

EMC TEST REPORT

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

**Product: 1xEVDO Data Modem with USB Cable
Model Number: MCD3000/ U720 / USB720
Part Number of USB Cable: 2175002
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: 10/6/2006
Project Number: 3106291
Report Number: 3106291LEX-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:

Manufacturer of the device:

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

Model number of the device:

MCD3000 / U720 / USB720

USB Cable Part Number:

2175002

Material Composition of USB Modem:

Polycarbonate/ABS

DC Input of USB Modem:

5V / 750mA

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:

LI270706200012

EUT receive date:

8/21/2006

EUT received condition:

Good condition production unit

Test start date:

10/4/2006

Test end date:

10/6/2006

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		
Model	MCD3000	
FCC ID	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

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

FCC ID: PKRNVWMCD3000

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.

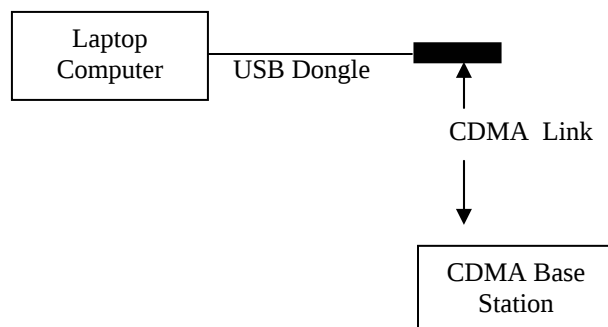
Table 1-2: Interconnecting Cables Used During Testing

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
USB Dongle Cable	93 cm	Yes	None	Laptop USB Connector	MCD3000 USB Connector

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 1xEVDO Data Modem with USB Cable was plugged into a USB dongle cable which 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 1xEVDO Data Modem with USB Cable to transmit on low, mid, and high channels and at maximum output power. When necessary, the base station was used to force the 1xEVDO Data Modem with USB Cable to transmit in EVDO mode. The FCC part 15 testing was performed with the 1xEVDO Data Modem with USB Cable 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	Compliant	9
§22.913, §24.232	Radiated RF Power Output	Compliant	11
§2.1053 §22.917(a) §24.238(a)	Radiated Spurious Emissions	Compliant	12
§15.107	Power Line Conducted Emissions	Compliant	17
§15.109	Receiver Spurious Emission	Compliant	19

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 1xEVDO Data Modem with USB Cable 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
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

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 1xEVDO Data Modem with USB Cable 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 1xEVDO Data Modem with USB Cable was installed in a laptop placed on top of a non-conductive support.
- Tests were performed with the 1xEVDO Data Modem with USB Cable transmitting in CDMA Cell and PCS bands on low, mid, and high channels.
- During the tests the 1xEVDO Data Modem with USB Cable 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 1xEVDO Data Modem with USB Cable 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

Tx Antenna Orientation	Technology	Band	Channel	EIRP (dBm)
0	CDMA	Cell	384	21.02
0	CDMA	Cell	777	20.91
0	CDMA	Cell	1013	21.98
0	CDMA	PCS	25	16.60
0	CDMA	PCS	600	18.10
0	CDMA	PCS	1175	16.47
45	CDMA	Cell	384	20.26
45	CDMA	Cell	777	20.90
45	CDMA	Cell	1013	21.85
45	CDMA	PCS	25	20.48
45	CDMA	PCS	600	21.77
45	CDMA	PCS	1175	20.54
90	CDMA	Cell	384	20.42
90	CDMA	Cell	777	21.28
90	CDMA	Cell	1013	21.88
90	CDMA	PCS	25	22.38
90	CDMA	PCS	600	23.44
90	CDMA	PCS	1175	22.29

5 RADIATED SPURIOUS EMISSIONS

FCC §2.1053, §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 EUT was placed on a non-conductive turntable. The measurement antenna was placed at a distance of 3 meters from the EUT. The Base Station Simulator was set to force the EUT to its maximum power setting. During the tests, the antenna height and EUT azimuth were varied in order to identify the maximum level of emissions from the EUT. This maximization process was repeated with the EUT positioned in each of its three orthogonal orientations.

The frequency range up to tenth harmonic was investigated for each of three fundamental frequencies (low, middle, and high channels) in each operating band. Once spurious emissions were identified, the power of the emission was determined using the substitution method described in TIA-603-B section 2.2.12 (Radiated Spurious Emissions).

