



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

914 WEST PATAPSCO AVENUE • BALTIMORE, MARYLAND 21230-3432 • PHONE (410) 354-3300 • FAX (410) 354-3313

33439 WESTERN AVENUE • UNION CITY, CALIFORNIA 94587 • PHONE (510) 489-6300 • FAX (510) 489-6372

3162 BELICK STREET • SANTA CLARA, CALIFORNIA 95054 • PHONE (408) 748-3585 • FAX (510) 489-6372

September 28, 2012

TenX Precision, LLC
11824 Jollyville Road, Suite 102
Austin, Texas 78759

Dear Daraius Hathiram,

Enclosed is the EMC Wireless test report for compliance testing of the TenX Precision, LLC, Echometer Wireless Sensor as tested to the requirements of Title 47 of the CFR, Ch. 1 (10-1-06 ed.), Part 15, Subpart B, ICES-003, Issue 4 February 2004 for a Class A Digital Device and FCC Part 15 Subpart C, RSS-210, Issue 8, Dec. 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: (\\TenX Precision, LLC\\EMCA33149B-FCC247 Rev. 1)

Certificates and reports shall not be reproduced except in full, without the written permission of MET Laboratories, Inc.

Electromagnetic Compatibility Criteria Test Report

for the

**TenX Precision, LLC
Echometer Wireless Sensor**

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

MET Report: EMCA33149B-FCC247 Rev. 1

September 28, 2012

Prepared For:

**TenX Precision, LLC
11824 Jollyville Road, Suite 102
Austin, Texas 78759**

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

Electromagnetic Compatibility Criteria Test Report

for the

TenX Precision, LLC
Echometer Wireless Sensor

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



Dusmantha Tennakoon
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, 15.247 and Industry Canada standards ICES-003, Issue 4 February 2004, RSS-210, Issue 8, Dec. 2010 under normal use and maintenance.



Shawn McMillen,
Wireless Manager, Electromagnetic Compatibility Lab

Draft Status Sheet

Draft Revision	Draft Date	Reason for Draft Revision
Ø	December 19, 2011	Initial Draft Issue.
1	September 28, 2012	Revised MPE per engineer corrections.

Table of Contents

I.	Executive Summary	1
	A. Purpose of Test	2
	B. Executive Summary	2
II.	Equipment Configuration	3
	A. Overview.....	4
	B. References.....	5
	C. Test Site	5
	D. Description of Test Sample.....	6
	E. Equipment Configuration.....	6
	F. Support Equipment	6
	G. Ports and Cabling Information.....	6
	H. Mode of Operation.....	6
	I. Method of Monitoring EUT Operation	7
	J. Modifications.....	7
	a) Modifications to EUT	7
	b) Modifications to Test Standard.....	7
	K. Disposition of EUT	7
III.	Electromagnetic Compatibility Criteria for Unintentional Radiators	8
	§ 15.107(a) Conducted Emissions Limits.....	9
	§ 15.109(a) Radiated Emissions Limits.....	10
IV.	Electromagnetic Compatibility Criteria for Intentional Radiators.....	14
	§ 15.203 Antenna Requirement	15
	§ 15.207(a) Conducted Emissions Limits.....	16
	§ 15.247(a)(a) 6 dB and 99% Bandwidth	17
	§ 15.247(b) Peak Power Output	21
	§ 15.247(d) Radiated Spurious Emissions Requirements and Band Edge.....	24
	§ 15.247(d) RF Conducted Spurious Emissions Requirements and Band Edge.....	37
	§ 15.247(e) Peak Power Spectral Density	41
	§ 15.247(i) Maximum Permissible Exposure	44
	RSS-GEN Receiver Spurious Emissions.....	45
V.	Test Equipment	48
VI.	Certification & User's Manual Information.....	50
	A. Certification Information	51
	B. Label and User's Manual Information	55
VII.	ICES-003 Procedural & Labeling Requirements.....	57

List of Tables

Table 1. Executive Summary of EMC Part 15.247 Compliance Testing	2
Table 2. EUT Summary Table.....	4
Table 3. References	5
Table 4. Equipment Configuration	6
Table 5. Support Equipment.....	6
Table 6. Ports and Cabling Information	6
Table 7. Conducted Limits for Radio Frequency Devices calculated from FCC Part 15 Subsections 15.107(a) (b) and 15.207(a)	9
Table 8. Radiated Emissions Limits calculated from FCC Part 15, § 15.109 (a) (b)	10
Table 9. Radiated Emissions Limits, Test Results, 30 MHz – 1 GHz, FCC Limits	11
Table 10. Radiated Emissions Limits, Test Results, ICES-003 Limits	12
Table 11. Conducted Limits for Intentional Radiators from FCC Part 15 § 15.207(a)	16
Table 12. 6 dB Occupied Bandwidth, Test Results	18
Table 13. 99% Occupied Bandwidth, Test Results	18
Table 14. Output Power Requirements from §15.247(b)	21
Table 15. Peak Power Output, Test Results	22
Table 16. Restricted Bands of Operation.....	24
Table 17. Radiated Emissions Limits Calculated from FCC Part 15, § 15.209 (a)	25
Table 18. Delta Method, Test Results	34
Table 19. Peak Power Spectral Density, Test Results	42
Table 20. Spurious Emission Limits for Receivers	45
Table 21. Test Equipment List	49

List of Plots

Plot 1. Radiated Emissions, 30 MHz - 1 GHz, FCC Limits	11
Plot 2. Radiated Emissions, ICES-003 Limits.....	12
Plot 3. 6 dB Occupied Bandwidth, Channel 11	19
Plot 4. 6 dB Occupied Bandwidth, Channel 19	19
Plot 5. 6 dB Occupied Bandwidth, Channel 26	19
Plot 6. 99% Occupied Bandwidth, Channel 11	20
Plot 7. 99% Occupied Bandwidth, Channel 19	20
Plot 8. 99% Occupied Bandwidth, Channel 26	20
Plot 9. Peak Power Output, Low Channel	23
Plot 10. Peak Power Output, Mid Channel	23
Plot 11. Peak Power Output, High Channel	23
Plot 12. Radiated Spurious Emissions, Channel 11	26
Plot 13. Radiated Spurious Emissions, Channel 11, 1 GHz – 5 GHz, Average	26
Plot 14. Radiated Spurious Emissions, Channel 11, 1 GHz – 5 GHz, Peak	26
Plot 15. Radiated Spurious Emissions, Channel 11, 5 GHz – 18 GHz, Peak	27
Plot 16. Radiated Spurious Emissions, Channel 11, 18 GHz – 26.5 GHz.....	27
Plot 17. Radiated Spurious Emissions, Channel 19	28
Plot 18. Radiated Spurious Emissions, Channel 19, 1 GHz – 5 GHz, Average	28
Plot 19. Radiated Spurious Emissions, Channel 19, 1 GHz – 5 GHz, Peak	28
Plot 20. Radiated Spurious Emissions, Channel 19, 5 GHz – 18 GHz, Peak	29
Plot 21. Radiated Spurious Emissions, Channel 19, 18 GHz – 26.5 GHz.....	29
Plot 22. Radiated Spurious Emissions, Channel 26.....	30
Plot 23. Radiated Spurious Emissions, Channel 26, 1 GHz – 5 GHz, Average	30
Plot 24. Radiated Spurious Emissions, Channel 26, 1 GHz – 5 GHz, Peak	30
Plot 25. Radiated Spurious Emissions, Channel 26, 5 GHz – 18 GHz, Peak	31

Plot 26. Radiated Spurious Emissions, Channel 26, 18 GHz – 26.5 GHz.....	31
Plot 27. Radiated Restricted Band Edge, Channel 11, Average	32
Plot 28. Radiated Restricted Band Edge, Channel 11, Peak.....	32
Plot 29. Average Fundamental	33
Plot 30. Peak Fundamental	33
Plot 31. Radiated Restricted Band Edge, Delta	34
Plot 32. Conducted Spurious Emissions, Channel 11, 30 MHz – 1 GHz	38
Plot 33. Conducted Spurious Emissions, Channel 11, 1 GHz – 26 GHz.....	38
Plot 34. Conducted Spurious Emissions, Channel 19, 30 MHz – 1 GHz	38
Plot 35. Conducted Spurious Emissions, Channel 19, 1 GHz – 26 GHz.....	39
Plot 36. Conducted Spurious Emissions, Channel 26, 30 MHz – 1 GHz	39
Plot 37. Conducted Spurious Emissions, Channel 26, 1 GHz – 26 GHz.....	39
Plot 38. Conducted Band Edge, Low Channel, 20 dB.....	40
Plot 39. Conducted Band Edge, High Channel, 20 dB	40
Plot 40. Peak Power Spectral Density, Channel 11	43
Plot 41. Peak Power Spectral Density, Channel 19	43
Plot 42. Peak Power Spectral Density, Channel 26	43
Plot 43. Receiver Spurious Emission, Channel 11, 30 MHz – 1 GHz.....	46
Plot 44. Receiver Spurious Emission, Channel 11, 1 GHz – 10 GHz	46
Plot 45. Receiver Spurious Emission, Channel 19, 30 MHz – 1 GHz.....	46
Plot 46. Receiver Spurious Emission, Channel 19, 1 GHz – 10 GHz	47
Plot 47. Receiver Spurious Emission, Channel 26, 30 MHz – 1 GHz.....	47
Plot 48. Receiver Spurious Emission, Channel 26, 1 GHz – 10 GHz	47

List of Figures

Figure 1. Block Diagram, Occupied Bandwidth Test Setup.....	17
Figure 2. Peak Power Output Test Setup.....	21
Figure 3. Block Diagram, Conducted Spurious Emissions Test Setup.....	37
Figure 4. Block Diagram, Peak Power Spectral Density Test Setup	41
Figure 5. Block Diagram, Conducted Receiver Spurious Emissions Test Setup	45

List of Photographs

Photograph 1. Radiated Emission, Test Setup.....	13
Photograph 2. Radiated Spurious Emissions, Test Setup, Below 1 GHz	35
Photograph 3. Radiated Spurious Emissions, Test Setup, 1 GHz – 18 GHz	35
Photograph 4. Radiated Spurious Emissions, Test Setup, 18 GHz – 26 GHz	36

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
μs	microseconds
NEBS	Network Equipment-Building System
PRF	Pulse Repetition Frequency
RF	Radio Frequency
RMS	Root-Mean-Square
TWT	Traveling Wave Tube
V/m	Volts per meter
VCP	Vertical Coupling Plane

I. Executive Summary

A. Purpose of Test

An EMC evaluation was performed to determine compliance of the TenX Precision, LLC Echometer Wireless Sensor, 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 Echometer Wireless Sensor. TenX Precision, LLC should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the Echometer Wireless Sensor, 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 TenX Precision, LLC, purchase order number 1053. All tests were conducted using measurement procedure ANSI C63.4-2003.

