



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

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November 27, 2013

Blacksumac, Inc.
126 York Street Suite 400
Ottawa, ON Canada K1N 5T5

Dear Heather McIntosh,

Enclosed is the EMC Wireless test report for compliance testing of the Blacksumac, Inc., Piper as tested to the requirements of Title 47 of the CFR, Ch. 1 (10-1-06 ed.), Part 15, Subpart B, ICES-003, Issue 5 August 2012 for a Class A Digital Device and FCC Part 15 Subpart C, RSS-210, Issue 8, December 2010 for Intentional Radiators.

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

Sincerely yours,
MET LABORATORIES, INC.

Jennifer Warnell
Documentation Department

Reference: (\Blacksumac, Inc.\EMC39564-FCC249 Rev. 1)

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Electromagnetic Compatibility Criteria Test Report

for the

**Blacksumac, Inc.
Piper**

Verified under
the FCC Certification Rules
contained in
Title 47 of the CFR, Parts 15 Subpart B & ICES-003
for Class A Digital Devices
&
15.249 Subpart C & RSS-210, Issue 8, December 2010
for Intentional Radiators

MET Report: EMC39564-FCC249 Rev. 1

November 27, 2013

Prepared For:

**Blacksumac, Inc.
126 York Street Suite 400
Ottawa, ON Canada K1N 5T5**

Prepared By:
MET Laboratories, Inc.
914 W. Patapsco Ave.
Baltimore, MD 21230

**Electromagnetic Compatibility Criteria
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Title 47 of the CFR, Parts 15 Subpart B & ICES-003
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&
15.249 Subpart C & RSS-210, Issue 8, December 2010
for Intentional Radiators



Benjamin Taylor, Project Engineer
Electromagnetic Compatibility Lab



Jennifer Warnell
Documentation Department

Engineering Statement: The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of the FCC Rules Parts 15B, 15.249 and Industry Canada standards ICES-003, Issue 5 August 2012, RSS-210, Issue 8, December 2010 under normal use and maintenance.



Asad Bajwa, Director
Electromagnetic Compatibility Lab



Report Status Sheet

Revision	Report Date	Reason for Revision
∅	November 7, 2013	Initial Issue.
1	November 27, 2013	Editorial correction.

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List of Terms and Abbreviations

AC	Alternating Current
ACF	Antenna Correction Factor
Cal	Calibration
<i>d</i>	Measurement Distance
dB	Decibels
dB μ A	Decibels above one microamp
dB μ V	Decibels above one microvolt
dB μ A/m	Decibels above one microamp per meter
dB μ V/m	Decibels above one microvolt per meter
DC	Direct Current
E	Electric Field
DSL	Digital Subscriber Line
ESD	Electrostatic Discharge
EUT	Equipment Under Test
<i>f</i>	Frequency
FCC	Federal Communications Commission
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
μ H	Microhenry
μ F	Microfarad
μ s	Microseconds
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 was performed to determine compliance of the Blacksumac, Inc. Piper, with the requirements of Part 15, §15.249. 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 Piper. Blacksumac, Inc. should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the Piper, has been **permanently** discontinued.

B. Executive Summary

The following tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 15, §15.249, in accordance with Blacksumac, Inc., purchase order number 9BLA2711R2. All tests were conducted using measurement procedure ANSI C63.4-2003.

FCC Reference	Canada Reference	Description	Results
15.107	ICES-003	AC Power Line Conducted Emissions	Compliant
15.109	ICES-003	Radiated Emissions	Compliant
§15.203	RSS GEN §7.1.2	Antenna Requirement	Compliant
§15.207	RSS GEN §7.2.4	AC Power Line Conducted Emissions	Compliant
§15.249 (a)	RSS-210 A2.9	Field Strength of Fundamental	Compliant
§15.249(a)(d), §15.209	RSS-Gen §7.2.5 and RSS-210 A2.0	Harmonics and Spurious Emissions	Compliant

Table 1. Executive Summary of EMC Part 15.249 Compliance Testing

II. Equipment Configuration

A. Overview

MET Laboratories, Inc. was contracted by Blacksumac, Inc. to perform testing on the Piper, under Blacksumac, Inc.'s purchase order number 9BLA2711R2.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the Blacksumac, Inc., Piper.

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

Model(s) Tested:	Piper	
EUT Specifications:	Primary Power to Module: 120 VAC, 60 Hz	
	FCC ID: 2AA5P-P10A001 IC: 11477A-P10A001	
	Equipment Code:	DTS
	Highest Fundamental Field Strength:	89.25 dB μ V/m @ 3m
	EUT Frequency Ranges:	908.4 MHz
Analysis:	The results obtained relate only to the item(s) tested.	
Environmental Test Conditions:	Temperature (15-35° C)	
	Relative Humidity (30-60%)	
	Barometric Pressure (860-1060 mbar)	
Evaluated by:	Benjamin Taylor	
Report Date(s):	November 27, 2013	

Table 2. EUT Specifications

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
RSS-210, Issue 8, December 2010	Low-power Licence-exempt Radiocommunications Devices (All Frequency Bands): Category I Equipment
ICES-003, Issue 5 August 2012	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
ISO/IEC 17025:2005	General Requirements for the Competence of Testing and Calibration Laboratories
ANSI C63.10-2009	American National Standard for Testing Unlicensed Wireless Devices

Table 3. References

C. Test Site

All testing was performed at MET Laboratories, Inc., 914 W. Patapsco Ave., Baltimore, MD 21230. 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 semi-anechoic chamber (equivalent to an Open Area Test Site). In accordance with §2.948(a)(3), a complete site description is contained at MET Laboratories.

D. Description of Test Sample

The Blacksumac, Inc. Feeder Meter System – Sensor, Equipment Under Test (EUT), is a consumer electronic device that monitors a user’s home. It can sit on a table or be mounted to a wall. It connects to the user’s home Wi-Fi network and can be controlled via an app on the user’s smart phone. Piper also has a z-wave radio to control z-wave home automation devices, if the user chooses. Piper has a battery backup (3xAA) for power outages.



Photograph 1. Blacksumac, Inc. Piper

E. Equipment Configuration

Ref. ID	Name / Description	Model Number	Part Number	Serial Number	Revision
1	Piper in Enclosure	71-00007	71-00007	BLSCT132800073	0.07
2	AC adaptor	WSU050-1500	--	1	--
3	Piper –no enclosure - with semi-rigid coax	71-00007	71-00007	BLSCT132800036	0.07

Table 4. Equipment Configuration

F. Support Equipment

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

Ref. ID	Name / Description	Manufacturer	Model Number
4	USB to Serial Cable	--	--
5	AC adaptor – extra for backup	Triad	WSU050-1500
6	Printed user documentation	Blacksumac	N/A
4	USB to Serial Cable (backup)	--	--

Table 5. Support Equipment

G. Mode of Operation

1. All radios off
2. Z-wave transmitting at 908.4MHz, Wi-Fi off
3. Z-wave transmitting at 908.4MHz + Wi-Fi transmitting
4. Wi-Fi transmitting

H. Monitoring Method

1. If the LED on Piper is ON, the device is powered and working. An antenna and spectrum analyzer is used to confirm Piper is transmitting on the correct channels.
2. If the LED on Piper of OFF, the device is not powered and not working.

I. Modifications

a) Modifications to EUT

Added an L-C filter at the output of a D-class audio amp.
Routing speaker wire in proper wire routing channel in the enclosure.

b) Modifications to Test Standard

No modifications were made to the test standard.

J. Disposition of EUT

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

III. Electromagnetic Compatibility Criteria for Unintentional Radiators

Electromagnetic Compatibility Criteria for Unintentional Radiators

§ 15.107 Conducted Emissions Limits

Test Requirement(s): **15.107 (a)** “Except for Class A digital devices, for equipment 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 30 MHz shall not exceed the limits in Table 6. Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminals.”

15.107 (b) “For a Class A digital device 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 30 MHz shall not exceed the limits in Table 6. Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminals. The lower limit applies at the band edges.”

Frequency range (MHz)	15.107(b), Class A Limits (dBµV)		15.107(a), Class B Limits (dBµV)	
	Quasi-Peak	Average	Quasi-Peak	Average
0.15- 0.5	79	66	66 - 56	56 - 46
0.5 – 5.0	73	60	56	46
5.0 - 30	73	60	60	50

Note 1 — The lower limit shall apply at the transition frequencies.

Table 6. Conducted Limits for Radio Frequency Devices calculated from FCC Part 15 Section 15.107(a) (b)

Test Procedures: The EUT was placed on a non-metallic table, 80cm above the ground plane and 40cm from a vertical ground plane. The method of testing, test conditions, and test procedures of ANSI C63.4 were used. The EUT was powered through a 50Ω/50µH LISN. An EMI receiver, connected to the measurement port of the LISN, scanned the frequency range from 150 kHz to 30 MHz in order to find the peak conducted emissions. All peak emissions within 6 dB of the limit were re-measured using a quasi-peak and/or average detector as appropriate.

Test Results: The EUT was compliant with the Class B requirement(s) of this section. Measured emissions were below applicable limits.

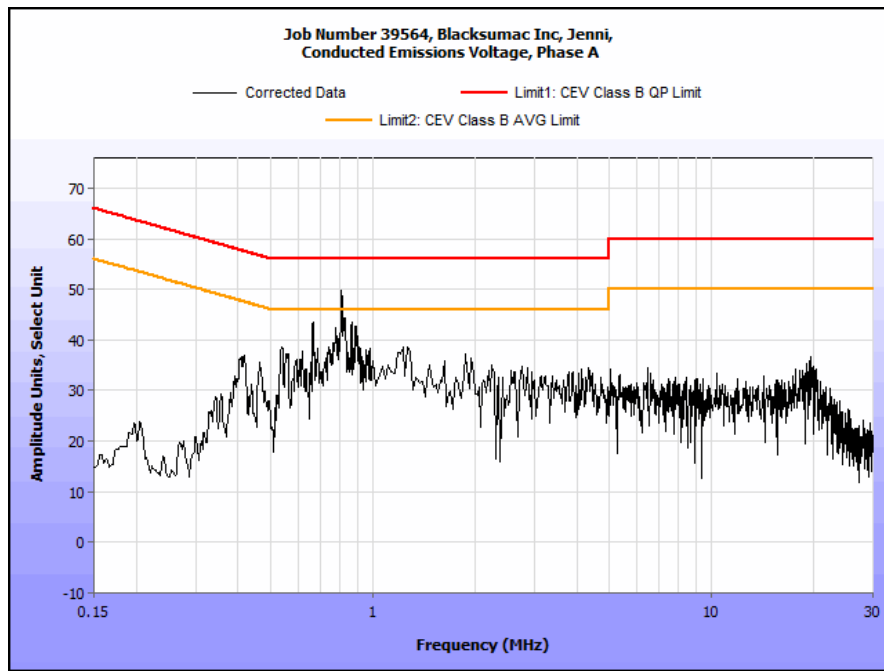
Test Engineer(s): Surinder Singh

Test Date(s): 06/05/13

Conducted Emissions - Voltage, AC Power, Phase Line (120 VAC, 60 Hz)

