



**FCC CFR47 PART 15 SUBPART E
INDUSTRY CANADA RSS-210 ISSUE 8**

CERTIFICATION TEST REPORT

FOR

Apple TV device (digital media receiver) with WiFi and Bluetooth Radios

MODEL NUMBER: A1469

FCC ID: BCGA1469

IC: 579C-A1469

REPORT NUMBER: 12U14680-3, Revision B

ISSUE DATE: DECEMBER 17, 2012

Prepared for
APPLE, INC.
1 INFINITE LOOP
CUPERTINO, CA 95014, U.S.A

Prepared by
UL CCS
47173 BENICIA STREET
FREMONT, CA 94538, U.S.A.
TEL: (510) 771-1000
FAX: (510) 661-0888



NVLAP LAB CODE 200065-0

Revision History

<u>Rev.</u>	<u>Issue Date</u>	<u>Revisions</u>	<u>Revised By</u>
--	12/10/12	Initial Issue	F. Ibrahim
A	12/17/12	Corrected Model Number	G. Persons
B	12/17/12	Corrected dates on data sheets	T. Chen

TABLE OF CONTENTS

1. ATTESTATION OF TEST RESULTS	7
2. TEST METHODOLOGY	8
3. FACILITIES AND ACCREDITATION	8
4. CALIBRATION AND UNCERTAINTY	8
4.1. MEASURING INSTRUMENT CALIBRATION	8
4.2. SAMPLE CALCULATION	8
4.3. MEASUREMENT UNCERTAINTY	8
5. EQUIPMENT UNDER TEST	9
5.1. DESCRIPTION OF EUT	9
5.2. MAXIMUM OUTPUT POWER	9
5.3. DESCRIPTION OF AVAILABLE ANTENNAS	9
5.4. SOFTWARE AND FIRMWARE	9
5.5. WORST-CASE CONFIGURATION AND MODE	10
5.6. DESCRIPTION OF TEST SETUP	11
6. TEST AND MEASUREMENT EQUIPMENT	13
7. ON TIME, DUTY CYCLE AND MEASUREMENT METHODS	14
7.1.1. ON TIME AND DUTY CYCLE RESULTS	14
7.1.2. MEASUREMENT METHOD FOR POWER AND PPSD	14
7.1.3. MEASUREMENT METHOD FOR AVG SPURIOUS EMISSIONS ABOVE 1 GHz	14
7.1.4. DUTY CYCLE PLOTS	15
8. ANTENNA PORT TEST RESULTS	17
8.1. 802.11a MODE IN THE 5.2 GHz BAND	17
8.1.1. 26 dB BANDWIDTH	17
8.1.2. 99% BANDWIDTH	20
8.1.3. AVERAGE POWER	23
8.1.4. OUTPUT POWER AND PPSD	24
8.1.5. PEAK EXCURSION	28
8.2. 802.11n HT20 MODE IN THE 5.2 GHz BAND	31
8.2.1. 26 dB BANDWIDTH	31
8.2.2. 99% BANDWIDTH	34
8.2.3. AVERAGE POWER	37
8.2.4. OUTPUT POWER AND PPSD	38
8.2.5. PEAK EXCURSION	42
8.3. 802.11n HT40 MODE IN THE 5.2 GHz BAND	45
8.3.1. 26 dB BANDWIDTH	45
8.3.2. 99% BANDWIDTH	47
8.3.3. AVERAGE POWER	49

8.3.4. OUTPUT POWER AND PPSD..... 50
8.3.5. PEAK EXCURSION 53
8.4. 802.11a MODE IN THE 5.3 GHz BAND..... 55
8.4.1. 26 dB BANDWIDTH 55
8.4.2. 99% BANDWIDTH 58
8.4.3. AVERAGE POWER 61
8.4.4. OUTPUT POWER AND PPSD..... 62
8.4.5. PEAK EXCURSION 66
8.4.6. TPC POWER..... 69
8.5. 802.11n HT20 MODE IN THE 5.3 GHz BAND..... 70
8.5.1. 26 dB BANDWIDTH 70
8.5.2. 99% BANDWIDTH 73
8.5.3. AVERAGE POWER 76
8.5.4. OUTPUT POWER AND PPSD..... 77
8.5.5. PEAK EXCURSION 81
8.5.6. TPC POWER..... 84
8.6. 802.11n HT40 MODE IN THE 5.3 GHz BAND..... 85
8.6.1. 26 dB BANDWIDTH 85
8.6.2. 99% BANDWIDTH 87
8.6.3. AVERAGE POWER 89
8.6.4. OUTPUT POWER AND PPSD..... 90
8.6.5. PEAK EXCURSION 93
8.6.6. TPC POWER..... 95
8.7. 802.11a MODE IN THE 5.6 GHz BAND..... 96
8.7.1. 26 dB BANDWIDTH 96
8.7.2. 99% BANDWIDTH 100
8.7.3. AVERAGE POWER 104
8.7.4. OUTPUT POWER AND PPSD..... 105
8.7.5. PEAK EXCURSION 110
8.7.6. TPC POWER..... 113
8.8. 802.11n HT20 MODE IN THE 5.6 GHz BAND..... 114
8.8.1. 26 dB BANDWIDTH 114
8.8.2. 99% BANDWIDTH 118
8.8.3. AVERAGE POWER 122
8.8.4. OUTPUT POWER AND PPSD..... 123
8.8.5. PEAK EXCURSION 128
8.8.6. TPC POWER..... 131
8.9. 802.11n HT40 MODE IN THE 5.6 GHz BAND..... 132
8.9.1. 26 dB BANDWIDTH 132
8.9.2. 99% BANDWIDTH 135
8.9.3. AVERAGE POWER 138
8.9.4. OUTPUT POWER AND PPSD..... 139
8.9.5. PEAK EXCURSION 143
8.9.6. TPC POWER..... 146
9. RADIATED TEST RESULTS 147
9.1. LIMITS AND PROCEDURE 147
9.2. TX ABOVE 1 GHz 802.11a MODE IN THE 5.2 GHz BAND..... 148

9.3. TX ABOVE 1 GHz 802.11n HT20 MODE IN THE 5.2 GHz BAND..... 151

9.4. TX ABOVE 1 GHz 802.11n HT40 MODE IN THE 5.2 GHz BAND..... 154

9.5. TX ABOVE 1 GHz 802.11a MODE IN THE 5.3 GHz BAND..... 159

9.6. TX ABOVE 1 GHz 802.11n HT20 MODE IN THE 5.3 GHz BAND..... 164

9.7. TX ABOVE 1 GHz 802.11n HT40 MODE IN THE 5.3 GHz BAND..... 169

9.8. TX ABOVE 1 GHz 802.11a MODE IN THE 5.6 GHz BAND..... 174

9.9. TX ABOVE 1 GHz 802.11n HT20 MODE IN THE 5.6 GHz BAND..... 181

9.10. TX ABOVE 1 GHz 802.11n HT40 MODE IN THE 5.6 GHz BAND 188

9.11. WORST-CASE BELOW 1 GHz 194

10. AC POWER LINE CONDUCTED EMISSIONS 197

11. DYNAMIC FREQUENCY SELECTION 201

11.1. OVERVIEW.....201

11.1.1. LIMITS201

11.1.2. TEST AND MEASUREMENT SYSTEM204

11.1.3. SETUP OF EUT (CLIENT MODE).....207

11.1.4. SETUP OF EUT (CLIENT-TO-CLIENT COMMUNICATIONS MODE).....208

11.1.5. DESCRIPTION OF EUT209

11.2. CLIENT MODE RESULTS FOR 20 MHz BANDWIDTH211

11.2.1. TEST CHANNEL211

11.2.2. RADAR WAVEFORM AND TRAFFIC211

11.2.3. OVERLAPPING CHANNEL TESTS213

11.2.4. MOVE AND CLOSING TIME.....213

11.3. CLIENT MODE RESULTS FOR 40 MHz BANDWIDTH218

11.3.1. TEST CHANNEL218

11.3.2. RADAR WAVEFORM AND TRAFFIC218

11.3.3. OVERLAPPING CHANNEL TESTS220

11.3.4. MOVE AND CLOSING TIME.....220

11.3.5. NON-OCCUPANCY PERIOD.....225

11.4. CLIENT-TO-CLIENT COMMUNICATIONS MODE RESULTS FOR 20 MHz BANDWIDTH.....226

11.4.1. TEST CHANNEL226

11.4.2. RADAR WAVEFORM AND TRAFFIC226

11.4.3. OVERLAPPING CHANNEL TESTS228

11.4.4. MOVE AND CLOSING TIME.....228

11.5. CLIENT-TO-CLIENT COMMUNICATIONS MODE RESULTS FOR 40 MHz BANDWIDTH.....233

11.5.1. TEST CHANNEL233

11.5.2. RADAR WAVEFORM AND TRAFFIC233

11.5.3. OVERLAPPING CHANNEL TESTS235

11.5.4. MOVE AND CLOSING TIME.....235

13. SETUP PHOTOS 240

13.1. ANTENNA PORT CONDUCTED RF MEASUREMENT SETUP240

13.2. *RADIATED RF MEASUREMENT SETUP FOR PORTABLE CONFIGURATION ..241*
13.3. *POWERLINE CONDUCTED EMISSIONS MEASUREMENT SETUP.....243*
13.4. *DYNAMIC FREQUENCY SELECTION MEASUREMENT SETUP.....244*

1. ATTESTATION OF TEST RESULTS

COMPANY NAME: APPLE, INC.
1 INFINITE LOOP
CUPERTINO, CA 95014, U.S.A.

EUT DESCRIPTION: Apple TV device (digital media receiver) with WiFi and Bluetooth Radios

MODEL: A1469

SERIAL NUMBER: PT779512 (RF); C07J700LF7G4 (DFS)

DATE TESTED: OCTOBER 22 – NOVEMBER 09, 2012

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
CFR 47 Part 15 Subpart E	Pass
INDUSTRY CANADA RSS-210 Issue 8 Annex 9	Pass
INDUSTRY CANADA RSS-GEN Issue 3	Pass

UL CCS tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL CCS based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL CCS and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL CCS will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of any government.

Approved & Released For UL CCS By:

Tested By:



FRANK IBRAHIM
WISE PROJECT LEADER
UL CCS

TOM CHEN
EMC ENGINEER
UL CCS

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC CFR 47 Part 2, FCC CFR 47 Part 15, FCC 06-96, FCC KDB 789033, ANSI C63.10-2009, RSS-GEN Issue 3, and RSS-210 Issue 8.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 Benicia Street, Fremont, California, USA.

UL CCS is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at <http://www.ccsemc.com>.

4. CALIBRATION AND UNCERTAINTY

4.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

4.2. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

$$\begin{aligned} \text{Field Strength (dBuV/m)} &= \text{Measured Voltage (dBuV)} + \text{Antenna Factor (dB/m)} + \\ &\text{Cable Loss (dB)} - \text{Preamp Gain (dB)} \\ 36.5 \text{ dBuV} + 18.7 \text{ dB/m} + 0.6 \text{ dB} - 26.9 \text{ dB} &= 28.9 \text{ dBuV/m} \end{aligned}$$

4.3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

PARAMETER	UNCERTAINTY
Conducted Disturbance, 0.15 to 30 MHz	3.52 dB
Radiated Disturbance, 30 to 1000 MHz	4.94 dB

Uncertainty figures are valid to a confidence level of 95%.

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The Apple TV device is a digital media receiver designed to play internet content onto a TV through an HDMI port. It incorporates WiFi and Bluetooth radios.

The radio module is manufactured by Broadcom.

5.2. MAXIMUM OUTPUT POWER

The transmitter has a maximum conducted output power as follows:

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
5180 - 5240	802.11a	14.15	26.00
5180 - 5240	802.11n HT20	14.05	25.41
5190 - 5230	802.11n HT40	15.59	36.22
5260 - 5320	802.11a	19.71	93.54
5260 - 5320	802.11n HT20	19.69	93.11
5270 - 5310	802.11n HT40	16.3	42.66
5500 - 5700	802.11a	19.66	92.47
5500 - 5700	802.11n HT20	20.44	110.66
5510 - 5670	802.11n HT40	16.37	43.35

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes a PIFA antenna, with a maximum gain as below.

Antenna Gain:	
Frequency (MHz)	Gain (dBi)
2412	3.4
5180	3.93
5260	3.16
5540	2.34
5745	2.62

5.4. SOFTWARE AND FIRMWARE

The firmware installed in the EUT during testing was Rel_6_10_56_189.

The test utility software used during testing was Broadcom WL tool Ver. 6.10 RC56.189.

5.5. WORST-CASE CONFIGURATION AND MODE

The fundamental of the EUT was investigated in three orthogonal orientations X,Y,Z, and it was found that X orientation is worst-case orientation; therefore, final radiated testing was performed with the EUT in the X orientation.

For Radiated Emissions below 1 GHz and Power line Conducted Emissions, the channel with the highest conducted output power was selected as a worst-case scenario.

The worst-case data rate for each mode, used for testing, was as follows, based on an input from the manufacturer of the radio.

All final tests in the 802.11n HT20 mode were made at MCS0
All final tests in the 802.11n HT40 mode were made at MCS0
All final tests in the 802.11a mode were made at 6 Mb/s

Whenever the second low channel in band has a higher target power than the first low channel, all testing for the first low channel (except output power, 26 dB BW, 99% BW, Radiated BE) has been done at the higher power value of the second low channel as worst-case scenario.

Whenever the second high channel in band has a higher target power than the first high channel, all testing for the first high channel (except output power, 26 dB BW, 99% BW, Radiated BE) has been done at the higher power value of the second high channel as worst-case scenario.

5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
Laptop PC	Apple	MacBook M42A	PT358811	DoC
AC-DC Adapter	Apple	A1343	N/A	N/A
Debug Board	Apple	J33	C0314030137DPK73T	N/A
Mouse	HP	MOAFUO	CT: FATSK0J9W0EFU4	DoC

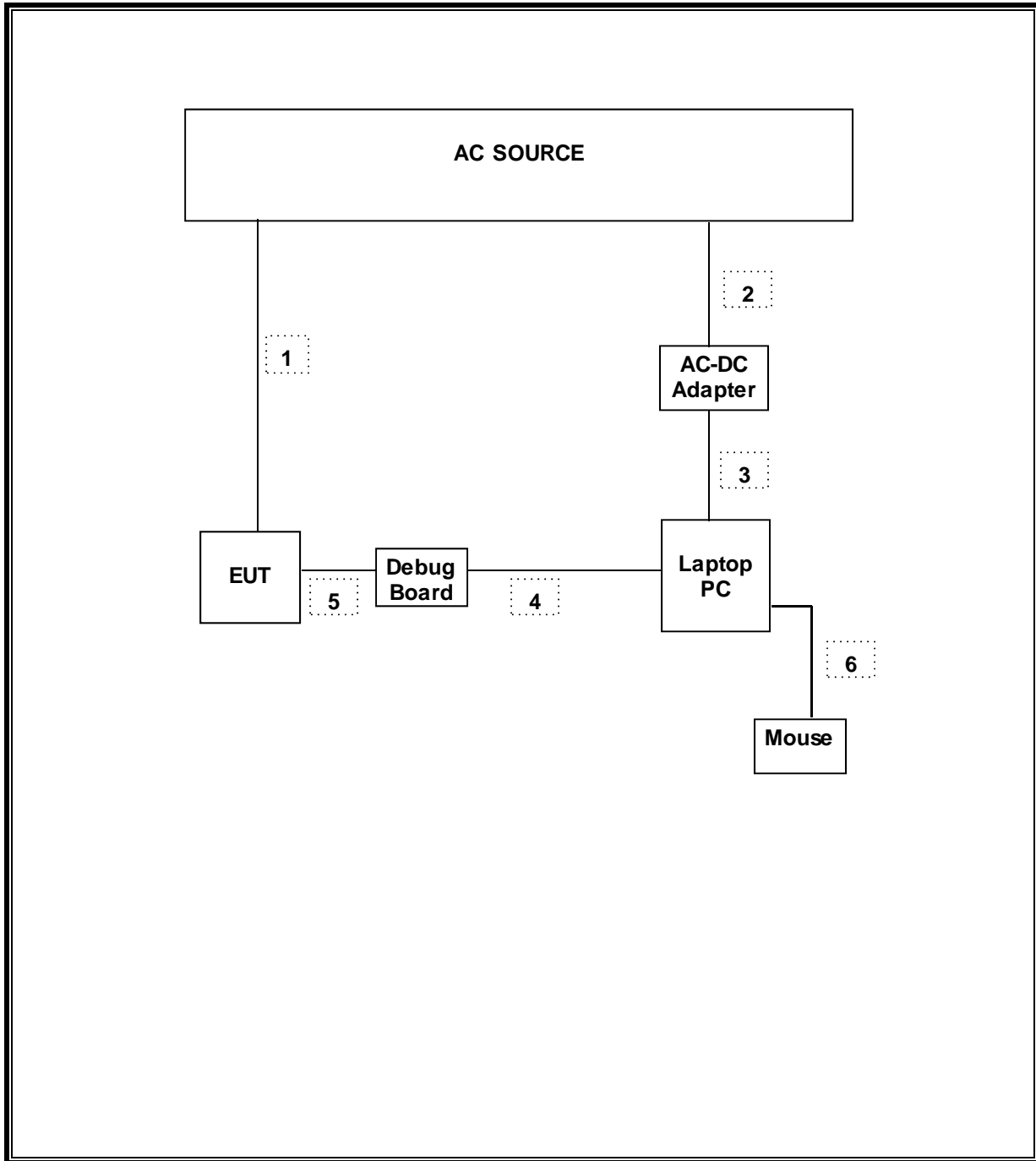
I/O CABLES

I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	AC	1	2P	Non-shielded	1.83	
2	AC	1	3P	Non-shielded	1.85	
3	DC	1	DC	Non-shielded	1.8	
4	USB	1	USB	Non-shielded	1.87	
5	Signal	1	Parallel	Non-shielded	0.09	
6	USB	1	USB	Non-shielded	1.9	

TEST SETUP

The EUT is powered by AC source only during test. Test software exercised the radio card.

SETUP DIAGRAM FOR TESTS



6. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

Test Equipment List				
Description	Manufacturer	Model	Asset	Cal Due
Preamplifier, 26.5 GHz	Agilent / HP	8449B	C01052	12/11/12
Antenna, Horn, 18 GHz	EMCO	3115	C00783	10/25/13
Preamplifier, 1300 MHz	Agilent / HP	8447D	C00580	11/11/12
Antenna, Bilog, 2 GHz	Sunol Sciences	JB1		02/07/13
Horn Antenna, 26.5 GHz	ARA	MWH-1826/B	C00589	04/23/13
Horn Antenna, 40 GHz	ARA	MWH-2640/B	C00981	06/14/13
Preamplifier, 40 GHz	Miteq	NSP4000-SP2	C00990	03/14/13
Spectrum Analyzer, 44 GHz	Agilent / HP	E4446A	C01069	12/15/12
E-Series Power Sensor 9 kHz~18 GHz	Agilent	E9304A	1260847C	05/23/13
P-Series single channel Power Meter	Agilent / HP	N1911A		07/27/13
Reject Filter, 5.725-5.825 GHz	Micro-Tronics	BRC13192	N02676	CNR
Reject Filter, 2.4-2.5 GHz	Micro-Tronics	BRM50702	N02685	CNR
Highpass Filter, 7.6 GHz	Micro-Tronics	HPM13195	N02682	CNR
EMI Test Receiver, 30MHz	R & S	ESHS 20	N02396	08/19/13
LISN, 30 MHz	FCC	LISN-50/250-25-2	N02625	12/13/12

7. ON TIME, DUTY CYCLE AND MEASUREMENT METHODS

LIMITS

None; for reporting purposes only.

