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Electromagnetic Compatibility Criteria
Test Report

for the

Motorola, Inc.
AP30 (2.4 GHz)

Verified under
the FCC Certification Rules
contained in
Title 47 of the CFR, Part 15.247, Subpart C
for Intentional Radiators

MET Report: EMCS17444A-FCC247

August 15, 2005

Prepared For:

Motorola, Inc.
485 N. Keller Rd., Ste. 250
Maitland, FL 32751

Prepared By:
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33439 Western Ave.
Union City, California 94587

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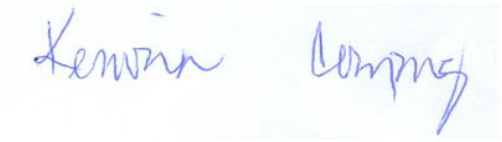

Kerwinn Corpuz, Project Engineer
Electromagnetic Compatibility Lab

Cheryl Anicete
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, 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 15, 2005	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
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**ilovolt
LISN	**L**ine **I**mpedance **S**tabilization **N**etwork
MHz	**M**ega**h**ertz
μH	**micro**henry
μF	**micro**farad
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 to determine compliance of the Motorola, Inc., AP30 (2.4 GHz) with the requirements of Part 15, Subpart C, §15.247 was performed. 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 Motorola, Inc., AP30 (2.4 GHz). Motorola, Inc. should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the AP30 (2.4 GHz) 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, Subpart C, §15.247, in accordance with Motorola, Inc., purchase order number 2640. All tests were conducted using measurement procedure ANSI C63.4-2003.

Reference	Description	IR Type (Requirement)			Compliance
		FHSS*	DSSS	Hybrid*	
Title 47 of the CFR, Part 15, Subpart C, §15.207	Conducted Emissions	N/A	✓	N/A	Measured emissions below applicable limits.
Title 47 of the CFR, Part 15, Subpart C, §15.209	Radiated Emission Limits; General Requirements	N/A	✓	N/A	Measured emissions below applicable limits.
Title 47 of the CFR, Part 15, Subpart C, §15.205	Restricted Bands of Operation	N/A	✓	N/A	Measured emissions below applicable limits.
Title 47 of the CFR, Part 15, Subpart C, §15.247(a)	Occupied Bandwidth	N/A	✓	N/A	Measured emissions below applicable limits.
Title 47 of the CFR, Part 15, Subpart C, §15.247(b)	Peak Power Output	N/A	✓	N/A	Measured emissions below applicable limits.
Title 47 of the CFR, Part 15, Subpart C, §15.247(c)	Spurious Emissions - Radiated and Conducted	N/A	✓	N/A	Measured emissions below applicable limits.
Title 47 of the CFR, Part 15, Subpart C, §15.247(d)	Power Density	N/A	✓	N/A	Measured emissions below applicable limits.

Table 1 Executive Summary of EMC Part 15.247 ComplianceTesting

*Not applicable, EUT is a DSSS unit.

NOTE: Spread spectrum systems are sharing these bands on a noninterference basis with systems supporting critical Government requirements that have been allocated the usage of these bands, secondary only to ISM equipment operated under the provisions of part 18 of this chapter. Many of these Government systems are airborne radiolocation systems that emit a high EIRP which can cause interference to other users. Also, investigations of the effect of spread spectrum interference to U. S. Government operations in the 902-928 MHz band may require a future decrease in the power limits allowed for spread spectrum operation.

II. Equipment Configuration

Model(s) Tested:	AP30 (2.4 GHz)
Model(s) Covered:	AP30 (2.4 GHz)
EUT Specifications:	Primary Power: 5Vdc
	FCC ID: QJEAP30240705
	Type of Modulation: OFDM
	Emission Designator: 12M6F1D (802.11b)
	Emission Designator: 16M5F1D (802.11g)
	Equipment Code: DSS
	Conducted RF Power Output (Peak): 214.8 mW (802.11b)
	Conducted RF Power Output (Peak): 229.1 mW (802.11g)
	Equipment Frequency Range: 2412 MHz – 2462 MHz
Analysis:	The results obtained relate only to the item(s) tested.
Environmental Test Conditions:	Temperature (15-35º C): 23º C
	Relative Humidity (30-60%): 51%
	Barometric Pressure (860-1060 mbar): 1020 mbar
Evaluated by:	Kerwinn Corpuz
Date(s):	06/28/05

A. Overview

The purpose of this series of tests was to verify compliance of the Motorola, Inc., AP30 (2.4 GHz) with the limits of CFR 47, §15.247 for Intentional Radiators.

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
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

AP30 – is a half duplex spread spectrum 802.11b/g radio module that operates in the band of 2.4 – 2.4835 GHz, Equipment Under Test (EUT) for the remainder of this document, is powered from a 5 Vdc supply.

Photograph 1. AP30 Radio

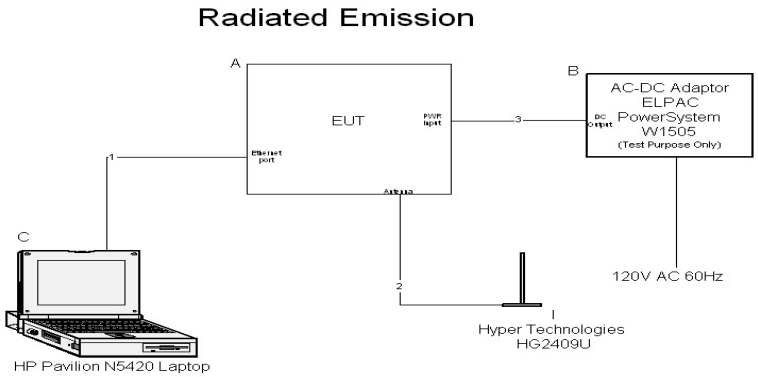


Figure 1. Block Diagram of Test Configuration (Radiated Emissions)

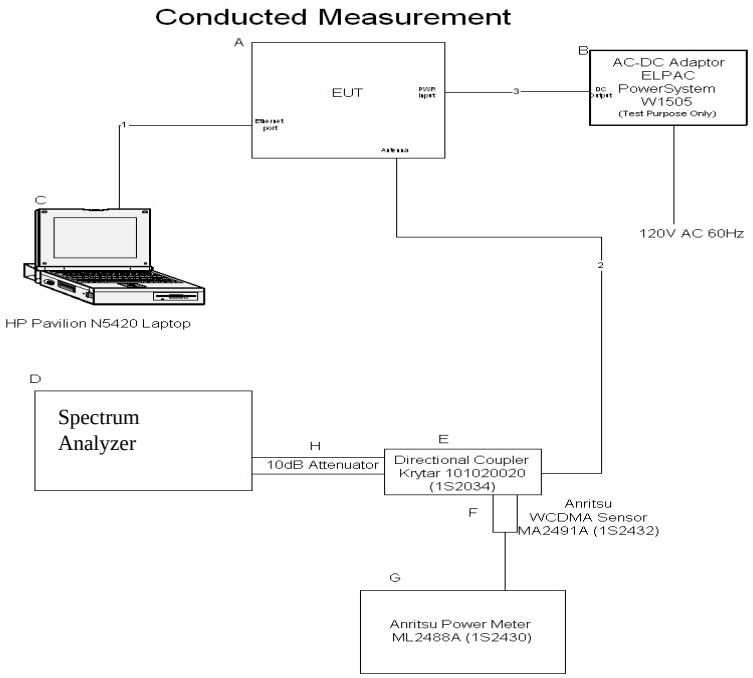


Figure 2. Block Diagram of Test Configuration (Conducted Measurement)

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	Part Number	Serial Number	Rev. #
A	2.4 GHz 802.11b/g radio	AP30	N/A	N/A	N/A
I	HyperLink (8.5dBi)	HG2409U	N/A	N/A	N/A

Table 2. Equipment Configuration (Radiated Emissions)

Ref. ID	Name / Description	Model Number	Part Number	Serial Number	Rev. #
A	2.4 GHz 802.11b/g radio	AP30	N/A	N/A	N/A

Table 3. Equipment Configuration (Conducted Measurement)

F. Support Equipment

Motorola, Inc. supplied support equipment necessary for the operation and testing of the AP30 (2.4 GHz). All support equipment supplied is listed in the following Support Equipment List.

Ref. ID	Name / Description	Manufacturer	Model Number	*Customer Supplied Calibration Data
**B	AC/DC Adapter	ELPAC Power System	W1505	N/A
C	Laptop	Hewlett Packard	Pavilion N5420	N/A

Table 4. Support Equipment (Radiated Emissions)

Ref. ID	Name / Description	Manufacturer	Model Number	*Customer Supplied Calibration Data
**B	AC/DC Adapter	ELPAC Power System	W1505	N/A
C	Laptop	Hewlett Packard	Pavilion N5420	N/A
D	Spectrum Analyzer	Agilent	E4448A	N/A
E	Directional coupler	Narda	N/A	N/A
		Krytar	101020020	N/A
F	WCDMA Sensor	Anritsu	MA2491A	N/A
G	Power Meter	Anritsu	ML2488A	N/A
H	10 dB Attenuator	Weinschel Corp	33-10-34	N/A

Table 5. Support Equipment (Conducted Measurement)

* 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 ?	Termination Box ID & Port ID
Conducted Measurement						
1	A, Ethernet Port	10/100 Ethernet	1	1	Yes	C
2	A, Antenna Port	SMA	1	0.3	Yes	E
3	A, DC Power Input	DSUB15 - Serial	1	2	No	B
Radiated Emissions						
1	A, Ethernet Port	10/100 Ethernet	1	1	Yes	C
2	A, Antenna Port	SMA	1	0.3	Yes	I
3	A, DC Power Input	DSUB15 - Serial	1	2	No	B

Table 6. Ports and Cabling Information

H. Mode of Operation

The EUT was set to maximum transmit power and 50% duty cycle.

The radio was power with 5 Vdc using AC/DC adapter for test purposes only. The AC/DC adapter will not be sold with this radio. The radio functions in a half duplex operation using a single pre-programmed channel for communication. Various test modes were used during the tests. The test modes can be used to generate traffic on any of the available channels (on 5 MHz boundaries) at a specified power setting and transmit duty cycle – as required to emulate a specific operation during test.

I. Method of Monitoring EUT Operation

A Spectrum Analyzer and a Power Meter were used to monitor the transmitter's modulated power On or Off and frequency allocation.

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 Motorola, Inc. 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.

Type of Antenna: linear dipole (with an omni-directional, radiation pattern)

Gain of Antenna: HyperLink; Model: HG2409U; 8.5 dBi
MaxRad; Model: MFB24008NMDC; 8 dBi

EUT was tested with the highest antenna gain, 8.5 dBi.

Test Engineer(s): Kerwinn Corpuz

Test Date(s): 06/28/2005

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.207 Conducted Emissions Limits

Test Requirement(s): **§ 15.207 (a):** For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30MHz, shall not exceed the limits in the following table, as measured using a 50 μH/50 Ω line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency range (MHz)	§ 15.207(a), Conducted Limit (dBμV)	
	Quasi-Peak	Average
* 0.15- 0.45	66 - 56	56 - 46
0.45 - 0.5	56	46
0.5 - 30	60	50

Table 7. Conducted Limits for Intentional Radiators from FCC Part 15 § 15.207(a)

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.207 Conducted Emissions Limits

Test Procedure: The EUT was placed on a 0.8 m-high wooden table inside a semi-anechoic chamber. The EUT was situated such that the back of the EUT was 0.4 m from one wall of the vertical ground plane, and the remaining sides of the EUT were no closer than 0.8 m from any other conductive surface. The EUT was powered from a 50 Ω/50 μH Line Impedance Stabilization Network (LISN). The EMC receiver scanned the frequency range from 150 kHz to 30 MHz. Conducted Emissions measurements were made in accordance with *ANSI C63.4-1992 "Methods and Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9kHz to 40 GHz"*. The measurements were performed over the frequency range of 0.15 MHz to 30 MHz using a 50 Ω/50 μH LISN as the input transducer to an EMC/field intensity meter. The tests were conducted in a RF-shielded enclosure.

Test Results: The AP30 radio is powered with 5Vdc, therefore Conducted Emission Voltage is not required.

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.209 Radiated Emissions Limits

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 8.

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

Test Procedure: The transmitter was set to the lowest channel with the highest output power and placed on a 0.8 m high wooden table inside in a semi-anechoic chamber. Various antennas were located between 3 m and 0.5 m from an adjustable antenna mast near the EUT. Measurements were performed with the EUT rotated 360 degrees and varying the adjustable antenna mast with 1 m to 4 m height to determine worst case orientation for maximum emissions. Repeated the measurement with middle and highest channel.

For frequencies from 30 MHz to 1 GHz, measurements were made using a quasi-peak detector with a 120 kHz bandwidth. For frequencies above 1 GHz, peak measurements were made with a resolution bandwidth of 1 MHz and a video bandwidth of 1MHz and average measurements were made with RBW = 1MHz and VBW = 10 Hz.

For intentional radiators with a digital device portion which operates below 10 GHz, the spectrum was investigated as per §15.33(a)(1) and §15.33(a)(4); i.e., the lowest RF signal generated or used in the device up to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

In accordance with §15.35(b) the limit on the radio frequency emissions as measured using instrumentation with a peak detector function shall be 20 dB above the maximum permitted average limit for the frequency being investigated unless a different peak emission limit is otherwise specified in the rules.

EUT Field Strength Final Amplitude = Raw Amplitude – PreAmp gain + Antenna Factor + Cable Loss – Distance Correction Factor (1 meter)

Test Results: The EUT was found compliant with the Radiated Emission limits of **§15.209(a)** for Intentional Radiators. See following pages for detailed test results.

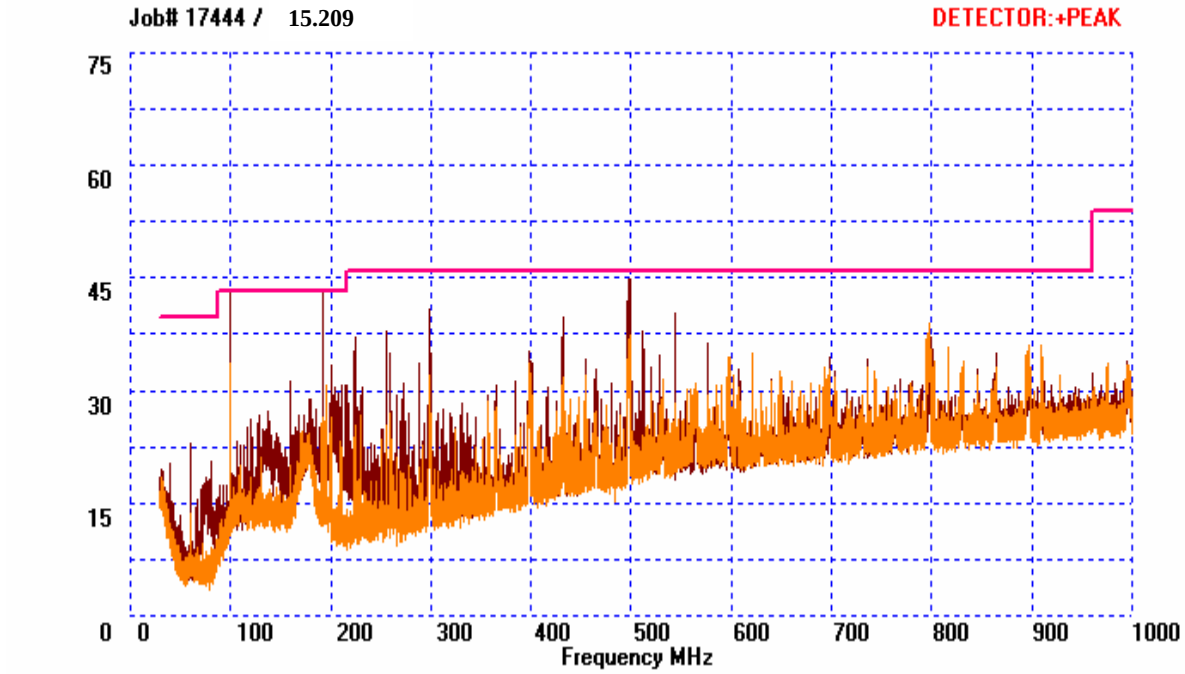
Test Engineer(s): Kerwinn Corpuz

Test Date(s): 07/06/2005

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.209 Radiated Emissions Limits

802.11b Radiated Emissions from 30 MHz – 1 GHz



= Vertical Polarization
= Horizontal Polarization

Quasi-Peak Results

Frequency (MHz)	Antenna Polarity (H/V)	EUT Azimuth (Degrees)	Antenna Height (m)	Uncorrected Amplitude (dBuv)	Antenna Correction Factor (dB/m) (+)	Pre Amp Gain (dB) (-)	Cable Loss (dB) (+)	Distance Correction Factor (dB)	Corrected Amplitude (dBuV/m)	Limit (dBuV/m)	Margin (dB)
***99.72**	**H**	**45**	**2.3**	**29.30**	**10.91**	**0.00**	**1.74**	**0.00**	**41.94**	**43.50**	**-1.56**
***192**	**H**	**231**	**2.1**	**30.00**	**9.61**	**0.00**	**2.48**	**0.00**	**42.09**	**43.50**	**-1.41**
298.96	H	198	2.08	20.40	14.10	0.00	2.92	0.00	37.42	46.00	-8.58
431.64	H	252	1.92	14.30	17.32	0.00	3.66	0.00	35.28	46.00	-10.73
***498.48**	**H**	**300**	**1.67**	**21.30**	**18.30**	**0.00**	**4.02**	**0.00**	**43.62**	**46.00**	**-2.38**
544.57	H	211	1.43	15.80	18.42	0.00	4.28	0.00	38.50	46.00	-7.50

Note: When transmit mode or receive mode were activated, there are no differences to emissions. For above 1 GHz measurement up to 5th harmonic of the highest operating frequency, emissions are noise floor during receive mode.

* - At this frequency, the measured electric-field strength exhibits a margin of compliance that is less than 3 dB below the specification limit. We recommend that every emission measured, have at least a 3 dB margin to allow for deviations in the emission characteristics that may occur during the production process.

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.209 Radiated Emissions Limits

802.11b – Low Channel (2412 MHz) Radiated Emissions Limits Test Results

Freq.	EUT Azimuth	Antenna Polarity	Height	Detector Peak or Average	Raw Amp. @ 1 m	Pre-Amp	Ant. Cor. Factor	Cable Loss	Dist. Cor. Factor	EUT Field Strength Final Amp.	Limit @ 3 m	Delta
(GHz)	(Degrees)	(H/V)	(m)	(Pk) / (Avg)	(dBuV)	(dB)	(dB)	(dB)	(dB)	(dBuV/m)	(dBuV/m)	(dBuV/m)
4.824	340	H	1.23	Pk	46.3	34.59	34.02	5.23	9.54	41.43	74	-32.57
4.824	340	H	1.23	Avg	42.8	34.59	34.02	5.23	9.54	37.93	54	-16.07
4.824	340	V	1.24	Pk	48.5	34.59	33.95	5.23	9.54	43.55	74	-30.45
4.824	340	V	1.24	Avg	44.8	34.59	33.95	5.23	9.54	39.85	54	-14.15
7.236	340	H	1.23	Pk	41.5	34.80	36.81	6.60	9.54	40.57	74	-33.43
7.236	340	H	1.23	Avg	28.7	34.80	36.81	6.60	9.54	27.77	54	-26.23
7.236	0	V	1.24	Pk	43.8	34.80	36.81	6.60	9.54	42.87	74	-31.13
7.236	0	V	1.24	Avg	33.2	34.80	36.81	6.60	9.54	32.27	54	-21.73
9.648	340	H	1.23	Pk	38.8	35.36	38.41	7.94	9.54	40.25	74	-33.75
9.648	340	H	1.23	Avg	28.7	35.36	38.41	7.94	9.54	30.15	54	-23.85
9.648	0	V	1.24	Pk	45.8	35.36	38.32	7.94	9.54	47.17	74	-26.83
9.648	0	V	1.24	Avg	41.5	35.36	38.32	7.94	9.54	42.87	54	-11.13

Note: Emissions after 4th harmonic of the operating frequency are noise floor.

