MET Laboratories, Inc. *Safety Certification - EMI - Telecom Environmental Simulation*
33439 WESTERN AVENUE ● UNION CITY, CALIFORNIA 94587 ● PHONE (510) 489-6300 ● FAX (510) 489-6372

August 9, 2006

Tessco Technologies
11126 McCormick Road
Hunt Valley, MD 2130

Dear Chris Marco,

Enclosed is the Class II Permissive Change test report for compliance testing of the Tessco Technologies Access Point with TerraWave Solutions 2.4 and 5GHz Integrated Antennas as tested to the requirements of Title 47 of the CFR, Ch. 1 (10-1-03 ed.), Title 47 of the CFR, Part 15.247 Subpart C and Part 15.407 Subpart E 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 Sanchez
Documentation Department

Reference: (\Tessco Technologies\EMCS20470-FCC247)

Electromagnetic Compatibility Criteria
Test Report

for the

Tessco Technologies Access Point with TerraWave Solutions 2.4 and 5GHz Integrated Antennas

Verified under
the FCC Certification Rules
for Class II Permissive Change
contained in
Title 47 of the CFR, Part 15.247, Subpart C, Part 15.407, Subpart E
for Intentional Radiators

MET Report: EMCS20470-FCC247PC

August 9, 2006

Prepared For:

Tessco Technologies
11126 McCormick Road
Hunt Valley, MD 2130

Prepared By:
MET Laboratories, Inc.
4855 Patrick Henry Dr., Building 6
Santa Clara, CA 95054

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for Intentional Radiators

Shawn McMillen, Project Engineer
Electromagnetic Compatibility Lab

Jennifer Sanchez
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 Part 15.247 and Part 15.407 of the FCC Rules under normal use and maintenance.

Tony Permsombut, Manager
Electromagnetic Compatibility Lab

Report Status Sheet

Revision	Report Date	Reason for Revision
∅	August 9, 2006	Initial Issue.

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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 µ
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
GR-1089-CORE	***(GR)*** **G**eneral **R**equirement(s) imposed by the NEBS standard, **(*CORE*) C**entral **O**ffice **R**ecovery **E**xpress (AT&T), ***(1089)*** specifies various parts of the General Requirements under Bellcore Technical Standard, Requirements for Electromagnetic Compatibility and Electrical Safety - Generic Criteria for Network Telecommunications Equipment
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 Tessco Technologies Access Point equipped with a 2.4 and 5GHz TerraWave Solutions Integrated Antenna with the requirements of Part 15, §15.247 and §15.407. 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 Access Point with TerraWave Solutions 2.4 and 5GHz Integrated Antennas. Tessco Technologies should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the Access Point with TerraWave Solutions 2.4 and 5GHz Integrated Antennas, 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 and §15.407 in accordance with Tessco Technologies, purchase order number 040917. All tests were conducted using measurement procedure ANSI C63.4-2003.

FCC Reference	RSS-210 and RSS-GEN	Description	Results
Transmitter Mode (TX)			
§15.207	6.6	AC Power Line Conducted Emissions	Compliant
§15.203/15.247(c)	N/A	Antenna Requirement	Compliant
§15.247(a)	A8.2	6dB Occupied Bandwidth	N/A
§15.247(b)	A8.4	Maximum Peak Conducted Output Power	Compliant
§15.247(d), §15.205, §15.209	A8.5	Spurious Radiated and Conducted Emissions	Compliant
§15.247(e)	A8.2/RSS-102	Peak Power Spectral Density	N/A
§15.247(e)	A8.2/RSS-102	RF Exposure	Compliant
Receiver Mode (RX)			
15.107	7.4	AC Power Line Conducted Emissions	Compliant
15.109	7.3	Radiated Spurious Emissions	Compliant

Table 1 Executive Summary of EMC Part 15.247 ComplianceTesting

Reference	Description	Results
15.403 (c)	26dB Occupied Bandwidth	N/A
15.407 (a)(1), (2), (3)	Conducted Transmitter Output Power	Compliant
15.407 (a)(1), (2), (3), (5)	Power Spectral Density	N/A
15.407 (a)(6)	Peak Excursion	N/A
15.407 (b)(1), (2), (5), (6)	Undesirable Emissions	Compliant
15.205/15.209	General Field Strength Limits (Restricted Bands and Radiated Emission Limits)	Compliant
15.207	AC Conducted Emissions 150KHz – 30MHz	N/A

II. Equipment Configuration

A. Overview

MET Laboratories, Inc. was contracted by Tessco Technologies to perform testing on the Access Point with TerraWave Solutions 2.4 and 5GHz Integrated Antennas, under Tessco Technologies's purchase order number 040917.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the Tessco Technologies, Access Point with TerraWave Solutions 2.4 and 5GHz Integrated Antennas.

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

Model(s) Tested:	Tessco Technologies Access Point with TerraWave Solutions 2.4GHz 19dBi gain and a 5GHz 23 dBi Integrated Antennas		
Antennas Covered:	Tessco Technologies Access Point with TerraWave Solutions 2.4GHz 19dBi gain and a 5GHz 23 dBi Integrated Antennas		
EUT Specifications:	Primary Power: 120VAC		
	FCC ID: UII102056		
	Type of Modulations:	DSSS (Direct Sequence Spread Spectrum) OFDM (Orthogonal Frequency Division multiplexing)	
	Equipment Code:	DTS	
	Peak RF Output Power 5GHz Bands:	5180-5240MHz	10.98dBm
		5260-5320MHz	16.45dBm
		5745-5805MHz	17.60dBm
	Peak RF Output Power 2.4GHz Band:	2.4GHz DSSS Mode	19.67dBm
		2.4GHz OFDM Mode	16.65dBm
	EUT Bands of Operation:	2400 – 2483.5 MHz	
		5180-5240MHz	
		5260-5320MHz	
		5745-5805MHz	
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:	Shawn McMillen		
Date(s):	August 9, 2006		

Table 2. Frequency Allocation for 802.11a/b/g

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
CFR 47, Part 15, Subpart B	Electromagnetic Compatibility: Criteria for Radio Frequency Devices
CFR 47, Part 15, Subpart E	Unlicensed National Information Infrastructure Devices (UNII)
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

C. Test Site

All testing was performed at MET Laboratories, Inc., 4855 Patrick Henry Drive, Building 6, Santa Clara, California 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 10 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. In accordance with §2.948(d), MET Laboratories has been accredited by the National Voluntary Laboratory Accreditation Program
(Lab Code: 100273-0).

D. Description of Test Sample

The Tessco Technologies Access point is a fully integrated dual radio AP equipped with TerraWave Solutions 2.4GHz 19dBi gain and a 5GHz 23 dBi Integrated Antennas. The 2.4GHz 19dBi antenna must be equipped with 9dB in line attenuation to be compliant with 15.205 requirements.
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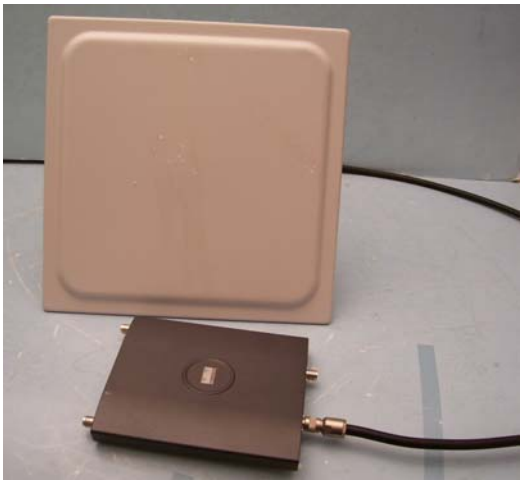


Photograph 1. Tessco Technologies Access Point with TerraWave Solutions 2.4 and 5GHz Integrated Antennas

