sigma:** 1.98 S/m (+/-5%)

ConvF

Channel X: 4.5 7%(K=2)
Channel Y: 4.5 7%(K=2)
Channel Z: 4.5 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-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: 16th November 2010
Released on: 16th 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

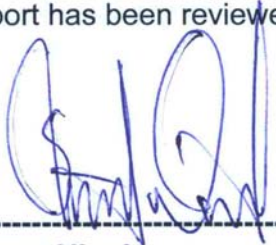
Dipole 180-00561 was a new calibration.

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

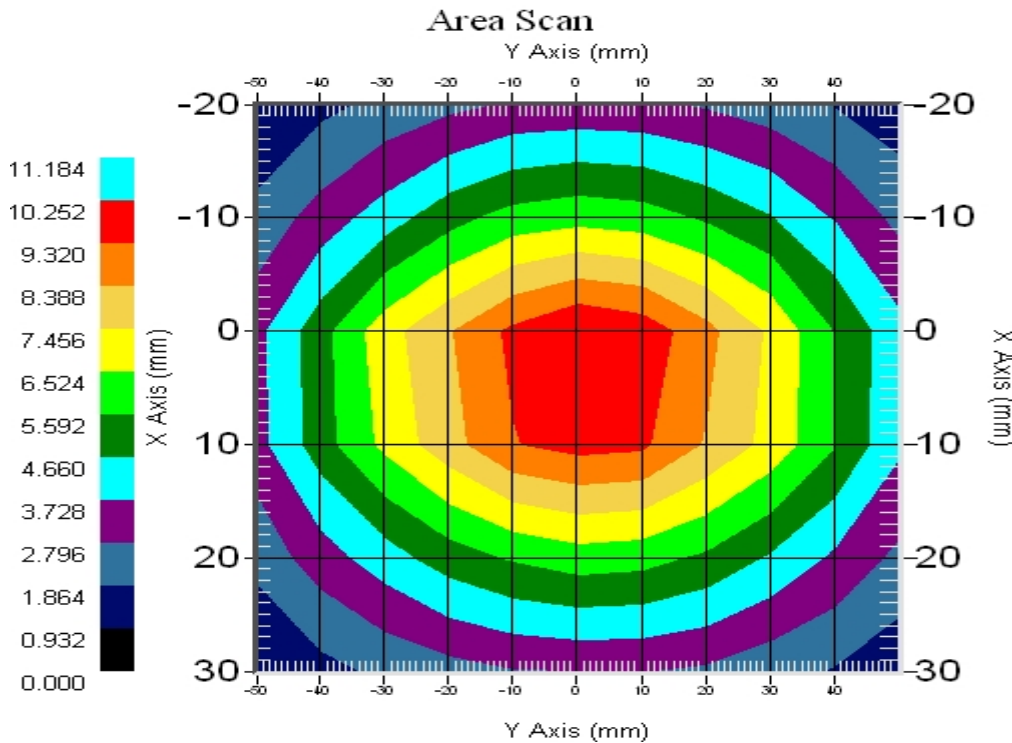
Length: 161.0 mm
Height: 89.8 mm

Electrical Specification

SWR: 1.143U
Return Loss: -24.058 dB
Impedance: 55.519 Ω

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

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

Tissue Validation

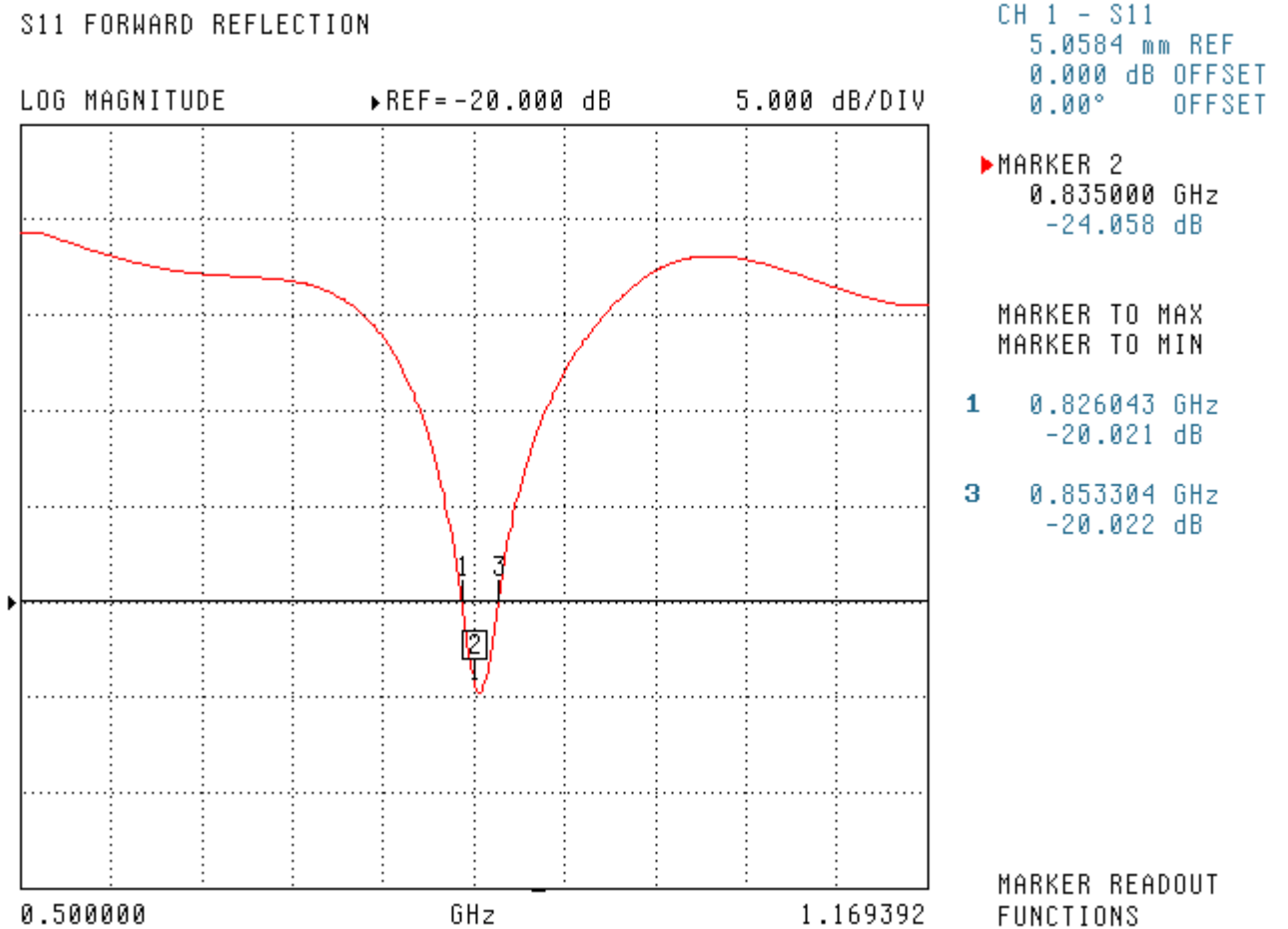
Body Tissue 835MHz	Measured
Dielectric constant, ϵ_r	57.19
Conductivity, σ [S/m]	0.97