PROCEDURE

KDB 789033 Zero-Span Spectrum Analyzer Method.

7.1.1. ON TIME AND DUTY CYCLE RESULTS

Mode	ON Time B (msec)	Period (msec)	Duty Cycle x (linear)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)	1/B Minimum VBW (kHz)
802.11a 20 MHz	2.0600	2.0910	0.985	98.5%	0.00	0.010
802.11n HT20	1.9150	1.9400	0.987	98.7%	0.00	0.010
802.11n HT40	0.9400	0.9567	0.983	98.3%	0.00	0.010

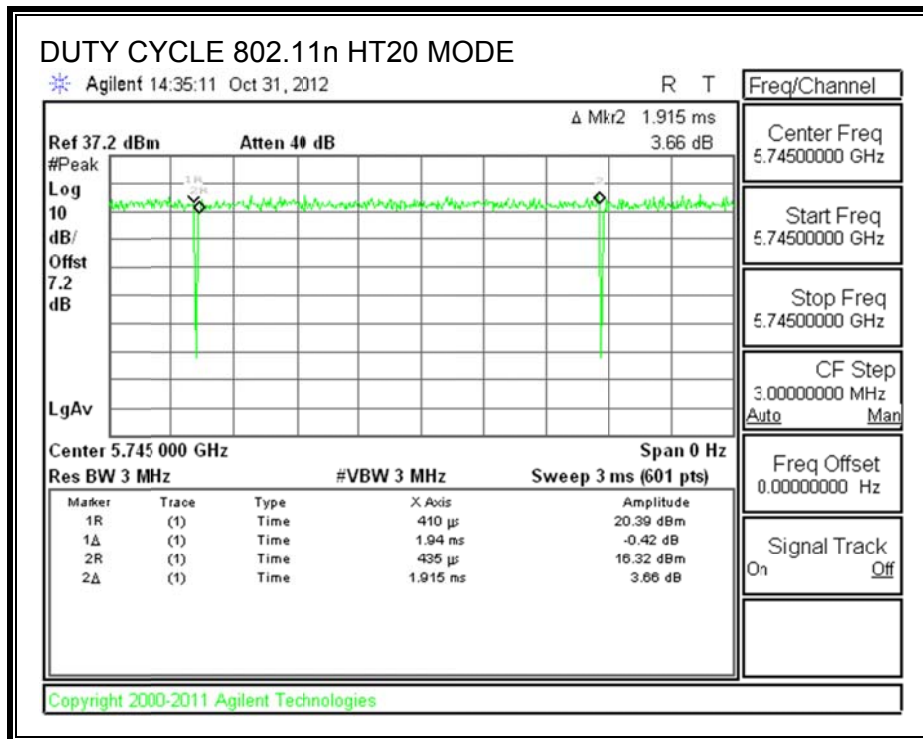
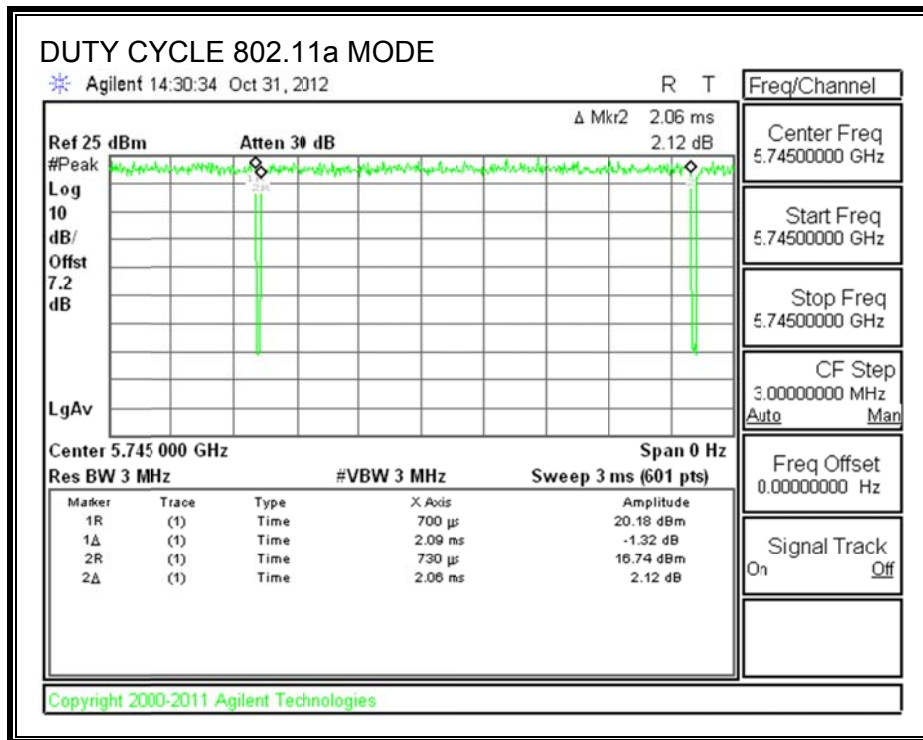
7.1.2. MEASUREMENT METHOD FOR POWER AND PPSD

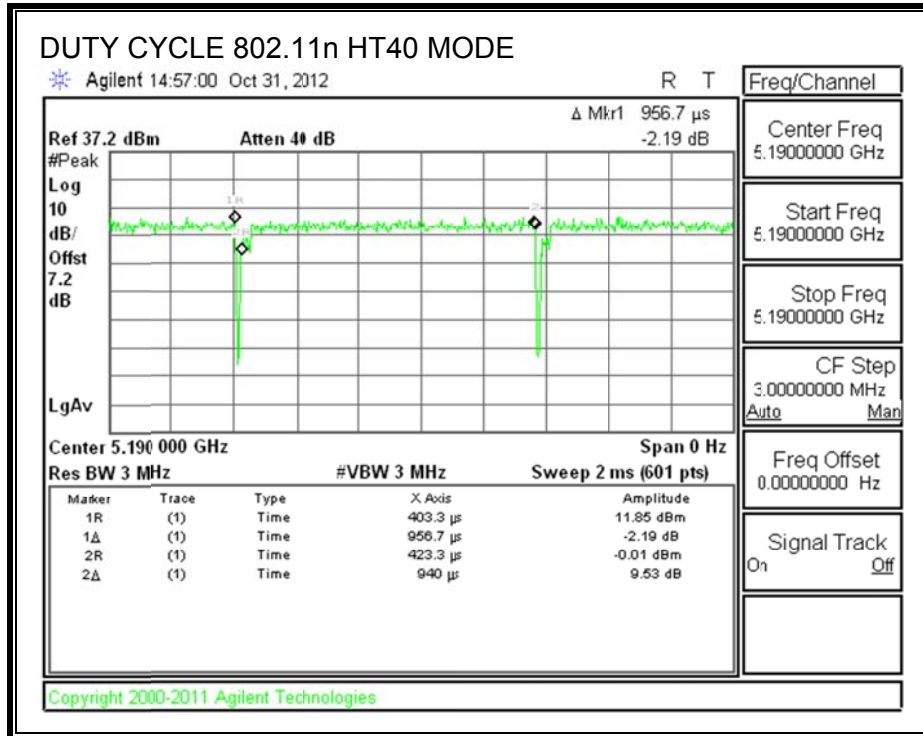
The Duty Cycle is greater than or equal to 98% therefore KDB 789033 Method SA-1 is used.

7.1.3. MEASUREMENT METHOD FOR AVG SPURIOUS EMISSIONS ABOVE 1 GHz

The Duty Cycle is greater than or equal to 98%, KDB 789033 Method VB with Power RMS Averaging is used.

7.1.4. DUTY CYCLE PLOTS





8. ANTENNA PORT TEST RESULTS

8.1. 802.11a MODE IN THE 5.2 GHz BAND

8.1.1. 26 dB BANDWIDTH

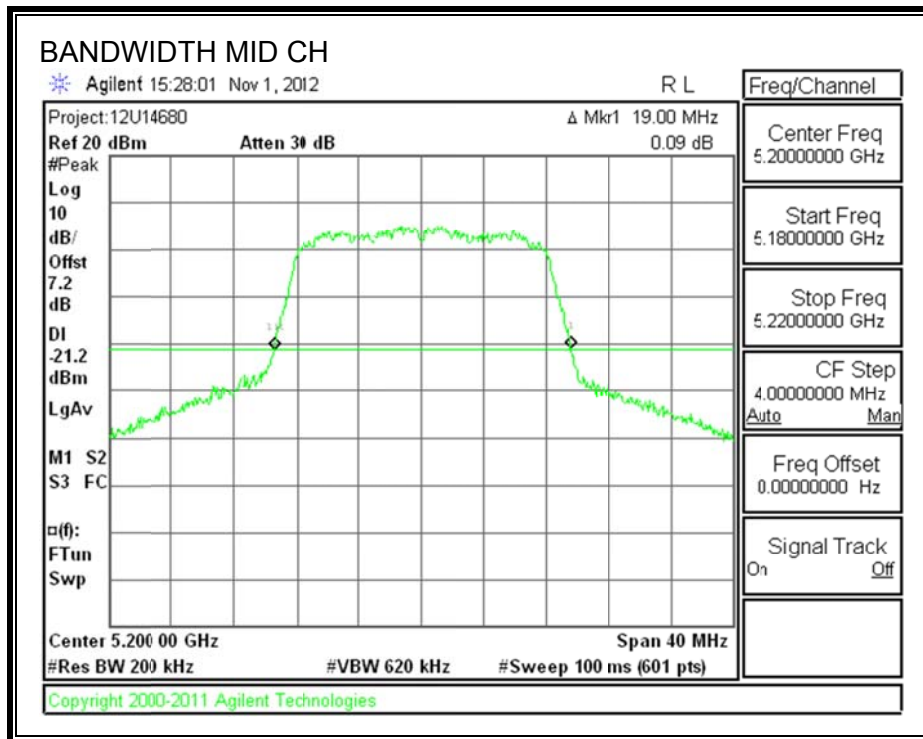
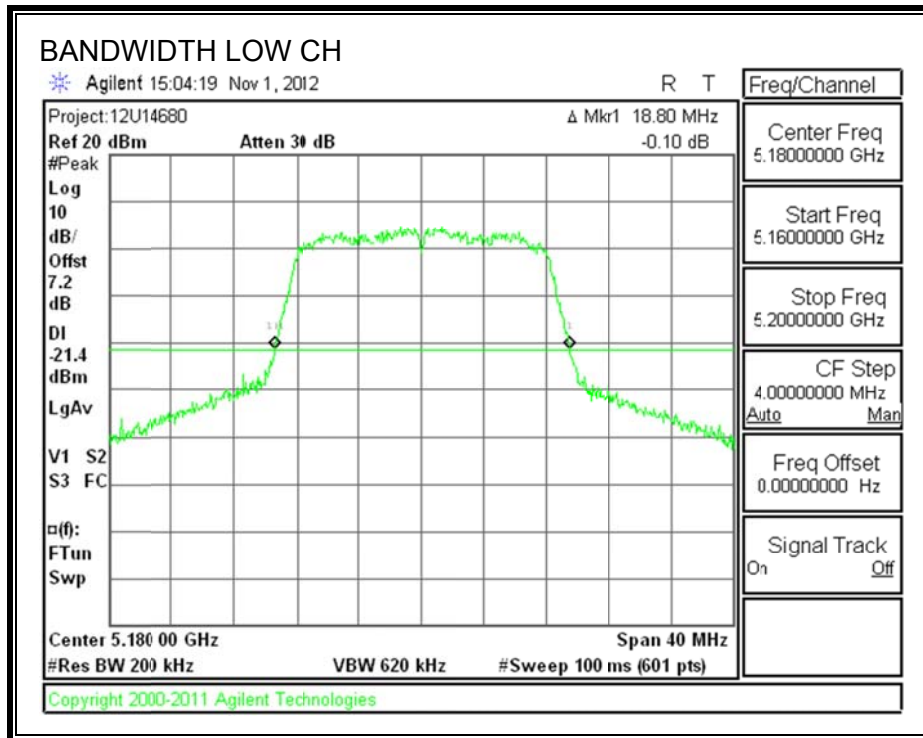
LIMITS

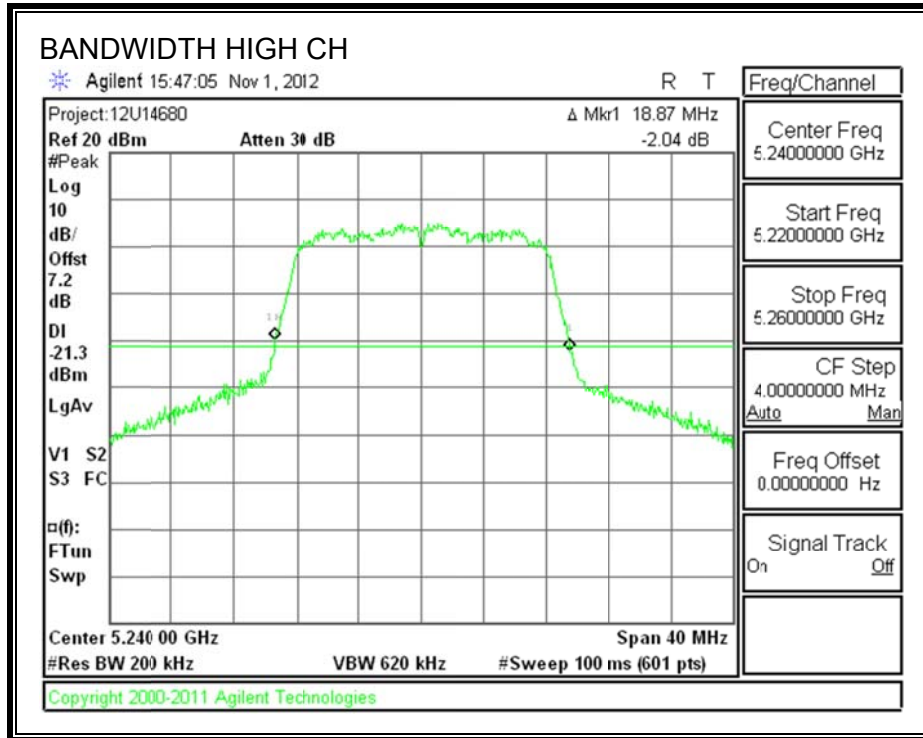
None; for reporting purposes only.

RESULTS

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
Low	5180	18.80
Mid	5200	19.00
High	5240	18.87

26 dB BANDWIDTH





8.1.2. 99% BANDWIDTH

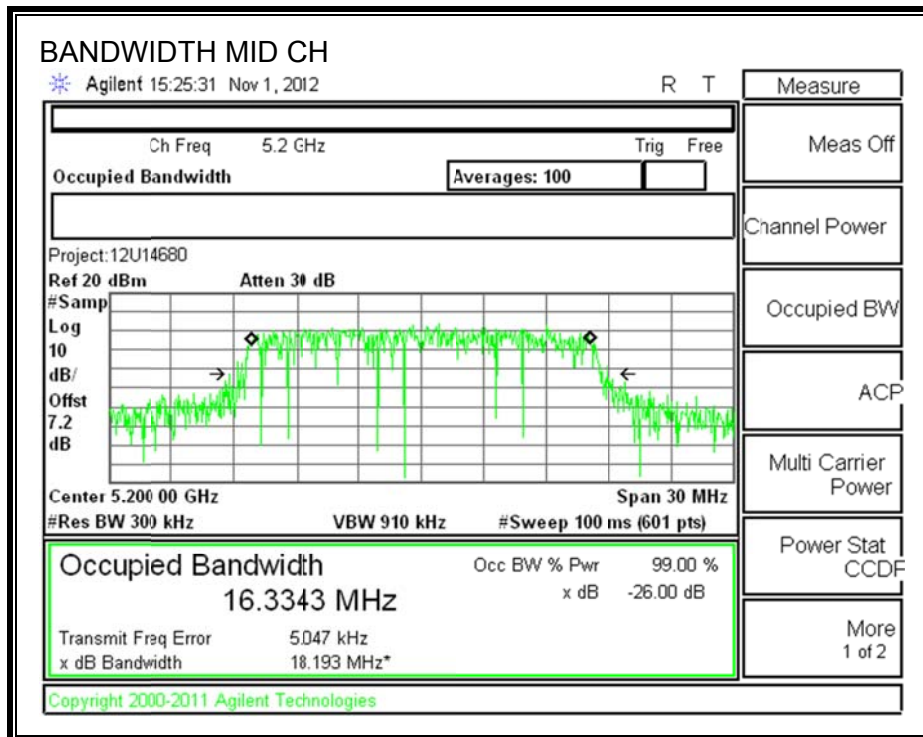
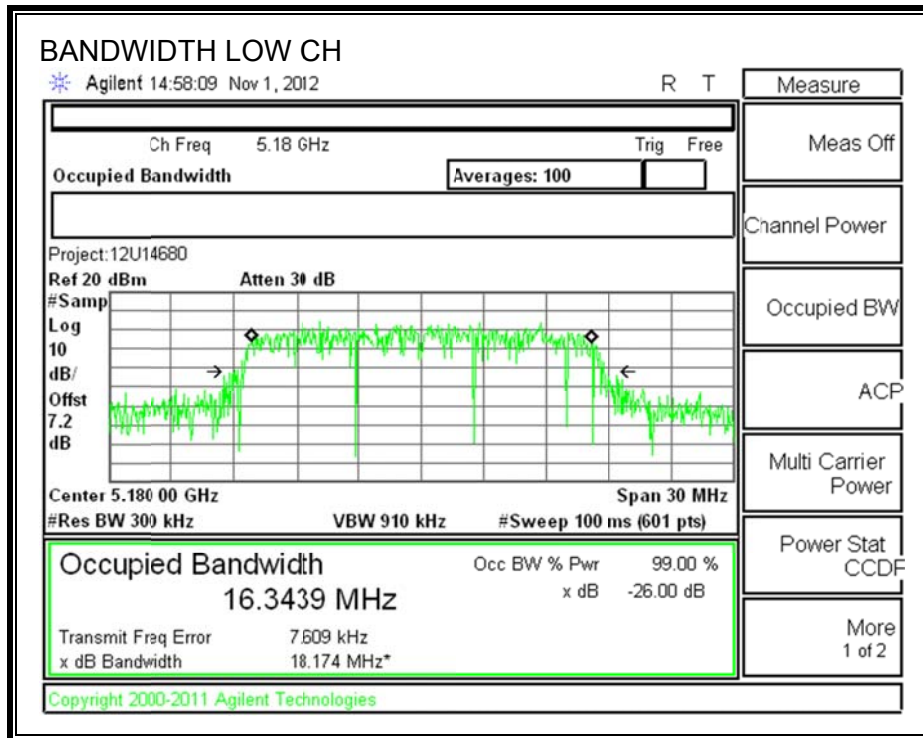
LIMITS

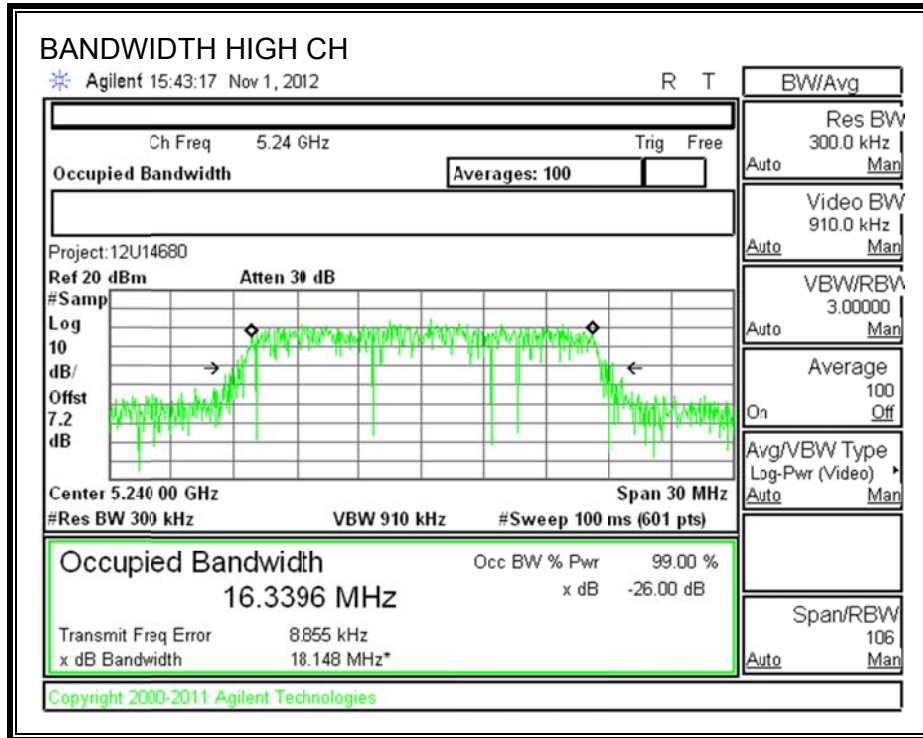
None; for reporting purposes only.