Frequency (MHz)	Uncorrected Meter Reading (dBµV) QP	Cable Loss (dB)	Corrected Measurement (dBµV) QP	Limit (dBµV) QP	Margin (dB) QP	Uncorrected Meter Reading (dBµV) Avg.	Cable Loss (dB)	Corrected Measurement (dBµV) AVG	Limit (dBµV) AVG	Margin (dB) AVG
0.399	16.89	0	16.89	57.87	-40.98	4.82	0	4.82	47.87	-43.05
0.677	18.37	0	18.37	56	-37.63	4.41	0	4.41	46	-41.59
0.804	21.49	0	21.49	56	-34.51	7.11	0	7.11	46	-38.89
1.946	16.11	0	16.11	56	-39.89	3.29	0	3.29	46	-42.71
4.633	12.66	0	12.66	56	-43.34	2.74	0	2.74	46	-43.26
19.22	15.38	0	15.38	60	-44.62	2.47	0	2.47	50	-47.53

Table 7. Conducted Emissions - Voltage, AC Power, Phase Line (120 VAC, 60 Hz)

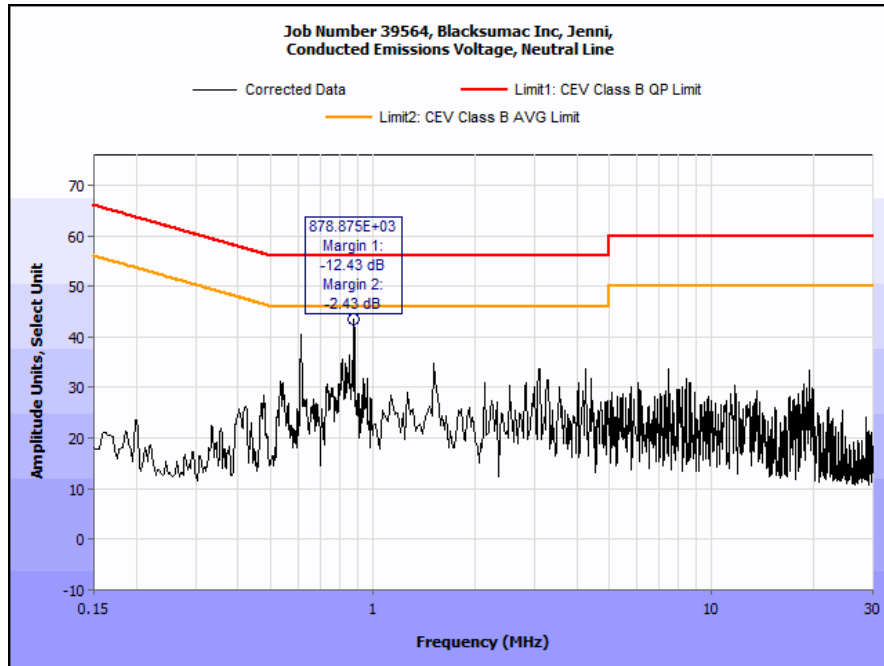


Plot 1. Conducted Emission, Phase Line Plot

Conducted Emissions - Voltage, AC Power, Neutral Line (120 VAC, 60 Hz)

Frequency (MHz)	Uncorrected Meter Reading (dBµV) QP	Cable Loss (dB)	Corrected Measurement (dBµV) QP	Limit (dBµV) QP	Margin (dB) QP	Uncorrected Meter Reading (dBµV) Avg.	Cable Loss (dB)	Corrected Measurement (dBµV) AVG	Limit (dBµV) AVG	Margin (dB) AVG
0.399	16.01	0	16.01	57.87	-41.86	3.6	0	3.6	47.87	-44.27
0.677	17.62	0	17.62	56	-38.38	4.013	0	4.013	46	-41.987
0.804	22.34	0	22.34	56	-33.66	6.407	0	6.407	46	-39.593
1.946	15.42	0	15.42	56	-40.58	3.152	0	3.152	46	-42.848
4.633	12.64	0	12.64	56	-43.36	2.222	0	2.222	46	-43.778
19.22	15.45	0	15.45	60	-44.55	2.987	0	2.987	50	-47.013

Table 8. Conducted Emissions - Voltage, AC Power, Neutral Line (120 VAC, 60 Hz)



Plot 2. Conducted Emission, Neutral Line Plot

Conducted Emission Limits Test Setup



Photograph 2. Conducted Emissions, Test Setup

Radiated Emission Limits

§ 15.109 Radiated Emissions Limits

Test Requirement(s): **15.109 (a)** Except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the Class B limits expressed in Table 9.

15.109 (b) The field strength of radiated emissions from a Class A digital device, as determined at a distance of 10 meters, shall not exceed the Class A limits expressed in Table 9.

Frequency (MHz)	Field Strength (dB μ V/m)	
	§15.109 (b), Class A Limit (dB μ V) @ 10m	§15.109 (a), Class B Limit (dB μ V) @ 3m
30 - 88	39.00	40.00
88 - 216	43.50	43.50
216 - 960	46.40	46.00
Above 960	49.50	54.00

Table 9. Radiated Emissions Limits calculated from FCC Part 15, §15.109 (a) (b)

Test Procedures: The EUT was placed on a non-metallic table, 80 cm above the ground plane on a turntable inside a semi-anechoic chamber. The method of testing and test conditions of ANSI C63.4 were used. An antenna was located 3 m from the EUT on an adjustable mast. A pre-scan was first performed in order to find prominent radiated emissions. For final emissions measurements at each frequency of interest, the EUT was rotated and the antenna height was varied between 1 m and 4 m in order to maximize the emission. Measurements in both horizontal and vertical polarities were made and the data was recorded. Unless otherwise specified, measurements were made using a quasi-peak detector with a 120 kHz bandwidth.

Test Results: The EUT was compliant with the Class B requirement(s) of this section. Measured emissions were below applicable limits.

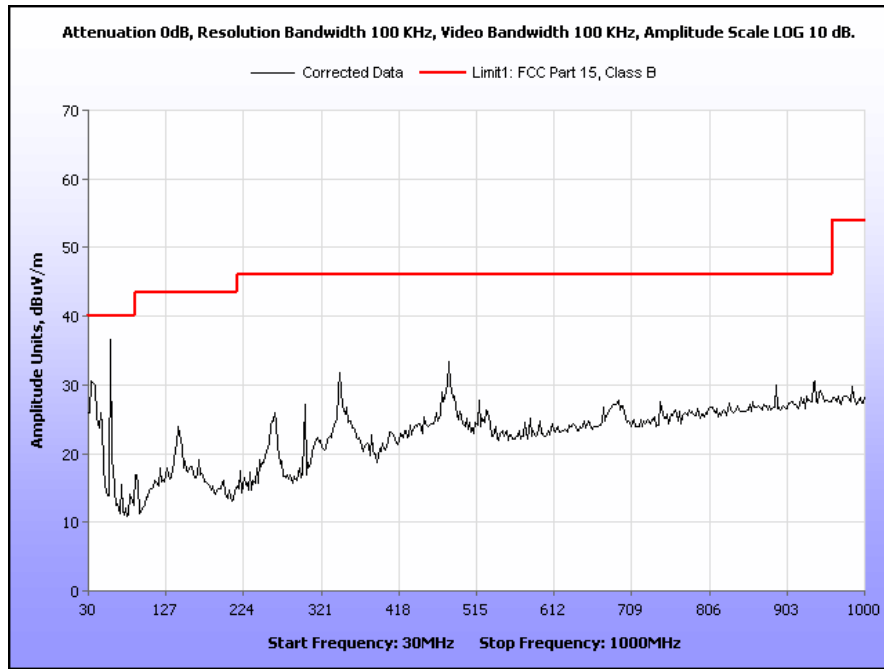
Test Engineer(s): Benjamin Taylor

Test Date(s): 10/02/13

Radiated Emissions Limits Test Results, Class B

Frequency (MHz)	EUT Azimuth (Degrees)	Antenna Polarity (H/V)	Antenna HEIGHT (m)	Uncorrected Amplitude (dBμV)	Antenna Correction Factor (dB) (+)	Cable Loss (dB) (+)	Distance Correction Factor (dB) (-)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
46.855586	348	H	1.09	5.65	9.89	0.46	0.00	16.00	40.00	-24.00
46.855586	359	V	1.06	10.41	9.89	0.46	0.00	20.76	40.00	-19.24
131.30261	331	H	1.08	5.72	13.77	0.92	0.00	20.41	43.50	-23.09
131.30261	317	V	1.11	6.34	13.77	0.92	0.00	21.03	43.50	-22.47
259.95992	290	H	1.04	5.72	12.80	1.32	0.00	19.84	46.00	-26.16
259.95992	304	V	1.08	7.36	12.80	1.32	0.00	21.48	46.00	-24.52
335.76152	270	H	1.08	5.18	14.82	1.33	0.00	21.33	46.00	-24.67
335.76152	282	V	1.05	5.65	14.82	1.33	0.00	21.80	46.00	-24.20
479.95029	172	H	1.05	6.71	17.90	1.82	0.00	26.43	46.00	-19.57
479.95029	172	V	1.02	15.16	17.90	1.82	0.00	34.88	46.00	-11.12
917.32841	210	H	1.09	6.23	23.10	2.81	0.00	32.14	46.00	-13.86
917.32841	196	V	1.12	6.30	23.10	2.81	0.00	32.21	46.00	-13.79

