PCTEST Engineering Laboratory, Inc.

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CERTIFICATE OF COMPLIANCE

MMC Technology Inc.
2F, Mirae Asset Venture Tower
996-1, Daechi-Dong, Gangnam-Gu
Seoul 135-280 Korea
Attention: Mr. Jaison Kim- Manager

Dates of Tests: September 13-14, 2001
Test Report S/N: 15.210905532.PWD
Test Site: PCTEST Lab, Columbia MD

FCC ID	**PWDMW411AP**
APPLICANT	**MMC Technology Inc.**

FCC Rule Part(s):	**§ 15.247; ANSI C-63.4 (1992)**
Classification:	**Spread Spectrum Transceiver (DSS)**
Method/System:	**Direct Sequence System**
Equipment Type:	**Wireless LAN**
Max Output Power:	**0.01 W (9.99 dBm)**
Frequency Range:	**2412 – 2483.5 MHz**
Trade/Model No(s).:	***MMC Technology Inc. MW411AP***

This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in ANSI C-63-4.

I 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.

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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NVLAP LAB CODE 100431-0

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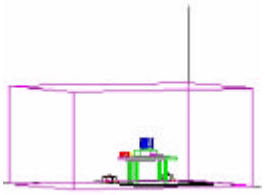
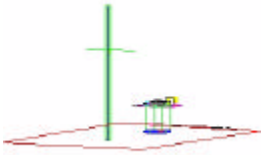


MEASUREMENT REPORT



Scope - Measurement and determination of electromagnetic emissions (EME) of radio frequency devices including intentional and/or unintentional radiators for compliance with the technical rules and regulations of the Federal Communications Commission.

§2.983(a) General Information

Applicant Name:	**MMC Technology Inc.**
Address:	**2F, Mirae Asset Venture Tower**
	996-1, Daechi-Dong, Gangnam-Gu
	Seoul 135-280 Korea
Attention:	**Mr. Jaison Kim- Manager**

- FCC ID: **PWDMW411AP**
- Class: Spread Spectrum Transceiver (DSS)
- Type: Wireless LAN
- Freq. Range: 2412 – 2483.5 MHz
- Method/System: Direct Sequence System (DSS)
- Model No(s): **MW411AP**
- Max. RF Output Power: 0.01 W (9.99 dBm)
- Rule Part(s): § 15.247
- Dates of Tests: September 13-14, 2001
- Place of Tests: PCTEST Lab, Columbia, MD U.S.A.
- Test Report S/N: 15.210905532.PWD

NVLAP Lab Code 100431-0

INTRODUCTION

The measurement procedure described in American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9kHz to 40GHz (ANSI C63.4-1992) and FCC Public Notice dated July 12, 1995 entitled "Guidance on Measurement for Direct Sequence Spread Spectrum Systems" were used in the measurement of **MMC Technology Inc. Spread Spectrum Wireless LAN.**

These measurement tests were conducted at ***PCTEST Engineering Laboratory, Inc.*** facility in New Concept Business Park, Guilford Industrial Park, Columbia, Maryland. The site address is 6660-B Dobbin Road, Columbia, MD 21045. The test site is one of the highest points in the Columbia area with an elevation of 390 feet above mean sea level. The site coordinates are 39° 11'15" N latitude and 76° 49'38" W longitude. The facility is 1.5 miles North of the FCC laboratory, and the ambient signal and ambient signal strength are approximately equal to those of the FCC laboratory. There are no FM or TV transmitters within 15 miles of the site. The detailed description of the measurement facility was found to be in compliance with the requirements of § 2.948 according to ANSI C63.4 on October 19, 1992.

PCTEST Location

The map at right shows the location of the PCTEST Lab, its proximity to the FCC Lab, the Columbia vicinity area, the Baltimore-Washington International (BWI) airport, and the city of Baltimore, and the Washington, D.C. area. (see Figure1).