Remarks: The EUT meets the specifications of **Section 15.209(a)** for Radiated Emissions of Intentional Radiators.

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.209 Radiated Emissions Limits

802.11b – Mid Channel (2437 MHz) Radiated Emissions Limits Test Results

Freq.	EUT Azimuth	Antenna Polarity	Height	Detector Peak or Average	Raw Amp. @ 1 m	Pre-Amp	Ant. Cor. Factor	Cable Loss	Dist. Cor. Factor	EUT Field Strength Final Amp.	Limit @ 3 m	Delta
(GHz)	(Degrees)	(H/V)	(m)	(Pk) / (Avg)	(dBuV)	(dB)	(dB)	(dB)	(dB)	(dBuV/m)	(dBuV/m)	(dBuV/m)
4.874	340	H	1.14	Pk	45.8	34.58	34.18	5.26	9.54	41.13	74	-32.87
4.874	340	H	1.14	Avg	42.3	34.58	34.18	5.26	9.54	37.63	54	-16.37
4.874	10	V	1.29	Pk	51	34.58	34.10	5.26	9.54	46.24	74	-27.76
4.874	10	V	1.29	Avg	48.6	34.58	34.10	5.26	9.54	43.84	54	-10.16
7.311	340	H	1.14	Pk	40.2	34.82	37.01	6.64	9.54	39.49	74	-34.51
7.311	340	H	1.14	Avg	29.5	34.82	37.01	6.64	9.54	28.79	54	-25.21
7.311	10	V	1.29	Pk	41.8	34.82	37.01	6.64	9.54	41.09	74	-32.91
7.311	10	V	1.29	Avg	31	34.82	37.01	6.64	9.54	30.29	54	-23.71
9.748	340	H	1.14	Pk	40.3	35.35	38.50	8.00	9.54	41.90	74	-32.10
9.748	340	H	1.14	Avg	29	35.35	38.50	8.00	9.54	30.60	54	-23.40
9.748	10	V	1.29	Pk	42.7	35.35	38.44	8.00	9.54	44.25	74	-29.75
9.748	10	V	1.29	Avg	33.3	35.35	38.44	8.00	9.54	34.85	54	-19.15

Note: Emissions after 4th harmonic of the operating frequency are noise floor.

Remarks: The EUT meets the specifications of **Section 15.209(a)** for Radiated Emissions of Intentional Radiators.

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.209 Radiated Emissions Limits

802.11b – High Channel (2462 MHz) Radiated Emissions Limits Test Results

Freq.	EUT Azimuth	Antenna Polarity	Height	Detector Peak or Average	Raw Amp. @ 1 m	Pre-Amp	Ant. Cor. Factor	Cable Loss	Dist. Cor. Factor	EUT Field Strength Final Amp.	Limit @ 3 m	Delta
(GHz)	(Degrees)	(H/V)	(m)	(Pk) / (Avg)	(dBuV)	(dB)	(dB)	(dB)	(dB)	(dBuV/m)	(dBuV/m)	(dBuV/m)
4.924	315	H	1.02	Pk	47.5	34.57	34.33	5.29	9.54	43.01	74	-30.99
4.924	315	H	1.02	Avg	43	34.57	34.33	5.29	9.54	38.51	54	-15.49
4.924	10	V	1.29	Pk	51.8	34.57	34.23	5.29	9.54	47.22	74	-26.78
4.924	10	V	1.29	Avg	48.8	34.57	34.23	5.29	9.54	44.22	54	-9.78
7.386	315	H	1.02	Pk	39.8	34.84	37.19	6.69	9.54	39.29	74	-34.71
7.386	315	H	1.02	Avg	26.2	34.84	37.19	6.69	9.54	25.69	54	-28.31
7.386	10	V	1.29	Pk	39.5	34.84	37.19	6.69	9.54	38.99	74	-35.01
7.386	10	V	1.29	Avg	26.2	34.84	37.19	6.69	9.54	25.69	54	-28.31
9.848	315	H	1.02	Pk	42.3	35.32	38.59	8.05	9.54	44.08	74	-29.92
9.848	315	H	1.02	Avg	31.2	35.32	38.59	8.05	9.54	32.98	54	-21.02
9.848	10	V	1.29	Pk	44.3	35.32	38.56	8.05	9.54	46.05	74	-27.95
9.848	10	V	1.29	Avg	37.5	35.32	38.56	8.05	9.54	39.25	54	-14.75

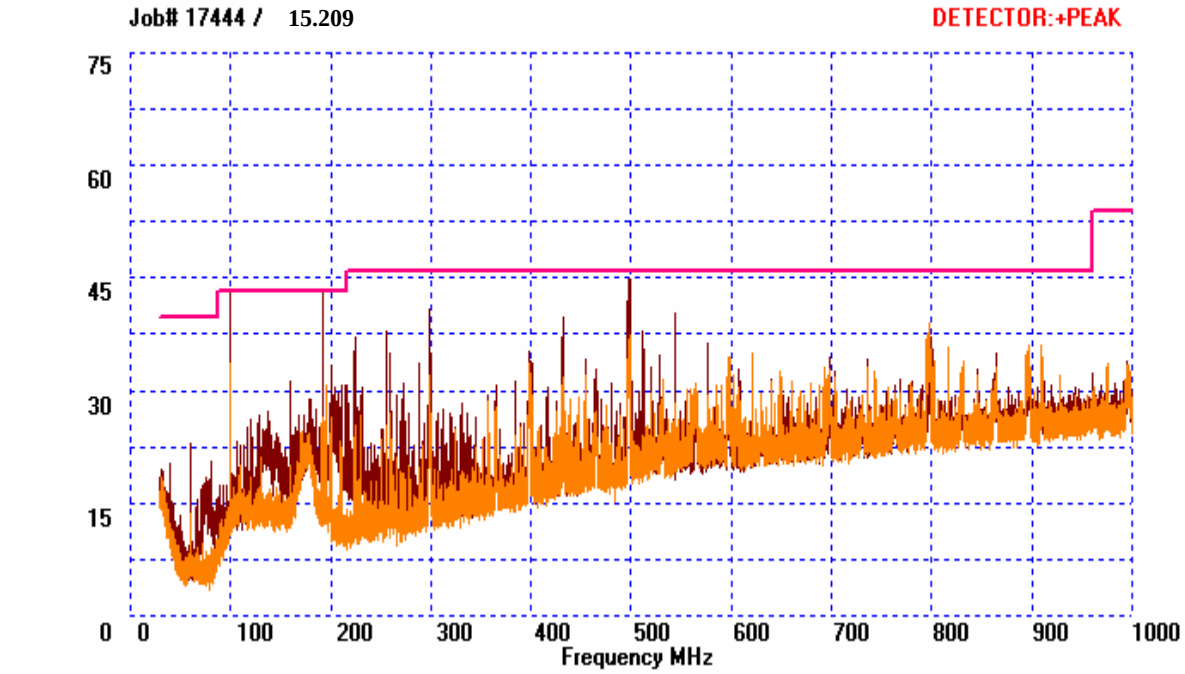
Note: Emissions after 4th harmonic of the operating frequency are noise floor.

Remarks: The EUT meets the specifications of **Section 15.209(a)** for Radiated Emissions of Intentional Radiators.

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.209 Radiated Emissions Limits

802.11g Radiated Emissions from 30 MHz – 1 GHz



= Vertical Polarization
= Horizontal Polarization

Quasi-Peak Results

Frequency (MHz)	Antenna Polarity (H/V)	EUT Azimuth (Degrees)	Antenna Height (m)	Uncorrected Amplitude (dBuv)	Antenna Correction Factor (dB/m) (+)	Pre Amp Gain (dB) (-)	Cable Loss (dB) (+)	Corrected Amplitude (dBuV/m)	Limit (dBuV/m)	Margin (dB)
99.72	**H**	**45**	**2.3**	**29.30**	**10.91**	**0.00**	**1.74**	**41.94**	**43.50**	**-1.56**
192	**H**	**231**	**2.1**	**30.00**	**9.61**	**0.00**	**2.48**	**42.09**	**43.50**	**-1.41**
298.96	H	198	2.08	20.40	14.10	0.00	2.92	37.42	46.00	-8.58
431.64	H	252	1.92	14.30	17.32	0.00	3.66	35.28	46.00	-10.73
498.48	**H**	**300**	**1.67**	**21.30**	**18.30**	**0.00**	**4.02**	**43.62**	**46.00**	**-2.38**
544.57	H	211	1.43	15.80	18.42	0.00	4.28	38.50	46.00	-7.50

Note: When transmit mode or receive mode were activated, there are no differences to emissions. For above 1 GHz measurement up to 5th harmonic of the highest operating frequency, emissions are noise floor during receive mode.

* - At this frequency, the measured electric-field strength exhibits a margin of compliance that is less than 3 dB below the specification limit. We recommend that every emission measured, have at least a 3 dB margin to allow for deviations in the emission characteristics that may occur during the production process.

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.209 Radiated Emissions Limits

802.11g – Low Channel (2412 MHz) Radiated Emissions Limits Test Results

Freq.	EUT Azimuth	Antenna Polarity	Height	Detector Peak or Average	Raw Amp. @ 1 m	Pre-Amp	Ant. Cor. Factor	Cable Loss	Dist. Cor. Factor	EUT Field Strength Final Amp.	Limit @ 3 m	Delta
(GHz)	(Degrees)	(H/V)	(m)	(Pk) / (Avg)	(dBuV)	(dB)	(dB)	(dB)	(dB)	(dBuV/m)	(dBuV/m)	(dBuV/m)
4.824	315	H	1.19	Pk	40.1	34.59	34.02	5.23	9.54	35.23	74	-38.77
4.824	315	H	1.19	Avg	30	34.59	34.02	5.23	9.54	25.13	54	-28.87
4.824	340	V	1.27	Pk	39.8	34.59	33.95	5.23	9.54	34.85	74	-39.15
4.824	340	V	1.27	Avg	31.2	34.59	33.95	5.23	9.54	26.25	54	-27.75

Note: Emissions after 2nd harmonic of the operating frequency are noise floor.

The EUT was tested at 3 m. The data has been corrected for comparison with the 10 m limit using the formula: 20log (3 m/10 m) as expressed in the 'Distance Correction' column.

Remarks: The EUT meets the specifications of **Section 15.209(a)** for Radiated Emissions of Intentional Radiators.

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.209 Radiated Emissions Limits

802.11g – Mid Channel (2437 MHz) Radiated Emissions Limits Test Results

Freq.	EUT Azimuth	Antenna Polarity	Height	Detector Peak or Average	Raw Amp. @ 1 m	Pre-Amp	Ant. Cor. Factor	Cable Loss	Dist. Cor. Factor	EUT Field Strength Final Amp.	Limit @ 3 m	Delta
(GHz)	(Degrees)	(H/V)	(m)	(Pk) / (Avg)	(dBuV)	(dB)	(dB)	(dB)	(dB)	(dBuV/m)	(dBuV/m)	(dBuV/m)
4.874	315	H	1.21	Pk	37.5	34.58	34.18	5.26	9.54	32.83	74	-41.17
4.874	315	H	1.21	Avg	27	34.58	34.18	5.26	9.54	22.33	54	-31.67
4.874	335	V	1.27	Pk	39.8	34.58	34.10	5.26	9.54	35.04	74	-38.96
4.874	335	V	1.27	Avg	32.3	34.58	34.10	5.26	9.54	27.54	54	-26.46

Note: Emissions after 2nd harmonic of the operating frequency are noise floor.

The EUT was tested at 3 m. The data has been corrected for comparison with the 10 m limit using the formula: 20log (3 m/10 m) as expressed in the 'Distance Correction' column.

Remarks: The EUT meets the specifications of **Section 15.209(a)** for Radiated Emissions of Intentional Radiators.

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.209 Radiated Emissions Limits

802.11g – High Channel (2462 MHz) Radiated Emissions Limits Test Results

Freq.	EUT Azimuth	Antenna Polarity	Height	Detector Peak or Average	Raw Amp. @ 1 m	Pre-Amp	Ant. Cor. Factor	Cable Loss	Dist. Cor. Factor	EUT Field Strength Final Amp.	Limit @ 3 m	Delta
(GHz)	(Degrees)	(H/V)	(m)	(Pk) / (Avg)	(dBuV)	(dB)	(dB)	(dB)	(dB)	(dBuV/m)	(dBuV/m)	(dBuV/m)
4.924	315	H	1.21	Pk	37	34.57	34.33	5.29	9.54	32.51	74	-41.49
4.924	315	H	1.21	Avg	27	34.57	34.33	5.29	9.54	22.51	54	-31.49
4.924	340	V	1.27	Pk	39.7	34.57	34.23	5.29	9.54	35.12	74	-38.88
4.924	340	V	1.27	Avg	32.5	34.57	34.23	5.29	9.54	27.92	54	-26.08

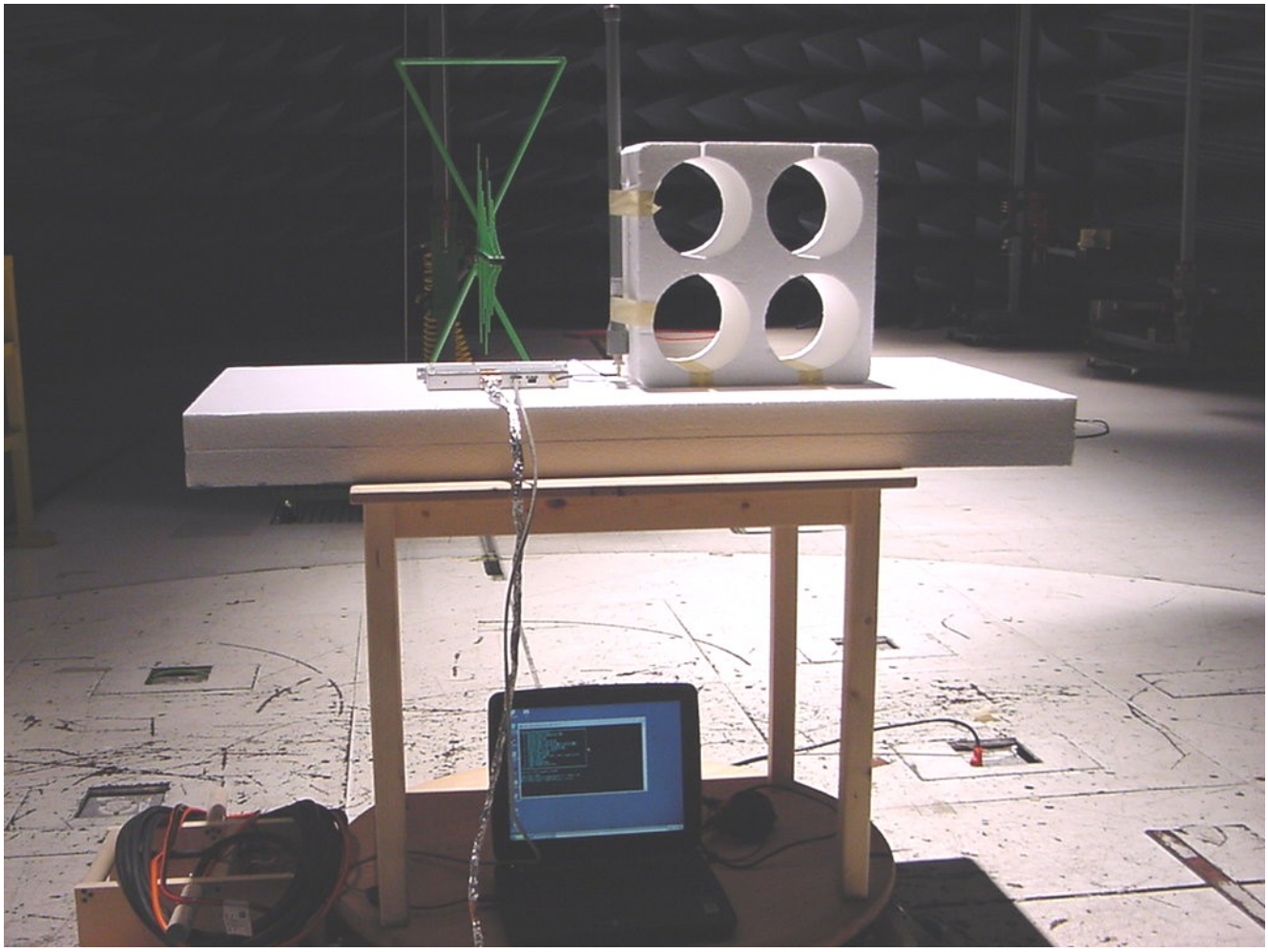
Note: Emissions after 2nd harmonic of the operating frequency are noise floor.

The EUT was tested at 3 m. The data has been corrected for comparison with the 10 m limit using the formula: 20log (3 m/10 m) as expressed in the 'Distance Correction' column.

Remarks: The EUT meets the specifications of **Section 15.209(a)** for Radiated Emissions of Intentional Radiators.