Electrical Calibration

Test	Result
S11 RL	-24.058dB
SWR	1.143U
Impedance	55.519 Ω

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

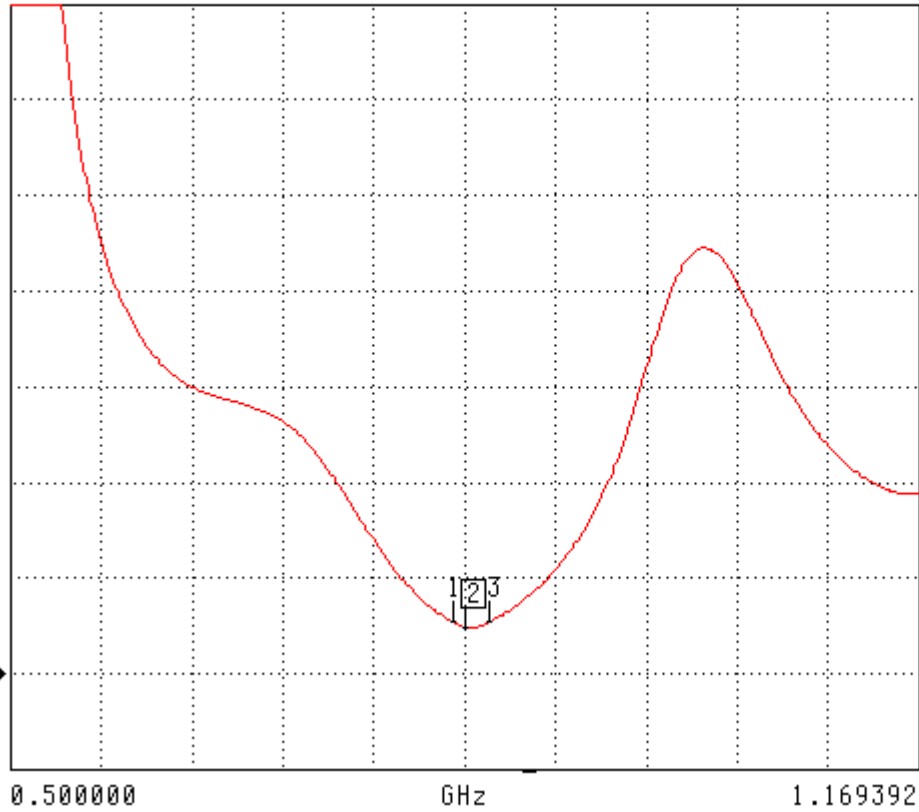
S11 Parameter Return Loss



SWR

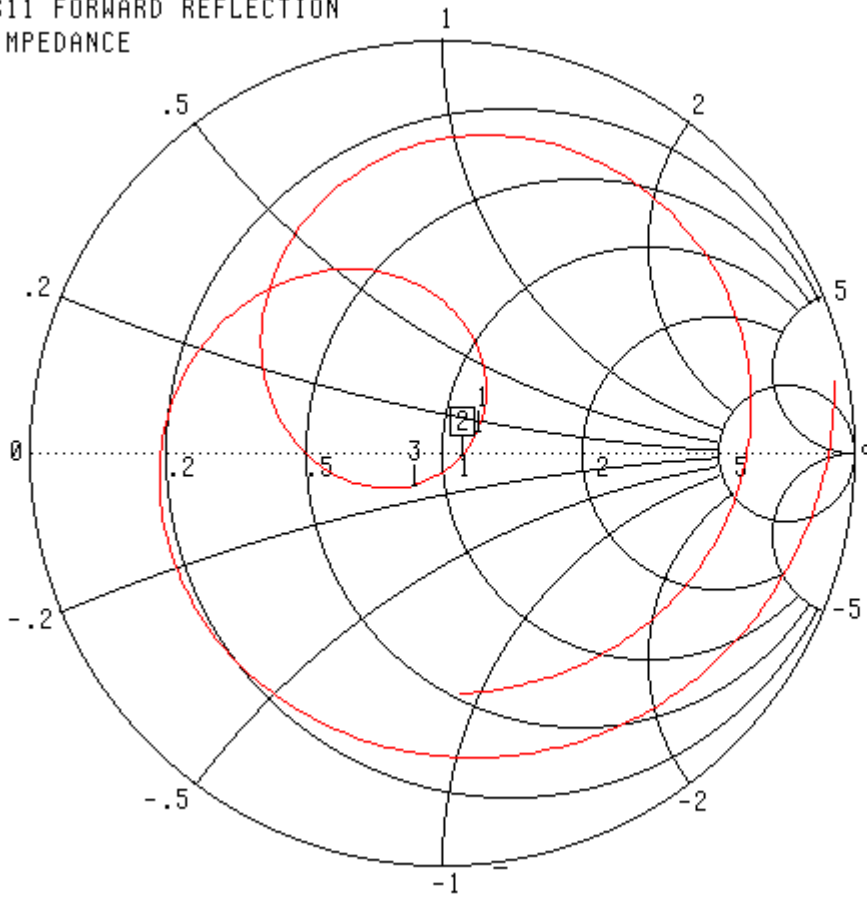
S11 FORWARD REFLECTION

SWR REF=172.168 mU 2.000 U/DIV



Smith Chart Dipole Impedance

S11 FORWARD REFLECTION
IMPEDANCE



0.500000 - 1.169392 GHz

