

### 8.7.3. AVERAGE POWER

#### LIMITS

None; for reporting purposes only.

#### TEST PROCEDURE

The transmitter output is connected to a power meter.

The cable assembly insertion loss of 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.

#### RESULTS

Channel	Frequency (MHz)	Power (dBm)
Low	5500	12.00
Mid	5580	11.98
High	5700	11.96

#### **8.7.4. OUTPUT POWER AND PPSD**

##### **LIMITS**

FCC §15.407 (a) (2)

IC RSS-210 A9.2 (2)

For the band 5.15–5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed the lesser of 50 mW or  $4 \text{ dBm} + 10 \log B$ , where B is the 99% emission bandwidth for IC (26dB emission bandwidth for FCC) in MHz. In addition, the peak power spectral density shall not exceed 4 dBm in any 1-MHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

99% bandwidth was used to calculate the power limit which was considered the worst case.

##### **DIRECTIONAL ANTENNA GAIN**

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

**RESULTS**

**Limits**

Channel	Frequency (MHz)	Fixed Limit (dBm)	B (MHz)	11 + 10 Log B Limit (dBm)	Directional Gain (dBi)	Power Limit (dBm)	PPSD Limit (dBm)
Low	5500	24	16.4	23.14	-0.83	23.14	11.00
Mid	5580	24	16.5	23.18	-0.83	23.18	11.00
High	5700	24	16.5	23.19	-0.83	23.19	11.00

<b>Duty Cycle CF (dB)</b>	0.08	<b>Included in Calculations of Corr'd Power &amp; PPSD</b>
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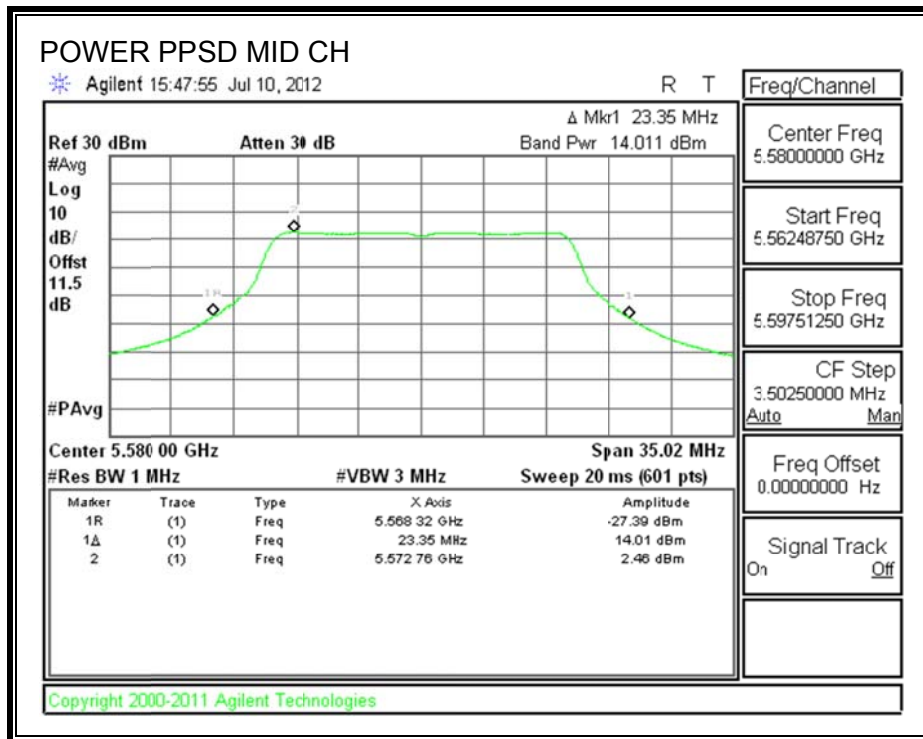
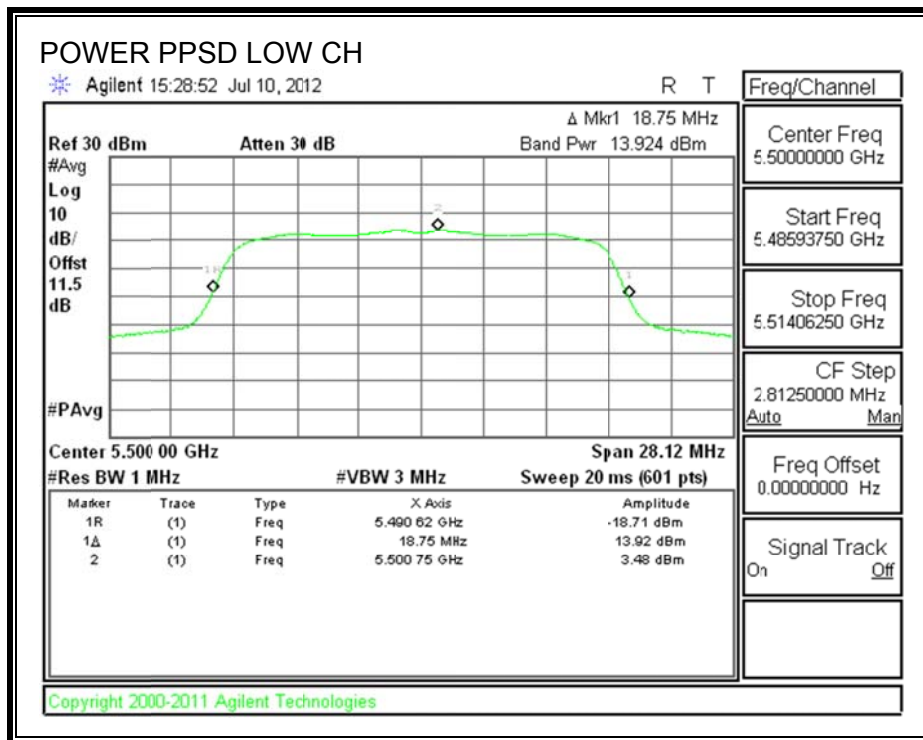
**Output Power Results**

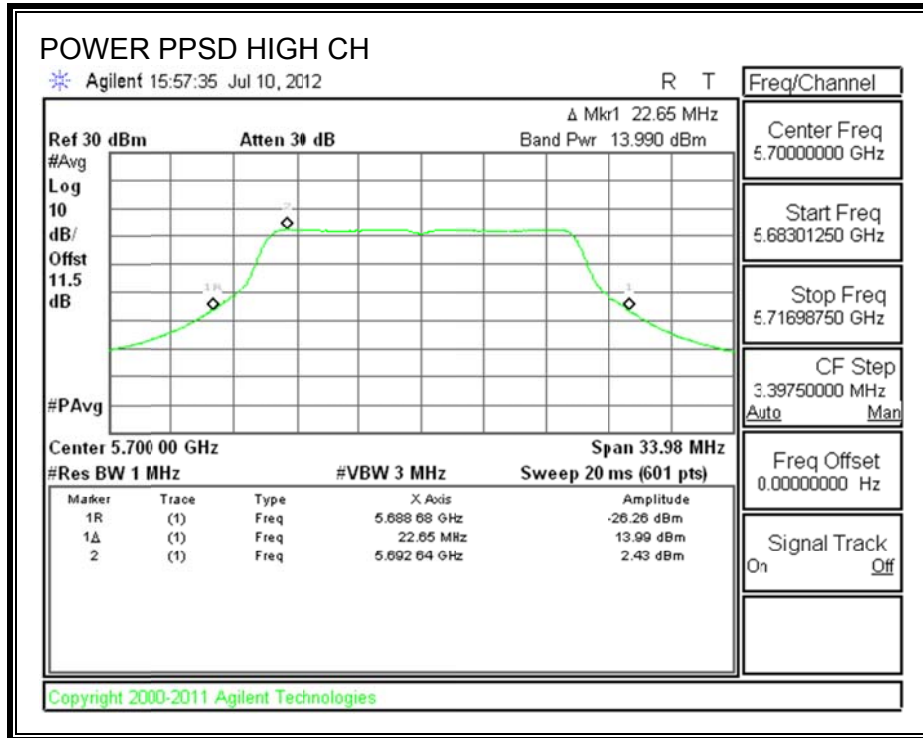
Channel	Frequency (MHz)	Meas Power (dBm)	Corr'd Power (dBm)	Power Limit (dBm)	Power Margin (dB)
Low	5500	13.92	14.00	23.14	-9.13
Mid	5580	14.01	14.09	23.18	-9.09
High	5700	13.99	14.07	23.19	-9.12

**PPSD Results**

Channel	Frequency (MHz)	Meas PPSD (dBm)	Corr'd PPSD (dBm)	PPSD Limit (dBm)	PPSD Margin (dB)
Low	5500	3.48	3.56	11.00	-7.44
Mid	5580	2.46	2.54	11.00	-8.46
High	5700	2.43	2.51	11.00	-8.49

**OUTPUT POWER AND PPSD**





### 8.7.5. PEAK EXCURSION

#### LIMITS

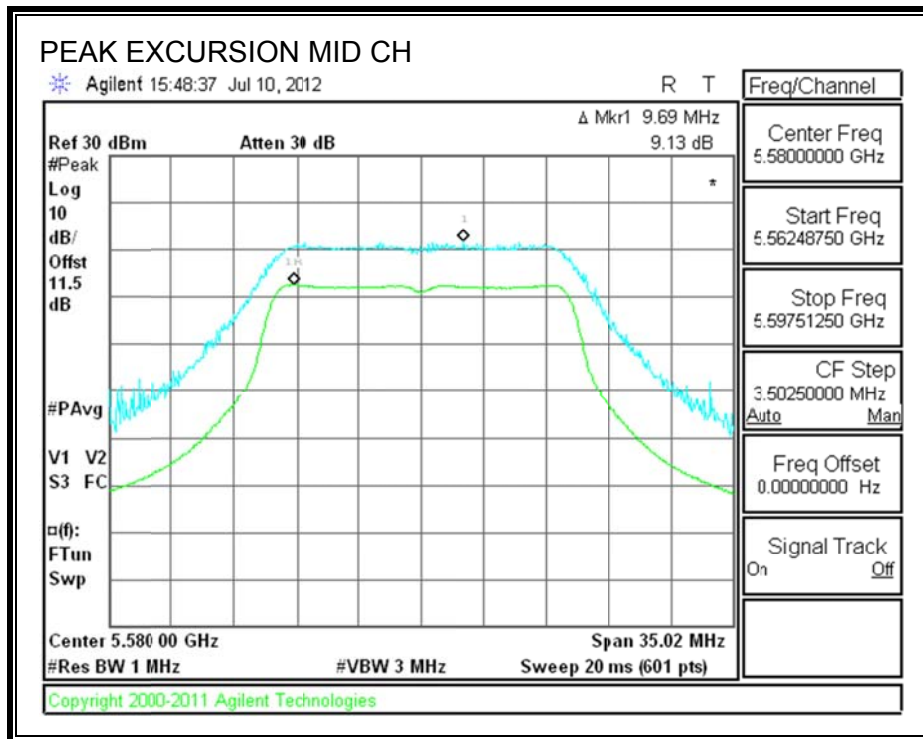
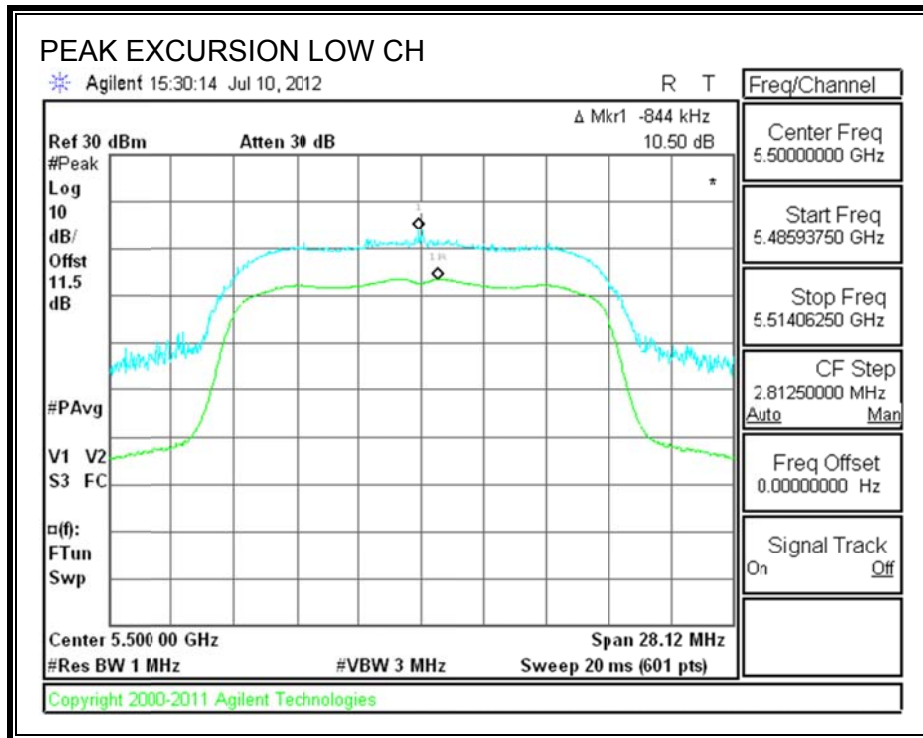
FCC §15.407 (a) (6)

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

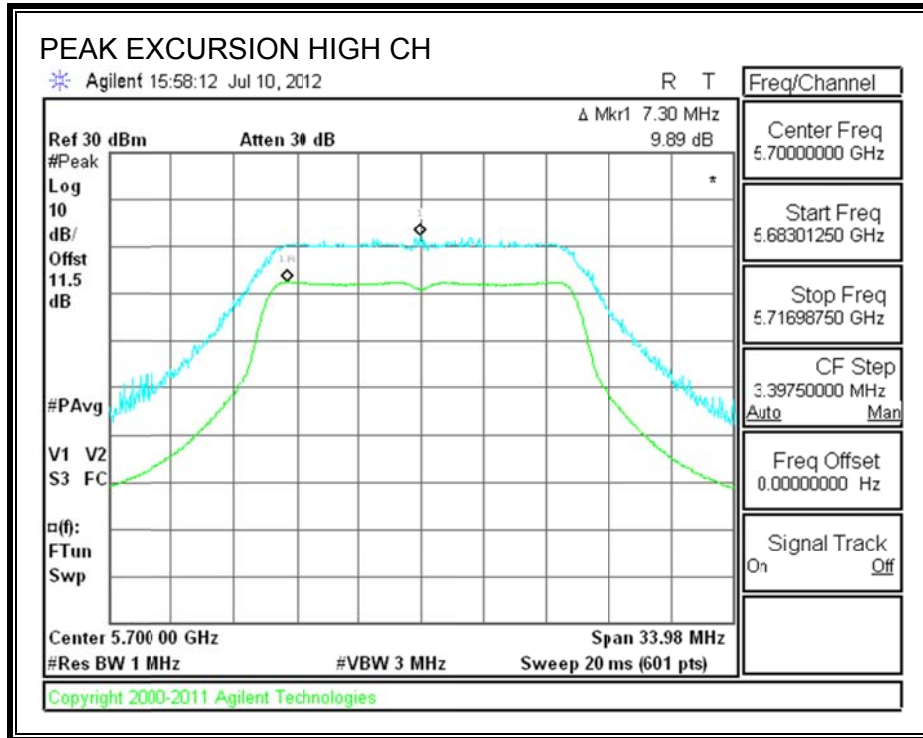
#### RESULTS

Channel	Frequency (MHz)	Peak Excursion (dB)	Limit (dB)	Margin (dB)
Low	5260	10.50	13	-2.50
Mid	5300	9.13	13	-3.87
High	5320	9.89	13	-3.11

**PEAK EXCURSION**







## 8.8. 802.11n HT20 MODE IN THE 5.6 GHz BAND

### 8.8.1. 26 dB BANDWIDTH

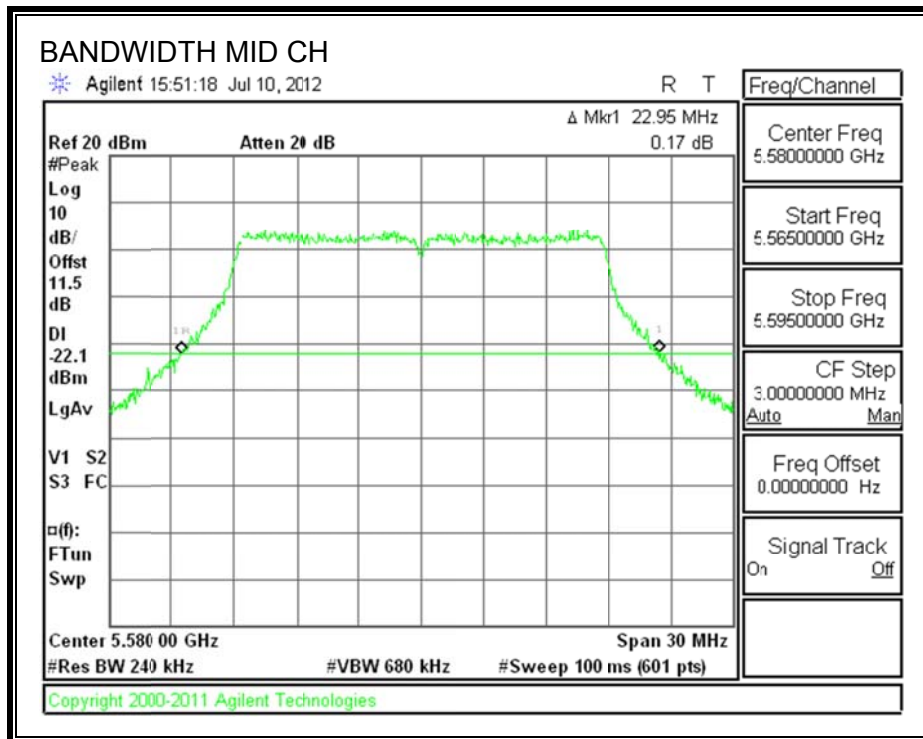
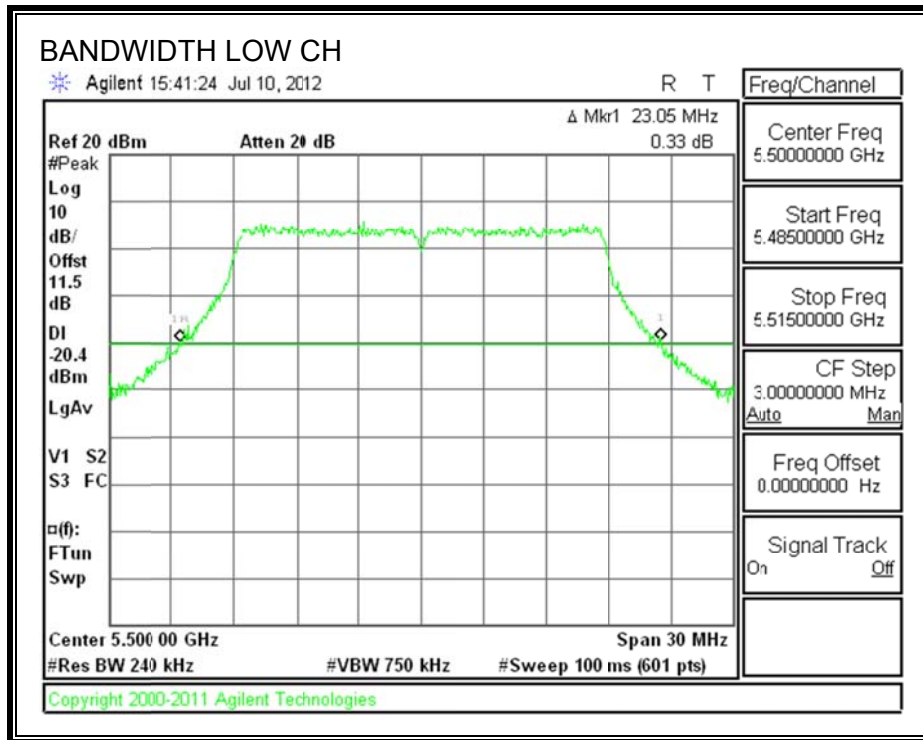
#### LIMITS

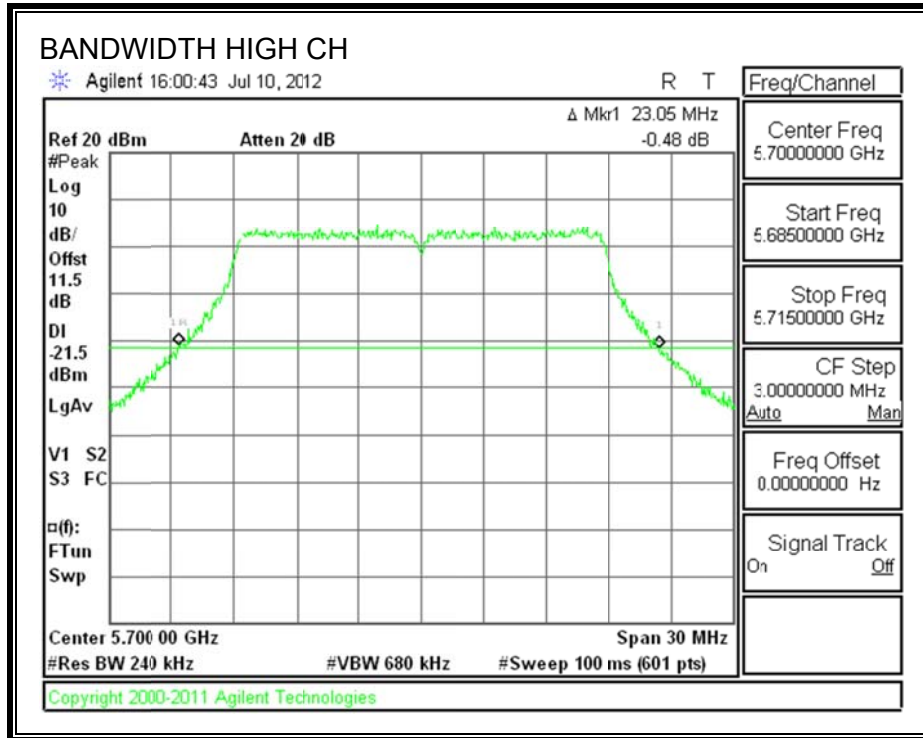
None; for reporting purposes only.

#### RESULTS

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
Low	5500	23.1
Mid	5580	23.0
High	5700	23.1

**26 dB BANDWIDTH**





### 8.8.2. 99% BANDWIDTH

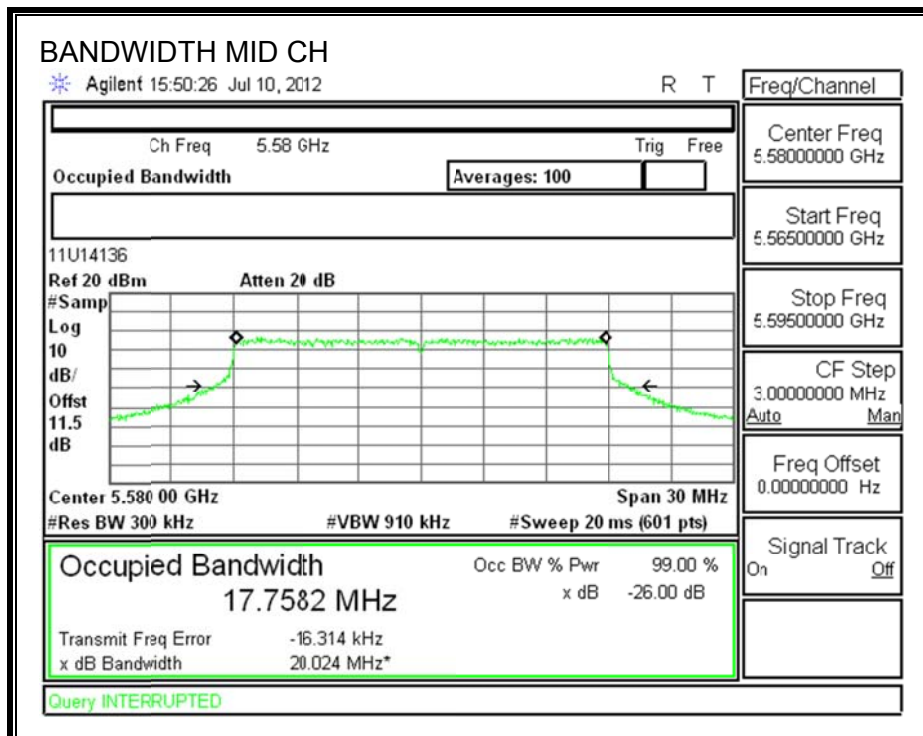
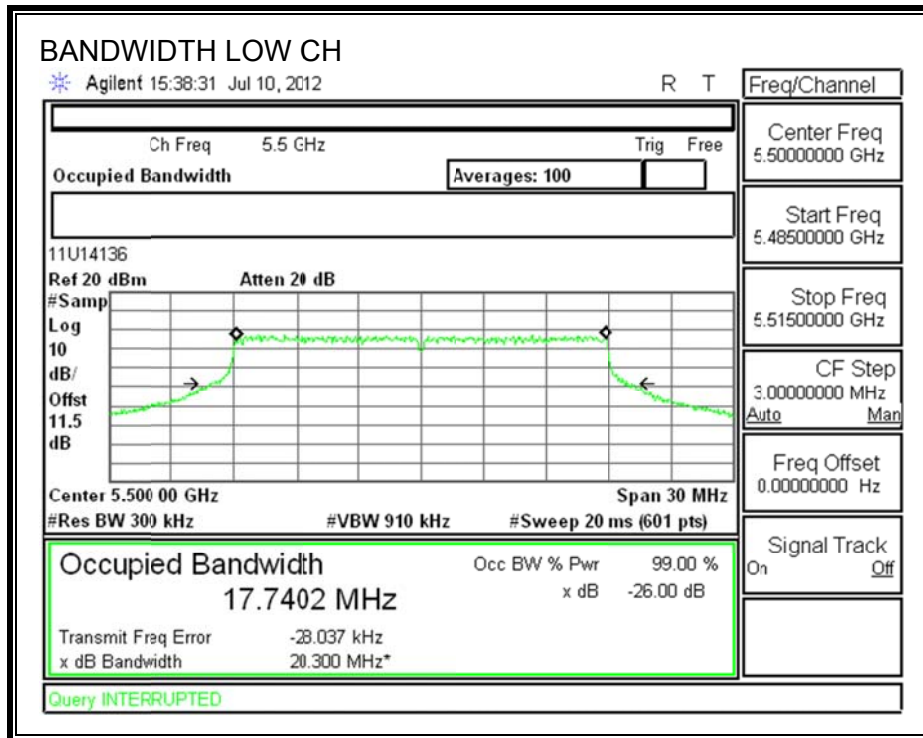
#### LIMITS

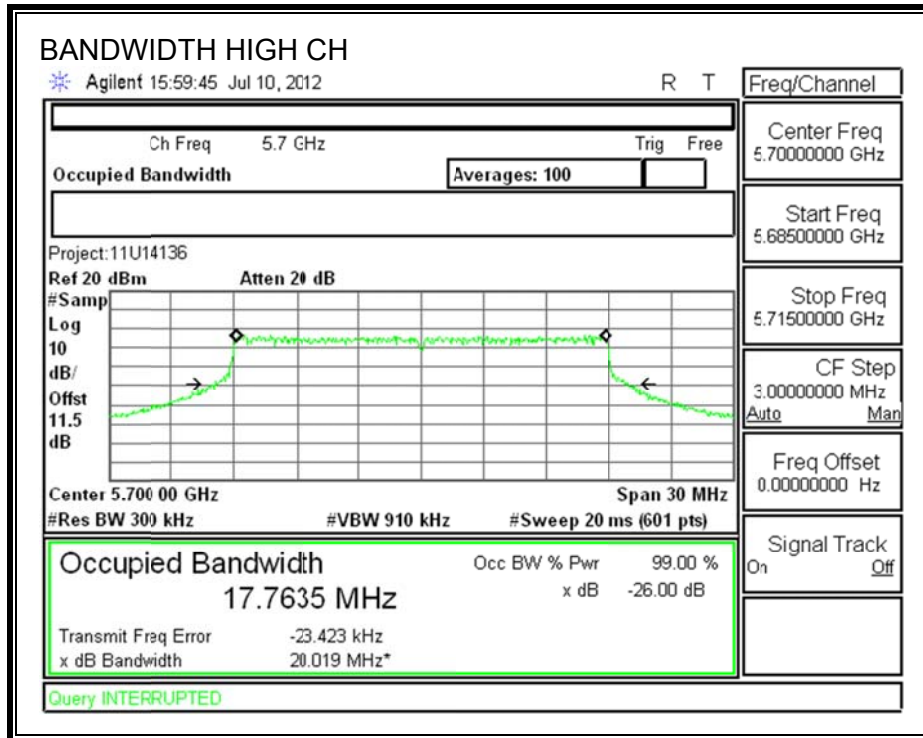
None; for reporting purposes only.

#### RESULTS

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	5500	17.740
Mid	5580	17.758
High	5700	17.764

**99% BANDWIDTH**





### 8.8.3. AVERAGE POWER

#### LIMITS

None; for reporting purposes only.

#### TEST PROCEDURE

The transmitter output is connected to a power meter.

The cable assembly insertion loss of 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.

#### RESULTS

Channel	Frequency (MHz)	Power (dBm)
Low	5500	12.00
Mid	5580	11.94
High	5700	12.00



#### **8.8.4. OUTPUT POWER AND PPSD**

##### **LIMITS**

FCC §15.407 (a) (2)

IC RSS-210 A9.2 (2)

For the band 5.15–5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed the lesser of 50 mW or  $4 \text{ dBm} + 10 \log B$ , where B is the 99% emission bandwidth for IC (26dB emission bandwidth for FCC) in MHz. In addition, the peak power spectral density shall not exceed 4 dBm in any 1-MHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

99% bandwidth was used to calculate the power limit which was considered the worst case.

