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April 27, 2011

Ubiquiti Networks  
91 E. Tasman  
San Jose, CA 95134

Dear Robert Pera,

Enclosed is the EMC Wireless test report for compliance testing of the Ubiquiti Networks, NanoStationLocoM5 as tested to the requirements for Indian Market.

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\EMCS82946-IND)

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## Electromagnetic Compatibility Criteria Test Report

for the

**Ubiquiti Networks  
NanoStationLocoM5**

**Tested under**  
Class A Digital Devices  
&  
Intentional Radiators

**MET Report: EMCS82946-IND**

April 27, 2011

**Prepared For:**

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

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

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&  
Intentional Radiators



Manasi Bhandiwad, 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 under normal use and maintenance.



Shawn McMillen,  
Wireless Manager, Electromagnetic Compatibility Lab

## Report Status Sheet

Revision	Report Date	Reason for Revision
Ø	April 27, 2011	Initial Issue.

## Table of Contents

<b>I.</b>	<b>Executive Summary .....</b>	<b>1</b>
A.	Purpose of Test .....	2
B.	Executive Summary .....	2
<b>II.</b>	<b>Equipment Configuration .....</b>	<b>3</b>
A.	Overview.....	4
B.	References.....	5
C.	Test Site .....	5
D.	Description of Test Sample.....	5
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
<b>III.</b>	<b>Electromagnetic Compatibility Criteria for Intentional Radiators.....</b>	<b>10</b>
	Conducted Emissions Limits .....	11
	6 dB and 99% Bandwidth.....	15
	Peak Power Output and Peak Excursion .....	31
	Peak Excursion Ratio .....	40
	RF Conducted Spurious Emissions Requirements and Band Edge .....	60
	Peak Power Spectral Density.....	76
	Maximum Permissible Exposure.....	85
<b>IV.</b>	<b>Test Equipment .....</b>	<b>86</b>

## List of Tables

Table 1. Executive Summary of EMC 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 Intentional Radiators .....	11
Table 8. Conducted Emissions - Voltage, Phase Line.....	12
Table 9. Conducted Emissions - Voltage, Neutral Line .....	13
Table 10. Occupied Bandwidth, Test Results.....	16
Table 11. Output Power Requirements .....	31
Table 12. RF Output Power, Test Results .....	32
Table 13. Peak Excursion Ratio .....	40
Table 14. Radiated Emissions Limits.....	48
Table 15. Spectral Density, Test Results.....	77
Table 16. Test Equipment List .....	87

## List of Plots

Plot 1. Conducted Emission, Phase Line Plot .....	12
Plot 2. Conducted Emission, Neutral Line Plot.....	13
Plot 3. 6 dB Occupied Bandwidth, Low Channel, a Mode, Port 0 .....	17
Plot 4. 6 dB Occupied Bandwidth, Mid Channel, a Mode, Port 0.....	17
Plot 5. 6 dB Occupied Bandwidth, High Channel, a Mode, Port 0 .....	17
Plot 6. 6 dB Occupied Bandwidth, Low Channel, HT10, Port 0.....	18
Plot 7. 6 dB Occupied Bandwidth, Mid Channel, HT10, Port 0 .....	18
Plot 8. 6 dB Occupied Bandwidth, High Channel, HT10, Port 0 .....	18
Plot 9. 6 dB Occupied Bandwidth, Low Channel, HT20, Port 0.....	19
Plot 10. 99% Occupied Bandwidth, Mid Channel, HT20, Port 0.....	19
Plot 11. 6 dB Occupied Bandwidth, High Channel, HT20, Port 0 .....	19
Plot 12. 6 dB Occupied Bandwidth, HT40, Port 0 .....	20
Plot 13. 99% Occupied Bandwidth, Low Channel, a Mode, Port 0 .....	21
Plot 14. 99% Occupied Bandwidth, Mid Channel, a Mode, Port 0 .....	21
Plot 15. 99% Occupied Bandwidth, High Channel, a Mode, Port 0 .....	21
Plot 16. 99% Occupied Bandwidth, Low Channel, HT10, Port 0 .....	22
Plot 17. 99% Occupied Bandwidth, Mid Channel, HT10, Port 0.....	22
Plot 18. 99% Occupied Bandwidth, High Channel, HT10, Port 0.....	22
Plot 19. 99% Occupied Bandwidth, Low Channel, HT20, Port 0 .....	23
Plot 20. 6 dB Occupied Bandwidth, Mid Channel, HT20, Port 0 .....	23
Plot 21. 99% Occupied Bandwidth, High Channel, HT20, Port 0.....	23
Plot 22. 99% Occupied Bandwidth, HT40, Port 0.....	24
Plot 23. 6 dB Occupied Bandwidth, Low Channel, HT10, Port 1 .....	25
Plot 24. 6 dB Occupied Bandwidth, Mid Channel, HT10, Port 1 .....	25
Plot 25. 6 dB Occupied Bandwidth, High Channel, HT10, Port 1 .....	25
Plot 26. 6 dB Occupied Bandwidth, Low Channel, HT20, Port 1 .....	26
Plot 27. 6 dB Occupied Bandwidth, Mid Channel, HT20, Port 1 .....	26
Plot 28. 6 dB Occupied Bandwidth, High Channel, HT20, Port 1 .....	26
Plot 29. 6 dB Occupied Bandwidth, HT40, Port 1 .....	27
Plot 30. 99% Occupied Bandwidth, Low Channel, HT10, Port 1 .....	28
Plot 31. 99% Occupied Bandwidth, Mid Channel, HT10, Port 1 .....	28

Plot 32. 99% Occupied Bandwidth, High Channel, HT10, Port 1.....	28
Plot 33. 99% Occupied Bandwidth, Low Channel, HT20, Port 1 .....	29
Plot 34. 99% Occupied Bandwidth, Mid Channel, HT20, Port 1.....	29
Plot 35. 99% Occupied Bandwidth, High Channel, HT20, Port 1.....	29
Plot 36. 99% Occupied Bandwidth, HT40, Port 1 .....	30
Plot 37. Peak Output Power, Low Channel, a Mode, Port 0 .....	33
Plot 38. Peak Output Power, Mid Channel, a Mode, Port 0 .....	33
Plot 39. Peak Output Power, High Channel, a Mode, Port 0.....	33
Plot 40. Peak Output Power, Low Channel, HT10, Port 0 .....	34
Plot 41. Peak Output Power, Mid Channel, HT10, Port 0 .....	34
Plot 42. Peak Output Power, High Channel, HT10, Port 0 .....	34
Plot 43. Peak Output Power, Low Channel, HT20, Port 0 .....	35
Plot 44. Peak Output Power, Mid Channel, HT20, Port 0.....	35
Plot 45. Peak Output Power, High Channel, HT20, Port 0 .....	35
Plot 46. Peak Output Power, HT40, Port 0.....	36
Plot 47. Peak Output Power, Low Channel, HT10, Port 1 .....	37
Plot 48. Peak Output Power, Mid Channel, HT10, Port 1 .....	37
Plot 49. Peak Output Power, High Channel, HT10, Port 1 .....	37
Plot 50. Peak Output Power, Low Channel, HT20, Port 1 .....	38
Plot 51. Peak Output Power, Mid Channel, HT20, Port 1 .....	38
Plot 52. Peak Output Power, High Channel, HT20, Port 1 .....	38
Plot 53. Peak Output Power, HT40, Port 1.....	39
Plot 54. Peak Excursion, Low Channel, a Mode, Port 0 .....	41
Plot 55. Peak Excursion, Mid Channel, a Mode, Port 0 .....	41
Plot 56. Peak Excursion, High Channel, a Mode, Port 0 .....	41
Plot 57. Peak Excursion, Low Channel, HT10, Port 0 .....	42
Plot 58. Peak Excursion, Mid Channel, HT10, Port 0.....	42
Plot 59. Peak Excursion, High Channel, HT10, Port 0.....	42
Plot 60. Peak Excursion, Low Channel, HT20, Port 0 .....	43
Plot 61. Peak Excursion, Mid Channel, HT20, Port 0.....	43
Plot 62. Peak Excursion, High Channel, HT20, Port 0.....	43
Plot 63. Peak Excursion, HT40, Port 0.....	44
Plot 64. Peak Excursion, Low Channel, HT10, Port 1 .....	45
Plot 65. Peak Excursion, Mid Channel, HT10, Port 1 .....	45
Plot 66. Peak Excursion, High Channel, HT10, Port 1.....	45
Plot 67. Peak Excursion, Low Channel, HT20, Port 1 .....	46
Plot 68. Peak Excursion, Mid Channel, HT20, Port 1 .....	46
Plot 69. Peak Excursion, High Channel, HT20, Port 1.....	46
Plot 70. Peak Excursion, HT40, Port 1 .....	47
Plot 71. Radiated Spurious Emissions, Low Channel, a Mode, 30 MHz – 1 GHz.....	49
Plot 72. Radiated Spurious Emissions, Low Channel, a Mode, 1 GHz – 18 GHz .....	49
Plot 73. Radiated Spurious Emissions, Low Channel, a Mode, 18 GHz – 40 GHz .....	49
Plot 74. Radiated Spurious Emissions, Mid Channel, a Mode, 30 MHz – 1 GHz .....	50
Plot 75. Radiated Spurious Emissions, Mid Channel, a Mode, 1 GHz – 18 GHz .....	50
Plot 76. Radiated Spurious Emissions, Mid Channel, a Mode, 18 GHz – 40 GHz .....	50
Plot 77. Radiated Spurious Emissions, High Channel, a Mode, 30 MHz – 1 GHz .....	51
Plot 78. Radiated Spurious Emissions, High Channel, a Mode, 1 GHz – 18 GHz.....	51
Plot 79. Radiated Spurious Emissions, High Channel, a Mode, 18 GHz – 40 GHz .....	51
Plot 80. Radiated Spurious Emissions, Low Channel, HT10, 30 MHz – 1 GHz.....	52
Plot 81. Radiated Spurious Emissions, Low Channel, HT10, 1 GHz – 18 GHz .....	52
Plot 82. Radiated Spurious Emissions, Low Channel, HT10, 18 GHz – 40 GHz .....	52
Plot 83. Radiated Spurious Emissions, Mid Channel, HT10, 30 MHz – 1 GHz .....	53
Plot 84. Radiated Spurious Emissions, Mid Channel, HT10, 1 GHz – 18 GHz .....	53

Plot 85. Radiated Spurious Emissions, Mid Channel, HT10, 18 GHz – 40 GHz.....	53
Plot 86. Radiated Spurious Emissions, High Channel, HT10, 30 MHz – 1 GHz.....	54
Plot 87. Radiated Spurious Emissions, High Channel, HT10, 1 GHz – 18 GHz.....	54
Plot 88. Radiated Spurious Emissions, High Channel, HT10, 18 GHz – 40 GHz.....	54
Plot 89. Radiated Spurious Emissions, Low Channel, HT20, 30 MHz – 1 GHz.....	55
Plot 90. Radiated Spurious Emissions, Low Channel, HT20, 1 GHz – 18 GHz.....	55
Plot 91. Radiated Spurious Emissions, Low Channel, HT20, 18 GHz – 40 GHz.....	55
Plot 92. Radiated Spurious Emissions, Mid Channel, HT20, 30 MHz – 1 GHz .....	56
Plot 93. Radiated Spurious Emissions, Mid Channel, HT20, 1 GHz – 18 GHz.....	56
Plot 94. Radiated Spurious Emissions, Mid Channel, HT20, 18 GHz – 40 GHz.....	56
Plot 95. Radiated Spurious Emissions, High Channel, HT20, 30 MHz – 1 GHz.....	57
Plot 96. Radiated Spurious Emissions, High Channel, HT20, 1 GHz – 18 GHz.....	57
Plot 97. Radiated Spurious Emissions, High Channel, HT20, 18 GHz – 40 GHz.....	57
Plot 98. Radiated Spurious Emissions, HT40, 30 MHz – 1 GHz.....	58
Plot 99. Radiated Spurious Emissions, HT40, 1 GHz – 18 GHz.....	58
Plot 100. Radiated Spurious Emissions, HT40, 18 GHz – 40 GHz.....	58
Plot 101. Radiated Spurious Emissions, Receive Mode, 30 MHz – 1 GHz .....	59
Plot 102. Radiated Spurious Emissions, Receive Mode, 1 GHz – 18 GHz.....	59
Plot 103. Radiated Spurious Emissions, Receive Mode, 18 GHz – 40 GHz.....	59
Plot 104. Conducted Spurious Emissions, Low Channel, a Mode, 30 MHz – 1 GHz, Port 0 .....	61
Plot 105. Conducted Spurious Emissions, Low Channel, a Mode, 1 GHz – 40 GHz, Port 0 .....	61
Plot 106. Conducted Spurious Emissions, Mid Channel, a Mode, 30 MHz – 1 GHz, Port 0 .....	61
Plot 107. Conducted Spurious Emissions, Mid Channel, a Mode, 1 GHz – 40 GHz, Port 0 .....	62
Plot 108. Conducted Spurious Emissions, High Channel, a Mode, 30 MHz – 1 GHz, Port 0.....	62
Plot 109. Conducted Spurious Emissions, High Channel, a Mode, 1 GHz – 40 GHz, Port 0 .....	62
Plot 110. Conducted Spurious Emissions, Low Channel, HT10, 30 MHz – 1 GHz, Port 0.....	63
Plot 111. Conducted Spurious Emissions, Low Channel, HT10, 1 GHz – 40 GHz, Port 0.....	63
Plot 112. Conducted Spurious Emissions, Mid Channel, HT10, 30 MHz – 1 GHz, Port 0.....	63
Plot 113. Conducted Spurious Emissions, Mid Channel, HT10, 1 GHz – 40 GHz, Port 0 .....	64
Plot 114. Conducted Spurious Emissions, High Channel, HT10, 30 MHz – 1 GHz, Port 0 .....	64
Plot 115. Conducted Spurious Emissions, High Channel, HT10, 1 GHz – 40 GHz, Port 0 .....	64
Plot 116. Conducted Spurious Emissions, Low Channel, HT20, 30 MHz – 1 GHz, Port 0 .....	65
Plot 117. Conducted Spurious Emissions, Low Channel, HT20, 1 GHz – 40 GHz, Port 0 .....	65
Plot 118. Conducted Spurious Emissions, Mid Channel, HT20, 30 MHz – 1 GHz, Port 0 .....	65
Plot 119. Conducted Spurious Emissions, Mid Channel, HT20, 1 GHz – 40 GHz, Port 0 .....	66
Plot 120. Conducted Spurious Emissions, High Channel, HT20, 30 MHz – 1 GHz, Port 0 .....	66
Plot 121. Conducted Spurious Emissions, High Channel, HT20, 1 GHz – 40 GHz, Port 0 .....	66
Plot 122. Conducted Spurious Emissions, HT40, 30 MHz – 1 GHz, Port 0 .....	67
Plot 123. Conducted Spurious Emissions, HT40, 1 GHz – 40 GHz, Port 0 .....	67
Plot 124. Conducted Spurious Emissions, Low Channel, HT10, 30 MHz – 1 GHz, Port 1 .....	68
Plot 125. Conducted Spurious Emissions, Mid Channel, HT10, 30 MHz – 1 GHz, Port 1 .....	68
Plot 126. Conducted Spurious Emissions, High Channel, HT10, 30 MHz – 1 GHz, Port 1 .....	68
Plot 127. Conducted Spurious Emissions, Low Channel, HT20, 30 MHz – 1 GHz, Port 1 .....	69
Plot 128. Conducted Spurious Emissions, Mid Channel, HT20, 30 MHz – 1 GHz, Port 1 .....	69
Plot 129. Conducted Spurious Emissions, High Channel, HT20, 30 MHz – 1 GHz, Port 1 .....	69
Plot 130. Conducted Spurious Emissions, HT40, 30 MHz – 1 GHz, Port 1 .....	70
Plot 131. Conducted Spurious Emissions, Low Channel, a Mode, P0, 20 dBc.....	71
Plot 132. Conducted Spurious Emissions, High Channel, a Mode, P0, 20 dBc .....	71
Plot 133. Conducted Spurious Emissions, Low Channel, HT10, P0, 20 dBc.....	71
Plot 134. Conducted Spurious Emissions, High Channel, HT10, P0, 20 dBc .....	72
Plot 135. Conducted Spurious Emissions, Low Channel, HT20, P0, 20 dBc.....	72
Plot 136. Conducted Spurious Emissions, High Channel, HT20, P0, 20 dBc .....	72
Plot 137. Conducted Spurious Emissions, Low Channel, HT40, P0, 20 dBc.....	73

Plot 138. Conducted Spurious Emissions, High Channel, HT40, P0, 20 dBc .....	73
Plot 139. Conducted Spurious Emissions, Low Channel, HT10, P1, 20 dBc.....	74
Plot 140. Conducted Spurious Emissions, High Channel, HT10, P1, 20 dBc .....	74
Plot 141. Conducted Spurious Emissions, Low Channel, HT20, P1, 20 dBc.....	74
Plot 142. Conducted Spurious Emissions, High Channel, HT20, P1, 20 dBc .....	75
Plot 143. Conducted Spurious Emissions, Low Channel, HT40, P1, 20 dBc.....	75
Plot 144. Conducted Spurious Emissions, High Channel, HT40, P1, 20 dBc .....	75
Plot 145. Peak Power Spectral Density, Low Channel, a Mode, Port 0 .....	78
Plot 146. Peak Power Spectral Density, Mid Channel, a Mode, Port 0 .....	78
Plot 147. Peak Power Spectral Density, High Channel, a Mode, Port 0 .....	78
Plot 148. Peak Power Spectral Density, Low Channel, HT10, Port 0 .....	79
Plot 149. Peak Power Spectral Density, Mid Channel, HT10, Port 0.....	79
Plot 150. Peak Power Spectral Density, High Channel, HT10, Port 0 .....	79
Plot 151. Peak Power Spectral Density, Low Channel, HT20, Port 0 .....	80
Plot 152. Peak Power Spectral Density, Mid Channel, HT20, Port 0.....	80
Plot 153. Peak Power Spectral Density, High Channel, HT20, Port 0 .....	80
Plot 154. Peak Power Spectral Density, HT40, Port 0 .....	81
Plot 155. Peak Power Spectral Density, Low Channel, HT10, Port 1 .....	82
Plot 156. Peak Power Spectral Density, Mid Channel, HT10, Port 1.....	82
Plot 157. Peak Power Spectral Density, High Channel, HT10, Port 1 .....	82
Plot 158. Peak Power Spectral Density, Low Channel, HT20, Port 1 .....	83
Plot 159. Peak Power Spectral Density, Mid Channel, HT20, Port 1.....	83
Plot 160. Peak Power Spectral Density, High Channel, HT20, Port 1 .....	83
Plot 161. Peak Power Spectral Density, HT40, Port 1 .....	84

## List of Figures

Figure 1. Block Diagram of Test Configuration.....	7
Figure 2. Block Diagram, Occupied Bandwidth Test Setup.....	15
Figure 3. Peak Power Output Test Setup.....	31
Figure 4. Peak Excursion Ration Test Setup .....	40
Figure 5. Block Diagram, Conducted Spurious Emissions Test Setup.....	60
Figure 6. Block Diagram, Peak Power Spectral Density Test Setup.....	76

## List of Photographs

Photograph 1. Ubiquiti Networks NanoStationLocoM5 .....	6
Photograph 2. Conducted Emissions, Test Setup .....	14

## List of Terms and Abbreviations

<b>AC</b>	Alternating Current
<b>ACF</b>	Antenna Correction Factor
<b>Cal</b>	Calibration
<i>d</i>	Measurement Distance
<b>dB</b>	Decibels
<b>dB<sub>μ</sub>A</b>	Decibels above one <b>microamp</b>
<b>dB<sub>μ</sub>V</b>	Decibels above one <b>microvolt</b>
<b>dB<sub>μ</sub>A/m</b>	Decibels above one <b>microamp per meter</b>
<b>dB<sub>μ</sub>V/m</b>	Decibels above one <b>microvolt per meter</b>
<b>DC</b>	Direct Current
<b>E</b>	Electric Field
<b>DSL</b>	Digital Subscriber Line
<b>ESD</b>	Electrostatic Discharge
<b>EUT</b>	Equipment Under Test
<i>f</i>	Frequency
<b>FCC</b>	Federal Communications Commission
<b>GRP</b>	Ground Reference Plane
<b>H</b>	Magnetic Field
<b>HCP</b>	Horizontal Coupling Plane
<b>Hz</b>	Hertz
<b>IEC</b>	International Electrotechnical Commission
<b>kHz</b>	kilohertz
<b>kPa</b>	kilopascal
<b>kV</b>	kilovolt
<b>LISN</b>	Line Impedance Stabilization Network
<b>MHz</b>	Megahertz
<b>μH</b>	<b>microhenry</b>
<b>μ</b>	<b>microfarad</b>
<b>μs</b>	<b>microseconds</b>
<b>NEBS</b>	Network Equipment-Building System
<b>PRF</b>	Pulse Repetition Frequency
<b>RF</b>	Radio Frequency
<b>RMS</b>	Root-Mean-Square
<b>TWT</b>	Traveling Wave Tube
<b>V/m</b>	Volts <b>per meter</b>
<b>VCP</b>	Vertical Coupling Plane

# I. Executive Summary

## A. Purpose of Test

An EMC evaluation was performed to determine compliance of the Ubiquiti Networks NanoStationLocoM5, with the requirements for Digital Devices and Intentional Radiators. All references are to the most current version. The following data is presented in support of the Certification of the NanoStationLocoM5. Ubiquiti Networks should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the NanoStationLocoM5, has been **permanently** discontinued.

## B. Executive Summary

The following tests were conducted on a sample of the equipment for the purpose of demonstrating compliance, in accordance with Ubiquiti Networks, purchase order number US100132. All tests were conducted using measurement procedure ANSI C63.4-2003.

Description	Status
Conducted Emission Limits for a Class B Digital Device	Compliant
Occupied Bandwidth	Compliant
RF Output Power	Compliant
Radiated Spurious Emissions	Compliant
Conducted Spurious Emissions	Compliant
Power Spectral Density	Compliant

**Table 1. Executive Summary of EMC Compliance Testing**

## II. Equipment Configuration

## A. Overview

MET Laboratories, Inc. was contracted by Ubiquiti Networks to perform testing on the NanoStationLocoM5, under Ubiquiti Networks's purchase order number US100132.

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, NanoStationLocoM5.

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

<b>Model(s) Tested:</b>	NanoStationLocoM5
<b>Model(s) Covered:</b>	NanoStationLocoM5
<b>EUT Specifications:</b>	Primary Power: 120 VAC, 60 Hz
	Type of Modulations: OFDM
	Peak RF Output Power: a Mode: 19.11 dBm HT10: 19.1 dBm HT20: 19.02 dBm HT40: 18.82 dBm
	EUT Frequency Ranges: 5825 – 5875 MHz
	Occupied Bandwidth: a Mode: 17.18 MHz HT10: 9.56 MHz HT20: 17.96 MHz HT40: 36.32 MHz
	Antenna Type: Integral 13 dBi Antenna
<b>Analysis:</b>	The results obtained relate only to the item(s) tested.
<b>Environmental Test Conditions:</b>	Temperature: 15-35° C
	Relative Humidity: 30-60%
	Barometric Pressure: 860-1060 mbar
<b>Evaluated by:</b>	Manasi Bhandiwad
<b>Report Date(s):</b>	April 27, 2011

**Table 2. EUT Summary Table**

## B. References

<b>CFR 47, Part 15, Subpart C</b>	Federal Communication Commission, Code of Federal Regulations, Title 47, Part 15: General Rules and Regulations, Allocation, Assignment, and Use of Radio Frequencies
<b>CFR 47, Part 15, Subpart B</b>	Electromagnetic Compatibility: Criteria for Radio Frequency Devices
<b>CFR 47, Part 15, Subpart E</b>	Unlicensed National Information Infrastructure Devices (UNII)
<b>ANSI C63.4:2003</b>	Methods and Measurements of Radio-Noise Emissions from Low-Voltage Electrical And Electronic Equipment in the Range of 9 kHz to 40 GHz
<b>ANSI/NCSL Z540-1-1994</b>	Calibration Laboratories and Measuring and Test Equipment - General Requirements
<b>ANSI/ISO/IEC 17025:2000</b>	General Requirements for the Competence of Testing and Calibration Laboratories
<b>ANSI C63.10-2009</b>	American National Standard for Testing Unlicensed Wireless Devices

**Table 3. References**

## C. Test Site

All testing was performed at MET Laboratories, Inc., 914 W. Patapsco Ave., Baltimore, MD 21230. All equipment used in making physical determinations is accurate and bears recent traceability to the National Institute of Standards and Technology.

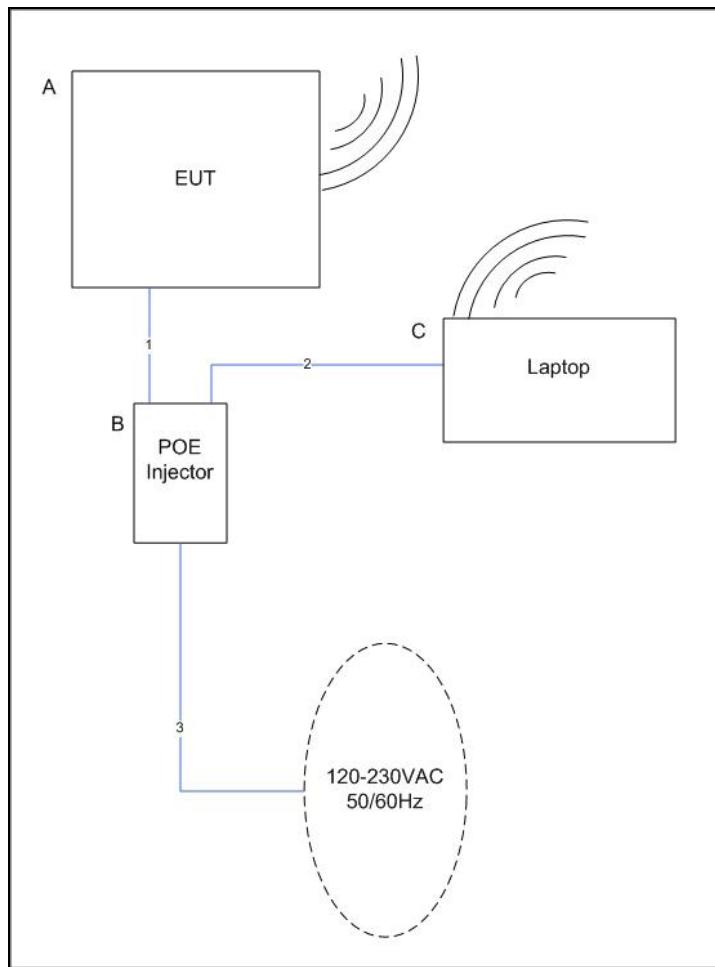
Radiated Emissions measurements were performed in a 3 meter semi-anechoic chamber (equivalent to an Open Area Test Site). In accordance with §2.948(a)(3), a complete site description is contained at MET Laboratories.