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

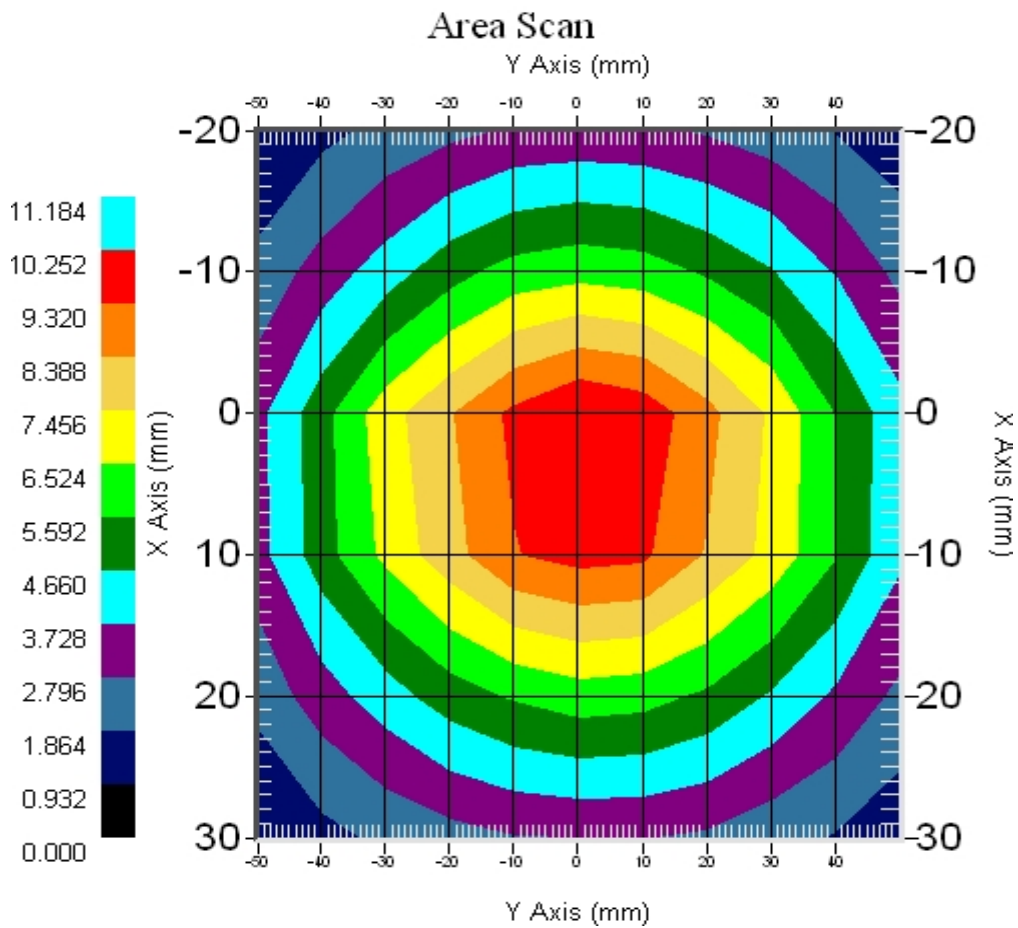
MARKER TO MAX
MARKER TO MIN

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: 16th 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

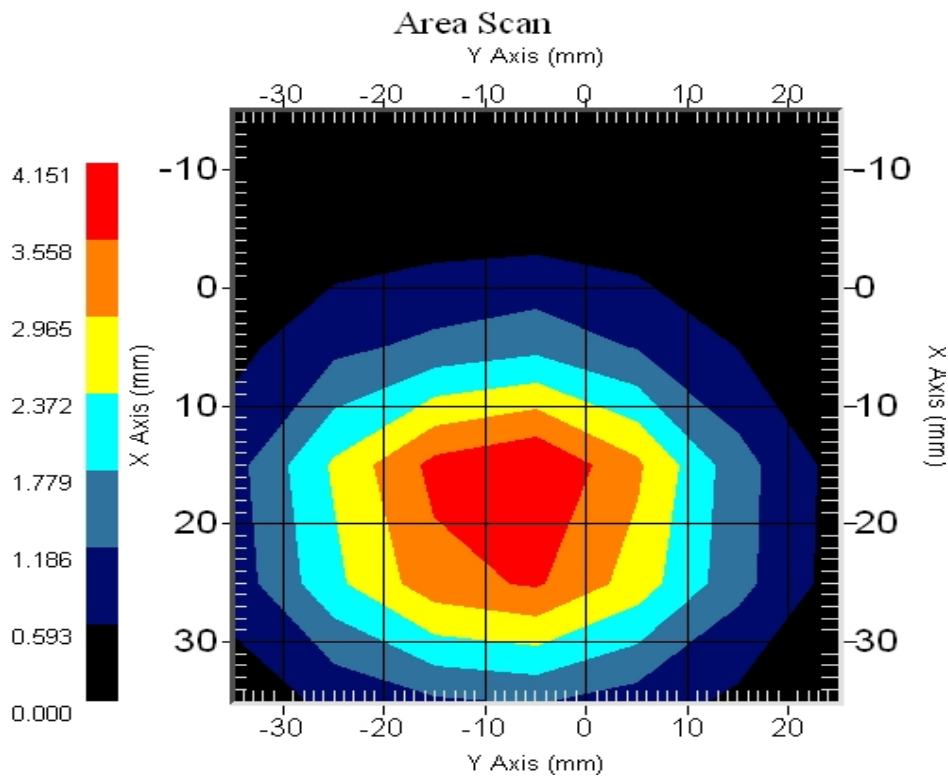
Length: 67.1 mm
Height: 38.9 mm

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

APREL Length	APREL Height	Measured Length	Measured Height
68.0 mm	39.5 mm	67.1mm	38.9 mm

