FCC CFR47 PART 15 SUBPART E

CERTIFICATION TEST REPORT
CLASS II PERMISSIVE CHANGE

FOR

802.11 a/b/g/n 2X2 ACCESS POINT

MODEL NUMBER: A1392

FCC ID: BCGA1392

REPORT NUMBER: 15U21850-E22V3

ISSUE DATE: NOVEMBER 19, 2015

Prepared for
APPLE, INC.
1 INFINITE LOOP
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Prepared by
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NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
V1	11/11/15	Initial issue. Upgrade 12U14326-7 report to 5.2/5.3/5.6GHz band to new rule per KDB 789033 D02 v01.	T. Chu
V2	11/18/15	Revised report to address TCB's questions	T. Chu
V3	11/19/15	Revised Section 5.2 to address TCB's question	T. Chu

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1. ATTESTATION OF TEST RESULTS

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

EUT DESCRIPTION: 802.11 a/b/g/n 2X2 ACCESS POINT

MODEL: A1392

SERIAL NUMBER: C86H809NF2R9 (RADIATED UNIT),
PT602637 (CONDUCTED UNIT)

DATE TESTED: MARCH 12 – MAY 18, 2012

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
CFR 47 Part 15 Subpart E	Pass

UL Verification Services Inc. 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 Verification Services Inc. 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 Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of any government.

Approved & Released For
UL Verification Services Inc. By::

FRANK IBRAHIM
EMC SUPERVISOR
UL Verification Services Inc.

Tested By:

TOM CHEN
EMC ENGINEER
UL Verification Services Inc.

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC CFR 47 Part 2, FCC CFR 47 Part 15, FCC 14-30, FCC KDB 662911 D01 v02r01, FCC KDB 905462 D02 v01r02/D03 v01r01/D06 v01, FCC KDB 789033 D02 v01, FCC KDB 644545 D03 v01 ANSI C63.10-2009.

3. FACILITIES AND ACCREDITATION

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

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at http://ts.nist.gov/standards/scopes/2000650.htm.

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:

Field Strength (dBuV/m) = Measured Voltage (dBuV) + Antenna Factor (dB/m) + Cable Loss (dB) – Preamp Gain (dB)

36.5 dBuV + 18.7 dB/m + 0.6 dB – 26.9 dB = 28.9 dBuV/m

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 EUT is an 802.11 a/b/g/n transceiver Access Point.

5.2. DESCRIPTION OF CLASS II PERMISSIVE CHANGE

Upgrade 5.2/5.3/5.6GHz band to new rule per KDB 789033 D02 v01.

We have reviewed the original test report for UNII-1, UNII-2A and UNII-2C bands and are hereby attesting that all current technical requirements are still met and all applicable test procedures remain the same. Therefore, the original report is still applicable and no additional testing is done.

We updated the following on this report:

- Updated report to latest KDB 789033 D02 v01.
- 5.2G output power table limit/PPSD limit.
- Removed IC related information.
- Removed Peak Excursion.

5.3. MAXIMUM OUTPUT POWER

The transmitter has a maximum conducted output power as follows:

Frequency (MHz)	Mode	Output Power (dBm)	Output Power (mW)
5180 - 5240	802.11a 2TX	15.03	31.84
5180 - 5240	802.11n HT20 2TX	14.55	28.51
5190 - 5230	802.11n HT40 2TX	16.52	44.87
5260 - 5320	802.11a 2TX	21.13	129.72
5260 - 5320	802.11n HT20 2TX	21.19	131.52
5270 - 5310	802.11n HT40 2TX	22.21	166.34
5500 - 5700	802.11a 2TX	21.98	157.76
5500 - 5700	802.11n HT20 2TX	22.08	161.44
5510 - 5670	802.11n HT40 2TX	21.95	156.68

5.4. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes 2 IFA integrated antennas, with the following peak gains in dBi:

Frequency Range (MHz)	Ant0	Ant1
2400-2483.5	1.49	1.82
5150-5250	0.93	1.88
5250-5350	1.54	2.07
5470-5725	3.09	3.28
5745-5850	2.74	3.11

5.5. SOFTWARE AND FIRMWARE

The Utility software installed in the EUT during testing was ART v3.3.

The firmware installed in the EUT during testing was v7.6.2.d1auto20120216T6T0030-T0T

5.6. 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.

Worst-case data rates as provided by the manufacturer are:
For 11b mode: 1Mbps
For 11g mode: 6Mbps
For 11n HT20 (2.4 GHz band): MCS0
For 11a mode: 6Mbps
For 11n HT20 (5.8 GHz band): MCS0
For 11n HT40 (5.8 GHz band): MCS0

EUT only has one orientation (laid down on the desktop) and it was tested in that orientation.

Since EUT passed radiated with antenna, no conducted spurious was performed.

5.7. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST			
Description	Manufacturer	Model	Serial Number
AC Adapter	Apple	A1184	N/A
Laptop PC	Apple	MacBook Pro	AOU269116

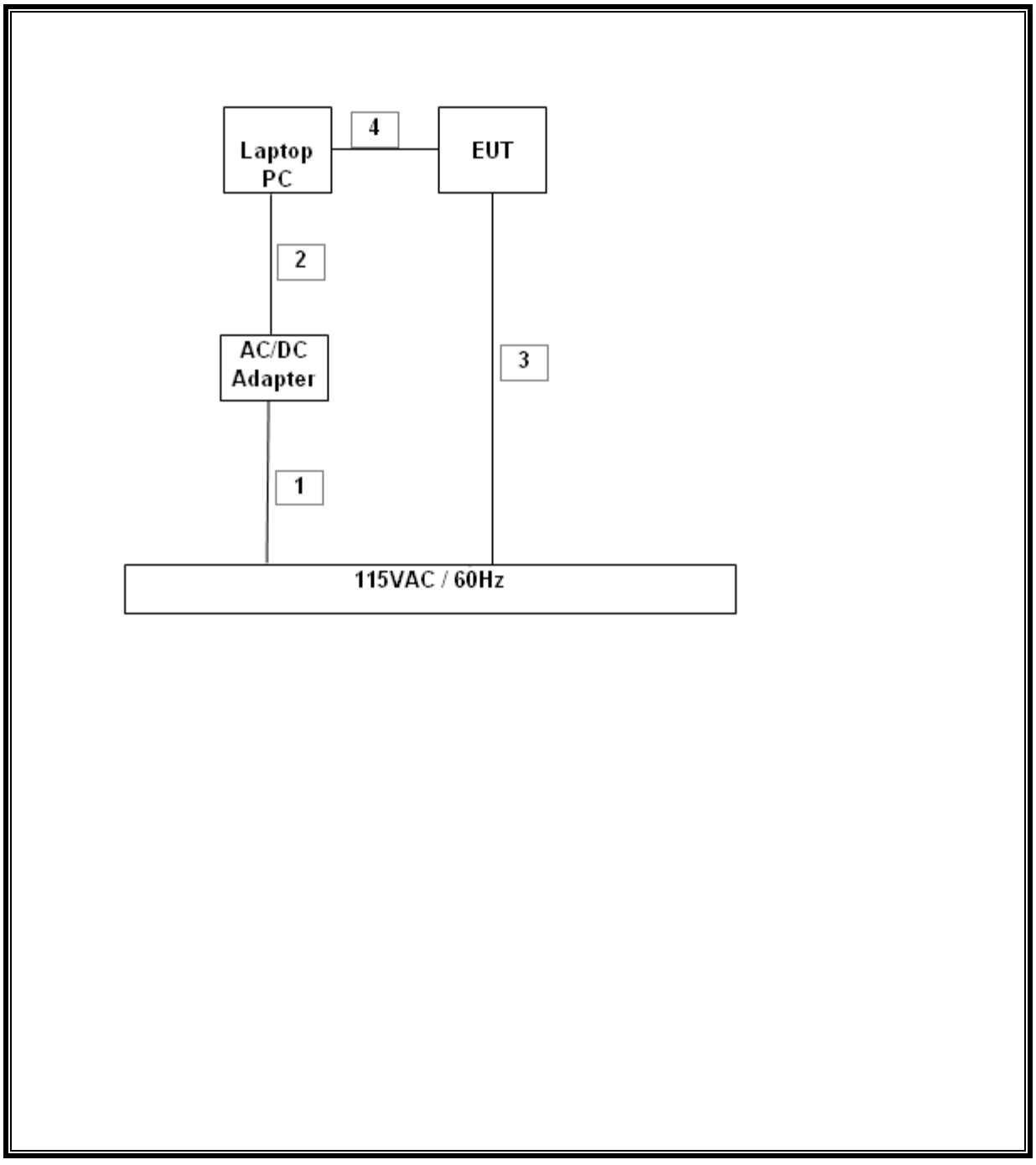
I/O CABLES

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	2.5m	N/A
3	AC	1	AC	Unshielded	2m	N/A
4	Ethernet	1	RJ45	Shielded	1.5m	N/A

TEST SETUP

The Access Point EUT is controlled externally with a laptop, via Ethernet.

SETUP DIAGRAM FOR TESTS



6. TEST AND MEASUREMENT EQUIPMENT

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

TEST EQUIPMENT LIST				
Description	**Manufacturer**	**Model**	**Asset**	**Cal Due**
Preamplifier, 26.5 GHz	Agilent / HP	8449B	C01052	07/14/12
Antenna, Horn, 18 GHz	EMCO	3115	C00945	06/29/12
Preamplifier, 1300 MHz	Agilent / HP	8447D	C00580	11/11/12
Antenna, Bilog, 2 GHz	Sunol Sciences	JB1	C01016	07/12/12
Horn Antenna, 26.5 GHz	ARA	MWH-1826/B	C00589	07/28/12
Horn Antenna, 40 GHz	ARA	MWH-2640/B	C00981	06/14/12
Preamplifier, 40 GHz	Miteq	NSP4000-SP2	C00990	03/14/13
Reject Filter, 2.0-2.9 GHz	Micro-Tronics	BRM50702	N02684	CNR
High Pass Filter, 7.6 GHz	Micro-Tronics	HPM13195	N02682	CNR
Spectrum Analyzer, 44 GHz	Agilent / HP	E4446A	C01159	05/11/12
Peak Power Meter	Agilent	N1911A	1260847C	08/04/12
Peak Power Sensor	Agilent	E9323A	1244073F	08/04/12
Reject Filter, 5.725-5.825 GHz	Micro-Tronics	BRC13192	N02676	CNR
Reject Filter, 2.4-2.5 GHz	Micro-Tronics	BRM50702	N02685	CNR
Highpass Filter, 7.6 GHz	Micro-Tronics	HPM13195	N02682	CNR
EMI Test Receiver, 30MHz	R & S	ESHS 20	N02396	08/19/13
LISN, 30 MHz	FCC	LISN-50/250-25-2	N02625	12/13/12

7. 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.

7.1.1. ON TIME AND DUTY CYCLE RESULTS

Mode	ON Time B (msec)	Period (msec)	Duty Cycle x (linear)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)	1/B Minimum VBW (kHz)
802.11a 20 MHz	1.353	1.400	0.966	96.6%	0.15	0.739
802.11n HT20	1.263	1.310	0.964	96.4%	0.16	0.792
802.11n HT40	0.6317	0.6533	0.967	96.7%	0.15	1.583

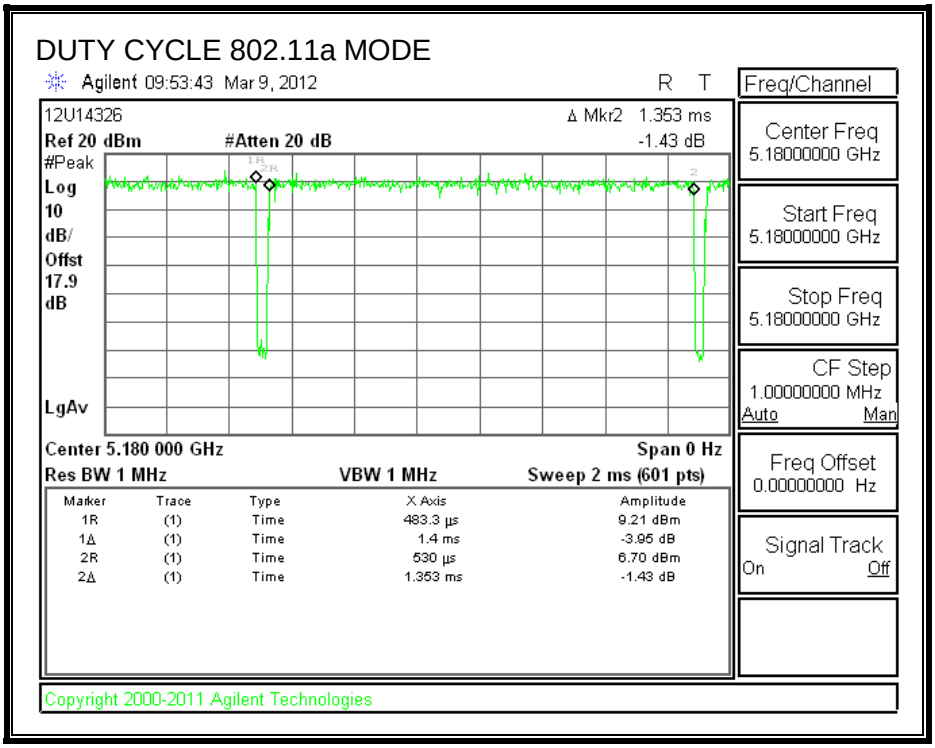
7.1.2. MEASUREMENT METHOD FOR POWER AND PPSD

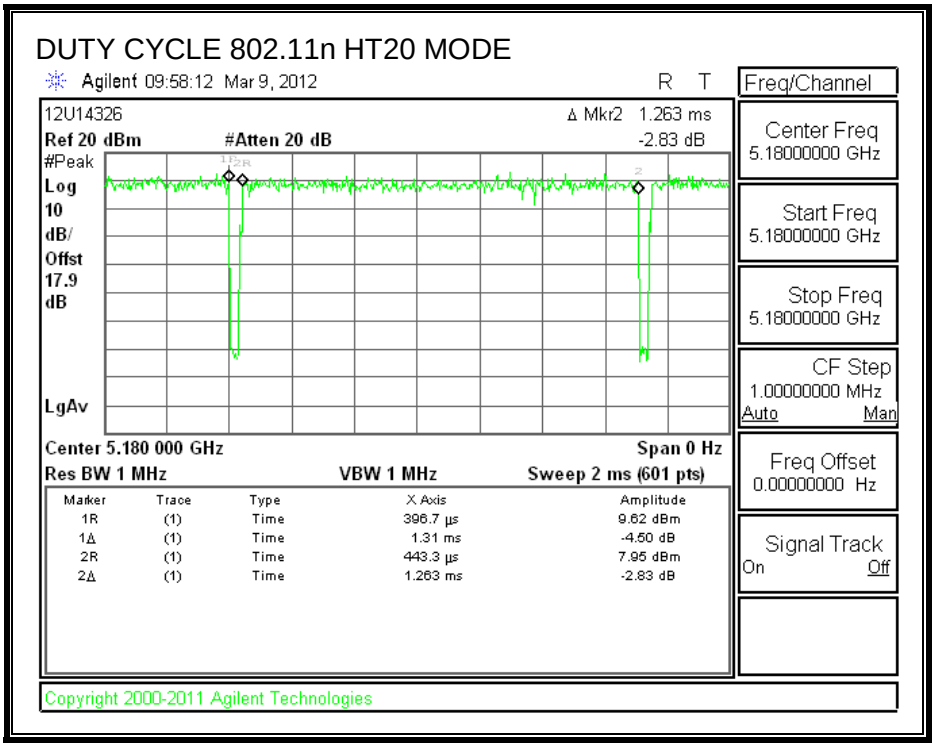
The Duty Cycle is less than 98% and not consistent therefore KDB 789033 Method SA-3 Alternative with Power RMS Averaging is used.

7.1.3. MEASUREMENT METHOD FOR AVG SPURIOUS EMISSIONS ABOVE 1 GHz

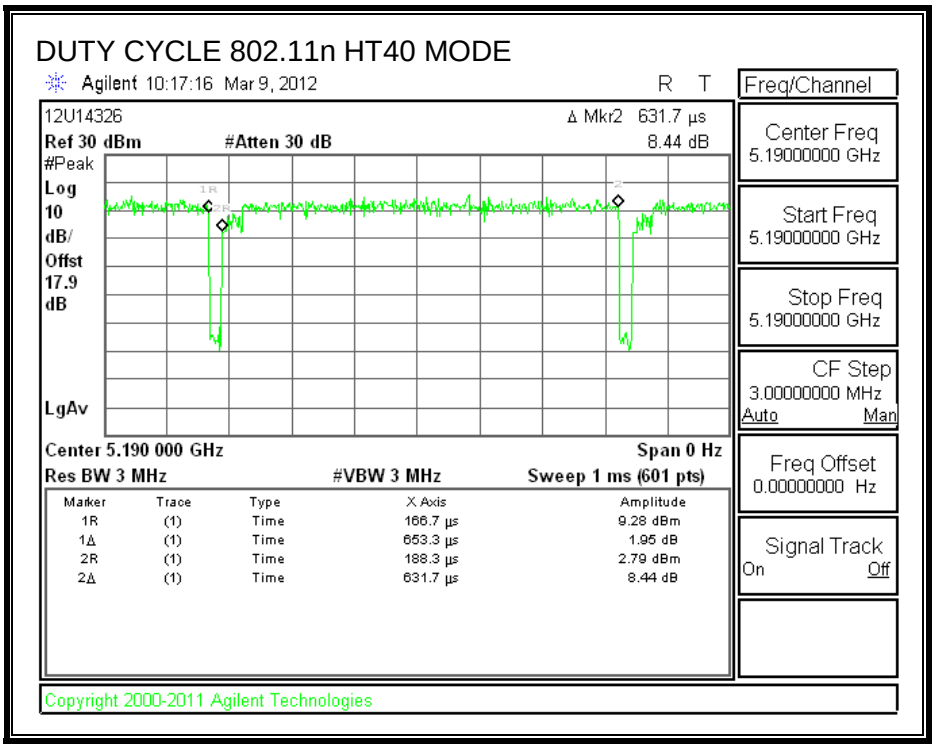
The Duty Cycle is less than 98% and consistent, KDB 789033 Method VB with Power RMS Averaging is used.

7.1.4. DUTY CYCLE PLOTS





DUTY CYCLE 802.11n HT40 MODE



7.2. 802.11a MODE IN THE 5.2 GHz BAND

7.2.1. 26 dB BANDWIDTH

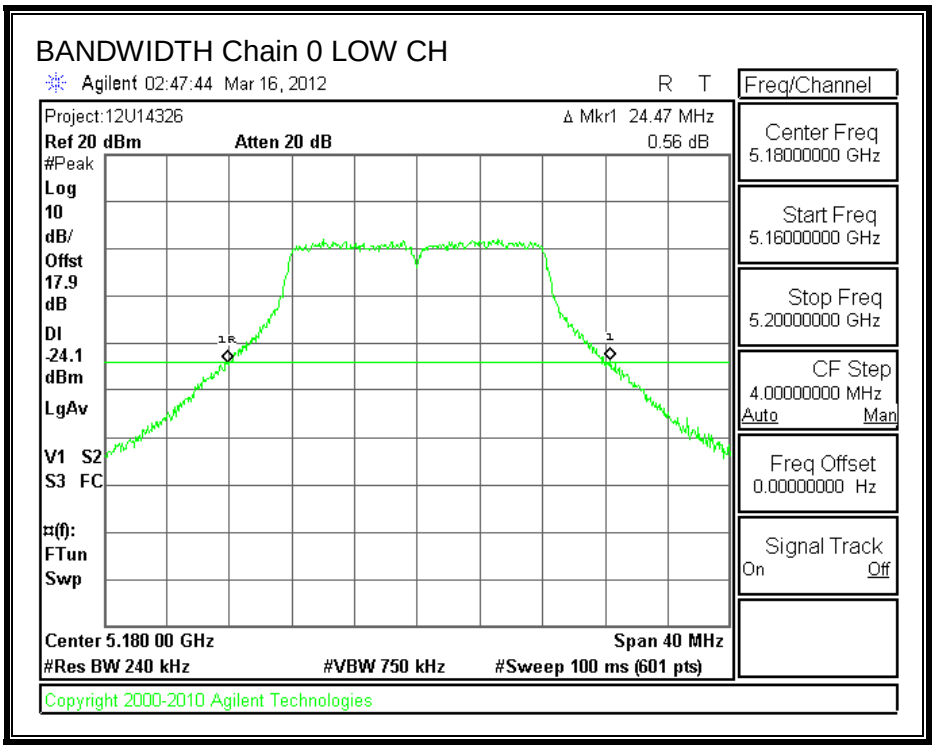
LIMITS

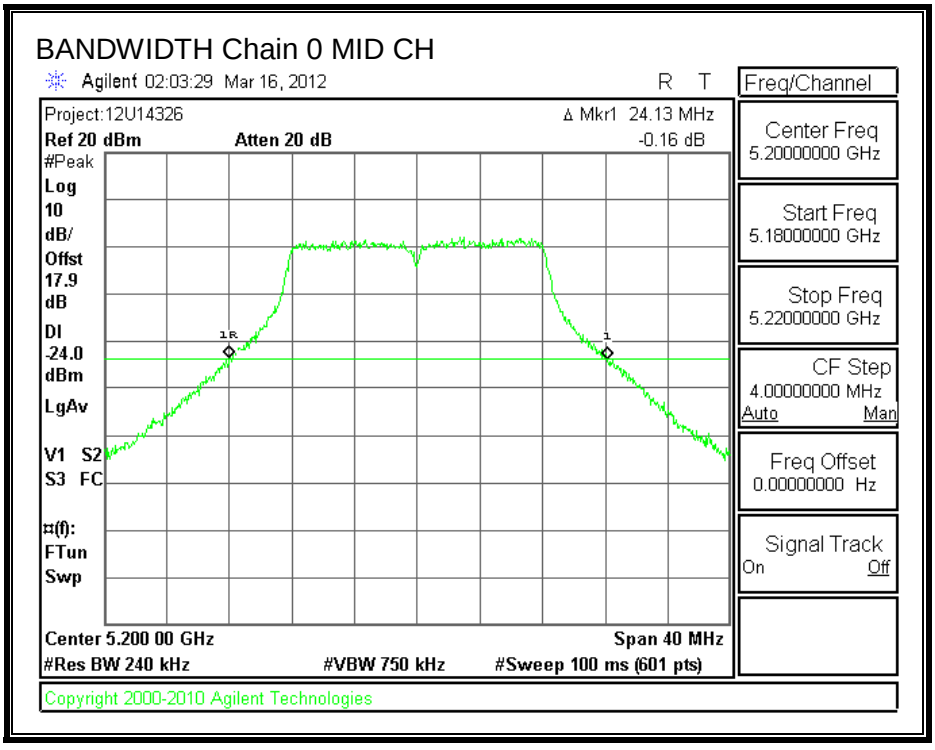
None; for reporting purposes only.

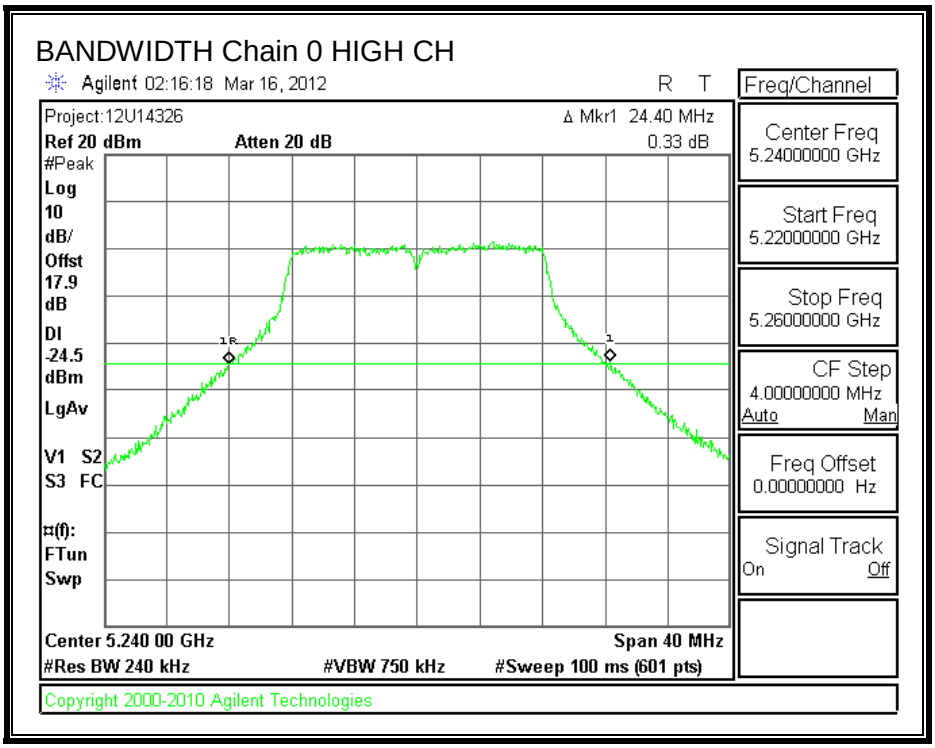
RESULTS

Channel	Frequency (MHz)	26 dB BW Chain 0 (MHz)	26 dB BW Chain 1 (MHz)
Low	5180	24.47	23.80
Mid	5200	24.13	23.80
High	5240	24.40	24.07

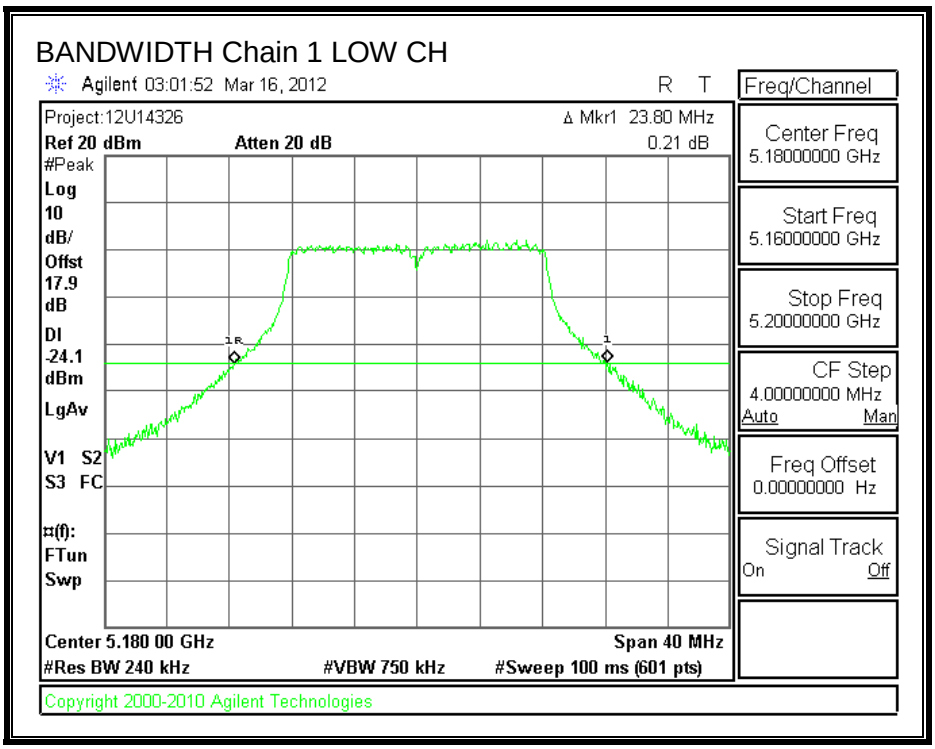
26 dB BANDWIDTH, Chain 0

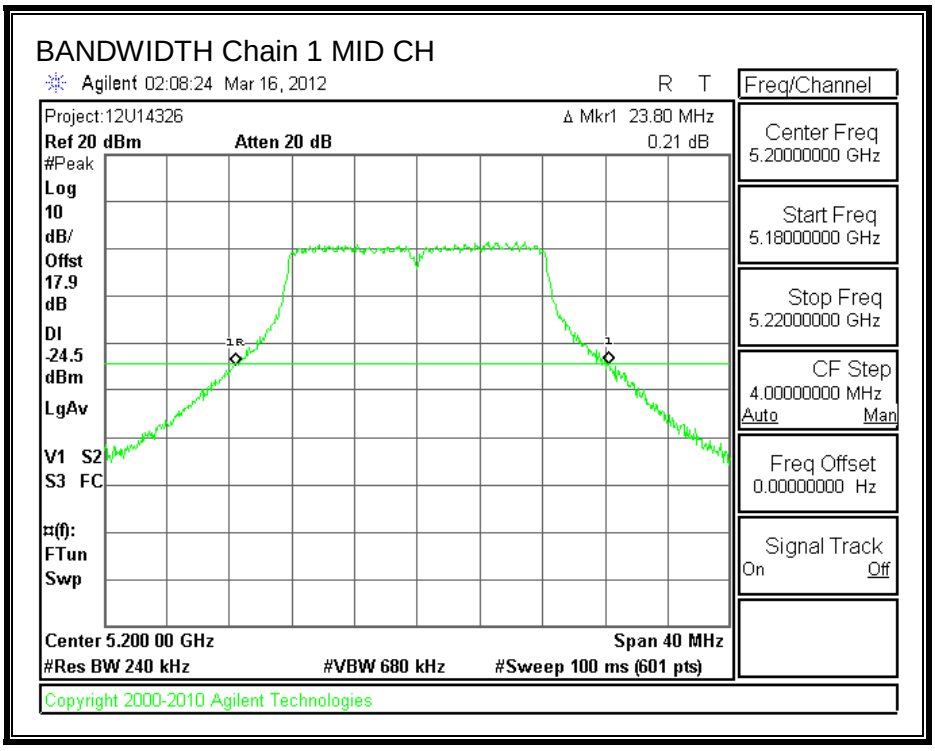


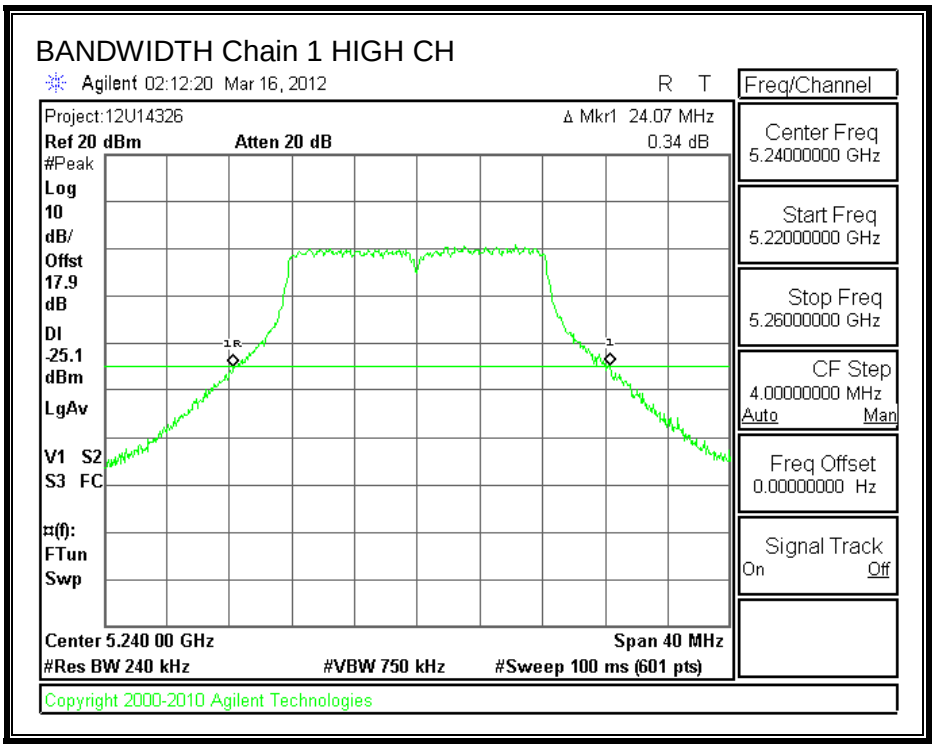




26 dB BANDWIDTH, Chain 1







7.2.2. 99% BANDWIDTH

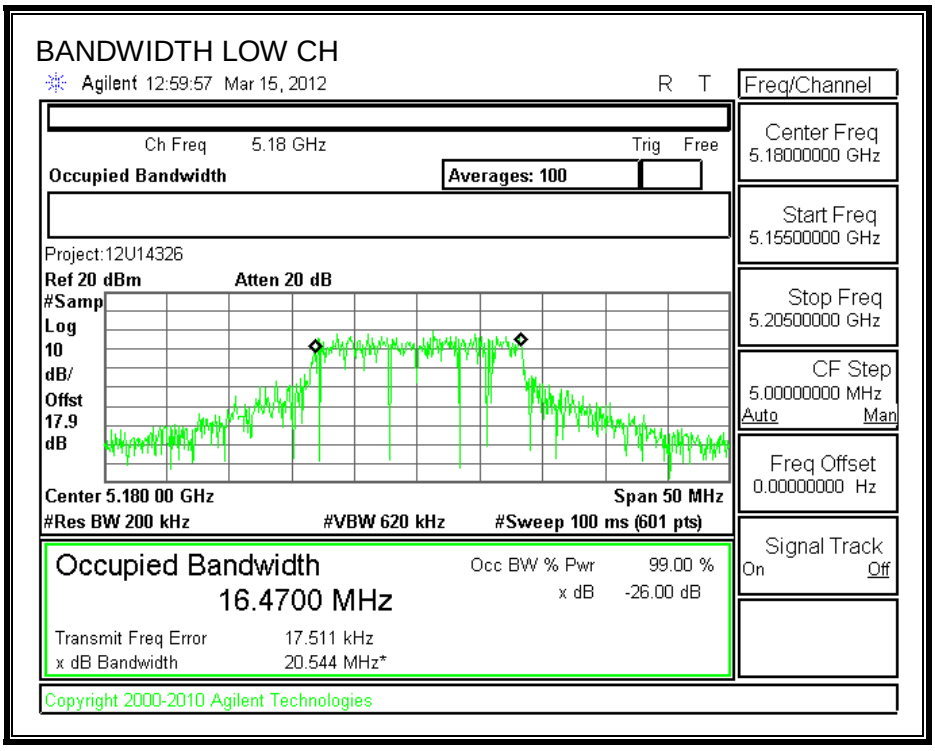
LIMITS

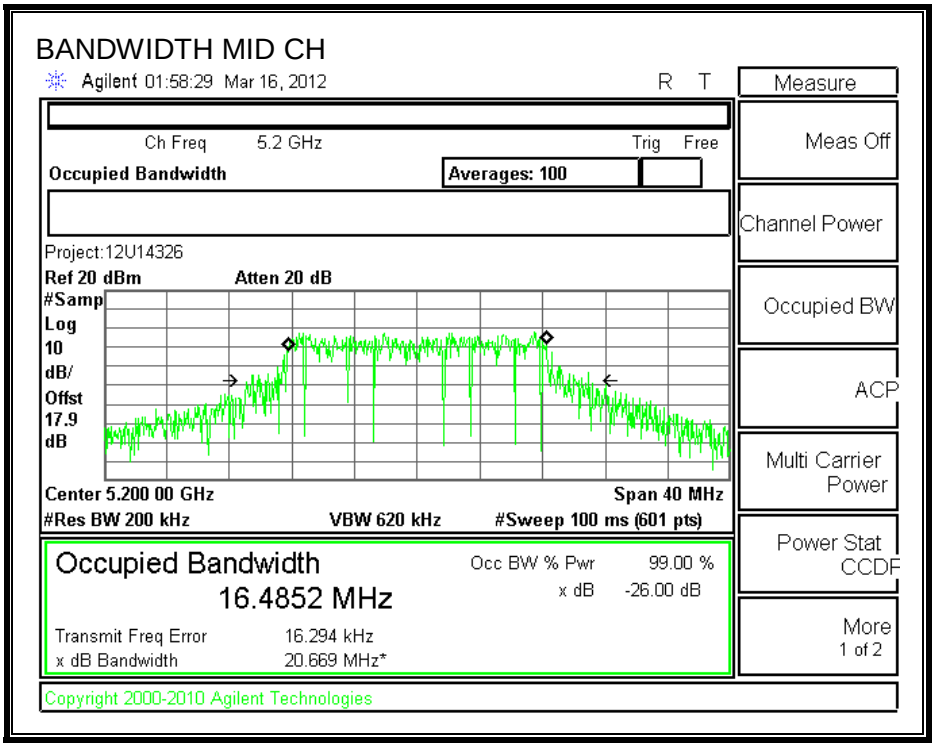
None; for reporting purposes only.

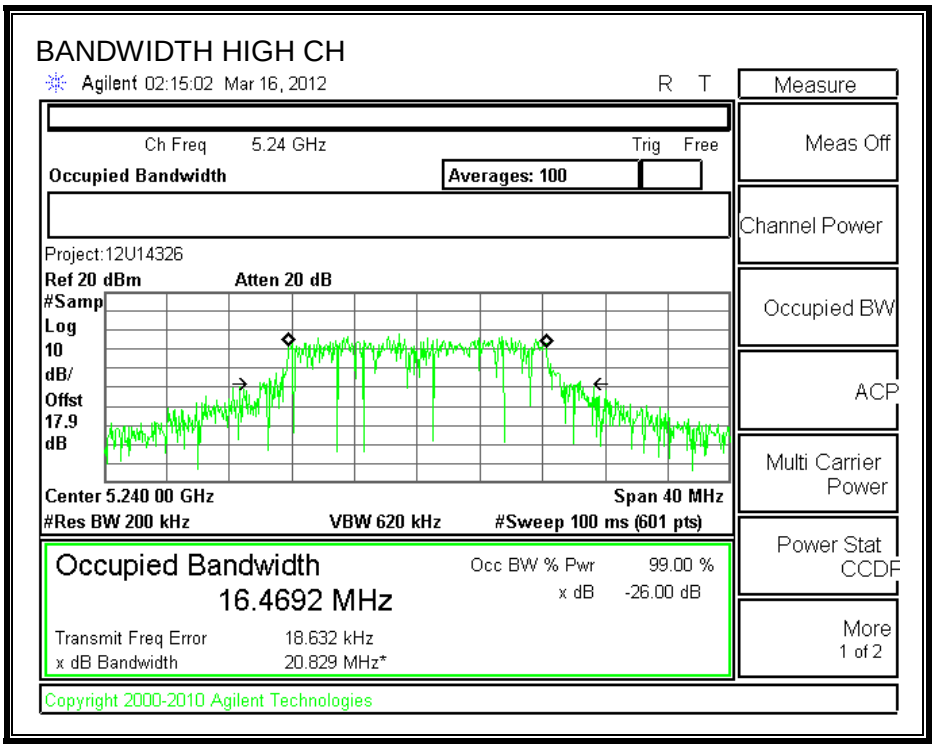
RESULTS

Channel	Frequency (MHz)	99% BW Chain 0 (MHz)	99% BW Chain 1 (MHz)
Low	5180	16.4700	16.4798
Mid	5200	16.4852	16.4717
High	5240	16.4692	16.4800

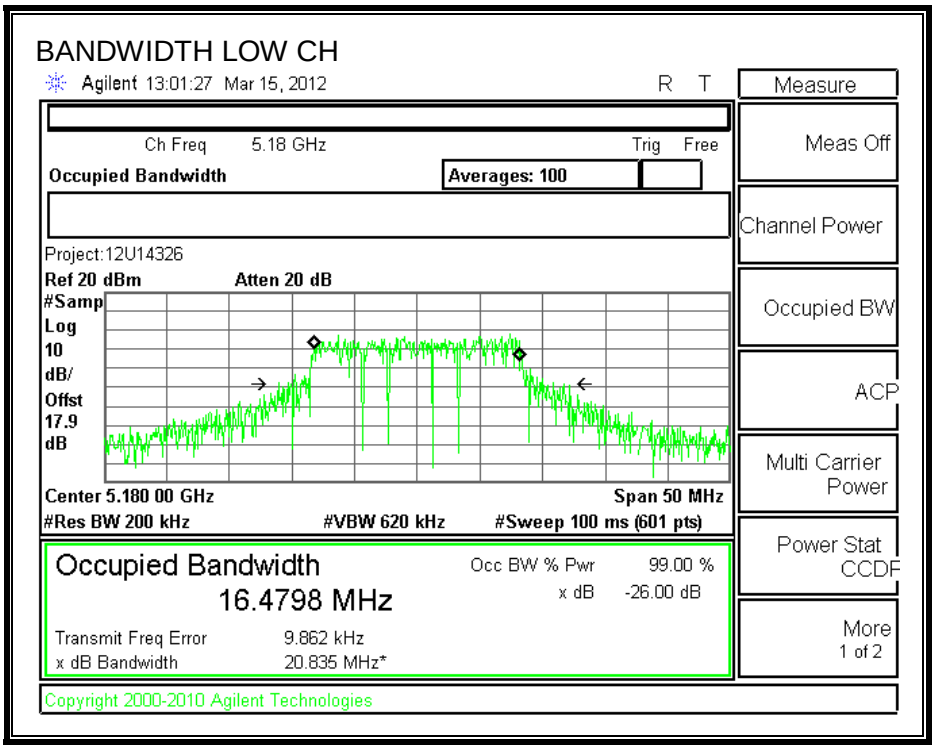
99% BANDWIDTH CHAIN 0

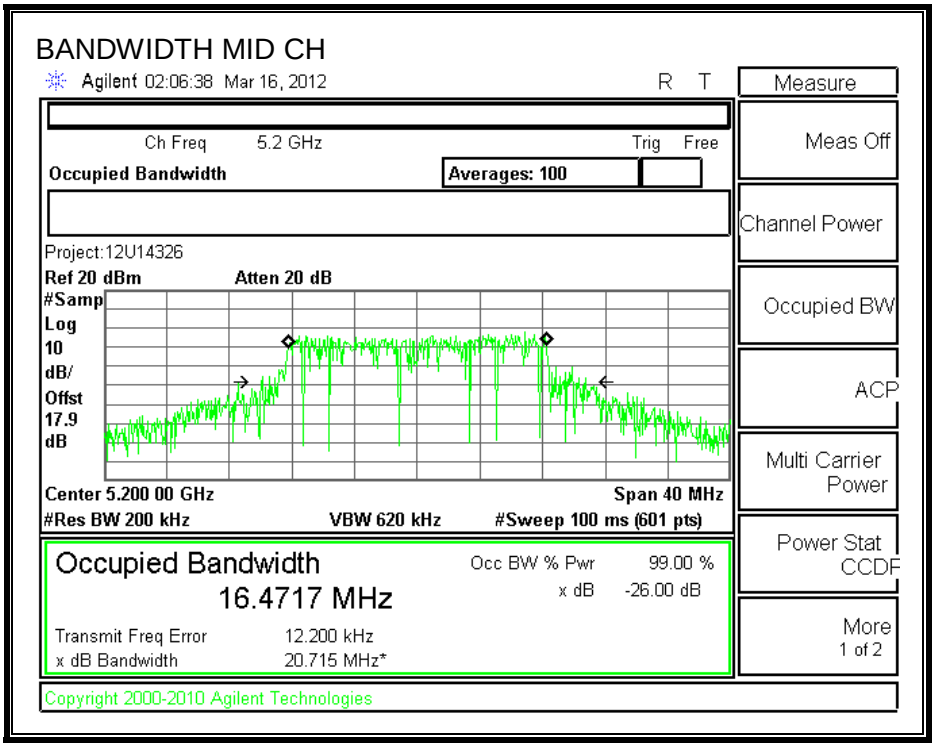


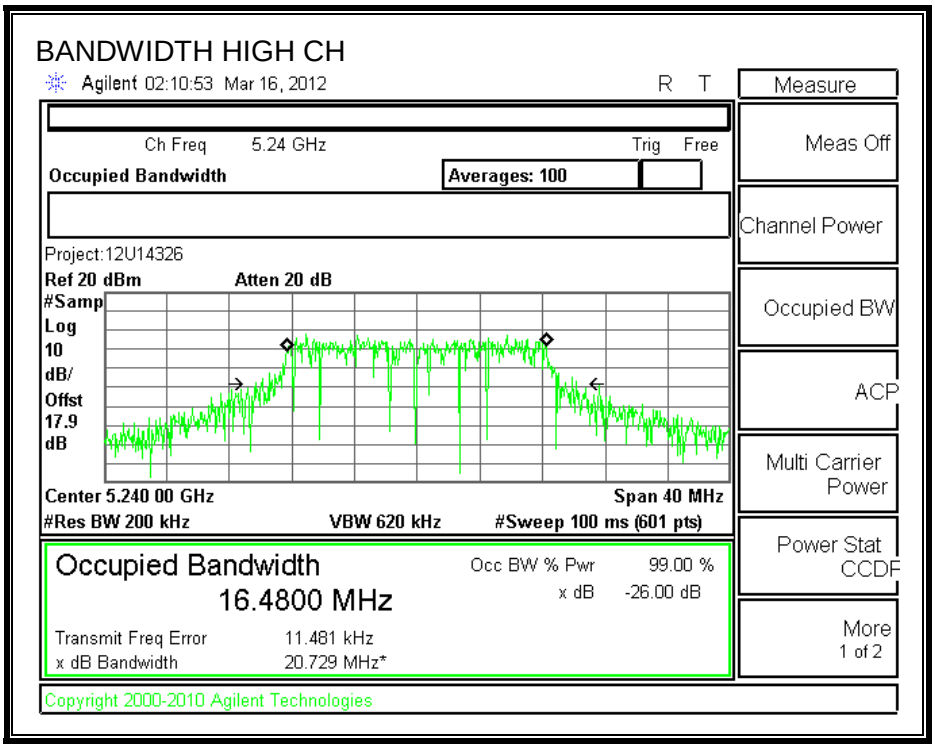




99% BANDWIDTH CHAIN 1







7.2.3. AVERAGE POWER

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

The cable assembly insertion loss of 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

Average Power Results

Channel	Frequency (MHz)	Chain 0 Power (dBm)	Chain 1 Power (dBm)	Total Power (dBm)
Low	5180	11.60	12.10	14.87
Mid	5200	11.90	11.80	14.86
High	5240	11.00	11.30	14.16

7.2.4. OUTPUT POWER AND PPSD

LIMITS

FCC §15.407 (a) (1)

(i) For an outdoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. The maximum e.i.r.p. at any elevation angle above 30 degrees as measured from the horizon must not exceed 125 mW (21 dBm).