Electromagnetic Compatibility Criteria for Intentional Radiators

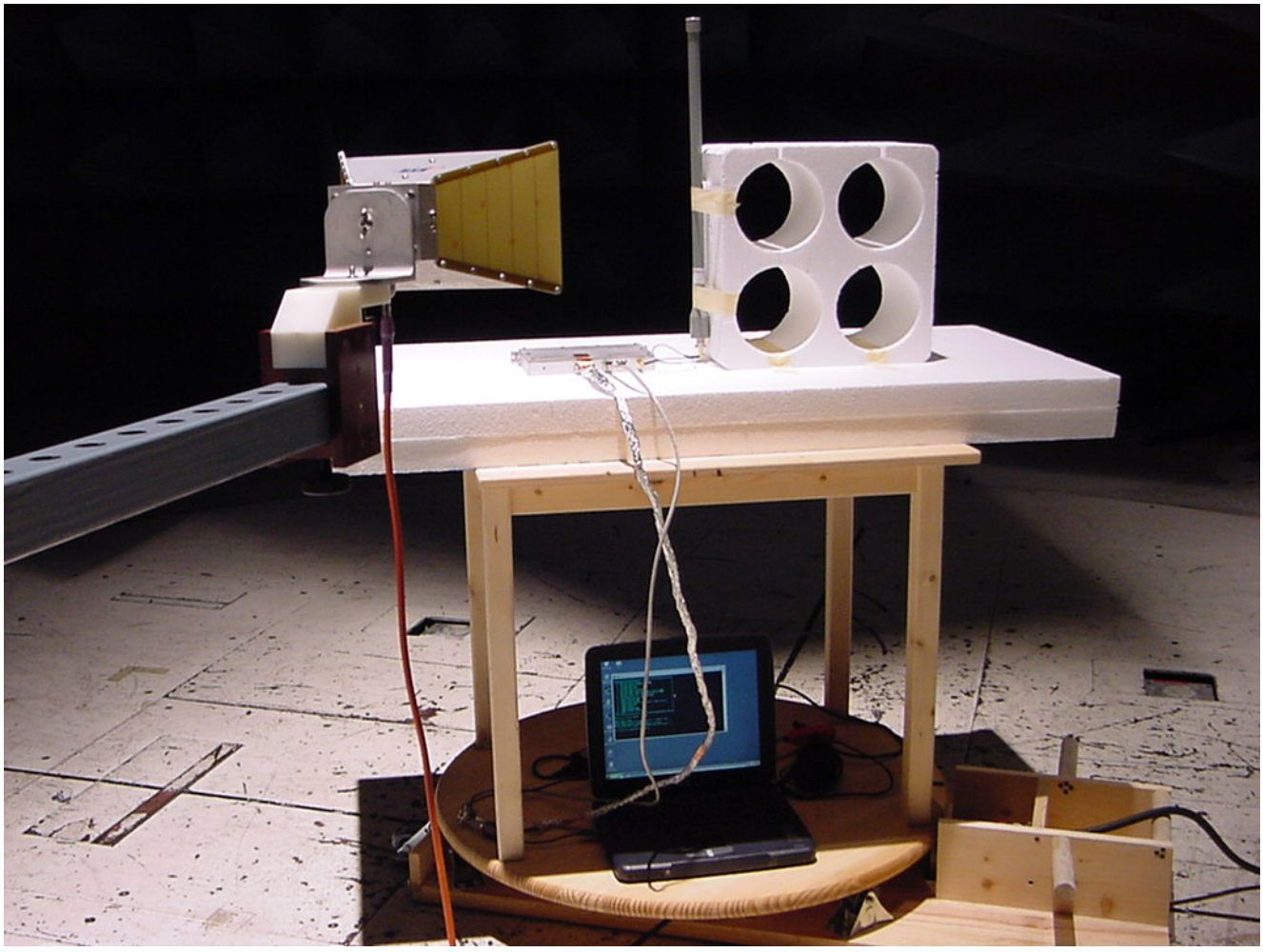
§ 15.209 Radiated Emissions Limits



Photograph 2. Radiated Emission Limits (Below 1 GHz), Test Setup

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.209 Radiated Emissions Limits



Photograph 3. Radiated Emission Limits (Above 1 GHz), Test Setup

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(a) 6 dB and 99% Bandwidth

Test Requirements: **§ 15.247(a):** Operation under the provisions of this section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:

For systems using digital modulation techniques, the EUT may operate in the 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz bands. The minimum 6dB bandwidth shall be at least 500 kHz.

Test Procedure: The transmitter was set to the lowest with the highest output power and connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using a RBW approximately equal to 1% of the total emission bandwidth, VBW > RBW. The 6 dB and 99% Bandwidth was measured and recorded. The measurements was repeated with middle and highest channel.

Test Results Equipment complies with § 15.247 (a). The 6 dB and 99% Bandwidth was determined from the plots on the following pages.

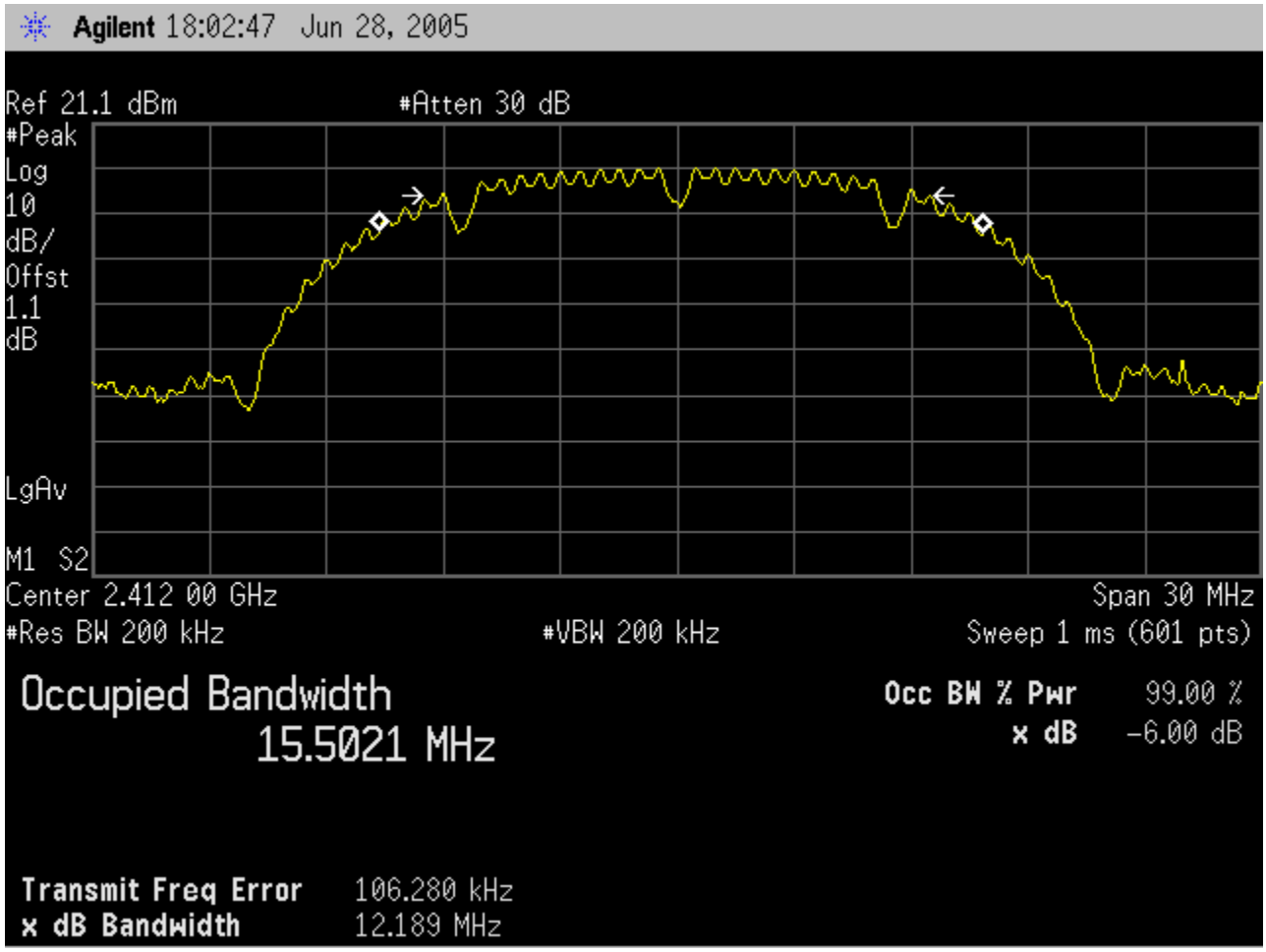
802.11b			
Carrier Channel	**Frequency (MHz)**	**Measured 6 dB Bandwidth (MHz)**	**Measured 99% Bandwidth (MHz)**
Low	2412	12.189	15.5021
Mid	2437	12.193	15.4939
High	2462	12.612	15.5374
802.11g			
Carrier Channel	**Frequency (MHz)**	**Measured 6 dB Bandwidth (MHz)**	**Measured 99% Bandwidth (MHz)**
Low	2412	16.552	16.7255
Mid	2437	16.522	16.7693
High	2462	16.520	16.8397

Test Engineer: Kerwinn Corpuz

Test Date: 06/28/2005

Electromagnetic Compatibility Criteria for Intentional Radiators

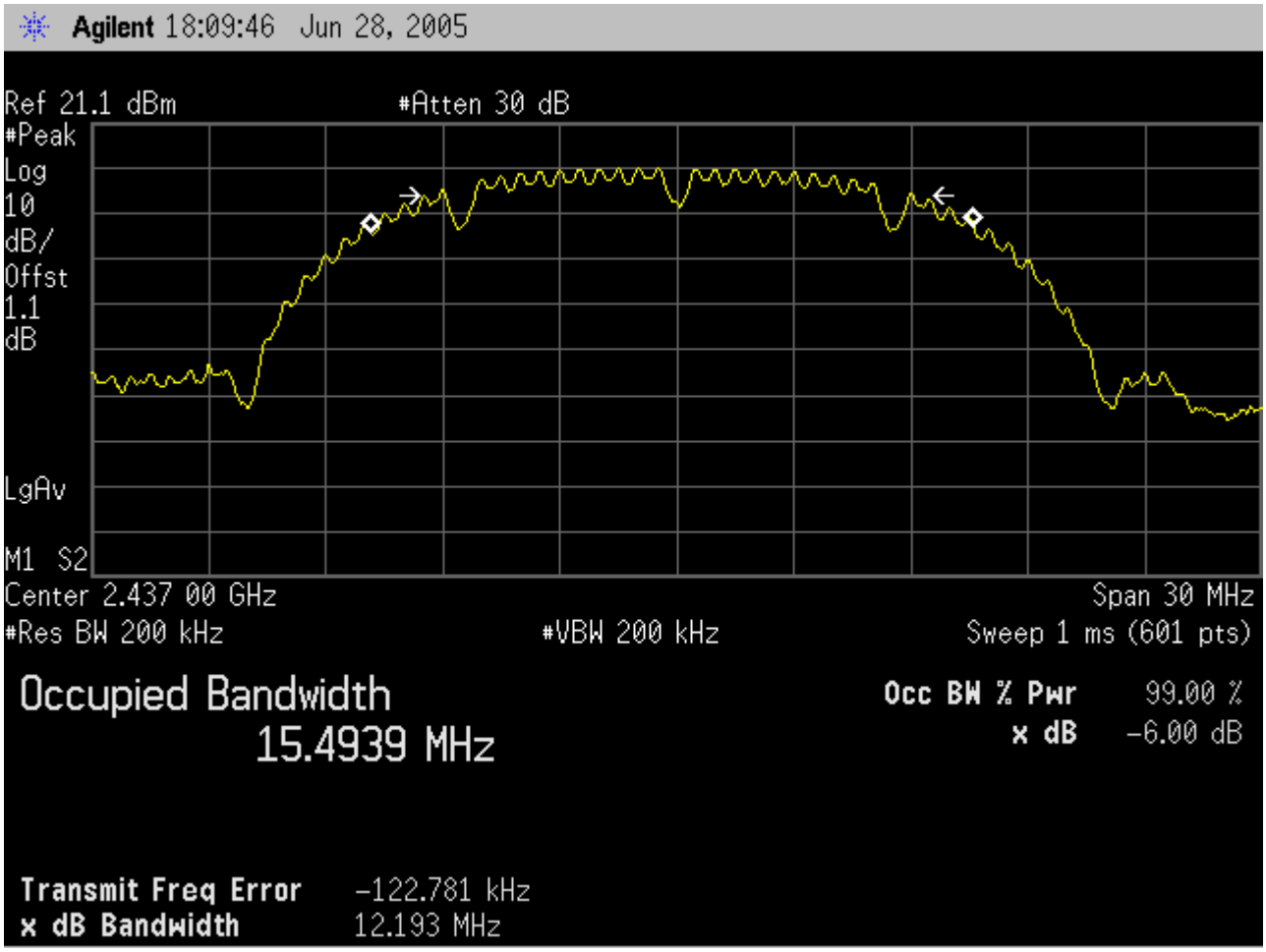
§ 15.247(a) 6 dB and 99% Bandwidth (802.11b)



802.11b – 6 dB and 99% Bandwidth @ 2412 MHz (Low channel)

Electromagnetic Compatibility Criteria for Intentional Radiators

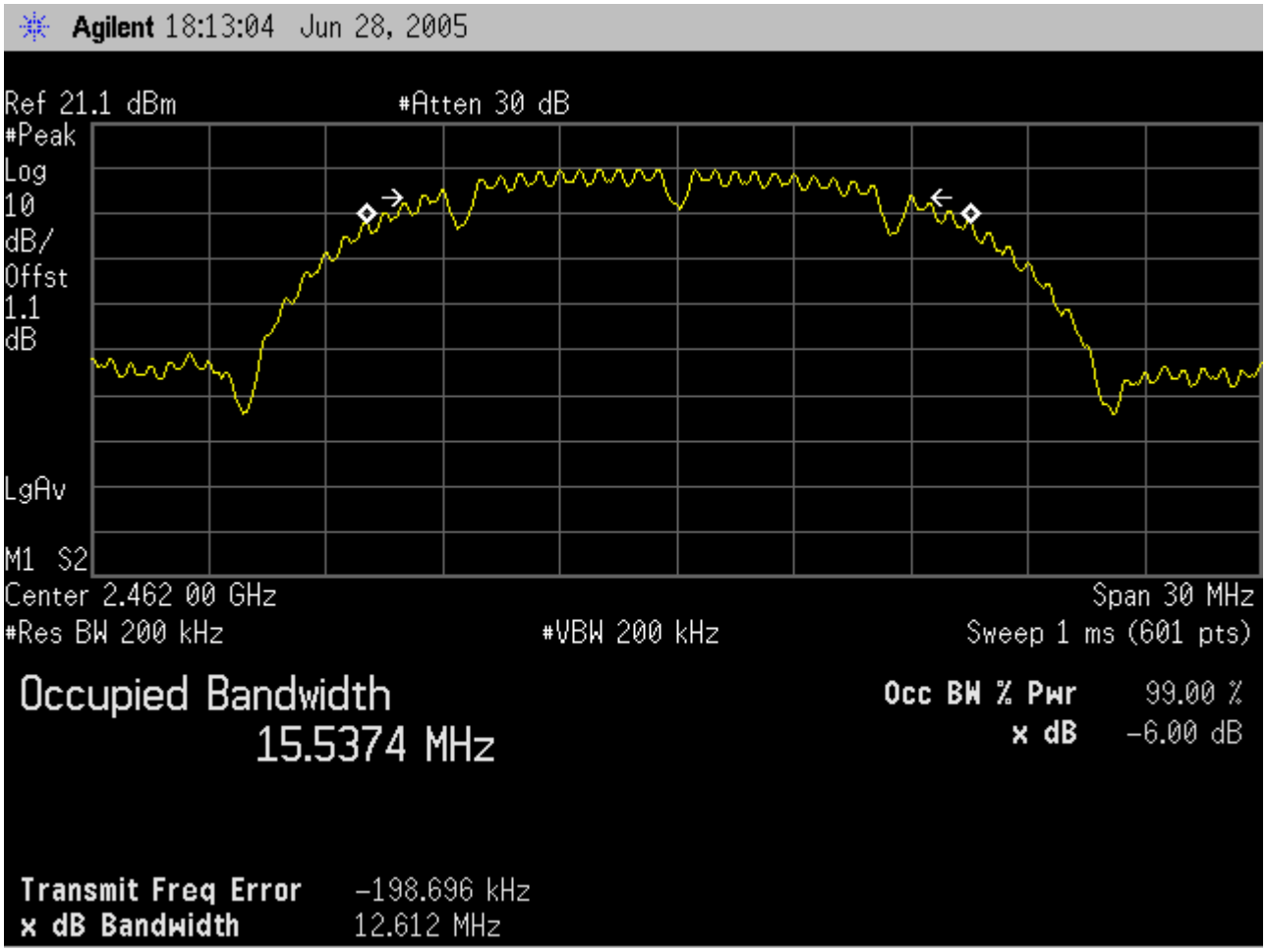
§ 15.247(a) 6 dB and 99% Bandwidth (802.11b)



802.11b – 6 dB and 99% Bandwidth @ 2437 MHz (Mid channel)

Electromagnetic Compatibility Criteria for Intentional Radiators

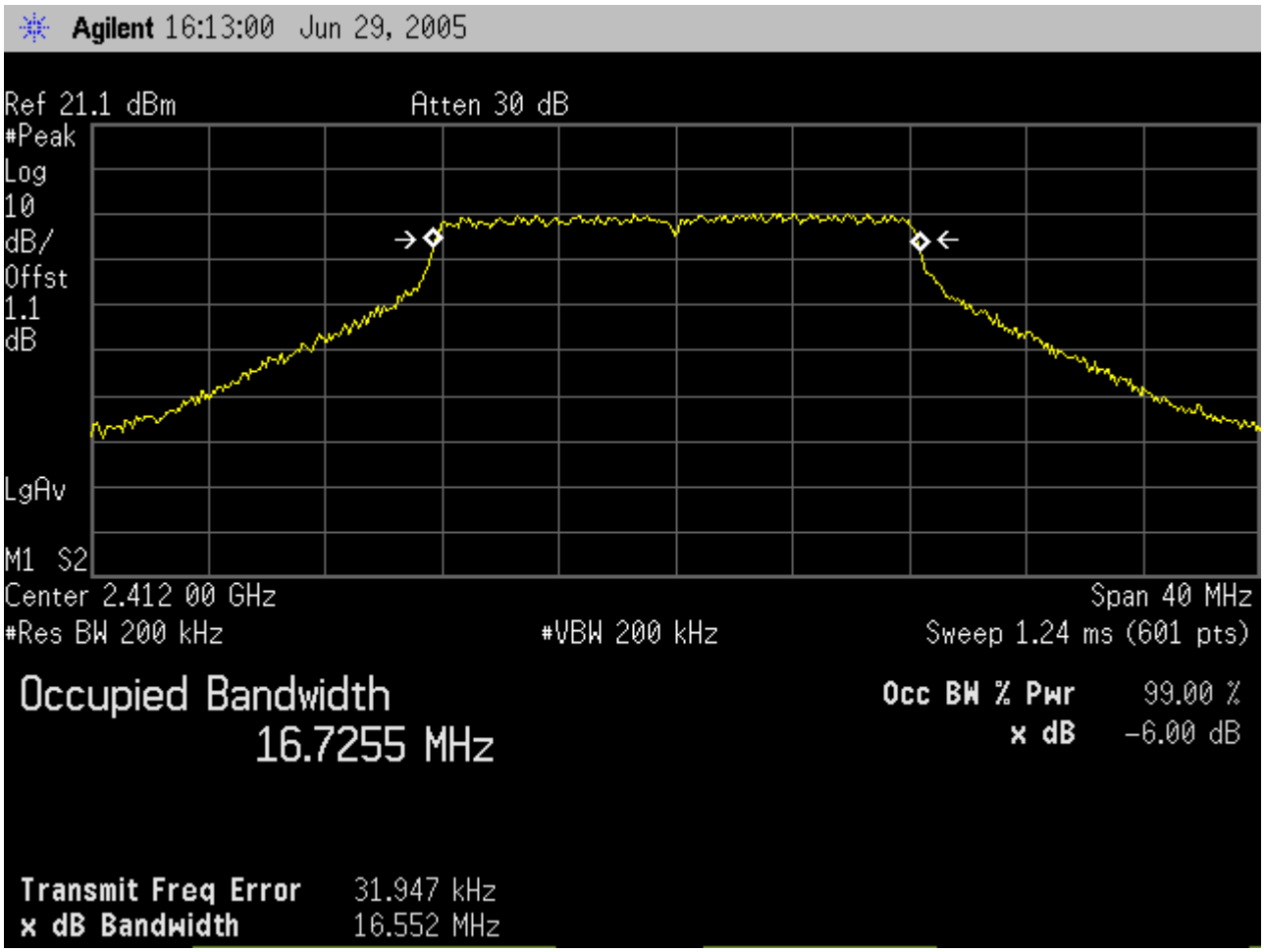
§ 15.247(a) 6 dB and 99% Bandwidth (802.11b)