##### **DIRECTIONAL ANTENNA GAIN**

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

**RESULTS**

**Limits**

Channel	Frequency (MHz)	Fixed Limit (dBm)	B (MHz)	11 + 10 Log B Limit (dBm)	Directional Gain (dBi)	Power Limit (dBm)	PPSD Limit (dBm)
Low	5500	24	17.7	23.49	-0.83	23.49	11.00
Mid	5580	24	17.8	23.49	-0.83	23.49	11.00
High	5700	24	17.8	23.50	-0.83	23.50	11.00

<b>Duty Cycle CF (dB)</b>	0.08	<b>Included in Calculations of Corr'd Power &amp; PPSD</b>
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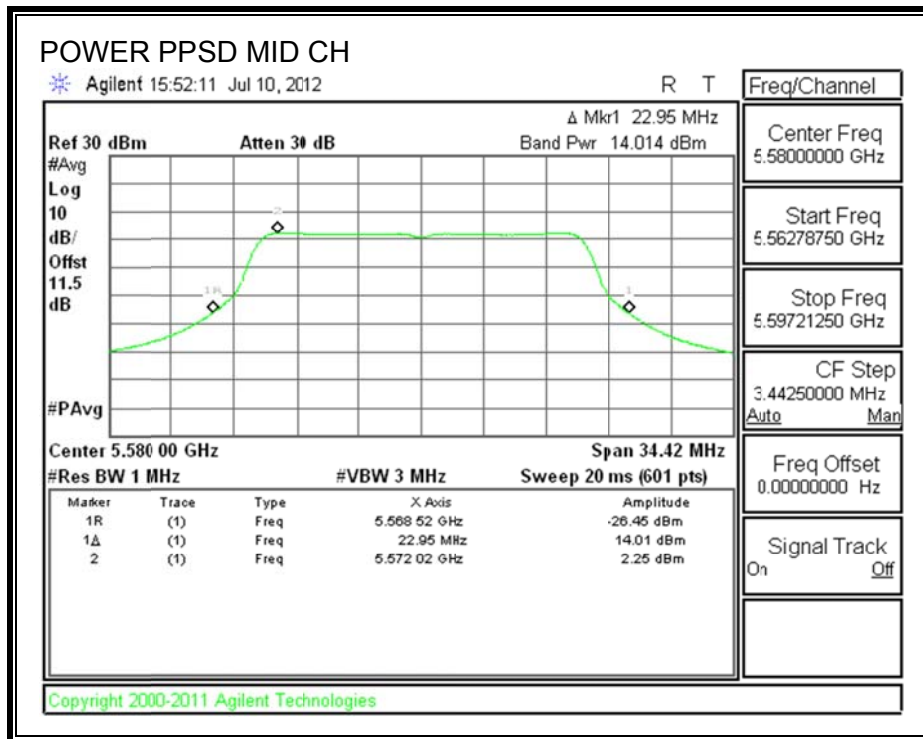
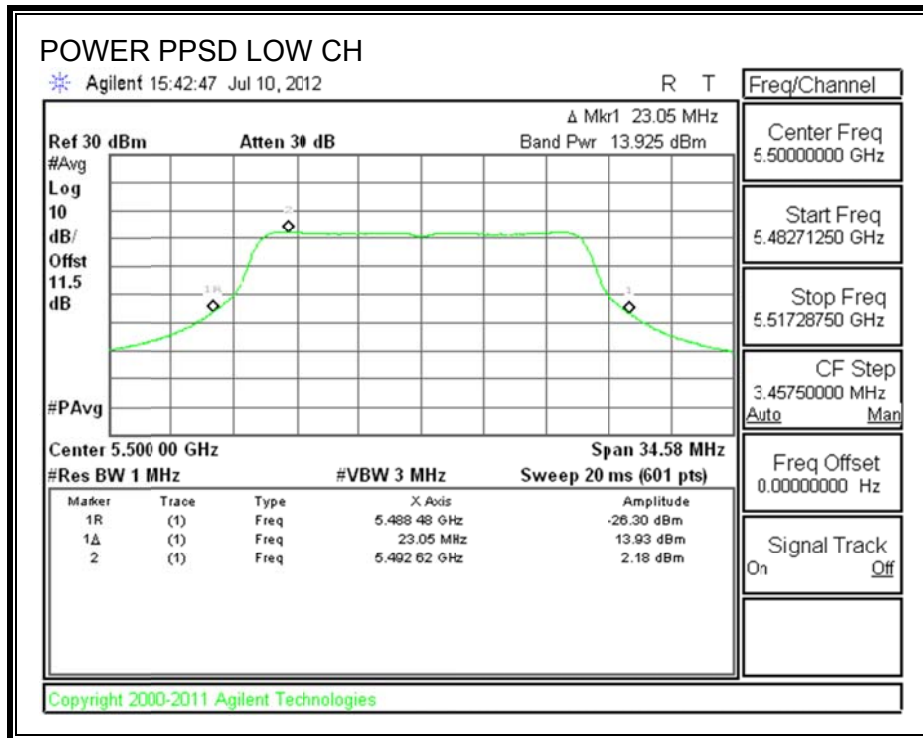
**Output Power Results**

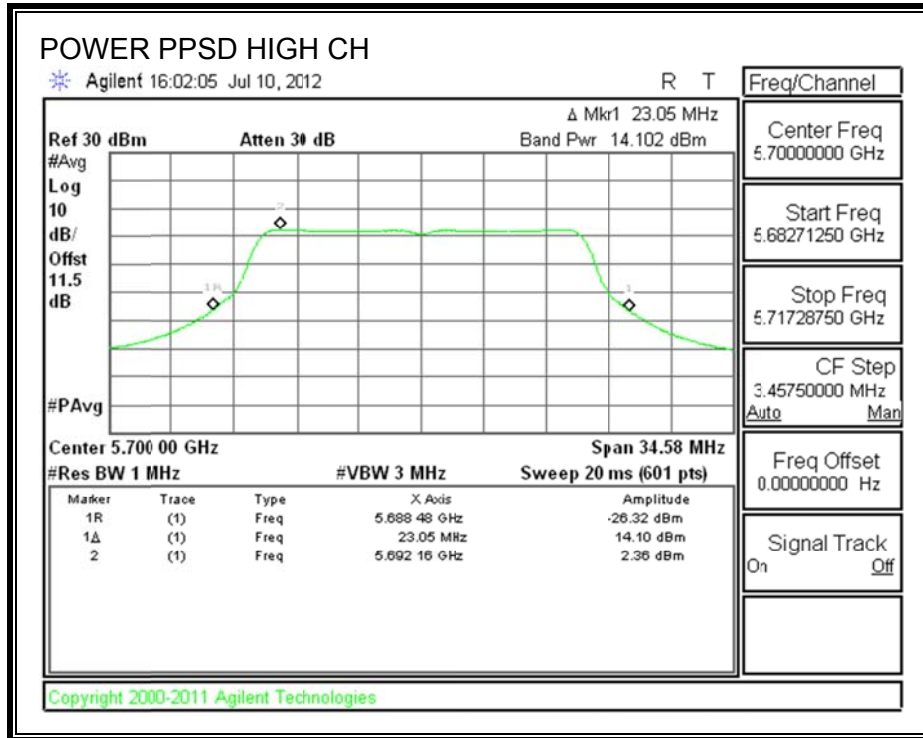
Channel	Frequency (MHz)	Meas Power (dBm)	Corr'd Power (dBm)	Power Limit (dBm)	Power Margin (dB)
Low	5500	13.93	14.01	23.49	-9.48
Mid	5580	14.01	14.09	23.49	-9.40
High	5700	14.10	14.18	23.50	-9.31

**PPSD Results**

Channel	Frequency (MHz)	Meas PPSD (dBm)	Corr'd PPSD (dBm)	PPSD Limit (dBm)	PPSD Margin (dB)
Low	5500	2.18	2.26	11.00	-8.74
Mid	5580	2.25	2.33	11.00	-8.67
High	5700	2.36	2.44	11.00	-8.56

**OUTPUT POWER AND PPSD**





### 8.8.5. PEAK EXCURSION

#### LIMITS

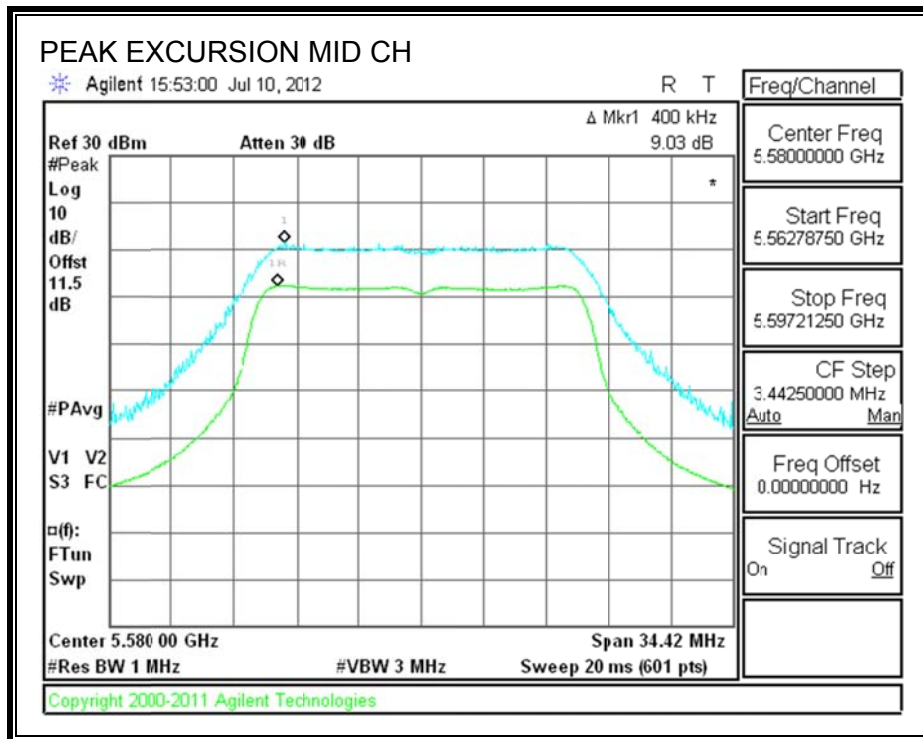
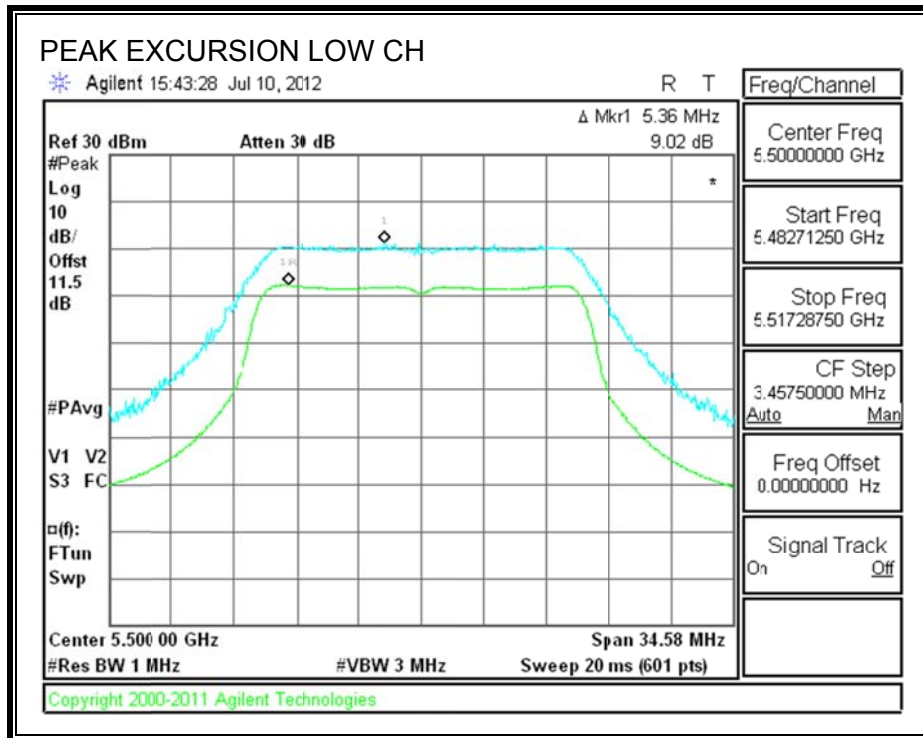
FCC §15.407 (a) (6)

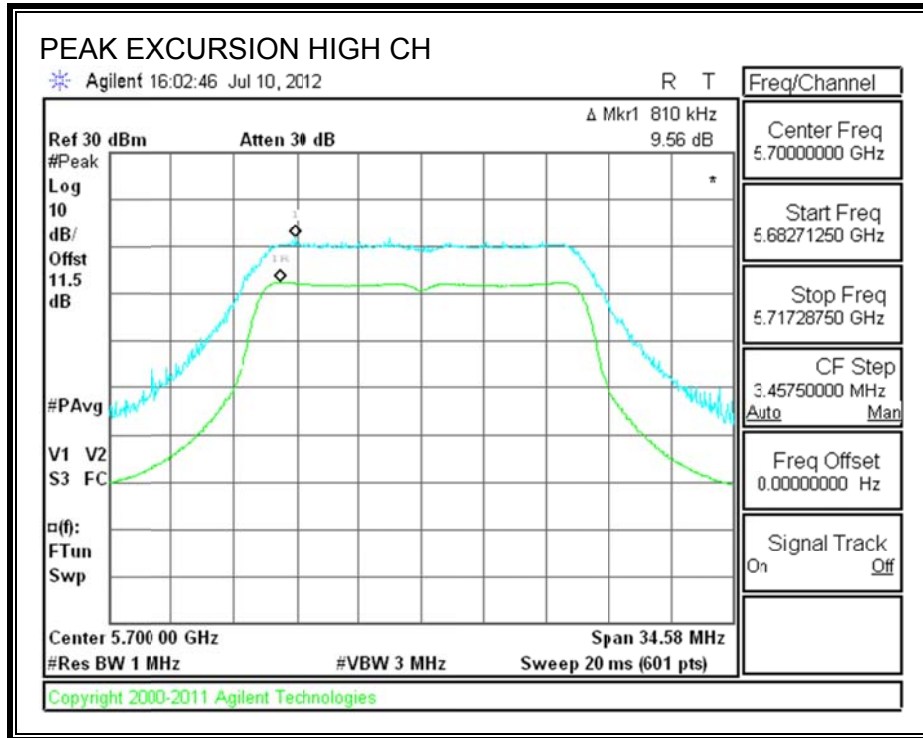
The ratio of the peak excursion of the modulation envelope (measured using a peak hold function) to the peak transmit power (measured as specified above) shall not exceed 13 dB across any 1 MHz bandwidth or the emission bandwidth whichever is less.

#### RESULTS

Channel	Frequency (MHz)	Peak Excursion (dB)	Limit (dB)	Margin (dB)
Low	5500	9.02	13	-3.98
Mid	5580	9.03	13	-3.97
High	5700	9.56	13	-3.44

**PEAK EXCURSION**





## 8.9. 802.11n HT40 MODE IN THE 5.6 GHz BAND

### 8.9.1. 26 dB BANDWIDTH

#### LIMITS

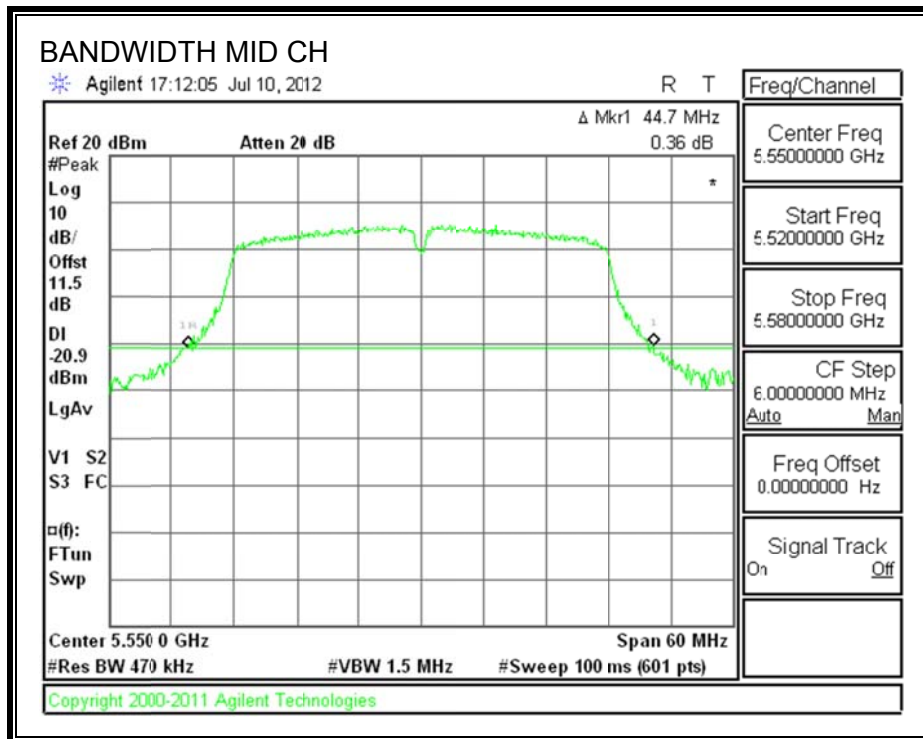
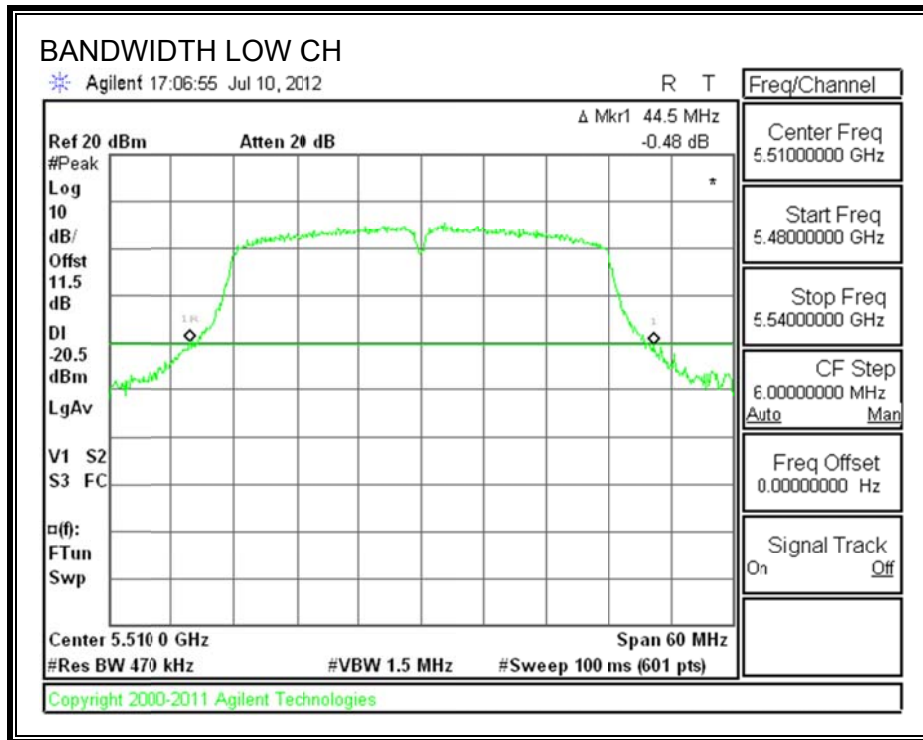
None; for reporting purposes only.

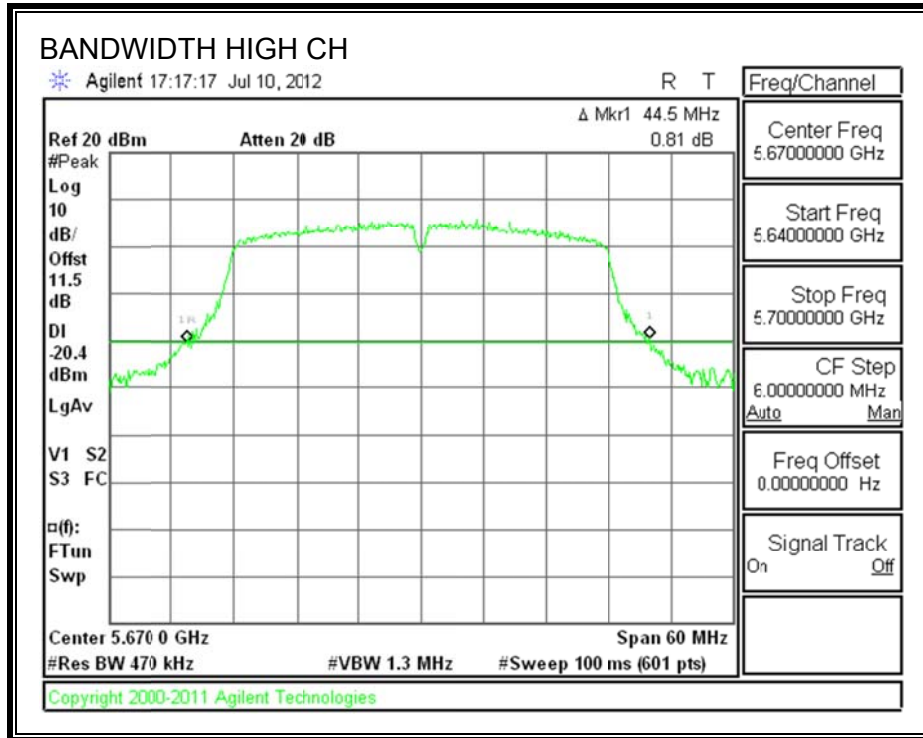
#### RESULTS

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
Low	5510	44.5
Mid	5550	44.7
High	5670	44.5



**26 dB BANDWIDTH**





### 8.9.2. 99% BANDWIDTH

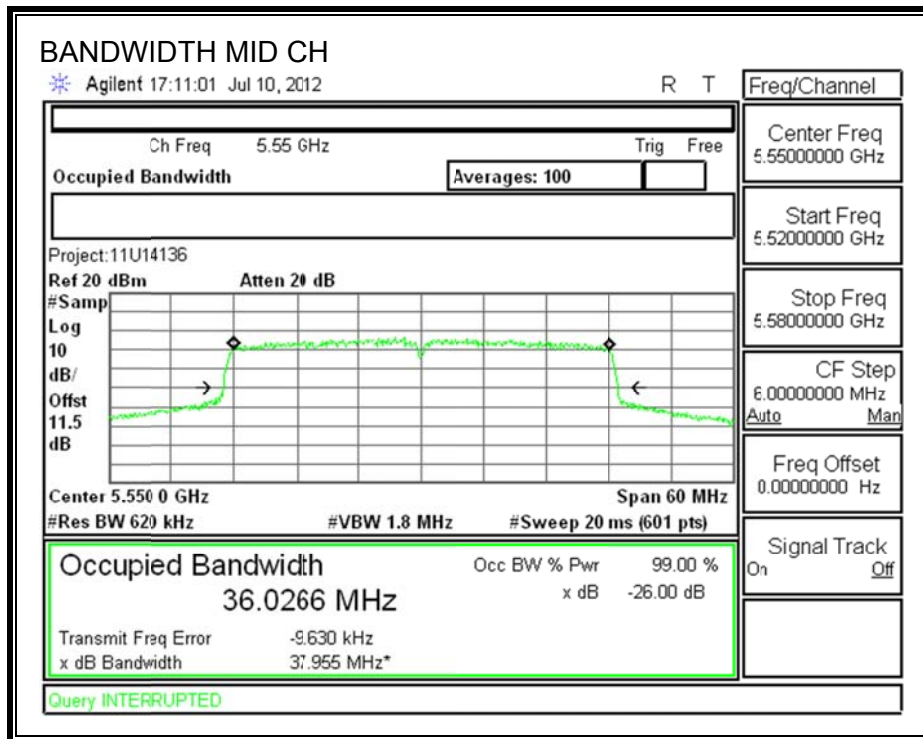
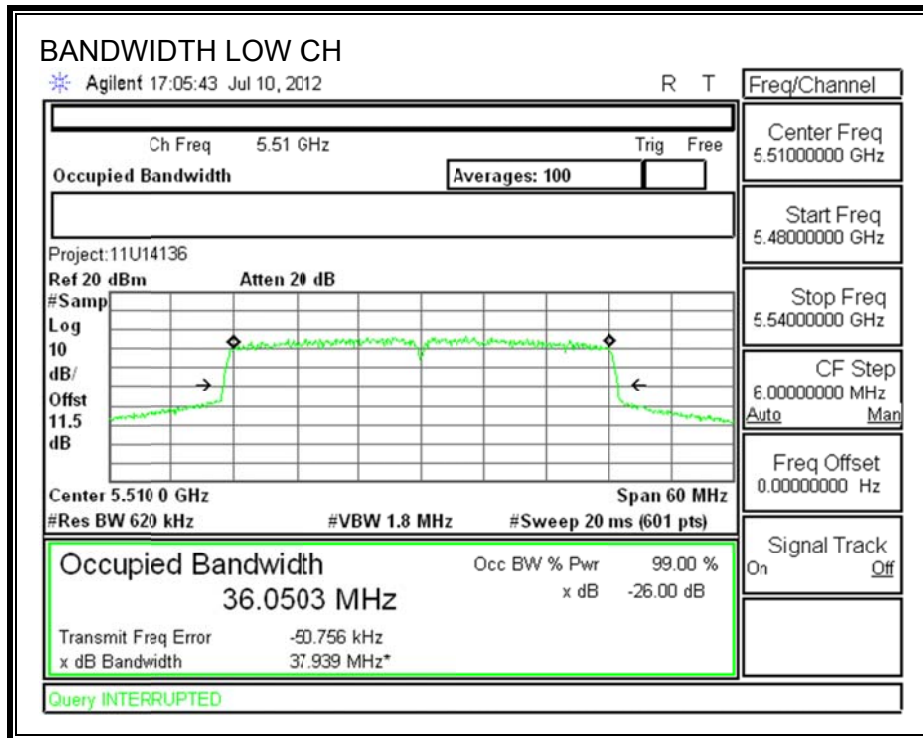
#### LIMITS

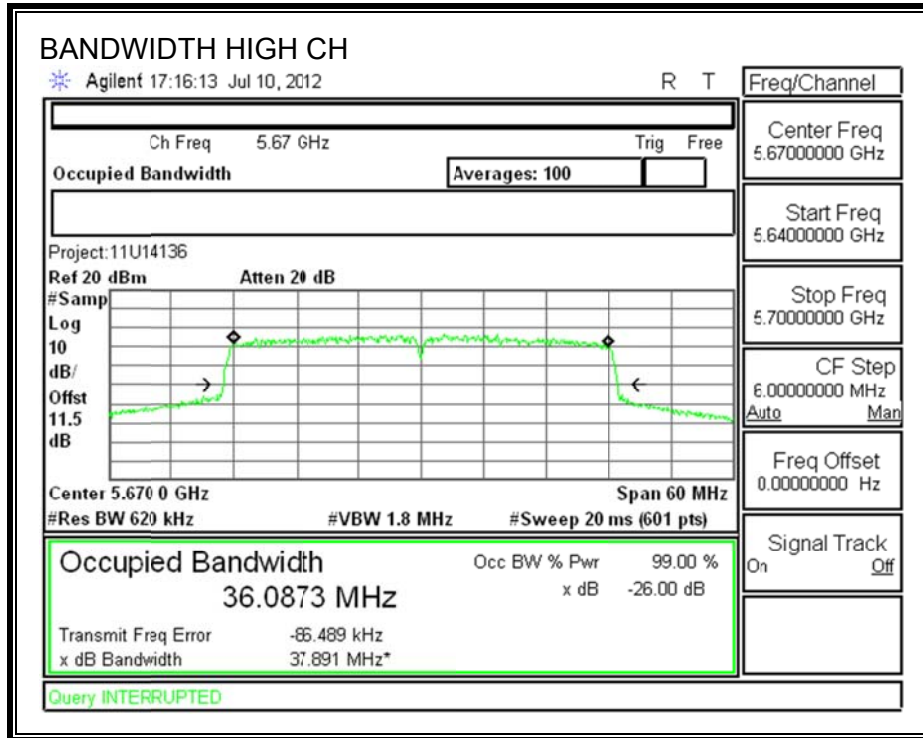
None; for reporting purposes only.

#### RESULTS

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	5510	36.1
Mid	5550	36.0
High	5670	36.1

**99% BANDWIDTH**





### 8.9.3. AVERAGE POWER

#### LIMITS

None; for reporting purposes only.

#### TEST PROCEDURE

The transmitter output is connected to a power meter.

The cable assembly insertion loss of 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.

#### RESULTS

Channel	Frequency (MHz)	Power (dBm)
Low	5510	11.95
Mid	5550	11.97
High	5670	11.95

#### **8.9.4. OUTPUT POWER AND PPSD**

##### **LIMITS**

FCC §15.407 (a) (2)

IC RSS-210 A9.2 (3)

For the band 5.15–5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed the lesser of 50 mW or  $4 \text{ dBm} + 10 \log B$ , where B is the 99% emission bandwidth for IC (26dB emission bandwidth for FCC) in MHz. In addition, the peak power spectral density shall not exceed 4 dBm in any 1-MHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

99% bandwidth was used to calculate the power limit which was considered the worst case.

##### **DIRECTIONAL ANTENNA GAIN**

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

**RESULTS**

**Limits**

Channel	Frequency (MHz)	Fixed Limit (dBm)	B (MHz)	11 + 10 Log B (dBm)	Directional Gain (dBi)	Power Limit (dBm)	PPSD Limit (dBm)
Low	5510	24	36.1	26.57	-0.83	24.00	11.00
Mid	5550	24	36.0	26.57	-0.83	24.00	11.00
High	5670	24	36.1	26.57	-0.83	24.00	11.00

<b>Duty Cycle CF (dB)</b>	0.16	<b>Included in Calculations of Corr'd Power &amp; PPSD</b>
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**Output Power Results**

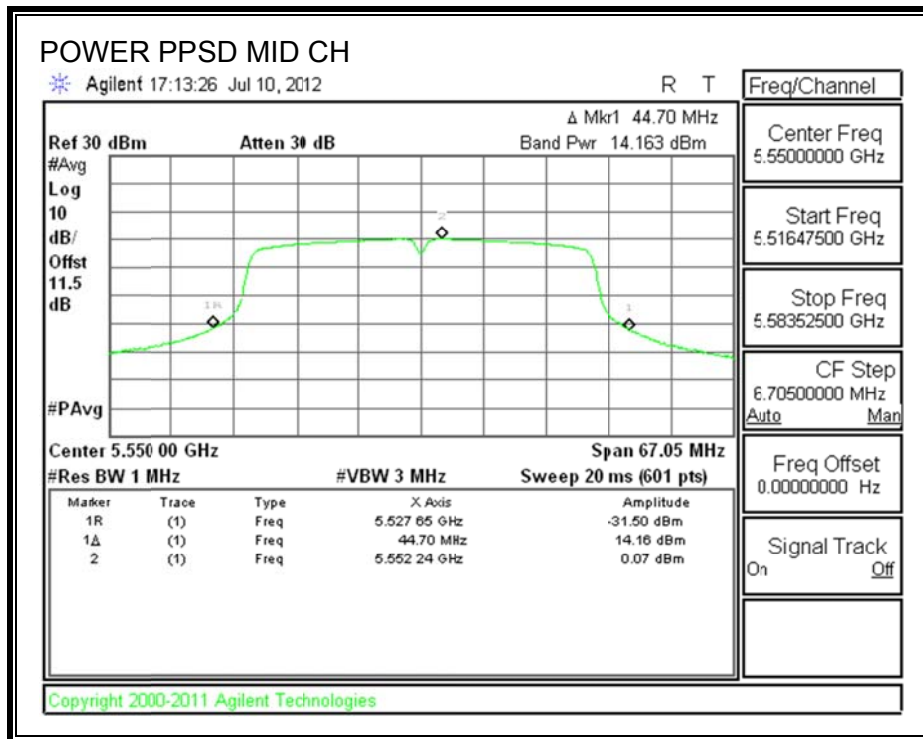
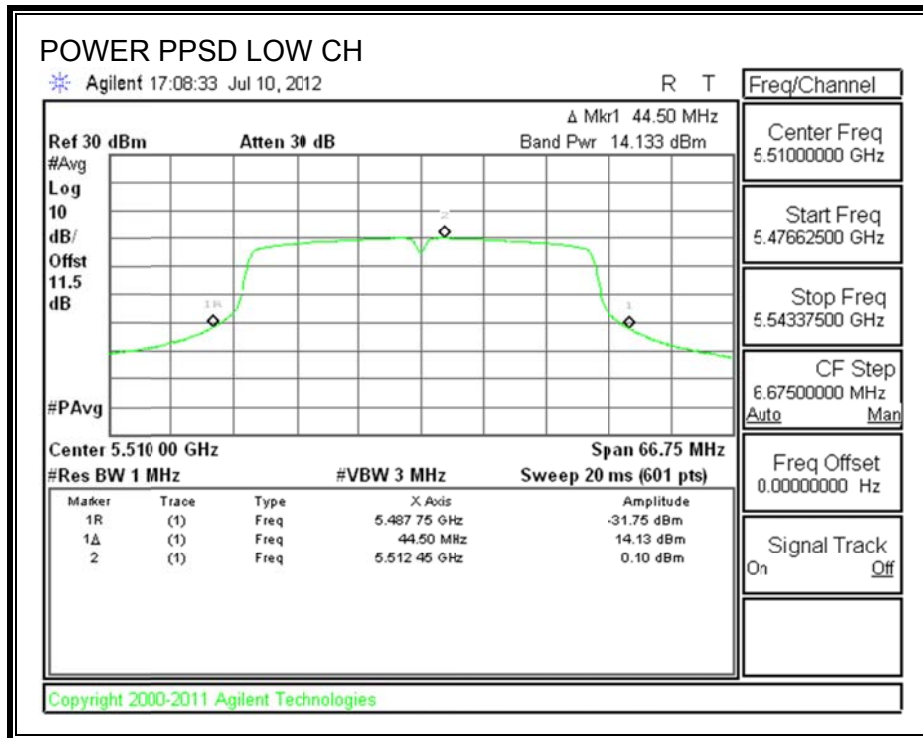
Channel	Frequency (MHz)	Meas Power (dBm)	Corr'd Power (dBm)	Power Limit (dBm)	Power Margin (dB)
Low	5510	14.13	14.29	24.00	-9.71
Mid	5550	14.16	14.32	24.00	-9.68
High	5670	14.00	14.16	24.00	-9.84

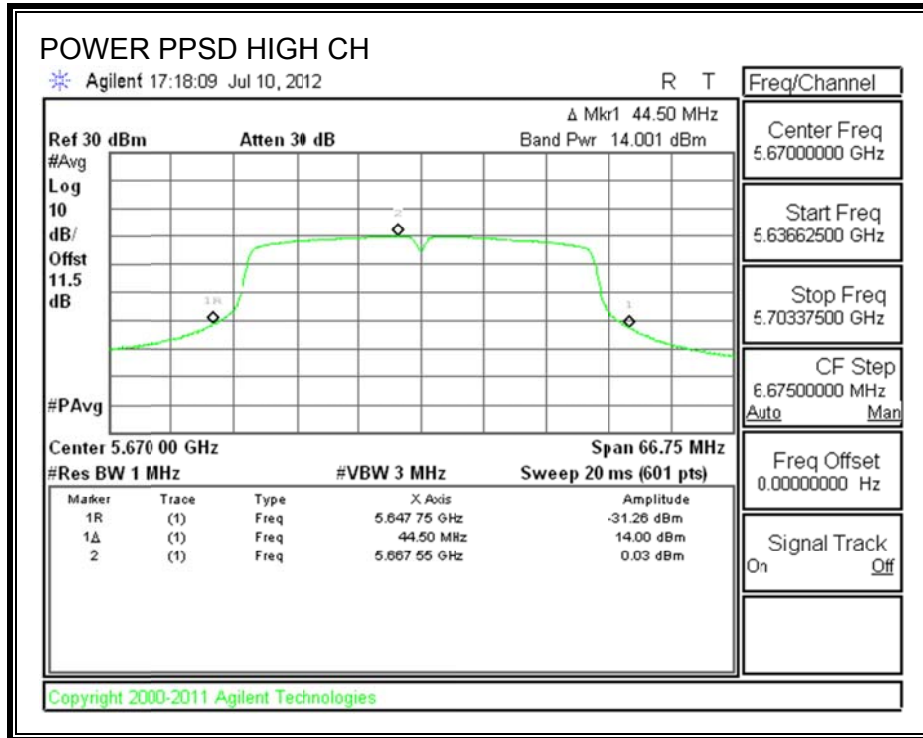
**PPSD Results**

Channel	Frequency (MHz)	Meas PPSD (dBm)	Corr'd PPSD (dBm)	PPSD Limit (dBm)	PPSD Margin (dB)
Low	5510	0.10	0.26	11.00	-10.74
Mid	5550	0.07	0.23	11.00	-10.77
High	5670	0.03	0.19	11.00	-10.81



**OUTPUT POWER AND PPSD**





### 8.9.5. PEAK EXCURSION

#### LIMITS

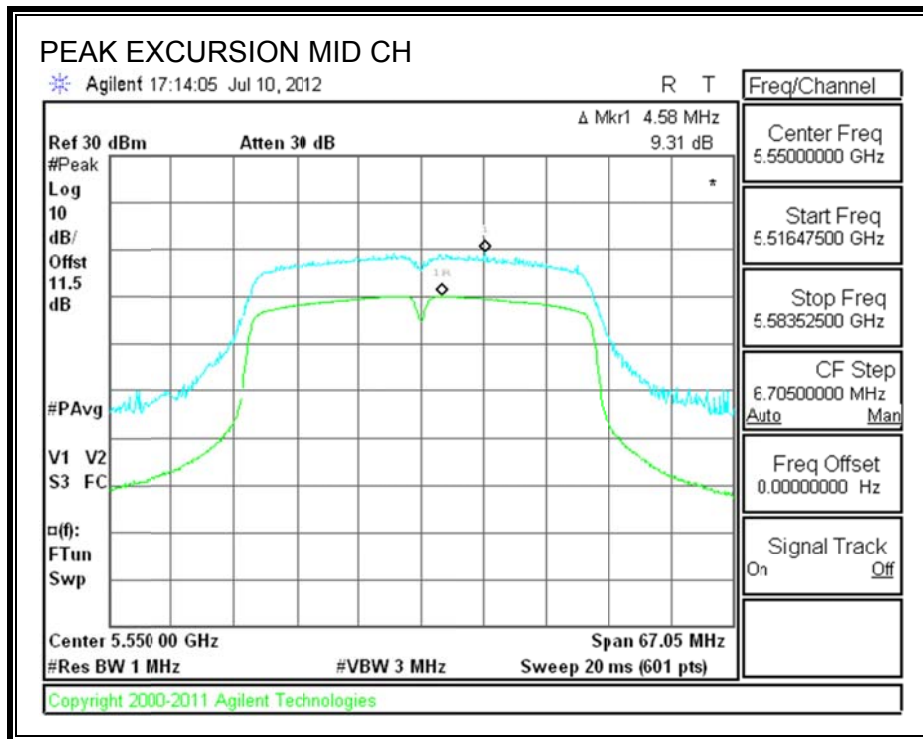
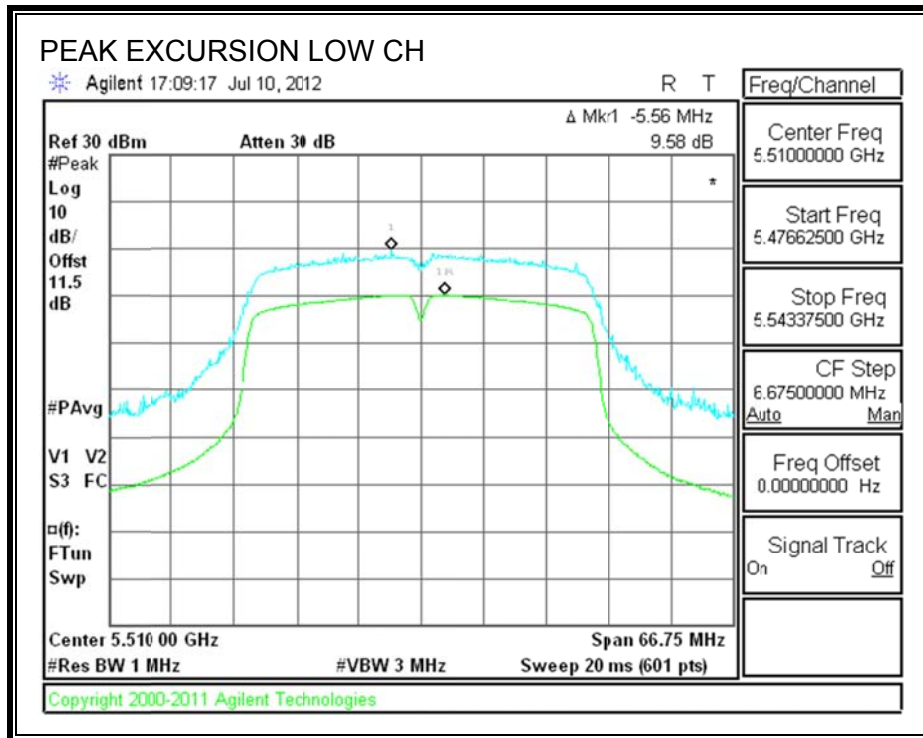
FCC §15.407 (a) (6)

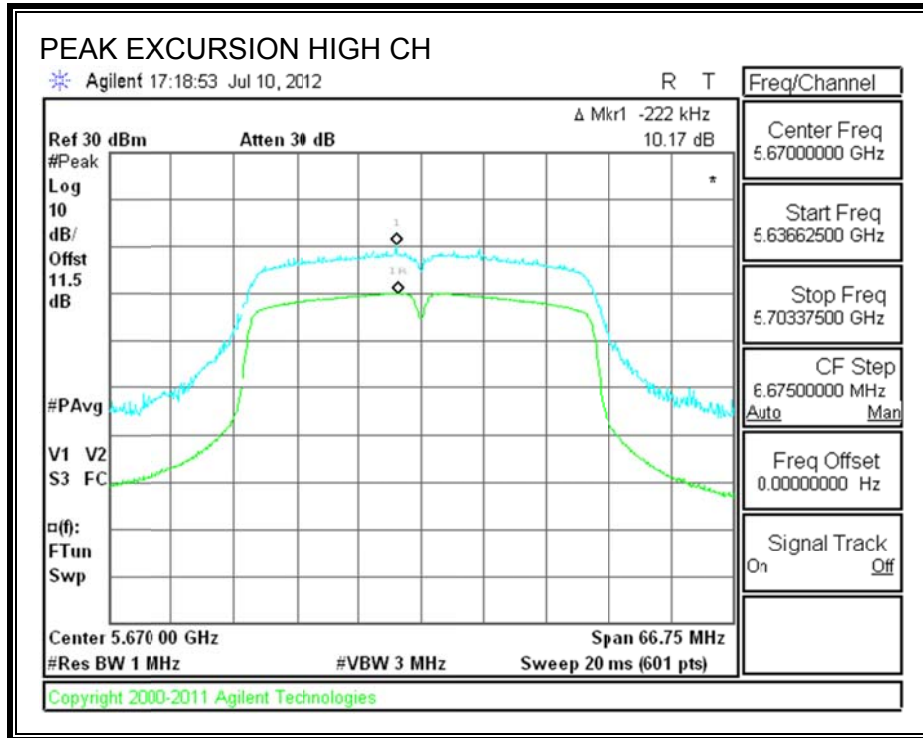
The ratio of the peak excursion of the modulation envelope (measured using a peak hold function) to the peak transmit power (measured as specified above) shall not exceed 13 dB across any 1 MHz bandwidth or the emission bandwidth whichever is less.