(ii) For an indoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

(iii) For fixed point-to-point access points operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. Fixed point-to-point U-NII devices may employ antennas with directional gain up to 23 dBi without any corresponding reduction in the maximum conducted output power or maximum power spectral density. For fixed point-to-point transmitters that employ a directional antenna gain greater than 23 dBi, a 1 dB reduction in maximum conducted output power and maximum power spectral density is required for each 1 dB of antenna gain in excess of 23 dBi. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

(iv) For mobile and portable client devices in the 5.15-5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250 mW provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

DIRECTIONAL ANTENNA GAIN

The TX chains are correlated and the antenna gain is unequal among the chains. The directional gain is:

Chain 0 Antenna Gain (dBi)	Chain 1 Antenna Gain (dBi)	Correlated Chains Directional Gain (dBi)
0.93	1.88	4.43

RESULTS

Limits

Channel	Frequency (MHz)	Directional Gain (dBi)	Power Limit (dBm)	PPSD Limit (dBm)
Low	5180	4.43	30.00	17.00
Mid	5200	4.43	30.00	17.00
High	5240	4.43	30.00	17.00

Output Power Results

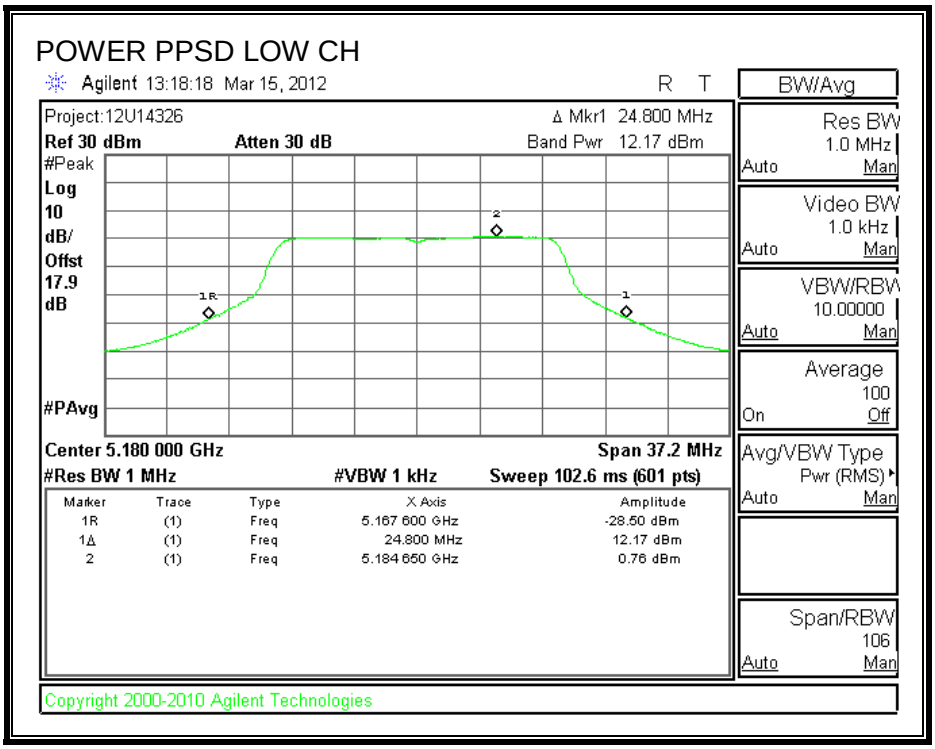
Channel	Frequency (MHz)	Chain 0 Meas Power (dBm)	Chain 1 Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Power Margin (dB)
Low	5180	12.17	11.87	15.03	30.00	-14.97
Mid	5200	12.07	11.63	14.87	30.00	-15.13
High	5240	11.51	10.90	14.22	30.00	-15.78

PPSD Results

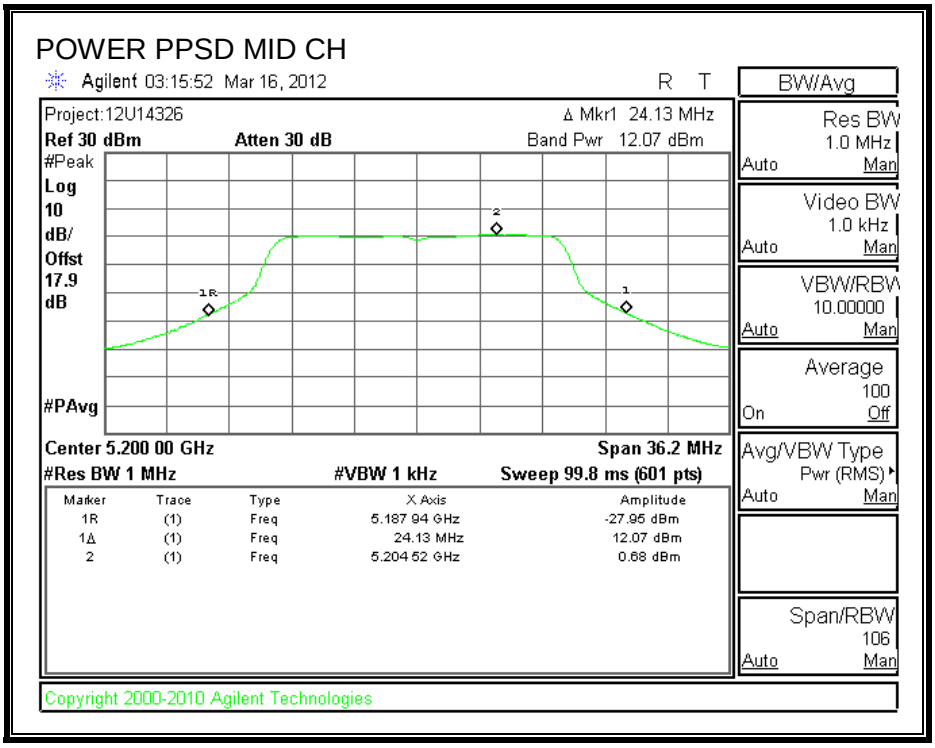
Channel	Frequency (MHz)	Chain 0 Meas PPSD (dBm)	Chain 1 Meas PPSD (dBm)	Total Corr'd PPSD (dBm)	PPSD Limit (dBm)	PPSD Margin (dB)
Low	5180	0.76	0.34	3.57	17.00	-13.43
Mid	5200	0.68	0.15	3.43	17.00	-13.57
High	5240	0.24	-0.62	2.84	17.00	-14.16

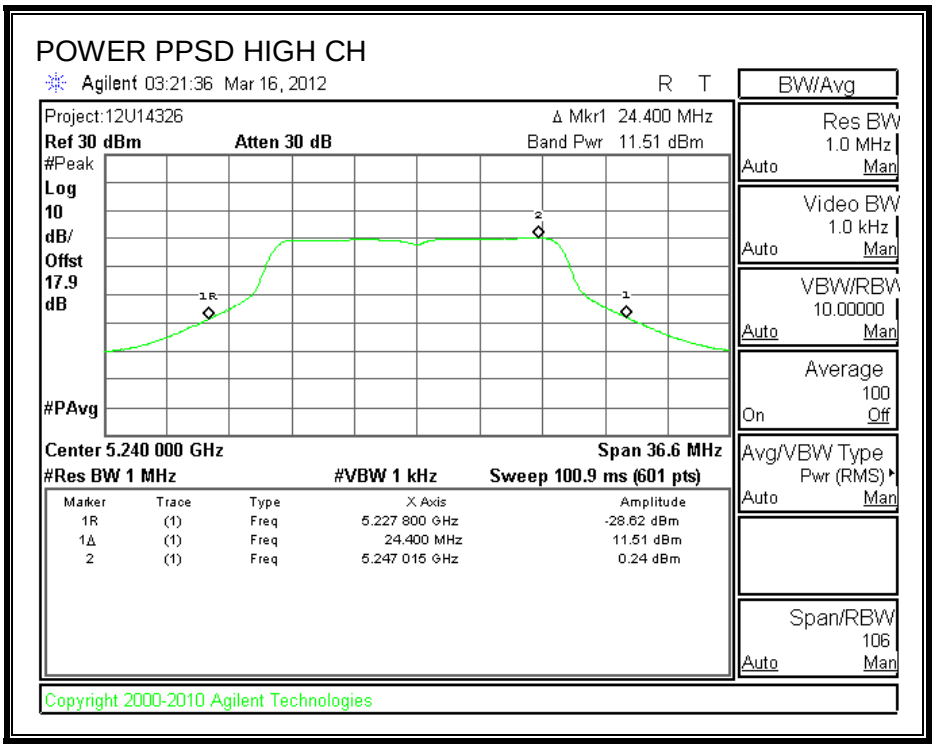
OUTPUT POWER AND PPSD CHAIN 0

POWER PPSD LOW CH

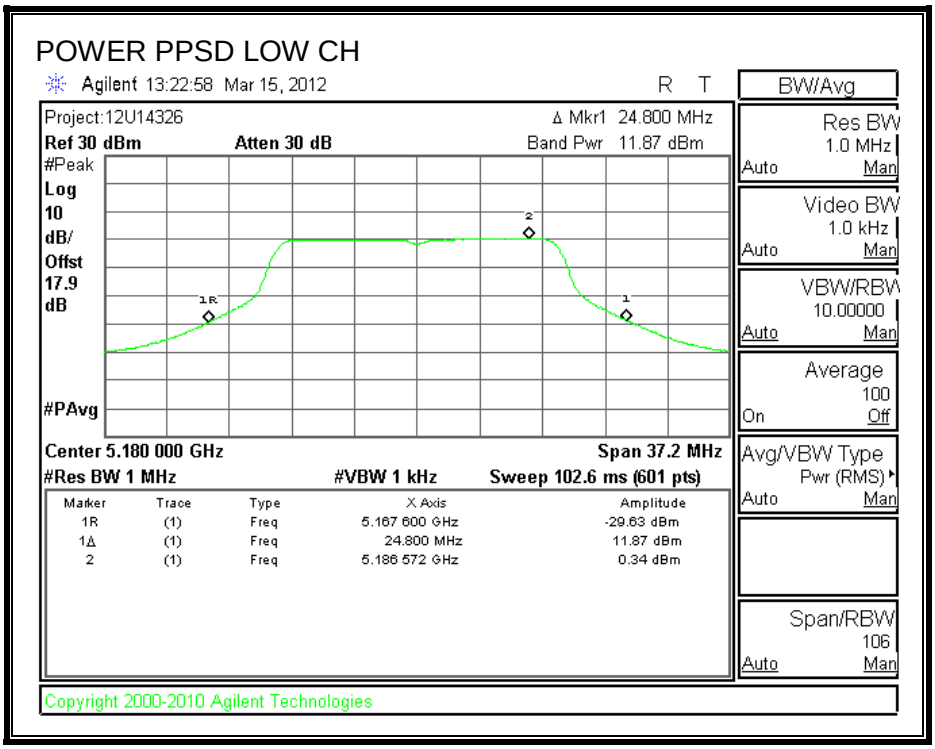


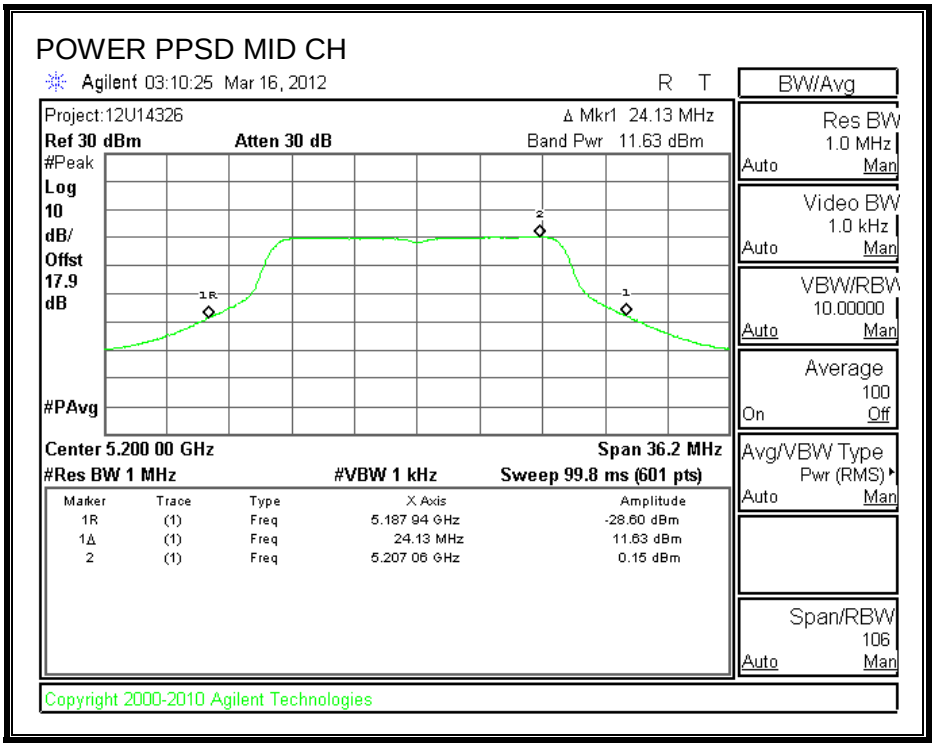
POWER PPSD MID CH

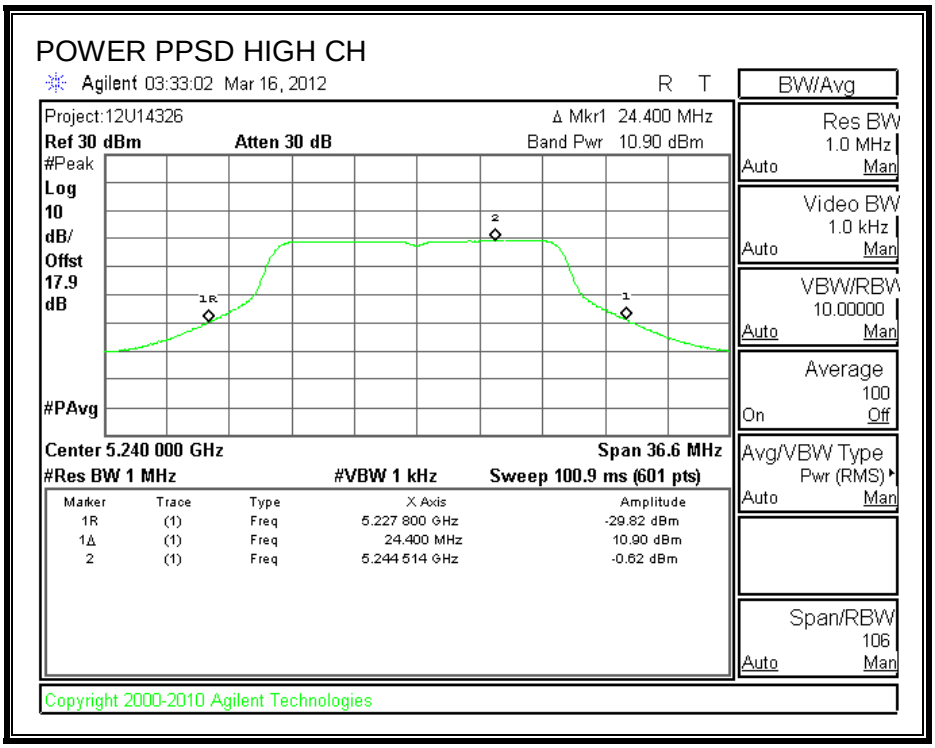




OUTPUT POWER AND PPSD CHAIN 1







7.3. 802.11n HT20 MODE IN THE 5.2 GHz BAND

7.3.1. 26 dB BANDWIDTH

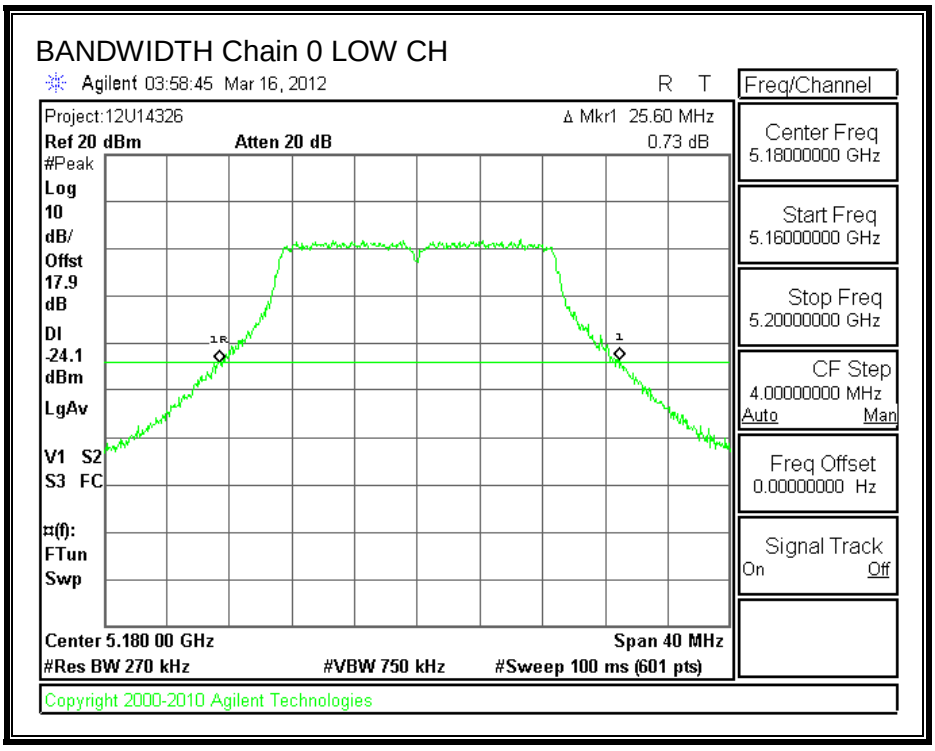
LIMITS

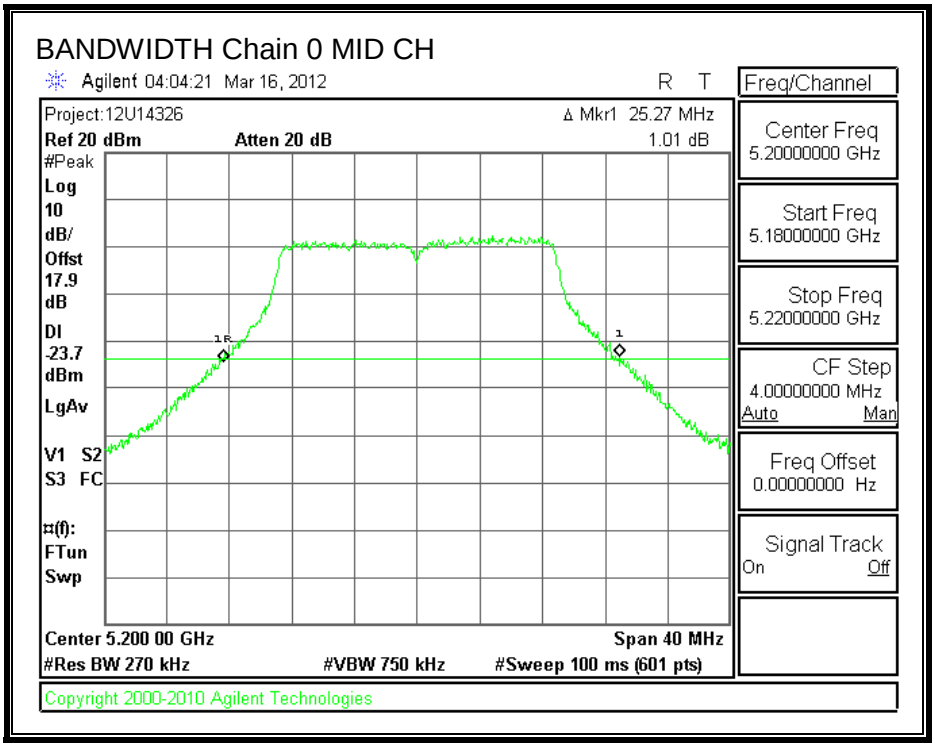
None; for reporting purposes only.

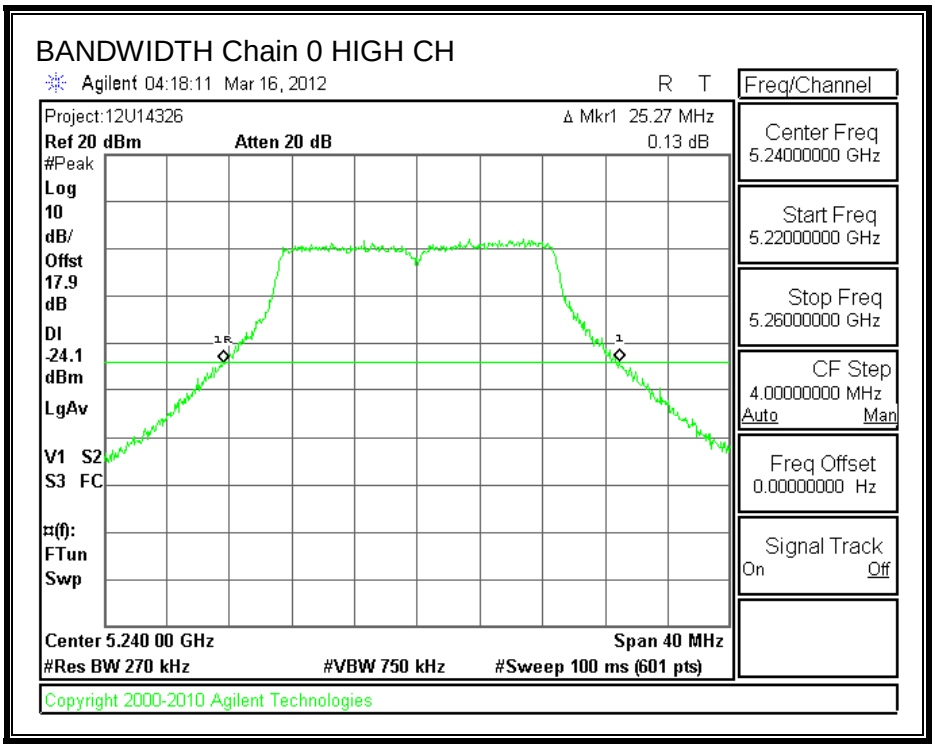
RESULTS

Channel	Frequency (MHz)	26 dB BW Chain 0 (MHz)	26 dB BW Chain 1 (MHz)
Low	5180	25.60	25.20
Mid	5200	25.27	25.13
High	5240	25.27	25.00

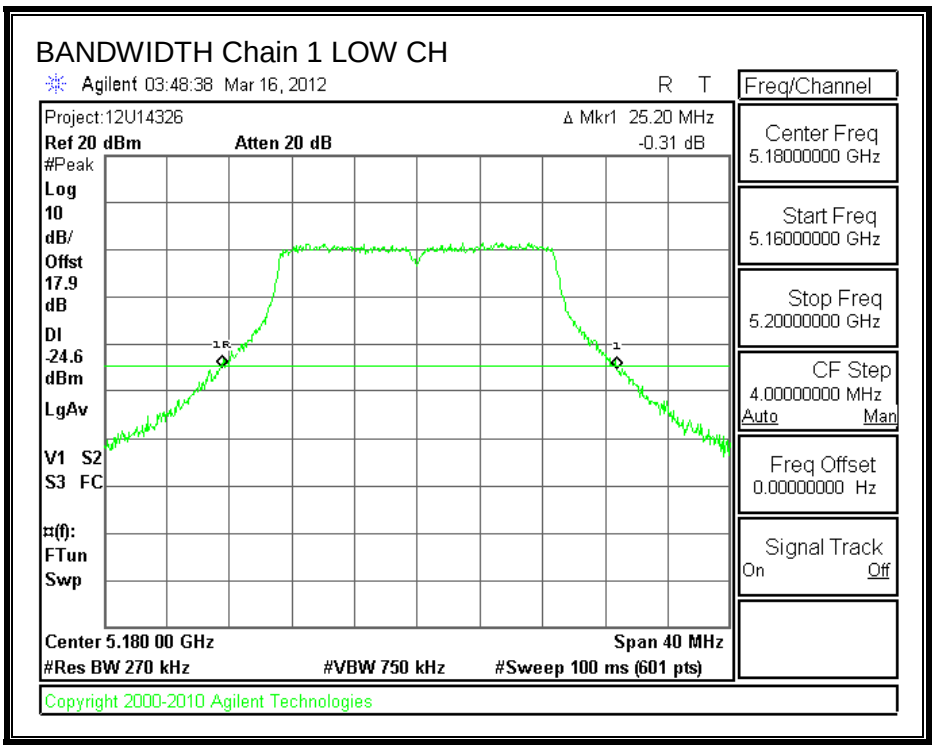
26 dB BANDWIDTH, Chain 0



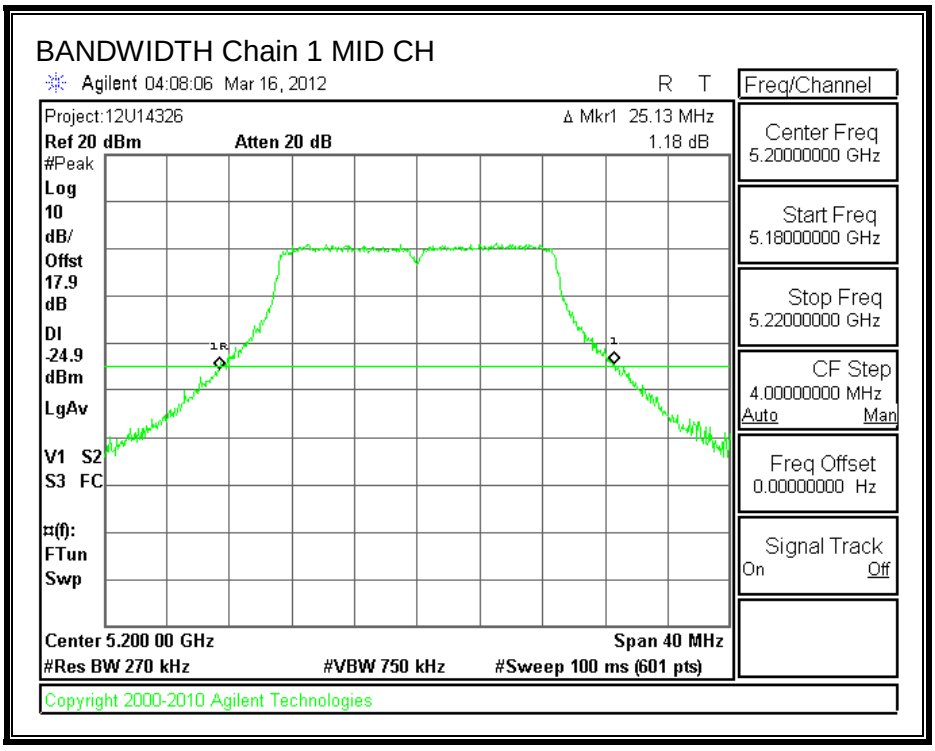




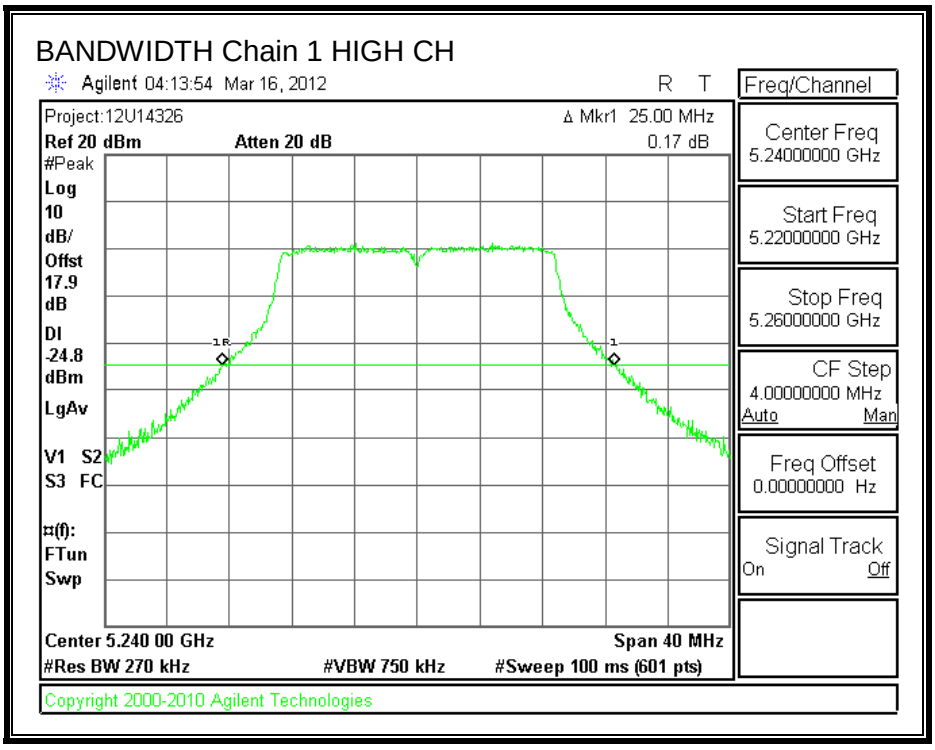
26 dB BANDWIDTH, Chain 1



BANDWIDTH Chain 1 MID CH



BANDWIDTH Chain 1 HIGH CH



7.3.2. 99% BANDWIDTH

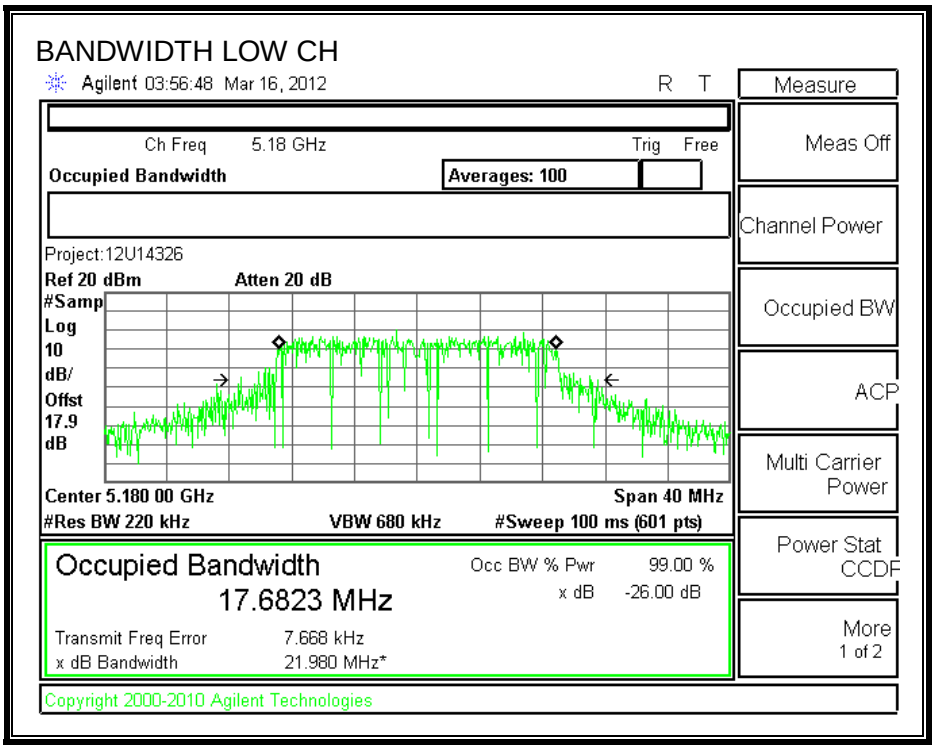
LIMITS

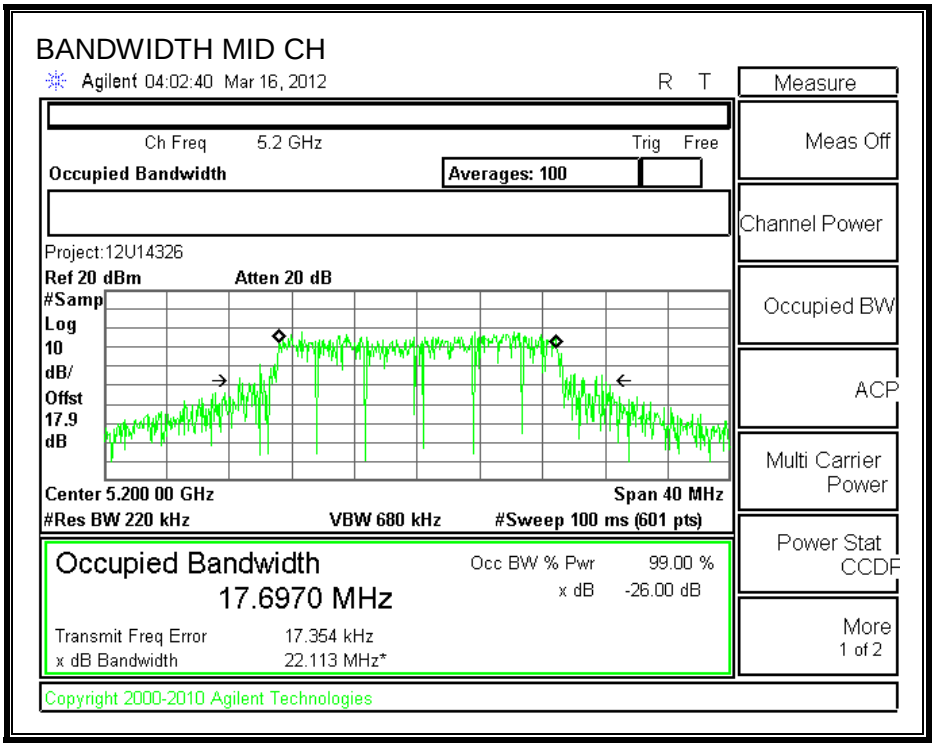
None; for reporting purposes only.

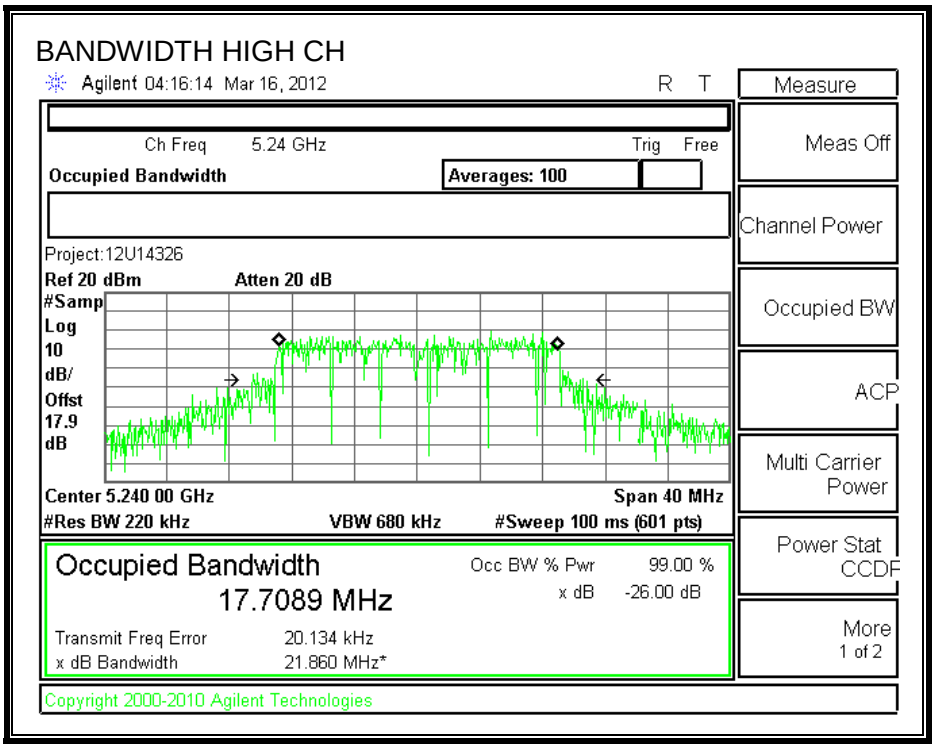
RESULTS

Channel	Frequency (MHz)	99% BW Chain 0 (MHz)	99% BW Chain 1 (MHz)
Low	5180	17.6823	17.6982
Mid	5200	17.6970	17.6879
High	5240	17.7089	17.6777

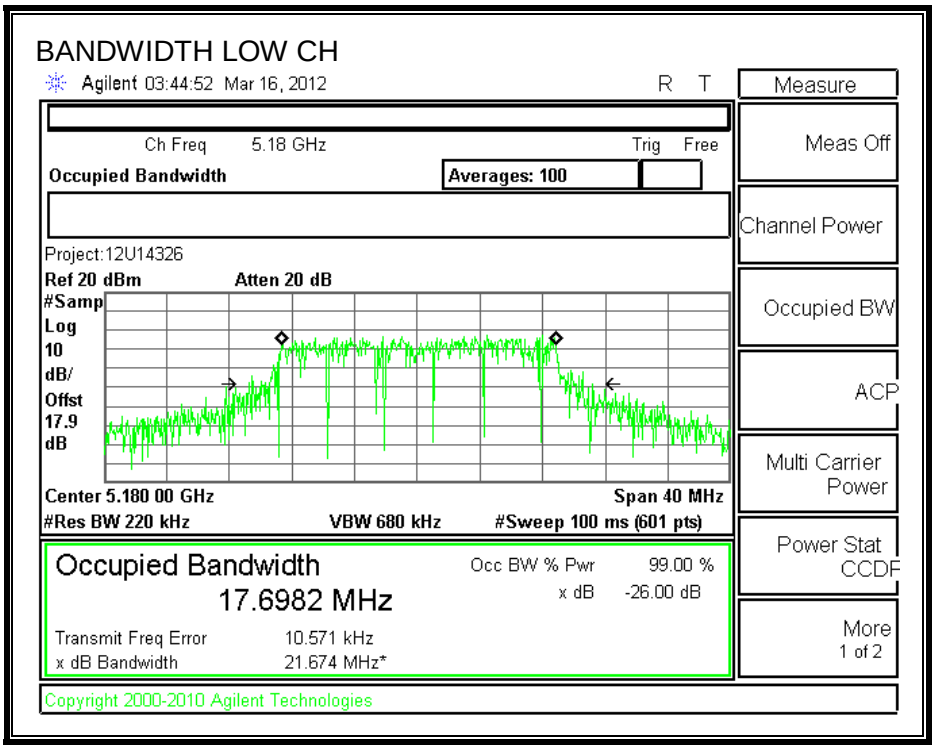
99% BANDWIDTH CHAIN 0

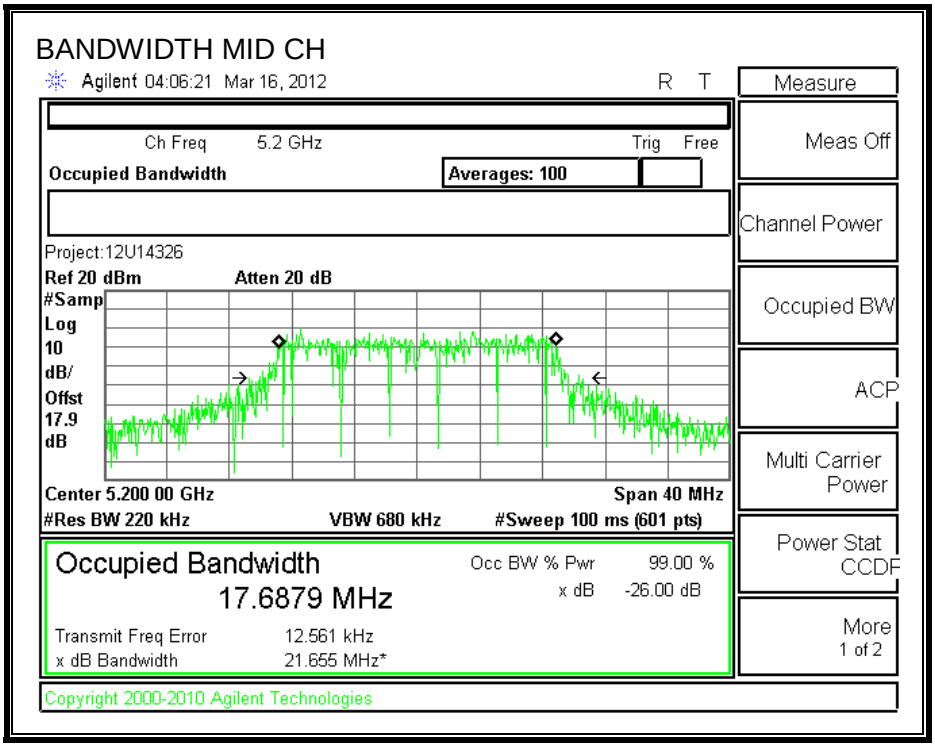


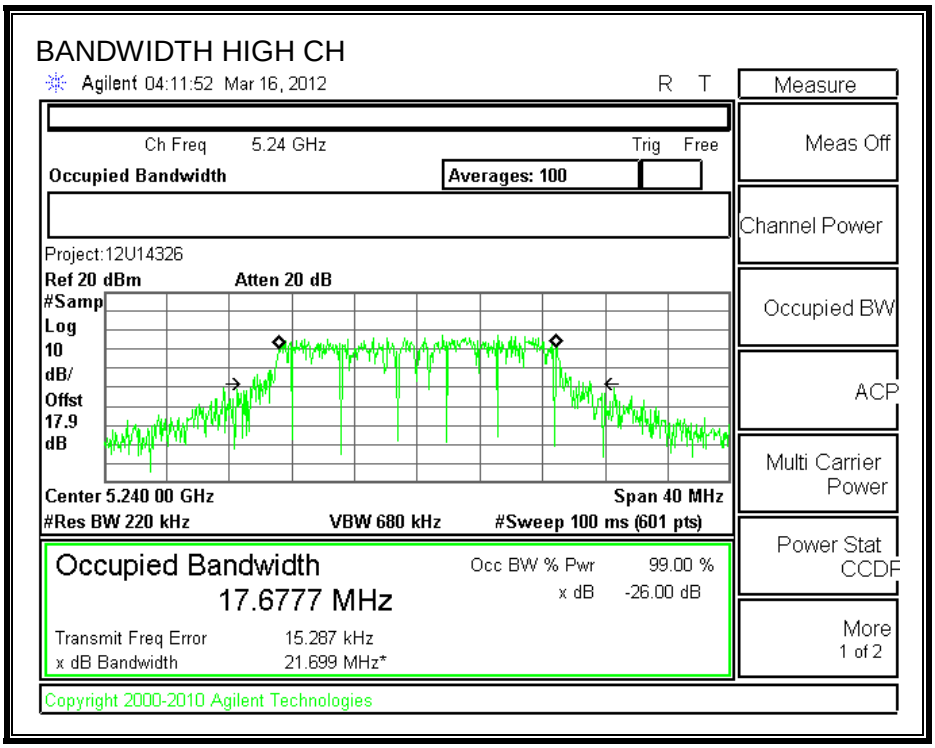




99% BANDWIDTH CHAIN 1







7.3.3. AVERAGE POWER

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

The cable assembly insertion loss of 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

Average Power Results

Channel	Frequency (MHz)	Chain 0 Power (dBm)	Chain 1 Power (dBm)	Total Power (dBm)
Low	5180	11.40	11.50	14.46
Mid	5200	11.40	11.40	14.41
High	5240	11.10	11.50	14.31

7.3.4. OUTPUT POWER AND PPSD

LIMITS

FCC §15.407 (a) (1)

(i) For an outdoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. The maximum e.i.r.p. at any elevation angle above 30 degrees as measured from the horizon must not exceed 125 mW (21 dBm).

(ii) For an indoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

(iii) For fixed point-to-point access points operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. Fixed point-to-point U-NII devices may employ antennas with directional gain up to 23 dBi without any corresponding reduction in the maximum conducted output power or maximum power spectral density. For fixed point-to-point transmitters that employ a directional antenna gain greater than 23 dBi, a 1 dB reduction in maximum conducted output power and maximum power spectral density is required for each 1 dB of antenna gain in excess of 23 dBi. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

(iv) For mobile and portable client devices in the 5.15-5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250 mW provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

DIRECTIONAL ANTENNA GAIN

The TX chains are uncorrelated and the antenna gain is unequal among the chains. The directional gain is:

Chain 0 Antenna Gain (dBi)	Chain 1 Antenna Gain (dBi)	Uncorrelated Chains Directional Gain (dBi)
0.93	1.88	1.43

RESULTS

Limits

Channel	Frequency (MHz)	Directional Gain (dBi)	Power Limit (dBm)	PPSD Limit (dBm)
Low	5180	1.43	30.00	17.00
Mid	5200	1.43	30.00	17.00
High	5240	1.43	30.00	17.00

Output Power Results

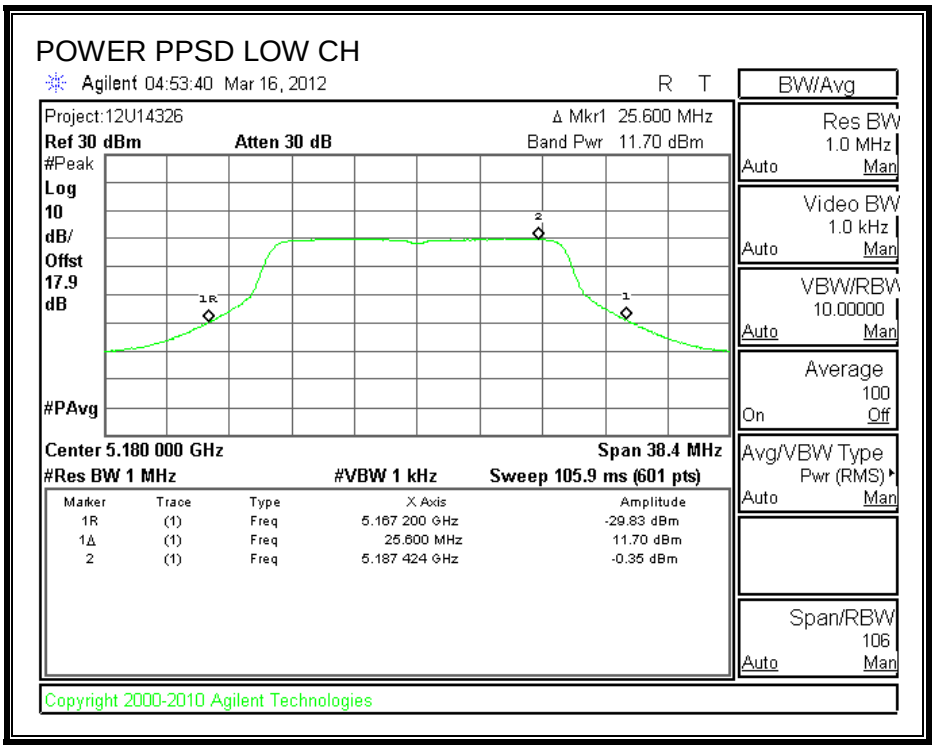
Channel	Frequency (MHz)	Chain 0 Meas Power (dBm)	Chain 1 Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Power Margin (dB)
Low	5180	11.70	11.36	14.55	30.00	-15.45
Mid	5200	11.52	11.06	14.31	30.00	-15.69
High	5240	11.31	10.77	14.06	30.00	-15.94

PPSD Results

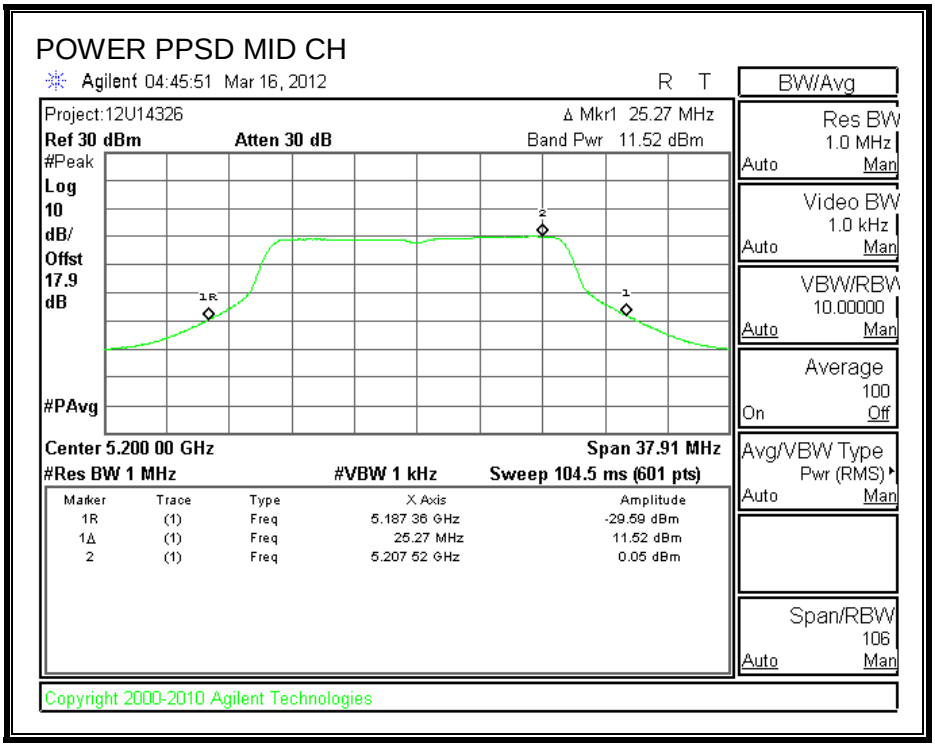
Channel	Frequency (MHz)	Chain 0 Meas PPSD (dBm)	Chain 1 Meas PPSD (dBm)	Total Corr'd PPSD (dBm)	PPSD Limit (dBm)	PPSD Margin (dB)
Low	5180	-0.35	-0.47	2.60	17.00	-14.40
Mid	5200	0.05	-0.76	2.67	17.00	-14.33
High	5240	-0.12	-1.08	2.44	17.00	-14.56