802.11b – 6 dB and 99% Bandwidth @ 2462 MHz (High channel)

Electromagnetic Compatibility Criteria for Intentional Radiators

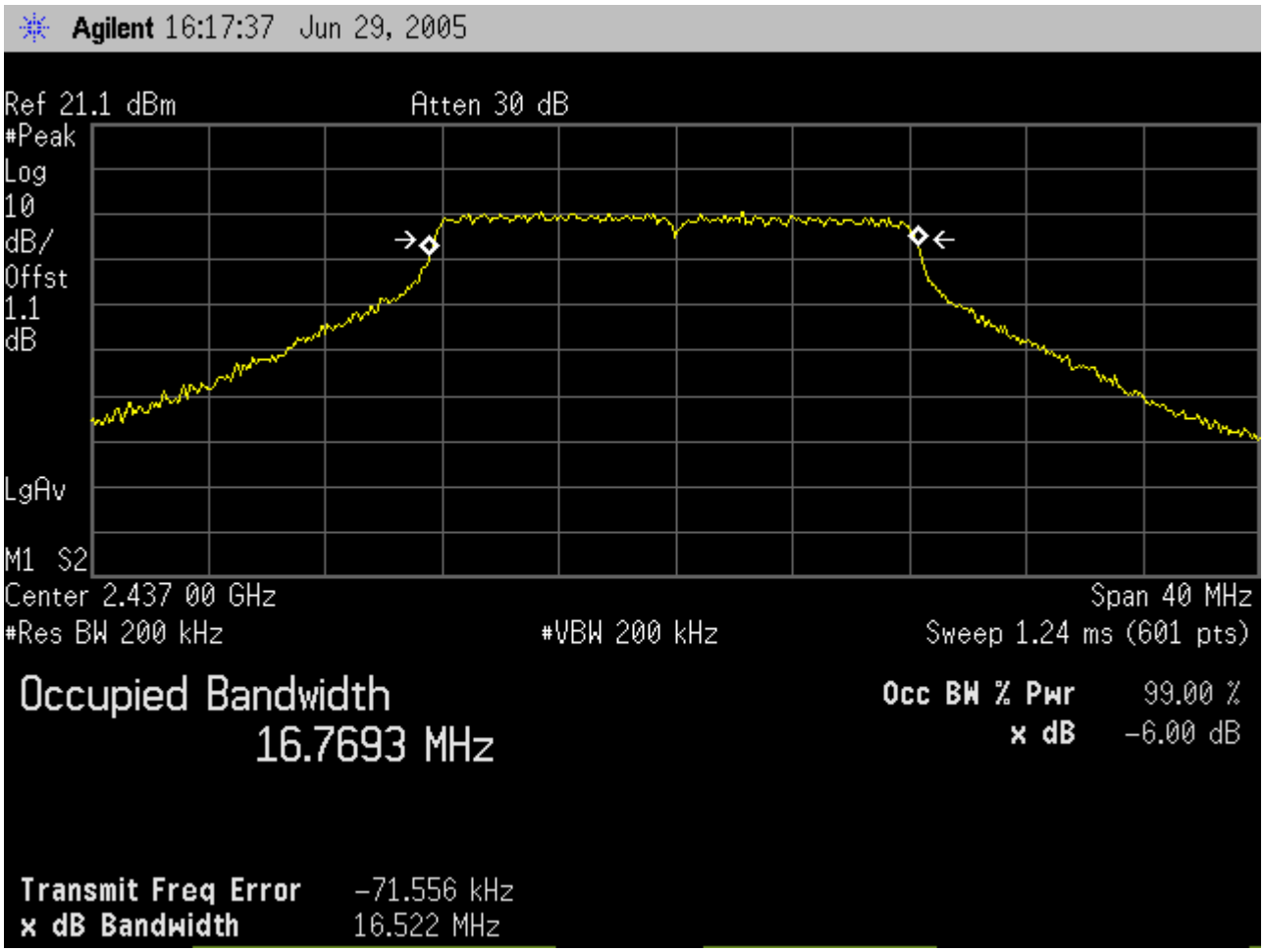
§ 15.247(a) 6 dB and 99% Bandwidth (802.11g)



802.11g – 6 dB and 99% Bandwidth @ 2412 MHz (Low channel)

Electromagnetic Compatibility Criteria for Intentional Radiators

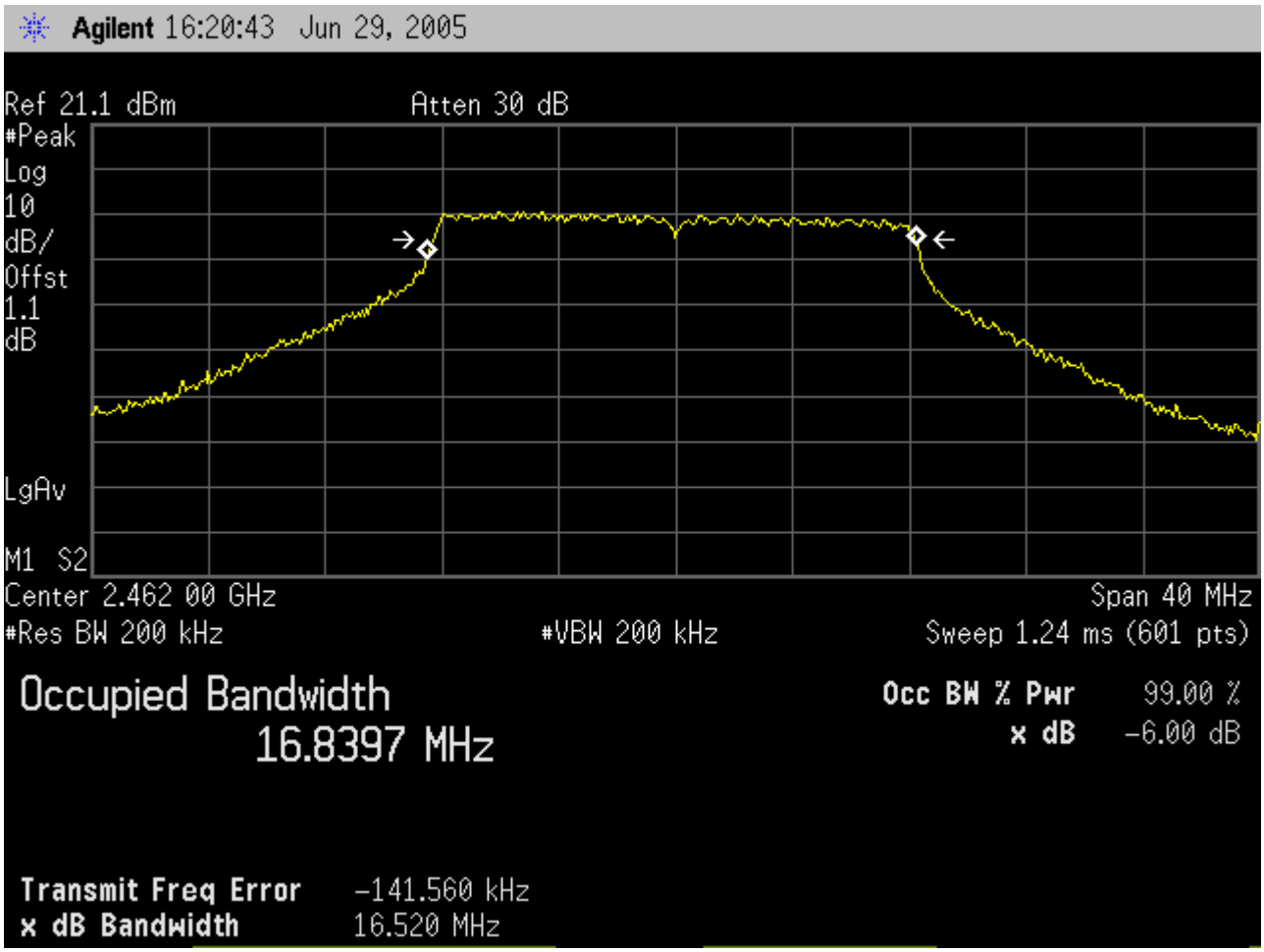
§ 15.247(a) 6 dB and 99% Bandwidth (802.11g)



802.11g – 6 dB and 99% Bandwidth @ 2437 MHz (Mid channel)

Electromagnetic Compatibility Criteria for Intentional Radiators

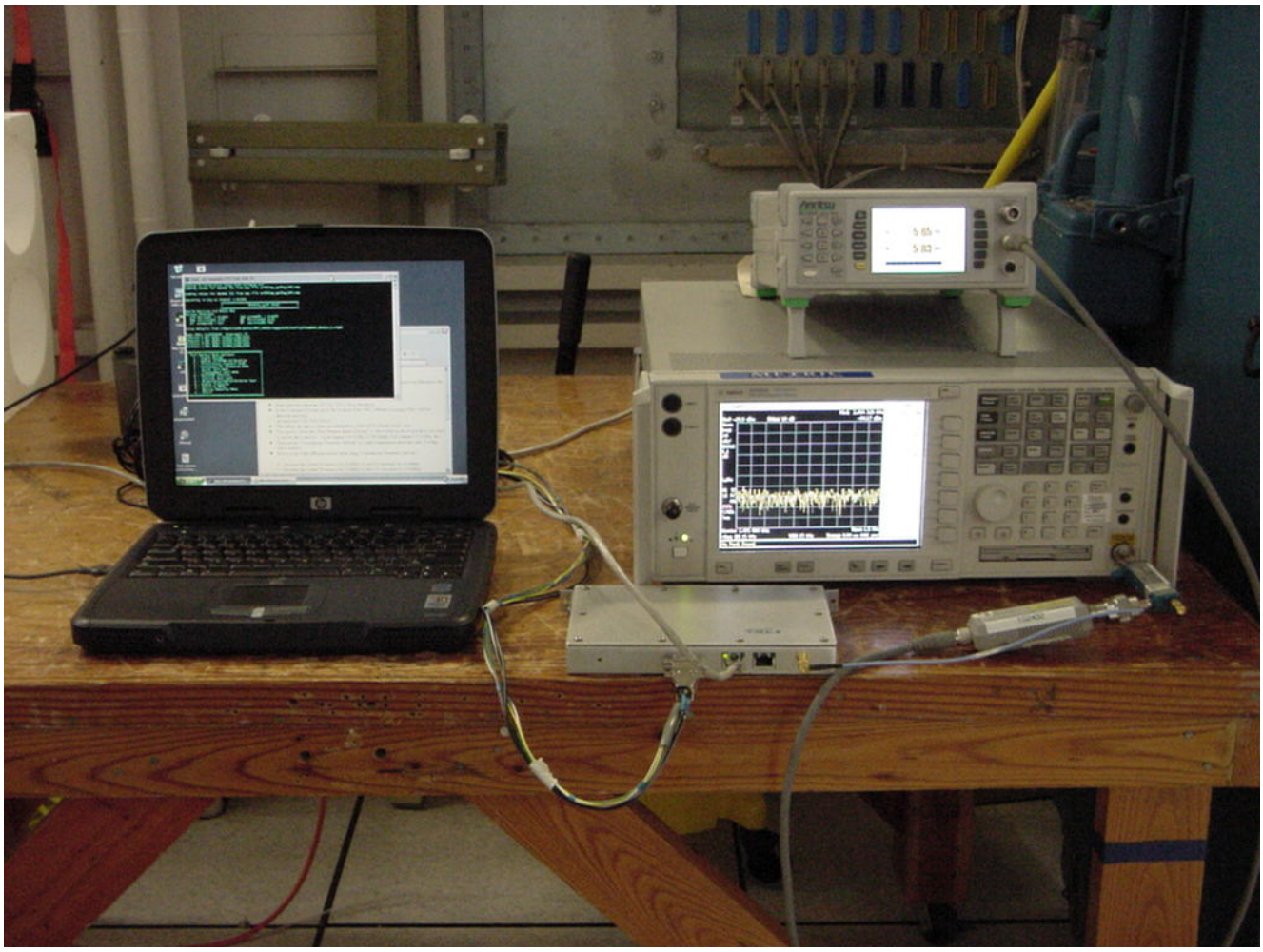
§ 15.247(a) 6 dB and 99% Bandwidth (802.11g)



802.11g – 6 dB and 99% Bandwidth @ 2462 MHz (High channel)

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(a) 6 dB and 99% Bandwidth



Photograph 4. Occupied Bandwidth Test Setup

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(b) Peak Power Output and RF Exposure

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 9. Output Power Requirements from §15.247

Except for:

Systems operating in the 2400 – 2483.5 MHz band, and

5725 – 5850 MHz band that are used exclusively for fixed, point-to-point operations,

§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 9, 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.

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(b) Peak Power Output and RF Exposure

Test Procedure: The transmitter was set to the lowest channel with the highest output power and connected through a directional coupler, a Spectrum Analyzer to monitor the frequency channel, and a Peak Power Meter to measure the maximum power output. Repeated the measurement with middle and highest channel.

Test Results: Equipment complies with the Peak Power Output limits of **§ 15.247(b)**.

802.11b		
Carrier Channel	**Frequency (MHz)**	**Measured Peak Output Power dBm (watt)**
Low	2412	23.32 (0.215)
Mid	2437	23.12 (0.205)
High	2462	23.24 (0.211)
802.11g		
Carrier Channel	**Frequency (MHz)**	**Measured Peak Output Power dBm (watt)**
Low	2412	23.60 (0.229)
Mid	2437	23.44 (0.221)
High	2462	23.51 (0.224)

Test Engineer: Kerwinn Corpuz

Test Date: 06/28/2005

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 @ 2412 – 2462 MHz; highest conducted power = 23.6 dBm (peak) therefore, **Limit for Uncontrolled exposure: 1 mW/cm^2 or 10 W/m^2**

EUT maximum antenna gain = 8.5 dBi.

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

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

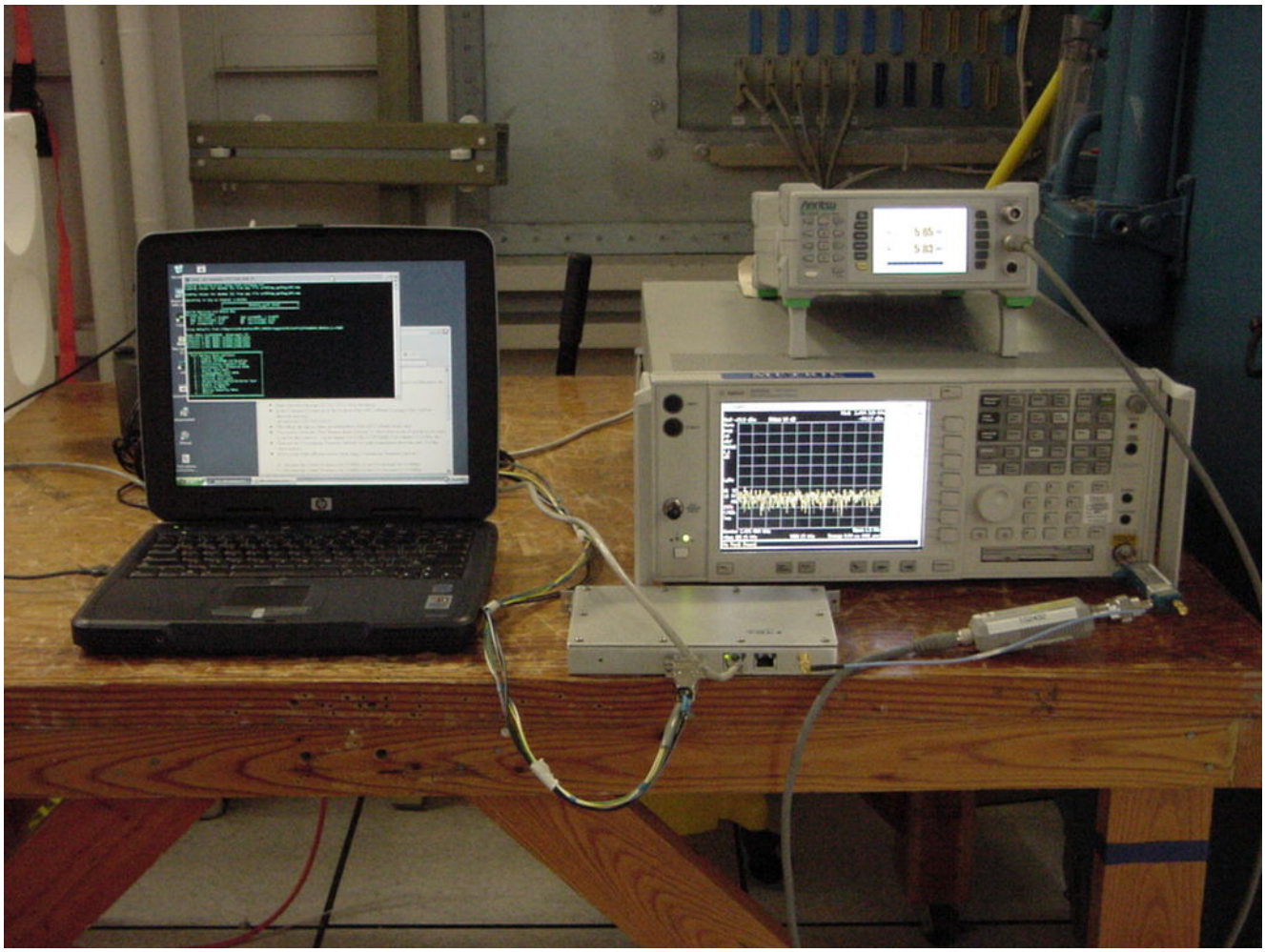
where, S = Power Density
P = Power Input to antenna (0.229 Watts)
G = Antenna Gain (7.079 in numeric)
R = distance to the center of radiation of the antenna (20 cm or 0.2 m)

$S = 0.229W * 7.079dB / 4 * 3.14 * (0.2m)^2 = 1.6212W / 0.5027m^2 = 3.225\ W/m^2$

Test Results: EUT complies with 20cm distance exposure.

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(b) Peak Power Output and RF Exposure



Photograph 5. Peaks Power Output Test Setup

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(c) Spurious Emissions Requirements – Radiated and RF Conducted

Test Requirements: **§15.247(c)**; **§ 15.209 (a); §15.205:** Emissions outside the frequency band.

§15.247(c): 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

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(c) Spurious Emissions Requirements – Radiated and RF Conducted

Test Procedure: The transmitter was set to the lowest channel with the highest output power and placed on a 0.8 m high wooden table inside in a semi-anechoic chamber. Various antennas were located between 3 m and 0.5 m from an adjustable antenna mast near the EUT. Measurements were performed with the EUT rotated 360 degrees and varying the adjustable antenna mast with 1 m to 4 m height to determine worst case orientation for maximum emissions. Repeated the measurement with middle and highest channel.

