



MET Laboratories, Inc.

Safety Certification - EMI - Telecom Environmental Simulation

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December 2, 2010

Echelon Corporation
550 Meridian Avenue
San Jose, CA 95126

Dear Yaqoob Bhimla,

Enclosed is the EMC Wireless test report for compliance testing of the Echelon Corporation, IEM RF Module ZIGBEE:835-0701-51 with Street Light Bridge (SLB)/Antenna as tested to the requirements of Title 47 of the CFR, Ch. 1 (10-1-06 ed.), Part 15, Subpart B for a Class B Digital Device and FCC Part 15 Subpart C 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: (\Echelon Corporation\EMCS82296-FCC247 Rev. 3)

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Echelon Corporation
IEM RF Module ZIGBEE:835-0701-51
with Street Light Bridge (SLB)/Antenna

Electromagnetic Compatibility
Cover Page
CFR Title 47, Part 15B, 15.247

Electromagnetic Compatibility Criteria Test Report

for the

Echelon Corporation
IEM RF Module ZIGBEE:835-0701-51 with Street Light Bridge (SLB)/Antenna

Tested under
the FCC Certification Rules
contained in
Title 47 of the CFR, Parts 15 Subpart B
for Class B Digital Devices
&
15.247 Subpart C for Intentional Radiators

MET Report: EMCS82296-FCC247 Rev. 3

December 2, 2010

Prepared For:

Echelon Corporation
550 Meridian Avenue
San Jose, CA 95126

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



Echelon Corporation
IEM RF Module ZIGBEE:835-0701-51
with Street Light Bridge (SLB)/Antenna

Electromagnetic Compatibility
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CFR Title 47, Part 15B, 15.247

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contained in
Title 47 of the CFR, Parts 15 Subpart B
for A Digital Devices
&
15.247 Subpart C for Intentional Radiators

Anderson Soungpanya
Electromagnetic Compatibility Lab

Jennifer Warnell
Documentation Department

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

Shawn McMillen,
Wireless Manager, Electromagnetic Compatibility Lab



Echelon Corporation
IEM RF Module ZIGBEE:835-0701-51
with Street Light Bridge (SLB)/Antenna

Electromagnetic Compatibility
Report Status
CFR Title 47, Part 15B, 15.247

Report Status Sheet

Revision	Report Date	Reason for Revision
Ø	October 27, 2010	Initial Issue.
1	November 16, 2010	Revised to reflect correct EUT name.
2	November 23, 2010	Revised to reflect engineer corrections.
3	December 2, 2010	Revised to reflect engineer corrections.



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Echelon Corporation

IEM RF Module ZIGBEE:835-0701-51
with Street Light Bridge (SLB)/Antenna

Electromagnetic Compatibility
List of Terms and Abbreviations
CFR Title 47, Part 15B, 15.247

List of Terms and Abbreviations

AC	Alternating Current
ACF	Antenna Correction Factor
Cal	Calibration
<i>d</i>	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
<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
μH	microhenry
μ	microfarad
μ s	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



Echelon Corporation

IEM RF Module ZIGBEE:835-0701-51
with Street Light Bridge (SLB)/Antenna

Electromagnetic Compatibility
Executive Summary
CFR Title 47, Part 15B, 15.2473

I. Executive Summary



Echelon Corporation

IEM RF Module ZIGBEE:835-0701-51
with Street Light Bridge (SLB)/Antenna

Electromagnetic Compatibility
Executive Summary
CFR Title 47, Part 15B, 15.2473

A. Purpose of Test

An EMC evaluation was performed to determine compliance of the Echelon Corporation IEM RF Module ZIGBEE:835-0701-51 with Street Light Bridge (SLB)/Antenna, with the requirements of Part 15, §15.247. All references are to the most current version of Title 47 of the Code of Federal Regulations in effect. In accordance with §2.1033, the following data is presented in support of the Certification of the IEM RF Module ZIGBEE:835-0701-51 with Street Light Bridge (SLB)/Antenna. Echelon Corporation should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the IEM RF Module ZIGBEE:835-0701-51 with Street Light Bridge (SLB)/Antenna, has been **permanently** discontinued.

B. Executive Summary

The following tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 15, §15.247, in accordance with Echelon Corporation, purchase order number 30362. All tests were conducted using measurement procedure ANSI C63.4-2003.

FCC Reference 47 CFR Part 15.247:2005	Description	Compliance
47 CFR Part 15.107 (a)	Conducted Emission Limits for a Class B Digital Device	Compliant
47 CFR Part 15.109 (a)	Radiated Emission Limits for a Class B Digital Device	Compliant
Title 47 of the CFR, Part 15 §15.203	Antenna Requirement	Compliant
Title 47 of the CFR, Part 15 §15.207(a)	Conducted Emission Voltage	Compliant
Title 47 of the CFR, Part 15 §15.247(a)(1)	Occupied Bandwidth	Compliant
Title 47 of the CFR, Part 15 §15.247(b)	RF Output Power	Compliant
Title 47 of the CFR, Part 15 §15.209, §15.247(d)	Radiated Spurious Emissions	Compliant
Title 47 of the CFR, Part 15 §15.205	Emissions at Restricted Band	Compliant
Title 47 of the CFR, Part 15 §15.209, §15.247(d)	Conducted Spurious Emissions	Compliant
Title 47 of the CFR, Part 15; §15.247(e)	Power Spectral Density	Compliant
Title 47 of the CFR, Part 15 §15.247(i)	Maximum Permissible Exposure	Compliant
N/A	Receiver Spurious Emissions	Compliant

Table 1. Executive Summary of EMC Part 15.247 Compliance Testing



Echelon Corporation

IEM RF Module ZIGBEE:835-0701-51
with Street Light Bridge (SLB)/Antenna

Electromagnetic Compatibility
Equipment Configuration
CFR Title 47, Part 15B, 15.247

II. Equipment Configuration



Echelon Corporation

IEM RF Module ZIGBEE:835-0701-51
with Street Light Bridge (SLB)/Antenna

Electromagnetic Compatibility
Equipment Configuration
CFR Title 47, Part 15B, 15.247

A. Overview

MET Laboratories, Inc. was contracted by Echelon Corporation to perform testing on the IEM RF Module ZIGBEE:835-0701-51 with Street Light Bridge (SLB)/Antenna, under Echelon Corporation's purchase order number 30362.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the Echelon Corporation, IEM RF Module ZIGBEE:835-0701-51 with Street Light Bridge (SLB)/Antenna.

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

Model(s) Tested:	IEM RF Module ZIGBEE:835-0701-51 with Street Light Bridge (SLB)/Antenna	
Model(s) Covered:	IEM RF Module (ZIGBEE: 835-0701-51), Model # 79010-03 with IEC Electrical Meter, 83332-3XXXX Poly-Phase Used with IEC Electrical Meter, 83332-3XXXX Poly-Phase, X can be replaced with 0 -9, A-Z based on the feature of the Meter. Meter models that are fully populated are 83332-3IHAF and 83332-1IHAF	
EUT Specifications:	Primary Power: 120 VAC, 60 Hz	
	FCC ID:	
	Type of Modulations:	DSSS
	Equipment Code:	DTS
	Peak RF Output Power:	7.45dBm
	EUT Frequency Ranges:	2405 - 2480MHz
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:	Anderson Soungpanya	
Report Date(s):	December 2, 2010	

Table 2. EUT Summary Table



Echelon Corporation

IEM RF Module ZIGBEE:835-0701-51
with Street Light Bridge (SLB)/Antenna

Electromagnetic Compatibility
Equipment Configuration
CFR Title 47, Part 15B, 15.247

B. References

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

Table 3. References

C. Test Site

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

Radiated Emissions measurements were performed in a 10 meter semi-anechoic chamber (equivalent to an Open Area Test Site). In accordance with §2.948(a)(3), a complete site description is contained at MET Laboratories.

D. Description of Test Sample

The Echelon Corporation IEM RF Module ZIGBEE:835-0701-51 with Street Light Bridge (SLB)/Antenna, Equipment Under Test (EUT), is as follows:

IEC Meter Description:

The Echelon electrical meters, and the NES system that the meter operate within, provide a comprehensive set of energy services. Some of these services are: automated two-way meter reading, Time of Use metering, remote electronic disconnect and local physical reconnect, distribution system asset optimization, outage detection and restoration management, blackout and brownout detection, comprehensive revenue protection, real-time direct load control, and more.

IEM RF Module Description:

In addition to PL communication, Echelon is providing RF communication capabilities for the home owner to communicate within the house hold appliances and other interfaces for the utility usage.



Photograph 1. Echelon Corporation IEM RF Module ZIGBEE:835-0701-51 with Street Light Bridge (SLB)/Antenna



Echelon Corporation

IEM RF Module ZIGBEE:835-0701-51
with Street Light Bridge (SLB)/Antenna

Electromagnetic Compatibility
Equipment Configuration
CFR Title 47, Part 15B, 15.247

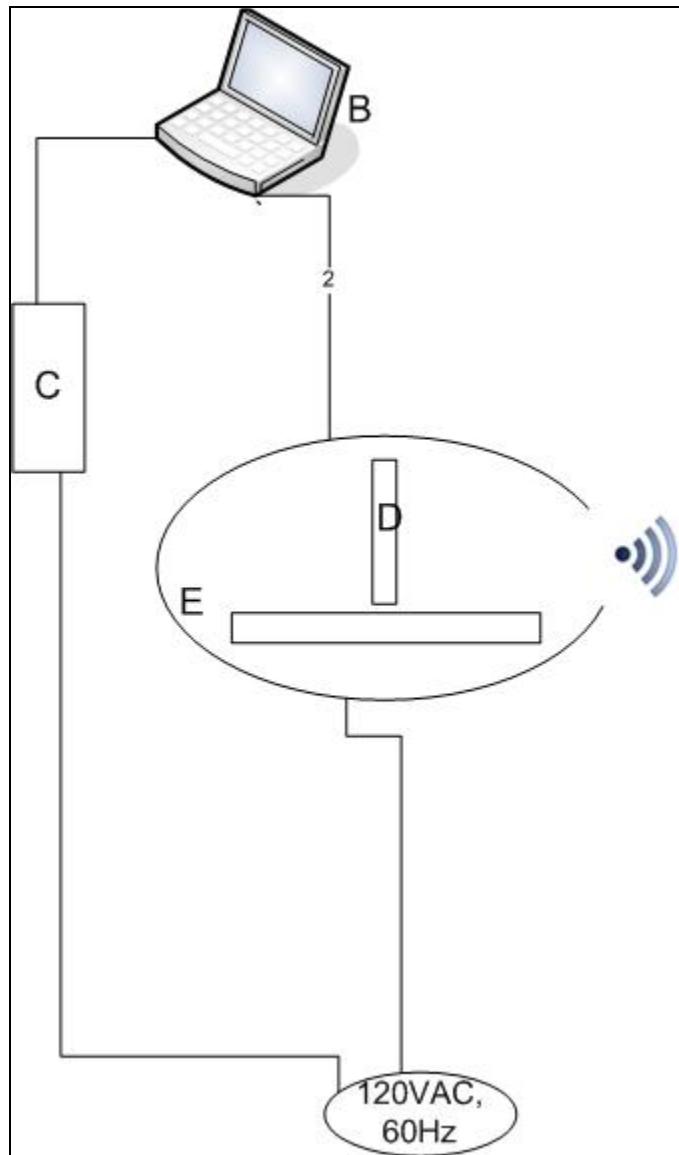


Figure 1. Block Diagram of Test Configuration



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IEM RF Module ZIGBEE:835-0701-51
with Street Light Bridge (SLB)/AntennaElectromagnetic Compatibility
Equipment Configuration
CFR Title 47, Part 15B, 15.247

E. Equipment Configuration

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

Ref. ID	Name / Description	Model Number	Serial Number
D	IEM RF Module (ZIGBEE)	79010-03	Production
E	SLB	76520R	Production

Table 4. Equipment Configuration

F. Support Equipment

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

Ref. ID	Name / Description	Manufacturer	Model Number	Serial Number
B	Laptop	Lenovo	15303	ABU0113792
C	AC power adapter	Lenovo	ADP-90RHB	N/A

Table 5. Support Equipment

G. Ports and Cabling Information

Ref. ID	Port Name on EUT	Cable Description	Qty.	Length (m)	Shielded (Y/N)	Termination Point
1	AC power	3 conductor AC power cord	1	1.5	N	110-230VAC/50-60Hz

Table 6. Ports and Cabling Information

H. Mode of Operation

The EUT communicates through air via transmit and receive function. Support equipment directly communicates with EUT via RF.