FCC Reference 47 CFR Part 15.247:2005	IC Reference RSS-210 Issue 8: 2010; RSS-GEN Issue 3: 2010	Description	Compliance
47 CFR Part 15.107 (a)	ICES-003 Issue 4 February 2004	Conducted Emission Limits for a Class A Digital Device	Not Applicable Battery operated
47 CFR Part 15.109 (a)	ICES-003 Issue 4 February 2004	Radiated Emission Limits for a Class A Digital Device	Compliant
Title 47 of the CFR, Part 15 §15.203	N/A	Antenna Requirement	Compliant
Title 47 of the CFR, Part 15 §15.207(a)	RSS-GEN (7.2.4)	Conducted Emission Limits	Not Applicable Battery operated
Title 47 of the CFR, Part 15 §15.247(a)(2)	RSS-Gen(4.6)	6dB Occupied Bandwidth	Compliant
		99% Occupied Bandwidth	Compliant
Title 47 of the CFR, Part 15 §15.247(b)	RSS-210(A8.4)	Peak Power Output	Compliant
Title 47 of the CFR, Part 15 §15.247(d); §15.209; §15.205	RSS-210(A8.5)	Radiated Spurious Emissions Requirements	Compliant
Title 47 of the CFR, Part 15 §15.247(d)	RSS-210(A8.5)	RF Conducted Spurious Emissions Requirements	Compliant
Title 47 of the CFR, Part 15 §15.247(d)	RSS-210(A8.5)	RF Conducted Band Edge	Compliant
Title 47 of the CFR, Part 15; §15.247(e)	RSS-210(A8.2)	Peak Power Spectral Density	Compliant
Title 47 of the CFR, Part 15 §15.247(i)	RSS-Gen(5.6)	Maximum Permissible Exposure (MPE)	Compliant
N/A	RSS-Gen(4.10)	Receiver Spurious Emissions	Compliant

Table 1. Executive Summary of EMC Part 15.247 Compliance Testing

II. Equipment Configuration

A. Overview

MET Laboratories, Inc. was contracted by TenX Precision, LLC to perform testing on the Echometer Wireless Sensor, under TenX Precision, LLC's purchase order number 1053.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the TenX Precision, LLC, Echometer Wireless Sensor.

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

Model(s) Tested:	Echometer Wireless Sensor	
Model(s) Covered:	Echometer Wireless Sensor	
EUT Specifications:	Primary Power: 120 VAC, 60 Hz	
	FCC ID: Q5Q-WS IC: 10048A-WS	
	Type of Modulations:	FSK
	Equipment Code:	DTS
	Peak RF Output Power:	4.68 dBm
	EUT Frequency Ranges:	2405 – 2480 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:	Dusmantha Tennakoon	
Report Date(s):	September 28, 2012	

Table 2. EUT Summary Table

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, Dec. 2010	Low-power Licence-exempt Radiocommunications Devices (All Frequency Bands): Category I Equipment
RSS-GEN, Issue 3, Dec. 2010	General Requirements and Information for the Certification of Radio Apparatus
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., 13301 McCallen Pass, Austin, TX 78753. 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 TenX Precision, LLC Echometer Wireless Sensor (Model WS), Equipment Under Test (EUT), is one of a family of wireless sensors used to acquire data such as Pressure, Load, Acceleration and Temperature. The sensors are used in conjunctions with the Echometer Wireless Base. It is a battery operated product (Li-Ion sealed internal battery) and an externally attached antenna.

E. Equipment Configuration

The EUT was set up as outlined in **Error! Reference source not found.**, Block Diagram of Test Setup. All cards, racks, etc., incorporated as part of the EUT is included in the following list.

Ref. ID	Name / Description	Model Number	Part Number	Serial Number	Revision
N/A	Echometer Wireless Sensor	WS	40-1235	1001	2

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
N/A	Laptop	Dell	N/A
N/A	Echometer Wireless Base	Echometer	WB100

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	Antenna	Direct mount SMA Antenna	1		No	N/A
2	Ext Charger	Hookup Wire	1	1	No	N/A

Table 6. Ports and Cabling Information

H. Mode of Operation

The EUT will be operated standalone running on its internal battery during testing. It supports diagnostic commands that can set it up in the testing modes described below. The commands will be issued wirelessly from an Echometer Wireless Base/Laptop.

Continuous Transmit, selectable 802.15.4 channel

Continuous Receive, selectable 802.15.4 channel

During Normal Operation, the EUT typically transmits a beacon every 10 secs. When requested by the Base the EUT acquires data from its attached sensors and transmits the data real time to the Base.

I. Method of Monitoring EUT Operation

Continuous Transmit operation can be monitored on a Spectrum Analyzer at the selected channel.

In Continuous Receive Mode, an LED on the device will be flashed to indicate that the diagnostic mode is in progress.

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 TenX Precision, LLC upon completion of testing.

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 not applicable with the Class A requirement(s) of this section. The device is battery operated.

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 8.

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 8.

Frequency (MHz)	Field Strength (dBμV/m)	
	§15.109 (b), Class A Limit (dBμV) @ 10m	§15.109 (a), Class B Limit (dBμV) @ 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 8. 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 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 A requirement(s) of this section. Measured emissions were below applicable limits.

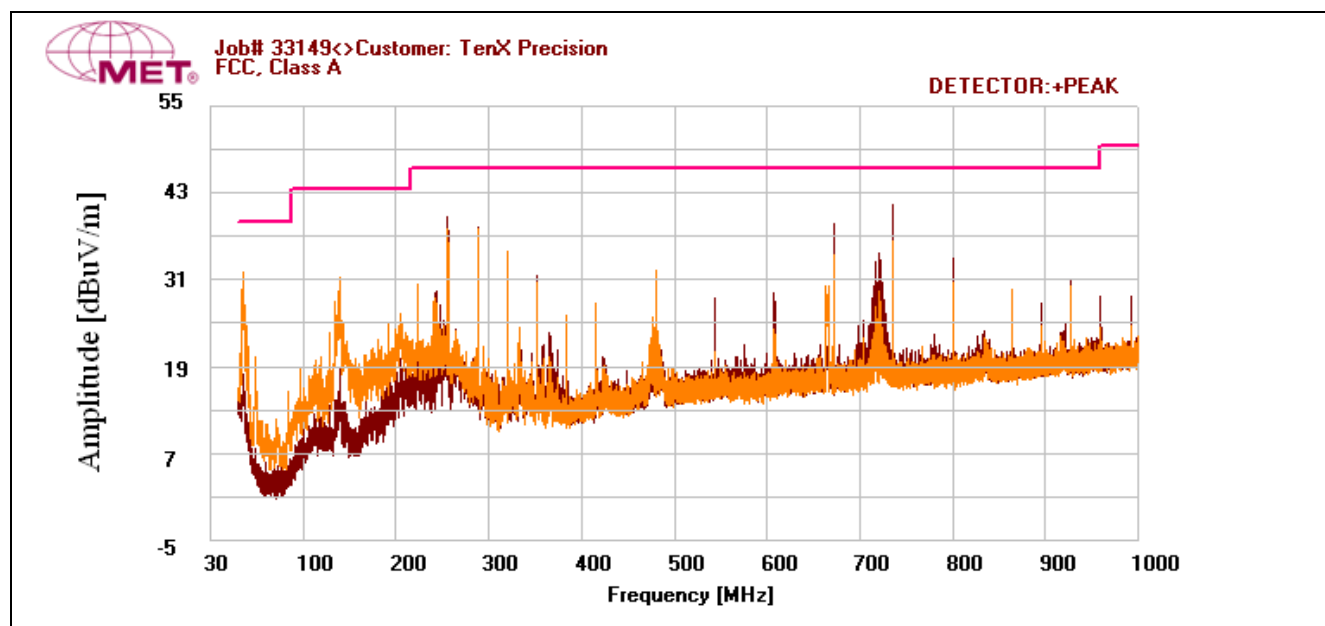
Test Engineer(s): Ram Shrestha

Test Date(s): 10/27/11

Radiated Emissions Limits Test Results, Class A

Frequency (MHz)	Antenna Polarity	EUT Azimuth (Degrees)	Antenna Height (cm)	Uncorrected Amplitude (dBuV)	ACF (dB/m)	Pre Amp Gain (dB)	CBL (dB)	DCF (dB)	Corrected Amplitude (dBuV/m)	Limit (dBuV/m)	Margin (dB)
736.012	H	71	143	41.05	19.032	19.586	0.01	0	40.506	46.4	-5.894
672.005	H	93	137	40.02	18.394	19.484	0.01	0	38.94	46.4	-7.46
255.995	H	0	392	50.4	12.104	20.648	0.01	0	41.866	46.4	-4.534
287.979	V	128	156	42.54	12.613	20.622	0.01	0	34.541	46.4	-11.859
35.56	V	310	100	34.05	15.31	22.025	0.01	0	27.345	39	-11.655
256.018	V	64	100	45.69	12.104	20.648	0.01	0	37.156	46.4	-9.244

Table 9. Radiated Emissions Limits, Test Results, 30 MHz – 1 GHz, FCC Limits

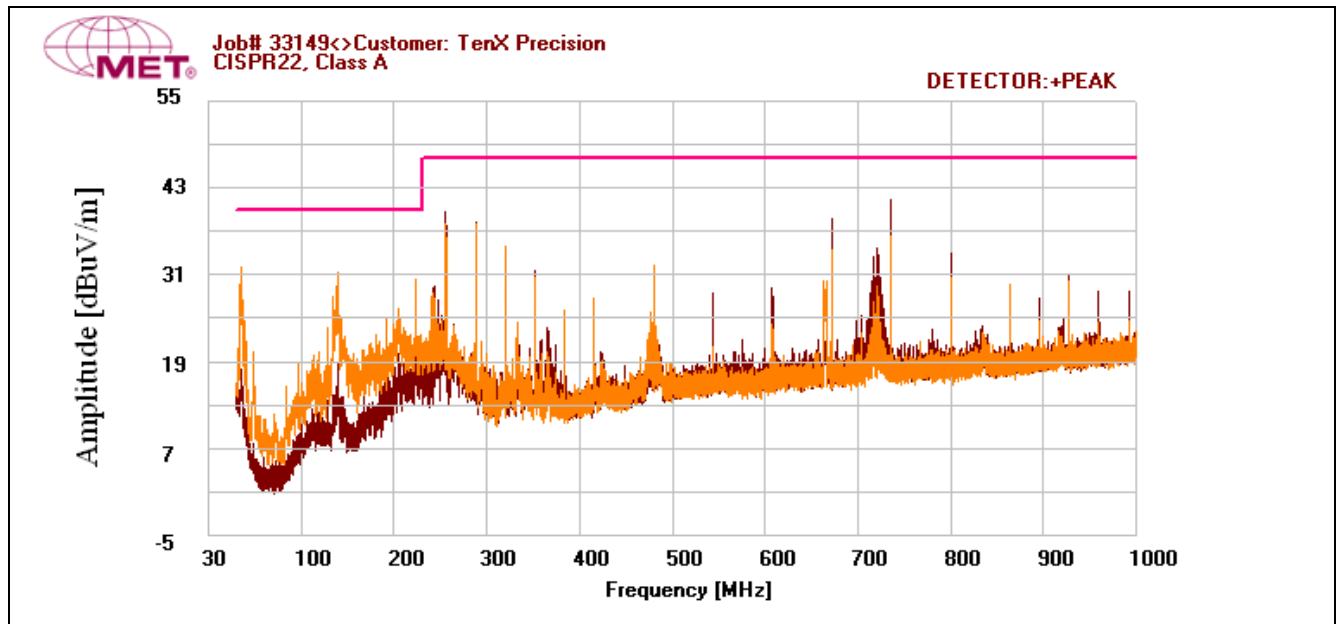


Plot 1. Radiated Emissions, 30 MHz - 1 GHz, FCC Limits

Radiated Emissions Limits Test Results, Class A

Frequency (MHz)	Antenna Polarity	EUT Azimuth (Degrees)	Antenna Height (cm)	Uncorrected Amplitude (dBuV)	ACF (dB/m)	Pre Amp Gain (dB)	CBL (dB)	DCF (dB)	Corrected Amplitude (dBuV/m)	Limit (dBuV/m)	Margin (dB)
736.012	V	71	143	41.05	19.032	19.586	0.01	0	40.506	47	-6.494
672.005	H	93	137	40.02	18.394	19.484	0.01	0	38.94	47	-8.06
255.995	H	0	392	50.4	12.104	20.648	0.01	0	41.866	47	-5.134
287.979	V	128	156	42.54	12.613	20.622	0.01	0	34.541	47	-12.459
35.56	V	310	100	34.05	15.31	22.025	0.01	0	27.345	40	-12.655
256.018	V	64	100	45.69	12.104	20.648	0.01	0	37.156	47	-9.844

Table 10. Radiated Emissions Limits, Test Results, ICES-003 Limits



Plot 2. Radiated Emissions, ICES-003 Limits

Radiated Emission Limits Test Setup



Photograph 1. Radiated Emission, 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. The EUT uses an unique connector.