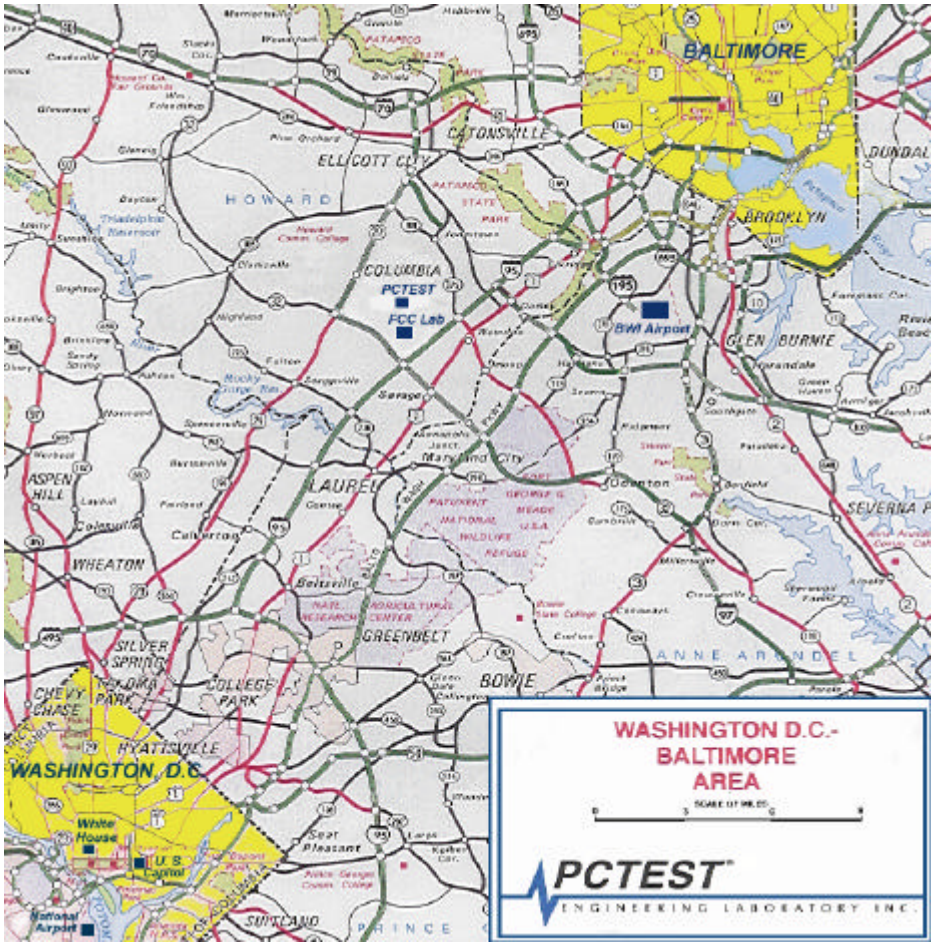


Figure 1. Map of the Greater Baltimore and Metropolitan Washington, D.C. area.

PRODUCT INFORMATION

Equipment Description:

The Equipment under test (EUT) is the **MMC Technology Inc. PWDMW411AP** wireless LAN using spread spectrum direct sequence and time division duplex techniques.

Frequency Range:	2412 – 2483.5 MHz
Modulation:	Direct Sequence Spread Spectrum, CCK, DBPSK, DQPSK
Max RF Output Power:	0.01 W (9.99 dBm)
Power Supply:	Input: 90-260VAC, 50/60Hz, 1.2A
Power Cord:	*Unshielded* DC power cord
Dimensions (WxHxD):	55 x 129 x 5 mm
Weight (Net):	44g

