TEST REPORT

Report Number: 100900227DEN-004
Project Number: G100900227

Report Issue Date: 10/12/2012

Product Designation: **Model: ID:058**

Standards: **FCC Part 15, Subpart E**
Unlicensed National Information Infrastructure (U-NII) Devices

Tested by:
Intertek Testing Services NA, Inc.
1795 Dogwood St. Suite 200
Louisville, CO 80027

Client:
Echostar Technologies, LLC
90 Inverness Circle East
Englewood, CO 80112

Report prepared by

Randy Thompson
Senior EMC Project Engineer

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Michael Spataro
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1 Introduction and Conclusion

The tests indicated in section 2.0 were performed on the product constructed as described in section 3.0. The remaining test sections are the verbatim text from the actual data sheets used during the investigation. These test sections include the test name, the specified test Method, a list of the actual Test Equipment Used, documentation Photos, Results and raw Data. No additions, deviations, or exclusions have been made from the standard(s) unless specifically noted.

Based on the results of our investigation, we have concluded **the product tested complies with the requirements of the standard(s) indicated.** The results obtained in this test report pertain only to the item(s) tested.

1.1 Test Report Scope

This specific test report applies to the following Wi-Fi radio transceiver configured within the product under test:

- IEEE 802.11a/n HT20/HT40, 5150 - 5250 MHz

The product was fully tested and passed all radio transceiver requirements. Refer to the following Intertek test reports for details:

- RF4CE Radio, 2.4GHz (Intertek Report 100900227DEN-001)
- Bluetooth Radio, 2.4GHz (Intertek Report 100900227DEN-002)
- Wi-Fi Radio IEEE 802.11b/g/n HT20/HT40, 2400 – 2483.5 MHz, IEEE 802.11a/n HT20/HT40, 5725 – 5850 MHz (Intertek Report 100900227DEN-003)
- Wi-Fi Radio IEEE 802.11a/n HT20/HT40, 5150 – 5250 MHz:
  (Intertek Report 100900227DEN-004)
- Unintentional/ Receiver Mode of Operation (Intertek Report 100900227DEN-005)

1.2 Test Methodology

Both RF conducted port and radiated emissions measurements were performed according to the procedures in ANSI C63.10:2009 and the general procedures of FCC Parts 2 and 15 of CFR47.
In addition, specific testing utilized the FCC Guidance documents defined in each specific test section.
Radiated emissions tests were formed at an antenna-to-product distance of 3-meters.

1.3 Test Facility

Intertek Denver's testing facilities are located at 1795 Dogwood St. Suite 200 Louisville, CO 80027. The testing facility is ISO17025:2005 accredited by A2LA, our lab code is 2506.02, our VCCI registration numbers are. R-1643, C-1752 and T-1558, our FCC designation no. US1121 and our IC lab no. 2042N.

Testing contained in this test report may not be covered under the laboratories scope of accreditation.
A note will be placed in the specific test section for testing not coved under the laboratories scope.

2 Test Summary

Test Section	Tests	FCC Reference	Test Date	Result
5	26 dB Bandwidth	15.407(a)(1)	09/25/2012 09/26/2012	Reference Only
5	Conducted Output Power	15.407(a)(1)	09/25/2012 09/26/2012	Pass
6	Peak Power Spectral Density (PPSD)	15.407(a)(1)(5)	10/04/2012	Pass
7	Peak Excursion Ratio of Modulation Envelope	15.407(a)(6)	09/22/2012 09/24/2012	Pass
8	Out-of-Band Antenna Conducted Emission	15.407(b)(1)	10/04/2012	Pass
9	Frequency Stability	15.407(g)	10/03/2012	Pass
10	Transmitter Radiated Emissions	15.407(b)(1) 15.209/ 15.205	9/22/2012	Pass
11	Radiated Emissions – Digital Receiver	15.109	9/22/2012	Pass Note 1
12	AC Line Conducted Emissions	15.207	9/25/2012	Pass
13	Antenna Requirement	15.203	N/A	Pass

Notes:

1) Product Receiver/Standby Mode of Operation: The product was tested and passed - refer to Intertek Report 100900227DEN-005 for details.

2.1 Radio Information (Specific to this test report)

Applicant	Echostar Technologies, LLC
Model Number	ID:058
FCC Identifier.	DKNX34
IC Identifier	N/A
Product Use	Satellite Receiver
Rated RF Output Power	14.8mW (11.7 dBm)
Frequency Range	5150 – 5250 MHz
Modulation Type	OFDM, MCS
Number of Channels	IEEE 802.11a, IEEE 802.11n HT20, IEEE 802.11n HT40 5150 – 5250 MHz 5180 MHz, 5220 MHz, 5240MHz (a/n HT20 mode) 5190 MHz, 5230 MHz (n HT40 mode)
Antenna(s) & Gain	Internal Embedded Antennas, U.FL cable connector Antenna 0: 3.2dBi @ 5.2GHz, Antenna 1: 1.8 dBi @ 5.2GHz
Manufacturer Name & Address	Echostar Technologies, LLC 90 Inverness Circle East Englewood, CO 80112

2.2 Product Channel Configurations

Channels in the 5150 – 5250 MHz Band					
Number	**Frequency, MHz**	**a/ n HT20 mode**		**n HT40 mode**	
36	5180	x	tested	---	
38	5190	---	---	x	tested
40	5200	---	---	---	
44	5220	x	tested	---	
46	5230	---	---	x	tested
48	5240	x	tested	--	

Note: x = available channels

3 Description of Equipment Under Test

Equipment Under Test			
Description	Manufacturer	Model Number	Serial Number
Advanced Satellite Receiver Set-Top Box	Echostar Technologies, LLC	ID:058	EMC1

Receive Date:	09/11/2012
Received Condition:	Good
Type:	Production Samples

Description of Equipment Under Test (provided by client)
The ID:058 is a satellite set-top box incorporating Sling place shifting technology designed to operate as a server in the whole home DVR system. The ID:058 has a RF4CE 2.4GHz Synkro solution to interface to a remote control , a Bluetooth Class 2 transceiver for supported accessories, and an 802.11a/b/g/n Wi-Fi transceiver for connection to the customer's internet wirelessly. The RF4CE radio is located on the main board and uses a detachable antenna located on the back panel of the set-top box. The Bluetooth transceiver is on a separate PCB that is located within the front panel plastics. The Bluetooth transceiver uses a printed antenna. The 802.11a/b/g/n transceiver is located on the same PCB as the Bluetooth transceiver. The 802.11a/b/g/n transceiver uses two antennas that are attached via U.FL connectors and two different lengths of mini coax cable. These antennas are located within the front bezel assembly. Removal of the Bluetooth and 802.11a/b/g/n transceivers does not alter the RF characteristics of the RF4CE transceiver. The ID:058 provides HDMI, Composite and Component A/V outputs as well as Ethernet, USB and eSATA. For the purposes of this specific test report, the product supports the following data rates in the 5150-5250MHz band: ▪ IEEE 802.11a: 6, 9, 12, 18, 24, 36, 48, 54Mbps ▪ IEEE 802.11n: MCS0, MCS1, MCS2, MCS3, MCS4, MCS5, MCS6, MCS7 In 802.11n HT20 and 802.11n HT40 modes, the nominal bandwidth is 20MHz and 40MHz respectively.

Equipment Under Test Power Configuration			
Rated Voltage	Rated Current	Rated Frequency	Number of Phases
100-120VAC	0.5A	60Hz	1

Operating modes of the EUT: Intentional Tx Testing

No.	Descriptions of EUT Exercising
1	Product configured in transmit mode at full power, CW signal.
2	Product configured for continuous transmission, full power with modulation/data transfer enabled.
3	Product set up with all signal and I/O cable ports populated and terminated with either active or passive loads. Wi-Fi radio enabled, Ethernet data transfer, USB data transfer, and eSATA data transfer. Video output to all A/V connections.

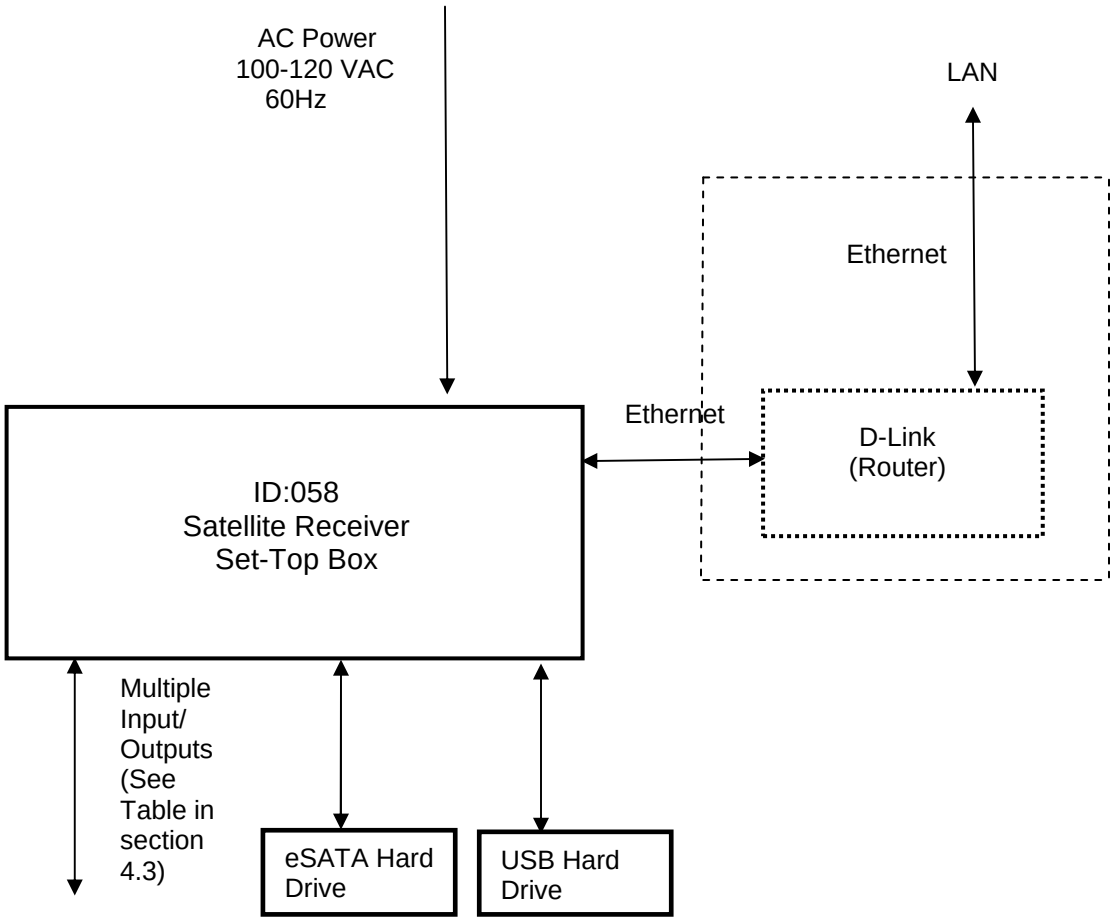
Note: The chosen mode of operation described above is dependent upon the specific test to be performed.

4 System setup including cable interconnection details, support equipment and simplified block diagram

4.1 Method:

Record the details of EUT cabling, document the support equipment, and show the interconnections in a block diagram.

4.2 EUT Block Diagram:



Note: Dashed lines indicate auxiliary/support equipment outside the test area

4.3 Support Data:

ID	Description/ Function	Shield Type	Length	Connector	Connection	Ferrites
1	AC Power	None	1 meter	AC	DE51 Power In	No
2	2x Ethernet	None	> 3 meter	RJ-45	Router/Switch	No
3	USB	Foil	< 1 meter	USB	USB Drive	No
4	Front Panel USB	Foil	< 1 meter	USB	Terminator	No
5	USB	Foil	< 1 meter	USB	Terminator	No
6	RCA A/V Outputs	Braid	1 meter	RCA	Matched Impedance Loads	No
7	HDMI Digital Video Out	Foil	1 meter	HDMI	EDIDI Simulation Box	No
8	RF Coax Cable	Braid	> 3 meter	Type F	Terminator	No
9	eSATA Cable	Braid	< 1 meter		eSATA Drive	No
10	Composite Video Out	Braid	< 1 meter	RCA	Terminator	No
11	Phone Cable	None	< 1 meter	RJ-11	Unterminated	No

Support Equipment			
Description	Manufacturer	Model Number	Serial Number
Router/Switch	D-Link	EBR-2310	-----

Note: All product ports were fully populated with appropriate cables. All cables were terminated with an active load or typical device/peripheral.

5 Conducted Output Power

5.1 Method

Unless otherwise stated no deviations were made from FCC Part 15.407(a)(1).

This testing was performed at Intertek Denver, located at 1795 Dogwood St. Suite 200, Louisville, CO 80027.

5.2 Test Equipment Used:

Asset ID	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DEN-073	EMI Receiver	RHODE & SCHWARZ	ESU 26	100265	1/11/2012	1/10/2013
E1	RF Conducted Port Cable	-----	45-7221-19	001	09/12/2012	09/12/2013
E2	RF Conducted Port Cable	-----	True Blue	001	09/12/2012	09/12/2013

5.3 Test Requirement

For the band 5.15–5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed the lesser of 50 mW or 4 dBm + 10 log B, where B = 26dB EBW.

The maximum output power is the total transmit power (power set to maximum) delivered to all antennas. Power must be summed across all antennas.

If transmitting antennas of directional gain greater than 6 dBi are used, the maximum conducted output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

5.4 Test Procedure

The antenna port of the EUT was connected to the input port of a spectrum analyzer/power meter to measure the Maximum Conducted Transmitter Output Power.

The procedures described in FCC Publication 789033 (Guidelines for Compliance Testing of U-NII Devices), were used.

- Method C)3)f), Method SA-3 (RMS detection with max hold)

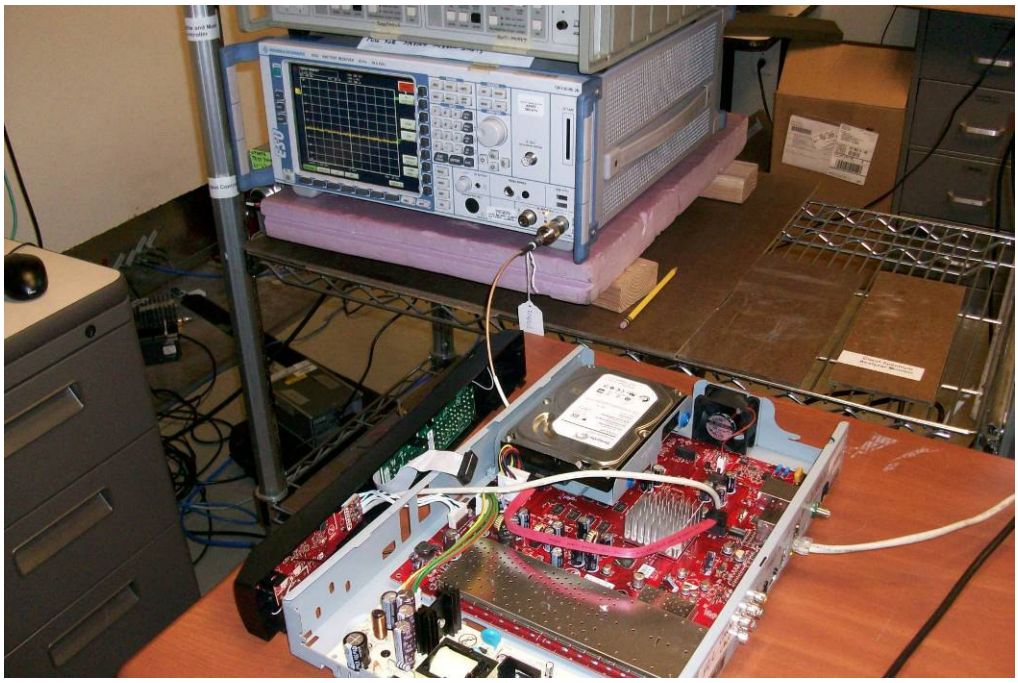
In addition, the procedures described in FCC Publication 662911 (Emissions Testing of Transmitters with Multiple Outputs in the Same Band) were used.

5.5 Results:

The sample tested was found to Comply.

5.6 Setup Photographs:

Conducted Output Power Test setup



5.7 Test Data Summary:

Conducted Output Power – Antenna 0
FCC Part 15.407(a)(1)

Channel	Frequency, MHz	Standard/ Data Rate	Conducted Power (Average dBm)	Conducted Power Limit (dBm)	Plot
36	5180	802.11a, 12Mbps	11.41	14.0	x
		802.11n HT20, MCS3	11.49	14.0	x
38	5190	802.11n HT40, MCS0	10.44	14.0	x
44	5220	802.11a, 9Mbps	11.10	14.0	x
		802.11n HT20, MCS1	11.21	14.0	x
46	5230	802.11n HT40, MCS0	10.63	14.0	x
48	5240	802.11a, 12Mbps	11.49	14.0	x
		802.11n HT20, MCS1	11.64	14.0	x

Note: Conducted Power limit adjusted from 17dbm to 14dBm for dual antenna port product.

Conducted Output Power – Antenna 1
FCC Part 15.407(a)(1)

Channel	Frequency, MHz	Standard/ Data Rate	Conducted Power (Average dBm)	Conducted Power Limit (dBm)	Plot
36	5180	802.11a, 12Mbps	10.17	14.0	x
		802.11n HT20, MCS2	10.19	14.0	x
38	5190	802.11n HT40, MCS0	8.91	14.0	x
44	5220	802.11a, 12Mbps	10.37	14.0	x
		802.11n HT20, MCS1	10.50	14.0	x
46	5230	802.11n HT40, MCS0	10.05	14.0	x
48	5240	802.11a, 12Mbps	10.16	14.0	x
		802.11n HT20, MCS0	10.58	14.0	x

Note: Conducted Power limit adjusted from 17.0dBm to 14dBm for dual antenna port product.

The above data summary tables represent the worst-case modulation/data rate combination.

MIMO Calculations

Highest conducted power:
Antenna 0 = 11.64 dBm = 14.6 mW
Antenna 1 = 10.58 dBm = 11.5 mW
Sum = 26.1 mW

Maximum conducted output power per 15.407 (a)(1) = 50 mW

Delta = -23.9 mW

Test Data: Antenna 0

Channels in 5150 to 5250 MHz Band – FCC Part 15.407(a)(1)
(RF Conducted Port Power – Antenna 0)

Modulation Mode	Tx Channel	Frequency (MHz)	Data Rate	Peak Conducted (dBm)	Cable Loss (dB)	Final Conducted (dBm)	Spec Limit dBm	Adjusted Limit MIMO(dBm)	Delta Limit	Test Result	EBW (MHz)	Plot
OFDM	36	5180	6	9.87	1.53	11.40	17	14	-2.60	Pass		
Power Index = 16			9	9.86	1.53	11.39	17	14	-2.61	Pass		
			12	**9.88**	**1.53**	**11.41**	**17**	**14**	**-2.59**	**Pass**	**19.23**	**x**
			18	9.87	1.53	11.40	17	14	-2.60	Pass		
			24	9.83	1.53	11.36	17	14	-2.64	Pass		
			36	9.74	1.53	11.27	17	14	-2.73	Pass		
			48	9.69	1.53	11.22	17	14	-2.78	Pass		
802.11a			54	9.67	1.53	11.20	17	14	-2.80	Pass		
	44	5220	6	9.54	1.53	11.07	17	14	-2.93	Pass		
			9	**9.57**	**1.53**	**11.10**	**17**	**14**	**-2.90**	**Pass**	**19.23**	**x**
			12	9.56	1.53	11.09	17	14	-2.91	Pass		
			18	9.55	1.53	11.08	17	14	-2.92	Pass		
			24	9.49	1.53	11.02	17	14	-2.98	Pass		
			36	9.44	1.53	10.97	17	14	-3.03	Pass		
			48	9.41	1.53	10.94	17	14	-3.06	Pass		
802.11a			54	9.41	1.53	10.94	17	14	-3.06	Pass		
	48	5240	6	9.96	1.53	11.49	17	14	-2.51	Pass		
			9	9.95	1.53	11.48	17	14	-2.52	Pass		
			12	**9.96**	**1.53**	**11.49**	**17**	**14**	**-2.51**	**Pass**	**19.15**	**x**
			18	9.93	1.53	11.46	17	14	-2.54	Pass		
			24	9.89	1.53	11.42	17	14	-2.58	Pass		
			36	9.82	1.53	11.35	17	14	-2.65	Pass		
			48	9.83	1.53	11.36	17	14	-2.64	Pass		
802.11a			54	9.79	1.53	11.32	17	14	-2.68	Pass		

Modulation Mode	Tx Channel	Frequency (MHz)	Data Rate	Peak Conducted (dBm)	Cable Loss (dB)	Final Conducted (dBm)	Spec Limit dBm	Adjusted Limit MIMO (dBm)	Delta Limit	Test Result	EBW (MHz)	Plot
MCS	36	5180	MCS0	9.91	1.53	11.44	17	14	-2.56	Pass		
Power Index = 16			MCS1	9.94	1.53	11.47	17	14	-2.53	Pass		
			MCS2	9.95	1.53	11.48	17	14	-2.52	Pass		
			MCS3	**9.96**	**1.53**	**11.49**	**17**	**14**	**-2.51**	**Pass**	**19.72**	**x**
			MCS4	9.85	1.53	11.38	17	14	-2.62	Pass		
			MCS5	9.85	1.53	11.38	17	14	-2.62	Pass		
			MCS6	9.77	1.53	11.30	17	14	-2.70	Pass		
802.11n HT20			MCS7	9.72	1.53	11.25	17	14	-2.75	Pass		
	44	5220	MCS0	9.68	1.53	11.21	17	14	-2.79	Pass		
			MCS1	**9.68**	**1.53**	**11.21**	**17**	**14**	**-2.79**	**Pass**	**19.71**	**x**
			MCS2	9.65	1.53	11.18	17	14	-2.82	Pass		
			MCS3	9.65	1.53	11.18	17	14	-2.82	Pass		
			MCS4	9.60	1.53	11.13	17	14	-2.87	Pass		
			MCS5	9.60	1.53	11.13	17	14	-2.87	Pass		
			MCS6	9.52	1.53	11.05	17	14	-2.95	Pass		
802.11n HT20			MCS7	9.48	1.53	11.01	17	14	-2.99	Pass		
	48	5240	MCS0	10.07	1.53	11.60	17	14	-2.40	Pass		
			MCS1	**10.11**	**1.53**	**11.64**	**17**	**14**	**-2.36**	**Pass**	**19.63**	**x**
			MCS2	10.05	1.53	11.58	17	14	-2.42	Pass		
			MCS3	10.11	1.53	11.64	17	14	-2.36	Pass		
			MCS4	10.04	1.53	11.57	17	14	-2.43	Pass		
			MCS5	10.01	1.53	11.54	17	14	-2.46	Pass		
			MCS6	9.98	1.53	11.51	17	14	-2.49	Pass		
802.11n HT20			MCS7	9.85	1.53	11.38	17	14	-2.62	Pass		

Modulation Mode	Tx Channel	Frequency (MHz)	Data Rate	Peak Conducted (dBm)	Cable Loss (dB)	Final Conducted (dBm)	Spec Limit dBm	Adjusted Limit MIMO (dBm)	Delta Limit	Test Result	EBW (MHz)	Plot
MCS	38	5190	MCS0	8.69	1.53	10.22	17	14	-3.78	Pass		
Power Index = 16			MCS1	8.60	1.53	10.13	17	14	-3.87	Pass		
			MCS2	8.43	1.53	9.96	17	14	-4.04	Pass		
			MCS3	8.50	1.53	10.03	17	14	-3.97	Pass		
			MCS4	8.49	1.53	10.02	17	14	-3.98	Pass		
			MCS5	**8.91**	**1.53**	**10.44**	**17**	**14**	**-3.56**	**Pass**	**39.23**	**x**
			MCS6	8.60	1.53	10.13	17	14	-3.87	Pass		
802.11n HT40			MCS7	8.51	1.53	10.04	17	14	-3.96	Pass		
	46	5230	**MCS0**	**9.10**	**1.53**	**10.63**	**17**	**14**	**-3.37**	**Pass**	**38.97**	**x**
			MCS1	9.00	1.53	10.53	17	14	-3.47	Pass		
			MCS2	8.74	1.53	10.27	17	14	-3.73	Pass		
			MCS3	8.88	1.53	10.41	17	14	-3.59	Pass		
			MCS4	8.71	1.53	10.24	17	14	-3.76	Pass		
			MCS5	8.62	1.53	10.15	17	14	-3.85	Pass		
			MCS6	8.53	1.53	10.06	17	14	-3.94	Pass		
802.11n HT40			MCS7	8.57	1.53	10.10	17	14	-3.90	Pass		

FCC Part 15.407(a)(1) Limit: 50mW (17 dBm)

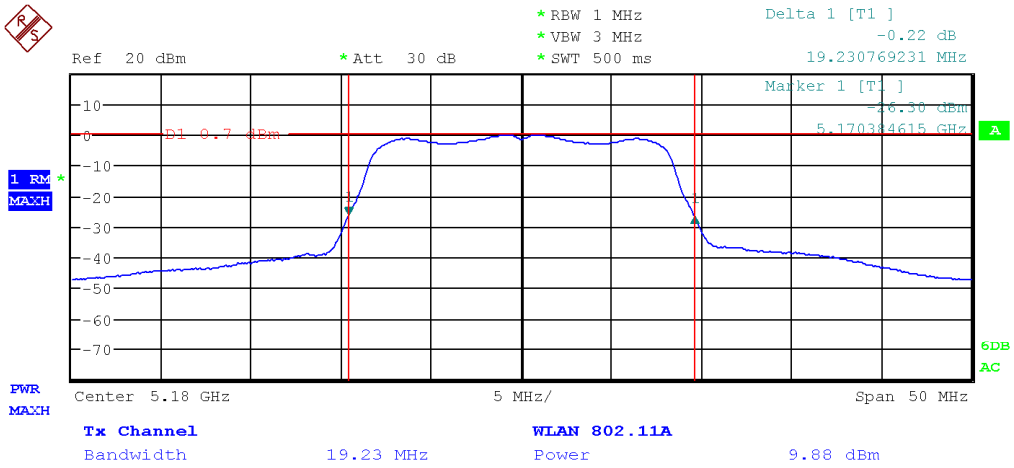
Adjusted Limit for MIMO devices: 25mW (14 dBm) per antenna port

The worst-case RF Conducted Power measurement was 802.11n HT20 MCS Modulation Mode, Channel 48: 11.64 dBm (-2.36 dBm under the limit)

5.8 Plots: Antenna 0

Channels in 5150 to 5250 MHz Band – FCC Part 15.407(a)(1)
(RF Conducted Port Power – Antenna 0)

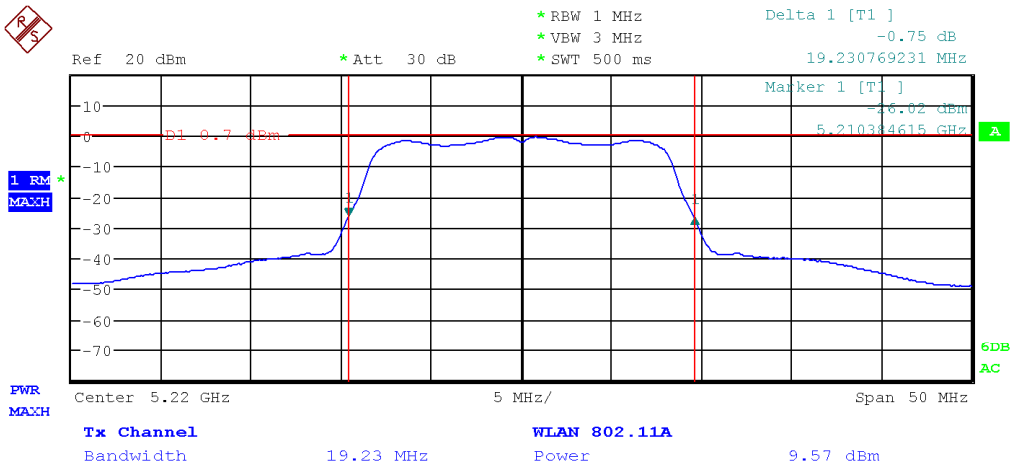
802.11a OFDM Modulation Mode
Channel 36



CH0-

Date: 26.SEP.2012 16:19:18

Channel 44



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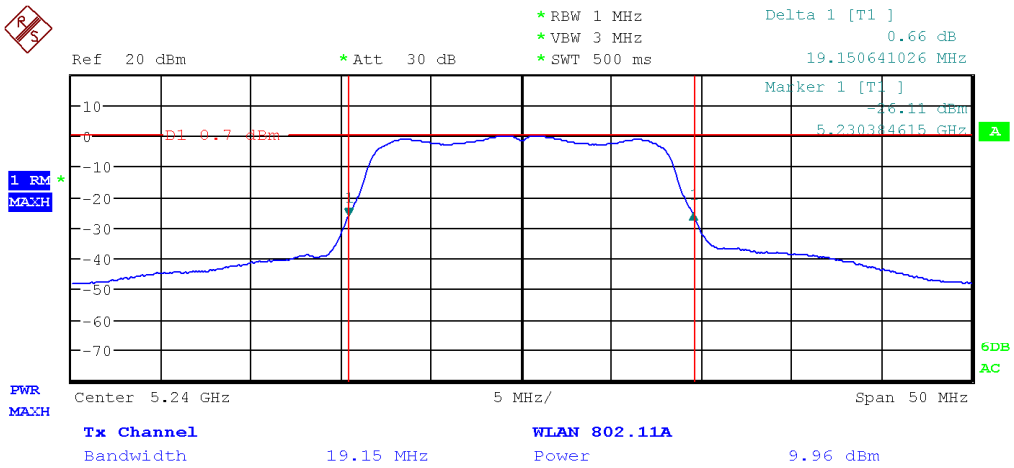
Date: 26.SEP.2012 16:23:56

Channel 48



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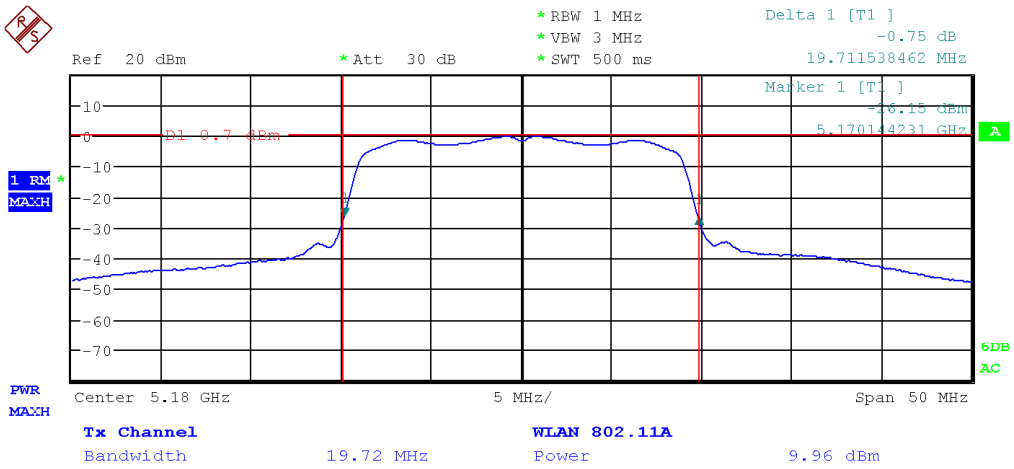
Date: 26.SEP.2012 16:28:16

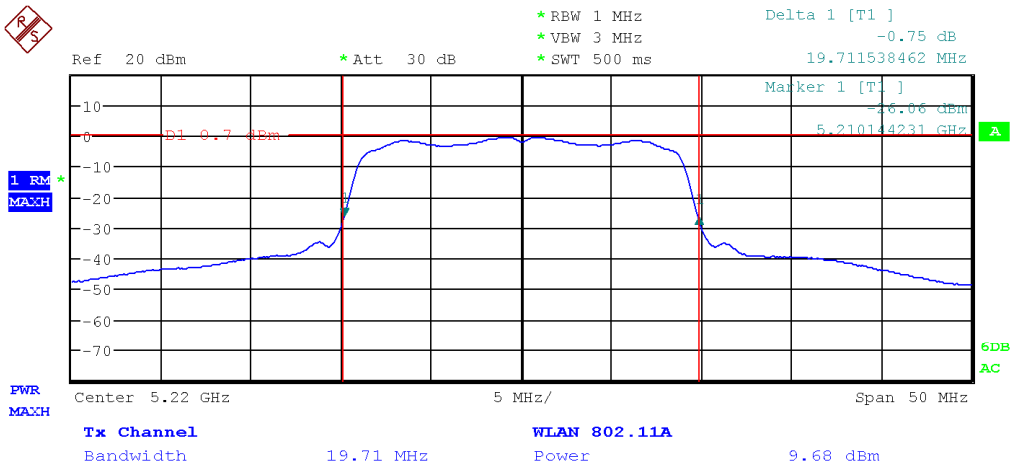
802.11n HT20 MCS Modulation Mode
Channel 36



CH0-

Date: 26.SEP.2012 16:21:30

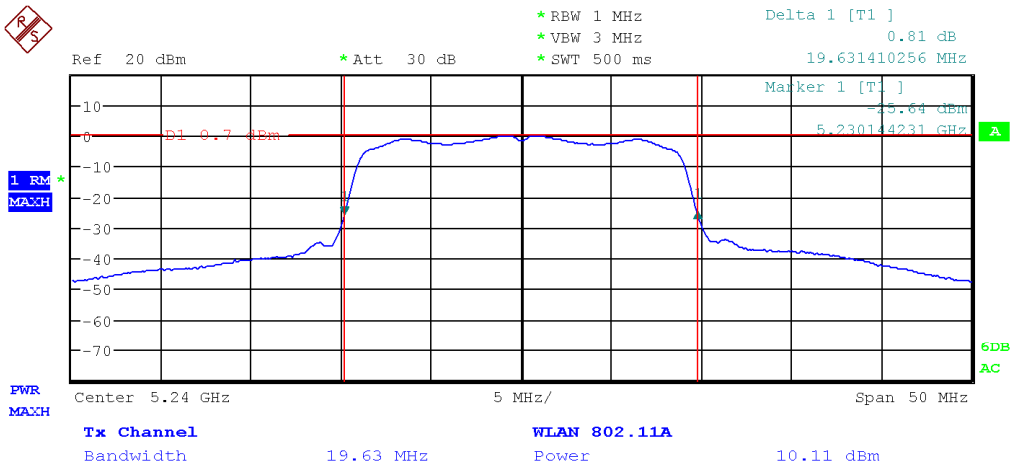
Channel 44



CH0-

Date: 26.SEP.2012 16:25:57

Channel 48



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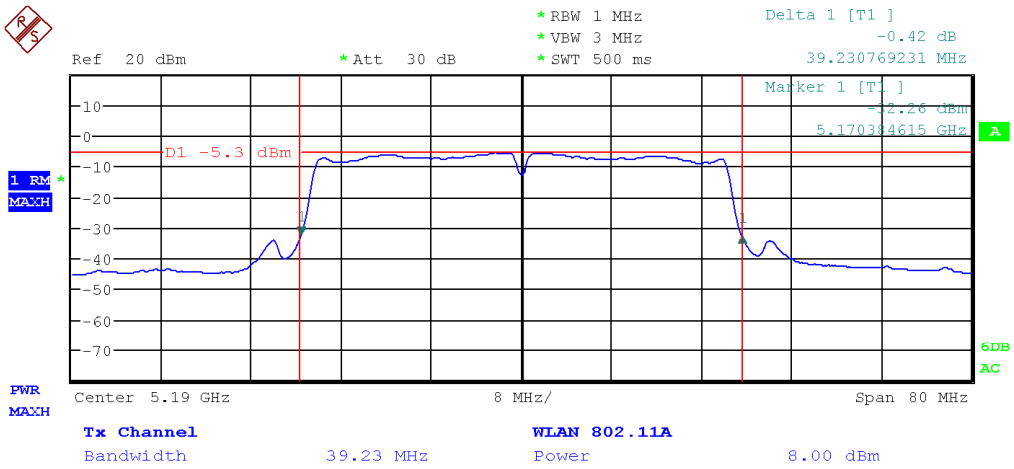
Date: 26.SEP.2012 16:30:09

802.11n HT40 MCS Modulation Mode
Channel 38



CH0-

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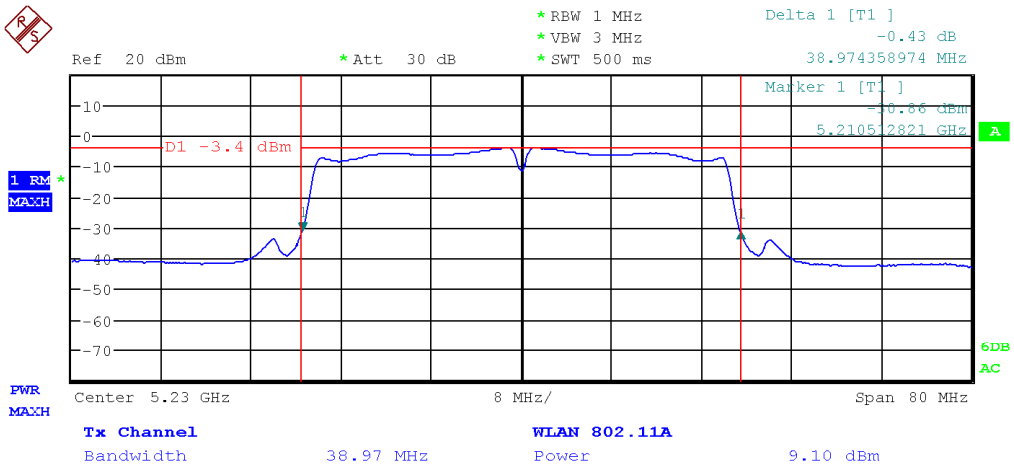
Channel 46



CH0-

Date: 26.SEP.2012 16:42:33

The above plots represent the worst-case channel, modulation and data rate tested.

5.9 Test Data: Antenna 1

Channels in 5150 to 5250 MHz Band – FCC Part 15.407(a)(1)
(RF Conducted Port Power – Antenna 1)

Modulation Mode	Tx Channel	Frequency (MHz)	Data Rate	Peak Conducted (dBm)	Cable Loss (dB)	Final Conducted (dBm)	Spec Limit dBm	Adjusted Limit MIMO(dBm)	Delta Limit	Test Result	EBW (MHz)	Plot
OFDM	36	5180	6	8.61	1.53	10.14	17	14	-3.86	Pass		
Power Index = 19			9	8.61	1.53	10.14	17	14	-3.86	Pass		
			12	**8.64**	**1.53**	**10.17**	**17**	**14**	**-3.83**	**Pass**	**19.39**	**x**
			18	8.61	1.53	10.14	17	14	-3.86	Pass		
			24	8.58	1.53	10.11	17	14	-3.89	Pass		
			36	8.49	1.53	10.02	17	14	-3.98	Pass		
			48	8.42	1.53	9.95	17	14	-4.05	Pass		
802.11a			54	8.50	1.53	10.03	17	14	-3.97	Pass		
	44	5220	6	8.70	1.53	10.23	17	14	-3.77	Pass		
			9	**8.84**	**1.53**	**10.37**	**17**	**14**	**-3.63**	**Pass**	**19.23**	**x**
			12	8.81	1.53	10.34	17	14	-3.66	Pass		
			18	8.77	1.53	10.30	17	14	-3.70	Pass		
			24	8.76	1.53	10.29	17	14	-3.71	Pass		
			36	8.69	1.53	10.22	17	14	-3.78	Pass		
			48	8.64	1.53	10.17	17	14	-3.83	Pass		
802.11a			54	8.63	1.53	10.16	17	14	-3.84	Pass		
	48	5240	6	8.62	1.53	10.15	17	14	-3.85	Pass		
			9	8.59	1.53	10.12	17	14	-3.88	Pass		
			12	**8.63**	**1.53**	**10.16**	**17**	**14**	**-3.84**	**Pass**	**19.15**	**x**
			18	8.60	1.53	10.13	17	14	-3.87	Pass		
			24	8.57	1.53	10.10	17	14	-3.90	Pass		
			36	8.49	1.53	10.02	17	14	-3.98	Pass		
			48	8.46	1.53	9.99	17	14	-4.01	Pass		
802.11a			54	8.49	1.53	10.02	17	14	-3.98	Pass		

Modulation Mode	Tx Channel	Frequency (MHz)	Data Rate	Peak Conducted (dBm)	Cable Loss (dB)	Final Conducted (dBm)	Spec Limit dBm	Adjusted Limit MIMO (dBm)	Delta Limit	Test Result	EBW (MHz)	Plot
MCS	36	5180	MCS0	8.60	1.53	10.13	17	14	-3.87	Pass		
Power Index = 19			MCS1	8.58	1.53	10.11	17	14	-3.89	Pass		
			MCS2	**8.66**	**1.53**	**10.19**	**17**	**14**	**-3.81**	**Pass**	**19.80**	**x**
			MCS3	8.59	1.53	10.12	17	14	-3.88	Pass		
			MCS4	8.49	1.53	10.02	17	14	-3.98	Pass		
			MCS5	8.51	1.53	10.04	17	14	-3.96	Pass		
			MCS6	8.44	1.53	9.97	17	14	-4.03	Pass		
802.11n HT20			MCS7	8.37	1.53	9.90	17	14	-4.10	Pass		
	44	5220	MCS0	8.93	1.53	10.46	17	14	-3.54	Pass		
			MCS1	**8.97**	**1.53**	**10.50**	**17**	**14**	**-3.50**	**Pass**	**19.87**	**x**
			MCS2	8.97	1.53	10.50	17	14	-3.50	Pass		
			MCS3	8.97	1.53	10.50	17	14	-3.50	Pass		
			MCS4	8.87	1.53	10.40	17	14	-3.60	Pass		
			MCS5	8.88	1.53	10.41	17	14	-3.59	Pass		
			MCS6	8.86	1.53	10.39	17	14	-3.61	Pass		
802.11n HT20			MCS7	8.75	1.53	10.28	17	14	-3.72	Pass		
	48	5240	**MCS0**	**9.05**	**1.53**	**10.58**	**17**	**14**	**-3.42**	**Pass**	**19.63**	**x**
			MCS1	10.54	1.53	12.07	17	14	-1.93	Pass		
			MCS2	10.53	1.53	12.06	17	14	-1.94	Pass		
			MCS3	10.54	1.53	12.07	17	14	-1.93	Pass		
			MCS4	10.48	1.53	12.01	17	14	-1.99	Pass		
			MCS5	10.43	1.53	11.96	17	14	-2.04	Pass		
			MCS6	10.36	1.53	11.89	17	14	-2.11	Pass		
802.11n HT20			MCS7	10.31	1.53	11.84	17	14	-2.16	Pass		

Modulation Mode	Tx Channel	Frequency (MHz)	Data Rate	Peak Conducted (dBm)	Cable Loss (dB)	Final Conducted (dBm)	Spec Limit dBm	Adjusted Limit MIMO (dBm)	Delta Limit	Test Result	EBW (MHz)	Plot
MCS	38	5190	**MCS0**	**7.38**	**1.53**	**8.91**	**17**	**14**	**-5.09**	**Pass**	**39.10**	**x**
Power Index = 19			MCS1	8.66	1.53	10.19	17	14	-3.81	Pass		
			MCS2	8.48	1.53	10.01	17	14	-3.99	Pass		
			MCS3	8.59	1.53	10.12	17	14	-3.88	Pass		
			MCS4	8.45	1.53	9.98	17	14	-4.02	Pass		
			MCS5	8.36	1.53	9.89	17	14	-4.11	Pass		
			MCS6	8.25	1.53	9.78	17	14	-4.22	Pass		
802.11n HT40			MCS7	8.24	1.53	9.77	17	14	-4.23	Pass		
	46	5230	**MCS0**	**8.52**	**1.53**	**10.05**	**17**	**14**	**-3.95**	**Pass**	**38.97**	**x**
			MCS1	9.95	1.53	11.48	17	14	-2.52	Pass		
			MCS2	9.80	1.53	11.33	17	14	-2.67	Pass		
			MCS3	9.93	1.53	11.46	17	14	-2.54	Pass		
			MCS4	9.71	1.53	11.24	17	14	-2.76	Pass		
			MCS5	9.61	1.53	11.14	17	14	-2.86	Pass		
			MCS6	9.58	1.53	11.11	17	14	-2.89	Pass		
802.11n HT40			MCS7	9.49	1.53	11.02	17	14	-2.98	Pass		

FCC Part 15.407(a)(1) Limit: 50mW (17 dBm)

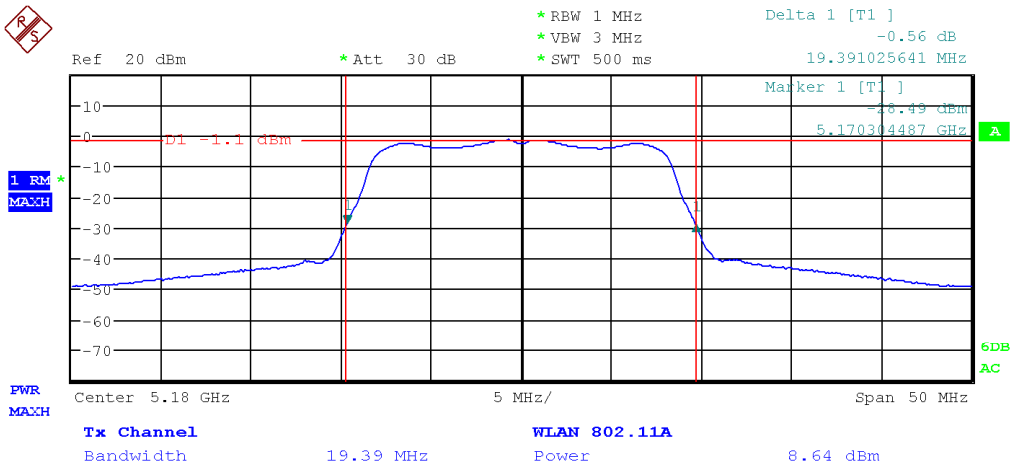
Adjusted Limit for MIMO devices: 25mW (14 dBm) per antenna port

