

RF Exposure Lab

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CERTIFICATE OF COMPLIANCE SAR EVALUATION

Novatel Wireless
6715 8th Street N.E.
Calgary, Alberta, Canada T2E 7H7

Dates of Test: November 3 - 4, 2010
Test Report Number: SAR.20101101

FCC ID:	NBZNRM-MC545
IC Certificate:	3229A- MC545
Model(s):	MC545
Test Sample:	Engineering Unit Same as Production
Serial No.:	Unit 5
Equipment Type:	Wireless Modem
Classification:	Portable Transmitter Next to Body
TX Frequency Range:	824.2 – 848.8 MHz, 1850.2 – 1909.8 MHz
Frequency Tolerance:	± 25 ppm
Maximum RF Output:	850 MHz (GPRS) – 32.64 dBm, 1900 MHz (GPRS) – 29.76 dBm, 1900 MHz (WCDMA) – 22.60 dBm Conducted
Signal Modulation:	GMSK, 8PSK, WCDMA
Antenna Type (Length):	Internal
Application Type:	Certification
FCC Rule Parts:	Part 22, 24
Industry Canada:	RSS-102

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. C95.1-1999 and had been tested in accordance with the measurement procedures specified in IEEE 1528-2003, OET Bulletin 65 Supp. C, RSS-102 and Safety Code 6 (See test report).

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

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



Jay M. Moulton
Vice President



Certificate # 2387.01

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1. Introduction

This measurement report shows compliance of the Novatel Wireless Model MC545 FCC ID: NBZNRM-MC545 with FCC Part 2, 1093, ET Docket 93-62 Rules for mobile and portable devices and IC Certificate: 3229A-MC545 with RSS102 & Safety Code 6. 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.

For USB dongle transmitters, the device is required to be tested on all four sides of the modem. Two of the orientations (1 horizontal side and 1 vertical side) must be conducted installed in a laptop. The remaining two sides may be conducted at the end of 12" high quality USB extender cable.

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.

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



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).

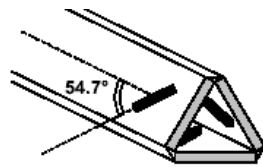
The overall uncertainty for the methodology and algorithms the ALSAS-10-U used during the SAR calculation was evaluated using the data from IEEE 1528 f3 algorithm:

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

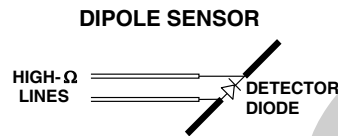
The probe used during the measurement process has been assessed to provide values for diode compression. These values are calculated during the probe calibration exercise and are used in the mathematical calculations for the assessment of SAR.

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.

Confidential

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
Mixing Percentage			
Water		52.40	69.91
Sugar		45.00	0.00
Salt		1.40	0.13
HEC		1.00	0.00
Bactericide		0.10	0.00
DGBE		0.00	29.96
Dielectric Constant	Target	55.20	53.30
Conductivity (S/m)	Target	0.97	1.52

Device Holder



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

6. Definition of Reference Points

Ear Reference Point

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

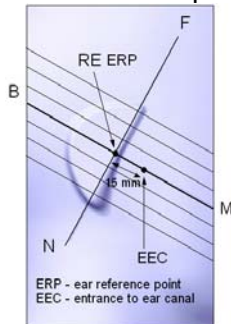


Figure 6.1 Close-up side view of ERP's



Figure 6.2 Front, back and side view of SAM

Device Reference Points

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

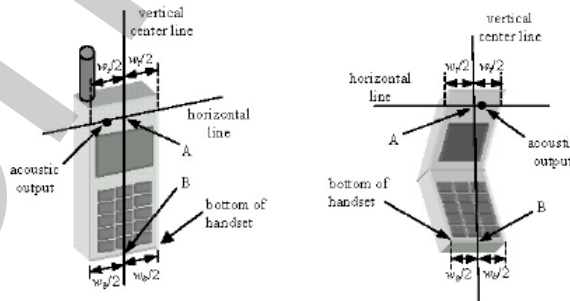


Figure 6.3 Handset Vertical Center & Horizontal Line Reference Points

7. Test Configuration Positions

Positioning for Cheek/Touch [5]

1. Position the device close to the surface of the phantom such that point A is on the (virtual) extension of the line passing through points RE and LE on the phantom (see Figure 7.1), such that the plane defined by the vertical center line and the horizontal line of the device is approximately parallel to the sagittal plane of the phantom.

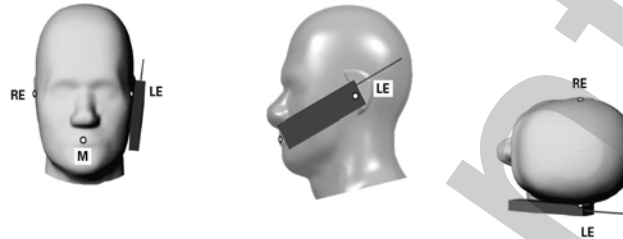


Figure 7.1 Front, Side and Top View of Cheek/Touch Position

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

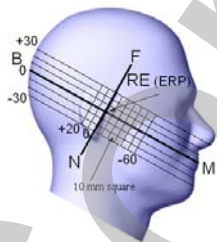


Figure 7.2 Side view w/ relevant markings

Positioning for Ear / 15° Tilt [5]

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

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

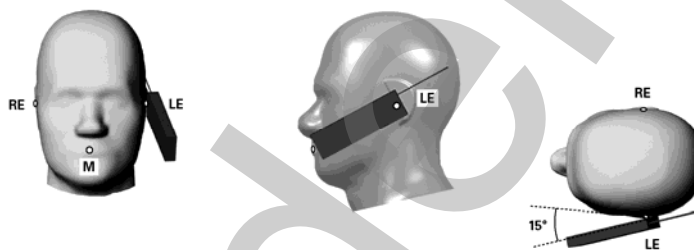


Figure 7.3 Front, Side and Top View of Ear/15° Tilt Position

Body Worn Configurations

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

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

Body-worn accessories may not always be supplied or available as options for some devices intended to be authorized for body-worn use. In this case, a test configuration where a separation distance between the back of the device and the flat phantom is used. All test position spacings are documented.

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

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

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

8. ANSI/IEEE C95.1 – 1999 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.

9. Measurement Uncertainty

Exposure Assessment Measurement Uncertainty

Source of Uncertainty	Tolerance Value	Probability Distribution	Divisor	c_i^1 (1-g)	c_i^1 (10-g)	Standard Uncertainty (1-g) %	Standard Uncertainty (10-g) %	v_i
Measurement System								
Probe Calibration	3.5	normal	1	1	1	3.5	3.5	∞
Axial Isotropy	3.7	rectangular	√3	$(1-cp)^{1/2}$	$(1-cp)^{1/2}$	1.5	1.5	∞
Hemispherical Isotropy	10.9	rectangular	√3	√cp	√cp	4.4	4.4	∞
Boundary Effect	1.0	rectangular	√3	1	1	0.6	0.6	∞
Linearity	4.7	rectangular	√3	1	1	2.7	2.7	∞
Detection Limit	1.0	rectangular	√3	1	1	0.6	0.6	∞
Readout Electronics	1.0	normal	1	1	1	1.0	1.0	∞
Response Time	0.8	rectangular	√3	1	1	0.5	0.5	∞
Integration Time	1.7	rectangular	√3	1	1	1.0	1.0	∞
RF Ambient Condition	3.0	rectangular	√3	1	1	1.7	1.7	∞
Probe Positioner Mech. Restriction	0.4	rectangular	√3	1	1	0.2	0.2	∞
Probe Positioning with respect to Phantom Shell	2.9	rectangular	√3	1	1			∞
Extrapolation and Integration	3.7	rectangular	√3	1	1			∞
Test Sample Positioning	4.0	normal	1	1	1	1.7	1.7	7
Device Holder Uncertainty	2.0	normal	1	1	1	2.1	2.1	2
Drift of Output Power	4.2	rectangular	√3	1	1	4.0	4.0	∞
Phantom and Setup						2.0	2.0	
Phantom Uncertainty(shape & thickness tolerance)	3.4	rectangular	√3	1	1	4.4	4.4	∞
Liquid Conductivity(target)	5.0	rectangular	√3	0.7	0.5			∞
Liquid Conductivity(meas.)	0.5	normal	1	0.7	0.5	2.0	2.0	5
Liquid Permittivity(target)	5.0	rectangular	√3	0.6	0.5	2.0	1.4	∞
Liquid Permittivity(meas.)	1.0	normal	1	0.6	0.5	0.7	0.5	5
Combined Uncertainty		RSS				10.3	10.1	>500
Combined Uncertainty (coverage factor=2)		Normal (k=2)				20.5	20.2	>500

10. System Validation

Tissue Verification

Table 10.1 Measured Tissue Parameters

		835 MHz Body		1900 MHz Body		1900 MHz Body	
Date(s)		Nov. 3, 2010		Nov. 3, 2010		Nov. 4, 2010	
Liquid Temperature (°C)	20.0	Target	Measured	Target	Measured	Target	Measured
Dielectric Constant: ϵ		55.20	55.04	53.30	53.25	53.30	53.12
Conductivity: σ		0.97	0.98	1.52	1.54	1.52	1.55

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 extrapolated to 1 watt. (Graphic Plots Attached)

Table 10.2 System Dipole Validation Target & Measured

	Test Frequency	Targeted SAR _{1g} (W/kg)	Measure SAR _{1g} (W/kg)	Deviation (%)
03-Nov-2010	835 MHz	9.49	9.07	- 4.43
03-Nov-2010	1900 MHz	38.70	39.93	+ 3.18
04-Nov-2010	1900 MHz	38.70	39.37	+ 1.73

See Appendix A for data plots.

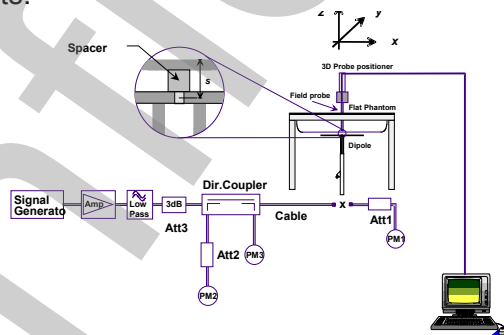


Figure 10.1 Dipole Validation Test Setup

11. SAR Test Data Summary

See Measurement Result Data Pages

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

Procedures Used To Establish Test Signal

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

Device Test Condition

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 testing was conducted on all side sides of the modem. The bottom side testing was conducted with the modem installed in a side USB port on a Toshiba Portege A600 Laptop. The right side testing was conducted with the modem installed in a rear USB port on a Dell Latitude D631 Laptop. All other positions were conducted with the modem installed on a 12 inch USB extension cable. The extension cable was installed in a side USB port on a Toshiba Portege A600. The gap was measured to be 5 mm from the phantom for all sides.

This device is capable of operating in 850/1900 GSM/GPRS/EDGE frequency bands. In GSM/GPRS mode, the device is in Class 4 for 850 MHz and Class 1 for 1900 MHz. In EDGE mode, the device is in Class E2 for 850/1900 MHz. The GSM/GPRS testing was conducted in the GPRS mode. The GPRS mode has 2-slot and 4-slot configurations. The power measured is peak power. The average power in GPRS 1-Slot is ½ dB higher than the average power in GPRS 2-slot which is ½ dB higher than 4-slot . The EDGE mode is 3 dB lower than its equivalent slot configuration for GPRS. Therefore, the device was only tested in the highest power configuration which was 1-slot GPRS.

The WCDMA testing was conducted using 12.2 kbps RMC configured in Test Loop Mode 1. The HSPA testing was conducted with HS-DPCCH, E-DPCCH and E-DPDCH all enabled and a 12.2 kbps RMC. FRC was configured according to HS-DPCCH Sub-Test 1 using H-set 1 and QPSK.

12. FCC Measurement Procedures – March 2008

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

12.1 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.

12.2 SAR Measurement Conditions for WCDMA/HSDPA/HSUPA

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

For Rel99

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

For HSDPA Rel 6

- Establish a Test Mode 1 loop back with both 1 12.2kbps RMC channel and a H-Set1 Fixed Reference Channel (FRC). With the 8820 this is accomplished by setting the signal Channel Coding to “Fixed Reference Channel” and configuring for HSET-1 QKSP.
- Set beta values and HSDPA settings for HSDPA Subtest1 according to Table below.
- Send continuously Up power control commands to the UNDP-1
- Measure the power at the UNDP-1 antenna connector using the power meter with modulated average detector.
- Repeat the measurement for the HSDPA Subtest2, 3 and 4 as given in Table below.

For HSUPA Rel 6

- Use UL RMC 12.2kbps and FRC H-Set1 QPSK, Test Mode 1 loop back. With the 8960 this is accomplished by setting the signal Channel Coding to “E-DCH Test Channel” and configuring the equipment category to Cat5_10ms.
- Set the Absolute Grant for HSUPA Subtest1 according to Table below.
- Set the UNDP power to be at least 5dB lower than the Maximum output power
- Send power control bits to give one TPC_cmd = +1 command to the UNDP. If UNDP doesn't send any E-DPCH data with decreased E-TFCI within 500ms, then repeat this process until the decreased E-TFCI is reported.
- Confirm that the E-TFCI transmitted by the UNDP is equal to the target E-TFCI in Table below. If the E-TFCI transmitted by the UNDP is not equal to the target E-TFCI, then send power control bits to give one TPC_cmd = -1 command to the UE. If UE sends any E-DPCH data with decreased E-TFCI within 500 ms, send new

power control bits to give one TPC_cmd = -1 command to the UE. Then confirm that the E-TFCI transmitted by the UE is equal to the target E-TFCI in Table below.

- Measure the power using the power meter with modulated average detector.
- Repeat the measurement for the HSUPA Subtest2, 3, 4 and 5 as given in Table below.

12.2 SAR Measurement Conditions for GSM

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

3GPP Release Version	Mode	PCS Band [dBm]			Sub-Test (See Table Below)	MPR
		9262	9400	9538		
99	WCDMA	22.18	22.60	22.51	-	-
6	HSDPA	22.12	22.54	22.46	1	0
6		22.07	22.51	22.40	2	0
6		21.67	22.08	22.02	3	0.5
6		21.61	22.10	21.97	4	0.5
6	HSUPA	22.16	22.55	22.42	1	0
6		20.20	20.62	20.49	2	2
6		21.13	21.49	21.56	3	1
6		20.23	20.57	20.59	4	2
6		22.12	22.57	22.41	5	0

Sub-Test Setup for Release 6 HSDPA

Sub-Test	β_c	β_d	B_c / β_d	β_{hs}
1	2/15	15/15	2/15	4/15
2	12/15	15/15	15/15	24/15
3	15/15	8/15	15/8	30/15
4	15/15	4/15	15/4	30/15

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

Sub-Test Setup for Release 6 HSUPA

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

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

GPRS/1 slot		
Band	Channel	Power
Cellular	128	32.62
	190	32.39
	251	32.64
PCS	512	29.57
	661	29.76
	810	29.68

GPRS/2 slot		
Band	Channel	Power
Cellular	128	29.41
	190	29.18
	251	29.39
PCS	512	26.34
	661	26.51
	810	26.46

EDGE/1 slot		
Band	Channel	Power
Cellular	128	29.34
	190	29.07
	251	29.32
PCS	512	26.41
	661	26.61
	810	26.65

EDGE/2 slot		
Band	Channel	Power
Cellular	128	26.43
	190	26.17
	251	26.35
PCS	512	23.31
	661	23.47
	810	23.45

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12.2 SAR Device Functionality

The MC547 utilizes a mechanism that alters the transmit functionality of the device based on the angle of the USB connector. When the device is inserted into a horizontal USB port (Reference KDB 447498, "Horizontal Up position 'A'") the modem hinge has been engineered to automatically orient the modem angle to 120°. At this angle the modem will function normally. If the modem is moved slightly either up or down (110° to 130°) there is no affect on the performance of the device. Should the MC547 move at an angle less than 110° or greater than 130° the transmit power will turn off. There is a delay mechanism that allows the modem to continue transmitting for 5s in the case of accidental movement. Once the device has been returned to the 120° position normal operation can be restored.

The measured SAR orientations have been considered based on the possible USB positions stated in KDB 447498.

The following is a description of the process by which the UUT, under normal operation, disables it's transmitter after being triggered by a USB orientation mechanism. The MC547 have a mechanical switch in the USB hinge assembly which disables the transmitter when not in the desired 120 degree orientation. The UUT is only supposed to operate it's transmitters when in normal USB orientation (approx 120 degrees).

Supporting operational verification:

Figure 1: QXDM logging of Tx Power when using the USB Tx Power disable Switch

Figure 2: QXDM message shown the triggering event to turn off the Transmitter.

Figure 3: QXDM showing the UUT going into LPM - Low Power Mode

Figure 4: QXDM message showing the actual deactivation of the transmitter by software, about 10-12 seconds later. Completed transition to LPM.

Figure 5: QXDM message showing Layer 1 in IDLE state. No transmitter is on in this state, only the receiver.

Figure 6: QXDM message showing UUT allowing Transmit operation again (XMIT ALLOWED) and setting the UUT to ONLINE mode.

Figure 7: QXDM message showing transitioning back to the 120 degree normal operating mode, returning to ONLINE mode for connecting to the network.

Figure 8: QXDM message showing successful transition from ONLINE mode to ACQ (acquired cell information)

Figure 9: QXDM message showing successful Tx RACH and getting back in a call.

USB Hardware Switch for controlling Power Amplifier Mode of operation.

Below is a plot of the WCDMA Tx power (green lines) based on a Qualcomm tool (QXDM) that is capable of reporting real time operation and messaging during operation. The red, yellow and blue lines have been added to the plot to explain events that happen. Refer to the detailed description below.

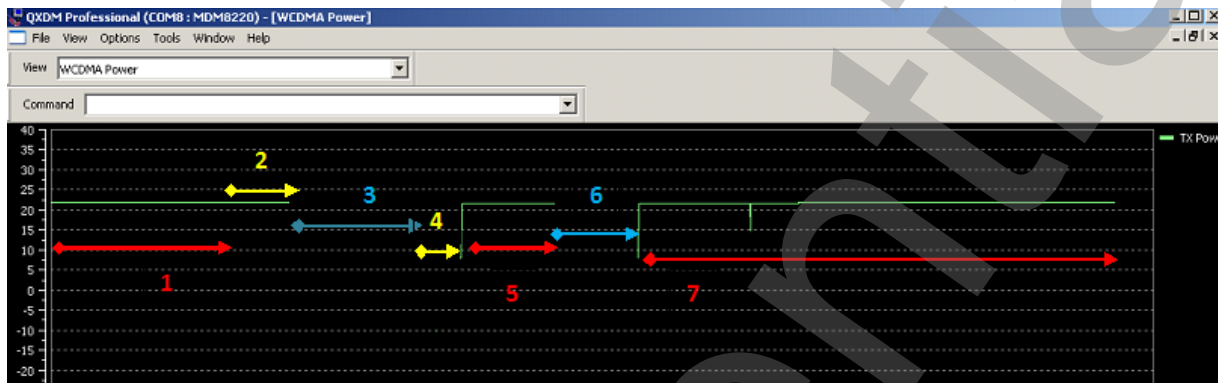


Figure 10:QXDM logging of Tx Power when using the USB Tx Power disable Switch

The above diagram is described further below. For the above diagram the GREEN lines are the actual transmitted power by the UUT, based on QXDM logging information.

- RED arrows show the transmitting portions
- YELLOW arrows describe TRIGGER events based on USB switch input
- BLUE arrows represent Rx only (Tx OFF) or "IDLE".

1. Unit under test is in a call transmitting at +23dBm full power, with the UUT in its normal 120 degree operating position.
2. During the call, the UUT is placed into a "flat" position, 0 degrees.
3. Within approximately 12 seconds, the UUT ceases transmit operation (no green line showing Tx power)
4. UUT is returned to the normal operating position (120 degrees).
5. Shortly after returning to the 120 degree position, the UUT re-registers with the network.
6. After re-registering with the network, the UUT returns to an "IDLE" state (no Tx) waiting for a command to connect to the network again.
7. UUT is initiated into a normal call again, transmitting full at +23dBm, in the UUT's normal operating position.

The diagram on the previous page, is also shown here in QXDM messages. Numbers shown below match that of the original plot, Figure 1.

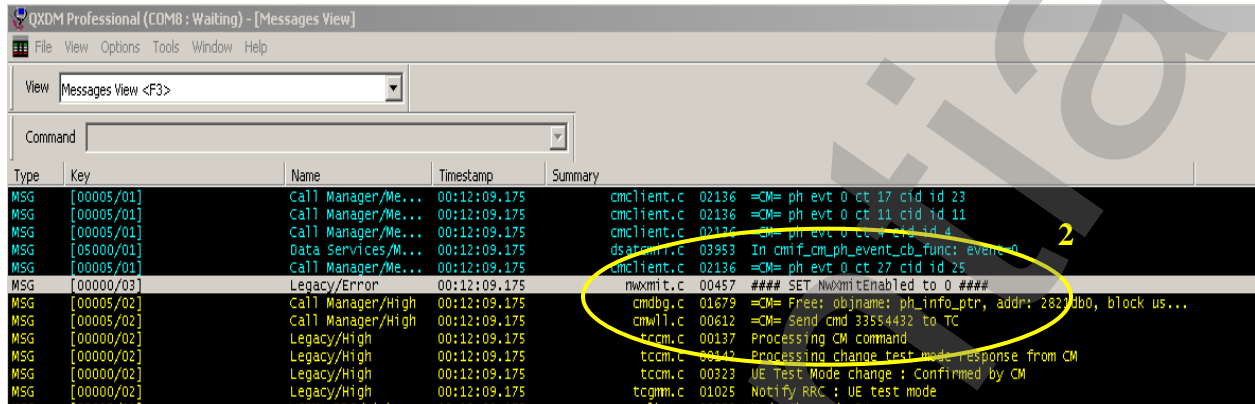


Figure 11: QXDM message shown the triggering event to turn off the Transmitter.

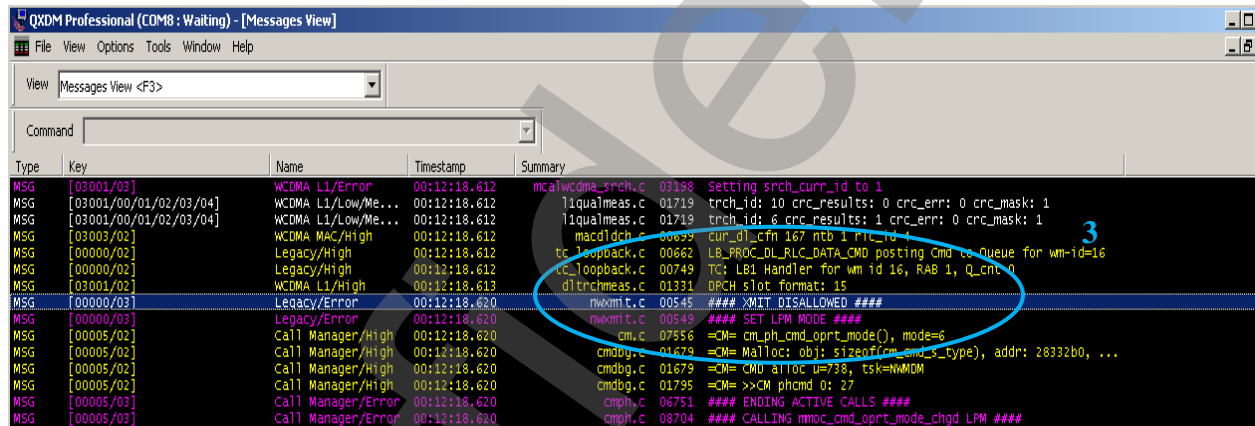


Figure 12: QXDM showing the UUT going into LPM - Low Power Mode

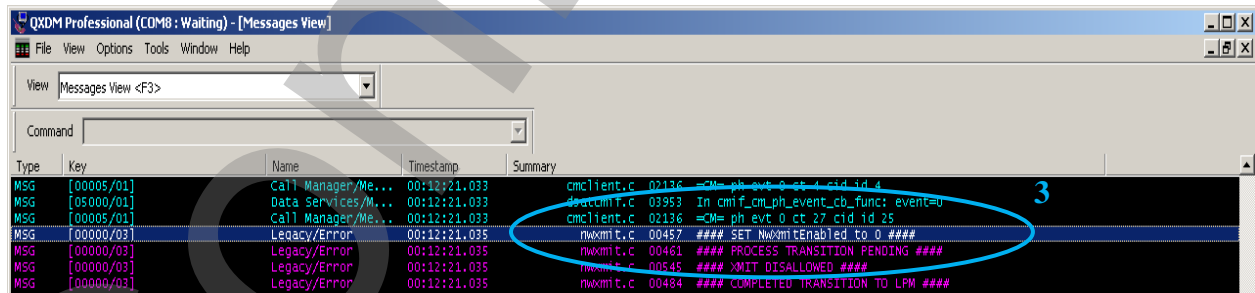


Figure 13: QXDM message showing the actual deactivation of the transmitter by software, about 10-12 seconds later. Completed transition to LPM (Low Power Mode).

```

Type   Key      Name      Timestamp  Summary
MSG    [03001/02] WCDMA L1/High 00:12:23.865 tlm.c 01581 tlm_set_align: Align cntr 5 psc 9 freq 4407 ch off (fr 0, cx8 0), ...
MSG    [03001/02] WCDMA L1/High 00:12:23.865 tlm.c 01585 wrd_tm_0111: (1, CX8, 12, 16, 1)
MSG    [03001/02] WCDMA L1/High 00:12:23.866 tlm.c 02832 hw sw cfn diff 1/p update needed|usage|update needed|slam pending ...
MSG    [03001/02] WCDMA L1/High 00:12:23.866 d1phch.c 08525 d1_phch_deallocate_stmr_ctr: Deallocated d1_phch_stmr_ctr_info[0]
MSG    [03001/03] WCDMA L1/Error 00:12:23.866 tlmsetup.c 04613 L1 state now IDLE
MSG    [03001/02] WCDMA L1/High 00:12:23.866 tlmsetup.c 04625 Tlm_previous_state: 6 1
    
```

Figure 14: QXDM message showing Layer 1 in IDLE state. No transmitter is on in this state, only the receiver.

```

Type   Key      Name      Timestamp  Summary
MSG    [00000/02] Legacy/High 00:00:00.000 dog_keepalive.c 00532 Received Remote Dog Keepalive ACK
MSG    [00000/02] Legacy/High 00:00:00.000 clkrgn_msm.c 03471 Clock regime 72 set to 20000000 Hz
MSG    [00000/02] Legacy/High 00:00:00.000 dog_keepalive.c 00532 Received Remote Dog Keepalive ACK
MSG    [00000/02] Legacy/High 00:00:00.000 clkrgn_msm.c 03471 Clock regime 72 set to 144000 Hz
MSG    [00000/02] Legacy/High 00:00:00.000 dog_keepalive.c 00532 Received Remote Dog Keepalive ACK
MSG    [00000/03] Legacy/Error 00:12:29.621 nwxmit.c 00526 ### XMIT ALLOWED ###
MSG    [00000/03] Legacy/Error 00:12:29.621 nwxmit.c 00529 ### SET ONLINE MODE ###
    
```