Radiated Emission
2.4 Ghz

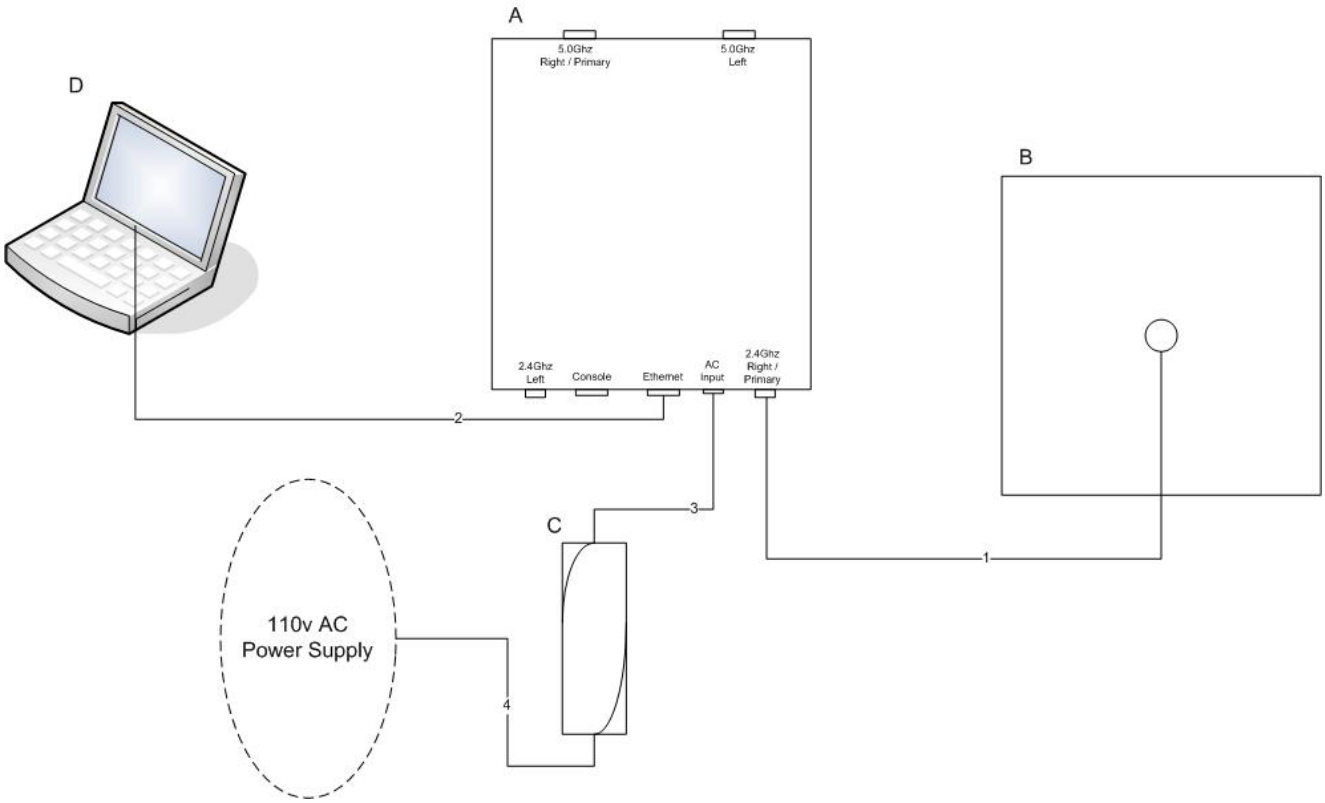


Figure 1. Block Diagram of Test Configuration (2.4GHz)

Radiated Emission
5.0 Ghz

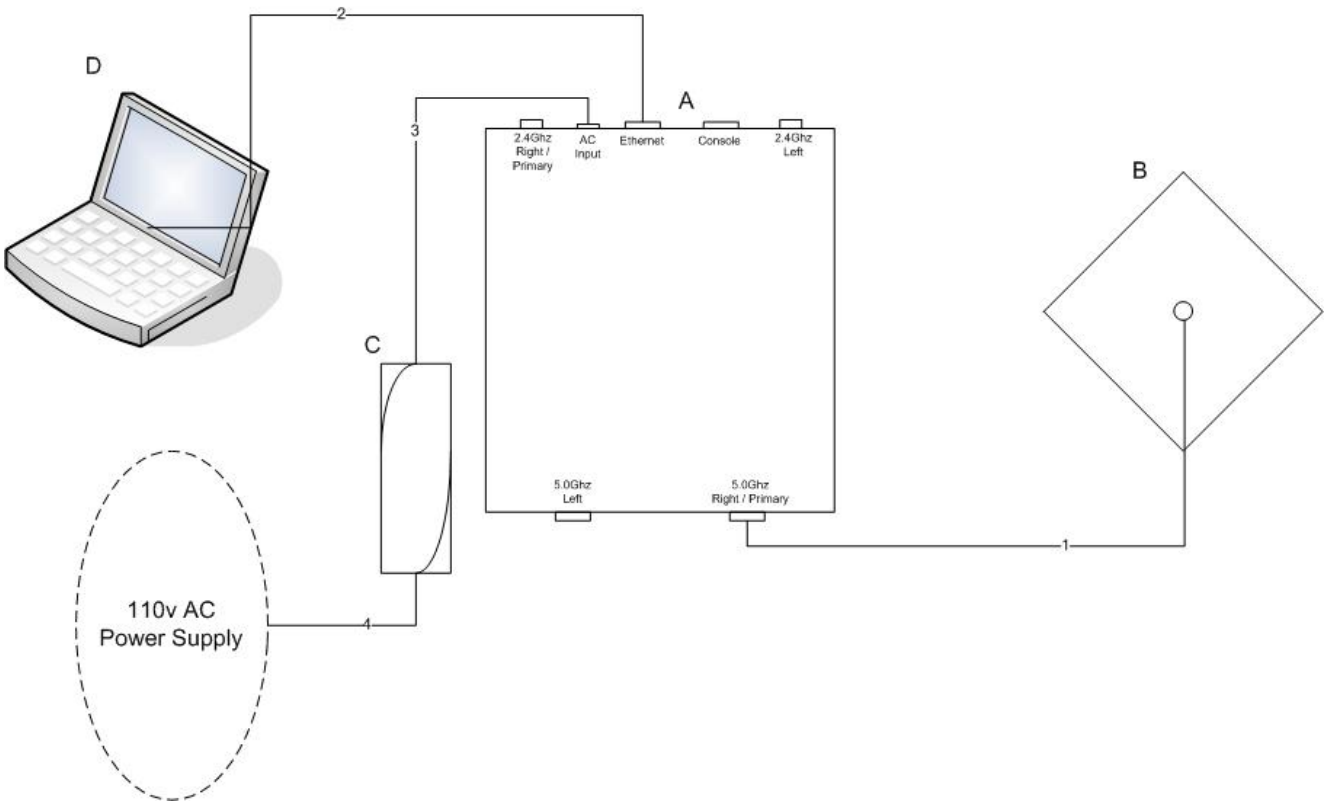


Figure 2. Block Diagram of Test Configuration (5 GHz)

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
A	Router (Tessco)	AIR-AP1242AG AK9	FTX0940B056
B	2.4 GHz Antenna (ARC Wireless Solutions)	N/A	ANT-A-1123-02
C	AC Adapter (Tessco)	PSA18U-480C	I41824520A3

Table 3. Equipment Configuration (2.4 GHz)

Ref. ID	Name / Description	Model Number	Serial Number
A	Router (Tessco)	AIR-AP1242AG AK9	FTX0940B056
B	5.0 GHz Antenna (ARC Wireless Solutions)	N/A	ANT-A-1723-01
C	AC Adapter (Tessco)	PSA18U-480C	I41824520A3

Table 4. Equipment Configuration (5 GHz

F. Support Equipment

Tessco Technologies supplied support equipment necessary for the operation and testing of the Access Point with TerraWave Solutions 2.4 and 5GHz Integrated Antennas. All support equipment supplied is listed in the following Support Equipment List.