The worst-case RF Conducted Power measurement was 802.11n HT20 MCS Modulation Mode, Channel 48: 10.58 dBm (-3.42 dBm under the limit)

5.10 Plots: Antenna 1

Channels in 5150 to 5250 MHz Band – FCC Part 15.407(a)(1)
(RF Conducted Port Power – Antenna 1)

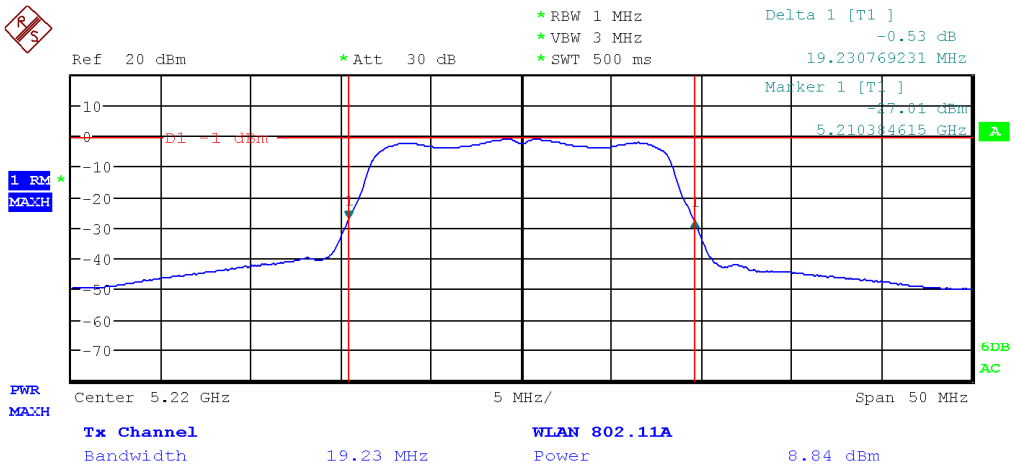
802.11a OFDM Modulation Mode
Channel 36



CH0-

Date: 26.SEP.2012 15:22:53

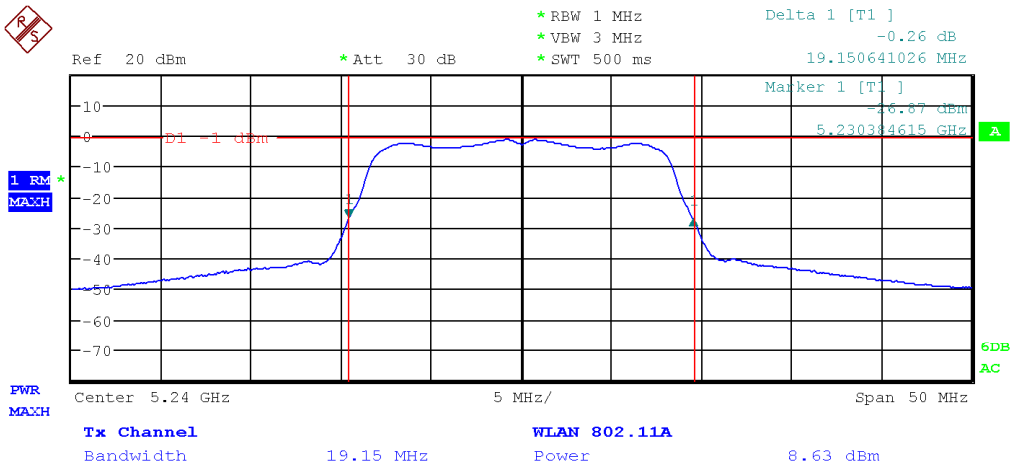
Channel 44



CH0-

Date: 26.SEP.2012 15:27:40

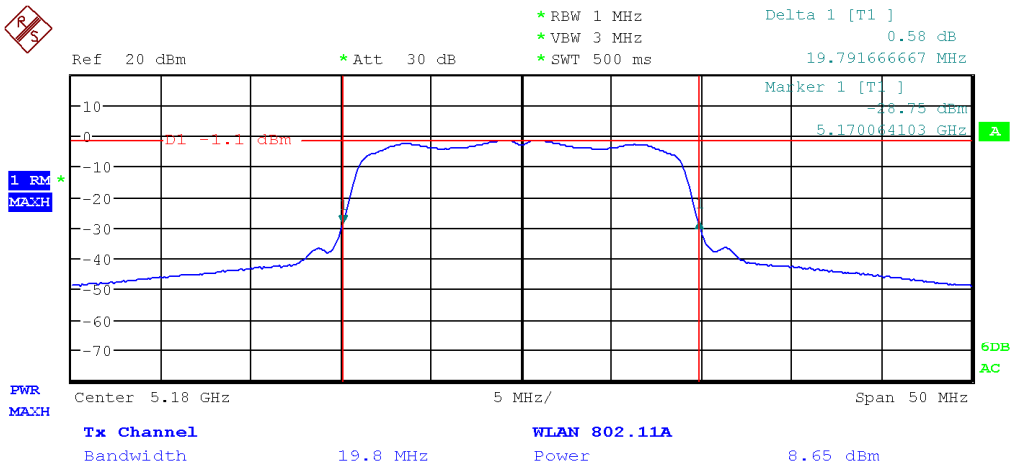
Channel 48



CH0-

Date: 26.SEP.2012 15:34:18

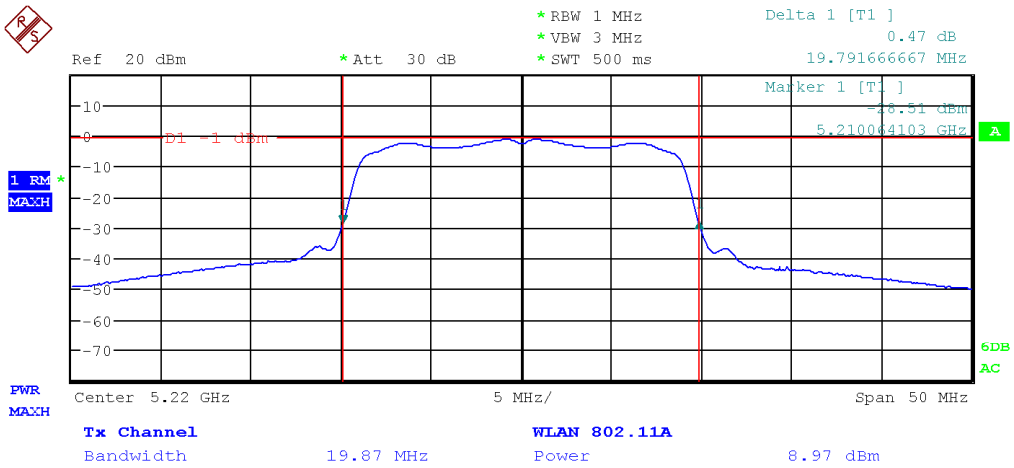
802.11n HT20 MCS Modulation Mode
Channel 36



CH0-

Date: 26.SEP.2012 15:25:05

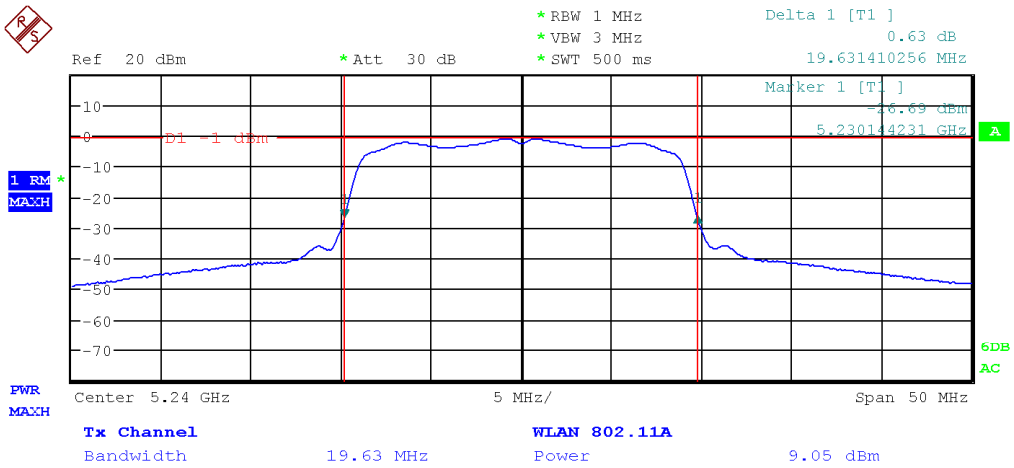
Channel 44



CH0-

Date: 26.SEP.2012 15:30:10

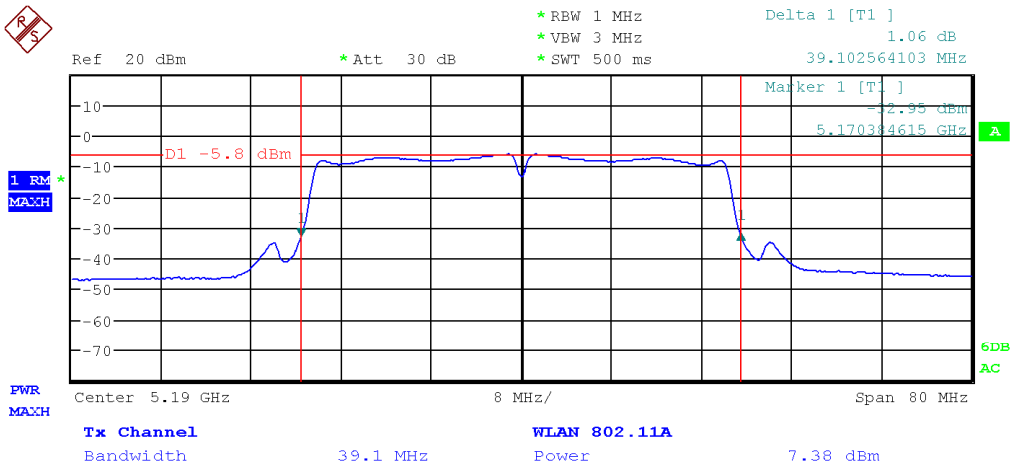
Channel 48



CH0-

Date: 26.SEP.2012 16:03:53

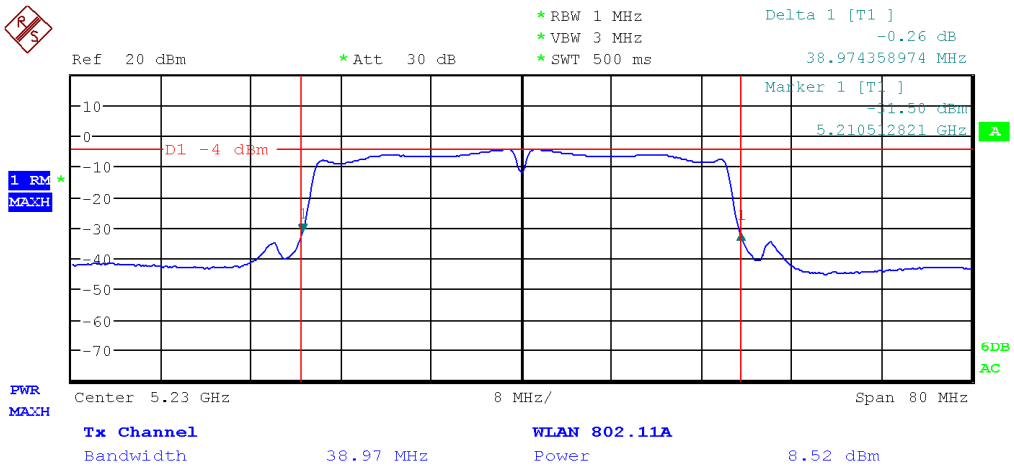
802.11n HT40 MCS Modulation Mode
Channel 38



CH0-

Date: 26.SEP.2012 16:07:13

Channel 46



CH0-

Date: 26.SEP.2012 16:09:29

The above plots represent the worst-case channel, modulation and data rate tested.

6 Peak Power Spectral Density – Peak PSD

6.1 Method

Unless otherwise stated no deviations were made from FCC Part 15.407(a)(1).

This testing was performed at Intertek Denver, located at 1795 Dogwood St. Suite 200, Louisville, CO 80027.

6.2 Test Equipment Used:

Asset ID	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
18913	Spectrum Analyzer	Hewlett-Packard	E7405A	My44211889	7/16/2012	7/16/2013
E1	RF Conducted Port Cable	-----	45-7221-19	001	09/12/2012	09/12/2013

6.3 Test Requirements:

For the band 5.15–5.25 GHz, the peak power spectral density shall not exceed 4 dBm in any 1 MHz band. If transmitting antennas of directional gain greater than 6 dBi are used, the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

6.4 Test Procedure:

The antenna port of the EUT was connected to the input port of a spectrum analyzer to measure the Peak Power Spectral Density (PPSD).

The procedures described in the FCC Publication 789033 (Guidelines for Compliance Testing of U-NII Devices), were used.

- Peak Power Spectral Density (PPSD) - Method E)1)2)

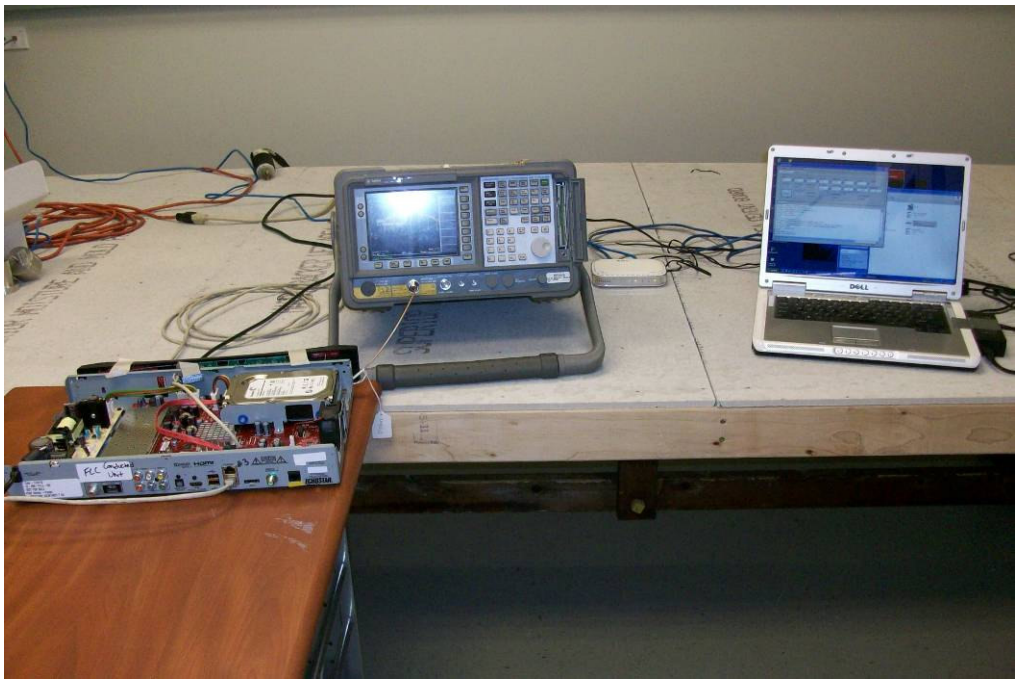
In addition, the procedures described in FCC Publication 662911 (Emissions Testing of Transmitters with Multiple Outputs in the Same Band) were used.

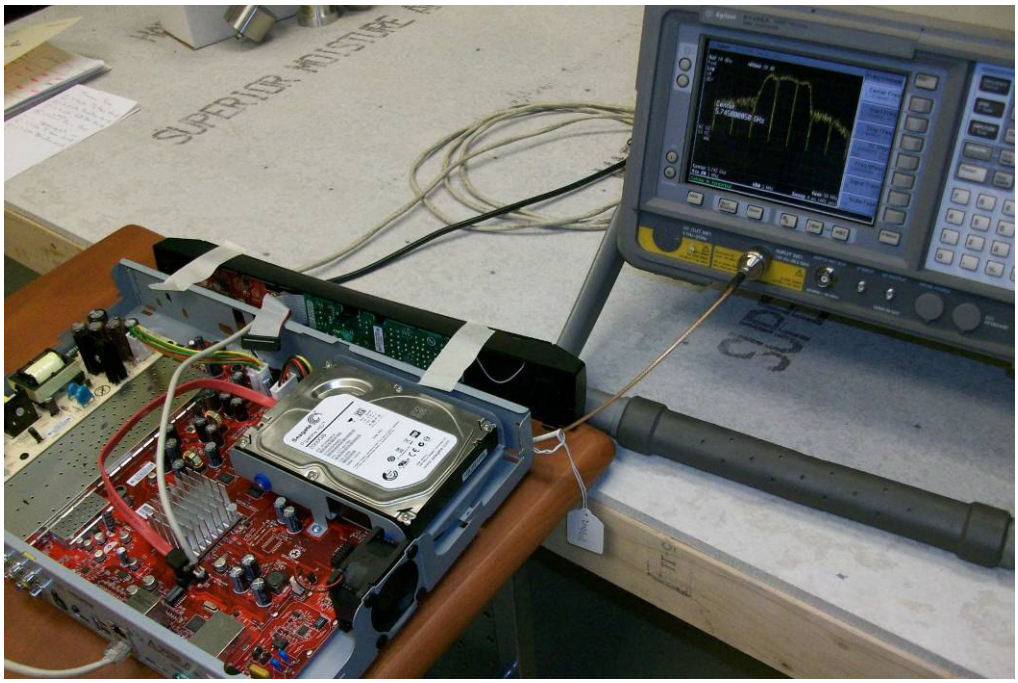
6.5 Test Results:

The sample tested was found to Comply.

6.6 Setup Photographs:

Peak Power Spectral Density - Test setup





6.7 Test Data Summary:

Peak Power Spectral Density – Antenna 0
FCC Part 15.407(a)(1)(5)

Channel	Frequency, MHz	Standard/ Data Rate	PSD (Peak dBm)	PSD Limit (dBm)	Plot
36	5180	802.11a, 12Mbps	-0.80	4.0	x
		802.11n HT20, MCS3	-0.67	4.0	x
38	5190	802.11n HT40, MCS0	-0.81	4.0	x
44	5220	802.11a, 9Mbps	-1.52	4.0	x
		802.11n HT20, MCS1	-1.27	4.0	x
46	5230	802.11n HT40, MCS0	-0.84	4.0	x
48	5240	802.11a, 12Mbps	-1.94	4.0	x
		802.11n HT20, MCS1	-2.31	4.0	x

Note: PSD measurement above corrected for dual antenna port product.

Peak Power Spectral Density – Antenna 1
FCC Part 15.407(a)(1)(5)

Channel	Frequency, MHz	Standard/ Data Rate	PSD (Peak dBm)	PSD Limit (dBm)	Plot
36	5180	802.11a, 12Mbps	0.78	4.0	x
		802.11n HT20, MCS2	0.33	4.0	x
38	5190	802.11n HT40, MCS0	-1.95	4.0	x
44	5220	802.11a, 12Mbps	-0.66	4.0	x
		802.11n HT20, MCS1	-0.60	4.0	x
46	5230	802.11n HT40, MCS0	-4.22	4.0	x
48	5240	802.11a, 12Mbps	-1.27	4.0	x
		802.11n HT20, MCS0	-0.58	4.0	x

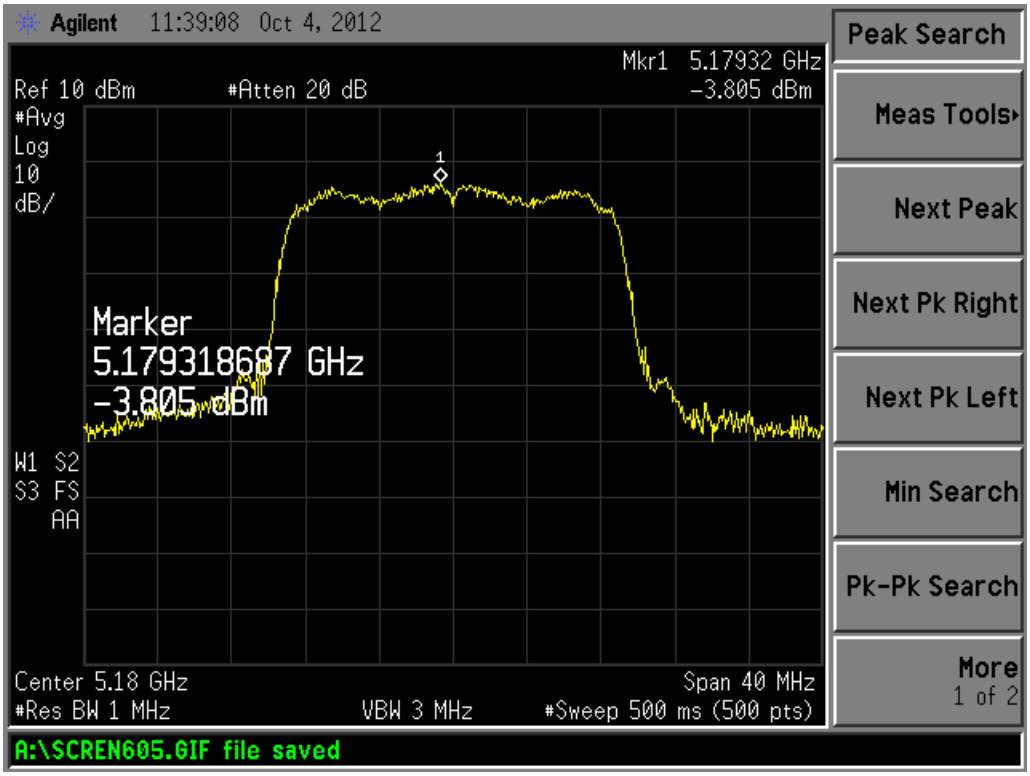
Note: PSD measurement above corrected for dual antenna port product.

6.8 Test Data/Plots: Antenna 0

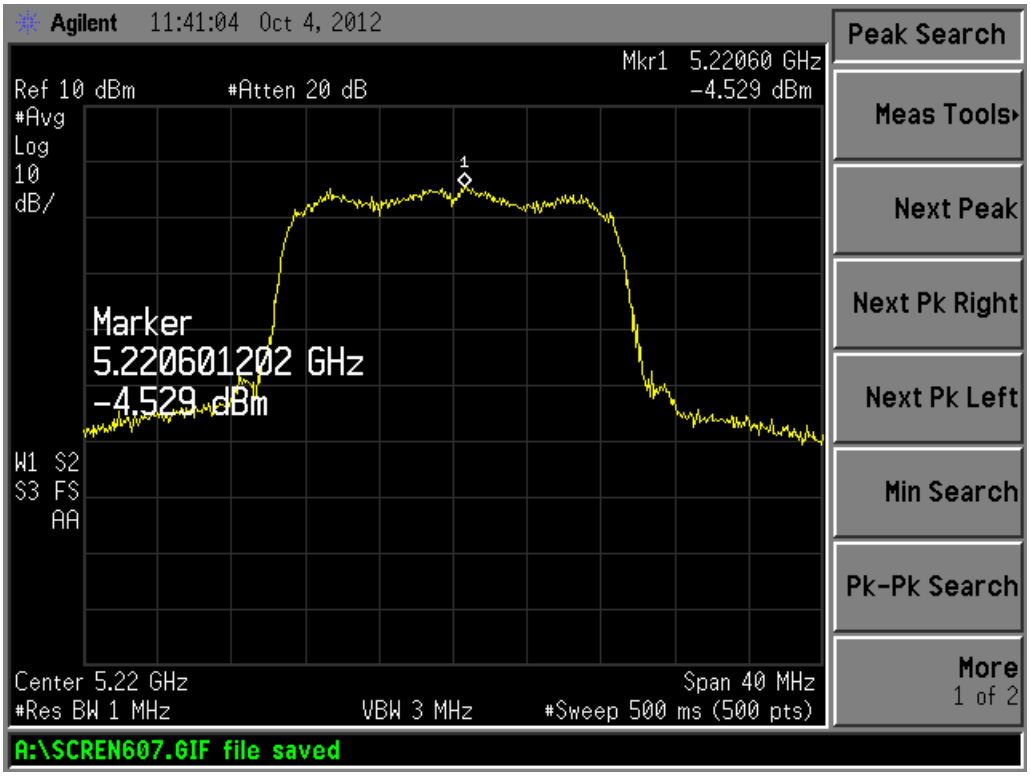
Channels 5150 to 5250 MHz - FCC Part 15.407(a)(1)
(Peak Power Spectral Density – PPSD – Antenna 0)

802.11a – OFDM Modulation Mode

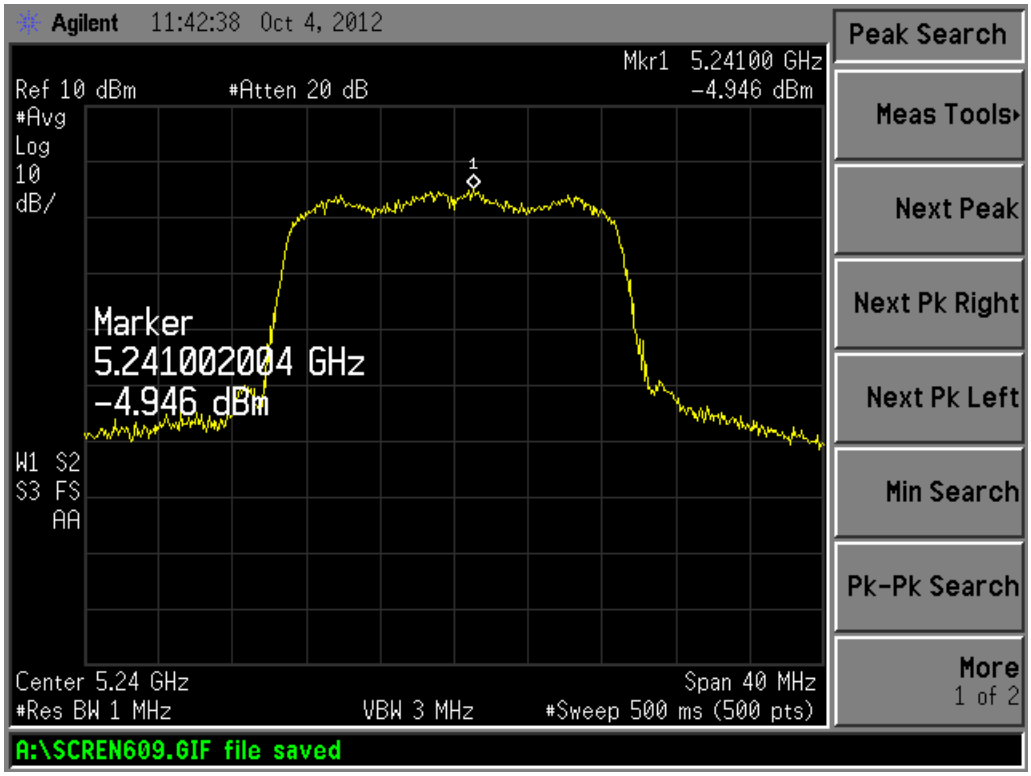
Channel 36



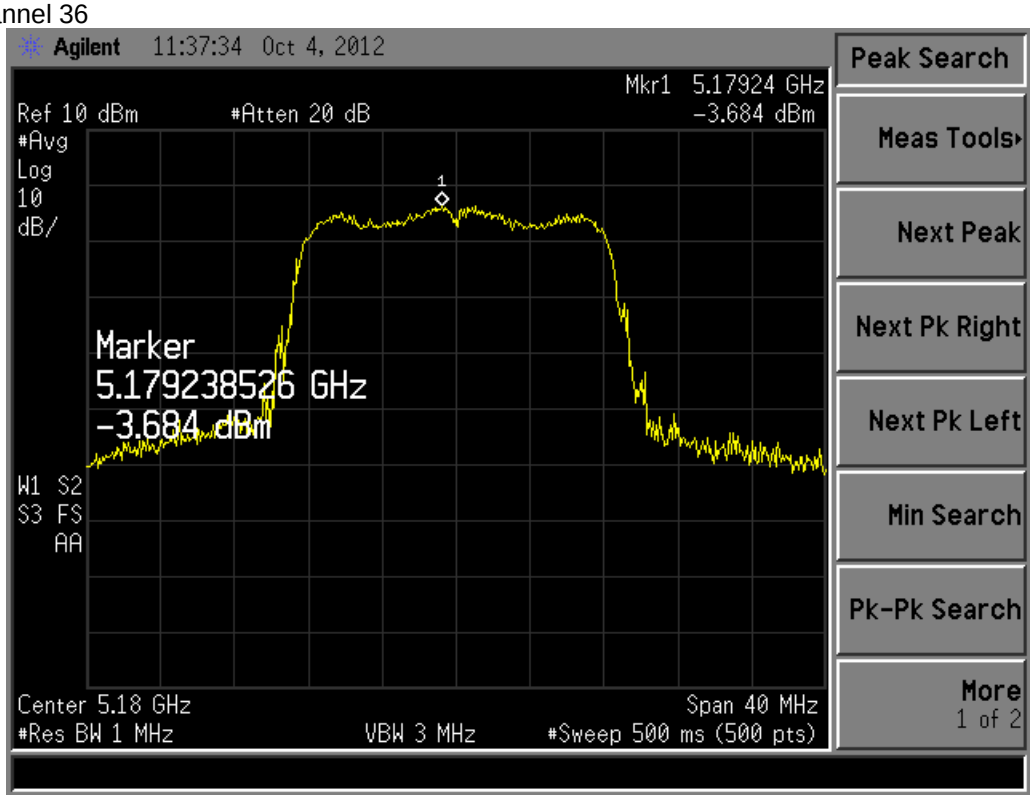
Channel 44



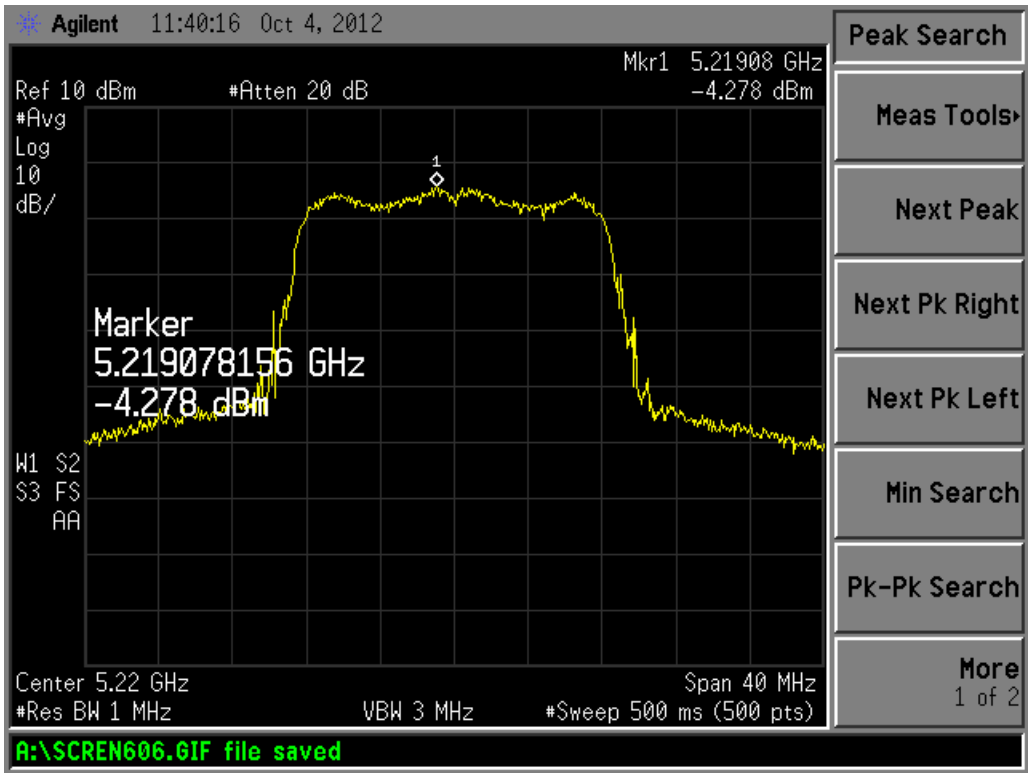
Channel 48


Agilent 11:42:38 Oct 4, 2012
Mkr1 5.24100 GHz
-4.946 dBm
Ref 10 dBm
#Atten 20 dB
#Avg
Log
10
dB/
Marker
5.241002004 GHz
-4.946 dBm
W1 S2
S3 FS
AA
Center 5.24 GHz
#Res BW 1 MHz
VBW 3 MHz
Span 40 MHz
#Sweep 500 ms (500 pts)
A:\SCREN609.GIF file saved
Peak Search
Meas Tools
Next Peak
Next Pk Right
Next Pk Left
Min Search
Pk-Pk Search
More
1 of 2

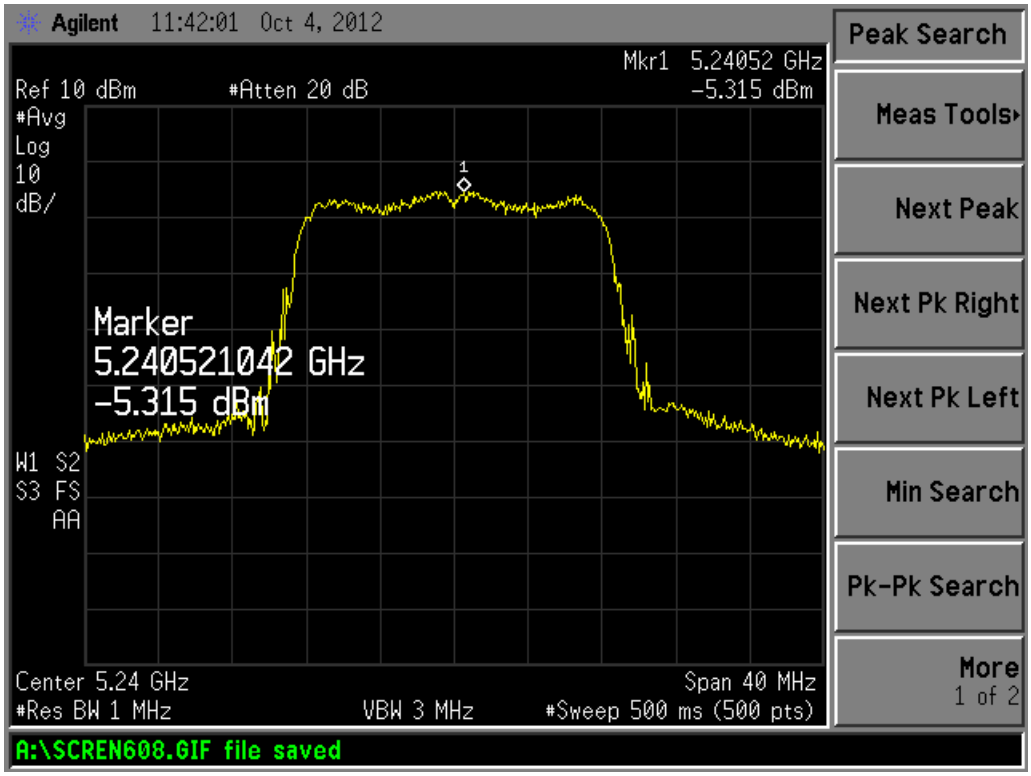
802.11n HT20 – MCS Modulation Mode
*Channel 36



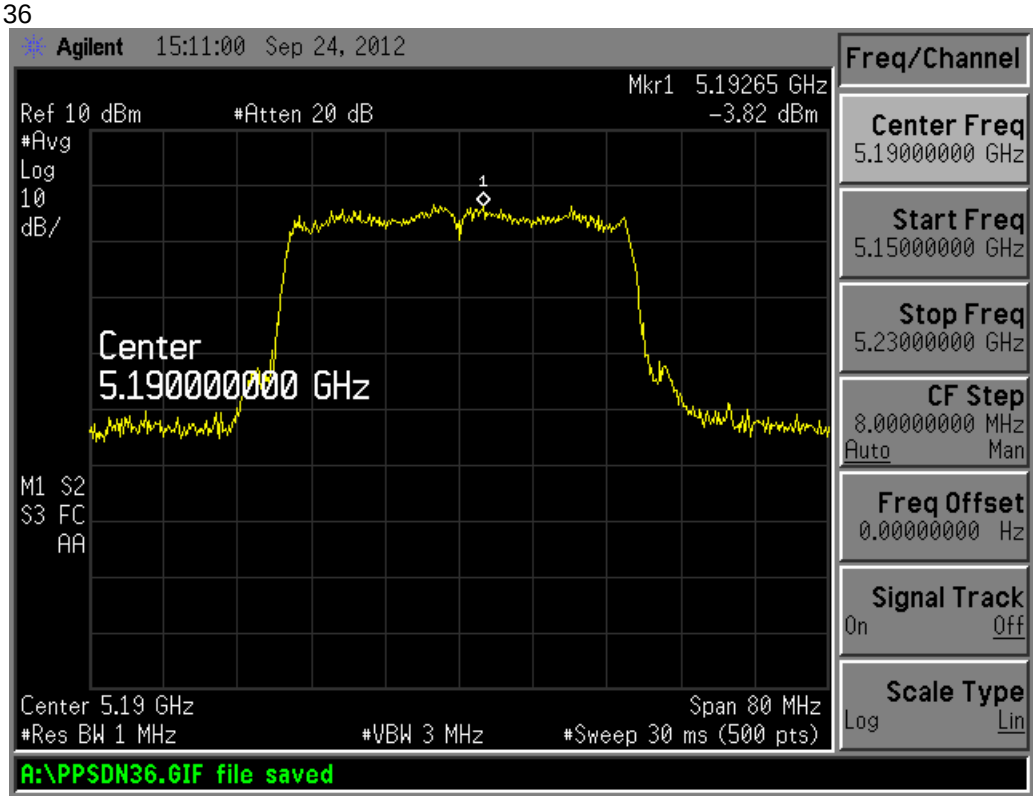
Channel 44



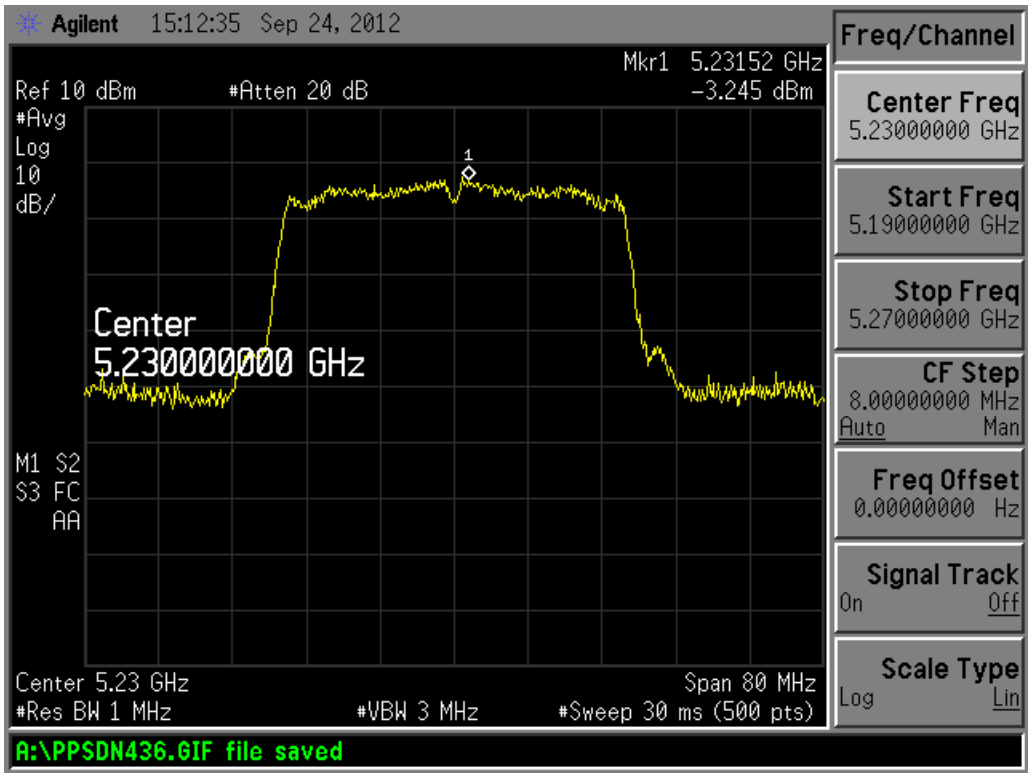
Channel 48


Agilent 11:42:01 Oct 4, 2012
Mkr1 5.24052 GHz
-5.315 dBm
Ref 10 dBm
#Atten 20 dB
#Avg
Log
10
dB/
Marker
5.240521042 GHz
-5.315 dBm
W1 S2
S3 FS
AA
Center 5.24 GHz
#Res BW 1 MHz
VBW 3 MHz
Span 40 MHz
#Sweep 500 ms (500 pts)
A:\SCREN608.GIF file saved
Peak Search
Meas Tools
Next Peak
Next Pk Right
Next Pk Left
Min Search
Pk-Pk Search
More
1 of 2

802.11n HT40 MCS Modulation Mode
Channel 36



Channel 44



Per FCC Guidance Document: 662911 D01 Multiple Transmitter Output: 10/25/2011

"In-Band Power Spectral Density (PSD) Measurements" – Method 2
Measure and add 10 log(N) dB to each spectrum value before comparing to the emissions limit, where "N" is the number of outputs. Summing the spectra across the outputs is not required.