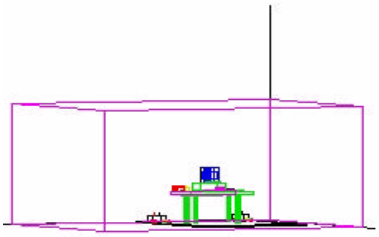


Figure 4. Shielded Enclosure Line-Conducted Test Facility

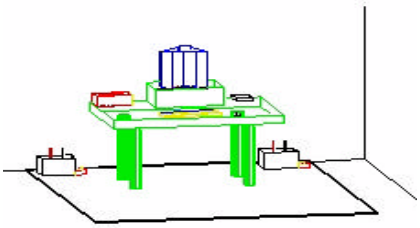


Figure 2. Line Conducted Emission Test Set-Up

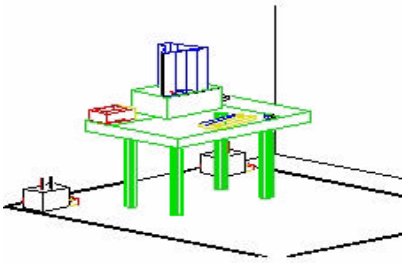


Figure 3. Wooden Table & Bonded LISNs

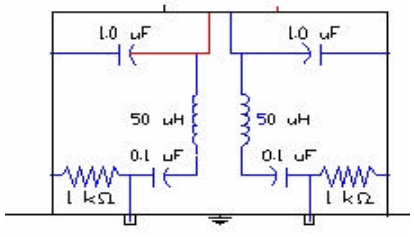


Figure 5. LISN Schematic Diagram

Description of Tests

Conducted Emissions

The line-conducted facility is located inside a 16'x20'x10' shielded enclosure. It is manufactured by Ray Proof Series 81 (see Figure 2). The shielding effectiveness of the shielded room is in accordance with MIL-Std-285 or NSA 65-6. A 1m. x 1.5m. wooden table 80cm. high is placed 40cm. away from the vertical wall and 1.5m away from the side wall of the shielded room (see Figure 3). Solar Electronics and EMCO Model 3725/2 (10kHz-30MHz) 50Ω/50µH Line-Impedance Stabilization Networks (LISNs) are bonded to the shielded room (see Figure 4). The EUT is powered from the Solar LISN and the support equipment is powered from the EMCO LISN. Power to the LISNs are filtered by a high-current high-insertion loss Ray Proof power line filters (100dB 14kHz-10GHz). The purpose of the filter is to attenuate ambient signal interference and this filter is also bonded to the shielded enclosure. All electrical cables are shielded by braided tinned copper zipper tubing with inner diameter of 1/2". If the EUT is a DC-powered device, power will be derived from the source power supply it normally will be powered from and this supply lines will be connected to the Solar LISN. LISN schematic diagram is shown in Figure 5. All interconnecting cables more than 1 meter were shortened by non-inductive bundling (serpentine fashion) to a 1-meter length. Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The RF output of the LISN was connected to the spectrum analyzer to determine the frequency producing the maximum EME from the EUT. The spectrum was scanned from 450kHz to 30MHz with 20 msec. sweep time. The frequency producing the maximum level was reexamined using EMI/ Field Intensity Meter and Quasi-Peak adapter. The detector function was set to CISPR quasi-peak mode. The bandwidth of the receiver was set to 10 kHz. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each EME emission. Each emission was maximized by: switching power lines; varying the mode of operation or resolution; clock or data exchange speed; scrolling H pattern to the EUT and/or support equipment, and powering the monitor from the floor mounted outlet box and the computer aux AC outlet, if applicable; whichever determined the worst-case emission. Photographs of the worst-case emission can be seen in Attachment H. Each EME reported was calibrated using the HP8640B signal generator.