I. Method of Monitoring EUT Operation

Computer is monitoring the communication between Host and EUT.

EUT's performance is monitored by continuously observing the received RF signal from EUT displayed on laptop using "Chanalyzer 3.4" software. A reset will cause that transmission to stop, and it can only be restarted via entering the information on the Lap Top.



Echelon Corporation

IEM RF Module ZIGBEE:835-0701-51
with Street Light Bridge (SLB)/Antenna

Electromagnetic Compatibility
Equipment Configuration
CFR Title 47, Part 15B, 15.247

J. Modifications

a) Modifications to EUT

No modifications were made to the EUT.

b) Modifications to Test Standard

No modifications were made to the test standard.

K. Disposition of EUT

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



Echelon Corporation

IEM RF Module ZIGBEE:835-0701-51
with Street Light Bridge (SLB)/Antenna

Electromagnetic Compatibility
Unintentional Radiators
CFR Title 47, Part 15B, 15.247

III. Electromagnetic Compatibility Criteria for Unintentional Radiators

Electromagnetic Compatibility Criteria

§ 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 7. 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 7. 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.

15.207(a), Except as shown in paragraphs (b) and (c) of this section*, charging, AC adapters or battery eliminators 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 the Table 7, as measured using a 50 μ H/50 ohms 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 frequencies ranges.

Frequency range (MHz)	Class A Conducted Limits (dB μ V)		*Class B Conducted Limits (dB μ V)	
	Quasi-Peak	Average	Quasi-Peak	Average
* 0.15- 0.45	79	66	66 - 56	56 - 46
0.45 - 0.5	79	66	56	46
0.5 - 30	73	60	60	50

Note 1 — The lower limit shall apply at the transition frequencies.
 Note 2 — The limit decreases linearly with the logarithm if the frequency in the range 0.15 MHz to 0.5 MHz.
 * -- Limits per Subsection 15.207(a).

Table 7. Conducted Limits for Radio Frequency Devices calculated from FCC Part 15 Subsections 15.107(a) (b) and 15.207(a)

Test Results:

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

Test Engineer(s):

Anderson Soungpanya

Test Date(s):

09/14/10



Echelon Corporation

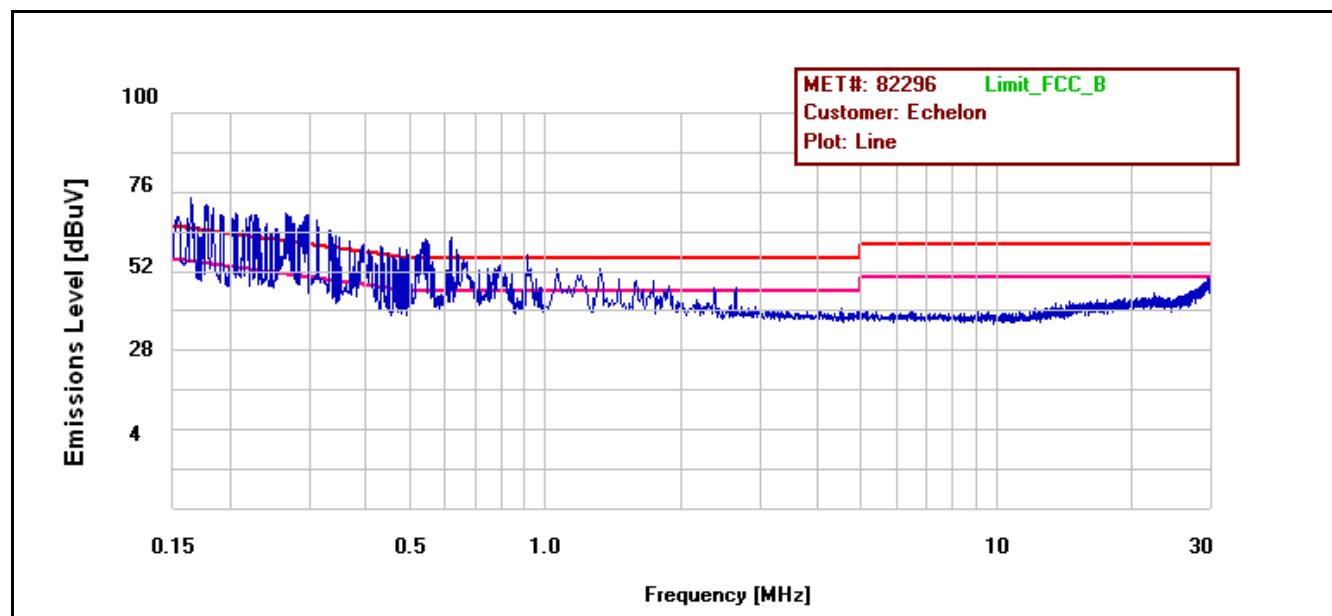
IEM RF Module ZIGBEE:835-0701-51
with Street Light Bridge (SLB)/Antenna

Electromagnetic Compatibility
Unintentional Radiators
CFR Title 47, Part 15B, 15.247

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

Line	Freq (MHz)	QP Amplitude	QP Limit	Delta	Pass	Average Amplitude	Average Limit	Delta	Pass
Line	.167	56.29	65.111	-8.821	Pass	43.85	55.111	-11.261	Pass
Line	.227	48.28	62.568	-14.288	Pass	41.69	52.568	-10.878	Pass
Line	.321	46.77	59.698	-12.928	Pass	37.57	49.698	-12.128	Pass
Line	.277	49.31	60.919	-11.609	Pass	42.71	50.919	-8.209	Pass
Line	.532	48.29	56	-7.71	Pass	39.37	46	-6.63	Pass
Line	.614	46.11	56	-9.89	Pass	36.85	46	-9.15	Pass

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



Plot 1. Conducted Emission, Phase Line Plot



Echelon Corporation

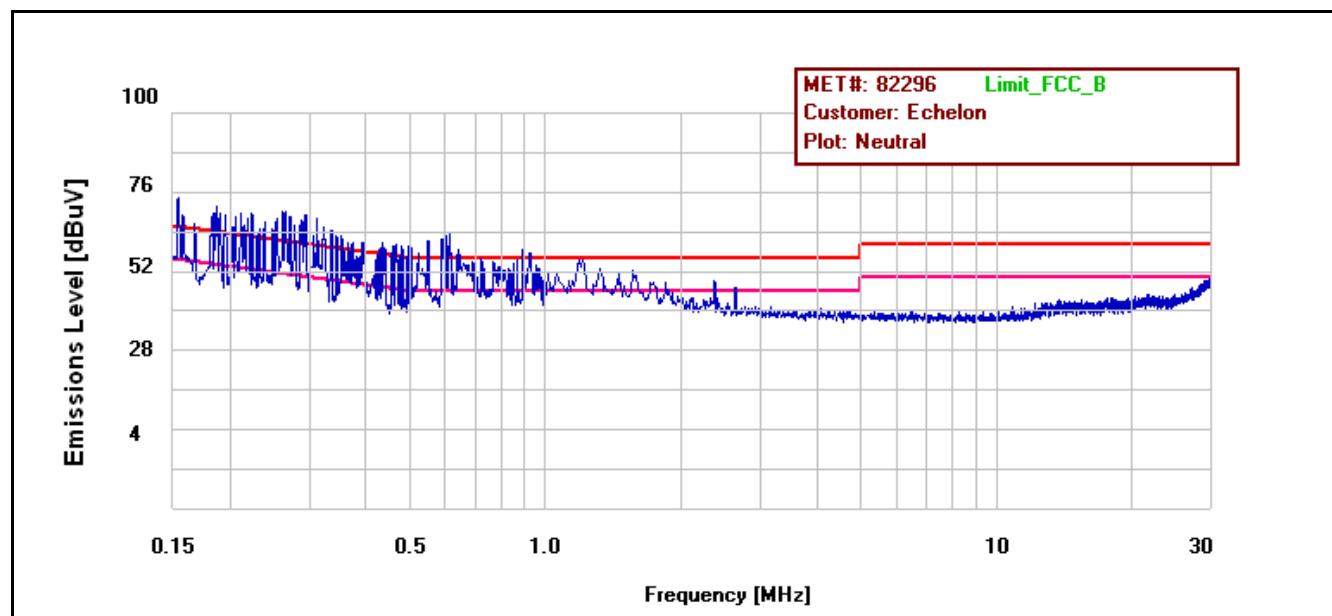
IEM RF Module ZIGBEE:835-0701-51
with Street Light Bridge (SLB)/Antenna

Electromagnetic Compatibility
Unintentional Radiators
CFR Title 47, Part 15B, 15.247

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

Line	Freq (MHz)	QP Amplitude	QP Limit	Delta	Pass	Average Amplitude	Average Limit	Delta	Pass
Neutral	.159	57.89	65.517	-7.627	Pass	47.87	55.517	-7.647	Pass
Neutral	.225	50.31	62.641	-12.331	Pass	44.29	52.641	-8.351	Pass
Neutral	.267	52.18	61.224	-9.044	Pass	45.83	51.224	-5.394	Pass
Neutral	.345	50.21	59.101	-8.891	Pass	39.28	49.101	-9.821	Pass
Neutral	.552	52.19	56	-3.81	Pass	37.73	46	-8.27	Pass
Neutral	.629	53.11	56	-2.89	Pass	40.18	46	-5.82	Pass

Table 9. Conducted Emissions - Voltage, AC Power, Neutral Line (120 VAC, 60 Hz)



Plot 2. Conducted Emission, Neutral Line Plot



Echelon Corporation

IEM RF Module ZIGBEE:835-0701-51
with Street Light Bridge (SLB)/Antenna

Electromagnetic Compatibility
Unintentional Radiators
CFR Title 47, Part 15B, 15.247

Conducted Emission Limits Test Setup



Photograph 2. Conducted Emissions, Test Setup



Photograph 3. Conducted Emissions, Test Setup, Side View

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 10.

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 10.