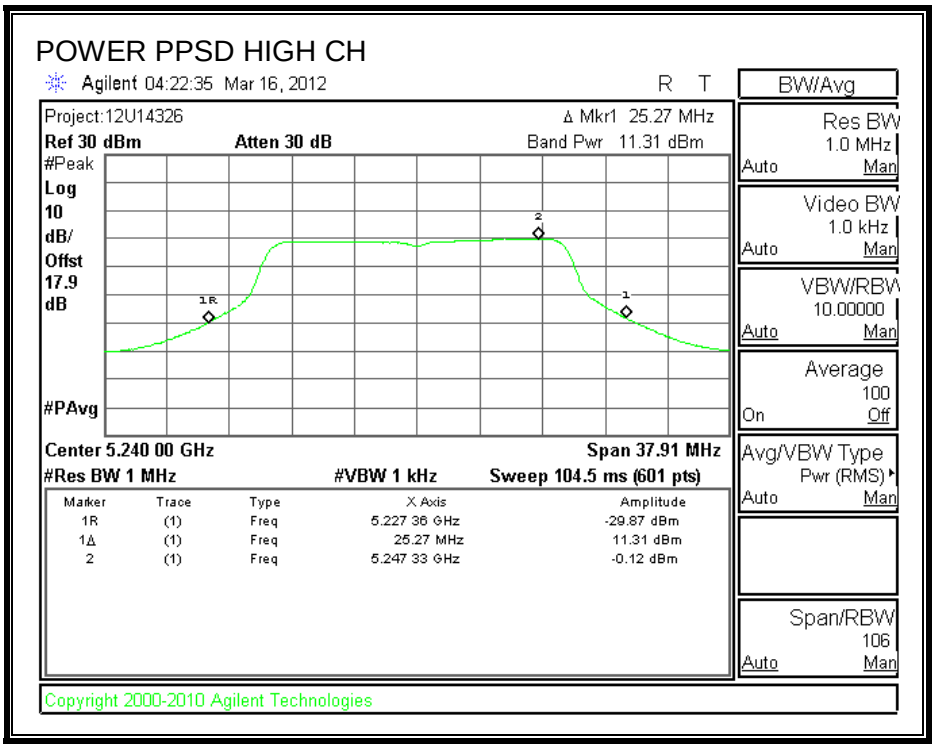
OUTPUT POWER AND PPSD CHAIN 0

POWER PPSD LOW CH

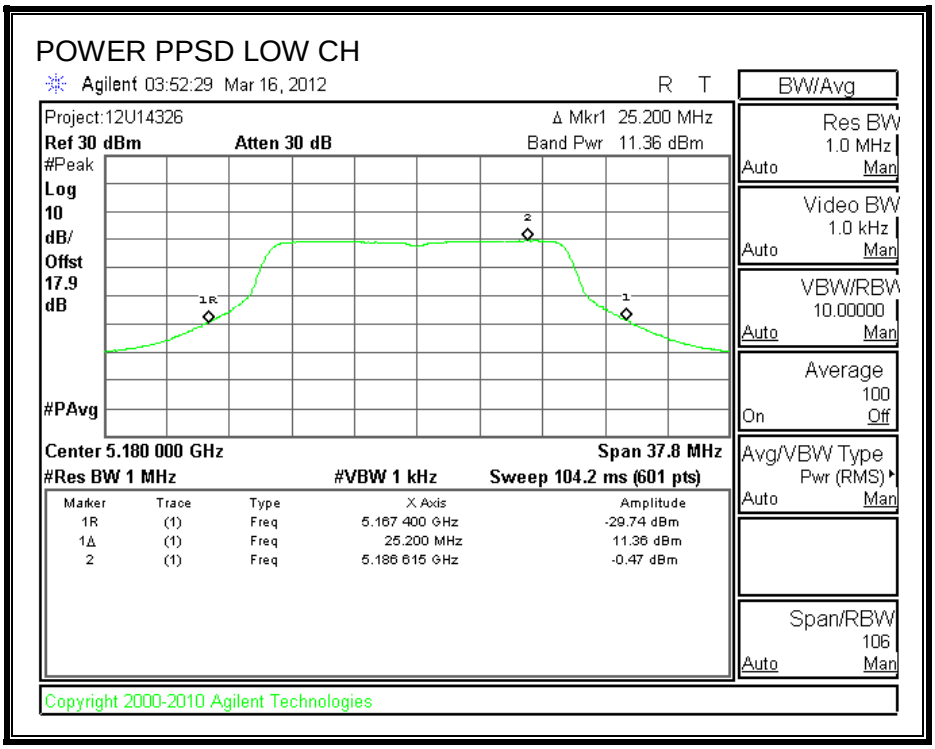


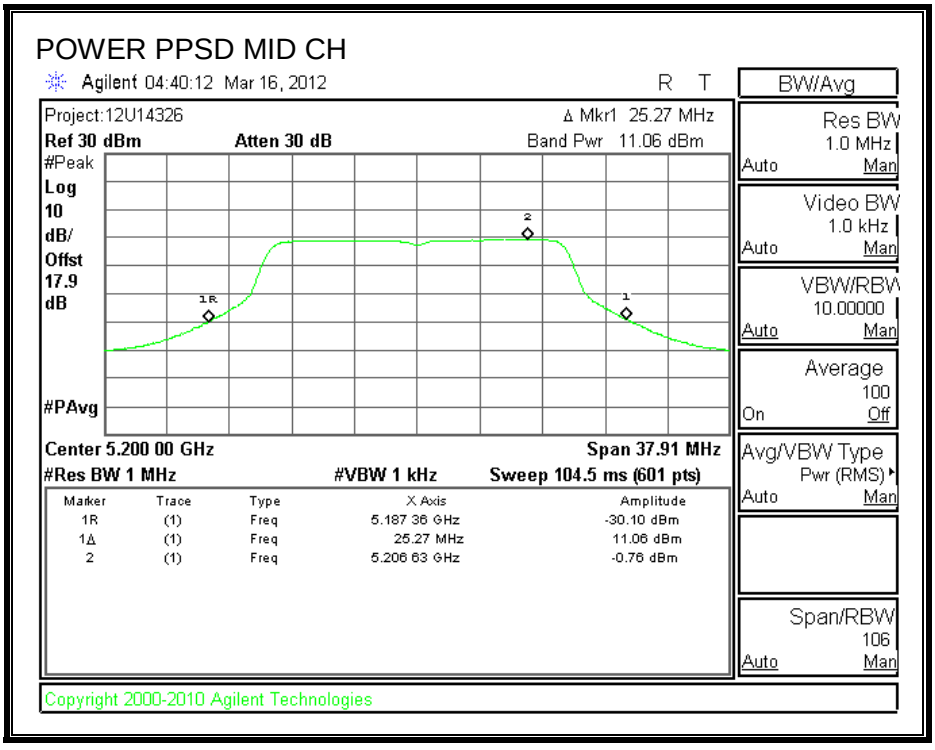
POWER PPSD MID CH

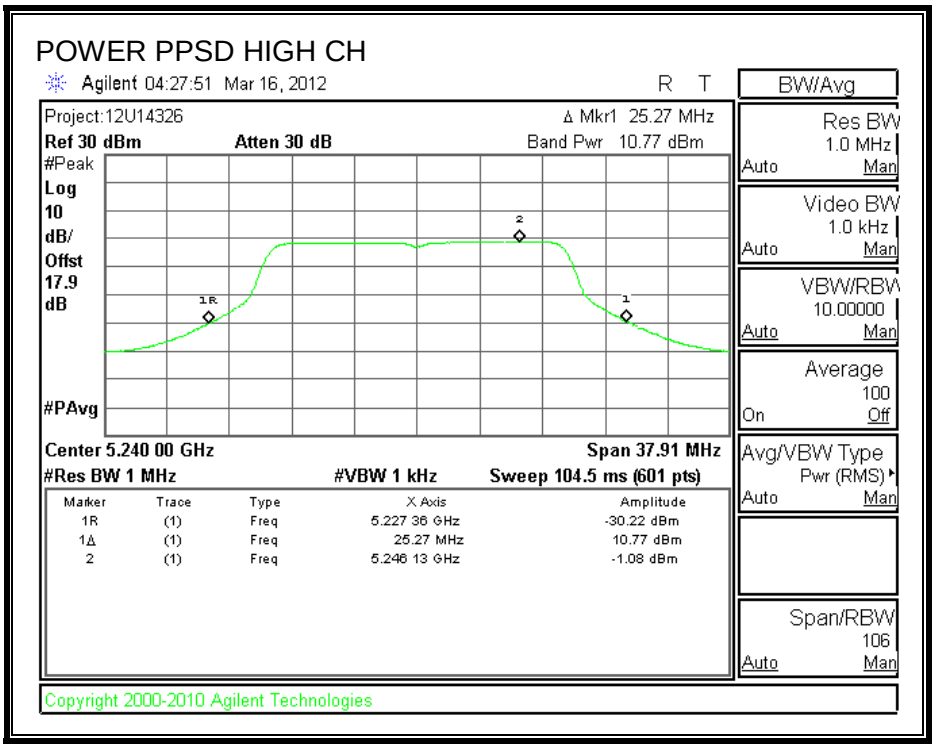




OUTPUT POWER AND PPSD CHAIN 1







7.4. 802.11n HT40 MODE IN THE 5.2 GHz BAND

7.4.1. 26 dB BANDWIDTH

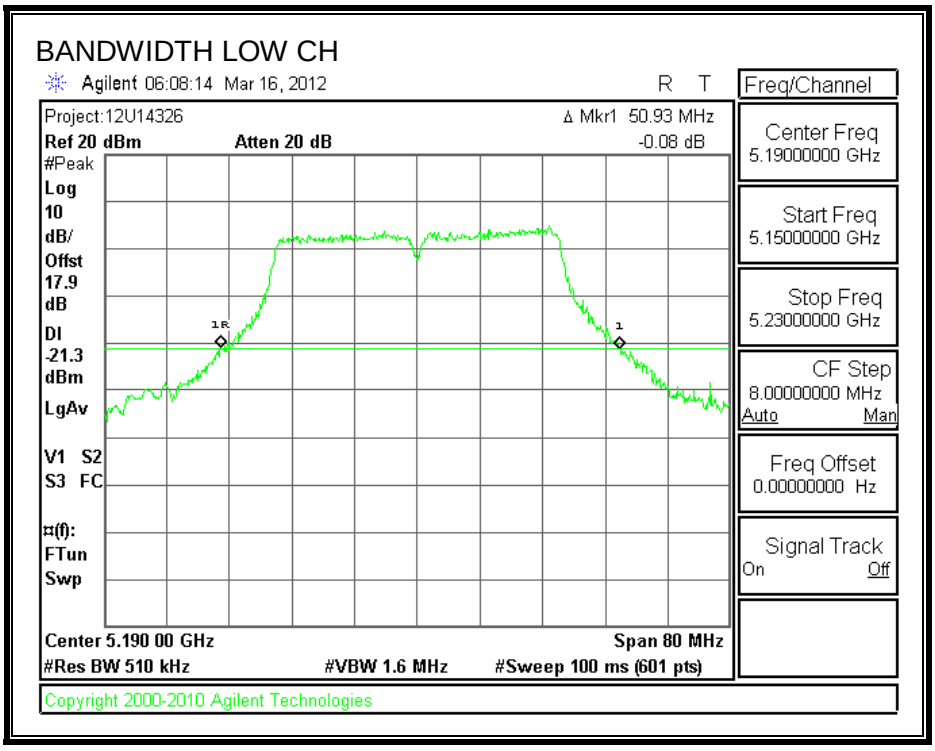
LIMITS

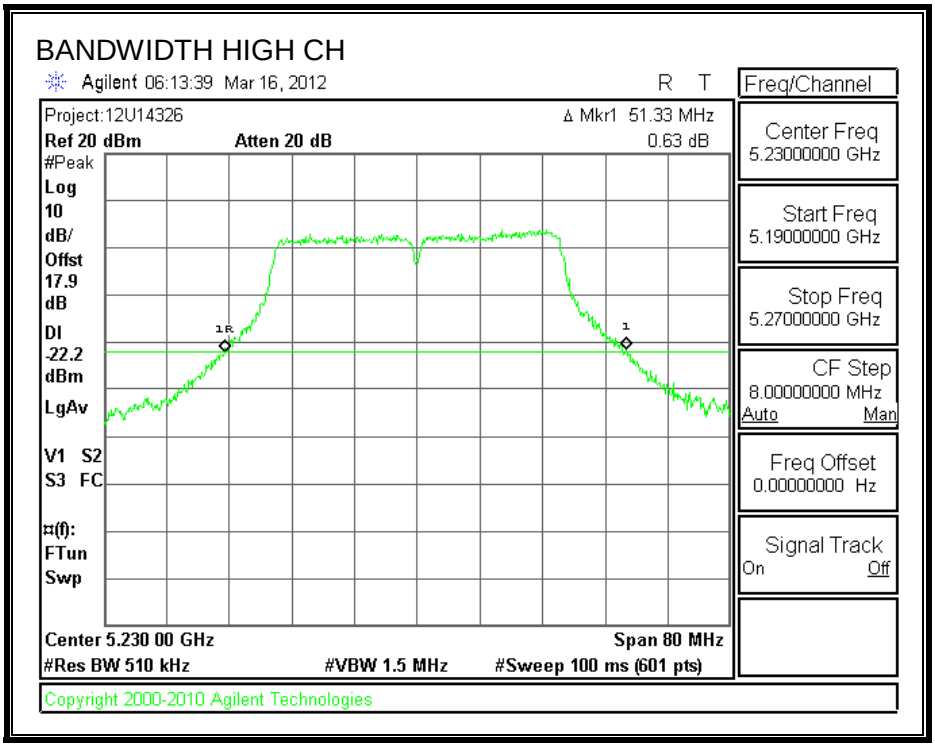
None; for reporting purposes only.

RESULTS

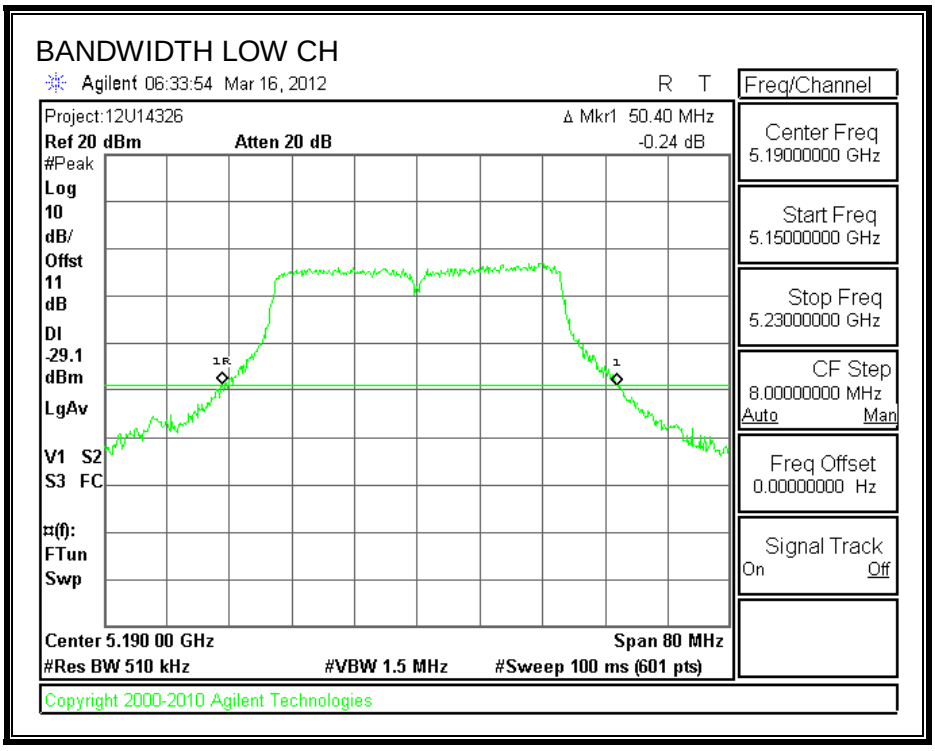
Channel	Frequency (MHz)	26 dB BW Chain 0 (MHz)	26 dB BW Chain 1 (MHz)
Low	5190	50.93	50.40
High	5230	51.33	50.53

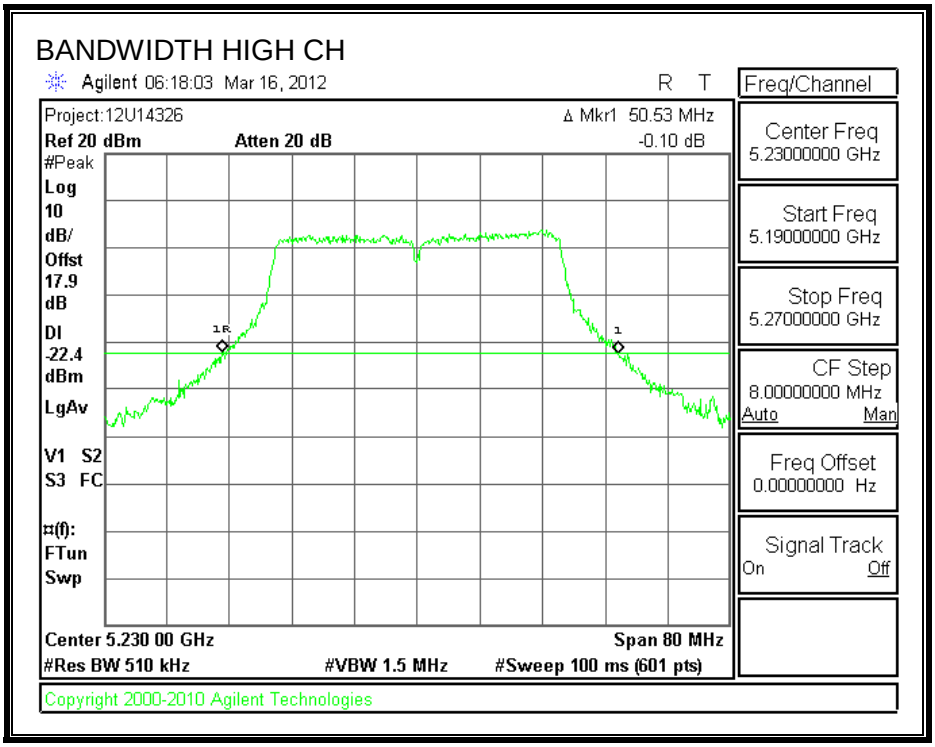
26 dB BANDWIDTH CHAIN 0





26 dB BANDWIDTH CHAIN 1





7.4.2. 99% BANDWIDTH

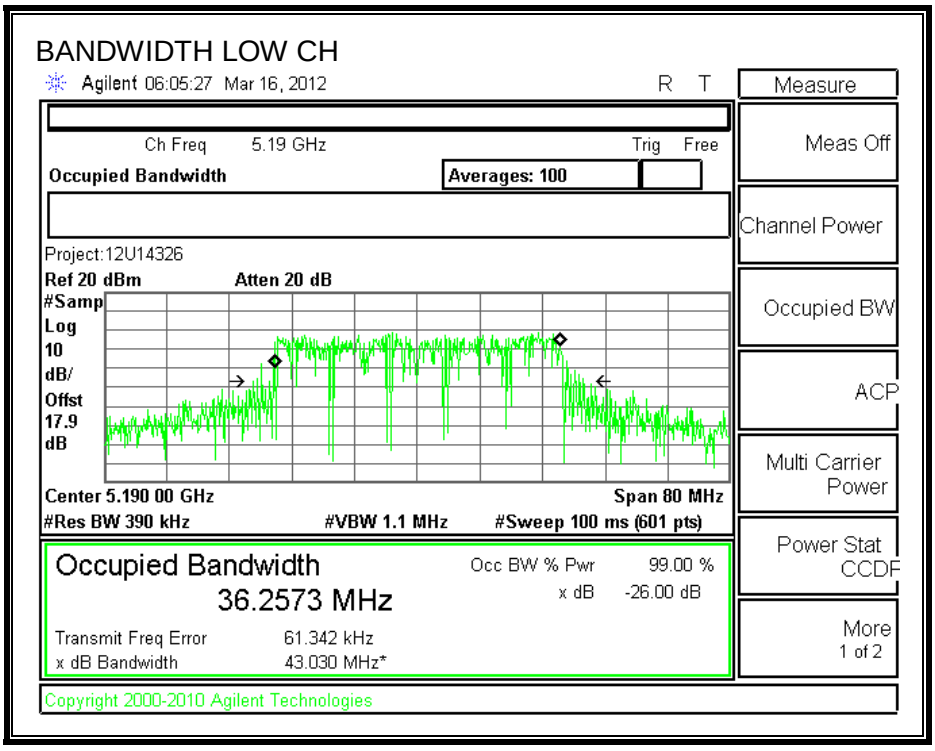
LIMITS

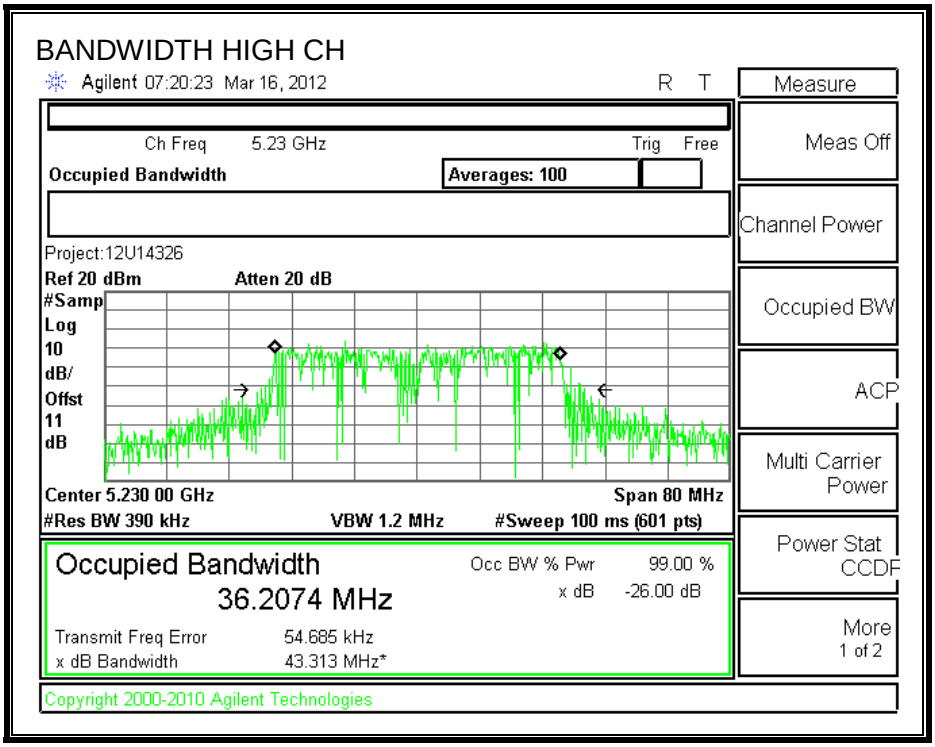
None; for reporting purposes only.

RESULTS

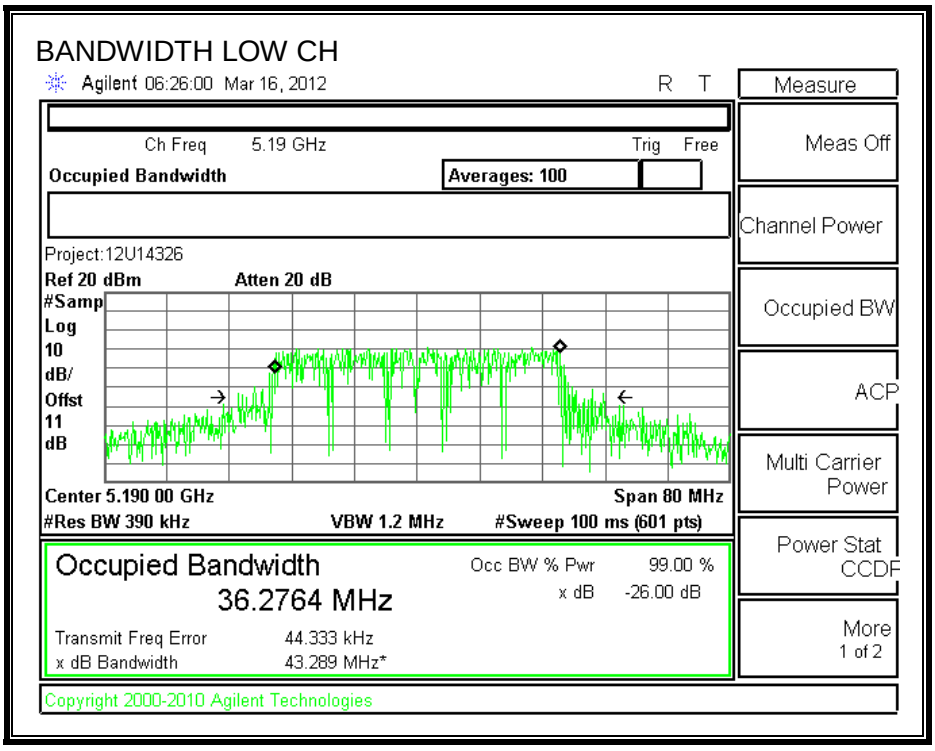
Channel	Frequency (MHz)	99% BW Chain 0 (MHz)	99% BW Chain 1 (MHz)
Low	5190	36.2573	36.2764
High	5230	36.2074	36.2519

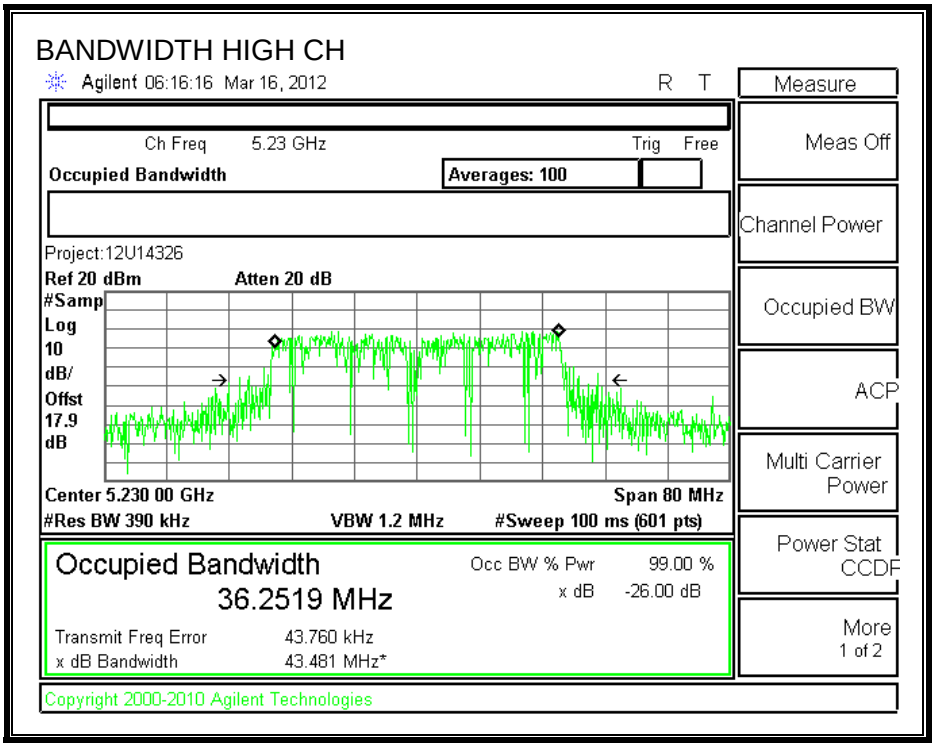
99% BANDWIDTH CHAIN 0





99% BANDWIDTH CHAIN 1





7.4.3. AVERAGE POWER

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

The cable assembly insertion loss of 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

Average Power Results

Channel	Frequency (MHz)	Chain 0 Power (dBm)	Chain 1 Power (dBm)	Total Power (dBm)
Low	5190	13.60	13.50	16.56
High	5230	13.10	12.90	16.01

7.4.4. OUTPUT POWER AND PPSD

LIMITS

FCC §15.407 (a) (1)

(i) For an outdoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. The maximum e.i.r.p. at any elevation angle above 30 degrees as measured from the horizon must not exceed 125 mW (21 dBm).

(ii) For an indoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

(iii) For fixed point-to-point access points operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. Fixed point-to-point U-NII devices may employ antennas with directional gain up to 23 dBi without any corresponding reduction in the maximum conducted output power or maximum power spectral density. For fixed point-to-point transmitters that employ a directional antenna gain greater than 23 dBi, a 1 dB reduction in maximum conducted output power and maximum power spectral density is required for each 1 dB of antenna gain in excess of 23 dBi. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

(iv) For mobile and portable client devices in the 5.15-5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250 mW provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

DIRECTIONAL ANTENNA GAIN

The TX chains are uncorrelated and the antenna gain is unequal among the chains. The directional gain is:

Chain 0 Antenna Gain (dBi)	Chain 1 Antenna Gain (dBi)	Uncorrelated Chains Directional Gain (dBi)
0.93	1.88	1.43

RESULTS

Limits

Channel	Frequency (MHz)	Directional Gain (dBi)	Power Limit (dBm)	PPSD Limit (dBm)
Low	5190	1.43	30.00	17.00
High	5230	1.43	30.00	17.00

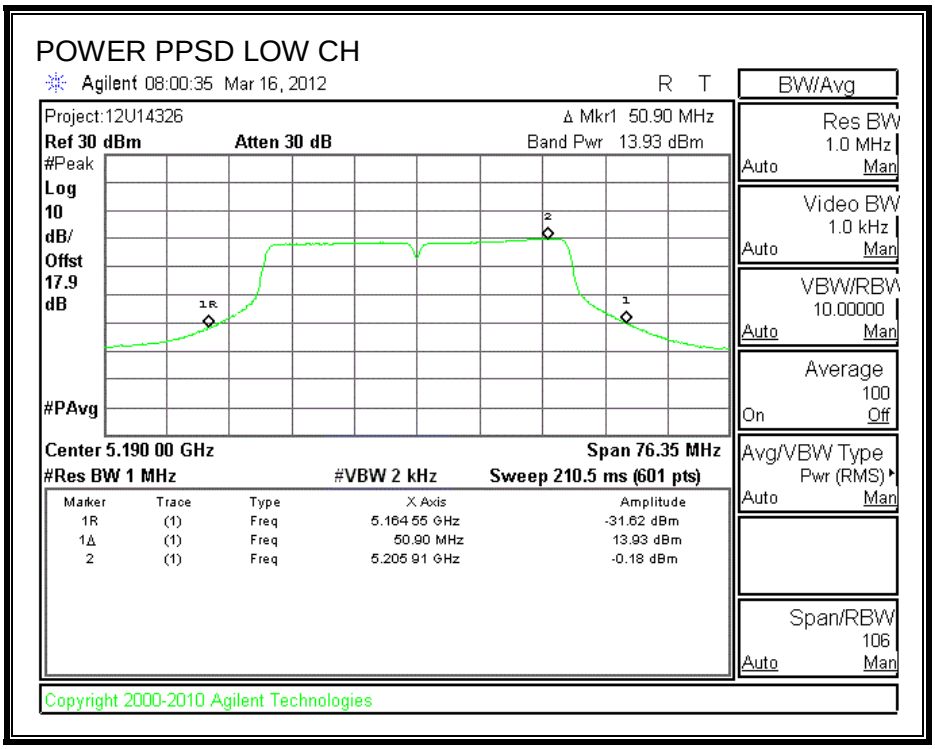
Output Power Results

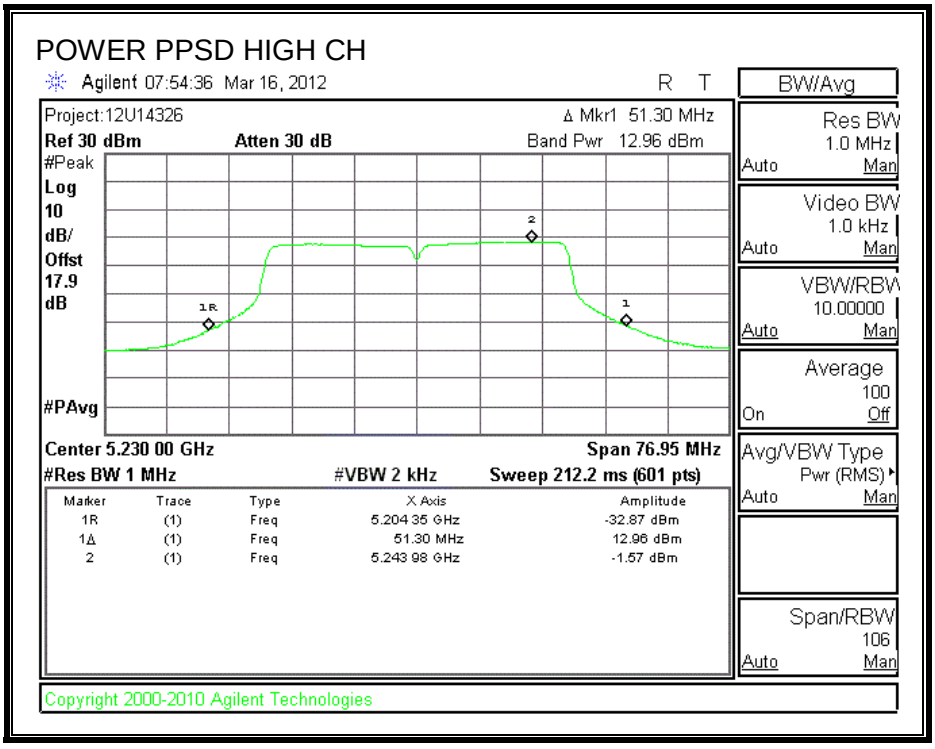
Channel	Frequency (MHz)	Chain 0 Meas Power (dBm)	Chain 1 Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Power Margin (dB)
Low	5190	13.93	13.05	16.52	30.00	-13.48
High	5230	12.96	12.43	15.72	30.00	-14.28

PPSD Results

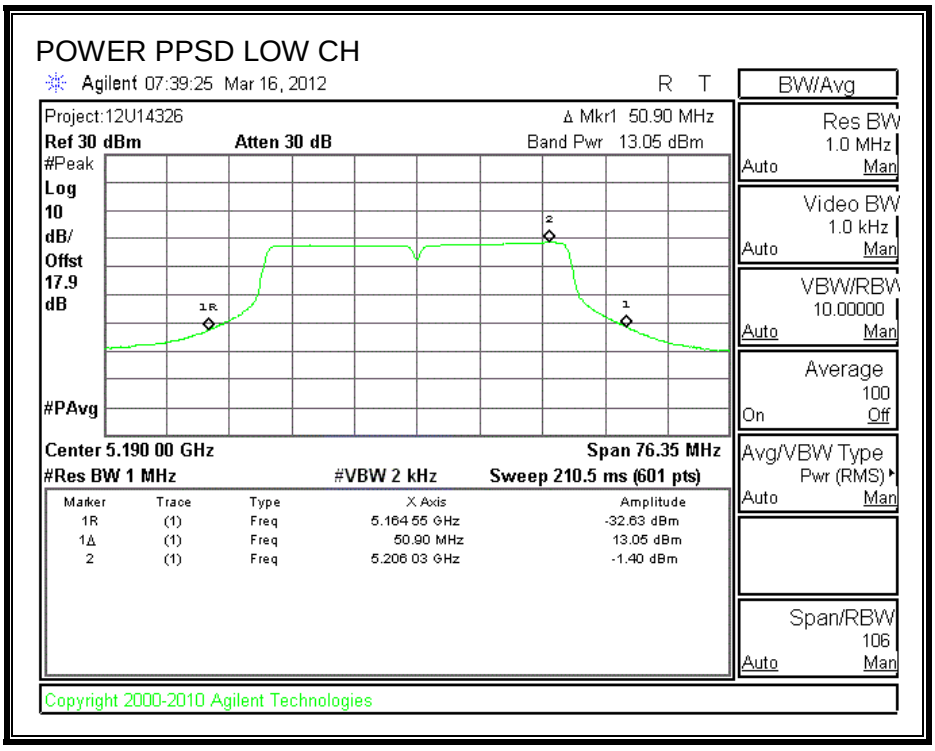
Channel	Frequency (MHz)	Chain 0 Meas PPSD (dBm)	Chain 1 Meas PPSD (dBm)	Total Corr'd PPSD (dBm)	PPSD Limit (dBm)	PPSD Margin (dB)
Low	5190	-0.18	-1.40	2.26	17.00	-14.74
High	5230	-1.57	-2.07	1.20	17.00	-15.80

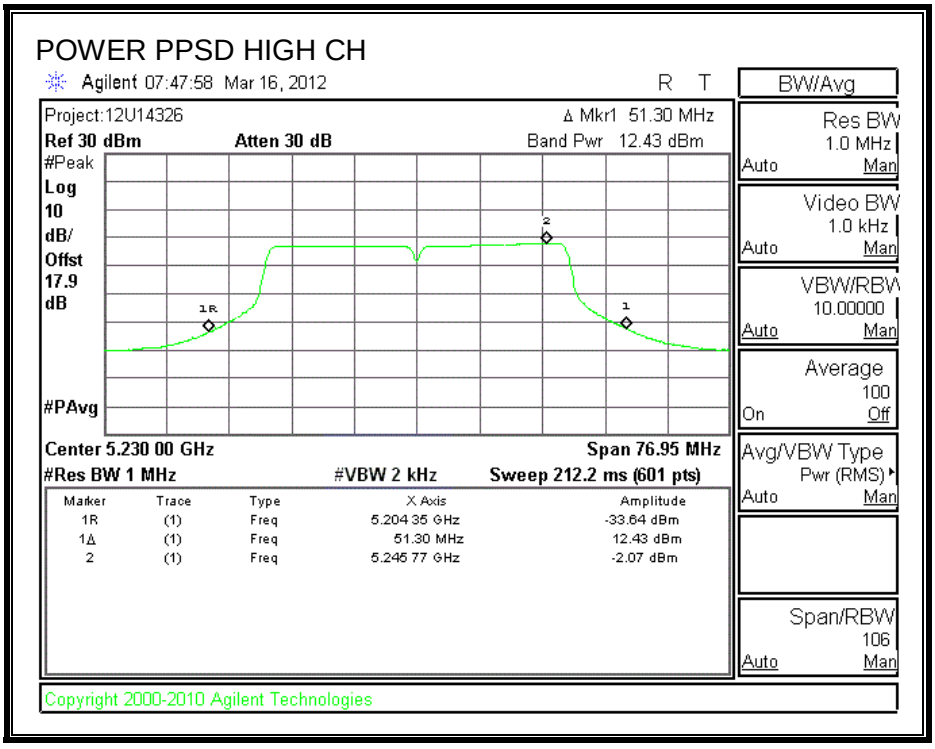
OUTPUT POWER AND PPSD CHAIN 0





OUTPUT POWER AND PPSD CHAIN 1





7.5. 802.11a MODE IN THE 5.3 GHz BAND

7.5.1. 26 dB BANDWIDTH

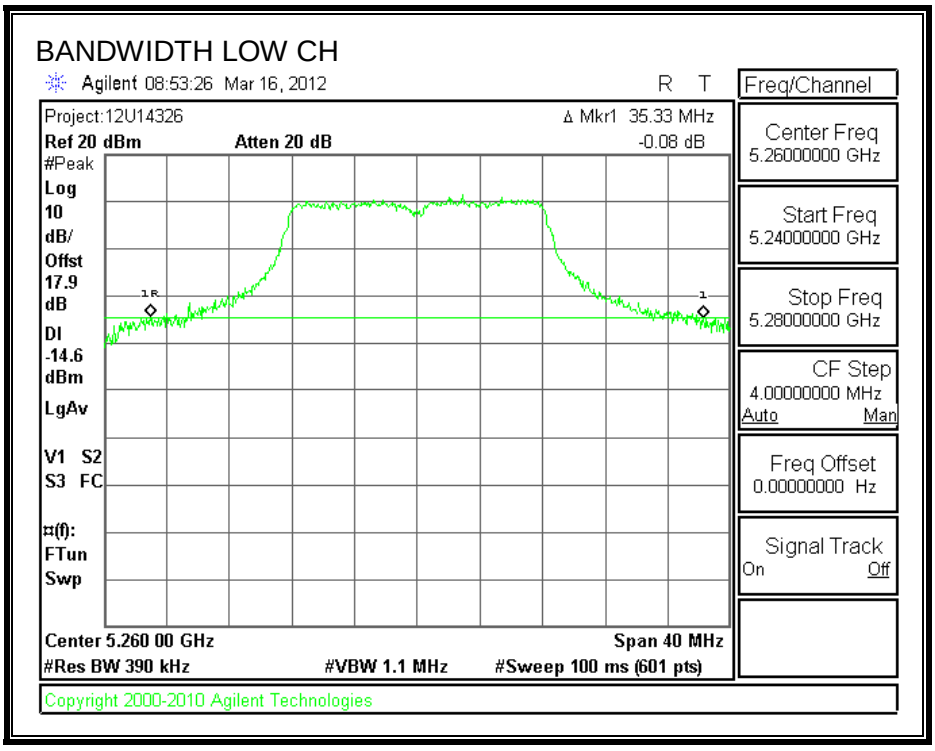
LIMITS

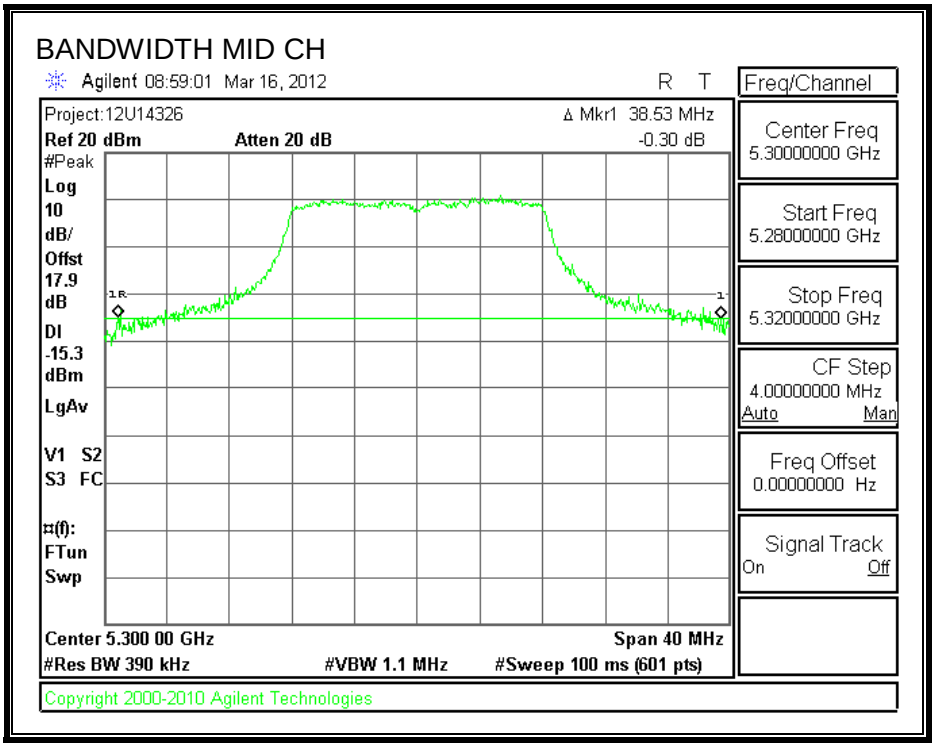
None; for reporting purposes only.

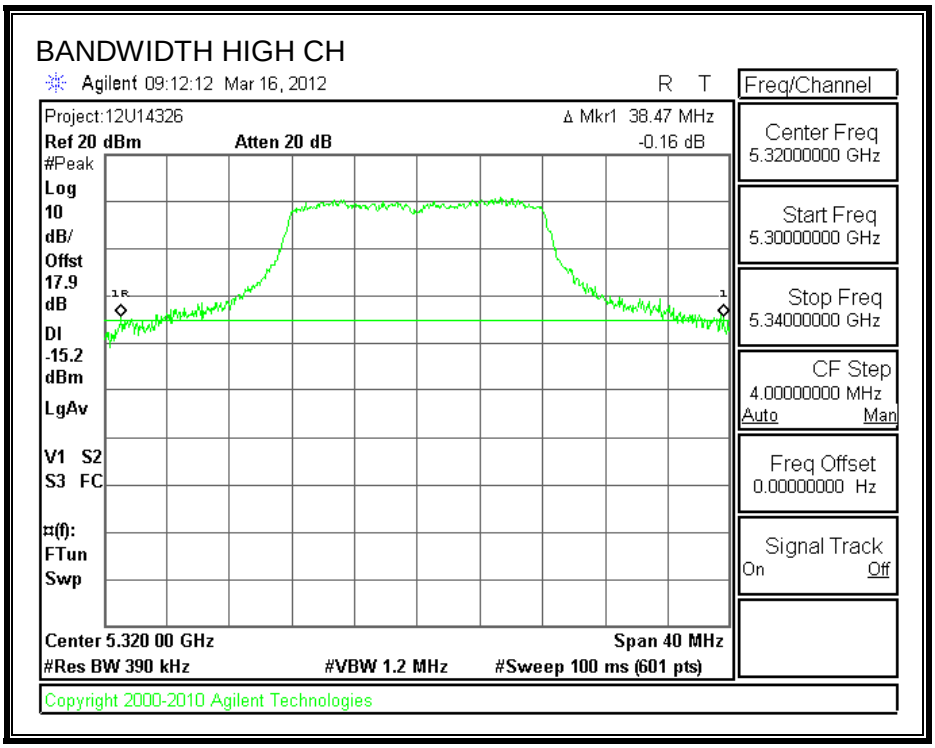
RESULTS

Channel	Frequency (MHz)	26 dB BW Chain 0 (MHz)	26 dB BW Chain 1 (MHz)
Low	5260	35.33	30.42
Mid	5300	38.53	32.08
High	5320	38.47	38.83

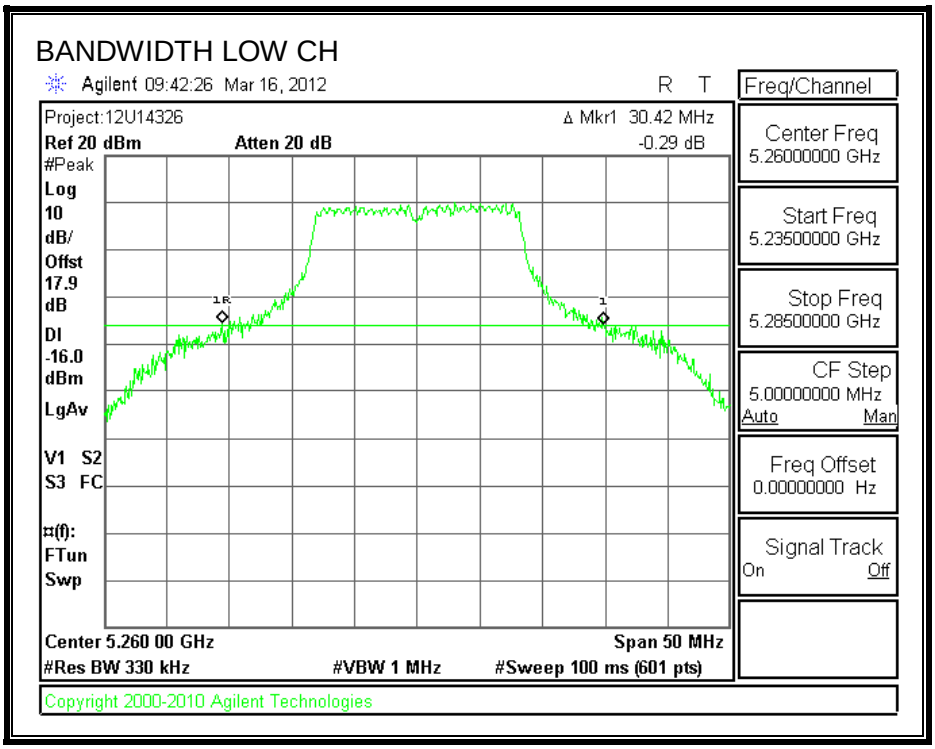
26 dB BANDWIDTH CHAIN 0

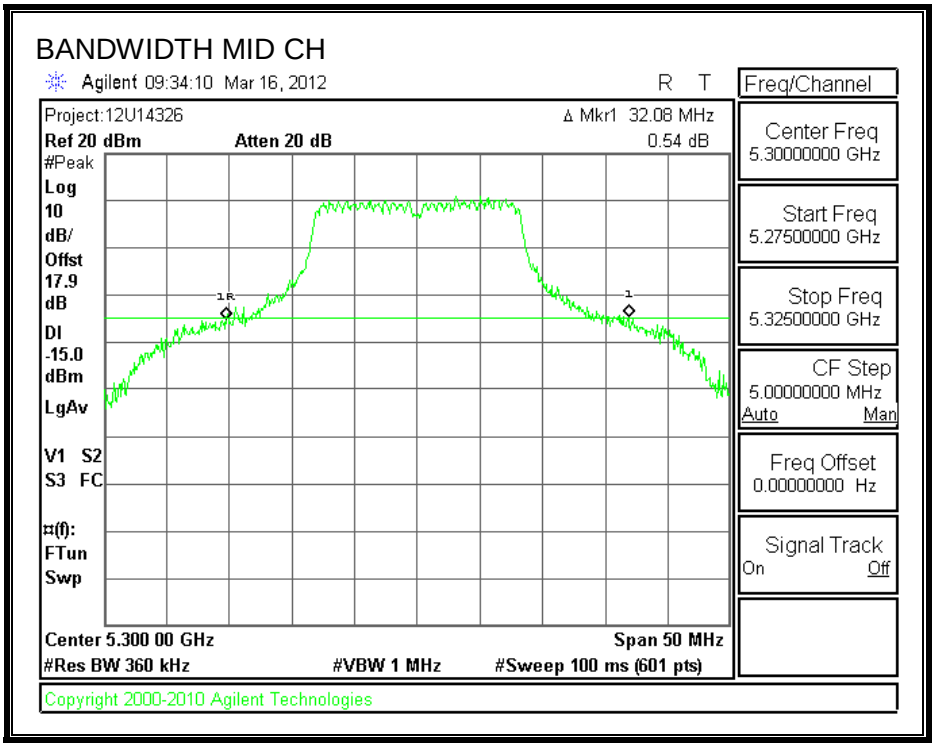


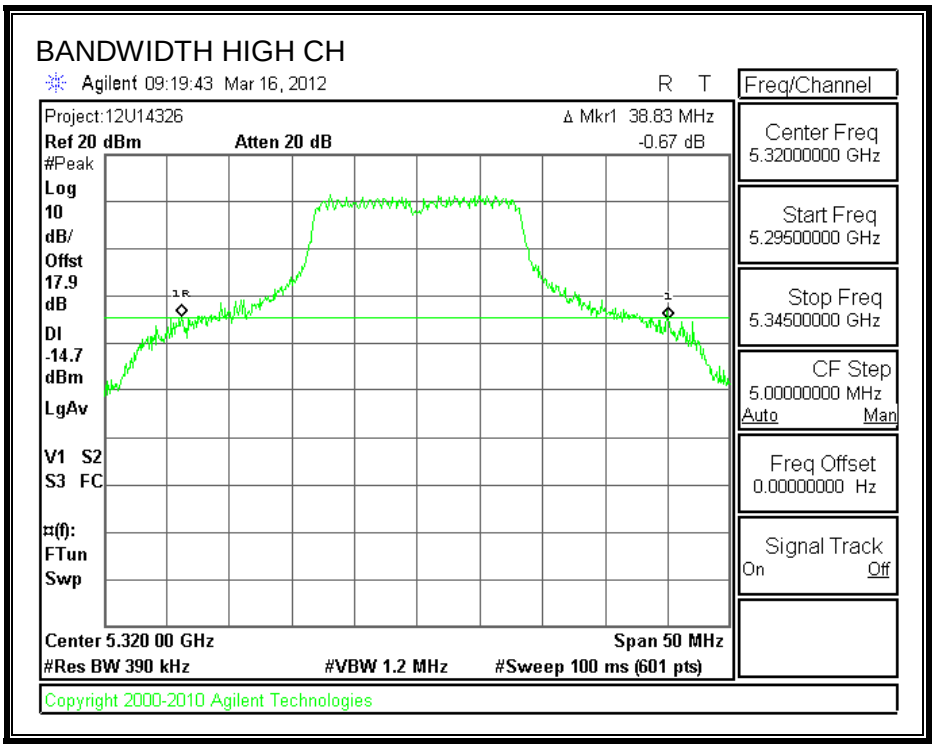




26 dB BANDWIDTH CHAIN 1







7.5.2. 99% BANDWIDTH

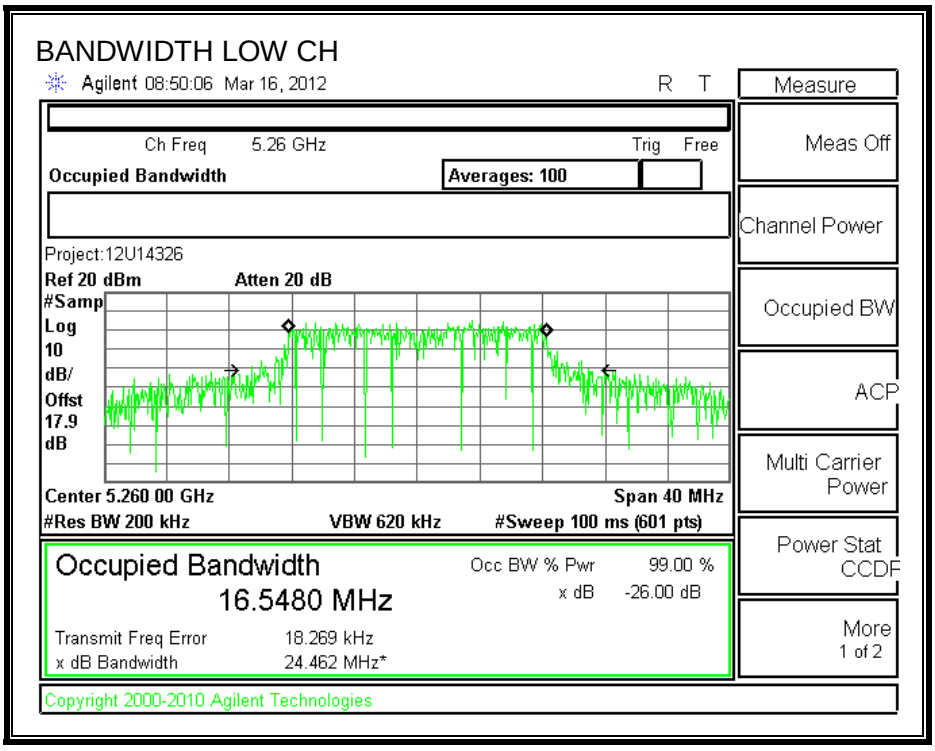
LIMITS

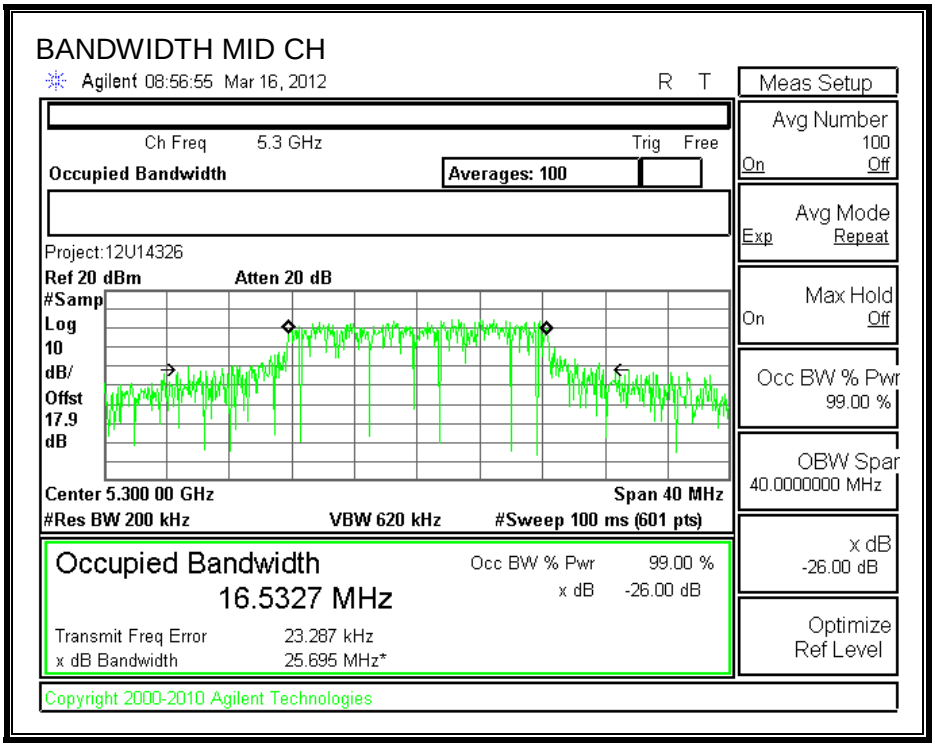
None; for reporting purposes only.

