



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

CERTIFICATION TEST REPORT

FOR

802.11 a/b/g/n radio, Bluetooth Radio Function

MODEL NUMBER: A1403

**FCC ID: BCGA1403
IC: 579C-A1403**

REPORT NUMBER: 11U13938-2, Revision D

ISSUE DATE: FEBRUARY 03, 2012

Prepared for
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NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
--	12/12/11	Initial Issue	F. Ibrahim
A	12/13/11	Revised Antenna Gains	A. Zaffar
B	02/02/12	Updated antenna port and radiated testing per KDB 789033 D01 dated 10/25/2011	F. Ibrahim
C	02/02/12	Revised 1. Model number 2. FCC and IC ID	A. Zaffar
D	02/03/12	Revised EUT description	A. Zaffar

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1. ATTESTATION OF TEST RESULTS

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

EUT DESCRIPTION: The Apple iPad, Model A1403 is a tablet device with iPod functions (music, application support, and video), 802.11a/b/g/n radio, Bluetooth radio functions, and cellular using the CDMA/GSM 2G/3G/LTE data radio functions.

MODEL: A1403

SERIAL NUMBER: PT667496, PT654922

DATE TESTED: SEPTEMBER 20 to DECEMBER 10, 2011 AND JANUARY 30-FEBRUARY 02, 2012.

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

Compliance Certification Services (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 CCS By:

Tested By:



FRANK IBRAHIM
EMC SUPERVISOR
COMPLIANCE CERTIFICATION SERVICES

CHIN PANG
EMC TECHNICIAN
COMPLIANCE CERTIFICATION SERVICES

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.4-2003, FCC CFR 47 Part 2, FCC CFR 47 Part 15, RSS-GEN Issue 2, ICES-003 ISSUE 4, 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.

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:

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

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 iPad, Model A1403 is a tablet device with iPod functions (music, application support, and video), 802.11a/b/g/n radio, Bluetooth radio functions, and cellular using the CDMA/GSM 2G/3G/LTE data radio functions.

5.2. MAXIMUM OUTPUT POWER

The transmitter has a maximum peak conducted output power as follows:

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
5180 – 5240	802.11a	13.81	24.04
5180 – 5240	802.11n HT20	13.87	24.38
5260 – 5320	802.11a	17.63	57.94
5260 – 5320	802.11n HT20	17.72	59.16
5500 – 5700	802.11a	16.69	46.67
5500 – 5700	802.11n HT20	16.90	48.98

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes a PiFA integrated antenna, with the following gain:

5.2 GHz band: 4.63 dBi
5.6 GHz band: 4.51 dBi

5.4. SOFTWARE AND FIRMWARE

The firmware installed in the EUT during testing was 9B87
The EUT driver software installed during testing was Broadcom_Rel_5_90_156_24
The test utility software used during testing was WL_tool.

5.5. WORST-CASE CONFIGURATION AND MODE

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

Worst-case data rates as provided by the manufacturer are:

For 11b mode: 1Mbps
For 11g mode: 6Mbps
For 11a mode: 6Mbps
For 11n HT20: MCS0

EUT is a portable device that has three orientations; therefore, X Y and Z orientations have been investigated, and the worst case was found to be at Z position.

5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST			
Description	Manufacturer	Model	Serial Number
Earphone	Apple	NA	NA
AC Adaptor	Apple	A1344	N/A

I/O CABLES (Conducted Setup)

I/O Cable List						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length	Remarks
1	Antenna	1	SMA	Shielded	0.1m	To Spectrum Analyzer

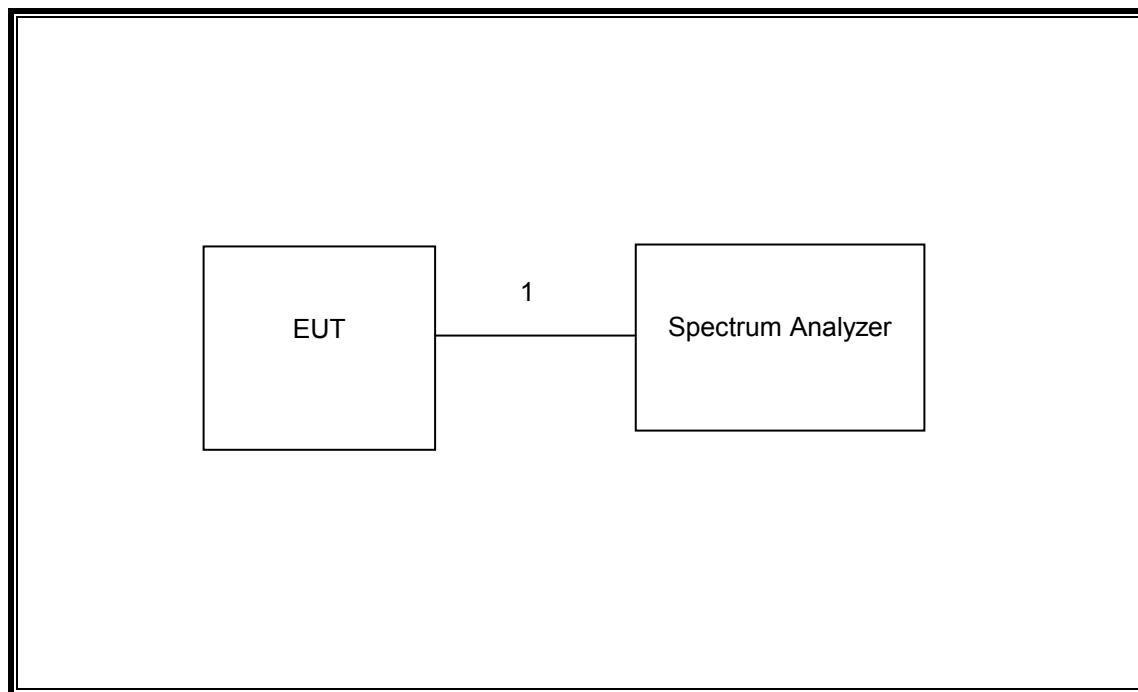
I/O CABLES (Radiated Setup)

I/O CABLE LIST						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length	Remarks
1	AC	1	AC	unshielded	2m	N/A
2	DC	1	DC	unshielded	1m	N/A
3	Jack	1	Earphone	unshielded	0.5m	N/A

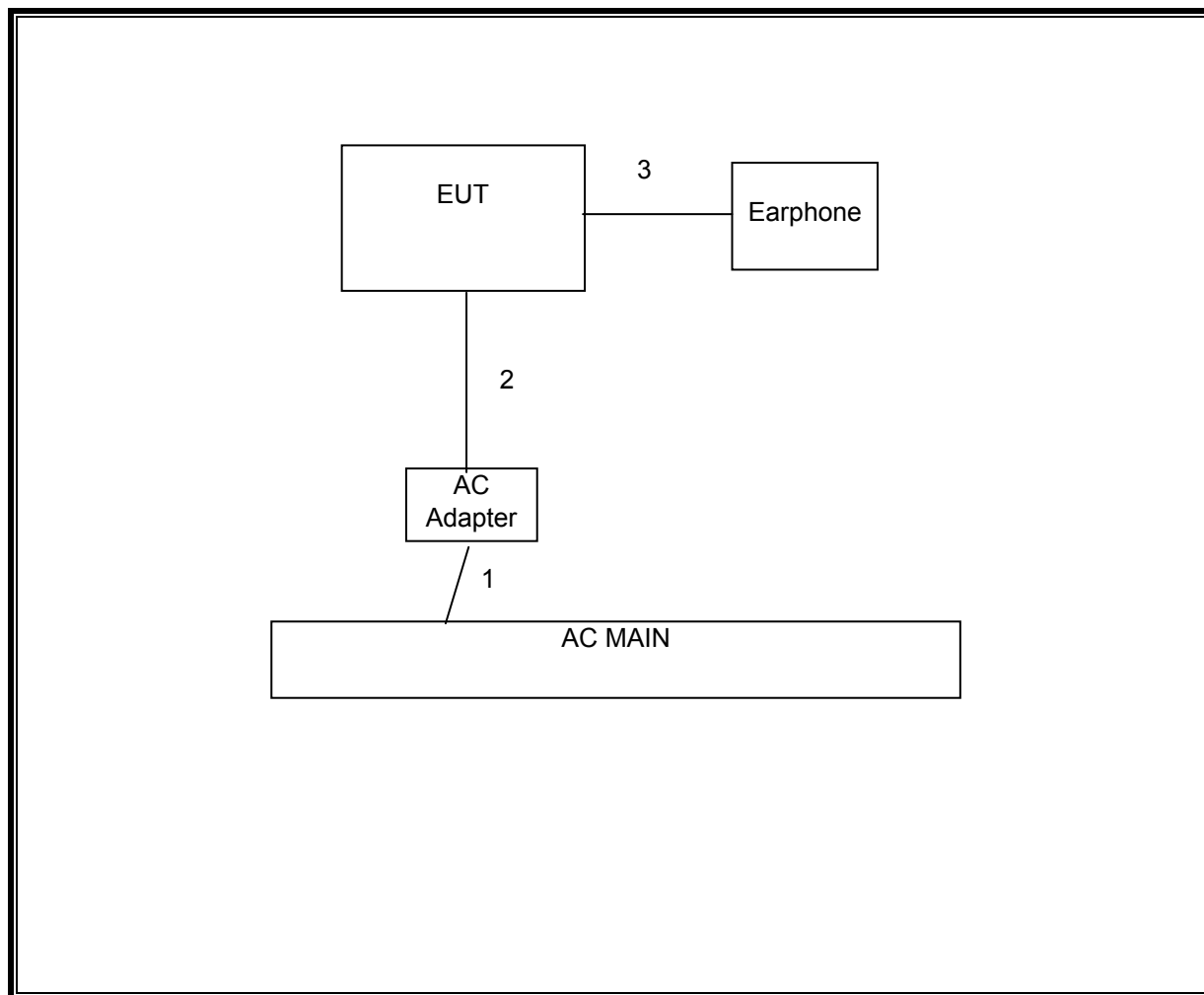
TEST SETUP

The EUT is a stand-alone device.

SETUP DIAGRAM FOR TESTS (CONDUCTED)



SETUP DIAGRAM FOR TESTS (RADIATED)



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 Date	Cal Due
Spectrum Analyzer, 44 GHz	Agilent / HP	E4446A	C01012	09-02-11	09-02-12
Preamplifier, 26.5 GHz	Agilent / HP	8449B	C01063	07-12-11	07-12-12
Preamplifier, 1300 MHz	Agilent / HP	8447D	C00580	01-27-11	01-27-12
EMI Test Receiver, 9 kHz-7 GHz	R & S	ESCI 7	1000741	07-06-11	07-06-12
LISN, 30 MHz	FOC	LISN-50/250-25-2	N02625	11-10-11	11-10-12
Highpass Filter, 7.6 GHz	Maro-Tronics	HPM13195	N02682	CNR	CNR
Antenna, Horn, 18 GHz	EMCO	3115	C00783	06-29-11	06-29-12
Peak Power Meter	Agilent / HP	E4416A	C00963	03-22-11	03-22-13
Peak / Average Power Sensor	Agilent / HP	E9327A	C00964	04-13-11	04-13-12
Antenna, Horn, 26.5 GHz	ARA	MMH-1826B	C00589	07-28-11	07-28-12
Antenna, Horn, 40 GHz	ARA	MMH-2640B	C00981	06-14-11	06-14-12
Preamplifier, 40 GHz	Miteq	NSP4000-SP2	C00990	08-02-11	08-02-12

7. ANTENNA PORT TEST RESULTS

7.1. ON TIME, DUTY CYCLE AND MEASUREMENT METHODS

LIMITS

None; for reporting purposes only.

PROCEDURE

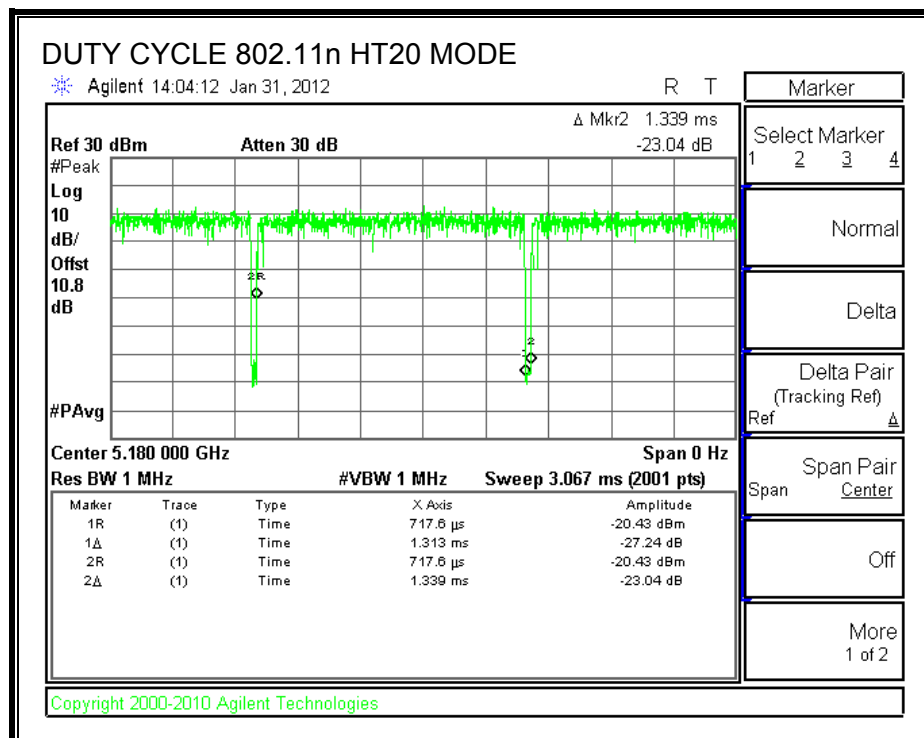
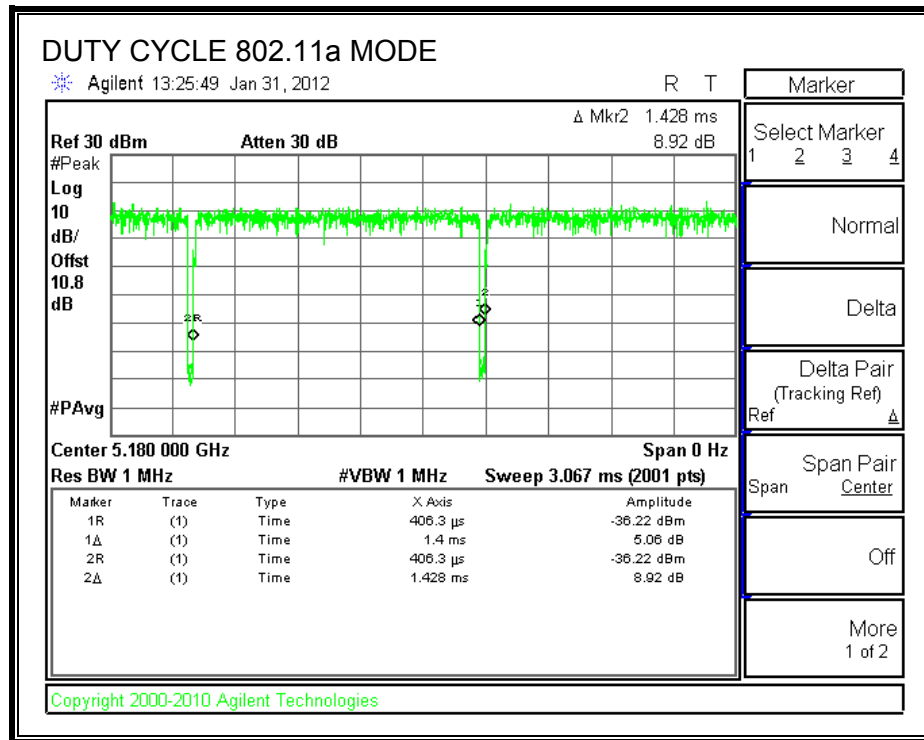
KDB 789033 Zero-Span Spectrum Analyzer Method.

ON TIME AND DUTY CYCLE RESULTS

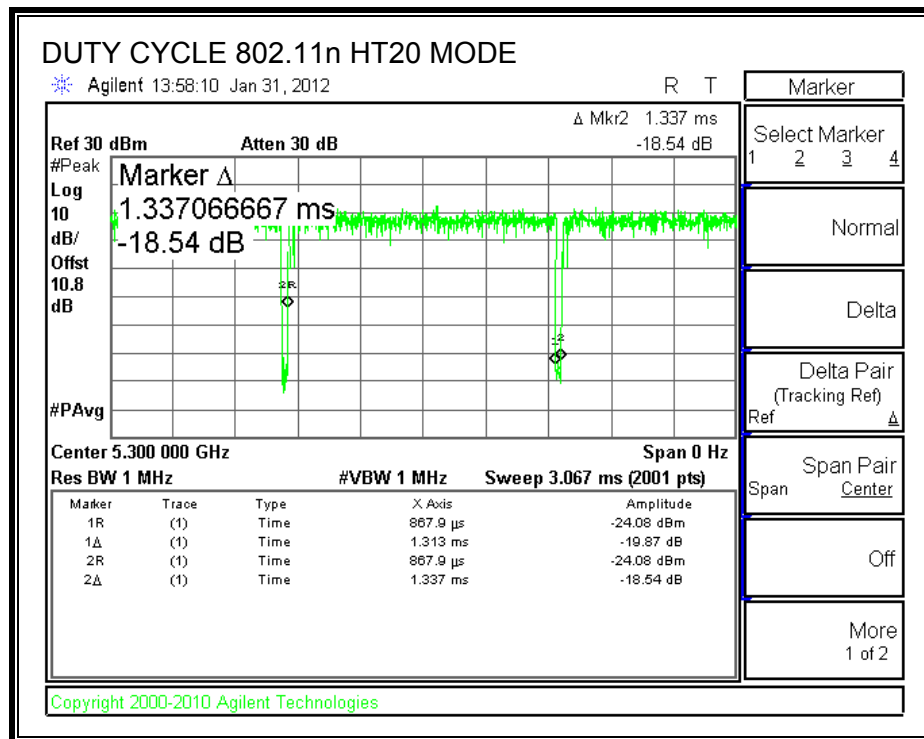
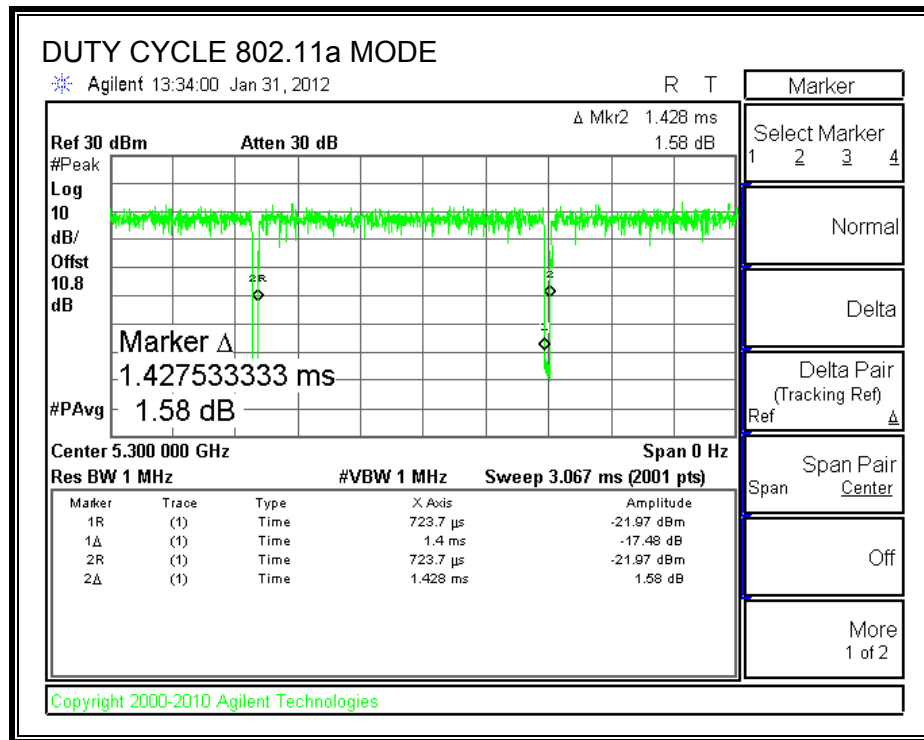
Mode	ON Time B (msec)	Period (msec)	Duty Cycle x (linear)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)	1/B Minimum VBW (kHz)
5.2GHz, 802.11a	1.400	1.428	0.980	98.0%	0.09	0.714
5.2GHz 802.11HT20	1.313	1.339	0.981	98.1%	0.09	0.762
5.3GHzm 802.11a	1.400	1.428	0.980	98.0%	0.09	0.714
5.3GHz 802.11HT20	1.313	1.337	0.982	98.2%	0.08	0.762
5.6GHz, 802.11a	1.400	1.428	0.980	98.0%	0.09	0.714
5.6GHz, 802.11HT20	1.317	1.342	0.981	98.1%	0.08	0.759

DUTY CYCLE PLOTS

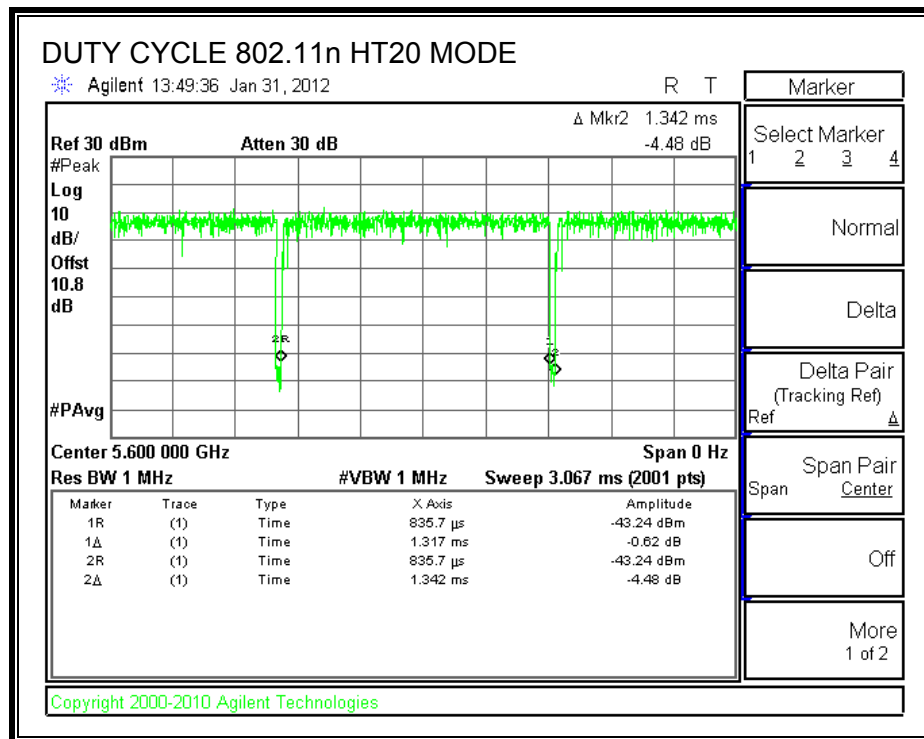
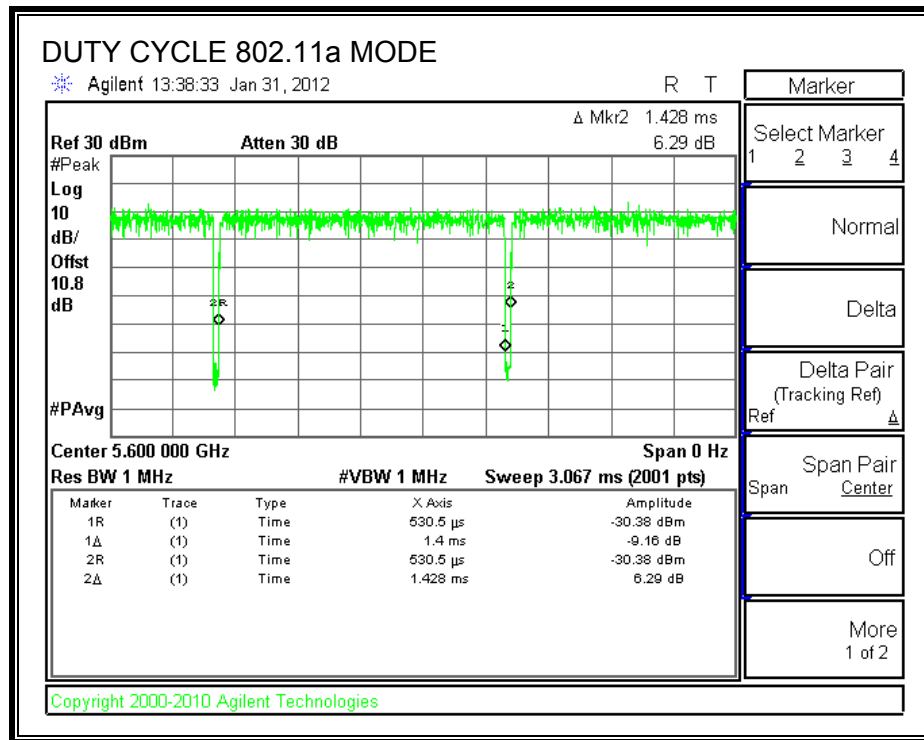
5.2GHz BAND



5.3GHz BAND



5.6GHz BAND



7.2. 802.11a LEGACY MODE IN THE 5.2 GHz BAND

7.2.1. 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

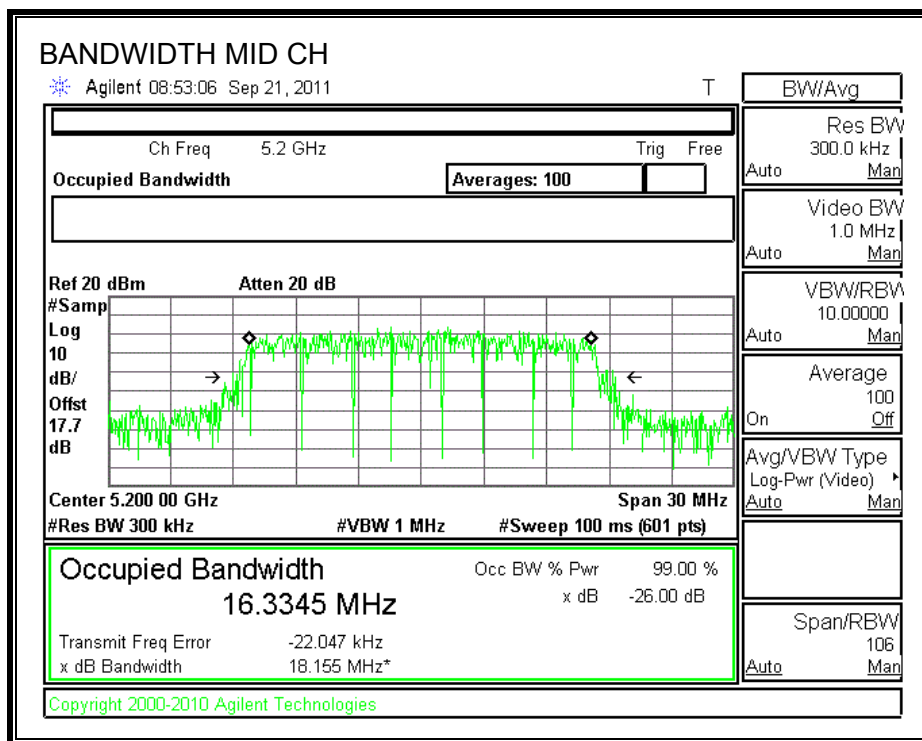
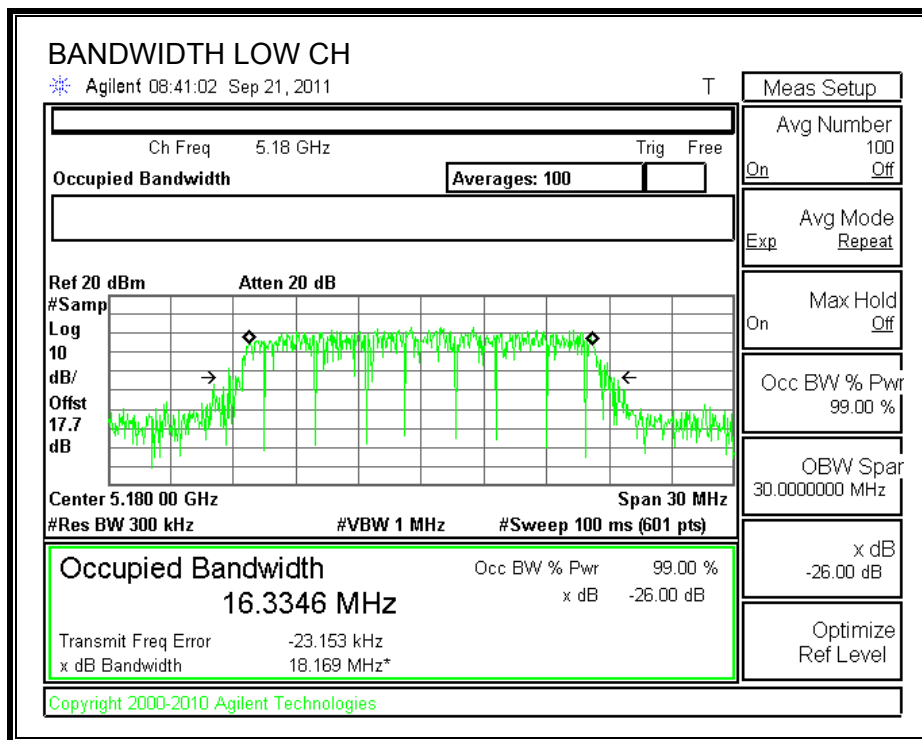
TEST PROCEDURE

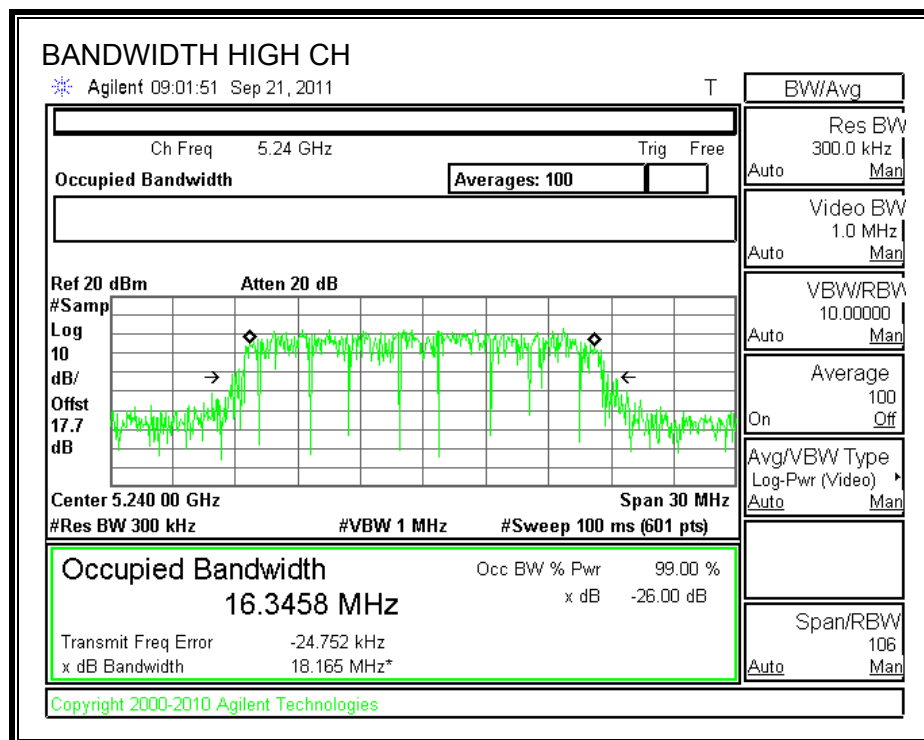
The transmitter outputs are connected to the spectrum analyzer via a combiner. The RBW is set to 1% to 3% of the measured bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal bandwidth function is utilized.

RESULTS

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	5180	16.3346
Middle	5200	16.3345
High	5240	16.3458

99% BANDWIDTH





7.2.2. 26dB BANDWIDTH

LIMITS

None; for reporting purposes only.

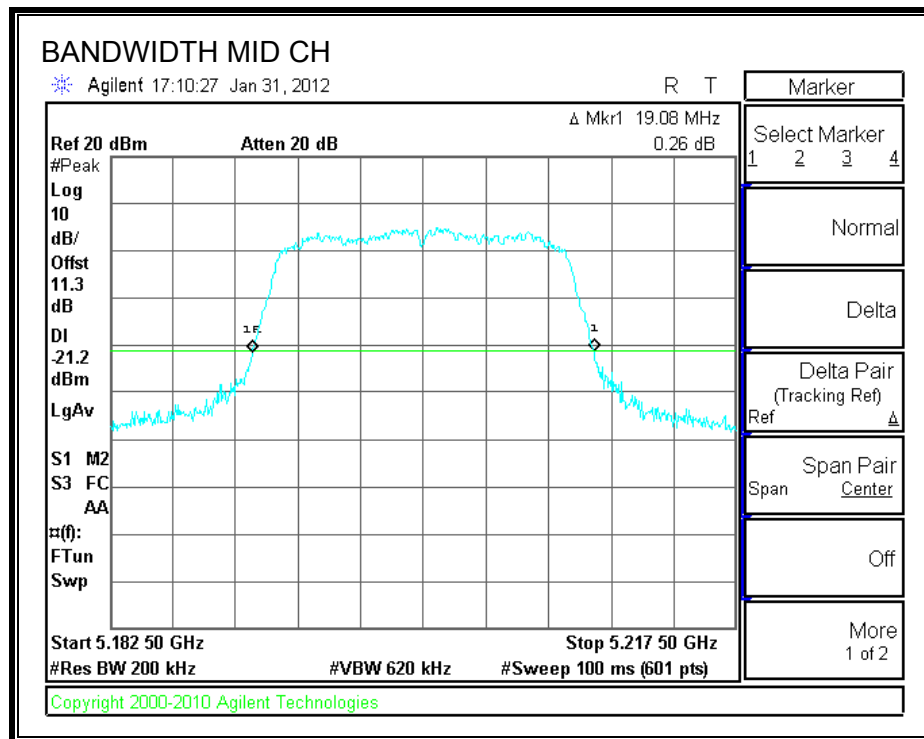
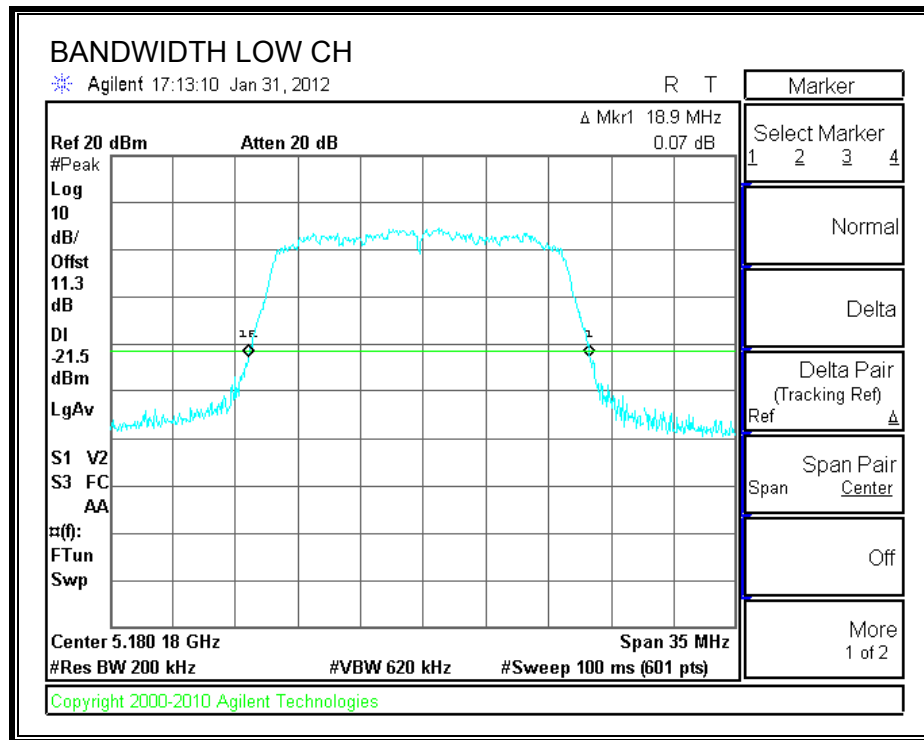
TEST PROCEDURE

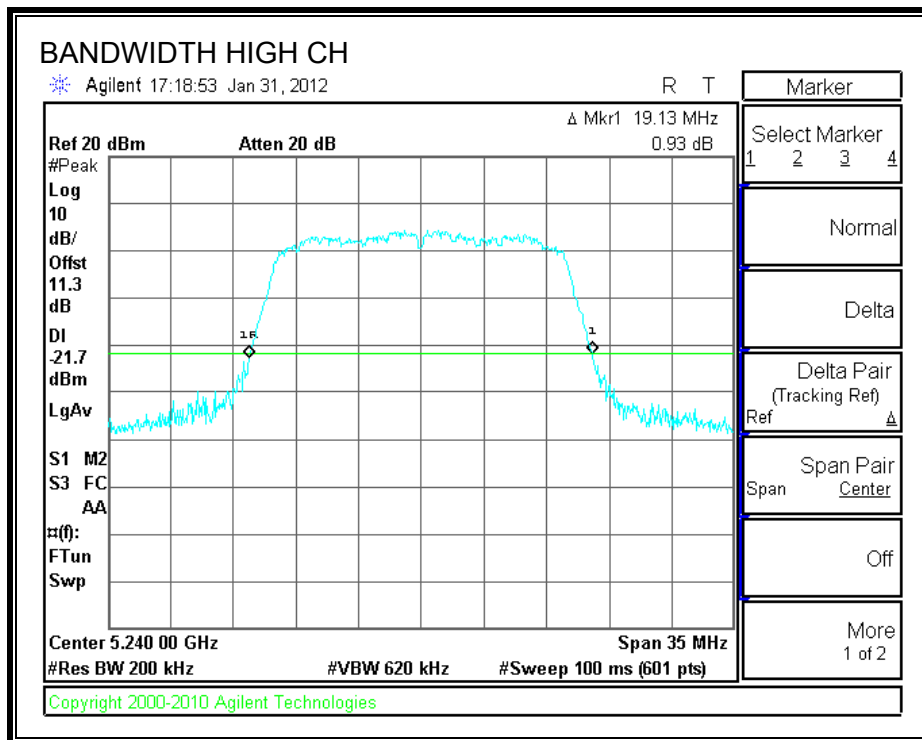
KDB 789033 D01 dated 10/25/2011.

RESULTS

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
Low	5180	18.90
Middle	5200	19.08
High	5240	19.13

26dB BANDWIDTH





7.2.3. OUTPUT POWER

LIMITS

FCC §15.407 (a) (1)

IC RSS-210 A9.2 (1)

For the 5.15-5.25 GHz band, 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. If transmitting antennas of directional gain greater than 6 dBi are used, both the peak transmit 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.

TEST PROCEDURE

KDB 789033 D01 dated 10/25/2011.

RESULTS

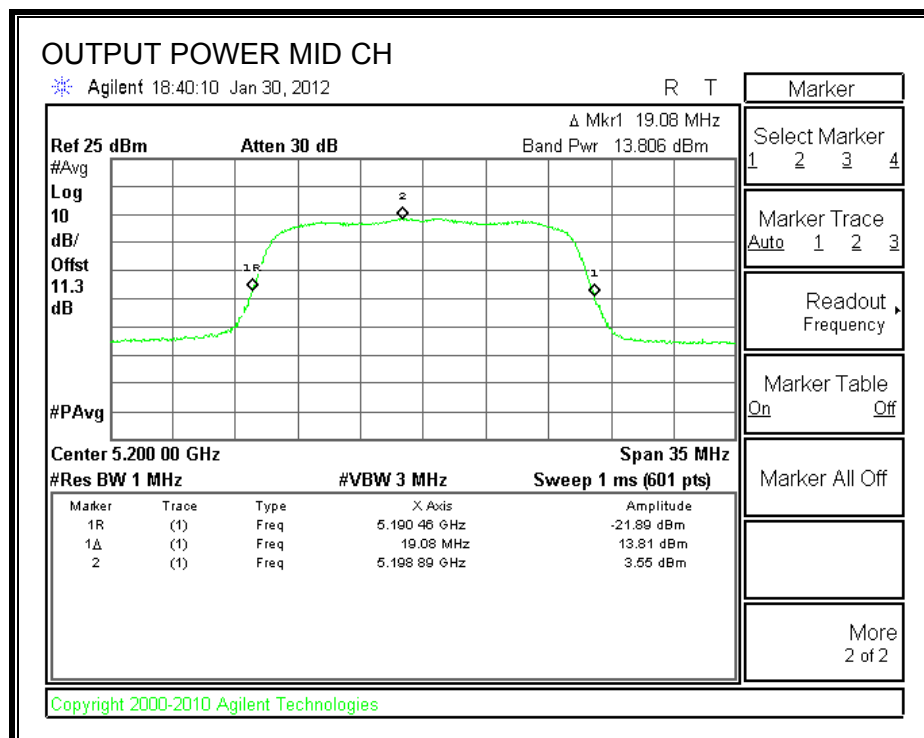
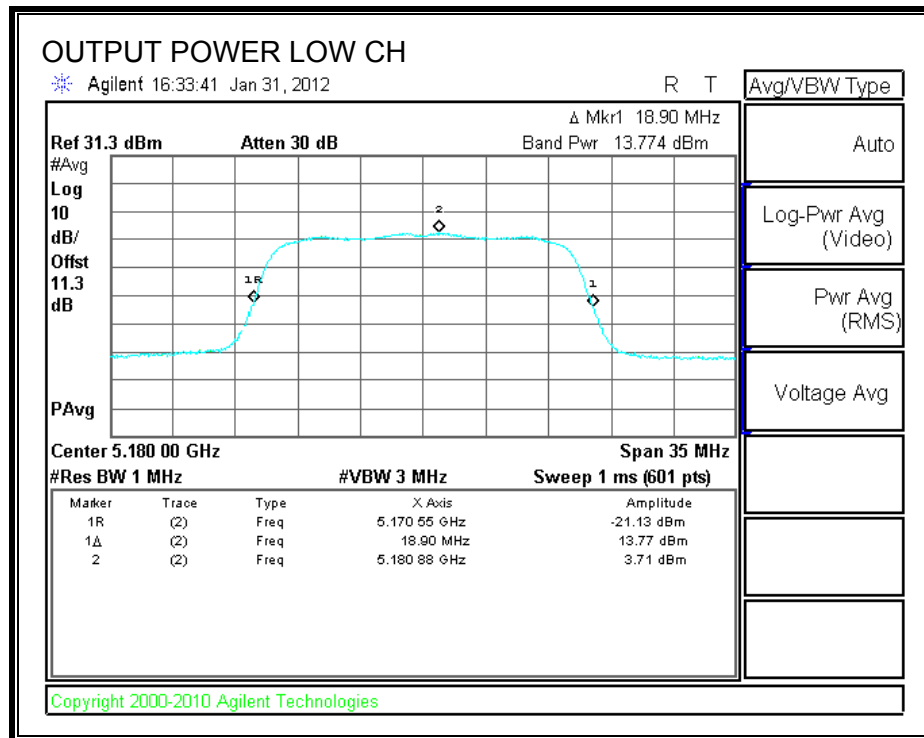
Limit

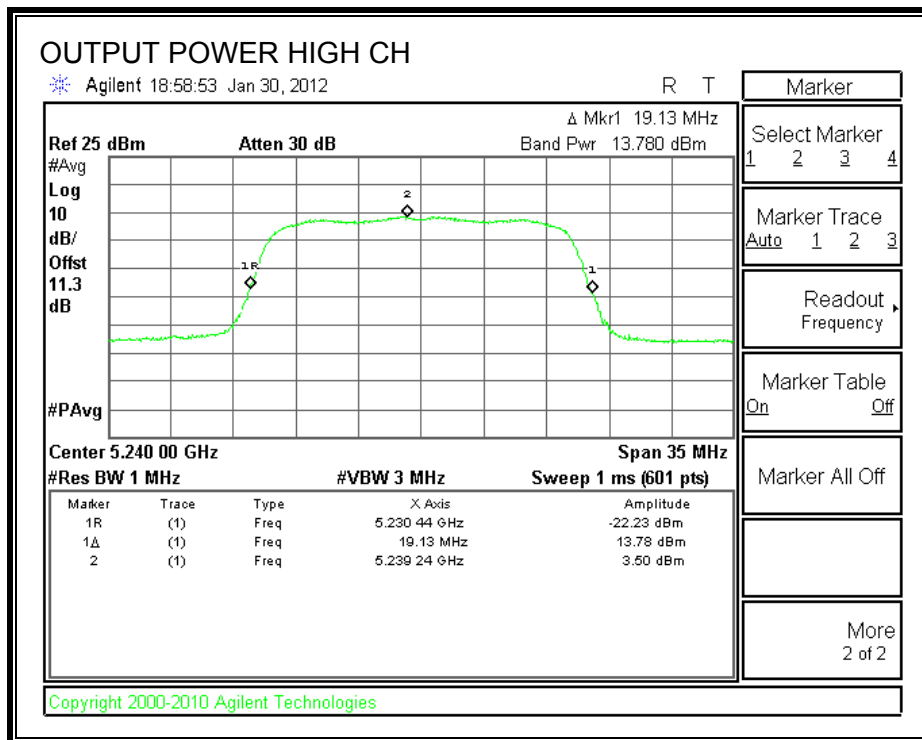
Channel	Frequency (MHz)	Fixed Limit (dBm)	B (MHz)	4 + 10 Log B Limit (dBm)	Antenna Gain (dBi)	Limit (dBm)
Low	5180	17	18.90	16.76	4.63	16.76
Mid	5200	17	19.08	16.81	4.63	16.81
High	5240	17	19.13	16.82	4.63	16.82

Results

Channel	Frequency (MHz)	Power (dBm)	Limit (dBm)	Margin (dB)
Low	5180	13.774	16.76	-2.991
Mid	5200	13.806	16.81	-3.000
High	5240	13.780	16.82	-3.037

OUTPUT POWER





7.2.4. AVERAGE POWER

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

RESULTS

The cable assembly insertion loss of 11.3 dB (including 10 dB pad and 1.3 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency (MHz)	Power (dBm)
Low	5180	13.68
Middle	5200	13.58
High	5240	13.62

7.2.5. PEAK POWER SPECTRAL DENSITY

LIMITS

FCC §15.407 (a) (1)

IC RSS-210 A9.2 (1)

For the 5.15-5.25 GHz band, 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 peak transmit 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.

The maximum antenna gain is less than or equal to 6 dBi, therefore the limit is 4 dBm.