## D. Description of Test Sample

The Ubiquiti Networks NanoStationLocoM5, Equipment Under Test (EUT), is a 5GHz Hi Power 2x2 MIMO.



**Photograph 1. Ubiquiti Networks NanoStationLocoM5**



**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	Serial Number
A	LocoM5 (Conducted Sample)	M5L	M0B10PSH
A	LocoM5 (Radiated Sample)	M5L	M0B408D8
B	Power Supply	UBI-POE-24-5	0912-0009854
B	Power Supply	CPWA240500US	POEZC101126181008

**Table 4. Equipment Configuration**

## F. Support Equipment

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

Ref. ID	Name / Description	Manufacturer	Model Number	Serial Number
C	Laptop	Dell	Vostro 1510	4953929473

**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	LocoM5 - Main	Ethernet	1	10	Y	PSU – POE port
1	PSU - POE	Ethernet	1	10	Y	LocoM5 - Main
2	PSU - LAN	Ethernet	1	10	Y	Laptop
3	AC port	AC Cable	1	0.5	Y	100-240VAC Source

**Table 6. Ports and Cabling Information**

## H. Mode of Operation

Transmit 6-54Mbps at 5 GHz.

## I. Method of Monitoring EUT Operation

IP connectivity is maintained with the EUT. If IP connectivity is lost, EUT connectivity shall be re-established upon power up or re-boot.

## 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 upon completion of testing.

### III. Electromagnetic Compatibility Criteria for Intentional Radiators

## Electromagnetic Compatibility Criteria for Intentional Radiators

### Conducted Emissions Limits

**Test Requirement(s):** 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  $\mu$ H/50  $\Omega$  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)	Conducted Limit (dB $\mu$ V)	
	Quasi-Peak	Average
* 0.15- 0.45	66 - 56	56 - 46
0.45 - 0.5	56	46
0.5 - 30	60	50

**Table 7. Conducted Limits for Intentional Radiators**

**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  $\Omega$ /50  $\mu$ 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  $\Omega$ /50  $\mu$ 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.

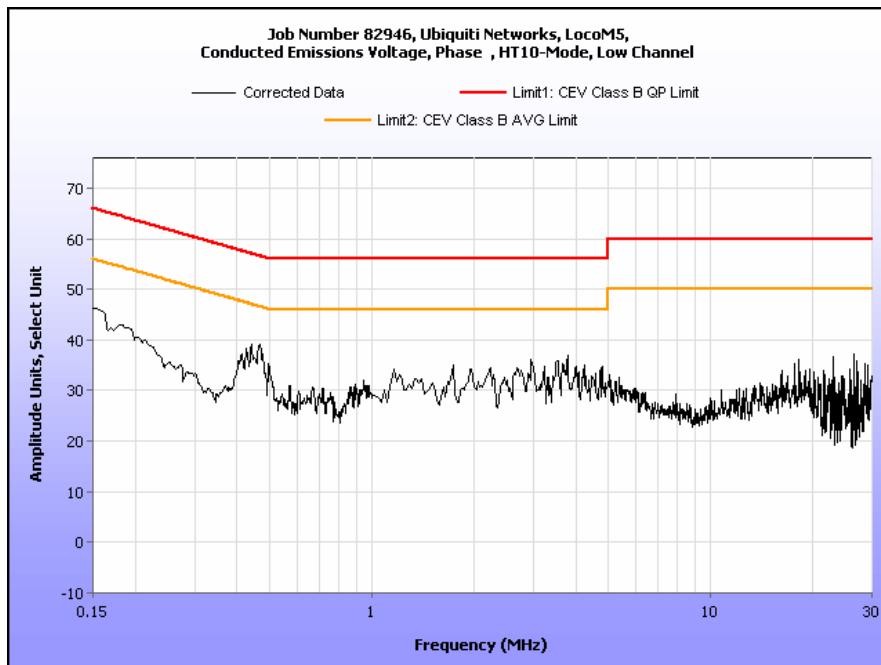
**Test Engineer(s):** Manasi Bhandiwad

**Test Date(s):** 04/01/11

## Conducted Emissions Test Results

Frequency (MHz)	Uncorrected Meter Reading (dBuV) QP	Cable Loss (dB)	Corrected Measurement (dBuV) QP	Limit (dBuV) QP	Margin (dB) QP	Uncorrected Meter Reading (dBuV) Avg.	Cable Loss (dB)	Corrected Measurement (dBuV) AVG	Limit (dBuV) AVG	Margin (dB) AVG
0.45075	51.69	0.03	51.72	56.86	-5.14	42.47	0.03	42.5	46.86	-4.36
0.71425	41.9	0.03	41.93	56	-14.07	36.14	0.03	36.17	46	-9.83
0.883	30.97	0.06	31.03	56	-24.97	21.31	0.06	21.37	46	-24.63
2.7	37.33	0.18	37.51	56	-18.49	31.01	0.18	31.19	46	-14.81
3.28625	36.64	0.2	36.84	56	-19.16	30.6	0.2	30.8	46	-15.2
3.916	36.81	0.24	37.05	56	-18.95	32.63	0.24	32.87	46	-13.13

Table 8. Conducted Emissions - Voltage, Phase Line

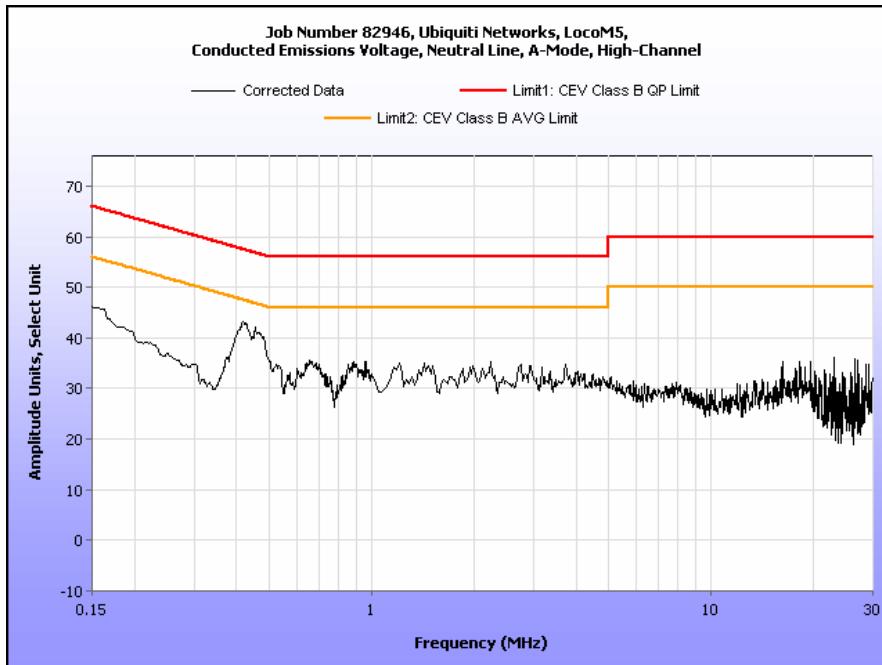


Plot 1. Conducted Emission, Phase Line Plot

## Conducted Emissions Test Results

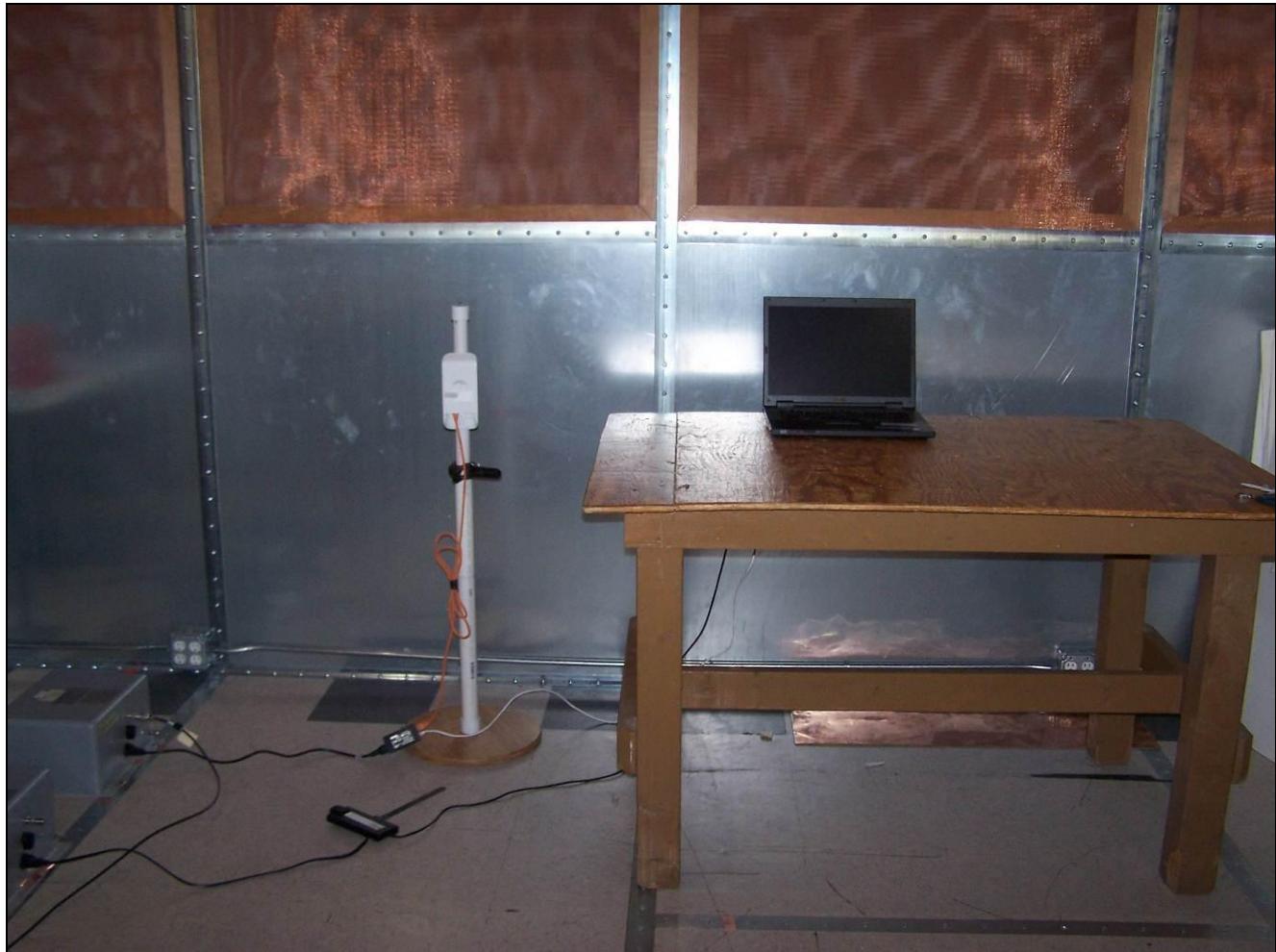
Frequency (MHz)	Uncorrected Meter Reading (dBuV) QP	Cable Loss (dB)	Corrected Measurement (dBuV) QP	Limit (dBuV) QP	Margin (dB) QP	Uncorrected Meter Reading (dBuV) Avg.	Cable Loss (dB)	Corrected Measurement (dBuV) AVG	Limit (dBuV) AVG	Margin (dB) AVG
0.4535	40.07	0.03	40.1	56.81	-16.71	28.41	0.03	28.44	46.81	-18.37
0.9	35.16	0.06	35.22	56	-20.78	27.01	0.06	27.07	46	-18.93
0.6805	39.22	0.04	39.26	56	-16.74	31.56	0.04	31.6	46	-14.4
1.595	41.7	0.14	41.84	56	-14.16	34.88	0.14	35.02	46	-10.98
2.208	40.05	0.16	40.21	56	-15.79	34.97	0.16	35.13	46	-10.87
1.63125	41.18	0.14	41.32	56	-14.68	35.52	0.14	35.66	46	-10.34

**Table 9. Conducted Emissions - Voltage, Neutral Line**



**Plot 2. Conducted Emission, Neutral Line Plot**

### Conducted Emissions Test Setup Photo



Photograph 2. Conducted Emissions, Test Setup

## Electromagnetic Compatibility Criteria for Intentional Radiators

### 6 dB and 99% Bandwidth

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

The minimum 6dB bandwidth shall be at least 500 kHz.

**Test Procedure:**

**6 dB Occupied Bandwidth:**

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. Peak detector was used.

**99% Occupied Bandwidth:**

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 span,  $VBW > RBW$ . The 99% Bandwidth was measured and recorded. The measurements were performed on the low, mid and high channels. Sample detector was used.

**Test Results**

The EUT was compliant with this requirement.

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

**Test Engineer(s):** Manasi Bhandiwad

**Test Date(s):** 03/16/11



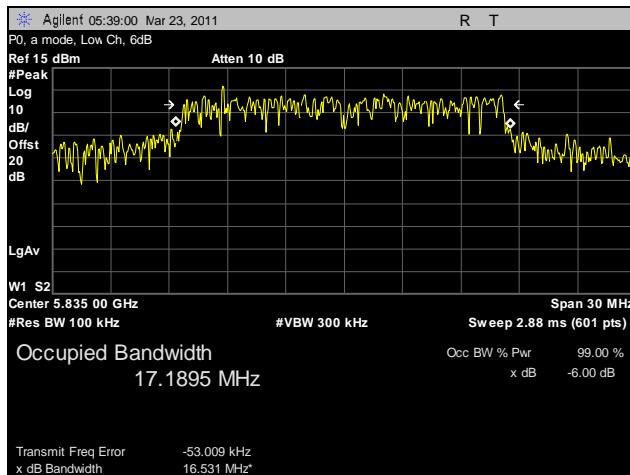
**Figure 2. Block Diagram, Occupied Bandwidth Test Setup**

## Occupied Bandwidth Test Results

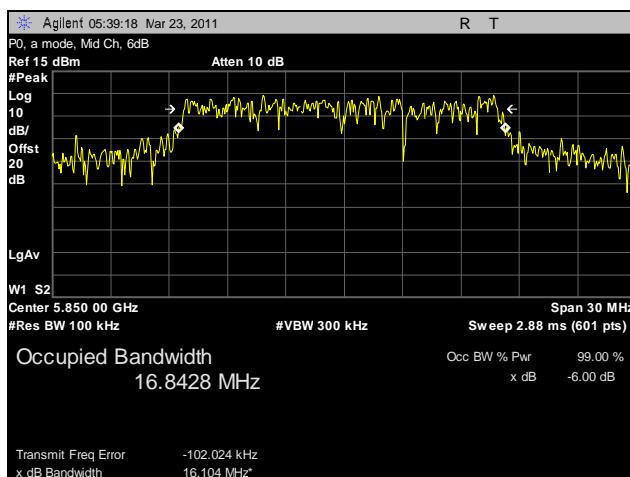
Mode	Carrier Channel	Frequency (MHz)	Occupied Bandwidth MHz			
			Port 1 MHz		Port 2 MHz	
			99%	6dB	99%	6dB
a	Low	5835	16.94	17.18	N/A	N/A
	Mid	5850	16.92	16.84		
	High	5865	16.97	16.59		
HT10	Low	5835	8.85	9.37	8.95	8.91
	Mid	5850	8.58	9.21	9.09	8.90
	High	5865	8.58	9.56	9.04	8.88
HT20	Low	5835	18.01	17.88	18.13	17.71
	Mid	5850	18.11	17.96	17.81	17.74
	High	5865	17.69	17.87	17.75	17.69
HT40	-	5850	36.11	26.35	36.11	36.28

Table 10. Occupied Bandwidth, Test Results

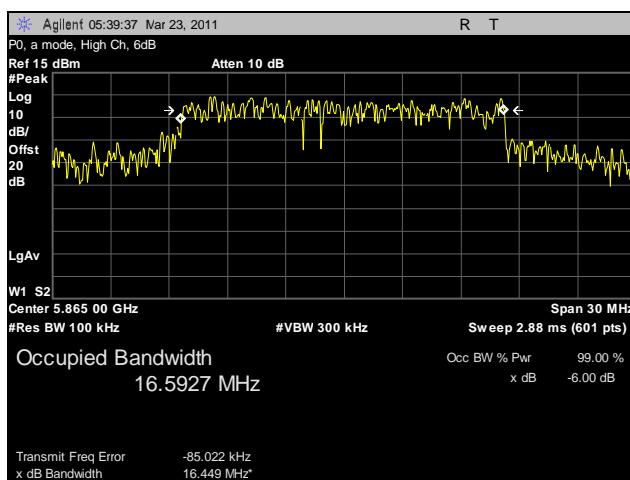
## 6 dB Occupied Bandwidth Test Results, a Mode, Port 0



Plot 3. 6 dB Occupied Bandwidth, Low Channel, a Mode, Port 0

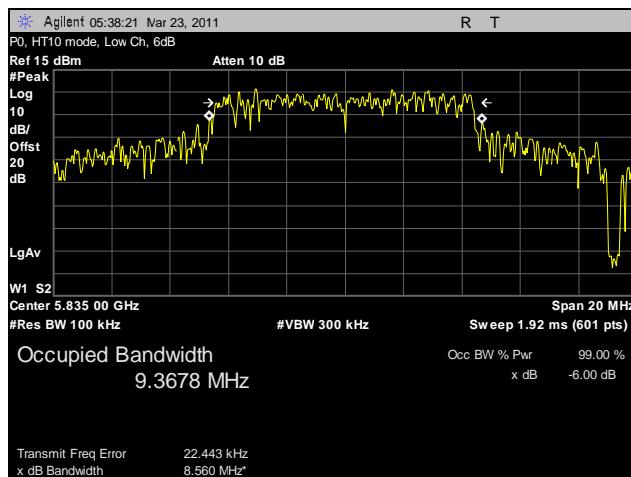


Plot 4. 6 dB Occupied Bandwidth, Mid Channel, a Mode, Port 0

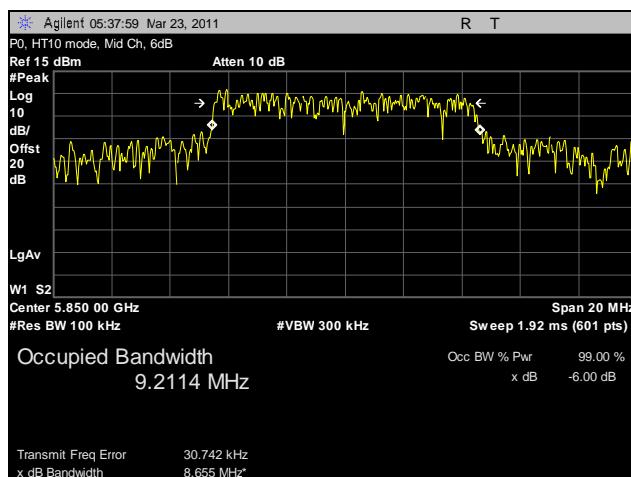


Plot 5. 6 dB Occupied Bandwidth, High Channel, a Mode, Port 0

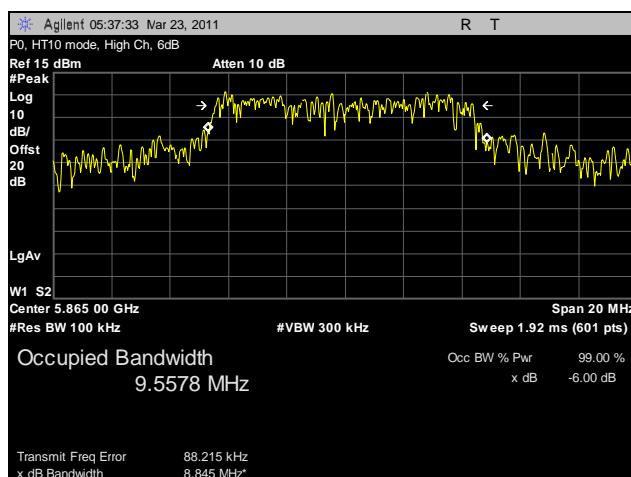
## 6 dB Occupied Bandwidth Test Results, HT10, Port 0



Plot 6. 6 dB Occupied Bandwidth, Low Channel, HT10, Port 0

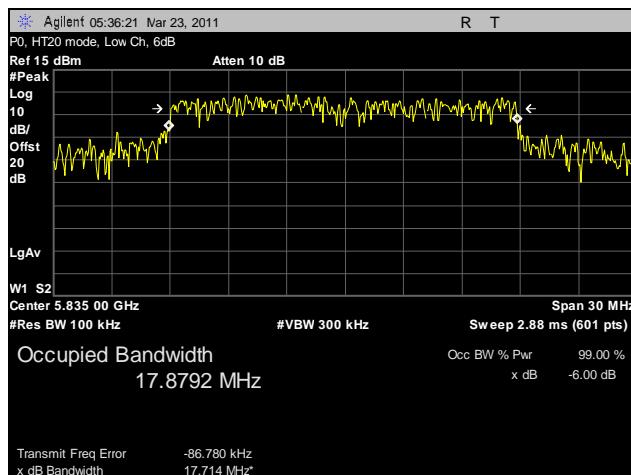


Plot 7. 6 dB Occupied Bandwidth, Mid Channel, HT10, Port 0

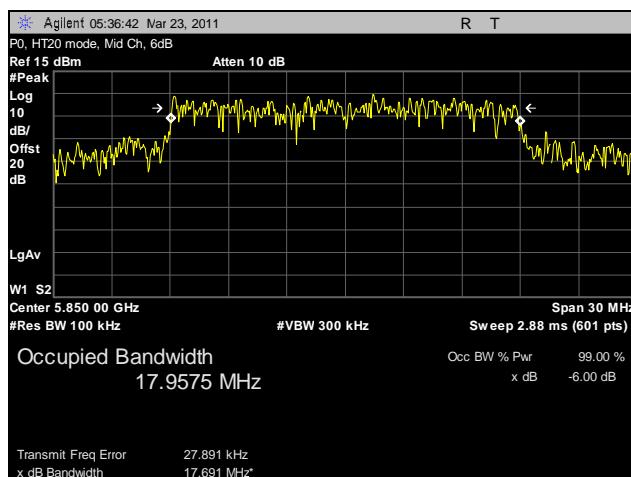


Plot 8. 6 dB Occupied Bandwidth, High Channel, HT10, Port 0

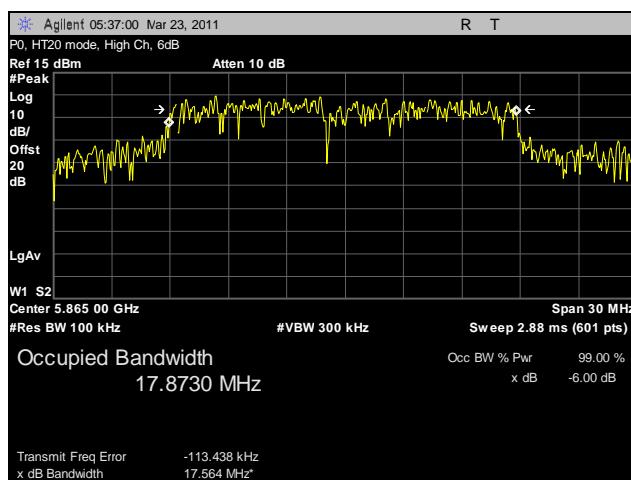
## 6 dB Occupied Bandwidth Test Results, HT20, Port 0



Plot 9. 6 dB Occupied Bandwidth, Low Channel, HT20, Port 0

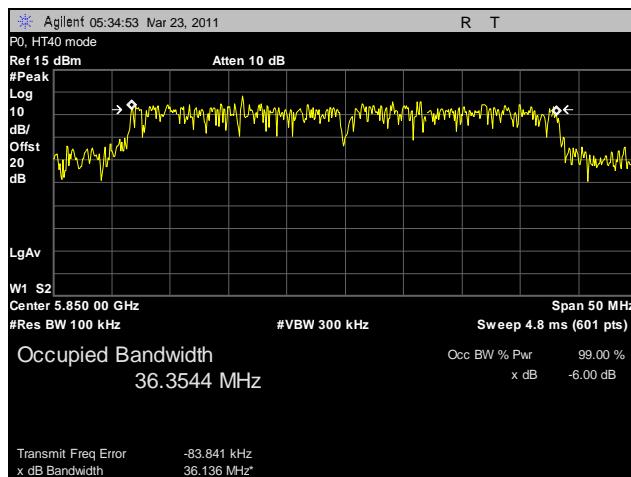


Plot 10. 99% Occupied Bandwidth, Mid Channel, HT20, Port 0



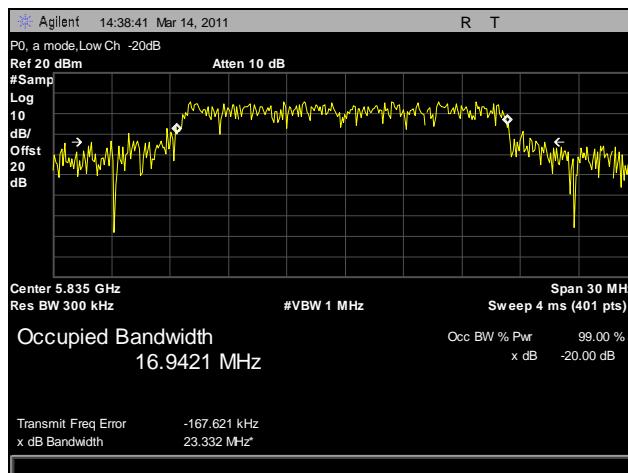
Plot 11. 6 dB Occupied Bandwidth, High Channel, HT20, Port 0

## 6 dB Occupied Bandwidth Test Results, HT40, Port 0

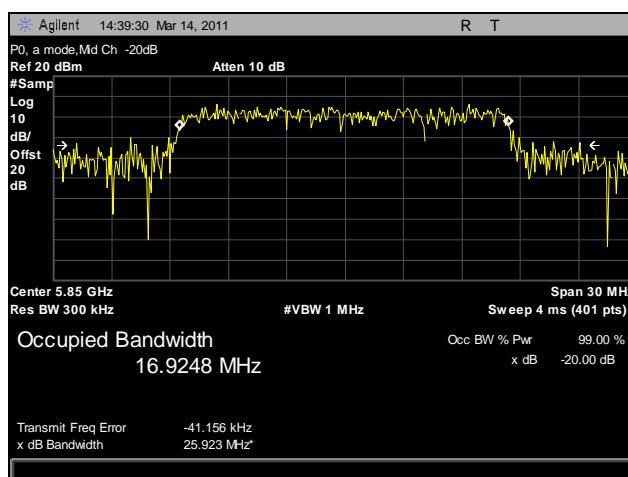


**Plot 12. 6 dB Occupied Bandwidth, HT40, Port 0**

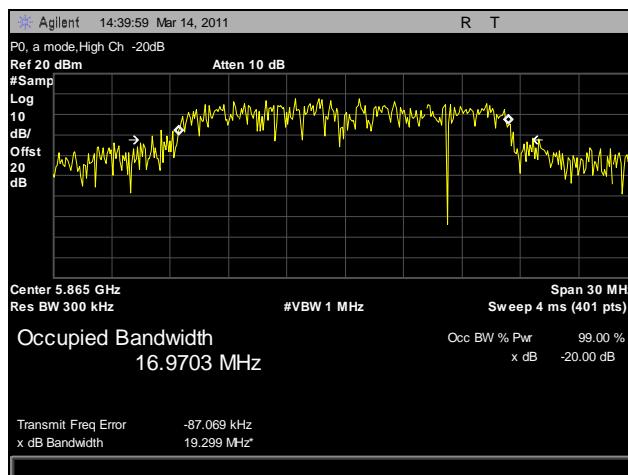
## 99% Occupied Bandwidth Test Results, a Mode, Port 0