#### RESULTS

Channel	Frequency (MHz)	Peak Excursion (dB)	Limit (dB)	Margin (dB)
Low	5510	9.58	13	-3.42
Mid	5550	9.31	13	-3.69
High	5670	10.17	13	-2.83

**PEAK EXCURSION**





## 9. RADIATED TEST RESULTS

### 9.1. 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.

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.

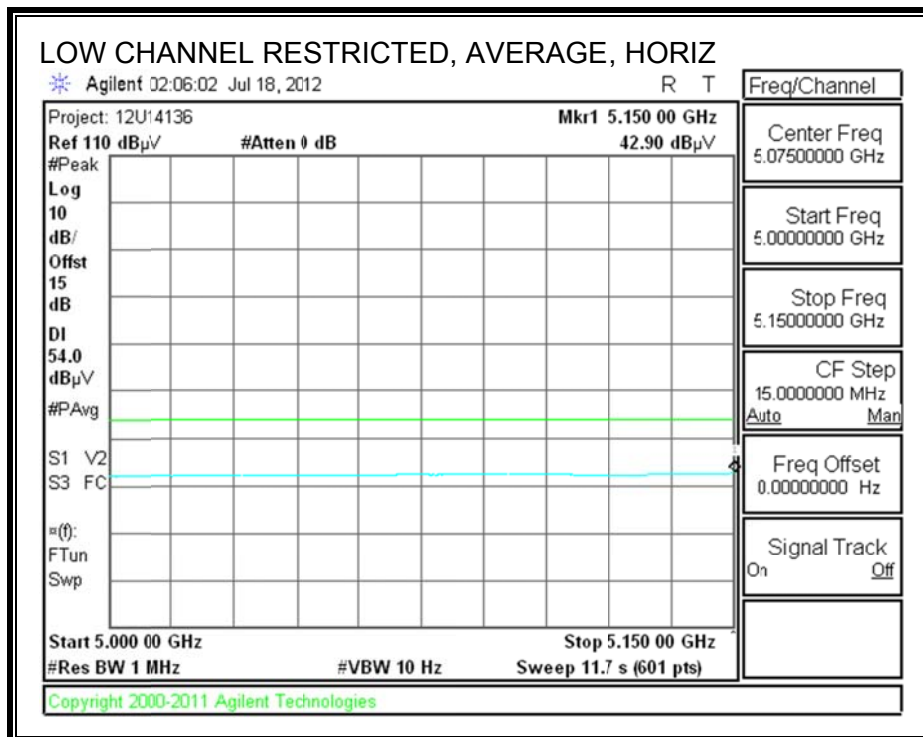
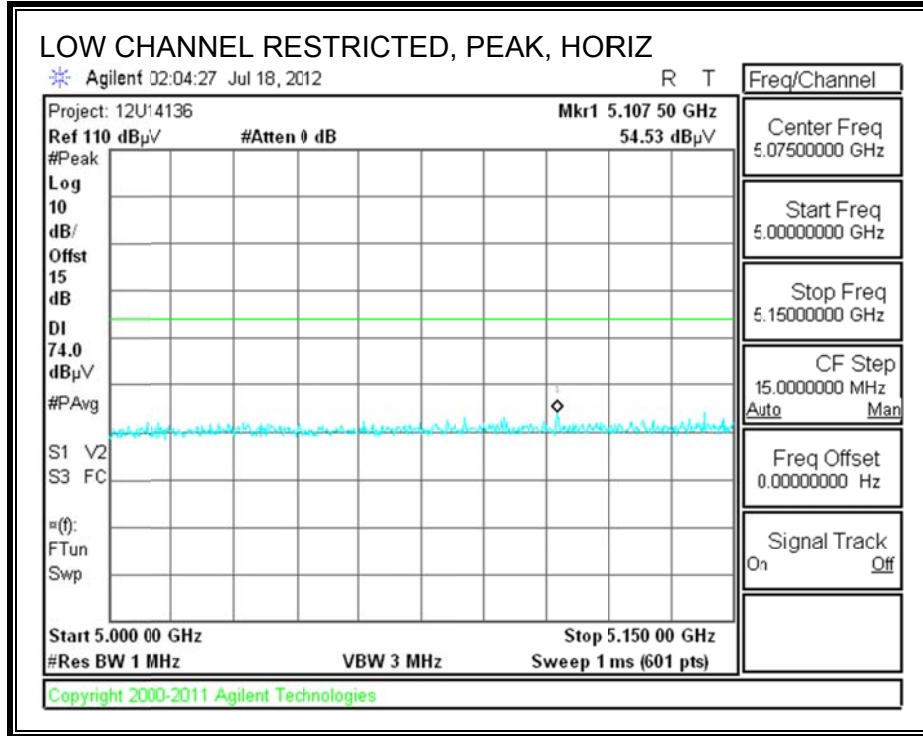
For measurements above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 1 MHz for peak measurements and as applicable for average measurements.

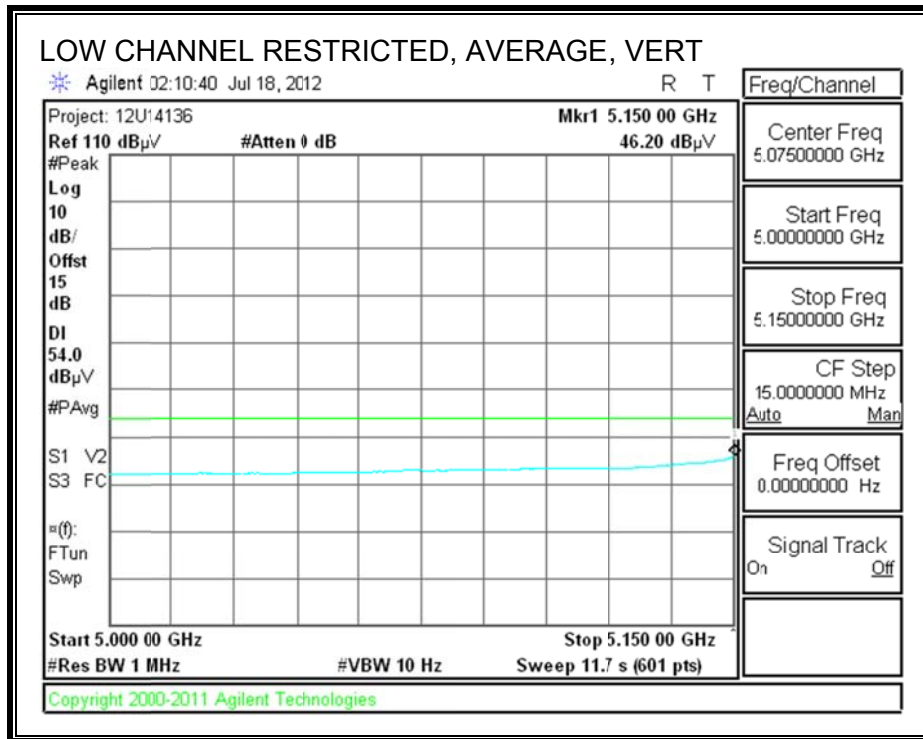
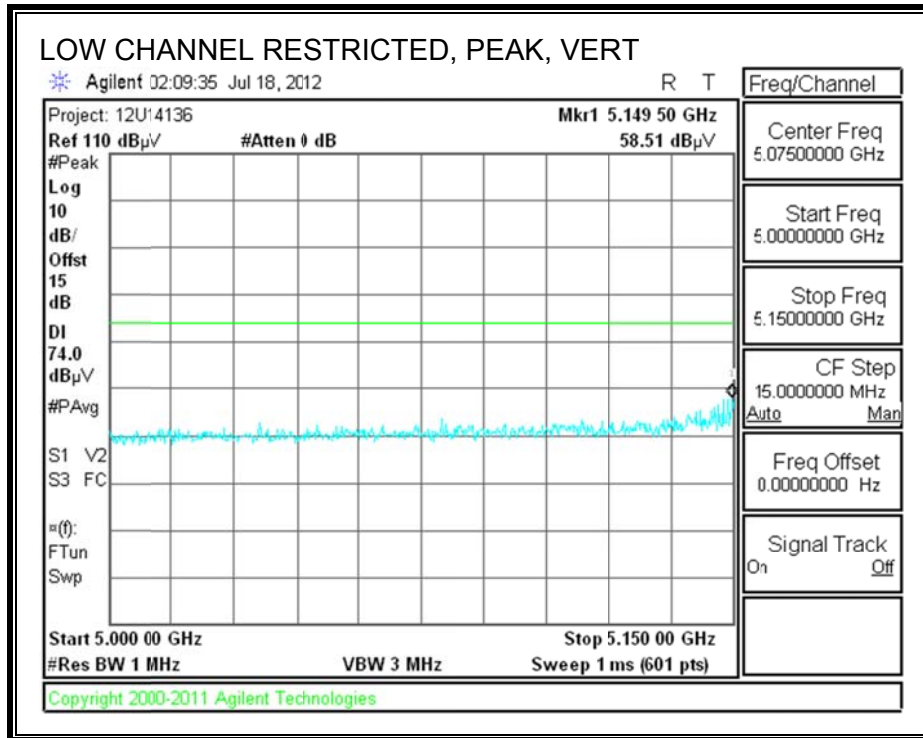
The spectrum from 30 MHz to 40 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in each applicable band.

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.

## 9.2. TRANSMITTER ABOVE 1 GHz

### 9.2.1. TX ABOVE 1 GHz 802.11a MODE IN THE 5.2 GHz BAND RESTRICTED BANDEDGE (LOW CHANNEL)







### HARMONICS AND SPURIOUS EMISSIONS

**High Frequency Measurement**  
 Compliance Certification Services, Fremont 5m Chamber

Test Engr: Tom Chen  
 Date: 07/19/12  
 Project #: 11U14136  
 Company: Apple Inc.  
 Test Target: FCC Class B  
 Mode Oper: 802.11a, TX mode

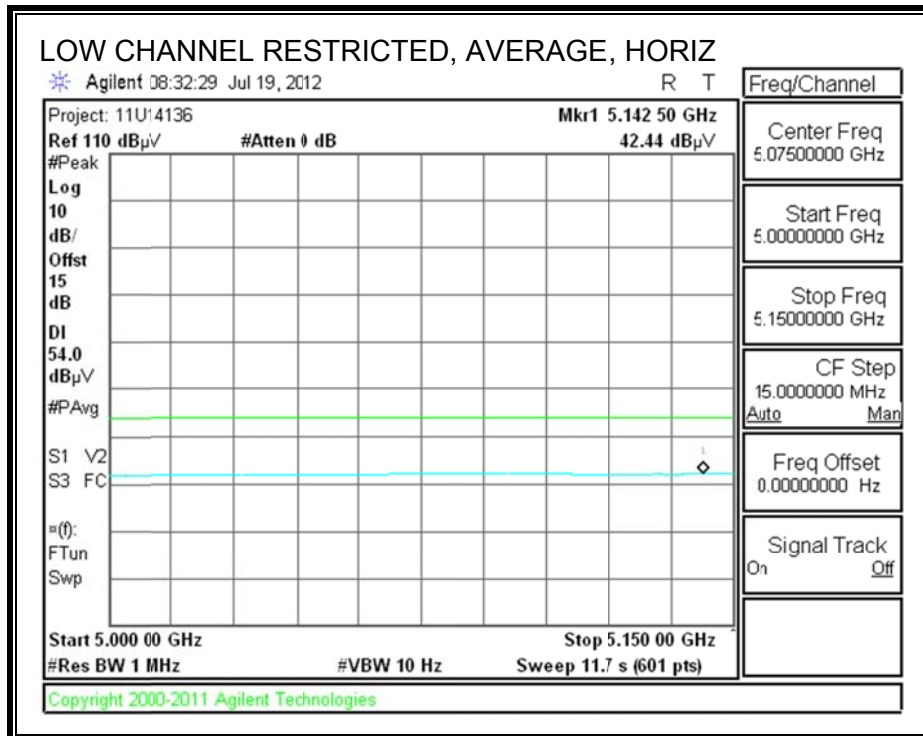
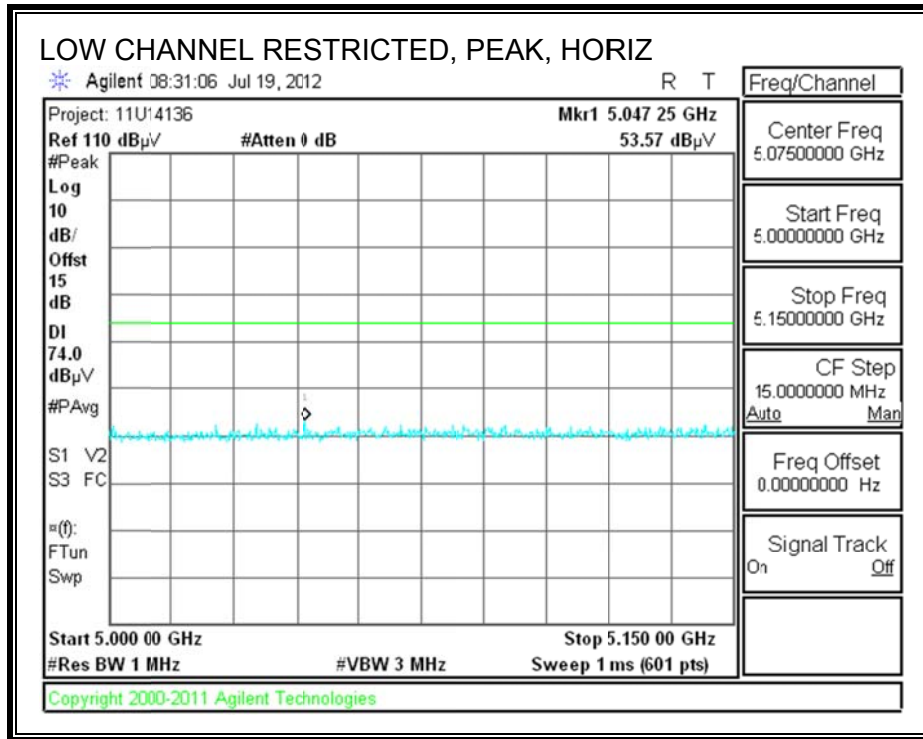
f Measurement Frequency Amp Preamp Gain Average Field Strength Limit  
 Dist Distance to Antenna D Corr Distance Correct to 3 meters Peak Field Strength Limit  
 Read Analyzer Reading Avg Average Field Strength @ 3 m Margin vs. Average Limit  
 AF Antenna Factor Peak Calculated Peak Field Strength Margin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

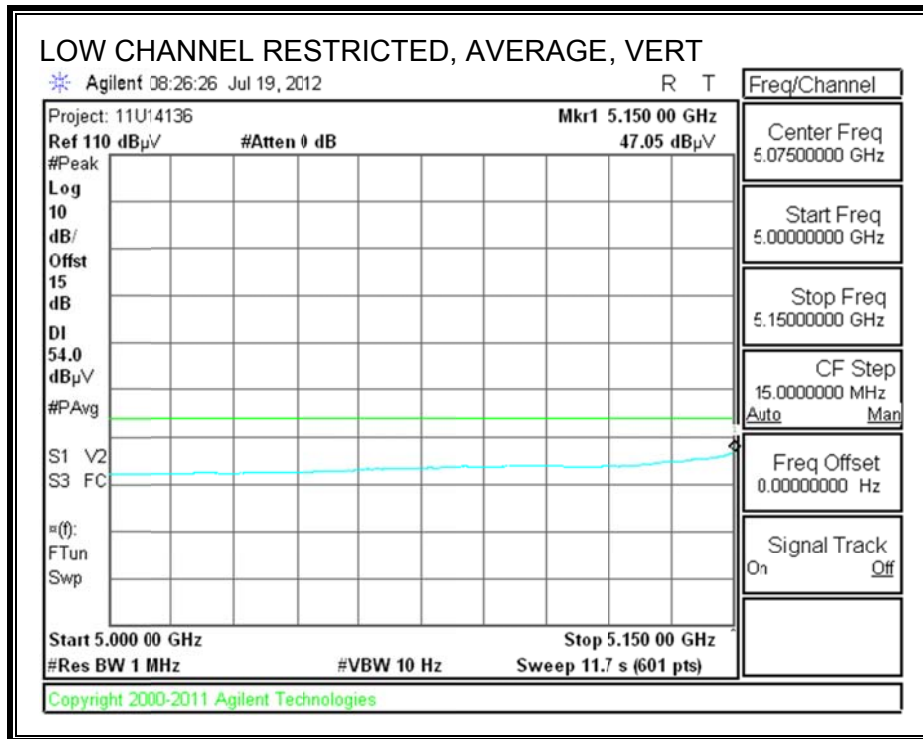
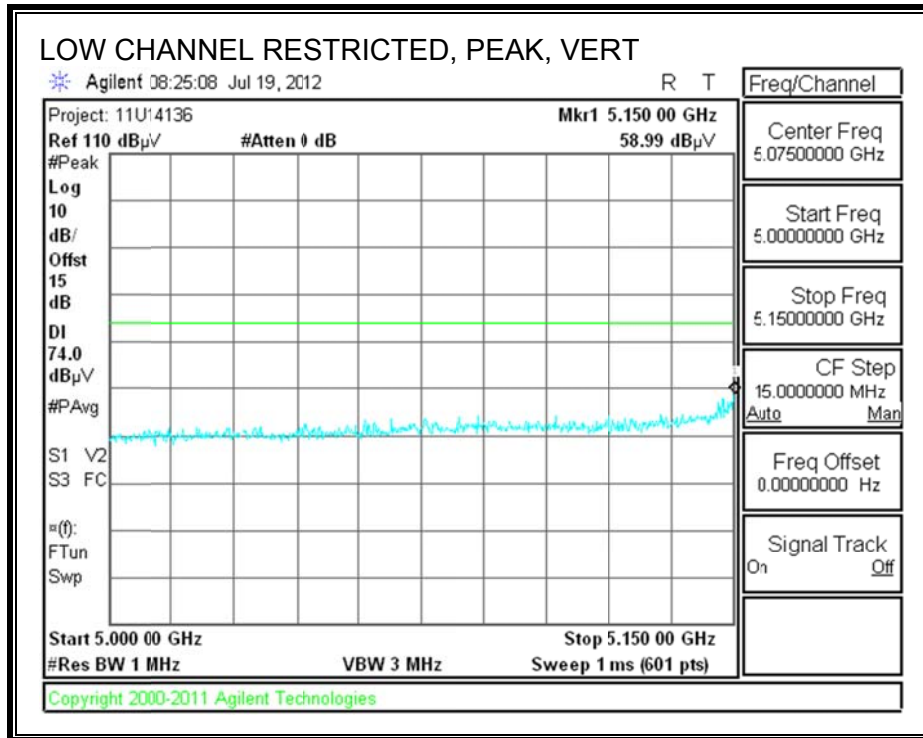
f GHz	Dist (m)	Read dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Corr. dBuV/m	Limit dBuV/m	Margin dB	Ant. Pol. V/H	Det. P/A/QP	Notes
<b>5180MHz 11a</b>													
15.540	3.0	36.7	39.1	12.2	-32.3	0.0	0.7	56.4	74.0	-17.6	V	P	
15.540	3.0	25.7	39.1	12.2	-32.3	0.0	0.7	45.4	54.0	-8.6	V	A	
15.540	3.0	35.5	39.1	12.2	-32.3	0.0	0.7	55.2	74.0	-18.8	H	P	
15.540	3.0	25.7	39.1	12.2	-32.3	0.0	0.7	45.4	54.0	-8.6	H	A	
<b>5200MHz 11a</b>													
15.600	3.0	36.5	38.9	12.2	-32.3	0.0	0.7	56.0	74.0	-18.0	H	P	
15.600	3.0	25.6	38.9	12.2	-32.3	0.0	0.7	45.1	54.0	-8.9	H	A	
15.600	3.0	36.3	38.9	12.2	-32.3	0.0	0.7	55.9	74.0	-18.1	V	P	
15.600	3.0	25.6	38.9	12.2	-32.3	0.0	0.7	45.1	54.0	-8.9	V	A	
<b>5240MHz 11a</b>													
15.720	3.0	36.2	38.5	12.3	-32.2	0.0	0.7	55.5	74.0	-18.5	V	P	
15.720	3.0	25.5	38.5	12.3	-32.2	0.0	0.7	44.8	54.0	-9.2	V	A	
15.720	3.0	35.6	38.5	12.3	-32.2	0.0	0.7	54.9	74.0	-19.1	H	P	
15.720	3.0	25.5	38.5	12.3	-32.2	0.0	0.7	44.7	54.0	-9.3	H	A	

Rev. 4.1.2.7

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

### 9.2.2. TX ABOVE 1 GHz 802.11n HT20 MODE IN THE 5.2 GHz BAND RESTRICTED BANDEDGE (LOW CHANNEL)





### HARMONICS AND SPURIOUS EMISSIONS

**High Frequency Measurement**  
 Compliance Certification Services, Fremont 5m Chamber

**Test Engr:** Tom Chen  
**Date:** 07/19/12  
**Project #:** 11U14136  
**Company:** Apple Inc.  
**Test Target:** FCC Class B  
**Mode Oper:** 802.11n HT20, TX mode

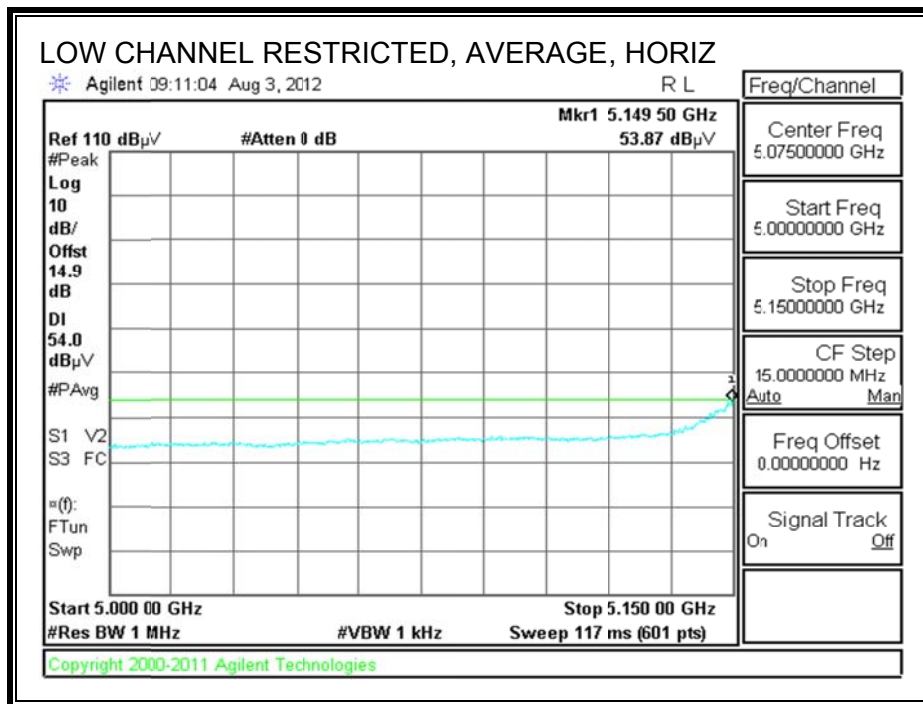
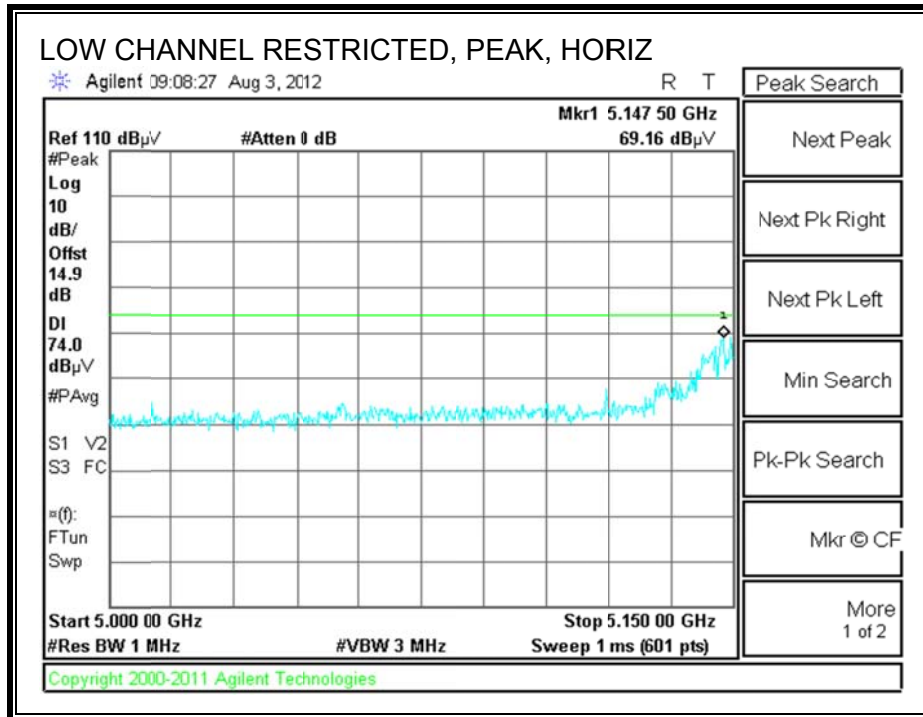
f	Measurement Frequency	Amp	Preamp Gain	Average Field Strength Limit
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters	Peak Field Strength Limit
Read	Analyzer Reading	Avg	Average Field Strength @ 3 m	Margin vs. Average Limit
AF	Antenna Factor	Peak	Calculated Peak Field Strength	Margin vs.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

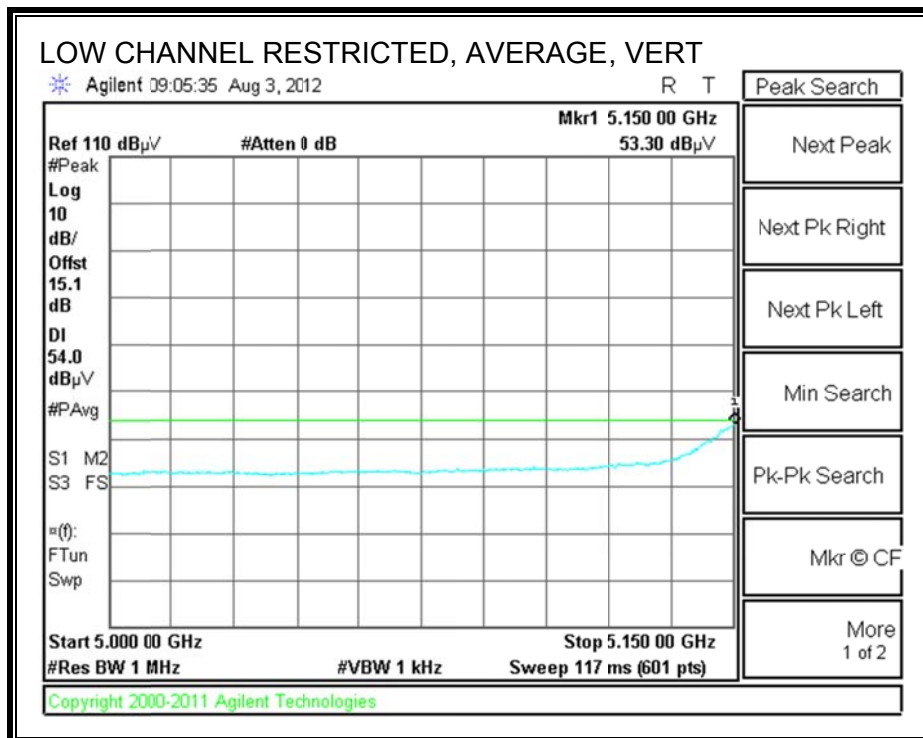
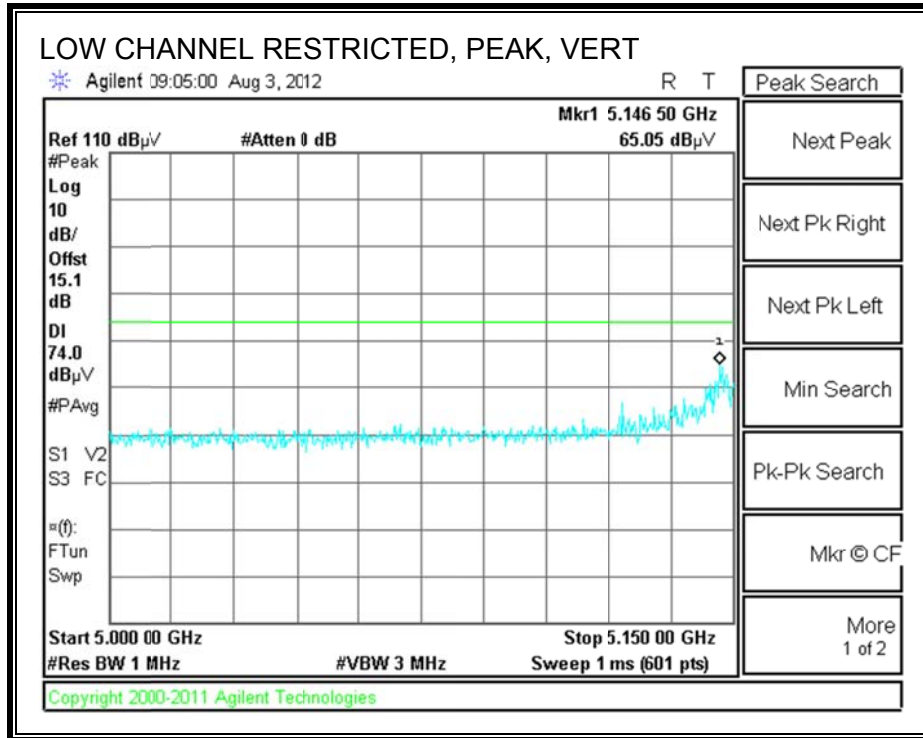
f GHz	Dist (m)	Read dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Corr. dBuV/m	Limit dBuV/m	Margin dB	Ant. Pol. V/H	Det. P/A/QP	Notes
<b>5180MHz HT20</b>													
15.540	3.0	36.1	39.1	12.2	-32.3	0.0	0.7	55.8	74.0	-18.2	H	P	
15.540	3.0	25.6	39.1	12.2	-32.3	0.0	0.7	45.3	54.0	-8.7	H	A	
15.540	3.0	35.7	39.1	12.2	-32.3	0.0	0.7	55.4	74.0	-18.6	V	P	
15.540	3.0	25.6	39.1	12.2	-32.3	0.0	0.7	45.3	54.0	-8.7	V	A	
<b>5200MHz HT20</b>													
15.600	3.0	36.1	38.9	12.2	-32.3	0.0	0.7	55.7	74.0	-18.3	V	P	
15.600	3.0	25.5	38.9	12.2	-32.3	0.0	0.7	45.1	54.0	-8.9	V	A	
15.600	3.0	35.8	38.9	12.2	-32.3	0.0	0.7	55.4	74.0	-18.6	H	P	
15.600	3.0	25.5	38.9	12.2	-32.3	0.0	0.7	45.1	54.0	-8.9	H	A	
<b>5240MHz HT20</b>													
15.720	3.0	36.1	38.5	12.3	-32.2	0.0	0.7	55.4	74.0	-18.6	H	P	
15.720	3.0	25.5	38.5	12.3	-32.2	0.0	0.7	44.7	54.0	-9.3	H	A	
15.720	3.0	35.7	38.5	12.3	-32.2	0.0	0.7	55.0	74.0	-19.0	V	P	
15.720	3.0	25.5	38.5	12.3	-32.2	0.0	0.7	44.8	54.0	-9.2	V	A	

Rev. 4.1.2.7

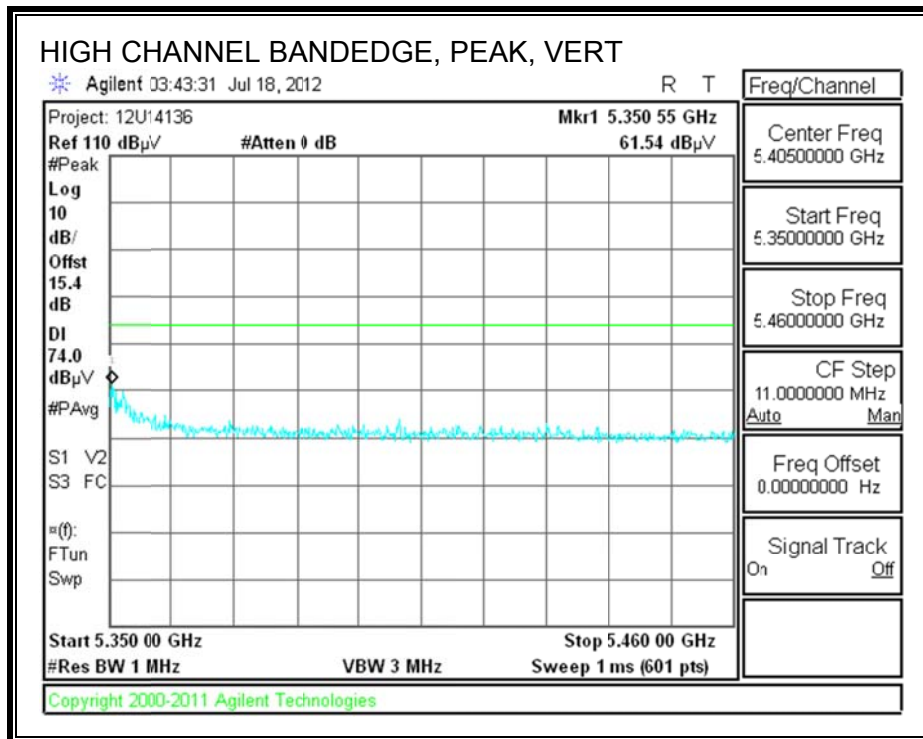
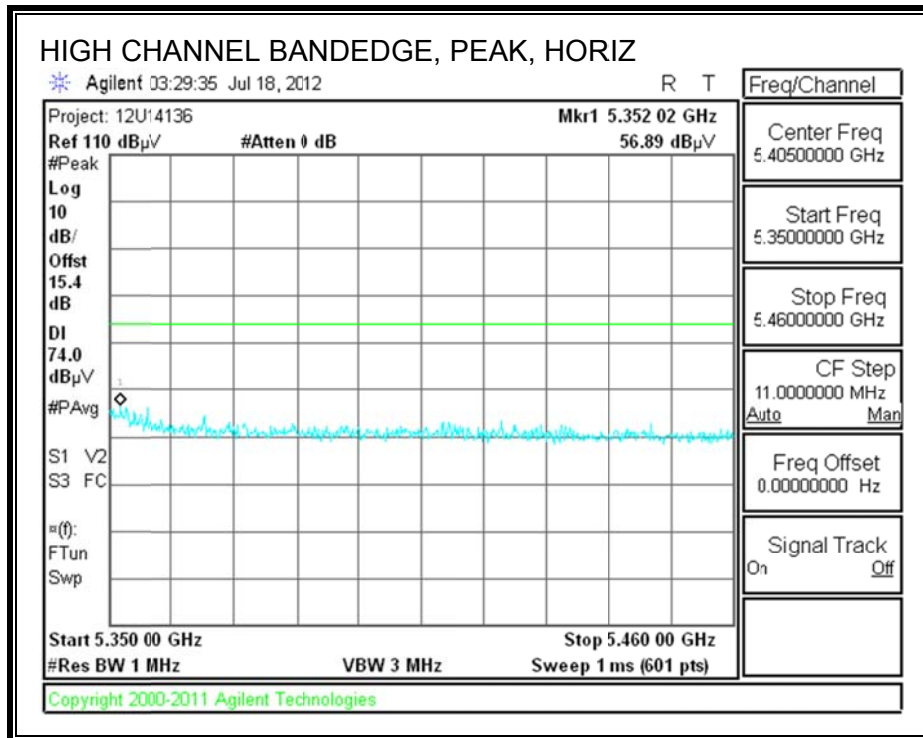
Note: No other emissions were detected above the system noise floor.