Tissue Validation

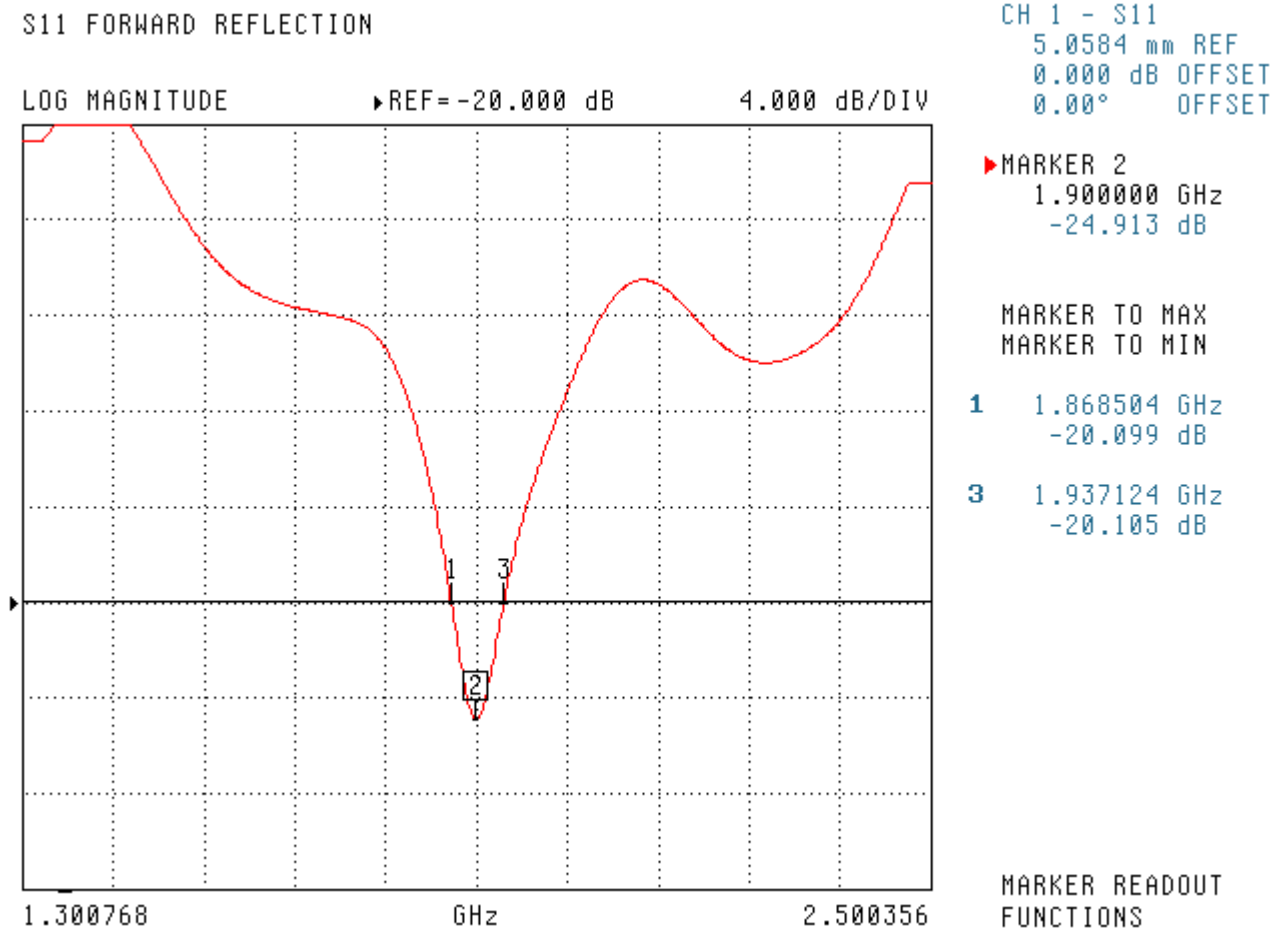
Body Tissue 1900 MHz	Measured
Dielectric constant, ϵ_r	53.87
Conductivity, σ [S/m]	1.55

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.

