

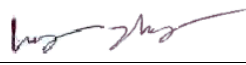

FCC PART 24 TYPE APPROVAL EMI MEASUREMENT AND TEST REPORT

For

Novatel Wireless Technologies Ltd.

Suite 200, 6715 – 8th Street N.E.
Calgary, Alberta
Canada, T2E 7H7

FCC ID: NBZNRM-U520

This Report Concerns: <input checked="" type="checkbox"/> Original Report	Equipment Type: 3G Wireless PC card modem
Test Engineer: Ling Zhang / 	
Report No.: R0404162	
Report Date: 2004-05-14	
Reviewed By: Hans Mellberg / 	
Prepared By: Bay Area Compliance Laboratory Corporation (BACL) 230 Commercial Street Sunnyvale, CA 94085 Tel: (408) 732-9162 Fax: (408) 732 9164	

Note: This test report is specially limited to the above client company and the product model only. It may not be duplicated without prior written consent of Bay Area Compliance Laboratory Corporation. This report **must not** be used by the client to claim product endorsement by NVLAP or any agency of the U.S. Government.

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GENERAL INFORMATION

Product Description for Equipment Under Test (EUT)

The *Novatel Wireless Technologies Ltd.* product, FCC ID:NBZNRM-U520 or the "EUT" as referred to in this report is a 3G Wireless PC card modem, which measures approximately 120mm(L) x 53mm(W) x 8mm(H). The EUT operates at the frequency of 1852.4 – 1907.6 MHz, maximum output power (ERP) 21.6dBm (0.144W), frequency tolerance 2.5ppm and emission designator 4M13GXW.

** The test data gathered are from typical production sample, serial number: 004400-00-471321-8, provided by the manufacturer.*

Objective

This type approval report is prepared on behalf of *Novatel Wireless Technologies Ltd.* in accordance with Part 2, Subpart J, and Part 24 Subpart E of the Federal Communication Commissions rules.

The objective is to determine compliance with FCC rules for output power, modulation characteristic, occupied bandwidth, spurious emission at antenna terminal, field strength of spurious radiation, frequency stability, band edge and radiated margin.

Related Submittal(s)/Grant(s)

No Related Submittals

Test Methodology

All tests and measurements indicated in this document were performed in accordance with the Code of Federal Regulations Title 47 Part 2, Sub-part J as well as the following parts:

Part 24 Subpart E - PCS

Applicable Standards: TIA EIA 137-A, TIA EIA 98-C, ANSI 63.4-1992, and TIA/EIA-603A.

All radiated and conducted emissions measurement was performed at Bay Area Compliance Laboratory, Corp. The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

Test Facility

The Open Area Test site used by BACL Corp. to collect radiated and conducted emission measurement data is located in the back parking lot of the building at 230 Commercial Street, Sunnyvale, California, USA.

Test site at BACL Corp. has been fully described in reports submitted to the Federal Communication Commission (FCC) and Voluntary Control Council for Interference (VCCI). The details of these reports has been found to be in compliance with the requirements of Section 2.948 of the FCC Rules and Article 8 of the VCCI regulations. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-1992.

The Federal Communications Commission and Voluntary Control Council for Interference has the reports on file and is listed under FCC file 31040/SIT 1300F2 and VCCI Registration No.: C-1298 and R-1234. The test site has been approved by the FCC and VCCI for public use and is listed in the FCC Public Access Link (PAL) database.

Additionally, BACLa is a National Institute of Standards and Technology (NIST) accredited laboratory, under the National Voluntary Laboratory Accredited Program (Lab Code 200167-0). The scope of the accreditation covers the FCC Method - 47 CFR Part 15 - Digital Devices, CISPR 22: 1997, Electromagnetic Interference - Limits and Methods of Measurement of Information Technology Equipment test methods.

SYSTEM TEST CONFIGURATION

Justification

The EUT was configured for testing according to TIA/EIA 603A.

The final qualification test was performed with the EUT operating at normal mode.

Block Diagram

Please refer to Exhibit D.

Equipment Modifications

No modifications were made to the EUT.

Local Support Equipment List and Details

Manufacturer	Description	Model	Serial Number	FCC ID
Dell	Notebook	Latitude	CIF0B00227	DOC
HP	Printer	Thinkjet 2225C	2512S43681	BS46XU2225C
Everex	Modem	EV-945	None	E3E5UVEV-945

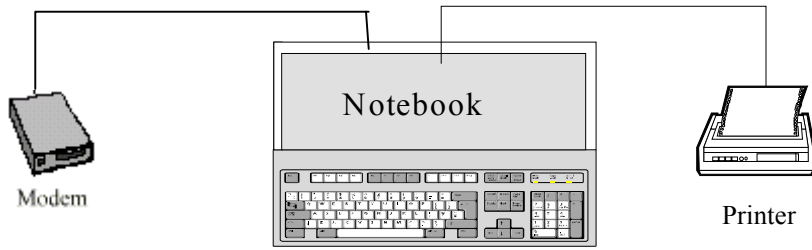
External Cables List and Details

Cable Description	Length (M)	From	To
Unshielded Serial Cable	1.5	Modem Port/Host	Modem
Shielded Printer Cable	2	Parallel / Host	HP Printer

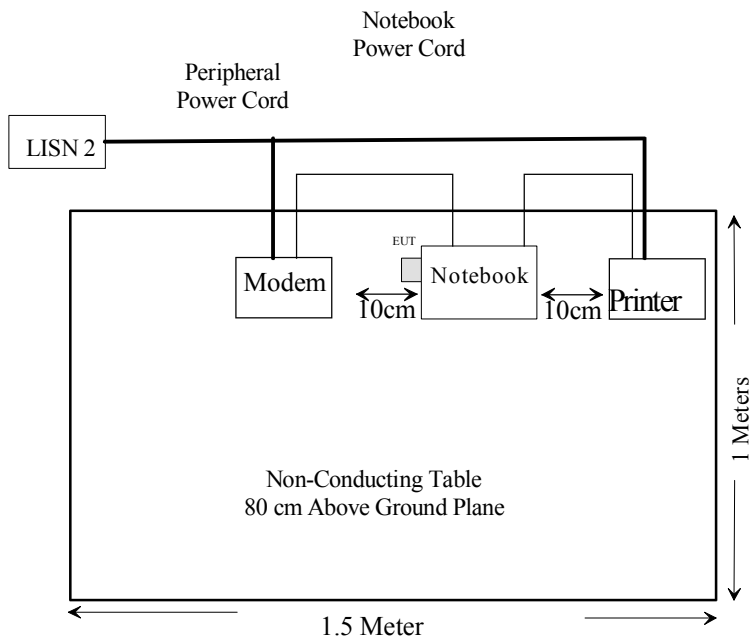
Power Supply Information

Manufacturer	Description	Model	Serial Number	FCC ID
DELL	AC adapter	AA20031	CN-09364U-16291-13J-0E3F	DOC

Configuration of Test System



Test Setup Block Diagram



SUMMARY OF TEST RESULTS

Results reported relate only to the product tested, serial number: 004400-00-471321-8.