The spurious emissions attenuation was calculated as the difference between radiated power at the fundamental frequency and at the spurious emissions frequency.

5.2 Test Results

The MCD3000 met the radiated spurious emission requirements. All detectable spurious emissions were at least 20dB below the limit as shown in the following graphs.

Figure 5-1: Radiated Spurious Emissions (Cell Band; Low Channel)

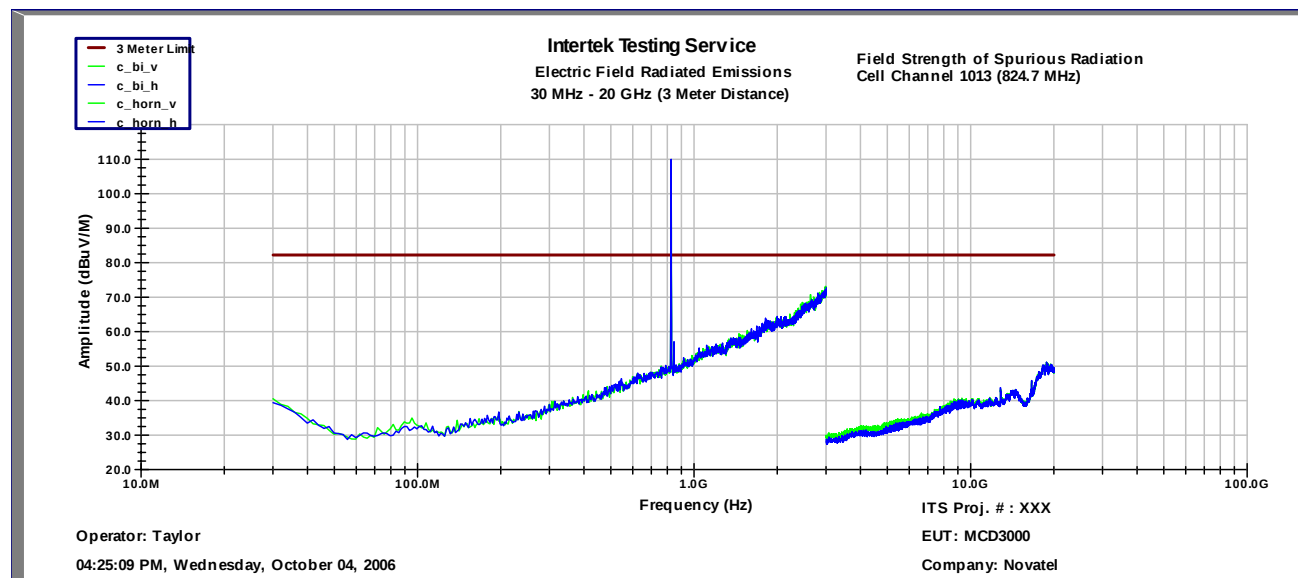


Figure 5-2: Radiated Spurious Emissions (Cell Band; Mid Channel)