There are (2) antenna ports on the product under test. Therefore, 10 log(2) dB = 3.01dB

The worst-case measured PSD: 802.11n HT20 MCS Modulation Mode, Channel 36
(-3.68dBm)

FCC Part 15.407(a)(1) PSD Limit: +4.00 dBm in any 1MHz band (Antenna directional gains ≤ 6dBi)

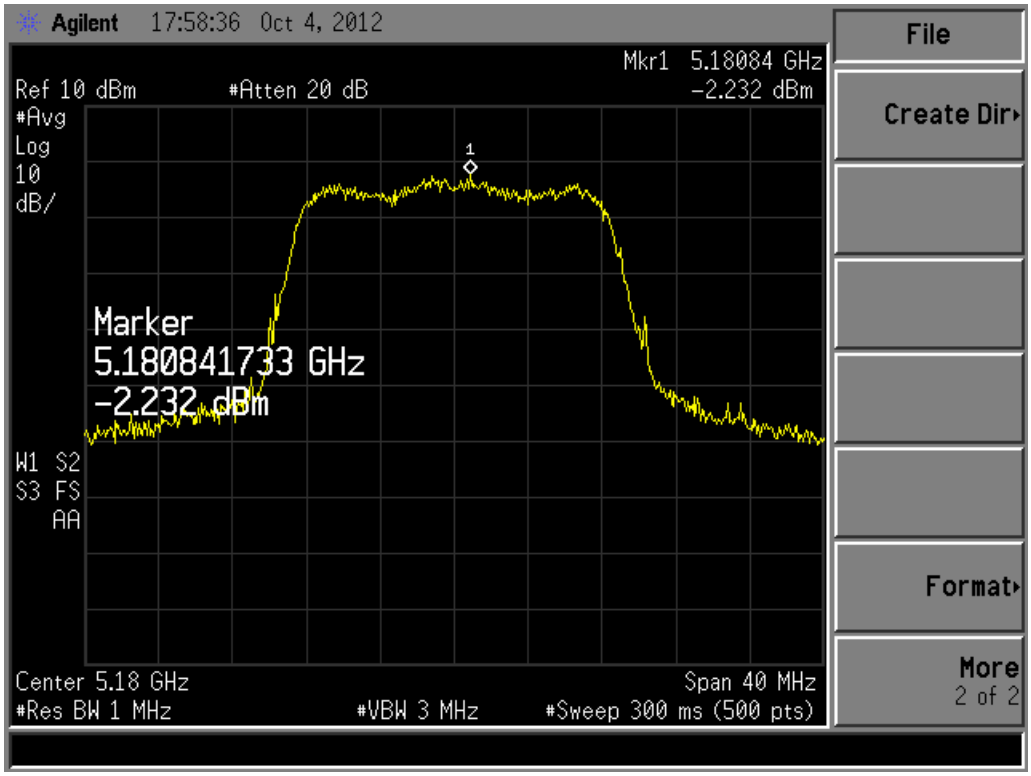
Therefore, -3.68 dBm + 3.01 dBm = -0.67 dBm (4.67 dB under the limit)

6.9 Test Data/Plots: Antenna 1

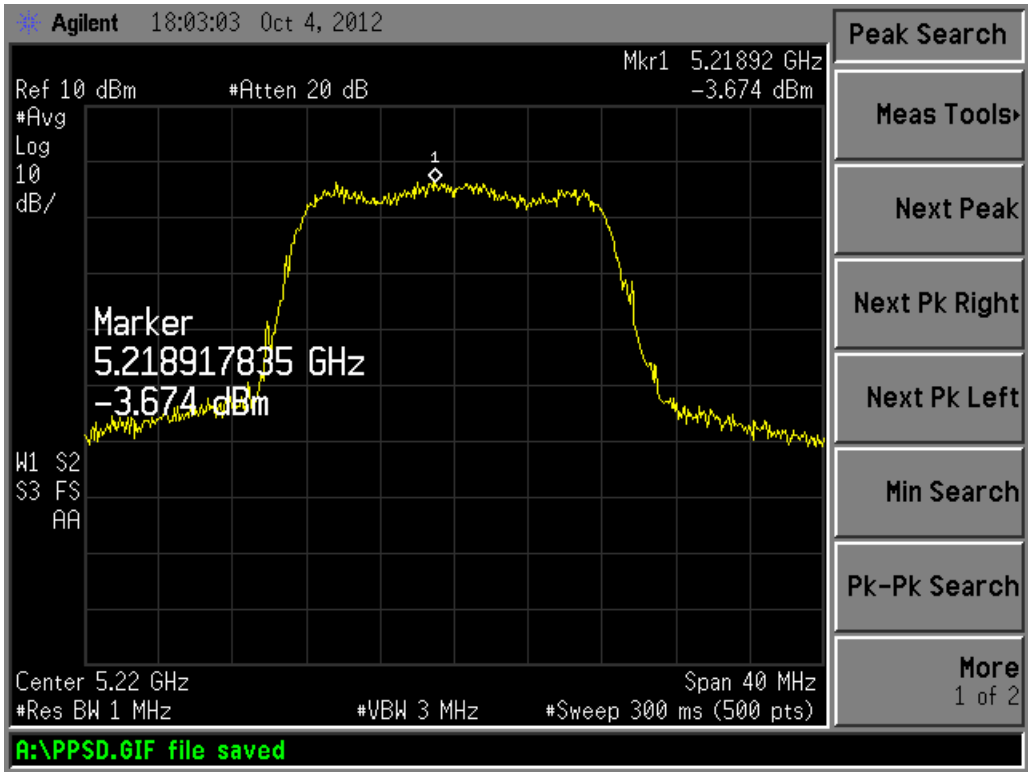
Channels 5150 to 5250 MHz - FCC Part 15.407(a)(1)
(Peak Power Spectral Density – PPSD – Antenna 1)

802.11a – OFDM Modulation Mode

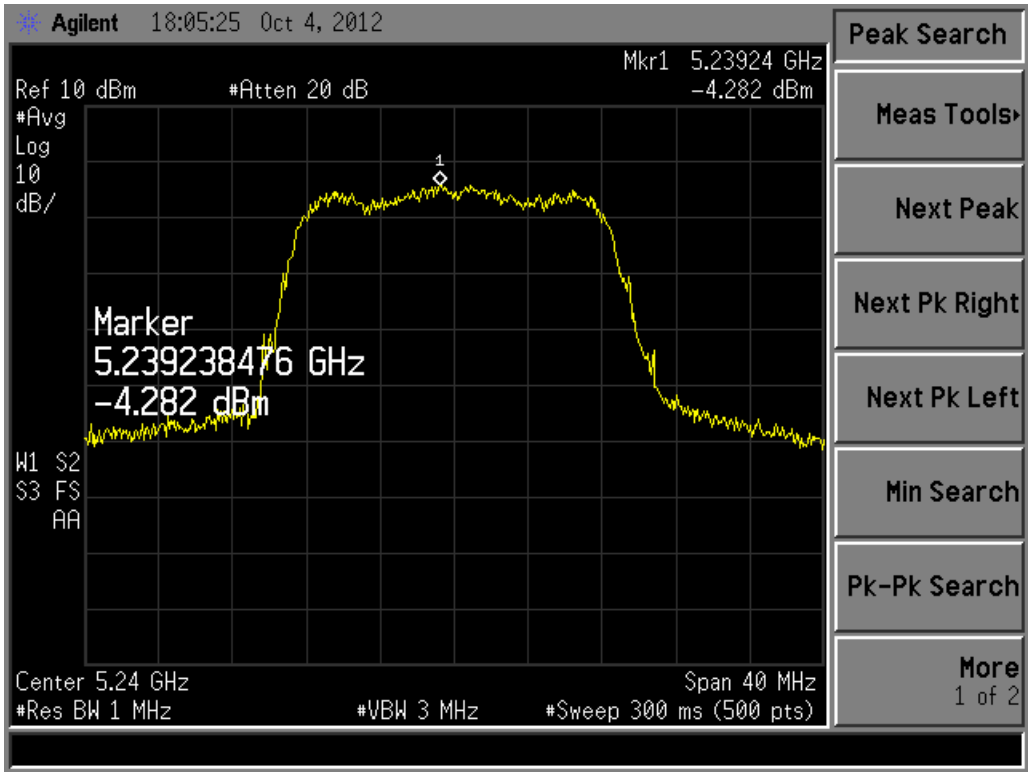
*Channel 36



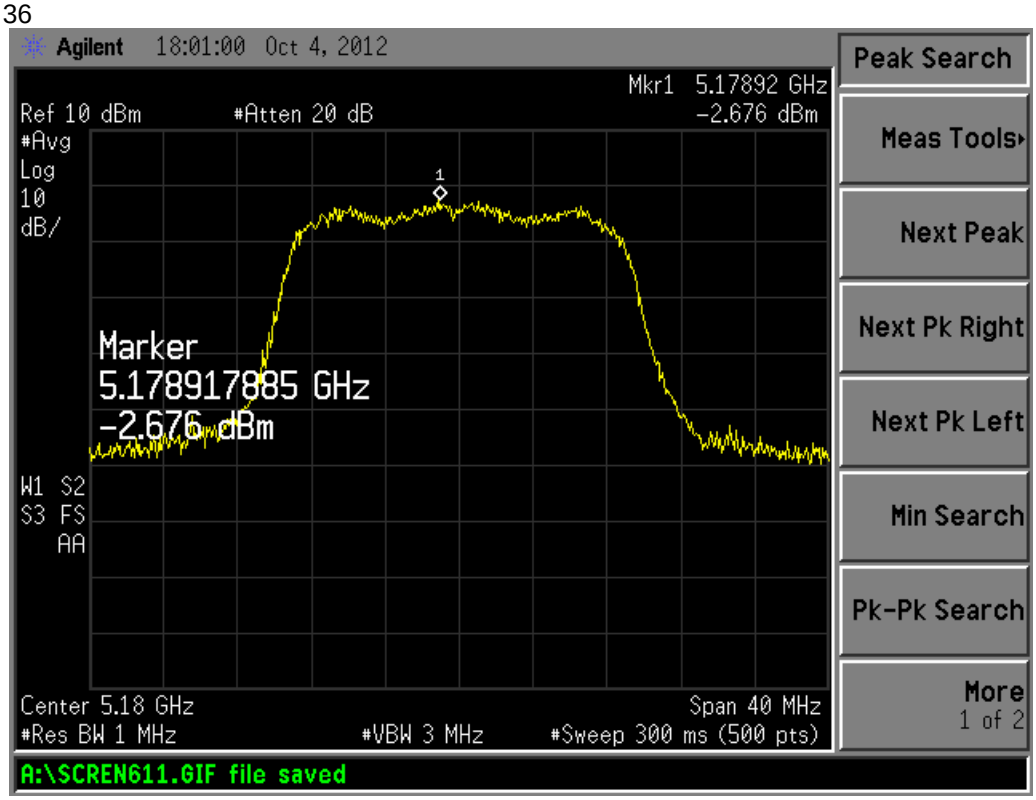
Channel 44



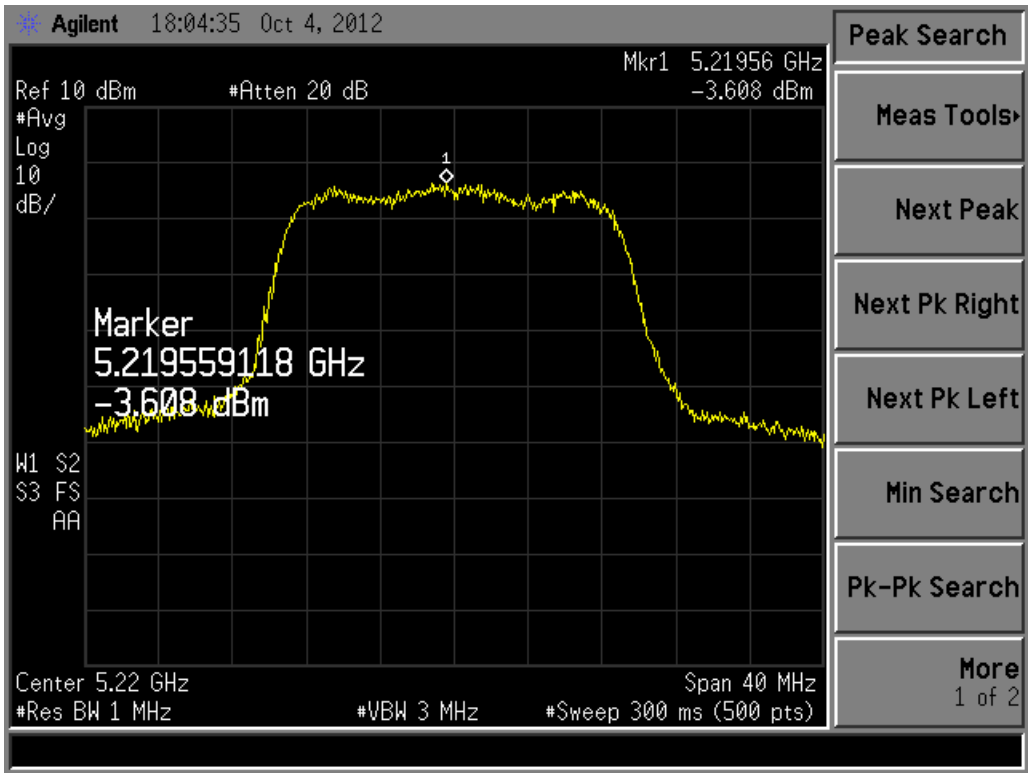
Channel 48


Agilent 18:05:25 Oct 4, 2012
Mkr1 5.23924 GHz
-4.282 dBm
Ref 10 dBm
#Atten 20 dB
#Avg
Log
10
dB/
Marker
5.239238476 GHz
-4.282 dBm
W1 S2
S3 FS
AA
Center 5.24 GHz
#Res BW 1 MHz
#VBW 3 MHz
Span 40 MHz
#Sweep 300 ms (500 pts)
Peak Search
Meas Tools
Next Peak
Next Pk Right
Next Pk Left
Min Search
Pk-Pk Search
More
1 of 2

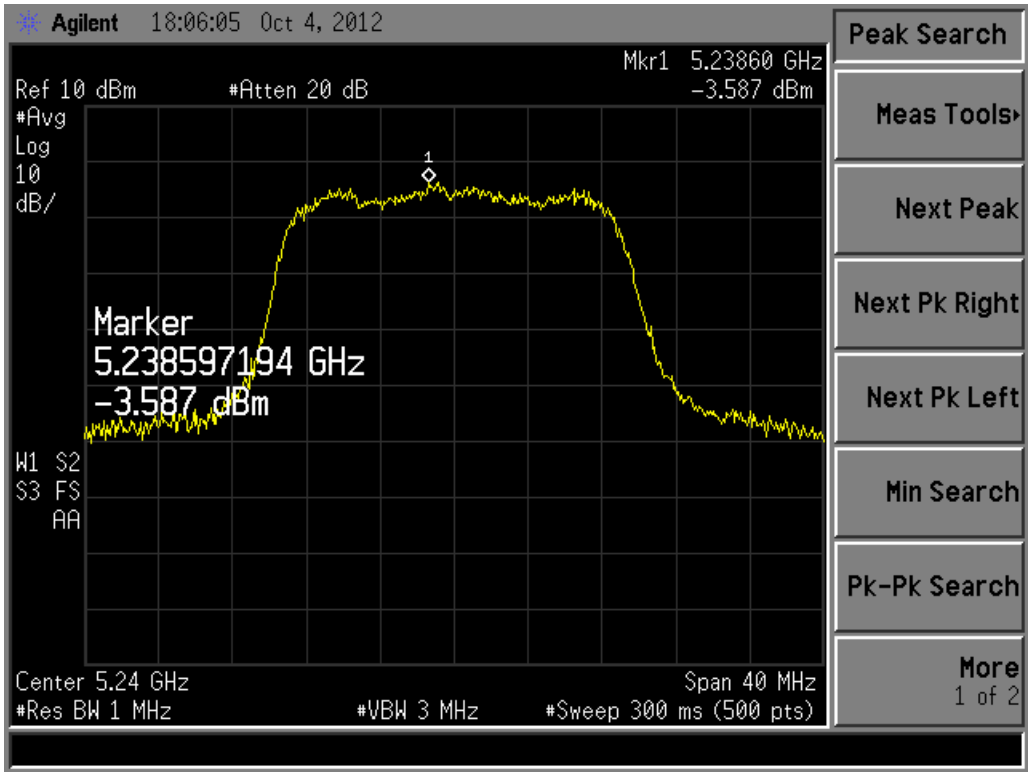
802.11n HT20 – MCS Modulation Mode
Channel 36



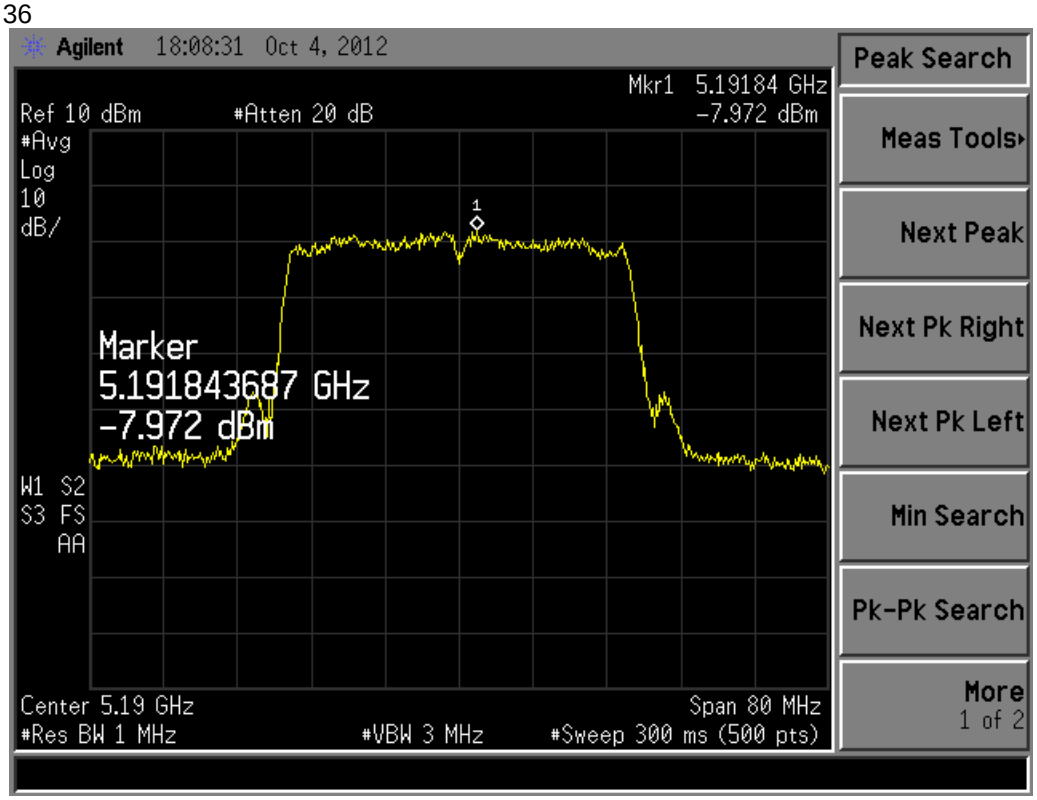
Channel 44



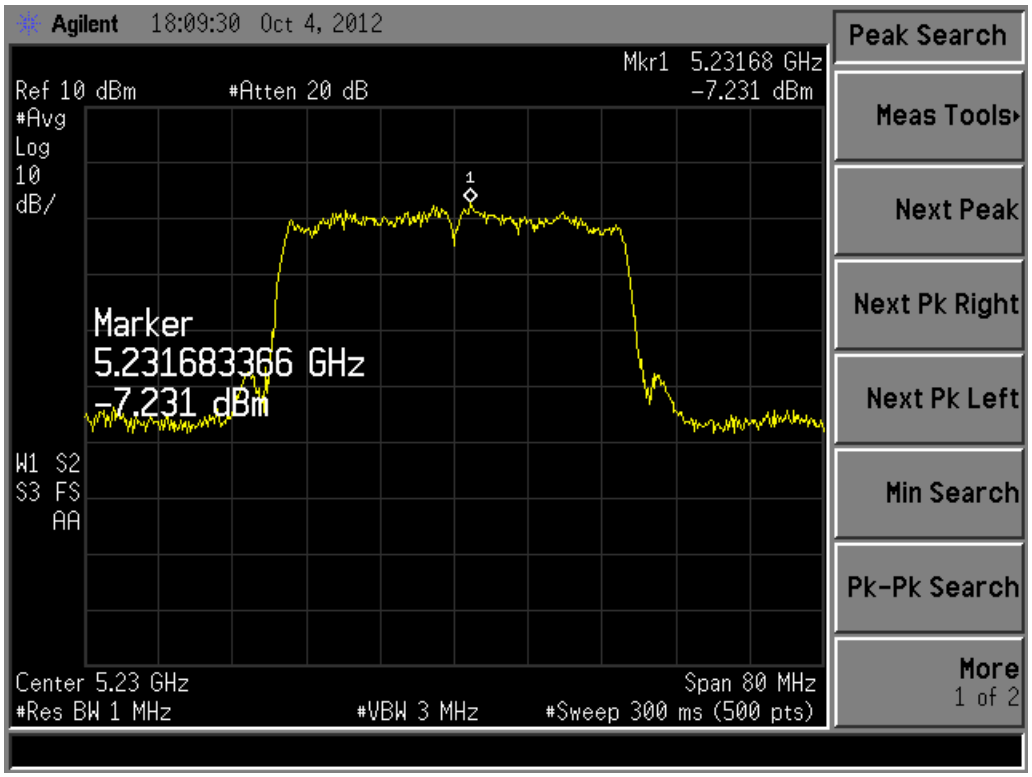
Channel 48


Agilent 18:06:05 Oct 4, 2012
Mkr1 5.23860 GHz
-3.587 dBm
Ref 10 dBm
#Atten 20 dB
#Avg
Log
10
dB/
Marker
5.238597194 GHz
-3.587 dBm
W1 S2
S3 FS
AA
Center 5.24 GHz
Span 40 MHz
#Res BW 1 MHz
#VBW 3 MHz
#Sweep 300 ms (500 pts)
Peak Search
Meas Tools
Next Peak
Next Pk Right
Next Pk Left
Min Search
Pk-Pk Search
More
1 of 2

802.11n HT40 MCS Modulation Mode
Channel 36



Channel 44



Per FCC Guidance Document: 662911 D01 Multiple Transmitter Output: 10/25/2011

"In-Band Power Spectral Density (PSD) Measurements" – Method 2
Measure and add 10 log(N) dB to each spectrum value before comparing to the emissions limit, where "N" is the number of outputs. Summing the spectra across the outputs is not required.

There are (2) antenna ports on the product under test. Therefore, 10 log(2) dB = 3.01dB

The worst-case measured PSD: 802.11a OFDM Modulation Mode, Channel 36
(-2.23 dBm)

FCC 15.407(a)(1) PSD Limit: +4.00 dBm in any 1MHz band
(Antenna directional gains ≤ 6dBi)

Therefore, -2.23 dBm + 3.01 dBm = 0.78 dBm (3.22 dB under the limit)

6.10 Peak Excursion Ratio of Modulation Envelope

6.11 Method

Unless otherwise stated no deviations were made from FCC Part 15.407(a)(6)

This testing was performed at Intertek Denver, located at 1795 Dogwood St. Suite 200, Louisville, CO 80027.

6.12 Test Equipment Used:

Asset ID	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
18913	Spectrum Analyzer	Hewlett-Packard	E7405A	My44211889	7/16/2012	7/16/2013
E1	RF Conducted Port Cable	-----	45-7221-19	001	09/12/2012	09/12/2013

6.13 Test Requirements:

The Ratio of the peak excursion of the modulation envelope to the maximum conducted output power shall not exceed 13 dB across any 1 MHz bandwidth.

6.14 Test Procedure:

The antenna port of the EUT was connected to the input of a spectrum analyzer to measure the Ratio of the Peak Excursion of the modulation envelope.

The procedures described in FCC Publication 789033 (Guidelines for Compliance Testing on U-NII Devices) were used. The Peak Excursion measurement is the measured max peak hold of the spectrum using a Peak detector and max peak hold of the spectrum using the procedure of PPSD.
The difference between the peaks is the Ratio of the Peak Excursion of the modulation envelope.

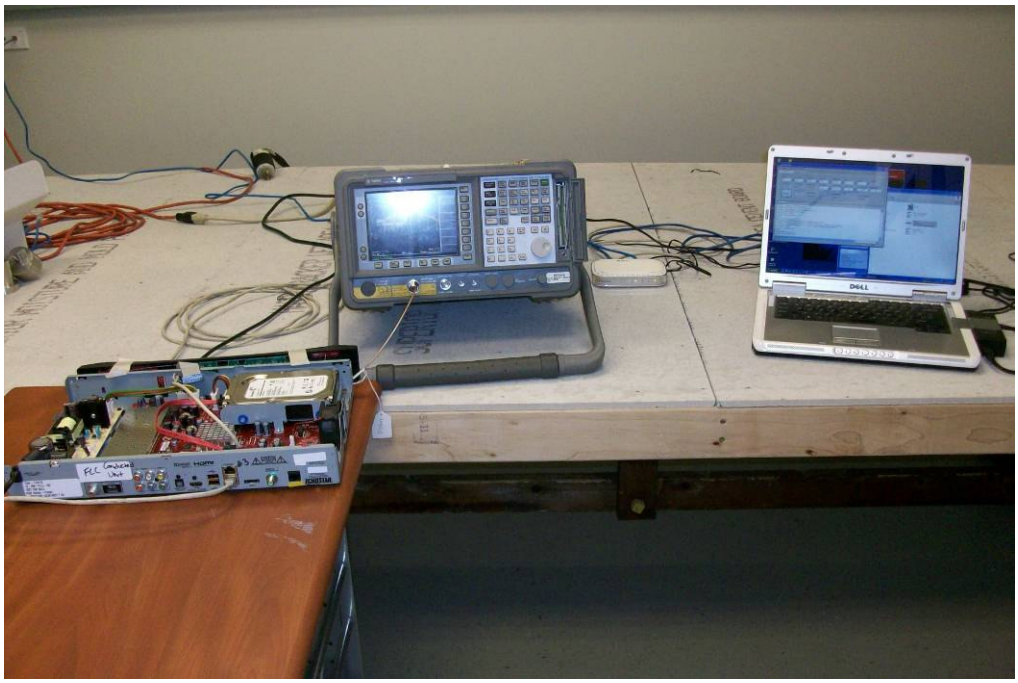
- Peak Excursion Measurement - Method F) and E)1)2)

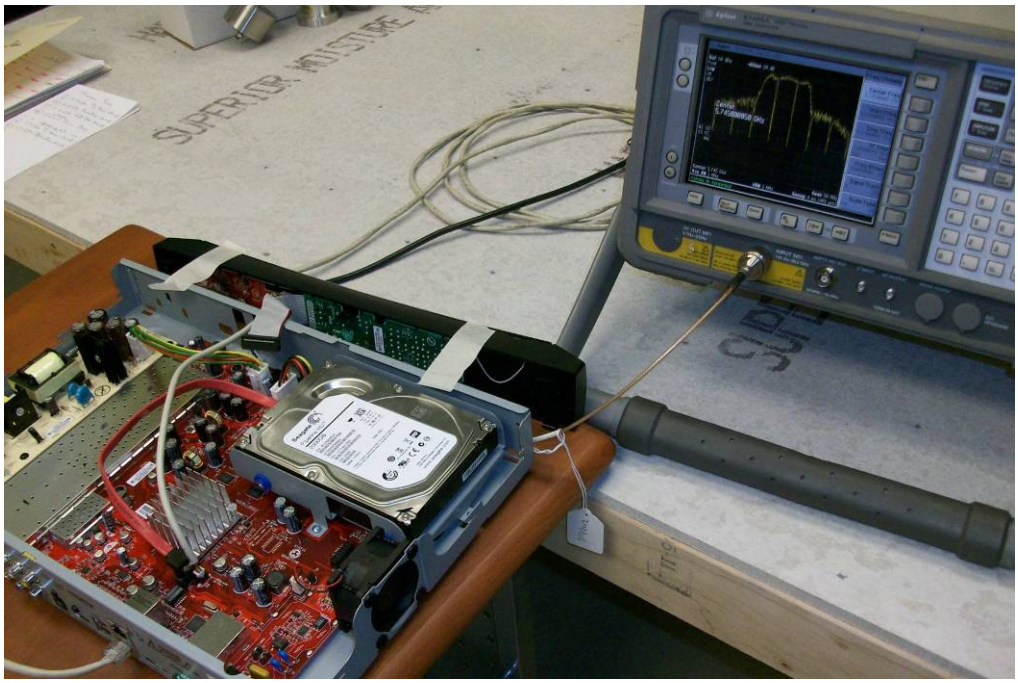
6.15 Test Results:

The sample tested was found to Comply.

6.16 Setup Photographs:

Peak Excursion - Test setup





6.17 Test Data Summary:

Peak Excursion Ratio of the Modulation Envelope – Antenna 0
FCC Part 15.407(a)(6)

Channel	Frequency, MHz	Standard/ Data Rate	Peak Excursion Ratio (dBm)	Peak Excursion Limit (dB)	Plot
36	5180	802.11a, 12Mbps	4.43	13.0	x
		802.11n HT20, MCS3	5.82	13.0	x
38	5190	802.11n HT40, MCS0	4.57	13.0	x
44	5220	802.11a, 9Mbps	5.36	13.0	x
		802.11n HT20, MCS1	5.48	13.0	x
46	5230	802.11n HT40, MCS0	5.14	13.0	x
48	5240	802.11a, 12Mbps	6.09	13.0	x
		802.11n HT20, MCS1	4.15	13.0	x

Peak Excursion Ratio of the Modulation Envelope – Antenna 1
FCC Part 15.407(a)(6)

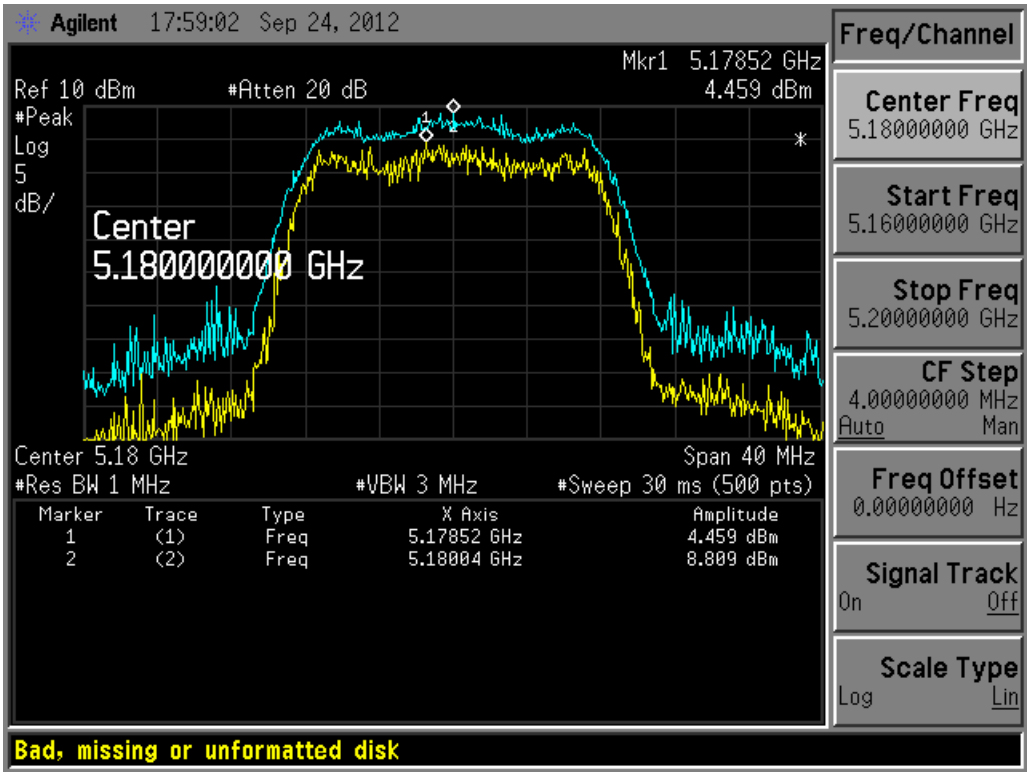
Channel	Frequency, MHz	Standard/ Data Rate	Peak Excursion Ratio (dBm)	Peak Excursion Limit (dB)	Plot
36	5180	802.11a, 12Mbps	4.27	13.0	x
		802.11n HT20, MCS2	6.82	13.0	x
38	5190	802.11n HT40, MCS0	5.88	13.0	x
44	5220	802.11a, 12Mbps	5.81	13.0	x
		802.11n HT20, MCS1	6.69	13.0	x
46	5230	802.11n HT40, MCS0	5.45	13.0	x
48	5240	802.11a, 12Mbps	6.74	13.0	x
		802.11n HT20, MCS0	5.65	13.0	x

Note: The above data summary tables represent the worst-case modulation/data rate combinations.

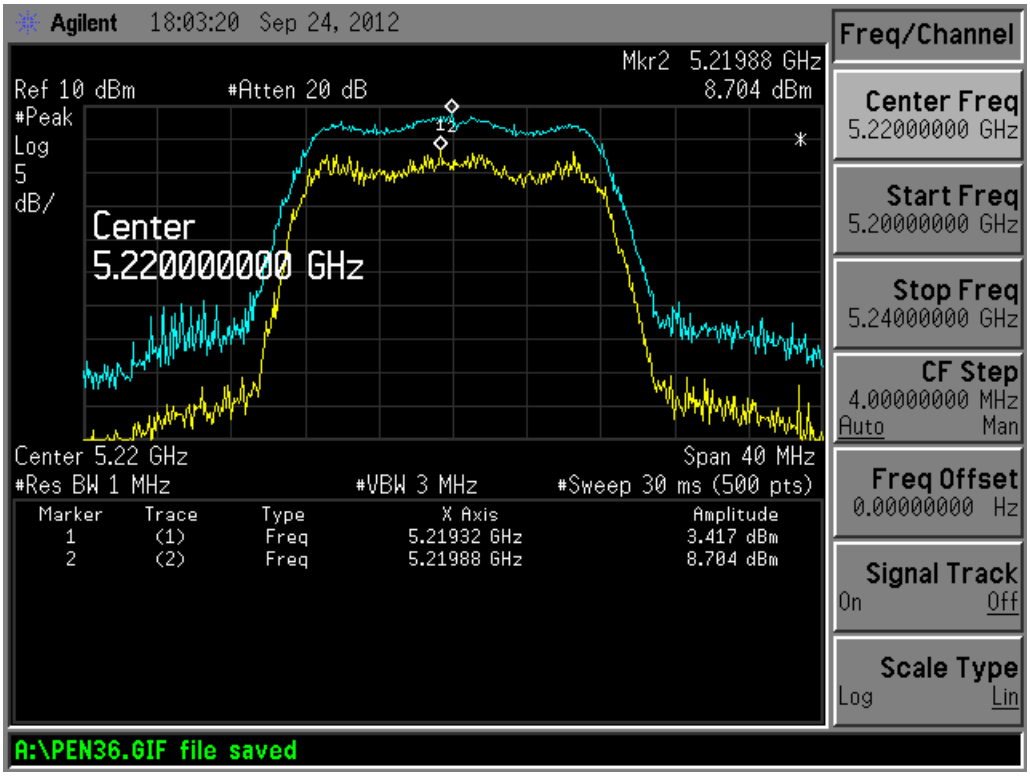
6.18 Test Data/Plots: Antenna 0

Channels 5150 to 5250 MHz - FCC Part 15.407(a)(6)
(Peak Excursion – Antenna 0)

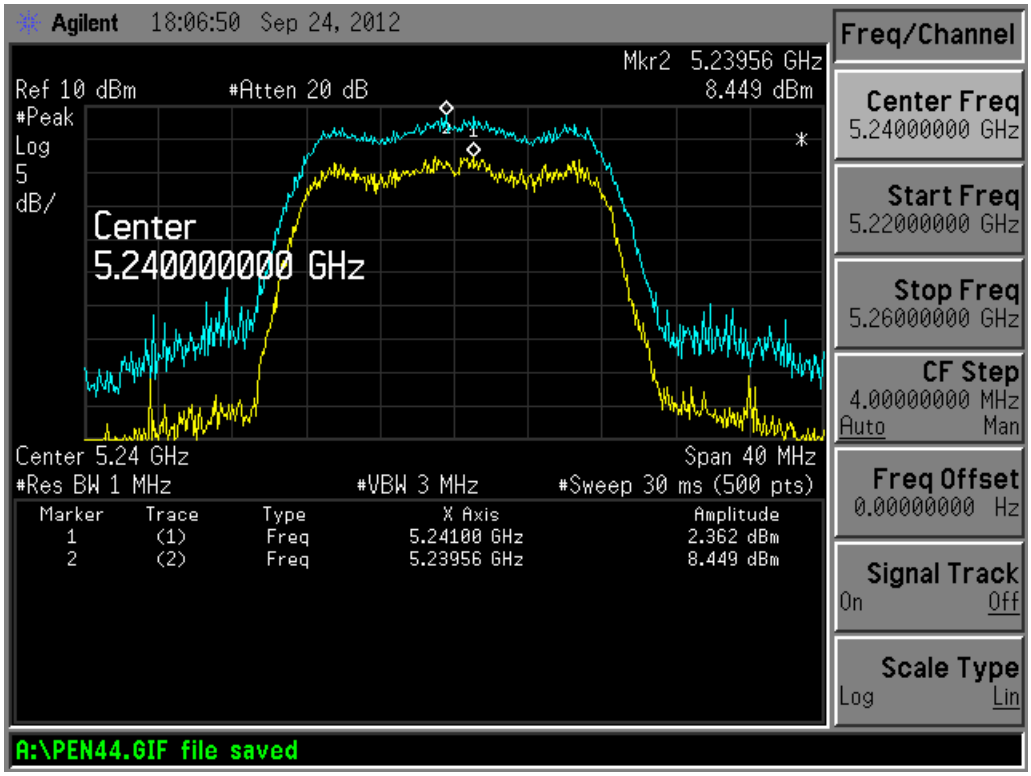
802.11a – OFDM Modulation Mode
Channel 36



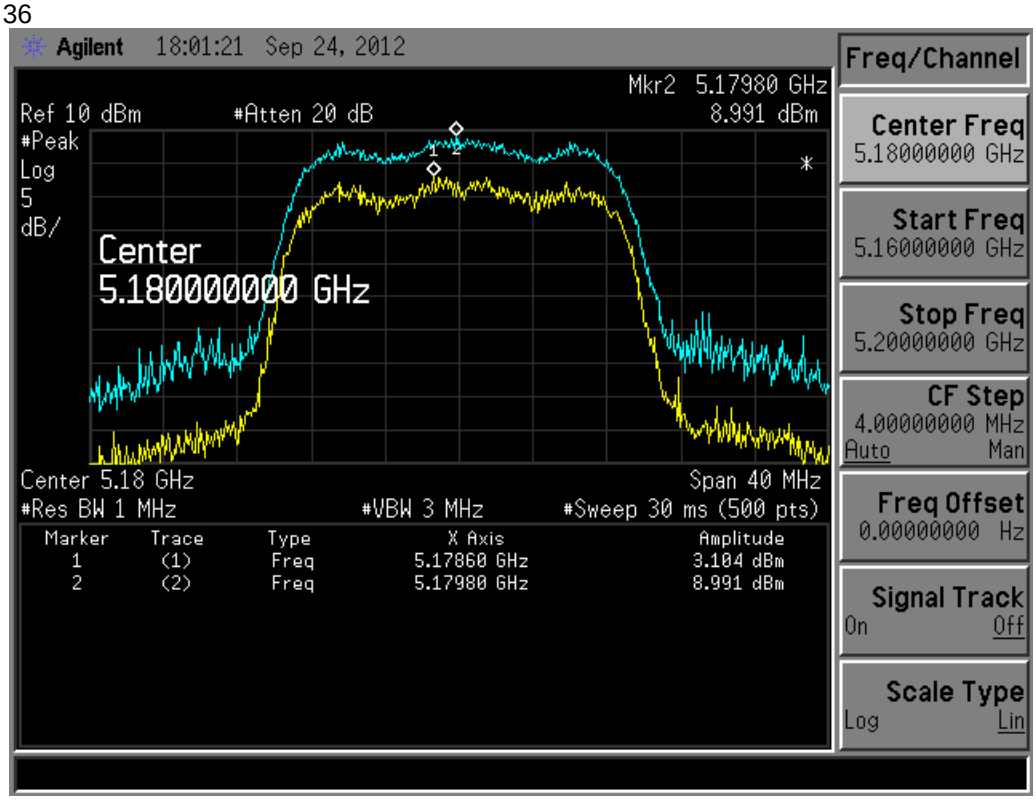
Channel 44



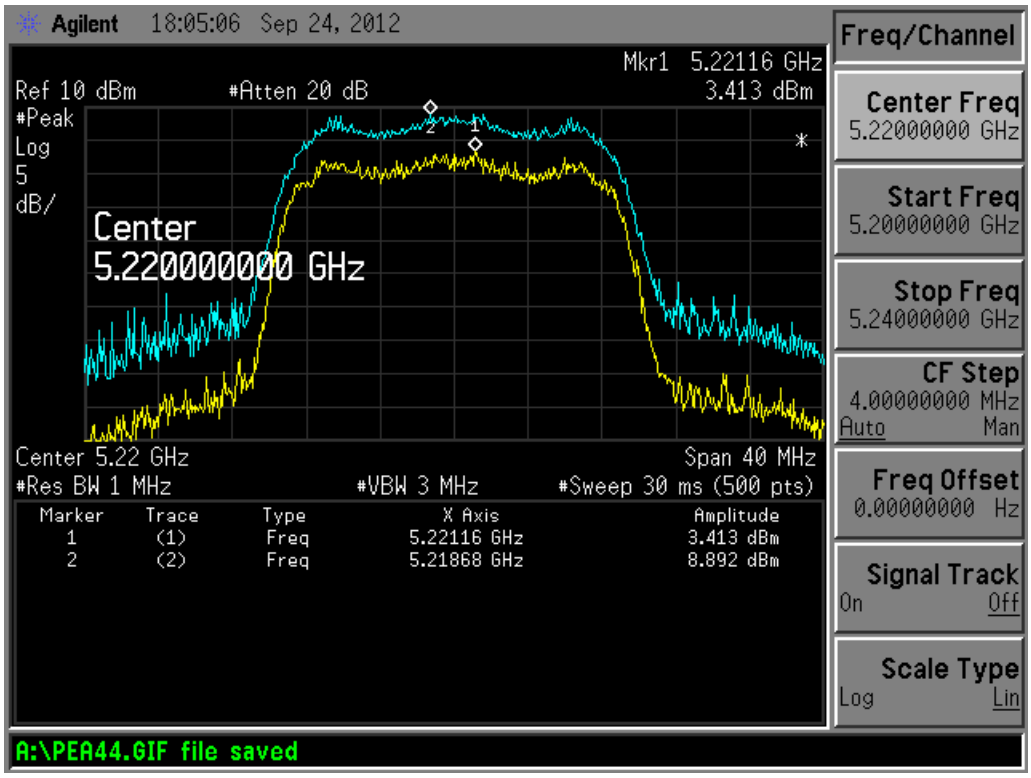
*Channel 48


Agilent 18:06:50 Sep 24, 2012
Mkr2 5.23956 GHz
Ref 10 dBm
#Atten 20 dB
8.449 dBm
#Peak
Log
5
dB/
Center
5.240000000 GHz
Center 5.24 GHz
Span 40 MHz
#Res BW 1 MHz
#VBW 3 MHz
#Sweep 30 ms (500 pts)
Marker Trace Type X Axis Amplitude
1 (1) Freq 5.24100 GHz 2.362 dBm
2 (2) Freq 5.23956 GHz 8.449 dBm
Freq/Channel
Center Freq
5.24000000 GHz
Start Freq
5.22000000 GHz
Stop Freq
5.26000000 GHz
CF Step
4.00000000 MHz
Auto Man
Freq Offset
0.00000000 Hz
Signal Track
On Off
Scale Type
Log Lin
A:\PEN44.GIF file saved

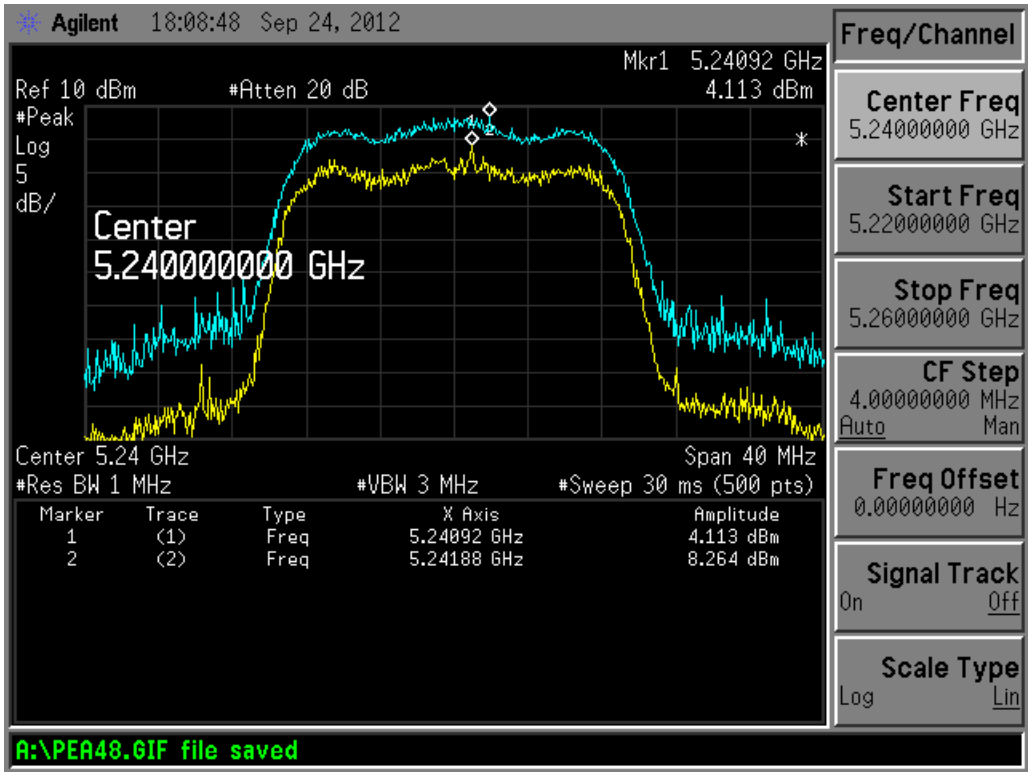
802.11n HT20 – MCS Modulation Mode
Channel 36



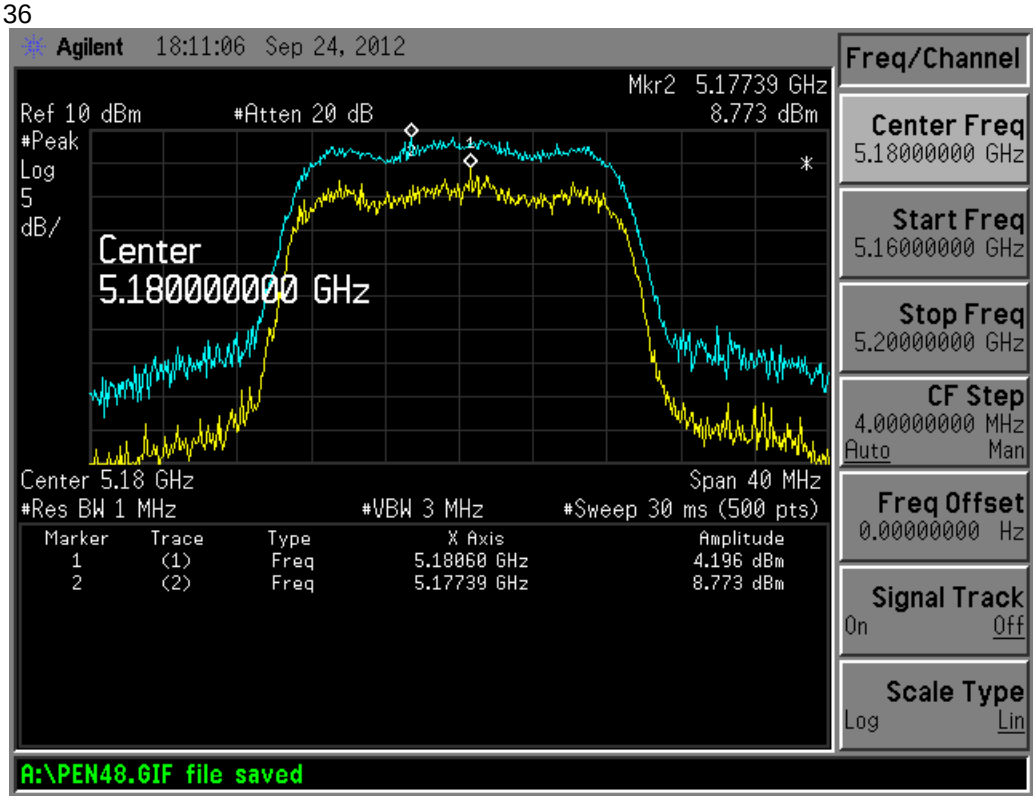
Channel 44



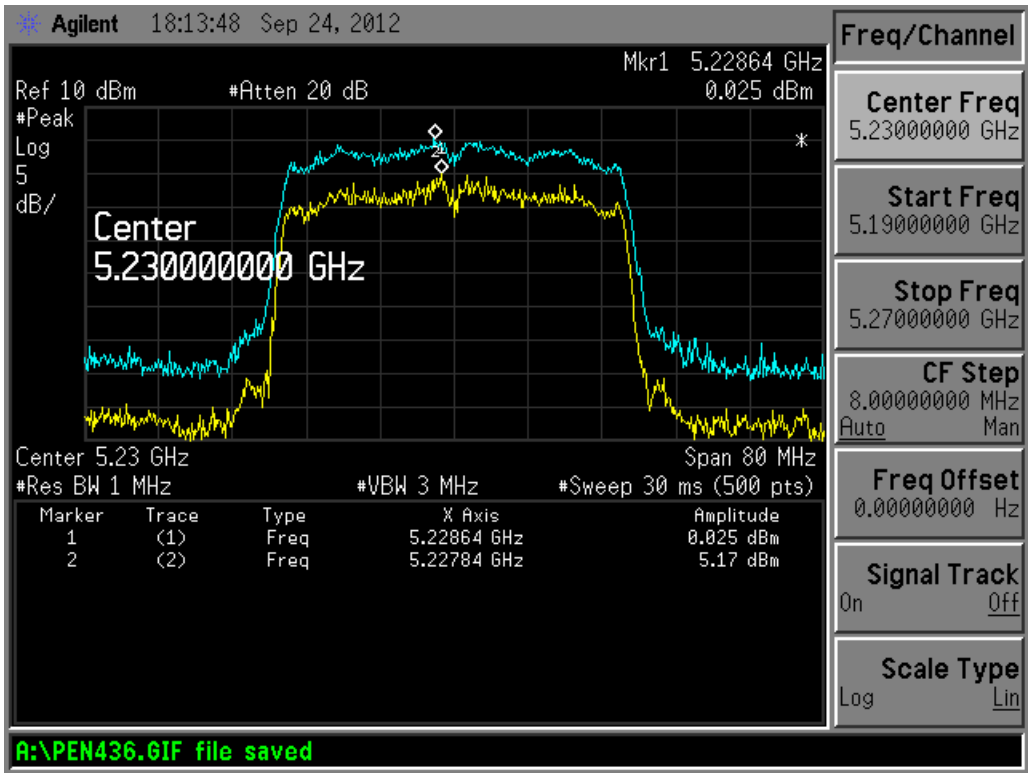
Channel 48


Agilent 18:08:48 Sep 24, 2012
Mkr1 5.24092 GHz
Ref 10 dBm
#Atten 20 dB
4.113 dBm
#Peak
Log
5
dB/
Center
5.240000000 GHz
Center 5.24 GHz
Span 40 MHz
#Res BW 1 MHz
#VBW 3 MHz
#Sweep 30 ms (500 pts)
Marker Trace Type X Axis Amplitude
1 (1) Freq 5.24092 GHz 4.113 dBm
2 (2) Freq 5.24188 GHz 8.264 dBm
Freq/Channel
Center Freq
5.24000000 GHz
Start Freq
5.22000000 GHz
Stop Freq
5.26000000 GHz
CF Step
4.00000000 MHz
Auto Man
Freq Offset
0.00000000 Hz
Signal Track
On Off
Scale Type
Log Lin
A:\PEA48.GIF file saved