RESULTS

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	5180	16.3439
Mid	5200	16.3343
High	5240	16.3396

99% BANDWIDTH





8.1.3. AVERAGE POWER

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

The cable assembly insertion loss of 10.9 dB (including 10 dB pad and 0.9 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

RESULTS

Channel	Frequency (MHz)	Power (dBm)
Low	5180	14.0
Mid	5200	14.0
High	5240	14.0

8.1.4. OUTPUT POWER AND PPSD

LIMITS

FCC §15.407 (a) (1)

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 $4 \text{ dBm} + 10 \log B$, where B is the 26–dB emission bandwidth in MHz. In addition, 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, both the maximum conducted output power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

IC RSS-210 A9.2 (1)

The maximum e.i.r.p. shall not exceed 200 mW or $10 + 10 \log_{10} B$, dBm, whichever power is less. B is the 99% emission bandwidth in MHz. The e.i.r.p. spectral density shall not exceed 10 dBm in any 1.0 MHz band.

DIRECTIONAL ANTENNA GAIN

There is only one transmitter output therefore the directional gain is equal to the antenna gain.

RESULTS

Bandwidth and Antenna Gain

Channel	Frequency (MHz)	Min 26 dB BW (MHz)	Min 99% BW (MHz)	Directional Gain (dBi)
Low	5180	18.80	16.3439	3.93
Mid	5200	19.00	16.3343	3.93
High	5240	18.87	16.3396	3.93

Limits

Channel	Frequency (MHz)	FCC Power Limit (dBm)	IC EIRP Limit (dBm)	Max IC Power (dBm)	Power Limit (dBm)	FCC PPSD Limit (dBm)	IC eirp PSD Limit (dBm)	PPSD Limit (dBm)
Low	5180	16.74	22.13	18.20	16.74	4.00	10.00	4.00
Mid	5200	16.79	22.13	18.20	16.79	4.00	10.00	4.00
High	5240	16.76	22.13	18.20	16.76	4.00	10.00	4.00

Duty Cycle CF (dB)	0.00	Included in Calculations of Corr'd Power & PPSD
---------------------------	------	--

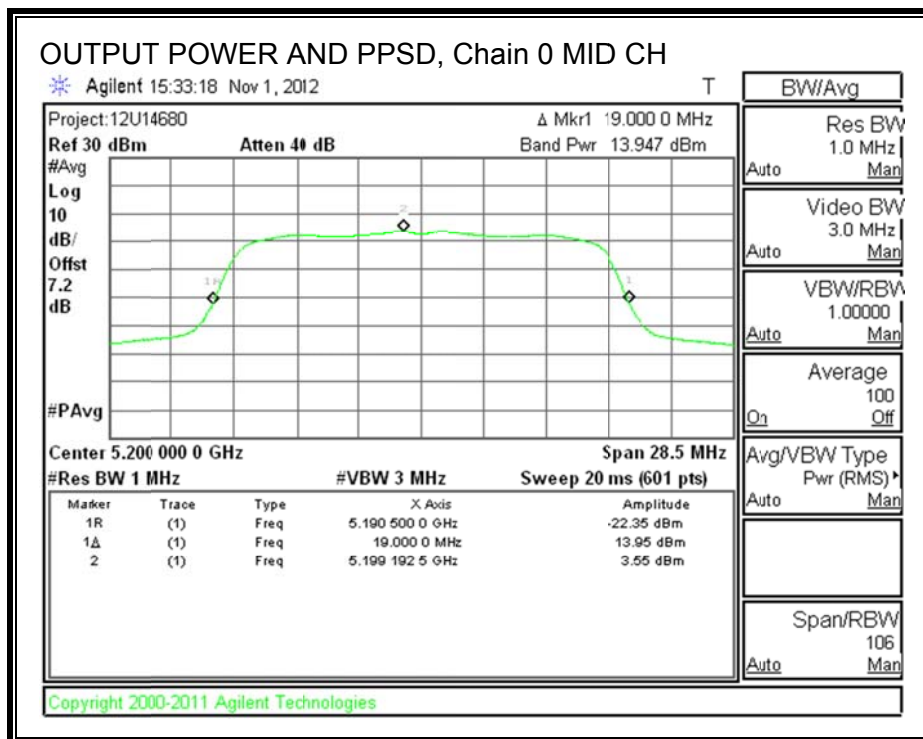
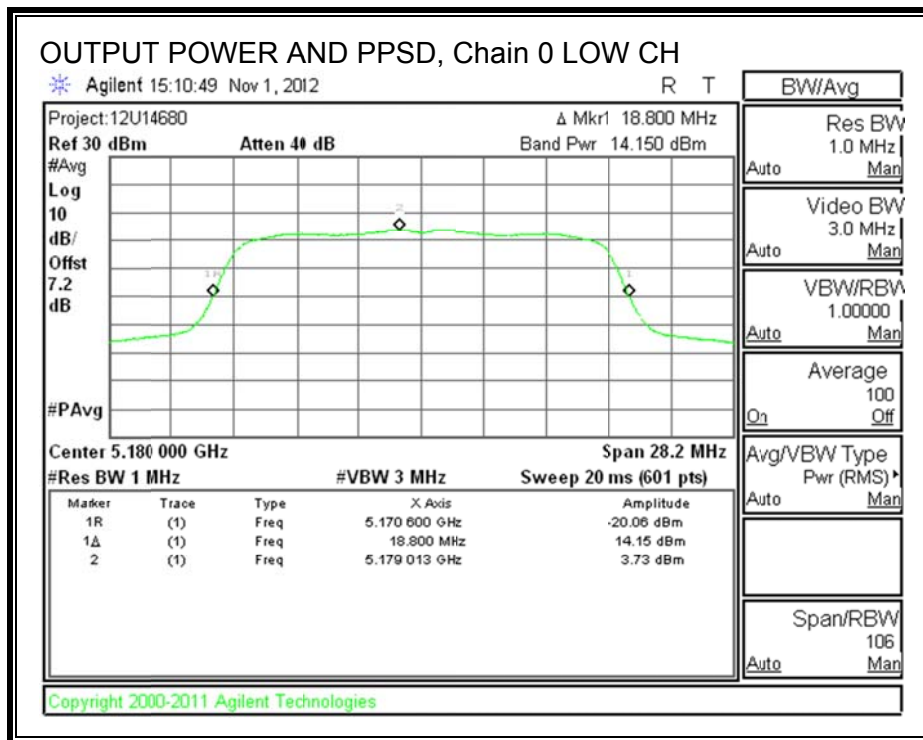
Output Power Results

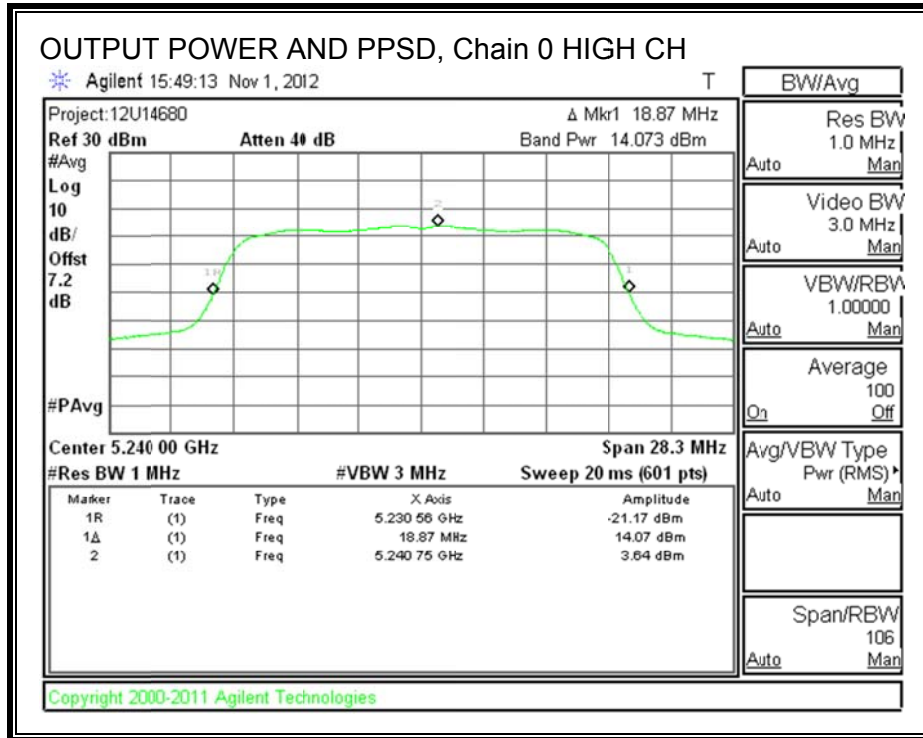
Channel	Frequency (MHz)	Chain 0 Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Power Margin (dB)
Low	5180	14.150	14.150	16.74	-2.592
Mid	5200	13.947	13.947	16.79	-2.841
High	5240	14.073	14.073	16.76	-2.685

PPSD Results

Channel	Frequency (MHz)	Chain 0 Meas PPSD (dBm)	Total Corr'd PPSD (dBm)	PPSD Limit (dBm)	PPSD Margin (dB)
Low	5180	3.73	3.73	4.00	-0.27
Mid	5200	3.55	3.55	4.00	-0.45
High	5240	3.64	3.64	4.00	-0.36

OUTPUT POWER AND PPSD, Chain 0





8.1.5. PEAK EXCURSION

LIMITS

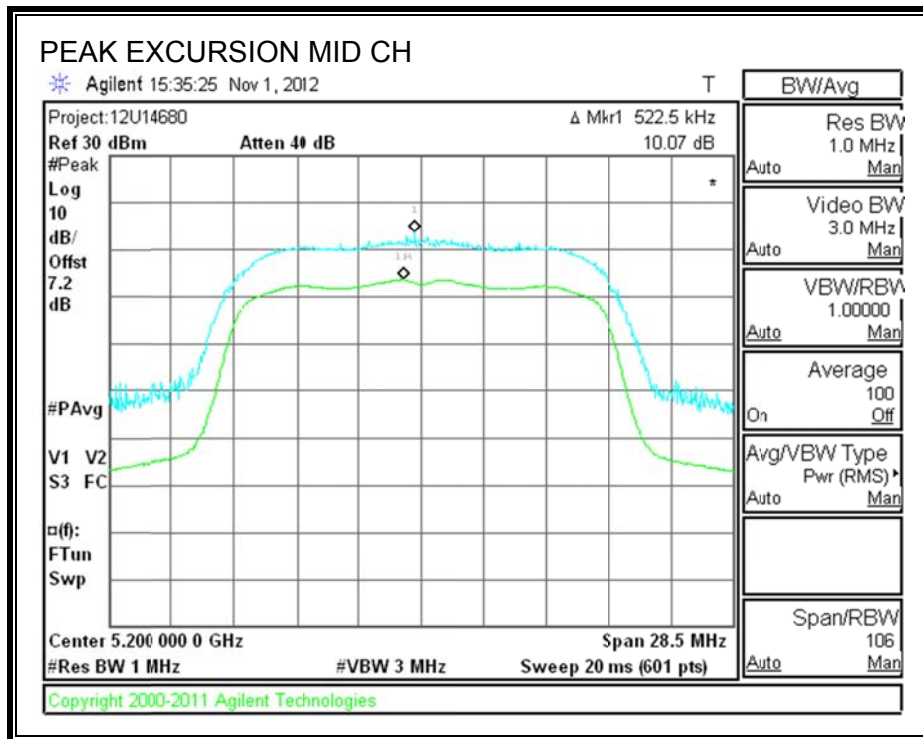
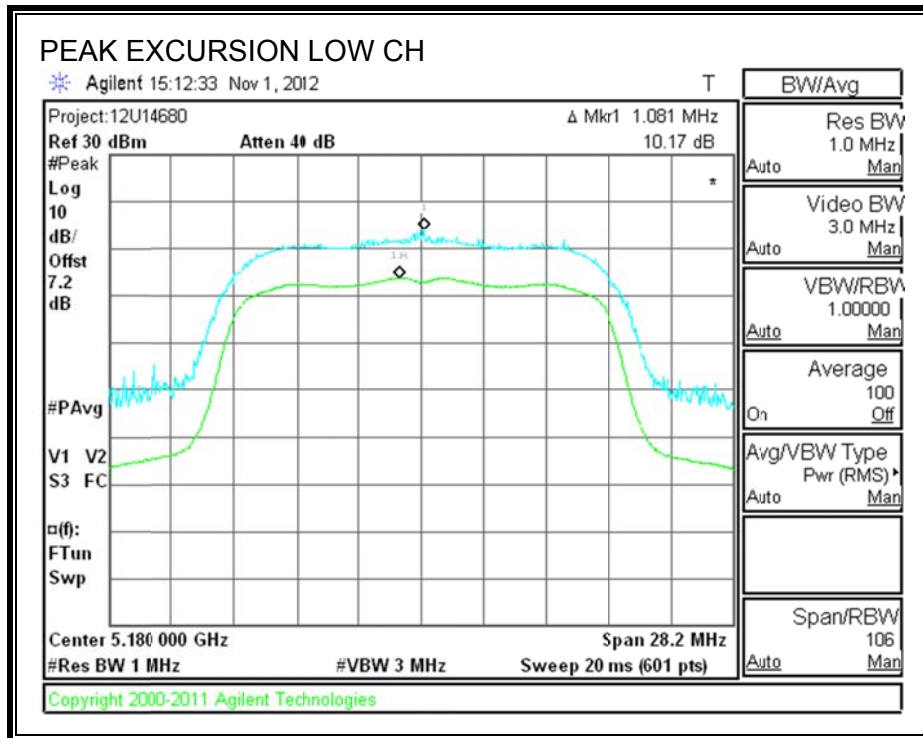
FCC §15.407 (a) (6)

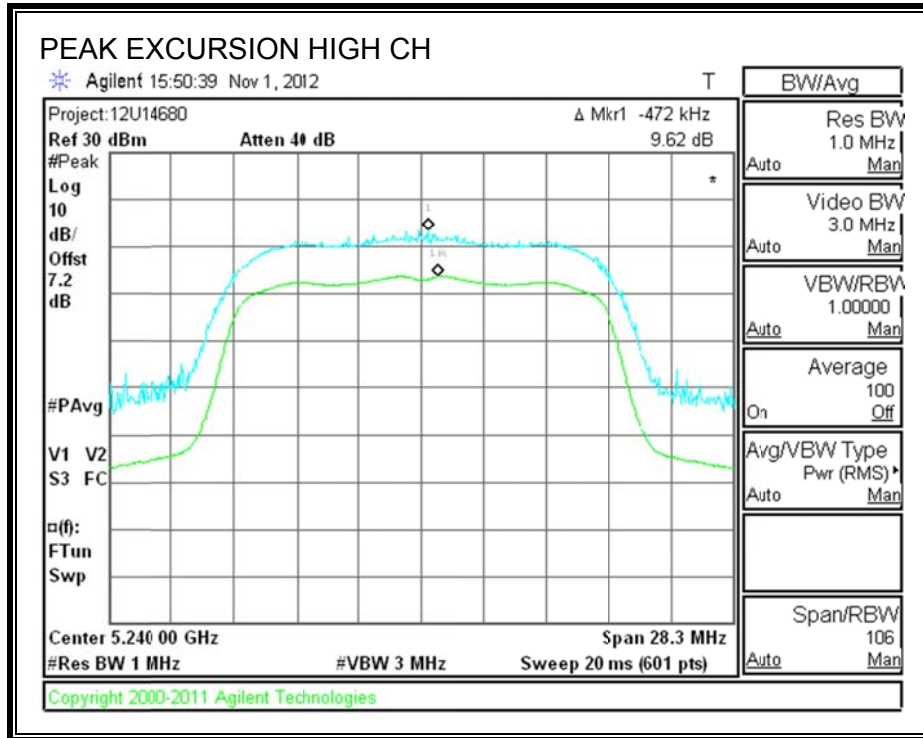
The ratio of the peak excursion of the modulation envelope (measured using a peak hold function) to the peak transmit power (measured as specified above) shall not exceed 13 dB across any 1 MHz bandwidth or the emission bandwidth whichever is less.