### 9.2.3. TX ABOVE 1 GHz 802.11n HT40 MODE IN THE 5.2 GHz BAND RESTRICTED BANDEDGE (LOW CHANNEL)





### AUTHORIZED BANDEDGE (HIGH CHANNEL)



### HARMONICS AND SPURIOUS EMISSIONS

**High Frequency Measurement**  
 Compliance Certification Services, Fremont 5m Chamber

**Test Engr:** Tom Chen  
**Date:** 07/20/12  
**Project #:** 11U14136  
**Company:** Apple Inc.  
**Test Target:** FCC Class B  
**Mode Oper:** 802.11n, HT40, TX mode

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	

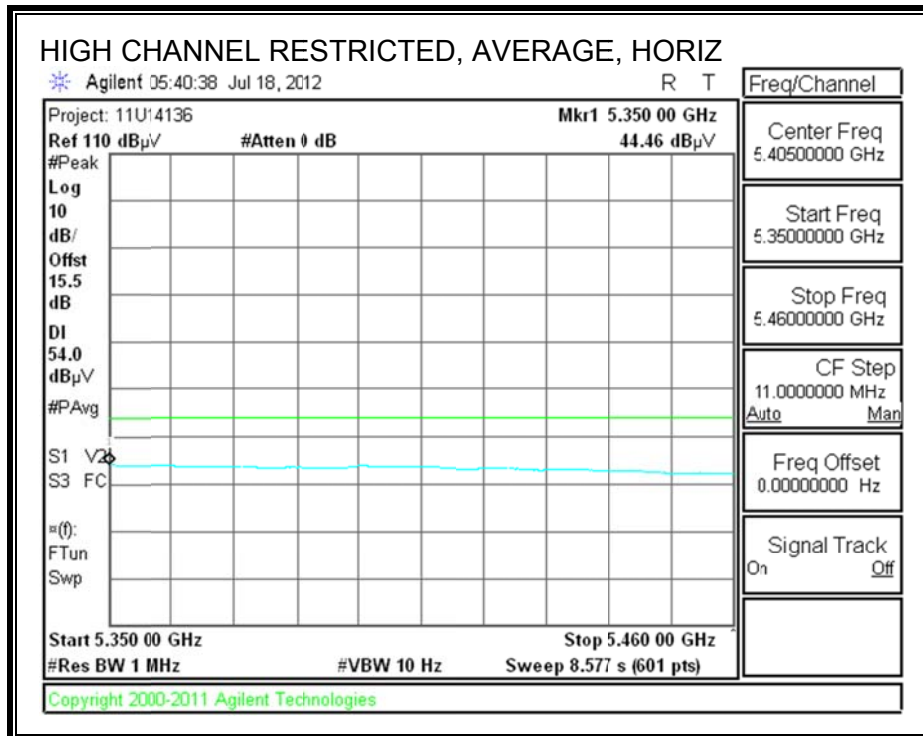
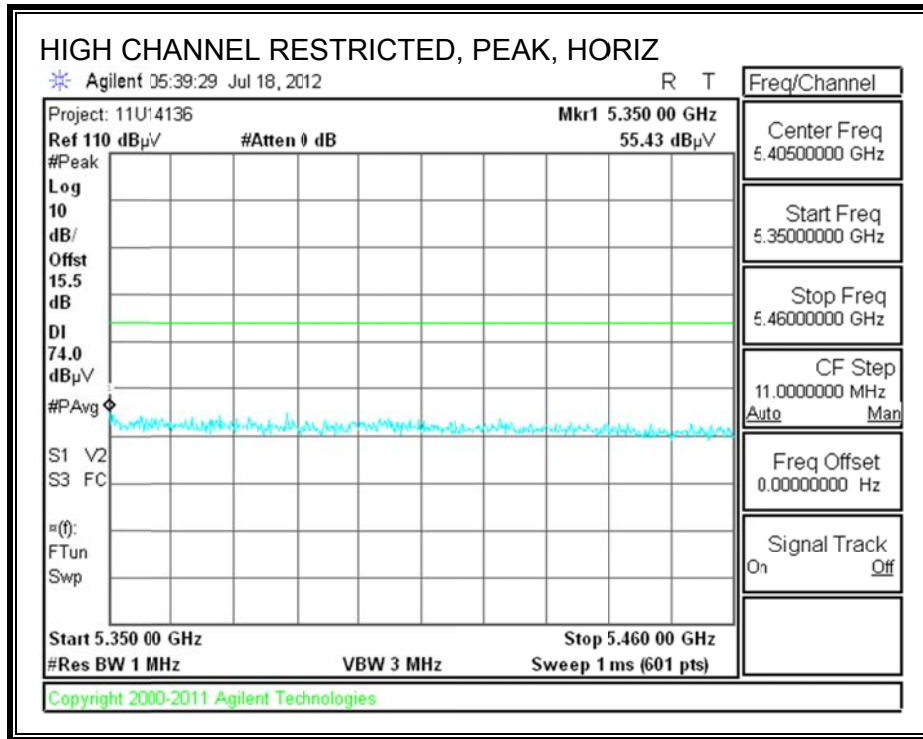
f GHz	Dist (m)	Read dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Filtr dB	Corr. dBuV/m	Limit dBuV/m	Margin dB	Ant. Pol. V/H	Det. P/A/QP	Notes
<b>5190MHz HT40</b>													
15.570	3.0	36.0	39.0	12.5	-32.3	0.0	0.7	56.0	74.0	-18.0	H	P	
15.570	3.0	25.5	39.0	12.5	-32.3	0.0	0.7	45.4	54.0	-8.6	H	A	
15.570	3.0	35.4	39.0	12.5	-32.3	0.0	0.7	55.4	74.0	-18.6	V	P	
15.570	3.0	25.5	39.0	12.5	-32.3	0.0	0.7	45.4	54.0	-8.6	V	A	
<b>5230MHz HT40</b>													
15.690	3.0	35.7	38.6	12.6	-32.3	0.0	0.7	55.3	74.0	-18.7	V	P	
15.690	3.0	25.4	38.6	12.6	-32.3	0.0	0.7	45.0	54.0	-9.0	V	A	
15.690	3.0	36.0	38.6	12.6	-32.3	0.0	0.7	55.6	74.0	-18.4	H	P	
15.690	3.0	25.3	38.6	12.6	-32.3	0.0	0.7	45.0	54.0	-9.0	H	A	

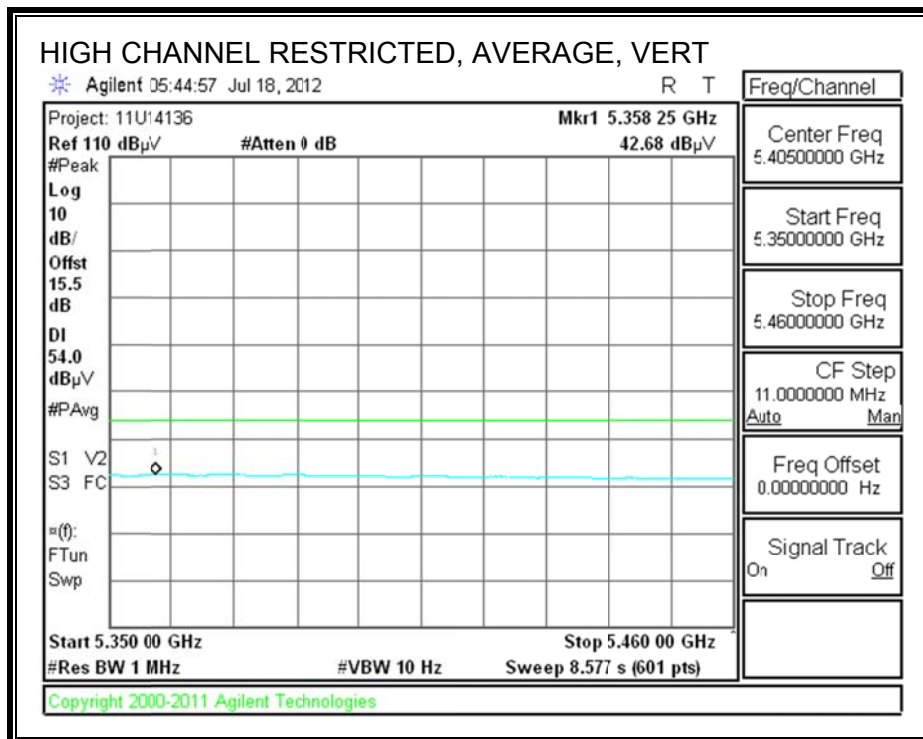
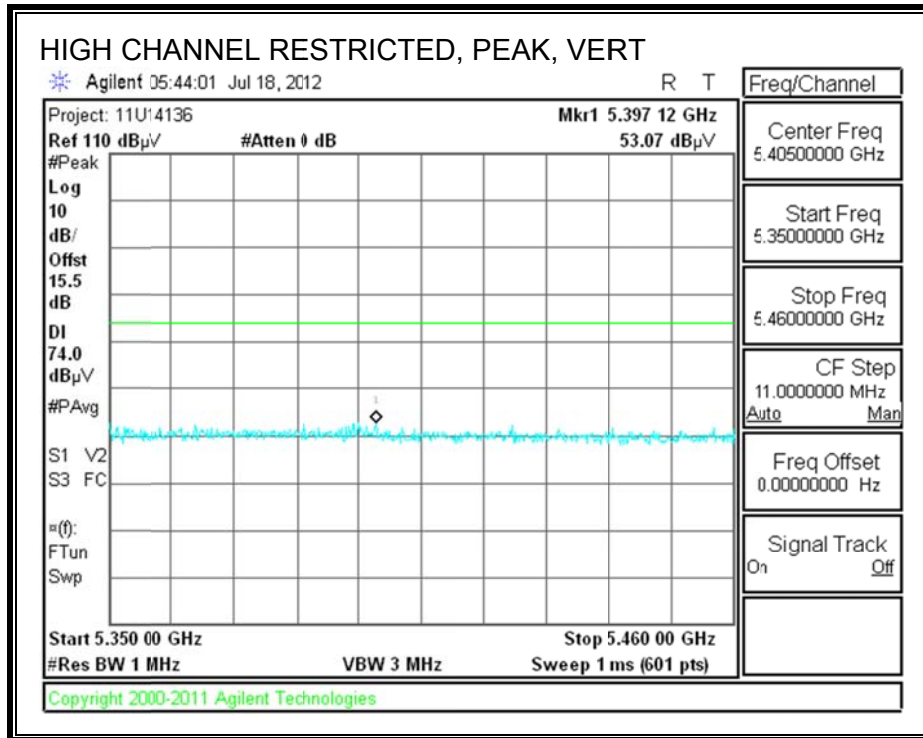
Rev. 4.1.2.7

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



### 9.2.4. TX ABOVE 1 GHz 802.11a MODE IN THE 5.3 GHz BAND RESTRICTED BANDEDGE (HIGH CHANNEL)





### HARMONICS AND SPURIOUS EMISSIONS

**High Frequency Measurement**

Compliance Certification Services, Fremont 5m Chamber

Test Engr: Tom Chen  
 Date: 07/19/12  
 Project #: 11U14136  
 Company: Apple Inc.  
 Test Target: FCC Class B  
 Mode Oper: 802.11a, TX mode

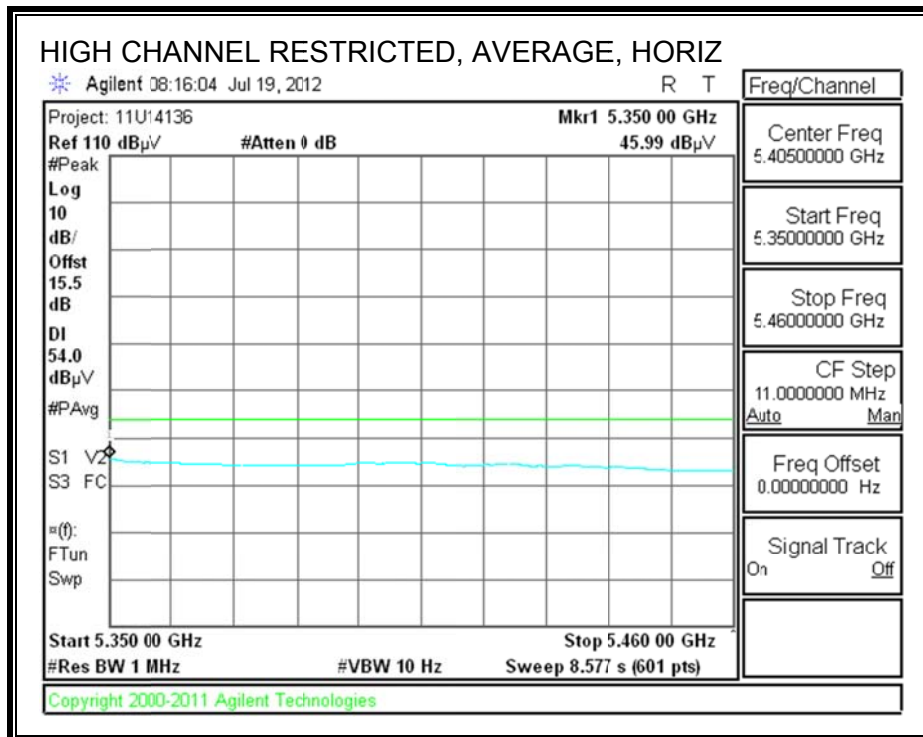
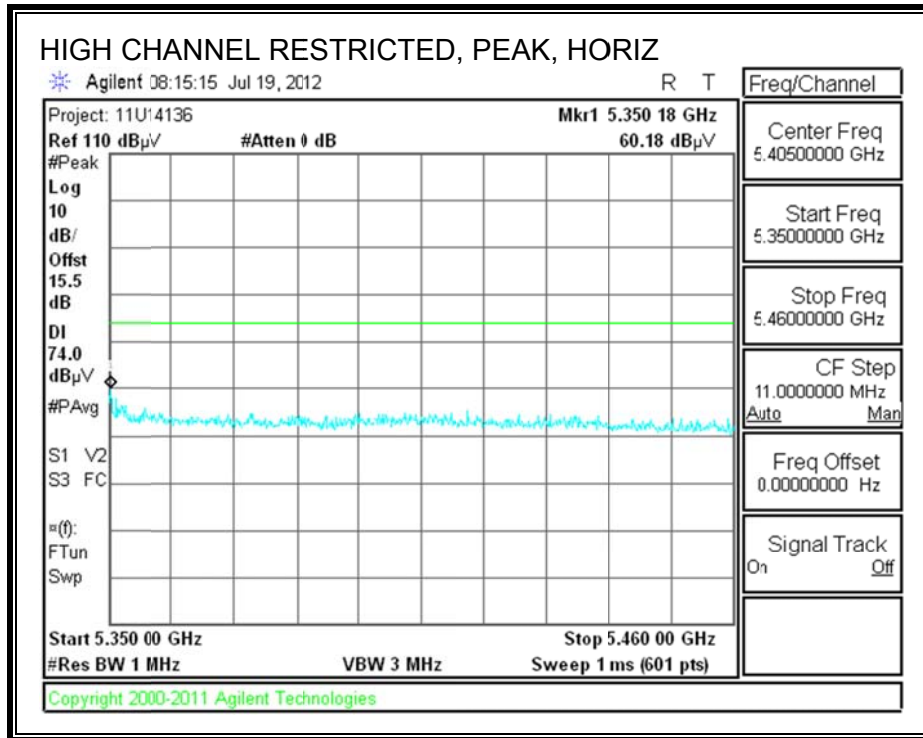
f	Measurement Frequency	Amp	Preamp Gain	Average Field Strength Limit
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters	Peak Field Strength Limit
Read	Analyzer Reading	Avg	Average Field Strength @ 3 m	Margin vs. Average Limit
AF	Antenna Factor	Peak	Calculated Peak Field Strength	Margin vs.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

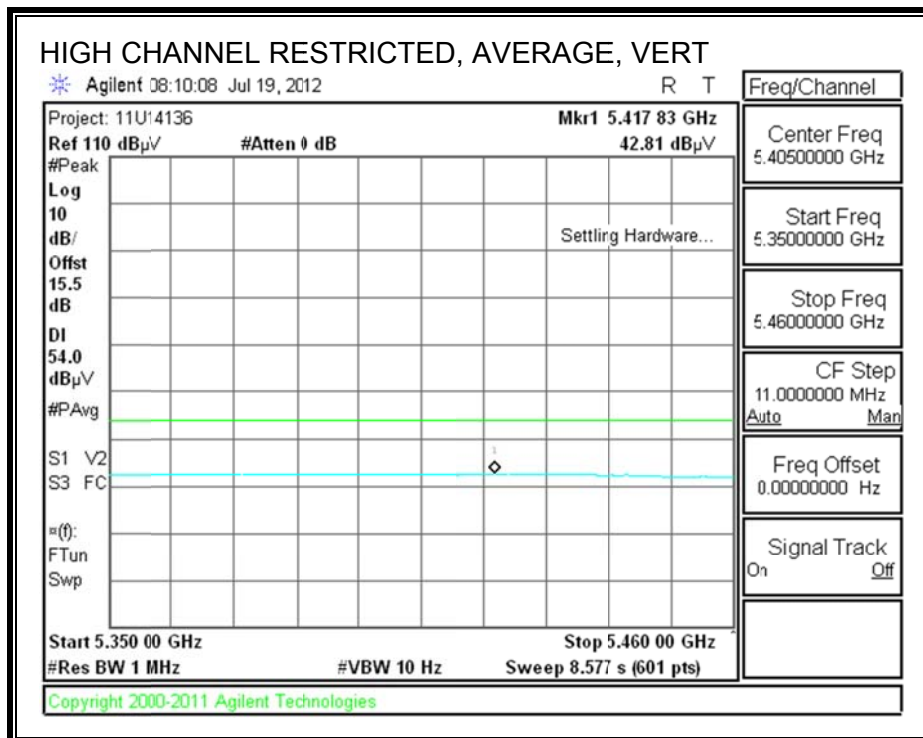
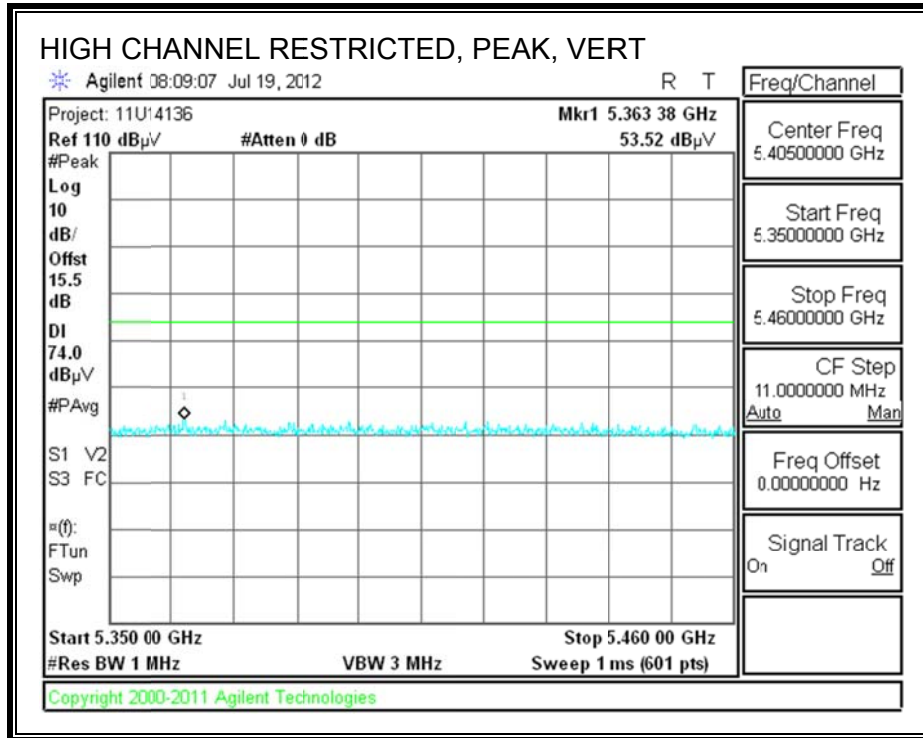
f GHz	Dist (m)	Read dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Corr. dBuV/m	Limit dBuV/m	Margin dB	Ant. Pol. V/H	Det. P/A/QP	Notes
<b>5260MHz 11a</b>													
15.780	3.0	35.7	38.3	12.3	-32.2	0.0	0.7	54.8	74.0	-19.2	V	P	
15.780	3.0	25.2	38.3	12.3	-32.2	0.0	0.7	44.3	54.0	-9.7	V	A	
15.780	3.0	35.9	38.3	12.3	-32.2	0.0	0.7	55.0	74.0	-19.0	H	P	
15.780	3.0	25.2	38.3	12.3	-32.2	0.0	0.7	44.3	54.0	-9.7	H	A	
<b>5300MHz 11a</b>													
15.900	3.0	34.6	37.9	12.4	-32.2	0.0	0.7	53.4	74.0	-20.6	V	P	
15.900	3.0	24.5	37.9	12.4	-32.2	0.0	0.7	43.3	54.0	-10.7	V	A	
15.900	3.0	34.6	37.9	12.4	-32.2	0.0	0.7	53.5	74.0	-20.5	H	P	
15.900	3.0	24.5	37.9	12.4	-32.2	0.0	0.7	43.3	54.0	-10.7	H	A	
<b>5320MHz 11a</b>													
15.960	3.0	35.5	37.7	12.4	-32.2	0.0	0.7	54.1	74.0	-19.9	H	P	
15.960	3.0	24.7	37.7	12.4	-32.2	0.0	0.7	43.3	54.0	-10.7	H	A	
15.960	3.0	34.9	37.7	12.4	-32.2	0.0	0.7	53.5	74.0	-20.5	V	P	
15.960	3.0	24.7	37.7	12.4	-32.2	0.0	0.7	43.4	54.0	-10.6	V	A	

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

### 9.2.5. TX ABOVE 1 GHz 802.11n HT20 MODE IN THE 5.3 GHz BAND RESTRICTED BANDEDGE (HIGH CHANNEL)





### HARMONICS AND SPURIOUS EMISSIONS

**High Frequency Measurement**  
 Compliance Certification Services, Fremont 5m Chamber

Test Engr: Tom Chen  
 Date: 07/19/12  
 Project #: 11U14136  
 Company: Apple Inc.  
 Test Target: FCC Class B  
 Mode Oper: 802.11n HT20, TX mode

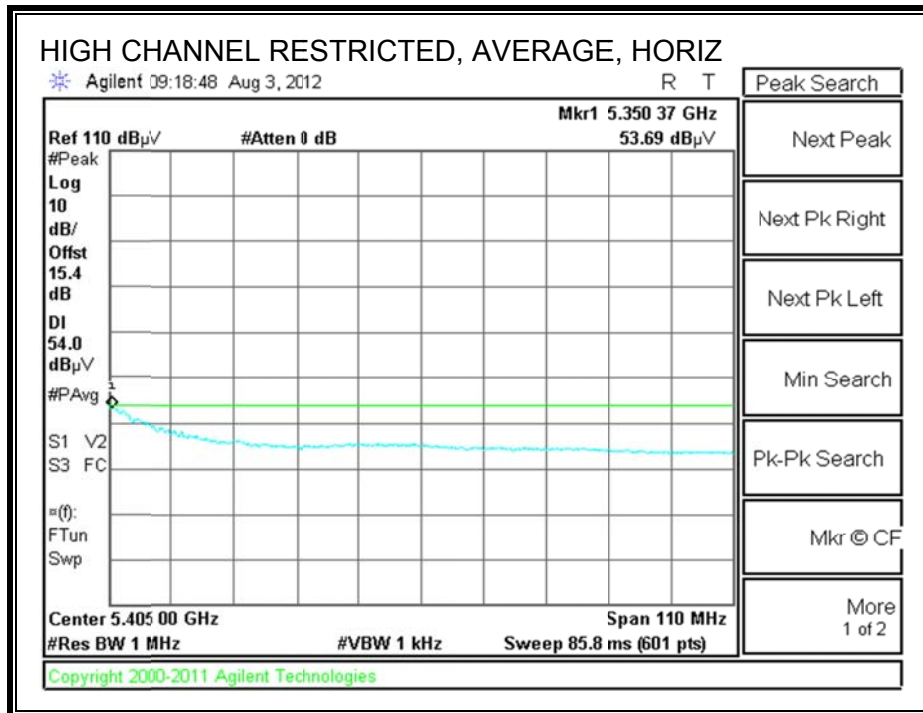
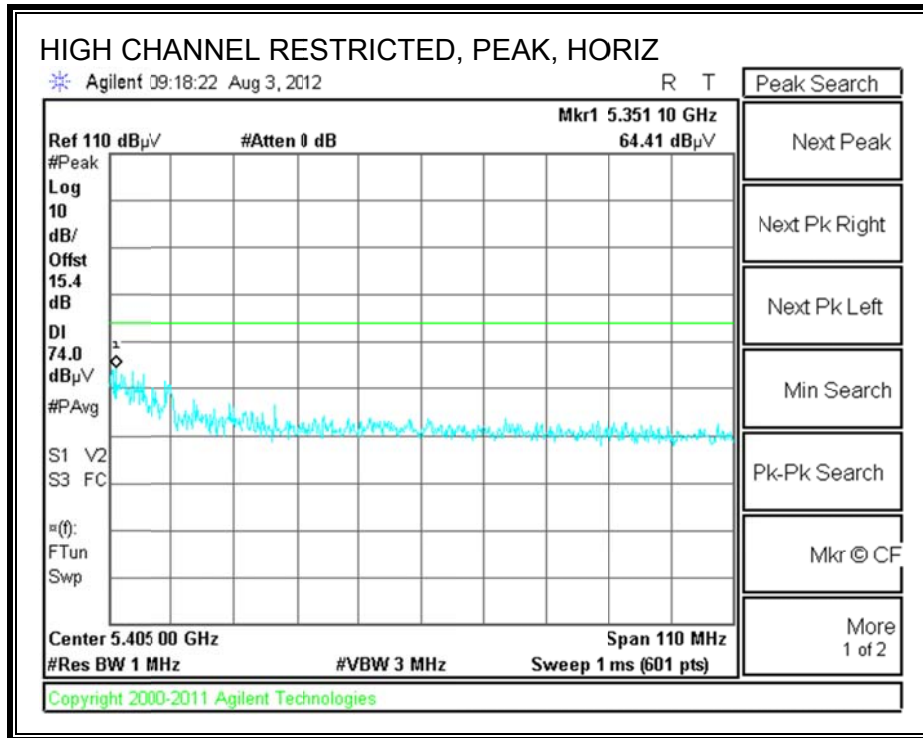
f	Measurement Frequency	Amp	Preamp Gain	Average Field Strength Limit
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters	Peak Field Strength Limit
Read	Analyzer Reading	Avg	Average Field Strength @ 3 m	Margin vs. Average Limit
AF	Antenna Factor	Peak	Calculated Peak Field Strength	Margin vs.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