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 10. 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 inside a semi-anechoic chamber. The method of testing and test conditions of ANSI C63.4 were used. An antenna was located 10m 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):

Anderson Soungpanya

Test Date(s):

09/16/10



Echelon Corporation

IEM RF Module ZIGBEE:835-0701-51
with Street Light Bridge (SLB)/Antenna

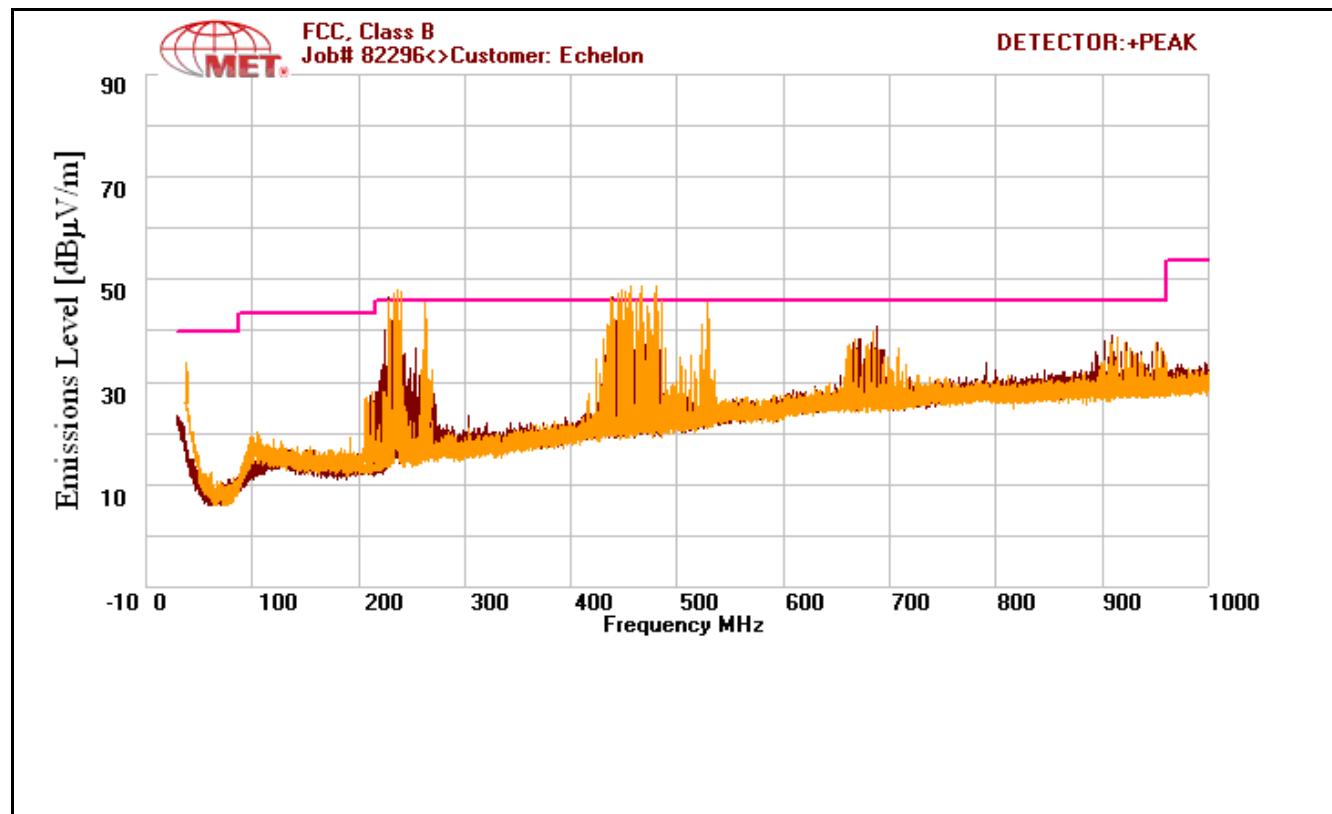
Electromagnetic Compatibility
Unintentional Radiators
CFR Title 47, Part 15B, 15.247

Radiated Emissions Limits Test Results, Class B

Frequency (MHz)	Antenna Polarity	EUT Azimuth (Degrees)	Antenna Height (cm)	Uncorrected Amplitude (dBuV)	ACF (dB/m)	CBL (dB)	Corrected Amplitude (dBuV)	Limit (dBuV)	Margin (dB)
450.67	V	156	100	14.34	16.8	3.549	34.689	46	-11.311
707.01	V	10	250	3.45	18.64	4.452	26.542	46	-19.458
238.83	V	35	150	12.87	11.183	2.517	26.57	46	-19.43
464.97	H	116	100	10.55	16.6	3.631	30.781	46	-15.219
263.87	H	100	167	12.5	13.9	3.693	30.093	46	-15.907
443.18	H	222	154	4.55	16.8	4.396	25.746	46	-20.254
464.48	V	85	100	14.95	17.269	4.518	36.737	46	-9.263
524.21	V	122	122	12.22	17.984	4.831	35.035	46	-10.965

Table 11. Radiated Emissions Limits, Test Results

Note: * - Emissions are transients that when investigated with a QP Detector, the amplitude is very low.



Plot 3. Radiated Emissions, Pre-Scan, 30 MHz - 1 GHz

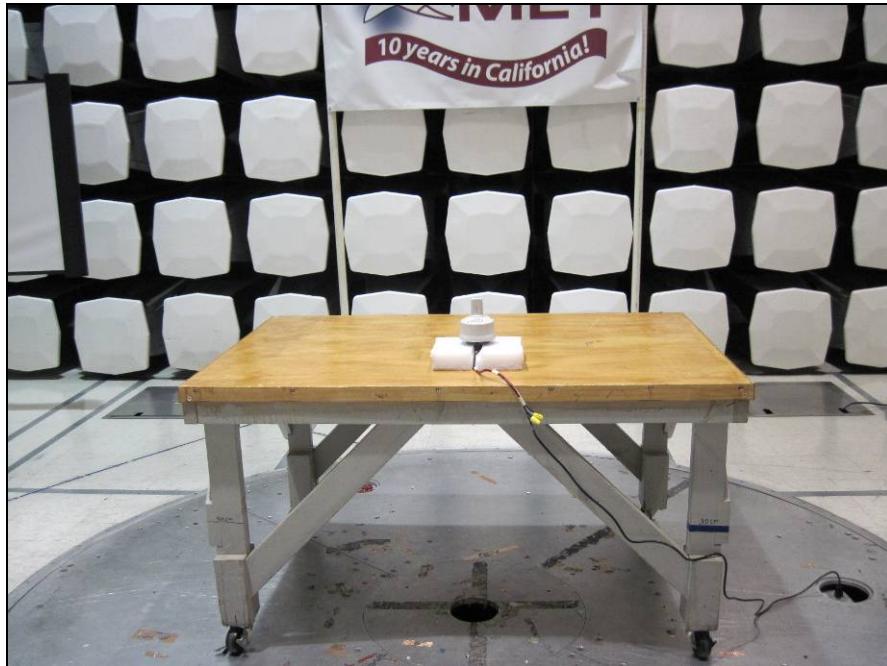


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with Street Light Bridge (SLB)/Antenna

Electromagnetic Compatibility
Unintentional Radiators
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Radiated Emission Limits Test Setup



Photograph 4. Radiated Emissions, Test Setup



Photograph 5. Radiated Emissions, Test Setup, Biolog



Photograph 6. Radiated Emission, Test Setup, Rear Review



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IEM RF Module ZIGBEE:835-0701-51
with Street Light Bridge (SLB)/Antenna

Electromagnetic Compatibility
Intentional Radiators
CFR Title 47, Part 15B, 15.247

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 with the criteria of §15.203 by virtue of being permanently attached to the unit.

Test Engineer(s): Anderson Soungpanya

Test Date(s): 08/30/10

Gain	Type	Model	Manufacturer
2.1 dBi	Integral	375-1293-51	Echelon

Table 12. Antenna List



Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.207 Conducted Emissions Limits

Test Requirement(s): § 15.207 (a): For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30MHz, shall not exceed the limits in the following table, as measured using a 50 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 - 0.45	66 - 56	56 - 46
0.45 - 0.5	56	46
0.5 - 30	60	50

Table 13. Conducted Limits for Intentional Radiators from FCC Part 15 § 15.207(a)

§ 15.207 (b): The limit shown in paragraph (a) of this section shall not apply to carrier current systems operating as intentional radiators on frequencies below 30 MHz. In lieu thereof, these carrier current systems shall be subject to the following standards: (1) For carrier current system containing their fundamental emission within the frequency band 535–1705 kHz and intended to be received using a standard AM broadcast receiver: no limit on conducted emissions. (2) For all other carrier current systems: 1000 μ V within the frequency band 535–1705 kHz, as measured using a 50 μ H/50 ohms LISN.

Test Procedure:

The EUT was placed on a 0.8 m-high wooden table inside a screen room. The EUT was situated such that the back of the EUT was 0.4 m from one wall of the vertical ground plane, and the remaining sides of the EUT were no closer than 0.8 m from any other conductive surface. The EUT was powered from a 50 Ω /50 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. The EUT can transmit using wireless Zigbee and on the carrier current. For the purpose of this testing, the transmitters were turned on. Scans were preformed with the transmitters on.

Test Results:

The EUT was compliant with this requirement. Measured emissions were below the applicable limits.

Test Engineer(s):

Anderson Soungpanya

Test Date(s):

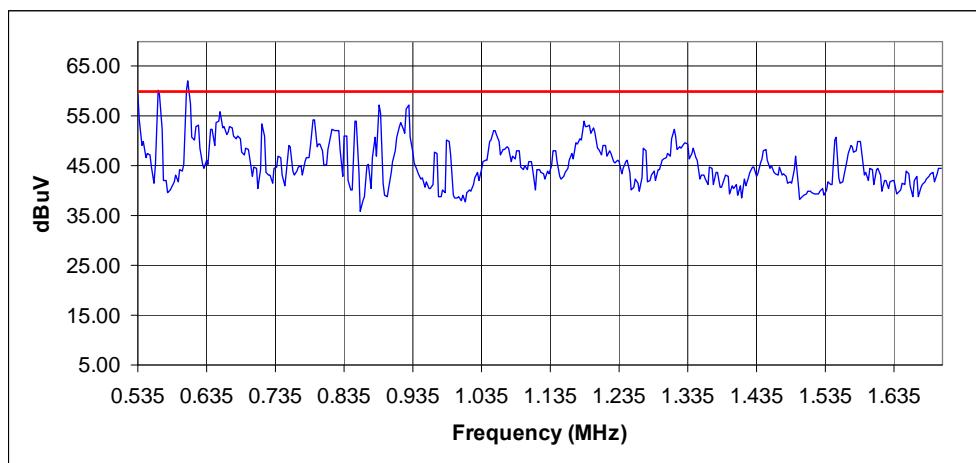
09/16/10



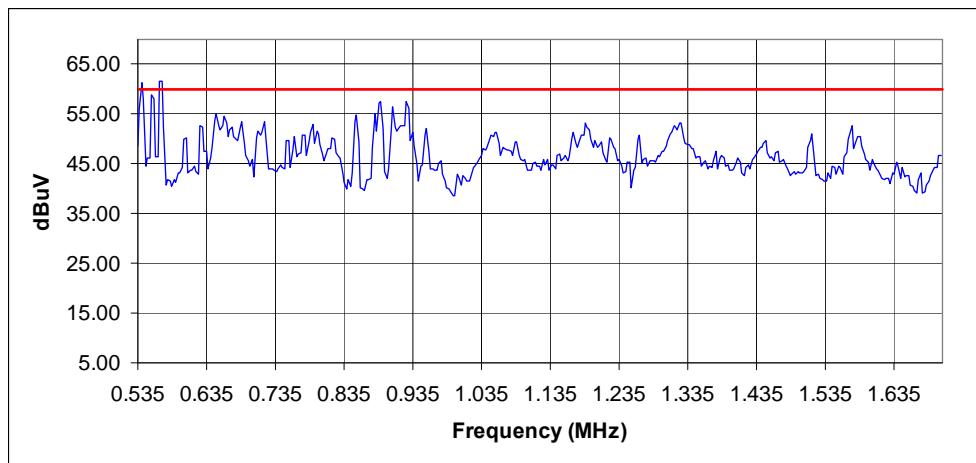
15.207 Conducted Emissions Test Results

Line	Freq (MHz)	QP Amplitude	QP Limit	Delta	Pass	Average Amplitude	Average Limit	Delta	Pass
Line	.663	46.95	56	-9.05	Pass	33.55	46	-12.45	Pass
Line	.607	39.08	56	-16.92	Pass	29.42	46	-16.58	Pass
Line	.567	43.14	56	-12.86	Pass	27.79	46	-18.21	Pass
Neutral	.572	45.07	56	-10.93	Pass	28.77	46	-17.23	Pass
Neutral	.540	47.19	56	-8.81	Pass	30.31	46	-15.69	Pass
Neutral	.888	41.05	56	-14.95	Pass	28.08	46	-17.92	Pass

