MET Laboratories, Inc. *Safety Certification - EMI - Telecom Environmental Simulation*
914 WEST PATAPSCO AVENUE ● BALTIMORE, MARYLAND 21230-3432 ● PHONE (410) 354-3300 ● FAX (410) 354-3313
33439 WESTERN AVENUE ● UNION CITY, CALIFORNIA 94587 ● PHONE (510) 489-6300 ● FAX (510) 489-6372
3162 BELICK STREET ● SANTA CLARA, CALIFORNIA 95054 ● PHONE (408 748-3585 ● FAX (510) 489-6372

January 13, 2010

Ubiquiti Networks
91 E. Tasman
San Jose, CA 95134

Dear Robert Pera,

Enclosed is the EMC test report for compliance testing of the Ubiquiti Networks, M2G tested to the requirements of ETSI EN 300 328 (Article 3.2 of R&TTE Directive).

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\EMCS81790-ETS328)

MET Laboratories, Inc. *Safety Certification - EMI - Telecom Environmental Simulation*
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Electromagnetic Compatibility Criteria
Test Report

For the

Ubiquiti Networks
Model M2G

Tested under

ETSI EN 300 328

(Article 3.2 of R&TTE Directive)

MET Report: EMCS81790-ETS328

January 13, 2010

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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MET Report: EMCS81790-ETS328

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 ETSI EN 300 328 of the EU Rules under normal use and maintenance.

Shawn McMillen,
Wireless Manager, Electromagnetic Compatibility Lab

Report Status Sheet

Revision	Report Date	Reason for Revision
∅	January 13, 2010	Initial Issue.

Table of Contents

I. Requirements Summary **1**
II. Equipment Configuration **3**
A. Overview 4
B. References 4
C. Test Site 4
D. Description of Test Sample 4
E. Equipment Configuration 7
F. Ports and Cabling Information 7
G. Mode of Operation 8
H. Method of Monitoring EUT Operation 8
I. Modifications 8
a) Modifications to EUT 8
b) Modifications to Test Standard 8
J. Disposition of EUT 8
III. Conformance Requirements **9**
4.3.1 Maximum Transmit Power 10
4.3.2 Maximum EIRP Spectral Density 12
4.3.3 Frequency Range 18
4.3.5 Medium Access Protocol 34
4.3.6 Transmitter Spurious Emissions - Conducted 35
4.3.6 Transmitter Spurious Emissions - Radiated 45
4.3.7 Receiver Spurious Emissions - Conducted 56
4.3.7 Receiver Spurious Emissions - Radiated 59
IV. Test Equipment **62**

List of Tables

Table 1. Summary of EMC ETSI EN 300 328 (Article 3.2 of R&TTE Directive) Compliance Testing 2
Table 2. Test References 4
Table 3. Equipment Configuration 7
Table 4. Support Equipment 7
Table 5. Ports and Cabling Information 7
Table 6. EIRP, Test Results, 802.11n 20MHz 11
Table 7. EIRP, Test Results, 802.11n 40MHz 11
Table 8. Peak Spectral Density, Test Results 13
Table 9. Frequency Range, Test Results, 802.11n 20MHz 19
Table 10. Frequency Range, Test Results, 802.11n 40MHz 19
Table 11. Transmitter limits for narrowband spurious emissions 35
Table 12. Transmitter limits for wideband spurious emissions 35
Table 13. Transmitter limits for narrowband spurious emissions 45
Table 14. Transmitter limits for wideband spurious emissions 45
Table 15. Narrowband spurious emission limits for receivers 56
Table 16. Wideband spurious emission limits for receivers 56
Table 17. Narrowband spurious emission limits for receivers 59
Table 18. Wideband spurious emission limits for receivers 59

List of Photographs

Photograph 1. Radiated Emissions Setup, Bilog 55
Photograph 2. Radiated Emissions Setup, Horn 55

List of Plots

Plot 1. Low Channel, Power Spectral Density, Determination, 802.11n 20MHz Bandwidth 14
Plot 2. Low Channel, Power Spectral Density, 802.11n 20MHz Bandwidth 14
Plot 3. Mid Channel, Power Spectral Density, Determination, 802.11n 20MHz Bandwidth 15
Plot 4. Mid Channel, Power Spectral Density, 802.11n 20MHz Bandwidth 15
Plot 5. High Channel, Power Spectral Density, Determination, 802.11n 20MHz Bandwidth 16
Plot 6. High Channel, Power Spectral Density, 802.11n 20MHz Bandwidth 16
Plot 7. Power Spectral Density, Determination, 802.11n 40MHz Bandwidth 17
Plot 8. Power Spectral Density, 802.11n 40MHz Bandwidth 17
Plot 9. Frequency Range, Low Channel, Low Temp., Low Voltage, 802.11n 20MHz 20
Plot 10. Frequency Range, Low Channel, Low Temp., Normal Voltage, 802.11n 20MHz 20
Plot 11. Frequency Range, Low Channel, Low Temp., High Voltage, 802.11n 20MHz 21
Plot 12. Frequency Range, Low Channel, Normal Temp., Low Voltage, 802.11n 20MHz 21
Plot 13. Frequency Range, Low Channel, Normal Temp., Normal Voltage, 802.11n 20MHz 22
Plot 14. Frequency Range, Low Channel, Normal Temp., High Voltage, 802.11n 20MHz 22
Plot 15. Frequency Range, Low Channel, High Temp., Low Voltage, 802.11n 20MHz 23
Plot 16. Frequency Range, Low Channel, High Temp., Normal Voltage, 802.11n 20MHz 23
Plot 17. Frequency Range, Low Channel, High Temp., High Voltage, 802.11n 20MHz 24
Plot 18. Frequency Range, High Channel, Low Temp., Low Voltage, 802.11n 20MHz 24
Plot 19. Frequency Range, High Channel, Low Temp., Normal Voltage, 802.11n 20MHz 25
Plot 20. Frequency Range, High Channel, Low Temp., High Voltage, 802.11n 20MHz 25
Plot 21. Frequency Range, High Channel, Normal Temp., Low Voltage, 802.11n 20MHz 26
Plot 22. Frequency Range, High Channel, Normal Temp., Normal Voltage, 802.11n 20MHz 26

Plot 23. Frequency Range, High Channel, Normal Temp., High Voltage, 802.11n 20MHz 27
Plot 24. Frequency Range, High Channel, High Temp., Low Voltage, 802.11n 20MHz 27
Plot 25. Frequency Range, High Channel, High Temp., Normal Voltage, 802.11n 20MHz 28
Plot 26. Frequency Range, High Channel, High Temp., High Voltage, 802.11n 20MHz..... 28
Plot 27. Frequency Range, Low Temp., Low Voltage, 802.11n 40MHz 29
Plot 28. Frequency Range, Low Temp., Normal Voltage, 802.11n 40MHz 29
Plot 29. Frequency Range, Low Temp., High Voltage, 802.11n 40MHz 30
Plot 30. Frequency Range, Normal Temp., Low Voltage, 802.11n 40MHz 30
Plot 31. Frequency Range, Normal Temp., Normal Voltage, 802.11n 40MHz 31
Plot 32. Frequency Range, Normal Temp., High Voltage, 802.11n 40MHz 31
Plot 33. Frequency Range, High Temp., Low Voltage, 802.11n 40MHz 32
Plot 34. Frequency Range, High Temp., Normal Voltage, 802.11n 40MHz 32
Plot 35. Frequency Range, High Temp., High Voltage, 802.11n 40MHz..... 33
Plot 36. Conducted Spurious Emission, Low Channel, 30 MHz – 1 GHz, 802.11n 20MHz 37
Plot 37. Conducted Spurious Emission, Low Channel, 1 GHz - 12.75 GHz, 802.11n 20MHz 37
Plot 38. Conducted Spurious Emission, Low Channel, 1.8GHz Hz - 1.9 GHz, 802.11n 20MHz..... 38
Plot 39. Conducted Spurious Emission, Low Channel, 5.15 GHz - 5.3 GHz, 802.11n 20MHz 38
Plot 40. Conducted Spurious Emission, Mid Channel, 30 MHz – 1 GHz, 802.11n 20MHz..... 39
Plot 41. Conducted Spurious Emission, Mid Channel, 1 GHz - 12.75 GHz, 802.11n 20MHz 39
Plot 42. Conducted Spurious Emission, Mid Channel, 1.8GHz Hz - 1.9 GHz, 802.11n 20MHz..... 40
Plot 43. Conducted Spurious Emission, Mid Channel, 5.15 GHz - 5.3 GHz, 802.11n 20MHz 40
Plot 44. Conducted Spurious Emission, High Channel, 30 MHz – 1 GHz, 802.11n 20MHz 41
Plot 45. Conducted Spurious Emission, High Channel, 1 GHz - 12.75 GHz, 802.11n 20MHz..... 41
Plot 46. Conducted Spurious Emission, High Channel, 1.8GHz Hz - 1.9 GHz, 802.11n 20MHz 42
Plot 47. Conducted Spurious Emission, High Channel, 5.15 GHz - 5.3 GHz, 802.11n 20MHz..... 42
Plot 48. Conducted Spurious Emission, 30 MHz – 1 GHz, 802.11n 40MHz..... 43
Plot 49. Conducted Spurious Emission, 1 GHz - 12.75 GHz, 802.11n 40MHz..... 43
Plot 50. Conducted Spurious Emission, 1.8GHz Hz - 1.9 GHz, 802.11n 40MHz 44
Plot 51. Conducted Spurious Emission, 5.15 GHz - 5.3 GHz, 802.11n 40MHz..... 44
Plot 52. Radiated Spurious Emission, Low Channel, 30 MHz – 1 GHz, 802.11n 20MHz 47
Plot 53. Radiated Spurious Emission, Low Channel, 1 GHz - 12.75 GHz, 802.11n 20MHz..... 47
Plot 54. Radiated Spurious Emission, Low Channel, 1.8GHz Hz - 1.9 GHz, 802.11n 20MHz..... 48
Plot 55. Radiated Spurious Emission, Low Channel, 5.15 GHz - 5.3 GHz, 802.11n 20MHz..... 48
Plot 56 Radiated Spurious Emission, Mid Channel, 30 MHz – 1 GHz, 802.11n 20MHz..... 49
Plot 57. Radiated Spurious Emission, Mid Channel, 1 GHz - 12.75 GHz, 802.11n 20MHz 49
Plot 58. Radiated Spurious Emission, Mid Channel, 1.8GHz Hz - 1.9 GHz, 802.11n 20MHz..... 50
Plot 59. Radiated Spurious Emission, Mid Channel, 5.15 GHz - 5.3 GHz, 802.11n 20MHz 50
Plot 60. Radiated Spurious Emission, High Channel, 30 MHz – 1 GHz, 802.11n 20MHz..... 51
Plot 61. Radiated Spurious Emission, High Channel, 1 GHz - 12.75 GHz, 802.11n 20MHz..... 51
Plot 62. Radiated Spurious Emission, High Channel, 1.8GHz Hz - 1.9 GHz, 802.11n 20MHz 52
Plot 63. Radiated Spurious Emission, High Channel, 5.15 GHz - 5.3 GHz, 802.11n 20MHz..... 52
Plot 64. Radiated Spurious Emission, 30 MHz – 1 GHz, 802.11n 40MHz..... 53
Plot 65. Radiated Spurious Emission, 1 GHz - 12.75 GHz, 802.11n 40MHz..... 53
Plot 66. Radiated Spurious Emission, 1.8GHz Hz - 1.9 GHz, 802.11n 40MHz 54
Plot 67. Radiated Spurious Emission, 5.15 GHz - 5.3 GHz, 802.11n 40MHz..... 54
Plot 68. Conducted Receiver Spurious Emission, 30 MHz – 1 GHz 58
Plot 69. Conducted Receiver Spurious Emission, 1 GHz – 12.75 GHz 58
Plot 70. Radiated Receiver Spurious Emission, 30 MHz – 1 GHz..... 61
Plot 71. Radiated Receiver Spurious Emission, 1 GHz – 12.75 GHz 61

List of Terms and Abbreviations

AC	**A**lternating **C**urrent
ACF	**A**ntenna **C**orrection **F**actor
Cal	**Cal**ibration
d	**M**easurement **D**istance
dB	**D**eci**b**els
dBµA	**D**eci**b**els above one **micro**amp
dBµV	**D**eci**b**els above one **micro**volt
dBµA/m	**D**eci**b**els above one **micro**amp **per m**eter
dBµV/m	**D**eci**b**els above one **micro**volt **per m**eter
DC	**D**irect **C**urrent
E	**E**lectric Field
DSL	**D**igital **S**ubscriber **L**ine
ESD	**E**lectro**s**tatic **D**ischarge
EUT	**E**quipment **U**nder **T**est
f	**F**requency
CISPR	**C**omite **I**nternational **S**pecial des **P**erturbations **R**adioelectriques (International Special Committee on Radio Interference)
GRP	**G**round **R**eference **P**lane
H	Magnetic Field
HCP	**H**orizontal **C**oupling **P**lane
Hz	**H**ert**z**
IEC	**I**nternational **E**lectrotechnical **C**ommission
kHz	**k**ilo**H**ert**z**
kPa	**k**ilo**Pa**scal
kV	**k**ilo**v**olt
LISN	**L**ine **I**mpedance **S**tabilization **N**etwork
MHz	**M**ega**H**ertz
µH	**micro**Henry
µF	**micro**Farad
µs	**micros**econds
PRF	**P**ulse **R**epetition **F**requency
RF	**R**adio **F**requency
RMS	**R**oot-**M**ean-**S**quare
V/m	**V**olts **per m**eter
VCP	**V**ertical **C**oupling **P**lane

I. Requirements Summary

A. Requirements Summary

ETSI EN 300 328 Section Number	Descriptive Name	Compliance			Comments
		Yes	No	N/A	
Sections 4.3.1	Maximum Transmit Power	✓			Compliant
Sections 4.3.2	Maximum EIRP Spectral Density	✓			Compliant
Sections 4.3.3	Frequency Range	✓			Compliant
Sections 4.3.5	Medium Access Protocol	✓			Compliant
Sections 4.3.6	Conducted Transmitter Spurious Emissions	✓			Compliant
	Radiated Transmitter Spurious Emissions	✓			Compliant
Sections 4.3.7	Conducted Receiver Spurious Emissions	✓			Compliant
	Radiated Receiver Spurious Emissions	✓			Compliant

Table 1. Summary of EMC ETSI EN 300 328 (Article 3.2 of R&TTE Directive) Compliance Testing

II. Equipment Configuration

A. Overview

MET Laboratories, Inc. was contracted by Ubiquiti Networks to perform testing on a M2G.

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 model M2G.

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

Model(s) Tested:	M2G
Model(s) Number:	M2G
EUT Specifications:	Primary Power from Laptop: 5 VDC, 1A
	Secondary Power: N/A
Lab Ambient (Normal) Test Conditions:	Temperature: 15-35º C
	Relative Humidity: 30-60%
	Atmospheric Pressure: 860-1060 mbar
Extreme Test Conditions:	Temperature: -20 to +55º C
	Relative Humidity: 30-60%
Evaluated by:	Anderson Soungpanya
Report Date(s):	January 13, 2010

B. References

ETSI EN 300 328 V1.7.1 (2006-10)	Electromagnetic compatibility and Radio spectrum Matters (ERM); Wideband Transmission systems; data transmission equipment in the 2.4 GHz ISM band and using spread spectrum modulation techniques; Part1: Technical characteristics and test conditions

Table 2. Test 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.

D. Description of Test Sample

The Ubiquiti Networks M2G, Equipment Under Test (EUT), is an outdoor 2.4GHz CPE device.

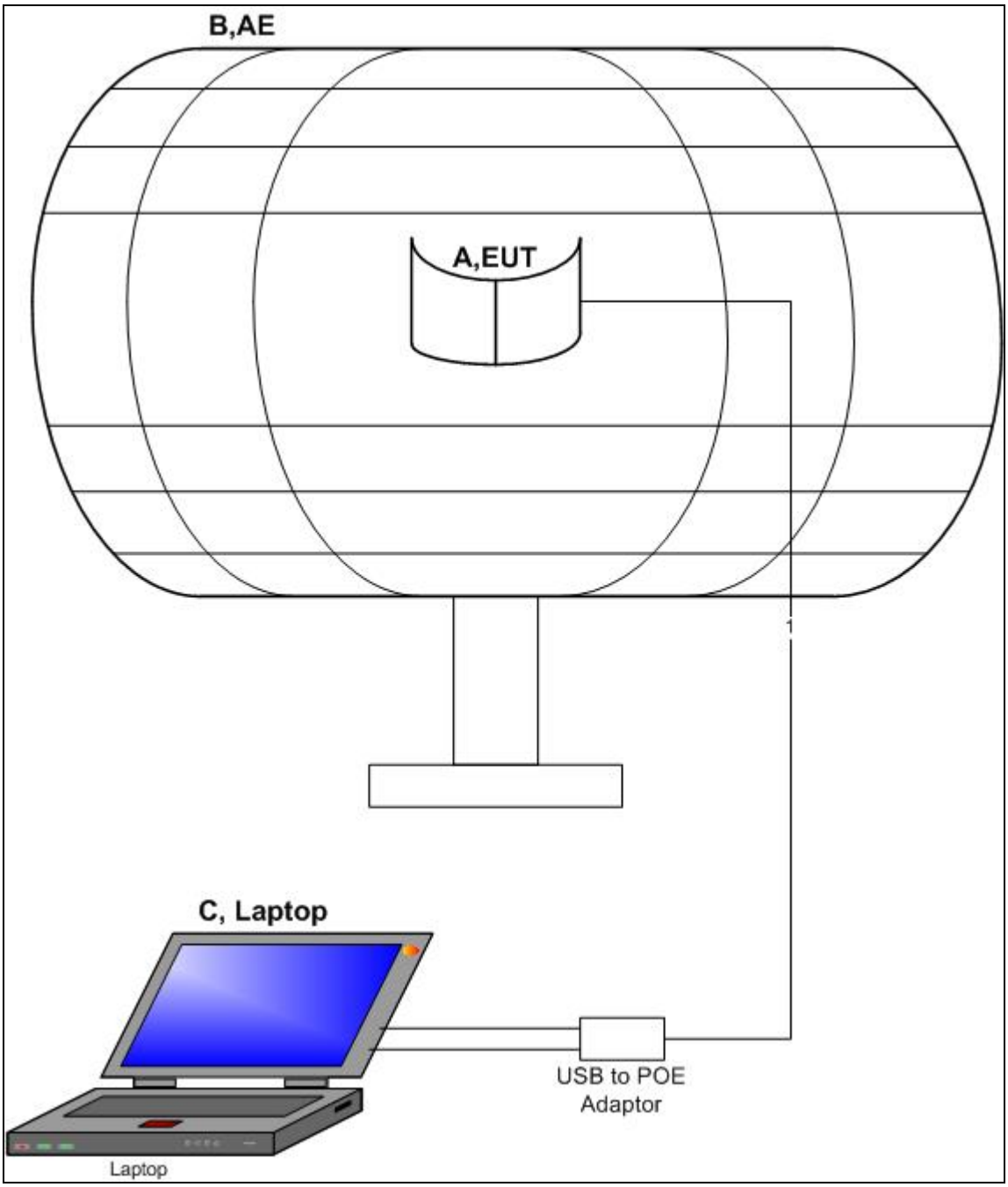


Figure 1. Block Diagram of Test Configuration with Grid Antenna

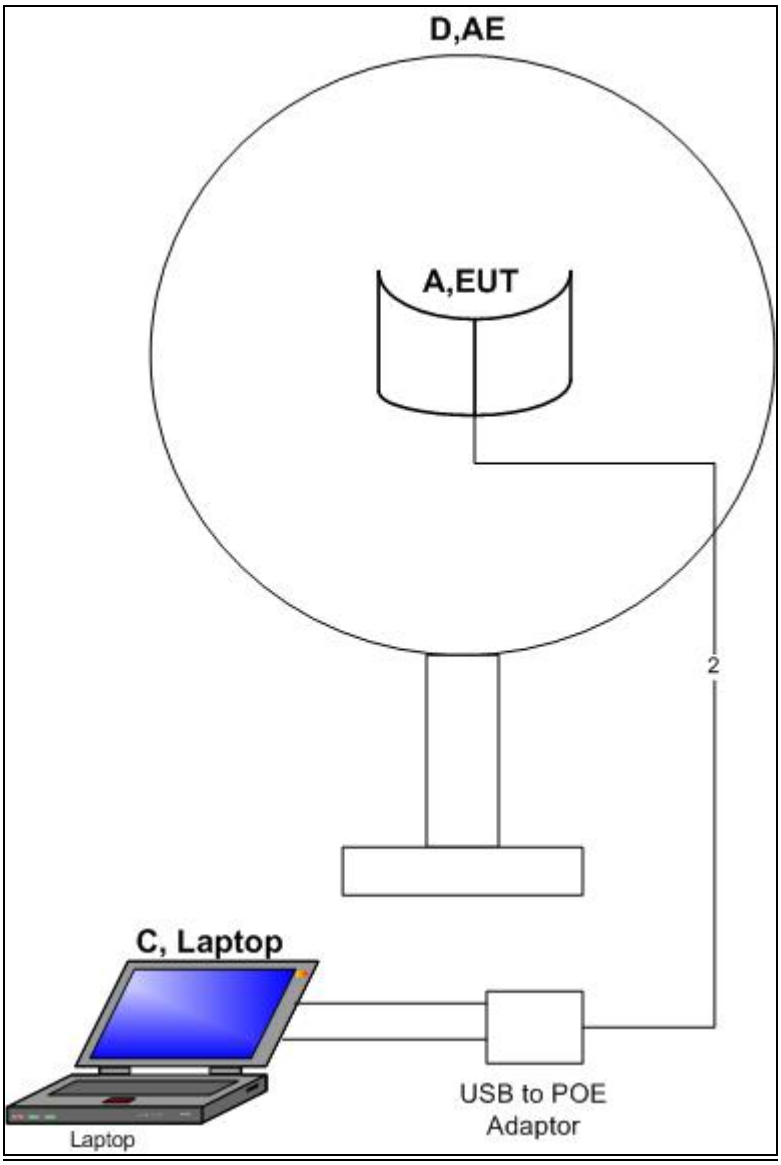


Figure 2. Block Diagram of Test Configuration with Dish Antenna

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	2GHz Radio	M2G	0923

Table 3. Equipment Configuration

F. Support Equipment

Ubiquiti Networks supplied support equipment necessary for the operation and testing of the M2G. All support equipment supplied is listed in the following Support Equipment List.

Ref. ID	Name / Description	Manufacturer	Model Number
B	Grid Antenna	Ubiquiti	2009-8-13
C	Laptop	Dell	Vastro 1000
D	Dish Antenna	Ubiquiti	Proto 1

Table 4. Support Equipment

G. Ports and Cabling Information

Ref. ID	Port name on EUT	Cable Description or reason for no cable	Qty.	Length (m)	Shielded (Y/N)	Termination Box ID & Port Name
Configuration with Grid Antenna						
1	A,EUT	CAT 5E	1	3	Y	C, Laptop
Configuration with Dish Antenna						
2	A,EUT	CAT 5E	1	3	Y	C, Laptop

Table 5. Ports and Cabling Information

H. Mode of Operation

The EUT operates in OFDM mode.

I. Method of Monitoring EUT Operation

A Spectrum Analyzer and a Power Meter was use to monitor the EUT's transmitter channel and power output.

J. Modifications

a) Modifications to EUT

No modifications 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. Conformance Requirements

Conformance Requirements

4.3.1 Maximum Transmit Power

Test Requirement(s): **ETSI EN 300 328-1, Clause 4.3.1:**

4.3.1.1 Definition

The maximum transmit power is defined as the maximum isotropic radiated power of the equipment.

4.3.1.2 Limit

The equivalent isotropic radiated power (e.i.r.p.) shall be equal to or less than -10 dBW (100 mW). This limit shall apply for any combination of power level and intended antenna assembly.

Test Procedure: The EUT was connected directly to a spectrum analyzer capable of measuring the peak and average RF power of a modulated carrier. Measurements were carried out in all modulations available and at the low, mid and high channels of the transmit band. Both normal and extreme test conditions were observed. The EIRP was calculated the following equation:

P = A + G + 10 log (1/x); where A is the measured power, x is the duty cycle and G is the antenna assembly gain.

Test Results: The EUT as tested was found compliant with the specified limits in clause 4.3.1.2.