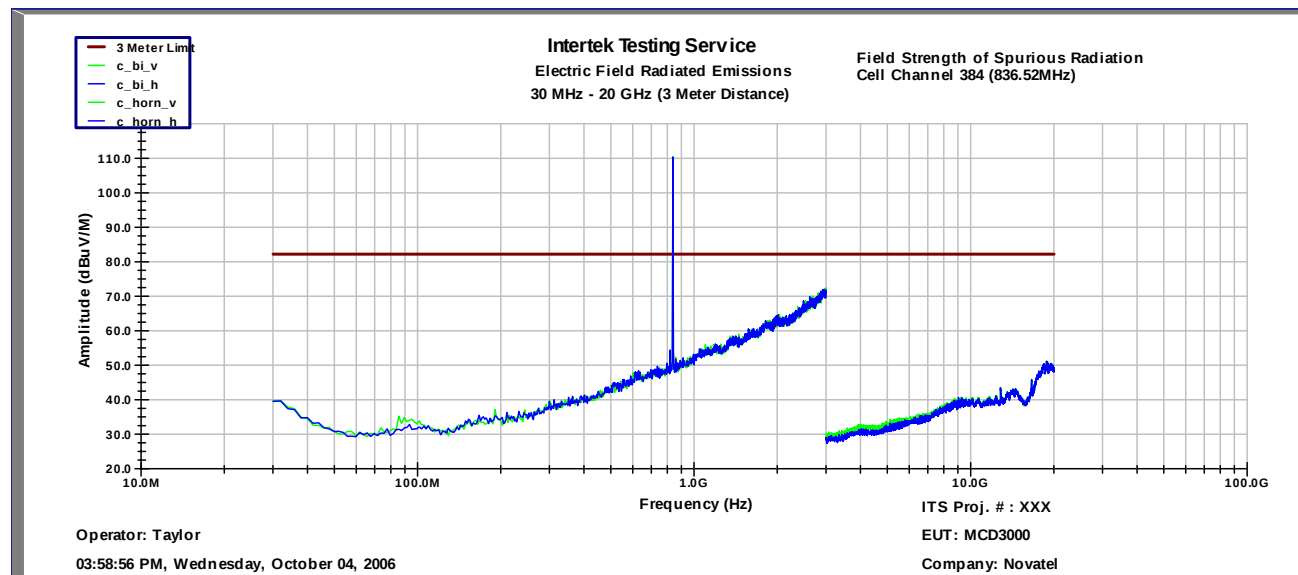


Figure 5-3: Radiated Spurious Emissions (Cell Band; High Channel)

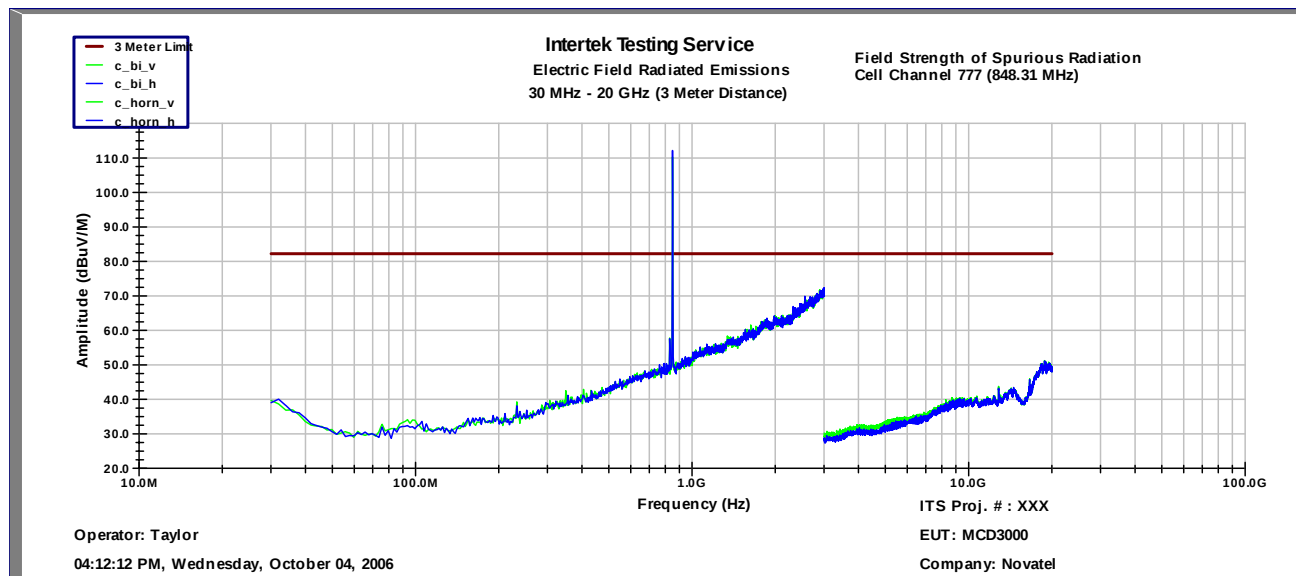


Figure 5-4: Radiated Spurious Emissions (PCS Band; Low Channel)

