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June 5, 2012

Ubiquiti Networks, Inc.
91 E. Tasman Drive
San Jose, CA 95134

Dear Jennifer Sanchez,

Enclosed is the EMC Wireless test report for compliance testing of the Ubiquiti Networks, Inc., WispStation M5 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: (\\Ubiquiti Networks, Inc.\\EMCS34046-FCC247 Rev. 1)

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Electromagnetic Compatibility Criteria Test Report

for the

**Ubiquiti Networks, Inc.
WispStation M5**

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: EMCS34046-FCC247 Rev. 1

June 5, 2012

Prepared For:

**Ubiquiti Networks, Inc.
91 E. Tasman Drive
San Jose, CA 95134**

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

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for Intentional Radiators



Anderson Soungpanya, 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

Report Status Sheet

Revision	Report Date	Reason for Revision
∅	May 16, 2012	Initial Issue.
1	June 5, 2012	Revised to reflect corrected model name and MPE Calculation.

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.....	8
	F. Support Equipment	8
	G. Ports and Cabling Information.....	8
	H. Mode of Operation.....	9
	I. Method of Monitoring EUT Operation	9
	J. Modifications	9
	a) Modifications to EUT.....	9
	b) Modifications to Test Standard.....	9
	K. Disposition of EUT	9
III.	Electromagnetic Compatibility Criteria for Unintentional Radiators	10
	§ 15.107(a) Conducted Emissions Limits.....	11
	§ 15.109(a) Radiated Emissions Limits.....	15
IV.	Electromagnetic Compatibility Criteria for Intentional Radiators	21
	§ 15.203 Antenna Requirement	22
	§ 15.207(a) Conducted Emissions Limits.....	23
	§ 15.247(a)(a) 6 dB and 99% Bandwidth	27
	§ 15.247(b) Peak Power Output	37
	§ 15.247(d) Radiated Spurious Emissions Requirements and Band Edge.....	43
	§ 15.247(d) RF Conducted Spurious Emissions Requirements and Band Edge.....	70
	§ 15.247(e) Peak Power Spectral Density	83
	§ 15.247(i) Maximum Permissible Exposure	89
	RSS-GEN Receiver Spurious Emissions.....	90
V.	Test Equipment	92
VI.	Certification & User's Manual Information	94
	A. Certification Information	95
	B. Label and User's Manual Information	99
VII.	ICES-003 Procedural & Labeling Requirements.....	101

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	8
Table 5. Support Equipment.....	8
Table 6. Ports and Cabling Information	8
Table 7. Conducted Limits for Radio Frequency Devices calculated from FCC Part 15 Subsections 15.107(a) (b)	11
Table 8. Conducted Emissions - Voltage, AC Power, Phase Line (24 V, 0.5 A PoE)	12
Table 9. Conducted Emissions - Voltage, AC Power, Neutral Line (24 V, 0.5 A PoE).....	13
Table 10. Radiated Emissions Limits calculated from FCC Part 15, §15.109 (a) (b)	15
Table 11. Radiated Emissions Limits, Test Results, 30 MHz – 1 GHz, FCC Limits	16
Table 12. Radiated Emissions Limits, Test Results, ICES-003 Limits	18
Table 13. Antenna List	22
Table 14. Conducted Limits for Intentional Radiators from FCC Part 15 § 15.207(a)	23
Table 15. Conducted Emissions, 15.207(a), Phase Line, Test Results	24
Table 16. Conducted Emissions, 15.207(a), Neutral Line, Test Results	25
Table 17. 6 dB Occupied Bandwidth, Test Results	28
Table 18. 99% Occupied Bandwidth, Test Results	28
Table 19. Output Power Requirements from §15.247(b)	37
Table 20. Peak Power Output, Test Results	38
Table 21. Restricted Bands of Operation.....	43
Table 22. Radiated Emissions Limits Calculated from FCC Part 15, § 15.209 (a)	44
Table 23. Peak Power Spectral Density, Test Results	84
Table 24. Spurious Emission Limits for Receivers	90
Table 25. Test Equipment List	93

List of Plots

Plot 1. Conducted Emissions, Phase Line Plot	12
Plot 2. Conducted Emissions, Neutral Line Plot	13
Plot 3. Radiated Emissions, 30 MHz - 1 GHz, FCC Limits	16
Plot 4. Radiated Emissions, Above 1 GHz, FCC Limits	17
Plot 5. Radiated Emissions, ICES-003 Limits	18
Plot 6. Conducted Emissions, 15.207(a), Phase Line	24
Plot 7. Conducted Emissions, 15.207(a), Neutral Line	25
Plot 8. 6 dB Occupied Bandwidth, Low Channel, HT5	29
Plot 9. 6 dB Occupied Bandwidth, Mid Channel, HT5	29
Plot 10. 6 dB Occupied Bandwidth, High Channel, HT5	29
Plot 11. 6 dB Occupied Bandwidth, Low Channel, HT10	30
Plot 12. 6 dB Occupied Bandwidth, Mid Channel, HT10	30
Plot 13. 6 dB Occupied Bandwidth, High Channel, HT10	30
Plot 14. 6 dB Occupied Bandwidth, Low Channel, HT20	31
Plot 15. 6 dB Occupied Bandwidth, Mid Channel, HT20	31
Plot 16. 6 dB Occupied Bandwidth, High Channel, HT20	31
Plot 17. 6 dB Occupied Bandwidth, Low Channel, HT40	32
Plot 18. 6 dB Occupied Bandwidth, Mid Channel, HT40	32
Plot 19. 6 dB Occupied Bandwidth, High Channel, HT40	32
Plot 20. 99% Occupied Bandwidth, Low Channel, HT5	33
Plot 21. 99% Occupied Bandwidth, Mid Channel, HT5	33
Plot 22. 99% Occupied Bandwidth, High Channel, HT5	33
Plot 23. 99% Occupied Bandwidth, Low Channel, HT10	34
Plot 24. 99% Occupied Bandwidth, Mid Channel, HT10	34

Plot 25. 99% Occupied Bandwidth, High Channel, HT10	34
Plot 26. 99% Occupied Bandwidth, Low Channel, HT20	35
Plot 27. 99% Occupied Bandwidth, Mid Channel, HT20	35
Plot 28. 99% Occupied Bandwidth, High Channel, HT20	35
Plot 29. 99% Occupied Bandwidth, Low Channel, HT40	36
Plot 30. 99% Occupied Bandwidth, Mid Channel, HT40	36
Plot 31. 99% Occupied Bandwidth, High Channel, HT40	36
Plot 32. Peak Power Output, Low Channel, HT5	39
Plot 33. Peak Power Output, Mid Channel, HT5	39
Plot 34. Peak Power Output, High Channel, HT5	39
Plot 35. Peak Power Output, Low Channel, HT10	40
Plot 36. Peak Power Output, Mid Channel, HT10	40
Plot 37. Peak Power Output, High Channel, HT10	40
Plot 38. Peak Power Output, Low Channel, HT20	41
Plot 39. Peak Power Output, Mid Channel, HT20	41
Plot 40. Peak Power Output, High Channel, HT20	41
Plot 41. Peak Power Output, Low Channel, HT40	42
Plot 42. Peak Power Output, Mid Channel, HT40	42
Plot 43. Peak Power Output, High Channel, HT40	42
Plot 44. Radiated Spurious Emissions, Low Channel, 30 MHz – 1 GHz, HT5	45
Plot 45. Radiated Spurious Emissions, Low Channel, 1 GHz – 7 GHz, Average, HT5	45
Plot 46. Radiated Spurious Emissions, Low Channel, 1 GHz – 7 GHz, Peak, HT5	45
Plot 47. Radiated Spurious Emissions, Low Channel, 5.3 GHz – 5.7 GHz, Average, HT5	46
Plot 48. Radiated Spurious Emissions, Low Channel, 7 GHz – 18 GHz, HT5	46
Plot 49. Radiated Spurious Emissions, Mid Channel, 30 MHz – 1 GHz, HT5	46
Plot 50. Radiated Spurious Emissions, Mid Channel, 1 GHz – 7 GHz, Average, HT5	47
Plot 51. Radiated Spurious Emissions, Mid Channel, 1 GHz – 7 GHz, Peak, HT5	47
Plot 52. Radiated Spurious Emissions, Mid Channel, 5.3 GHz – 5.7 GHz, Average, HT5	47
Plot 53. Radiated Spurious Emissions, Mid Channel, 5.3 GHz – 5.7 GHz, Peak, HT5	48
Plot 54. Radiated Spurious Emissions, Mid Channel, 7 GHz – 18 GHz, HT5	48
Plot 55. Radiated Spurious Emissions, High Channel, 30 MHz – 1 GHz, HT5	48
Plot 56. Radiated Spurious Emissions, High Channel, 1 GHz – 7 GHz, Average, HT5	49
Plot 57. Radiated Spurious Emissions, High Channel, 1 GHz – 7 GHz, Peak, HT5	49
Plot 58. Radiated Spurious Emissions, High Channel, 5.3 GHz – 5.7 GHz, Average, HT5	49
Plot 59. Radiated Spurious Emissions, High Channel, 5.3 GHz – 5.7 GHz, Peak, HT5	50
Plot 60. Radiated Spurious Emissions, High Channel, 7 GHz – 18 GHz, HT5	50
Plot 61. Radiated Spurious Emissions, Low Channel, 30 MHz – 1 GHz, HT10	51
Plot 62. Radiated Spurious Emissions, Low Channel, 1 GHz – 7 GHz, Average, HT10	51
Plot 63. Radiated Spurious Emissions, Low Channel, 1 GHz – 7 GHz, Peak, HT10	51
Plot 64. Radiated Spurious Emissions, Low Channel, 5.3 GHz – 5.7 GHz, Average, HT10	52
Plot 65. Radiated Spurious Emissions, Low Channel, 5.3 GHz – 5.7 GHz, Peak, HT10	52
Plot 66. Radiated Spurious Emissions, Low Channel, 7 GHz – 18 GHz, HT10	52
Plot 67. Radiated Spurious Emissions, Mid Channel, 30 MHz – 1 GHz, HT10	53
Plot 68. Radiated Spurious Emissions, Mid Channel, 1 GHz – 7 GHz, Average, HT10	53
Plot 69. Radiated Spurious Emissions, Mid Channel, 1 GHz – 7 GHz, Peak, HT10	53
Plot 70. Radiated Spurious Emissions, Mid Channel, 5.3 GHz – 5.7 GHz, Average, HT10	54
Plot 71. Radiated Spurious Emissions, Mid Channel, 5.3 GHz – 5.7 GHz, Peak, HT10	54
Plot 72. Radiated Spurious Emissions, Mid Channel, 7 GHz – 18 GHz, HT10	54
Plot 73. Radiated Spurious Emissions, High Channel, 30 MHz – 1 GHz, HT10	55
Plot 74. Radiated Spurious Emissions, High Channel, 1 GHz – 7 GHz, Average, HT10	55
Plot 75. Radiated Spurious Emissions, High Channel, 1 GHz – 7 GHz, Peak, HT10	55
Plot 76. Radiated Spurious Emissions, High Channel, 5.3 GHz – 5.7 GHz, Average, HT10	56
Plot 77. Radiated Spurious Emissions, High Channel, 5.3 GHz – 5.7 GHz, Peak, HT10	56
Plot 78. Radiated Spurious Emissions, High Channel, 7 GHz – 18 GHz, HT10	56
Plot 79. Radiated Spurious Emissions, Low Channel, 30 MHz – 1 GHz, HT20	57

Plot 80. Radiated Spurious Emissions, Low Channel, 1 GHz – 7 GHz, Average, HT20.....	57
Plot 81. Radiated Spurious Emissions, Low Channel, 1 GHz – 7 GHz, Peak, HT20.....	57
Plot 82. Radiated Spurious Emissions, Low Channel, 5.3 GHz – 5.7 GHz, Average, HT20.....	58
Plot 83. Radiated Spurious Emissions, Low Channel, 7 GHz – 18 GHz, HT20.....	58
Plot 84. Radiated Spurious Emissions, Mid Channel, 30 MHz – 1 GHz, HT20.....	58
Plot 85. Radiated Spurious Emissions, Mid Channel, 1 GHz – 7 GHz, Average, HT20.....	59
Plot 86. Radiated Spurious Emissions, Mid Channel, 1 GHz – 7 GHz, Peak, HT20.....	59
Plot 87. Radiated Spurious Emissions, Mid Channel, 5.3 GHz – 5.7 GHz, Average, HT20.....	59
Plot 88. Radiated Spurious Emissions, Mid Channel, 7 GHz – 18 GHz, HT20.....	60
Plot 89. Radiated Spurious Emissions, High Channel, 30 MHz – 1 GHz, HT20.....	60
Plot 90. Radiated Spurious Emissions, High Channel, 1 GHz – 7 GHz, Average, HT20.....	60
Plot 91. Radiated Spurious Emissions, High Channel, 1 GHz – 7 GHz, Peak, HT20.....	61
Plot 92. Radiated Spurious Emissions, High Channel, 5.3 GHz – 5.7 GHz, Average, HT20.....	61
Plot 93. Radiated Spurious Emissions, High Channel, 5.2 GHz – 5.8 GHz, Peak, HT20.....	61
Plot 94. Radiated Spurious Emissions, High Channel, 7 GHz – 18 GHz, HT20.....	62
Plot 95. Radiated Spurious Emissions, Low Channel, 30 MHz – 1 GHz, HT40.....	63
Plot 96. Radiated Spurious Emissions, Low Channel, 1 GHz – 7 GHz, Average, HT40.....	63
Plot 97. Radiated Spurious Emissions, Low Channel, 1 GHz – 7 GHz, Peak, HT40.....	63
Plot 98. Radiated Spurious Emissions, Low Channel, 5.3 GHz – 5.7 GHz, Average, HT40.....	64
Plot 99. Radiated Spurious Emissions, Low Channel, 7 GHz – 18 GHz, HT40.....	64
Plot 100. Radiated Spurious Emissions, Mid Channel, 30 MHz – 1 GHz, HT40.....	64
Plot 101. Radiated Spurious Emissions, Mid Channel, 1 GHz – 7 GHz, Average, HT40.....	65
Plot 102. Radiated Spurious Emissions, Mid Channel, 1 GHz – 7 GHz, Peak, HT40.....	65
Plot 103. Radiated Spurious Emissions, Mid Channel, 5.3 GHz – 5.7 GHz, Average, HT40.....	65
Plot 104. Radiated Spurious Emissions, Mid Channel, 5.3 GHz – 5.7 GHz, Peak, HT40.....	66
Plot 105. Radiated Spurious Emissions, Mid Channel, 7 GHz – 18 GHz, HT40.....	66
Plot 106. Radiated Spurious Emissions, High Channel, 30 MHz – 1 GHz, HT40.....	66
Plot 107. Radiated Spurious Emissions, High Channel, 1 GHz – 7 GHz, Average, HT40.....	67
Plot 108. Radiated Spurious Emissions, High Channel, 1 GHz – 7 GHz, Peak, HT40.....	67
Plot 109. Radiated Spurious Emissions, High Channel, 5.3 GHz – 5.7 GHz, Average, HT40.....	67
Plot 110. Radiated Spurious Emissions, High Channel, 5.3 GHz – 5.7 GHz, Peak, HT40.....	68
Plot 111. Radiated Spurious Emissions, High Channel, 7 GHz – 18 GHz, HT40.....	68
Plot 114. Conducted Spurious Emissions, Low Channel, 30 MHz – 1 GHz, HT5.....	71
Plot 115. Conducted Spurious Emissions, Low Channel, 1 GHz – 40 GHz, HT5.....	71
Plot 116. Conducted Spurious Emissions, Mid Channel, 30 MHz – 1 GHz, HT5.....	71
Plot 117. Conducted Spurious Emissions, Mid Channel, 1 GHz – 40 GHz, HT5.....	72
Plot 118. Conducted Spurious Emissions, High Channel, 30 MHz – 1 GHz, HT5.....	72
Plot 119. Conducted Spurious Emissions, High Channel, 1 GHz – 40 GHz, HT5.....	72
Plot 120. Conducted Spurious Emissions, Low Channel, 30 MHz – 1 GHz, HT10.....	73
Plot 121. Conducted Spurious Emissions, Low Channel, 1 GHz – 40 GHz, HT10.....	73
Plot 122. Conducted Spurious Emissions, Mid Channel, 30 MHz – 1 GHz, HT10.....	73
Plot 123. Conducted Spurious Emissions, Mid Channel, 1 GHz – 40 GHz, HT10.....	74
Plot 124. Conducted Spurious Emissions, High Channel, 30 MHz – 1 GHz, HT10.....	74
Plot 125. Conducted Spurious Emissions, High Channel, 1 GHz – 40 GHz, HT10.....	74
Plot 126. Conducted Spurious Emissions, Low Channel, 30 MHz – 1 GHz, HT20.....	75
Plot 127. Conducted Spurious Emissions, Low Channel, 1 GHz – 40 GHz, HT20.....	75
Plot 128. Conducted Spurious Emissions, Mid Channel, 30 MHz – 1 GHz, HT20.....	75
Plot 129. Conducted Spurious Emissions, Mid Channel, 1 GHz – 40 GHz, HT20.....	76
Plot 130. Conducted Spurious Emissions, High Channel, 30 MHz – 1 GHz, HT20.....	76
Plot 131. Conducted Spurious Emissions, High Channel, 1 GHz – 40 GHz, HT20.....	76
Plot 132. Conducted Spurious Emissions, Low Channel, 30 MHz – 1 GHz, HT40.....	77
Plot 133. Conducted Spurious Emissions, Low Channel, 1 GHz – 40 GHz, HT40.....	77
Plot 134. Conducted Spurious Emissions, Mid Channel, 30 MHz – 1 GHz, HT40.....	77
Plot 135. Conducted Spurious Emissions, Mid Channel, 1 GHz – 40 GHz, HT40.....	78
Plot 136. Conducted Spurious Emissions, High Channel, 30 MHz – 1 GHz, HT40.....	78

Plot 137. Conducted Spurious Emissions, High Channel, 1 GHz – 40 GHz, HT40	78
Plot 138. Conducted Band Edge, Low Channel, HT5	79
Plot 139. Conducted Band Edge, High Channel, HT5	79
Plot 138. Conducted Band Edge, Low Channel, HT10	80
Plot 139. Conducted Band Edge, High Channel, HT10	80
Plot 138. Conducted Band Edge, Low Channel, HT20	81
Plot 139. Conducted Band Edge, High Channel, HT20	81
Plot 138. Conducted Band Edge, Low Channel, HT40	82
Plot 139. Conducted Band Edge, High Channel, HT40	82
Plot 140. Peak Power Spectral Density, Low Channel, HT5	85
Plot 141. Peak Power Spectral Density, Mid Channel, HT5	85
Plot 142. Peak Power Spectral Density, High Channel, HT5	85
Plot 143. Peak Power Spectral Density, Low Channel, HT10	86
Plot 144. Peak Power Spectral Density, Mid Channel, HT10	86
Plot 145. Peak Power Spectral Density, High Channel, HT10	86
Plot 146. Peak Power Spectral Density, Low Channel, HT20	87
Plot 147. Peak Power Spectral Density, Mid Channel, HT20	87
Plot 148. Peak Power Spectral Density, High Channel, HT20	87
Plot 149. Peak Power Spectral Density, Low Channel, HT40	88
Plot 150. Peak Power Spectral Density, Mid Channel, HT40	88
Plot 151. Peak Power Spectral Density, High Channel, HT40	88
Plot 152. Receiver Spurious Emission, 30 MHz – 1 GHz	91
Plot 153. Receiver Spurious Emission, 1 GHz – 18 GHz	91

List of Figures

Figure 1. Block Diagram of Test Configuration	7
Figure 2. Block Diagram, Occupied Bandwidth Test Setup	27
Figure 3. Peak Power Output Test Setup	37
Figure 4. Block Diagram, Conducted Spurious Emissions Test Setup	70
Figure 5. Block Diagram, Peak Power Spectral Density Test Setup	83
Figure 6. Block Diagram, Conducted Receiver Spurious Emissions Test Setup	90

List of Photographs

Photograph 1. Ubiquiti Networks, Inc. WispStation M5	6
Photograph 2. Conducted Emissions, Test Setup, Front View	14
Photograph 3. Conducted Emissions, Test Setup, Side View	14
Photograph 4. Radiated Emissions, Test Setup	19
Photograph 5. Radiated Emissions, Test Setup, 30 MHz – 1 GHz	19
Photograph 6. Radiated Emissions, Test Setup, 1 GHz – 10 GHz	20
Photograph 7. Conducted Emissions, 15.207(a), Test Setup, Front View	26
Photograph 8. Conducted Emissions, 15.207(a), Test Setup, Side View	26
Photograph 9. Radiated Spurious Emissions, Test Setup, 30 MHz – 1 GHz	69
Photograph 10. Radiated Spurious Emissions, Test Setup, 1 GHz – 18 GHz	69

List of Terms and Abbreviations

AC	Alternating Current
ACF	Antenna Correction Factor
Cal	Calibration
<i>d</i>	Measurement Distance
dB	Decibels
dB μ A	Decibels above one microamp
dB μ V	Decibels above one microvolt
dB μ A/m	Decibels above one microamp per meter
dB μ V/m	Decibels above one microvolt per meter
DC	Direct Current
E	Electric Field
DSL	Digital Subscriber Line
ESD	Electrostatic Discharge
EUT	Equipment Under Test
<i>f</i>	Frequency
FCC	Federal Communications Commission
GRP	Ground Reference Plane
H	Magnetic Field
HCP	Horizontal Coupling Plane
Hz	Hertz
IEC	International Electrotechnical Commission
kHz	kilohertz
kPa	kilopascal
kV	kilovolt
LISN	Line Impedance Stabilization Network
MHz	Megahertz
μ H	microhenry
μ	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

I. Executive Summary

A. Purpose of Test

An EMC evaluation was performed to determine compliance of the Ubiquiti Networks, Inc. WispStation M5, 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 WispStation M5. Ubiquiti Networks, Inc. should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the WispStation M5, 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 Ubiquiti Networks, Inc., purchase order number US100273. 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	Compliant
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	Compliant
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 Ubiquiti Networks, Inc. to perform testing on the WispStation M5, under Ubiquiti Networks, Inc.'s purchase order number US100273.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the Ubiquiti Networks, Inc., WispStation M5.

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

Model(s) Tested:	WispStation M5				
Model(s) Covered:	WispStation M5				
EUT Specifications:	Primary Power: 24 V, 0.5 A PoE				
	FCC ID: SWX-WSM5 IC: 6545A-WSM5				
	Type of Modulations:	OFDM			
	Equipment Code:	DTS			
	Peak RF Output Power:	HT5	HT10	HT20	HT40
		21.60 dBm (0.145 W)	21.79 dBm (0.151 W)	22.26 dBm (0.168 W)	21.15 dBm (0.130 W)
	EUT Frequency Ranges:	HT5	HT10	HT20	HT40
		5730-5845 MHz	5735-5840 MHz	5735-5840 MHz	5750-5825 MHz
Occupied Bandwidth:	HT5	HT10	HT20	HT40	
	4.2087 MHz	8.5847 MHz	17.8322 MHz	36.7347 MHz	
Antenna:	23 dBi Panel Antenna				
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):	June 5, 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

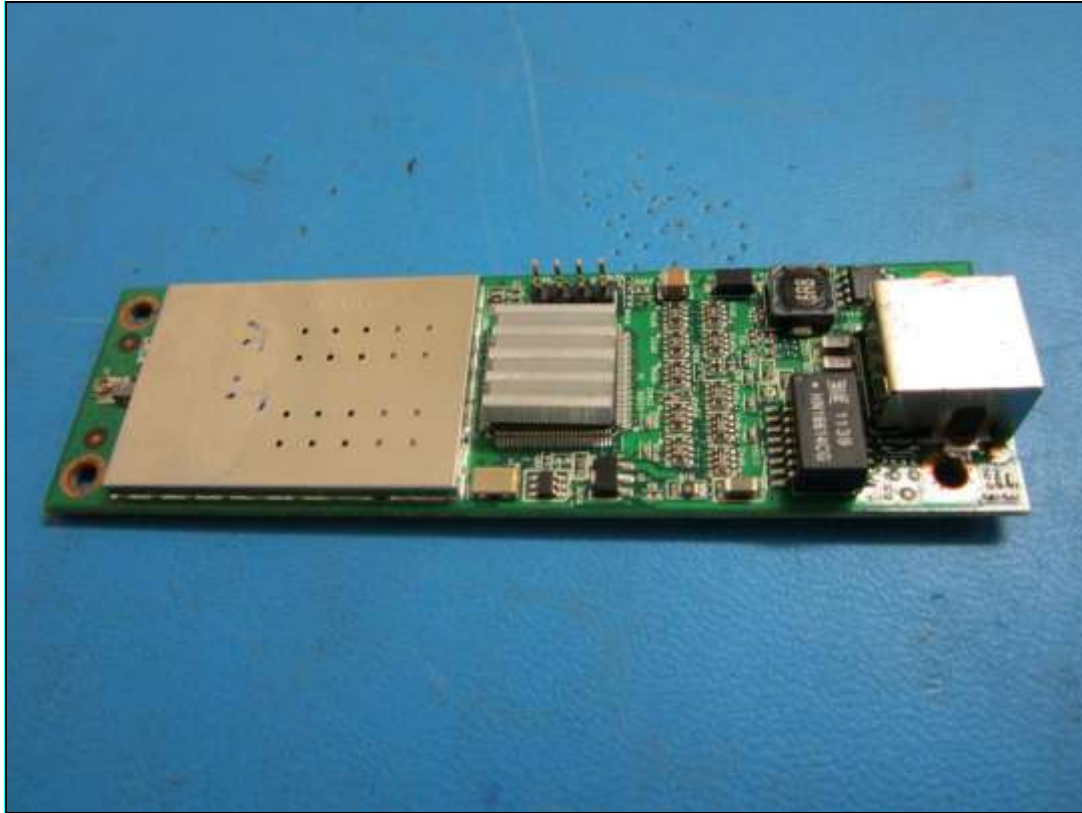
C. Test Site

All testing was performed at MET Laboratories, Inc., 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 Ubiquiti Networks, Model WispStation M5, Equipment Under Test (EUT) is a 802.11a/n MIMO module. The EUT operates in the 5.7-5.8GHz band.



Photograph 1. Ubiquiti Networks, Inc. WispStation M5

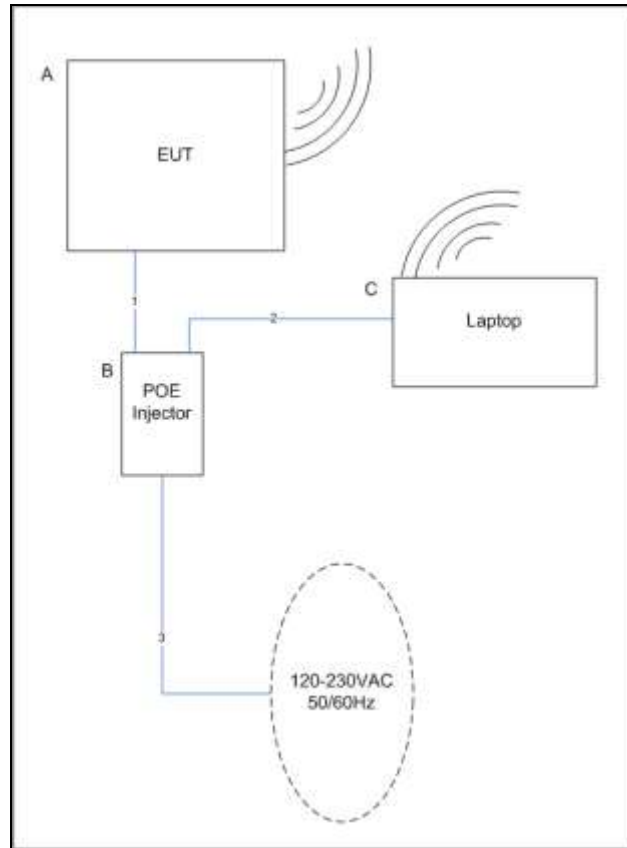


Figure 1. Block Diagram of Test Configuration

E. Equipment Configuration

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

Ref. ID	Name / Description	Model Number	Part Number	Serial Number
A	WSM5	WSM5	NA	1134T002722A04C47
B	POE	UB1-POE-24-5	NA	1101-0107198

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
C	Laptop	Dell	Vostro 1000

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	A, Ethernet	CAT 5	1	.5	Y	B
2	B, Data	CAT 5	1	.5	Y	C, Laptop
3	B, AC In	Power Cord	1	.5	N	100-240V AC power

Table 6. Ports and Cabling Information

H. Mode of Operation

The EUT was operated using Atheros Radio Test Software.

I. Method of Monitoring EUT Operation

Note if ping times out and does not return. If the unit locks up and requires power down, it is a fail.

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 Ubiquiti Networks, Inc. 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.

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.

Table 7. Conducted Limits for Radio Frequency Devices calculated from FCC Part 15 Subsections 15.107(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, test conditions, and test procedures of ANSI C63.4 were used. The EUT was powered through a 50 Ω /50 μ H LISN. An EMI receiver, connected to the measurement port of the LISN, scanned the frequency range from 150 kHz to 30 MHz in order to find the peak conducted emissions. All peak emissions within 6 dB of the limit were re-measured using a quasi-peak and/or average detector as appropriate.