Plot 13. 99% Occupied Bandwidth, Low Channel, a Mode, Port 0

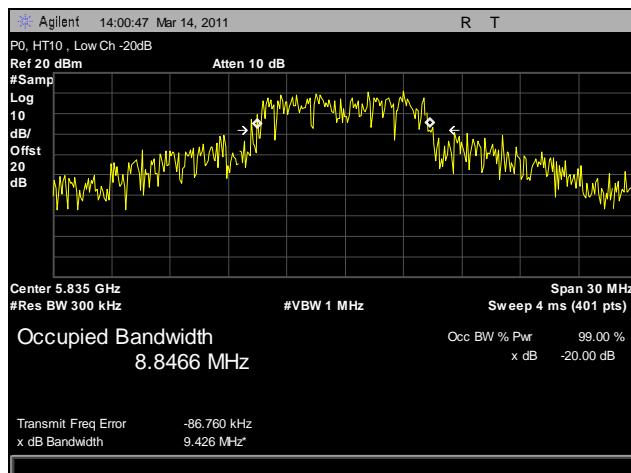


Plot 14. 99% Occupied Bandwidth, Mid Channel, a Mode, Port 0

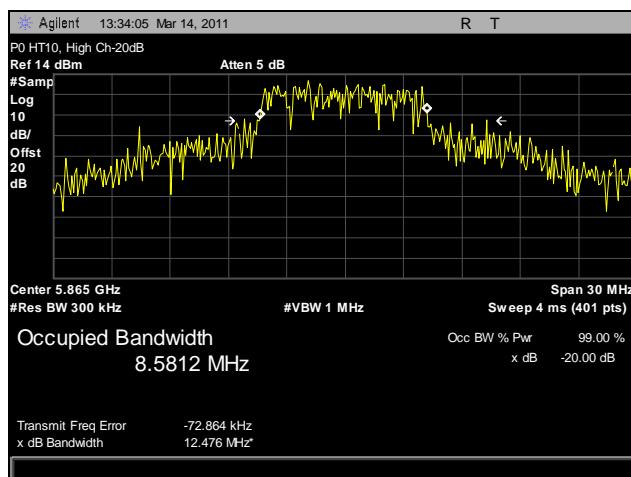


Plot 15. 99% Occupied Bandwidth, High Channel, a Mode, Port 0

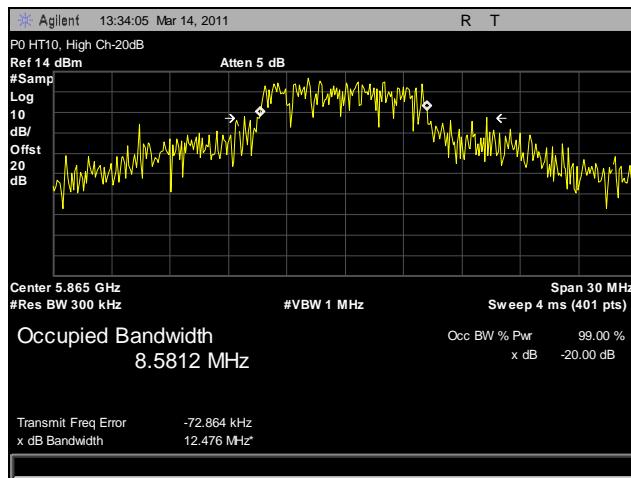
## 99% Occupied Bandwidth Test Results, HT10, Port 0



Plot 16. 99% Occupied Bandwidth, Low Channel, HT10, Port 0

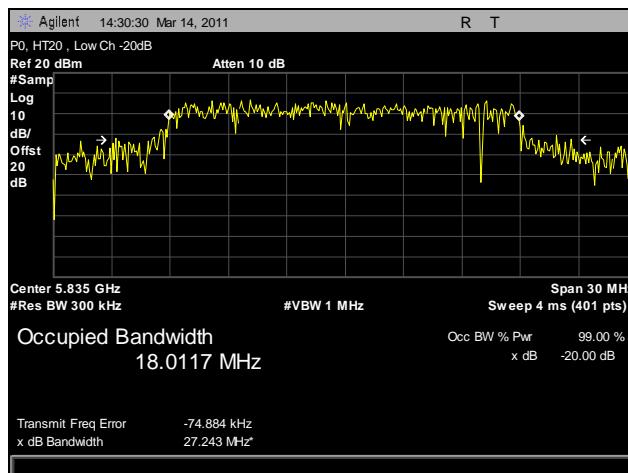


Plot 17. 99% Occupied Bandwidth, Mid Channel, HT10, Port 0

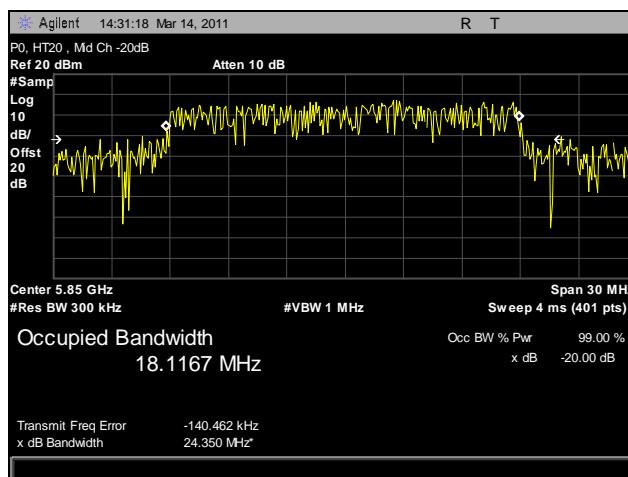


Plot 18. 99% Occupied Bandwidth, High Channel, HT10, Port 0

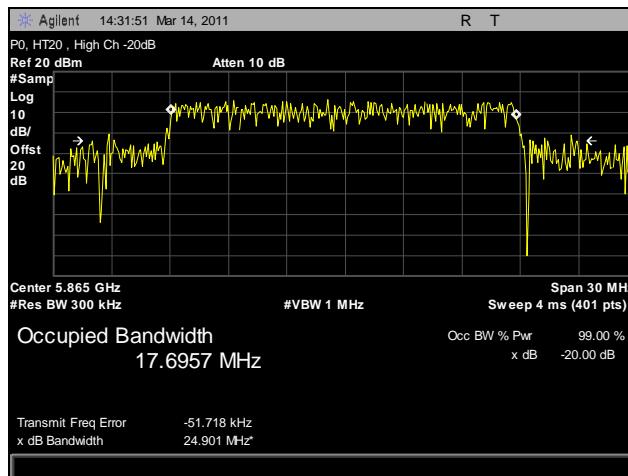
## 99% Occupied Bandwidth Test Results, HT20, Port 0



Plot 19. 99% Occupied Bandwidth, Low Channel, HT20, Port 0

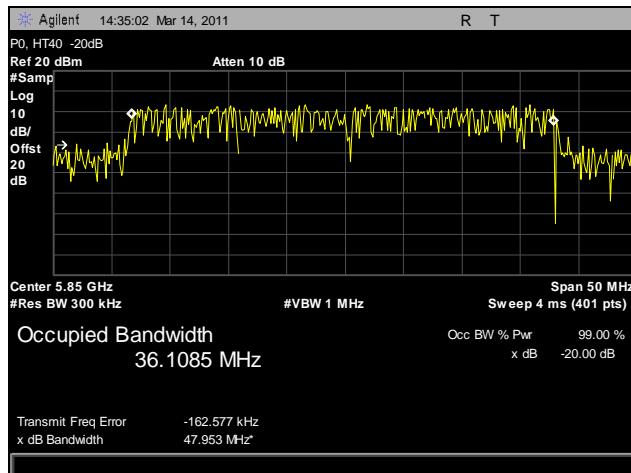


Plot 20. 6 dB Occupied Bandwidth, Mid Channel, HT20, Port 0



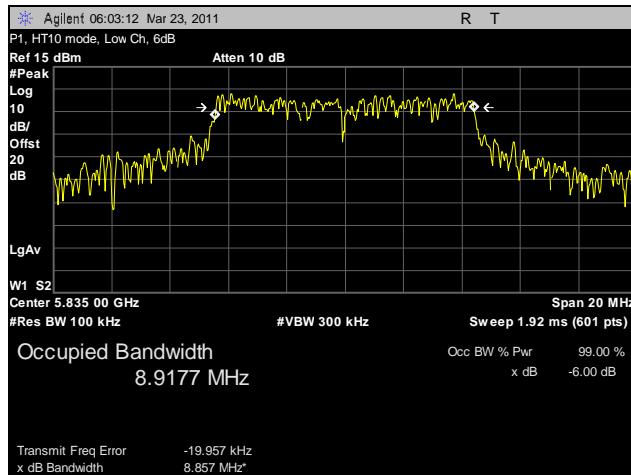
Plot 21. 99% Occupied Bandwidth, High Channel, HT20, Port 0

## 99% Occupied Bandwidth Test Results, HT40, Port 0

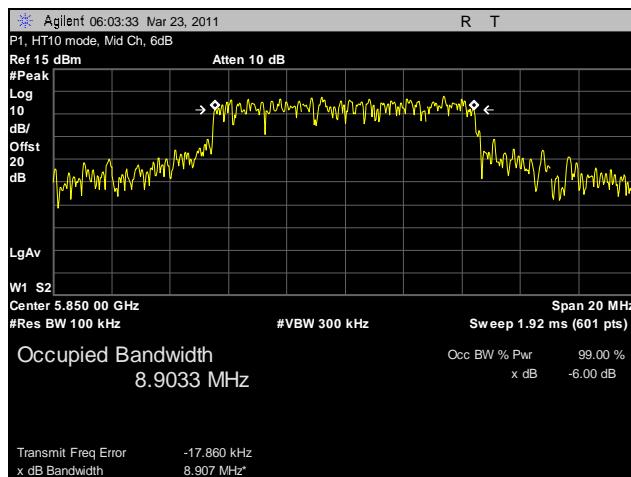


Plot 22. 99% Occupied Bandwidth, HT40, Port 0

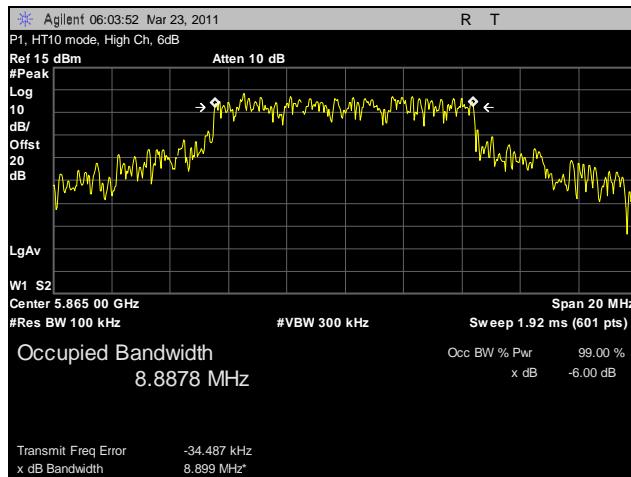
## 6 dB Occupied Bandwidth Test Results, HT10, Port 1



Plot 23. 6 dB Occupied Bandwidth, Low Channel, HT10, Port 1

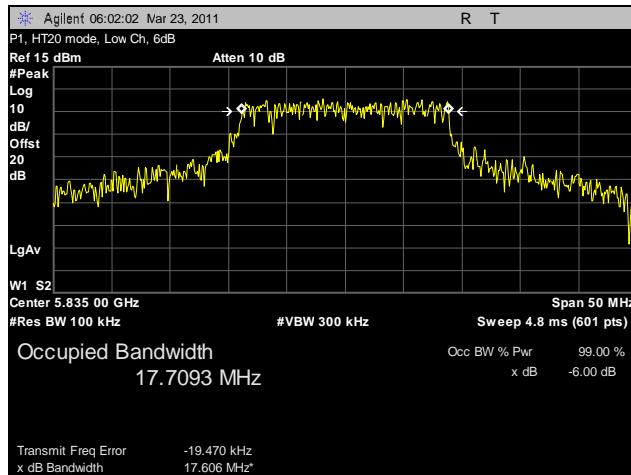


Plot 24. 6 dB Occupied Bandwidth, Mid Channel, HT10, Port 1

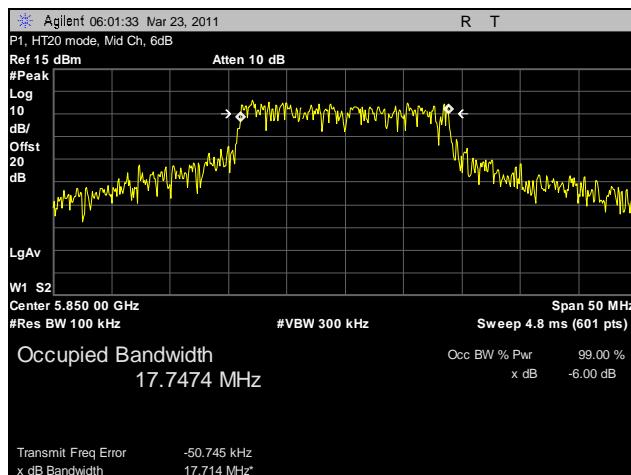


Plot 25. 6 dB Occupied Bandwidth, High Channel, HT10, Port 1

## 6 dB Occupied Bandwidth Test Results, HT20, Port 1



Plot 26. 6 dB Occupied Bandwidth, Low Channel, HT20, Port 1

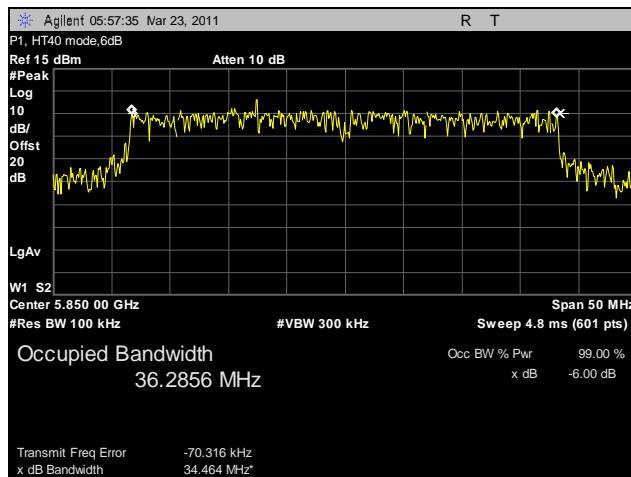


Plot 27. 6 dB Occupied Bandwidth, Mid Channel, HT20, Port 1



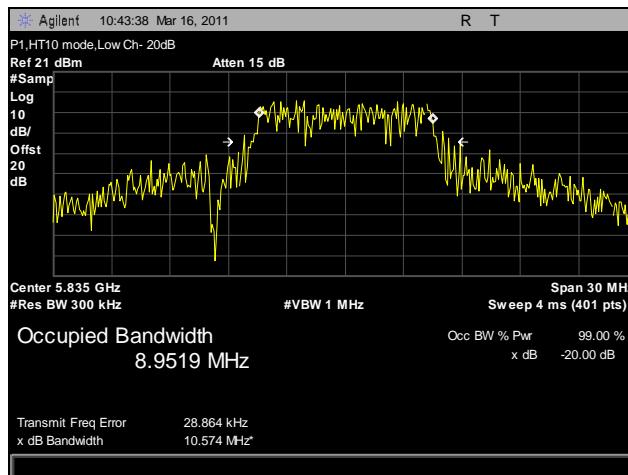
Plot 28. 6 dB Occupied Bandwidth, High Channel, HT20, Port 1

## 6 dB Occupied Bandwidth Test Results, HT40, Port 1

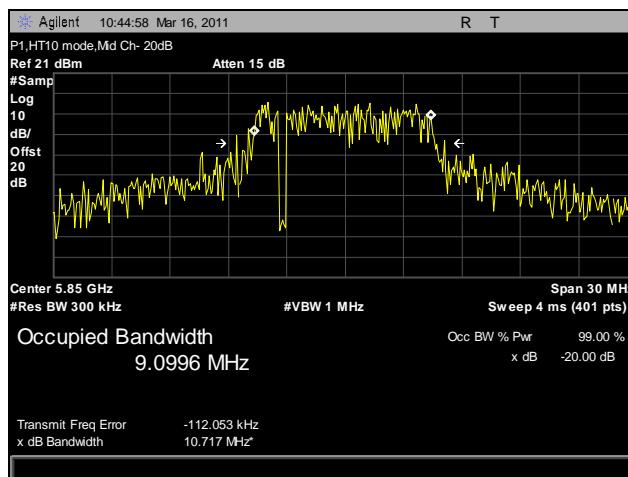


**Plot 29. 6 dB Occupied Bandwidth, HT40, Port 1**

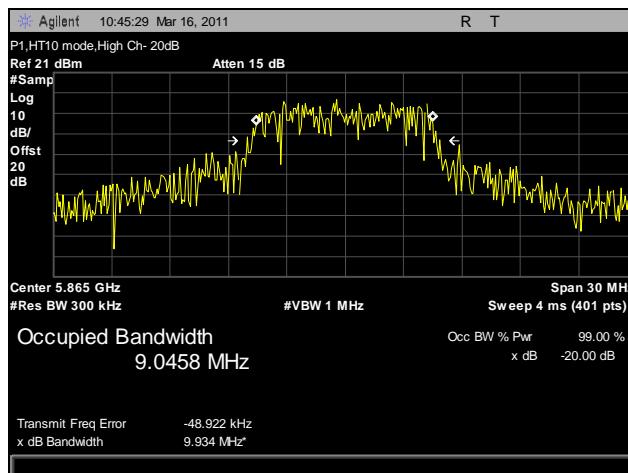
## 99% Occupied Bandwidth Test Results, HT10, Port 1



Plot 30. 99% Occupied Bandwidth, Low Channel, HT10, Port 1

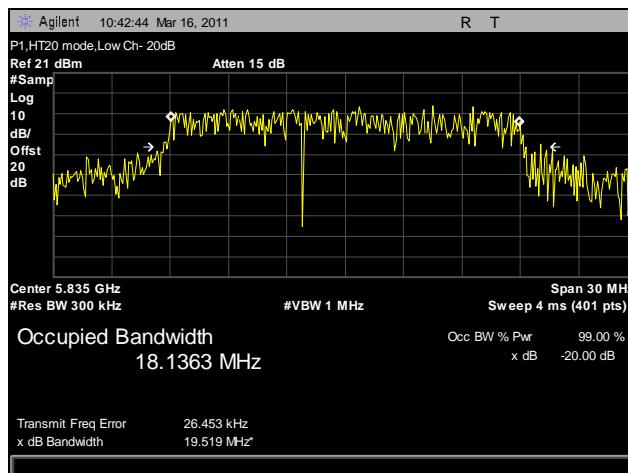


Plot 31. 99% Occupied Bandwidth, Mid Channel, HT10, Port 1

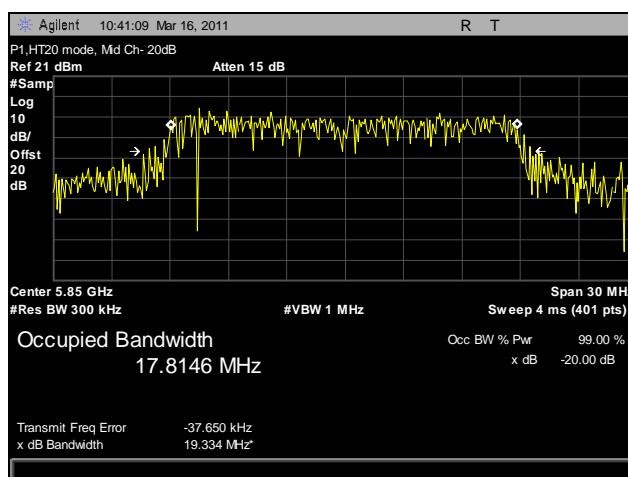


Plot 32. 99% Occupied Bandwidth, High Channel, HT10, Port 1

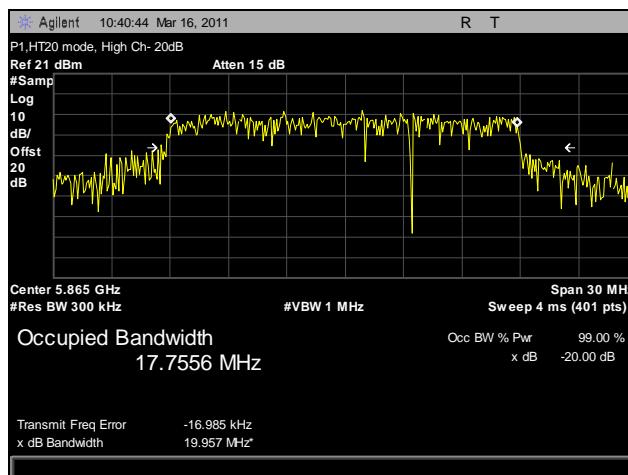
## 99% Occupied Bandwidth Test Results, HT20, Port 1



Plot 33. 99% Occupied Bandwidth, Low Channel, HT20, Port 1

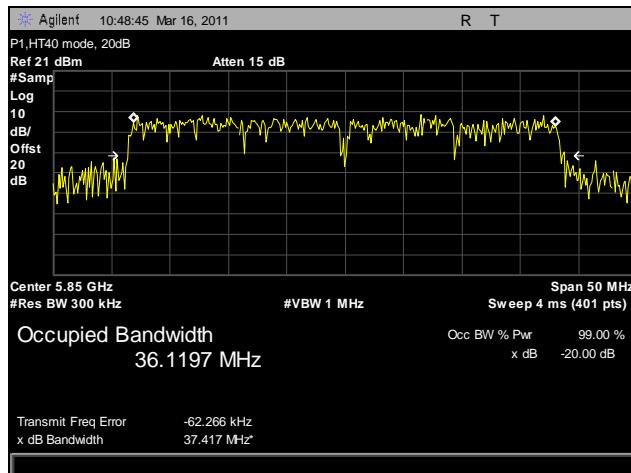


Plot 34. 99% Occupied Bandwidth, Mid Channel, HT20, Port 1



Plot 35. 99% Occupied Bandwidth, High Channel, HT20, Port 1

## 99% Occupied Bandwidth Test Results, HT40, Port 1



Plot 36. 99% Occupied Bandwidth, HT40, Port 1

## Electromagnetic Compatibility Criteria for Intentional Radiators

### Peak Power Output and Peak Excursion

**Test Requirements:** The maximum peak output power of the intentional radiator shall not exceed the following:

Digital Transmission Systems (MHz)	Output Limit
5825–5875	36 dBm EIRP

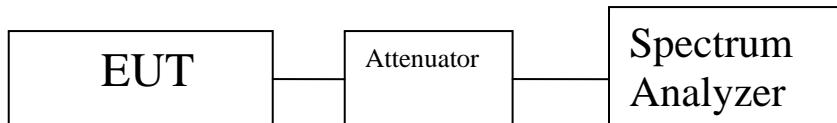
**Table 11. Output Power Requirements**

**Test Procedure:** The EUT was connected to a Spectrum Analyzer. The power was measured on three channels.

**Test Results:** The EUT was compliant with the Peak Power Output limits.

**Test Engineer(s):** Manasi Bhandiwad

**Test Date(s):** 03/21/11



**Figure 3. Peak Power Output Test Setup**

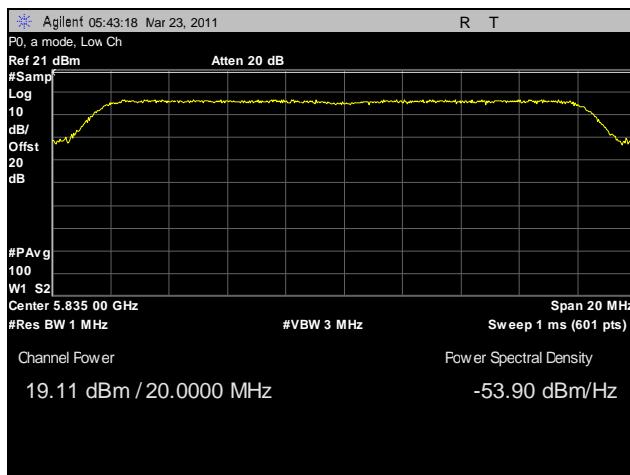
## RF Power Output Test Results

Peak Conducted Output Power dBm							
Mode	Carrier Channel	Frequency (MHz)	Port 1 dBm	Port 2 dBm	Summed Peak Output Power dBm	Limit dBm	Margin dBm
a	Low	5835	19.11	N/A	19.11	23	-3.89
	Mid	5850	19.08	N/A	19.08	23	-3.92
	High	5865	19.01	N/A	19.01	23	-3.99
HT10	Low	5835	19.1	16.27	19.89	23	-3.11
	Mid	5850	19.02	16.26	19.83	23	-3.17
	High	5865	18.79	16.08	19.63	23	-3.37
HT20	Low	5835	19.02	16.59	19.84	23	-3.16
	Mid	5850	18.74	16.24	19.59	23	-3.41
	High	5865	18.79	16.29	19.64	23	-3.36
HT40	-	5850	18.82	16.16	19.66	23	-3.34

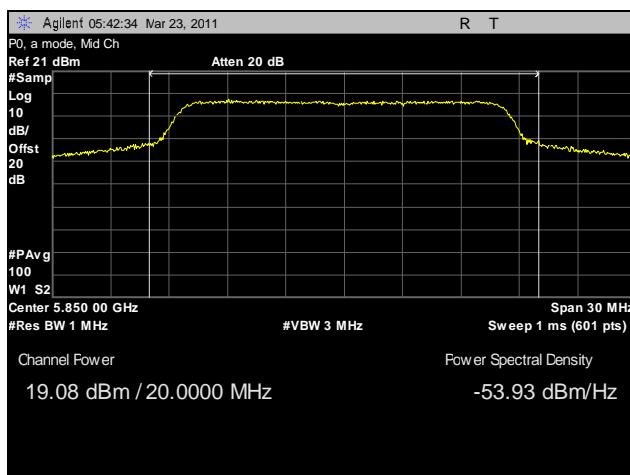
**Table 12. RF Output Power, Test Results**

The transmitter was connected directly to a spectrum analyzer through an attenuator. The power level was set to the maximum level on the EUT. The RBW was set to 1 MHz and VBW was set to 3 MHz. The method of measurement number from the FCC public notice DA 02-2138 was used.