For frequencies from 30 MHz to 1 GHz, measurements were made using a quasi-peak detector with a 120 kHz bandwidth. For frequencies above 1 GHz, peak measurements were made with a resolution bandwidth of 1 MHz and a video bandwidth of 1MHz and average measurements were made with RBW = 1MHz and VBW = 10 Hz.

For intentional radiators with a digital device portion which operates below 10 GHz, the spectrum was investigated as per §15.33(a)(1) and §15.33(a)(4); i.e., the lowest RF signal generated or used in the device up to the 10^{th} harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

In accordance with §15.35(b) the limit on the radio frequency emissions as measured using instrumentation with a peak detector function shall be 20dB above the maximum permitted average limit for the frequency being investigated unless a different peak emission limit is otherwise specified in the rules.

For RF Conducted Emissions, the transmitter was set to the lowest channel and the output was connected to the spectrum analyzer. Set the Display Line 20 dB below the operating frequency. RBW = 100 kHz, VBW $\geq$ RBW. Scan through 10^{th} harmonic of the highest fundamental frequency. Repeated the measurement with middle and highest channel.

For Radiated Emissions Bandedge measurement, set the Spectrum Analyzer REL OFFSET to 22.9 dB to compensate the distance correction factor + antenna factor + cable loss. Set the transmitter to the lowest channel with maximum output power and record the reading at 2390 MHz. Repeat step by setting the transmitter to the highest channel and record the reading at 2483.5 MHz.

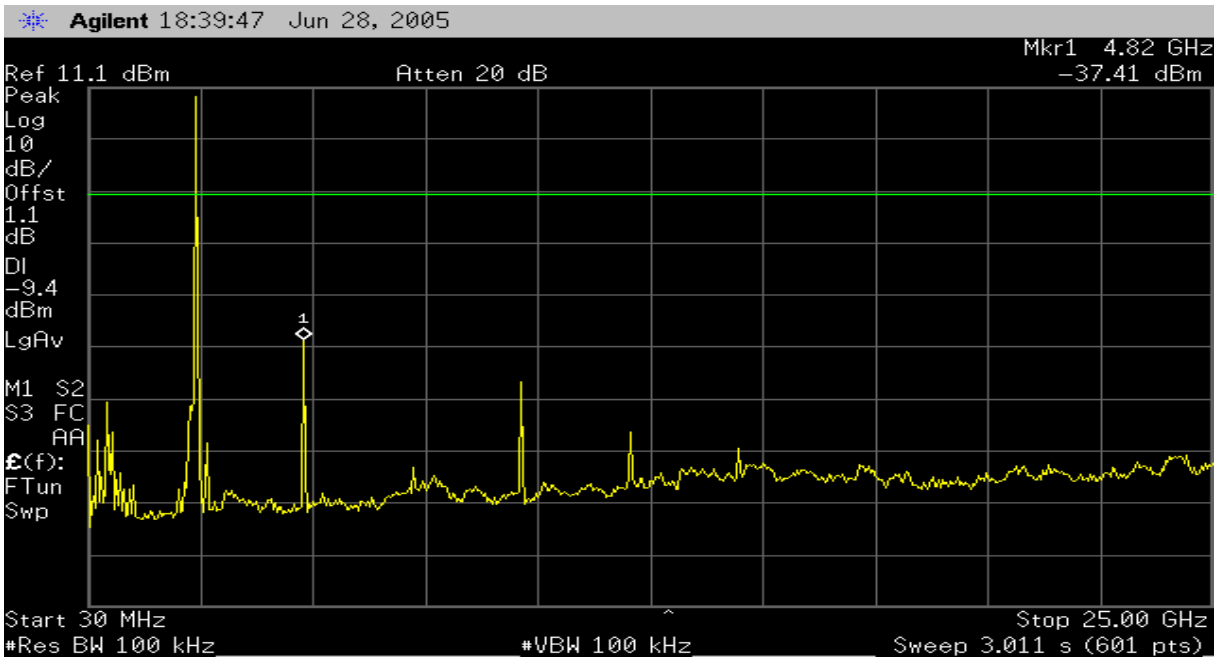
Test Results: Equipment complies with the Spurious Emissions Requirements – Radiated and RF Conducted limits of **§ 15.247 (c)**. For Radiated Emissions result, refer to section "§15.209: Radiated Emission Limits". See following pages for detailed test results with RF Conducted Spurious Emissions and §15.205.

Test Engineer: Kerwinn Corpuz

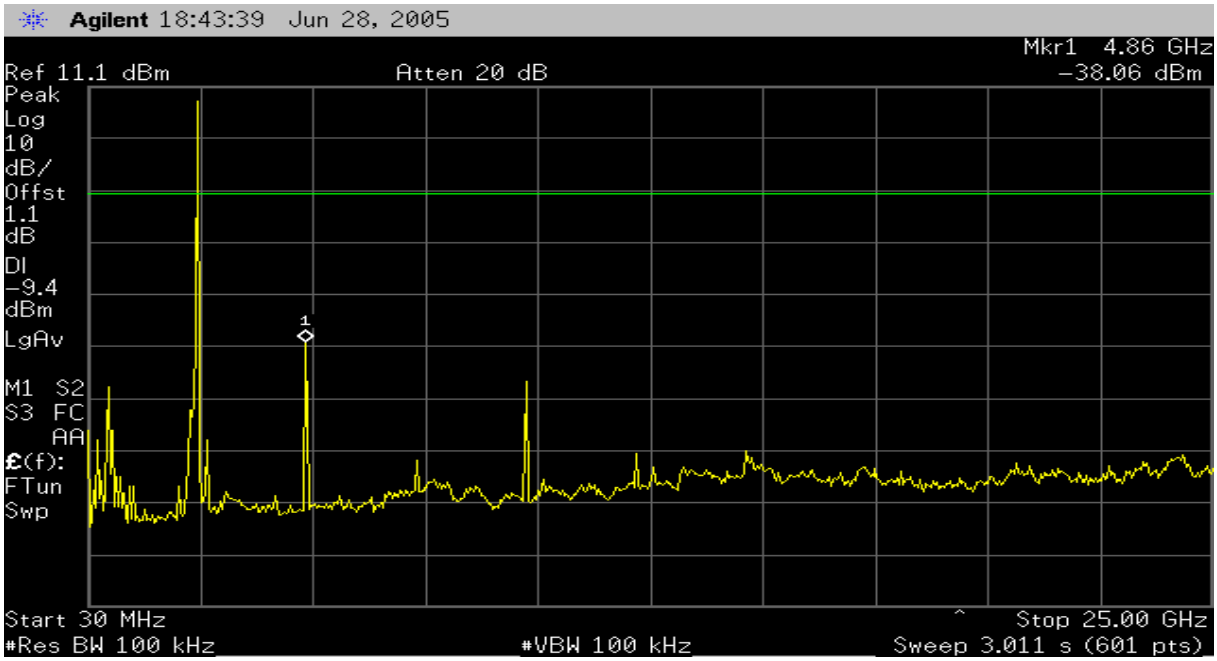
Test Date: 06/29/2005

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(c) Spurious Emissions Requirements – RF Conducted (802.11b)



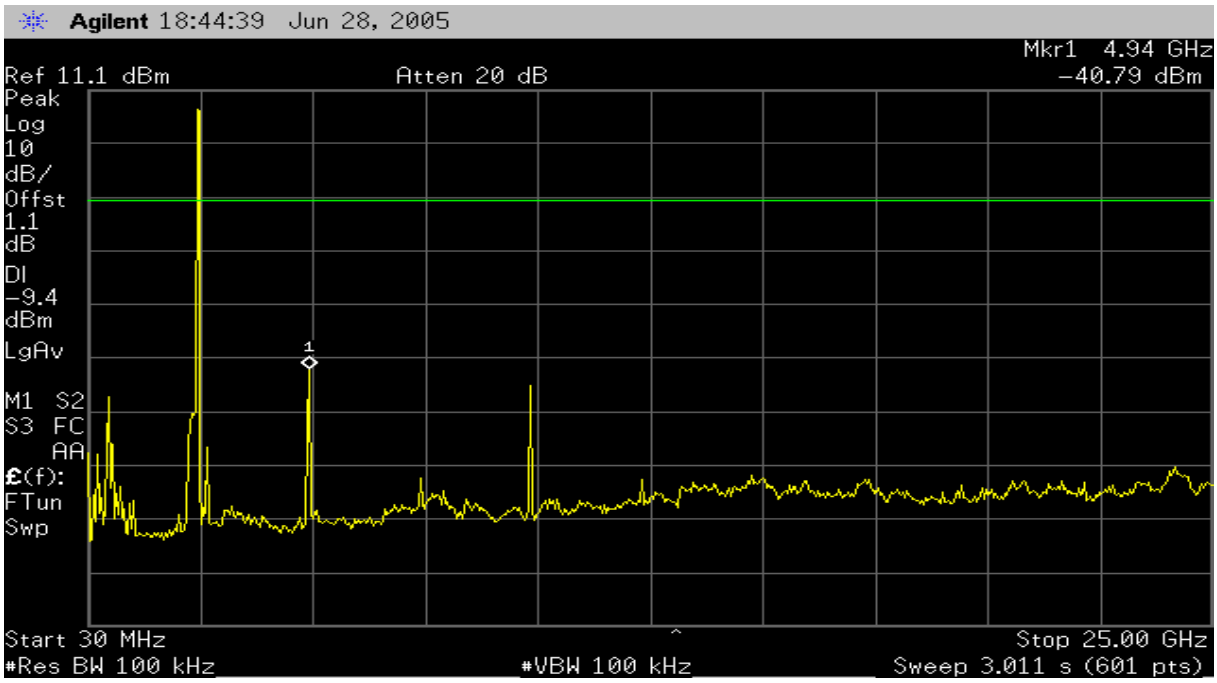
802.11b – Conducted Spurious Emission for 2412 MHz (Low channel)
Note: Emission above the limit is the fundamental.



802.11b – Conducted Spurious Emission for 2437 MHz (Mid channel)
Note: Emission above the limit is the fundamental.

Electromagnetic Compatibility Criteria for Intentional Radiators

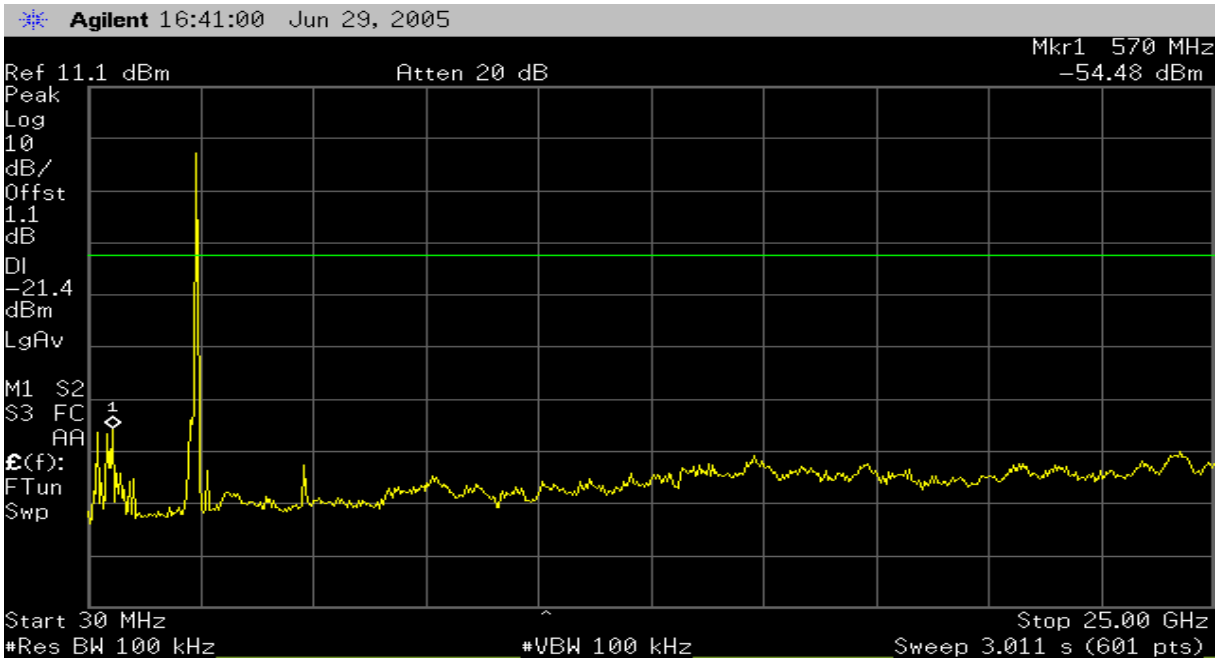
§ 15.247(c) Spurious Emissions Requirements – RF Conducted (802.11b)



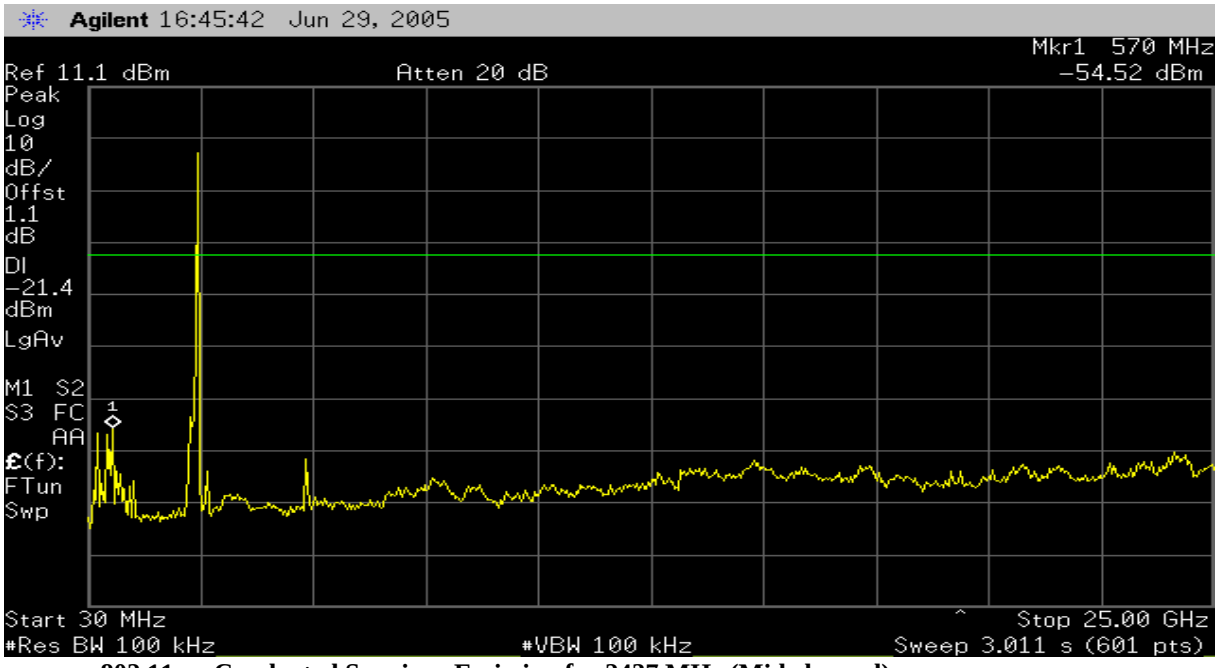
802.11b – Conducted Spurious Emission for 2462 MHz (High channel)
Note: Emission above the limit is the fundamental.

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(c) Spurious Emissions Requirements – RF Conducted (802.11g)



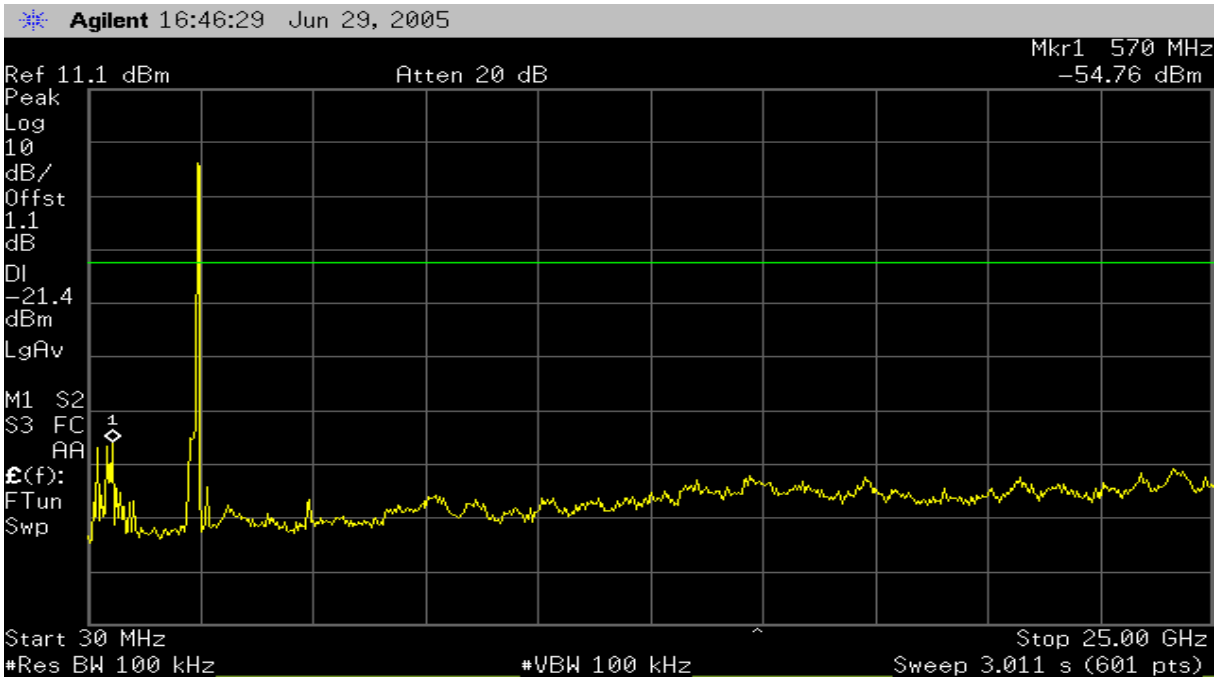
802.11g – Conducted Spurious Emission for 2412 MHz (Low channel)
Note: Emission above the limit is the fundamental.



802.11g – Conducted Spurious Emission for 2437 MHz (Mid channel)
Note: Emission above the limit is the fundamental.