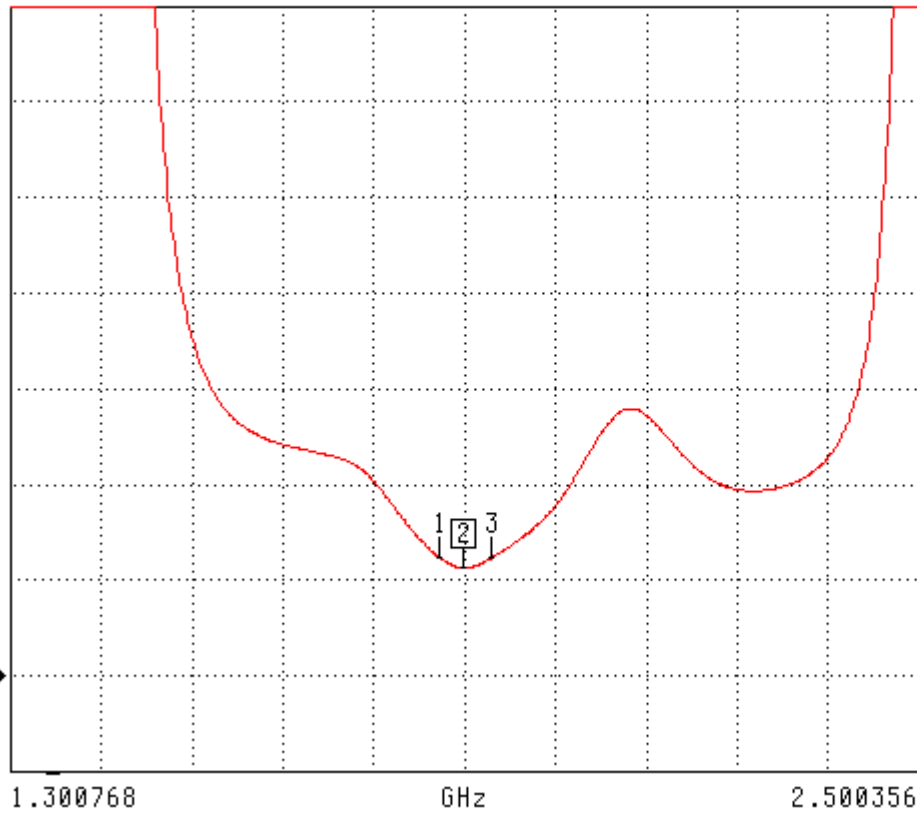
S11 Parameter Return Loss



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

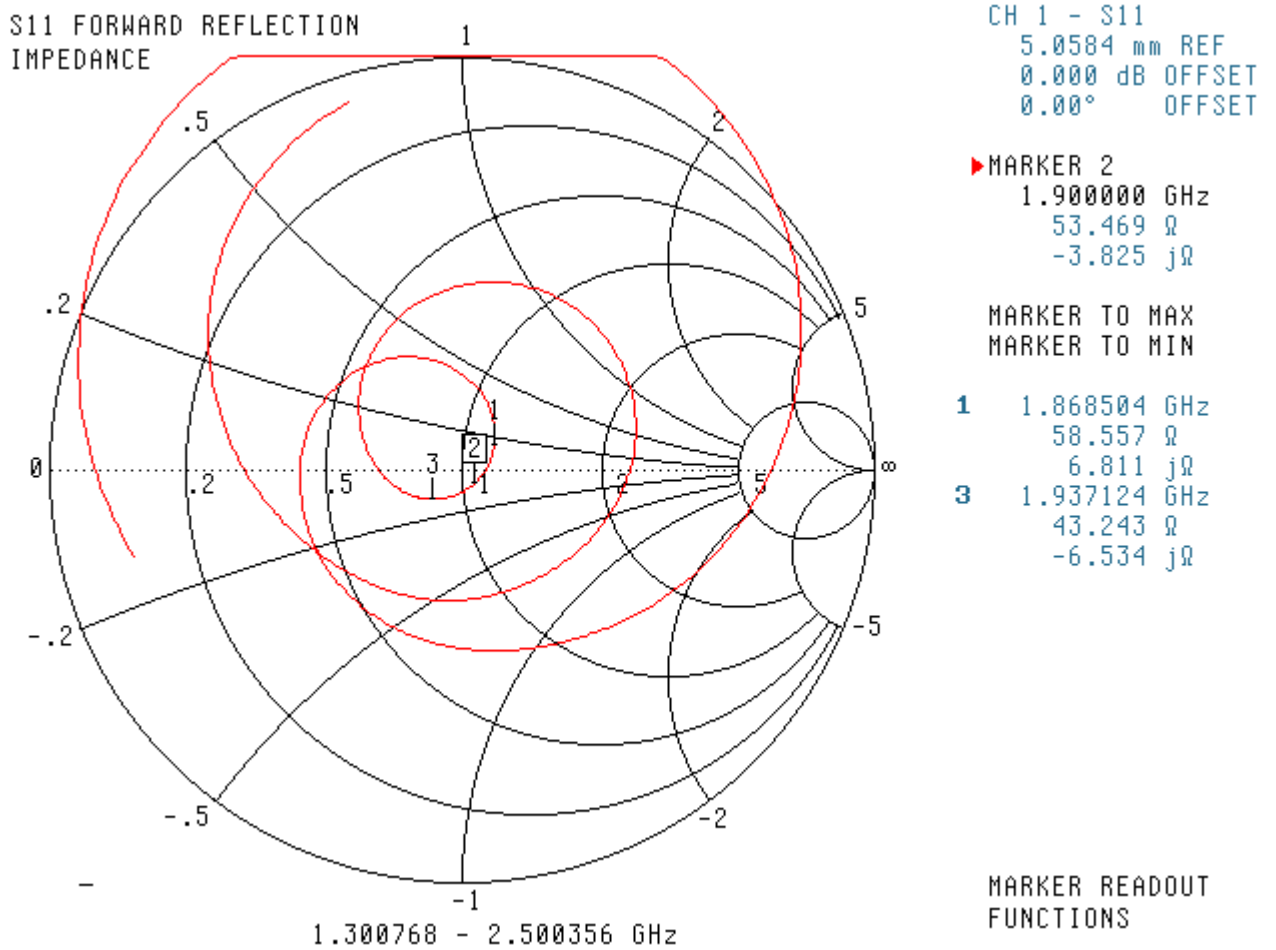
MARKER TO MAX
MARKER TO MIN

1 1.868504 GHz
1.231 U

3 1.937124 GHz
1.226 U

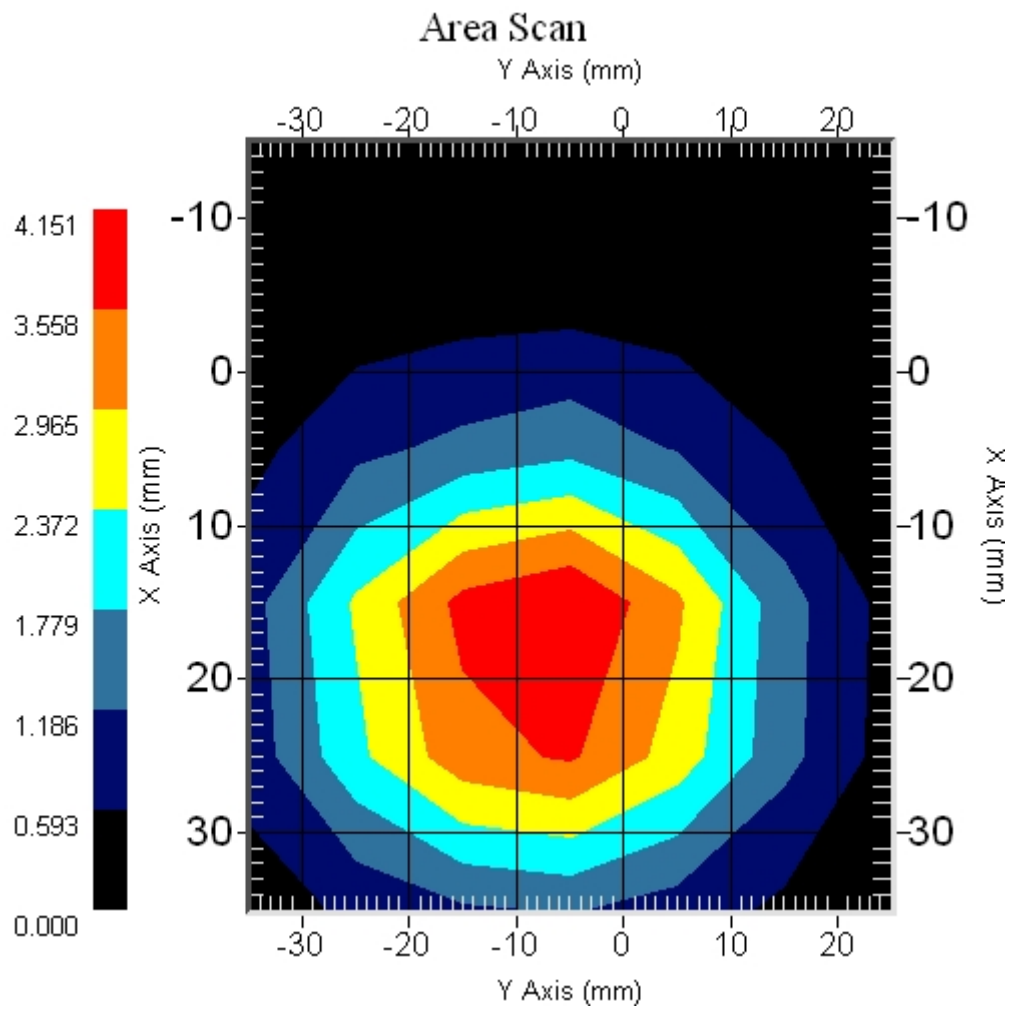
MARKER READOUT
FUNCTIONS

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.