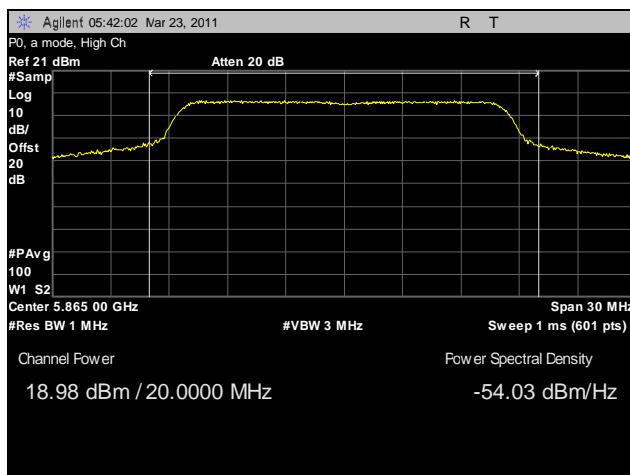
## RF Output Power Test Results, a Mode, Port 0



Plot 37. Peak Output Power, Low Channel, a Mode, Port 0

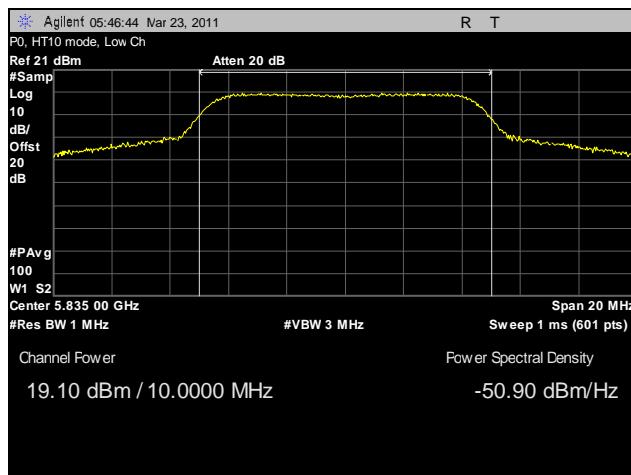


Plot 38. Peak Output Power, Mid Channel, a Mode, Port 0

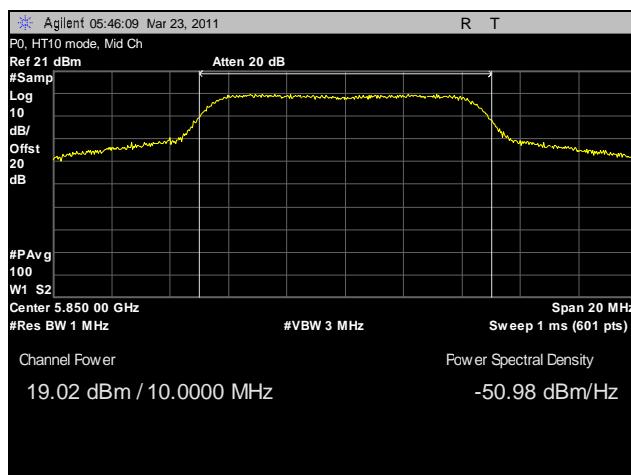


Plot 39. Peak Output Power, High Channel, a Mode, Port 0

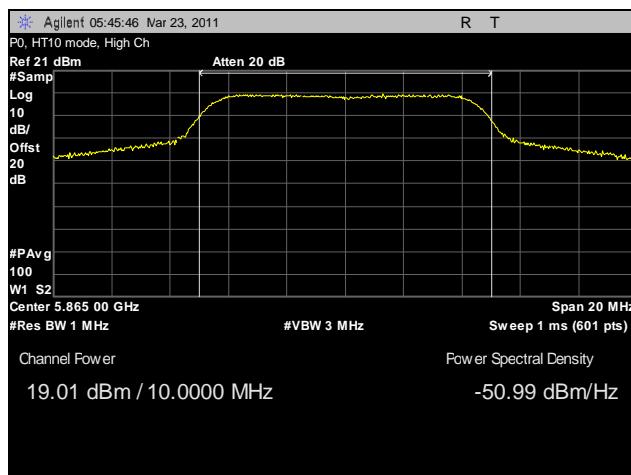
## RF Output Power Test Results, HT10, Port 0



**Plot 40. Peak Output Power, Low Channel, HT10, Port 0**

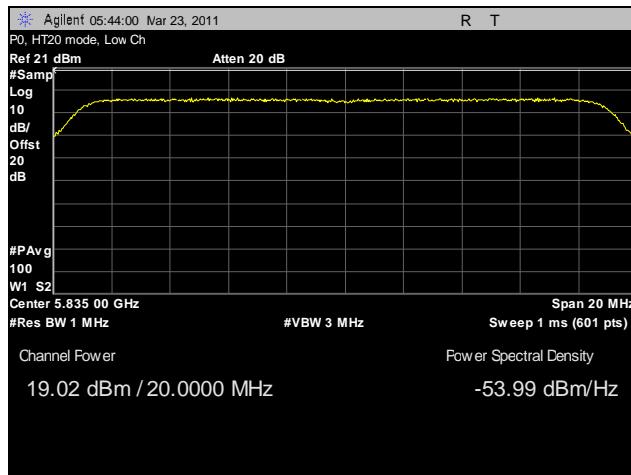


**Plot 41. Peak Output Power, Mid Channel, HT10, Port 0**

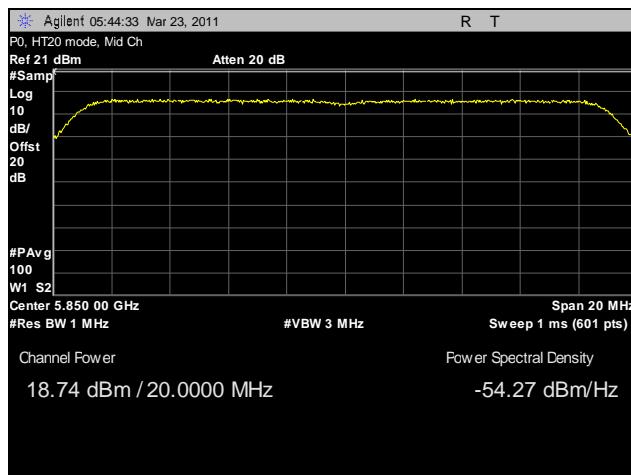


**Plot 42. Peak Output Power, High Channel, HT10, Port 0**

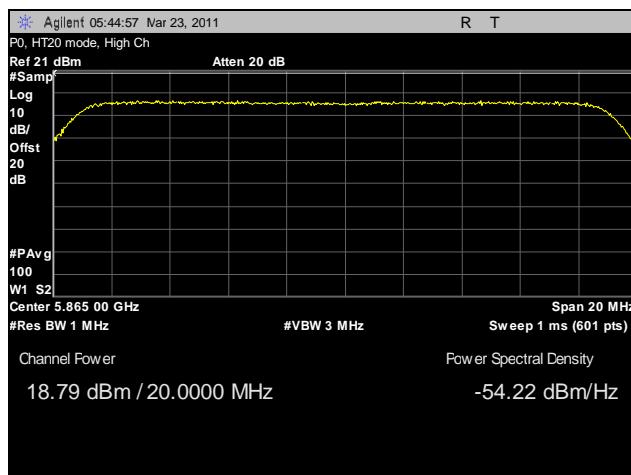
## RF Output Power Test Results, HT20, Port 0



Plot 43. Peak Output Power, Low Channel, HT20, Port 0

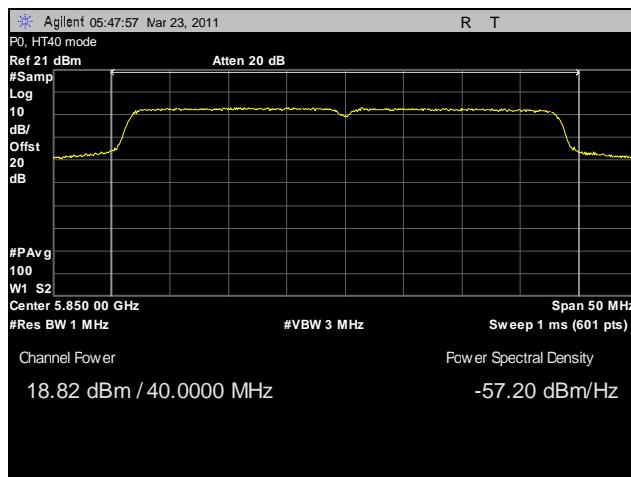


Plot 44. Peak Output Power, Mid Channel, HT20, Port 0



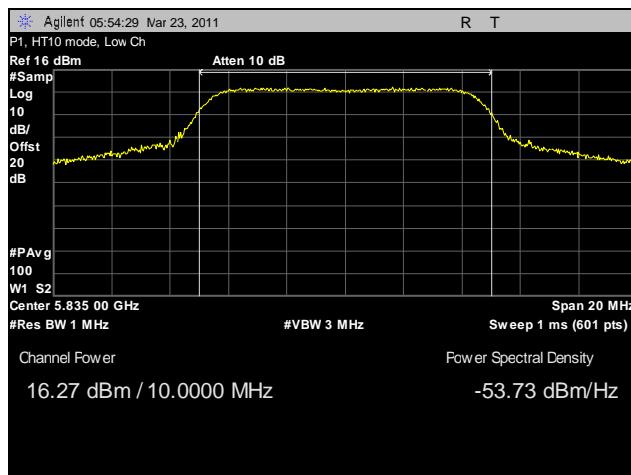
Plot 45. Peak Output Power, High Channel, HT20, Port 0

## RF Output Power Test Results, HT40, Port 0

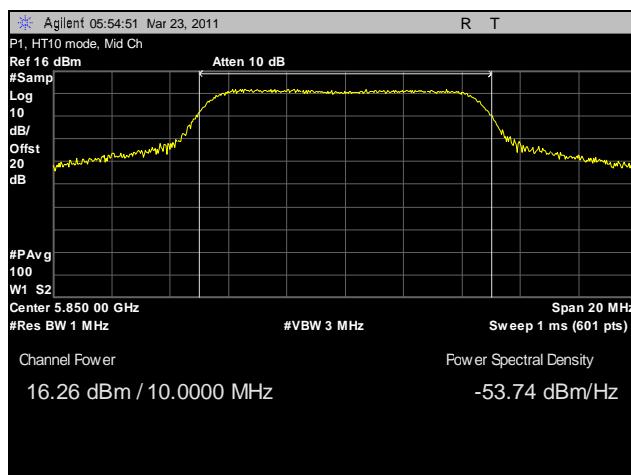


**Plot 46. Peak Output Power, HT40, Port 0**

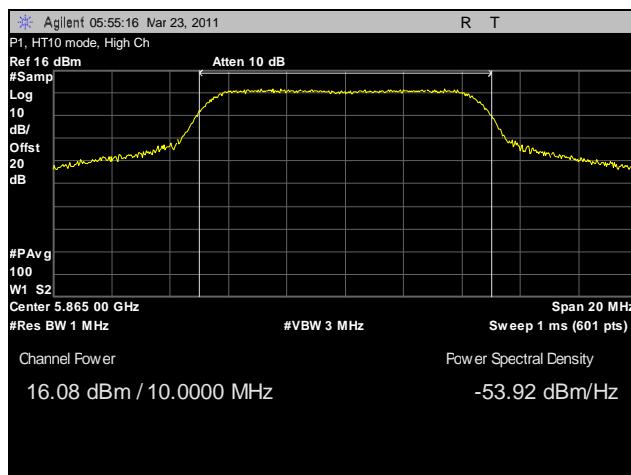
## RF Output Power Test Results, HT10, Port 1



**Plot 47. Peak Output Power, Low Channel, HT10, Port 1**

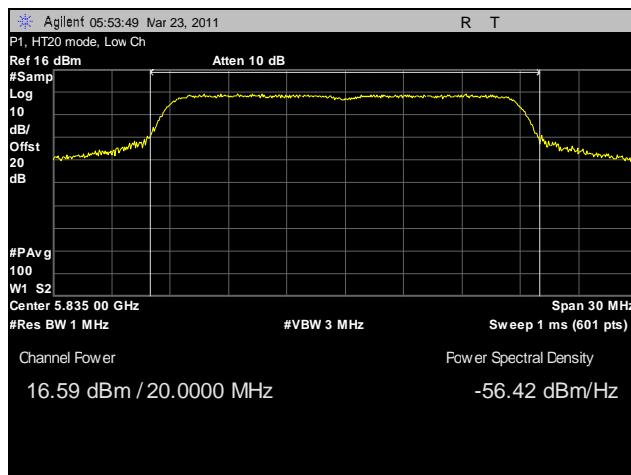


**Plot 48. Peak Output Power, Mid Channel, HT10, Port 1**

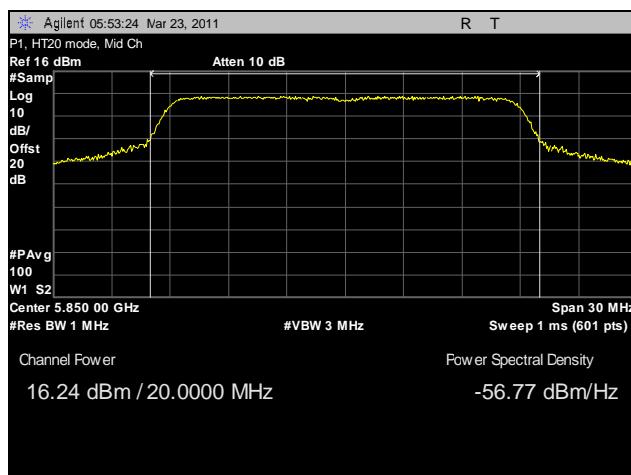


**Plot 49. Peak Output Power, High Channel, HT10, Port 1**

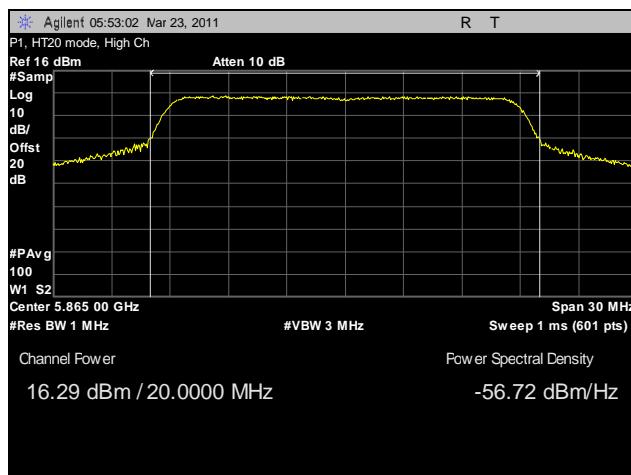
## RF Output Power Test Results, HT20, Port 1



**Plot 50. Peak Output Power, Low Channel, HT20, Port 1**

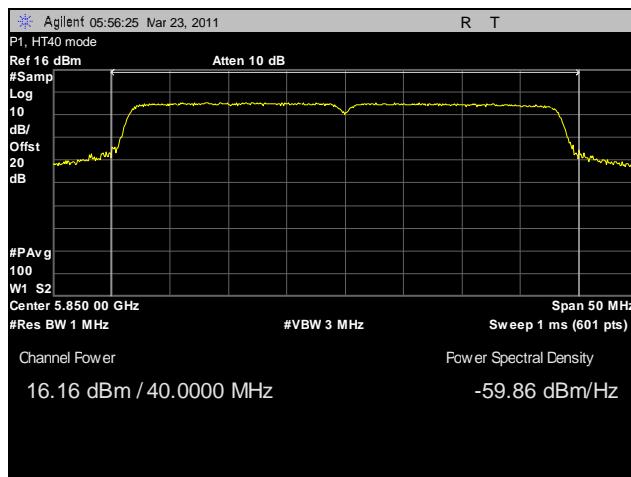


**Plot 51. Peak Output Power, Mid Channel, HT20, Port 1**



**Plot 52. Peak Output Power, High Channel, HT20, Port 1**

## RF Output Power Test Results, HT40, Port 1



**Plot 53. Peak Output Power, HT40, Port 1**

## Electromagnetic Compatibility Criteria for Intentional Radiators

### Peak Excursion Ratio

**Test Requirements:** The ratio of the peak excursion of the modulation envelope (measured using a peak hold function) to the maximum conducted output power (measured as specified above) shall not exceed 13 dB across any 1 MHz bandwidth or the emission bandwidth whichever is less.

**Test Procedure:** The EUT was connected directly to the spectrum analyzer through an attenuator. The span was set to view the entire emission bandwidth. Since method #1 of FCC public notice DA 02-2138 was used for peak conducted output transmit power, the second trace was created using method #1.

**Test Results:** Equipment was compliant with the peak excursion ratio limits.

**Test Engineer(s):** Manasi Bhandiwad

**Test Date(s):** 03/16/11

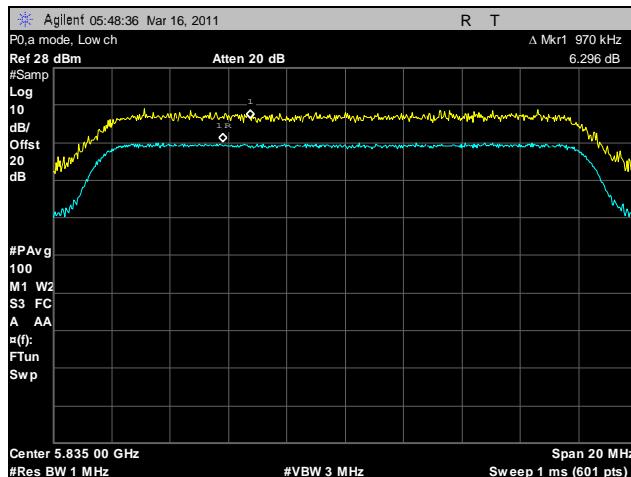


**Figure 4. Peak Excursion Ration Test Setup**

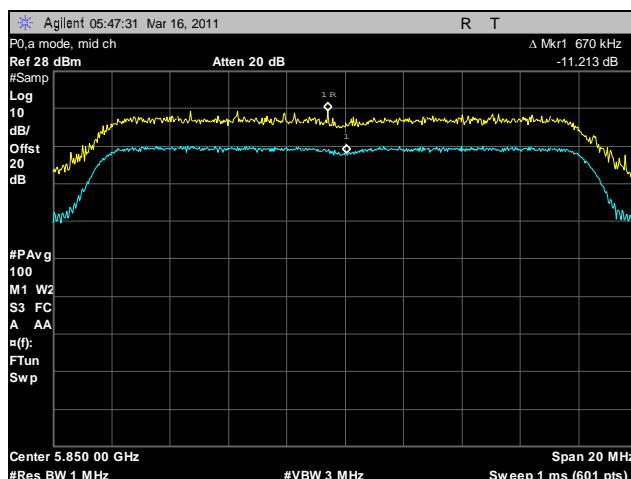
Peak Excursion dB Limit =13dB				
Mode	Carrier Channel	Frequency (MHz)	Port 1 dB	Port 2 dB
a	Low	5835	6.296	N/A
	Mid	5850	11.213	N/A
	High	5865	7.278	N/A
HT10	Low	5835	10.195	9.268
	Mid	5850	6.947	9.953
	High	5865	10.354	8.418
HT20	Low	5835	6.228	8.28
	Mid	5850	6.102	8.225
	High	5865	8.899	9.273
HT40	-	5850	7.226	9.1

**Table 13. Peak Excursion Ratio**

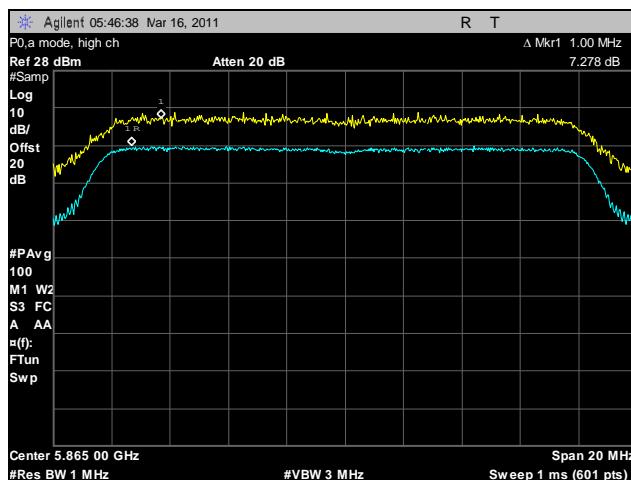
## Peak Excursion Ration Test Results, a Mode, Port 0



Plot 54. Peak Excursion, Low Channel, a Mode, Port 0

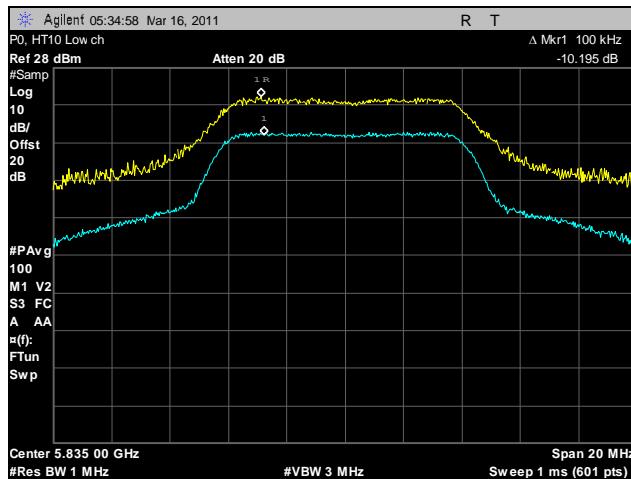


Plot 55. Peak Excursion, Mid Channel, a Mode, Port 0

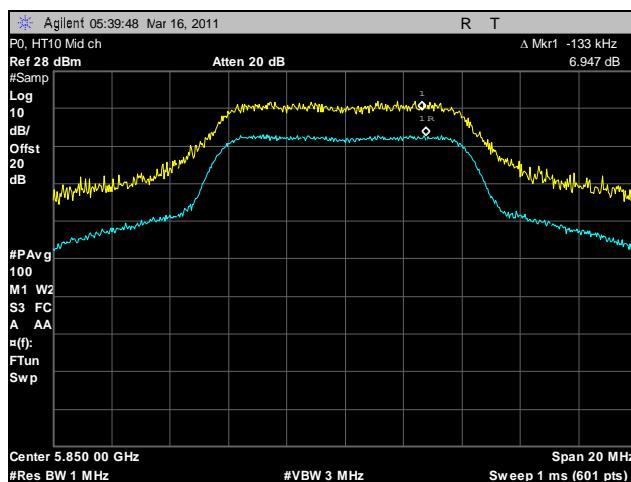


Plot 56. Peak Excursion, High Channel, a Mode, Port 0

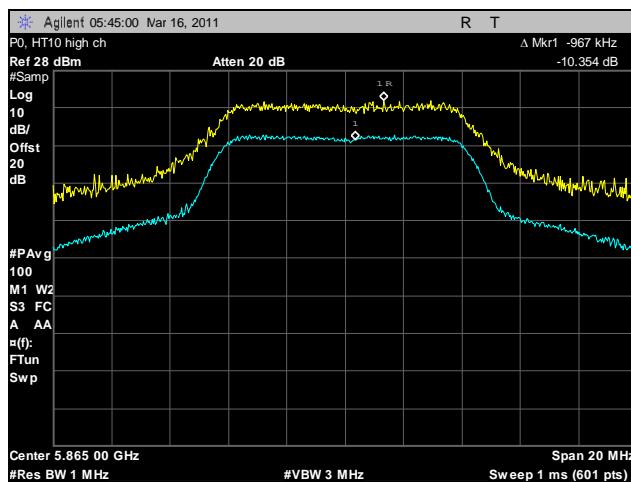
## Peak Excursion Ration Test Results, HT10, Port 0



Plot 57. Peak Excursion, Low Channel, HT10, Port 0

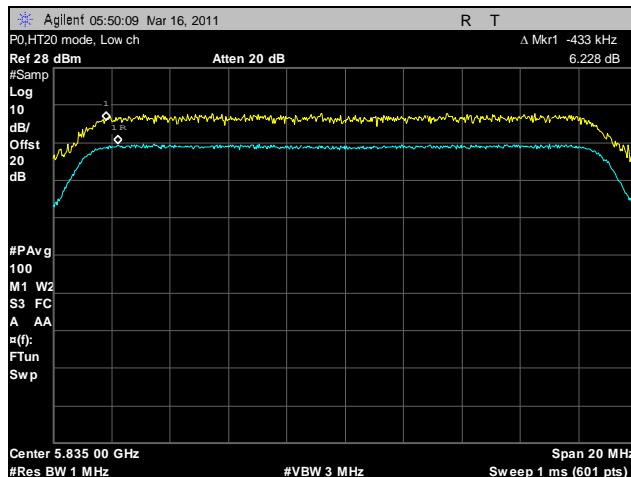


Plot 58. Peak Excursion, Mid Channel, HT10, Port 0

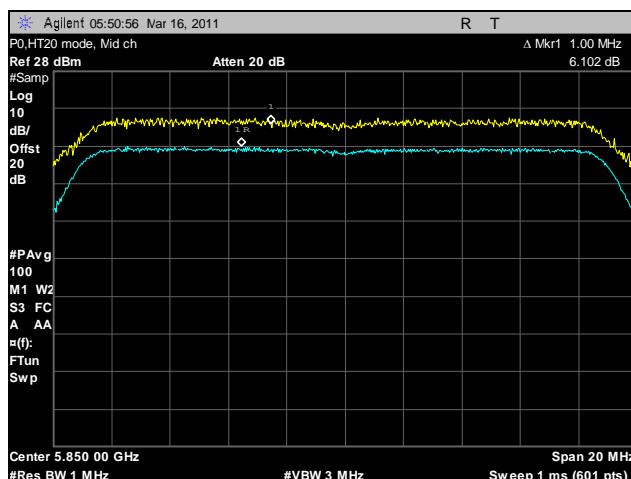


Plot 59. Peak Excursion, High Channel, HT10, Port 0

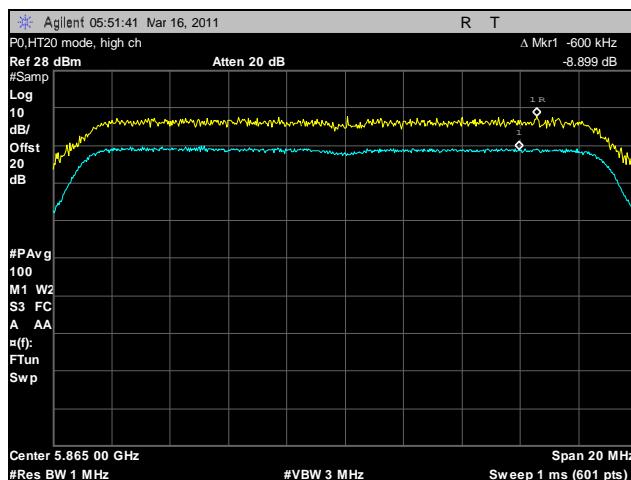
## Peak Excursion Ration Test Results, HT20, Port 0