Figure 15: QXDM message showing UUT allowing Transmit operation again (XMIT ALLOWED) and setting the UUT to ONLINE mode.

```

Type   Key      Name      Timestamp  Summary
MSG    [00005/01] Call Manager/Me... 00:12:29.623 cmclient.c 02136 <CM= ph evt 0 ct 4 cid id 4
MSG    [05000/01] Data Services/M... 00:12:29.623 dsatcmf.c 03953 In cmif_cm_ph_event_cb_func: event=0
MSG    [00005/01] Call Manager/Me... 00:12:29.623 cmclient.c 02136 <CM= ph evt 0 ct 4 cid id 4
MSG    [00000/03] Legacy/Error 00:12:29.623 nwxmit.c 00457 ### SET NwxmitEnabled to 1 ###
MSG    [00000/03] Legacy/Error 00:12:29.623 nwxmit.c 00461 ### PROCESS TRANSITION PENDING ###
MSG    [00000/03] Legacy/Error 00:12:29.623 nwxmit.c 00526 ### XMIT ALLOWED ###
MSG    [00000/03] Legacy/Error 00:12:29.623 nwxmit.c 00470 ### COMPLETED TRANSITION TO ONLINE ###
MSG    [00005/02] Call Manager/High 00:12:29.623 smdbnc.c 01679 <CM= Free: objname: ph_info_ptr, addr: 2e600, hlock:used...
    
```

Figure 16: QXDM message showing transitioning back to the 120 degree normal operating mode, returning to ONLINE mode for connecting to the network.

```

Type   Key      Name      Timestamp  Summary
MSG    [00000/02] Legacy/High 00:12:29.830 rtr8600.c 01573 Enabling RF GP CLK
MSG    [00000/02] Legacy/High 00:12:29.831 rtr8600.c 01573 Enabling RF GP CLK
MSG    [00000/02] Legacy/High 00:12:29.832 rfwcdmali1h_msm.c 00562 using cx16 group patch delay 0
MSG    [00000/02] Legacy/High 00:12:29.832 rtr8600.c 00715 Rx Tune Mode: 1, Band: 4, Channel: 440/
MSG    [03001/03] WCDMA L1/Error 00:12:29.835 tlmsetup.c 04929 L1 state now ACQ 7
MSG    [03001/04] WCDMA L1/Fatal 00:12:29.835 srchacq.c 01631 ACQ REQ:RX AGC -65 Chan 4407
MSG    [03001/02] WCDMA L1/High 00:12:29.835 srchacq.c 01634 Apply AGC THRESH 0, acq_mode=17 acq_mech=0
MSG    [03001/02] WCDMA L1/High 00:12:29.835 srchacq.c 01690 DEBUG_TBARK: FULL SERVICE ACQ
MSG    [03001/02] WCDMA L1/High 00:12:29.835 t1utils.c 02389 stored_vco() vco:3555 rot:-1 vco_type:9
MSG    [03001/02] WCDMA L1/High 00:12:29.835 srchacq.c 01241 ACQ:curr_freq_offset 1s -1, tctxo_mgr_rot:-1
MSG    [03001/02] WCDMA L1/High 00:12:29.835 srchacq.c 01486 Set trk_to_PDM:2270 [0-4095] freq_offset:-1 [7.3242 Hz] from_tctxo...
MSG    [03001/02] WCDMA L1/High 00:12:29.835 wsrch.c 10484 Config multiple freq hypo, acq_substate 0 curr_rotator -1
    
```

Figure 17: QXDM message showing successful transition from ONLINE mode to ACQ (acquired cell information)

The screenshot shows the QXDM Professional interface with a list of messages. The messages are organized into columns: Type, Key, Name, Timestamp, and Summary. A red circle highlights the message with the following details:

Type	Key	Name	Timestamp	Summary
MSG	[03001/02]	WCDMA L1/High	00:12:31.973	wl1tr1.c 05369 dltr1: DC Fing 16 pn pos -1, rotator 0 rssi0 0
MSG	[03001/03]	WCDMA L1/Error	00:12:31.973	wl1tr1.c 02966 dltr1: number of reassignable fings for sorting: 0 numool fings
MSG	[03001/03]	WCDMA L1/Error	00:12:31.973	wl1tr1.c 03787 dltr1: ref fing selection for cell 0 kicked in, current ref fing 0...
MSG	[03001/04]	WCDMA L1/Fatal	00:12:31.980	wenc.c 07555 rach status 1
MSG	[03001/02]	WCDMA L1/High	00:12:31.980	srchfach.c 06997 unresv infinite reqid 1 dnisk 0
MSG	[03001/04]	WCDMA L1/Fatal	00:12:31.980	wenc.c 07600 enc_rach_done_isr: a1_Sum 0x84b1 status 1, n_prime 1 SFN at RACH C...
MSG	[03001/04]	WCDMA L1/Fatal	00:12:31.980	wenc.c 07814 RACH TX successful, TXAQC -10, a1_Sum 84b1
MSG	[03003/02]	WCDMA MAC/High	00:12:31.980	macrach.c 00883 rcvd L1_PRACH_ACK from L1
MSG	[03003/02]	WCDMA MAC/High	00:12:31.980	macrach.c 00307 Sending RRC_CMACH_STATUS_IND to RRC
MSG	[03003/02]	WCDMA MAC/High	00:12:31.980	macrach.c 00221 Released DSM items, set Trch=0
MSG	[03005/02]	WCDMA RRC/High	00:12:31.980	rrrcrce.c 06837 CMACH Status Ind with status 0
MSG	[03005/02]	WCDMA RRC/High	00:12:31.980	rrrcrce.c 03890 T300 is 400 ms
MSG	[03005/02]	WCDMA RRC/High	00:12:31.980	rrrcrce.c 01547 Started timer:0 val:400 ms

Figure 18: QXDM message showing successful Tx RACH and getting back in a call.

SAR Data Summary – 850 MHz Body – GPRS

MEASUREMENT RESULTS

Gap	Side	Frequency		Modulation	Begin/End Power		TX Level	Multislot Configuration	SAR (W/kg)
		MHz	Ch.		(dBm)	(dBm)			
5 mm	Top	836.6	190	GMSK	32.39	32.38	0	1 Slot	0.743
	Bottom	836.6	190	GMSK	32.37	32.37	0	1 Slot	0.341
	Right	836.6	190	GMSK	32.38	32.37	0	1 Slot	0.573
	Left	836.6	190	GMSK	32.39	32.38	0	1 Slot	0.720
	Tip	836.6	190	GMSK	32.38	32.37	0	1 Slot	0.155

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



Jay M. Moulton
 Vice President

Note: When the measured channel is 3 dB or more below the limit the remaining channels are not required to be tested per KDB 447498 section 1) e).


SAR Data Summary – 1900 MHz Body – GPRS

MEASUREMENT RESULTS

Gap	Side	Frequency		Modulation	Begin/End Power		TX Level	Multislot Configuration	SAR (W/kg)
		MHz	Ch.		(dBm)	(dBm)			
5 mm	Top	1850.2	512	GMSK	29.57	29.56	0	1 Slot	1.153
		1880.0	661	GMSK	29.76	29.76	0	1 Slot	0.981
		1908.8	810	GMSK	29.68	29.67	0	1 Slot	1.064
	Bottom	1880.0	661	GMSK	29.75	29.74	0	1 Slot	0.616
	Right	1880.0	661	GMSK	29.76	29.75	0	1 Slot	0.512
	Left	1850.2	512	GMSK	29.56	29.56	0	1 Slot	0.898
		1880.0	661	GMSK	29.75	29.74	0	1 Slot	0.934
		1908.8	810	GMSK	29.66	29.65	0	1 Slot	0.945
	Tip	1880.0	661	GMSK	29.75	29.74	0	1 Slot	0.305

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

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



 Jay M. Moulton
 Vice President

Note: When the measured channel is 3 dB or more below the limit the remaining channels are not required to be tested per KDB 447498 section 1) e).

SAR Data Summary – 1900 MHz Body – WCDMA

MEASUREMENT RESULTS

Gap	Side	Frequency		Modulation	Begin/End Power		RMC	Test Set Up	SAR (W/kg)
		MHz	Ch.		(dBm)	(dBm)			
5 mm	Top	1852.4	9612	WCDMA	22.18	22.16	12.2 kbps	Test Loop 1	1.150
		1880.0	9750	WCDMA	22.60	22.53	12.2 kbps	Test Loop 1	1.124
		1907.6	9888	WCDMA	22.51	22.47	12.2 kbps	Test Loop 1	1.286
	Bottom	1880.0	9750	WCDMA	22.57	22.51	12.2 kbps	Test Loop 1	0.697
	Right	1852.4	9612	WCDMA	22.12	22.08	12.2 kbps	Test Loop 1	0.944
		1880.0	9750	WCDMA	22.53	22.48	12.2 kbps	Test Loop 1	0.901
		1907.6	9888	WCDMA	22.47	22.43	12.2 kbps	Test Loop 1	1.000
	Left	1852.4	9612	WCDMA	22.15	22.09	12.2 kbps	Test Loop 1	1.187
		1880.0	9750	WCDMA	22.56	22.47	12.2 kbps	Test Loop 1	1.192
		1907.6	9888	WCDMA	22.49	22.42	12.2 kbps	Test Loop 1	1.384
	Tip	1880.0	9750	WCDMA	22.53	22.48	12.2 kbps	Test Loop 1	0.272

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

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



 Jay M. Moulton
 Vice President

Note: When the measured channel is 3 dB or more below the limit the remaining channels are not required to be tested per KDB 447498 section 1) e).

13. Test Equipment List

Table 12.1 Equipment Specifications

Type	Calibration Due Date	Serial Number
ThermoCRS Robot	N/A	RAF0338198
ThermoCRS Controller	N/A	RCF0338224
ThermoCRS Teach Pendant (Joystick)	N/A	STP0334405
IBM Computer, 2.66 MHz P4	N/A	8189D8U KCPR08N
Aprel E-Field Probe ALS-E020	09/22/2010	RFE-215
Aprel E-Field Probe ALS-E030	07/14/2011	E030-001
Aprel Dummy Probe	N/A	023
Aprel Left Phantom	N/A	RFE-267
Aprel Right Phantom	N/A	RFE-268
Aprel UniPhantom	N/A	RFE-273
Aprel Validation Dipole ALS-D-450-S-2	01/12/2011	RFE-362
Aprel Validation Dipole ALS-D-835-S-2	01/14/2011	180-00561
Aprel Validation Dipole ALS-D-900-S-2	01/12/2011	RFE-275
Aprel Validation Dipole ALS-D-1900-S-2	01/15/2011	210-00713
Aprel Validation Dipole ALS-D-2450-S-2	01/12/2011	RFE-278
Aprel Validation Dipole RFE-D-2600-S-2	01/18/2011	RFE-121
Aprel Validation Dipole RFE-D-BB-S-2	01/12/2011	235-00801
Agilent (HP) 437B Power Meter	03/24/2011	3125U08837
Agilent (HP) 8481B Power Sensor	03/24/2011	3318A05384
Advantest R3261A Spectrum Analyzer	03/24/2011	31720068
Agilent (HP) 8350B Signal Generator	04/19/2011	2749A10226
Agilent (HP) 83525A RF Plug-In	04/19/2011	2647A01172
Agilent (HP) 8753C Vector Network Analyzer	03/25/2011	3135A01724
Agilent (HP) 85047A S-Parameter Test Set	03/25/2011	2904A00595
Agilent (HP) E55125C Base Station Sim.	03/25/2012	MY48360364
Aprel Dielectric Probe Assembly	N/A	0011
Head Equivalent Matter (450 MHz)	N/A	N/A
Head Equivalent Matter (835 MHz)	N/A	N/A
Head Equivalent Matter (1900 MHz)	N/A	N/A
Head Equivalent Matter (2450 MHz)	N/A	N/A
Body Equivalent Matter (450 MHz)	N/A	N/A
Body Equivalent Matter (835 MHz)	N/A	N/A
Body Equivalent Matter (1900 MHz)	N/A	N/A
Body Equivalent Matter (2450 MHz)	N/A	N/A
Body Equivalent Matter (5200 MHz)	N/A	N/A
Body Equivalent Matter (5800 MHz)	N/A	N/A

14. 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.

15. 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 – 1999, 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 – 2002, IEEE Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields – RF and Microwave, New York: IEEE, 1992.
- [4] Federal Communications Commission, OET Bulletin 65 (Edition 97-01), Supplement C (Edition 01-01), Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields, July 2001.
- [5] IEEE Standard 1528 – 2003, IEEE Recommended Practice for Determining the Peak-Spatial Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communication Devices: Measurement Techniques, October 2003.
- [6] Industry Canada, RSS – 102e, Radio Frequency Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands), November 2005.
- [7] Industry Canada, Safety Code 6, Limits of Human Exposure to Radiofrequency Electromagnetic Fields in the Frequency Range from 3kHz to 300 GHz, 1999.

Appendix A – System Validation Plots and Data

```

*****
Test Result for UIM Dielectric Parameter
Wed 03/Nov/2010 12:01:38
Freq Frequency(GHz)
FCC_eH FCC Bulletin 65 Supplement C ( June 2001) Limits for Head Epsilon
FCC_sH FCC Bulletin 65 Supplement C (June 2001) Limits for Head Sigma
FCC_eB FCC Limits for Body Epsilon
FCC_sB FCC Limits for Body Sigma
Test_e Epsilon of UIM
Test_s Sigma of UIM
*****
Freq FCC_eB FCC_sB Test_e Test_s
0.8050 55.32 0.97 55.19 0.94
0.8150 55.28 0.97 55.14 0.95
0.8250 55.24 0.97 55.09 0.96
0.8350 55.20 0.97 55.04 0.98
0.8450 55.17 0.98 55.00 0.99
0.8550 55.14 0.99 54.96 1.01
0.8650 55.11 1.01 54.92 1.02

```

```

*****
Test Result for UIM Dielectric Parameter
Wed 03/Nov/2010 03:39:48
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 53.30 1.51
1.8800 53.30 1.52 53.28 1.52
1.8900 53.30 1.52 53.26 1.53
1.9000 53.30 1.52 53.25 1.54
1.9100 53.30 1.52 53.23 1.55
1.9200 53.30 1.52 53.21 1.57
1.9300 53.30 1.52 53.20 1.58

```

Test Result for UIM Dielectric Parameter

Thu 04/Nov/2010 06:25:15

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	53.17	1.51
1.8800	53.30	1.52	53.16	1.52
1.8900	53.30	1.52	53.14	1.54
1.9000	53.30	1.52	53.12	1.55
1.9100	53.30	1.52	53.10	1.57
1.9200	53.30	1.52	53.07	1.58
1.9300	53.30	1.52	53.05	1.59

SAR Test Report

By Operator : Jay
Measurement Date : 03-Nov-2010
Starting Time : 03-Nov-2010 12:10:41 PM
End Time : 03-Nov-2010 12:25:49 PM
Scanning Time : 908 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 : 0.999 W/kg
Power Drift-Finish: 0.972 W/kg
Power Drift (%) : -2.646

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 : 03-Nov-2010
Temperature : 20.00 °C
Ambient Temp. : 23.00 °C
Humidity : 49.00 RH%
Epsilon : 55.04 F/m
Sigma : 0.98 S/m
Density : 1000.00 kg/cu. m

Probe Data

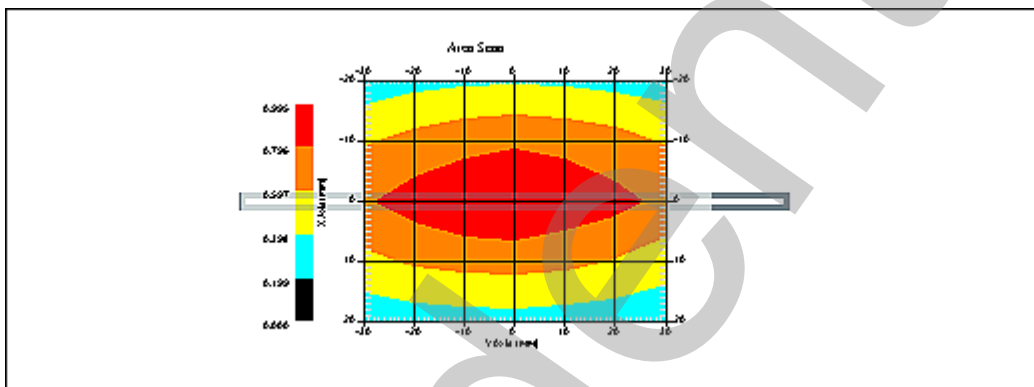
Name : Probe 215 - RFEL
Model : E020
Type : E-Field Triangle
Serial No. : 215
Last Calib. Date : 22-Sep-2010
Frequency : 835.00 MHz
Duty Cycle Factor: 1
Conversion Factor: 6.3
Probe Sensitivity: 1.20 1.20 1.20 $\mu\text{V}/(\text{V}/\text{m})^2$
Compression Point: 95.00 mV
Offset : 1.56 mm

Measurement Data

Crest Factor : 1
Scan Type : Complete
Tissue Temp. : 20.00 °C
Ambient Temp. : 25.00 °C
Set-up Date : 03-Nov-2010
Set-up Time : 9:21:48 AM
Area Scan : 5x7x1 : Measurement x=10mm, y=10mm, z=4mm
Zoom Scan : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

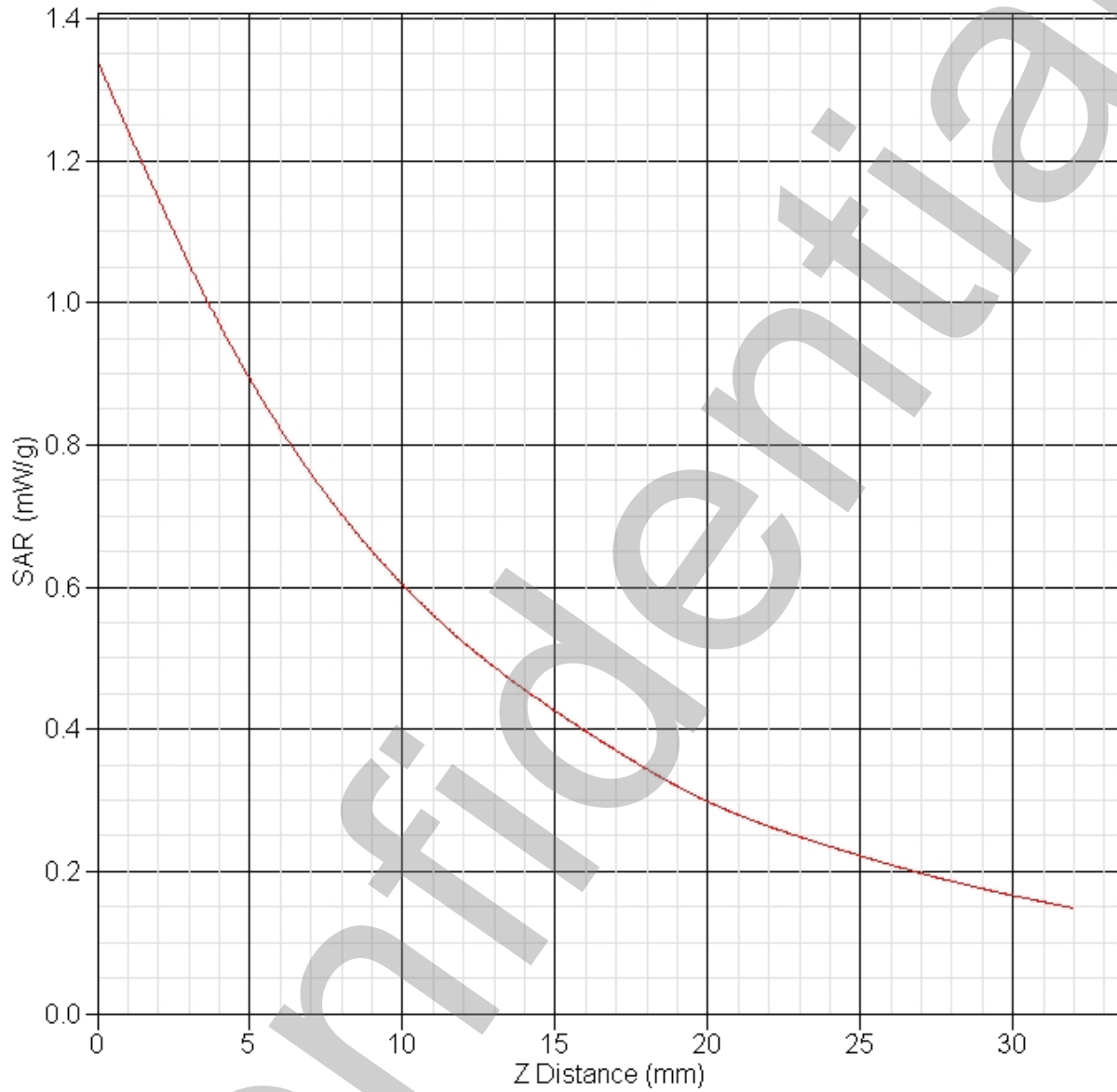
Other Data

DUT Position : Touch
Separation : 15 mm
Channel : Mid



1 gram SAR value : 0.907 W/kg
10 gram SAR value : 0.570 W/kg
Area Scan Peak SAR : 0.994 W/kg
Zoom Scan Peak SAR : 1.341 W/kg

SAR-Z Axis
at Hotspot x:0.22 y:-0.17



SAR Test Report

By Operator : Jay
Measurement Date : 03-Nov-2010
Starting Time : 03-Nov-2010 03:59:22 PM
End Time : 03-Nov-2010 04:12:21 PM
Scanning Time : 779 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 : 4.552 W/kg
Power Drift-Finish: 4.532 W/kg
Power Drift (%) : -0.448

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 : 03-Nov-2010
Temperature : 20.00 °C
Ambient Temp. : 23.00 °C
Humidity : 49.00 RH%
Epsilon : 53.25 F/m
Sigma : 1.54 S/m
Density : 1000.00 kg/cu. m

Probe Data

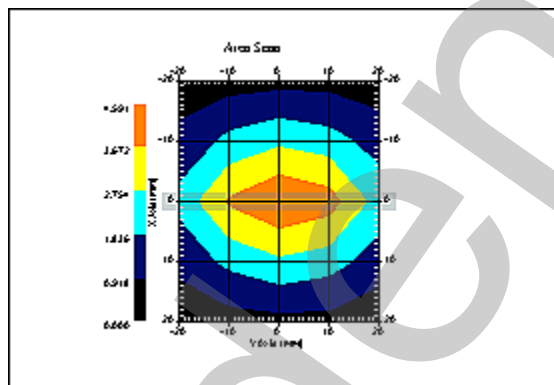
Name : Probe 215 - RFEL
Model : E020
Type : E-Field Triangle
Serial No. : 215
Last Calib. Date : 22-Sep-2010
Frequency : 1900.00 MHz
Duty Cycle Factor: 1
Conversion Factor: 5
Probe Sensitivity: 1.20 1.20 1.20 $\mu\text{V}/(\text{V}/\text{m})^2$
Compression Point: 95.00 mV
Offset : 1.56 mm

Measurement Data

Crest Factor : 1
Scan Type : Complete
Tissue Temp. : 20.00 °C
Ambient Temp. : 23.00 °C
Set-up Date : 03-Nov-2010
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

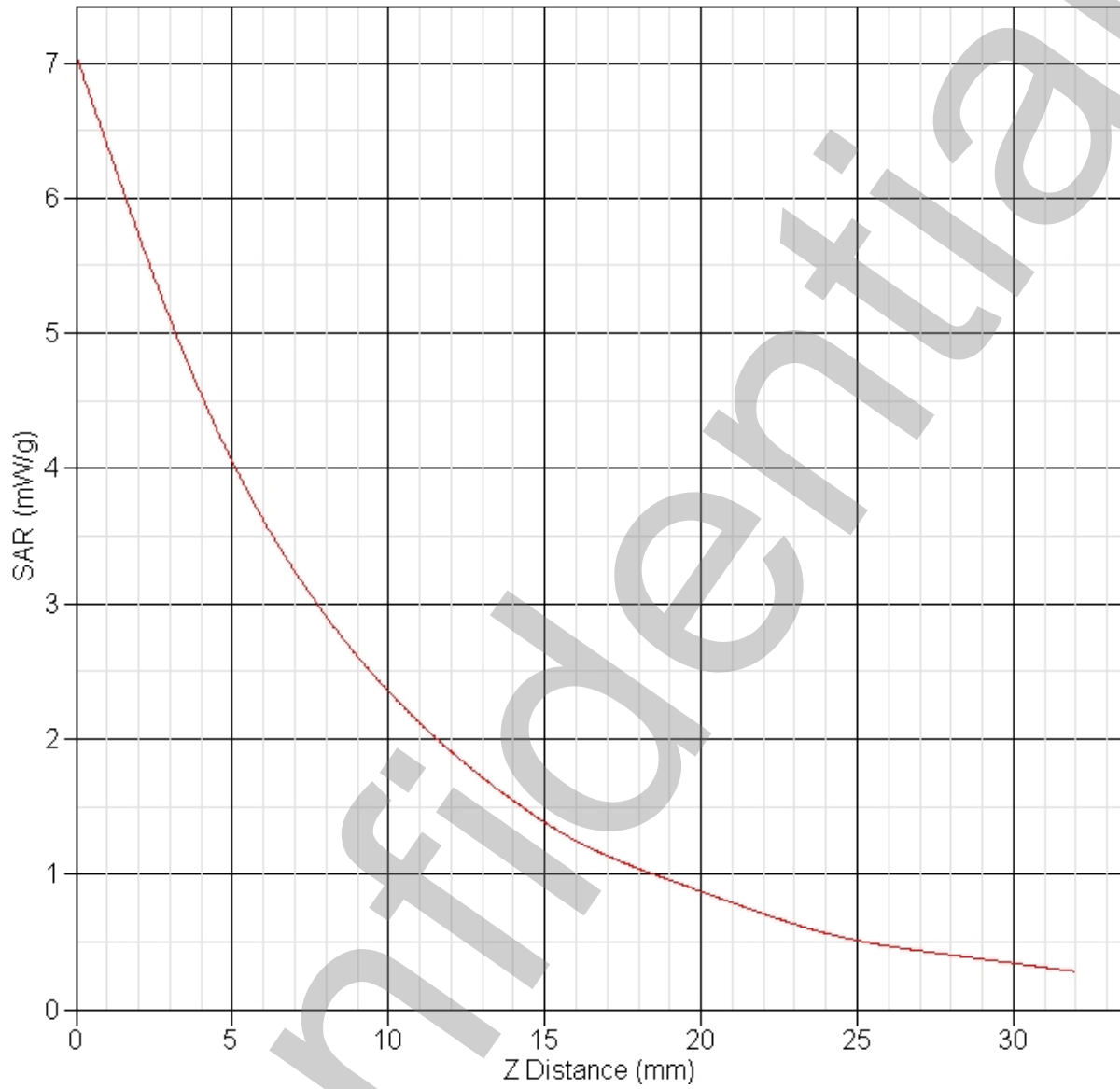
Other Data

DUT Position : Touch
Separation : 10 mm
Channel : Mid



1 gram SAR value : 3.993 W/kg
10 gram SAR value : 2.076 W/kg
Area Scan Peak SAR : 4.591 W/kg
Zoom Scan Peak SAR : 7.066 W/kg