NCL CALIBRATION LABORATORIES

Calibration File No: DC-1182

Project Number: RFEB-5552

C E R T I F I C A T E O F C A L I B R A T I O N

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-2450-S-2

Frequency: 2450 MHz

Serial No: RFE-278

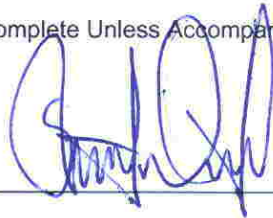
Customer: RFEL

Body Calibration

Calibrated: 18th November 2010
Released on: 19th 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

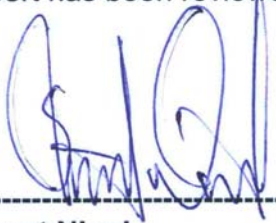
Dipole RFE-278 was a new calibration.

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

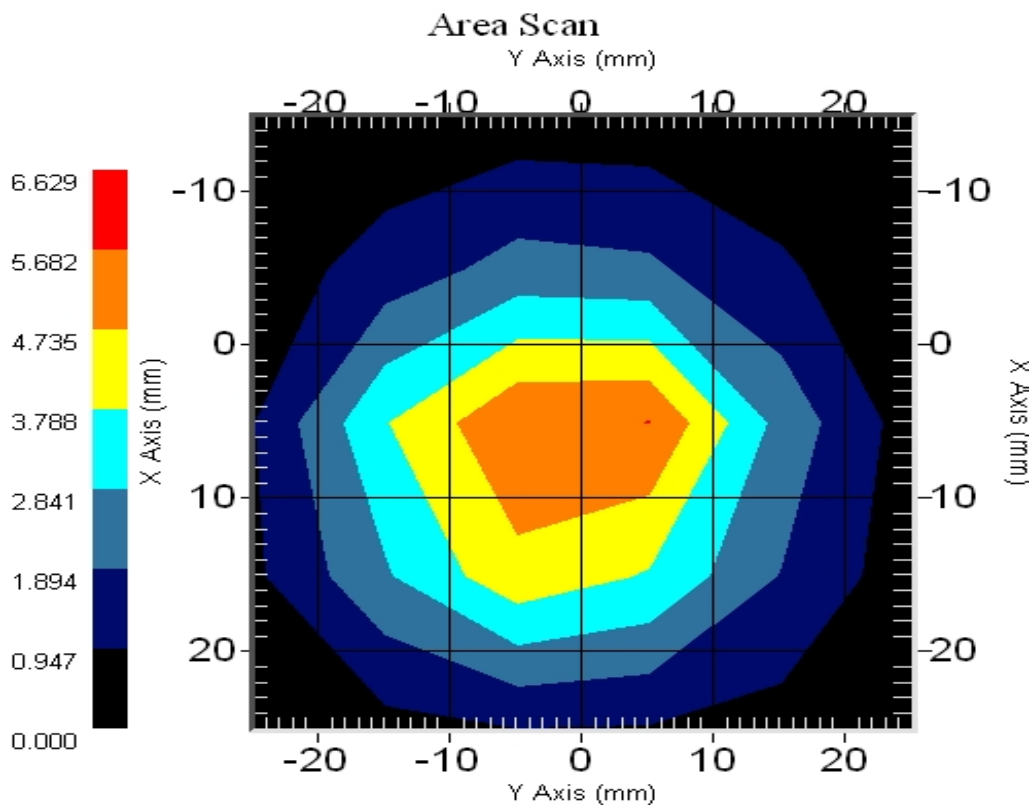
Length: 51.5 mm
Height: 30.4 mm

Electrical Specification

SWR: 1.249 U
Return Loss: -19.170 dB
Impedance: 42.223 Ω

System Validation Results @ 100mW

Frequency	1 Gram	10 Gram	Peak
2450 MHz	5.15	2.31	10.01



Introduction

This Calibration Report has been produced in line with the SSI Dipole Calibration Procedure SSI-TP-018-ALSAS. The results contained within this report are for Validation Dipole RFE-278. 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 RFE-278 was a re-calibration.

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

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

Dipole Calibration Results

Mechanical Verification

APREL Length	APREL Height	Measured Length	Measured Height
51.5 mm	30.4 mm	52.1 mm	31.0 mm

Tissue Validation

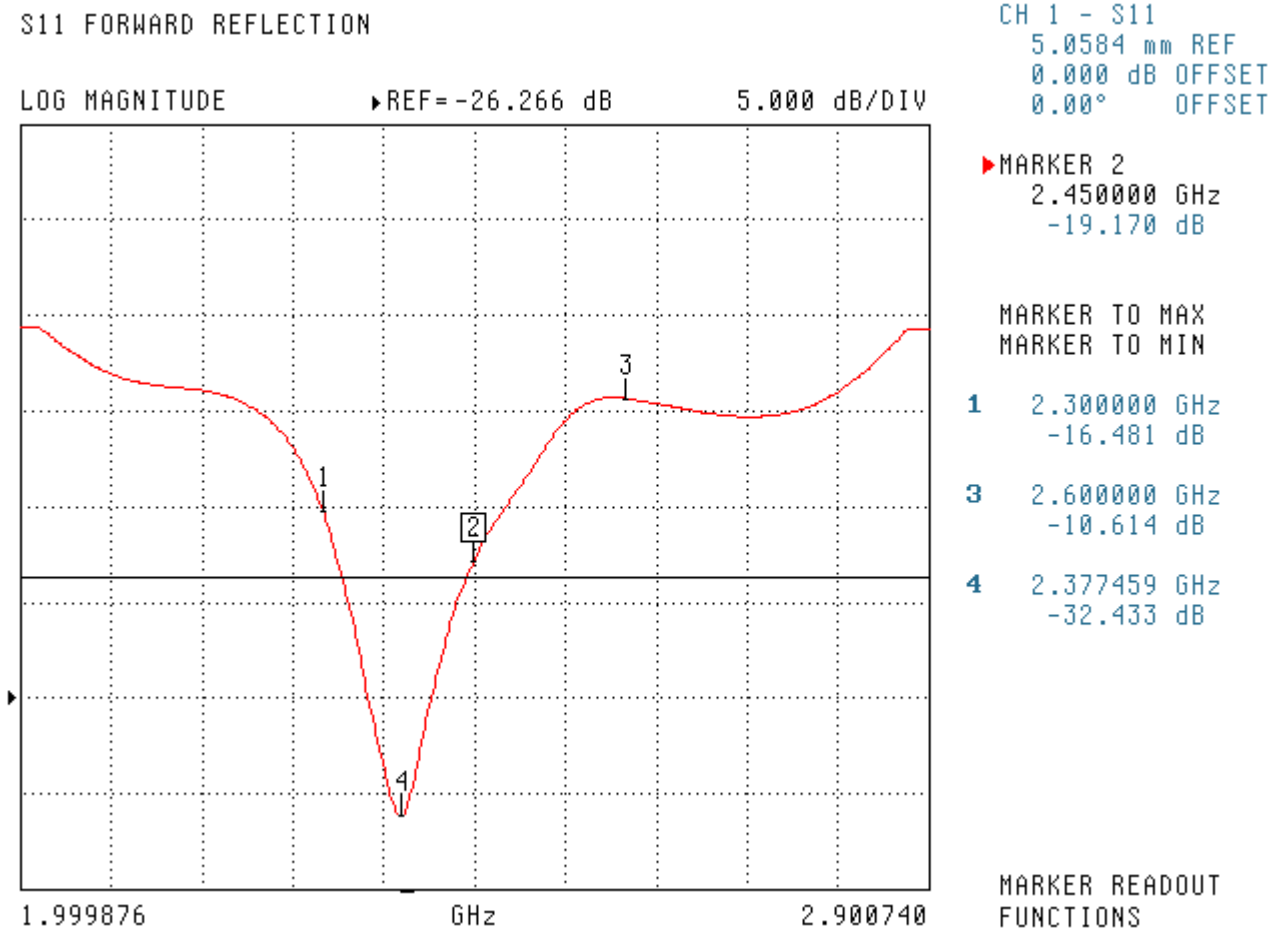
Body Tissue 2450 MHz	Measured
Dielectric constant, ϵ_r	52.0
Conductivity, σ [S/m]	1.92