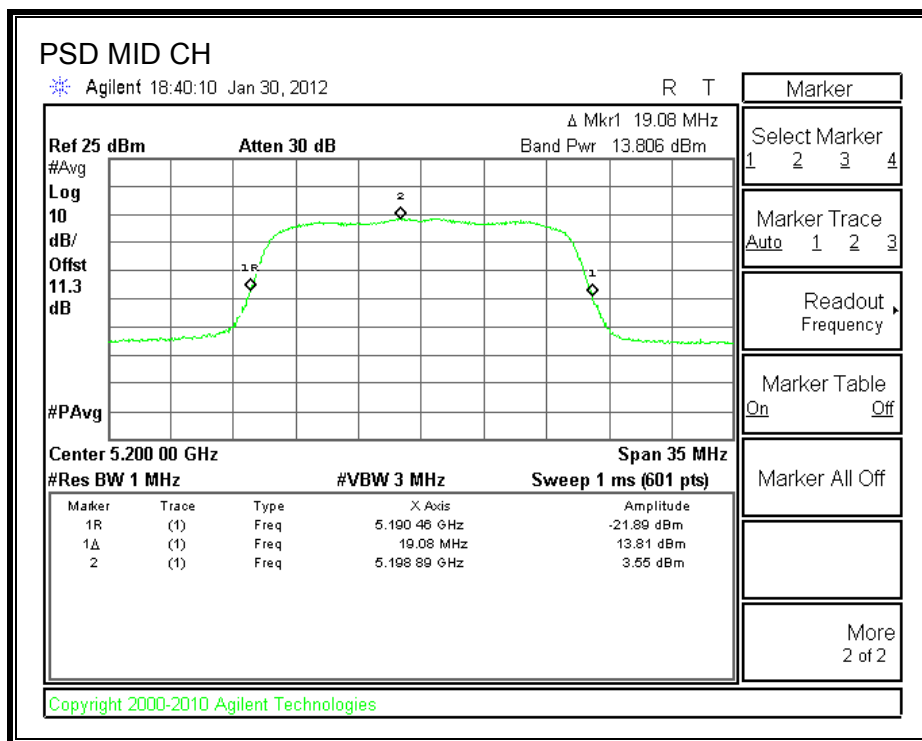
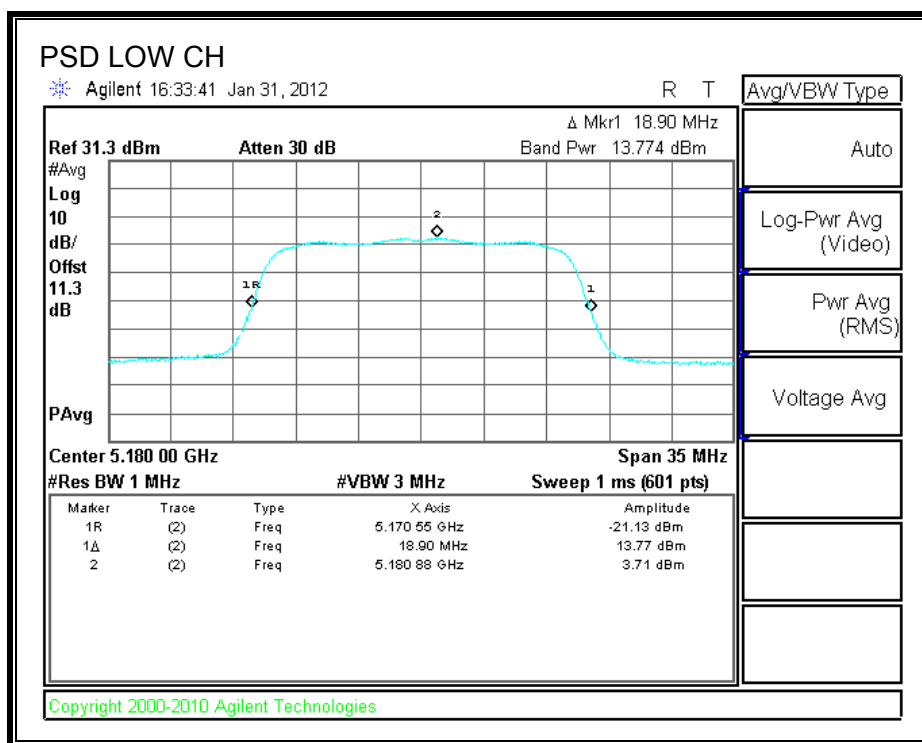
TEST PROCEDURE

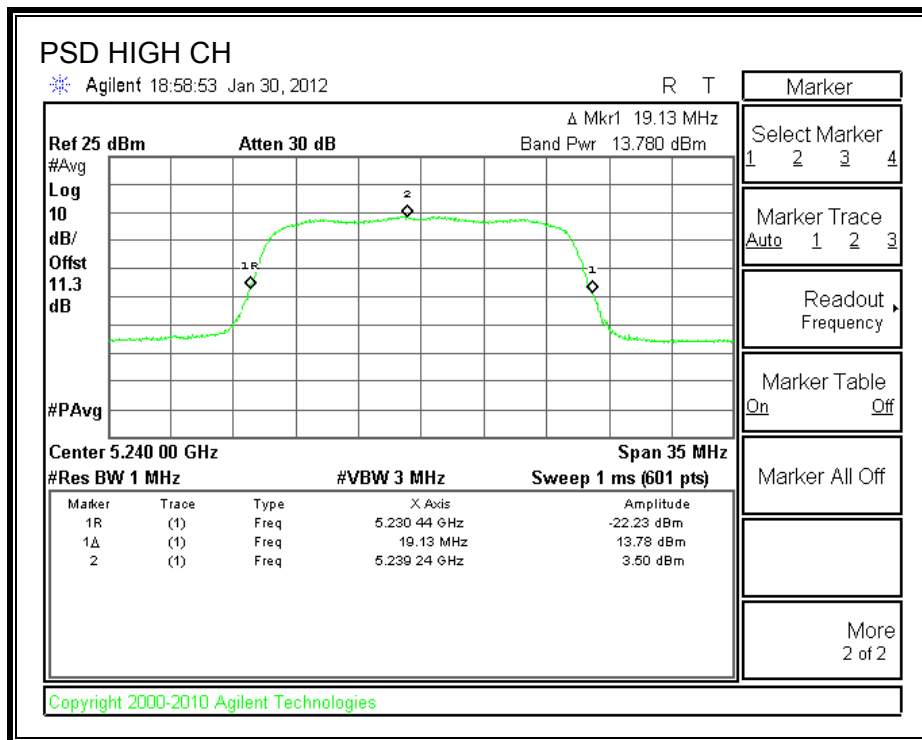
KDB 789033 D01 dated 10/25/2011.

RESULTS

Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	5180	3.710	4	-0.29
Middle	5200	3.550	4	-0.45
High	5240	3.500	4	-0.50

POWER SPECTRAL DENSITY





7.2.6. 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.

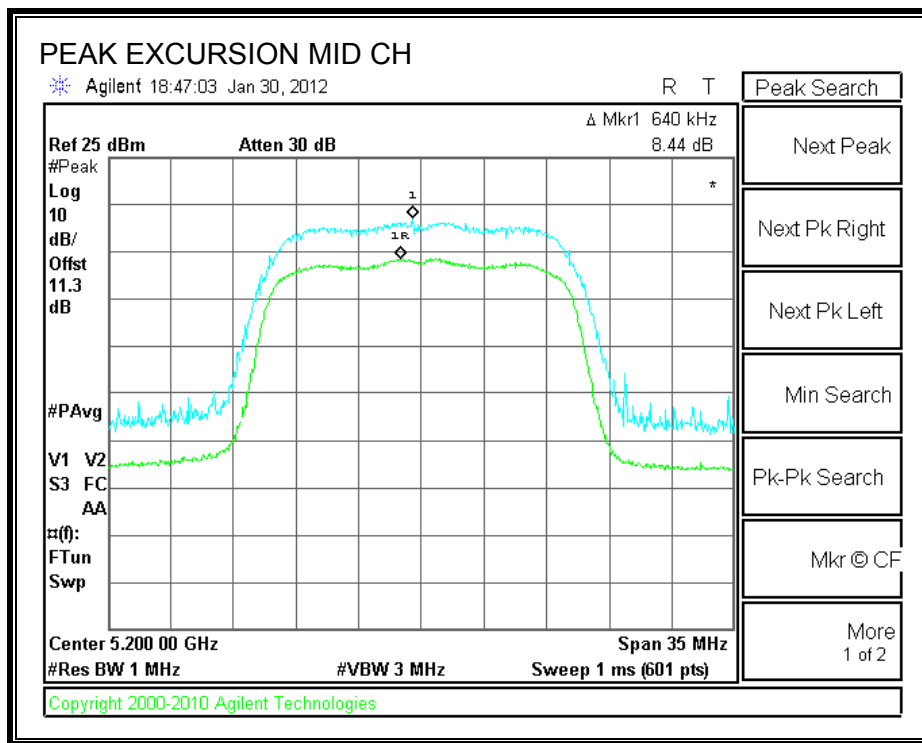
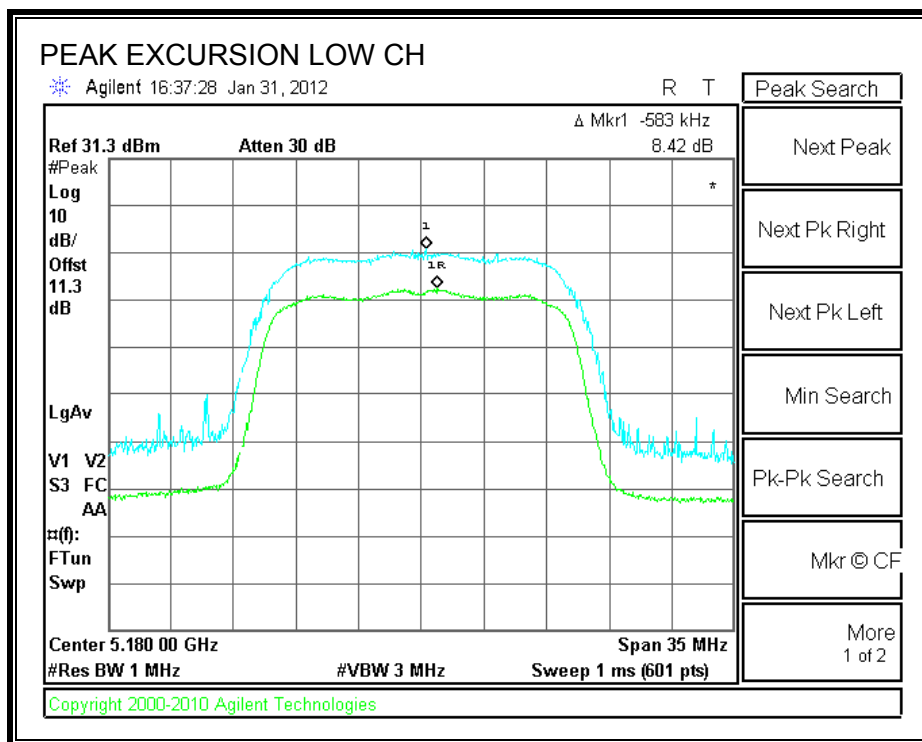
TEST PROCEDURE

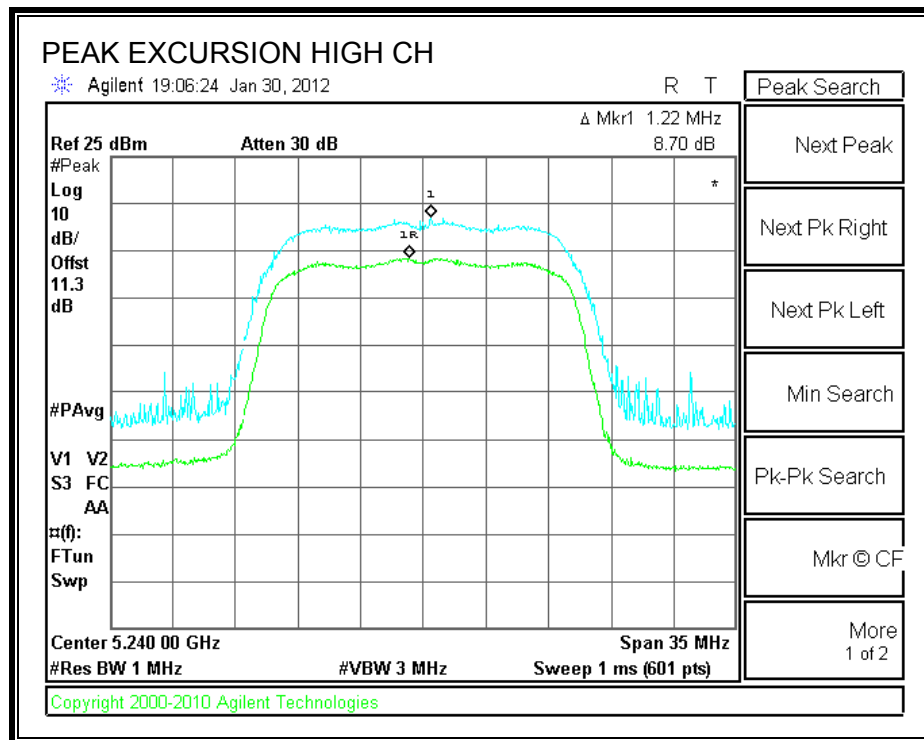
KDB 789033 D01 dated 10/25/2011.

RESULTS

Channel	Frequency (MHz)	Peak Excursion (dB)	Limit (dB)	Margin (dB)
Low	5180	8.42	13	-4.58
Middle	5200	8.44	13	-4.56
High	5240	8.70	13	-4.30

PEAK EXCURSION





7.3. 802.11n HT20 MODE IN THE 5.2 GHz BAND

7.3.1. 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

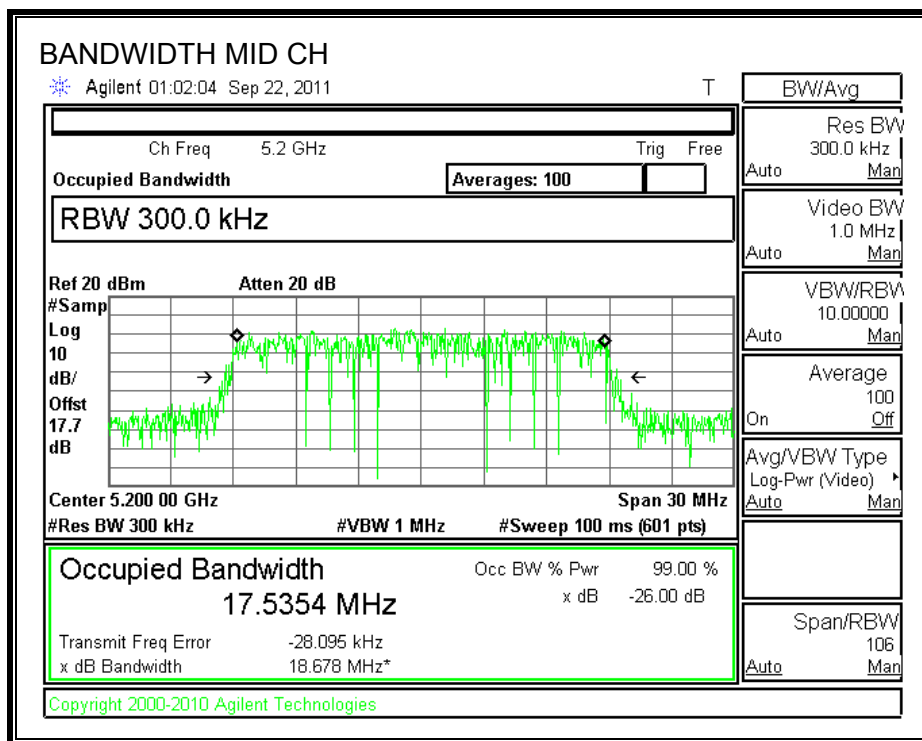
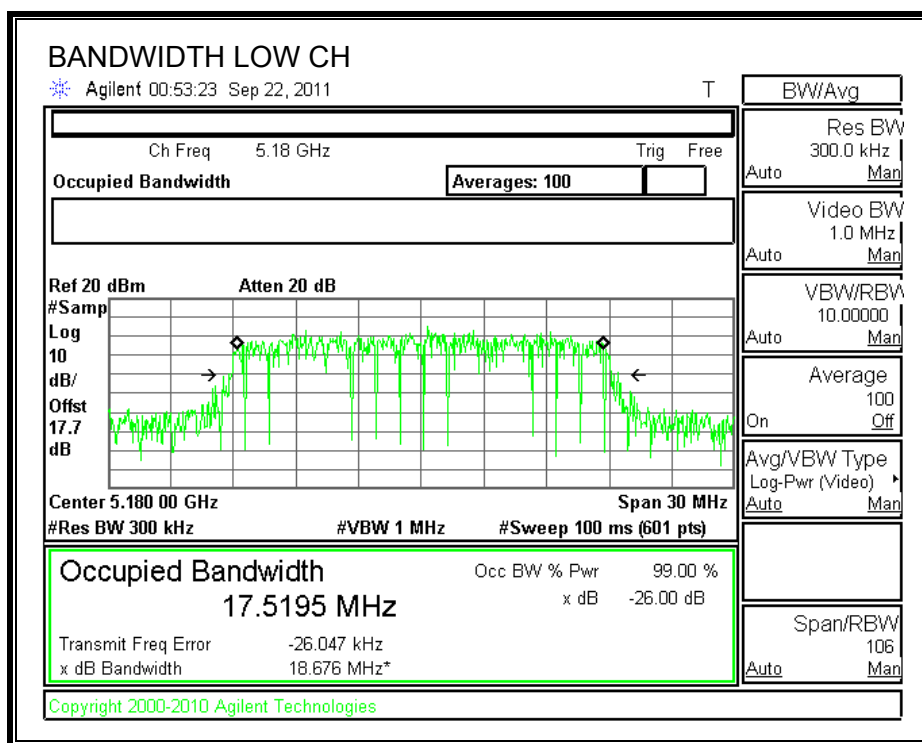
TEST PROCEDURE

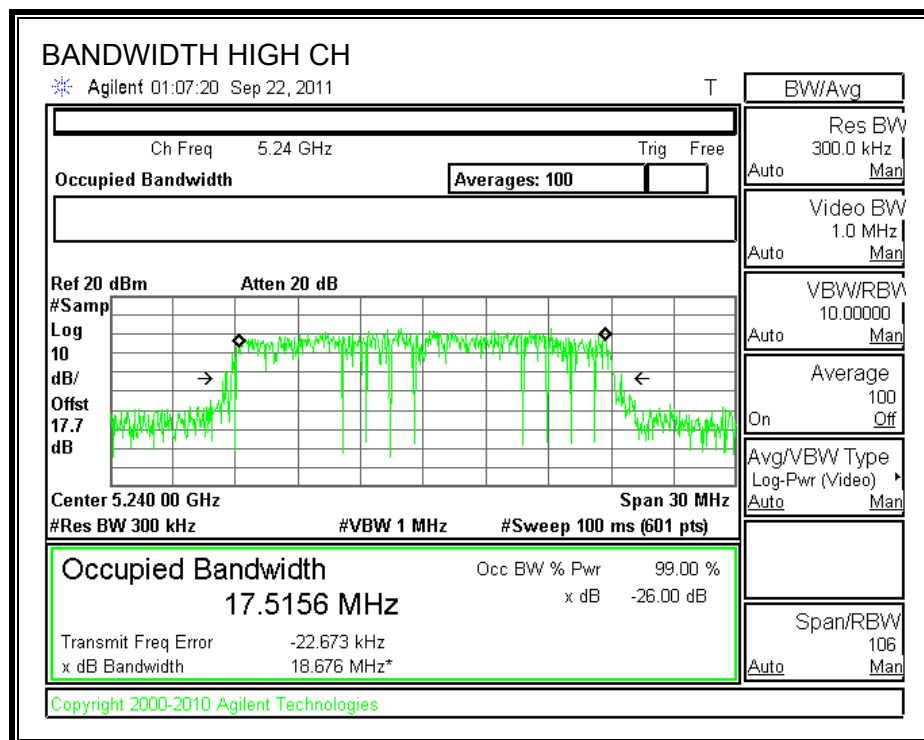
The transmitter outputs are connected to the spectrum analyzer via a combiner. The RBW is set to 1% to 3% of the measured bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal bandwidth function is utilized.

RESULTS

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	5180	17.5195
Middle	5200	17.5354
High	5240	17.5156

99% BANDWIDTH





7.3.2. 26 dB BANDWIDTH

LIMITS

None; for reporting purposes only.

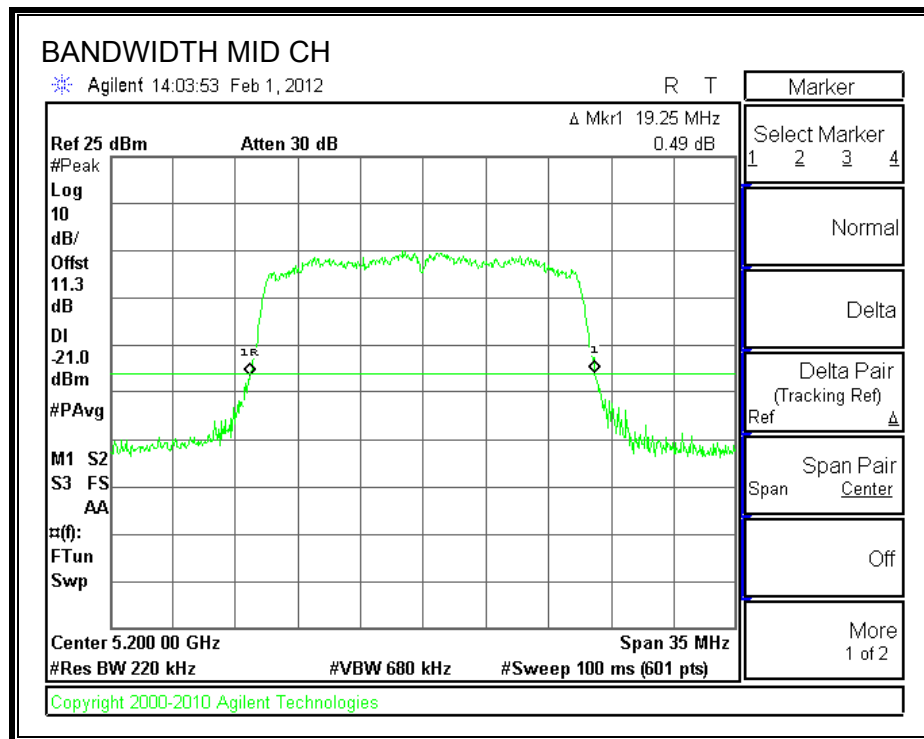
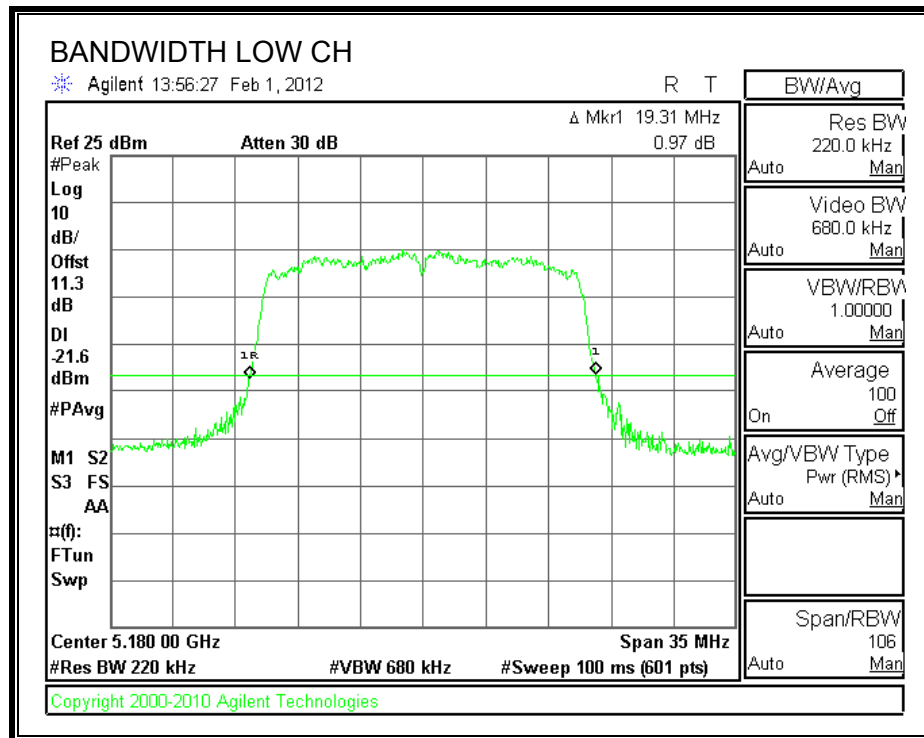
TEST PROCEDURE

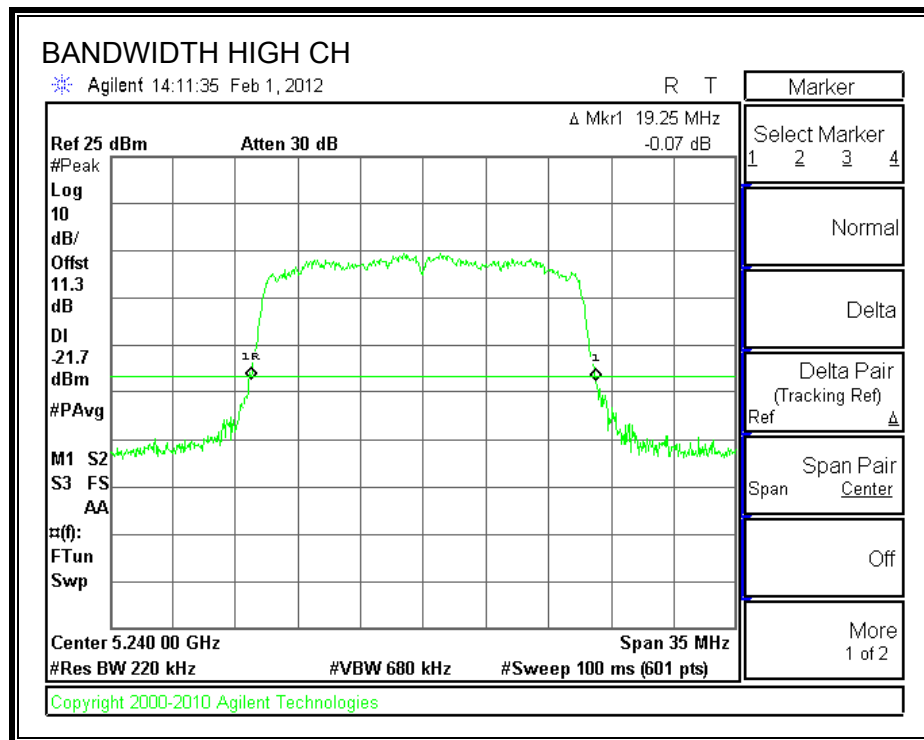
KDB 789033 D01 dated 10/25/2011.

RESULTS

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
Low	5180	19.31
Middle	5200	19.25
High	5240	19.25

26 dB BANDWIDTH





7.3.3. OUTPUT POWER

LIMITS

FCC §15.407 (a) (1)

IC RSS-210 A9.2 (1)

For the 5.15-5.25 GHz band, 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. If transmitting antennas of directional gain greater than 6 dBi are used, both the peak transmit 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.

TEST PROCEDURE

KDB 789033 D01 dated 10/25/2011.

RESULTS

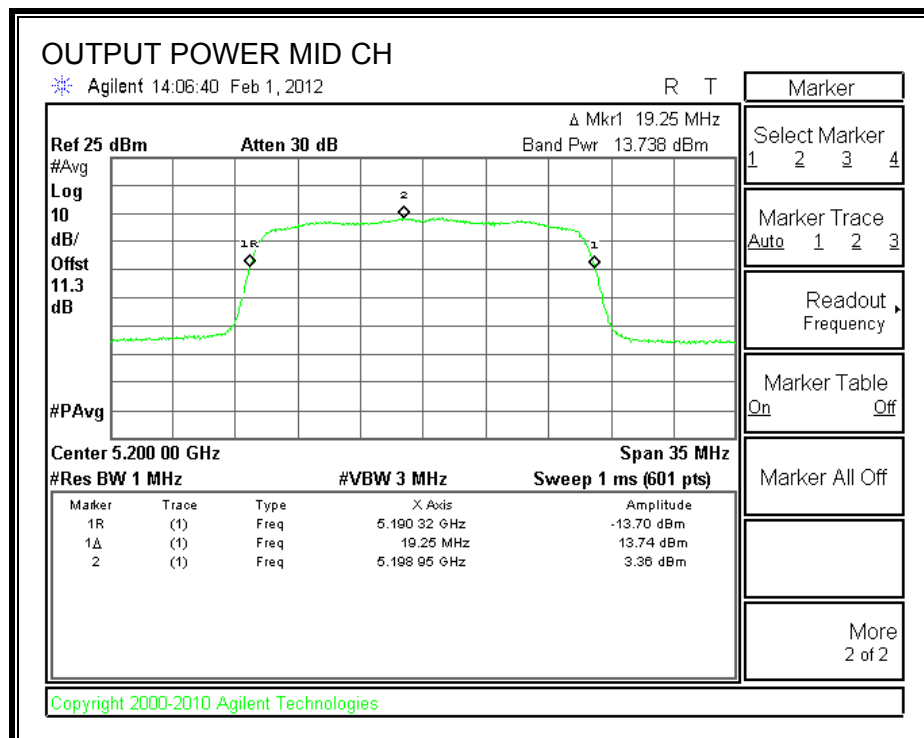
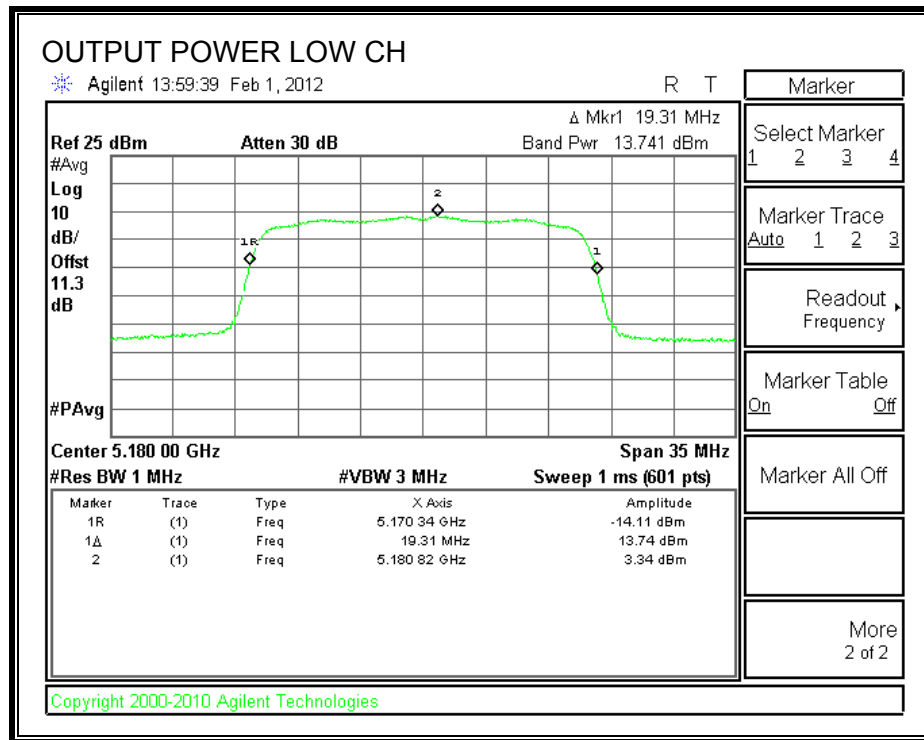
Limit

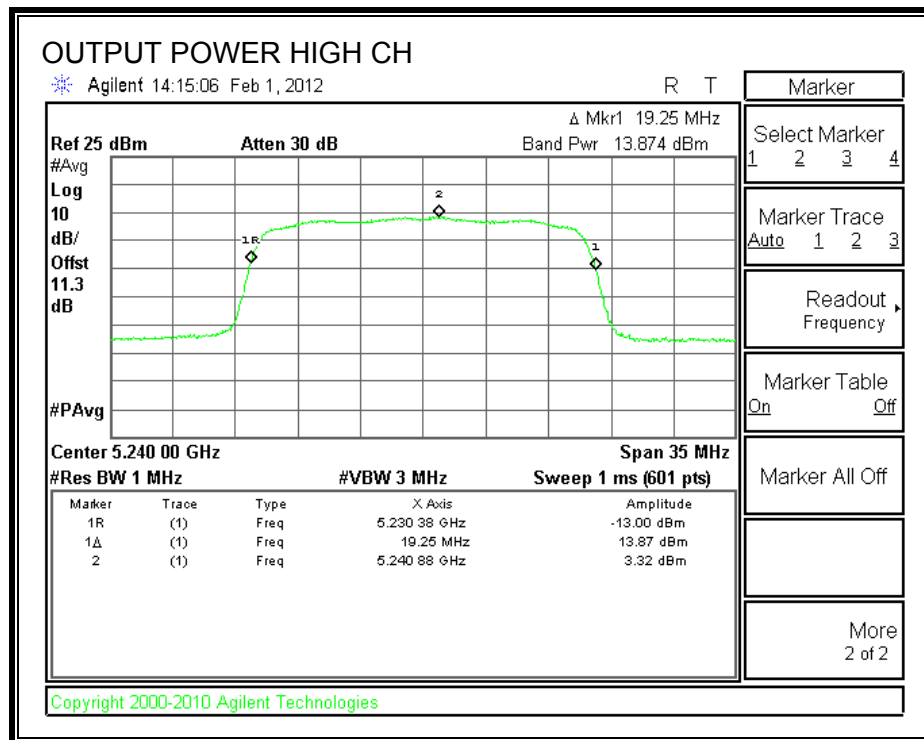
Channel	Frequency (MHz)	Fixed Limit (dBm)	B (MHz)	4 + 10 Log B Limit (dBm)	Antenna Gain (dBi)	Limit (dBm)
Low	5180	17	19.31	16.86	4.63	16.86
Mid	5200	17	19.25	16.84	4.63	16.84
High	5240	17	19.25	16.84	4.63	16.84

Results

Channel	Frequency (MHz)	Power (dBm)	Limit (dBm)	Margin (dB)
Low	5180	13.741	16.86	-3.117
Mid	5200	13.738	16.84	-3.106
High	5240	13.874	16.84	-2.970

OUTPUT POWER





7.3.4. AVERAGE POWER

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

RESULTS

The cable assembly insertion loss of 11.3 dB (including 10 dB pad and 1.3 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency (MHz)	Power (dBm)
Low	5180	13.57
Middle	5200	13.61
High	5240	13.59

7.3.5. PEAK POWER SPECTRAL DENSITY

LIMITS

FCC §15.407 (a) (1)

IC RSS-210 A9.2 (1)

For the 5.15-5.25 GHz band, 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 peak transmit 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.

The maximum antenna gain is less than or equal to 6 dBi, therefore the limit is 4 dBm.

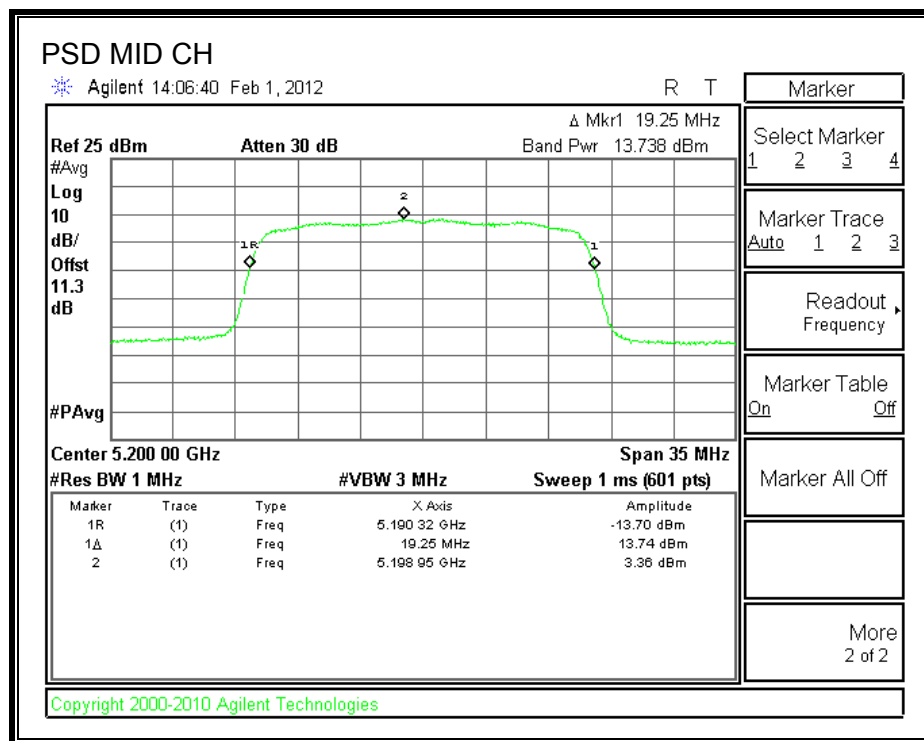
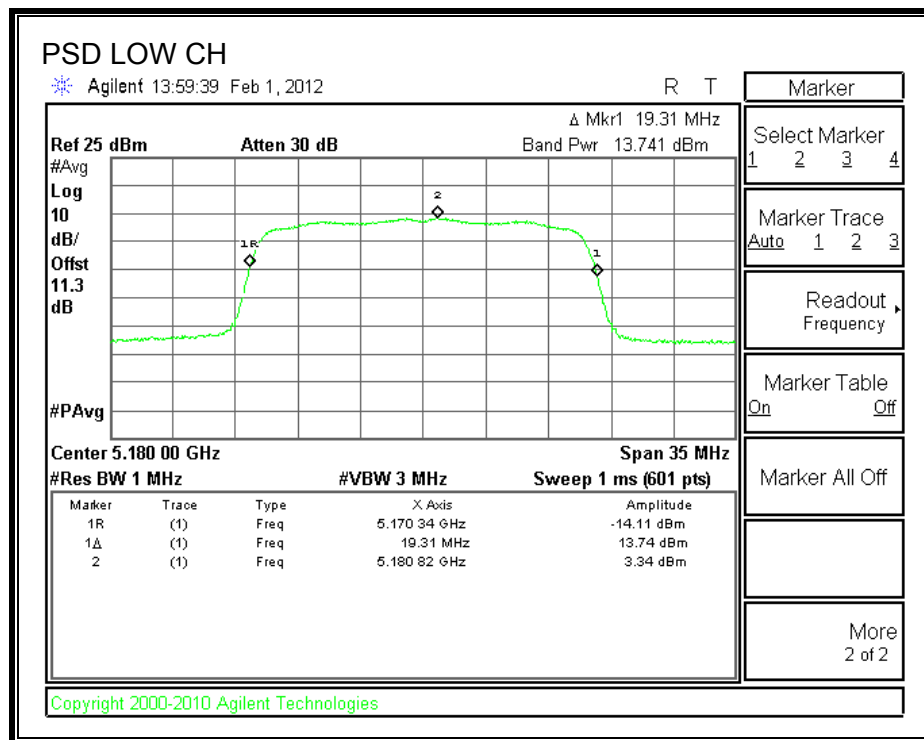
TEST PROCEDURE

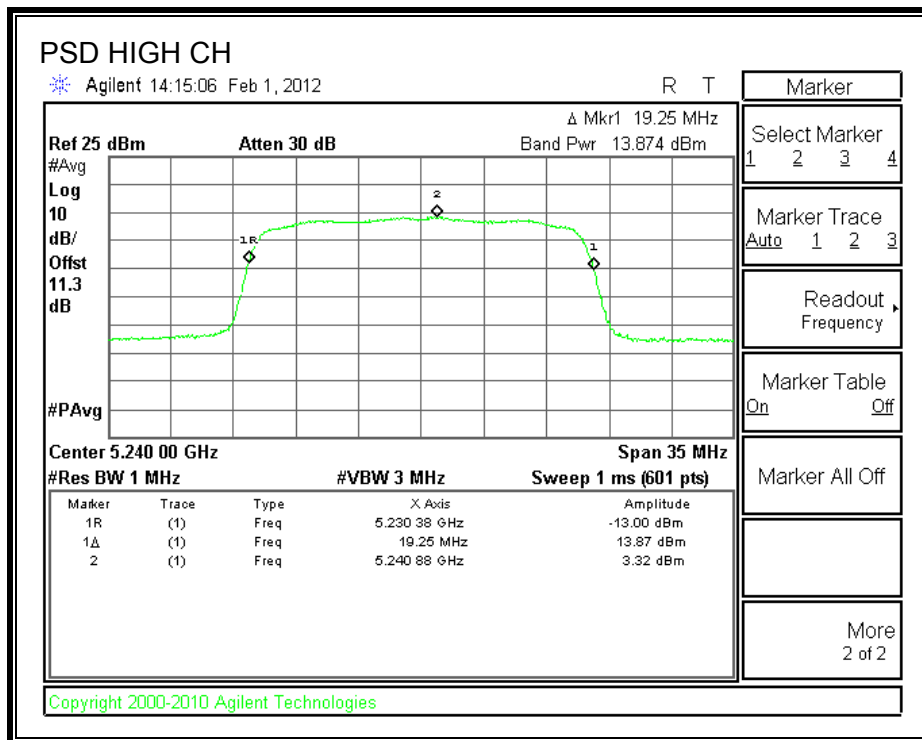
KDB 789033 D01 dated 10/25/2011.

RESULTS

Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	5180	3.340	4	-0.66
Middle	5200	3.360	4	-0.64
High	5240	3.320	4	-0.68

POWER SPECTRAL DENSITY





7.3.6. 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.

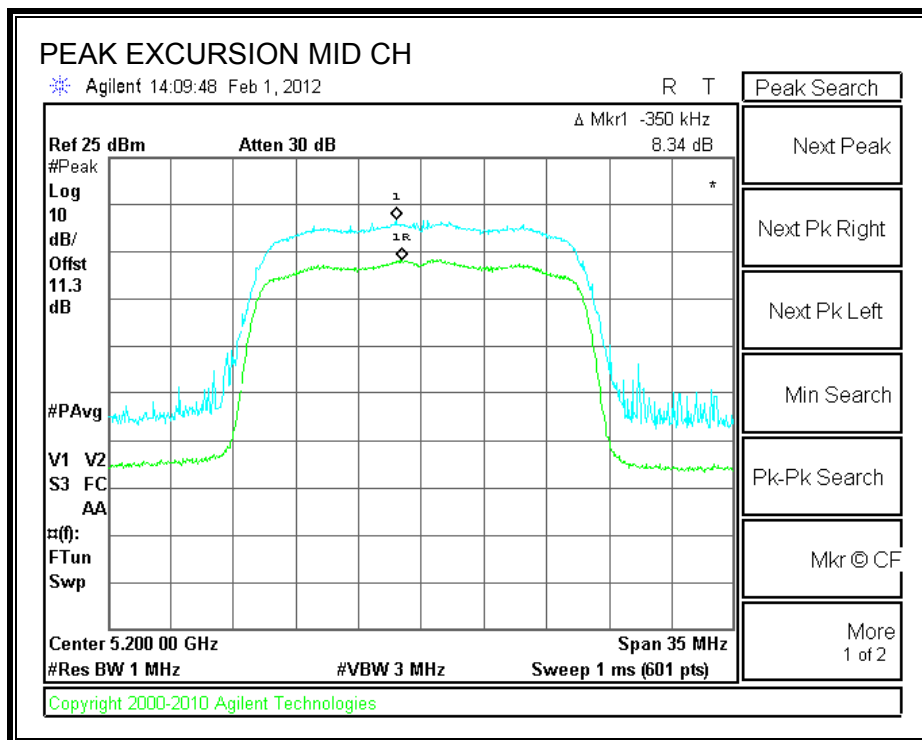
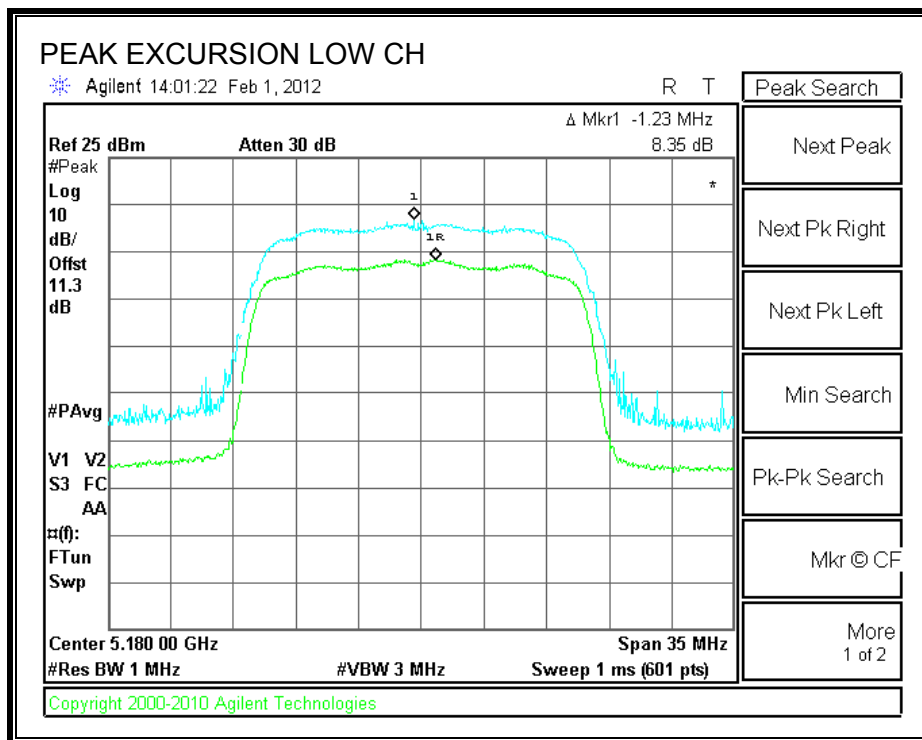
TEST PROCEDURE

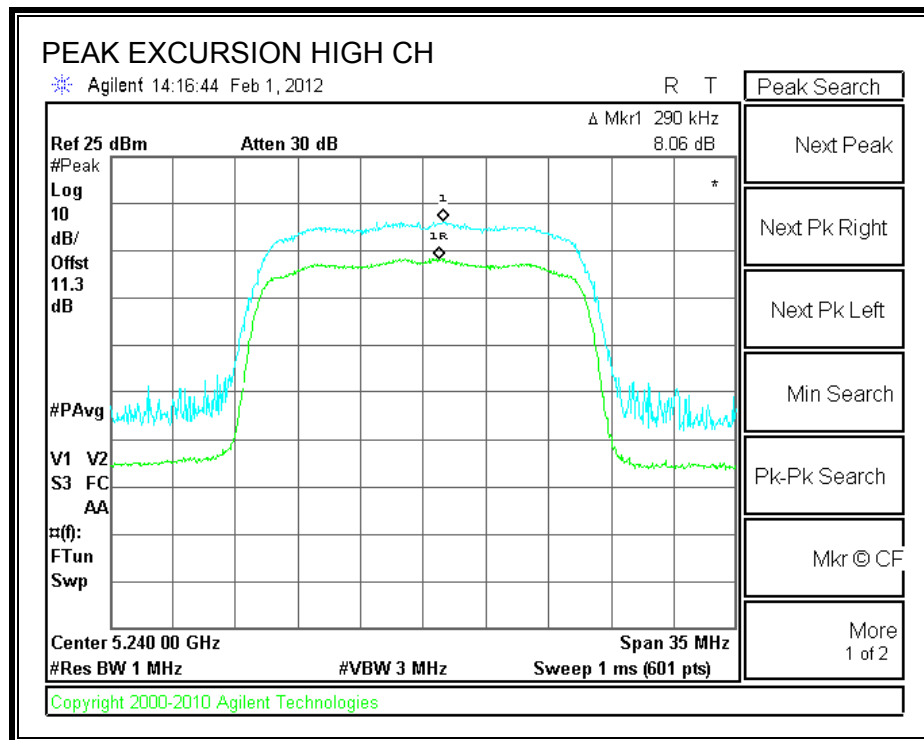
KDB 789033 D01 dated 10/25/2011.

