



MET Laboratories, Inc. *Safety Certification - EMI - Telecom Environmental Simulation*
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**Electromagnetic Compatibility Criteria
Test Report**

For the

Sensys Networks

**AP240-E Wireless Sensor Device
FCC ID: TDB-AP240E**

Verified under
the FCC Certification Rules contained in
Title 47 of the CFR, Part 15, Subpart C
for Intentional Radiators

MET Report: EMCU18353-FCC247

November 3, 2005

Prepared For:

Sensys Networks
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Prepared By:
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Union City, California 94587-3201



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AP240-E Wireless Sensor Device
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Tested Under

The FCC Certification Rules contained in
Title 47 of the CFR, Part 15, Subpart C
for Intentional Radiators

A handwritten signature in blue ink that appears to read "G. Alansalon".

Guada Alansalon
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, Section 15.247 of the FCC Rules under normal use and maintenance.

A handwritten signature in blue ink that appears to read "A. Bajwa".

Asad Bajwa, Project Engineer and Manager
Electromagnetic Compatibility Lab



Table of Contents

I.	Executive Summary	1
	A. Purpose of Test	2
	B. Executive Summary	2
II.	Equipment Configuration	3
	A. Overview	5
	B. References	5
	C. Test Site	5
	D. Description of Test Sample	5
	E. EUT's Frequency	6
	F. Internal View Photographs of EUT	7
	G. Equipment Configuration	11
	H. Support Equipment	11
	I. Ports and Cabling Information	11
	J. Mode of Operation	12
	K. Method of Monitoring EUT Operation	12
	L. Modifications	12
	a) Modifications to EUT	12
	b) Modifications to Test Standard	12
	M. Disposition of EUT	12
III.	Electromagnetic Compatibility Criteria for Intentional Radiators	13
	§ 15.203 Antenna Requirement	14
	§ 15.207(a) Conducted Limits	15
	§ 15.209(a) Radiated Emission Limits	19
	§ 15.247(a) Bandwidth & Channelization Requirements	22
	§ 15.247(b) Output Power and RF Exposure	25
	§ 15.247(c) Power Spectral Density	30
	§ 15.247(c) Spurious Emissions Requirements – Radiated and RF Conducted	34
IV.	Test Equipment	46
V.	Certification & User's Manual Information	48
	A. Certification Information	49
	B. Label and User's Manual Information	53
VI.	Exhibits	55



List of Tables

Table 1. Executive Summary of EMC Part 15.247 Compliance Testing	2
Table 2 EUT's Frequency Table	6
Table 3. Equipment Configuration	11
Table 4. Support Equipment	11
Table 5. Ports and Cabling Information (RF Antenna Conducted Test Configuration)	11
Table 6 Conducted Limits for Intentional Radiators from FCC Part § 15.207(a)	15
Table 7. Radiated Emissions Limits Calculated from FCC Part 15, § 15.209 (a)	19
Table 8. Output Power Requirements from §15.247	25
Table 9. RF Exposure Requirements - 1.1307(b) (2); 1.1310	29
Table 10. Restricted Bands of Operation from FCC Part 15, § 15.205	34

List of Figures

Figure 1. RF Antenna Conducted Test Configuration	10
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List of Photographs

Photograph 1. Conducted Limits Test Setup	18
Photograph 2. Radiated Emission Test Setup, 30-1000 MHz	21
Photograph 3 Power Density Test Setup	33
Photograph 4 Spurious Emissions Requirements – Radiated and RF Conducted Test Setup	36
Photograph 5. Spurious Radiated Emissions Measurement Test Setup	41
Photograph 6. Spurious Conducted Measurements Test Setup	45

List of Plots

Plot 1 Low-Channel Occupied BW	23
Plot 2 Mid-Channel Occupied BW	23
Plot 3 High-Channel Occupied BW	24
Plot 4 Low Channel (2402 MHz) Power Output	27
Plot 5 Mid Channel (2441 MHz) Power	27
Plot 6 High Channel (2480 MHz) Power	28
Plot 7 Power Spectral Density Plot 1	31
Plot 8 Power Spectral Density Plot 2	31
Plot 9 Power Spectral Density Plot 3	32
Plot 10 Low-Channel (2402 MHz) Spurious Emission, 30 MHz - 2.9 GHz	42
Plot 11 Low-Channel (2402 MHz) Spurious Emission, 2.68 – 25 GHz	42
Plot 12 Mid-channel (2441 MHz) Spurious Emission, 2.68 GHz - 25 GHz	43
Plot 13 High channel (2480 MHz) Spurious Emission, 30 MHz - 2.9 GHz	44
Plot 14 High-Channel (2480 MHz) Spurious Emission, 2.68 GHz - 25 GHz	44



List of Terms and Abbreviations

AC	Alternating Current
ACF	Antenna Correction Factor
Cal	Calibration
d	Measurement Distance
dB	Decibels
dBμA	Decibels above one microamp
dBμV	Decibels above one microvolt
dBμA/m	Decibels above one microamp per meter
dBμV/m	Decibels above one microvolt per meter
DC	Direct Current
E	Electric Field
DSL	Digital Subscriber Line
ESD	Electrostatic Discharge
EUT	Equipment Under Test
f	Frequency
FCC	Federal Communications Commission
GR-1089-CORE	(<i>GR</i>) General Requirement(s) imposed by the NEBS standard, (<i>CORE</i>) Central Office Recovery Express (AT&T), (<i>1089</i>) 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	Ground Reference Plane
H	Magnetic Field
HCP	Horizontal Coupling Plane
Hz	Hertz
IEC	International Electrotechnical Commission
kHz	kilohertz
kPa	kilopascal
kV	kilovolt
LISN	Line Impedance Stabilization Network
MHz	Megahertz
μH	microhenry
μF	microfarad
μs	microseconds
NEBS	Network Equipment-Building System
PRF	Pulse Repetition Frequency
RF	Radio Frequency
RMS	Root-Mean-Square
TWT	Traveling Wave Tube
V/m	Volts per meter
VCP	Vertical Coupling Plane



I. Executive Summary



A. Purpose of Test

An EMC evaluation to determine compliance of the Sensys Networks AP240-E Wireless Sensor Device 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 Sensys Networks AP240-E Wireless Sensor Device. Sensys Networks should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the Wireless Sensor Device, Model: AP240-E 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. All tests were conducted using measurement procedure ANSI C63.4-2001.

Reference	Description	Compliance
Title 47 of the CFR, Part 15, Subpart C, §15.203	Antenna Requirement	Compliant
Title 47 of the CFR, Part 15, Subpart C, §15.207(a);	Electromagnetic Compatibility - Conducted Emissions for Intentional Radiators	Compliant
Title 47 of the CFR, Part 15, Subpart C, §15.209(a)	Electromagnetic Compatibility - Radiated Emissions for Intentional Radiators	Compliant
Title 47 of the CFR, Part 15, Subpart C, §15.247(a)	Bandwidth & Channelization	Compliant
Title 47 of the CFR, Part 15, Subpart C, §15.247(b)	Output Power and RF Exposure	Compliant
Title 47 of the CFR, Part 15, Subpart C, §15.247(c)	Power Spectral Density	Compliant
Title 47 of the CFR, Part 15, Subpart C, §15.247(c)	Spurious Emissions Requirements – Radiated and RF Conducted	Compliant

Table 1. Executive Summary of EMC Part 15.247 Compliance Testing



Sensys Networks, Inc.
AP240-E Wireless Sensor Device

Electromagnetic Compatibility
Equipment Configuration
CFR Title 47, Part 15, Subpart C

II. Equipment Configuration



Sensys Networks, Inc.
AP240-E Wireless Sensor Device

Electromagnetic Compatibility
Equipment Configuration
CFR Title 47, Part 15, Subpart C

Type of Submission/Rule:	Part 15.247 Original Filing
Model(s) Tested:	AP240-E Wireless Sensor Device
Model(s) Number:	AP240-E Wireless Sensor Device
EUT Specifications:	Primary Power from laptop: 120 VAC, 60 Hz
	Secondary Power: 5 VDC from USB
	RF Power Output (conducted): 0.419 MW
	Equipment Frequency Range: 2405-2475 MHz
	Equipment Code: DTS
Lab Ambient (Normal) Test Conditions:	Temperature: 15-35° C
	Relative Humidity: 30-60%
	Atmospheric Pressure: 860-1060 mbar
Evaluated by:	Asad Bajwa
Test Date(s):	October 17, 2005



A. Overview

The purpose of this series of tests was to verify compliance of the Sensys Networks Wireless Sensor Device Model: AP240-E 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., 33439 Western Avenue, Union City, California 94587-3201. 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 semi-anechoic chamber. 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 AP240-E Wireless Sensor Device is a high-end access point for the VDS5240 family of wireless sensor vehicle detection products. It offers a rich set of features that simplify installation, traffic monitoring, and data reporting.



E. EUT's Frequency

CHANNEL	FREQUENCY(GHz)
*1	2.405
2	2.410
3	2.415
4	2.420
5	2.425
6	2.430
7	2.435
*8	2.440
9	2.445
10	2.450
11	2.455
12	2.460
13	2.465
14	2.470
*15	2.475

Table 2 EUT's Frequency Table

- 1) This is for sure that all frequencies are in 2.405 GHz to 2.475 GHz for this Module.
- 2) Section 15.31(m): Measurements on intentional radiators or receivers shall be performed at three frequencies for operating frequency range over 10 MHz. The locations of these frequencies are one near the top, one near the middle, and one near the bottom.
- 3) The items as specified in test report are needed to be tested to these three frequencies for EUT to communicate with Direct Spread Spectrum System:

Top: Channel – 1
Middle: Channel – 8
Bottom: Channel – 15



Sensys Networks, Inc.
AP240-E Wireless Sensor Device

Electromagnetic Compatibility
Equipment Configuration
CFR Title 47, Part 15, Subpart C

F. Internal View Photographs of EUT





Sensys Networks, Inc.
AP240-E Wireless Sensor Device

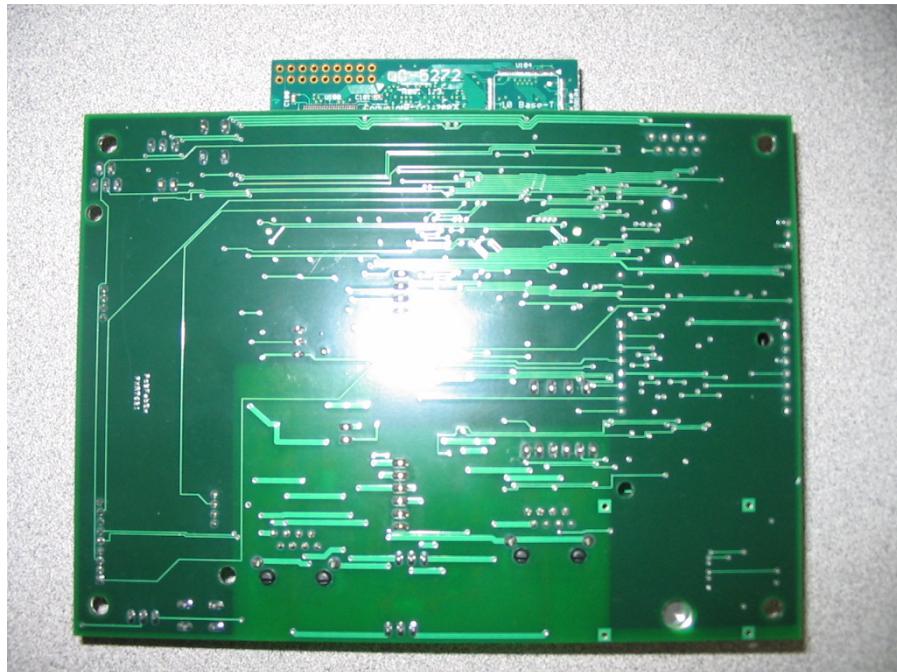
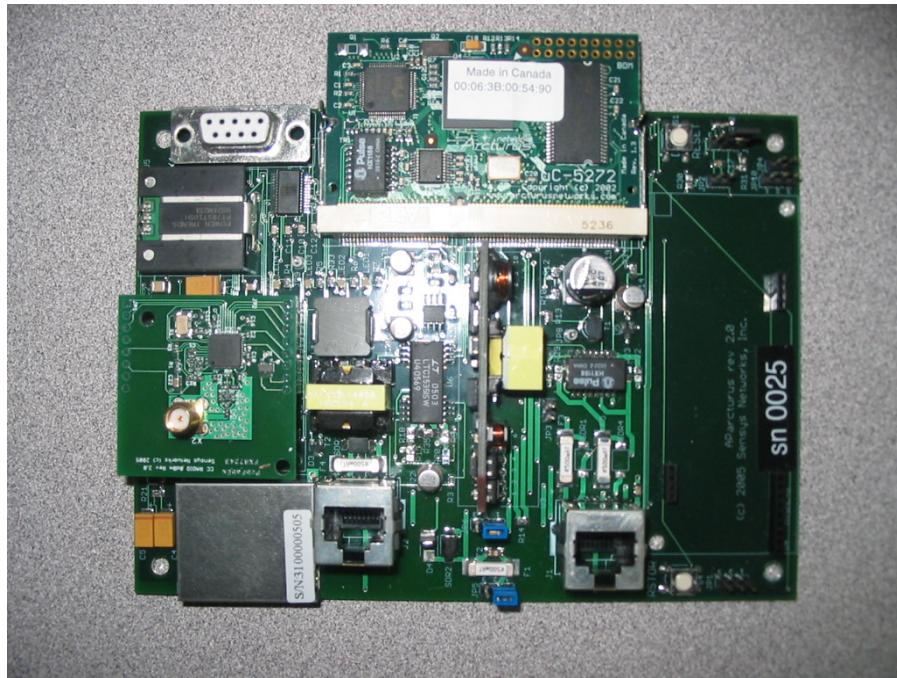
Electromagnetic Compatibility
Equipment Configuration
CFR Title 47, Part 15, Subpart C





