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RF EXPOSURE EVALUATION (MAXIMUM PERMISSIBLE EXPOSURE)

Applicant Name:

Novatel Wireless Inc.
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United States

Date of Testing:

June 15, 2007

Test Site/Location:

PCTEST Lab, Columbia, MD, USA

Test Report Serial No.:

0705160473.NBZ

FCC ID: NBZNRM-MC950D

APPLICANT: Novatel Wireless Inc.

EUT Type: 850/1900 GSM/WCDMA/EDGE USB Modem

FCC Rule Part(s): FCC Part 1 (§1.1310) and Part 2 (§2.1091)

FCC Classification: PCS Licensed Transmitter (PCB)

Test Procedure: OET Bulletin 65

The device bearing the FCC Identifier specified above has been shown to comply with the applicable technical standards as indicated in the measurement report and has been tested in accordance with the measurement procedures specified in FCC OET Bulletin 65 (See Test Report). These measurements were performed with no deviation from the standards.

I authorize and attest to the accuracy of data. All measurements reported herein were performed by me 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.

NVLAP accreditation does not constitute any product endorsement by NVLAP or any agency of the United States Government. PCTEST certifies that no party to this application has been denied the FCC benefits pursuant to Section 5301 of the Anti-Drug Abuse Act of 1988, 21 U.S.C. 862.


Randy Ortanez
President






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1.0 RF EXPOSURE EVALUATION – MAXIMUM PERMISSIBLE EXPOSURE (MPE)

1.1 Introduction

This document is prepared on behalf of Novatel Wireless Inc. to show compliance with the RF Exposure requirements as required in §1.1310 of the FCC Rules and Regulations and RSS-102 of Industry Canada.

The limit for Maximum Permissible Exposure (MPE), specified in FCC §1.1310, is listed in Table 1-1. According to FCC §1.1310 and RSS-102: the criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in §1.1307(b).

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm ²)	Average Time (Minutes)
(A) Limits For Occupational / Control Exposures (f = frequency)				
30-300	61.4	0.163	1.0	6
300-1500	...	...	f/300	6
1500-100,000	...	...	5.0	6
(B) Limits For General Population / Uncontrolled Exposure (f = frequency)				
30-300	27.5	0.073	0.2	30
300-1500	...	...	f/1500	30
1500-100,000	...	...	1.0	30

Table 1-1. Limits for Maximum Permissible Exposure (MPE)

1.2 EUT Description

EUT:



Model: MC950D

Grantee: Novatel Wireless Inc.

EUT Type: 850/1900 GSM/WCDMA/EDGE USB Modem

FCC ID: NBZNRM-MC950D

The setup is comprised of a Compaq Presario V4000 notebook connected to the 850/1900 GSM/WCDMA/EDGE USB Modem through a male-to-female USB cable. The EUT was placed into the provided holder which was placed on the top edge of the notebooks lid. This configuration provides a greater than 20cm separation for mobile device criterion.

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1.3 MPE Requirements Overview



Three different categories of transmitters are defined by the FCC in OET Bulletin 65. These categories are fixed installation, mobile, and portable and are defined as follows:

- **Fixed Installations:** fixed location means that the device, including its antenna, is physically secured at a permanent location and is not able to be easily moved to another location. Additionally, distance to humans from the antenna is maintained to at least 2 meters.
- **Mobile Devices:** a mobile device is defined as a transmitting device designed to be used in other than fixed locations and to be generally used in such a way that a separation distance of at least 20 centimeters is normally maintained between the transmitter's radiating structures and the body of the user or nearby persons. Transmitters designed to be used by consumers or workers that can be easily re-located, such as a wireless modem operating in a laptop computer, are considered mobile devices if they meet the 20 centimeter separation requirement. The FCC rules for evaluating mobile devices for RF compliance are found in 47 CFR §2.1091.
- **Portable Devices:** a portable device is defined as a transmitting device designed to be used so that the radiating structure(s) of the device is/are within 20 centimeters of the body of the user. Portable device requirements are found in Section 2.1093 of the FCC's Rules (47 CFR§2.1093).

The FCC also categorizes the use of the device as based upon the user's awareness and ability to exercise control over his or her exposure. The two categories defined are Occupational/ Controlled Exposure and General Population/Uncontrolled Exposure. These two categories are defined as follows:

- **Occupational/Controlled Exposure:** 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. Awareness of the potential for RF exposure in a workplace or similar environment can be provided through specific training as part of a RF safety program. If appropriate, warning signs and labels can also be used to establish such awareness by providing prominent information on the risk of potential exposure and instructions on methods to minimize such exposure risks.
- **General Population/Uncontrolled 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. Warning labels placed on low-power consumer devices such as cellular telephones are not considered sufficient to allow the device to be considered under the occupational/controlled category, and the general population/uncontrolled exposure limits apply to these devices.