FCC RULE	DESCRIPTION OF TEST	RESULT
§ 2.1047	Modulation Characteristics	Compliant
§ 2.1053	Field Strength of Spurious Radiation	Compliant
§2.1093	RF Exposure	Compliant
§ 2.1046, § 24.232	RF Output Power	Compliant
§ 2.1046, § 24.232	Conducted Output Power	Compliant
§ 2.1049 § 24.238	Out of Band Emission, Occupied Bandwidth	Compliant
§ 2.1051, § 24.238(a)	Spurious Emissions at Antenna Terminals	Compliant
§ 2.1055 (a) § 2.1055 (d) § 24.235	Frequency stability vs. temperature Frequency stability vs. voltage	Compliant
§24.238	Band Edge	Compliant

§2.1047 - MODULATION CHARACTERISTIC

Applicable Standard

Requirement: FCC § 2.1047.

Test Procedure

UMTS digital mode is used by EUT.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Cal. Date
HP	Spectrum Analyzer	HP8564E	3943A01781	2003-08-01
HP	Plotter	HP7470A	2541A49659	Not Required

* **Statement of Traceability:** **BACL Corp.** certifies that all calibrations have been performed in accordance to NVLAP requirements, traceable to the NIST.

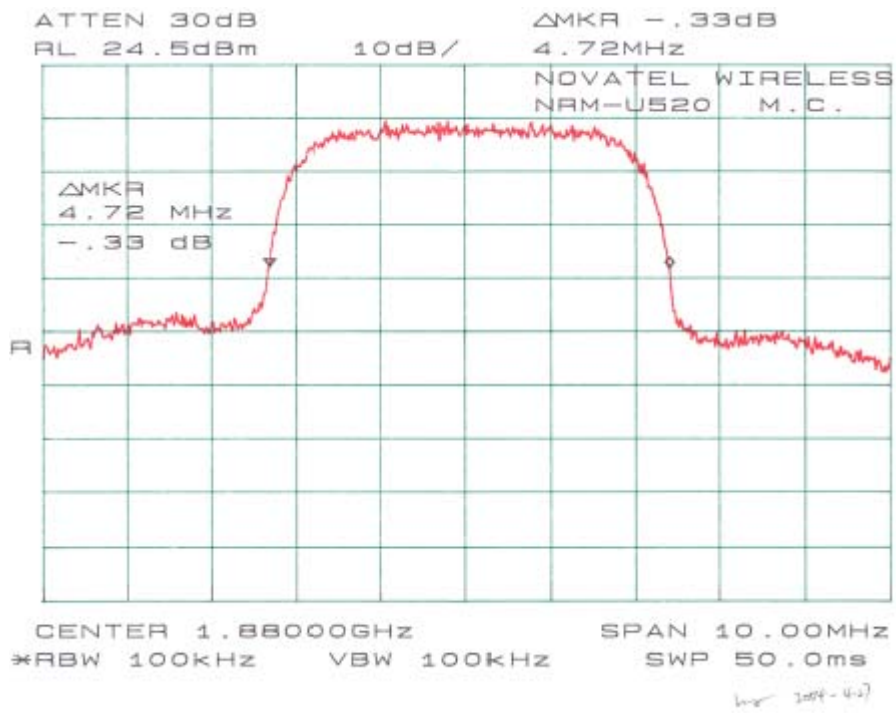
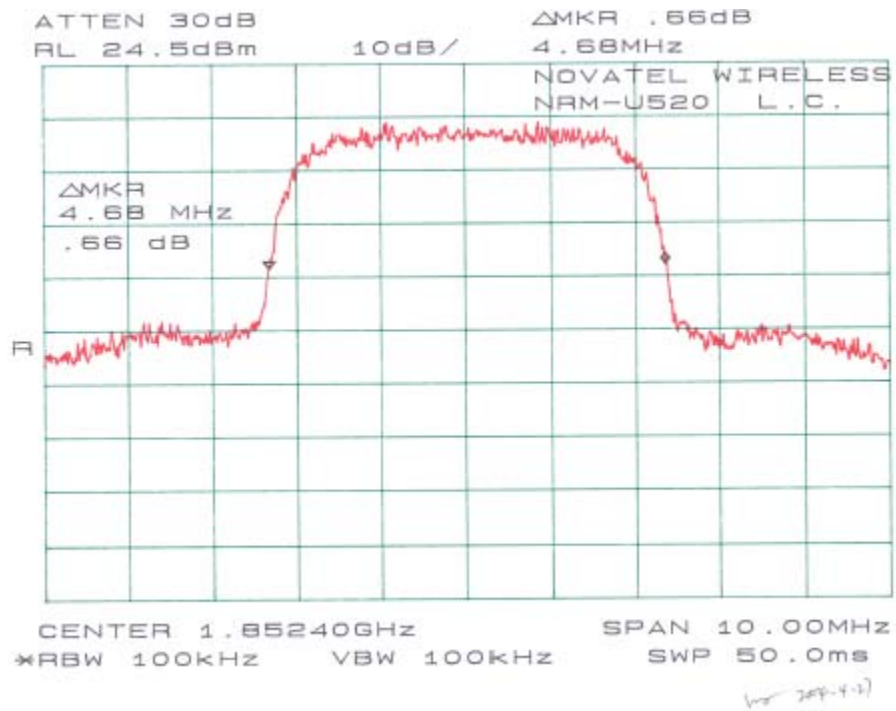
Environmental Conditions

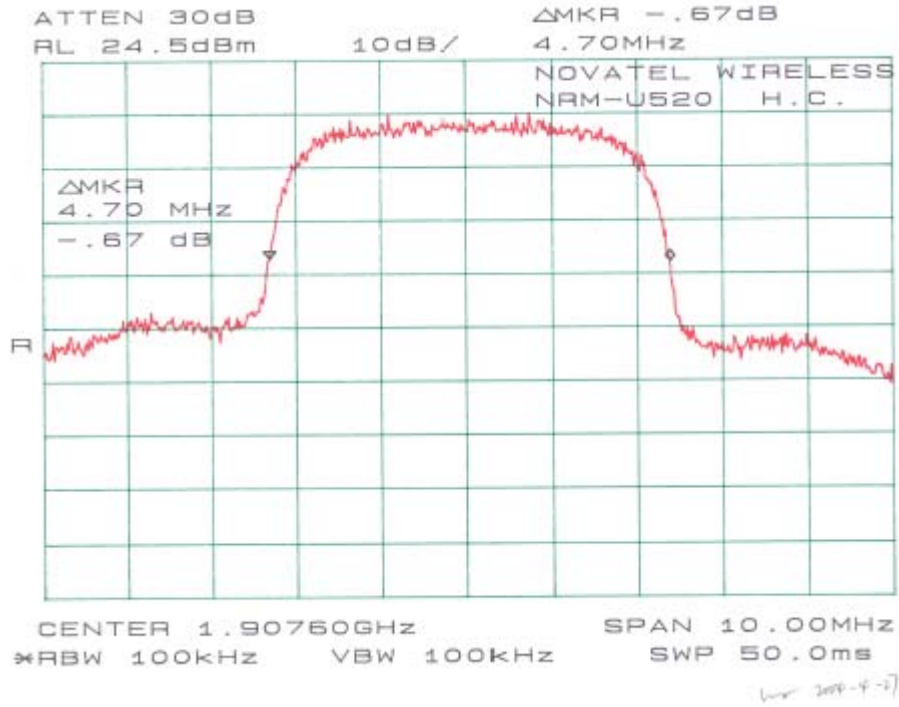
Temperature:	28.9° C
Relative Humidity:	28%
ATM Pressure:	1013.9 mbar

The testing was performed by Ling Zhang on 2004-04-27.