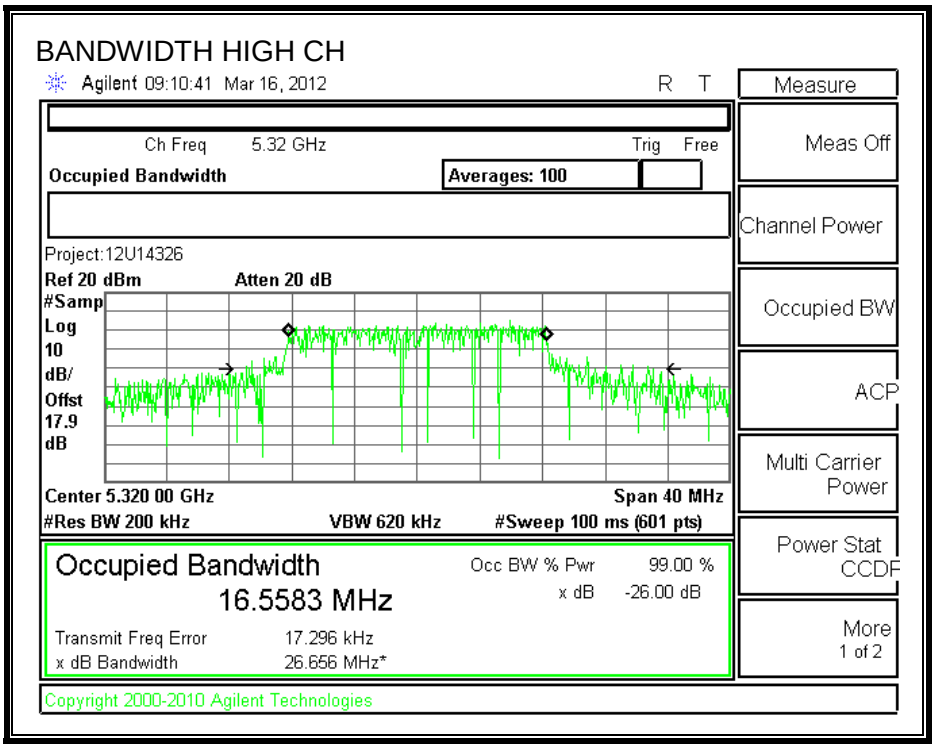
RESULTS

Channel	Frequency (MHz)	99% BW Chain 0 (MHz)	99% BW Chain 1 (MHz)
Low	5260	16.5480	16.4972
Mid	5300	16.5327	16.5361
High	5320	16.5583	16.5623

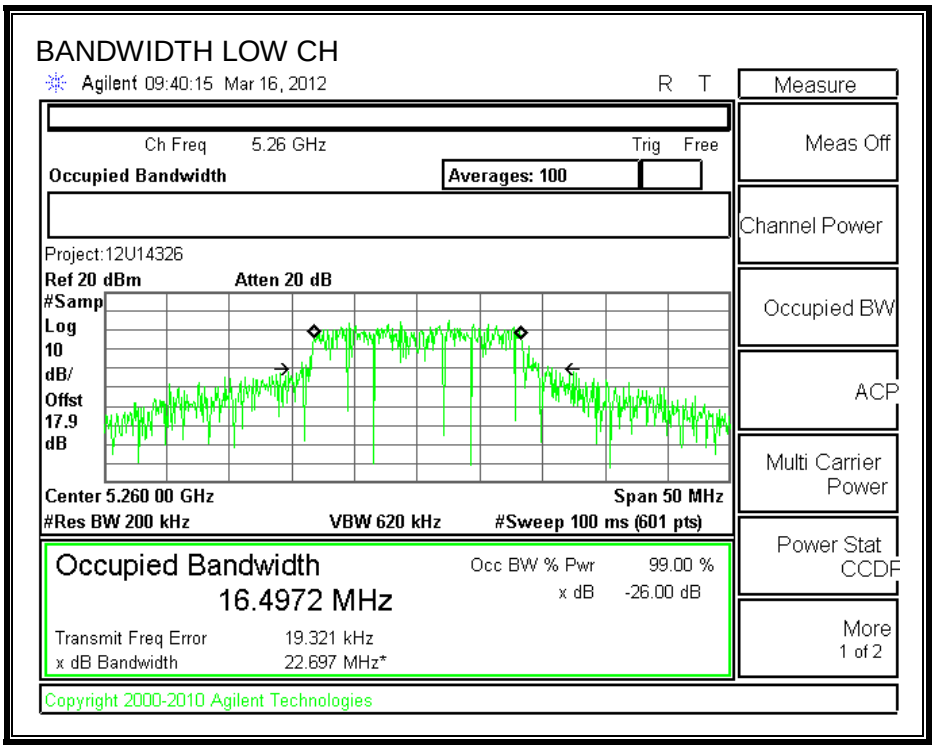
99% BANDWIDTH CHAIN 0

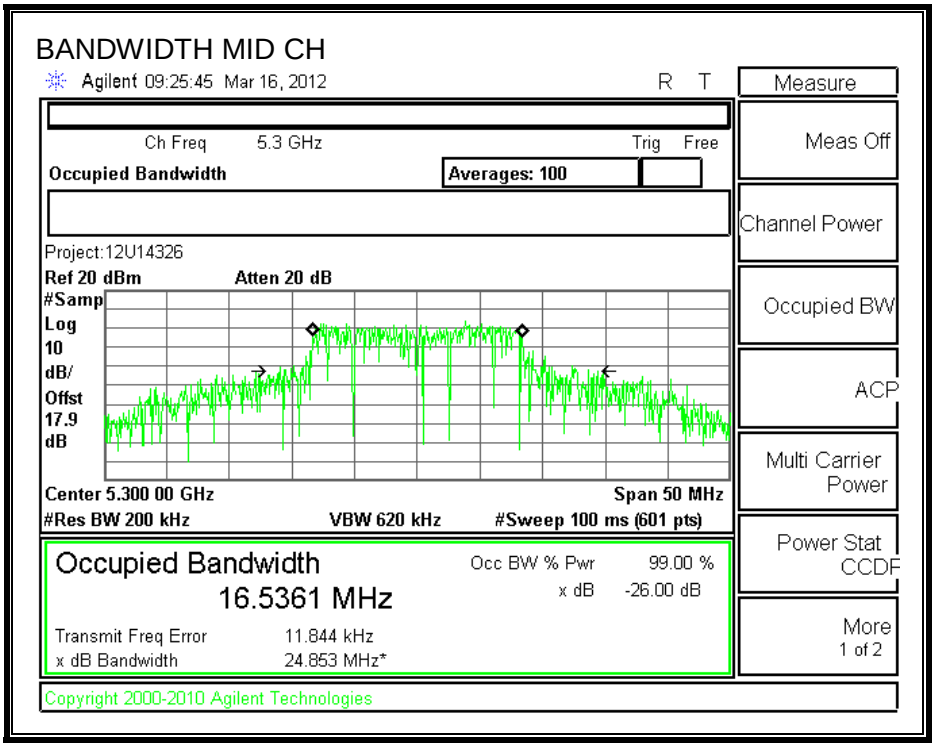


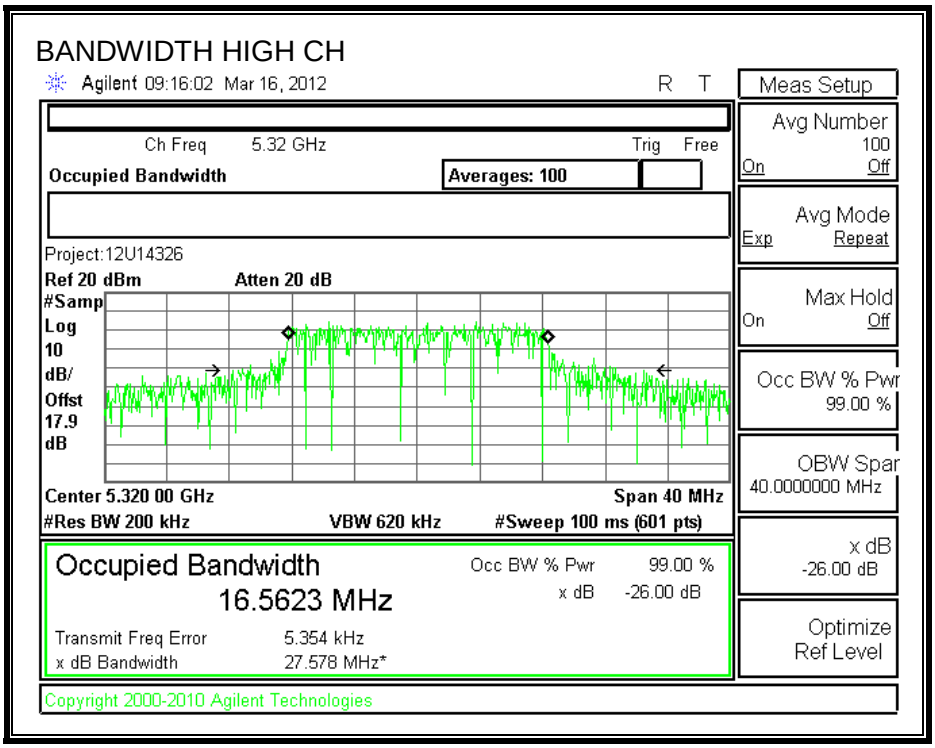




99% BANDWIDTH CHAIN 1







7.5.3. AVERAGE POWER

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

The cable assembly insertion loss of 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

Average Power Results

Channel	Frequency (MHz)	Chain 0 Power (dBm)	Chain 1 Power (dBm)	Total Power (dBm)
Low	5260	17.60	18.05	20.84
Mid	5300	18.10	17.60	20.87
High	5320	17.60	18.00	20.81

7.5.4. OUTPUT POWER AND PPSD

LIMITS

FCC §15.407 (a) (2)

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

DIRECTIONAL ANTENNA GAIN

The TX chains are correlated and the antenna gain is unequal among the chains. The directional gain is:

Chain 0 Antenna Gain (dBi)	Chain 1 Antenna Gain (dBi)	Correlated Chains Directional Gain (dBi)
1.54	2.07	4.82

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	5260	24	30.42	25.83	4.82	24.00	11.00
Mid	5300	24	32.08	26.06	4.82	24.00	11.00
High	5320	24	38.47	26.85	4.82	24.00	11.00

Output Power Results

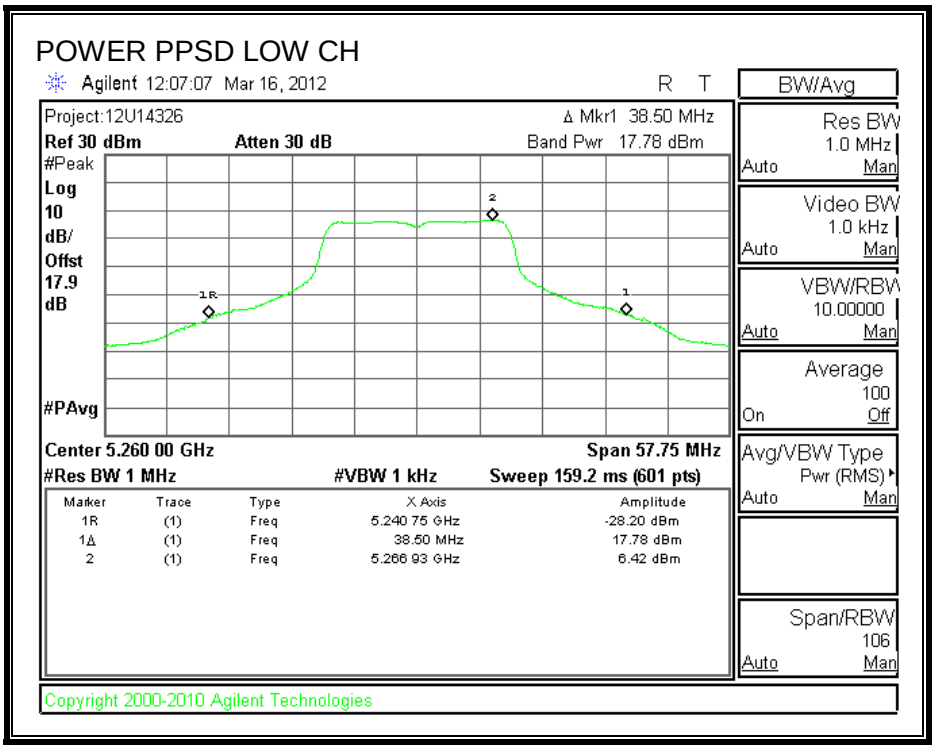
Channel	Frequency (MHz)	Chain 0 Meas Power (dBm)	Chain 1 Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Power Margin (dB)
Low	5260	17.78	18.14	20.97	24.00	-3.03
Mid	5300	18.33	17.90	21.13	24.00	-2.87
High	5320	18.05	18.09	21.08	24.00	-2.92

PPSD Results

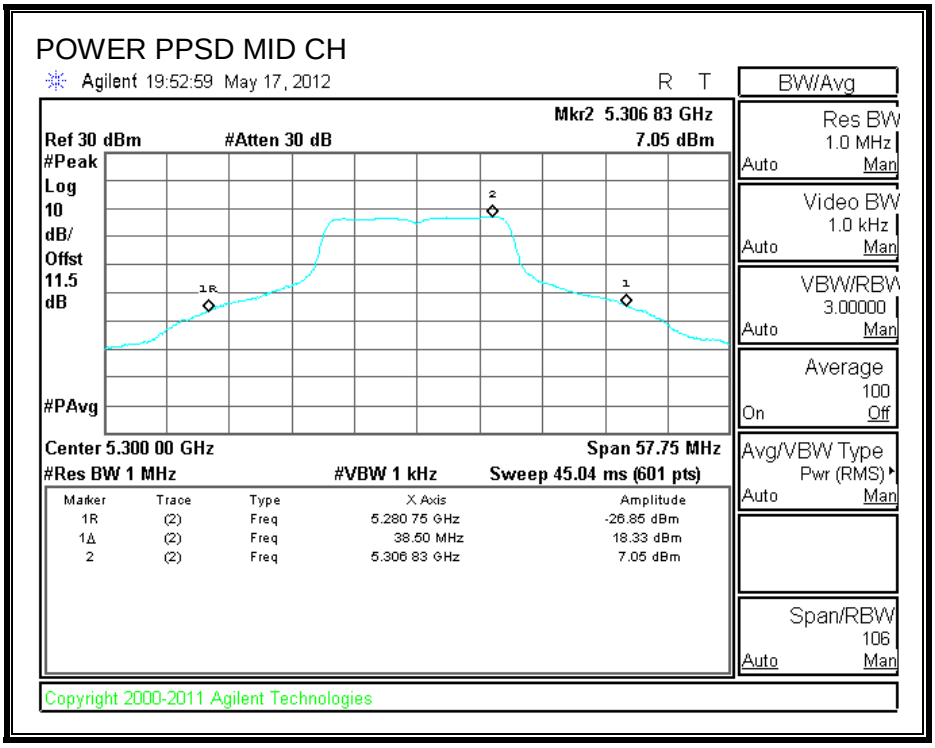
Channel	Frequency (MHz)	Chain 0 Meas PPSD (dBm)	Chain 1 Meas PPSD (dBm)	Total Corr'd PPSD (dBm)	PPSD Limit (dBm)	PPSD Margin (dB)
Low	5260	6.42	6.60	9.52	11.00	-1.48
Mid	5300	7.05	6.46	9.78	11.00	-1.22
High	5320	6.76	6.67	9.73	11.00	-1.27

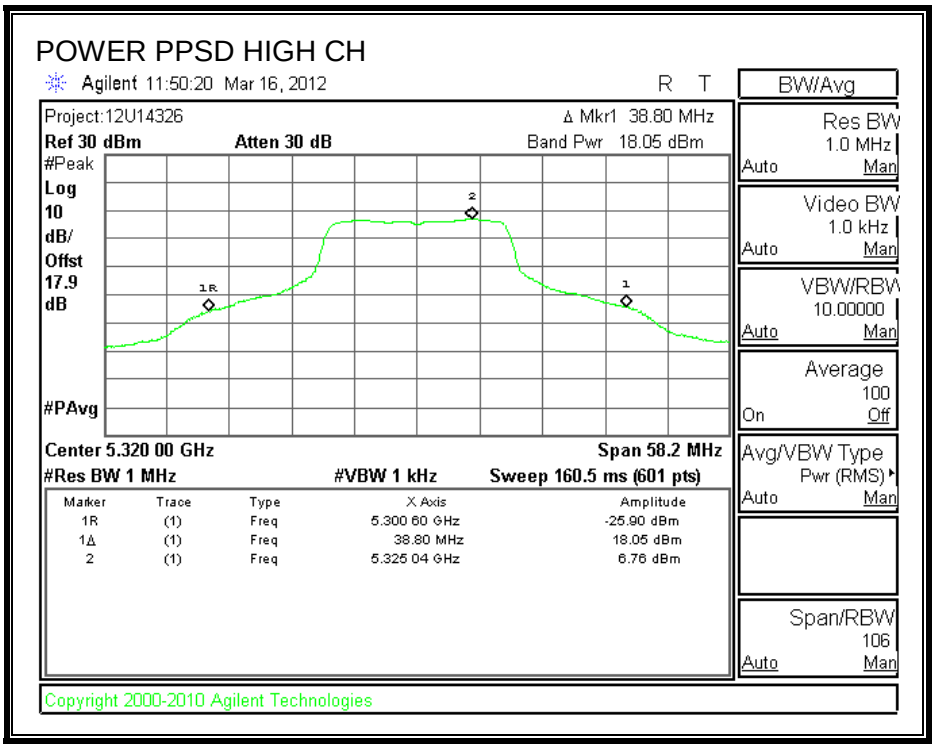
OUTPUT POWER AND PPSD CHAIN 0

POWER PPSD LOW CH



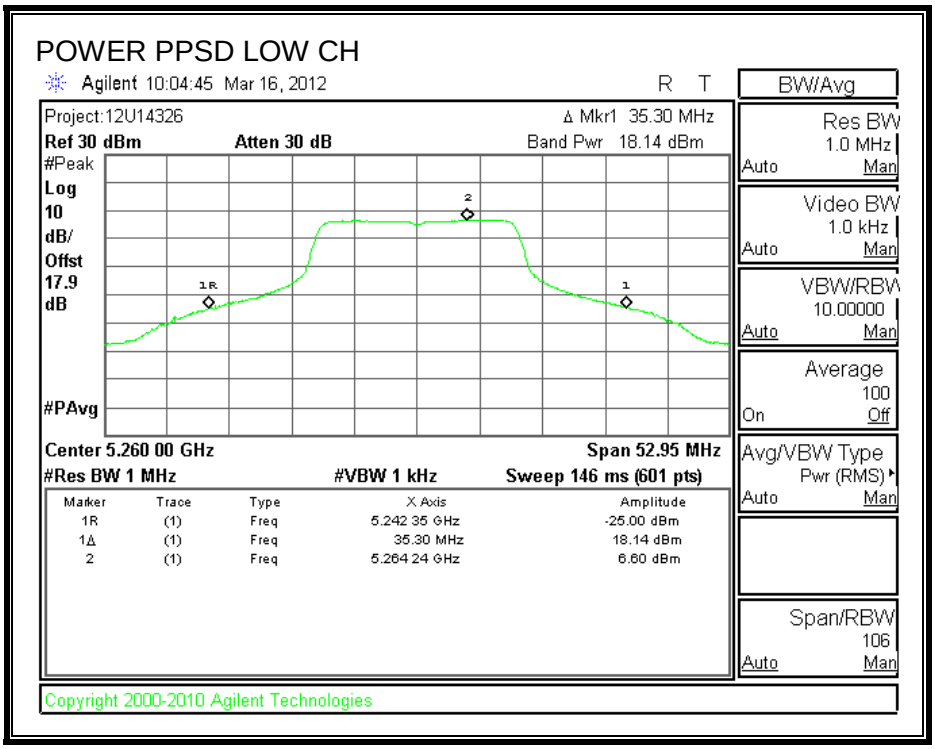
POWER PPSD MID CH



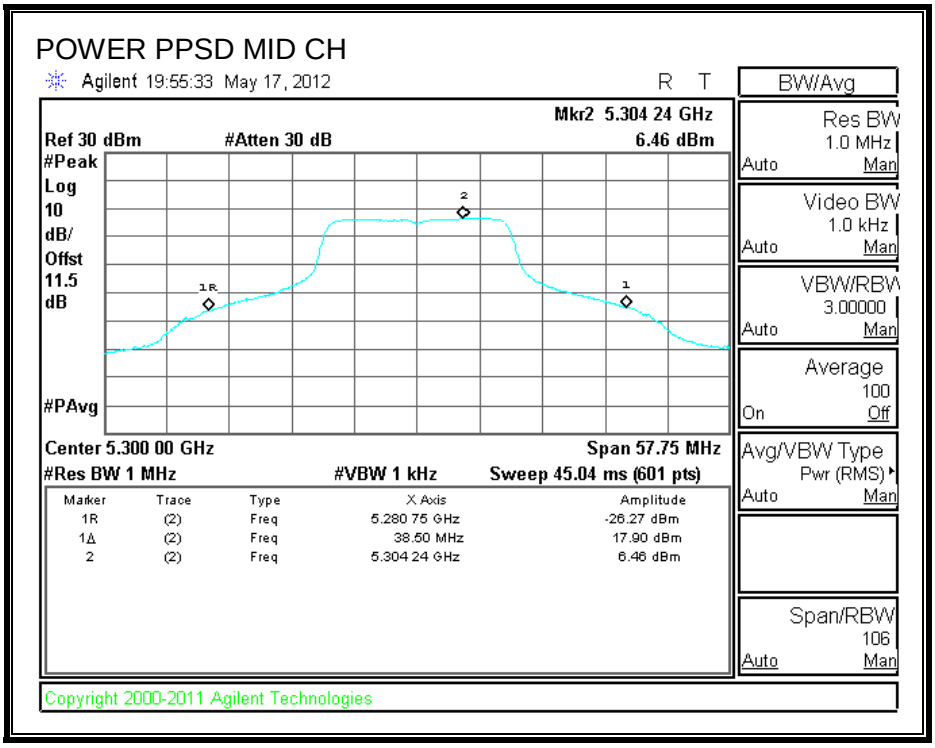


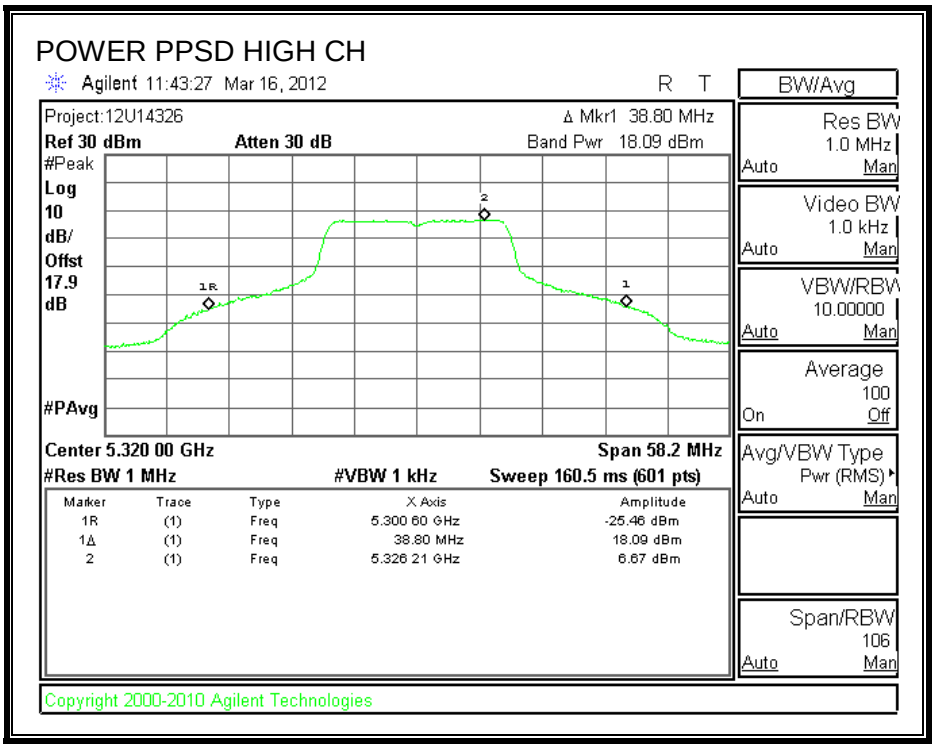
OUTPUT POWER AND PPSD CHAIN 1

POWER PPSD LOW CH



POWER PPSD MID CH





7.6. 802.11n HT20 MODE IN THE 5.3 GHz BAND

7.6.1. 26 dB BANDWIDTH

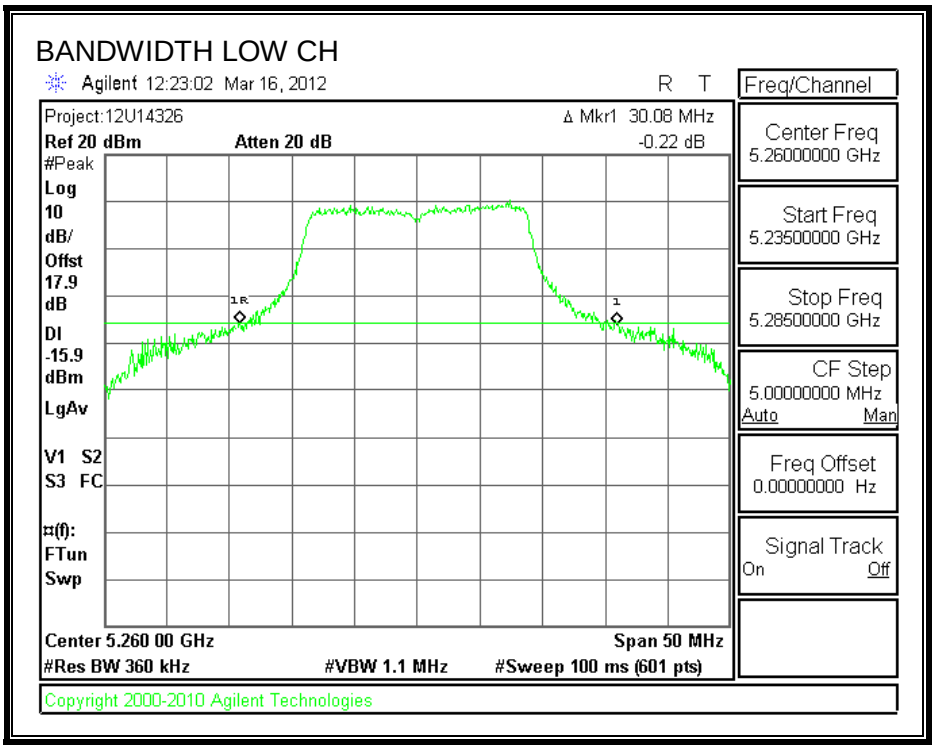
LIMITS

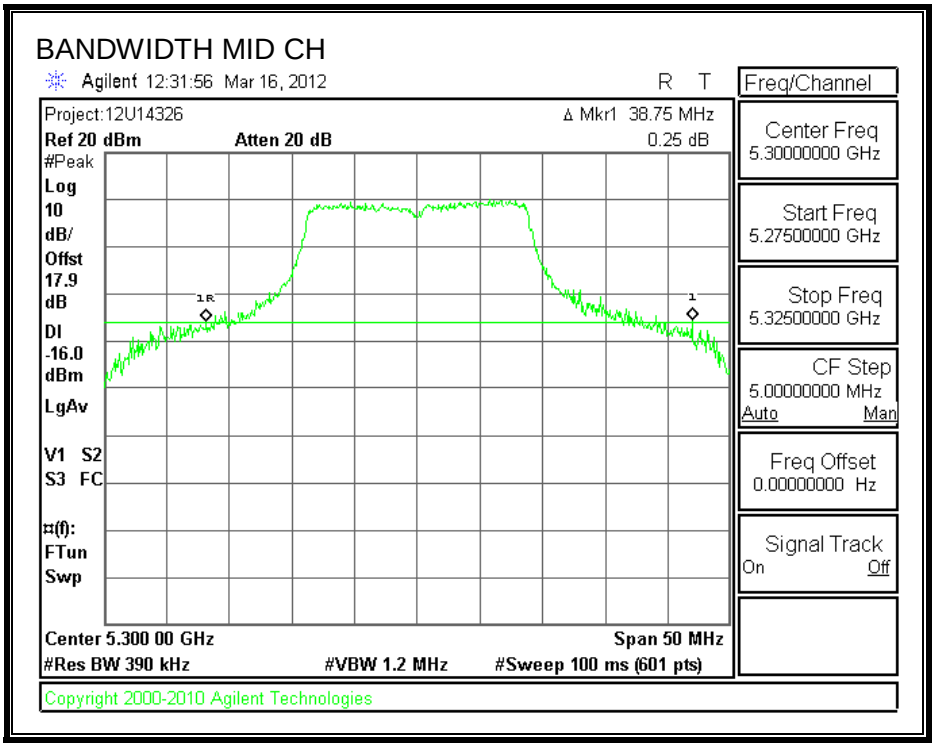
None; for reporting purposes only.

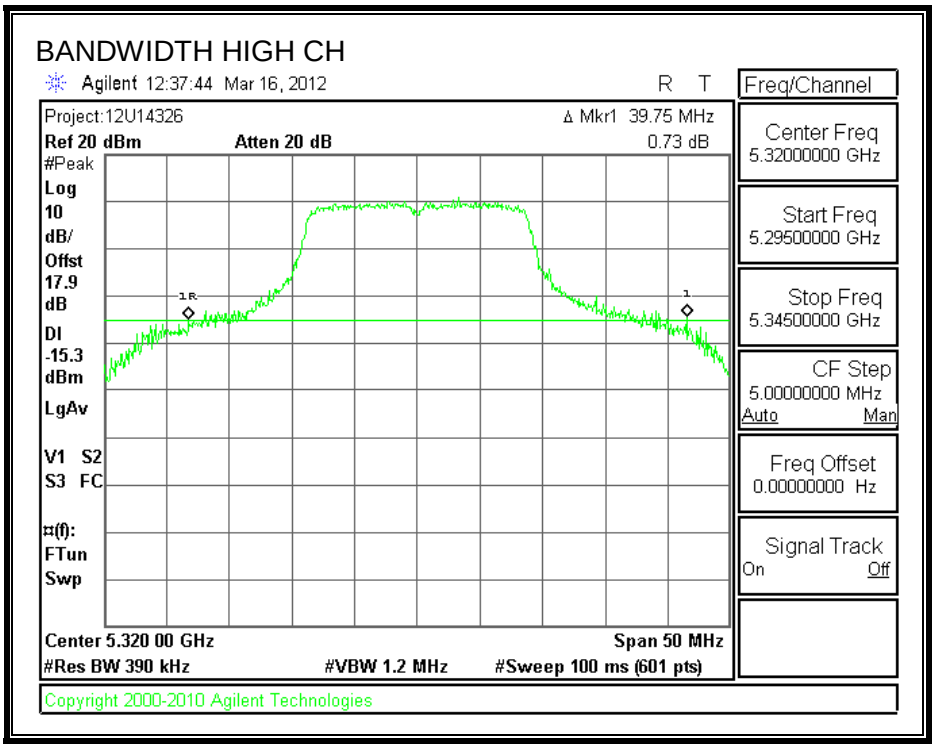
RESULTS

Channel	Frequency (MHz)	26 dB BW Chain 0 (MHz)	26 dB BW Chain 1 (MHz)
Low	5260	30.08	32.75
Mid	5300	38.75	39.17
High	5320	39.75	43.58

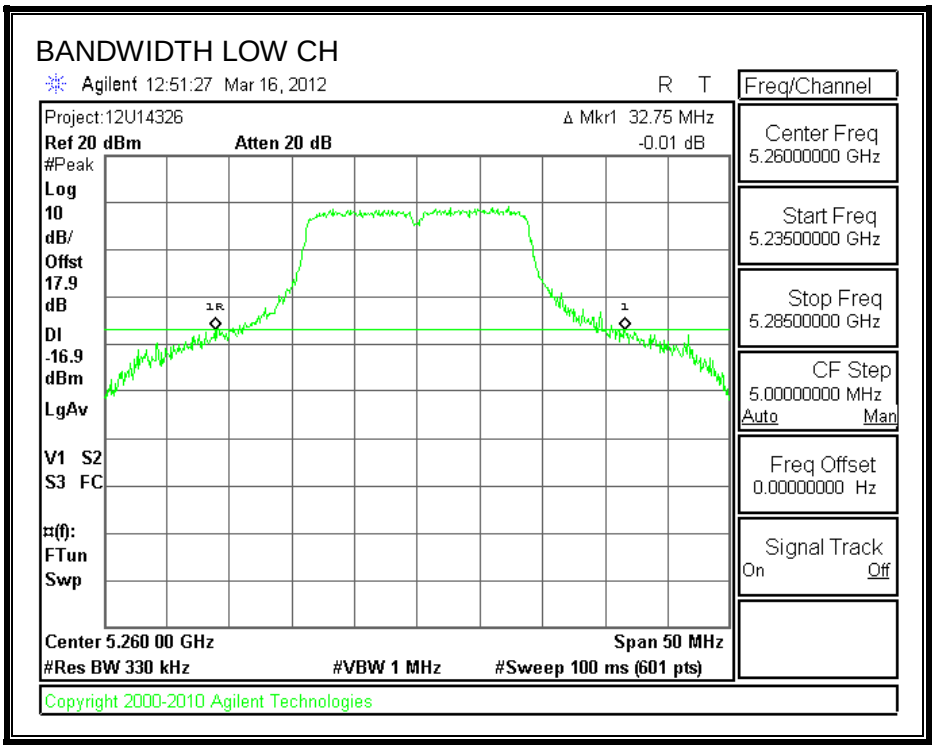
26 dB BANDWIDTH CHAIN 0

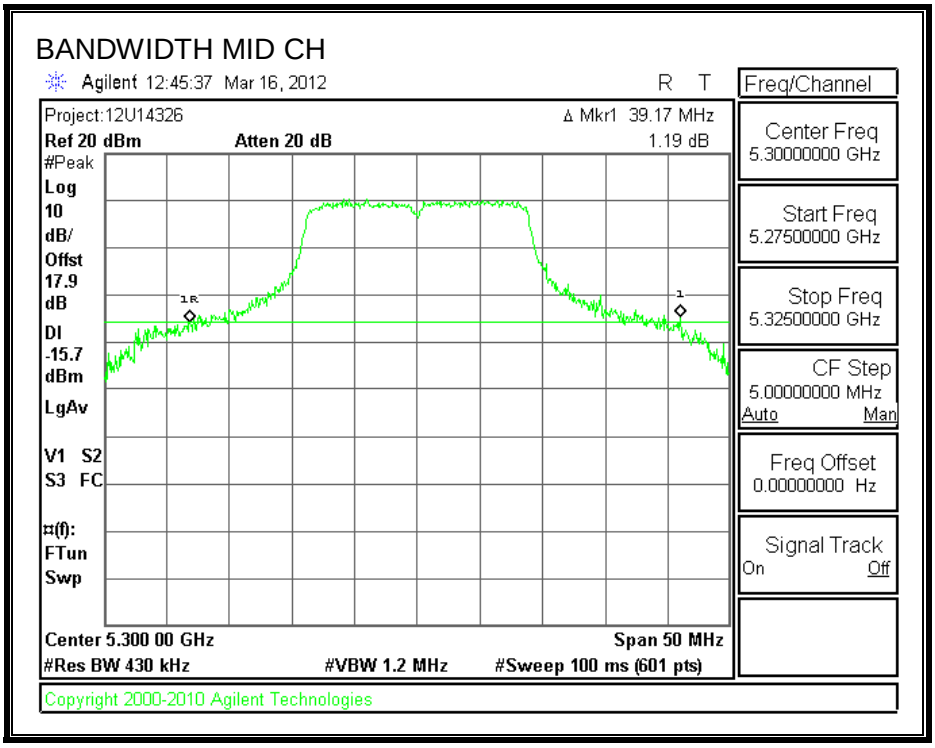


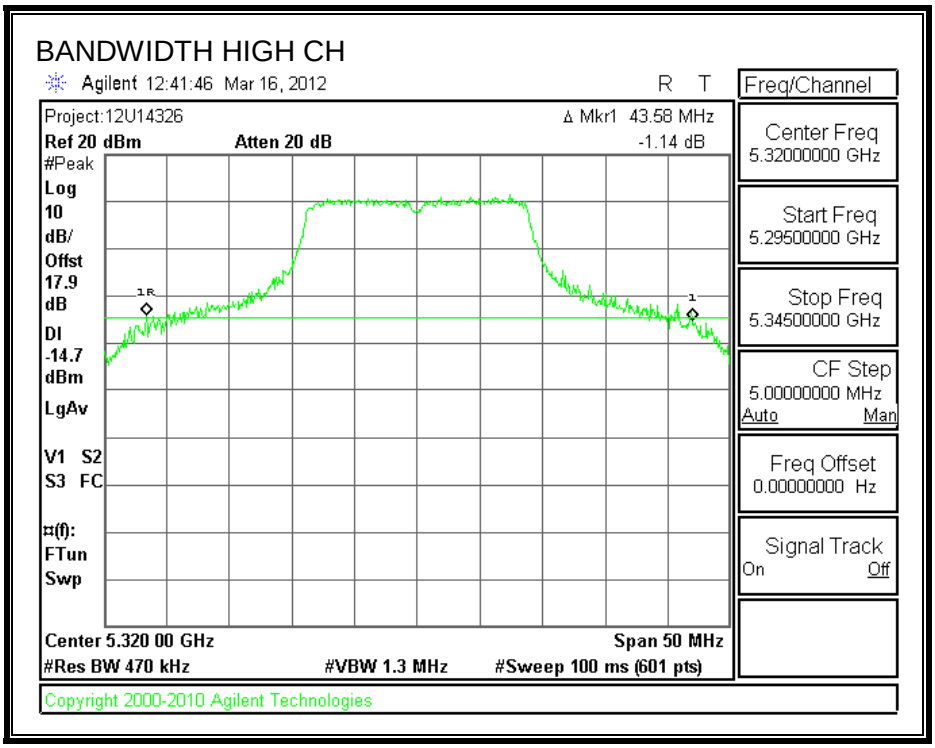




26 dB BANDWIDTH CHAIN 1







7.6.2. 99% BANDWIDTH

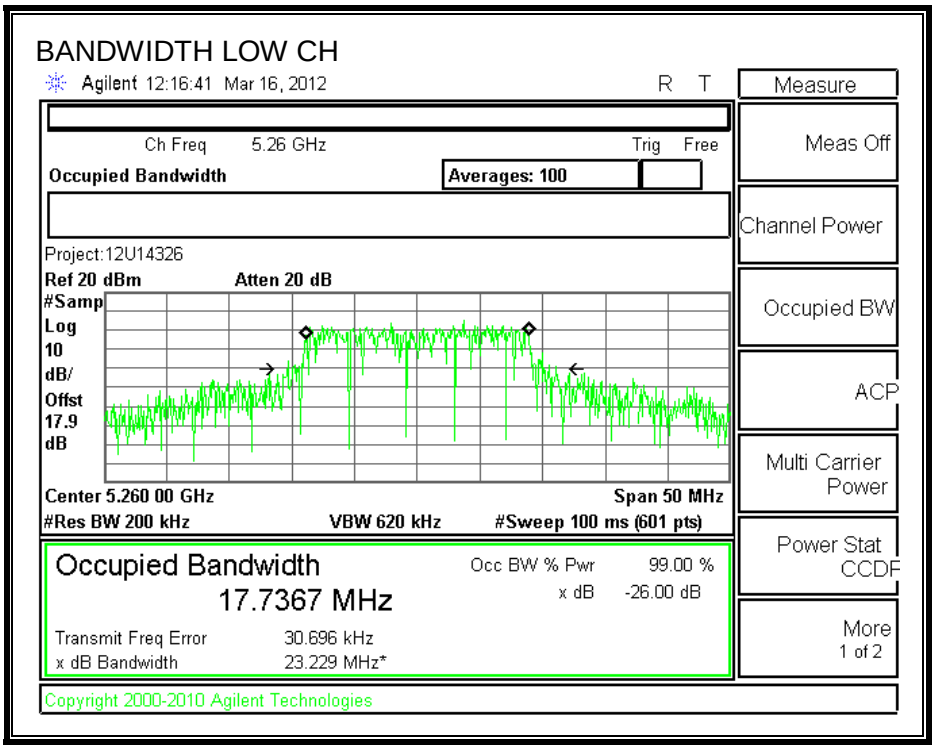
LIMITS

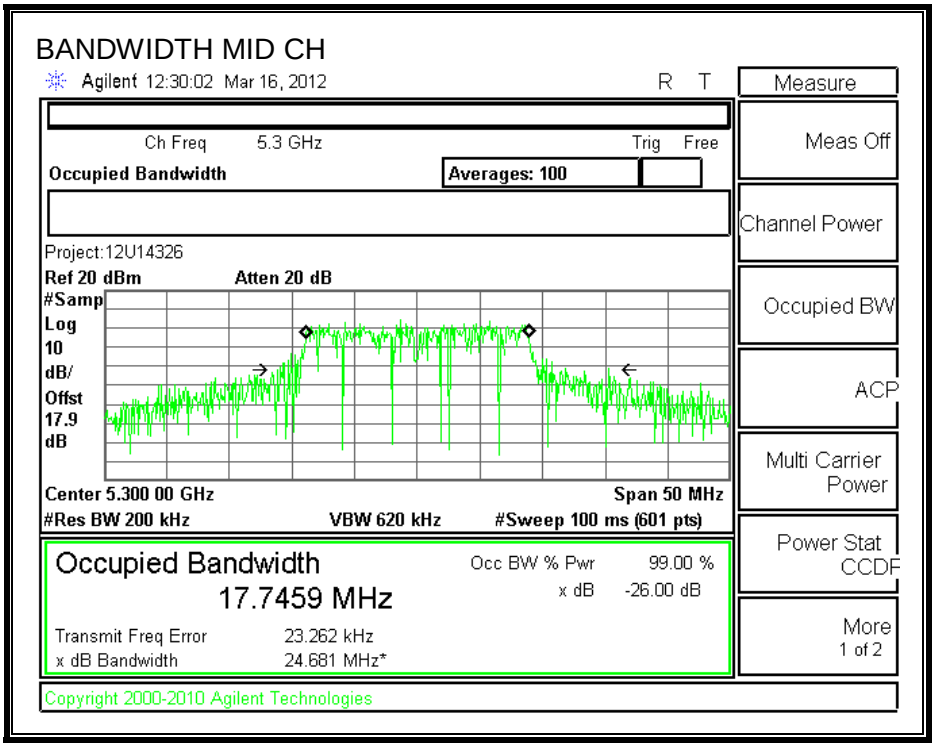
None; for reporting purposes only.