Sensys Networks, Inc.
AP240-E Wireless Sensor Device

Electromagnetic Compatibility
Equipment Configuration
CFR Title 47, Part 15, Subpart C





Sensys Networks, Inc.
AP240-E Wireless Sensor Device

Electromagnetic Compatibility
Equipment Configuration
CFR Title 47, Part 15, Subpart C

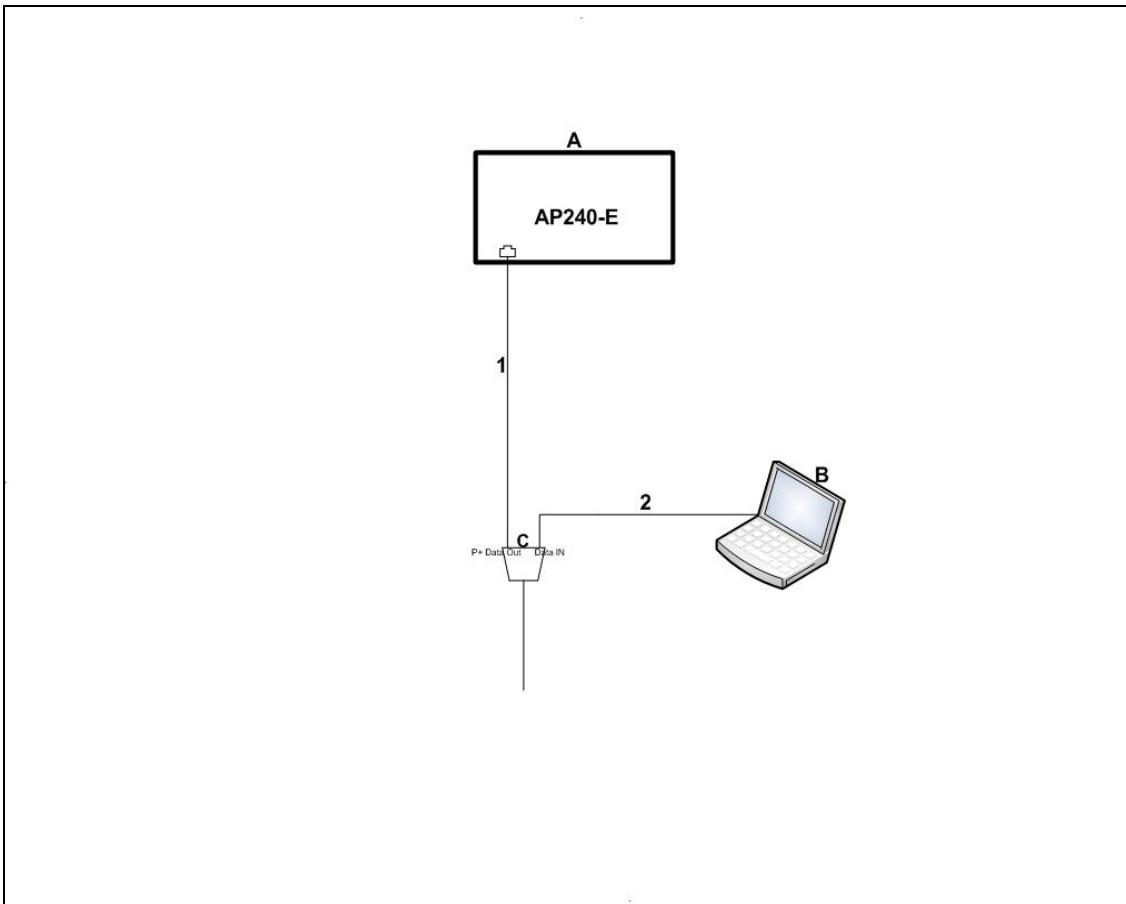


Figure 1. RF Antenna Conducted Test Configuration



G. Equipment Configuration

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

Ref. ID	Slot #	Name / Description	Model Number	*Part Number	Serial Number	Revision
A		Wireless Sensor Device	AP240-E	800-240-015-X-000	27	22

Table 3. Equipment Configuration

Note: * - X is a digit that indicates option such as GPRS, GPS, etc.

H. Support Equipment

Sensys Networks supplied support equipment necessary for the operation and testing of the Wireless Sensor Device Model: AP240-E. All support equipment supplied is listed in the following Support Equipment List.

Ref. ID	Name / Description	Manufacturer	Model Number	*Customer Supplied Calibration Data
B	Pentium II Laptop	IBM Corp.	Think Pad 600 2645-51U	N/A
C	Flush Mount Sensor	Sensys Networks	240-100-0-000	N/A

Table 4. 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.

I. 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	Ethernet	Straight through Ethernet Cable (Provide Data and Power to the EUT)	1	10	No	C
2	Cross-Over Cable	Cross-Over Cable	1	2	No	From C to Laptop

Table 5. Ports and Cabling Information (RF Antenna Conducted Test Configuration)



J. Mode of Operation

The EUT was operated in the following manner:

The EUT was connected to a USB port of a laptop computer. It is capable of transmitting in GFSK @ 1 Mbps and 8PSK @ 3 Mbps modes using a PRBS9 pattern and a DH5/3-DH5 packet type.

K. Method of Monitoring EUT Operation

Performance of the EUT was monitored in the following manner:

A software was used to control the EUT's transmission to change channel location, packet size, modulation and turning the RF on or off.

L. 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.

M. Disposition of EUT

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



Sensys Networks
AP240-E Wireless Sensor Device

Electromagnetic Compatibility Criteria
for Intentional Radiators
CFR Title 47, Part 15, Subpart C

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 a permanently attached internal antenna soldered onto the EUT and is not accessible by the user. The EUT is therefore compliant with §15.203.

Type of Antenna: PC board mounted antenna

Gain of Antenna: 5 dBi

Test Engineer(s): Asad Bajwa

Test Date(s): 10/17/05



Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.207(a) Conducted 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 μ H/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 (dB μ V)	
	Quasi-Peak	Average
0.15- 0.5	66 – 56*	56 – 46*
0.5 - 0.5	56	46
0.5 - 30	60	50

* Decreases with the logarithm of the frequency

Table 6 Conducted Limits for Intentional Radiators from FCC Part § 15.207(a)

Test Procedure:

The transmitter was set to the middle channel and placed on a 0.8 m high wooden table inside in a semi-anechoic chamber (See Photograph 1). The EUT was situated such that the back of the EUT was 0.4 m from the vertical conducting 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 μ H 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 9 kHz to 40 GHz"*. The measurements were performed over the frequency range of 0.15 MHz to 30 MHz using a 50 Ω /50 μ H LISN as the input transducer to an EMC/field intensity meter.

Results:

Equipment meets the specifications of **Section 15.207 (a)** for Intentional Radiators. Test result details appear on following pages.

Test Engineer(s): Riaz Momand

Test Date(s): 10/05/05



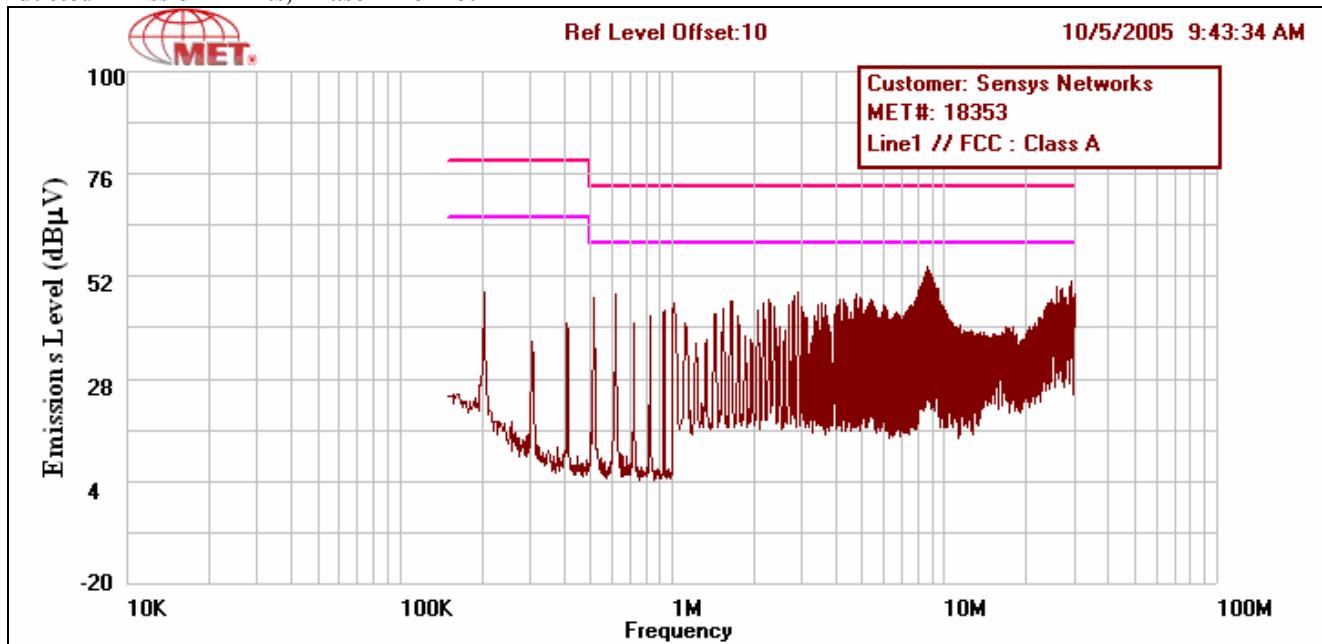
Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.207(a) Conducted Emissions

Conducted Emissions - Voltage, Worst Case Emissions, AC Power, Phase Line TX Mode

Frequency (MHz)	QP Amplitude (dB μ V)	QP Limit (dB μ V)	Delta (dB)	Pass	Average Amplitude (dB μ V)	Average Limit (dB μ V)	Delta (dB)	Pass
0.1035	50.40	94.452	-44.052	Pass	47.50	78.909	-31.409	Pass
0.2070	49.30	79.000	-29.700	Pass	44.10	66.000	-21.900	Pass
0.5180	49.98	73.000	-23.02	Pass	48.91	60.000	-11.090	Pass
0.6216	49.90	73.000	-23.100	Pass	49.10	60.000	-10.900	Pass
0.3111	40.90	79.000	-38.100	Pass	38.30	66.000	-27.700	Pass
0.9320	47.30	73.000	-25.700	Pass	45.70	60.000	-14.300	Pass
1.0380	48.30	73.000	-24.700	Pass	47.10	60.000	-12.900	Pass
1.6600	48.50	73.000	-24.500	Pass	47.00	60.000	-13.000	Pass
2.9060	49.60	73.000	-23.400	Pass	46.30	60.000	-13.700	Pass
8.7200	53.30	73.000	-19.700	Pass	49.80	60.000	-10.200	Pass

Conducted Emission Limits, Phase Line Plot



Note: Test was performed on Worst Case Mode.

Remarks: EUT meets the specifications of **Section 15.207(a)** for Intentional Radiators.



