

**EMC TEST REPORT**

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

**Product: USB connected 1xEVDO Data Modem  
Model Number: MCD3000/ U720 / USB720  
Product FCCID: PKRNVWMCD3000**

**Tested to the Criteria in  
FCC Part 15, Subpart B,  
FCC Part 22 Subpart H, and FCC Part 24 Subpart E**

**Date: 9/22/2006  
Project Number: 3103199  
Report Number: 3103199LEX-002**

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Evaluation For: Novatel Wireless  
Model No: MCD3000 / U720 / USB720

FCC ID: PKRNVWMCD3000

## 1 JOB DESCRIPTION

The MCD3000 has been tested at the request of:

<b>Manufacturer of the device:</b>	Novatel Wireless 9645 Scranton Rd, Suite 205 San Diego, CA, 92121
<b>Model number of the device:</b>	MCD3000 / U720 / USB720
<b>Name of contact:</b>	John Spall
<b>Telephone:</b>	(858) 812-3477
<b>E-mail:</b>	jspall@nvtl.com
<b>Manufacturer of the radio:</b>	Novatel Wireless
<b>Model Number of the radio:</b>	ES720
<b>Serial Number of the radio:</b>	LI270706200012
<b>EUT receive date:</b>	8/21/2006
<b>EUT received condition:</b>	Good condition production unit
<b>Test start date:</b>	9/20/2006
<b>Test end date:</b>	9/22/2006

**1.1 Test Sample Description**

The MCD3000 is a USB-connected CDMA2000 Ev-Do (Rev 0) modem which can be used in either desktop or laptop applications.

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

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

Test sample Accessories		
<b>Battery type</b>	None	
<b>Belt clip</b>	None	

<b>Test Signal Mode</b>	
<b>Test Commands</b>	
<b>Base Station Simulator</b>	X

**1.2 System Support Equipment**

Table 1-1 contains the details of the support equipment associated with the Equipment Under Test during the testing.

*Table 1-1: System Support Equipment*

Description	Manufacturer	Model Number	Serial Number
Laptop Computer	Compaq	Presario V4000	2CE6030PJ

**1.3 Cables Used During Testing**

Table 1-2 contains the details of the cables used during the testing. Since the USB connected 1xEVDO Data Modem plugged directly into a USB port on a computer, the only cables used were the power cords for the laptop.

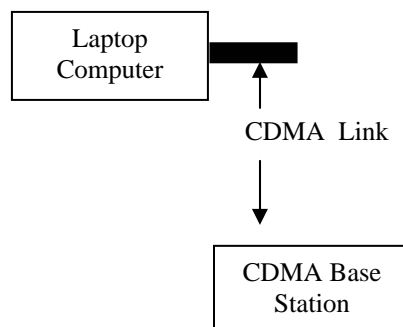
*Table 1-2: Interconnecting Cables Used During Testing*

Cables					
Description	Length	Shielding	Ferrites	Connection	
				From	To
AC Power Cord	3 ft	None	None	AC Power Source	Laptop Power Brick
DC Power Cord	5 ft	None	None	Laptop Power Brick	Laptop DC Power Input

#### 1.4 System Block Diagram(s)

The diagrams below detail the interconnection of the EUT and its accessories during the testing.

*Figure 1-1: Radiated Test Configuration*



#### 1.5 Mode(s) of operation / Engineering Judgments

The USB connected 1xEVDO Data Modem was plugged into a USB port on a laptop computer during all testing. The laptop was powered by the AC/DC power brick supplied with it. During the testing a base station simulator was used to force the USB connected 1xEVDO Data Modem to transmit on low, mid, and high channels and at maximum output power. When necessary, the base station was used to force the USB connected 1xEVDO Data Modem to transmit in EVDO mode. The FCC part 15 testing was performed with the USB connected 1xEVDO Data Modem in receive mode only.

## 2 EXECUTIVE SUMMARY

Testing was performed for Novatel Wireless on the MCD3000. A description of the tests performed and the results are shown in the table below. For actual test data, see the corresponding report section following this summary table.