Table 10. Radiated Emissions Limits, Test Results, 30 MHz – 1 GHz, FCC Limits

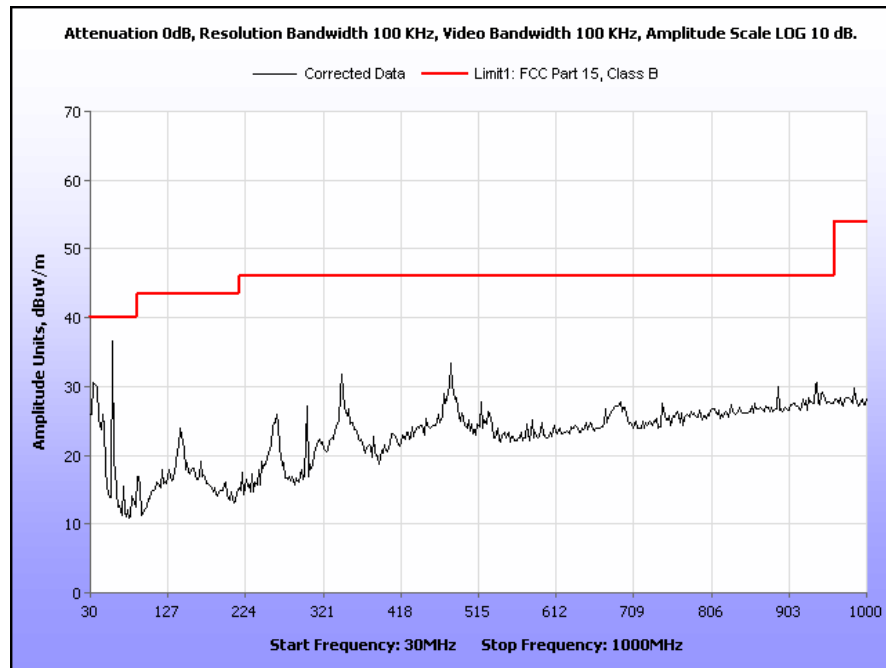


Plot 3. Radiated Emissions, 30 MHz - 1 GHz, FCC Limits

Radiated Emissions Limits Test Results, Class B

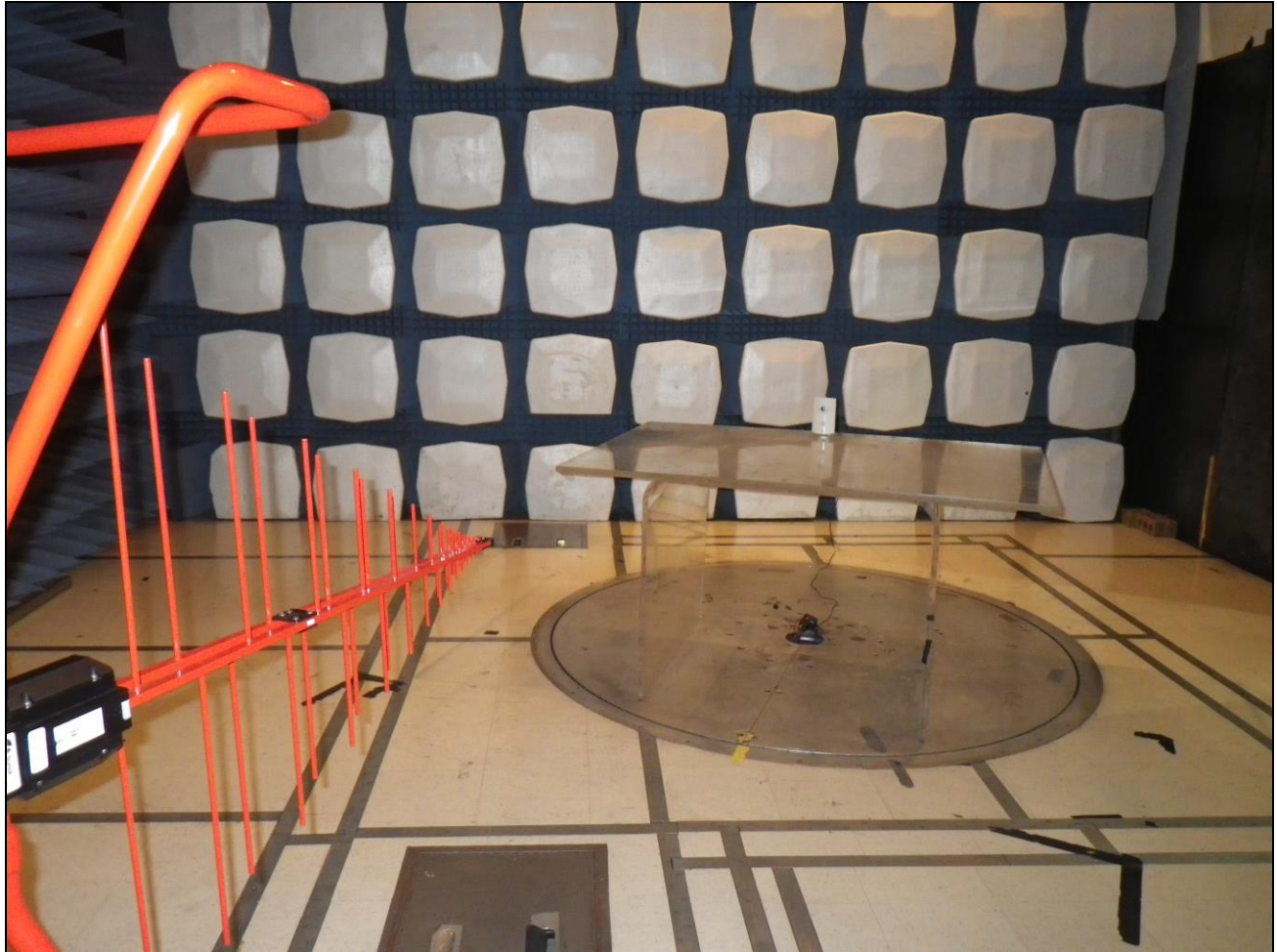
Frequency (MHz)	EUT Azimuth (Degrees)	Antenna Polarity (H/V)	Antenna HEIGHT (m)	Uncorrected Amplitude (dBμV)	Antenna Correction Factor (dB) (+)	Cable Loss (dB) (+)	Distance Correction Factor (dB) (-)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
46.855586	348	H	1.09	5.65	9.89	0.46	10.46	5.54	30.00	-24.46
46.855586	359	V	1.06	10.41	9.89	0.46	10.46	10.30	30.00	-19.70
131.30261	331	H	1.08	5.72	13.77	0.92	10.46	9.95	30.00	-20.05
131.30261	317	V	1.11	6.34	13.77	0.92	10.46	10.57	30.00	-19.43
259.95992	290	H	1.04	5.72	12.80	1.32	10.46	9.38	37.00	-27.62
259.95992	304	V	1.08	7.36	12.80	1.32	10.46	11.02	37.00	-25.98
335.76152	270	H	1.08	5.18	14.82	1.33	10.46	10.87	37.00	-26.13
335.76152	282	V	1.05	5.65	14.82	1.33	10.46	11.34	37.00	-25.66
479.95029	172	H	1.05	6.71	17.90	1.82	10.46	15.97	37.00	-21.03
479.95029	172	V	1.02	15.16	17.90	1.82	10.46	24.42	37.00	-12.58
917.32841	210	H	1.09	6.23	23.10	2.81	10.46	21.68	37.00	-15.32
917.32841	196	V	1.12	6.30	23.10	2.81	10.46	21.75	37.00	-15.25

Table 11. Radiated Emissions Limits, Test Results, ICES-003 Limits



Plot 4. Radiated Emissions, ICES-003 Limits

Radiated Emissions Limits Test Setup



Photograph 3. Radiated Emissions, Test Setup

IV. Electromagnetic Compatibility Criteria for Intentional Radiators

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.203 Antenna Requirement

Test Requirement: § 15.203: An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

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

- a.) Antenna must be permanently attached to the unit.
- b.) Antenna must use a unique type of connector to attach to the EUT.
- c.) Unit must be professionally installed. Installer shall be responsible for verifying that the correct antenna is employed with the unit.

Results: The EUT as tested is compliant the criteria of §15.203. EUT contains an integral antenna.

Test Engineer(s): Benjamin Taylor

Test Date(s): 08/29/13

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.207(a) 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 μ H/50 Σ 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- 0.45	66 - 56	56 - 46
0.45 - 0.5	56	46
0.5 - 30	60	50

Table 12. Conducted Limits for Intentional Radiators from FCC Part 15 § 15.207(a)

Test Procedure: The EUT was placed on a non-metallic table, 80cm from ground plane and 40cm from a vertical ground plane. 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 C63.4-2003 "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 μ H LISN as the input transducer to an EMC/field intensity meter. For the purpose of this testing, the transmitter was turned on. Scans were performed with the transmitter on.

Test Results: The EUT was compliant with this requirement.

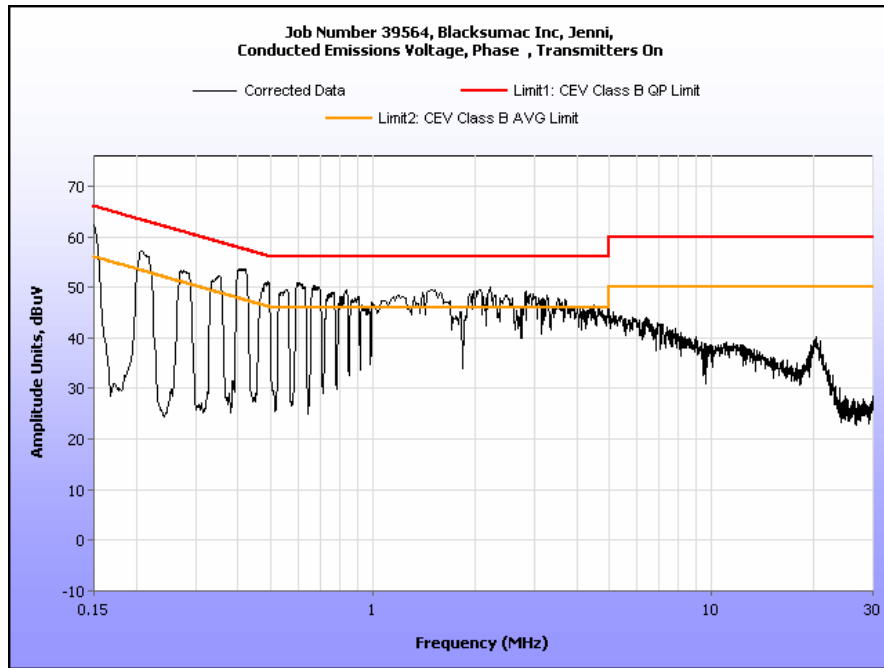
Test Engineer(s): Benjamin Taylor

Test Date(s): 09/09/13

15.207(a) Conducted Emissions Test Results

Frequency (MHz)	Uncorrected Meter Reading (dBμV) QP	Cable Loss (dB)	Corrected Measurement (dBμV) QP	Limit (dBμV) QP	Margin (dB) QP	Uncorrected Meter Reading (dBμV) Avg.	Cable Loss (dB)	Corrected Measurement (dBμV) AVG	Limit (dBμV) AVG	Margin (dB) AVG
0.2024	54.57	0	54.57	63.51	-8.94	39.55	0	39.55	53.51	-13.96
0.404	50.52	0	50.52	57.77	-7.25	33.91	0	33.91	47.77	-13.86
0.5985	46.9	0	46.9	56	-9.1	27.08	0	27.08	46	-18.92
1.534	45.91	0	45.91	56	-10.09	29.45	0	29.45	46	-16.55
2.7	45.45	0	45.45	56	-10.55	25.87	0	25.87	46	-20.13

Table 13. Conducted Emissions, 15.207(a), Phase Line, Test Results

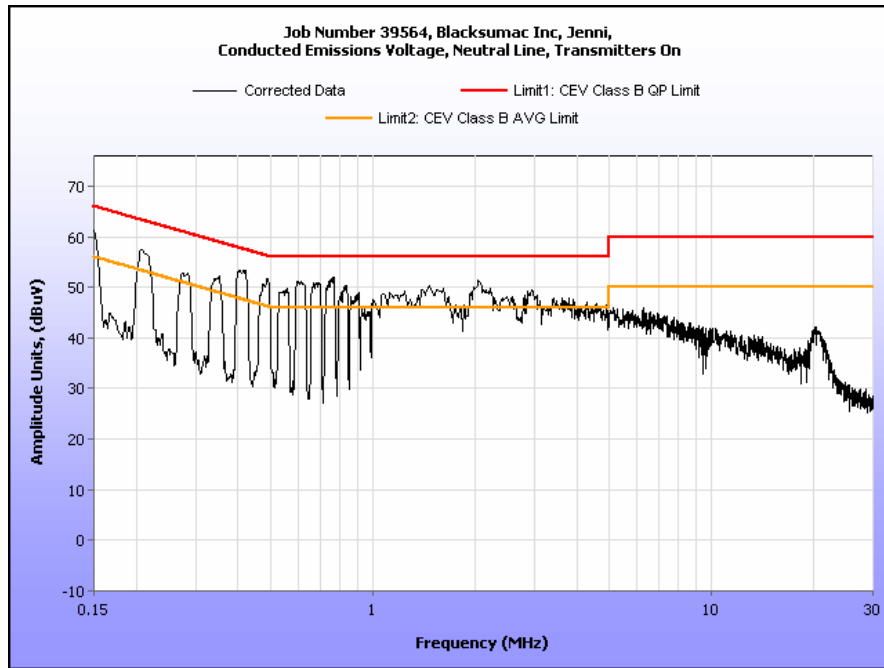


Plot 5. Conducted Emissions, 15.207(a), Phase Line

15.207(a) Conducted Emissions Test Results

Frequency (MHz)	Uncorrected Meter Reading (dB μ V) QP	Cable Loss (dB)	Corrected Measurement (dB μ V) QP	Limit (dB μ V) QP	Margin (dB) QP	Uncorrected Meter Reading (dB μ V) Avg.	Cable Loss (dB)	Corrected Measurement (dB μ V) AVG	Limit (dB μ V) AVG	Margin (dB) AVG
0.1994	53.89	0	53.89	63.64	-9.75	40.78	0	40.78	53.64	-12.86
0.4015	50.85	0	50.85	57.82	-6.97	38.67	0	38.67	47.82	-9.15
0.7686	47.38	0	47.38	56	-8.62	28.42	0	28.42	46	-17.58
1.4577	47.89	0	47.89	56	-8.11	30.19	0	30.19	46	-15.81
2.09	46.64	0	46.64	56	-9.36	30.5	0	30.5	46	-15.5