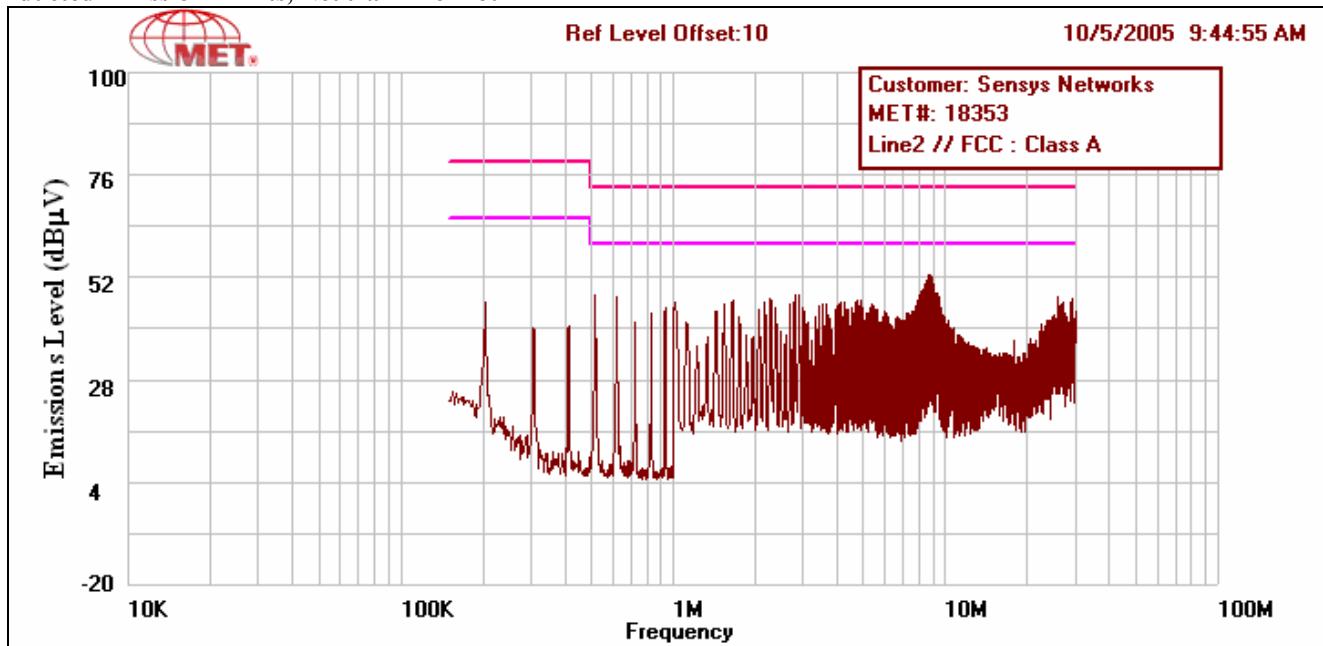
Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.207(a) Conducted Emissions

Conducted Emissions - Voltage, Worst Case Emissions, AC Power, Neutral Line

Frequency (MHz)	QP Amplitude (dB μ V)	QP Limit (dB μ V)	Delta (dB)	Pass	Average Amplitude (dB μ V)	Average Limit (dB μ V)	Delta (dB)	Pass
0.1038	48.3	94.331	-46.031	Pass	45.4	78.808	-33.408	Pass
0.2074	47.9	79.000	-31.100	Pass	42.4	66.000	-23.600	Pass
0.4143	44.5	79.000	-34.500	Pass	42.1	66.000	-23.900	Pass
0.5194	49.4	73.000	-23.600	Pass	48.4	60.000	-11.600	Pass
0.6222	50.1	73.000	-22.900	Pass	49.3	60.000	-10.700	Pass
1.0380	47.9	73.000	-25.100	Pass	46.5	60.000	-13.500	Pass
1.6200	48.0	73.000	-25.000	Pass	46.1	60.000	-13.900	Pass
2.2840	48.9	73.000	-24.100	Pass	46.6	60.000	-13.400	Pass
8.7220	55.0	73.000	-18.000	Pass	51.2	60.000	-8.800	Pass
9.0300	52.0	73.000	-21.000	Pass	49.5	60.000	-10.500	Pass

Conducted Emission Limits, Neutral Line Plot



Note: Test was performed in Worst Case Mode.

Remarks: EUT meets the specifications of **Section 15.207(a)** for Intentional Radiators.

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.207(a) Conducted Emissions



Photograph 1. Conducted Limits Test Setup



Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.209(a) Radiated Emission 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 7.

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

Table 7. Radiated Emissions Limits Calculated from FCC Part 15, § 15.209 (a)

Test Procedure:

The transmitter was set to the lowest channel and placed on a 0.8 m high wooden table inside in a semi-anechoic chamber (See Photograph 2). 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 oriented in 3 orthogonal axis and rotated 360 degrees 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.

Test Results:

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

Test Engineer(s):

Asad Bajwa

Test Date(s):

October 18, 2005



Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.209(a) Radiated Emission

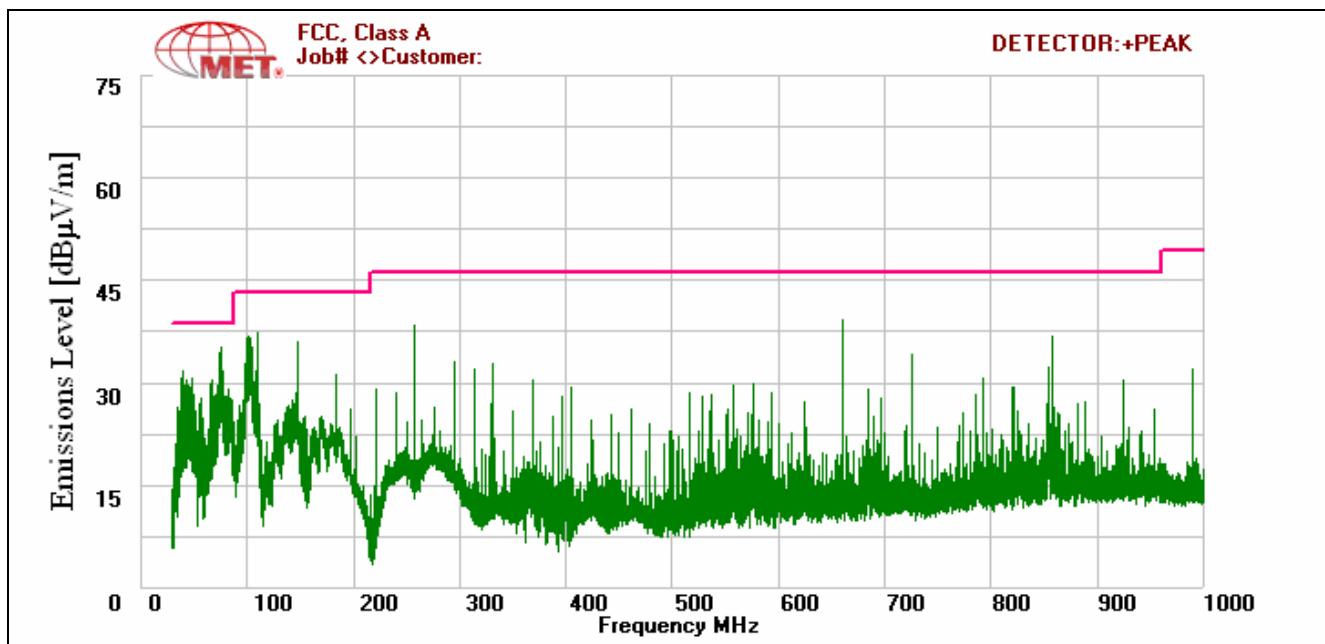
Radiated Emissions Limits Worst Case, 30 – 1000 MHz Vertical and Horizontal

Frequency (MHz)	Antenna Polarity	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)	Limit (dBuV)	Margin (dB)
*40.280	V	68	0.99	35.423	10.688	0	0.440	-10.46	36.091	39.0	-2.909
*74.600	V	227	1.00	40.773	5.980	0	0.522	-10.46	36.815	39.0	-2.185
66.000	V	227	1.00	39.954	7.700	0	0.490	-10.46	37.684	39.0	-1.316
621.680	H	-1	1.55	14.538	20.750	0	1.309	-10.46	26.137	46.4	-20.263
895.750	V	360	1.55	17.104	22.158	0	1.744	-10.46	30.546	46.4	-15.854
258.040	H	282	1.51	30.585	12.680	0	0.907	-10.46	33.712	46.4	-12.688

Note 1: * - 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.

Note 2: There are no detectable emissions between 0.9 GHz and 25 GHz.

Note 3: Test was performed in Worst Case Mode.



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

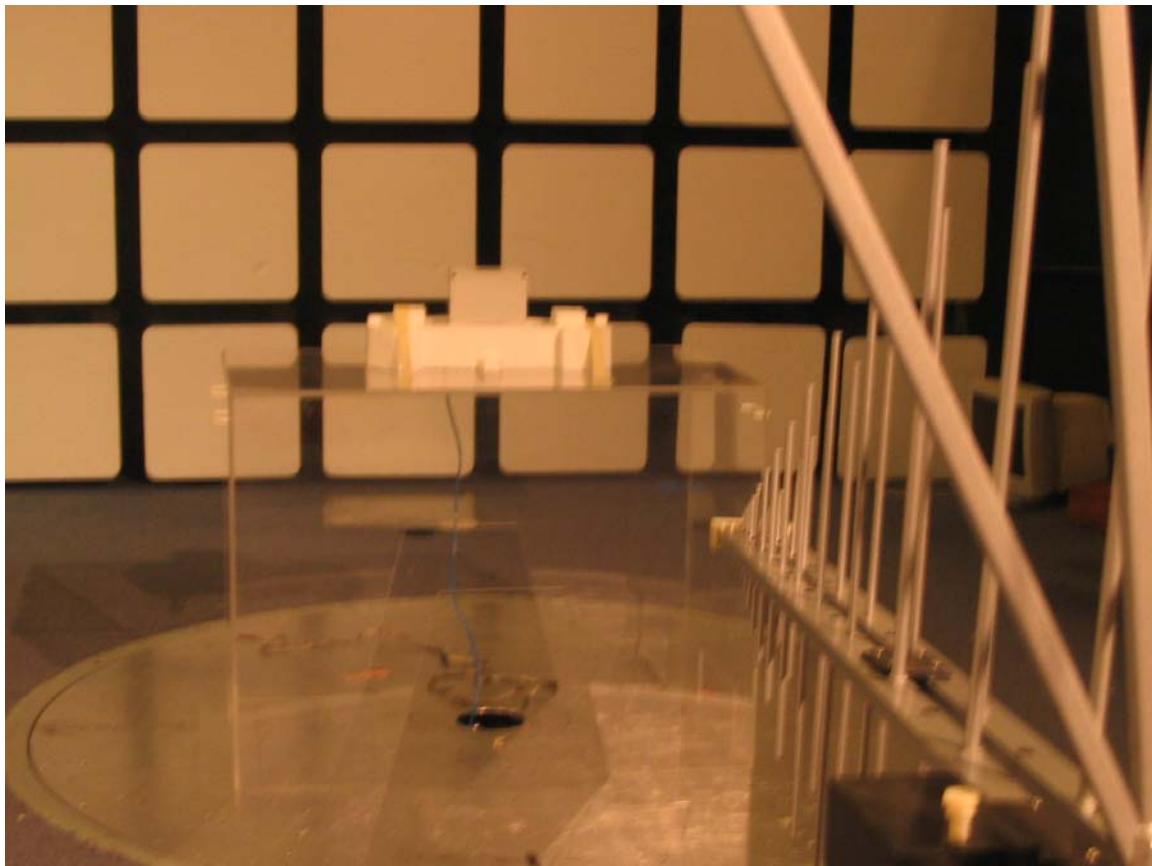


Sensys Networks
AP240-E Wireless Sensor Device

Electromagnetic Compatibility Criteria
for Intentional Radiators
CFR Title 47, Part 15, Subpart C

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.209(a) Radiated Emission



Photograph 2. Radiated Emission Test Setup, 30-1000 MHz



Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(a) Bandwidth & Channelization Requirements

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. For DTS, the minimum 6 dB bandwidth shall be at least 500 kHz. For frequency hopping systems, the EUT shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

Test Procedure:

The transmitter was set to the lowest channel and the output was connected to the spectrum analyzer. 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 20 dB bandwidth was measured and recorded. Repeated the measurement with middle and highest channel.

Frequency hopping was set when channelization requirements were measured.

Test Results:

The EUT was found compliant with the Radiated Emission limits of **§15.247(a)** for Intentional Radiators. See following pages for detailed test results.