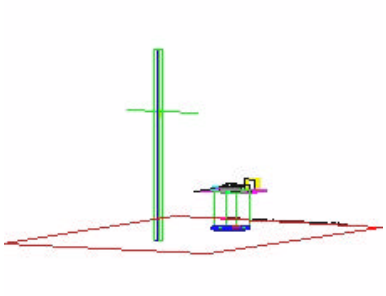


Figure 6. 3-Meter Test Site

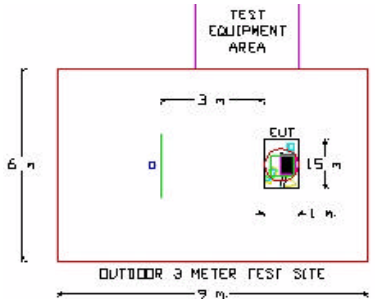


Figure 7. Dimensions of Outdoor Test Site

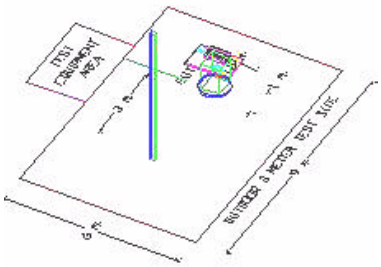


Figure 8. Turntable and System Setup

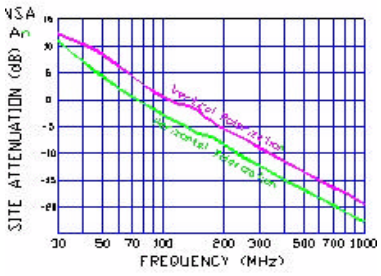


Figure 9. Normalized Site Attenuation Curves (H&V)

Description of tests (Continued)

Radiated Emissions

Preliminary measurements were made indoors at 1 meter using broadband antennas, broadband amplifier, and spectrum analyzer to determine the frequency producing the maximum EME. Appropriate precaution was taken to ensure that all EME from the EUT were maximized and investigated. The system configuration, clock speed, mode of operation or video resolution, turntable azimuth with respect to the antenna were noted for each frequency found. The spectrum was scanned from 30 to 200 MHz using biconical antenna and from 200 to 1000 MHz using log-spiral antenna. Above 1 GHz, linearly polarized double ridge horn antennas were used.

Final measurements were made outdoors at 3-meter test range using Roberts™ Dipole antennas or horn antenna (see Figure 6). The test equipment was placed on a wooden and plastic bench situated on a 1.5 x 2 meter area adjacent to the measurement area (see Figure 7). Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. Each frequency found during pre-scan measurements was re-examined and investigated using EMI/Field Intensity Meter and Quasi-Peak Adapter. The detector function was set to CISPR quasi-peak mode and the bandwidth of the receiver was set to 100kHz or 1 MHz depending on the frequency or type of signal.

The half-wave dipole antenna was tuned to the frequency found during preliminary radiated measurements. The EUT, support equipment and interconnecting cables were re-configured to the set-up producing the maximum emission for the frequency and were placed on top of a 0.8-meter high non-metallic 1 x 1.5 meter table (see Figure 8). The EUT, support equipment, and interconnecting cables were re-arranged and manipulated to maximize each EME emission. The turntable containing the system was rotated; the antenna height was varied 1 to 4 meters and stopped at the azimuth or height producing the maximum emission. Each emission was maximized by: varying the mode of operation or resolution; clock or data exchange speed; scrolling H pattern to the EUT and/or support equipment, and powering the monitor from the floor mounted outlet box and the computer aux AC outlet, if applicable; and changing the polarity of the antenna, whichever determined the worst-case emission. Photographs of the worst-case emission can be seen in Attachment H. Each EME reported was calibrated using the HP8640B signal generator. The Theoretical Normalized Site Attenuation Curves for both horizontal and vertical polarization are shown in Figure 9.

§ 15.205 Restricted Bands

Special attention is made for the EUT's harmonic and spurious radiated emission in the restricted bands of operation. The EUT was tested from 9kHz and up to the tenth harmonic of the fundamental frequency of the transmitter using CISPR quasi peak detector below 1GHz. Above 1 GHz, average measurements was used using RBW 1 MHz – VBW 10Hz and linearly polarized horn antennas. In addition, peak measurements were taken to ensure that the peak levels are not more than 20dB above the average limit. All out of band emissions, other than those created by the spreading sequency, data sequence, and the carrier modulation must not exceed the limits show int Table 2 per 15.209.