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



SAR Test Report

By Operator : Jay
Measurement Date : 04-Nov-2010
Starting Time : 04-Nov-2010 06:33:41 AM
End Time : 04-Nov-2010 06:47:00 AM
Scanning Time : 799 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 : 4.265 W/kg
Power Drift-Finish: 4.284 W/kg
Power Drift (%) : 0.453

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 : 04-Nov-2010
Temperature : 20.00 °C
Ambient Temp. : 23.00 °C
Humidity : 49.00 RH%
Epsilon : 53.12 F/m
Sigma : 1.55 S/m
Density : 1000.00 kg/cu. m

Probe Data

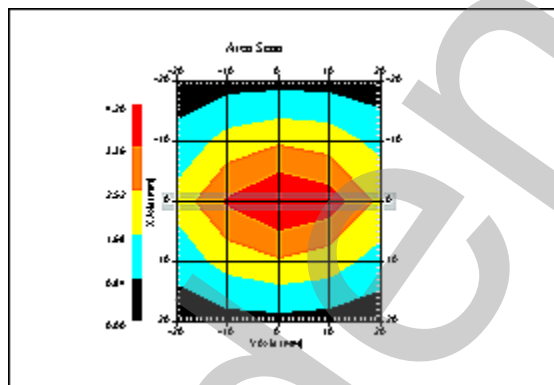
Name : Probe 215 - RFEL
Model : E020
Type : E-Field Triangle
Serial No. : 215
Last Calib. Date : 22-Sep-2010
Frequency : 1900.00 MHz
Duty Cycle Factor: 1
Conversion Factor: 5
Probe Sensitivity: 1.20 1.20 1.20 $\mu\text{V}/(\text{V}/\text{m})^2$
Compression Point: 95.00 mV
Offset : 1.56 mm

Measurement Data

Crest Factor : 1
Scan Type : Complete
Tissue Temp. : 20.00 °C
Ambient Temp. : 23.00 °C
Set-up Date : 04-Nov-2010
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

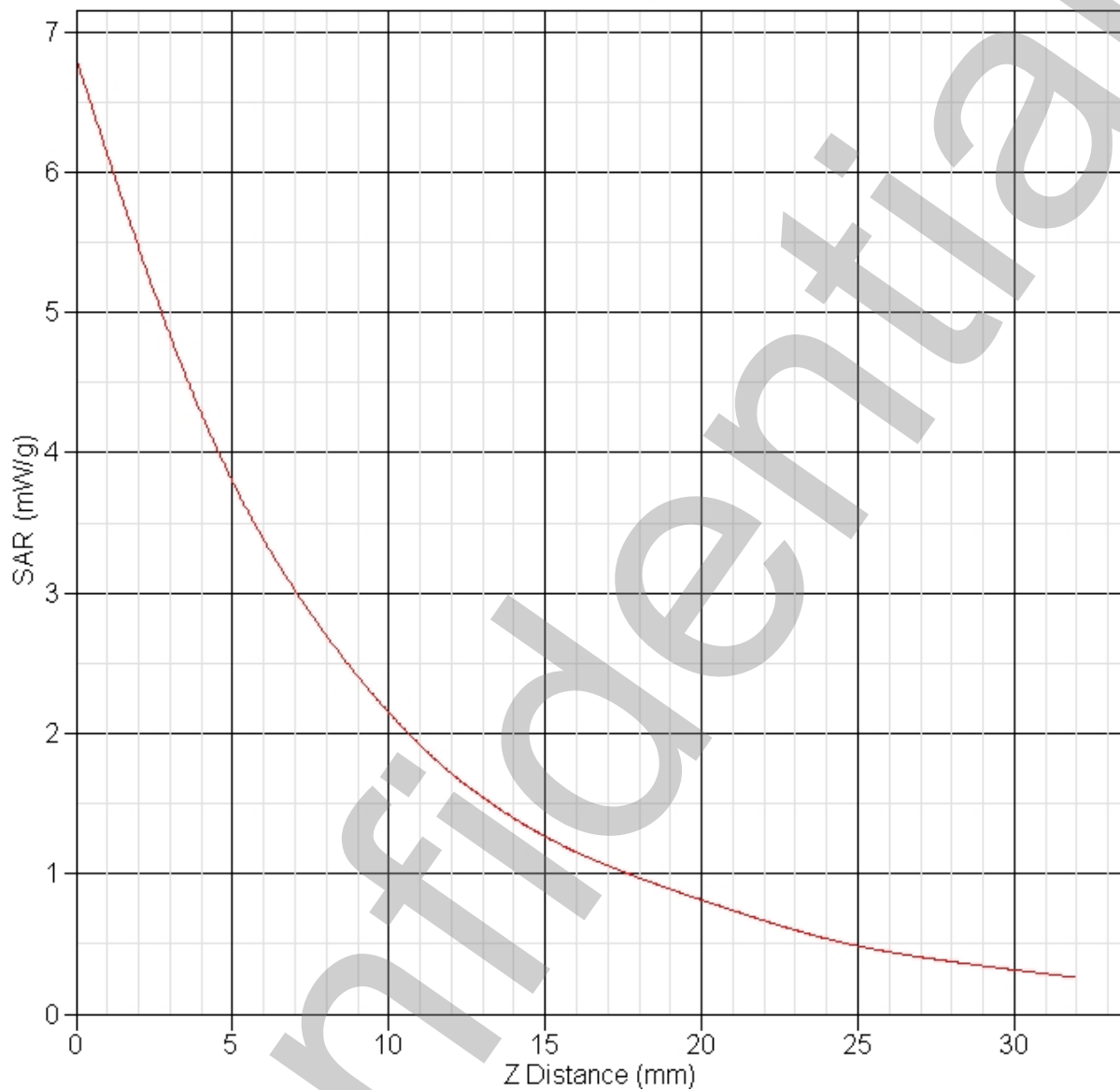
Other Data

DUT Position : Touch
Separation : 10 mm
Channel : Mid



1 gram SAR value : 3.937 W/kg
10 gram SAR value : 1.933 W/kg
Area Scan Peak SAR : 4.200 W/kg
Zoom Scan Peak SAR : 6.816 W/kg

SAR-Z Axis
at Hotspot x:0.25 y:-0.17



Appendix B – SAR Test Data Plots

Confidential

SAR Test Report

By Operator : Jay
Measurement Date : 03-Nov-2010
Starting Time : 03-Nov-2010 12:41:07 PM
End Time : 03-Nov-2010 01:06:17 PM
Scanning Time : 1510 secs

Product Data

Device Name : Novatel Wireless
Serial No. : Unit 5
Mode : GPRS 1-Slot
Model : MC545
Frequency : 850.00 MHz
Max. Transmit Pwr : 2 W
Drift Time : 0 min(s)
Length : 80 mm
Width : 30 mm
Depth : 9 mm
Antenna Type : Internal
Orientation : Top
Power Drift-Start : 0.720 W/kg
Power Drift-Finish: 0.697 W/kg
Power Drift (%) : -3.196

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 : 03-Nov-2010
Temperature : 20.00 °C
Ambient Temp. : 23.00 °C
Humidity : 40.00 RH%
Epsilon : 55.04 F/m
Sigma : 0.98 S/m
Density : 1000.00 kg/cu. m

Probe Data

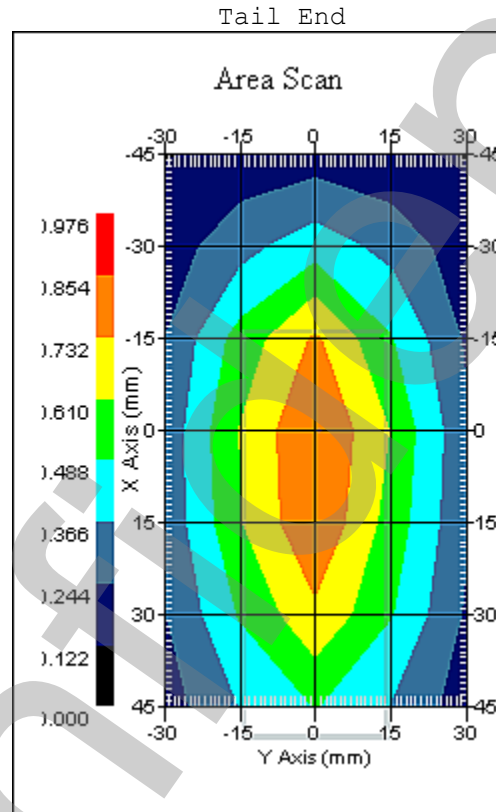
Name : Probe 215 - RFEL
Model : E020
Type : E-Field Triangle
Serial No. : 215
Last Calib. Date : 22-Sep-2010
Frequency : 835.00 MHz
Duty Cycle Factor: 8
Conversion Factor: 6.3
Probe Sensitivity: 1.20 1.20 1.20 $\mu\text{V}/(\text{V}/\text{m})^2$
Compression Point: 95.00 mV
Offset : 1.56 mm

Measurement Data

Crest Factor : 8
Scan Type : Complete
Tissue Temp. : 20.00 °C
Ambient Temp. : 23.00 °C
Set-up Date : 03-Nov-2010
Set-up Time : 12:33:42 PM
Area Scan : 7x5x1 : Measurement x=15mm, y=15mm, z=4mm
Zoom Scan : 7x7x10 : Measurement x=4mm, y=4mm, z=2.5mm

Other Data

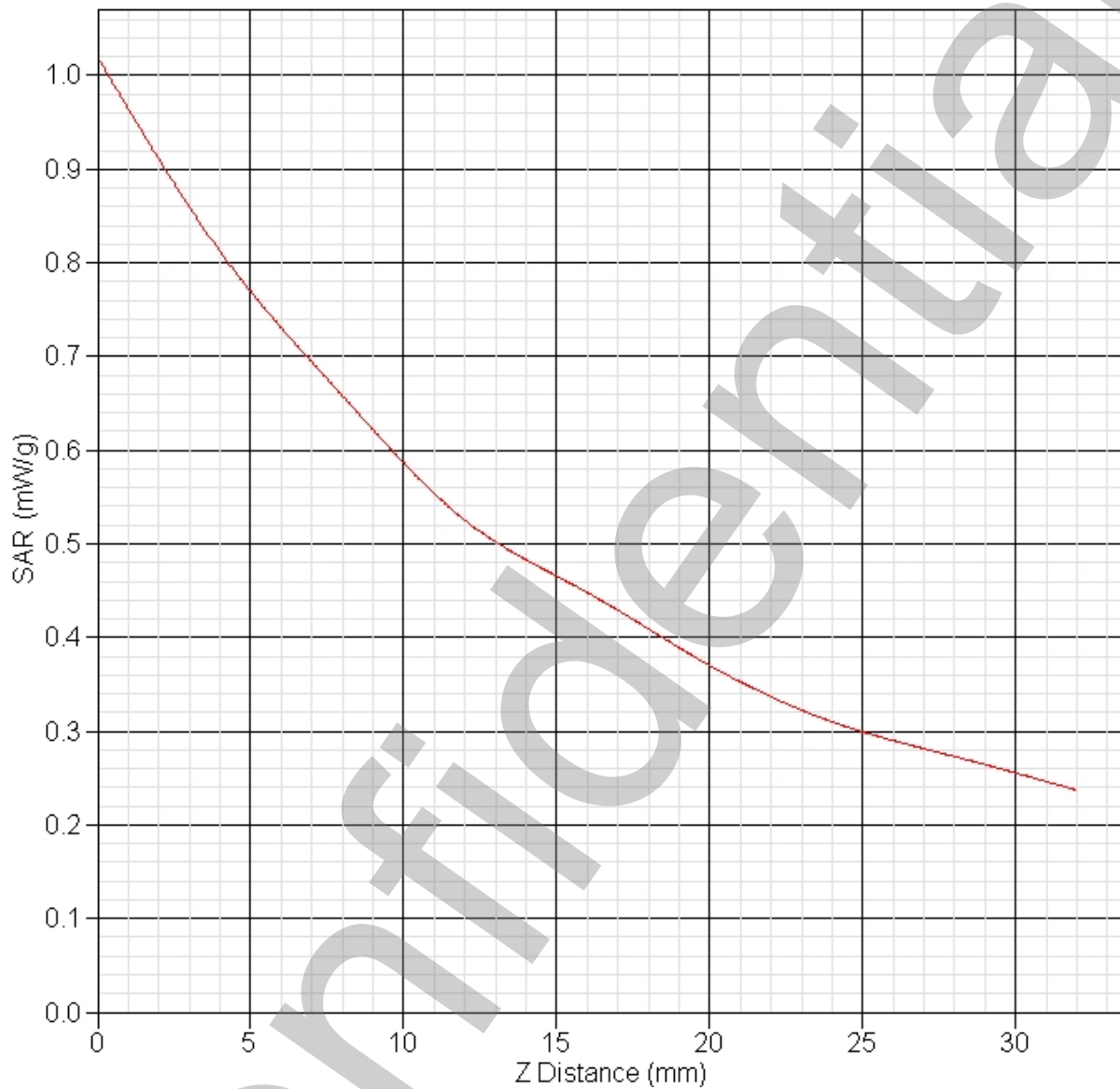
DUT Position : Top
Separation : 5 mm
Channel : Mid



Connector End

1 gram SAR value : 0.743 W/kg
10 gram SAR value : 0.527 W/kg
Area Scan Peak SAR : 0.855 W/kg
Zoom Scan Peak SAR : 1.020 W/kg

SAR-Z Axis
at Hotspot x:23.09 y:-0.10



SAR Test Report

By Operator : Jay
Measurement Date : 03-Nov-2010
Starting Time : 03-Nov-2010 01:12:30 PM
End Time : 03-Nov-2010 01:37:07 PM
Scanning Time : 1477 secs

Product Data

Device Name : Novatel Wireless
Serial No. : Unit 5
Mode : GPRS 1-Slot
Model : MC545
Frequency : 850.00 MHz
Max. Transmit Pwr : 2 W
Drift Time : 0 min(s)
Length : 80 mm
Width : 30 mm
Depth : 9 mm
Antenna Type : Internal
Orientation : Bottom
Power Drift-Start : 0.214 W/kg
Power Drift-Finish: 0.221 W/kg
Power Drift (%) : 3.270

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 : 03-Nov-2010
Temperature : 20.00 °C
Ambient Temp. : 23.00 °C
Humidity : 40.00 RH%
Epsilon : 55.04 F/m
Sigma : 0.98 S/m
Density : 1000.00 kg/cu. m

Probe Data

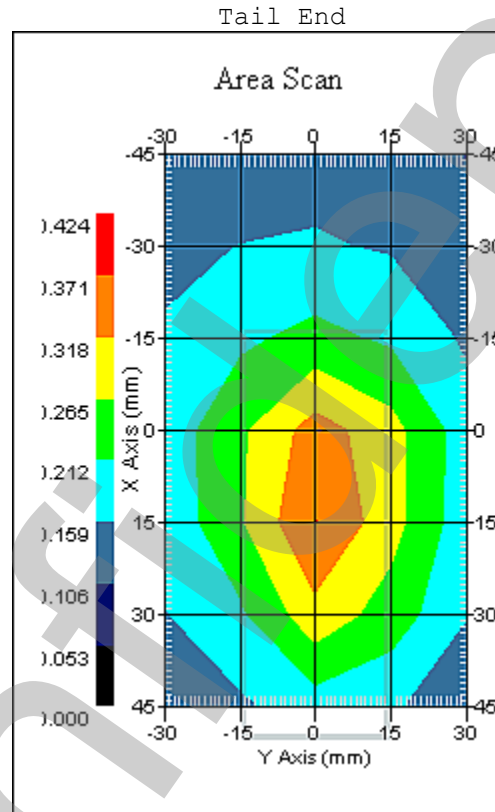
Name : Probe 215 - RFEL
Model : E020
Type : E-Field Triangle
Serial No. : 215
Last Calib. Date : 22-Sep-2010
Frequency : 835.00 MHz
Duty Cycle Factor: 8
Conversion Factor: 6.3
Probe Sensitivity: 1.20 1.20 1.20 $\mu\text{V}/(\text{V}/\text{m})^2$
Compression Point: 95.00 mV
Offset : 1.56 mm

Measurement Data

Crest Factor : 8
Scan Type : Complete
Tissue Temp. : 20.00 °C
Ambient Temp. : 23.00 °C
Set-up Date : 03-Nov-2010
Set-up Time : 1:52:20 PM
Area Scan : 7x5x1 : Measurement x=15mm, y=15mm, z=4mm
Zoom Scan : 7x7x10 : Measurement x=4mm, y=4mm, z=2.5mm

Other Data

DUT Position : Bottom
Separation : 5 mm
Channel : Mid



1 gram SAR value : 0.341 W/kg
10 gram SAR value : 0.238 W/kg
Area Scan Peak SAR : 0.373 W/kg
Zoom Scan Peak SAR : 0.520 W/kg

SAR Test Report

By Operator : Jay
Measurement Date : 03-Nov-2010
Starting Time : 03-Nov-2010 01:48:32 PM
End Time : 03-Nov-2010 02:13:12 PM
Scanning Time : 1480 secs

Product Data

Device Name : Novatel Wireless
Serial No. : Unit 5
Mode : GPRS 1-Slot
Model : MC545
Frequency : 850.00 MHz
Max. Transmit Pwr : 2 W
Drift Time : 0 min(s)
Length : 80 mm
Width : 9 mm
Depth : 30 mm
Antenna Type : Internal
Orientation : Right
Power Drift-Start : 0.567 W/kg
Power Drift-Finish: 0.548 W/kg
Power Drift (%) : -3.355

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 : 03-Nov-2010
Temperature : 20.00 °C
Ambient Temp. : 23.00 °C
Humidity : 40.00 RH%
Epsilon : 55.04 F/m
Sigma : 0.98 S/m
Density : 1000.00 kg/cu. m

Probe Data

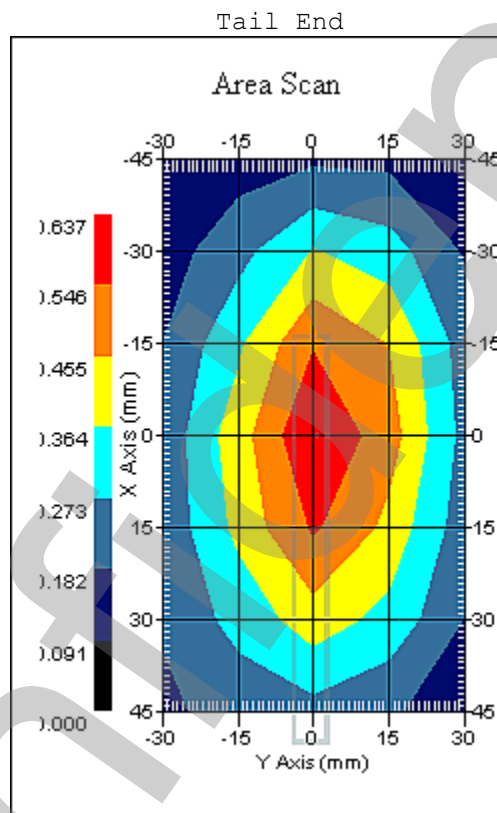
Name : Probe 215 - RFEL
Model : E020
Type : E-Field Triangle
Serial No. : 215
Last Calib. Date : 22-Sep-2010
Frequency : 835.00 MHz
Duty Cycle Factor: 8
Conversion Factor: 6.3
Probe Sensitivity: 1.20 1.20 1.20 $\mu\text{V}/(\text{V}/\text{m})^2$
Compression Point: 95.00 mV
Offset : 1.56 mm

Measurement Data

Crest Factor : 8
Scan Type : Complete
Tissue Temp. : 20.00 °C
Ambient Temp. : 23.00 °C
Set-up Date : 03-Nov-2010
Set-up Time : 12:33:42 PM
Area Scan : 7x5x1 : Measurement x=15mm, y=15mm, z=4mm
Zoom Scan : 7x7x10 : Measurement x=4mm, y=4mm, z=2.5mm

Other Data

DUT Position : Right
Separation : 5 mm
Channel : Mid



1 gram SAR value : 0.573 W/kg
10 gram SAR value : 0.406 W/kg
Area Scan Peak SAR : 0.636 W/kg
Zoom Scan Peak SAR : 0.830 W/kg

SAR Test Report

By Operator : Jay
Measurement Date : 03-Nov-2010
Starting Time : 03-Nov-2010 02:22:23 PM
End Time : 03-Nov-2010 02:47:09 PM
Scanning Time : 1486 secs

Product Data

Device Name : Novatel Wireless
Serial No. : Unit 5
Mode : GPRS 1-Slot
Model : MC545
Frequency : 850.00 MHz
Max. Transmit Pwr : 2 W
Drift Time : 0 min(s)
Length : 80 mm
Width : 9 mm
Depth : 30 mm
Antenna Type : Internal
Orientation : Left
Power Drift-Start : 0.728 W/kg
Power Drift-Finish: 0.726 W/kg
Power Drift (%) : -0.292

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 : 03-Nov-2010
Temperature : 20.00 °C
Ambient Temp. : 23.00 °C
Humidity : 40.00 RH%
Epsilon : 55.04 F/m
Sigma : 0.98 S/m
Density : 1000.00 kg/cu. m

Probe Data

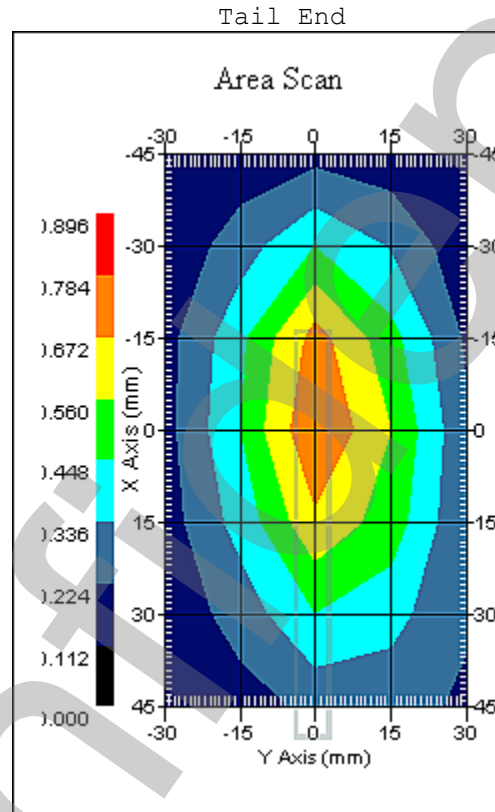
Name : Probe 215 - RFEL
Model : E020
Type : E-Field Triangle
Serial No. : 215
Last Calib. Date : 22-Sep-2010
Frequency : 835.00 MHz
Duty Cycle Factor: 8
Conversion Factor: 6.3
Probe Sensitivity: 1.20 1.20 1.20 $\mu\text{V}/(\text{V}/\text{m})^2$
Compression Point: 95.00 mV
Offset : 1.56 mm

Measurement Data

Crest Factor : 8
Scan Type : Complete
Tissue Temp. : 20.00 °C
Ambient Temp. : 23.00 °C
Set-up Date : 03-Nov-2010
Set-up Time : 1:52:20 PM
Area Scan : 7x5x1 : Measurement x=15mm, y=15mm, z=4mm
Zoom Scan : 7x7x10 : Measurement x=4mm, y=4mm, z=2.5mm

Other Data

DUT Position : Left
Separation : 5 mm
Channel : Mid



1 gram SAR value : 0.720 W/kg
10 gram SAR value : 0.504 W/kg
Area Scan Peak SAR : 0.786 W/kg
Zoom Scan Peak SAR : 1.040 W/kg

SAR Test Report

By Operator : Jay
Measurement Date : 03-Nov-2010
Starting Time : 03-Nov-2010 02:58:50 PM
End Time : 03-Nov-2010 03:23:22 PM
Scanning Time : 1472 secs

Product Data

Device Name : Novatel Wireless
Serial No. : Unit 5
Mode : GPRS 1-Slot
Model : MC545
Frequency : 850.00 MHz
Max. Transmit Pwr : 2 W
Drift Time : 0 min(s)
Length : 9 mm
Width : 30 mm
Depth : 80 mm
Antenna Type : Internal
Orientation : Tip
Power Drift-Start : 0.169 W/kg
Power Drift-Finish: 0.172 W/kg
Power Drift (%) : 1.775

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 : 03-Nov-2010
Temperature : 20.00 °C
Ambient Temp. : 23.00 °C
Humidity : 40.00 RH%
Epsilon : 55.04 F/m
Sigma : 0.98 S/m
Density : 1000.00 kg/cu. m

Probe Data

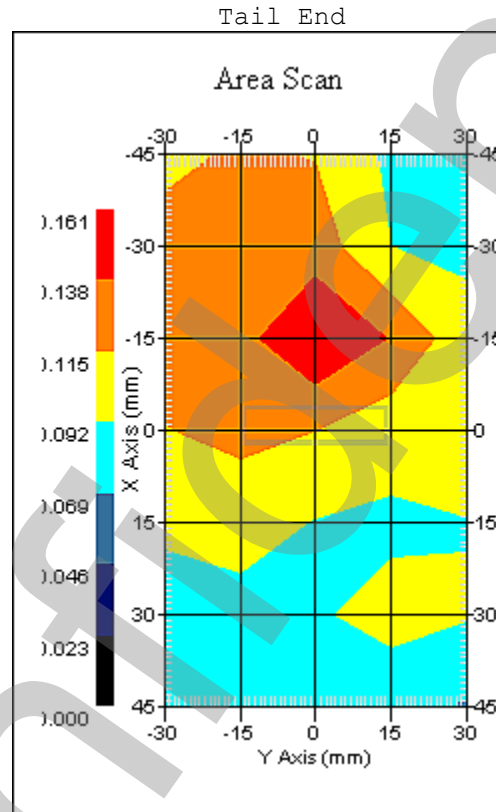
Name : Probe 215 - RFEL
Model : E020
Type : E-Field Triangle
Serial No. : 215
Last Calib. Date : 22-Sep-2010
Frequency : 835.00 MHz
Duty Cycle Factor: 8
Conversion Factor: 6.3
Probe Sensitivity: 1.20 1.20 1.20 $\mu\text{V}/(\text{V}/\text{m})^2$
Compression Point: 95.00 mV
Offset : 1.56 mm