RESULTS

Channel	Frequency (MHz)	Peak Excursion (dB)	Limit (dB)	Margin (dB)
Low	5180	8.35	13	-4.65
Middle	5200	8.34	13	-4.66
High	5240	8.06	13	-4.94

PEAK EXCURSION





7.4. 802.11a MODE IN THE 5.3 GHz BAND

7.4.1. 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

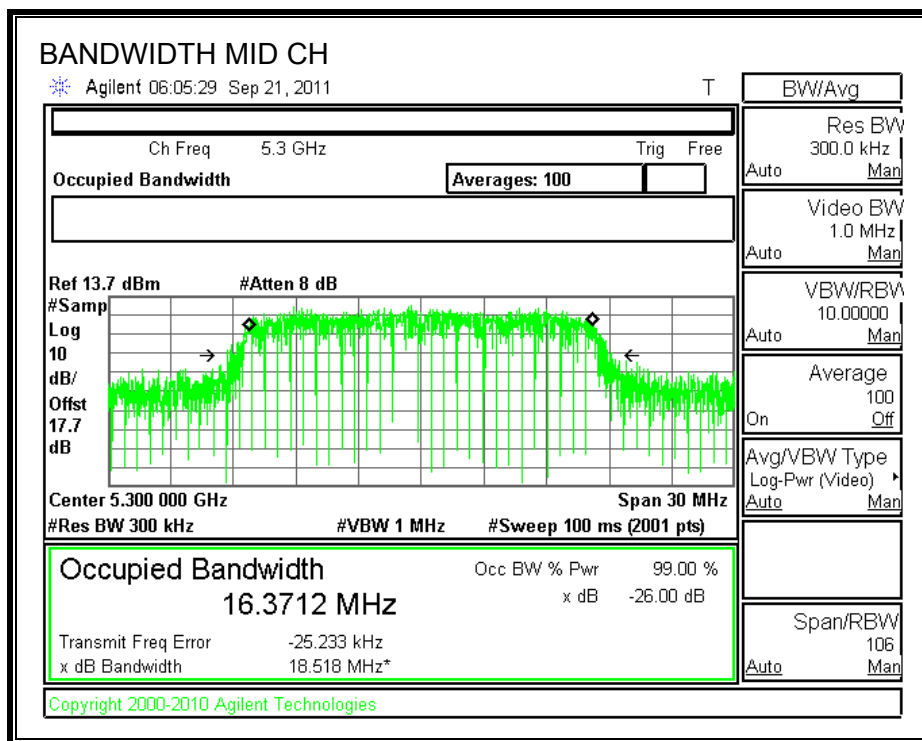
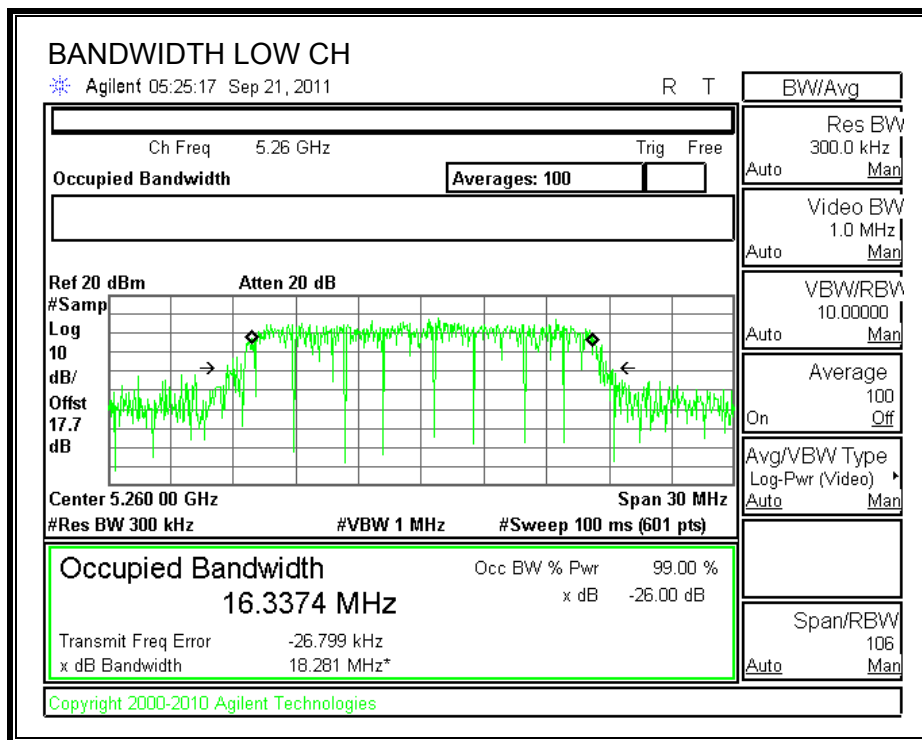
TEST PROCEDURE

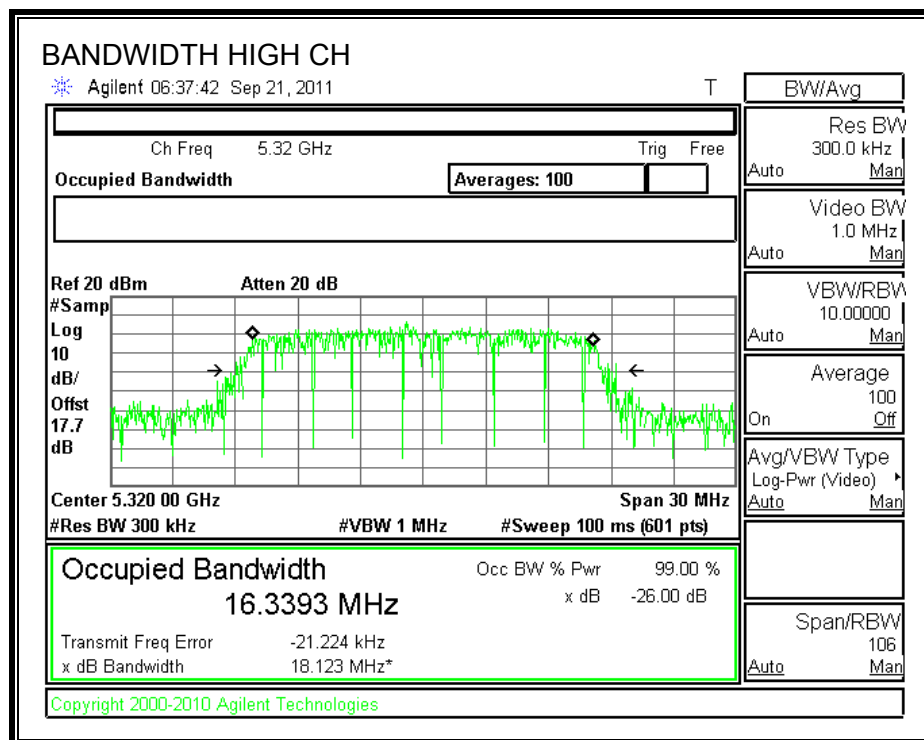
The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 3% of the measured bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal bandwidth function is utilized.

RESULTS

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	5260	16.3374
Middle	5300	16.3712
High	5320	16.3393

99% BANDWIDTH





7.4.2. 26 dB BANDWIDTH

LIMITS

None; for reporting purposes only.

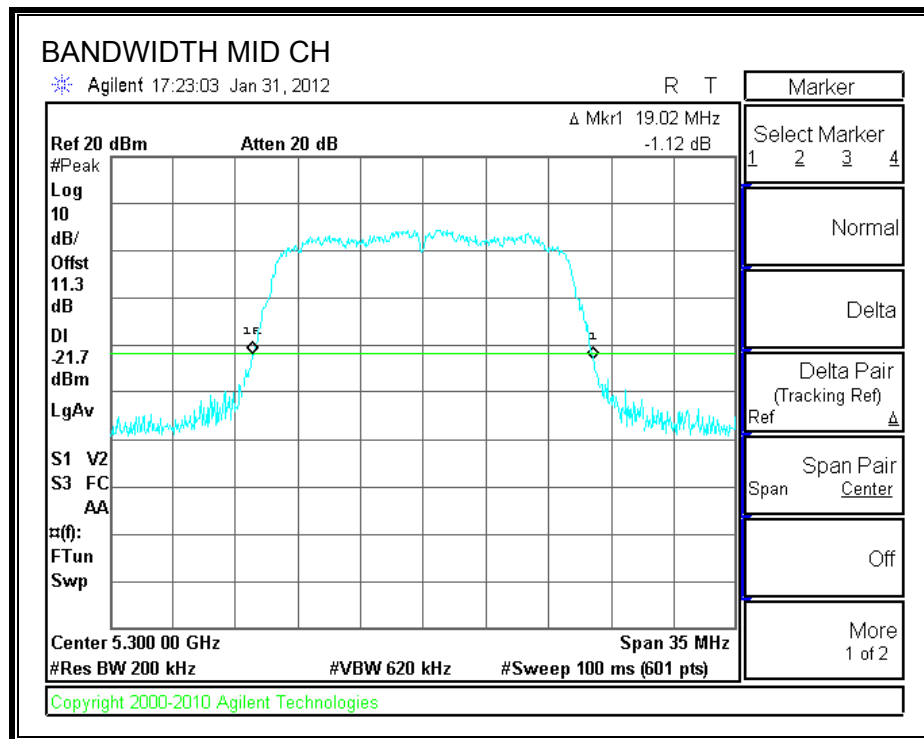
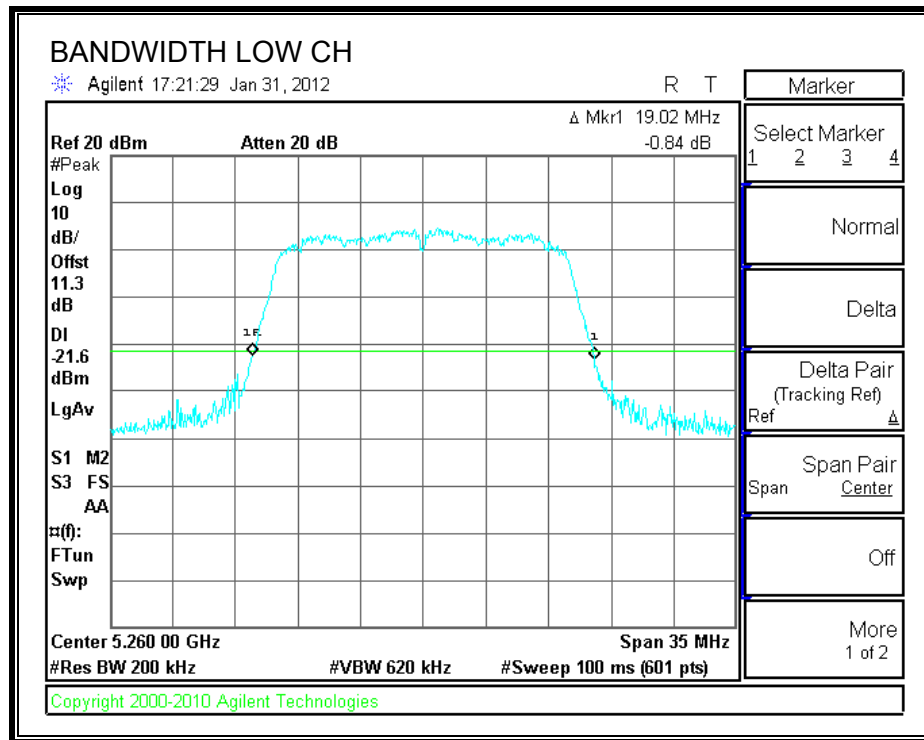
TEST PROCEDURE

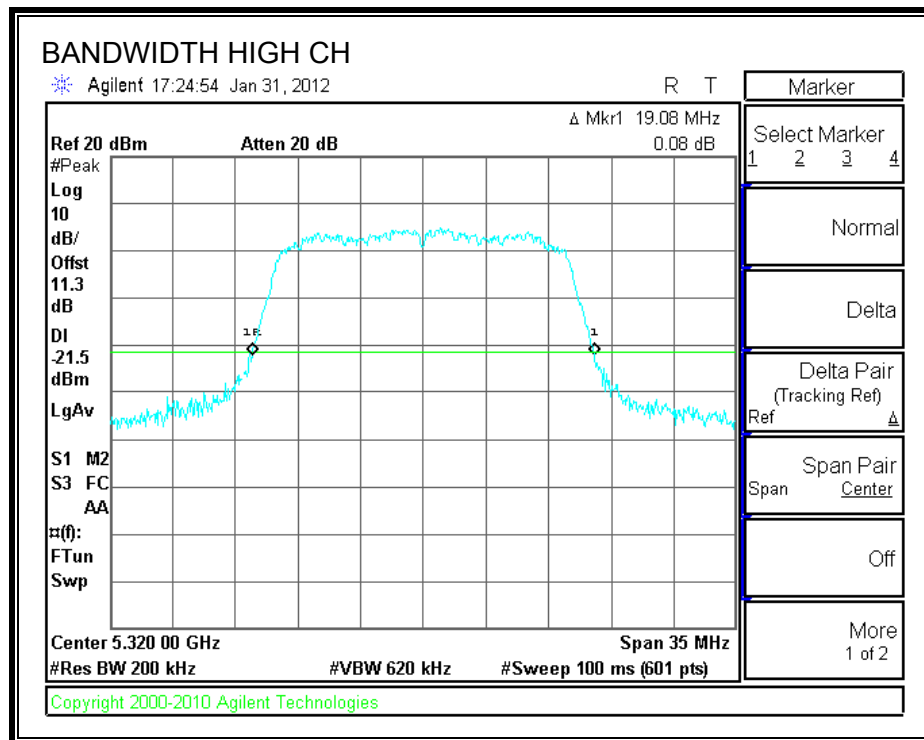
KDB 789033 D01 dated 10/25/2011.

RESULTS

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
Low	5260	19.02
Middle	5300	19.02
High	5320	19.08

26 dB BANDWIDTH





7.4.3. OUTPUT POWER

LIMITS

FCC §15.407 (a) (2)

IC RSS-210 A9.2 (2)

For the 5.25-5.35 GHz band, 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. If transmitting antennas of directional gain greater than 6 dBi are used, both the peak transmit 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.

TEST PROCEDURE

KDB 789033 D01 dated 10/25/2011.

RESULTS

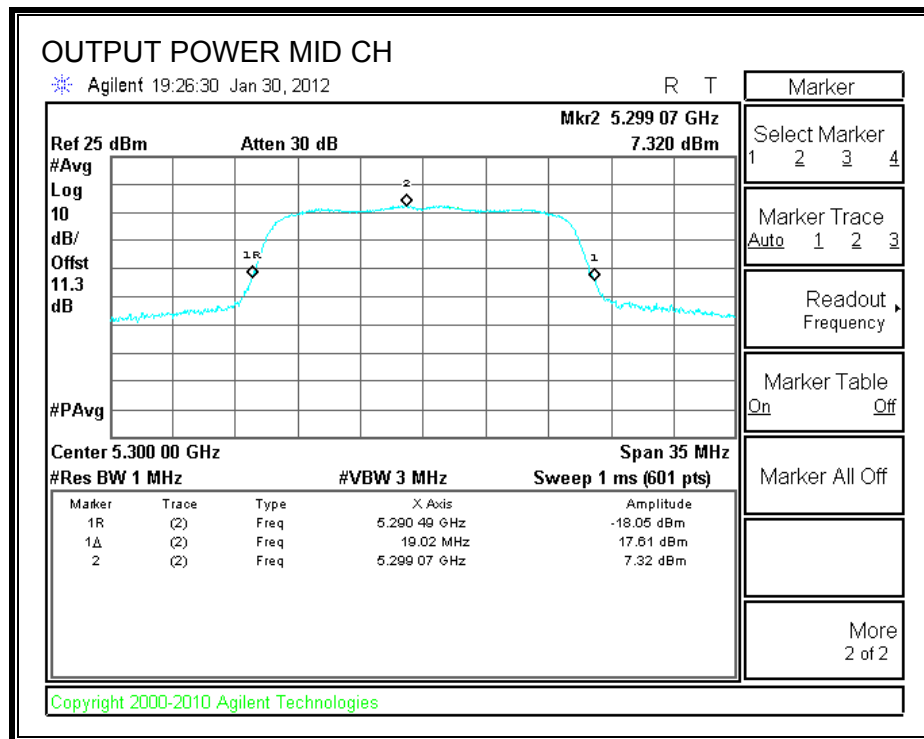
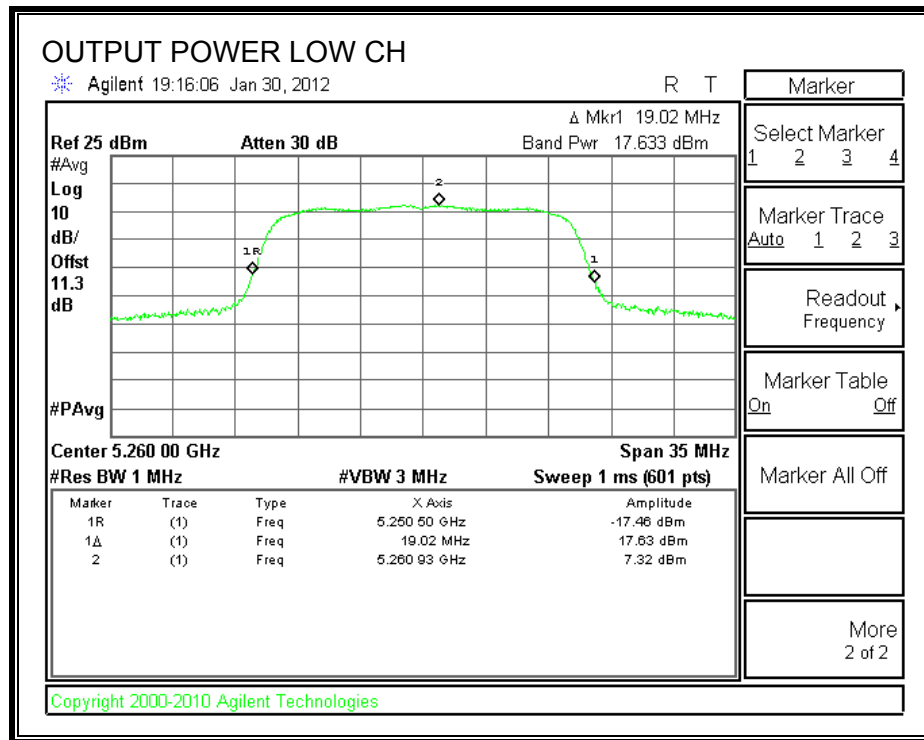
Limit

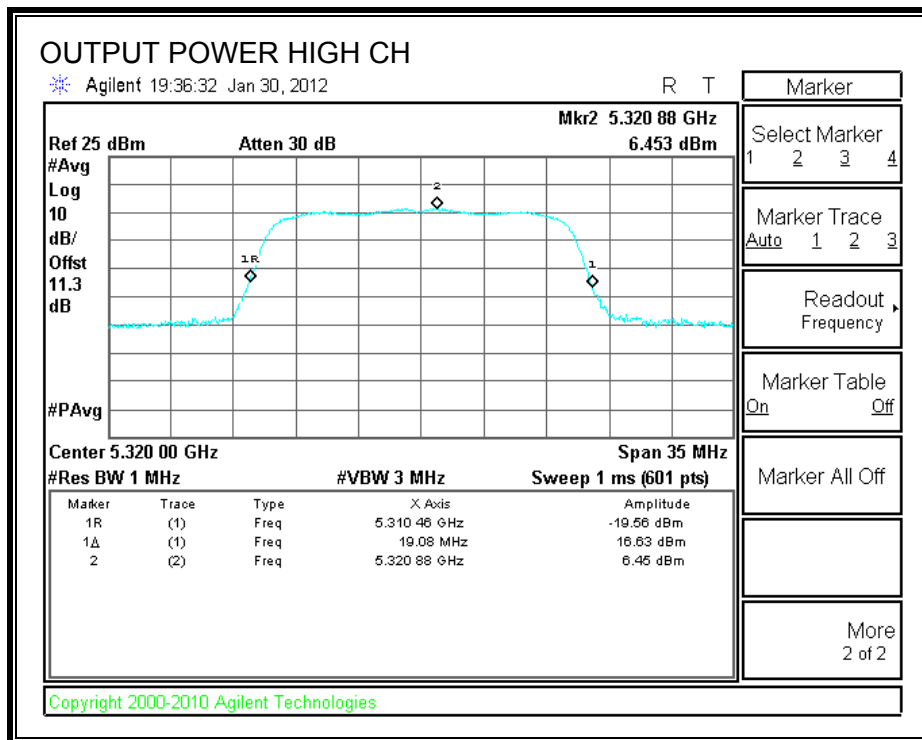
Channel	Frequency (MHz)	Fixed Limit (dBm)	B (MHz)	11 + 10 Log B Limit (dBm)	Antenna Gain (dBi)	Limit (dBm)
Low	5260	24	19.02	23.79	4.63	23.79
Mid	5300	24	19.02	23.79	4.63	23.79
High	5320	24	19.08	23.81	4.63	23.81

Results

Channel	Frequency (MHz)	Power (dBm)	Limit (dBm)	Margin (dB)
Low	5260	17.633	23.79	-6.159
Mid	5300	17.610	23.79	-6.182
High	5320	16.630	23.81	-7.176

OUTPUT POWER





7.4.4. AVERAGE POWER

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

RESULTS

The cable assembly insertion loss of 11.3 dB (including 10 dB pad 1.3 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Frequency (MHz)	Power (dBm)
5260	17.50
5300	17.50
5320	16.40

7.4.5. PEAK POWER SPECTRAL DENSITY

LIMITS

FCC §15.407 (a) (2)

IC RSS-210 A9.2 (2)

For the 5.25–5.35 GHz band, 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 peak transmit 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.

The maximum antenna gain is less than or equal to 6 dBi, therefore the limit is 11 dBm.

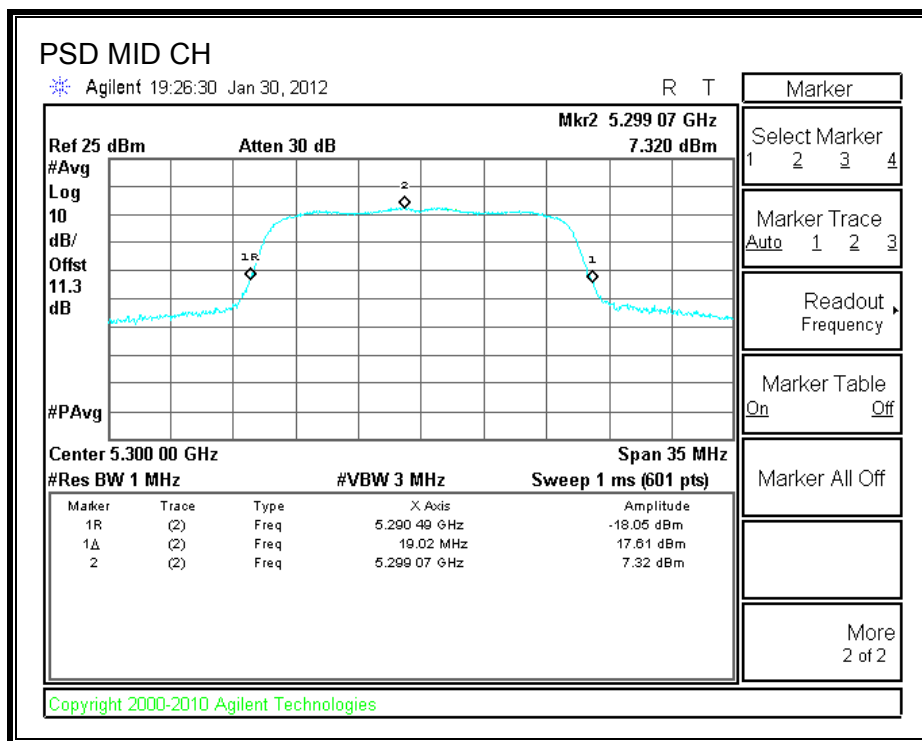
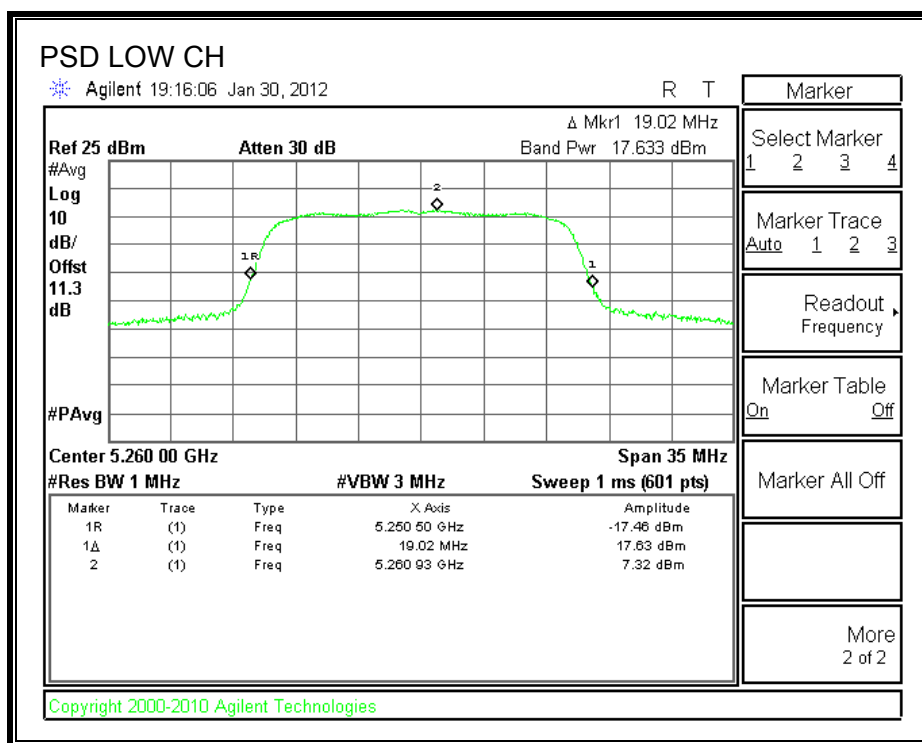
TEST PROCEDURE

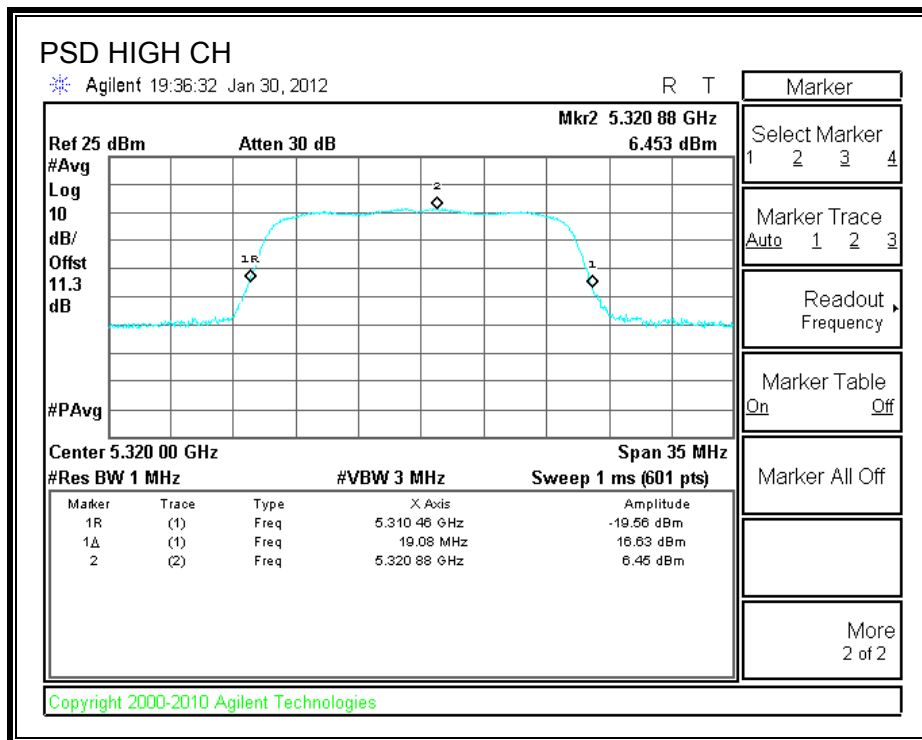
KDB 789033 D01 dated 10/25/2011.

RESULTS

Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	5260	7.320	11	-3.68
Middle	5300	7.320	11	-3.68
High	5320	6.450	11	-4.55

POWER SPECTRAL DENSITY





7.4.6. 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.

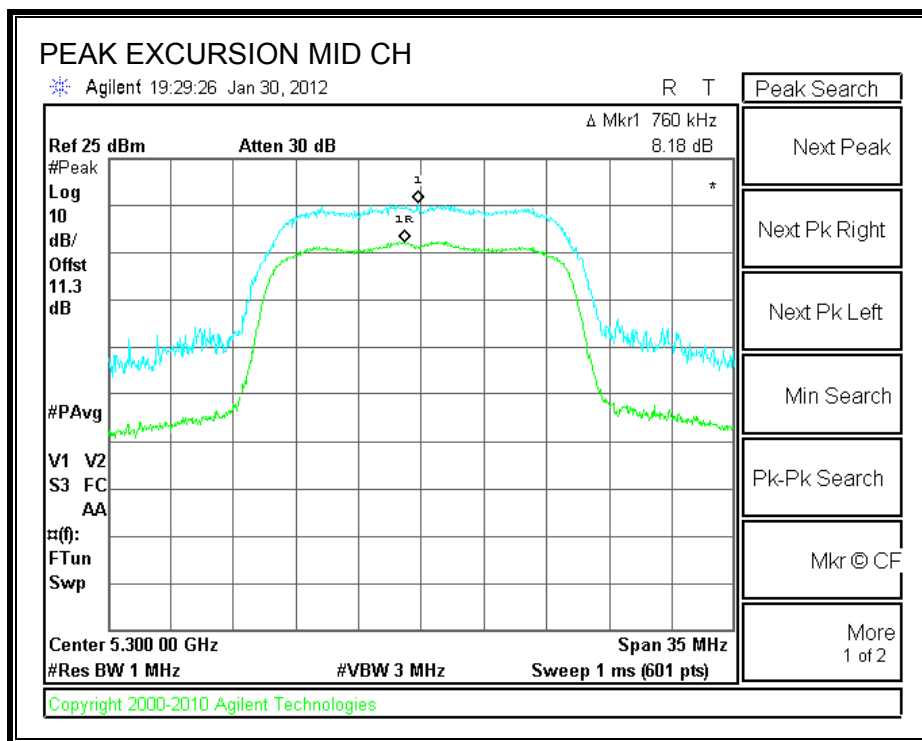
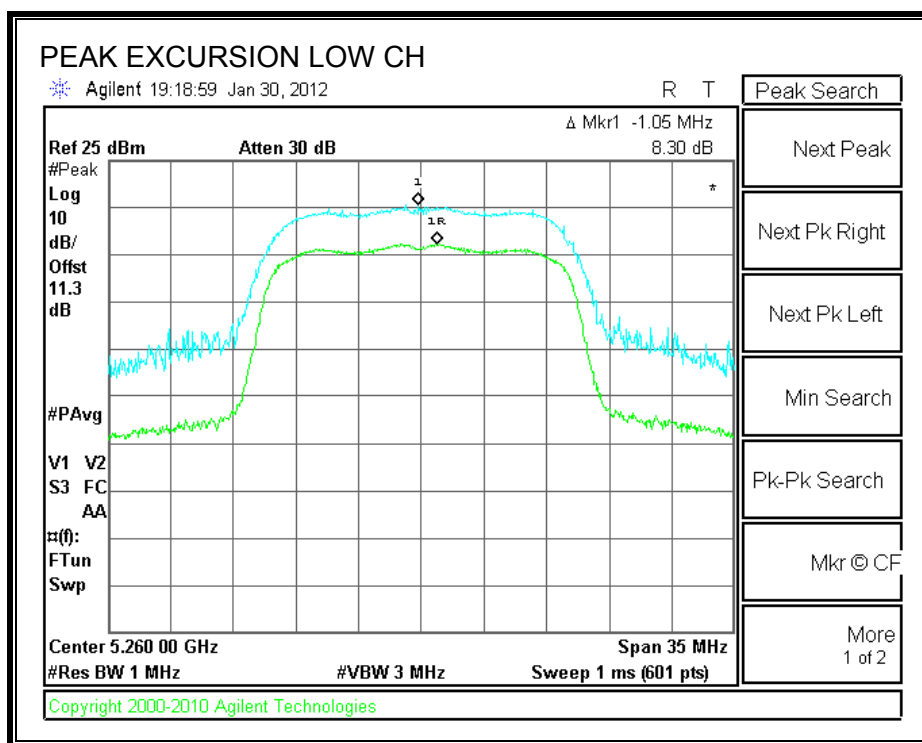
TEST PROCEDURE

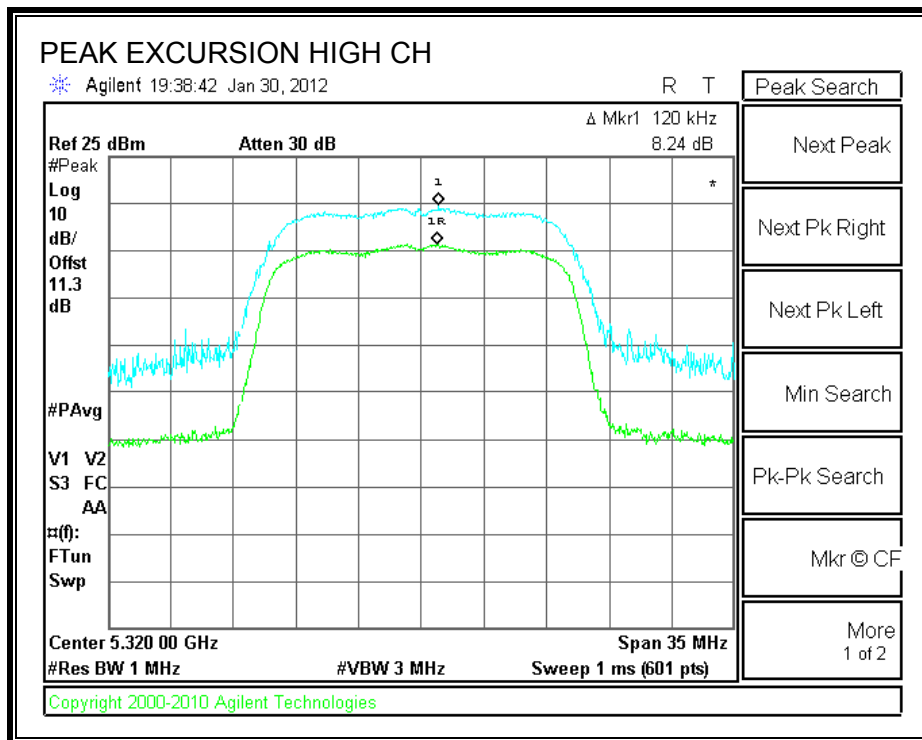
KDB 789033 D01 dated 10/25/2011.

RESULTS

Channel	Frequency (MHz)	Peak Excursion (dB)	Limit (dB)	Margin (dB)
Low	5260	8.30	13	-4.70
Middle	5300	8.18	13	-4.82
High	5320	8.24	13	-4.76

PEAK EXCURSION





7.5. 802.11n HT20 MODE IN THE 5.3 GHz BAND

7.5.1. 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

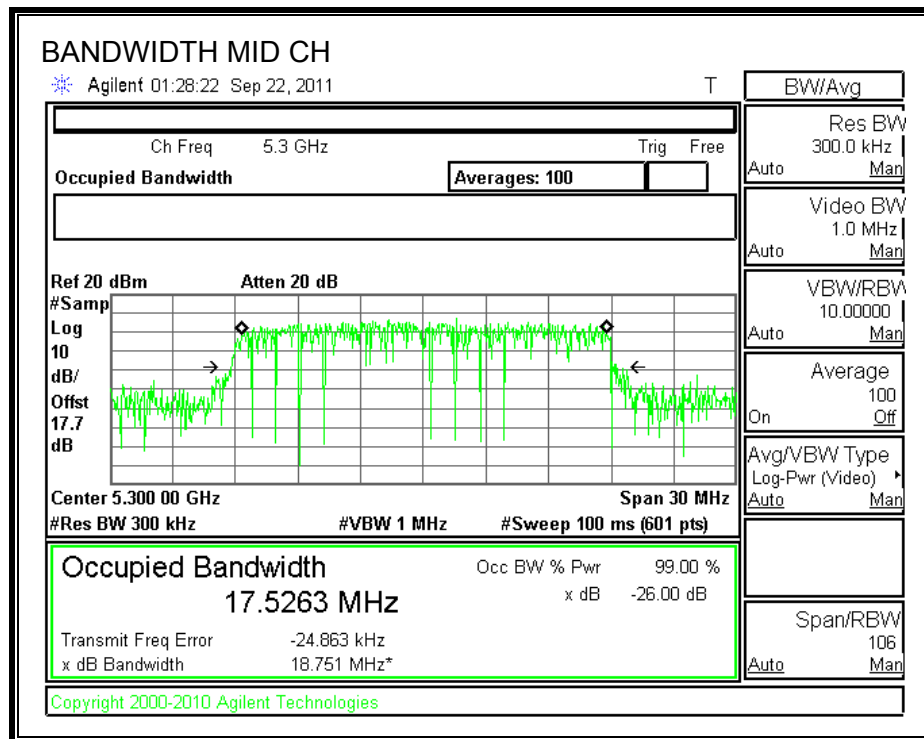
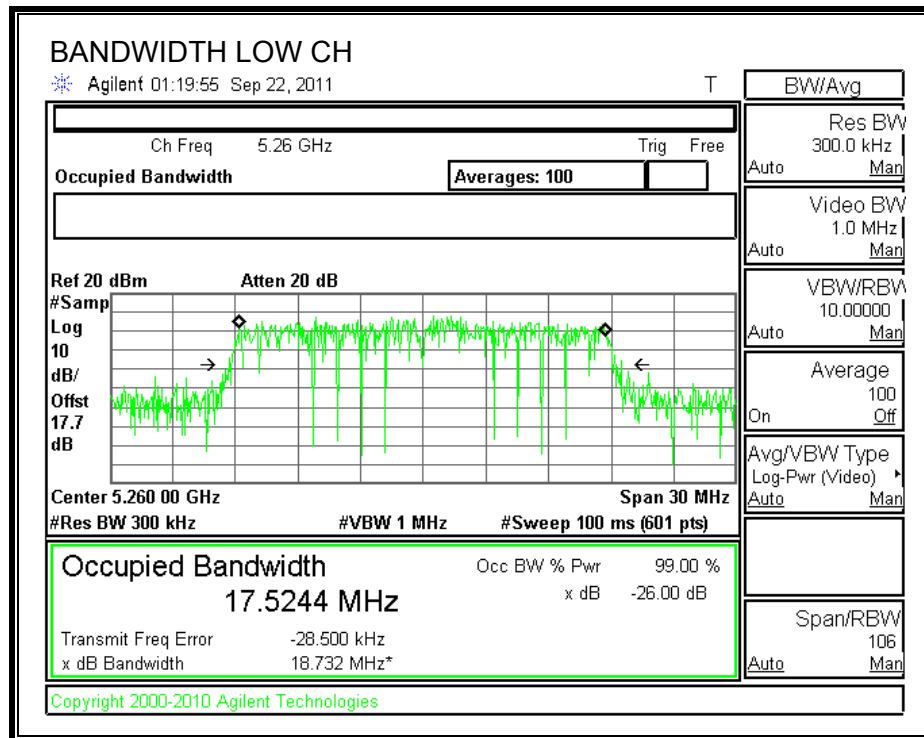
TEST PROCEDURE

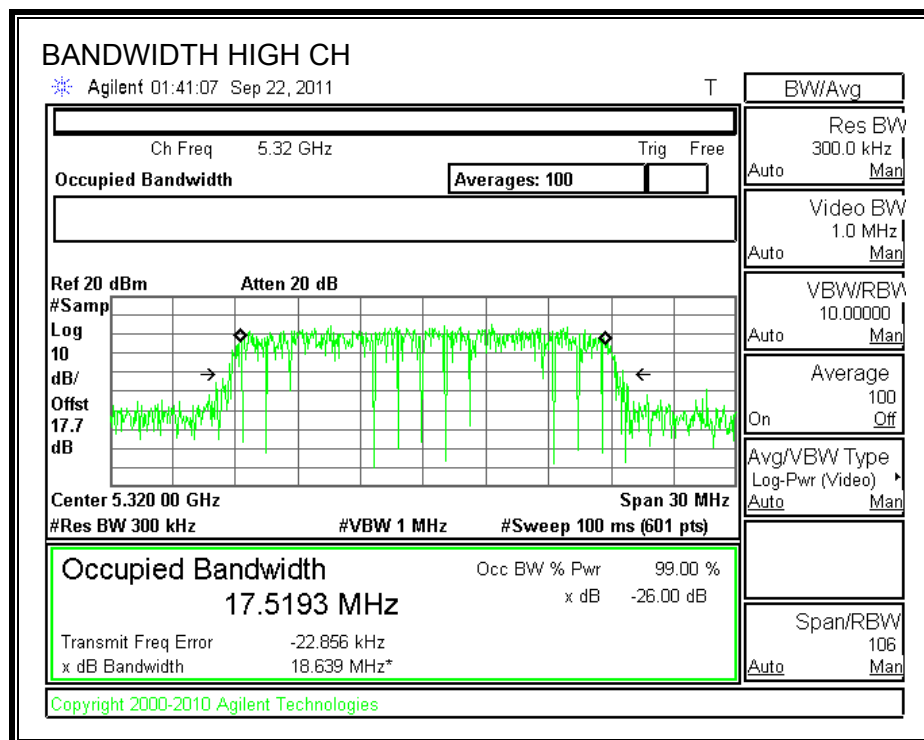
The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 3% of the measured bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal bandwidth function is utilized.

RESULTS

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	5260	17.5244
Middle	5300	17.5263
High	5320	17.5193

99% BANDWIDTH





7.5.2. 26 dB BANDWIDTH

LIMITS

None; for reporting purposes only.

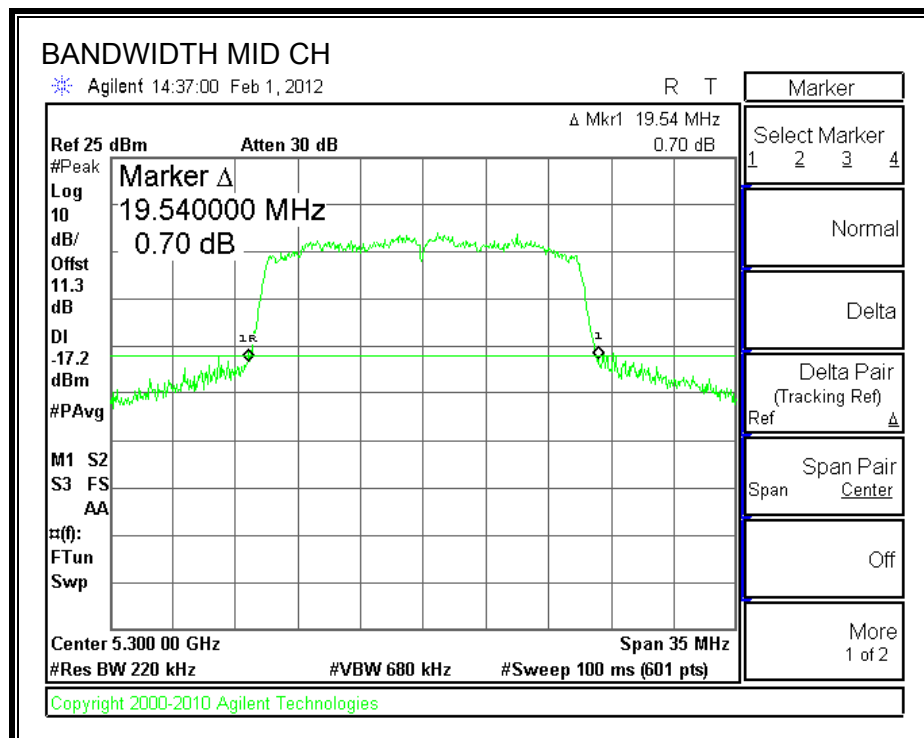
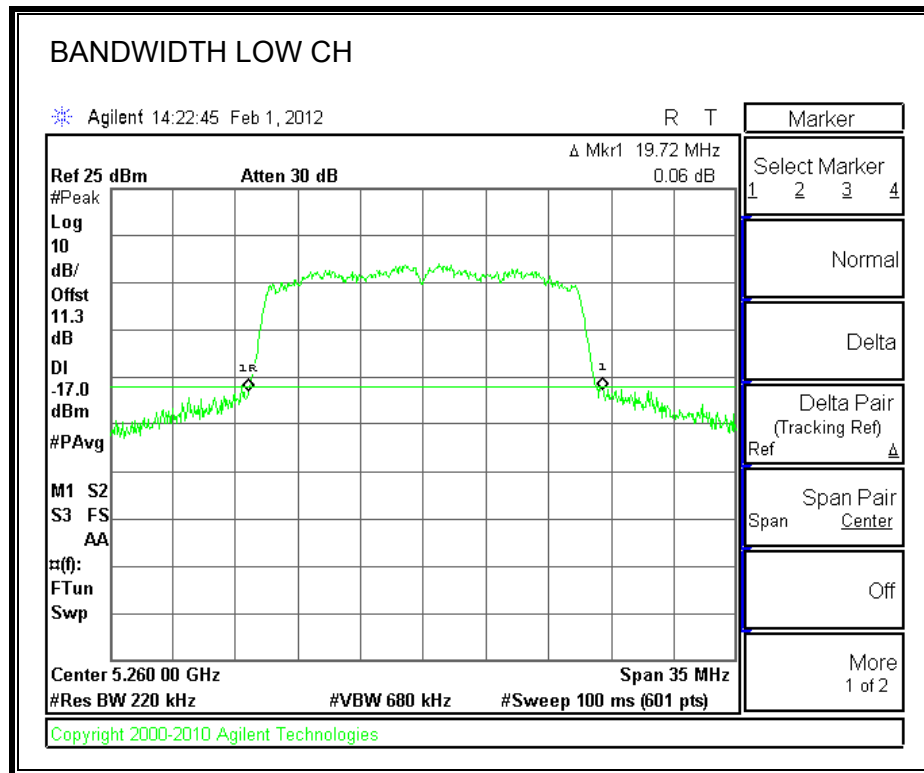
TEST PROCEDURE

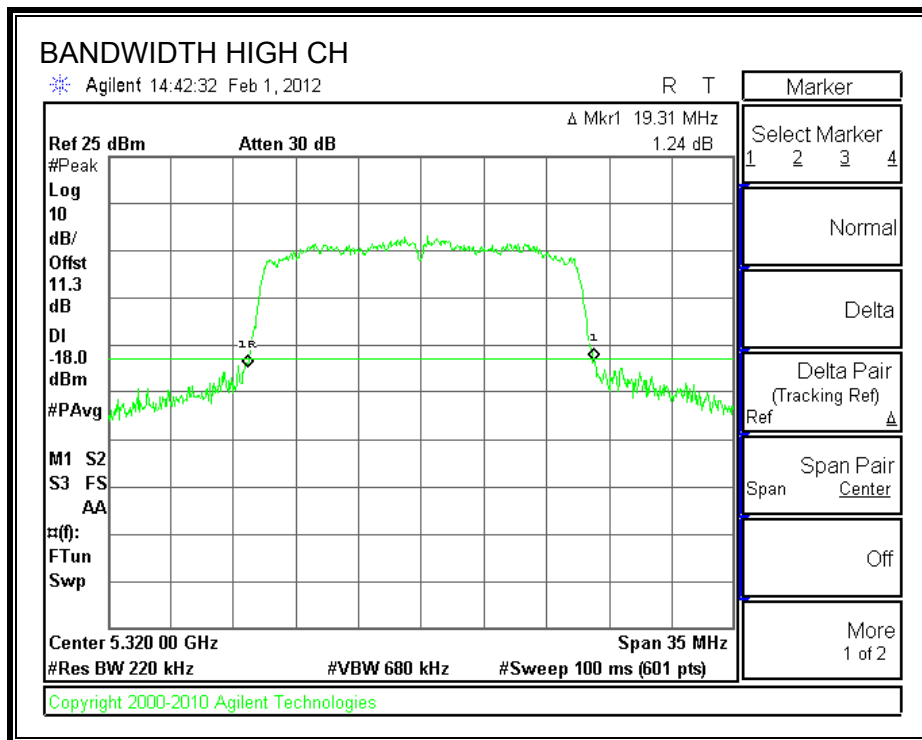
KDB 789033 D01 dated 10/25/2011.