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(c) Spurious Emissions Requirements – RF Conducted (802.11g)

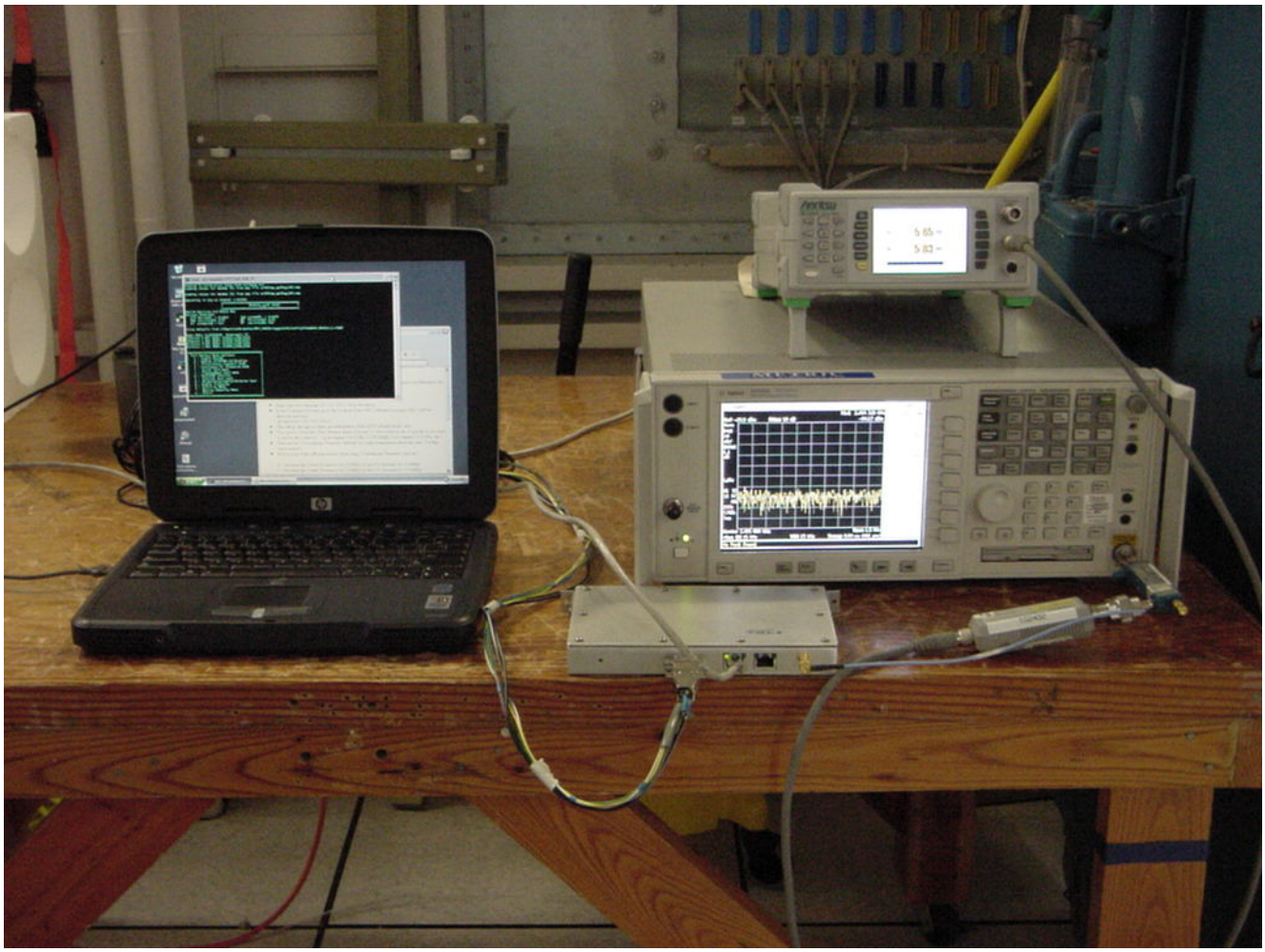


802.11g – Conducted Spurious Emission for 2462 MHz (High channel)

Note: Emission above the limit is the fundamental.

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(c) Spurious Emissions Requirements – RF Conducted



Photograph 6. Conducted Spurious Emissions Test Setup

Electromagnetic Compatibility Criteria for Intentional Radiators

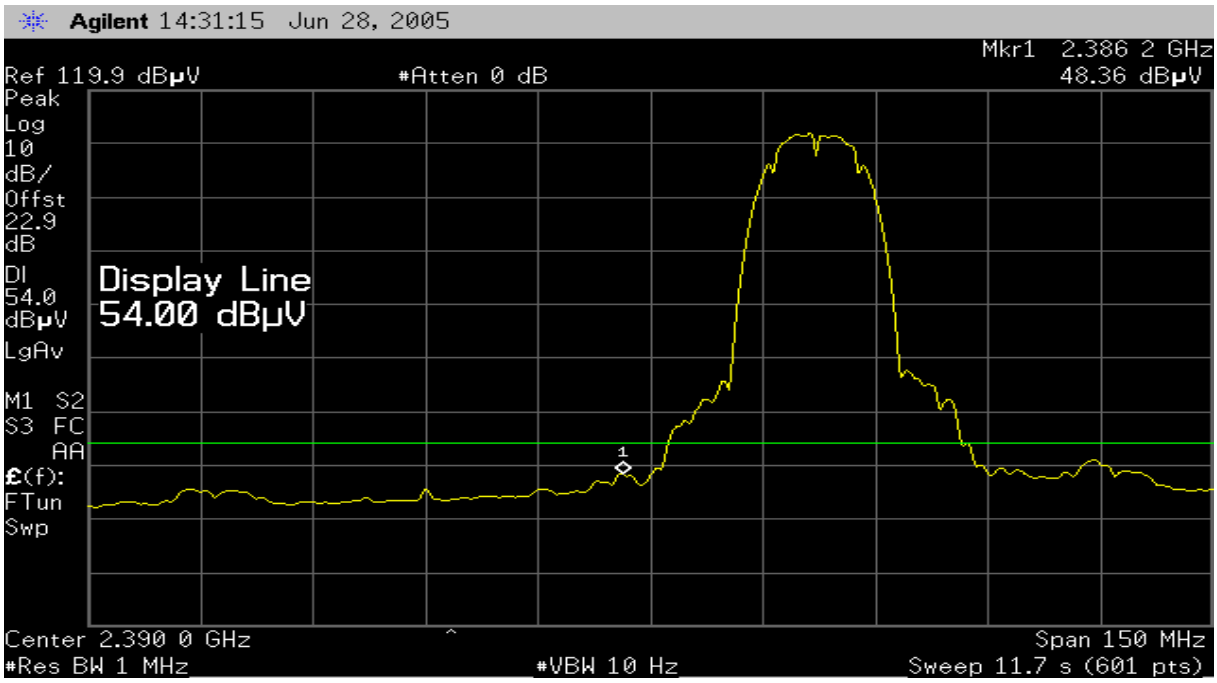
§ 15.205 Spurious Emissions Requirements – Restricted Bandedge

802.11b						
EUT Channel / Frequency	**Bandedge Frequency**	**Detector**	**Distance Measured**	**Corrected Amplitude**	**Limit @ 3 m**	**Margin**
(MHz)	**(MHz)**	**(Peak or Average)**	**(m; meter)**	**(dBuV/m)**	**(dBuv/m)**	**(dB)**
Low / 2412	2386.2	Average	1	48.36	54	-5.64
Low / 2412	2390	Peak	1	59.54	74	-14.46
High / 2462	2483.5	Average	1	49.33	54	-4.67
High / 2462	2483.8	Peak	1	59.86	74	-14.14
802.11g						
EUT Channel / Frequency	**Bandedge Frequency**	**Detector**	**Distance Measured**	**Corrected Amplitude**	**Limit @ 3 m**	**Margin**
(MHz)	**(MHz)**	**(Peak or Average)**	**(m; meter)**	**(dBuV/m)**	**(dBuv/m)**	**(dB)**
Low / 2412	2390	Average	1	47.85	54	-6.15
Low / 2412	2390	Peak	1	62.48	74	-11.52
High / 2462	2483.5	Average	1	47.05	54	-6.95
High / 2462	2483.5	Peak	1	62.78	74	-11.22

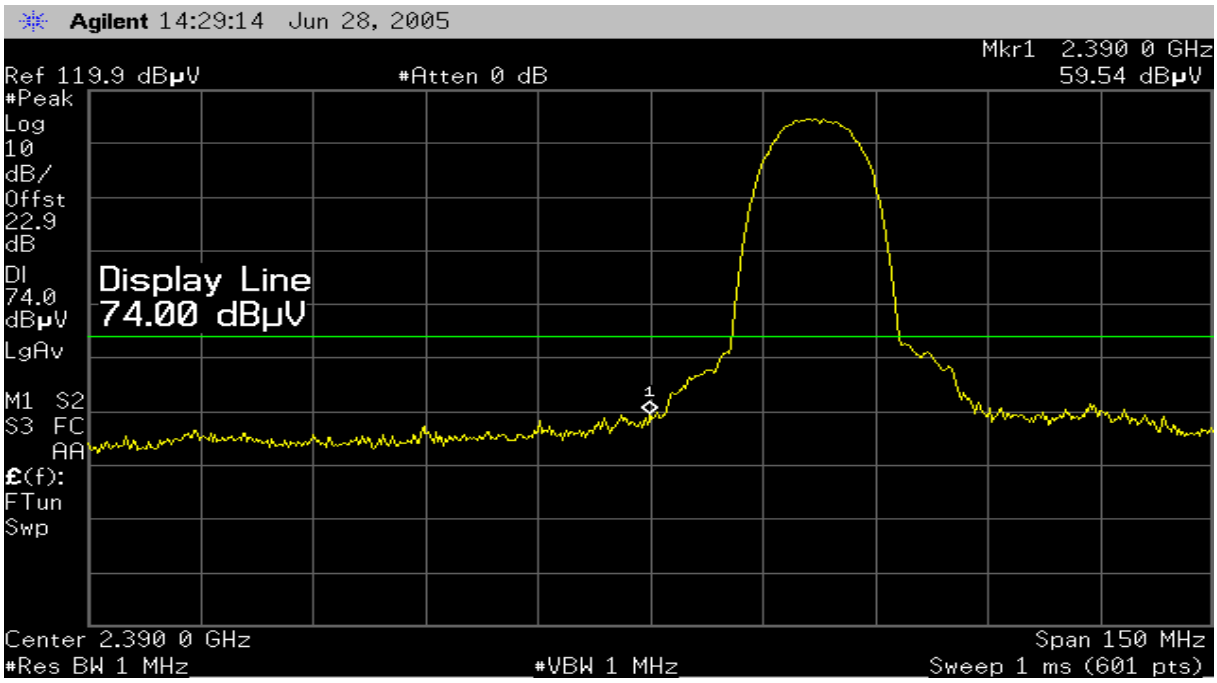
Note: EUT's worst case Emissions at vertical polarization.

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.205 Spurious Emissions Requirements – Restricted Bandedge (802.11b)



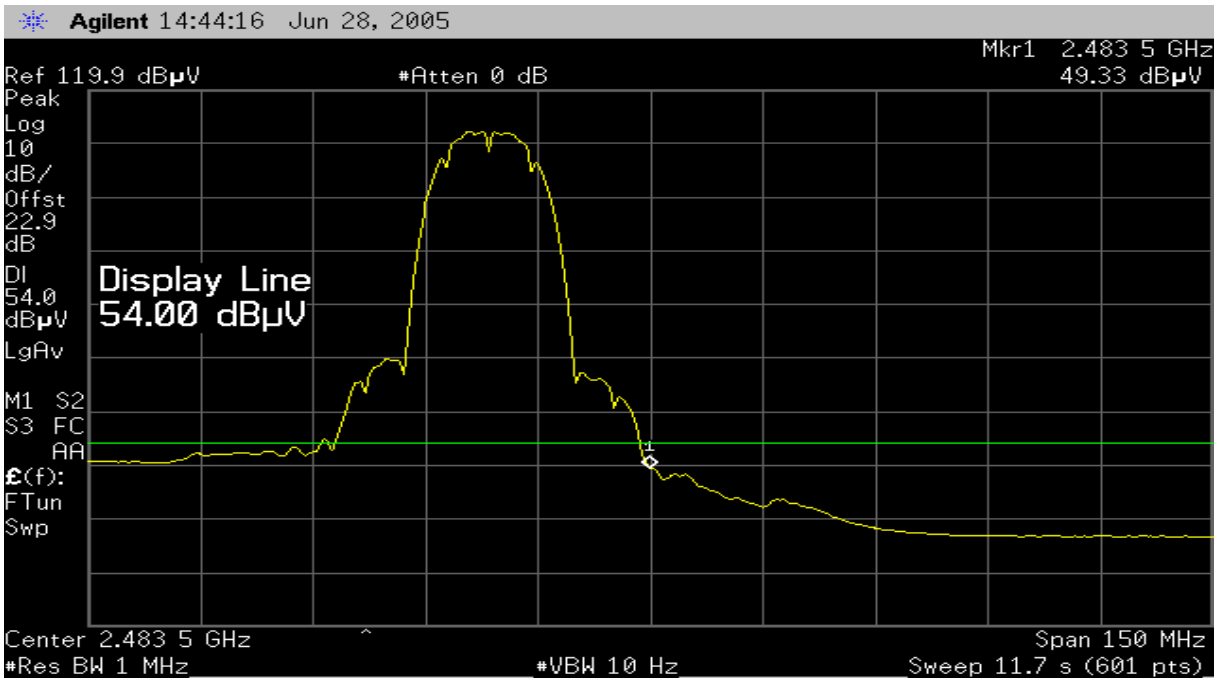
802.11b – AVERAGE Limit at Lower Edge for 2412 MHz Plot



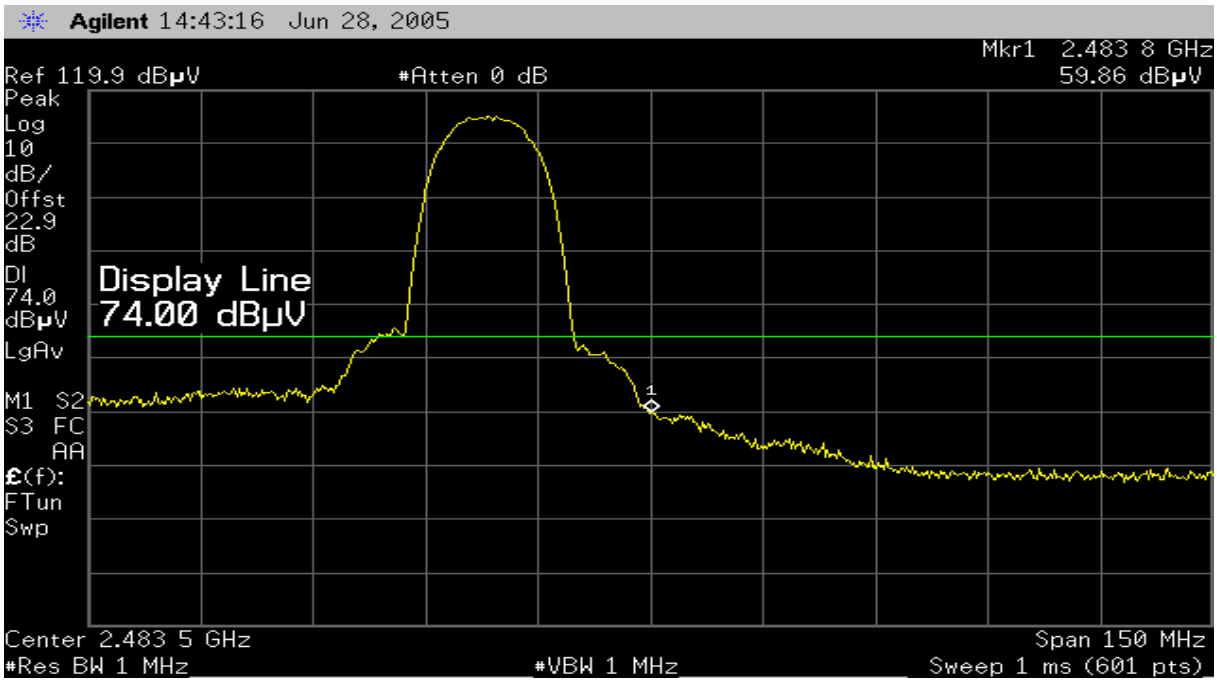
802.11b – PEAK Limit at Lower Edge for 2412 MHz Plot

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.205 Spurious Emissions Requirements – Restricted Bandedge (802.11b)



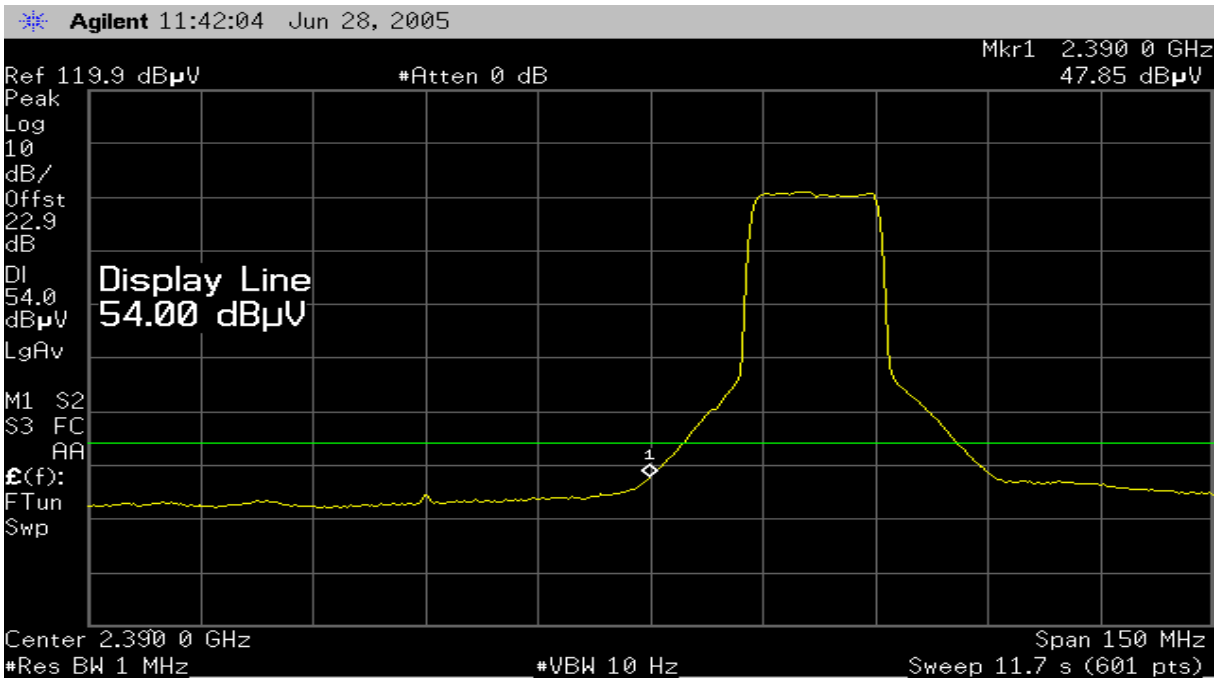
802.11b – AVERAGE Limit at Upper Edge for 2462 MHz Plot