Test Engineer: Anderson Soungpanya

Test Date: 10/07/09

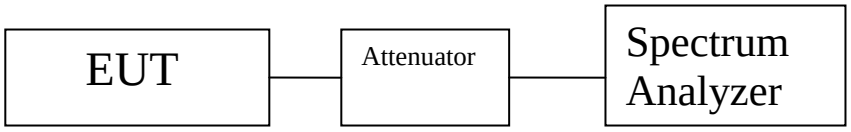


Figure 3. Maximum Transmit Power

Maximum Transmit Power (EIRP) Test Results

Channel	Temperature	Voltage	Mode	Conducted Power (dBm)	Antenna Gain (dBi)	EIRP
Low	Nominal	Nominal	802.11n 20MHz	-6.82	24	17.18
Mid	Nominal	Nominal	802.11n 20MHz	-6.62	24	17.38
High	Nominal	Nominal	802.11n 20MHz	-6.79	24	17.21
Low	Maximum	Minimum	802.11n 20MHz	-7.83	24	16.17
Low	Maximum	Maximum	802.11n 20MHz	-7.88	24	16.12
Mid	Maximum	Minimum	802.11n 20MHz	-7.02	24	16.98
Mid	Maximum	Maximum	802.11n 20MHz	-7.42	24	16.58
High	Maximum	Minimum	802.11n 20MHz	-7.37	24	16.63
High	Maximum	Maximum	802.11n 20MHz	-7.33	24	16.67
Low	Minimum	Minimum	802.11n 20MHz	-4.53	24	19.47
Low	Minimum	Maximum	802.11n 20MHz	-4.56	24	19.44
Mid	Minimum	Minimum	802.11n 20MHz	-4.22	24	19.78
Mid	Minimum	Maximum	802.11n 20MHz	-4.25	24	19.75
High	Minimum	Minimum	802.11n 20MHz	-4.36	24	19.64
High	Minimum	Maximum	802.11n 20MHz	-4.33	24	19.67

Table 6. EIRP, Test Results, 802.11n 20MHz

Channel	Temperature	Voltage	Mode	Conducted Power (dBm)	Antenna Gain (dBi)	EIRP
Mid	Nominal	Nominal	802.11n 40MHz	-7.02	24	16.98
Mid	Minimum	Minimum	802.11n 40MHz	-4.16	24	19.84
Mid	Minimum	Maximum	802.11n 40MHz	-4.41	24	19.59
Mid	Maximum	Minimum	802.11n 40MHz	-7.45	24	16.55
Mid	Maximum	Maximum	802.11n 40MHz	-7.76	24	16.24

Table 7. EIRP, Test Results, 802.11n 40MHz

Conformance Requirements

4.3.2 Maximum EIRP Spectral Density

Test Requirement(s): **ETSI EN 300 328 Section 4.3.2:**

4.3.2.1 Definition
The maximum EIRP spectral density is defined as the highest EIRP level in Watts per Hertz generated by the transmitter within the power envelope.

4.3.2.2 Limit
For wide band modulations other then FHSS (e.g. DSSS, OFDM, etc.), the maximum EIRP spectral density is limited to 10 mW per MHz.

Test Procedure: The EUT was connected directly to a spectrum analyzer through an attenuator. The EUT was set to transmit at the highest power level in the appropriate modulation. For DTS modulations, the spectrum analyzer was set with a resolution band width of 1MHz, a positive peak detector, max hold function and a span three times the Occupied Band width. The frequency which produced the highest output across the channel bandwidth was recorded. The spectrum analyzer was then set to this frequency and the channel power/MHz was measured using the spectrum analyzer's channel power function. The maximum spectral power density EIRP was determined using the following equation:
P = A + G + 10 log (1/x); where A is the measured power, x is the duty cycle and G is the antenna assembly gain.

Test Results: The EUT as tested was found compliant with the specified limits of Clause 4.3.2.2.

Maximum SPD <= 10mW (10 dBm) per MHz EIRP in Normal Test Condition, SPD = Spectral Power Density.

Test Engineer: Anderson Soungpanya

Test Date: 10/06/09

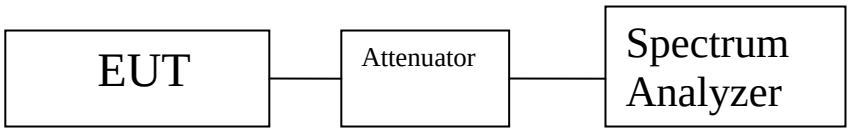
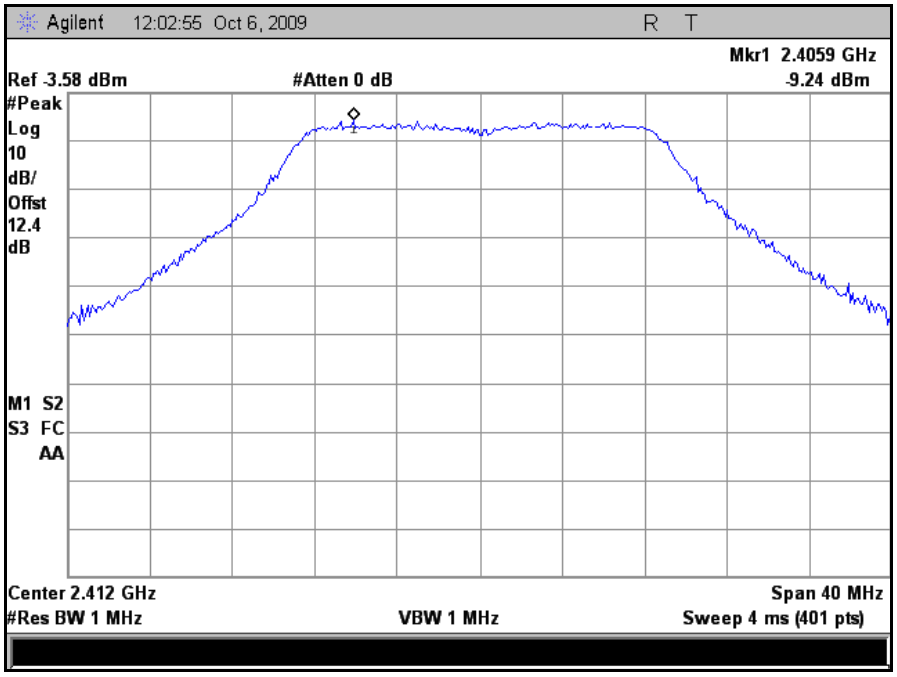


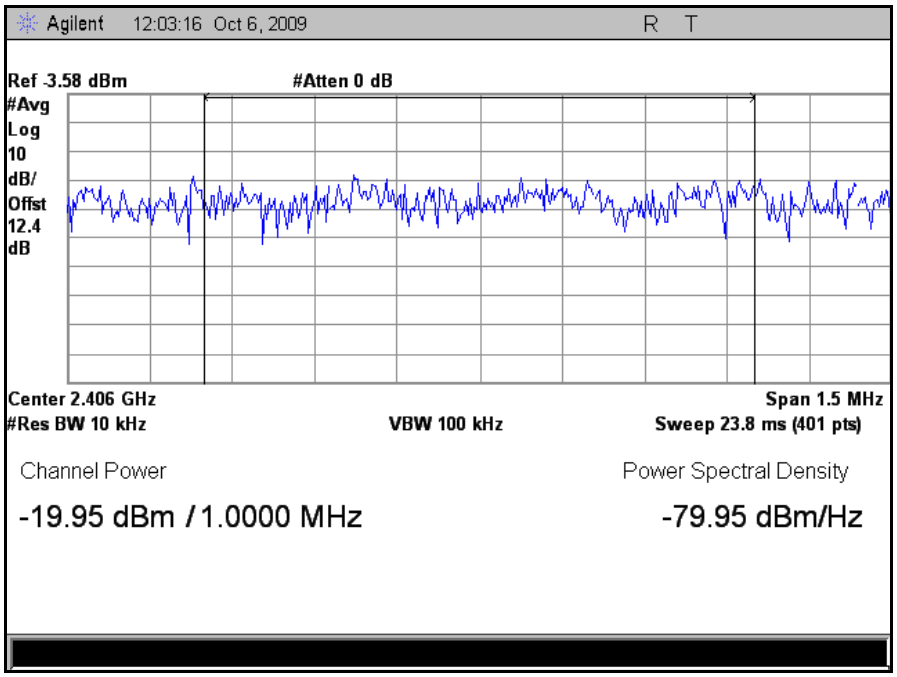
Figure 4. Maximum Spectral Density

Mode	Frequency (GHz)	Measured Maximum Spectral Power Density (dBm)	Antenna Gain	Measured Maximum Spectral Power Density EIRP (dBm)	Maximum SPD Limit (dBm)
802.11n 20MHz	2406	-19.95	24	4.05	10
	2437	-18.76	24	5.24	10
	2462	-17.97	24	6.03	10
802.11n 40MHz	2437	-21.69	24	2.31	10

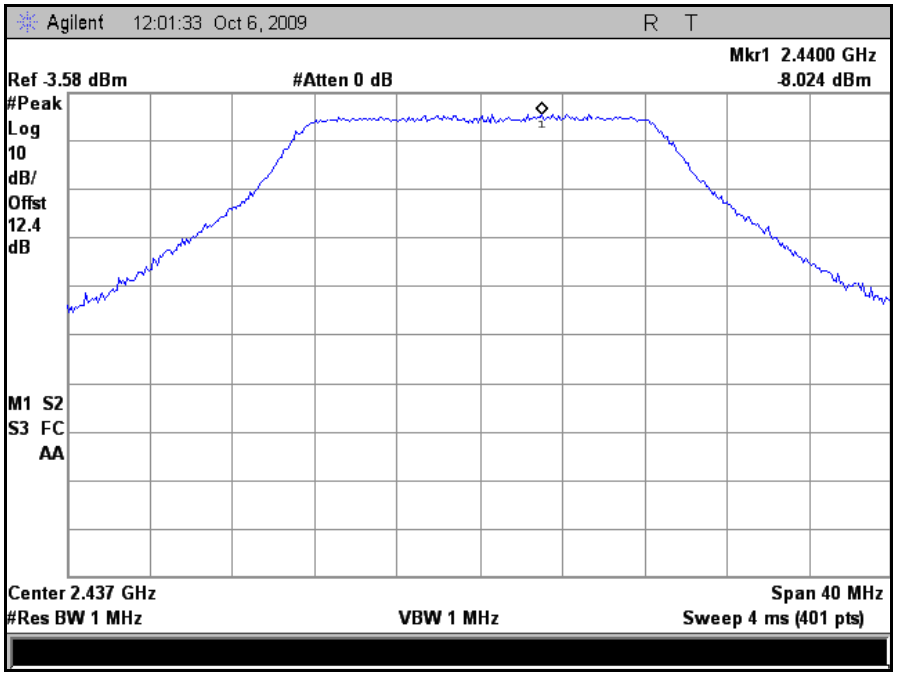
Table 8. Peak Spectral Density, Test Results



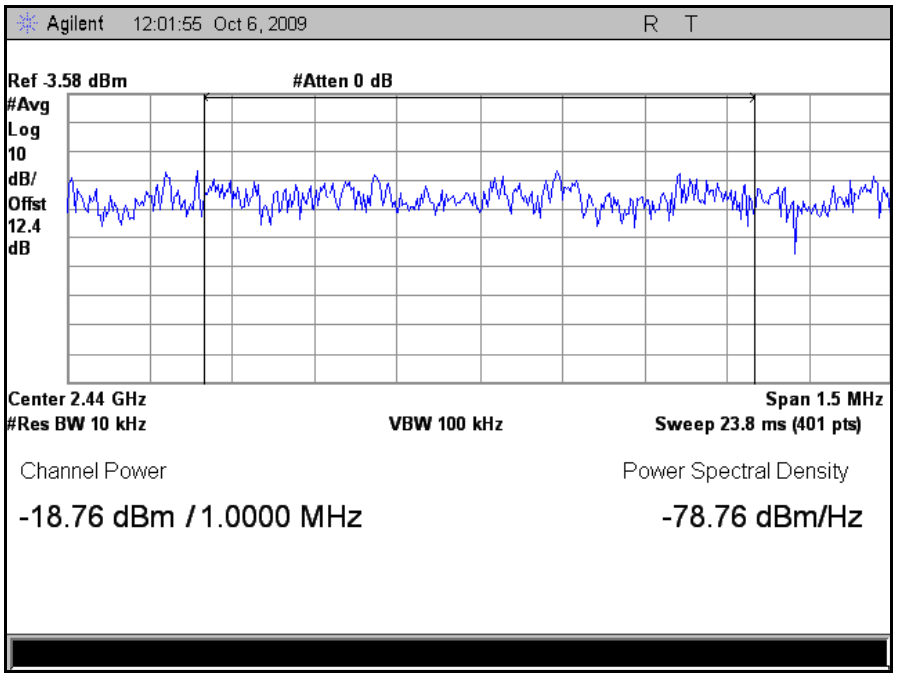
Plot 1. Low Channel, Power Spectral Density, Determination, 802.11n 20MHz Bandwidth



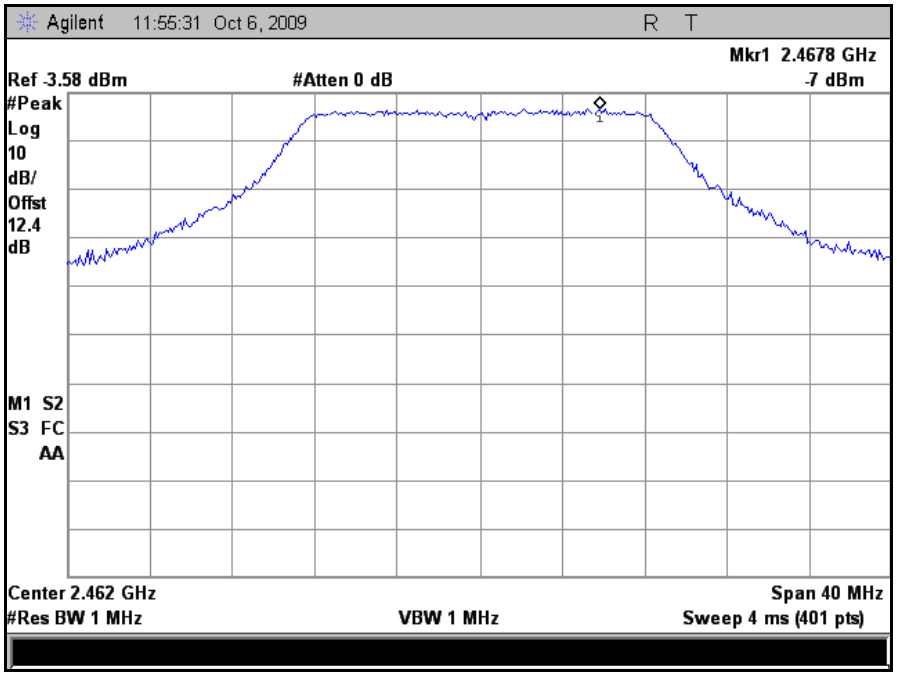
Plot 2. Low Channel, Power Spectral Density, 802.11n 20MHz Bandwidth



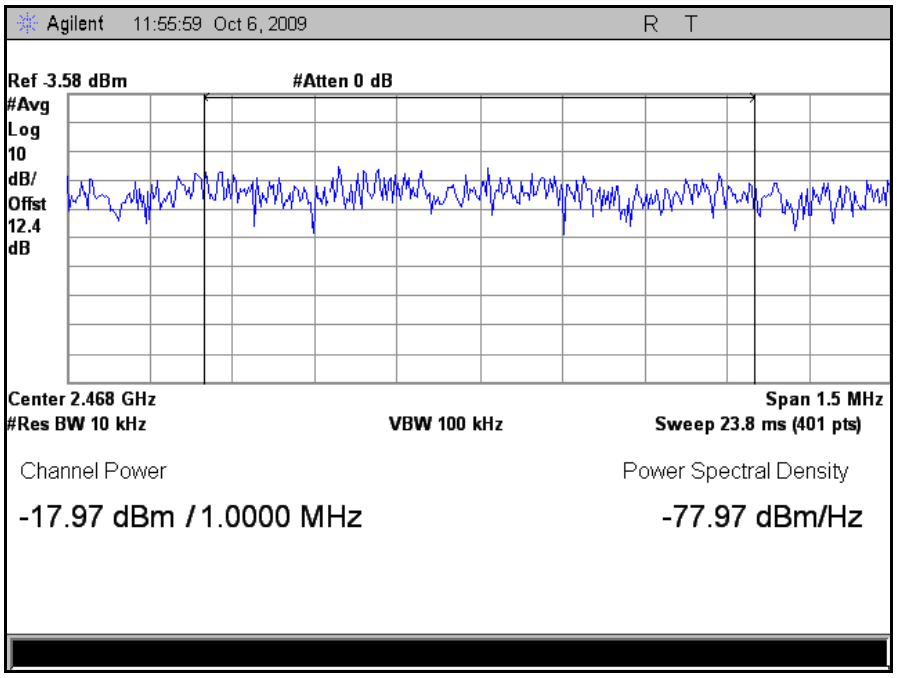
Plot 3. Mid Channel, Power Spectral Density, Determination, 802.11n 20MHz Bandwidth



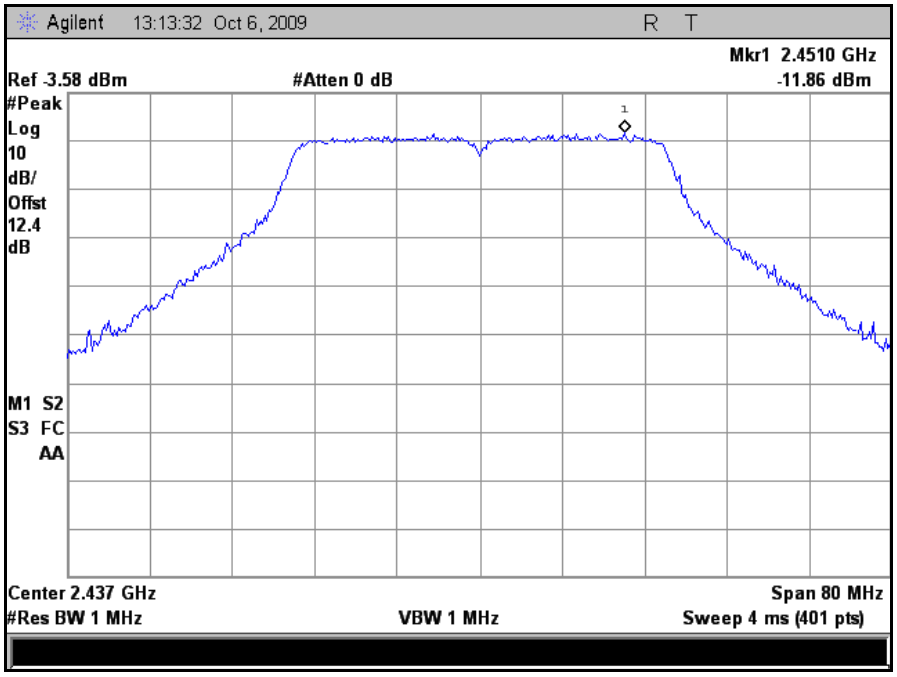
Plot 4. Mid Channel, Power Spectral Density, 802.11n 20MHz Bandwidth



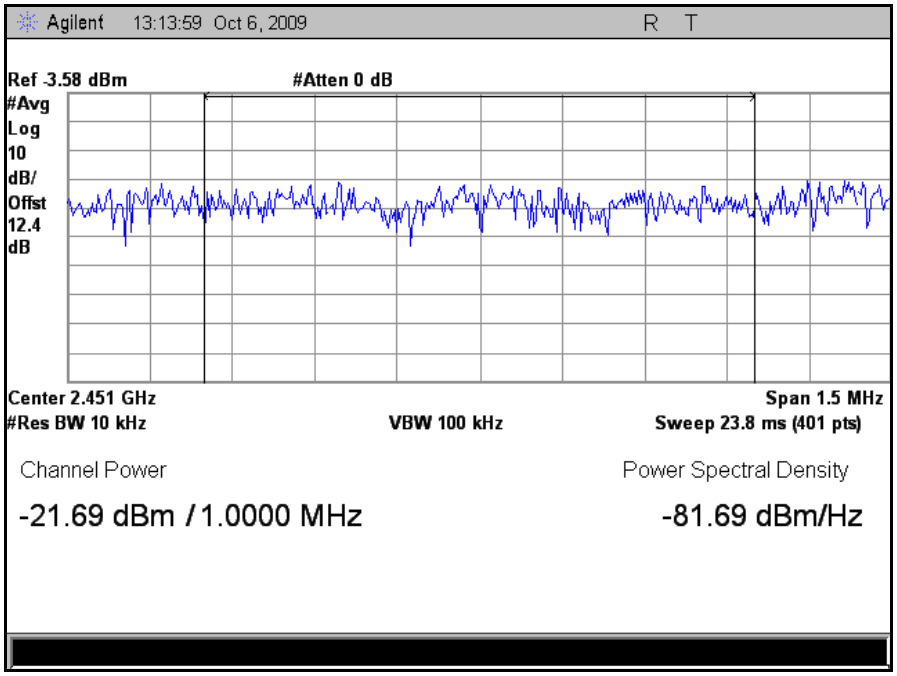
Plot 5. High Channel, Power Spectral Density, Determination, 802.11n 20MHz Bandwidth



Plot 6. High Channel, Power Spectral Density, 802.11n 20MHz Bandwidth



Plot 7. Power Spectral Density, Determination, 802.11n 40MHz Bandwidth



Plot 8. Power Spectral Density, 802.11n 40MHz Bandwidth

Conformance Requirements

4.3.3 Frequency Range

Test Requirement(s): **EN 300 328 Clause 4.3.3:**

4.3.3.1 Definition

The frequency range of the equipment is determined by the lowest and highest frequencies occupied by the spectrum envelope.

fH is the highest frequency of the spectrum envelope: it is the frequency furthest above the frequency of maximum power where the EIRP spectral density drops below the level of -80 dBm/Hz (-30 dBm if measured in a 100 kHz bandwidth).

fL is the lowest frequency of the spectrum envelope; it is the frequency furthest below the frequency of maximum power where the EIRP spectral density drops below the level of -80 dBm/Hz (or -30 dBm if measured in a 100 kHz bandwidth).

For a given operating frequency, the width of the spectrum envelope is (*fH* - *fL*). In equipment that allows adjustment or selection of different operating frequencies, the power envelope takes up different positions in the allocated band. The frequency range is determined by the lowest value of *fL* and the highest value of *fH* resulting from the adjustment of the equipment to the lowest and highest operating frequencies.

4.3.3.2 Limit

For all equipment the frequency range shall lie within the band 2.4 GHz to 2.4835 GHz (*fL* > 2.4 GHz and *fH* < 2.4835 GHz).

Test Procedure: The EUT was connected directly to a spectrum analyzer through a attenuator. The resolution band width of the spectrum analyzer was set to 100 KHz with video averaging and a minimum of 50 sweeps. The lowest and highest carrier frequencies generated by all modulations was set to transmit at the highest rated power level of the EUT. The frequency at which the spectral density dropped by 30dBm from the maximum level measured was recorded for both the upper and lower frequencies of the transmit band. This procedure was carried out at both normal and extreme conditions.

Test Results: The EUT as tested was found compliant with the specified limits of Clause 4.3.3.2.