Measurement Data

Crest Factor : 8
Scan Type : Complete
Tissue Temp. : 20.00 °C
Ambient Temp. : 23.00 °C
Set-up Date : 03-Nov-2010
Set-up Time : 1:52:20 PM
Area Scan : 7x5x1 : Measurement x=15mm, y=15mm, z=4mm
Zoom Scan : 7x7x10 : Measurement x=4mm, y=4mm, z=2.5mm

Other Data

DUT Position : Tip
Separation : 5 mm
Channel : Mid



1 gram SAR value : 0.155 W/kg
10 gram SAR value : 0.113 W/kg
Area Scan Peak SAR : 0.160 W/kg
Zoom Scan Peak SAR : 0.260 W/kg

SAR Test Report

By Operator : Jay
Measurement Date : 03-Nov-2010
Starting Time : 03-Nov-2010 05:02:50 PM
End Time : 03-Nov-2010 05:27:44 PM
Scanning Time : 1494 secs

Product Data

Device Name : Novatel Wireless
Serial No. : Unit 5
Mode : GPRS 1-Slot
Model : MC545
Frequency : 1900.00 MHz
Max. Transmit Pwr : 1 W
Drift Time : 0 min(s)
Length : 80 mm
Width : 30 mm
Depth : 9 mm
Antenna Type : Internal
Orientation : Top
Power Drift-Start : 0.818 W/kg
Power Drift-Finish: 0.796 W/kg
Power Drift (%) : -2.680

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 : 03-Nov-2010
Temperature : 20.00 °C
Ambient Temp. : 23.00 °C
Humidity : 36.00 RH%
Epsilon : 53.25 F/m
Sigma : 1.54 S/m
Density : 1000.00 kg/cu. m

Probe Data

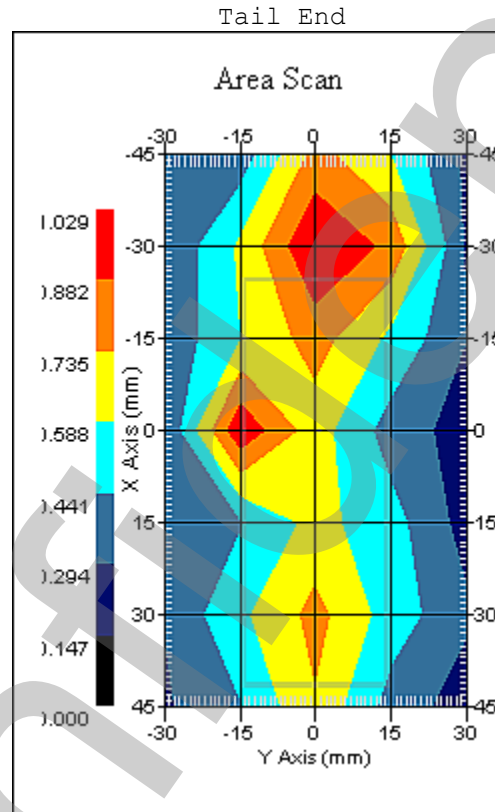
Name : Probe 215 - RFEL
Model : E020
Type : E-Field Triangle
Serial No. : 215
Last Calib. Date : 22-Sep-2010
Frequency : 1900.00 MHz
Duty Cycle Factor: 8
Conversion Factor: 5
Probe Sensitivity: 1.20 1.20 1.20 $\mu\text{V}/(\text{V}/\text{m})^2$
Compression Point: 95.00 mV
Offset : 1.56 mm

Measurement Data

Crest Factor : 8
Scan Type : Complete
Tissue Temp. : 20.00 °C
Ambient Temp. : 23.00 °C
Set-up Date : 03-Nov-2010
Set-up Time : 3:37:45 PM
Area Scan : 7x5x1 : Measurement x=15mm, y=15mm, z=4mm
Zoom Scan : 7x7x10 : Measurement x=4mm, y=4mm, z=2.5mm

Other Data

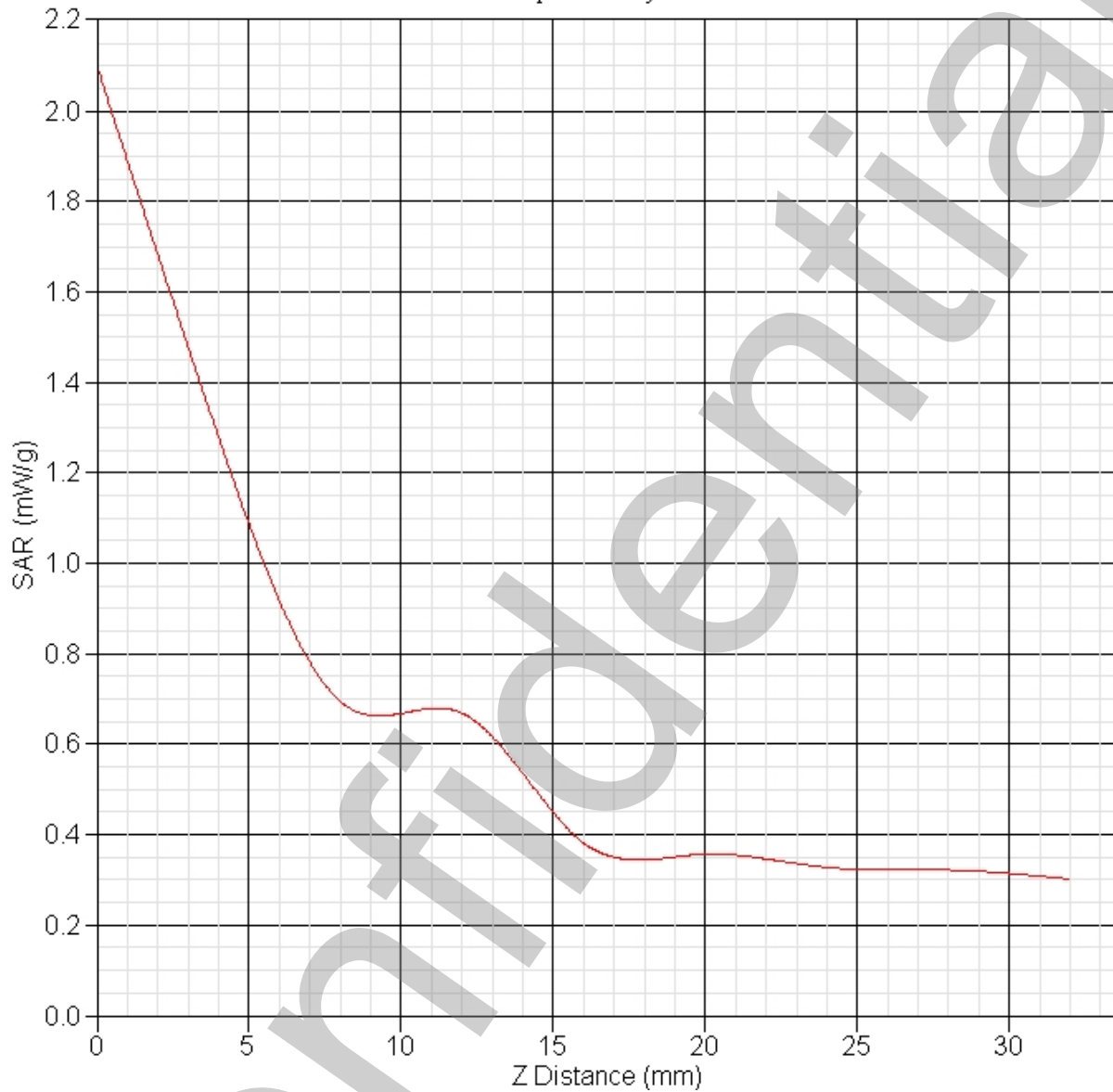
DUT Position : Top
Separation : 5 mm
Channel : Low



Connector End

1 gram SAR value : 1.153 W/kg
10 gram SAR value : 0.663 W/kg
Area Scan Peak SAR : 1.027 W/kg
Zoom Scan Peak SAR : 2.101 W/kg

SAR-Z Axis
at Hotspot x:-6.97 y:-0.13



SAR Test Report

By Operator : Jay
Measurement Date : 03-Nov-2010
Starting Time : 03-Nov-2010 04:25:51 PM
End Time : 03-Nov-2010 04:50:51 PM
Scanning Time : 1500 secs

Product Data

Device Name : Novatel Wireless
Serial No. : Unit 5
Mode : GPRS 1-Slot
Model : MC545
Frequency : 1900.00 MHz
Max. Transmit Pwr : 1 W
Drift Time : 0 min(s)
Length : 80 mm
Width : 30 mm
Depth : 9 mm
Antenna Type : Internal
Orientation : Top
Power Drift-Start : 1.025 W/kg
Power Drift-Finish: 0.991 W/kg
Power Drift (%) : -3.314

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 : 03-Nov-2010
Temperature : 20.00 °C
Ambient Temp. : 23.00 °C
Humidity : 36.00 RH%
Epsilon : 53.25 F/m
Sigma : 1.54 S/m
Density : 1000.00 kg/cu. m

Probe Data

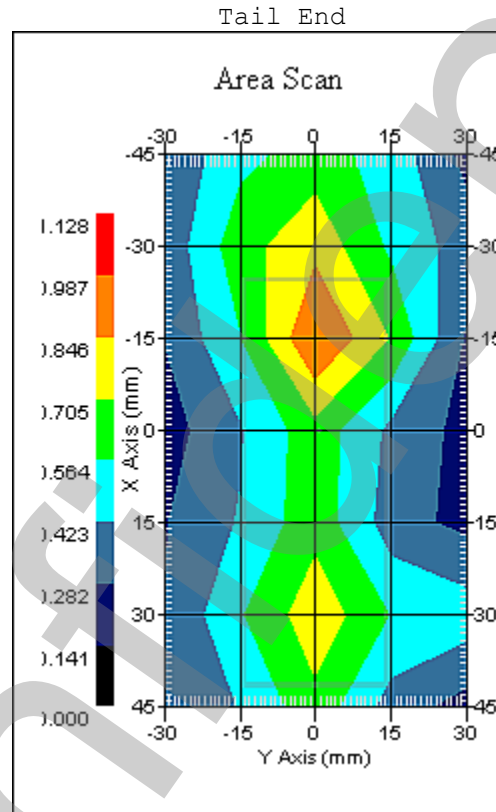
Name : Probe 215 - RFEL
Model : E020
Type : E-Field Triangle
Serial No. : 215
Last Calib. Date : 22-Sep-2010
Frequency : 1900.00 MHz
Duty Cycle Factor: 8
Conversion Factor: 5
Probe Sensitivity: 1.20 1.20 1.20 $\mu\text{V}/(\text{V}/\text{m})^2$
Compression Point: 95.00 mV
Offset : 1.56 mm

Measurement Data

Crest Factor : 8
Scan Type : Complete
Tissue Temp. : 20.00 °C
Ambient Temp. : 23.00 °C
Set-up Date : 03-Nov-2010
Set-up Time : 3:37:45 PM
Area Scan : 7x5x1 : Measurement x=15mm, y=15mm, z=4mm
Zoom Scan : 7x7x10 : Measurement x=4mm, y=4mm, z=2.5mm

Other Data

DUT Position : Top
Separation : 5 mm
Channel : Mid



1 gram SAR value : 0.981 W/kg
10 gram SAR value : 0.610 W/kg
Area Scan Peak SAR : 0.988 W/kg
Zoom Scan Peak SAR : 2.692 W/kg

SAR Test Report

By Operator : Jay
Measurement Date : 03-Nov-2010
Starting Time : 03-Nov-2010 05:34:40 PM
End Time : 03-Nov-2010 05:59:42 PM
Scanning Time : 1502 secs

Product Data

Device Name : Novatel Wireless
Serial No. : Unit 5
Mode : GPRS 1-Slot
Model : MC545
Frequency : 1900.00 MHz
Max. Transmit Pwr : 1 W
Drift Time : 0 min(s)
Length : 80 mm
Width : 30 mm
Depth : 9 mm
Antenna Type : Internal
Orientation : Top
Power Drift-Start : 0.893 W/kg
Power Drift-Finish: 0.863 W/kg
Power Drift (%) : -3.355

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 : 03-Nov-2010
Temperature : 20.00 °C
Ambient Temp. : 23.00 °C
Humidity : 36.00 RH%
Epsilon : 53.25 F/m
Sigma : 1.54 S/m
Density : 1000.00 kg/cu. m

Probe Data

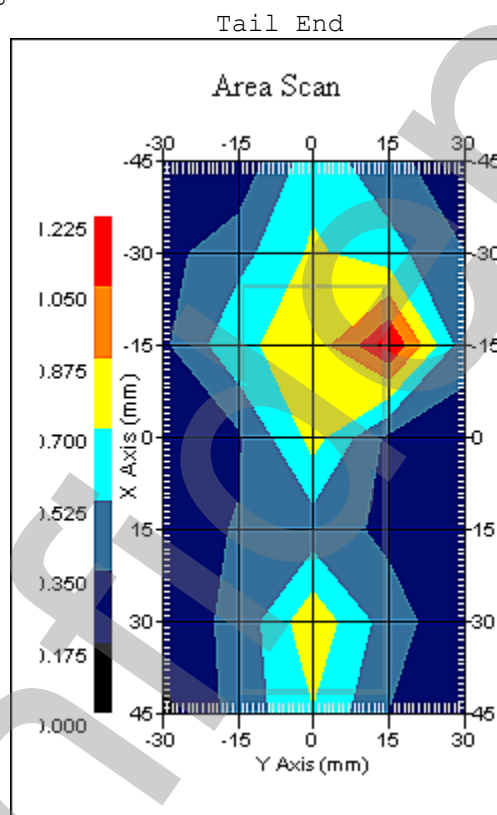
Name : Probe 215 - RFEL
Model : E020
Type : E-Field Triangle
Serial No. : 215
Last Calib. Date : 22-Sep-2010
Frequency : 1900.00 MHz
Duty Cycle Factor: 8
Conversion Factor: 5
Probe Sensitivity: 1.20 1.20 1.20 $\mu\text{V}/(\text{V}/\text{m})^2$
Compression Point: 95.00 mV
Offset : 1.56 mm

Measurement Data

Crest Factor : 8
Scan Type : Complete
Tissue Temp. : 20.00 °C
Ambient Temp. : 23.00 °C
Set-up Date : 03-Nov-2010
Set-up Time : 3:37:45 PM
Area Scan : 7x5x1 : Measurement x=15mm, y=15mm, z=4mm
Zoom Scan : 7x7x10 : Measurement x=4mm, y=4mm, z=2.5mm

Other Data

DUT Position : Top
Separation : 5 mm
Channel : High



Connector End

1 gram SAR value : 1.064 W/kg
10 gram SAR value : 0.824 W/kg
Area Scan Peak SAR : 1.222 W/kg
Zoom Scan Peak SAR : 2.013 W/kg

SAR Test Report

By Operator : Jay
Measurement Date : 04-Nov-2010
Starting Time : 04-Nov-2010 01:22:17 PM
End Time : 04-Nov-2010 01:46:01 PM
Scanning Time : 824 secs

Product Data

Device Name : Novatel Wireless
Serial No. : Unit 5
Mode : GPRS 1-Slot
Model : MC545
Frequency : 1900.00 MHz
Max. Transmit Pwr : 1 W
Drift Time : 0 min(s)
Length : 80 mm
Width : 30 mm
Depth : 9 mm
Antenna Type : Internal
Orientation : Bottom
Power Drift-Start : 0.401 W/kg
Power Drift-Finish: 0.407 W/kg
Power Drift (%) : 1.493

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 : 04-Nov-2010
Temperature : 20.00 °C
Ambient Temp. : 23.00 °C
Humidity : 36.00 RH%
Epsilon : 53.12 F/m
Sigma : 1.55 S/m
Density : 1000.00 kg/cu. m

Probe Data

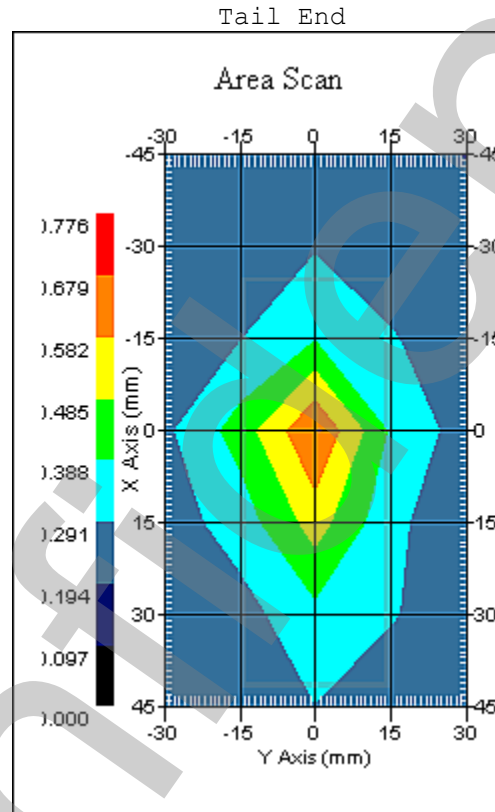
Name : Probe 215 - RFEL
Model : E020
Type : E-Field Triangle
Serial No. : 215
Last Calib. Date : 22-Sep-2010
Frequency : 1900.00 MHz
Duty Cycle Factor: 8
Conversion Factor: 5
Probe Sensitivity: 1.20 1.20 1.20 $\mu\text{V}/(\text{V}/\text{m})^2$
Compression Point: 95.00 mV
Offset : 1.56 mm

Measurement Data

Crest Factor : 8
Scan Type : Complete
Tissue Temp. : 20.00 °C
Ambient Temp. : 23.00 °C
Set-up Date : 04-Nov-2010
Set-up Time : 7:01:17 AM
Area Scan : 7x5x1 : Measurement x=15mm, y=15mm, z=4mm
Zoom Scan : 7x7x10 : Measurement x=4mm, y=4mm, z=2.5mm

Other Data

DUT Position : Bottom
Separation : 5 mm
Channel : Mid



1 gram SAR value : 0.616 W/kg
10 gram SAR value : 0.411 W/kg
Area Scan Peak SAR : 0.680 W/kg
Zoom Scan Peak SAR : 1.000 W/kg

SAR Test Report

By Operator : Jay
Measurement Date : 04-Nov-2010
Starting Time : 04-Nov-2010 09:50:04 AM
End Time : 04-Nov-2010 10:14:58 AM
Scanning Time : 1494 secs

Product Data

Device Name : Novatel Wireless
Serial No. : Unit 5
Mode : GPRS 1-Slot
Model : MC545
Frequency : 1900.00 MHz
Max. Transmit Pwr : 1 W
Drift Time : 0 min(s)
Length : 80 mm
Width : 9 mm
Depth : 30 mm
Antenna Type : Internal
Orientation : Right
Power Drift-Start : 0.694 W/kg
Power Drift-Finish: 0.720 W/kg
Power Drift (%) : 3.743

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 : 04-Nov-2010
Temperature : 20.00 °C
Ambient Temp. : 23.00 °C
Humidity : 36.00 RH%
Epsilon : 53.12 F/m
Sigma : 1.55 S/m
Density : 1000.00 kg/cu. m

Probe Data

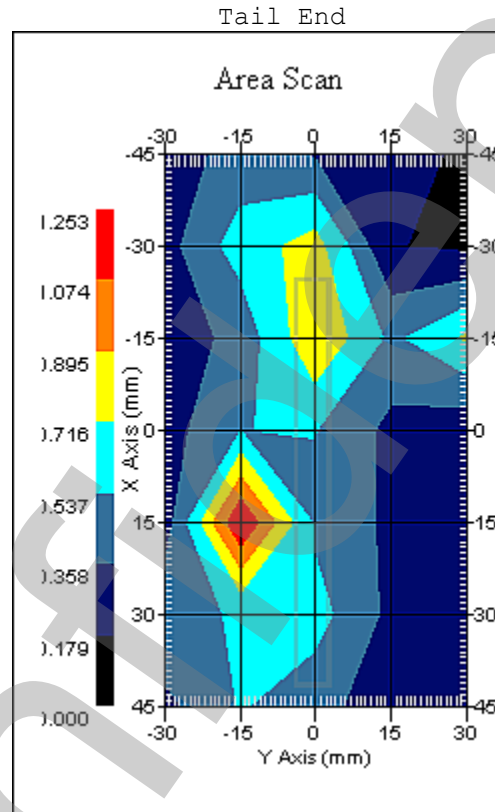
Name : Probe 215 - RFEL
Model : E020
Type : E-Field Triangle
Serial No. : 215
Last Calib. Date : 22-Sep-2010
Frequency : 1900.00 MHz
Duty Cycle Factor: 8
Conversion Factor: 5
Probe Sensitivity: 1.20 1.20 1.20 $\mu\text{V}/(\text{V}/\text{m})^2$
Compression Point: 95.00 mV
Offset : 1.56 mm

Measurement Data

Crest Factor : 8
Scan Type : Complete
Tissue Temp. : 20.00 °C
Ambient Temp. : 23.00 °C
Set-up Date : 04-Nov-2010
Set-up Time : 7:01:17 AM
Area Scan : 7x5x1 : Measurement x=15mm, y=15mm, z=4mm
Zoom Scan : 7x7x10 : Measurement x=4mm, y=4mm, z=2.5mm

Other Data

DUT Position : Right
Separation : 5 mm
Channel : Mid



Connector End

1 gram SAR value : 0.512 W/kg
10 gram SAR value : 0.454 W/kg
Area Scan Peak SAR : 1.252 W/kg
Zoom Scan Peak SAR : 2.622 W/kg

SAR Test Report

By Operator : Jay
Measurement Date : 04-Nov-2010
Starting Time : 04-Nov-2010 10:44:51 AM
End Time : 04-Nov-2010 11:09:44 AM
Scanning Time : 1493 secs

Product Data

Device Name : Novatel Wireless
Serial No. : Unit 5
Mode : GPRS 1-Slot
Model : MC545
Frequency : 1900.00 MHz
Max. Transmit Pwr : 1 W
Drift Time : 0 min(s)
Length : 80 mm
Width : 9 mm
Depth : 30 mm
Antenna Type : Internal
Orientation : Left
Power Drift-Start : 0.909 W/kg
Power Drift-Finish: 0.909 W/kg
Power Drift (%) : 0.895

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 : 04-Nov-2010
Temperature : 20.00 °C
Ambient Temp. : 23.00 °C
Humidity : 36.00 RH%
Epsilon : 53.12 F/m
Sigma : 1.55 S/m
Density : 1000.00 kg/cu. m

Probe Data

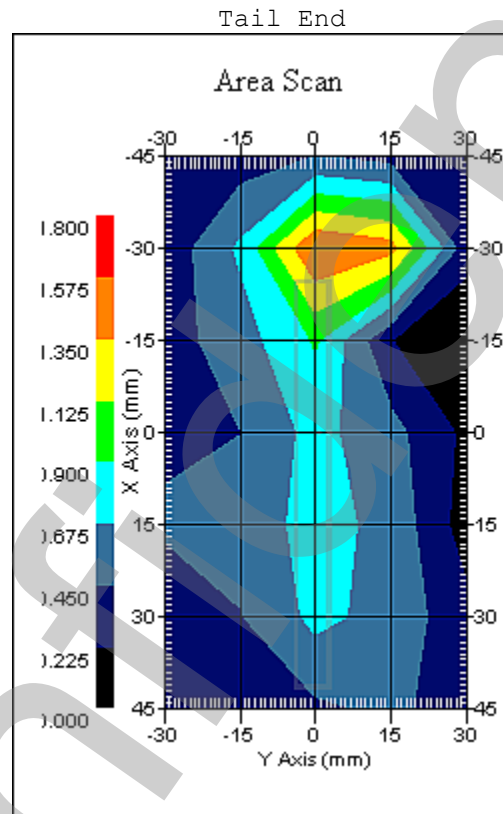
Name : Probe 215 - RFEL
Model : E020
Type : E-Field Triangle
Serial No. : 215
Last Calib. Date : 22-Sep-2010
Frequency : 1900.00 MHz
Duty Cycle Factor: 8
Conversion Factor: 5
Probe Sensitivity: 1.20 1.20 1.20 $\mu\text{V}/(\text{V}/\text{m})^2$
Compression Point: 95.00 mV
Offset : 1.56 mm

Measurement Data

Crest Factor : 8
Scan Type : Complete
Tissue Temp. : 20.00 °C
Ambient Temp. : 23.00 °C
Set-up Date : 04-Nov-2010
Set-up Time : 7:01:17 AM
Area Scan : 7x5x1 : Measurement x=15mm, y=15mm, z=4mm
Zoom Scan : 7x7x10 : Measurement x=4mm, y=4mm, z=2.5mm

Other Data

DUT Position : Left
Separation : 5 mm
Channel : Low



Connector End

1 gram SAR value : 0.898 W/kg
10 gram SAR value : 0.527 W/kg
Area Scan Peak SAR : 1.576 W/kg
Zoom Scan Peak SAR : 1.811 W/kg

SAR Test Report

By Operator : Jay
Measurement Date : 04-Nov-2010
Starting Time : 04-Nov-2010 10:18:27 AM
End Time : 04-Nov-2010 10:43:26 AM
Scanning Time : 1499 secs

Product Data

Device Name : Novatel Wireless
Serial No. : Unit 5
Mode : GPRS 1-Slot
Model : MC545
Frequency : 1900.00 MHz
Max. Transmit Pwr : 1 W
Drift Time : 0 min(s)
Length : 80 mm
Width : 9 mm
Depth : 30 mm
Antenna Type : Internal
Orientation : Left
Power Drift-Start : 0.816 W/kg
Power Drift-Finish: 0.835 W/kg
Power Drift (%) : 2.328

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 : 04-Nov-2010
Temperature : 20.00 °C
Ambient Temp. : 23.00 °C
Humidity : 36.00 RH%
Epsilon : 53.12 F/m
Sigma : 1.55 S/m
Density : 1000.00 kg/cu. m

Probe Data

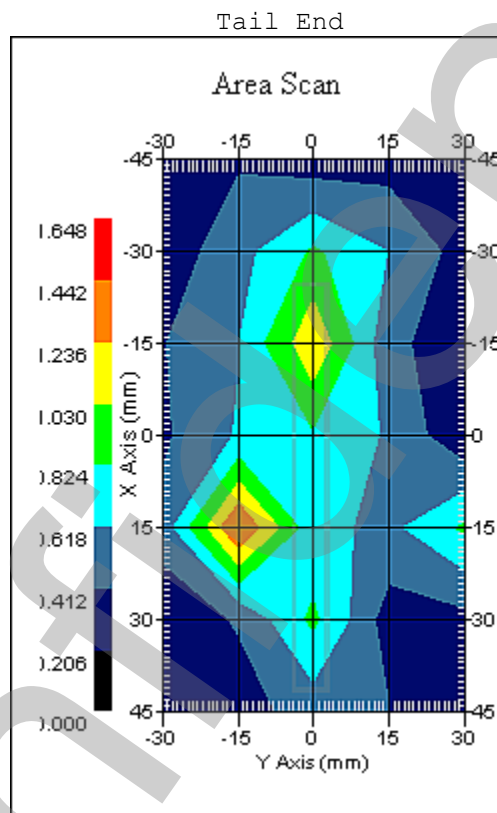
Name : Probe 215 - RFEL
Model : E020
Type : E-Field Triangle
Serial No. : 215
Last Calib. Date : 22-Sep-2010
Frequency : 1900.00 MHz
Duty Cycle Factor: 8
Conversion Factor: 5
Probe Sensitivity: 1.20 1.20 1.20 $\mu\text{V}/(\text{V}/\text{m})^2$
Compression Point: 95.00 mV
Offset : 1.56 mm