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

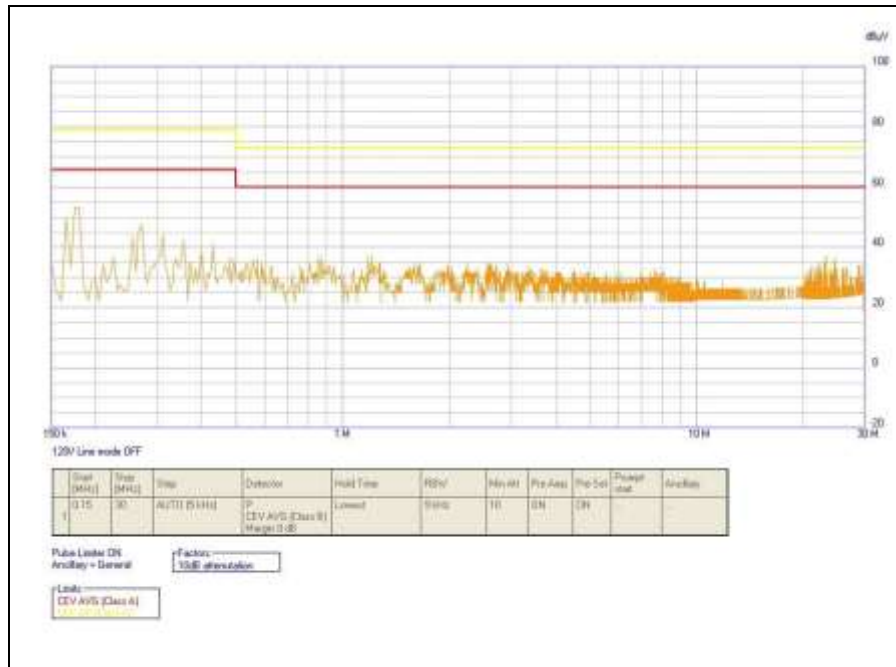
Test Engineer(s): Joe Vang

Test Date(s): 01/24/12

Conducted Emissions - Voltage, AC Power, Phase Line (24 V, 0.5 A PoE)

Line	Freq. (MHz)	QP Amplitude	QP Limit	Delta	Pass	Average Amplitude	Average Limit	Delta	Pass
line	0.165	44.84	79	-34.16	Pass	28.03	66	-37.97	Pass
line	0.18	36.72	79	-42.28	Pass	17.48	66	-48.52	Pass
line	0.27	28.16	79	-50.84	Pass	10.21	66	-55.79	Pass

Table 8. Conducted Emissions - Voltage, AC Power, Phase Line (24 V, 0.5 A PoE)

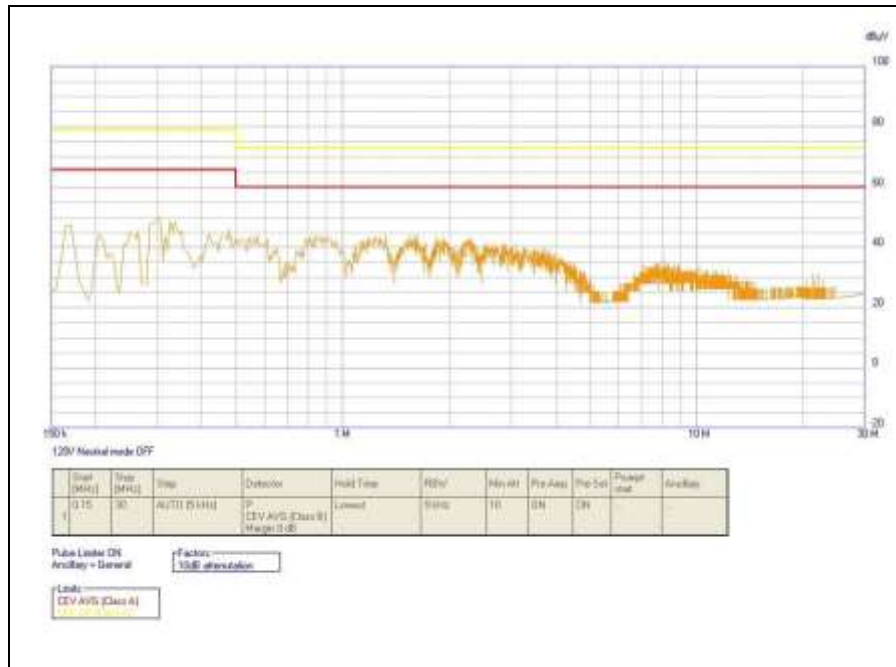


Plot 1. Conducted Emissions, Phase Line Plot

Conducted Emissions - Voltage, AC Power, Neutral Line (24 V, 0.5 A PoE)

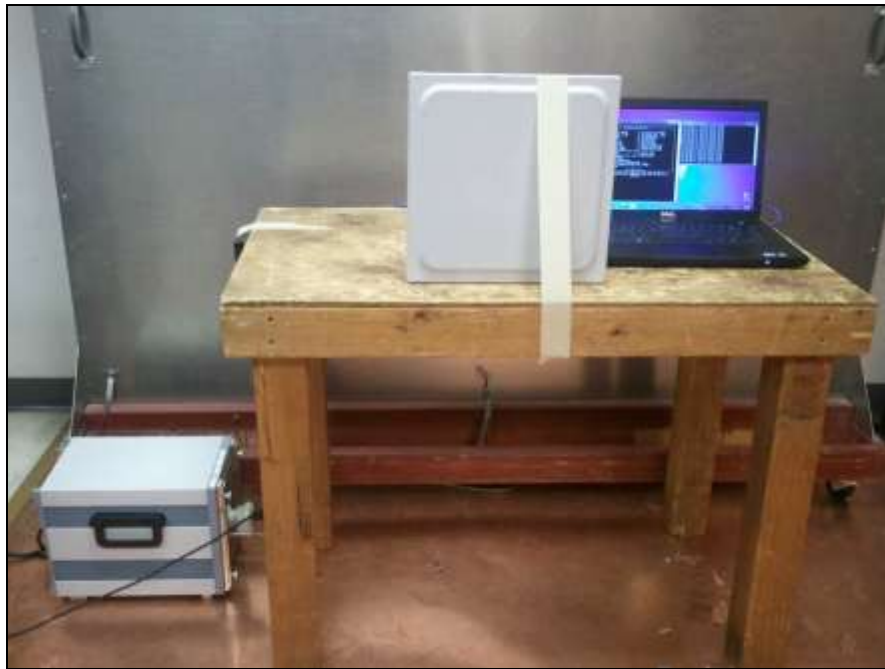
Line	Freq. (MHz)	QP Amplitude	QP Limit	Delta	Pass	Average Amplitude	Average Limit	Delta	Pass
neutral	0.17	44.85	79	-34.15	Pass	37.2	66	-28.8	Pass
neutral	0.3	48.09	79	-30.91	Pass	42.5	66	-23.5	Pass
neutral	0.325	44.82	79	-34.18	Pass	30.72	66	-35.28	Pass

Table 9. Conducted Emissions - Voltage, AC Power, Neutral Line (24 V, 0.5 A PoE)



Plot 2. Conducted Emissions, Neutral Line Plot

Conducted Emission Limits Test Setup



Photograph 2. Conducted Emissions, Test Setup, Front View



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 10 m from the EUT on an adjustable mast for 30-1GHzm and 3m for 1-10GHz. 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.

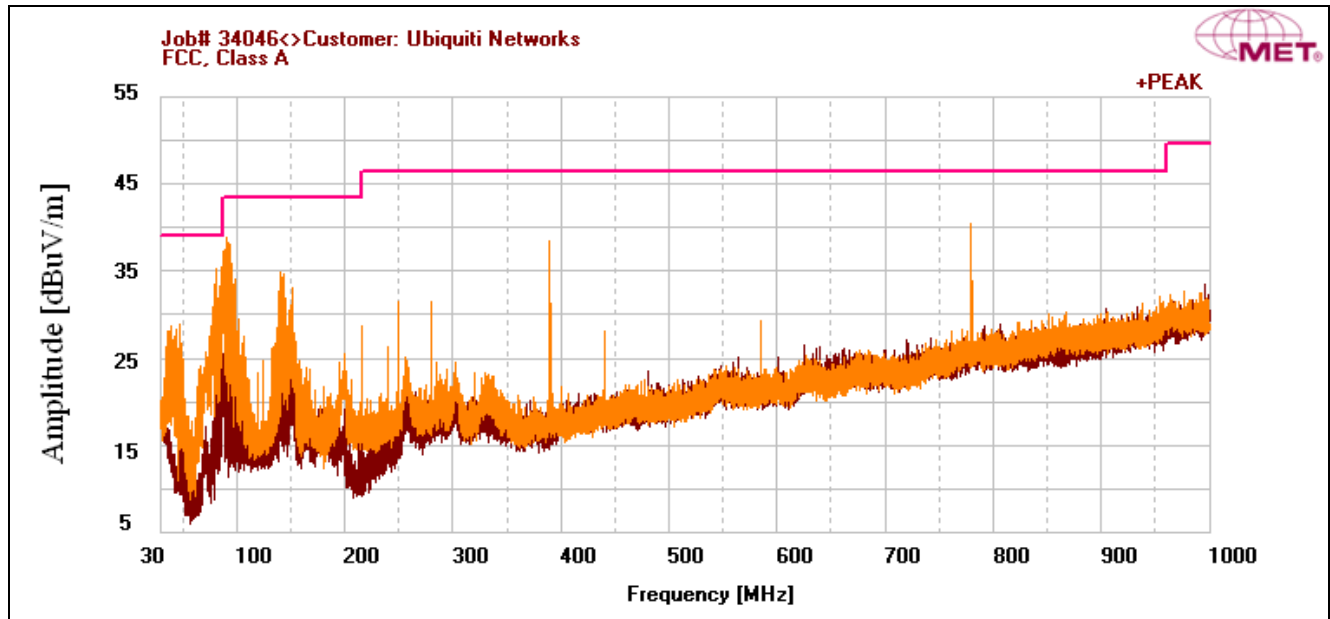
Test Engineer(s): Anderson Soungpanya

Test Date(s): 04/30/12

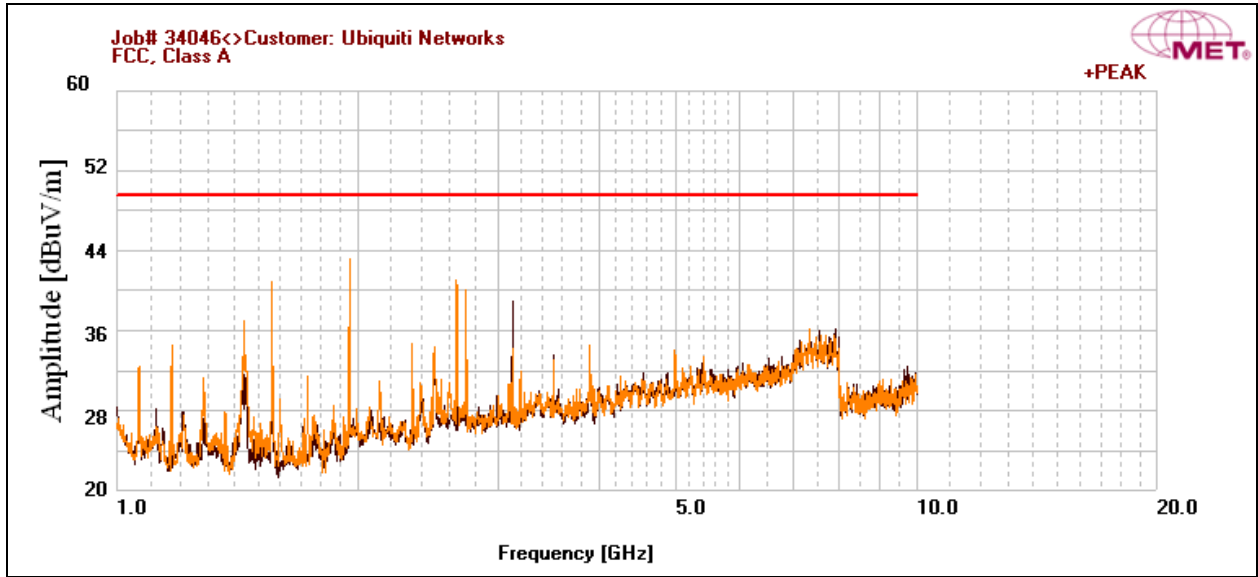
Radiated Emissions Limits Test Results, Class A

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)	Limit (dBuV)	Margin (dB)
1950	V	77	100	81.9	27.771	54.654	0	-10.46	44.557	49.5	-4.943
1560	V	67	100	85.96	25.679	54.139	0	-10.46	47.04	49.5	-2.46
2730	V	95	100	72.27	29.71	55.824	0	-10.46	35.696	49.5	-13.804
97.56	V	125	100	56.44	10.956	29.635	0	0	37.761	43.5	-5.739
144.09	V	201	100	50.12	10.591	29.198	0	0	31.513	43.5	-11.987
389.97	V	10	100	51.54	15.899	27.543	0	0	39.896	46.4	-6.504
779.97	V	143	150	47.16	20.099	25.718	0	0	41.541	46.4	-4.859
779.97	H	150	100	46.97	20.099	25.718	0	0	41.351	46.4	-5.049
389.97	H	132	100	48.55	15.899	27.543	0	0	36.906	46.4	-9.494

Table 11. Radiated Emissions Limits, Test Results, 30 MHz – 1 GHz, FCC Limits



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

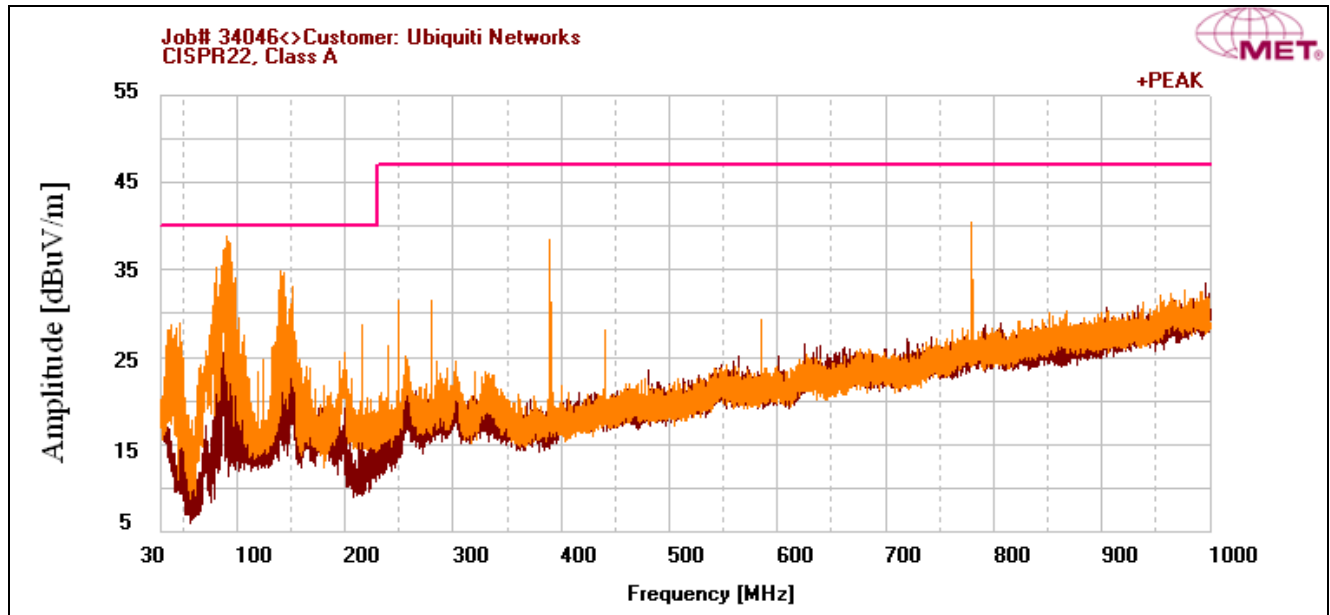


Plot 4. Radiated Emissions, Above 1 GHz, FCC Limits

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)	Limit (dBuV)	Margin (dB)
97.56	V	125	100	56.44	10.956	29.635	0	0	37.761	40	-2.239
144.09	V	201	100	50.12	10.591	29.198	0	0	31.513	40	-8.487
389.97	V	10	100	51.54	15.899	27.543	0	0	39.896	47	-7.104
779.97	V	143	150	47.16	20.099	25.718	0	0	41.541	47	-5.459
779.97	H	150	100	46.97	20.099	25.718	0	0	41.351	47	-5.649
389.97	H	132	100	48.55	15.899	27.543	0	0	36.906	47	-10.09

Table 12. Radiated Emissions Limits, Test Results, ICES-003 Limits

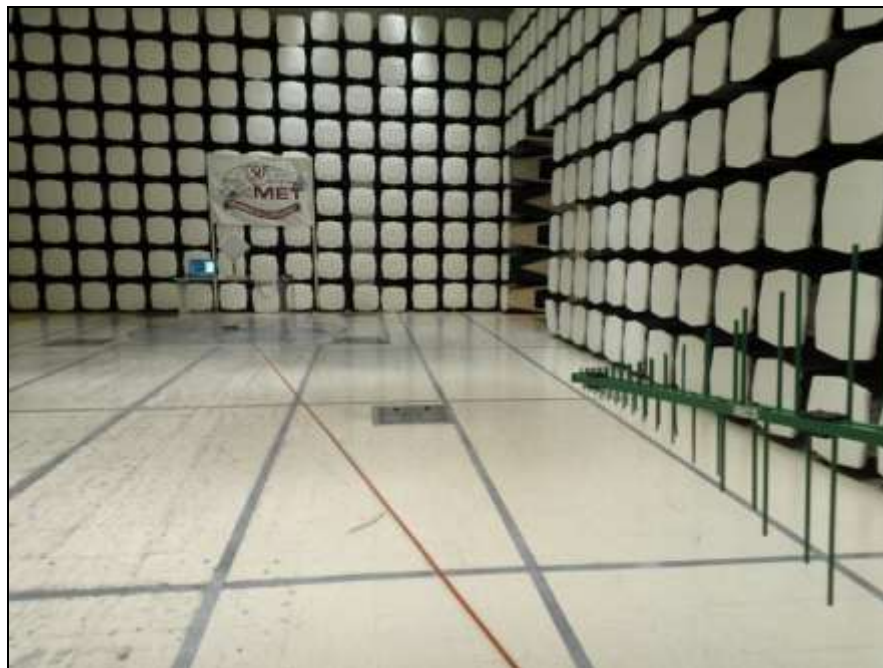


Plot 5. Radiated Emissions, ICES-003 Limits

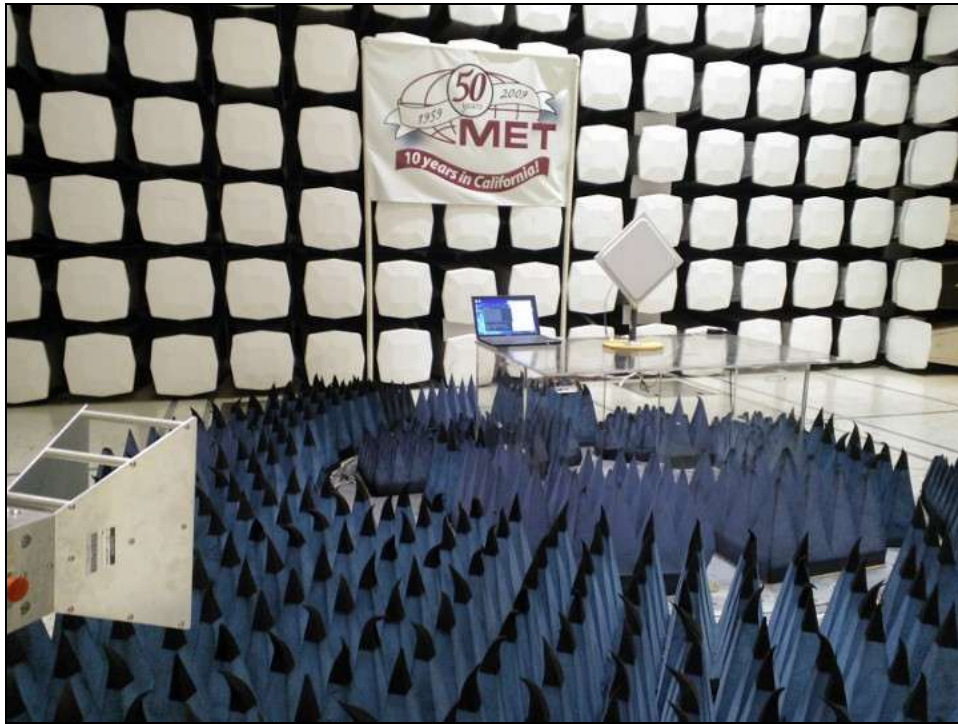
Radiated Emission Limits Test Setup



Photograph 4. Radiated Emissions, Test Setup



Photograph 5. Radiated Emissions, Test Setup, 30 MHz – 1 GHz



Photograph 6. Radiated Emissions, Test Setup, 1 GHz – 10 GHz

IV. Electromagnetic Compatibility Criteria for Intentional Radiators

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.203 Antenna Requirement

Test Requirement:

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

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

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

Results:

The EUT as tested is compliant the criteria of §15.203. EUT uses a U.FL connector which is an unique type of connector.

Test Engineer(s):

Anderson Sounghpanya

Test Date(s):

04/30/12

Gain	Type	Model	Manufacturer
23 dBi	Panel	ARC-IA5823B01	ARC Wireless Solutions

Table 13. Antenna List

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 14. 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 compliant with this requirement. Measured emissions were below applicable limits.

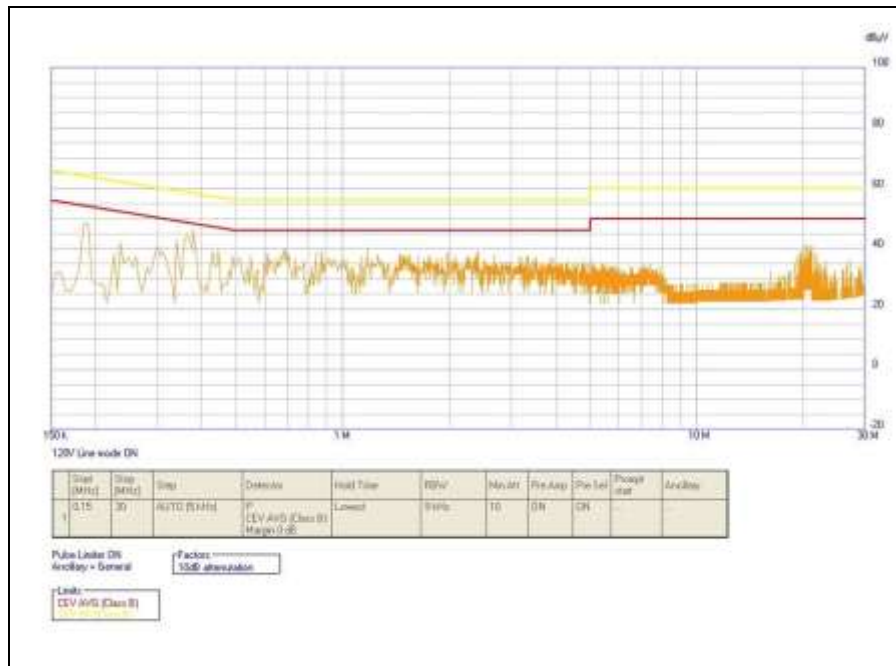
Test Engineer(s): Joe Vang

Test Date(s): 01/24/12

15.207(a) Conducted Emissions Test Results

Line	Freq. (MHz)	QP Amplitude	QP Limit	Delta	Pass	Average Amplitude	Average Limit	Delta	Pass
Line	0.19	45.03	64.042	-19.012	Pass	27.43	54.042	-26.612	Pass
Line	0.235	40.58	62.281	-21.701	Pass	23.34	52.281	-28.941	Pass
Line	0.34	35.2	59.222	-24.022	Pass	20.17	49.222	-29.052	Pass
Line	0.365	41.89	58.634	-16.744	Pass	31.91	48.634	-16.724	Pass
Line	0.38	40.81	58.3	-17.49	Pass	29.7	48.3	-18.6	Pass
Line	20.255	38.09	60	-21.91	Pass	32.42	50	-17.58	Pass

Table 15. Conducted Emissions, 15.207(a), Phase Line, Test Results

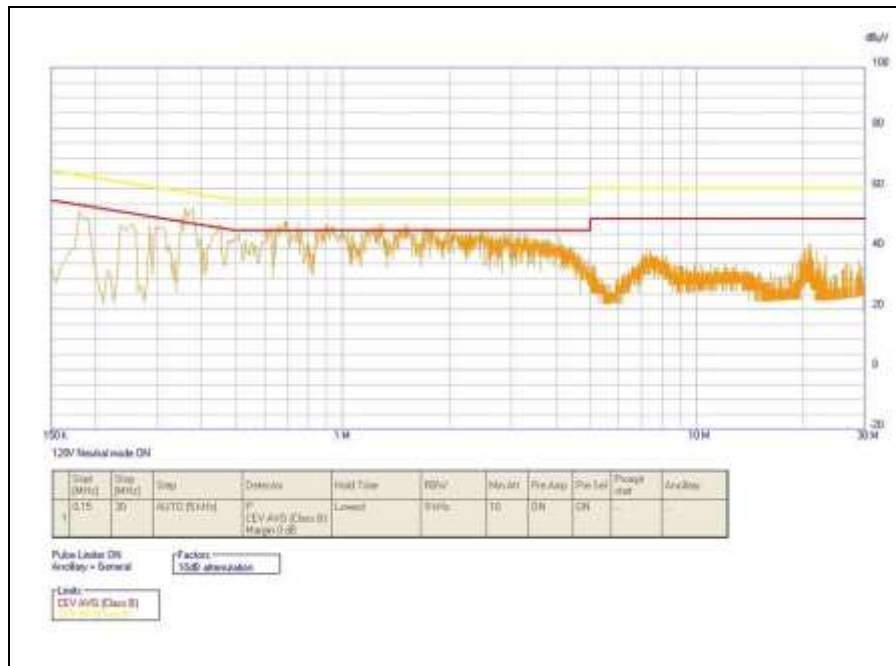


Plot 6. Conducted Emissions, 15.207(a), Phase Line

15.207(a) Conducted Emissions Test Results

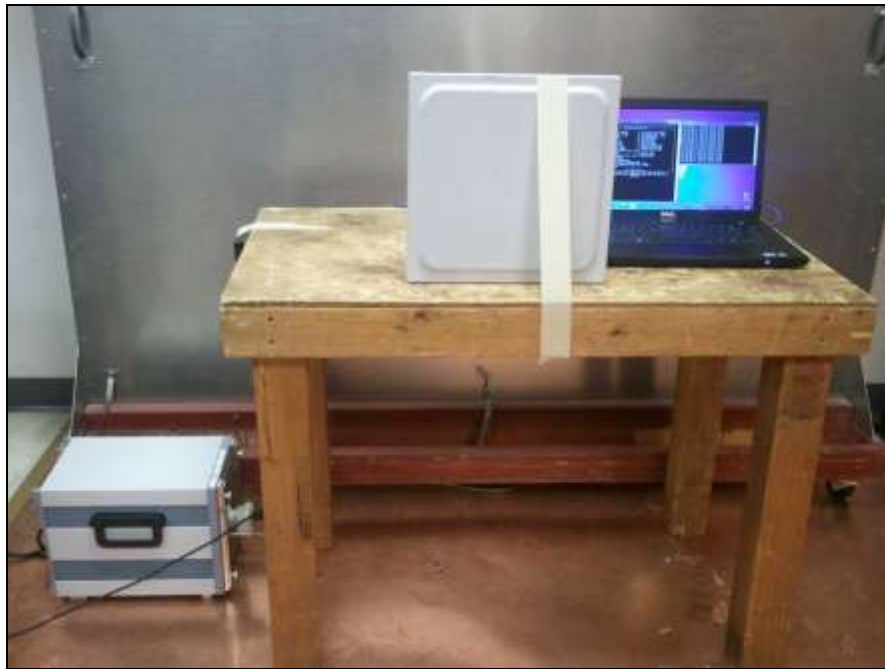
Line	Freq. (MHz)	QP Amplitude	QP Limit	Delta	Pass	Average Amplitude	Average Limit	Delta	Pass
Neutral	0.18	47.45	64.49	-17.04	Pass	34.7	54.49	-19.79	Pass
Neutral	0.35	47.42	58.982	-11.562	Pass	30.3	48.982	-18.682	Pass
Neutral	0.36	49.78	58.748	-8.968	Pass	40.33	48.748	-8.418	Pass
Neutral	0.685	45.86	56	-10.14	Pass	37.4	46	-8.6	Pass
Neutral	0.75	42.74	56	-13.26	Pass	31.96	46	-14.04	Pass
Neutral	1.52	43.62	56	-12.38	Pass	32.63	46	-13.37	Pass

Table 16. Conducted Emissions, 15.207(a), Neutral Line, Test Results



Plot 7. Conducted Emissions, 15.207(a), Neutral Line

15.207(a) Conducted Emissions Test Setup



Photograph 7. Conducted Emissions, 15.207(a), Test Setup, Front View



Photograph 8. Conducted Emissions, 15.207(a), Test Setup, Side View

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): Anderson Soungpanya

Test Date(s): 01/12/12

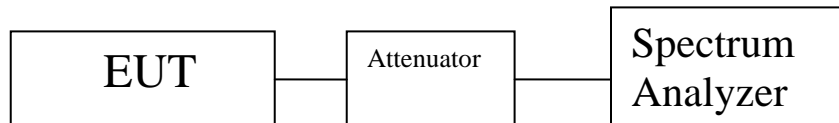


Figure 2. Block Diagram, Occupied Bandwidth Test Setup

Occupied Bandwidth Test Results

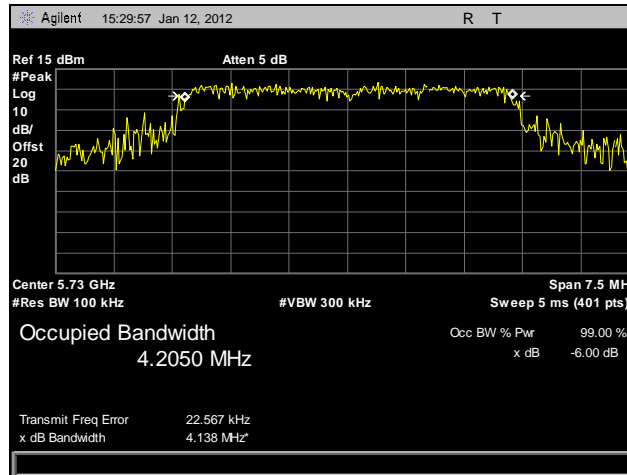
Occupied Bandwidth			
	Carrier Channel	Frequency (MHz)	Measured 6 dB Bandwidth (MHz)
HT5	Low	5730	4.138
	Mid	5785	4.125
	High	5845	4.115
HT10	Low	5735	8.190
	Mid	5785	8.004
	High	5840	8.244
HT20	Low	5735	17.661
	Mid	5785	17.695
	High	5840	17.402
HT40	Low	5750	36.338
	Mid	5785	36.597
	High	5825	36.558