Table 14. Conducted Emissions, 15.207, Test Results, 0.535 – 1.705 MHz



Plot 4 Conducted Emissions, Phase Line, 0.535 – 1.705 MHz



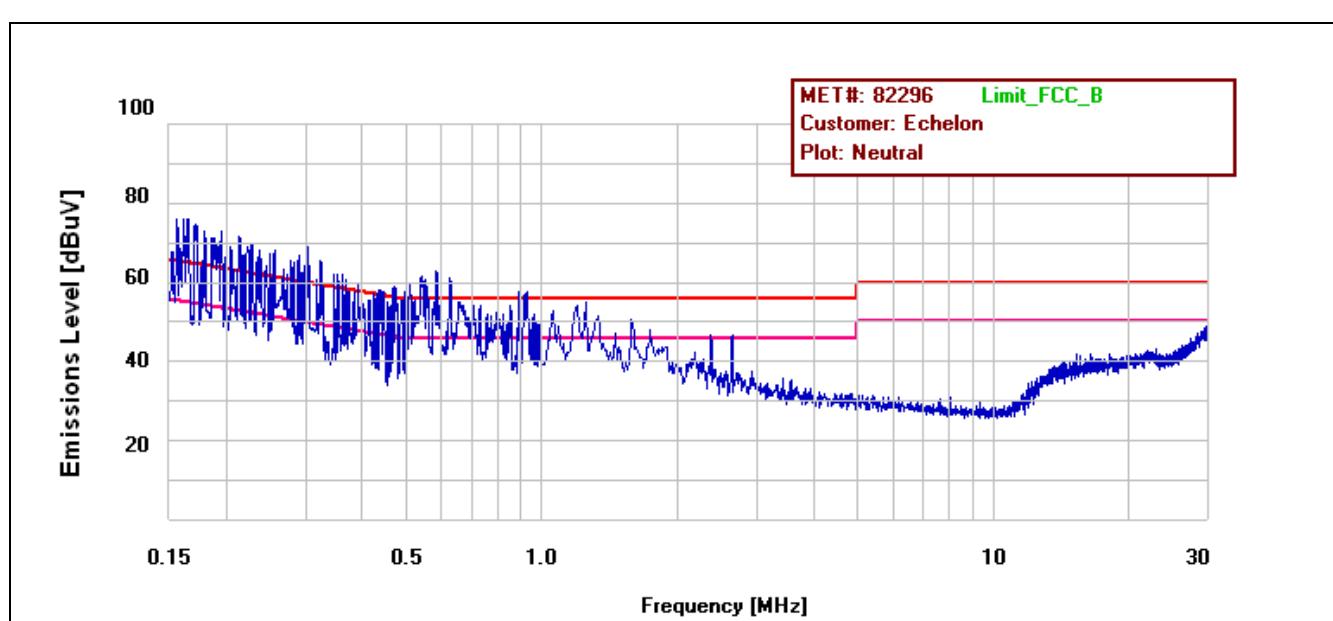
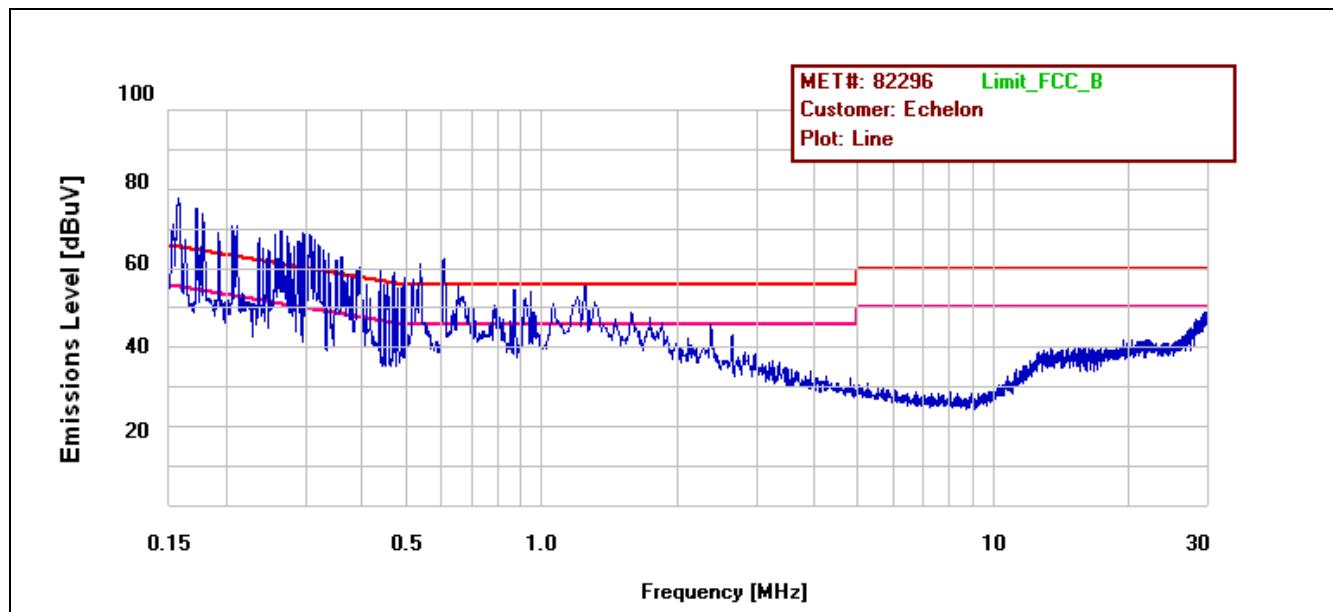
Plot 5. Conducted Emissions, Neutral Line, 0.535 – 1.705 MHz



15.207 Conducted Emissions Test Results

Line	Freq (MHz)	QP Amplitude	QP Limit	Delta	Pass	Average Amplitude	Average Limit	Delta	Pass
Line	.166	57.81	65.16	-7.35	Pass	45.42	55.16	-9.74	Pass
Line	.185	56.88	64.263	-7.383	Pass	43.02	54.263	-11.243	Pass
Line	.264	54.13	61.317	-7.187	Pass	47.57	51.317	-3.747	Pass
Line	.309	51.83	60.014	-8.184	Pass	41.03	50.014	-8.984	Pass
Line	.359	47.32	58.771	-11.451	Pass	37.48	48.771	-11.291	Pass
Line	.423	42.64	57.413	-14.773	Pass	34.32	47.413	-13.093	Pass
Line	.545	44.99	56	-11.01	Pass	31.98	46	-14.02	Pass
Line	.600	44.38	56	-11.62	Pass	28.21	46	-17.79	Pass
Line	.663	47.42	56	-8.58	Pass	34.39	46	-11.61	Pass
Line	.764	40.01	56	-15.99	Pass	30.45	46	-15.55	Pass
Line	.804	42.58	56	-13.42	Pass	30.55	46	-15.45	Pass
Line	.923	46.88	56	-9.12	Pass	35.71	46	-10.29	Pass
Line	1.19	46.75	56	-9.25	Pass	34.22	46	-11.78	Pass
Line	1.31	46.16	56	-9.84	Pass	34.88	46	-11.12	Pass
Line	2.36	43.55	56	-12.45	Pass	36.53	46	-9.47	Pass
Line	29.49	43.7	60	-16.3	Pass	28.87	50	-21.13	Pass
Neutral	.156	58.27	65.675	-7.405	Pass	43.38	55.675	-12.295	Pass
Neutral	.182	56.22	64.398	-8.178	Pass	36.57	54.398	-17.828	Pass
Neutral	.264	54.83	61.317	-6.487	Pass	44.23	51.317	-7.087	Pass
Neutral	.209	51.98	63.252	-11.272	Pass	41.27	53.252	-11.982	Pass
Neutral	.302	51.08	60.204	-9.124	Pass	35.53	50.204	-14.674	Pass
Neutral	.393	48.12	58.022	-9.902	Pass	33.71	48.022	-14.312	Pass
Neutral	.413	43.79	57.611	-13.821	Pass	33.11	47.611	-14.501	Pass
Neutral	.531	46.79	56	-9.21	Pass	29.14	46	-16.86	Pass
Neutral	.621	41.34	56	-14.66	Pass	35.57	46	-10.43	Pass
Neutral	.761	39.21	56	-16.79	Pass	30.12	46	-15.88	Pass
Neutral	.919	47.18	56	-8.82	Pass	35.61	46	-10.39	Pass
Neutral	1.18	46.25	56	-9.75	Pass	34.52	46	-11.48	Pass
Neutral	2.36	43.27	56	-12.73	Pass	36.02	46	-9.98	Pass
Neutral	29.89	43.24	60	-16.76	Pass	28.92	50	-21.08	Pass

Table 15. Conducted Emissions, 15.207, Test Results, 2.4 GHz Band On





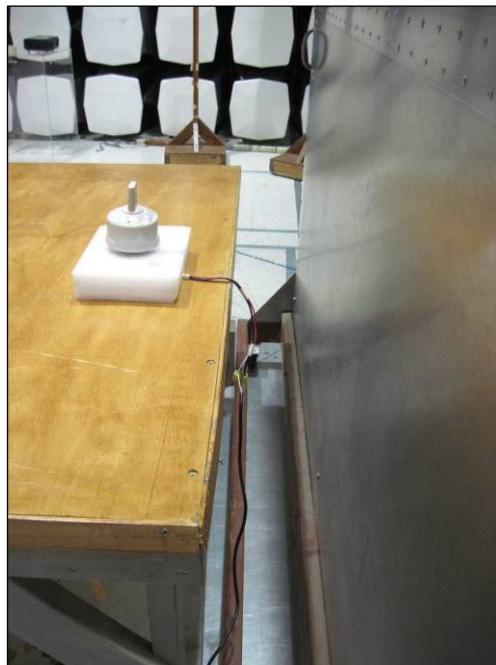
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with Street Light Bridge (SLB)/Antenna

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Intentional Radiators
CFR Title 47, Part 15B, 15.247

15.207 Conducted Emissions Test Setup Photo



Photograph 7. Conducted Emissions, 15.207, Test Setup



Photograph 8. Conducted Emissions, 15.207, Test Setup, Side View

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(a) 6 dB and 99% Bandwidth

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

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

Test Procedure: The transmitter was on and transmitting at the highest output power. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using a RBW approximately 1% of the total emission bandwidth, $VBW > RBW$. The 6 dB Bandwidth was measured and recorded. The measurements were performed on the low, mid and high channels.

Test Results The EUT was compliant with § 15.247 (a).

The 6 dB and 99% Bandwidth was determined from the plots on the following pages.