Test Engineer(s): Dusmantha Tennakoon

Test Date(s): 11/02/11

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

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. For the purpose of this testing, the transmitter was turned on. Scans were performed with the transmitter on.

Test Results: The EUT was not applicable with this requirement. The device is battery operated.

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(a)(2) 6 dB and 99% Bandwidth

Test Requirements: § 15.247(a)(2): 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)(2).

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

Test Engineer(s): Dusmantha Tennakoon

Test Date(s): 10/28/11

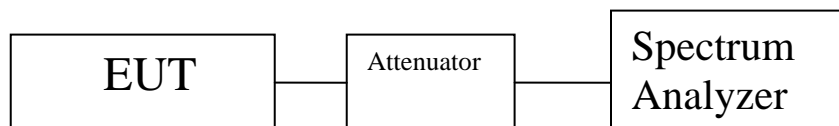


Figure 1. Block Diagram, Occupied Bandwidth Test Setup

Occupied Bandwidth Test Results

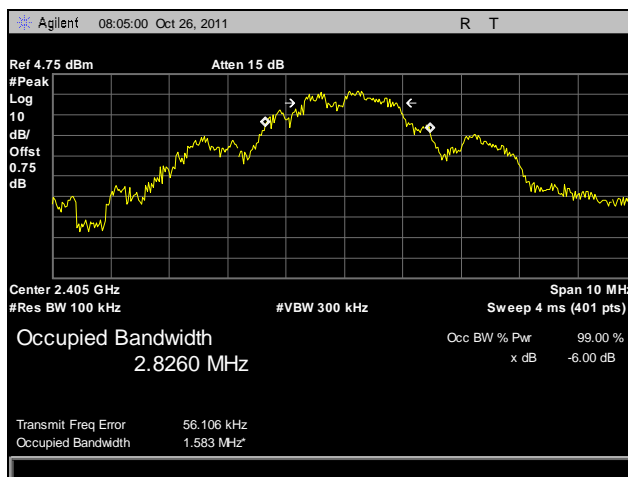
Occupied Bandwidth		
Carrier Channel	Frequency (MHz)	Measured 6 dB Bandwidth (MHz)
Channel 11	2405	1.583
Channel 19	2445	1.566
Channel 26	2480	1.477

Table 12. 6 dB Occupied Bandwidth, Test Results

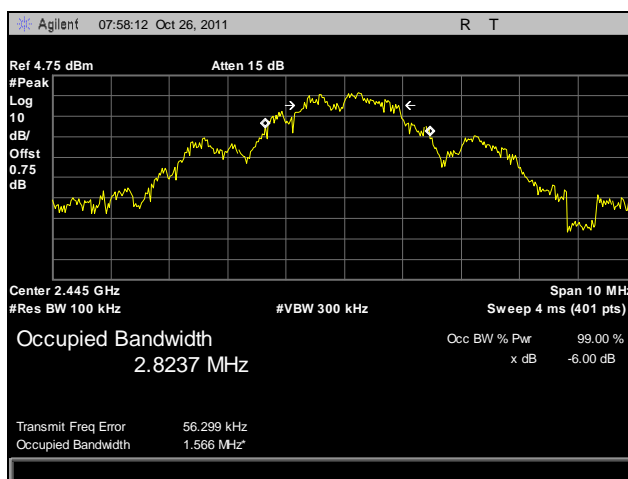
Occupied Bandwidth		
Carrier Channel	Frequency (MHz)	Measured 99% Bandwidth (MHz)
Channel 11	2405	2.8931
Channel 19	2445	2.8272
Channel 26	2480	2.7729

Table 13. 99% Occupied Bandwidth, Test Results

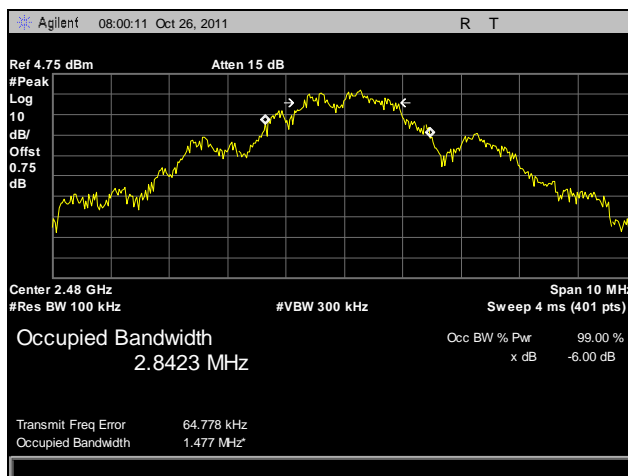
Occupied Bandwidth Test Results



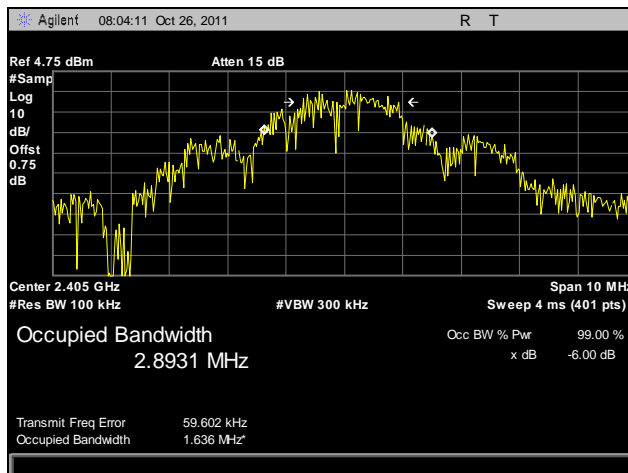
Plot 3. 6 dB Occupied Bandwidth, Channel 11



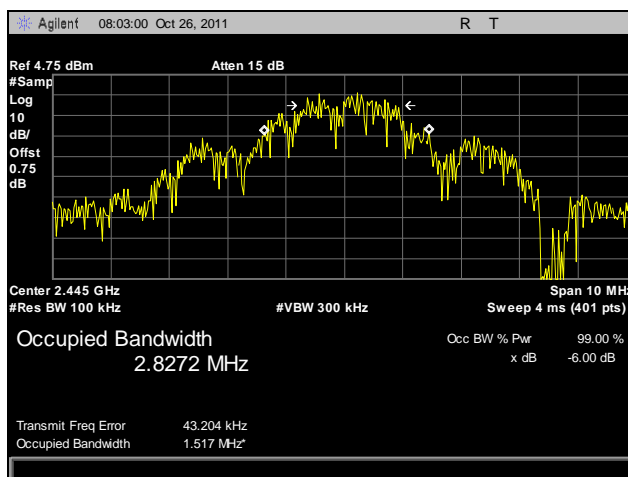
Plot 4. 6 dB Occupied Bandwidth, Channel 19



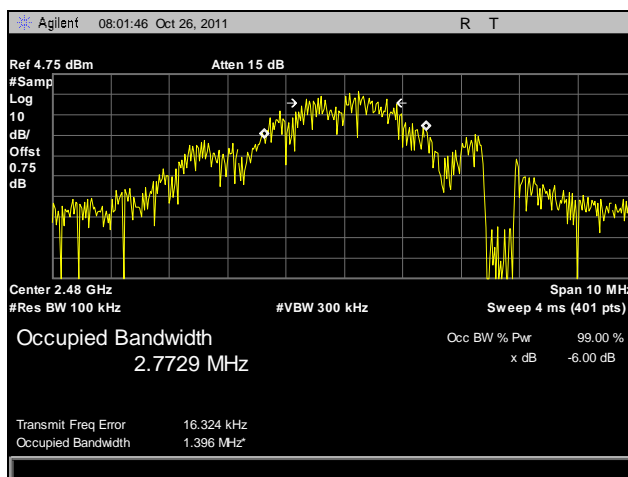
Plot 5. 6 dB Occupied Bandwidth, Channel 26



Plot 6. 99% Occupied Bandwidth, Channel 11



Plot 7. 99% Occupied Bandwidth, Channel 19



Plot 8. 99% Occupied Bandwidth, Channel 26

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(b) Peak Power Output

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 14. Output Power Requirements from §15.247(b)

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

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): Dusmantha Tennakoon

Test Date(s): 10/28/11

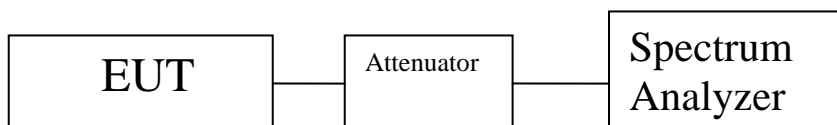


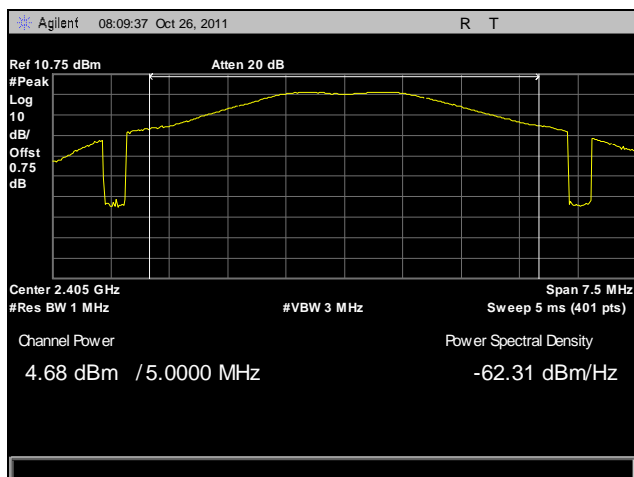
Figure 2. Peak Power Output Test Setup

Peak Power Output Test Results

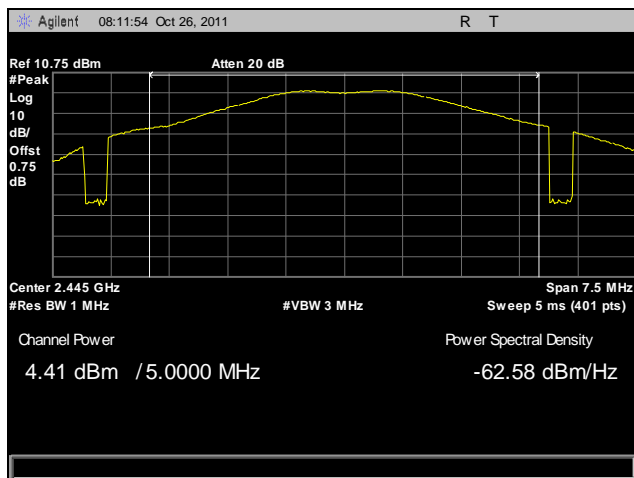
Peak Conducted Output Power		
Carrier Channel	Frequency (MHz)	Measured Peak Output Power dBm
Channel 11	2405	4.68
Channel 19	2445	4.41
Channel 26	2480	4.46