Test Engineer:

Asad Bajwa

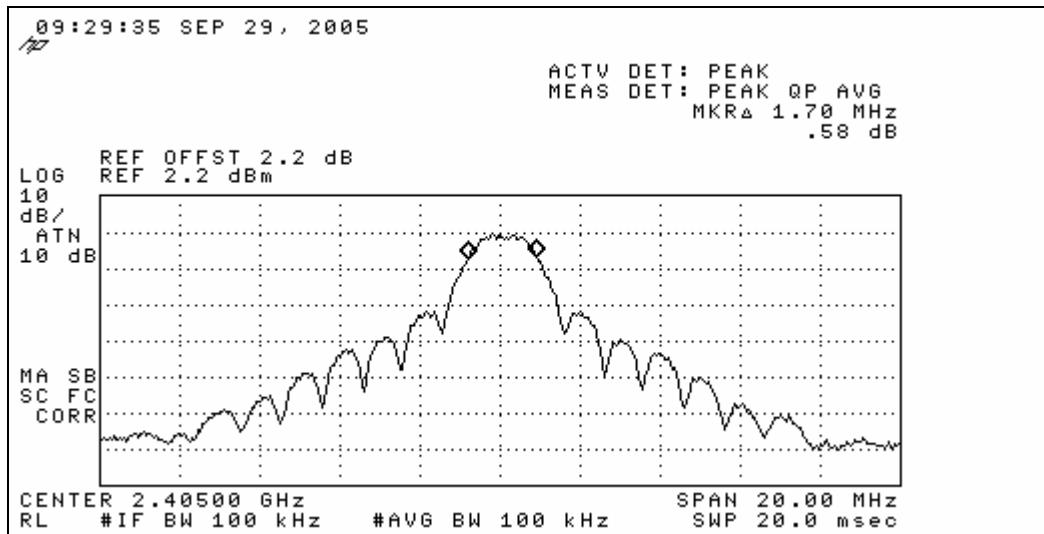
Test Date(s):

10/17/05

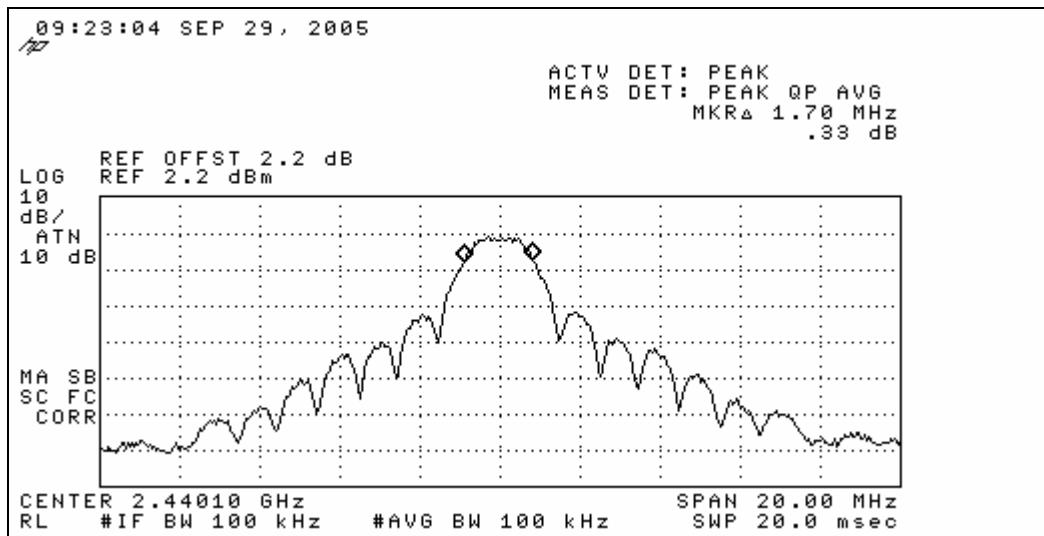


Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247 6 dB Bandwidth



Plot 1 Low-Channel Occupied BW

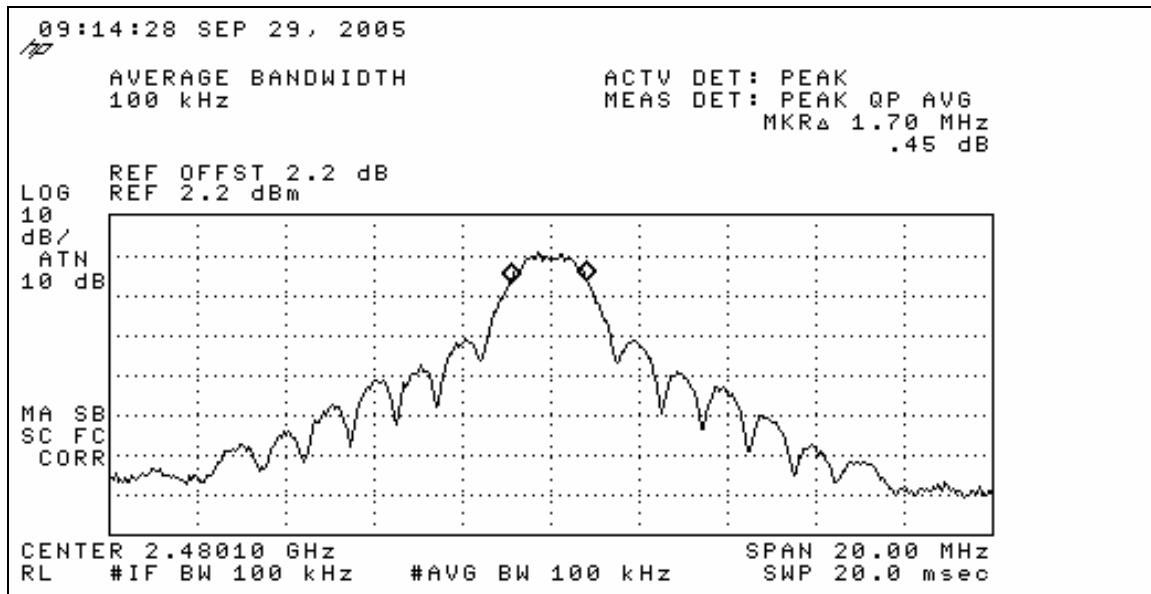


Plot 2 Mid-Channel Occupied BW



Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247 6 dB Bandwidth



Plot 3 High-Channel Occupied BW



Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(b) Output Power and RF Exposure

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

Frequency Hopping Systems Band (MHz)	Output Limit for systems with 25 to <50 Channels (Watts)	Output Limit for systems with ≥ 50 Channels (Watts)
902-928	0.250	1.000
2400-2483.5	0.125	1.000
5725- 5850	1.000	1.000

Table 8. 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,

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 8, 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.

RF Exposure Requirements - §15.247(b) (5); §1.1307(b) (1): 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.



Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(b) Output Power and RF Exposure

Test Procedure: The transmitter was set to the lowest channel and the output was connected to the spectrum analyzer. The RBW was set at least 3 times larger than the bandwidth of the emission, $VBW \geq RBW$. The output power was measured and recorded. Repeated the measurement with middle and highest channel.

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

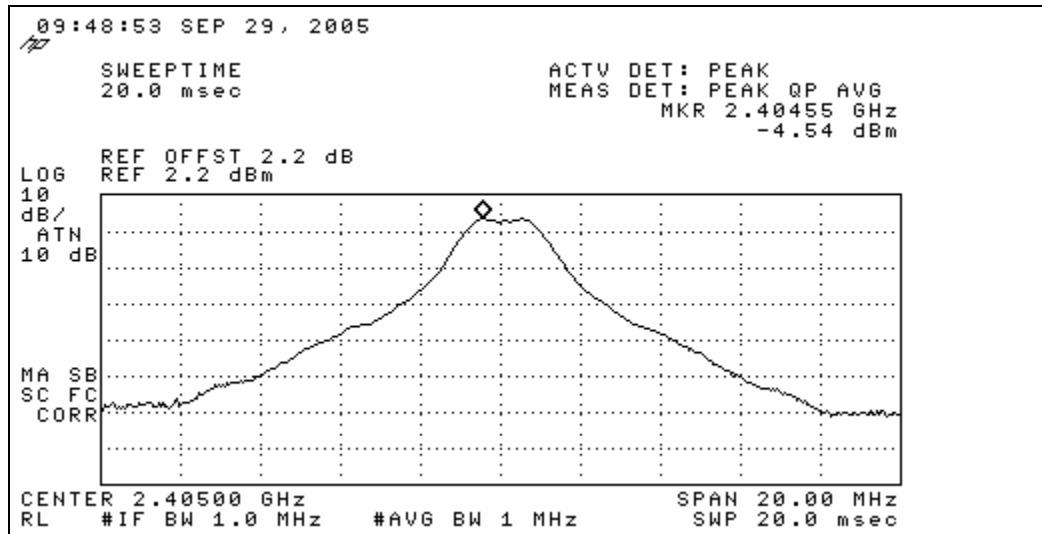
The peak output power was determined from the plots on the following page(s).

Test Engineer: Asad Bajwa

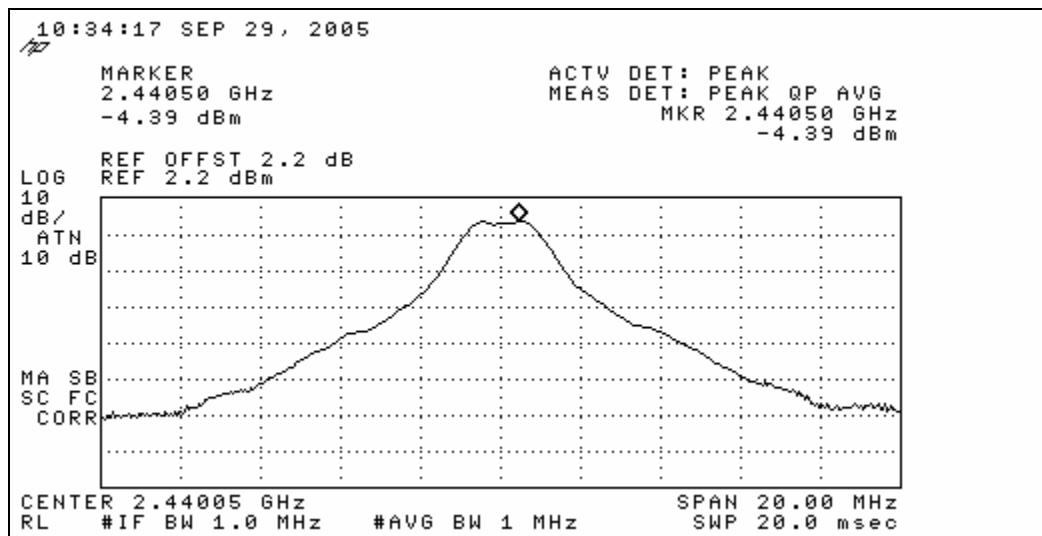
Test Date(s): 10/16/05

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(b) Output Power and RF Exposure



Plot 4 Low Channel (2402 MHz) Power Output

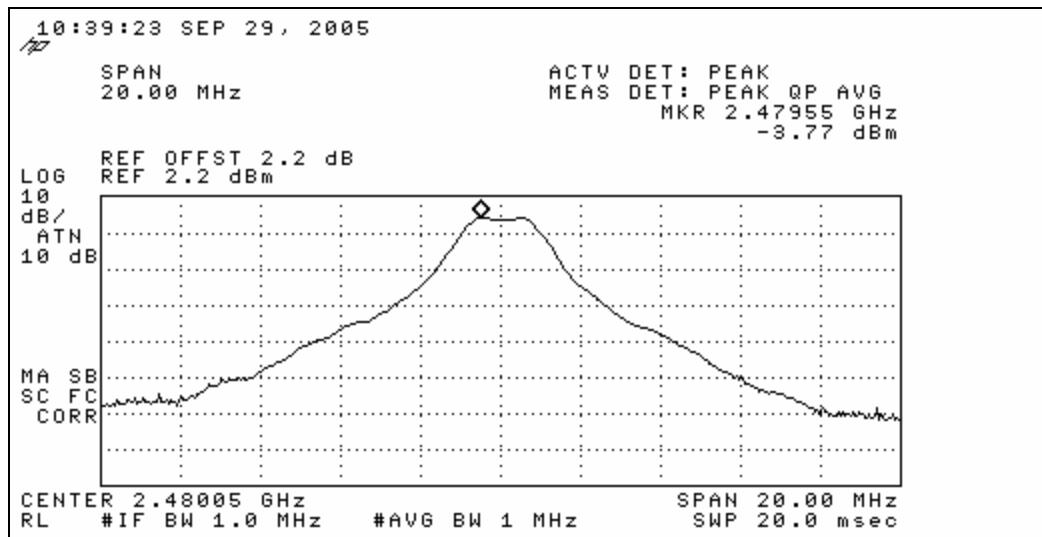


Plot 5 Mid Channel (2441 MHz) Power



Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(b) Output Power and RF Exposure





Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(b) Output Power and RF Exposure, cont.