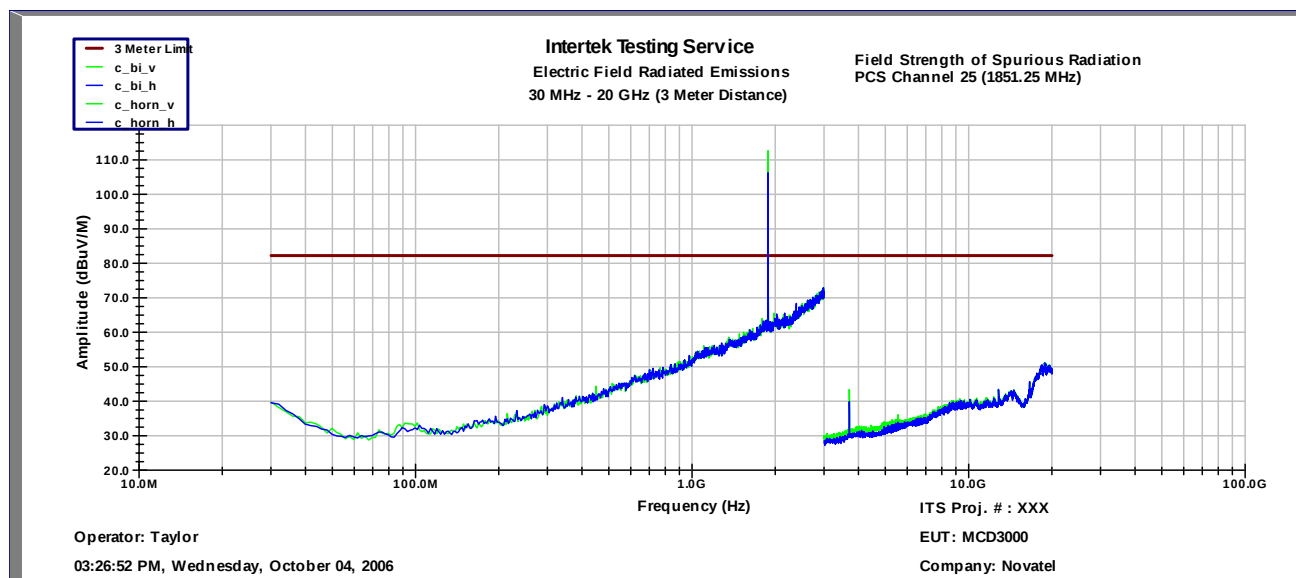


Figure 5-5: Radiated Spurious Emissions (PCS Band; Mid Channel)

