SPECIFIC ABSORPTION RATE (SAR) TEST REPORT

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

Product: 1xEVDO Data Modem with USB Cable
Model Number of Data Modem: MCD3000 / U720 / USB720
Part Number of USB Cable: 2175002
Data Modem FCCID: PKRNVWMCD3000

Tested to the SAR Criteria in
FCC OET Bulletin 65, Supplement C (Edition 01-01)

Date: 10/31/2006
Project Number: 3106291
Report Number: 3106291LEX-003

Prepared By:  **Date:** 10/31/2006

Vinay Kutty, Senior Project Engineer

Approved By:  **Date:** 10/31/2006

Bryan C. Taylor, Team Leader – Engineering

TABLE OF CONTENTS

1.0 Document History

Revision/ Project Number	Writer Initials	Date	Change
1.0 /3106291	VK	10/31/2006	Original document

2.0 References

1] ANSI, *ANSI/IEEE C95.1-1991: IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3kHz to 300 GHz*, The Institute of electrical and Electronics Engineers, Inc., New York, NY 10017, 1992

[2] Federal Communications Commission, "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields", OET Bulletin 65, FCC, Washington, D.C. 20554, 1997

[3] Thomas Schmid, Oliver Egger, and Niels Kuster, "Automated E-field scanning system for dosimetric assessments", *IEEE Transaction on Microwave Theory and Techniques*, vol. 44, pp. 105-113, Jan. 1996.

[4] Niels Kuster, Ralph Kastle, and Thomas Schmid, "Dosimetic evaluation of mobile communications equipment with know precision", IEICE Transactions on Communications, vol. E80-B, no. 5, pp.645-652, May 1997.

5] NIS81, NAMAS, "The treatment of uncertainty in EMC measurement", Tech. Rep., NAMAS Executive, National Physical Laboratory, Teddinton, Middlesex, England, 1994.

6] Barry N. Tayor and Chris E. Kuyatt, "Guidelines for evaluating and expressing the uncertainty of NIST measurement results", Tech. Rep., National Institute of Standards and Technology, 1994.

3.0 Introduction

The MCD3000 1xEVDO Data Modem with USB Cable was evaluated for SAR in accordance with the requirements for RF Exposure compliance testing defined in FCC OET Bulletin 65, Supplement C (Edition 01-01). Testing was performed at the Intertek facility in Lexington, Kentucky.

For the evaluation, the dosimetric assessment system DASY4 was used. The phantom employed was the "SAM Twin Phantom". The total uncertainty for the evaluation of the spatial peak SAR values averaged over a cube of 1g tissue mass had been assessed for this system to be ±21.9%.

The MCD3000 was tested at the maximum output power measured by Intertek. Maximum output power measurements are tabulated under **Heading 11.0 - Tabular Test Results**.

The maximum spatial peak SAR value for the sample device averaged over 1g was found to be:

Phantom	Mode	Device Face Under Test	Separation Distance from Flat Phantom	Worst Case Extrapolated SAR_{1g} mW/g
Flat Section (Body Mode)	1908.75 MHz (PCS); Antenna fully open at 90°	Right edge	8.5 mm	**1.540**
Flat Section (Body Mode)	1908.75 MHz (PCS); Antenna fully open at 90°	Right edge	10 mm	**1.286**

Based on the worst-case data presented above, the MCD3000 with USB Cable was found to be **compliant** with the 1.6 mW/g requirement defined in OET Bulletin 65, Supplement C (Edition 01-01) when separated from the flat phantom by 8.5 mm and 10 mm.

Note: The scope of this evaluation does not include phantom separation distances that are less than 8.5mm. This is due to specific wording in the MCD3000's user documentation which addresses the safe operating distance of the device from the user. Please see Page 20 of this report for details.

Modifications made to test sample

Intertek implemented no modifications.

4.0 Test Site Description

The SAR test site located at 731 Enterprise Drive, Lexington KY 40510 is comprised of the SPEAG model DASY 4 automated near-field scanning system, which is a package, optimized for dosimetric evaluation of mobile radios [3]. This system is installed in an ambient-free shielded chamber. The Ambient temperature is controlled to 22.2 $\pm 2^{O}$C. Because the HVAC operates as a closed system, the relative humidity remains constant at 50 $\pm$5%. During the SAR evaluations, the RF ambient conditions are monitored continuously for signals that might interfere with the test results. The tissue simulating liquid is also stored in this area in order to keep it at the same constant ambient temperature as the room.

Figure 1: Intertek SAR Test Site

Measurement Equipment

The following major equipment/components were used for the SAR evaluations:

SAR Measurement System			
EQUIPMENT	**SPECIFICATIONS**	**S/N #**	**Cal. Due**
Robot	**Stäubli RX60L**	597412-01	N/A
	Repeatability: ± 0.025mm Accuracy: 0.806×10^{-3} degree Number of Axes: 6		
E-Field Probe	**EX3DV3**	3516	10/20/2006
	Frequency Range: 900MHz to 6GHz Probe Linearity: ± 0.2 dB (30 MHz to 6 GHz) Length: 34.5 cm Distance between the probe tip and the dipole center: 2.7 mm Tip Diameter: 2.4 mm Calibration: 900, 1800, 2450, 5200 and 5800 MHz for head & body tissue simulating liquid		
Data Acquisition	**DAE4**	358	3/2007
	Measurement Range: 1µV to >200mV Input offset Voltage: < 1µV (with auto zero) Input Resistance: 200 M		
Phantom	**SAM Twin V4.0**	TP-1243	N/A
Complies with IEEE P1528-2003	Type SAM Twin, Homogenous Shell Material: Fiberglass Thickness: 2 ± 0.2 mm Capacity: 20 liter Size of the flat section: approx. 320 x 230 mm		
Device holder	Non-conductive holder supplied with DASY4, dielectric constant less than 5.0	N/A	N/A
Network Analyzer	**Agilent 8753ES**	US39173983	8/14/2007
	Frequency Range: 30KHz – 6.0 GHz		
Signal Generator	**Agilent 8648B**	4037A03337	8/15/2007
	Frequency Range: 9KHz – 2 GHz		
Spectrum Analyzer	**Rohde & Schwarz FSP**	1164.4391.07	8/2/2007
	Frequency Range: 9KHz – 7 GHz		
Wireless Communications Test Set	**Agilent 8960**	3130	10/10/2007

Measurement Uncertainty

The Table below includes the uncertainty budget suggested by the IEEE Std 1528-200X and determined by SPEAG for the DASY4 measurement System

Error Description	Uncertainty Value	Prob. Dist.	Div.	c_i (1g)	c_i (10g)	Std.Unc. (1g)	Std.Unc. (10g)	(v_i) v_{eff}
Measurement System								
Probe Calibration	±5.9%	N	1	1	1	±5.9%	±5.9%	∞
Axial Isotropy	±4.7%	R	√3	0.7	0.7	±1.9%	±1.9%	∞
Hemispherical Isotropy	±9.6%	R	√3	0.7	0.7	±3.9%	±3.9%	∞
Boundary Effect	±1.0%	R	√3	1	1	±0.6%	±0.6%	∞
Linearity	±4.7%	R	√3	1	1	±2.7%	±2.7%	∞
System Detection Limits	±1.0%	R	√3	1	1	±0.6%	±0.6%	∞
Readout Electronics	±0.3%	N	1	1	1	±0.3%	±0.3%	∞
Response Time	±0.8%	R	√3	1	1	±0.5%	±0.5%	∞
Integration Time	±2.6%	R	√3	1	1	±1.5%	±1.5%	∞
RF Ambient Conditions	±3.0%	R	√3	1	1	±1.7%	±1.7%	∞
Probe Positioner	±0.4%	R	√3	1	1	±0.2%	±0.2%	∞
Probe Positioning	±2.9%	R	√3	1	1	±1.7%	±1.7%	∞
Max. SAR Eval.	±1.0%	R	√3	1	1	±0.6%	±0.6%	∞
Test sample Related								
Device Positioning	±2.9%	N	1	1	1	±2.9%	±2.9%	145
Device Holder	±3.6%	N	1	1	1	±3.6%	±3.6%	5
Power Drift	±5.0%	R	√3	1	1	±2.9%	±2.9%	∞
Phantom and Tissue Parameters								
Phantom Uncertainty	±4.0%	R	√3	1	1	±2.3%	±2.3%	∞
Liquid Conductivity (target)	±5.0%	R	√3	0.64	0.43	±1.8%	±1.2%	∞
Liquid Conductivity (meas.)	±2.5%	N	1	0.64	0.43	±1.6%	±1.1%	∞
Liquid Permittivity (target)	±5.0%	R	√3	0.6	0.49	±1.7%	±1.4%	∞
Liquid Permittivity (meas.)	±2.5%	N	1	0.6	0.49	±1.5%	±1.2%	∞
Combined Standard Uncertainty						±10.9%	±10.7%	387
Expanded STD Uncertainty						**±21.9%**	**±21.4%**	

Notes.

1. Worst Case uncertainty budget for DASY4 assessed according to IEEE 1528. The budget is valid for the frequency range 300 MHz – 3 GHz and represents a worst-case analysis. For specific tests and configurations, the uncertainty could be considerably smaller.

Measurement Traceability

All measurements described in this report are traceable to National Institute of Standards and Technology (NIST) standards or appropriate national standards.

5.0 Job Description

The MCD3000 1xEVDO Data Modem with USB Cable has been tested to the requirements defined in OET Bulletin 65, Supplement C (Edition 01-01) at the request of:

Manufacturer of the device:	Novatel Wireless 9645 Scranton Rd, Suite 205 San Diego, CA, 92121
Model number of the device:	MCD3000 / U720 / USB720 with USB Cable
USB Cable Part Number:	2175002
Material Composition of USB Modem:	Polycarbonate/ABS
DC Input of USB Modem:	5V / 750 mA
Name of contact:	John Spall
Telephone:	(858) 812-3477
E-mail:	jspall@nvtl.com
Manufacturer of the radio:	Novatel Wireless
Model Number of the radio:	ES720
Serial Number of the radio:	LI200706200167
EUT receive date:	9/22/2006
EUT received condition:	Good condition production unit
Test start date:	10/3/2006
Test end date:	10/5/2006

Test Sample Description

The MCD3000 is a USB-connected CDMA2000 1x Ev-Do (Rev 0) modem which can be used in either desktop or laptop applications. The modem is also supplied with a 93 cm-long USB cable that will allow the modem to be positioned away from the host, i.e. in a 'USB-dongle' configuration.

Test sample		
Model	MCD3000 with USB cable (P/N 2175002)	
FCC ID of Modem	**PKRNVWMCD3000**	
Device Category	Portable	
RF Exposure Category	General Population/Uncontrolled Environment	
System	CDMA-2000 1x RTT / 1x Ev-Do, Rev 0	
Frequency Band	824.7 MHz – 848.31 MHz (Cell) ; 1851.25 MHz – 1908.75 MHz (PCS)	
Mode(s) of Operation	CDMA-2000 1x RTT	CDMA-2000 1x Ev-Do, Rev 0
Duty Cycle	1:1	1:1
Maximum output power (measured by Intertek at the module's external RF connector)	24.03 dBm (252.93 mW)	24.16 dBm (260.62 mW)

Test Sample Antenna(s)		
Type	Main antenna: Monopole	Diversity antenna: Planar Inverted F Antenna
Configuration	Flip-up (0° - 90°)	Fixed / Planar
Dimensions	35 mm length	18 mm by 25 mm
Location	Hinge assembly on side of MCD3000	Mounted on inside of top cover
Gain (Worst Case)	3dBi (Cell and PCS bands)	0-1dBi (Cell and PCS bands)

Test sample Accessories	
Battery type	None
Belt clip	None

Test Signal Mode	
Test Commands	
Base Station Simulator	X

Test Sample Pictures:

Internal and external test sample pictures can be found in the following accompanying documents:

MCD3000 with USB Cable Internal Photographs.pdf
MCD3000 with USB Cable External Photographs.pdf

6.0 System Verification

Dipole System Validation

Prior to the assessment, the system was verified to be within ±10% of the specifications by using the system validation kit. The validation was performed at 900 MHz and 1800MHz using head tissue.

Figure 2: Photograph of System Verification (900MHz Dipole Positioned at Flat Phantom)[1]

[1] A similar positioning of an 1800MHz dipole was used.