Plot 60. Peak Excursion, Low Channel, HT20, Port 0

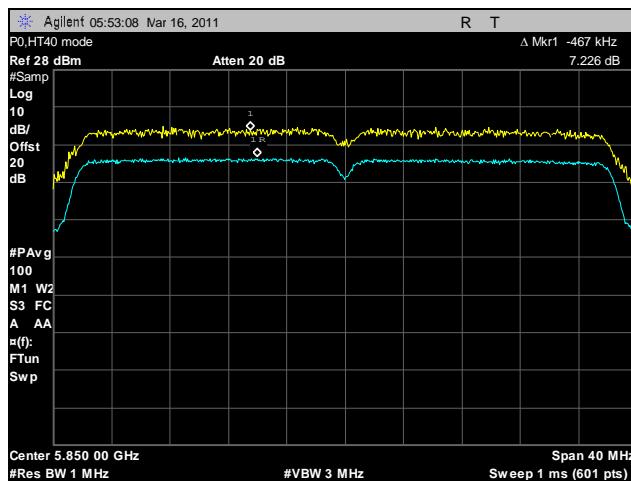


Plot 61. Peak Excursion, Mid Channel, HT20, Port 0



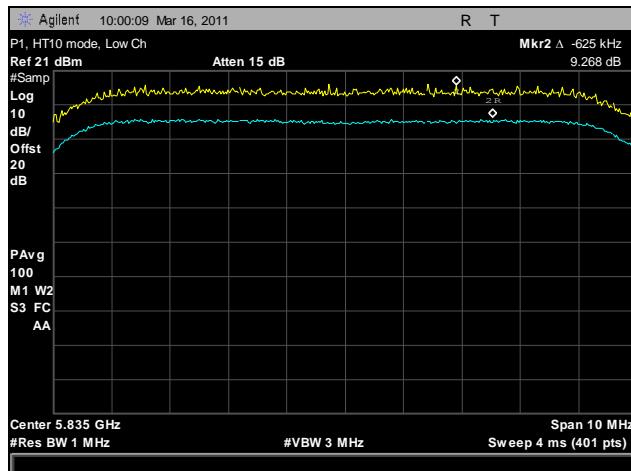
Plot 62. Peak Excursion, High Channel, HT20, Port 0

## Peak Excursion Ration Test Results, HT40, Port 0

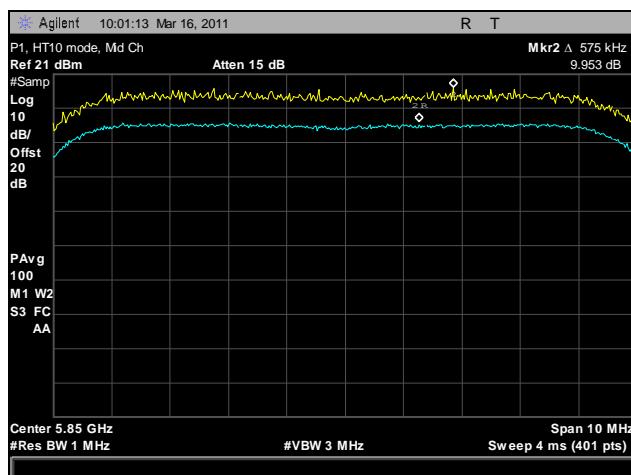


Plot 63. Peak Excursion, HT40, Port 0

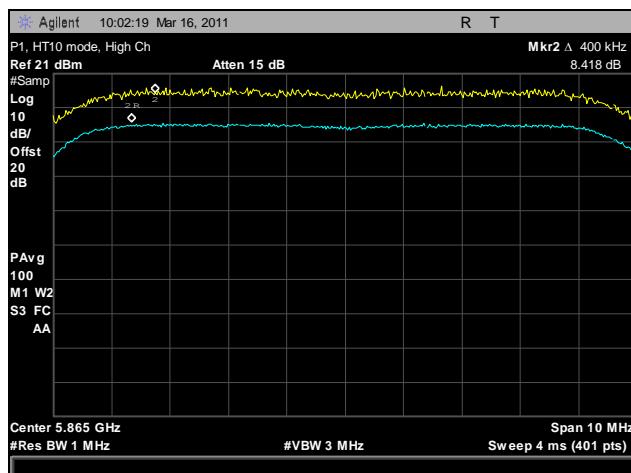
## Peak Excursion Ration Test Results, HT10, Port 1



Plot 64. Peak Excursion, Low Channel, HT10, Port 1

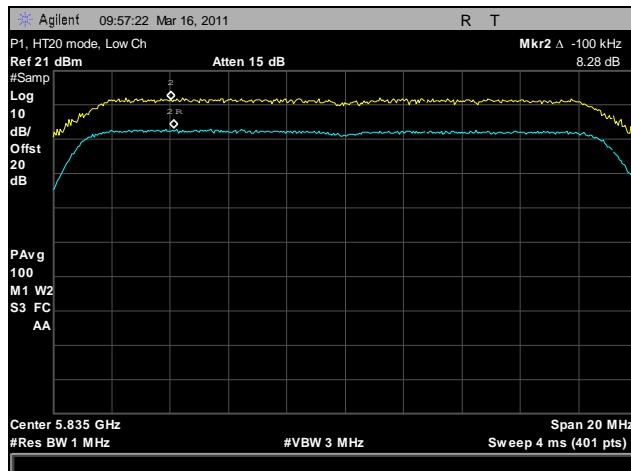


Plot 65. Peak Excursion, Mid Channel, HT10, Port 1

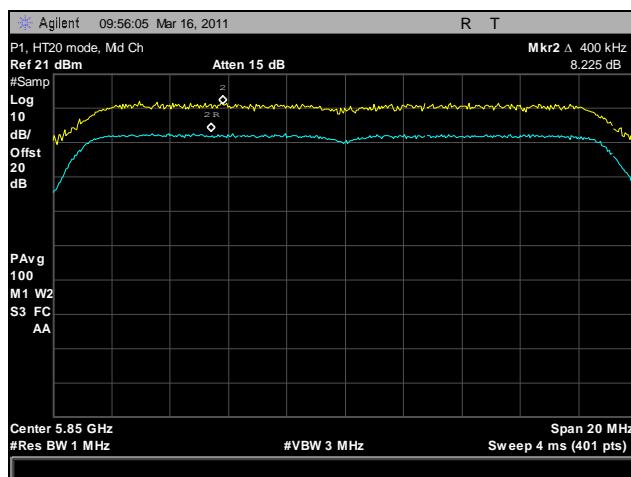


Plot 66. Peak Excursion, High Channel, HT10, Port 1

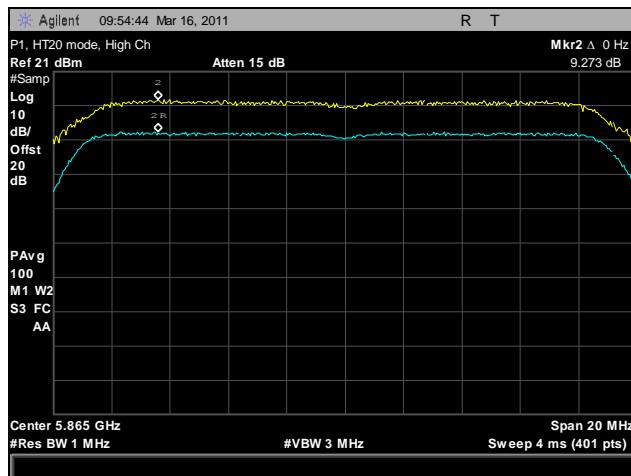
## Peak Excursion Ration Test Results, HT20, Port 1



Plot 67. Peak Excursion, Low Channel, HT20, Port 1

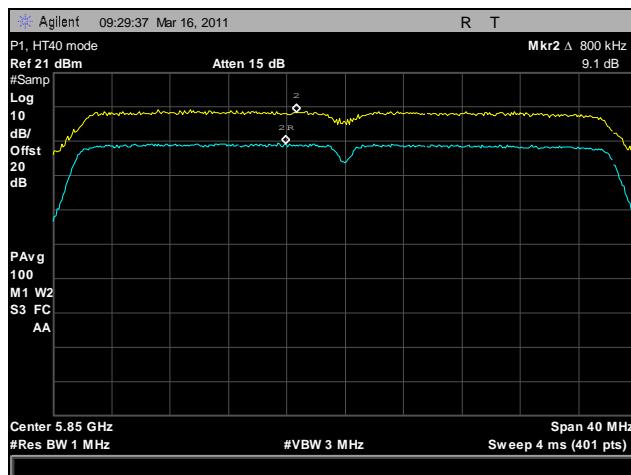


Plot 68. Peak Excursion, Mid Channel, HT20, Port 1



Plot 69. Peak Excursion, High Channel, HT20, Port 1

## Peak Excursion Ration Test Results, HT40, Port 1



Plot 70. Peak Excursion, HT40, Port 1

## Electromagnetic Compatibility Criteria for Intentional Radiators

### Radiated Spurious Emissions Requirements

**Test Requirements:** Emissions outside the frequency band.

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 is not required. In addition, radiated emissions which fall in the restricted bands, must also comply with the radiated emission limits.

**Test Requirement(s):** Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in Table 14.

Frequency (MHz)	Radiated Emission Limits (dB $\mu$ V) @ 3m
30 - 88	40.00
88 - 216	43.50
216 - 960	46.00
Above 960	54.00

**Table 14. Radiated Emissions Limits**

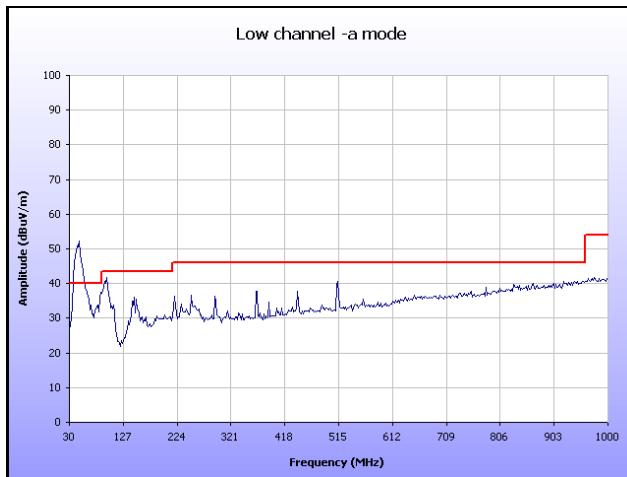
**Test Procedures:** The transmitter was turned on. Measurements were performed of the low, mid and high Channels. The EUT was rotated orthogonally through all three axes. Plots shown are corrected for both antenna correction factor and distance and compared to a 3 m limit line.

**Test Results:** The EUT was compliant with the Radiated Spurious Emission limits. In the 30 MHz – 1 GHz range, the emissions on all the channels – low, mid, and high are over the limits. However, it has been identified that these emissions which exceed the limits are digital emissions. This is further evident from the 30 MHz – 1 GHz plots for the low, mid and high channel in the receiver mode.

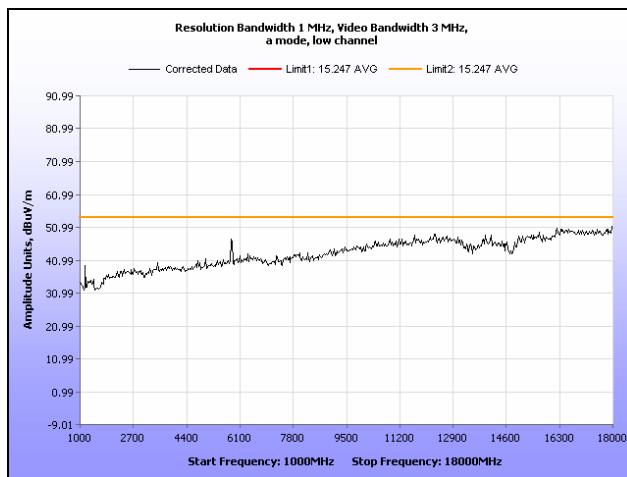
**Test Engineer(s):** Manasi Bhandiwad

**Test Date(s):** 04/11/11

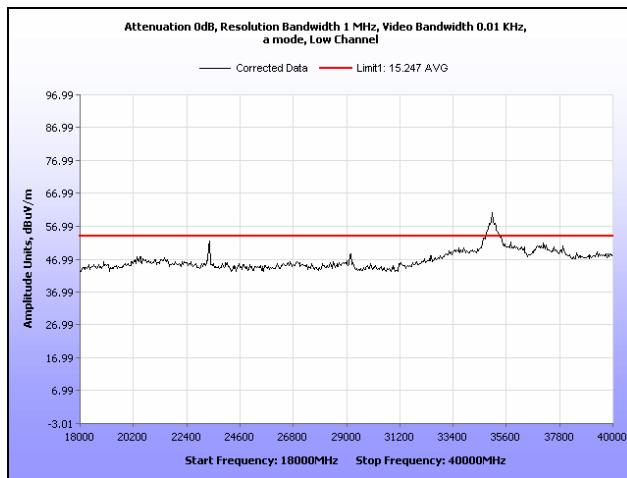
## Radiated Spurious Emissions Test Results, a Mode



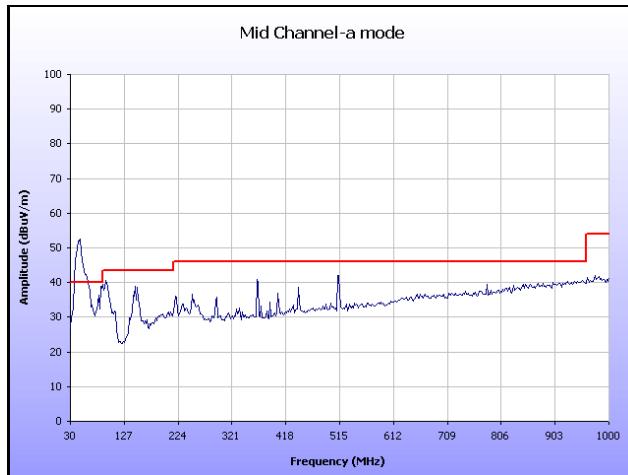
**Plot 71. Radiated Spurious Emissions, Low Channel, a Mode, 30 MHz – 1 GHz**



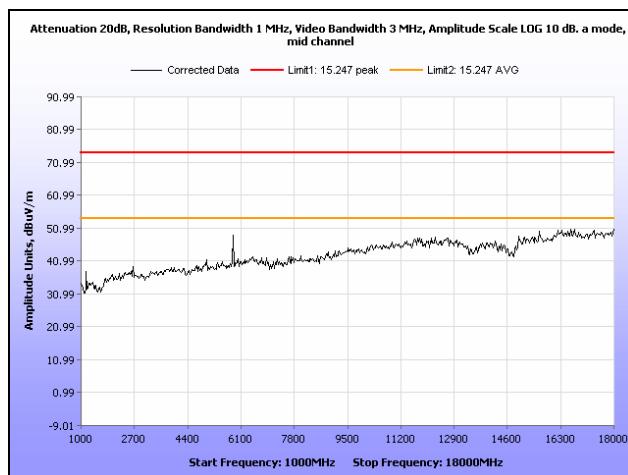
**Plot 72. Radiated Spurious Emissions, Low Channel, a Mode, 1 GHz – 18 GHz**



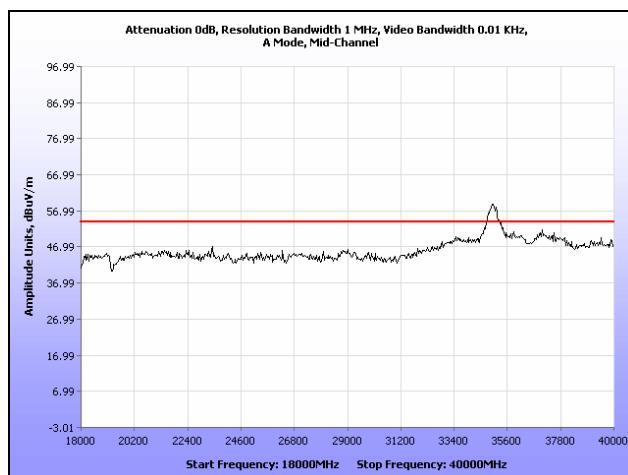
**Plot 73. Radiated Spurious Emissions, Low Channel, a Mode, 18 GHz – 40 GHz**



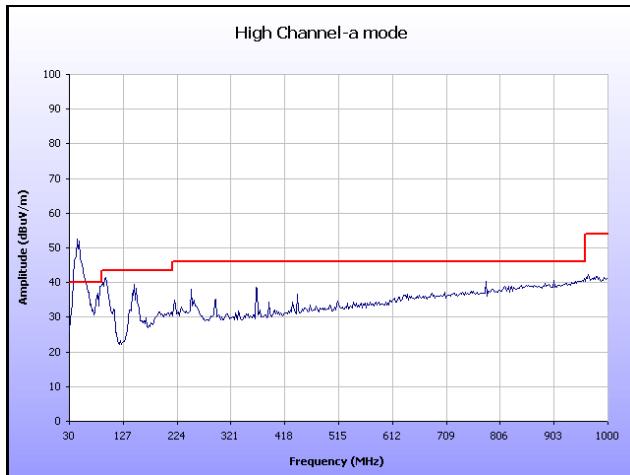
**Plot 74. Radiated Spurious Emissions, Mid Channel, a Mode, 30 MHz – 1 GHz**



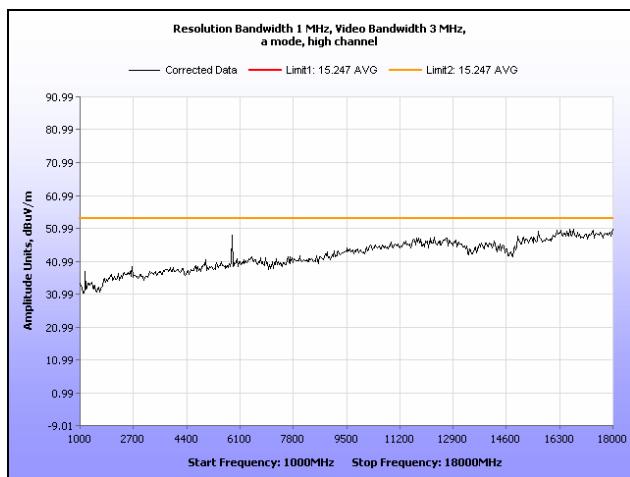
**Plot 75. Radiated Spurious Emissions, Mid Channel, a Mode, 1 GHz – 18 GHz**



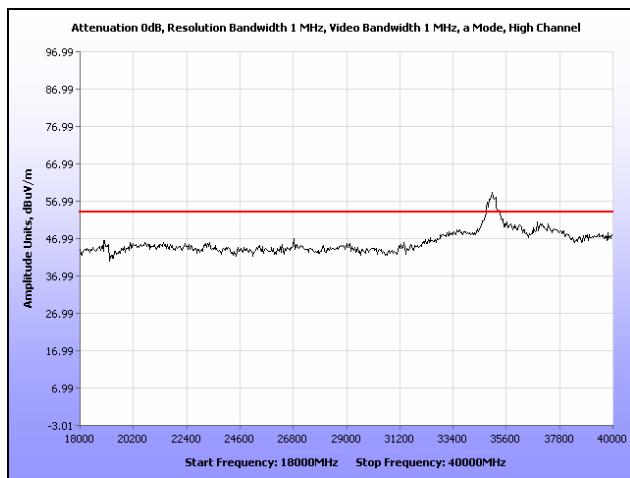
**Plot 76. Radiated Spurious Emissions, Mid Channel, a Mode, 18 GHz – 40 GHz**



**Plot 77. Radiated Spurious Emissions, High Channel, a Mode, 30 MHz – 1 GHz**

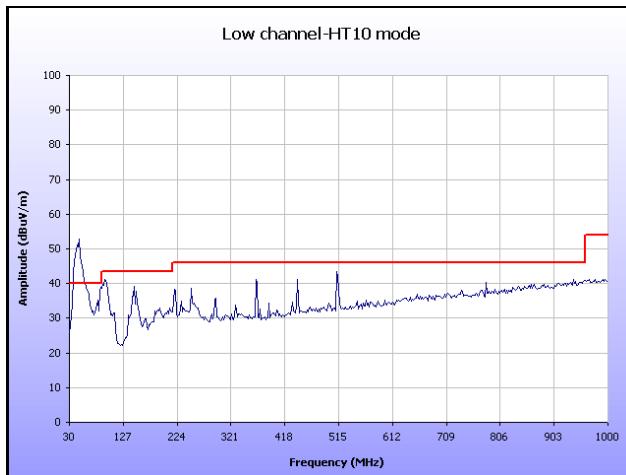


**Plot 78. Radiated Spurious Emissions, High Channel, a Mode, 1 GHz – 18 GHz**

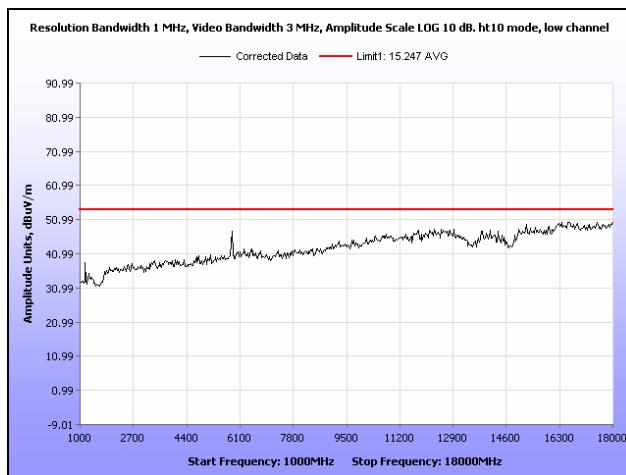


**Plot 79. Radiated Spurious Emissions, High Channel, a Mode, 18 GHz – 40 GHz**

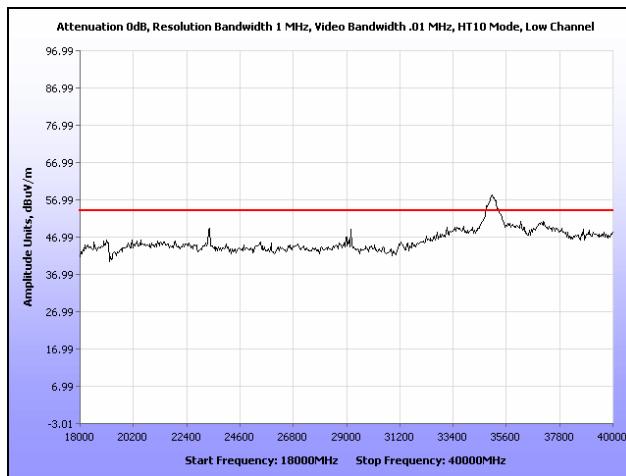
## Radiated Spurious Emissions Test Results, HT10



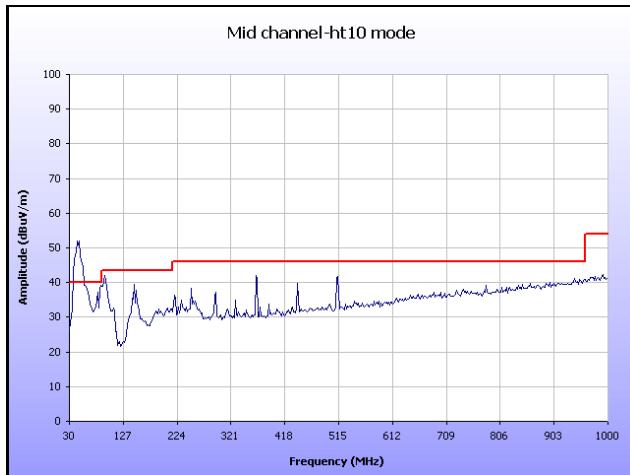
**Plot 80.** Radiated Spurious Emissions, Low Channel, HT10, 30 MHz – 1 GHz



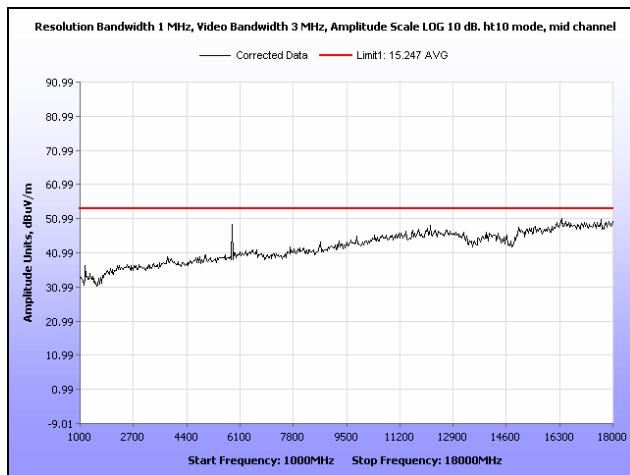
**Plot 81.** Radiated Spurious Emissions, Low Channel, HT10, 1 GHz – 18 GHz



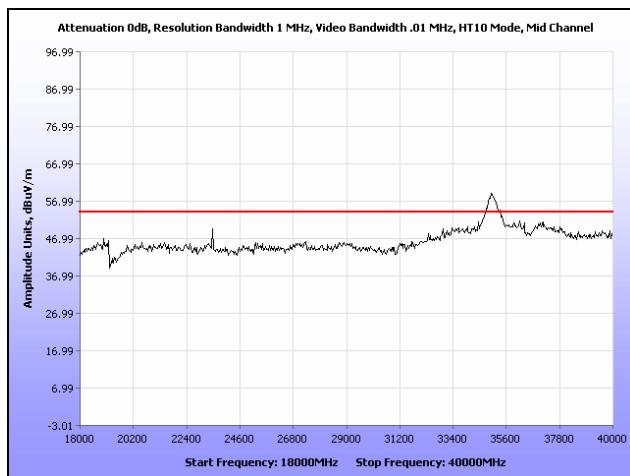
**Plot 82.** Radiated Spurious Emissions, Low Channel, HT10, 18 GHz – 40 GHz



