MET Laboratories, Inc. *Safety Certification - EMI - Telecom Environmental Simulation*
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June 16, 2010

Modular Mining Systems
3289 E. Hemisphere Loop
Tuscon, Arizona 85706

Dear Luiz Steinberg,

Enclosed is the EMC Wireless test report for compliance testing of the Motorola, Inc. MOTOMESH Duo 4300-58 as tested to the requirements of Title 47 of the CFR, Ch. 1 (10-1-06 ed.), Class II Permissive Change FCC Part 15 Subpart C, RSS-210, Issue 7, June 2007 for Intentional Radiators.

Thank you for using the services of MET Laboratories, Inc. If you have any questions regarding these results or if MET can be of further service to you, please feel free to contact me.

Sincerely yours,
MET LABORATORIES, INC.

Jennifer Warnell
Documentation Department

Reference: (\Modular Mining Systems\EMCS82389-FCC247 CIIPC Rev. 1)

Electromagnetic Compatibility Criteria
Test Report

for the

Modular Mining Systems
Motorola Inc. MOTOMESH Duo 4300-58

Tested under
the FCC Certification Rules
contained in
Class II Permissive Change
15.247 Subpart C & RSS-210, Issue 7, June 2007
for Intentional Radiators

MET Report: EMCS82389-FCC247 CIIPC Rev. 1

June 16, 2010

Prepared For:

Modular Mining Systems
3289 E. Hemisphere Loop
Tuscon, Arizona 85706

Prepared By:
MET Laboratories, Inc.
3162 Belick St.
Santa Clara, CA 95054

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15.247 Subpart C & RSS-210, Issue 7, June 2007
for Intentional Radiators

Anderson Soungpanya, Project Engineer
Electromagnetic Compatibility Lab

Jennifer Warnell
Documentation Department

Engineering Statement: The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of the FCC Rules Parts 15B, 15.247 and Industry Canada standards ICES-003, Issue 4 February 2004, RSS-210, Issue 7, June 2007 under normal use and maintenance.

Shawn McMillen,
Wireless Manager, Electromagnetic Compatibility Lab

Report Status Sheet

Revision	Report Date	Reason for Revision
∅	June 3, 2010	Initial Issue.
1	June 16, 2010	Corrected EUT name.

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List of Terms and Abbreviations

AC	**A**lternating **C**urrent
ACF	**A**ntenna **C**orrection **F**actor
Cal	**Cal**ibration
d	**M**easurement **D**istance
dB	**D**eci**b**els
dBµA	**D**eci**b**els above one **micro**amp
dBµV	**D**eci**b**els above one **micro**volt
dBµA/m	**D**eci**b**els above one **micro**amp **per m**eter
dBµV/m	**D**eci**b**els above one **micro**volt **per m**eter
DC	**D**irect **C**urrent
E	**E**lectric Field
DSL	**D**igital **S**ubscriber **L**ine
ESD	**E**lectro**s**tatic **D**ischarge
EUT	**E**quipment **U**nder **T**est
f	**F**requency
FCC	**F**ederal **C**ommunications **C**ommission
GRP	**G**round **R**eference **P**lane
H	Magnetic Field
HCP	**H**orizontal **C**oupling **P**lane
Hz	**H**ert**z**
IEC	**I**nternational **E**lectrotechnical **C**ommission
kHz	**k**ilo**h**ert**z**
kPa	**k**ilo**pa**scal
kV	**k**ilo**v**olt
LISN	**L**ine **I**mpedance **S**tabilization **N**etwork
MHz	**M**ega**h**ertz
µH	**microh**enry
µ	**microf**arad
µs	**micros**econds
NEBS	**N**etwork **E**quipment-**B**uilding **S**ystem
PRF	**P**ulse **R**epetition **F**requency
RF	**R**adio **F**requency
RMS	**R**oot-**M**ean-**S**quare
TWT	**T**raveling **W**ave **T**ube
V/m	**V**olts **per m**eter
VCP	**V**ertical **C**oupling **P**lane

I. Executive Summary

A. Purpose of Test

An EMC evaluation was performed to determine compliance of the Motorola Inc. MOTOMESH Duo 4300-58, with the requirements of Part 15, §15.247. All references are to the most current version of Title 47 of the Code of Federal Regulations in effect. In accordance with §2.1033, the following data is presented in support of the Certification of the MOTOMESH Duo 4300-58. Modular Mining Systems should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the MOTOMESH Duo 4300-58, has been **permanently** discontinued.

B. Executive Summary

The following tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 15, §15.247, in accordance with Modular Mining Systems, purchase order number 4500032862. All tests were conducted using measurement procedure ANSI C63.4-2003.

FCC Reference 47 CFR Part 15.247:2005	IC Reference RSS-210 Issue 7: 2007	Description	Compliance
Title 47 of the CFR, Part 15 §15.203	N/A	Antenna Requirement	Compliant
Title 47 of the CFR, Part 15 §15.247(b)	RSS-210(A8.4)	RF Output Power	Compliant
Title 47 of the CFR, Part 15 §15.209, §15.247(d)	RSS-210(A8.5)	Radiated Spurious Emissions	Compliant
Title 47 of the CFR, Part 15 §15.205	RSS-210(A8.5)	Emissions at Restricted Band	Compliant

Table 1. Executive Summary of EMC Part 15.247 ComplianceTesting

II. Equipment Configuration

A. Overview

MET Laboratories, Inc. was contracted by Modular Mining Systems to perform testing on the MOTOMESH Duo 4300-58, under Modular Mining Systems's purchase order number 4500032862.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the Motorola Inc., MOTOMESH Duo 4300-58.

The results obtained relate only to the item(s) tested.

Model(s) Tested:	MOTOMESH Duo 4300-58	
Model(s) Covered:	MOTOMESH Duo 4300-58	
EUT Specifications:	Primary Power: 120 VAC, 60 Hz	
	FCC ID: QJE-MM4300-58 IC: 4602A-MM430058	
	Type of Modulations:	CCK/OFDM
	Equipment Code:	DTS
	Peak RF Output Power:	0.246 W
	EUT Frequency Ranges:	2412 – 2462 MHz
Analysis:	The results obtained relate only to the item(s) tested.	
Environmental Test Conditions:	Temperature: 15-35º C	
	Relative Humidity: 30-60%	
	Barometric Pressure: 860-1060 mbar	
Evaluated by:	Anderson Soungpanya	
Report Date(s):	June 16, 2010	

Table 2. EUT Summary Table

B. References

CFR 47, Part 15, Subpart C	Federal Communication Commission, Code of Federal Regulations, Title 47, Part 15: General Rules and Regulations, Allocation, Assignment, and Use of Radio Frequencies
RSS-210, Issue 7, June 2007	Low-power Licence-exempt Radiocommunications Devices (All Frequency Bands): Category I Equipment
CFR 47, Part 15, Subpart B	Electromagnetic Compatibility: Criteria for Radio Frequency Devices
ICES-003, Issue 4 February 2004	Electromagnetic Compatibility: Criteria for Radio Frequency Devices
ANSI C63.4:2003	Methods and Measurements of Radio-Noise Emissions from Low-Voltage Electrical And Electronic Equipment in the Range of 9 kHz to 40 GHz
ANSI/NCSL Z540-1-1994	Calibration Laboratories and Measuring and Test Equipment - General Requirements
ANSI/ISO/IEC 17025:2000	General Requirements for the Competence of Testing and Calibration Laboratories
ANSI C63.10-2009	American National Standard for Testing Unlicensed Wireless Devices

Table 3. References

C. Test Site

All testing was performed at MET Laboratories, Inc., 3162 Belick St., Santa Clara, CA 95054. All equipment used in making physical determinations is accurate and bears recent traceability to the National Institute of Standards and Technology.

Radiated Emissions measurements were performed in a 3 meter semi-anechoic chamber (equivalent to an Open Area Test Site). In accordance with §2.948(a)(3), a complete site description is contained at MET Laboratories.

D. Description of Test Sample

The Motorola Inc. MOTOMESH Duo 4300-58, Equipment Under Test (EUT), is a dual radio unit. The system operates at 2.4 GHz (ISM band 802.11 b/g) and 5.X GHz using an Atheros AP30 chipset.