Measurement Data

Crest Factor : 8
Scan Type : Complete
Tissue Temp. : 20.00 °C
Ambient Temp. : 23.00 °C
Set-up Date : 04-Nov-2010
Set-up Time : 7:01:17 AM
Area Scan : 7x5x1 : Measurement x=15mm, y=15mm, z=4mm
Zoom Scan : 7x7x10 : Measurement x=4mm, y=4mm, z=2.5mm

Other Data

DUT Position : Left
Separation : 5 mm
Channel : Mid



Connector End

1 gram SAR value : 0.934 W/kg
10 gram SAR value : 0.543 W/kg
Area Scan Peak SAR : 1.444 W/kg
Zoom Scan Peak SAR : 2.092 W/kg

SAR Test Report

By Operator : Jay
Measurement Date : 04-Nov-2010
Starting Time : 04-Nov-2010 11:10:26 AM
End Time : 04-Nov-2010 11:34:31 AM
Scanning Time : 1445 secs

Product Data

Device Name : Novatel Wireless
Serial No. : Unit 5
Mode : GPRS 1-Slot
Model : MC545
Frequency : 1900.00 MHz
Max. Transmit Pwr : 1 W
Drift Time : 0 min(s)
Length : 80 mm
Width : 9 mm
Depth : 30 mm
Antenna Type : Internal
Orientation : Left
Power Drift-Start : 0.912 W/kg
Power Drift-Finish: 0.936 W/kg
Power Drift (%) : 2.637

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 : 04-Nov-2010
Temperature : 20.00 °C
Ambient Temp. : 23.00 °C
Humidity : 36.00 RH%
Epsilon : 53.12 F/m
Sigma : 1.55 S/m
Density : 1000.00 kg/cu. m

Probe Data

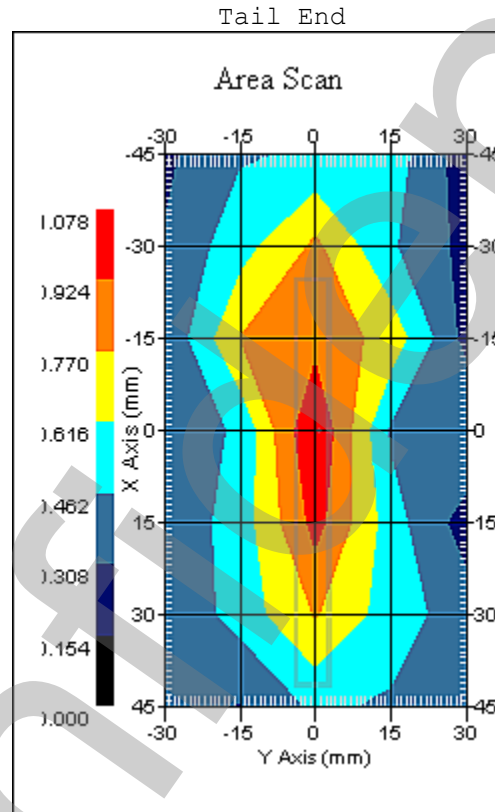
Name : Probe 215 - RFEL
Model : E020
Type : E-Field Triangle
Serial No. : 215
Last Calib. Date : 22-Sep-2010
Frequency : 1900.00 MHz
Duty Cycle Factor: 8
Conversion Factor: 5
Probe Sensitivity: 1.20 1.20 1.20 $\mu\text{V}/(\text{V}/\text{m})^2$
Compression Point: 95.00 mV
Offset : 1.56 mm

Measurement Data

Crest Factor : 8
Scan Type : Complete
Tissue Temp. : 20.00 °C
Ambient Temp. : 23.00 °C
Set-up Date : 04-Nov-2010
Set-up Time : 7:01:17 AM
Area Scan : 7x5x1 : Measurement x=15mm, y=15mm, z=4mm
Zoom Scan : 7x7x10 : Measurement x=4mm, y=4mm, z=2.5mm

Other Data

DUT Position : Left
Separation : 5 mm
Channel : High



Connector End

1 gram SAR value : 0.945 W/kg
10 gram SAR value : 0.577 W/kg
Area Scan Peak SAR : 1.075 W/kg
Zoom Scan Peak SAR : 0.300 W/kg

SAR Test Report

By Operator : Jay
Measurement Date : 03-Nov-2010
Starting Time : 03-Nov-2010 06:05:30 PM
End Time : 03-Nov-2010 06:30:30 PM
Scanning Time : 1500 secs

Product Data

Device Name : Novatel Wireless
Serial No. : Unit 5
Mode : GPRS 1-Slot
Model : MC545
Frequency : 1900.00 MHz
Max. Transmit Pwr : 1 W
Drift Time : 0 min(s)
Length : 9 mm
Width : 30 mm
Depth : 80 mm
Antenna Type : Internal
Orientation : Tip
Power Drift-Start : 0.223 W/kg
Power Drift-Finish: 0.231 W/kg
Power Drift (%) : 3.584

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 : 03-Nov-2010
Temperature : 20.00 °C
Ambient Temp. : 23.00 °C
Humidity : 36.00 RH%
Epsilon : 53.25 F/m
Sigma : 1.54 S/m
Density : 1000.00 kg/cu. m

Probe Data

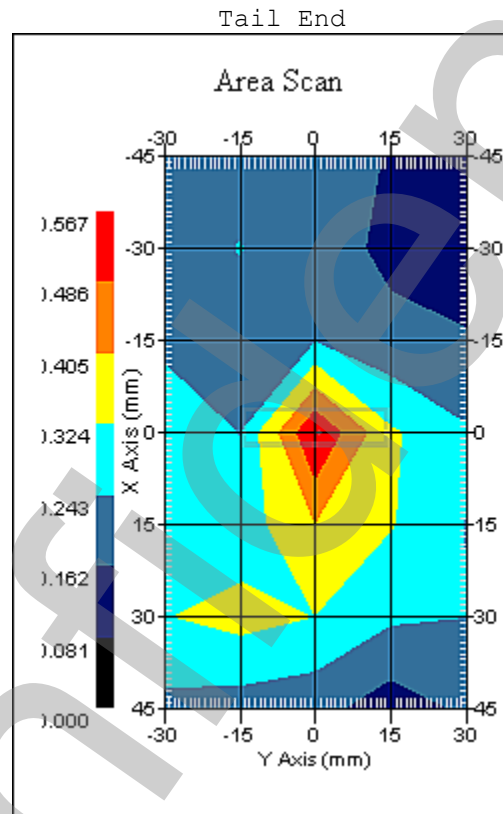
Name : Probe 215 - RFEL
Model : E020
Type : E-Field Triangle
Serial No. : 215
Last Calib. Date : 22-Sep-2010
Frequency : 1900.00 MHz
Duty Cycle Factor: 8
Conversion Factor: 5
Probe Sensitivity: 1.20 1.20 1.20 $\mu\text{V}/(\text{V}/\text{m})^2$
Compression Point: 95.00 mV
Offset : 1.56 mm

Measurement Data

Crest Factor : 8
Scan Type : Complete
Tissue Temp. : 20.00 °C
Ambient Temp. : 23.00 °C
Set-up Date : 03-Nov-2010
Set-up Time : 3:37:45 PM
Area Scan : 7x5x1 : Measurement x=15mm, y=15mm, z=4mm
Zoom Scan : 7x7x10 : Measurement x=4mm, y=4mm, z=2.5mm

Other Data

DUT Position : Tip
Separation : 5 mm
Channel : Mid



1 gram SAR value : 0.305 W/kg
10 gram SAR value : 0.265 W/kg
Area Scan Peak SAR : 0.566 W/kg
Zoom Scan Peak SAR : 0.580 W/kg

SAR Test Report

By Operator : Jay
Measurement Date : 04-Nov-2010
Starting Time : 04-Nov-2010 07:34:58 AM
End Time : 04-Nov-2010 07:59:39 AM
Scanning Time : 1481 secs

Product Data

Device Name : Novatel Wireless
Serial No. : Unit 5
Mode : WCDMA
Model : MC545
Frequency : 1900.00 MHz
Max. Transmit Pwr : 0.182 W
Drift Time : 0 min(s)
Length : 80 mm
Width : 30 mm
Depth : 9 mm
Antenna Type : Internal
Orientation : Top
Power Drift-Start : 0.994 W/kg
Power Drift-Finish: 1.038 W/kg
Power Drift (%) : 4.421

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 : 04-Nov-2010
Temperature : 20.00 °C
Ambient Temp. : 23.00 °C
Humidity : 36.00 RH%
Epsilon : 53.12 F/m
Sigma : 1.55 S/m
Density : 1000.00 kg/cu. m

Probe Data

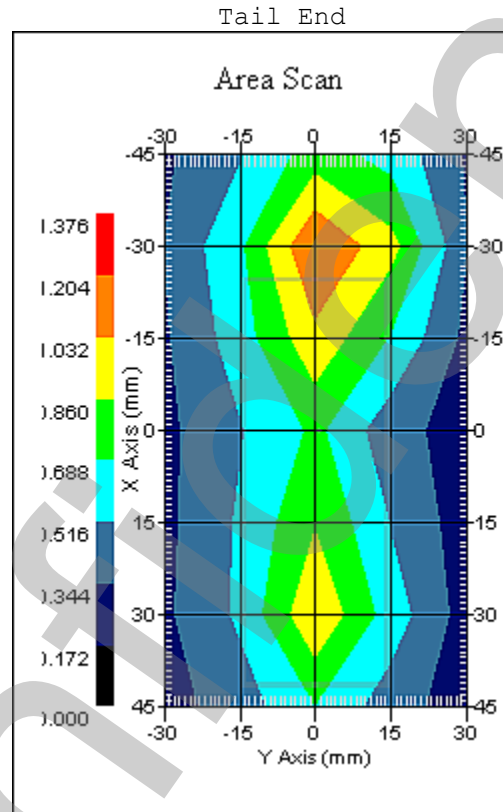
Name : Probe 215 - RFEL
Model : E020
Type : E-Field Triangle
Serial No. : 215
Last Calib. Date : 22-Sep-2010
Frequency : 1900.00 MHz
Duty Cycle Factor: 1
Conversion Factor: 5
Probe Sensitivity: 1.20 1.20 1.20 $\mu\text{V}/(\text{V}/\text{m})^2$
Compression Point: 95.00 mV
Offset : 1.56 mm

Measurement Data

Crest Factor : 1
Scan Type : Complete
Tissue Temp. : 20.00 °C
Ambient Temp. : 23.00 °C
Set-up Date : 04-Nov-2010
Set-up Time : 7:01:17 AM
Area Scan : 7x5x1 : Measurement x=15mm, y=15mm, z=4mm
Zoom Scan : 7x7x10 : Measurement x=4mm, y=4mm, z=2.5mm

Other Data

DUT Position : Top
Separation : 5 mm
Channel : Low



Connector End

1 gram SAR value : 1.150 W/kg
10 gram SAR value : 0.692 W/kg
Area Scan Peak SAR : 1.207 W/kg
Zoom Scan Peak SAR : 1.851 W/kg

SAR Test Report

By Operator : Jay
Measurement Date : 04-Nov-2010
Starting Time : 04-Nov-2010 07:06:21 AM
End Time : 04-Nov-2010 07:31:16 AM
Scanning Time : 1495 secs

Product Data

Device Name : Novatel Wireless
Serial No. : Unit 5
Mode : WCDMA
Model : MC545
Frequency : 1900.00 MHz
Max. Transmit Pwr : 0.182 W
Drift Time : 0 min(s)
Length : 80 mm
Width : 30 mm
Depth : 9 mm
Antenna Type : Internal
Orientation : Top
Power Drift-Start : 1.053 W/kg
Power Drift-Finish: 1.004 W/kg
Power Drift (%) : -4.694

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 : 04-Nov-2010
Temperature : 20.00 °C
Ambient Temp. : 23.00 °C
Humidity : 36.00 RH%
Epsilon : 53.12 F/m
Sigma : 1.55 S/m
Density : 1000.00 kg/cu. m

Probe Data

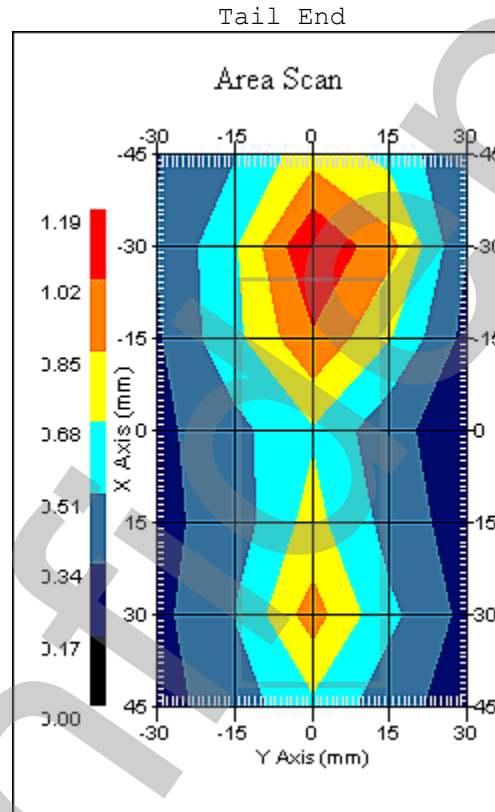
Name : Probe 215 - RFEL
Model : E020
Type : E-Field Triangle
Serial No. : 215
Last Calib. Date : 22-Sep-2010
Frequency : 1900.00 MHz
Duty Cycle Factor: 1
Conversion Factor: 5
Probe Sensitivity: 1.20 1.20 1.20 $\mu\text{V}/(\text{V}/\text{m})^2$
Compression Point: 95.00 mV
Offset : 1.56 mm

Measurement Data

Crest Factor : 1
Scan Type : Complete
Tissue Temp. : 20.00 °C
Ambient Temp. : 23.00 °C
Set-up Date : 04-Nov-2010
Set-up Time : 7:01:17 AM
Area Scan : 7x5x1 : Measurement x=15mm, y=15mm, z=4mm
Zoom Scan : 7x7x10 : Measurement x=4mm, y=4mm, z=2.5mm

Other Data

DUT Position : Top
Separation : 5 mm
Channel : Mid



1 gram SAR value : 1.124 W/kg
10 gram SAR value : 0.711 W/kg
Area Scan Peak SAR : 1.188 W/kg
Zoom Scan Peak SAR : 1.731 W/kg

SAR Test Report

By Operator : Jay
Measurement Date : 04-Nov-2010
Starting Time : 04-Nov-2010 08:03:02 AM
End Time : 04-Nov-2010 08:27:58 AM
Scanning Time : 1496 secs

Product Data

Device Name : Novatel Wireless
Serial No. : Unit 5
Mode : WCDMA
Model : MC545
Frequency : 1900.00 MHz
Max. Transmit Pwr : 0.182 W
Drift Time : 0 min(s)
Length : 80 mm
Width : 30 mm
Depth : 9 mm
Antenna Type : Internal
Orientation : Top
Power Drift-Start : 1.261 W/kg
Power Drift-Finish: 1.306 W/kg
Power Drift (%) : 3.612

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 : 04-Nov-2010
Temperature : 20.00 °C
Ambient Temp. : 23.00 °C
Humidity : 36.00 RH%
Epsilon : 53.12 F/m
Sigma : 1.55 S/m
Density : 1000.00 kg/cu. m

Probe Data

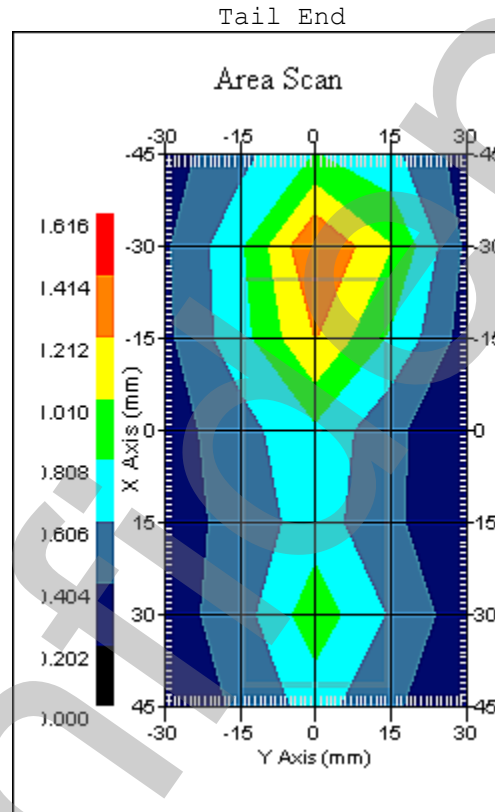
Name : Probe 215 - RFEL
Model : E020
Type : E-Field Triangle
Serial No. : 215
Last Calib. Date : 22-Sep-2010
Frequency : 1900.00 MHz
Duty Cycle Factor: 1
Conversion Factor: 5
Probe Sensitivity: 1.20 1.20 1.20 $\mu\text{V}/(\text{V}/\text{m})^2$
Compression Point: 95.00 mV
Offset : 1.56 mm

Measurement Data

Crest Factor : 1
Scan Type : Complete
Tissue Temp. : 20.00 °C
Ambient Temp. : 23.00 °C
Set-up Date : 04-Nov-2010
Set-up Time : 7:01:17 AM
Area Scan : 7x5x1 : Measurement x=15mm, y=15mm, z=4mm
Zoom Scan : 7x7x10 : Measurement x=4mm, y=4mm, z=2.5mm

Other Data

DUT Position : Top
Separation : 5 mm
Channel : High



1 gram SAR value : 1.286 W/kg
10 gram SAR value : 0.756 W/kg
Area Scan Peak SAR : 1.416 W/kg
Zoom Scan Peak SAR : 2.171 W/kg

SAR Test Report

By Operator : Jay
Measurement Date : 04-Nov-2010
Starting Time : 04-Nov-2010 12:55:10 PM
End Time : 04-Nov-2010 01:18:49 PM
Scanning Time : 1419 secs

Product Data

Device Name : Novatel Wireless
Serial No. : Unit 5
Mode : WCDMA
Model : MC545
Frequency : 1900.00 MHz
Max. Transmit Pwr : 0.182 W
Drift Time : 0 min(s)
Length : 80 mm
Width : 30 mm
Depth : 9 mm
Antenna Type : Internal
Orientation : Bottom
Power Drift-Start : 0.430 W/kg
Power Drift-Finish: 0.437 W/kg
Power Drift (%) : 1.619

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 : 04-Nov-2010
Temperature : 20.00 °C
Ambient Temp. : 23.00 °C
Humidity : 36.00 RH%
Epsilon : 53.12 F/m
Sigma : 1.55 S/m
Density : 1000.00 kg/cu. m

Probe Data

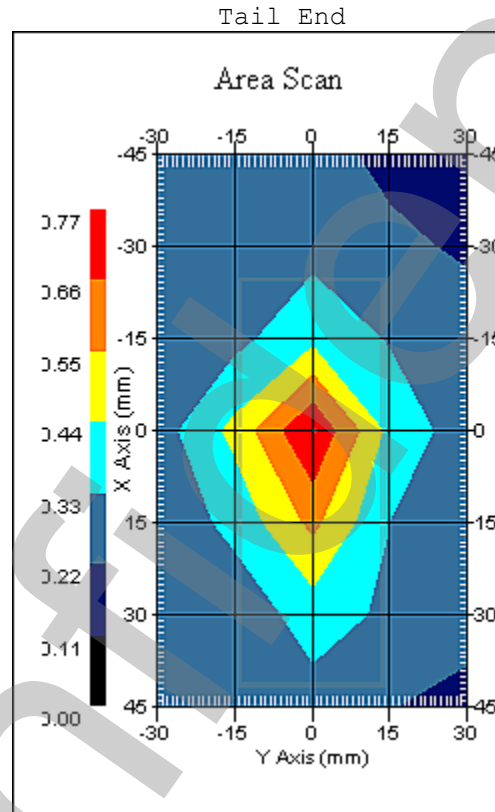
Name : Probe 215 - RFEL
Model : E020
Type : E-Field Triangle
Serial No. : 215
Last Calib. Date : 22-Sep-2010
Frequency : 1900.00 MHz
Duty Cycle Factor: 1
Conversion Factor: 5
Probe Sensitivity: 1.20 1.20 1.20 $\mu\text{V}/(\text{V}/\text{m})^2$
Compression Point: 95.00 mV
Offset : 1.56 mm

Measurement Data

Crest Factor : 1
Scan Type : Complete
Tissue Temp. : 20.00 °C
Ambient Temp. : 23.00 °C
Set-up Date : 04-Nov-2010
Set-up Time : 7:01:17 AM
Area Scan : 7x5x1 : Measurement x=15mm, y=15mm, z=4mm
Zoom Scan : 7x7x10 : Measurement x=4mm, y=4mm, z=2.5mm

Other Data

DUT Position : Bottom
Separation : 5 mm
Channel : Mid



1 gram SAR value : 0.697 W/kg
10 gram SAR value : 0.447 W/kg
Area Scan Peak SAR : 0.769 W/kg
Zoom Scan Peak SAR : 1.181 W/kg

SAR Test Report

By Operator : Jay
Measurement Date : 04-Nov-2010
Starting Time : 04-Nov-2010 08:56:43 AM
End Time : 04-Nov-2010 09:21:22 AM
Scanning Time : 1479 secs

Product Data

Device Name : Novatel Wireless
Serial No. : Unit 5
Mode : WCDMA
Model : MC545
Frequency : 1900.00 MHz
Max. Transmit Pwr : 0.182 W
Drift Time : 0 min(s)
Length : 80 mm
Width : 9 mm
Depth : 30 mm
Antenna Type : Internal
Orientation : Right
Power Drift-Start : 0.922 W/kg
Power Drift-Finish: 0.920 W/kg
Power Drift (%) : -0.300

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 : 04-Nov-2010
Temperature : 20.00 °C
Ambient Temp. : 23.00 °C
Humidity : 36.00 RH%
Epsilon : 53.12 F/m
Sigma : 1.55 S/m
Density : 1000.00 kg/cu. m

Probe Data

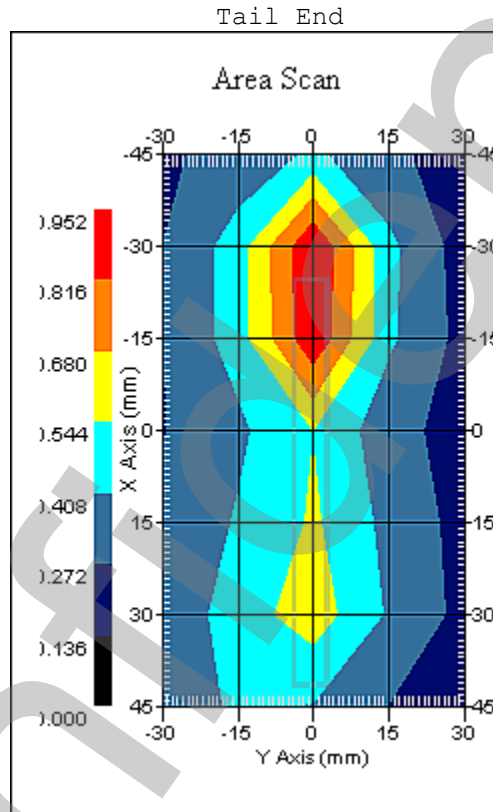
Name : Probe 215 - RFEL
Model : E020
Type : E-Field Triangle
Serial No. : 215
Last Calib. Date : 22-Sep-2010
Frequency : 1900.00 MHz
Duty Cycle Factor: 1
Conversion Factor: 5
Probe Sensitivity: 1.20 1.20 1.20 $\mu\text{V}/(\text{V}/\text{m})^2$
Compression Point: 95.00 mV
Offset : 1.56 mm

Measurement Data

Crest Factor : 1
Scan Type : Complete
Tissue Temp. : 20.00 °C
Ambient Temp. : 23.00 °C
Set-up Date : 04-Nov-2010
Set-up Time : 7:01:17 AM
Area Scan : 7x5x1 : Measurement x=15mm, y=15mm, z=4mm
Zoom Scan : 7x7x10 : Measurement x=4mm, y=4mm, z=2.5mm

Other Data

DUT Position : Right
Separation : 5 mm
Channel : Low



1 gram SAR value : 0.944 W/kg
10 gram SAR value : 0.553 W/kg
Area Scan Peak SAR : 0.950 W/kg
Zoom Scan Peak SAR : 1.641 W/kg

SAR Test Report

By Operator : Jay
Measurement Date : 04-Nov-2010
Starting Time : 04-Nov-2010 08:30:38 AM
End Time : 04-Nov-2010 08:55:16 AM
Scanning Time : 1478 secs

Product Data

Device Name : Novatel Wireless
Serial No. : Unit 5
Mode : WCDMA
Model : MC545
Frequency : 1900.00 MHz
Max. Transmit Pwr : 0.182 W
Drift Time : 0 min(s)
Length : 80 mm
Width : 9 mm
Depth : 30 mm
Antenna Type : Internal
Orientation : Right
Power Drift-Start : 0.899 W/kg
Power Drift-Finish: 0.876 W/kg
Power Drift (%) : -2.515

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 : 04-Nov-2010
Temperature : 20.00 °C
Ambient Temp. : 23.00 °C
Humidity : 36.00 RH%
Epsilon : 53.12 F/m
Sigma : 1.55 S/m
Density : 1000.00 kg/cu. m

Probe Data

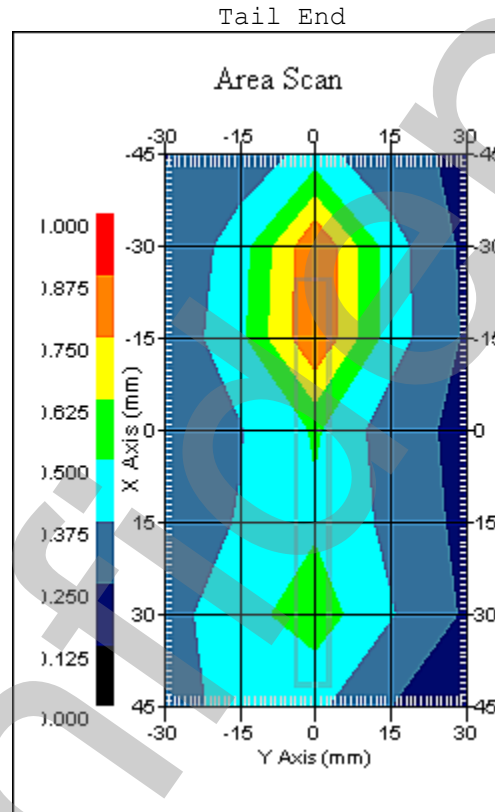
Name : Probe 215 - RFEL
Model : E020
Type : E-Field Triangle
Serial No. : 215
Last Calib. Date : 22-Sep-2010
Frequency : 1900.00 MHz
Duty Cycle Factor: 1
Conversion Factor: 5
Probe Sensitivity: 1.20 1.20 1.20 $\mu\text{V}/(\text{V}/\text{m})^2$
Compression Point: 95.00 mV
Offset : 1.56 mm