Test Engineer(s): Anderson Soungpanya

Test Date(s): 08/30/10

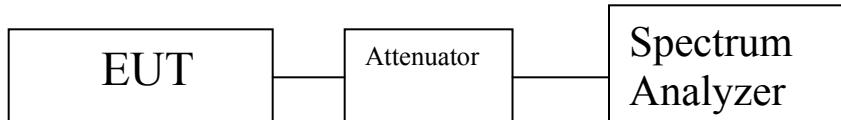


Figure 2. Block Diagram, Occupied Bandwidth Test Setup



Occupied Bandwidth Test Results

Occupied Bandwidth		
Carrier Channel	Frequency (MHz)	Measured 6 dB Bandwidth (MHz)
Low	2405	1.536
Mid	2440	1.586
High	2480	1.741

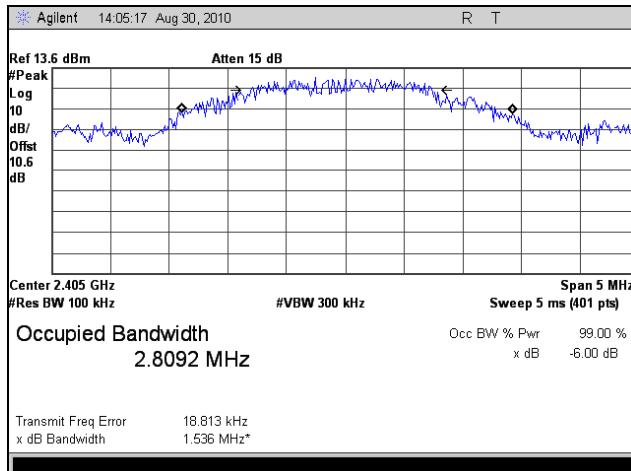
Table 16. Occupied Bandwidth, 6 dB Bandwidth, Test Results

Occupied Bandwidth		
Carrier Channel	Frequency (MHz)	Measured 99% Bandwidth (MHz)
Low	2405	2.7412
Mid	2440	2.7176
High	2480	2.6973

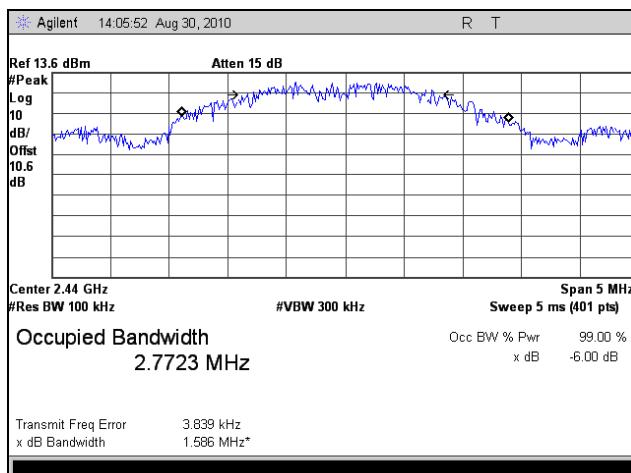
Table 17. Occupied Bandwidth, 99% Bandwidth, Test Results



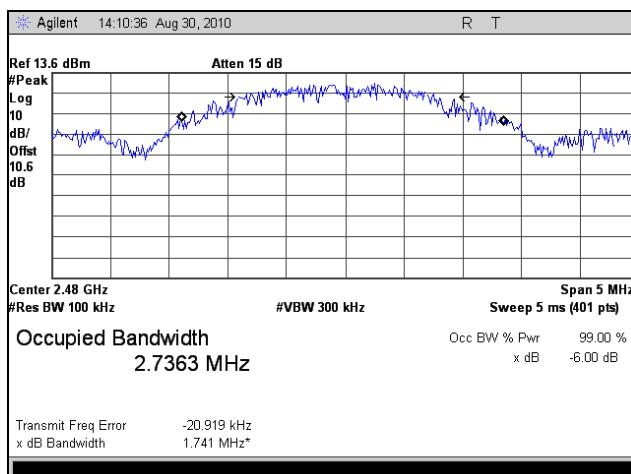
Occupied Bandwidth Test Results



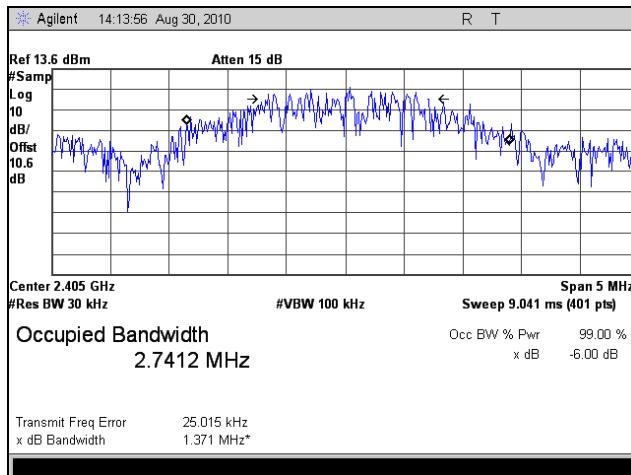
Plot 8. Occupied Band Width, Low Channel, FCC, 6 dB



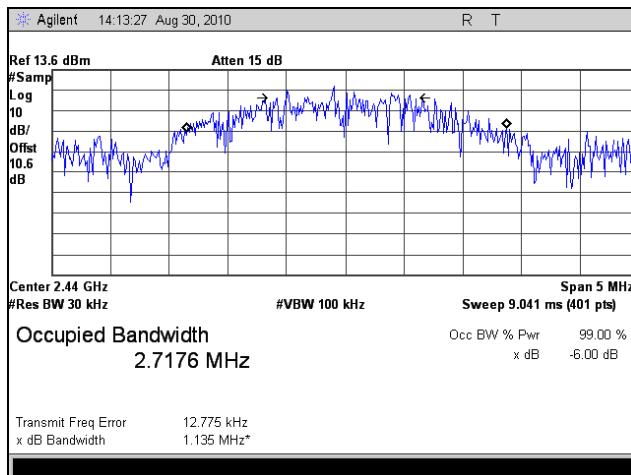
Plot 9. Occupied Band Width, Mid Channel, FCC, 6 dB



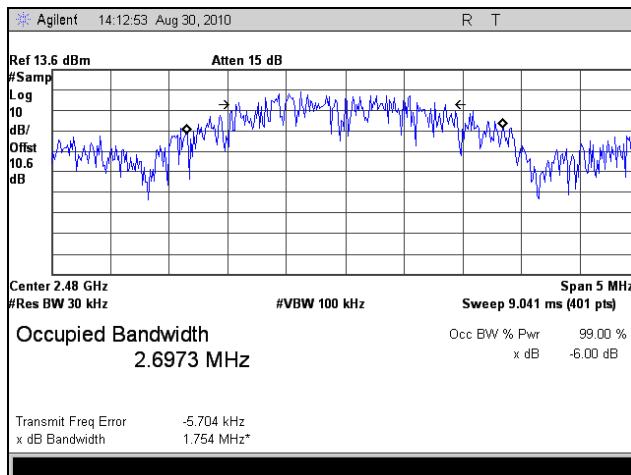
Plot 10. Occupied Band Width, High Channel, FCC, 6 dB



Plot 11. Occupied Band Width, Low Channel, 99 % OBW



Plot 12. Occupied Band Width, Mid Channel, 99% OBW



Plot 13. Occupied Band Width, High Channel, 99 % OBW

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(b) Peak Power Output and RF Exposure

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

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

Table 18. Output Power Requirements from §15.247

§15.247(c): if transmitting antennas of directional gain greater than 6 dBi are used the peak output power from the intentional radiator shall be reduced below the stated values in the Table 18, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

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

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

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

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

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

Test Engineer(s): Anderson Soungpanya

Test Date(s): 09/10/10

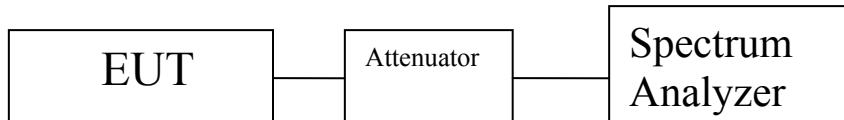


Figure 3. Peak Power Output Test Setup



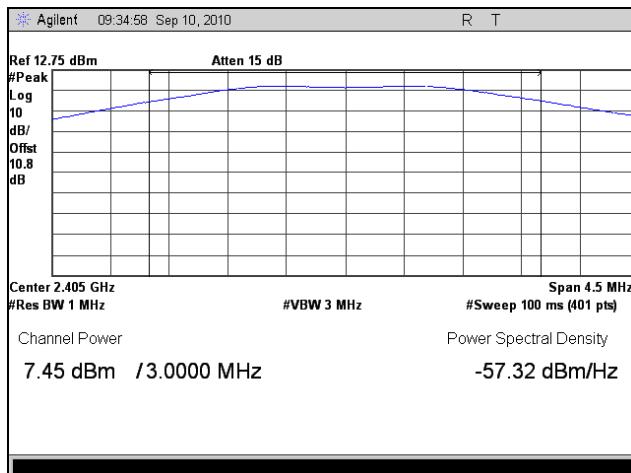
RF Power Output Test Results

Peak Conducted Output Power		
Carrier Channel	Frequency (MHz)	Measured Peak Output Power dBm
Low	2405	7.45
Mid	2440	7.07
High	2480	6.23

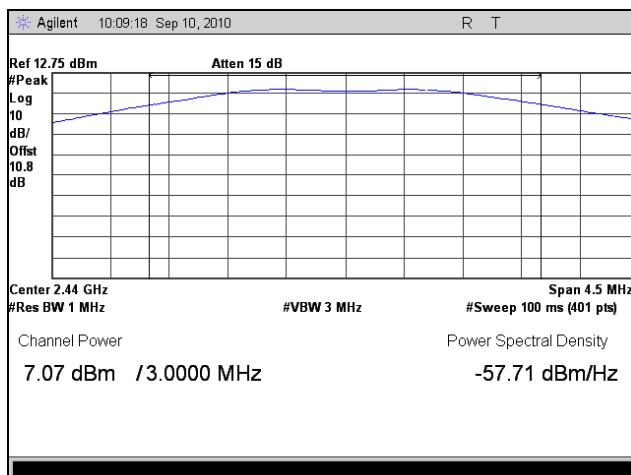
Table 19. RF Output Power Test Results



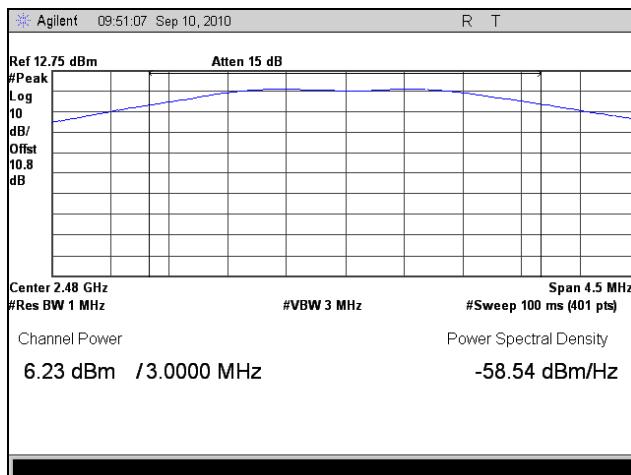
RF Output Power Test Results



Plot 14. Peak Output Power, Low Channel



Plot 15. Peak Output Power, Mid Channel



Plot 16. Peak Output Power, High Channel



Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(b) RF Exposure

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

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

MPE Limit Calculation: EUT's operating frequencies @ 2400-2483.5 MHz; highest conducted power = 7.45dBm (peak) therefore, **Limit for Uncontrolled exposure: 1 mW/cm² or 10 W/m²**

EUT maximum antenna gain = 2.1 dBi.