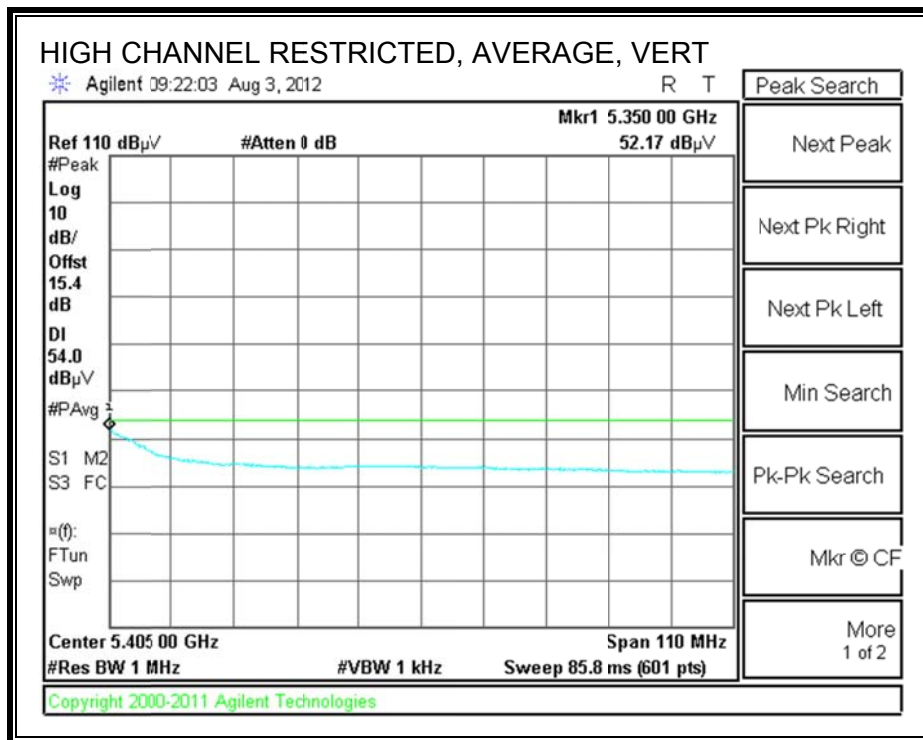
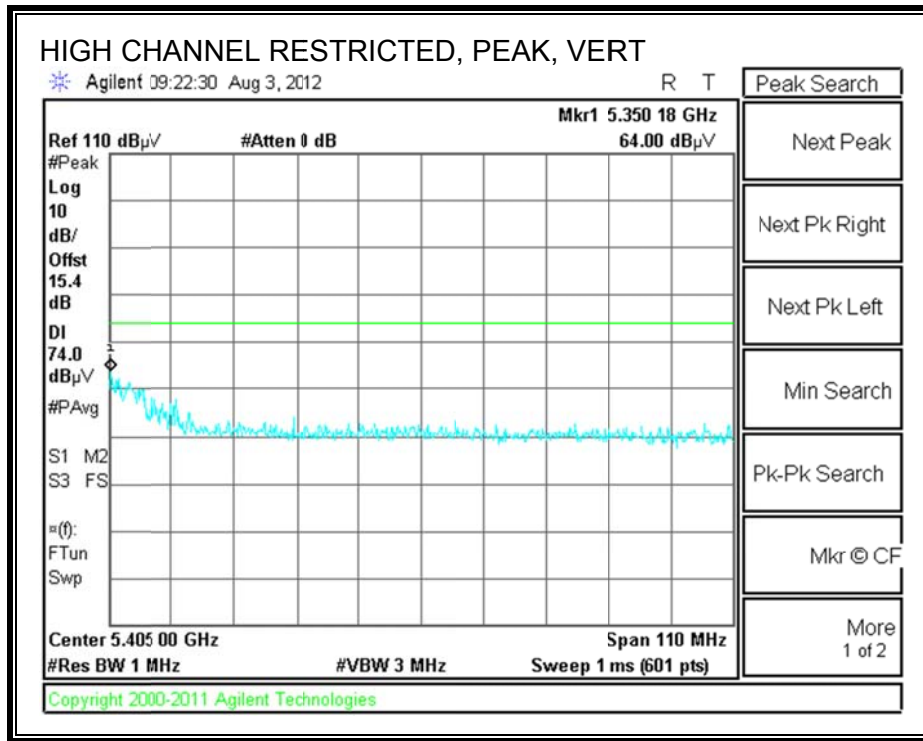
f GHz	Dist (m)	Read dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Ftr dB	Corr dB	Limit dBuV/m	Margin dB	Ant. Pol. V/H	Det. P/A/QP	Notes
<b>5260MHz HT20</b>													
15.780	3.0	35.5	38.3	12.3	-32.2	0.0	0.7	54.6	74.0	-19.4	V	P	
15.780	3.0	25.1	38.3	12.3	-32.2	0.0	0.7	44.2	54.0	-9.8	V	A	
15.780	3.0	36.1	38.3	12.3	-32.2	0.0	0.7	55.2	74.0	-18.8	H	P	
15.780	3.0	25.1	38.3	12.3	-32.2	0.0	0.7	44.2	54.0	-9.8	H	A	
<b>5300MHz HT20</b>													
10.600	3.0	34.3	38.1	9.7	-33.9	0.0	0.8	49.0	74.0	-25.0	H	P	
10.600	3.0	23.7	38.1	9.7	-33.9	0.0	0.8	38.4	54.0	-15.6	H	A	
15.900	3.0	35.1	37.9	12.4	-32.2	0.0	0.7	53.9	74.0	-20.1	H	P	
15.900	3.0	24.4	37.9	12.4	-32.2	0.0	0.7	43.2	54.0	-10.8	H	A	
<b>5300MHz HT20</b>													
10.600	3.0	35.2	38.1	9.7	-33.9	0.0	0.8	49.9	74.0	-24.1	V	P	
10.600	3.0	23.9	38.1	9.7	-33.9	0.0	0.8	38.6	54.0	-15.4	V	A	
15.900	3.0	35.0	37.9	12.4	-32.2	0.0	0.7	53.8	74.0	-20.2	V	P	
15.900	3.0	24.5	37.9	12.4	-32.2	0.0	0.7	43.3	54.0	-10.7	V	A	
<b>5320MHz HT20</b>													
10.640	3.0	34.6	38.2	9.8	-33.9	0.0	0.8	49.4	74.0	-24.6	V	P	
10.640	3.0	24.3	38.2	9.8	-33.9	0.0	0.8	39.1	54.0	-14.9	V	A	
15.960	3.0	34.7	37.7	12.4	-32.2	0.0	0.7	53.3	74.0	-20.7	V	P	
15.960	3.0	24.7	37.7	12.4	-32.2	0.0	0.7	43.3	54.0	-10.7	V	A	
<b>5320MHz HT20</b>													
10.640	3.0	33.7	38.2	9.8	-33.9	0.0	0.8	48.5	74.0	-25.5	H	P	
10.640	3.0	24.4	38.2	9.8	-33.9	0.0	0.8	39.2	54.0	-14.8	H	A	
15.960	3.0	35.0	37.7	12.4	-32.2	0.0	0.7	53.7	74.0	-20.3	H	P	
15.960	3.0	24.7	37.7	12.4	-32.2	0.0	0.7	43.4	54.0	-10.6	H	A	

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

### 9.2.6. TX ABOVE 1 GHz 802.11n HT40 MODE IN THE 5.3 GHz BAND RESTRICTED BANDEDGE (HIGH CHANNEL)







### HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement  
 Compliance Certification Services, Fremont 5m Chamber

Test Engr: Tom Chen  
 Date: 07/20/12  
 Project #: 11U14136  
 Company: Apple Inc.  
 Test Target: FCC Class B  
 Mode Oper: 802.11n, HT40, TX mode

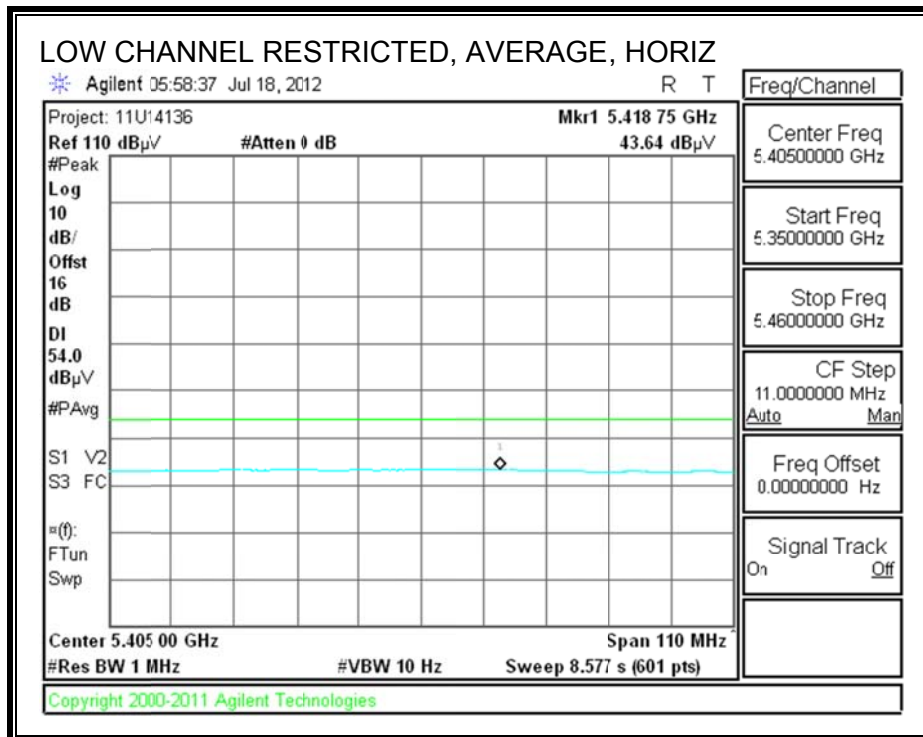
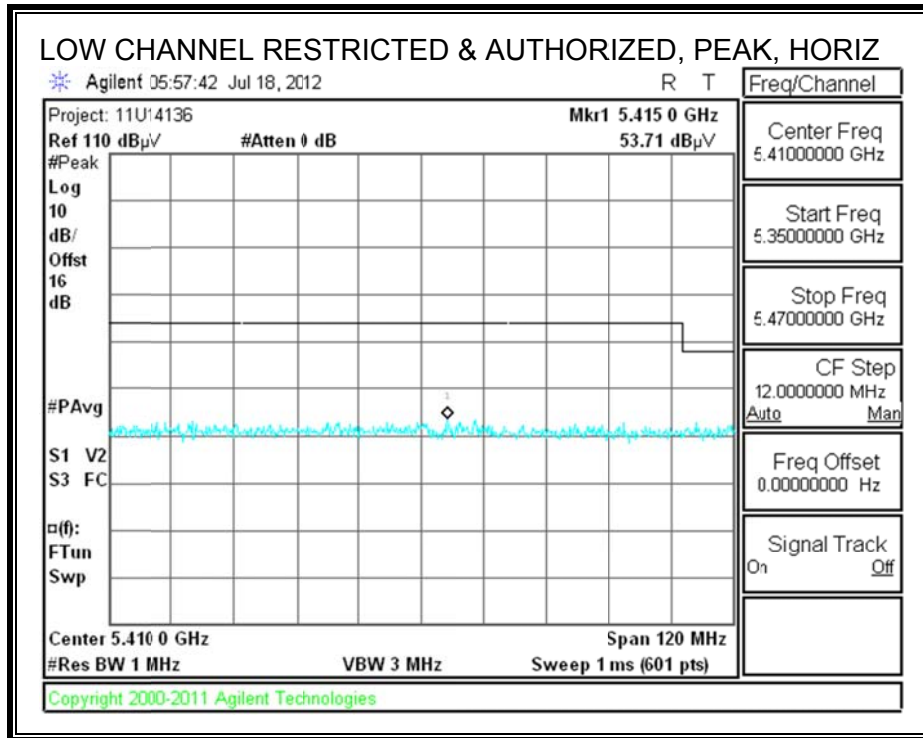
f	Measurement Frequency	Amp	Preamp Gain	Average Field Strength Limit
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters	Peak Field Strength Limit
Read	Analyzer Reading	Avg	Average Field Strength @ 3 m	Margin vs. Average Limit
AF	Antenna Factor	Peak	Calculated Peak Field Strength	Margin vs.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

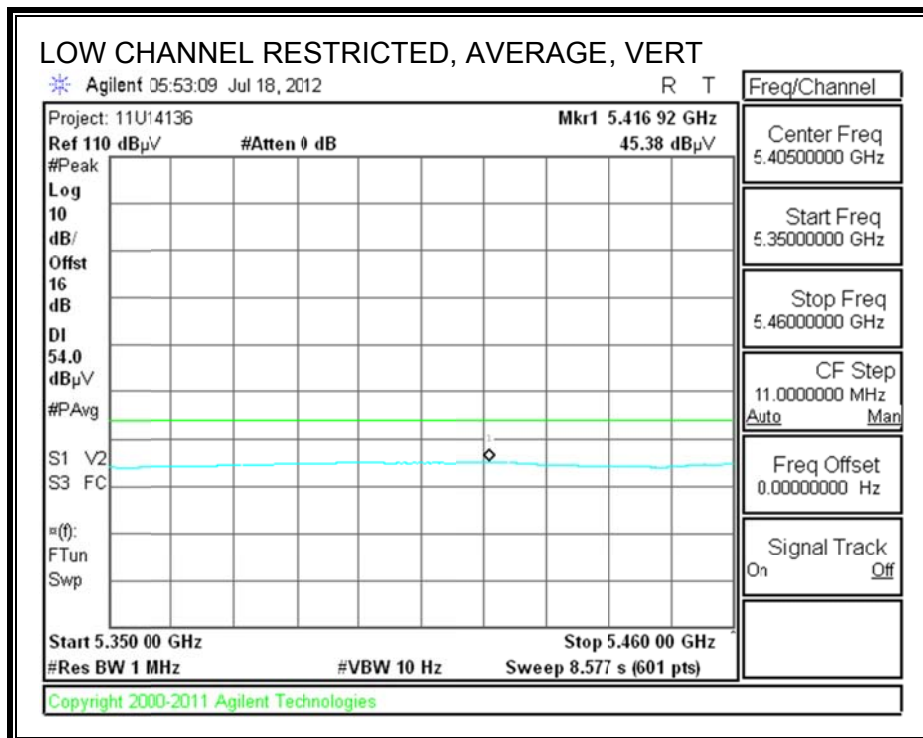
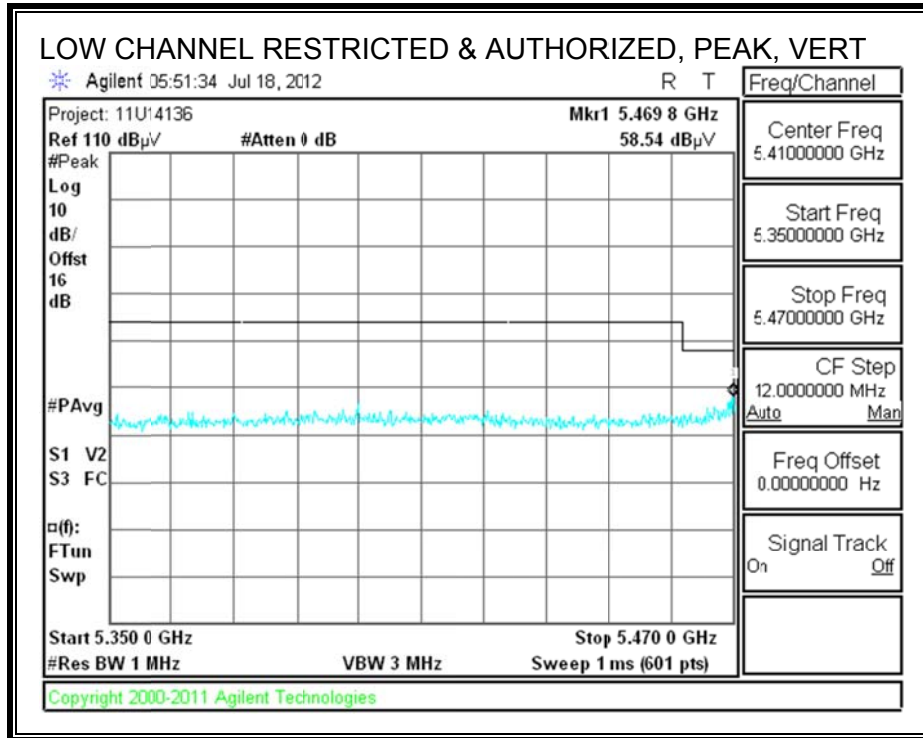
f GHz	Dist (m)	Read dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Corr. dBuV/m	Limit dBuV/m	Margin dB	Ant. Pol. V/H	Det. P/A/QP	Notes
<b>5310MHz HT40</b>													
10.620	3.0	35.2	38.1	9.7	-33.9	0.0	0.8	49.9	74.0	-24.1	H	P	
10.620	3.0	24.2	38.1	9.7	-33.9	0.0	0.8	38.9	54.0	-15.1	H	A	
10.620	3.0	35.5	38.1	9.7	-33.9	0.0	0.8	50.2	74.0	-23.8	V	P	
10.620	3.0	24.2	38.1	9.7	-33.9	0.0	0.8	38.9	54.0	-15.1	V	A	
<b>5270MHz HT40</b>													
15.810	3.0	35.8	38.2	12.6	-32.2	0.0	0.7	55.1	74.0	-18.9	V	P	
15.810	3.0	24.4	38.2	12.6	-32.2	0.0	0.7	43.8	54.0	-10.2	V	A	
15.810	3.0	35.4	38.2	12.6	-32.2	0.0	0.7	54.7	74.0	-19.3	H	P	
15.810	3.0	24.5	38.2	12.6	-32.2	0.0	0.7	43.8	54.0	-10.2	H	A	

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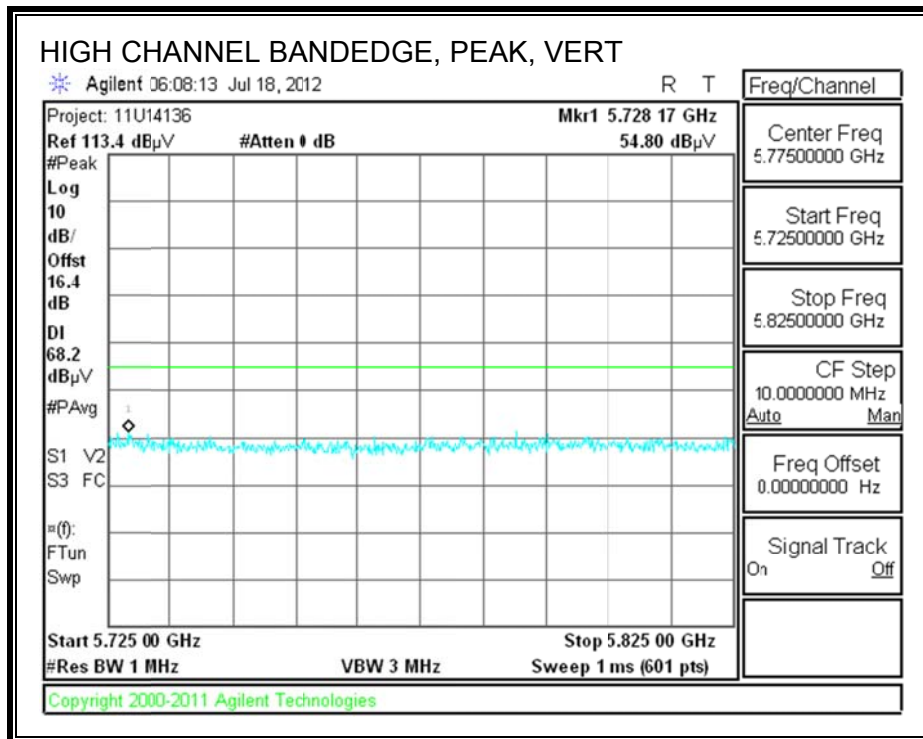
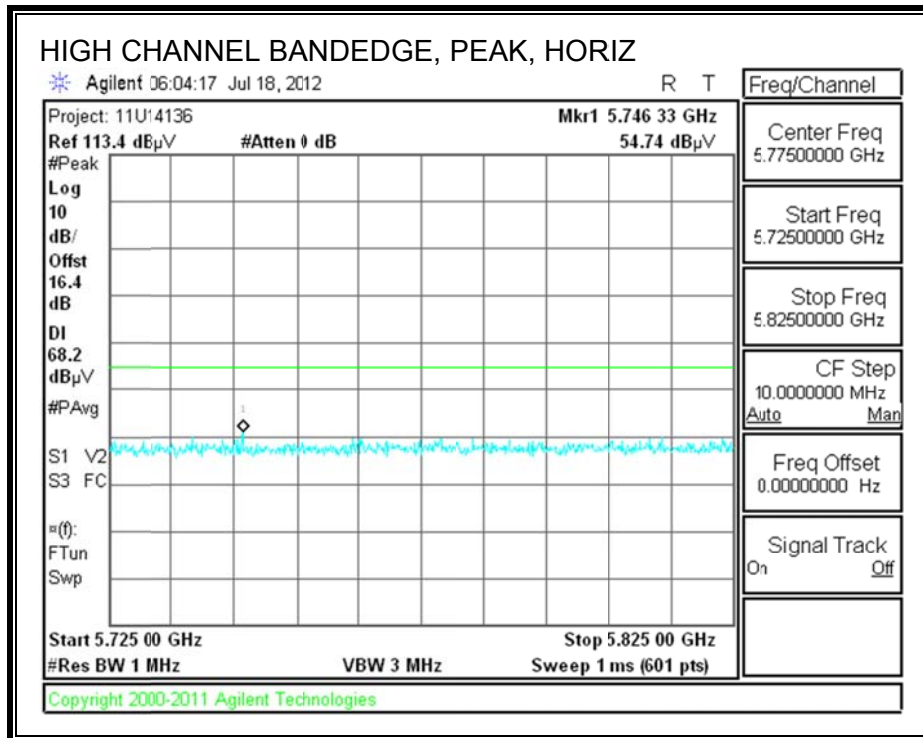
Note: No other emissions were detected above the system noise floor.

### 9.2.7. TX ABOVE 1 GHz 802.11a MODE IN THE 5.6 GHz BAND RESTRICTED & AUTHORIZED BANDEDGE (LOW CHANNEL)





### AUTHORIZED BANDEDGE (HIGH CHANNEL)



### HARMONICS AND SPURIOUS EMISSIONS

**High Frequency Measurement**  
 Compliance Certification Services, Fremont 5m Chamber

**Test Engr:** Tom Chen  
**Date:** 07/19/12  
**Project #:** 11U14136  
**Company:** Apple Inc.  
**Test Target:** FCC Class B  
**Mode Oper:** 802.11a, TX mode

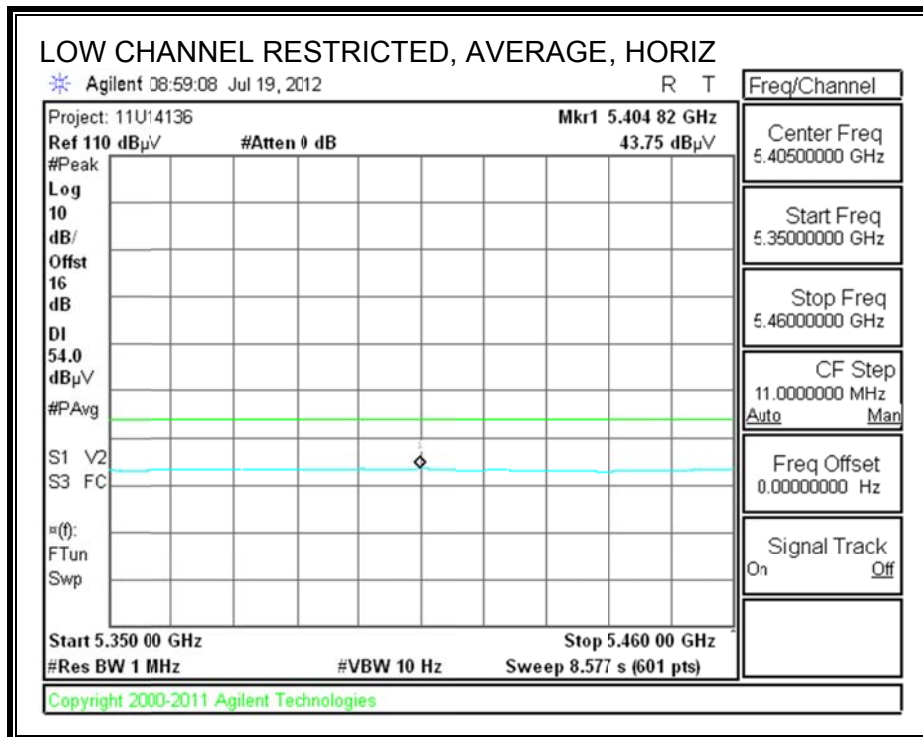
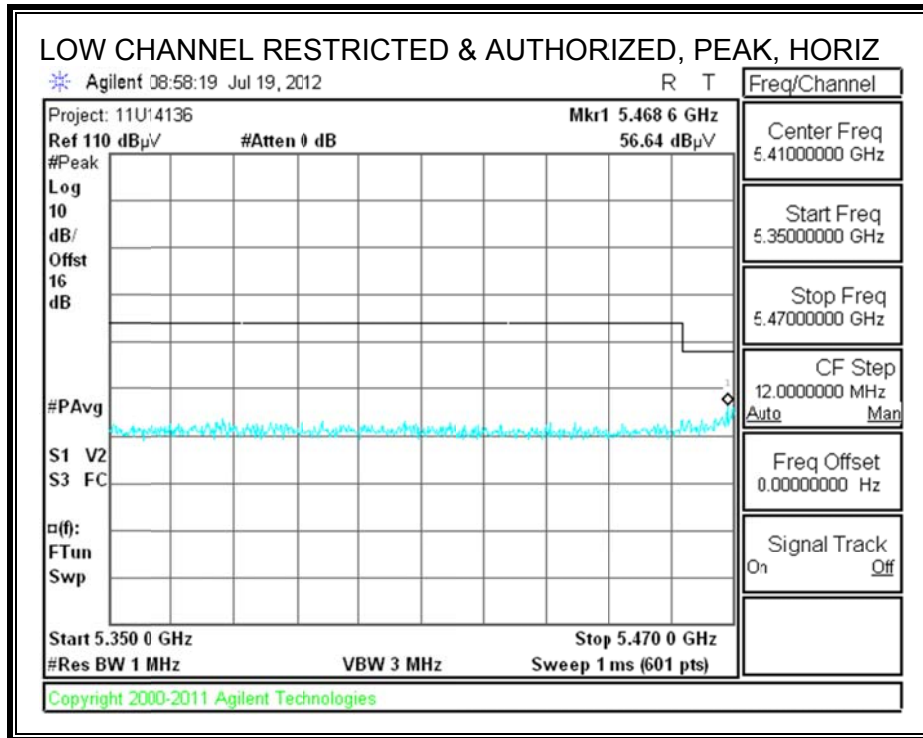
f	Measurement Frequency	Amp	Preamp Gain	Average Field Strength Limit
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters	Peak Field Strength Limit
Read	Analyzer Reading	Avg	Average Field Strength @ 3 m	Margin vs. Average Limit
AF	Antenna Factor	Peak	Calculated Peak Field Strength	Margin vs.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

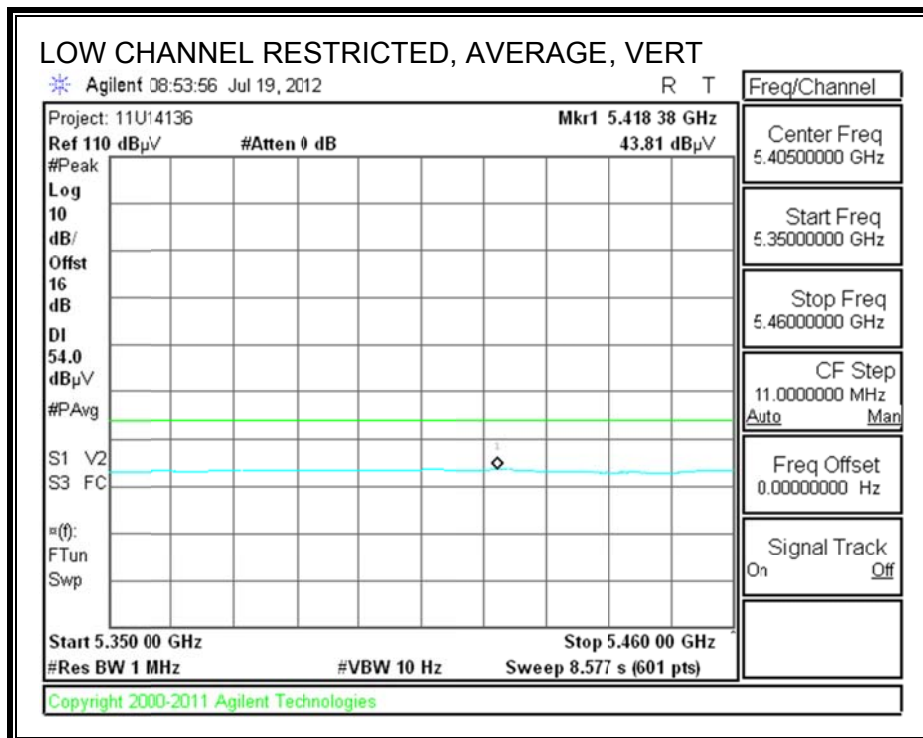
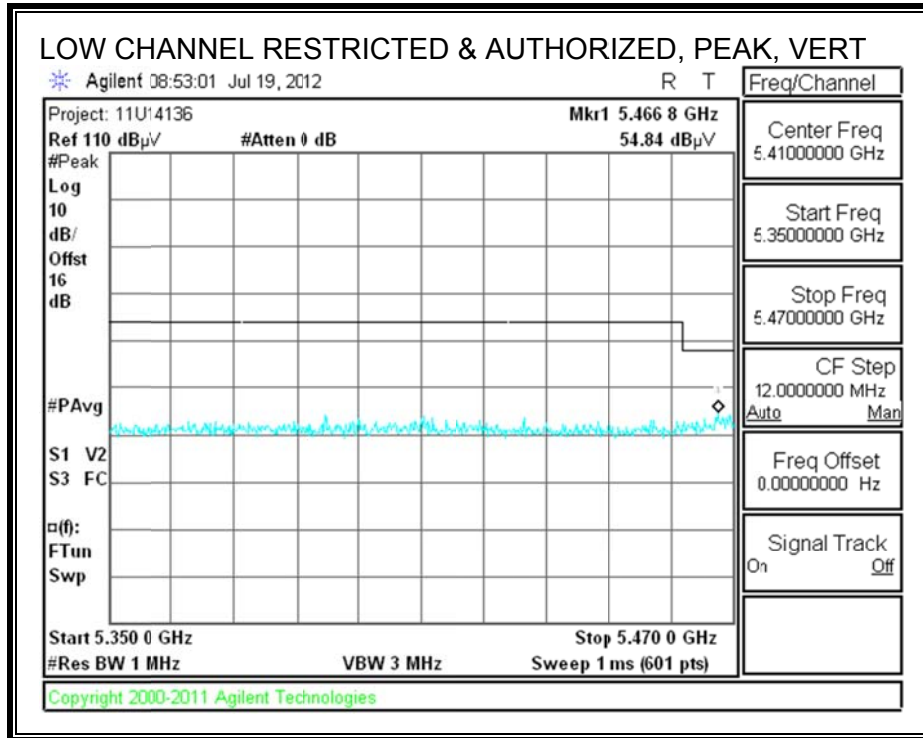
f GHz	Dist (m)	Read dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Corr. dBuV/m	Limit dBuV/m	Margin dB	Ant. Pol. V/H	Det. P/A/QP	Notes
<b>5500MHz 11a</b>													
11.000	3.0	35.8	38.3	10.2	-33.5	0.0	0.7	51.5	74.0	-22.5	V	P	
11.000	3.0	25.0	38.3	10.2	-33.5	0.0	0.7	40.7	54.0	-13.3	V	A	
11.000	3.0	35.8	38.3	10.2	-33.5	0.0	0.7	51.6	74.0	-22.4	H	P	
11.000	3.0	25.0	38.3	10.2	-33.5	0.0	0.7	40.7	54.0	-13.3	H	A	
<b>5580MHz 11a</b>													
11.160	3.0	35.5	38.5	10.3	-33.3	0.0	0.7	51.8	74.0	-22.2	H	P	
11.160	3.0	24.6	38.5	10.3	-33.3	0.0	0.7	40.9	54.0	-13.1	H	A	
11.160	3.0	34.9	38.5	10.3	-33.3	0.0	0.7	51.2	74.0	-22.8	V	P	
11.160	3.0	24.5	38.5	10.3	-33.3	0.0	0.7	40.8	54.0	-13.2	V	A	
<b>5700MHz 11a</b>													
11.400	3.0	35.0	38.7	10.6	-33.0	0.0	0.7	52.1	74.0	-21.9	V	P	
11.400	3.0	24.6	38.7	10.6	-33.0	0.0	0.7	41.6	54.0	-12.4	V	A	
11.400	3.0	35.3	38.7	10.6	-33.0	0.0	0.7	52.3	74.0	-21.7	H	P	
11.400	3.0	24.5	38.7	10.6	-33.0	0.0	0.7	41.6	54.0	-12.4	H	A	

Rev. 4.1.2.7

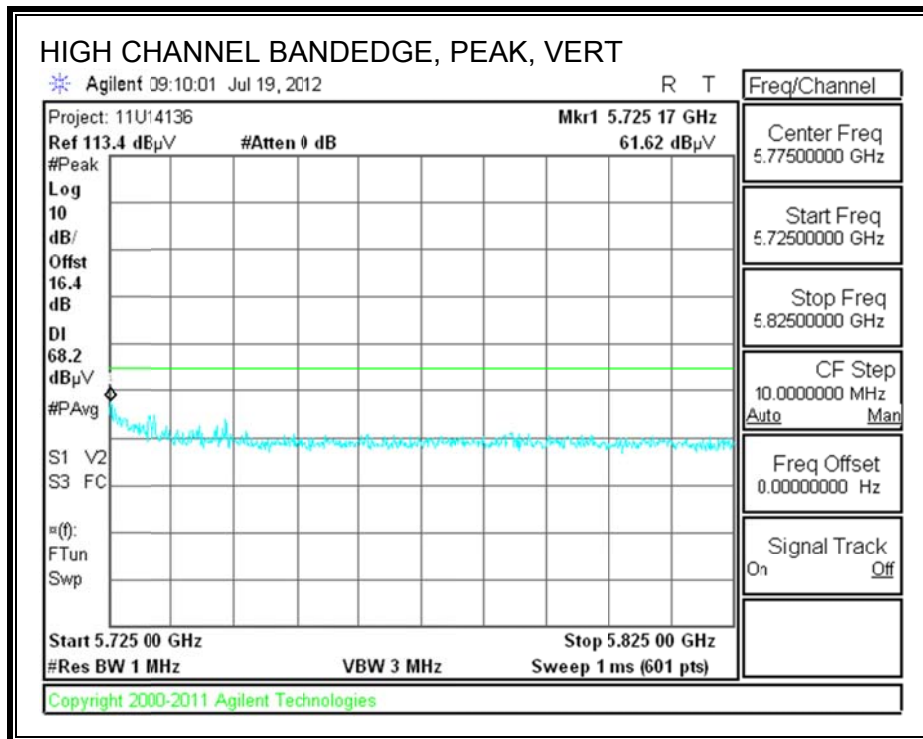
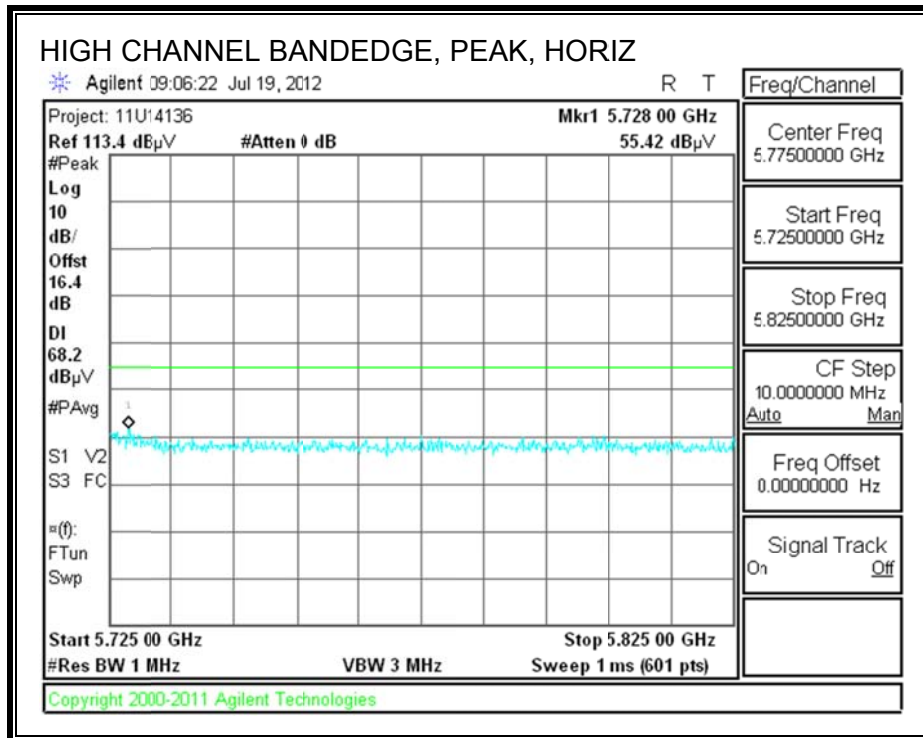
Note: No other emissions were detected above the system noise floor.