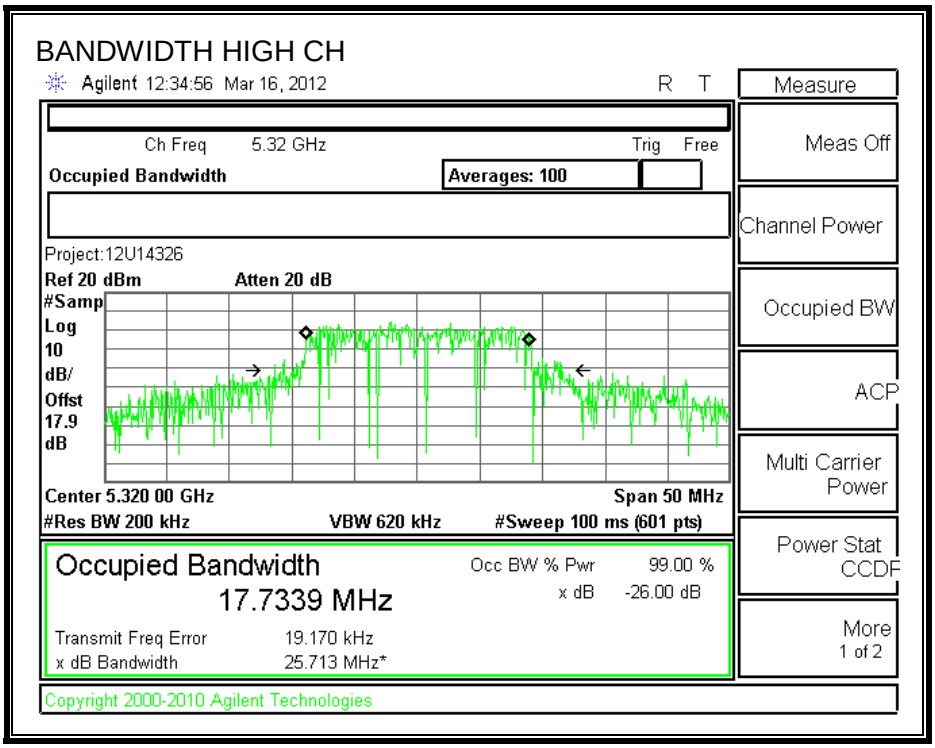
RESULTS

Channel	Frequency (MHz)	99% BW Chain 0 (MHz)	99% BW Chain 1 (MHz)
Low	5260	17.7367	17.6964
Mid	5300	17.7459	17.7317
High	5320	17.7339	17.7907

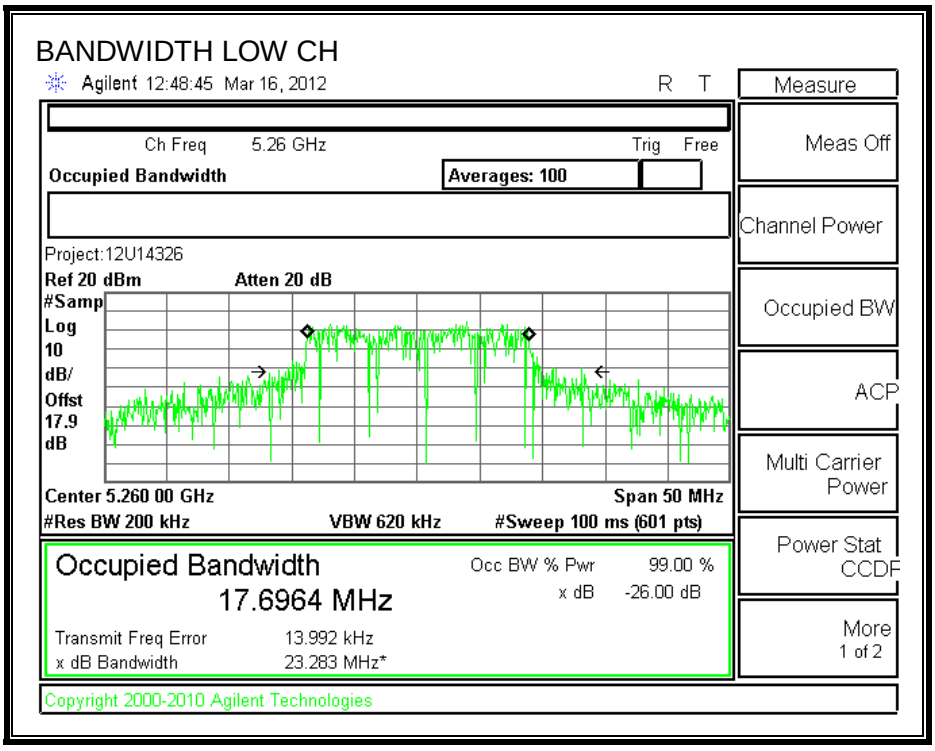
99% BANDWIDTH CHAIN 0

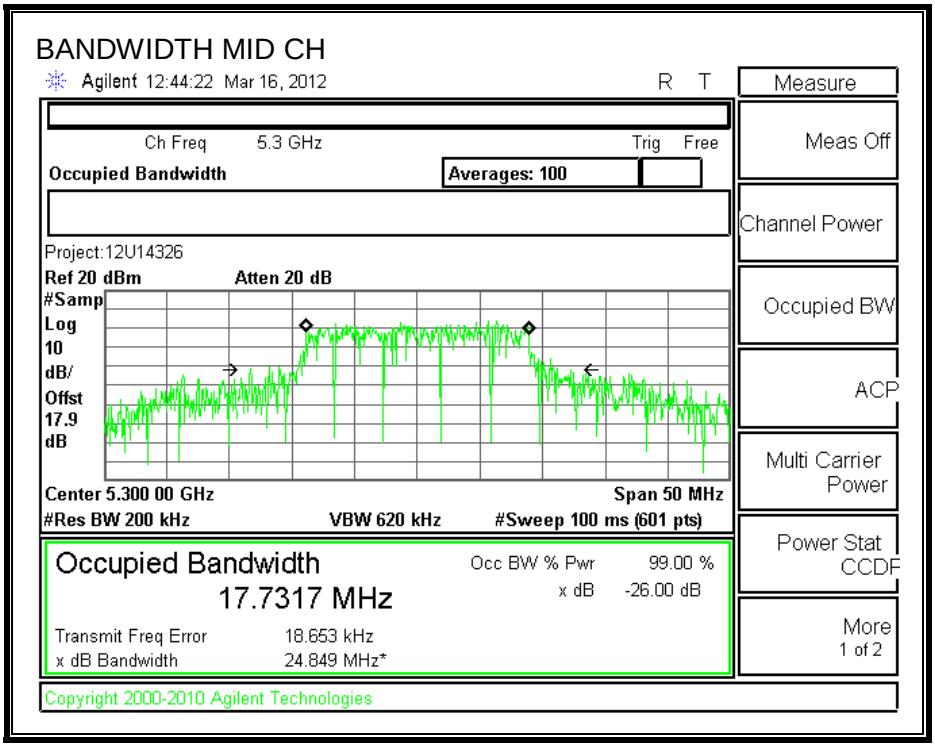


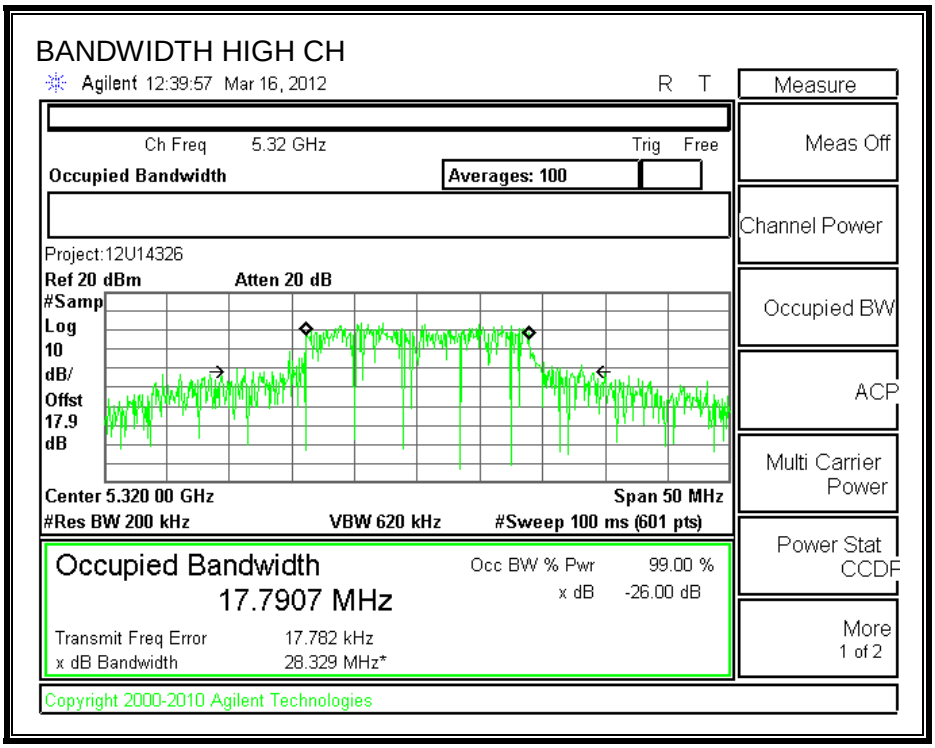




99% BANDWIDTH CHAIN 1







7.6.3. 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

Average Power Results

Channel	Frequency (MHz)	Chain 0 Power (dBm)	Chain 1 Power (dBm)	Total Power (dBm)
Low	5260	17.70	17.60	20.66
Mid	5300	18.05	17.55	20.82
High	5320	18.10	17.65	20.89

7.6.4. OUTPUT POWER AND PPSD

LIMITS

FCC §15.407 (a) (2)

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

DIRECTIONAL ANTENNA GAIN

The TX chains are uncorrelated and the antenna gain is unequal among the chains. The directional gain is:

Chain 0 Antenna Gain (dBi)	Chain 1 Antenna Gain (dBi)	Uncorrelated Chains Directional Gain (dBi)
1.54	2.07	1.81

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	5260	24	30.08	25.78	1.81	24.00	11.00
Mid	5300	24	38.75	26.88	1.81	24.00	11.00
High	5320	24	39.75	26.99	1.81	24.00	11.00

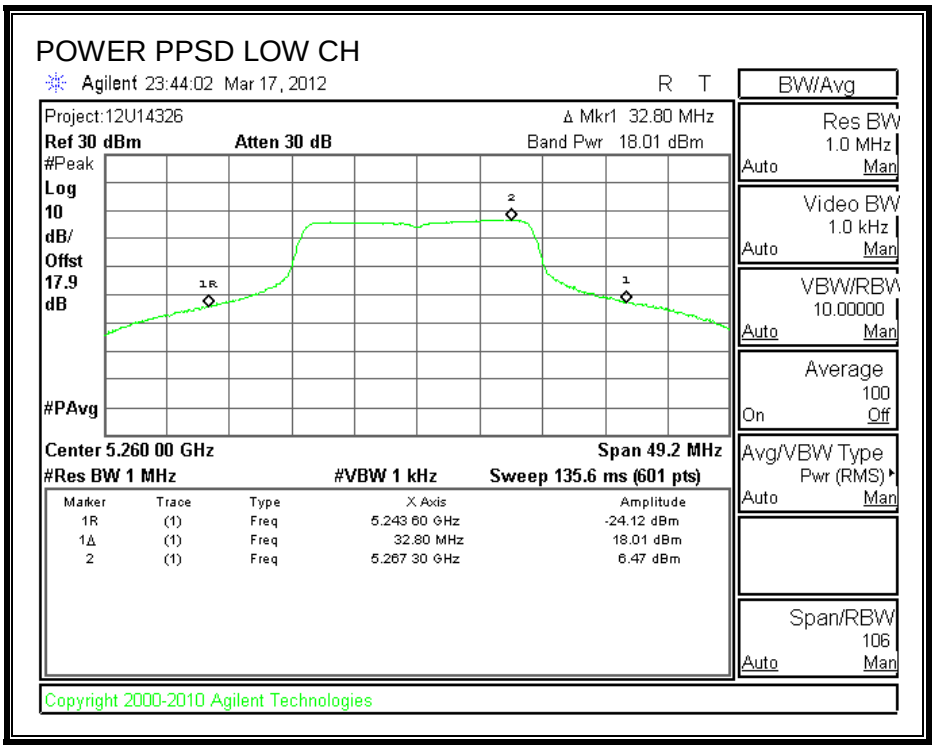
Output Power Results

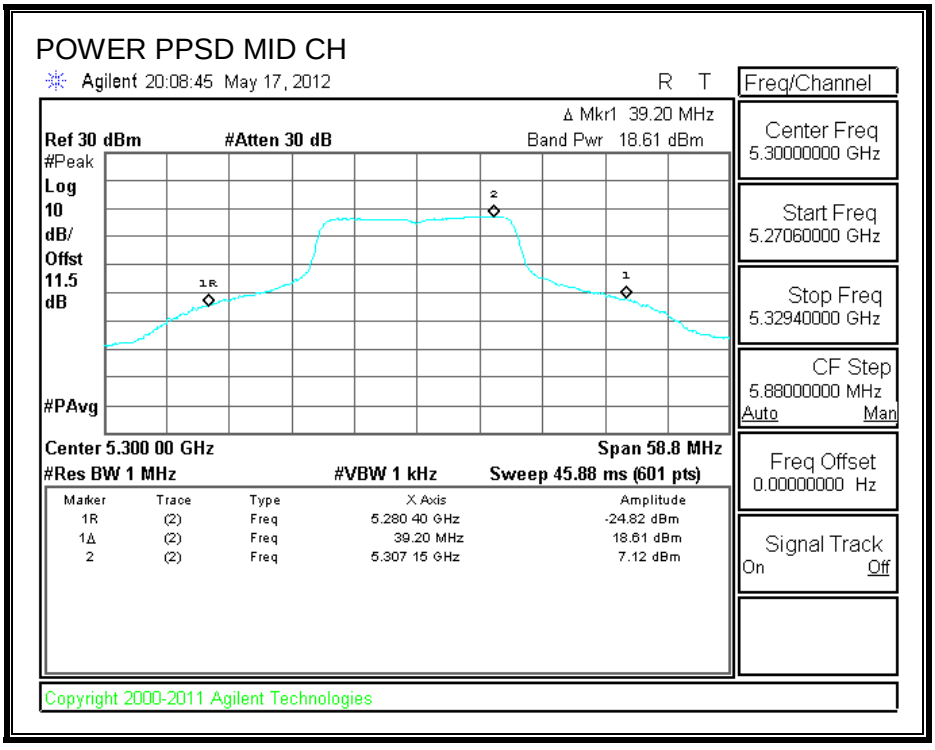
Channel	Frequency (MHz)	Chain 0 Meas Power (dBm)	Chain 1 Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Power Margin (dB)
Low	5260	18.01	17.71	20.87	24.00	-3.13
Mid	5300	18.61	17.70	21.19	24.00	-2.81
High	5320	18.42	17.82	21.14	24.00	-2.86

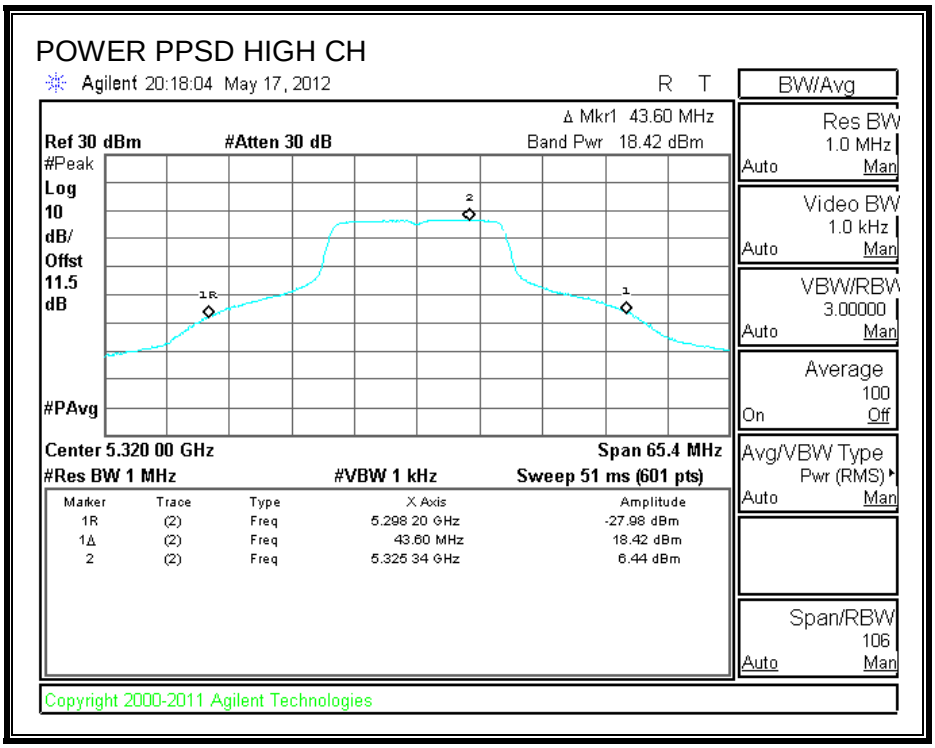
PPSD Results

Channel	Frequency (MHz)	Chain 0 Meas PPSD (dBm)	Chain 1 Meas PPSD (dBm)	Total Corr'd PPSD (dBm)	PPSD Limit (dBm)	PPSD Margin (dB)
Low	5260	6.47	5.78	9.15	11.00	-1.85
Mid	5300	7.12	5.71	9.48	11.00	-1.52
High	5320	6.44	6.06	9.26	11.00	-1.74

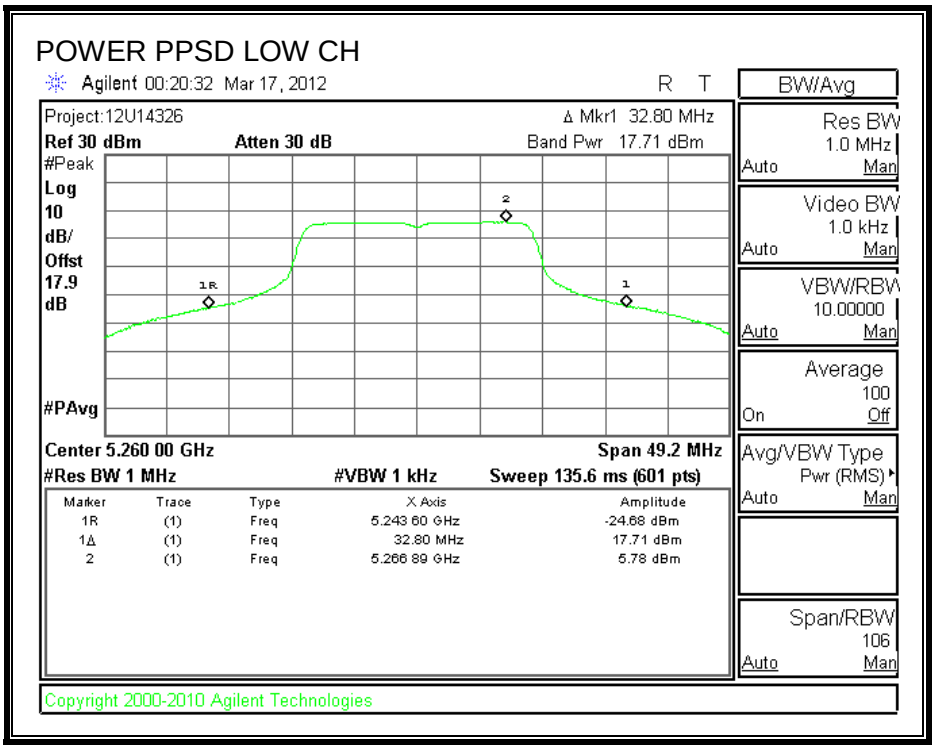
OUTPUT POWER AND PPSD CHAIN 0

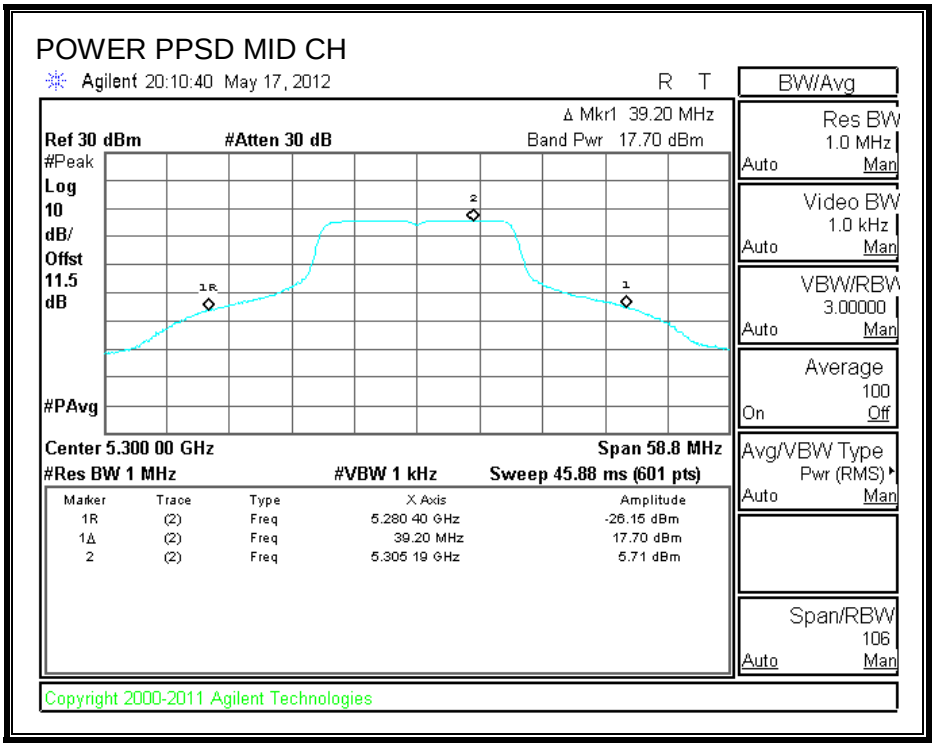


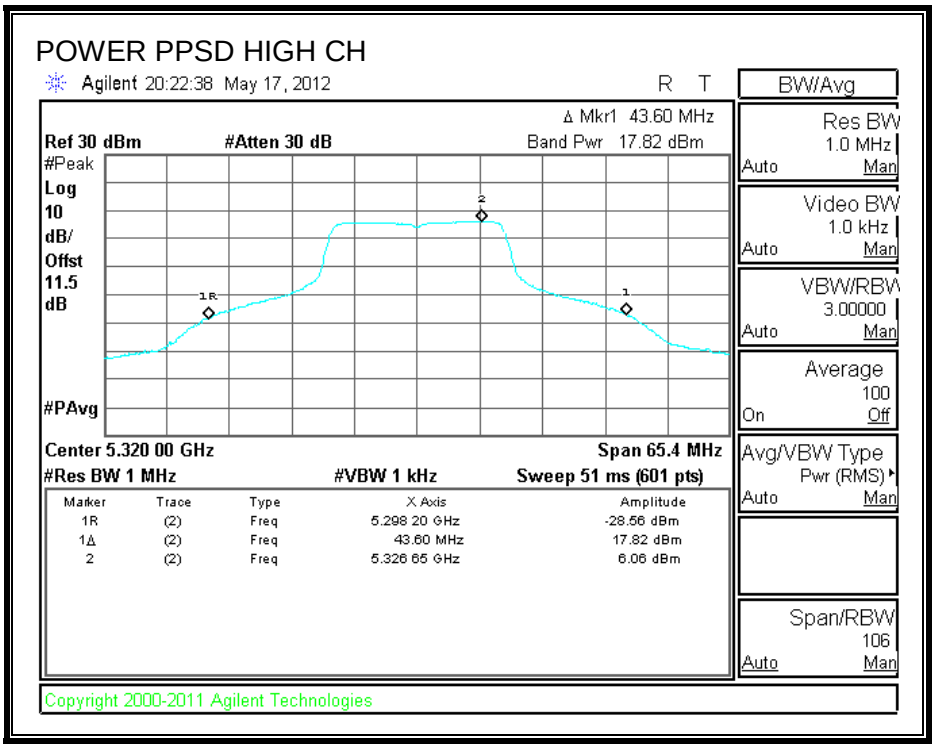




OUTPUT POWER AND PPSD CHAIN 1







7.7. 802.11n HT40 MODE IN THE 5.3 GHz BAND

7.7.1. 26 dB BANDWIDTH

LIMITS

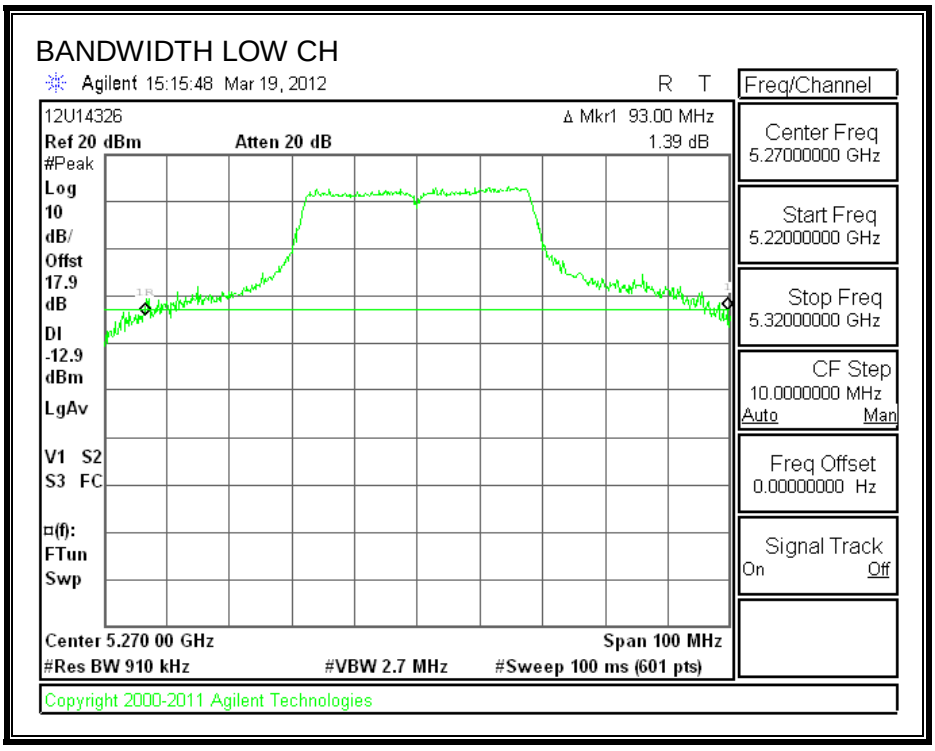
None; for reporting purposes only.

RESULTS

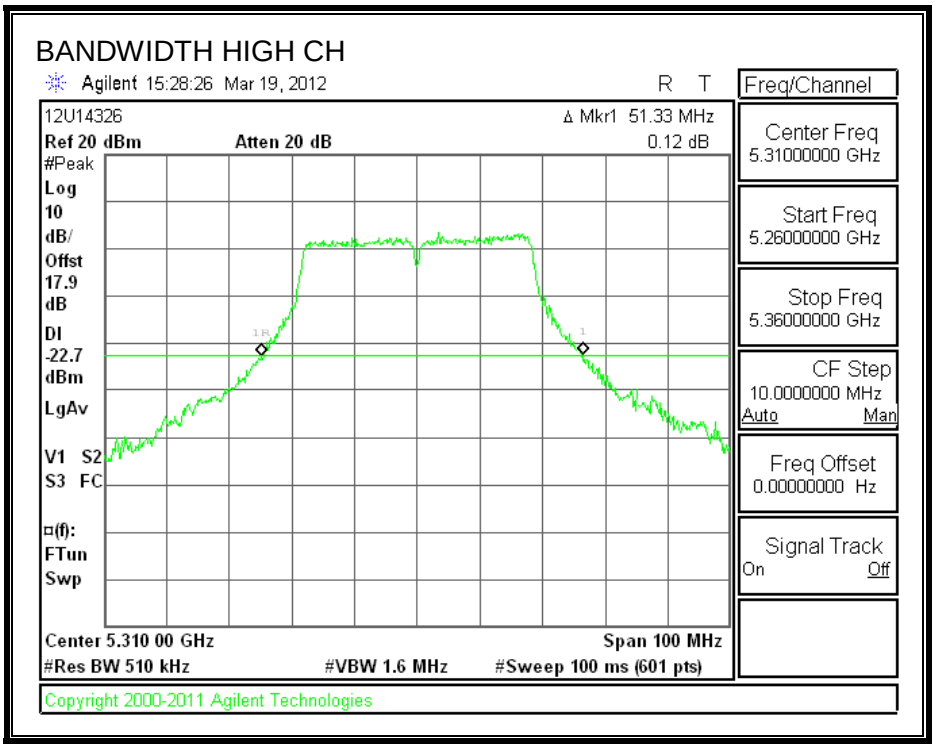
Channel	Frequency (MHz)	26 dB BW Chain 0 (MHz)	26 dB BW Chain 1 (MHz)
Low	5270	93.00	87.00
High	5310	51.33	51.17

26 dB BANDWIDTH CHAIN 0

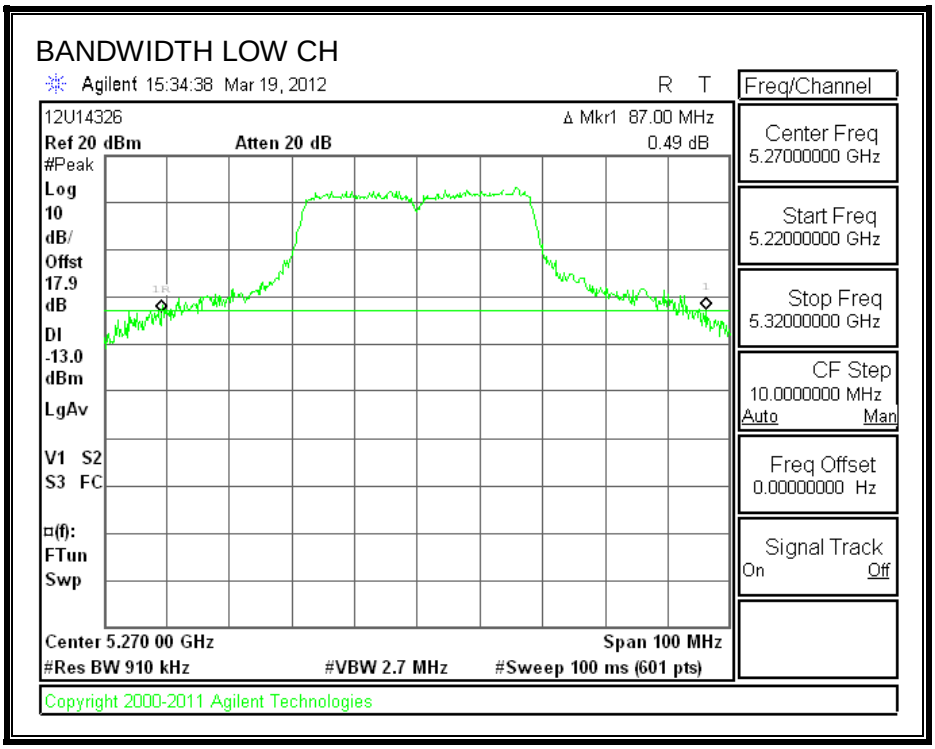
BANDWIDTH LOW CH

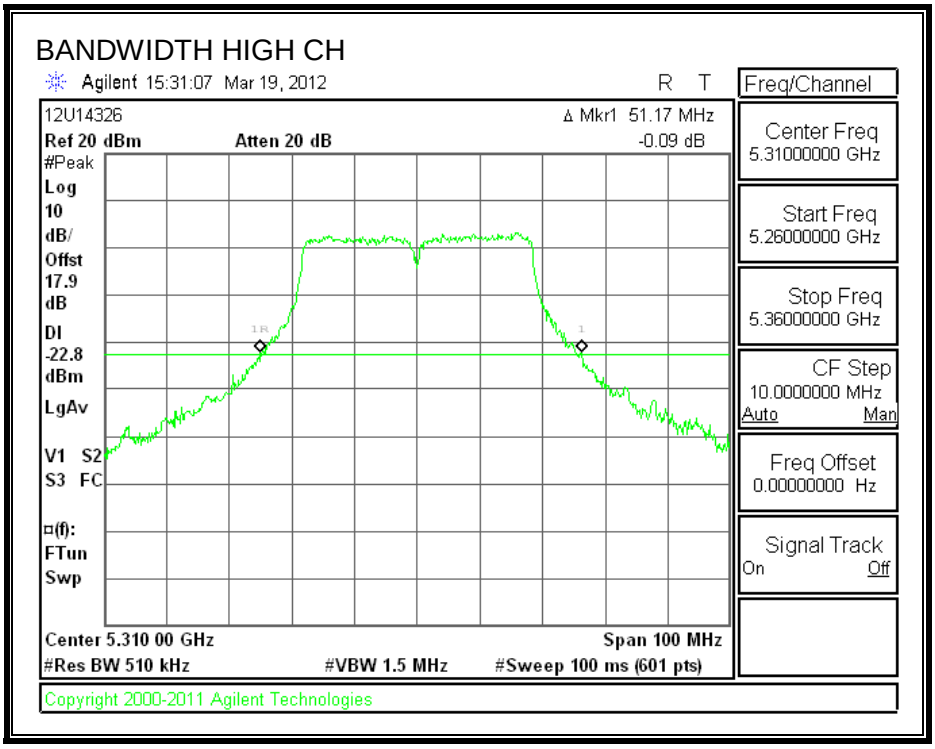


BANDWIDTH HIGH CH



26 dB BANDWIDTH CHAIN 1





7.7.2. 99% BANDWIDTH

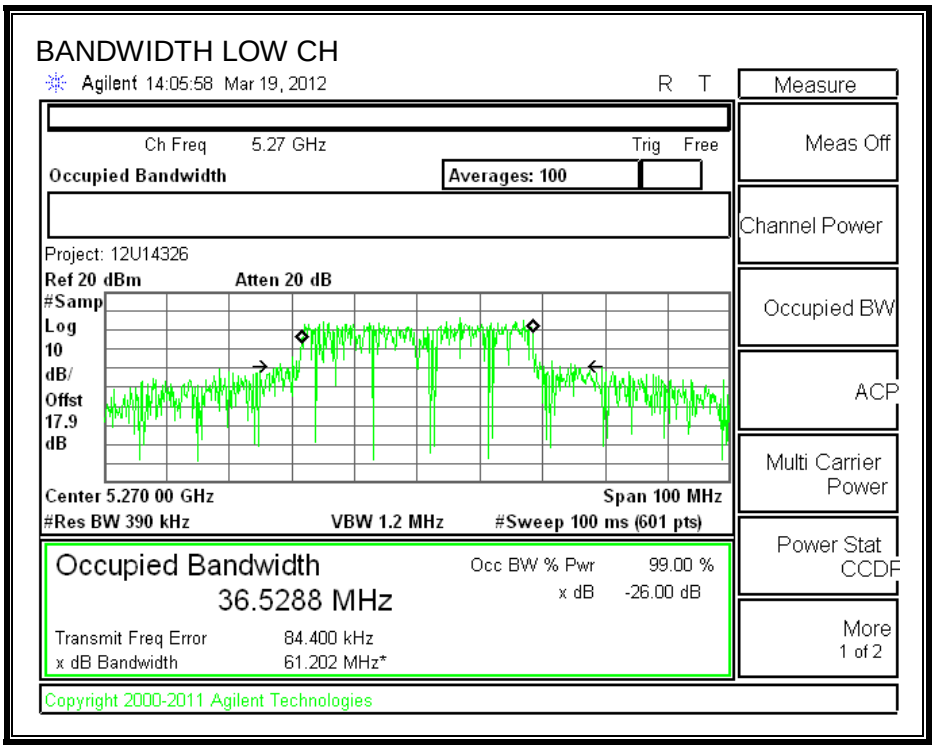
LIMITS

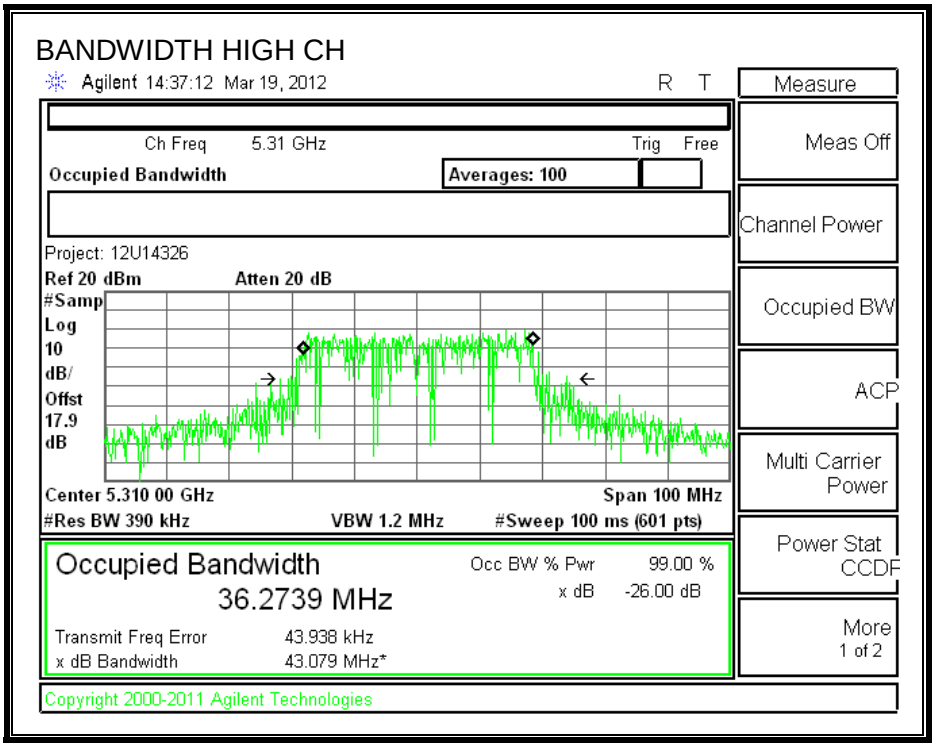
None; for reporting purposes only.

RESULTS

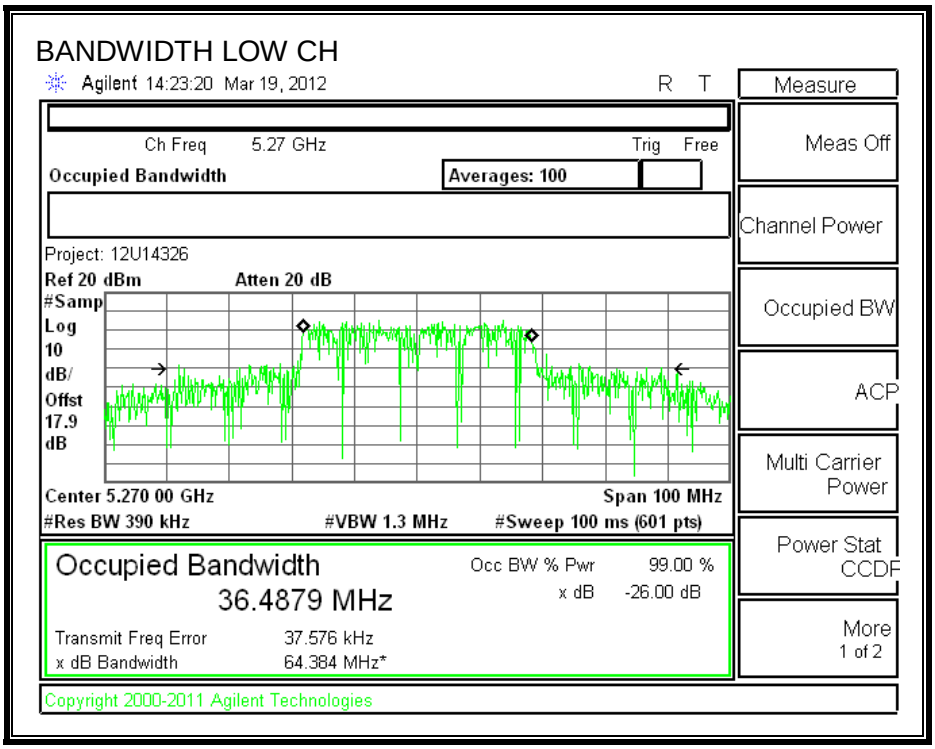
Channel	Frequency (MHz)	99% BW Chain 0 (MHz)	99% BW Chain 1 (MHz)
Low	5270	36.5288	36.4879
High	5310	36.2739	36.2095

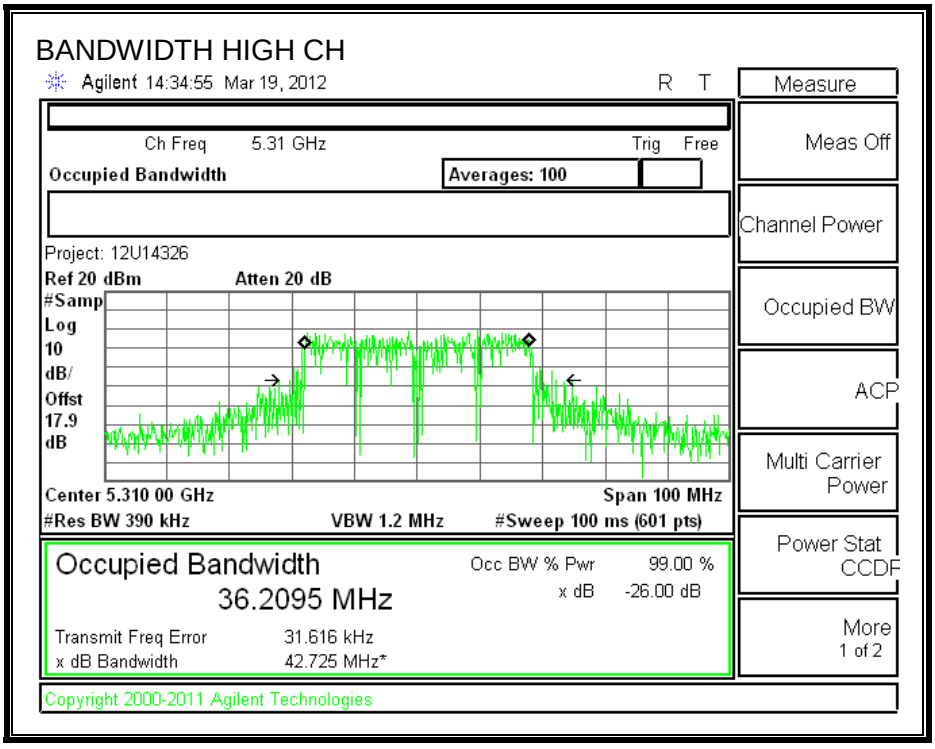
99% BANDWIDTH CHAIN 0





99% BANDWIDTH CHAIN 1





7.7.3. 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

Average Power Results

Channel	Frequency (MHz)	Chain 0 Power (dBm)	Chain 1 Power (dBm)	Total Power (dBm)
Low	5270	19.00	18.90	21.96
High	5310	13.50	12.80	16.17

7.7.4. OUTPUT POWER AND PPSD

LIMITS

FCC §15.407 (a) (2)

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

DIRECTIONAL ANTENNA GAIN

The TX chains are uncorrelated and the antenna gain is unequal among the chains. The directional gain is:

Chain 0 Antenna Gain (dBi)	Chain 1 Antenna Gain (dBi)	Uncorrelated Chains Directional Gain (dBi)
1.54	2.07	1.81

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	5270	24	87.00	30.40	1.81	24.00	11.00
High	5310	24	51.17	28.09	1.81	24.00	11.00

Output Power Results

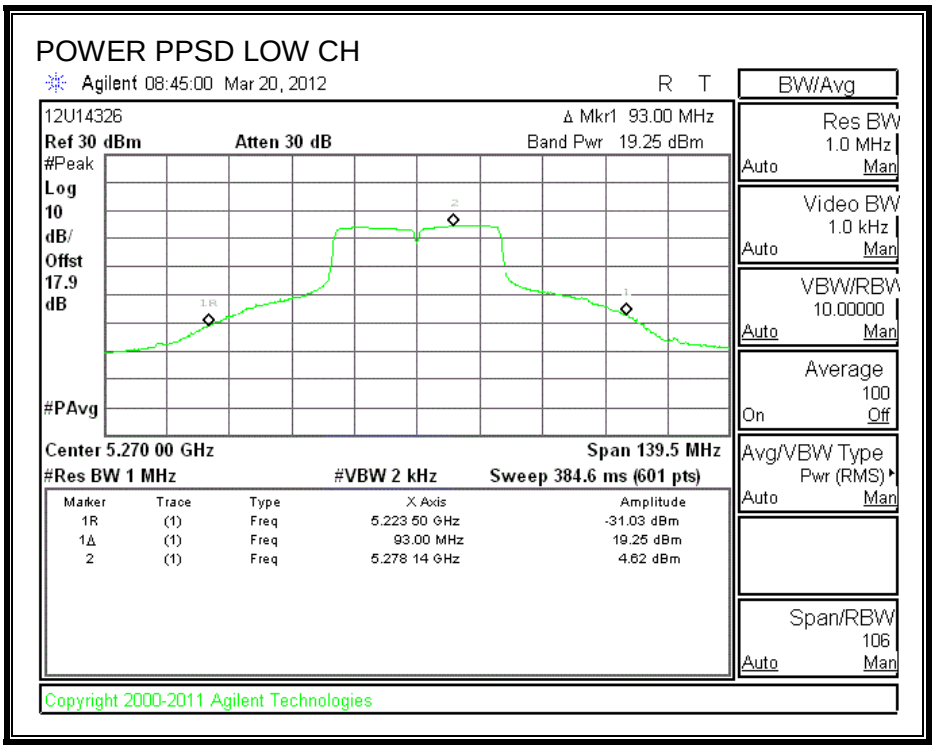
Channel	Frequency (MHz)	Chain 0 Meas Power (dBm)	Chain 1 Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Power Margin (dB)
Low	5270	19.25	19.15	22.21	24.00	-1.79
High	5310	13.64	12.93	16.31	24.00	-7.69

PPSD Results

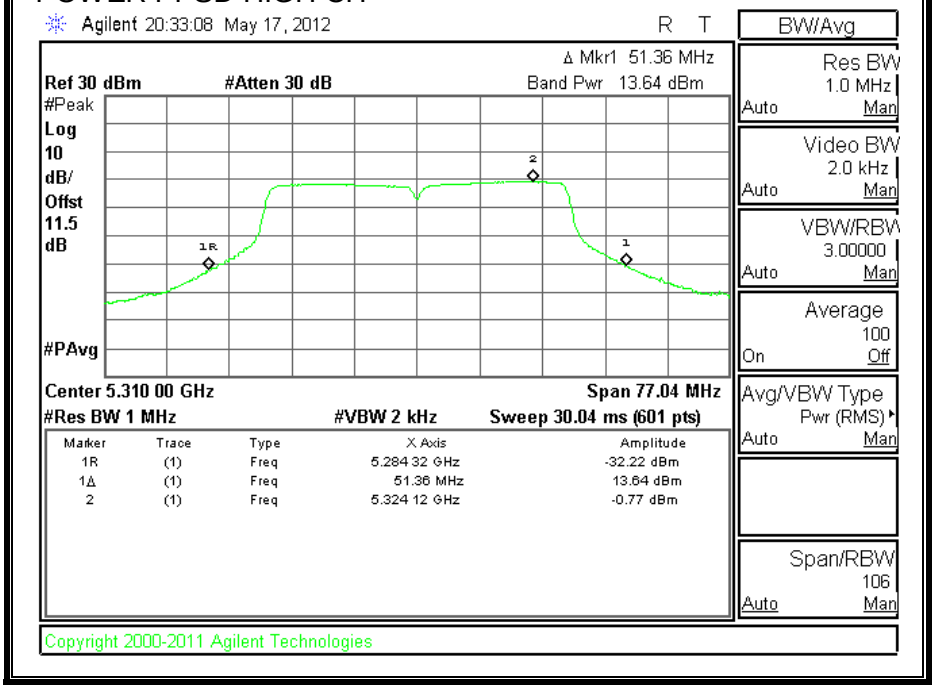
Channel	Frequency (MHz)	Chain 0 Meas PPSD (dBm)	Chain 1 Meas PPSD (dBm)	Total Corr'd PPSD (dBm)	PPSD Limit (dBm)	PPSD Margin (dB)
Low	5270	4.62	4.48	7.56	11.00	-3.44
High	5310	-0.77	-1.49	1.90	11.00	-9.10

OUTPUT POWER AND PPSD CHAIN 0

POWER PPSD LOW CH

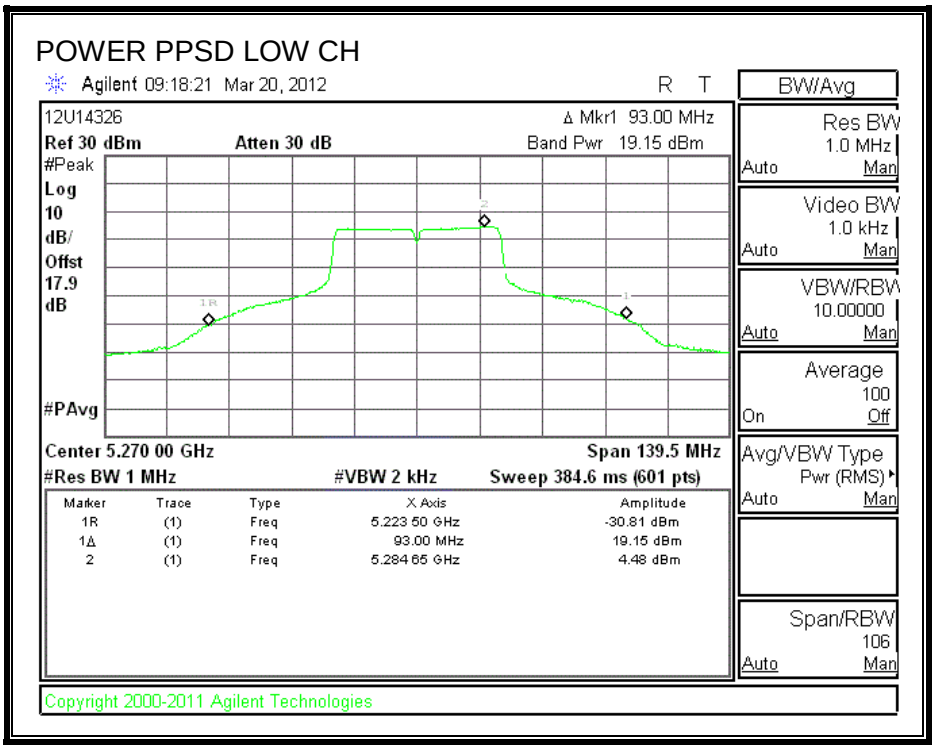


POWER PPSD HIGH CH

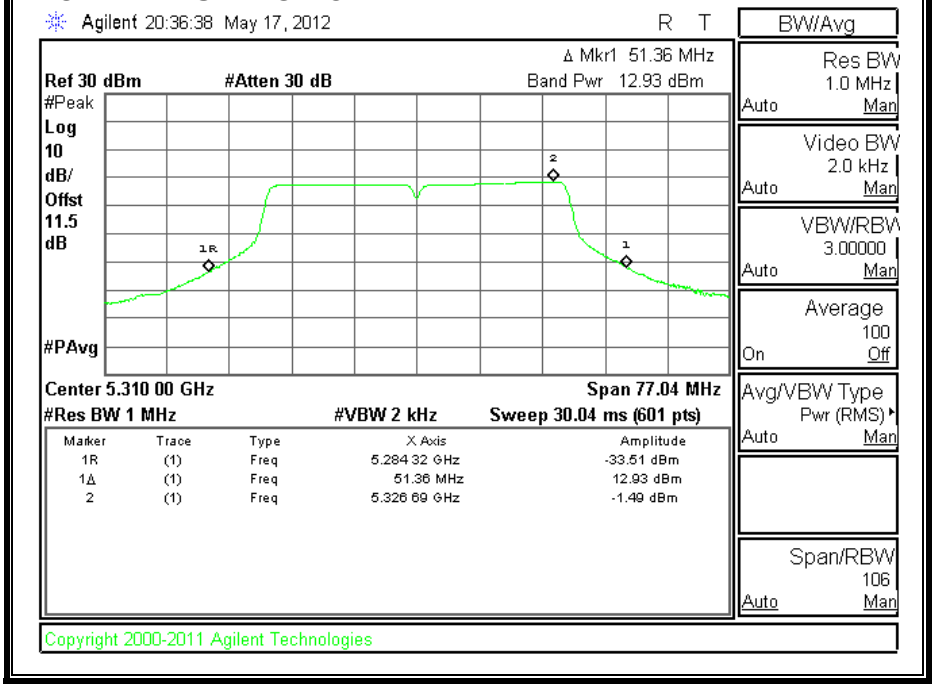


OUTPUT POWER AND PPSD CHAIN 1

POWER PPSD LOW CH



POWER PPSD HIGH CH



7.8. 802.11a MODE IN THE 5.6 GHz BAND

7.8.1. 26 dB BANDWIDTH

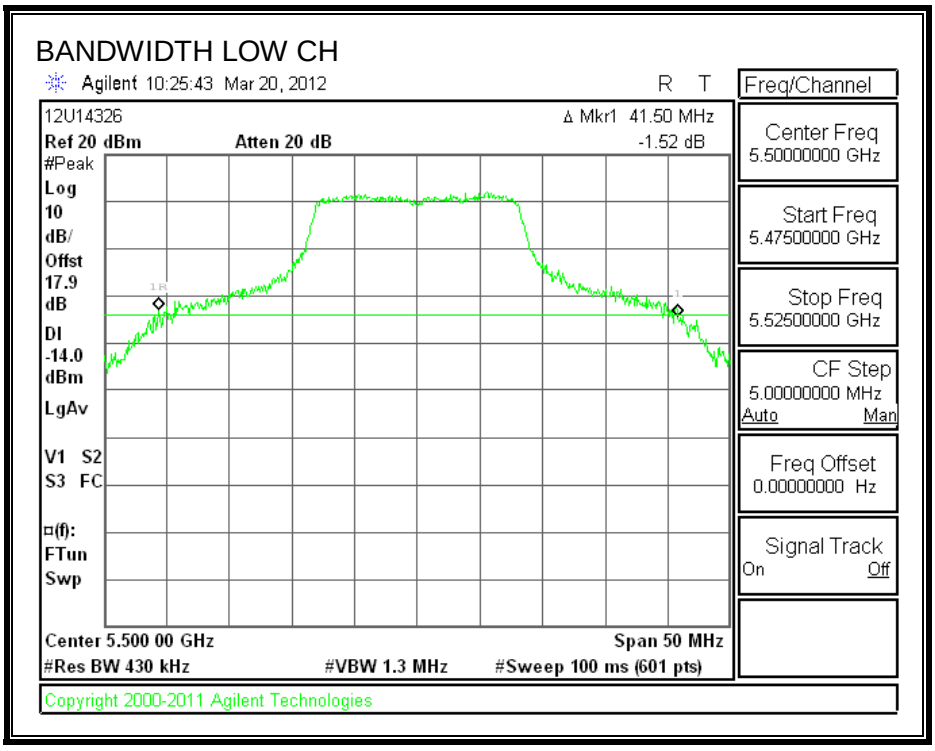
LIMITS

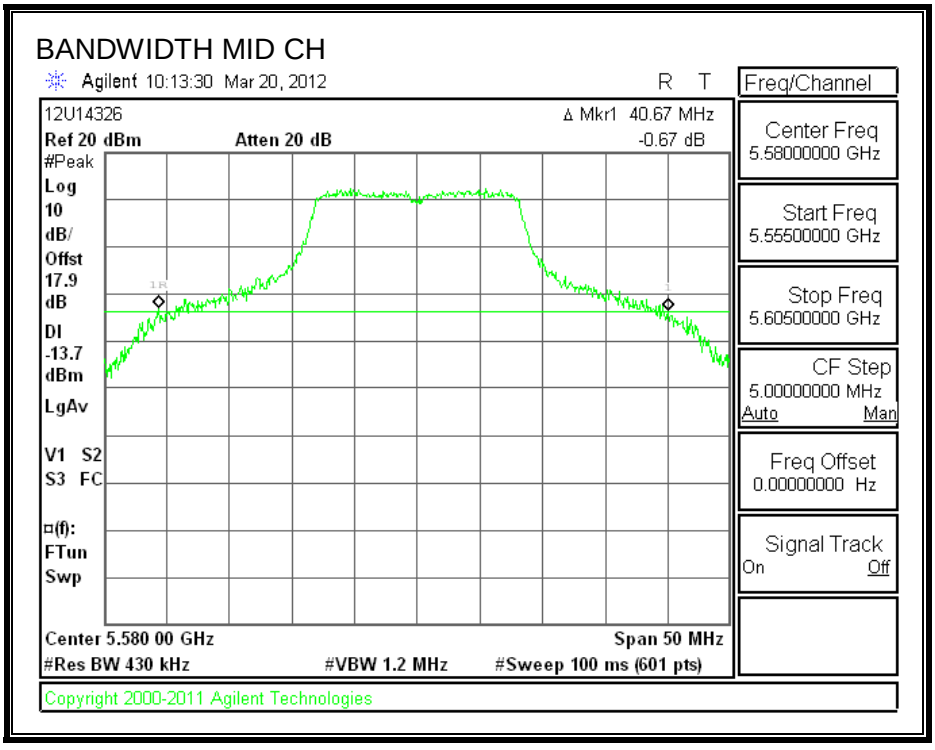
None; for reporting purposes only.