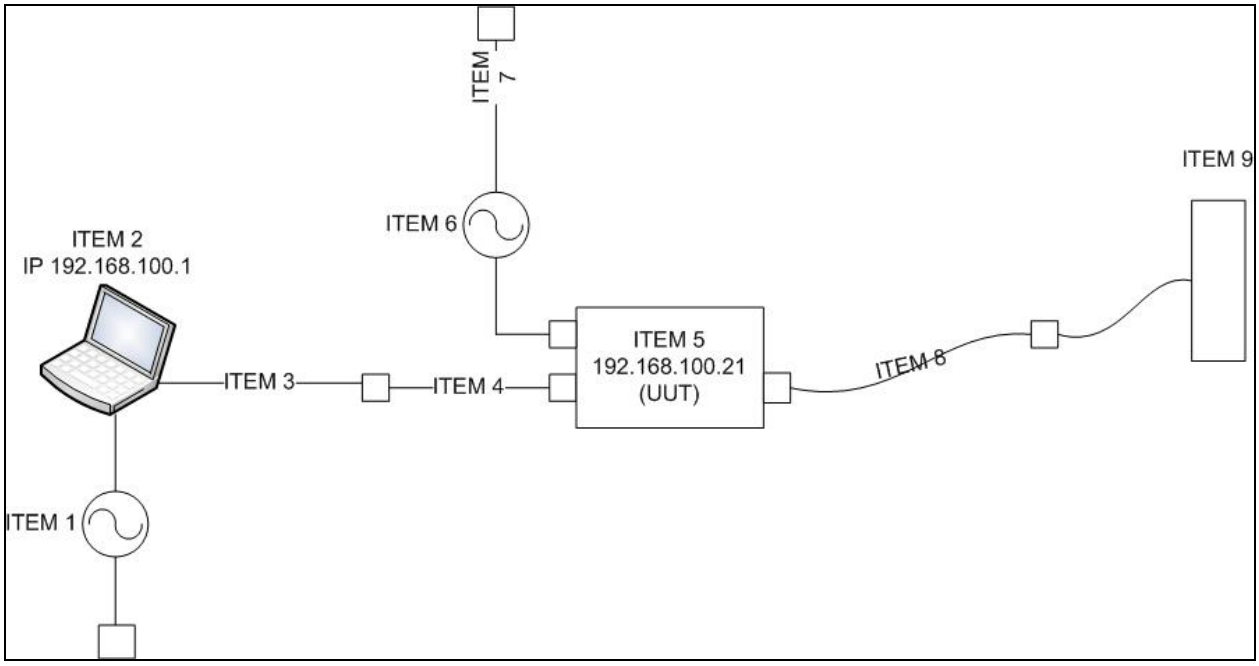


Figure 1. Block Diagram of Test Configuration

E. Equipment Configuration

The EUT was set up as outlined in Figure 1, Block Diagram of Test Setup. All cards, racks, etc., incorporated as part of the EUT is included in the following list.

Ref. ID	Name / Description	Model Number	Serial Number
5	Motomesh Duo 4300 58 DC Model: MM2.0 2.4/5.8 DC BX Eth0: 00195EB4EF13	MLUX4037A	683ZHW4810

Table 4. Equipment Configuration

F. Support Equipment

Support equipment necessary for the operation and testing of the EUT is included in the following list.

Ref. ID	Name / Description	Manufacturer	Model Number	Serial Number
1	Power Supply 90W-AC Adapter Input: 100-240VAC Output: 19.5VDC	Dell	PA-1900-02D	N/A
2	Laptop PC (Atheros Radio Software ART Included)	Dell	Dell Precision M65	Service Tag #6MFV3C1 Express Service Code 14417594785 CN-0JF242-48643-6AK-0040 Rev A01
3	Cable Ethernet RJ45-M to RJ45-M ~50 ft	Generic Component	N/A	N/A
4	Cable Ethernet Adapter RJ45-F to Circle-8pins-M ~1 ft	Generic Component	N/A	N/A
6	Power Supply AC Power Adaptor Input: 100-240VAC, 50-60Hz Output: 12VDC, 3A	Generic Component	AD-740U-1120	N/A
7	Cable AC 121565-001	Generic Component	N/A	N/A
8	Coax Cable RG-58 N-M to N-M WiFi 2.4-2.485GHz ~ 16 ft	Generic Component	N/A	N/A
9	2.4GHz Sector Antenna Sector Panel 90D 10 dBi	Maxrad	MSP2401090	271935

Table 5. Support Equipment

G. Mode of Operation

Atheros Radio Test Software included

Instructions:

Setup and Instructions to run MOTOMESH Duo (2.4 GHz/5.8 GHz AC/DC) EUTs

1. Identify the 12V VDC power source. Using the custom power cable provided, connect 4-pin power cord mating connector to DC MOTOMESH Duo EUT.
2. Connect 8-pin ETH connector of ETH cable assembly to POE OPT port of MOTOMESH Duo UUT and RJ45 connector of cable assembly to ETH port of laptop.
3. Power up MOTOMESH Duo EUT and laptop. Note: NO PASSWORD REQUIRED.
4. Ping the MotoMesh Duo unit (IP 192.168.100.21). After a successful ping reply double click ART.BAT file at Desktop to activate Atheros Radio Test menu.
5. At Test Harness Main Options menu select Load (E)EPROM Calibration by typing ‘e’ then select (C)ontinuous transmit mode by typing ‘c’. Continuous Transmit Options menu appears.
6. To toggle between 2.4 GHz and 5.8 GHz radios as UUT, hit the Esc key first then select Toggle M(o)de by typing ‘o’ or to toggle between 2.4 GHz and 5.x GHz radios as UUT, hit the Esc key first then select Toggle M(o)de by typing ‘o’.
7. To change various channel, power output, etc, follow the options available from the Continuous Transmit Options menu.

Considerations to match output power according with current FCC and IC Grants for this Class II Permissive Change. However these values may vary at MET Lab.
For modulation CCK, set Output power to 28 at ART for all channels
For Modulation OFDM, set Output power to 21.5 for channel 1 and 22 for channels 6 and 11.

H. Modifications

a) Modifications to EUT

No modifications were made to the EUT.

b) Modifications to Test Standard

No modifications were made to the test standard.

I. Disposition of EUT

The test sample including all support equipment submitted to the Electro-Magnetic Compatibility Lab for testing was returned to Modular Mining Systems upon completion of testing.

III. Electromagnetic Compatibility Criteria for Intentional Radiators

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.203 Antenna Requirement

Test Requirement: **§ 15.203:** An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall 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 the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

The structure and application of the EUT were analyzed to determine compliance with Section 15.203 of the Rules. Section 15.203 states that the subject device must meet at least one of the following criteria:

a.) Antenna must be permanently attached to the unit.

b.) Antenna must use a unique type of connector to attach to the EUT.

c.) Unit must be professionally installed. Installer shall be responsible for verifying that the correct antenna is employed with the unit.

Results: The EUT as tested is compliant the criteria of §15.203. The antenna is professionally installed.

Test Engineer(s): Anderson Soungpanya

Test Date(s): 05/19/10

Gain	Type	Model	Manufacturer
10	Panel	MSP2401090	Maxrad

Table 6. Antenna List

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(b) Peak Power Output

Test Requirements: **§15.247(b):** The maximum peak output power of the intentional radiator shall not exceed the following:

Digital Transmission Systems (MHz)	Output Limit (Watts)
902-928	1.000
2400–2483.5	1.000
5725– 5850	1.000

Table 7. Output Power Requirements from §15.247

§15.247(c): if transmitting antennas of directional gain greater than 6 dBi are used the peak output power from the intentional radiator shall be reduced below the stated values in the Table 7, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Systems operating in the 2400 – 2483.5 MHz band and using a point to point application may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

Systems operating in the 5725 – 5850 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter peak output power.

Fixed, point-to-point operation excludes the use of point-to-multipoint systems, omni-directional applications, and multiple co-located intentional radiators transmitting the same information. The operator of the spread spectrum intentional radiator or, if the equipment is professionally installed, the installer is responsible for ensuring that the system is used exclusively for fixed, point-to-point operations. The instruction manual furnished with the intentional radiator shall contain language in the installation instructions informing the operator and the installer of this responsibility.

Test Procedure: The transmitter was connected to a calibrated spectrum analyzer. The EUT was measured at the low, mid and high channels of each band at the maximum power level.

Test Results: The EUT was compliant with the Peak Power Output limits of **§15.247(b)**. Measured emissions were below applicable limits.

Test Engineer(s): Anderson Soungpanya

Test Date(s): 05/19/10

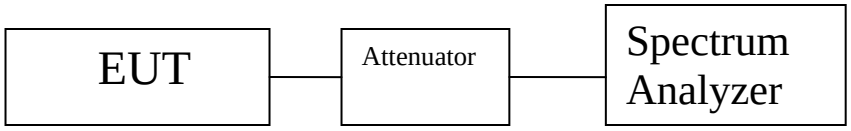


Figure 2. Peak Power Output Test Setup

RF Power Output Test Results

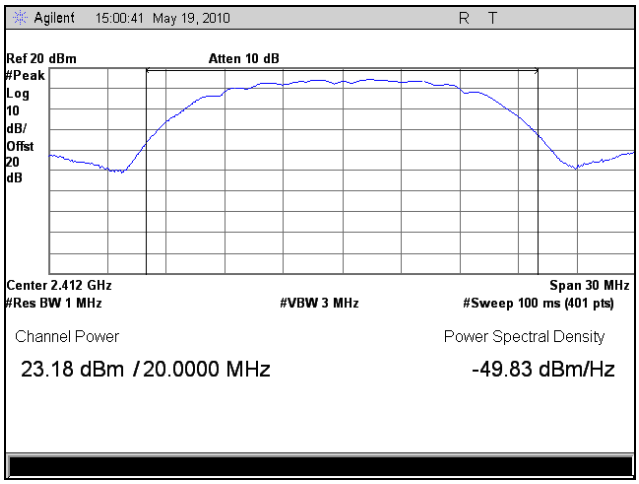
Peak Conducted Output Power		
Carrier Channel	**Frequency (MHz)**	**Measured Peak Output Power dBm**
Low	2412	23.18
Mid	2437	22.58
High	2462	22.02

Table 8. RF Output Power Test Results, 802.11b, Into Antenna (With 16ft Cable)