RESULTS

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
Low	5260	19.72
Middle	5300	19.54
High	5320	19.31

26 dB BANDWIDTH





7.5.3. OUTPUT POWER

LIMITS

FCC §15.407 (a) (2)

IC RSS-210 A9.2 (2)

For the 5.25-5.35 GHz band, 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. If transmitting antennas of directional gain greater than 6 dBi are used, both the peak transmit 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.

TEST PROCEDURE

KDB 789033 D01 dated 10/25/2011.

RESULTS

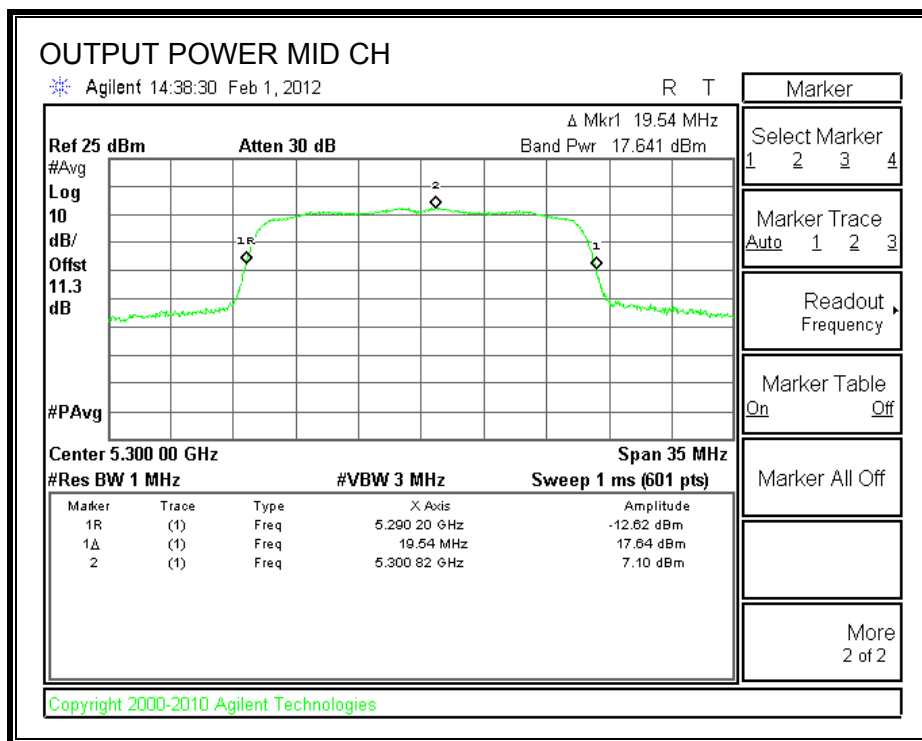
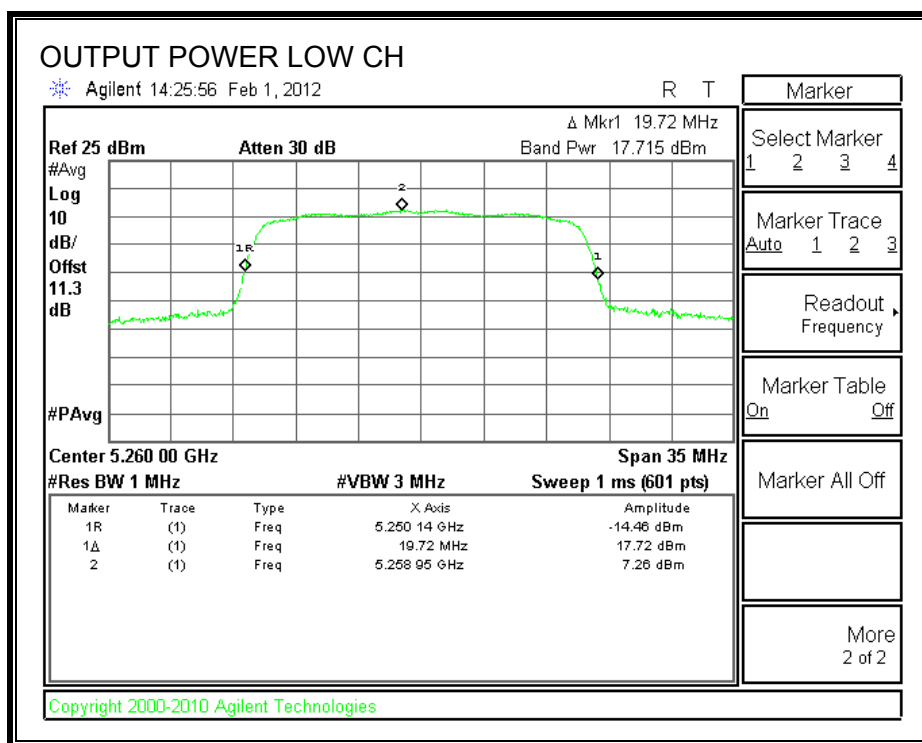
Limit

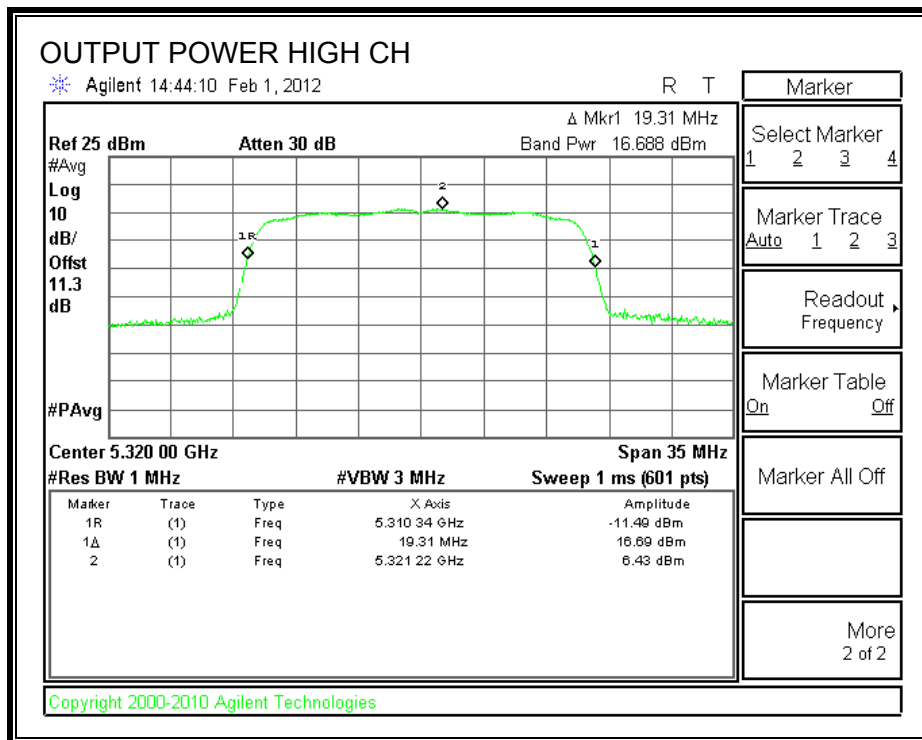
Channel	Frequency (MHz)	Fixed Limit (dBm)	B (MHz)	11 + 10 Log B Limit (dBm)	Antenna Gain (dBi)	Limit (dBm)
Low	5260	24	19.72	23.95	4.63	23.95
Mid	5300	24	19.54	23.91	4.63	23.91
High	5320	24	19.31	23.86	4.63	23.86

Results

Channel	Frequency (MHz)	Power (dBm)	Limit (dBm)	Margin (dB)
Low	5260	17.715	23.95	-6.234
Mid	5300	17.641	23.91	-6.268
High	5320	16.688	23.86	-7.168

OUTPUT POWER





7.5.4. AVERAGE POWER

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

RESULTS

The cable assembly insertion loss of 11.3 dB (including 10 dB pad and 1.3 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Frequency (MHz)	Power (dBm)
5260	17.40
5300	17.40
5320	16.40

7.5.5. PEAK POWER SPECTRAL DENSITY

LIMITS

FCC §15.407 (a) (2)

IC RSS-210 A9.2 (2)

For the 5.25–5.35 GHz band, 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 peak transmit 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.

The maximum antenna gain is less than or equal to 6 dBi, therefore the limit is 11 dBm.

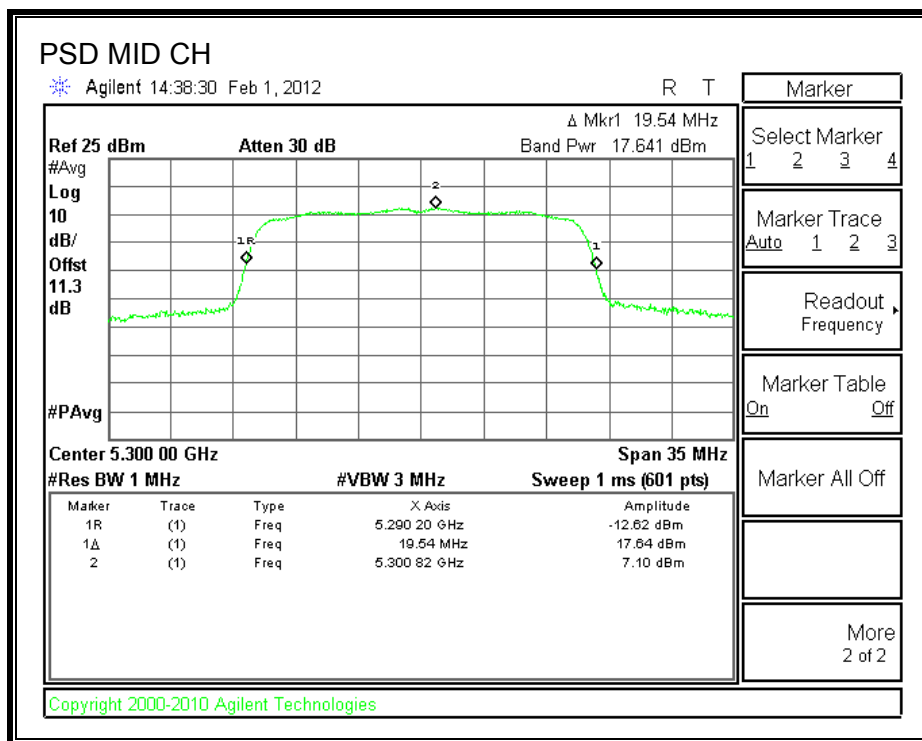
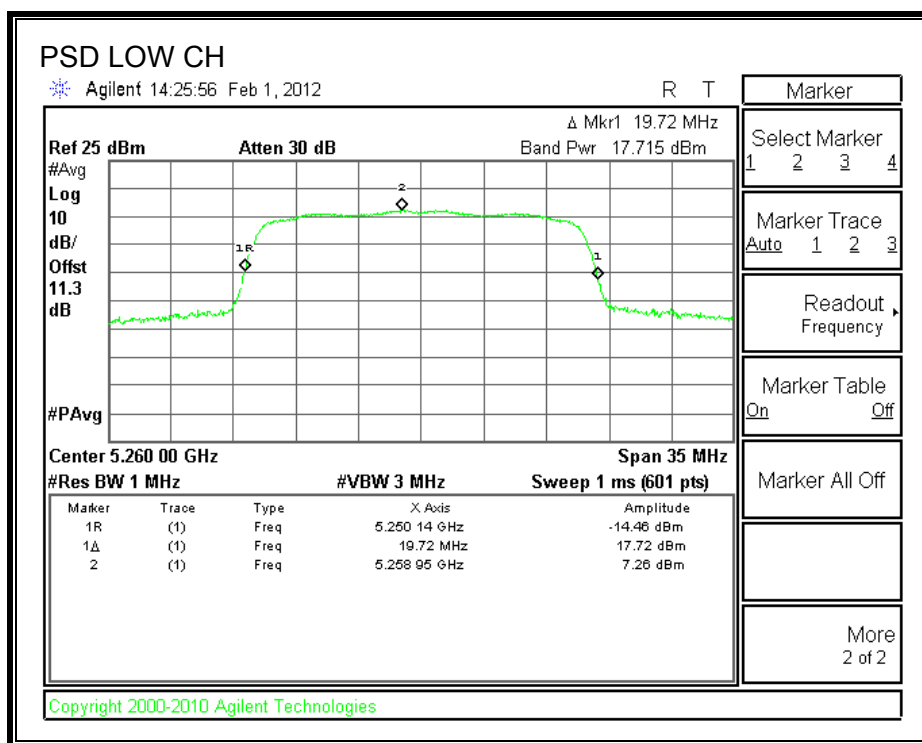
TEST PROCEDURE

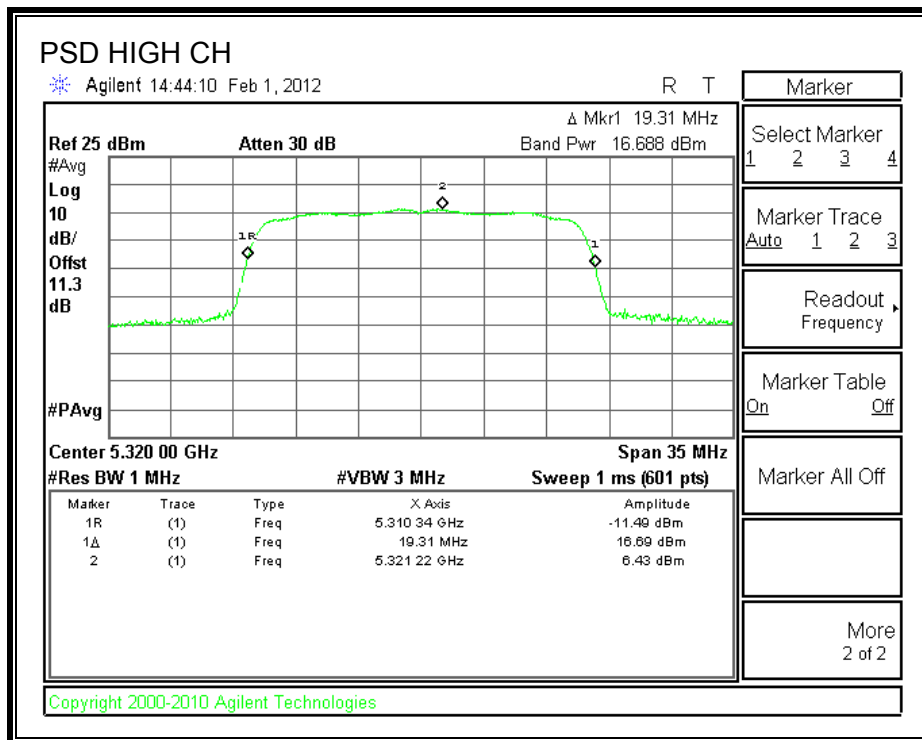
KDB 789033 D01 dated 10/25/2011.

RESULTS

Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	5260	7.260	11	-3.73
Middle	5300	7.100	11	-3.69
High	5320	6.430	11	-3.57

POWER SPECTRAL DENSITY





7.5.6. 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.

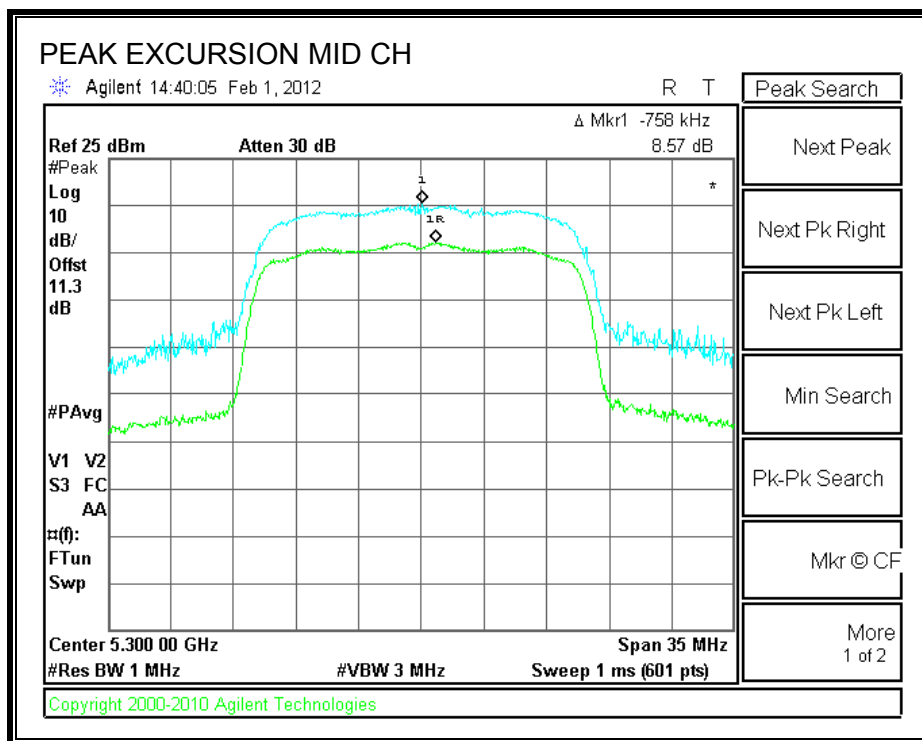
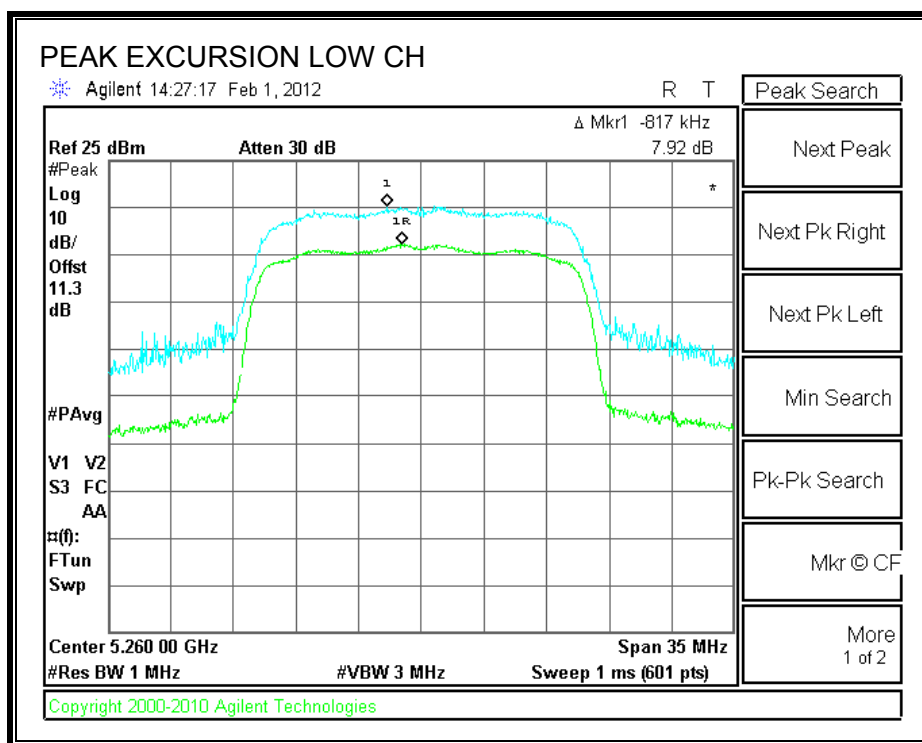
TEST PROCEDURE

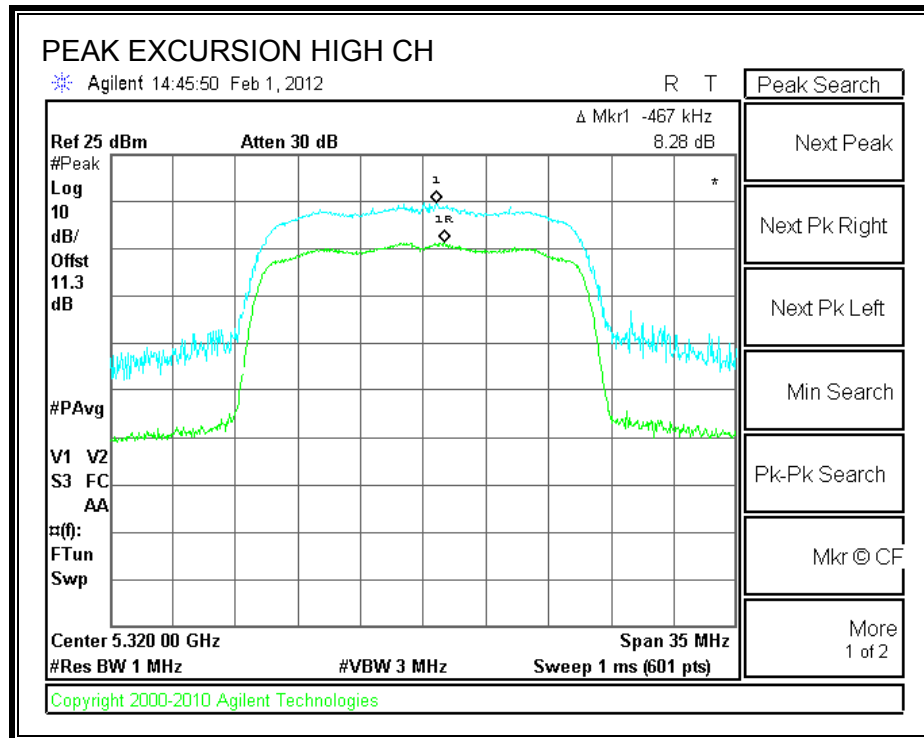
KDB 789033 D01 dated 10/25/2011.

RESULTS

Channel	Frequency (MHz)	Peak Excursion (dB)	Limit (dB)	Margin (dB)
Low	5260	7.92	13	-5.08
Middle	5300	8.57	13	-4.43
High	5320	8.28	13	-4.72

PEAK EXCURSION





7.6. 802.11a MODE IN THE 5.6 GHz BAND

7.6.1. 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

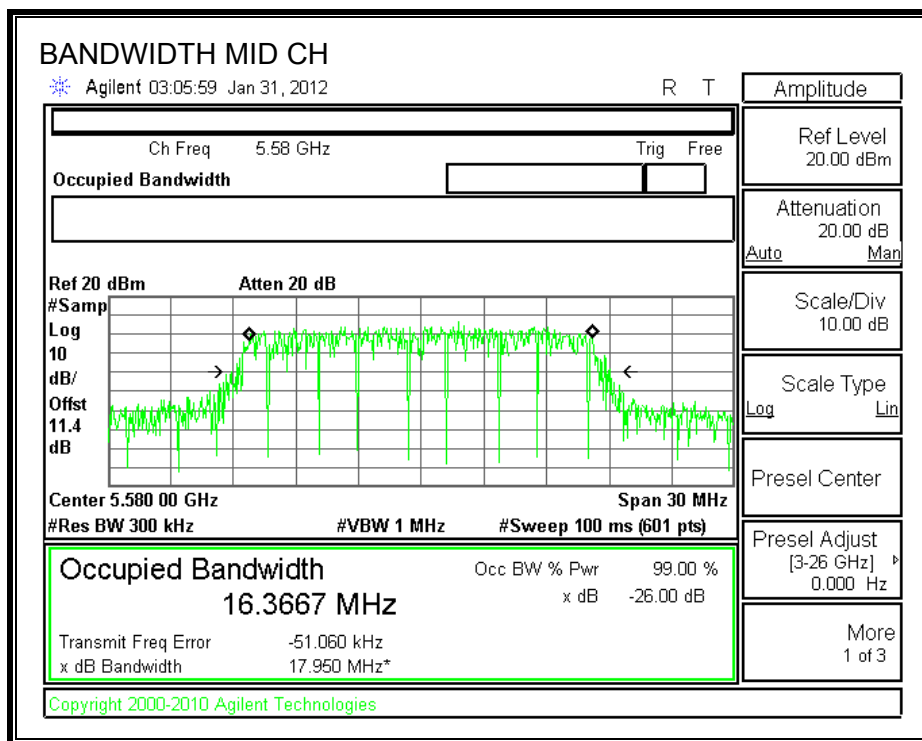
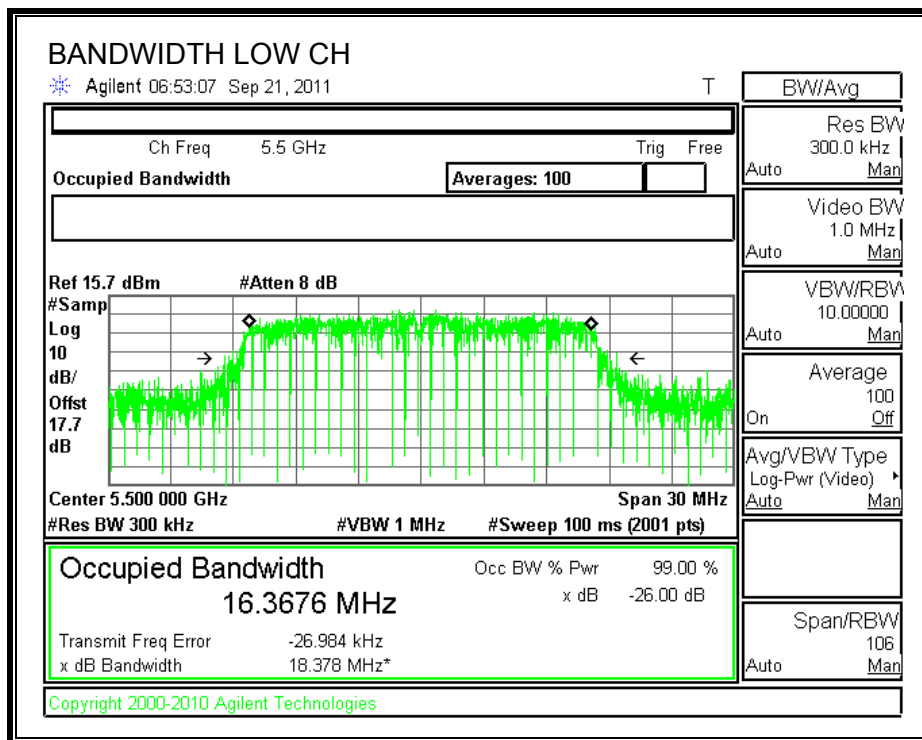
TEST PROCEDURE

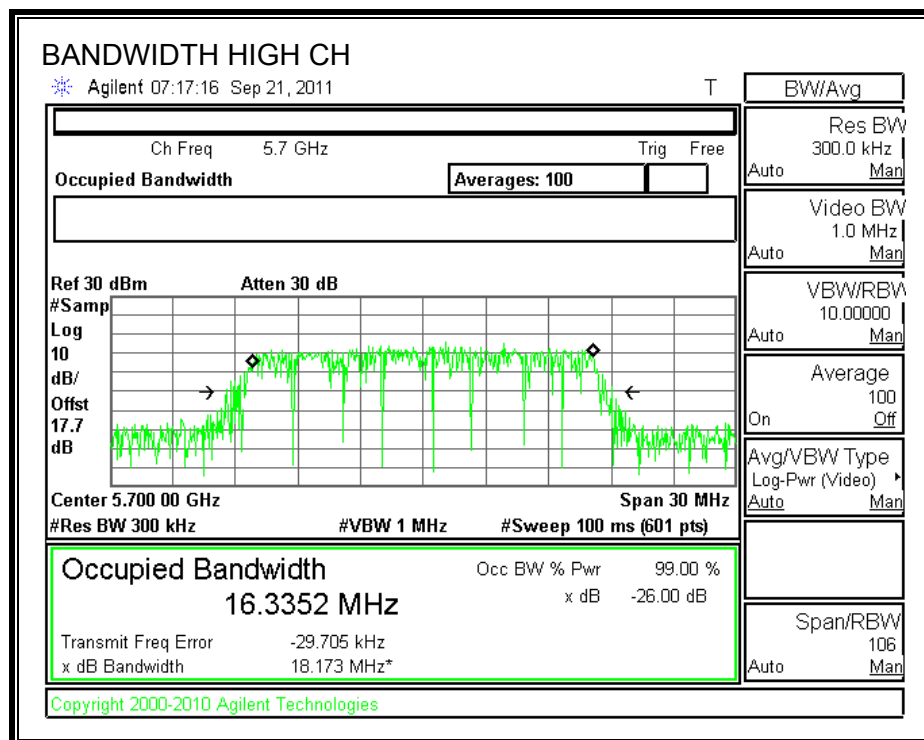
The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 3% of the measured bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal bandwidth function is utilized.

RESULTS

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	5500	16.3676
Middle	5580	16.3667
High	5700	16.3352

99% BANDWIDTH





7.6.2. 26 dB BANDWIDTH

LIMITS

None; for reporting purposes only.

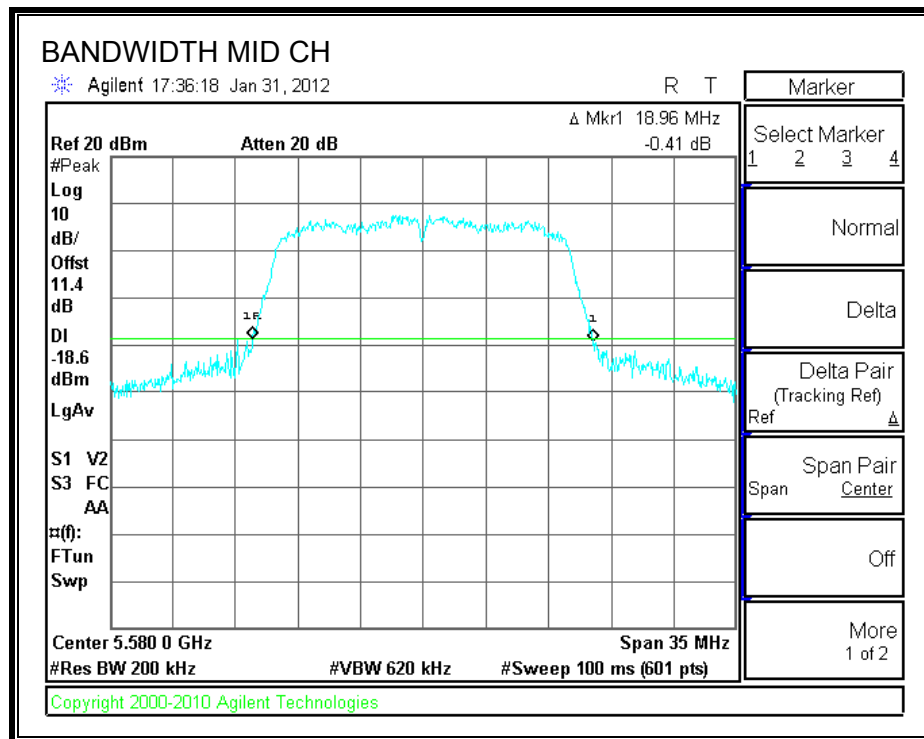
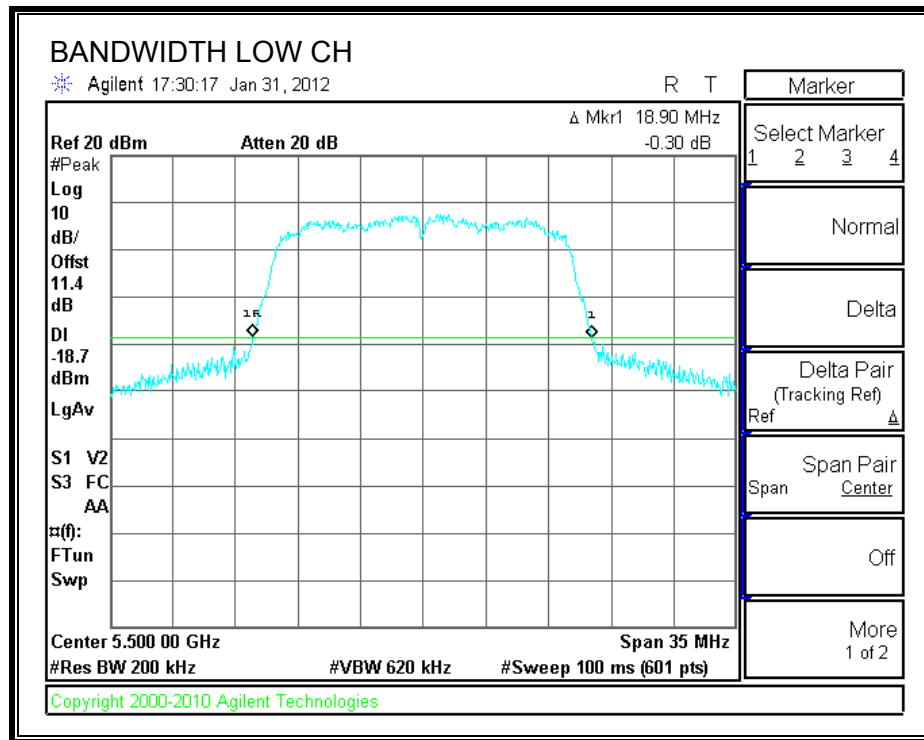
TEST PROCEDURE

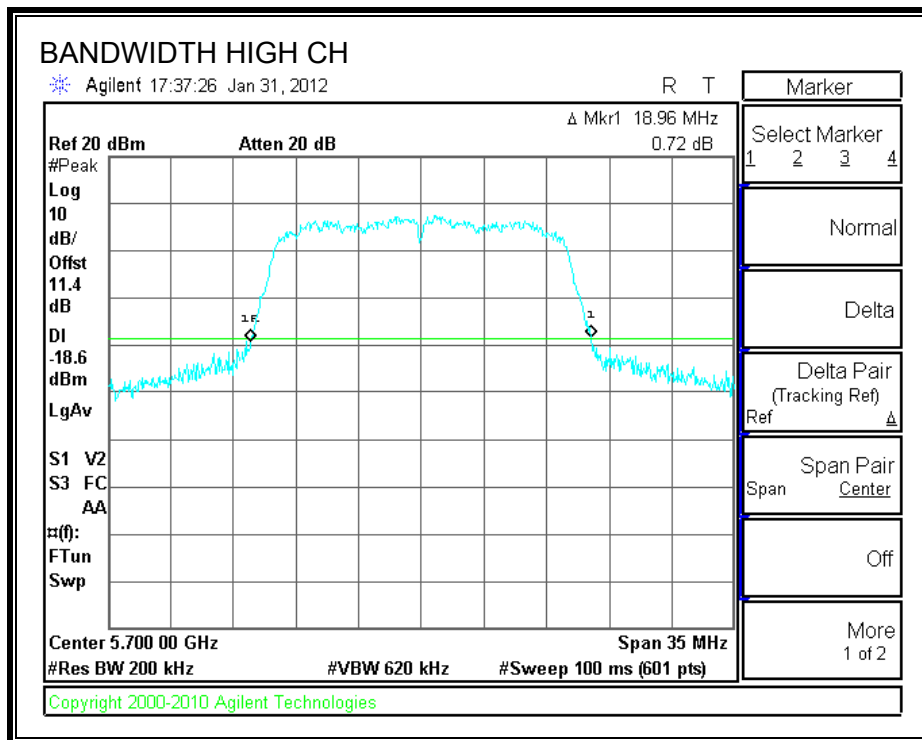
KDB 789033 D01 dated 10/25/2011.

RESULTS

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
Low	5500	18.90
Middle	5580	18.96
High	5700	18.96

26 dB BANDWIDTH





7.6.3. OUTPUT POWER

LIMITS

FCC §15.407 (a) (2)

IC RSS-210 A9.2 (2)

For the 5.47-5.725 GHz band, 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. If transmitting antennas of directional gain greater than 6 dBi are used, both the peak transmit 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.

TEST PROCEDURE

KDB 789033 D01 dated 10/25/2011.

RESULTS

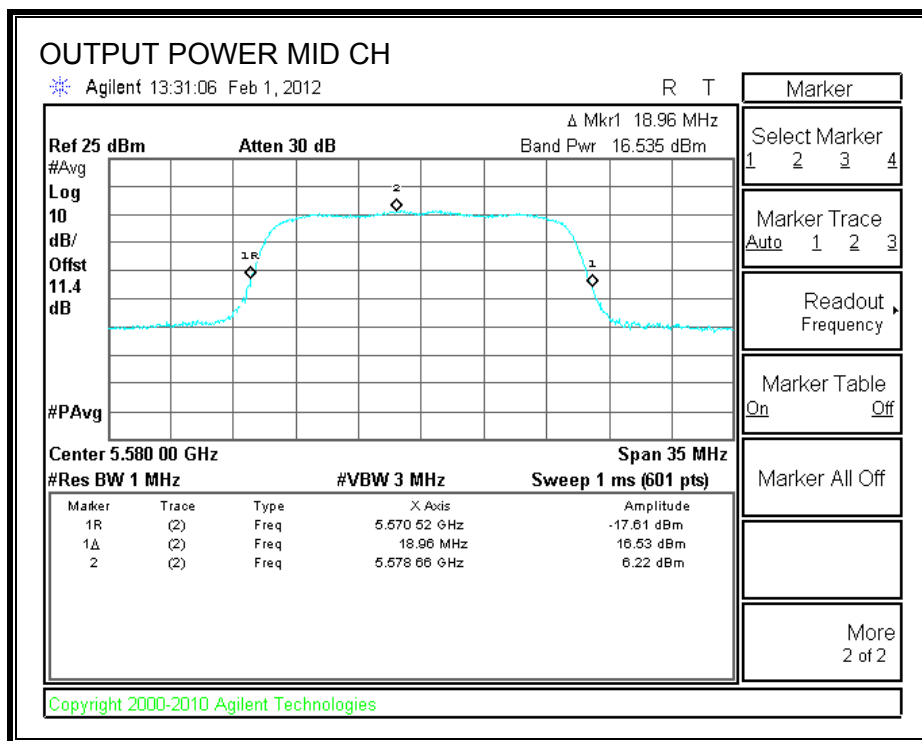
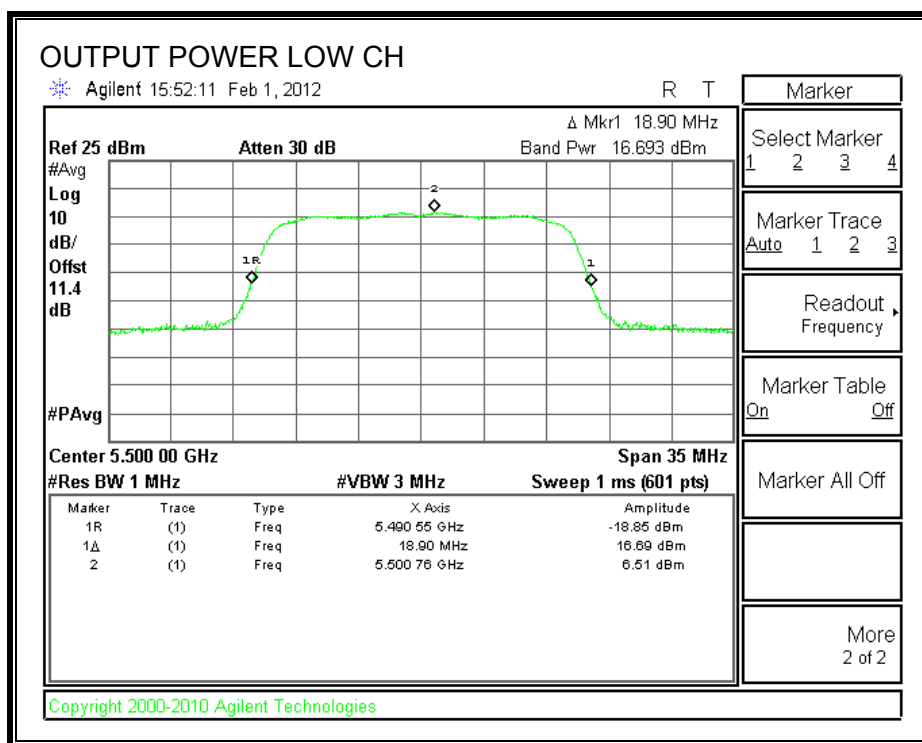
Limit

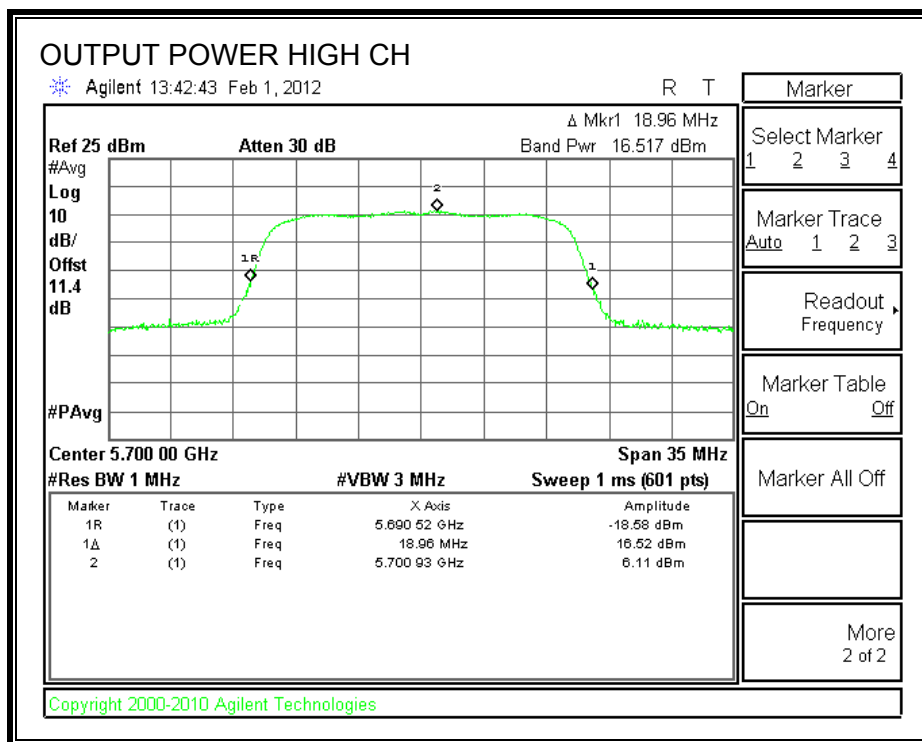
Channel	Frequency (MHz)	Fixed Limit (dBm)	B (MHz)	11 + 10 Log B Limit (dBm)	Antenna Gain (dBi)	Limit (dBm)
Low	5500	24	18.90	23.76	4.51	23.76
Mid	5580	24	18.96	23.78	4.51	23.78
High	5700	24	18.96	23.78	4.51	23.78

Results

Channel	Frequency (MHz)	Power (dBm)	Limit (dBm)	Margin (dB)
Low	5500	16.693	23.76	-7.072
Mid	5580	16.535	23.78	-7.243
High	5700	16.517	23.78	-7.261

OUTPUT POWER





7.6.4. AVERAGE POWER

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

RESULTS

The cable assembly insertion loss of 11.4 dB (including 10 dB pad and 1.4 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency (MHz)	Power (dBm)
Low	5500	16.50
Middle	5580	16.45
High	5700	16.50

7.6.5. PEAK POWER SPECTRAL DENSITY

LIMITS

FCC §15.407 (a) (2)

IC RSS-210 A9.2 (2)

For the 5.47-5.725 GHz band, 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 peak transmit 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.

The maximum antenna gain is less than or equal to 6 dBi, therefore the limit is 11 dBm.

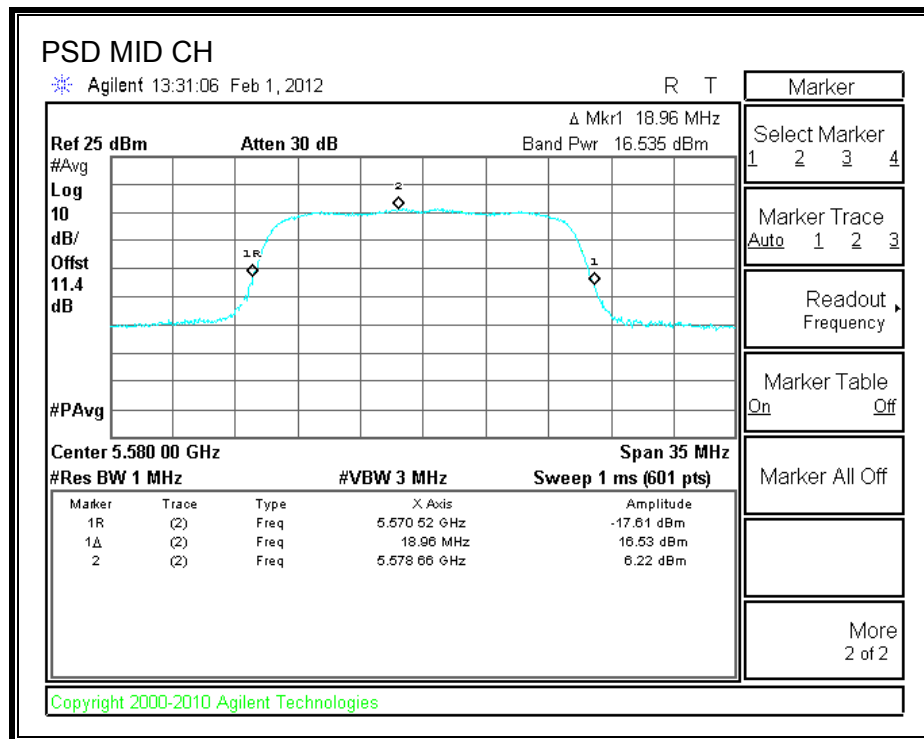
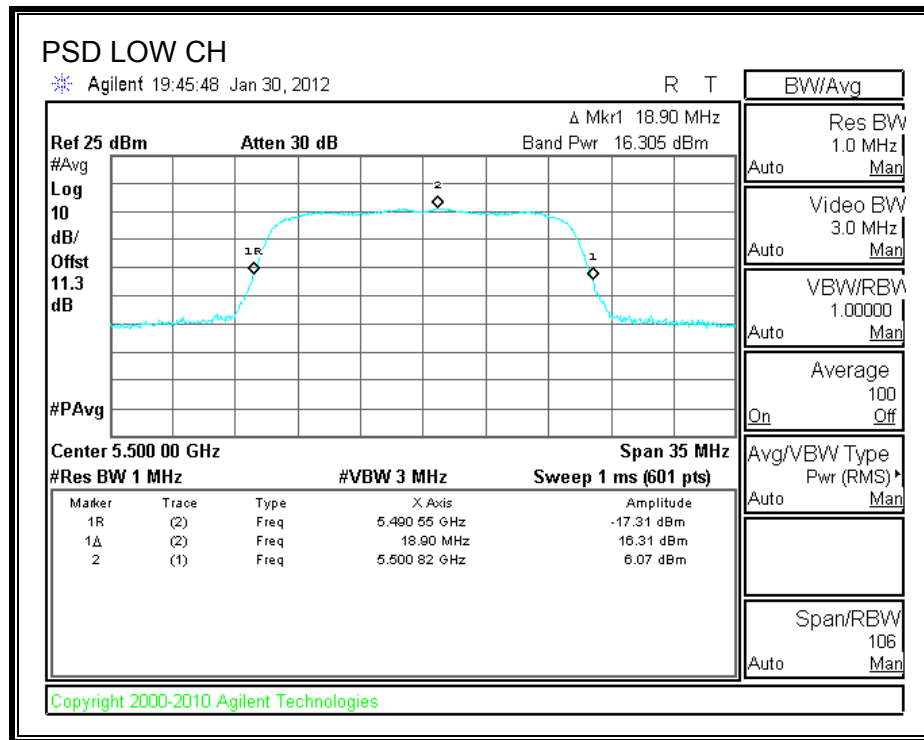
TEST PROCEDURE

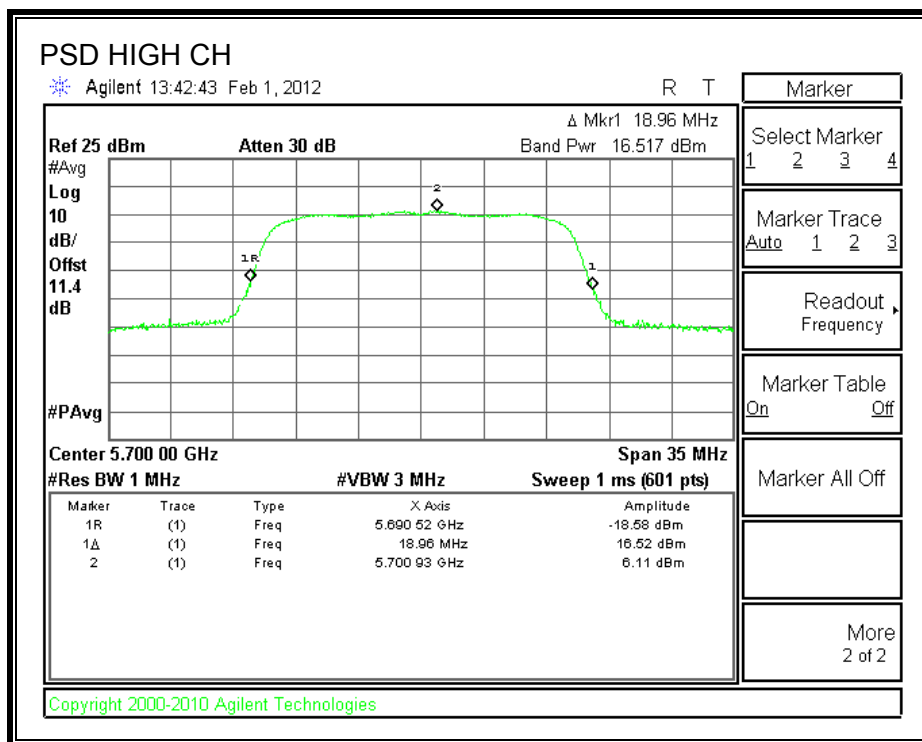
KDB 789033 D01 dated 10/25/2011.