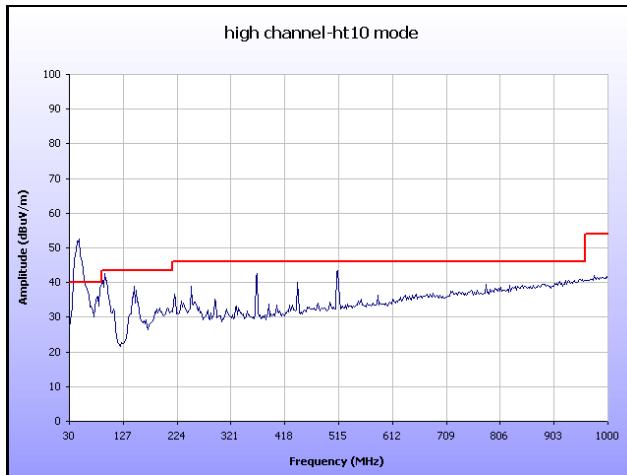
**Plot 83. Radiated Spurious Emissions, Mid Channel, HT10, 30 MHz – 1 GHz**



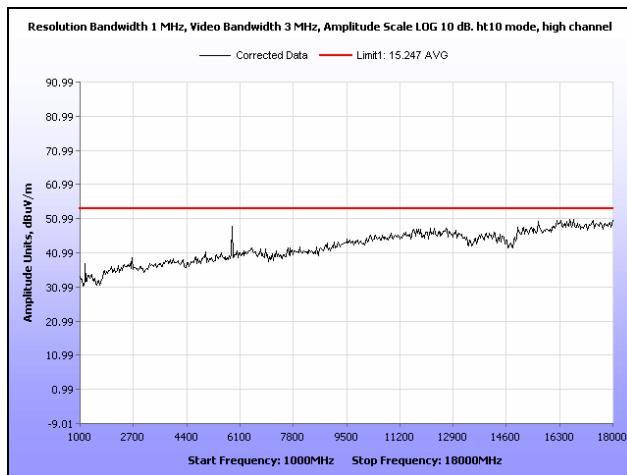
**Plot 84. Radiated Spurious Emissions, Mid Channel, HT10, 1 GHz – 18 GHz**



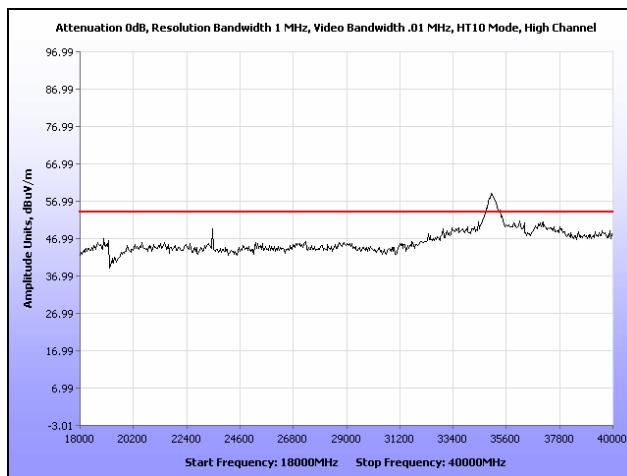
**Plot 85. Radiated Spurious Emissions, Mid Channel, HT10, 18 GHz – 40 GHz**



**Plot 86. Radiated Spurious Emissions, High Channel, HT10, 30 MHz – 1 GHz**

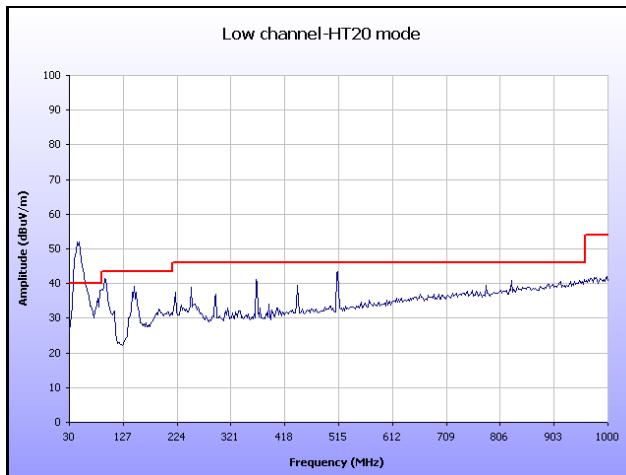


**Plot 87. Radiated Spurious Emissions, High Channel, HT10, 1 GHz – 18 GHz**

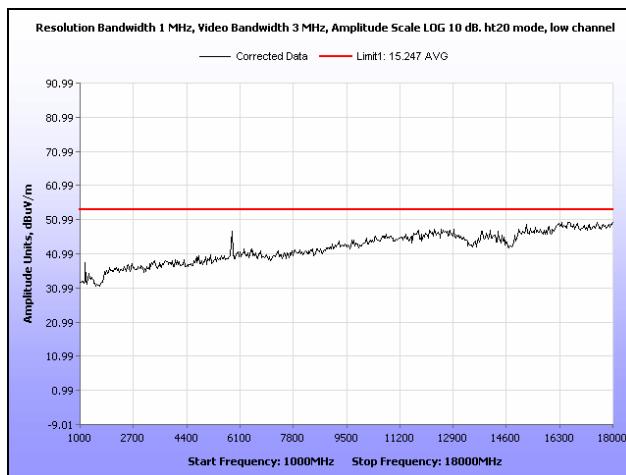


**Plot 88. Radiated Spurious Emissions, High Channel, HT10, 18 GHz – 40 GHz**

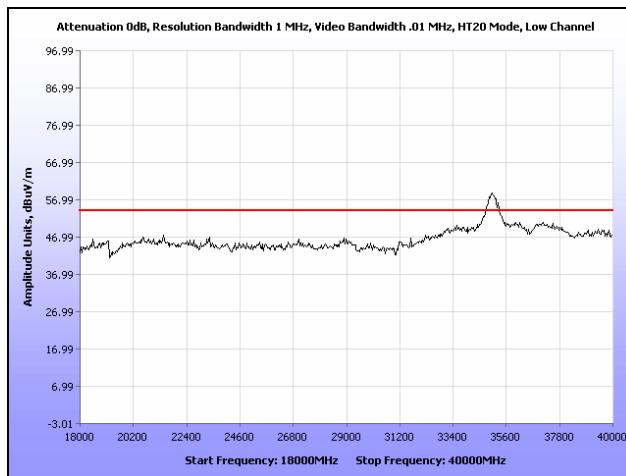
## Radiated Spurious Emissions Test Results, HT20



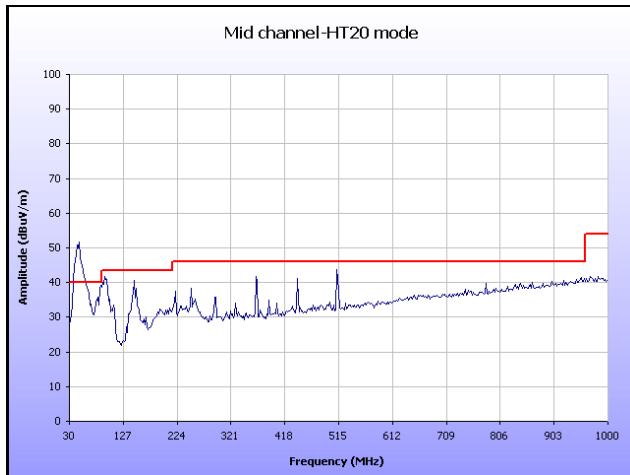
**Plot 89. Radiated Spurious Emissions, Low Channel, HT20, 30 MHz – 1 GHz**



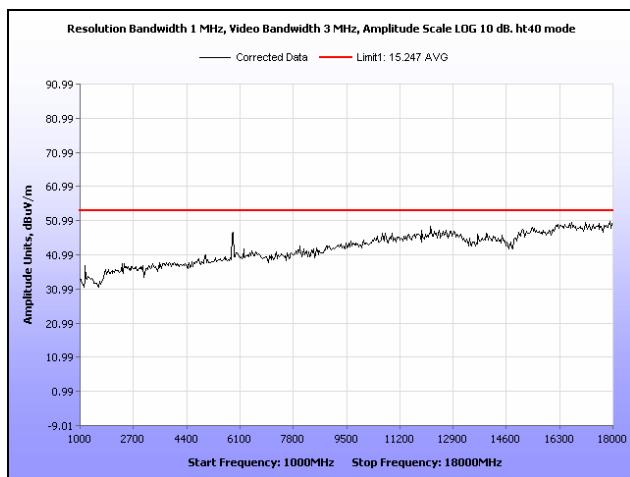
**Plot 90. Radiated Spurious Emissions, Low Channel, HT20, 1 GHz – 18 GHz**



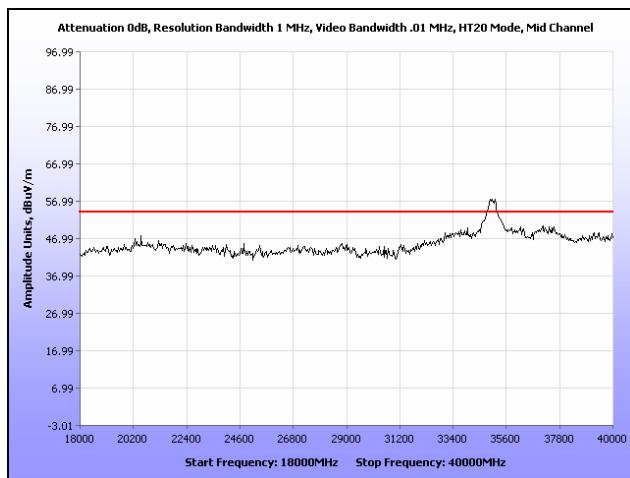
**Plot 91. Radiated Spurious Emissions, Low Channel, HT20, 18 GHz – 40 GHz**



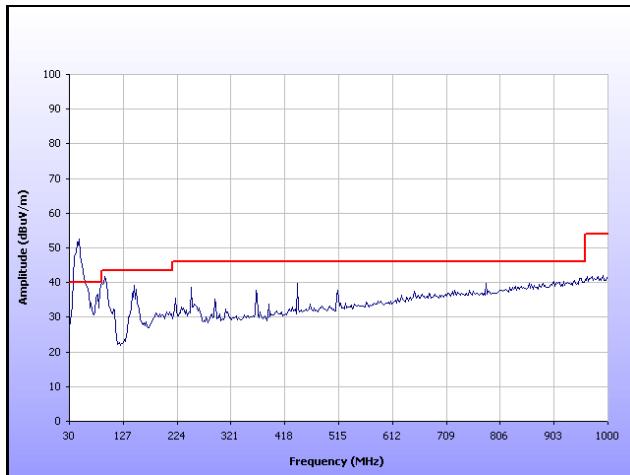
**Plot 92. Radiated Spurious Emissions, Mid Channel, HT20, 30 MHz – 1 GHz**



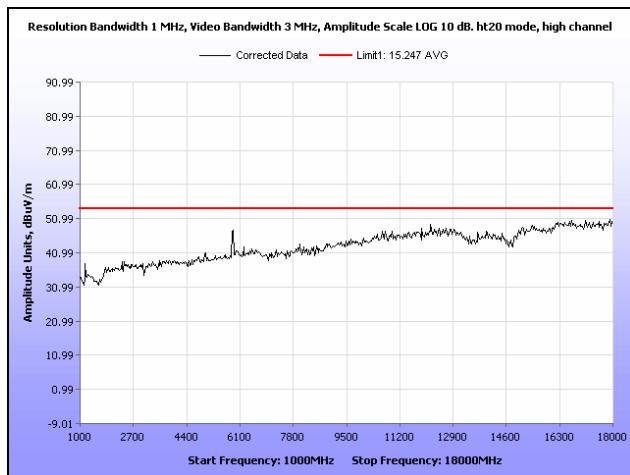
**Plot 93. Radiated Spurious Emissions, Mid Channel, HT20, 1 GHz – 18 GHz**



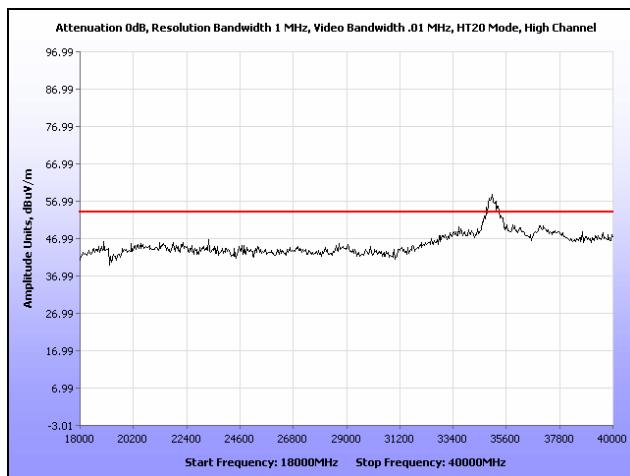
**Plot 94. Radiated Spurious Emissions, Mid Channel, HT20, 18 GHz – 40 GHz**



**Plot 95. Radiated Spurious Emissions, High Channel, HT20, 30 MHz – 1 GHz**

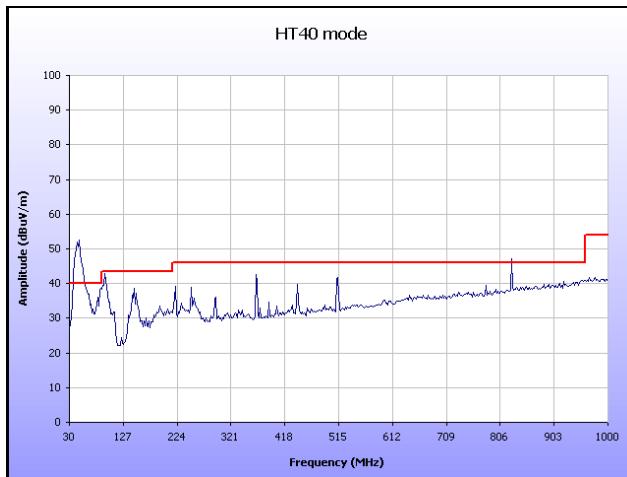


**Plot 96. Radiated Spurious Emissions, High Channel, HT20, 1 GHz – 18 GHz**

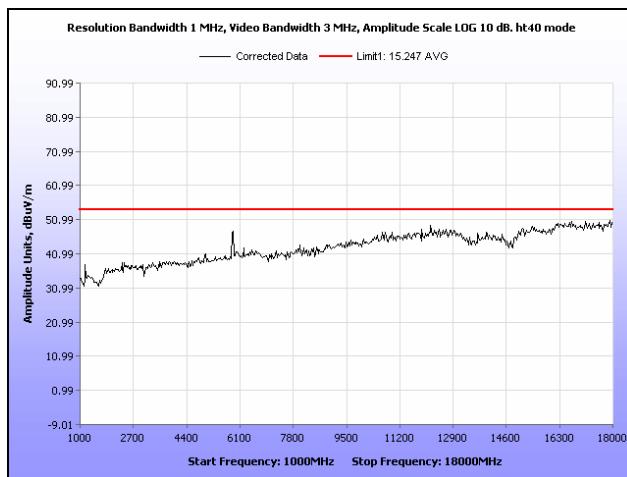


**Plot 97. Radiated Spurious Emissions, High Channel, HT20, 18 GHz – 40 GHz**

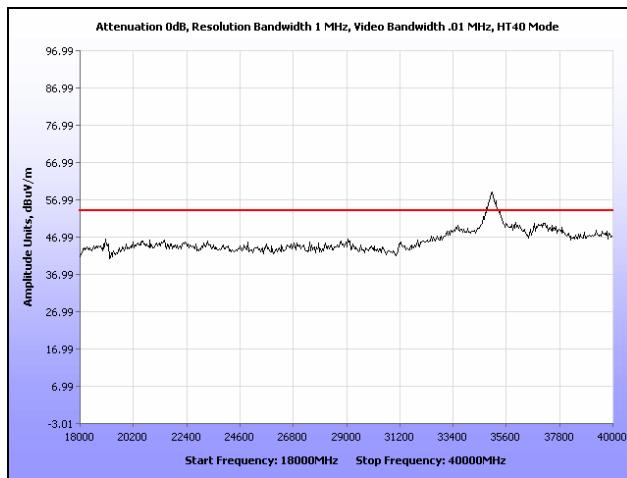
## Radiated Spurious Emissions Test Results, HT40



Plot 98. Radiated Spurious Emissions, HT40, 30 MHz – 1 GHz

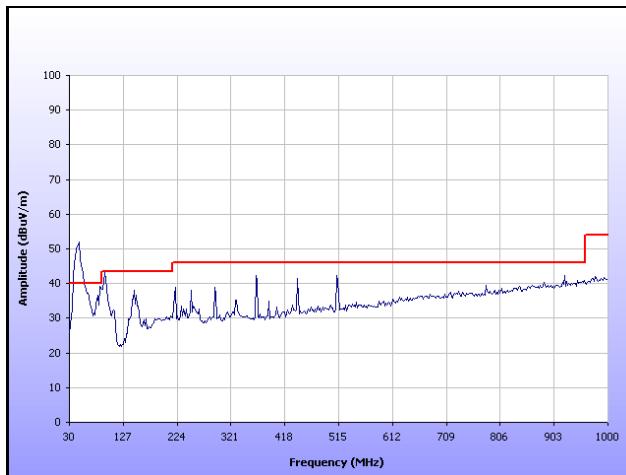


Plot 99. Radiated Spurious Emissions, HT40, 1 GHz – 18 GHz

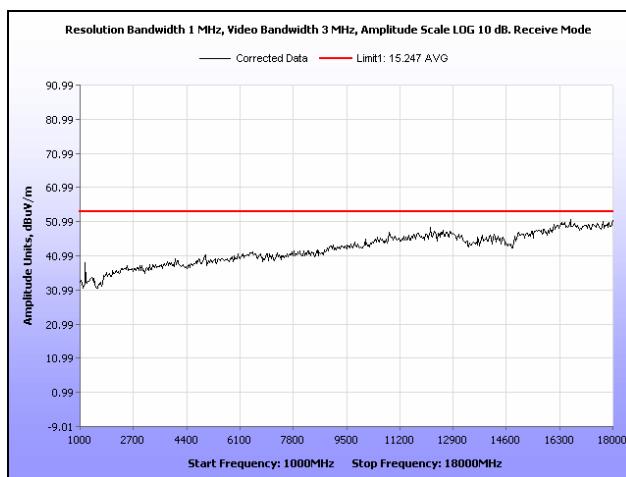


Plot 100. Radiated Spurious Emissions, HT40, 18 GHz – 40 GHz

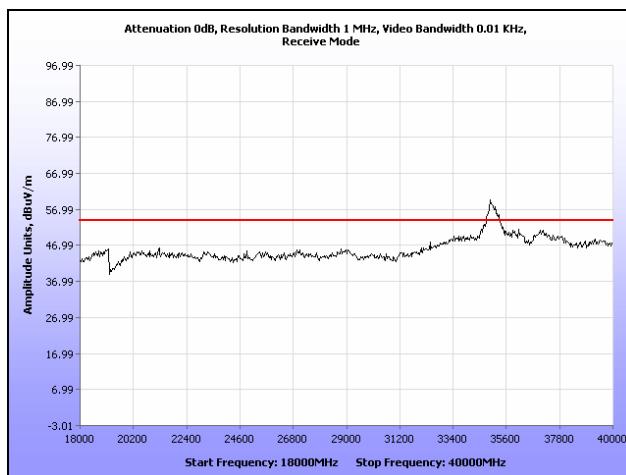
## Radiated Spurious Emissions Test Results



**Plot 101.** Radiated Spurious Emissions, Receive Mode, 30 MHz – 1 GHz



**Plot 102.** Radiated Spurious Emissions, Receive Mode, 1 GHz – 18 GHz



**Plot 103.** Radiated Spurious Emissions, Receive Mode, 18 GHz – 40 GHz

## Electromagnetic Compatibility Criteria for Intentional Radiators

### RF Conducted Spurious Emissions Requirements and Band Edge

**Test Requirement:** 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.

**Test Procedure:** For intentional radiators with a digital device portion which operates below 10 GHz, the spectrum was investigated; i.e., the lowest RF signal generated or used in the device up to the 10<sup>th</sup> harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

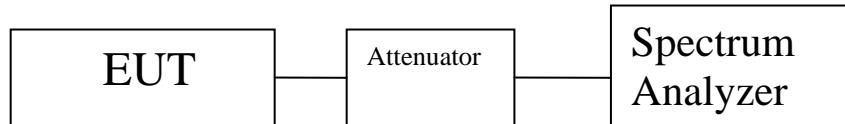
Since the EUT had an integral antenna, conducted measurements could not be performed. Measurements needed to be taken radiated. An antenna was located 3 m away from the EUT and plots were taken. The EUT was rotated through all three orthogonal axes. The plots were corrected for both antenna correction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

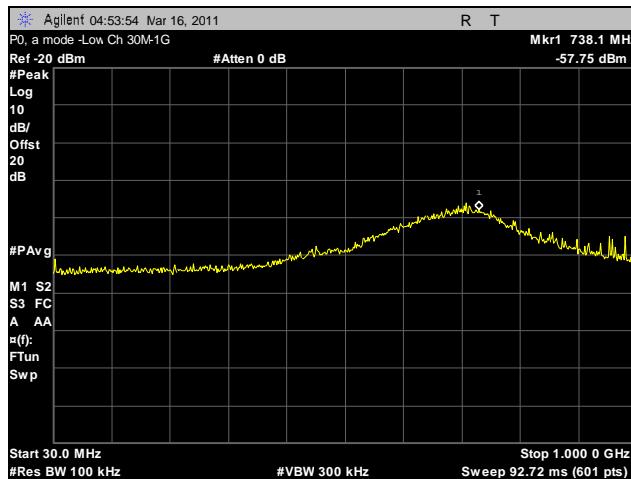
**Test Engineer(s):** Manasi Bhandiwad

**Test Date(s):** 04/20/11

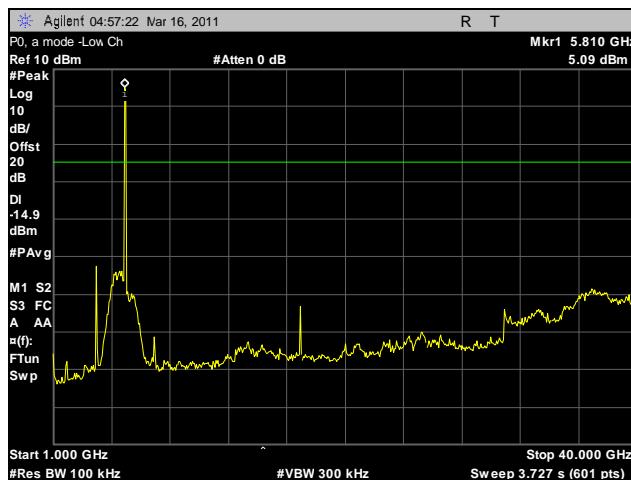


**Figure 5. Block Diagram, Conducted Spurious Emissions Test Setup**

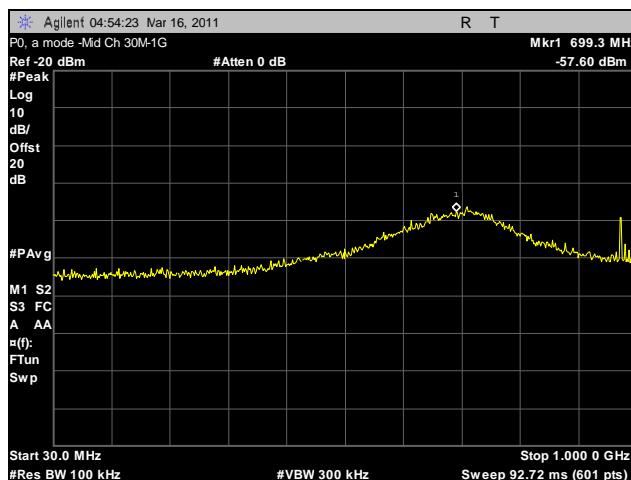
## Conducted Spurious Emissions Test Results, a Mode, Port 0



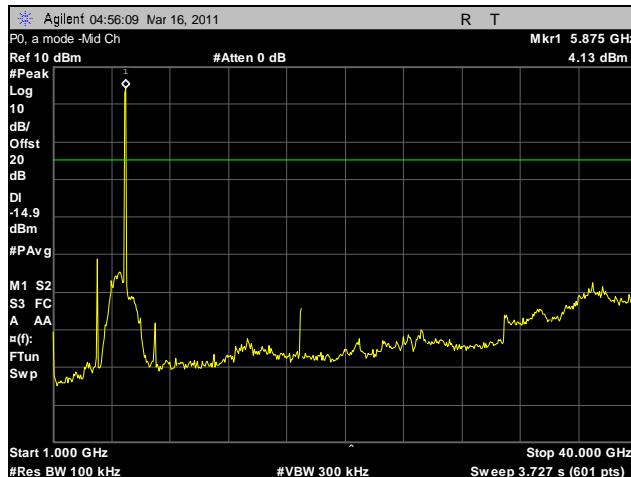
**Plot 104.** Conducted Spurious Emissions, Low Channel, a Mode, 30 MHz – 1 GHz, Port 0



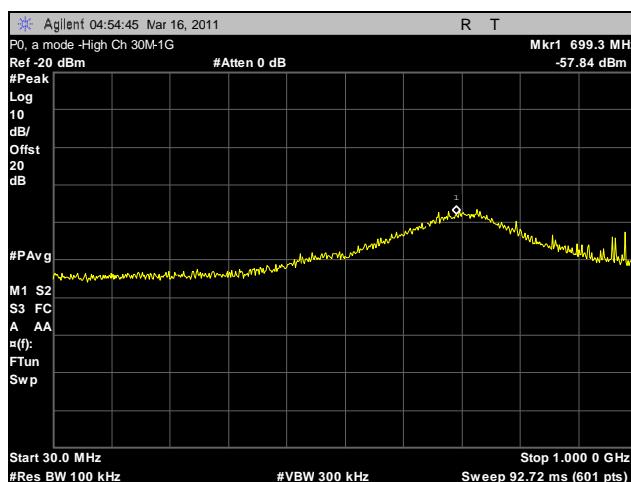
**Plot 105.** Conducted Spurious Emissions, Low Channel, a Mode, 1 GHz – 40 GHz, Port 0



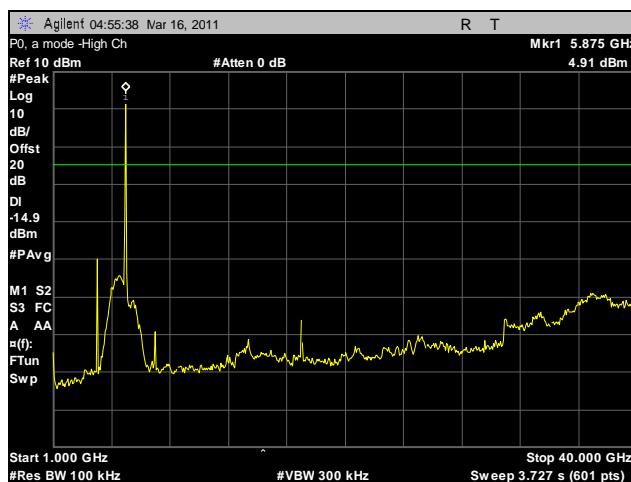
**Plot 106.** Conducted Spurious Emissions, Mid Channel, a Mode, 30 MHz – 1 GHz, Port 0