Table 14. Conducted Emissions, 15.207(a), Neutral Line, Test Results



Plot 6. Conducted Emissions, 15.207(a), Neutral Line

15.207(a) Conducted Emissions Test Setup Photo

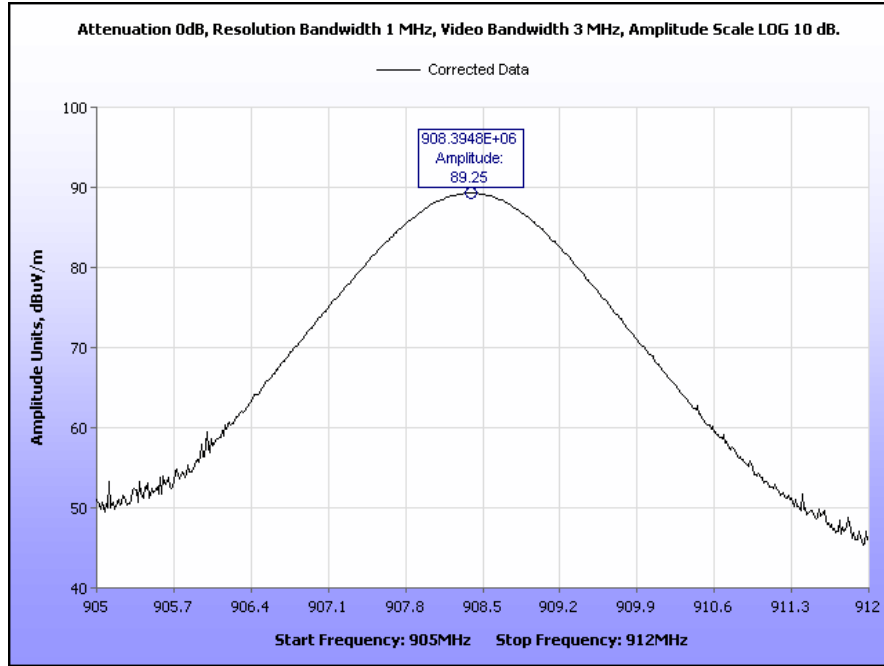


Photograph 4. Conducted Emissions, 15.207(a), Test Setup

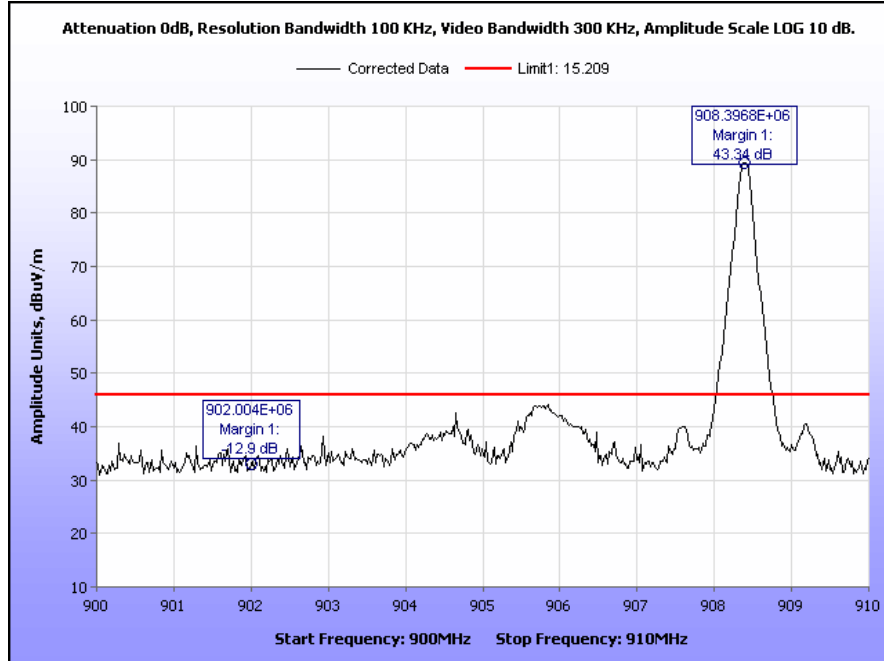
Electromagnetic Compatibility Criteria for Intentional Radiators

§15.249(a) Radiated Field Strength of Fundamental

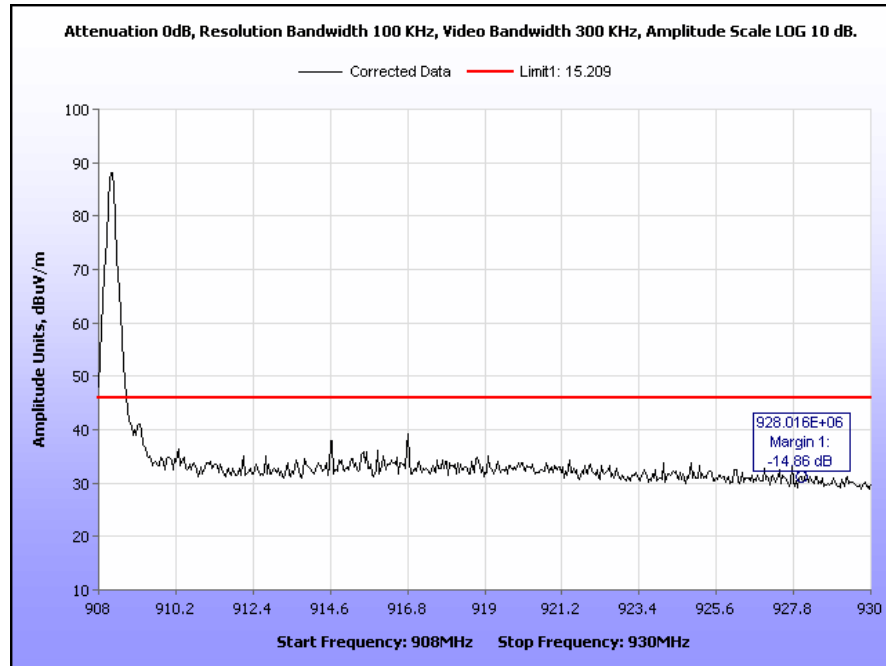
- Test Requirements:** § 15.249(a): The 3 meter field strength of the fundamental emissions from intentional radiators operated within the 902 – 928 MHz frequency bands shall comply with the following requirement: 50 millivolts/meter (94dB μ V/m), quasi-peak mode measurement.
- Test Procedure:** Measurements 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. The antenna was placed 3m away from the EUT. The EUT was rotated about all three orthogonal axis.
- Test Results:** The EUT is compliant with the requirements of § 15.249(a).
- Test Engineer(s):** Benjamin Taylor
- Test Date(s):** 09/25/19



Plot 7. Radiated Field Strength of Fundamental, 908 MHz



Plot 8. Radiated Field Strength of Fundamental, Low Channel, Band Edge

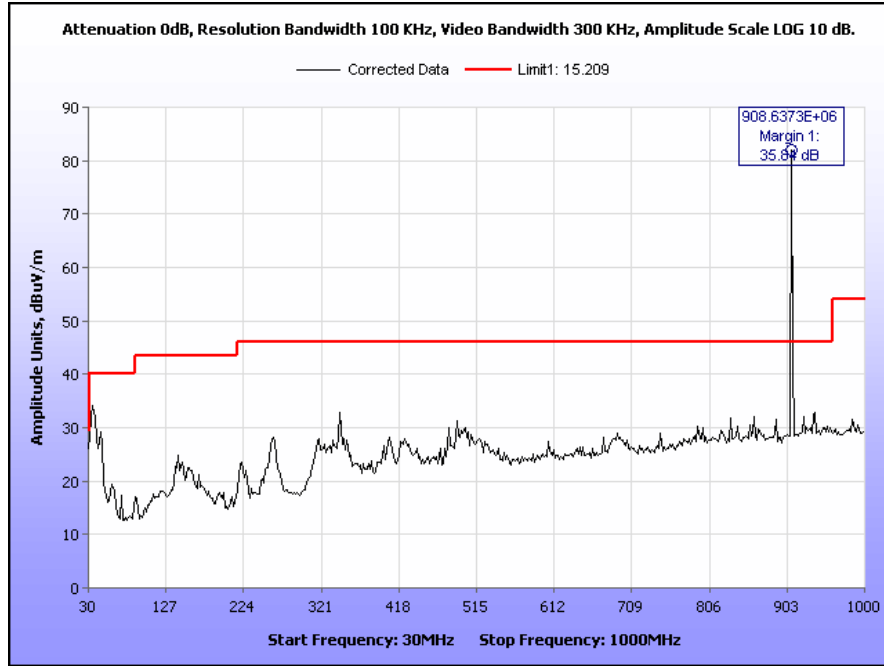


Plot 9. Radiated Field Strength of Fundamental, High Channel, Band Edge

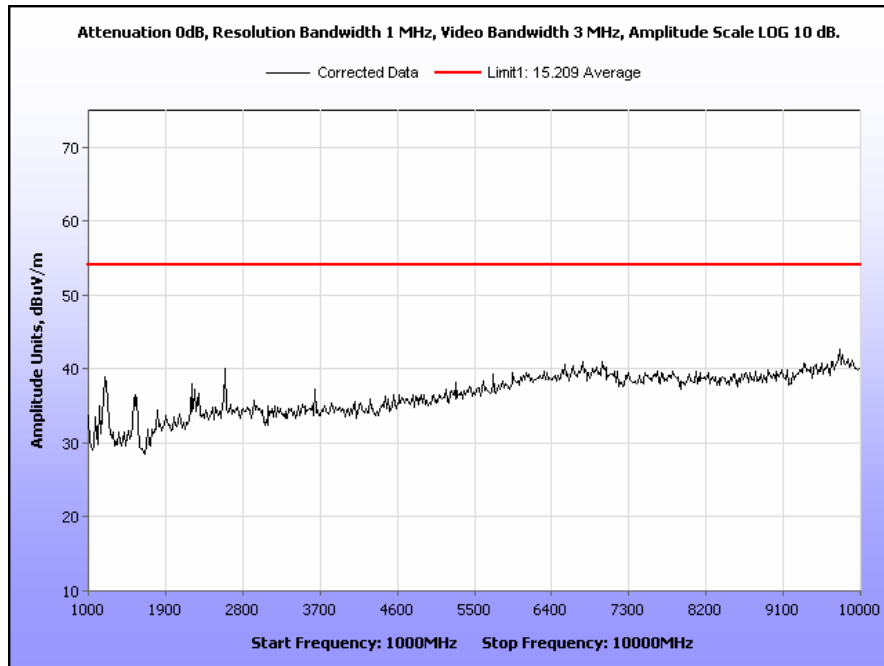
Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.249(a)(d) Harmonics and Spurious Emissions Requirements