Test Results

Please refer to the hereinafter plots.





§2.1053 - SPURIOUS RADIATED EMISSIONS

Applicable Standard

Requirements: CFR 47, § 2.1053.

Test Procedure

The transmitter was placed on a wooden turntable, and it was transmitting into a non-radiating load which was also placed on the turntable.

The measurement antenna was placed at a distance of 3 meters from the EUT. During the tests, the antenna height and polarization as well as EUT azimuth were varied in order to identify the maximum level of emissions from the EUT. The test was performed by placing the EUT on 3-orthogonal axis.

The frequency range up to tenth harmonic of the fundamental frequency was investigated.

Remove the EUT and replace it with substitution antenna. A signal generator was connected to the substitution antenna by a non-radiating cable. The absolute levels of the spurious emissions were measured by the substitution.

Spurious emissions in dB = 10 lg (TXpwr in Watts/0.001) – the absolute level

Spurious attenuation limit in dB = 43 + 10 Log₁₀ (power out in Watts)

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Cal. Date
HP	Spectrum Analyzer	8568B	2601A02165	2003-07-03
HP	Amplifier	8447E	2944A10187	2003-09-23
HP	Quasi-Peak Adapter	85650A	3019A05393	2003-06-13
EMCO	Biconical Antenna	3110B	9309-1165	2003-10-11
EMCO	Log Periodic Antenna	3146	2101	2003-10-11
AH System	Horn Antenna	SAS-200/511	261	2003-08-02
HP	Spectrum Analyzer	HP8564E	3943A01781	2003-08-01

* **Statement of Traceability:** **BACL Corp.** certifies that all calibrations have been performed in accordance to NVLAP requirements, traceable to the NIST.

Environmental Conditions

Temperature:	28.9° C
Relative Humidity:	28%
ATM Pressure:	1013.9 mbar

The testing was performed by Ling Zhang on 2004-04-27.

Test Result

Low Frequency: -26.9 dB at 5557.2 MHz
 Middle Frequency: -26.7 dB at 5640 MHz
 High Frequency: -27.1 dB at 5722.8 MHz

Indicated		EUT			Substitution		Generator			Standard	
Frequency MHz	Ampl. dBuV/m	Table Angle Degree	Test Antenna Height Meter	Polar H/V	Frequency MHz	Level dBm	Antenna Gain Corrected	Cable Loss dB	Absolute Level dBm	FCC Limit dBm	FCC Margin dB
Low Channel											
1852.4	122.00	90	1.8	v	1852.4	14.0	8.3	1.2	21.1		
1852.4	122.50	0	1.0	h	1852.4	14.5	8.3	1.2	21.6		
5557.2	44.67	60	1.2	v	5557.2	-47.7	10.6	2.8	-39.9	-13	-26.9
5557.2	44.00	270	1.6	h	5557.2	-48.2	10.6	2.8	-40.4	-13	-27.4
3704.8	47.50	15	1.6	v	3704.8	-50.4	10.3	2.0	-42.1	-13	-29.1
3704.8	46.50	0	2.0	h	3704.8	-52.1	10.3	2.0	-43.8	-13	-30.8
MIDDLE CHANNEL											
1880.0	122.00	90	2.2	v	1880	12.9	8.3	1.2	20.0		
1880.0	124.00	330	1.0	h	1880	14.9	8.3	1.2	22.0		
5640.0	44.83	300	1.5	v	5640	-47.5	10.6	2.8	-39.7	-13	-26.7
5640.0	44.67	330	1.5	h	5640	-47.6	10.6	2.8	-39.8	-13	-26.8
3760.0	47.33	30	1.0	v	3760	-50.6	10.3	2.0	-42.3	-13	-29.3
3760.0	47.83	0	2.0	h	3760	-51.8	10.3	2.0	-43.5	-13	-30.5
HIGH CHANNEL											
1907.6	122.50	90	1.3	v	1907.6	14.5	8.3	1.2	21.6		
1907.6	122.50	0	1.0	h	1907.6	14.4	8.3	1.2	21.5		
5722.8	44.33	60	1.4	v	5722.8	-47.9	10.6	2.8	-40.1	-13	-27.1
5722.8	44.17	90	1.0	h	5722.8	-48.0	10.6	2.8	-40.2	-13	-27.2
3815.2	49.83	250	2.0	h	3815.2	-48.9	10.3	2.0	-40.6	-13	-27.6
3815.2	48.67	90	1.0	v	3815.2	-49.7	10.3	2.0	-41.4	-13	-28.4

§2.1046, & §24.232 - RF POWER OUTPUT

Applicable Standard

According to FCC §2.1046 and §24.232 (1), mobile/portable stations are limited to 2 watts EIRP.

Test Procedure

1. On a test site, the EUT shall be placed at 1.5m height on a turn table, and in the position closest to normal use as declared by the applicant.
2. The test antenna shall be oriented initially for vertical polarization located 3m from EUT to correspond to the frequency of the transmitter.
3. The output of the test antenna shall be connected to the measuring receiver and the quasi-peak detector is used for the measurement.
4. The transmitter shall be switched on, if possible, without modulation and the measuring receiver shall be tuned to the frequency of the transmitter under test.
5. The test antenna shall be raised and lowered through the specified range of height until a maximum signal level is detected by the measuring receiver.
6. The transmitter shall then be rotated through 360° in the horizontal plane, until the maximum signal level is detected by the measuring receiver.
7. The test antenna shall be raised and lowered again through the specified range of height until a maximum signal level is detected by the measuring receiver.
8. The maximum signal level detected by the measuring receiver shall be noted.
9. The transmitter shall be replaced by a horn (substitution antenna).
10. The substitution antenna shall be orientated for vertical polarization and the length of the substitution antenna shall be adjusted to correspond to the frequency of the transmitter.
11. The substitution antenna shall be connected to a calibrated signal generator.
12. In necessary, the input attenuator setting of the measuring receiver shall be adjusted in order to increase the sensitivity of the measuring receiver.
13. The test antenna shall be raised and lowered through the specified range of height to ensure that the maximum signal is received.
14. The input signal to the substitution antenna shall be adjusted to the level that produces a level detected by the measuring receiver, which is equal to the level noted while the transmitter radiated power was measured, corrected for the change of input attenuator setting of the measuring receiver.
15. The input level to the substitution antenna shall be recorded as power level in dBm, corrected for any change of input attenuator setting of the measuring receiver.
16. The measurement shall be repeated with the test antenna and the substitution antenna orientated for horizontal polarization.
17. The measure of the effective radiated power is the large of the two levels recorded, at the input to the substitution antenna, corrected for gain of the substitution antenna if necessary.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Cal. Date
HP	Spectrum Analyzer	8568B	2601A02165	2003-07-03
HP	Amplifier	8447E	2944A10187	2003-09-23
HP	Quasi-Peak Adapter	85650A	3019A05393	2003-06-13
EMCO	Biconical Antenna	3110B	9309-1165	2003-10-11
EMCO	Log Periodic Antenna	3146	2101	2003-10-11
AH System	Horn Antenna	SAS-200/511	261	2003-08-02

* **Statement of Traceability: BACL Corp.** certifies that all calibrations have been performed in accordance to NVLAP requirements, traceable to the NIST.

Environmental Conditions

Temperature:	28.9° C
Relative Humidity:	28%
ATM Pressure:	1013.9 mbar

The testing was performed by Ling Zhang on 2004-04-27.