Table 15. Peak Power Output, Test Results

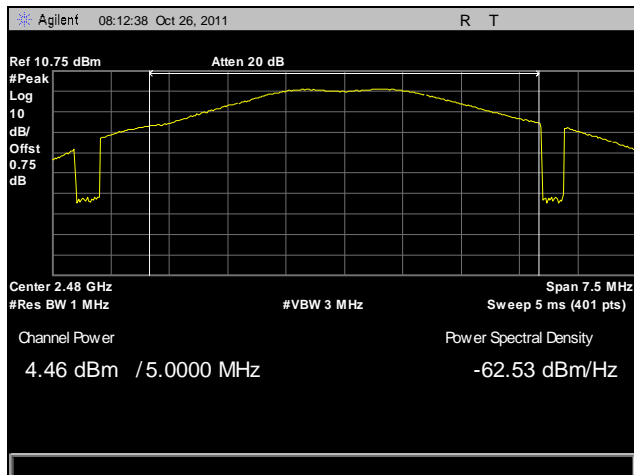
Peak Power Output Test Results



Plot 9. Peak Power Output, Low Channel



Plot 10. Peak Power Output, Mid Channel



Plot 11. Peak Power Output, High Channel

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 16. 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 17.

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

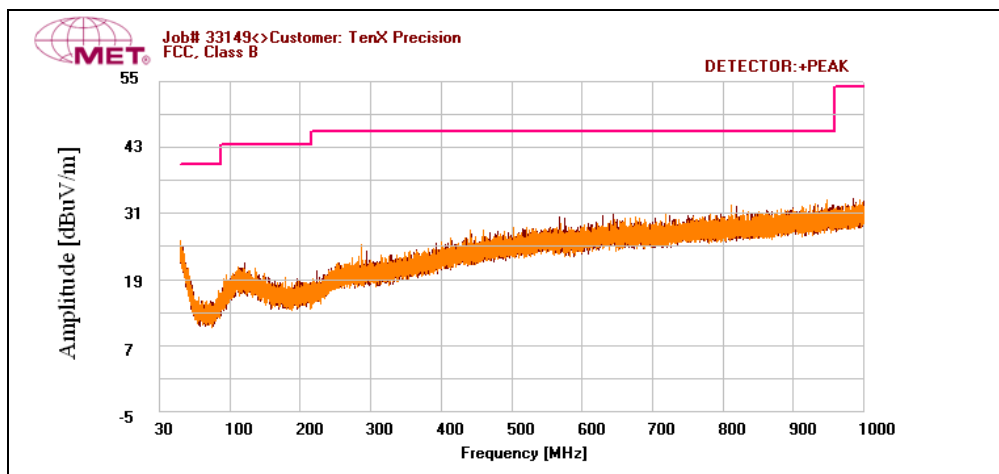
Test Procedures: The transmitter was turned on. Measurements were performed of the low, mid and high Channels. The EUT was rotated orthogonally through all three axes. Plots shown are corrected for both antenna correction factor and distance and compared to a 3 m limit line. Only noise floor was measured above 18 GHz.

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

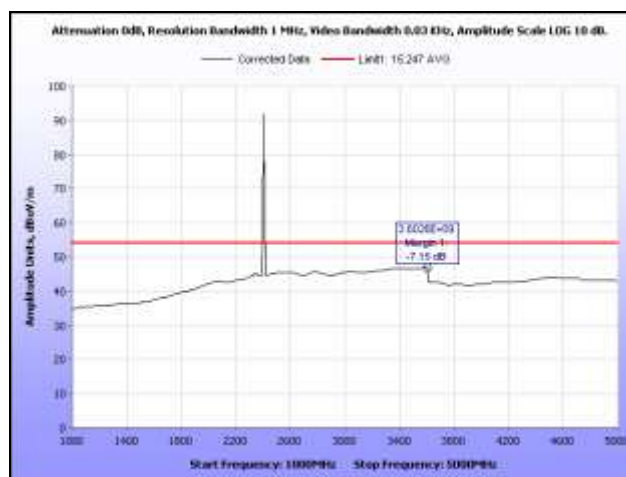
Test Engineer(s): Ram Shrestha

Test Date(s): 10/28/11

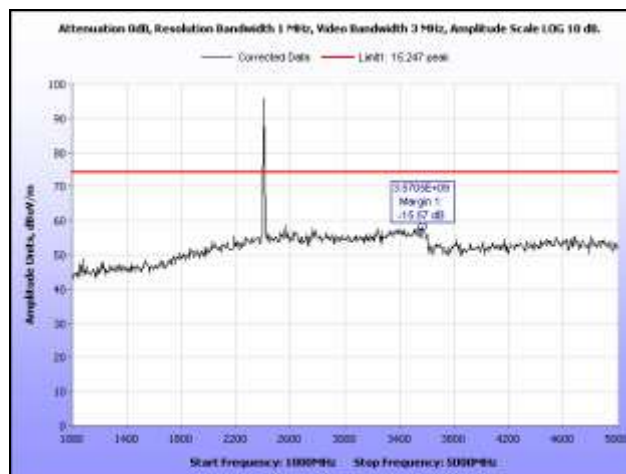
Radiated Spurious Emissions Test Results



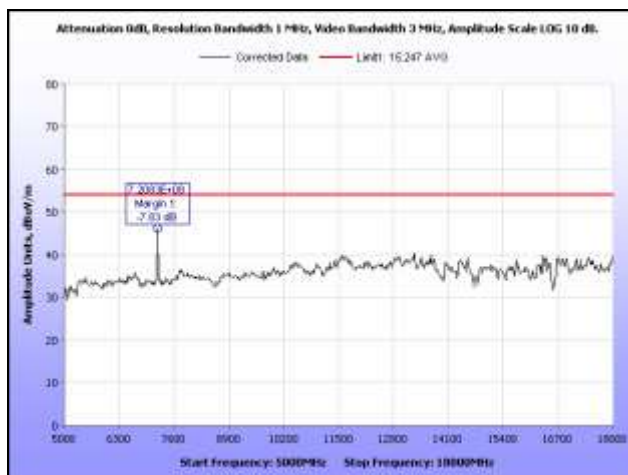
Plot 12. Radiated Spurious Emissions, Channel 11



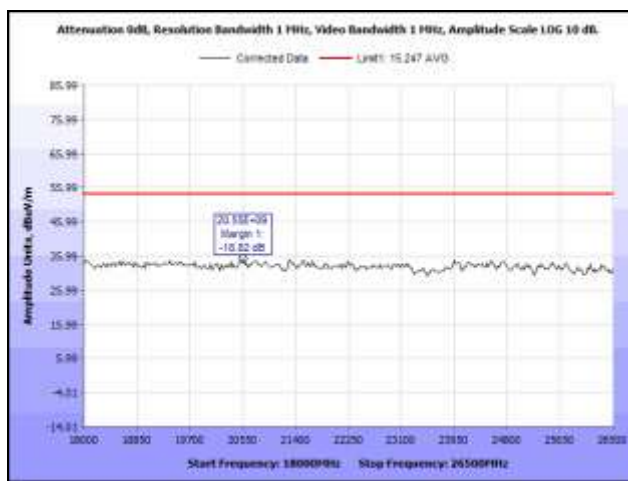
Plot 13. Radiated Spurious Emissions, Channel 11, 1 GHz – 5 GHz, Average



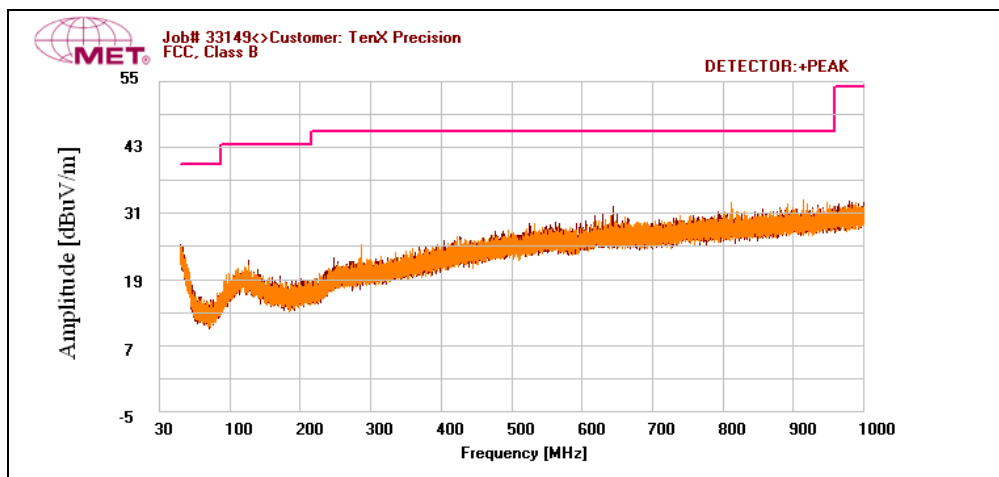
Plot 14. Radiated Spurious Emissions, Channel 11, 1 GHz – 5 GHz, Peak



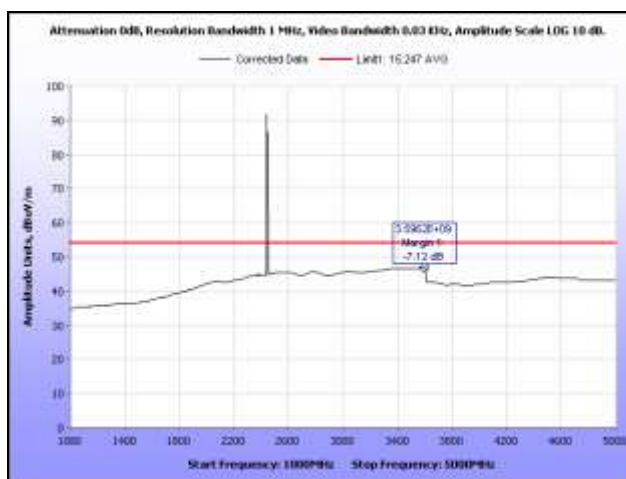
Plot 15. Radiated Spurious Emissions, Channel 11, 5 GHz – 18 GHz, Peak



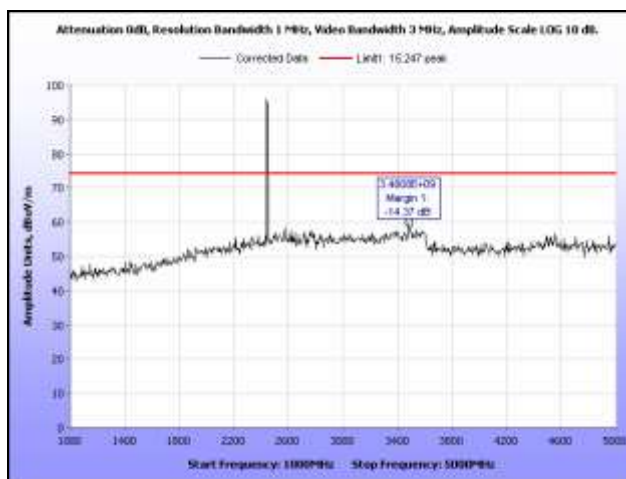
Plot 16. Radiated Spurious Emissions, Channel 11, 18 GHz – 26.5 GHz