Frequency (MHz)	F/S (UV/m)	Meas. Dist. (Meters)
0.009-0.490	2400/F (kHz)	300
0.490-1.705	24000/F (kHz)	30
1.705-30.00	30	30
30.0-88.0	100	3
88.0-216.0	150	3
216.0-960.0	200	3
Above 960	500	3

Tab. 2. Radiated Emission Limits Per 15.209

Test Equipment

HP 8566B	**Spectrum Analyzer 100Hz-22GHz**
HP83017A	**Microwave Analyzer 40dB Gain (0.5 – 26.5 GHz)**
HP 3784A	**Digital Transmission Analyzer**
Gigatronics	**POWER METER MODEL 8651A**
EMCO 3115	**Horn Antenna (1 – 18GHz)**
HP 8495A	**20dB Attenuator (DC-40GHz) 0-70dB**
HP 8493B	**10dB Attenuator**
MicroCoax Cables	**Low Loss Microwave Cables (1-26.5 GHz)**
CDI Dipoles	**Dipole Antennas (30 – 1000 MHz)**

§ 15.203 Antenna Requirement

An intentional radiator antenna shall be designed to ensure that no antenna other that that furnished by the applicant can be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with this requirement.

CONCLUSION

The **MMC Technology Inc. PWDMW411AP** complies with the requirement of §15.203. The antenna is **permanently attached.**

§15.247(a)(2) – Direct Sequence Bandwidth

Minimum Standard – The transmitter shall have a minimum 6 dB BW of 500 kHz. These are conducted measurements.

Res. Bandwidth =	100 kHz (5dB/div)
Vid. BW =	100 kHz
Span =	30 MHz
Ref. Level	0 dBm
Sweep	7.5ms

FREQUENCY (MHz)	Channel	6dB Bandwidth (MHz)
2412	01	10.3
2438	06	9.8
2472	13	9.9

Table 3. 6dB Bandwidth measurements

REMARKS:

PASS

§15.247(b) Maximum Peak Output Power

Minimum Standard – The maximum peak output power of the transmitter shall not exceed 1 watt. These are conducted measurements.

Res. Bandwidth =	3 MHz (10dB/div)
Vid. BW=	3 MHz
Span=	30 MHz
Ref. Level	10 dBm
Sweep	4 ms sec

Max. Power Peak + Atten = dBm ⇒ Watts

FREQUENCY (MHz)	Channel	Power Output Conducted (dBm)	Power Output Radiated (mW)
2412	01	9.9	10.0
2438	06	9.9	10.0
2472	13	9.9	10.0

Table 4. Output Power Measurements

Notes:

The Power Output measurements were taken with a Peak reading Power Meter.

REMARKS:

PASS

§15.247(c) Power Density

Minimum Standard – The transmitted power density average over any 1 second interval shall not be greater than 8dBm in any 3kHz bandwidth within these bands. These are conducted measurements.

Res. Bandwidth =	3 kHz (5dB/div)
Vid. BW =	3 kHz
Span =	30 MHz
Ref. Level	0 dBm
Sweep	1000 sec

Peak + Atten = dBm ⇒ (Limit < 8dBm)

FREQ (MHz)	Channel	Power Density (dBm)
2412	01	-5.0
2438	06	-3.5
2472	13	-7.8

Table 5. Output Power Density Data.