Ref. ID	Name / Description	Manufacturer	Model Number	Serial Number
D	Laptop	Dell	Inspiron 630M	416-70166-5CG01LI

Table 5. Support Equipment

* The 'Customer Supplied Calibration Data' column will be marked as either not applicable, not available, or will contain the calibration date supplied by the customer.
** The AC/DC Adapter was use to power the EUT for testing purpose only, will not be sold with radio.

G. Ports and Cabling Information

Ref. ID	Port name on EUT	Cable Description or reason for no cable	Qty.	Length (m)	Shielded? (Y/N)	Termination Box ID & Port ID
1	A, 5.0GHz Right/Primary	LMR 400 (Coaxial)	1	1	Yes	B
2	A, Enternet	CAT 5	1	10	No	D
3	A, AC Input	AC	1	1.5	No	C
4	C	AC	1	2	No	110v AC Power Supply

Table 6. Ports and Cabling Information

H. Mode of Operation

Gui

I. Method of Monitoring EUT Operation

A Spectrum Analyzer and a Power Meter was use to monitor the EUT's transmitter channel and power output.

J. 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.

K. Disposition of EUT

The test sample including all support equipment submitted to the Electro-Magnetic Compatibility Lab for testing was returned to Tessco Technologies 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 meets the criteria of this rule by virtue of having professionally installed. The EUT is therefore compliant with §15.203.

Antenna		
Model No. / Gain	2.4 GHz 19 dBi Integrated Antenna	5 GHz 23 dBi Integrated Antenna
Vendor	TerraWave Solutions	TerraWave Solutions

Test Engineer(s): Shawn McMillen

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(b), § 15. 407(a) (1), (2) Peak Power Output and RF Exposure

Test Requirements: **§15.247(b), §15.407(a) (1), (2):** The maximum peak output power of the intentional radiator shall not exceed the following:

Digital Transmission Systems (MHz)	Output Limit
902-928	1.000W
2400–2483.5	1.000W
5150-5250	50mW
5250-5350	250mW
5725– 5850	1.000W

Table 7. Output Power Requirements from §15.247 and §15.407

§15.247(b): 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 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.

§15.407(a) (1): For the band 5.15-5.25 GHz the peak transmit power over the frequency band of operation shall not exceed the lesser 50mW or 4dBm + 10logB, where B is the 26-dB emission bandwidth in MHz.

§15.407(a) (2): For the band 5.25-5.35GHz the peak transmit power over the frequency band of operation shall not exceed the lesser of 250mW or 11dBm + 10logB, where B is the 26-dB emission bandwidth in MHz.

Test Procedure: The transmitter was connected to a calibrated Power Meter. The EUT was measured at the low, mid and high channels of each band at a data rate which gave the maximum power level.

Test Results: Equipment complies with the Peak Power Output limits of **§ 15.247(b)** and **§ 15.401(a) (1), § 15.401(a) (2)**.

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(b) Peak Power Output and RF Exposure

RF Exposure Requirements: **§1.1307(b)(1) and §1.1307(b)(2):** Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines.

RF Radiation Exposure Limit: **§1.1310:** As specified in this section, the Maximum Permissible Exposure (MPE) Limit shall be used to evaluate the environmental impact of human exposure to radiofrequency (RF) radiation as specified in Sec. 1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of Sec. 2.1093 of this chapter.

MPE Limit Calculation: EUT's operating frequencies @ 2400-2483.5 MHz; highest conducted power = 19.67dBm (peak) therefore, **Limit for Uncontrolled exposure: 1 mW/cm^2 or 10 W/m^2**

EUT maximum antenna gain = 19 dBi – 9dB required attenuation.
Therefore the maximum antenna gain = 10dBi

Equation from page 18 of OET 65, Edition 97-01

$S = PG / 4\pi R^2$ or $R = \sqrt{PG / 4\pi S}$

where, S = Power Density (1 mW/cm^2)
P = Power Input to antenna (92.68mW)
G = Antenna Gain (10.0 numeric)

$S = (92.68*10/ 4*3.14*20.0^2) = (926.8/ 5024) = 0.18$ mW/cm^2

MPE Limit Calculation: EUT's operating frequencies @ 5180-5240 MHz; highest conducted power = 11.0dBm (peak) therefore, **Limit for Uncontrolled exposure: 1 mW/cm^2 or 10 W/m^2**

EUT maximum antenna gain = 23 dBi

Equation from page 18 of OET 65, Edition 97-01

$S = PG / 4\pi R^2$ or $R = \sqrt{PG / 4\pi S}$

where, S = Power Density (1 mW/cm^2)
P = Power Input to antenna (12.59mW)
G = Antenna Gain (199.5 numeric)

$S = (12.59*199.5/ 4*3.14*20.0^2) = (2511.7/ 5024) = 0.50$ mW/cm^2

MPE Limit Calculation: EUT's operating frequencies @ 5260-5320 MHz; highest conducted power = 16.45dBm (peak) therefore, **or 10 W/m^2**

EUT maximum antenna gain = 23 dBi

Equation from page 18 of OET 65, Edition 97-01

$S = PG / 4\pi R^2$ or $R = \sqrt{PG / 4\pi S}$

where, S = Power Density (1 mW/cm^2)
P = Power Input to antenna (44.15mW)
G = Antenna Gain (199.5 numeric)

$R = (44.15*199.5/ 4*3.14*1.0)^{1/2} = (8809.3/ 12.56)^{1/2}$ = 26.48cm separation distance to meet the 1 mW/cm^2 Limit for Uncontrolled exposure.

MPE Limit Calculation: EUT's operating frequencies @ 5745-5825 MHz; highest conducted power = 17.60dBm (peak) therefore, **or 10 W/m^2**

EUT maximum antenna gain = 23 dBi

Equation from page 18 of OET 65, Edition 97-01

$S = PG / 4\pi R^2$ or $R = \sqrt{PG / 4\pi S}$

where, S = Power Density (1 mW/cm^2)
P = Power Input to antenna (57.5mW)
G = Antenna Gain (199.5 numeric)

$R = (57.5*199.5/ 4*3.14*1.0)^{1/2} = (11471.25/12.56)^{1/2}$ = 30.22cm separation distance to meet the 1 mW/cm^2 Limit for Uncontrolled exposure.

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(d), § 15.407(b)(1),(2), (5), (6) Harmonic Emissions – Radiated and Conducted , Undesirable Emissions

Test Requirements: **§15.247(d)**; **§ 15.407(b)(1),(2), (5), (6)**; Error! Reference source not found.**; §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).

§ 15.407(b)(1): In any 1MHz bandwidth outside the frequency band 5.15-5.25GHz in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power shall not exceed -27dBm.

§ 15.407(b)(2): In any 1MHz bandwidth outside the frequency band 5.25-5.35GHz in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power shall not exceed -27dBm.