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

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

where, S = Power Density (1 mW/cm²)
P = Power Input to antenna (5.55mW)
G = Antenna Gain (1.62 numeric)

$$R = (5.55 * 1.62 / 4 * 3.14 * 1.0)^{1/2} = (9.01 / 12.56)^{1/2} = 0.847\text{cm}$$



Electromagnetic Compatibility Criteria for Intentional Radiators

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

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

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

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

MHz	MHz	MHz	GHz
0.090–0.110-----	16.42–16.423	399.9–410	4.5–5.15
¹ 0.495–0.505-----	16.69475–16.69525	608–614	5.35–5.46
2.1735–2.1905-----	16.80425–16.80475	960–1240	7.25–7.75
4.125–4.128-----	25.5–25.67	1300–1427	8.025–8.5
4.17725–4.17775-----	37.5–38.25	1435–1626.5	9.0–9.2
4.20725–4.20775-----	73–74.6	1645.5–1646.5	9.3–9.5
6.215–6.218-----	74.8–75.2	1660–1710	10.6–12.7
6.26775–6.26825-----	108–121.94	1718.8–1722.2	13.25–13.4
6.31175–6.31225-----	123–138	2200–2300	14.47–14.5
8.291–8.294-----	149.9–150.05	2310–2390	15.35–16.2
8.362–8.366-----	156.52475–156.52525	2483.5–2500	17.7–21.4
8.37625–8.38675-----	156.7–156.9	2655–2900	22.01–23.12
8.41425–8.41475-----	162.0125–167.17	3260–3267	23.6–24.0
12.29–12.293-----	167.72–173.2	3332–3339	31.2–31.8
12.51975–12.52025-----	240–285	3345.8–3358.36.	43–36.5
12.57675–12.57725-----	322–335.4	3600–4400	(²)

Table 20. Restricted Bands of Operation

¹ Until February 1, 1999, this restricted band shall be 0.490 – 0.510 MHz.

² Above 38.6



Test Requirement(s): **§ 15.209 (a):** Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in Table 21.

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

Table 21. Radiated Emissions Limits Calculated from FCC Part 15, § 15.209 (a)

Test Procedures: The transmitter was turned on. Measurements were performed of the low, mid and high Channels. The EUT was rotated orthogonally through all three axes. Plots shown are corrected for both antenna correction factor and Cable loss. Only noise floor was measured above 18 GHz.

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

Test Engineer(s): Anderson Soungpanya

Test Date(s): 09/10/10



Harmonic Emissions Requirements – Radiated

Freq. (GHz)	Antenna Polarity (H/V)	Raw Amp. @ 3 m (dBuV/m)	P. Amp (dB)	Ant. Cor. Factor (dB/m)	Cable Loss (dB)	EUT Field Strength Final Amp. (dBuV/m)	Limit Detector Peak / Avg. (Peak) / (Avg.)	Limit @ 3 m (dBuV/m)	Delta (dB)
4.81	V	63.08	34.41	26.34	5.27	60.28	Peak	74	-13.72
4.81	V	52.74	34.41	26.34	5.27	49.94	Avg.	54	-4.06
7.215	V	52.38	34.66	27.56	5.71	50.99	Peak	74	-23.01
7.215	V	33.24	34.66	27.56	5.71	31.85	Avg.	54	-22.15
9.62	V	50.21	35.23	28.78	6.36	50.12	Peak	74	-23.88
9.62	V	34.11	35.23	28.78	6.36	34.02	Avg.	54	-19.98

Table 22. Radiated Harmonic Emissions, Test Results, Low Channel

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

Freq. (GHz)	Antenna Polarity (H/V)	Raw Amp. @ 3 m (dBuV/m)	P. Amp (dB)	Ant. Cor. Factor (dB/m)	Cable Loss (dB)	EUT Field Strength Final Amp. (dBuV/m)	Limit Detector Peak / Avg. (Peak) / (Avg.)	Limit @ 3 m (dBuV/m)	Delta (dB)
4.88	V	62.89	34.39	26.43	5.34	60.26	Peak	74	-13.74
4.88	V	54.99	34.39	26.43	5.34	52.36	Avg.	54	-1.64
7.32	V	54.74	34.68	27.63	5.75	53.44	Peak	74	-20.56
7.32	V	34.11	34.68	27.63	5.75	32.81	Avg.	54	-21.19
9.76	V	51.83	35.20	28.77	6.16	51.56	Peak	74	-22.44
9.76	V	34.38	35.20	28.77	6.16	34.11	Avg.	54	-19.89

Table 23. Radiated Harmonic Emissions, Test Results, Mid Channel

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

Freq. (GHz)	Antenna Polarity (H/V)	Raw Amp. @ 3 m (dBuV/m)	P. Amp (dB)	Ant. Cor. Factor (dB/m)	Cable Loss (dB)	EUT Field Strength Final Amp. (dBuV/m)	Limit Detector Peak / Avg. (Peak) / (Avg.)	Limit @ 3 m (dBuV/m)	Delta (dB)
4.96	V	64.19	34.37	26.54	5.39	61.74	Peak	74	-12.26
4.96	V	52.19	34.37	26.54	5.39	49.74	Avg.	54	-4.26
7.44	V	52.15	34.73	27.73	5.81	50.97	Peak	74	-23.03
7.44	V	34.1	34.73	27.73	5.81	32.92	Avg.	54	-21.08
9.92	V	50.32	35.18	28.78	5.98	49.90	Peak	74	-24.10
9.92	V	33.92	35.18	28.78	5.98	33.50	Avg.	54	-20.50

Table 24. Radiated Harmonic Emissions, Test Results, High Channel

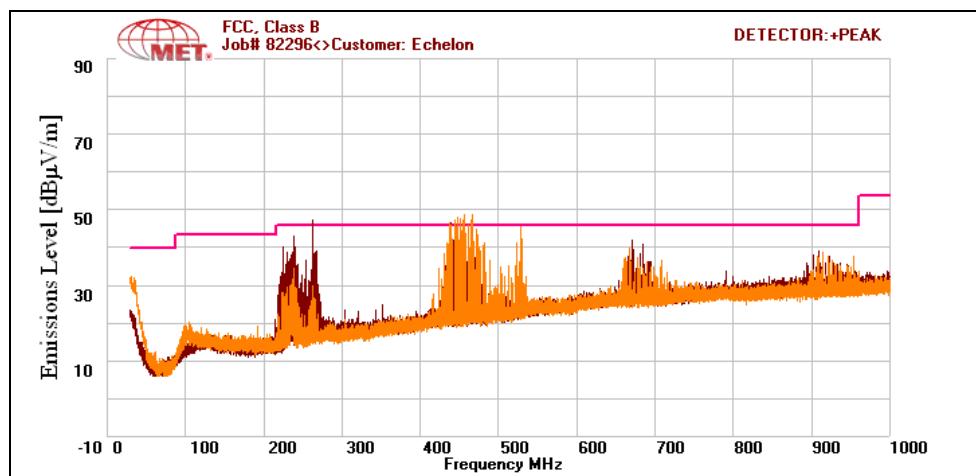
Note: All other emissions were measured at the noise floor of the spectrum analyzer.

Radiated Spurious Emissions Test Results

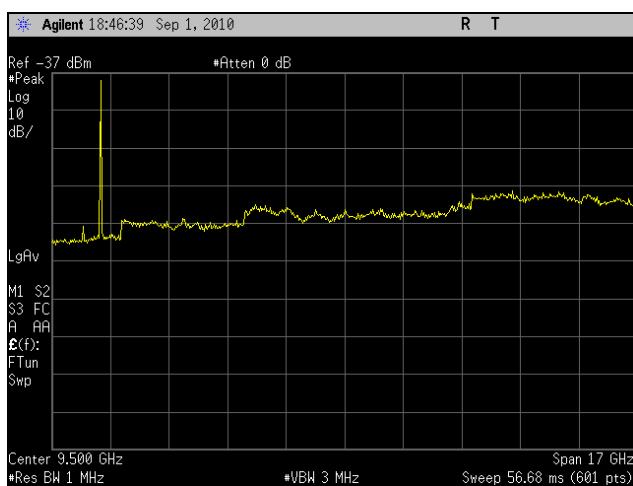
Frequency (MHz)	Antenna Polarity	EUT Azimuth (Degrees)	Antenna Height (cm)	Uncorrected Amplitude (dB _u V)	ACF (dB/m)	CBL (dB)	Corrected Amplitude (dB _u V)	Limit (dB _u V)	Margin (dB)
263.87	H	100	167	12.5	13.9	3.693	30.093	46	-15.907
443.18	H	222	154	4.55	16.8	4.396	25.746	46	-20.254
464.48	V	85	100	14.95	17.269	4.518	36.737	46	-9.263
524.21	V	122	122	12.22	17.984	4.831	35.035	46	-10.965

Table 25. Radiated Emissions, §15.209, Test Results

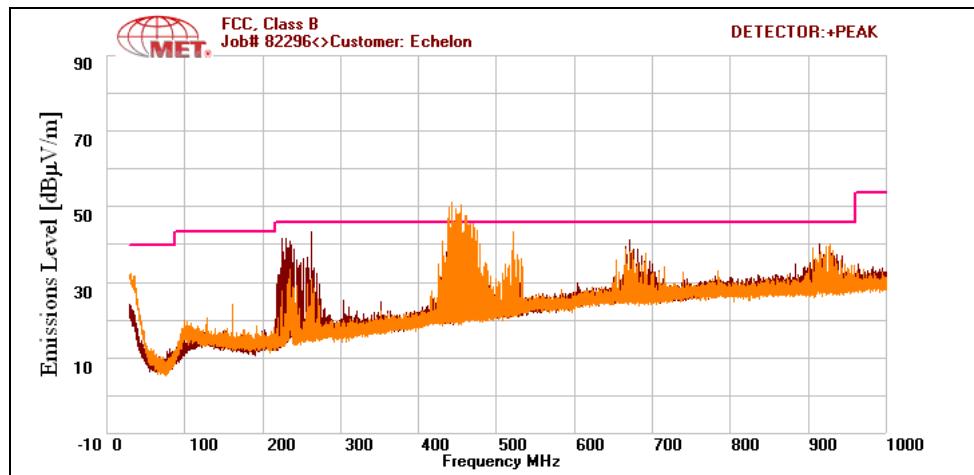
Note: Worst case emissions were investigated for low mid and high channels. Detected spurious on 30MHz-1GHz plots are transients. All three channels had the same transient phenomena. Pulses were investigated with a QP detector and are under the limit of 15.209. See Table 25 for QP values.



Plot 17. Radiated Spurious Emissions, Low Channel, 30 MHz – 1 GHz



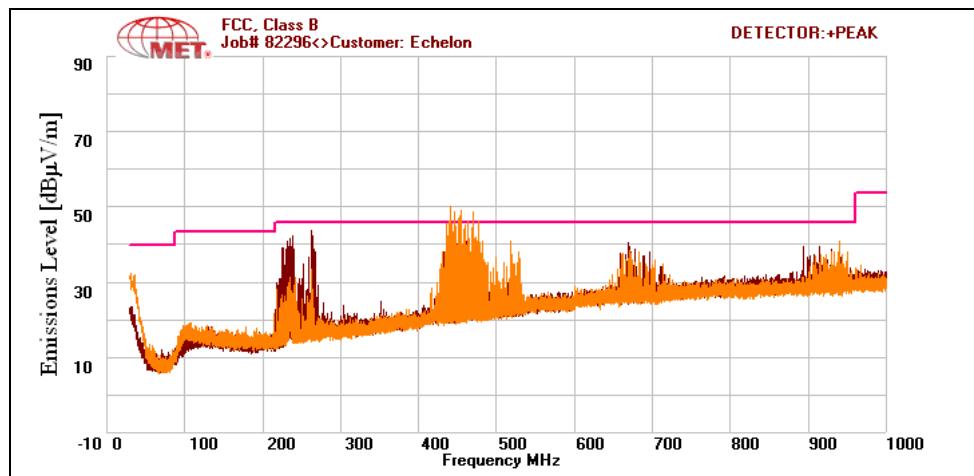
Plot 18. Radiated Spurious Emissions, Low Channel, 1 GHz – 18 GHz