### 9.2.8. TX ABOVE 1 GHz 802.11n HT20 MODE IN THE 5.6 GHz BAND RESTRICTED & AUTHORIZED BANDEDGE (LOW CHANNEL)





### AUTHORIZED BANDEDGE (HIGH CHANNEL)





### HARMONICS AND SPURIOUS EMISSIONS

**High Frequency Measurement**  
 Compliance Certification Services, Fremont 5m Chamber

Test Engr: Tom Chen  
 Date: 07/19/12  
 Project #: 11U14136  
 Company: Apple Inc.  
 Test Target: FCC Class B  
 Mode Oper: 802.11n HT20, TX mode

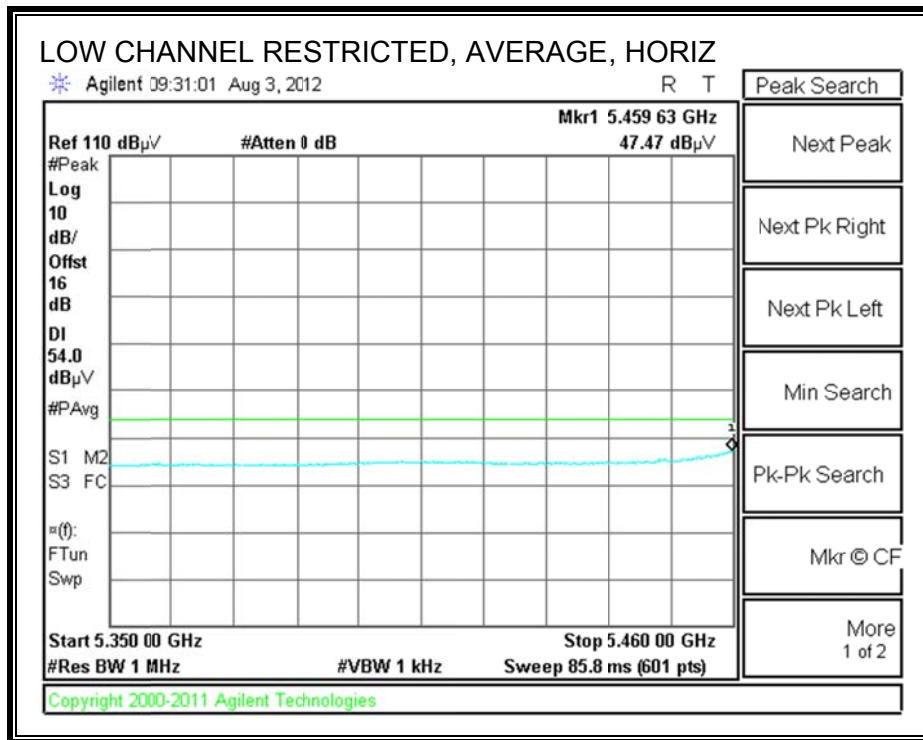
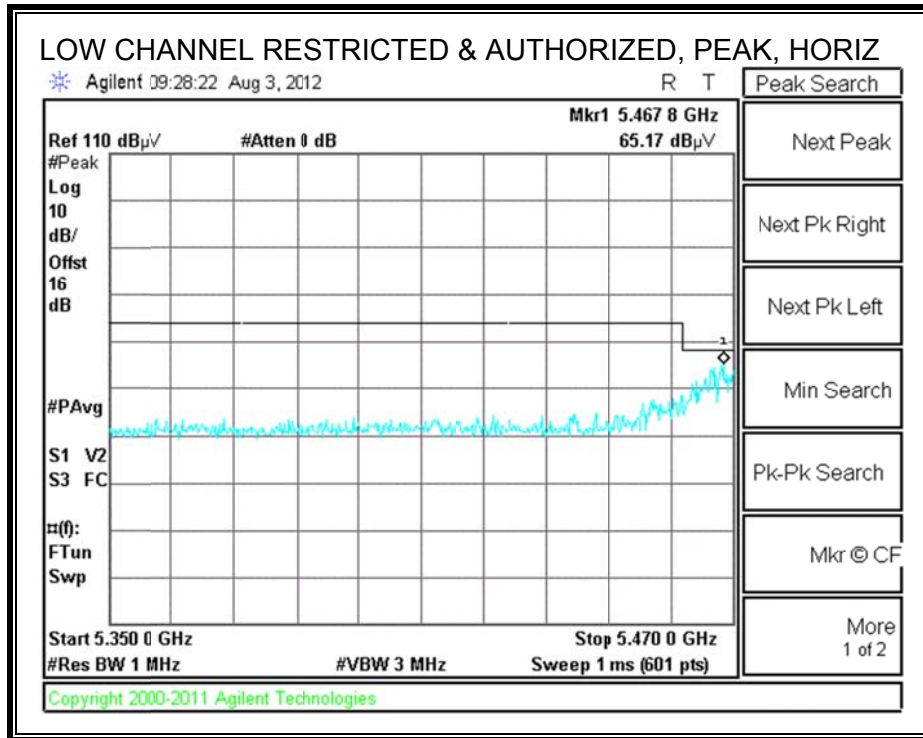
f	Measurement Frequency	Amp	Preamp Gain	Average Field Strength Limit
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters	Peak Field Strength Limit
Read	Analyzer Reading	Avg	Average Field Strength @ 3 m	Margin vs. Average Limit
AF	Antenna Factor	Peak	Calculated Peak Field Strength	Margin vs.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

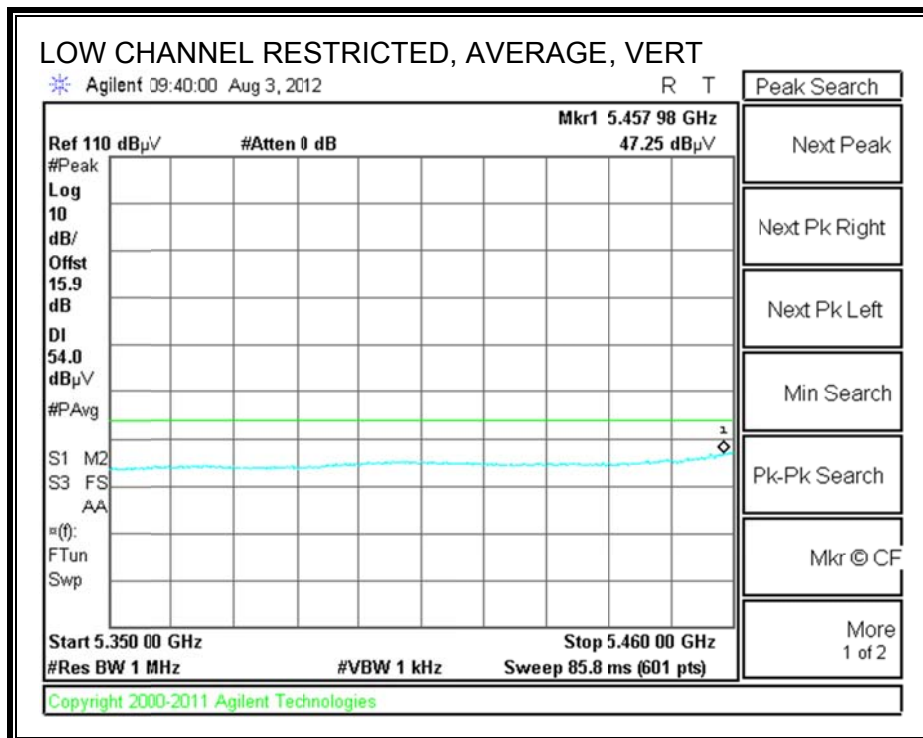
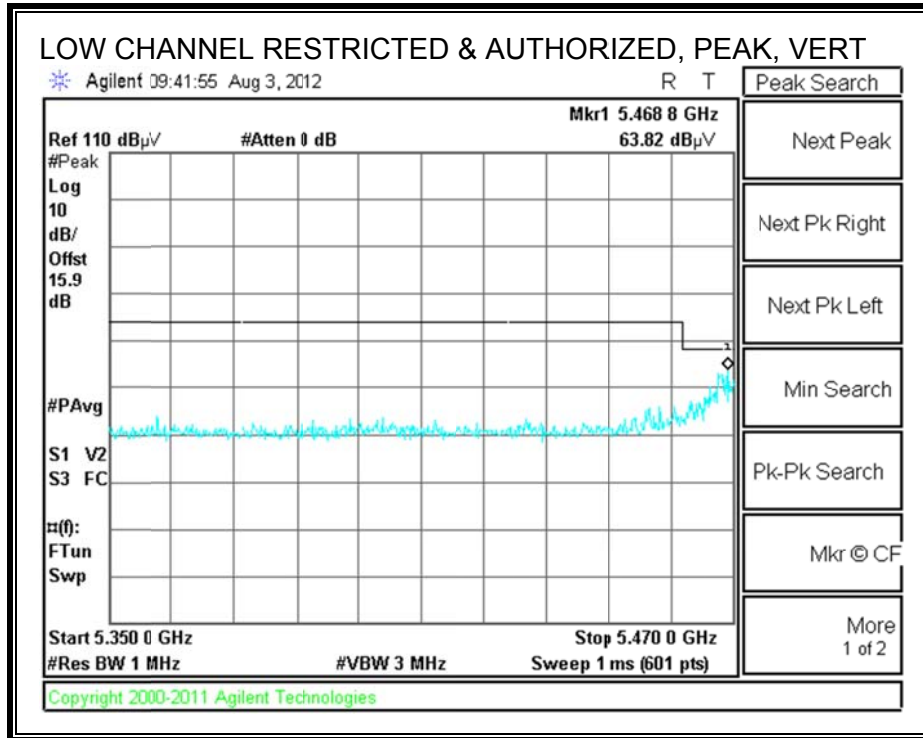
f GHz	Dist (m)	Read dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Corr. dBuV/m	Limit dBuV/m	Margin dB	Ant. Pol. V/H	Det. P/A/QP	Notes
<b>5500MHz HT20</b>													
11.000	3.0	35.0	38.3	10.2	-33.5	0.0	0.7	50.8	74.0	-23.2	H	P	
11.000	3.0	24.9	38.3	10.2	-33.5	0.0	0.7	40.7	54.0	-13.3	H	A	
11.000	3.0	36.5	38.3	10.2	-33.5	0.0	0.7	52.2	74.0	-21.8	V	P	
11.000	3.0	24.9	38.3	10.2	-33.5	0.0	0.7	40.7	54.0	-13.3	V	A	
<b>5580MHz HT20</b>													
11.160	3.0	35.3	38.5	10.3	-33.3	0.0	0.7	51.5	74.0	-22.5	V	P	
11.160	3.0	24.6	38.5	10.3	-33.3	0.0	0.7	40.9	54.0	-13.1	V	A	
11.160	3.0	34.8	38.5	10.3	-33.3	0.0	0.7	51.1	74.0	-22.9	H	P	
11.160	3.0	24.6	38.5	10.3	-33.3	0.0	0.7	40.9	54.0	-13.1	H	A	
<b>5700MHz HT20</b>													
11.400	3.0	35.4	38.7	10.6	-33.0	0.0	0.7	52.5	74.0	-21.5	V	P	
11.400	3.0	24.5	38.7	10.6	-33.0	0.0	0.7	41.5	54.0	-12.5	V	A	
11.400	3.0	35.1	38.7	10.6	-33.0	0.0	0.7	52.1	74.0	-21.9	H	P	
11.400	3.0	24.4	38.7	10.6	-33.0	0.0	0.7	41.4	54.0	-12.6	H	A	

Rev. 4.1.2.7

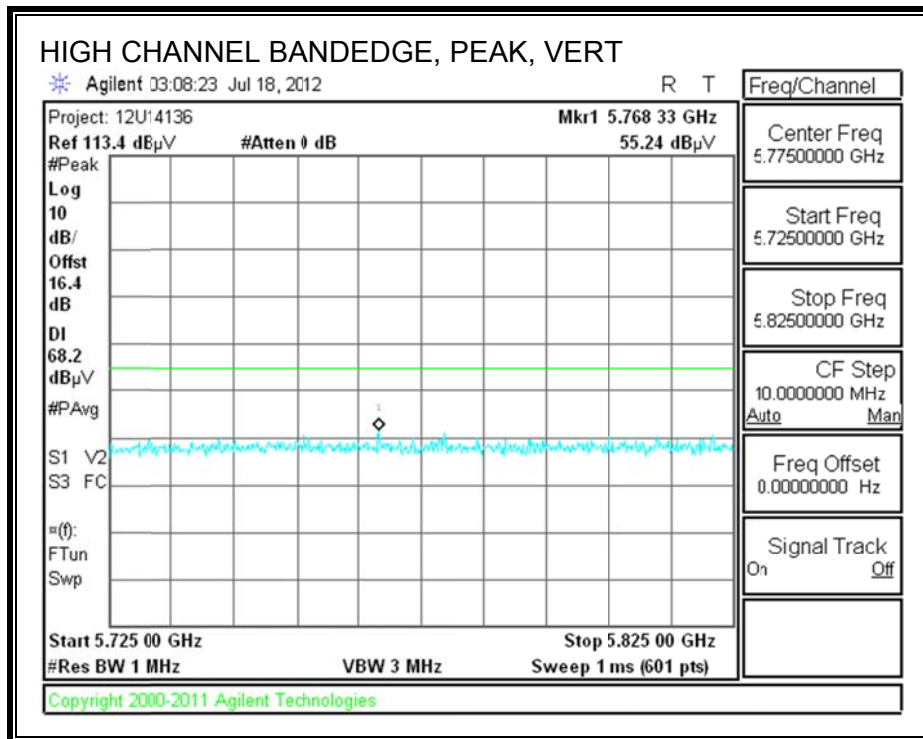
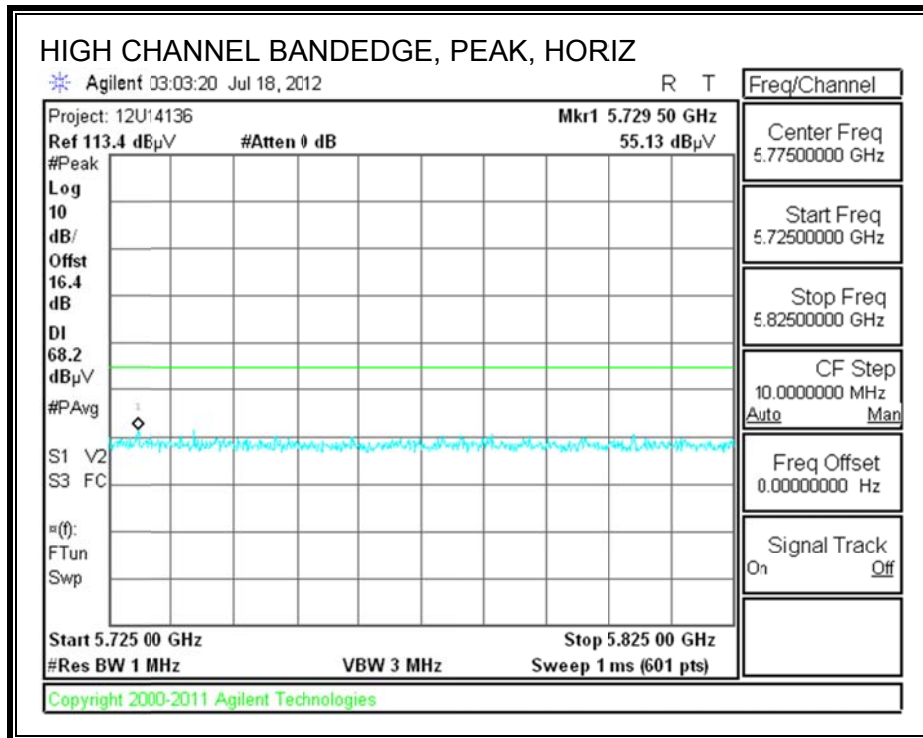
Note: No other emissions were detected above the system noise floor.

### 9.2.9. TX ABOVE 1 GHz 802.11n HT40 MODE IN THE 5.6 GHz BAND RESTRICTED & AUTHORIZED BANDEDGE (LOW CHANNEL)





### AUTHORIZED BANDEDGE (HIGH CHANNEL)



### HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement  
 Compliance Certification Services, Fremont 5m Chamber

Test Engr: Tom Chen  
 Date: 07/20/12  
 Project #: 11U14136  
 Company: Apple Inc.  
 Test Target: FCC Class B  
 Mode Oper: 802.11n HT40, TX mode

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

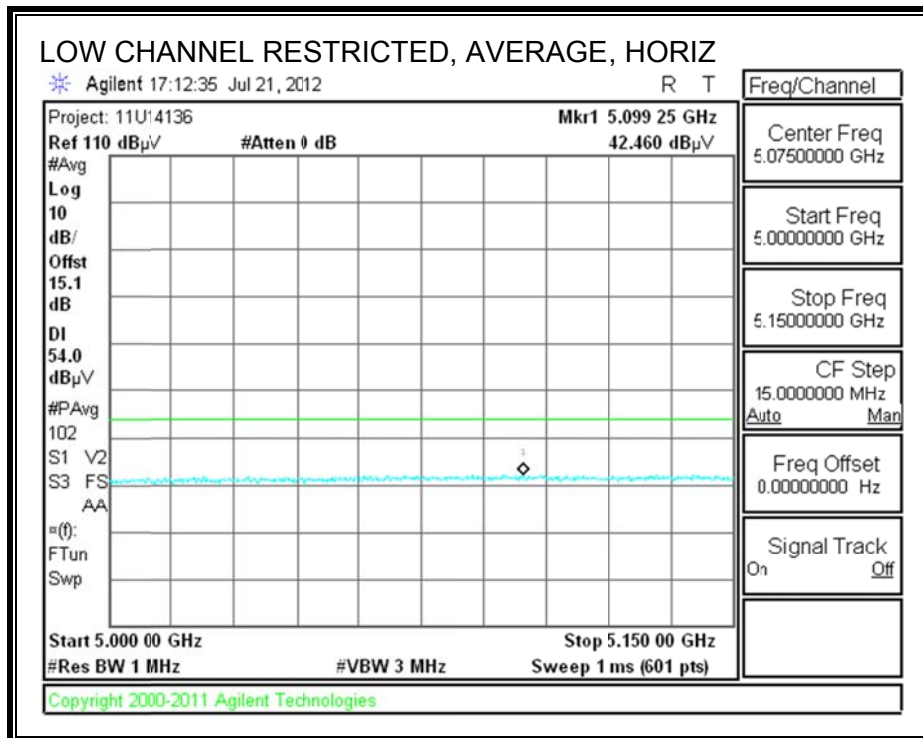
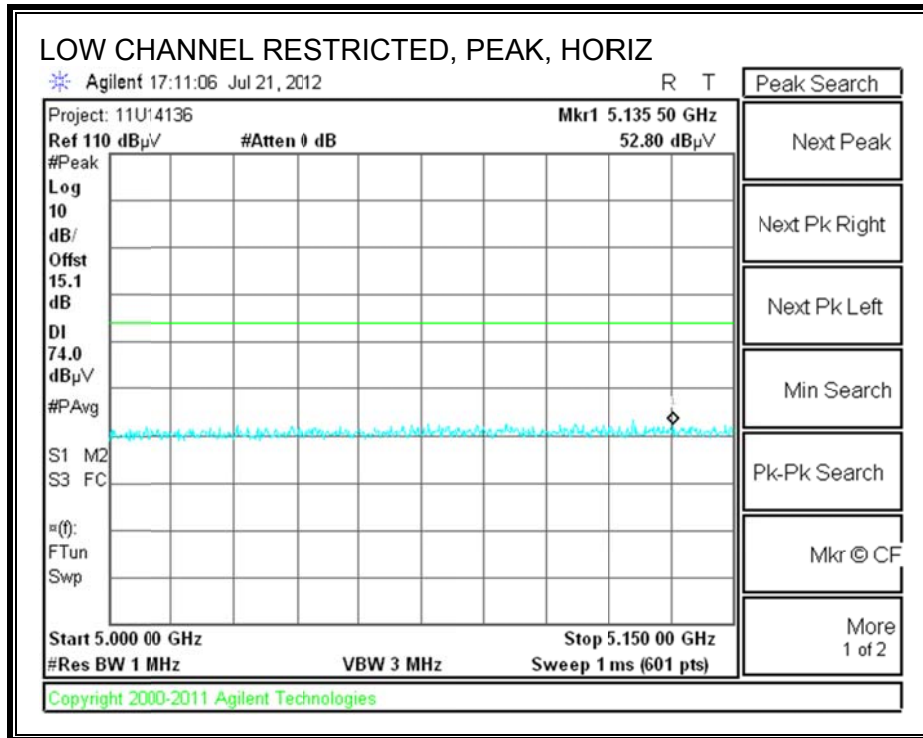
f GHz	Dist (m)	Read dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Ftr dB	Corr. dBuV/m	Limit dBuV/m	Margin dB	Ant. Pol. V/H	Det. P/A/QP	Notes
<b>5510 MHz HT40</b>													
11.020	3.0	34.8	38.3	10.2	-33.4	0.0	0.7	50.7	74.0	-23.3	V	P	
11.020	3.0	24.8	38.3	10.2	-33.4	0.0	0.7	40.7	54.0	-13.3	V	A	
11.020	3.0	35.1	38.3	10.2	-33.4	0.0	0.7	51.0	74.0	-23.0	H	P	
11.020	3.0	24.8	38.3	10.2	-33.4	0.0	0.7	40.6	54.0	-13.4	H	A	
<b>5550MHz HT40</b>													
11.100	3.0	35.3	38.4	10.3	-33.3	0.0	0.7	51.4	74.0	-22.6	H	P	
11.100	3.0	24.7	38.4	10.3	-33.3	0.0	0.7	40.8	54.0	-13.2	H	A	
11.100	3.0	34.8	38.4	10.3	-33.3	0.0	0.7	50.9	74.0	-23.1	V	P	
11.100	3.0	24.7	38.4	10.3	-33.3	0.0	0.7	40.8	54.0	-13.2	V	A	
<b>5670MHz HT40</b>													
11.340	3.0	34.6	38.7	10.6	-33.0	0.0	0.7	51.4	74.0	-22.6	V	P	
11.340	3.0	24.0	38.7	10.6	-33.0	0.0	0.7	40.9	54.0	-13.1	V	A	
11.340	3.0	34.9	38.7	10.6	-33.0	0.0	0.7	51.7	74.0	-22.3	H	P	
11.340	3.0	23.9	38.7	10.6	-33.0	0.0	0.7	40.7	54.0	-13.3	H	A	

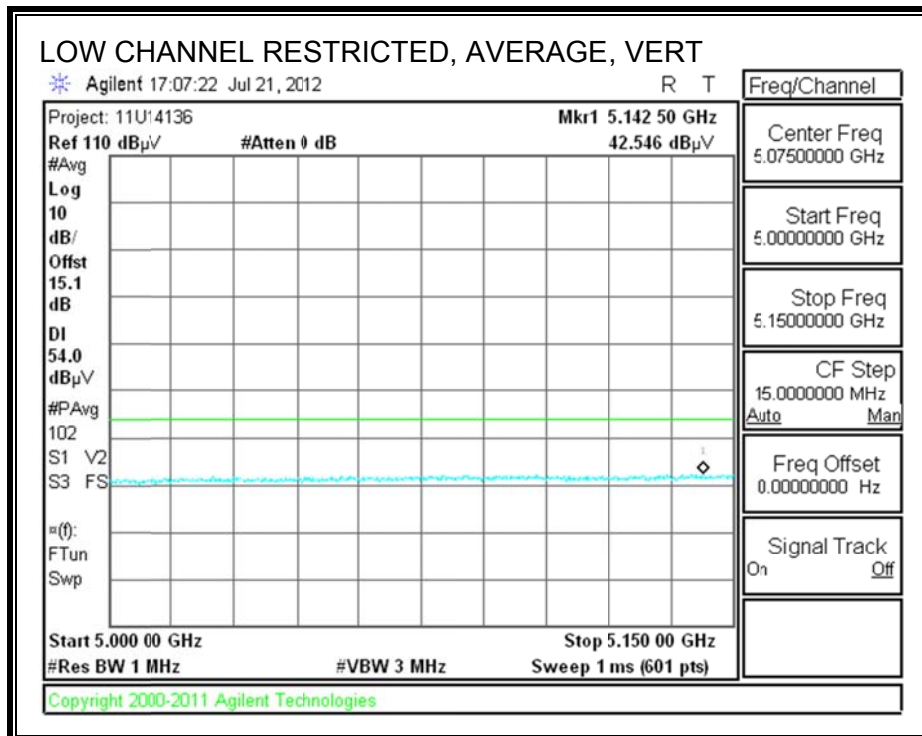
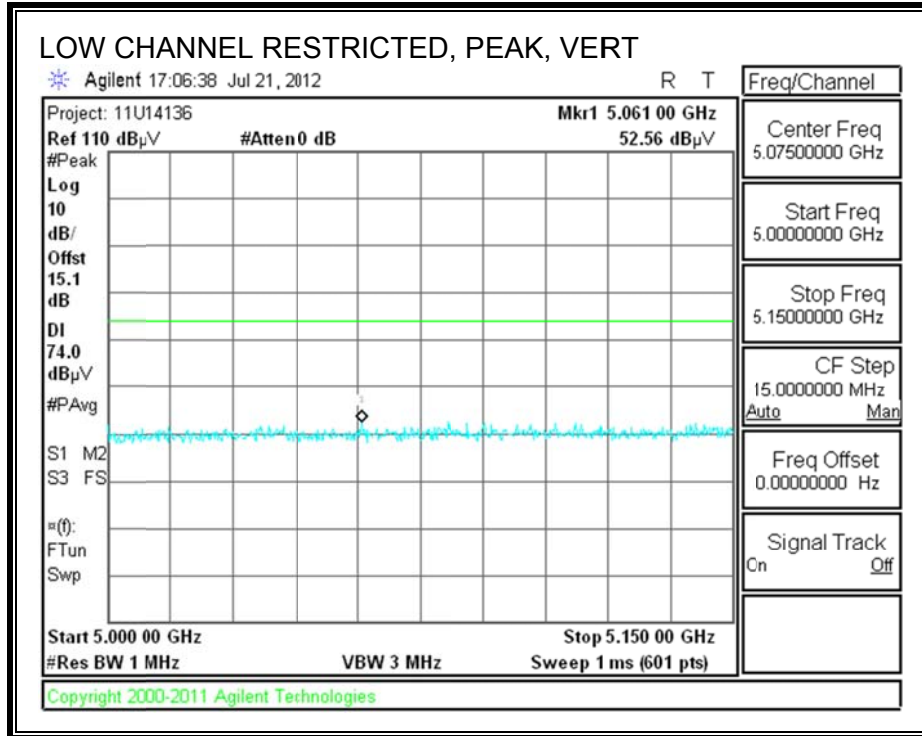
Rev. 4.1.2.7

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

### 9.2.10. 2.4GHZ AND 5GHZ BAND CO-LOCATION

#### BANDEDGE (CHANNEL 36 and Bluetooth High CHANNEL)





**HARMONICS AND SPURIOUS EMISSIONS**

Compliance Certification Services, Fremont 5m Chamber

Test Engr: Tom Chen  
 Date: 08/06/12  
 Project #: 11U14136  
 Company: Apple Inc.  
 Test Target: FCC Class B  
 Mode Oper: Bluetooth Hi Channel and UNII Band Channel 36 both on TX mode

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
<b>5180 MHz</b>													
10.360	3.0	38.6	38.0	9.4	-35.8	0.0	0.0	50.3	74.0	-23.7	H	P	
10.360	3.0	25.9	38.0	9.4	-35.8	0.0	0.0	37.5	54.0	-16.5	H	A	
10.360	3.0	41.4	38.0	9.4	-35.8	0.0	0.0	53.1	74.0	-20.9	V	P	
10.360	3.0	26.9	38.0	9.4	-35.8	0.0	0.0	38.6	54.0	-15.4	V	A	
<b>2480 MHz</b>													
4.960	3.0	57.2	33.2	6.4	-35.5	0.0	0.0	61.3	74.0	-12.7	H	P	
4.960	3.0	41.7	33.2	6.4	-35.5	0.0	0.0	45.8	54.0	-8.2	H	A	
4.960	3.0	59.1	33.2	6.4	-35.5	0.0	0.0	63.2	74.0	-10.8	V	P	
4.960	3.0	43.2	33.2	6.4	-35.5	0.0	0.0	47.3	54.0	-6.7	V	A	

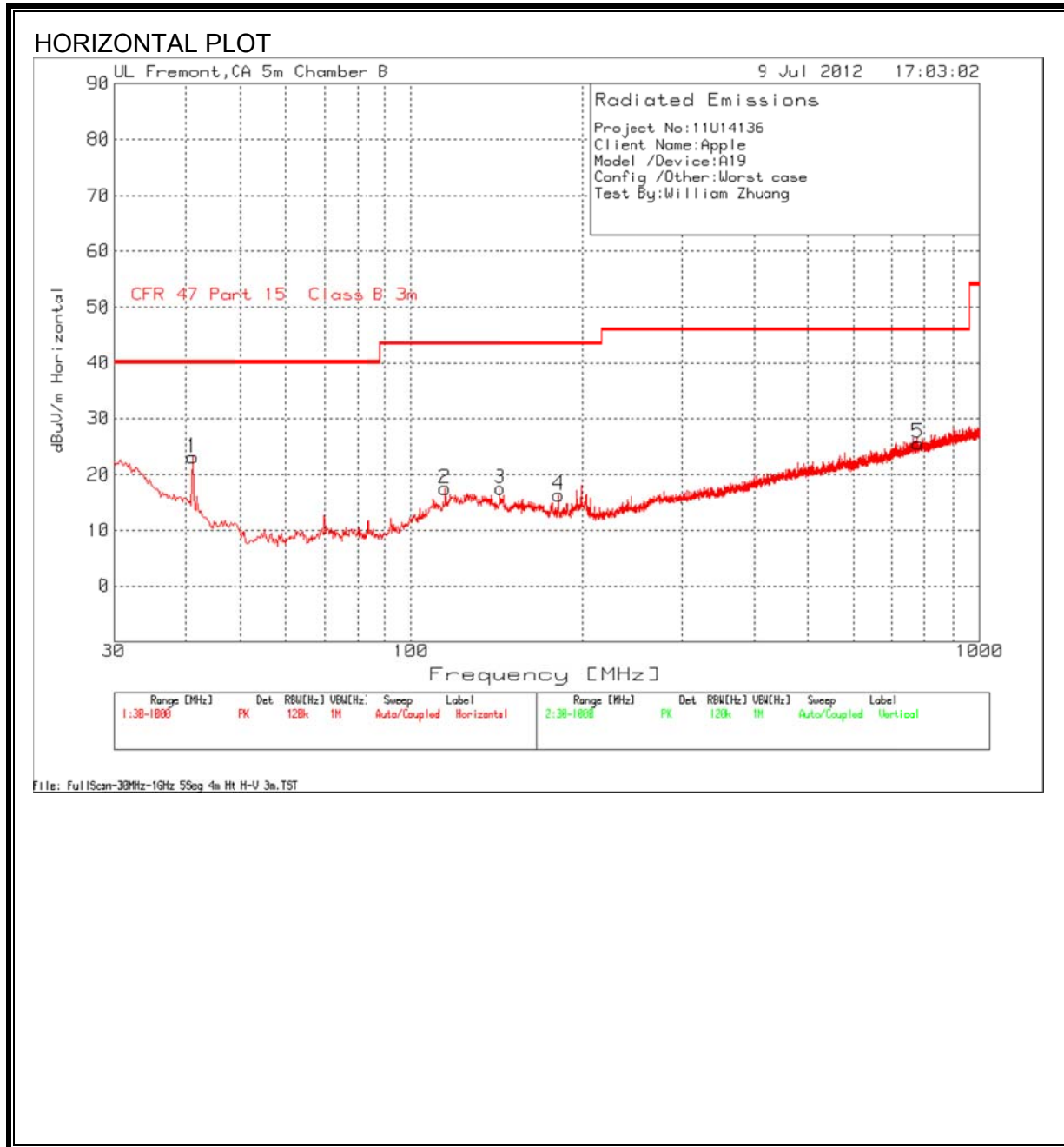
Rev. 4.1.2.7

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

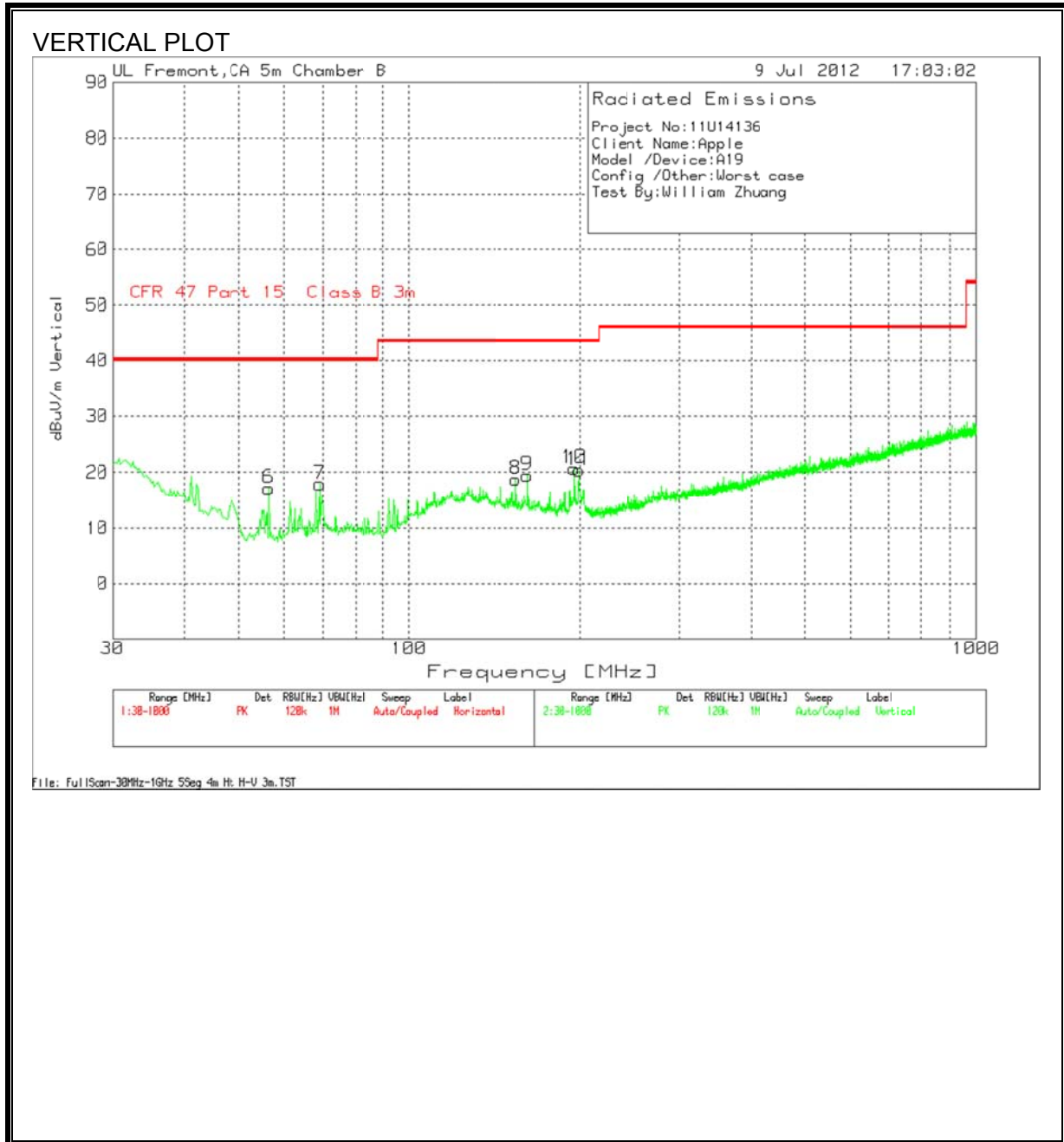


### 9.3. WORST-CASE BELOW 1 GHz

#### SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION, HORIZONTAL)



**SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION, VERTICAL)**



**HORIZONTAL AND VERTICAL DATA**

Project No:11U14136								
Client Name:Apple								
Model /Device:A1428								
Config /Other:Worst case								
Test By:William Zhuang								