Test Engineer: Anderson Soungpanya

Test Date: 10/07/09

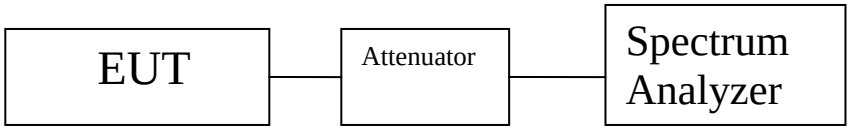


Figure 5. Frequency Range Test Setup

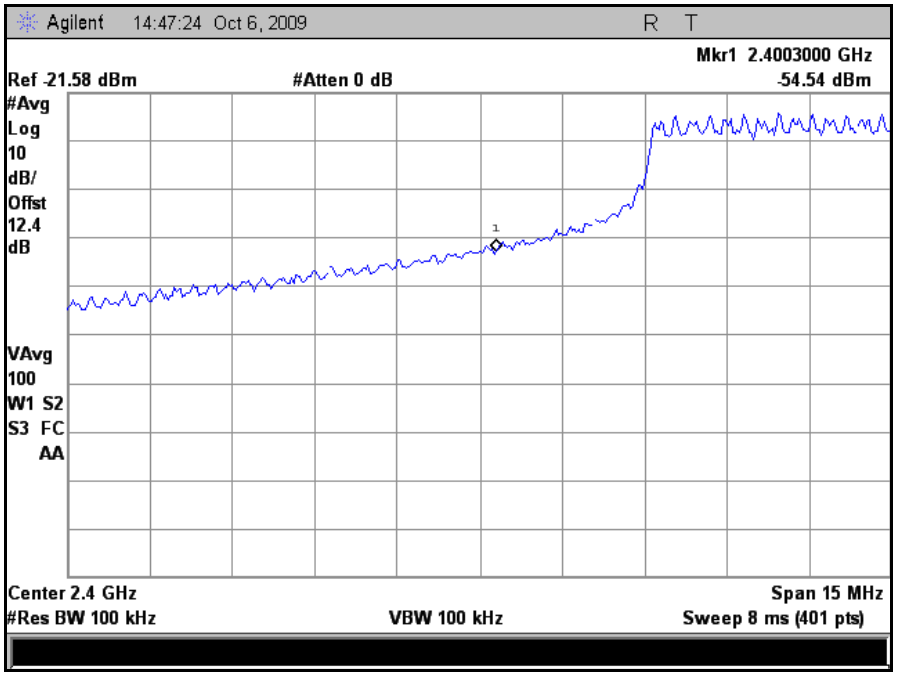
4.3.3 Frequency Range

Frequency Range						
Temp	**Voltage**	**Mode**	**Low**	**High**	**Margin**	**Limit**
Nominal	Minimum	OFDM	2400.552	2474.277	73.725	83.50
Nominal	Nominal	OFDM	2400.529	2472.604	72.075	83.50
Nominal	Maximum	OFDM	2400.552	2472.642	72.090	83.50
Minimum	Minimum	OFDM	2400.300	2473.725	73.425	83.50
Minimum	Nominal	OFDM	2400.525	2473.800	73.275	83.50
Minimum	Maximum	OFDM	2400.600	2473.950	73.350	83.50
Maximum	Minimum	OFDM	2400.600	2474.963	74.363	83.50
Maximum	Nominal	OFDM	2400.600	2472.488	71.888	83.50
Maximum	Maximum	OFDM	2400.638	2472.488	71.850	83.50

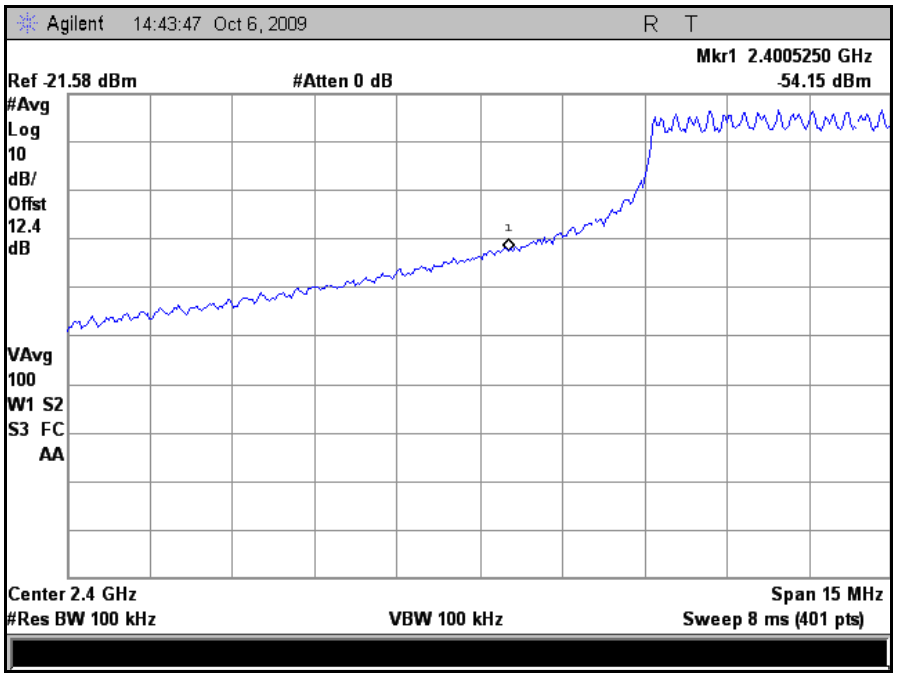
Table 9. Frequency Range, Test Results, 802.11n 20MHz

Frequency Range						
Temp	**Voltage**	**Mode**	**Low**	**High**	**Margin**	**Limit**
Nominal	Minimum	OFDM	2417.00	2457.25	40.25	83.50
Nominal	Nominal	OFDM	2417.75	2456.50	38.75	83.50
Nominal	Maximum	OFDM	2417.00	2457.00	40.00	83.50
Minimum	Minimum	OFDM	2416.50	2457.75	41.25	83.50
Minimum	Nominal	OFDM	2416.50	2457.75	41.25	83.50
Minimum	Maximum	OFDM	2416.50	2458.00	41.50	83.50
Maximum	Minimum	OFDM	2417.75	2456.25	38.50	83.50
Maximum	Nominal	OFDM	2417.75	2456.25	38.50	83.50
Maximum	Maximum	OFDM	2417.50	2456.50	39.00	83.50

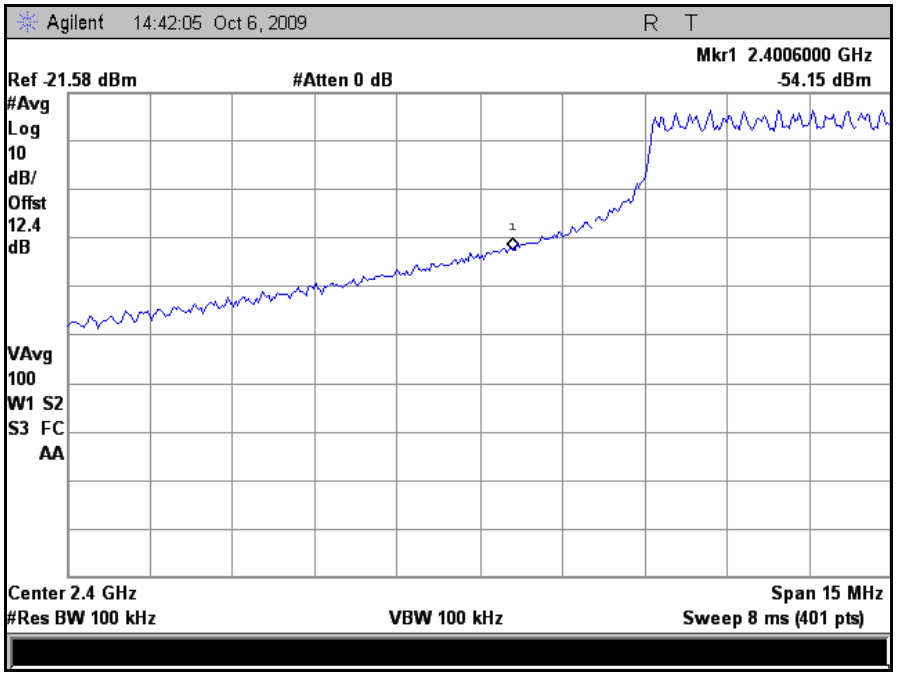
Table 10. Frequency Range, Test Results, 802.11n 40MHz



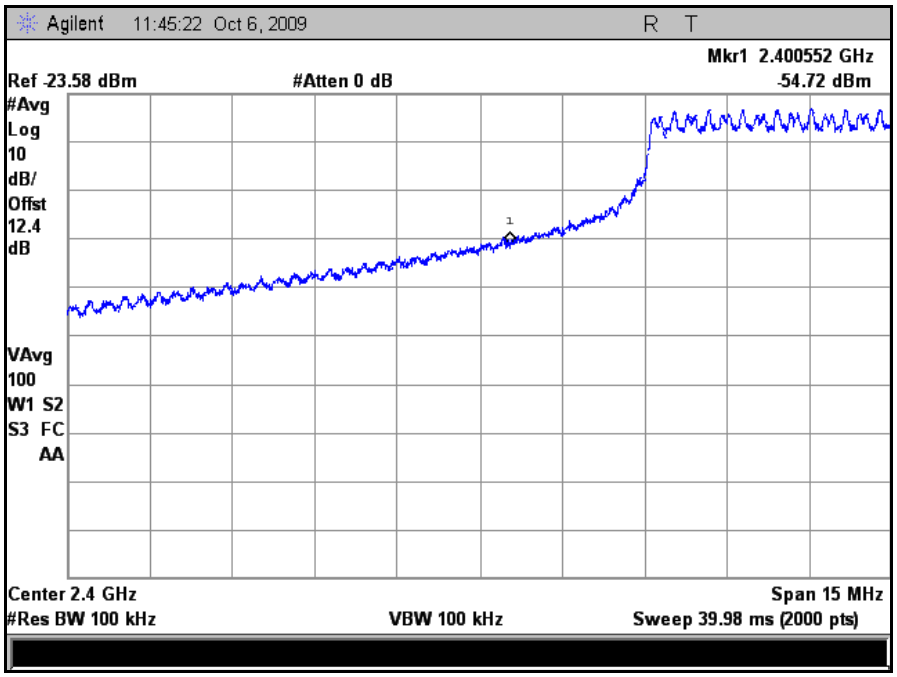
Plot 9. Frequency Range, Low Channel, Low Temp., Low Voltage, 802.11n 20MHz



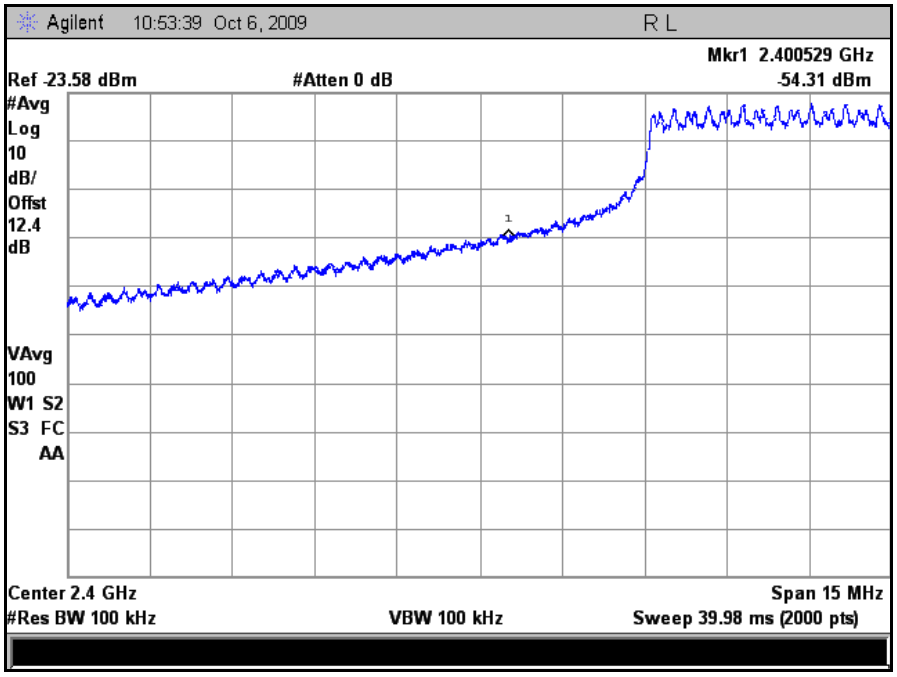
Plot 10. Frequency Range, Low Channel, Low Temp., Normal Voltage, 802.11n 20MHz



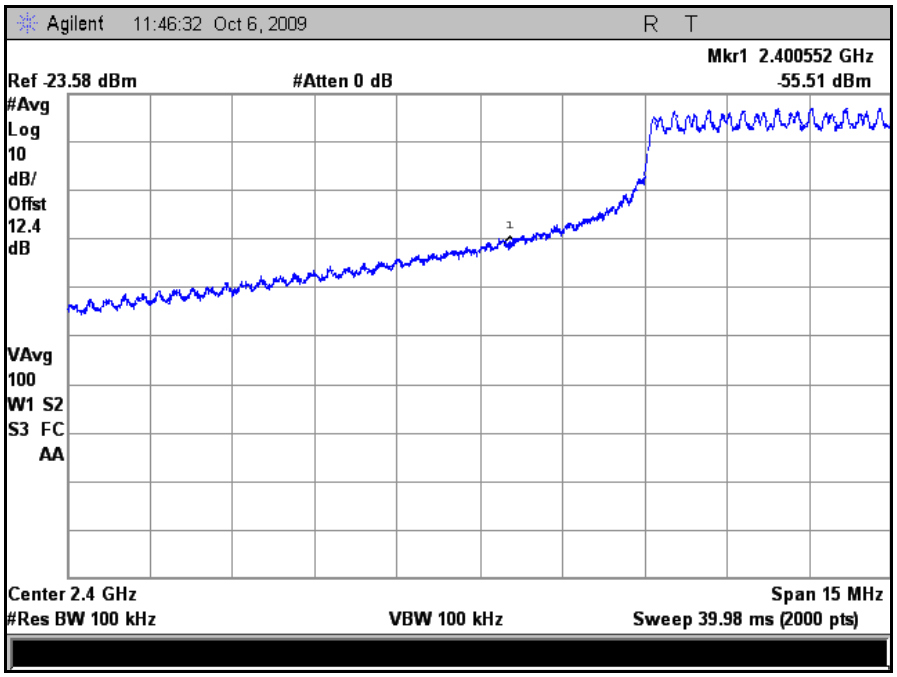
Plot 11. Frequency Range, Low Channel, Low Temp., High Voltage, 802.11n 20MHz



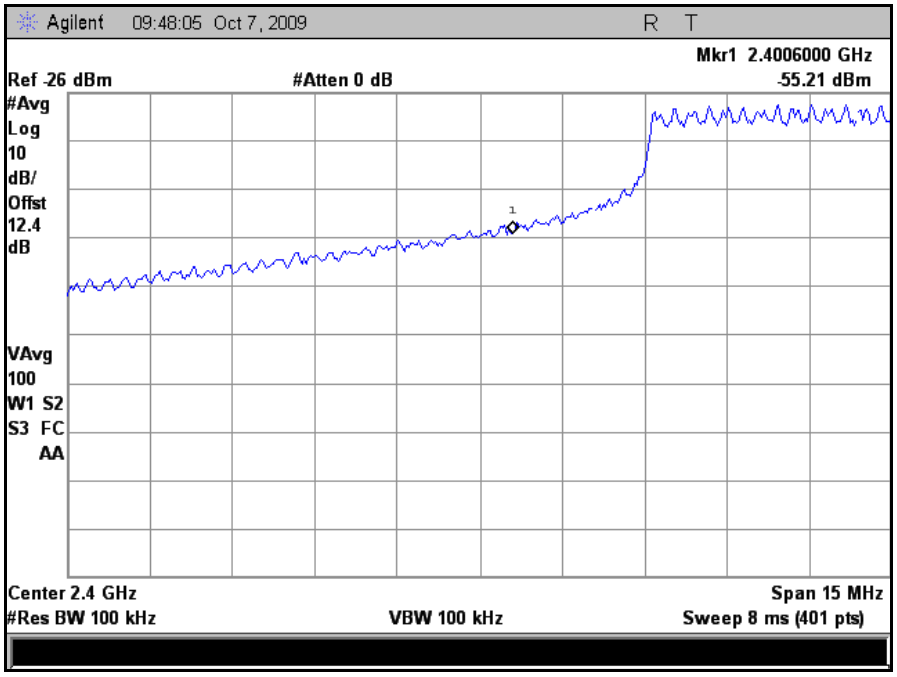
Plot 12. Frequency Range, Low Channel, Normal Temp., Low Voltage, 802.11n 20MHz



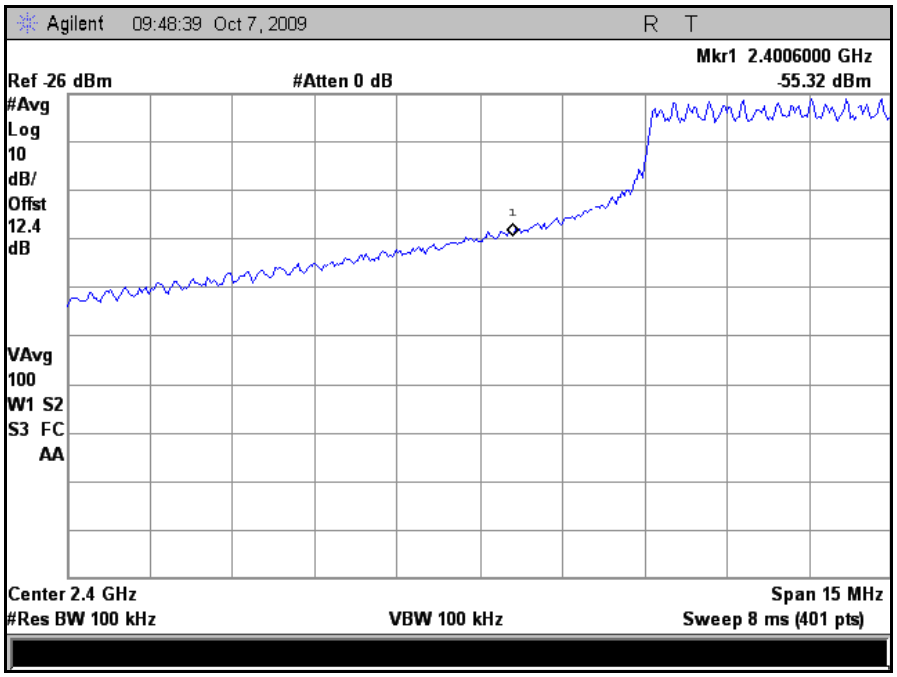
Plot 13. Frequency Range, Low Channel, Normal Temp., Normal Voltage, 802.11n 20MHz



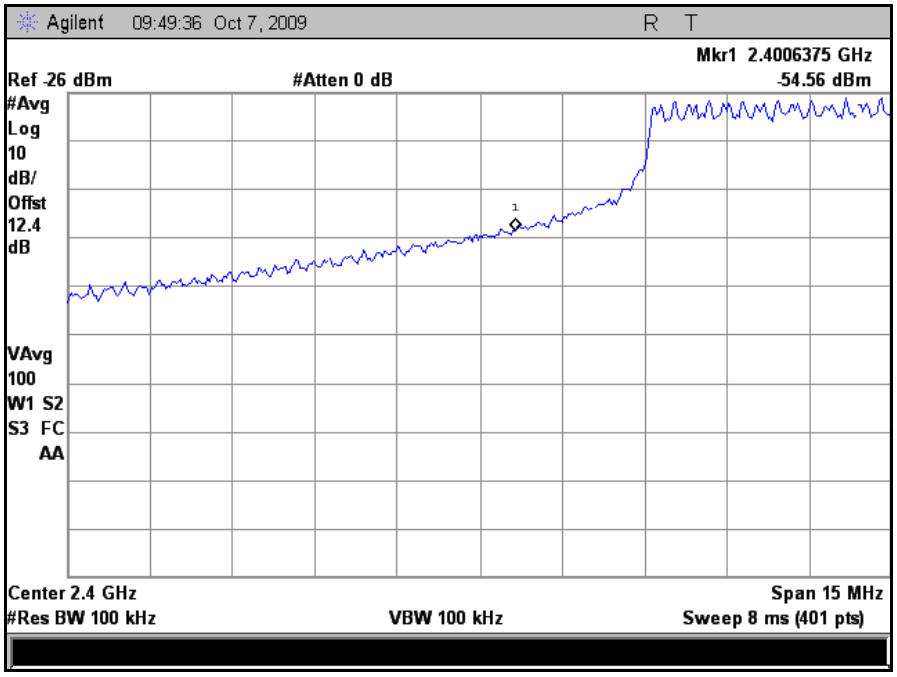
Plot 14. Frequency Range, Low Channel, Normal Temp., High Voltage, 802.11n 20MHz



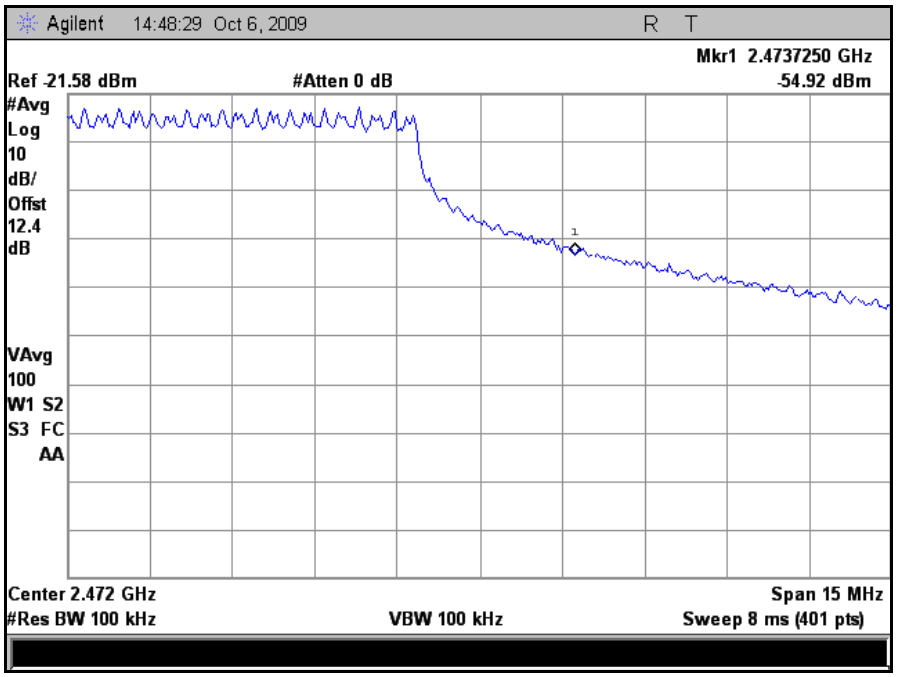
Plot 15. Frequency Range, Low Channel, High Temp., Low Voltage, 802.11n 20MHz



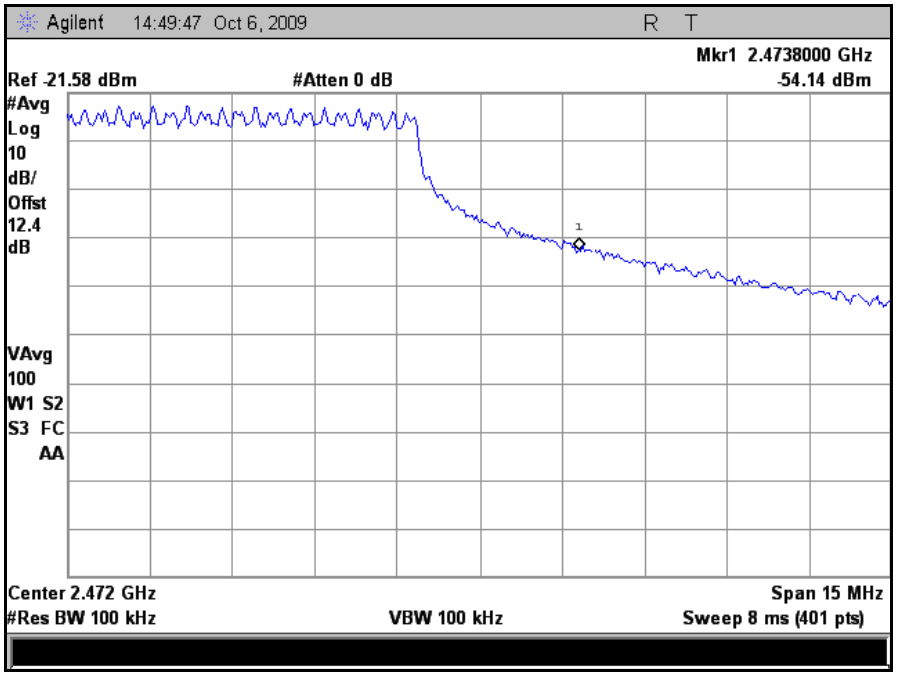
Plot 16. Frequency Range, Low Channel, High Temp., Normal Voltage, 802.11n 20MHz



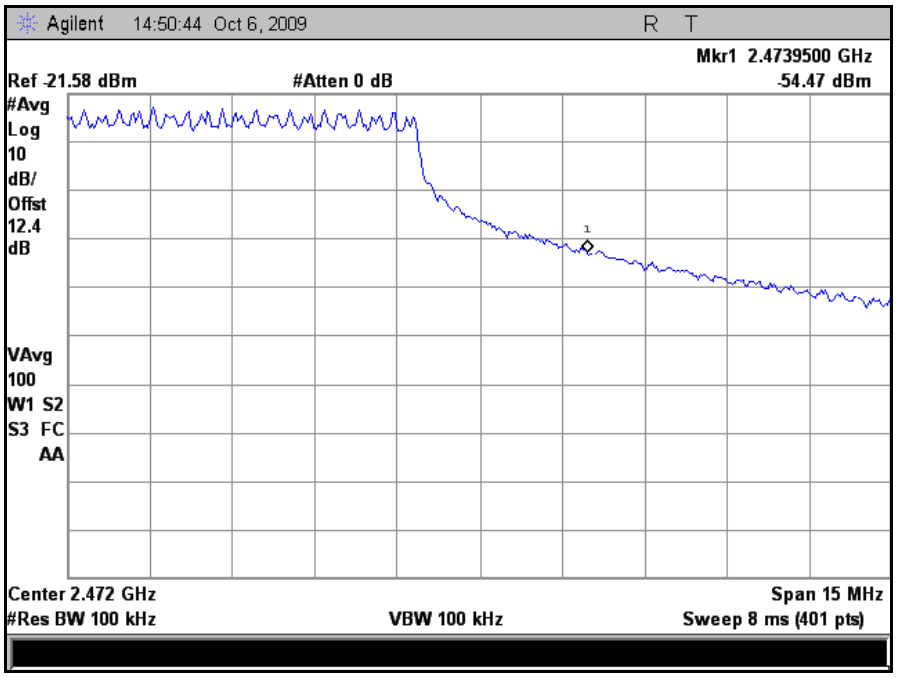
Plot 17. Frequency Range, Low Channel, High Temp., High Voltage, 802.11n 20MHz