RESULTS

Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	5500	6.070	11	-4.93
Middle	5580	6.220	11	-4.78
High	5700	6.110	11	-4.89

POWER SPECTRAL DENSITY





7.6.6. 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.

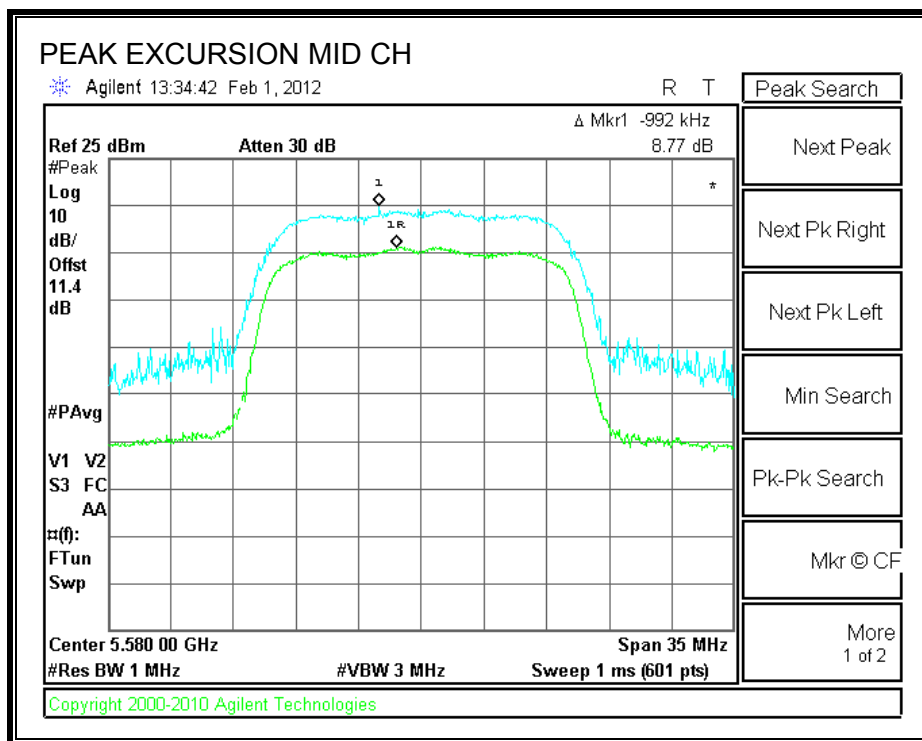
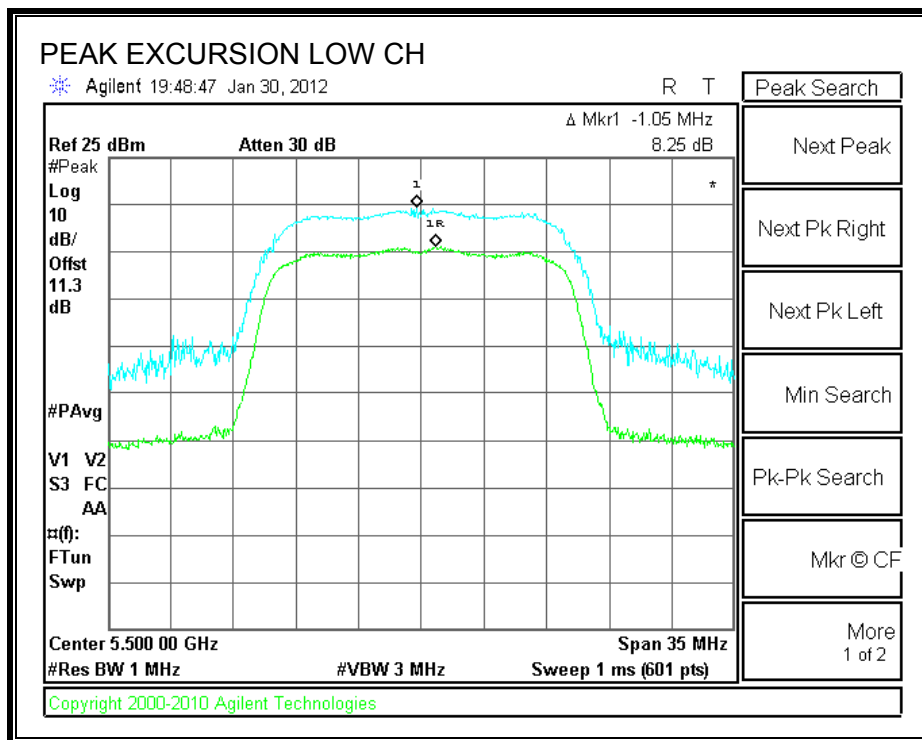
TEST PROCEDURE

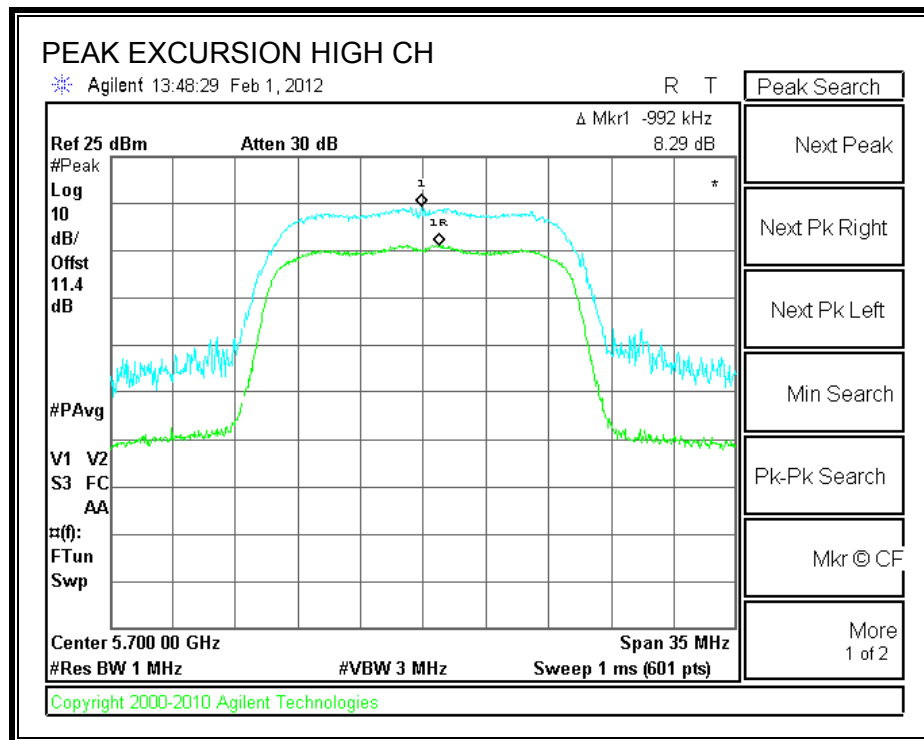
KDB 789033 D01 dated 10/25/2011.

RESULTS

Channel	Frequency (MHz)	Peak Excursion (dB)	Limit (dB)	Margin (dB)
Low	5500	8.25	13	-4.75
Middle	5580	8.77	13	-4.23
High	5700	8.29	13	-4.71

PEAK EXCURSION





7.7. 802.11n HT20 MODE IN THE 5.6 GHz BAND

7.7.1. 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

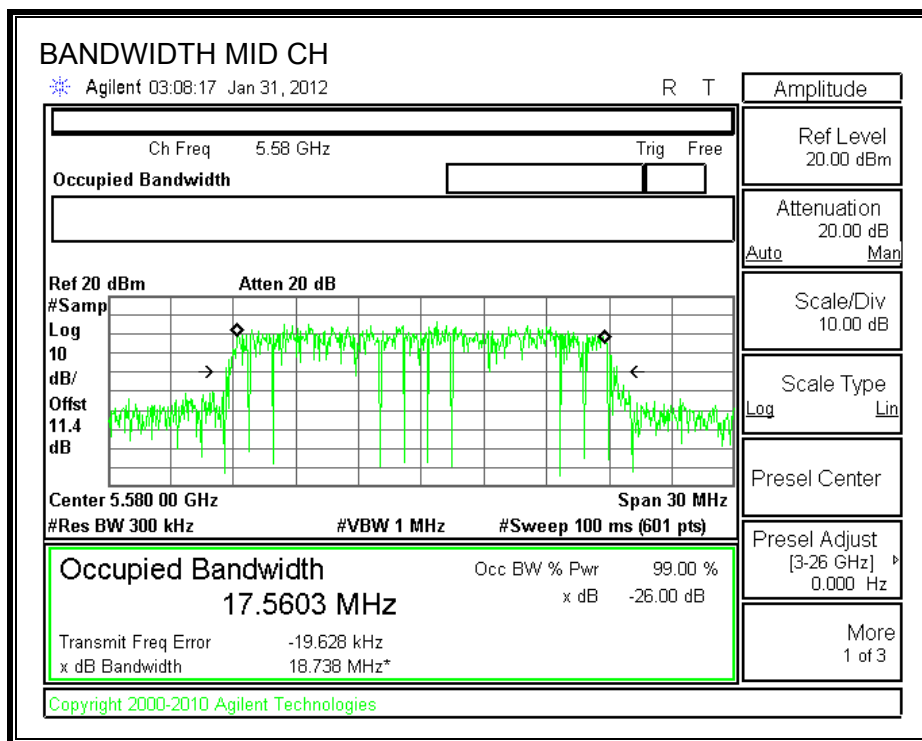
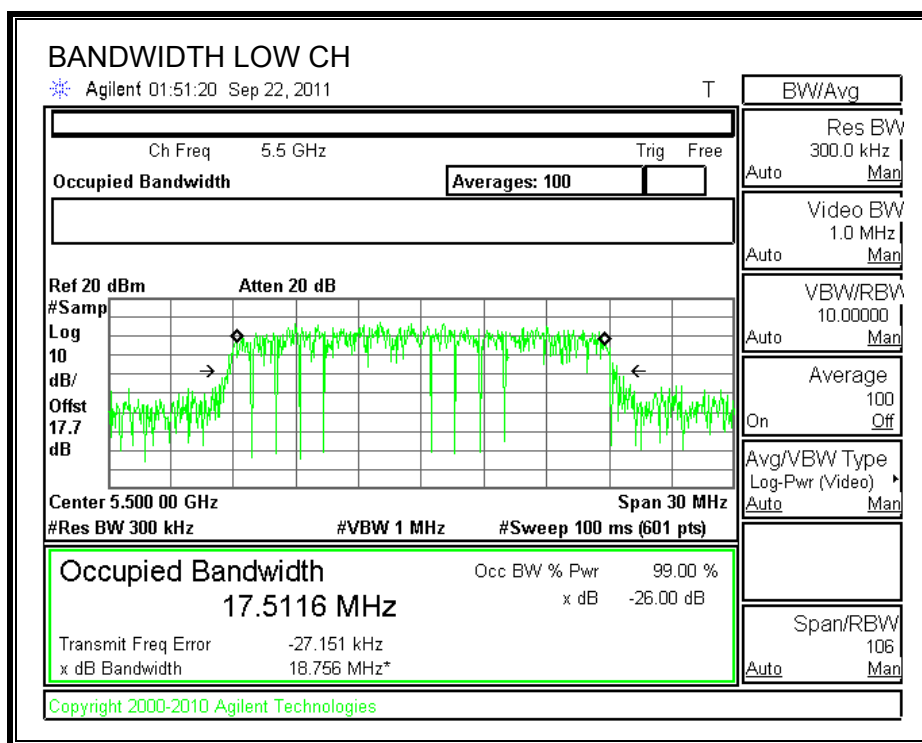
TEST PROCEDURE

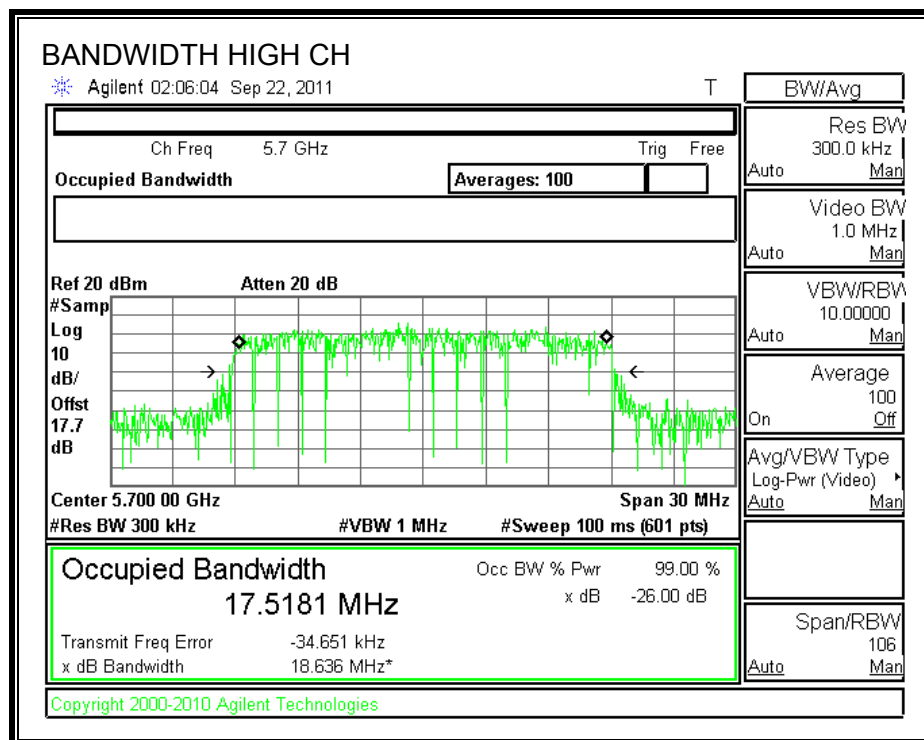
The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 3% of the measured bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal bandwidth function is utilized.

RESULTS

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	5500	17.5116
Middle	5580	17.5603
High	5700	17.5181

99% BANDWIDTH





7.7.2. 26 dB BANDWIDTH

LIMITS

None; for reporting purposes only.

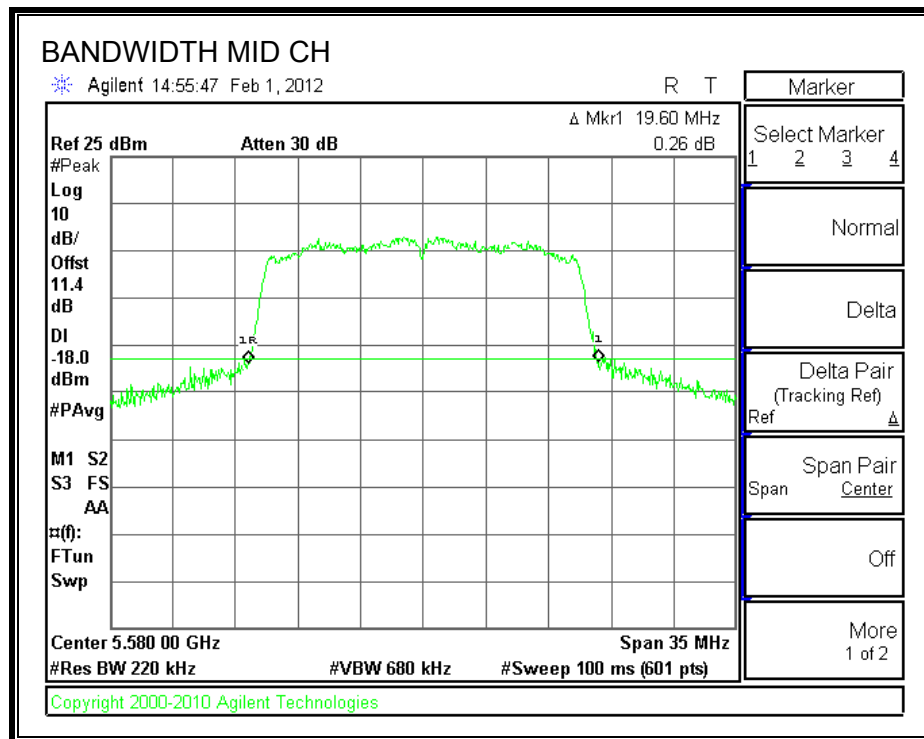
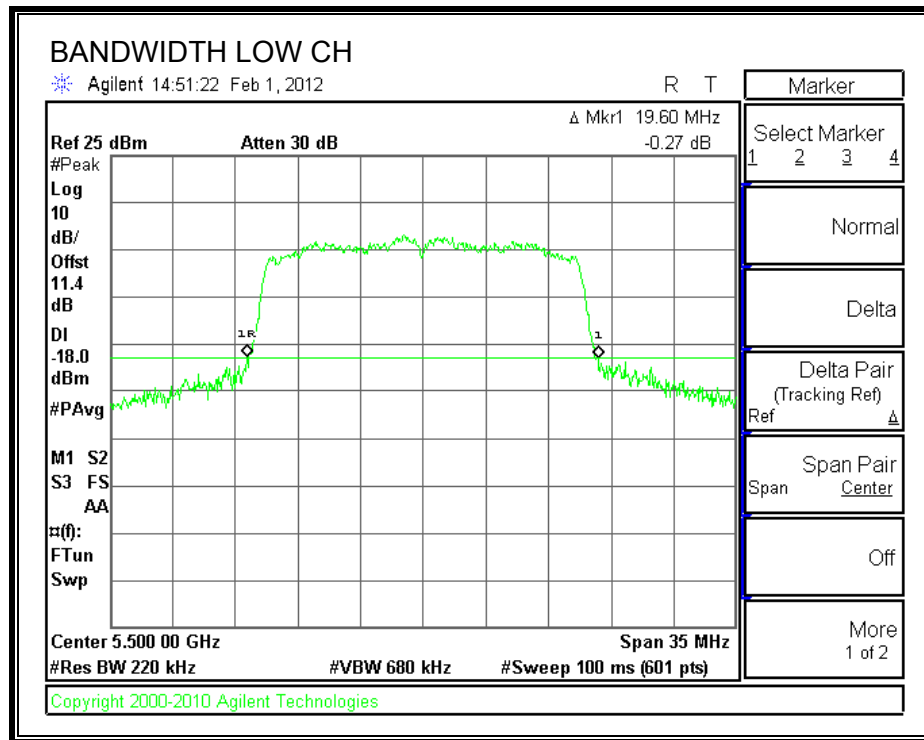
TEST PROCEDURE

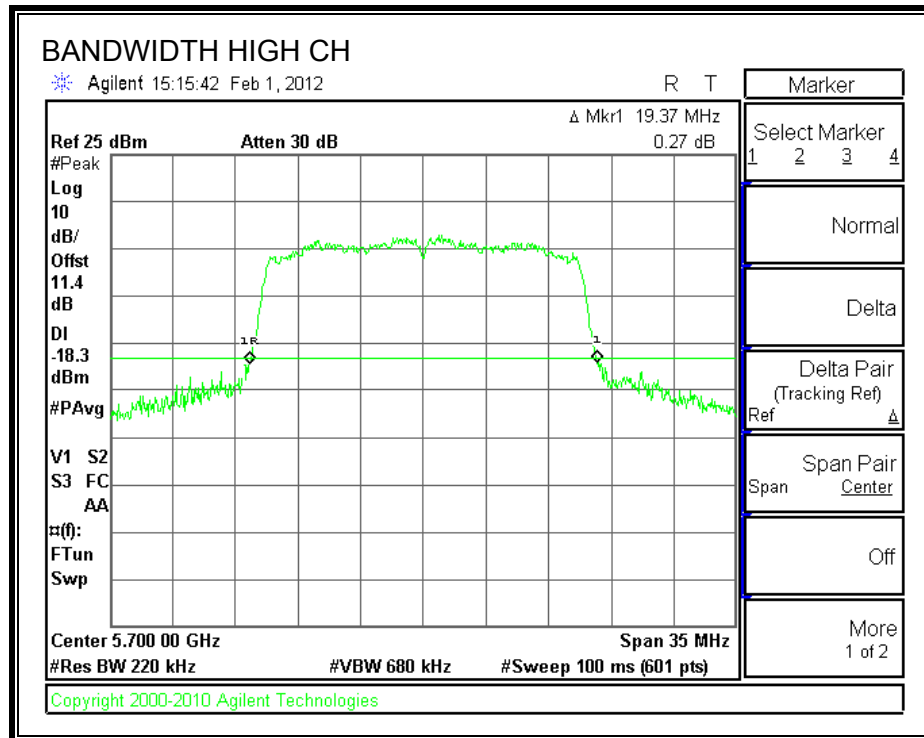
KDB 789033 D01 dated 10/25/2011.

RESULTS

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	5500	19.60	17.5116
Middle	5580	19.60	17.5264
High	5700	19.37	17.5181

26 dB BANDWIDTH





7.7.3. OUTPUT POWER

LIMITS

FCC §15.407 (a) (2)

IC RSS-210 A9.2 (2)

For the 5.47-5.725 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed the lesser of 250 mW or 11 dBm + 10 log B, where B is the 26-dB emission bandwidth in MHz. If transmitting antennas of directional gain greater than 6 dBi are used, both the peak transmit 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.

TEST PROCEDURE

KDB 789033 D01 dated 10/25/2011.

RESULTS

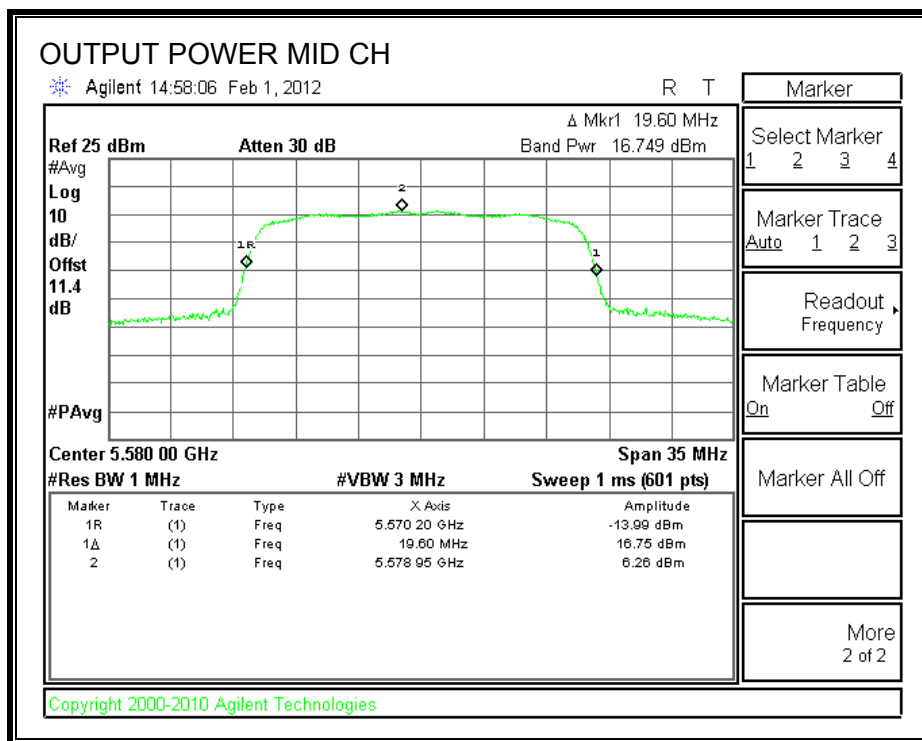
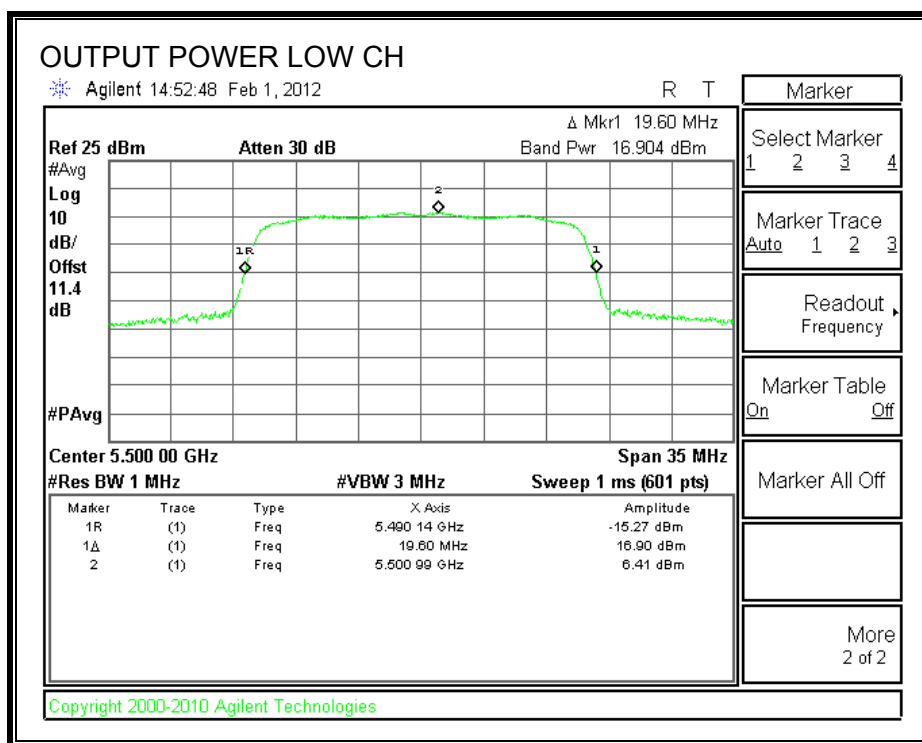
Limit

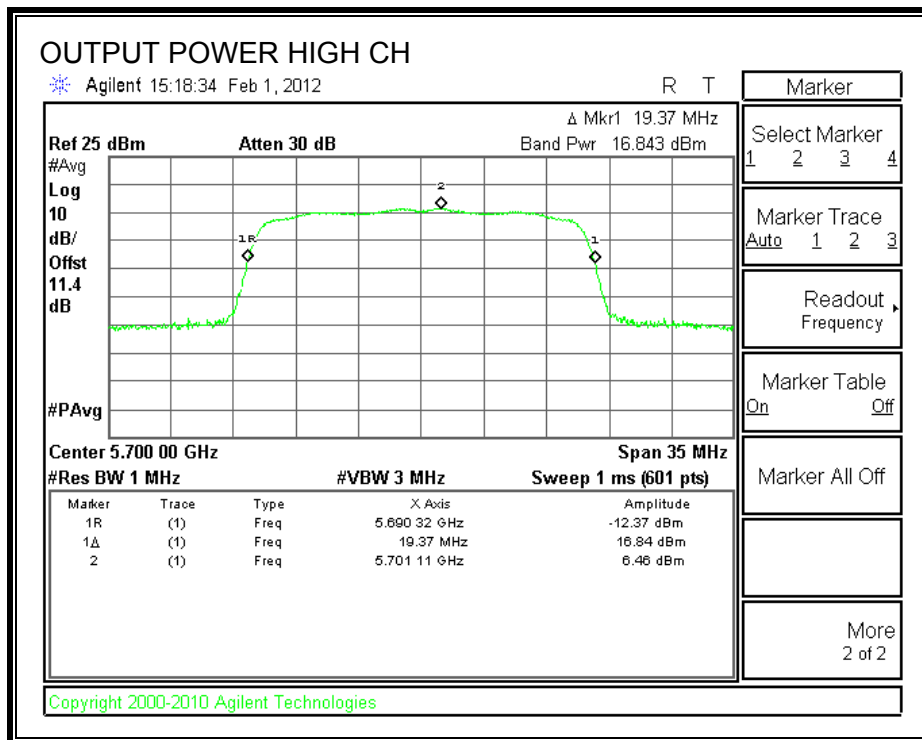
Channel	Frequency (MHz)	Fixed Limit (dBm)	B (MHz)	11 + 10 Log B Limit (dBm)	Antenna Gain (dBi)	Limit (dBm)
Low	5500	24	19.60	23.92	4.51	23.92
Mid	5580	24	19.60	23.92	4.51	23.92
High	5700	24	19.37	23.87	4.51	23.87

Results

Channel	Frequency (MHz)	Power (dBm)	Limit (dBm)	Margin (dB)
Low	5500	16.904	23.92	-7.019
Mid	5580	16.749	23.92	-7.174
High	5700	16.843	23.87	-7.028

OUTPUT POWER





7.7.4. AVERAGE POWER

LIMIT

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

RESULTS

The cable assembly insertion loss of 11.4 dB (including 10 dB pad and 1.4 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency (MHz)	Power (dBm)
Low	5500	16.50
Middle	5580	16.50
High	5700	16.50

7.7.5. PEAK POWER SPECTRAL DENSITY

LIMITS

FCC §15.407 (a) (2)

IC RSS-210 A9.2 (2)

For the 5.47-5.725 GHz band, 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 peak transmit 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.

The maximum antenna gain is less than or equal to 6 dBi, therefore the limit is 11 dBm.

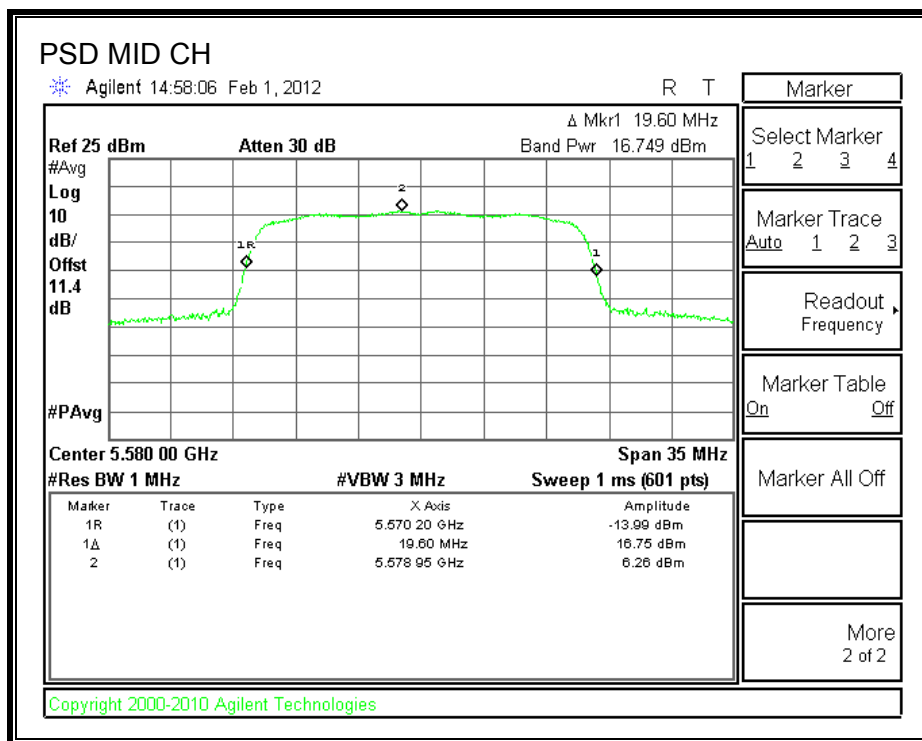
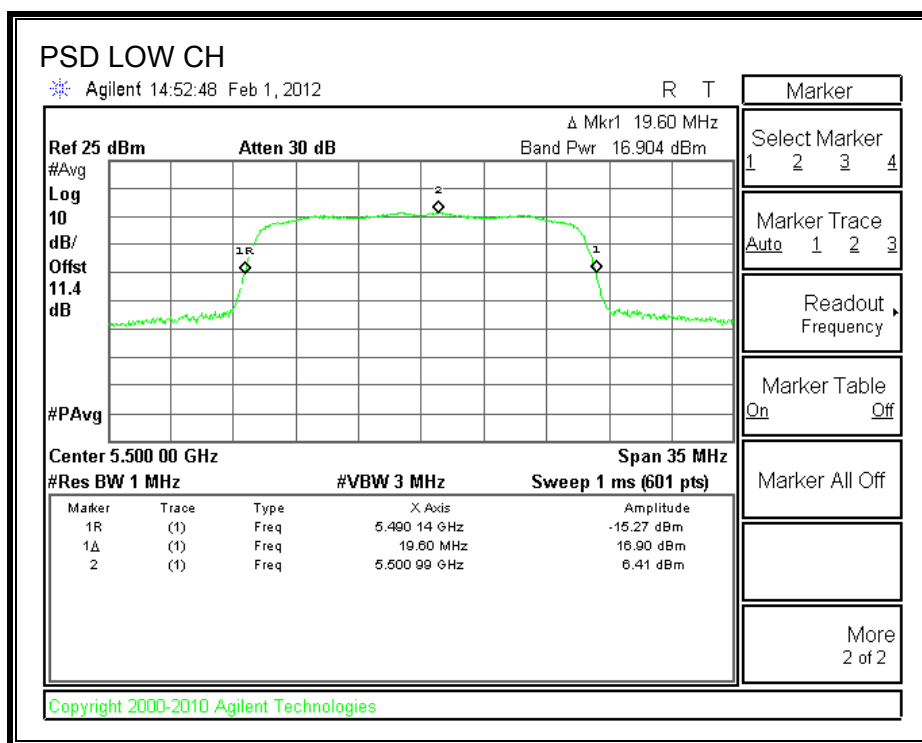
TEST PROCEDURE

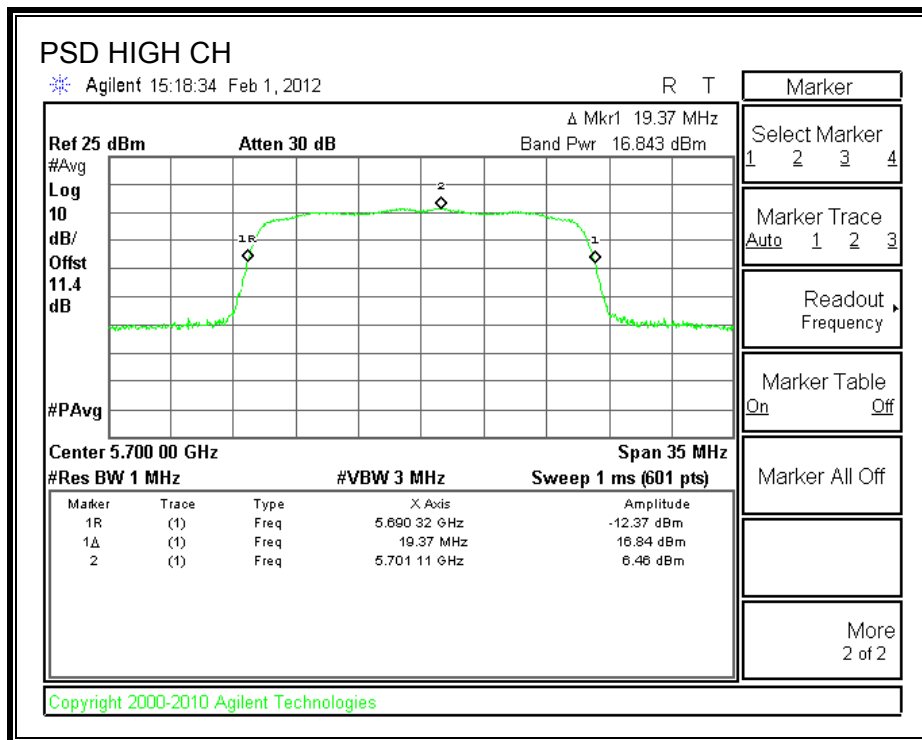
KDB 789033 D01 dated 10/25/2011.

RESULTS

Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	5500	6.410	11	-4.59
Middle	5580	6.260	11	-4.74
High	5700	6.460	11	-4.54

POWER SPECTRAL DENSITY





7.7.6. 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.

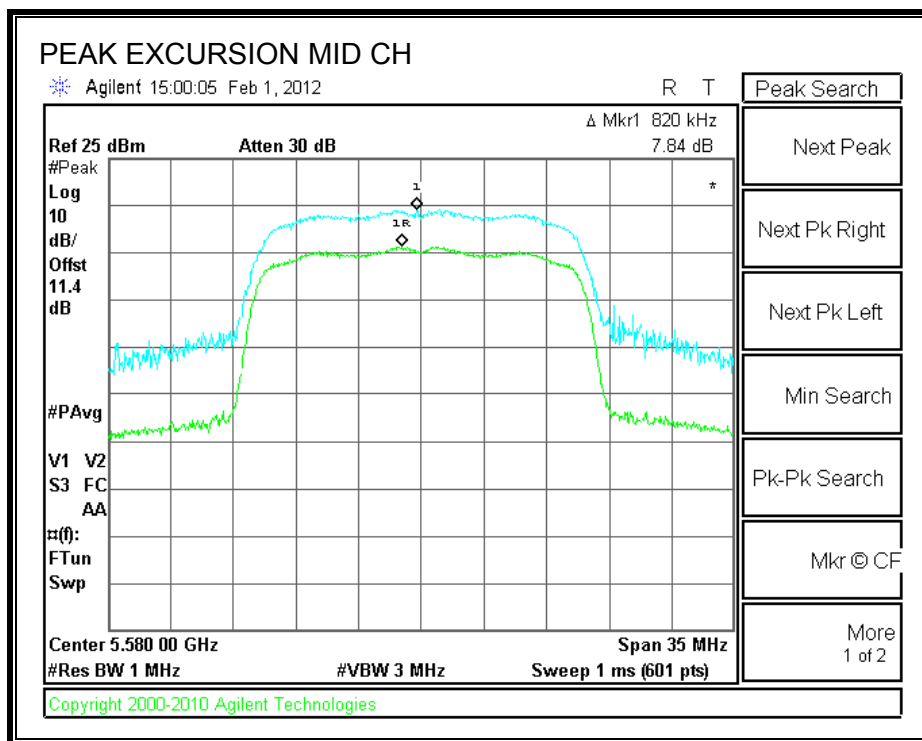
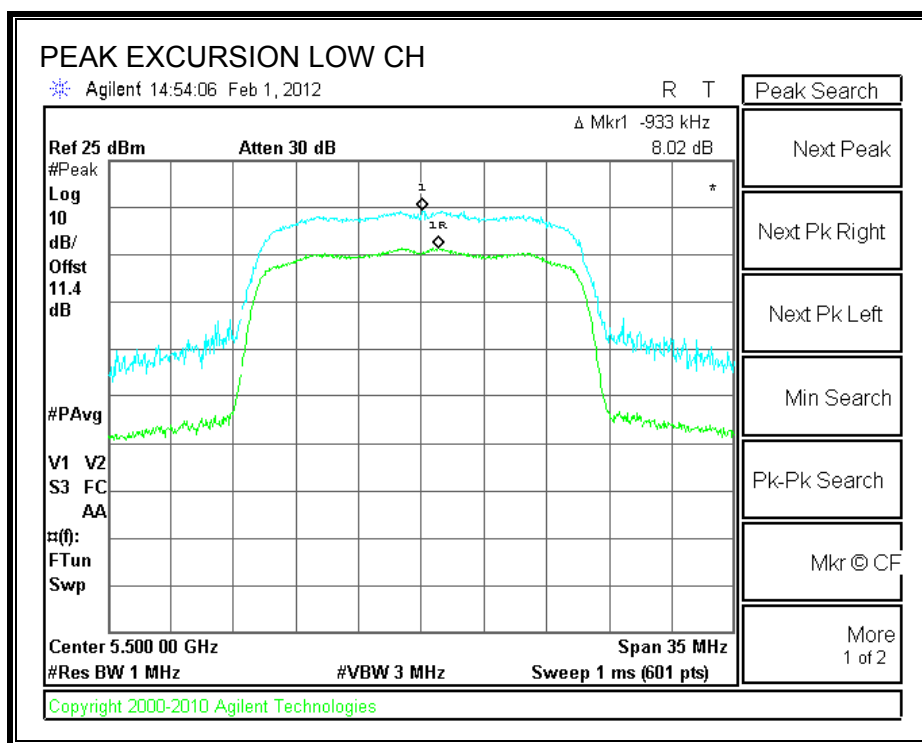
TEST PROCEDURE

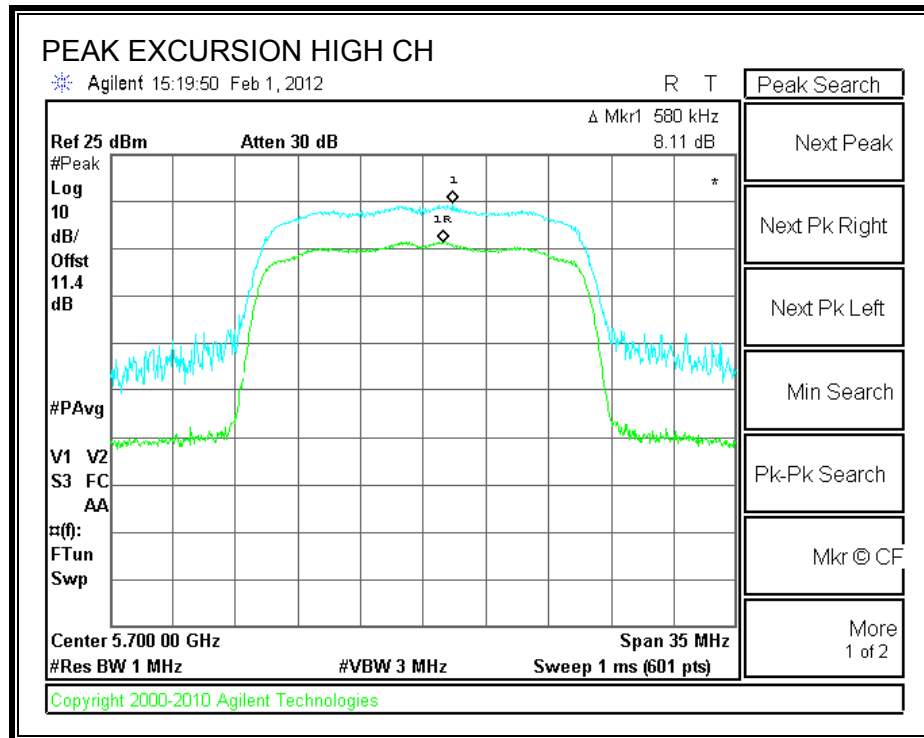
KDB 789033 D01 dated 10/25/2011.

RESULTS

Channel	Frequency (MHz)	Peak Excursion (dB)	Limit (dB)	Margin (dB)
Low	5500	8.02	13	-4.98
Middle	5580	7.84	13	-5.16
High	5700	8.11	13	-4.89

PEAK EXCURSION





8. RADIATED TEST RESULTS

8.1. LIMITS AND PROCEDURE

LIMITS

FCC §15.205 and §15.209

IC RSS-210 Clause 2.6 (Transmitter)

IC RSS-GEN Clause 6 (Receiver)

Frequency Range (MHz)	Field Strength Limit (uV/m) at 3 m	Field Strength Limit (dBuV/m) at 3 m
30 - 88	100	40
88 - 216	150	43.5
216 - 960	200	46
Above 960	500	54

TEST PROCEDURE

The EUT is placed on a non-conducting table 80 cm above the ground plane. The antenna to EUT distance is 3 meters. The EUT is configured in accordance with ANSI C63.4. The EUT is set to transmit in a continuous mode.

For measurements below 1 GHz the resolution bandwidth is set to 100 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

For measurements above 1 GHz the resolution bandwidth is set to 1 MHz, then the video bandwidth is set to 1 MHz for peak measurements and 10 Hz for average measurements.

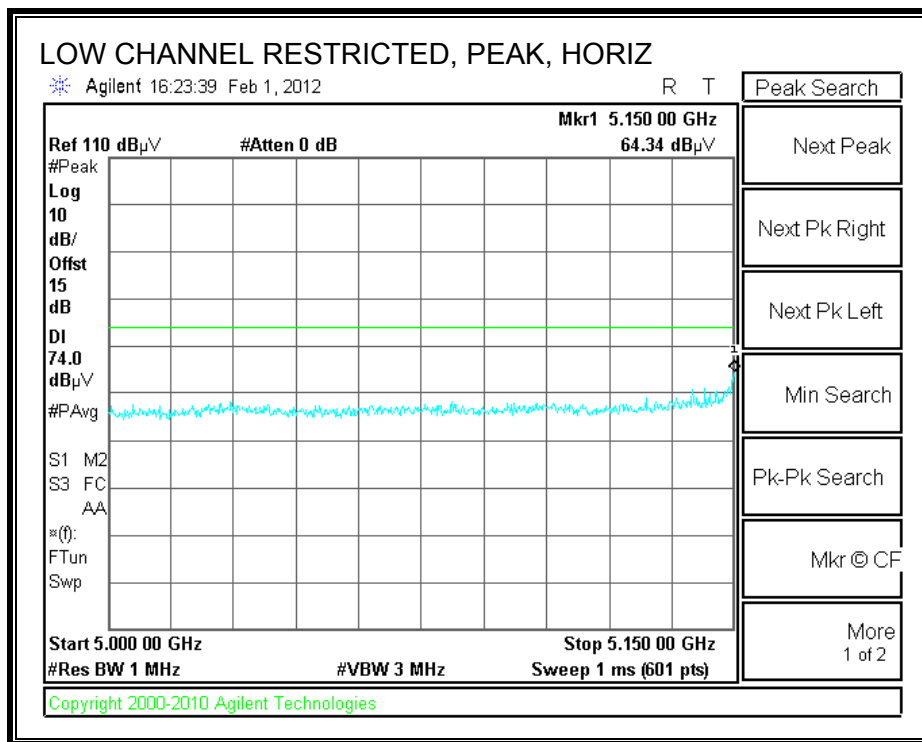
The spectrum from 30 MHz to 40 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in each applicable band.