Horizontal 30 - 1000MHz

Test Frequency	Meter Reading	Detector	T122 Sunol Bilog.TXT (dB)	5mB Amp Path 30-1000MHz (dB)	dBuV/m	CFR 47 Part 15 Class B 3m	Margin	Polarity
41.0492	39.36	PK	13	-29.2	23.16	40	-16.84	Horz
114.5164	32.49	PK	13.5	-28.4	17.59	43.5	-25.91	Horz
143.2054	32.78	PK	12.9	-28.1	17.58	43.5	-25.92	Horz
181.5867	32.98	PK	11.1	-27.7	16.38	43.5	-27.12	Horz
783.2814	29.99	PK	21.2	-25.5	25.69	46	-20.31	Horz

Vertical 30 - 1000MHz

Test Frequency	Meter Reading	Detector	T122 Sunol Bilog.TXT (dB)	5mB Amp Path 30-1000MHz (dB)	dBuV/m	CFR 47 Part 15 Class B 3m	Margin	Polarity
56.3629	38.93	PK	7.2	-29	17.13	40	-22.87	Vert
69.1567	38.74	PK	8.1	-28.9	17.94	40	-22.06	Vert
154.2546	34.3	PK	12.5	-28	18.8	43.5	-24.7	Vert
161.4269	35	PK	12.4	-27.9	19.5	43.5	-24	Vert
195.1559	36.44	PK	11.9	-27.6	20.74	43.5	-22.76	Vert
199.0328	35.32	PK	12.7	-27.6	20.42	43.5	-23.08	Vert

## 10. 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.

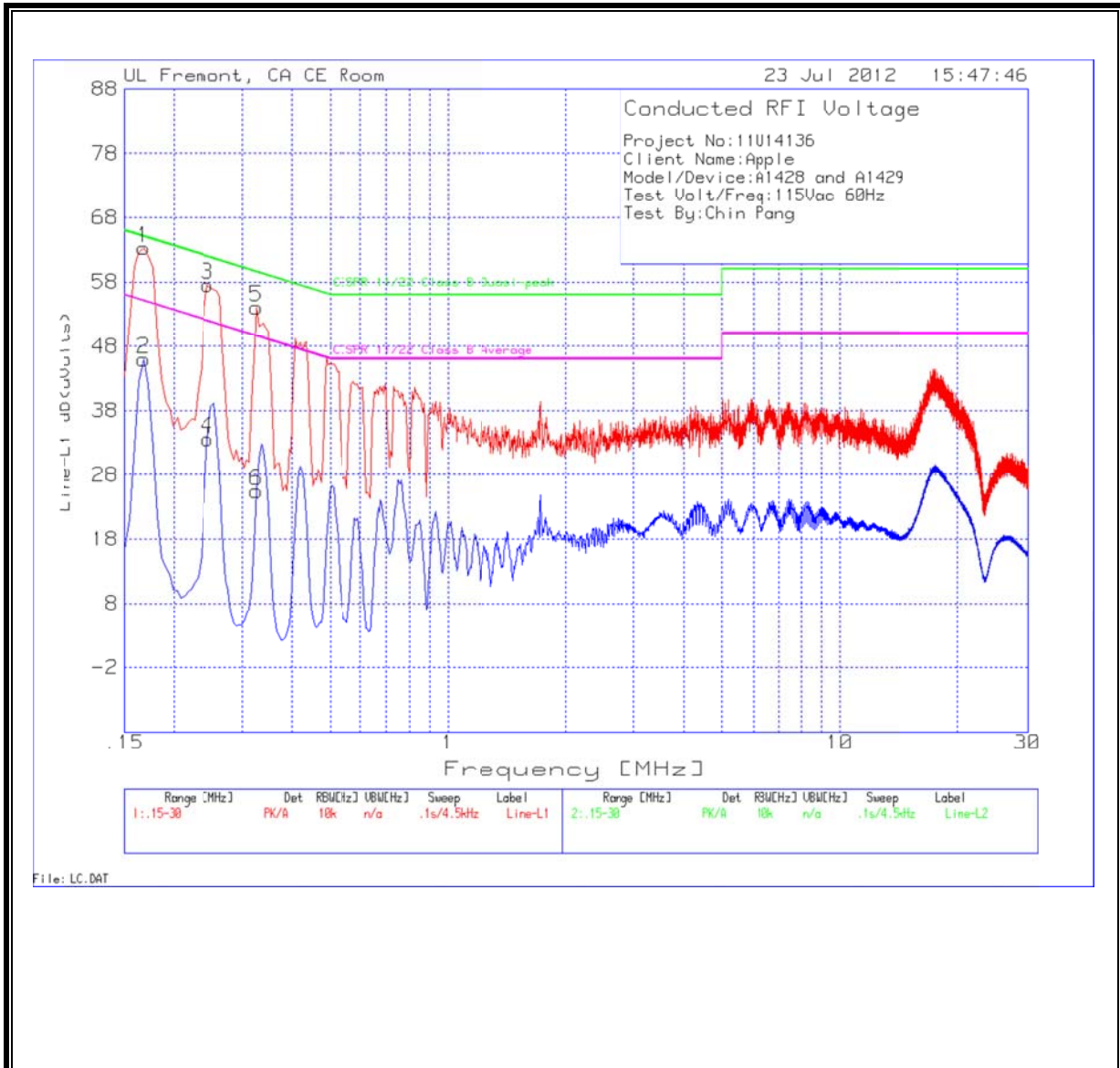
Line conducted data is recorded for both NEUTRAL and HOT lines.

### RESULTS

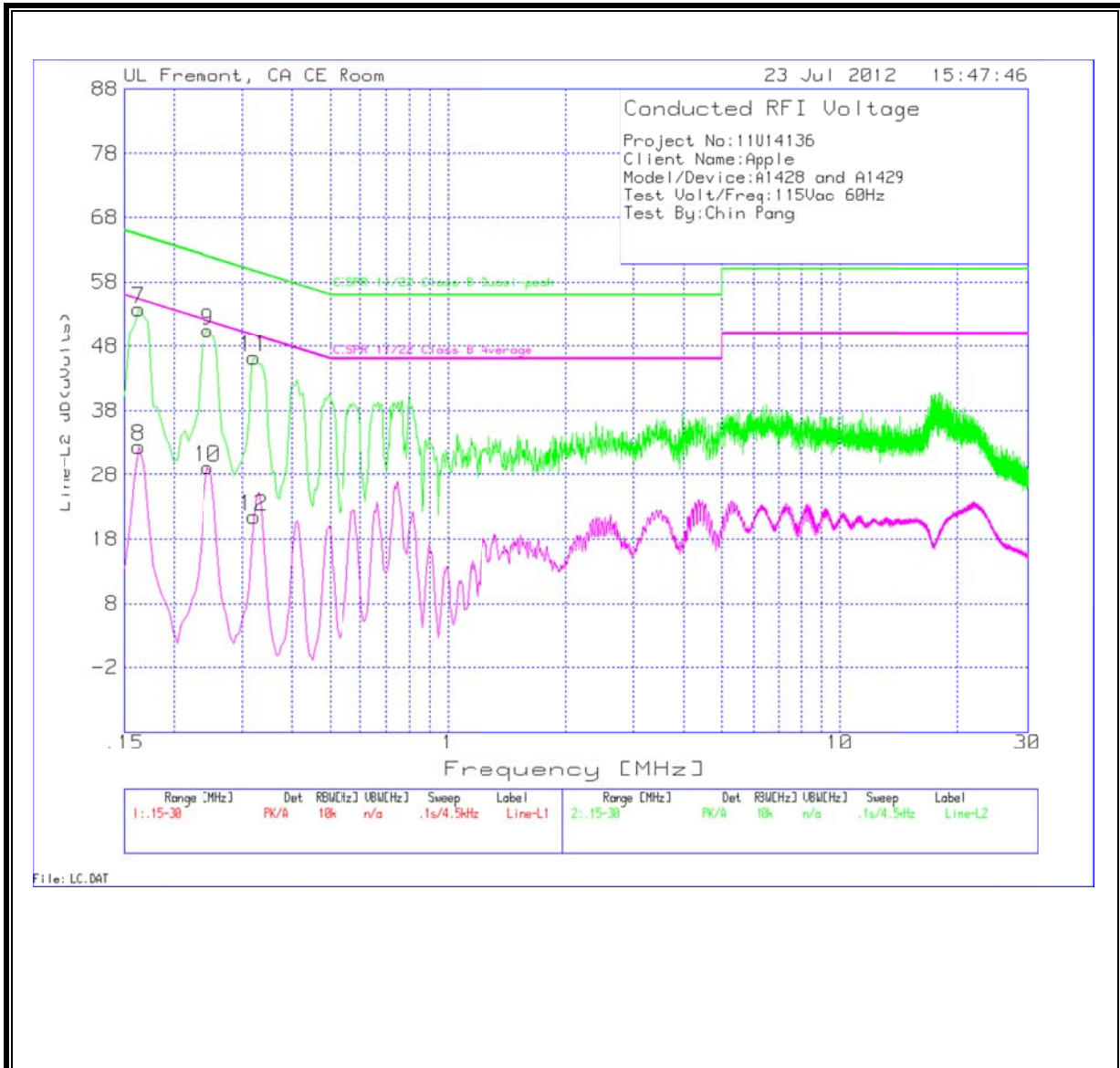
**6 WORST EMISSIONS**

Project No:11U14136									
Client Name:Apple									
Model/Device:A1428 and A1429									
Test Volt/Freq:115Vac 60Hz									
Test By:Chin Pang									
Line-L1 .15 - 30MHz									
Test Freq	Meter Rea	Detector	T24 IL L1.T	LC Cables	dB(uVolts	CISPR 11/2	Margin	CISPR 11/2	Margin
0.168	63.2	PK	0.1	0	63.3	65.1	-1.8	-	-
0.168	45.89	Av	0.1	0	45.99	-	-	55.1	-9.11
0.2445	57.43	PK	0.1	0	57.53	61.9	-4.37	-	-
0.2445	33.52	Av	0.1	0	33.62	-	-	51.9	-18.28
0.3255	54.03	PK	0.1	0	54.13	59.6	-5.47	-	-
0.3255	25.37	Av	0.1	0	25.47	-	-	49.6	-24.13
Line-L2 .15 - 30MHz									
Test Freq	Meter Rea	Detector	T24 IL L2.T	LC Cables	dB(uVolts	CISPR 11/2	Margin	CISPR 11/2	Margin
0.1635	53.72	PK	0.1	0	53.82	65.3	-11.48	-	-
0.1635	32.37	Av	0.1	0	32.47	-	-	55.3	-22.83
0.2445	50.33	PK	0.1	0	50.43	61.9	-11.47	-	-
0.2445	29.13	Av	0.1	0	29.23	-	-	51.9	-22.67
0.321	46.08	PK	0.1	0	46.18	59.7	-13.52	-	-
0.321	21.42	Av	0.1	0	21.52	-	-	49.7	-28.18

**LINE 1 RESULTS**



**LINE 2 RESULTS**



## 11. DYNAMIC FREQUENCY SELECTION

### 11.1. OVERVIEW

#### 11.1.1. 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".

Testing was also conducted per KDB 365942.



**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

Note 1: This is the level at the input of the receiver assuming a 0 dBi receive antenna  
 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.

**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

The instant that the *Channel Move Time* and the *Channel Closing Transmission Time* begins is as follows:  
 For the Short pulse radar Test Signals this instant is the end of the *Burst*.  
 For the Frequency Hopping radar Test Signal, this instant is the end of the last radar burst generated.  
 For the Long Pulse radar Test Signal this instant is the end of the 12 second period defining the radar transmission.  
 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 to facilitate 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.

**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**

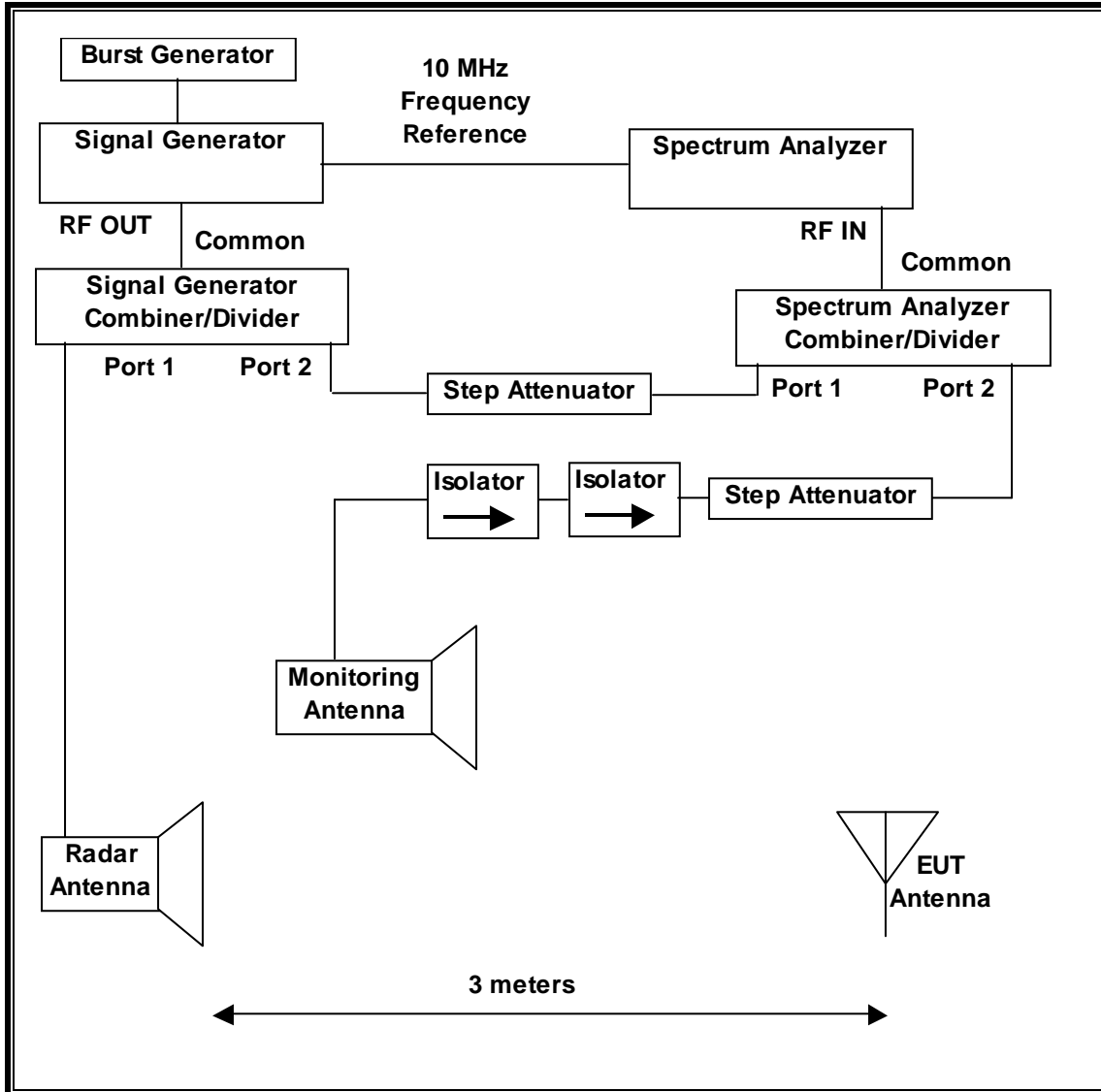
Radar Waveform	Bursts	Pulses per Burst	Pulse Width (µsec)	Chirp Width (MHz)	PRI (µsec)	Minimum Percentage of Successful Detection	Minimum Trials
5	8-20	1-3	50-100	5-20	1000-2000	80%	30

**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

### 11.1.2. 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.

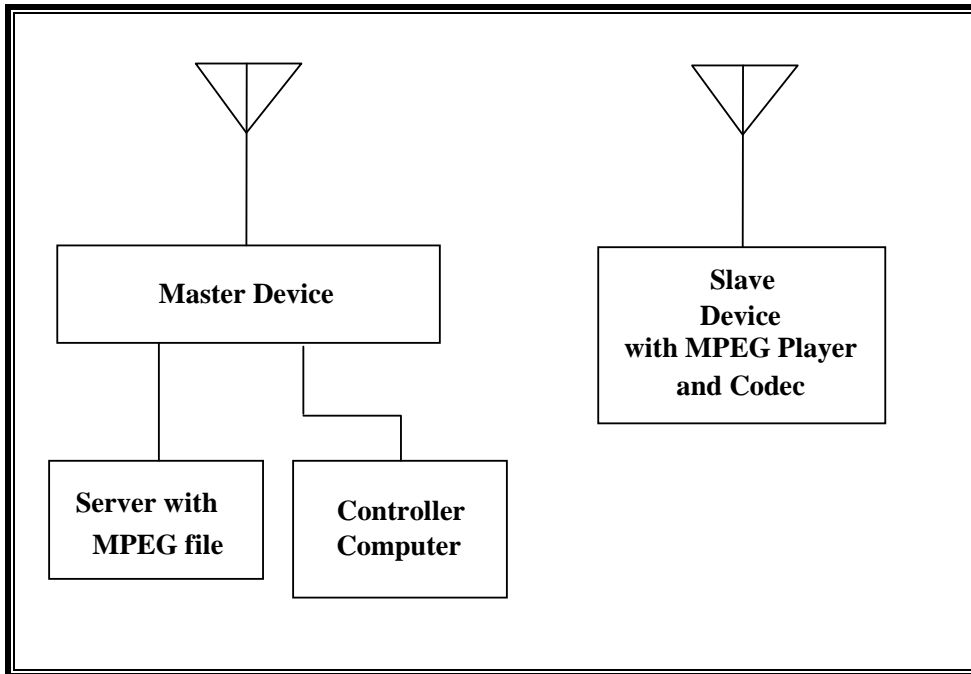
**TEST AND MEASUREMENT EQUIPMENT**

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, 26.5 GHz	Agilent / HP	E4440A	C01178	08/15/12
Vector Signal Generator, 20GHz	Agilent / HP	E8267C	C01066	11/17/12

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

#### RADIATED METHOD TEST SETUP



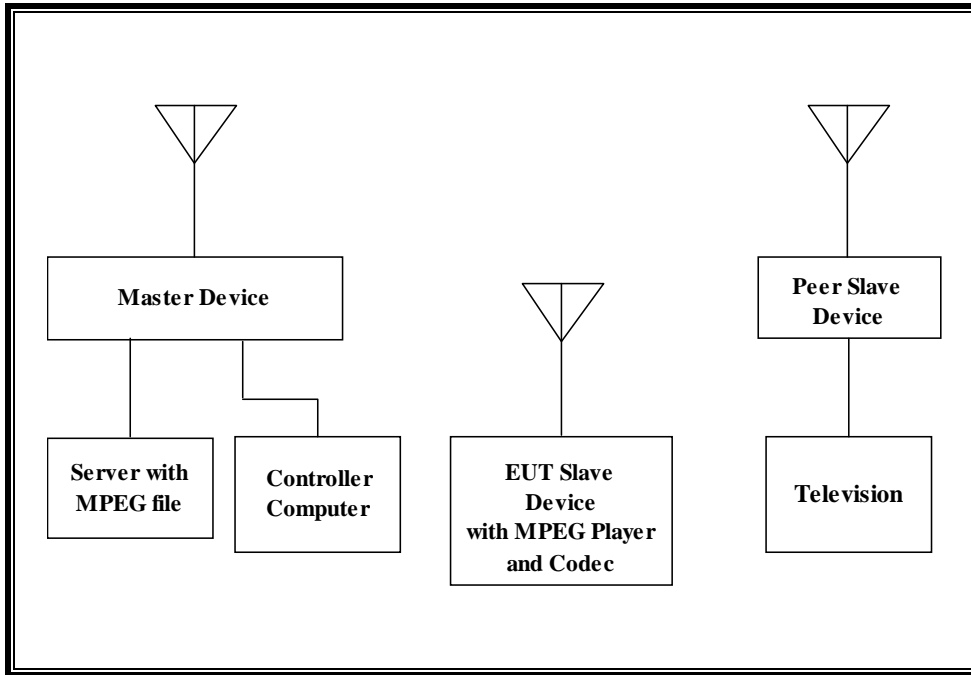
#### SUPPORT EQUIPMENT

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 (Master Device)	Cisco	AIR-AP1252AG-A-K9	FTX130390D9	LDK102061
AC Adapter (AP)	Delta Electronics	EADP-45BB B	DTH1049902N	DoC
Notebook PC (Server)	Apple	MacBook Pro A1150	AOU257941	DoC
AC Adapter (Server)	Delta Electronics	A1344	MV05104CNAL1A	DoC
Notebook PC (Controller)	Dell	PP18L	10657517725	DoC
AC Adapter (Controller PC)	Dell	LA65SN0-00	CN-ODF263-71615-6AU-1019	DoC

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

#### RADIATED METHOD 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 (Master Device)	Cisco	AIR-AP1252AG-A-K9	FTX130390D9	LDK102061
AC Adapter (AP)	Delta Electronics	EADP-45BB B	DTH1049902N	DoC
Notebook PC (Server)	Apple	MacBook Pro A1150	AOU257941	DoC
AC Adapter (Server)	Delta Electronics	A1344	MV05104CNAL1A	DoC
Notebook PC (Controller)	Dell	PP18L	10657517725	DoC
AC Adapter (Controller PC)	Dell	LA65SN0-00	CN-ODF263-71615-6AU-1019	DoC
Apple TV (Peer Slave Device)	Apple	A1427	C07GY040F14P	BCGA1427
LCD Television	Samsung	T23A350	Z3VEHCRC300508H	DoC

### **11.1.5. DESCRIPTION OF EUT**

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

The EUT is a Slave Device without Radar Detection.

The highest power level within these bands is 12.89 dBm EIRP in the 5250-5350 MHz band and 13.49 dBm EIRP in the 5470-5725 MHz band.

The only antenna assembly utilized with the EUT has a gain of  $-1.66$  dBi in the 5250-5350 MHz band and  $-0.83$  dBi in the 5470-5725 MHz band.

The rated output power of the Master unit is  $> 23$  dBm (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 margin to the limit.

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

In the client mode, 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 Safari web browser. In the Client-to-Client Communications mode, WLAN traffic is generated by streaming the video file TestFile.mp2 "6 ½ Magic Hours" from the Master, to the Slave, and mirror to the peer slave device in full motion video mode using Safari web browser.

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

The EUT utilizes the 802.11a/n architecture. Two nominal channel bandwidths of 20 MHz and 40 MHz are implemented in standard client mode.

One nominal channel bandwidth of 20 MHz is implemented in Client-to-Client Communications mode.

The software installed in the EUT is IOS (Build 10A371).

### **UNIFORM CHANNEL SPREADING**

This requirement is not applicable to Slave radio 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  $> 23\text{dBm}$  (EIRP). Therefore the required interference threshold level is  $-64\text{ dBm}$ . After correction for procedural adjustments, the required radiated threshold at the antenna port is  $-64 + 1 = -63\text{ dBm}$ .

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

The software installed in the access point is 12.4(25d)JA1.

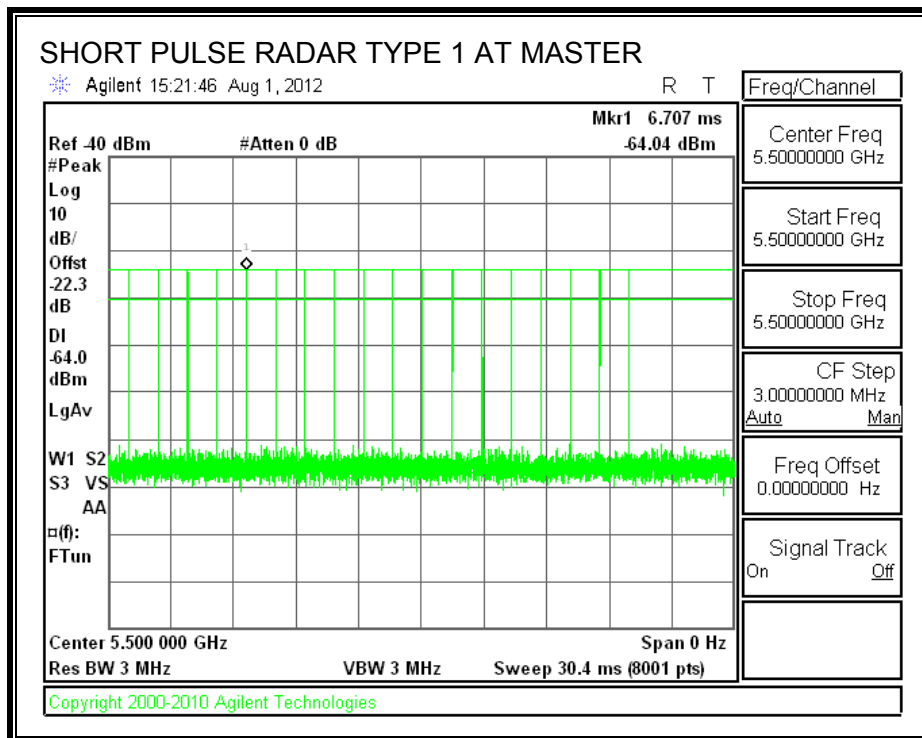
## 11.2. CLIENT MODE RESULTS FOR 20 MHz BANDWIDTH

### 11.2.1. TEST CHANNEL

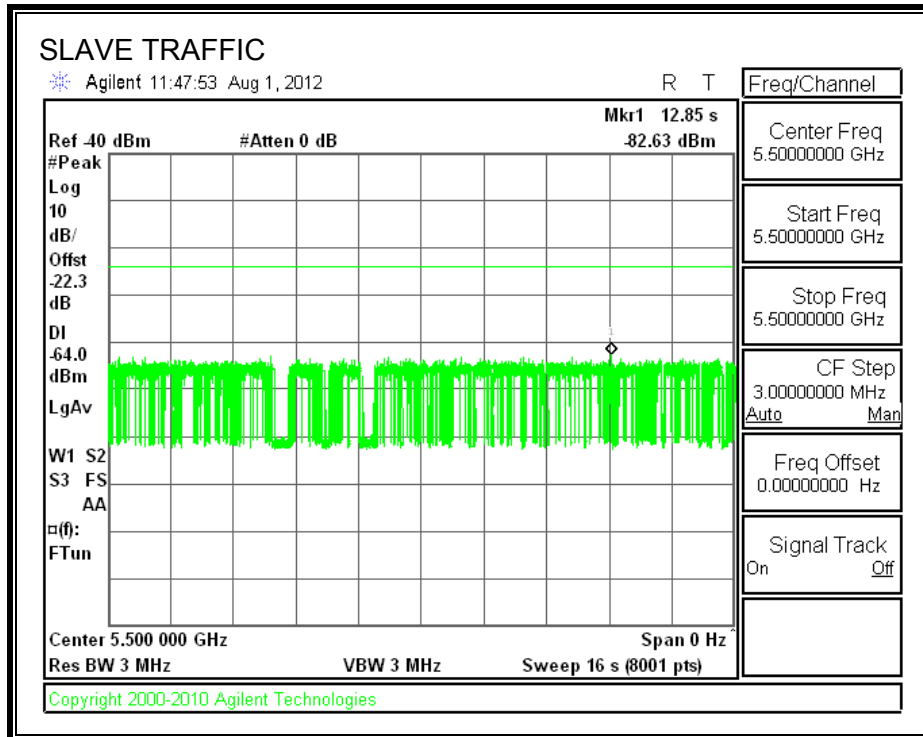
All tests were performed at a channel center frequency of 5500 MHz.

### 11.2.2. RADAR WAVEFORM AND TRAFFIC

#### RADAR WAVEFORM



**TRAFFIC**



**11.2.3. OVERLAPPING CHANNEL TESTS**

**RESULTS**

These tests are not applicable.

**11.2.4. 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).

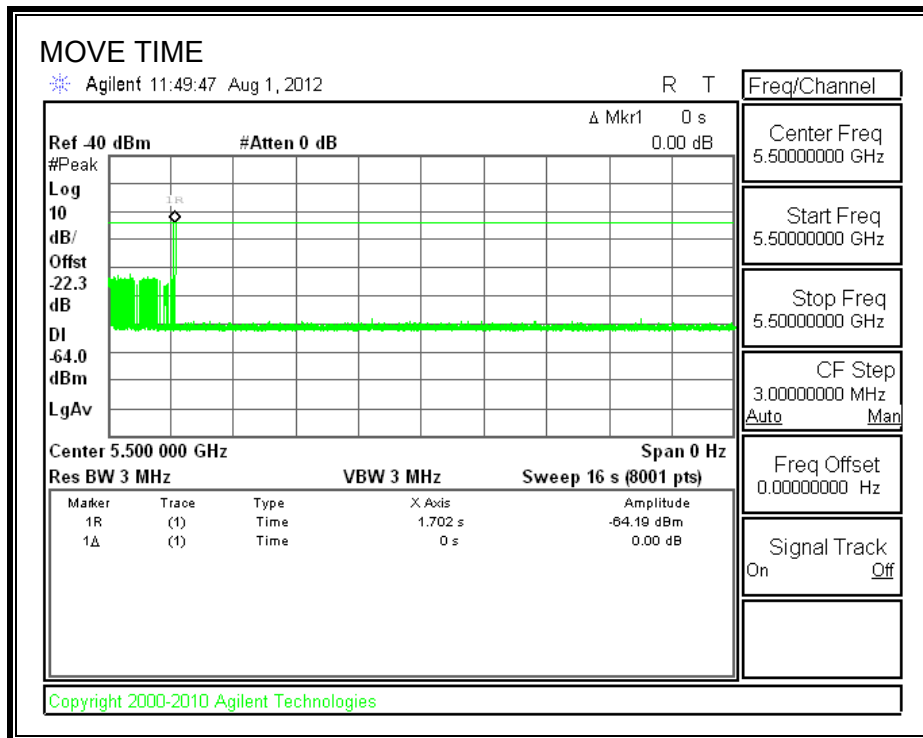
The observation period over which the IC aggregate time is calculated begins at (Reference Marker) and ends no earlier than (Reference Marker + 10 sec).