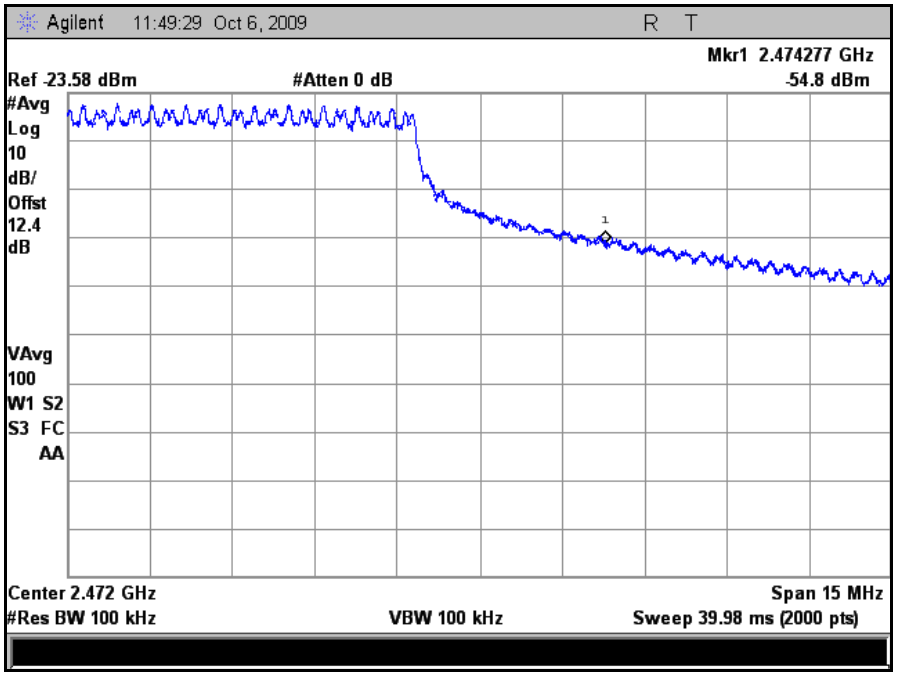
Plot 18. Frequency Range, High Channel, Low Temp., Low Voltage, 802.11n 20MHz



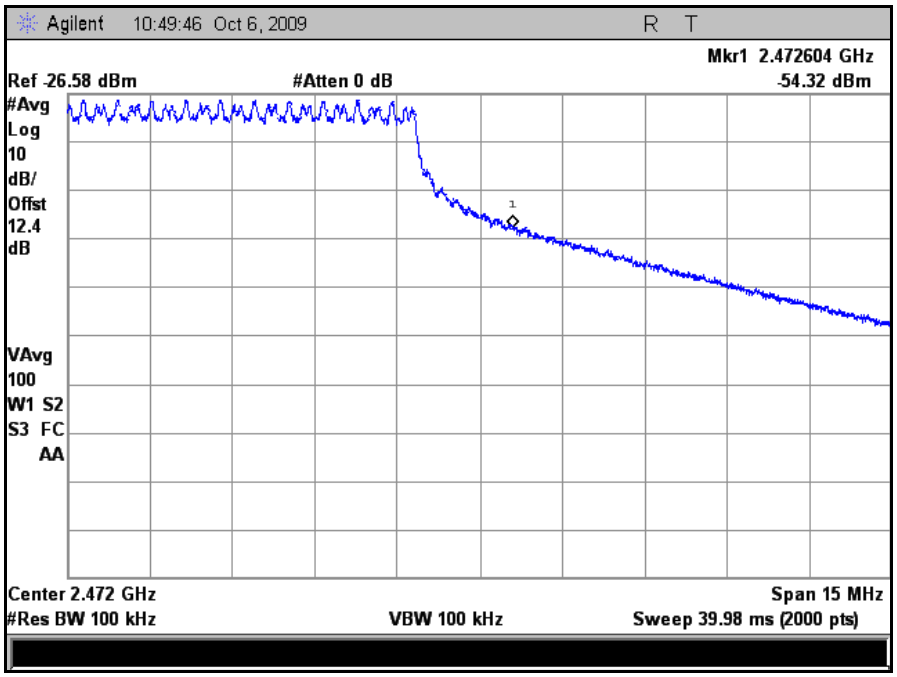
Plot 19. Frequency Range, High Channel, Low Temp., Normal Voltage, 802.11n 20MHz



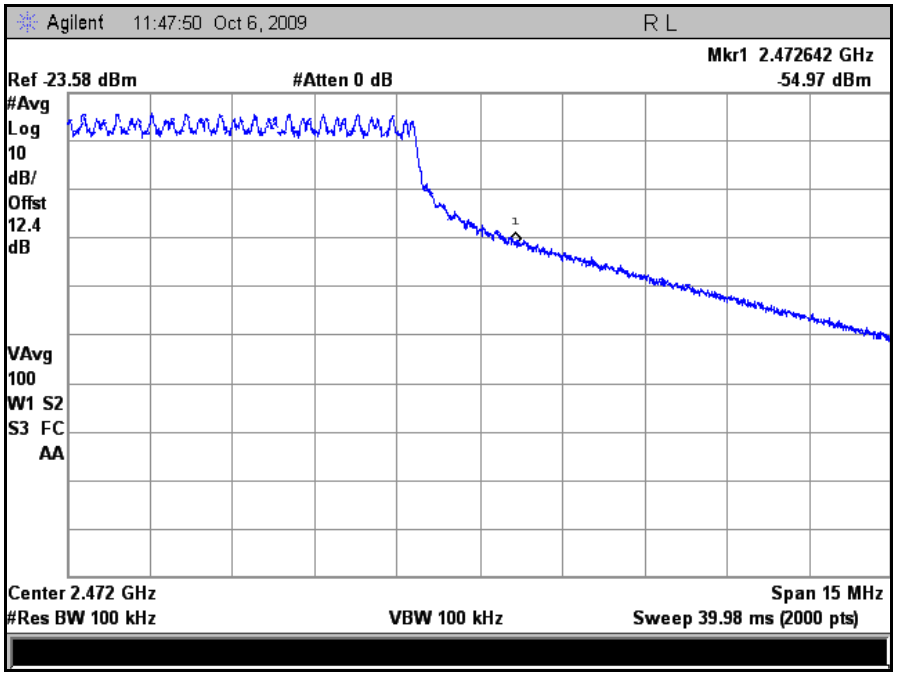
Plot 20. Frequency Range, High Channel, Low Temp., High Voltage, 802.11n 20MHz



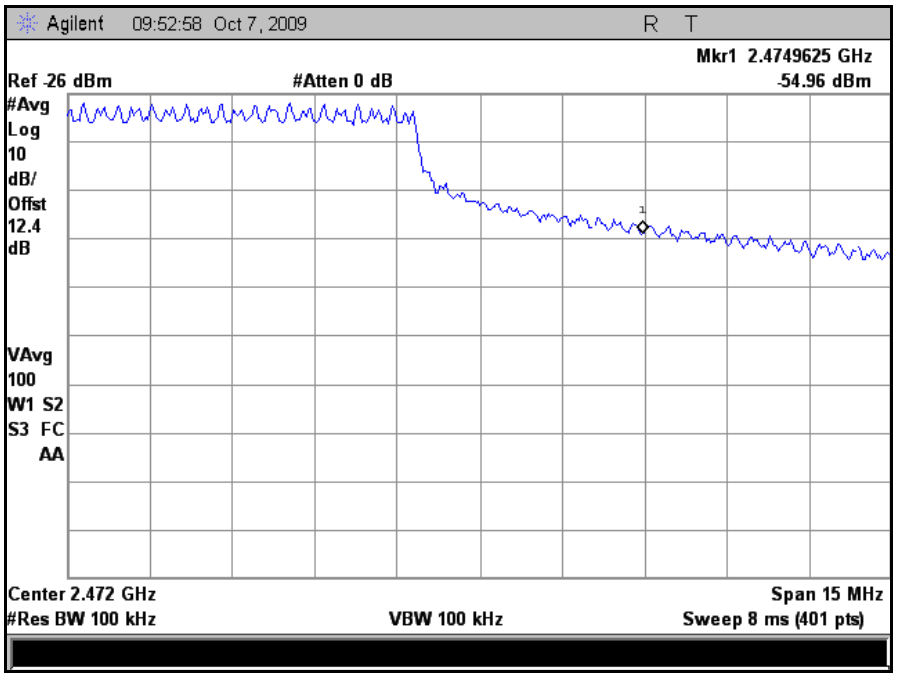
Plot 21. Frequency Range, High Channel, Normal Temp., Low Voltage, 802.11n 20MHz



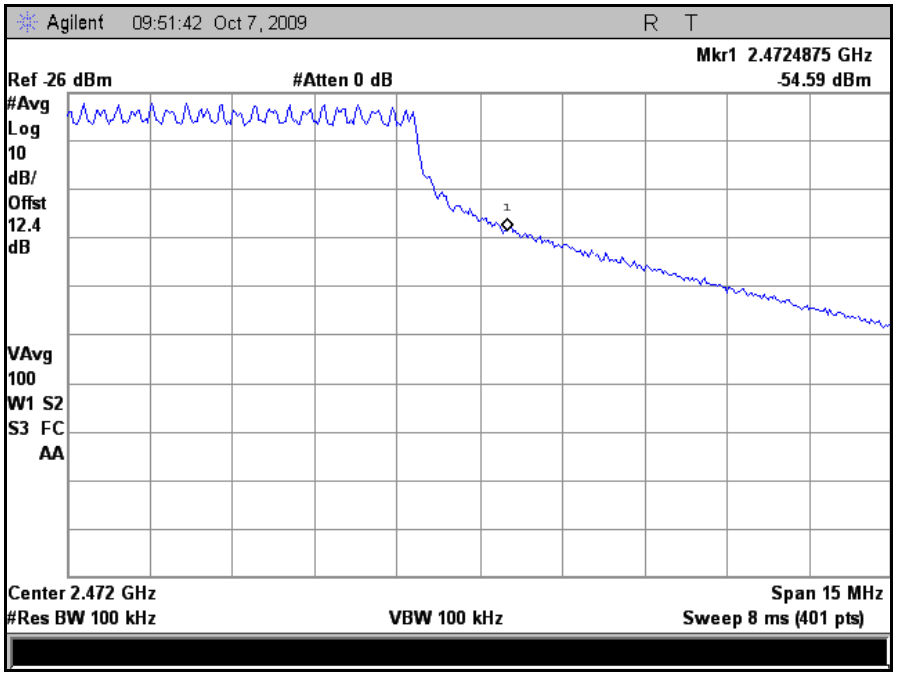
Plot 22. Frequency Range, High Channel, Normal Temp., Normal Voltage, 802.11n 20MHz



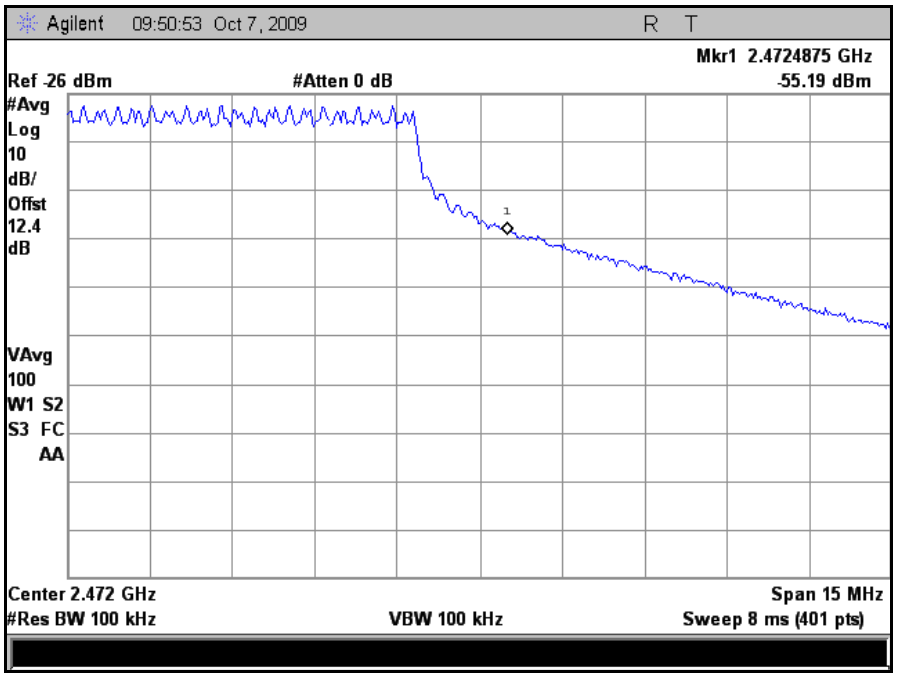
Plot 23. Frequency Range, High Channel, Normal Temp., High Voltage, 802.11n 20MHz



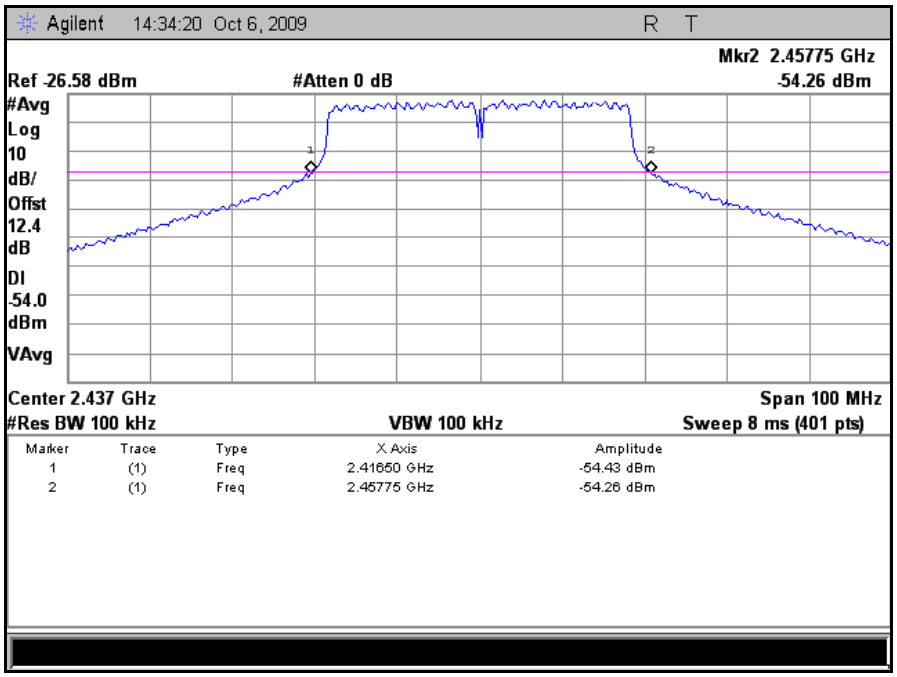
Plot 24. Frequency Range, High Channel, High Temp., Low Voltage, 802.11n 20MHz



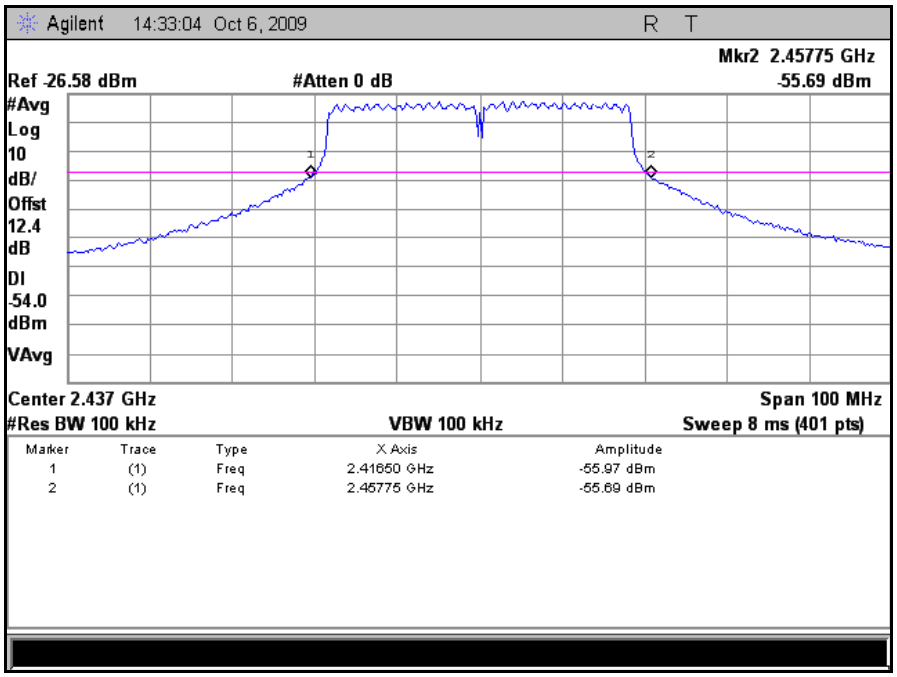
Plot 25. Frequency Range, High Channel, High Temp., Normal Voltage, 802.11n 20MHz



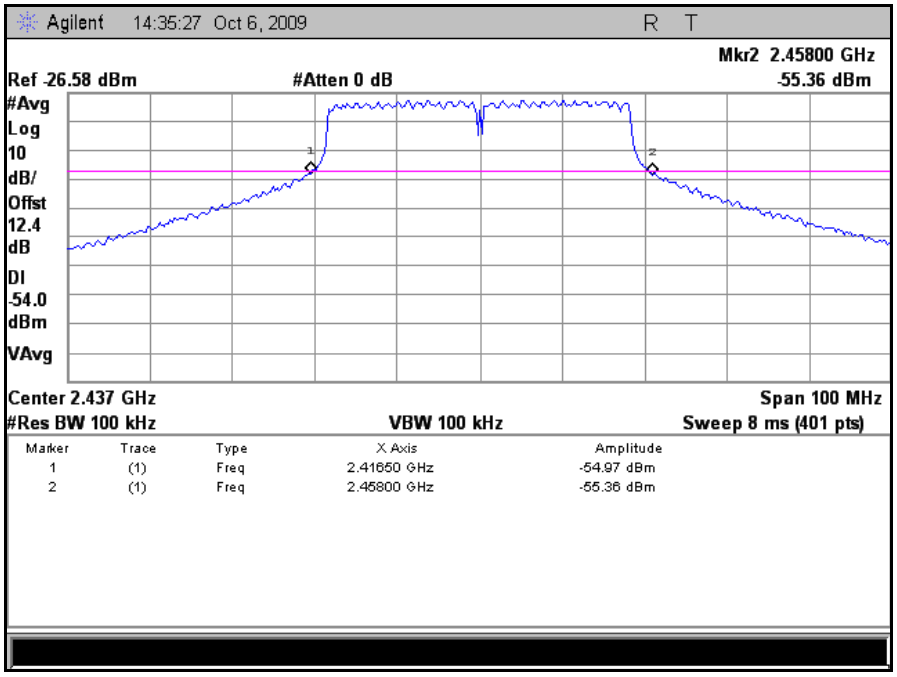
Plot 26. Frequency Range, High Channel, High Temp., High Voltage, 802.11n 20MHz



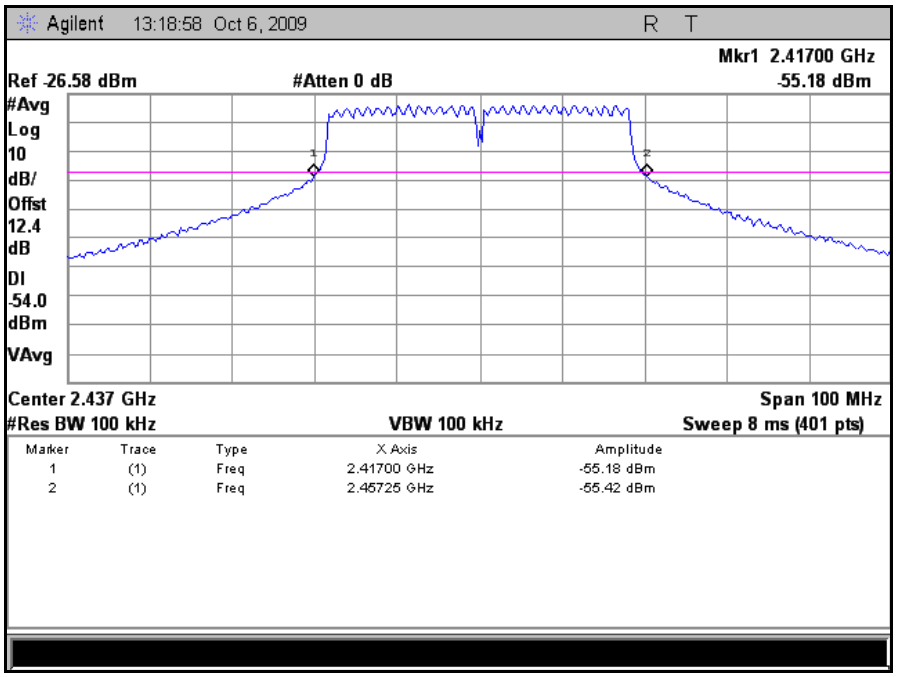
Plot 27. Frequency Range, Low Temp., Low Voltage, 802.11n 40MHz



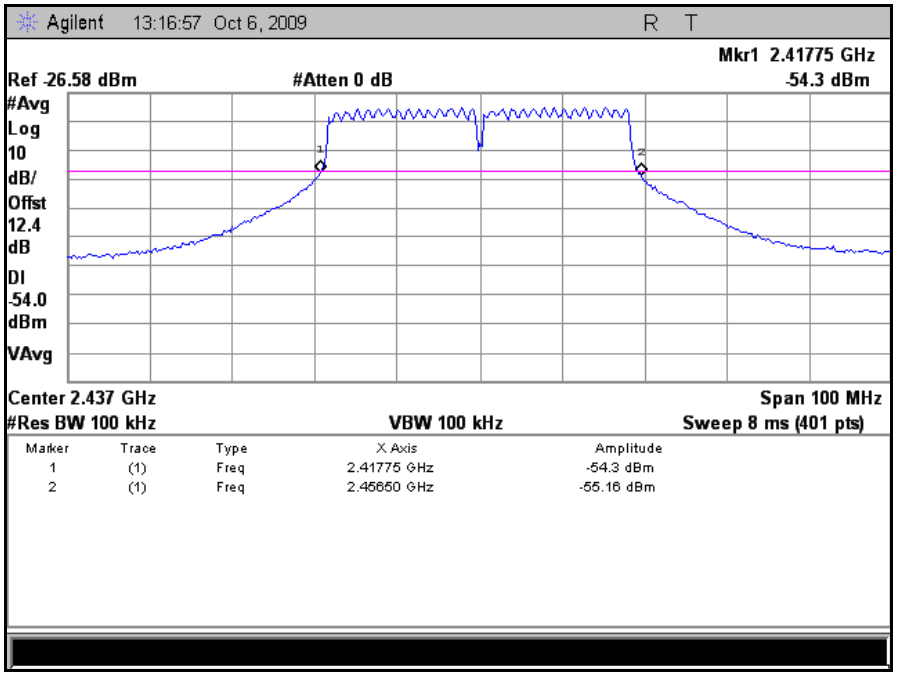
Plot 28. Frequency Range, Low Temp., Normal Voltage, 802.11n 40MHz



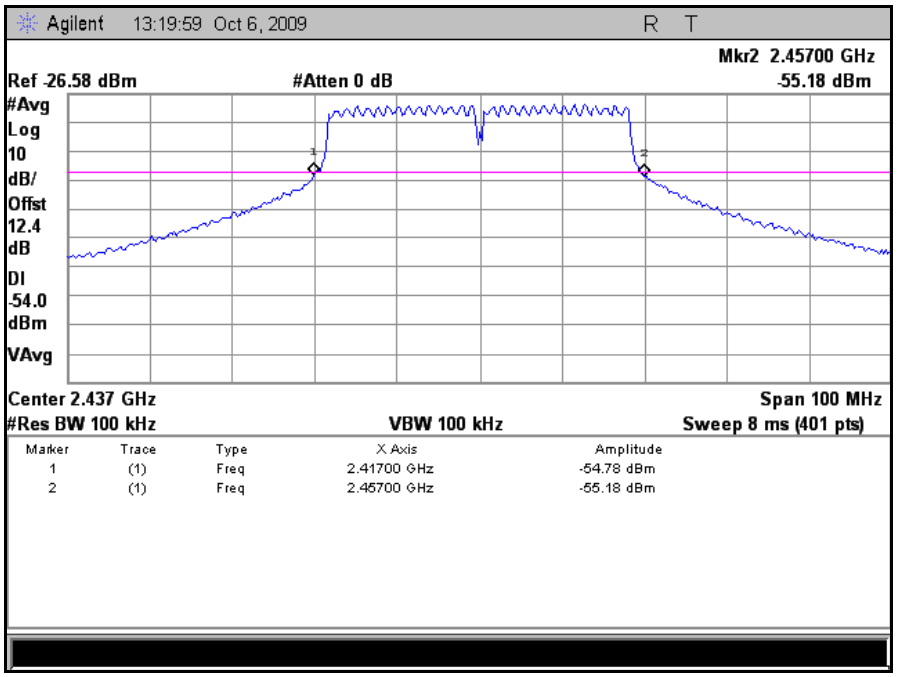
Plot 29. Frequency Range, Low Temp., High Voltage, 802.11n 40MHz