**Plot 107. Conducted Spurious Emissions, Mid Channel, a Mode, 1 GHz – 40 GHz, Port 0**

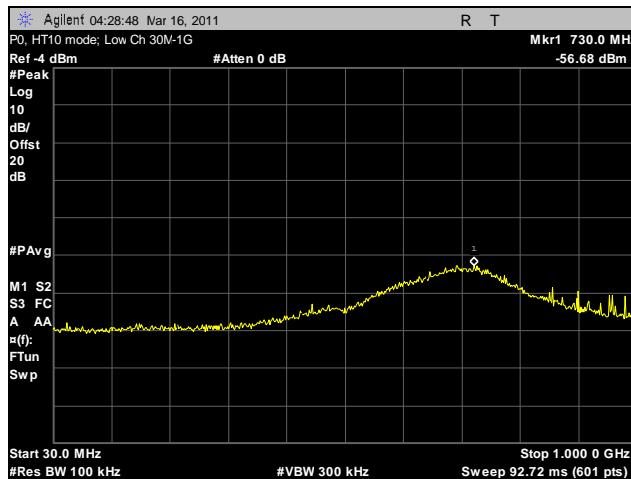


**Plot 108. Conducted Spurious Emissions, High Channel, a Mode, 30 MHz – 1 GHz, Port 0**

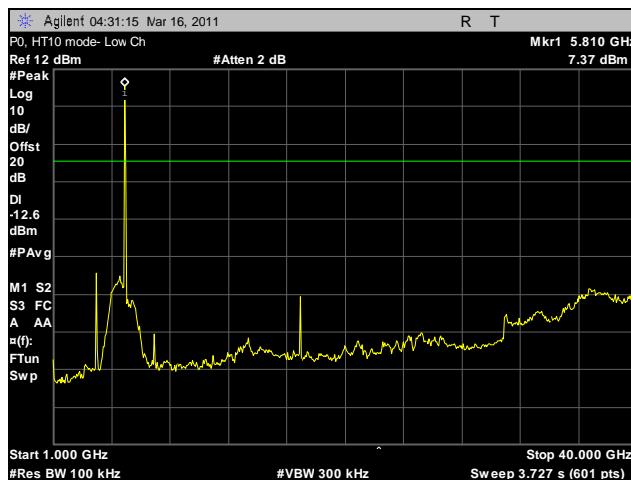


**Plot 109. Conducted Spurious Emissions, High Channel, a Mode, 1 GHz – 40 GHz, Port 0**

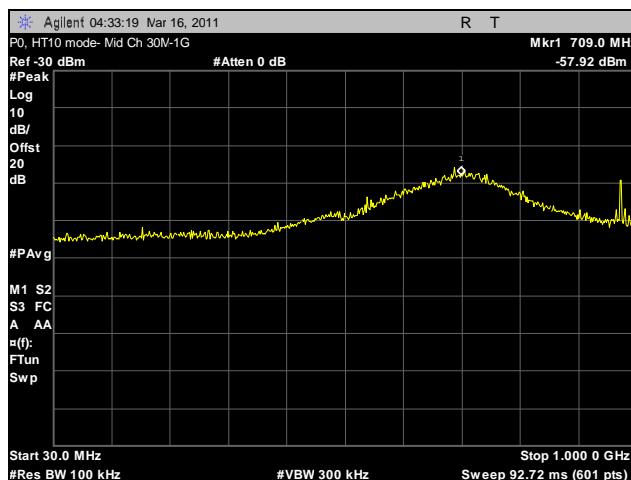
## Conducted Spurious Emissions Test Results, HT10, Port 0



Plot 110. Conducted Spurious Emissions, Low Channel, HT10, 30 MHz – 1 GHz, Port 0



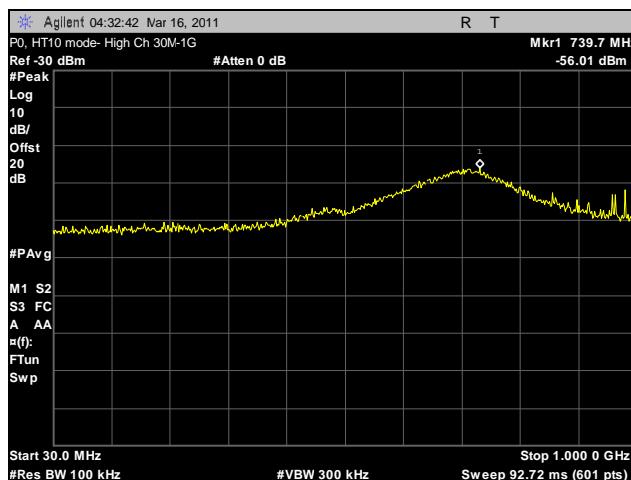
Plot 111. Conducted Spurious Emissions, Low Channel, HT10, 1 GHz – 40 GHz, Port 0



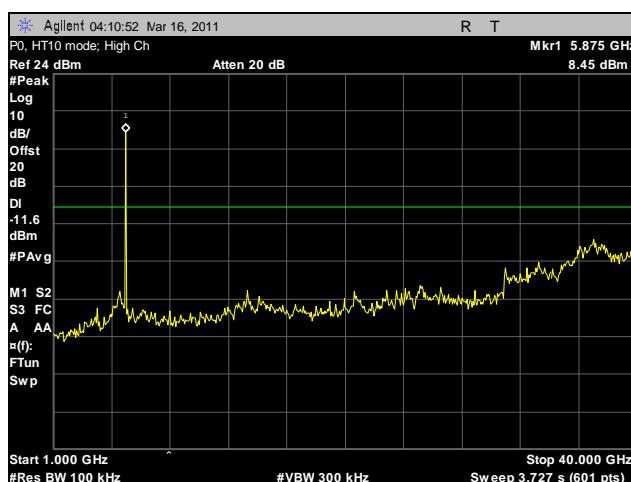
Plot 112. Conducted Spurious Emissions, Mid Channel, HT10, 30 MHz – 1 GHz, Port 0



Plot 113. Conducted Spurious Emissions, Mid Channel, HT10, 1 GHz – 40 GHz, Port 0

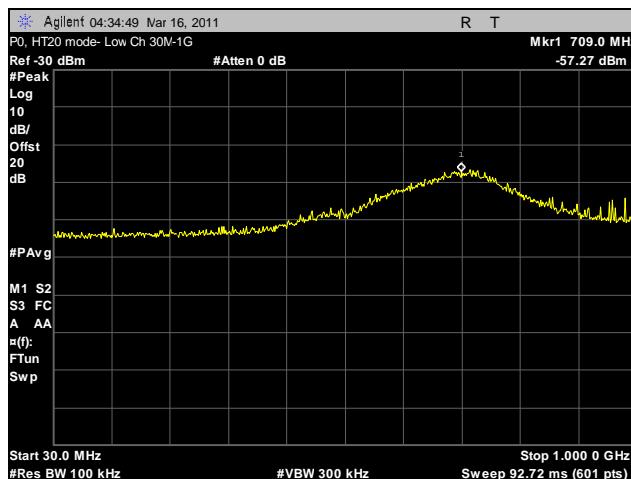


Plot 114. Conducted Spurious Emissions, High Channel, HT10, 30 MHz – 1 GHz, Port 0



Plot 115. Conducted Spurious Emissions, High Channel, HT10, 1 GHz – 40 GHz, Port 0

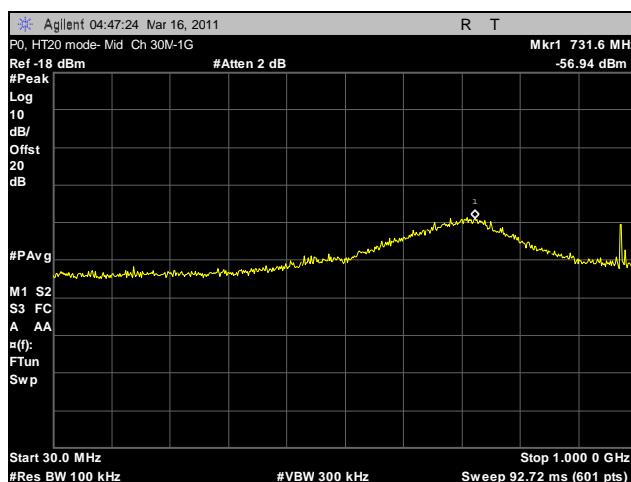
## Conducted Spurious Emissions Test Results, HT20, Port 0



Plot 116. Conducted Spurious Emissions, Low Channel, HT20, 30 MHz – 1 GHz, Port 0



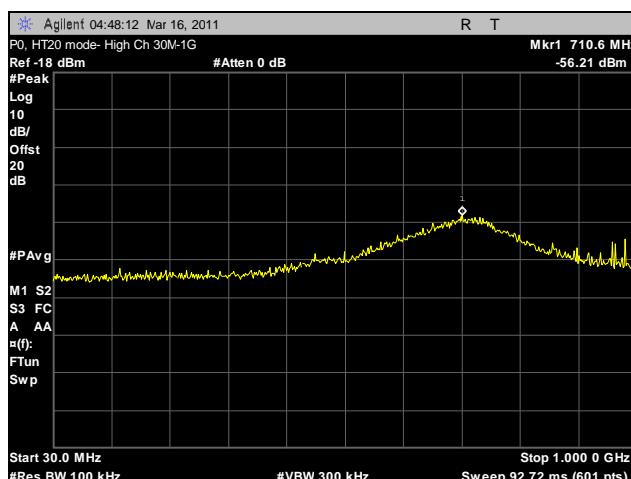
Plot 117. Conducted Spurious Emissions, Low Channel, HT20, 1 GHz – 40 GHz, Port 0



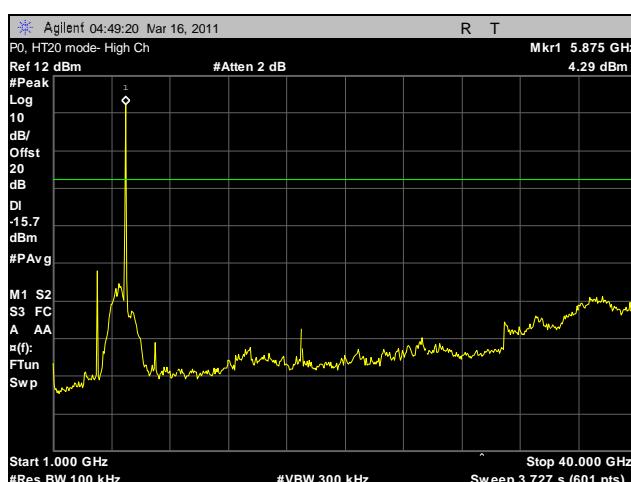
Plot 118. Conducted Spurious Emissions, Mid Channel, HT20, 30 MHz – 1 GHz, Port 0



Plot 119. Conducted Spurious Emissions, Mid Channel, HT20, 1 GHz – 40 GHz, Port 0

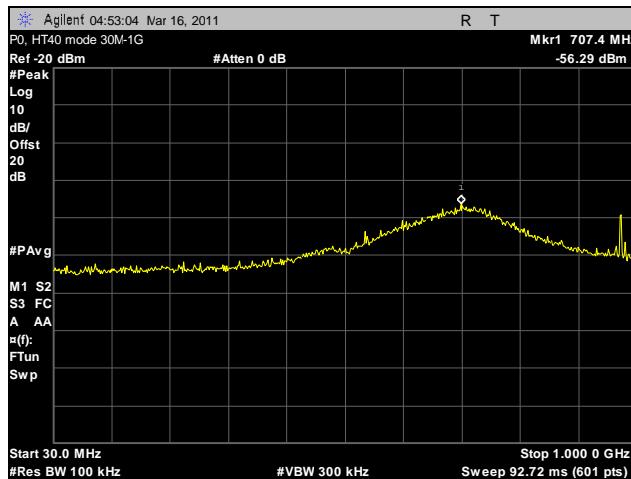


Plot 120. Conducted Spurious Emissions, High Channel, HT20, 30 MHz – 1 GHz, Port 0

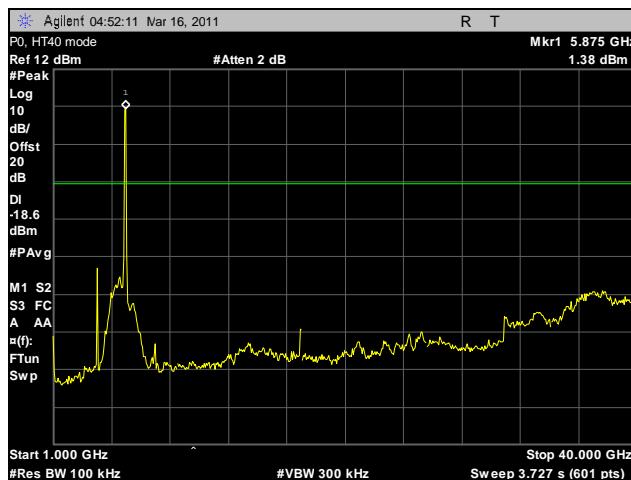


Plot 121. Conducted Spurious Emissions, High Channel, HT20, 1 GHz – 40 GHz, Port 0

## Conducted Spurious Emissions Test Results, HT40, Port 0

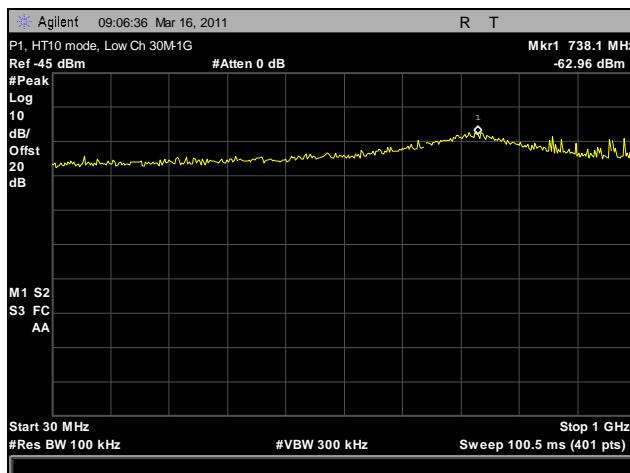


Plot 122. Conducted Spurious Emissions, HT40, 30 MHz – 1 GHz, Port 0

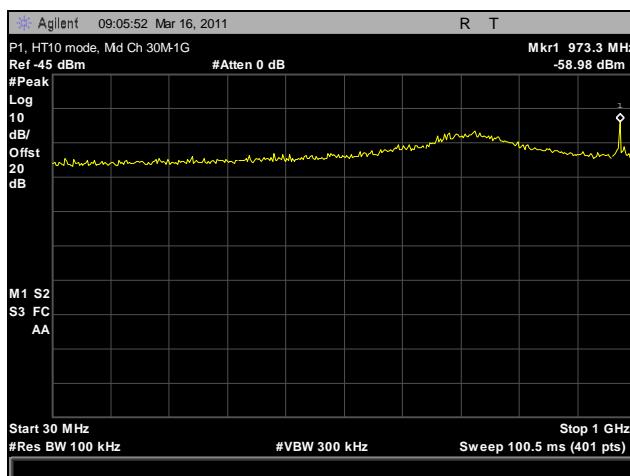


Plot 123. Conducted Spurious Emissions, HT40, 1 GHz – 40 GHz, Port 0

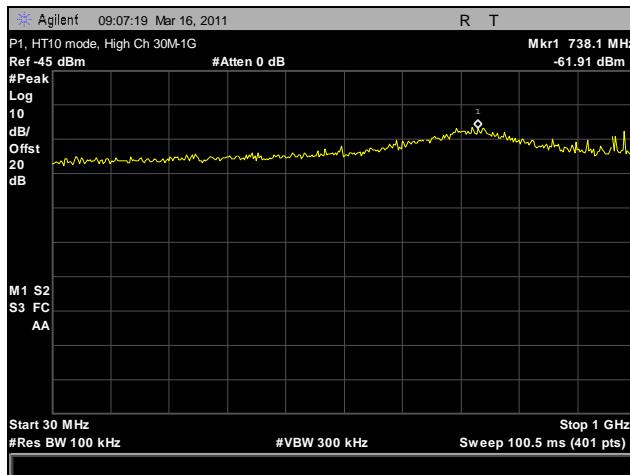
## Conducted Spurious Emissions Test Results, HT10, Port 1



Plot 124. Conducted Spurious Emissions, Low Channel, HT10, 30 MHz – 1 GHz, Port 1

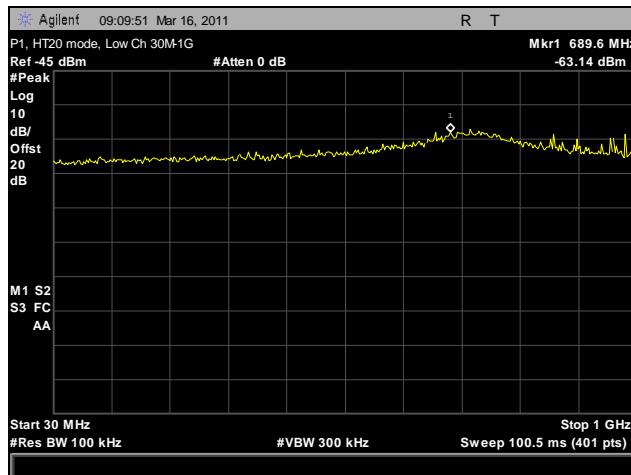


Plot 125. Conducted Spurious Emissions, Mid Channel, HT10, 30 MHz – 1 GHz, Port 1

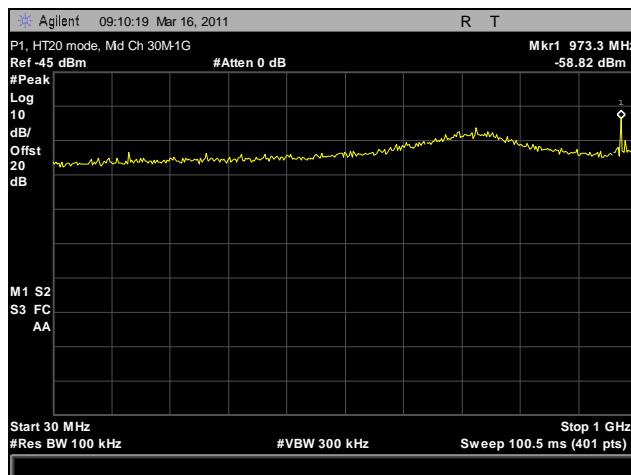


Plot 126. Conducted Spurious Emissions, High Channel, HT10, 30 MHz – 1 GHz, Port 1

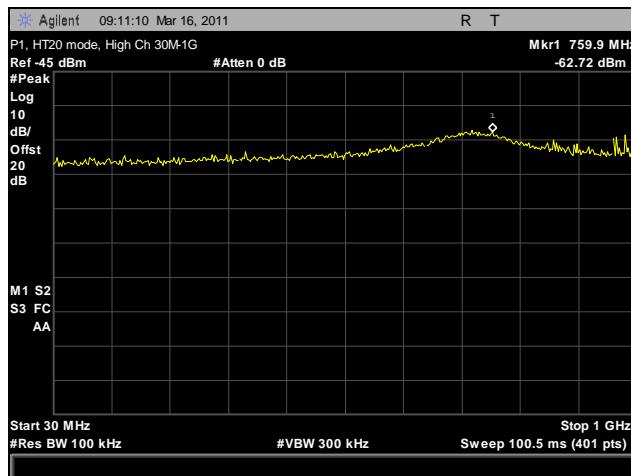
## Conducted Spurious Emissions Test Results, HT20, Port 1



Plot 127. Conducted Spurious Emissions, Low Channel, HT20, 30 MHz – 1 GHz, Port 1

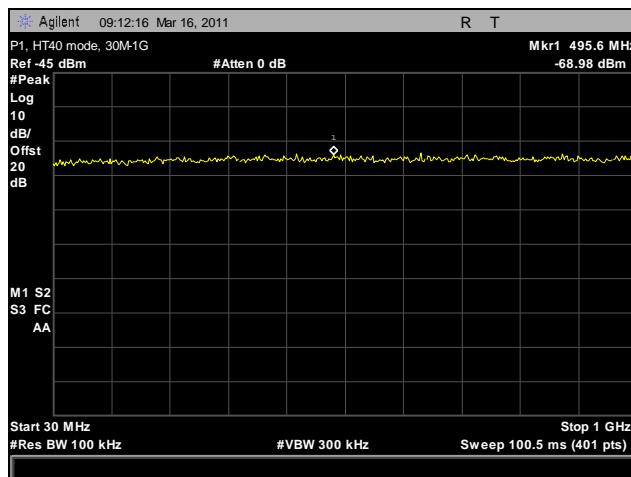


Plot 128. Conducted Spurious Emissions, Mid Channel, HT20, 30 MHz – 1 GHz, Port 1



Plot 129. Conducted Spurious Emissions, High Channel, HT20, 30 MHz – 1 GHz, Port 1

## Conducted Spurious Emissions Test Results, HT40, Port 1

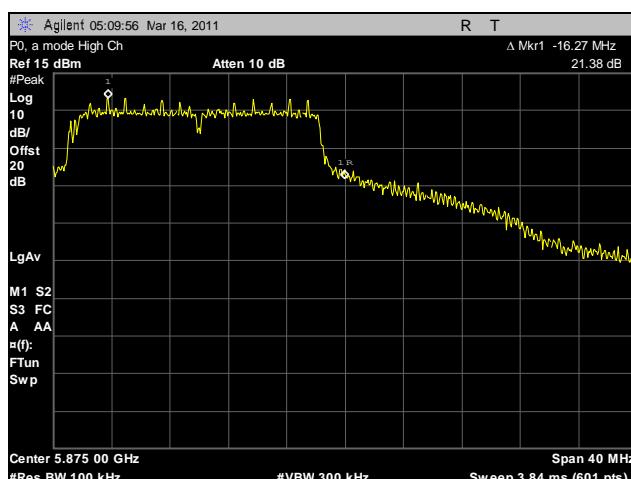


Plot 130. Conducted Spurious Emissions, HT40, 30 MHz – 1 GHz, Port 1

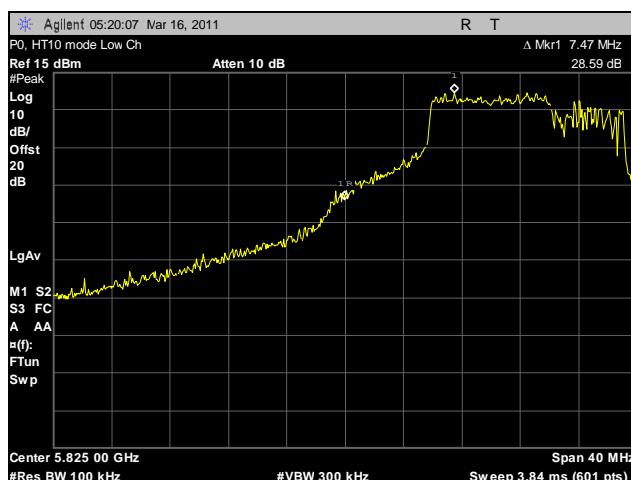
## Conducted Band Edge Test Results, P0



Plot 131. Conducted Spurious Emissions, Low Channel, a Mode, P0, 20 dBc



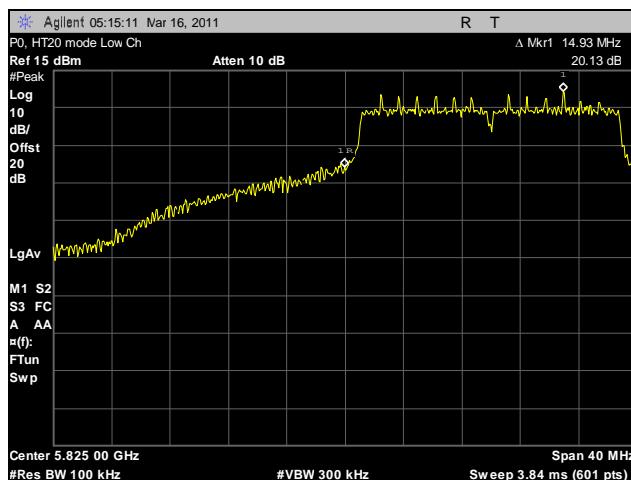
Plot 132. Conducted Spurious Emissions, High Channel, a Mode, P0, 20 dBc



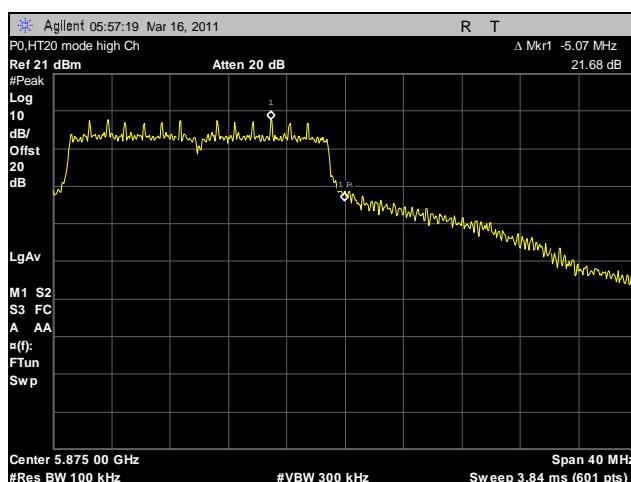
Plot 133. Conducted Spurious Emissions, Low Channel, HT10, P0, 20 dBc



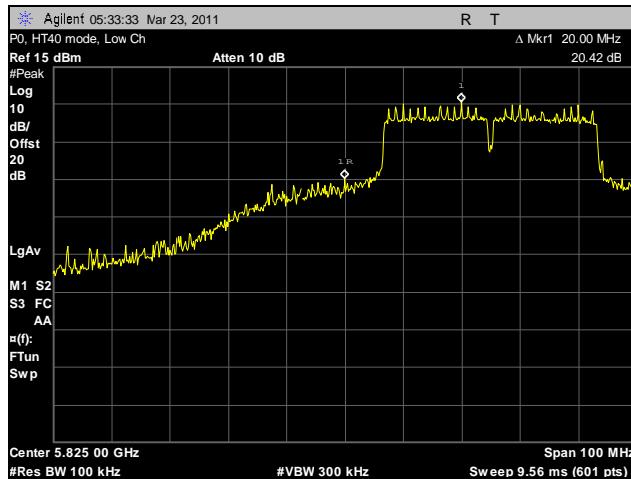
**Plot 134. Conducted Spurious Emissions, High Channel, HT10, P0, 20 dBc**