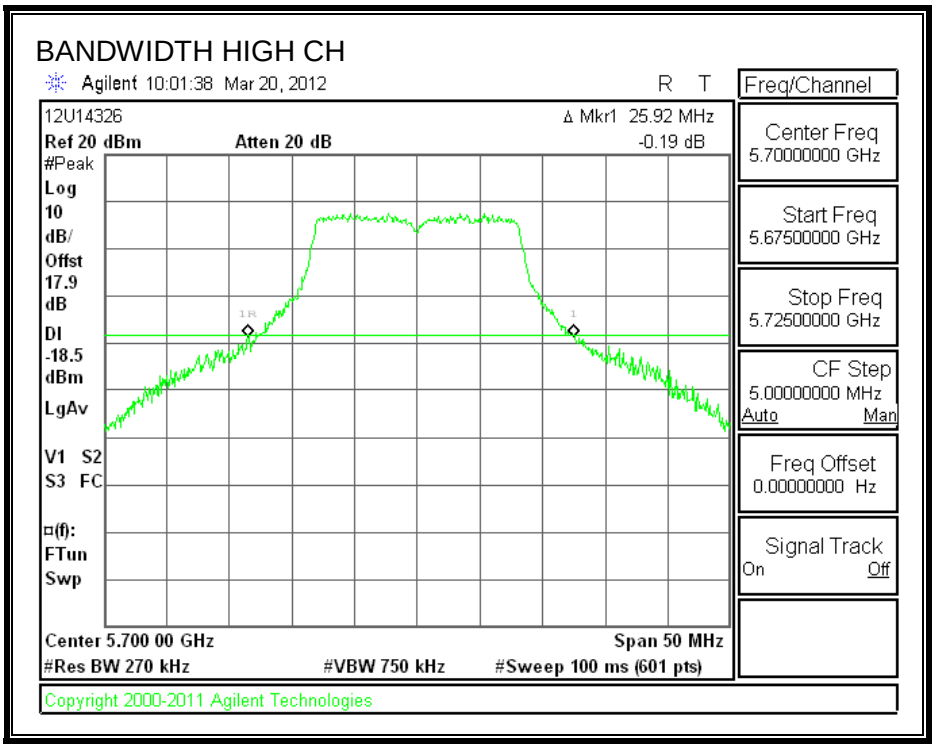
RESULTS

Channel	Frequency (MHz)	26 dB BW Chain 0 (MHz)	26 dB BW Chain 1 (MHz)
Low	5500	41.50	40.67
Mid	5580	40.67	39.08
High	5700	25.92	28.42

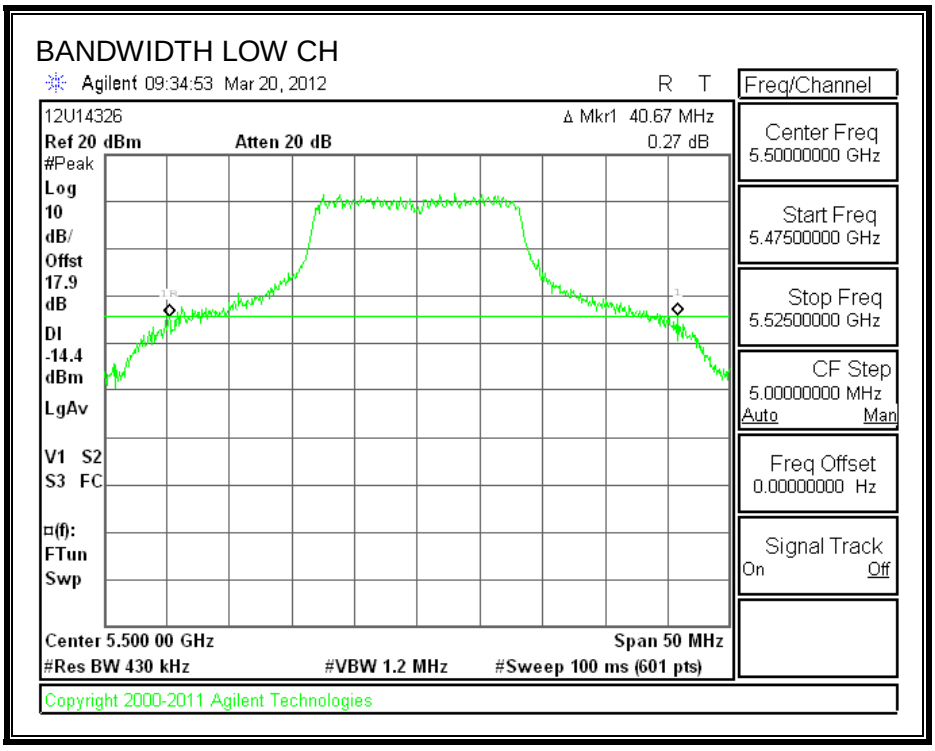
26 dB BANDWIDTH CHAIN 0

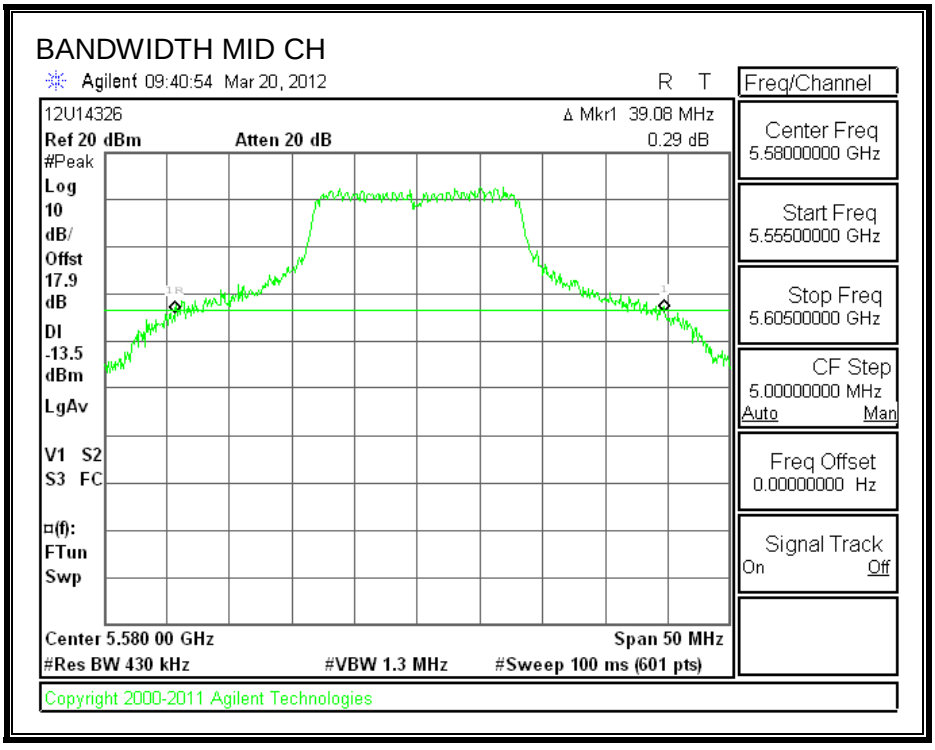


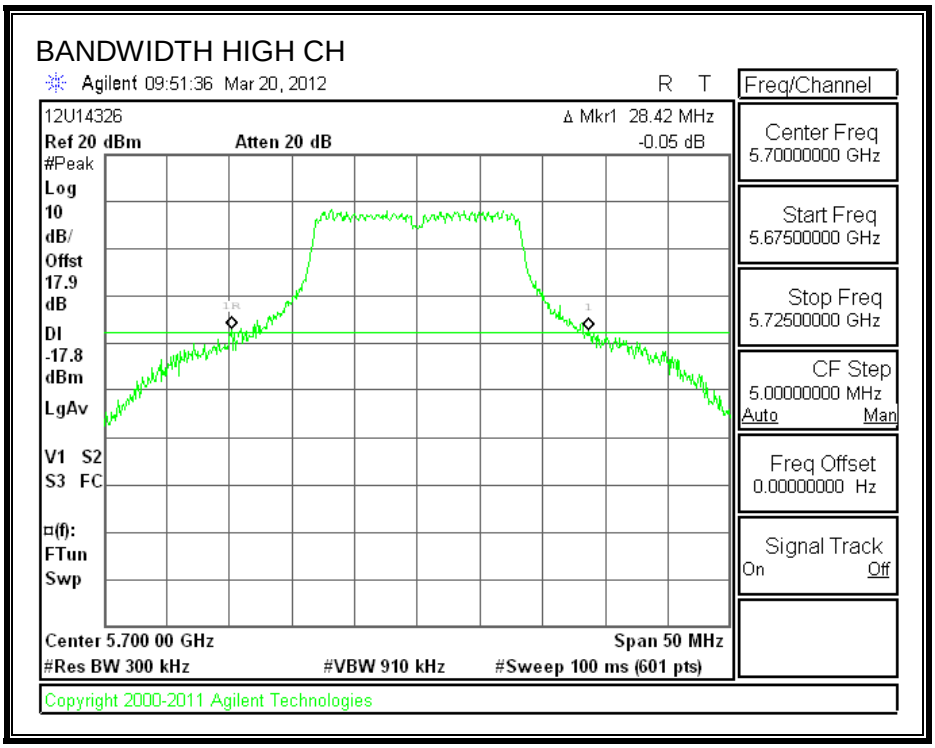




26 dB BANDWIDTH CHAIN 1







7.8.2. 99% BANDWIDTH

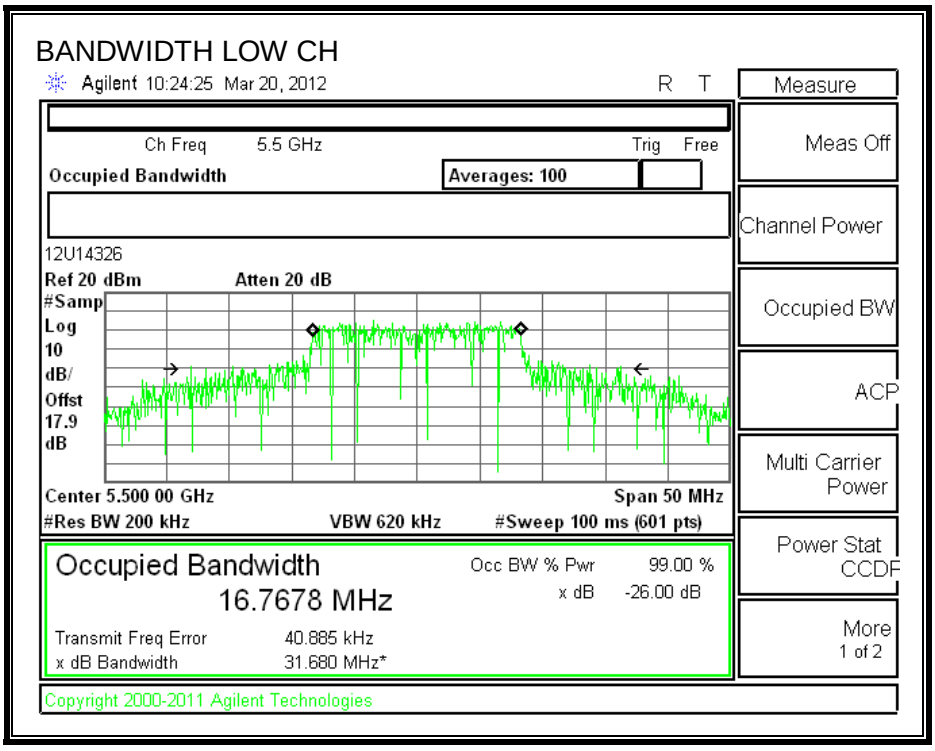
LIMITS

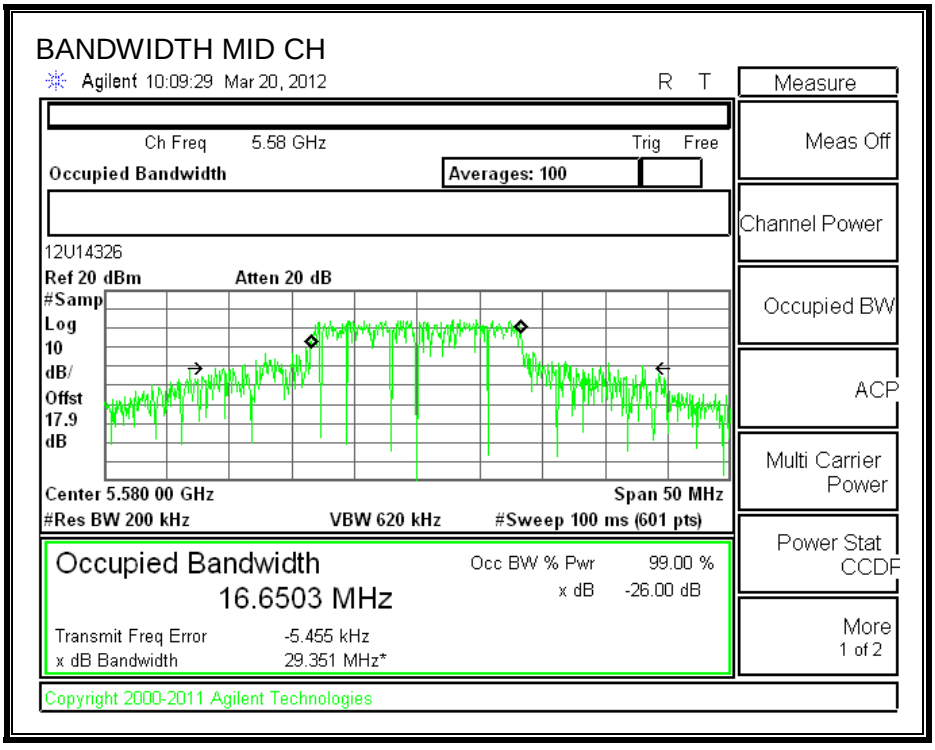
None; for reporting purposes only.

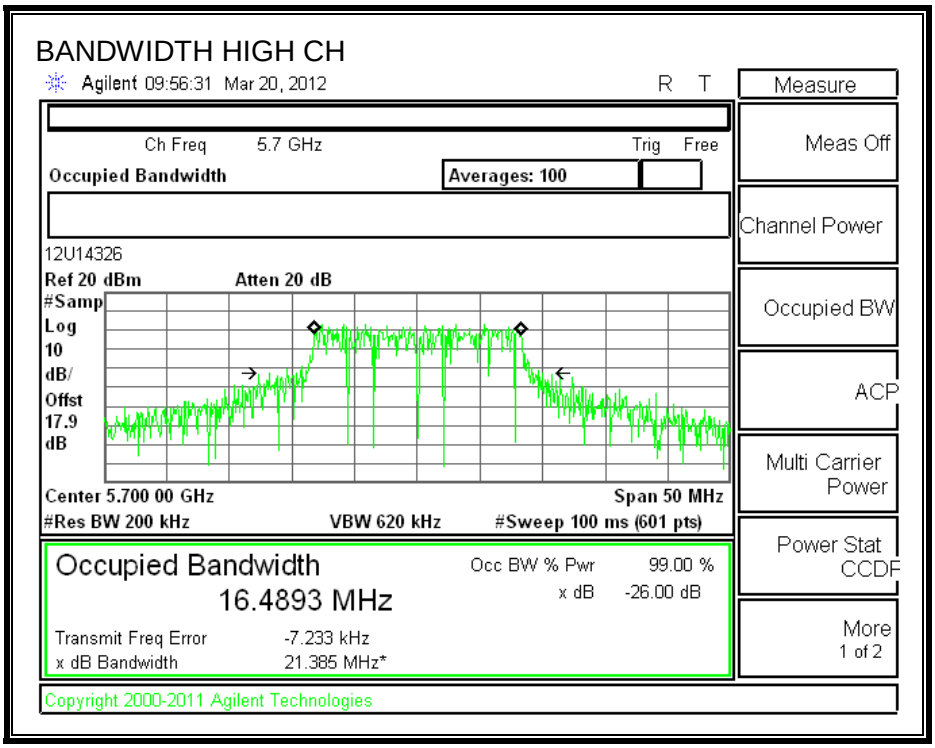
RESULTS

Channel	Frequency (MHz)	99% BW Chain 0 (MHz)	99% BW Chain 1 (MHz)
Low	5500	16.7678	16.6220
Mid	5580	16.6503	16.6646
High	5700	16.4893	16.4984

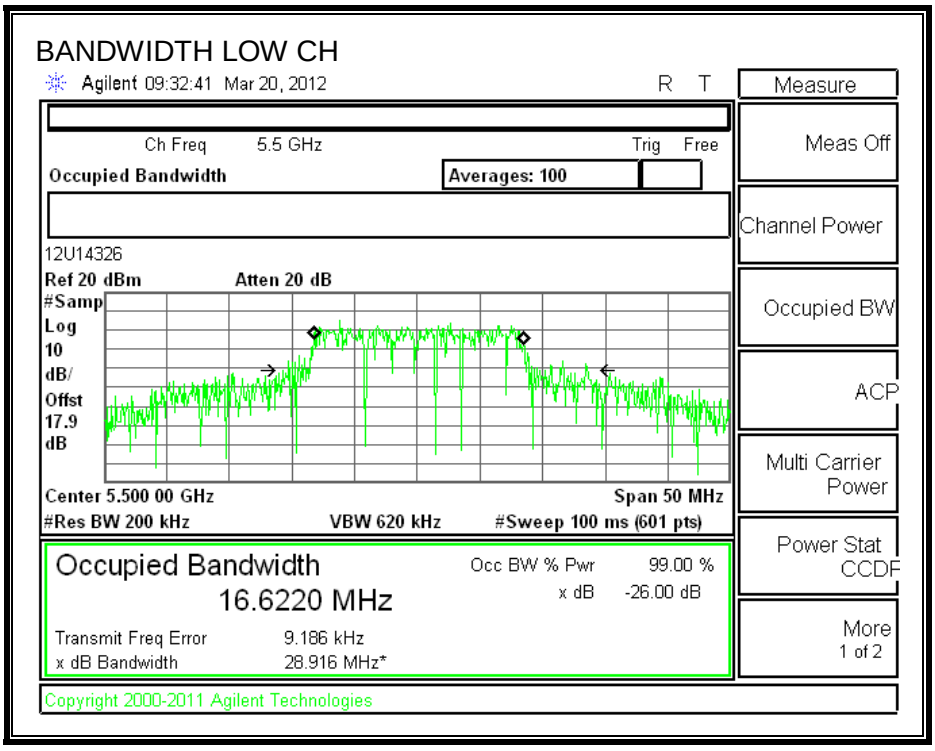
99% BANDWIDTH CHAIN 0

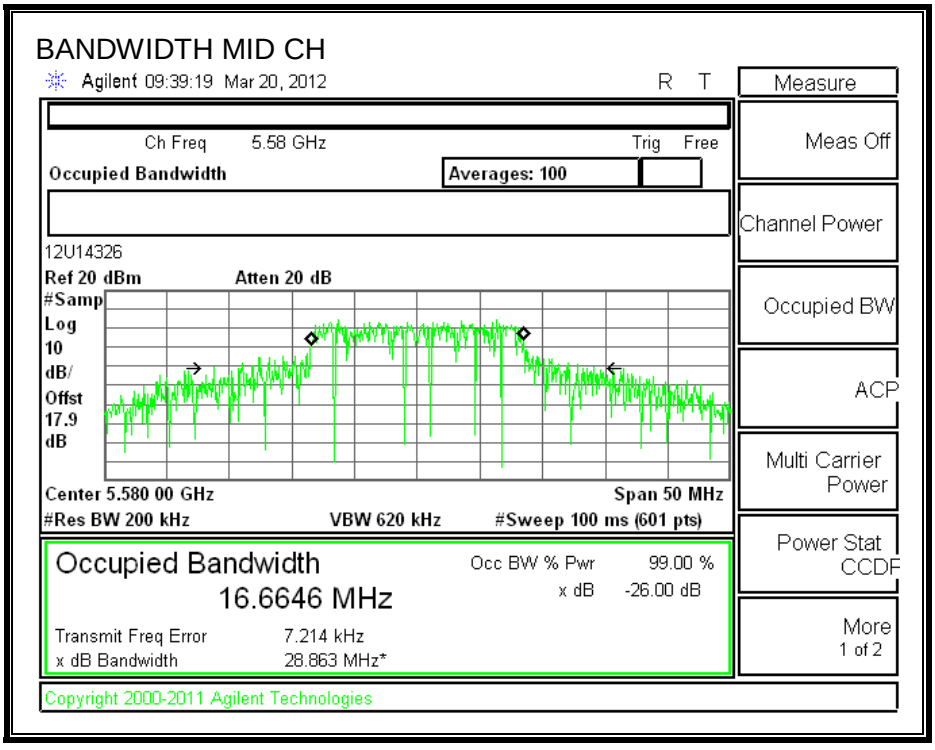


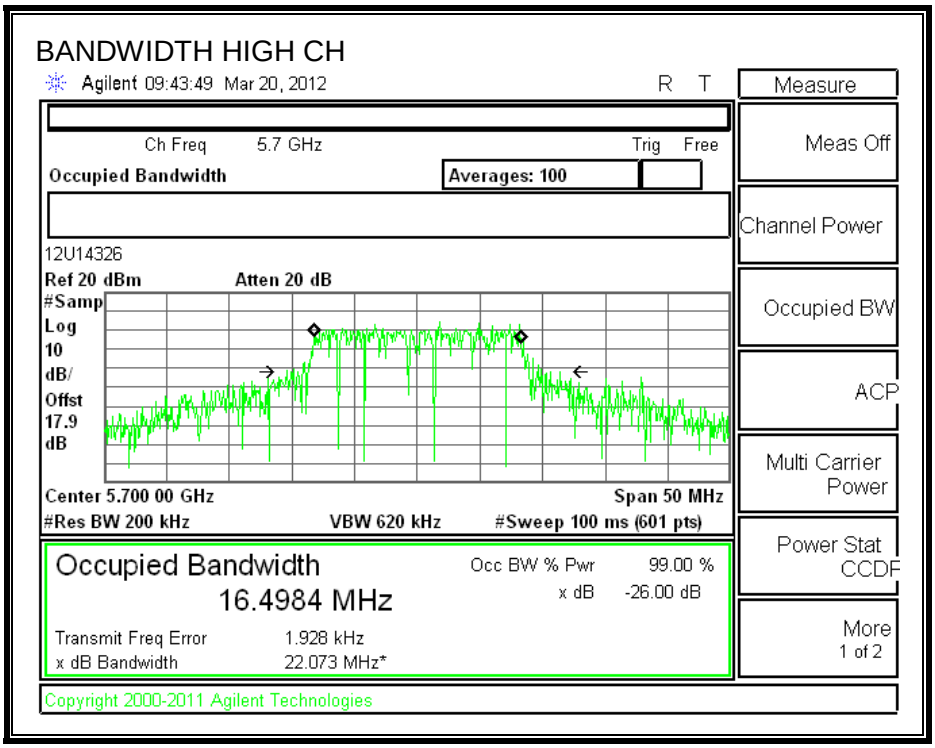




99% BANDWIDTH CHAIN 1







7.8.3. OUTPUT POWER AND PPSD

LIMITS

FCC §15.407 (a) (2)

For the band 5.47–5.725 GHz, 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. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1–MHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

DIRECTIONAL ANTENNA GAIN

The TX chains are correlated and the antenna gain is unequal among the chains. The directional gain is:

Chain 0 Antenna Gain (dBi)	Chain 1 Antenna Gain (dBi)	Correlated Chains Directional Gain (dBi)
3.09	3.28	6.20

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	40.67	27.09	6.20	23.80	10.80
Mid	5580	24	39.08	26.92	6.20	23.80	10.80
High	5700	24	25.92	25.14	6.20	23.80	10.80

Output Power Results

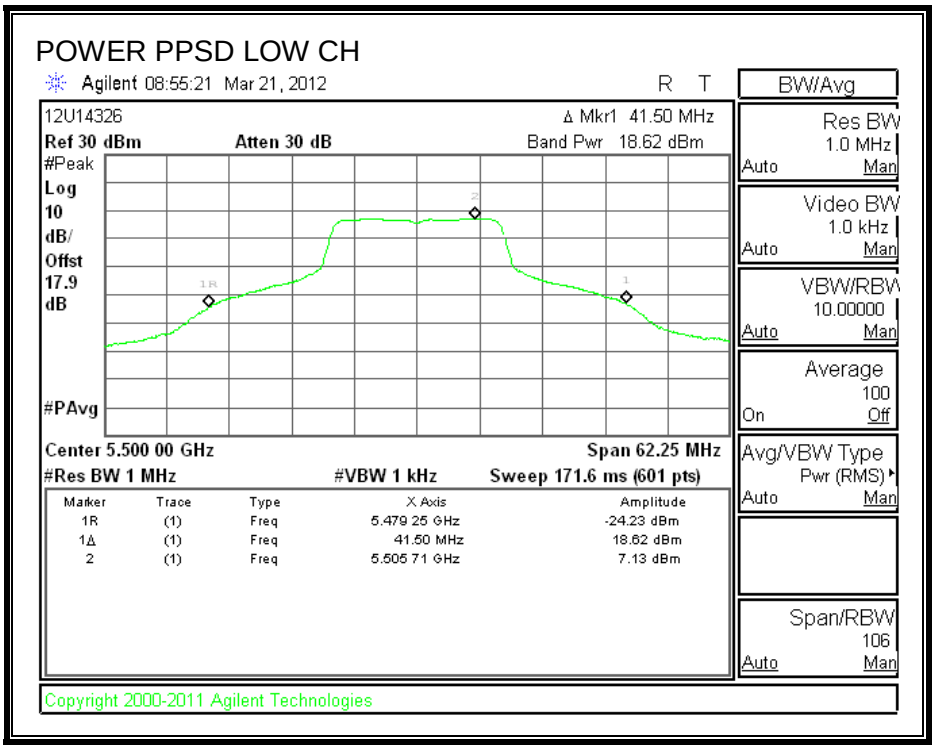
Channel	Frequency (MHz)	Chain 0 Meas Power (dBm)	Chain 1 Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Power Margin (dB)
Low	5500	18.62	17.34	21.04	23.80	-2.76
Mid	5580	19.61	18.22	21.98	23.80	-1.82
High	5700	16.52	16.27	19.40	23.80	-4.40

PPSD Results

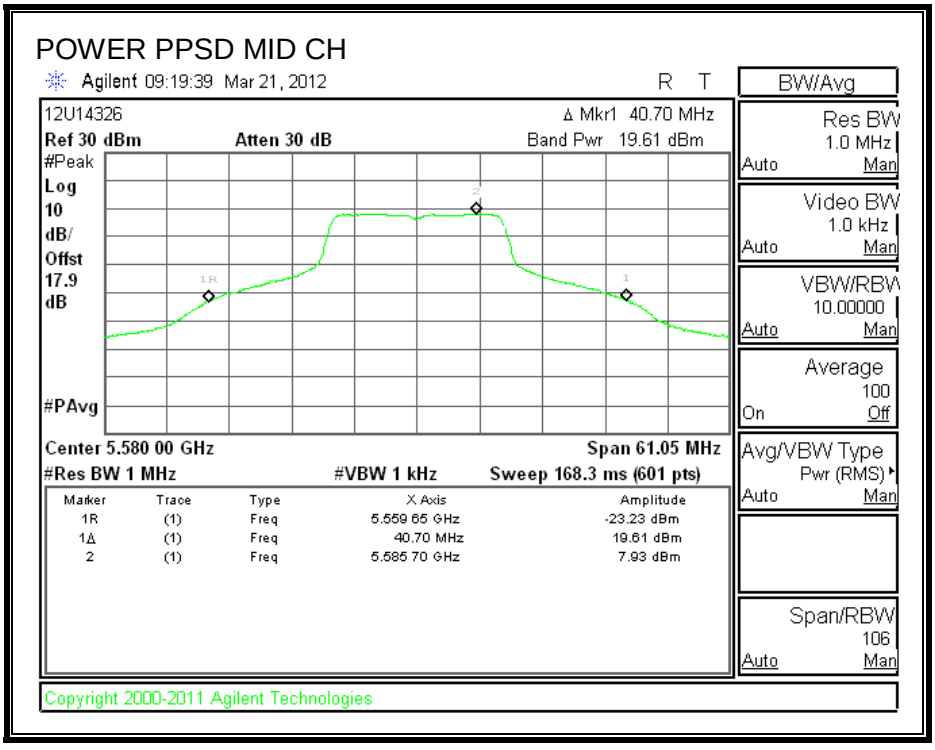
Channel	Frequency (MHz)	Chain 0 Meas PPSD (dBm)	Chain 1 Meas PPSD (dBm)	Total Corr'd PPSD (dBm)	PPSD Limit (dBm)	PPSD Margin (dB)
Low	5500	7.13	5.79	9.52	10.80	-1.28
Mid	5580	7.93	6.61	10.33	10.80	-0.47
High	5700	4.98	4.61	7.81	10.80	-2.99

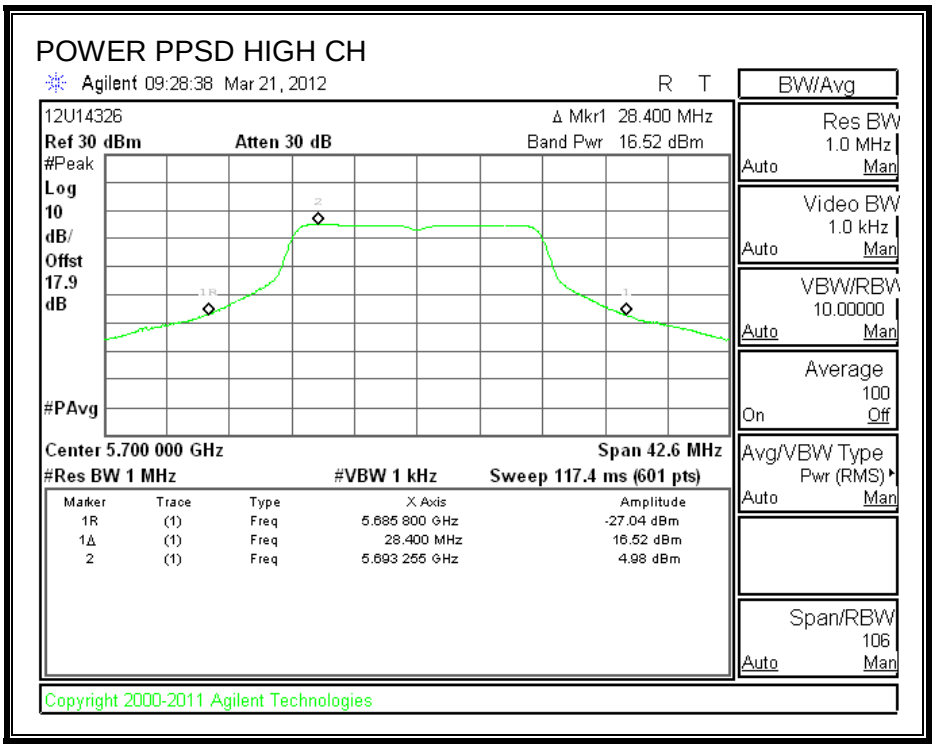
OUTPUT POWER AND PPSD CHAIN 0

POWER PPSD LOW CH

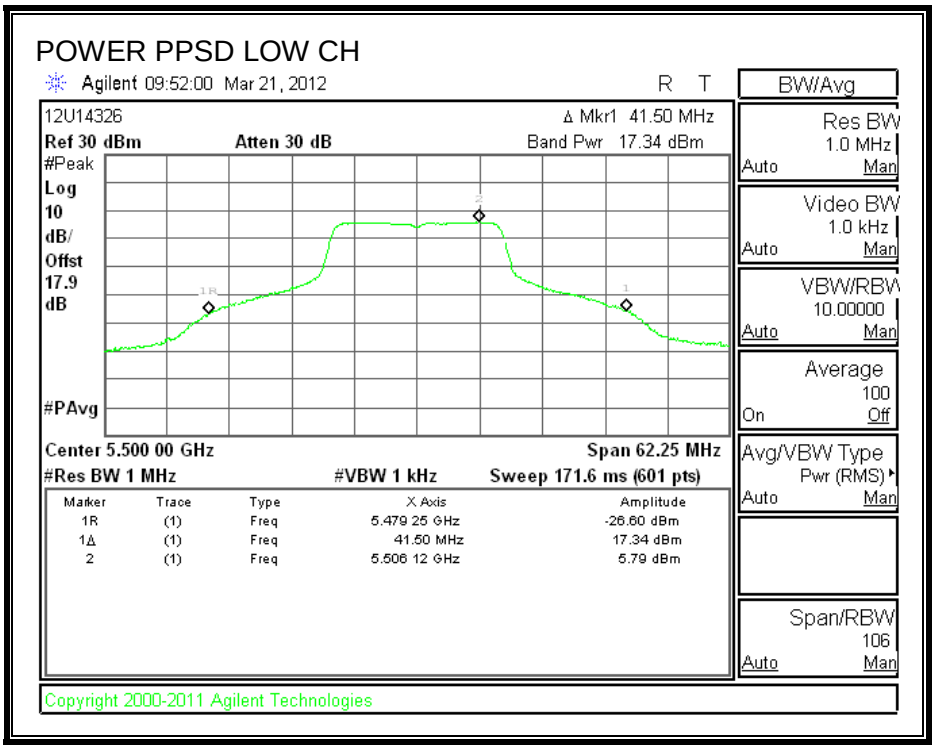


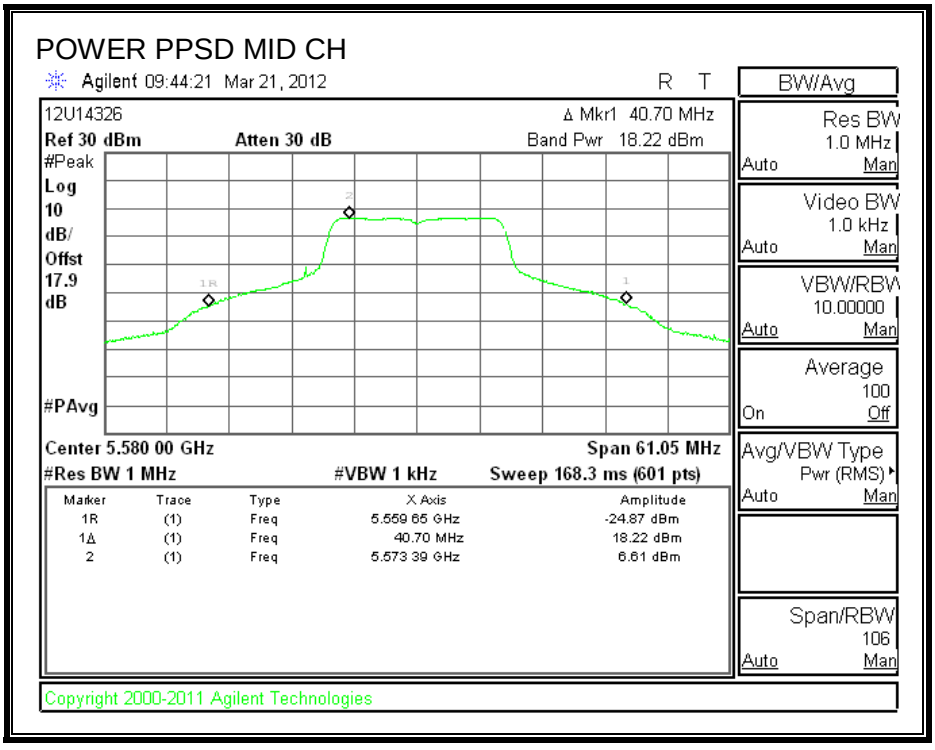
POWER PPSD MID CH

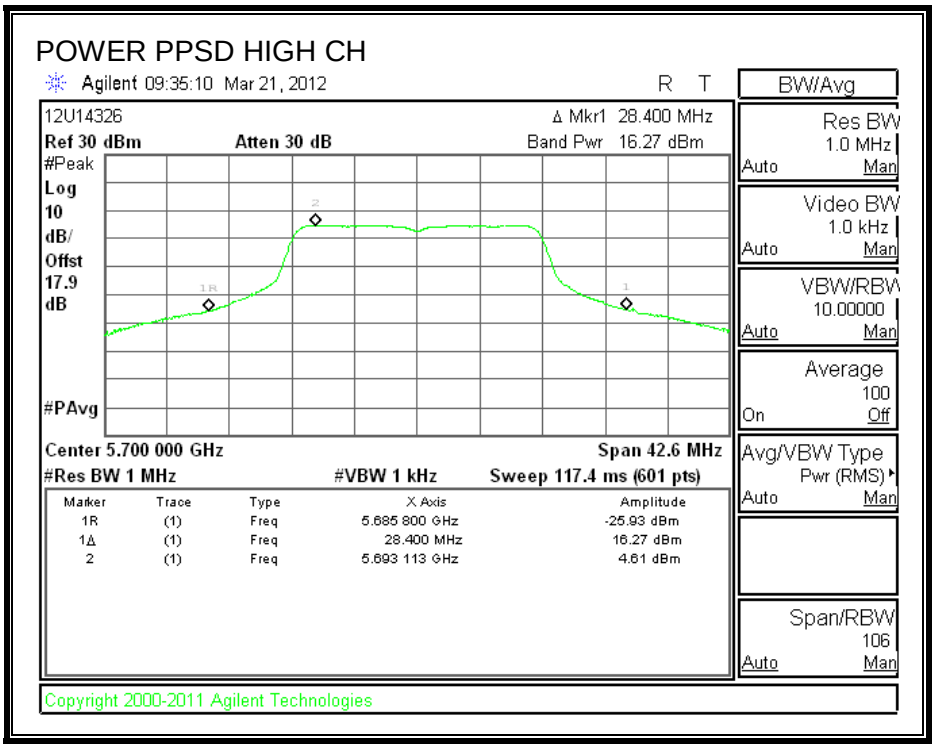




OUTPUT POWER AND PPSD CHAIN 1







7.9. 802.11n HT20 MODE IN THE 5.6 GHz BAND

7.9.1. 26 dB BANDWIDTH

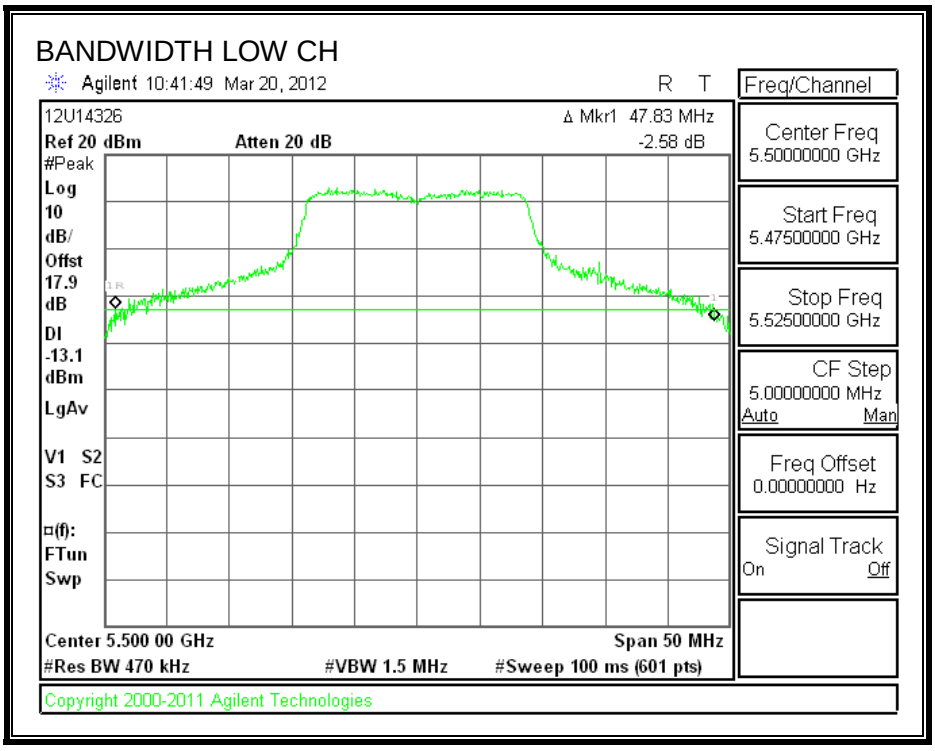
LIMITS

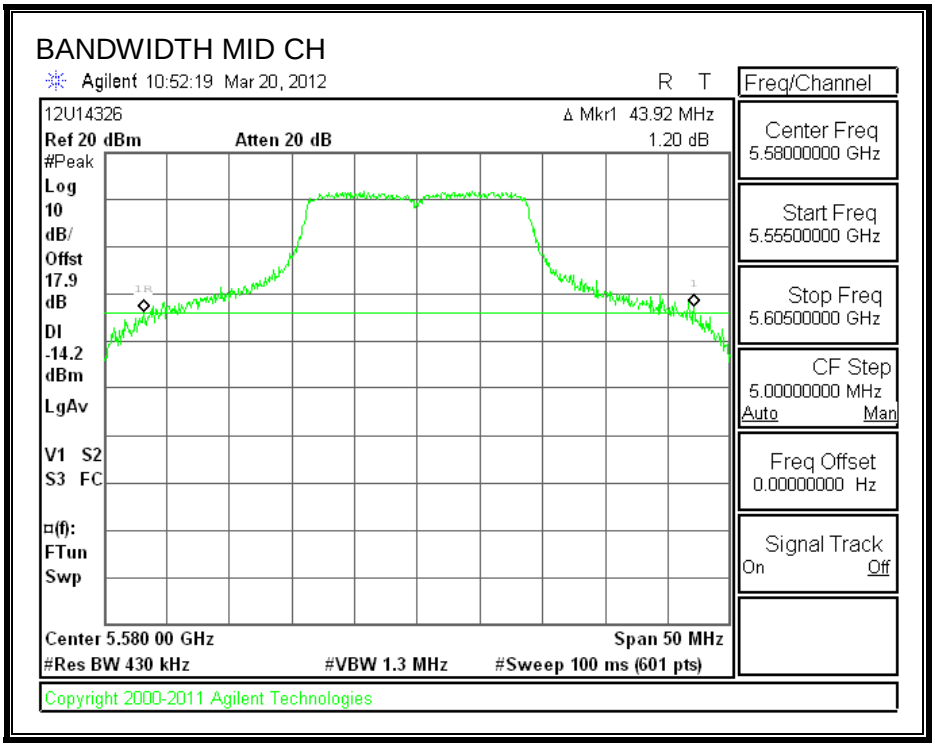
None; for reporting purposes only.

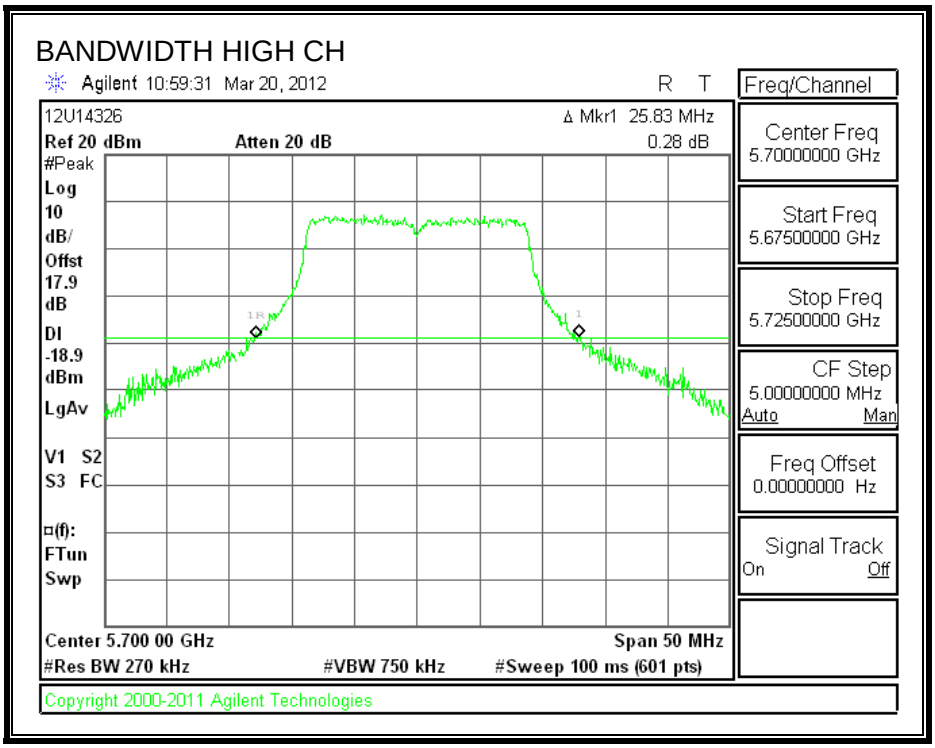
RESULTS

Channel	Frequency (MHz)	26 dB BW Chain 0 (MHz)	26 dB BW Chain 1 (MHz)
Low	5500	47.83	45.83
Mid	5580	43.92	44.83
High	5700	25.83	36.67

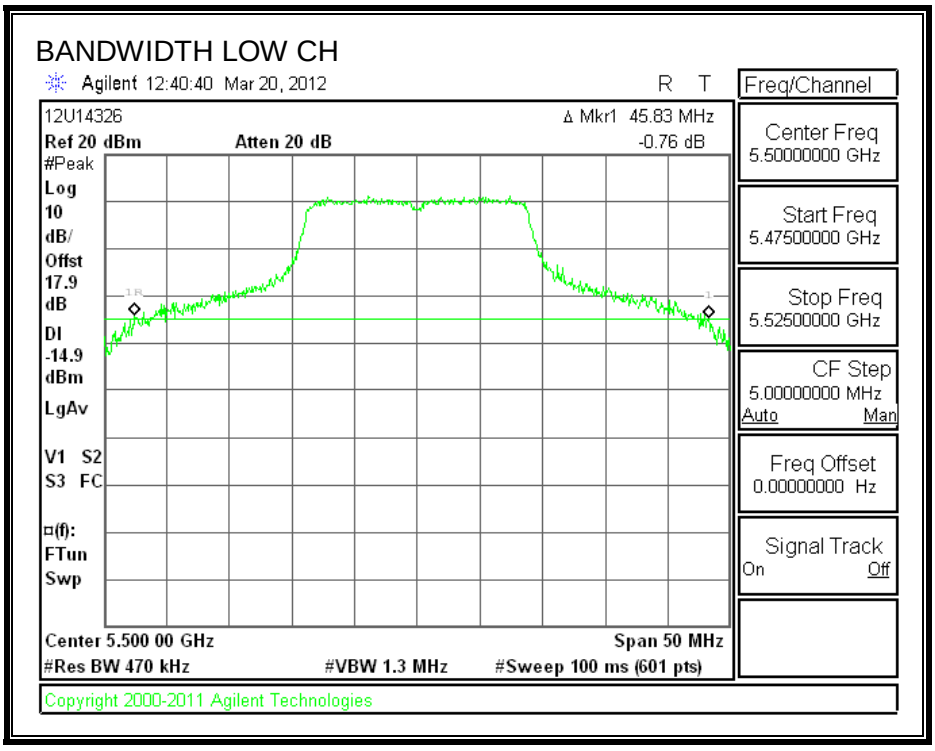
26 dB BANDWIDTH CHAIN 0

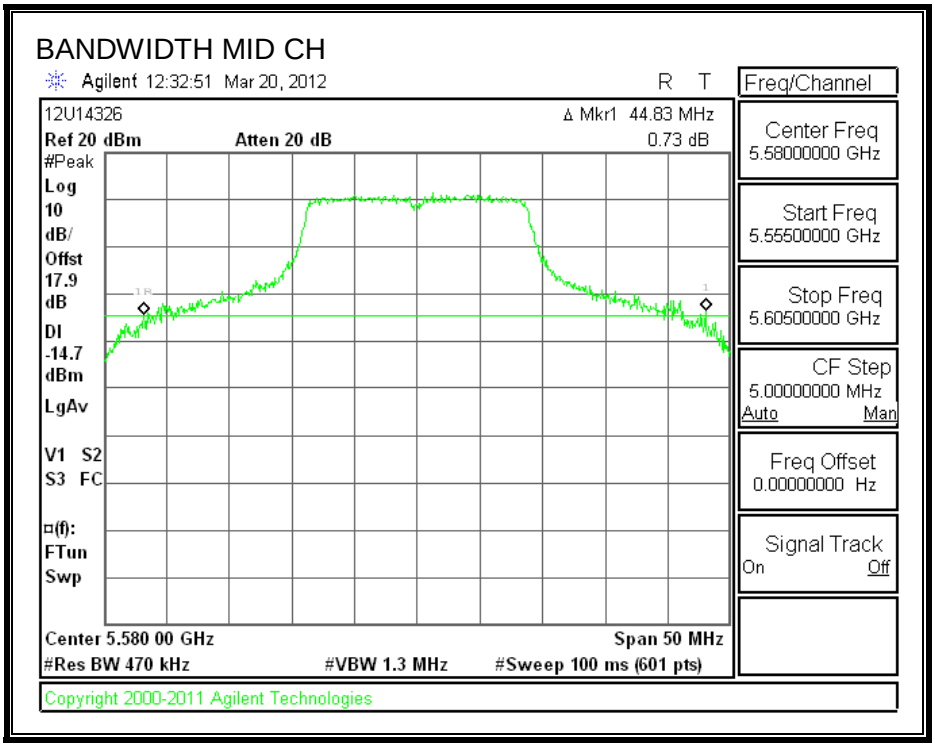




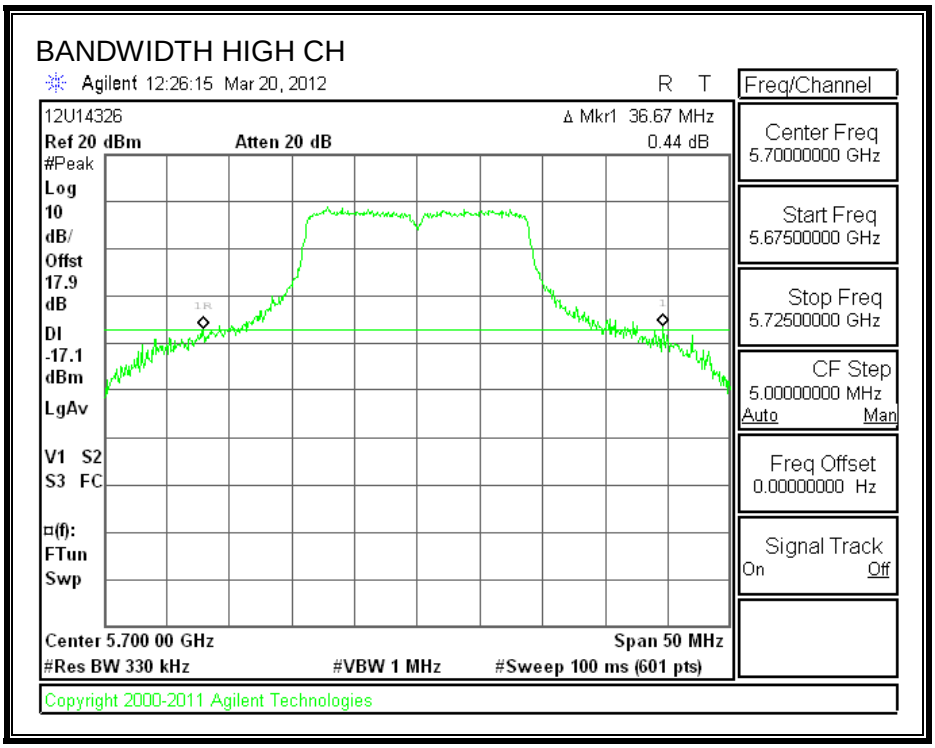


26 dB BANDWIDTH CHAIN 1





BANDWIDTH HIGH CH



7.9.2. 99% BANDWIDTH

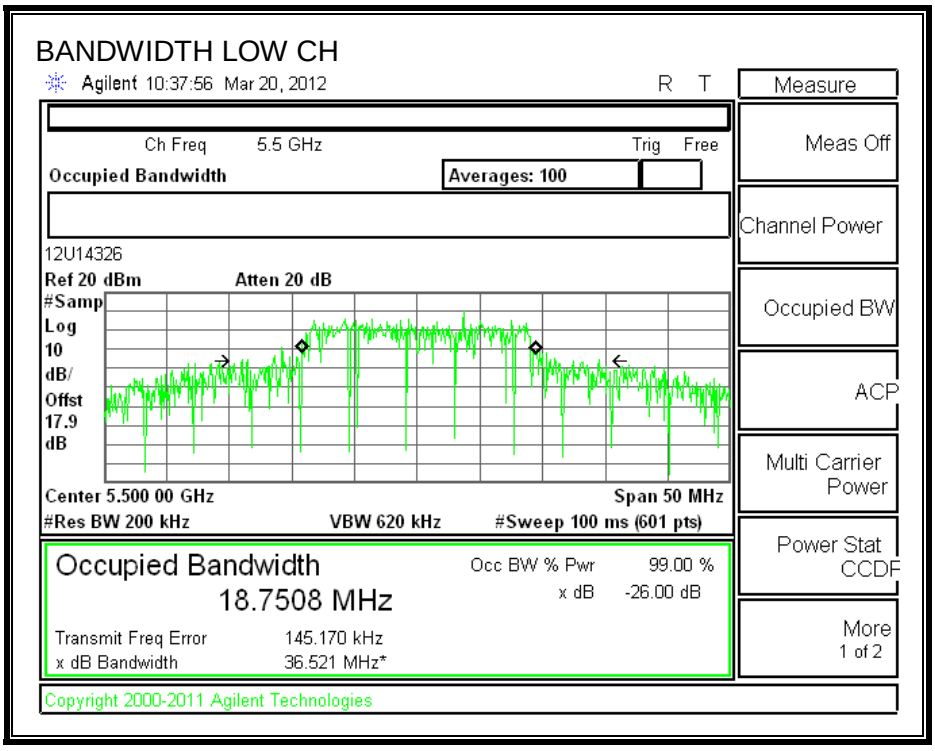
LIMITS

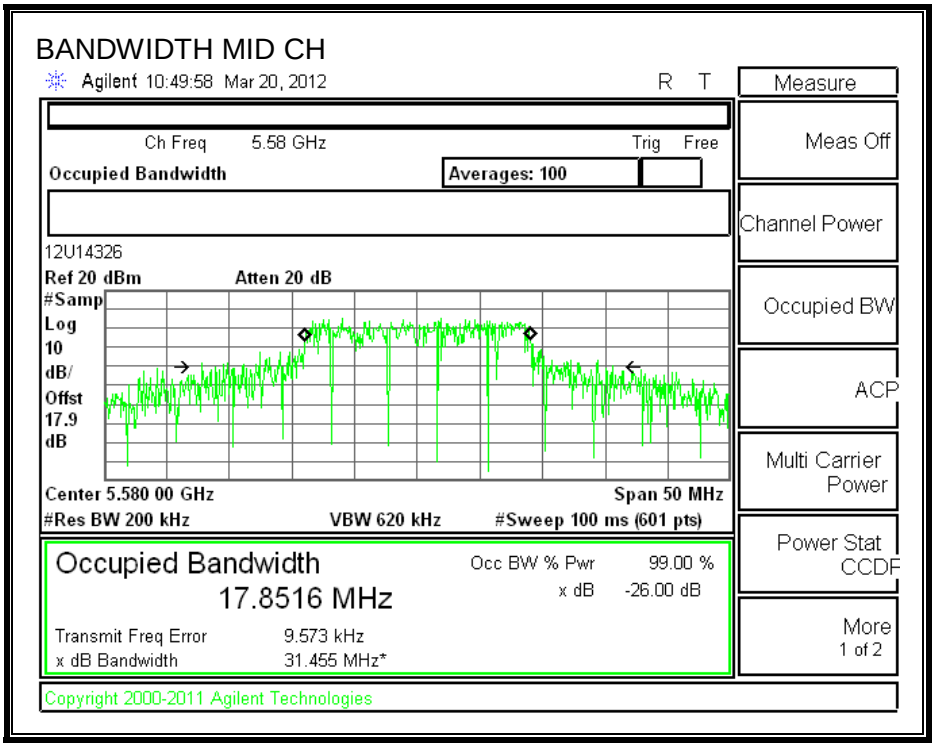
None; for reporting purposes only.