- Test Requirements:** Harmonics originating from devices that operate in the 902-928 MHz band shall meet the 500 microvolts/meter limit (i.e. 54 dBuV/m) with an average detector. In addition, emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.
- Test Procedure:** 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. Emissions below 1 GHz were performed with the antenna placed 3m away from EUT. For above 1 GHz, the measuring antenna was placed 1m away.
- Test Results:** The EUT is compliant with the harmonics and Spurious Emissions Requirements of §15.249(a)(d). For spurious emissions the lesser attenuation was the 15.209 limits.
- Test Engineer(s):** Benjamin Taylor
- Test Date(s):** 09/25/13

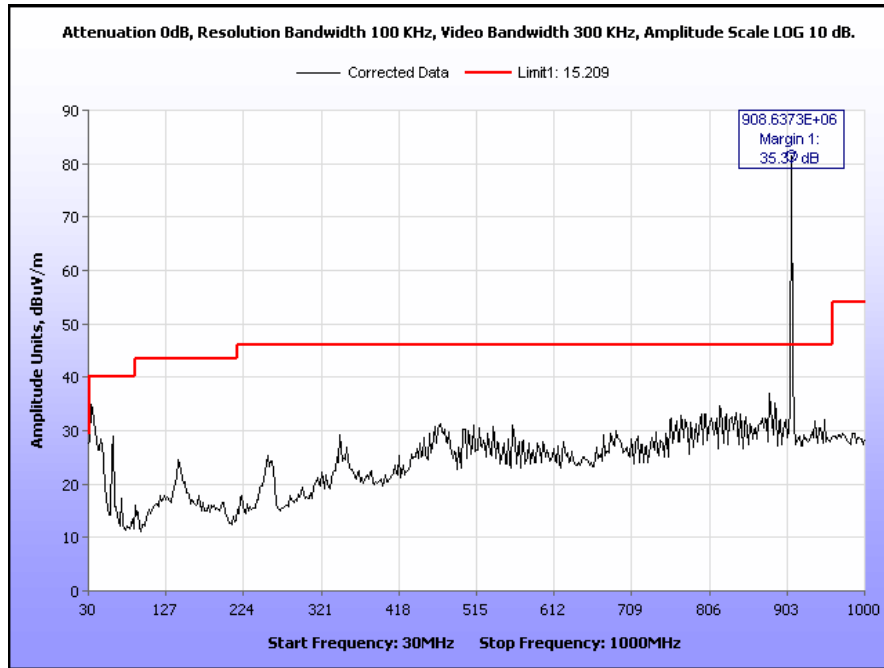


Plot 10. Radiated Spurious Emissions, 30 MHz – 1 GHz

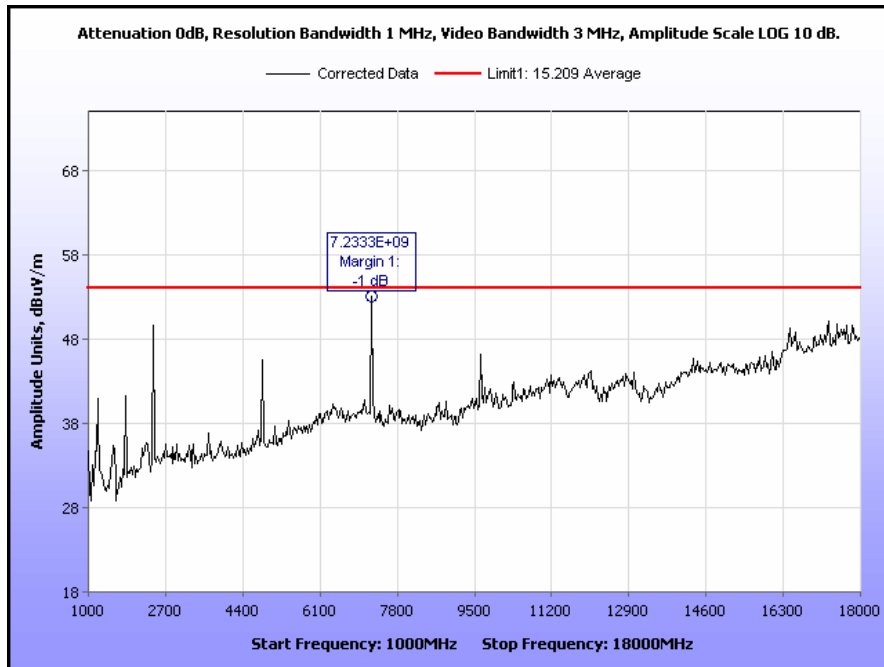


Plot 11. Radiated Spurious Emissions, 1 GHz – 10 GHz

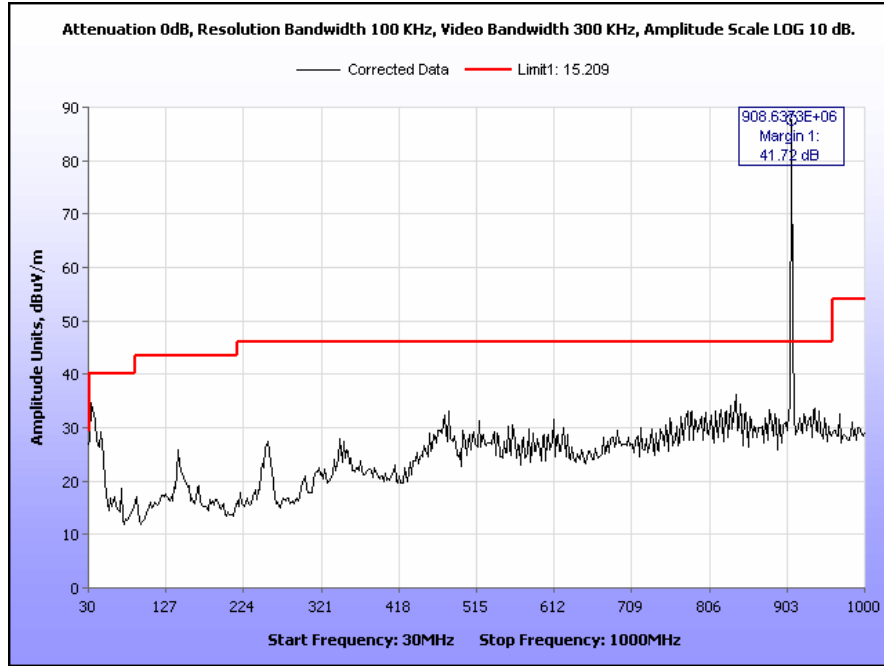
Simultaneous Operation



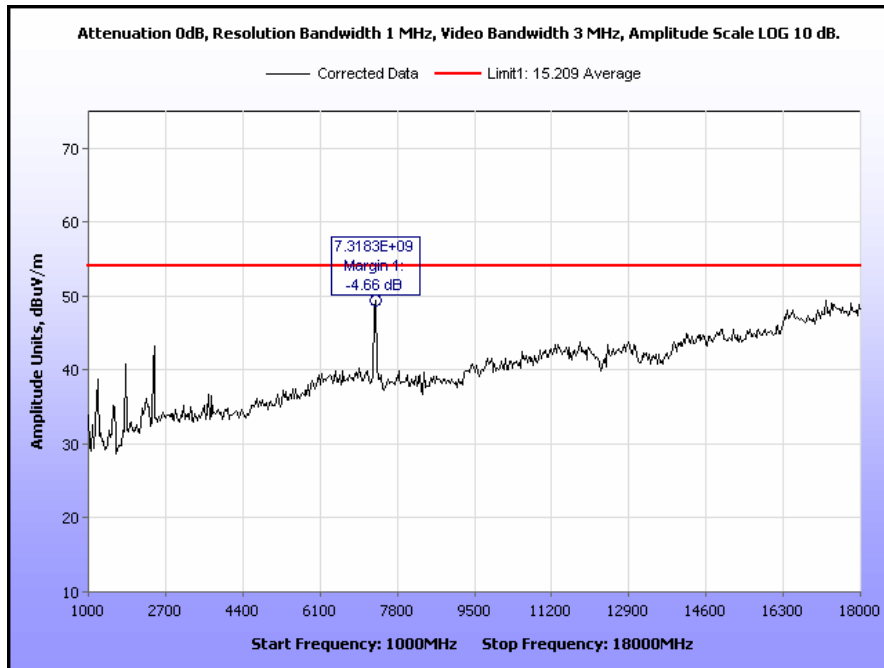
Plot 12. Radiated Spurious Emissions, Low Channel, 802.11b, 30 MHz – 1 GHz, 900 MHz TX



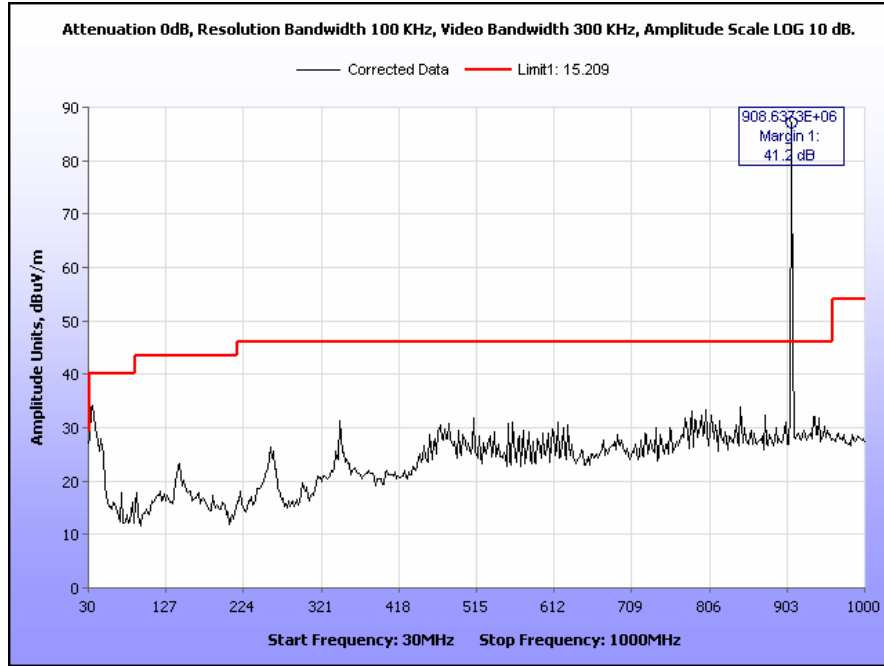
Plot 13. Radiated Spurious Emissions, Low Channel, 802.11b, 1 GHz – 18 GHz, 900 MHz TX