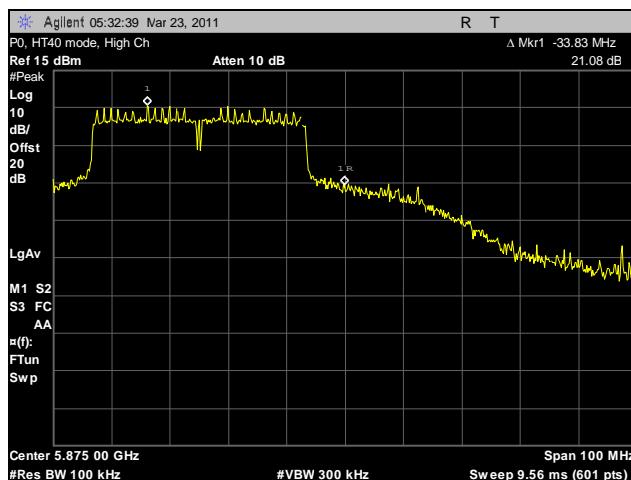
**Plot 135. Conducted Spurious Emissions, Low Channel, HT20, P0, 20 dBc**



**Plot 136. Conducted Spurious Emissions, High Channel, HT20, P0, 20 dBc**

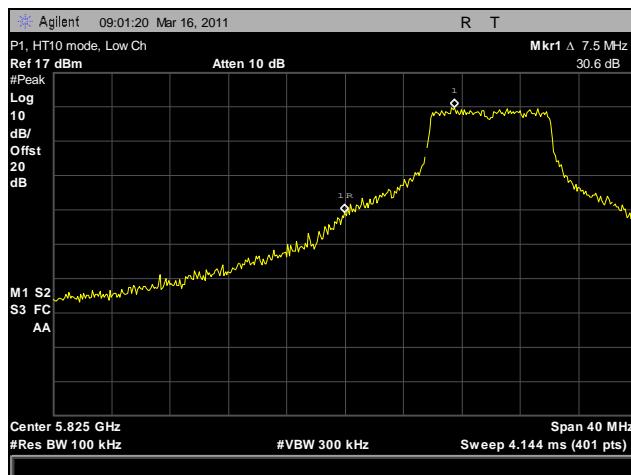


**Plot 137. Conducted Spurious Emissions, Low Channel, HT40, P0, 20 dBc**



**Plot 138. Conducted Spurious Emissions, High Channel, HT40, P0, 20 dBc**

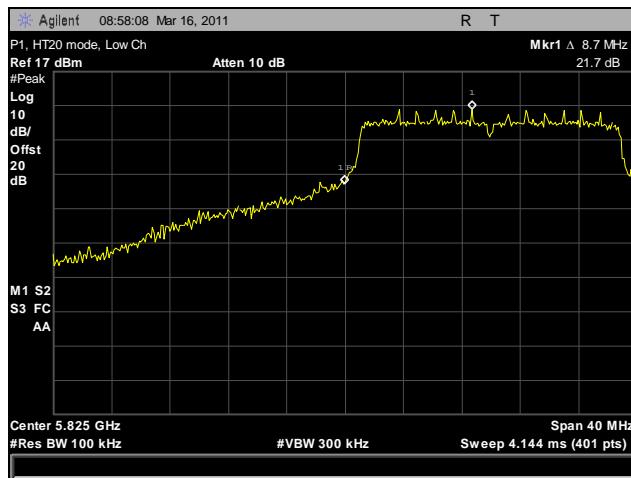
## Conducted Band Edge Test Results, P1



Plot 139. Conducted Spurious Emissions, Low Channel, HT10, P1, 20 dBc



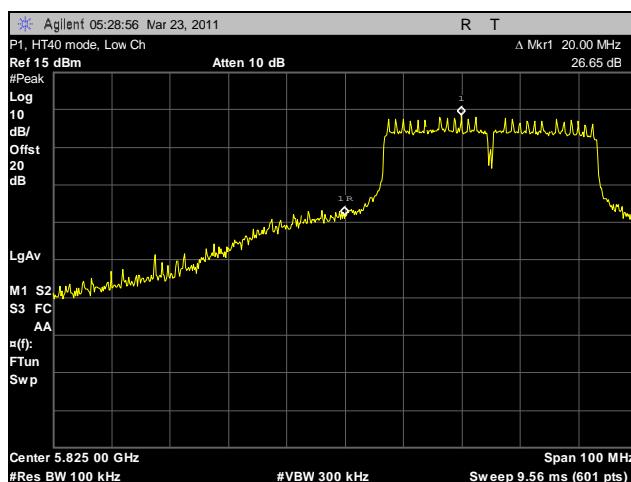
Plot 140. Conducted Spurious Emissions, High Channel, HT10, P1, 20 dBc



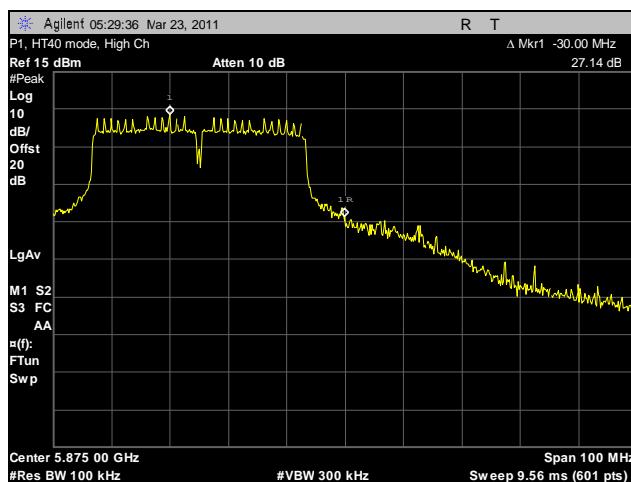
Plot 141. Conducted Spurious Emissions, Low Channel, HT20, P1, 20 dBc



**Plot 142. Conducted Spurious Emissions, High Channel, HT20, P1, 20 dBc**



**Plot 143. Conducted Spurious Emissions, Low Channel, HT40, P1, 20 dBc**



**Plot 144. Conducted Spurious Emissions, High Channel, HT40, P1, 20 dBc**

## Electromagnetic Compatibility Criteria for Intentional Radiators

### Peak Power Spectral Density

**Test Requirements:** For digitally modulated systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 17dBm in any 1 MHz band during any time interval of continuous transmission.

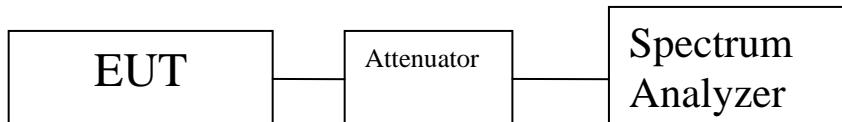
**Test Procedure:** The transmitter was connected directly to a Spectrum Analyzer through an attenuator. The power level was set to the maximum level on the EUT. The RBW was set to 1MHz and the VBW was set to 3MHz. The method of measurement #2 from the FCC Public Notice DA 02-2138 was used.

**Test Results:** The EUT was compliant with the peak power spectral density limits.

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

**Test Engineer:** Manasi Bhandiwad

**Test Date:** 03/21/11



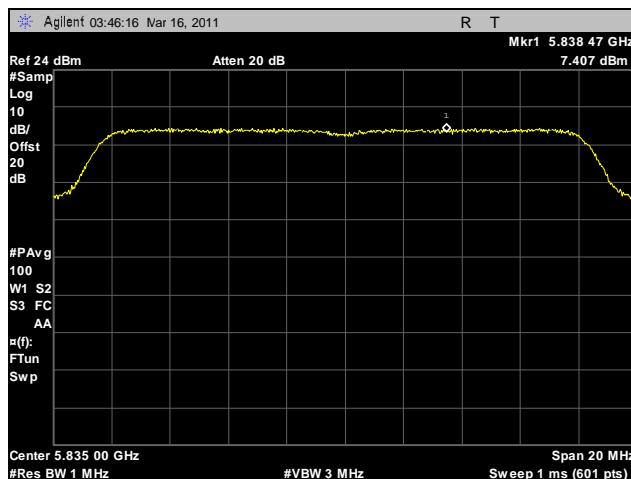
**Figure 6. Block Diagram, Peak Power Spectral Density Test Setup**

## Peak Power Spectral Density Test Results

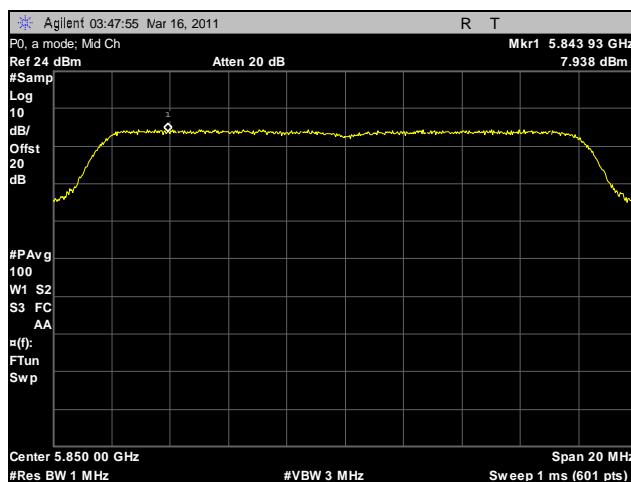
Peak Power Spectral Density dBm Limit = 10dBm						
Mode	Carrier Channel	Frequency (MHz)	Port 1 dBm	Margin	Port 2 dBm	Margin
a	Low	5835	7.407	-2.493	N/A	N/A
	Mid	5850	7.938	-2.062		
	High	5865	7.704	-2.296		
HT10	Low	5835	7.285	-2.715	6.891	-3.109
	Mid	5850	8.11	-1.89	6.047	-3.953
	High	5865	8.215	-1.785	6.339	-3.661
HT20	Low	5835	7.755	-2.245	4.083	-5.917
	Mid	5850	7.895	-2.105	3.749	-6.251
	High	5865	4.989	-5.111	3.746	-6.254
HT40	-	5850	3.86	-6.14	0.234	-9.766

**Table 15. Spectral Density, Test Results**

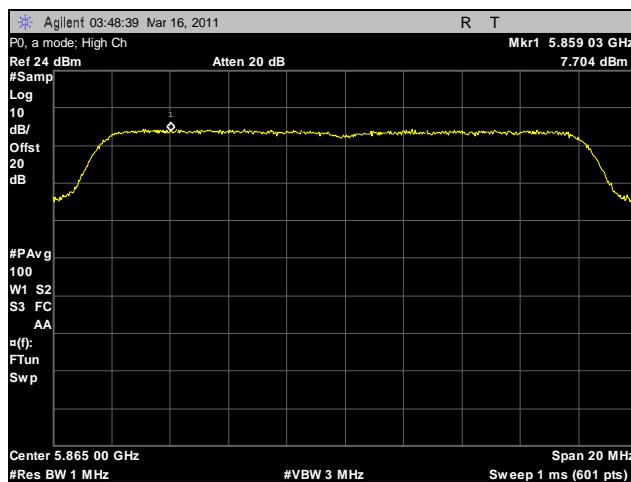
## Peak Power Spectral Density, a Mode, Port 0



Plot 145. Peak Power Spectral Density, Low Channel, a Mode, Port 0

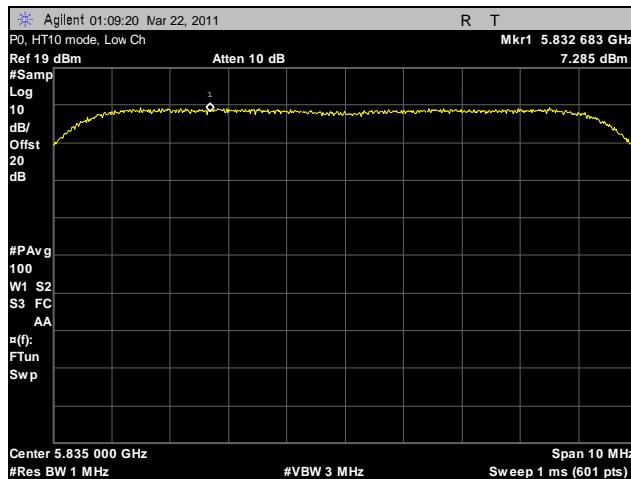


Plot 146. Peak Power Spectral Density, Mid Channel, a Mode, Port 0

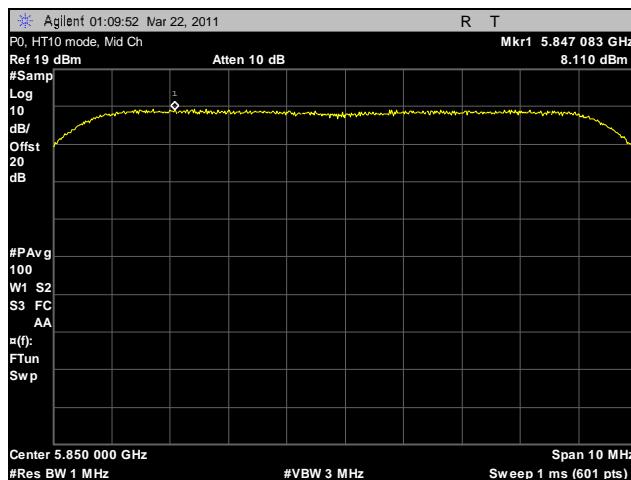


Plot 147. Peak Power Spectral Density, High Channel, a Mode, Port 0

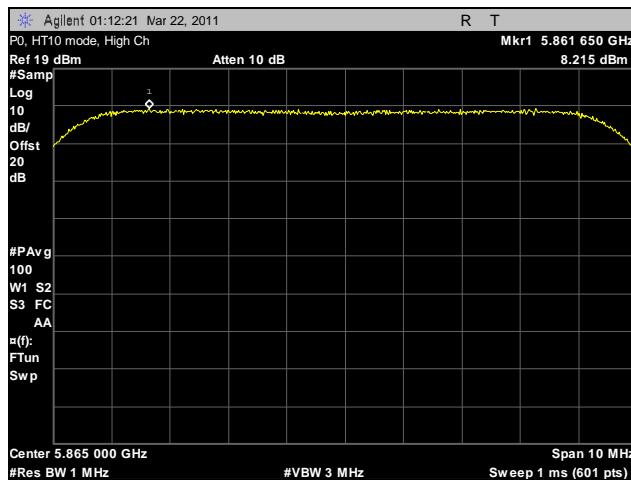
## Peak Power Spectral Density, HT10, Port 0



Plot 148. Peak Power Spectral Density, Low Channel, HT10, Port 0

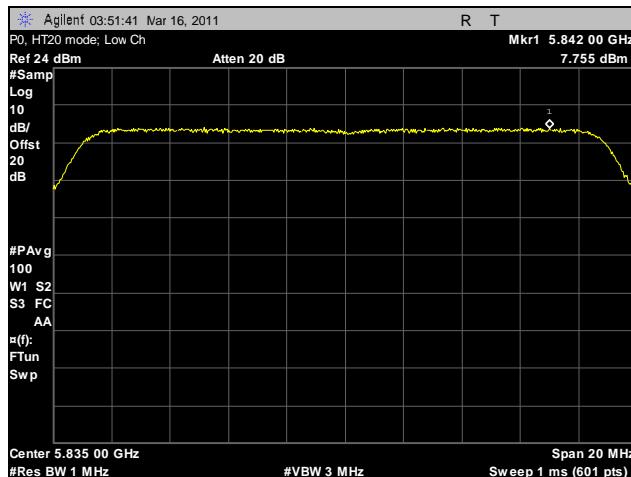


Plot 149. Peak Power Spectral Density, Mid Channel, HT10, Port 0

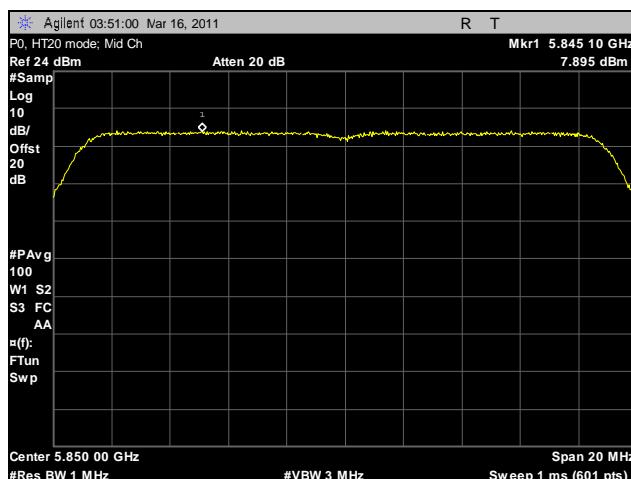


Plot 150. Peak Power Spectral Density, High Channel, HT10, Port 0

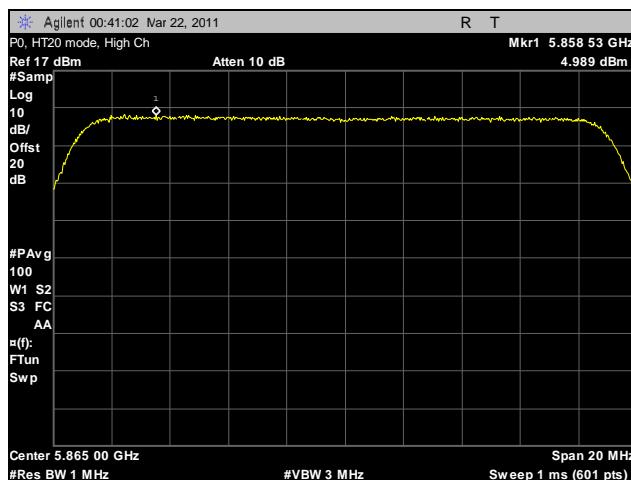
## Peak Power Spectral Density, HT20, Port 0



Plot 151. Peak Power Spectral Density, Low Channel, HT20, Port 0

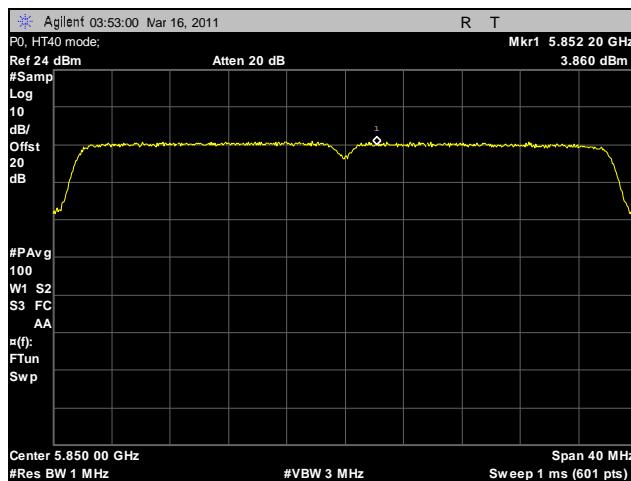


Plot 152. Peak Power Spectral Density, Mid Channel, HT20, Port 0

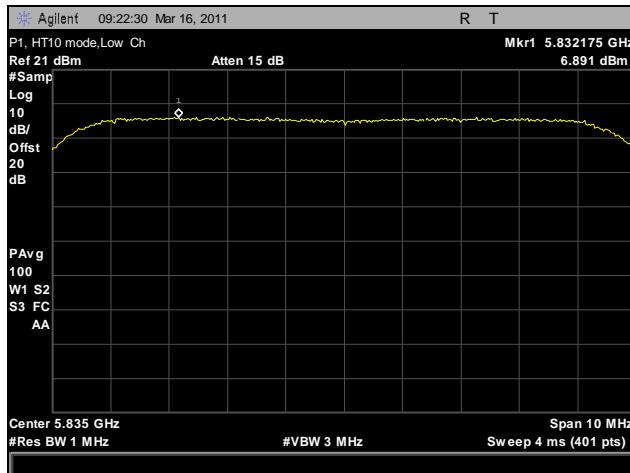


Plot 153. Peak Power Spectral Density, High Channel, HT20, Port 0

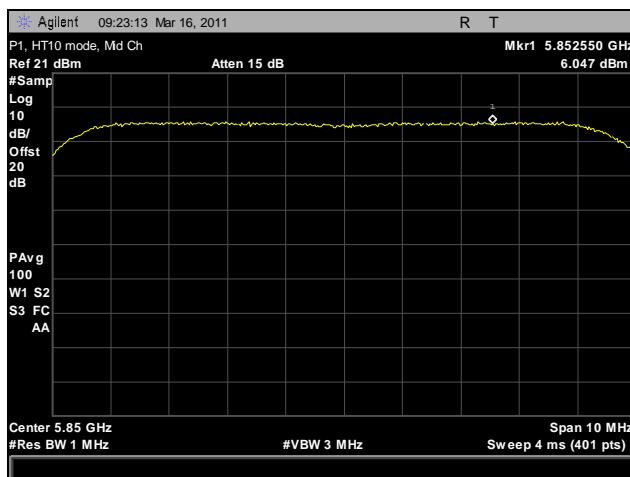
## Peak Power Spectral Density, HT40, Port 0



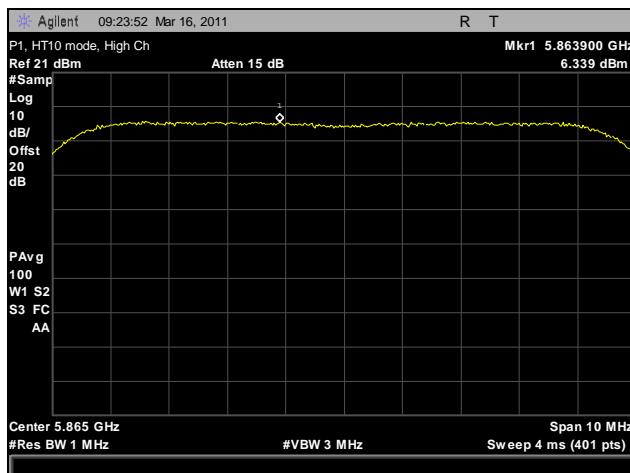
## Peak Power Spectral Density, HT10, Port 1



Plot 155. Peak Power Spectral Density, Low Channel, HT10, Port 1

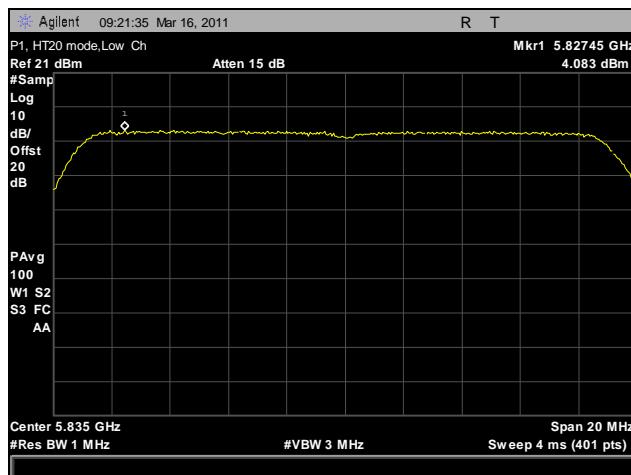


Plot 156. Peak Power Spectral Density, Mid Channel, HT10, Port 1

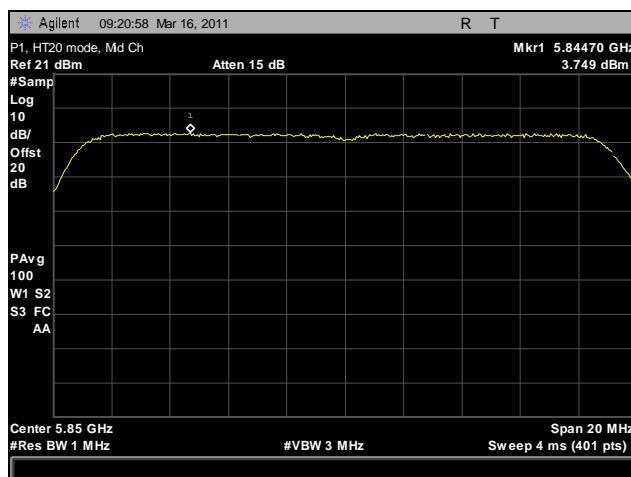


Plot 157. Peak Power Spectral Density, High Channel, HT10, Port 1

## Peak Power Spectral Density, HT20, Port 1



Plot 158. Peak Power Spectral Density, Low Channel, HT20, Port 1

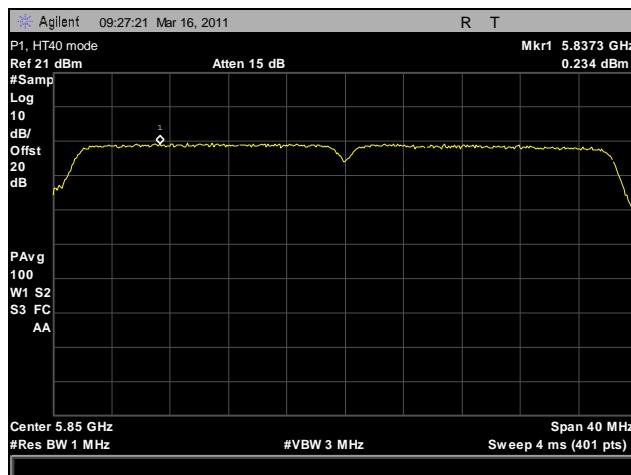


Plot 159. Peak Power Spectral Density, Mid Channel, HT20, Port 1



Plot 160. Peak Power Spectral Density, High Channel, HT20, Port 1

## Peak Power Spectral Density, HT40, Port 1



Plot 161. Peak Power Spectral Density, HT40, Port 1

## Electromagnetic Compatibility Criteria for Intentional Radiators

### Maximum Permissible Exposure

**RF Exposure Requirements:** 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:** 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.

**Test Results:**

$$S = PG / 4\pi R^2$$

Gain of the antenna = 13dBi

$$S = 0.324 \text{ mW/Cm}^2$$

## 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
1T4409	EMI RECEIVER	ROHDE & SCHWARZ	ESIB7	5/25/2010	5/25/2011
1T4568	RADIATING NOISE SOURCE	MET LABORATORIES	N/A	SEE NOTE	
1T4300	SEMI-ANECHOIC CHAMBER # 1	EMC TEST SYSTEMS	NONE	8/23/2010	8/23/2013
1T4751	ANTENNA - BILOG	SUNOL SCIENCES	JB6	11/3/2010	11/3/2011
1T4612	SPECTRUM ANALYZER	AGILENT	E4407B	9/27/2010	9/27/2011
1T4565	LISN (24 AMP)	SOLAR ELECTRONICS	9252-50-R-24-BNC	10/28/2010	10/28/2011
1T4564	LISN (24 AMP)	SOLAR ELECTRONICS	9252-50-R-24-BNC	10/6/2010	10/6/2011
1T4758	THERMO-HYGROMETER	CONTROL COMPANY	4040	5/21/2010	5/21/2012

**Table 16. Test Equipment List**

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

# End of Report