REMARKS:

PASS

RADIATED Measurements (Fundamental & Harmonics)

Operating Frequency: 2412 MHz
Distance of Measurements: 3 meters
Channel: 01

FREQ. (MHz)	**Level*** (dBm)	**AFCL** (dB)	**POL** (H/V)	**DET QP/AVG**	**F/S** (µV/m)	**F/S** (dBµV/m)	**Margin** (dB)
2412.0	- 34.5	32.7	V	Peak	181551.6	105.2	n/a
4824.0	- 100.0	40.4	V	Peak	234.2	47.4	6.6
7236.0	- 117.8	47.4	V	Peak	67.8	36.6	17.4

Table 6. Internal Antenna

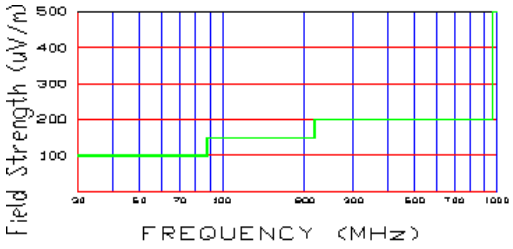


Figure 10. Restricted band harmonics and spurious limits.

Above 1 GHz limit is 500 uV/m (54dBu/m)

NOTES:

1. All harmonics in the restricted bands specified in §15.205 are below the limit shown in table 2. (note: * Restricted Band)

2. All harmonics/spurs are at least 20 dB below the highest emission in the authorized band using RBW = 100kHz

3. Average Measurements > 1GHz using RBW = 1 MHz VBW = 10 Hz

4. The peak emissions above 1 GHz are not more than 20 dB above the average limit.

5. The antenna is manipulated through typical positions, polarity and length during the tests.

6. The EUT is supplied with nominal AC voltage or/and a new/fully recharged battery.

7. The spectrum is measured from 9kHz to the 10th harmonic and the worst-case emissions are reported.

8. < - 132 are below the analyzer floor level.

RADIATED Measurements (Fundamental & Harmonics)

Operating Frequency: 2438 MHz
Distance of Measurements: 3 meters
Channel: 06

FREQ. (MHz)	**Level*** (dBm)	**AFCL** (dB)	**POL** (H/V)	**DET QP/AVG**	**F/S** (µV/m)	**F/S** (dBµV/m)	**Margin** (dB)
2438.0	- 34.6	32.8	V	Peak	181970.1	105.2	n/a
4876.0	-99.0	40.5	V	Peak	266.1	48.5	5.5
7314.0	- 116.5	48.0	V	Peak	84.1	38.5	15.5

Table 7. Internal Antenna

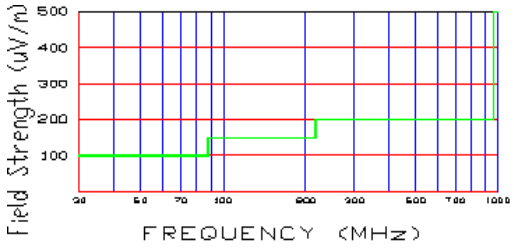


Figure 11. Restricted band harmonics and spurious limits.

Above 1 GHz limit is 500 uV/m (54dBu/m)

NOTES:

1. All harmonics in the restricted bands specified in §15.205 are below the limit shown in table 2. (note: * Restricted Band)

2. All harmonics/spurs are at least 20 dB below the highest emission in the authorized band using RBW = 100kHz

3. Average Measurements > 1GHz using RBW = 1 MHz VBW = 10 Hz

4. The peak emissions above 1 GHz are not more than 20 dB above the average limit.

5. The antenna is manipulated through typical positions, polarity and length during the tests.

6. The EUT is supplied with nominal AC voltage or/and a new/fully recharged battery.

7. The spectrum is measured from 9kHz to the 10th harmonic and the worst-case emissions are reported.

8. < - 132 are below the analyzer floor level.