RESULTS

Channel	Frequency (MHz)	Peak Excursion (dB)	Limit (dB)	Margin (dB)
Low	5180	10.17	13	-2.83
Mid	5200	10.07	13	-2.93
High	5240	9.62	13	-3.38

PEAK EXCURSION





8.2. 802.11n HT20 MODE IN THE 5.2 GHz BAND

8.2.1. 26 dB BANDWIDTH

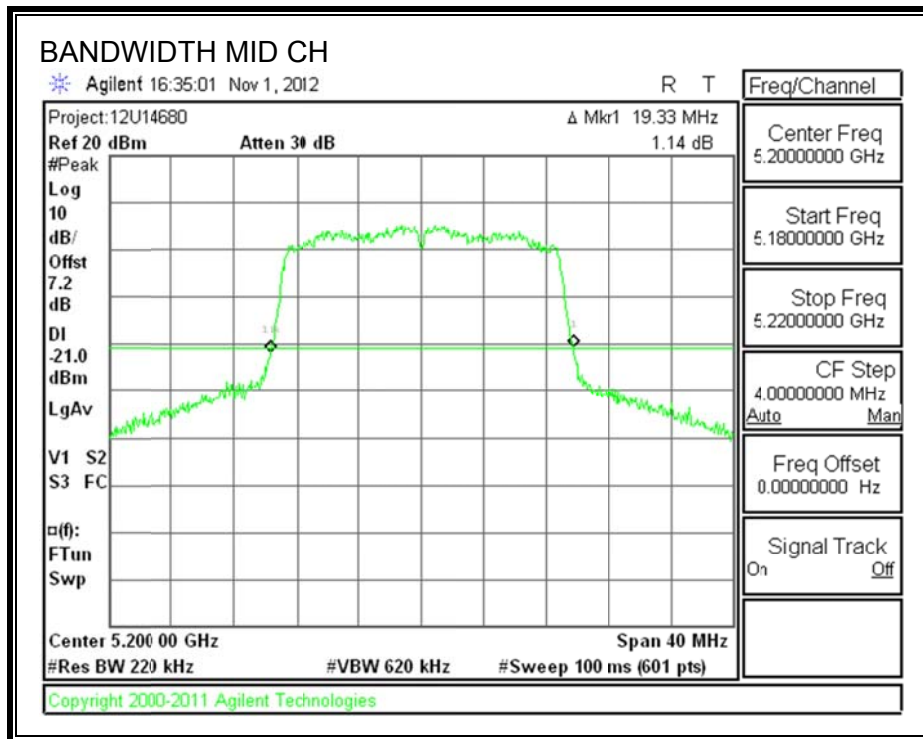
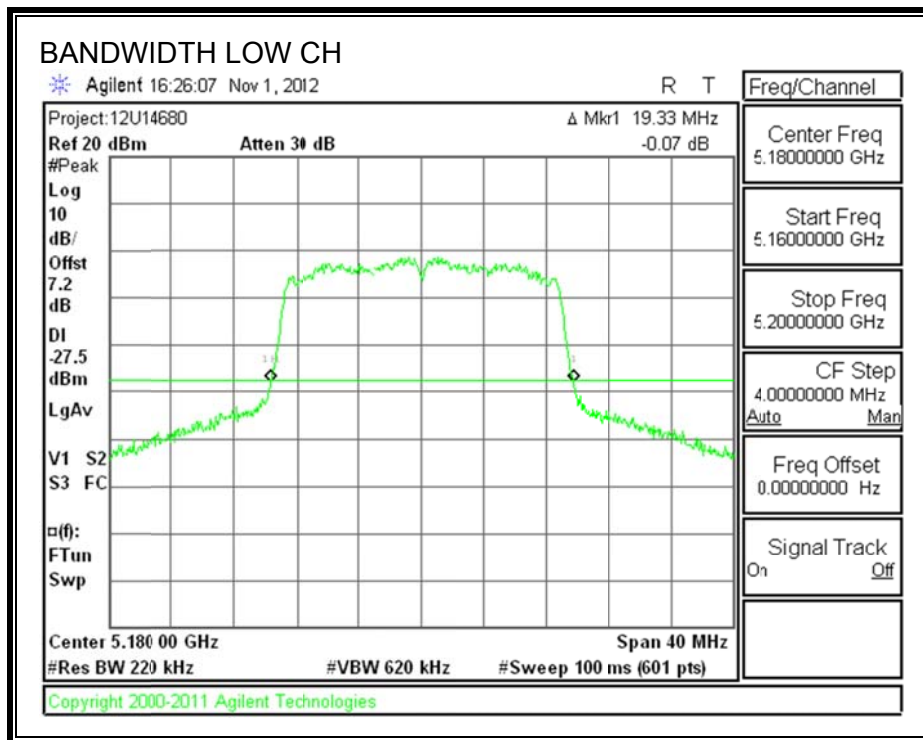
LIMITS

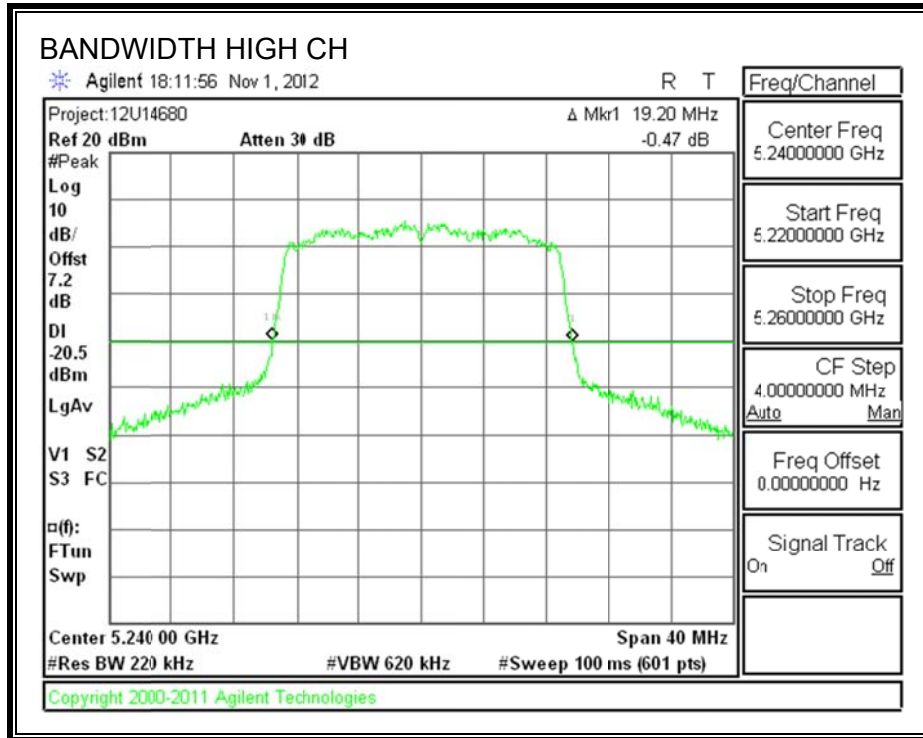
None; for reporting purposes only.

RESULTS

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
Low	5180	19.33
Mid	5200	19.33
High	5240	19.20

26 dB BANDWIDTH





8.2.2. 99% BANDWIDTH

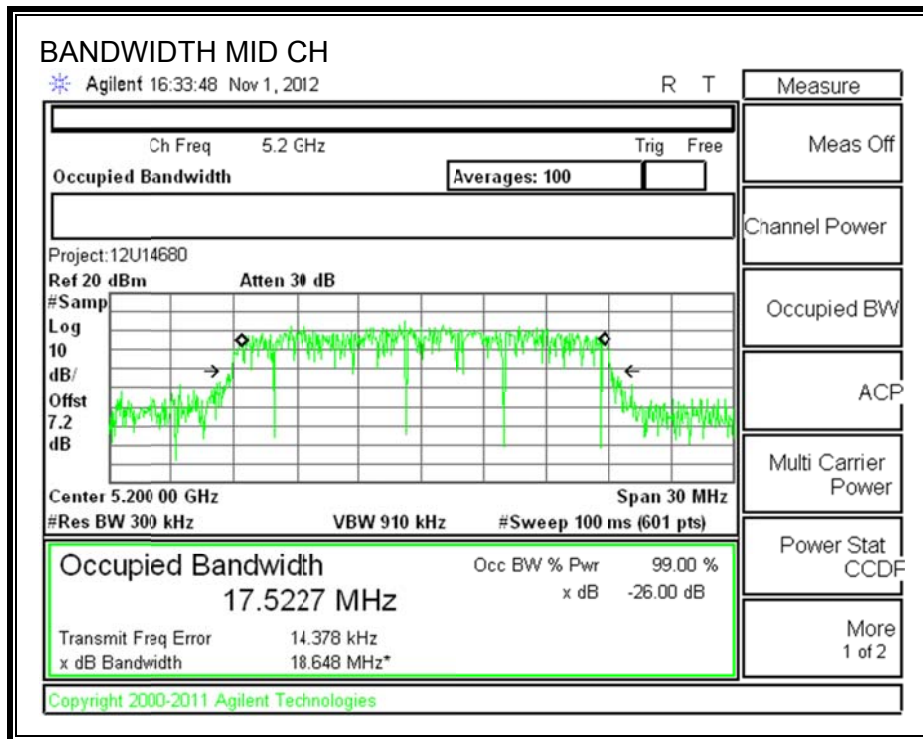
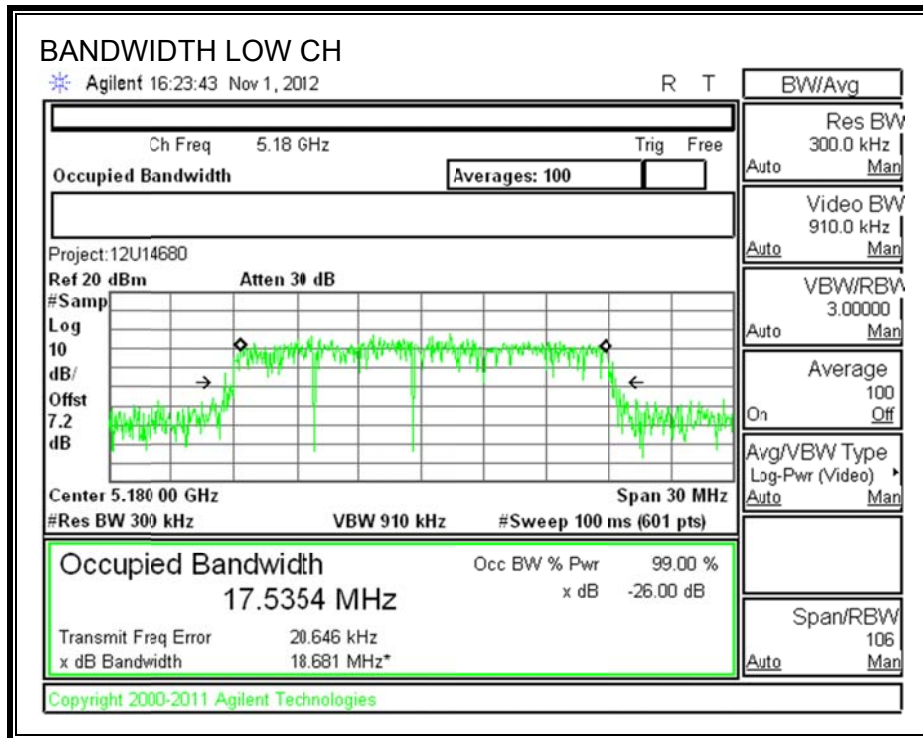
LIMITS

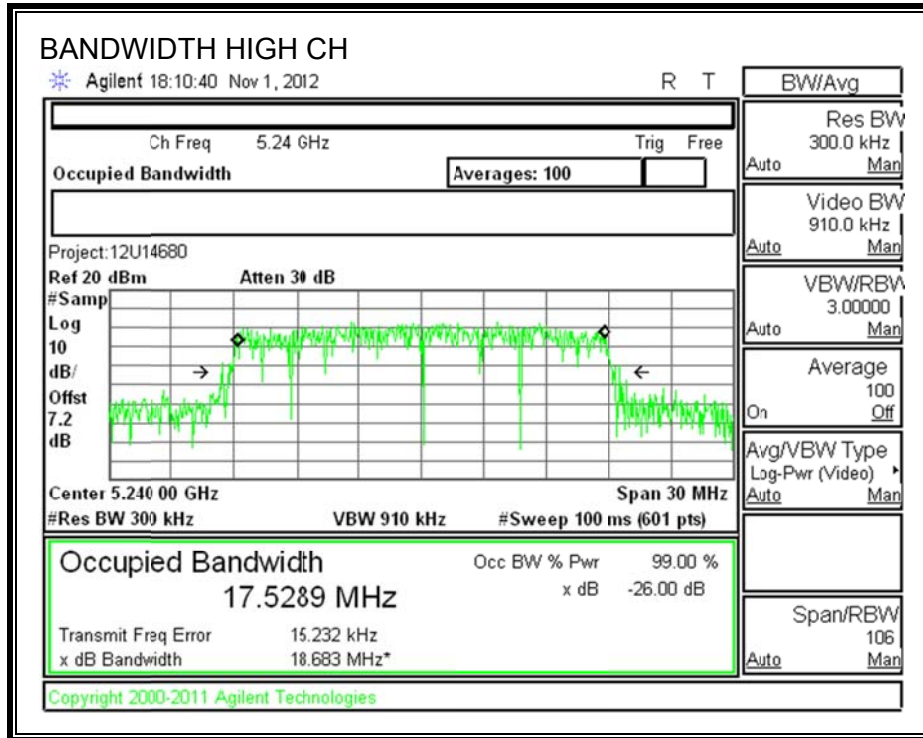
None; for reporting purposes only.

RESULTS

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	5180	17.5354
Mid	5200	17.5227
High	5240	17.5289

99% BANDWIDTH





8.2.3. AVERAGE POWER

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

The cable assembly insertion loss of 10.9 dB (including 10 dB pad and 0.9 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

RESULTS

Channel	Frequency (MHz)	Power (dBm)
Low	5180	14.0
Mid	5200	14.0
High	5240	14.0

8.2.4. OUTPUT POWER AND PPSD

LIMITS

FCC §15.407 (a) (1)

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 $4 \text{ dBm} + 10 \log B$, where B is the 26–dB emission bandwidth in MHz. In addition, 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, both the maximum conducted output power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

IC RSS-210 A9.2 (1)

The maximum e.i.r.p. shall not exceed 200 mW or $10 + 10 \log_{10} B$, dBm, whichever power is less. B is the 99% emission bandwidth in MHz. The e.i.r.p. spectral density shall not exceed 10 dBm in any 1.0 MHz band.

DIRECTIONAL ANTENNA GAIN

There is only one transmitter output therefore the directional gain is equal to the antenna gain.

RESULTS

Bandwidth and Antenna Gain

Channel	Frequency (MHz)	Min 26 dB BW (MHz)	Min 99% BW (MHz)	Directional Gain (dBi)
Low	5180	19.33	17.5354	3.93
Mid	5200	19.33	17.5227	3.93
High	5240	19.20	17.5289	3.93

Limits

Channel	Frequency (MHz)	FCC Power Limit (dBm)	IC EIRP Limit (dBm)	Max IC Power (dBm)	Power Limit (dBm)	FCC PPSD Limit (dBm)	IC eirp PSD Limit (dBm)	PPSD Limit (dBm)
Low	5180	16.86	22.44	18.51	16.86	4.00	10.00	4.00
Mid	5200	16.86	22.44	18.51	16.86	4.00	10.00	4.00
High	5240	16.83	22.44	18.51	16.83	4.00	10.00	4.00

Duty Cycle CF (dB)	0.00	Included in Calculations of Corr'd Power & PPSD
---------------------------	------	--

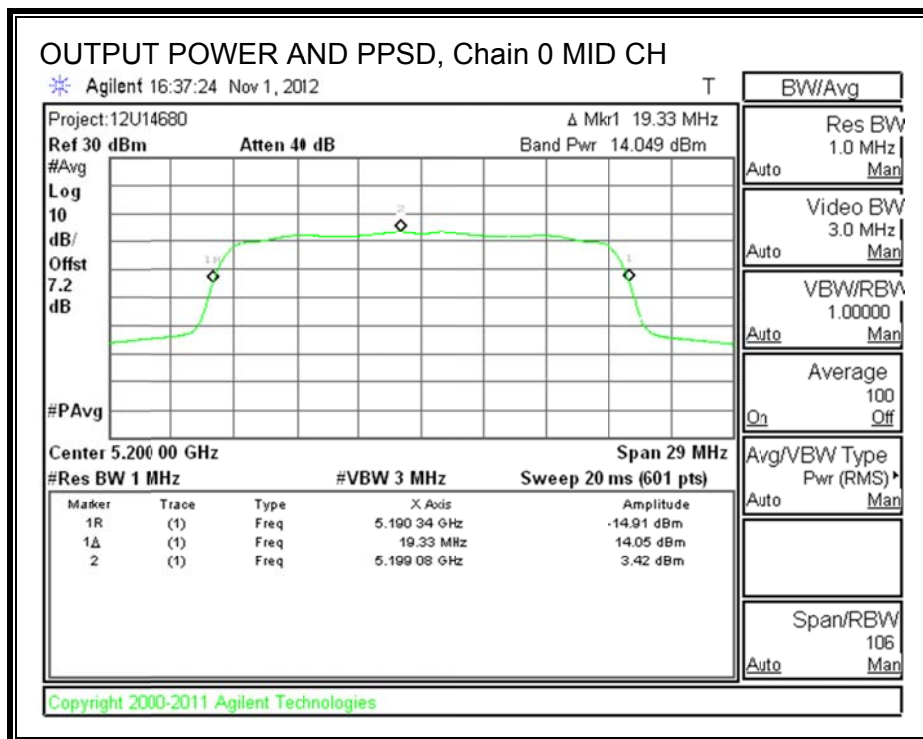
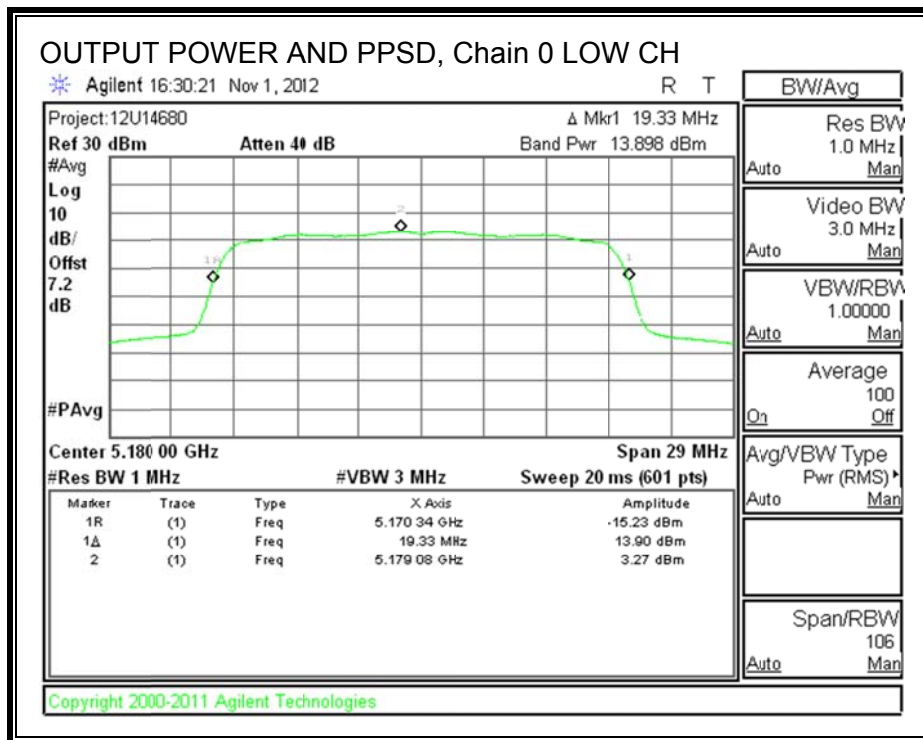
Output Power Results