Measurement Data

Crest Factor : 1
Scan Type : Complete
Tissue Temp. : 20.00 °C
Ambient Temp. : 23.00 °C
Set-up Date : 04-Nov-2010
Set-up Time : 7:01:17 AM
Area Scan : 7x5x1 : Measurement x=15mm, y=15mm, z=4mm
Zoom Scan : 7x7x10 : Measurement x=4mm, y=4mm, z=2.5mm

Other Data

DUT Position : Right
Separation : 5 mm
Channel : Mid



1 gram SAR value : 0.901 W/kg
10 gram SAR value : 0.543 W/kg
Area Scan Peak SAR : 0.877 W/kg
Zoom Scan Peak SAR : 1.591 W/kg

SAR Test Report

By Operator : Jay
Measurement Date : 04-Nov-2010
Starting Time : 04-Nov-2010 09:23:49 AM
End Time : 04-Nov-2010 09:48:28 AM
Scanning Time : 1479 secs

Product Data

Device Name : Novatel Wireless
Serial No. : Unit 5
Mode : WCDMA
Model : MC545
Frequency : 1900.00 MHz
Max. Transmit Pwr : 0.182 W
Drift Time : 0 min(s)
Length : 80 mm
Width : 9 mm
Depth : 30 mm
Antenna Type : Internal
Orientation : Right
Power Drift-Start : 0.998 W/kg
Power Drift-Finish: 1.041 W/kg
Power Drift (%) : 4.268

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 : 04-Nov-2010
Temperature : 20.00 °C
Ambient Temp. : 23.00 °C
Humidity : 36.00 RH%
Epsilon : 53.12 F/m
Sigma : 1.55 S/m
Density : 1000.00 kg/cu. m

Probe Data

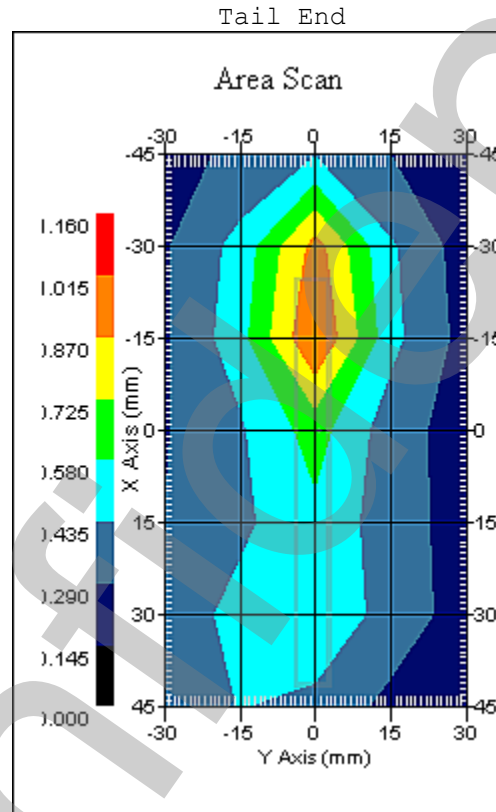
Name : Probe 215 - RFEL
Model : E020
Type : E-Field Triangle
Serial No. : 215
Last Calib. Date : 22-Sep-2010
Frequency : 1900.00 MHz
Duty Cycle Factor: 1
Conversion Factor: 5
Probe Sensitivity: 1.20 1.20 1.20 $\mu\text{V}/(\text{V}/\text{m})^2$
Compression Point: 95.00 mV
Offset : 1.56 mm

Measurement Data

Crest Factor : 1
Scan Type : Complete
Tissue Temp. : 20.00 °C
Ambient Temp. : 23.00 °C
Set-up Date : 04-Nov-2010
Set-up Time : 7:01:17 AM
Area Scan : 7x5x1 : Measurement x=15mm, y=15mm, z=4mm
Zoom Scan : 7x7x10 : Measurement x=4mm, y=4mm, z=2.5mm

Other Data

DUT Position : Right
Separation : 5 mm
Channel : High



Connector End

1 gram SAR value : 1.000 W/kg
10 gram SAR value : 0.592 W/kg
Area Scan Peak SAR : 1.016 W/kg
Zoom Scan Peak SAR : 1.751 W/kg

SAR Test Report

By Operator : Jay
Measurement Date : 04-Nov-2010
Starting Time : 04-Nov-2010 12:01:31 PM
End Time : 04-Nov-2010 12:25:25 PM
Scanning Time : 1434 secs

Product Data

Device Name : Novatel Wireless
Serial No. : Unit 5
Mode : WCDMA
Model : MC545
Frequency : 1900.00 MHz
Max. Transmit Pwr : 0.182 W
Drift Time : 0 min(s)
Length : 80 mm
Width : 9 mm
Depth : 30 mm
Antenna Type : Internal
Orientation : Left
Power Drift-Start : 1.304 W/kg
Power Drift-Finish: 1.303 W/kg
Power Drift (%) : -0.031

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 : 04-Nov-2010
Temperature : 20.00 °C
Ambient Temp. : 23.00 °C
Humidity : 36.00 RH%
Epsilon : 53.12 F/m
Sigma : 1.55 S/m
Density : 1000.00 kg/cu. m

Probe Data

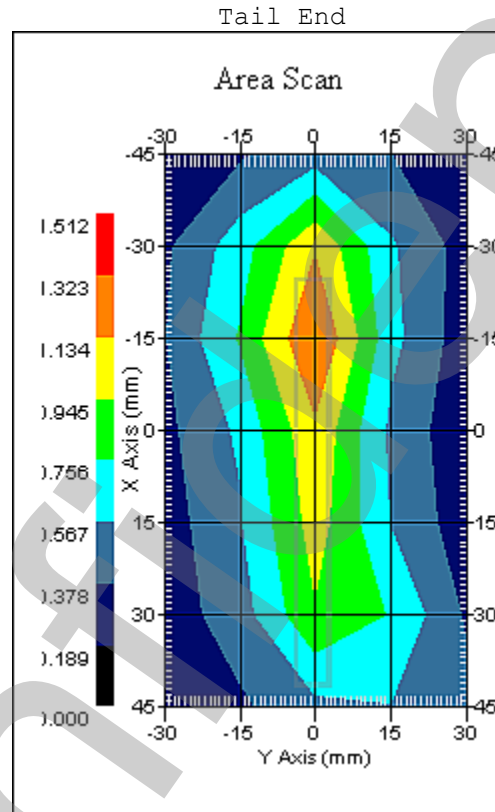
Name : Probe 215 - RFEL
Model : E020
Type : E-Field Triangle
Serial No. : 215
Last Calib. Date : 22-Sep-2010
Frequency : 1900.00 MHz
Duty Cycle Factor: 1
Conversion Factor: 5
Probe Sensitivity: 1.20 1.20 1.20 $\mu\text{V}/(\text{V}/\text{m})^2$
Compression Point: 95.00 mV
Offset : 1.56 mm

Measurement Data

Crest Factor : 1
Scan Type : Complete
Tissue Temp. : 20.00 °C
Ambient Temp. : 23.00 °C
Set-up Date : 04-Nov-2010
Set-up Time : 7:01:17 AM
Area Scan : 7x5x1 : Measurement x=15mm, y=15mm, z=4mm
Zoom Scan : 7x7x10 : Measurement x=4mm, y=4mm, z=2.5mm

Other Data

DUT Position : Left
Separation : 5 mm
Channel : Low



1 gram SAR value : 1.187 W/kg
10 gram SAR value : 0.719 W/kg
Area Scan Peak SAR : 1.325 W/kg
Zoom Scan Peak SAR : 1.951 W/kg

SAR Test Report

By Operator : Jay
Measurement Date : 04-Nov-2010
Starting Time : 04-Nov-2010 11:36:22 AM
End Time : 04-Nov-2010 12:00:02 PM
Scanning Time : 1420 secs

Product Data

Device Name : Novatel Wireless
Serial No. : Unit 5
Mode : WCDMA
Model : MC545
Frequency : 1900.00 MHz
Max. Transmit Pwr : 0.182 W
Drift Time : 0 min(s)
Length : 80 mm
Width : 9 mm
Depth : 30 mm
Antenna Type : Internal
Orientation : Left
Power Drift-Start : 1.302 W/kg
Power Drift-Finish: 1.300 W/kg
Power Drift (%) : -0.112

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 : 04-Nov-2010
Temperature : 20.00 °C
Ambient Temp. : 23.00 °C
Humidity : 36.00 RH%
Epsilon : 53.12 F/m
Sigma : 1.55 S/m
Density : 1000.00 kg/cu. m

Probe Data

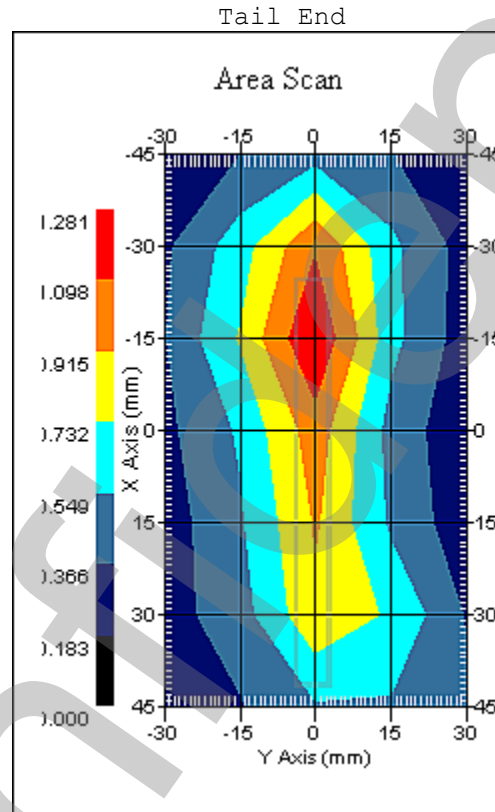
Name : Probe 215 - RFEL
Model : E020
Type : E-Field Triangle
Serial No. : 215
Last Calib. Date : 22-Sep-2010
Frequency : 1900.00 MHz
Duty Cycle Factor: 1
Conversion Factor: 5
Probe Sensitivity: 1.20 1.20 1.20 $\mu\text{V}/(\text{V}/\text{m})^2$
Compression Point: 95.00 mV
Offset : 1.56 mm

Measurement Data

Crest Factor : 1
Scan Type : Complete
Tissue Temp. : 20.00 °C
Ambient Temp. : 23.00 °C
Set-up Date : 04-Nov-2010
Set-up Time : 7:01:17 AM
Area Scan : 7x5x1 : Measurement x=15mm, y=15mm, z=4mm
Zoom Scan : 7x7x10 : Measurement x=4mm, y=4mm, z=2.5mm

Other Data

DUT Position : Left
Separation : 5 mm
Channel : Mid



Connector End

1 gram SAR value : 1.192 W/kg
10 gram SAR value : 0.719 W/kg
Area Scan Peak SAR : 1.280 W/kg
Zoom Scan Peak SAR : 1.981 W/kg

SAR Test Report

By Operator : Jay
Measurement Date : 04-Nov-2010
Starting Time : 04-Nov-2010 12:27:39 PM
End Time : 04-Nov-2010 12:51:23 PM
Scanning Time : 1424 secs

Product Data

Device Name : Novatel Wireless
Serial No. : Unit 5
Mode : WCDMA
Model : MC545
Frequency : 1900.00 MHz
Max. Transmit Pwr : 0.182 W
Drift Time : 0 min(s)
Length : 80 mm
Width : 9 mm
Depth : 30 mm
Antenna Type : Internal
Orientation : Left
Power Drift-Start : 1.487 W/kg
Power Drift-Finish: 1.523 W/kg
Power Drift (%) : 2.443

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 : 04-Nov-2010
Temperature : 20.00 °C
Ambient Temp. : 23.00 °C
Humidity : 36.00 RH%
Epsilon : 53.12 F/m
Sigma : 1.55 S/m
Density : 1000.00 kg/cu. m

Probe Data

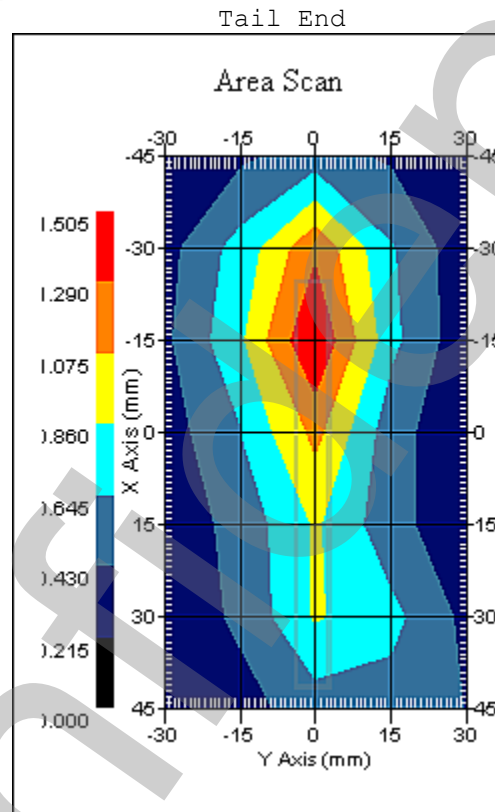
Name : Probe 215 - RFEL
Model : E020
Type : E-Field Triangle
Serial No. : 215
Last Calib. Date : 22-Sep-2010
Frequency : 1900.00 MHz
Duty Cycle Factor: 1
Conversion Factor: 5
Probe Sensitivity: 1.20 1.20 1.20 $\mu\text{V}/(\text{V}/\text{m})^2$
Compression Point: 95.00 mV
Offset : 1.56 mm

Measurement Data

Crest Factor : 1
Scan Type : Complete
Tissue Temp. : 20.00 °C
Ambient Temp. : 23.00 °C
Set-up Date : 04-Nov-2010
Set-up Time : 7:01:17 AM
Area Scan : 7x5x1 : Measurement x=15mm, y=15mm, z=4mm
Zoom Scan : 7x7x10 : Measurement x=4mm, y=4mm, z=2.5mm

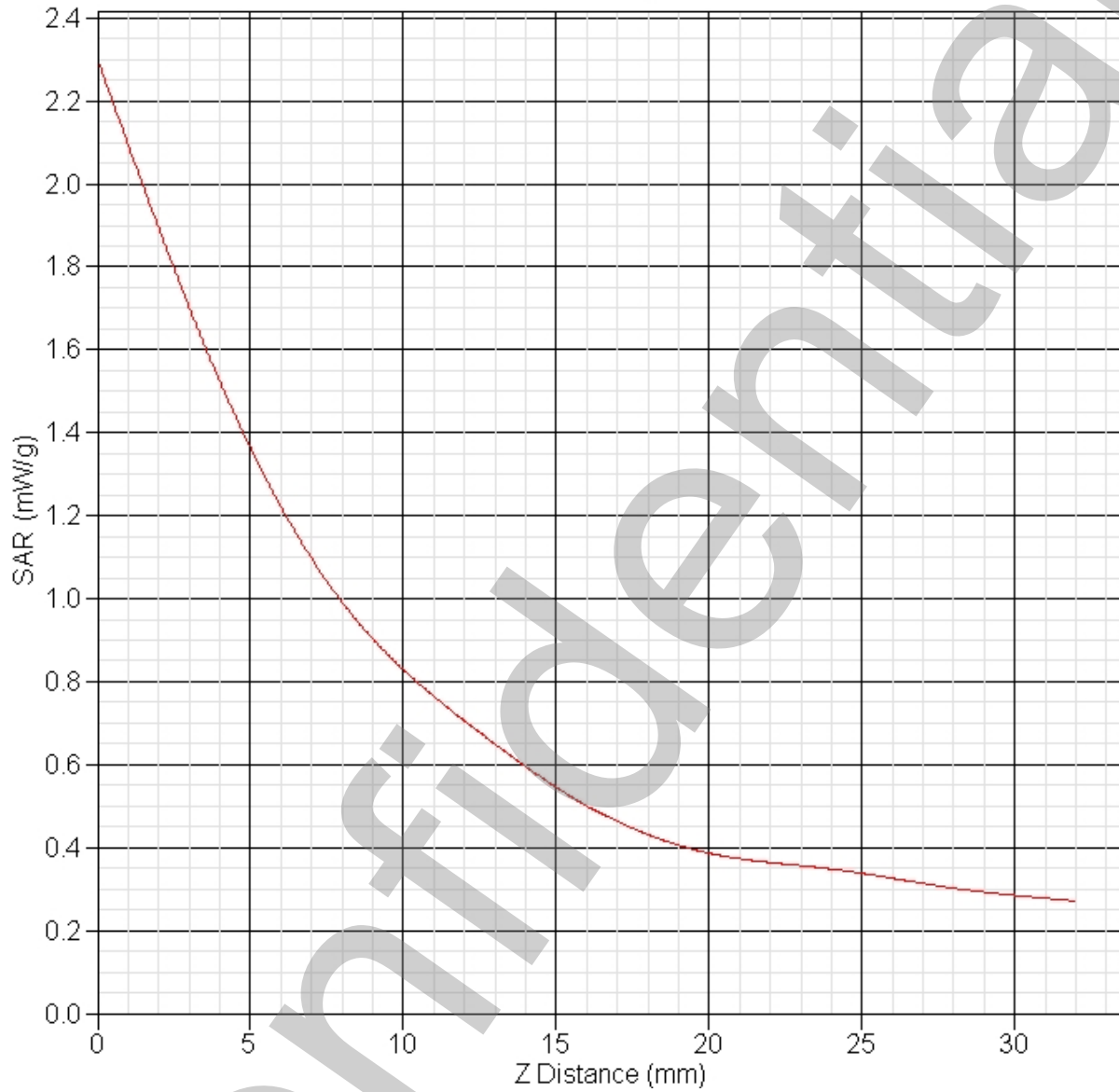
Other Data

DUT Position : Left
Separation : 5 mm
Channel : High



1 gram SAR value : 1.384 W/kg
10 gram SAR value : 0.812 W/kg
Area Scan Peak SAR : 1.503 W/kg
Zoom Scan Peak SAR : 2.302 W/kg

SAR-Z Axis
at Hotspot x:0.04 y:-0.14



SAR Test Report

By Operator : Jay
Measurement Date : 04-Nov-2010
Starting Time : 04-Nov-2010 01:50:15 PM
End Time : 04-Nov-2010 02:14:09 PM
Scanning Time : 1434 secs

Product Data

Device Name : Novatel Wireless
Serial No. : Unit 5
Mode : WCDMA
Model : MC545
Frequency : 1900.00 MHz
Max. Transmit Pwr : 0.182 W
Drift Time : 0 min(s)
Length : 9 mm
Width : 30 mm
Depth : 80 mm
Antenna Type : Internal
Orientation : Tip
Power Drift-Start : 0.341 W/kg
Power Drift-Finish: 0.350 W/kg
Power Drift (%) : 2.630

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 : 04-Nov-2010
Temperature : 20.00 °C
Ambient Temp. : 23.00 °C
Humidity : 36.00 RH%
Epsilon : 53.12 F/m
Sigma : 1.55 S/m
Density : 1000.00 kg/cu. m

Probe Data

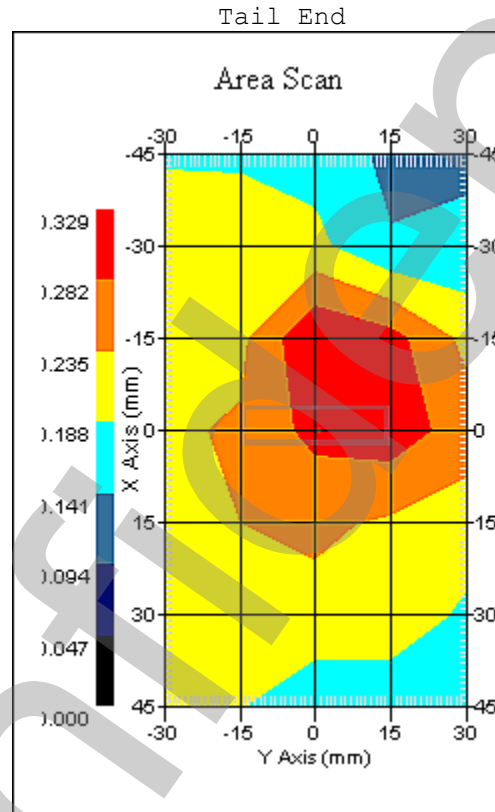
Name : Probe 215 - RFEL
Model : E020
Type : E-Field Triangle
Serial No. : 215
Last Calib. Date : 22-Sep-2010
Frequency : 1900.00 MHz
Duty Cycle Factor: 1
Conversion Factor: 5
Probe Sensitivity: 1.20 1.20 1.20 $\mu\text{V}/(\text{V}/\text{m})^2$
Compression Point: 95.00 mV
Offset : 1.56 mm

Measurement Data

Crest Factor : 1
Scan Type : Complete
Tissue Temp. : 20.00 °C
Ambient Temp. : 23.00 °C
Set-up Date : 04-Nov-2010
Set-up Time : 7:01:17 AM
Area Scan : 7x5x1 : Measurement x=15mm, y=15mm, z=4mm
Zoom Scan : 7x7x10 : Measurement x=4mm, y=4mm, z=2.5mm

Other Data

DUT Position : Tip
Separation : 5 mm
Channel : Mid



1 gram SAR value : 0.272 W/kg
10 gram SAR value : 0.226 W/kg
Area Scan Peak SAR : 0.327 W/kg
Zoom Scan Peak SAR : 0.400 W/kg

Appendix D – Probe Calibration Data Sheets

Confidential

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.

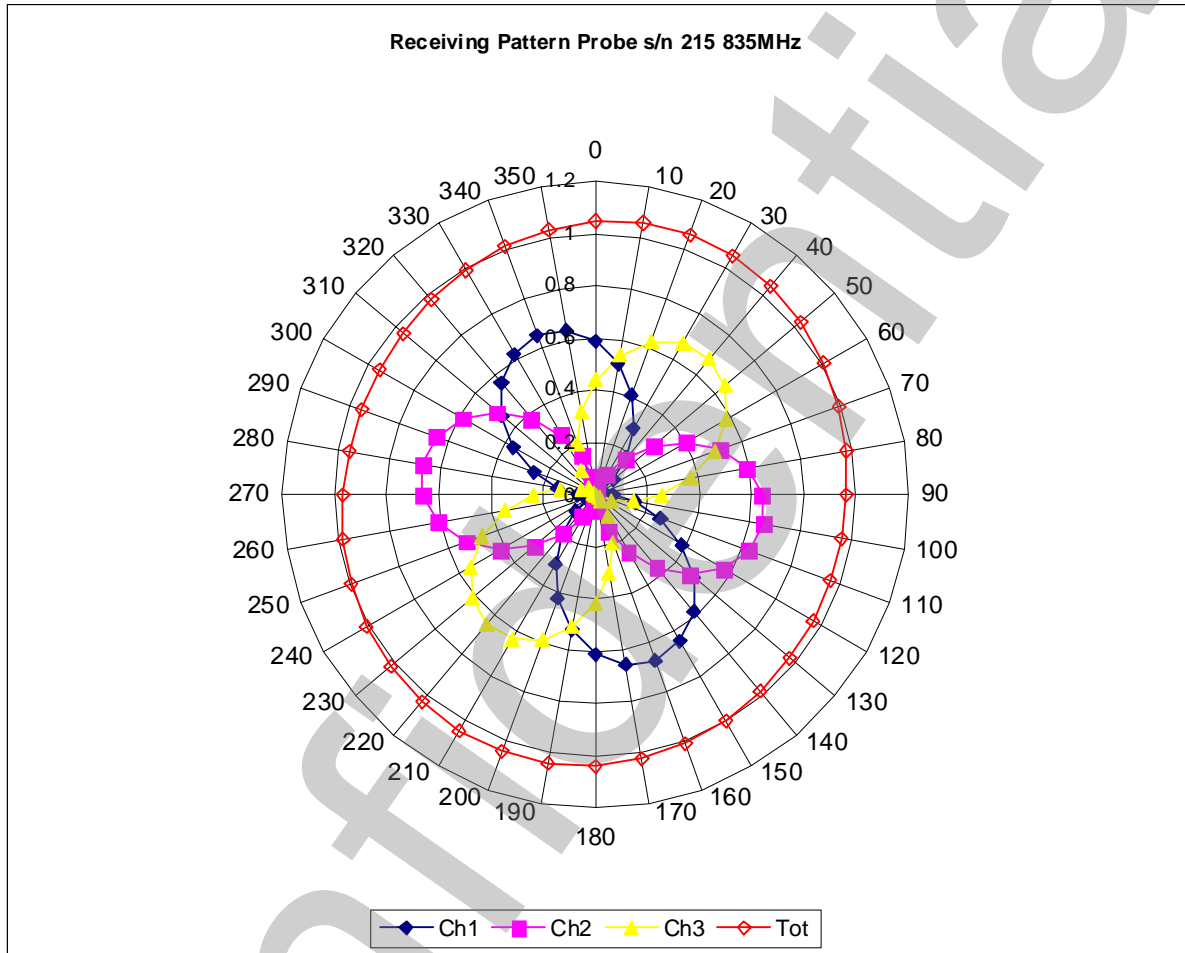
Boundary Effect:

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.