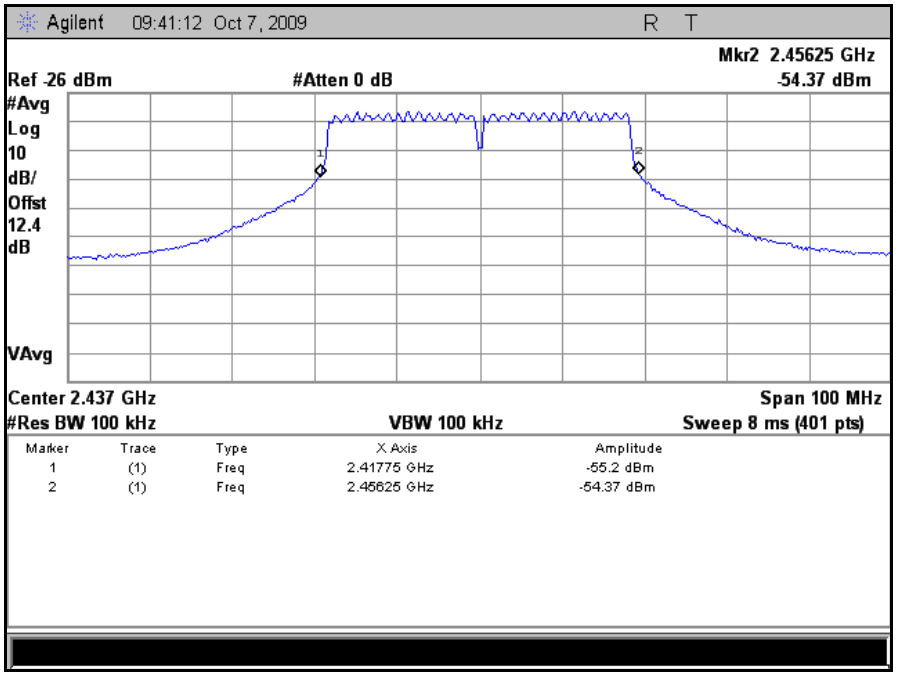
Plot 30. Frequency Range, Normal Temp., Low Voltage, 802.11n 40MHz



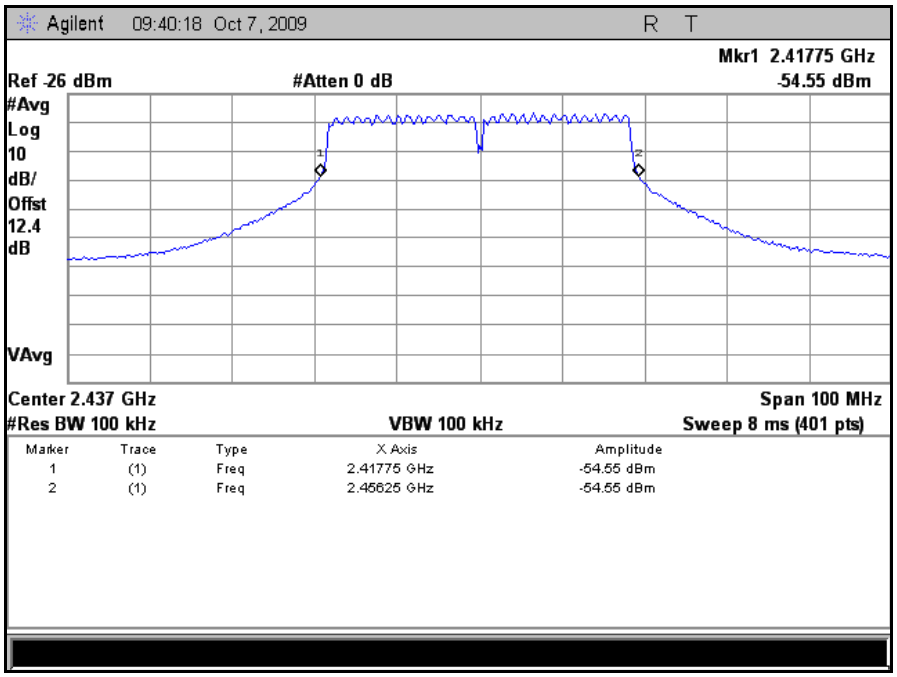
Plot 31. Frequency Range, Normal Temp., Normal Voltage, 802.11n 40MHz



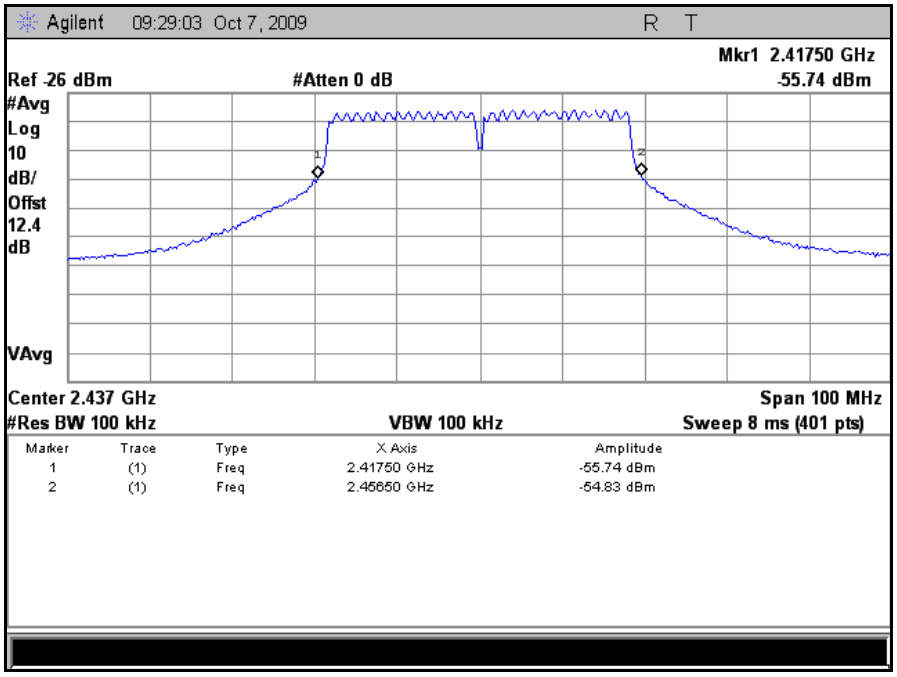
Plot 32. Frequency Range, Normal Temp., High Voltage, 802.11n 40MHz



Plot 33. Frequency Range, High Temp., Low Voltage, 802.11n 40MHz



Plot 34. Frequency Range, High Temp., Normal Voltage, 802.11n 40MHz



Plot 35. Frequency Range, High Temp., High Voltage, 802.11n 40MHz

4.3.5 Medium Access Protocol

Test Requirement(s): **EN 300 328, Clause 4.3.5:**

4.3.5.1 Definition

A medium access protocol is a mechanism designed to facilitate spectrum sharing with other devices in a wireless network.

4.3.5.2 Limit

A medium access protocol shall be implemented by the equipment.

Test Results: The EUT facilitates medium access protocol and therefore is compliant with the requirements of Clause 4.3.5.2.

Test Engineer: Anderson Soungpanya

Test Date: 09/09/09

4.3.6 Transmitter Spurious Emissions - Conducted

Test Requirement(s): **EN 300 328, Clause 4.3.6:**

4.3.6.1 Definition

Transmitter spurious emissions are emissions outside the frequency range(s) of the equipment as defined in *Clause 4.3.3.1* when the equipment is in Transmit mode and/or in Standby mode.

4.3.6.2 Limit

The spurious emissions of the transmitter shall not exceed the values in Table 11 and Table 12 and in the indicated bands.

Frequency Range	Limit when operating	Limit when in standby
30 MHz to 1 GHz	-36 dBm	-57 dBm
above 1 GHz to 12,75 GHz	-30 dBm	-47 dBm
1,8 GHz to 1,9 GHz 5,15 GHz to 5,3 GHz	-47 dBm	-47 dBm

Table 11. Transmitter limits for narrowband spurious emissions

The above limit values apply to narrowband emissions, e.g. as caused by local oscillator leakage. The measurement bandwidth for such emissions may be as small as necessary to achieve a reliable measurement result.

Wideband emissions shall not exceed the values given in Table 12.

Frequency Range	Limit when operating	Limit when in standby
30 MHz to 1 GHz	-86 dBm	-107 dBm/Hz
above 1 GHz to 12,75 GHz	-80 dBm	-97 dBm/Hz
1,8 GHz to 1,9 GHz 5,15 GHz to 5,3 GHz	-97 dBm	-97 dBm/Hz

Table 12. Transmitter limits for wideband spurious emissions

4.3.6 Transmitter Spurious Emissions - Conducted

Test Procedure: The EUT was connected directly to a spectrum analyzer through an attenuator. The resolution band width of the spectrum analyzer was set to 100 KHz and the video band width set to 30 KHz. A positive peak detector was used along with peak hold function. The measurement was performed using normal operation of the equipment.

Test Results: The EUT as tested was found compliant with the specified requirements of Clause 4.3.6.2.

Test Engineer: Anderson Soungpanya

Test Date: 10/07/09

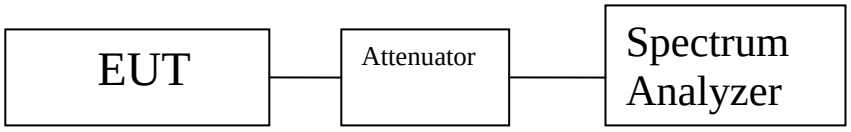
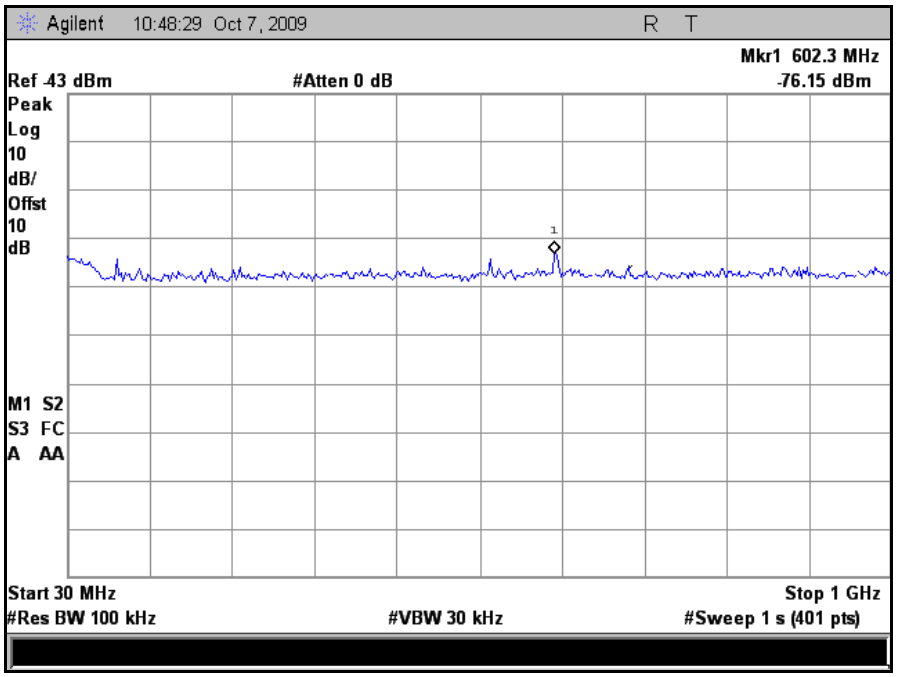


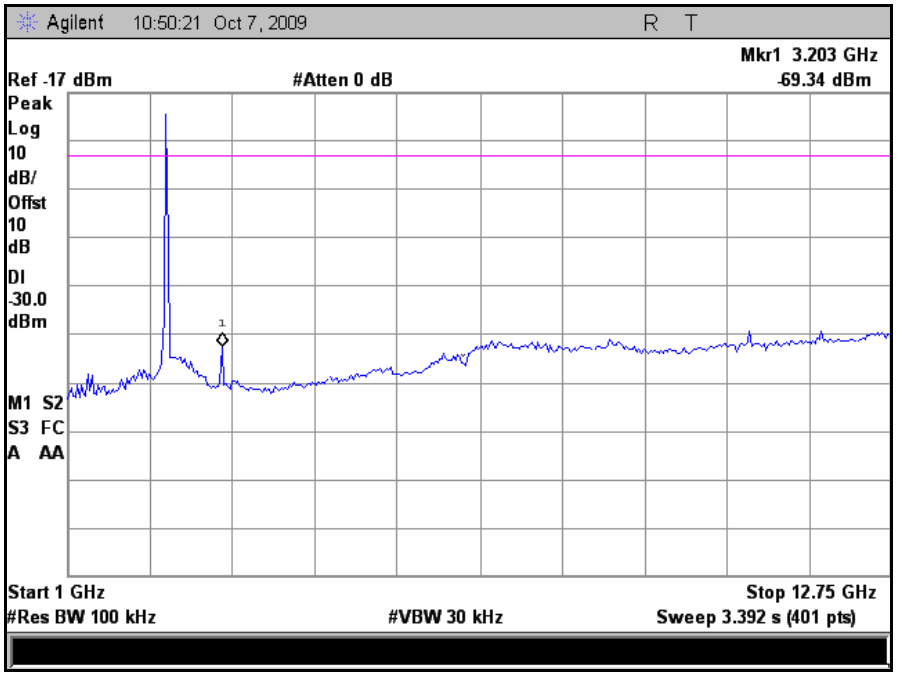
Figure 6. Transmitter Spurious Emissions - Conducted Test Setup

Conformance Requirements

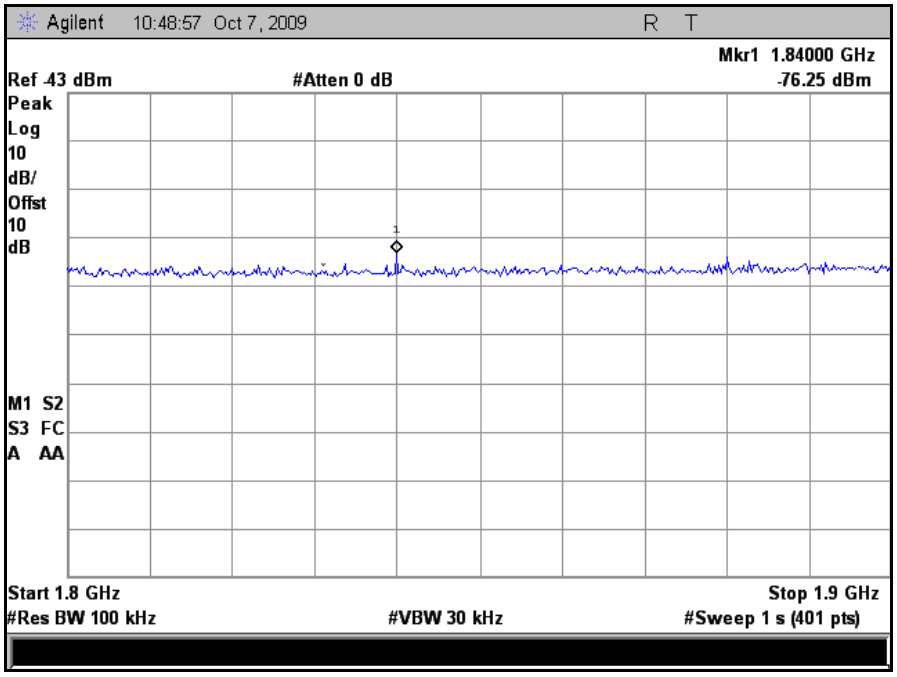
4.3.6 Transmitter Spurious Emissions - Conducted



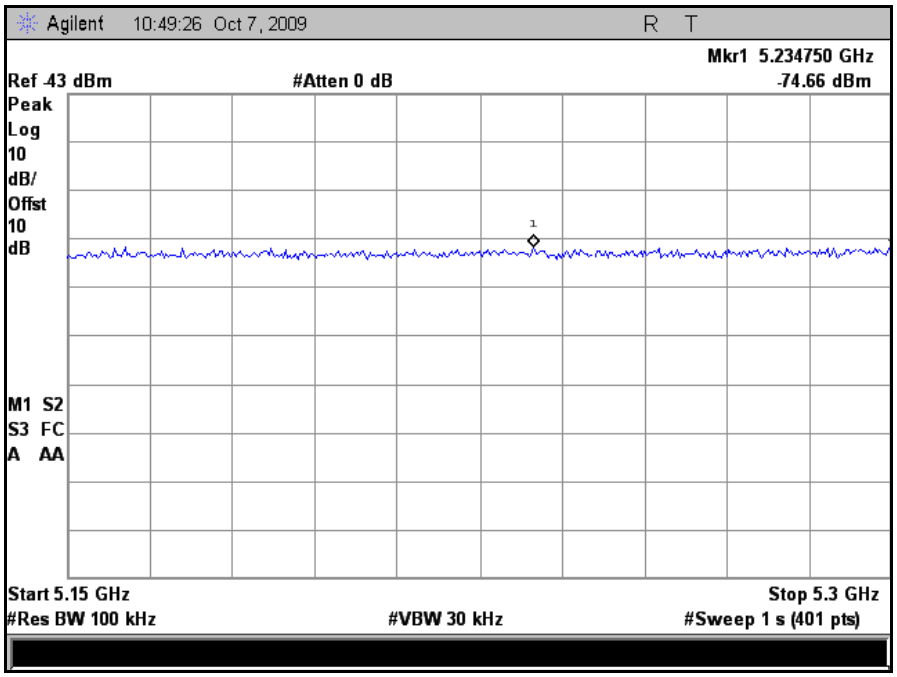
Plot 36. Conducted Spurious Emission, Low Channel, 30 MHz – 1 GHz, 802.11n 20MHz



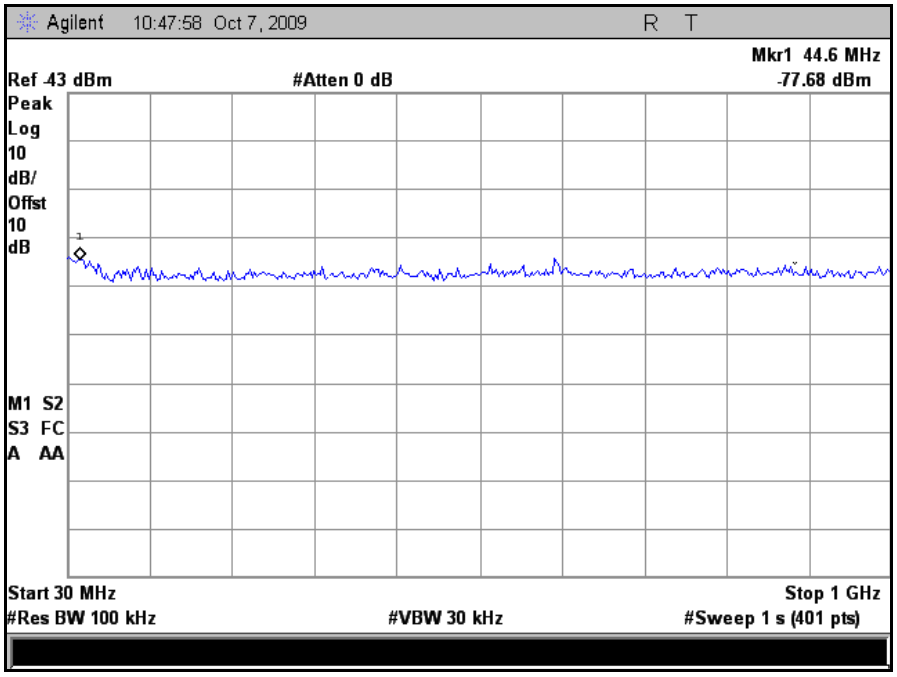
Plot 37. Conducted Spurious Emission, Low Channel, 1 GHz - 12.75 GHz, 802.11n 20MHz



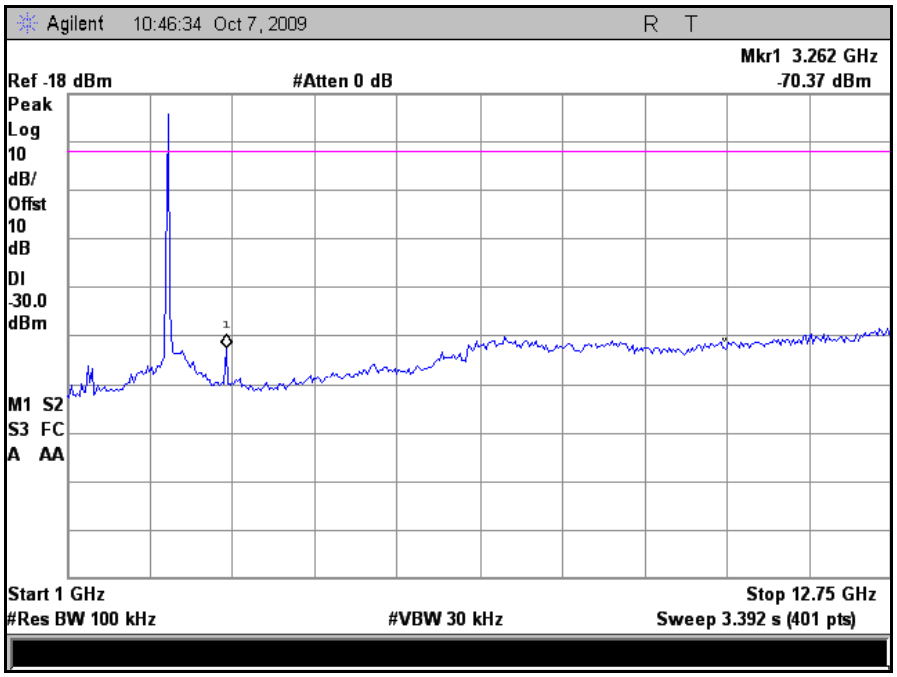
Plot 38. Conducted Spurious Emission, Low Channel, 1.8GHz Hz - 1.9 GHz, 802.11n 20MHz



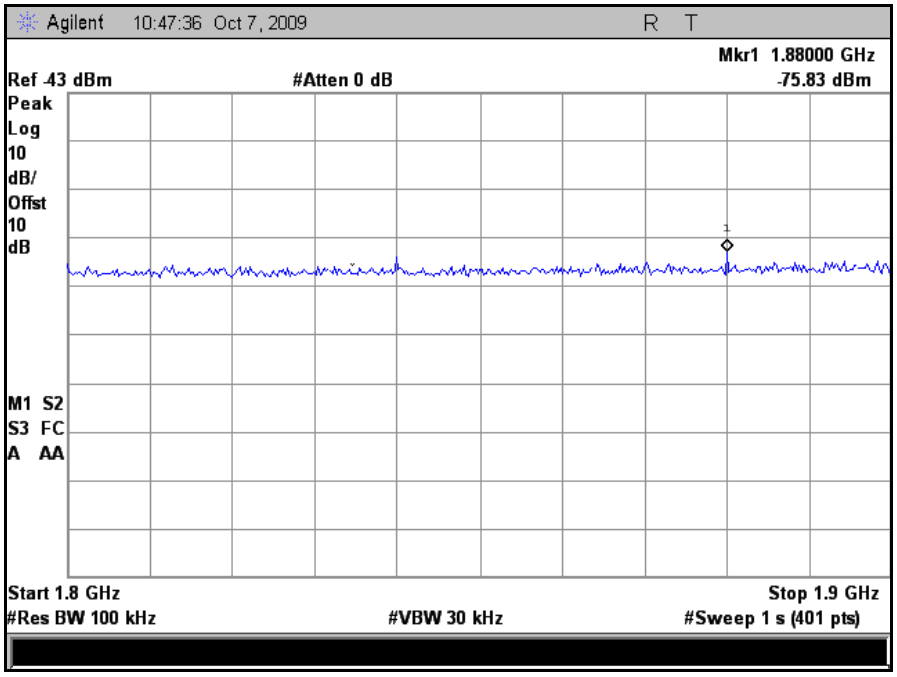
Plot 39. Conducted Spurious Emission, Low Channel, 5.15 GHz - 5.3 GHz, 802.11n 20MHz



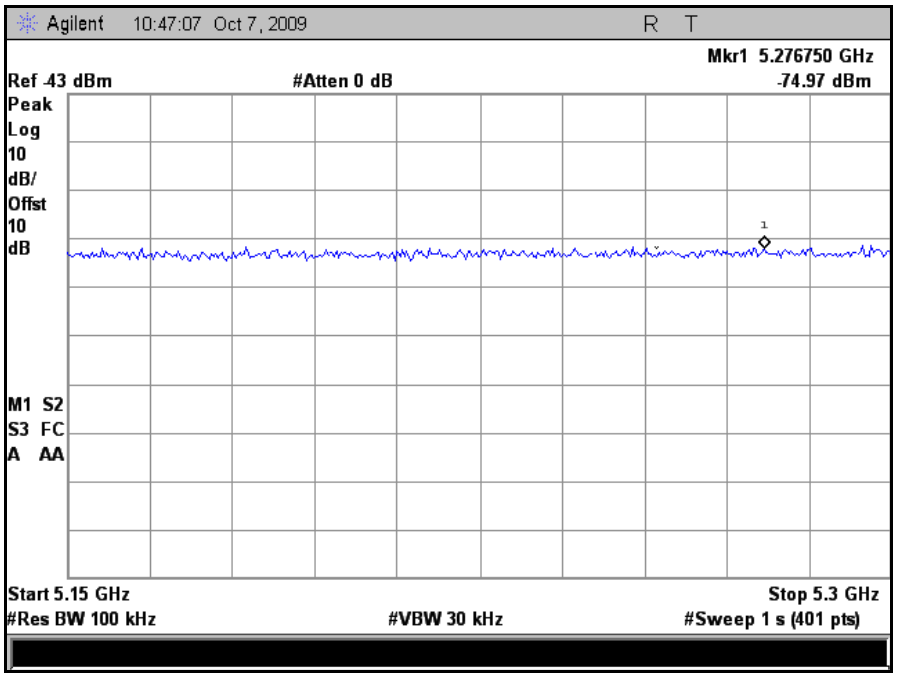
Plot 40. Conducted Spurious Emission, Mid Channel, 30 MHz – 1 GHz, 802.11n 20MHz