Table 17. 6 dB Occupied Bandwidth, Test Results

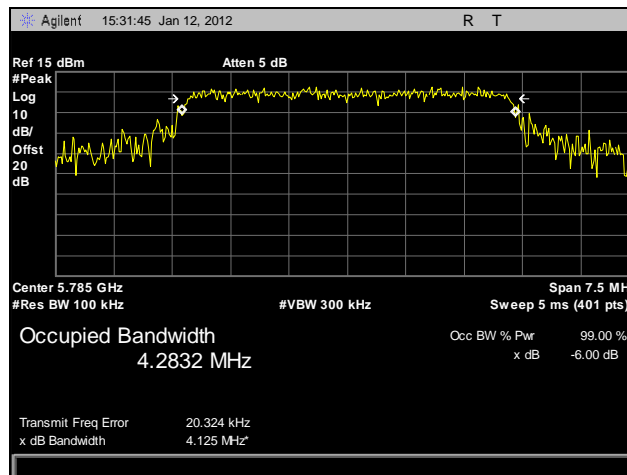
Occupied Bandwidth			
	Carrier Channel	Frequency (MHz)	Measured 99% Bandwidth (MHz)
HT5	Low	5730	4.1988
	Mid	5785	4.2087
	High	5845	4.1588
HT10	Low	5735	8.4468
	Mid	5785	8.4169
	High	5840	8.5847
HT20	Low	5735	17.8074
	Mid	5785	17.8322
	High	5840	17.7001
HT40	Low	5750	36.4915
	Mid	5785	36.2973
	High	5825	36.7347

Table 18. 99% Occupied Bandwidth, Test Results

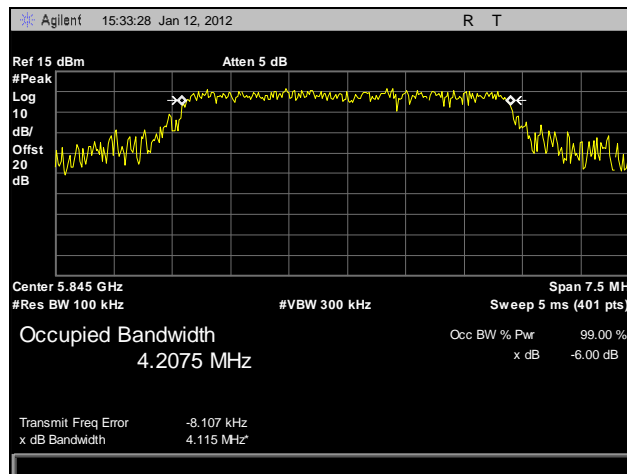
6 dB Occupied Bandwidth Test Results, HT5



Plot 8. 6 dB Occupied Bandwidth, Low Channel, HT5

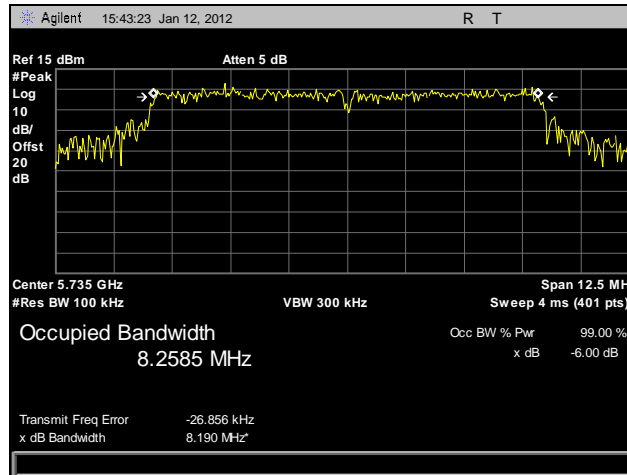


Plot 9. 6 dB Occupied Bandwidth, Mid Channel, HT5

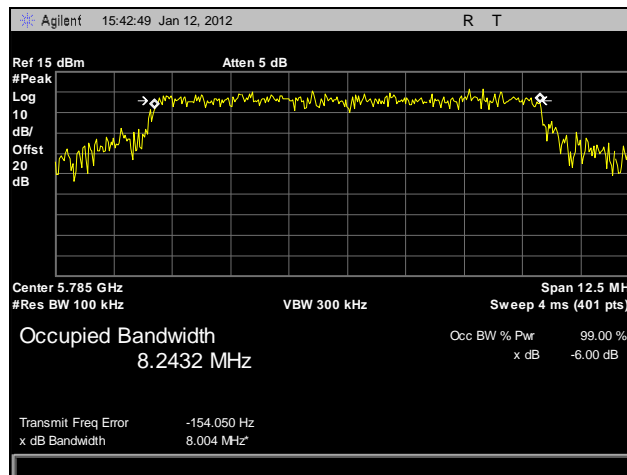


Plot 10. 6 dB Occupied Bandwidth, High Channel, HT5

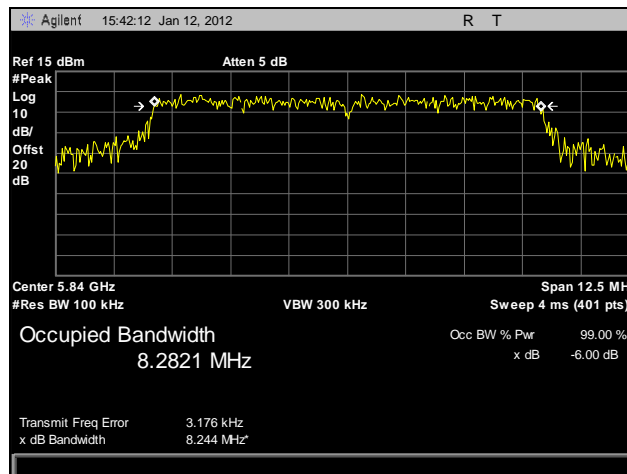
6 dB Occupied Bandwidth Test Results, HT10



Plot 11. 6 dB Occupied Bandwidth, Low Channel, HT10

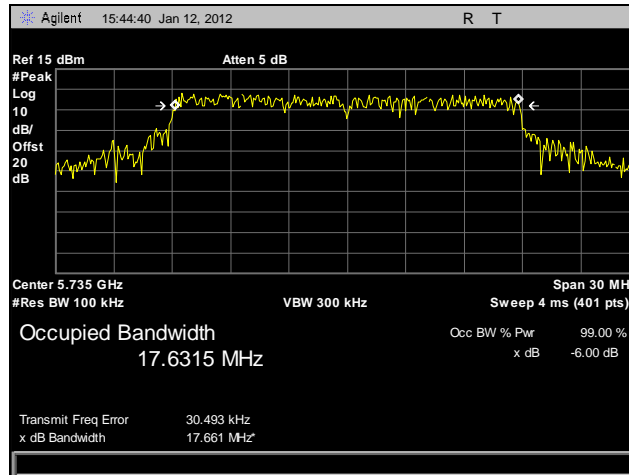


Plot 12. 6 dB Occupied Bandwidth, Mid Channel, HT10

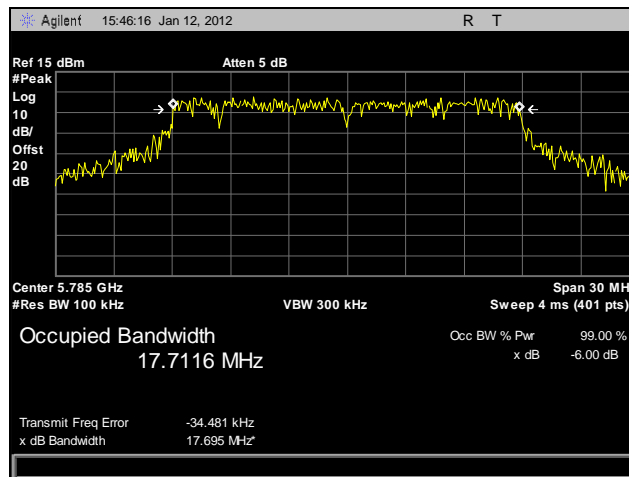


Plot 13. 6 dB Occupied Bandwidth, High Channel, HT10

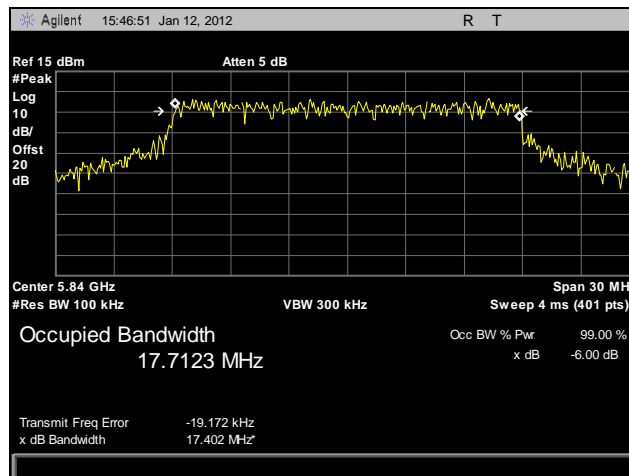
6 dB Occupied Bandwidth Test Results, HT20



Plot 14. 6 dB Occupied Bandwidth, Low Channel, HT20

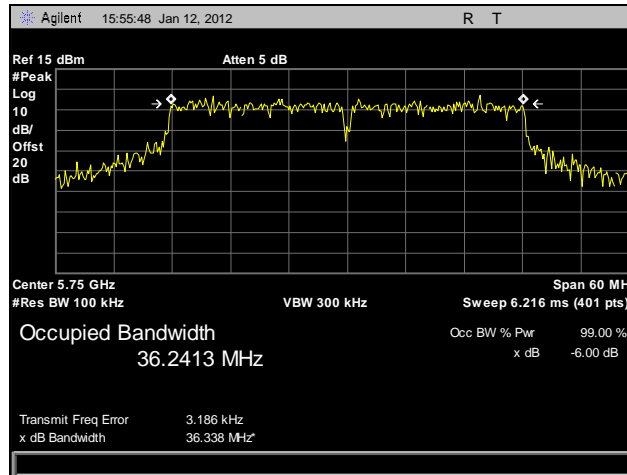


Plot 15. 6 dB Occupied Bandwidth, Mid Channel, HT20

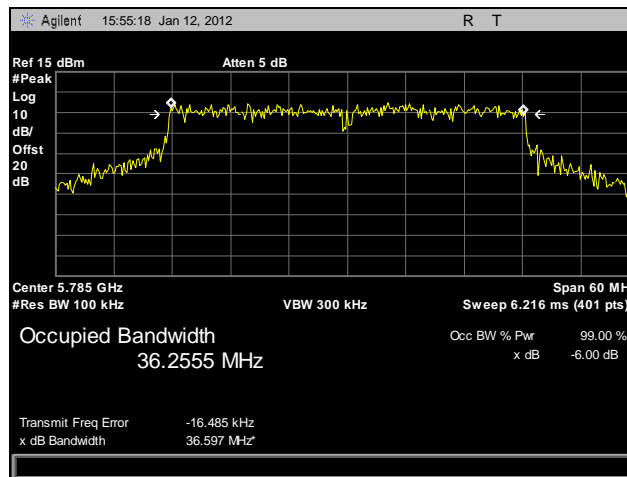


Plot 16. 6 dB Occupied Bandwidth, High Channel, HT20

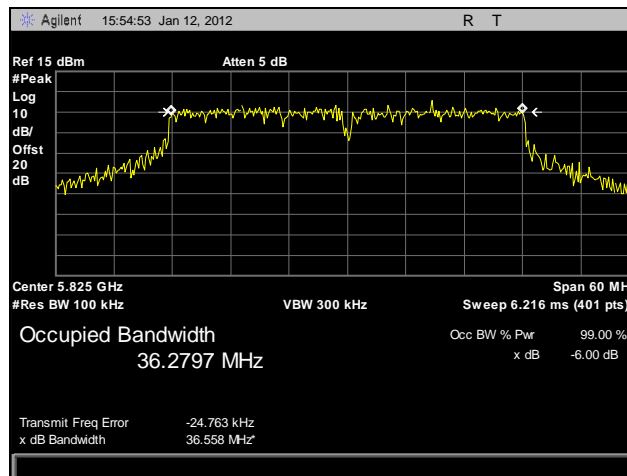
6 dB Occupied Bandwidth Test Results, HT40



Plot 17. 6 dB Occupied Bandwidth, Low Channel, HT40

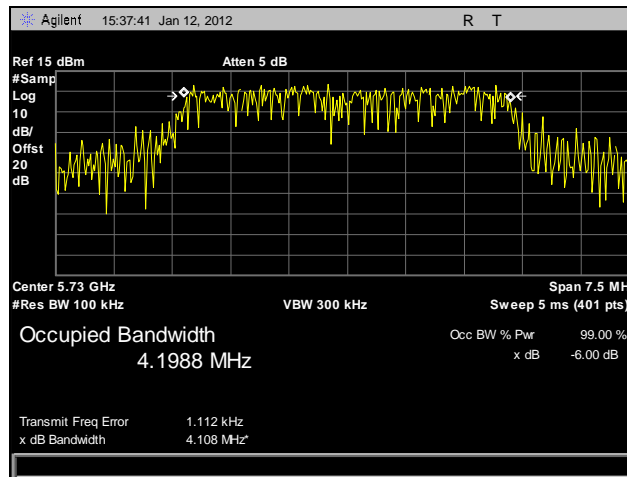


Plot 18. 6 dB Occupied Bandwidth, Mid Channel, HT40

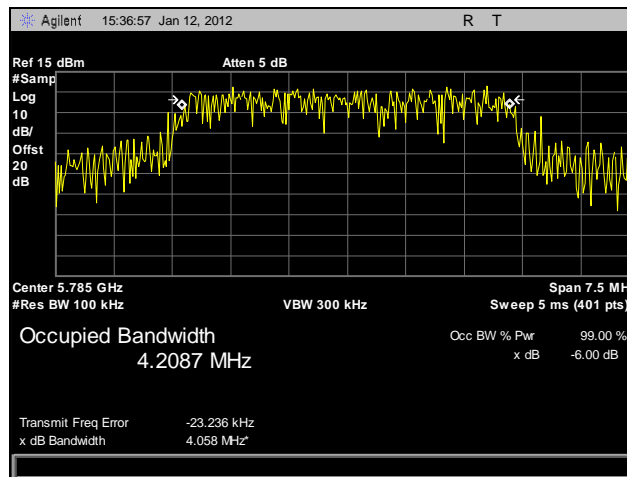


Plot 19. 6 dB Occupied Bandwidth, High Channel, HT40

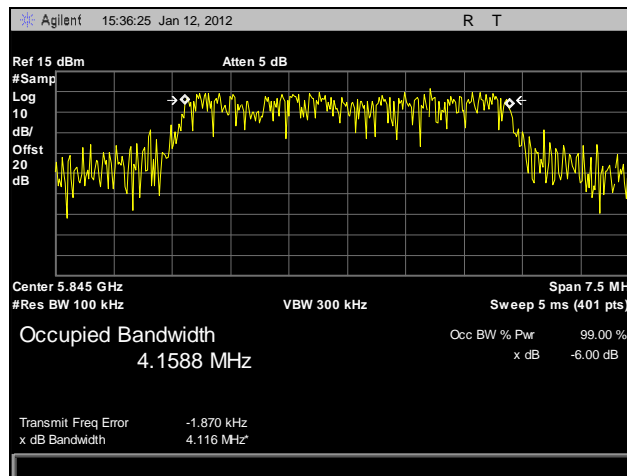
99% Occupied Bandwidth Test Results, HT5



Plot 20. 99% Occupied Bandwidth, Low Channel, HT5

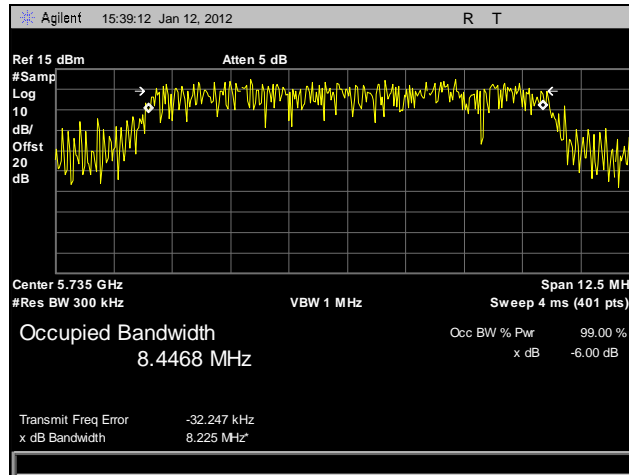


Plot 21. 99% Occupied Bandwidth, Mid Channel, HT5

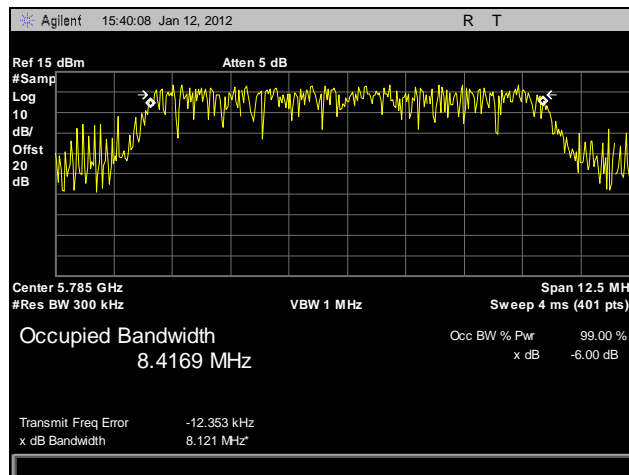


Plot 22. 99% Occupied Bandwidth, High Channel, HT5

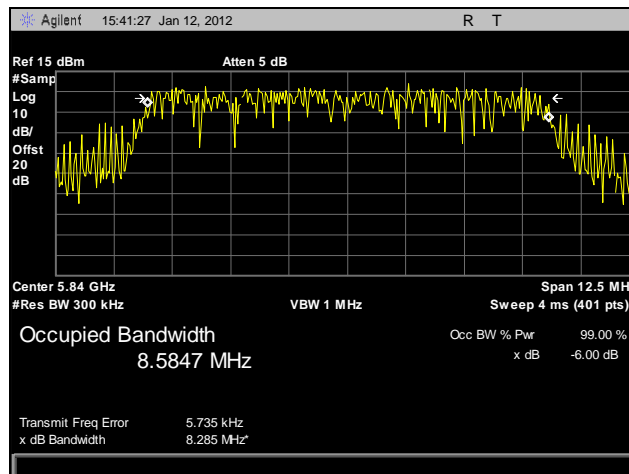
99% Occupied Bandwidth Test Results, HT10



Plot 23. 99% Occupied Bandwidth, Low Channel, HT10

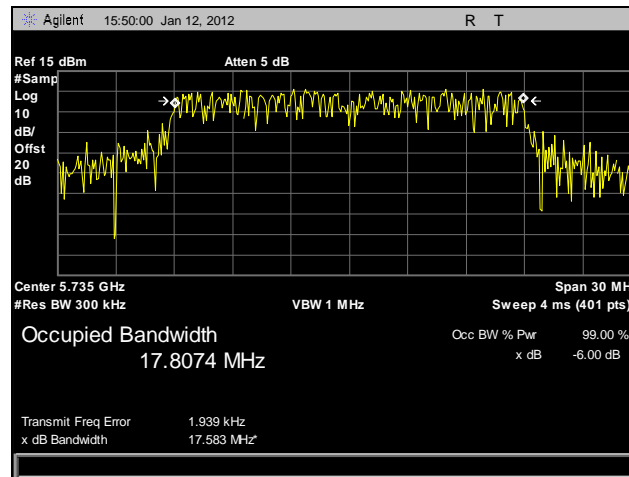


Plot 24. 99% Occupied Bandwidth, Mid Channel, HT10

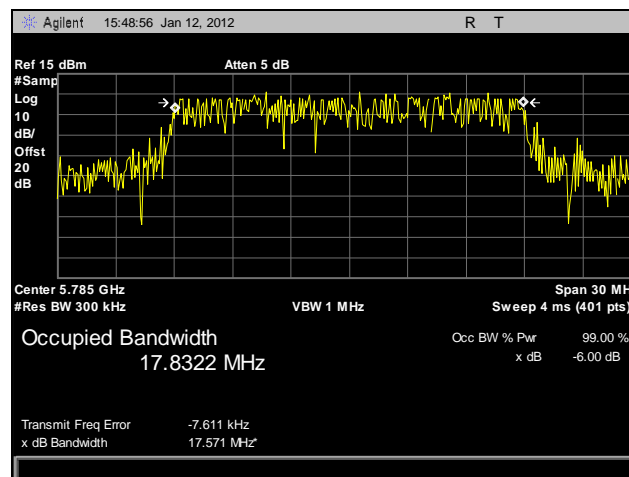


Plot 25. 99% Occupied Bandwidth, High Channel, HT10

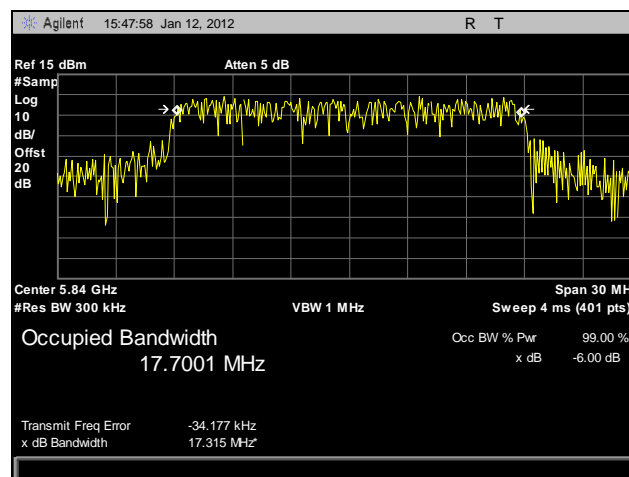
99% Occupied Bandwidth Test Results, HT20



Plot 26. 99% Occupied Bandwidth, Low Channel, HT20

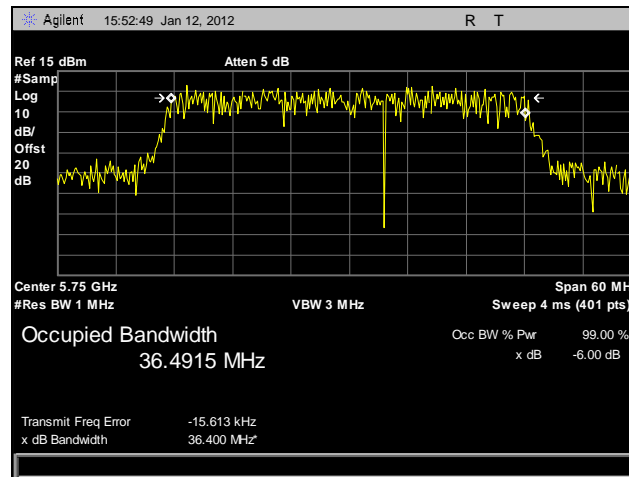


Plot 27. 99% Occupied Bandwidth, Mid Channel, HT20

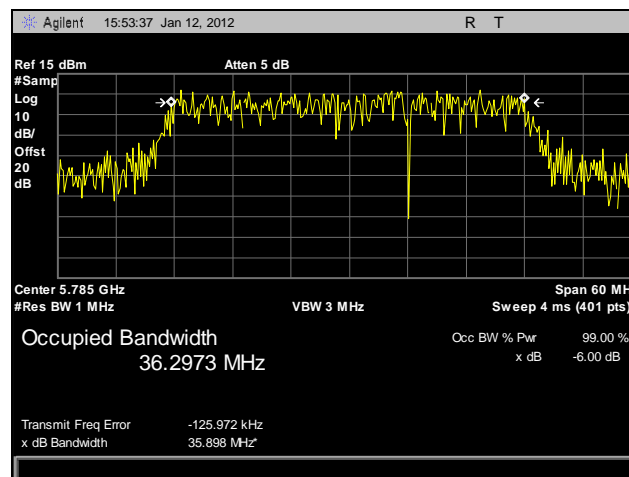


Plot 28. 99% Occupied Bandwidth, High Channel, HT20

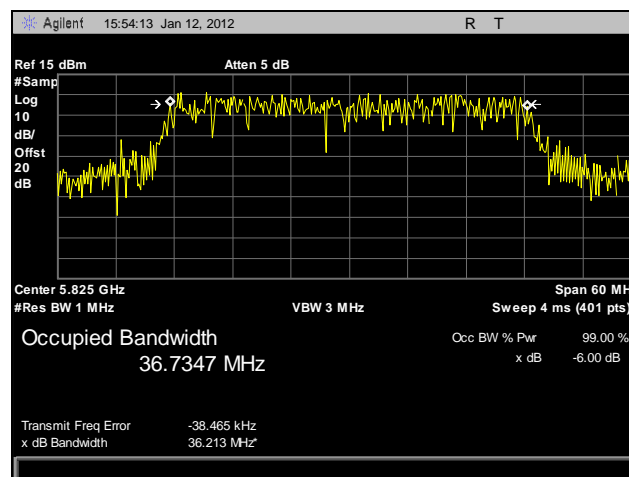
99% Occupied Bandwidth Test Results, HT40



Plot 29. 99% Occupied Bandwidth, Low Channel, HT40



Plot 30. 99% Occupied Bandwidth, Mid Channel, HT40



Plot 31. 99% Occupied Bandwidth, High Channel, HT40

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 19. 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 19, 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): Anderson Soungpanya

Test Date(s): 01/12/12

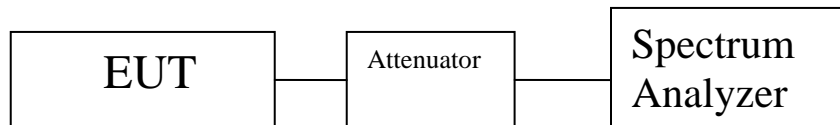


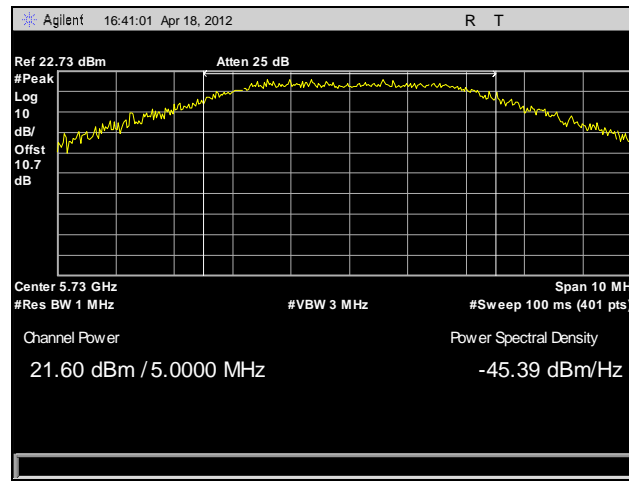
Figure 3. Peak Power Output Test Setup

Peak Power Output Test Results

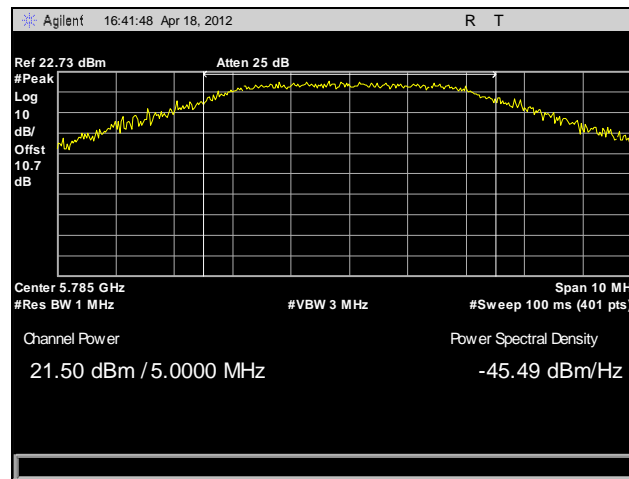
Peak Conducted Output Power			
	Carrier Channel	Frequency (MHz)	Measured Peak Output Power dBm
HT5	Low	5730	21.60
	Mid	5785	21.50
	High	5845	21.29
HT10	Low	5735	21.38
	Mid	5785	21.79
	High	5840	21.45
HT20	Low	5735	22.26
	Mid	5785	21.20
	High	5840	21.26
HT40	Low	5750	20.71
	Mid	5785	21.01
	High	5825	21.15