The MCD3000 was **compliant** with all tests mentioned below.

FCC Rule	Test Description	Result	Page
§2.1046	Conducted RF Power Output	<b>Compliant</b>	9
§22.913, §24.232	Radiated RF Power Output	<b>Compliant</b>	11
§2.1051 §22.917(a) §24.238(a)	Conducted Spurious Emissions at Antenna Terminals	<b>Compliant</b>	13
§15.107	Power Line Conducted Emissions	<b>Compliant</b>	16
§15.109	Receiver Spurious Emission	<b>Compliant</b>	17

### 2.1 Modifications required for compliance

No modifications were implemented by Intertek. All results in this report pertain to the un-modified sample provided to Intertek.

## 2.2 Test Site

All testing was performed at the Intertek office located at 731 Enterprise Drive, Lexington Kentucky, 40510.

The test site is listed with the FCC under registration number 485103.

The test site is listed with Industry Canada under site number IC 2055.

The conducted emissions for mains ports, radiated emissions, and telco ports conducted emissions sites are listed with the VCCI under registration numbers C-2214, R2056, and T-195.

## 2.3 Test Equipment

Description	Manufacturer	Model Number	Asset Number	Calibration due date
Horn Antenna	EMCO	3115	2360	7/28/2007
EMI Receiver	Rohde & Schwarz	ESI 26	2327	9/6/2007
LISN			2508	5/9/2007
Bilog Antenna	EMCO	3142C	3133	11/30/2006
Preamplifier	Miteq	AFS44-00102000-30-10P-44	3075	6/15/2007
Base Station Simulator	Agilent	8960	3130	10/10/2007
Power Meter	Gigatronics	8541C	3165	6/25/2007
Power Meter	Gigatronics	8541C	3166	6/25/2007
Power Sensor	Gigatronics	8541C	3167	6/25/2007
Power Sensor	Gigatronics	8541C	3168	6/25/2007



### 3 CONDUCTED RF POWER

FCC Rule: §2.1046

#### 3.1 Test Procedure

- 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.

#### 3.2 Test Results

The USB connected 1xEVDO Data Modem met the RF power output requirements of FCC Part 22 Subpart H and FCC Part FCC Part 24 Subpart E. The test results are located in Table 3-1.

*Table 3-1 Conducted RF Power*

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

#### **4 RADIATED RF POWER**

FCC Rule §22.913; The Effective Radiated Power (ERP) of mobile transmitters and auxiliary test transmitters must not exceed 7 Watts.

FCC Rule §24.232; The equivalent Isotropic Radiated Power (EIRP) must not exceed 2 Watts.

##### **4.1 Test Procedure**

- The USB connected 1xEVDO Data Modem was tested in an anechoic chamber with a 2-axis position system that permits taking complete spherical scans of the EUT's radiation patterns.
- The chamber was pre-calibrated using a substitution method to yield radiated power results referenced to an isotropic radiator (EIRP).
- For all tests, the USB connected 1xEVDO Data Modem was installed in a laptop placed on top of a non-conductive support.
- Tests were performed with the USB connected 1xEVDO Data Modem transmitting in CDMA Cell and PCS bands on low, mid, and high channels.
- During the tests the USB connected 1xEVDO Data Modem was weakly coupled to the test set and configured to transmit in full data rate mode.
- Radiated power was measured at each 15 degree step.
- From these measurements, the software calculates the angle at which maximum radiated power occurs and the radiated power at this angle is extracted.

**4.2 Test Results**

The USB connected 1xEVDO Data Modem met the radiated power requirements of FCC §24.232. The test results are located in Table 4-1. These test results are referenced to an isotropic radiator (EIRP). To get results in reference to a dipole (ERP) subtract 2.14 from these values.