Electrical Calibration

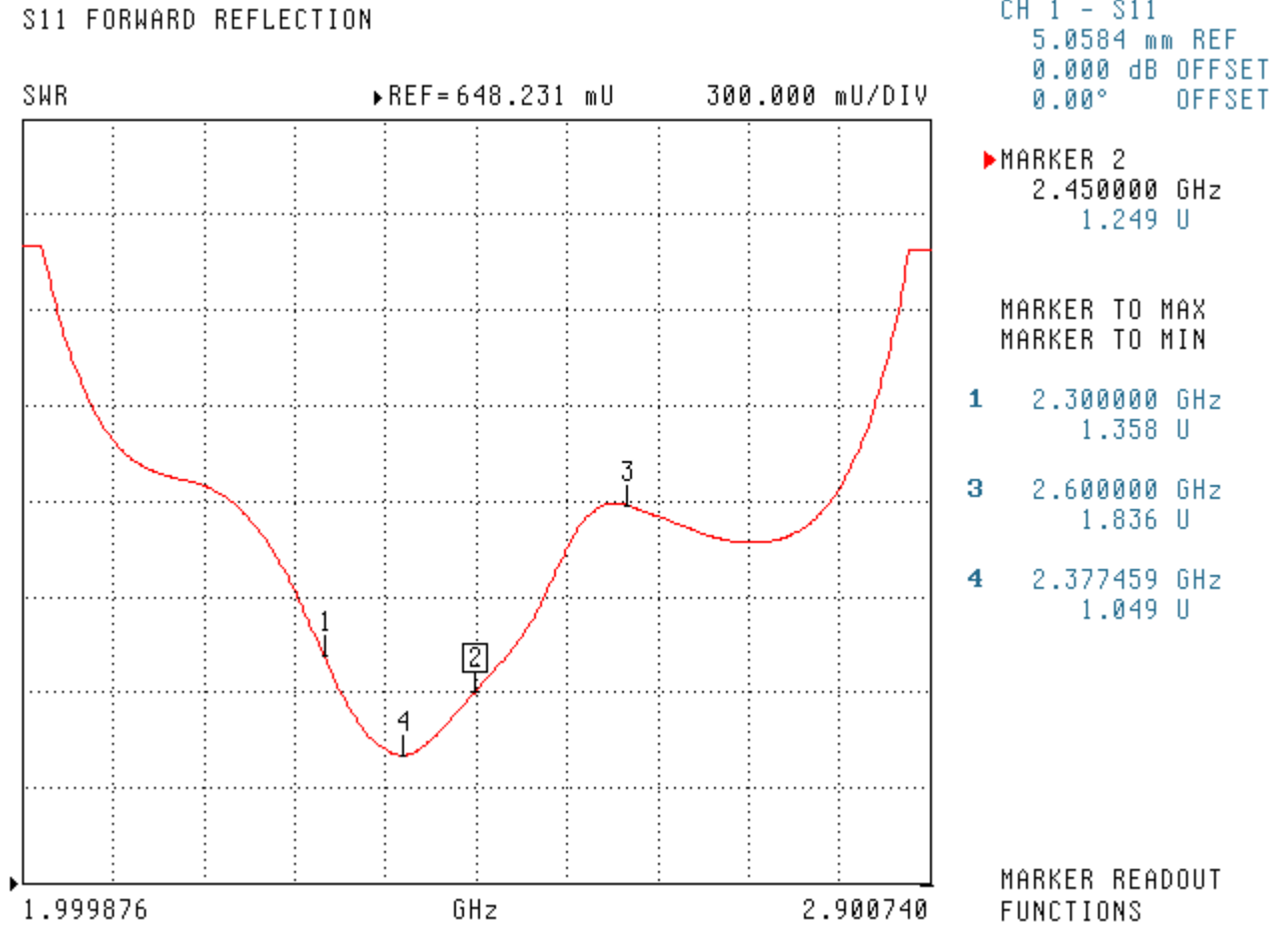
Test	Result
S11 R/L	-19.170 dB
SWR	1.249 U
Impedance	42.223 Ω