Reference Dipole Validation – CDMA Cell Band Tests								
Frequency Measure (MHz)	**Dipole Type**	**Dipole Serial Number**	**Fluid Type**	**Dipole Power Input**	**Cal. Lab SAR (1g)**	**Measured SAR (1g)**	**% Error SAR (1g)**	**Date**
900	D900V2	13	900 MHz Head	1W	10.6	11.06	4.34	10/5/20006

Dipole dimensions: L=150.2 mm, D=3.6 mm
The following information, regarding the impedance of the D900V2, S/N #: 013 dipole was supplied by SPEAG:

Feed-point impedance at 900 MHz: Re{Z} = 50.3 Ohm; Im{Z} = 0.7 Ohm
Return Loss at 900 MHz: -41.9 dB

Reference Dipole Validation - CDMA PCS Band Tests								
Frequency Measure (MHz)	**Dipole Type**	**Dipole Serial Number**	**Fluid Type**	**Dipole Power Input**	**Cal. Lab SAR (1g)**	**Measured SAR (1g)**	**% Error SAR (1g)**	**Date**
1800	D1800V2	224	1800 MHz Head	1W	39.7	42.30	6.55	10/3/2006
1800	D1800V2	224	1800 MHz Head	1W	39.7	36.15	8.94	10/4/2006

Dipole dimensions: L=72.7 mm, D=3.6 mm
The following information, regarding the impedance of the D1800V2, S/N #: 224 dipole was supplied by SPEAG:

Feed-point impedance at 1800 MHz: Re{Z} = 50.4 Ohm; Im{Z} = -3.1 Ohm
Return Loss at 1800 MHz: -30.2 dB

Evaluation For: Novatel Wireless Modem FCC ID: **PKRNVWMCD3000**
Model: MCD3000 / U720 / USB720 with USB Cable (P/N 2175002)

Tissue Simulating Liquid Description and Validation

Simulation Liquid; Frequency: 900 MHz		
Ingredient	**Head**	**Body**
Water	41.45 %	52.4 %
Sugar	56.0 %	45.0 %
Salt	1.45 %	1.4 %
Bactericide	0.1 %	0.1 %
HEC	1.0 %	1.0 %

Simulation Liquid; Frequency: 1900 MHz		
Ingredient	**Head**	**Body**
Water	54.9	70.45
NaCl	0.18	0.36
Sugar	0	0
HEC	0	0
Bactericide	0	0
Triton X-100	0	0
DGBE	44.92	29.18

Note: The amounts of each ingredient specified in the tables are not the exact amounts of the final test solution. The final test solution was adjusted by adding small amounts of the appropriate ingredient to calibrate the solution to meet the proper dielectric parameters.

The ambient temperature of the test site, as well as the temperature of the tissue simulating fluid, were recorded on each day of testing, as shown in the table below:

Date	Ambient Temperature(°F)	Muscle Simulating Liquid Temperature (°F) f=900MHz	Head Simulating Liquid Temperature (°F) f=900MHz	Muscle Simulating Liquid Temperature (°F) f=1800MHz	Head Simulating Liquid Temperature (°F) f=1800MHz
10/3/2006	73.1	Not used	Not used	71.6	71.4
10/4/2006	73.5	Not used	Not used	71.8	71.7
10/5/2006	72.9	71.4	71.6	Not used	Not used

The dielectric parameters were verified prior to assessment using the HP 8753A Network Analyzer. The dielectric parameters (ε_r, σ) on each day of testing were as follows:

Head Tissue Parameters - CDMA Cell Band Tests								
Frequency Measure (MHz)	**Dielectric Constant Target**	**Dielectric Constant Measure**	**Dielectric % Deviation**	**Imaginary Part**	**Conductivity Target**	**Conductivity Measure**	**Conductivity % Deviation**	**Date**
813	41.6	41.24	0.87	19.1	0.9	0.86	4.08	10/5/2006
900	41.5	40.38	2.70	18.95	0.97	0.95	2.25	10/5/2006
Body Tissue Parameters - CDMA Cell Band Tests								
Frequency Measure (MHz)	**Dielectric Constant Target**	**Dielectric Constant Measure**	**Dielectric % Deviation**	**Imaginary Part**	**Conductivity Target**	**Conductivity Measure**	**Conductivity % Deviation**	**Date**
813	55.3	55.75	0.81	20.5	0.97	0.93	4.48	10/5/2006
900	55	55.27	0.49	20.2	1.05	1.01	3.74	10/5/2006

Head Tissue Parameters - CDMA PCS Band Tests								
Frequency Measure (MHz)	**Dielectric Constant Target**	**Dielectric Constant Measure**	**Dielectric % Deviation**	**Imaginary Part**	**Conductivity Target**	**Conductivity Measure**	**Conductivity % Deviation**	**Date**
1800	40	42	5.00	14.65	1.4	1.47	4.72	10/3/2006
1800	40	41.8	4.50	14.5	1.4	1.45	3.65	10/4/2006
Body Tissue Parameters - CDMA PCS Band Tests								
Frequency Measure (MHz)	**Dielectric Constant Target**	**Dielectric Constant Measure**	**Dielectric % Deviation**	**Imaginary Part**	**Conductivity Target**	**Conductivity Measure**	**Conductivity % Deviation**	**Date**
1800	53.3	52.9	0.75	15.8	1.52	1.58	4.02	10/3/2006
1800	53.3	53	0.56	15.2	1.52	1.52	0.07	10/4/2006

Maximum mass density $\rho = 1$ g/cm^3
Maximum deviation of the dielectric parameters from the recommended values was 5 %.
During the measurements, the liquid level was maintained to a level of 15 cm with a tolerance of ±0.2 cm.

7.0 Evaluation Procedures

Prior to any testing, the appropriate fluid was used to fill the phantom to a depth of 15 cm ±0.2cm. The fluid parameters were verified and the dipole validation was performed as described in the previous sections.

Test Positions:

The Device was positioned against the SAM and flat phantom using the exact procedure described in Supplement C Edition 01 – 01 of Federal Communications Commission, "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields", OET Bulletin 65, FCC, Washington, D.C. 20554, 1997.

Reference Power Measurement:

The measurement probe was positioned at a fixed location above the reference point. A power measurement was made with the probe above this reference position so it could used for the assessing the power drift later in the test procedure.

Coarse Scan:

A coarse area scan with a horizontal grid spacing of 15 x 15 mm was performed in order to find the approximate location of the peak SAR value. This scan was performed with the measurement probe at a constant height in the simulating fluid. A two dimensional spline interpolation algorithm was then used to determine the peaks and gradients within the scanned area.

Zoom Scan:

A zoom scan was performed around the approximate location of the peak SAR as determined from the coarse scan. The zoom scan was comprised of a measurement volume of 30 x 30 x 30 mm based on 7 x 7 x 7 points. On the basis of this data set, the spatial peak SAR value was evaluated with the following procedure:

Data Extrapolation:

Since the center of the dipoles in the measurement probe are 2.7 mm away from the tip of the probe, and the distance between the surface and the lowest measurement point is 1.6 mm the data at the surface was extrapolated. The extrapolation was based on a least square algorithm. A polynomial of the fourth order was calculated through the points in the Z-axes. This polynomial was then used to evaluate the points between the surface and the probe tip.

The maximum interpolated value was searched with a straightforward sorting algorithm. Around this maximum, the SAR values averaged over the spatial volumes (1g or 10g) were computed using a 3-D spline interpolation algorithm. The 3-D spline is composed of three one-dimensional splines with the "Not a knot" condition (in x, y and z directions). The volume was integrated with a trapezoidal algorithm. 1000 points (10 x 10 x 10) were interpolated to calculate the average.

All neighboring volumes were evaluated until no neighboring volume with a higher average value was found.

Reference Power Measurement:

The probe was positioned at precisely the same reference point and the reference power measurement was repeated. The difference between the initial reference power and the final one is referred to as the power drift. If the power drift exceeded 5% of the final peak SAR value, the measurement was repeated.

RF Ambient Activity:

During the entire SAR evaluation, the RF ambient activity was monitored using a spectrum analyzer with an antenna connected to it. The spectrum analyzer was tuned to the frequency of measurement and with one trace set to max hold mode. In this way, it was possible to determine if at any point during the SAR measurement there was an interfering ambient signal. If an ambient signal was detected, then the SAR measurement was repeated.

8.0 Test Configuration / Test Photographs

For the purpose of this evaluation, the MCD3000 with USB Cable was considered to be a USB-dongle device. The MCD3000 modem itself was considered to be an Access Terminal (AT) which operates under the CDMA2000 High Rate Packet Data, Rev. 0, 1x Ev-Do protocol. The device can be used in either desktop or laptop applications and has previously been filed with the FCC, in addition to being documented under Intertek Report Number 3103199LEX-001.

The test plan that was agreed upon by Intertek and Novatel Wireless followed the FCC procedures for testing USB-dongle devices, as described during the FCC TCB Workshop of October 2nd - 4th, 2006. Additional guidance was provided to Intertek during direct correspondence with the FCC (Ref: Response to Inquiry to FCC, Tracking Number 143149). See **SAR Measurements**, below, for setup details.

Note: The MCD3000 modem was configured for testing according to the FCC document, "SAR Measurement Procedures for 3G Devices, June 2006". The MCD3000 was configured for measurements in CDMA2000 1xRTT and 1x Ev-Do modes using Qualcomm QPST Version 2.7 Build 231 software. Then, an Agilent 8960 base station simulator was used to place the MCD3000 in a call at the appropriate channel.

Output Power Verification:

Output power verification of the MCD3000 was performed according to the FCC 3G document. Results of this verification are shown under **Heading 11.0 - Tabular Test Results**.

SAR Measurements:

The MCD3000 is capable of operating in CDMA2000 1xRTT and 1x Ev-Do modes. According to the FCC 3G document, SAR is not required for 1xRTT mode when the maximum average output power of each channel is less than 0.25 dBm higher than that measured in the 1x Ev-Do mode. **Heading 10.0 - Engineering Judgments** provides further details on the output power comparison that was used to justify the exemption of Body-mode scans in 1xRTT mode.

3-host testing of the MCD3000 was previously conducted by Intertek and submitted to the FCC, as described above. Testing of the MCD3000 with USB Cable was performed in 'USB-dongle' mode with a single host, as follows:

The results of Intertek's prior evaluation of the MCD3000 in 3 hosts were used to determine which laptop configurations resulted in maximum SAR results in each frequency band.

The worst-case 1g SAR in the CDMA PCS Band (0.738 mW/g) was found to occur in the Compaq Laptop. The minimum separation distance of the modem was 8.5 mm, as illustrated below:

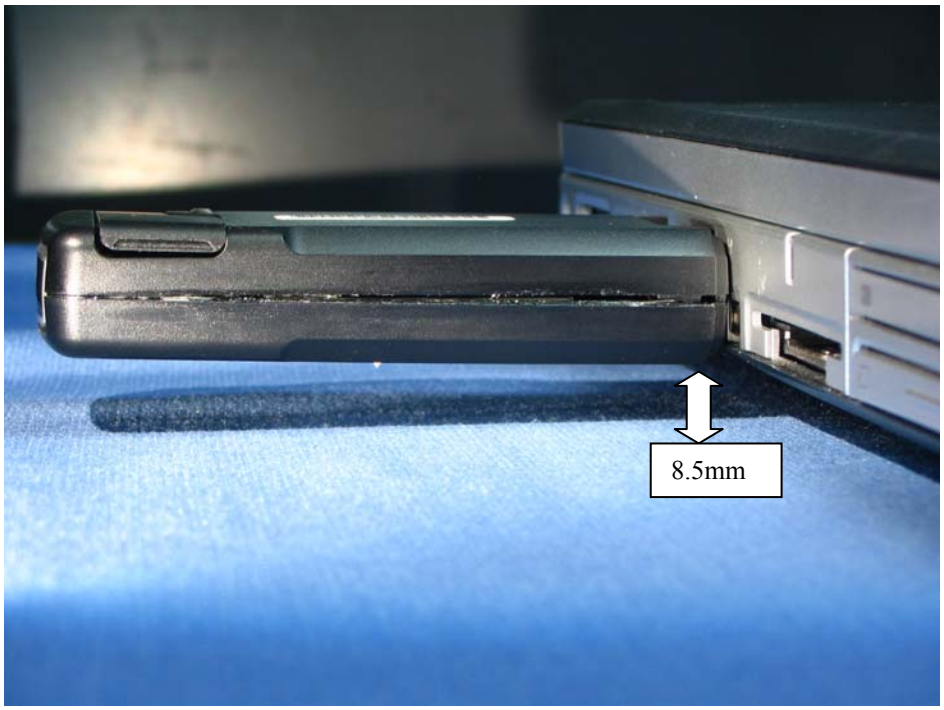

Figure 3: MCD3000 – Minimum distance to base of Compaq laptop

The worst-case 1g SAR in the CDMA Cell Band (0.521 mW/g) was found to occur in the Acer Laptop. The minimum separation distance of the modem was 10 mm, as illustrated below:

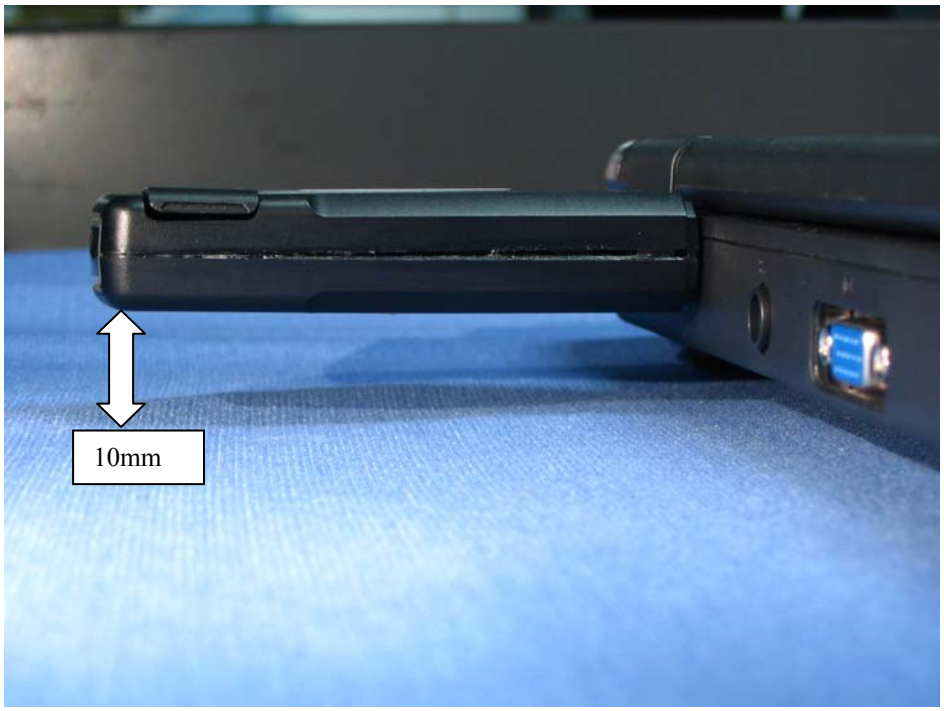

Figure 4: MCD3000 – Minimum distance to base of Acer laptop

These separation distances of 8.5 mm and 10 mm were used for the USB-dongle mode tests.
Since the overall worst-case SAR for the MCD3000 was found in the Compaq laptop, this laptop was chosen for the single-host tests in USB-dongle mode.