Table 20. Peak Power Output, Test Results

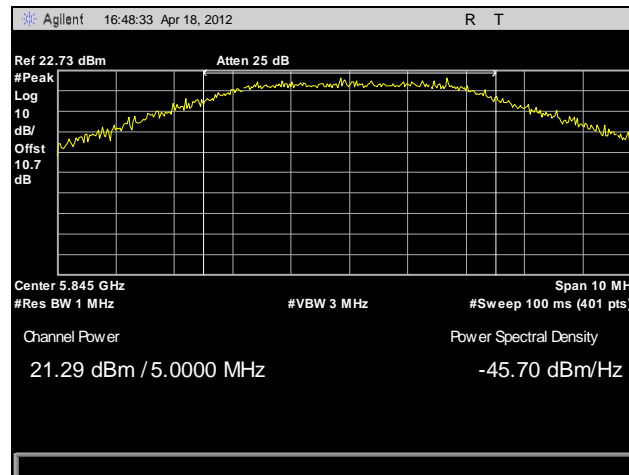
Peak Power Output Test Results, HT5



Plot 32. Peak Power Output, Low Channel, HT5

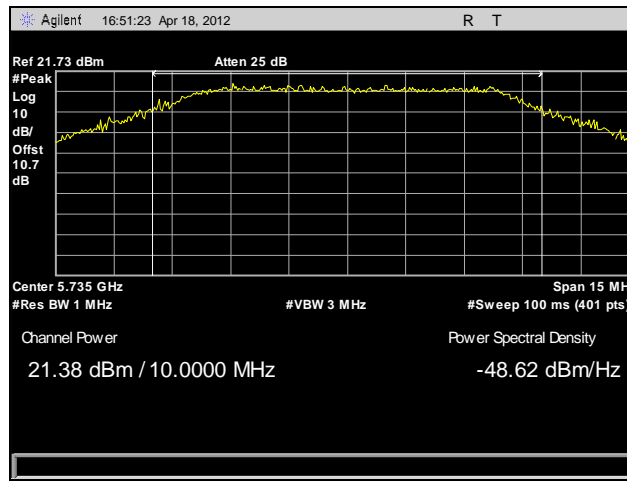


Plot 33. Peak Power Output, Mid Channel, HT5

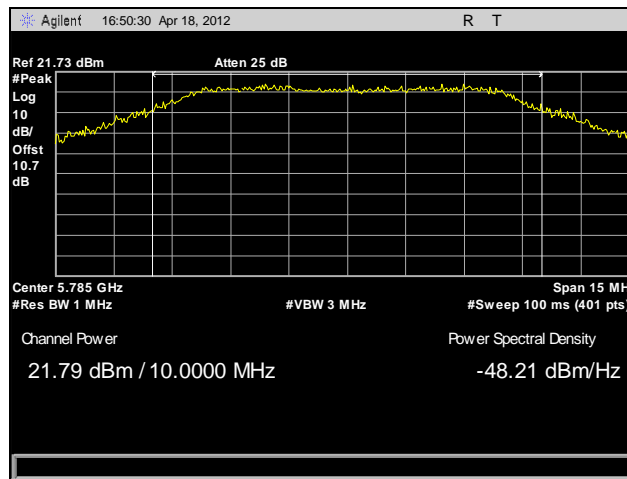


Plot 34. Peak Power Output, High Channel, HT5

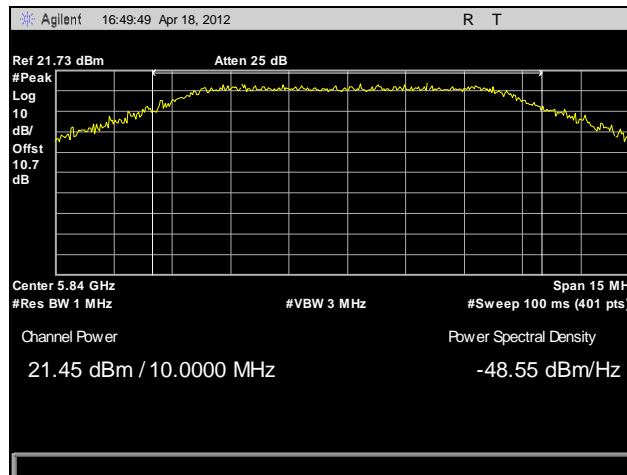
Peak Power Output Test Results, HT10



Plot 35. Peak Power Output, Low Channel, HT10

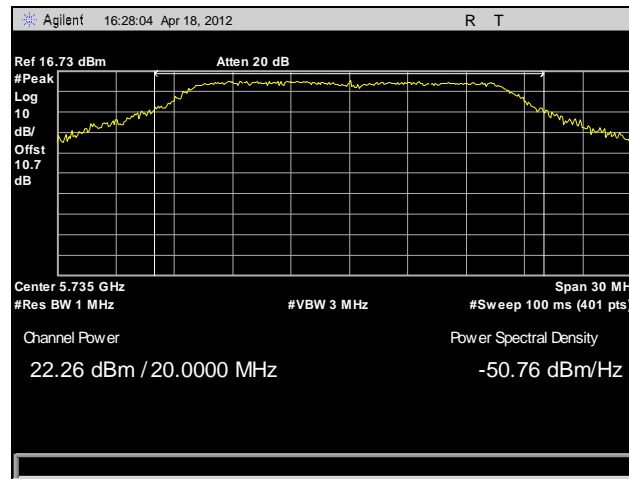


Plot 36. Peak Power Output, Mid Channel, HT10

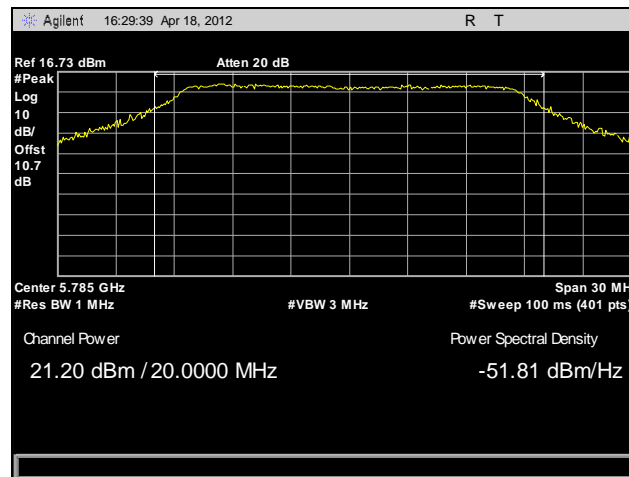


Plot 37. Peak Power Output, High Channel, HT10

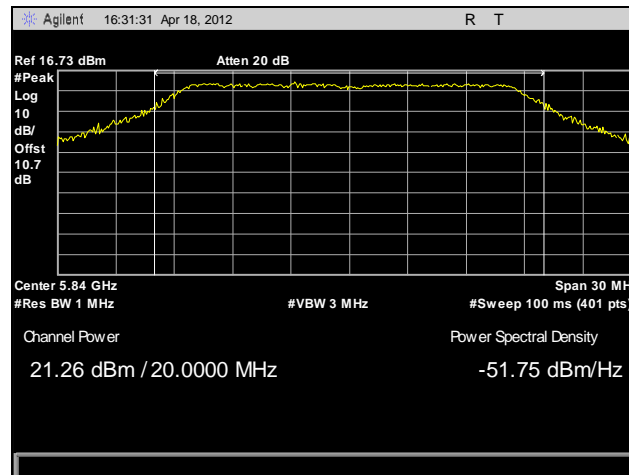
Peak Power Output Test Results, HT20



Plot 38. Peak Power Output, Low Channel, HT20

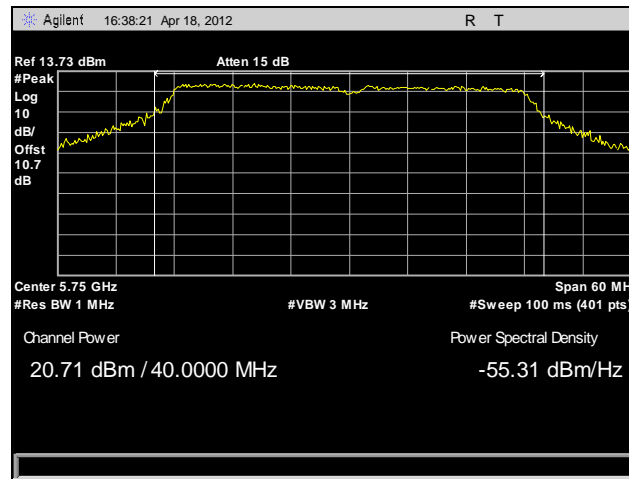


Plot 39. Peak Power Output, Mid Channel, HT20

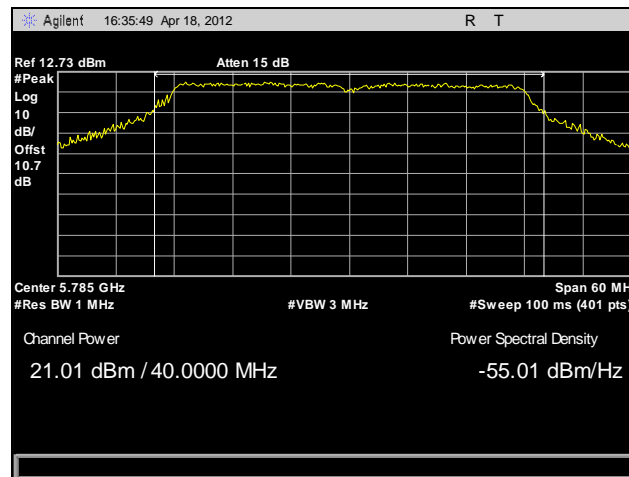


Plot 40. Peak Power Output, High Channel, HT20

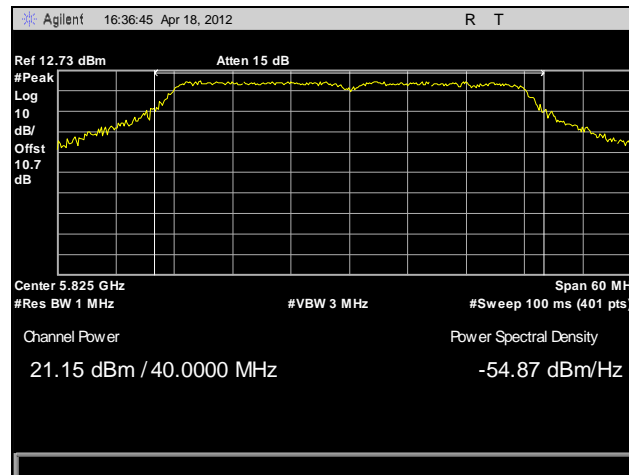
Peak Power Output Test Results, HT40



Plot 41. Peak Power Output, Low Channel, HT40



Plot 42. Peak Power Output, Mid Channel, HT40



Plot 43. Peak Power Output, High Channel, HT40

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 21. 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 22.

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

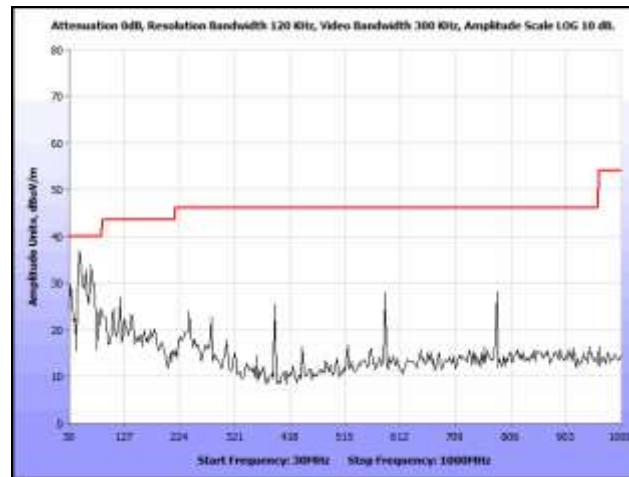
Test Procedures: The transmitter was turned on. Measurements were performed of the low, mid and high Channels. The EUT was rotated orthogonally through all three axes. Plots shown are corrected for antenna correction factor, preamplifier, cable loss and distance and compared to a 3 m limit line. Only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

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

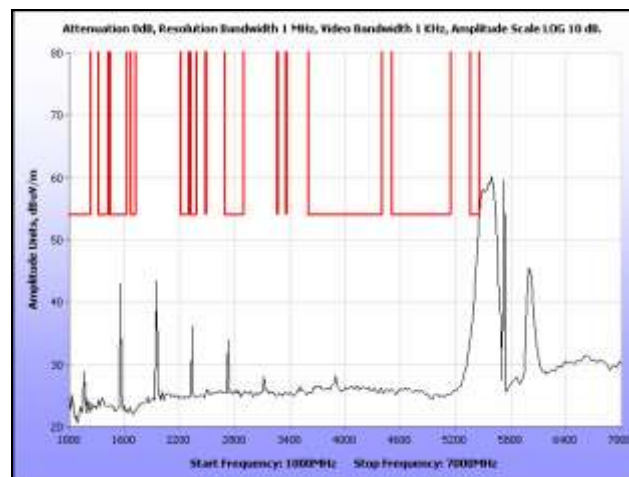
Test Engineer(s): Lionel Gabrillo

Test Date(s): 04/30/12

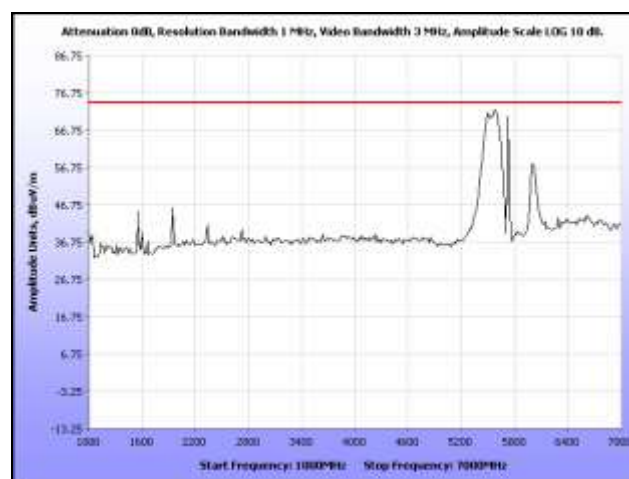
Radiated Spurious Emissions Test Results, HT5



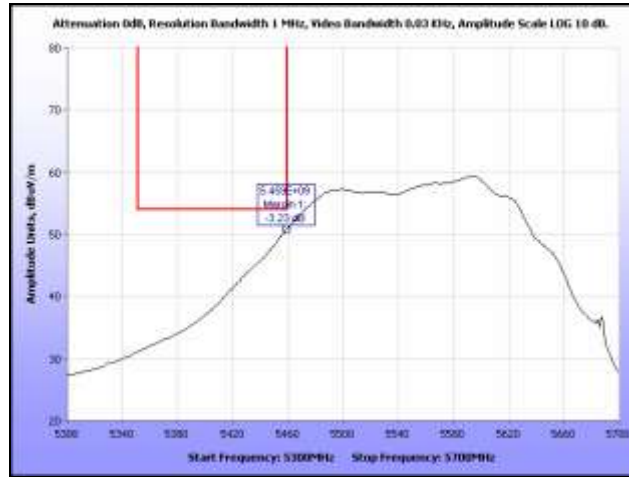
Plot 44. Radiated Spurious Emissions, Low Channel, 30 MHz – 1 GHz, HT5



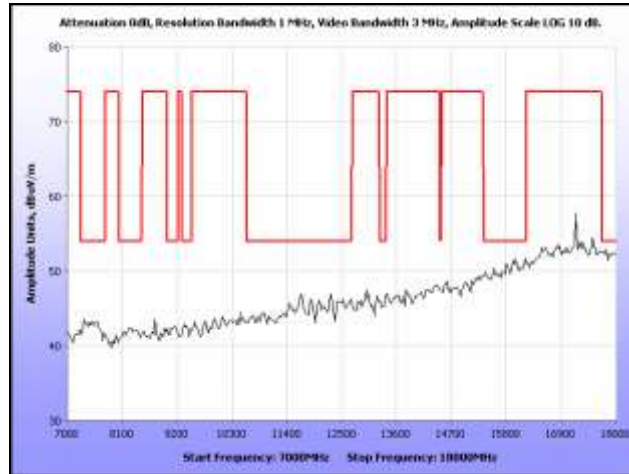
Plot 45. Radiated Spurious Emissions, Low Channel, 1 GHz – 7 GHz, Average, HT5



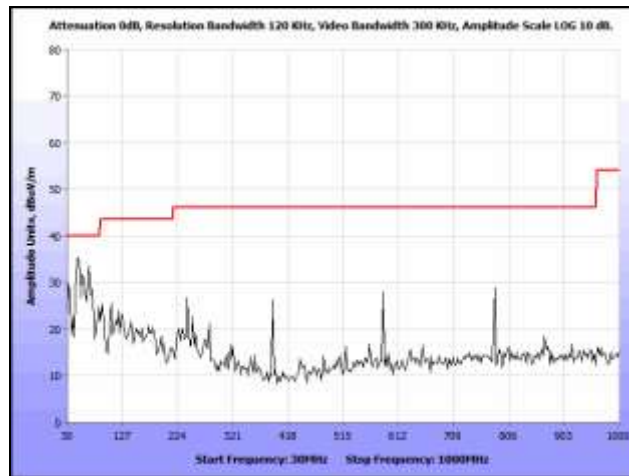
Plot 46. Radiated Spurious Emissions, Low Channel, 1 GHz – 7 GHz, Peak, HT5



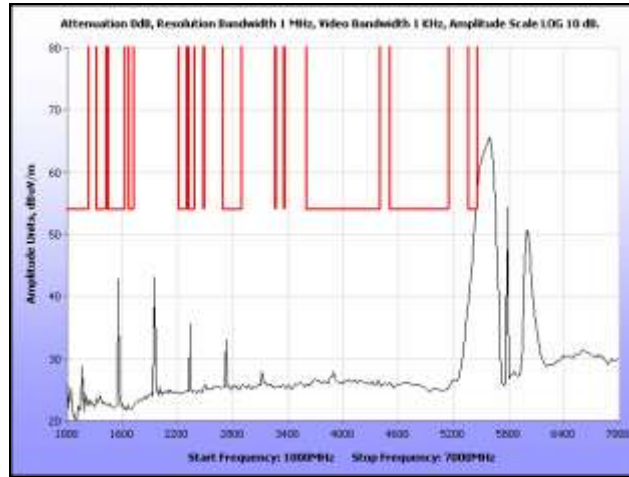
Plot 47. Radiated Spurious Emissions, Low Channel, 5.3 GHz – 5.7 GHz, Average, HT5



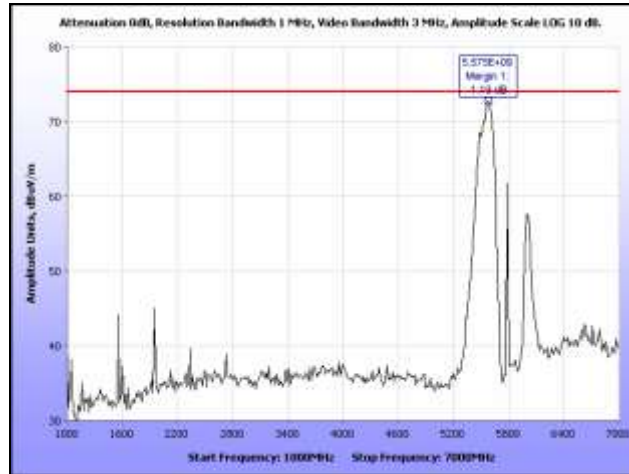
Plot 48. Radiated Spurious Emissions, Low Channel, 7 GHz – 18 GHz, HT5



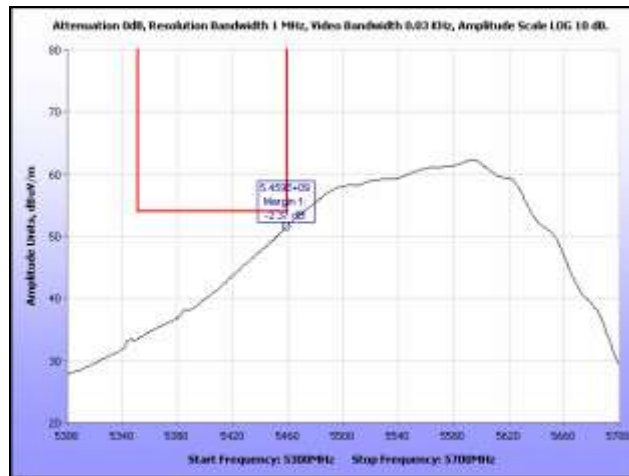
Plot 49. Radiated Spurious Emissions, Mid Channel, 30 MHz – 1 GHz, HT5



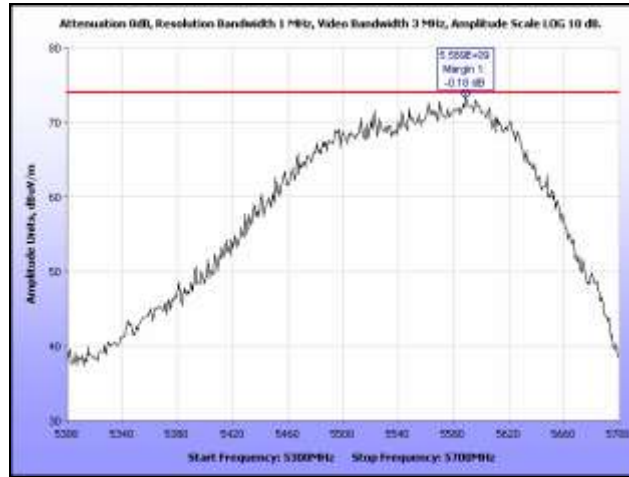
Plot 50. Radiated Spurious Emissions, Mid Channel, 1 GHz – 7 GHz, Average, HT5



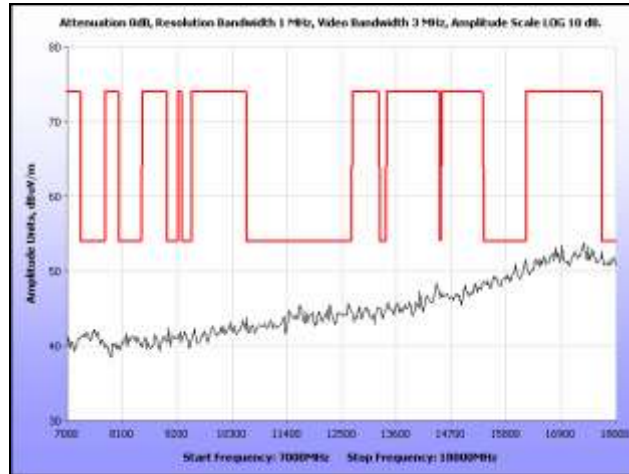
Plot 51. Radiated Spurious Emissions, Mid Channel, 1 GHz – 7 GHz, Peak, HT5



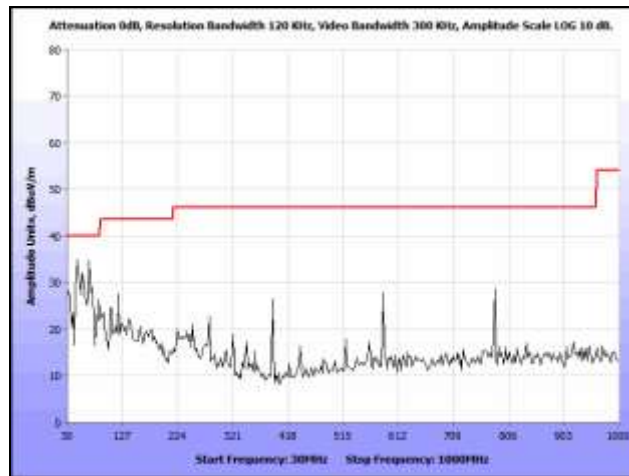
Plot 52. Radiated Spurious Emissions, Mid Channel, 5.3 GHz – 5.7 GHz, Average, HT5



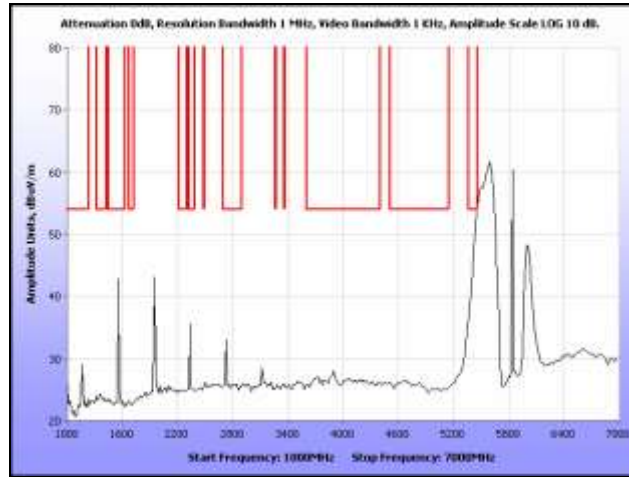
Plot 53. Radiated Spurious Emissions, Mid Channel, 5.3 GHz – 5.7 GHz, Peak, HT5



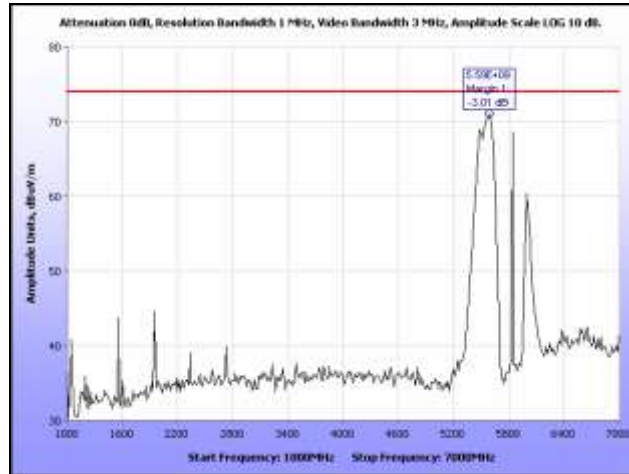
Plot 54. Radiated Spurious Emissions, Mid Channel, 7 GHz – 18 GHz, HT5



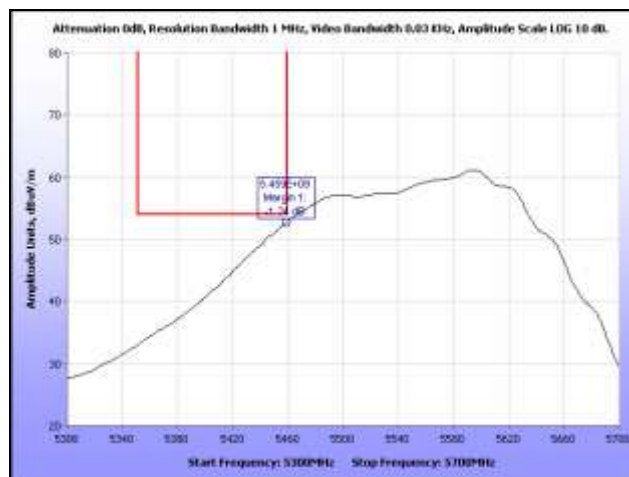
Plot 55. Radiated Spurious Emissions, High Channel, 30 MHz – 1 GHz, HT5



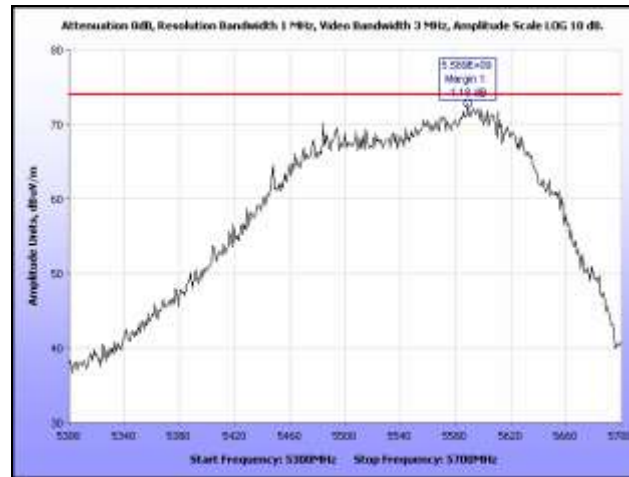
Plot 56. Radiated Spurious Emissions, High Channel, 1 GHz – 7 GHz, Average, HT5



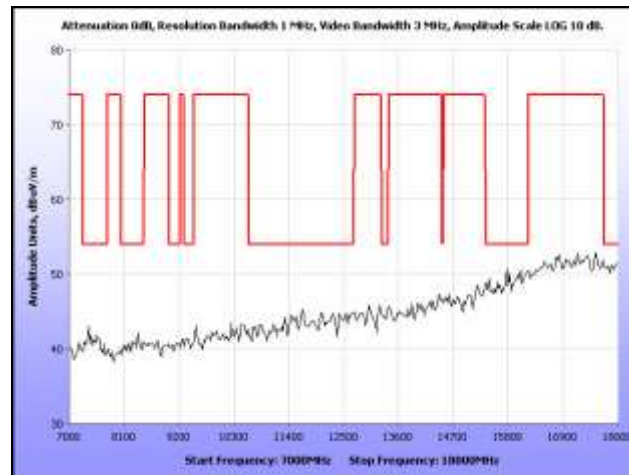
Plot 57. Radiated Spurious Emissions, High Channel, 1 GHz – 7 GHz, Peak, HT5



Plot 58. Radiated Spurious Emissions, High Channel, 5.3 GHz – 5.7 GHz, Average, HT5