§ 15.407(b)(6): 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 8. Restricted Bands of Operation

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

Test Engineer(s): Shawn McMillen

Test Date(s): August 4, 2006

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(d) Harmonic Emissions Requirements – Radiated (802.11b)

Frequency (MHz)	Receive Antenna Polarity (H/V)	Uncorrected Field strength (dBµV)@ 3m	Preamp (dB)	Antenna Factor (dB)	Cable Loss (dB)	Corrected Field Strength @ 3m (dBµV)	Limit @ 3m (dBµV)	Margin (dB)	Measurement Type
4824.0	V	41.7	35.1	33.5	5.2	45.3	74.0	28.7	pk
4824.0	V	30.8	35.1	33.5	5.2	34.4	54.0	19.6	avg
7236.0	V	42.5	35.1	37.0	6.2	50.6	74.0	23.4	pk
7236.0	V	31.5	35.1	37.0	6.2	39.6	54.0	14.4	avg

Low Channel 2412MHz

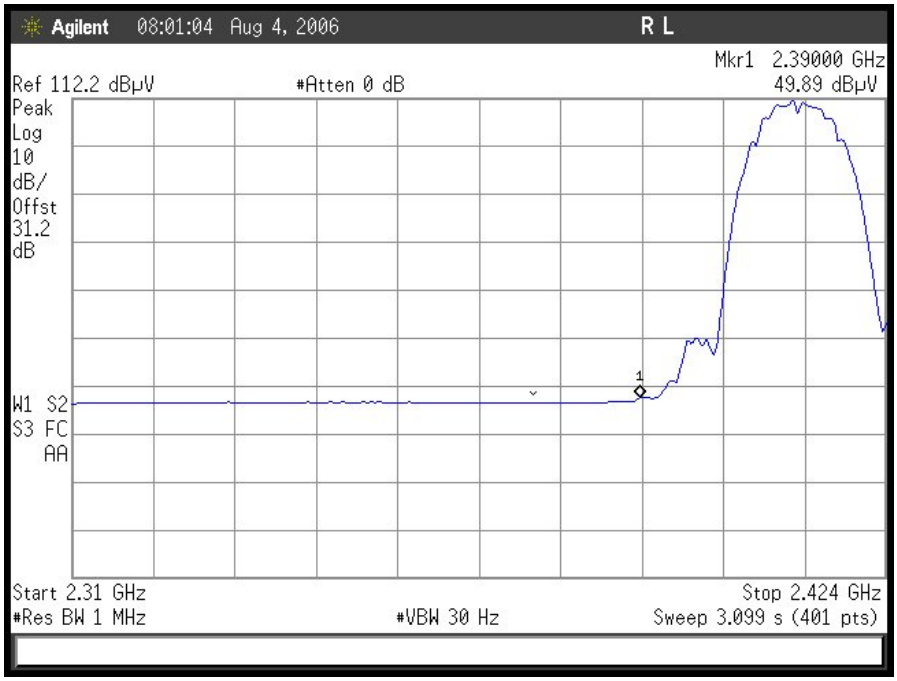
Frequency (MHz)	Receive Antenna Polarity (H/V)	Uncorrected Field strength (dBµV)@ 3m	Preamp (dB)	Antenna Factor (dB)	Cable Loss (dB)	Corrected Field Strength @ 3m (dBµV)	Limit @ 3m (dBµV)	Margin (dB)	Measurement Type
4874.0	V	40.5	35.1	33.5	5.2	44.1	74.0	29.9	pk
4874.0	V	30.5	35.1	33.5	5.2	34.0	54.0	20.0	avg
7311.0	V	42.4	35.1	37.0	6.2	50.5	74.0	23.5	pk
7311.0	V	32.3	35.1	37.0	6.2	40.4	54.0	13.6	avg

Mid Channel 2437MHz

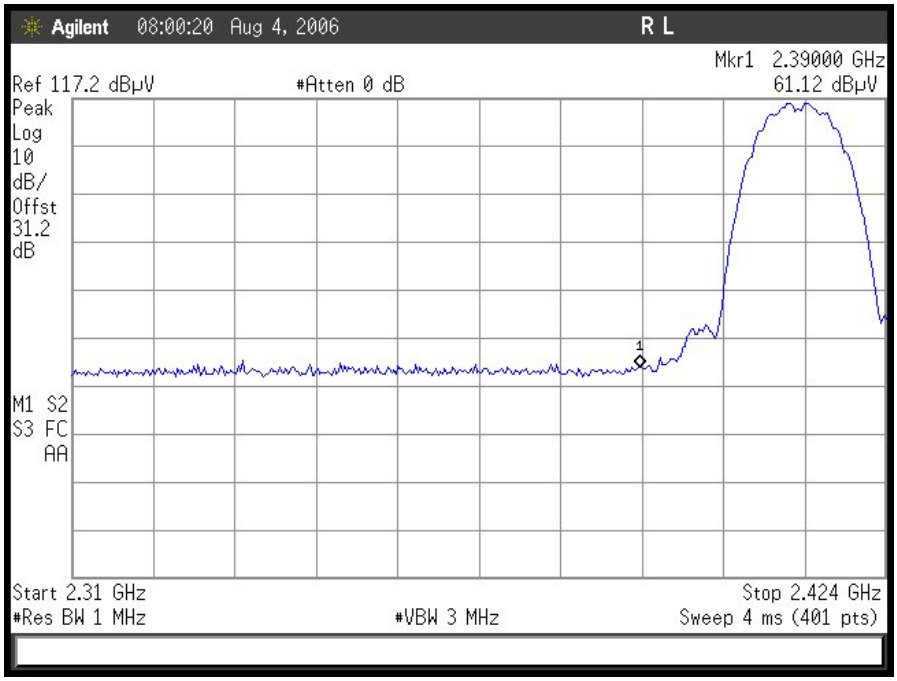
Frequency (MHz)	Receive Antenna Polarity (H/V)	Uncorrected Field strength (dBµV)@ 3m	Preamp (dB)	Antenna Factor (dB)	Cable Loss (dB)	Corrected Field Strength @ 3m (dBµV)	Limit @ 3m (dBµV)	Margin (dB)	Measurement Type
4924.0	V	40.9	35.1	33.5	5.2	44.4	74.0	29.6	pk
4924.0	V	30.6	35.1	33.5	5.2	34.2	54.0	19.8	avg
7386.0	V	43.3	35.1	37.0	6.2	51.4	74.0	22.6	pk
7386.0	V	32.2	35.1	37.0	6.2	40.3	54.0	13.7	avg

High Channel 2462MHz

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

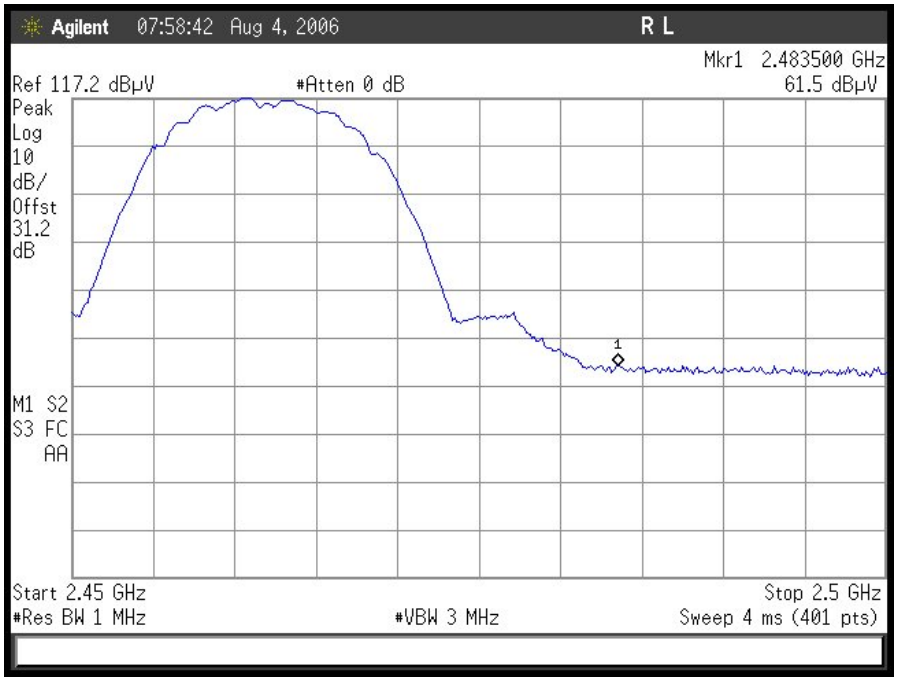


802.11/b – Lower Band Edge Average 2.4GHz



802.11/b – Lower Band Edge Peak 2.4GHz

802.11/b – High Band Edge Average 2.4GHz



802.11/b – High Band Edge Peak 2.4GHz

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(d) Harmonic Emissions Requirements – Radiated (802.11g)