802.11n HT40 MCS Modulation Mode
Channel 36



Channel 44



FCC Part 15.407(a)(6) Limit: 13dBm per 1MHz Bandwidth

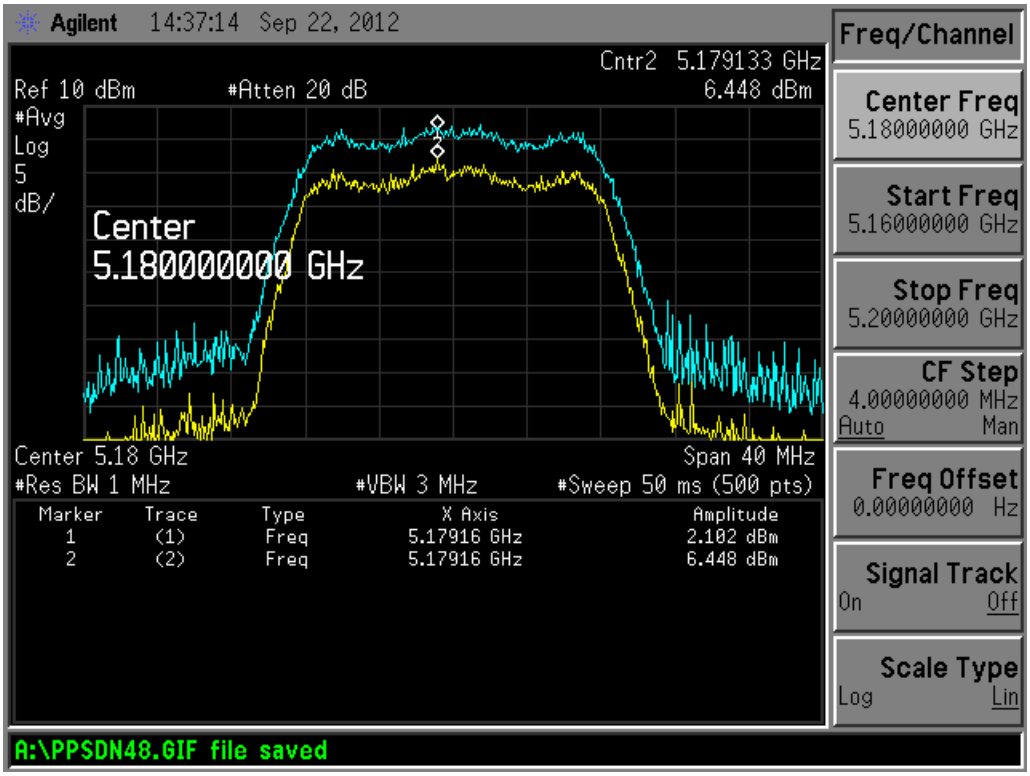
The worst-case peak excursion is: 802.11a – OFDM Modulation Mode, Channel 48
Peak Level: 8.45 dBm
RMS/Average Level: 2.36 dBm

Peak Excursion: 8.45dBm – 2.36 dBm = 6.09 dBm (6.91dB under limit)

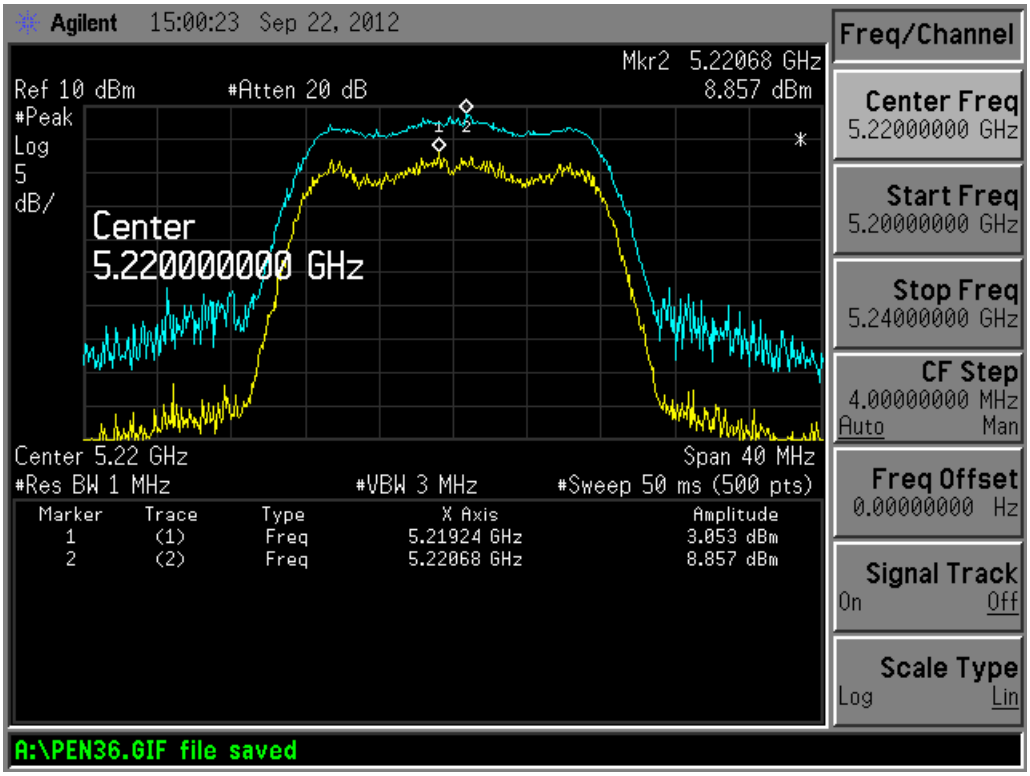
6.19 Test Data/Plots: Antenna 1

Channels 5150 to 5250 MHz - FCC Part 15.407(a)(6)
(Peak Excursion – Antenna 1)

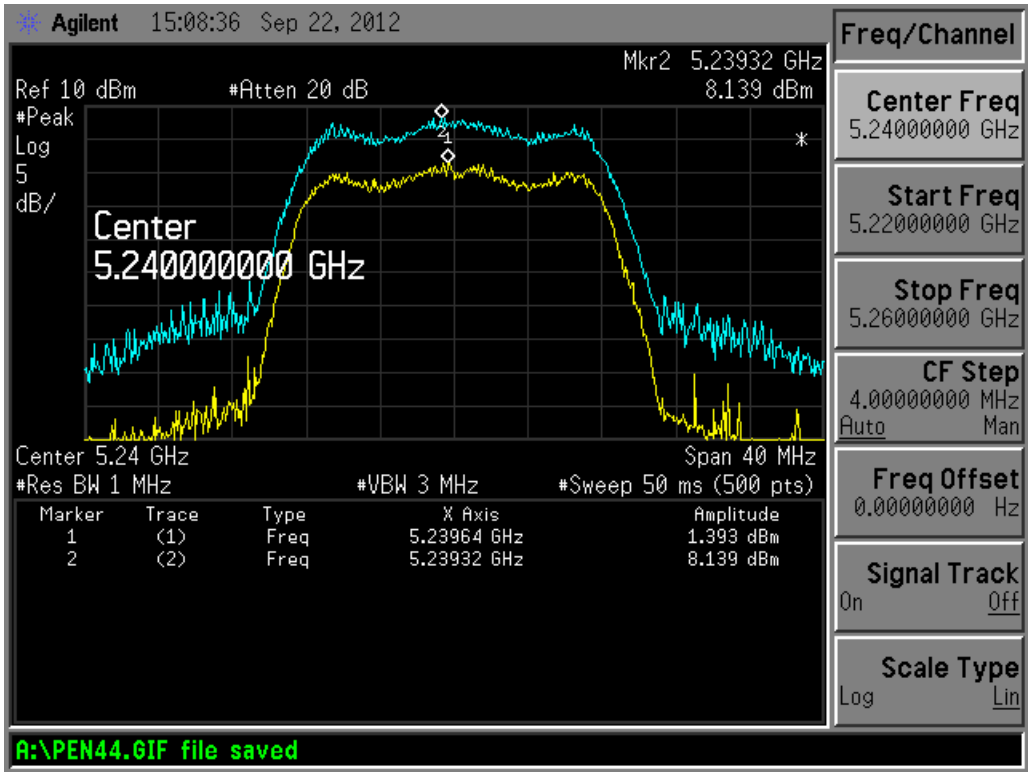
802.11a – OFDM Modulation Mode
Channel 36



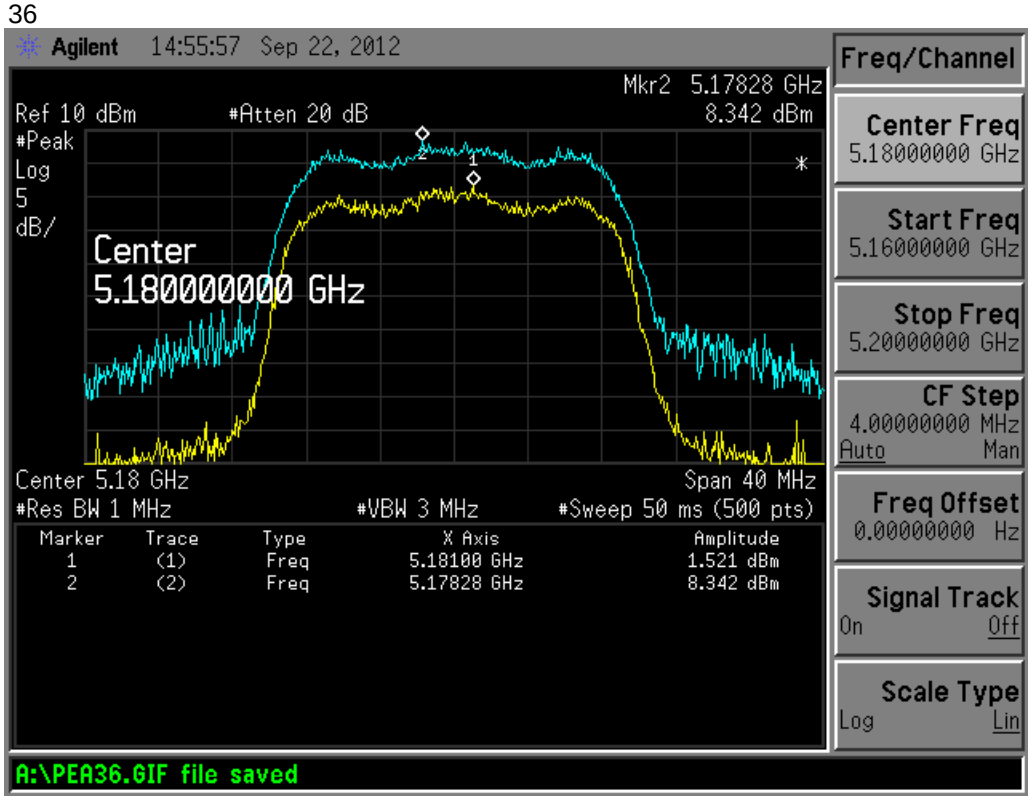
Channel 44



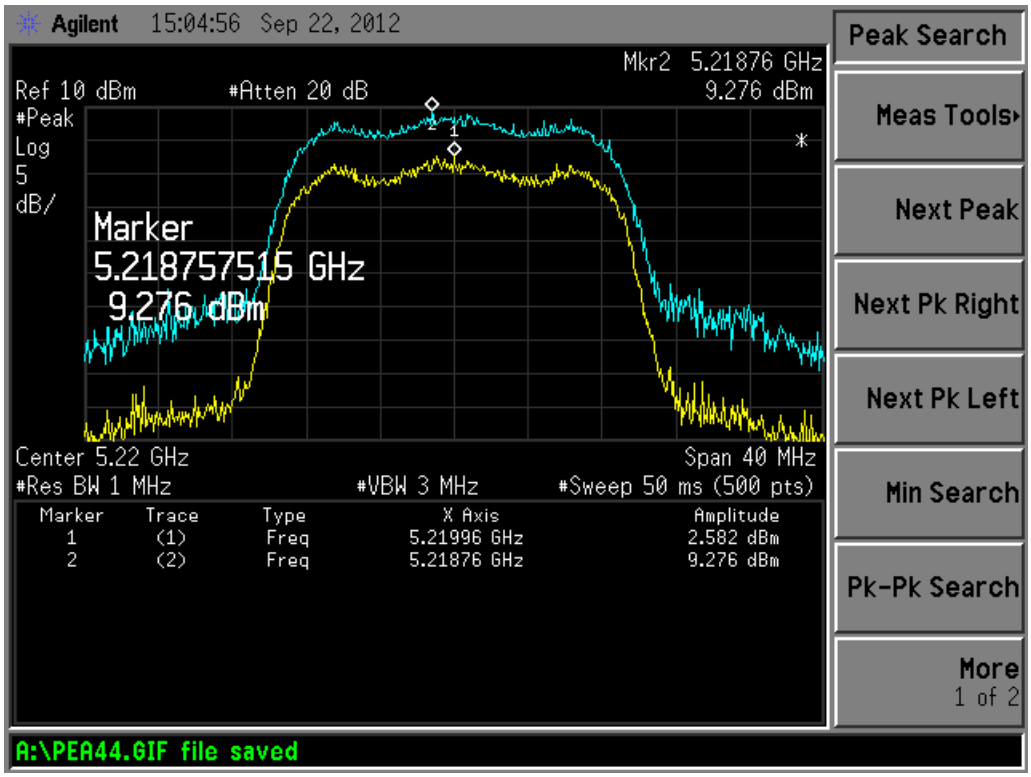
Channel 48


Agilent 15:08:36 Sep 22, 2012
Mkr2 5.23932 GHz
8.139 dBm
Ref 10 dBm
#Atten 20 dB
#Peak
Log
5
dB/
Center
5.240000000 GHz
Center 5.24 GHz
Span 40 MHz
#Res BW 1 MHz
#VBW 3 MHz
#Sweep 50 ms (500 pts)
Marker Trace Type X Axis Amplitude
1 (1) Freq 5.23964 GHz 1.393 dBm
2 (2) Freq 5.23932 GHz 8.139 dBm
Freq/Channel
Center Freq
5.24000000 GHz
Start Freq
5.22000000 GHz
Stop Freq
5.26000000 GHz
CF Step
4.00000000 MHz
Auto Man
Freq Offset
0.00000000 Hz
Signal Track
On Off
Scale Type
Log Lin
A:\PEN44.GIF file saved

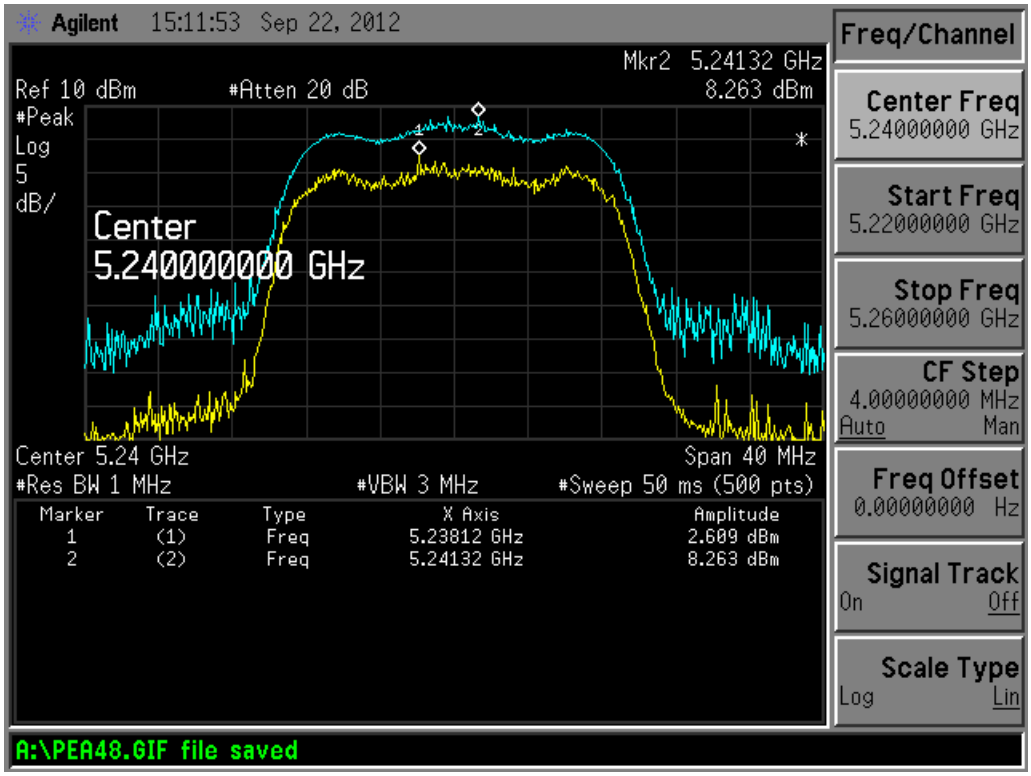
802.11n HT20 – MCS Modulation Mode
*Channel 36



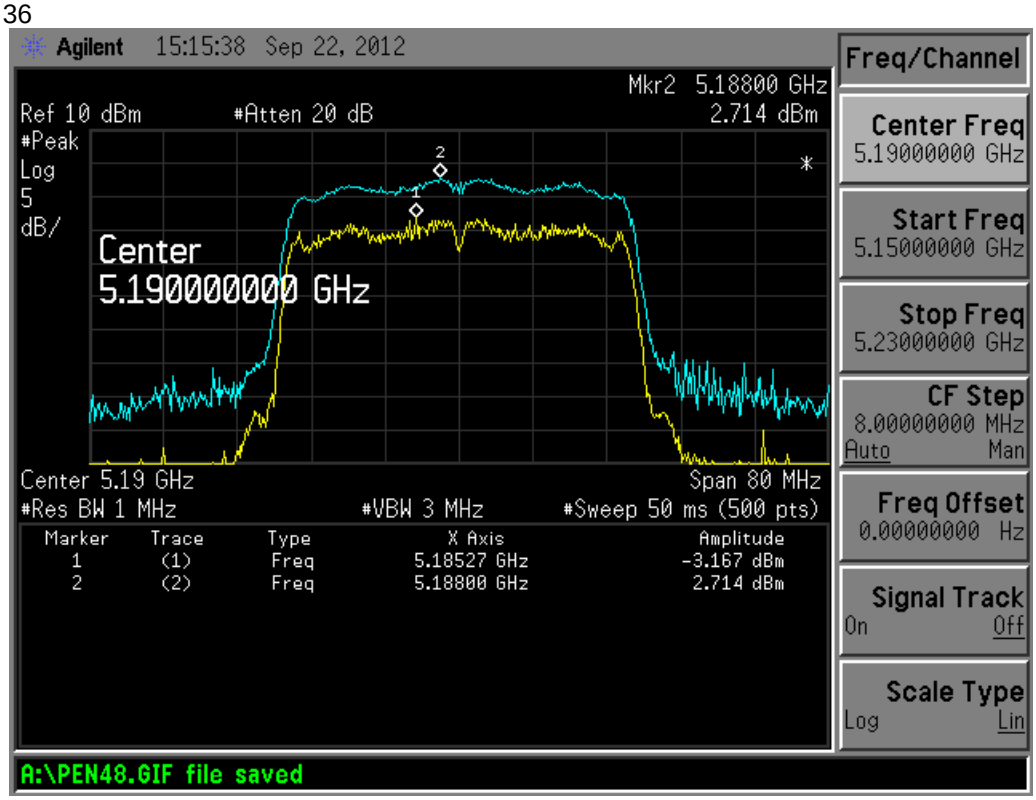
Channel 44



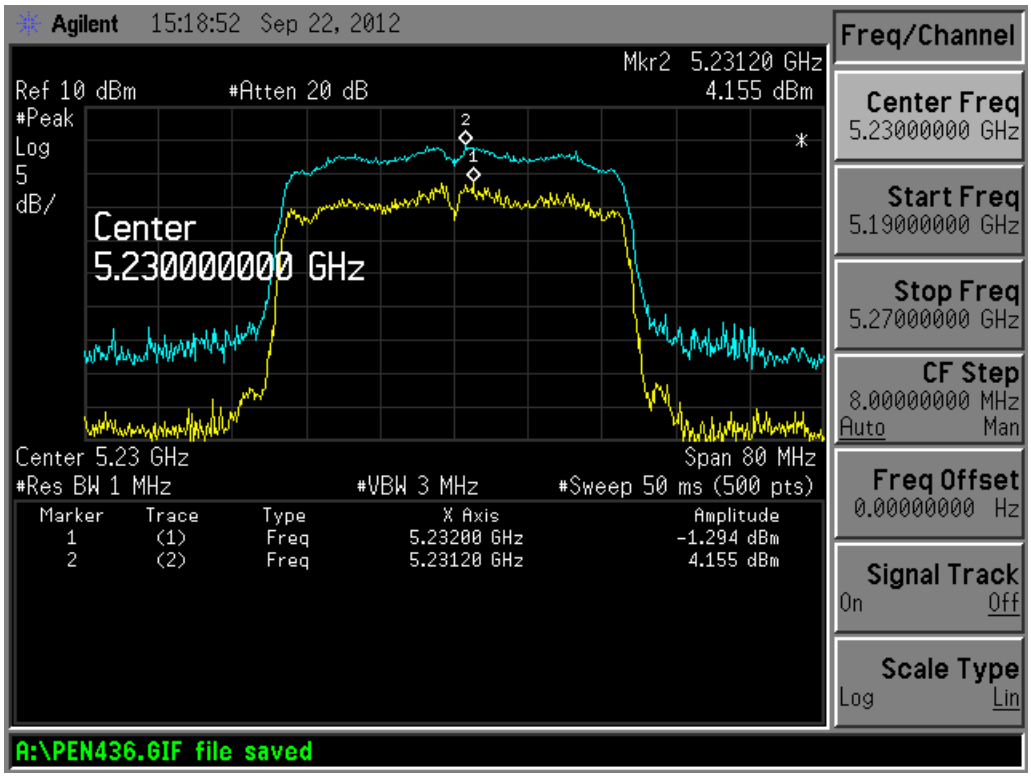
Channel 48


Agilent 15:11:53 Sep 22, 2012
Mkr2 5.24132 GHz
Ref 10 dBm
#Atten 20 dB
8.263 dBm
#Peak
Log
5
dB/
Center
5.240000000 GHz
Center 5.24 GHz
Span 40 MHz
#Res BW 1 MHz
#VBW 3 MHz
#Sweep 50 ms (500 pts)
Marker Trace Type X Axis Amplitude
1 (1) Freq 5.23812 GHz 2.609 dBm
2 (2) Freq 5.24132 GHz 8.263 dBm
Freq/Channel
Center Freq
5.24000000 GHz
Start Freq
5.22000000 GHz
Stop Freq
5.26000000 GHz
CF Step
4.00000000 MHz
Auto Man
Freq Offset
0.00000000 Hz
Signal Track
On Off
Scale Type
Log Lin
A:\PEA48.GIF file saved

802.11n HT40 MCS Modulation Mode
Channel 36



Channel 44



Peak Excursion Limit per FCC 15.407(a)(6): 13dB per 1MHz bandwidth

The worst-case peak excursion is: 802.11n HT20 – MCS Modulation Mode, Channel 36

Peak Level: 8.34 dBm
RMS/Average Level: 1.52 dBm

Peak Excursion: 8.34dBm – 1.52 dBm = 6.82 dBm (6.18 dB under limit)

7 Out-of-Band Antenna Conducted Emissions – Including Band Edge

7.1 Method

Unless otherwise stated no deviations were made from FCC Part 15.407(b)(1).

This testing was performed at Intertek Denver, located at 1795 Dogwood St. Suite 200, Louisville, CO 80027.

7.2 Test Equipment Used:

Asset ID	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
E1	RF Conducted Port Cable	-----	45-7221-19	001	09/12/2012	09/12/2013
18913	Spectrum Analyzer	Hewlett-Packard	E7405A	My44211889	7/16/2012	7/16/2013

7.3 Test Requirement:

For transmitters operating in the 5.15–5.25 GHz band: all emissions outside of the allowed 5.15–5.35 GHz band shall not exceed an EIRP of –27 dBm/MHz.

7.4 Test Procedure:

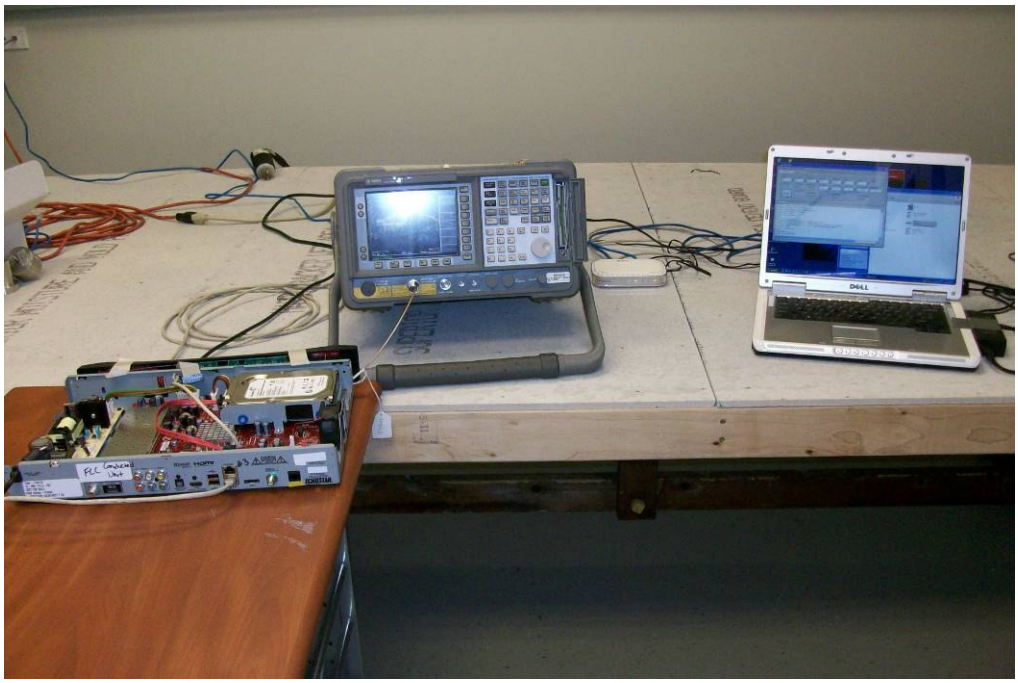
A spectrum analyzer/receiver was connected to the antenna port of the transmitter. The spectrum analyzer/receiver Resolution Bandwidth was set to 1 MHz. The out-of-band emissions were measured from 30 MHz to 26 GHz for the low, middle and high channels. Measurements included band edge measurements. Antenna gain (max) was added to the conducted port measurements to determine the maximum EIRP.

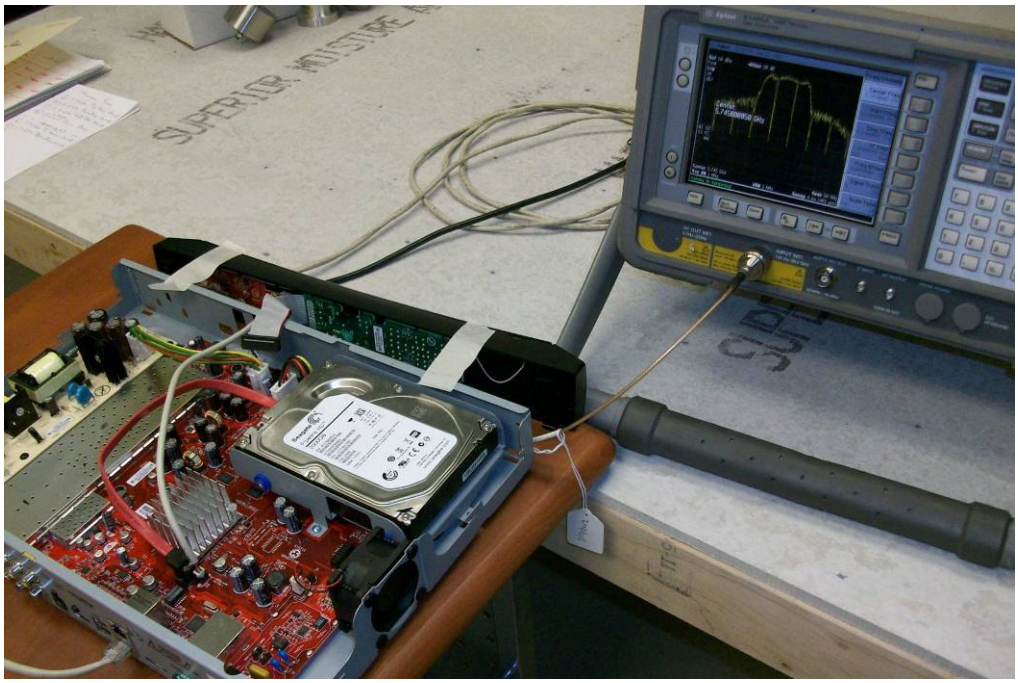
7.5 Test Results:

The sample tested was found to Comply.

7.6 Setup Photographs:

Out-of-Band Antenna Conducted Emissions - Test setup





7.7 Test Data Summary: Antenna 0

Out-of-Band Conducted Emissions – Antenna 0
FCC Part 15.407(b)(1)

Channel	Frequency, MHz	Standard/ Data Rate	Scan Range	Plot
36	5180	802.11a, 12Mbps	30 MHz – 26 GHz (worst-case: -58.56 dBm) 31.56dB under -27dBm EIRP Limit	x
		802.11n HT20, MCS3	30 MHz – 26 GHz	x
38	5190	802.11n HT40, MCS0	30 MHz – 26 GHz	x
44	5220	802.11a, 9Mbps	30 MHz – 26 GHz	x
		802.11n HT20, MCS1	30 MHz – 26 GHz	x
46	5230	802.11n HT40, MCS0	30 MHz – 26 GHz	x
48	5240	802.11a, 12Mbps	30 MHz – 26 GHz	x
		802.11n HT20, MCS1	30 MHz – 26 GHz	x

Out-of-Band Conducted Spurious Emissions at the Band Edge – Antenna 0

Channel	Frequency, MHz	Standard/ Data Rate	Peak Conducted Spurious Outside 5150-5250 MHz Band (dBm)	Margin to -27dBm EIRP Limit @ max antenna gain 3.2 dBi (dB)
38	5190	802.11n HT40, MCS0	-52.50	-22.3
46	5230	802.11n HT40, MCS0	-36.81	-6.61

Note: The above table represents the worst-case band edge measurements of all bands and modulation/data modes.

7.8 Test Data Summary: Antenna 1

Out-of-Band Conducted Emissions – Antenna 1
FCC Part 15.407(b)(1)

Channel	Frequency, MHz	Standard/ Data Rate	Scan Range	Plot
36	5180	802.11a, 12Mbps	30 MHz – 26 GHz	x
		802.11n HT20, MCS2	30 MHz – 26 GHz	x
38	5190	802.11n HT40, MCS0	30 MHz – 26 GHz (worst-case -59.27 dBm) 32.27dB under -27dBm EIRP Limit	x
44	5220	802.11a, 12Mbps	30 MHz – 26 GHz	x
		802.11n HT20, MCS1	30 MHz – 26 GHz	x
46	5230	802.11n HT40, MCS0	30 MHz – 26 GHz	x
48	5240	802.11a, 12Mbps	30 MHz – 26 GHz	x
		802.11n HT20, MCS0	30 MHz – 26 GHz	x

Out-of-Band Conducted Spurious Emissions at the Band Edge – Antenna 1

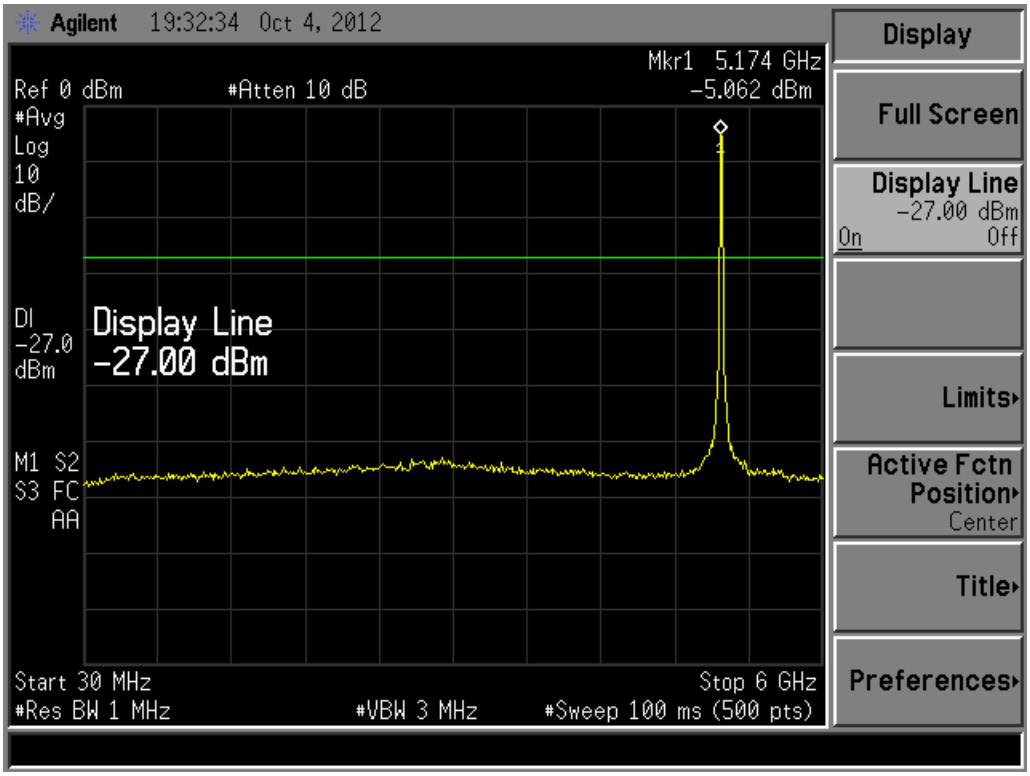
Channel	Frequency, MHz	Standard/ Data Rate	Peak Conducted Spurious Outside 5150-5250 MHz Band (dBm)	Margin to -27dBm EIRP Limit @ max antenna gain 1.8 dBi (dB)
38	5190	802.11n HT40, MCS0	-48.28	-19.48
46	5230	802.11n HT40, MCS0	-36.24	-7.44

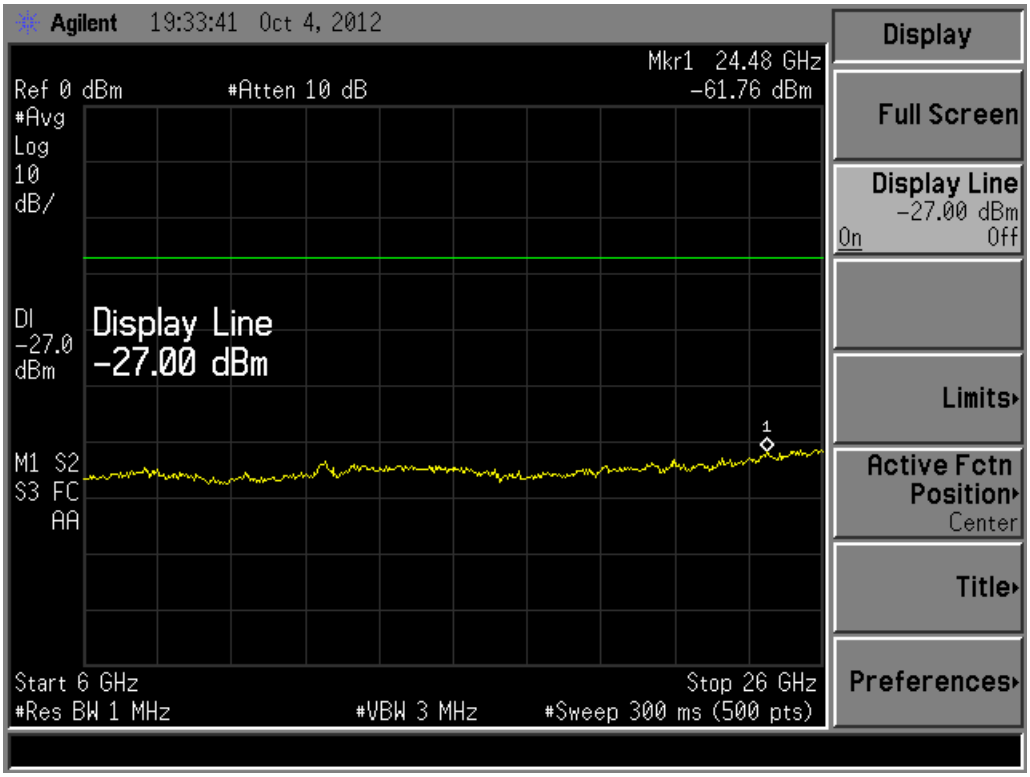
Note: The above table represents the worst-case band edge measurements of all bands and modulation/data modes.

7.9 Test Data/Plots: Antenna 0

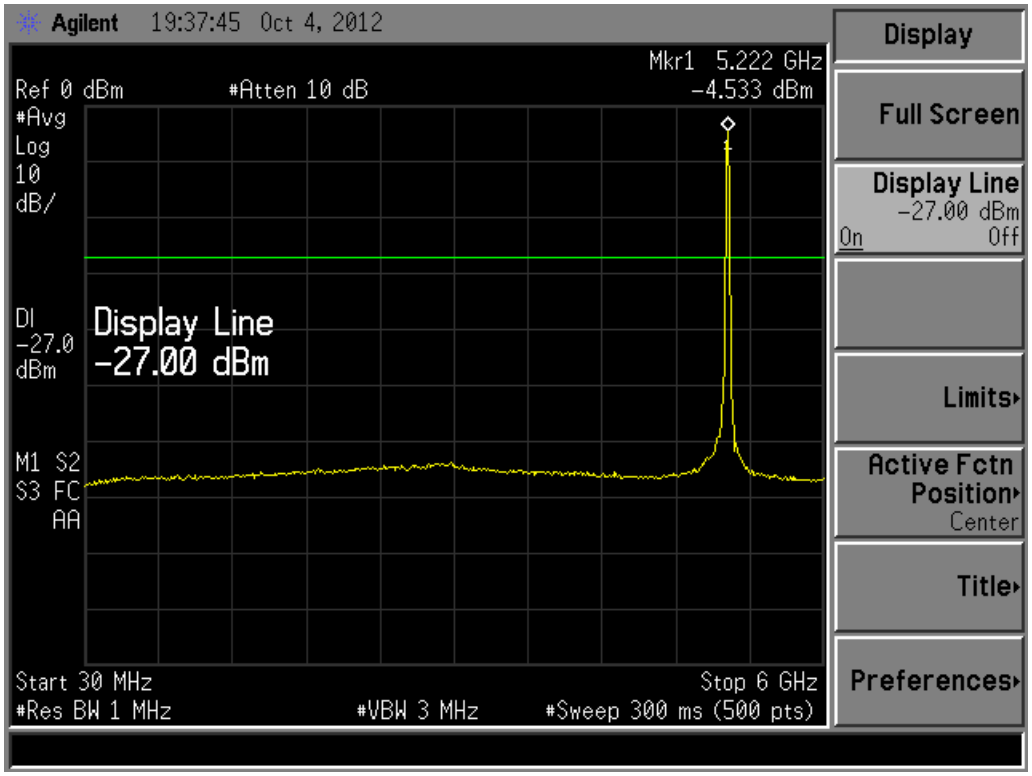
Channels 5150 to 5250 MHz - FCC Part 15.407(b)(1)
(Out-of-Band Antenna Conducted Emissions – Antenna 0)

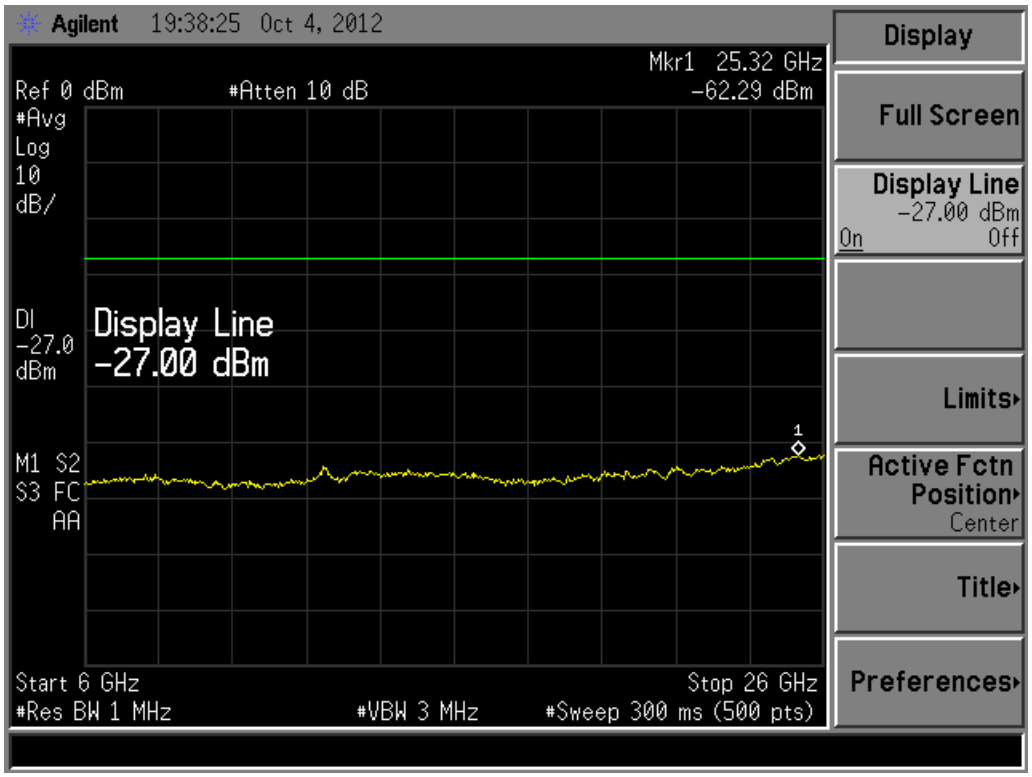
802.11a – OFDM Modulation Mode
*Channel 36