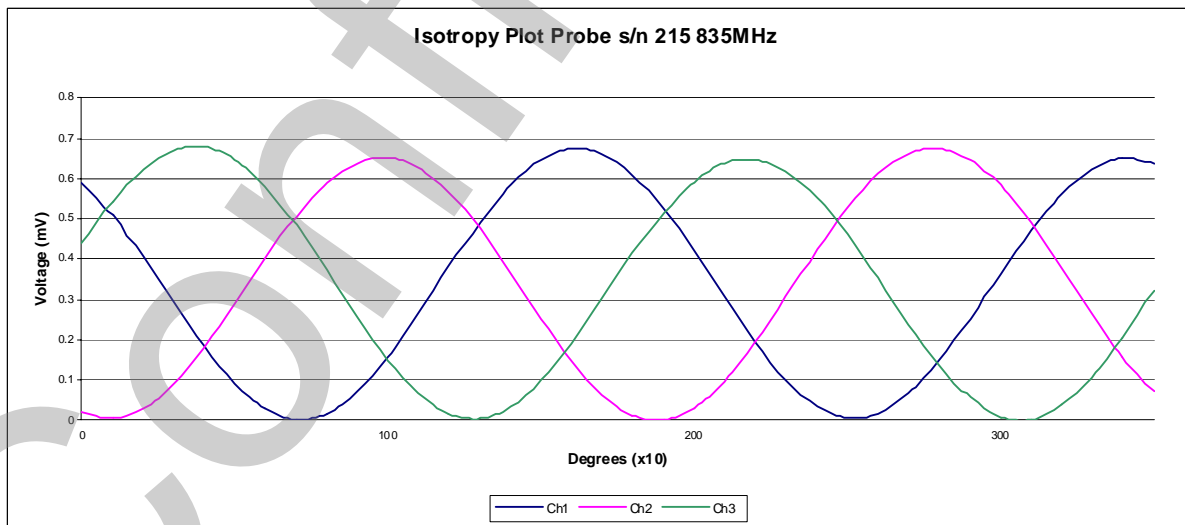
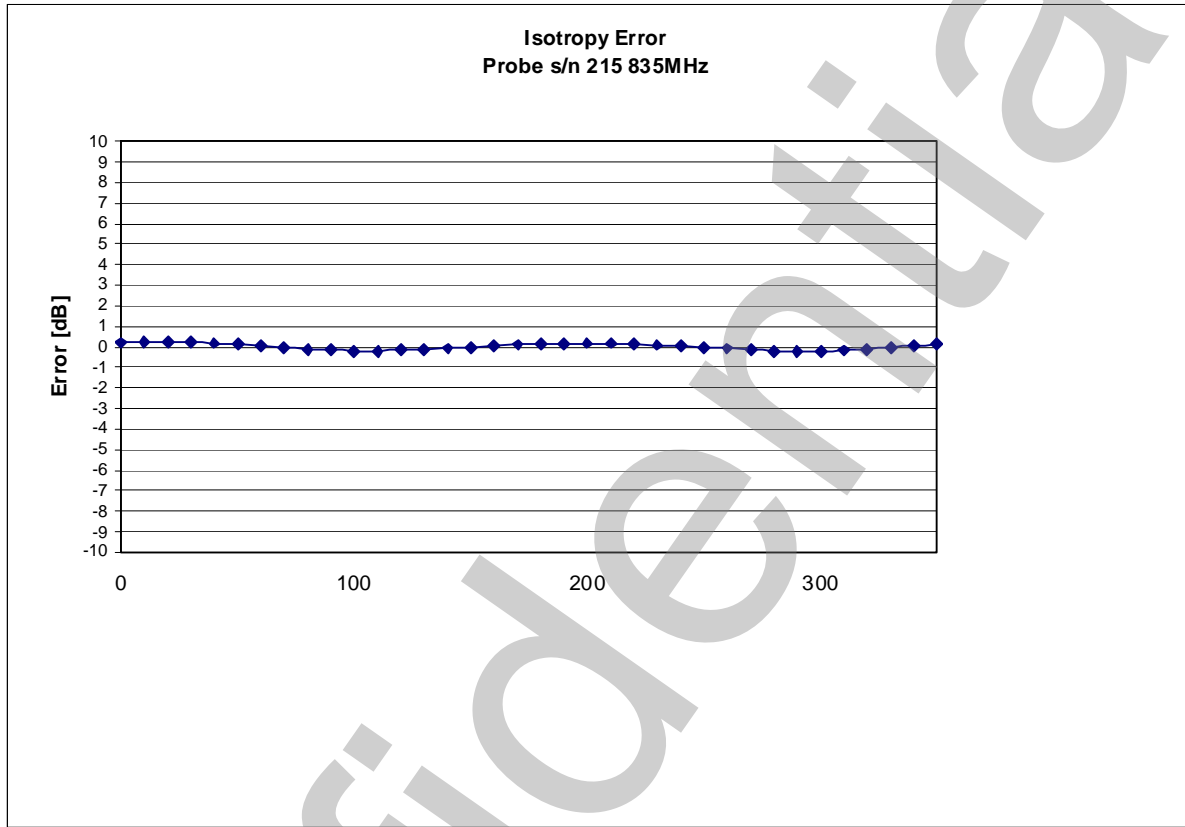
Spatial Resolution:

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)



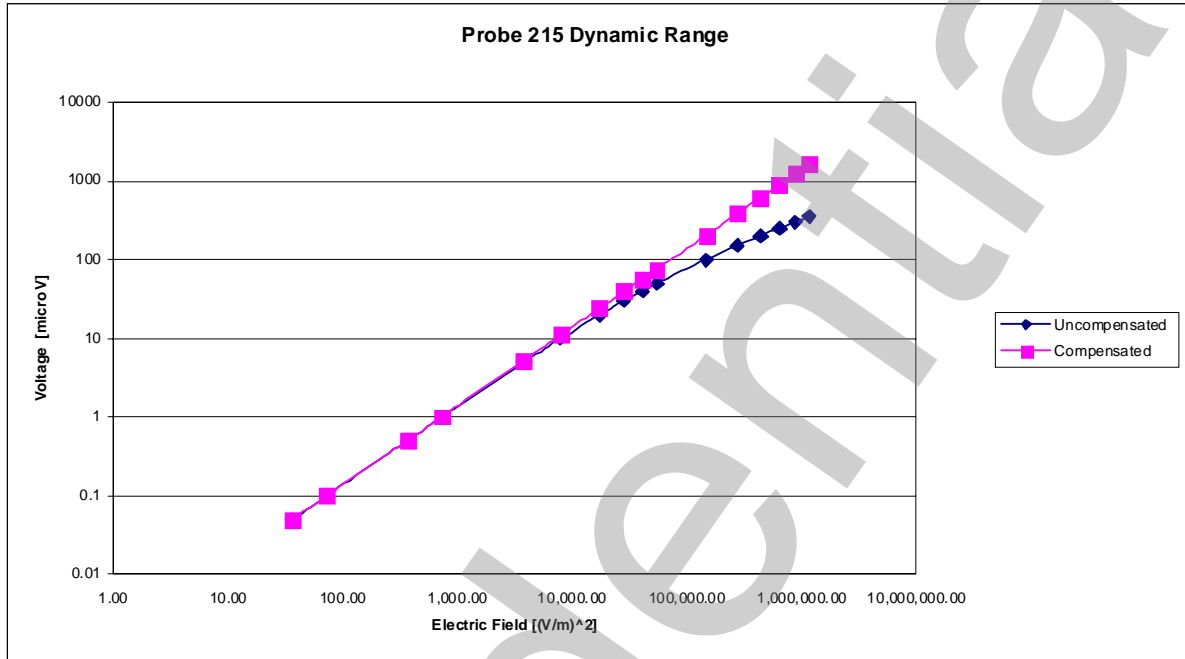
Isotropy Error 835 MHz (Air)



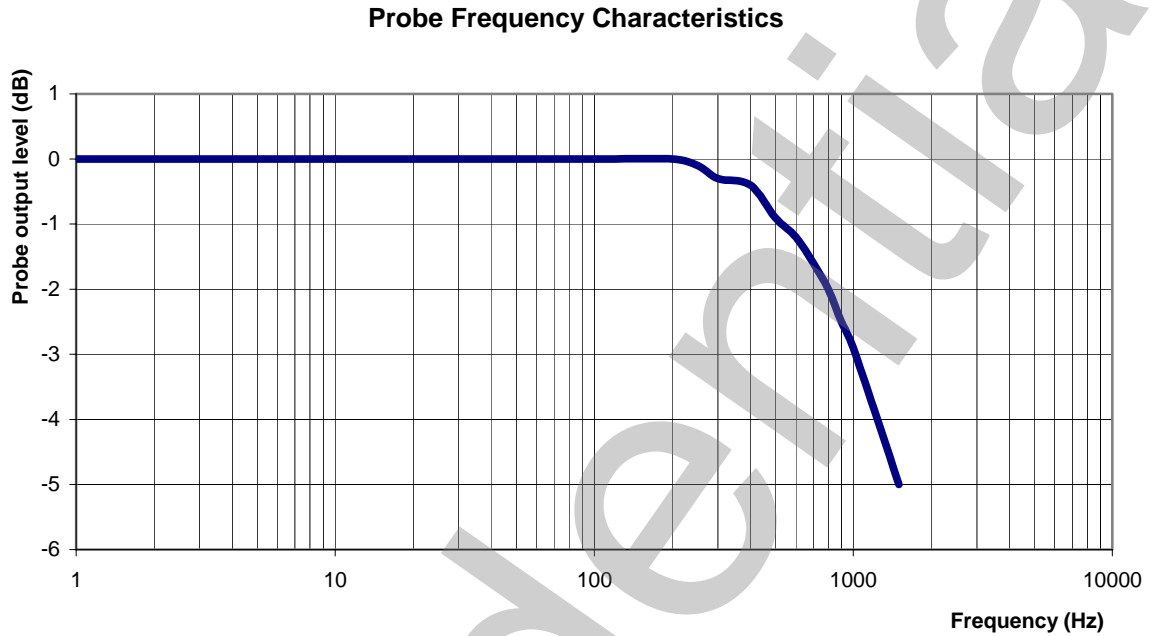
Isotropicity Tissue:

0.10 dB

Dynamic Range



Video Bandwidth



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 M Ω .

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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Confidential

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.

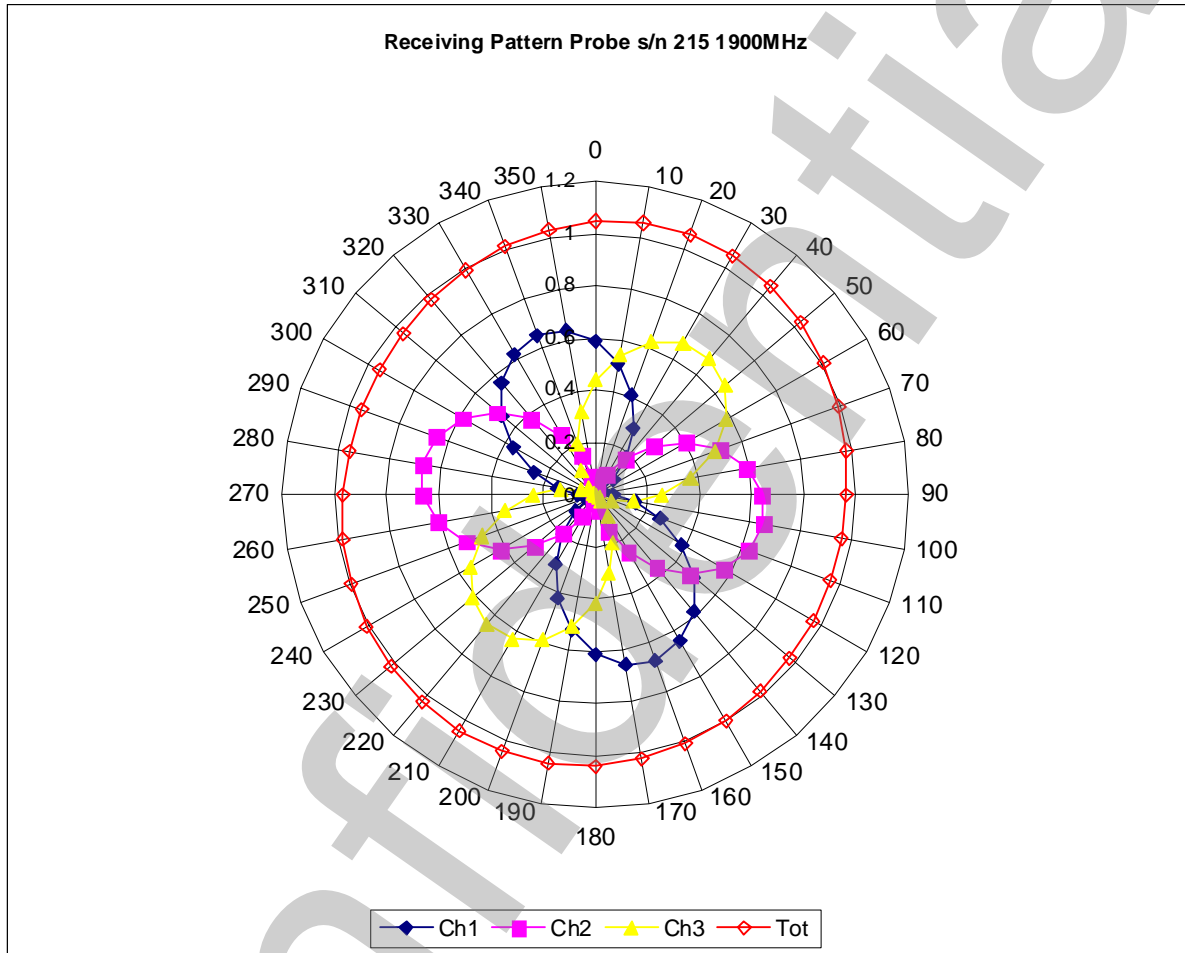
Boundary Effect:

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.

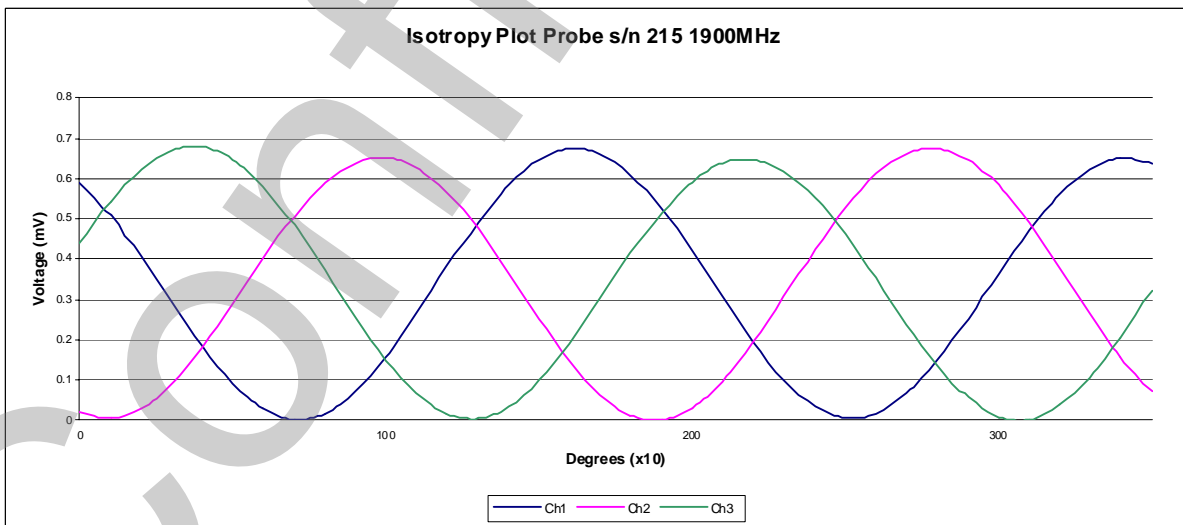
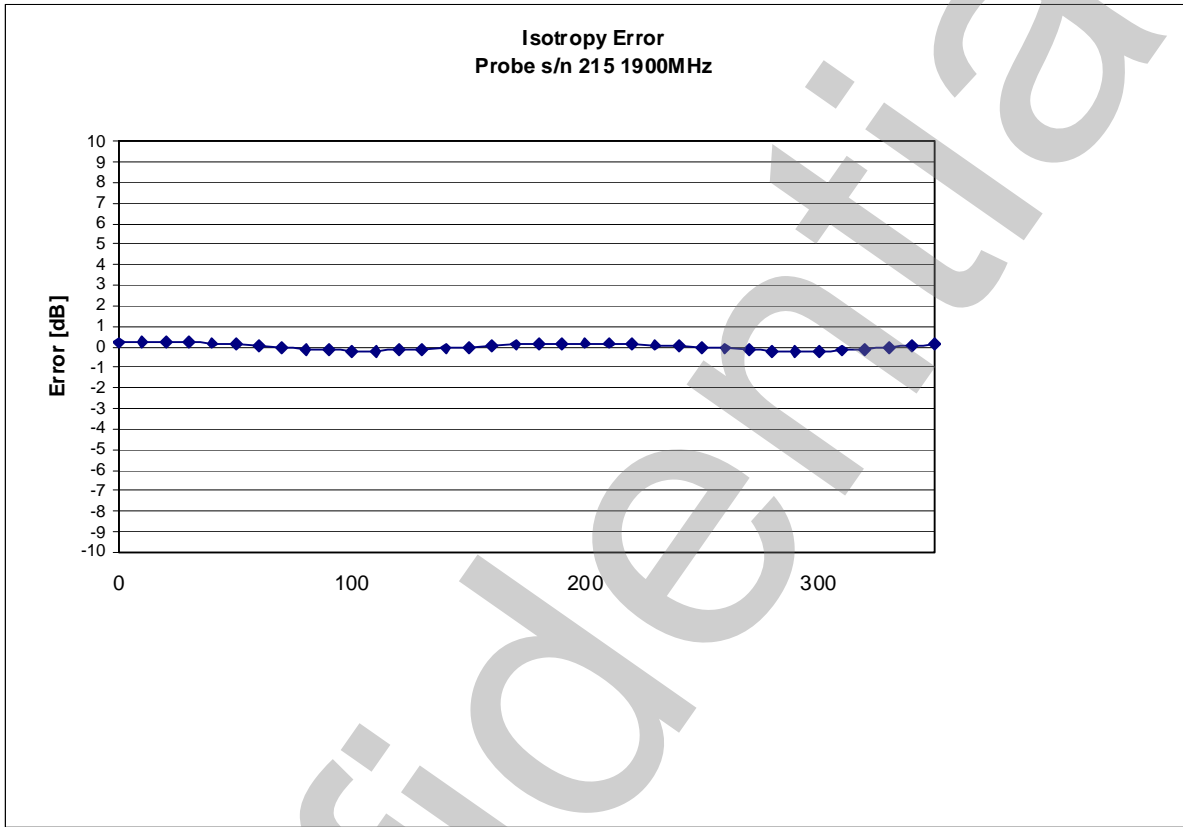
Spatial Resolution:

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)



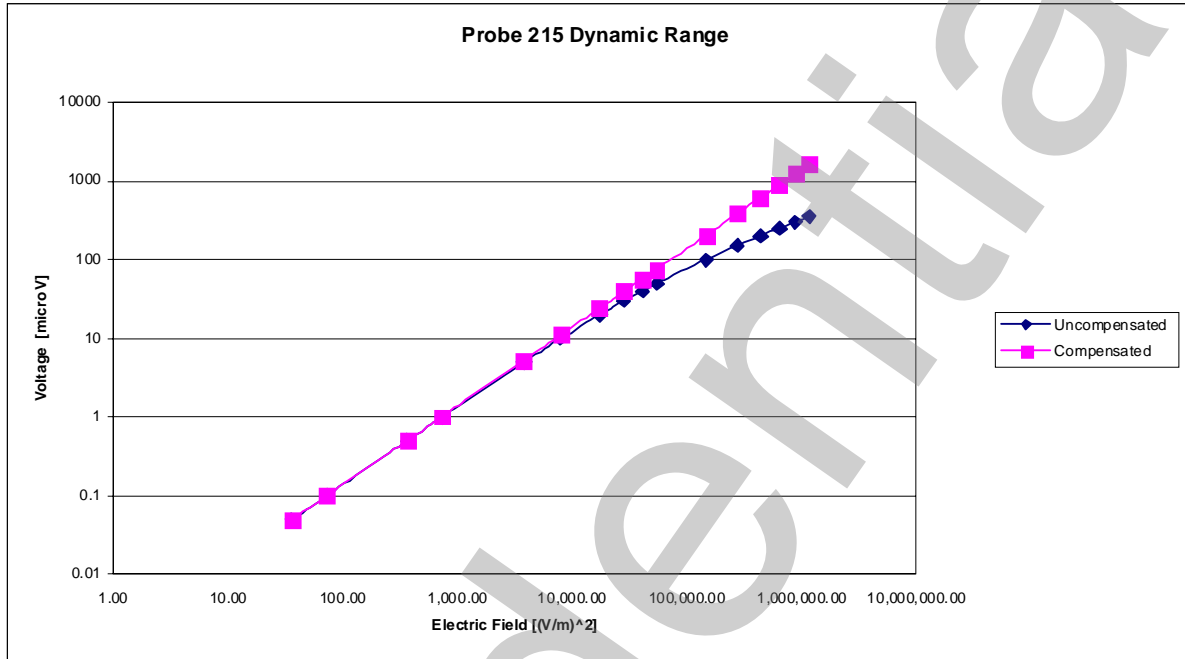
Isotropy Error 1900 MHz (Air)



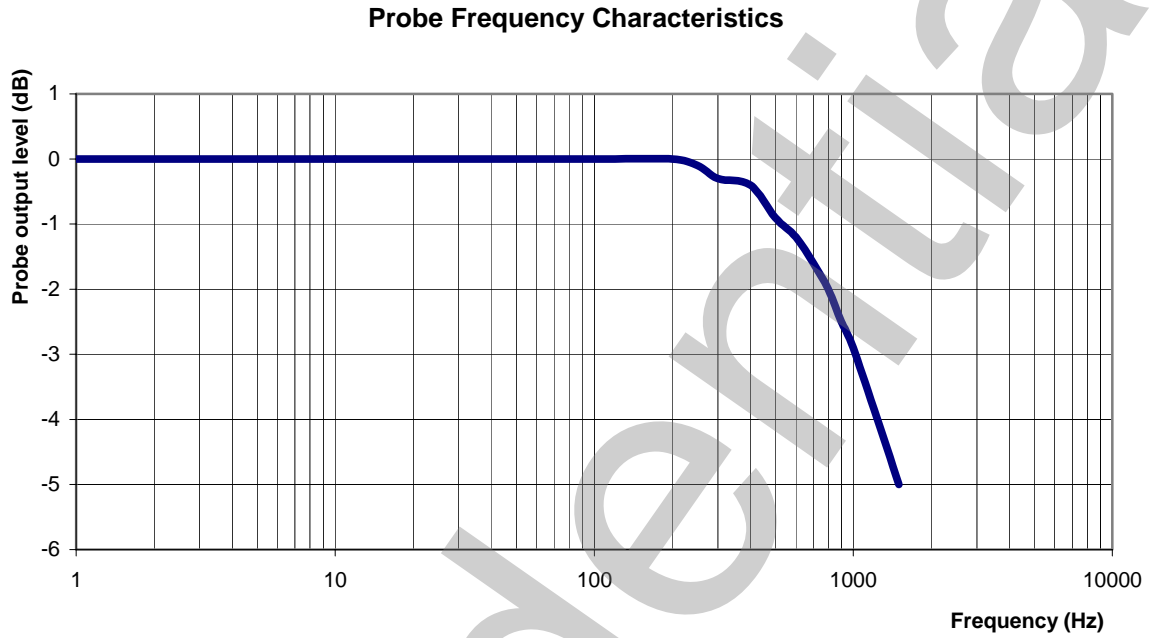
Isotropicity Tissue:

0.10 dB

Dynamic Range



Video Bandwidth



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 M Ω .

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.

Confidential

Appendix E – Dipole Calibration Data Sheets

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NCL CALIBRATION LABORATORIES

Calibration File No: DC-1114
Project Number: RFEL-835-Dipole-5480

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

Calibrated: 14th January 2010
Released on: 19th January 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

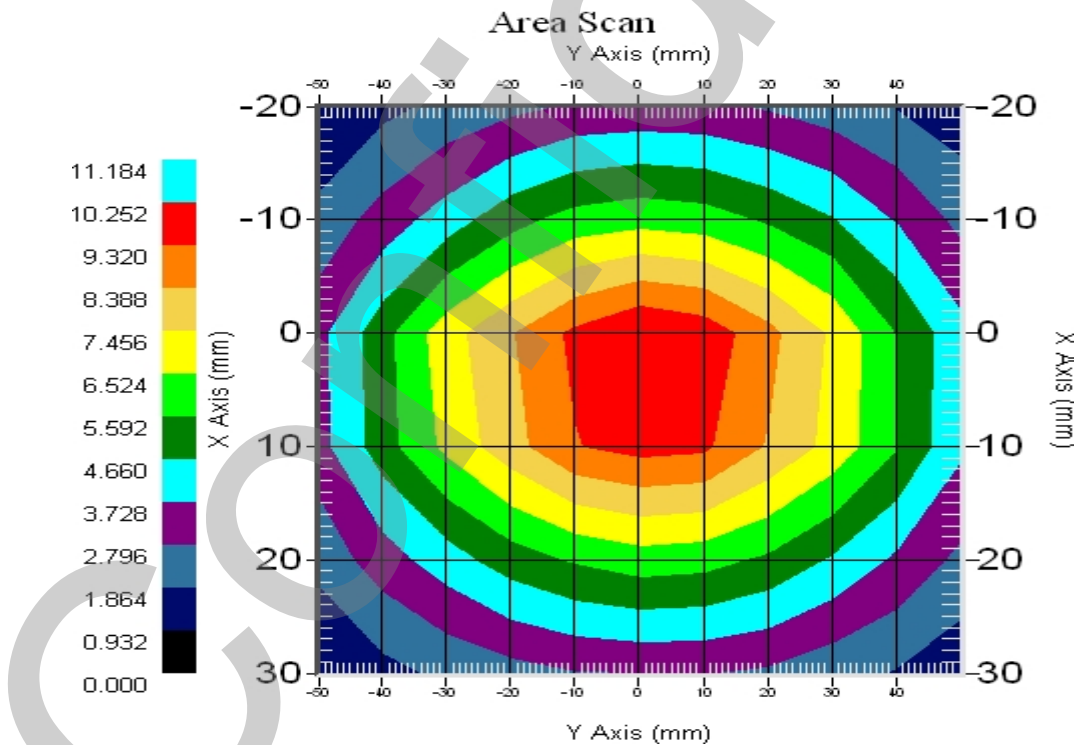
Length: 161.0 mm
Height: 89.8 mm

Electrical Specification

SWR: 1.009U
Return Loss: -47.751 dB
Impedance: 50.065 Ω

System Validation Results

Frequency	1 Gram	10 Gram	Peak
835 MHz	9.49	6.1	14.21



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

Head Tissue 835MHz	Measured
Dielectric constant, ϵ_r	41.54
Conductivity, σ [S/m]	0.91