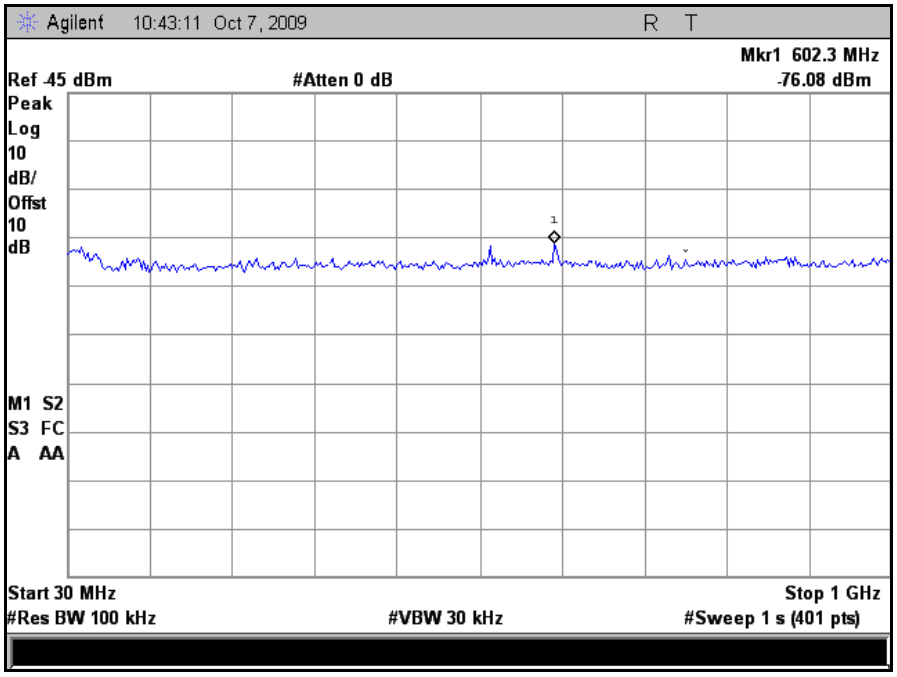
Plot 41. Conducted Spurious Emission, Mid Channel, 1 GHz - 12.75 GHz, 802.11n 20MHz



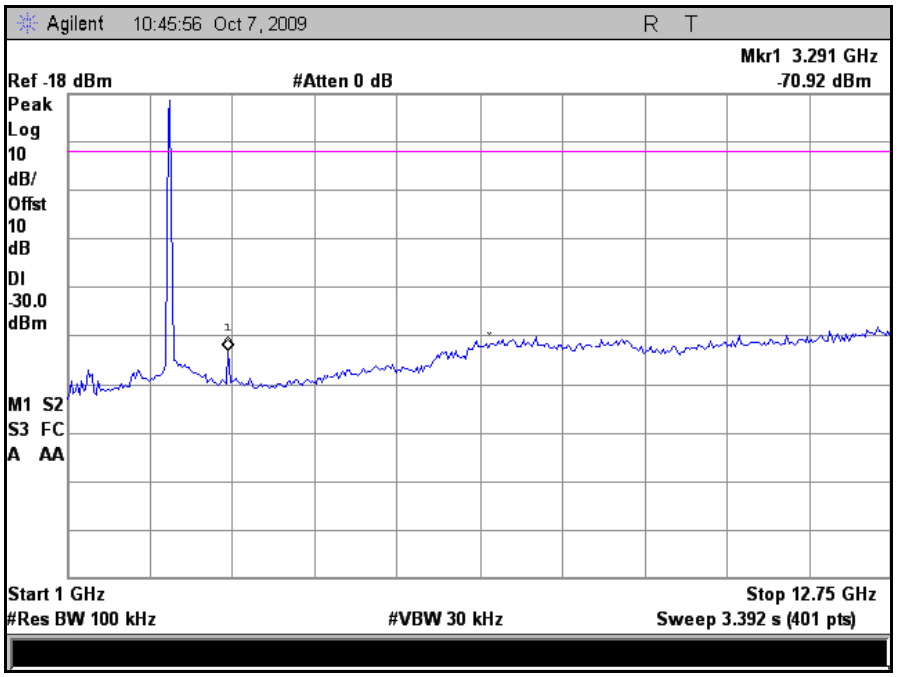
Plot 42. Conducted Spurious Emission, Mid Channel, 1.8GHz Hz - 1.9 GHz, 802.11n 20MHz



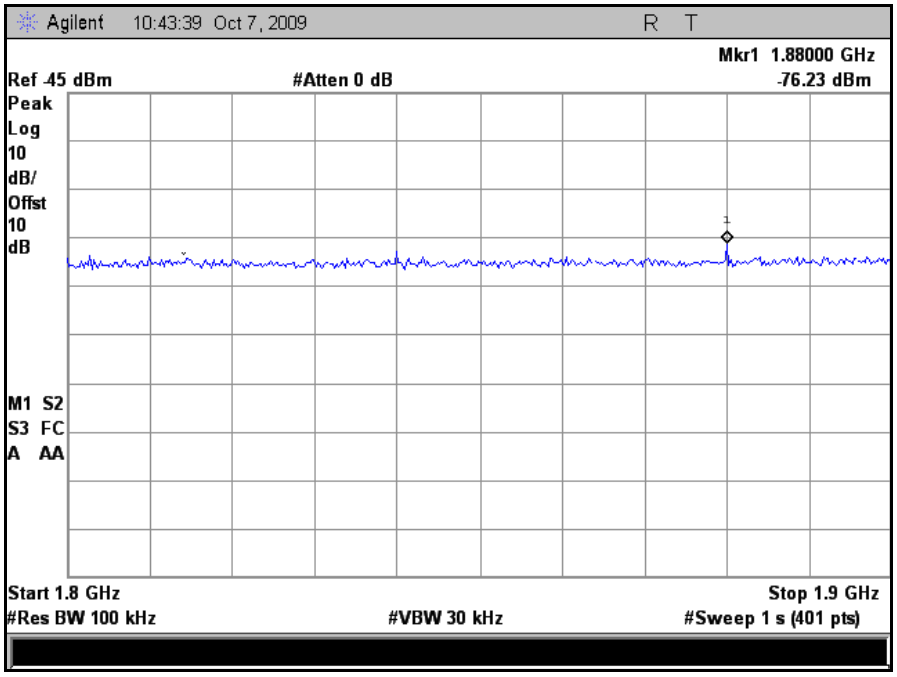
Plot 43. Conducted Spurious Emission, Mid Channel, 5.15 GHz - 5.3 GHz, 802.11n 20MHz



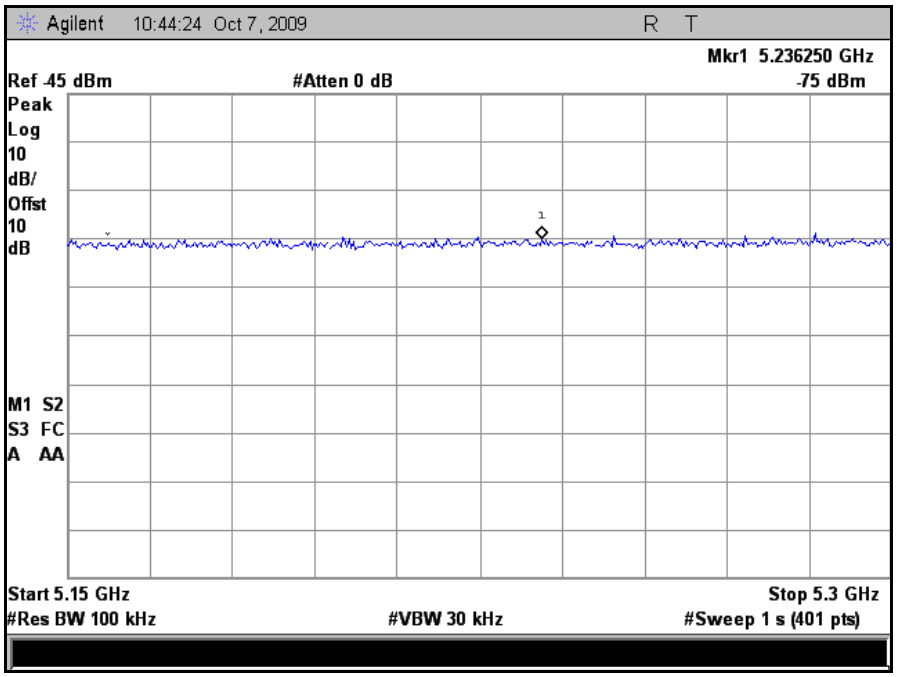
Plot 44. Conducted Spurious Emission, High Channel, 30 MHz – 1 GHz, 802.11n 20MHz



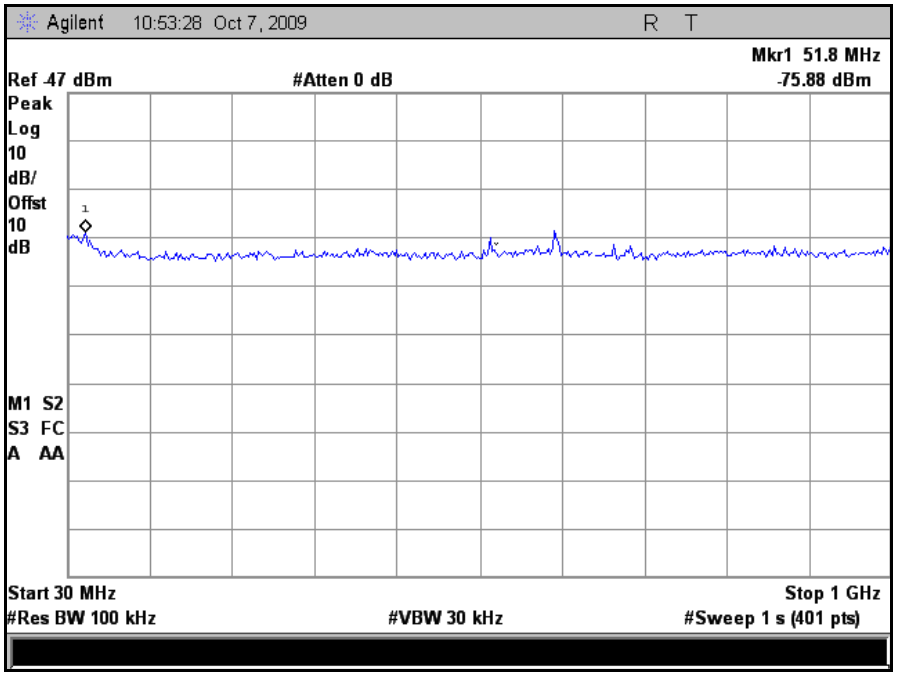
Plot 45. Conducted Spurious Emission, High Channel, 1 GHz - 12.75 GHz, 802.11n 20MHz



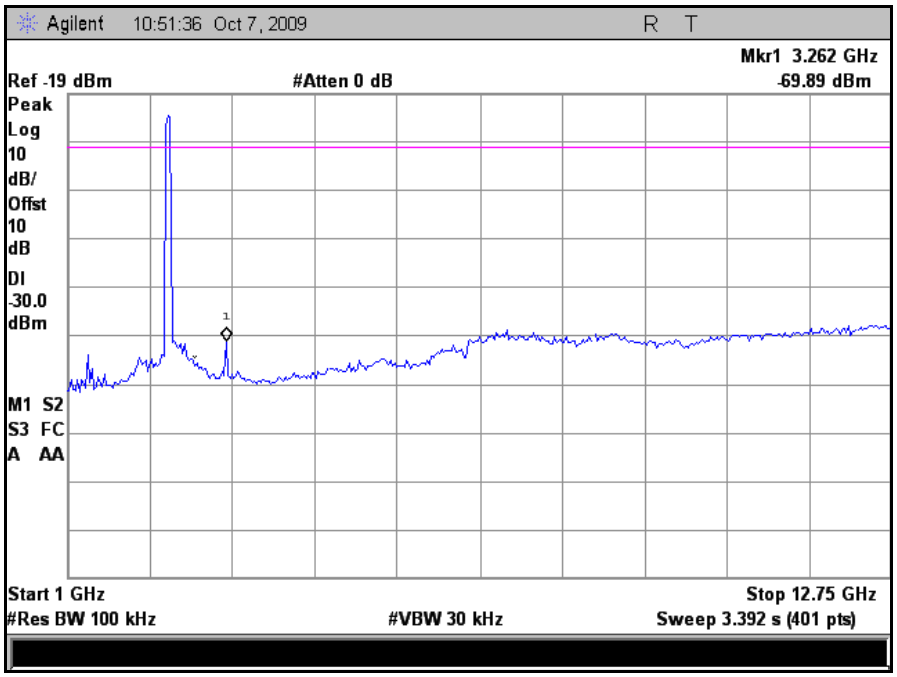
Plot 46. Conducted Spurious Emission, High Channel, 1.8GHz Hz - 1.9 GHz, 802.11n 20MHz



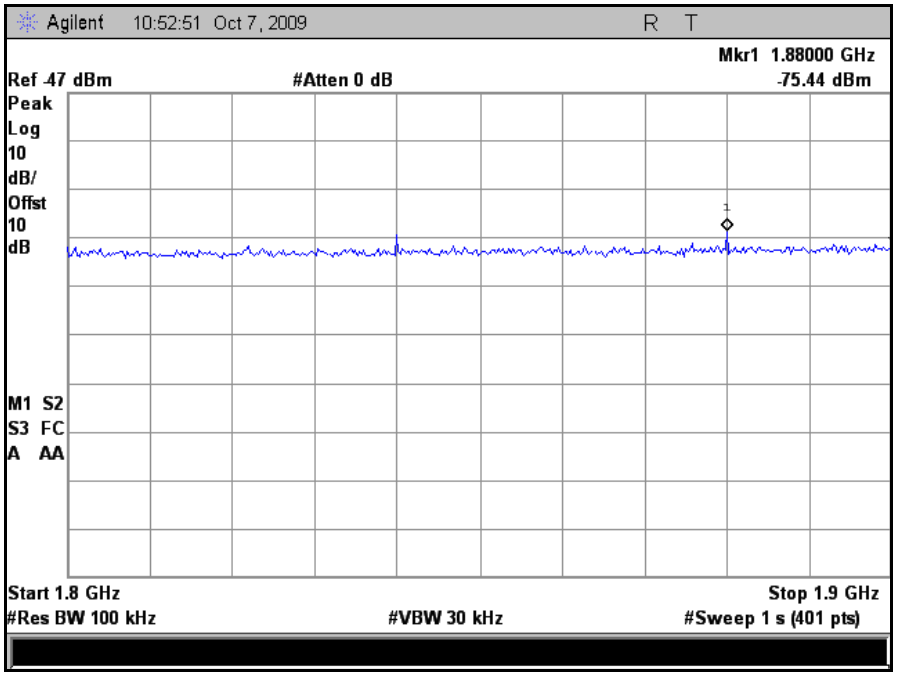
Plot 47. Conducted Spurious Emission, High Channel, 5.15 GHz - 5.3 GHz, 802.11n 20MHz



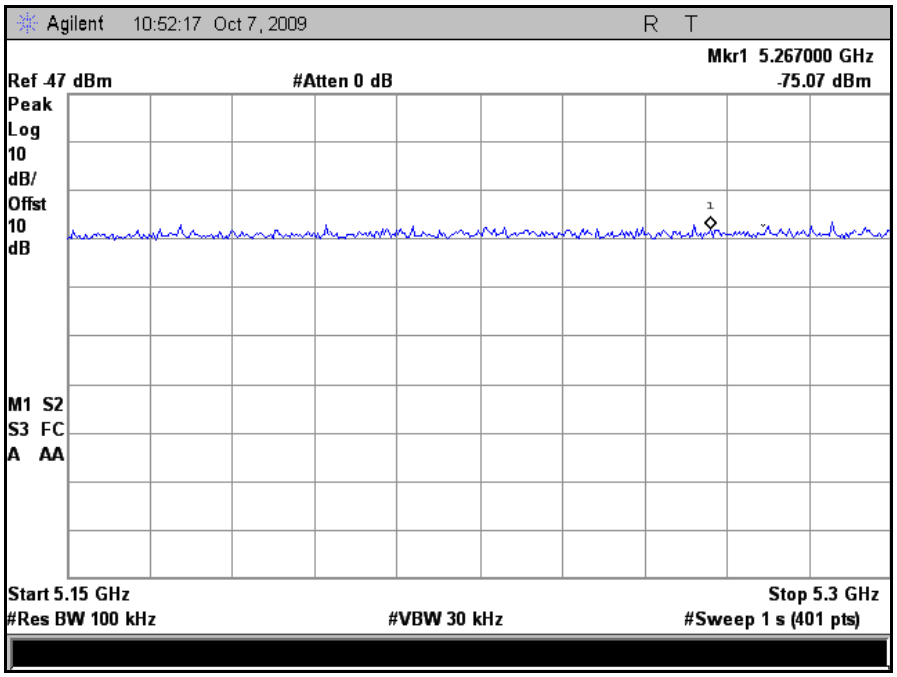
Plot 48. Conducted Spurious Emission, 30 MHz – 1 GHz, 802.11n 40MHz



Plot 49. Conducted Spurious Emission, 1 GHz - 12.75 GHz, 802.11n 40MHz



Plot 50. Conducted Spurious Emission, 1.8GHz Hz - 1.9 GHz, 802.11n 40MHz



Plot 51. Conducted Spurious Emission, 5.15 GHz - 5.3 GHz, 802.11n 40MHz

4.3.6 Transmitter Spurious Emissions - Radiated

Test Requirement(s): **EN 300 328, Clause 4.3.6:**

4.3.6.1 Definition

Transmitter spurious emissions are emissions outside the frequency range(s) of the equipment as defined in *Clause 4.3.3.1* when the equipment is in Transmit mode and/or in Standby mode.

4.3.6.2 Limit

The spurious emissions of the transmitter shall not exceed the values in Table 11 and Table 12 and in the indicated bands.

Frequency Range	Limit when operating	Limit when in standby
30 MHz to 1 GHz	-36 dBm	-57 dBm
above 1 GHz to 12,75 GHz	-30 dBm	-47 dBm
1,8 GHz to 1,9 GHz 5,15 GHz to 5,3 GHz	-47 dBm	-47 dBm

Table 13. Transmitter limits for narrowband spurious emissions

The above limit values apply to narrowband emissions, e.g. as caused by local oscillator leakage. The measurement bandwidth for such emissions may be as small as necessary to achieve a reliable measurement result.

Wideband emissions shall not exceed the values given in Table 12.

Frequency Range	Limit when operating	Limit when in standby
30 MHz to 1 GHz	-86 dBm	-107 dBm/Hz
above 1 GHz to 12,75 GHz	-80 dBm	-97 dBm/Hz
1,8 GHz to 1,9 GHz 5,15 GHz to 5,3 GHz	-97 dBm	-97 dBm/Hz

Table 14. Transmitter limits for wideband spurious emissions

Test Procedure: The EUT was placed on a 1.5m high wooden table inside a semi-anechoic chamber. The measurements were performed using normal operation of the equipment. The method of testing, test conditions, and test procedures of *Annex B* were used. The frequencies and amplitudes of field strengths were recorded for reference during final measurements.

The EUT was set to transmit at its highest output power at both the low and high channels of the transmit band as well as all applicable modulations. The receive antenna was adjusted between 1 and 4 m in order to find the maximum emission. The table was also rotated about 360^0. Both vertical and horizontal polarizations were used to determine the maximum emission.

In order to determine the magnitude of each emission within 6dB of the limit, other than the noise floor of the spectrum analyzer, the signal substitution method was used as described in Annex B of *EN 300 328*.

Test Results: The EUT as tested was found compliant with the specified limits of Clause 4.3.6.2.

Test Engineer: Anderson Soungpanya

Test Date: 10/07/09

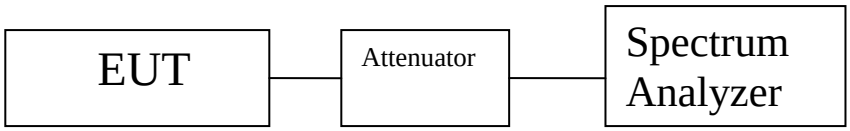
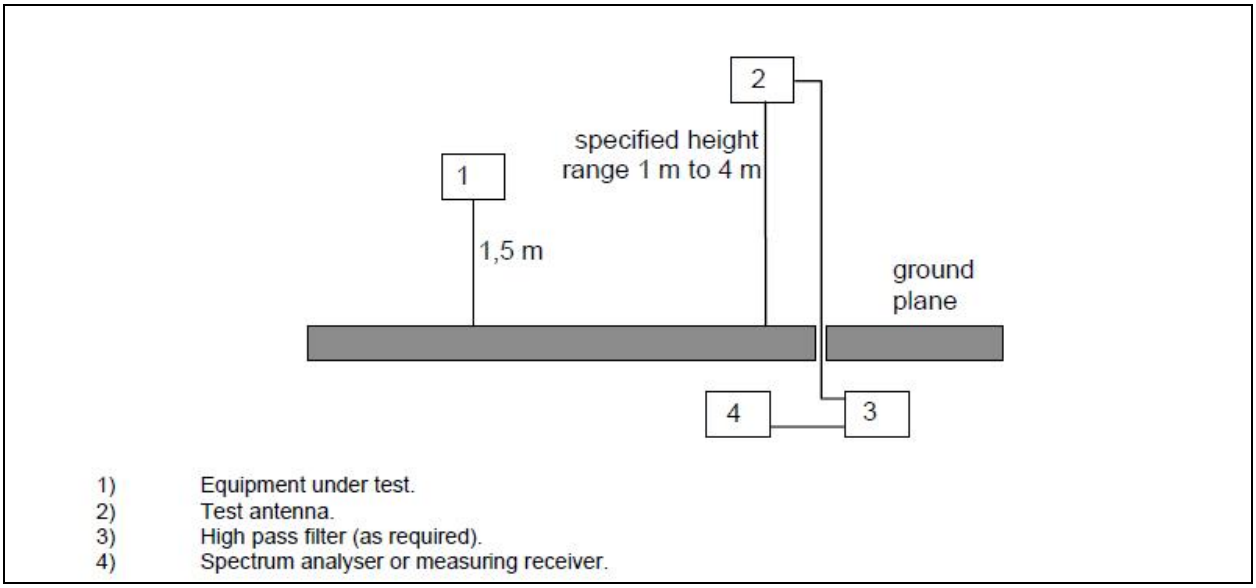
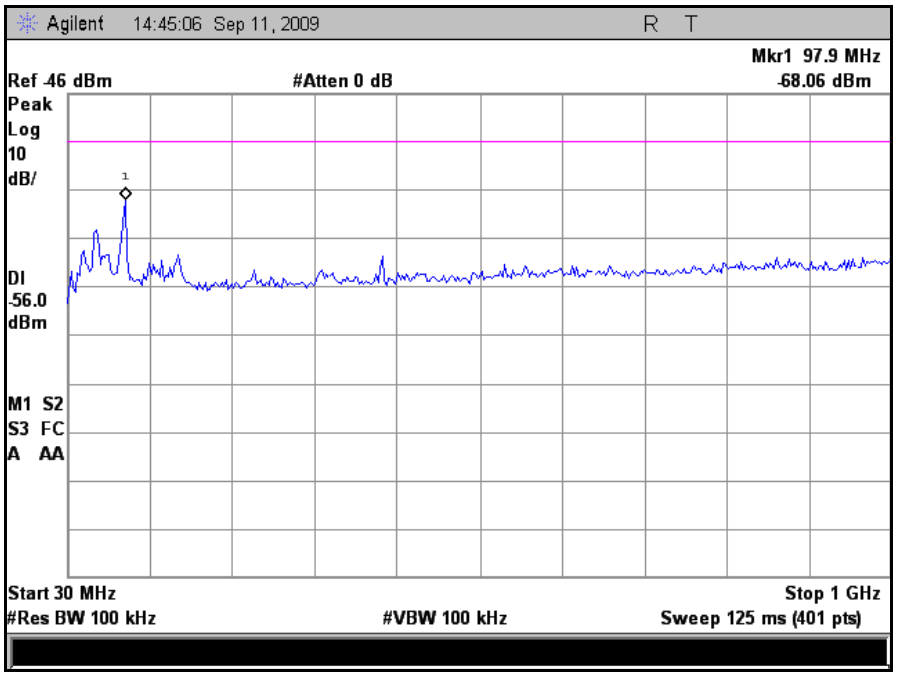