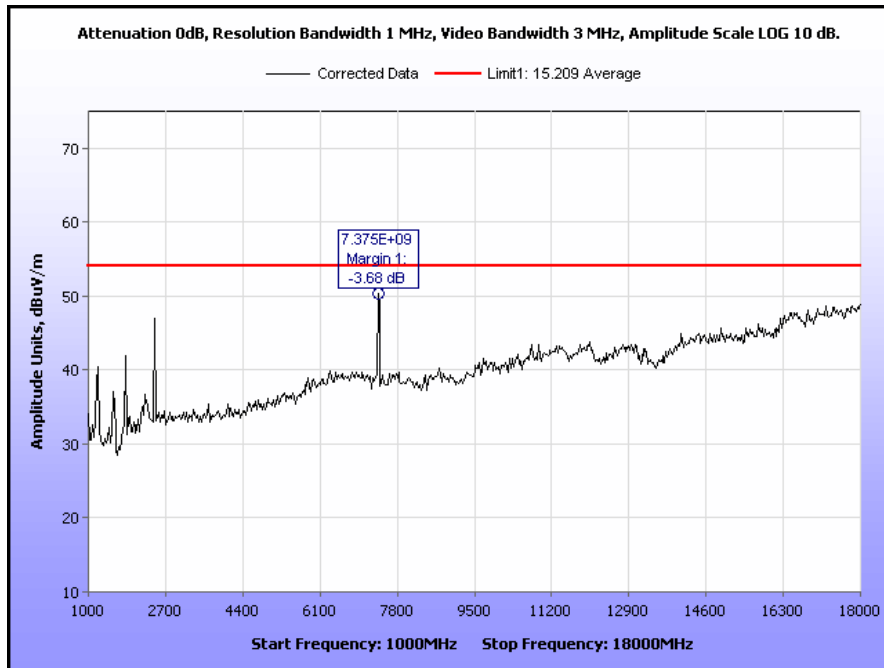
Plot 14. Radiated Spurious Emissions, Mid Channel, 802.11b, 30 MHz – 1 GHz, 900 MHz TX



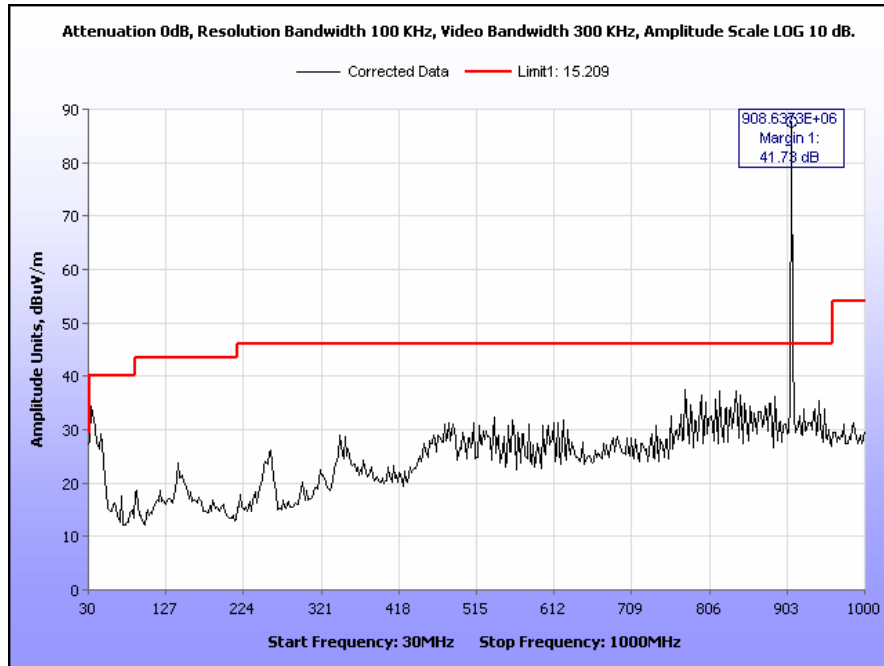
Plot 15. Radiated Spurious Emissions, Mid Channel, 802.11b, 1 GHz – 18 GHz, 900 MHz TX



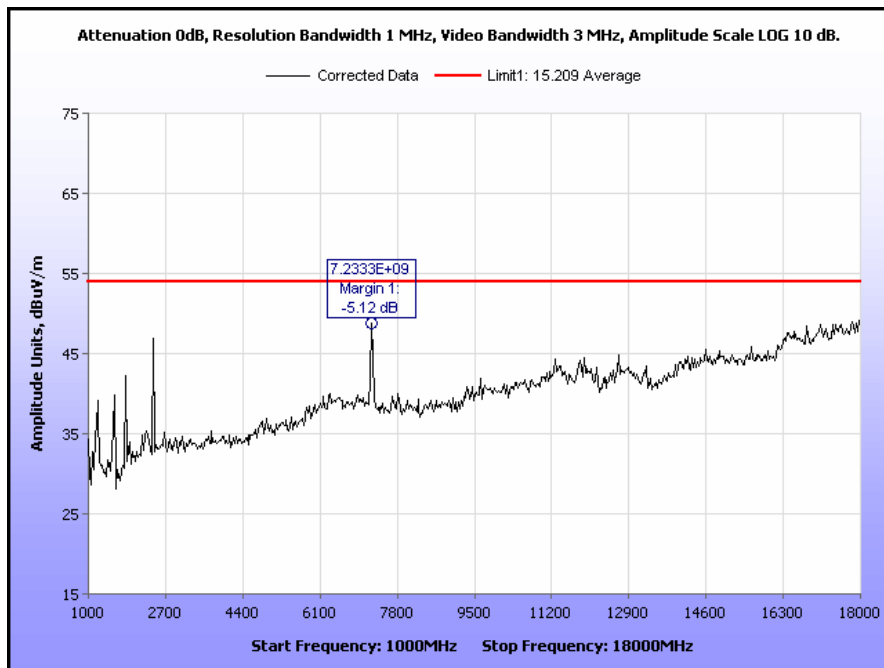
Plot 16. Radiated Spurious Emissions, High Channel, 802.11b, 30 MHz – 1 GHz, 900 MHz TX



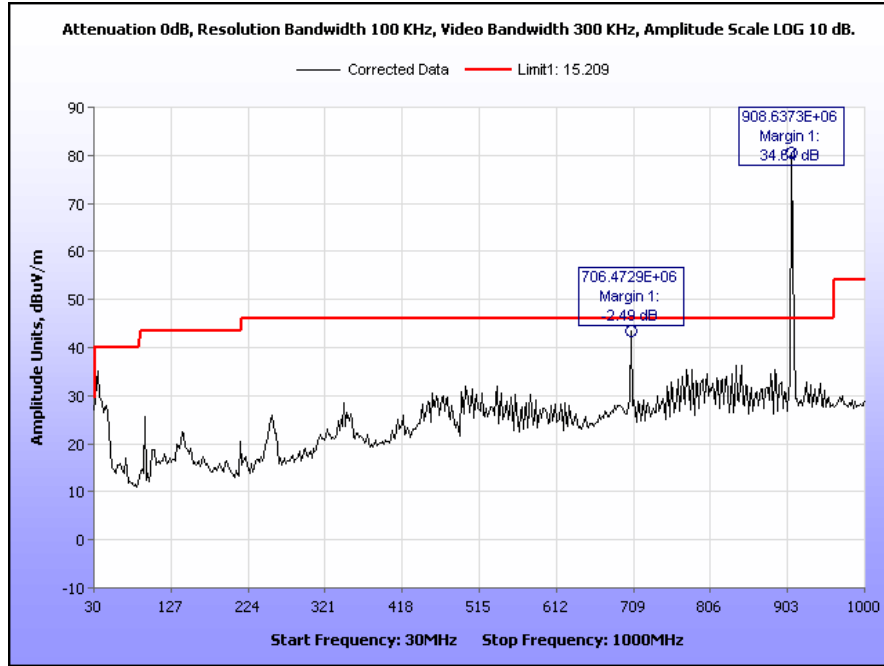
Plot 17. Radiated Spurious Emissions, High Channel, 802.11b, 1 GHz – 18 GHz, 900 MHz TX



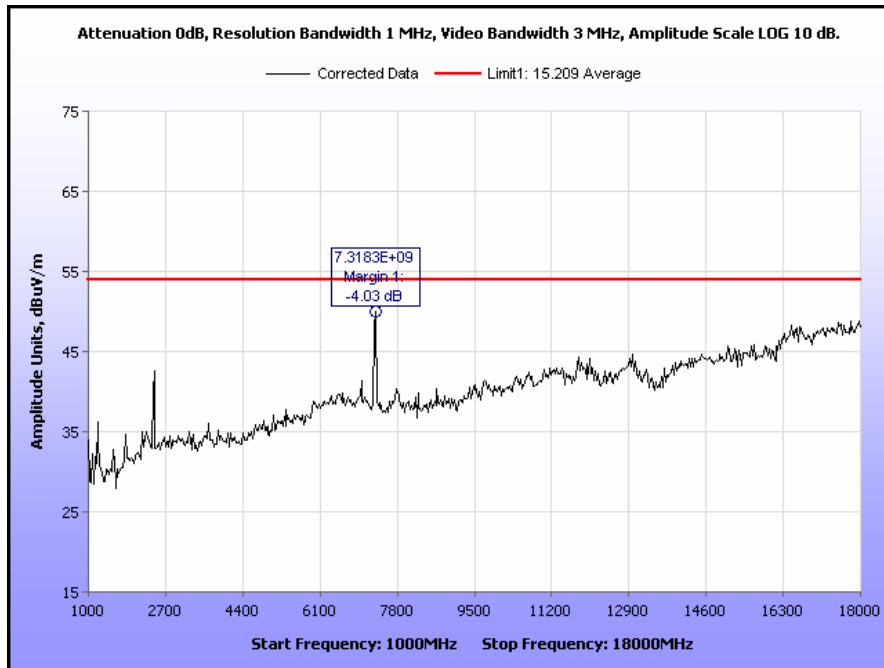
Plot 18. Radiated Spurious Emissions, Low Channel, 802.11g, 30 MHz – 1 GHz, 900 MHz TX



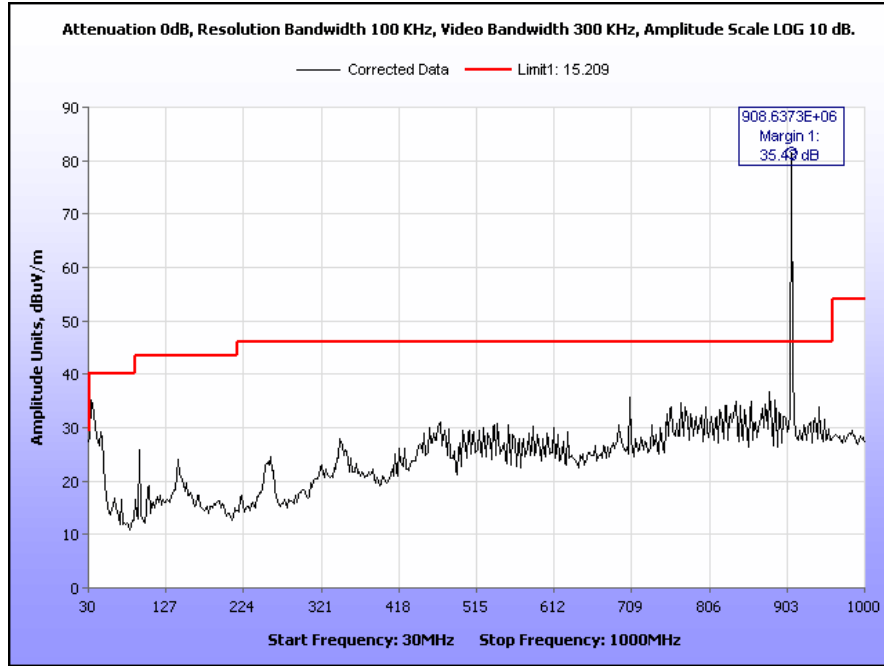
Plot 19. Radiated Spurious Emissions, Low Channel, 802.11g, 1 GHz – 18 GHz, 900 MHz TX