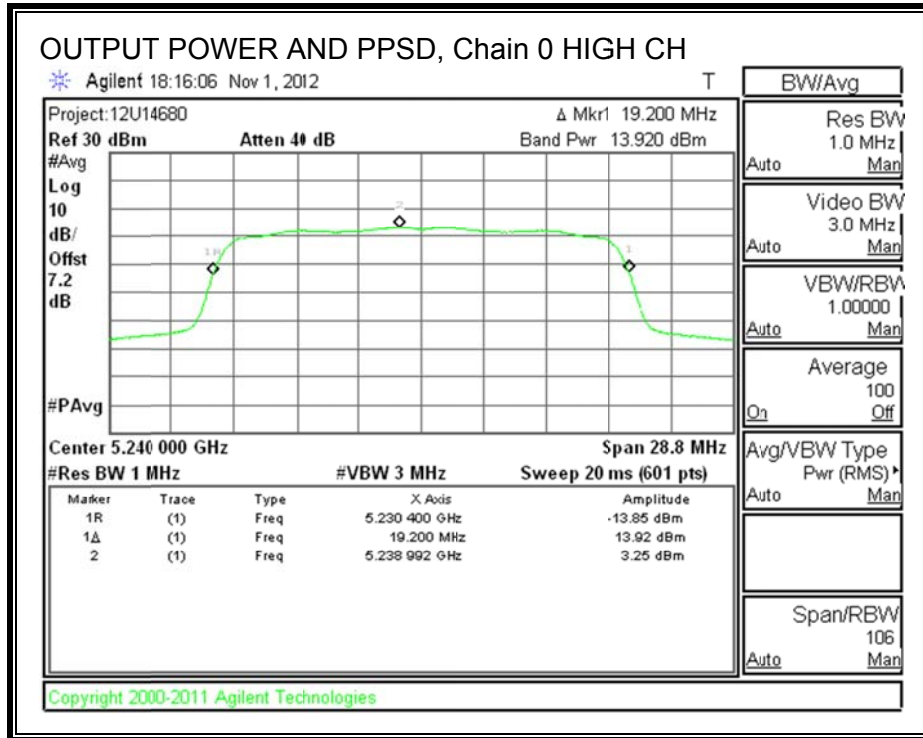
Channel	Frequency (MHz)	Chain 0 Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Power Margin (dB)
Low	5180	13.898	13.898	16.86	-2.964
Mid	5200	14.049	14.049	16.86	-2.813
High	5240	13.920	13.920	16.83	-2.913

PPSD Results

Channel	Frequency (MHz)	Chain 0 Meas PPSD (dBm)	Total Corr'd PPSD (dBm)	PPSD Limit (dBm)	PPSD Margin (dB)
Low	5180	3.27	3.27	4.00	-0.73
Mid	5200	3.42	3.42	4.00	-0.58
High	5240	3.25	3.25	4.00	-0.75

OUTPUT POWER AND PPSD, Chain 0





8.2.5. PEAK EXCURSION

LIMITS

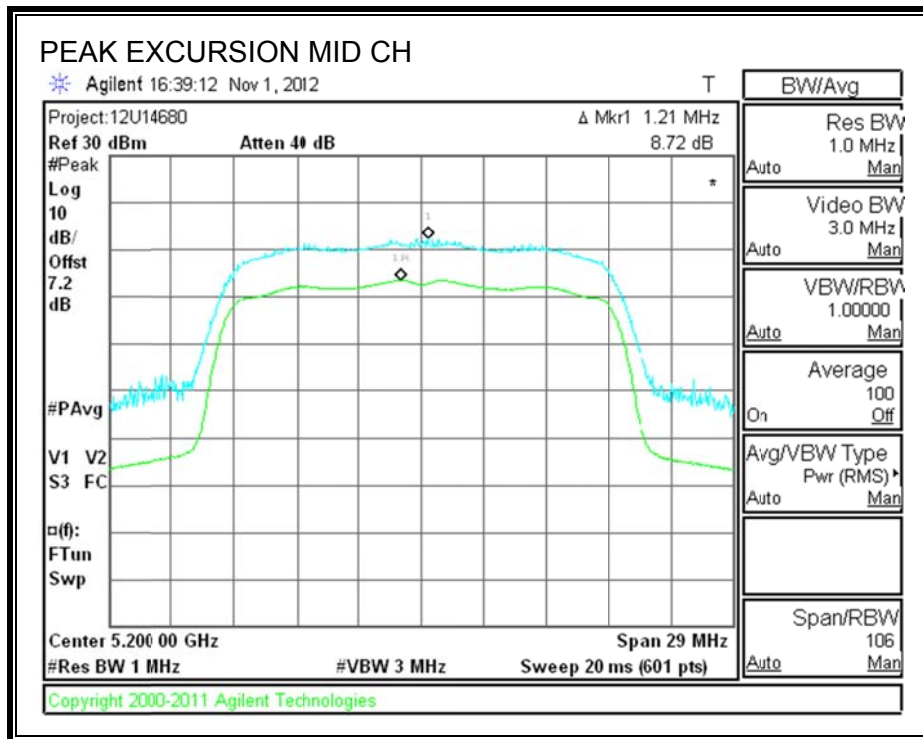
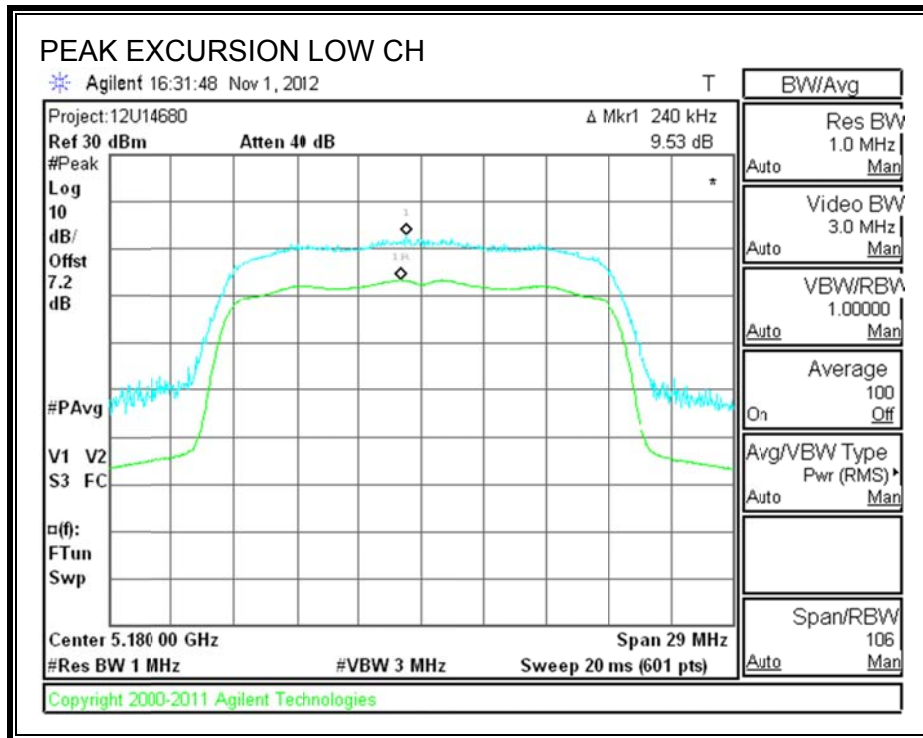
FCC §15.407 (a) (6)

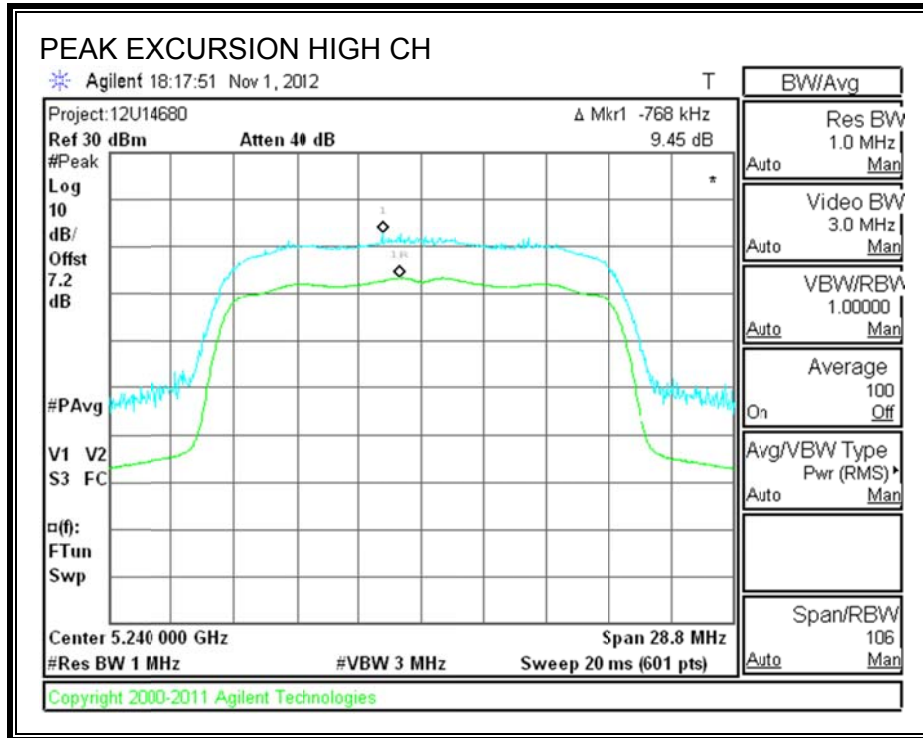
The ratio of the peak excursion of the modulation envelope (measured using a peak hold function) to the peak transmit power (measured as specified above) shall not exceed 13 dB across any 1 MHz bandwidth or the emission bandwidth whichever is less.

RESULTS

Channel	Frequency (MHz)	Peak Excursion (dB)	Limit (dB)	Margin (dB)
Low	5180	9.53	13	-3.47
Mid	5200	8.72	13	-4.28
High	5240	9.45	13	-3.55

PEAK EXCURSION





8.3. 802.11n HT40 MODE IN THE 5.2 GHz BAND

8.3.1. 26 dB BANDWIDTH

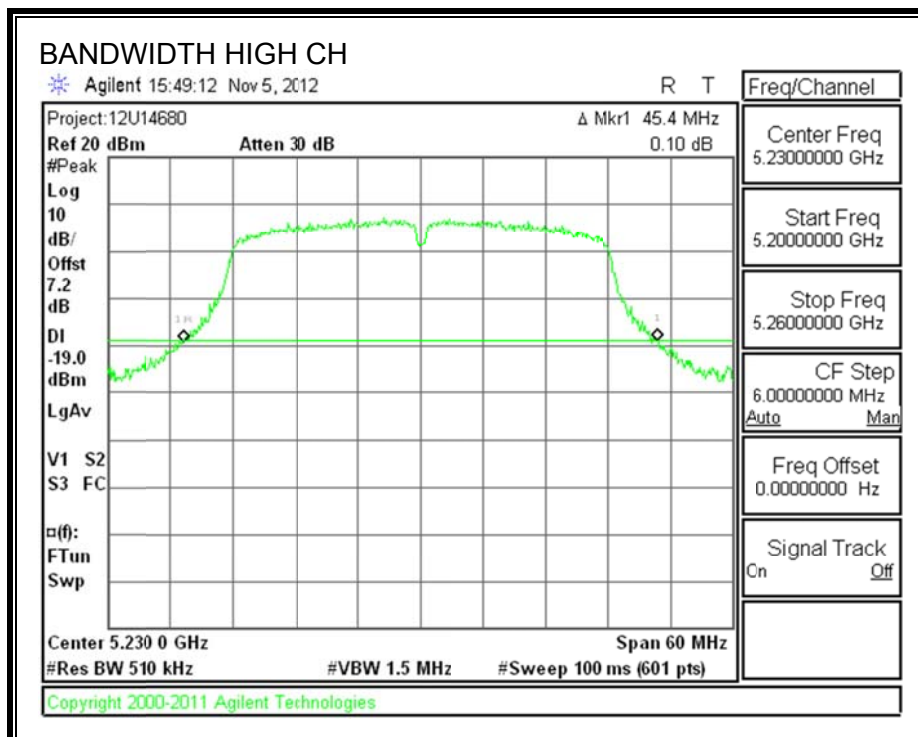
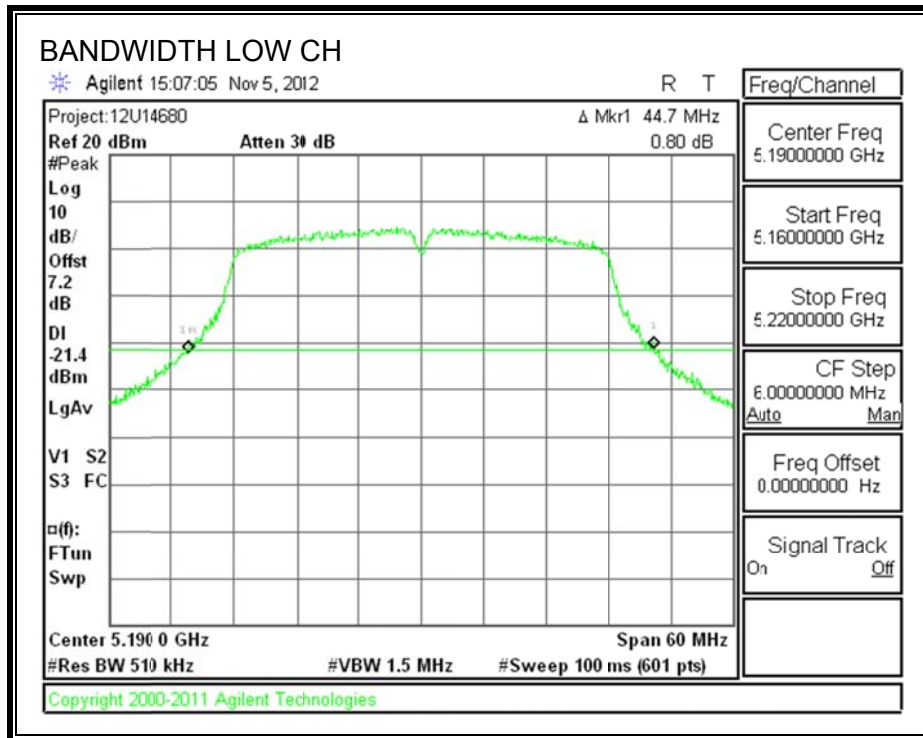
LIMITS

None; for reporting purposes only.

RESULTS

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
Low	5190	44.7
High	5230	45.4

26 dB BANDWIDTH



8.3.2. 99% BANDWIDTH

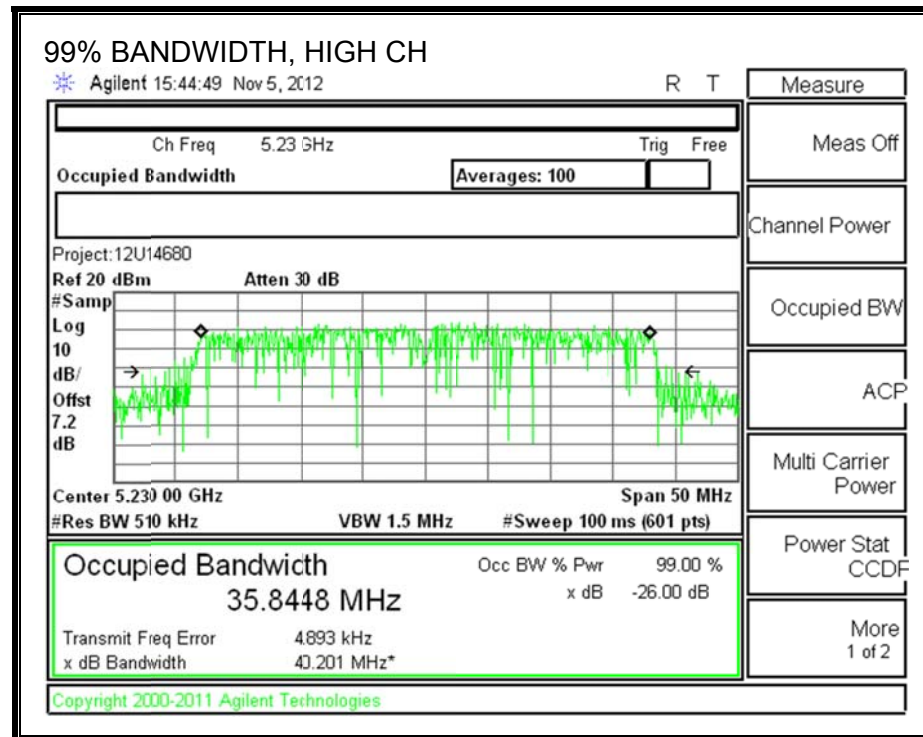
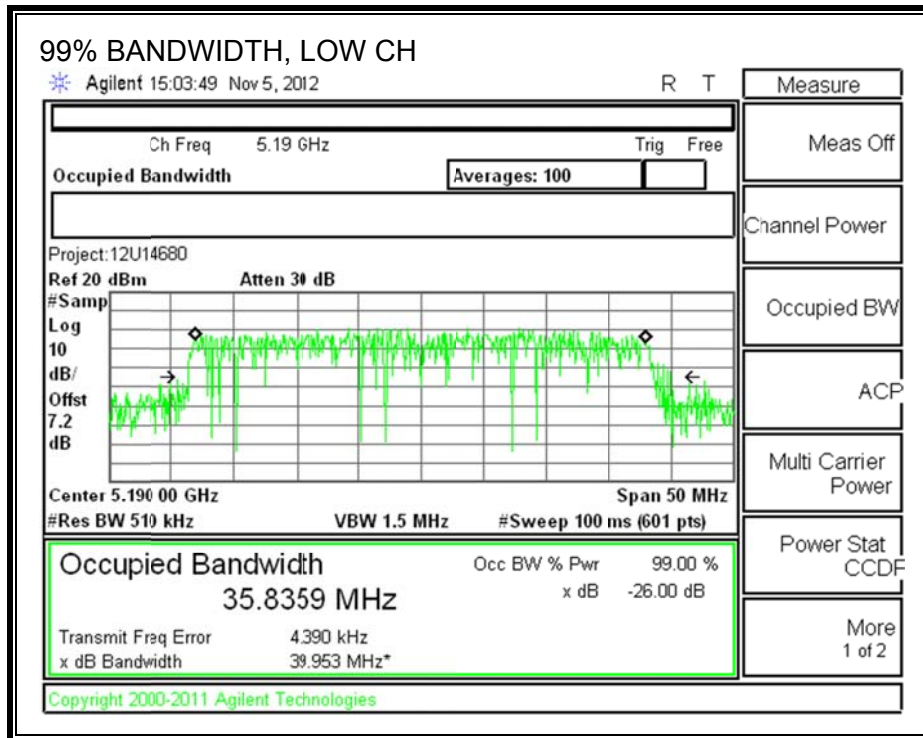
LIMITS

None; for reporting purposes only.

RESULTS

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	5190	35.8359
High	5230	35.8448

99% BANDWIDTH



8.3.3. AVERAGE POWER

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

The cable assembly insertion loss of 10.9 dB (including 10 dB pad and 0.9 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

RESULTS

Channel	Frequency (MHz)	Power (dBm)
Low	5190	12.5
High	5230	15.5

8.3.4. OUTPUT POWER AND PPSD

LIMITS

FCC §15.407 (a) (1)

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 $4 \text{ dBm} + 10 \log B$, where B is the 26–dB emission bandwidth in MHz. In addition, 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, both the maximum conducted output power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

IC RSS-210 A9.2 (1)

The maximum e.i.r.p. shall not exceed 200 mW or $10 + 10 \log_{10} B$, dBm, whichever power is less. B is the 99% emission bandwidth in MHz. The e.i.r.p. spectral density shall not exceed 10 dBm in any 1.0 MHz band.