*Table 4-1 Radiated RF Power*

<b>Tx Antenna Orientation</b>	<b>Technology</b>	<b>Band</b>	<b>Channel</b>	<b>EIRP (dBm)</b>
0	CDMA	Cell	384	26.89
0	CDMA	Cell	777	27.08
0	CDMA	Cell	1013	<b>28.34</b>
0	CDMA	PCS	25	22.07
0	CDMA	PCS	600	23.13
0	CDMA	PCS	1175	21.73
45	CDMA	Cell	384	25.22
45	CDMA	Cell	777	26.18
45	CDMA	Cell	1013	26.80
45	CDMA	PCS	25	24.43
45	CDMA	PCS	600	25.15
45	CDMA	PCS	1175	24.19
90	CDMA	Cell	384	25.22
90	CDMA	Cell	777	26.43
90	CDMA	Cell	1013	26.50
90	CDMA	PCS	25	25.04
90	CDMA	PCS	600	26.08
90	CDMA	PCS	1175	26.32

## 5 OUT OF BAND EMISSION AT ANTENNA TERMINALS

FCC §2.1051, §22.917(a), §24.238(a)

Out of Band Emissions: The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least  $43 + 10 \log(P)$  dB.

### 5.1 Test Procedure

- The RF output of the transceiver was connected to a spectrum analyzer and a base station simulator through an RF coupler.
- The base station simulator was set to force the EUT to its maximum power setting.
- The resolution bandwidth of the spectrum analyzer was set at 1 MHz.
- Sufficient scans were taken to show the out of band emissions if any up to 10th harmonic.
- The resulting data was corrected for the loss from the RF coupler and connecting cable and was plotted against the limit.
- Testing was performed on low, mid, and high channels.

**5.2 Test Results**

The MCD3000 met the out of band emission at antenna terminal requirements.

Figure 5-1: Out of band emissions at antenna terminals – CDMA 800 Channel 384, 777, and 1013

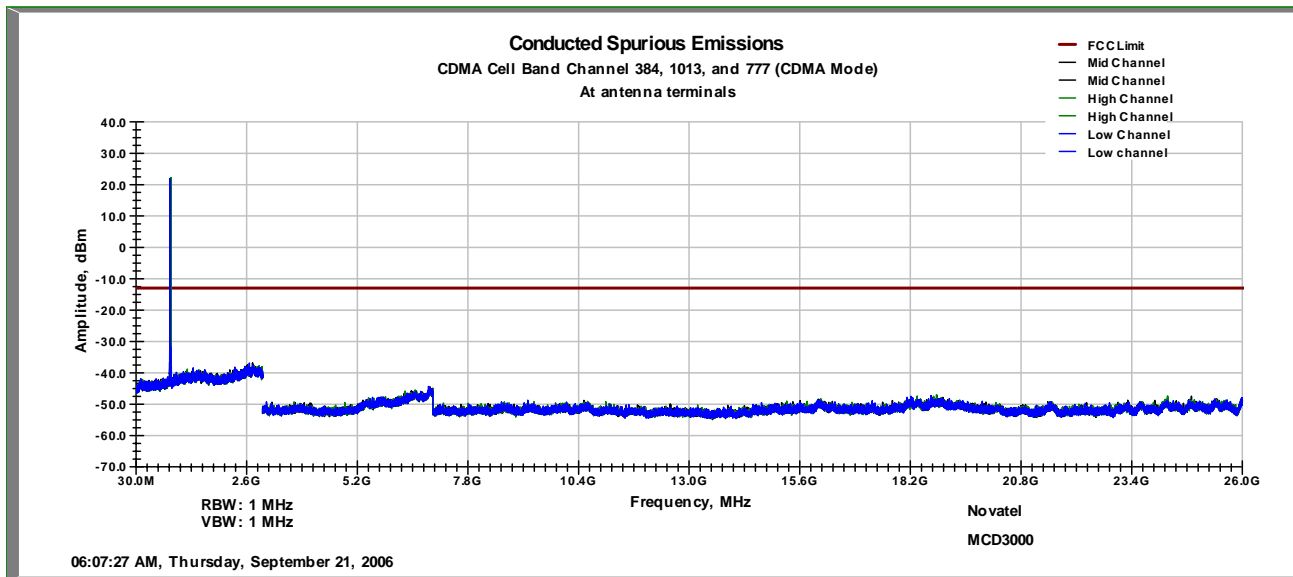


Figure 5-2: Out of band emissions at antenna terminals – CDMA 800 Channel 384, 777, and 1013 (EVDO)