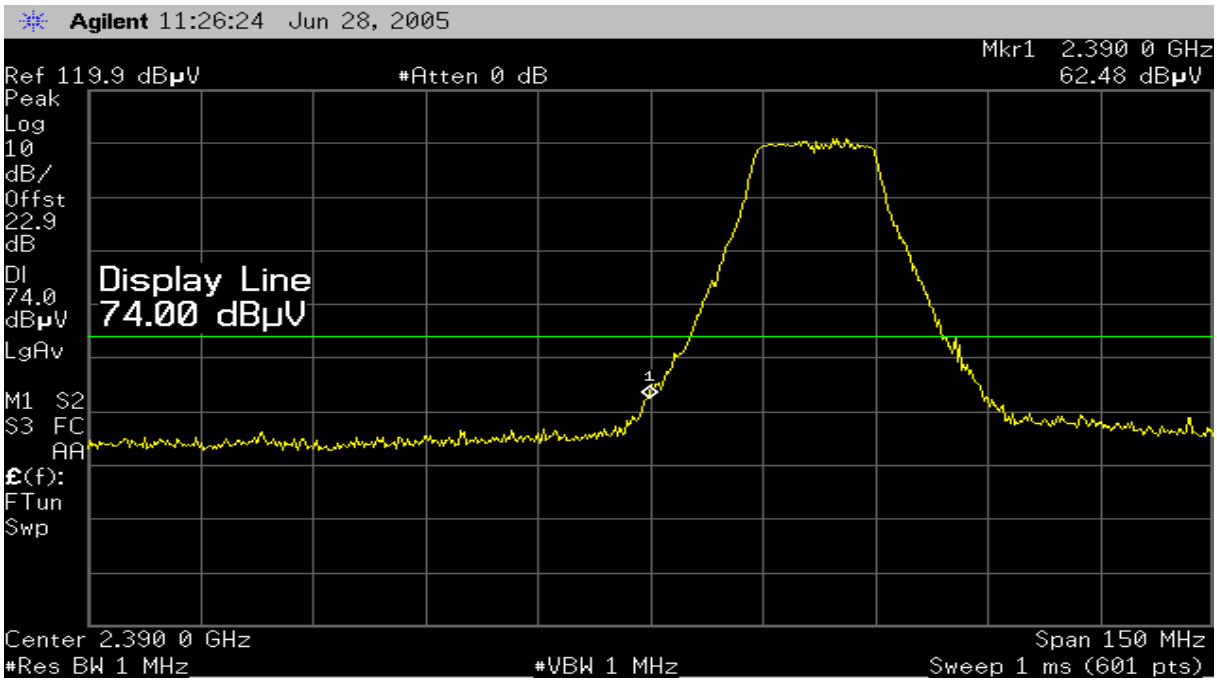
802.11b – PEAK Limit at Upper Edge for 2462 MHz Plot

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.205 Spurious Emissions Requirements – Restricted Bandedge (802.11g)



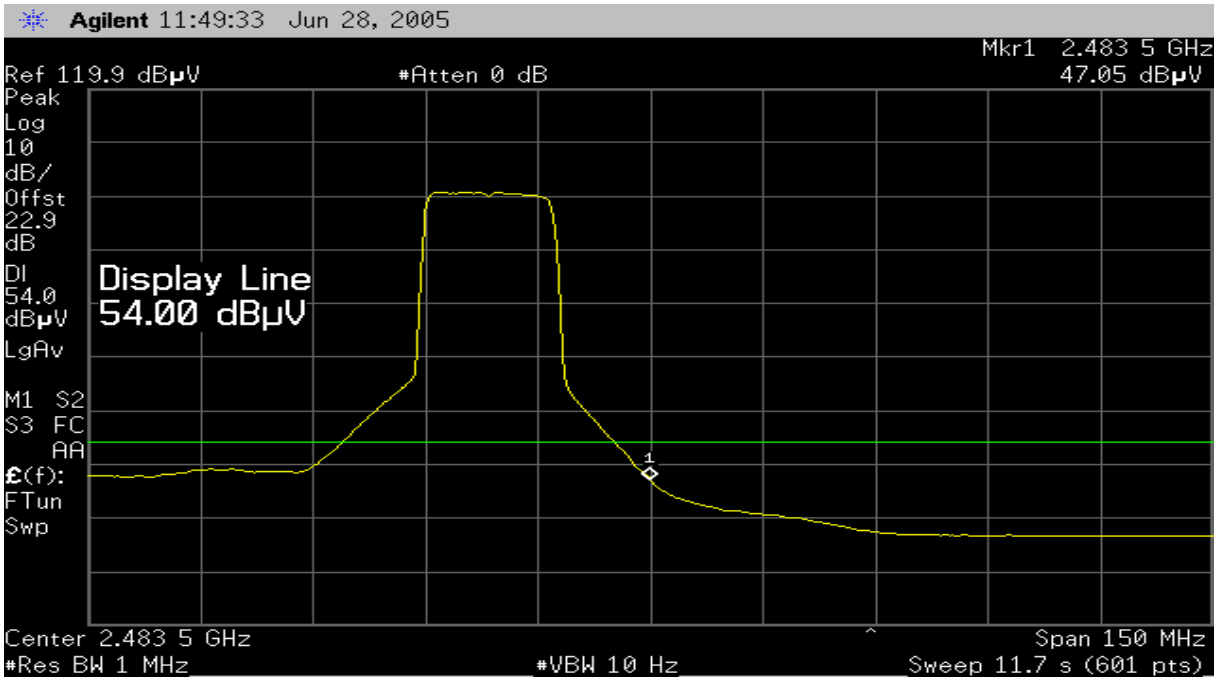
802.11g – AVERAGE Limit at Lower Edge for 2412 MHz Plot



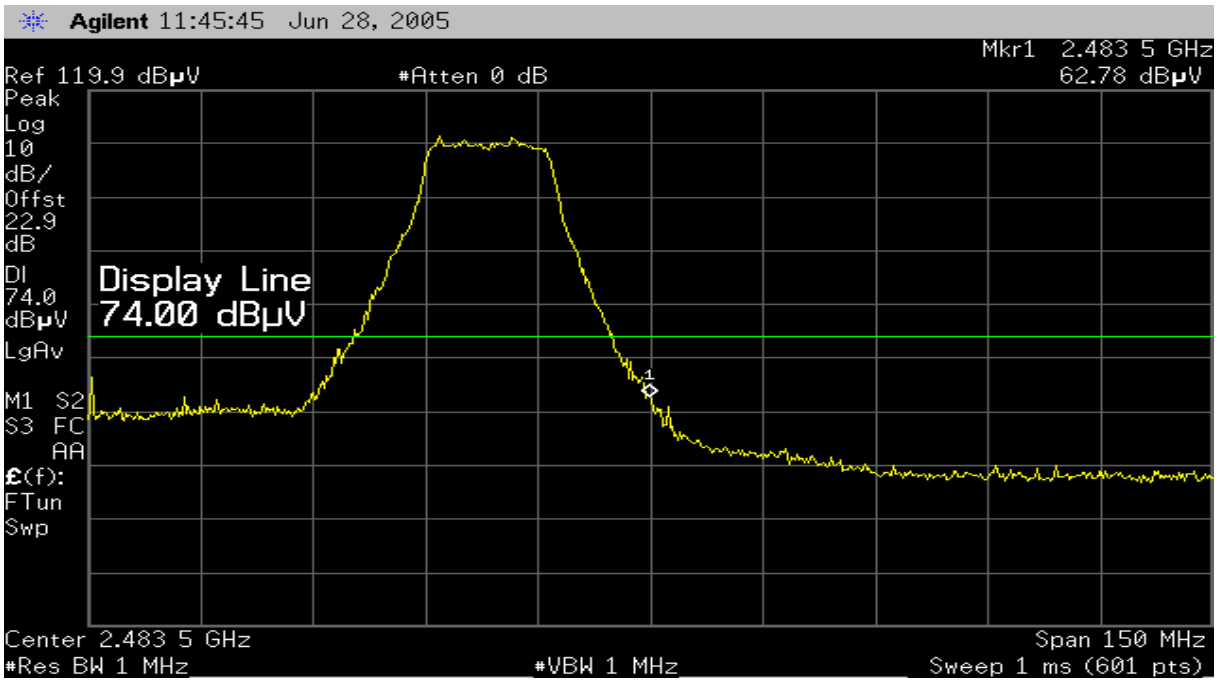
802.11g – PEAK Limit at Lower Edge for 2412 MHz Plot

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.205 Spurious Emissions Requirements – Restricted Bandedge (802.11g)



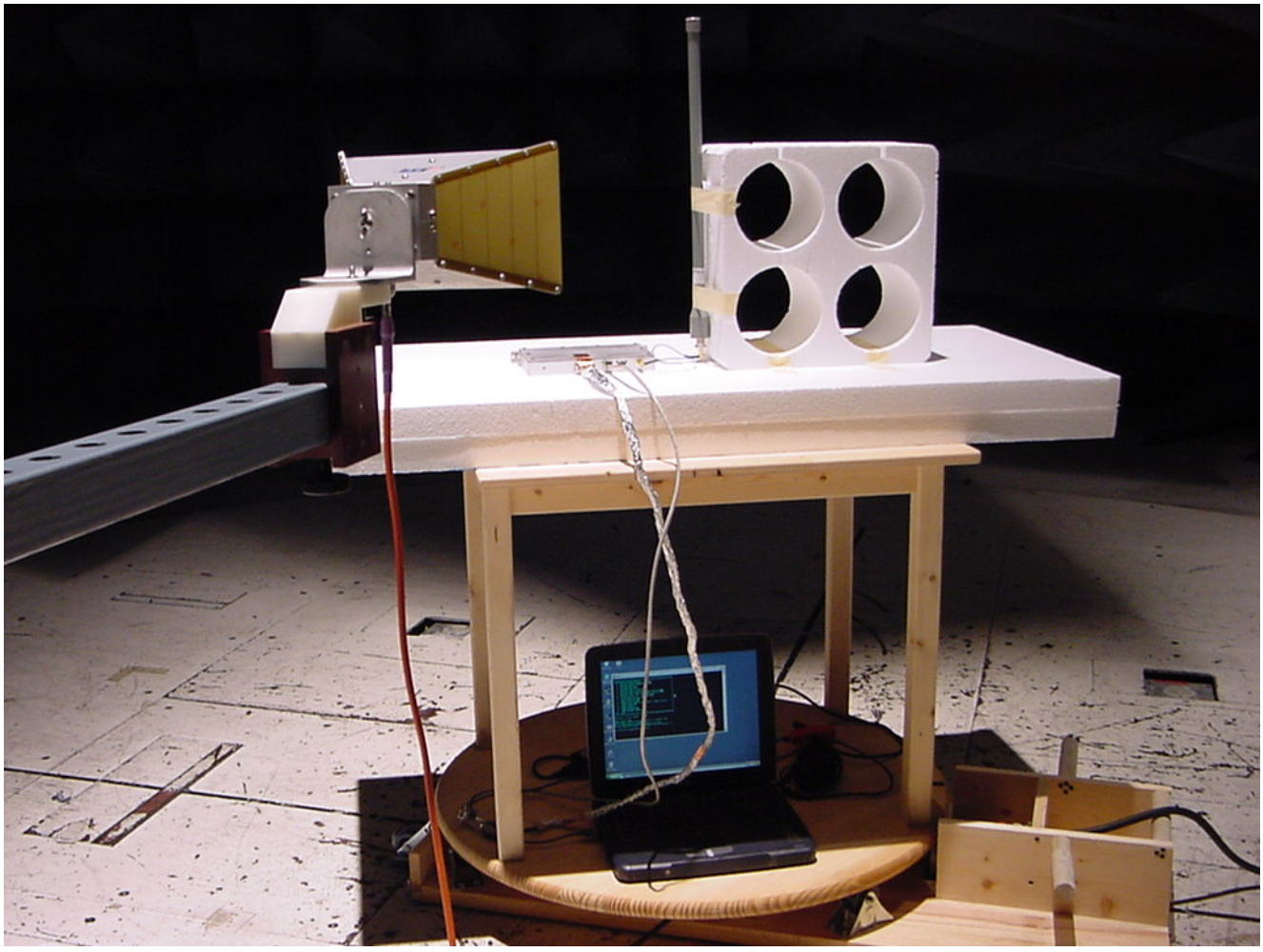
802.11g – AVERAGE Limit at Upper Edge for 2462 MHz Plot



802.11g – PEAK Limit at Upper Edge for 2462 MHz Plot

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.205 Spurious Emissions Requirements – Restricted Bandedge



Photograph 7. Restricted Bandedge Test Setup

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(d) Peak Power Spectral Density

Test Requirements: **§15.247(d):** For digitally modulated systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8tdBm in any 3 kHz band during any time interval of continuous transmission.

Test Procedure: The transmitter was set to the lowest channel with the highest output power and connected through a directional coupler, a Spectrum Analyzer, and a Peak Power Meter to monitor the maximum power output. A 1.1 dB Offset was applied to the Spectrum Analyzer to compensate the cable loss. The RBW and VBW was set to 3 kHz and a SPAN of 1.5 MHz with a 500 second sweep to the Spectrum Analyzer. Repeated the measurement with middle and highest channel.

Test Results: Equipment complies with the peak power spectral density limits of **§ 15.247 (d)**. The peak power spectral density was determined from plots on the following page(s).

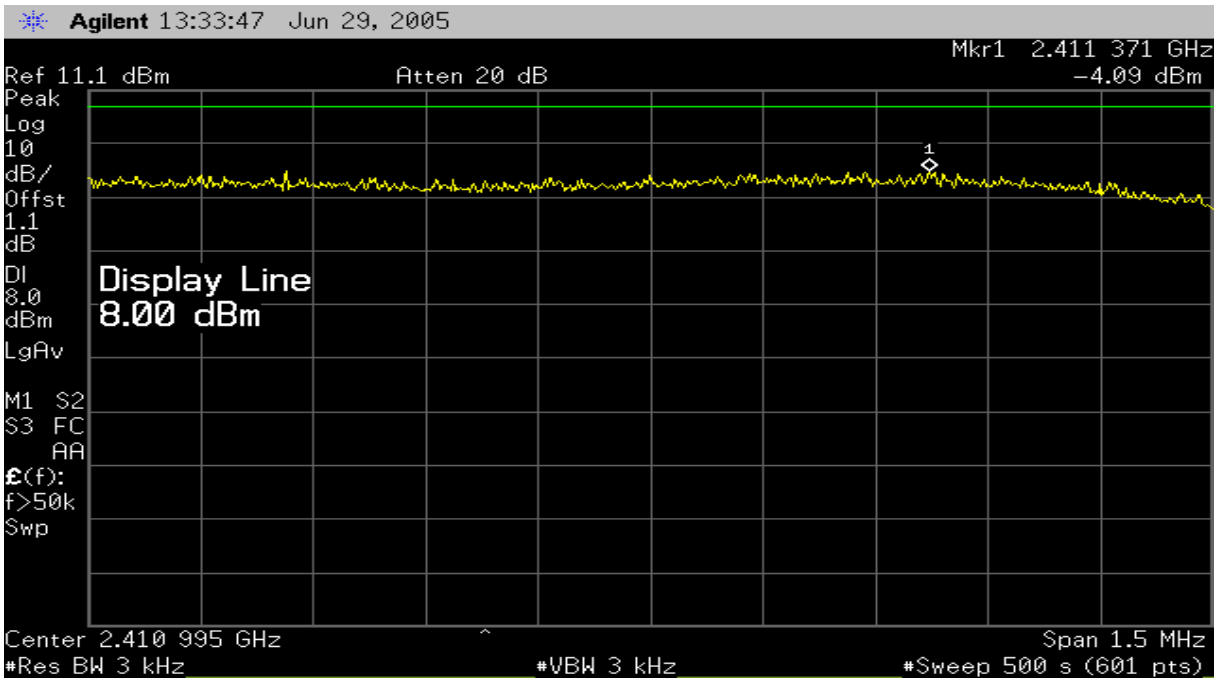
802.11b				
Carrier Channel	**Frequency (MHz)**	**Measured PPSD (dBm)**	**Limit (dBm)**	**Margin (dB)**
Low	2412	-4.09	8	-12.09
Mid	2437	-3.14	8	-11.14
High	2462	-2.77	8	-10.77
802.11g				
Carrier Channel	**Frequency (MHz)**	**Measured PPSD (dBm)**	**Limit (dBm)**	**Margin (dB)**
Low	2412	-11.53	8	-19.53
Mid	2437	-12.15	8	-20.15
High	2462	-11.5	8	-19.5

Test Engineer: Kerwinn Corpuz

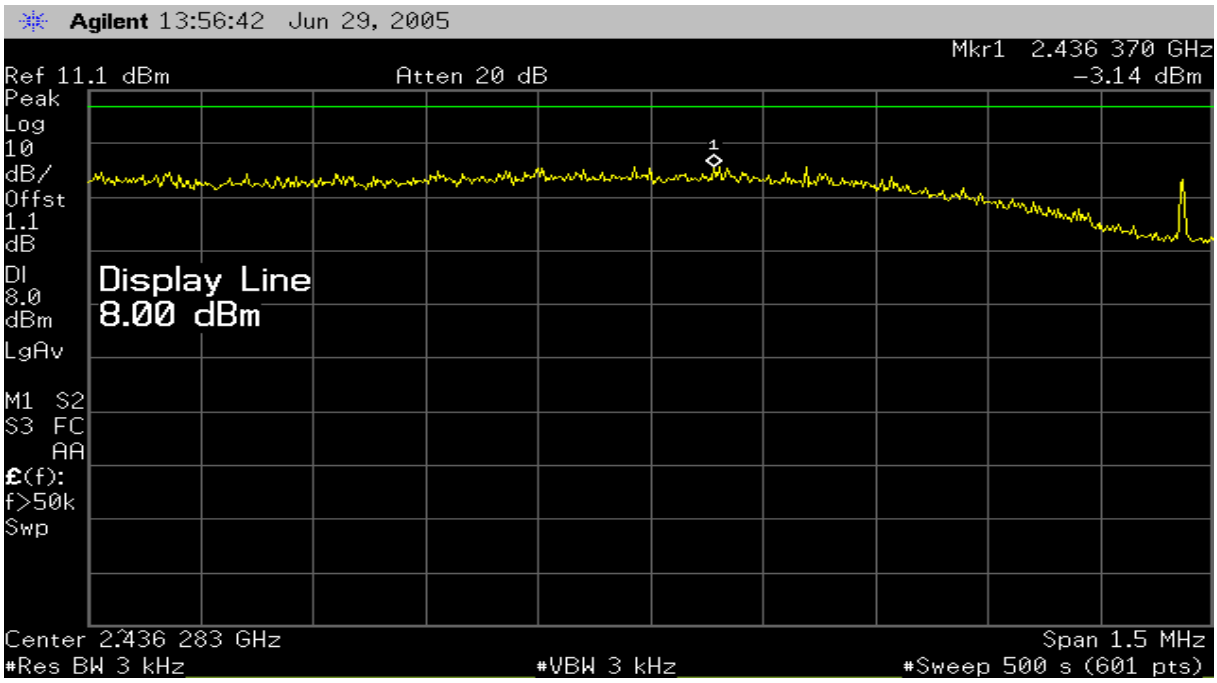
Test Date: 06/29/2005

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(d) Peak Power Spectral Density (802.11b)