**RESULTS**

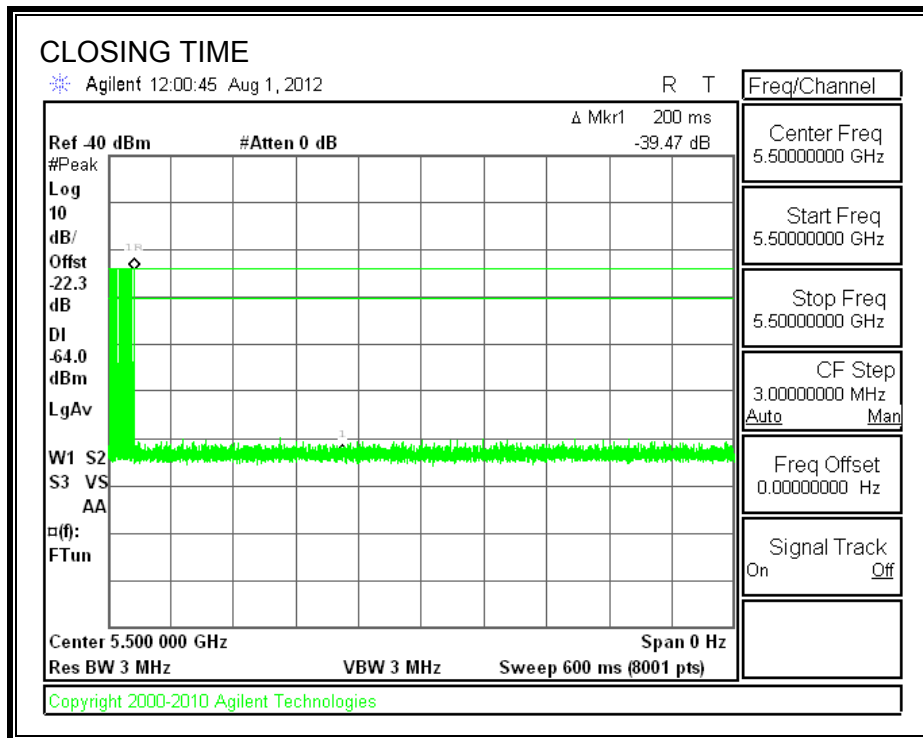
Agency	Channel Move Time (sec)	Limit (sec)
FCC / IC	0.000	10

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

**MOVE TIME**

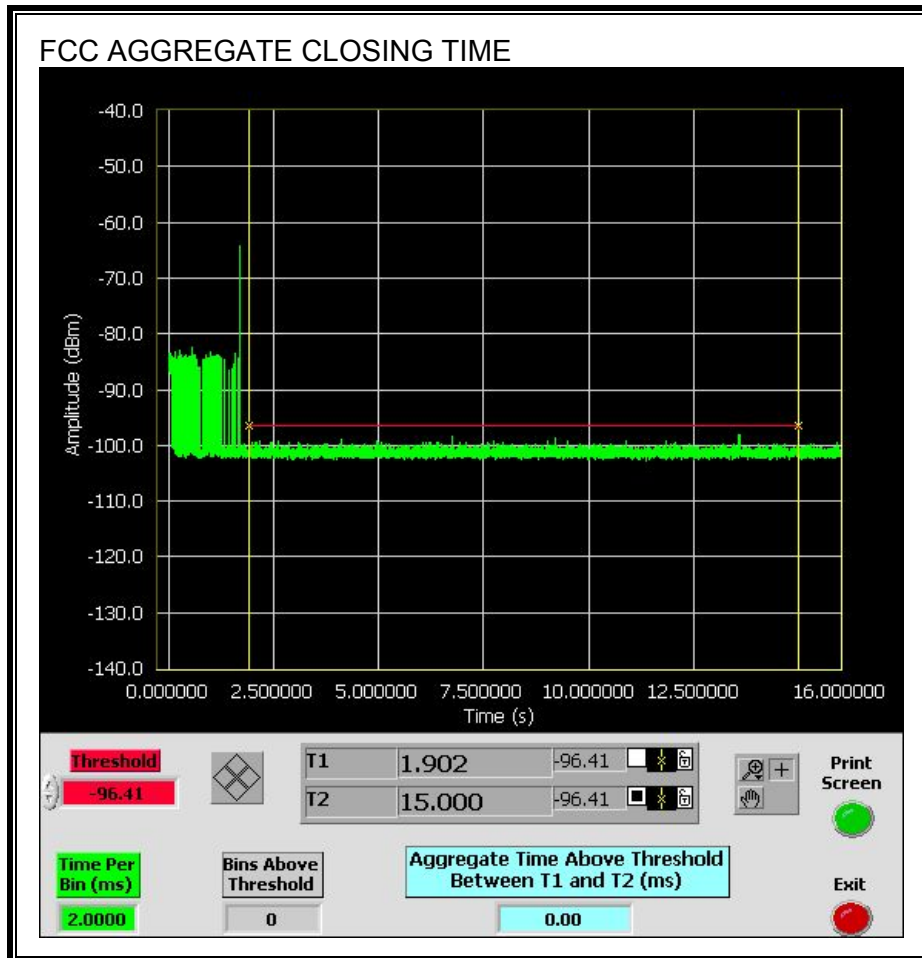


**CHANNEL CLOSING TIME**

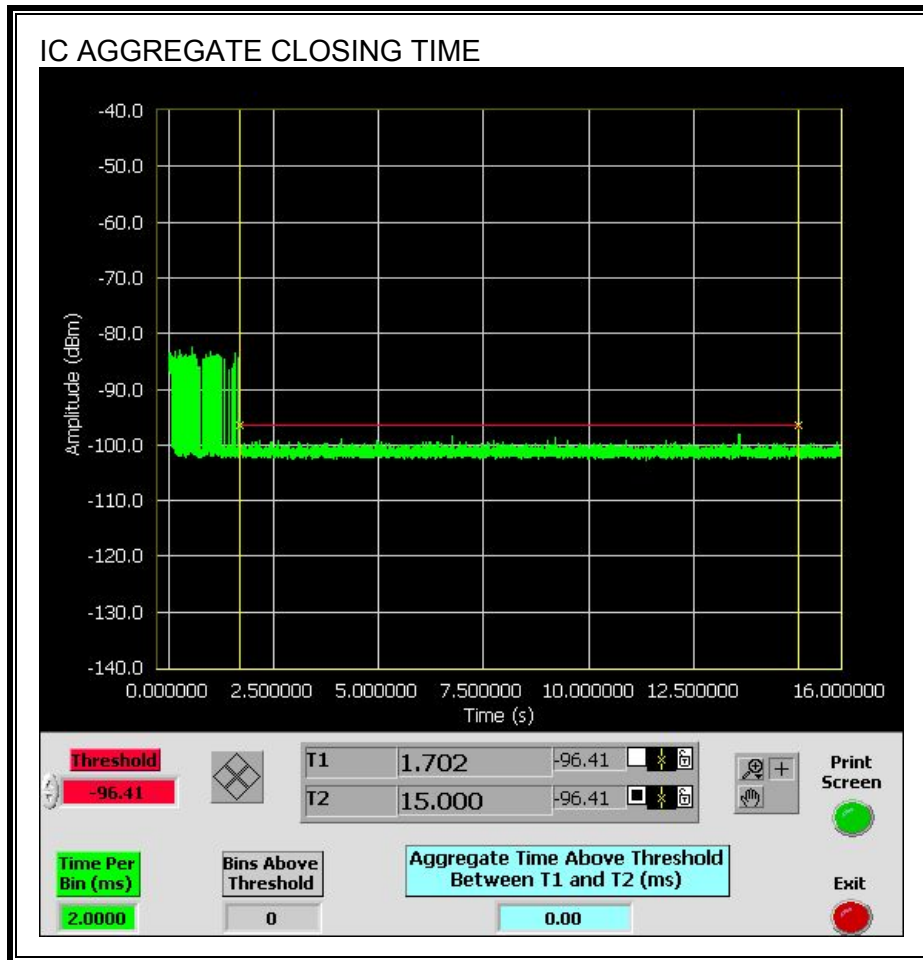


**AGGREGATE CHANNEL CLOSING TRANSMISSION TIME**

No transmissions are observed during the FCC aggregate monitoring period.



No transmissions are observed during the IC aggregate monitoring period.





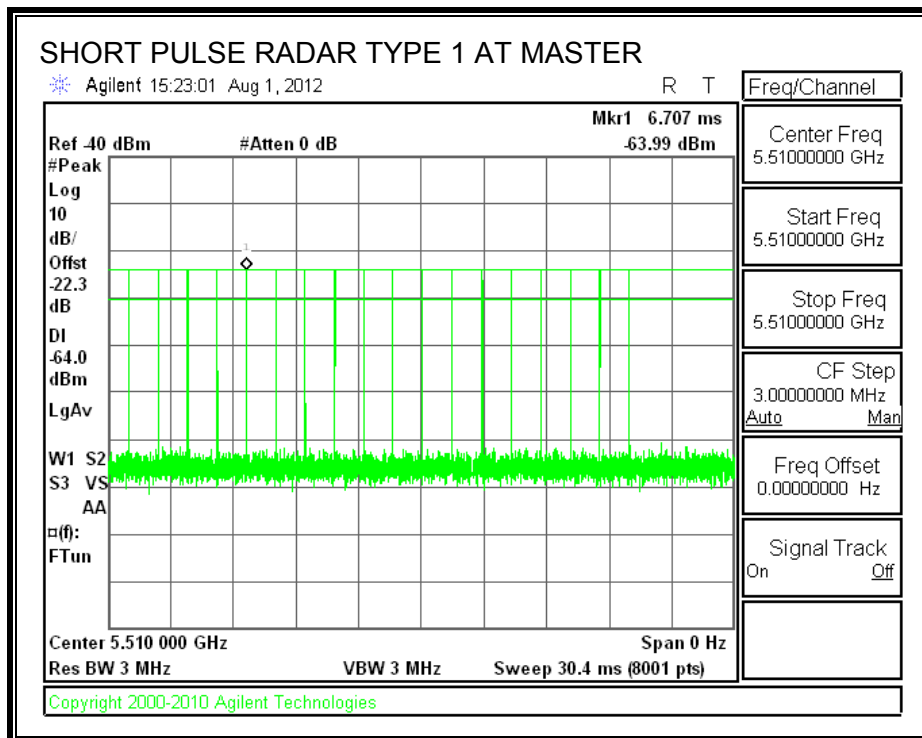
### 11.3. CLIENT MODE RESULTS FOR 40 MHz BANDWIDTH

#### 11.3.1. TEST CHANNEL

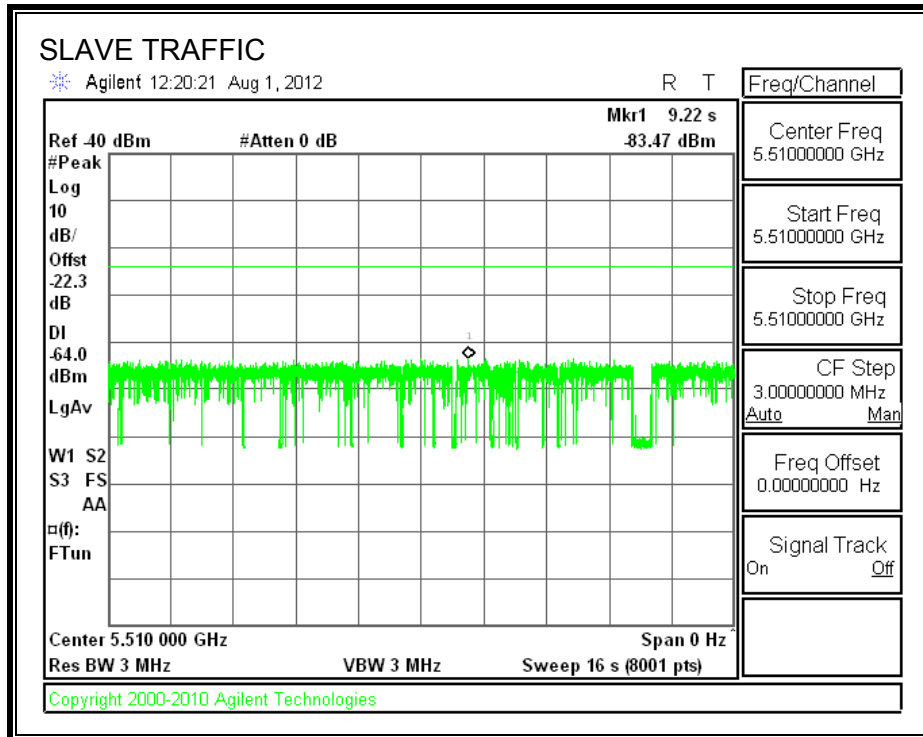
All tests were performed at a channel center frequency of 5510 MHz.

#### 11.3.2. RADAR WAVEFORM AND TRAFFIC

##### RADAR WAVEFORM



**TRAFFIC**



**11.3.3. OVERLAPPING CHANNEL TESTS**

**RESULTS**

These tests are not applicable.

**11.3.4. 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).

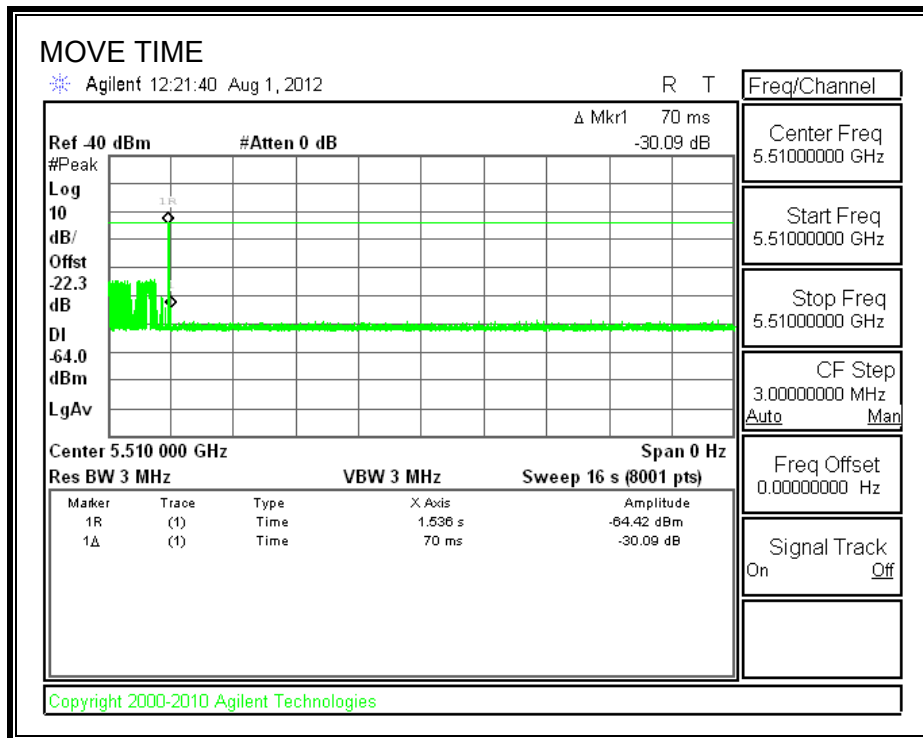
The observation period over which the IC aggregate time is calculated begins at (Reference Marker) and ends no earlier than (Reference Marker + 10 sec).

**RESULTS**

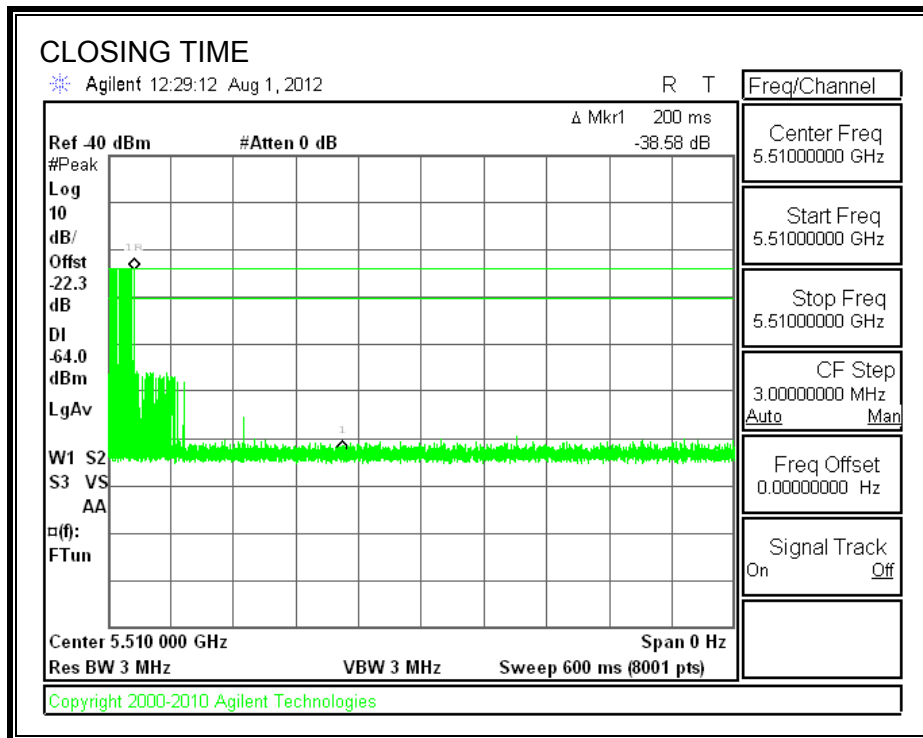
Agency	Channel Move Time (sec)	Limit (sec)
FCC / IC	0.070	10

Agency	Aggregate Channel Closing Transmission Time (msec)	Limit (msec)
FCC	0.0	60
IC	4.0	260

**MOVE TIME**

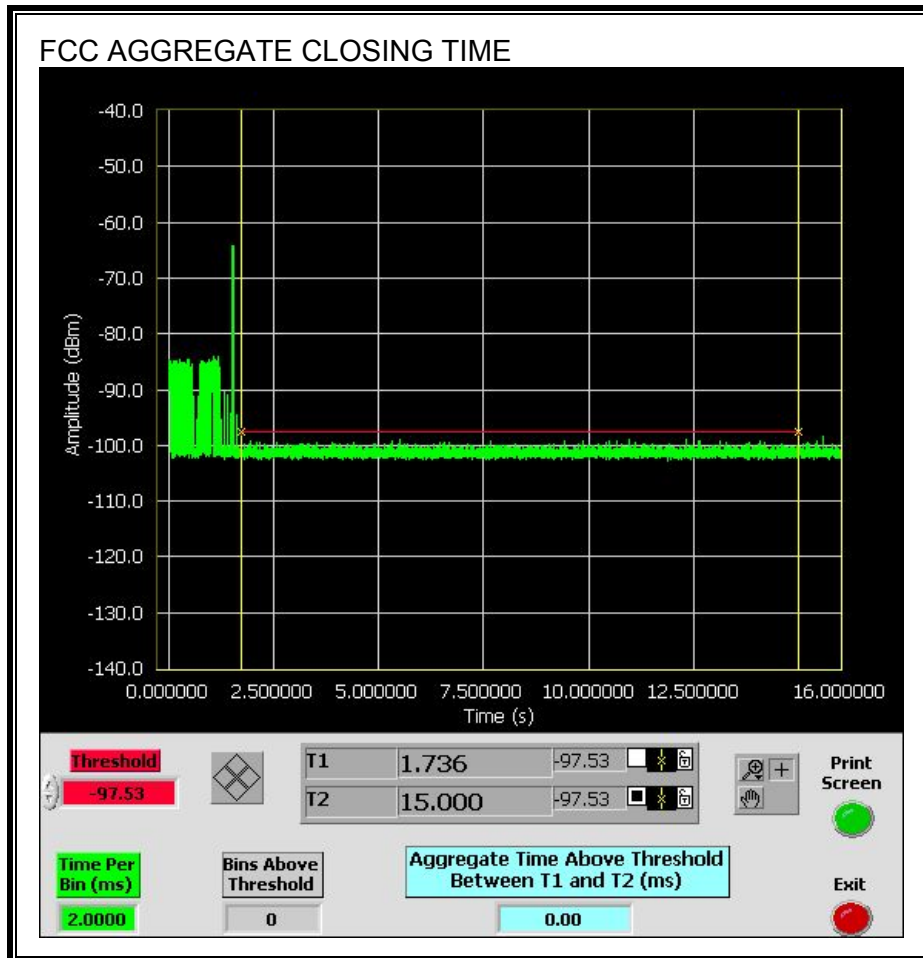


**CHANNEL CLOSING TIME**

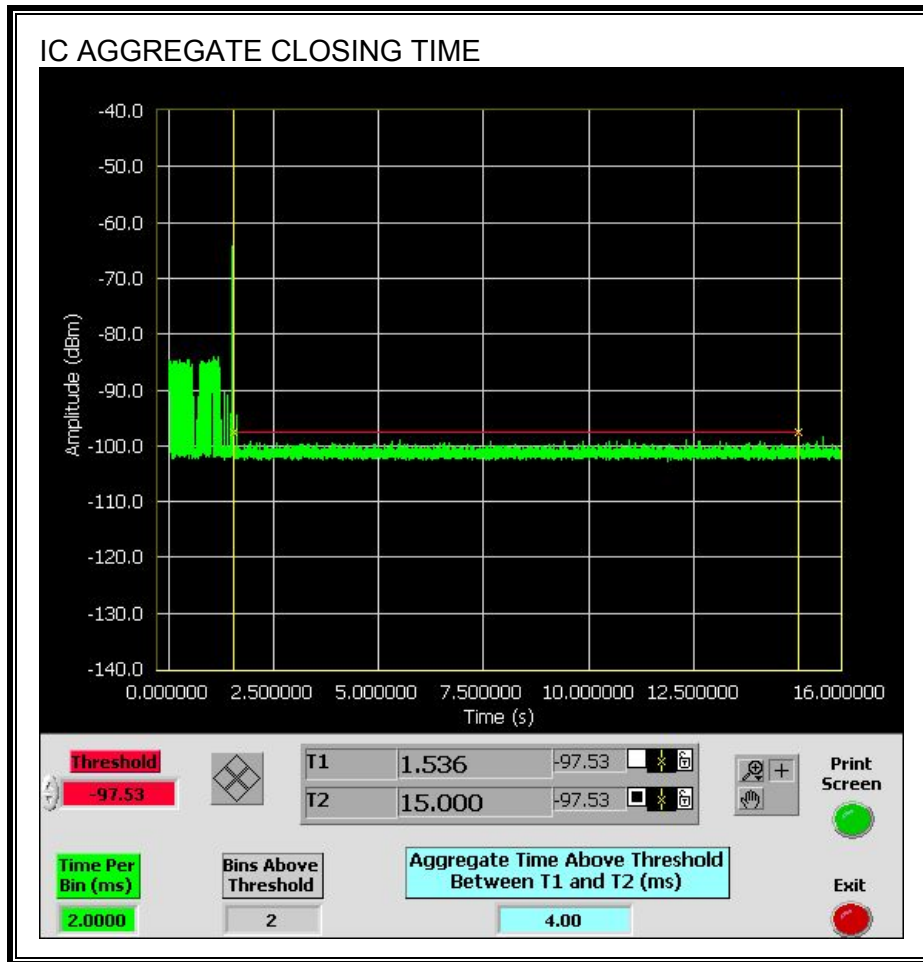


**AGGREGATE CHANNEL CLOSING TRANSMISSION TIME**

No transmissions are observed during the FCC aggregate monitoring period.



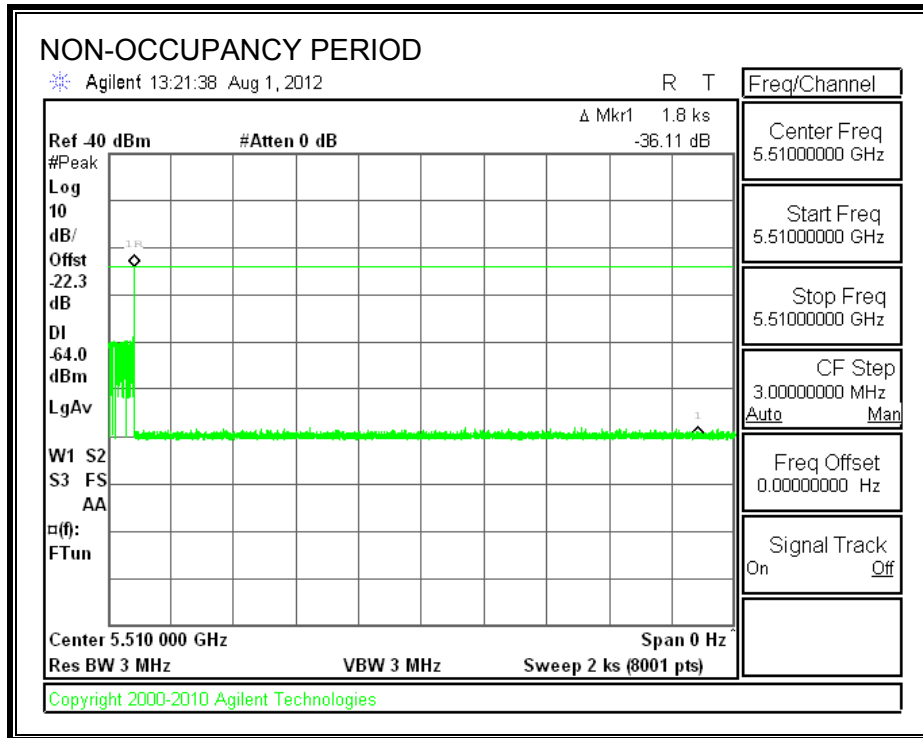
Only intermittent transmissions are observed during the IC aggregate monitoring period.



### 11.3.5. NON-OCCUPANCY PERIOD

#### RESULTS

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





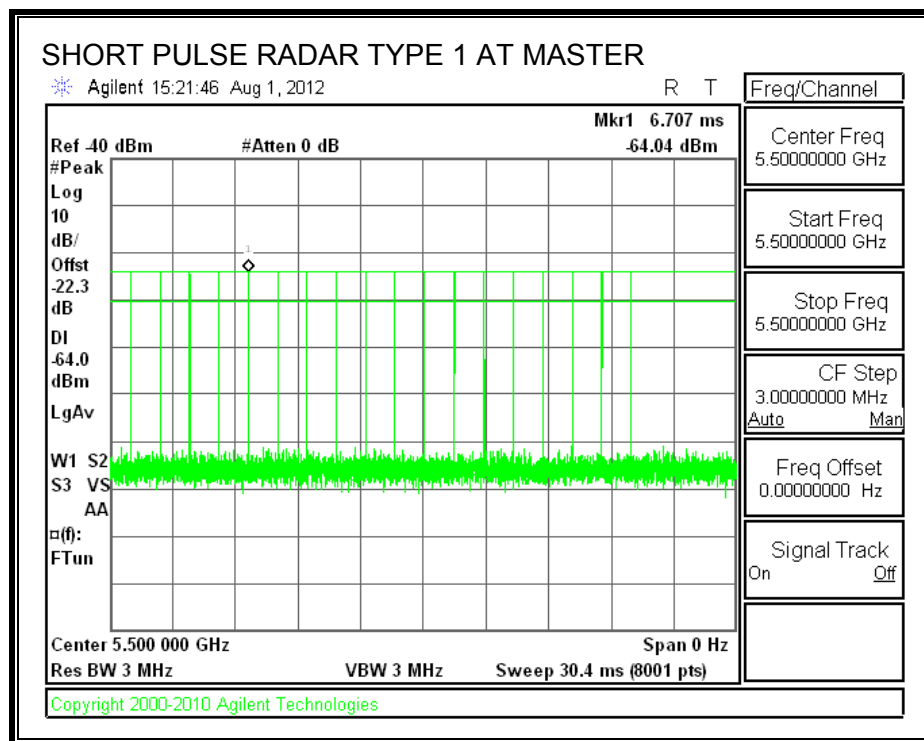
## 11.4. CLIENT-TO-CLIENT COMMUNICATIONS MODE RESULTS FOR 20 MHz BANDWIDTH

### 11.4.1. TEST CHANNEL

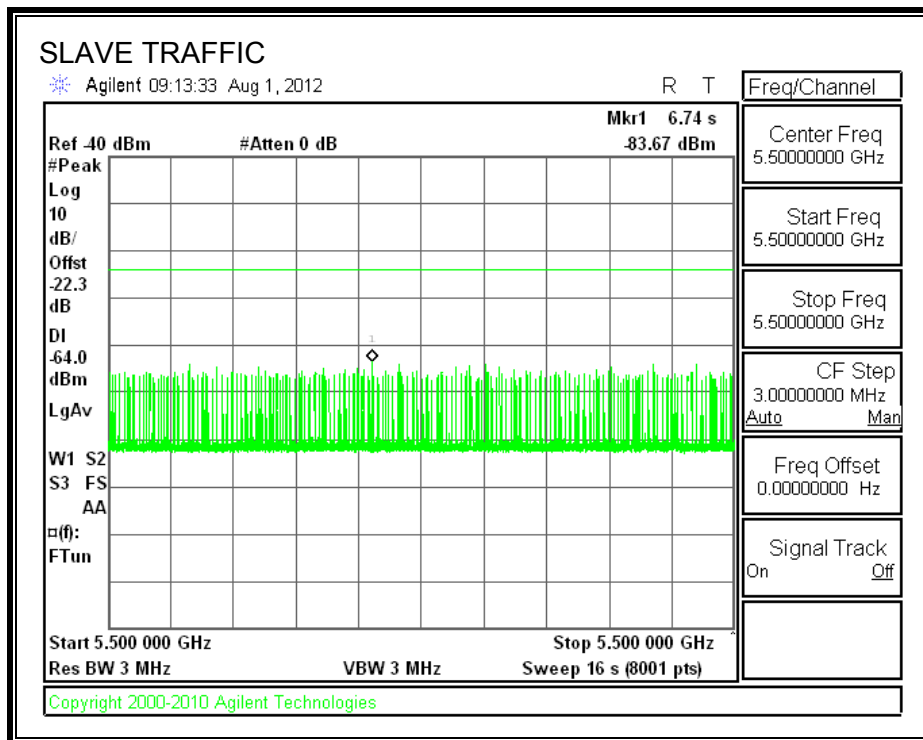
All tests were performed at a channel center frequency of 5500 MHz.

### 11.4.2. RADAR WAVEFORM AND TRAFFIC

#### RADAR WAVEFORM



**TRAFFIC**



**11.4.3. OVERLAPPING CHANNEL TESTS**

**RESULTS**

These tests are not applicable.

**11.4.4. 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).

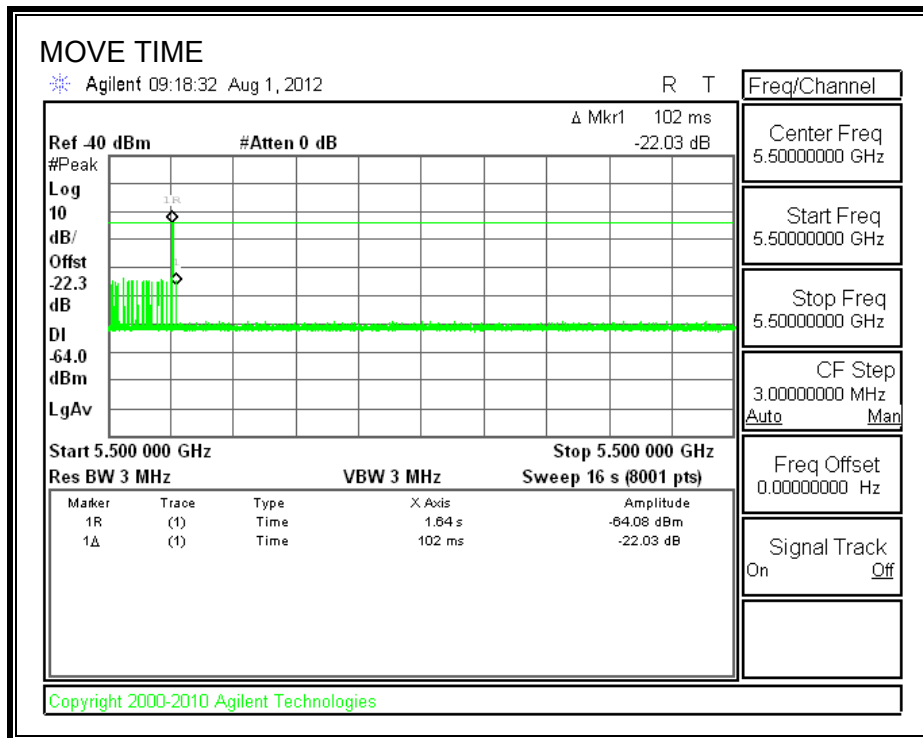
The observation period over which the IC aggregate time is calculated begins at (Reference Marker) and ends no earlier than (Reference Marker + 10 sec).

**RESULTS**

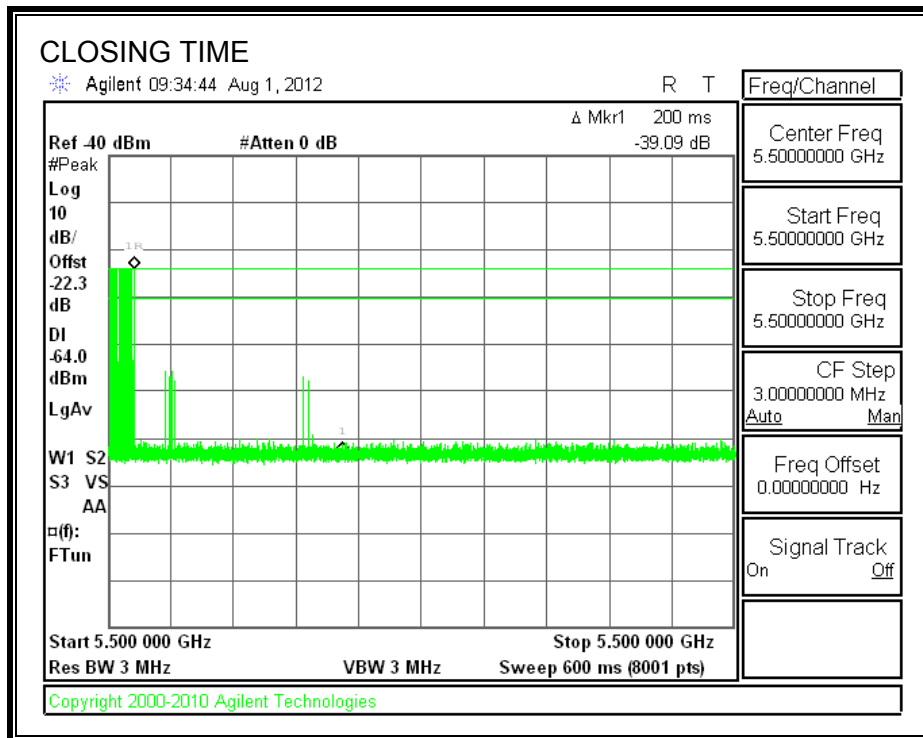
Agency	Channel Move Time (sec)	Limit (sec)
FCC / IC	0.102	10

Agency	Aggregate Channel Closing Transmission Time (msec)	Limit (msec)
FCC	0.0	60
IC	4.0	260

**MOVE TIME**

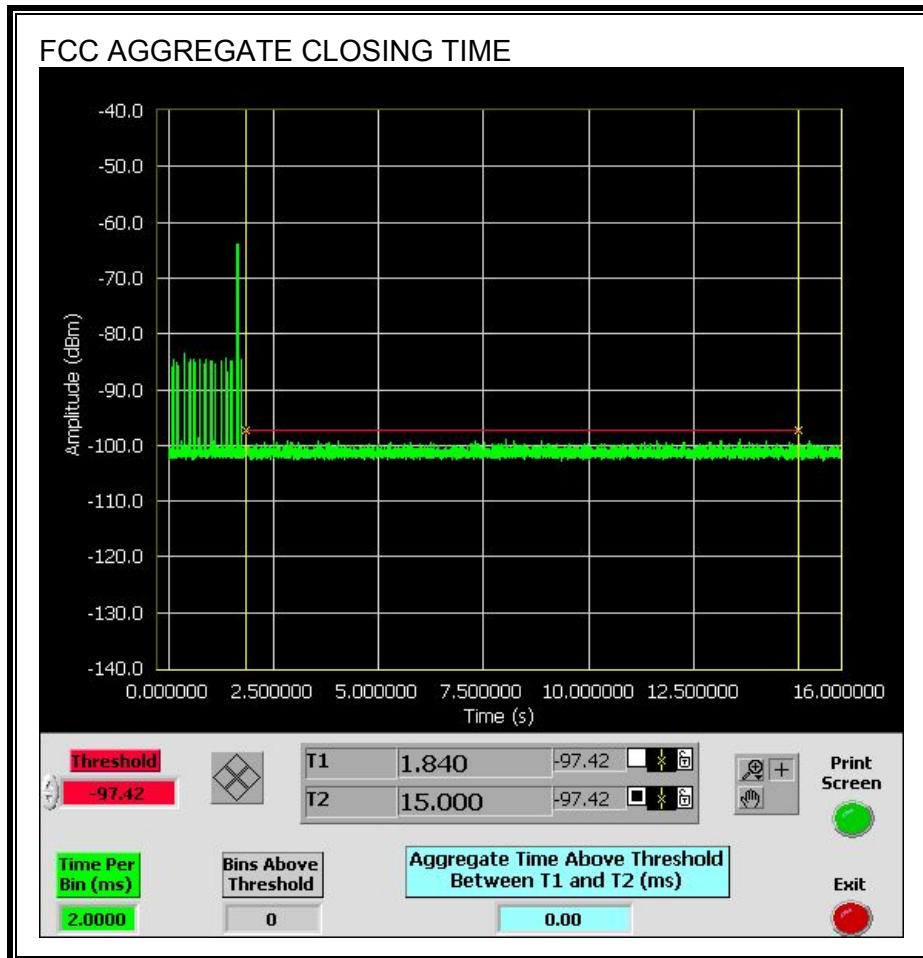


**CHANNEL CLOSING TIME**



**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.