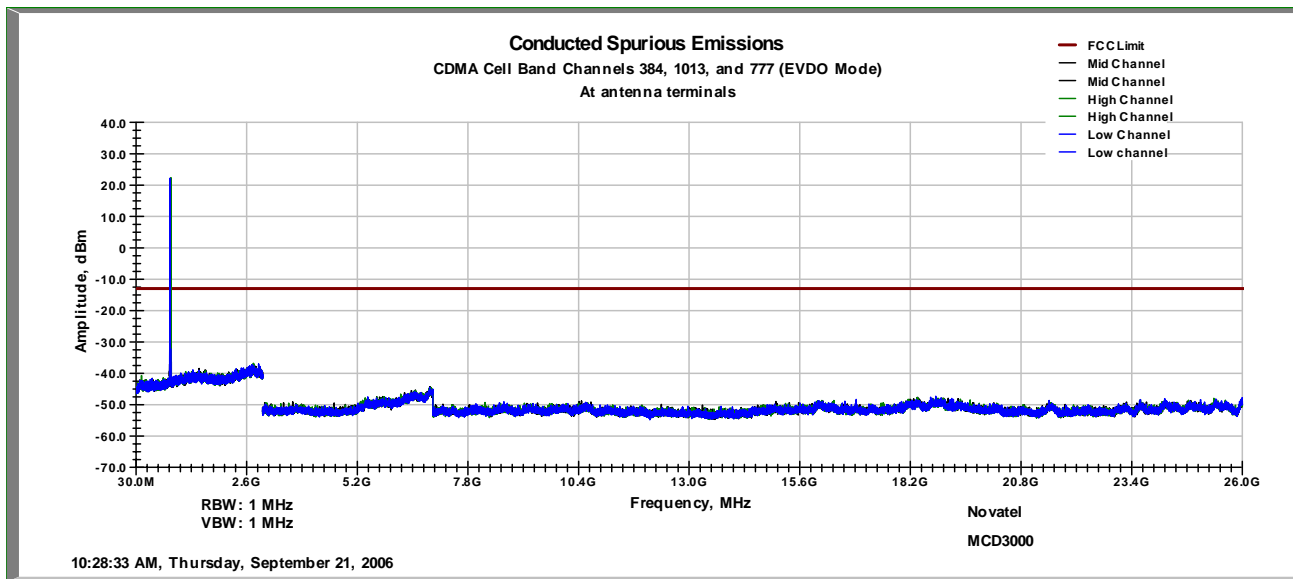


Figure 5-3: Out of band emissions at antenna terminals – CDMA1900 Channel 25, 600, 1175