Test Results

FREQUENCY (MHZ)	SUBSTITUTION READING (dBm)	SUBSTITUTION ANTENNA GAIN	SUBSTITUTION CALBE LOSS (dB)	EIRP (dBm)
1852.4	14.5	8.3	1.2	21.6
1880.0	14.9	8.3	1.2	22.0
1907.6	14.5	8.3	1.2	21.6

Sample calculation:

Absolute level = substitution reading + antenna gain - cable loss

For example:

$$14.9 + 8.3 - 1.2 = 22.0$$

§2.1046, & §24.232 – CONDUCTED OUTPUT POWER

Applicable Standard

According to FCC §2.1046 and §24.232 (b), Mobile/Portable Station are limited to 2 Watts e.i.r.p. Peak Power.

Test Procedure

The RF output of the transmitter was connected to the input of the spectrum analyzer through sufficient attenuation.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Cal. Date
HP	Spectrum Analyzer	HP8564E	3943A01781	2003-08-01
HP	Plotter	HP7470A	2541A49659	Not Required
A.H. Systems	Horn Antenna	SAS200	261	2003-05-31
ETS	Logperiodic Antenna	3148	0004-1155	2003-10-11
EMCO	Biconical Antenna	3110B	9603-2315	2003-10-11

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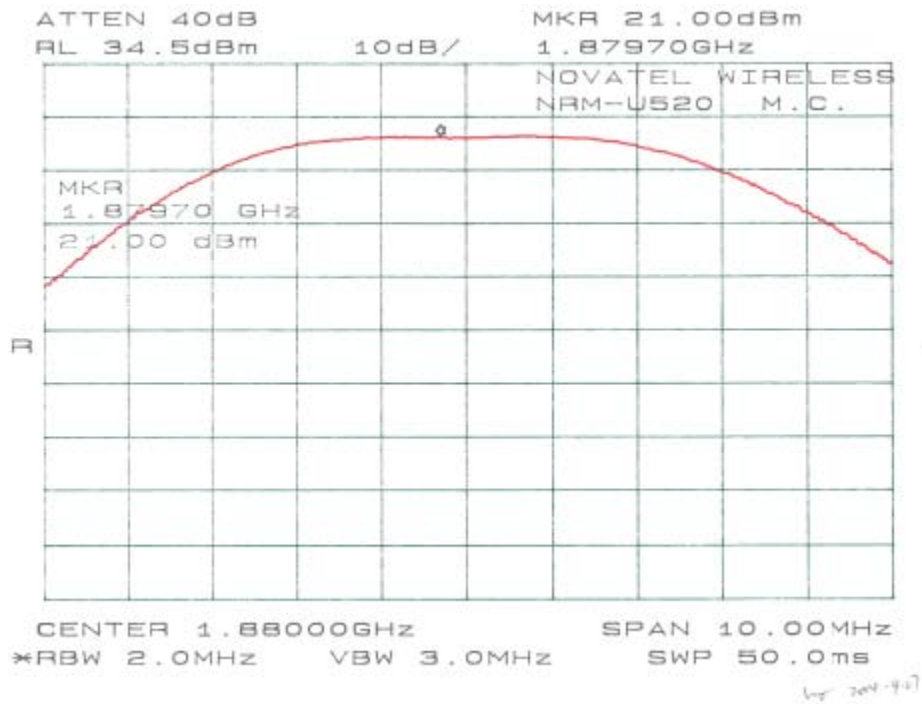
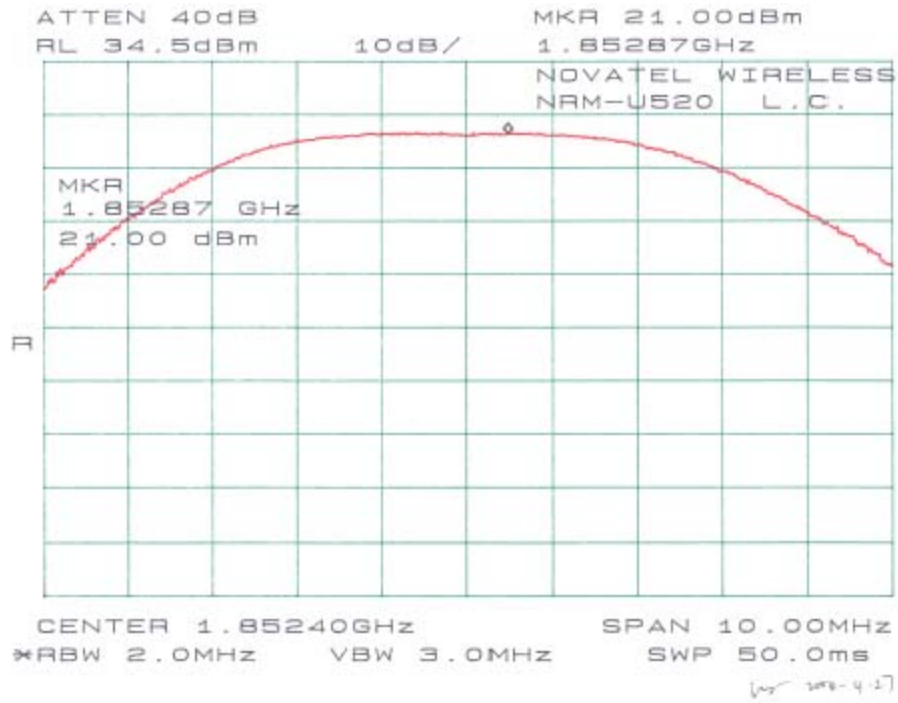
Environmental Conditions

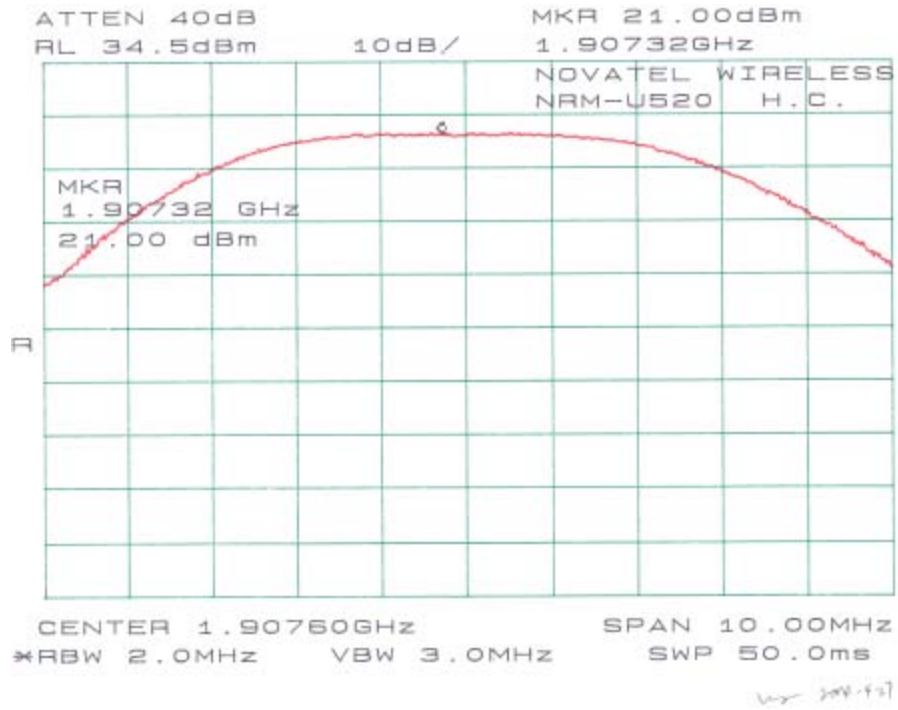
Temperature:	28.9° C
Relative Humidity:	28%
ATM Pressure:	1013.9 mbar

The testing was performed by Ling Zhang on 2004-04-27.