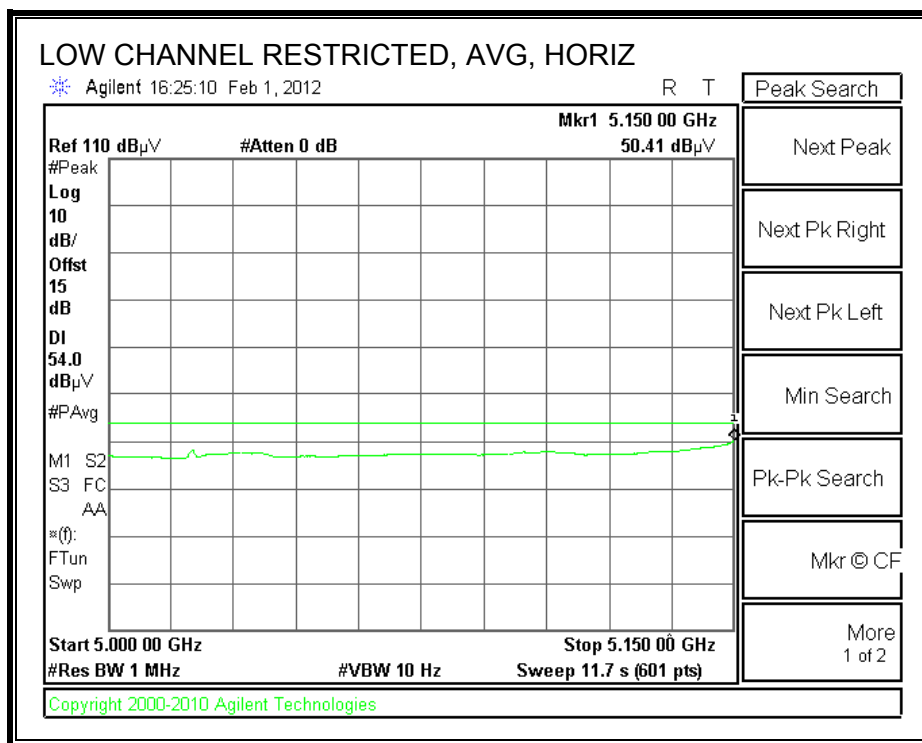
The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized in both the vertical and the horizontal positions.

8.2. TRANSMITTER ABOVE 1 GHz

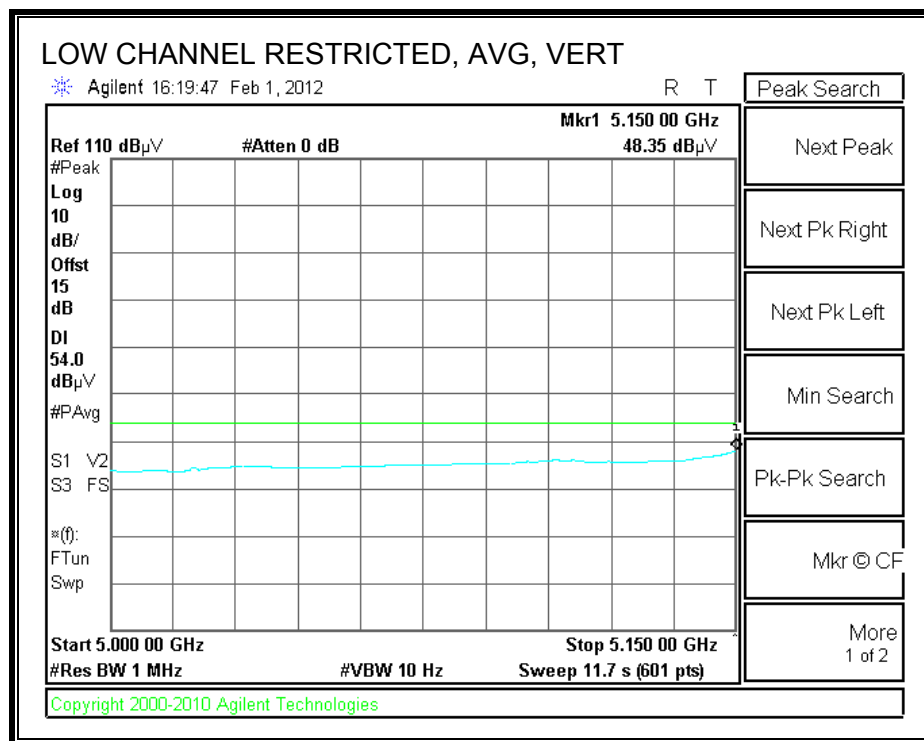
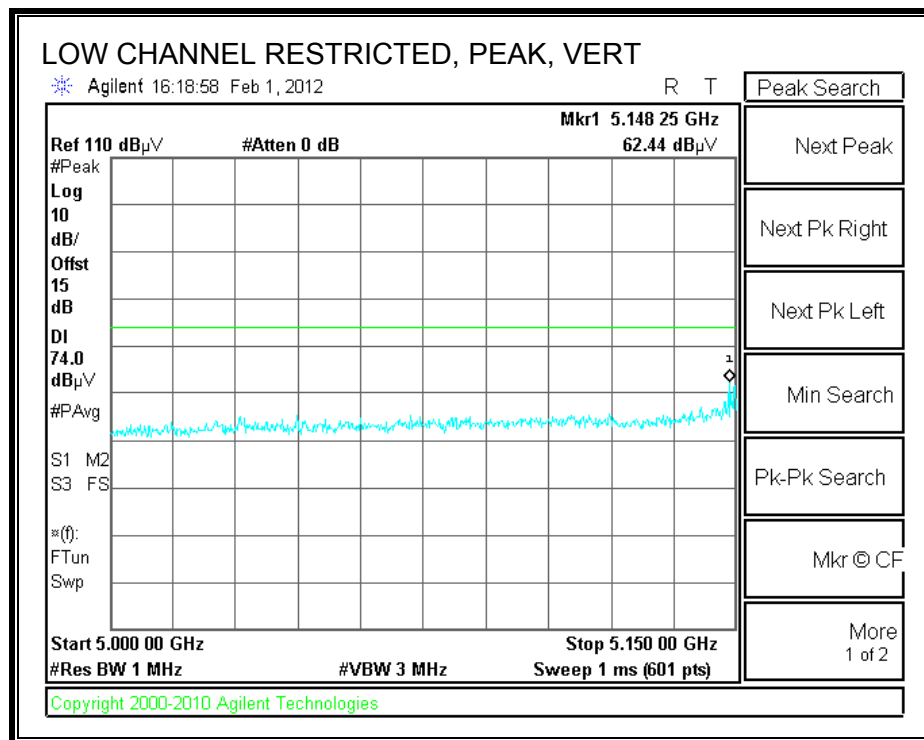
8.2.1. TX ABOVE 1 GHz FOR 802.11a MODE IN THE 5.2 GHz BAND

RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)





RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)



HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement

Compliance Certification Services, Fremont 5m Chamber

Test Engr: Chin Pang
Date: 10/27/11
Project #: 11U13938
Company: Apple
Test Target: FCC 15.407
Mode Oper: TX, a mode, 5.2GHz band

f	Measurement Frequency	Amp	Preamp Gain	Average Field Strength Limit
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters	Peak Field Strength Limit
Read	Analyzer Reading	Avg	Average Field Strength @ 3 m	Margin vs. Average Limit
AF	Antenna Factor	Peak	Calculated Peak Field Strength	Margin vs. Peak Limit
CL	Cable Loss	HPF	High Pass Filter	

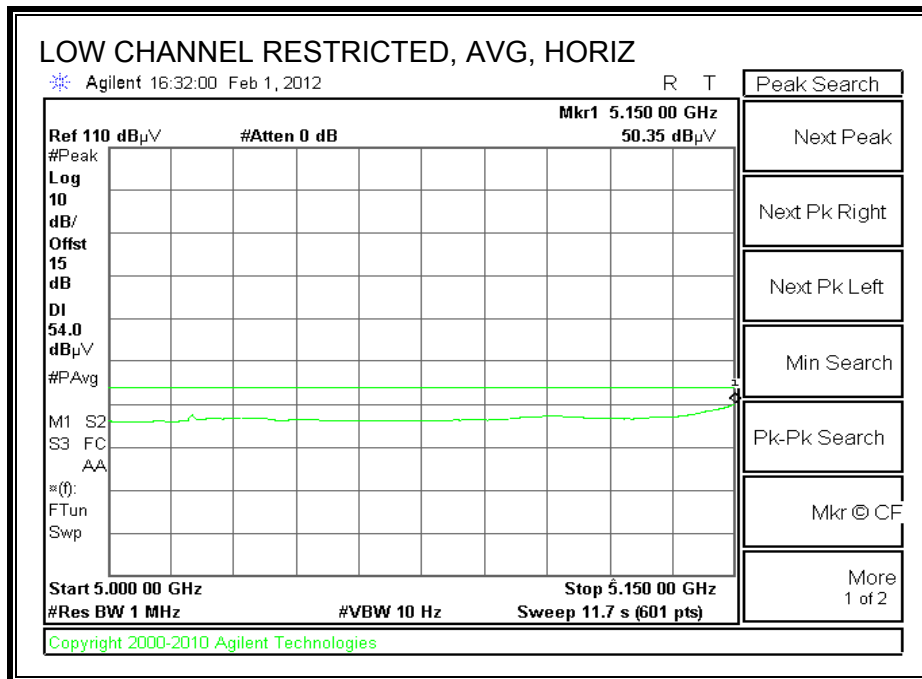
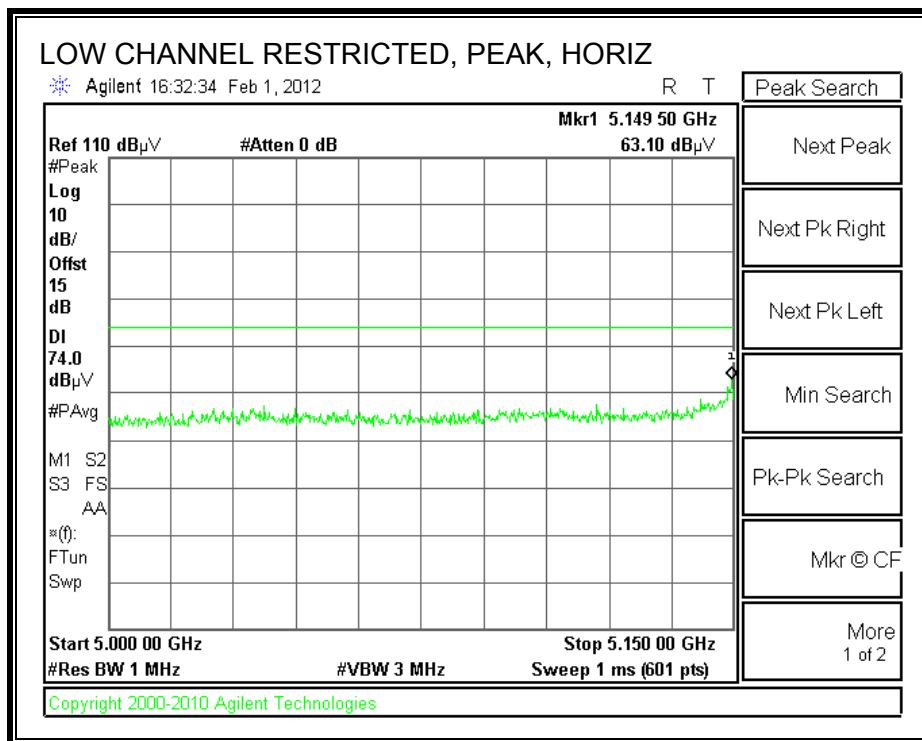
f GHz	Dist (m)	Read dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Corr. dBuV/m	Limit dBuV/m	Margin dB	Ant. Pol. V/H	Det. P/A/QP	Notes
Low Ch, 5180MHz													
15.540	3.0	33.3	39.9	11.3	-32.3	0.0	0.7	53.0	74.0	-21.0	V	P	
15.540	3.0	21.4	39.9	11.3	-32.3	0.0	0.7	41.0	54.0	-13.0	V	A	
15.540	3.0	33.9	39.9	11.3	-32.3	0.0	0.7	53.5	74.0	-20.5	H	P	
15.540	3.0	21.5	39.9	11.3	-32.3	0.0	0.7	41.1	54.0	-12.9	H	A	
Mid Ch, 5200MHz													
15.600	3.0	34.0	39.7	11.4	-32.3	0.0	0.7	53.5	74.0	-20.5	V	P	
15.600	3.0	21.9	39.7	11.4	-32.3	0.0	0.7	41.4	54.0	-12.6	V	A	
15.600	3.0	33.7	39.7	11.4	-32.3	0.0	0.7	53.2	74.0	-20.8	H	P	
15.600	3.0	21.6	39.7	11.4	-32.3	0.0	0.7	41.2	54.0	-12.8	H	A	
High Ch, 5240MHz													
15.720	3.0	34.1	39.4	11.4	-32.3	0.0	0.7	53.4	74.0	-20.6	V	P	
15.720	3.0	21.4	39.4	11.4	-32.3	0.0	0.7	40.7	54.0	-13.3	V	A	
15.720	3.0	33.6	39.4	11.4	-32.3	0.0	0.7	52.8	74.0	-21.2	H	P	
15.720	3.0	21.4	39.4	11.4	-32.3	0.0	0.7	40.6	54.0	-13.4	H	A	

Rev. 4.1.2.7

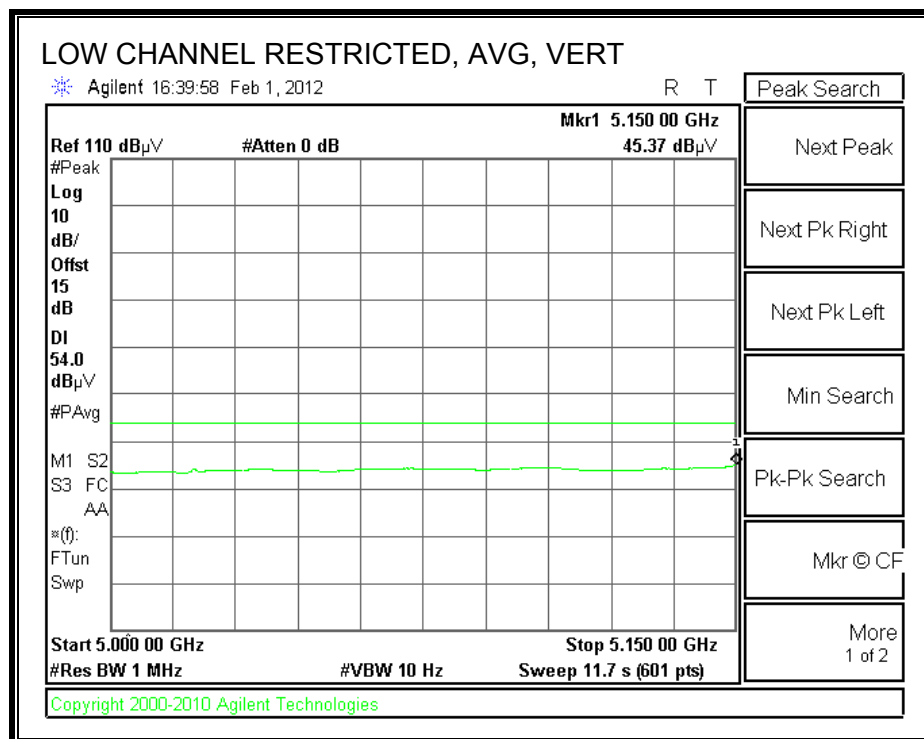
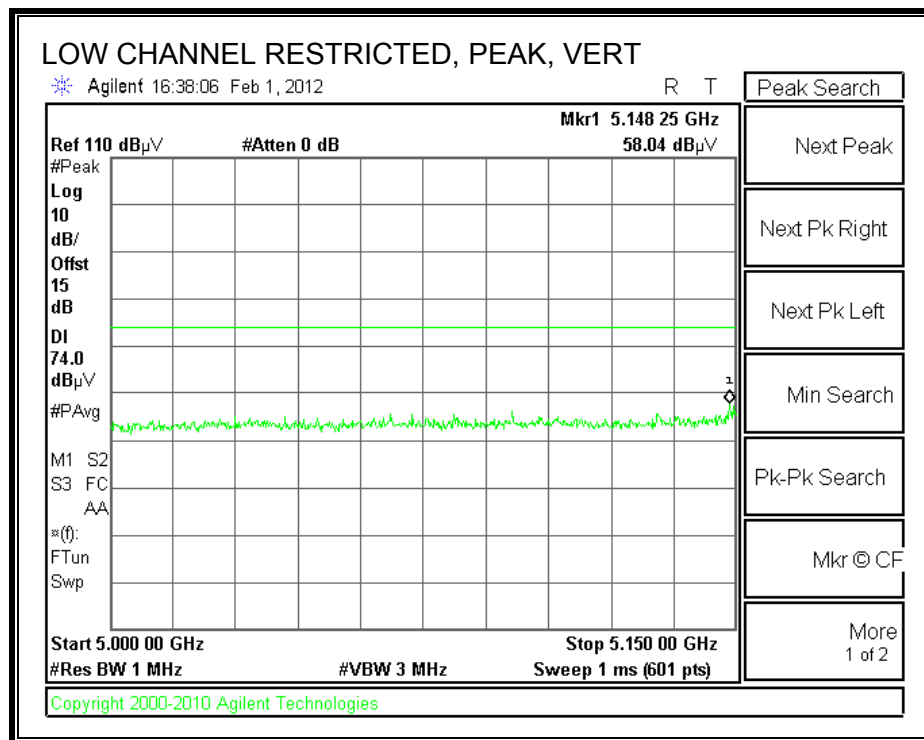
Note: No other emissions were detected above the system noise floor.

8.2.2. TX ABOVE 1 GHz FOR 802.11n HT20 MODE IN THE 5.2 GHz BAND

RESTRICTED BANEDGE (LOW CHANNEL, HORIZONTAL)



RESTRICTED BANEDGE (LOW CHANNEL, VERTICAL)



HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement

Compliance Certification Services, Fremont 5m Chamber

Test Engr: Chin Pang
Date: 10/28/11
Project #: 11U13938
Company: Apple
Test Target: FCC 15.407
Mode Oper: TX, HT20 5.2GHz Band

f	Measurement Frequency	Amp	Preamp Gain	Average Field Strength Limit
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters	Peak Field Strength Limit
Read	Analyzer Reading	Avg	Average Field Strength @ 3 m	Margin vs. Average Limit
AF	Antenna Factor	Peak	Calculated Peak Field Strength	Margin vs. Peak Limit
CL	Cable Loss	HPF	High Pass Filter	

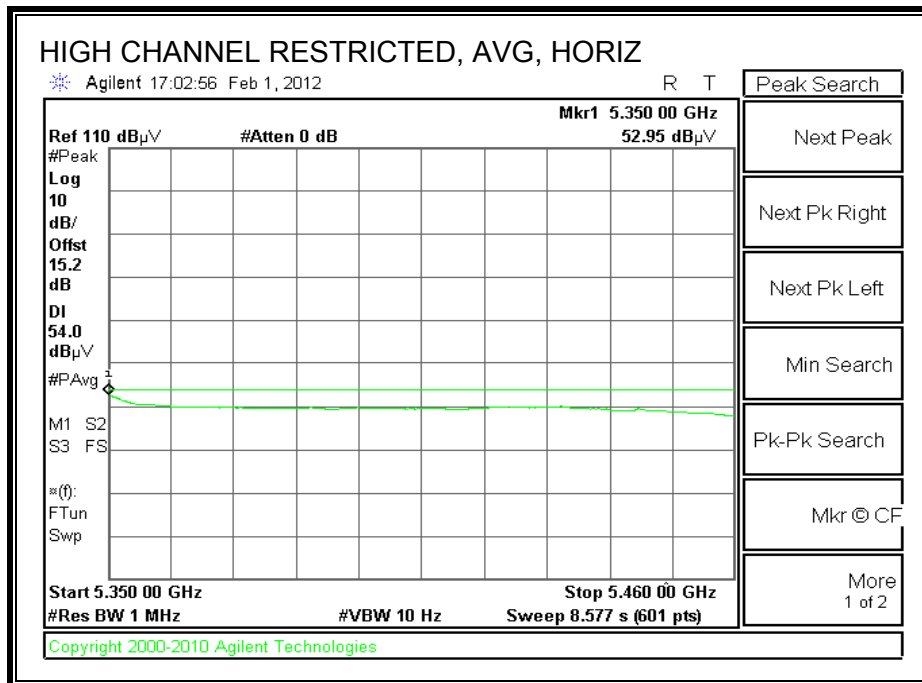
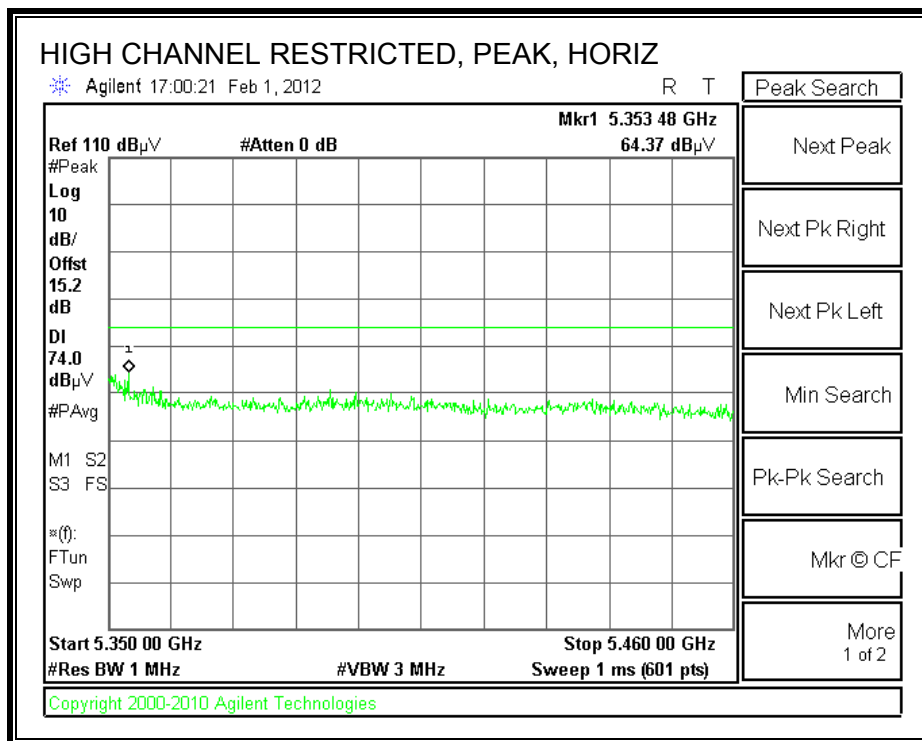
f GHz	Dist (m)	Read dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Corr. dBuV/m	Limit dBuV/m	Margin dB	Ant. Pol. V/H	Det. P/A/QP	Notes
Low Ch, 5180MHz													
15.540	3.0	34.3	39.9	11.3	-32.3	0.0	0.7	54.0	74.0	-20.0	V	P	
15.540	3.0	22.3	39.9	11.3	-32.3	0.0	0.7	41.9	54.0	-12.1	V	A	
15.540	3.0	34.6	39.9	11.3	-32.3	0.0	0.7	54.2	74.0	-19.8	H	P	
15.540	3.0	22.3	39.9	11.3	-32.3	0.0	0.7	41.9	54.0	-12.1	H	A	
Mid Ch, 5200MHz													
15.600	3.0	34.4	39.7	11.4	-32.3	0.0	0.7	53.9	74.0	-20.1	V	P	
15.600	3.0	21.8	39.7	11.4	-32.3	0.0	0.7	41.3	54.0	-12.7	V	A	
15.600	3.0	34.9	39.7	11.4	-32.3	0.0	0.7	54.4	74.0	-19.6	H	P	
15.600	3.0	22.4	39.7	11.4	-32.3	0.0	0.7	41.9	54.0	-12.1	H	A	
High Ch, 5240MHz													
15.720	3.0	33.4	39.4	11.4	-32.3	0.0	0.7	52.7	74.0	-21.3	V	P	
15.720	3.0	21.2	39.4	11.4	-32.3	0.0	0.7	40.5	54.0	-13.5	V	A	
15.720	3.0	34.1	39.4	11.4	-32.3	0.0	0.7	53.4	74.0	-20.6	H	P	
15.720	3.0	21.4	39.4	11.4	-32.3	0.0	0.7	40.6	54.0	-13.4	H	A	

Rev. 4.1.2.7

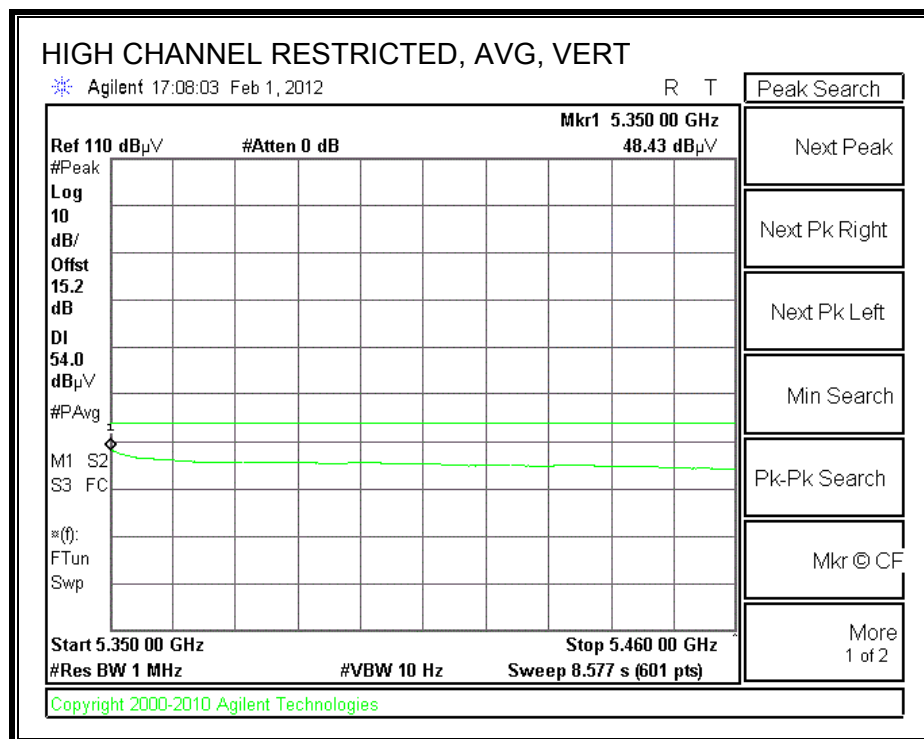
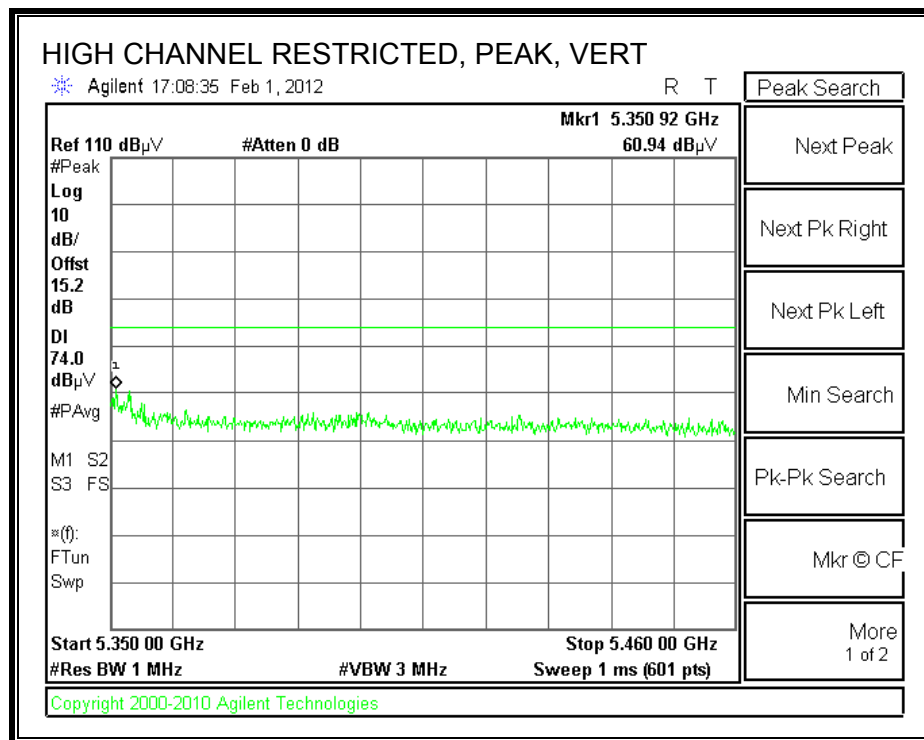
Note: No other emissions were detected above the system noise floor.

8.2.3. TX ABOVE 1GHz FOR 802.11a MODE IN THE 5.3 GHz BAND

RESTRICTED BANEDGE (HIGH CHANNEL, HORIZONTAL)



RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)



HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement

Compliance Certification Services, Fremont 5m Chamber

Test Engr: Chin Pang
Date: 10/27/11
Project #: 11U13938
Company: Apple
Test Target: FCC 15.407
Mode Oper: TX, a mode, 5.3GHz band

f Measurement Frequency Amp Preamp Gain Average Field Strength Limit
Dist Distance to Antenna D Corr Distance Correct to 3 meters Peak Field Strength Limit
Read Analyzer Reading Avg Average Field Strength @ 3 m Margin vs. Average Limit
AF Antenna Factor Peak Calculated Peak Field Strength Margin vs. Peak Limit
CL Cable Loss HPF High Pass Filter

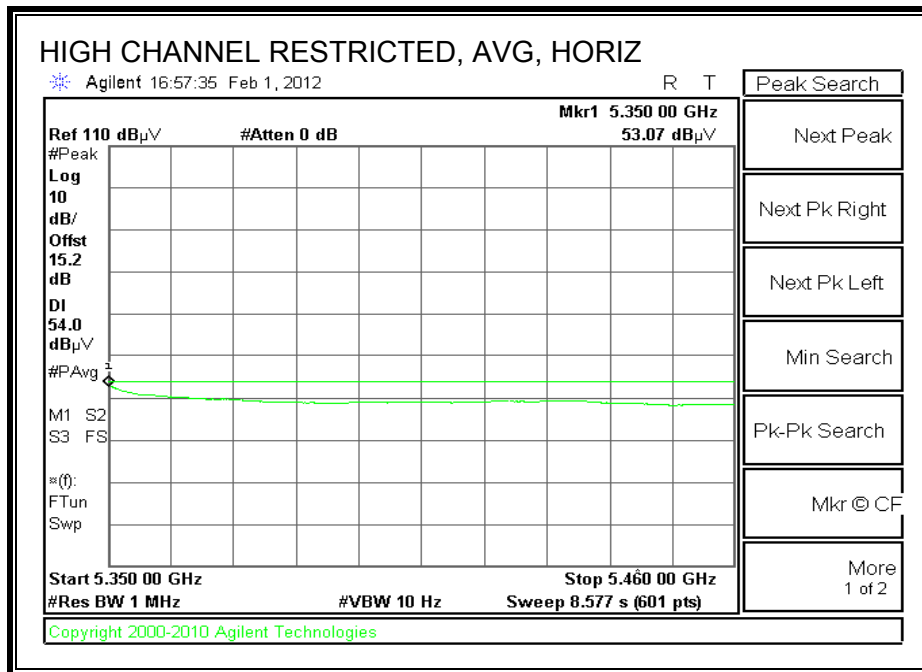
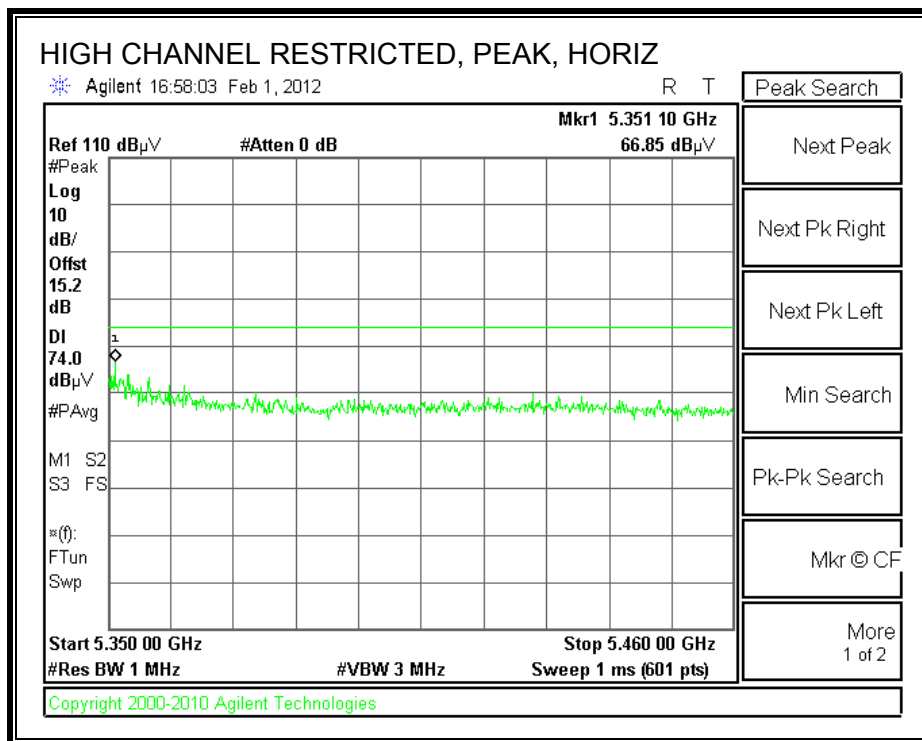
f GHz	Dist (m)	Read dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Corr. dBuV/m	Limit dBuV/m	Margin dB	Ant. Pol. V/H	Det. P/A/QP	Notes
Low Ch, 5260MHz													
15.780	3.0	33.4	39.2	11.5	-32.2	0.0	0.7	52.5	74.0	-21.5	H	P	
15.780	3.0	21.6	39.2	11.5	-32.2	0.0	0.7	40.7	54.0	-13.3	H	A	
15.780	3.0	34.5	39.2	11.5	-32.2	0.0	0.7	53.6	74.0	-20.4	V	P	
15.780	3.0	21.5	39.2	11.5	-32.2	0.0	0.7	40.7	54.0	-13.3	V	A	
Mid Ch, 5300MHz													
10.600	3.0	35.2	38.4	9.0	-34.3	0.0	0.8	49.1	74.0	-24.9	H	P	
10.600	3.0	22.7	38.4	9.0	-34.3	0.0	0.8	36.6	54.0	-17.4	H	A	
15.900	3.0	35.2	38.9	11.5	-32.2	0.0	0.7	54.0	74.0	-20.0	H	P	
15.900	3.0	21.5	38.9	11.5	-32.2	0.0	0.7	40.3	54.0	-13.7	H	A	
10.600	3.0	36.0	38.4	9.0	-34.3	0.0	0.8	49.9	74.0	-24.1	V	P	
10.600	3.0	22.7	38.4	9.0	-34.3	0.0	0.8	36.6	54.0	-17.4	V	A	
15.900	3.0	34.1	38.9	11.5	-32.2	0.0	0.7	52.9	74.0	-21.1	V	P	
15.900	3.0	21.4	38.9	11.5	-32.2	0.0	0.7	40.3	54.0	-13.7	V	A	
High Ch, 5320MHz													
10.640	3.0	35.0	38.4	9.1	-34.2	0.0	0.8	49.0	74.0	-25.0	H	P	
10.640	3.0	22.8	38.4	9.1	-34.2	0.0	0.8	36.8	54.0	-17.2	H	A	
15.960	3.0	34.2	38.7	11.5	-32.2	0.0	0.7	52.9	74.0	-21.1	H	P	
15.960	3.0	21.6	38.7	11.5	-32.2	0.0	0.7	40.3	54.0	-13.7	H	A	
10.640	3.0	34.9	38.4	9.1	-34.2	0.0	0.8	48.9	74.0	-25.1	V	P	
10.640	3.0	22.8	38.4	9.1	-34.2	0.0	0.8	36.8	54.0	-17.2	V	A	
15.960	3.0	34.5	38.7	11.5	-32.2	0.0	0.7	53.2	74.0	-20.8	V	P	
15.960	3.0	21.5	38.7	11.5	-32.2	0.0	0.7	40.3	54.0	-13.7	V	A	

Rev. 4.1.2.7

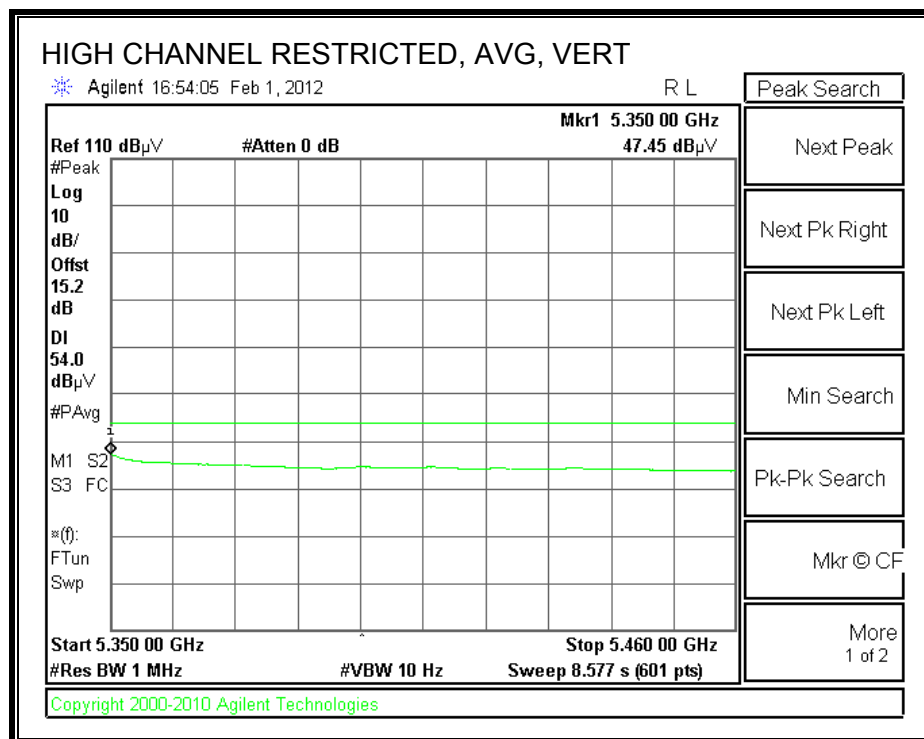
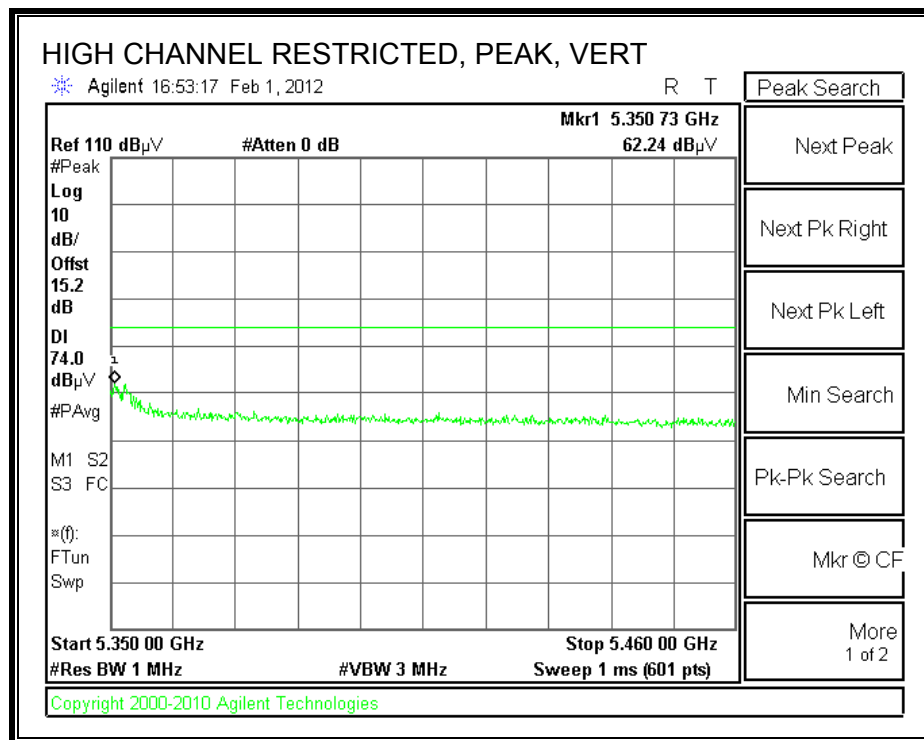
Note: No other emissions were detected above the system noise floor.

8.2.4. TX ABOVE 1GHz FOR 802.11n HT20 MODE IN THE 5.3GHz BAND

RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)



RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)



HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement Compliance Certification Services, Fremont 5m Chamber

Test Engr: Chin Pang
Date: 10/28/11
Project #: 11U13938
Company: Apple
Test Target: FCC 15.407
Mode Oper: TX, HT20, 5.3GHz band

f	Measurement Frequency	Amp	Preamp Gain	Average Field Strength Limit
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters	Peak Field Strength Limit
Read	Analyzer Reading	Avg	Average Field Strength @ 3 m	Margin vs. Average Limit
AF	Antenna Factor	Peak	Calculated Peak Field Strength	Margin vs. Peak Limit
CL	Cable Loss	HPF	High Pass Filter	

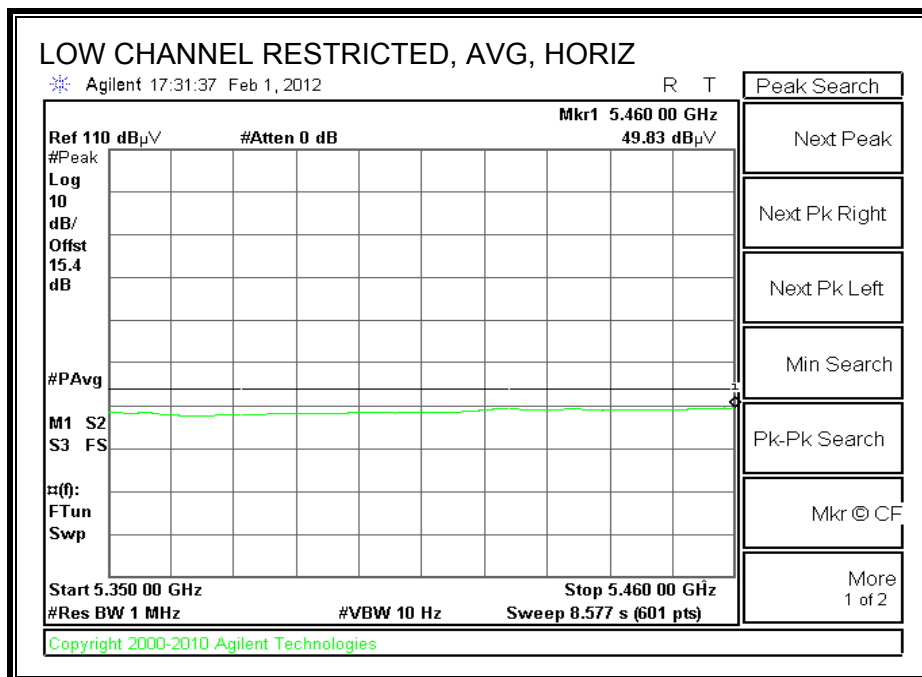
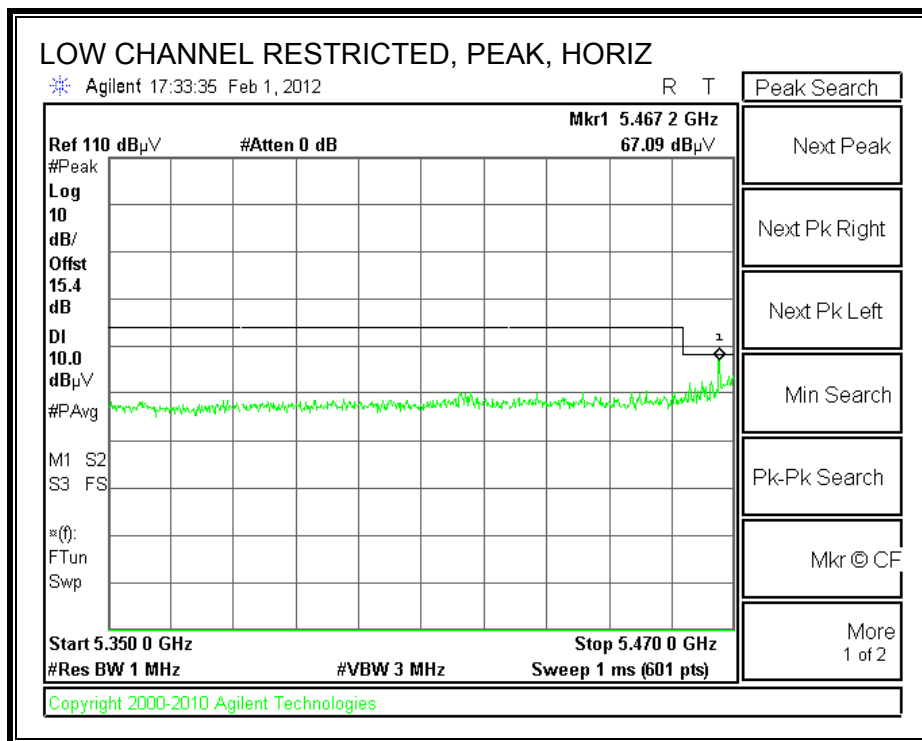
f GHz	Dist (m)	Read dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Corr. dBuV/m	Limit dBuV/m	Margin dB	Ant. Pol. V/H	Det. P/A/QP	Notes
Low Ch, 5260MHz													
15.780	3.0	33.8	39.2	11.5	-32.2	0.0	0.7	53.0	74.0	-21.0	H	P	
15.780	3.0	21.5	39.2	11.5	-32.2	0.0	0.7	40.7	54.0	-13.3	H	A	
15.780	3.0	33.4	39.2	11.5	-32.2	0.0	0.7	52.5	74.0	-21.5	V	P	
15.780	3.0	21.4	39.2	11.5	-32.2	0.0	0.7	40.6	54.0	-13.4	V	A	
Mid Ch, 5300MHz													
10.600	3.0	36.0	38.4	9.0	-34.3	0.0	0.8	49.9	74.0	-24.1	H	P	
10.600	3.0	23.2	38.4	9.0	-34.3	0.0	0.8	37.1	54.0	-16.9	H	A	
15.900	3.0	33.4	38.9	11.5	-32.2	0.0	0.7	52.2	74.0	-21.8	H	P	
15.900	3.0	21.2	38.9	11.5	-32.2	0.0	0.7	40.1	54.0	-13.9	H	A	
10.600	3.0	38.5	38.4	9.0	-34.3	0.0	0.8	52.4	74.0	-21.6	V	P	
10.600	3.0	24.3	38.4	9.0	-34.3	0.0	0.8	38.2	54.0	-15.8	V	A	
15.900	3.0	33.9	38.9	11.5	-32.2	0.0	0.7	52.8	74.0	-21.2	V	P	
15.900	3.0	21.2	38.9	11.5	-32.2	0.0	0.7	40.1	54.0	-13.9	V	A	
High Ch, 5320Mhz													
10.640	3.0	35.3	38.4	9.1	-34.2	0.0	0.8	49.3	74.0	-24.7	H	P	
10.640	3.0	23.3	38.4	9.1	-34.2	0.0	0.8	37.3	54.0	-16.7	H	A	
15.960	3.0	33.9	38.7	11.5	-32.2	0.0	0.7	52.7	74.0	-21.3	H	P	
15.960	3.0	21.2	38.7	11.5	-32.2	0.0	0.7	40.0	54.0	-14.0	H	A	
10.640	3.0	35.8	38.4	9.1	-34.2	0.0	0.8	49.8	74.0	-24.2	V	P	
10.640	3.0	23.7	38.4	9.1	-34.2	0.0	0.8	37.8	54.0	-16.2	V	A	
15.960	3.0	33.4	38.7	11.5	-32.2	0.0	0.7	52.2	74.0	-21.8	V	P	
15.960	3.0	21.3	38.7	11.5	-32.2	0.0	0.7	40.1	54.0	-13.9	V	A	

Rev. 4.1.2.7

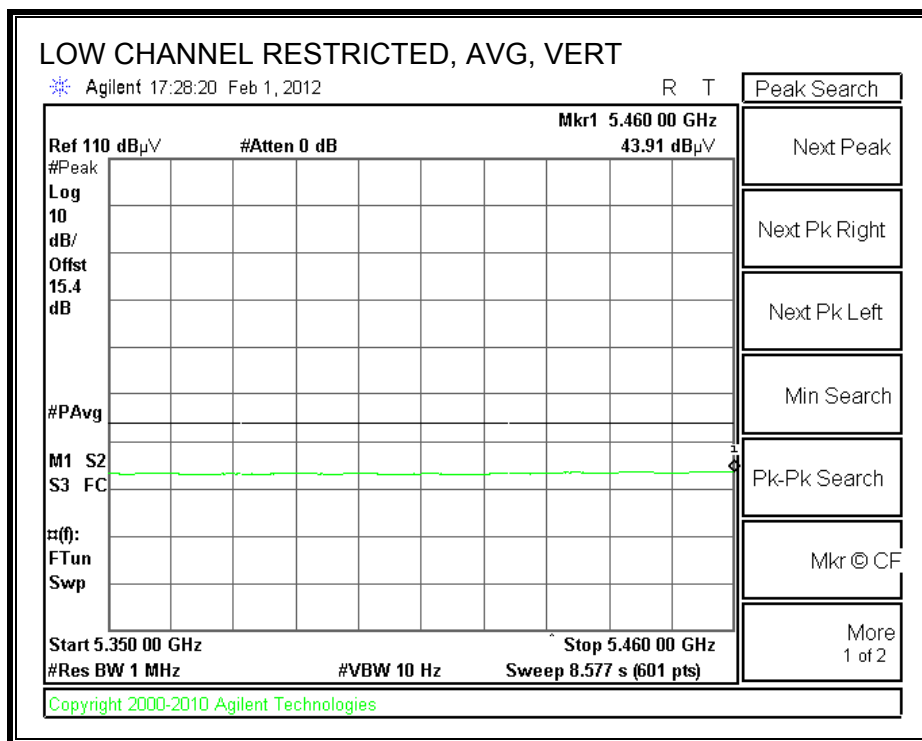
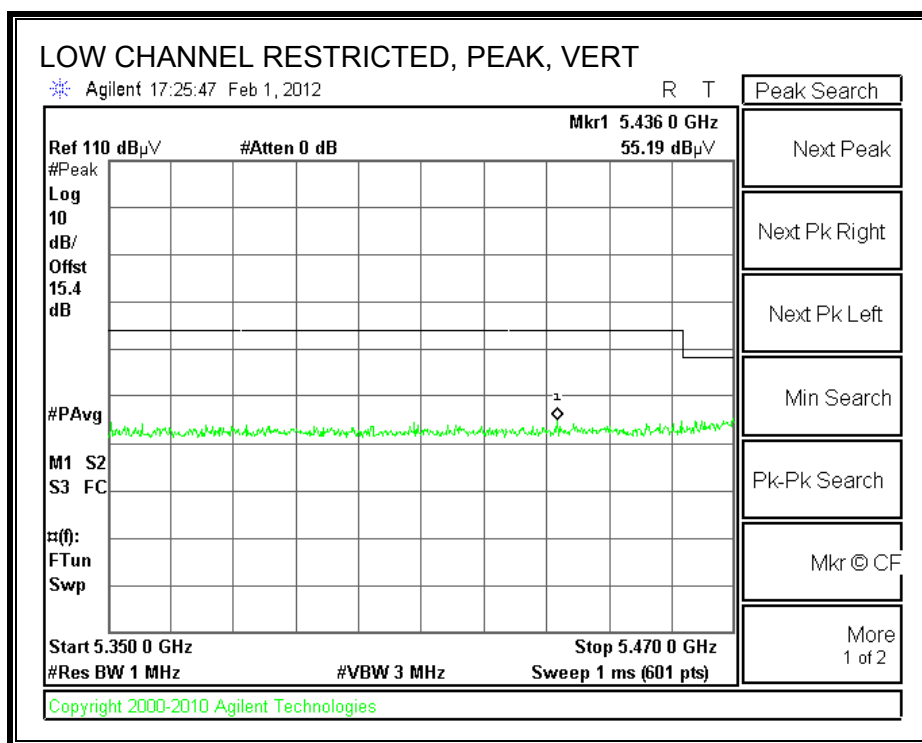
Note: No other emissions were detected above the system noise floor.