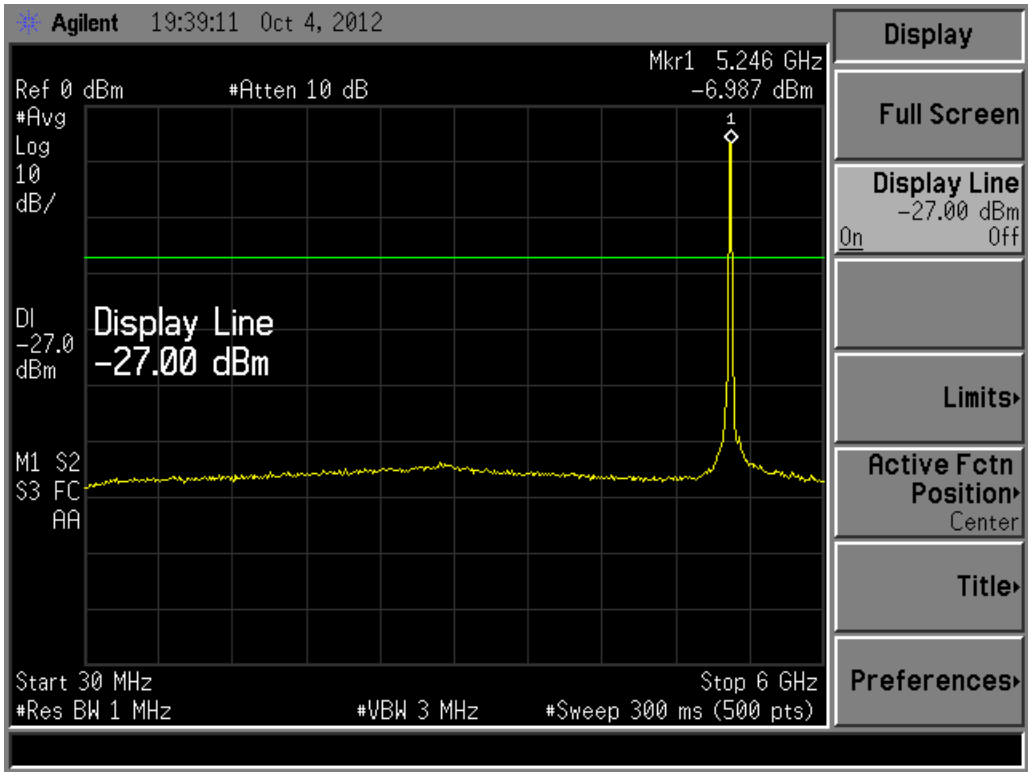


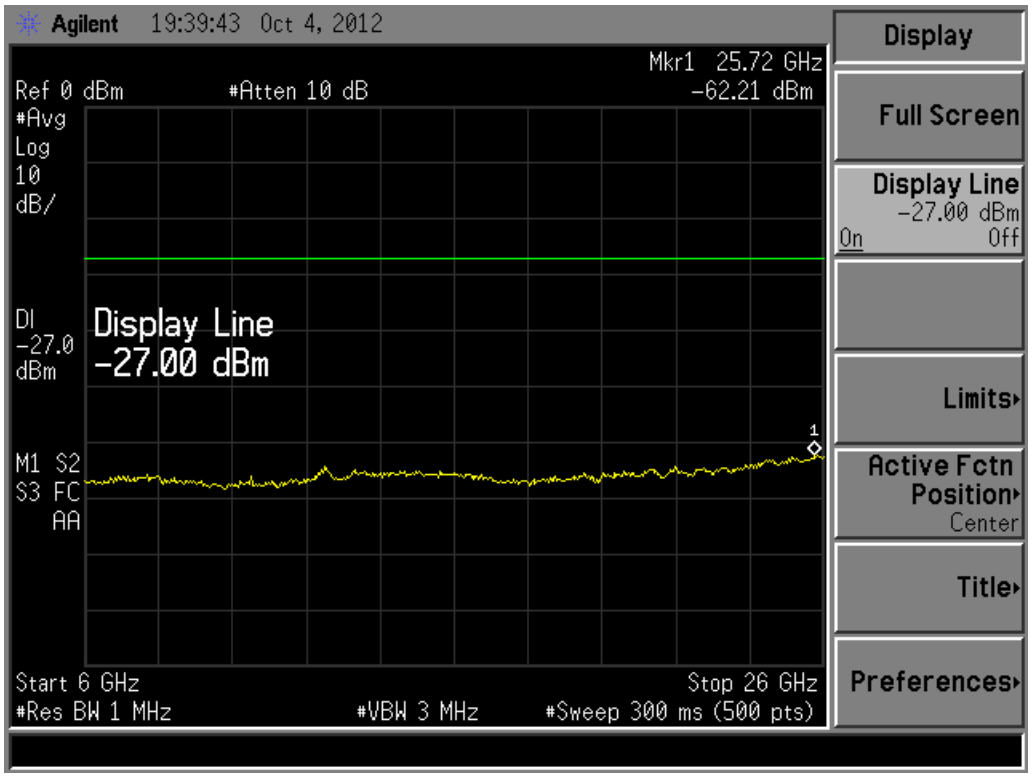
Channel 44


Agilent 19:37:45 Oct 4, 2012
Mkr1 5.222 GHz
-4.533 dBm
Ref 0 dBm
#Atten 10 dB
#Avg
Log
10
dB/
Dl
-27.0
dBm
Display Line
-27.00 dBm
M1 S2
S3 FC
AA
Start 30 MHz
#Res BW 1 MHz
#VBW 3 MHz
Stop 6 GHz
#Sweep 300 ms (500 pts)
Display
Full Screen
Display Line
-27.00 dBm
On
Off
Limits
Active Fctn
Position
Center
Title
Preferences

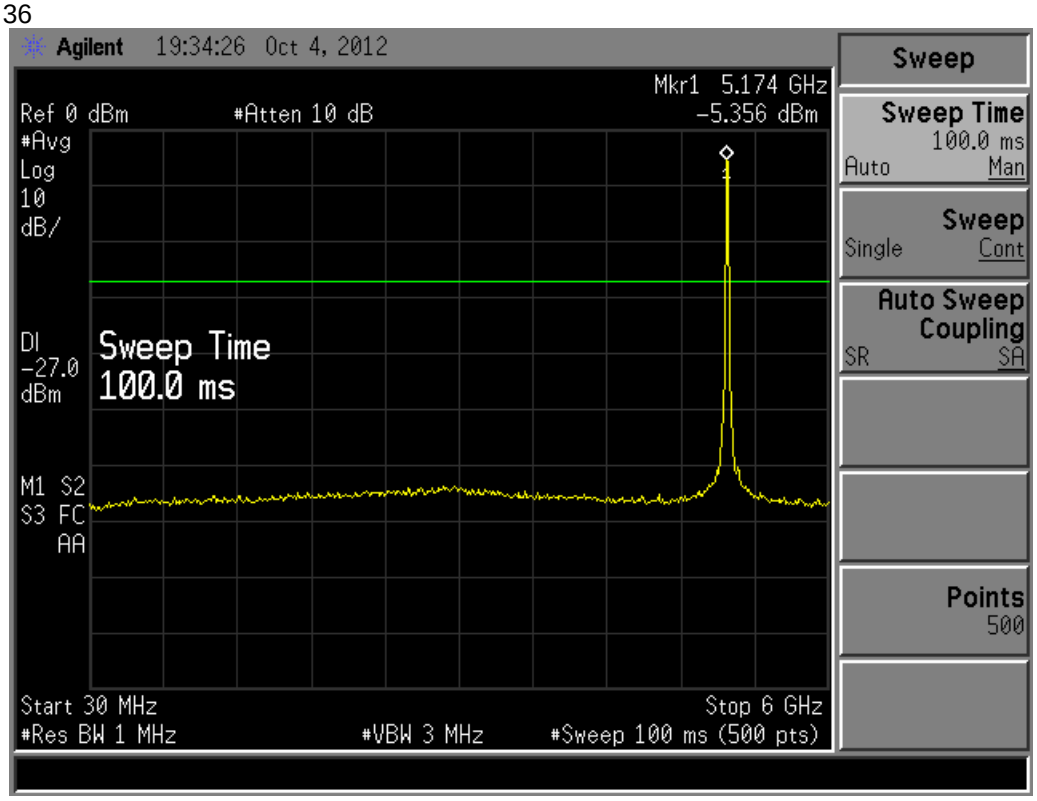

Agilent 19:38:25 Oct 4, 2012
Mkr1 25.32 GHz
-62.29 dBm
Ref 0 dBm
#Atten 10 dB
#Avg
Log
10
dB/
Dl
-27.0
dBm
Display Line
-27.00 dBm
M1 S2
S3 FC
AA
Start 6 GHz
#Res BW 1 MHz
#VBW 3 MHz
Stop 26 GHz
#Sweep 300 ms (500 pts)
Display
Full Screen
Display Line
-27.00 dBm
On
Off
Limits
Active Fctn
Position
Center
Title
Preferences

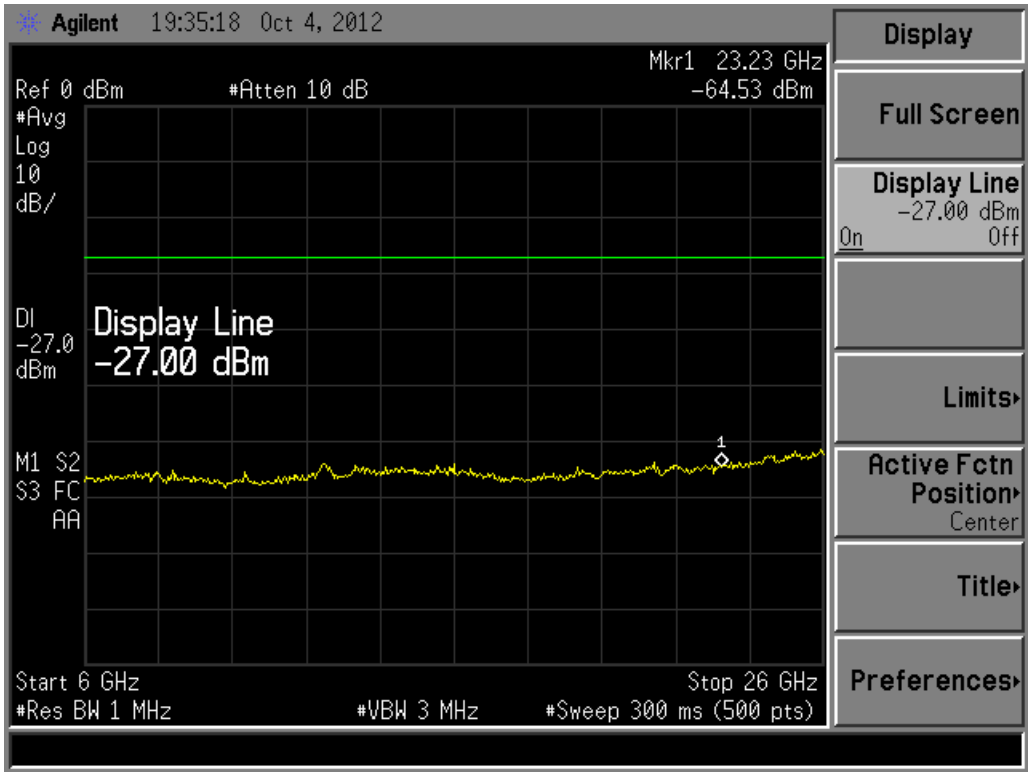
Channel 48


Agilent 19:39:11 Oct 4, 2012
Mkr1 5.246 GHz
-6.987 dBm
Ref 0 dBm
#Atten 10 dB
#Avg
Log
10
dB/
Dl
-27.0
dBm
Display Line
-27.00 dBm
M1 S2
S3 FC
AA
Start 30 MHz
#Res BW 1 MHz
#VBW 3 MHz
Stop 6 GHz
#Sweep 300 ms (500 pts)
Display
Full Screen
Display Line
-27.00 dBm
On
Off
Limits
Active Fctn
Position
Center
Title
Preferences

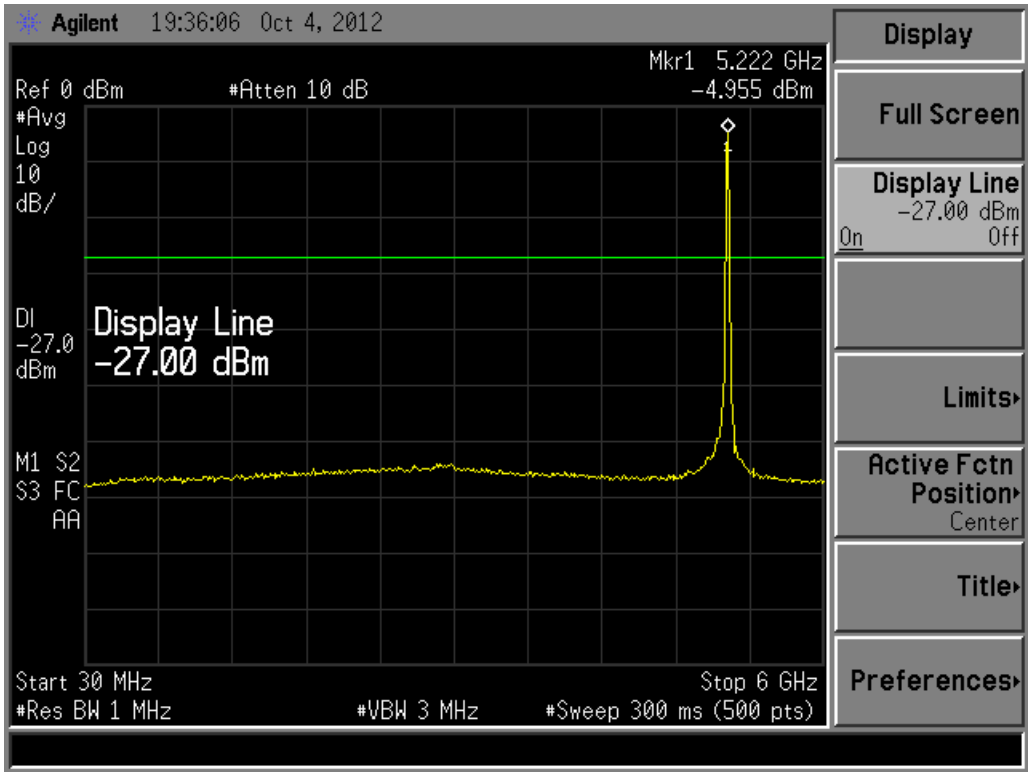

Agilent 19:39:43 Oct 4, 2012
Mkr1 25.72 GHz
-62.21 dBm
Ref 0 dBm
#Atten 10 dB
#Avg
Log
10
dB/
Dl
-27.0
dBm
Display Line
-27.00 dBm
M1 S2
S3 FC
AA
Start 6 GHz
#Res BW 1 MHz
#VBW 3 MHz
Stop 26 GHz
#Sweep 300 ms (500 pts)
Display
Full Screen
Display Line
-27.00 dBm
On
Off
Limits
Active Fctn
Position
Center
Title
Preferences

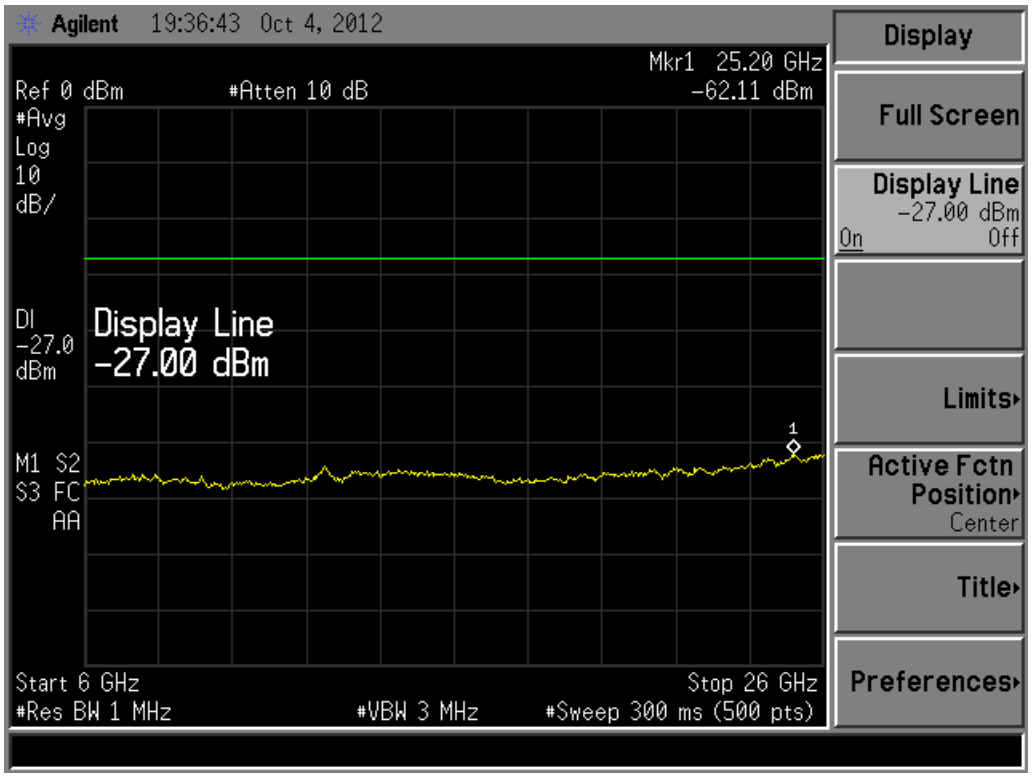
802.11n HT20 – MCS Modulation Mode
Channel 36



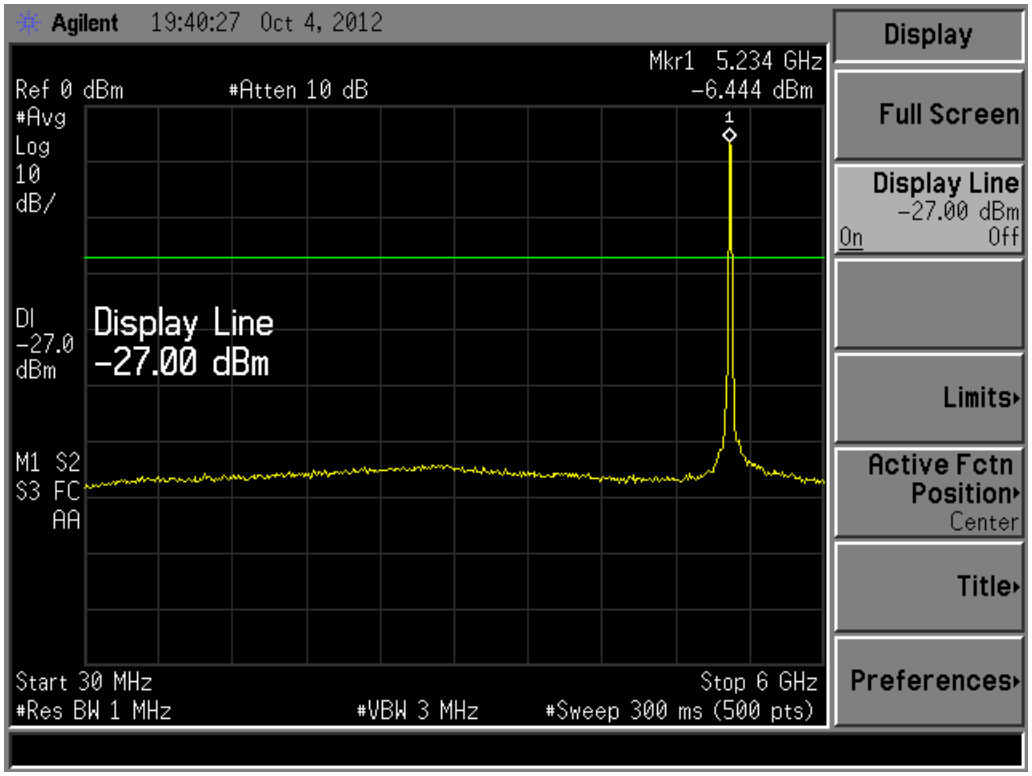


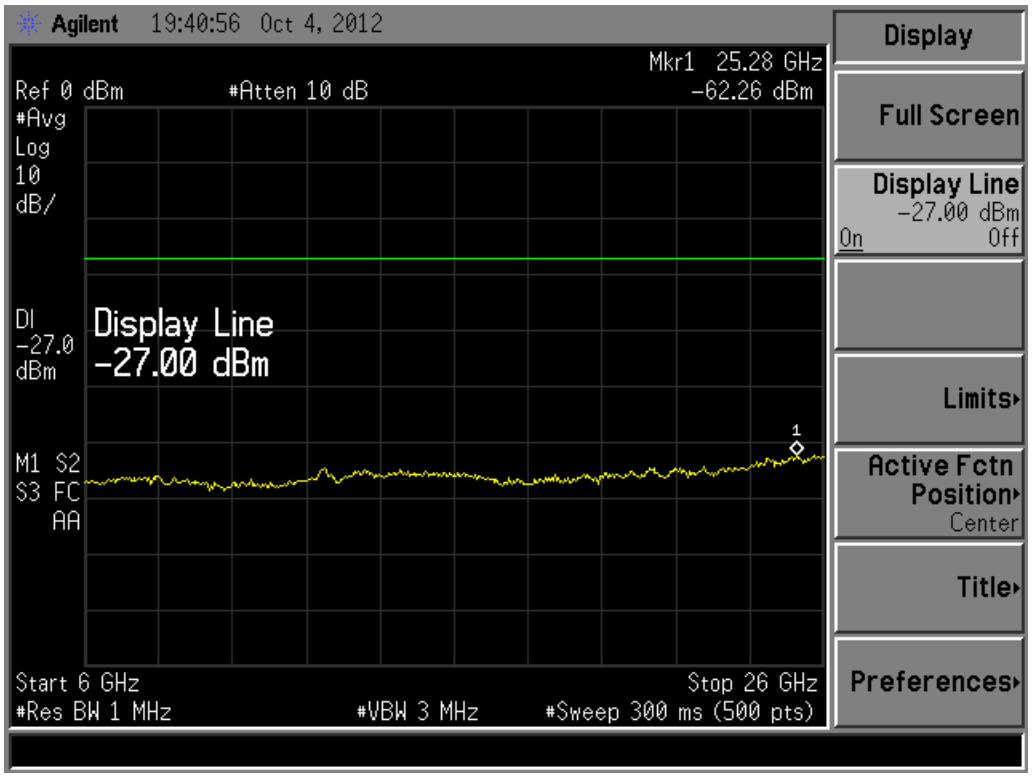
Channel 44


Agilent 19:36:06 Oct 4, 2012
Mkr1 5.222 GHz
-4.955 dBm
Ref 0 dBm
#Atten 10 dB
#Avg
Log
10
dB/
Dl
-27.0
dBm
Display Line
-27.00 dBm
M1 S2
S3 FC
AA
Start 30 MHz
#Res BW 1 MHz
#VBW 3 MHz
Stop 6 GHz
#Sweep 300 ms (500 pts)
Display
Full Screen
Display Line
-27.00 dBm
On
Off
Limits
Active Fctn
Position
Center
Title
Preferences

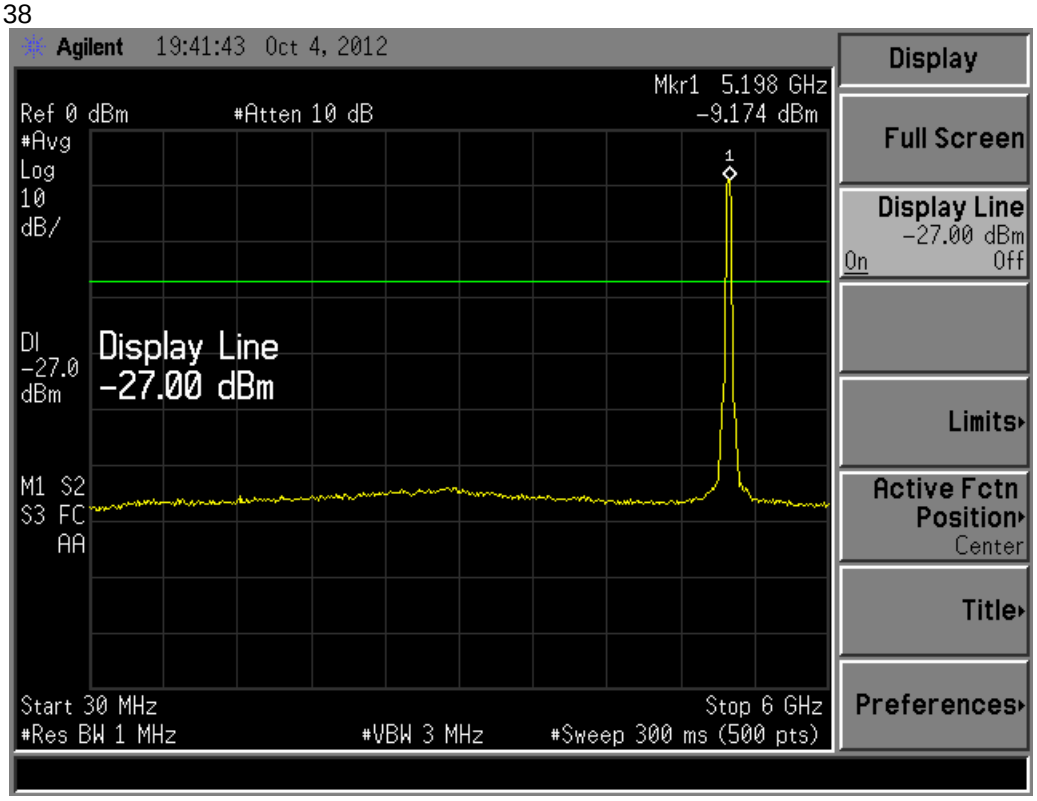

Agilent 19:36:43 Oct 4, 2012
Mkr1 25.20 GHz
-62.11 dBm
Ref 0 dBm
#Atten 10 dB
#Avg
Log
10
dB/
Dl
-27.0
dBm
Display Line
-27.00 dBm
M1 S2
S3 FC
AA
Start 6 GHz
#Res BW 1 MHz
#VBW 3 MHz
Stop 26 GHz
#Sweep 300 ms (500 pts)
Display
Full Screen
Display Line
-27.00 dBm
On
Off
Limits
Active Fctn
Position
Center
Title
Preferences

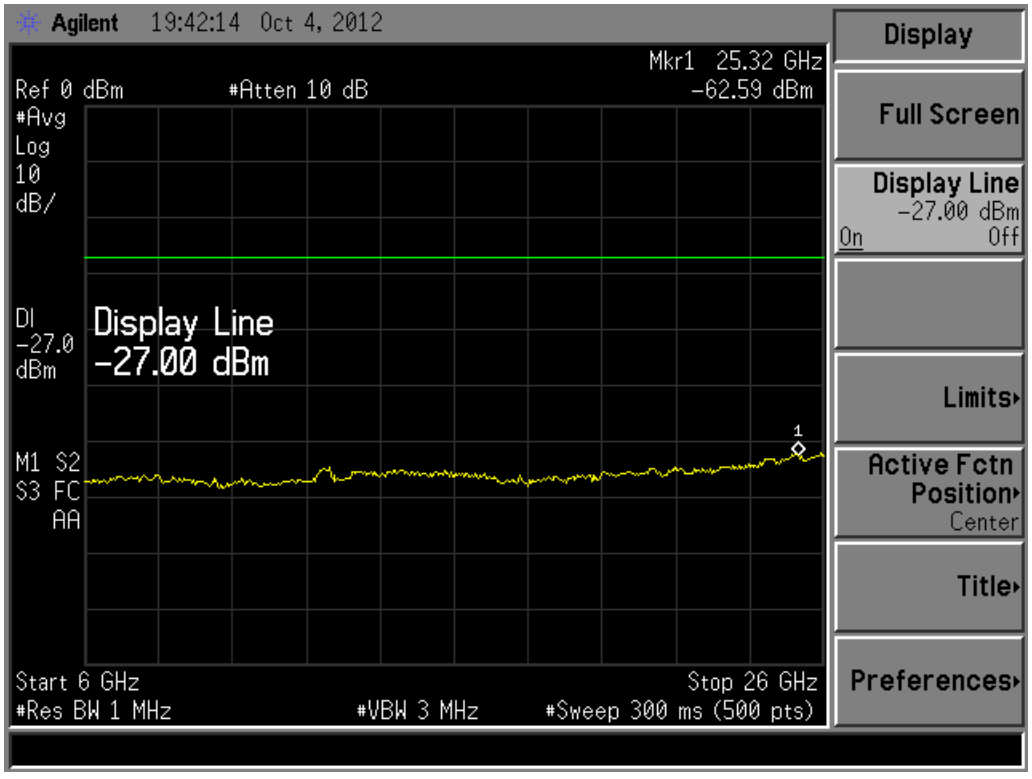
Channel 48


Agilent 19:40:27 Oct 4, 2012
Mkr1 5.234 GHz
-6.444 dBm
Ref 0 dBm
#Atten 10 dB
#Avg
Log
10
dB/
Dl
-27.0
dBm
Display Line
-27.00 dBm
M1 S2
S3 FC
AA
Start 30 MHz
#Res BW 1 MHz
#VBW 3 MHz
Stop 6 GHz
#Sweep 300 ms (500 pts)
Display
Full Screen
Display Line
-27.00 dBm
On
Off
Limits
Active Fctn
Position
Center
Title
Preferences

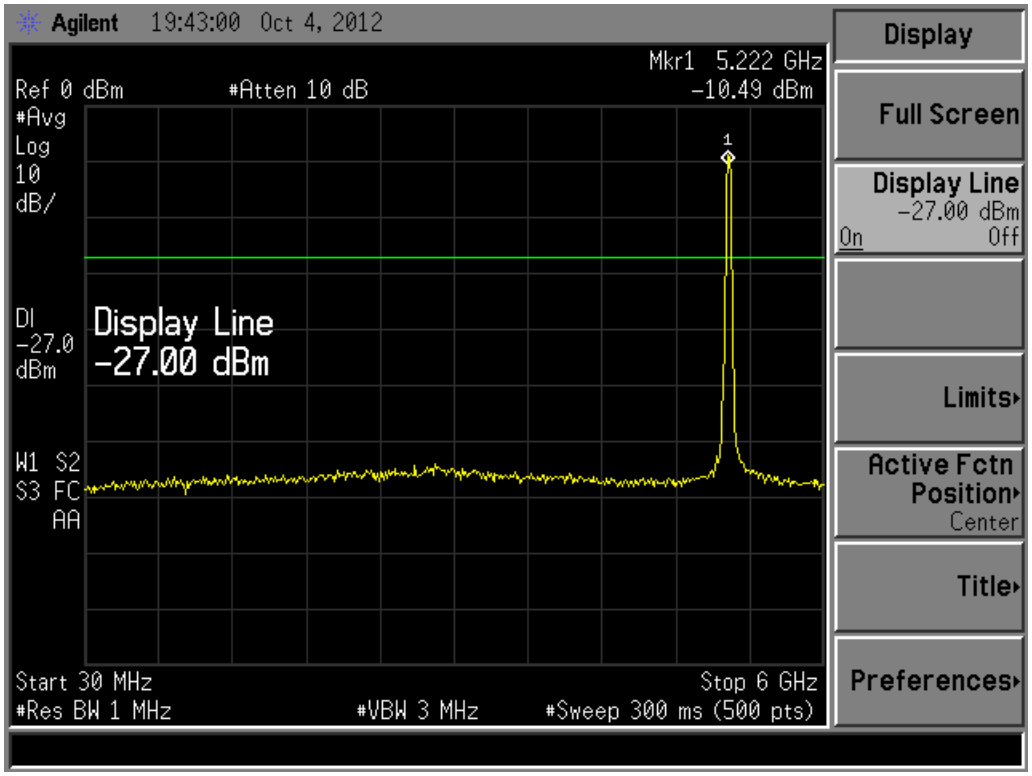

Agilent 19:40:56 Oct 4, 2012
Mkr1 25.28 GHz
-62.26 dBm
Ref 0 dBm
#Atten 10 dB
#Avg
Log
10
dB/
Dl
-27.0
dBm
Display Line
-27.00 dBm
M1 S2
S3 FC
AA
Start 6 GHz
#Res BW 1 MHz
#VBW 3 MHz
Stop 26 GHz
#Sweep 300 ms (500 pts)
Display
Full Screen
Display Line
-27.00 dBm
On
Off
Limits
Active Fctn
Position
Center
Title
Preferences

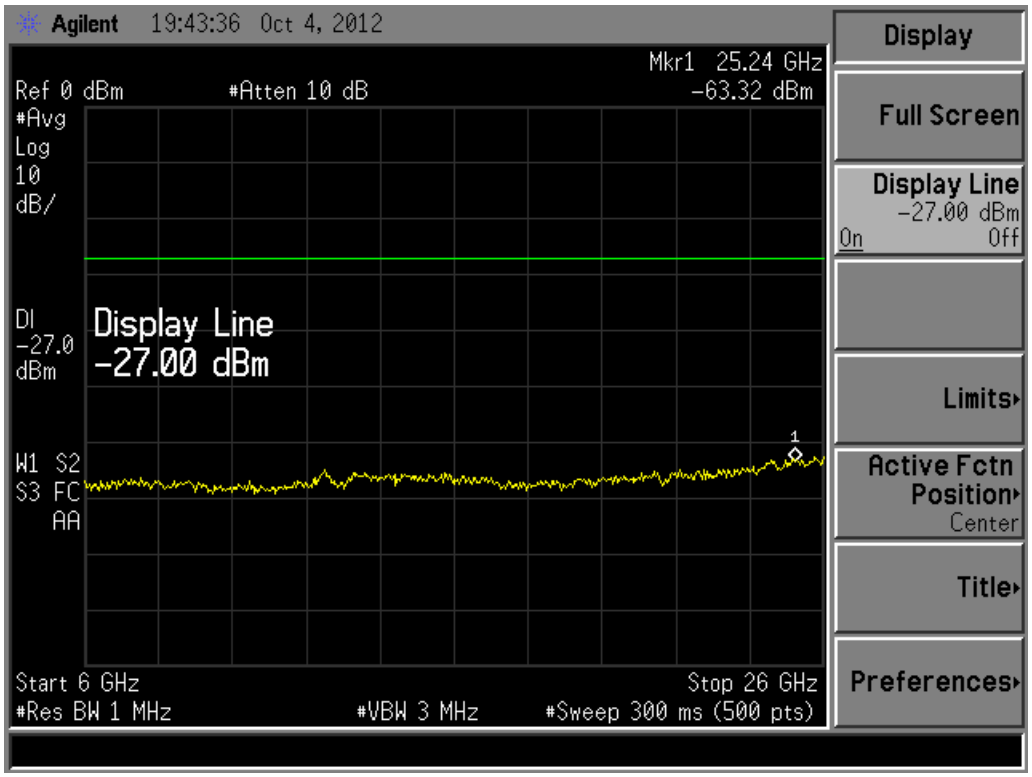
802.11n HT40 MCS Modulation Mode
Channel 38





Channel 46





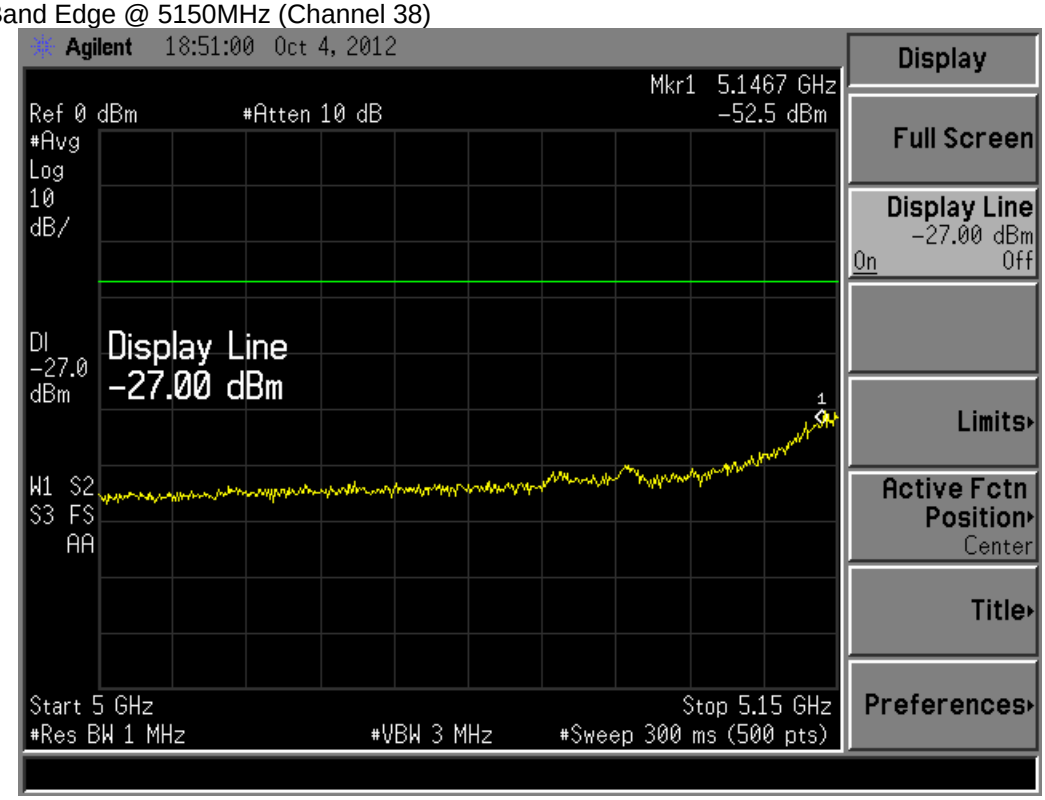
FCC Part 15.407(b)(1) Out-of-Band Antenna Conducted Emissions Limit : EIRP -27dBm/MHz
(Maximum Antenna Gain @ 5.2GHz: 3.2 dBi)

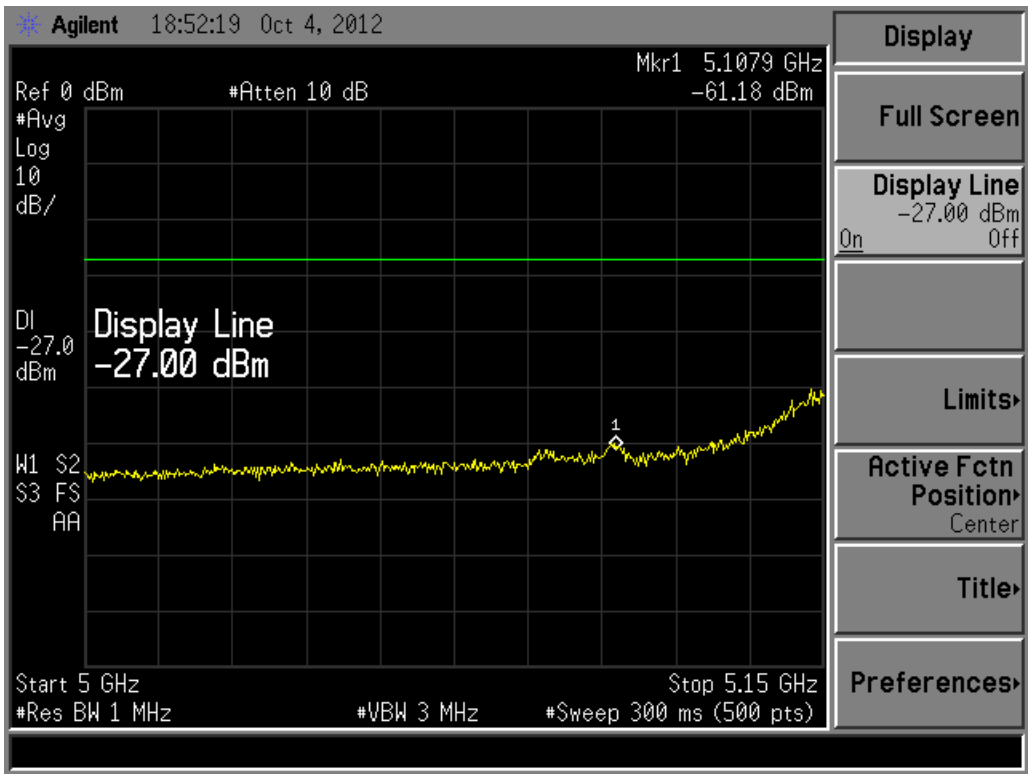
Worst-case out-of-band emission: 802.11a – OFDM Modulation Mode, Channel 36 (-61.76 dBm)
Therefore, -61.76 dBm + 3.2 dB (antenna gain) = EIRP -58.56dBm (31.56 dB under the limit)

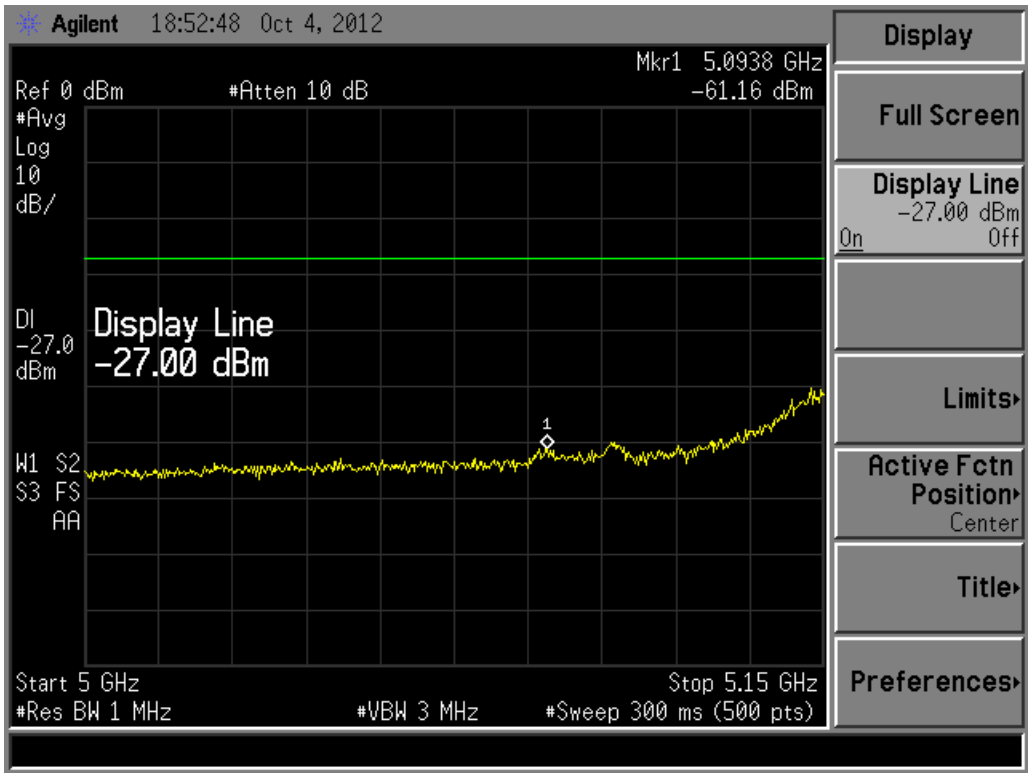
7.10 Test Data/Plots – Band Edge: Antenna 0

Channels 5150 to 5250 MHz - FCC Part 15.407(b)(1)
(Out-of-Band Antenna Conducted Emissions @ Band Edge – Antenna 0)

802.11n HT40 MCS Modulation Mode
Lower Band Edge @ 5150MHz (Channel 38)





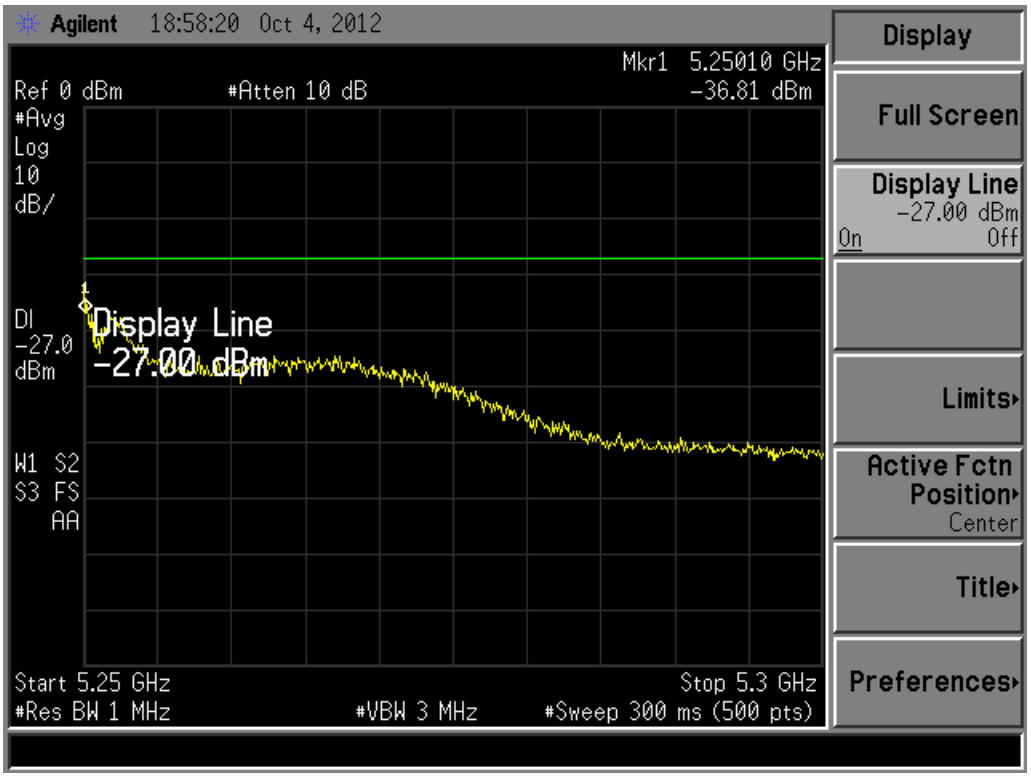


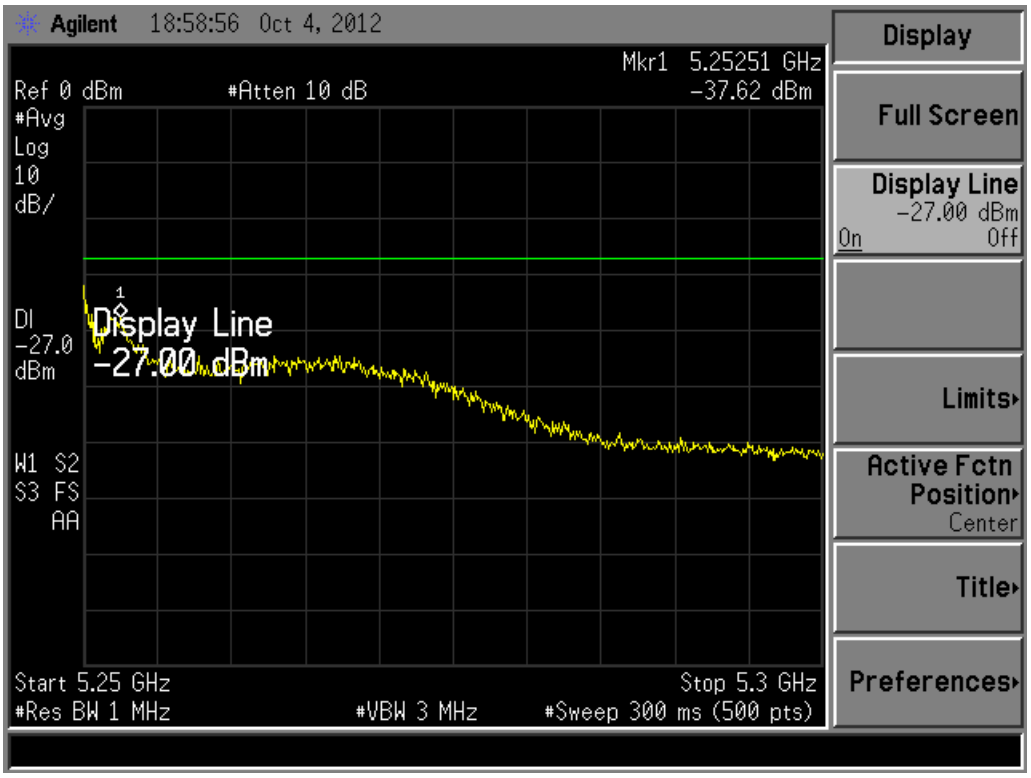
FCC Part 15.407(b)(1) Out-of-Band Antenna Conducted Emissions Limit: EIRP -27dBm/MHz

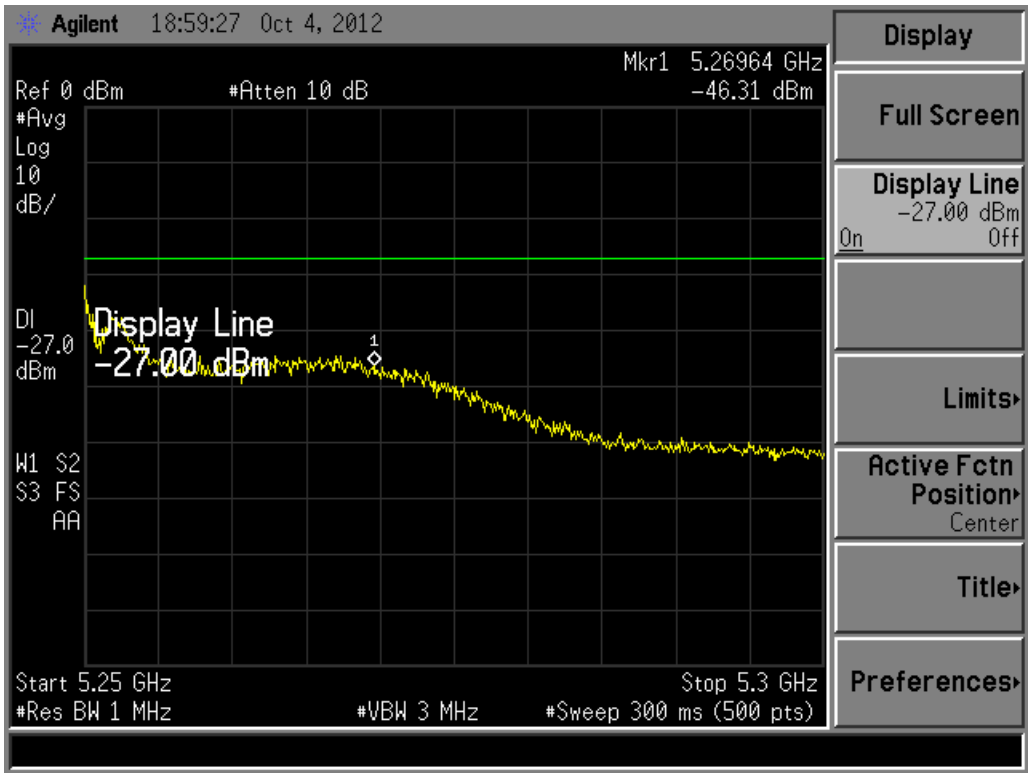
Antenna Gain @ 5.2GHz: 3.2 dBi

Worst-case Lower Band Edge Measurement: -52.5 dBm + 3.2 dB (antenna gain) = EIRP -49.3 dBm (22.3 dB under the limit).