Remarks: Equipment complies with the Output Power and RF Exposure limits of § 15.247 (b).

Test Results:

Channel #	Channel (MHz)	Max Conducted Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP(mW)
1	2405	-4.54	5.0	0.46	1.11
8	2441	-4.39	5.0	0.61	1.15
15	2480	-3.77	5.0	1.23	1.32

Table 9. RF Exposure Requirements - 1.1307(b) (2); 1.1310

Specification: 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.

MPE Limit Calculation: EUT's operating frequencies @ 2402 - 2480 MHz; EIRP 1.32 dBm therefore, **Limit for Uncontrolled exposure: 1 mW/cm² or 10 W/m²**

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

$$S = PG / 4\pi R^2 \quad \text{where, } S = \text{Power Density}$$

P = Power Input to antenna (0.000419 Watts)

G = Antenna Gain (5 dBi) – numeric gain (3.16)

R = distance to the center of radiation of the antenna (20 cm or 0.2 m)

$$S = 0.000419W \times 3.16 / 4 \times 3.14 \times (0.2m)^2 = 0.0135W / 0.5024m^2 = .002W/m^2$$

EUT comply with 20cm distance exposure.



Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(c) 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 8 dBm in any 3 kHz band during any time interval of continuous transmission.

Test Procedure: The transmitter output was connected to the spectrum analyzer through an attenuator.

RBW = 3 kHz, VBW > RBW

Sweep = Span/3 kHz

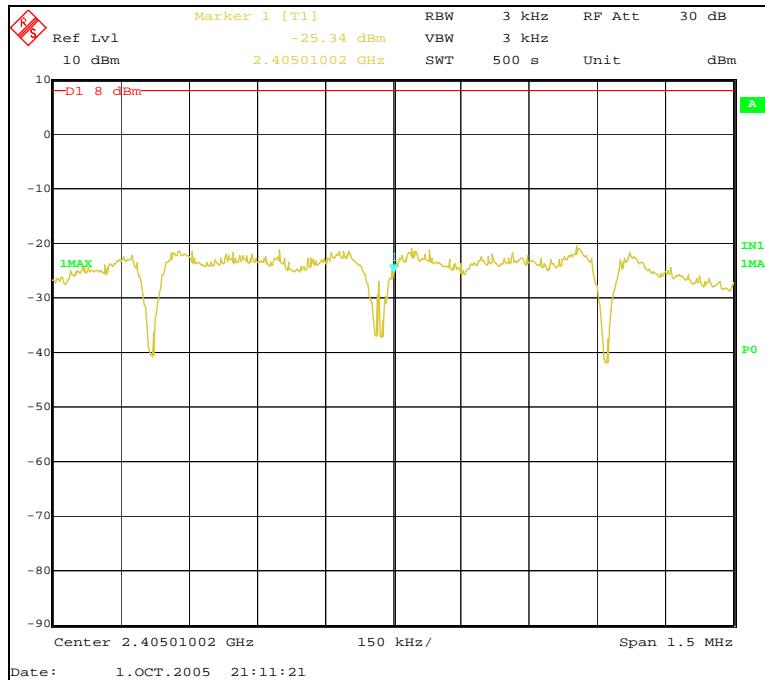
Test Results: Equipment complies with the power spectral density limits of **§15.247 (d)**. The power spectral density was determined from plots on the following page(s).

Test Engineer: Asad Bajwa

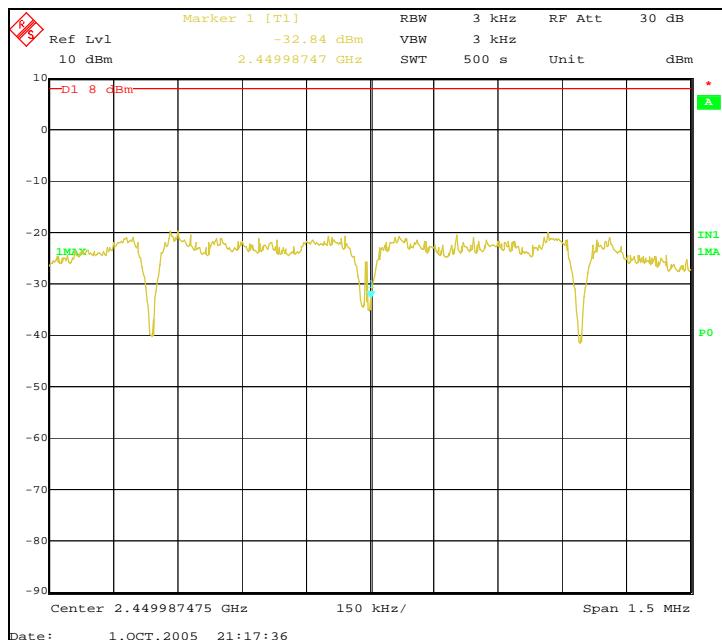
Test Date: 10/17/05

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(c) Power Spectral Density Test Results



Plot 7 Power Spectral Density Plot 1

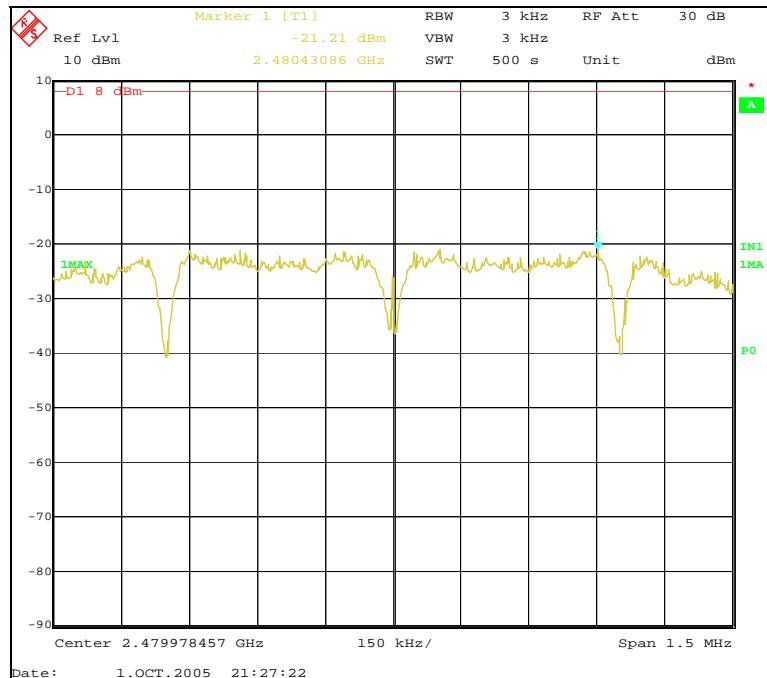


Plot 8 Power Spectral Density Plot 2



Electromagnetic Compatibility Criteria for Intentional Radiators

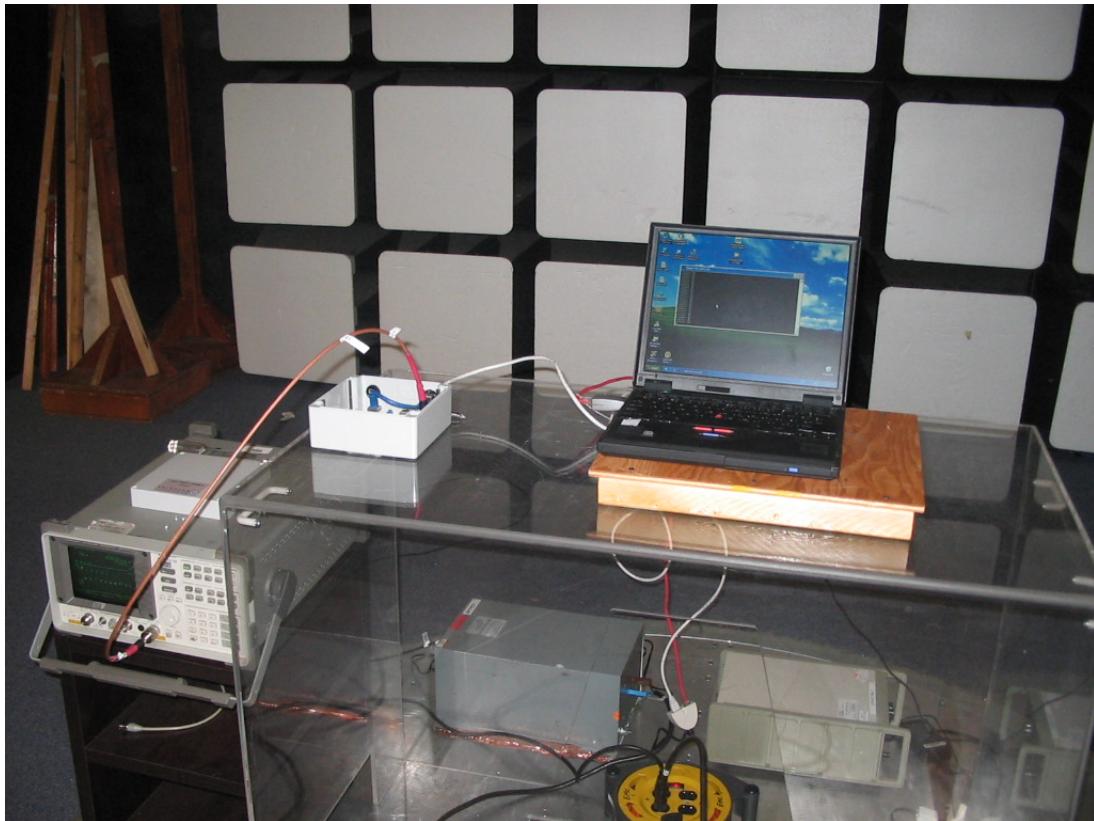
§ 15.247(c) Power Spectral Density Test Results



Plot 9 Power Spectral Density Plot 3

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(c) Power Spectral Density Test Setup



Photograph 3 Power Spectral Density Test Setup



Electromagnetic Compatibility Criteria for Intentional Radiators

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

Test Requirement(s): **§ 15.205 (a):** Except as shown in paragraph (d) of **15.205 Restricted bands of operation**, only spurious emissions are permitted in any of the frequency bands specified in Table 10:

§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).

MHz	MHz	MHz	GHz
0.090–0.110	16.42–16.423	399.9–410	4.5–5.15
0.495–0.505 (Note 1)	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	(Note 2)
13.36–13.41.			

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

Table 10. Restricted Bands of Operation from FCC Part 15, § 15.205



Electromagnetic Compatibility Criteria for Intentional Radiators

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

§ 15.205 (b): Except as provided in paragraphs (d) and (e) of this section, the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in §15.209.

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

Test Results: The EUT complied with the requirement(s) of this section. There is no detectable emission at 2.39 GHz. (noise floor).

Emissions at restricted band at 3 meters (2.4835 GHz):

$$(24.29 + 28.77 - 10) \text{ dB}\mu\text{V} = 43.06 \text{ dB}\mu\text{V}$$

The 28.77 dB is antenna factor @ 2.4835 GHz
The 10 dB is distance correction factor.