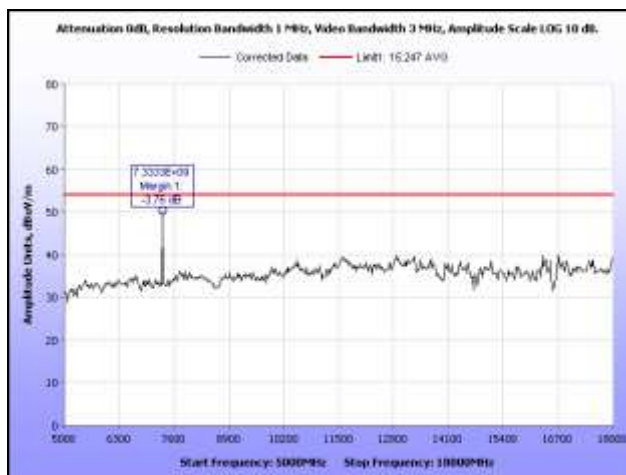
Plot 17. Radiated Spurious Emissions, Channel 19



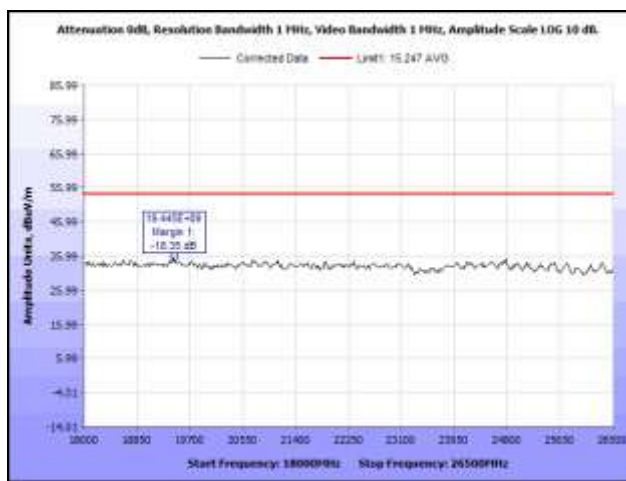
Plot 18. Radiated Spurious Emissions, Channel 19, 1 GHz – 5 GHz, Average



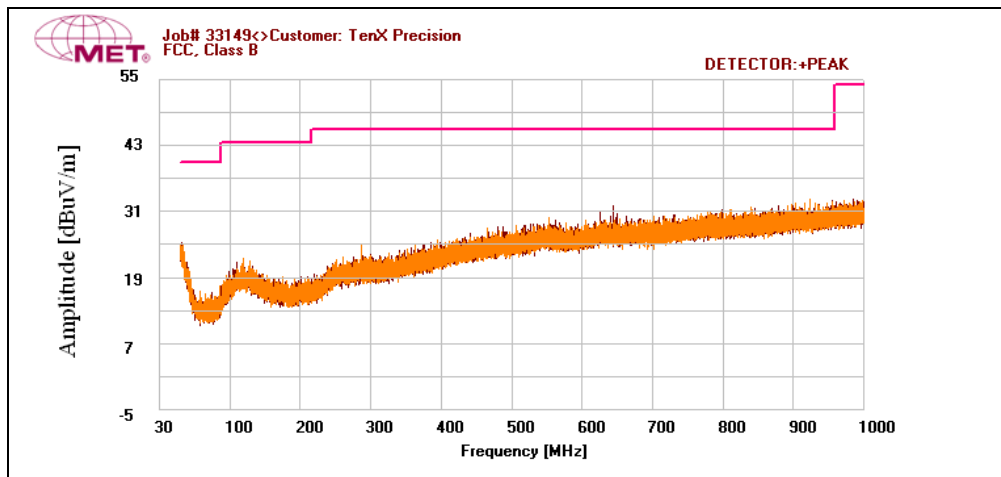
Plot 19. Radiated Spurious Emissions, Channel 19, 1 GHz – 5 GHz, Peak



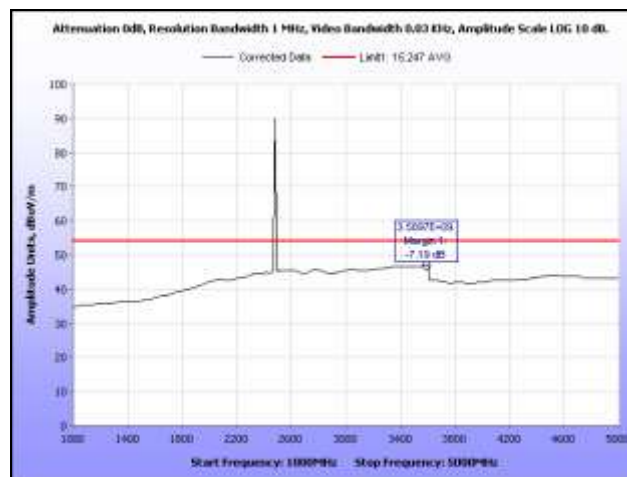
Plot 20. Radiated Spurious Emissions, Channel 19, 5 GHz – 18 GHz, Peak



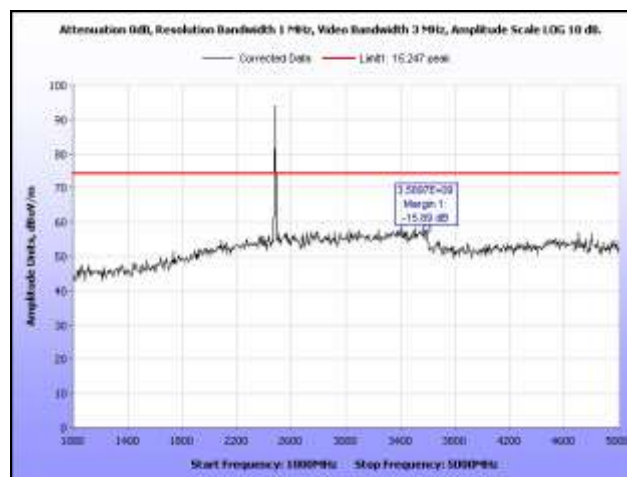
Plot 21. Radiated Spurious Emissions, Channel 19, 18 GHz – 26.5 GHz



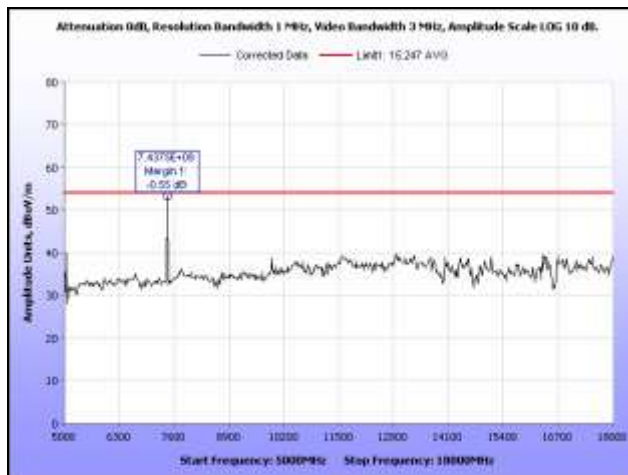
Plot 22. Radiated Spurious Emissions, Channel 26



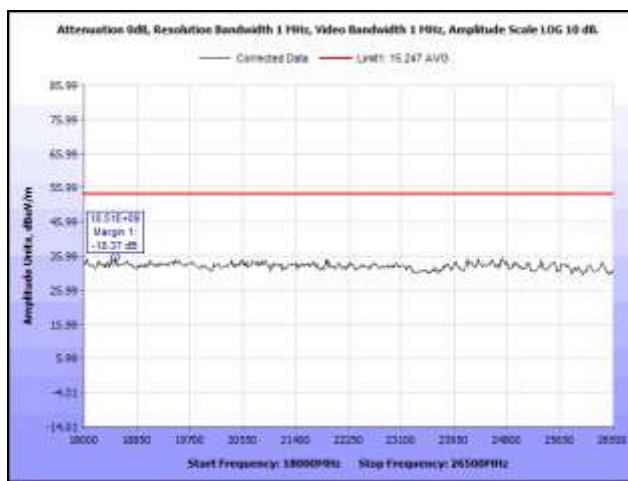
Plot 23. Radiated Spurious Emissions, Channel 26, 1 GHz – 5 GHz, Average



Plot 24. Radiated Spurious Emissions, Channel 26, 1 GHz – 5 GHz, Peak



Plot 25. Radiated Spurious Emissions, Channel 26, 5 GHz – 18 GHz, Peak

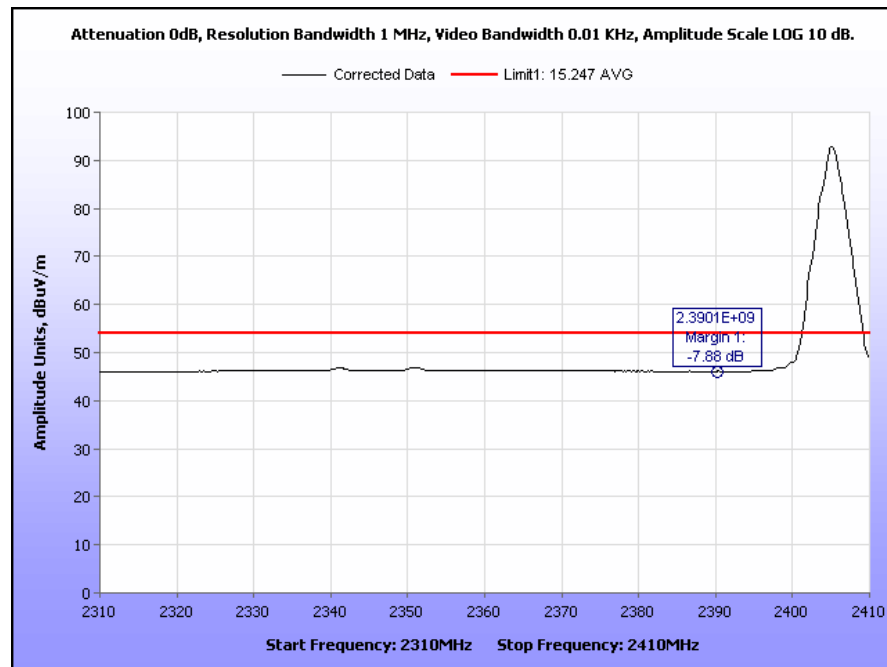


Plot 26. Radiated Spurious Emissions, Channel 26, 18 GHz – 26.5 GHz

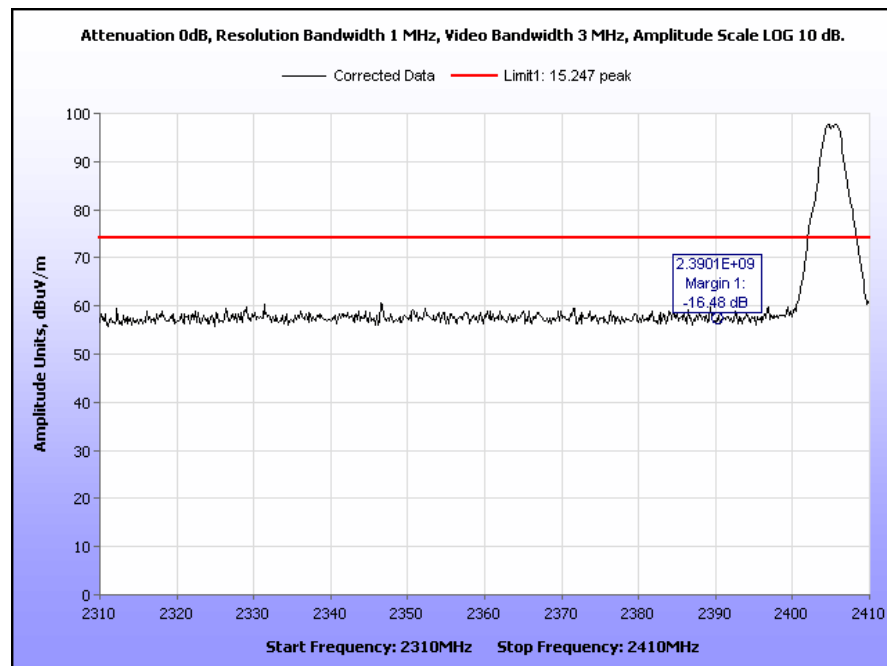
Radiated Band Edge Measurements

Test Procedures:

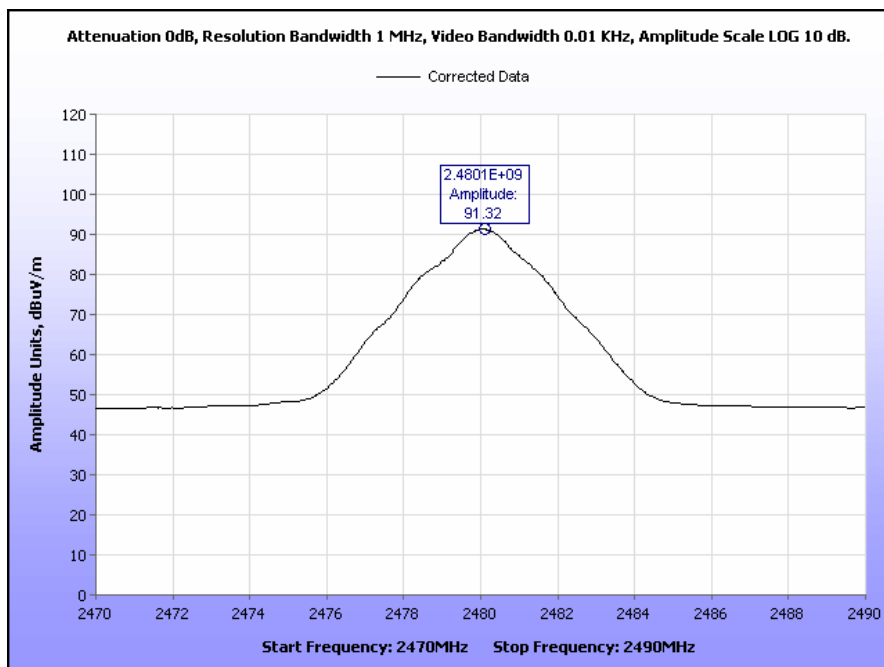
The transmitter was turned on. Measurements were performed of the low, mid and high Channels. The EUT was rotated orthogonally through all three axes. Plots shown are corrected for both antenna correction factor and distance and compared to a 3 m limit line. Delta marker method was used for high channel.



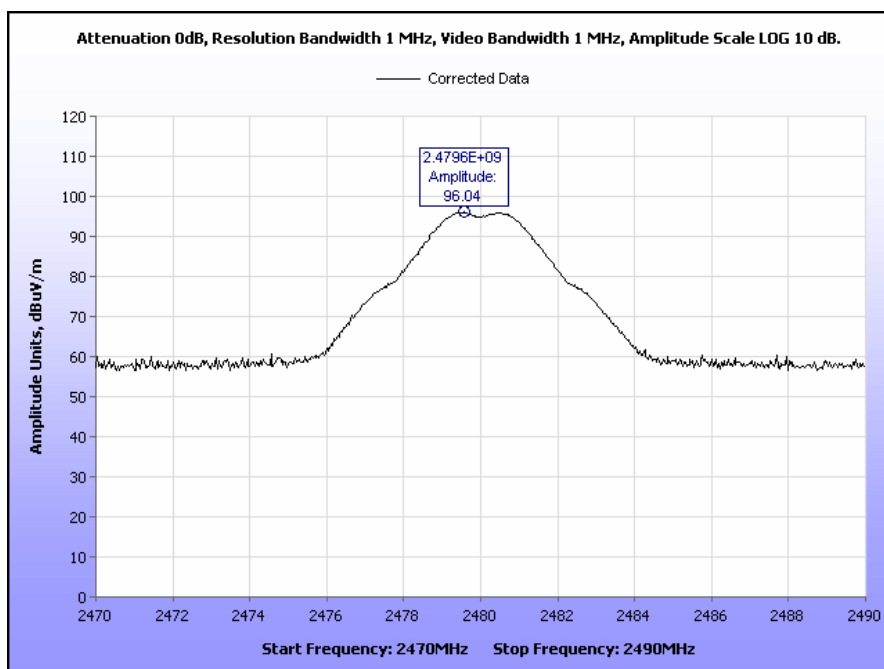
Plot 27. Radiated Restricted Band Edge, Channel 11, Average



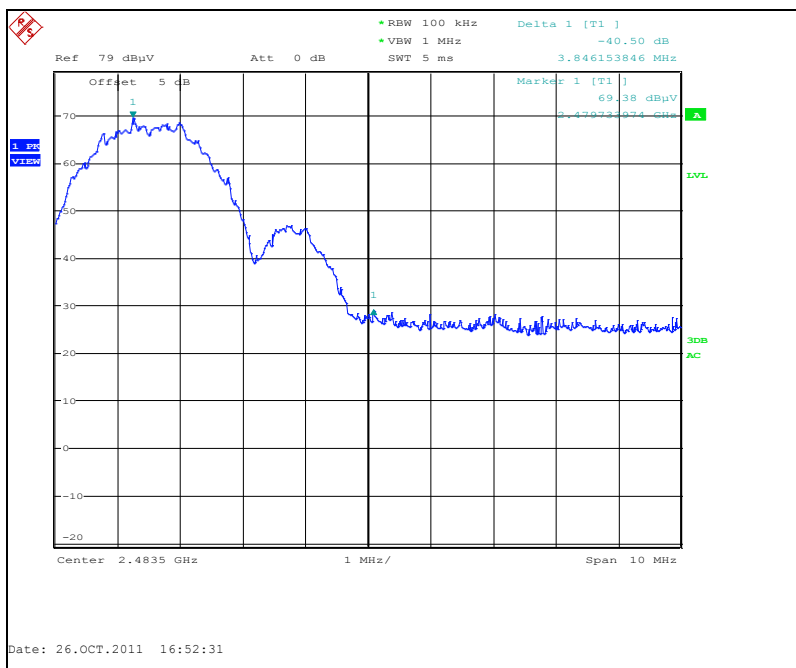
Plot 28. Radiated Restricted Band Edge, Channel 11, Peak



Plot 29. Average Fundamental



Plot 30. Peak Fundamental



Plot 31. Radiated Restricted Band Edge, Delta

Channel	Fundamental Field Strength (dBuV/m) @ 3m - Peak		Delta (dB)	Corrected Band Edge Field strength (dBuV/m) @ 3m	
	Peak	Avg		Peak	Avg
26	95.21	90.3	-39.59	55.62	50.71

Table 18. Delta Method, Test Results

Radiated Spurious Emissions Test Setup



Photograph 2. Radiated Spurious Emissions, Test Setup, Below 1 GHz



Photograph 3. Radiated Spurious Emissions, Test Setup, 1 GHz – 18 GHz



Photograph 4. Radiated Spurious Emissions, Test Setup, 18 GHz – 26 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.

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): Dusmantha Tennakoon

Test Date(s): 10/28/11

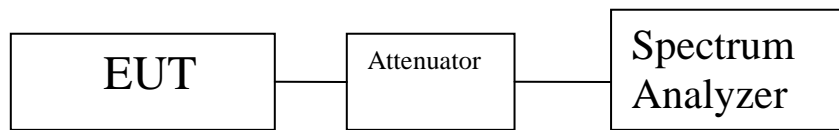
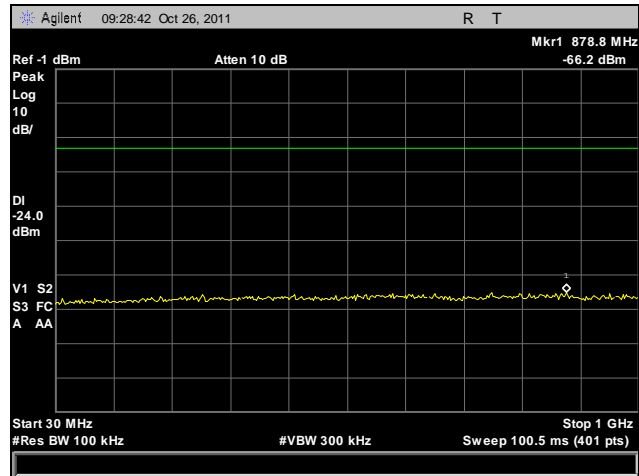
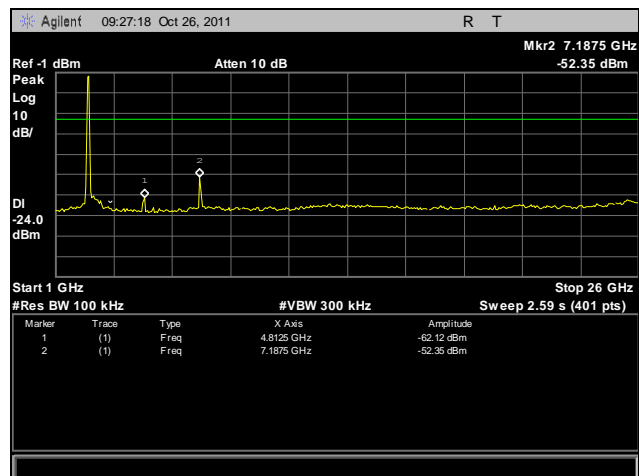


Figure 3. Block Diagram, Conducted Spurious Emissions Test Setup

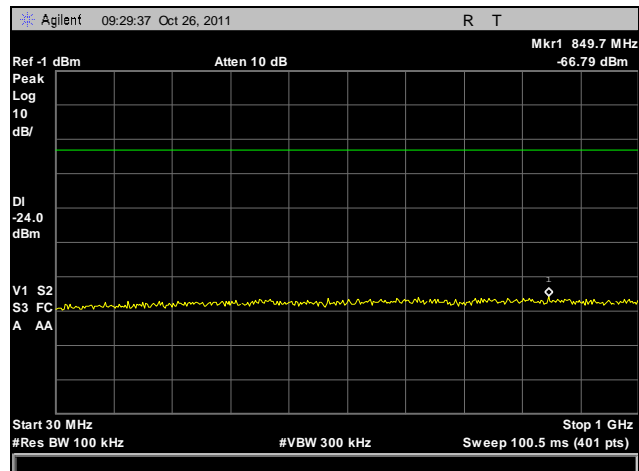
Conducted Spurious Emissions Test Results