DIRECTIONAL ANTENNA GAIN

There is only one transmitter output therefore the directional gain is equal to the antenna gain.

RESULTS

Bandwidth and Antenna Gain

Channel	Frequency (MHz)	Min 26 dB BW (MHz)	Min 99% BW (MHz)	Directional Gain (dBi)
Low	5190	44.7	35.8359	3.93
High	5230	45.4	35.8448	3.93

Limits

Channel	Frequency (MHz)	FCC Power Limit (dBm)	IC EIRP Limit (dBm)	Max IC Power (dBm)	Power Limit (dBm)	FCC PPSD Limit (dBm)	IC eirp PSD Limit (dBm)	PPSD Limit (dBm)
Low	5190	17.00	23.00	19.07	17.00	4.00	10.00	4.00
High	5230	17.00	23.00	19.07	17.00	4.00	10.00	4.00

Duty Cycle CF (dB)	0.00	Included in Calculations of Corr'd Power & PPSD
---------------------------	------	--

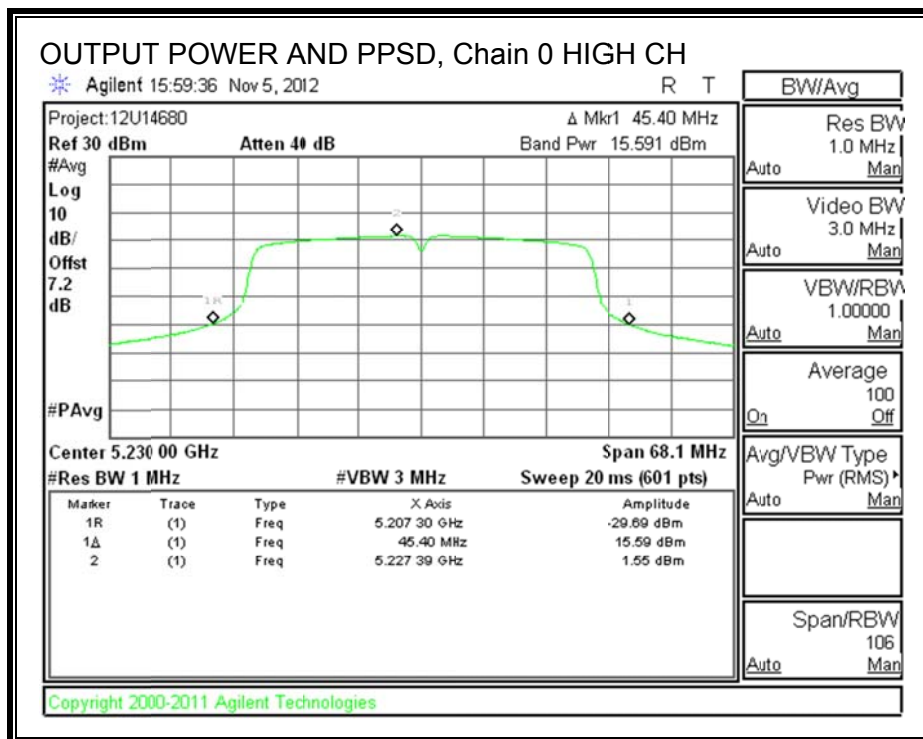
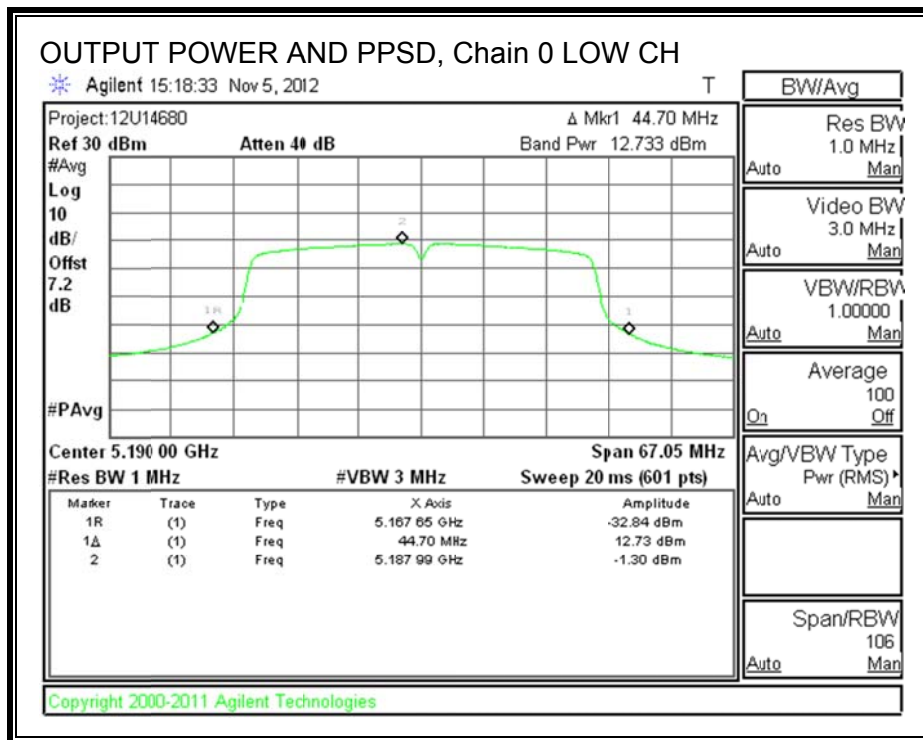
Output Power Results

Channel	Frequency (MHz)	Chain 0 Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Power Margin (dB)
Low	5190	12.733	12.733	17.00	-4.267
High	5230	15.591	15.591	17.00	-1.409

PPSD Results

Channel	Frequency (MHz)	Chain 0 Meas PPSD (dBm)	Total Corr'd PPSD (dBm)	PPSD Limit (dBm)	PPSD Margin (dB)
Low	5190	-1.30	-1.30	4.00	-5.30
High	5230	1.55	1.55	4.00	-2.45

OUTPUT POWER AND PPSD, Chain 0



8.3.5. PEAK EXCURSION

LIMITS

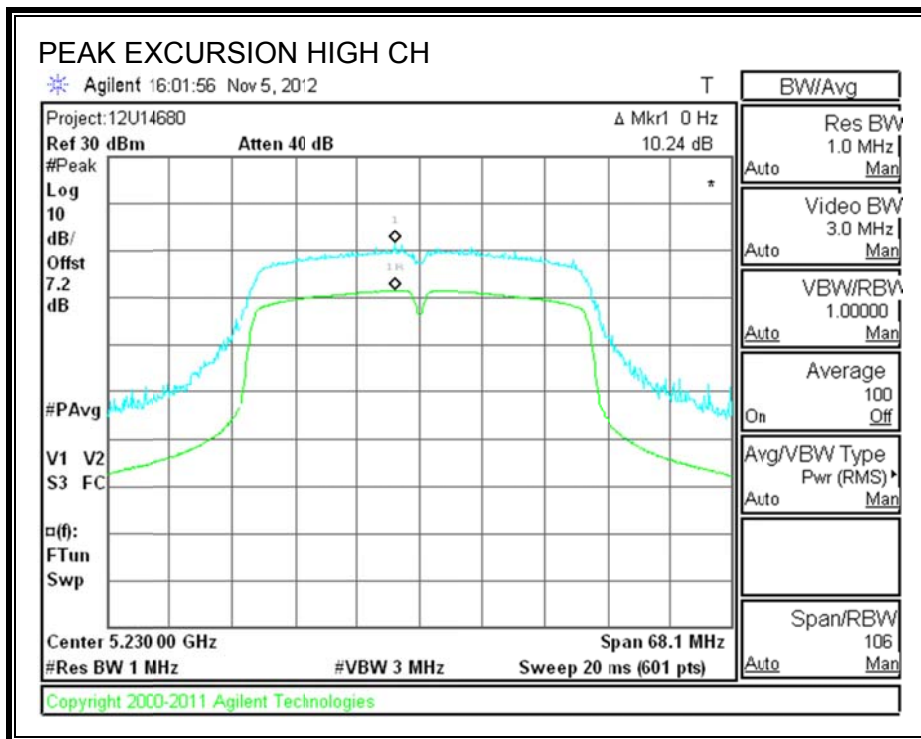
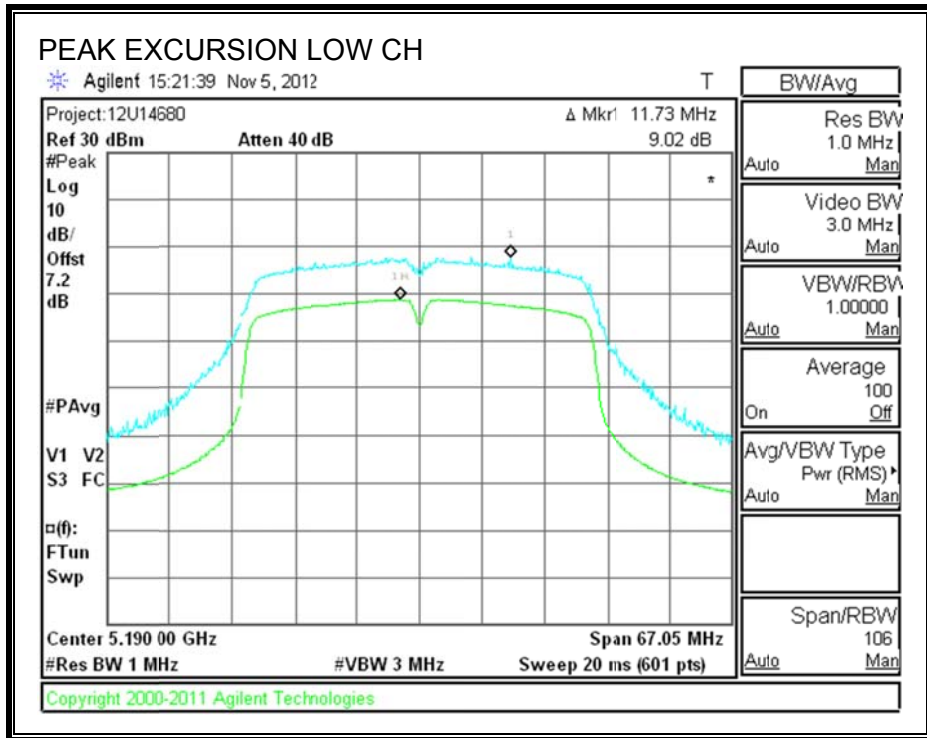
FCC §15.407 (a) (6)

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

RESULTS

Channel	Frequency (MHz)	Peak Excursion (dB)	Limit (dB)	Margin (dB)
Low	5190	9.02	13	-3.98
High	5230	10.24	13	-2.76

PEAK EXCURSION



8.4. 802.11a MODE IN THE 5.3 GHz BAND

8.4.1. 26 dB BANDWIDTH

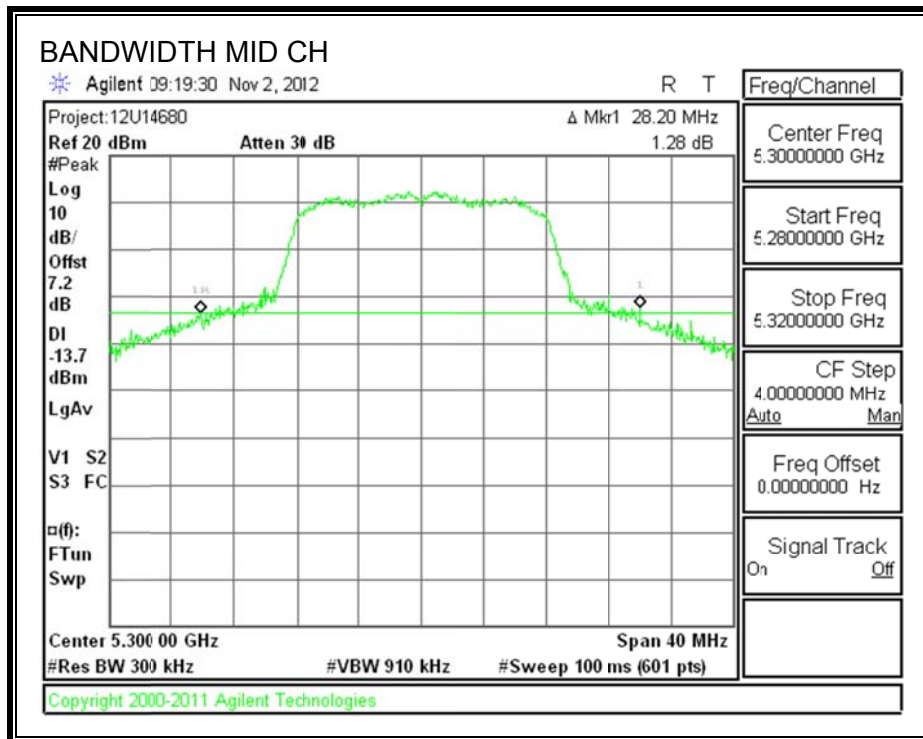
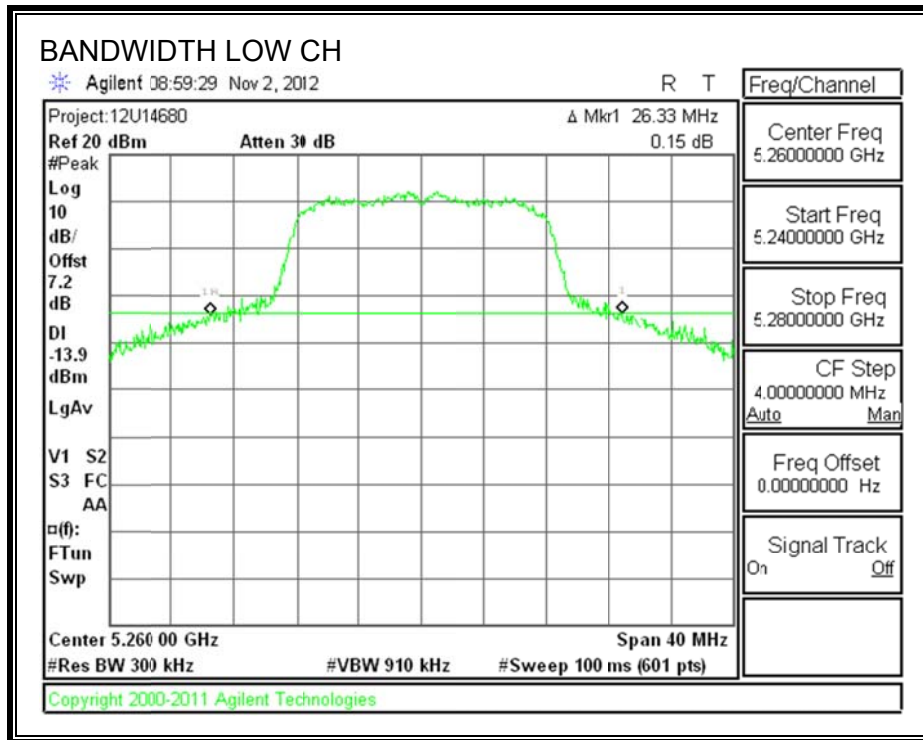
LIMITS

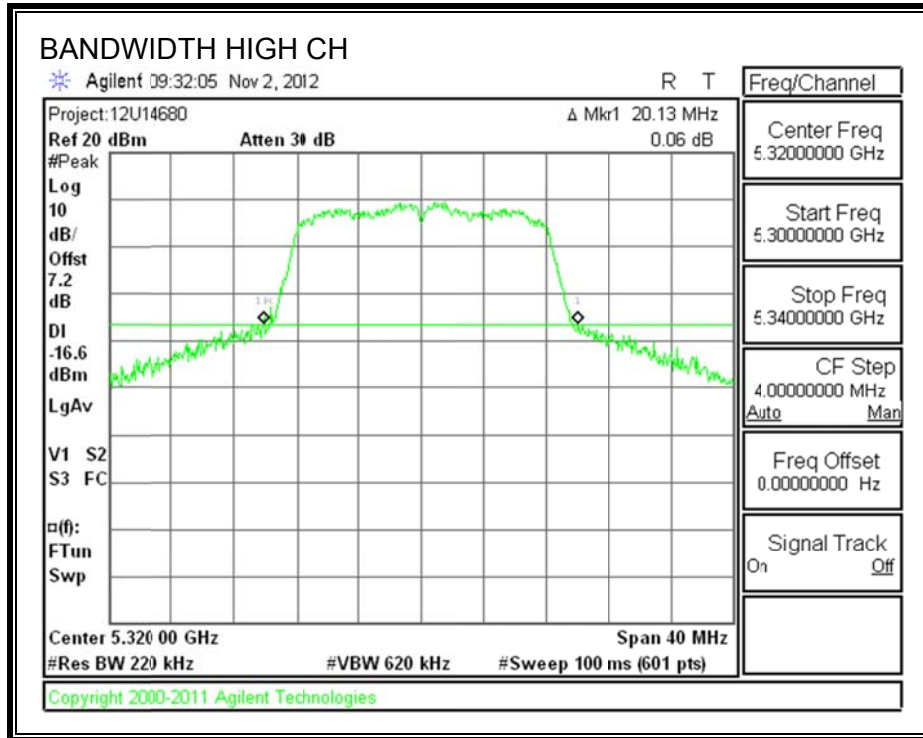
None; for reporting purposes only.