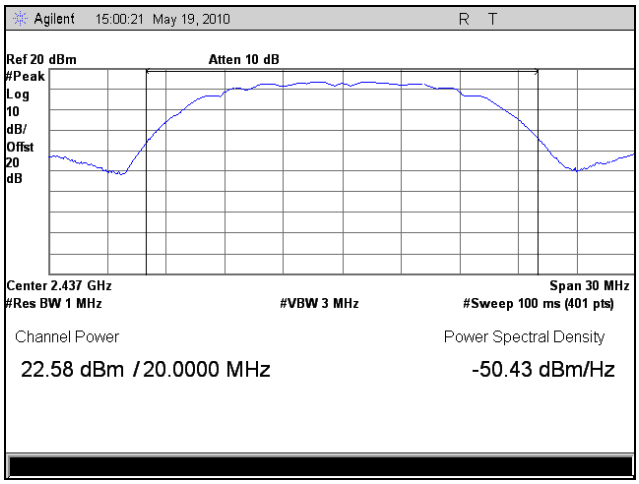
Peak Conducted Output Power		
Carrier Channel	**Frequency (MHz)**	**Measured Peak Output Power dBm**
Low	2412	23.91
Mid	2437	23.79
High	2462	23.38

Table 9. RF Output Power Test Results, 802.11g, Into Antenna (With 16ft Cable)

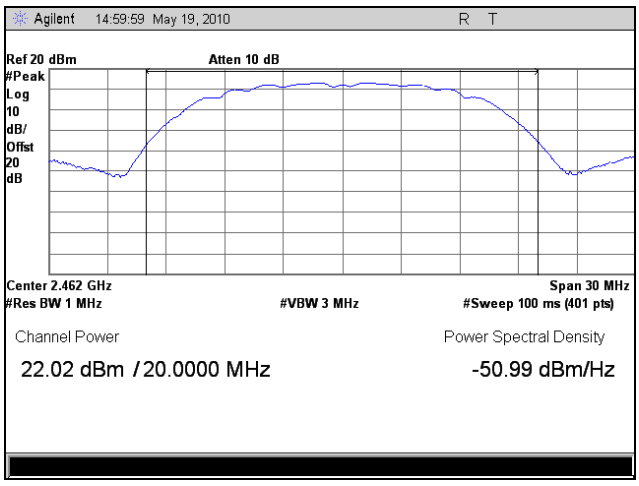
RF Output Power Test Results



Plot 1. Output Power, 2412 MHz Low Channel, 802.11b, Into Antenna (With 16ft Cable)

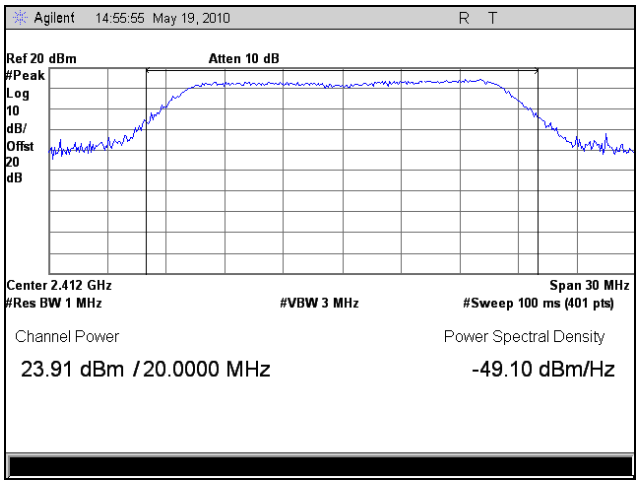


Plot 2. Output Power, 2437 MHz Mid Channel, 802.11b, Into Antenna (With 16ft Cable)

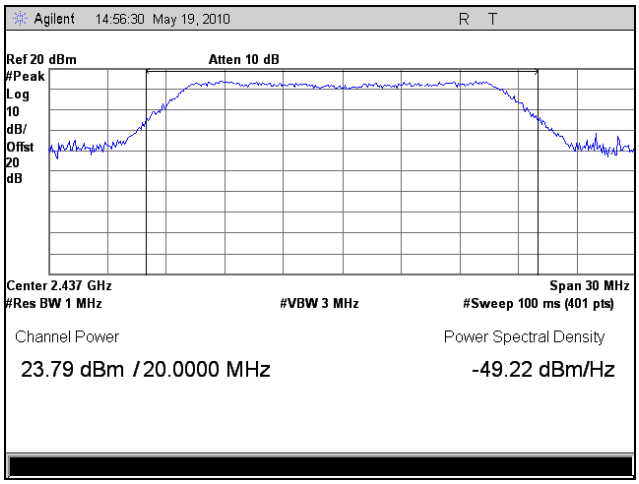


Plot 3. Output Power, 2462 MHz High Channel, 802.11b, Into Antenna (With 16ft Cable)

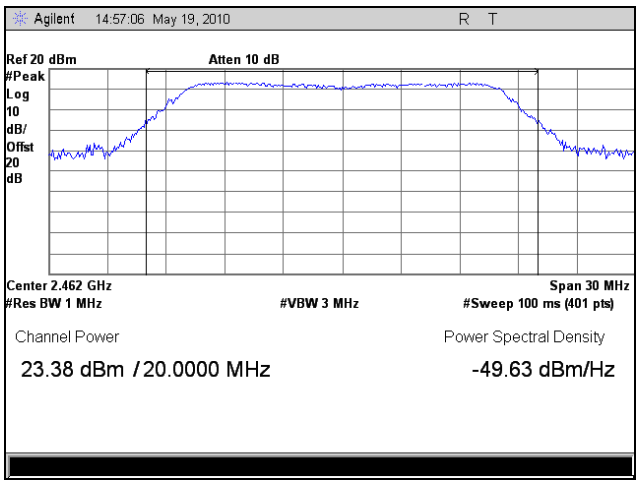
RF Output Power Test Results



Plot 4. Output Power, 2412 MHz Low Channel, 802.11g, Into Antenna (With 16ft Cable)



Plot 5. Output Power, 2437 MHz Mid Channel, 802.11g, Into Antenna (With 16ft Cable)



Plot 6. Output Power, 2462 MHz High Channel, 802.11g, Into Antenna (With 16ft Cable)

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(d) Radiated Spurious Emissions Requirements and Band Edge

Test Requirements: **§15.247(d); §15.205:** Emissions outside the frequency band.

§15.247(d): In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a).

§15.205(a): Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090–0.110----------	16.42–16.423	399.9–410	4.5–5.15
[1] 0.495–0.505----------	16.69475–16.69525	608–614	5.35–5.46
2.1735–2.1905----------	16.80425–16.80475	960–1240	7.25–7.75
4.125–4.128----------	25.5–25.67	1300–1427	8.025–8.5
4.17725–4.17775----------	37.5–38.25	1435–1626.5	9.0–9.2
4.20725–4.20775----------	73–74.6	1645.5–1646.5	9.3–9.5
6.215–6.218----------	74.8–75.2	1660–1710	10.6–12.7
6.26775–6.26825----------	108–121.94	1718.8–1722.2	13.25–13.4
6.31175–6.31225----------	123–138	2200–2300	14.47–14.5
8.291–8.294----------	149.9–150.05	2310–2390	15.35–16.2
8.362–8.366----------	156.52475–156.52525	2483.5–2500	17.7–21.4
8.37625–8.38675----------	156.7–156.9	2655–2900	22.01–23.12
8.41425–8.41475----------	162.0125–167.17	3260–3267	23.6–24.0
12.29–12.293----------	167.72–173.2	3332–3339	31.2–31.8
12.51975–12.52025----------	240–285	3345.8–3358 36.	43–36.5
12.57675–12.57725----------	322–335.4	3600–4400	([2])

Table 10. Restricted Bands of Operation

[1] Until February 1, 1999, this restricted band shall be 0.490 – 0.510 MHz.
[2] Above 38.6

Test Requirement(s): **§ 15.209 (a):** Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in Table 11.

Frequency (MHz)	§ 15.209(a),Radiated Emission Limits (dBµV) @ 3m
30 - 88	40.00
88 - 216	43.50
216 - 960	46.00
Above 960	54.00

Table 11. Radiated Emissions Limits Calculated from FCC Part 15, § 15.209 (a)

Test Procedures: The transmitter was turned. Measurements were performed of the low, mid and high Channels. The EUT was rotated orthogonally through all three axes. Plots shown are corrected for both antenna correction factor and distance and compared to a 3 m limit line. Only noise floor was measured above 18 GHz.

Test Results: The EUT was compliant with the Radiated Spurious Emission limits of **§ 15.247(d)**. Measured emissions were below applicable limits.

Test Engineer(s): Anderson Soungpanya

Test Date(s): 05/19/10

Harmonic Emissions Requirements – Radiated

Freq. (GHz)	Antenna Polarity (H/V)	Raw Amp. @ 3 m (dBuV/m)	P. Amp (dB)	Ant. Cor. Factor (dB/m)	Cable Loss (dB)	EUT Field Strength Final Amp. (dBuV/m)	Limit Detector Peak / Avg. (Peak) / (Avg.)	Limit @ 3 m (dBuV/m)	Delta (dB)
4.824	V	53.99	34.76	33.95	4.37	57.55	Peak	74	-16.45
4.824	V	49.37	34.76	33.95	4.37	52.93	Avg.	54	-1.07
7.236	V	44.43	35.01	35.62	5.59	50.63	Peak	74	-23.37
7.236	V	30.94	35.01	35.62	5.59	37.14	Avg.	54	-16.86
9.648	V	45.25	35.58	36.61	6.25	52.54	Peak	74	-21.46
9.648	V	32.02	35.58	36.61	6.25	39.31	Avg.	54	-14.69
12.06	V	44.51	35.00	38.76	6.60	54.86	Peak	74	-19.14
12.06	V	31.05	35.00	38.76	6.60	41.40	Avg.	54	-12.60

Table 12. Radiated Harmonic Emissions, 2412 MHz Low Channel, 802.11b

Note: All other emissions were measured at the noise floor of the spectrum analyzer.