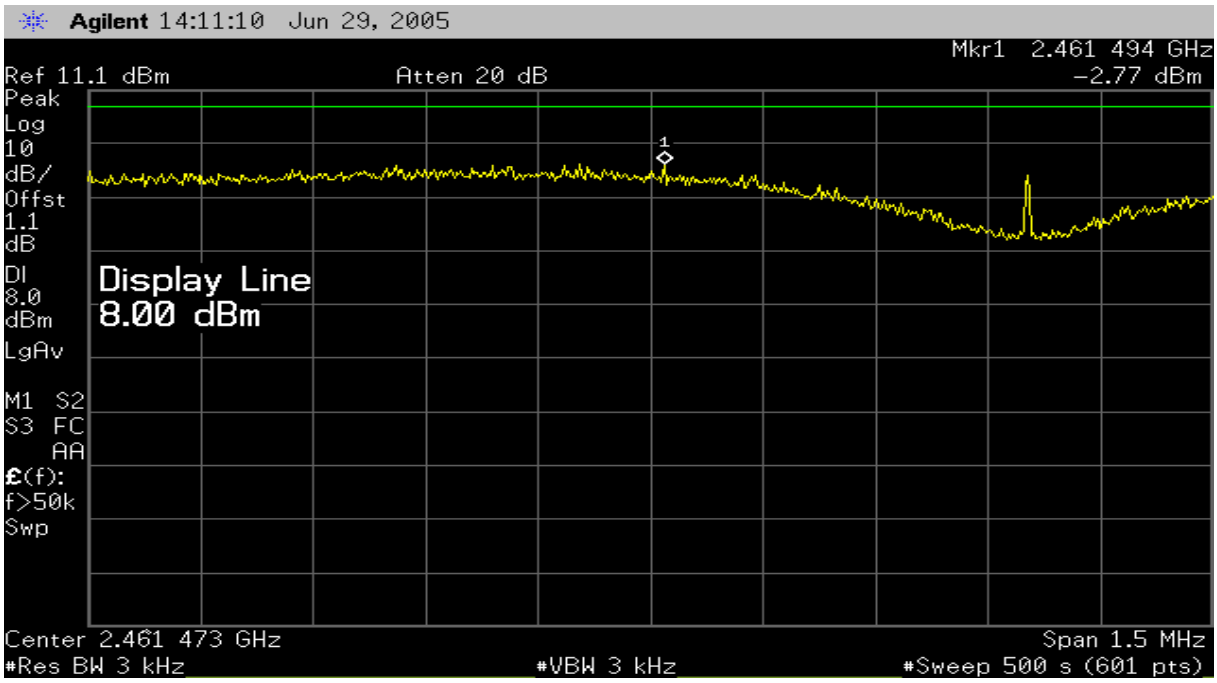
802.11b – Peak Power Spectral Density for 2412 MHz (Low channel)



802.11b – Peak Power Spectral Density for 2437 MHz (Mid channel)

Electromagnetic Compatibility Criteria for Intentional Radiators

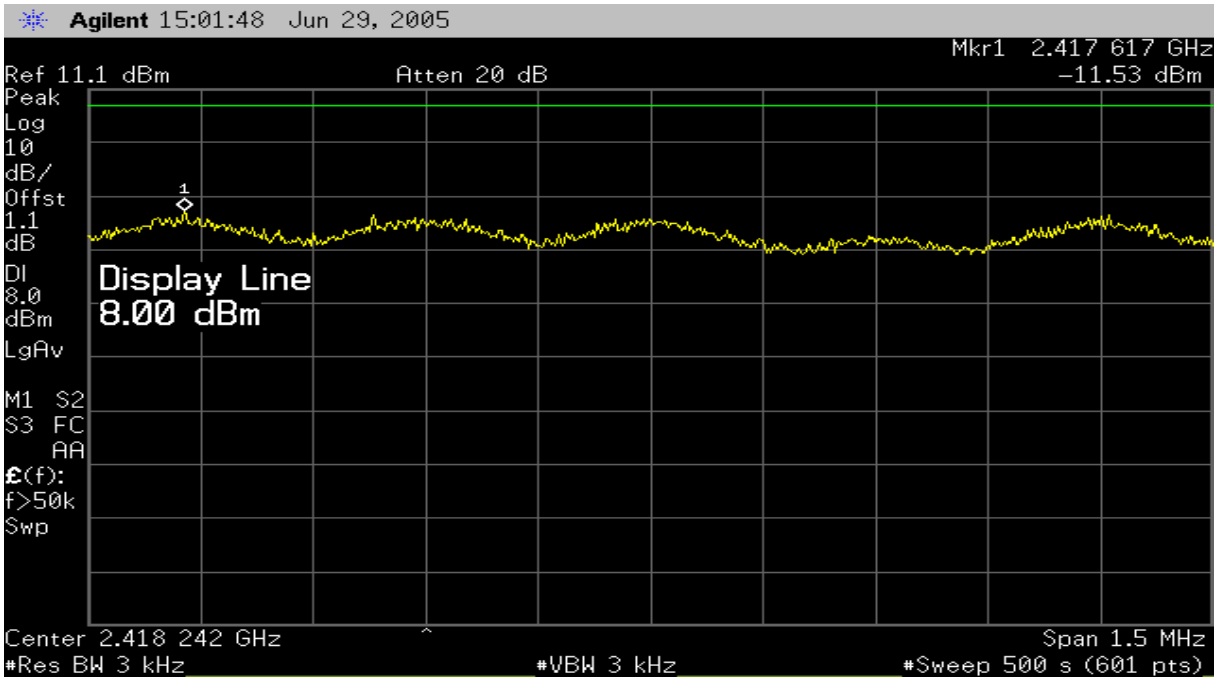
§ 15.247(d) Peak Power Spectral Density (802.11b)



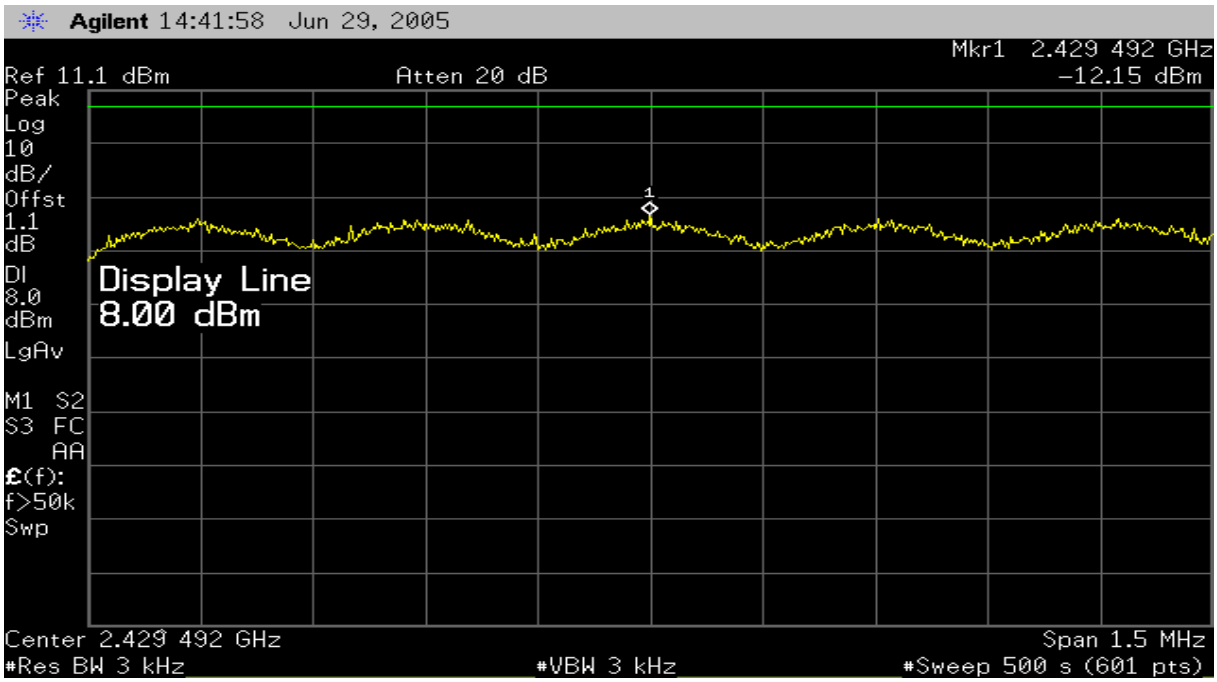
802.11b – Peak Power Spectral Density for 2462 MHz (High channel)

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(d) Peak Power Spectral Density (802.11g)



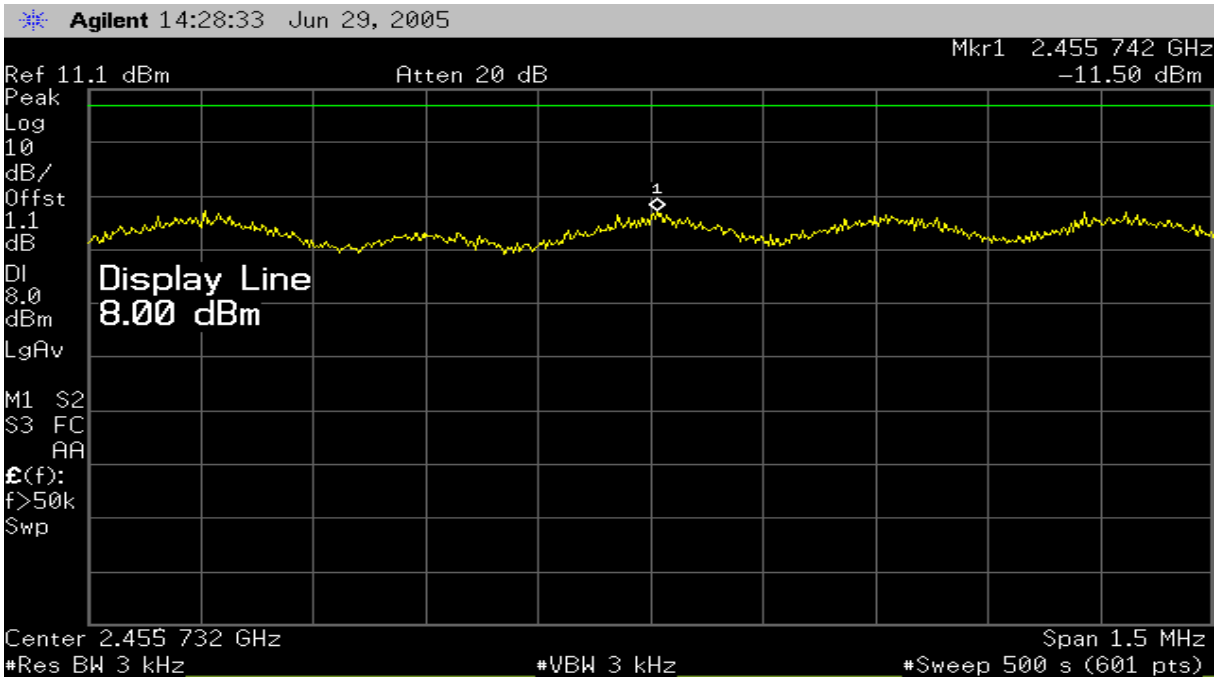
802.11g – Peak Power Spectral Density for 2412 MHz (Low channel)



802.11g – Peak Power Spectral Density for 2437 MHz (Mid channel)

Electromagnetic Compatibility Criteria for Intentional Radiators

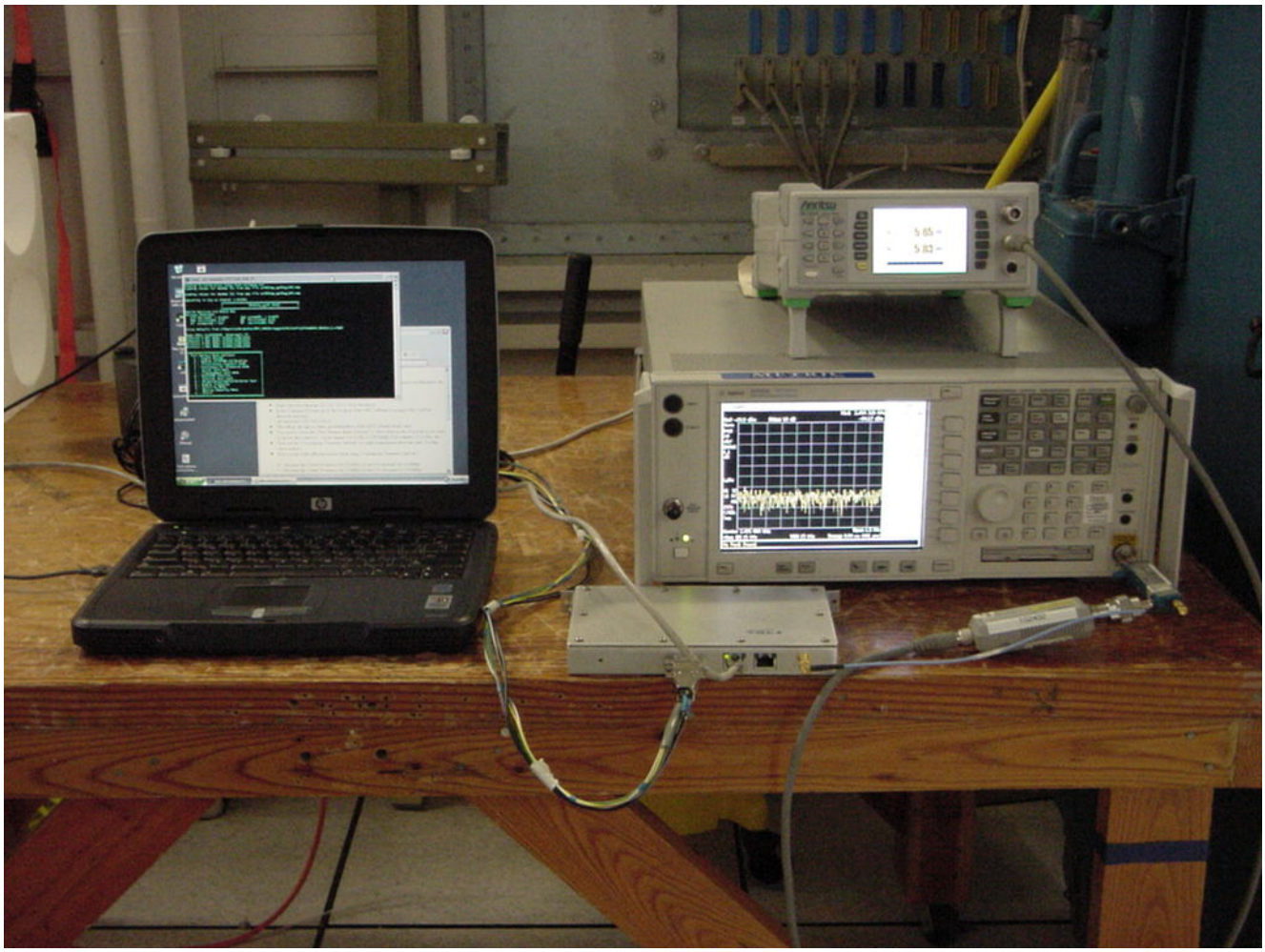
§ 15.247(d) Peak Power Spectral Density (802.11g)



802.11g – Peak Power Spectral Density for 2462 MHz (High channel)

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(d) Peak Power Spectral Density



Photograph 8. Peak Power Spectral Density Test Setup

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.

Test Name: § 15.247(c); § 15.209 Radiated Limits & § 15.205 Restricted Bandedge			**Test Date(s): 7/6/2005**		
MET Asset #	**Equipment**	**Manufacturer**	**Model**	**Last Cal Date**	**Cal Due Date**
RENTAL	SPECTRUM ANALYZER	AGILENT	E4448A	5/12/2005	5/12/2006
1S2421	EMI RECEIVER	ROHDE&SCHWARZ	ESIB 7	2/9/2005	2/9/2006
1S2184	BILOG ANTENNA	CHASE	CBL6112A	1/12/2005	1/12/2006
1S2121	PRE-AMPLIFIER	HEWLETT PACKARD	8449B	10/14/2004	10/14/2005
1S2198	ANTENNA, HORN	EMCO	3115	7/14/2005	7/14/2006
1S2202	ANTENNA, HORN, 1 METER	EMCO	3116	3/23/2004	3/23/2007
N/A	HIGH PASS FILTER	MICRO-TRONICS	HPM13146	SEE NOTE	
1S2263	CHAMBER, 10 METER	RANTEC	N2-14	7/25/2004	7/25/2005
Test Name: § 15.247(a) 6 dB and 99% Bandwidth			**Test Date(s): 06/28/2005**		
MET Asset #	**Equipment**	**Manufacturer**	**Model**	**Last Cal Date**	**Cal Due Date**
RENTAL	SPECTRUM ANALYZER	AGILENT	E4448A	5/12/2005	5/12/2006
1S2430	WIDEBAND POWER METER	ANRITSU COMPANY	ML2488A	1/12/2005	1/12/2006
1S2432	WIDEBAND POWER SENSOR	ANRITSU COMPANY	MA2491A	1/12/2005	1/12/2006
1S2034	COUPLER, DIRECTIONAL 1-20 GHz	KRYTAR	101020020	SEE NOTE	
1S2041	COUPLER, BI DIRECTIONALCOAXIAL	NARDA	N/A	SEE NOTE	

Test Name: § 15.247(b) Peak Power Output			Test Date(s): 06/28/2005		
MET Asset #	**Equipment**	**Manufacturer**	**Model**	**Last Cal Date**	**Cal Due Date**
RENTAL	SPECTRUM ANALYZER	AGILENT	E4448A	5/12/2005	5/12/2006
1S2430	WIDEBAND POWER METER	ANRITSU COMPANY	ML2488A	1/12/2005	1/12/2006
1S2432	WIDEBAND POWER SENSOR	ANRITSU COMPANY	MA2491A	1/12/2005	1/12/2006
1S2034	COUPLER, DIRECTIONAL 1-20 GHz	KRYTAR	101020020	SEE NOTE	
1S2041	COUPLER, BI DIRECTIONALCOAXIAL	NARDA	N/A	SEE NOTE	
Test Name: § 15.247(c) Spurious RF Conducted Emissions			**Test Date(s): 06/29/2005**		
MET Asset #	**Equipment**	**Manufacturer**	**Model**	**Last Cal Date**	**Cal Due Date**
RENTAL	SPECTRUM ANALYZER	AGILENT	E4448A	5/12/2005	5/12/2006
1S2430	WIDEBAND POWER METER	ANRITSU COMPANY	ML2488A	1/12/2005	1/12/2006
1S2432	WIDEBAND POWER SENSOR	ANRITSU COMPANY	MA2491A	1/12/2005	1/12/2006
1S2034	COUPLER, DIRECTIONAL 1-20 GHz	KRYTAR	101020020	SEE NOTE	
1S2041	COUPLER, BI DIRECTIONALCOAXIAL	NARDA	N/A	SEE NOTE	
Test Name: § 15.247(d) Peak Power Spectral Density			**Test Date(s): 06/29/2005**		
MET Asset #	**Equipment**	**Manufacturer**	**Model**	**Last Cal Date**	**Cal Due Date**
RENTAL	SPECTRUM ANALYZER	AGILENT	E4448A	5/12/2005	5/12/2006
1S2430	WIDEBAND POWER METER	ANRITSU COMPANY	ML2488A	1/12/2005	1/12/2006
1S2432	WIDEBAND POWER SENSOR	ANRITSU COMPANY	MA2491A	1/12/2005	1/12/2006
1S2034	COUPLER, DIRECTIONAL 1-20 GHz	KRYTAR	101020020	SEE NOTE	
1S2041	COUPLER, BI DIRECTIONALCOAXIAL	NARDA	N/A	SEE NOTE	

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.

VI. Exhibits

Exhibit A, Hopping Capability Requirements

Exhibit B, Non-Coordination Requirements

End of Report