Novatel has provided the following statement in their user manual for the MCD3000:

In order to comply with FCC RF Exposure requirements, this device must be installed so that a minimum separation distance of 8.5mm (0.33") is maintained between the antenna and all persons during ordinary operating conditions contingent upon the following:

1. The laptop or PC is placed on a desktop, table or flat surface
2. The device is placed on a flat surface

The above statement specifies that the intended-use position of the MCD3000 must be at least 8.5mm from the user. Therefore, the scope of this evaluation does not include phantom separation distances less than 8.5mm.

A summary of the host, test frequencies and separation distances used for the evaluation of the MCD3000 in USB-dongle mode is shown below:

Host	CDMA Band	Separation Distances Tested
Compaq V4000, SN 2CE61503GL	Cell	8.5mm, 10mm
Compaq V4000, SN 2CE61503GL	PCS	8.5mm, 10mm

Following the selection of separation distances to evaluate, the MCD3000 was examined in order to determine which edges of the device would be tested. It was determined that the surfaces shown in Figure 5, below, would be applicable to the current evaluation. Tips of the device were excluded, as permitted by the FCC. The top of the device, which contained its flip-antenna, was also excluded because this is not a normal-use rest surface.

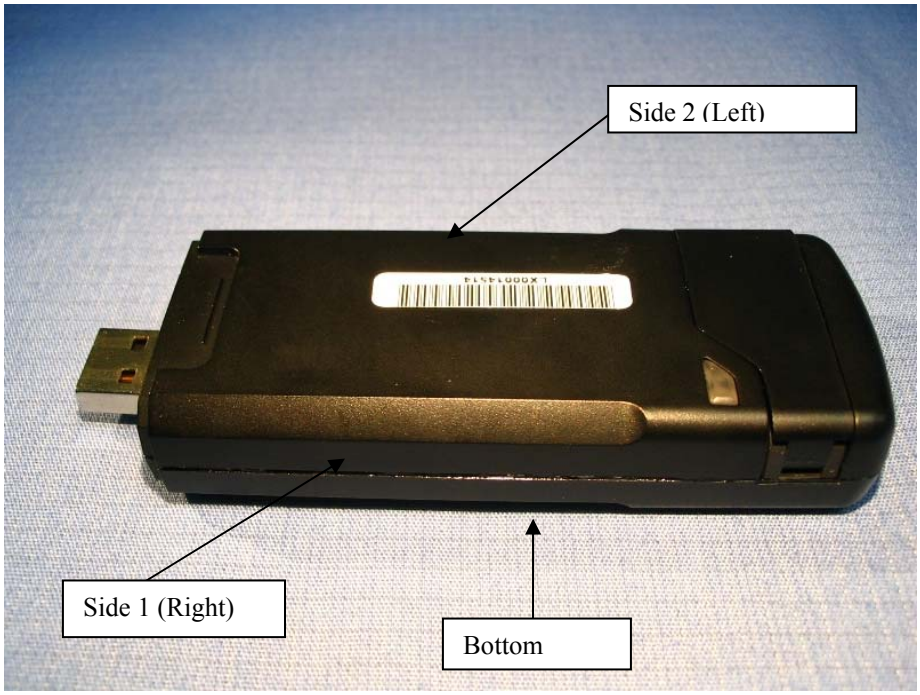

Figure 5: MCD3000 Surfaces under Evaluation

Once the test surfaces were identified, it was necessary to establish which antenna position would result in the maximum SAR for that particular surface. Bearing in mind that the device contains a flip antenna that can open from 0° to 90°, tests were conducted with the antenna positioned at 0°, 45° and 90°.

A series of area scans were peformed at the highest conducted output power channel in each frequency band. The MCD3000 was placed in a call at Channel 600 in PCS band and Channel 1013 in Cell band according to the FCC 3G test procedures. For the purpose of this investigation, a distance of 5 mm was used to separate the device edge from the phantom. Care was taken to maintain a constant device position while changing only the antenna position. The resulting peak SAR was used to determine the worst-case antenna position for that particular edge and frequency.

CDMA Band / Channel with Highest Output Power	Surface Under Evaluation	Antenna Position	Peak SAR (mW/g)
PCS / 600	Left Edge	**0°**	**1.88**
		45°	1.74
		90°	0.787
	Right Edge	0°	0.579
		45°	2.01
		90°	**5.17**
	Rest Surface	0°	0.7
		45°	0.895
		90°	**1.06**
Cell / 1013	Left Edge	0°	0.967
		45°	**0.969**
		90°	0.823
	Right Edge	**0°**	**1.08**
		45°	1.04
		90°	0.945
	Rest Surface	0°	1.57
		45°	**1.65**
		90°	1.64

Detailed measurement data, as well as the resulting area scan plots, are referenced under **Heading 12.0 - Graphical SAR Scan Results**.

Figure 6 through Figure 14, below, show the various device configurations that were examined to determine the worst-case antenna position for each edge of the MCD3000.