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

S11 Parameter Return Loss

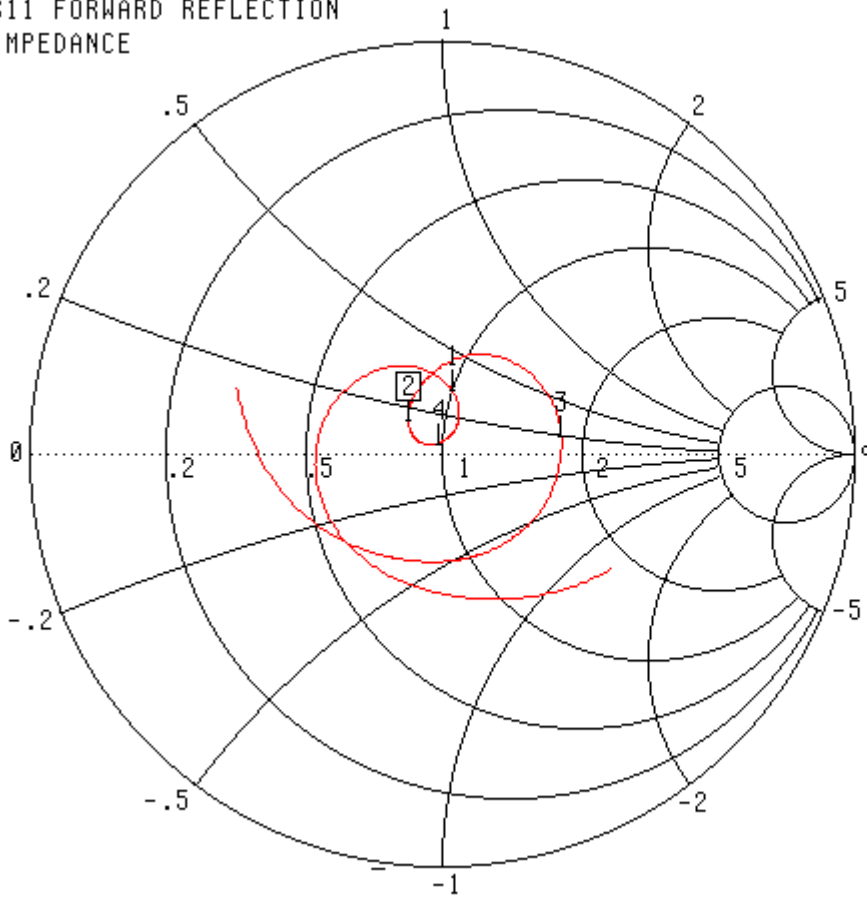


SWR



Smith Chart Dipole Impedance

S11 FORWARD REFLECTION
IMPEDANCE



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

▶ MARKER 2
2.450000 GHz
42.223 Ω
6.687 $j\Omega$

MARKER TO MAX
MARKER TO MIN

1	2.300000 GHz
	50.520 Ω
	15.426 $j\Omega$
3	2.600000 GHz
	90.912 Ω
	7.723 $j\Omega$
4	2.377459 GHz
	49.380 Ω
	2.028 $j\Omega$

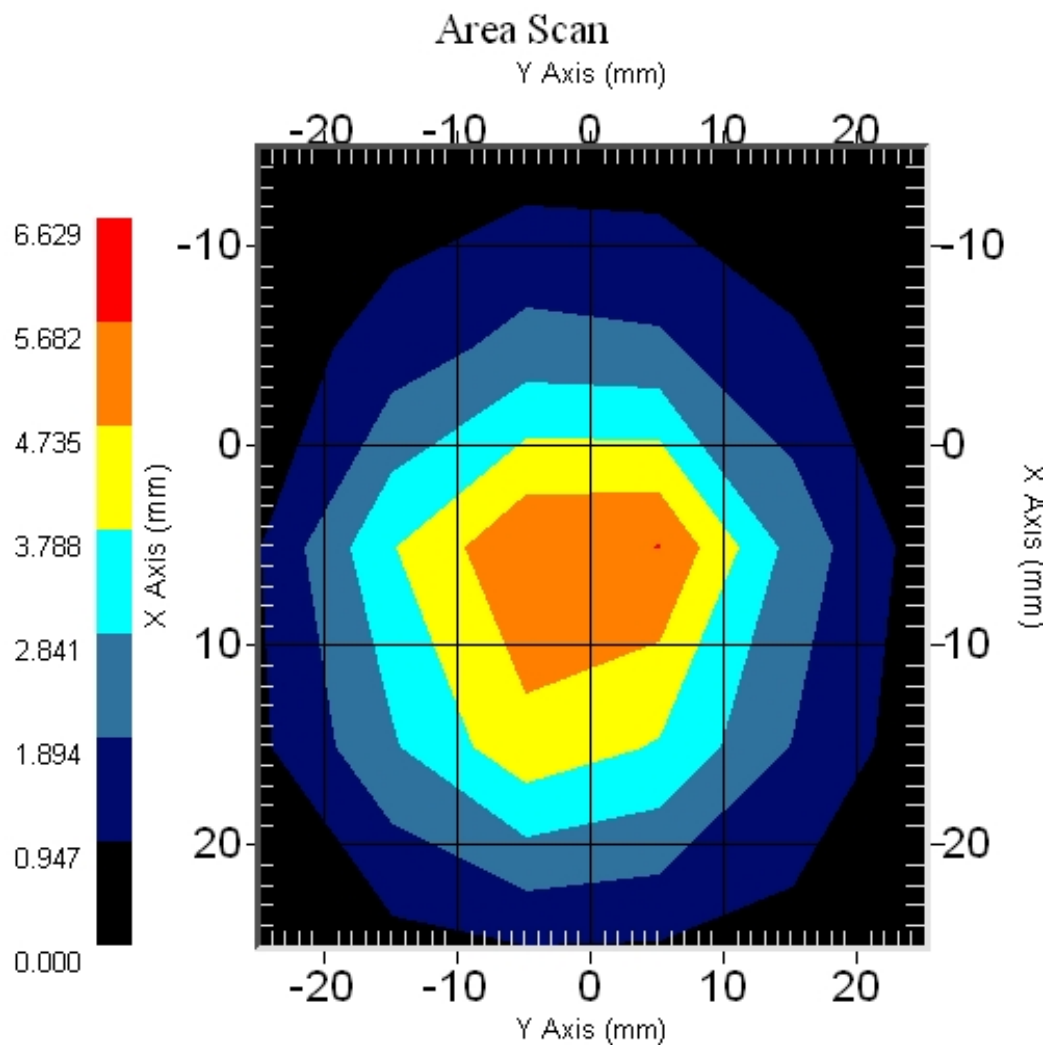
MARKER READOUT
FUNCTIONS

1.999876 - 2.900740 GHz

System Validation Results Using the Electrically Calibrated Dipole

Results @ 100mW

Body Tissue Frequency	1 Gram	10 Gram	Peak Above Feed Point
2450 MHz	5.15	2.31	10.01



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 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.

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CANADA K2R 1E6

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