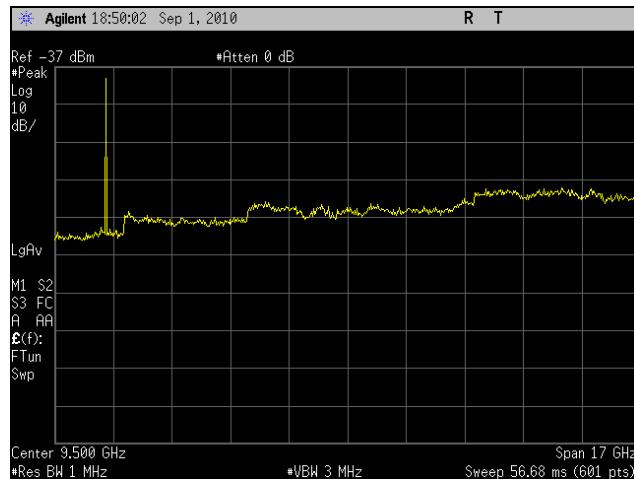
Plot 19. Radiated Spurious Emissions, Mid Channel, 30 MHz – 1 GHz



Plot 20. Radiated Spurious Emissions, Mid Channel, 1 GHz – 18 GHz



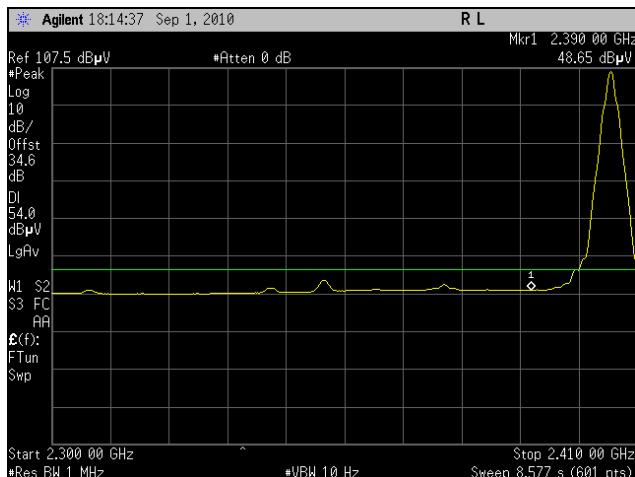
Plot 21. Radiated Spurious Emissions, High Channel, 30 MHz – 1 GHz



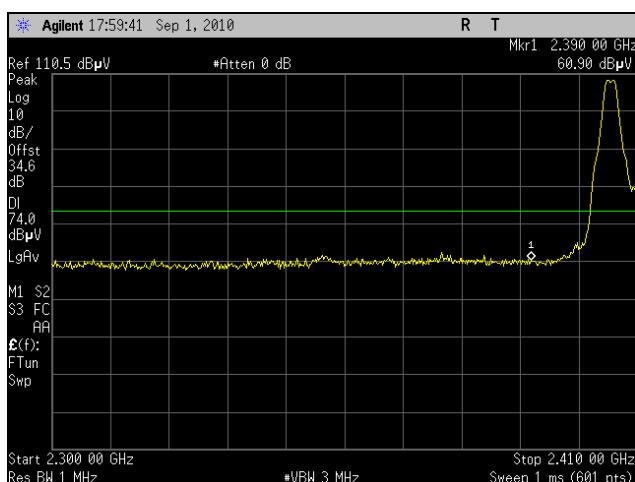
Plot 22. Radiated Spurious Emissions, High Channel, 1 GHz – 18 GHz



Radiated Band Edge Measurements



Plot 23. Radiated Restricted Band Edge, Average, Low Channel



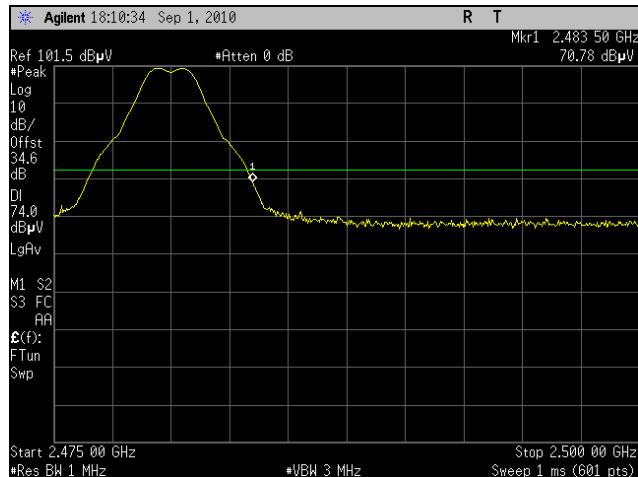
Plot 24. Radiated Restricted Band Edge, Peak, Low Channel

Test Procedures for Radiated Band Edge for High Channel 2480MHz:

1. The field strength of the fundamental emission was measured using a 1MHz RBW and a 3MHz VBW for the peak value and a 1MHz RBW and a 10Hz VBW for the average value.
2. The spectrum analyzer was spanned to encompass both the peak of the fundamental emission and the band edge emission under investigation. The RBW was set to 1% of the span and the VBW to 3x the RBW. The delta between the peak levels of the fundamental emission at the relevant band edge emission was measured and recorded.
3. The resulting delta value was used to determine compliance.

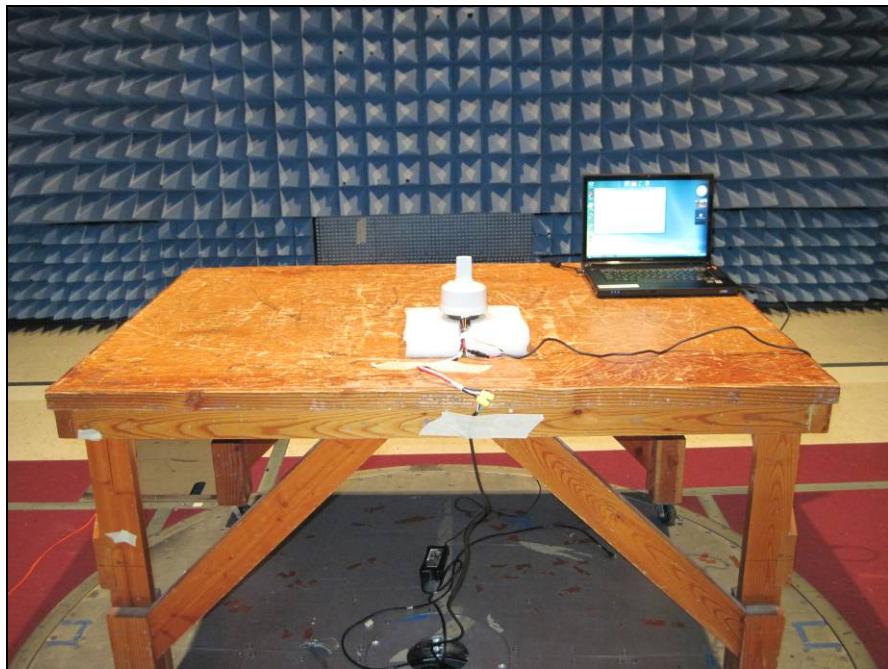
Emission	Corrected Amplitude (dBuV)	Delta Method (dBuV)	Band Edge Measurement (dBuV)	Limit (dBuV)	Margin (dBuV)
Avg.	97.83	43.99	53.84	54	0.16

Table 26. Radiated Band Edge, Test Results





Radiated Spurious Emissions Test Setup



Photograph 9. Radiated Spurious Emissions, Test Setup

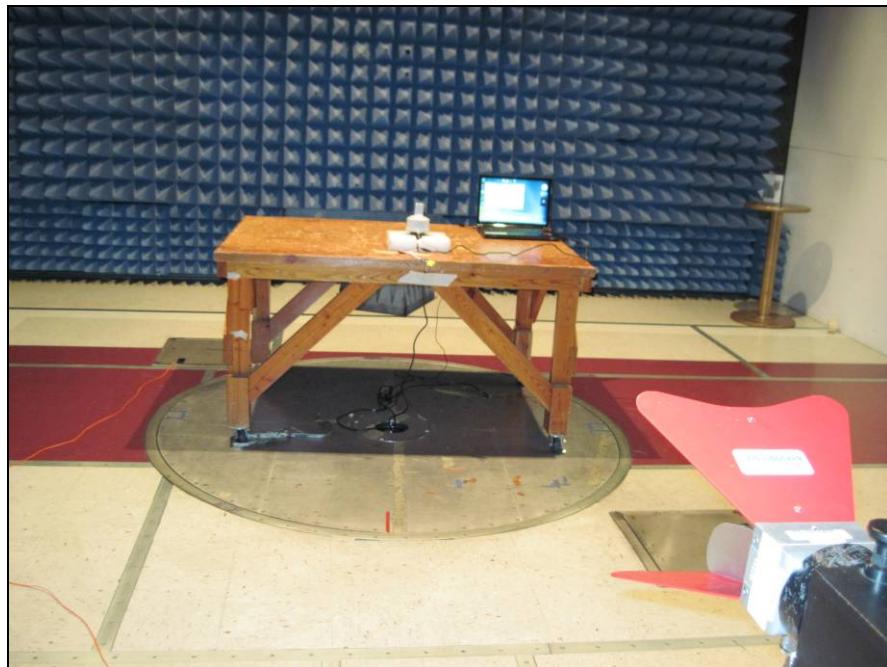


Photograph 10. Radiated Spurious Emissions, Test Setup, 30 MHz – 1 GHz



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Photograph 11. Radiated Spurious Emissions, Test Setup, 1 GHz – 18 GHz

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(d) RF Conducted Spurious Emissions Requirements and Band Edge

Test Requirement:

15.247(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

Test Procedure:

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.

A conducted version of the EUT was provided with a connector at the antenna ports. The spectrum analyzer was set to a 100 kHz resolution bandwidth and 300 kHz video bandwidth. Measurements were taken at the antenna port. Plots are corrected for external attenuation and cable loss.

See following pages for detailed test results with RF Conducted Spurious Emissions.

Test Results: The EUT was compliant with the Conducted Spurious Emission limits of **§15.247(d)**.

Test Engineer(s): Anderson Soungpanya

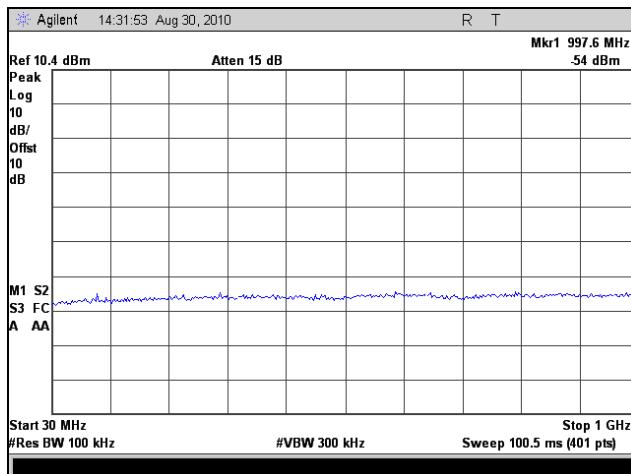
Test Date(s): 08/30/10



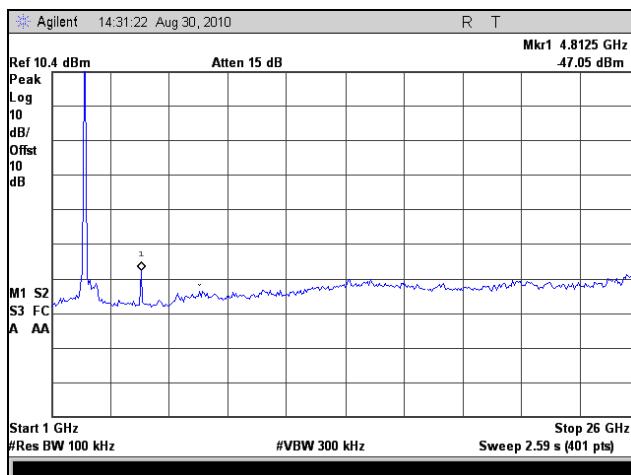
Figure 4. Block Diagram, Conducted Spurious Emissions Test Setup