Frequency (MHz)	Receive Antenna Polarity (H/V)	Uncorrected Field strength (dBµV)@ 3m	Preamp (dB)	Antenna Factor (dB)	Cable Loss (dB)	Corrected Field Strength @ 3m (dBµV)	Limit @ 3m (dBµV)	Margin (dB)	Measurement Type
4824.0	V	43.5	35.1	33.5	5.2	47.1	74.0	27.0	pk
4824.0	V	32.3	35.1	33.5	5.2	35.9	54.0	18.1	avg
7236.0	V	41.8	35.1	37.0	6.2	49.9	74.0	24.1	pk
7236.0	V	31.2	35.1	37.0	6.2	39.3	54.0	14.7	avg

Low Channel 2412MHz

Frequency (MHz)	Receive Antenna Polarity (H/V)	Uncorrected Field strength (dBµV)@ 3m	Preamp (dB)	Antenna Factor (dB)	Cable Loss (dB)	Corrected Field Strength @ 3m (dBµV)	Limit @ 3m (dBµV)	Margin (dB)	Measurement Type
4874.0	V	40.2	35.1	33.5	5.2	43.8	74.0	30.2	pk
4874.0	V	30.4	35.1	33.5	5.2	33.9	54.0	20.1	avg
7311.0	V	43.4	35.1	37.0	6.2	51.5	74.0	22.5	pk
7311.0	V	31.1	35.1	37.0	6.2	39.2	54.0	14.8	avg

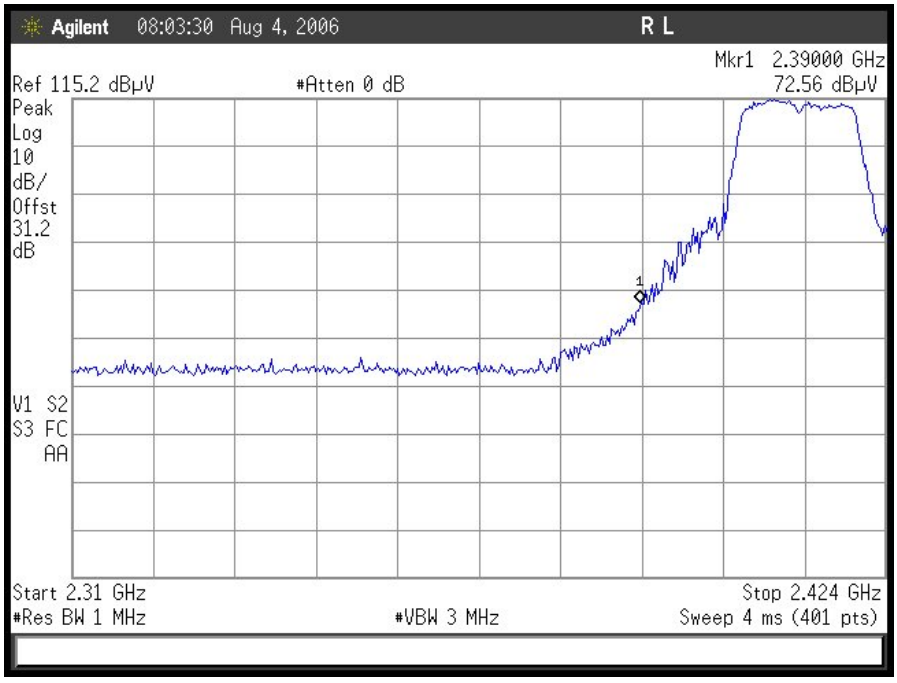
Mid Channel 2437MHz

Frequency (MHz)	Receive Antenna Polarity (H/V)	Uncorrected Field strength (dBµV)@ 3m	Preamp (dB)	Antenna Factor (dB)	Cable Loss (dB)	Corrected Field Strength @ 3m (dBµV)	Limit @ 3m (dBµV)	Margin (dB)	Measurement Type
4924.0	V	40.2	35.1	33.5	5.2	43.7	74.0	30.3	pk
4924.0	V	30.6	35.1	33.5	5.2	34.1	54.0	19.9	avg
7386.0	V	41.0	35.1	37.0	6.2	49.1	74.0	24.9	pk
7386.0	V	31.3	35.1	37.0	6.2	39.4	54.0	14.7	avg

High Channel 2462MHz

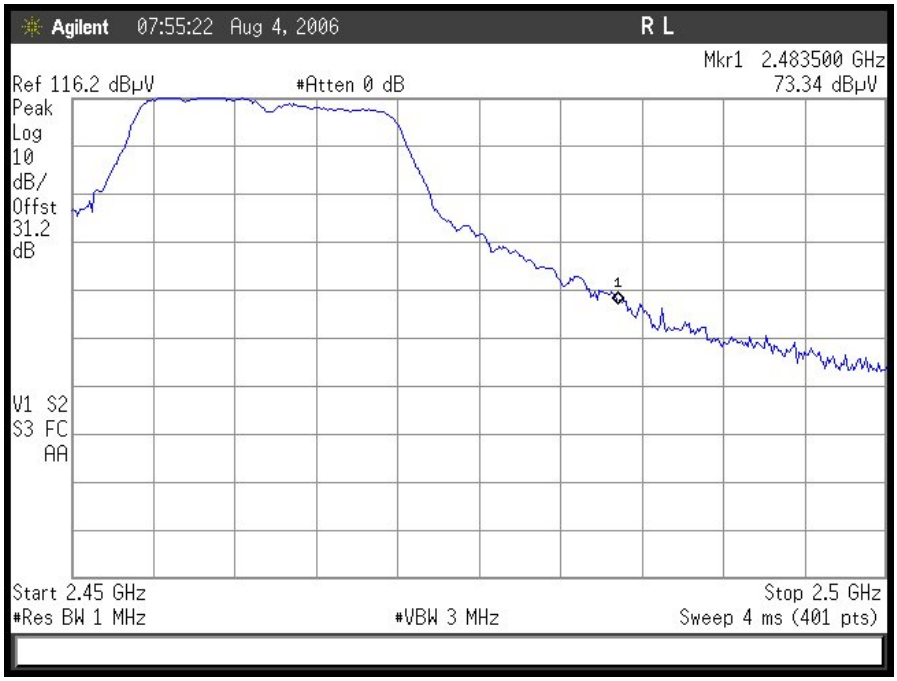
Note: All other emissions were measured at the noise floor of the spectrum analyzer

802.11/g – Lower Band Edge Average 2.4GHz



802.11/g – Lower Band Edge Peak 2.4GHz

802.11/g – High Band Edge Average 2.4GHz



802.11/g – High Band Edge Peak 2.4GHz

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.407(b)(1): Harmonic Emissions Requirements – Radiated (802.11a) 5.15 – 5.25GHz

Frequency (MHz)	Receive Antenna Polarity (H/V)	Spectrum Analyzer Reading (dBm)	Signal Generator (dB)	TX Gain (dBi)	Cable Loss (dB)	EIPR (dBm)	Limit at 3m (dBm)	Margin (dB)	Measurement Type
10360	V	-66.0	-75.7	12.5	6.4	-56.8	-33	23.8	pk
15540	V	-66.9	-75.5	12.5	8.3	-54.7	-33	21.7	pk
15540	V	-75.9	-87.7	15.7	8.3	-63.7	-53	10.7	avg