802.11n HT40 MCS Modulation Mode
Upper Band Edge @ 5250MHz (Channel 46)







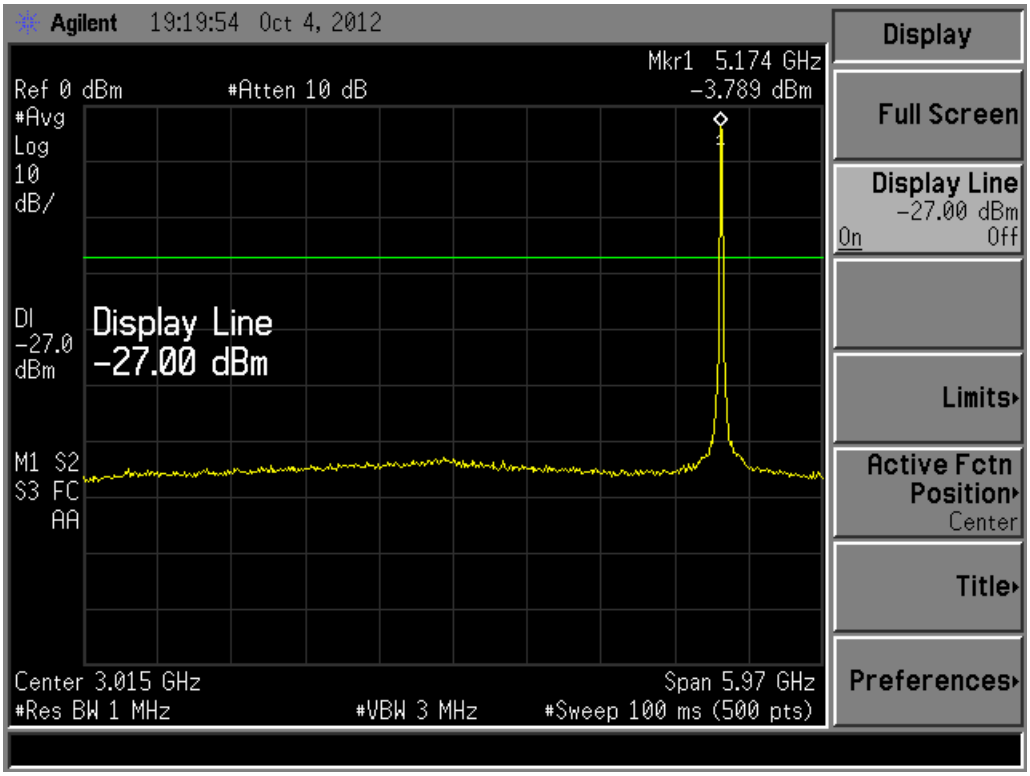
FCC Part 15.407(b)(1) Out-of-Band Antenna Conducted Emissions Limit: EIRP -27dBm/MHz (Antenna Gain @ 5.2GHz: 3.2 dBi)

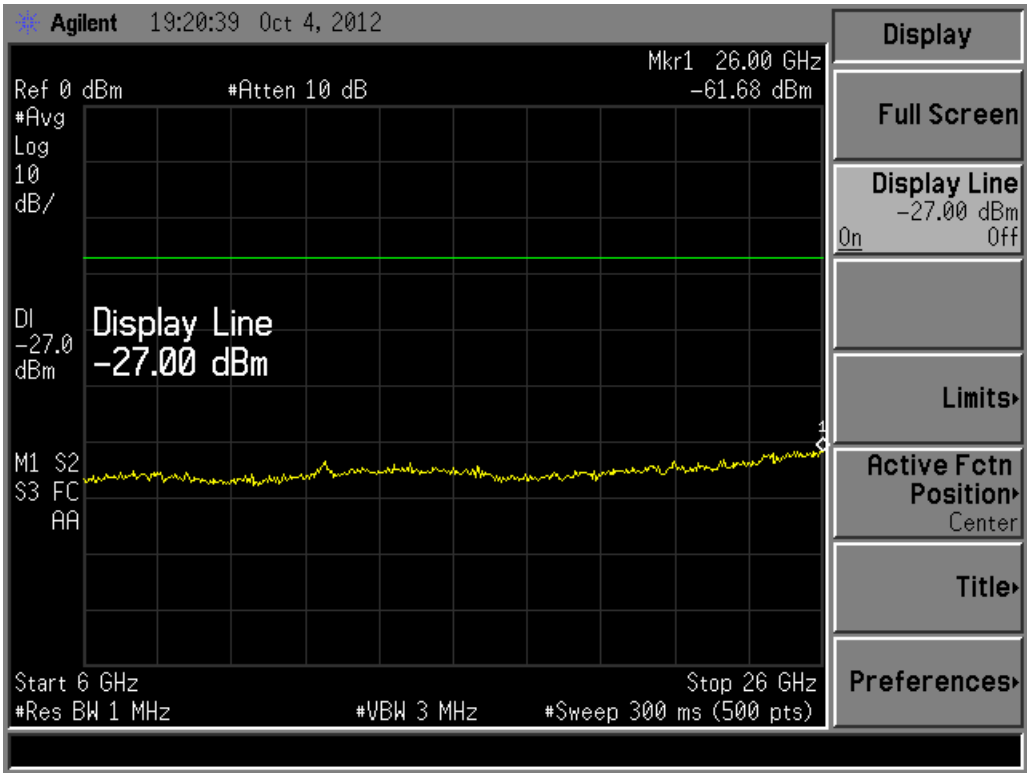
Worst-case Upper Band Edge Measurement: -36.81 dBm + 3.2 dB (antenna gain) = -33.61 dBm EIRP (6.61 dB under the limit).

7.11 Test Data/Plots: Antenna 1

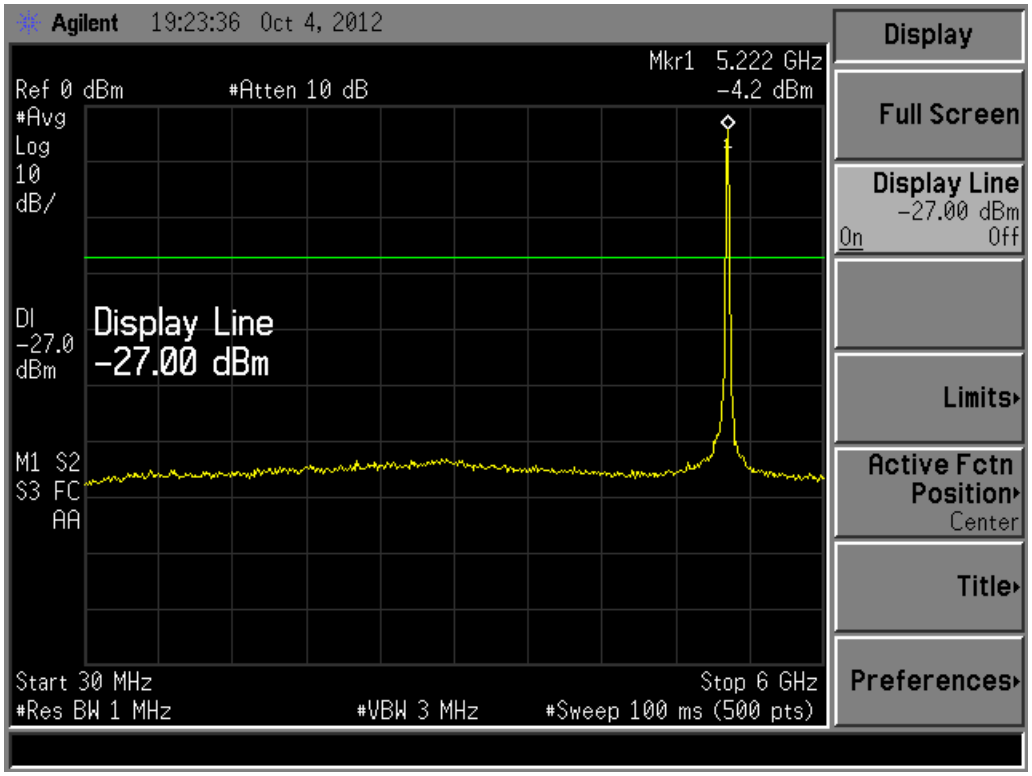
Channels 5150 to 5250 MHz - FCC Part 15.407(b)(1)
(Out-of-Band Antenna Conducted Emissions – Antenna 1)

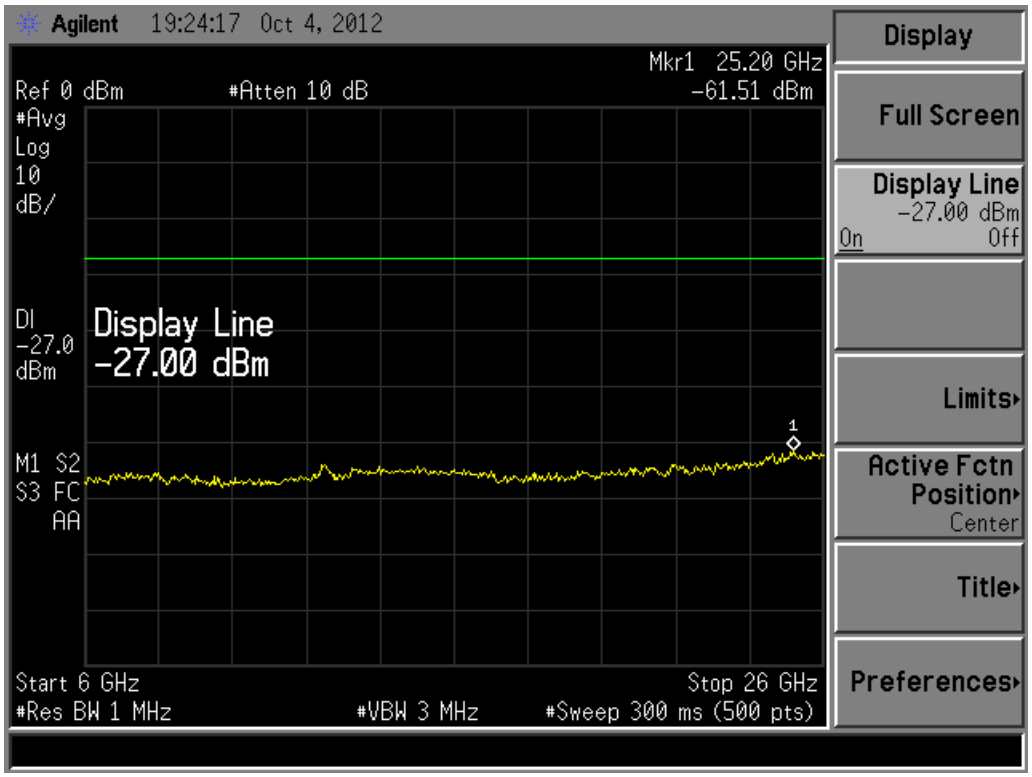
802.11a – OFDM Modulation Mode
Channel 36



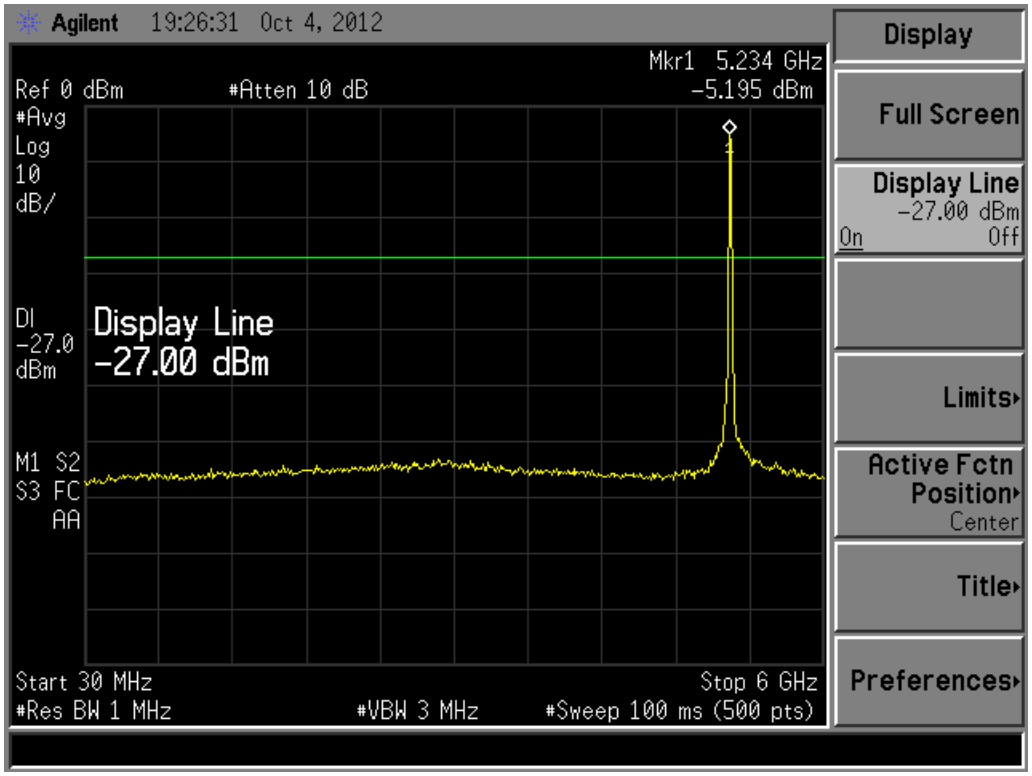


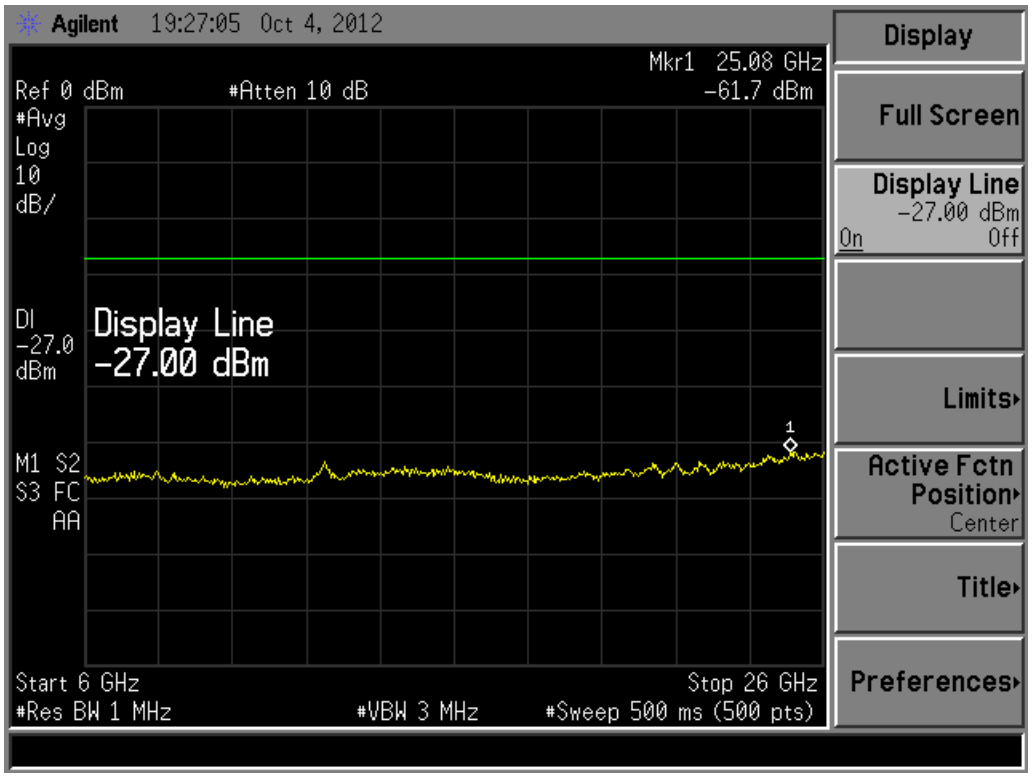
Channel 44


Agilent 19:23:36 Oct 4, 2012
Mkr1 5.222 GHz
-4.2 dBm
Ref 0 dBm
#Atten 10 dB
#Avg
Log
10
dB/
Dl
-27.0
dBm
Display Line
-27.00 dBm
M1 S2
S3 FC
AA
Start 30 MHz
#Res BW 1 MHz
#VBW 3 MHz
Stop 6 GHz
#Sweep 100 ms (500 pts)
Display
Full Screen
Display Line
-27.00 dBm
On
Off
Limits
Active Fctn
Position
Center
Title
Preferences

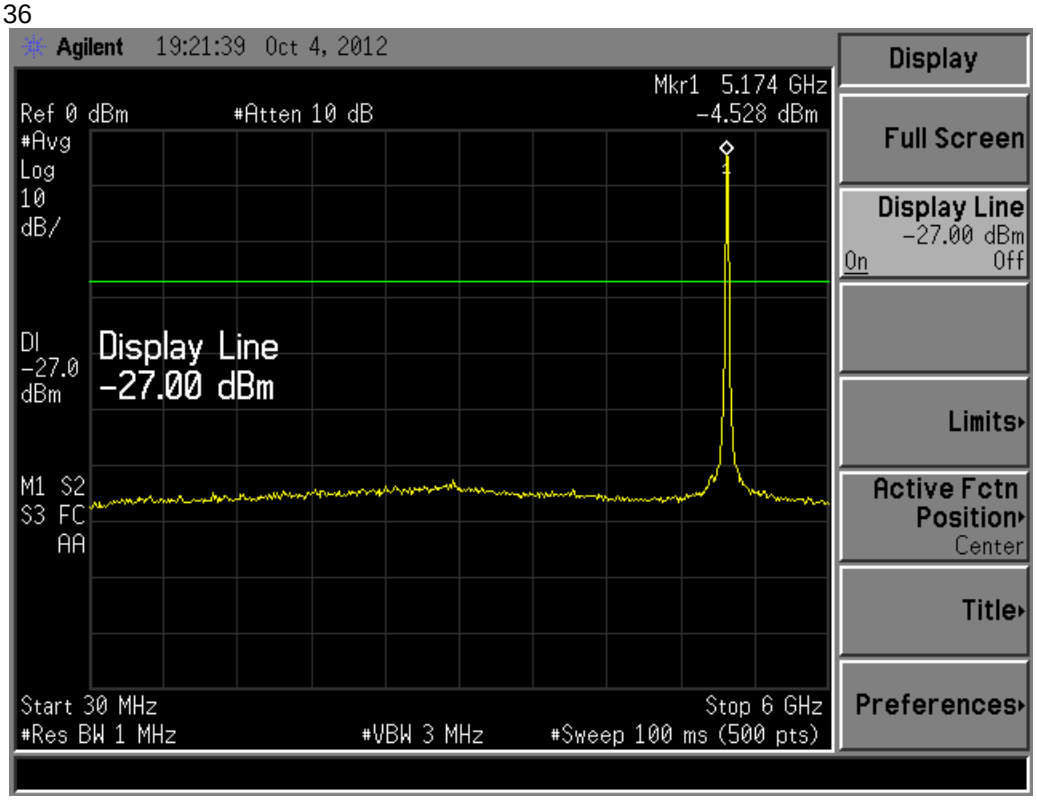

Agilent 19:24:17 Oct 4, 2012
Mkr1 25.20 GHz
-61.51 dBm
Ref 0 dBm
#Atten 10 dB
#Avg
Log
10
dB/
Dl
-27.0
dBm
Display Line
-27.00 dBm
M1 S2
S3 FC
AA
Start 6 GHz
#Res BW 1 MHz
#VBW 3 MHz
Stop 26 GHz
#Sweep 300 ms (500 pts)
Display
Full Screen
Display Line
-27.00 dBm
On
Off
Limits
Active Fctn
Position
Center
Title
Preferences

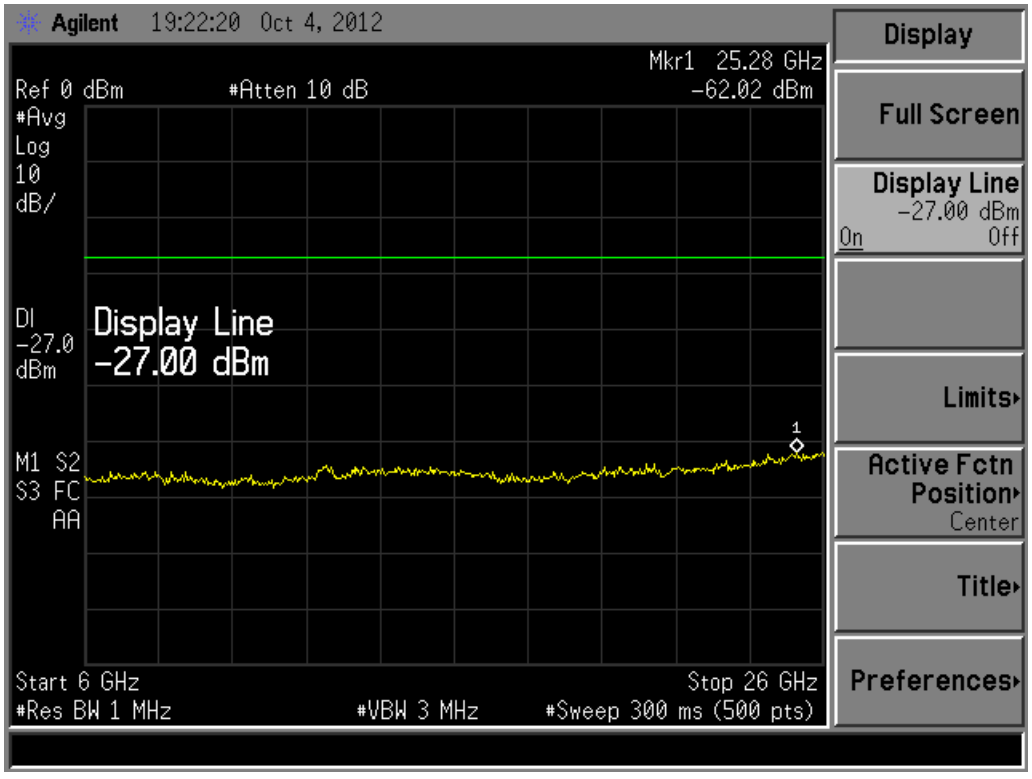
Channel 48


Agilent 19:26:31 Oct 4, 2012
Mkr1 5.234 GHz
-5.195 dBm
Ref 0 dBm
#Atten 10 dB
#Avg
Log
10
dB/
Dl
-27.0
dBm
Display Line
-27.00 dBm
M1 S2
S3 FC
AA
Start 30 MHz
#Res BW 1 MHz
#VBW 3 MHz
Stop 6 GHz
#Sweep 100 ms (500 pts)
Display
Full Screen
Display Line
-27.00 dBm
On
Off
Limits
Active Fctn
Position
Center
Title
Preferences

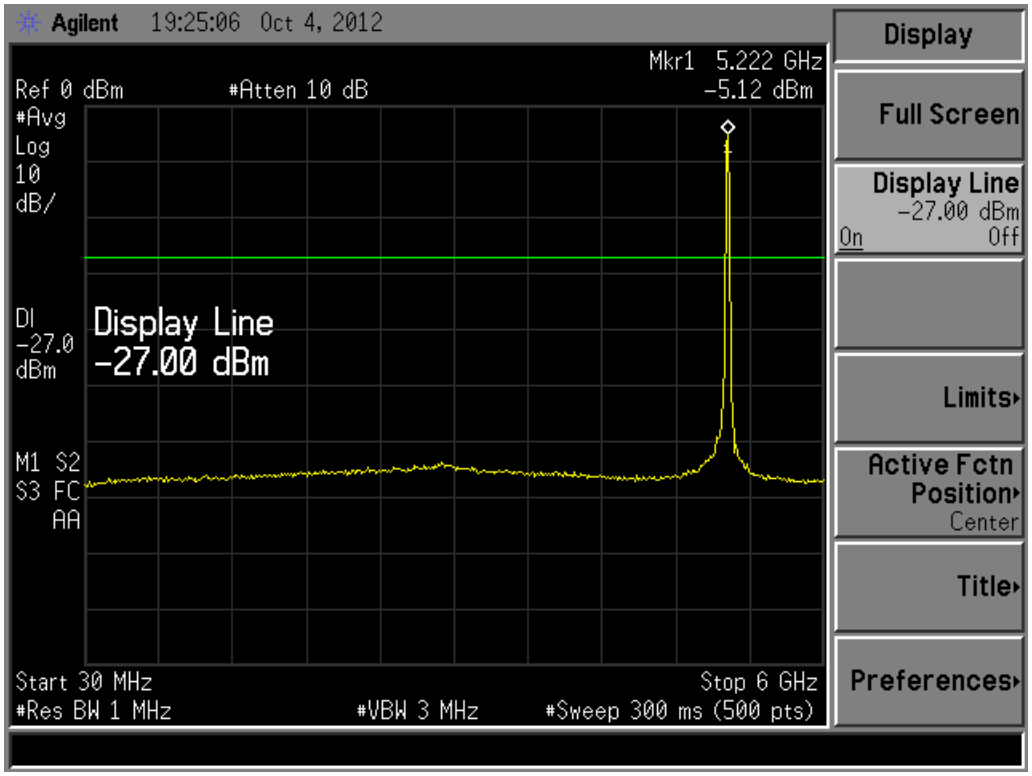

Agilent 19:27:05 Oct 4, 2012
Mkr1 25.08 GHz
-61.7 dBm
Ref 0 dBm
#Atten 10 dB
#Avg
Log
10
dB/
Dl
-27.0
dBm
Display Line
-27.00 dBm
M1 S2
S3 FC
AA
Start 6 GHz
#Res BW 1 MHz
#VBW 3 MHz
Stop 26 GHz
#Sweep 500 ms (500 pts)
Display
Full Screen
Display Line
-27.00 dBm
On
Off
Limits
Active Fctn
Position
Center
Title
Preferences

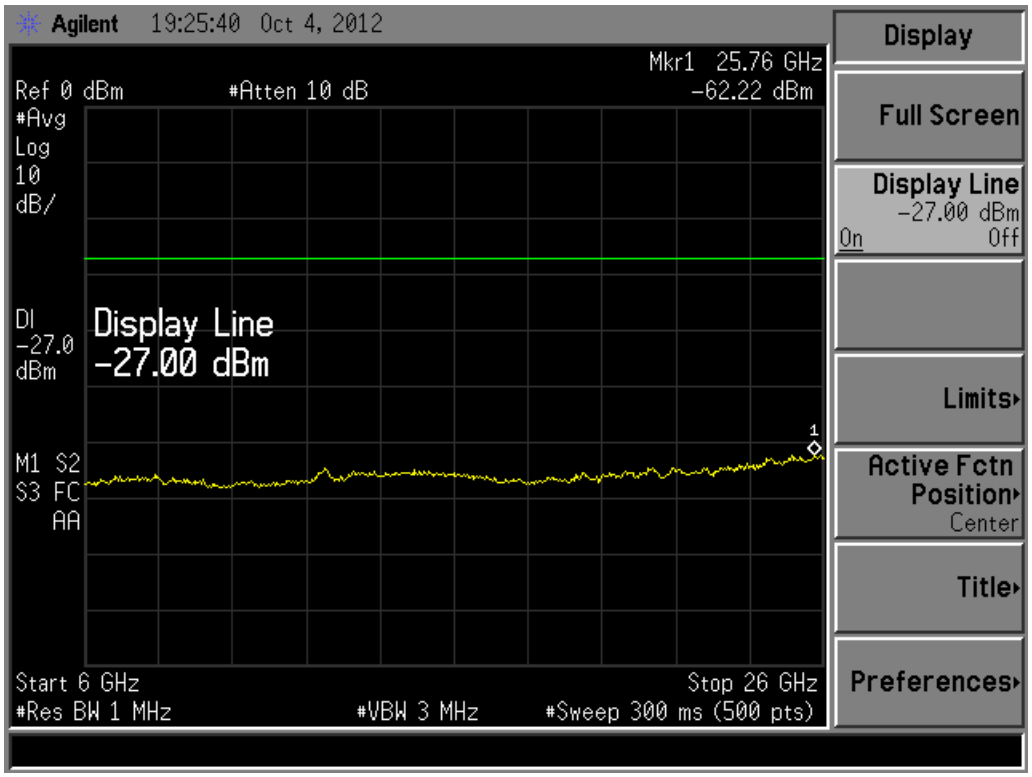
802.11n HT20 – MCS Modulation Mode
Channel 36



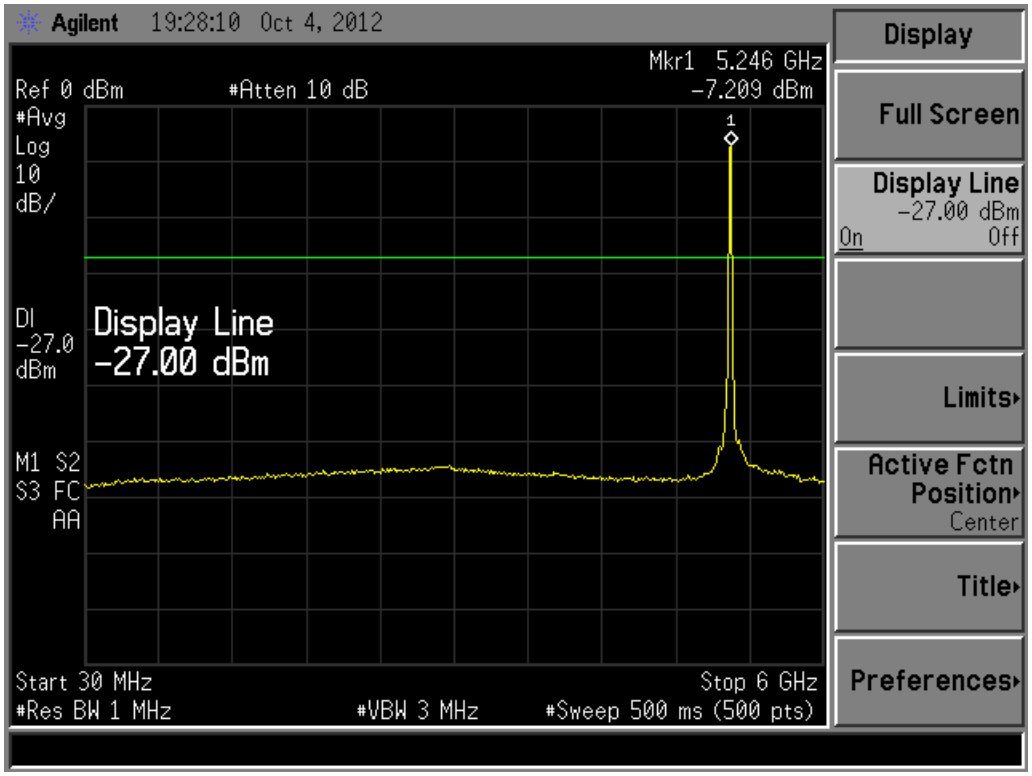


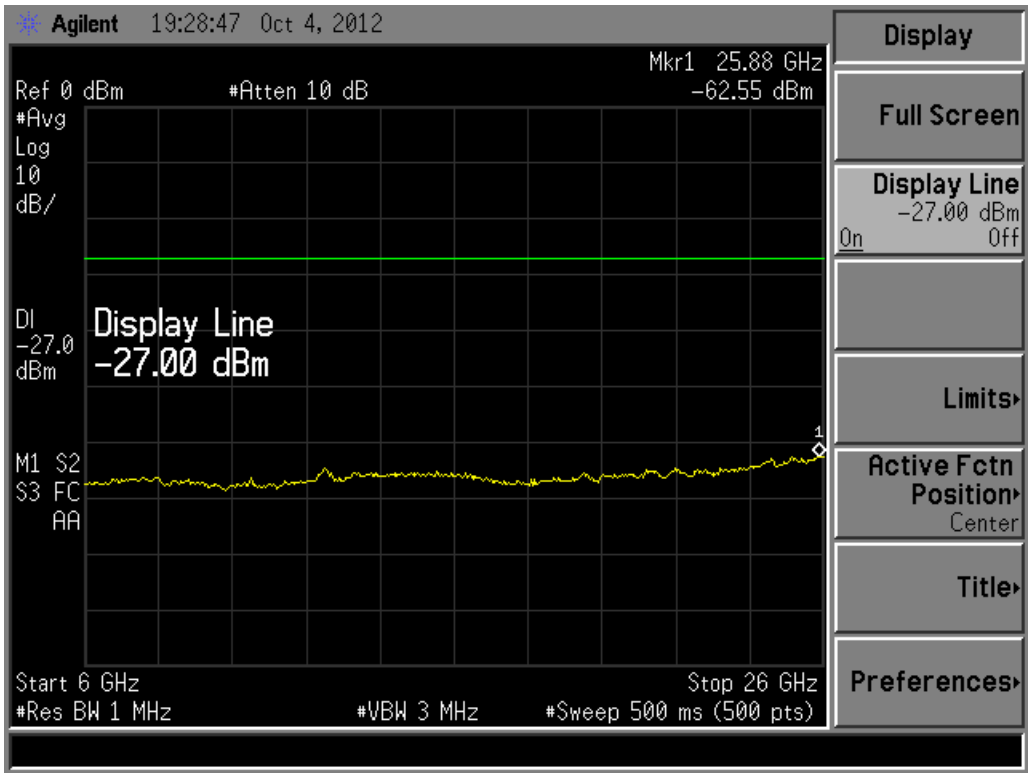
Channel 44


Agilent 19:25:06 Oct 4, 2012
Mkr1 5.222 GHz
-5.12 dBm
Ref 0 dBm
#Atten 10 dB
#Avg
Log
10
dB/
Dl
-27.0
dBm
Display Line
-27.00 dBm
M1 S2
S3 FC
AA
Start 30 MHz
#Res BW 1 MHz
#VBW 3 MHz
Stop 6 GHz
#Sweep 300 ms (500 pts)
Display
Full Screen
Display Line
-27.00 dBm
On
Off
Limits
Active Fctn
Position
Center
Title
Preferences

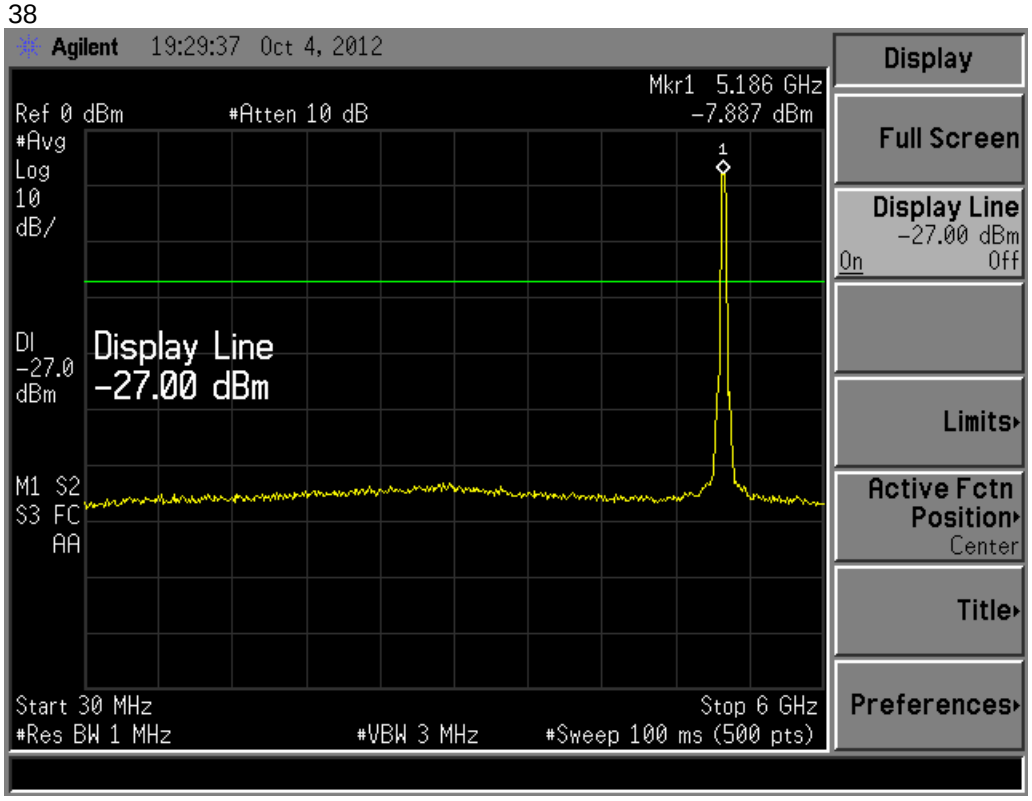

Agilent 19:25:40 Oct 4, 2012
Mkr1 25.76 GHz
-62.22 dBm
Ref 0 dBm
#Atten 10 dB
#Avg
Log
10
dB/
Dl
-27.0
dBm
Display Line
-27.00 dBm
M1 S2
S3 FC
AA
Start 6 GHz
#Res BW 1 MHz
#VBW 3 MHz
Stop 26 GHz
#Sweep 300 ms (500 pts)
Display
Full Screen
Display Line
-27.00 dBm
On
Off
Limits
Active Fctn
Position
Center
Title
Preferences

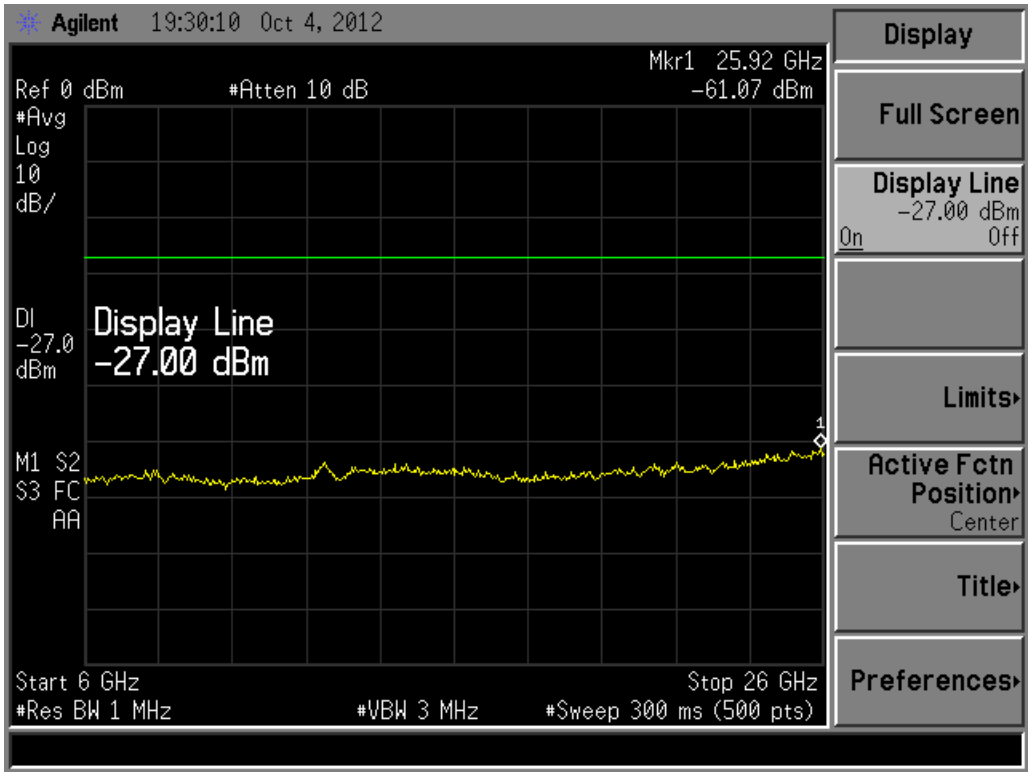
Channel 48


Agilent 19:28:10 Oct 4, 2012
Mkr1 5.246 GHz
-7.209 dBm
Ref 0 dBm
#Atten 10 dB
#Avg
Log
10
dB/
Dl
-27.0
dBm
Display Line
-27.00 dBm
M1 S2
S3 FC
AA
Start 30 MHz
#Res BW 1 MHz
#VBW 3 MHz
Stop 6 GHz
#Sweep 500 ms (500 pts)
Display
Full Screen
Display Line
-27.00 dBm
On
Off
Limits
Active Fctn
Position
Center
Title
Preferences

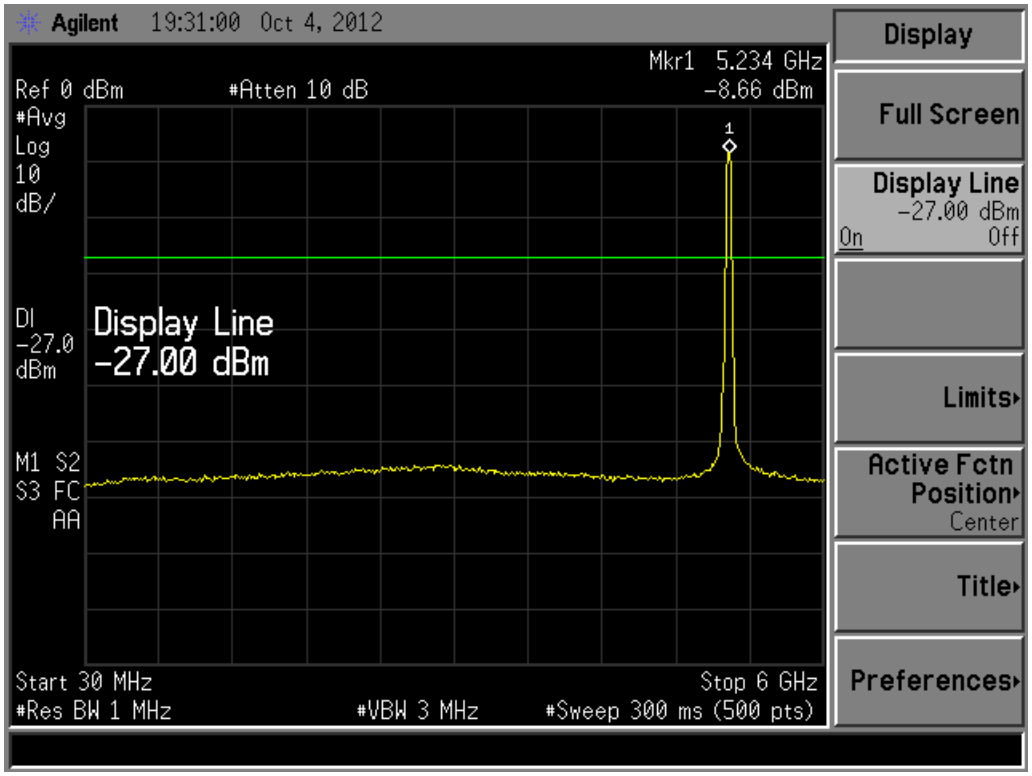

Agilent 19:28:47 Oct 4, 2012
Mkr1 25.88 GHz
-62.55 dBm
Ref 0 dBm
#Atten 10 dB
#Avg
Log
10
dB/
Dl
-27.0
dBm
Display Line
-27.00 dBm
M1 S2
S3 FC
AA
Start 6 GHz
#Res BW 1 MHz
#VBW 3 MHz
Stop 26 GHz
#Sweep 500 ms (500 pts)
Display
Full Screen
Display Line
-27.00 dBm
On
Off
Limits
Active Fctn
Position
Center
Title
Preferences