RESULTS

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
Low	5260	26.33
Mid	5300	28.20
High	5320	20.13

26 dB BANDWIDTH





8.4.2. 99% BANDWIDTH

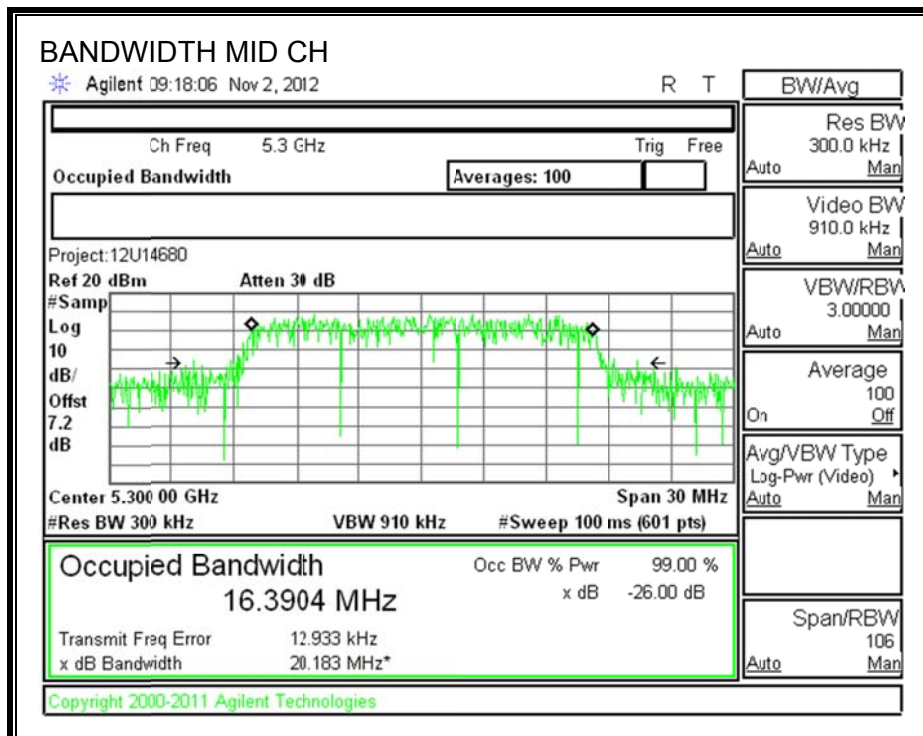
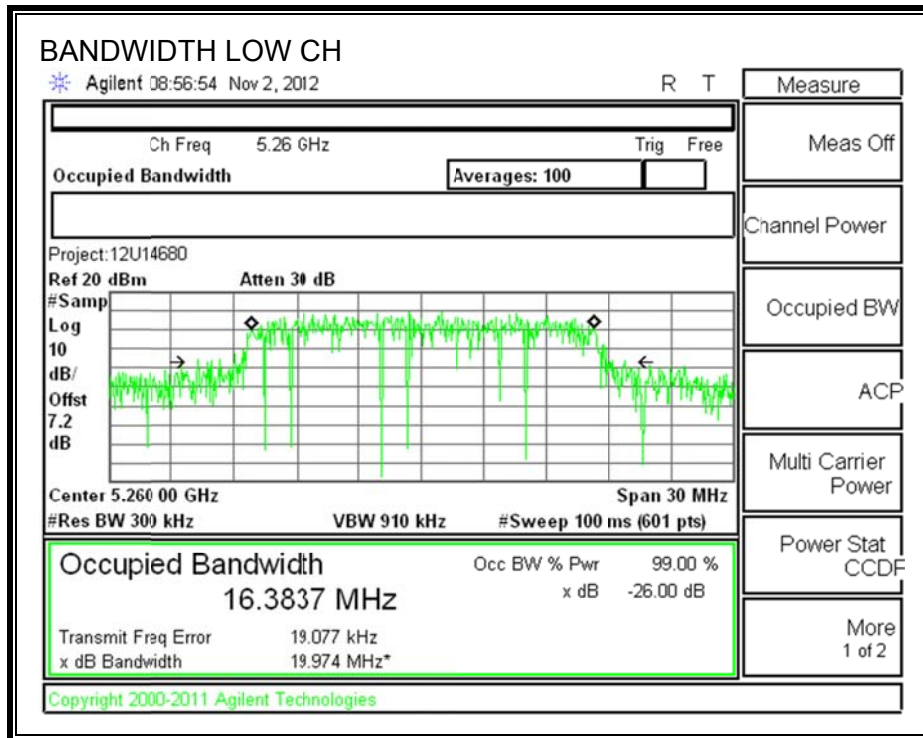
LIMITS

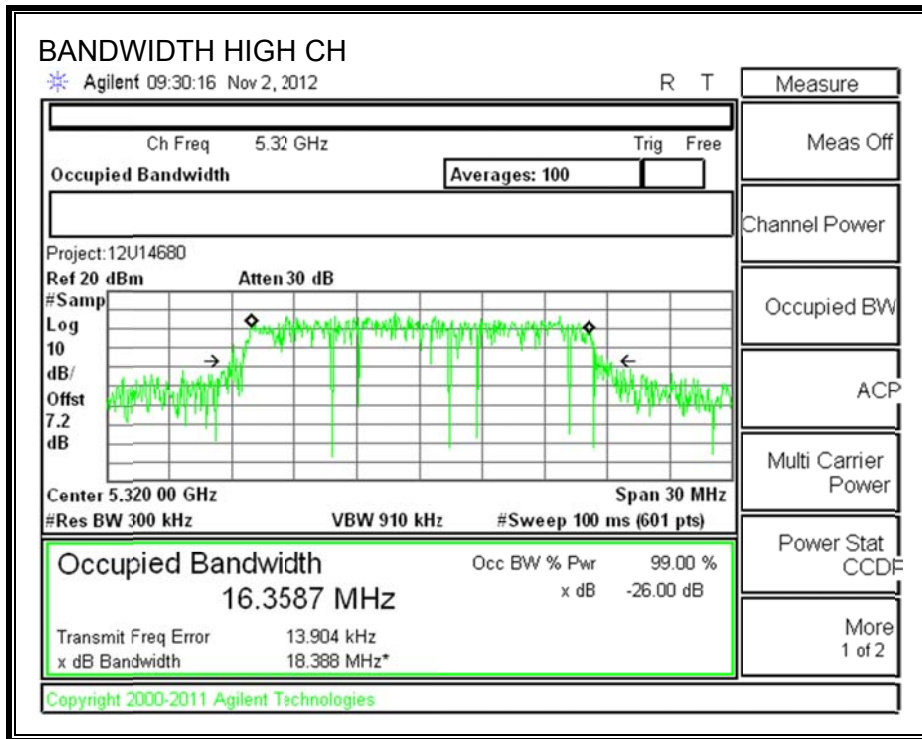
None; for reporting purposes only.

RESULTS

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	5260	16.3837
Mid	5300	16.3904
High	5320	16.3587

99% BANDWIDTH





8.4.3. AVERAGE POWER

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

The cable assembly insertion loss of 10.9 dB (including 10 dB pad and 0.9 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

RESULTS

Channel	Frequency (MHz)	Power (dBm)
Low	5260	19.5
Mid	5300	19.5
High	5320	18.0

8.4.4. OUTPUT POWER AND PPSD

LIMITS

FCC §15.407 (a) (1)

For the band 5.25–5.35 GHz, the maximum conducted output power over the frequency band of operation shall not exceed the lesser of 250 mW or $11 \text{ dBm} + 10 \log B$, where B is the 26-dB emission bandwidth in MHz. In addition, the peak power spectral density shall not exceed 11 dBm in any 1-MHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

IC RSS-210 A9.2 (1)

The maximum e.i.r.p. shall not exceed 200 mW or $10 + 10 \log_{10} B$, dBm, whichever power is less. B is the 99% emission bandwidth in MHz. The e.i.r.p. spectral density shall not exceed 10 dBm in any 1.0 MHz band.

DIRECTIONAL ANTENNA GAIN

There is only one transmitter output therefore the directional gain is equal to the antenna gain.

RESULTS

Bandwidth and Antenna Gain

Channel	Frequency (MHz)	Min 26 dB BW (MHz)	Min 99% BW (MHz)	Directional Gain (dBi)
Low	5260	26.33	16.3837	3.16
Mid	5300	28.20	16.3904	3.16
High	5320	20.13	16.3587	3.16

Limits

Channel	Frequency (MHz)	FCC Power Limit (dBm)	IC Power Limit (dBm)	IC EIRP Limit (dBm)	Power Limit (dBm)	FCC PPSD Limit (dBm)	IC PSD Limit (dBm)	PPSD Limit (dBm)
Low	5260	24.00	23.14	29.14	23.14	11.00	11.00	11.00
Mid	5300	24.00	23.15	29.15	23.15	11.00	11.00	11.00
High	5320	24.00	23.14	29.14	23.14	11.00	11.00	11.00

Duty Cycle CF (dB)	0.00	Included in Calculations of Corr'd Power & PPSD
---------------------------	------	--

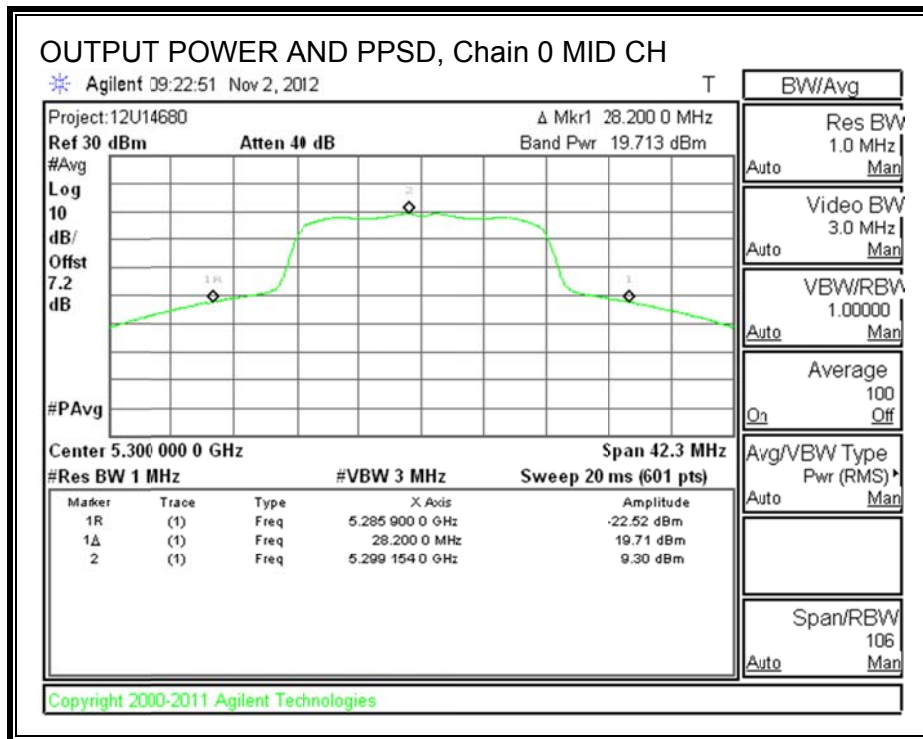
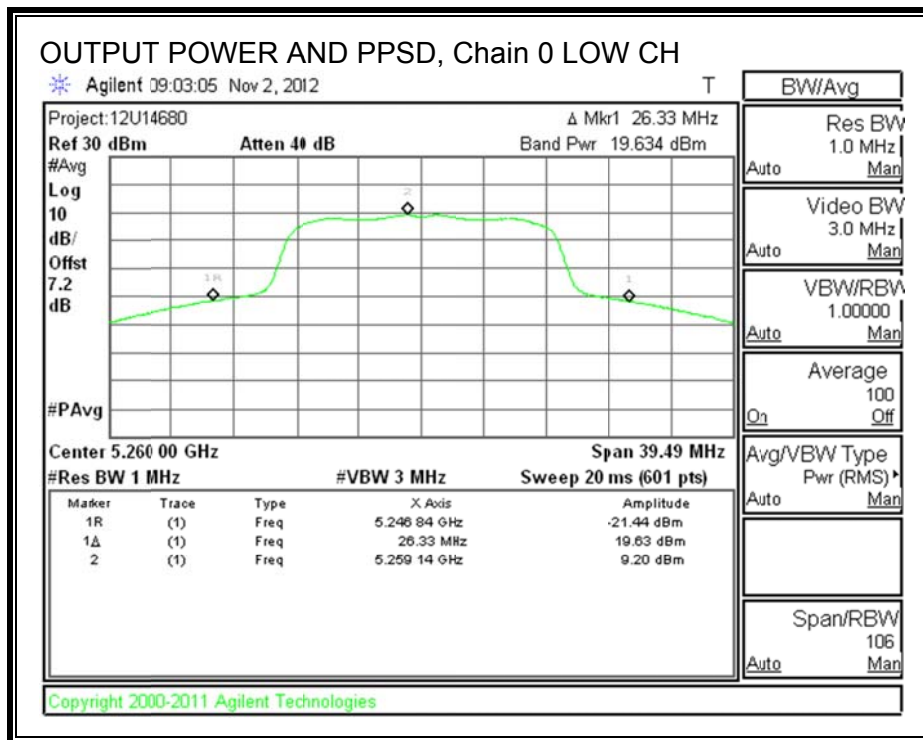
Output Power Results

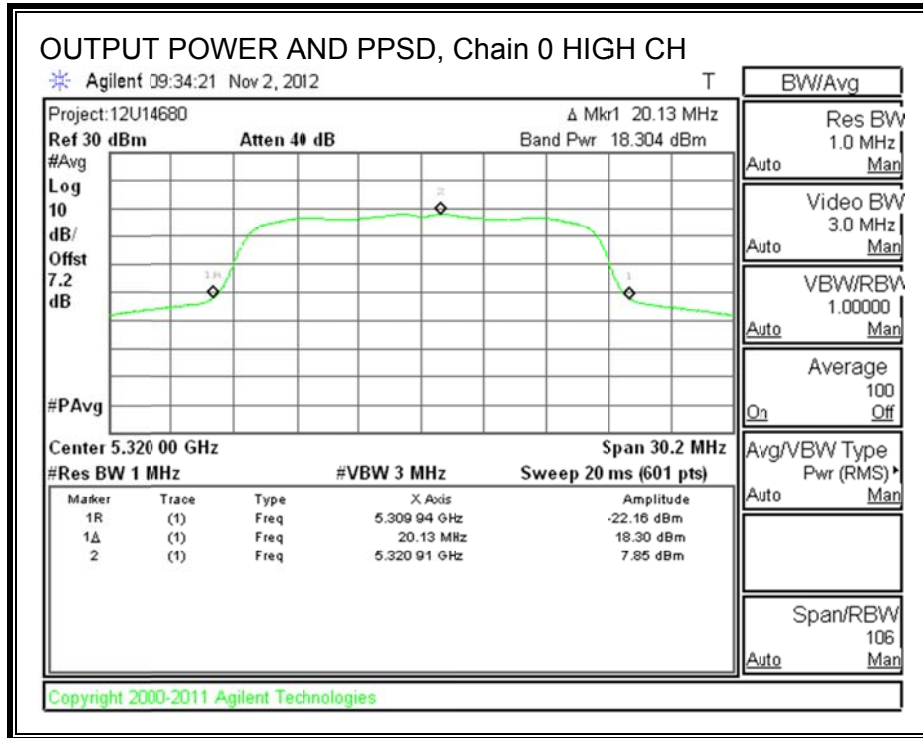
Channel	Frequency (MHz)	Chain 0 Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Power Margin (dB)
Low	5260	19.634	19.634	23.14	-3.510
Mid	5300	19.713	19.713	23.15	-3.433
High	5320	18.304	18.304	23.14	-4.833

PPSD Results

Channel	Frequency (MHz)	Chain 0 Meas PPSD (dBm)	Total Corr'd PPSD (dBm)	PPSD Limit (dBm)	PPSD Margin (dB)
Low	5260	9.20	9.20	11.00	-1.80
Mid	5300	9.29	9.29	11.00	-1.71
High	5320	7.85	7.85	11.00	-3.15

OUTPUT POWER AND PPSD, Chain 0





8.4.5. PEAK EXCURSION

LIMITS

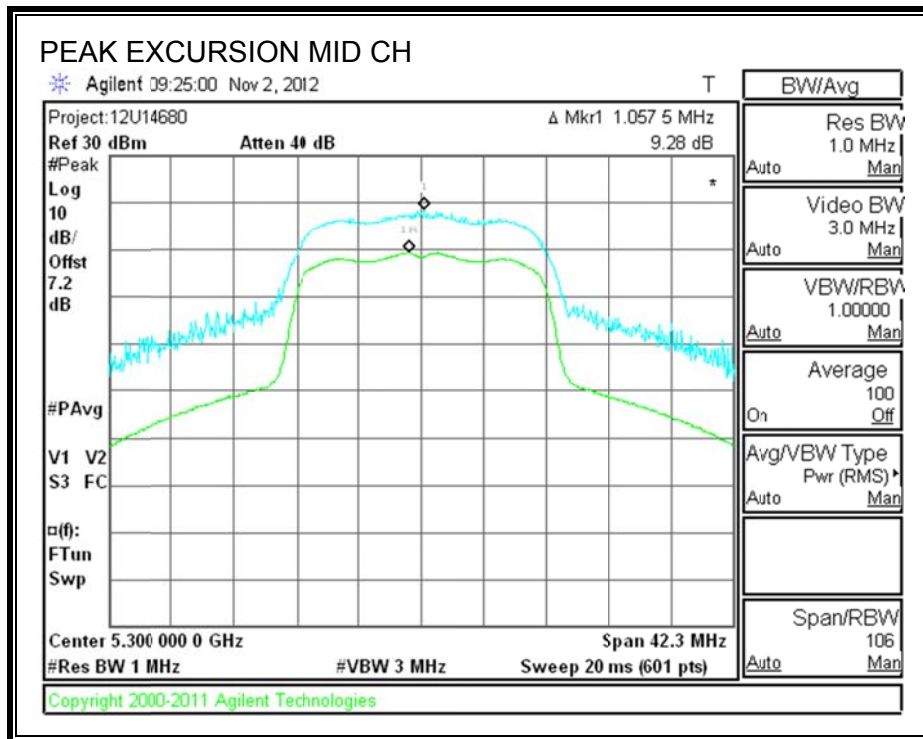
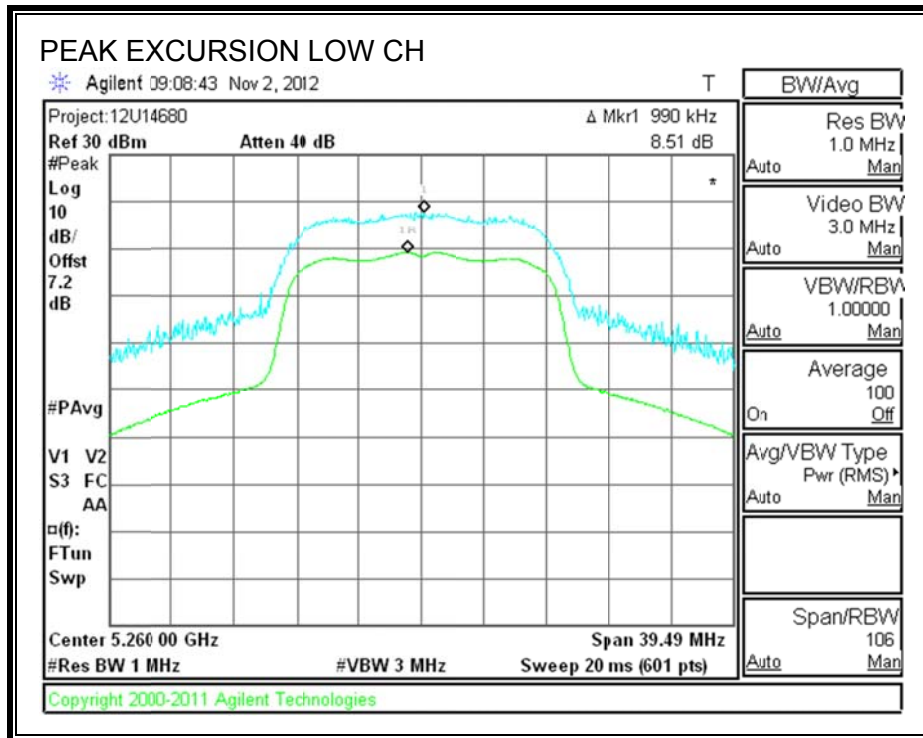
FCC §15.407 (a) (6)

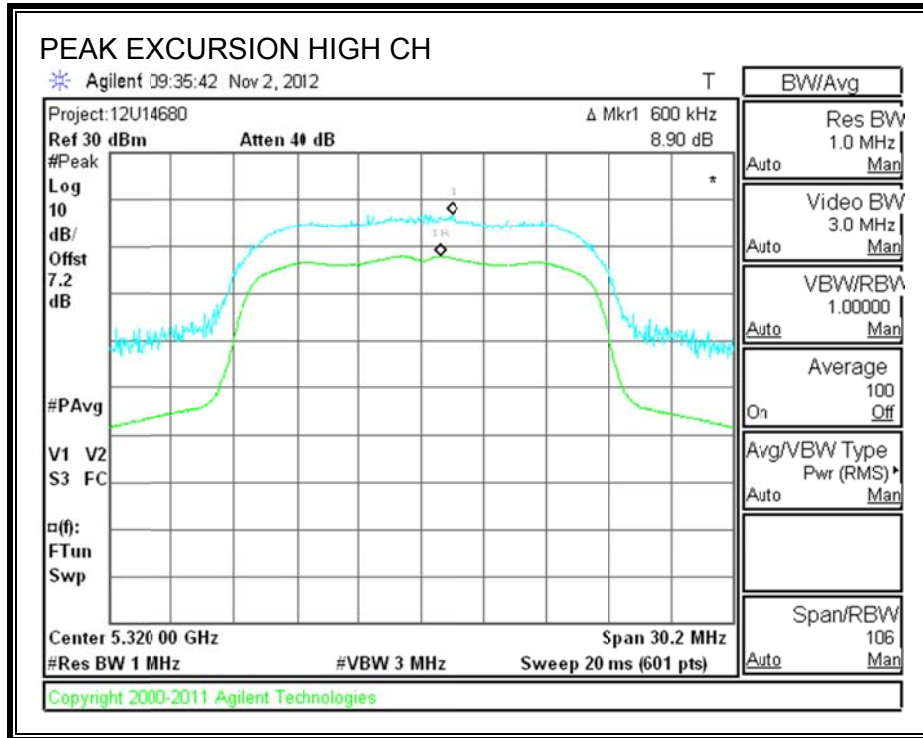
The ratio of the peak excursion of the modulation envelope (measured using a peak hold function) to the peak transmit power (measured as specified above) shall not exceed 13 dB across any 1 MHz bandwidth or the emission bandwidth whichever is less.