Test Results

Channel	Frequency (MHz)	Output Power in dBm	Output Power in W	Limit in W
LOW	1852.40	21.00	0.126	100
MIDDLE	1880.00	21.00	0.126	100
HIGH	1907.60	21.00	0.126	100





§2.1049, & §24.238 - OCCUPIED BANDWIDTH

Applicable Standard

Requirements: CFR 47, Section 2.1049, and Section 24.238.

Test Procedure

The RF output of the transmitter was connected to the input of the spectrum analyzer through sufficient attenuation.

The resolution bandwidth of the spectrum analyzer was set at 30 KHz and the 26 dB bandwidth was recorded.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Cal. Date
HP	Spectrum Analyzer	HP8564E	3943A01781	2003-08-01
HP	Plotter	HP7470A	2541A49659	Not Required

* **Statement of Traceability: BACL Corp.** certifies that all calibrations have been performed in accordance to NVLAP requirements, traceable to the NIST.

Environmental Conditions

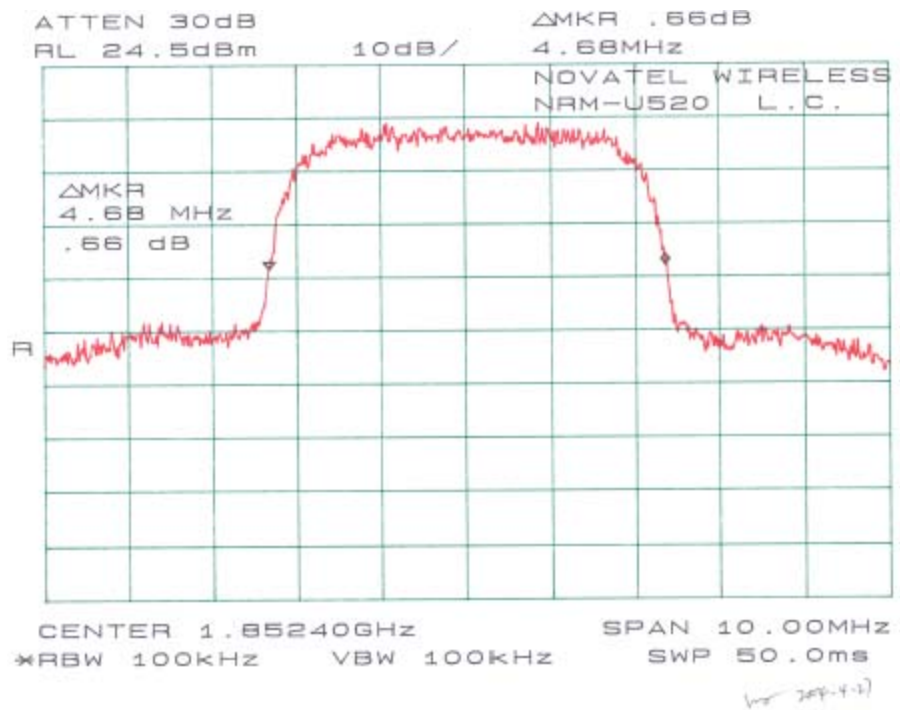
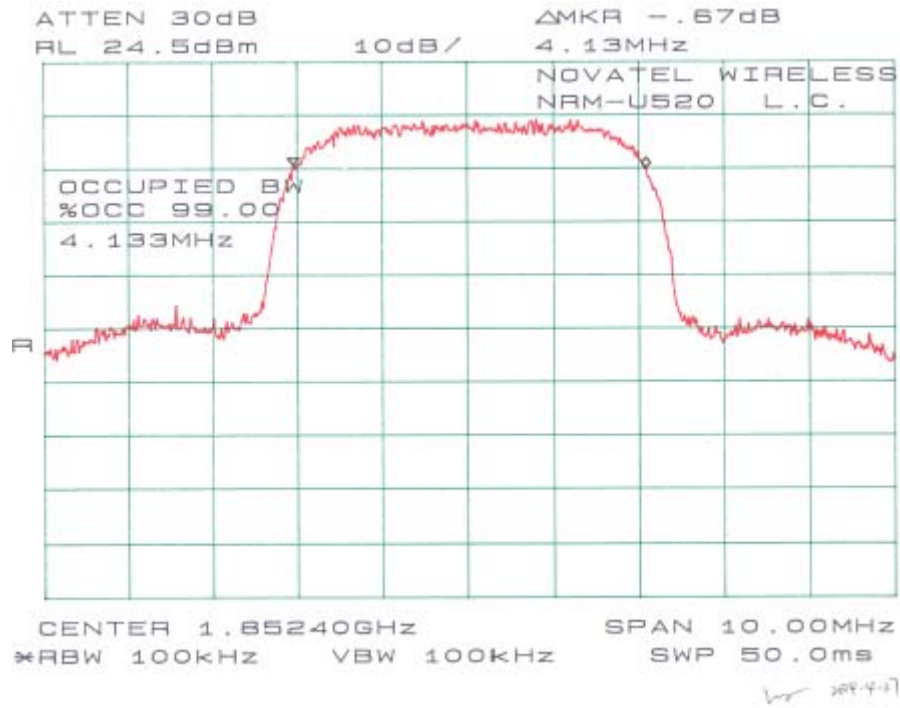
Temperature:	28.9° C
Relative Humidity:	28%
ATM Pressure:	1013.9 mbar