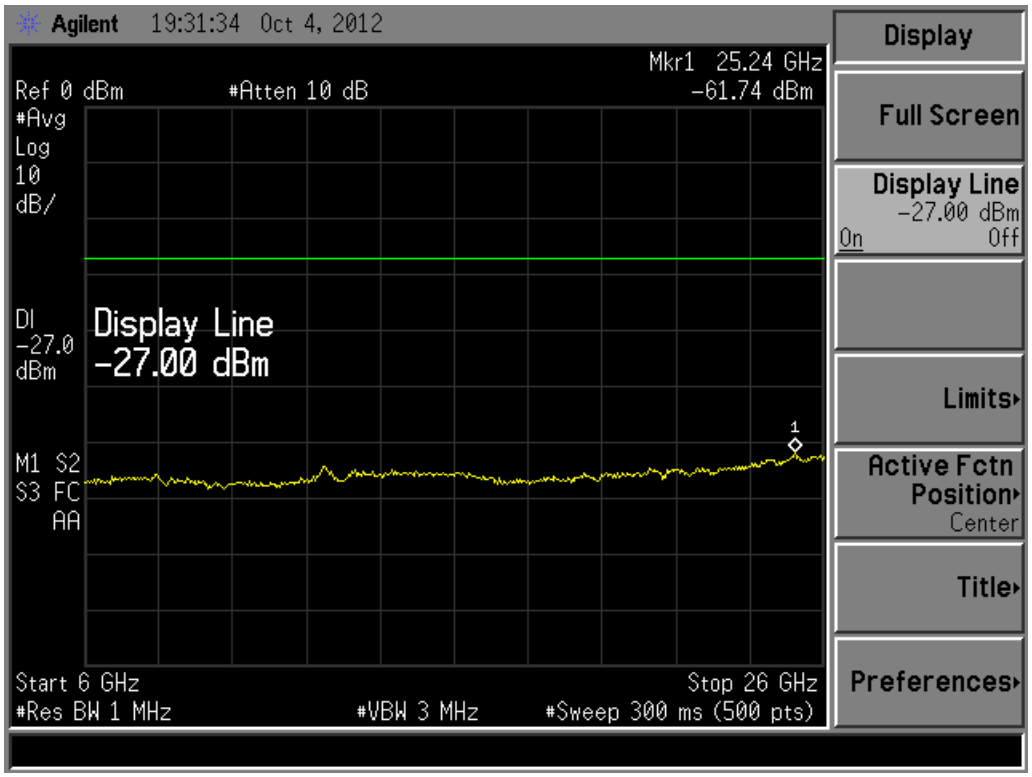
802.11n HT40 MCS Modulation Mode
*Channel 38





Channel 46





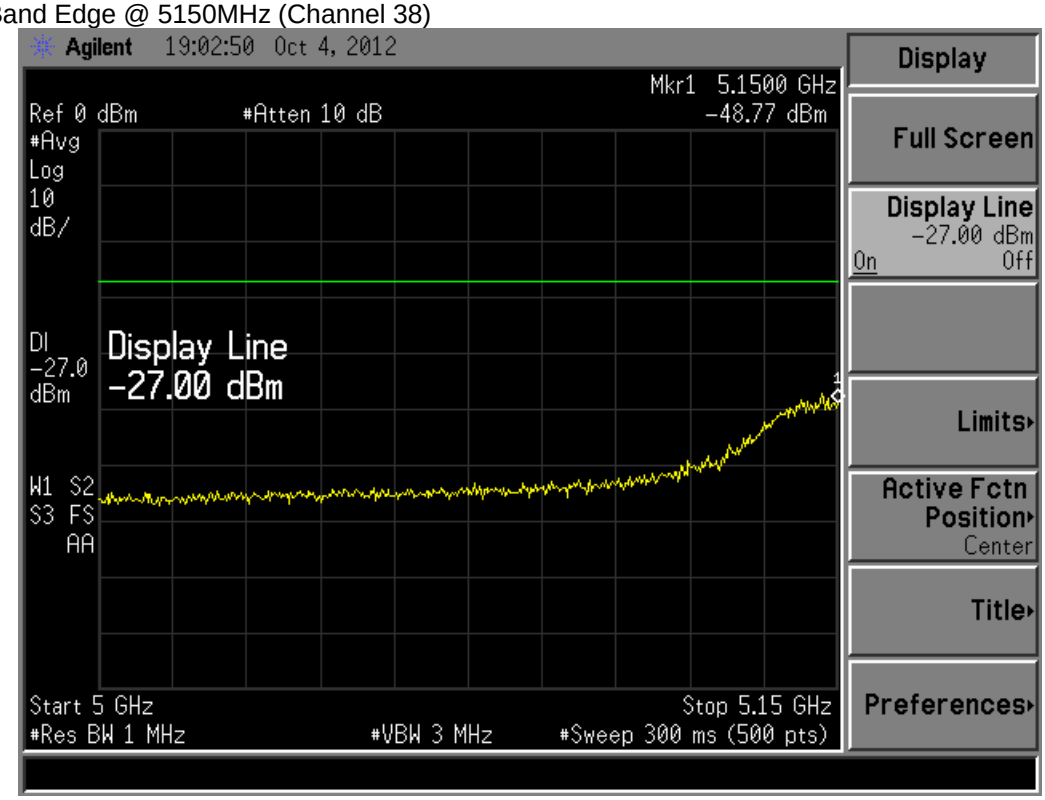
FCC Part 15.407(b)(1) Out-of-Band Antenna Conducted Emissions Limit: EIRP -27dBm/MHz
(Antenna Gain @ 5.2GHz: 1.8 dBi)

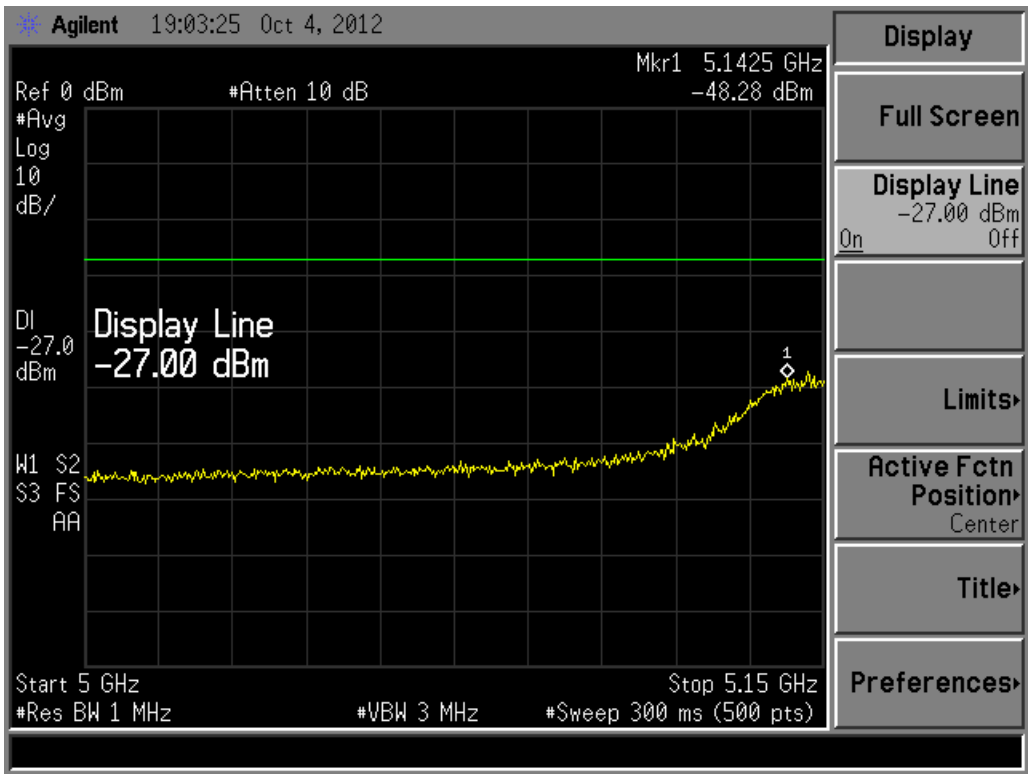
Worst-case out-of-band emission: 802.11n HT40 MCS Modulation Mode, Channel 38 (-61.07 dBm)
Therefore, -61.07 dBm + 1.8 dB (antenna gain) = EIRP -59.27 dBm (32.27 dB under the limit)

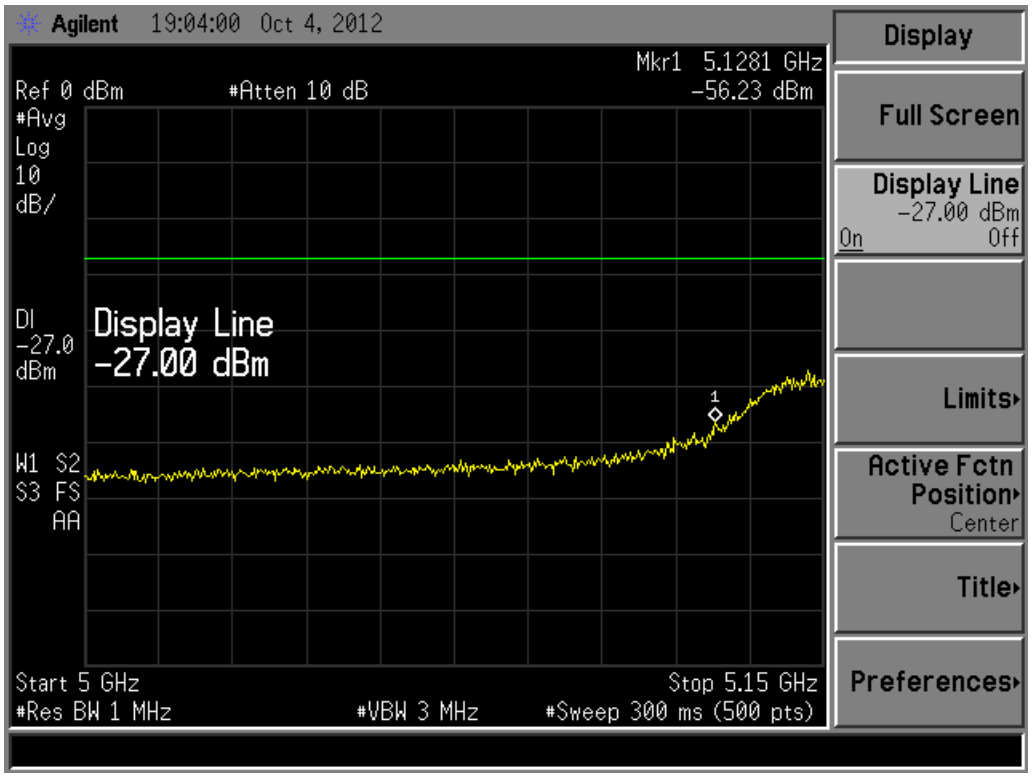
7.12 Test Data/Plots – Band Edge: Antenna 1

Channels 5150 to 5250 MHz - FCC Part 15.407(b)(1)
(Out-of-Band Antenna Conducted Emissions @ Band Edge – Antenna 1)

802.11n HT40 MCS Modulation Mode
Lower Band Edge @ 5150MHz (Channel 38)



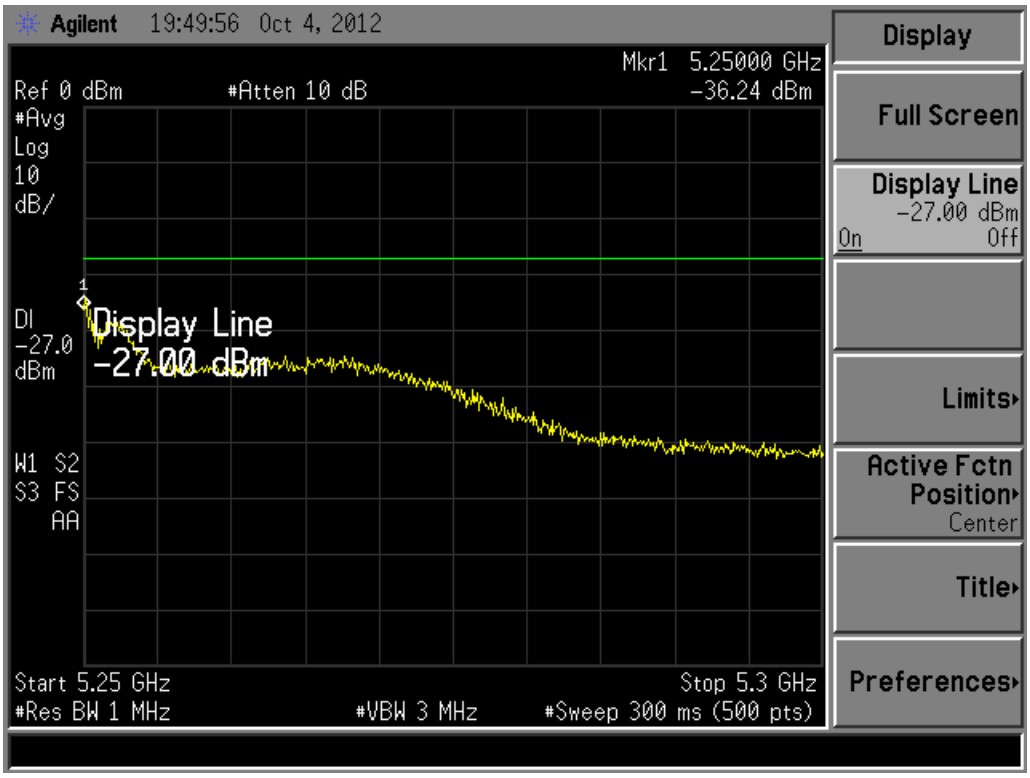


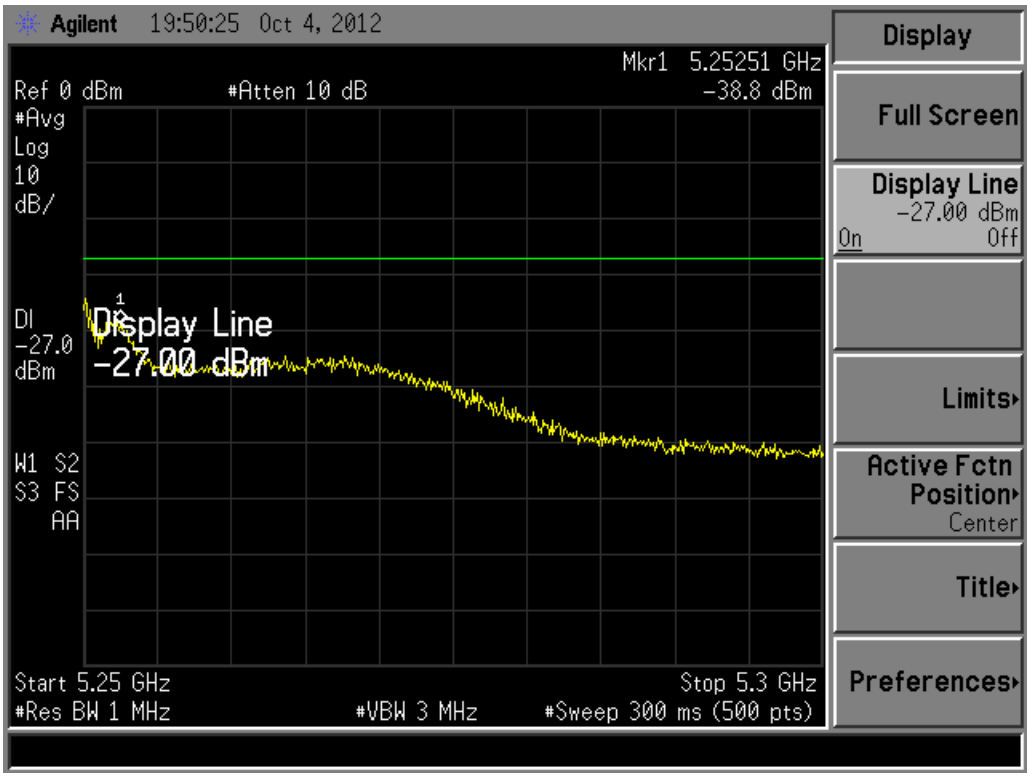


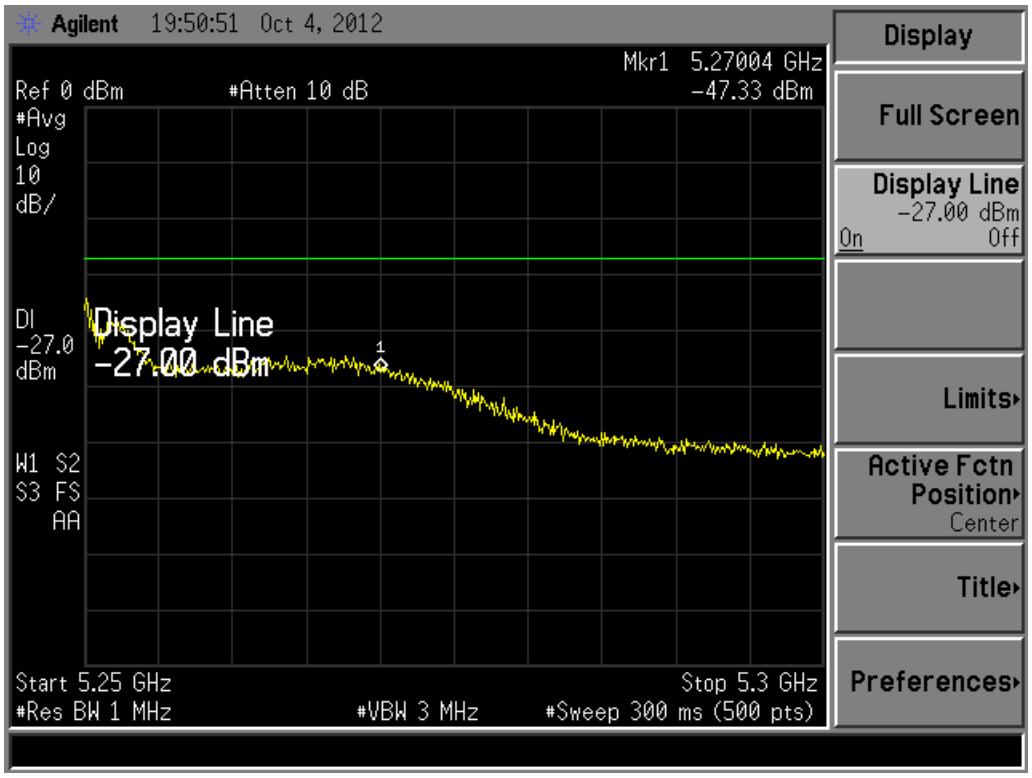
FCC 15.407(b)(1) Out-of-Band Antenna Conducted Emissions: EIRP -27dBm/MHz
(Antenna Gain @ 5.2GHz: 1.8 dBi)

Worst-case Lower Band Edge Measurement: -48.28 dBm + 1.8 dB (antenna gain) = EIRP -46.48 dBm (19.48 dB under the limit).

802.11n HT40 MCS Modulation Mode
Upper Band Edge @ 5250MHz (Channel 46)







FCC 15.407(b)(1) Out-of-Band Antenna Conducted Emissions: EIRP -27dBm/MHz
Antenna Gain @ 5.2GHz: 1.8 dBi

Worst-case Upper Band Edge Measurement: -36.24 dBm + 1.8 dB (antenna gain) = EIRP -34.44 dBm (7.44 dB under the limit).

8 Transmitter Frequency Stability

8.1 Method

Unless otherwise stated no deviations were made from FCC Part 15.407(g).

This testing was performed at Intertek Denver, located at 1795 Dogwood St. Suite 200, Louisville, CO 80027.

8.2 Test Equipment Used:

Asset ID	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
18913	Spectrum Analyzer	Hewlett-Packard	E7405A	My44211889	7/16/2012	7/16/2013
E2	RF Conducted Port Cable	-----	True Blue	001	09/12/2012	09/13/2013
18648	Environmental Chamber	Envirotronics	51-2024508	---	VBU	VBU
18940	Thermometer	Fluke	52II	90550018	05/19/2012	05/19/2013

8.3 Test Requirements:

Transmitter Frequency Stability is maintained within the band of operation under all conditions of normal operation as specified in the user's manual.

8.4 Test Procedure:

The EUT was placed in a temperature chamber and setup to transmit a carrier without modulation. The carrier frequency was measured with the spectrum analyzer with resolution bandwidth of 1kHz. The temperature was varied from 4.4ºC (40ºF) to 45ºC (113ºF), the operating temperature range stated in the user manual. After the temperature stabilized for approximately 30 minutes, the transmitting frequency was measured.

At room temperature, the frequency was measured when the EUT was powered between 90% and 110% of the nominal ac voltage.

8.5 Test Results:

The sample tested was found to Comply.

8.6 Setup Photographs:

Transmitter Frequency Stability - Test setup

8.7 Test Data Summary:

Frequency Stability - FCC Part 15.407(g)

Temperature, ℃	Frequency at Nominal Voltage, GHz	Maximum Deviation, From Frequency at 20ºC ppm
Nominal Frequency: 5.180 GHz		
4.4	5.18000300	2.51
20	5.179990000	0.00
45	5.180026450	7.04
Nominal Frequency: 5.220 GHz		
4.4	5.220001500	2.20
20	5.219990000	0.00
45	5.220022750	6.27
Nominal Frequency: 5.240 GHz		
4.4	5.240000002	0.10
20	5.239999500	0.00
45	5.240024030	4.68

Notes:

1. AC voltage was varied between ±10% of nominal with no significant change in frequency stability.
2. Manufacturer specifications for operating temperature: 40ºF (4.4ºC) to 113ºF (45ºC).
3. Manufacturer frequency tolerance specifications: 20ppm

$$\Delta f = \frac{f \times ppm}{10^6}$$

where *ppm* is the peak variation (expressed as +/-), f is the center frequency (in Hz), and Δf is the peak frequency variation (in Hz).

9 Transmitter Radiated Spurious Emissions including Band Edge

9.1 Method

Unless otherwise stated no deviations were made from FCC Part 15.407(b)(1)(6)(7) and FCC Part 15.209/205.

This testing was performed at Intertek Denver, located at 1795 Dogwood St. Suite 200, Louisville, CO 80027.

9.2 Test Equipment Used:

Asset ID	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DEN-073	EMI Receiver	RHODE & SCHWARZ	ESU 26	100265	1/11/2012	1/10/2013
18887	Horn Antenna 1-18GHz	EMCO	3115	9205-3886	2/28/2012	2/27/2013
18900	RF Pre-Amplifier (4-8 GHz)	Avantek	AFT97-8434-10F	1007	6/7/2012	6/7/2013
18901	RF Pre-Amplifier (8-16 GHz)	Avantek	AWT-18037	1002	6/7/2012	6/7/2013
18906	Amplifier (1-4 GHz)	Mini-Circuits Lab	ZHL-42	N052792-2	6/7/2012	6/7/2013
18912	9 kHz- 1.3GHz Pre Amp	Hewlett-Packard	8447F	3113A05545	6/6/2012	6/6/2013
19936	Bilog Antenna 30MHz - 6GHz	Sunol Sciences	JB6	A050707-1	11/15/2011	11/14/2012
SW-6	Software for Radiated and Conducted emissions.	Intertek	OATS vba	V. 3.0	VBU	VBU
18805	**Harmonic Mixer**	**HP**	**11970K**	**2332A01280**	**10/4/2010**	**10/4/2012**
18806	Harmonic Mixer	HP	11970A	3003A07640	10/15/2010	**10/15/2012**
18913	Spectrum Analyzer	Hewlett-Packard	E7405A	My44211889	7/16/2012	7/16/2013

9.3 Test Requirement:

Radiated emissions which fall in the restricted bands, as defined in FCC Part 15.205(a), must also comply with the radiated emission limits specified in Part 15.209(a) and Part 15.205(c). Measurements in the restricted bands include both peak detector and average detector measurements.
Measurements in non-restricted bands include peak detector measurements.

For transmitters operating in the 5.15–5.25 GHz band: all emissions outside of the 5.15–5.25 GHz band shall not exceed an EIRP of –27 dBm/MHz.

Note: This corresponds to a peak field strength level of 68.3 dB(µV/m) at 3-meter test distance when measured with a 1 MHz resolution bandwidth.

Unwanted emissions below 1GHz must comply with the general field strength limits defined in FCC Part 15.209, when measured with a quasi-peak detector.

9.4 Test Procedure:

The Resolution Bandwidth is 100 kHz or greater for frequencies 30 MHz -1000 MHz and 1 MHz for frequencies above 1000 MHz.

The EUT is placed on a plastic turntable that is 80 cm in height. If the EUT attaches to peripherals, they are connected and operational (as typical as possible). During testing, all cables are manipulated to produce worst-case emissions. The signal is maximized by rotating the turntable through a 360º rotation. The antenna height is varied from 1-4 meters. Both vertical and horizontal antenna configurations are utilized in the testing.

Radiated emissions are taken at 3-meter antenna-to-product test distance for all measurements.

Data is included for the worst-case configuration (the configuration which resulted in the highest emission levels).

The procedures described in the FCC Publication 789033 (Guidelines for Compliance Testing of U-NII Devices), were used.

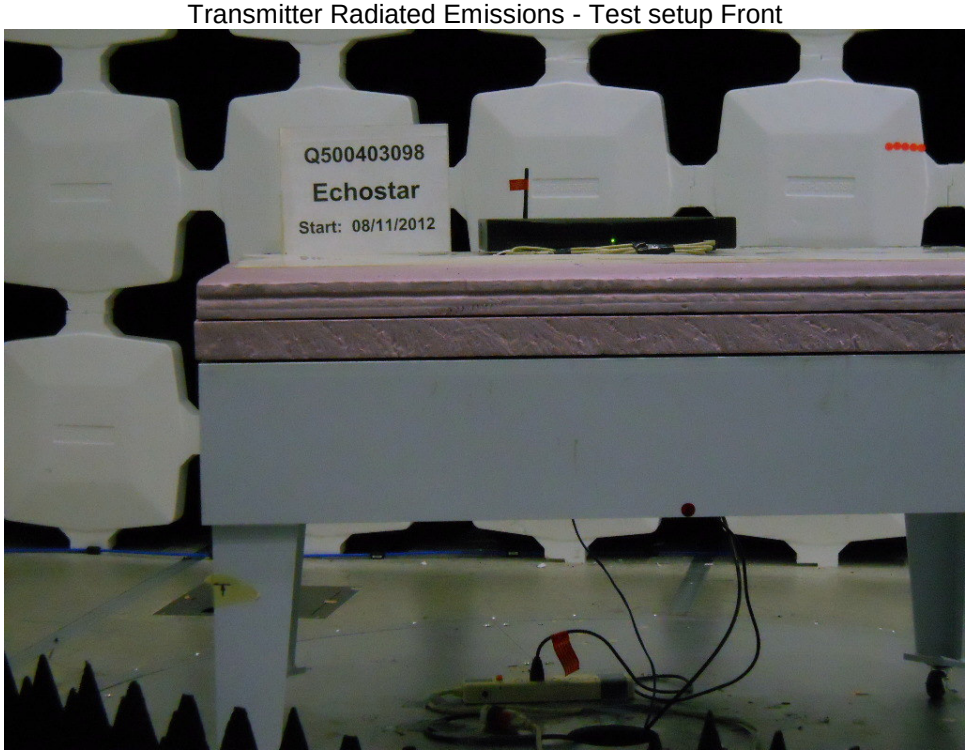
- FCC Part 15.407 G)

9.5 Test Results:

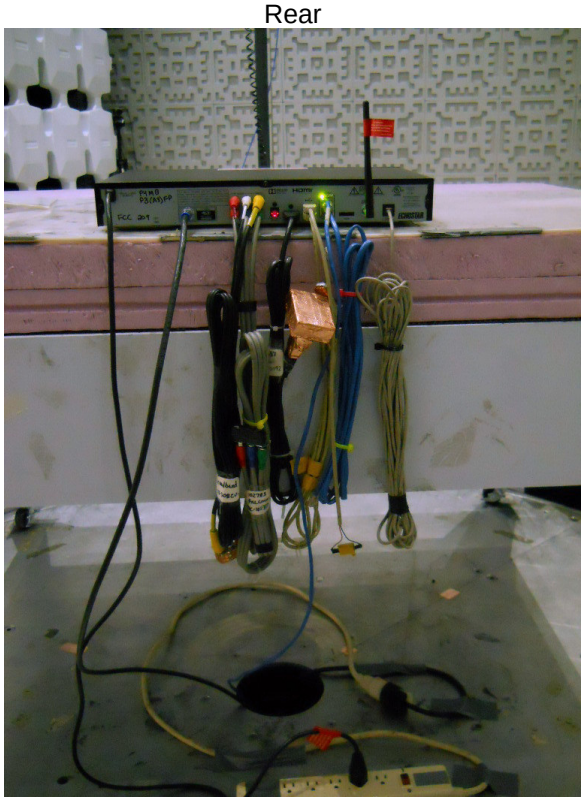
The sample tested was found to Comply.

9.6 Setup Photographs:

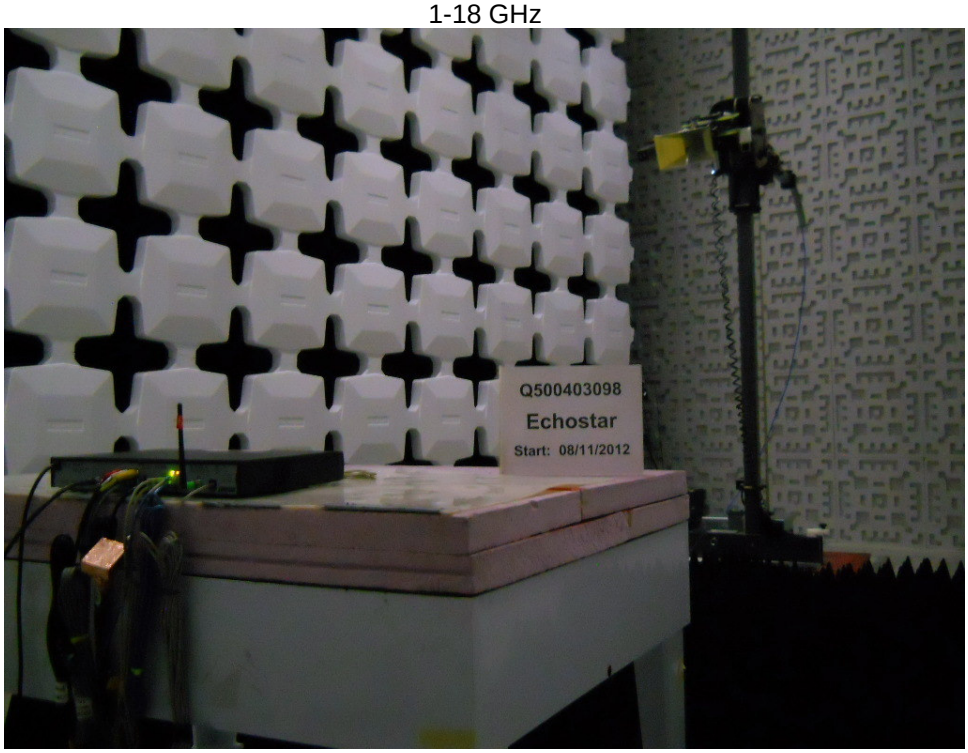
Transmitter Radiated Emissions - Test setup Front



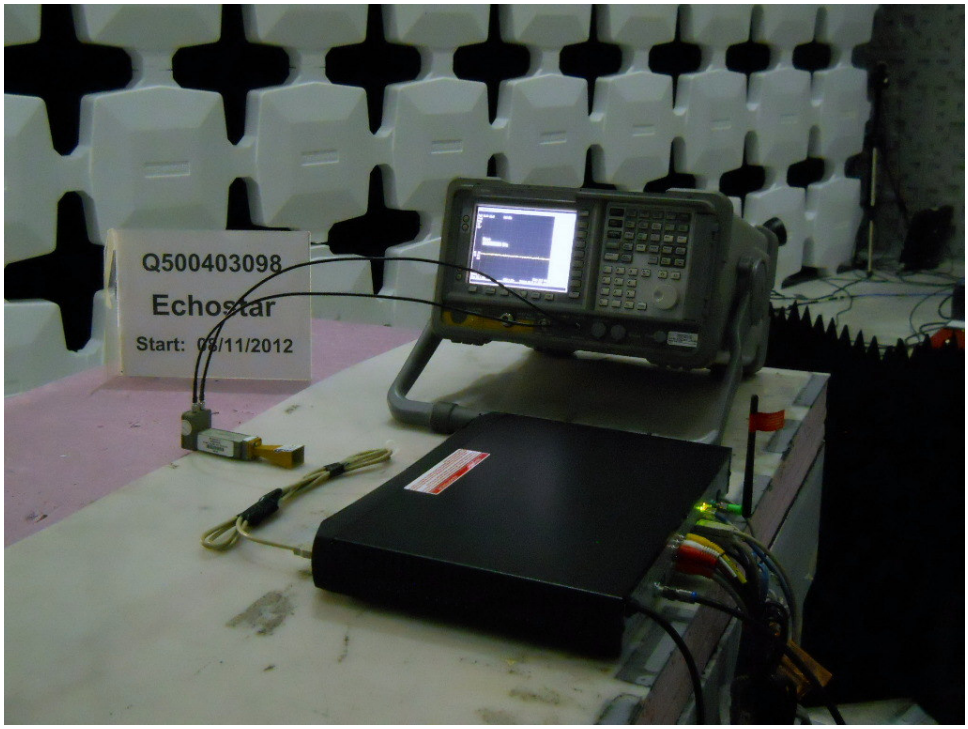
Rear



Antenna Setups
1-18 GHz



18-40GHz



9.7 Test Data – 802.11a

9.7.1 Radiated Harmonics in Restricted Bands – 802.11a

Test Report #:	100900227DEN-004	Test Area:	CC1		Temperature:	23.1	C
Test Method:		Test Date:	9/22/2012		Relative Humidity:	25.9	%
EUT Model #:	ID:058	EUT Power:	120V / 60Hz		Air Pressure:	84.09	kPa
EUT Serial #:	EMC1					Page:	
Manufacturer:	Echostar				Level Key		
EUT Description:	Advanced Satellite Receiver Set-Top Box				Pk - Peak	Nb - Narrow Band	
Notes:					Qp - QuasiPeak	Bb - Broad Band	
					Av - Average		

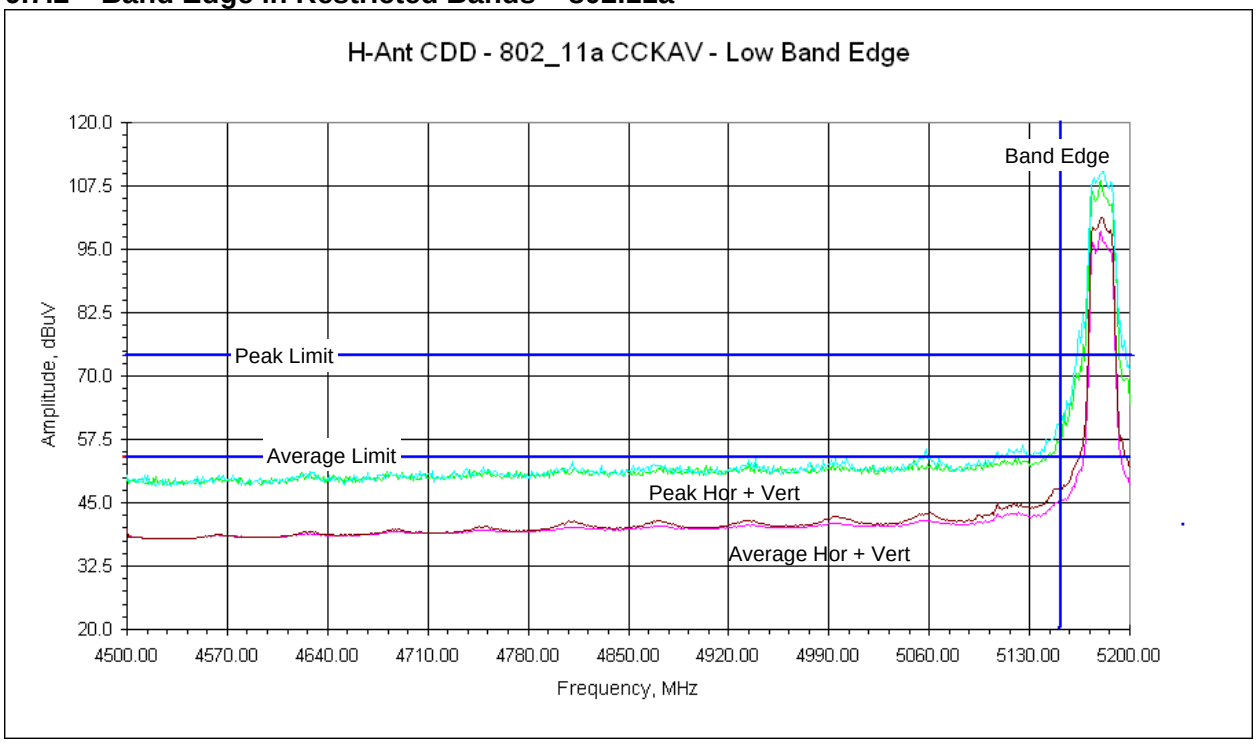
5GHz Band - 15.407 Tests

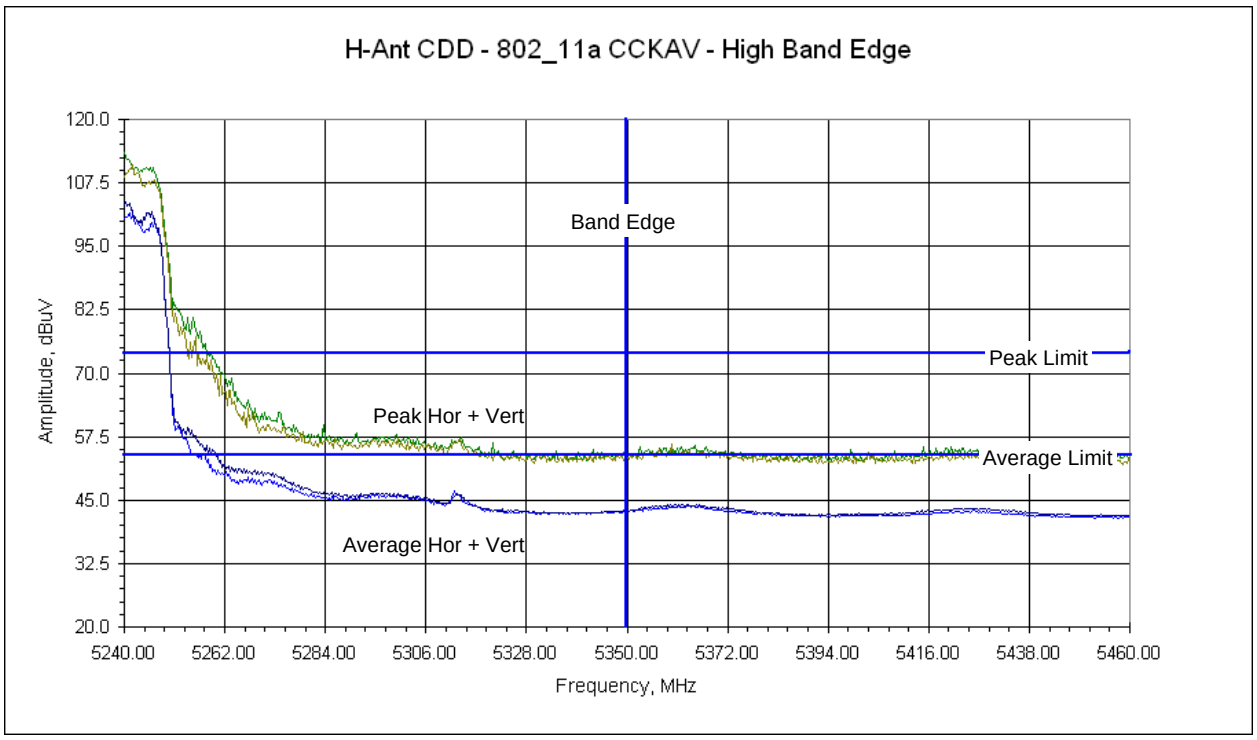
FREQ	LEVEL	DET	CABLE	ANT	PREAMP	ATTEN	FINAL	POL	HGT	AZ	Limit	DELTA1	RBW
MHz	dBuV	Qp Av Pk	+ [dB]	+ [dB/m]	- [dB]	+ [dB]	= [dBuV]	(V/H)	(m)	(DEG)	dBuV/m	15.209 >1GHz	(MHz)
802.11a													
Low Channel - CDD													
15540.0	46.69	Pk	9.91	40.11	47.85	4.26	53.12	H	1.00	360.0	74.0	- 20.88	1.00
15540.0	32.77	Av	9.91	40.11	47.85	4.26	39.20	H	1.00	360.0	54.0	- 14.80	1.00
15540.0	46.45	Pk	9.91	40.11	47.85	4.26	52.88	V	1.00	0.0	74.0	- 21.12	1.00
15540.0	32.78	Av	9.91	40.11	47.85	4.26	39.21	V	1.00	0.0	54.0	- 14.79	1.00
Mid Channel - CDD													
15660.0	45.50	Pk	9.99	39.52	47.94	4.16	51.23	H	1.00	360.0	74.0	- 22.77	1.00
15660.0	31.80	Av	9.99	39.52	47.94	4.16	37.53	H	1.00	360.0	54.0	- 16.47	1.00
15660.0	45.29	Pk	9.99	39.52	47.94	4.16	51.02	V	1.19	48.0	74.0	- 22.98	1.00
15660.0	31.88	Av	9.99	39.52	47.94	4.16	37.61	V	1.19	48.0	54.0	- 16.39	1.00
No harmonics were found above 18GHz. The following are noise floor measurements.													
20880.0	33.96	Pk	0.00	21.65	0.00	0.00	55.61	V			74.0	- 18.39	1.00
20880.0	- 0.49	Av	0.00	21.65	0.00	0.00	21.16	V			54.0	- 32.84	1.00
20880.0	33.59	Pk	0.00	21.65	0.00	0.00	55.24	H			74.0	- 18.76	1.00
20880.0	- 0.41	Av	0.00	21.65	0.00	0.00	21.24	H			54.0	- 32.76	1.00
31320.0	34.11	Pk	0.00	22.39	0.00	0.00	56.50	V			74.0	- 17.50	1.00
31320.0	- 0.58	Av	0.00	22.39	0.00	0.00	21.81	V			54.0	- 32.19	1.00
31320.0	34.51	Pk	0.00	22.39	0.00	0.00	56.90	H			74.0	- 17.10	1.00
31320.0	- 0.61	Av	0.00	22.39	0.00	0.00	21.78	H			54.0	- 32.22	1.00
Mid Channel - Ant 0													
15660.0	45.50	Pk	9.99	39.52	47.94	4.16	51.23	H	1.53	22.0	54.0	- 2.77	1.00
15660.0	31.80	Av	9.99	39.52	47.94	4.16	37.53	H	1.53	22.0	74.0	- 36.47	1.00
15660.0	45.41	Pk	9.99	39.52	47.94	4.16	51.14	V	1.14	360.0	54.0	- 2.86	1.00
15660.0	31.69	Av	9.99	39.52	47.94	4.16	37.42	V	1.14	360.0	74.0	- 36.58	1.00
Mid Channel - Ant 1													
15660.0	45.17	Pk	9.99	39.52	47.94	4.16	50.90	H	1.00	0.0	74.0	- 23.10	1.00
15660.0	31.56	Av	9.99	39.52	47.94	4.16	37.29	H	1.00	0.0	54.0	- 16.71	1.00
15660.0	45.51	Pk	9.99	39.52	47.94	4.16	51.24	V	1.00	360.0	74.0	- 22.76	1.00
15660.0	31.68	Av	9.99	39.52	47.94	4.16	37.41	V	1.00	360.0	54.0	- 16.59	1.00

High Channel - CDD

15720.0	44.79	Pk	10.02	39.39	47.97	4.13	50.35	H	1.00	70.0	54.0	- 3.65	1.00
15720.0	31.40	Av	10.02	39.39	47.97	4.13	36.96	H	1.00	70.0	74.0	- 37.04	1.00
15720.0	45.46	Pk	10.02	39.39	47.97	4.13	51.02	V	1.19	70.0	54.0	- 2.98	1.00
15720.0	31.36	Av	10.02	39.39	47.97	4.13	36.92	V	1.19	70.0	74.0	- 37.08	1.00
36456.0	- 0.56	Av	0.00	22.08	0.00	0.00	21.52	H			54.0	- 32.48	1.00