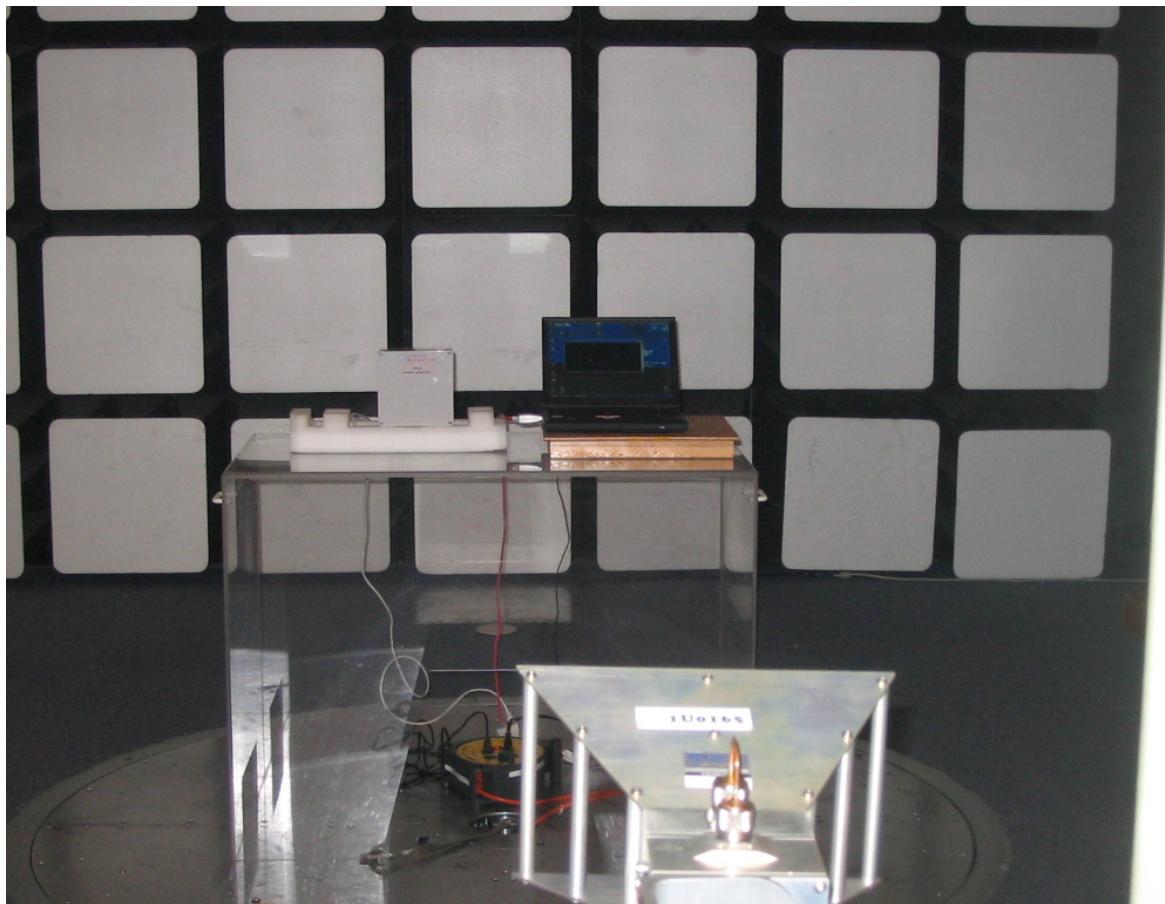
Limit: 54 dB μ V at 3 meters

Test Engineer(s): Asad Bajwa

Test Date(s): 10/15/05

Electromagnetic Compatibility Criteria for Intentional Radiators

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



Photograph 4 Spurious Emissions Requirements – Radiated and RF Conducted Test Setup



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 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 oriented in 3 orthogonal axis and rotated 360 degrees 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 1 MHz and average measurements were made with $RBW = 1 \text{ MHz}$ and $VBW = 10 \text{ Hz}$. Repeated the measurement with middle and highest channel.

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.

For Radiated Emissions Bandedge measurement, set an offset of 22.9 dB to the Spectrum Analyzer to compensate the antenna factor, cable loss and distance correction factor. 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.

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. $RBW = 100 \text{ kHz}$, $VBW \geq RBW$. Scan through 10th harmonic of the highest fundamental frequency. Repeated the measurement with middle and highest channel.

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 Restricted Bands.

Test Engineer:

Asad Bajwa

Test Date:

10/17/05



Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(c) Spurious Emissions Requirements – Radiated

Frequency (GHz)	EUT Azimuth (Degrees)	EUT Polarization (H/V)	Height (m)	Detector (AVG/ PK)	Raw (dB μ V)	Pre-Amp (dB)	Antenna Correction Factor (dB)	CBL (dB)	Distance Correction Factor (dB)	Corrected (dB μ V/m)	Limit (dB μ V/m)	Delta (dB μ V/m)	Remark(s)
4.810	0	H	1.2	AVG	28.2	34.52	34.80	3.61	9.54	22.54880	54.0	-31.4512	A & E
4.810	0	V	1.0	AVG	31.3	34.52	34.90	3.61	9.54	25.74880	54.0	-28.2512	A & E
4.810	0	H	1.2	PK	36.7	34.52	34.80	3.61	9.54	31.04880	74.0	-42.9512	A & E
4.810	0	V	1.0	PK	40.2	34.52	34.90	3.61	9.54	34.64880	74.0	-39.3512	A & E
7.215	0	H	1.2	AVG	32.3	34.50	38.05	4.55	9.54	30.85740	54.0	-23.1426	A & E
7.215	270	V	1.0	AVG	33.2	34.50	38.05	4.55	9.54	31.75740	54.0	-22.2426	A & E
7.215	135	H	1.2	PK	44.4	34.50	38.05	4.55	9.54	42.95740	74.0	-31.0426	A & E
7.215	270	V	1.0	PK	46.2	34.50	38.05	4.55	9.54	44.75740	74.0	-29.2426	A & E
9.620	135	H	1.2	AVG	31.3	34.90	39.20	5.45	9.54	31.51200	54.0	-22.488	A & E
9.620	270	V	1.0	AVG	32.4	34.90	39.10	5.45	9.54	32.51200	54.0	-21.488	A & E
9.620	135	H	1.2	PK	43.3	34.90	39.20	5.45	9.54	43.51200	74.0	-30.488	A & E
9.620	270	V	1.0	PK	43.7	34.90	39.10	5.45	9.54	43.81200	74.0	-30.188	A & E
12.025	135	H	1.2	AVG	34.5	34.10	40.91	6.50	9.54	38.27100	54.0	-15.729	A & E
12.025	270	V	1.0	AVG	34.5	34.10	40.99	6.50	9.54	38.35100	54.0	-15.649	A & E
12.025	135	H	1.2	PK	3.2	34.10	40.91	6.50	9.54	6.97100	74.0	-67.029	A & E
12.025	270	V	1.0	PK	44.2	34.10	40.99	6.50	9.54	48.05100	74.0	-25.949	A & E
14.430	135	H	1.2	AVG	37.8	33.73	41.37	7.14	9.54	43.04137	54.0	-10.95863	A & E
14.430	270	V	1.0	AVG	38	33.73	41.37	7.14	9.54	43.24137	54.0	-10.75863	A & E
14.430	135	H	1.2	PK	48.2	33.73	41.37	7.14	9.54	53.44137	74.0	-20.55863	A & E
14.430	270	V	1.0	PK	48.7	33.73	41.37	7.14	9.54	53.94137	74.0	-20.05863	A & E
16.835	135	H	1.2	AVG	35.6	33.99	41.85	7.85	15.56	35.75451	54.0	-18.24549	B & E
16.835	270	V	1.0	AVG	36.4	33.99	42.09	7.85	15.56	36.79851	54.0	-17.20149	B & E
16.835	135	H	1.2	PK	48.3	33.99	41.85	7.85	15.56	48.45451	74.0	-25.54549	B & E
16.835	270	V	1.0	PK	47.9	33.99	42.09	7.85	15.56	48.29851	74.0	-25.70149	B & E
19.240	135	H	1.2	AVG	37.56	33.78	44.78	8.93	15.56	41.92796	54.0	-12.07204	B & E
19.240	270	V	1.0	AVG	37.9	33.78	44.78	8.93	15.56	42.26796	54.0	-11.73204	B & E
19.240	135	H	1.2	PK	48.9	33.78	44.78	8.93	15.56	53.26796	74.0	-20.73204	B & E
19.240	270	V	1.0	PK	51.2	33.78	44.78	8.93	15.56	55.56796	74.0	-18.43204	B & E
21.645	135	H	1.2	AVG	45.1	34.24	45.36	9.41	20.00	45.63472	54.0	-8.365276	C & E
21.645	270	V	1.0	AVG	45.2	34.24	45.36	9.41	20.00	45.73472	54.0	-8.265276	C & E
21.645	135	H	1.2	PK	54.2	34.24	45.36	9.41	20.00	54.73472	74.0	-19.26528	C & E
21.645	270	V	1.0	PK	56.1	34.24	45.36	9.41	20.00	56.63472	74.0	-17.36528	C & E
24.050	135	H	1.2	AVG	45.2	34.23	45.78	10.1	20.00	46.93750	54.0	-7.062500	C & E
24.050	270	V	1.0	AVG	42.4	34.23	45.78	10.1	20.00	44.137500	54.0	-9.862500	C & E
24.050	135	H	1.2	PK	53.5	34.23	45.78	10.1	20.00	55.237500	74.0	-18.76250	C & E
24.050	270	V	1.0	PK	52.1	34.23	45.78	10.1	20.00	53.837500	74.0	-20.16250	C & E

Low Channel Emissions



Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(c) Spurious Emissions Requirements – Radiated

Frequency (GHz)	EUT Azimuth (Degrees)	EUT Polarization (H/V)	Height (m)	Detector (AVG/ PK)	Raw (dB μ V)	Pre-Amp (dB)	Antenna Correction Factor (dB)	CBL (dB)	Distance Correction Factor (dB)	Corrected (dB μ V/m)	Limit (dB μ V/m)	Delta (dB μ V/m)	Remark(s)
4.88	0	H	1.2	AVG	29.20	34.52	34.80	3.64	9.54	23.57600	54.0	-30.42400	A & E
4.88	0	V	1.0	AVG	32.20	34.52	34.90	3.64	9.54	26.67600	54.0	-27.32400	A & E
4.88	0	H	1.2	PK	35.60	34.52	34.80	3.64	9.54	29.97600	74.0	-44.02400	A & E
4.88	270	V	1.0	PK	39.70	34.52	34.90	3.64	9.54	34.17600	74.0	-39.82400	A & E
7.32	0	H	1.2	AVG	31.60	34.50	38.05	4.59	9.54	30.20300	54.0	-23.79700	A & E
7.32	0	V	1.0	AVG	32.40	34.50	38.05	4.59	9.54	31.00300	54.0	-22.99700	A & E
7.32	135	H	1.2	PK	44.40	34.50	38.05	4.59	9.54	43.00300	74.0	-30.99700	A & E
7.32	270	V	1.0	PK	46.2	34.50	38.05	4.59	9.54	44.80300	74.0	-29.19700	A & E
9.76	135	H	1.2	AVG	31.30	34.90	39.20	5.50	9.54	31.56000	54.0	-22.44000	A & E
9.76	270	V	1.0	AVG	32.40	34.90	39.10	5.50	9.54	32.56000	54.0	-21.44000	A & E
9.76	135	H	1.2	PK	43.30	34.90	39.20	5.50	9.54	43.56000	74.0	-30.44000	A & E
9.76	270	V	1.0	PK	43.70	34.90	39.10	5.50	9.54	43.86000	74.0	-30.14000	A & E
12.20	135	H	1.2	AVG	34.50	34.10	40.91	6.55	9.54	38.31500	54.0	-15.68500	A & E
12.20	270	V	1.0	AVG	34.50	34.10	40.99	6.55	9.54	38.39500	54.0	-15.60500	A & E
12.20	135	H	1.2	PK	3.20	34.10	40.91	6.55	9.54	7.01500	74.0	-66.98500	A & E
12.20	270	V	1.0	PK	44.20	34.10	40.99	6.55	9.54	48.09500	74.0	-25.90500	A & E
14.64	135	H	1.2	AVG	37.80	33.96	41.14	7.18	9.54	42.62816	54.0	-11.37180	A & E
14.64	270	V	1.0	AVG	38.00	33.96	41.10	7.18	9.54	42.78816	54.0	-11.21180	A & E
14.64	135	H	1.2	PK	48.20	33.96	41.14	7.18	9.54	53.02816	74.0	-20.97180	A & E
14.64	270	V	1.0	PK	48.70	33.96	41.10	7.18	9.54	53.48816	74.0	-20.51180	A & E
17.08	135	H	1.2	AVG	35.60	33.78	43.37	7.92	15.56	37.54657	54.0	-16.45340	B & E
17.08	270	V	1.0	AVG	36.40	33.78	43.62	7.92	15.56	38.59657	54.0	-15.40340	B & E
17.08	135	H	1.2	PK	48.30	33.78	43.37	7.92	15.56	50.24657	74.0	-23.75340	B & E
17.08	270	V	1.0	PK	47.90	33.78	43.62	7.92	15.56	50.09657	74.0	-23.90340	B & E
19.52	135	H	1.2	AVG	37.56	33.96	45.12	9.06	15.56	42.22700	54.0	-11.77300	B & E
19.52	270	V	1.0	AVG	37.90	33.96	45.12	9.06	15.56	42.56700	54.0	-11.43300	B & E
19.52	135	H	1.2	PK	48.90	33.96	45.12	9.06	15.56	53.56700	74.0	-20.43300	B & E
19.52	270	V	1.0	PK	51.20	33.96	45.12	9.06	15.56	55.86700	74.0	-18.13300	B & E
21.96	135	H	1.2	AVG	45.10	34.30	45.34	9.51	20.00	45.65695	54.0	-8.343050	C & E
21.96	270	V	1.0	AVG	45.20	34.30	45.34	9.51	20.00	45.75695	54.0	-8.243050	C & E
21.96	135	H	1.2	PK	54.20	34.30	45.34	9.51	20.00	54.75695	74.0	-19.243100	C & E
21.96	270	V	1.0	PK	56.10	34.30	45.34	9.51	20.00	56.65695	74.0	-17.343100	C & E
24.40	135	H	1.2	AVG	44.30	34.05	45.70	10.4	20.00	46.34430	54.0	-7.655700	C & E
24.40	270	V	1.0	AVG	41.60	34.05	45.70	10.4	20.00	43.64430	54.0	-10.35570	C & E
24.40	135	H	1.2	PK	52.40	34.05	45.70	10.4	20.00	54.44430	74.0	-19.55570	C & E
24.40	270	V	1.0	PK	53.70	34.05	45.70	10.0	20.00	55.74430	74.0	-18.25570	C & E