Freq. (GHz)	Antenna Polarity (H/V)	Raw Amp. @ 3 m (dBuV/m)	P. Amp (dB)	Ant. Cor. Factor (dB/m)	Cable Loss (dB)	EUT Field Strength Final Amp. (dBuV/m)	Limit Detector Peak / Avg. (Peak) / (Avg.)	Limit @ 3 m (dBuV/m)	Delta (dB)
4.874	V	53.28	34.74	33.94	4.41	56.89	Peak	74	-17.11
4.874	V	49.24	34.74	33.94	4.41	52.85	Avg.	54	-1.15
7.311	V	43.85	35.02	35.64	5.93	50.40	Peak	74	-23.60
7.311	V	30.62	35.02	35.64	5.93	37.17	Avg.	54	-16.83
9.748	V	45.31	35.55	36.75	6.29	52.80	Peak	74	-21.20
9.748	V	31.94	35.55	36.75	6.29	39.43	Avg.	54	-14.57
12.185	V	44.84	34.94	38.83	6.89	55.62	Peak	74	-18.38
12.185	V	31.18	34.94	38.83	6.89	41.96	Avg.	54	-12.04

Table 13. Radiated Harmonic Emissions, 2437 MHz Mid Channel, 802.11b

Note: All other emissions were measured at the noise floor of the spectrum analyzer.

Freq. (GHz)	Antenna Polarity (H/V)	Raw Amp. @ 3 m (dBuV/m)	P. Amp (dB)	Ant. Cor. Factor (dB/m)	Cable Loss (dB)	EUT Field Strength Final Amp. (dBuV/m)	Limit Detector Peak / Avg. (Peak) / (Avg.)	Limit @ 3 m (dBuV/m)	Delta (dB)
4.924	**V**	52.81	34.73	33.94	4.46	56.48	Peak	74	-17.52
4.924	**V**	47.85	34.73	33.94	4.46	51.52	Avg.	54	-2.48
7.386	**V**	43.27	35.05	35.65	6.24	50.11	Peak	74	-23.89
7.386	**V**	30.26	35.05	35.65	6.24	37.10	Avg.	54	-16.90
9.848	**V**	44.98	35.54	36.89	6.33	52.66	Peak	74	-21.34
9.848	**V**	31.25	35.54	36.89	6.33	38.93	Avg.	54	-15.07
12.31	**V**	43.93	34.83	38.89	7.31	55.30	Peak	74	-18.70
12.31	**V**	30.57	34.83	38.89	7.31	41.94	Avg.	54	-12.06

Table 14. Radiated Harmonic Emissions, 2462 MHz High Channel, 802.11b

Note: All other emissions were measured at the noise floor of the spectrum analyzer.

Harmonic Emissions Requirements – Radiated

Freq. (GHz)	Antenna Polarity (H/V)	Raw Amp. @ 3 m (dBuV/m)	P. Amp (dB)	Ant. Cor. Factor (dB/m)	Cable Loss (dB)	EUT Field Strength Final Amp. (dBuV/m)	Limit Detector Peak / Avg. (Peak) / (Avg.)	Limit @ 3 m (dBuV/m)	Delta (dB)
4.824	V	48.54	34.76	33.95	4.37	52.10	Peak	74	-21.90
4.824	V	33.89	34.76	33.95	4.37	37.45	Avg.	54	-16.55
7.236	V	44.21	35.01	35.62	5.59	50.41	Peak	74	-23.59
7.236	V	30.82	35.01	35.62	5.59	37.02	Avg.	54	-16.98
9.648	V	45.49	35.58	36.61	6.25	52.78	Peak	74	-21.22
9.648	V	31.97	35.58	36.61	6.25	39.26	Avg.	54	-14.74
12.06	V	44.74	35.00	38.76	6.60	55.09	Peak	74	-18.91
12.06	V	30.89	35.00	38.76	6.60	41.24	Avg.	54	-12.76

Table 15. Radiated Harmonic Emissions, 2412 MHz Low Channel, 802.11g

Note: All other emissions were measured at the noise floor of the spectrum analyzer.

Freq. (GHz)	Antenna Polarity (H/V)	Raw Amp. @ 3 m (dBuV/m)	P. Amp (dB)	Ant. Cor. Factor (dB/m)	Cable Loss (dB)	EUT Field Strength Final Amp. (dBuV/m)	Limit Detector Peak / Avg. (Peak) / (Avg.)	Limit @ 3 m (dBuV/m)	Delta (dB)
4.874	V	50.43	34.74	33.94	4.41	54.04	Peak	74	-19.96
4.874	V	34.13	34.74	33.94	4.41	37.74	Avg.	54	-16.26
7.311	V	44.19	35.02	35.64	5.93	50.74	Peak	74	-23.26
7.311	V	31.03	35.02	35.64	5.93	37.58	Avg.	54	-16.42
9.748	V	44.67	35.55	36.75	6.29	52.16	Peak	74	-21.84
9.748	V	30.63	35.55	36.75	6.29	38.12	Avg.	54	-15.88
12.185	V	44.83	34.94	38.83	6.89	55.61	Peak	74	-18.39
12.185	V	30.7	34.94	38.83	6.89	41.48	Avg.	54	-12.52

Table 16. Radiated Harmonic Emissions, 2437 MHz Mid Channel, 802.11g

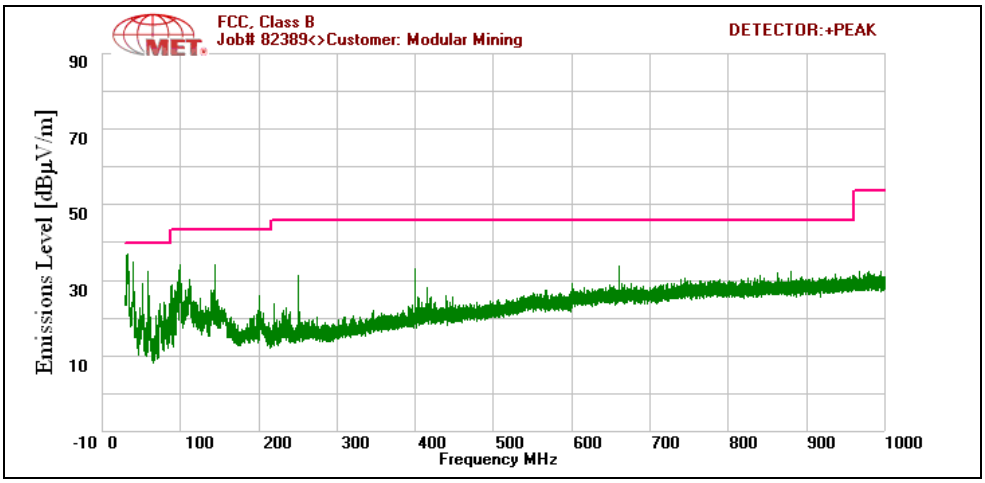
Note: All other emissions were measured at the noise floor of the spectrum analyzer.

Freq. (GHz)	Antenna Polarity (H/V)	Raw Amp. @ 3 m (dBuV/m)	P. Amp (dB)	Ant. Cor. Factor (dB/m)	Cable Loss (dB)	EUT Field Strength Final Amp. (dBuV/m)	Limit Detector Peak / Avg. (Peak) / (Avg.)	Limit @ 3 m (dBuV/m)	Delta (dB)
4.924	V	48.51	34.73	33.94	4.46	52.18	Peak	74	-21.82
4.924	V	33.26	34.73	33.94	4.46	36.93	Avg.	54	-17.07
7.386	V	44.82	35.05	35.65	6.24	51.66	Peak	74	-22.34
7.386	V	31.74	35.05	35.65	6.24	38.58	Avg.	54	-15.42
9.848	V	45.27	35.54	36.89	6.33	52.95	Peak	74	-21.05
9.848	V	30.81	35.54	36.89	6.33	38.49	Avg.	54	-15.51
12.31	V	44.28	34.83	38.89	7.31	55.65	Peak	74	-18.35
12.31	V	30.27	34.83	38.89	7.31	41.64	Avg.	54	-12.36

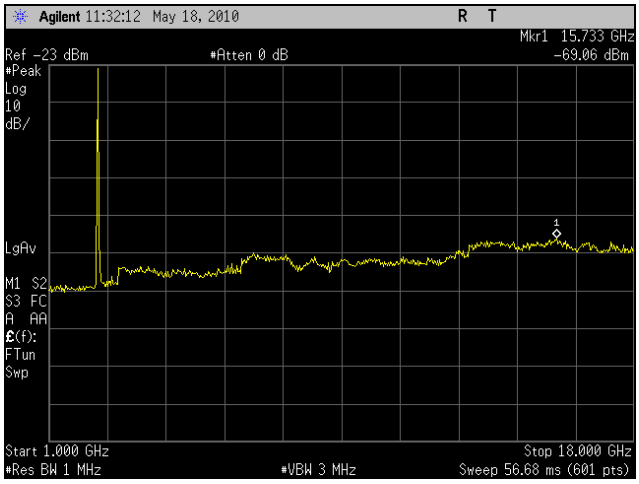
Table 17. Radiated Harmonic Emissions, 2462 MHz High Channel, 802.11g

Note: All other emissions were measured at the noise floor of the spectrum analyzer.