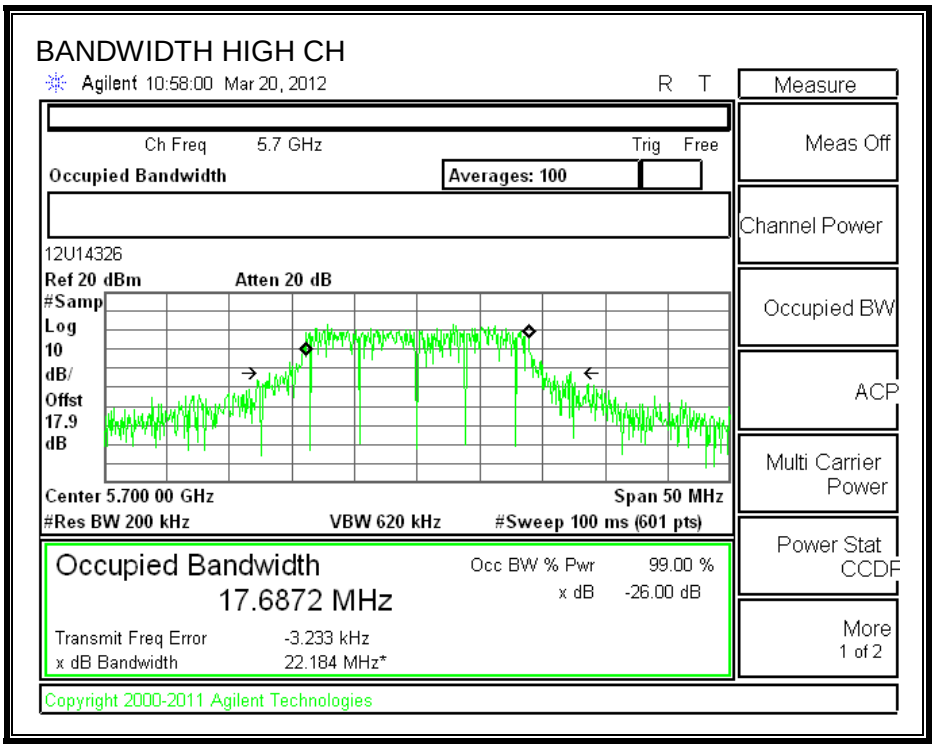
RESULTS

Channel	Frequency (MHz)	99% BW Chain 0 (MHz)	99% BW Chain 1 (MHz)
Low	5500	18.7508	17.9687
Mid	5580	17.8516	17.8484
High	5700	17.6872	17.7279

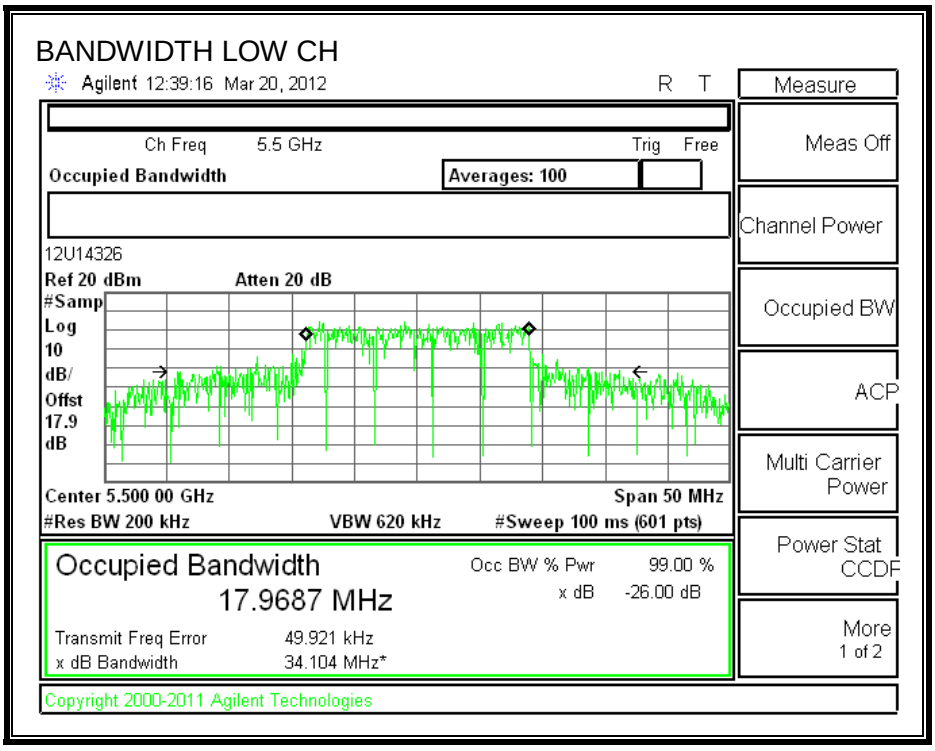
99% BANDWIDTH CHAIN 0

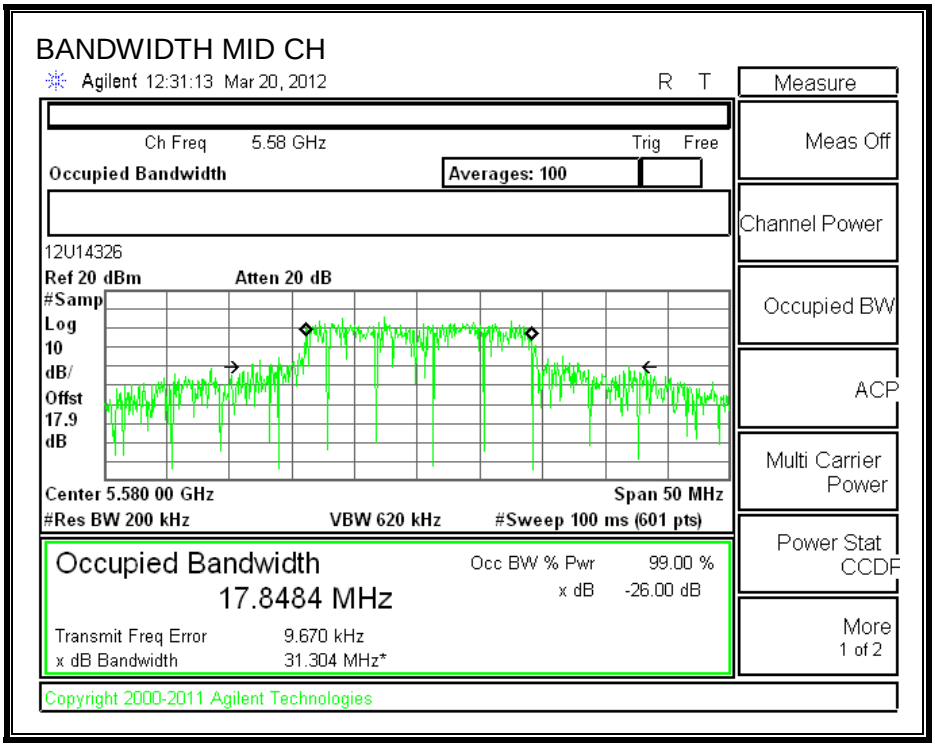


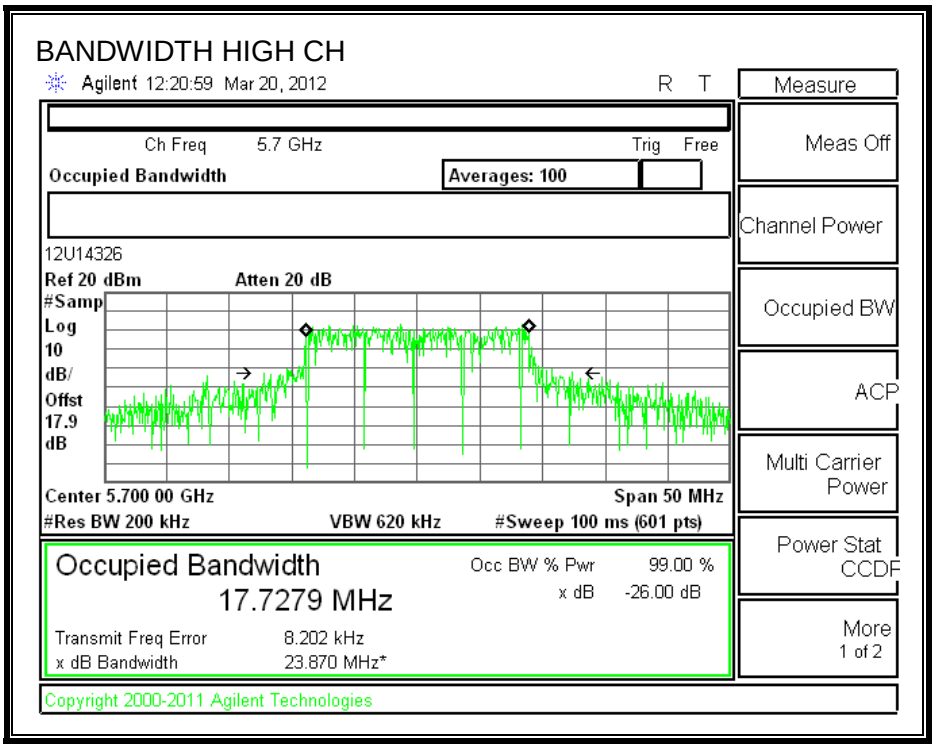




99% BANDWIDTH CHAIN 1







7.9.3. OUTPUT POWER AND PPSD

LIMITS

FCC §15.407 (a) (2)

For the band 5.47–5.725 GHz, 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. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1–MHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

DIRECTIONAL ANTENNA GAIN

The TX chains are uncorrelated and the antenna gain is unequal among the chains. The directional gain is:

Chain 0 Antenna Gain (dBi)	Chain 1 Antenna Gain (dBi)	Uncorrelated Chains Directional Gain (dBi)
3.09	3.28	3.19

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	45.83	27.61	3.19	24.00	11.00
Mid	5580	24	43.92	27.43	3.19	24.00	11.00
High	5700	24	25.83	25.12	3.19	24.00	11.00

Output Power Results

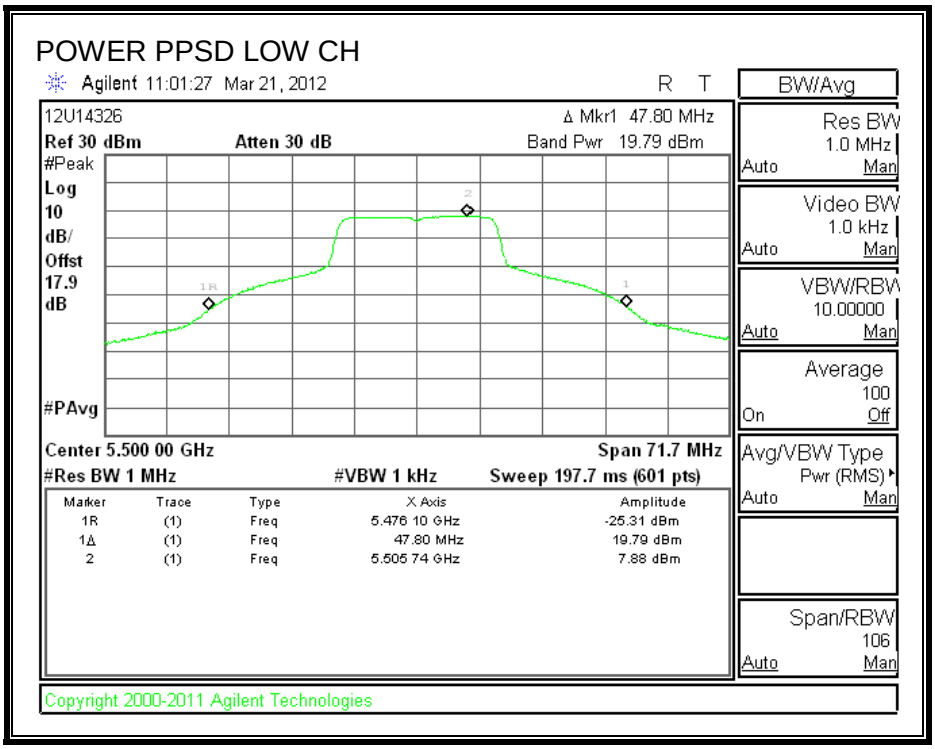
Channel	Frequency (MHz)	Chain 0 Meas Power (dBm)	Chain 1 Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Power Margin (dB)
Low	5500	19.79	18.08	22.03	24.00	-1.97
Mid	5580	19.60	18.48	22.08	24.00	-1.92
High	5700	16.66	17.04	19.86	24.00	-4.14

PPSD Results

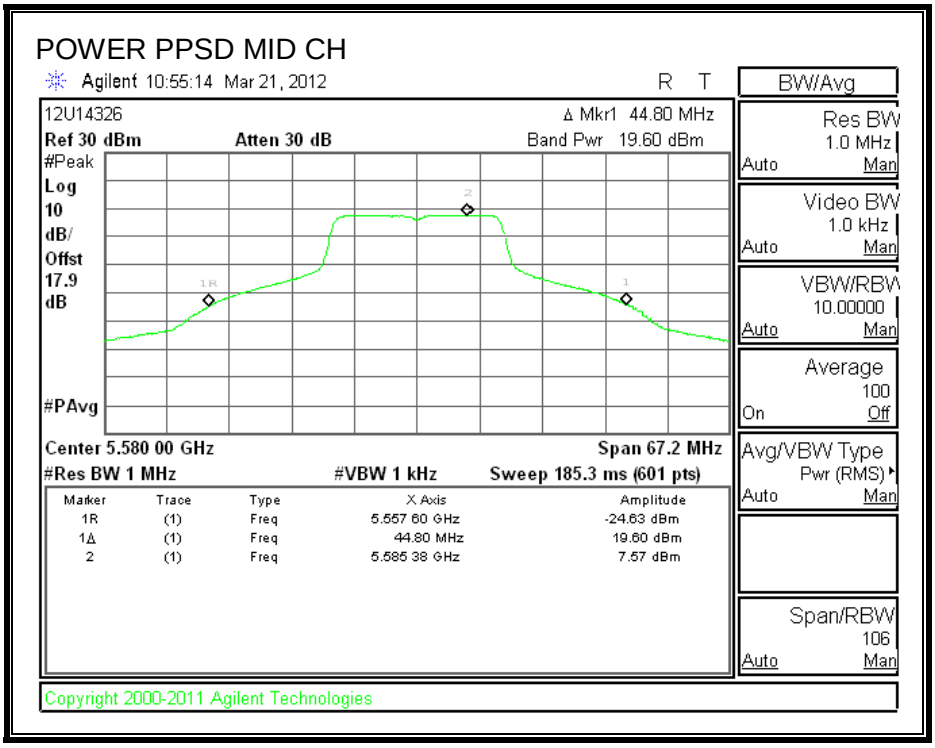
Channel	Frequency (MHz)	Chain 0 Meas PPSD (dBm)	Chain 1 Meas PPSD (dBm)	Total Corr'd PPSD (dBm)	PPSD Limit (dBm)	PPSD Margin (dB)
Low	5500	7.88	6.14	10.11	11.00	-0.89
Mid	5580	7.57	6.55	10.10	11.00	-0.90
High	5700	5.18	5.10	8.15	11.00	-2.85

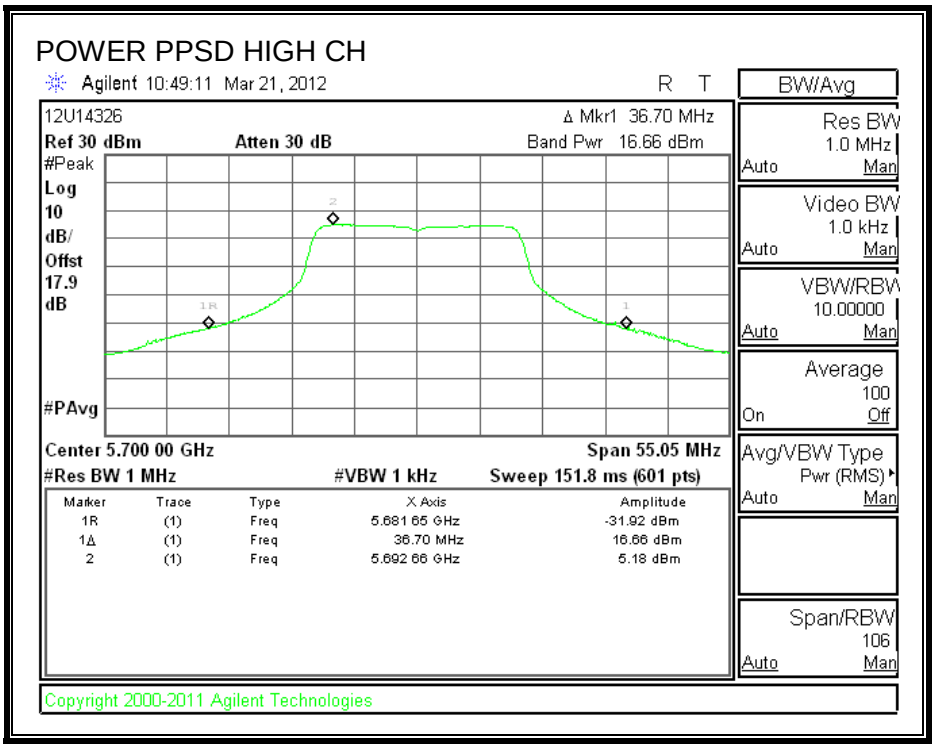
OUTPUT POWER AND PPSD CHAIN 0

POWER PPSD LOW CH



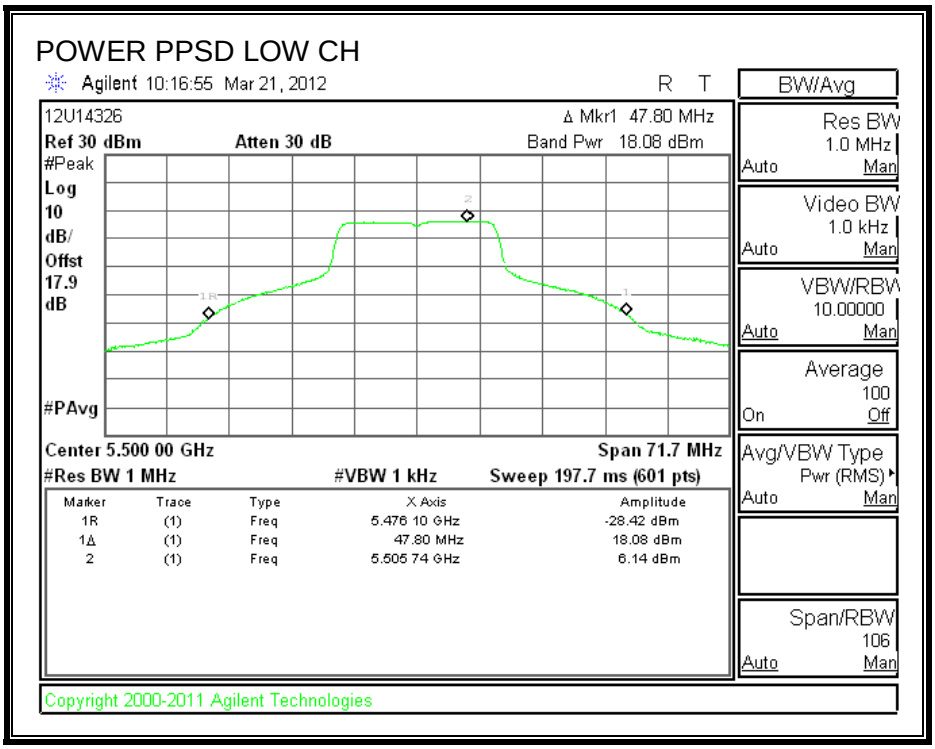
POWER PPSD MID CH



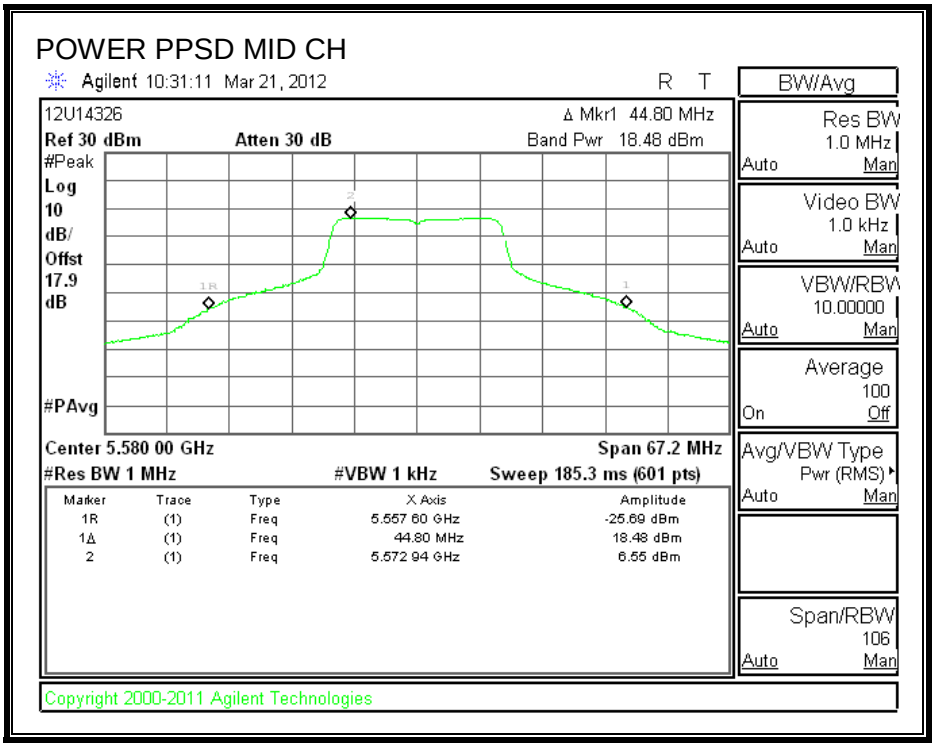


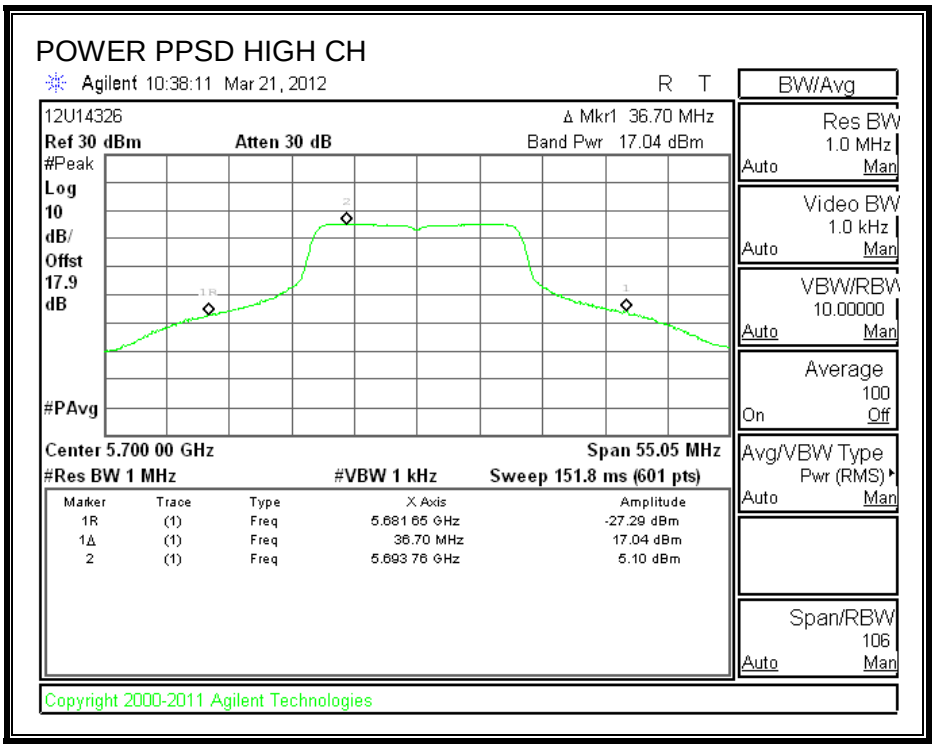
OUTPUT POWER AND PPSD CHAIN 1

POWER PPSD LOW CH



POWER PPSD MID CH





7.10. 802.11n HT40 MODE IN THE 5.6 GHz BAND

7.10.1. 26 dB BANDWIDTH

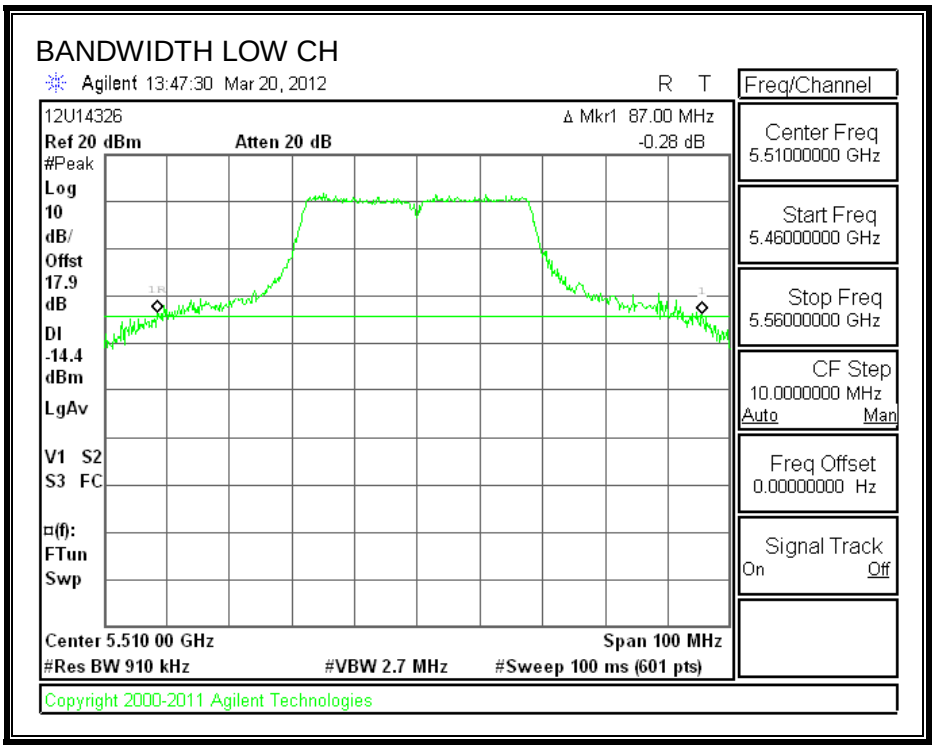
LIMITS

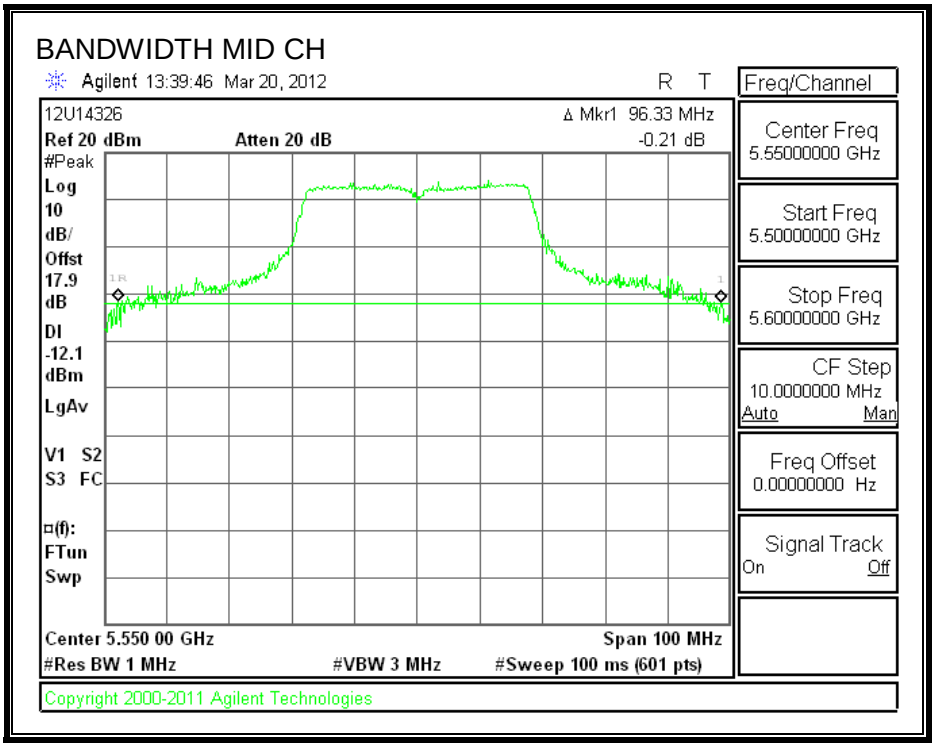
None; for reporting purposes only.

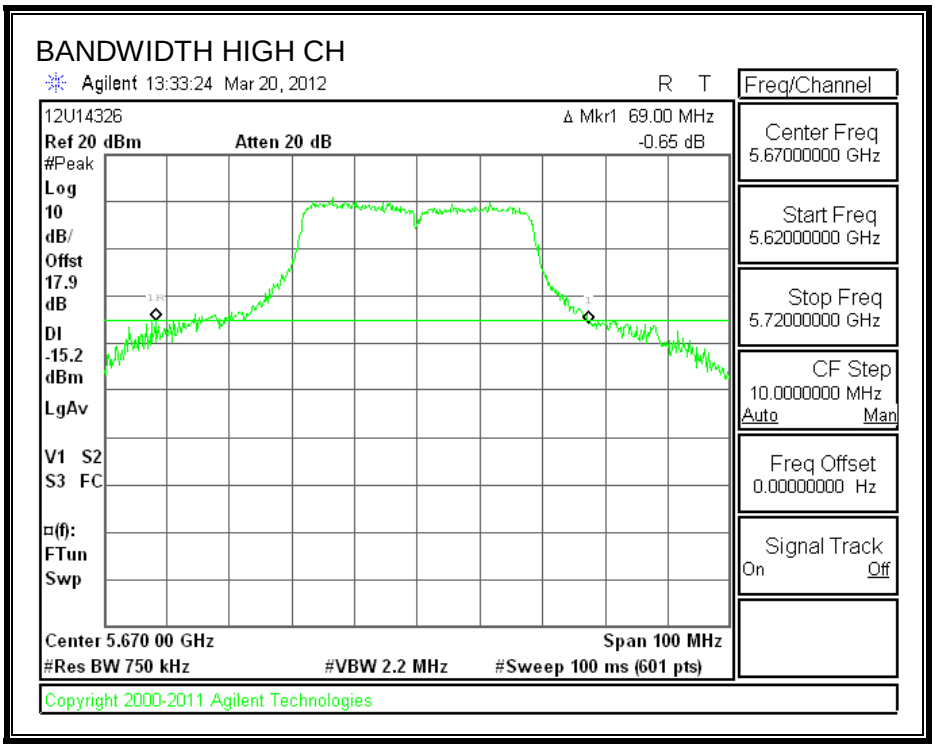
RESULTS

Channel	Frequency (MHz)	26 dB BW Chain 0 (MHz)	26 dB BW Chain 1 (MHz)
Low	5510	87.00	83.50
Mid	5550	96.33	88.67
High	5670	69.00	85.83

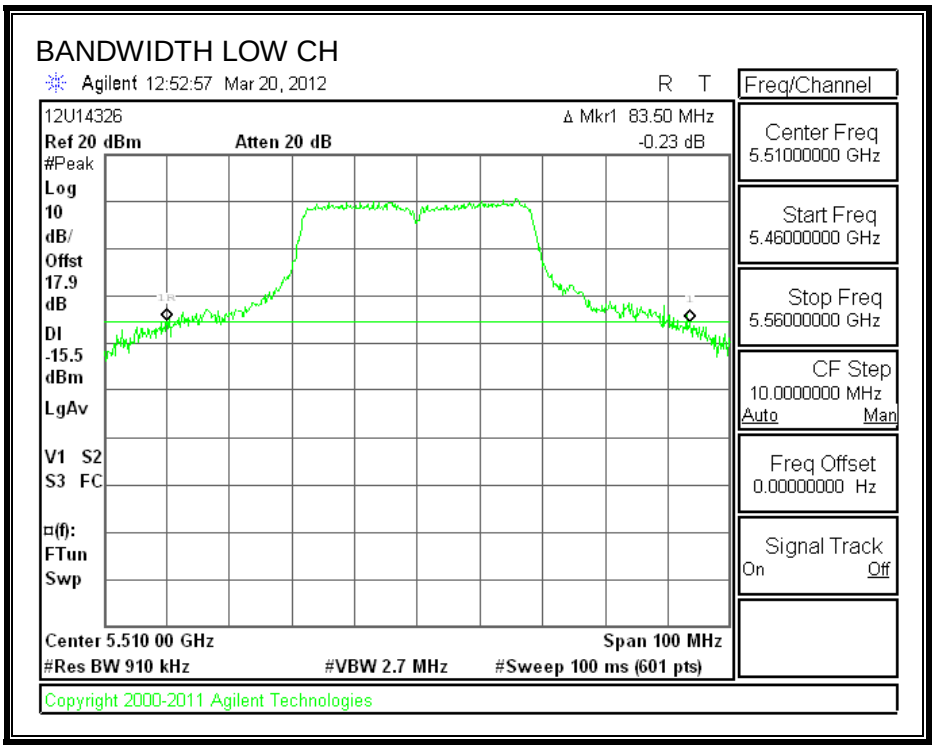
26 dB BANDWIDTH CHAIN 0

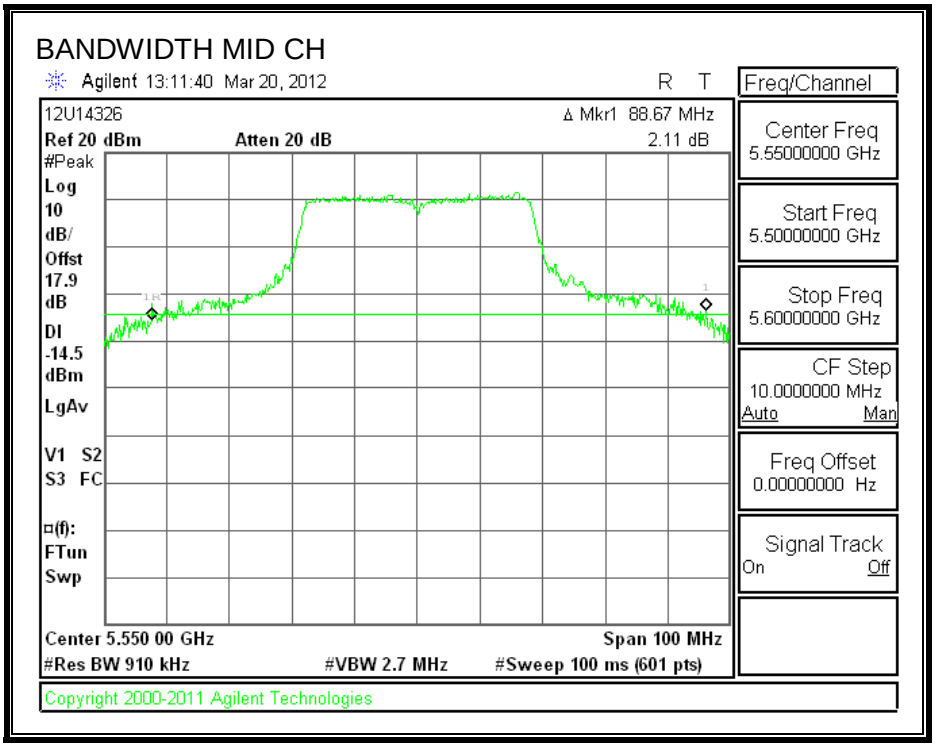


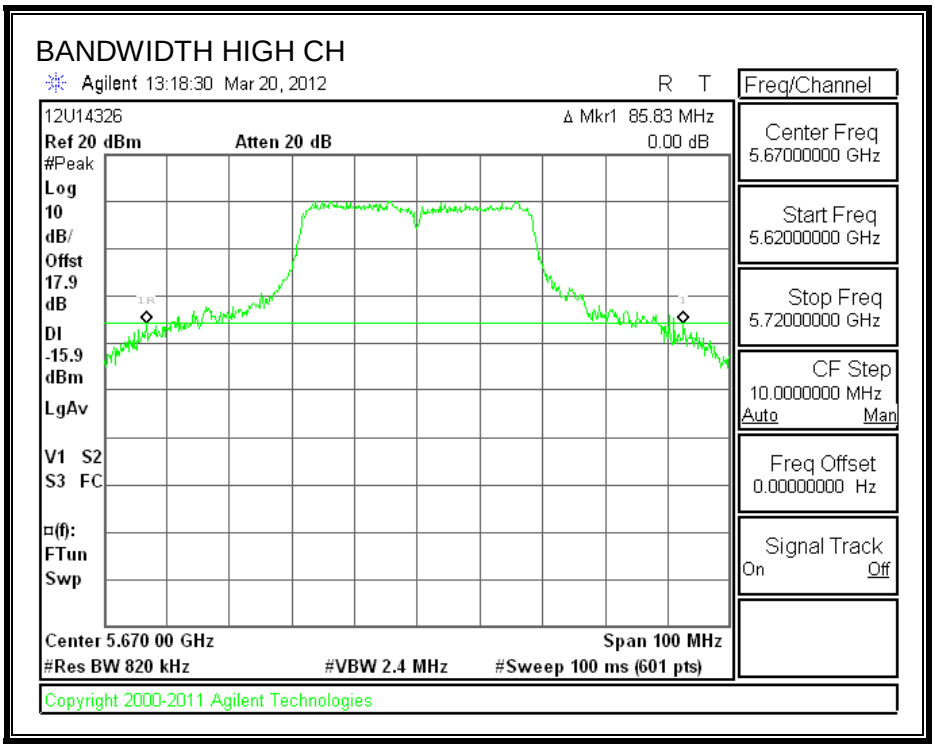




26 dB BANDWIDTH CHAIN 1







7.10.2. 99% BANDWIDTH

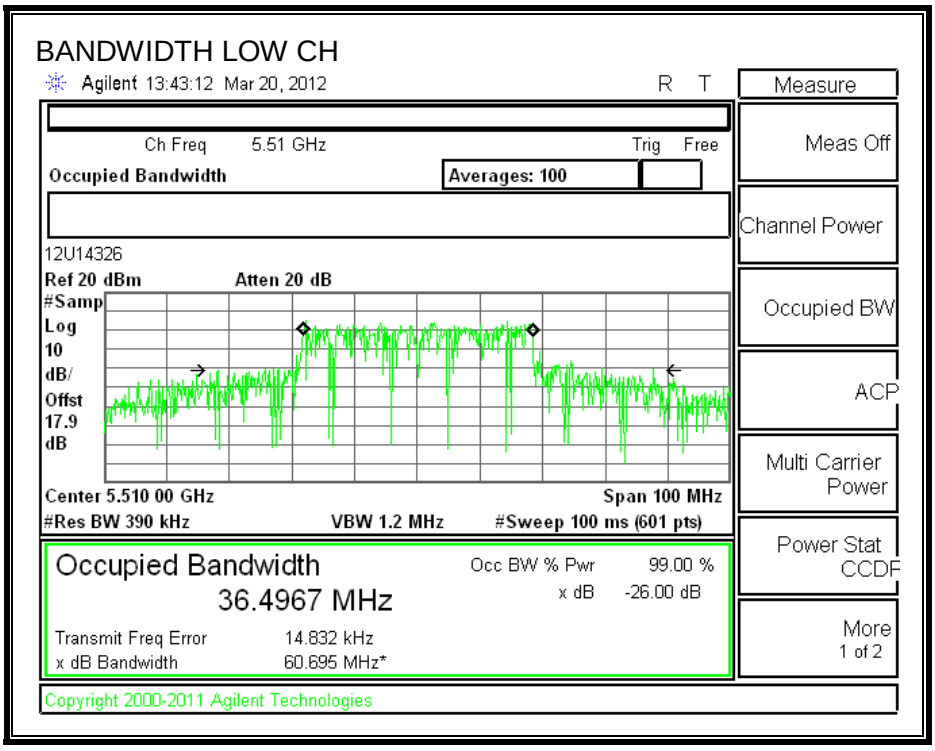
LIMITS

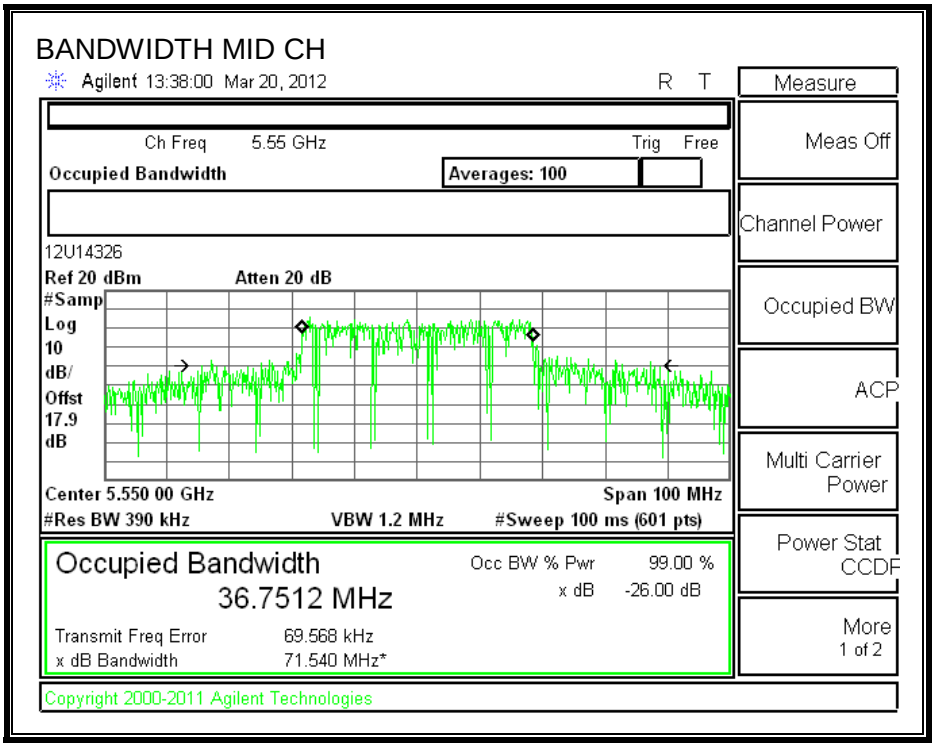
None; for reporting purposes only.