The Novatel 850/1900 GSM/WCDMA/EDGE USB Modem FCC ID: NBZNRM-MC950D is evaluated to the Mobile Device requirements and is considered a device to be used by the General Population/Uncontrolled Exposure.

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1.4 Procedure

The procedure used to determine the RF power density was based upon a calculation for determining compliance with the MPE requirements.

The power generated by this product is measured with a radiated methodology to determine the ERP/EIRP in the 850 and 1900 GSM and WCDMA bands. Through use of the Friis transmission formula and knowledge of the maximum ERP/EIRP in each band, the power density level is calculated at a distance of 20cm.

Friis Transmission Formula

$$S = \frac{EIRP}{4\pi R^2}$$

S = Power Density (mW/cm²)
 EIRP = maximum Equivalent Isotropic Radiated Power (mW)
 $\pi = 3.1416$
 r = distance between observation point and center of the radiator (cm)

Calculated MPE

The power density limit for General Population/Uncontrolled Exposure at each frequency is determined based on the information in Table 1-1. The EUT has a maximum transmit duty cycle of 49.74% in the GSM850 band. The power density level of the other three bands was based on 100% on-time with no duty cycle correction. Plots of the worst case timing and pulse widths in the GSM850 band are shown in Plot 1-1, Plot 1-2, and Plot 1-3. The maximum power in this band can be therefore be reduced by this duty cycle correction factor.

$$EIRP_{adj} = EIRP_{max} (dBm) - 10 * \text{Log}(\text{Duty Cycle})(dB)$$



Given the EIRP for each GSM and WCDMA band, the following power densities are calculated by frequency at 20cm spacing:

Frequency	824.2 MHz	
Limit	0.549 mW/cm ²	
Distance (cm), R =	20 cm	
Duty Cycle =	49.740 %	
Power (dBm), EIRP =	34.45 dBm	2786.12 mW
Corrected EIRP (dBm) =	31.42 dBm	1385.82
Power Density (S) =	0.276 mW/cm² (at 20cm)	
Minimum Distance =	14.2 cm	

Table 1-2. Calculated MPE Data for GSM850 Band

Frequency	1880 MHz	
Limit	1.000 mW/cm ²	
Distance (cm), R =	20 cm	
Power (dBm), EIRP =	32.9 dBm	1949.84 mW
Power Density (S) =	0.388 mW/cm² (at 20cm)	
Minimum Distance =	12.5 cm	

Table 1-3. Calculated MPE Data for GSM1900 Band

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Frequency	826.4 MHz	
Limit	0.551 mW/cm ²	
Distance (cm), R =	20 cm	
Power (dBm), EIRP =	27.05 dBm	506.99 mW
Power Density (S) =	0.101 mW/cm ²	(at 20cm)
Minimum Distance =	8.6 cm	