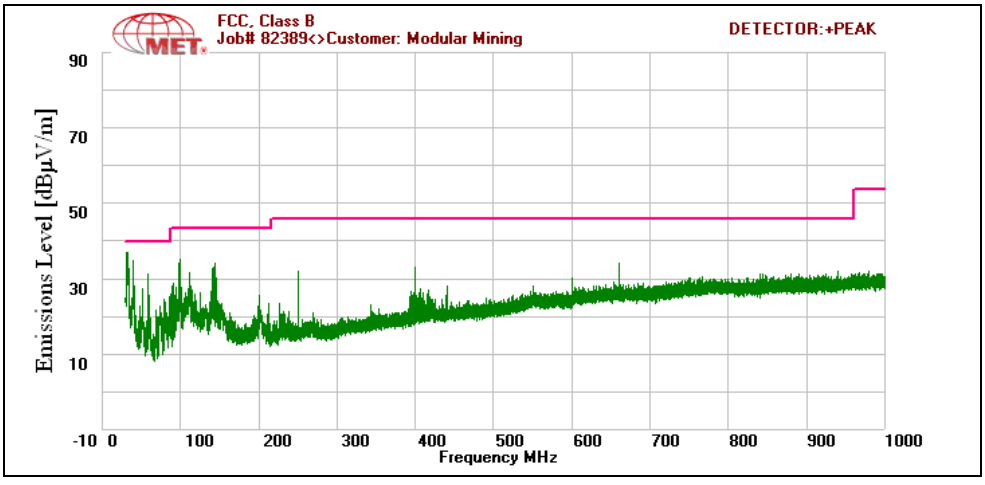
Radiated Spurious Emissions Test Results



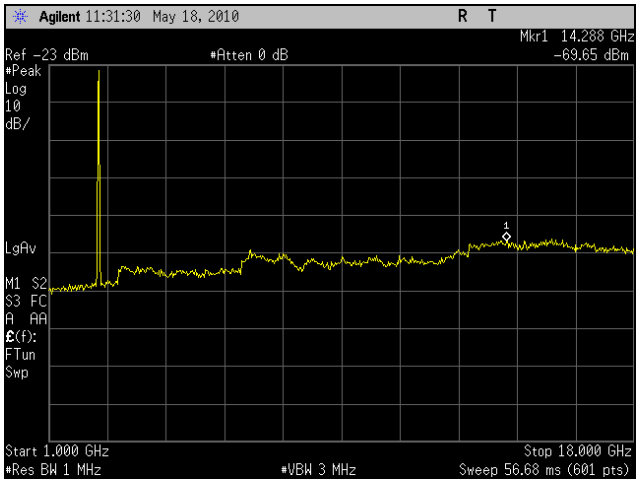
Plot 7. Radiated Spurious, 2412 MHz Low Channel, 802.11b, 30 MHz – 1 GHz



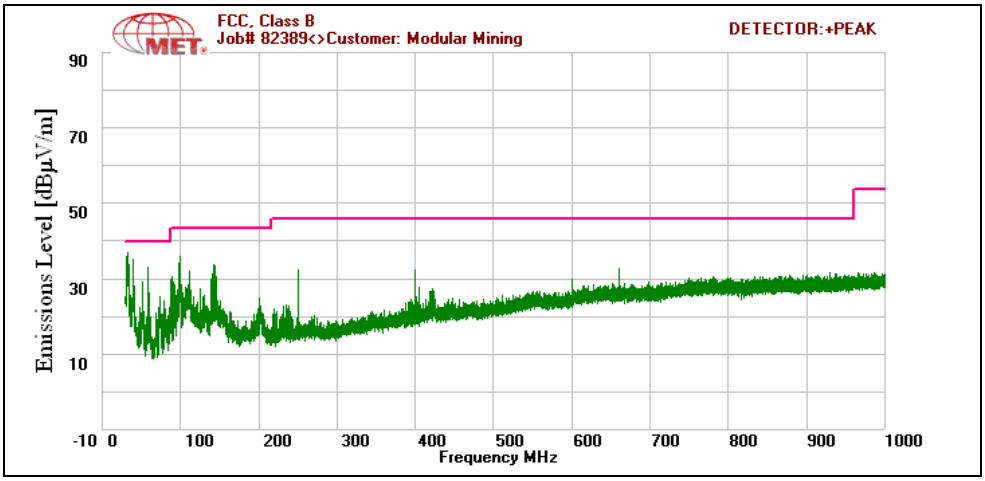
Plot 8. Radiated Spurious, 2412 MHz Low Channel, 802.11b, 1 GHz – 18 GHz



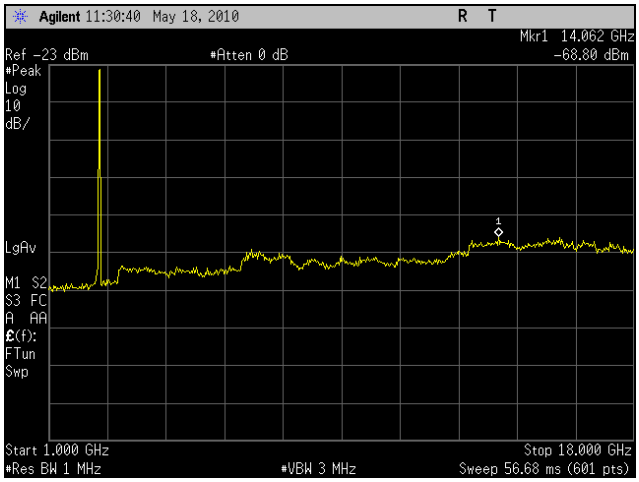
Plot 9. Radiated Spurious, 2437 MHz Mid Channel, 802.11b, 30 MHz – 1 GHz



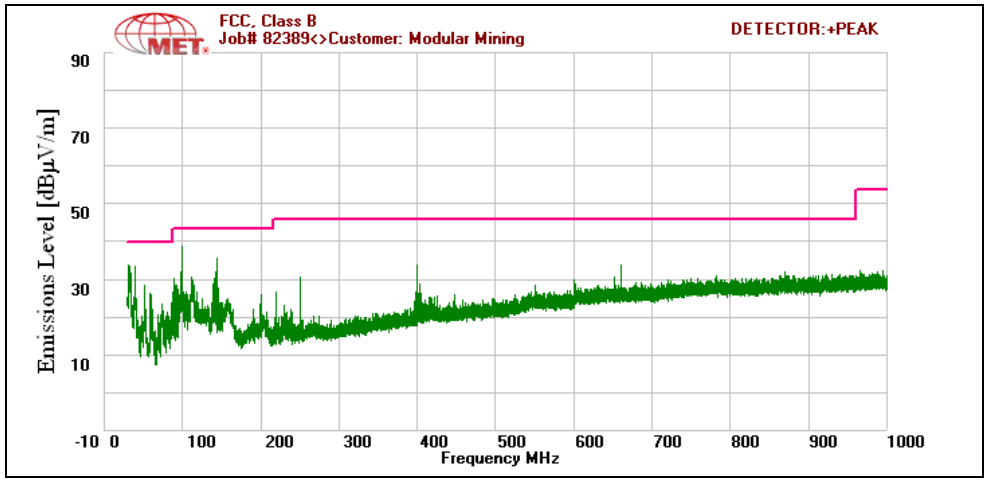
Plot 10. Radiated Spurious, 2437 MHz Mid Channel, 802.11b, 1 GHz – 18 GHz



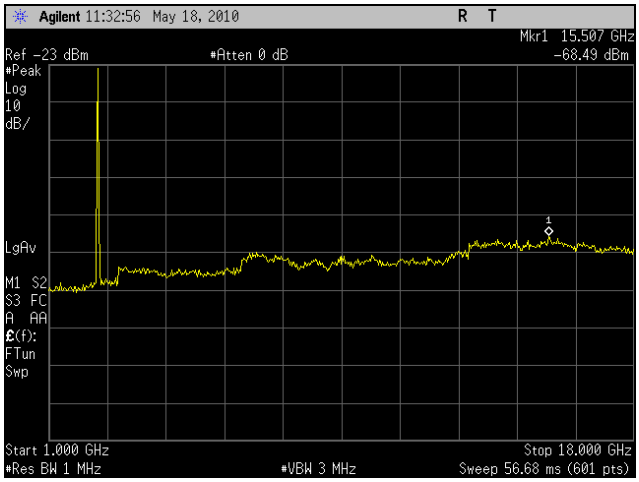
Plot 11. Radiated Spurious, 2462 MHz High Channel, 802.11b, 30 MHz – 1 GHz



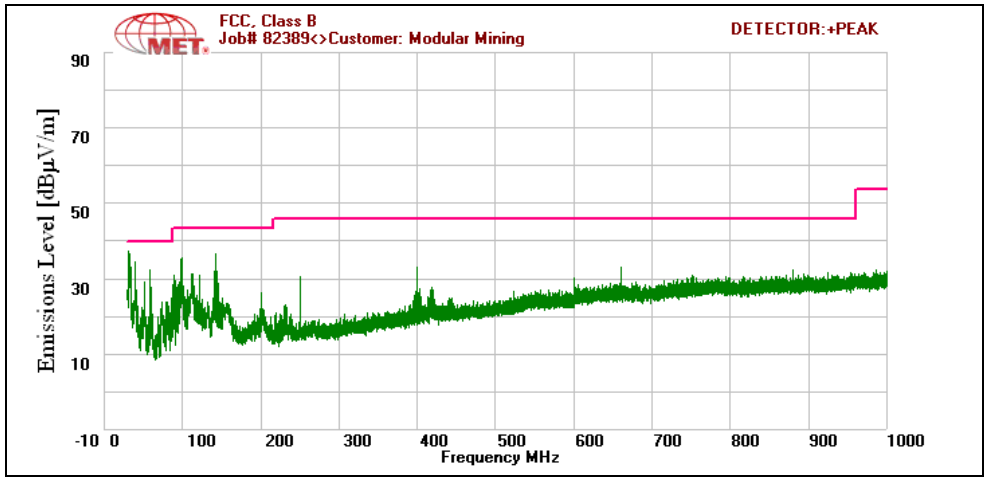
Plot 12. Radiated Spurious, 2462 MHz High Channel, 802.11b, 1 GHz – 18 GHz