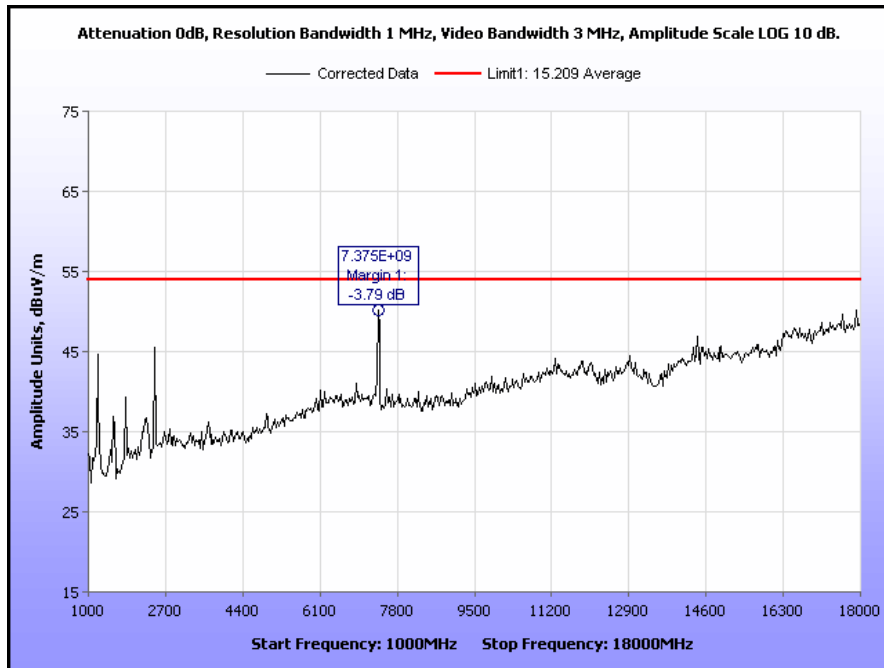
Plot 20. Radiated Spurious Emissions, Mid Channel, 802.11g, 30 MHz – 1 GHz, 900 MHz TX



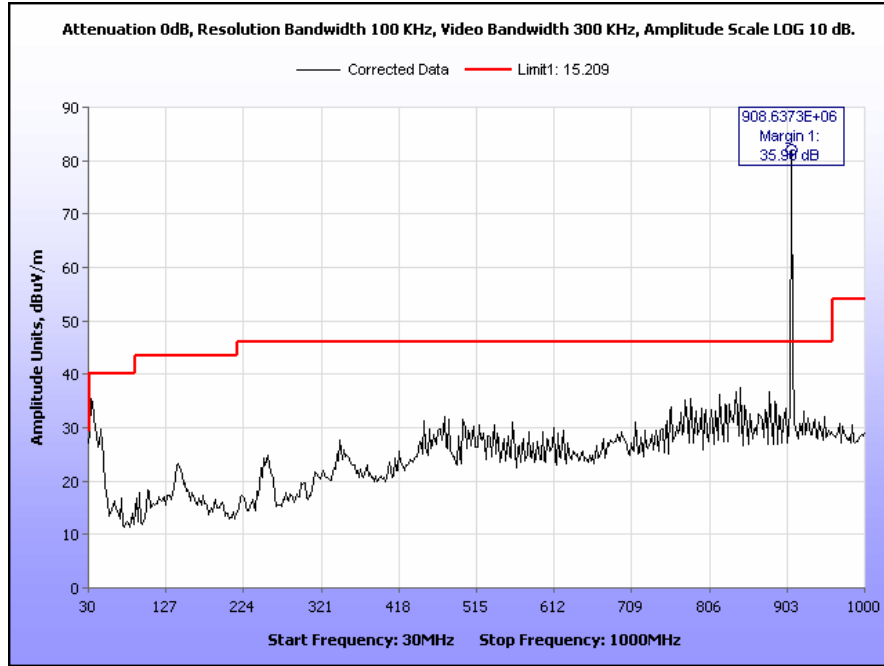
Plot 21. Radiated Spurious Emissions, Mid Channel, 802.11g, 1 GHz – 18 GHz, 900 MHz TX



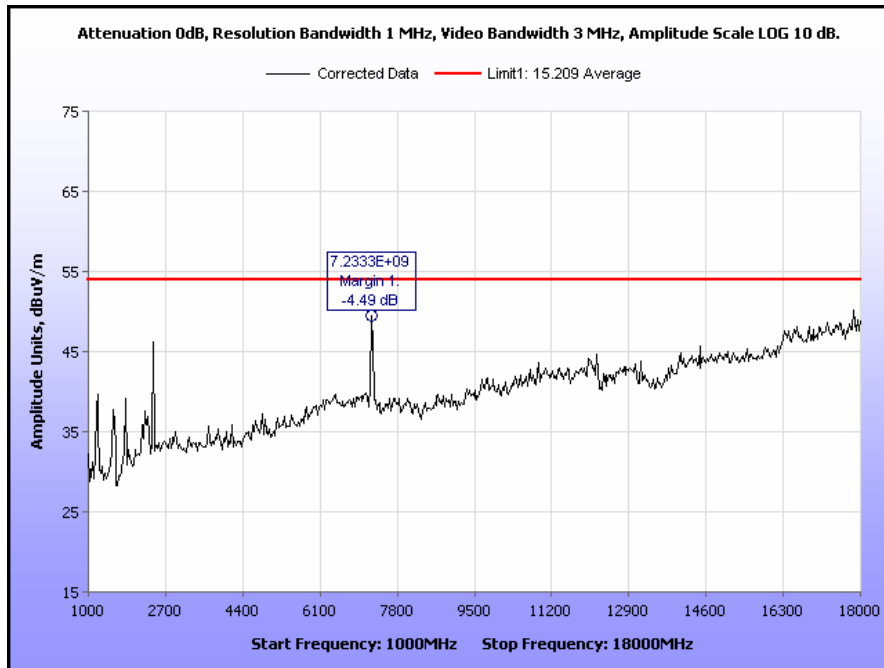
Plot 22. Radiated Spurious Emissions, High Channel, 802.11g, 30 MHz – 1 GHz, 900 MHz TX



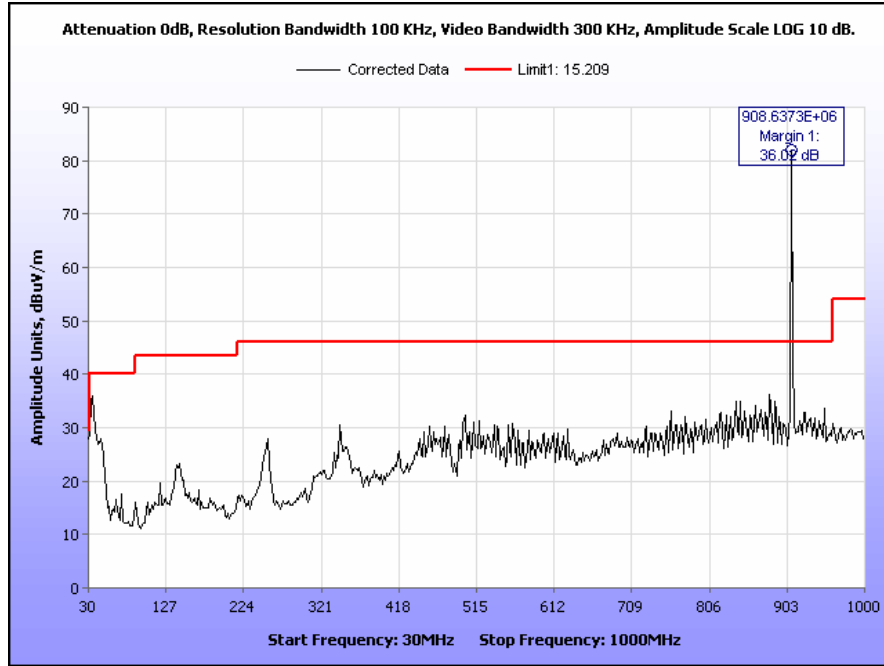
Plot 23. Radiated Spurious Emissions, High Channel, 802.11g, 1 GHz – 18 GHz, 900 MHz TX



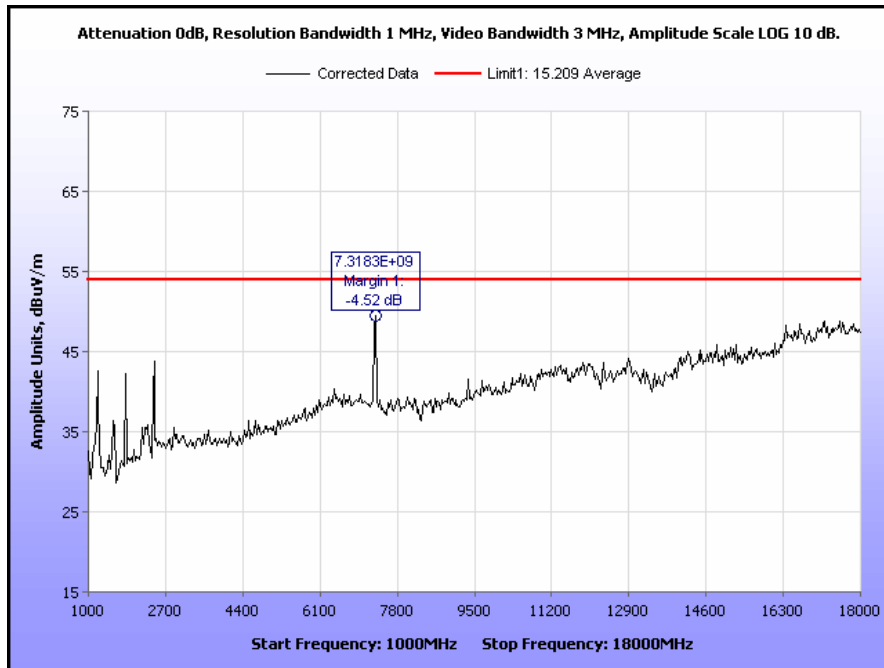
Plot 24. Radiated Spurious Emissions, Low Channel, 802.11n, 30 MHz – 1 GHz, 900 MHz TX