Figure 6: Left Edge - Antenna at 0 Degrees

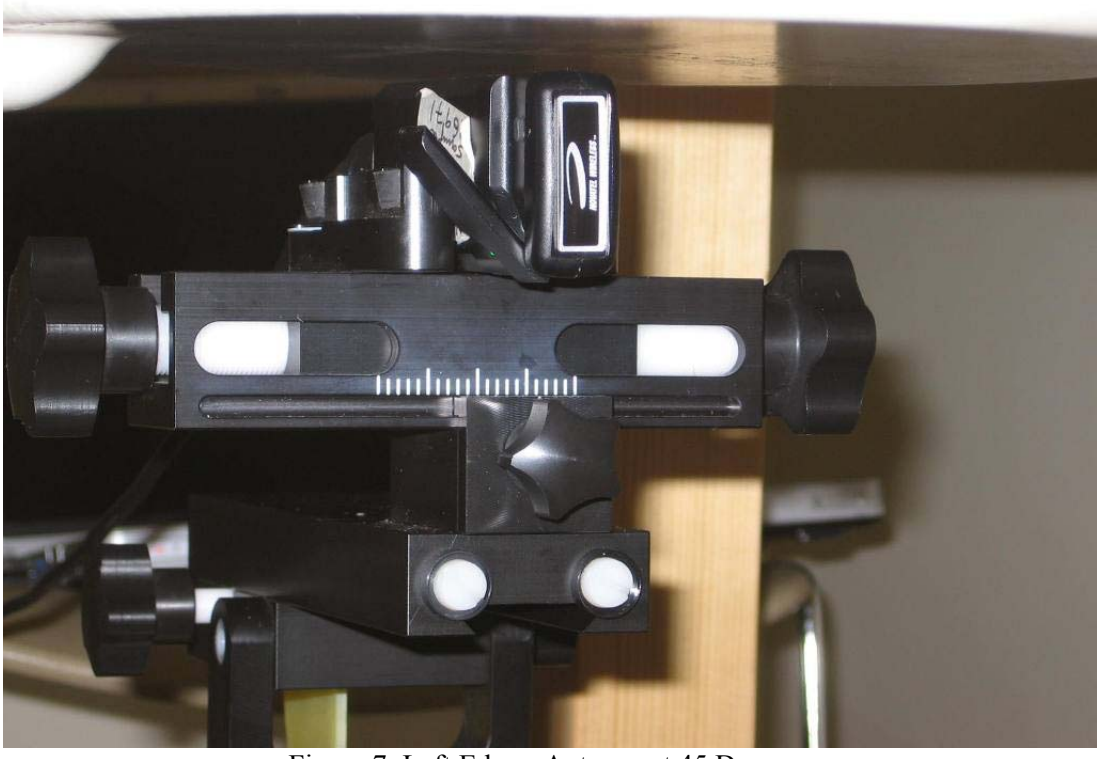

Figure 7: Left Edge - Antenna at 45 Degrees

Figure 8: Left Edge - Antenna at 90 Degrees

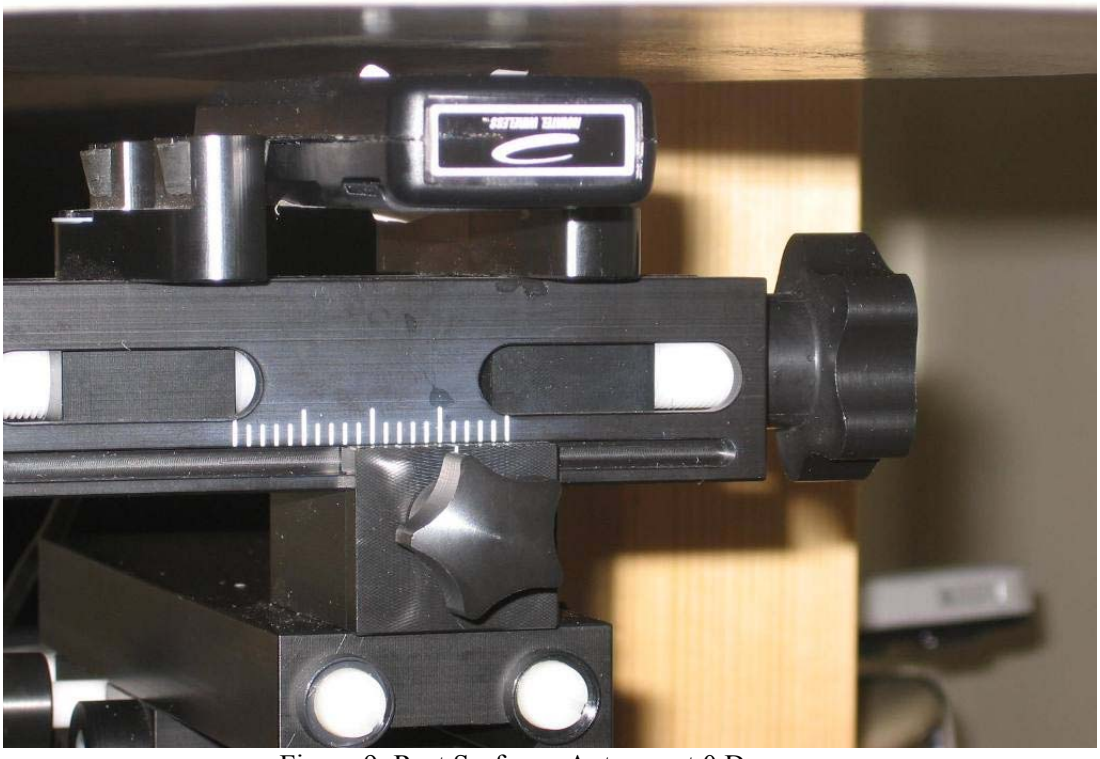

Figure 9: Rest Surface - Antenna at 0 Degrees

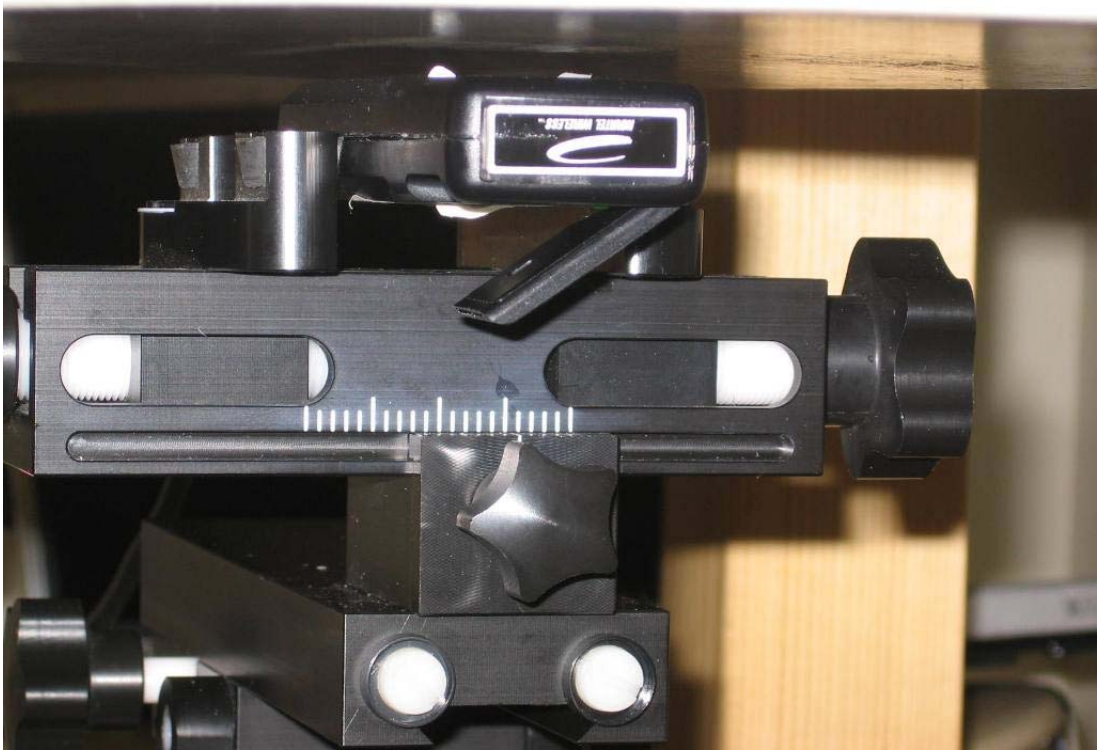

Figure 10: Rest Surface - Antenna at 45 Degrees

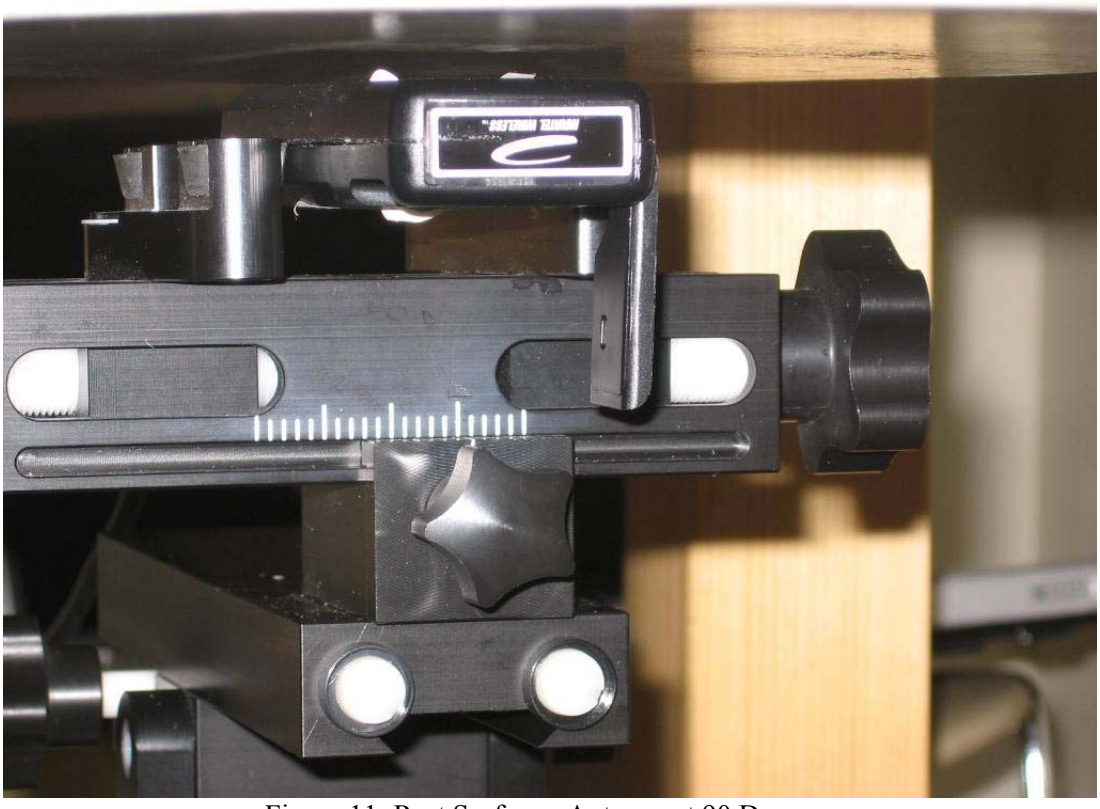

Figure 11: Rest Surface - Antenna at 90 Degrees

Figure 12: Right Edge - Antenna at 0 Degrees

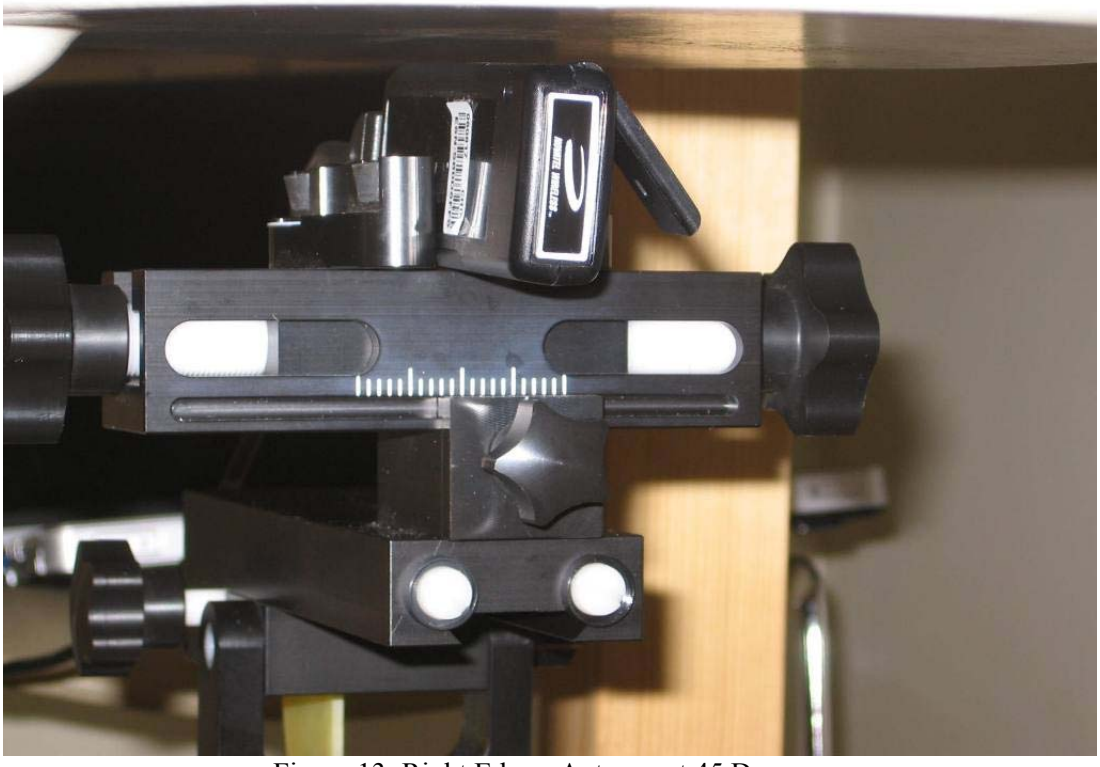

Figure 13: Right Edge - Antenna at 45 Degrees

Figure 14: Right Edge - Antenna at 90 Degrees

As a result, the following tests were determined to apply to the MCD3000 with USB cable:

CDMA Band	Laptop	Antenna position	Face of MCD3000 to be tested	d=8.5mm	d=10mm
PCS	Compaq	90°	Bottom (Rest)	•	•
		90°	Side 1 (Right)	•	•
		0°	Side 2 (Left)	•	•
Cell	Compaq	45°	Bottom (Rest)	•	•
		0°	Side 1 (Right)	•	•
		45°	Side 2 (Left)	•	•

The selected surfaces were mounted parallel to the base of the flat phantom, and a separating block was used to ensure the proper positioning of the device. Since the USB cable was a 'Y-Cable' (see Figure 15), both connectors were plugged into the laptop. The Compaq laptop was placed as far away from the MCD3000 as the USB cable would allow.

Figure 15: USB Y-Cable Shown as Connected

Photographs of each test configuration are shown below:

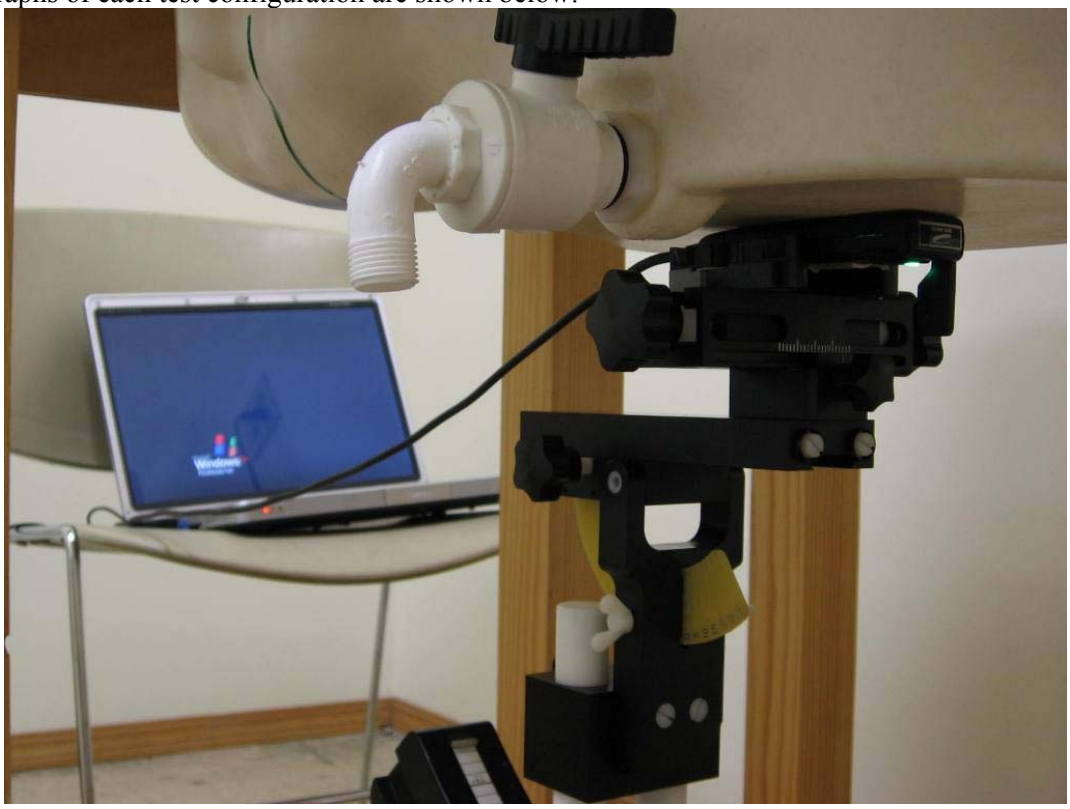

Figure 16: Setup for Tests on Rest Surface - PCS Band

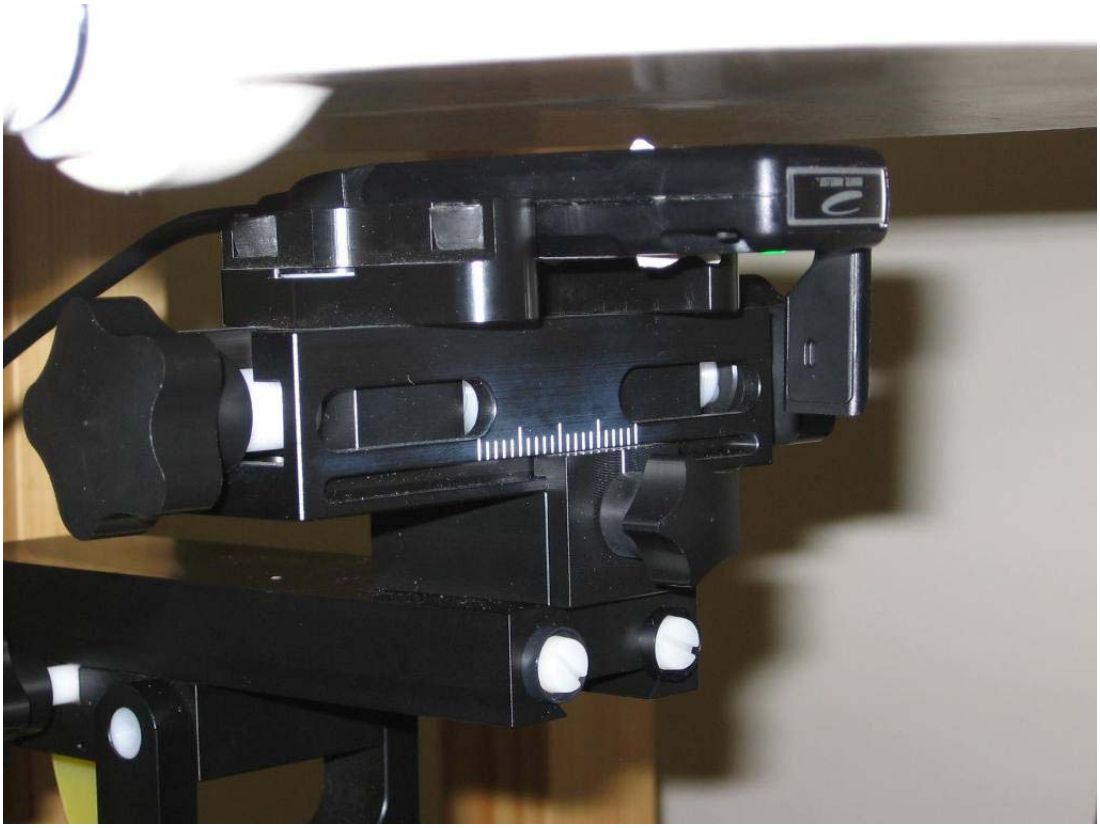

Figure 17: Rest Surface - 8.5mm Spacing with Antenna at 90 Degrees - PCS Band

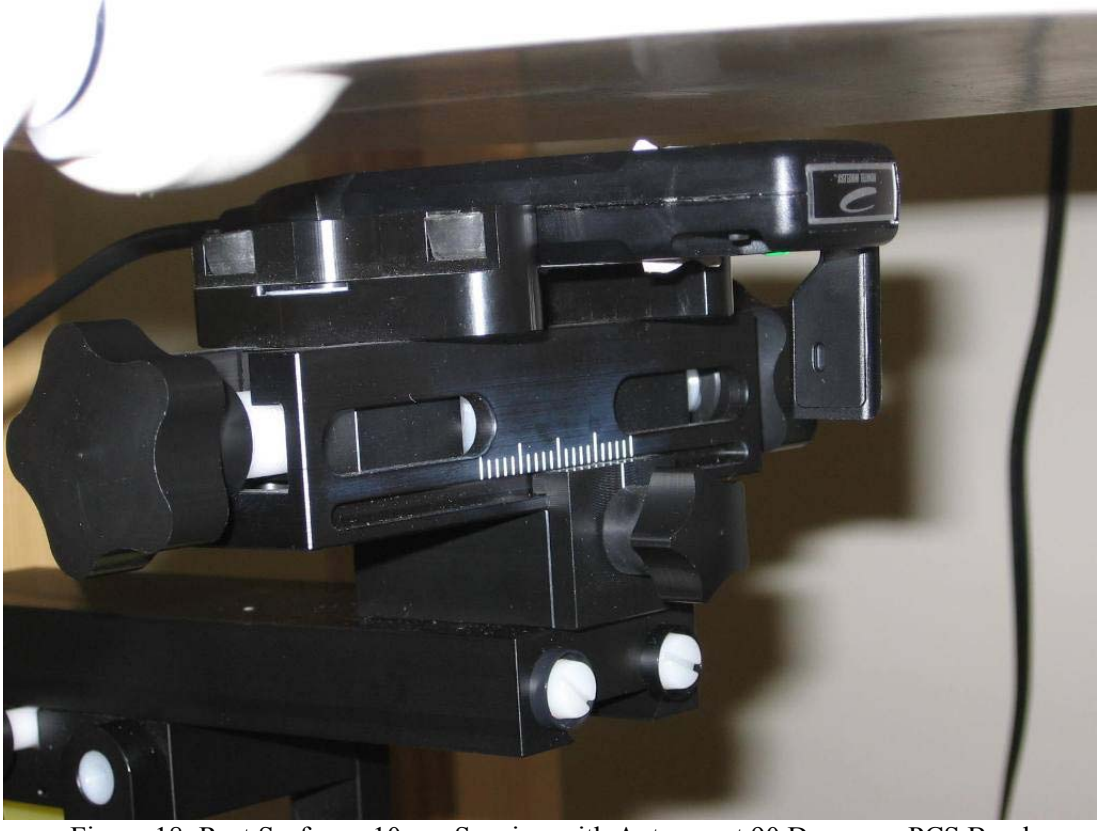

Figure 18: Rest Surface - 10mm Spacing with Antenna at 90 Degrees - PCS Band

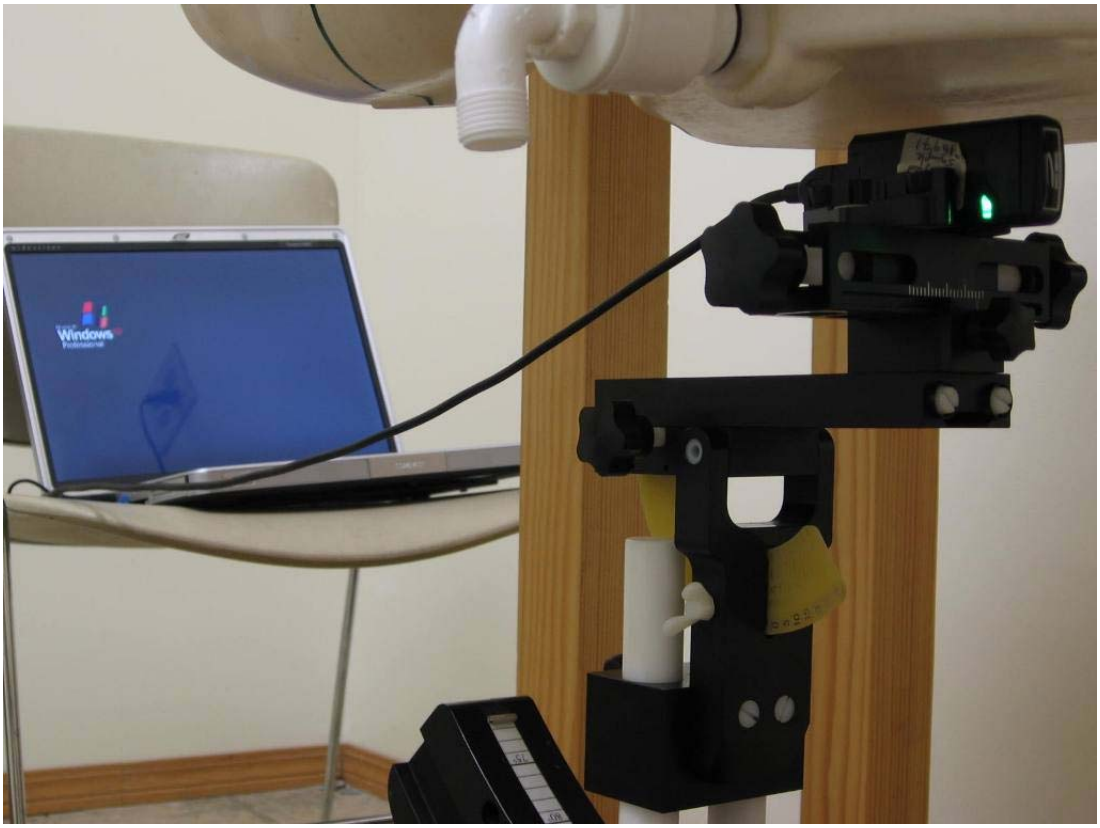

Figure 19: Setup for Tests on Left Edge - PCS Band

Figure 20: Left Edge - 8.5mm Spacing with Antenna at 0 Degrees - PCS Band

Figure 21: Left Edge - 10mm Spacing with Antenna at 0 Degrees - PCS Band

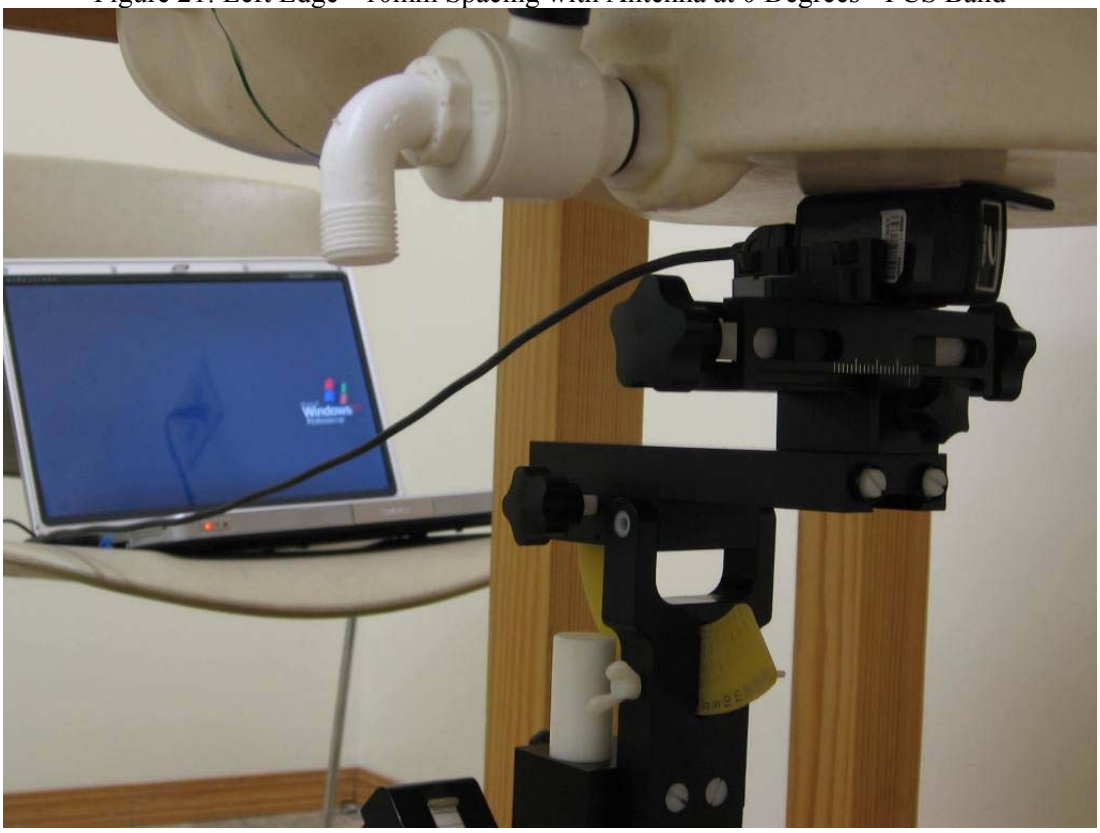

Figure 22: Setup for Tests on Right Edge - PCS Band

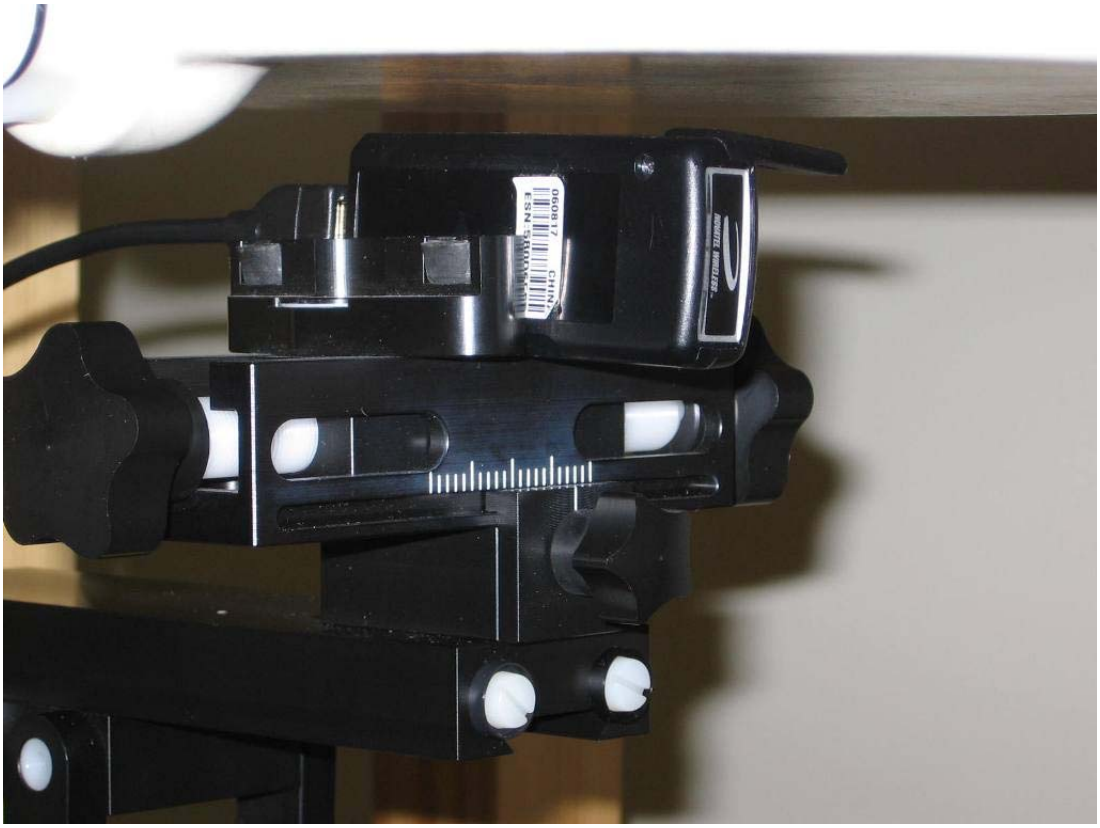

Figure 23: Right Edge - 8.5mm Spacing with Antenna at 90 Degrees - PCS Band

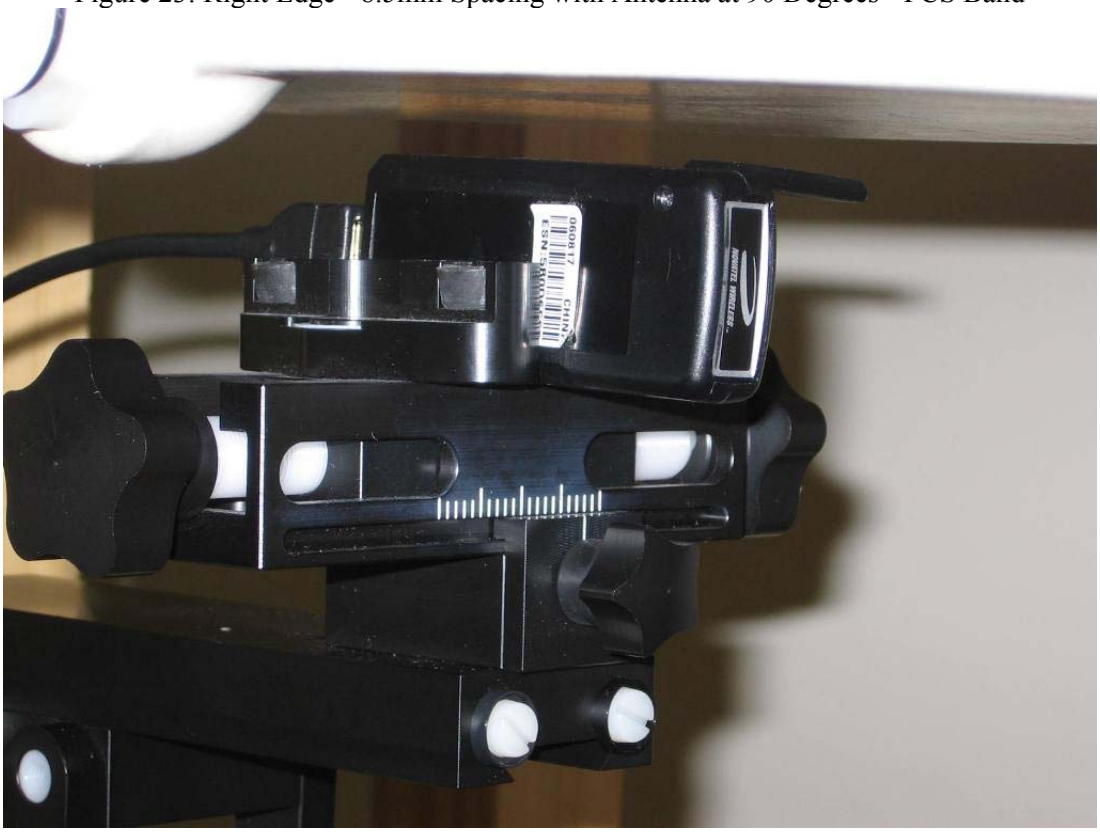

Figure 24: Right Edge - 10mm Spacing with Antenna at 90 Degrees - PCS Band

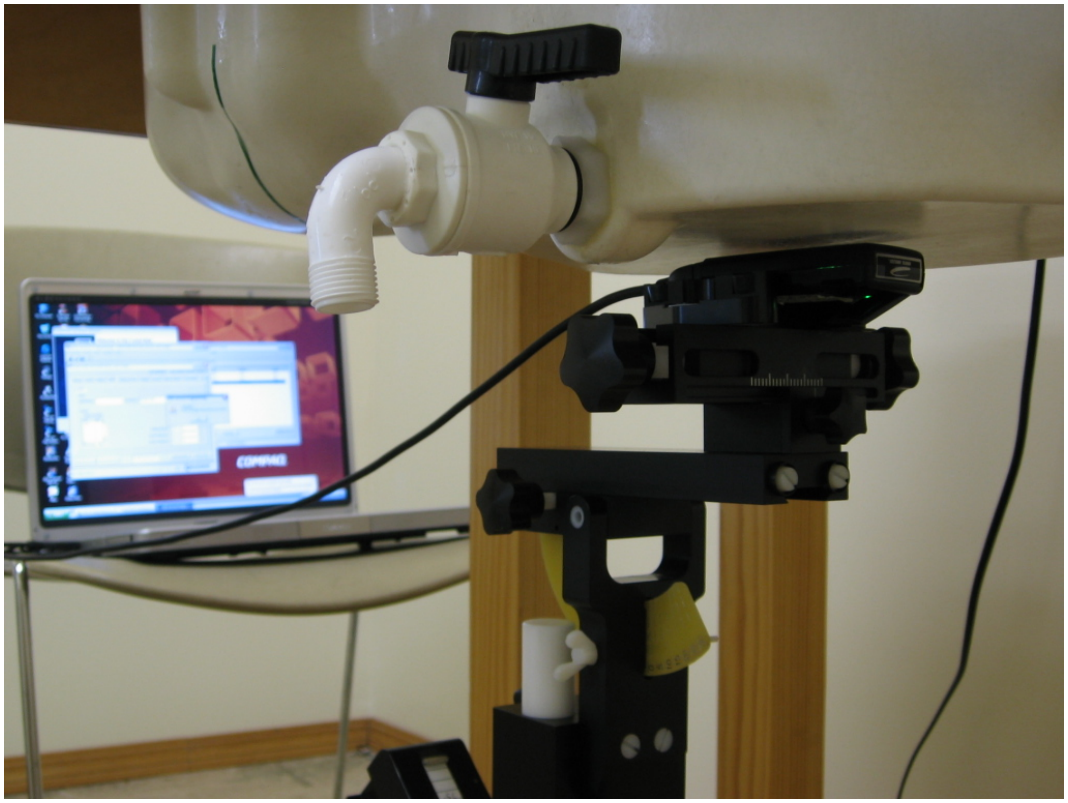

Figure 25: Setup for Tests on Rest Surface - Cell Band

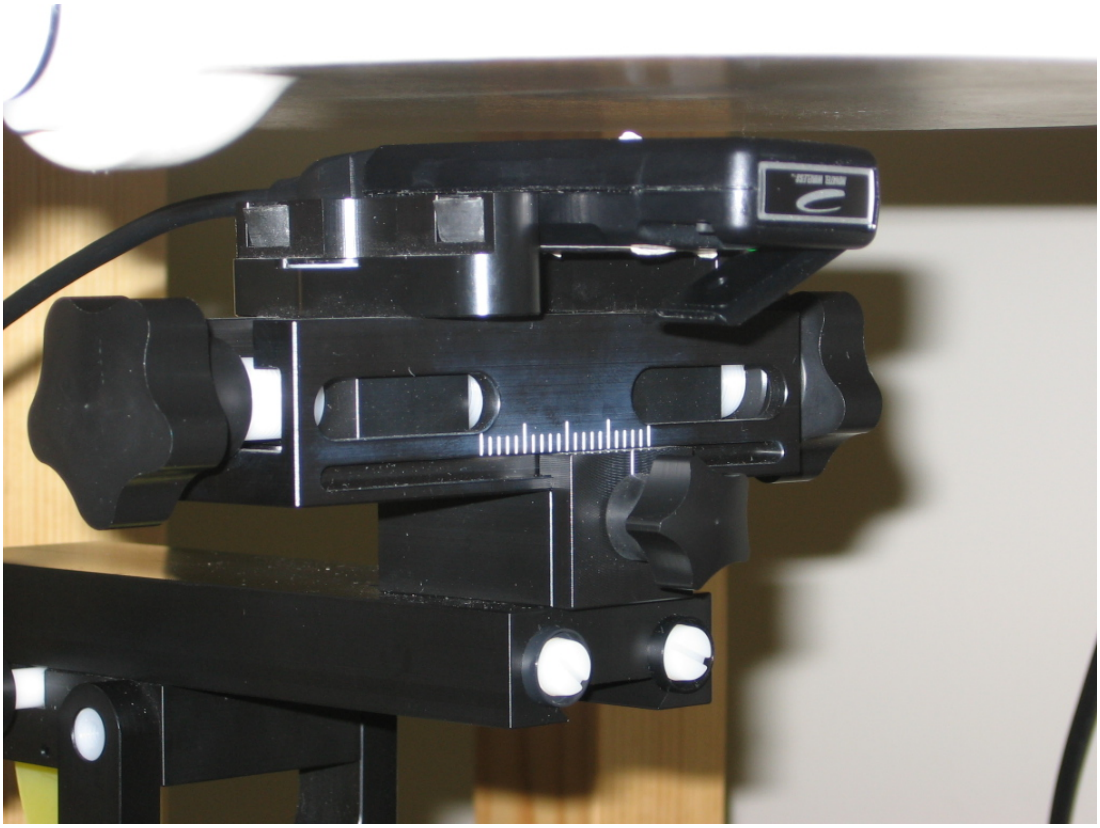

Figure 26: Rest Surface - 8.5mm Spacing with Antenna at 45 Degrees - Cell Band

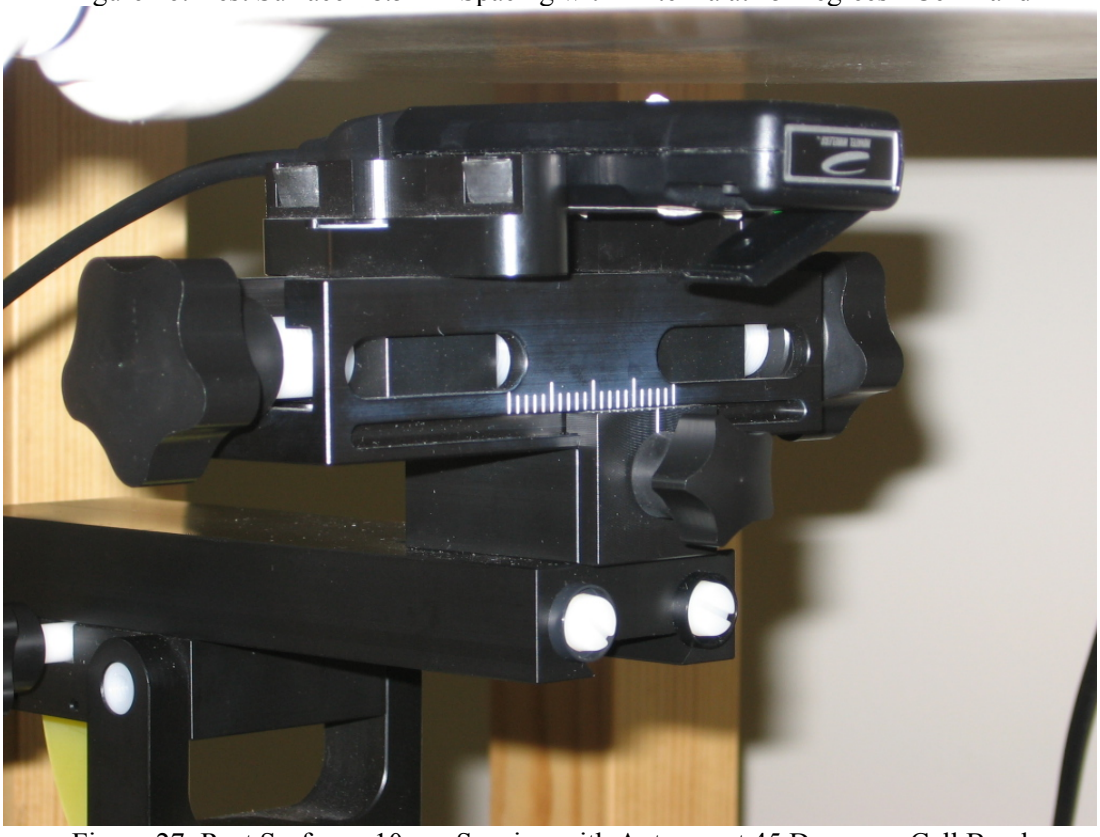

Figure 27: Rest Surface - 10mm Spacing with Antenna at 45 Degrees - Cell Band

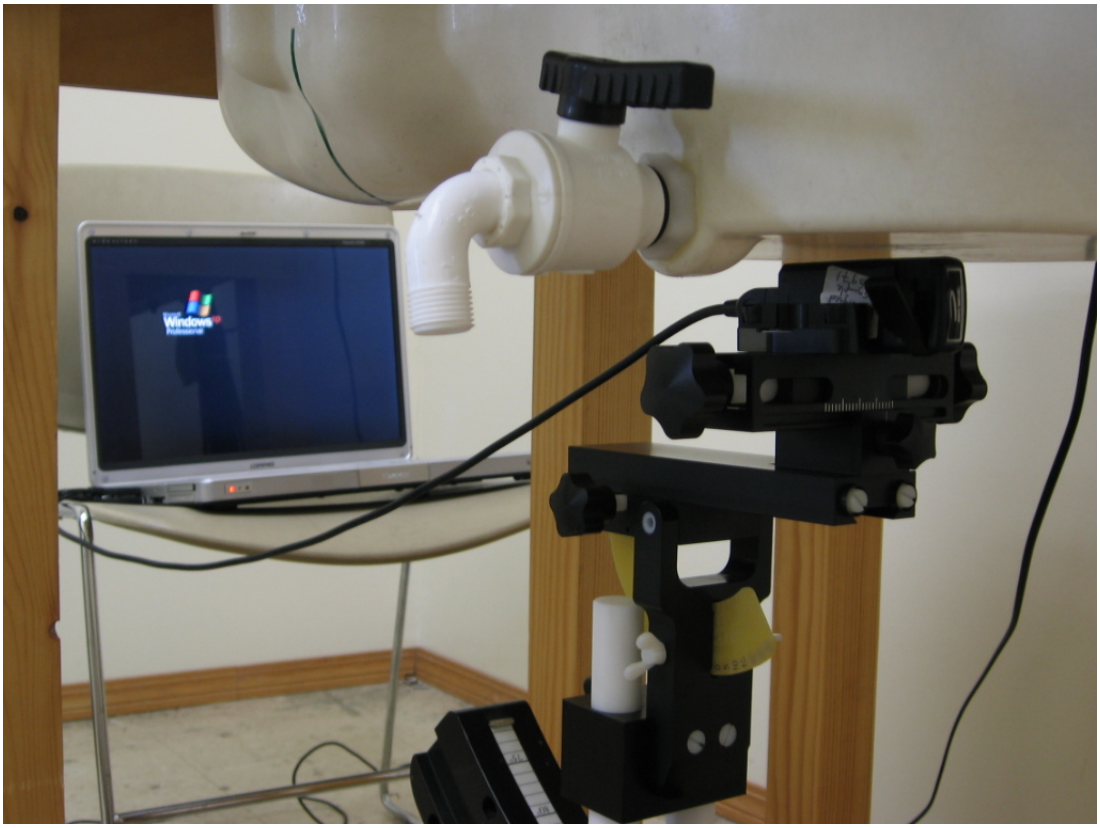

Figure 28: Setup for Tests on Left Edge - Cell Band

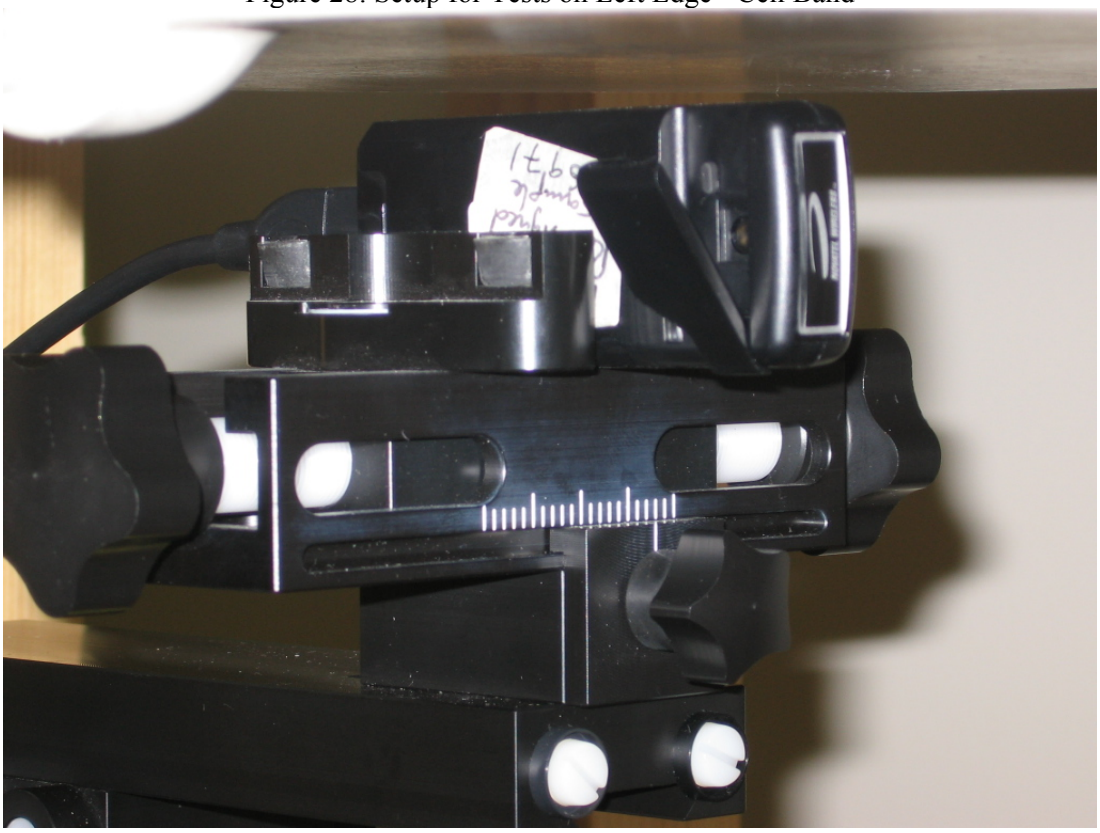

Figure 29: Left Edge - 8.5mm Spacing with Antenna at 45 Degrees - Cell Band

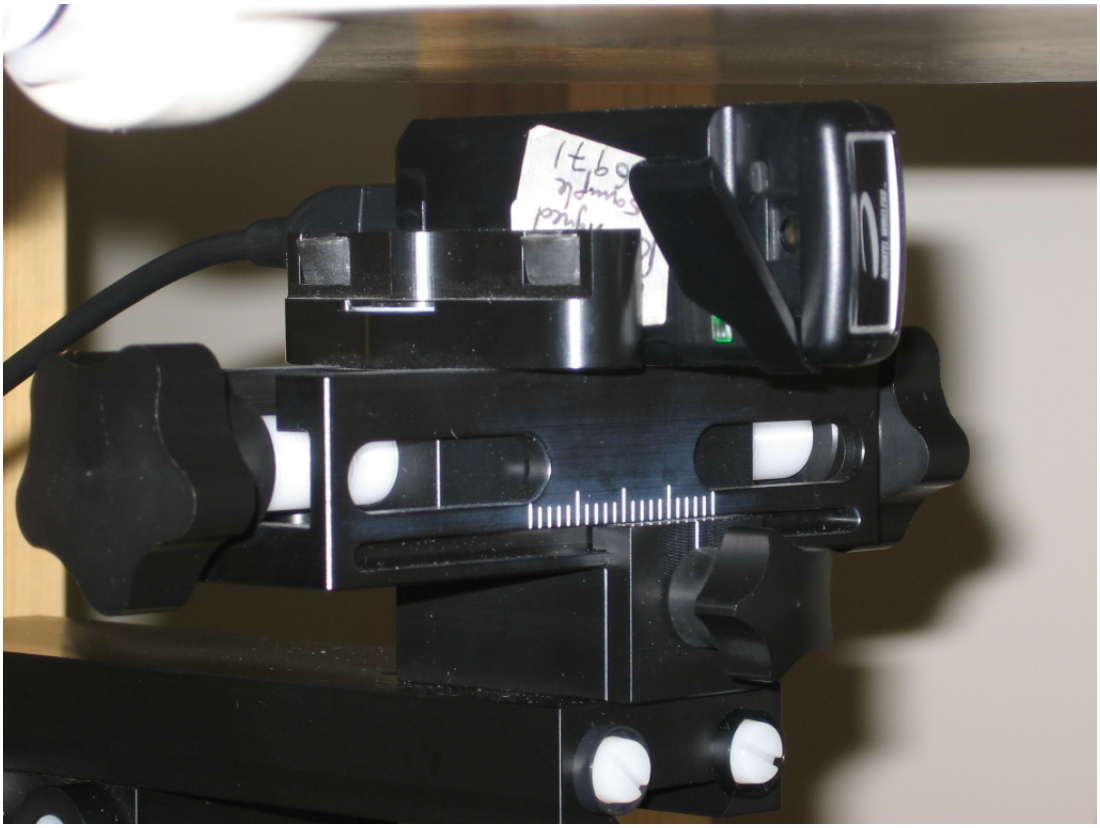

Figure 30: Left Edge - 10mm Spacing with Antenna at 45 Degrees - Cell Band

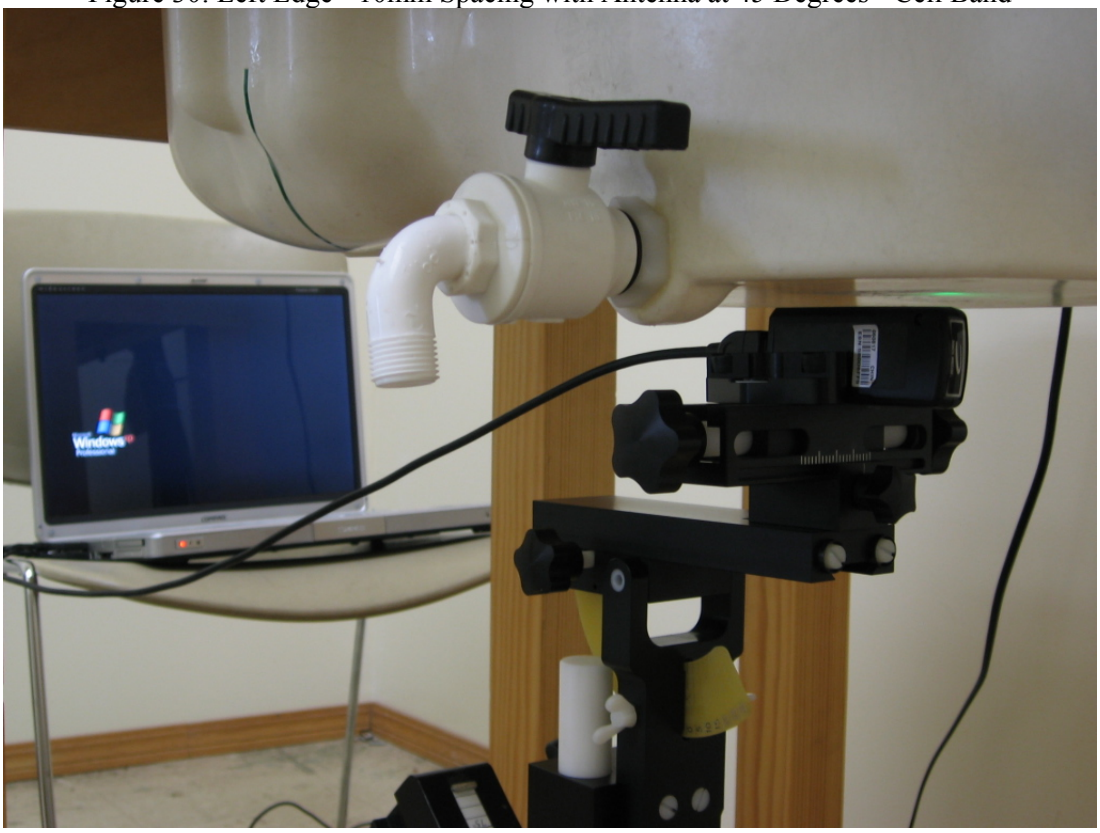

Figure 31: Setup for Tests on Right Edge - Cell Band

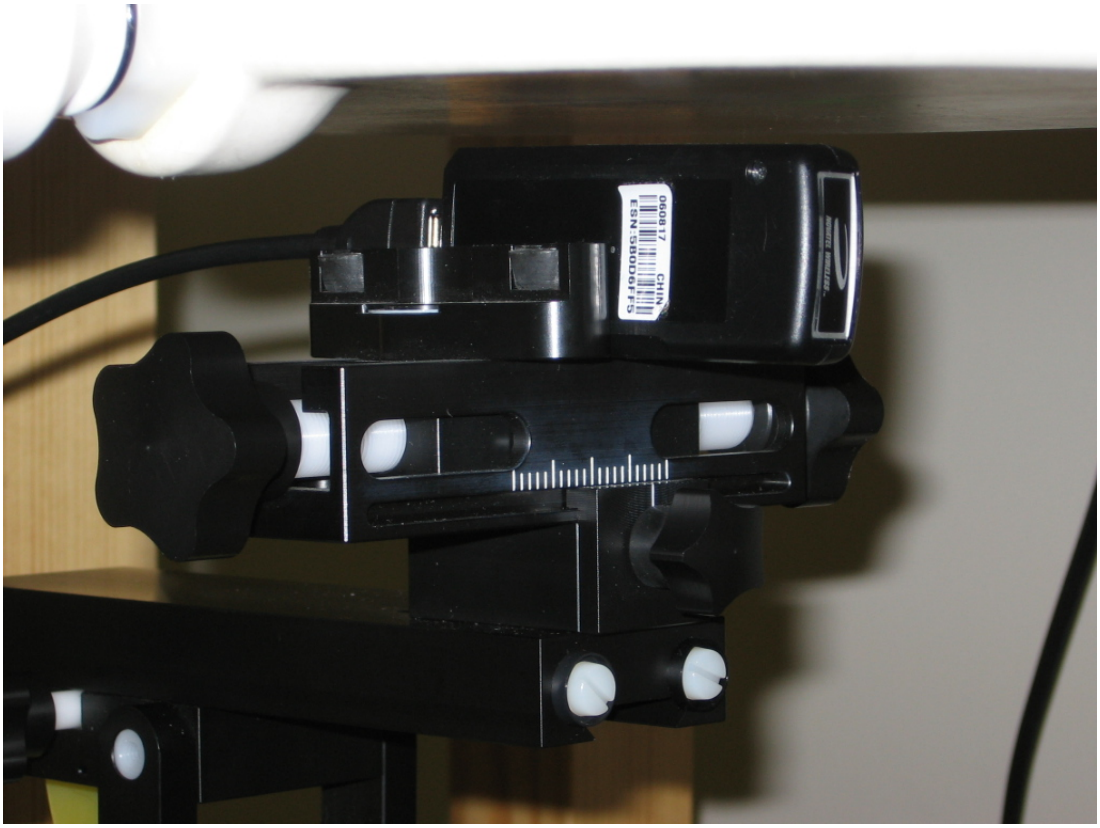

Figure 32: Right Edge - 8.5mm Spacing with Antenna at 0 Degrees - Cell Band

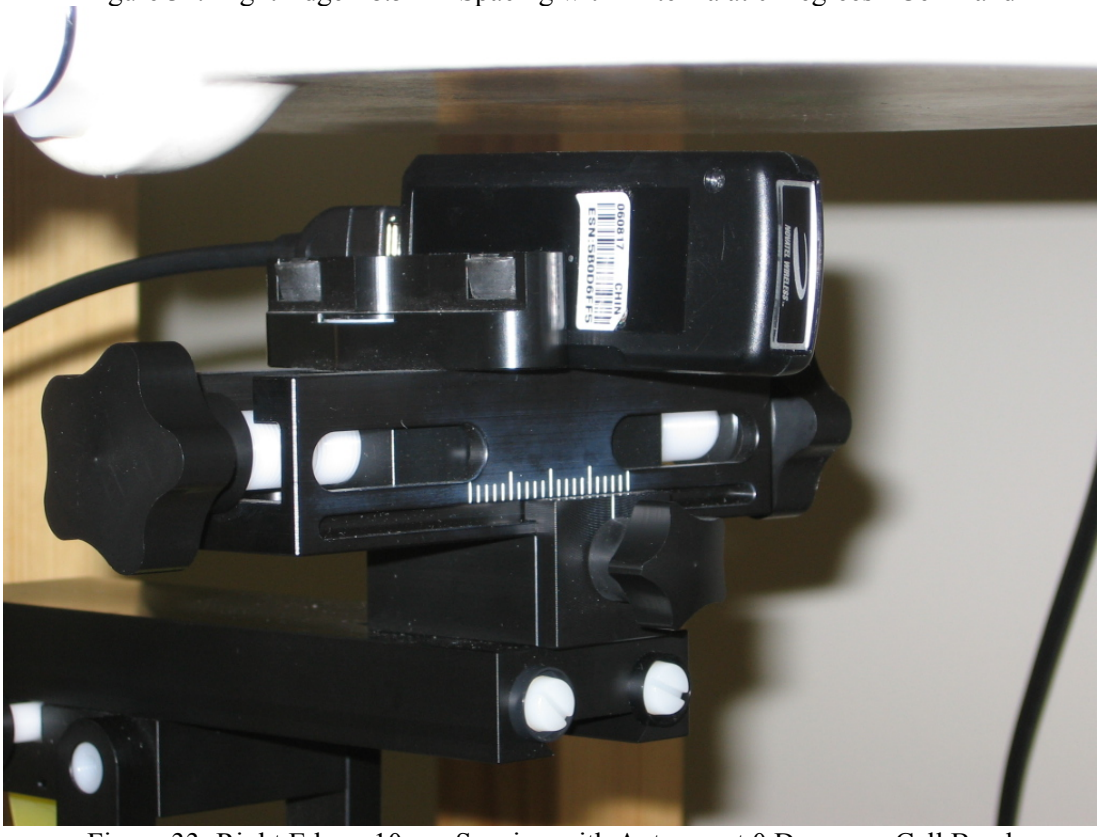

Figure 33: Right Edge - 10mm Spacing with Antenna at 0 Degrees - Cell Band

9.0 Criteria

The following FCC limits for SAR apply to devices operating in General Population/Uncontrolled Exposure environment:

Exposure (General Population/Uncontrolled Exposure environment)	SAR (W/kg)
Average over the whole body	0.08
Spatial Peak (1g)	1.60
Spatial Peak for hands, wrists, feet and ankles (10g)	4.00

10.0 Engineering Judgments

The MCD3000 was evaluated according to a test plan that was agreed upon by Intertek and Novatel Wireless (see **Heading 8. 0 Test Configuration / Test Photographs**).

The MCD3000 can operate in CDMA2000 1xRTT and 1x Ev-Do modes. According to the FCC 3G document, SAR is not required for 1xRTT mode when the maximum average output power of each channel is less than 0.25 dBm higher than that measured in the 1x Ev-Do mode. Therefore, an output power comparison was used to justify the exemption of Body-mode scans in 1xRTT mode. In no case did did the maximum average output power in 1x RTT mode exceed that measured in 1x Ev-Do mode by more than 0.25 dBm. The greatest difference was +0.22 dBm.

	Average Power (dBm)					
	Cell Channel			PCS Channel		
	1013	**384**	**777**	**25**	**600**	**1175**
1x Ev-Do Power	23.94	23.80	23.61	23.54	23.78	23.28
1x RTT Power	23.89	23.88	23.83	23.73	23.73	23.27
Difference: 1x RTT - 1x Ev-Do	-0.05	0.08	**0.22**	0.19	-0.05	-0.01

In 1xRTT mode, the device was placed in a call with power control bits set to “All Bits Up”. In 1x Ev-Do mode, a call was made with power control bits set to “All Bits Up”. The Reverse Data Channel rate was set to 153.6 kbps. FTAP was set to 307.2 kbps, transmitting in all slots.

11.0 Tabular Test Results

The results on the following page(s) were obtained when the device was tested in the condition described in this report. Detailed measurement data and plots, which reveal information about the location of the maximum SAR with respect to the device, are referenced under **Heading 12.0 - Graphical SAR Scan Results**. The extrapolated SAR results account for the drift measurements using the following formula:

Extrapolated SAR = Measured SAR*10^-(Drift/10)