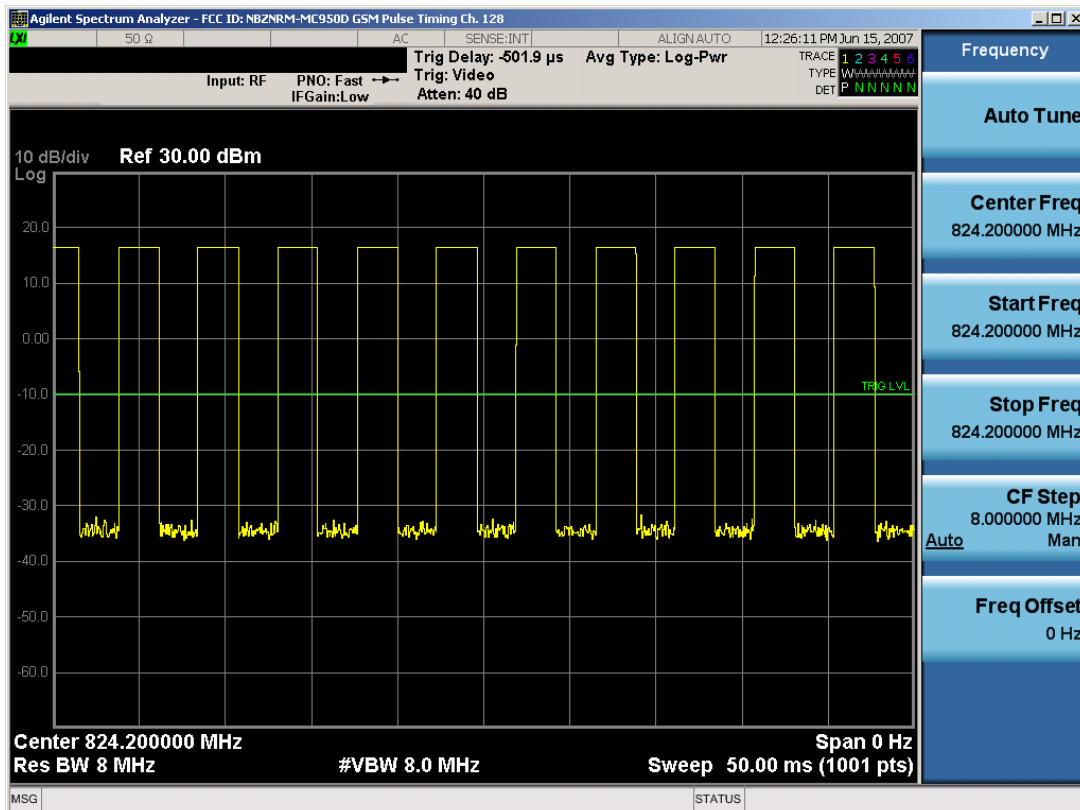
Table 1-4. Calculated MPE Data for WCDMA850 Band

Frequency	1852.4 MHz	
Limit	1.000 mW/cm ²	
Distance (cm), R =	20 cm	
Power (dBm), EIRP =	26.6 dBm	457.09 mW
Power Density (S) =	0.091 mW/cm ²	(at 20cm)
Minimum Distance =	6.0 cm	

Table 1-5. Calculated MPE Data for WCDMA1900 Band

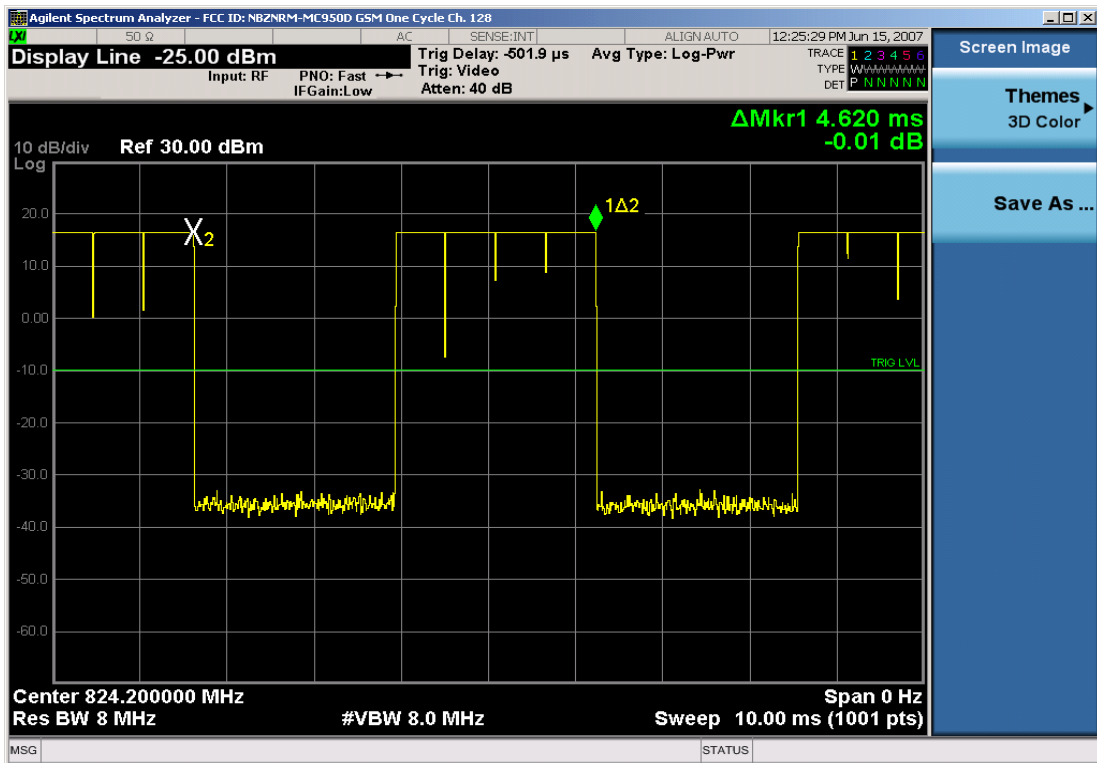
Timing Plots

The following plots show the transmitter set to operate at maximum power with maximum amount of “on” time, one full period, and one full pulse in a period, respectively. These plots provide a means by which to calculate a duty cycle which can be used to adjust the power used in the calculation of power density.