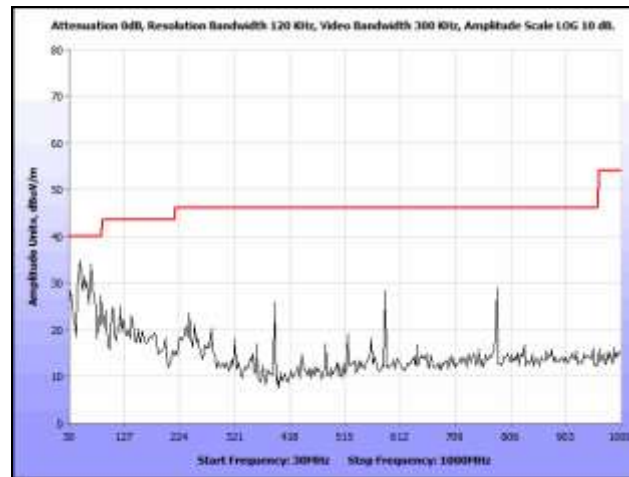


Plot 59. Radiated Spurious Emissions, High Channel, 5.3 GHz – 5.7 GHz, Peak, HT5

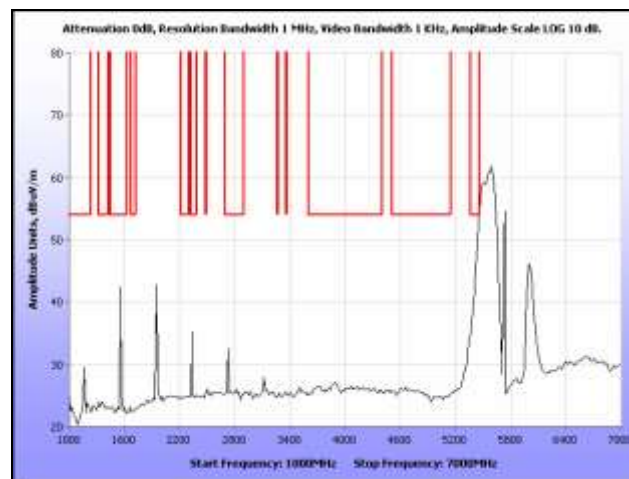


Plot 60. Radiated Spurious Emissions, High Channel, 7 GHz – 18 GHz, HT5

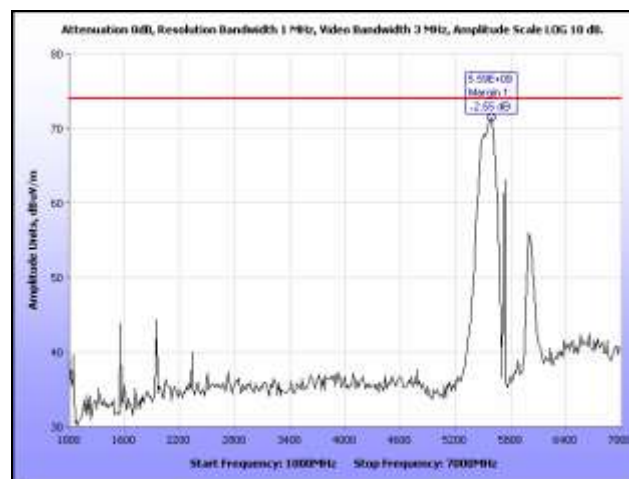
Radiated Spurious Emissions Test Results, HT10



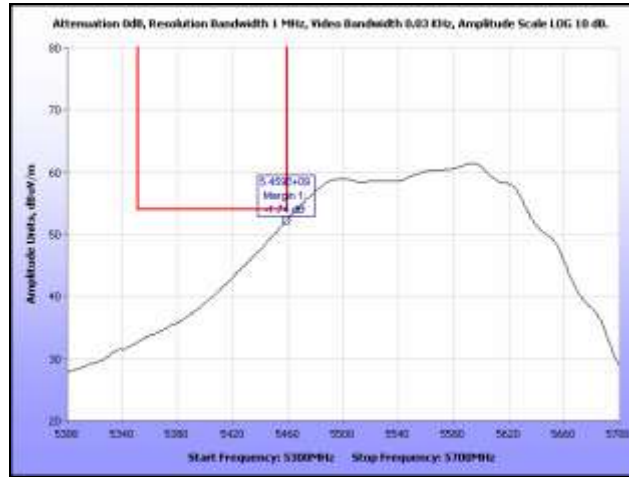
Plot 61. Radiated Spurious Emissions, Low Channel, 30 MHz – 1 GHz, HT10



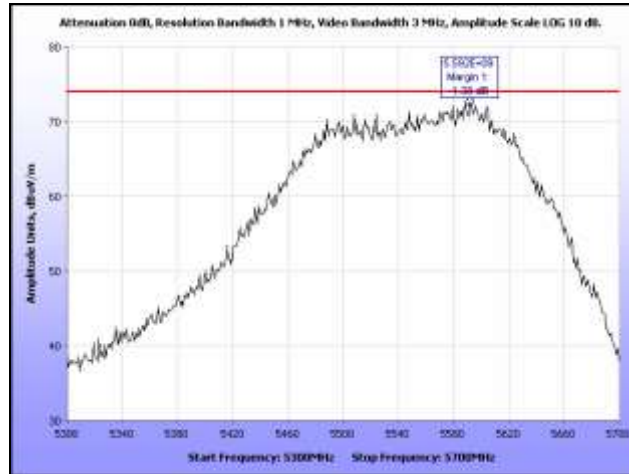
Plot 62. Radiated Spurious Emissions, Low Channel, 1 GHz – 7 GHz, Average, HT10



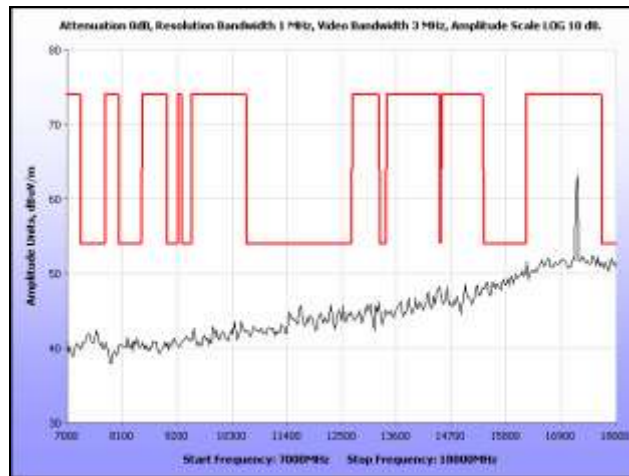
Plot 63. Radiated Spurious Emissions, Low Channel, 1 GHz – 7 GHz, Peak, HT10



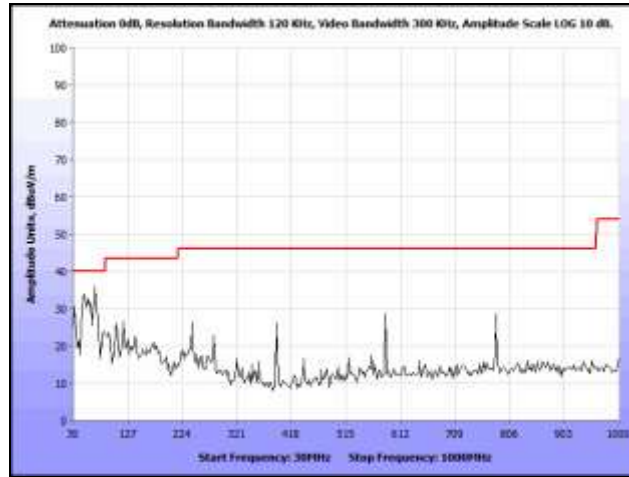
Plot 64. Radiated Spurious Emissions, Low Channel, 5.3 GHz – 5.7 GHz, Average, HT10



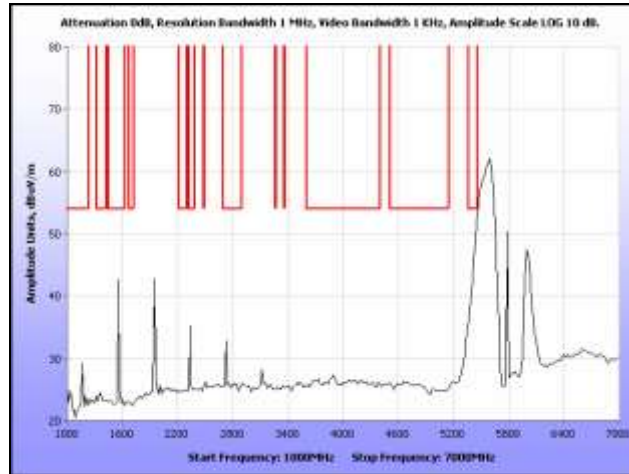
Plot 65. Radiated Spurious Emissions, Low Channel, 5.3 GHz – 5.7 GHz, Peak, HT10



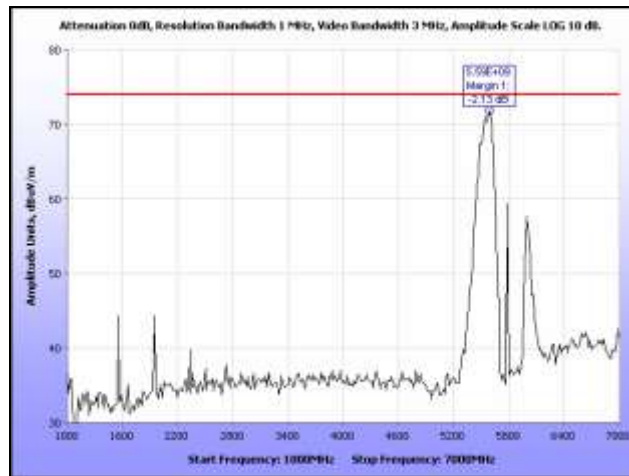
Plot 66. Radiated Spurious Emissions, Low Channel, 7 GHz – 18 GHz, HT10



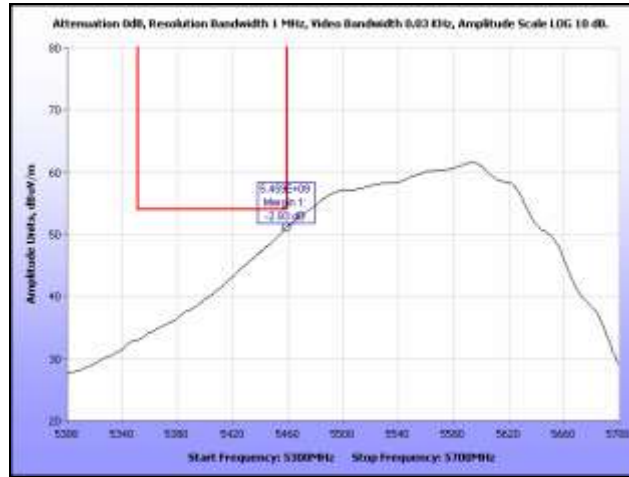
Plot 67. Radiated Spurious Emissions, Mid Channel, 30 MHz – 1 GHz, HT10



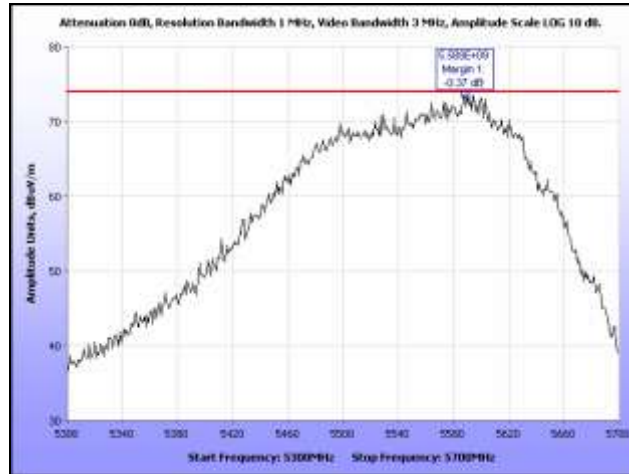
Plot 68. Radiated Spurious Emissions, Mid Channel, 1 GHz – 7 GHz, Average, HT10



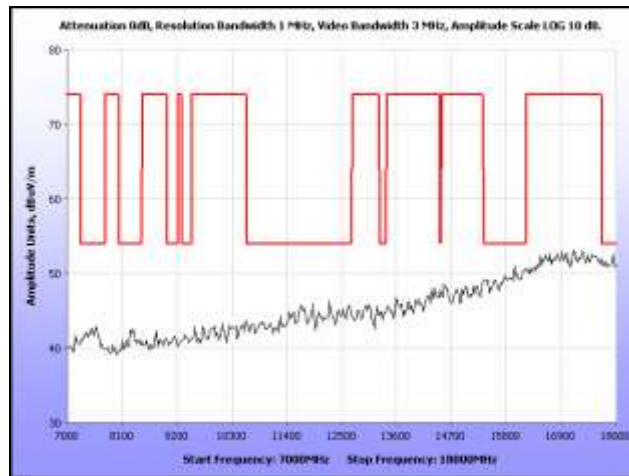
Plot 69. Radiated Spurious Emissions, Mid Channel, 1 GHz – 7 GHz, Peak, HT10



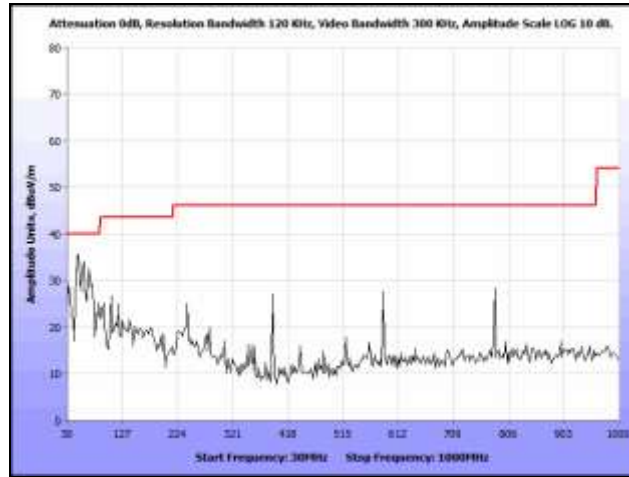
Plot 70. Radiated Spurious Emissions, Mid Channel, 5.3 GHz – 5.7 GHz, Average, HT10



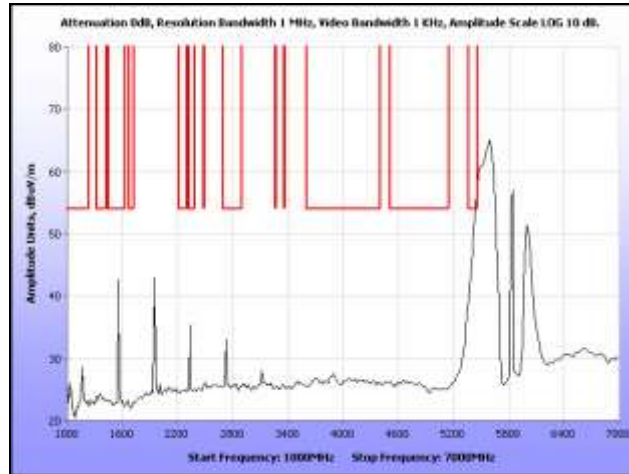
Plot 71. Radiated Spurious Emissions, Mid Channel, 5.3 GHz – 5.7 GHz, Peak, HT10



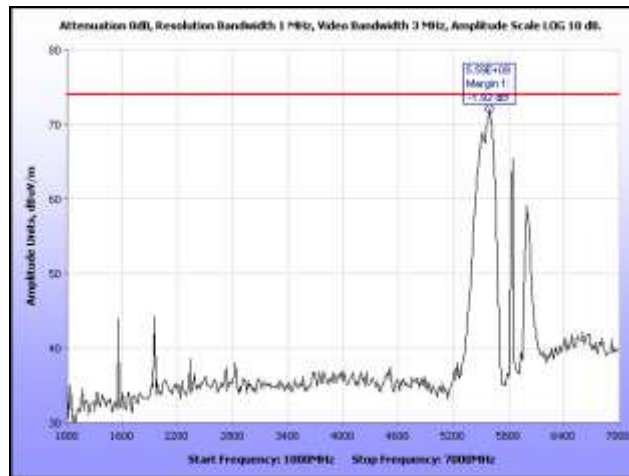
Plot 72. Radiated Spurious Emissions, Mid Channel, 7 GHz – 18 GHz, HT10



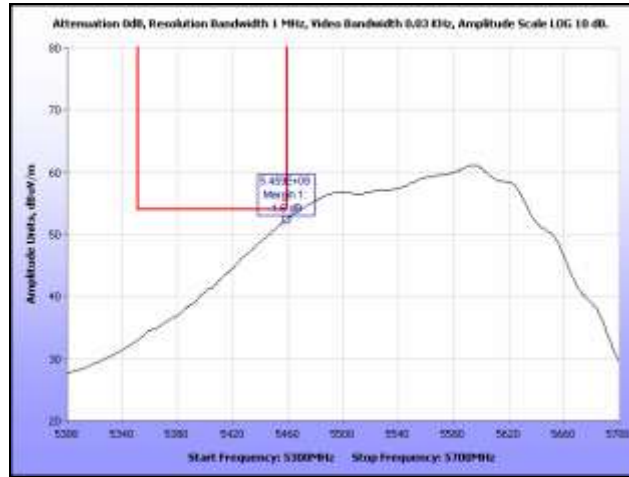
Plot 73. Radiated Spurious Emissions, High Channel, 30 MHz – 1 GHz, HT10



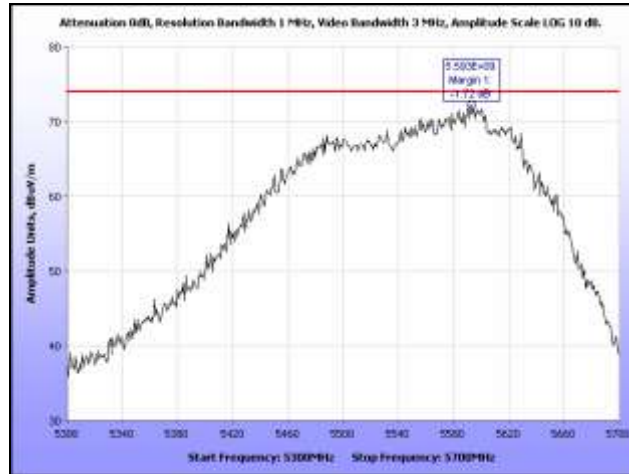
Plot 74. Radiated Spurious Emissions, High Channel, 1 GHz – 7 GHz, Average, HT10



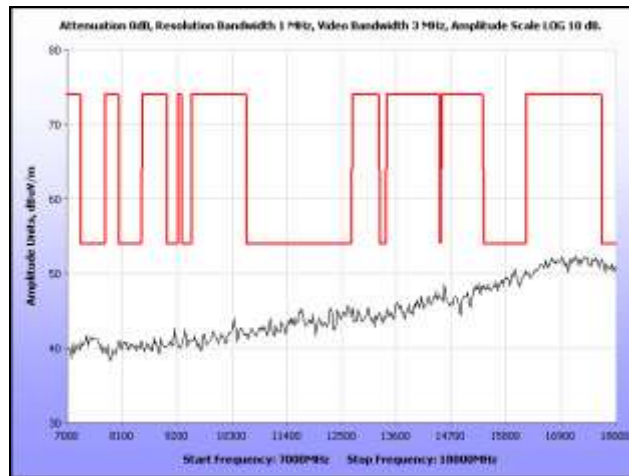
Plot 75. Radiated Spurious Emissions, High Channel, 1 GHz – 7 GHz, Peak, HT10



Plot 76. Radiated Spurious Emissions, High Channel, 5.3 GHz – 5.7 GHz, Average, HT10

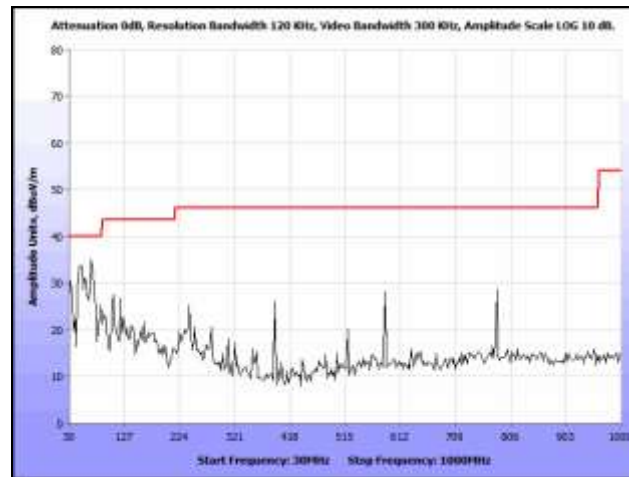


Plot 77. Radiated Spurious Emissions, High Channel, 5.3 GHz – 5.7 GHz, Peak, HT10

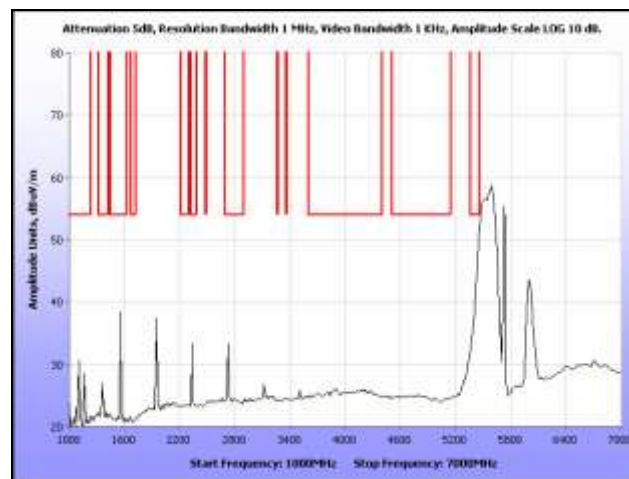


Plot 78. Radiated Spurious Emissions, High Channel, 7 GHz – 18 GHz, HT10

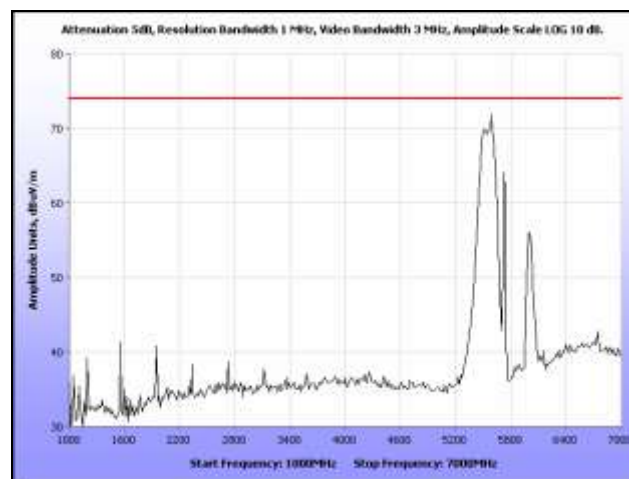
Radiated Spurious Emissions Test Results, HT20



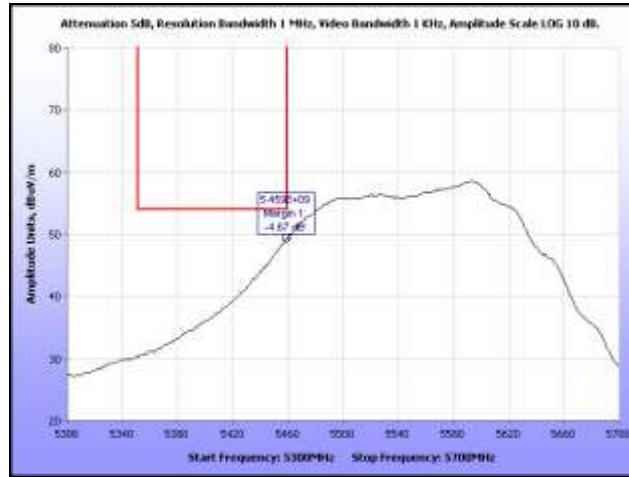
Plot 79. Radiated Spurious Emissions, Low Channel, 30 MHz – 1 GHz, HT20



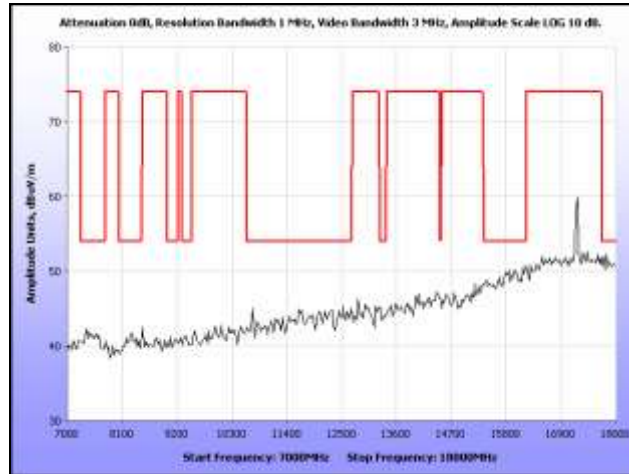
Plot 80. Radiated Spurious Emissions, Low Channel, 1 GHz – 7 GHz, Average, HT20



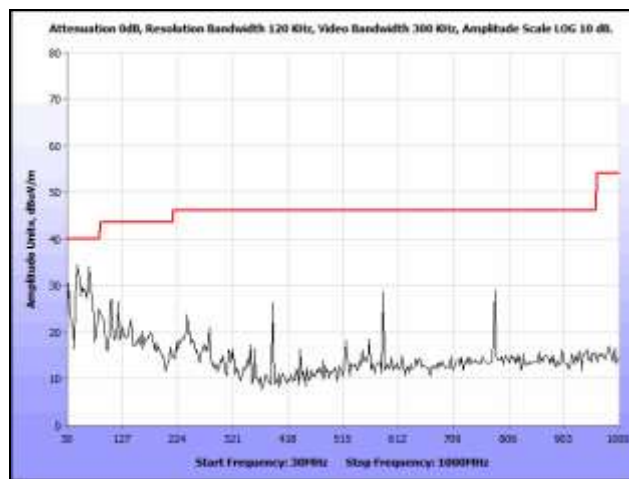
Plot 81. Radiated Spurious Emissions, Low Channel, 1 GHz – 7 GHz, Peak, HT20



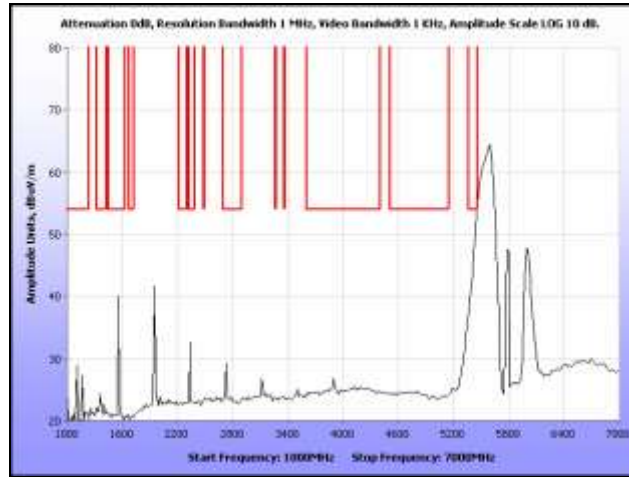
Plot 82. Radiated Spurious Emissions, Low Channel, 5.3 GHz – 5.7 GHz, Average, HT20



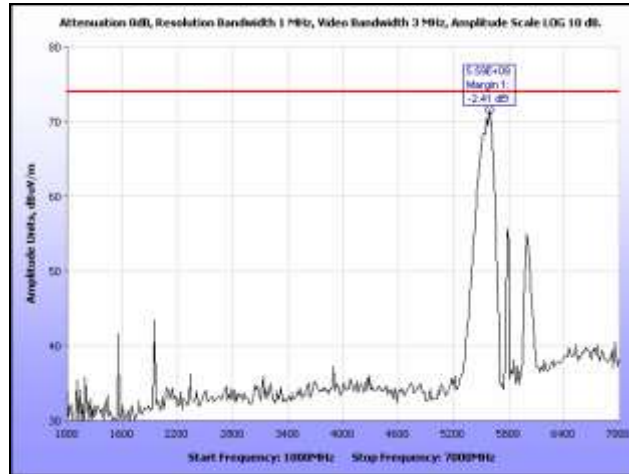
Plot 83. Radiated Spurious Emissions, Low Channel, 7 GHz – 18 GHz, HT20



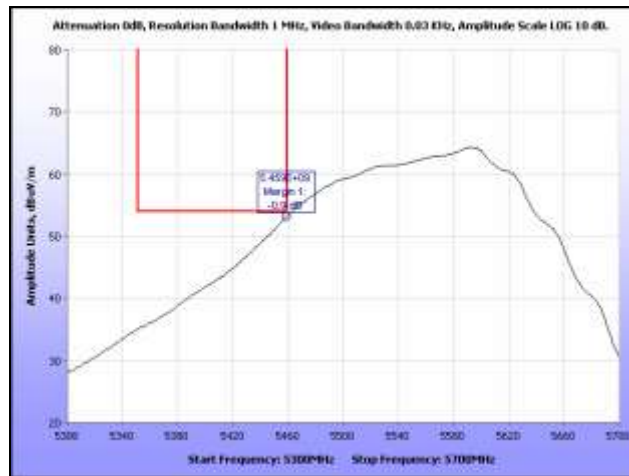
Plot 84. Radiated Spurious Emissions, Mid Channel, 30 MHz – 1 GHz, HT20



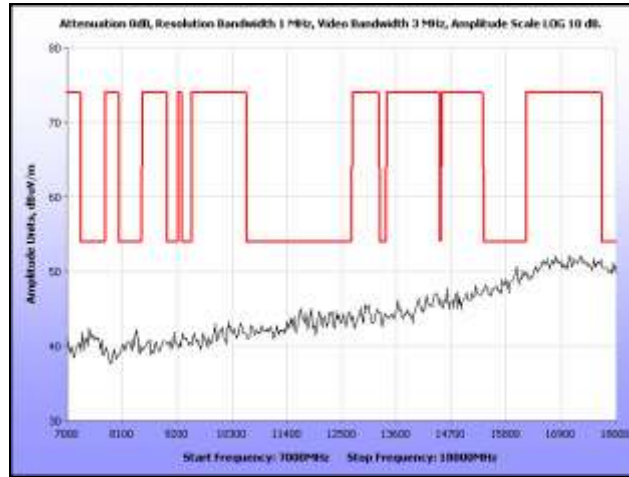
Plot 85. Radiated Spurious Emissions, Mid Channel, 1 GHz – 7 GHz, Average, HT20