For positive drift values no extrapolation was performed. A dashed line will appear in the table for the extrapolation values in this case.

Conducted Power Measurements

These conducted power measurements for the MCD3000 were made using an Agilent 8960 base station simulator. Cable loss was accounted for within the test set by offsetting the readings by the appropriate amounts. Readings were taken at the RF port that was present under the MCD3000's flip-antenna.

Measurements are provided in the table below for the MCD3000 operating in both CDMA2000 1xRTT and 1x Ev-Do modes. In 1xRTT mode, the device was placed in a call with power control bits set to "All Bits Up". In 1x Ev-Do mode, a call was made with power control bits set to "All Bits Up". The Reverse Data Channel rate was set to 153.6 kbps. FTAP was set to 307.2 kbps, transmitting in all slots.

	Max Power (dBm)					
	Cell Channel			**PCS Channel**		
	1013	**384**	**777**	**25**	**600**	**1175**
1x Ev-Do Power	**24.16**	23.97	24.04	23.76	23.90	23.66
1x RTT Power	24.00	**24.03**	23.98	23.93	23.82	23.30

Evaluation For: Novatel Wireless Modem FCC ID: **PKRNVWMCD3000**
Model: MCD3000 / U720 / USB720 with USB Cable (P/N 2175002)

Body Mode Tabular Test Results

During each test, the RF output power of the test sample varied by a small amount due to heat and battery output power variations in the laptop. To take this power drift into account, a reference measurement was performed at a predefined position in the fluid just before and just after each SAR scan. The difference in these values is recorded in the table below as the SAR drift. The 1-g SAR was extrapolated for drift and is shown in the table below.

Flat Phantom; Body / Data Mode; 1:1 Mode; CDMA PCS Band										
Freq. (MHz)	**Ant. Pos.**	**Laptop Used**	**Separation Distance from Flat Phantom**	**Device Face Under Test**	**Attachments or Accessories**	**SAR Drift (dB)**	**Measured 1-g SAR (mW/g)**	**Meas. 10g-SAR (mw/g)**	**Extrapolated Worst Case 1-g SAR (mW/g)**	**Extrapolated Worst Case 10-g SAR (mW/g)**