Low Channel 5180MHz

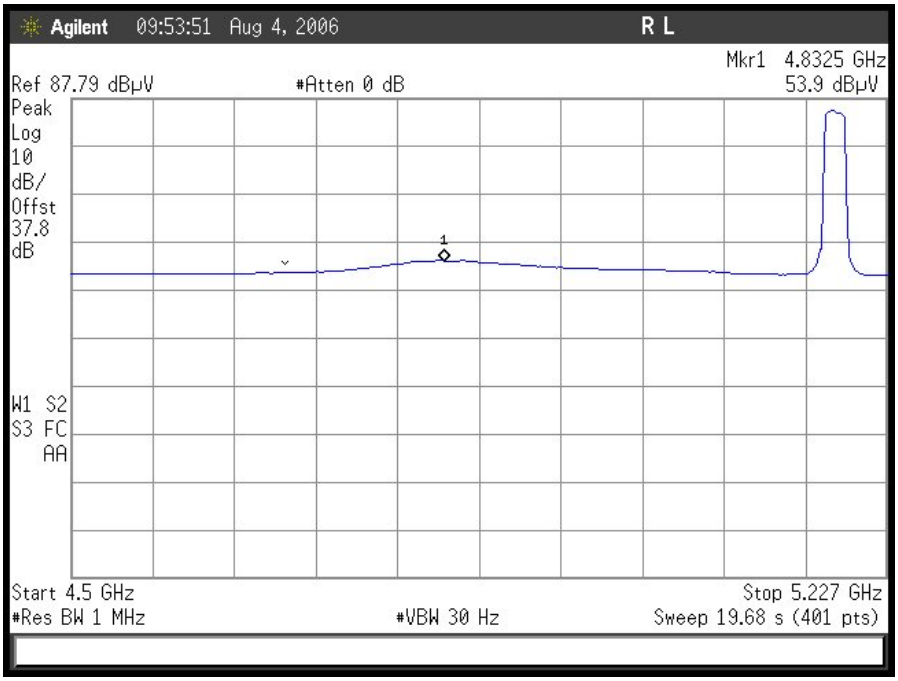
Frequency (MHz)	Receive Antenna Polarity (H/V)	Spectrum Analyzer Reading (dBm)	Signal Generator (dB)	TX Gain (dBi)	Cable Loss (dB)	EIPR (dBm)	Limit at 3m (dBm)	Margin (dB)	Measurement Type
10400	V	-66.4	-76.1	12.5	6.4	-57.2	-33	24.2	pk
15600	V	-66.3	-75.0	12.5	8.3	-54.1	-33	21.1	pk
15600	V	-76.0	-87.7	15.7	8.3	-63.7	-53	10.7	avg

Mid Channel 5200MHz

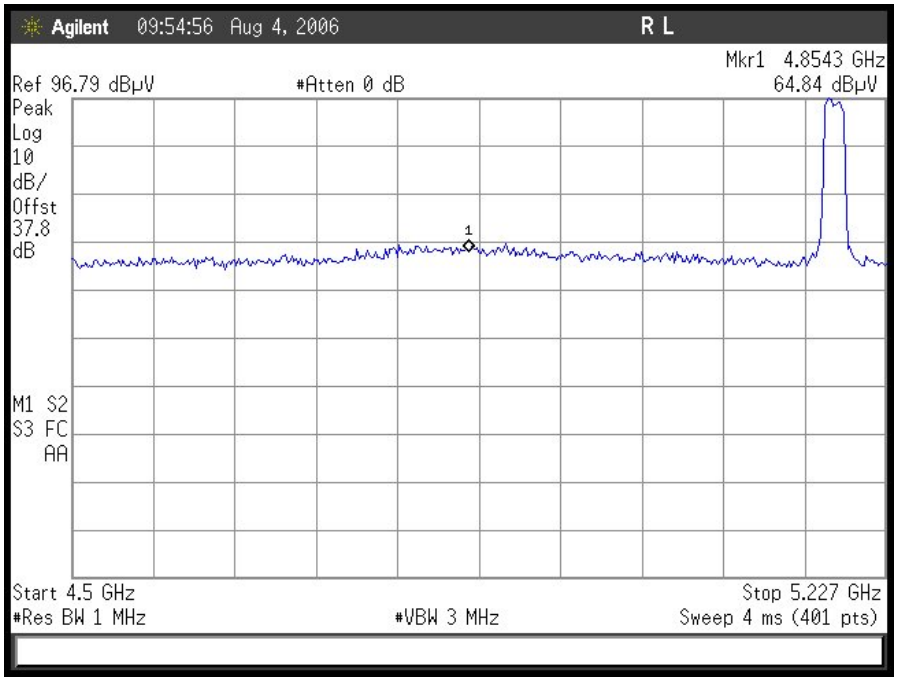
Frequency (MHz)	Receive Antenna Polarity (H/V)	Spectrum Analyzer Reading (dBm)	Signal Generator (dB)	TX Gain (dBi)	Cable Loss (dB)	EIPR (dBm)	Limit at 3m (dBm)	Margin (dB)	Measurement Type
10480	V	-68.9	-78.6	12.5	6.4	-59.7	-33	26.7	pk
15720	V	-66.9	-75.5	12.5	8.3	-54.6	-33	21.6	avg
15720	V	-75.8	-87.6	15.7	8.3	-63.6	-53	10.6	pk

High Channel 5240 MHz

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



802.11/a – Lower Band Edge Average 5.15 – 5.25GHz UNII



802.11/a – Lower Band Edge Peak 5.15 – 5.25GHz UNII

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.407(b)(2): Harmonic Emissions Requirements – Radiated (802.11a) 5.25 – 5.35GHz

Frequency (MHz)	Receive Antenna Polarity (H/V)	Spectrum Analyzer Reading (dBm)	Signal Generator (dB)	TX Gain (dBi)	Cable Loss (dB)	EIPR (dBm)	Limit at 3m (dBm)	Margin (dB)	Measurement Type
10520	V	-63.9	-73.3	12.5	6.4	-54.4	-33	21.4	pk
15780	V	-63.0	-74.6	15.7	8.3	-50.6	-33	17.6	pk
15780	V	-74.3	-86.0	15.7	8.3	-62.0	-53	9.0	avg

Low Channel 5260MHz

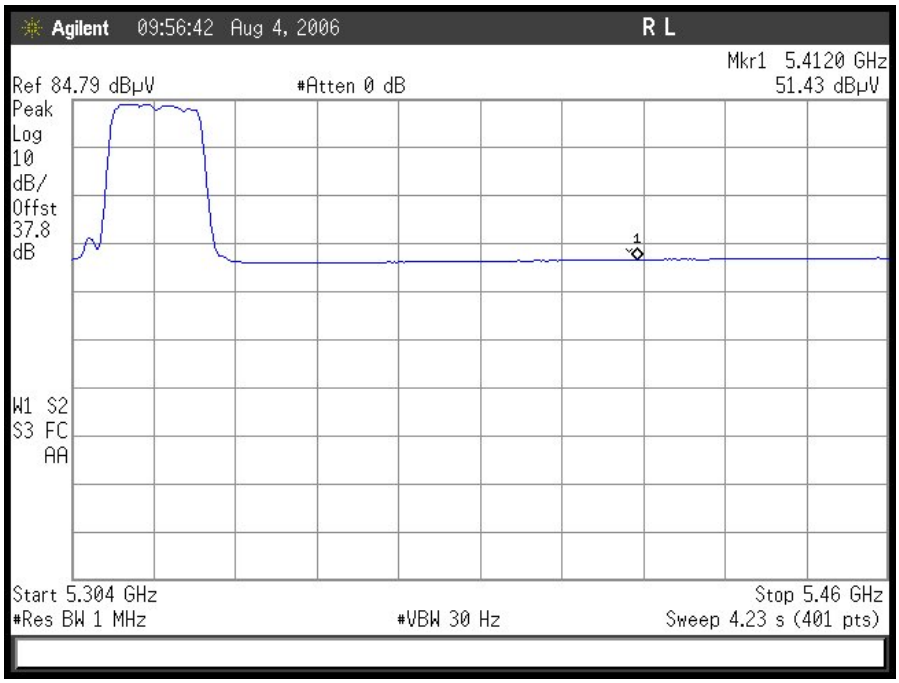
Frequency (MHz)	Receive Antenna Polarity (H/V)	Spectrum Analyzer Reading (dBm)	Signal Generator (dB)	TX Gain (dBi)	Cable Loss (dB)	EIPR (dBm)	Limit at 3m (dBm)	Margin (dB)	Measurement Type
10560	V	-64.8	-74.2	12.5	6.4	-55.3	-33	22.3	pk
15840	V	-63.4	-75.0	15.7	8.3	-51.0	-33	18.0	pk
15840	V	-72.1	-83.8	15.7	8.3	-59.8	-53	6.8	avg