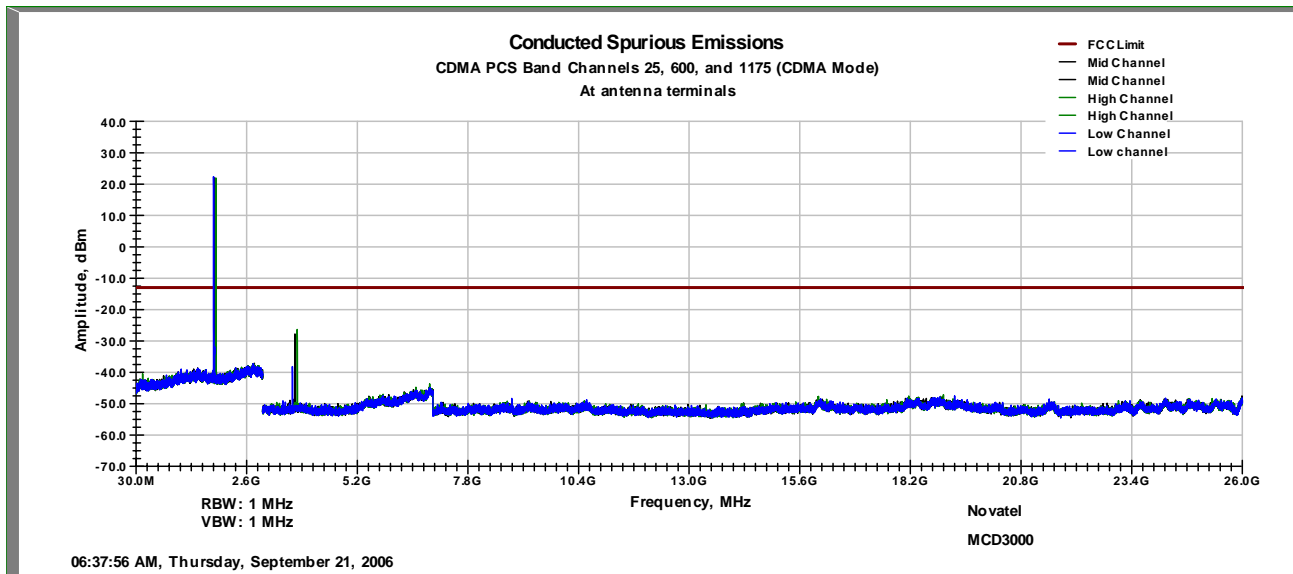
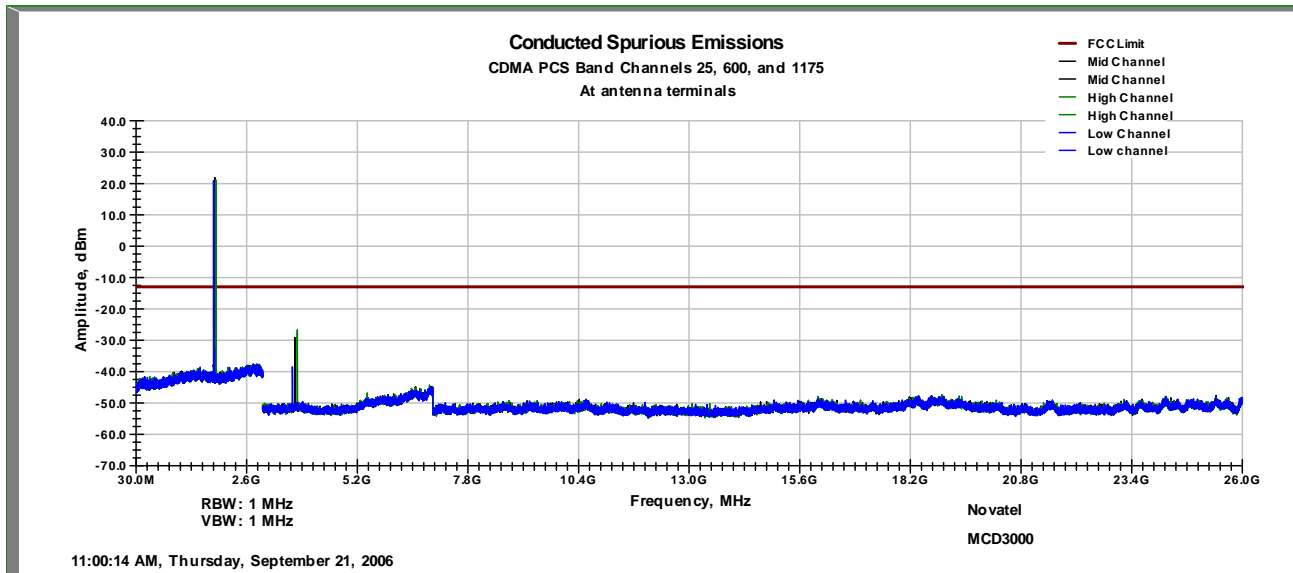