Mid-Channel Emissions



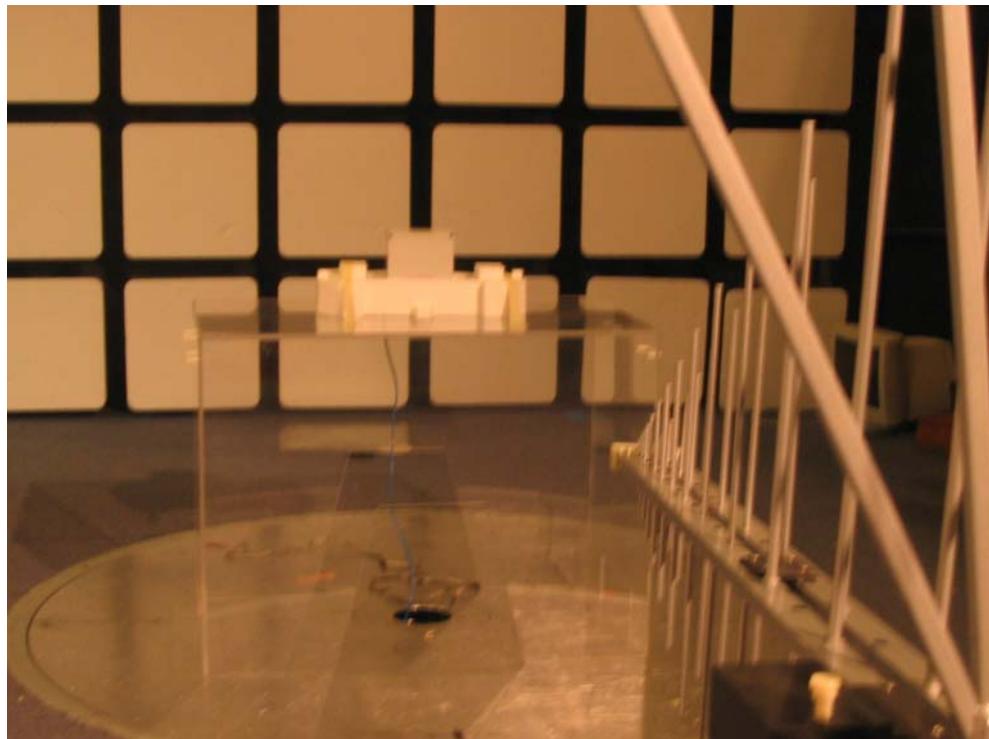
Electromagnetic Compatibility Criteria for Intentional Radiators
§ 15.247(c) Spurious Emissions Requirements – Radiated

Frequency (GHz)	EUT Azimuth (Degrees)	EUT Polarization (H/V)	Height (m)	Detector (AVG/PK)	Raw (dB μ V)	Pre-Amp (dB)	Antenna Correction Factor (dB)	CBL (dB)	Distance Correction Factor (dB)	Corrected (dB μ V/m)	Limit (dB μ V/m)	Delta (dB μ V/m)	Remark(s)
4.950	135	H	1.2	AVG	32.7	34.52	34.80	3.65	9.54	27.0896	54.0	-26.91040	A
4.950	270	V	1.0	AVG	38.9	34.52	34.90	3.65	9.54	33.3896	54.0	-20.61040	A
4.950	135	H	1.2	PK	46.9	34.52	34.80	3.65	9.54	41.2896	74.0	-32.71040	A
4.950	270	V	1.0	PK	53.9	34.52	34.90	3.65	9.54	48.3896	74.0	-25.61040	A
7.425	135	H	1.2	AVG	34.1	34.50	38.05	4.62	9.54	32.7258	54.0	-21.27420	A & E
7.425	270	V	1.0	AVG	34.6	34.50	38.05	4.62	9.54	33.2258	54.0	-20.77420	A & E
7.425	135	H	1.2	PK	44.9	34.50	38.05	4.62	9.54	43.5258	74.0	-30.47420	A & E
7.425	270	V	1.0	PK	44.8	34.50	38.05	4.62	9.54	43.4258	74.0	-30.57420	A & E
9.900	135	H	1.2	AVG	34.1	34.90	39.20	5.52	9.54	34.384	54.0	-19.61600	A & E
9.900	270	V	1.0	AVG	32.9	34.90	39.10	5.52	9.54	33.084	54.0	-20.91600	A & E
9.900	135	H	1.2	PK	44.4	34.90	39.20	5.52	9.54	44.684	74.0	-29.31600	A & E
9.900	270	V	1.0	PK	45.1	34.90	39.10	5.52	9.54	45.284	74.0	-28.71600	A & E
12.375	135	H	1.2	AVG	33.8	34.10	40.91	6.57	9.54	37.637	54.0	-16.36300	A & E
12.375	270	V	1.0	AVG	33.8	34.10	40.99	6.57	9.54	37.717	54.0	-16.28300	A & E
12.375	135	H	1.2	PK	43.8	34.10	40.91	6.57	9.54	47.637	74.0	-26.36300	A & E
12.375	270	V	1.0	PK	43.8	34.10	40.99	6.57	9.54	47.717	74.0	-26.28300	A & E
14.850	135	H	1.2	AVG	37.9	34.06	41.04	7.21	9.54	42.55498	54.0	-11.44500	A & E
14.850	270	V	1.0	AVG	37.8	34.06	40.98	7.21	9.54	42.39098	54.0	-11.60900	A & E
14.850	135	H	1.2	PK	48.6	34.06	41.04	7.21	9.54	53.25498	74.0	-20.74500	A & E
14.850	270	V	1.0	PK	47.8	34.06	40.98	7.21	9.54	52.39098	74.0	-21.60900	A & E
17.325	135	H	1.2	AVG	38.7	33.77	44.18	7.95	15.56	41.50474	54.0	-12.49530	B & E
17.325	270	V	1.0	AVG	38.8	33.77	44.29	7.95	15.56	41.71474	54.0	-12.28530	B & E
17.325	135	H	1.2	PK	51.1	33.77	44.18	7.95	15.56	53.90474	74.0	-20.09530	B & E
17.325	270	V	1.0	PK	50.3	33.77	44.29	7.95	15.56	53.21474	74.0	-20.78530	B & E
19.800	135	H	1.2	AVG	40.2	34.06	45.31	9.10	15.56	44.9974	54.0	-9.00260	B & E
19.800	270	V	1.0	AVG	38.8	34.06	45.31	9.10	15.56	43.5974	54.0	-10.40260	B & E
19.800	135	H	1.2	PK	50.2	34.06	45.31	9.10	15.56	54.9974	74.0	-19.00260	B & E
19.800	270	V	1.0	PK	49.6	34.06	45.31	9.10	15.56	54.3974	74.0	-19.60260	B & E
22.275	135	H	1.2	AVG	43.9	34.14	45.48	9.56	20.00	44.80525	54.0	-9.19475	C & E
22.275	270	V	1.0	AVG	44.2	34.14	45.48	9.56	20.00	45.10525	54.0	-8.89475	C & E
22.275	135	H	1.2	PK	54.8	34.14	45.48	9.56	20.00	55.70525	74.0	-18.29480	C & E
22.275	270	V	1.0	PK	55.3	34.14	45.48	9.56	20.00	56.20525	74.0	-17.79480	C & E
24.750	135	H	1.2	AVG	44.4	33.97	45.58	10.50	20.00	46.51066	54.0	-7.489340	C & E
24.750	270	V	1.0	AVG	44.2	33.97	45.58	10.50	20.00	46.31066	54.0	-7.689340	C & E
24.750	135	H	1.2	PK	54.3	33.97	45.58	10.50	20.00	56.41066	74.0	-17.58930	C & E
24.750	270	V	1.0	PK	54.8	33.97	45.58	10.50	20.00	56.91066	74.0	-17.08930	C & E

High-Channel Emissions

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(c) Spurious Emissions Requirements – Radiated

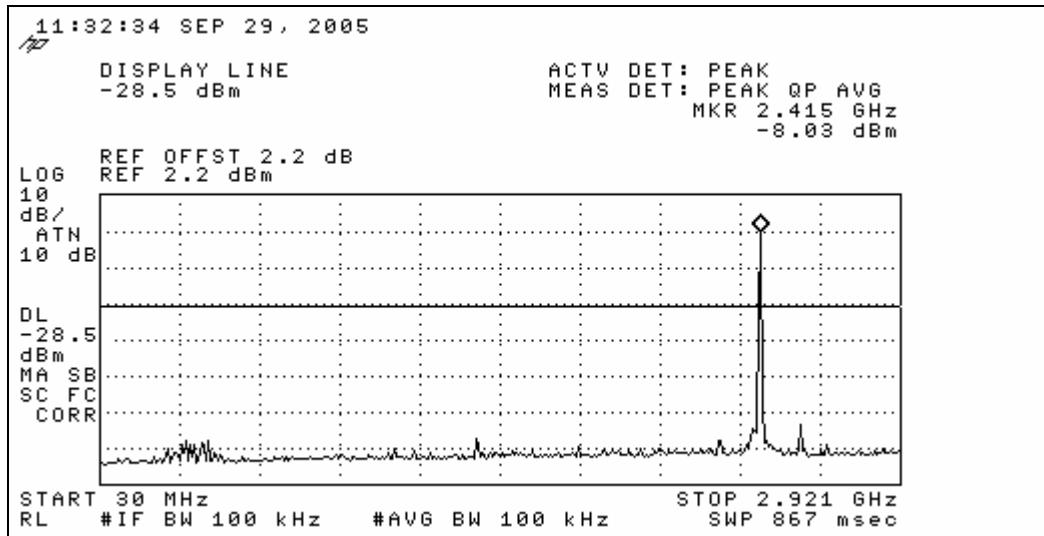


Photograph 5. Spurious Radiated Emissions Measurement Test Setup

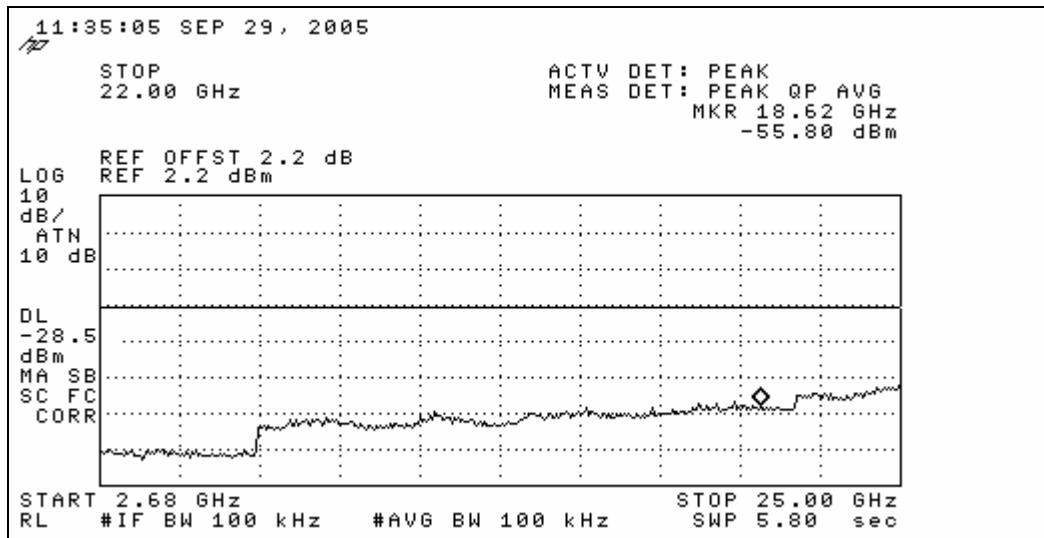


Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(c) Spurious Conducted Emissions Requirements