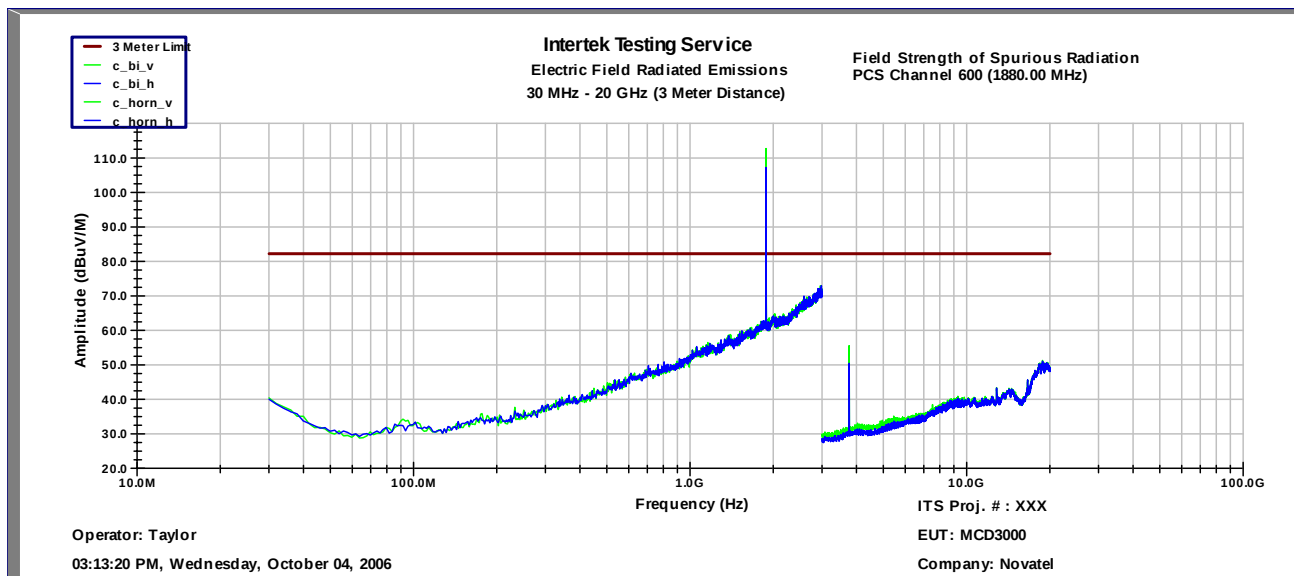
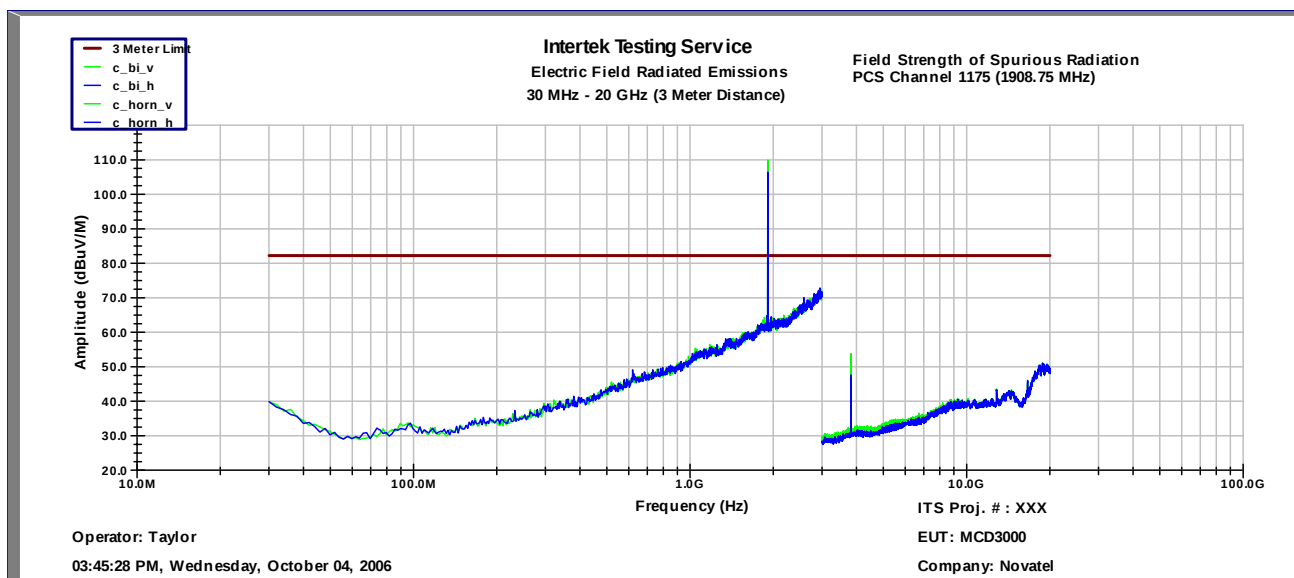


Figure 5-6: Radiated Spurious Emissions (PCS Band; High Channel)



6 POWER LINE CONDUCTED EMISSIONS

FCC §15.107

6.1 Test Procedure

Conducted voltage emission measurements were performed as follows:

- The 1xEVDO Data Modem with USB Cable 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 1xEVDO Data Modem with USB Cable 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.