Mid Channel 5280MHz

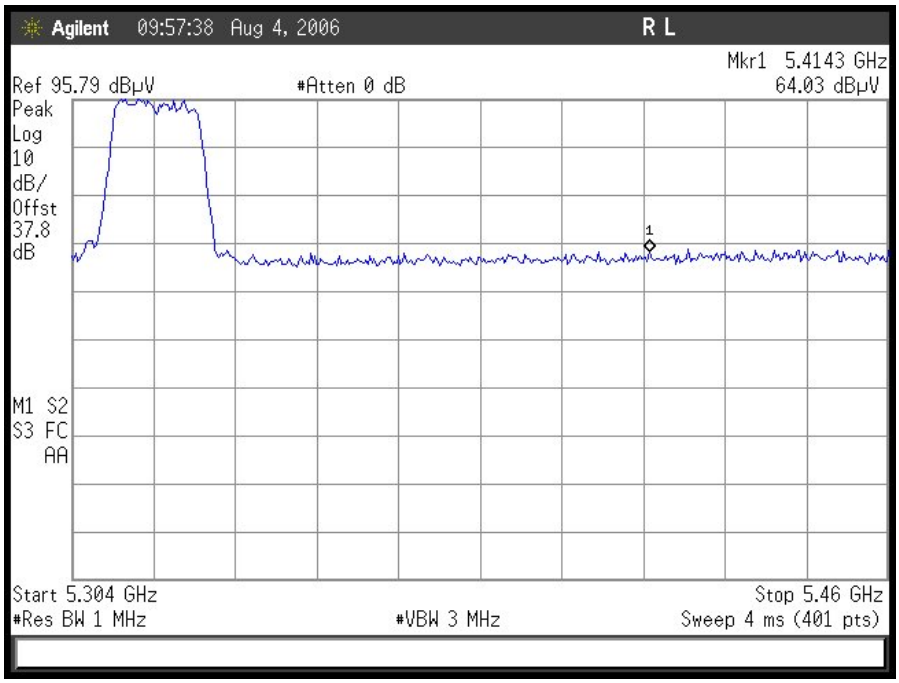
Frequency (MHz)	Receive Antenna Polarity (H/V)	Spectrum Analyzer Reading (dBm)	Signal Generator (dB)	TX Gain (dBi)	Cable Loss (dB)	EIPR (dBm)	Limit at 3m (dBm)	Margin (dB)	Measurement Type
10640	V	-63.7	-73.1	12.5	6.4	-54.2	-33	21.2	pk
10640	V	-75.5	-84.9	12.5	6.4	-66.0	-53	13.0	avg
15960	V	-62.7	-74.3	15.7	8.3	-50.4	-33	17.4	pk
15960	V	-74.9	-86.6	15.7	8.3	-62.6	-53	9.6	avg

High Channel 5320MHz

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



802.11/a – High Band Edge Average 5.25 – 5.35GHz UNII



802.11/a – High Band Edge Peak 5.25 – 5.35GHz UNII

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.407(b)(2): Harmonic Emissions Requirements – Radiated (802.11a) 5.725 – 5.825GHz

Frequency (MHz)	Receive Antenna Polarity (H/V)	Spectrum Analyzer Reading (dBm)	Signal Generator (dB)	TX Gain (dBi)	Cable Loss (dB)	EIPR (dBm)	Limit at 3m (dBm)	Margin (dB)	Measurement Type
11490	V	-64.3	-71.4	11.9	6.9	-52.6	-33	19.6	pk
11490	V	-75.9	-83.0	11.9	6.9	-64.2	-53	11.2	avg
17235	V	-63.6	-63.7	11.1	6.4	-46.2	-33	13.2	pk

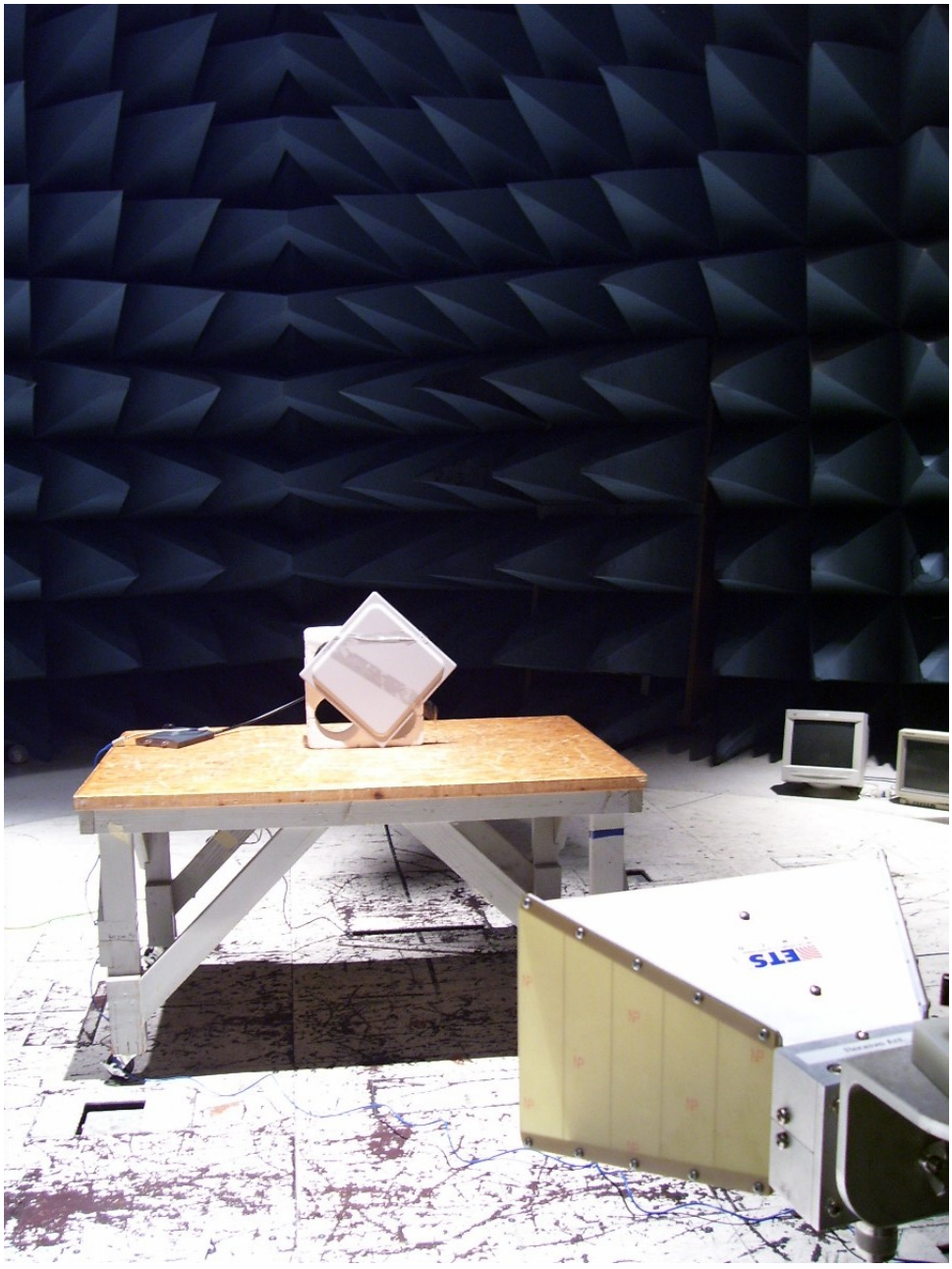
Low Channel 5745MHz

Frequency (MHz)	Receive Antenna Polarity (H/V)	Spectrum Analyzer Reading (dBm)	Signal Generator (dB)	TX Gain (dBi)	Cable Loss (dB)	EIPR (dBm)	Limit at 3m (dBm)	Margin (dB)	Measurement Type
11570	V	-65.0	-72.1	11.9	6.9	-53.3	-33	20.3	pk
11570	V	-76.0	-83.1	11.9	6.9	-64.3	-53	11.3	avg
17355	V	-64.0	-64.1	11.1	6.4	-46.6	-33	13.6	pk