Figure 5-4: Out of band emissions at antenna terminals – CDMA1900 Channel 25, 600, 1175 (EVDO)



## **6 POWER LINE CONDUCTED EMISSIONS**

FCC §15.107

### **6.1 Test Procedure**

Conducted voltage emission measurements were performed as follows:

- The USB connected 1xEVDO Data Modem was plugged into a laptop which was connected to a 120VAC power source using a Line Impedance Stabilization Network (LISN).
- A spectrum analyzer was connected to the RF port of the LISN installed on the line under test.
- The USB connected 1xEVDO Data Modem was powered and set to receive mode.
- The orientation of each connecting cable was varied to find the configuration that maximized the conducted emission.
- The insertion loss of the measurement cable, the LISN insertion loss, and the output of the spectrum analyzer were added together to give a corrected reading in dBuV.
- The corrected reading was compared to the limit above to determine compliance.
- A quasi-peak and/or average detector was used for measurements close to or exceeding the limit with a peak detector.

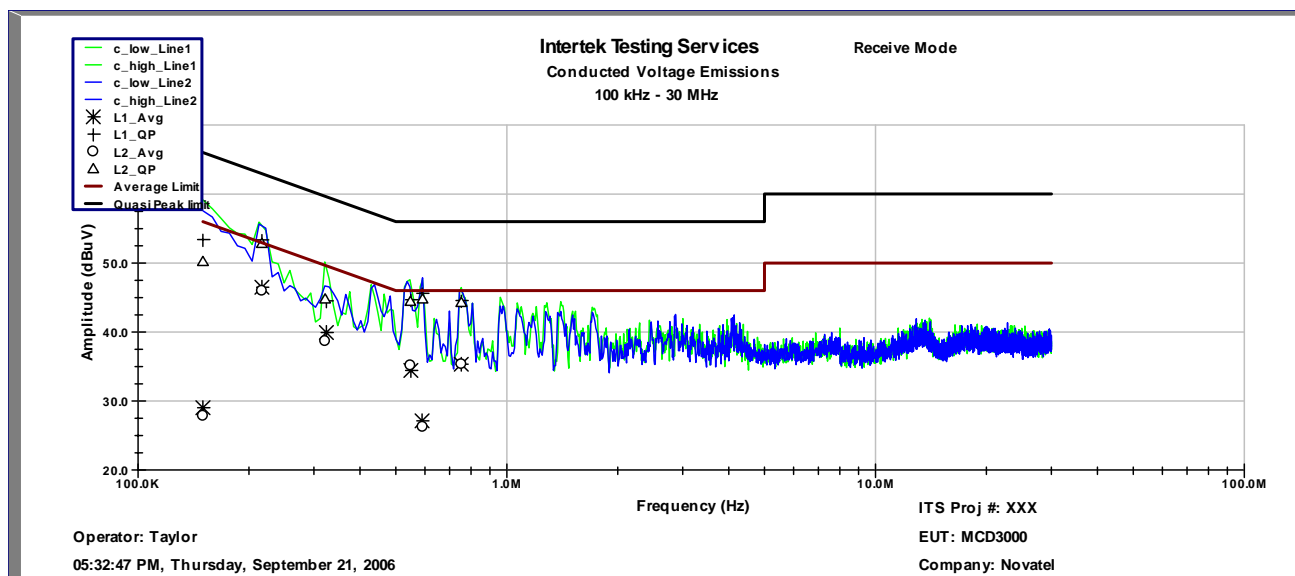
### 6.2 Test Results

The MCD3000 met the power line conducted emission requirements of FCC §15.107. The quasi-peak and average test results are located in Figure 6-1. Graphical data is shown in Figure 6-2. The graphical data, measured with the appropriate detector, was all below the class B quasi-peak and average limits. Testing was performed on the AC input of the host computer.