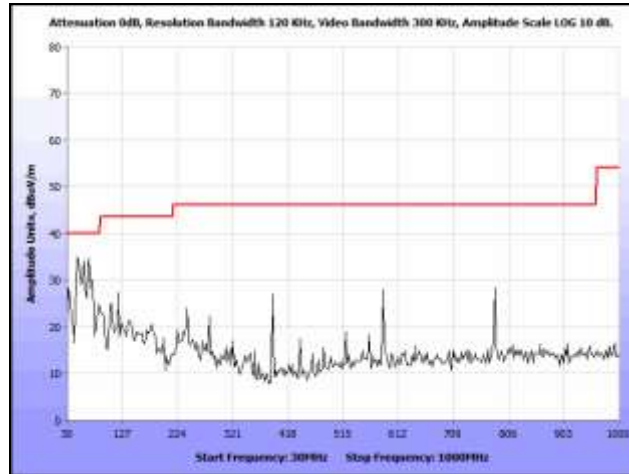
Plot 86. Radiated Spurious Emissions, Mid Channel, 1 GHz – 7 GHz, Peak, HT20



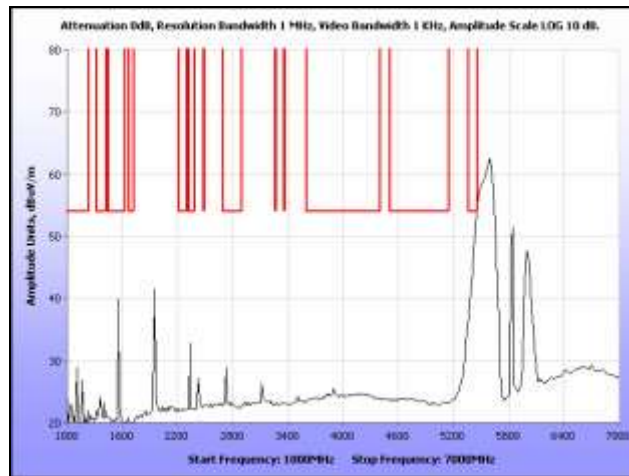
Plot 87. Radiated Spurious Emissions, Mid Channel, 5.3 GHz – 5.7 GHz, Average, HT20



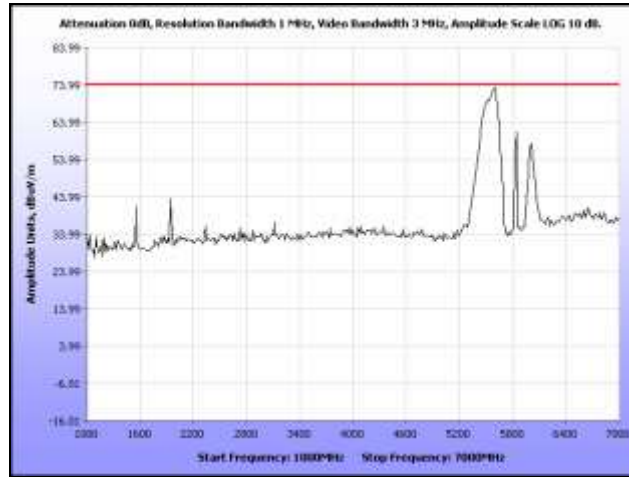
Plot 88. Radiated Spurious Emissions, Mid Channel, 7 GHz – 18 GHz, HT20



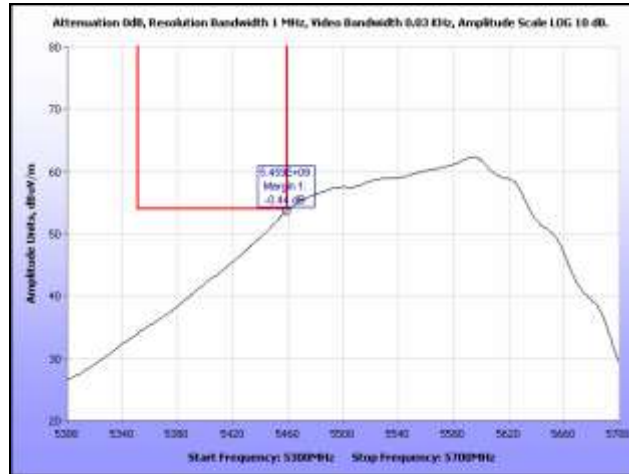
Plot 89. Radiated Spurious Emissions, High Channel, 30 MHz – 1 GHz, HT20



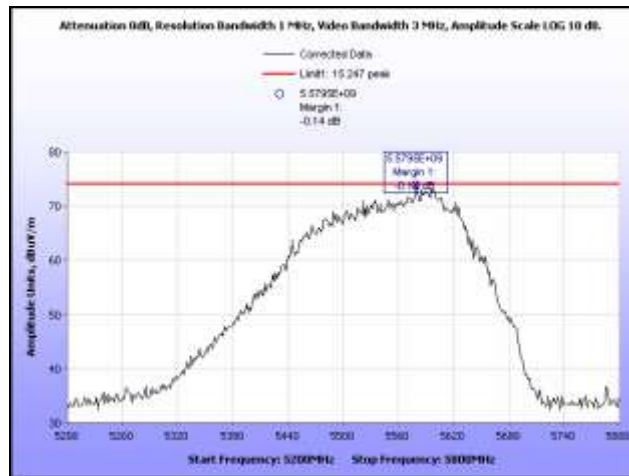
Plot 90. Radiated Spurious Emissions, High Channel, 1 GHz – 7 GHz, Average, HT20



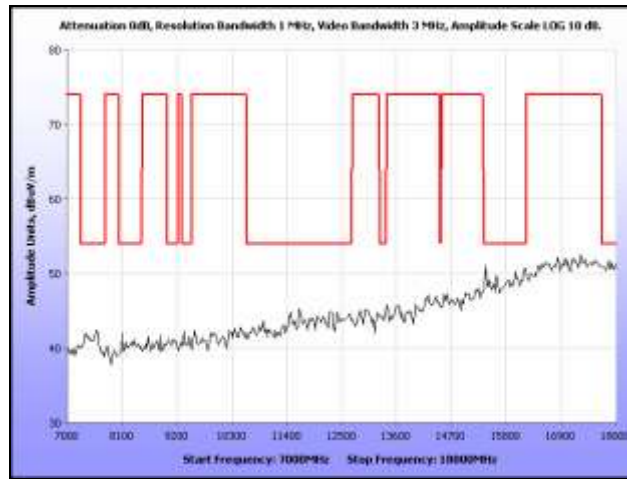
Plot 91. Radiated Spurious Emissions, High Channel, 1 GHz – 7 GHz, Peak, HT20



Plot 92. Radiated Spurious Emissions, High Channel, 5.3 GHz – 5.7 GHz, Average, HT20

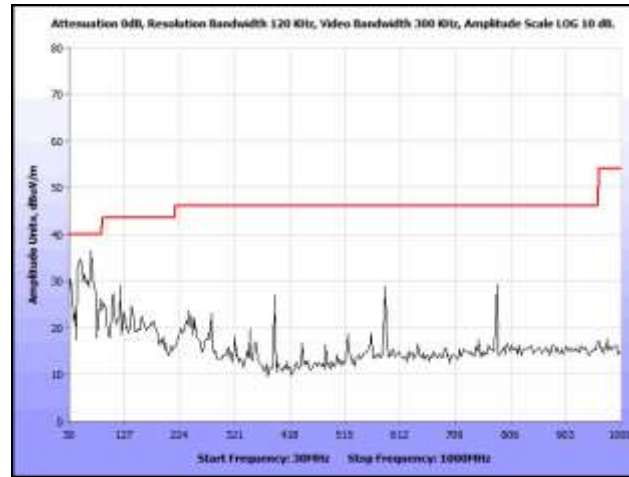


Plot 93. Radiated Spurious Emissions, High Channel, 5.2 GHz – 5.8 GHz, Peak, HT20

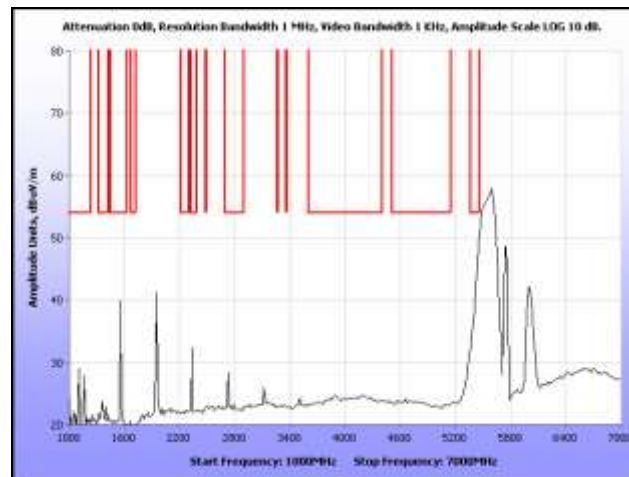


Plot 94. Radiated Spurious Emissions, High Channel, 7 GHz – 18 GHz, HT20

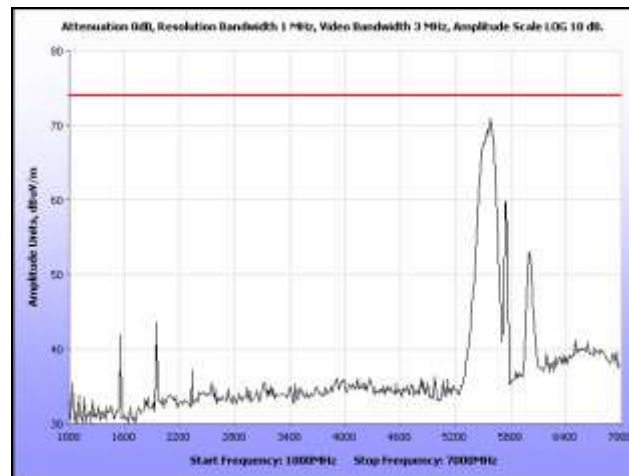
Radiated Spurious Emissions Test Results, HT40



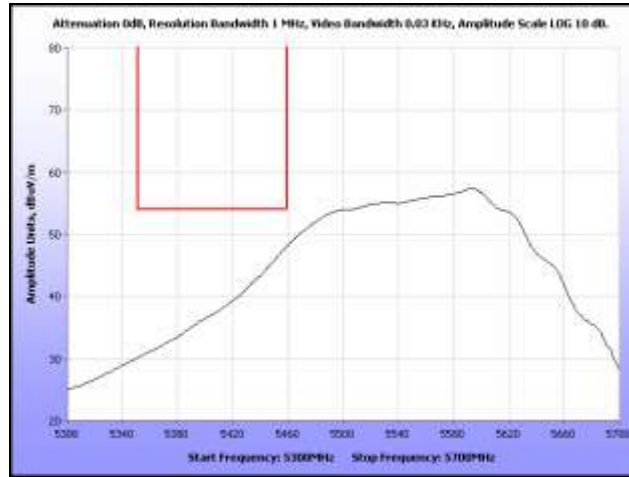
Plot 95. Radiated Spurious Emissions, Low Channel, 30 MHz – 1 GHz, HT40



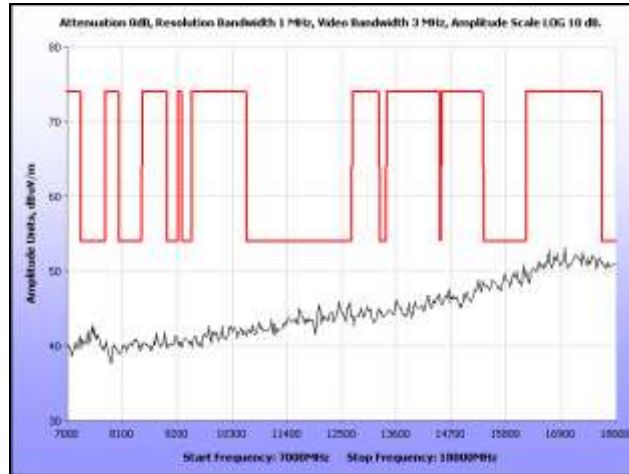
Plot 96. Radiated Spurious Emissions, Low Channel, 1 GHz – 7 GHz, Average, HT40



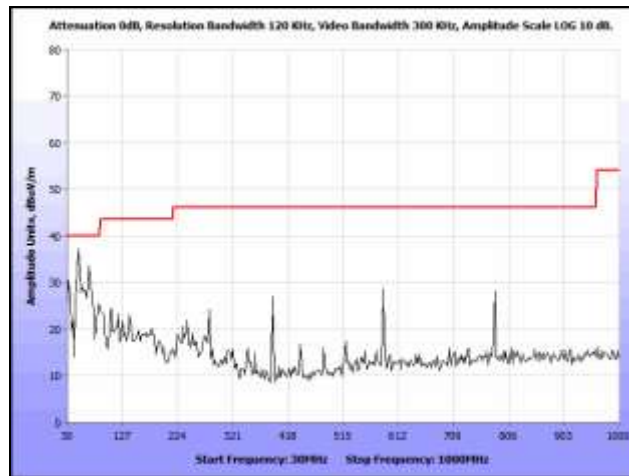
Plot 97. Radiated Spurious Emissions, Low Channel, 1 GHz – 7 GHz, Peak, HT40



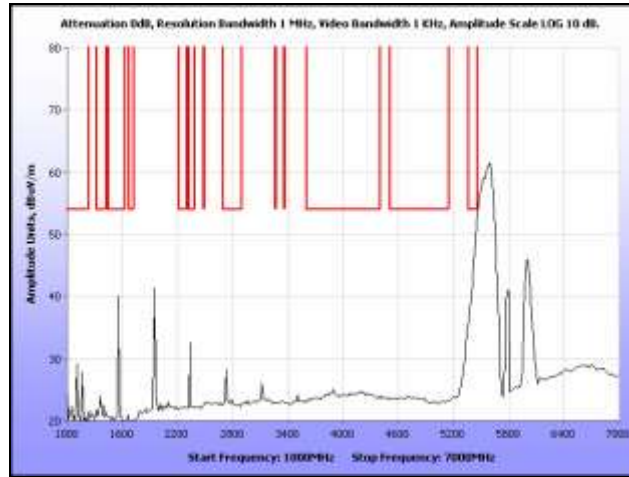
Plot 98. Radiated Spurious Emissions, Low Channel, 5.3 GHz – 5.7 GHz, Average, HT40



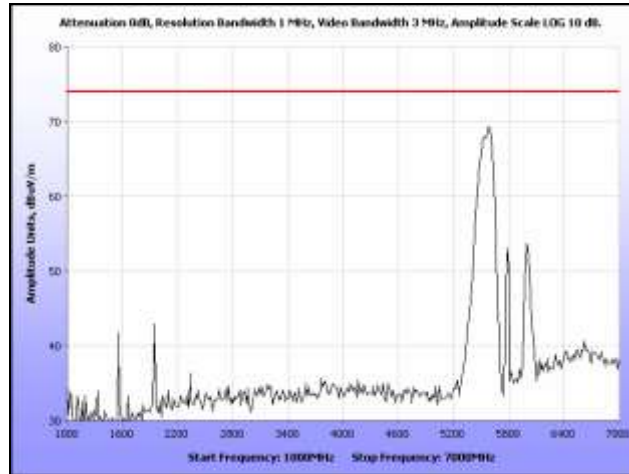
Plot 99. Radiated Spurious Emissions, Low Channel, 7 GHz – 18 GHz, HT40



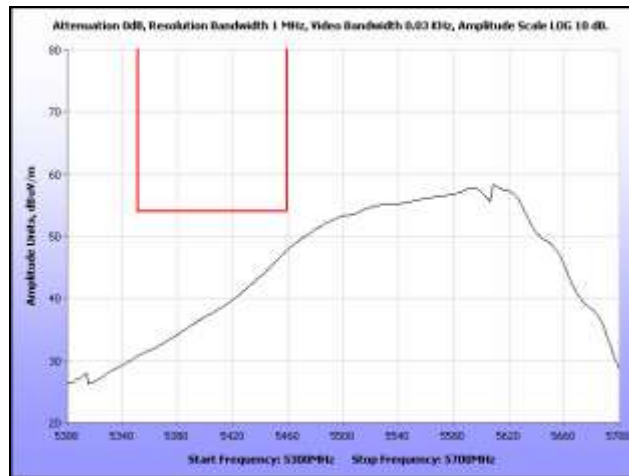
Plot 100. Radiated Spurious Emissions, Mid Channel, 30 MHz – 1 GHz, HT40



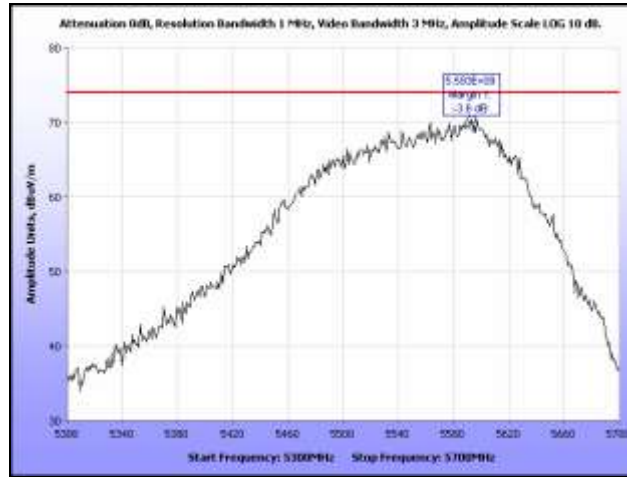
Plot 101. Radiated Spurious Emissions, Mid Channel, 1 GHz – 7 GHz, Average, HT40



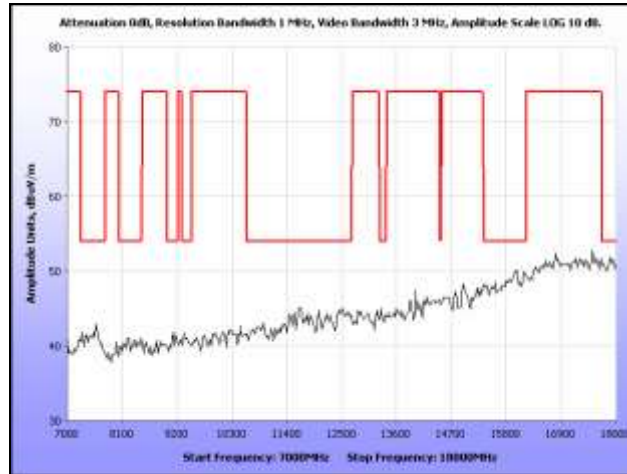
Plot 102. Radiated Spurious Emissions, Mid Channel, 1 GHz – 7 GHz, Peak, HT40



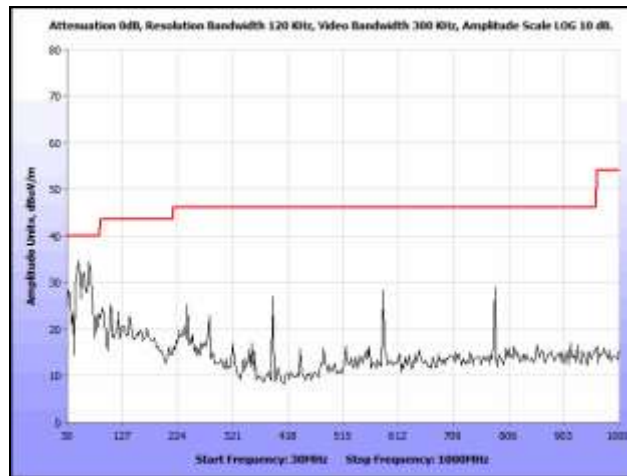
Plot 103. Radiated Spurious Emissions, Mid Channel, 5.3 GHz – 5.7 GHz, Average, HT40



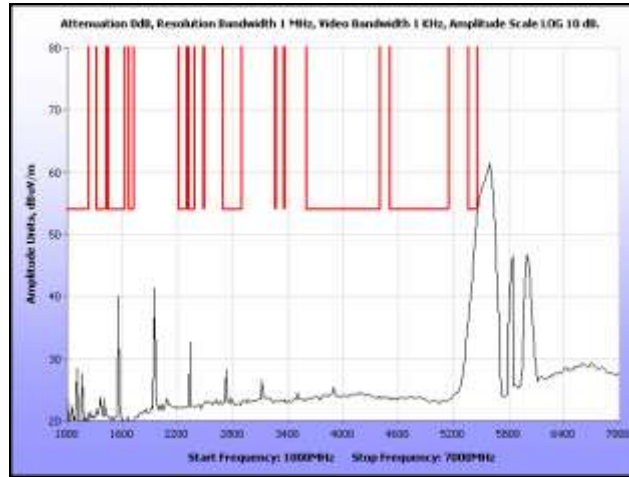
Plot 104. Radiated Spurious Emissions, Mid Channel, 5.3 GHz – 5.7 GHz, Peak, HT40



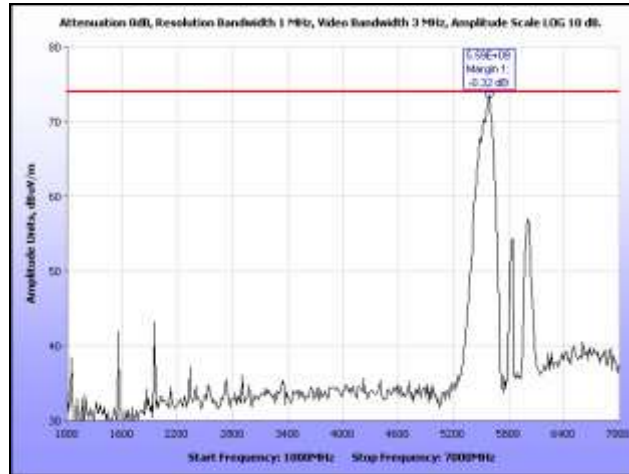
Plot 105. Radiated Spurious Emissions, Mid Channel, 7 GHz – 18 GHz, HT40



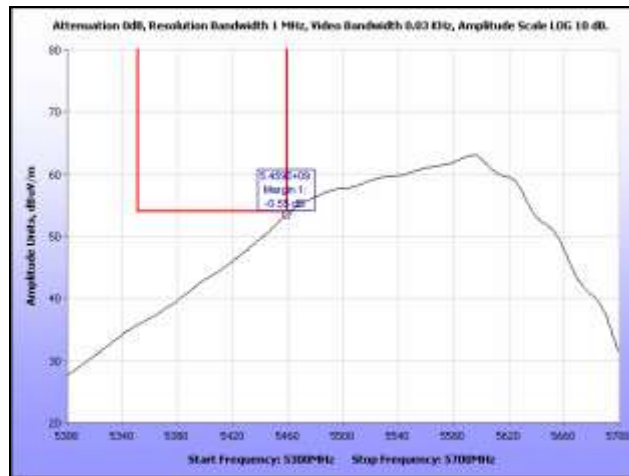
Plot 106. Radiated Spurious Emissions, High Channel, 30 MHz – 1 GHz, HT40



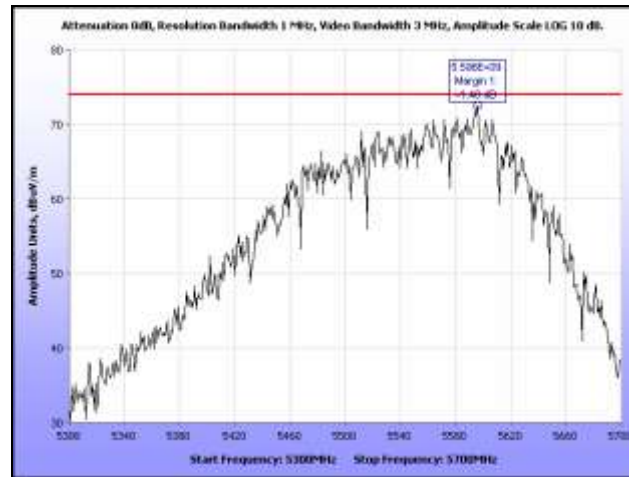
Plot 107. Radiated Spurious Emissions, High Channel, 1 GHz – 7 GHz, Average, HT40



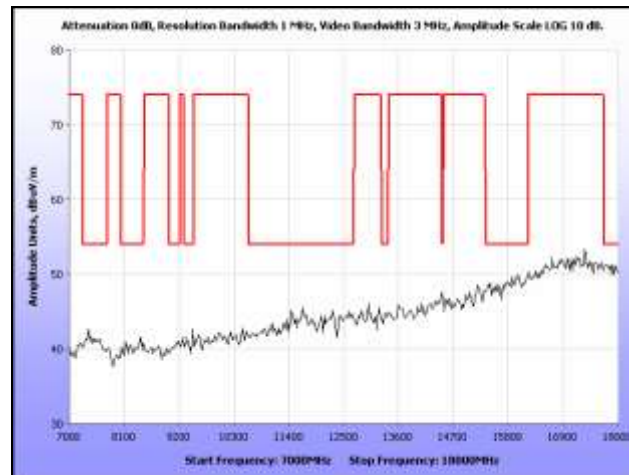
Plot 108. Radiated Spurious Emissions, High Channel, 1 GHz – 7 GHz, Peak, HT40



Plot 109. Radiated Spurious Emissions, High Channel, 5.3 GHz – 5.7 GHz, Average, HT40



Plot 110. Radiated Spurious Emissions, High Channel, 5.3 GHz – 5.7 GHz, Peak, HT40



Plot 111. Radiated Spurious Emissions, High Channel, 7 GHz – 18 GHz, HT40

Radiated Spurious Emissions Test Setup



Photograph 9. Radiated Spurious Emissions, Test Setup, 30 MHz – 1 GHz



Photograph 10. 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.