Electrical Calibration

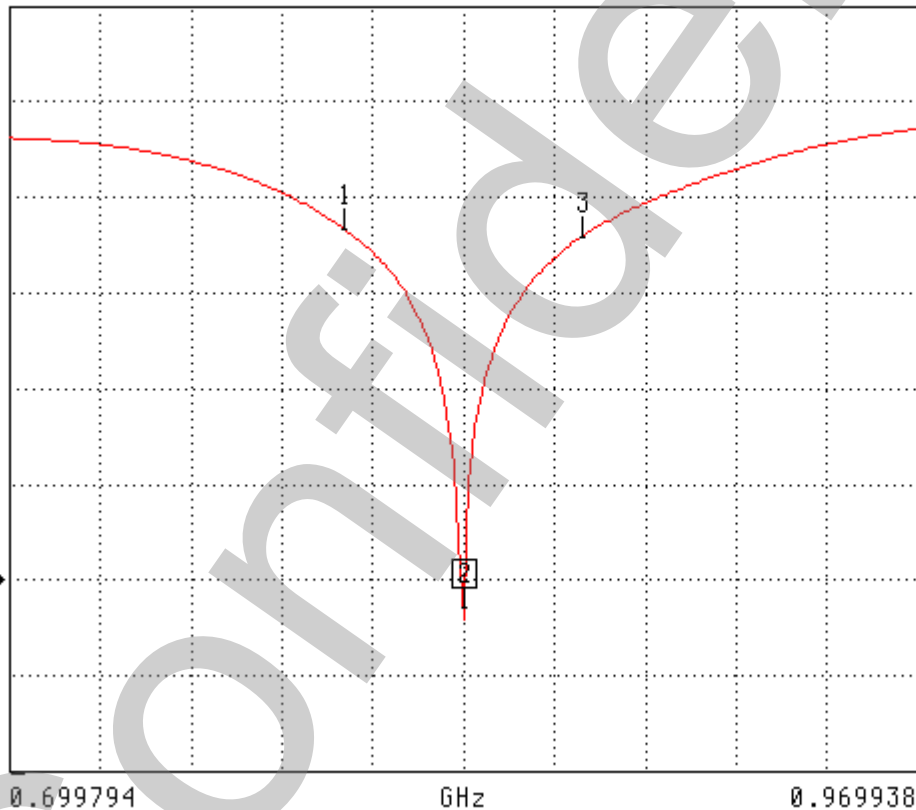
Test	Result
S11 RL	-47.751dB
SWR	1.009U
Impedance	50.065 Ω

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

S11 Parameter Return Loss

S11 FORWARD REFLECTION

LOG MAGNITUDE REF=-45.180 dB 9.000 dB/DIV



CH 1 - S11
REFERENCE PLANE
1.0000 cm

MARKER 2
0.835000 GHz
-47.751 dB

MARKER TO MAX
MARKER TO MIN

1 0.800000 GHz
-12.254 dB

3 0.870000 GHz
-12.903 dB

MARKER READOUT
FUNCTIONS

SWR

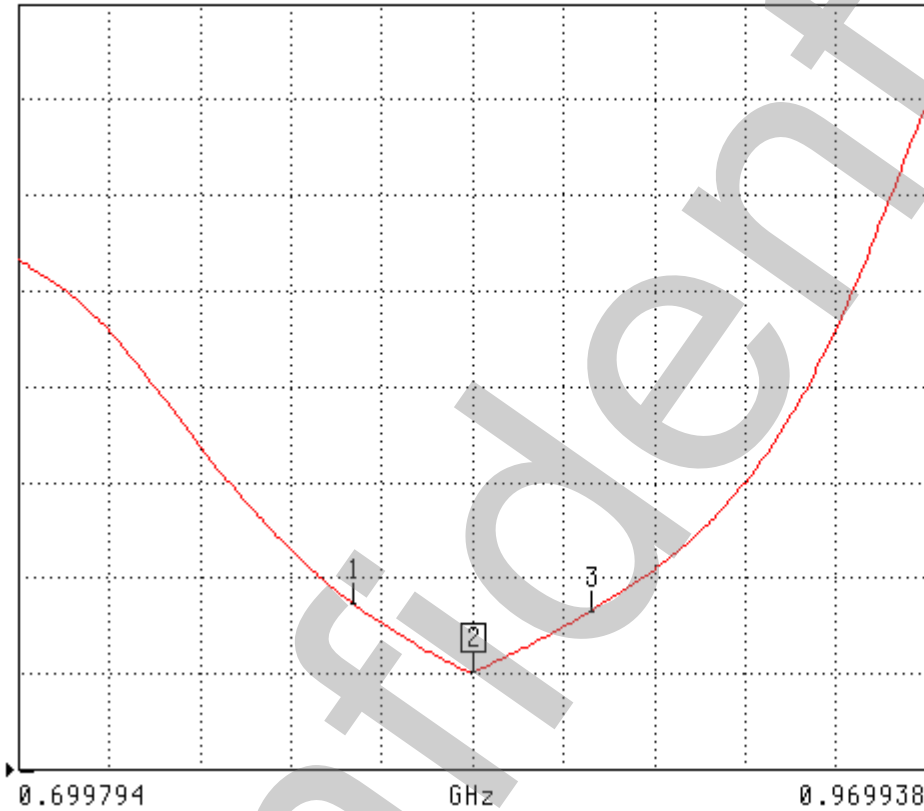
S11 FORWARD REFLECTION

SWR

REF= 97.512 mU

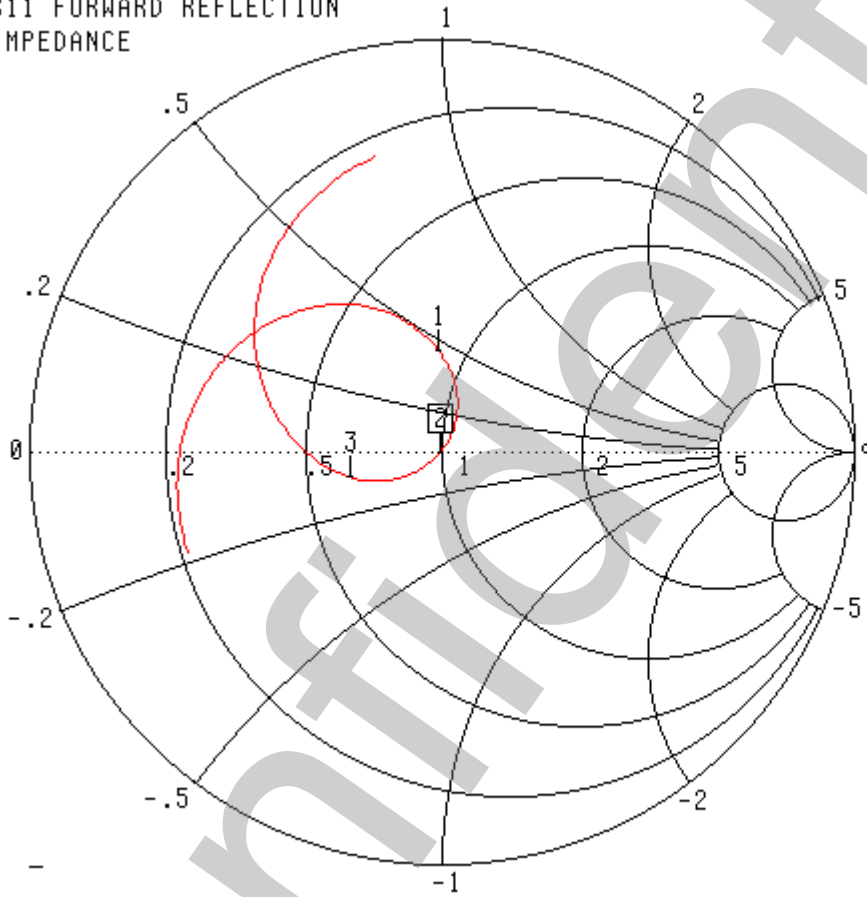
900.000 mU/DIV

CH 1 - S11
REFERENCE PLANE
1.0000 cm



Smith Chart Dipole Impedance

S11 FORWARD REFLECTION
IMPEDANCE



CH 1 - S11
REFERENCE PLANE
1.0000 cm

MARKER 2
0.835000 GHz
50.065 Ω
-410.940 $j\Omega$

MARKER TO MAX
MARKER TO MIN

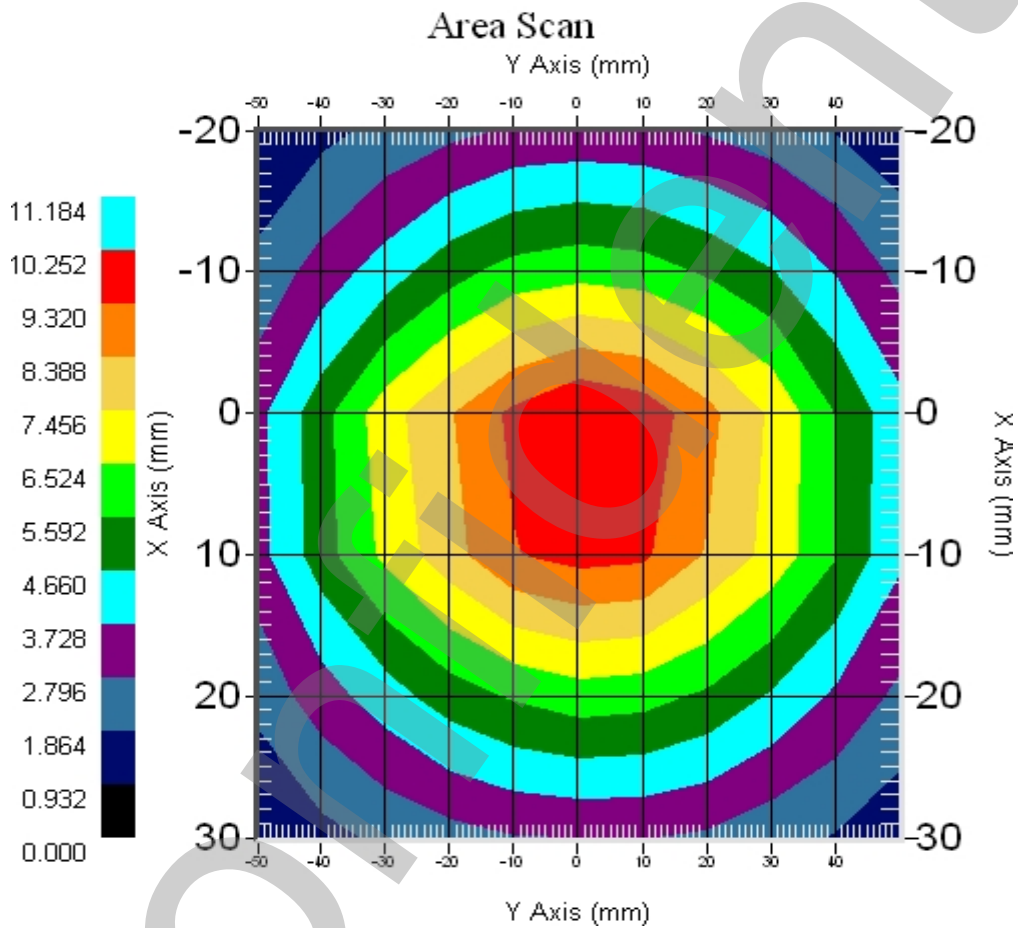
- 1** 0.800000 GHz
43.873 Ω
22.755 $j\Omega$
- 3** 0.870000 GHz
31.944 Ω
-4.372 $j\Omega$

▶ MARKER READOUT
FUNCTIONS

0.699794 - 0.969938 GHz

System Validation Results Using the Electrically Calibrated Dipole

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



Test Equipment

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

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NCL CALIBRATION LABORATORIES

Calibration File No: DC-1115
Project Number: RFEL-1900-Dipole-5481

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

Calibrated: 15th January 2010
Released on: 19th January 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

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

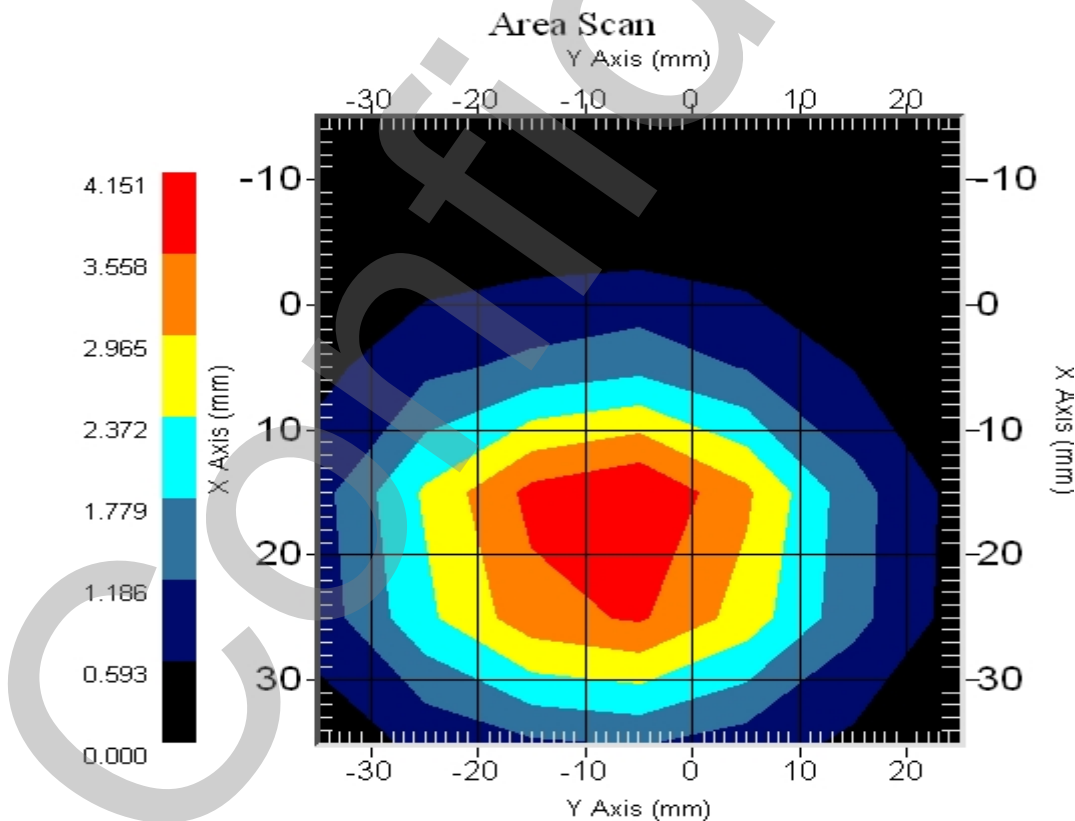
Length: 67.1 mm
Height: 38.9 mm

Electrical Specification

SWR: 1.011U
Return Loss: -45.642dB
Impedance: 50.194Ω

System Validation Results

Frequency	1 Gram	10 Gram	Peak
1900 MHz	38.7	20.5	69.7



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	67.1 mm	38.9 mm

Tissue Validation

Head Tissue 1900 MHz	Measured
Dielectric constant, ϵ_r	40.03
Conductivity, σ [S/m]	1.38

Electrical Calibration

Test	Result
S11 R/L	-45.642dB
SWR	1.011U
Impedance	50.194 Ω

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

S11 Parameter Return Loss

S11 FORWARD REFLECTION

LOG MAGNITUDE REF = -41.354 dB 7.000 dB/DIV

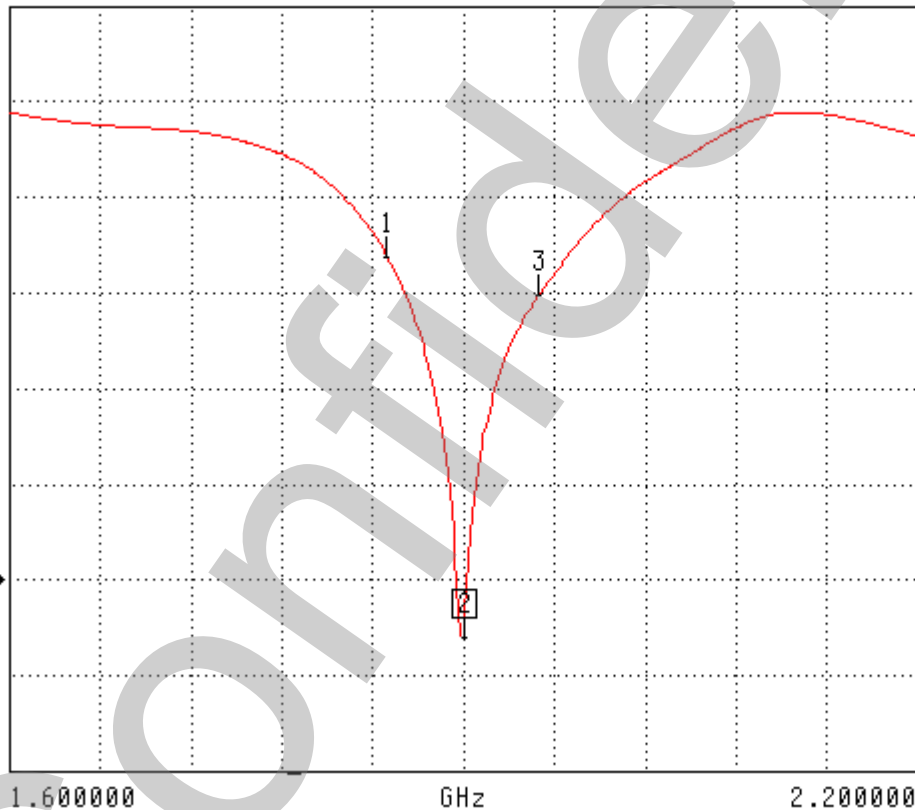
CH 1 - S11
REFERENCE PLANE
5.0000 mm

MARKER 2
1.900000 GHz
-45.642 dB

MARKER TO MAX
MARKER TO MIN

1 1.850000 GHz
-17.713 dB

3 1.950000 GHz
-20.590 dB



MARKER READOUT
FUNCTIONS

SWR

S11 FORWARD REFLECTION

SWR ▶ REF=592.479 mU 300.000 mU/DIV

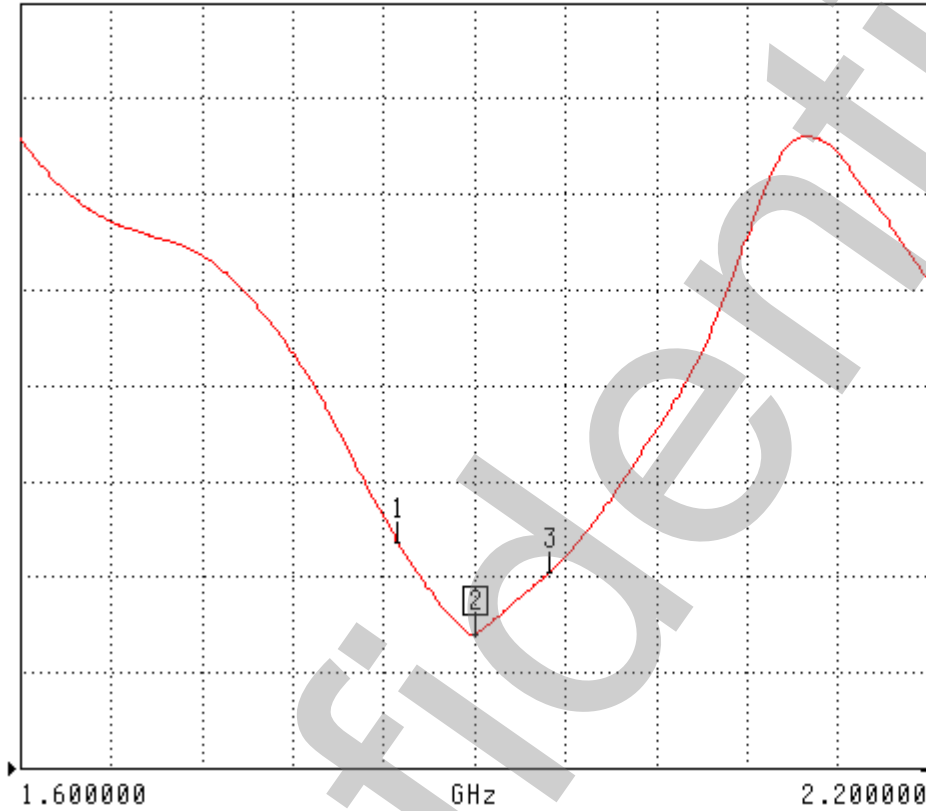
CH 1 - S11
REFERENCE PLANE
5.0000 mm

▶ MARKER 2
1.900000 GHz
1.011 U

MARKER TO MAX
MARKER TO MIN

1 1.850000 GHz
1.299 U

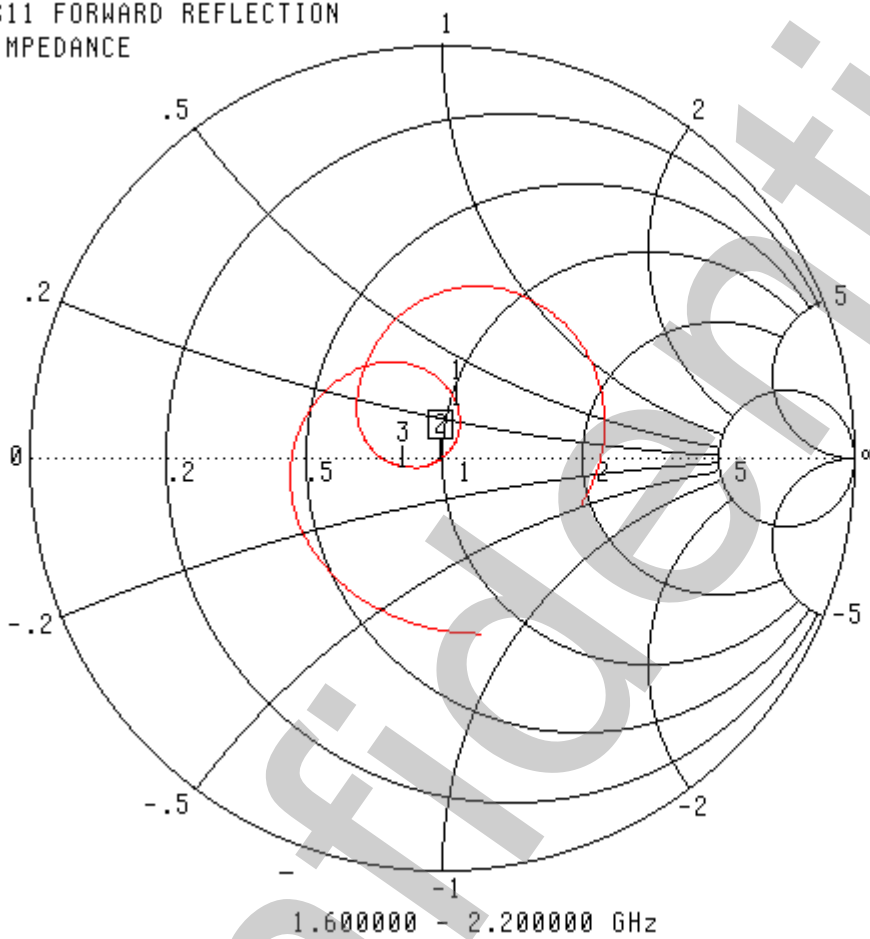
3 1.950000 GHz
1.206 U



MARKER READOUT
FUNCTIONS

Smith Chart Dipole Impedance

S11 FORWARD REFLECTION
IMPEDANCE



CH 1 - S11
REFERENCE PLANE
5.0000 mm

▶ MARKER 2
1.900000 GHz
50.194 Ω
-486.191 jΩ

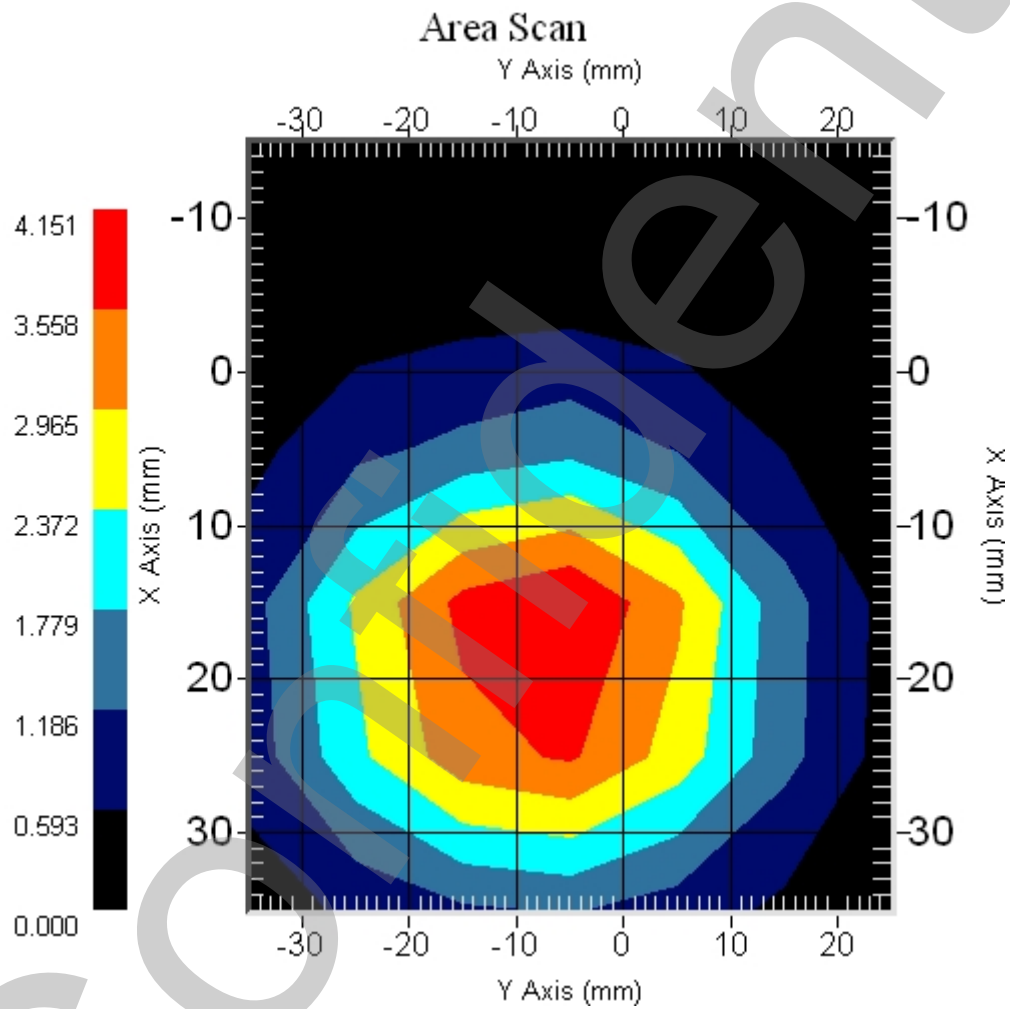
MARKER TO MAX
MARKER TO MIN

- 1** 1.850000 GHz
52.569 Ω
13.209 jΩ
- 3** 1.950000 GHz
41.678 Ω
-2.040 jΩ

MARKER READOUT
FUNCTIONS

System Validation Results Using the Electrically Calibrated Dipole

Head Tissue Frequency	1 Gram	10 Gram	Peak Above Feed Point
1900 MHz	38.7	20.5	69.7



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 2009.

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Appendix F – Phantom Calibration Data Sheets

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NCL CALIBRATION LABORATORIES

Calibration File No.: RFE-273

CERTIFICATE OF CALIBRATION

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

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

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

Calibrated By: Karen K. Feb 17/04.

NCL CALIBRATION LABORATORIES

51 SPECTRUM WAY
NEPEAN, ONTARIO
CANADA K2R 1E6

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