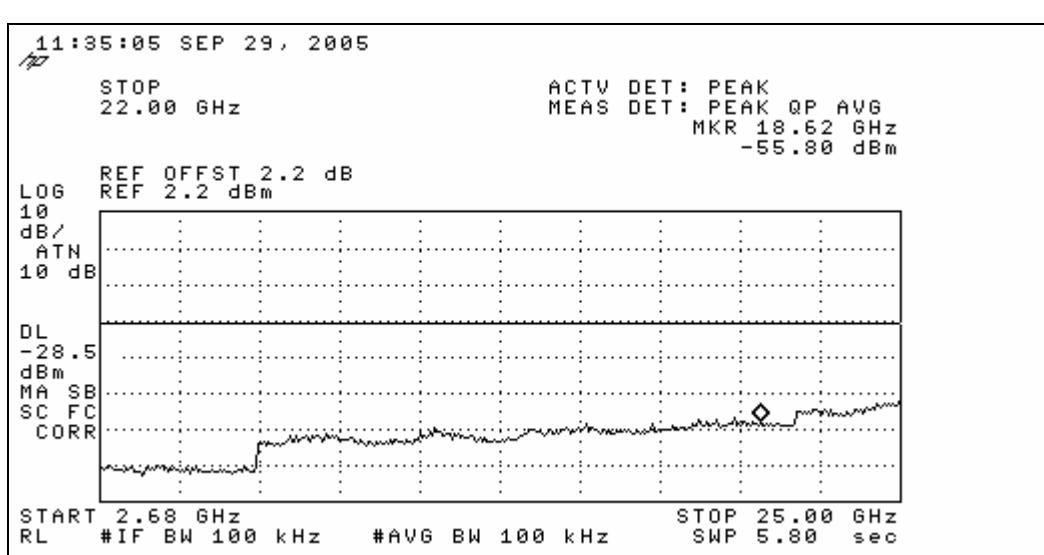
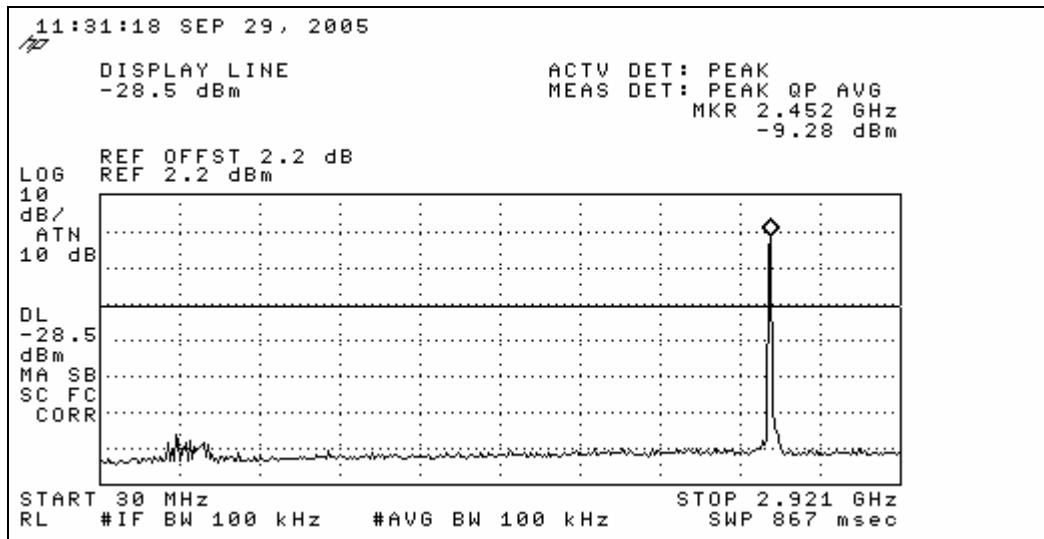
Plot 10 Low-Channel (2402 MHz) Spurious Emission, 30 MHz - 2.9 GHz



Plot 11 Low-Channel (2402 MHz) Spurious Emission, 2.68 – 25 GHz

Electromagnetic Compatibility Criteria for Intentional Radiators

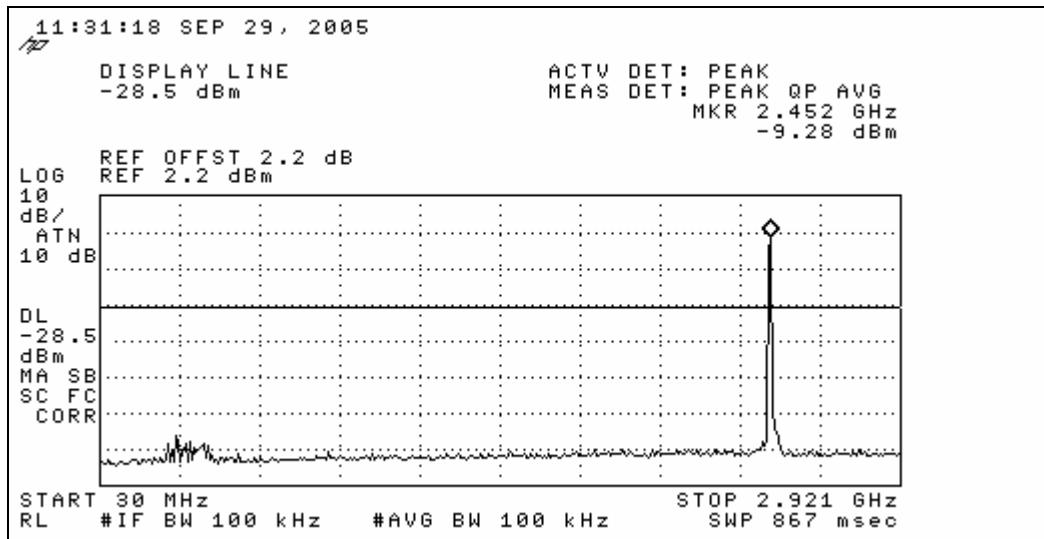
§ 15.247(c) Spurious Conducted Emissions Requirements



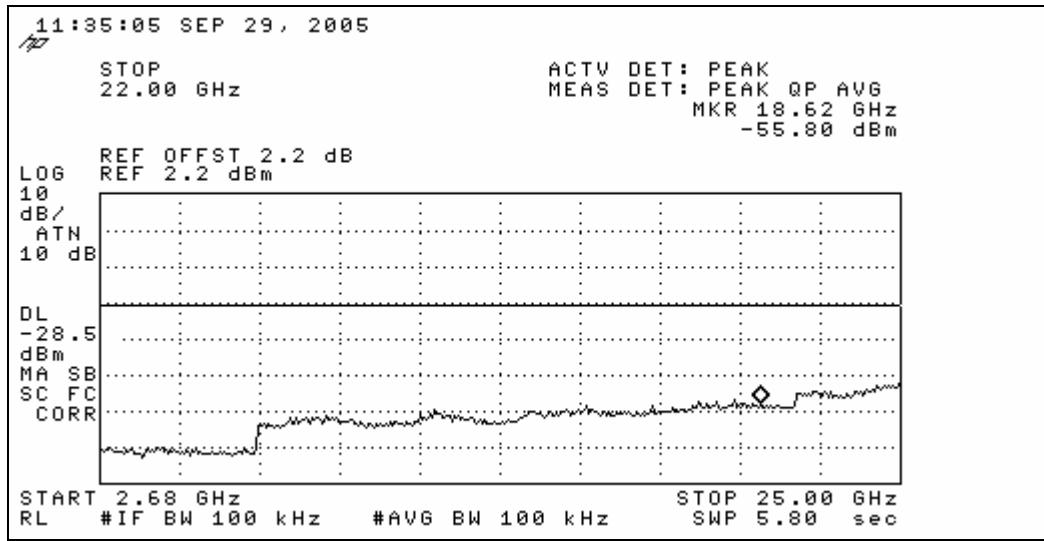
Plot 12 Mid-channel (2441 MHz) Spurious Emission, 2.68 GHz - 25 GHz

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(c) Spurious Conducted Emissions Requirements



Plot 13 High channel (2480 MHz) Spurious Emission, 30 MHz - 2.9 GHz

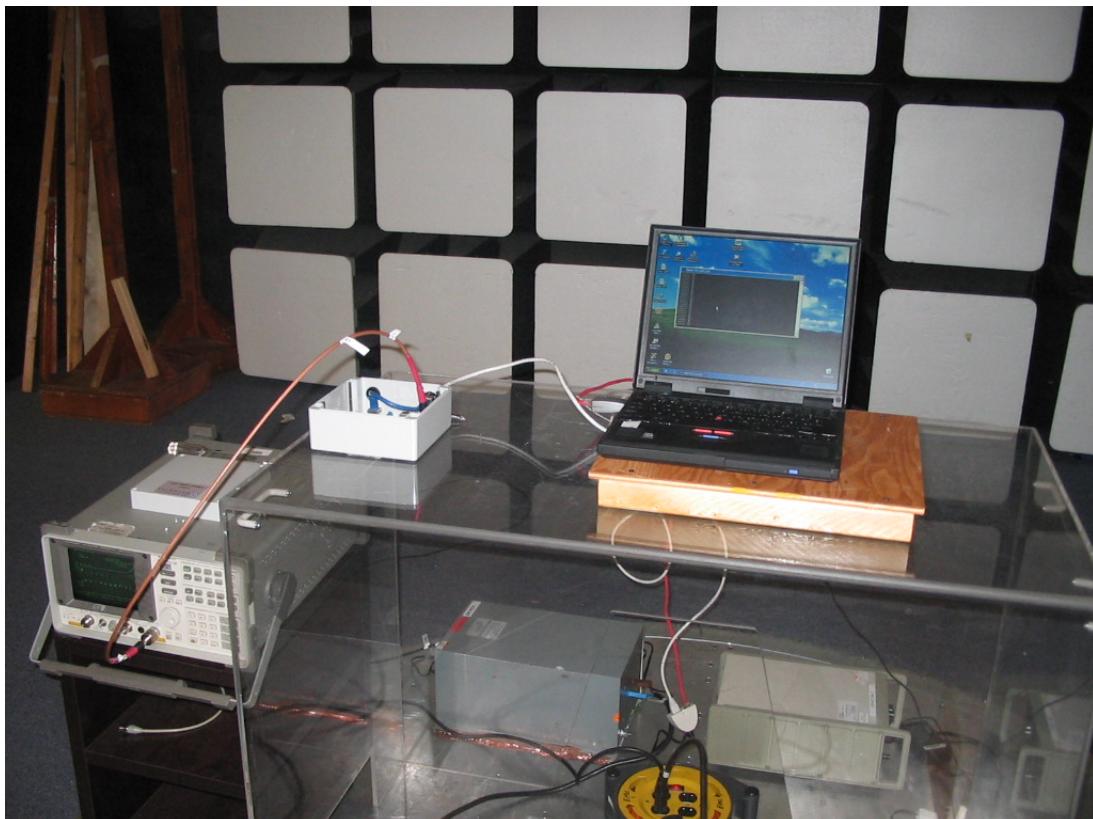


Plot 14 High-Channel (2480 MHz) Spurious Emission, 2.68 GHz - 25 GHz

Remarks: Equipment complies with the Spurious Emissions Requirements – RF Conducted limits of § 15.247(c).

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(c) Spurious Conducted Emissions Requirements



Photograph 6. Spurious Conducted Measurements 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.

All Test Equipment			Test Date(s): 03/28/05 – 04/15/05		
MET Asset #	Nomenclature	Manufacturer	Model	Last Cal Date	Cal Due Date
1U32	Semi- Anechoic Chamber	Lindgren Enclosures	Fact 4	07/25/05	07/25/06
1U170	Biconilog Antenna	ETS Lindgren	3142C	05/13/05	05/13/06
1U2	Spectrum Analyzer	Hewlett Packard	8593EM	03/07/05	03/07/06
1U165	Active Horn Antenna	Com-Power	AHA-118	01/29/05	01/29/06
1U27	Pre-Amplifier	Hewlett Packard	08449B H02	01/25/05	01/25/06
1U150	EMI Test Receiver	Rhode & Schwarz	ESIB7	04/15/05	04/15/06
1U98	LISN	Solar Electronics Company	8616-50-TS-200-N	11/15/05	11/15/06
1U97	LISN	Solar Electronics Company	8616-50-TS-200-N	11/15/05	11/15/06
1U92	Transient Limiter	Hewlett Packard	11947A	06/28/05	06/28/06



Sensys Networks
AP240-E Wireless Sensor Device

Electromagnetic Compatibility
Certification & User's Manual Information
CFR Title 47, Part 15, Subpart C

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.



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Electromagnetic Compatibility
Exhibits
CFR Title 47, Part 15, Subpart C

VI. Exhibits



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Exhibits
CFR Title 47, Part 15, Subpart C

Exhibit A, Hopping Capability Requirements



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Exhibits
CFR Title 47, Part 15, Subpart C

Exhibit B, Non-Coordination Requirements



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End of Report
CFR Title 47, Part 15, Subpart C

End of Report