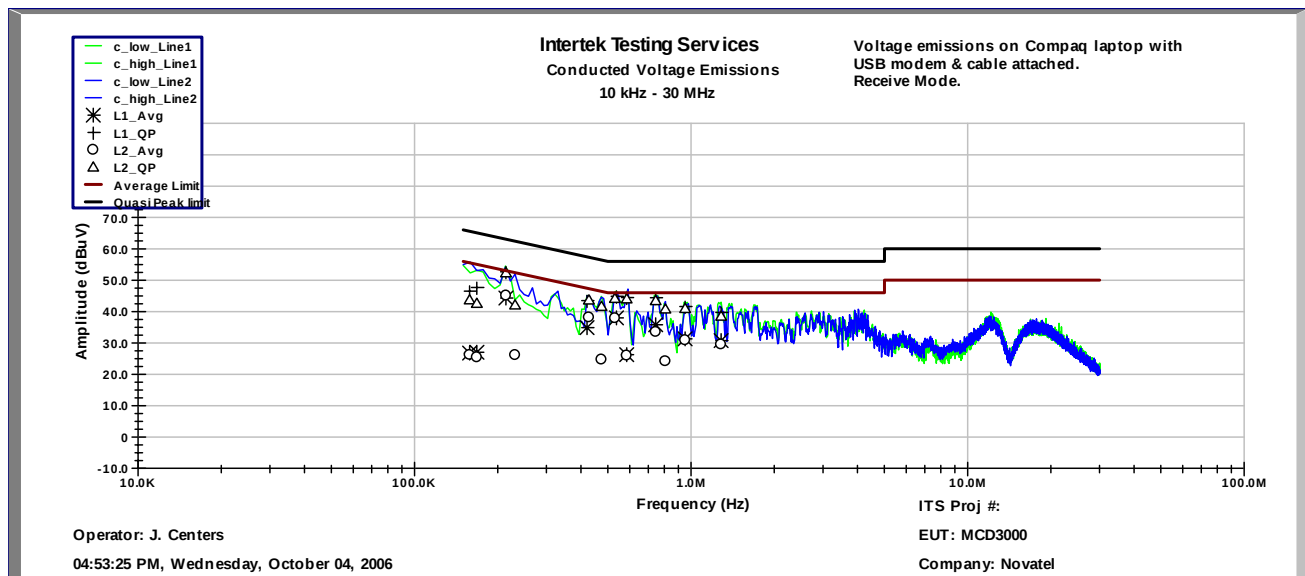
6.2 Test Results

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	158.0 KHz	46.49	65.57	-19.07	26.71	55.77	-29.06	Compliant
Line 1	168.0 KHz	47.66	65.06	-17.4	27.01	55.49	-28.48	Compliant
Line 1	214.1 KHz	52.65	63.04	-10.4	44.28	54.17	-9.89	Compliant
Line 1	420.0 KHz	43.47	57.45	-13.98	34.87	48.29	-13.42	Compliant
Line 1	537.0 KHz	44.84	56	-11.16	37.94	46	-8.06	Compliant
Line 1	584.7 KHz	44.44	56	-11.56	26.23	46	-19.77	Compliant
Line 1	744.0 KHz	44.38	56	-11.62	35.74	46	-10.26	Compliant
Line 1	951.0 KHz	41.56	56	-14.44	31.32	46	-14.68	Compliant
Line 1	1.284 MHz	39.71	56	-16.29	30.69	46	-15.31	Compliant
Line 2	158.0 KHz	43.65	65.57	-21.91	26.18	55.77	-29.59	Compliant
Line 2	168.0 KHz	42.55	65.06	-22.51	25.4	55.49	-30.09	Compliant
Line 2	214.1 KHz	52.31	63.04	-10.74	45.11	54.17	-9.06	Compliant
Line 2	231.0 KHz	42.04	62.41	-20.38	26.09	53.69	-27.6	Compliant
Line 2	426.8 KHz	43.62	57.31	-13.7	38.12	48.09	-9.97	Compliant
Line 2	474.0 KHz	41.58	56.44	-14.86	24.7	46.74	-22.04	Compliant
Line 2	530.3 KHz	44.11	56	-11.89	37.88	46	-8.12	Compliant
Line 2	584.7 KHz	43.99	56	-12.01	25.95	46	-20.05	Compliant
Line 2	744.0 KHz	43.41	56	-12.59	33.5	46	-12.5	Compliant
Line 2	807.0 KHz	40.76	56	-15.24	24.15	46	-21.85	Compliant
Line 2	951.0 KHz	40.92	56	-15.08	30.82	46	-15.18	Compliant
Line 2	1.284 MHz	38.44	56	-17.56	29.48	46	-16.52	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

Radiated Emission Limits at 3 meters	
Frequency (MHz)	Quasi-Peak limits, dB (μV/m)
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 1xEVDO Data Modem with USB Cable 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
233.34 MHz	H	2.33	11.65	35.99	46.02	-10.03	141	1	Compliant
497.76 MHz	H	3.39	17.7	33.3	46.02	-12.72	75	2	Compliant
528.0 MHz	H	3.5	18.54	36.71	46.02	-9.31	67	1	Compliant

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