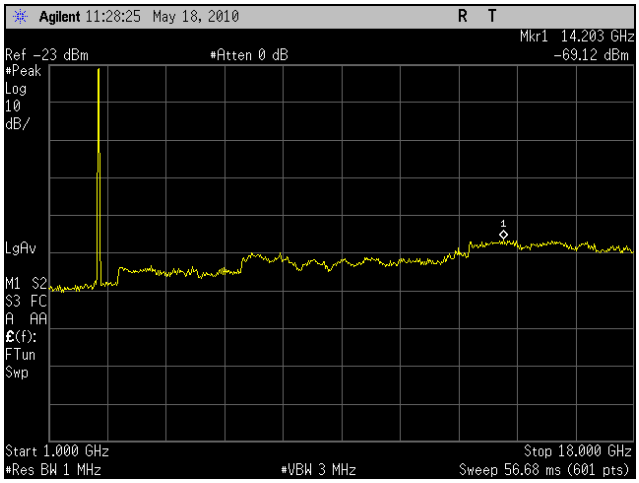
Plot 13. Radiated Spurious, 2412 MHz Low Channel, 802.11g, 30 MHz – 1 GHz



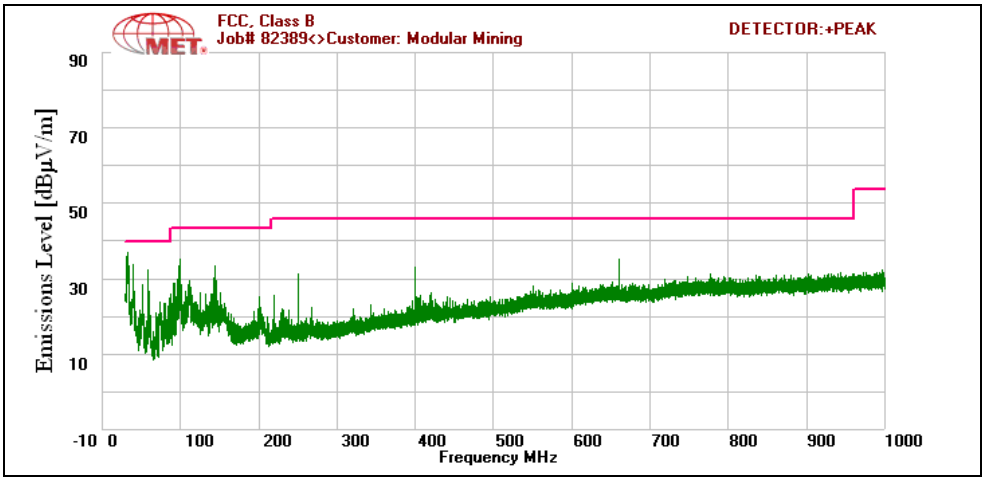
Plot 14. Radiated Spurious, 2412 MHz Low Channel, 802.11g, 1 GHz – 18 GHz



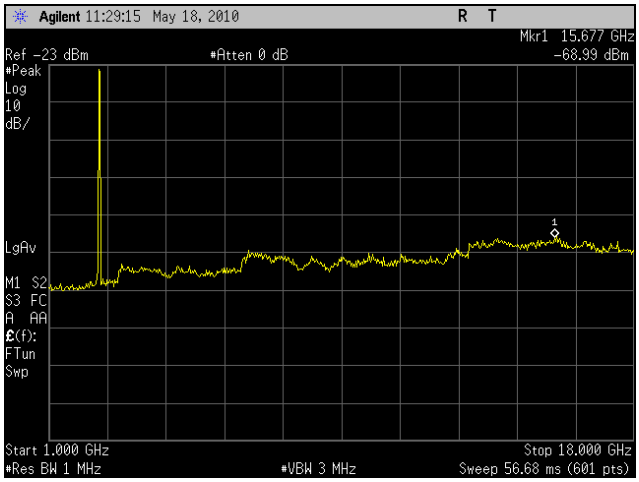
Plot 15. Radiated Spurious, 2437 MHz Mid Channel, 802.11g, 30 MHz – 1 GHz



Plot 16. Radiated Spurious, 2437 MHz Mid Channel, 802.11g, 1 GHz – 18 GHz

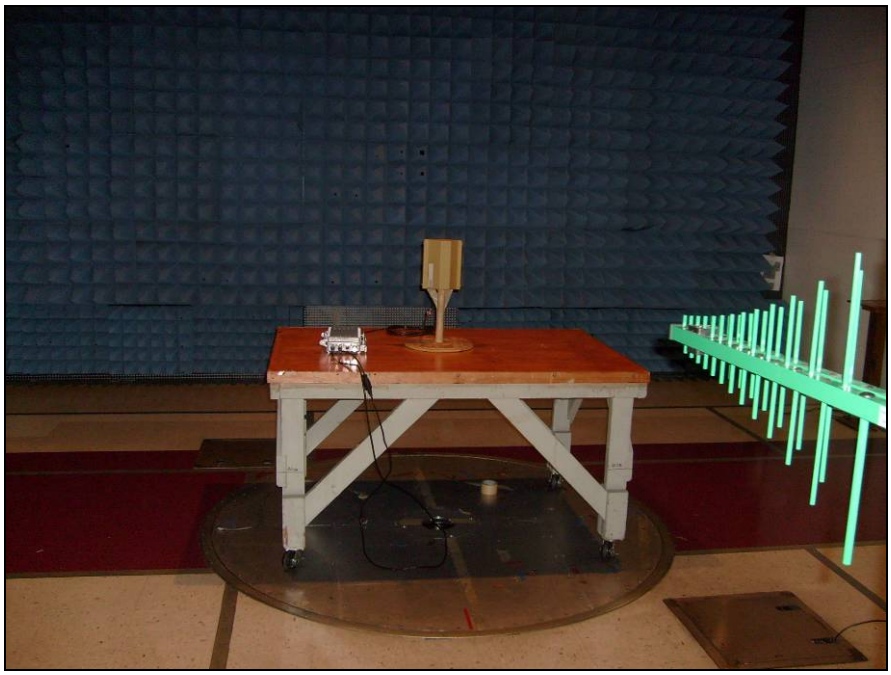


Plot 17. Radiated Spurious, 2462 MHz High Channel, 802.11g, 30 MHz – 1 GHz



Plot 18. Radiated Spurious, 2462 MHz High Channel, 802.11g, 1 GHz – 18 GHz

Photograph 1. Radiated Emissions, Test Setup

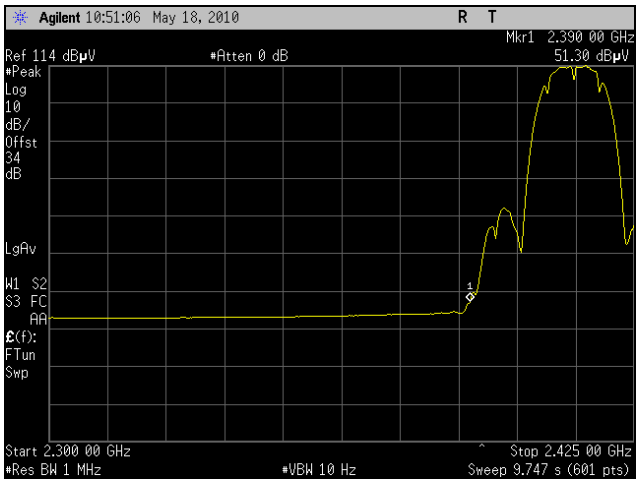


Photograph 2. Radiated Measurements, 30 MHz – 1 GHz

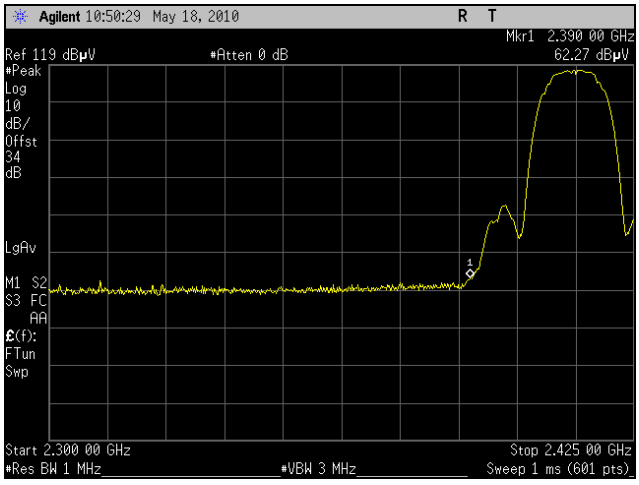
Photograph 3. Radiated Measurements, 1 GHz – 18 GHz

Radiated Band Edge Measurements

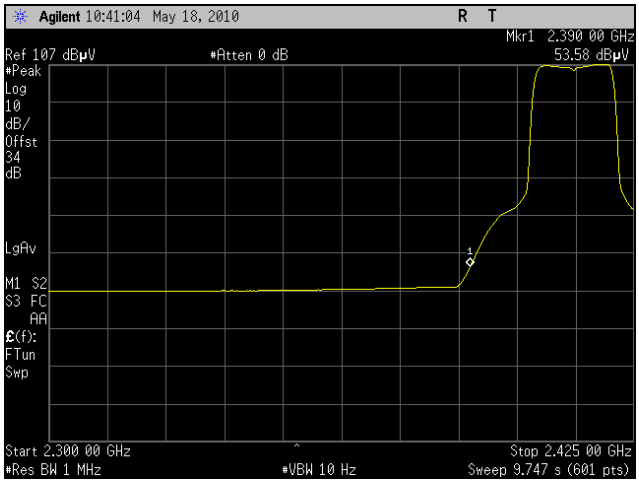
Test Procedures: The transmitter was turned on. Measurements were performed of the low, mid and high Channels. The EUT was rotated orthogonally through all three axes. Plots shown are corrected for both antenna correction factor and distance and compared to a 3 m limit line.