RADIATED Measurements (Fundamental & Harmonics)

Operating Frequency: 2472 MHz
Distance of Measurements: 3 meters
Channel: 13

FREQ. (MHz)	**Level*** (dBm)	**AFCL** (dB)	**POL** (H/V)	**DET QP/AVG**	**F/S** (µV/m)	**F/S** (dBµV/m)	**Margin** (dB)
2472.0	- 34.7	32.9	V	Peak	181551.6	105.2	n/a
4944.0	- 100.1	40.7	V	Peak	239.9	47.6	6.4
7416.0	- 118.0	48.2	V	Peak	72.4	37.2	16.8

Table 8. Internal Antenna

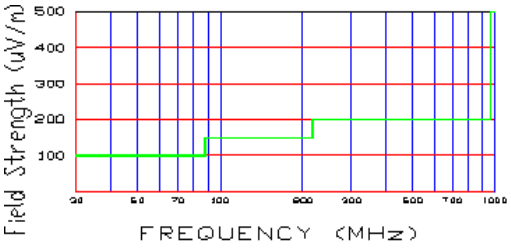


Figure 12. Restricted band harmonics and spurious limits.

Above 1 GHz limit is 500 uV/m (54dBu/m)

NOTES:

1. All harmonics in the restricted bands specified in §15.205 are below the limit shown in table 2. (note: * Restricted Band)

2. All harmonics/spurs are at least 20 dB below the highest emission in the authorized band using RBW = 100kHz

3. Average Measurements > 1GHz using RBW = 1 MHz VBW = 10 Hz

4. The peak emissions above 1 GHz are not more than 20 dB above the average limit.

5. The antenna is manipulated through typical positions, polarity and length during the tests.

6. The EUT is supplied with nominal AC voltage or/and a new/fully recharged battery.

7. The spectrum is measured from 9kHz to the 10th harmonic and the worst-case emissions are reported.

8. < - 132 are below the analyzer floor level.

RADIATED Measurements (Spurious)

Operating Frequency: 2412 – 2483.5 MHz

Distance of Measurements: 3 meters

FREQ. (MHz)	**Level*** (dBm)	**AFCL**** (dB)	**POL** (H/V)	**Height** (m)	**Azimuth** (° angle)	**F/S** (µV/m)	**Margin***** (dB)
131.9	- 82.1	12.6	V	2.9	115	73.3	- 6.2
176.2	- 84.3	13.5	H	2.9	135	64.6	- 7.3
191.7	- 86.4	16.1	V	2.7	110	68.4	- 6.8
288.4	- 89.6	20.2	V	2.3	240	75.7	- 8.4
383.1	- 92.1	23.2	H	1.8	175	80.4	- 7.9
430.2	- 93.9	24.4	H	1.5	220	75.0	- 8.5
671.5	-98.6	29.4	H	1.3	125	77.6	-8.2

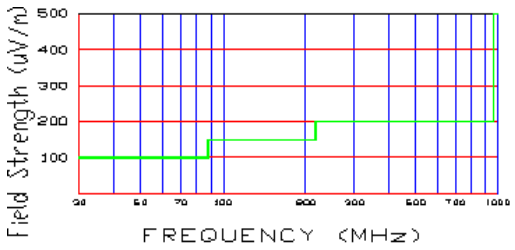


Figure 25. Restricted band harmonics and spurious limits.

NOTES:

1.All emissions were investigated and the worst case emissions are reported

2. For hand-held devices, the EUT is rotated through three orthogonal axis to determine which configuration produces the maximum emissions.

3. The EUT is supplied with the minimal AC voltage or/and a new/fully recharged battery.

4. The EUT was tested up to the 10th harmonic (24 GHz) and no significant emission was found.

Above 1 GHz limit is 500 uV/m (54dBu/m)

§15.247(e) PROCESSING GAIN (from MMC Technology Inc.)

See attached Processing Gain data from MMC Technology Inc..

Results:

PASS

The test results of Section 15.247(e) were confirmed by PCTEST Engineering Lab.