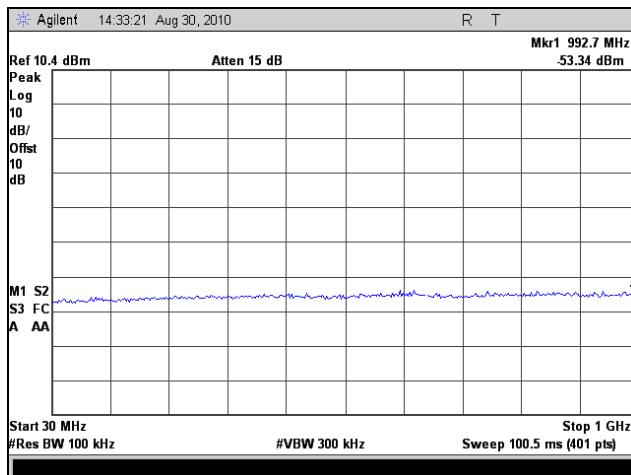
Conducted Spurious Emissions Test Results



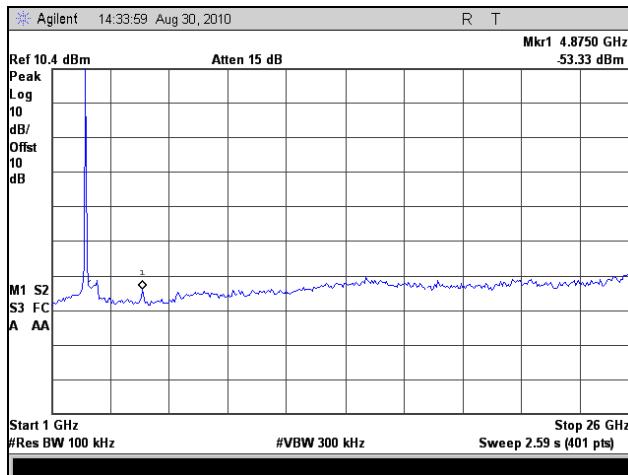
Plot 28. Conducted Emissions, Low Channel, 30 MHz – 1 GHz



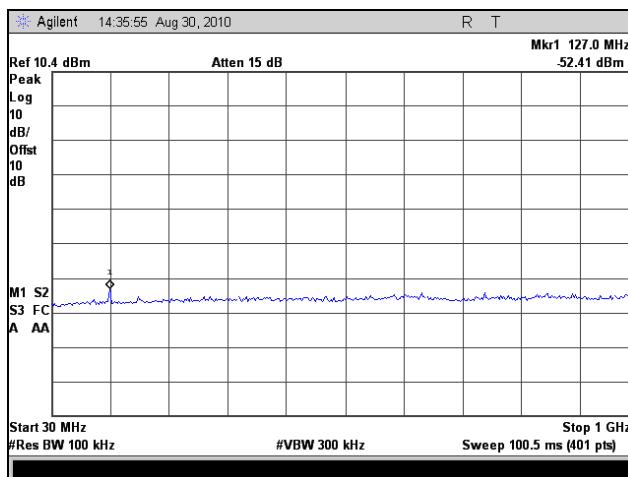
Plot 29. Conducted Emissions, Low Channel, 1 GHz – 26 GHz



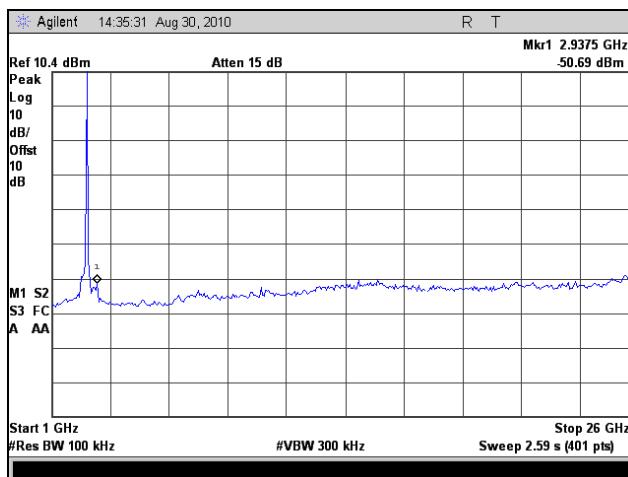
Plot 30. Conducted Emissions, Mid Channel, 30 MHz – 1 GHz



Plot 31. Conducted Emissions, Mid Channel, 1 GHz – 26 GHz



Plot 32. Conducted Emissions, High Channel, 30 MHz – 1 GHz



Plot 33. Conducted Emissions, High Channel, 1 GHz – 26 GHz



Conducted Band Edge Test Results



Plot 34. Conducted Band Edge, Low



Plot 35. Conducted Band Edge, High



Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(e) Peak Power Spectral Density

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

Test Procedure: The transmitter was connected directly to a Spectrum Analyzer through an attenuator. The power level was set to the maximum level. A RBW of 1 MHz and VBW of 3 MHz were used to determine the peak emissions within the band. The Spectrum analyzer was then set to a RBW of 3 kHz and VBW was set to 10 kHz. The SPAN of the analyzer was set to 1 MHz with a 333.3 second sweep. Measurements were carried out at the low, mid and high channels.

Test Results: The EUT was compliant with the peak power spectral density limits of **§ 15.247 (e)**.

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

Test Engineer: Anderson Soungpanya

Test Date: 08/30/10

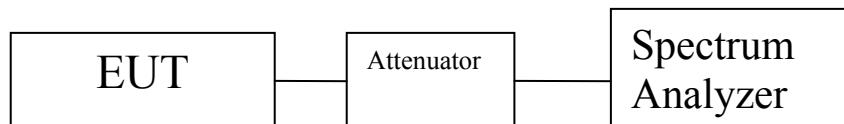


Figure 5. Block Diagram, Peak Power Spectral Density Test Setup



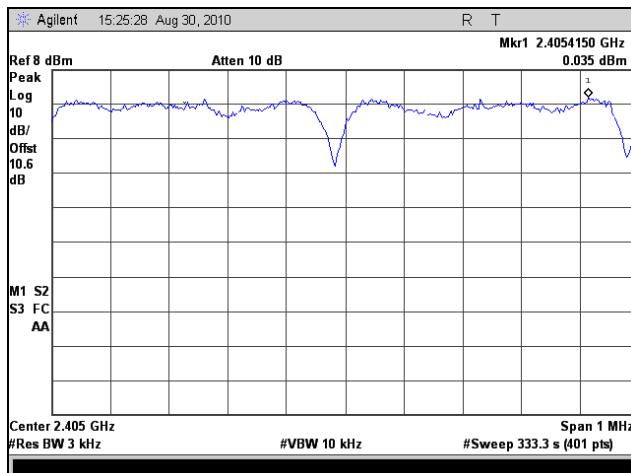
Peak Power Spectral Density Test Results

Peak Power Spectral Density				
Carrier Channel	Frequency (MHz)	Measured PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	2405	0.035	8	7.965
Mid	2440	-0.363	8	8.363
High	2480	-0.919	8	8.919

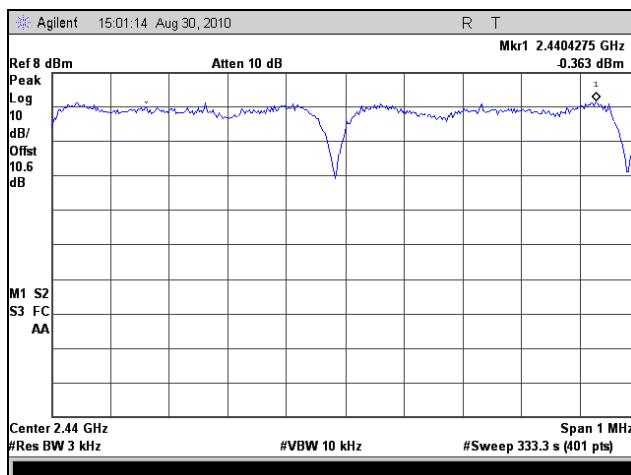
Table 27. Spectral Density, Test Results



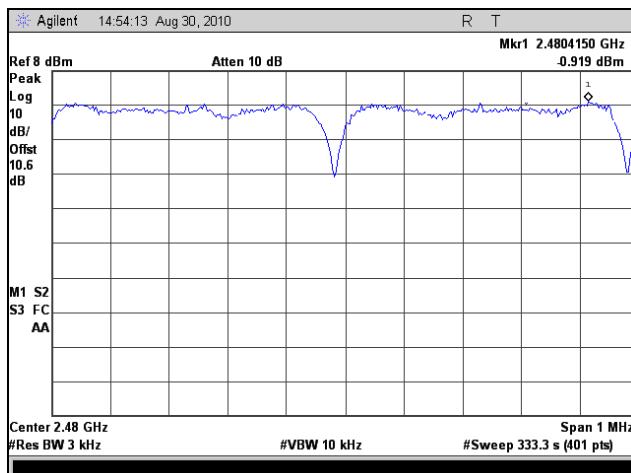
Peak Power Spectral Density



Plot 36. Peak Power Spectral Density, Low Channel



Plot 37. Peak Power Spectral Density, Mid Channel



Plot 38. Peak Power Spectral Density, High Channel



Echelon Corporation

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Electromagnetic Compatibility
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IV. Test Equipment



Echelon Corporation

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Test Equipment

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

MET Asset #	Equipment	Manufacturer	Model	Last Cal Date	Cal Due Date
1S2421	EMI RECEIVER	ROHDE&SCHWARZ	ESIB 7	07/06/2010	07/06/2011
1S2121	PRE-AMPLIFIER	HEWLETT PACKARD	8449B	SEE NOTE	
1S2501	EMI RECEIVER	ROHDE & SCHWARZ	ESU40	06/03/2010	06/03/2011
1S2603	HORN ANTENNA	ETS-LINDGREN	3117	04/09/2009	04/09/2011
1S2202	HORN ANTENNA	EMCO	3116	04/23/2010	04/23/2013
N/A	HIGH PASS FILTER	MICRO-TRONICS	HPM13146	SEE NOTE	
1S2041	COUPLER, BI DIRECTIONALCOAXIAL	NARDA	N/A	SEE NOTE	
1S2583	ANALYZER, SPECTRUM	AGILENT	E4447A	01/26/2010	01/12/2011
1S2460	ANALYZER, SPECTRUM 9 KHZ-40GHZ	AGILENT	E4407B	07/13/2010	07/13/2011
1S2508	LISN	SOLAR ELECTRONICS	9252-50-R24-BNC	08/06/2010	08/06/2011
1S2512	TRANSIENT LIMITER	AGILENT	11947A	SEE NOTE	
1S2518	THERMO-HYGROMETER	FISHER SCIENTIFIC	11-661-7D	01/28/2010	01/28/2012
1S2482	CHAMBER, 5 METER	PANASHIELD	641431	10/16/2009	10/16/2010
1S2108	RECIEVER, EMI, RF FILTER SECTION	HEWLETT PACKARD	85460A	11/10/2009	11/10/2010
1S2399	TURNTABLE CONTROLLER	SUNOL SCIENCE	SC99V	SEE NOTE	
1S2485	BILOG ANTENNA	TESEQ	CBL6112D	05/07/2010	05/07/2011

Table 28. Test Equipment List

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



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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 stages; 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.



Echelon Corporation
IEM RF Module ZIGBEE:835-0701-51
with Street Light Bridge (SLB)/Antenna

Electromagnetic Compatibility
End of Report
CFR Title 47, Part 15B, 15.247

End of Report