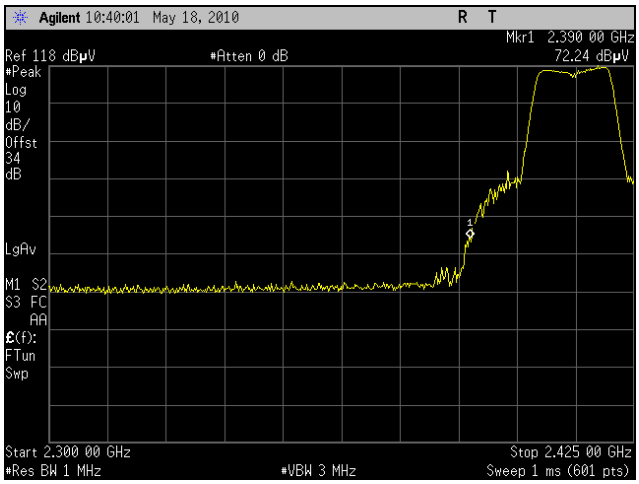
Plot 19. Radiated Band Edge, 2412 MHz, Low Channel, 802.11b (Average)



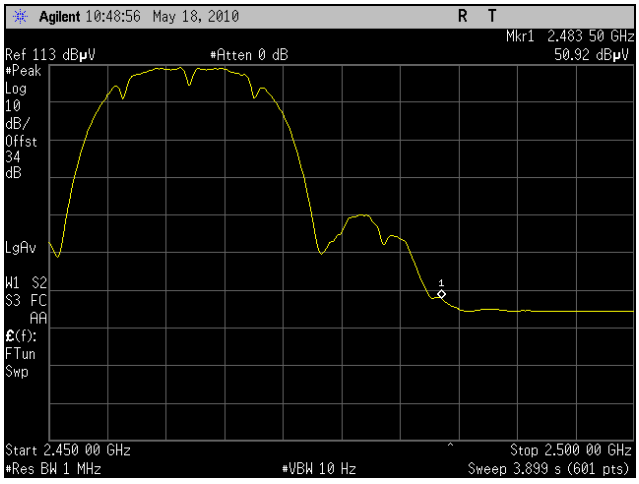
Plot 20. Radiated Band Edge, 2412 MHz, Low Channel, 802.11b (Peak)



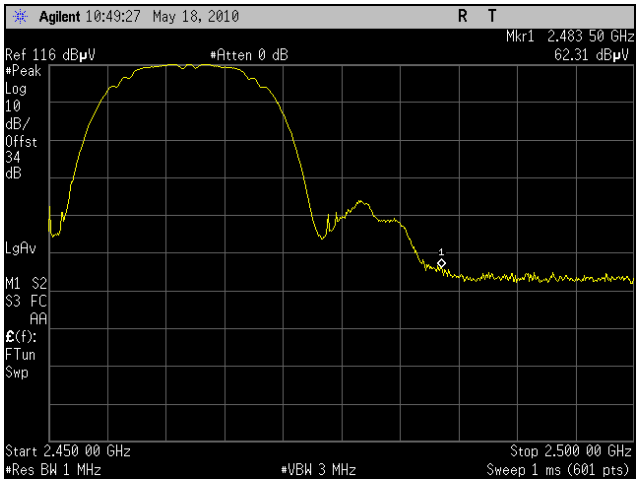
Plot 21. Radiated Band Edge, 2412 MHz, Low Channel, 802.11g (Average)



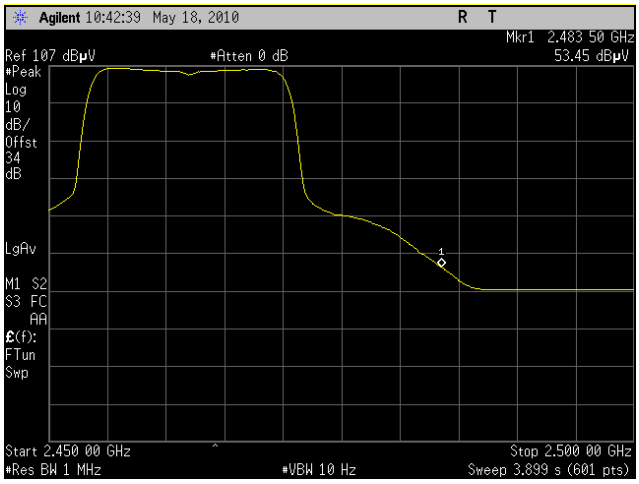
Plot 22. Radiated Band Edge, 2412 MHz, Low Channel, 802.11g (Peak)



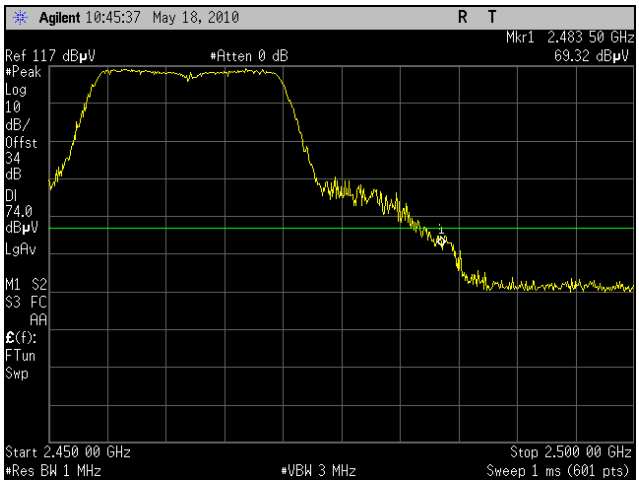
Plot 23. Radiated Band Edge, 2462 MHz, High Channel, 802.11b (Average)



Plot 24. Radiated Band Edge, 2462 MHz, High Channel, 802.11b (Peak)



Plot 25. Radiated Band Edge, 2462 MHz, High Channel, 802.11g (Average)



Plot 26. Radiated Band Edge, 2462 MHz, High Channel, 802.11g (Peak)

IV. Test Equipment

Test Equipment

Calibrated test equipment utilized during testing was maintained in a current state of calibration per the requirements of ANSI/NCSL Z540-1-1994 and ANSI/ISO/IEC 17025:2000.

MET Asset #	Equipment	Manufacturer	Model	Last Cal Date	Cal Due Date
1S2121	PRE-AMPLIFIER	HEWLETT PACKARD	8449B	SEE NOTE	
1S2501	EMI RECEIVER	ROHDE & SCHWARZ	ESU40	4/27/2009	5/27/2010
1S2128	HARMONIC MIXER	HEWLETT PACKARD	11970A	11/22/2008	11/22/2010
1S2129	HARMONIC MIXER	HEWLETT PACKARD	11970K	11/22/2008	11/22/2010
1S2603	HORN ANTENNA	ETS-LINDGREN	3117	4/9/2009	4/9/2011
1S2202	HORN ANTENNA	EMCO	3116	4/23/2010	4/23/2013
N/A	HIGH PASS FILTER	MICRO-TRONICS	HPM13146	SEE NOTE	
1S2041	COUPLER, BI DIRECTIONALCOAXIAL	NARDA	N/A	SEE NOTE	
1S2483	ANALYZER, SPECTRUM	AGILENT	E4447A	1/26/2010	1/26/2011
1S2460	ANALYZER, SPECTRUM 9 KHZ-40GHZ	AGILENT	E4407B	4/30/2010	4/30/2011
1S2482	CHAMBER, 5 METER	PANASHIELD	641431	10/16/2009	10/16/2010
1S2485	BILOG ANTENNA	TESEQ	CBL6112D	05/07/2010	05/07/2011

Table 18. Test Equipment List

Note: Functionally tested equipment is verified using calibrated instrumentation at the time of testing.

V. Certification & User's Manual Information

Certification & User's Manual Information

A. Certification Information

The following is extracted from Title 47 of the Code of Federal Regulations, Part 2, Subpart I — Marketing of Radio frequency devices:

§ 2.801 Radio-frequency device defined.

As used in this part, a radio-frequency device is any device which in its operation is capable of Emitting radio-frequency energy by radiation, conduction, or other means. Radio- frequency devices include, but are not limited to:

(a) The various types of radio communication transmitting devices described throughout this chapter.

(b) The incidental, unintentional and intentional radiators defined in Part 15 of this chapter.

(c) The industrial, scientific, and medical equipment described in Part 18 of this chapter.

(d) Any part or component thereof which in use emits radio-frequency energy by radiation, conduction, or other means.