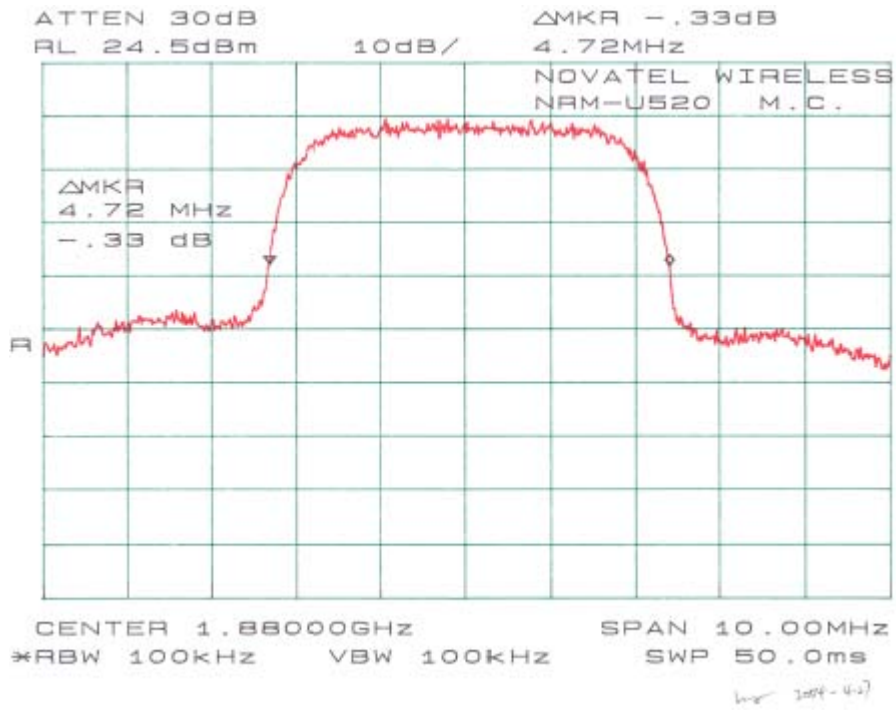
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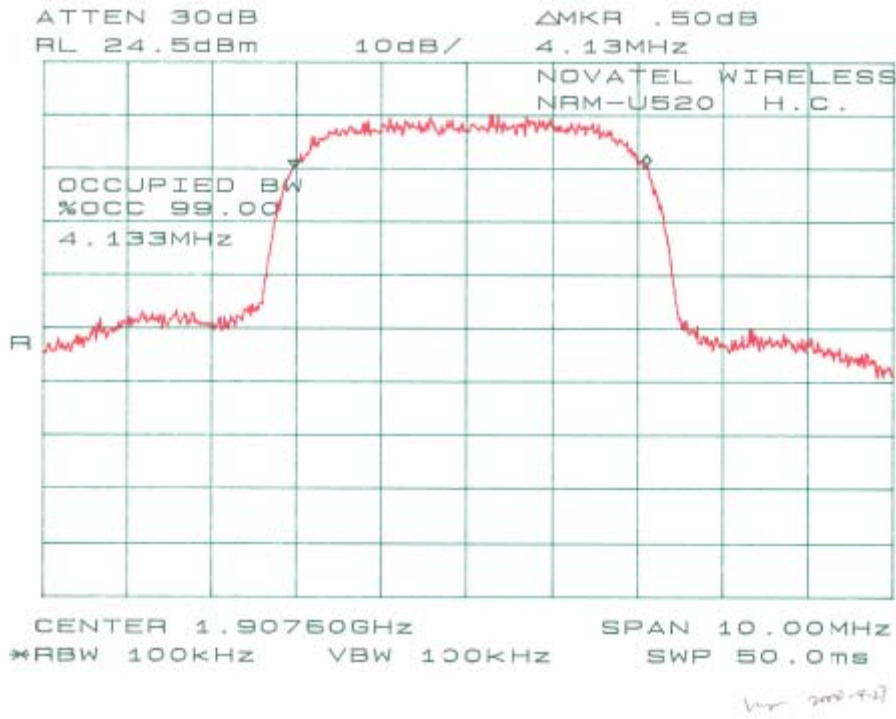
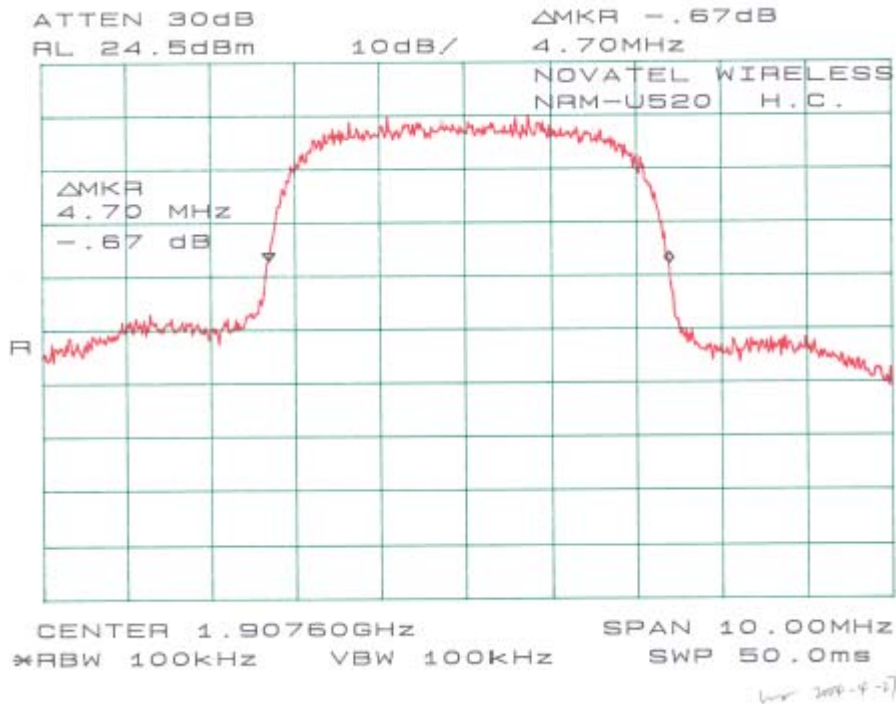
Test Results

Channel	Frequency (Mhz)	Type	Measurement (MHz)	Result
Low	1852.40	Occupied Bandwidth	4.13	Compliant
		26dB Bandwidth	4.68	Compliant
Middle	1880.00	Occupied Bandwidth	4.13	Compliant
		26dB Bandwidth	4.72	Compliant
High	1907.60	Occupied Bandwidth	4.70	Compliant
		26dB Bandwidth	4.13	Compliant

Please refer to the hereinafter plots.







§2.1051, & §24.238(a) - SPURIOUS EMISSIONS AT ANTENNA TERMINALS

Applicable Standard

Requirements: CFR 47, § 2.1051 & §24.238(a).

The spectrum was to be investigated to the tenth harmonics of the highest fundamental frequency as specified in § 2.1057.

Test Procedure

The RF output of the transceiver was connected to a spectrum analyzer through appropriate attenuation. The resolution bandwidth of the spectrum analyzer was set at 100 kHz. Sufficient scans were taken to show any out of band emissions up to 10th harmonic.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Cal. Date
HP	Spectrum Analyzer	HP8564E	3943A01781	2003-08-01
HP	Plotter	HP7470A	2541A49659	Not Required

* **Statement of Traceability: BACL Corp.** certifies that all calibrations have been performed in accordance to NVLAP requirements, traceable to the NIST.