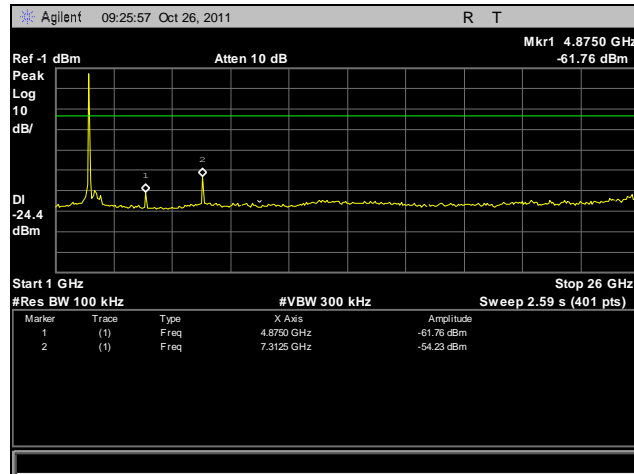
Plot 32. Conducted Spurious Emissions, Channel 11, 30 MHz – 1 GHz



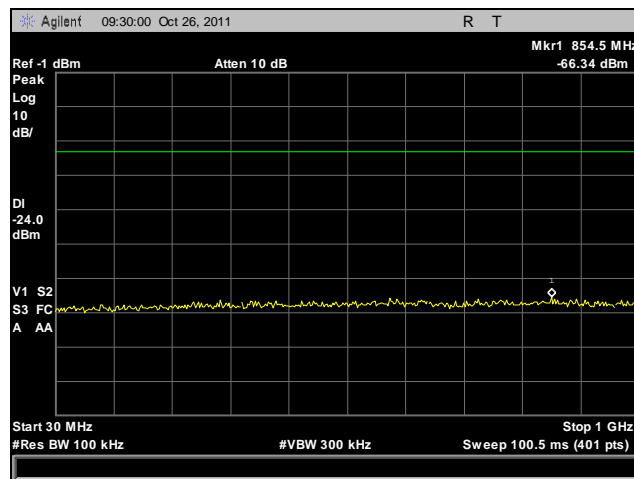
Plot 33. Conducted Spurious Emissions, Channel 11, 1 GHz – 26 GHz



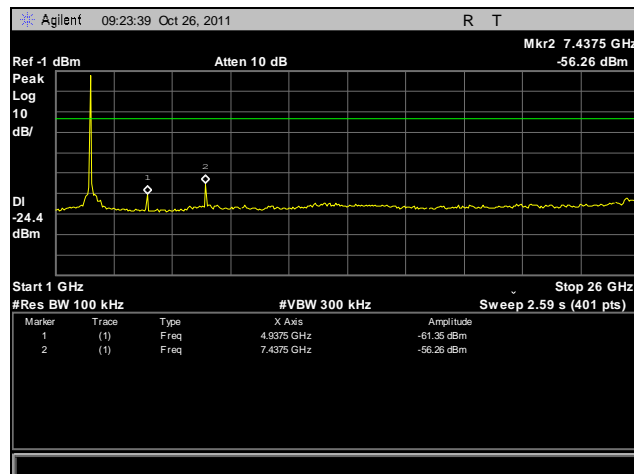
Plot 34. Conducted Spurious Emissions, Channel 19, 30 MHz – 1 GHz



Plot 35. Conducted Spurious Emissions, Channel 19, 1 GHz – 26 GHz

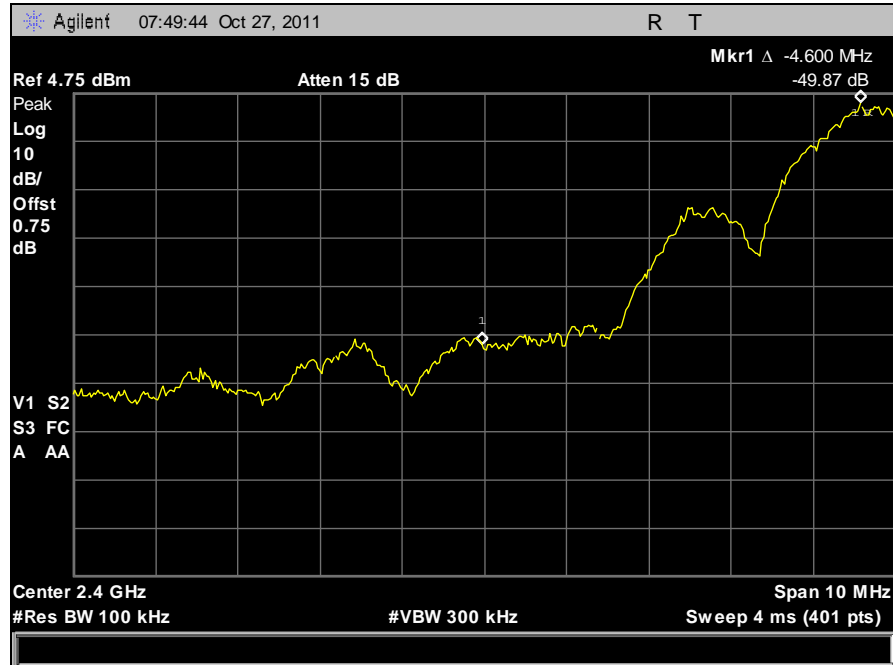


Plot 36. Conducted Spurious Emissions, Channel 26, 30 MHz – 1 GHz

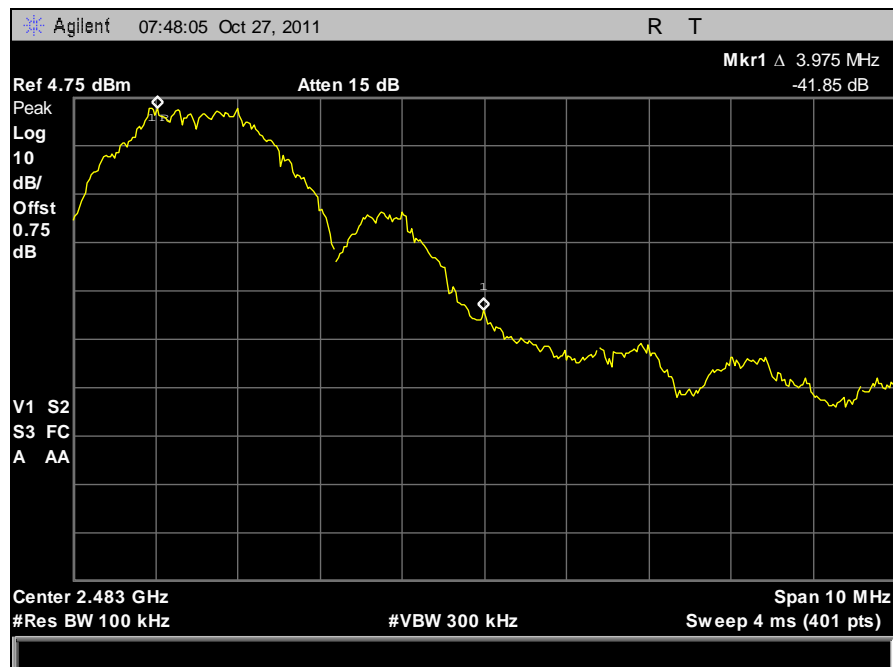


Plot 37. Conducted Spurious Emissions, Channel 26, 1 GHz – 26 GHz

Conducted Band Edge Test Results



Plot 38. Conducted Band Edge, Low Channel, 20 dB



Plot 39. Conducted Band Edge, High Channel, 20 dB

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 throughout each of the 100 sweeps of power averaging. The RBW was set to 3 kHz and a VBW set to 9 kHz or greater. The spectrum analyzer was set to an auto sweep time and a peak detector was used. 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: Dusmantha Tennakoon

Test Date: 10/28/11

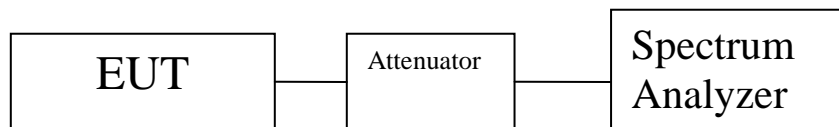


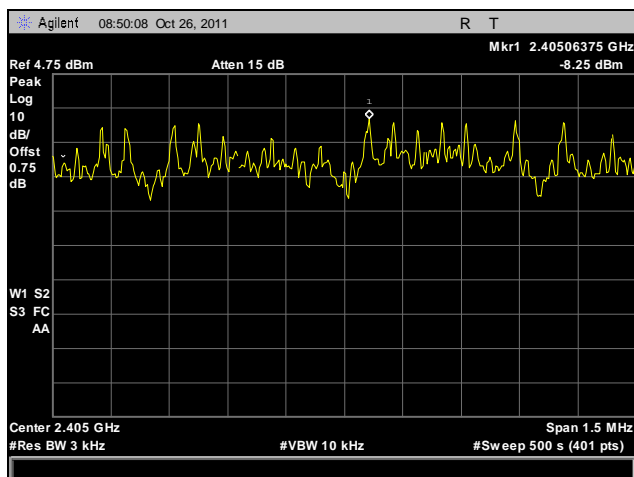
Figure 4. Block Diagram, Peak Power Spectral Density Test Setup

Peak Power Spectral Density Test Results

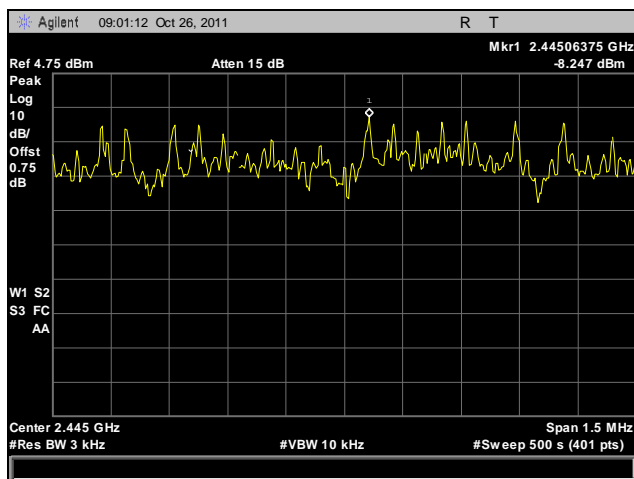
Peak Power Spectral Density				
Carrier Channel	Frequency (MHz)	Measured PPSD (dBm)	Limit (dBm)	Margin (dB)
Channel 11	2405	-8.25	8	-16.25
Channel 19	2445	-8.247	8	-16.247
Channel 26	2480	-8.023	8	-16.023

Table 19. Peak Power Spectral Density, Test Results

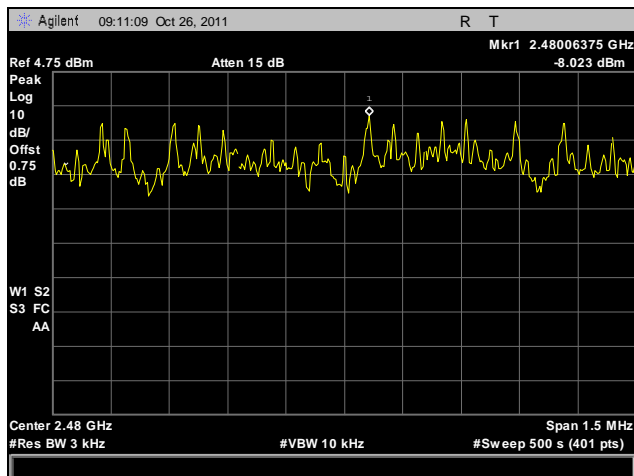
Peak Power Spectral Density



Plot 40. Peak Power Spectral Density, Channel 11



Plot 41. Peak Power Spectral Density, Channel 19



Plot 42. Peak Power Spectral Density, Channel 26

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(i) Maximum Permissible 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 @ 2405-2480 MHz; highest conducted power = 4.68 dBm (peak) therefore, **Limit for Uncontrolled exposure: 1 mW/cm² or 10 W/m²**

EUT maximum antenna gain = 2 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 (2.94 mW)
G = Antenna Gain (1.58 numeric)

$$S = (2.94 * 1.58 / 4 * 3.14 * 20^2) = 0.001 \text{ mW/cm}^2$$

So the exposure limit is met at 20 cm.