§ 2.803 Marketing of radio frequency devices prior to equipment authorization.

(a) Except as provided elsewhere in this chapter, no person shall sell or lease, or offer for sale or lease (including advertising for sale or lease), or import, ship or distribute for the purpose of selling or leasing or offering for sale or lease, any radio frequency device unless:

(1) In the case of a device subject to certification, such device has been authorized by the Commission in accordance with the rules in this chapter and is properly identified and labeled as required by §2.925 and other relevant sections in this chapter; or

(2) In the case of a device that is not required to have a grant of equipment authorization issued by the Commission, but which must comply with the specified technical standards prior to use, such device also complies with all applicable administrative (including verification of the equipment or authorization under a Declaration of Conformity, where required), technical, labeling and identification requirements specified in this chapter.

(d) Notwithstanding the provisions of paragraph (a) of this section, the offer for sale solely to business, commercial, industrial, scientific or medical users (but not an offer for sale to other parties or to end users located in a residential environment) of a radio frequency device that is in the conceptual, developmental, design or pre-production stage is permitted prior to equipment authorization or, for devices not subject to the equipment authorization requirements, prior to a determination of compliance with the applicable technical requirements *provided* that the prospective buyer is advised in writing at the time of the offer for sale that the equipment is subject to the FCC rules and that the equipment will comply with the appropriate rules before delivery to the buyer or to centers of distribution.

(e)(1) Notwithstanding the provisions of paragraph (a) of this section, prior to equipment authorization or determination of compliance with the applicable technical requirements any radio frequency device may be operated, but not marketed, for the following purposes and under the following conditions:

(i) Compliance testing;

(ii) Demonstrations at a trade show provided the notice contained in paragraph (c) of this section is displayed in a conspicuous location on, or immediately adjacent to, the device;

(iii) Demonstrations at an exhibition conducted at a business, commercial, industrial, scientific or medical location, but excluding locations in a residential environment, provided the notice contained in paragraphs (c) or (d) of this section, as appropriate, is displayed in a conspicuous location on, or immediately adjacent to, the device;

(iv) Evaluation of product performance and determination of customer acceptability, provided such operation takes place at the manufacturer's facilities during developmental, design or pre-production states; or

(v) Evaluation of product performance and determination of customer acceptability where customer acceptability of a radio frequency device cannot be determined at the manufacturer's facilities because of size or unique capability of the device, provided the device is operated at a business, commercial, industrial, scientific or medical user's site, but not at a residential site, during the development, design or pre-production stages.

(e)(2) For the purpose of paragraphs (e)(1)(iv) and (e)(1)(v) of this section, the term *manufacturer's facilities* includes the facilities of the party responsible for compliance with the regulations and the manufacturer's premises, as well as the facilities of other entities working under the authorization of the responsible party in connection with the development and manufacture, but not the marketing, of the equipment.

(f) For radio frequency devices subject to verification and sold solely to business, commercial, industrial, scientific and medical users (excluding products sold to other parties or for operation in a residential environment), parties responsible for verification of the devices shall have the option of ensuring compliance with the applicable technical specifications of this chapter at each end user's location after installation, provided that the purchase or lease agreement includes a proviso that such a determination of compliance be made and is the responsibility of the party responsible for verification of the equipment.

Certification & User's Manual Information

The following is extracted from Title 47 of the Code of Federal Regulations, Part 2, Subpart J — Equipment Authorization Procedures:

§ 2.901 Basis and Purpose

(a) In order to carry out its responsibilities under the Communications Act and the various treaties and international regulations, and in order to promote efficient use of the radio spectrum, the Commission has developed technical standards for radio frequency equipment and parts or components thereof. The technical standards applicable to individual types of equipment are found in that part of the rules governing the service wherein the equipment is to be operated.[1] *In addition to the technical standards provided, the rules governing the service may require that such equipment be verified by the manufacturer or importer*, be authorized under a Declaration of Conformity, or receive an equipment authorization from the Commission by one of the following procedures: certification or registration.

(b) The following sections describe the verification procedure, the procedure for a Declaration of Conformity, and the procedures to be followed in obtaining certification from the Commission and the conditions attendant to such a grant.

§ 2.907 Certification.

(a) Certification is an equipment authorization issued by the Commission, based on representation and test data submitted by the applicant.

(b) Certification attaches to all units subsequently marketed by the grantee which are identical (see Section 2.908) to the sample tested except for permissive changes or other variations authorized by the Commission pursuant to Section 2.1043.

[1] In this case, the equipment is subject to the rules of Part 15. More specifically, the equipment falls under Subpart B (of Part 15), which deals with unintentional radiators.

Certification & User's Manual Information

§ 2.948 Description of measurement facilities.

(a) Each party making measurements of equipment that is subject to an equipment authorization under Part 15 or Part 18 of this chapter, regardless of whether the measurements are filed with the Commission or kept on file by the party responsible for compliance of equipment marketed within the U.S. or its possessions, shall compile a description of the measurement facilities employed.

(1) If the measured equipment is subject to the verification procedure, the description of the measurement facilities shall be retained by the party responsible for verification of the equipment.

(i) If the equipment is verified through measurements performed by an independent laboratory, it is acceptable for the party responsible for verification of the equipment to rely upon the description of the measurement facilities retained by or placed on file with the Commission by that laboratory. In this situation, the party responsible for the verification of the equipment is not required to retain a duplicate copy of the description of the measurement facilities.

(ii) If the equipment is verified based on measurements performed at the installation site of the equipment, no specific site calibration data is required. It is acceptable to retain the description of the measurement facilities at the site at which the measurements were performed.

(2) If the equipment is to be authorized by the Commission under the certification procedure, the description of the measurement facilities shall be filed with the Commission's Laboratory in Columbia, Maryland. The data describing the measurement facilities need only be filed once but must be updated as changes are made to the measurement facilities or as otherwise described in this section. At least every three years, the organization responsible for filing the data with the Commission shall certify that the data on file is current.

Certification & User's Manual Information

Label and User's Manual Information

The following is extracted from Title 47 of the Code of Federal Regulations, Part 15, Subpart A — General:

§ 15.19 Labeling requirements.

(a) In addition to the requirements in Part 2 of this chapter, a device subject to certification or verification shall be labeled as follows:

(1) Receivers associated with the operation of a licensed radio service, e.g., FM broadcast under Part 73 of this chapter, land mobile operation under Part 90, etc., shall bear the following statement in a conspicuous location on the device:

This device complies with Part 15 of the FCC Rules. Operation is subject to the condition that this device does not cause harmful interference.

(2) A stand-alone cable input selector switch, shall bear the following statement in a conspicuous location on the device:

This device is verified to comply with Part 15 of the FCC Rules for use with cable television service.

(3) All other devices shall bear the following statement in a conspicuous location on the device:

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

(4) Where a device is constructed in two or more sections connected by wires and marketed together, the statement specified under paragraph (a) of this section is required to be affixed only to the main control unit.

(5) When the device is so small or for such use that it is not practicable to place the statement specified under paragraph (a) of this section on it, the information required by this paragraph shall be placed in a prominent location in the instruction manual or pamphlet supplied to the user or, alternatively, shall be placed on the container in which the device is marketed. However, the FCC identifier or the unique identifier, as appropriate, must be displayed on the device.

§ 15.21 Information to user.

The users manual or instruction manual for an intentional or unintentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Verification & User's Manual Information

The following is extracted from Title 47 of the Code of Federal Regulations, Part 15, Subpart B — Unintentional Radiators:

§ 15.105 Information to the user.

(a) For a Class A digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual:

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at own expense.

(b) For a Class B digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual:

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a residential environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

– Reorient or relocate the receiving antenna.

– Increase the separation between the equipment and receiver.

– Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

– Consult the dealer or an experienced radio/TV technician for help.

ICES-003 Procedural & Labeling Requirements

From the Industry Canada Electromagnetic Compatibility Advisory Bulletin entitled, "Implementation and Interpretation of the Interference-Causing Equipment Standard for Digital Apparatus, ICES-003" (EMCAB-3, Issue 2, July 1995):

> "At present, CISPR 22: 2002 and ICES technical requirements are essentially equivalent. Therefore, if you have CISPR 22: 2002 approval by meeting CISPR Publication 22, the only additional requirements are: to attach a note to the report of the test results for compliance, indicating that these results are deemed satisfactory evidence of compliance with ICES-003 of the Canadian Interference-Causing Equipment Regulations; to maintain these records on file for the requisite five year period; and to provide the device with a notice of compliance in accordance with ICES-003."

Procedural Requirements:

According to Industry Canada's Interference Causing Equipment Standard for Digital Apparatus ICES-003 Issue 4, February 2004:

Section 6.1: A record of the measurements and results, showing the date that the measurements were completed, shall be retained by the manufacturer or importer for a period of at least five years from the date shown in the record and made available for examination on the request of the Minister.

Section 6.2: A written notice indicating compliance must accompany each unit of digital apparatus to the end user. The notice shall be in the form of a label that is affixed to the apparatus. Where because of insufficient space or other constraints it is not feasible to affix a label to the apparatus, the notice may be in the form of a statement in the user's manual.

Labeling Requirements:

The suggested text for the notice, in English and in French, is provided below, from the Annex of ICES-003:

> This Class [2] digital apparatus complies with Canadian ICES-003.
>
> Cet appareil numérique de la classe [1] est conforme à la norme NMB-003 du Canada.

[2] Insert either A or B but not both as appropriate for the equipment requirements.

End of Report