Since the EUT had an integral antenna, conducted measurements could not be performed. Measurements needed to be taken radiated. An antenna was located 3 m away from the EUT and plots were taken. The EUT was rotated through all three orthogonal axes. The plots were corrected for both antenna correction factor 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 Sounghanya

Test Date(s): 01/12/12

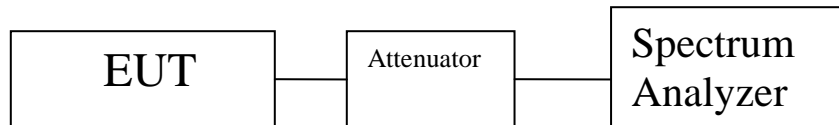
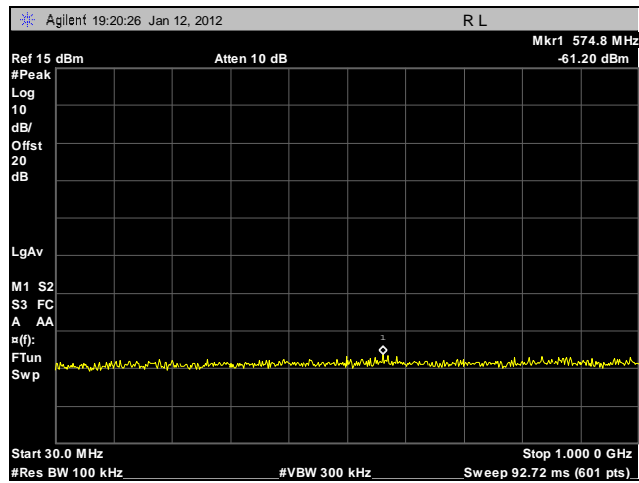
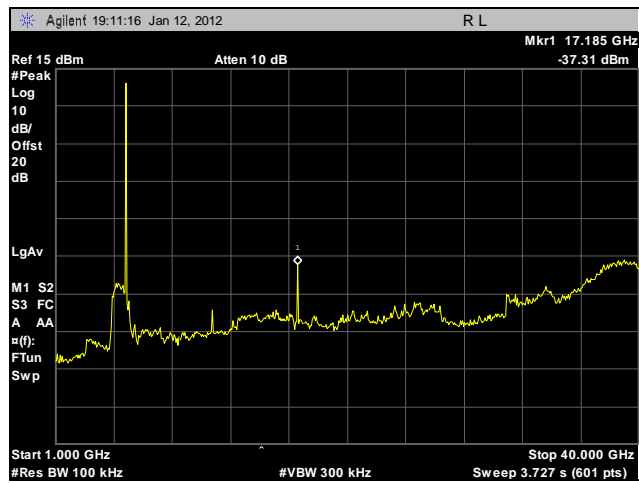


Figure 4. Block Diagram, Conducted Spurious Emissions Test Setup

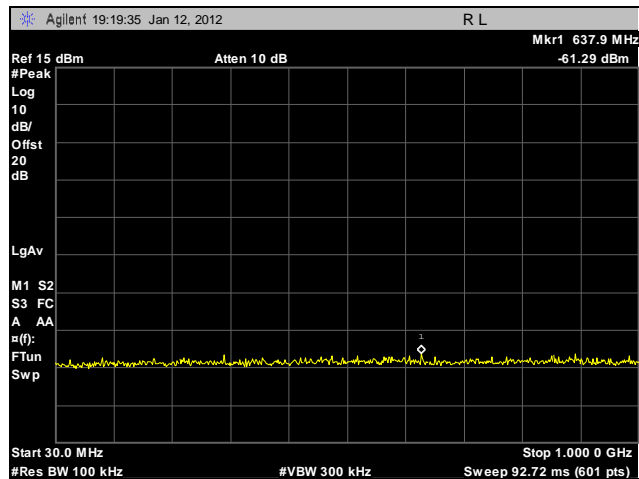
Conducted Spurious Emissions Test Results, HT5



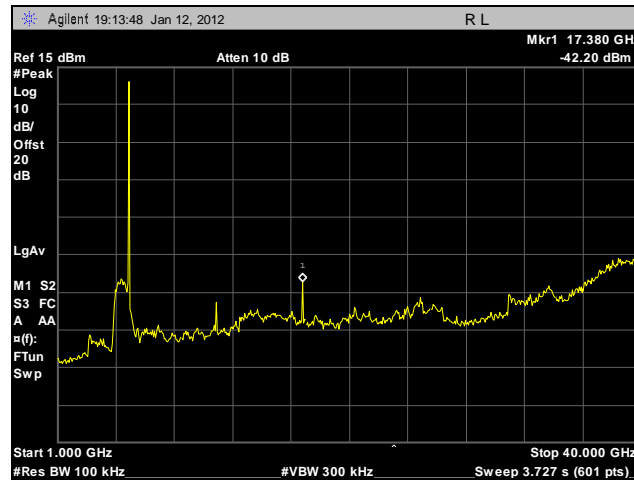
Plot 112. Conducted Spurious Emissions, Low Channel, 30 MHz – 1 GHz, HT5



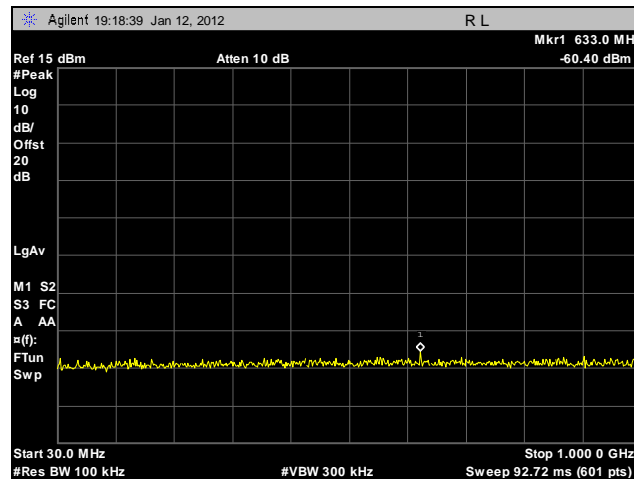
Plot 113. Conducted Spurious Emissions, Low Channel, 1 GHz – 40 GHz, HT5



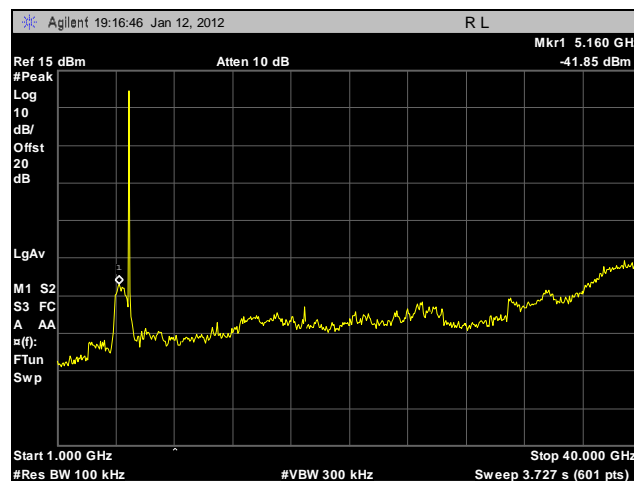
Plot 114. Conducted Spurious Emissions, Mid Channel, 30 MHz – 1 GHz, HT5



Plot 115. Conducted Spurious Emissions, Mid Channel, 1 GHz – 40 GHz, HT5

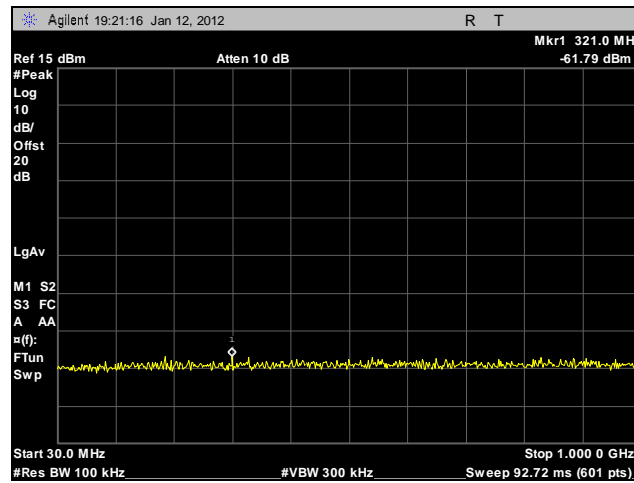


Plot 116. Conducted Spurious Emissions, High Channel, 30 MHz – 1 GHz, HT5

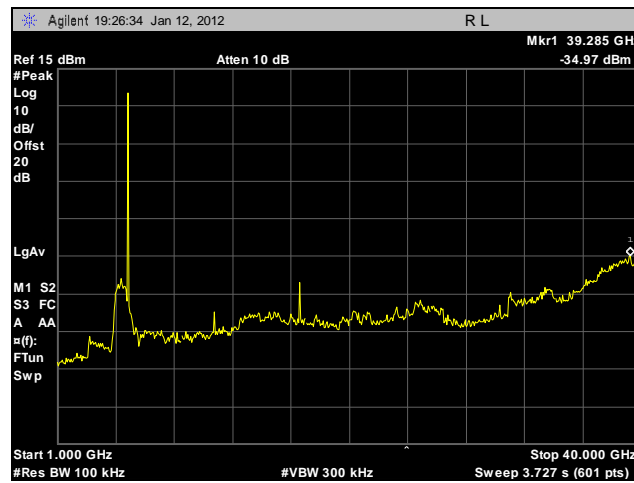


Plot 117. Conducted Spurious Emissions, High Channel, 1 GHz – 40 GHz, HT5

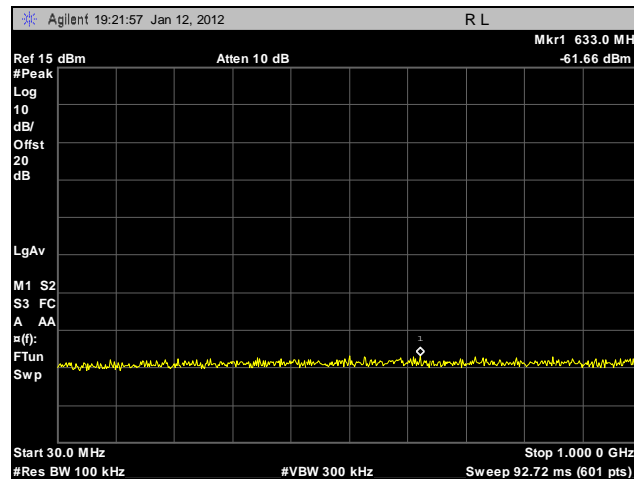
Conducted Spurious Emissions Test Results, HT10



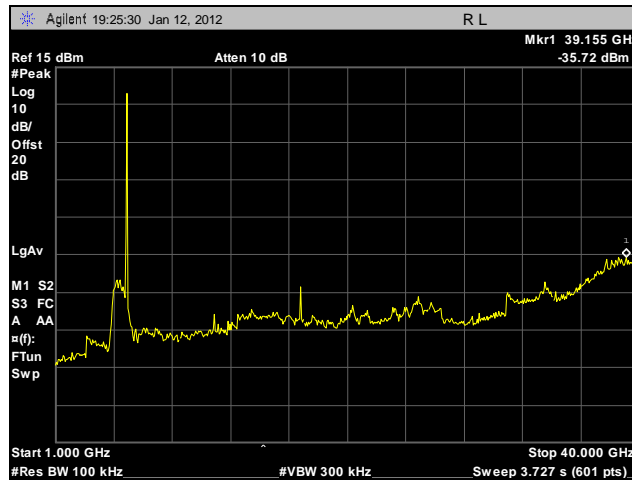
Plot 118. Conducted Spurious Emissions, Low Channel, 30 MHz – 1 GHz, HT10



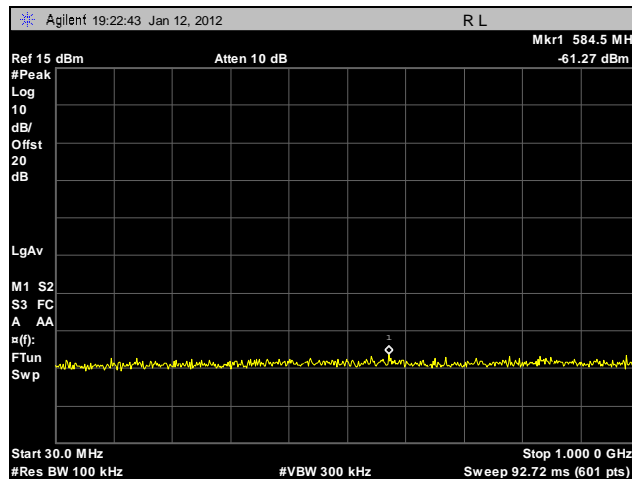
Plot 119. Conducted Spurious Emissions, Low Channel, 1 GHz – 40 GHz, HT10



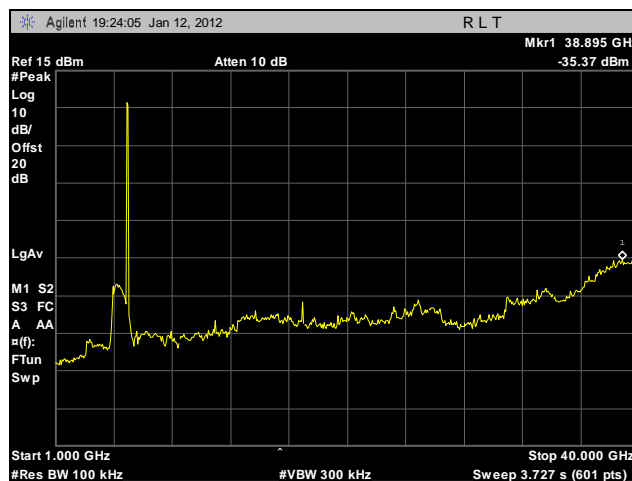
Plot 120. Conducted Spurious Emissions, Mid Channel, 30 MHz – 1 GHz, HT10



Plot 121. Conducted Spurious Emissions, Mid Channel, 1 GHz – 40 GHz, HT10

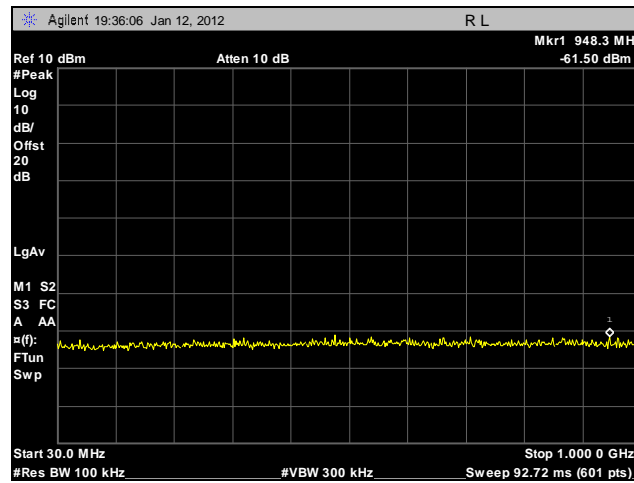


Plot 122. Conducted Spurious Emissions, High Channel, 30 MHz – 1 GHz, HT10

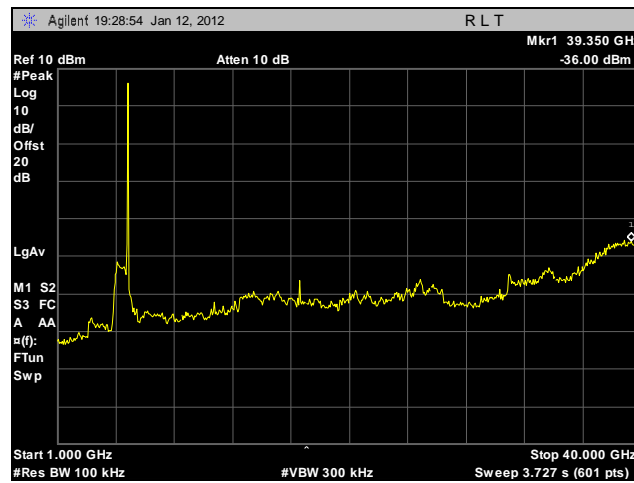


Plot 123. Conducted Spurious Emissions, High Channel, 1 GHz – 40 GHz, HT10

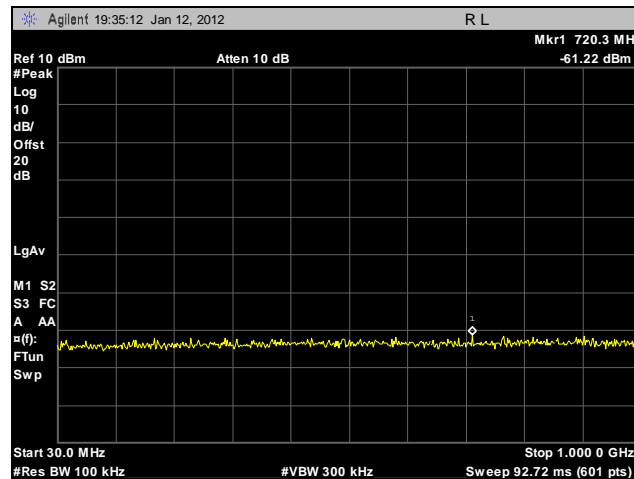
Conducted Spurious Emissions Test Results, HT20



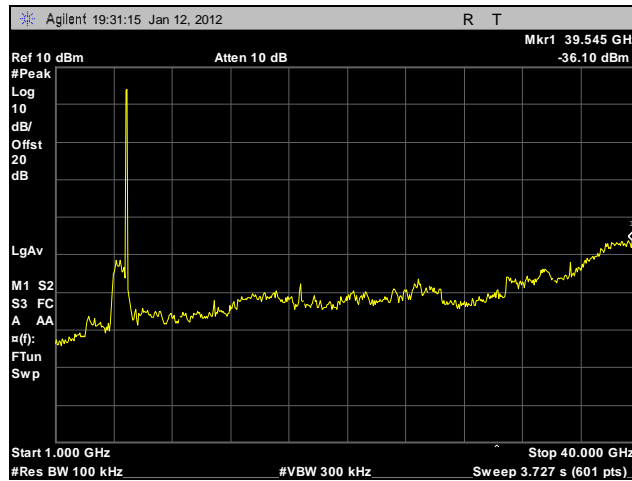
Plot 124. Conducted Spurious Emissions, Low Channel, 30 MHz – 1 GHz, HT20



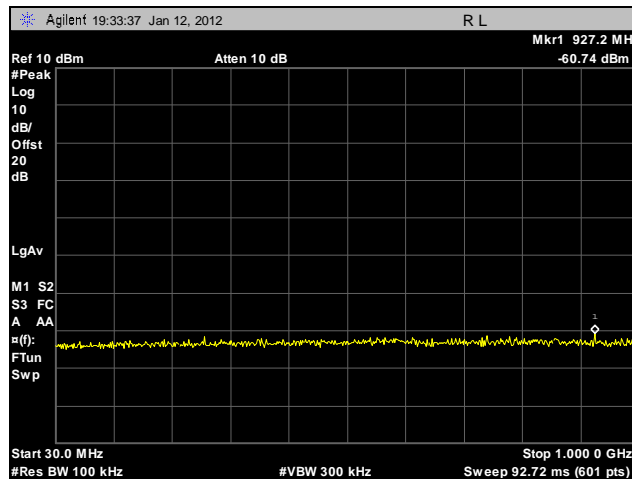
Plot 125. Conducted Spurious Emissions, Low Channel, 1 GHz – 40 GHz, HT20



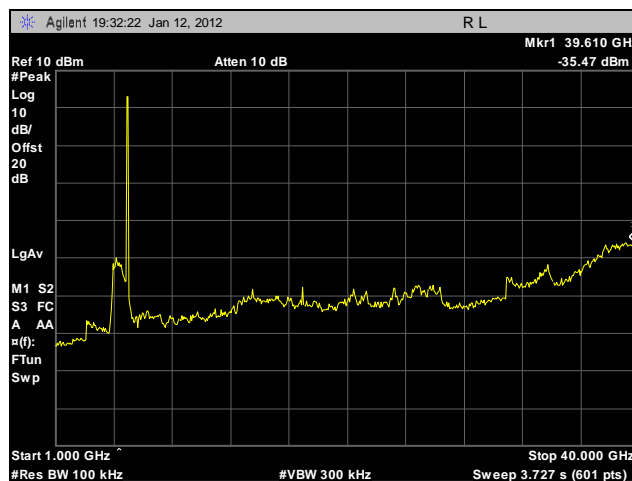
Plot 126. Conducted Spurious Emissions, Mid Channel, 30 MHz – 1 GHz, HT20



Plot 127. Conducted Spurious Emissions, Mid Channel, 1 GHz – 40 GHz, HT20

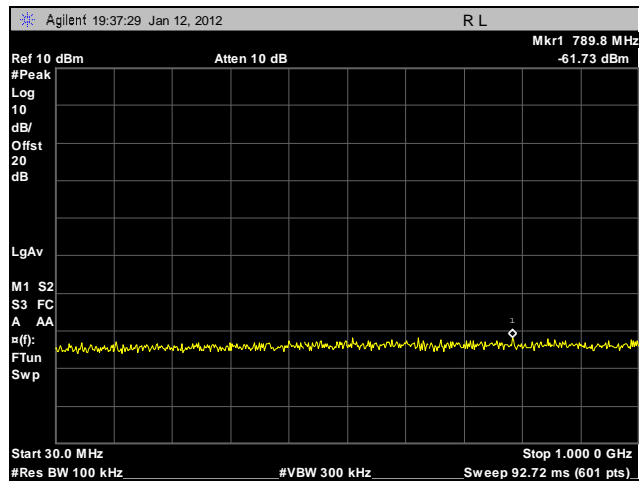


Plot 128. Conducted Spurious Emissions, High Channel, 30 MHz – 1 GHz, HT20

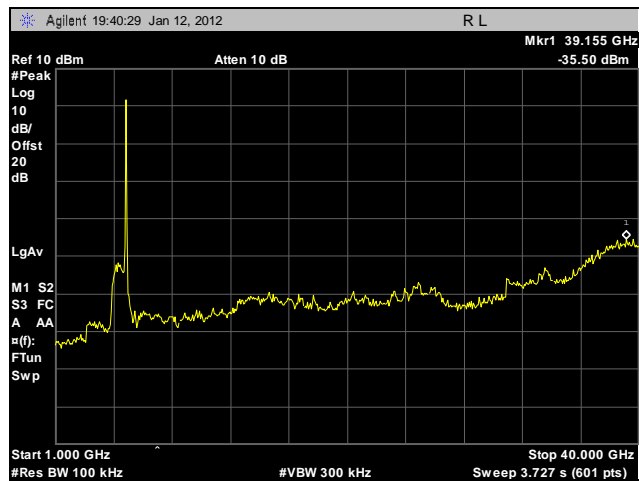


Plot 129. Conducted Spurious Emissions, High Channel, 1 GHz – 40 GHz, HT20

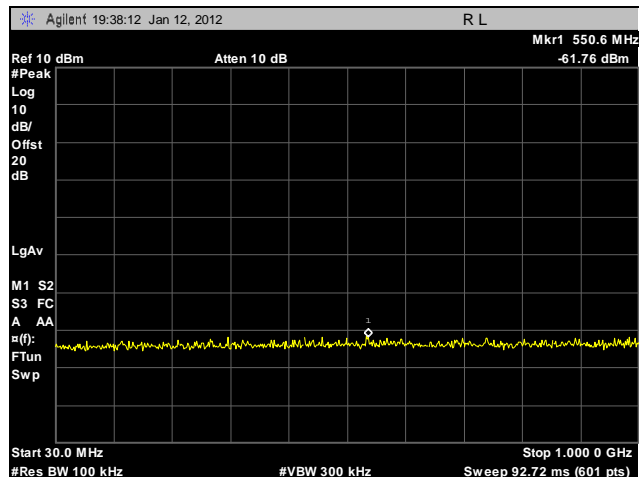
Conducted Spurious Emissions Test Results, HT40



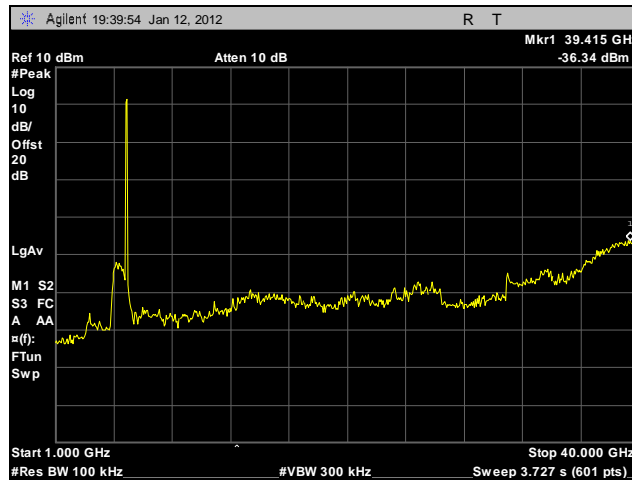
Plot 130. Conducted Spurious Emissions, Low Channel, 30 MHz – 1 GHz, HT40



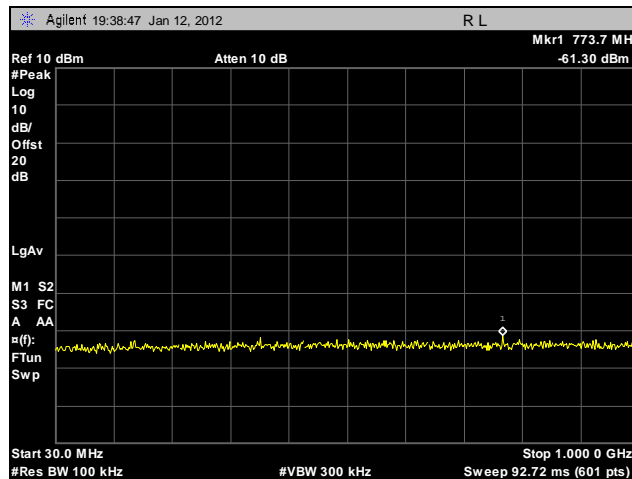
Plot 131. Conducted Spurious Emissions, Low Channel, 1 GHz – 40 GHz, HT40



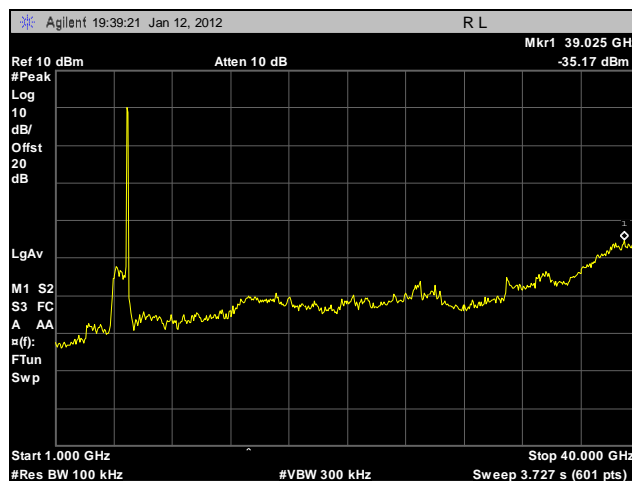
Plot 132. Conducted Spurious Emissions, Mid Channel, 30 MHz – 1 GHz, HT40