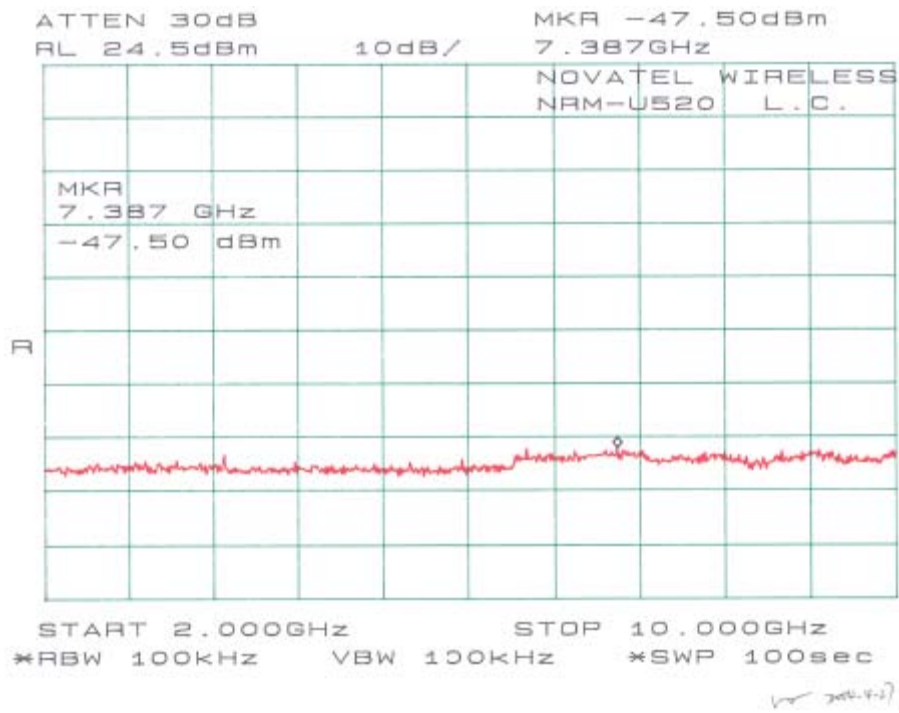
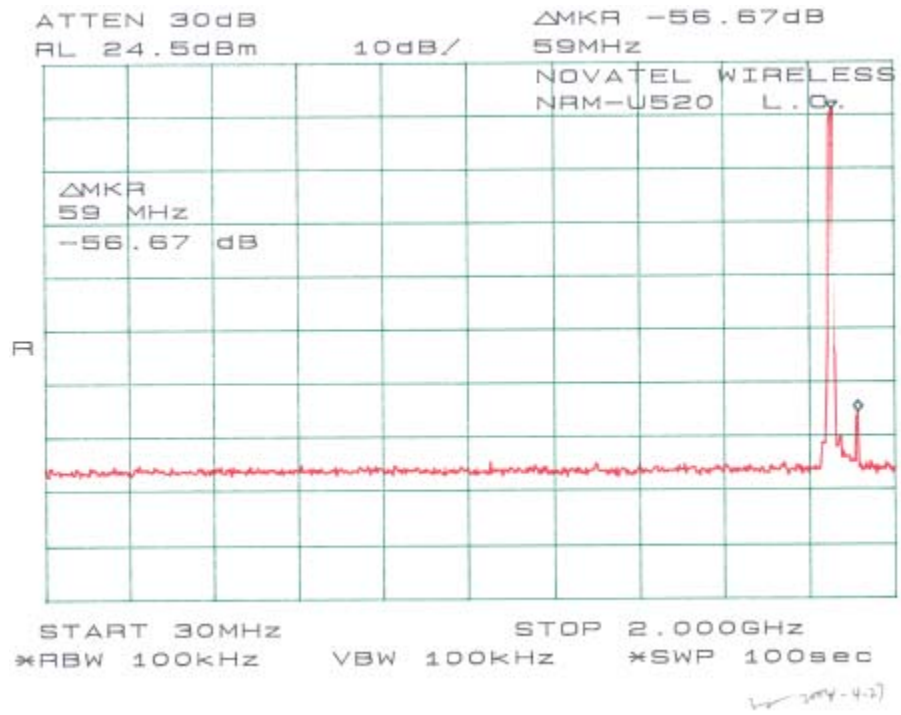
Environmental Conditions

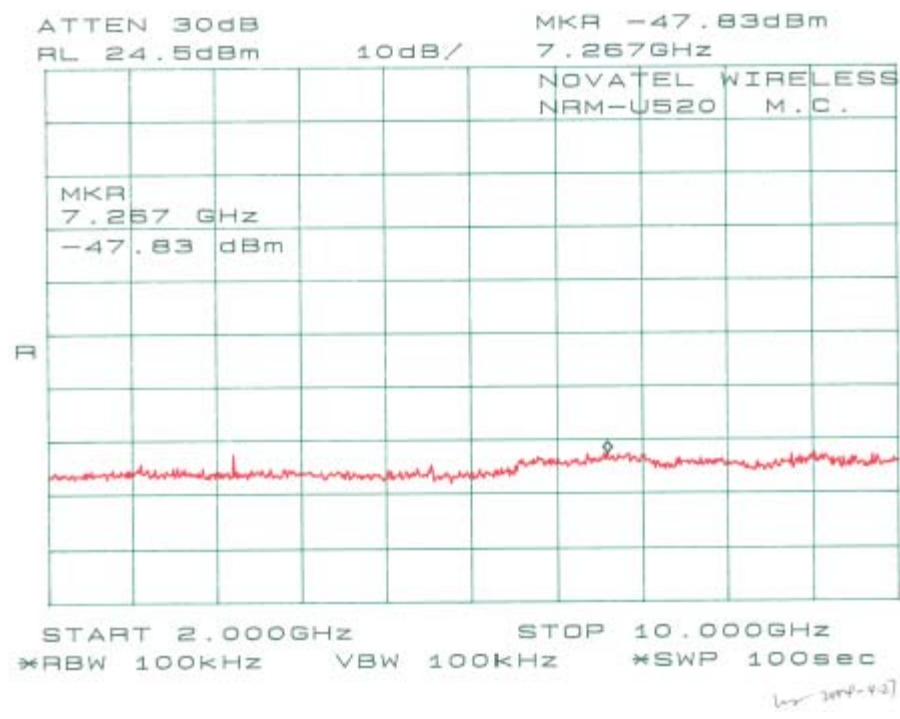
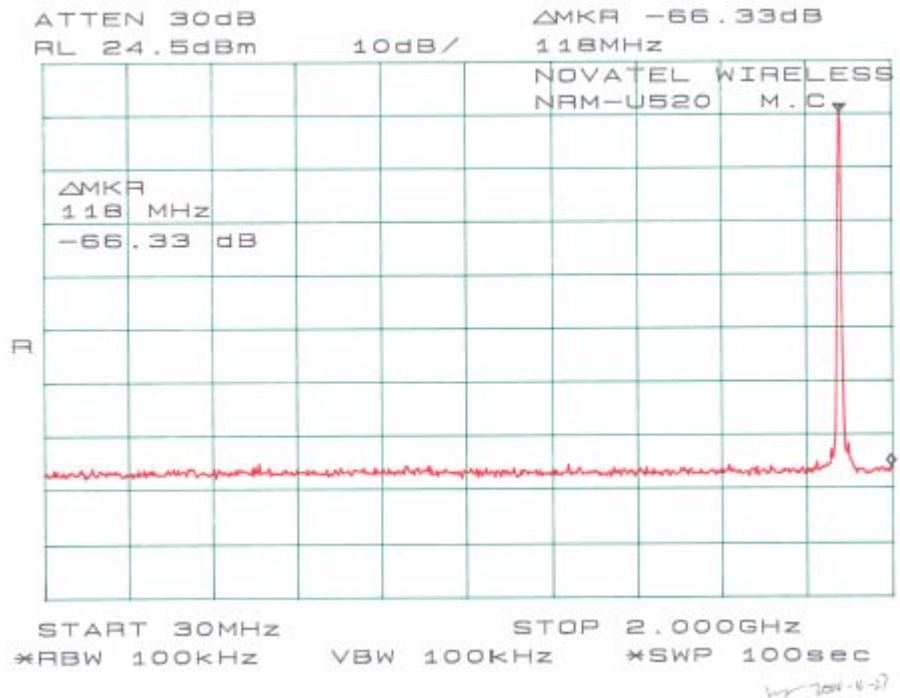
Temperature:	28.9° C
Relative Humidity:	28%
ATM Pressure:	1013.9 mbar