TEST EQUIPMENT

Type	Model	Cal. Due Date	S/N
Microwave Spectrum Analyzer	HP 8566B (100Hz-22GHz)	12/05/01	3638A08713
Microwave Spectrum Analyzer	HP 8566B (100Hz-22GHz)	04/17/02	2542A11898
Spectrum Analyzer/Tracking Gen.	HP 8591A (9kHz-1.8GHz)	06/02/02	3144A02458
Spectrum Analyzer	HP 8591A (9kHz-1.8GHz)	10/15/02	3108A02053
Spectrum Analyzer	HP 8594A (9kHz-2.9GHz)	11/02/02	3051A00187
Signal Generator*	HP 8640B (500Hz-1GHz)	06/02/02	2232A19558
Signal Generator*	HP 8640B (500Hz-1GHz)	06/02/02	1851A09816
Signal Generator*	Rohde & Schwarz (0.1-1000MHz)	09/11/02	894215/012
Ailtech/Eaton Receiver	NM 37/57A-SL (30-1000MHz)	04/12/02	0792-03271
Ailtech/Eaton Receiver	NM 37/57A (30-1000MHz)	03/11/02	0805-03334
Ailtech/Eaton Receiver	NM 17/27A (0.1-32MHz)	09/17/02	0608-03241
Quasi-Peak Adapter	HP 85650A	08/09/02	2043A00301
Ailtech/Eaton Adapter	CCA-7 CISPR/ANSI QP Adapter	03/11/02	0194-04082
RG58 Coax Test Cable	No. 167		n/a
Harmonic/Flicker Test System	HP 6841A (IEC 555-2/3)		3531A00115
Broadband Amplifier (2)	HP 8447D		1145A00470, 1937A03348
Broadband Amplifier	HP 8447F		2443A03784
Transient Limiter	HP 11947A (9kHz-200MHz)		2820A00300
Horn Antenna	EMCO Model 3115 (1-18GHz)		9704-5182
Horn Antenna	EMCO Model 3115 (1-18GHz)		9205-3874
Horn Antenna	EMCO Model 3116 (18-40GHz)		9203-2178
Biconical Antenna (4)	Eaton 94455/Eaton 94455-1/Singer 94455-1/Compliance Design 1295, 1332, 0355		
Log-Spiral Antenna (3)	Ailtech/Eaton 93490-1		0608, 1103, 1104
Roberts Dipoles	Compliance Design (1 set) A100		5118
Ailtech Dipoles	DM-105A (1 set)		33448-111
EMCO LISN (2)	3816/2		1077, 1079
EMCO LISN	3725/2		2009
Microwave Preamplifier 40dB Gain	HP 83017A (0.5-26.5GHz)		3123A00181
Microwave Cables	MicroCoax (1.0-26.5GHz)		
Ailtech/Eaton Receiver	NM37/57A-SL		0792-03271
Spectrum Analyzer	HP 8591A		3034A01395
Modulation Analyzer	HP 8901A		2432A03467
NTSC Pattern Generator	Leader 408		0377433
Noise Figure Meter	HP 8970B		3106A02189
Noise Figure Meter	Ailtech 7510		TE31700
Noise Generator	Ailtech 7010		1473
Microwave Survey Meter	Holaday Model 1501 (2.450GHz)		80931
Digital Thermometer	Extech Instruments 421305		426966
Attenuator	HP 8495A (0-70dB) DC-4GHz		
Bi-Directional Coax Coupler	Narda 3020A (50-1000MHz)		
Shielded Screen Room	RF Lindgren Model 26-2/2-0		6710 (PCT270)
Shielded Semi-Anechoic Chamber	Ray Proof Model S81		R2437 (PCT278)
Environmental Chamber	Associated Systems Model 1025 (Temperature/Humidity)		PCT285

* Calibration traceable to the National Institute of Standards and Technology (NIST).

CONCLUSION

The data collected shows that the **MMC Technology Inc. FCC ID: PWDMW411AP spread spectrum Wireless LAN** complies with Part 15.247 of the FCC Rules.