Plot 133. Conducted Spurious Emissions, Mid Channel, 1 GHz – 40 GHz, HT40

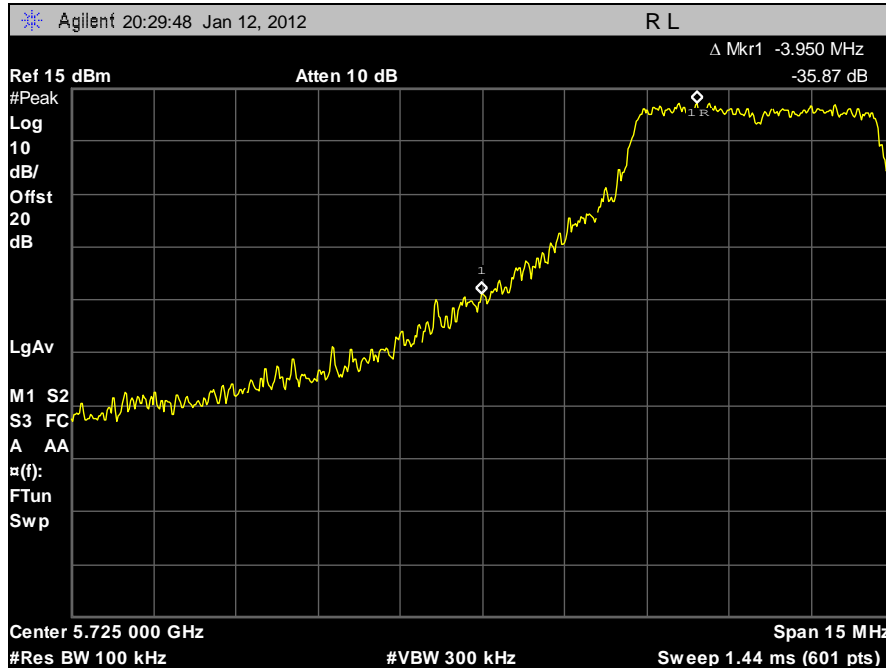


Plot 134. Conducted Spurious Emissions, High Channel, 30 MHz – 1 GHz, HT40

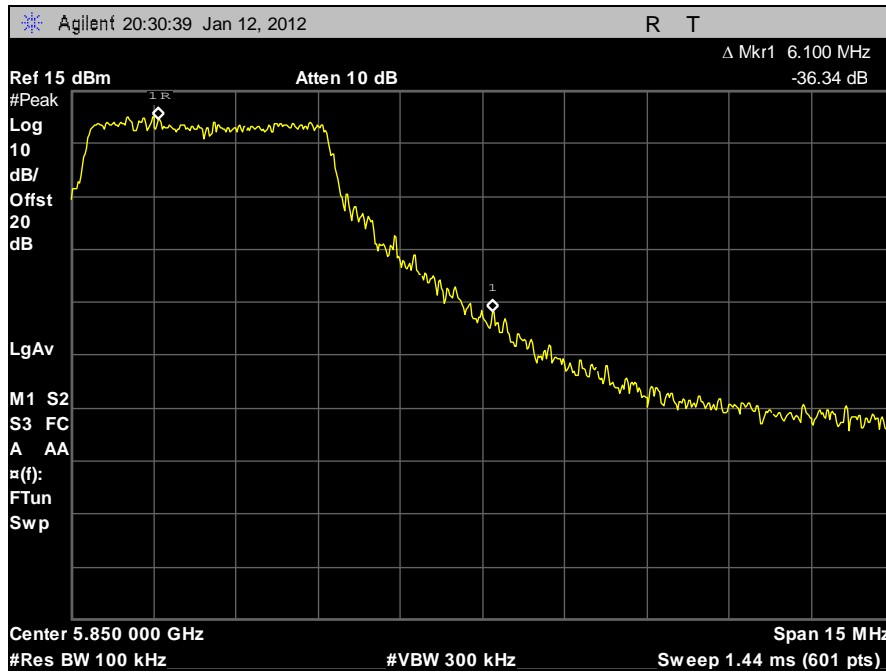


Plot 135. Conducted Spurious Emissions, High Channel, 1 GHz – 40 GHz, HT40

Conducted Band Edge Test Results, HT5

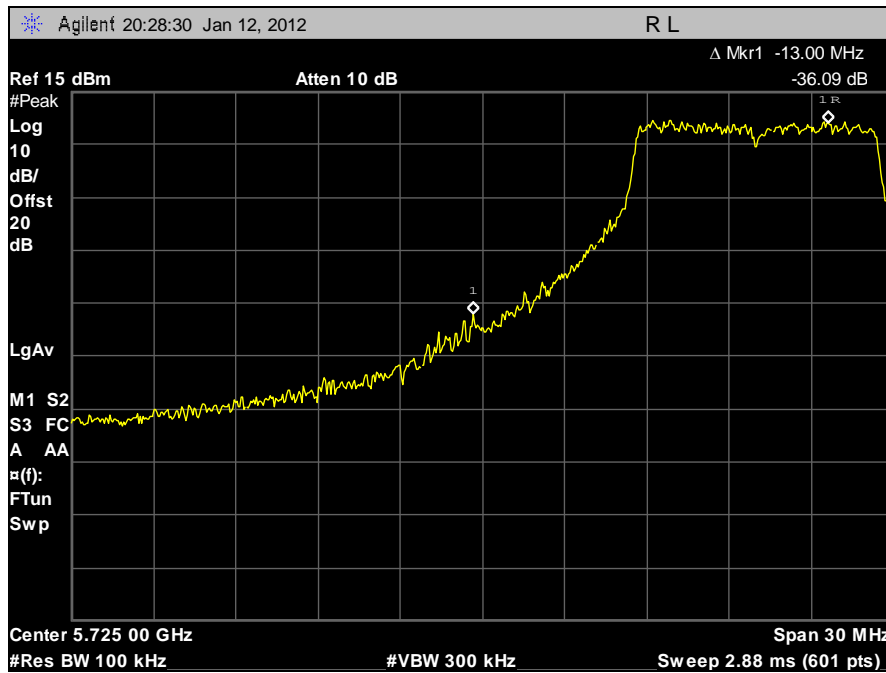


Plot 136. Conducted Band Edge, Low Channel, HT5

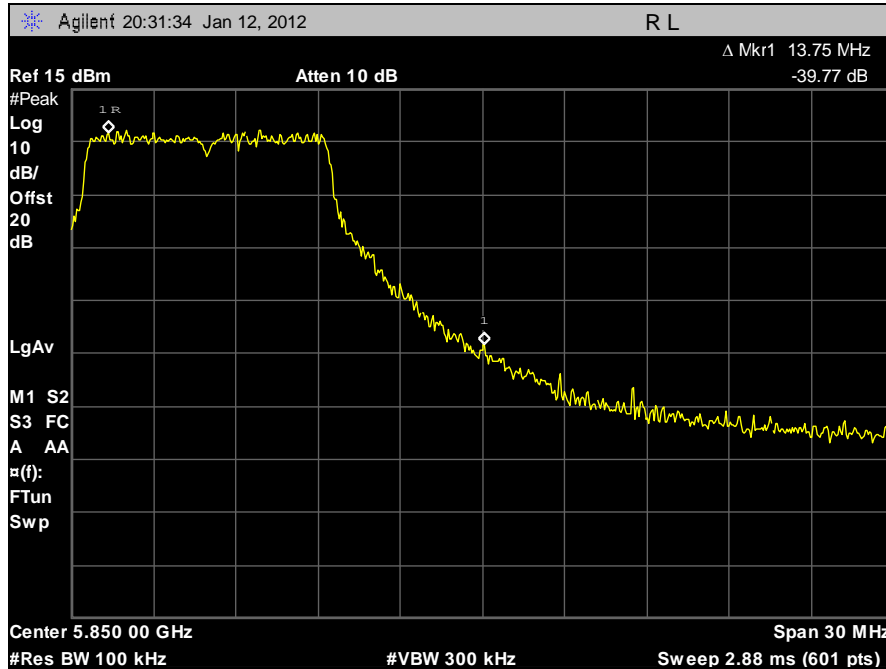


Plot 137. Conducted Band Edge, High Channel, HT5

Conducted Band Edge Test Results, HT10

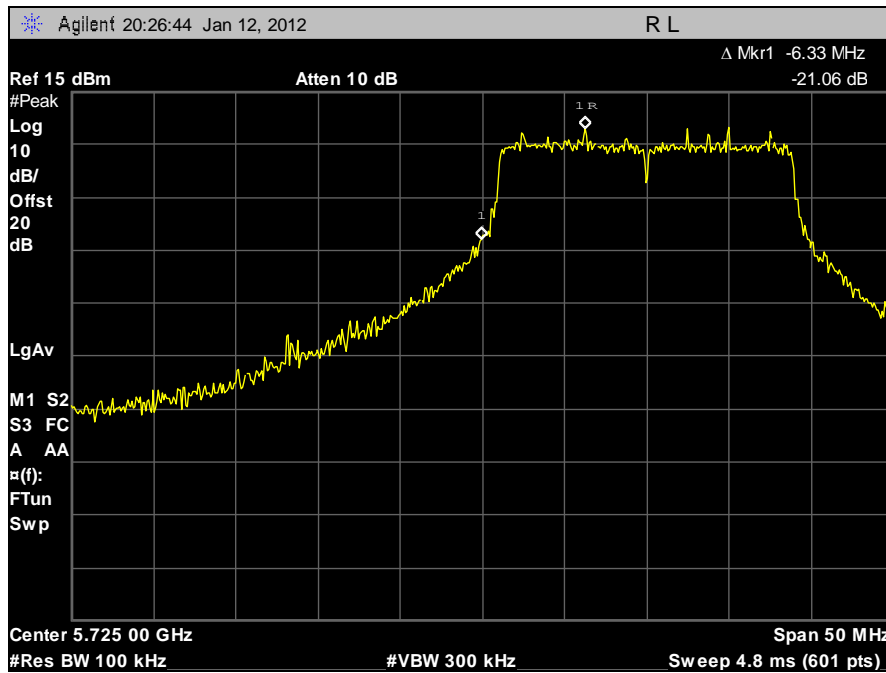


Plot 138. Conducted Band Edge, Low Channel, HT10

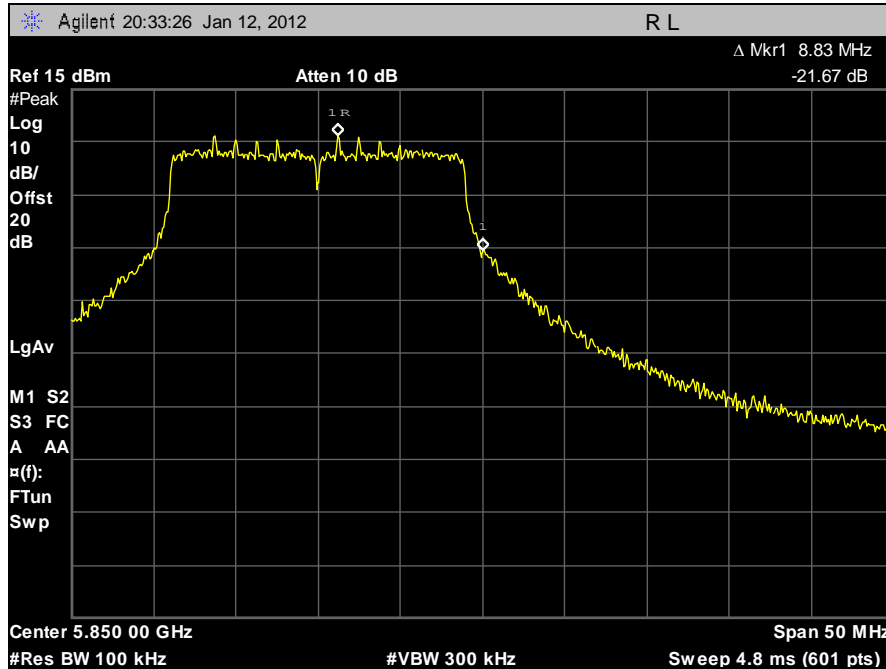


Plot 139. Conducted Band Edge, High Channel, HT10

Conducted Band Edge Test Results, HT20

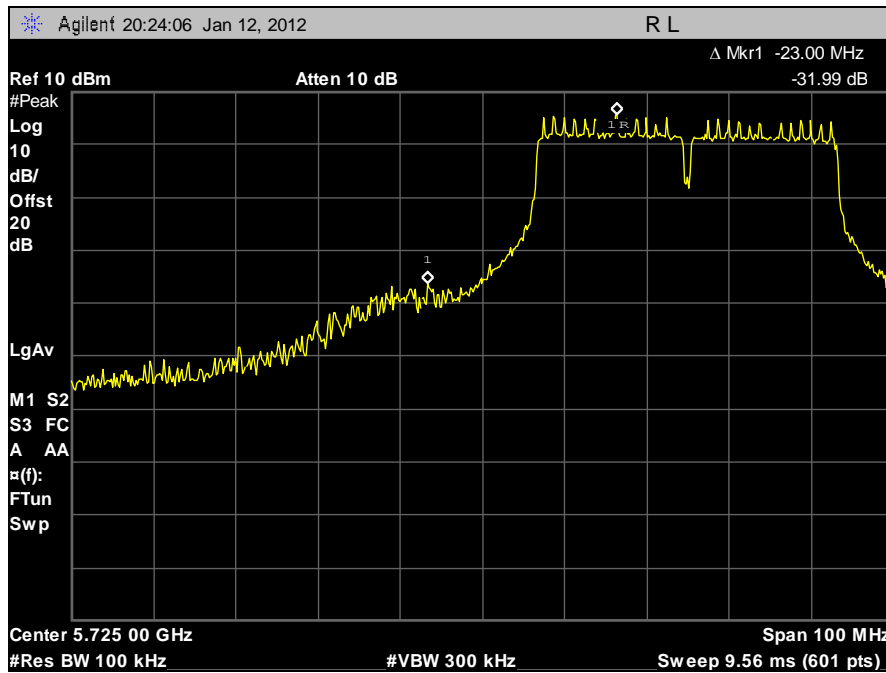


Plot 140. Conducted Band Edge, Low Channel, HT20

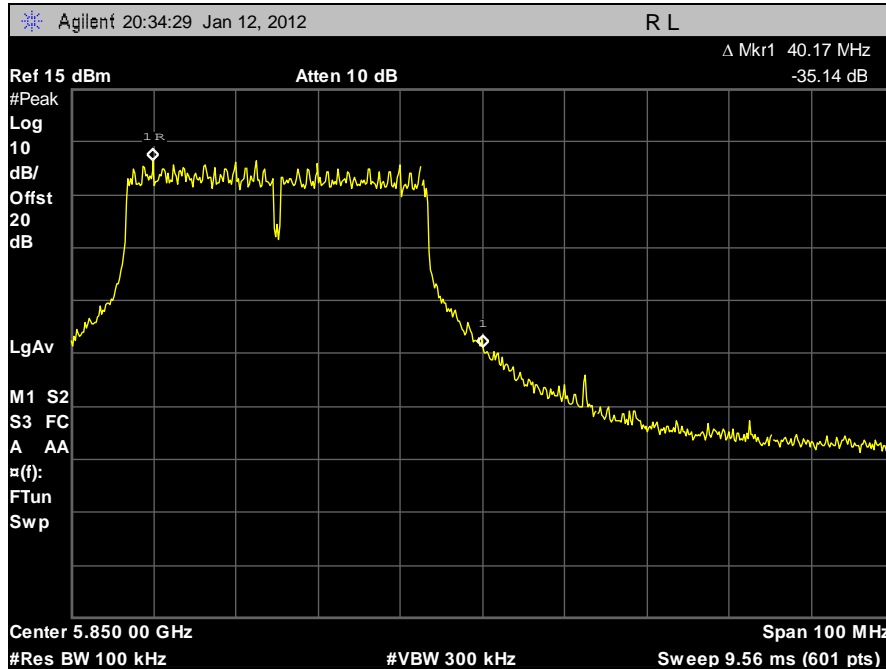


Plot 141. Conducted Band Edge, High Channel, HT20

Conducted Band Edge Test Results, HT40



Plot 142. Conducted Band Edge, Low Channel, HT40



Plot 143. Conducted Band Edge, High Channel, HT40

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: 01/12/12

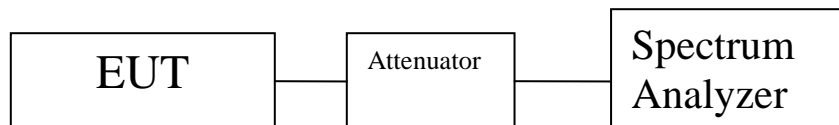


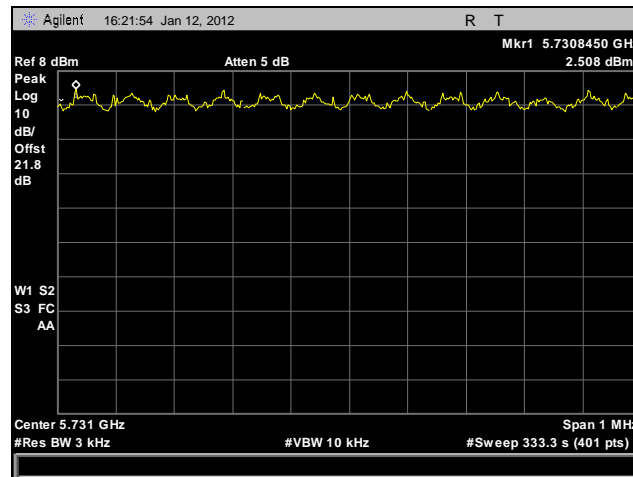
Figure 5. Block Diagram, Peak Power Spectral Density Test Setup

Peak Power Spectral Density Test Results

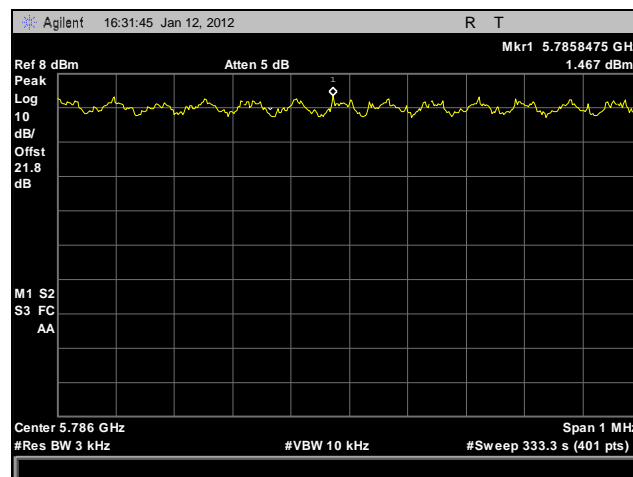
Peak Power Spectral Density					
	Carrier Channel	Frequency (MHz)	Measured PPSD (dBm)	Limit (dBm)	Margin (dB)
HT5	Low	5730	2.508	8	-5.492
	Mid	5785	1.467	8	-6.533
	High	5845	1.382	8	-6.618
HT10	Low	5735	0.233	8	-7.767
	Mid	5785	-0.354	8	-8.354
	High	5840	-2.219	8	-10.219
HT20	Low	5735	-3.458	8	-11.458
	Mid	5785	-3.759	8	-11.759
	High	5840	-4.875	8	-12.875
HT40	Low	5750	-6.103	8	-14.103
	Mid	5785	-7.111	8	-15.111
	High	5825	-7.145	8	-15.145

Table 23. Peak Power Spectral Density, Test Results

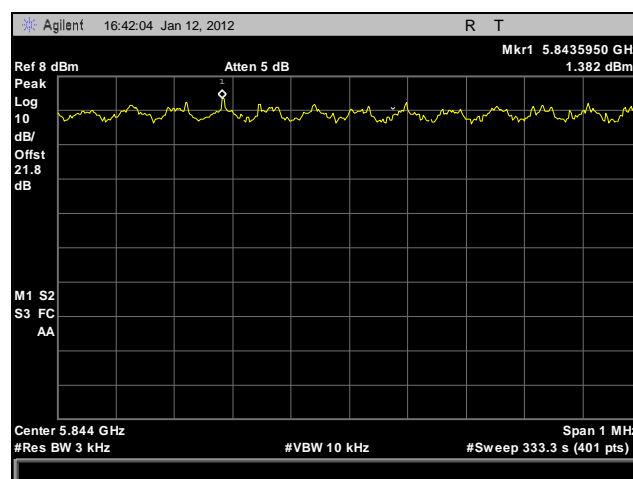
Peak Power Spectral Density, HT5



Plot 144. Peak Power Spectral Density, Low Channel, HT5

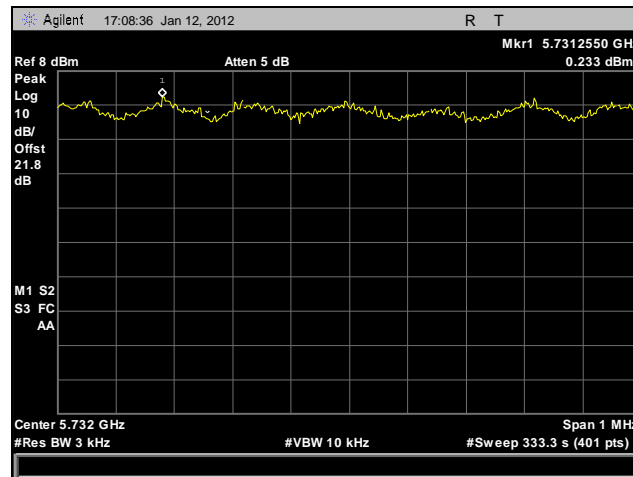


Plot 145. Peak Power Spectral Density, Mid Channel, HT5

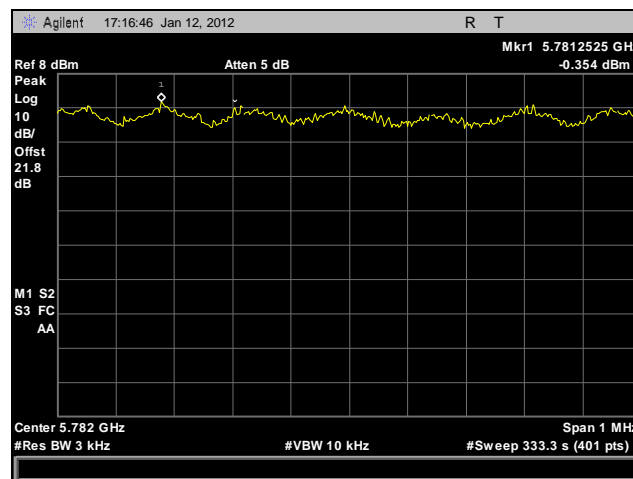


Plot 146. Peak Power Spectral Density, High Channel, HT5

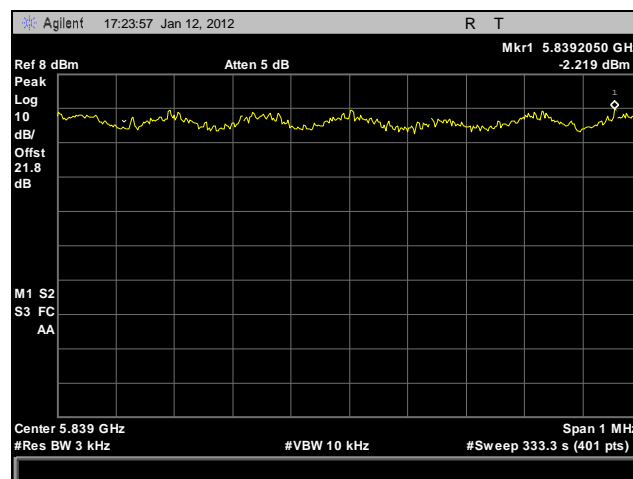
Peak Power Spectral Density, HT10



Plot 147. Peak Power Spectral Density, Low Channel, HT10

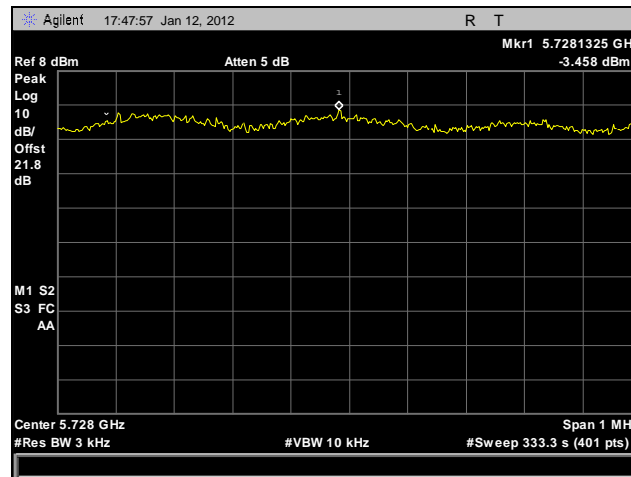


Plot 148. Peak Power Spectral Density, Mid Channel, HT10

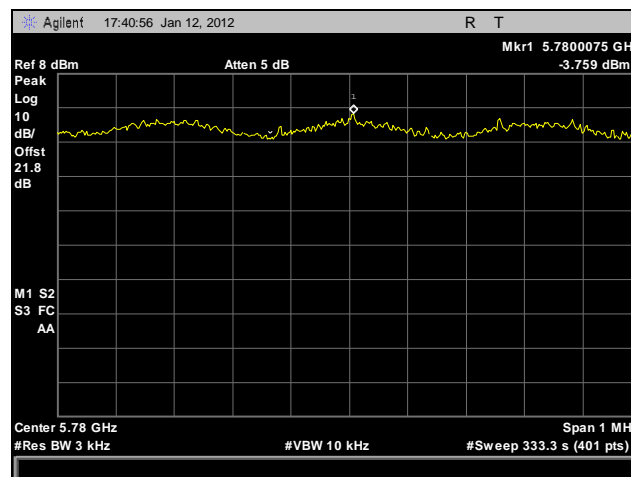


Plot 149. Peak Power Spectral Density, High Channel, HT10

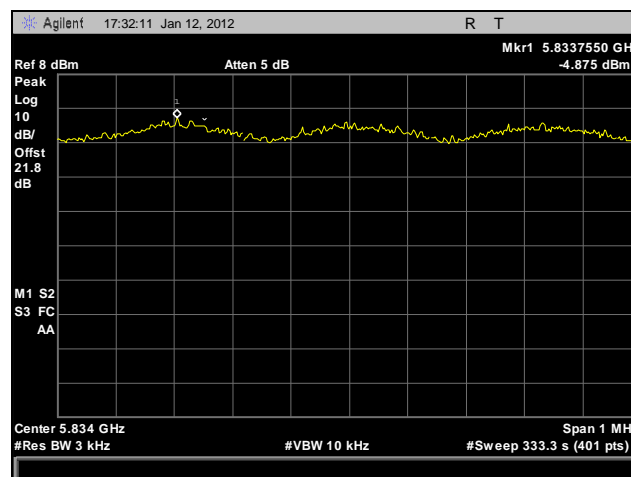
Peak Power Spectral Density, HT20



Plot 150. Peak Power Spectral Density, Low Channel, HT20

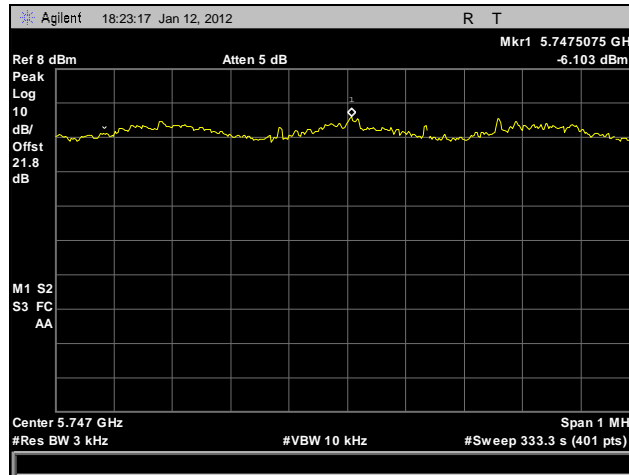


Plot 151. Peak Power Spectral Density, Mid Channel, HT20

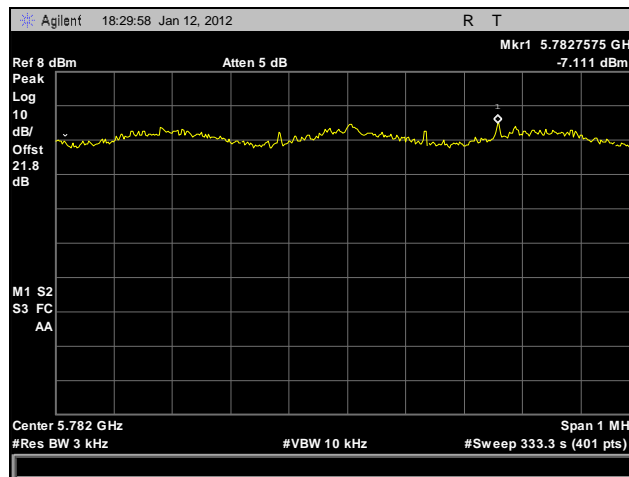


Plot 152. Peak Power Spectral Density, High Channel, HT20

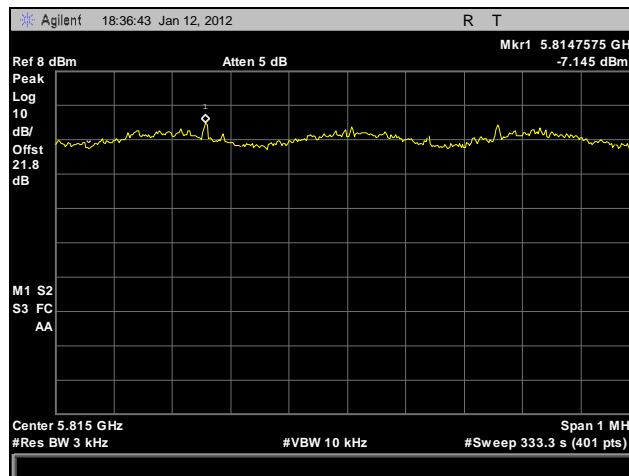
Peak Power Spectral Density, HT40



Plot 153. Peak Power Spectral Density, Low Channel, HT40



Plot 154. Peak Power Spectral Density, Mid Channel, HT40



Plot 155. Peak Power Spectral Density, High Channel, HT40

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 @ 5725-5850 MHz; highest conducted power = 22.26 dBm + 2dBm = 24.26dBm (peak) therefore, **Limit for Uncontrolled exposure: 1 mW/cm² or 10 W/m²**

EUT maximum antenna gain = 23 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 (266.69mW)
G = Antenna Gain (199.53 numeric)

$$R = (266.69 * 199.53 / 4 * 3.14 * 1.0)^{1/2} = (5321.83 / 12.56)^{1/2} = 65.08 \text{cm}$$

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 24.

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

Table 24. 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 300 kHz resolution was used 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): Anderson Soungpanya

Test Date(s): 01/12/2012

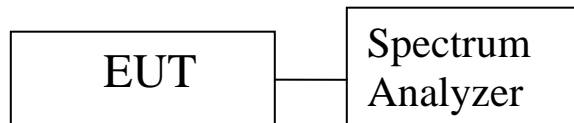
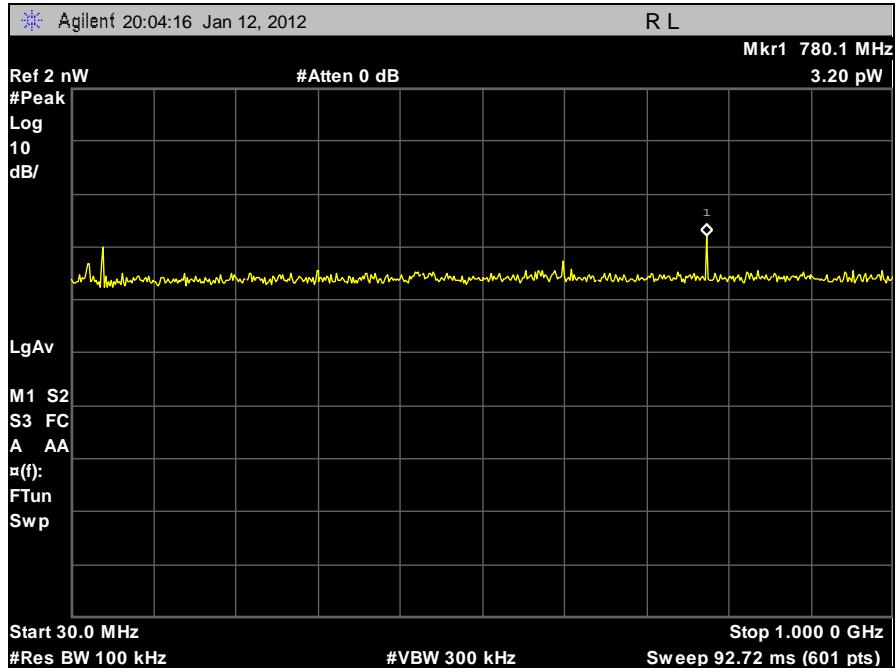
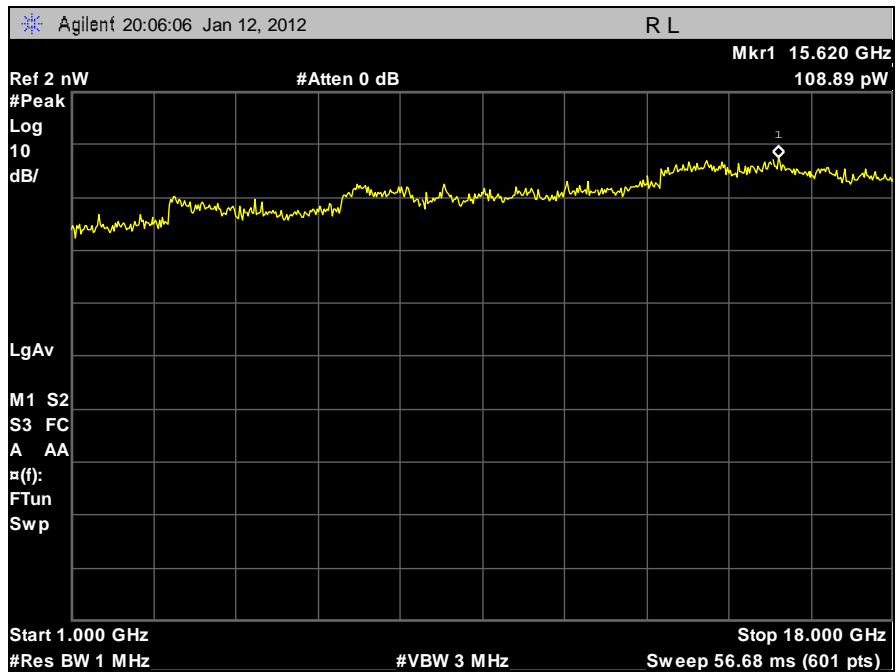


Figure 6. Block Diagram, Conducted Receiver Spurious Emissions Test Setup

Conducted Receiver Spurious Emissions



Plot 156. Receiver Spurious Emission, 30 MHz – 1 GHz



Plot 157. Receiver Spurious Emission, 1 GHz – 18 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
1S2603	HORN ANTENNA	ETS-LINDGREN	3117	05/09/2011	05/09/2012
1S2202	HORN ANTENNA	EMCO	3116	04/23/2010	04/23/2013
1S2583	ANALYZER, SPECTRUM	AGILENT	E4447A	03/27/2012	09/27/2013
1S2460	ANALYZER, SPECTRUM	AGILENT	E4407B	07/12/2011	07/12/2012
1S2482	CHAMBER, 5 METER	PANASHIELD	641431	11/22/2011	11/22/2012
1S2399	TURNTABLE CONTROLLER	SUNOL SCIENCE	SC99V	SEE NOTE	
1S2484	BILOG ANTENNA	TESEQ	CBL6112D	03/01/2011	03/01/2013
1S2481	10 METER CHAMBER	ETS-LINGREN	DKE- 8X8 DBL	11/6/2011	11/6/2012
1S2421	EMI TEST RECEIVER	ROHDE & SCHWARZ	ESIB 7	6/17/2011	6/17/2012
1S2506	SPECTRUM ANALYZER	RHODE & SCHWARZ	1164.4391.30 FSP	6/20/2011	6/20/2012
1S2583	SPECTRUM ANALYZER	AGILENT/HP	E4447A	3/27/2012	9/27/2013
1S2198	HORN ANTENNA	EMCO	3115	9/29/2011	9/29/2012
1S2485	BILOG ANTENNA	TESEQ	CBL6112D	5/17/2011	5/17/2012

Table 25. 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