1880.00000	90°	Compaq	8.5 mm	Rest surface	None	-0.056	0.459	0.266	0.465	0.269
1880.00000	0°	Compaq	8.5 mm	Side 2 "Left"	None	0.104	0.314	0.187	0.307	0.183
1851.25000	90°	Compaq	8.5 mm	Side 1 "Right"	None	0.050	1.500	0.790	-	-
1880.00000	90°	Compaq	8.5 mm	Side 1 "Right"	None	0.111	1.450	0.762	-	-
1908.75000	**90°**	**Compaq**	**8.5 mm**	**Side 1 "Right"**	**None**	**0.067**	**1.540**	**0.772**	**-**	**-**
1880.00000	90°	Compaq	10 mm	Rest surface	None	0.288	0.378	0.219	-	-
1880.00000	0°	Compaq	10 mm	Side 2 "Left"	None	-0.301	0.252	0.149	0.270	0.160
1851.25000	90°	Compaq	10 mm	Side 1 "Right"	None	0.037	1.190	0.645	-	-
1880.00000	90°	Compaq	10 mm	Side 1 "Right"	None	-0.199	1.180	0.641	1.235	0.671
1908.75000	**90°**	**Compaq**	**10 mm**	**Side 1 "Right"**	**None**	**-0.264**	**1.210**	**0.633**	**1.286**	**0.673**

Flat Phantom; Body / Data Mode; 1:1 Mode; CDMA Cell Band										
Freq. (MHz)	**Ant. Pos.**	**Laptop Used**	**Separation Distance from Flat Phantom**	**Device Face Under Test**	**Attachments or Accessories**	**SAR Drift (dB)**	**Measured 1-g SAR (mW/g)**	**Meas. 10g-SAR (mw/g)**	**Extrapolated Worst Case 1-g SAR (mW/g)**	**Extrapolated Worst Case 10-g SAR (mW/g)**
824.70000	45°	Compaq	8.5 mm	Rest surface	None	0.111	0.757	0.506	-	-
836.52000	45°	Compaq	8.5 mm	Rest surface	None	0.310	0.822	0.542	-	-
848.31000	45°	Compaq	8.5 mm	Rest surface	None	-0.168	0.821	0.548	0.853	0.570
836.52000	45°	Compaq	8.5 mm	Side 2 "Left"	None	0.120	0.469	0.309	-	-
836.52000	0°	Compaq	8.5 mm	Side 1 "Right"	None	-0.117	0.589	0.388	0.605	0.399
836.52000	45°	Compaq	10 mm	Rest surface	None	-0.156	0.680	0.463	0.705	0.480
836.52000	45°	Compaq	10 mm	Side 2 "Left"	None	0.248	0.413	0.272	-	-
836.52000	0°	Compaq	10 mm	Side 1 "Right"	None	-0.044	0.518	0.340	0.523	0.343

12.0 Graphical SAR Scan Results

Graphical SAR scan results can by found in the following accompanying document:

MCD3000 with USB Cable Graphical SAR Scan Results.pdf