8.2.5. TX ABOVE 1 GHz FOR 802.11a MODE IN THE 5.6 GHz BAND

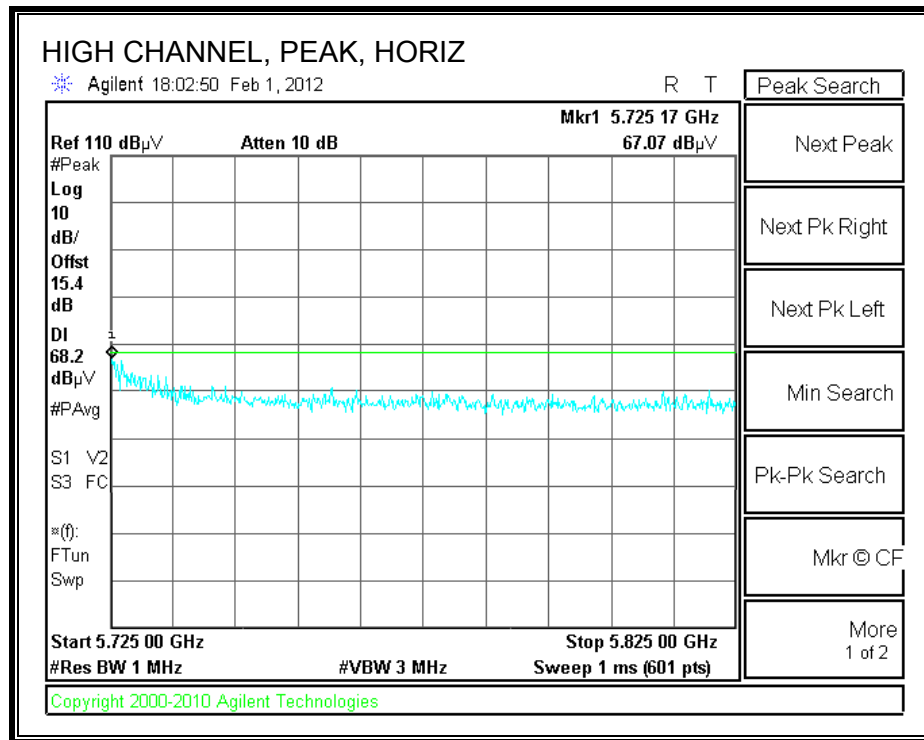
RESTRICTED BANEDGE (LOW CHANNEL, HORIZONTAL)



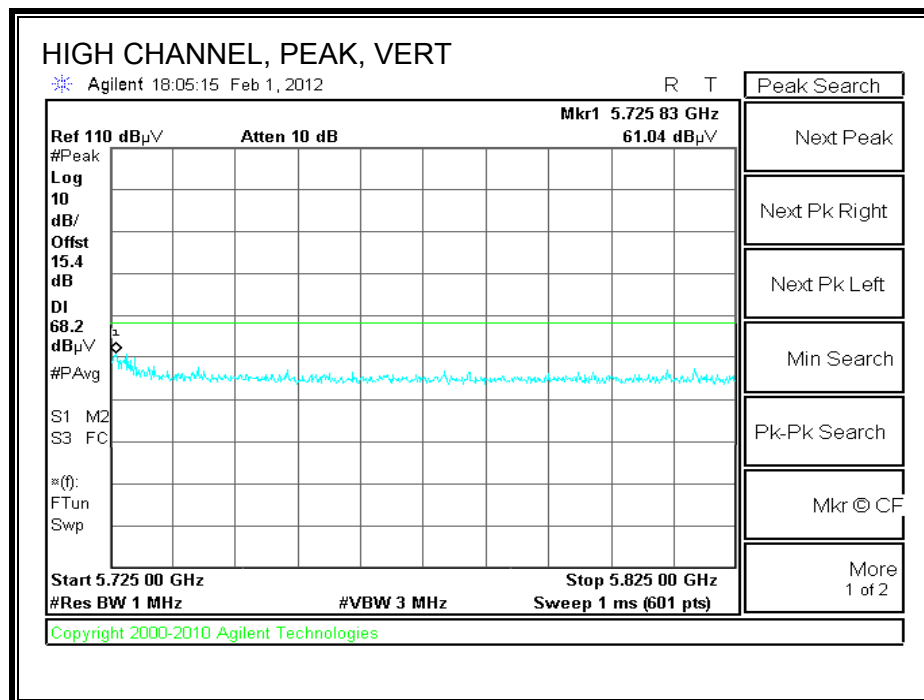
RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)



AUTHORIZED BANDEDGE (HIGH CHANNEL, HORIZONTAL)



AUTHORIZED BANDEDGE (HIGH CHANNEL, VERTICAL)



HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement

Compliance Certification Services, Fremont 5m Chamber

Test Engr: Chin Pang
Date: 10/28/11
Project #: 11U13938
Company: Apple
Test Target: FCC 15.407
Mode Oper: TX, a mode, 5.6GHz band

f	Measurement Frequency	Amp	Preamp Gain	Average Field Strength Limit
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters	Peak Field Strength Limit
Read	Analyzer Reading	Avg	Average Field Strength @ 3 m	Margin vs. Average Limit
AF	Antenna Factor	Peak	Calculated Peak Field Strength	Margin vs. Peak Limit
CL	Cable Loss	HPF	High Pass Filter	

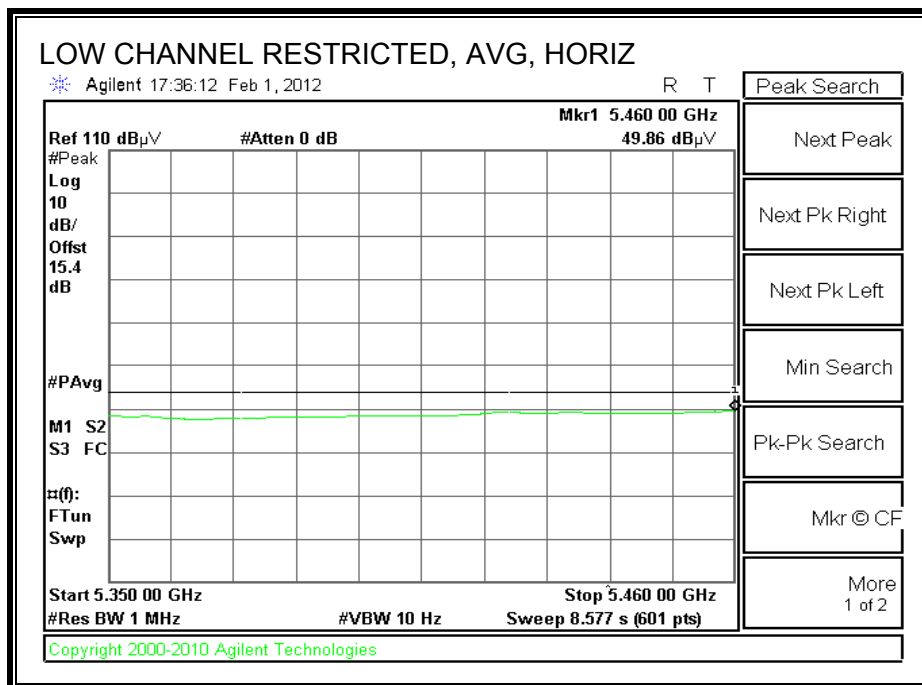
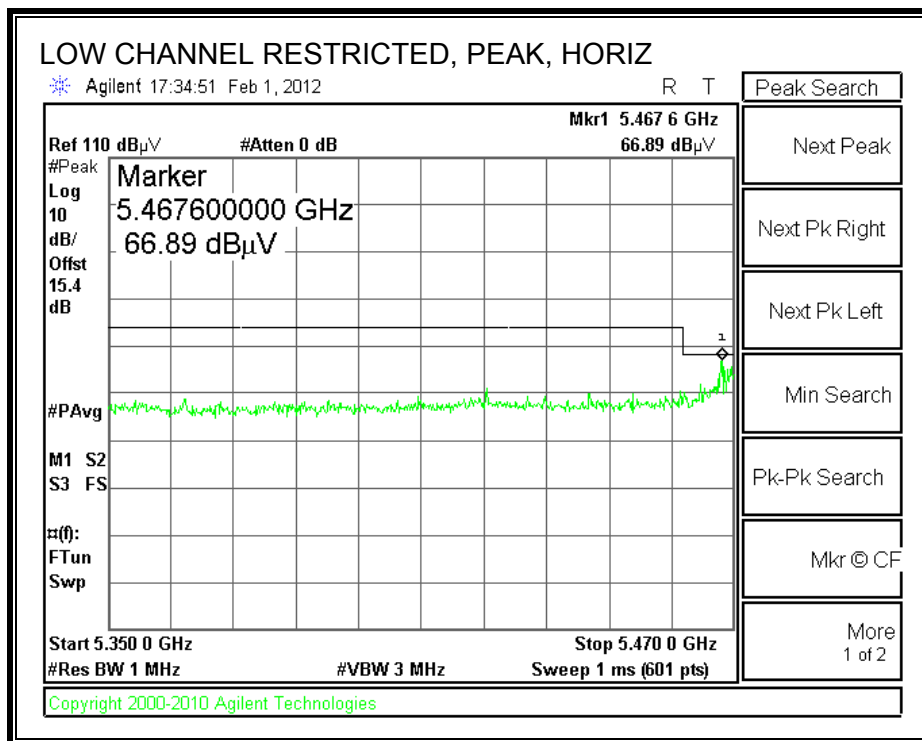
f GHz	Dist (m)	Read dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Corr. dBuV/m	Limit dBuV/m	Margin dB	Ant. Pol. V/H	Det. P/A/QP	Notes
Low Ch, 5500MHz													
11.000	3.0	35.3	38.7	9.2	-33.8	0.0	0.7	50.2	74.0	-23.8	V	P	
11.000	3.0	22.5	38.7	9.2	-33.8	0.0	0.7	37.4	54.0	-16.6	V	A	
11.000	3.0	36.0	38.7	9.2	-33.8	0.0	0.7	50.9	74.0	-23.1	H	P	
11.000	3.0	22.7	38.7	9.2	-33.8	0.0	0.7	37.6	54.0	-16.4	H	A	
Mid Ch, 5580MHz													
11.160	3.0	36.7	38.9	9.3	-33.5	0.0	0.7	52.2	74.0	-21.8	V	P	
11.160	3.0	25.6	38.9	9.3	-33.5	0.0	0.7	41.1	54.0	-12.9	V	A	
11.160	3.0	38.4	38.9	9.3	-33.5	0.0	0.7	53.9	74.0	-20.1	H	P	
11.160	3.0	26.7	38.9	9.3	-33.5	0.0	0.7	42.2	54.0	-11.8	H	A	
High Ch, 5700MHz													
11.400	3.0	35.6	39.1	9.4	-33.2	0.0	0.7	51.6	74.0	-22.4	V	P	
11.400	3.0	23.4	39.1	9.4	-33.2	0.0	0.7	39.4	54.0	-14.6	V	A	
11.400	3.0	35.3	39.1	9.4	-33.2	0.0	0.7	51.3	74.0	-22.7	H	P	
11.400	3.0	23.1	39.1	9.4	-33.2	0.0	0.7	39.1	54.0	-14.9	H	A	

Rev. 4.1.2.7

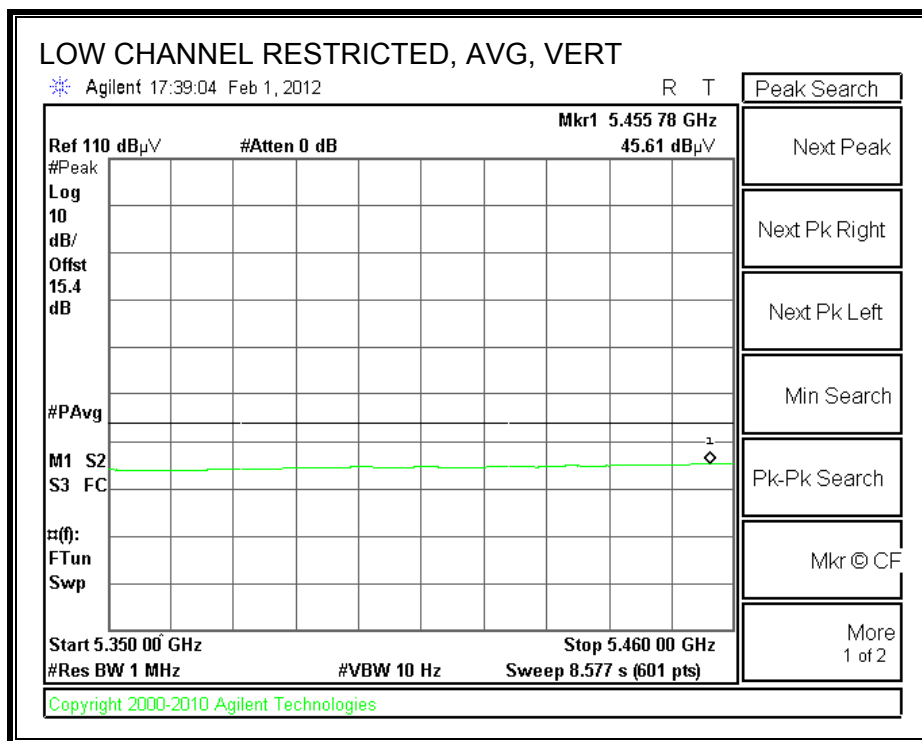
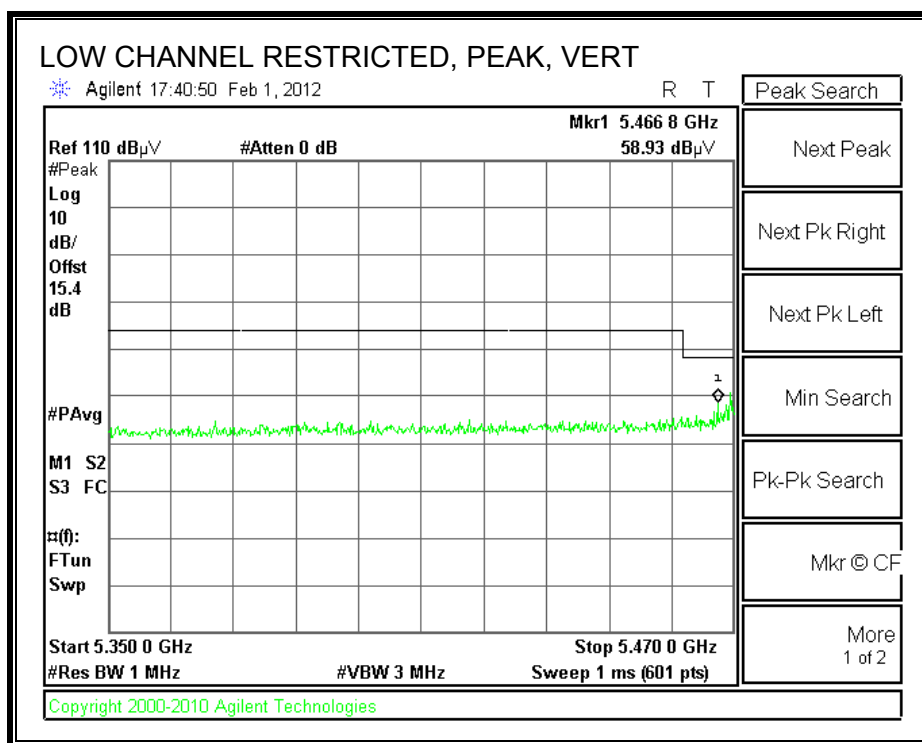
Note: No other emissions were detected above the system noise floor.

8.2.6. TX ABOVE 1 GHz FOR 802.11n HT20 MODE IN THE 5.6 GHz BAND

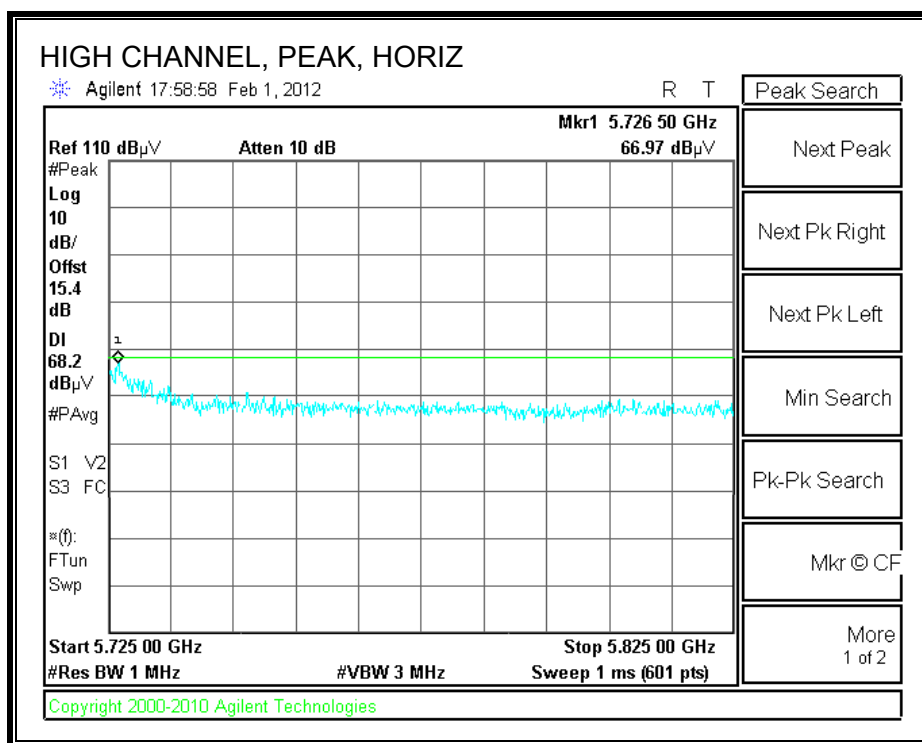
RESTRICTED BANEDGE (LOW CHANNEL, HORIZONTAL)



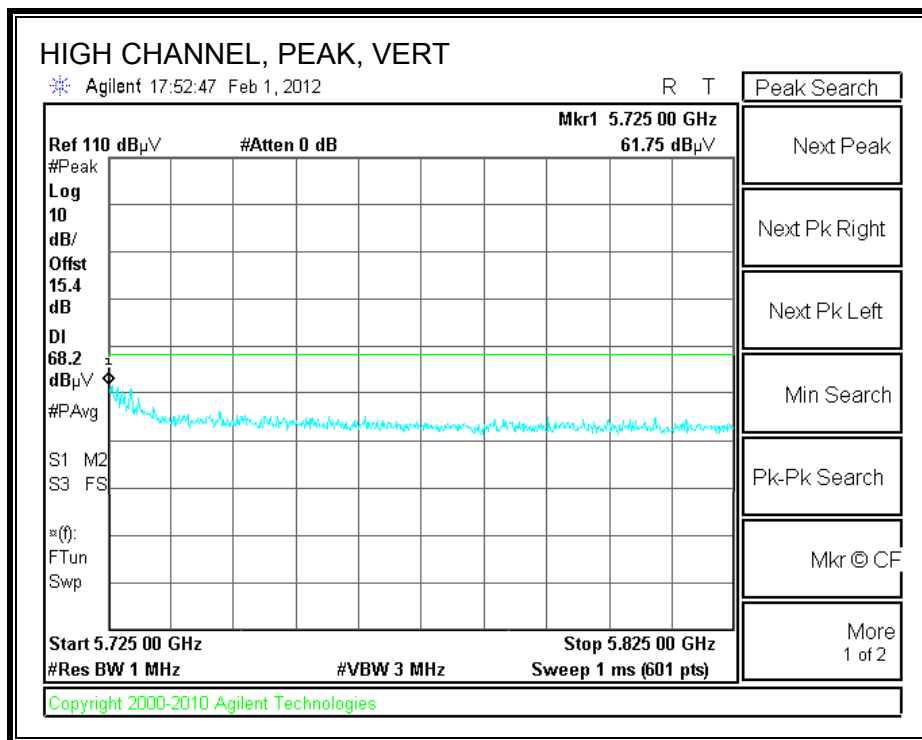
RESTRICTED BANEDGE (LOW CHANNEL, VERTICAL)



AUTHORIZED BANDEDGE (HIGH CHANNEL, HORIZONTAL)



AUTHORIZED BANDEDGE (HIGH CHANNEL, VERTICAL)



HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement

Compliance Certification Services, Fremont 5m Chamber

Test Engr: Chin Pang
Date: 10/28/11
Project #: 11U13938
Company: Apple
Test Target: FCC 15.407
Mode Oper: TX, HT20, 5.6GHz Band

f	Measurement Frequency	Amp	Preamp Gain	Average Field Strength Limit
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters	Peak Field Strength Limit
Read	Analyzer Reading	Avg	Average Field Strength @ 3 m	Margin vs. Average Limit
AF	Antenna Factor	Peak	Calculated Peak Field Strength	Margin vs. Peak Limit
CL	Cable Loss	HPF	High Pass Filter	

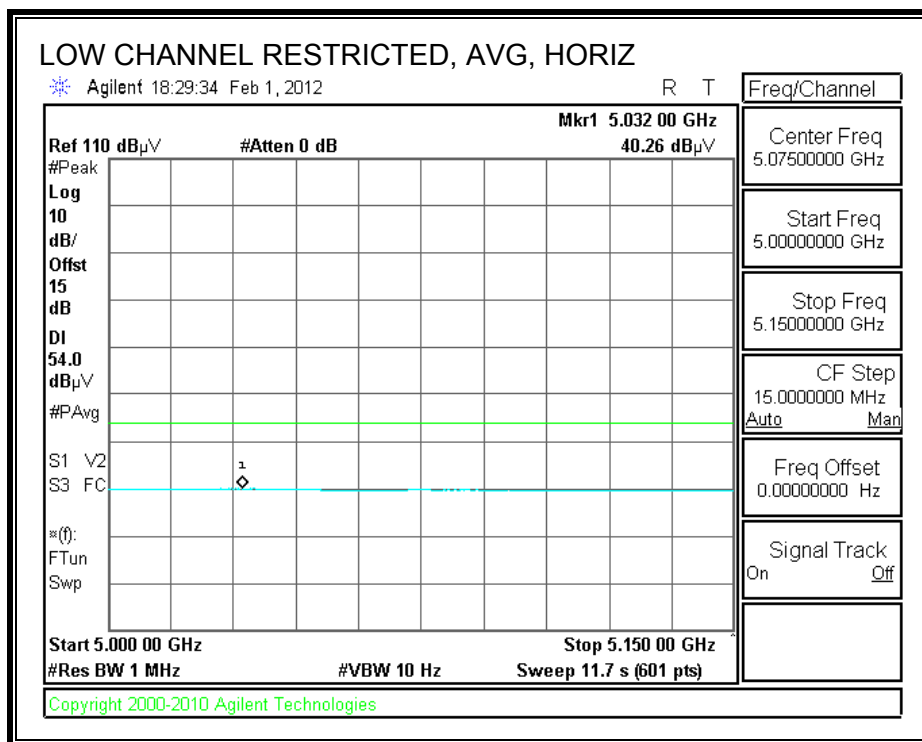
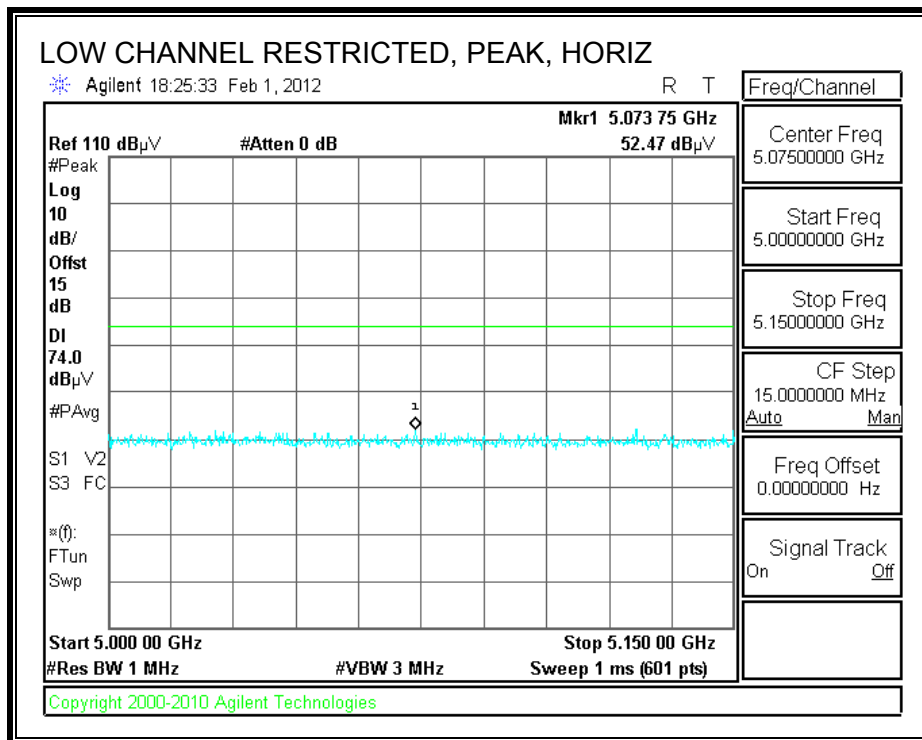
f GHz	Dist (m)	Read dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Corr. dBuV/m	Limit dBuV/m	Margin dB	Ant. Pol. V/H	Det. P/A/QP	Notes
Low Ch, 5500MHz													
11.000	3.0	35.0	38.7	9.2	-33.8	0.0	0.7	50.0	74.0	-24.0	H	P	
11.000	3.0	22.5	38.7	9.2	-33.8	0.0	0.7	37.5	54.0	-16.5	H	A	
11.000	3.0	35.6	38.7	9.2	-33.8	0.0	0.7	50.5	74.0	-23.5	V	P	
11.000	3.0	23.2	38.7	9.2	-33.8	0.0	0.7	38.2	54.0	-15.8	V	A	
Mid Ch, 5580MHz													
11.160	3.0	42.3	38.9	9.3	-33.5	0.0	0.7	57.8	74.0	-16.2	H	P	
11.160	3.0	28.8	38.9	9.3	-33.5	0.0	0.7	44.3	54.0	-9.7	H	A	
11.160	3.0	38.6	38.9	9.3	-33.5	0.0	0.7	54.1	74.0	-19.9	V	P	
11.160	3.0	26.3	38.9	9.3	-33.5	0.0	0.7	41.8	54.0	-12.2	V	A	
High Ch, 5700MHz													
11.400	3.0	35.8	39.1	9.4	-33.2	0.0	0.7	51.8	74.0	-22.2	H	P	
11.400	3.0	22.8	39.1	9.4	-33.2	0.0	0.7	38.8	54.0	-15.2	H	A	
11.400	3.0	34.8	39.1	9.4	-33.2	0.0	0.7	50.8	74.0	-23.2	V	P	
11.400	3.0	23.0	39.1	9.4	-33.2	0.0	0.7	39.0	54.0	-15.0	V	A	

Rev. 4.1.2.7

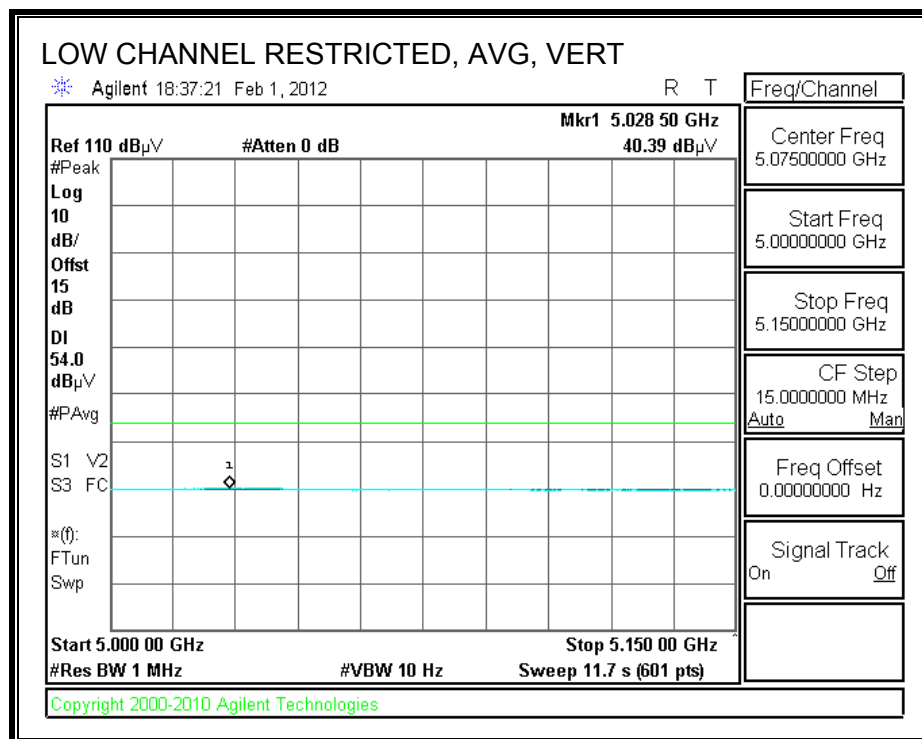
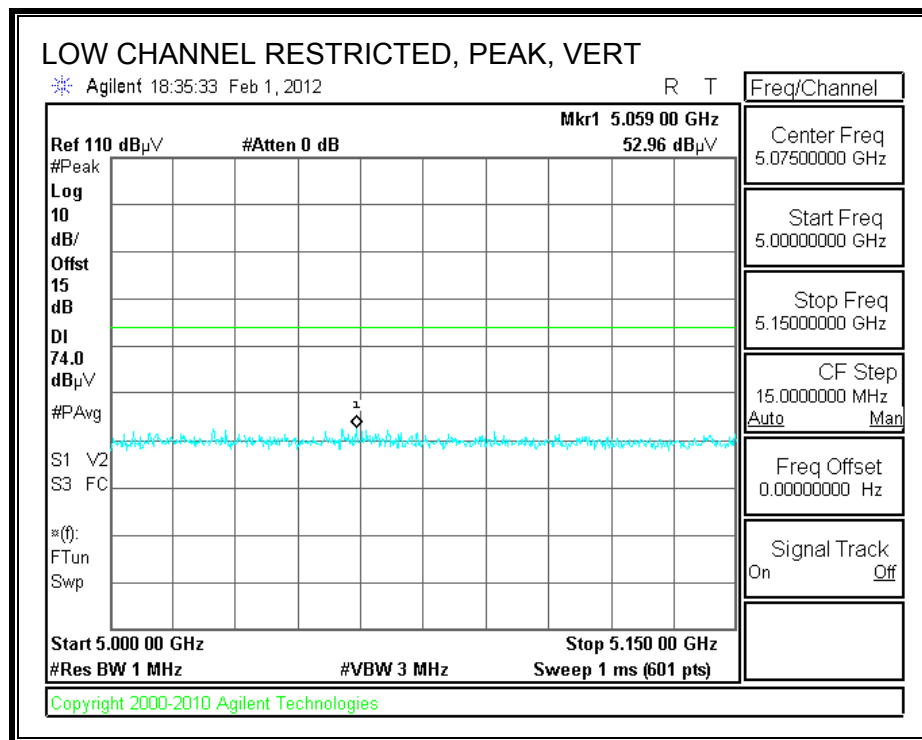
Note: No other emissions were detected above the system noise floor.

8.2.7. CO-LOCATION (WLAN+BT) TX ABOVE 1 GHz

RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)



HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement

Compliance Certification Services, Fremont 5m Chamber

Test Engr: Chin Pang
Date: 11-18-11
Project #: 11U13938
Company: Apple
Test Target: FCC UNII Band
Mode Oper: Co-Location, 5.2GHz and GFSK High Ch

f Measurement Frequency Amp Preamp Gain Average Field Strength Limit
Dist Distance to Antenna D Corr Distance Correct to 3 meters Peak Field Strength Limit
Read Analyzer Reading Avg Average Field Strength @ 3 m Margin vs. Average Limit
AF Antenna Factor Peak Calculated Peak Field Strength Margin vs. Peak Limit
CL Cable Loss HPF High Pass Filter

f GHz	Dist (m)	Read dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fitr dB	Corr. dBuV/m	Limit dBuV/m	Margin dB	Ant. Pol V/H	Det. P/A/QP	Notes
5180MHz													
10.360	3.0	45.9	38.2	8.9	-34.6	0.0	0.0	58.4	74.0	-15.6	V	P	
10.360	3.0	23.5	38.2	8.9	-34.6	0.0	0.0	36.0	54.0	-18.0	V	A	
15.540	3.0	34.2	39.9	11.3	-32.3	0.0	0.0	53.1	74.0	-20.9	V	P	
15.540	3.0	21.8	39.9	11.3	-32.3	0.0	0.0	40.7	54.0	-13.3	V	A	
10.360	3.0	35.9	38.2	8.9	-34.6	0.0	0.0	48.4	74.0	-25.6	H	P	
10.360	3.0	23.5	38.2	8.9	-34.6	0.0	0.0	36.0	54.0	-18.0	H	A	
15.540	3.0	34.1	39.9	11.3	-32.3	0.0	0.0	53.0	74.0	-21.0	H	P	
15.540	3.0	21.7	39.9	11.3	-32.3	0.0	0.0	40.6	54.0	-13.4	H	A	

Rev. 4.1.2.7

Note: No other emissions were detected above the system noise floor.

8.3. RECEIVER ABOVE 1 GHz

8.3.1. RX SPURIOUS ABOVE 1GHz IN THE 5.2 GHz BAND

High Frequency Measurement																
Compliance Certification Services, Fremont 5m Chamber-B																
Company:		Apple														
Project #:		11U13938														
Date:		10/31/2011														
Test Engineer:		Chin Pang														
Configuration:		EUT only														
Mode:		RX, 5.2GHz Band (Worst Case)														
Test Equipment:																
Horn 1-18GHz			Pre-amplifier 1-26GHz			Pre-amplifier 26-40GHz			Horn > 18GHz			Limit				
T59; S/N: 3245 @3m			T145 Agilent 3008A005c									FCC 15.209				
Hi Frequency Cables																
3' cable 22807700			12' cable 22807600			20' cable 22807500			HPF			Reject Filter			Peak Measurements	
3' cable 22807700			12' cable 22807600			20' cable 22807500									RBW=VBW=1MHz	
															Average Measurements	
															RBW=1MHz, VBW=10Hz	
f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Filtr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)	
1.142	3.0	47.5	31.5	24.5	2.8	-35.9	0.0	0.0	38.9	22.9	74	54	-35.1	-31.1	H	
3.158	3.0	46.8	30.4	30.8	5.0	-35.2	0.0	0.0	47.4	31.0	74	54	-26.6	-23.0	H	
1.058	3.0	48.0	32.0	24.1	2.7	-35.9	0.0	0.0	38.9	22.9	74	54	-35.1	-31.1	V	
2.542	3.0	46.5	30.0	29.0	4.4	-35.2	0.0	0.0	44.7	28.2	74	54	-29.3	-25.8	V	
Rev. 07.08.11																
Note: No other emissions were detected above the system noise floor.																
f	Measurement Frequency					Amp	Preamp Gain					Avg Lim	Average Field Strength Limit			
Dist	Distance to Antenna					D Corr	Distance Correct to 3 meters					Pk Lim	Peak Field Strength Limit			
Read	Analyzer Reading					Avg	Average Field Strength @ 3 m					Avg Mar	Margin vs. Average Limit			
AF	Antenna Factor					Peak	Calculated Peak Field Strength					Pk Mar	Margin vs. Peak Limit			
CL	Cable Loss					HPF	High Pass Filter									

8.3.2. RX SPURIOUS ABOVE 1GHz IN THE 5.3 GHz BAND

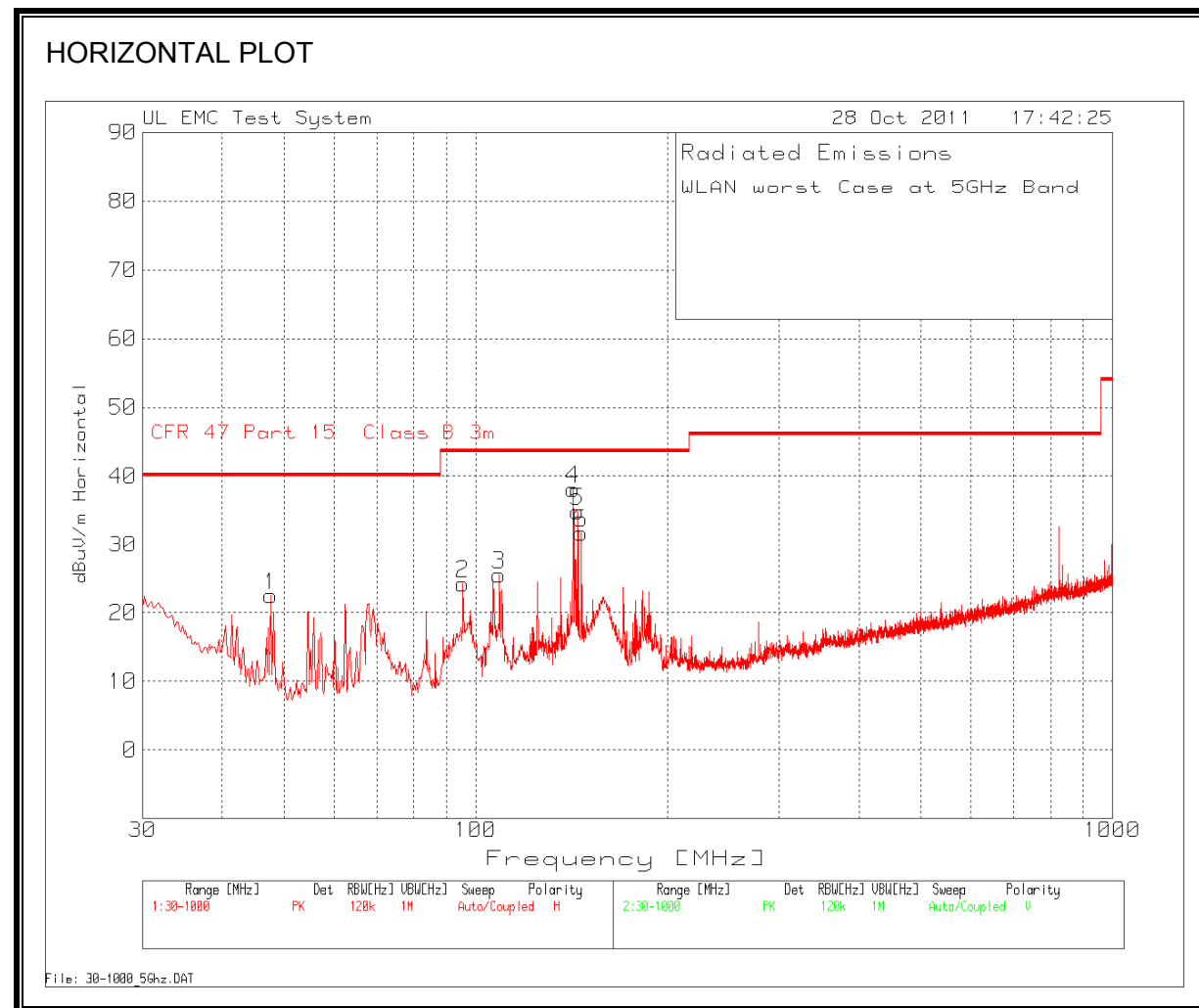
High Frequency Measurement																
Compliance Certification Services, Fremont 5m Chamber-B																
Company:		Apple														
Project #:		11U13938														
Date:		11/14/2011														
Test Engineer:		Chin Pang														
Configuration:		EUT only														
Mode:		RX, 5.3GHz Band (Worst Case)														
Test Equipment:																
Horn 1-18GHz			Pre-amplifier 1-26GHz			Pre-amplifier 26-40GHz			Horn > 18GHz			Limit				
T59; S/N: 3245 @3m			T145 Agilent 3008A005c									FCC 15.209				
Hi Frequency Cables																
3' cable 22807700			12' cable 22807600			20' cable 22807500			HPF			Reject Filter			Peak Measurements RBW=VBW=1MHz Average Measurements RBW=1MHz ; VBW=10Hz	
3' cable 22807700			12' cable 22807600			20' cable 22807500										
f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Filtr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)	
1.520	3.0	46.5	30.5	26.2	3.2	-35.7	0.0	0.0	40.3	24.3	74	54	-33.7	-29.7	H	
2.560	3.0	42.0	29.6	29.0	4.4	-35.2	0.0	0.0	40.2	27.8	74	54	-33.8	-26.2	H	
1.615	3.0	46.0	30.3	26.6	3.3	-35.6	0.0	0.0	40.4	24.7	74	54	-33.6	-29.3	V	
4.735	3.0	42.0	28.6	33.1	6.2	-34.8	0.0	0.0	46.5	33.1	74	54	-27.5	-20.9	V	
Rev. 07.08.11																
Note: No other emissions were detected above the system noise floor.																
f	Measurement Frequency					Amp	Preamp Gain					Avg Lim	Average Field Strength Limit			
Dist	Distance to Antenna					D Corr	Distance Correct to 3 meters					Pk Lim	Peak Field Strength Limit			
Read	Analyzer Reading					Avg	Average Field Strength @ 3 m					Avg Mar	Margin vs. Average Limit			
AF	Antenna Factor					Peak	Calculated Peak Field Strength					Pk Mar	Margin vs. Peak Limit			
CL	Cable Loss					HPF	High Pass Filter									

8.3.3. RX SPURIOUS ABOVE 1GHz IN THE 5.6 GHz BAND

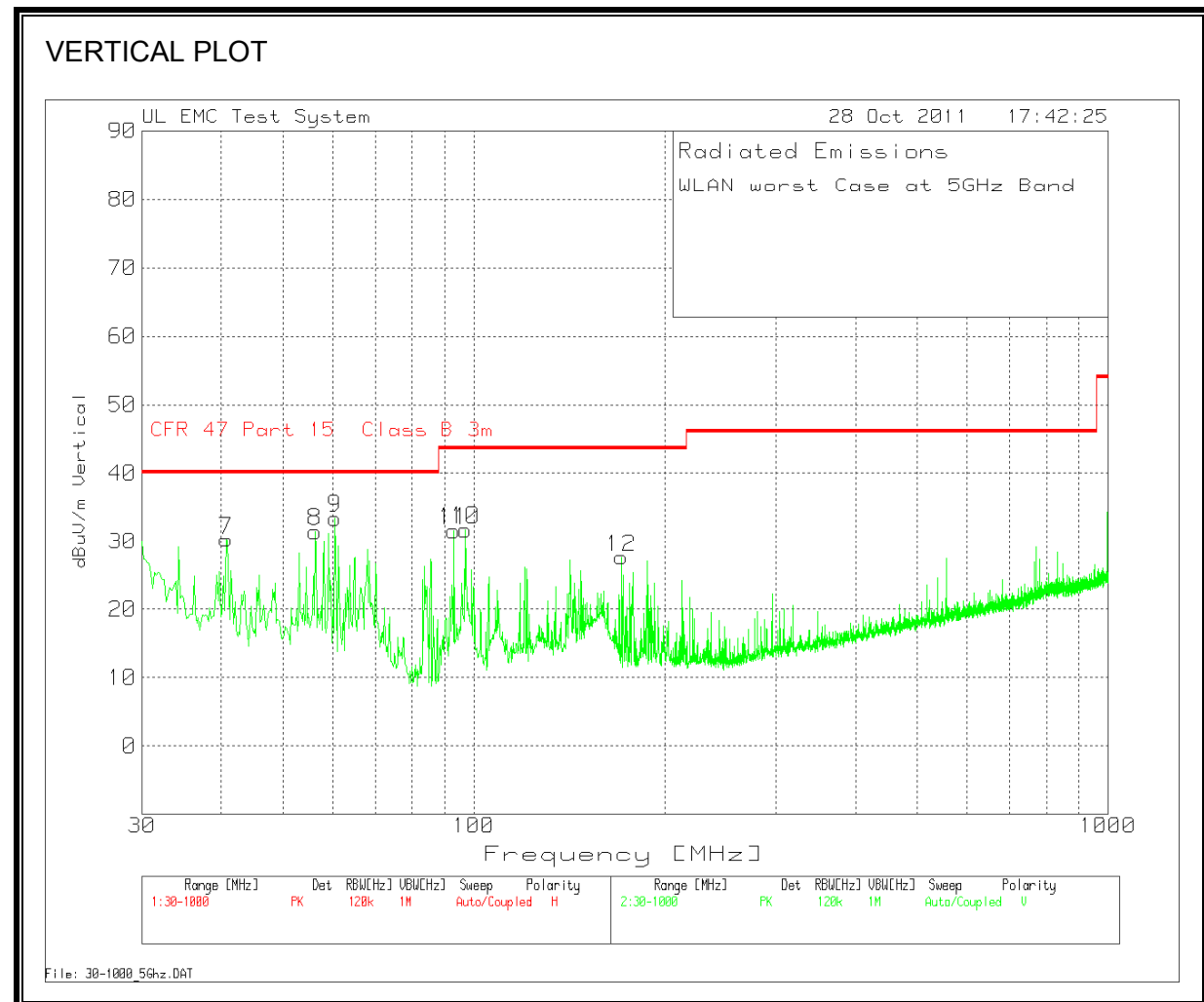
High Frequency Measurement																
Compliance Certification Services, Fremont 5m Chamber-B																
Company:		Apple														
Project #:		11U13938														
Date:		11/14/2011														
Test Engineer:		Chin Pang														
Configuration:		EUT only														
Mode:		RX, 5.6GHz Band (Worst Case)														
Test Equipment:																
Horn 1-18GHz			Pre-amplifier 1-26GHz			Pre-amplifier 26-40GHz			Horn > 18GHz			Limit				
T59; S/N: 3245 @3m			T145 Agilent 3008A005t									FCC 15.209				
Hi Frequency Cables																
3' cable 22807700			12' cable 22807600			20' cable 22807500			HPF			Reject Filter			Peak Measurements RBW=VBW=1MHz	
3' cable 22807700			12' cable 22807600			20' cable 22807500									Average Measurements RBW=1MHz; VBW=10Hz	
f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fldr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)	
1.513	3.0	45.0	30.1	26.2	3.2	-35.7	0.0	0.0	38.7	23.8	74	54	-35.3	-30.2	H	
2.267	3.0	43.0	29.5	28.4	4.1	-35.3	0.0	0.0	40.3	26.8	74	54	-33.7	-27.2	H	
1.620	3.0	45.0	30.0	26.7	3.3	-35.6	0.0	0.0	39.4	24.4	74	54	-34.6	-29.6	V	
3.360	3.0	42.0	28.6	31.2	5.1	-35.1	0.0	0.0	43.2	29.8	74	54	-30.8	-24.2	V	
Rev. 07.08.11																
Note: No other emissions were detected above the system noise floor.																
f	Measurement Frequency					Amp	Preamp Gain					Avg Lim	Average Field Strength Limit			
Dist	Distance to Antenna					D Corr	Distance Correct to 3 meters					Pk Lim	Peak Field Strength Limit			
Read	Analyzer Reading					Avg	Average Field Strength @ 3 m					Avg Mar	Margin vs. Average Limit			
AF	Antenna Factor					Peak	Calculated Peak Field Strength					Pk Mar	Margin vs. Peak Limit			
CL	Cable Loss					HPF	High Pass Filter									

8.4. RADIATED EMISSIONS BELOW 1 GHz

SPURIOUS EMISSIONS 30 TO 1000 MHz



SPURIOUS EMISSIONS 30 TO 1000 MHz



DATA

WLAN worst Case at 5GHz Band										
Range 1 30 - 1000MHz										
Frequency	Reading	Detector	Cable Loss	Amp Gain	Ant Gain	Corrected	15B Limit	Margin	Height	[Polarity
47.6399	41.46	PK	1	-29.4	9.4	22.46	40	-17.54	100	Horz
95.5196	43.19	PK	1.4	-29.3	8.9	24.19	43.5	-19.31	200	Horz
108.8949	41.59	PK	1.5	-29.3	11.7	25.49	43.5	-18.01	100	Horz
142.4301	52.57	PK	1.7	-29.2	13.1	38.17	43.5	-5.33	100	Horz
144.5624	49.42	PK	1.7	-29.1	12.9	34.92	43.5	-8.58	100	Horz
146.5008	46.39	PK	1.7	-29.1	12.8	31.79	43.5	-11.71	200	Horz
Range 2 30 - 1000MHz										
Frequency	Reading	Detector	Cable Loss	Amp Gain	Ant Gain	Corrected	15B Limit	Margin	Height	[Polarity
40.6615	45.05	PK	0.9	-29.4	13.7	30.25	40	-9.75	109	Vert
56.1691	51.9	PK	1.1	-29.4	7.9	31.5	40	-8.5	109	Vert
60.4337	53.76	PK	1.2	-29.4	7.9	33.46	40	-6.54	109	Vert
97.0703	50.34	PK	1.4	-29.3	9.3	31.74	43.5	-11.76	109	Vert
92.9996	51.23	PK	1.4	-29.3	8.3	31.63	43.5	-11.87	109	Vert
170.9253	44.75	PK	1.8	-29	10.1	27.65	43.5	-15.85	200	Vert

9. AC POWER LINE CONDUCTED EMISSIONS

LIMITS

FCC §15.207 (a)

RSS-Gen 7.2.2

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average
0.15-0.5	66 to 56 [*]	56 to 46 [*]
0.5-5	56	46
5-30	60	50

^{*} Decreases with the logarithm of the frequency.