RESULTS

Channel	Frequency (MHz)	Peak Excursion (dB)	Limit (dB)	Margin (dB)
Low	5260	8.51	13	-4.49
Mid	5300	9.28	13	-3.72
High	5320	8.90	13	-4.10

PEAK EXCURSION





8.4.6. TPC POWER

LIMITS

FCC §15.407 (h) (1)

IC RSS-210 A9.2 (2)

Transmit power control (TPC). U-NII devices operating in the 5.25–5.35 GHz band and the 5.47–5.725 GHz band shall employ a TPC mechanism. The U-NII device is required to have the capability to operate at least 6 dB below the mean EIRP value of 30 dBm. A TPC mechanism is not required for systems with an e.i.r.p. of less than 500 mW.

DIRECTIONAL ANTENNA GAIN

There is only one transmitter output therefore the directional gain is equal to the antenna gain.

RESULTS

EIRP is less than 27 dBm; therefore, TPC is not required.

8.5. 802.11n HT20 MODE IN THE 5.3 GHz BAND

8.5.1. 26 dB BANDWIDTH

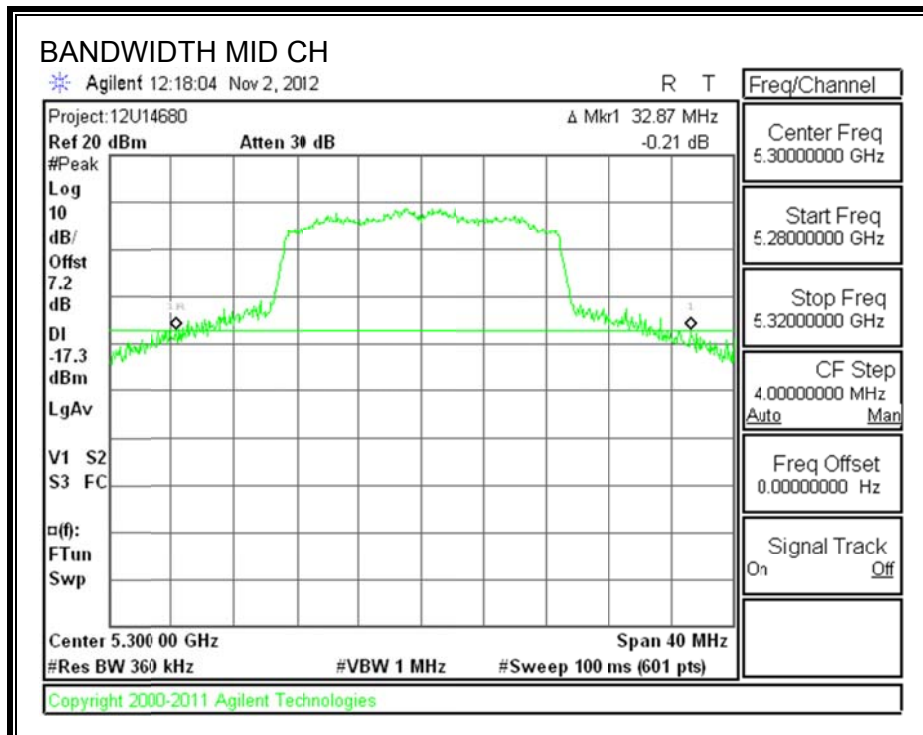
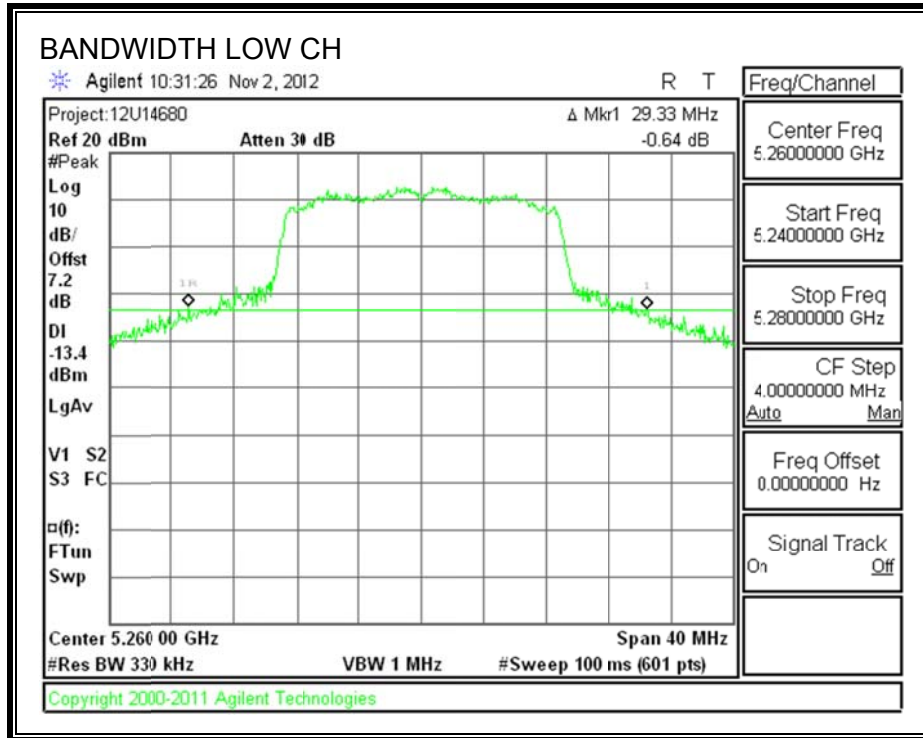
LIMITS

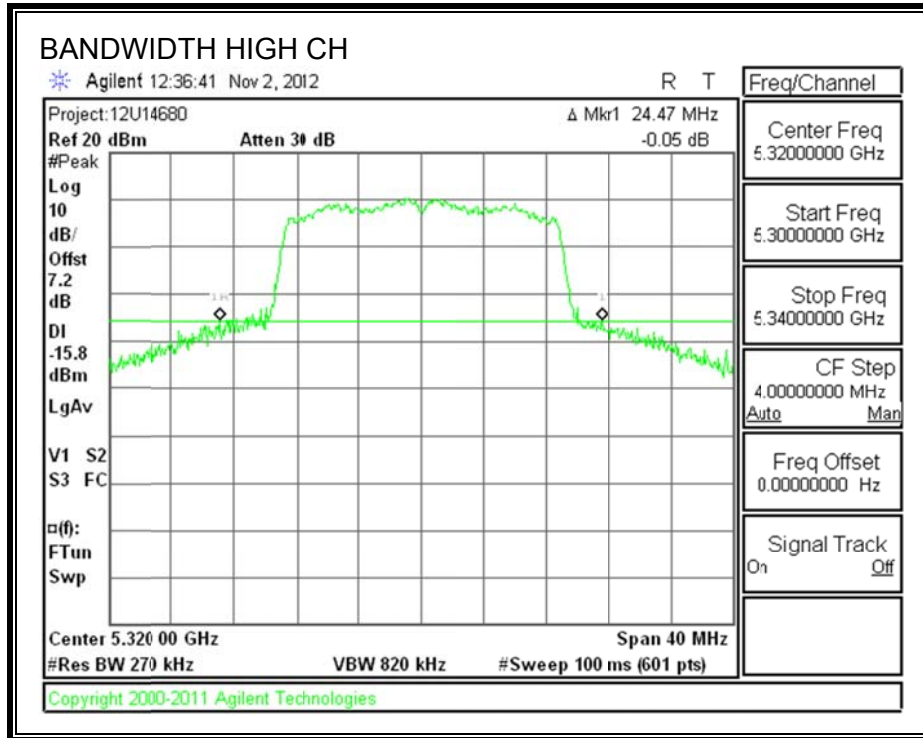
None; for reporting purposes only.

RESULTS

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
Low	5260	29.33
Mid	5300	32.87
High	5320	24.47

26 dB BANDWIDTH





8.5.2. 99% BANDWIDTH

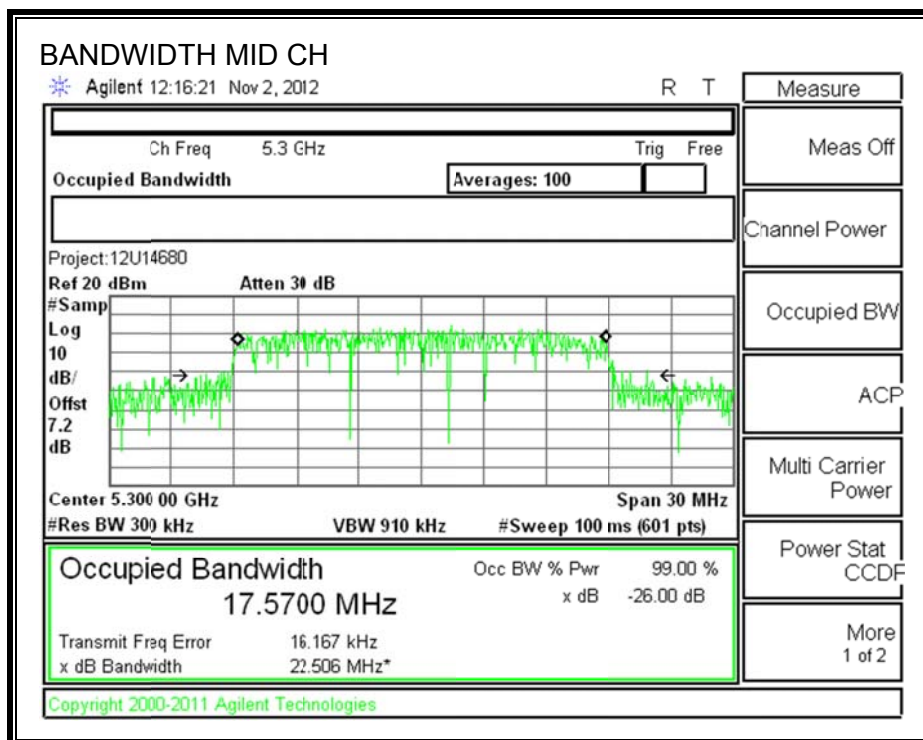
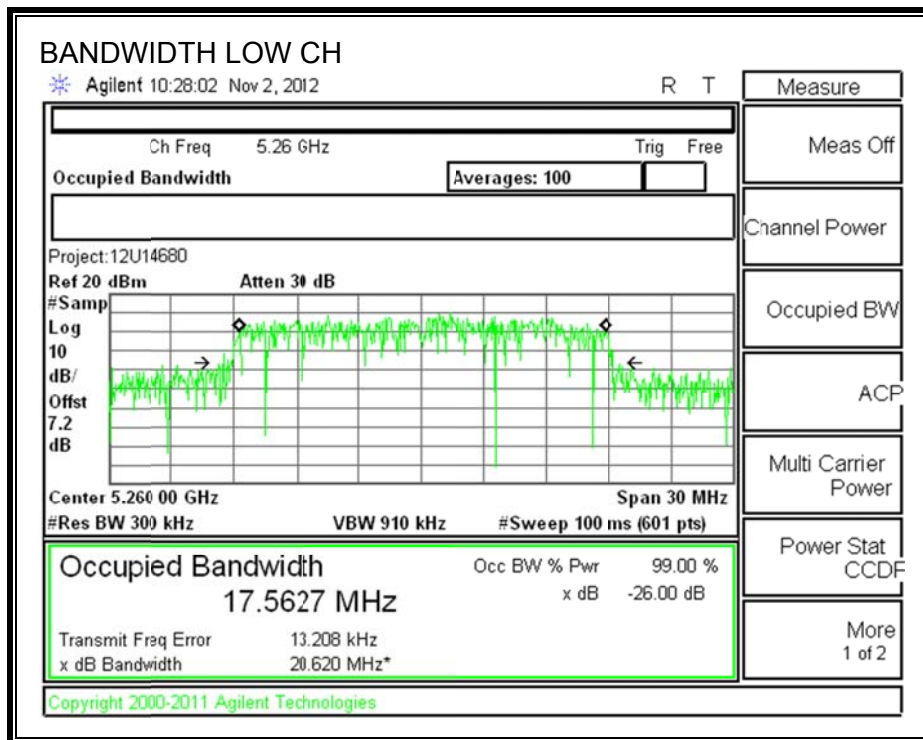
LIMITS

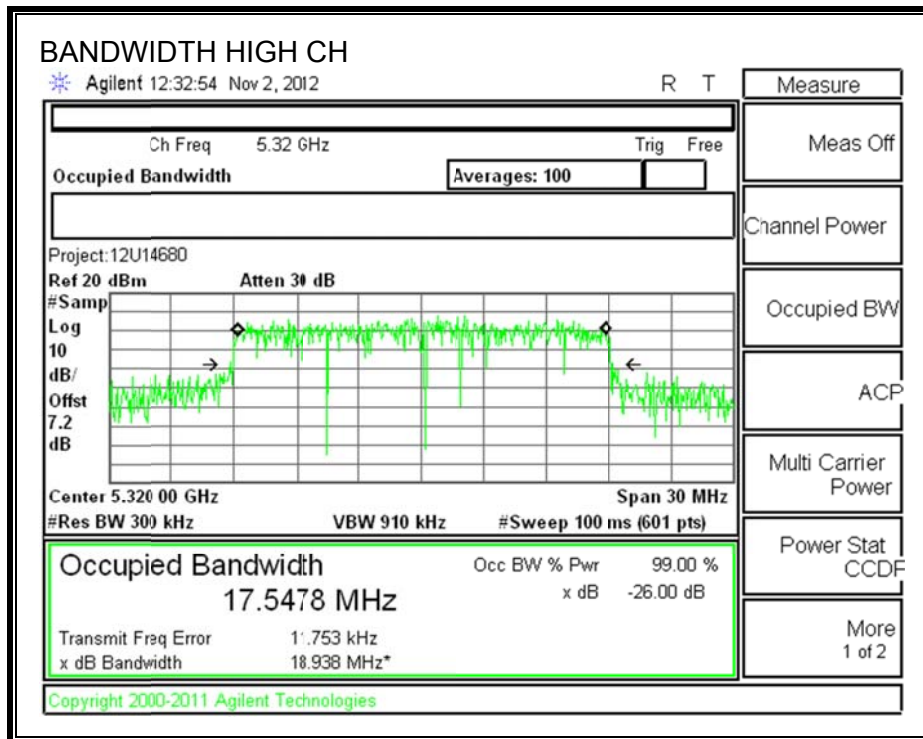
None; for reporting purposes only.

RESULTS

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	5260	17.5627
Mid	5300	17.5700
High	5320	17.5478

99% BANDWIDTH





8.5.3. AVERAGE POWER

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

The cable assembly insertion loss of 10.9 dB (including 10 dB pad and 0.9 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

RESULTS

Channel	Frequency (MHz)	Power (dBm)
Low	5260	19.5
Mid	5300	19.5
High	5320	18.0

8.5.4. OUTPUT POWER AND PPSD

LIMITS

FCC §15.407 (a) (1)

For the band 5.25–5.235 GHz, the maximum conducted output power over the frequency band of operation shall not exceed the lesser of 250 mW or $11 \text{ dBm} + 10 \log B$, where B is the 26-dB emission bandwidth in MHz. In addition, the peak power spectral density shall not exceed 11 dBm in any 1-MHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

IC RSS-210 A9.2 (1)

The maximum e.i.r.p. shall not exceed 200 mW or $10 + 10 \log_{10} B$, dBm, whichever power is less. B is the 99% emission bandwidth in MHz. The e.i.r.p. spectral density shall not exceed 10 dBm in any 1.0 MHz band.

DIRECTIONAL ANTENNA GAIN

There is only one transmitter output therefore the directional gain is equal to the antenna gain.

RESULTS

Bandwidth and Antenna Gain

Channel	Frequency (MHz)	Min 26 dB BW (MHz)	Min 99% BW (MHz)	Directional Gain (dBi)
Low	5260	29.33	17.5627	3.16
Mid	5300	32.87	17.5700	3.16
High	5320	24.47	17.5478	3.16

Limits

Channel	Frequency (MHz)	FCC Power Limit (dBm)	IC Power Limit (dBm)	IC EIRP Limit (dBm)	Power Limit (dBm)	FCC PPSD Limit (dBm)	IC PSD Limit (dBm)	PPSD Limit (dBm)
Low	5260	24.00	23.45	29.45	23.45	11.00	11.00	11.00
Mid	5300	24.00	23.45	29.45	23.45	11.00	11.00	11.00
High	5320	24.00	23.44	29.44	23.44	11.00	11.00	11.00

Duty Cycle CF (dB)	0.00	Included in Calculations of Corr'd Power & PPSD
---------------------------	------	--

Output Power Results

Channel	Frequency (MHz)	Chain 0 Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Power Margin (dB)
Low	5260	19.591	19.591	23.45	-3.855
Mid	5300	19.690	19.690	23.45	-3.758
High	5320	18.142	18.142	23.44	-5.300

PPSD Results

Channel	Frequency (MHz)	Chain 0 Meas PPSD (dBm)	Total Corr'd PPSD (dBm)	PPSD Limit (dBm)	PPSD Margin (dB)
Low	5260	8.95	8.95	11.00	-2.05
Mid	5300	9.05	9.05	11.00	-1.95
High	5320	7.48	7.48	11.00	-3.52

OUTPUT POWER AND PPSD, Chain 0