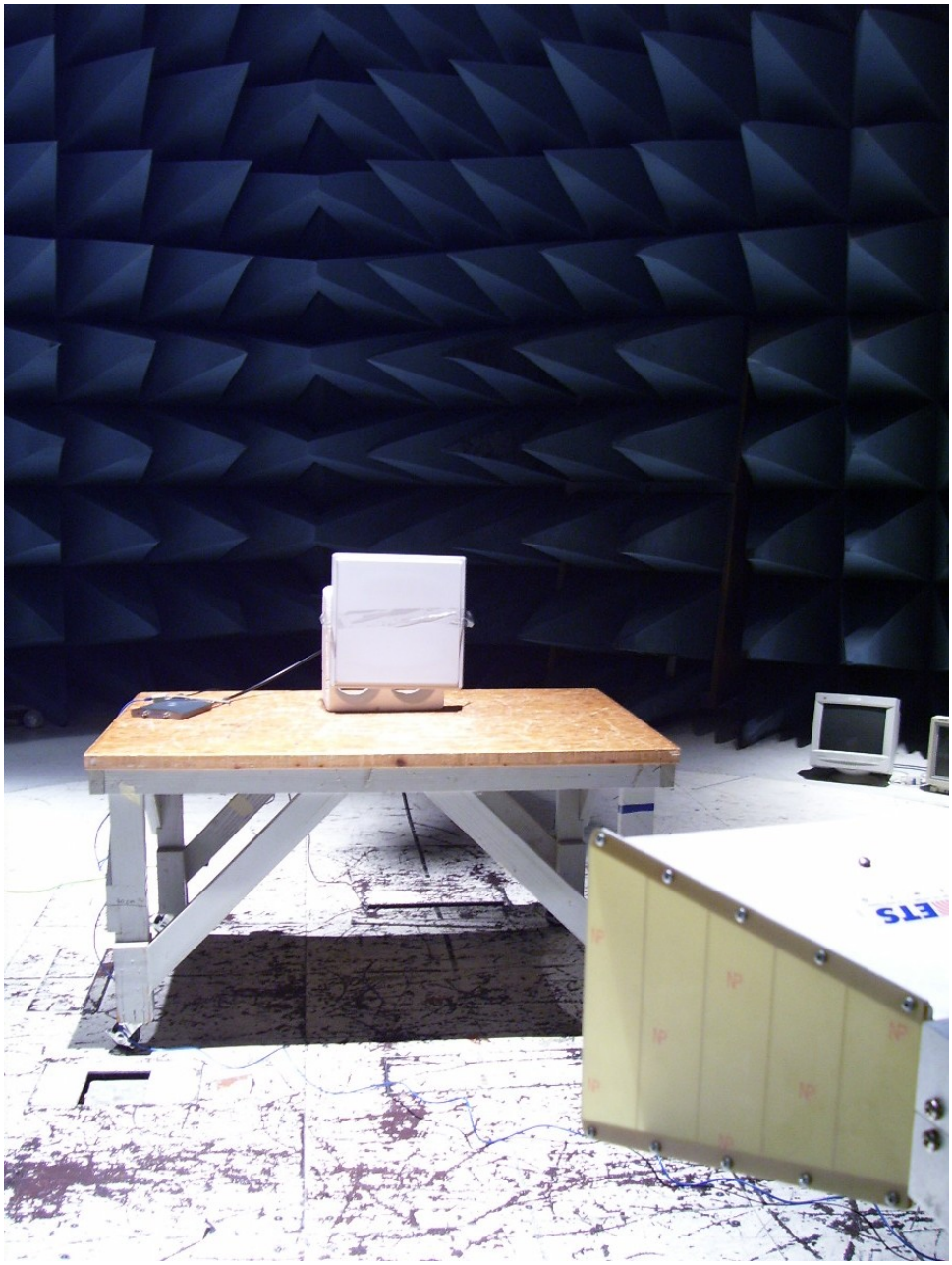
Mid Channel 5785MHz

Frequency (MHz)	Receive Antenna Polarity (H/V)	Spectrum Analyzer Reading (dBm)	Signal Generator (dB)	TX Gain (dBi)	Cable Loss (dB)	EIPR (dBm)	Limit at 3m (dBm)	Margin (dB)	Measurement Type
11610	V	-64.5	-71.6	11.9	6.9	-52.8	-33	19.8	pk
11610	V	-75.9	-83.0	11.9	6.9	-64.2	-53	11.2	avg
17415	V	-63.5	-63.6	11.1	6.4	-46.1	-33	13.1	pk

High Channel 5805MHz



Photograph 2. Test Equipment and setup for various Radiated Measurements, 2.4GHz



Photograph 3. Test Equipment and setup for various Radiated Measurements, 5GHz

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
1S2421	EMI RECEIVER	ROHDE&SCHWARZ	ESIB 7	2/9/2005	2/9/2007
1S2184	BILOG ANTENNA	CHASE	CBL6112A	1/12/2005	1/12/2007
1S2121	PRE-AMPLIFIER	HEWLETT PACKARD	8449B	10/14/2005	10/14/2006
1S2198	ANTENNA, HORN	EMCO	3115	7/14/2005	8/14/2006
1S2202	ANTENNA, HORN, 1 METER	EMCO	3116	3/23/2005	3/23/2007
N/A	HIGH PASS FILTER	MICRO-TRONICS	HPM13146	SEE NOTE	
1S2263	CHAMBER, 10 METER	RANTEC	N2-14	7/25/2005	8/15/2006
1S2430	WIDEBAND POWER METER	ANRITSU COMPANY	ML2488A	1/12/2005	1/12/2007
1S2432	WIDEBAND POWER SENSOR	ANRITSU COMPANY	MA2491A	1/12/2005	1/12/2007
1S2034	COUPLER, DIRECTIONAL 1-20 GHz	KRYTAR	101020020	SEE NOTE	
1S2041	COUPLER, BI DIRECTIONALCOAXIAL	NARDA	N/A	SEE NOTE	
1S2460	Analyzer, Spectrum 9 kHz-40GHz	Agilent	E4407B	07/06/2005	07/06/2008
1S2430	WIDEBAND POWER METER	ANRITSU COMPANY	ML2488A	1/12/2005	1/12/2007
1S2432	WIDEBAND POWER SENSOR	ANRITSU COMPANY	MA2491A	1/12/2005	1/12/2007
1S2034	COUPLER, DIRECTIONAL 1-20 GHz	KRYTAR	101020020	SEE NOTE	
1S2041	COUPLER, BI DIRECTIONALCOAXIAL	NARDA	N/A	SEE NOTE	
1S2128	Harmonic Mixer	Hewlett Packard	11970A	N/A	3/10/2007
1S2129	Harmonic Mixer	Hewlett Packard	11970K	N/A	3/10/2007

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 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.

End of Report