Figure 6-1: FCC §15.107 Power Line Conducted Emissions (Lines 1 and 2 )

Line	Frequency (MHz)	Quasi-Peak (dBuV)	Quasi-Peak Limit (dBuV)	Quasi-Peak Delta (dB)	Average (dBuV)	Average Limit (dBuV)	Average Delta (dB)	Results
Line 1	150.0 KHz	53.4	66	-12.6	29.03	56	-26.97	Compliant
Line 1	216.7 KHz	53.34	62.94	-9.6	46.48	54.09	-7.61	Compliant
Line 1	324.1 KHz	44.51	59.6	-15.09	39.93	51.03	-11.1	Compliant
Line 1	549.5 KHz	44.67	56	-11.33	34.43	46	-11.57	Compliant
Line 1	589.4 KHz	45.6	56	-10.4	27.13	46	-18.87	Compliant
Line 1	752.3 KHz	44.57	56	-11.43	35.33	46	-10.67	Compliant
Line 2	150.0 KHz	50.19	66	-15.81	27.85	56	-28.15	Compliant
Line 2	216.7 KHz	52.81	62.94	-10.13	45.98	54.09	-8.11	Compliant
Line 2	321.6 KHz	44.77	59.67	-14.89	38.67	51.1	-12.43	Compliant
Line 2	547.9 KHz	44.41	56	-11.59	35.16	46	-10.84	Compliant
Line 2	591.0 KHz	44.76	56	-11.24	26.26	46	-19.74	Compliant
Line 2	753.0 KHz	44.27	56	-11.73	35.35	46	-10.65	Compliant

Figure 6-2 FCC §15.10 Power Line Conducted Emissions (Lines 1 and 2 ) Graphical Data





**7 RECEIVER SPURIOUS EMISSIONS**

FCC §15.109

**7.1 Test Limits**

*Table 7-1 Radiated Emission Limit for FCC §15.109*

<b>Radiated Emission Limits at 3 meters</b>	
<b>Frequency (MHz)</b>	<b>Quasi-Peak limits, dB (µV/m)</b>
30 to 88	40.0
88 to 216	43.5
216 to 960	46.0
960 and up	54.0

**7.2 Test Procedure**

- Measurements are made over the frequency range of 30 MHz to five times the highest frequency operating within the device.
- The measuring receiver meets the requirements of Section One of CISPR 16 and the measuring antenna correlates to a balanced dipole.
- From 30 to 1000 MHz, a quasi-peak detector was used for measurement. Above 1000 MHz, average measurements were performed.
- The antenna is adjusted between 1m and 4m in height above the ground plane for maximum meter reading at each test frequency.
- The antenna-to-EUT azimuth is varied during the measurement to find the maximum field-strength readings.
- The antenna-to-EUT polarization (horizontal and vertical) is varied during the measurements to find the maximum field-strength readings.
- The EUT, where intended for tabletop use, is placed on a table whose top is 0.8m above the ground plane. The table is constructed of non-conductive materials. Its dimensions are 1m by 1.5m, but may be extended for larger EUT.
- Equipment setup for radiated disturbance tests followed the guidelines of ANSI C63.4.

### 7.3 Test Results

The USB connected 1xEVDO Data Modem was **compliant** with the radiated disturbance requirements of FCC §15.109 for a class B device. The maximized quasi peak data can be found in Figure 7-1.

Graphical data is shown in Figure 7-2.

Figure 7-1 FCC §15.109 Maximized Quasi Peak and Average Emissions

Frequency (MHz)	Polarity (H/V)	Cab. (dB)	Ant. (dB)	Corr. Reading. (dBuV/m)	Limit (dBuV/m)	Delta (dB)	Azimuth (deg)	Tower (m)	Results
497.76 MHz	H	3.39	17.7	34.16	46.02	-11.86	108	1	<b>Compliant</b>
31.832 MHz	V	0.74	17.1	30.12	40	-9.88	309	1	<b>Compliant</b>
101.5 MHz	V	1.38	9.01	29.94	43.52	-13.58	121	1	<b>Compliant</b>

Figure 7-2 FCC §15.109 Receiver Spurious Emissions Graphical Data