Electromagnetic Compatibility Criteria for Intentional Radiators

RSS-GEN Receiver Spurious Emissions Requirements

Test Requirements: The following receiver spurious emission limits shall be complied with:

- (a) If a radiated measurement is made, all spurious emissions shall comply with the limits of Table 20.

Spurious Frequency (MHz)	Field Strength (microvolt/m at 3 metres)
30 – 88	100
88 – 216	150
216 – 960	200
Above 960	500

Table 20. Spurious Emission Limits for Receivers

- (b) If a conducted measurement is made, no spurious output signals appearing at the antenna terminals shall exceed 2 nanowatts per any 4 kHz spurious frequency in the band 30-1000 MHz, or 5 nanowatts above 1 GHz.

Test Procedures: The EUT was programmed for receive mode only. Conducted measurements were taken at the antenna port of the EUT. 100 kHz resolution bandwidth was used from 30 MHz - 1 GHz and for measurements done above 1 GHz. All plots are corrected for cable loss.

Test Results: Equipment is compliant with the Receiver Spurious Emissions Requirements of RSS-GEN.

Test Engineer(s): Dusmantha Tennakoon

Test Date(s): 11/02/11

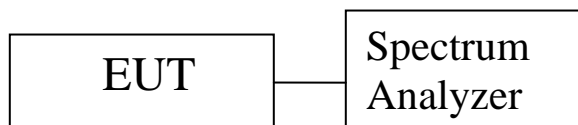
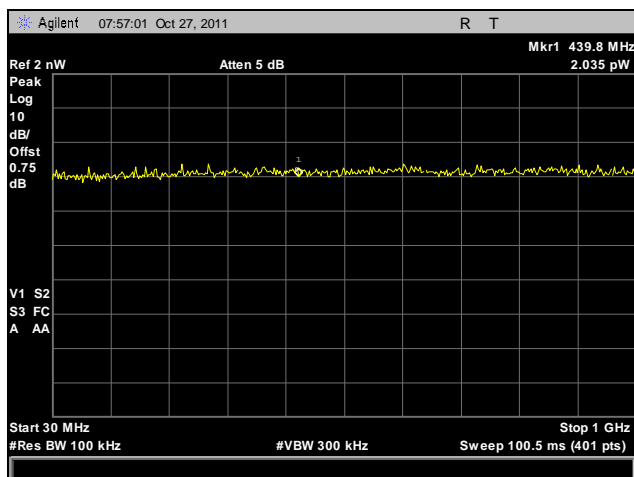
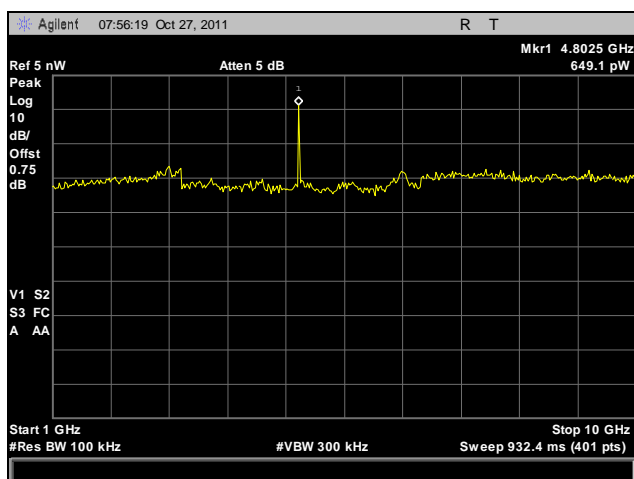


Figure 5. Block Diagram, Conducted Receiver Spurious Emissions Test Setup

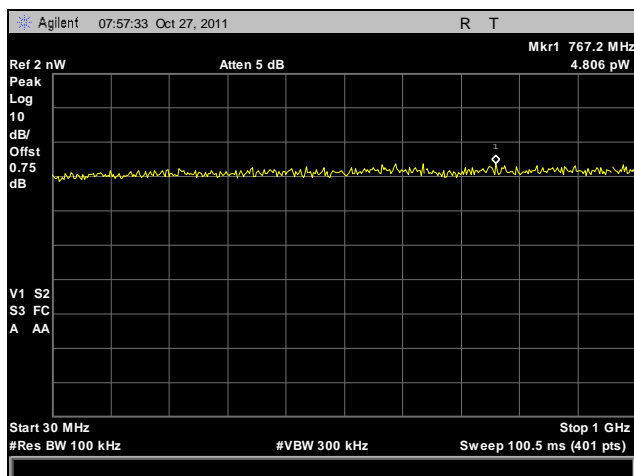
Conducted Receiver Spurious Emissions



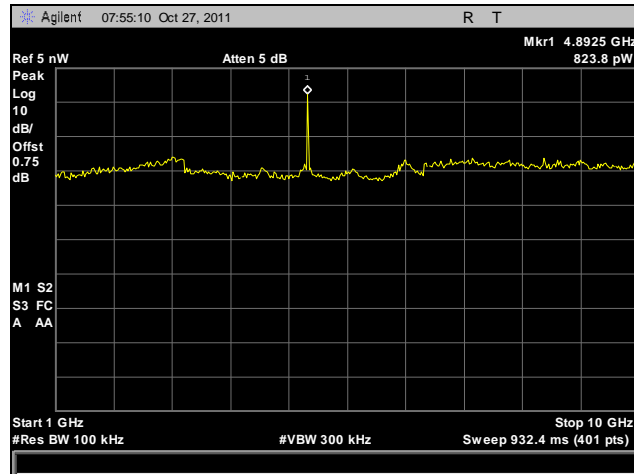
Plot 43. Receiver Spurious Emission, Channel 11, 30 MHz – 1 GHz



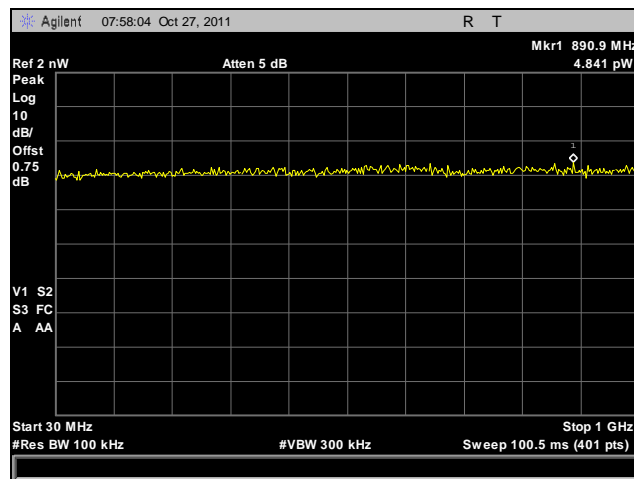
Plot 44. Receiver Spurious Emission, Channel 11, 1 GHz – 10 GHz



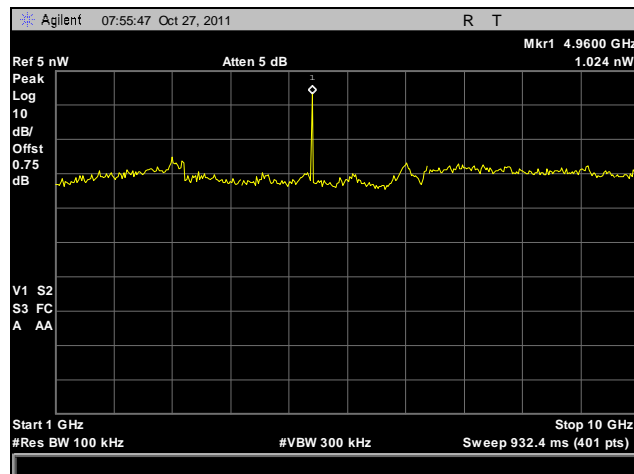
Plot 45. Receiver Spurious Emission, Channel 19, 30 MHz – 1 GHz



Plot 46. Receiver Spurious Emission, Channel 19, 1 GHz – 10 GHz



Plot 47. Receiver Spurious Emission, Channel 26, 30 MHz – 1 GHz



Plot 48. Receiver Spurious Emission, Channel 26, 1 GHz – 10 GHz

IV. Test Equipment

Test Equipment

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

MET Asset #	Equipment	Manufacturer	Model	Last Cal Date	Cal Due Date
1A1065	EMI RECEIVER	ROHDE & SCHWARZ	ESCI	12/15/2010	12/15/2011
1A1087	ATTENUATOR	ROHDE & SCHWARZ	ESH3Z2	3/11/2011	3/11/2012
1A1021	VOLTAGE DISPLAY	NEWPORT	Q9000-FUR6	9/15/2011	3/15/2012
1A1076	POWER TRANSFORMER	SUPERIOR ELECTRIC	POWERSTAT	SEE NOTE	
1A1019	ESH3-25 LISN (AE)	ROHDE & SCHWARZ	831-5518.2	SEE NOTE	
1A1119	TEST AREA	CUSTOM MADE	N/A	3/28/2011	3/28/2012
1A1122	LISN	TESEQ	NNB 51	3/31/2011	3/31/2012
1A1083	EMI TEST RECEIVER	ROHDE & SCHWARZ	ESU40	2/22/2011	2/22/2012
1A1088	PRE-AMP	RHODE & SCHWARZ	TS-PR1	5/2/2011	5/2/2012
1A1113	PRE-AMP	MINI-CIRCUIT	ZVA-183+	4/4/2011	4/4/2012
1A1072	PRE-AMP	MITEQ	AFS5-01001800-25-8P-6-PS	4/4/2011	4/4/2012
1A1090	PRE-AMP	MITEQ	AFS44-00102650-42-10P-44	4/4/2011	4/4/2012
1A1047	HORN ANTENNA (1-18GHZ)	ETS	3117	7/28/2010	1/28/2012
1A1026	18-26.5GHZ ANTENNA	ETS	011777-002	4/23/2010	4/23/2012
1A1050	BI-CONILOG ANTENNA (30MHZ TO 1GHZ)	SCHAFFNER	CBL6112D	4/22/2011	4/22/2012
1A1106	10M CHAMBER	ETS	SEMI-ANECHOIC	9/12/2011	9/12/2012

Table 21. Test Equipment List

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

1. 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