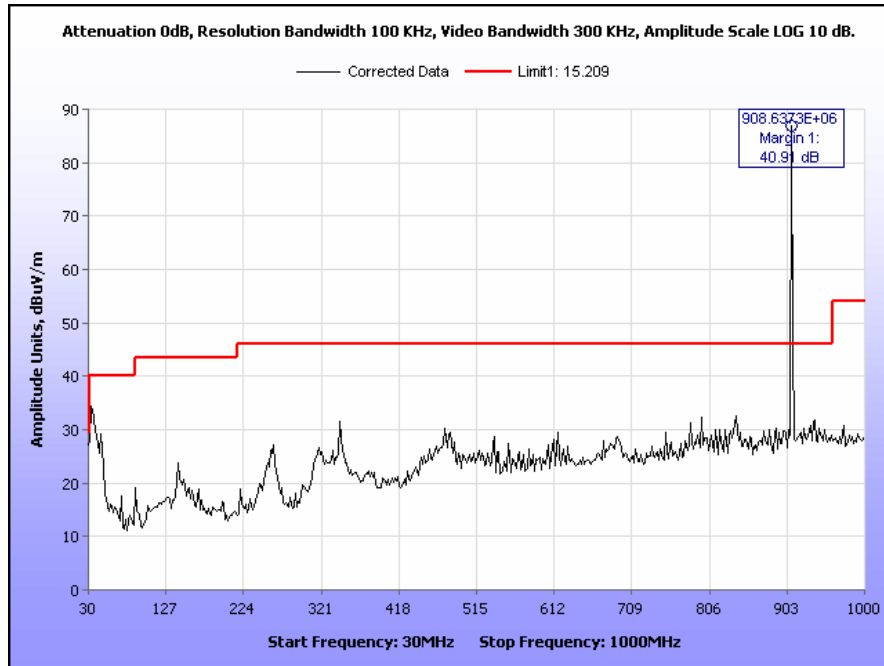
Plot 25. Radiated Spurious Emissions, Low Channel, 802.11n, 1 GHz – 18 GHz, 900 MHz TX



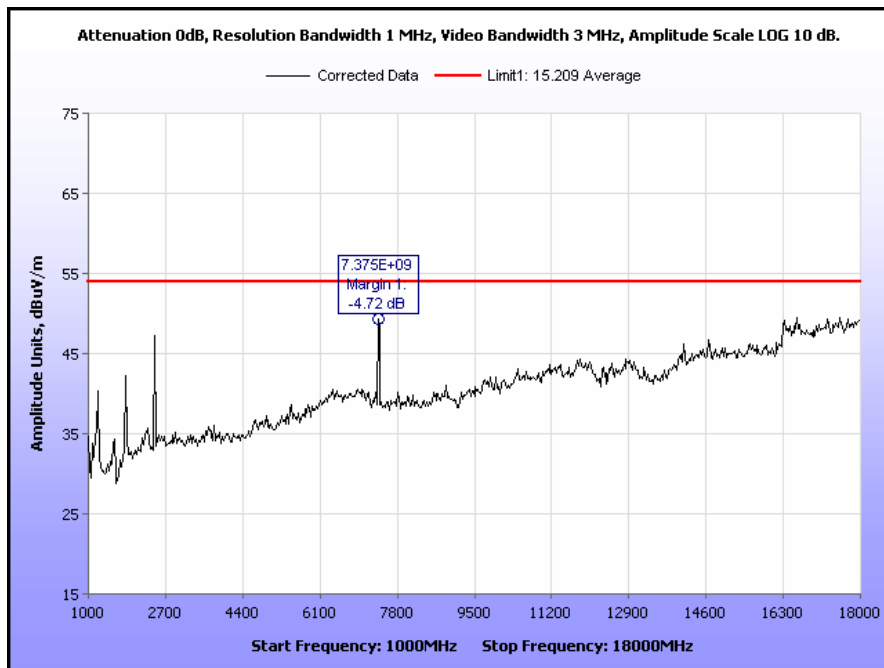
Plot 26. Radiated Spurious Emissions, Mid Channel, 802.11n, 30 MHz – 1 GHz, 900 MHz TX



Plot 27. Radiated Spurious Emissions, Mid Channel, 802.11n, 1 GHz – 18 GHz, 900 MHz TX



Plot 28. Radiated Spurious Emissions, High Channel, 802.11n, 30 MHz – 1 GHz, 900 MHz TX



Plot 29. Radiated Spurious Emissions, High Channel, 802.11n, 1 GHz – 18 GHz, 900 MHz TX

IV. Test Equipment

Test Equipment

Calibrated test equipment utilized during testing was maintained in a current state of calibration per the requirements of ISO/IEC 17025:2005.

MET Asset #	Equipment	Manufacturer	Model	Last Cal Date	Cal Due Date
1T4771	PSA SPECTRUM ANALYZER	AGILENT TECHNOLOGIES	E4446A	02/15/2013	08/15/2014
1T4409	EMI RECEIVER	ROHDE & SCHWARZ	ESIB7	07/16/2012	07/16/2014
1T4751	ANTENNA - BILOG	SUNOL SCIENCES	JB6	01/08/2013	07/08/2014
1T4483	ANTENNA; HORN	ETS-LINDGREN	3117	08/06/2012	02/06/2014
1T4745	ANTENNA, HORN	ETS-LINDGREN	3116	10/19/2012	10/19/2013
1T4300A	SEMI-ANECHOIC CHAMBER # 1 (FCC)	EMC TEST SYSTEMS	NONE	07/24/2012	07/24/2015
1T4442	PRE-AMPLIFIER, MICROWAVE	MITEQ	AFS42-01001800-30-10P	SEE NOTE	
1T4742	PRE-AMPLIFIER, HIGH-FREQUENCY	MITEQ	AFS42-01001800-30-10P-42	SEE NOTE	
1T4149	HIGH-FREQUENCY ANECHOIC CHAMBER	RAY-PROOF	81	NOT REQUIRED	

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



V. Certification & User's Manual Information



Certification & User's Manual Information

A. Certification Information

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

§ 2.801 Radio-frequency device defined.

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

- (a) The various types of radio communication transmitting devices described throughout this chapter.
- (b) *The incidental, unintentional and intentional radiators defined in Part 15 of this chapter.*
- (c) The industrial, scientific, and medical equipment described in Part 18 of this chapter.
- (d) Any part or component thereof which in use emits radio-frequency energy by radiation, conduction, or other means.

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

- (a) Except as provided elsewhere in this chapter, no person shall sell or lease, or offer for sale or lease (including advertising for sale or lease), or import, ship or distribute for the purpose of selling or leasing or offering for sale or lease, any radio frequency device unless:
 - (1) In the case of a device subject to certification, such device has been authorized by the Commission in accordance with the rules in this chapter and is properly identified and labeled as required by §2.925 and other relevant sections in this chapter; or
 - (2) In the case of a device that is not required to have a grant of equipment authorization issued by the Commission, but which must comply with the specified technical standards prior to use, such device also complies with all applicable administrative (including verification of the equipment or authorization under a Declaration of Conformity, where required), technical, labeling and identification requirements specified in this chapter.
- (d) Notwithstanding the provisions of paragraph (a) of this section, the offer for sale solely to business, commercial, industrial, scientific or medical users (but not an offer for sale to other parties or to end users located in a residential environment) of a radio frequency device that is in the conceptual, developmental, design or pre-production stage is permitted prior to equipment authorization or, for devices not subject to the equipment authorization requirements, prior to a determination of compliance with the applicable technical requirements *provided* that the prospective buyer is advised in writing at the time of the offer for sale that the equipment is subject to the FCC rules and that the equipment will comply with the appropriate rules before delivery to the buyer or to centers of distribution.



- (e)(1) Notwithstanding the provisions of paragraph (a) of this section, prior to equipment authorization or determination of compliance with the applicable technical requirements any radio frequency device may be operated, but not marketed, for the following purposes and under the following conditions:
- (i) *Compliance testing;*
 - (ii) Demonstrations at a trade show provided the notice contained in paragraph (c) of this section is displayed in a conspicuous location on, or immediately adjacent to, the device;
 - (iii) Demonstrations at an exhibition conducted at a business, commercial, industrial, scientific or medical location, but excluding locations in a residential environment, provided the notice contained in paragraphs (c) or (d) of this section, as appropriate, is displayed in a conspicuous location on, or immediately adjacent to, the device;
 - (iv) Evaluation of product performance and determination of customer acceptability, provided such operation takes place at the manufacturer's facilities during developmental, design or pre-production states; or
 - (v) Evaluation of product performance and determination of customer acceptability where customer acceptability of a radio frequency device cannot be determined at the manufacturer's facilities because of size or unique capability of the device, provided the device is operated at a business, commercial, industrial, scientific or medical user's site, but not at a residential site, during the development, design or pre-production stages.
- (e)(2) For the purpose of paragraphs (e)(1)(iv) and (e)(1)(v) of this section, the term *manufacturer's facilities* includes the facilities of the party responsible for compliance with the regulations and the manufacturer's premises, as well as the facilities of other entities working under the authorization of the responsible party in connection with the development and manufacture, but not the marketing, of the equipment.
- (f) For radio frequency devices subject to verification and sold solely to business, commercial, industrial, scientific and medical users (excluding products sold to other parties or for operation in a residential environment), parties responsible for verification of the devices shall have the option of ensuring compliance with the applicable technical specifications of this chapter at each end user's location after installation, provided that the purchase or lease agreement includes a proviso that such a determination of compliance be made and is the responsibility of the party responsible for verification of the equipment.



Certification & User's Manual Information

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

§ 2.901 Basis and Purpose

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

§ 2.907 Certification.

- (a) Certification is an equipment authorization issued by the Commission, based on representation and test data submitted by the applicant.
- (b) Certification attaches to all units subsequently marketed by the grantee which are identical (see Section 2.908) to the sample tested except for permissive changes or other variations authorized by the Commission pursuant to Section 2.1043.

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



Certification & User's Manual Information

§ 2.948 Description of measurement facilities.

- (a) Each party making measurements of equipment that is subject to an equipment authorization under Part 15 or Part 18 of this chapter, regardless of whether the measurements are filed with the Commission or kept on file by the party responsible for compliance of equipment marketed within the U.S. or its possessions, shall compile a description of the measurement facilities employed.
 - (1) If the measured equipment is subject to the verification procedure, the description of the measurement facilities shall be retained by the party responsible for verification of the equipment.
 - (i) *If the equipment is verified through measurements performed by an independent laboratory, it is acceptable for the party responsible for verification of the equipment to rely upon the description of the measurement facilities retained by or placed on file with the Commission by that laboratory. In this situation, the party responsible for the verification of the equipment is not required to retain a duplicate copy of the description of the measurement facilities.*
 - (ii) If the equipment is verified based on measurements performed at the installation site of the equipment, no specific site calibration data is required. It is acceptable to retain the description of the measurement facilities at the site at which the measurements were performed.
 - (2) If the equipment is to be authorized by the Commission under the certification procedure, the description of the measurement facilities shall be filed with the Commission's Laboratory in Columbia, Maryland. The data describing the measurement facilities need only be filed once but must be updated as changes are made to the measurement facilities or as otherwise described in this section. At least every three years, the organization responsible for filing the data with the Commission shall certify that the data on file is current.



Certification & User's Manual Information

Label and User's Manual Information

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

§ 15.19 Labeling requirements.

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

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

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

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

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

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

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

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

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

§ 15.21 Information to user.

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



Verification & User's Manual Information

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

§ 15.105 Information to the user.

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

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

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

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

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.



ICES-003 Procedural & Labeling Requirements

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

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

Procedural Requirements:

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

- Section 6.1: A record of the measurements and results, showing the date that the measurements were completed, shall be retained by the manufacturer or importer for a period of at least five years from the date shown in the record and made available for examination on the request of the Minister.
- Section 6.2: A written notice indicating compliance must accompany each unit of digital apparatus to the end user. The notice shall be in the form of a label that is affixed to the apparatus. Where because of insufficient space or other constraints it is not feasible to affix a label to the apparatus, the notice may be in the form of a statement in the user's manual.

Labeling Requirements:

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

This Class [²] digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe [¹] est conforme à la norme NMB-003 du Canada.

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

End of Report