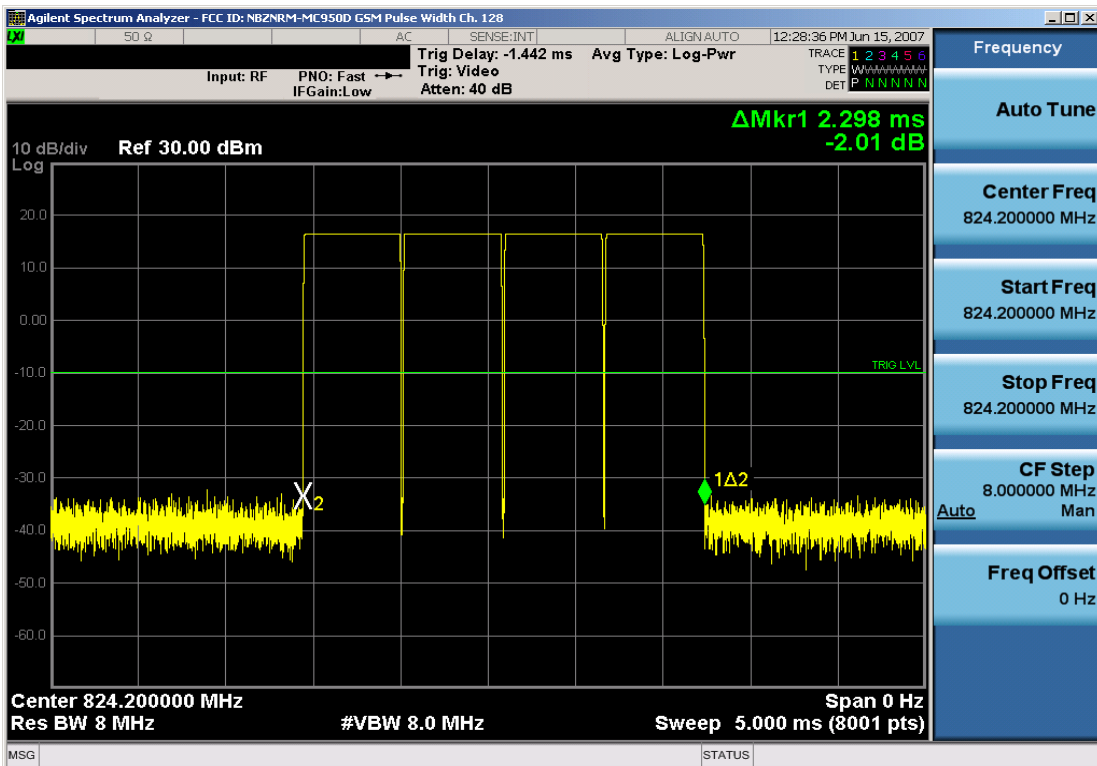


Plot 1-1. Transmitter Maximum Duty Cycle Operation in GSM850 Band

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Plot 1-2. One Full Transmission Cycle in GSM850 Band



Plot 1-3. Pulse Width in GSM850 Band

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Duty Cycle Calculation:

Duty Cycle = Total Tx Time / Tx Cycle Time



Based on the above plots the duty cycle is calculated as follows:

$$\text{Duty Cycle} = (2.298 \text{ ms}) / 4.620 \text{ ms} = 0.4974 (49.74\%)$$

1.5 Summary of Results



Frequency Band (MHz)	Corrected EIRP (dBm)	MPE at 20cm (mW/cm ²)	Test Result
824.2 – 848.8	31.42	0.276	PASS
826.4 – 846.6	32.90	0.388	PASS
1850.2 – 1909.8	27.05	0.101	PASS
1852.4 – 1907.6	26.60	0.091	PASS

Table 1-5. Maximum Permissible Exposure Summary Table

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2.0 CONCLUSION

The device meets the mobile RF exposure limit at a 20cm separation distance as specified in §2.1091 of the FCC Rules and Regulations and RSS-102 of Industry Canada. An appropriate RF exposure compliance statement will be placed in the user's manual.

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