TEST PROCEDURE

The EUT is placed on a non-conducting table 40 cm from the vertical ground plane and 80 cm above the horizontal ground plane. The EUT is configured in accordance with ANSI C63.4.

The receiver is set to a resolution bandwidth of 9 kHz. Peak detection is used unless otherwise noted as quasi-peak or average.

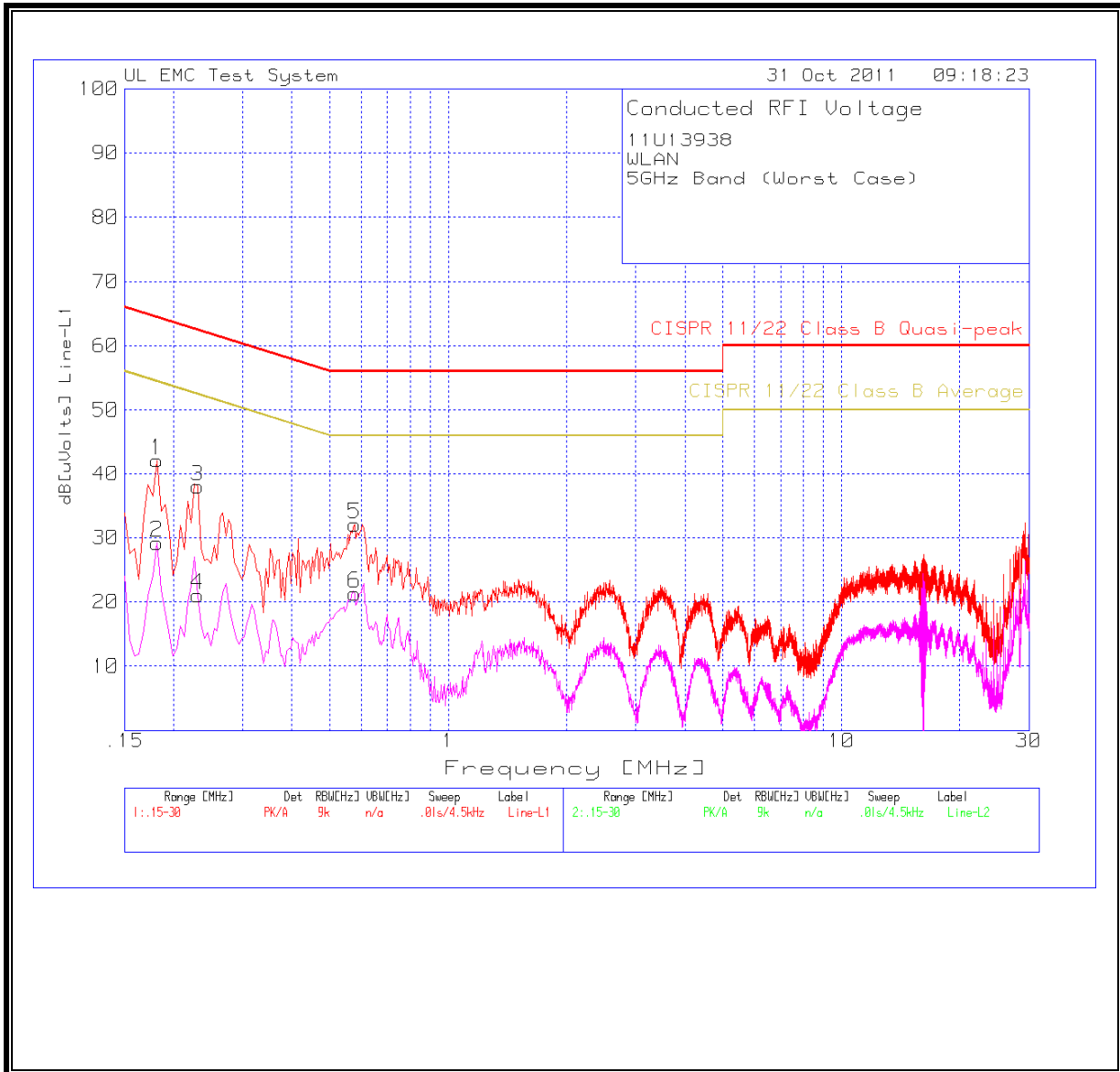
Line conducted data is recorded for both NEUTRAL and HOT lines.

RESULTS

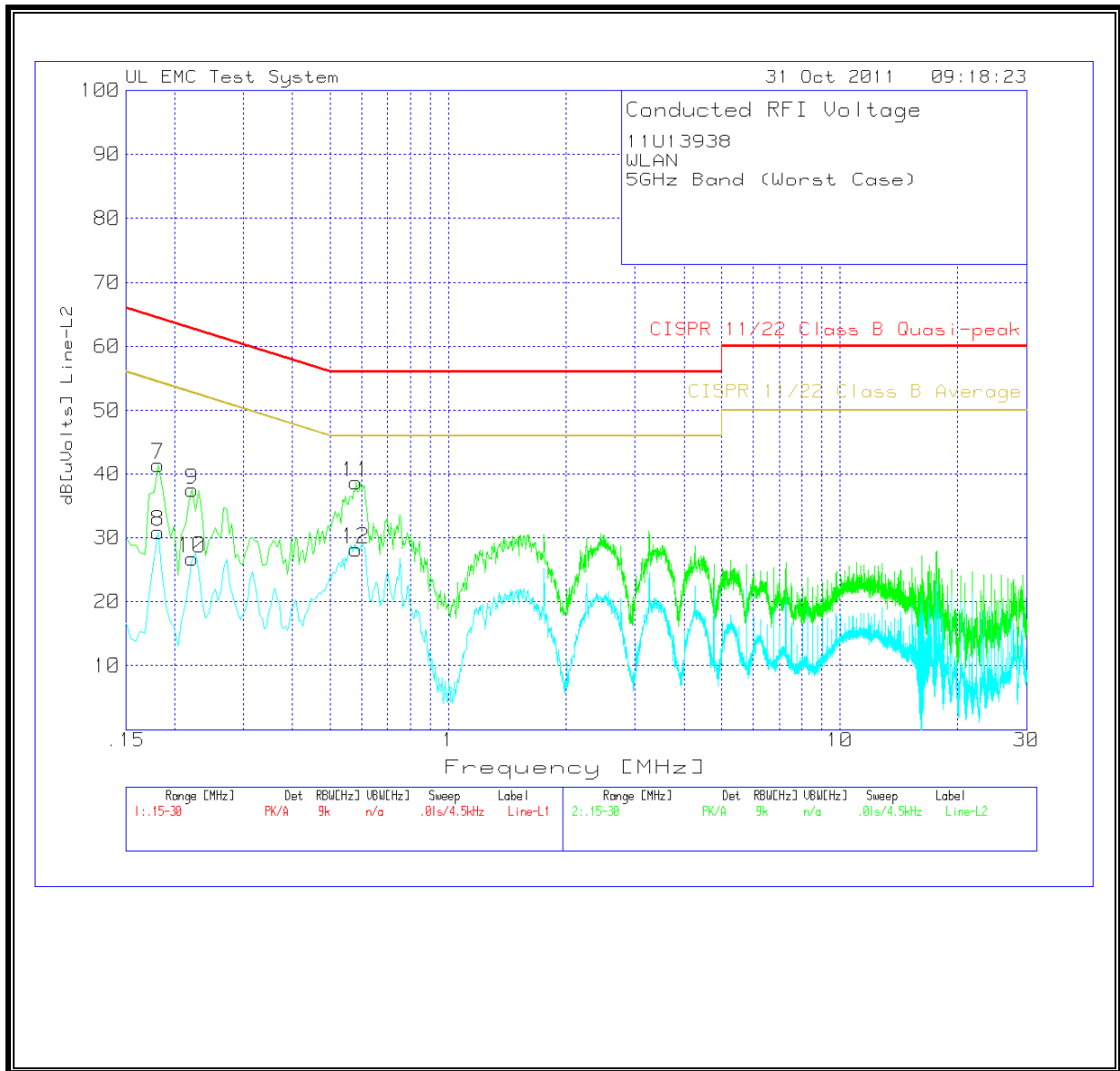
6 WORST EMISSIONS

11U13938							
WLAN							
5GHz Band (Worst Case)							
Line-L1 .15 - 30MHz							
Frequency	Reading	Detector	Corrected Reading	Class B Qp	Margin	Class B Avg	Margin
0.1815	42.2	PK	42.2	64.4	-22.2	54.4	-12.2
0.1815	29.17	Av	29.17	-	-	54.4	-25.23
0.231	38.03	PK	38.03	62.4	-24.37	52.4	-14.37
0.231	21.1	Av	21.1	-	-	52.4	-31.3
0.5775	32	PK	32	56	-24	46	-14
0.5775	21.33	Av	21.33	-	-	46	-24.67
Line-L2 .15 - 30MHz							
Frequency	Reading	Detector	Corrected Reading	Class B Qp	Margin	Class B Avg	Margin
0.1815	41.55	PK	41.55	64.4	-22.85	54.4	-12.85
0.1815	30.87	Av	30.87	-	-	54.4	-23.53
0.222	37.53	PK	37.53	62.7	-25.17	52.7	-15.17
0.222	26.69	Av	26.69	-	-	52.7	-26.01
0.582	38.68	PK	38.68	56	-17.32	46	-7.32
0.582	28.19	Av	28.19	-	-	46	-17.81

LINE 1 RESULTS



LINE 2 RESULTS



10. DYNAMIC FREQUENCY SELECTION

10.1. OVERVIEW

10.1.1. LIMITS

INDUSTRY CANADA

IC RSS-210 is closely harmonized with FCC Part 15 DFS rules. The deviations are as follows:

RSS-210 Issue 7 A9.4 (b) (ii) **Channel Availability Check Time:** ...

Additional requirements for the band 5600-5650 MHz: Until further notice, devices subject to this Section shall not be capable of transmitting in the band 5600-5650 MHz, so that Environment Canada weather radars operating in this band are protected.

RSS-210 Issue 7 A9.4 (b) (iv) **Channel closing time:** the maximum channel closing time is 260 ms.

FCC

§15.407 (h) and FCC 06-96 APPENDIX "COMPLIANCE MEASUREMENT PROCEDURES FOR UNLICENSED-NATIONAL INFORMATION INFRASTRUCTURE DEVCIES OPERATING IN THE 5250-5350 MHz AND 5470-5725 MHz BANDS INCORPORATING DYNAMIC FREQUENCY SELECTION".

Table 1: Applicability of DFS requirements prior to use of a channel

Requirement	Operational Mode		
	Master	Client (without radar detection)	Client (with radar detection)
Non-Occupancy Period	Yes	Not required	Yes
DFS Detection Threshold	Yes	Not required	Yes
Channel Availability Check Time	Yes	Not required	Not required
Uniform Spreading	Yes	Not required	Not required

Table 2: Applicability of DFS requirements during normal operation

Requirement	Operational Mode		
	Master	Client (without DFS)	Client (with DFS)
DFS Detection Threshold	Yes	Not required	Yes
Channel Closing Transmission Time	Yes	Yes	Yes
Channel Move Time	Yes	Yes	Yes

Table 3: Interference Threshold values, Master or Client incorporating In-Service Monitoring

Maximum Transmit Power	Value (see note)
≥ 200 milliwatt	-64 dBm
< 200 milliwatt	-62 dBm
<p>Note 1: This is the level at the input of the receiver assuming a 0 dBi receive antenna</p> <p>Note 2: Throughout these test procedures an additional 1 dB has been added to the amplitude of the test transmission waveforms to account for variations in measurement equipment. This will ensure that the test signal is at or above the detection threshold level to trigger a DFS response.</p>	

Table 4: DFS Response requirement values

Parameter	Value
<i>Non-occupancy period</i>	30 minutes
<i>Channel Availability Check Time</i>	60 seconds
<i>Channel Move Time</i>	10 seconds
<i>Channel Closing Transmission Time</i>	200 milliseconds + approx. 60 milliseconds over remaining 10 second period
<p>The instant that the <i>Channel Move Time</i> and the <i>Channel Closing Transmission Time</i> begins is as follows:</p> <p>For the Short pulse radar Test Signals this instant is the end of the <i>Burst</i>.</p> <p>For the Frequency Hopping radar Test Signal, this instant is the end of the last radar burst generated.</p> <p>For the Long Pulse radar Test Signal this instant is the end of the 12 second period defining the radar transmission.</p> <p>The Channel Closing Transmission Time is comprised of 200 milliseconds starting at the beginning of the Channel Move Time plus any additional intermittent control signals required facilitating channel changes (an aggregate of approximately 60 milliseconds) during the remainder of the 10 second period. The aggregate duration of control signals will not count quiet periods in between transmissions.</p>	

Table 5 – Short Pulse Radar Test Waveforms

Radar Type	Pulse Width (Microseconds)	PRI (Microseconds)	Pulses	Minimum Percentage of Successful Detection	Minimum Trials
1	1	1428	18	60%	30
2	1-5	150-230	23-29	60%	30
3	6-10	200-500	16-18	60%	30
4	11-20	200-500	12-16	60%	30
Aggregate (Radar Types 1-4)				80%	120

Table 6 – Long Pulse Radar Test Signal

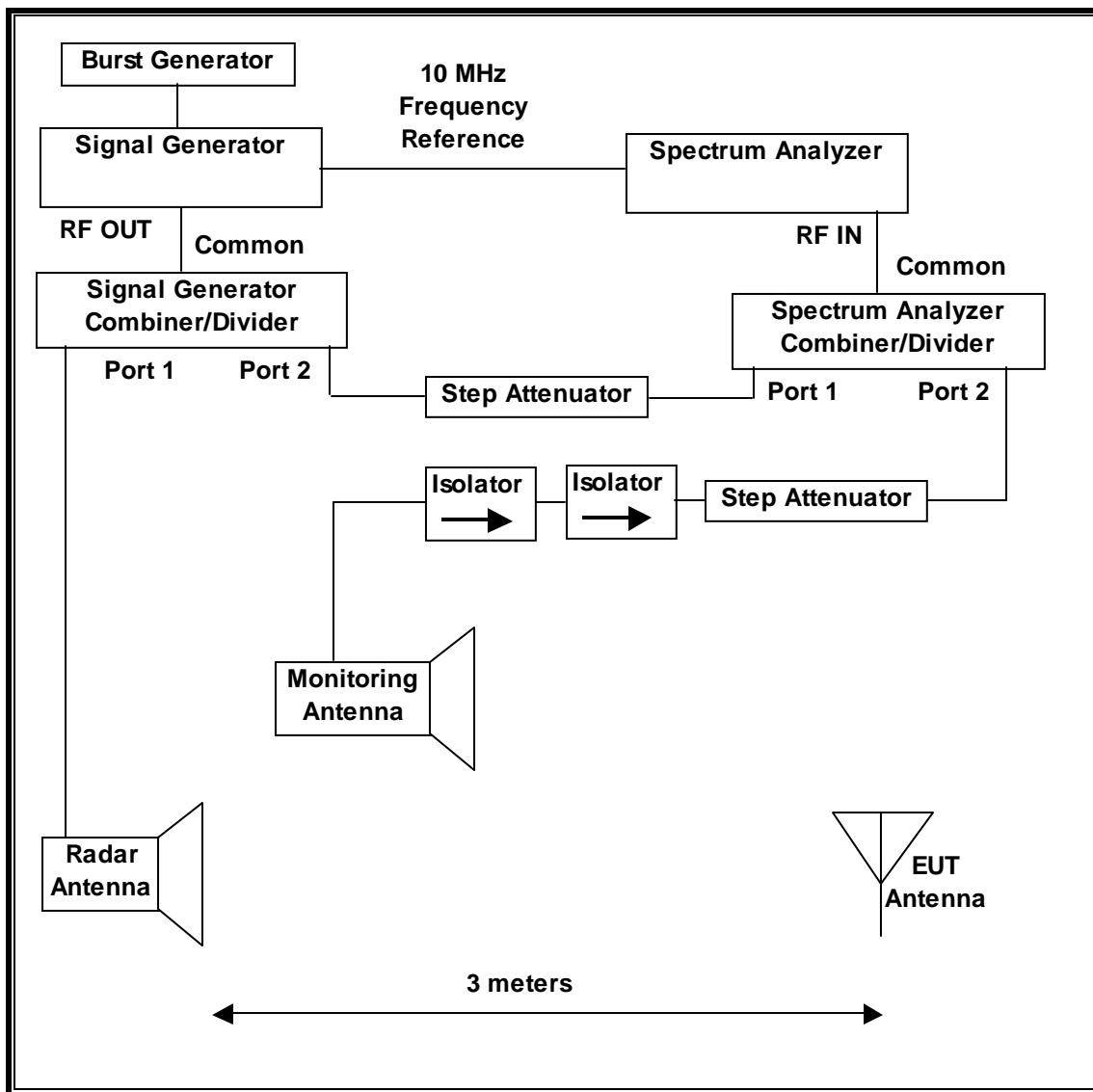
Radar Waveform	Bursts	Pulses per Burst	Pulse Width (µsec)	Chirp Width (MHz)	PRI (µsec)	Minimum Percentage of Successful Detection	Minimum Trials
5	8-20	1-3	50-100	5-20	1000-2000	80%	30

Table 7 – Frequency Hopping Radar Test Signal

Radar Waveform	Pulse Width (µsec)	PRI (µsec)	Burst Length (ms)	Pulses per Hop	Hopping Rate (kHz)	Minimum Percentage of Successful Detection	Minimum Trials
6	1	333	300	9	.333	70%	30

10.1.2. TEST AND MEASUREMENT SYSTEM

RADIATED METHOD SYSTEM BLOCK DIAGRAM



SYSTEM OVERVIEW

The short pulse and long pulse signal generating system utilizes the NTIA software. The Vector Signal Generator has been validated by the NTIA. The hopping signal generating system utilizes the CCS simulated hopping method and system, which has been validated by the DoD, FCC and NTIA. The software selects waveform parameters from within the bounds of the signal type on a random basis using uniform distribution.

The short pulse types 2, 3 and 4, and the long pulse type 5 parameters are randomized at run-time.

The hopping type 6 pulse parameters are fixed while the hopping sequence is based on the August 2005 NTIA Hopping Frequency List. The initial starting point randomized at run-time and each subsequent starting point is incremented by 475. Each frequency in the 100-length segment is compared to the boundaries of the EUT Detection Bandwidth and the software creates a hopping burst pattern in accordance with Section 7.4.1.3 Method #2 Simulated Frequency Hopping Radar Waveform Generating Subsystem of FCC 06-96 APPENDIX. The frequency of the signal generator is incremented in 1 MHz steps from F_L to F_H for each successive trial. This incremental sequence is repeated as required to generate a minimum of 30 total trials and to maintain a uniform frequency distribution over the entire Detection Bandwidth.

The signal monitoring equipment consists of a spectrum analyzer. The aggregate ON time is calculated by multiplying the number of bins above a threshold during a particular observation period by the dwell time per bin, with the analyzer set to peak detection and max hold.

SYSTEM CALIBRATION

A 50-ohm load is connected in place of the spectrum analyzer, and the spectrum analyzer is connected to a horn antenna via a coaxial cable, with the reference level offset set to (horn antenna gain – coaxial cable loss). The signal generator is set to CW mode. The amplitude of the signal generator is adjusted to yield a level of –64 dBm as measured on the spectrum analyzer.

Without changing any of the instrument settings, the spectrum analyzer is reconnected to the Common port of the Spectrum Analyzer Combiner/Divider. The Reference Level Offset of the spectrum analyzer is adjusted so that the displayed amplitude of the signal is –64 dBm.

The spectrum analyzer displays the level of the signal generator as received at the antenna ports of the Master Device. The interference detection threshold may be varied from the calibrated value of –64 dBm and the spectrum analyzer will still indicate the level as received by the Master Device.

ADJUSTMENT OF DISPLAYED TRAFFIC LEVEL

A link is established between the Master and Slave and the distance between the units is adjusted as needed to provide a suitable received level at the Master and Slave devices. The video test file is streamed to generate WLAN traffic. The monitoring antenna is adjusted so that the WLAN traffic level, as displayed on the spectrum analyzer, is at lower amplitude than the radar detection threshold.

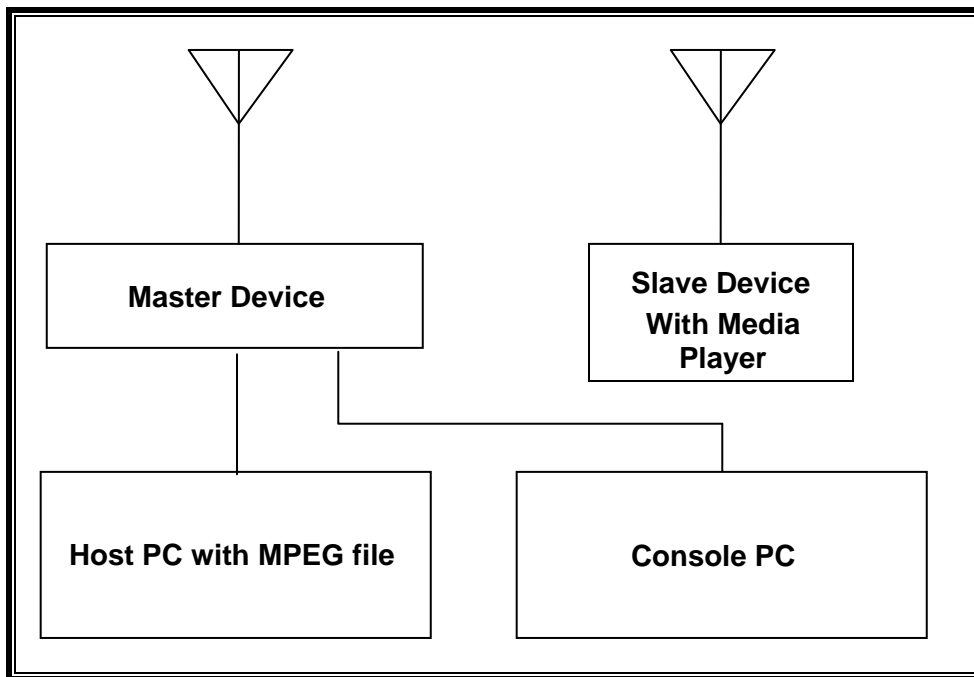
TEST AND MEASUREMENT EQUIPMENT

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

TEST EQUIPMENT LIST				
Description	Manufacturer	Model	Asset Number	Cal Due
Spectrum Analyzer, 44 GHz	Agilent / HP	E4446A	C00169	04/07/12
Arbitrary Waveform Generator	Agilent / HP	33220A	C01146	09/16/12
MXG MW Analog Sig. Gen.	Agilent / HP	N5183A	N/A	04/26/12

10.1.3. SETUP OF EUT

RADIATED METHOD EUT TEST SETUP



SUPPORT EQUIPMENT

The following support equipment was utilized for the DFS tests documented in this report:

PERIPHERAL SUPPORT EQUIPMENT LIST				
Description	Manufacturer	Model	Serial Number	FCC ID
Wireless Access Point	Cisco	AIR-AP1252AG-A-K9	FTX120690N2	LDK102061
AC Adapter (AP)	Delta Electronics	EADP-45BB B	DTH112490BD	DoC
Notebook PC (Console)	Dell	PP18L	10657517725	DoC
AC Adapter (Console PC)	Dell	LA65SN0-00	CN-ODF263-71615-6AU-1019	DoC
Notebook PC (Server)	Apple	17" MacBook Pro	SW860401CV59	DoC
AC Adapter (Server PC)	Lite On Technologies	A1343	C061164078DDJ94AY	DoC

10.1.4. DESCRIPTION OF EUT

The EUT operates over the 5250-5350 MHz and 5470-5725 MHz ranges.

The EUT is a Slave Device with without Radar Detection.

The highest power level within these bands is 22.23 dBm EIRP in the 5250-5350 MHz band and 21.18 dBm EIRP in the 5470-5725 MHz band.

The only antenna assembly utilized with the EUT has a gain of 4.63 dBi in the 5250-5350 MHz band and 4.51 dBi in the 5470-5725 MHz band.

The rated output power of the Master unit is > 23dBm (EIRP). Therefore the required interference threshold level is -64 dBm. After correction for procedural adjustments, the required radiated threshold at the antenna port is $-64 + 1 = -63$ dBm.

The calibrated radiated DFS Detection Threshold level is set to -64 dBm. The tested level is lower than the required level hence it provides a margin to the limit.

The EUT uses one transmitter/receiver chain connected to an antenna to perform radiated tests.

WLAN traffic is generated by streaming the video file TestFile.mp2 "6 ½ Magic Hours" from the Master to the Slave in full motion video mode using Quick Time media player.

TPC is not required since the maximum EIRP is less than 500 mW (27 dBm), however TPC is implemented.

The EUT utilizes the 802.11a/n architecture. One nominal channel bandwidth, 20 MHz, is implemented.

MANUFACTURER'S STATEMENT REGARDING UNIFORM CHANNEL SPREADING

This is not applicable to slave devices.

OVERVIEW OF MASTER DEVICE WITH RESPECT TO §15.407 (h) REQUIREMENTS

The Master Device is a Cisco Access Point, FCC ID: LDK102061. The minimum antenna gain for the Master Device is 3.5 dBi.

The rated output power of the Master unit is > 23dBm (EIRP). Therefore the required interference threshold level is -64 dBm. After correction for procedural adjustments, the required radiated threshold at the antenna port is $-64 + 1 = -63$ dBm.

The calibrated radiated DFS Detection Threshold level is set to -64 dBm. The tested level is lower than the required level hence it provides a margin to the limit.

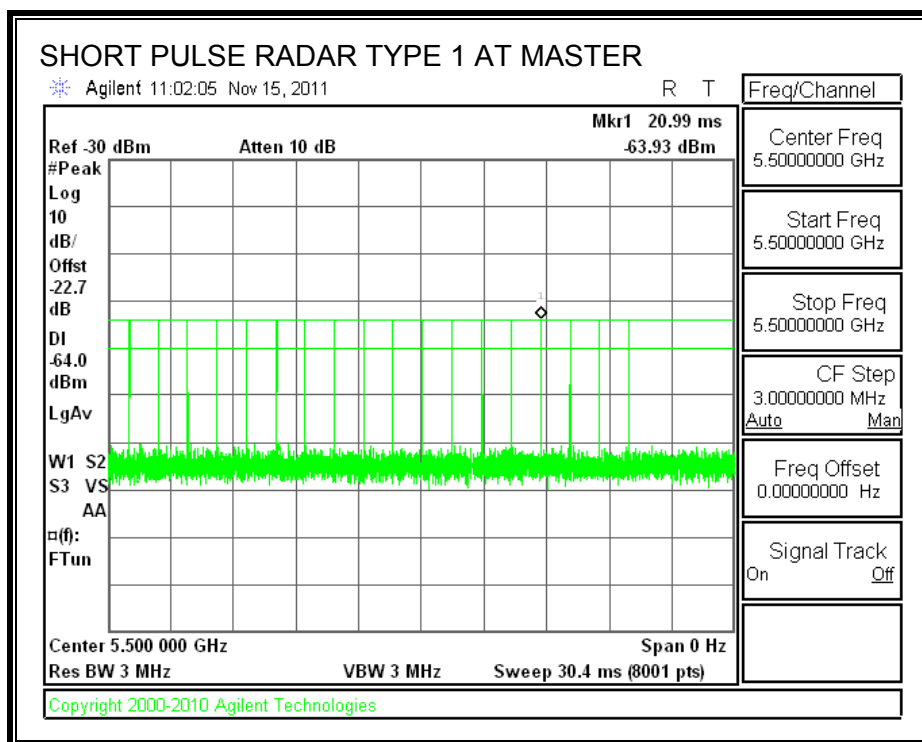
10.2. RESULTS FOR 20 MHz BANDWIDTH

10.2.1. TEST CHANNEL

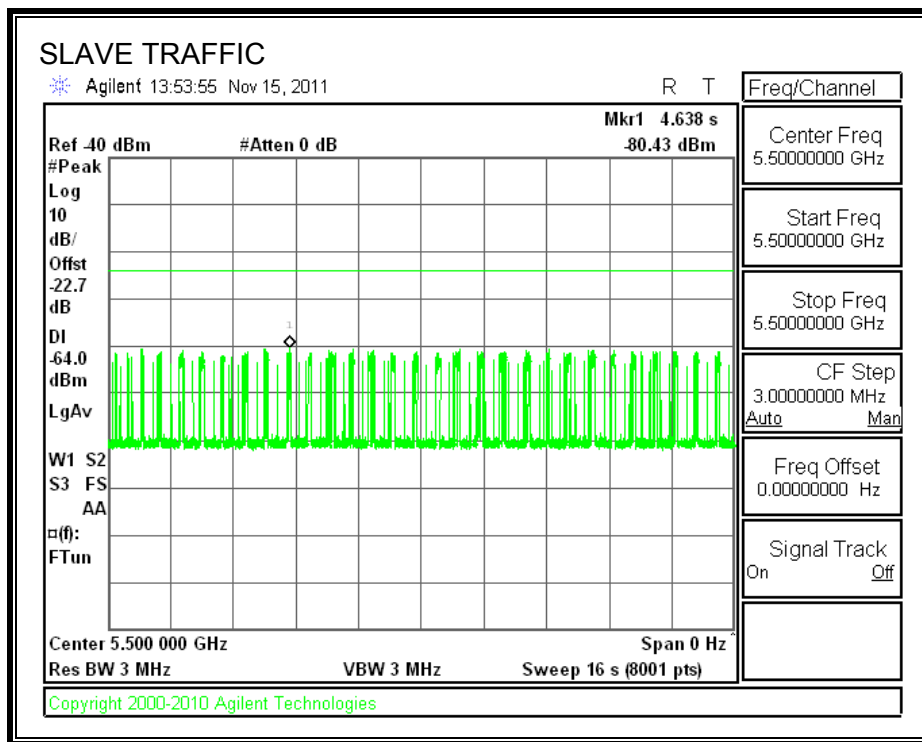
All tests were performed at a channel center frequency of 5500 MHz.

10.2.2. RADAR WAVEFORM AND TRAFFIC

RADAR WAVEFORM



TRAFFIC



10.2.3. OVERLAPPING CHANNEL TESTS

RESULTS

These tests are not applicable.

10.2.4. MOVE AND CLOSING TIME

REPORTING NOTES

The reference marker is set at the end of last radar pulse.

The delta marker is set at the end of the last WLAN transmission following the radar pulse. This delta is the channel move time.

The aggregate channel closing transmission time is calculated as follows:

Aggregate Transmission Time =
(Number of analyzer bins showing transmission) * (dwell time per bin)

The observation period over which the FCC aggregate time is calculated begins at (Reference Marker + 200 msec) and ends no earlier than (Reference Marker + 10 sec).

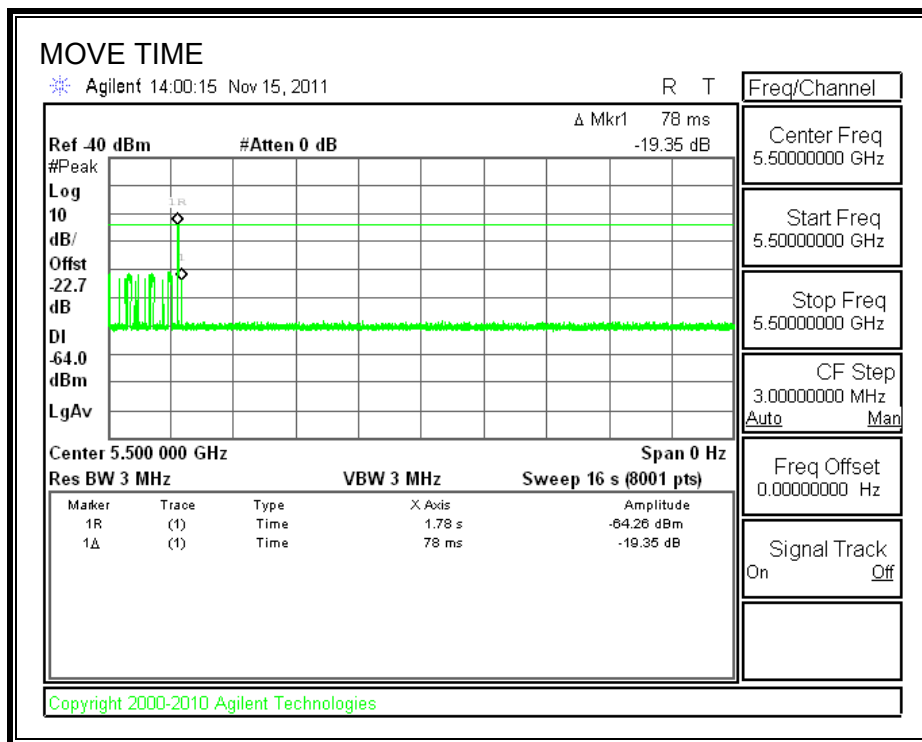
The observation period over which the IC aggregate time is calculated begins at (Reference Marker) and ends no earlier than (Reference Marker + 10 sec).

RESULTS

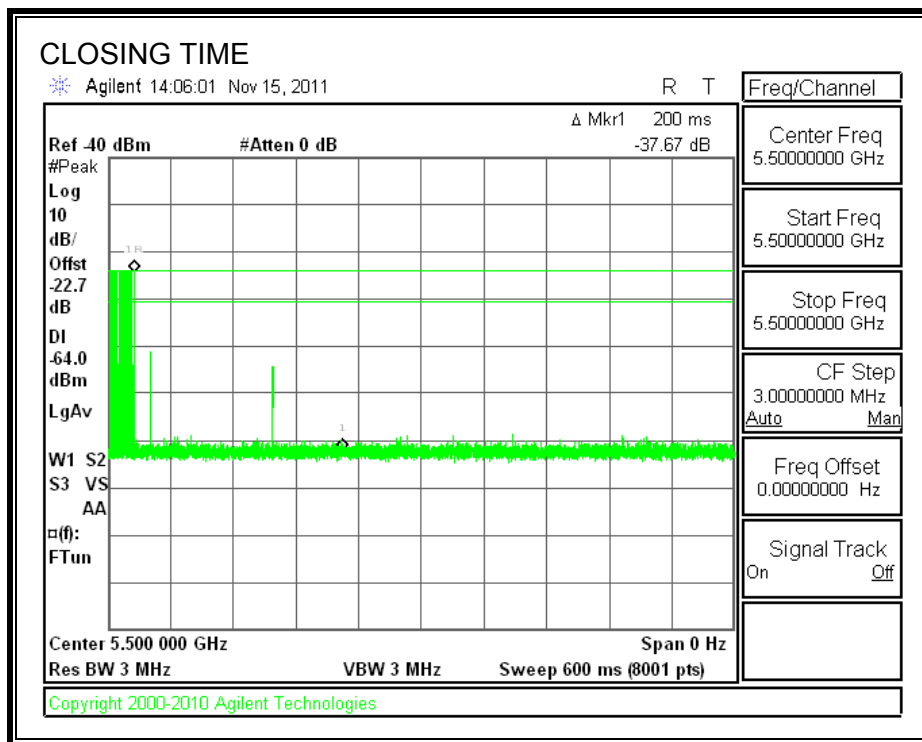
Agency	Channel Move Time (sec)	Limit (sec)
FCC / IC	0.070	10

Agency	Aggregate Channel Closing Transmission Time (msec)	Limit (msec)
FCC	0.0	60
IC	2.0	260

MOVE TIME

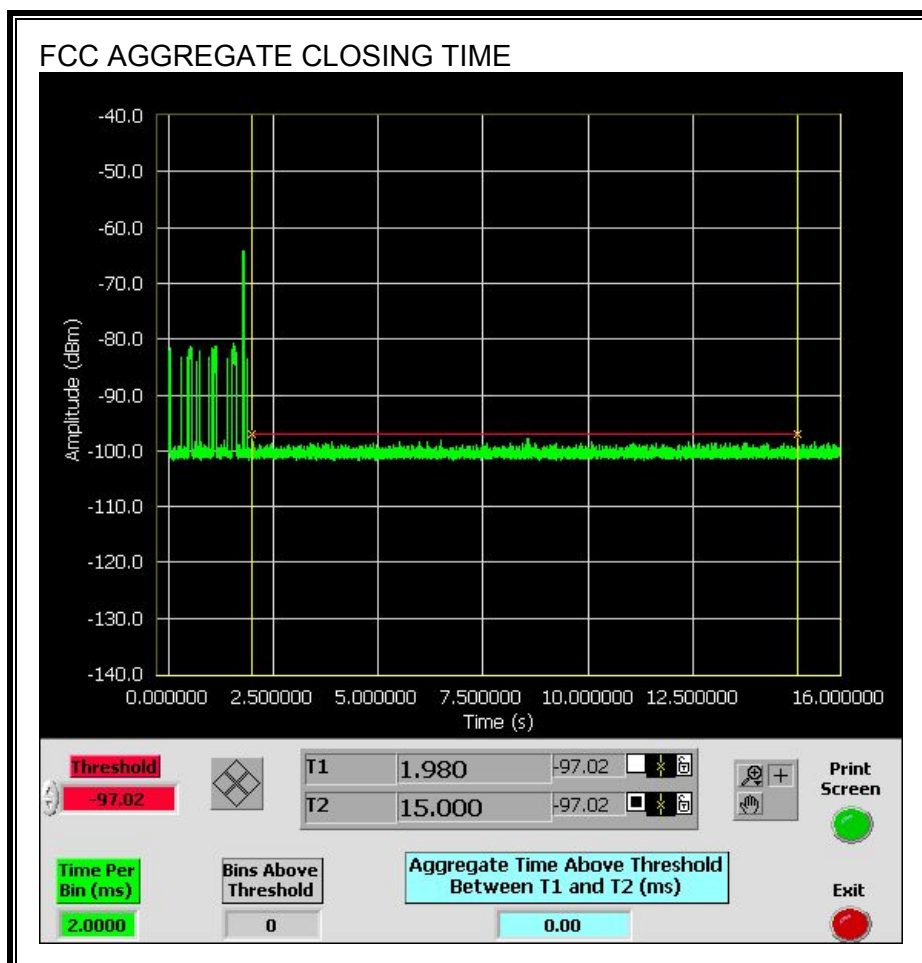


CHANNEL CLOSING TIME

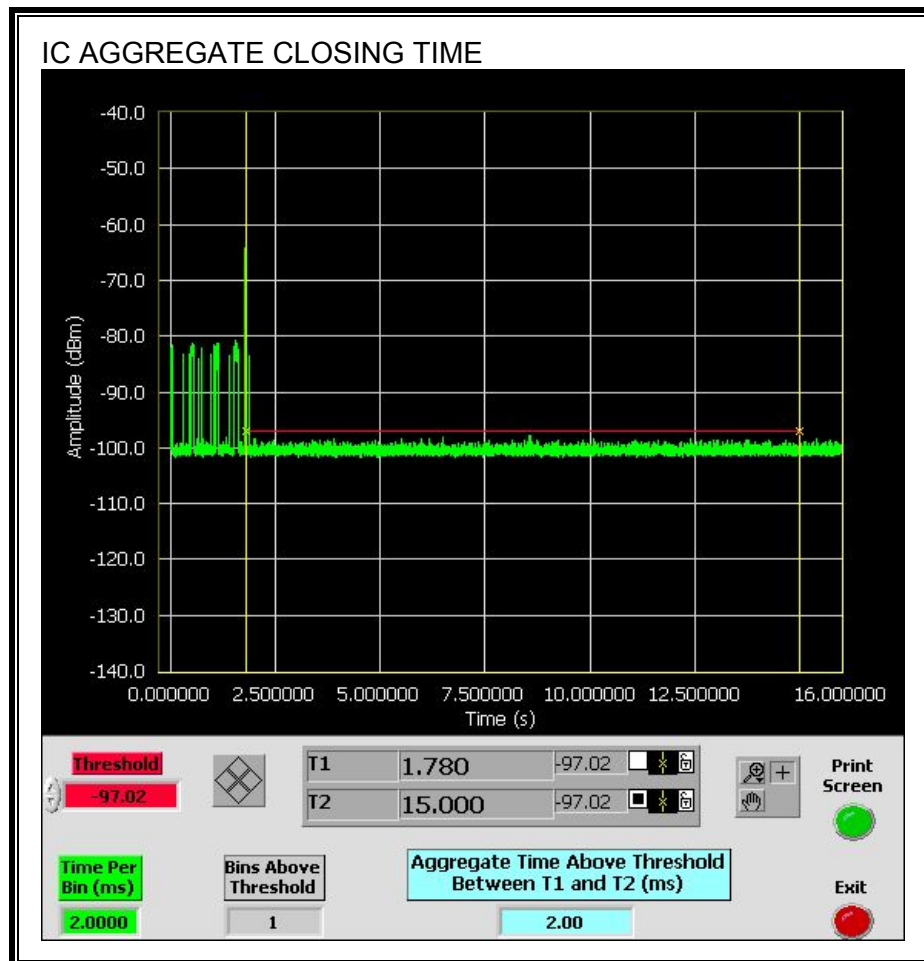


AGGREGATE CHANNEL CLOSING TRANSMISSION TIME

No transmissions are observed during the FCC aggregate monitoring period.



Only intermittent transmissions are observed during the IC aggregate monitoring period.



10.2.5. NON-OCCUPANCY PERIOD

RESULTS

No EUT transmissions were observed on the test channel during the 30-minute observation time.