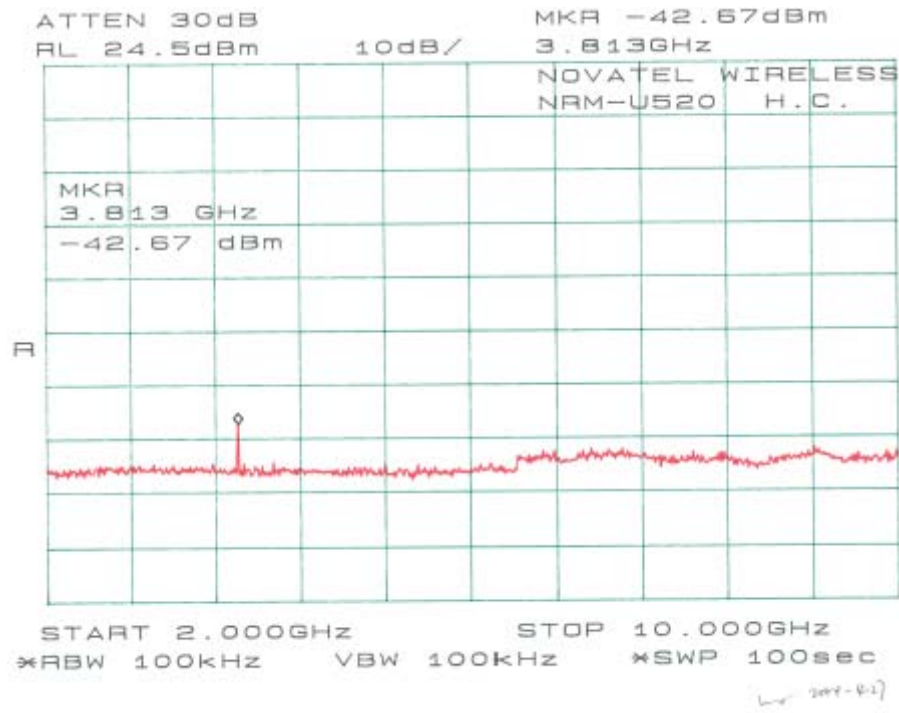
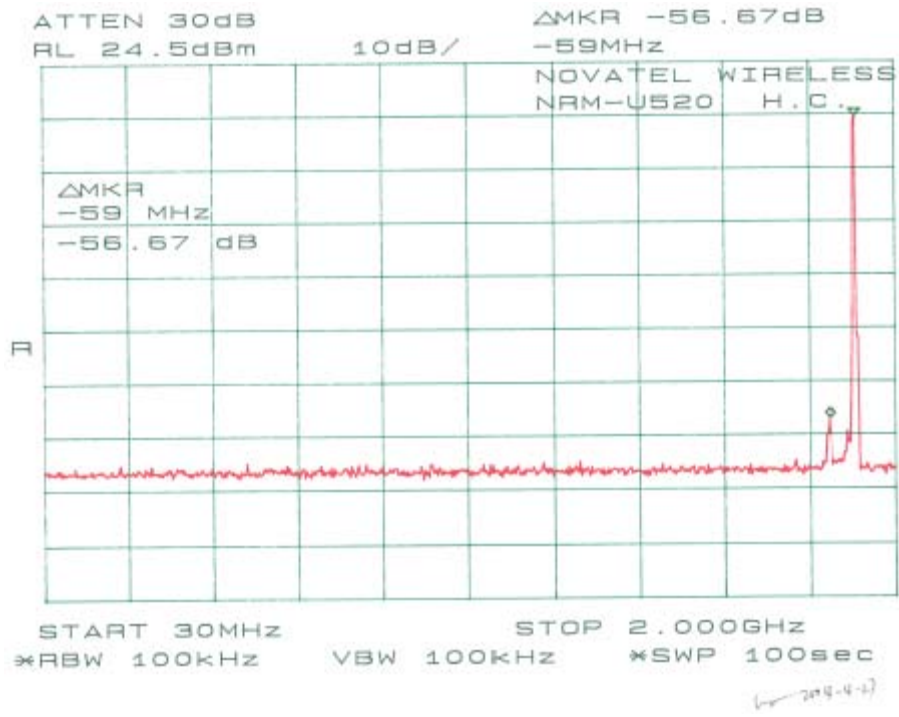
The testing was performed by Ling Zhang on 2004-04-27.

Test Results

Please refer to the hereinafter plots.







§2.1055 (a), §2.1055 (d), & §24.235 - FREQUENCY STABILITY

Applicable Standard

Requirements: FCC § 2.1055 (a), § 2.1055 (d) & following:

According to §24.235, The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block.

Test Procedure

Frequency Stability vs. Temperature: The equipment under test was connected to an external DC power supply and the RF output was connected to a frequency counter via feed-through attenuators. The EUT was placed inside the temperature chamber. The DC leads and RF output cable exited the chamber through an opening made for the purpose.

After the temperature stabilized for approximately 20 minutes, the frequency output was recorded from the counter.

Frequency Stability vs. Voltage: An external variable DC power supply was connected to the battery terminals of the equipment under test. The voltage was set to 115% of the nominal value and was then decreased until the transmitter light no longer illuminated; i.e., the battery end point. The output frequency was recorded for each battery voltage.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Cal. Date
HP	Spectrum Analyzer	HP8564E	3943A01781	2003-08-01
HP	Plotter	HP7470A	2541A49659	Not Required
HP	Temperature Oven	7475A	2541A49659	N/R

* **Statement of Traceability:** **BACL Corp.** certifies that all calibrations have been performed in accordance to NVLAP requirements, traceable to the NIST.

Environmental Conditions

Temperature:	28.9° C
Relative Humidity:	28%
ATM Pressure:	1013.9 mbar

The testing was performed by Ling Zhang on 2004-04-27.

Test Results*Frequency Stability Versus Temperature*

Reference Frequency: 1880 MHz, Limit: 2.5ppm			
Environment Temperature (°C)	Power Supplied (Vdc)	Frequency Measure with Time Elapsed	
		MHz	PPM Error
50	120	1879.999921	-0.042
40	120	1879.999934	-0.035
30	120	1879.999915	-0.045
20	120	1879.999936	-0.034
10	120	1880.000032	-0.036
0	120	1880.000060	0.032
-10	120	1880.000078	0.041
-20	120	1880.000127	0.068
-30	120	1880.000137	0.073

Frequency Stability Versus Battery Voltage

Reference Frequency: 1880MHz, Limit: 2.5ppm			
Power Supplied (Vdc)	Environment Temperature(°C)	MHz	ppm
102	20	1880.000154	0.082
138	20	1880.000095	0.051

§24.238 – BAND EDGE

Applicable Standard

According to §24.238, 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.

Test Procedure

The RF output of the transmitter was connected to the input of the spectrum analyzer through sufficient attenuation.

The center of the spectrum analyzer was set to block edge frequency, RBW set to 30KHz.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Cal. Date
HP	Spectrum Analyzer	HP8564E	3943A01781	2003-08-01
HP	Plotter	HP7470A	2541A49659	Not Required

* **Statement of Traceability:** **BACL Corp.** certifies that all calibrations have been performed in accordance to NVLAP requirements, traceable to the NIST.

Environmental Conditions

Temperature:	28.9° C
Relative Humidity:	28%
ATM Pressure:	1013.9 mbar

The testing was performed by Ling Zhang on 2004-04-27.

Test Results

Please refer to the following plots.