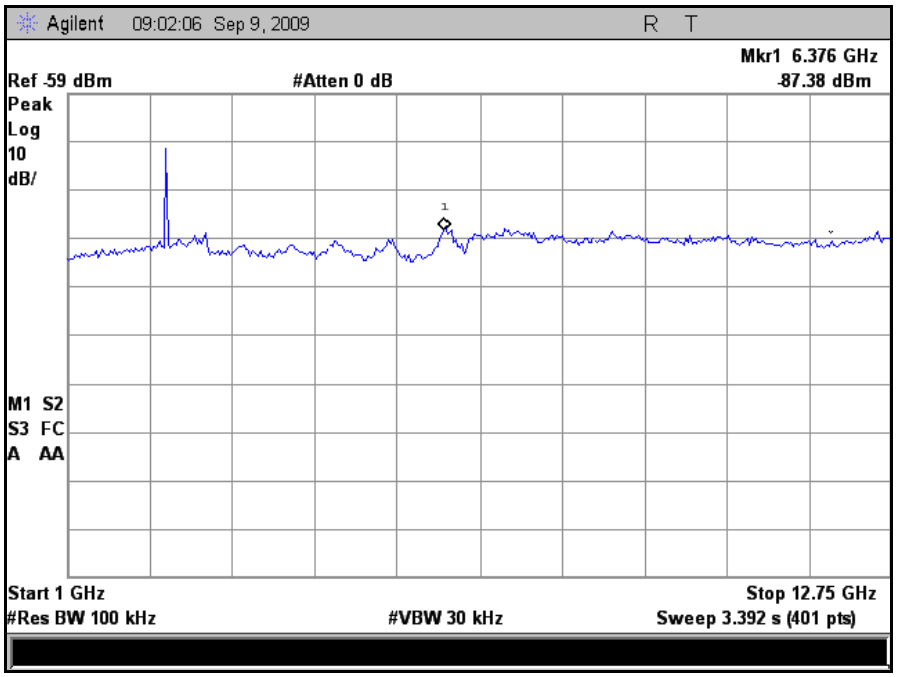
Figure 7. Transmitter Spurious Emissions - Radiated Test Setup



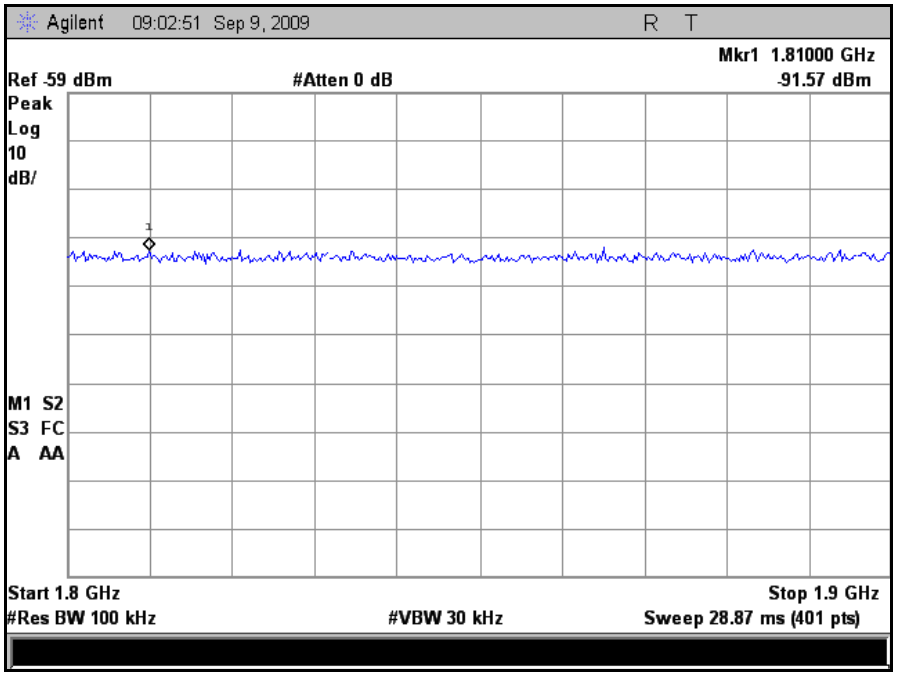
4.3.6 Transmitter Spurious Emissions - Radiated



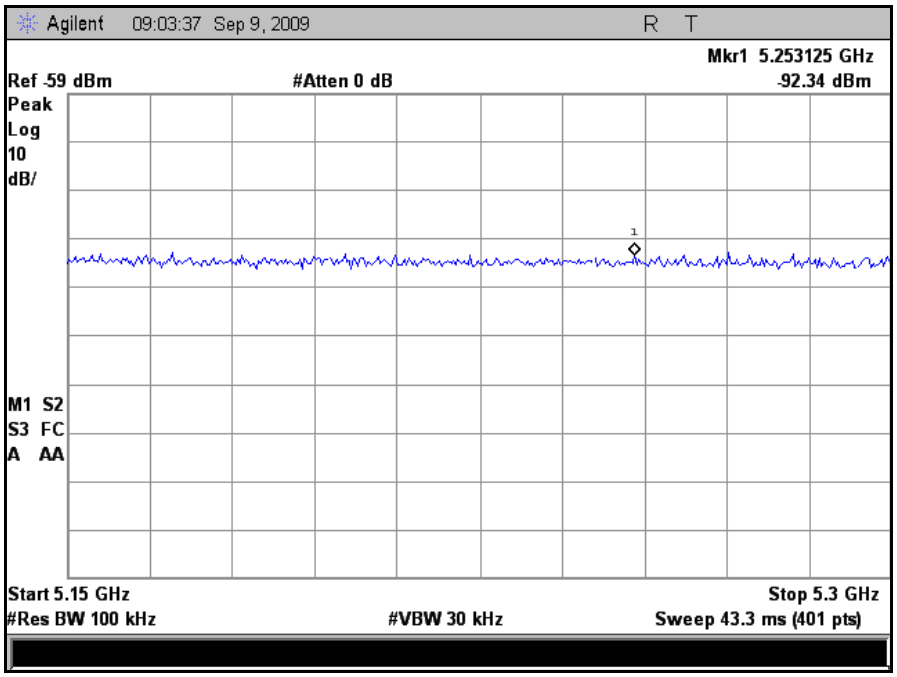
Plot 52. Radiated Spurious Emission, Low Channel, 30 MHz – 1 GHz, 802.11n 20MHz



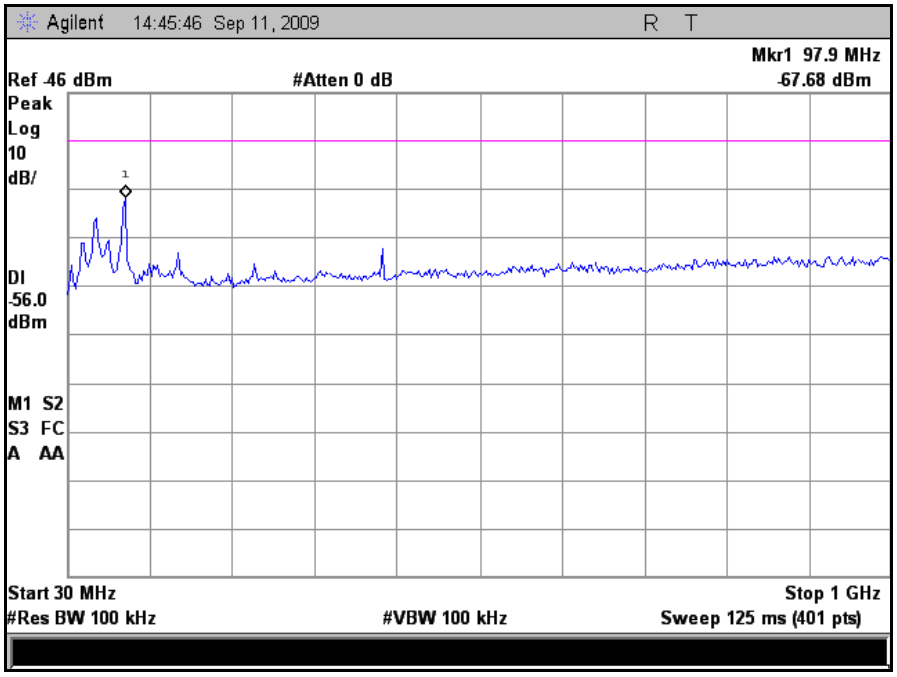
Plot 53. Radiated Spurious Emission, Low Channel, 1 GHz - 12.75 GHz, 802.11n 20MHz



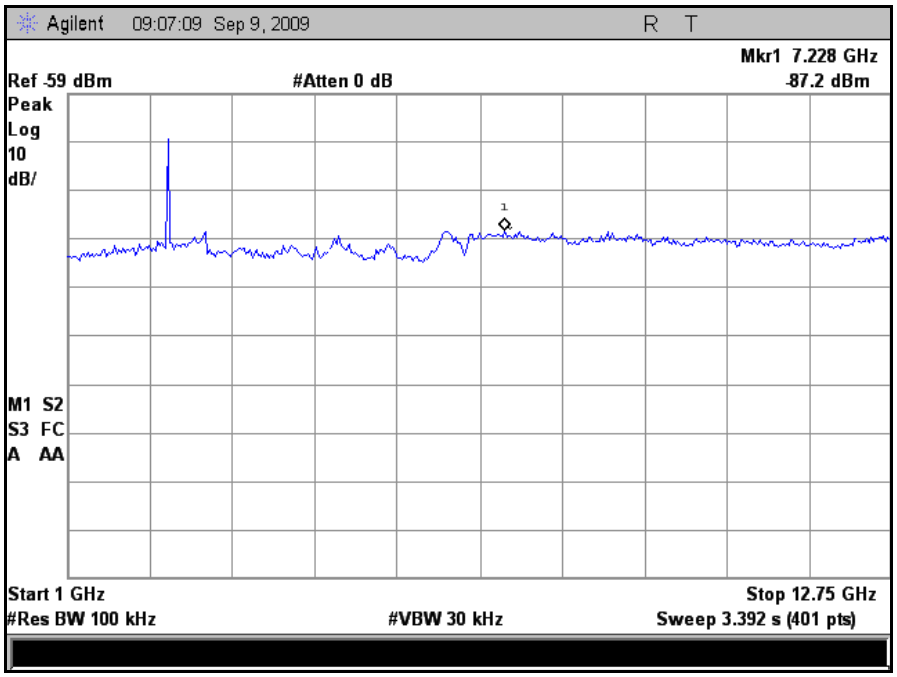
Plot 54. Radiated Spurious Emission, Low Channel, 1.8GHz Hz - 1.9 GHz, 802.11n 20MHz



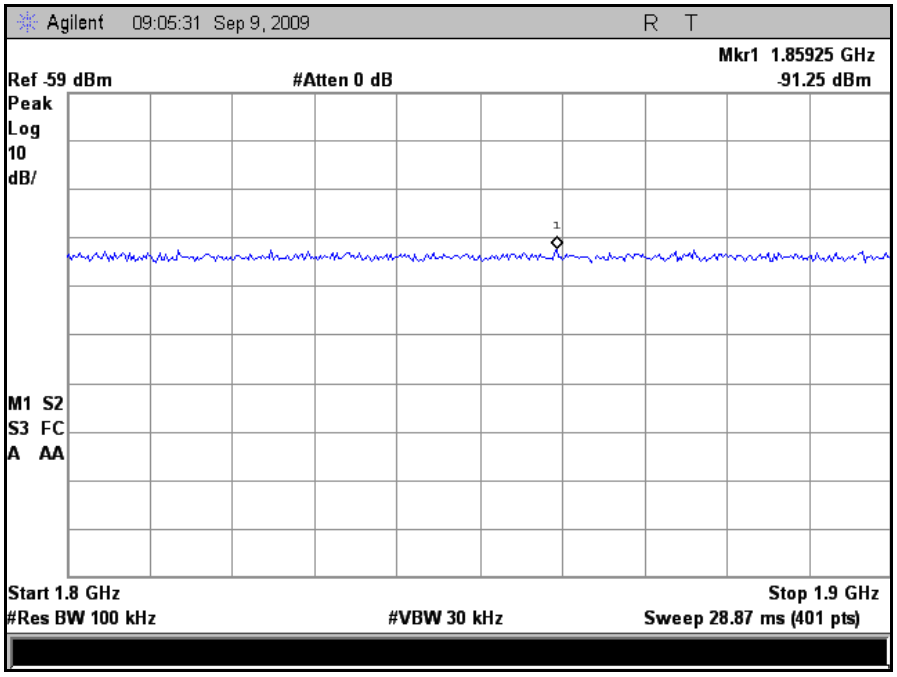
Plot 55. Radiated Spurious Emission, Low Channel, 5.15 GHz - 5.3 GHz, 802.11n 20MHz



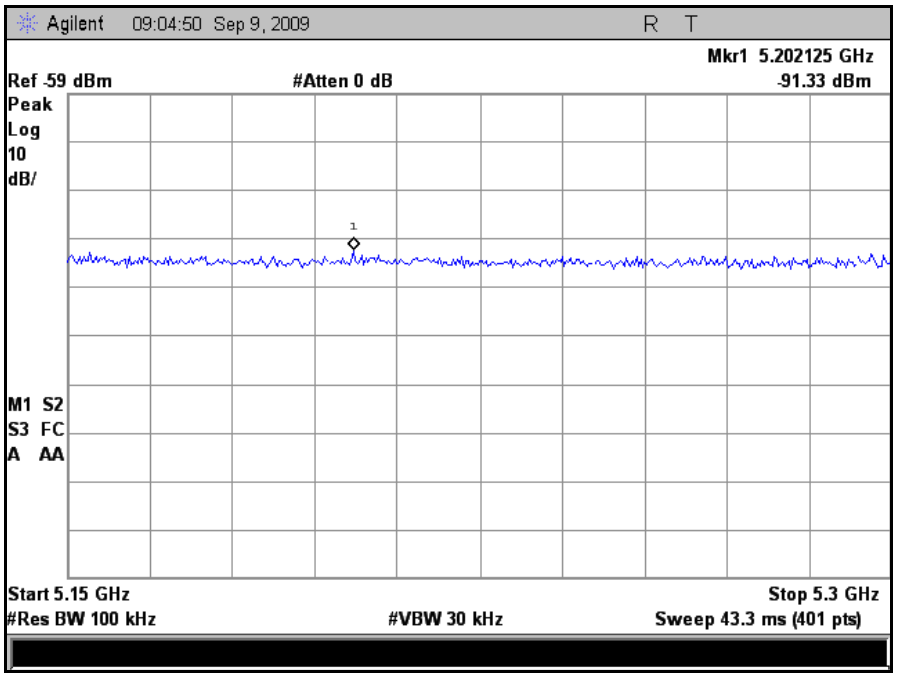
Plot 56 Radiated Spurious Emission, Mid Channel, 30 MHz – 1 GHz, 802.11n 20MHz



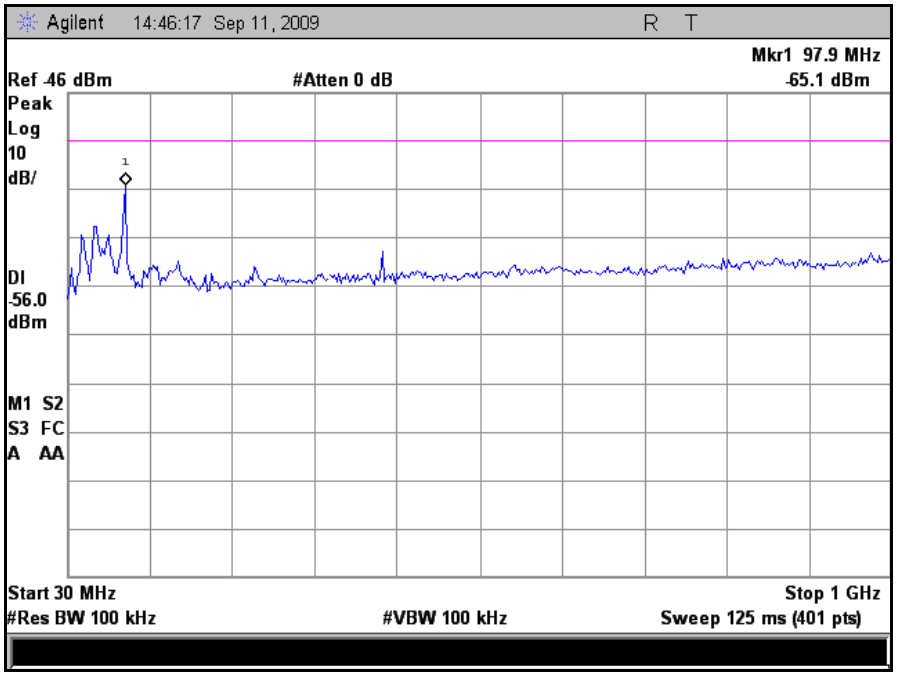
Plot 57. Radiated Spurious Emission, Mid Channel, 1 GHz - 12.75 GHz, 802.11n 20MHz



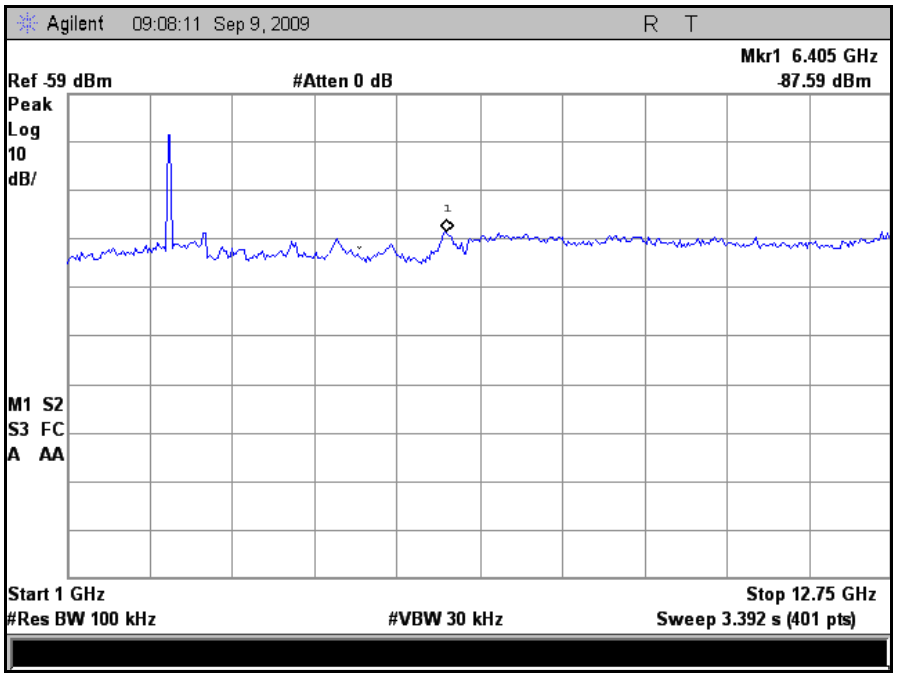
Plot 58. Radiated Spurious Emission, Mid Channel, 1.8GHz Hz - 1.9 GHz, 802.11n 20MHz



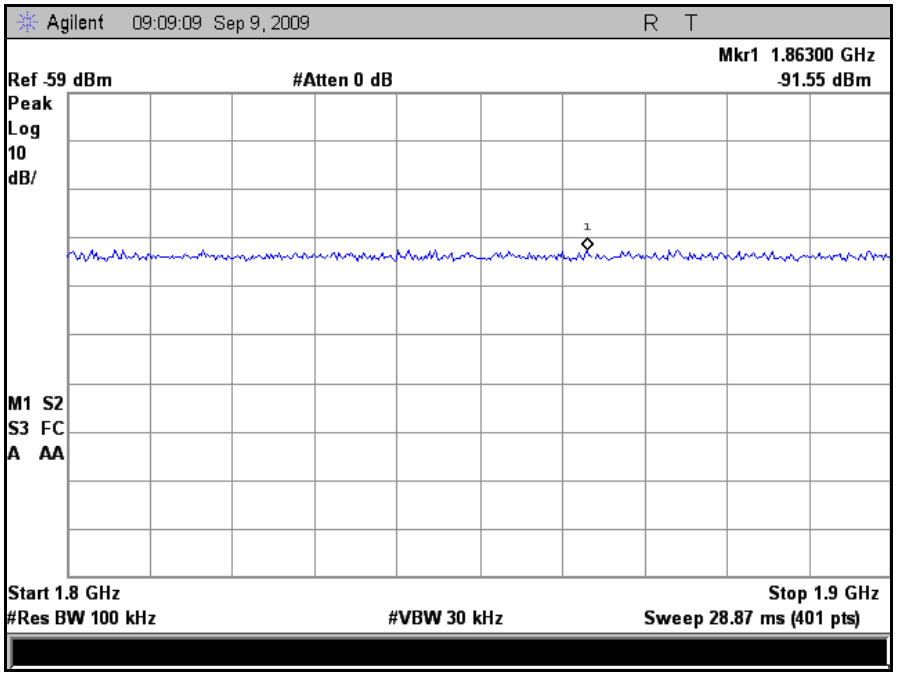
Plot 59. Radiated Spurious Emission, Mid Channel, 5.15 GHz - 5.3 GHz, 802.11n 20MHz



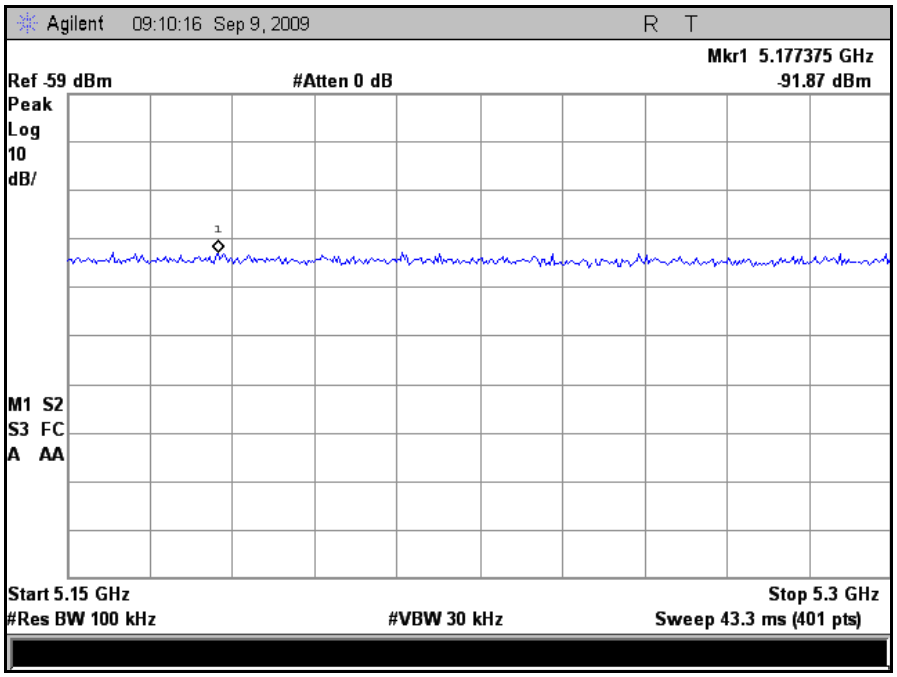
Plot 60. Radiated Spurious Emission, High Channel, 30 MHz – 1 GHz, 802.11n 20MHz



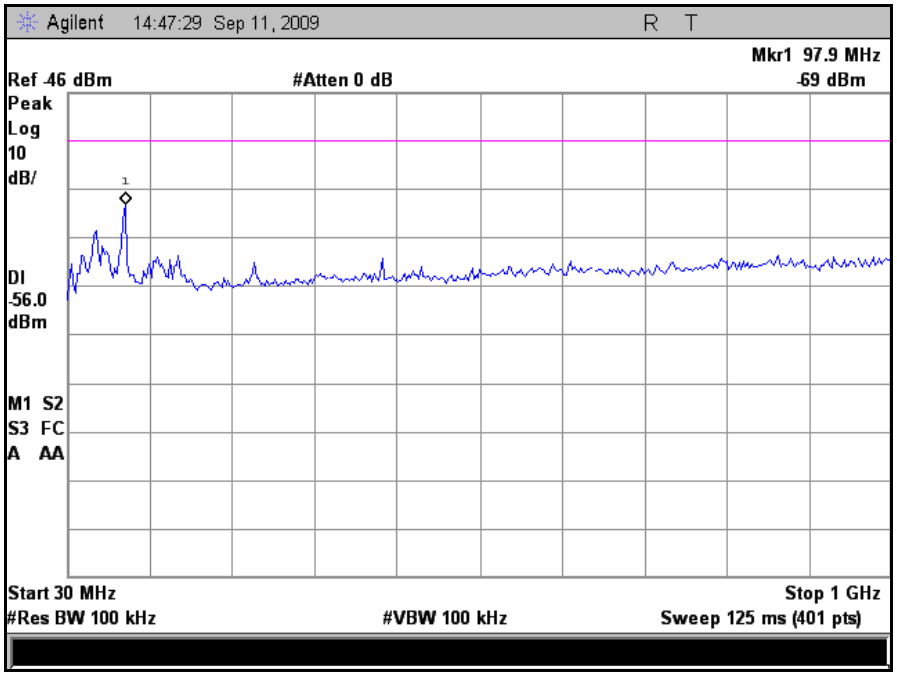
Plot 61. Radiated Spurious Emission, High Channel, 1 GHz - 12.75 GHz, 802.11n 20MHz