9.7.2 Band Edge in Restricted Bands – 802.11a





9.8 Test Data – 802.11n HT20

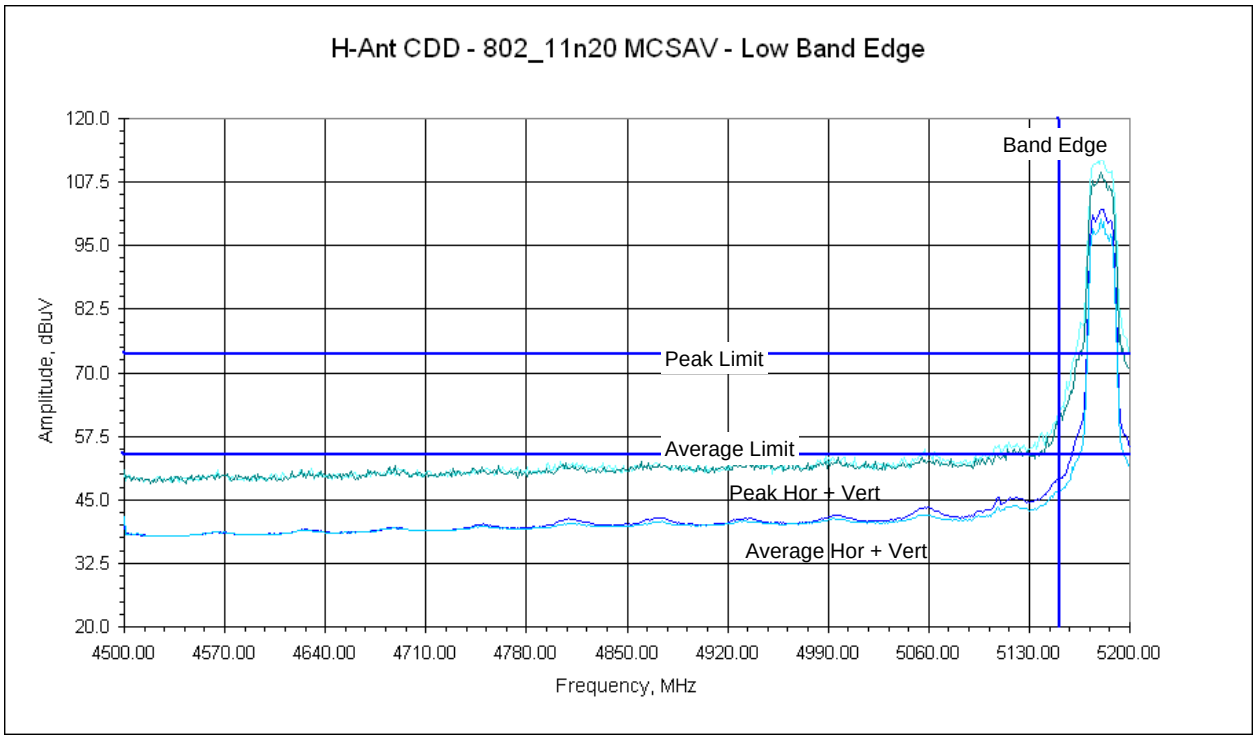
9.8.1 Radiated Harmonics in Restricted Bands

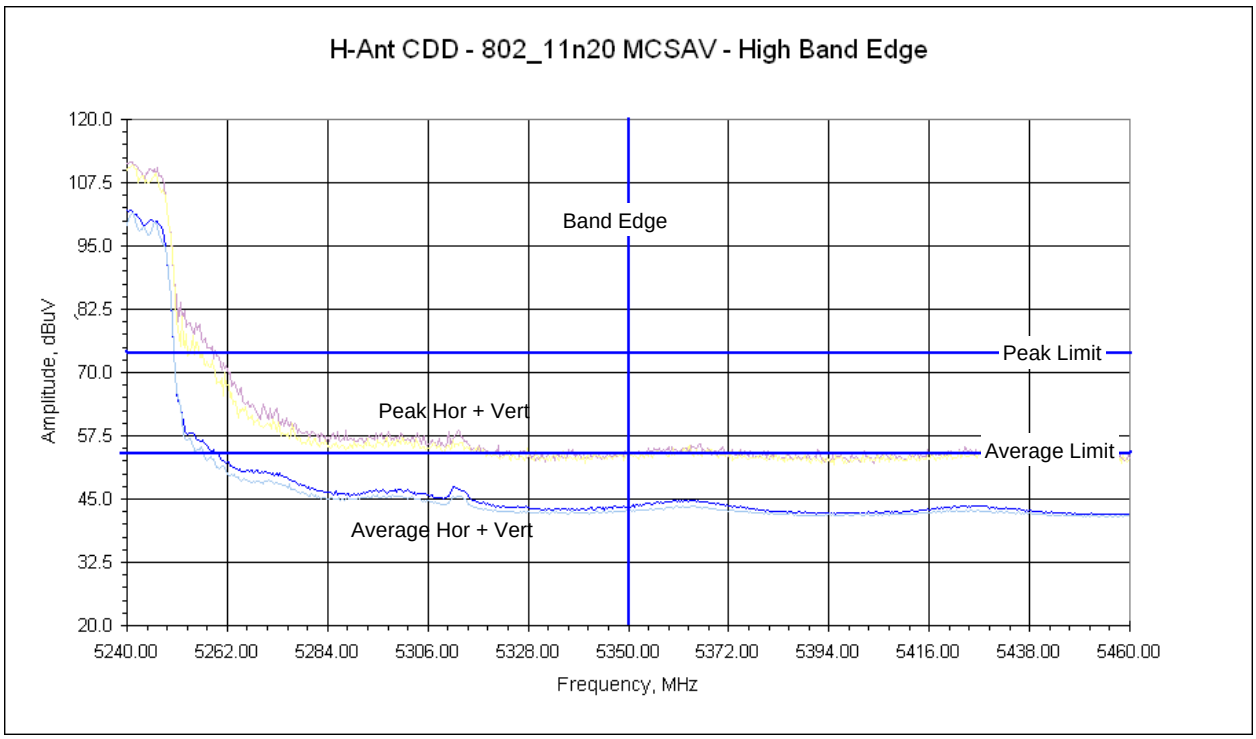
Test Report #:	100900227DEN-004	Test Area:	CC1		Temperature:	23.1	C
Test Method:		Test Date:	9/22/2012		Relative Humidity:	25.9	%
EUT Model #:	ID:058	EUT Power:	120V / 60Hz		Air Pressure:	84.09	kPa
EUT Serial #:	EMC1					Page:	
Manufacturer:	Echostar				Level Key		
EUT Description:	Advanced Satellite Receiver Set-Top Box				Pk - Peak	Nb - Narrow Band	
Notes:					Qp - QuasiPeak	Bb - Broad Band	
					Av - Average		

5GHz Band - 15.407 Tests

FREQ	LEVEL	DET	CABLE	ANT	PREAMP	ATTEN	FINAL	POL	HGT	AZ	Limit	DELTA1	RBW
MHz	dBuV	Qp Av Pk	+ [dB]	+ [dB/m]	- [dB]	+ [dB]	= [dBuV]	(V/H)	(m)	(DEG)	dBuV/m	15.209 >1GHz	(MHz)
802.11n(20) - CDD													
Low Ch													
15546.0	46.00	Pk	9.94	39.91	47.88	4.23	52.19	H	1.00	265.0	74.0	- 21.81	1.00
15546.0	32.37	Av	9.94	39.91	47.88	4.23	38.56	H	1.00	265.0	54.0	- 15.44	1.00
15546.0	46.51	Pk	9.94	39.91	47.88	4.23	52.70	V	1.00	346.0	74.0	- 21.30	1.00
15546.0	32.45	Av	9.94	39.91	47.88	4.23	38.64	V	1.00	346.0	54.0	- 15.36	1.00
Mid Ch													
15660.0	46.16	Pk	9.99	39.52	47.94	4.16	51.89	H	1.00	360.0	74.0	- 22.11	1.00
15660.0	31.70	Av	9.99	39.52	47.94	4.16	37.43	H	1.00	360.0	54.0	- 16.57	1.00
15660.0	46.16	Pk	9.99	39.52	47.94	4.16	51.89	V	1.00	23.0	74.0	- 22.11	1.00
15660.0	31.85	Av	9.99	39.52	47.94	4.16	37.58	V	1.00	23.0	54.0	- 16.42	1.00
No harmonics were found above 18GHz. The following are noise floor measurements.													
20880.0	34.86	Pk	0.00	21.65	0.00	0.00	56.51	V			74.0	- 17.49	1.00
20880.0	- 0.38	Av	0.00	21.65	0.00	0.00	21.27	V			54.0	- 32.73	1.00
20880.0	33.83	Pk	0.00	21.65	0.00	0.00	55.48	H			74.0	- 18.52	1.00
20880.0	- 0.38	Av	0.00	21.65	0.00	0.00	21.27	H			54.0	- 32.73	1.00
31320.0	34.19	Pk	0.00	22.39	0.00	0.00	56.58	V			74.0	- 17.42	1.00
31320.0	- 0.60	Av	0.00	22.39	0.00	0.00	21.79	V			54.0	- 32.21	1.00
31320.0	33.51	Pk	0.00	22.39	0.00	0.00	55.90	V			74.0	- 18.10	1.00
31320.0	- 0.59	Av	0.00	22.39	0.00	0.00	21.80	V			54.0	- 32.20	1.00
High Ch													
15660.0	45.43	Pk	9.99	39.52	47.94	4.16	51.16	H	1.00	111.0	74.0	- 22.84	1.00
15660.0	31.82	Av	9.99	39.52	47.94	4.16	37.55	H	1.00	111.0	54.0	- 16.45	1.00
15660.0	45.43	Pk	9.99	39.52	47.94	4.16	51.16	V	1.00	230.0	74.0	- 22.84	1.00
15660.0	31.82	Av	9.99	39.52	47.94	4.16	37.55	V	1.00	230.0	54.0	- 16.45	1.00

9.8.2 Band Edge in Restricted Bands – 802. 11n HT20





9.9 Test Data – 802.11n HT40

9.9.1 Radiated Harmonics in Restricted Bands

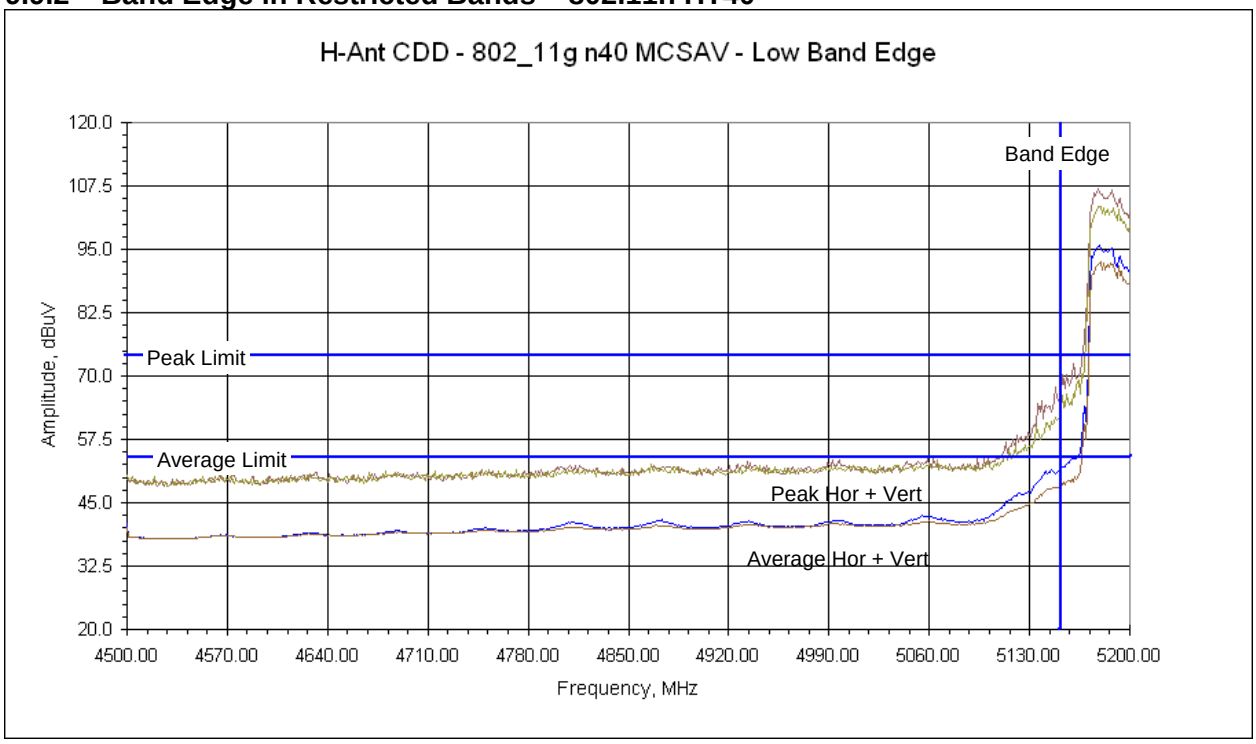
Test Report #:	100900227DEN-004	Test Area:	CC1		Temperature:	23.1	C
Test Method:		Test Date:	9/22/2012		Relative Humidity:	25.9	%
EUT Model #:	ID:058	EUT Power:	120V / 60Hz		Air Pressure:	84.09	kPa
EUT Serial #:	EMC1					Page:	
Manufacturer:	Echostar				Level Key		
EUT Description:	Advanced Satellite Receiver Set-Top Box				Pk - Peak	Nb - Narrow Band	
Notes:					Qp - QuasiPeak	Bb - Broad Band	
					Av - Average		

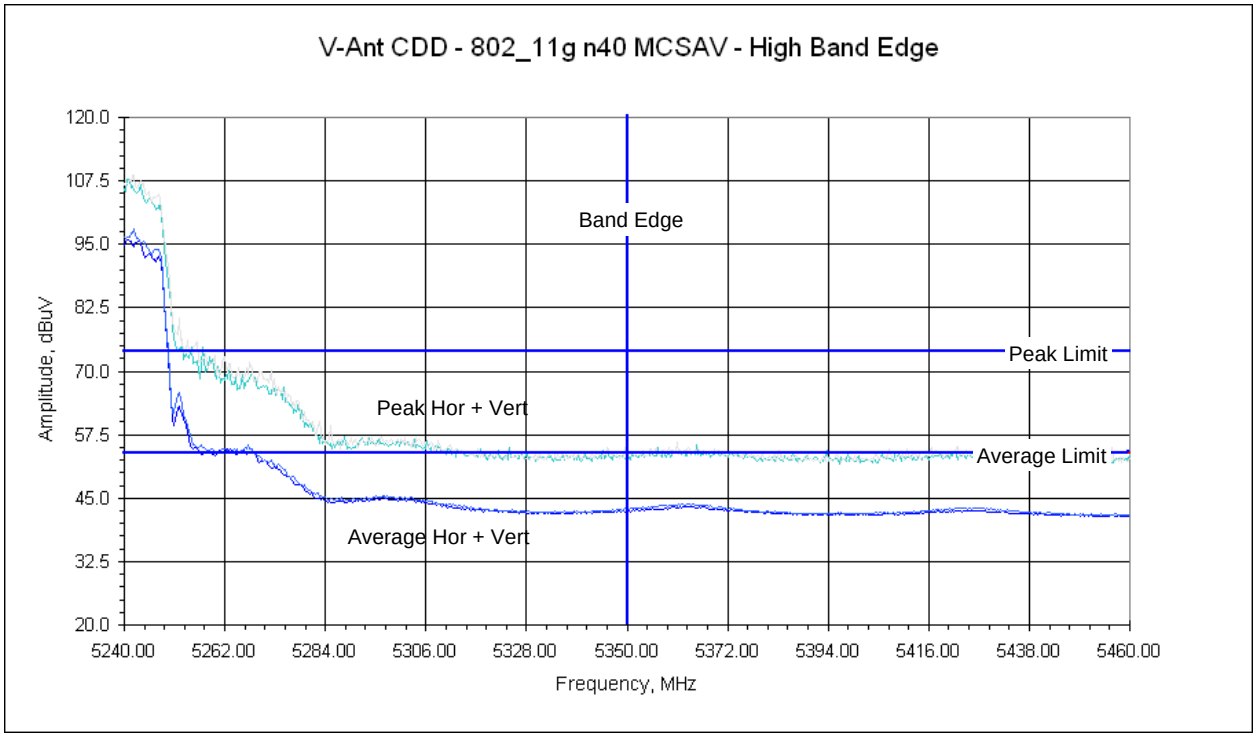
5GHz Band - 15.407 Tests

FREQ	LEVEL	DET	CABLE	ANT	PREAMP	ATTEN	FINAL	POL	HGT	AZ	Limit	DELTA1	RBW
MHz	dBuV	Qp Av Pk	+ [dB]	+ [dB/m]	- [dB]	+ [dB]	= [dBuV]	(V/H)	(m)	(DEG)	dBuV/m	15.209 >1GHz	(MHz)
802.11n(40) - CDD													
Low Ch											54.0		
15573.0	45.37	Pk	9.95	39.81	47.89	4.21	51.44	H	1.00	120.0	54.0	- 2.56	1.00
15573.0	31.60	Av	9.95	39.81	47.89	4.21	37.68	H	1.00	120.0	74.0	- 36.32	1.00
15573.0	45.28	Pk	9.95	39.81	47.89	4.21	51.36	V	1.00	360.0	54.0	- 2.64	1.00
15573.0	31.60	Av	9.95	39.81	47.89	4.21	37.68	V	1.00	360.0	74.0	- 36.32	1.00
High Ch											54.0		
15613.0	45.79	Pk	9.97	39.67	47.92	4.19	51.70	H	1.00	290.0	74.0	- 22.30	1.00
15613.0	31.85	Av	9.97	39.67	47.92	4.19	37.76	H	1.00	290.0	54.0	- 16.24	1.00
15613.0	46.00	Pk	9.97	39.67	47.92	4.19	51.91	V	1.00	52.0	74.0	- 22.09	1.00
15613.0	31.85	Av	9.97	39.67	47.92	4.19	37.76	V	1.00	52.0	54.0	- 16.24	1.00
No harmonics were found above 18GHz. The following are noise floor measurements.													
20832.0	33.50	Pk	0.00	21.69	0.00	0.00	55.19	V			74.0	- 18.81	1.00
20832.0	- 0.36	Av	0.00	21.69	0.00	0.00	21.33	V			54.0	- 32.67	1.00
20832.0	34.19	Pk	0.00	21.69	0.00	0.00	55.88	H			74.0	- 18.12	1.00
20832.0	- 0.39	Av	0.00	21.69	0.00	0.00	21.30	H			54.0	- 32.70	1.00
31248.0	31.56	Pk	0.00	22.35	0.00	0.00	53.91	V			74.0	- 20.09	1.00
31248.0	- 0.34	Av	0.00	22.35	0.00	0.00	22.01	V			54.0	- 31.99	1.00
31248.0	35.02	Pk	0.00	22.35	0.00	0.00	57.37	H			74.0	- 16.63	1.00
31248.0	- 0.34	Av	0.00	22.35	0.00	0.00	22.01	H			54.0	- 31.99	1.00
36456.0	34.32	Pk	0.00	22.08	0.00	0.00	56.40	V			74.0	- 17.60	1.00
36456.0	- 0.56	Av	0.00	22.08	0.00	0.00	21.52	V			54.0	- 32.48	1.00
36456.0	34.06	Pk	0.00	22.08	0.00	0.00	56.14	H			74.0	- 17.86	1.00
36456.0	- 0.56	Av	0.00	22.08	0.00	0.00	21.52	H			54.0	- 32.48	1.00

Note: Harmonics above 18GHz were not seen and were only measured for the center channel of the band for any particular modulation type.

9.9.2 Band Edge in Restricted Bands – 802.11n HT40





Example calculation:

Measured Level	+	Transducer, Cable Loss & Amplifier corrections	=	Corrected Reading	Specification Limit	-	Corrected Reading	=	Delta Specification
(dBµV)		(dB)		(dBµV/m)	(dBµV/m)		(dBµV/m)		
14.0		**14.9**		**28.9**	**40.0**		**28.9**		**-11.1**

Notes: None

Deviations, Additions, or Exclusions: None

10 AC Mains Conducted Emissions

10.1 Method

Unless otherwise stated no deviations were made from FCC Part 15.207.

This testing was performed at Intertek Denver, located at 1795 Dogwood St. Suite 200, Louisville, CO 80027.

10.2 Test Equipment Used:

Asset ID	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
18885	Transient Limiter	Hewlett-Packard	11947A	3107A00700	5/3/2012	5/3/2013
DEN-073	EMI Receiver	RHODE & SCHWARZ	ESU 26	100265	1/11/2012	1/10/2013
18914	Single Phase LISN	EMCO	3816/NM	9408-1003	4/5/2012	4/5/2013
SW-6	Software for Radiated and Conducted emissions.	Intertek	OATS vba	V. 2.0	VBU	VBU

10.3 Test Requirement:

The product must pass the AC Conducted average and quasi-peak Class B Limits defined in FCC Part 15.207.

10.4 Test Procedure:

Measurements are carried out using quasi-peak and average detector receivers in accordance with CISPR 16. An AMN is required to provide a pre-determined impedance at all frequencies across the power feed at the point of measurement of terminal voltage and also to provide isolation of the circuit under test from the ambient noise on the power lines. An AMN as defined in CISPR 16 shall be used. The EUT is located so that the distance between the boundary of the EUT and the closest surface of the AMN is 0.8m.

Where a flexible mains cord is provided by the manufacturer, this shall be 1m long or if in excess of 1m, the excess cable is folded back and forth as far as possible so as to form a bundle not exceeding 0.4m in length.
The EUT is arranged and connected with cables terminated in accordance with the product specification.

Conducted disturbance is measured between the phase lead and the reference ground, and between the neutral lead and the reference ground. Both measured values are reported.

The EUT, where intended for tabletop use, is placed on a table whose top is 0.8m above the ground plane. A vertical, metal reference plane is placed 0.4m from the EUT. The vertical metal reference-plane is at least 2m by 2m. The EUT shall be kept at least 0.8m from any other metal surface or other ground plane not being part of the EUT. The table is constructed of non-conductive materials. Its dimensions are 1m by 1.5m, but may be extended for larger EUT.

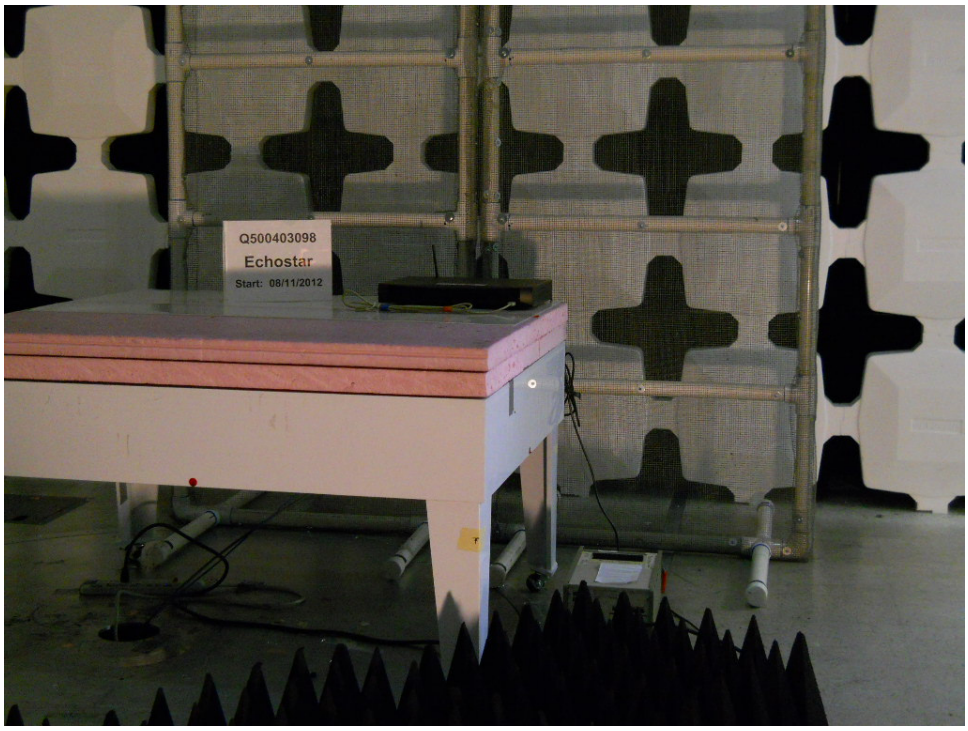
Equipment setup for conducted disturbance tests followed the guidelines of ANSI C63.4.

10.5 Test Results:

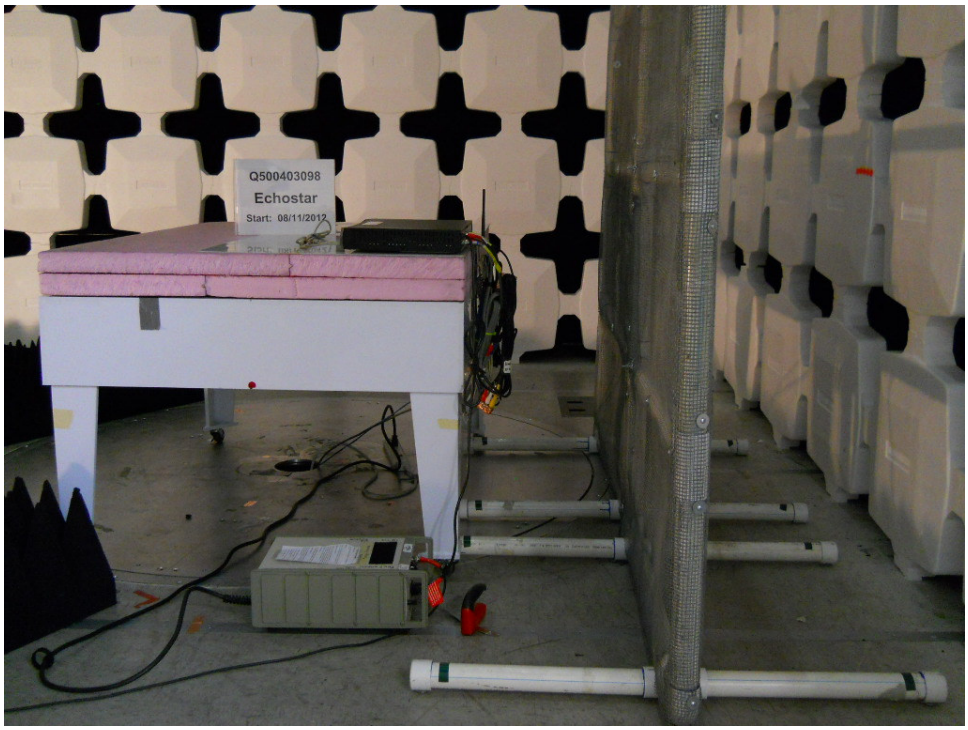
The sample tested was found to Comply.

10.6 Setup Photographs:

Test Setup – Conducted Emissions (Front View)



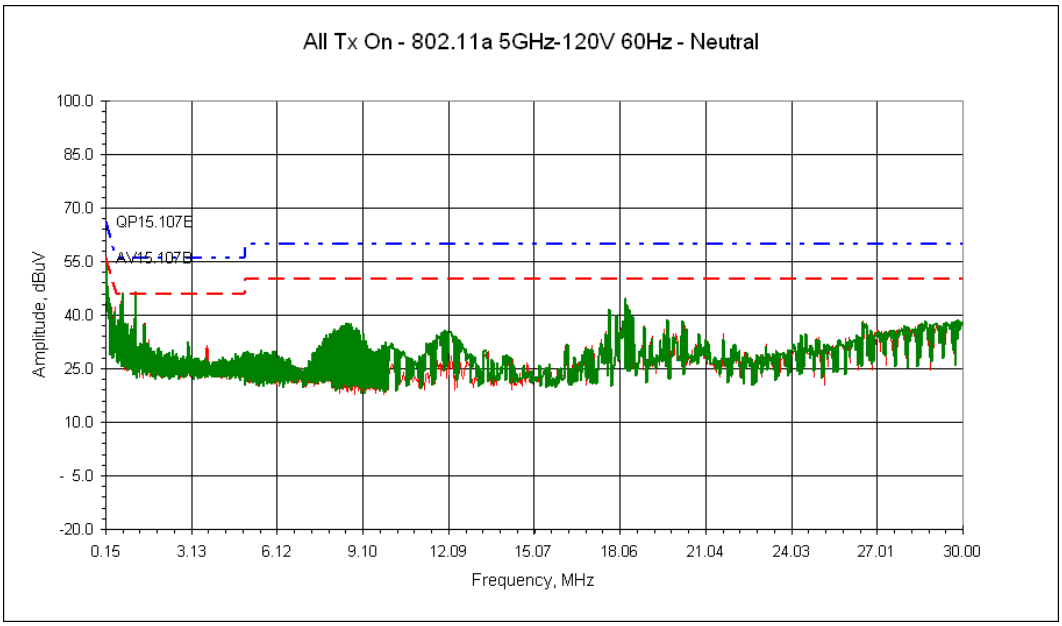
Test Setup – Conducted Emissions (Side View)



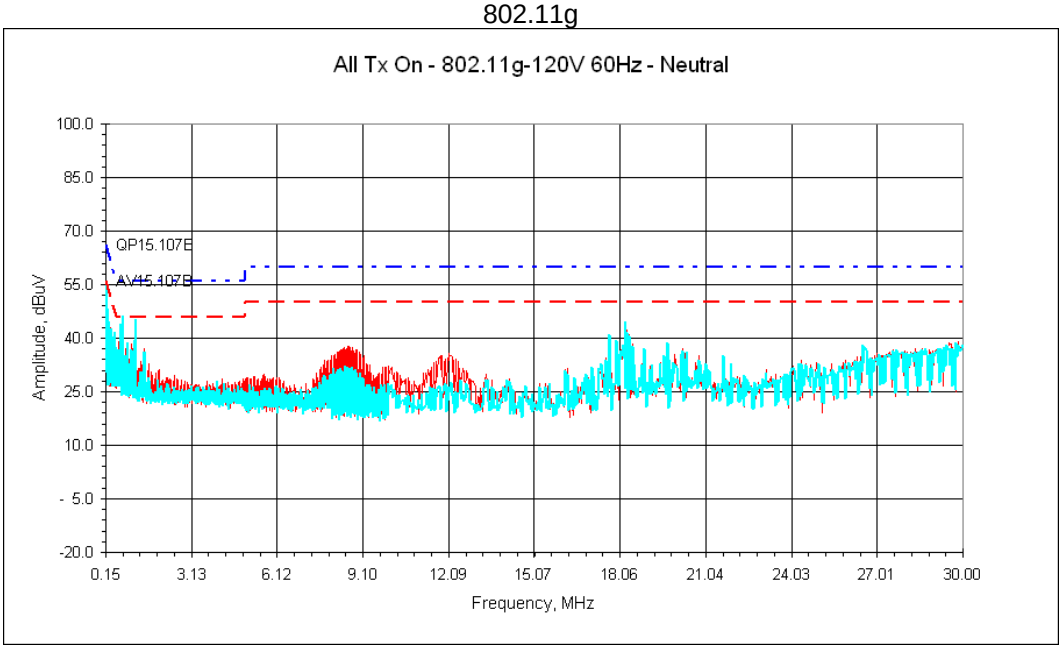
10.7 Plots: Tx Enabled Conducted Emissions

Conducted Emissions – FCC 15.107, Class B (150 kHz to 30 MHz)

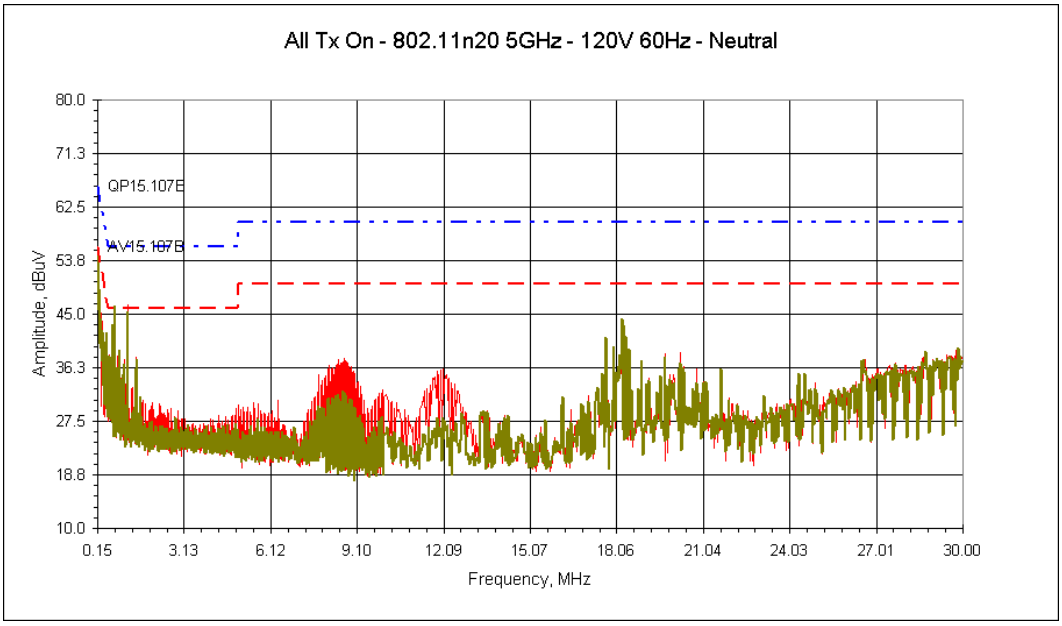
802.11a



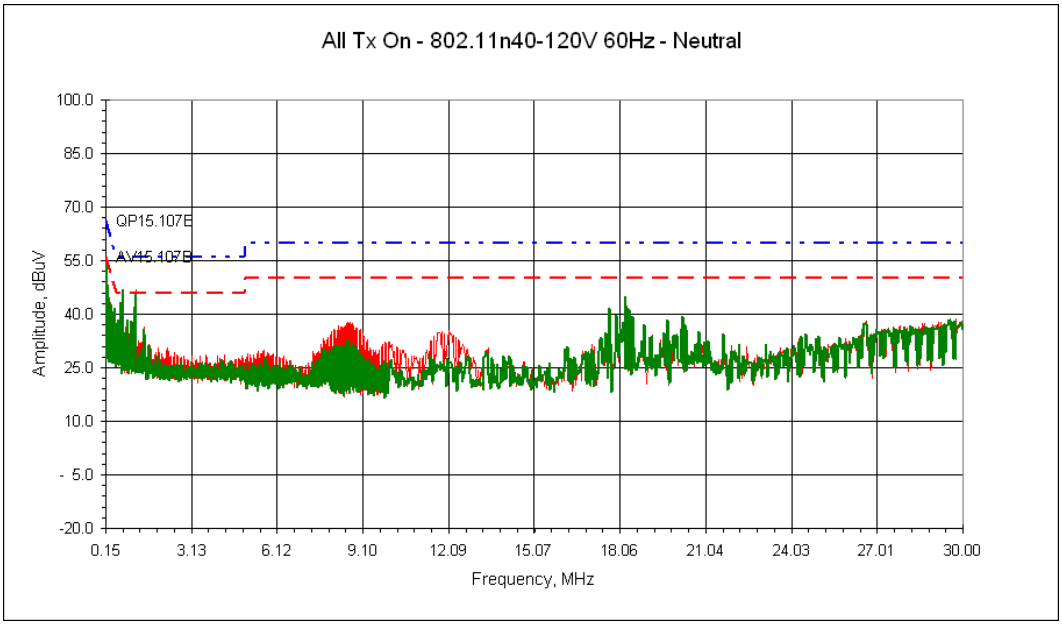
802.11g



802.11n HT20



802.11n HT40

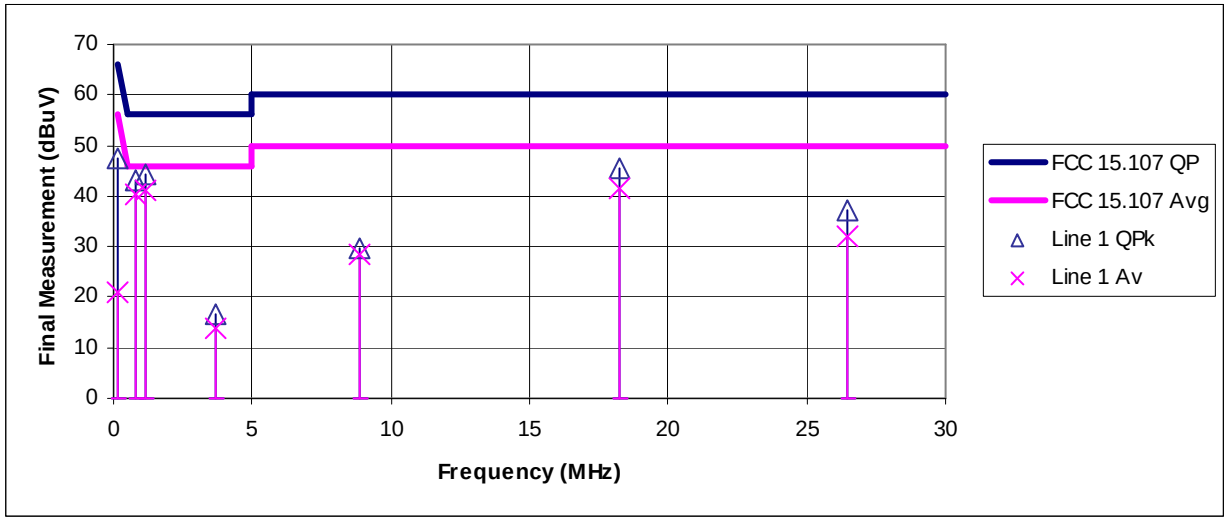


Note: Peak measurements plotted against FCC 15.107 Average & Quasi-Peak Limit

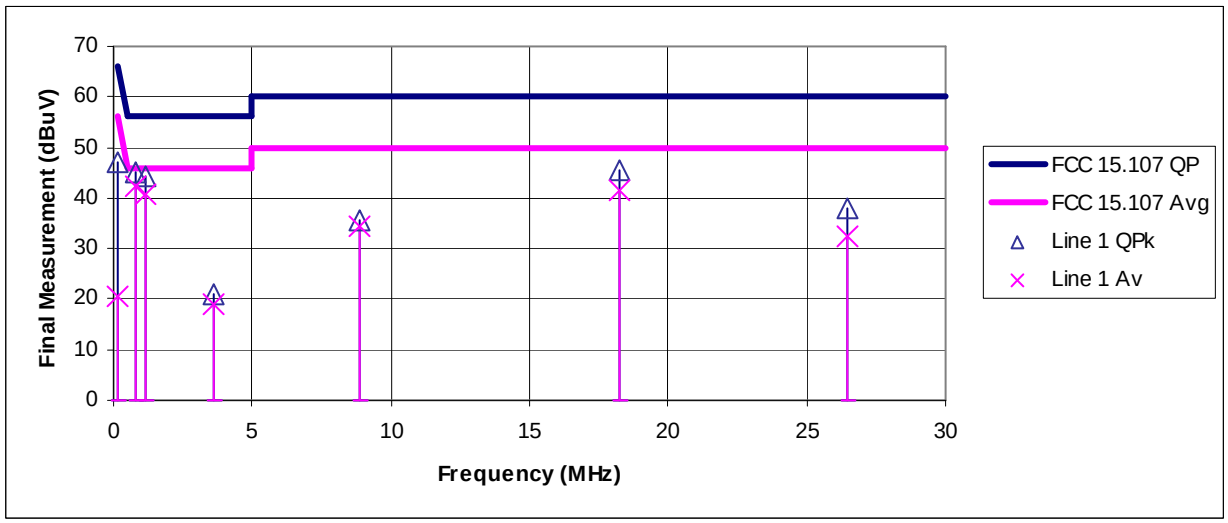
Plots: Final Quasi-Peak and Average Measurements

Conducted Emissions – FCC 15.107, Class B (150 kHz to 30 MHz)

Line 1



Neutral



10.8 Test Data: Tx Enabled Conducted Emissions

Conducted Electromagnetic Emissions

Test Report #:	**100900227DEN-001**	Test Area:	CC1 Radiated	Temperature:	22.4 °C
Test Method:	FCC Part 15.107 Class B	Test Date:	9/25/2012	Relative Humidity:	20.2 %
EUT Model #:	ID:058	EUT Power:	120VAC/60Hz	Air Pressure:	83.69 kPa
EUT Serial #:	EMC1				
Manufacturer:	Echostar				
EUT Description:	Advanced Satellite Receiver				

Notes: **Product configured for Tx mode - modulated - worst-case data**

No significant difference seen between modulations of the 802.11 radio. All measurements taken with 802.11n HT20 modulation.

Level Key	
Pk – Peak	Nb – Narrow Band
Qp – QuasiPeak	Bb – Broad Band
Av - Average	

FREQ	LEVEL	DET	CABLE	LISN	PREAMP	ATTEN	FINAL	TEST POINT	DELTA1	DELTA2	RBW
MHz	dBuV	Qp Av Pk	+ [dB]	+ [dB/m]	- [dB]	+ [dB]	= [dBuV]	Other - N - L1 - L2 - L3	QP 15.107B	AV 15.107B	(MHz)
0.151	37.43	Qp	0.10	0.04	0.00	9.95	47.52	Line 1	- 18.41	NA	0.009
0.151	10.92	Av	0.10	0.04	0.00	9.95	21.01	Line 1	NA	- 34.92	0.009
0.760	33.00	Qp	0.21	0.03	0.00	9.97	43.21	Line 1	- 12.79	NA	0.009
0.760	30.10	Av	0.21	0.03	0.00	9.97	40.31	Line 1	NA	- 5.69	0.009
1.189	34.16	Qp	0.20	0.03	0.00	9.97	44.36	Line 1	- 11.64	NA	0.009
1.189	31.07	Av	0.20	0.03	0.00	9.97	41.27	Line 1	NA	- 4.73	0.009
3.684	6.45	Qp	0.30	0.04	0.00	9.97	16.76	Line 1	- 39.24	NA	0.009
3.684	3.63	Av	0.30	0.04	0.00	9.97	13.94	Line 1	NA	- 32.06	0.009
8.848	19.15	Qp	0.50	0.10	0.00	9.99	29.74	Line 1	- 30.26	NA	0.009
8.848	17.88	Av	0.50	0.10	0.00	9.99	28.47	Line 1	NA	- 21.53	0.009
18.243	34.12	Qp	1.10	0.19	0.00	10.02	45.42	Line 1	- 14.58	NA	0.009
18.243	30.06	Av	1.10	0.19	0.00	10.02	41.36	Line 1	NA	- 8.64	0.009
26.488	25.89	Qp	1.20	0.17	0.00	10.04	37.30	Line 1	- 22.70	NA	0.009
26.488	20.76	Av	1.20	0.17	0.00	10.04	32.17	Line 1	NA	- 17.83	0.009
0.151	36.93	Qp	0.10	0.04	0.00	9.95	47.02	Line 2	- 18.91	NA	0.009
0.151	10.44	Av	0.10	0.04	0.00	9.95	20.53	Line 2	NA	- 35.40	0.009
0.760	34.72	Qp	0.21	0.02	0.00	9.97	44.92	Line 2	- 11.08	NA	0.009
0.760	32.09	Av	0.21	0.02	0.00	9.97	42.29	Line 2	NA	- 3.71	0.009
1.189	33.94	Qp	0.20	0.02	0.00	9.97	44.14	Line 2	- 11.86	NA	0.009
1.189	30.54	Av	0.20	0.02	0.00	9.97	40.74	Line 2	NA	- 5.26	0.009
3.624	10.77	Qp	0.30	0.03	0.00	9.97	21.08	Line 2	- 34.92	NA	0.009
3.624	8.76	Av	0.30	0.03	0.00	9.97	19.07	Line 2	NA	- 26.93	0.009
8.848	24.88	Qp	0.50	0.11	0.00	9.99	35.47	Line 2	- 24.53	NA	0.009
8.848	23.91	Av	0.50	0.11	0.00	9.99	34.50	Line 2	NA	- 15.50	0.009
18.243	34.11	Qp	1.10	0.19	0.00	10.02	45.42	Line 2	- 14.58	NA	0.009
18.243	30.02	Av	1.10	0.19	0.00	10.02	41.33	Line 2	NA	- 8.67	0.009
26.488	26.35	Qp	1.20	0.26	0.00	10.04	37.85	Line 2	- 22.15	NA	0.009
26.488	21.06	Av	1.20	0.26	0.00	10.04	32.56	Line 2	NA	- 17.44	0.009

Example calculation:

Measured Level	+	Transducer, Cable Loss & Amplifier corrections	=	Corrected Reading	Specification Limit	-	Corrected Reading	=	Delta Specification
(dBµV)		(dB)		(dBµV/m)	(dBµV/m)		(dBµV/m)		
14.0		**14.9**		**28.9**	**40.0**		**28.9**		**-11.1**

Notes: No significant difference seen between modulations of the 802.11 radio. All measurements taken with 802.11n HT20 modulation.

Deviations, Additions, or Exclusions: None

11 Antenna Requirements

11.1 Method

Unless otherwise stated no deviations were made from FCC Part 15.203..

This testing was performed at Intertek Denver, located at 1795 Dogwood St. Suite 200, Louisville, CO 80027.

11.2 Results:

The sample tested was found to comply.

The product incorporates internal embedded antennas with U.FL compatible cable connectors.
The user has no direct access to the antennas.

12 Measurement Uncertainty

The measured value related to the corresponding limit will be used to decide whether the equipment meets the requirements.

The measurement uncertainty figures were calculated and correspond to a coverage factor of k = 2, providing a confidence level of respectively 95.45 % in the case where the distributions characterizing the actual measurement uncertainties are normal (Gaussian).

Measurement uncertainty Table

Parameter	Uncertainty ±	Notes
Radiated emissions, 10kHz to 1000 MHz	4.4 dB	
Radiated emissions, 1 to 18 GHz	4.7 dB	
AC mains Conducted emissions, 9kHz to 30 MHz	3.14 dB	
Disturbance Power 30 to 1000 MHz	3.3 dB	
Telecom Port Conducted emissions, Voltage 150 kHz to 30 MHz	3.11 dB	

13 Necessary Modifications

The following Power Indices were necessary for compliance:
Antenna 0: PI = 16
Antenna 1: PI = 19

All radiated measurements taken with both antennas transmitting simultaneously were taken with PI=19. The software didn't allow for individual power index factors assigned to each antenna. Only one power index factor was allowed.

Revision History

Revision Level	Date	Report Number	Notes
0	10/12/2012	100900227DEN-004	Original Issue