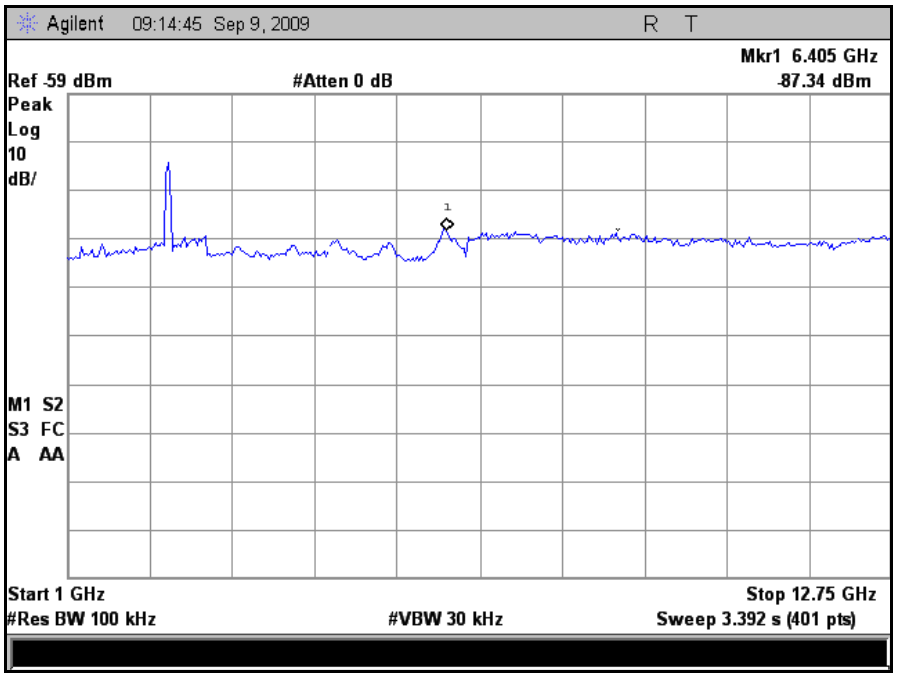
Plot 62. Radiated Spurious Emission, High Channel, 1.8GHz Hz - 1.9 GHz, 802.11n 20MHz



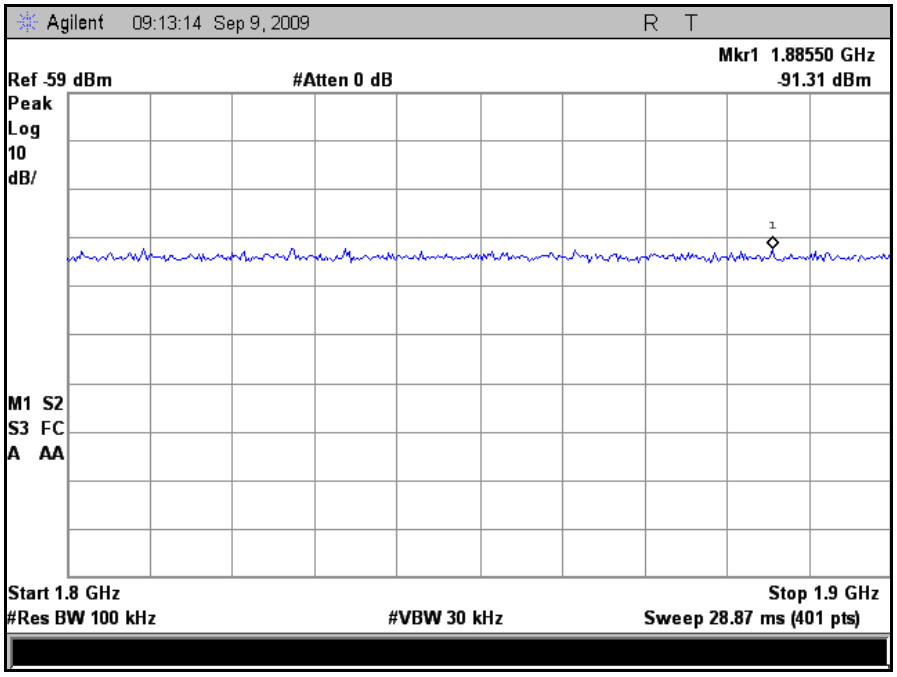
Plot 63. Radiated Spurious Emission, High Channel, 5.15 GHz - 5.3 GHz, 802.11n 20MHz



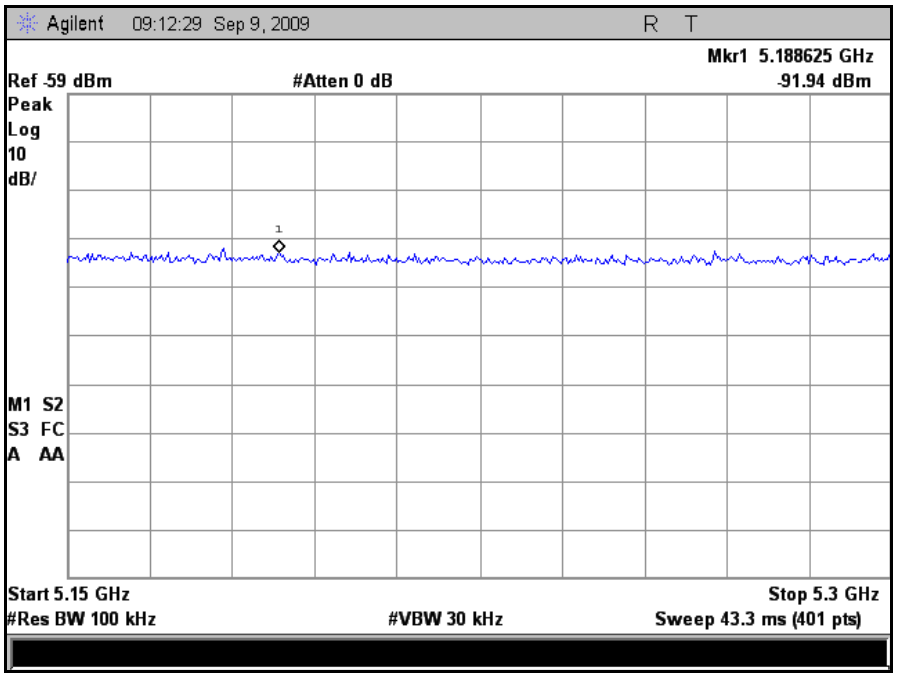
Plot 64. Radiated Spurious Emission, 30 MHz – 1 GHz, 802.11n 40MHz



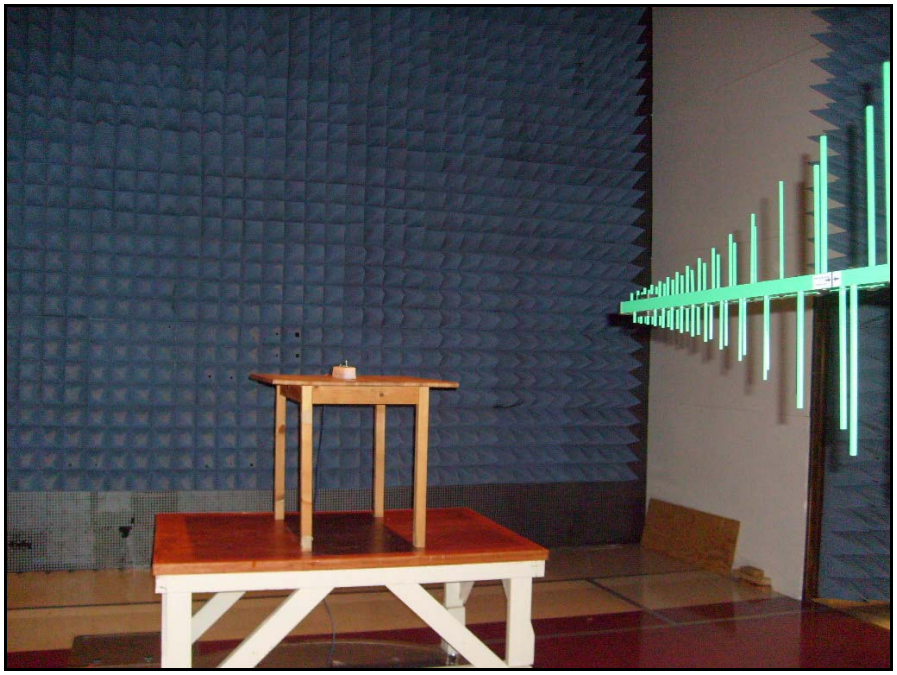
Plot 65. Radiated Spurious Emission, 1 GHz - 12.75 GHz, 802.11n 40MHz



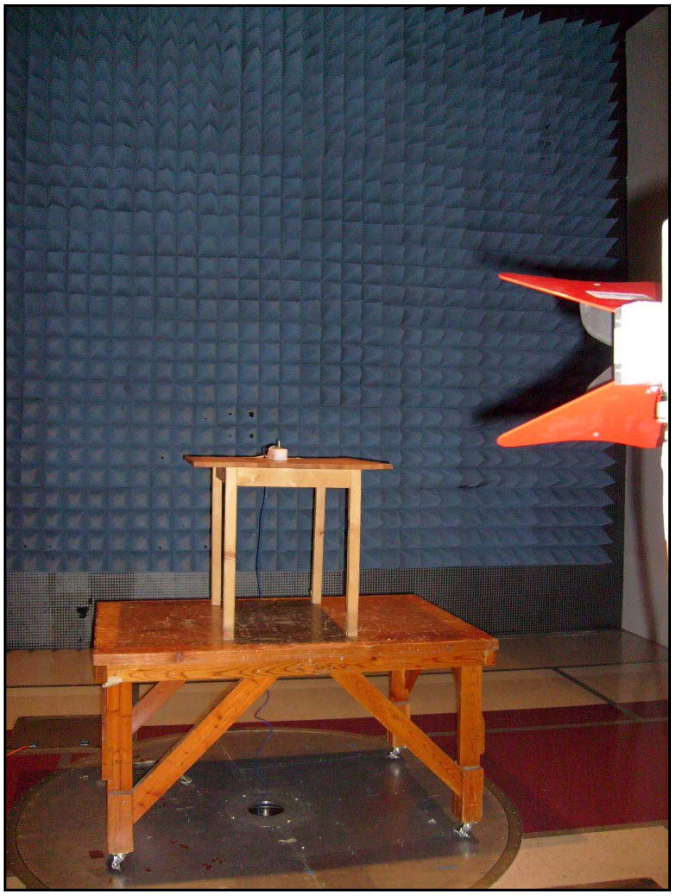
Plot 66. Radiated Spurious Emission, 1.8GHz Hz - 1.9 GHz, 802.11n 40MHz



Plot 67. Radiated Spurious Emission, 5.15 GHz - 5.3 GHz, 802.11n 40MHz



Photograph 1. Radiated Emissions Setup, Bilog



Photograph 2. Radiated Emissions Setup, Horn

Conformance Requirements

4.3.7 Receiver Spurious Emissions - Conducted

Test Requirement(s): 4.3.7.1 Definition

Receiver spurious emissions are emissions at any frequency when the equipment is in received mode.

4.3.7.2 Limit

The spurious emissions of the receiver shall not exceed the values in tables Table 15 and Table 16 and in the indicated bands.

Frequency Range	Limit
30 MHz to 1 GHz	-57 dBm
above 1 GHz to 12,75 GHz	-47 dBm

Table 15. Narrowband spurious emission limits for receivers

The above limit values apply to narrowband emissions, e.g. as caused by local oscillator leakage. The measurement bandwidth for such emissions may be as small as necessary to get a reliable measurement result.

Wideband emissions shall not exceed the values given in Table 16.

Frequency Range	Limit
30 MHz to 1 GHz	-107dBm/Hz
above 1 GHz to 12,75 GHz	-97 dBm/Hz

Table 16. Wideband spurious emission limits for receivers

Test Procedure: The EUT was placed on a 1.5m high wooden table inside a semi-anechoic chamber. The measurements were performed using normal operation of the equipment. The method of testing, test conditions, and test procedures of *Annex B* were used. The frequencies and amplitudes of field strengths were recorded for reference during final measurements.

The EUT was set to transmit at its highest output power at both the low and high channels of the transmit band as well as all applicable modulations. The receive antenna was adjusted between 1 and 4 m in order to find the maximum emission. The table was also rotated about 360^0. Both vertical and horizontal polarizations were used to determine the maximum emission.

In order to determine the magnitude of each emission within 6dB of the limit, other than the noise floor of the spectrum analyzer, the signal substitution method was used as described in Annex B of *EN 300 328*.

Test Results: The EUT as tested was found compliant with the specified limits of Clause 4.3.7.2.

Test Engineer: Anderson Soungpanya

Test Date: 10/07/09

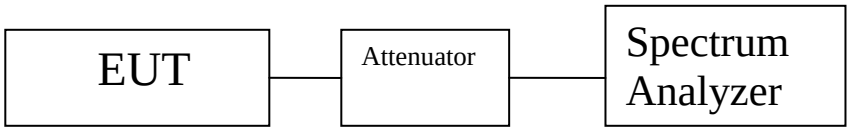
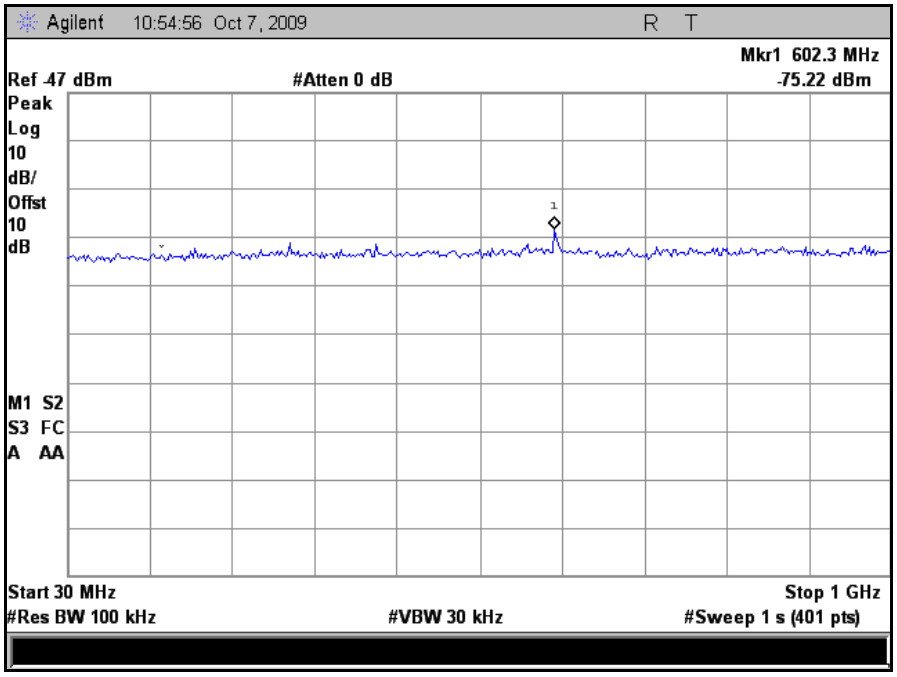
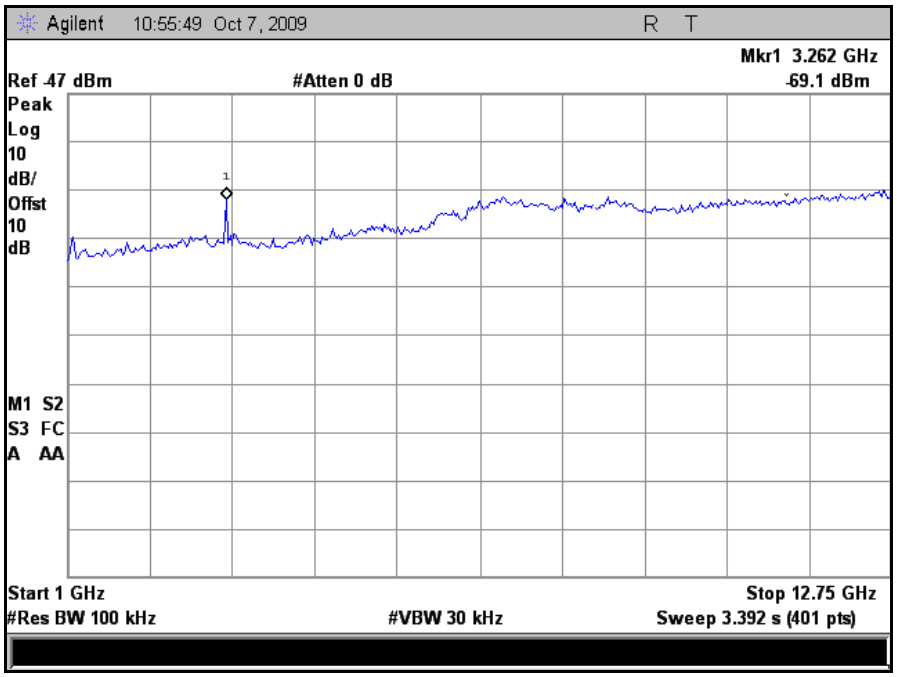


Figure 8. Receiver Spurious Emissions

Receiver Spurious Emissions - Conducted



Plot 68. Conducted Receiver Spurious Emission, 30 MHz – 1 GHz



Plot 69. Conducted Receiver Spurious Emission, 1 GHz – 12.75 GHz

Conformance Requirements

4.3.7 Receiver Spurious Emissions – Radiated

Test Requirement(s): 4.3.7.1 Definition

Receiver spurious emissions are emissions at any frequency when the equipment is in received mode.

4.3.7.2 Limit

The spurious emissions of the receiver shall not exceed the values in tables Table 15 and Table 16 and in the indicated bands.

Frequency Range	Limit
30 MHz to 1 GHz	-57 dBm
above 1 GHz to 12,75 GHz	-47 dBm

Table 17. Narrowband spurious emission limits for receivers

The above limit values apply to narrowband emissions, e.g. as caused by local oscillator leakage. The measurement bandwidth for such emissions may be as small as necessary to get a reliable measurement result.

Wideband emissions shall not exceed the values given in Table 16.

Frequency Range	Limit
30 MHz to 1 GHz	-107dBm/Hz
above 1 GHz to 12,75 GHz	-97 dBm/Hz

Table 18. Wideband spurious emission limits for receivers

Test Procedure: The EUT was placed on a 1.5m high wooden table inside a semi-anechoic chamber. The measurements were performed using normal operation of the equipment. The method of testing, test conditions, and test procedures of *Annex B* were used. The frequencies and amplitudes of field strengths were recorded for reference during final measurements.

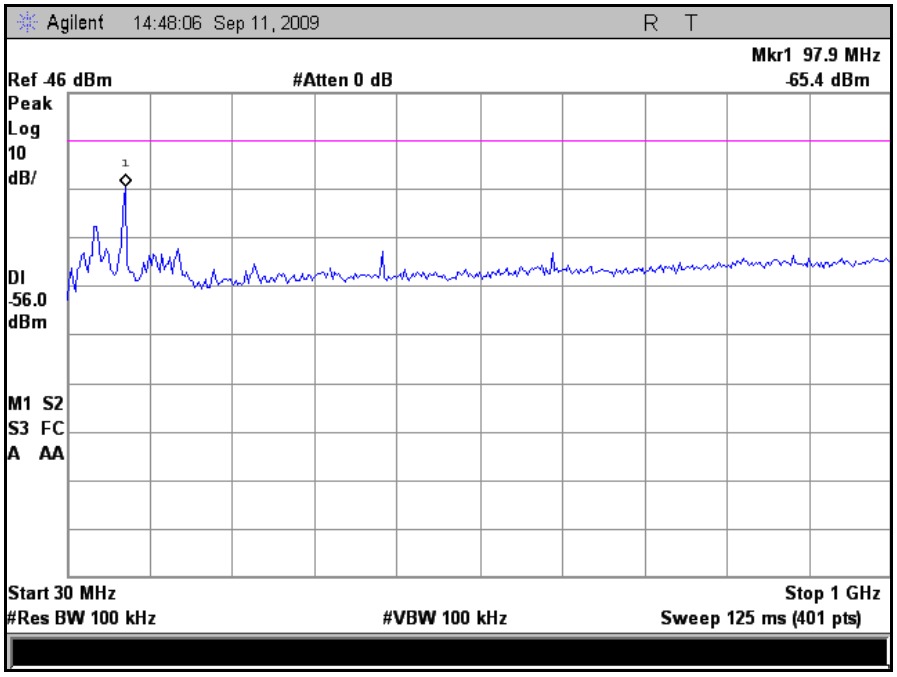
The EUT was set to transmit at its highest output power at both the low and high channels of the transmit band as well as all applicable modulations. The receive antenna was adjusted between 1 and 4 m in order to find the maximum emission. The table was also rotated about 360^0. Both vertical and horizontal polarizations were used to determine the maximum emission.

In order to determine the magnitude of each emission within 6dB of the limit, other than the noise floor of the spectrum analyzer, the signal substitution method was used as described in Annex B of *EN 300 328*.

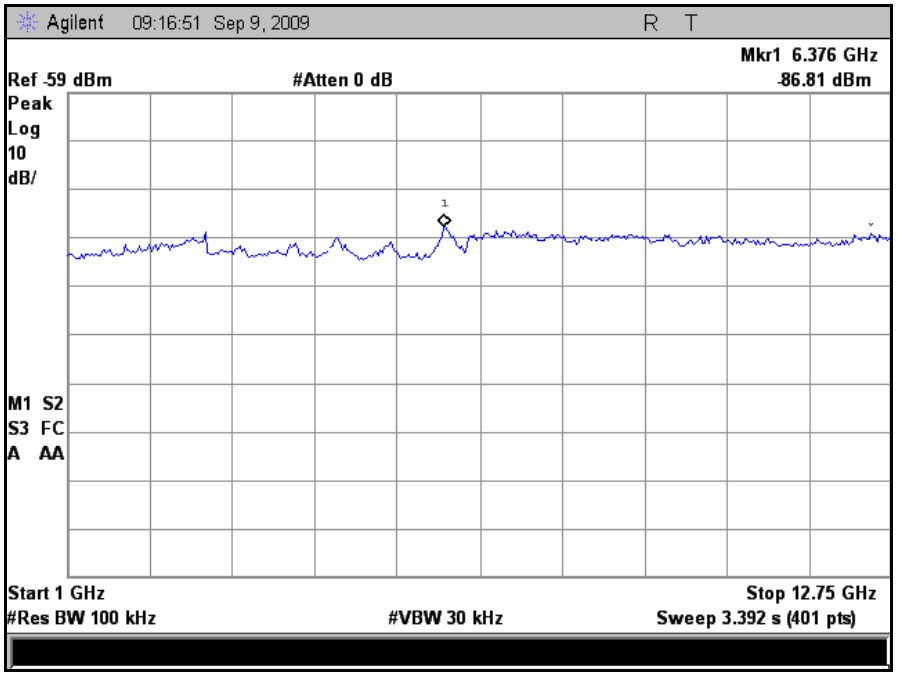
Test Results: The EUT as tested was found compliant with the specified limits of Clause 4.3.7.2.

Test Engineer: Anderson Soungpanya

Test Date: 10/07/09



Plot 70. Radiated Receiver Spurious Emission, 30 MHz – 1 GHz



Plot 71. Radiated Receiver Spurious Emission, 1 GHz – 12.75 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
1S2421	EMI RECEIVER	ROHDE&SCHWARZ	ESIB 7	05/27/2009	05/27/2010
1S2184	BILOG ANTENNA	CHASE	CBL6112A	SEE NOTE	
1S2121	PRE-AMPLIFIER	HEWLETT PACKARD	8449B	SEE NOTE	
1S2198	ANTENNA, HORN	EMCO	3115	09/03/2009	09/03/2010
1S2520	THERMO-HYGROMETER	FISHER SCIENTIFIC	11-661-7D	11/14/2007	11/13/2009
1S2482	CHAMBER, 5 METER	PANASHIELD	641431	11/22/2008	11/22/2009
1S2202	ANTENNA, HORN, 1 METER	EMCO	3116	04/10/2007	04/10/2010
N/A	HIGH PASS FILTER	MICRO-TRONICS	HPM13146	SEE NOTE	
1S2034	COUPLER, DIRECTIONAL 1-20 GHZ	KRYTAR	101020020	SEE NOTE	
1S2583	SPECTRUM ANALYZER	AGILENT	E4447A	1/12/2009	1/12/2010
1S2460	ANALYZER, SPECTRUM 9 KHZ-40GHZ	AGILENT	E4407B	04/14/2009	04/14/2010

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

End of Report