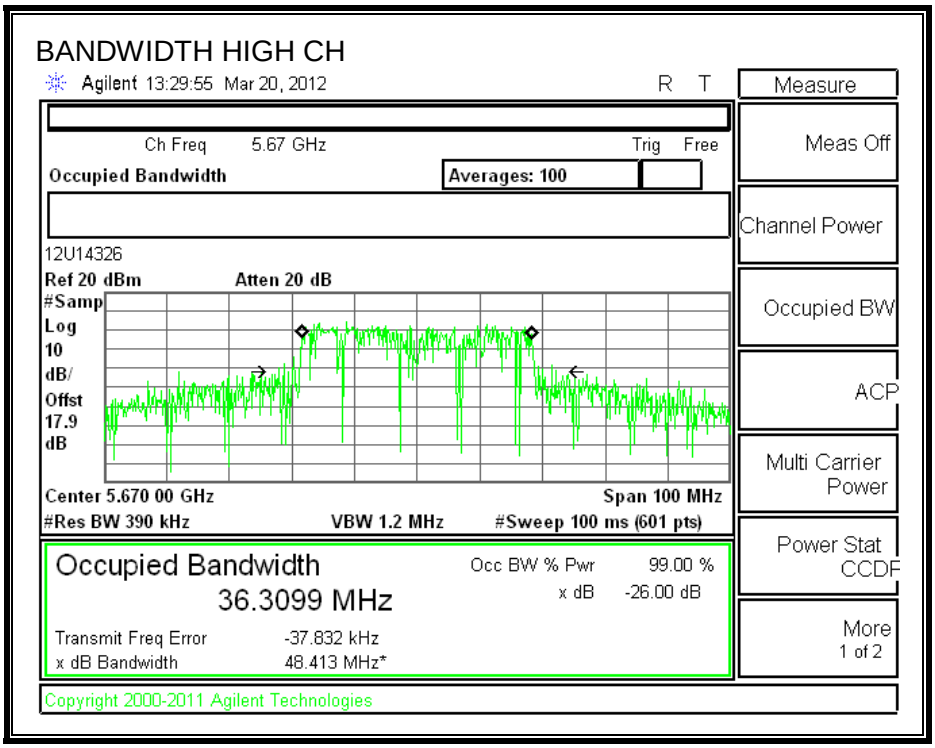
RESULTS

Channel	Frequency (MHz)	99% BW Chain 0 (MHz)	99% BW Chain 1 (MHz)
Low	5510	36.4967	36.4182
Mid	5550	36.7512	36.4850
High	5670	36.3099	36.3255

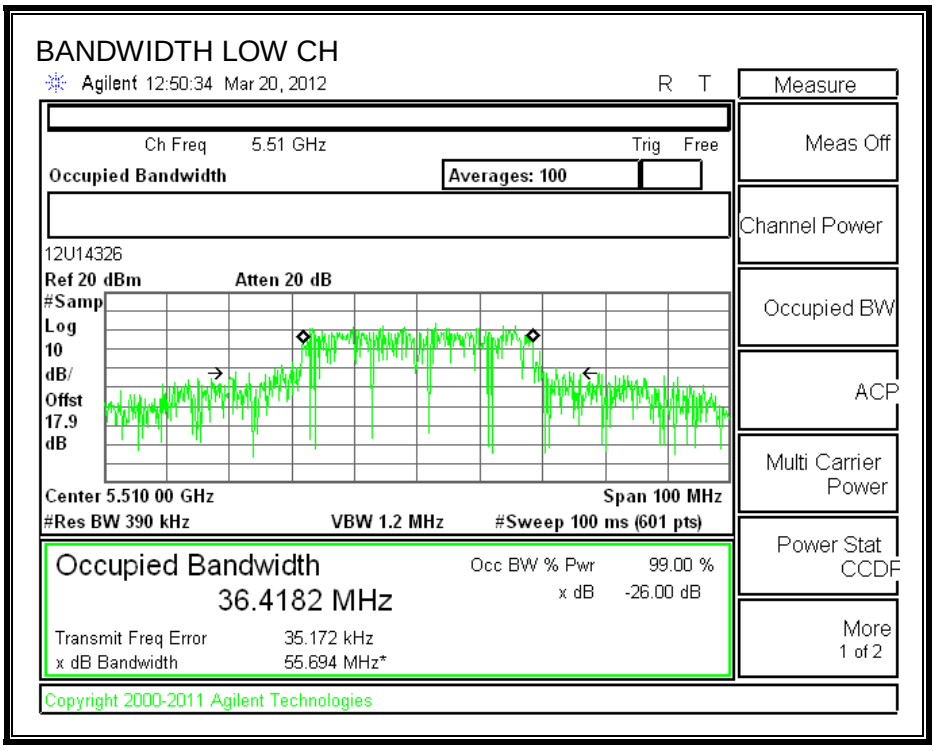
99% BANDWIDTH CHAIN 0

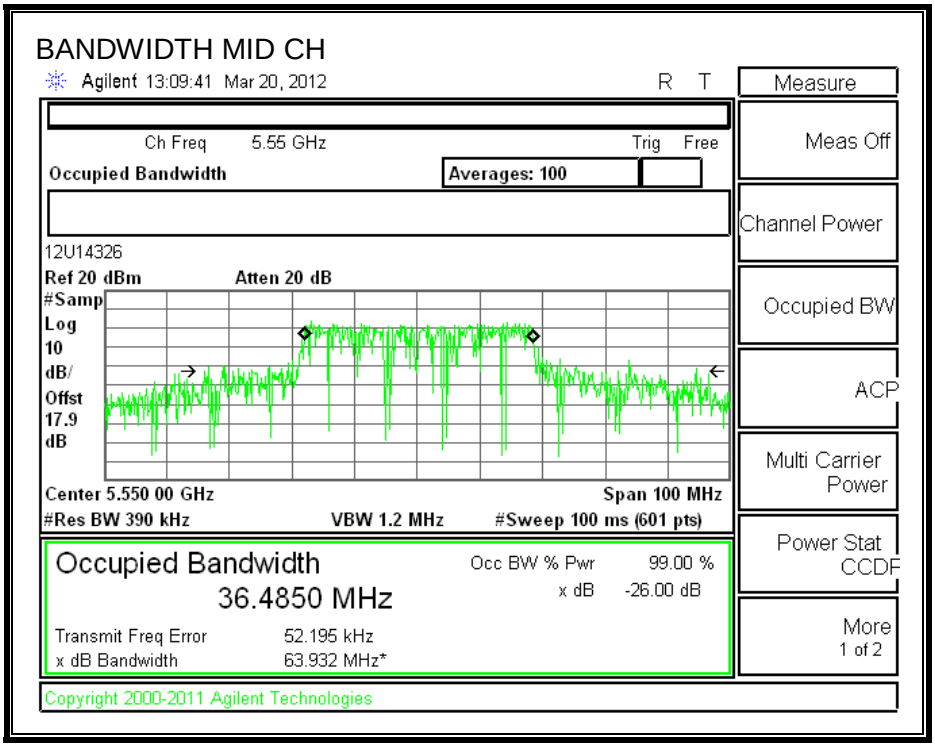


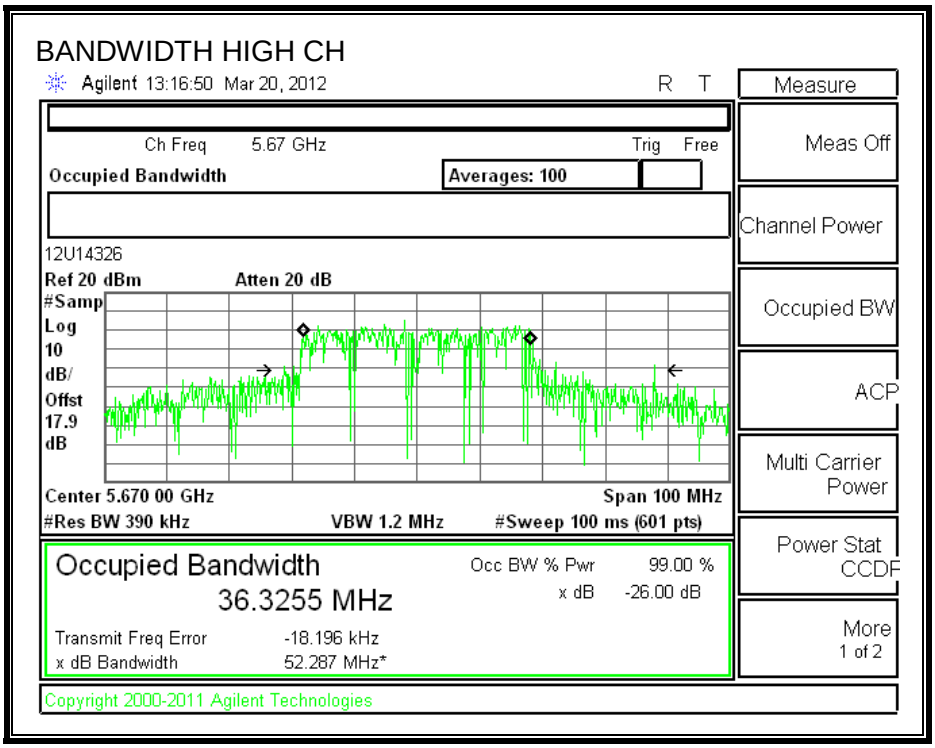




99% BANDWIDTH CHAIN 1







7.10.3. 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

Average Power Results

Channel	Frequency (MHz)	Chain 0 Power (dBm)	Chain 1 Power (dBm)	Total Power (dBm)
Low	5510	17.70	16.70	20.24
Mid	5550	19.10	17.80	21.51
High	5670	17.50	17.10	20.31

7.10.4. OUTPUT POWER AND PPSD

LIMITS

FCC §15.407 (a) (2)

For the band 5.47–5.725 GHz, 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. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1–MHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

DIRECTIONAL ANTENNA GAIN

The TX chains are uncorrelated and the antenna gain is unequal among the chains. The directional gain is:

Chain 0 Antenna Gain (dBi)	Chain 1 Antenna Gain (dBi)	Uncorrelated Chains Directional Gain (dBi)
3.09	3.29	3.19

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	5510	24	83.50	30.22	3.19	24.00	11.00
Mid	5550	24	88.67	30.48	3.19	24.00	11.00
High	5670	24	69.00	29.39	3.19	24.00	11.00

Output Power Results

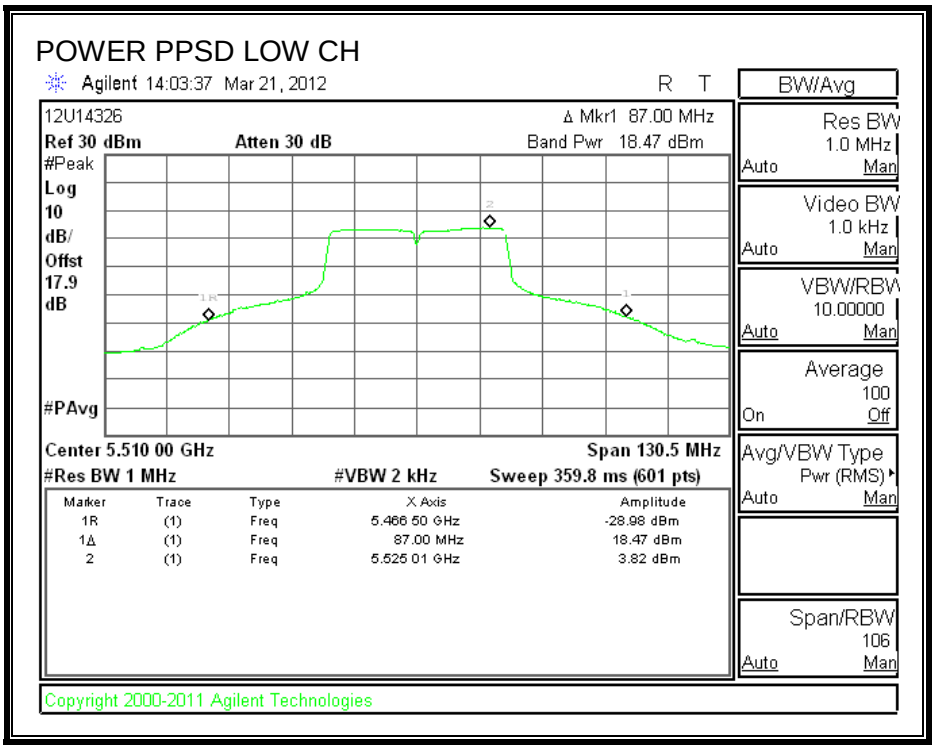
Channel	Frequency (MHz)	Chain 0 Meas Power (dBm)	Chain 1 Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Power Margin (dB)
Low	5510	18.47	17.25	20.91	24.00	-3.09
Mid	5550	19.85	17.78	21.95	24.00	-2.05
High	5670	18.02	16.99	20.55	24.00	-3.45

PPSD Results

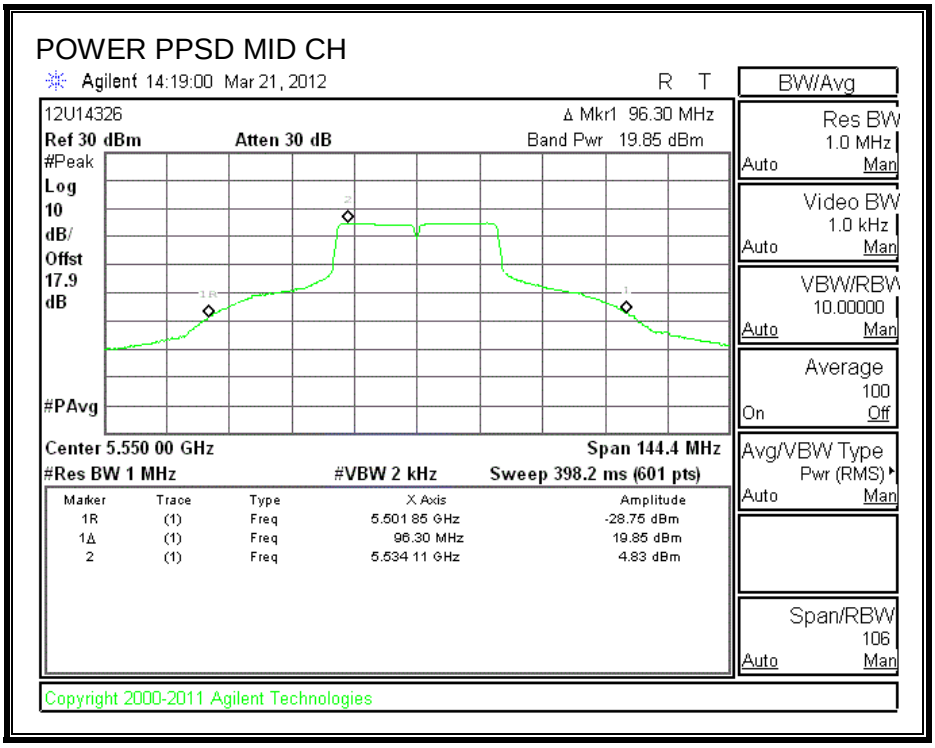
Channel	Frequency (MHz)	Chain 0 Meas PPSD (dBm)	Chain 1 Meas PPSD (dBm)	Total Corr'd PPSD (dBm)	PPSD Limit (dBm)	PPSD Margin (dB)
Low	5510	3.82	2.29	6.13	11.00	-4.87
Mid	5550	4.83	2.96	7.01	11.00	-3.99
High	5670	3.66	2.36	6.07	11.00	-4.93

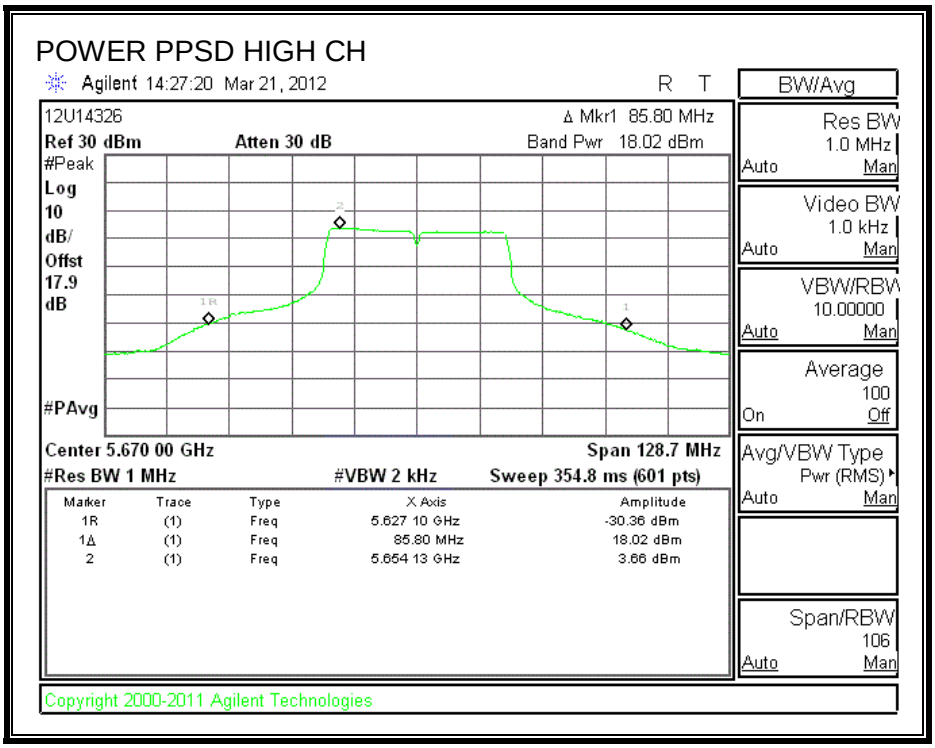
OUTPUT POWER AND PPSD CHAIN 0

POWER PPSD LOW CH



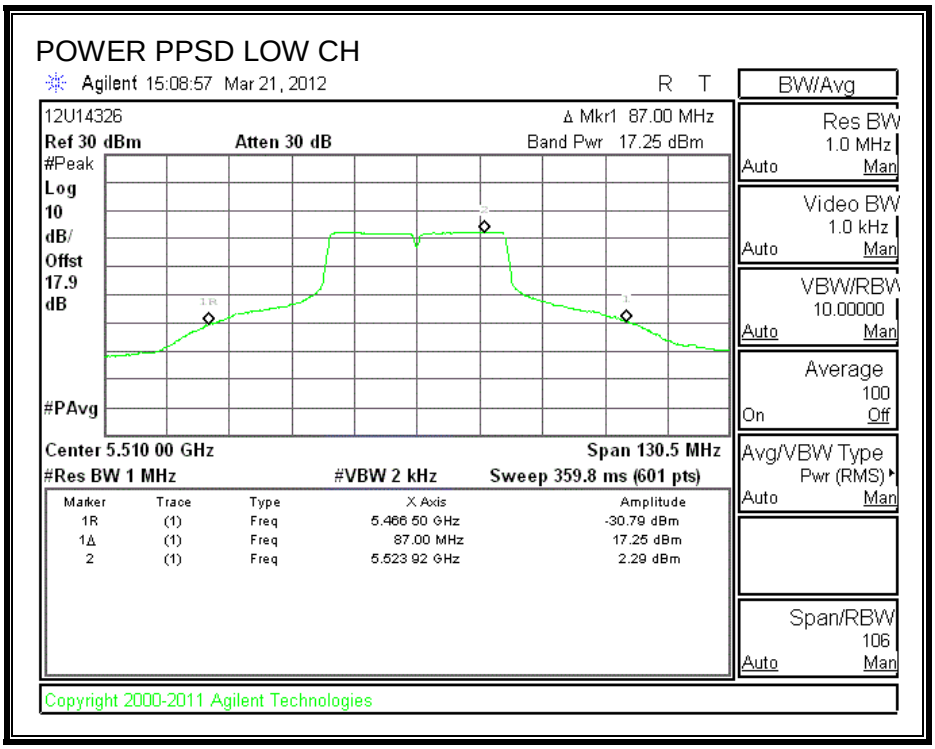
POWER PPSD MID CH



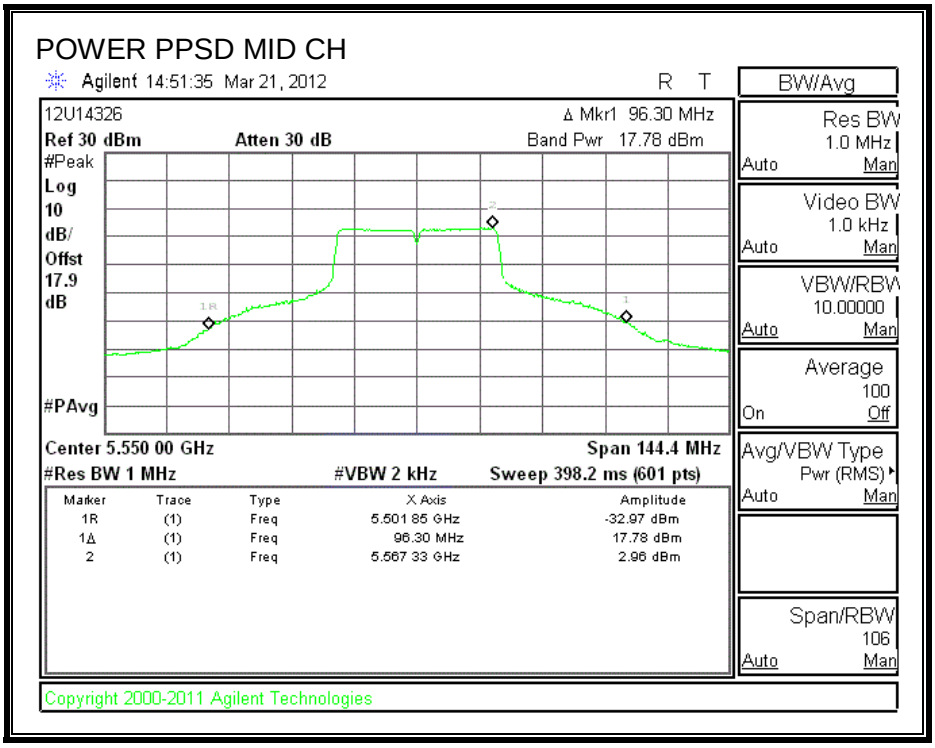


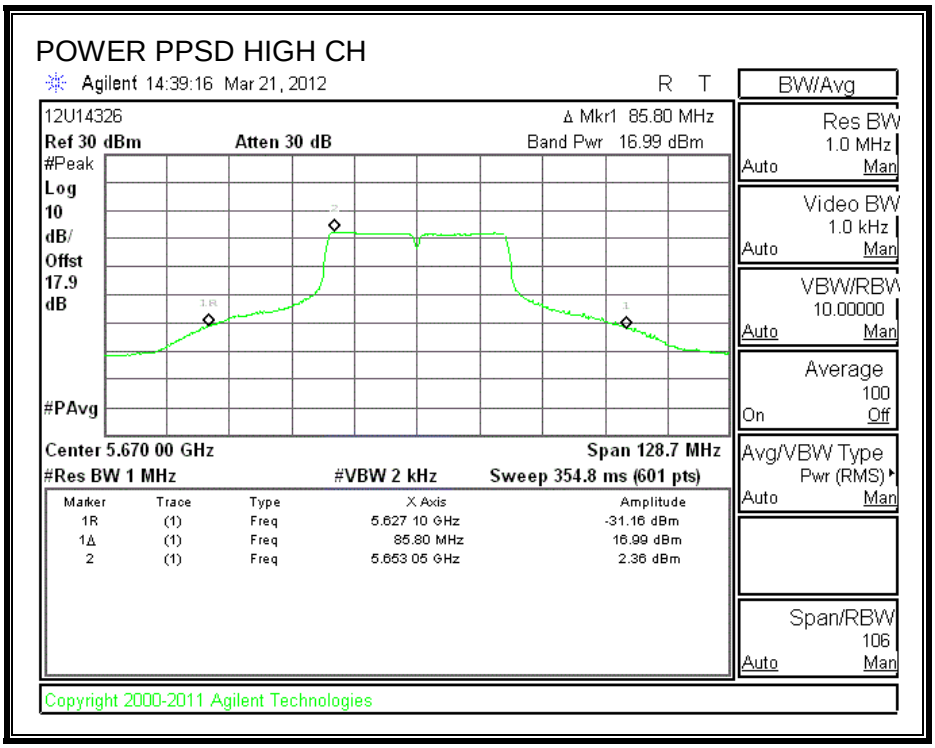
OUTPUT POWER AND PPSD CHAIN 1

POWER PPSD LOW CH



POWER PPSD MID CH





8. RADIATED TEST RESULTS

8.1. LIMITS AND PROCEDURE

LIMITS

FCC §15.205 and §15.209

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.

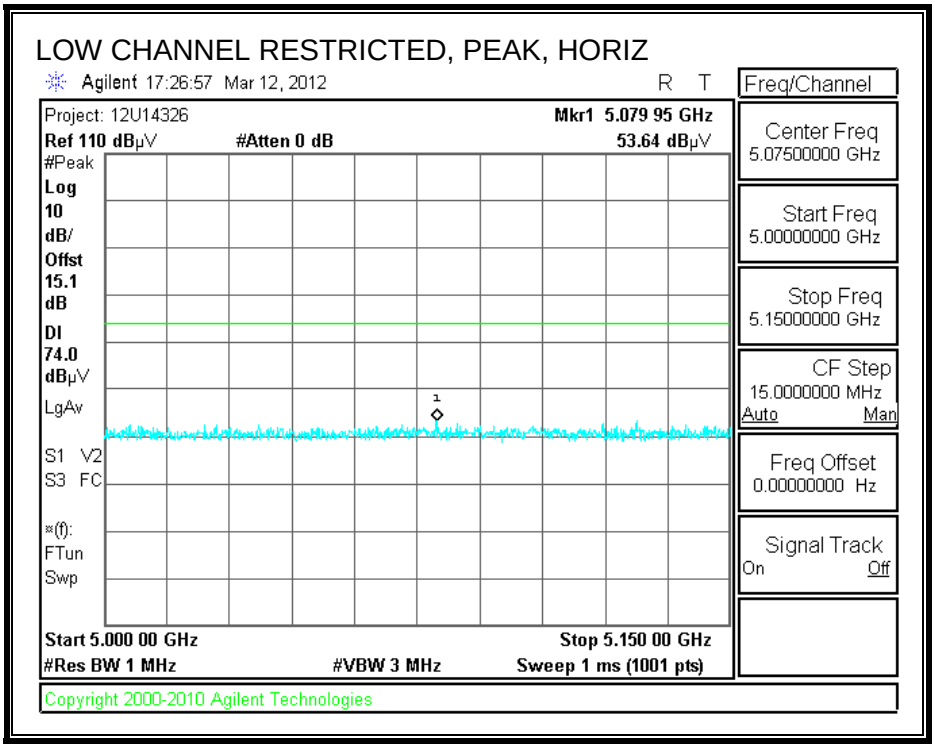
TEST RESULT

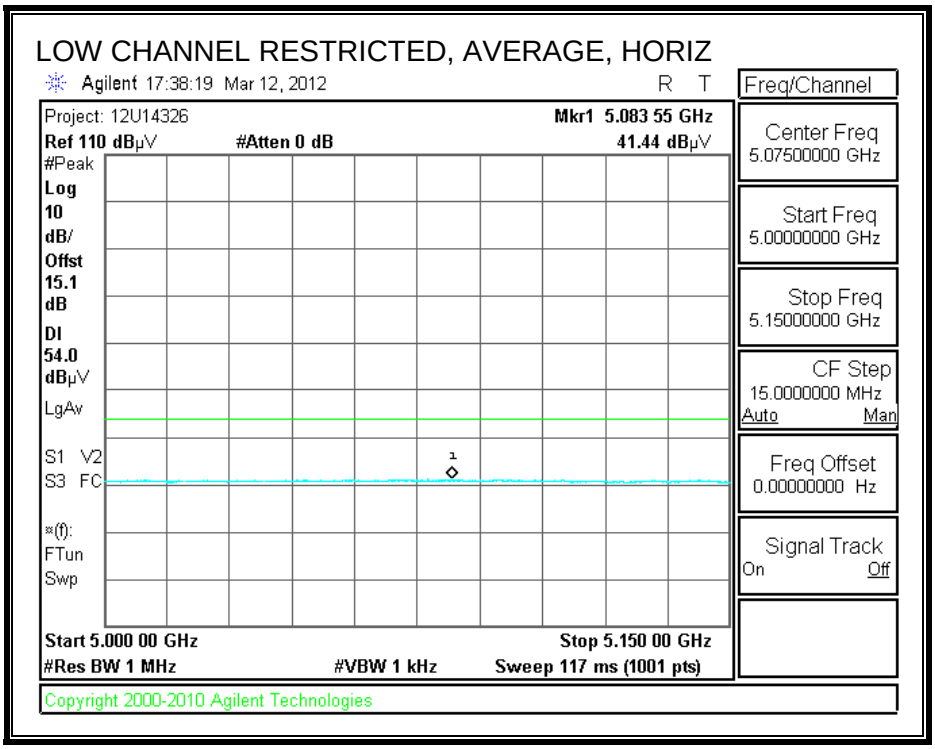
No other spurious emissions were found above 18G.

8.2. TRANSMITTER ABOVE 1 GHz

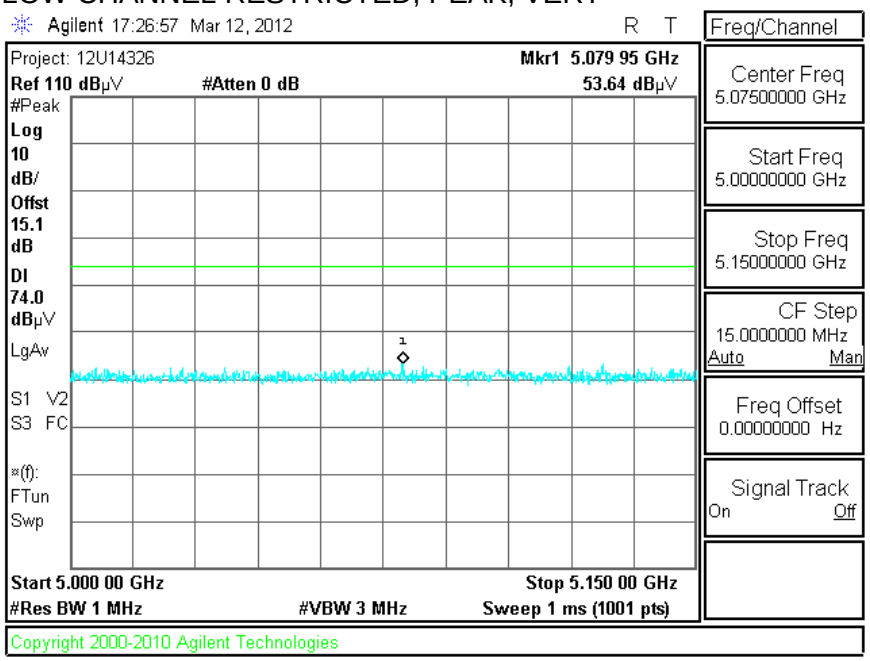
8.2.1. TX ABOVE 1 GHz 802.11a MODE IN THE 5.2 GHz BAND

RESTRICTED BANDEDGE (LOW CHANNEL)

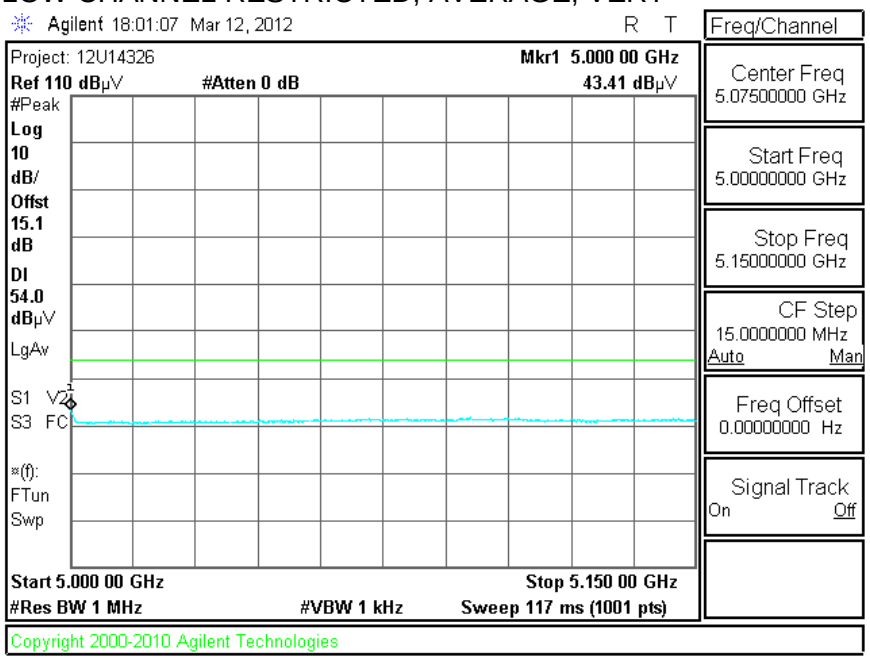




LOW CHANNEL RESTRICTED, PEAK, VERT



LOW CHANNEL RESTRICTED, AVERAGE, VERT



HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement
Compliance Certification Services, Fremont 5m Chamber

Test Engr: Tom Chen
Date: 03/22/12
Project #: 12U14326
Company: Apple
Test Target: FCC Class B
Mode Oper: 802.11a, W52 TX mode

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

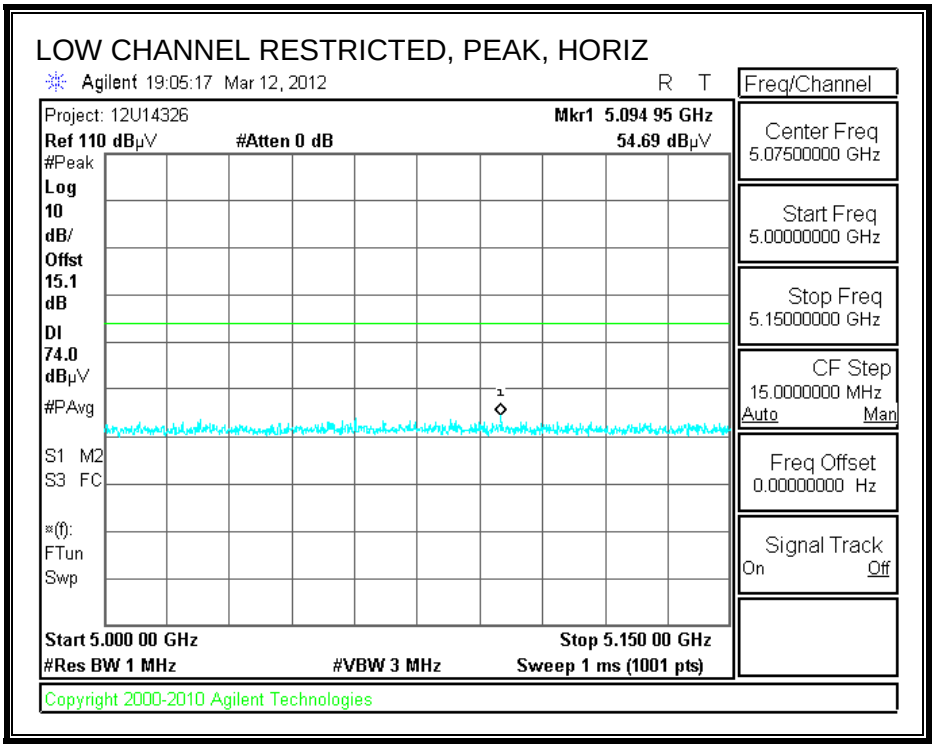
Average Field Strength Limit
Peak Field Strength Limit
Margin vs. Average Limit
Margin vs. Peak Limit

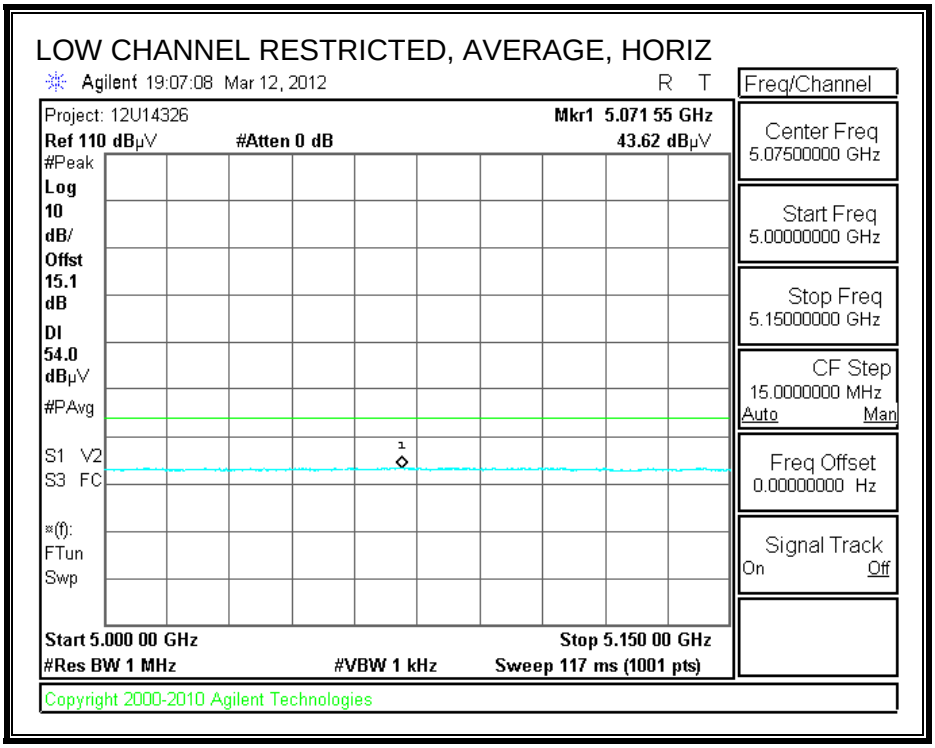
f GHz	Dist (m)	Read dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Corr. dBuV/m	Limit dBuV/m	Margin dB	Ant. Pol. V/H	Det. P/A/QP	Notes
5180MHz 11a													
15.540	3.0	35.1	39.1	12.5	-32.3	0.0	0.7	55.1	74.0	-18.9	V	P	
15.540	3.0	22.8	39.1	12.5	-32.3	0.0	0.7	42.8	54.0	-11.2	V	A	
15.540	3.0	35.7	39.1	12.5	-32.3	0.0	0.7	55.7	74.0	-18.3	H	P	
15.540	3.0	22.8	39.1	12.5	-32.3	0.0	0.7	42.8	54.0	-11.2	H	A	
5200MHz 11a													
15.540	3.0	34.9	39.1	12.5	-32.3	0.0	0.7	54.9	74.0	-19.1	H	P	
15.540	3.0	22.8	39.1	12.5	-32.3	0.0	0.7	42.8	54.0	-11.2	H	A	
15.600	3.0	35.3	38.9	12.5	-32.3	0.0	0.7	55.2	74.0	-18.8	V	P	
15.600	3.0	22.9	38.9	12.5	-32.3	0.0	0.7	42.7	54.0	-11.3	V	A	
5240MHz 11a													
15.720	3.0	34.5	38.5	12.6	-32.2	0.0	0.7	54.0	74.0	-20.0	V	P	
15.720	3.0	22.7	38.5	12.6	-32.2	0.0	0.7	42.2	54.0	-11.8	V	A	
15.720	3.0	35.4	38.5	12.6	-32.2	0.0	0.7	54.9	74.0	-19.1	H	P	
15.720	3.0	22.7	38.5	12.6	-32.2	0.0	0.7	42.2	54.0	-11.8	H	A	

Rev. 4.1.2.7
Note: No other emissions were detected above the system noise floor.

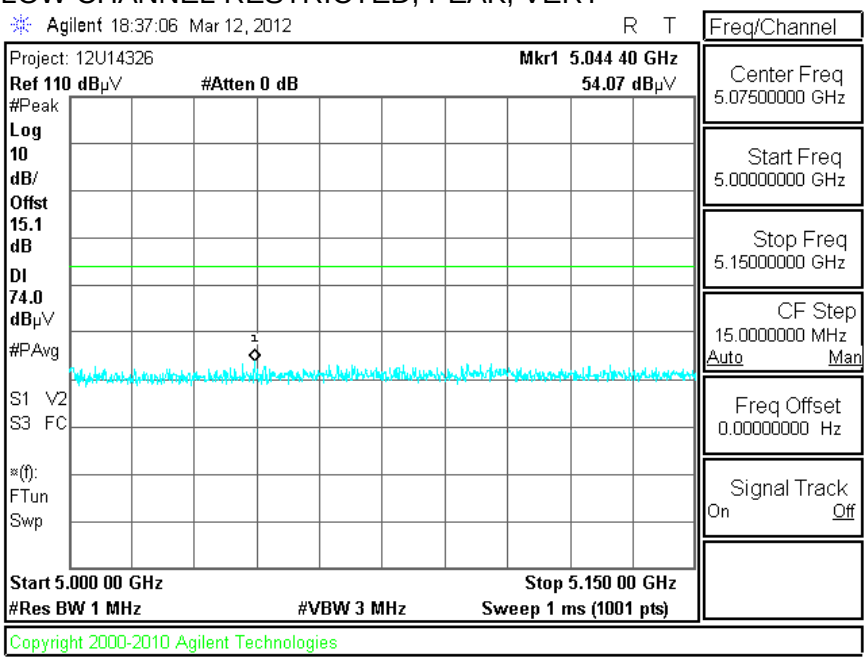
8.2.2. TX ABOVE 1 GHz 802.11n HT20 MODE IN THE 5.2 GHz BAND

RESTRICTED BANDEDGE (LOW CHANNEL)

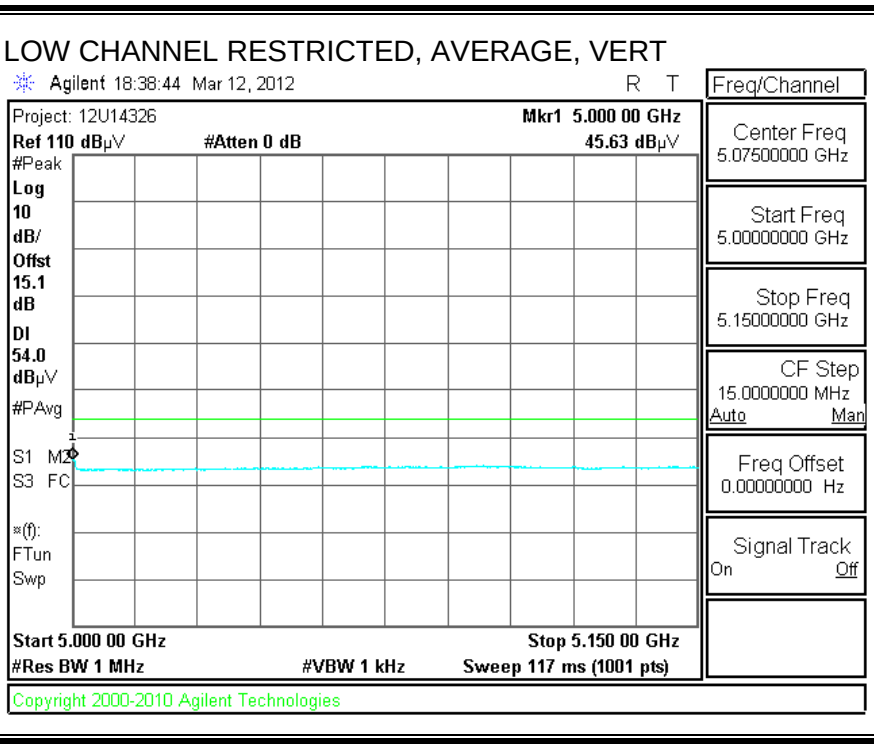




LOW CHANNEL RESTRICTED, PEAK, VERT



LOW CHANNEL RESTRICTED, AVERAGE, VERT



HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement
Compliance Certification Services, Fremont 5m Chamber

Test Engr: Tom Chen
Date: 03/22/12
Project #: 12U14326
Company: Apple
Test Target: FCC Class B
Mode Oper: 802.HT20, W52 TX mode

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

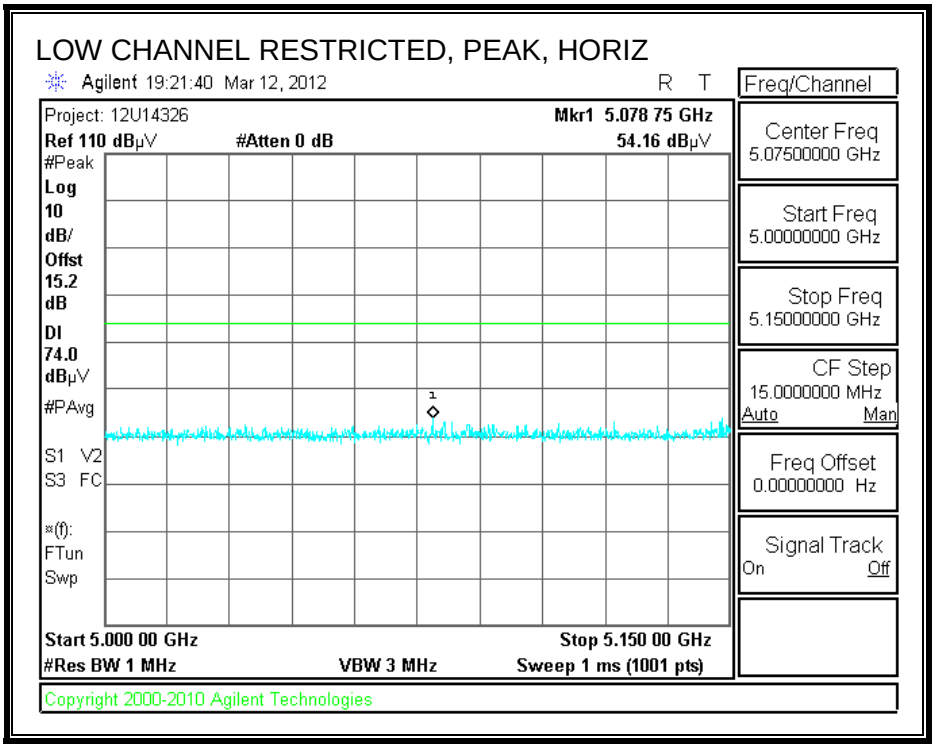
Average Field Strength Limit
Peak Field Strength Limit
Margin vs. Average Limit
Margin vs. Peak Limit

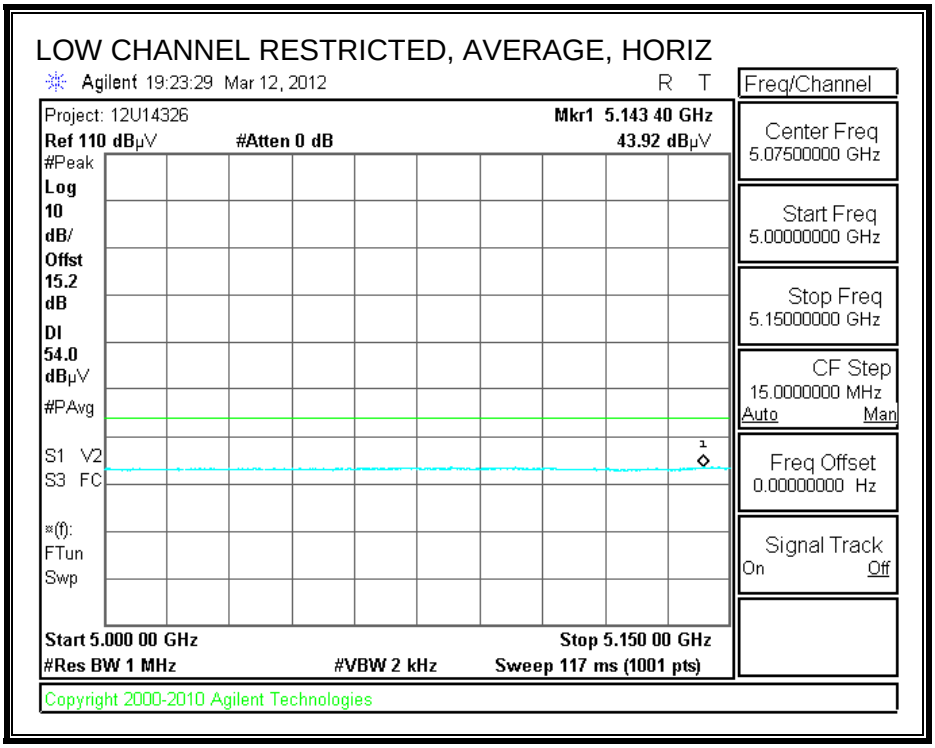
f GHz	Dist (m)	Read dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Corr. dBuV/m	Limit dBuV/m	Margin dB	Ant. Pol. V/H	Det. P/A/QP	Notes
5180MHz HT20													
15.540	3.0	35.2	39.1	12.5	-32.3	0.0	0.7	55.2	74.0	-18.8	H	P	
15.540	3.0	22.7	39.1	12.5	-32.3	0.0	0.7	42.8	54.0	-11.2	H	A	
15.540	3.0	35.9	39.1	12.5	-32.3	0.0	0.7	55.9	74.0	-18.1	V	P	
15.540	3.0	22.7	39.1	12.5	-32.3	0.0	0.7	42.7	54.0	-11.3	V	A	
5200MHz HT20													
15.600	3.0	35.6	38.9	12.5	-32.3	0.0	0.7	55.4	74.0	-18.6	V	P	
15.600	3.0	22.9	38.9	12.5	-32.3	0.0	0.7	42.7	54.0	-11.3	V	A	
15.600	3.0	35.1	38.9	12.5	-32.3	0.0	0.7	55.0	74.0	-19.0	H	P	
15.600	3.0	22.9	38.9	12.5	-32.3	0.0	0.7	42.7	54.0	-11.3	H	A	
5240MHz HT20													
15.720	3.0	35.0	38.5	12.6	-32.2	0.0	0.7	54.5	74.0	-19.5	H	P	
15.720	3.0	22.7	38.5	12.6	-32.2	0.0	0.7	42.3	54.0	-11.7	H	A	
15.720	3.0	35.2	38.5	12.6	-32.2	0.0	0.7	54.7	74.0	-19.3	V	P	
15.720	3.0	22.7	38.5	12.6	-32.2	0.0	0.7	42.3	54.0	-11.7	V	A	

Rev. 4.1.2.7
Note: No other emissions were detected above the system noise floor.

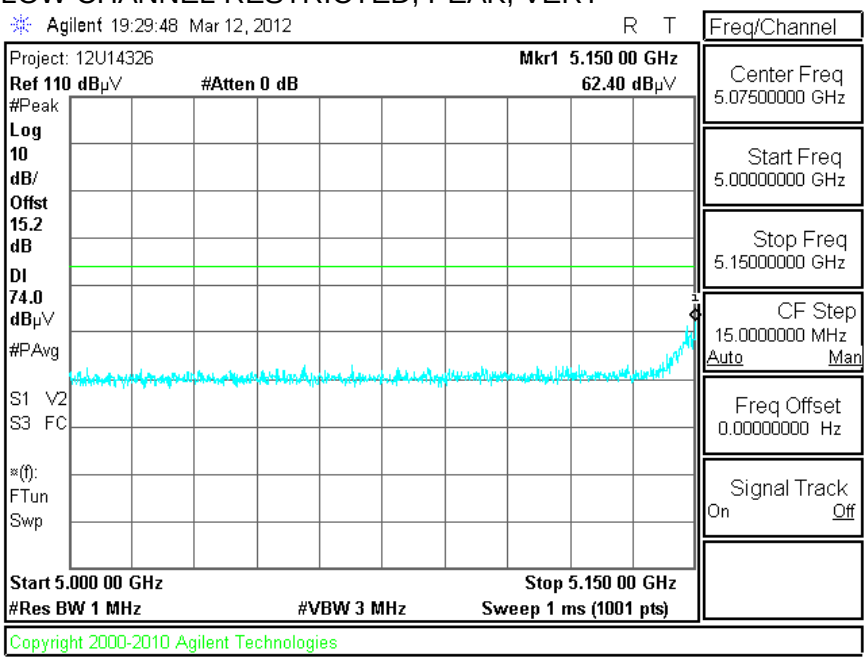
8.2.3. TX ABOVE 1 GHz 802.11n HT40 MODE IN THE 5.2 GHz BAND

RESTRICTED BANDEDGE (LOW CHANNEL)

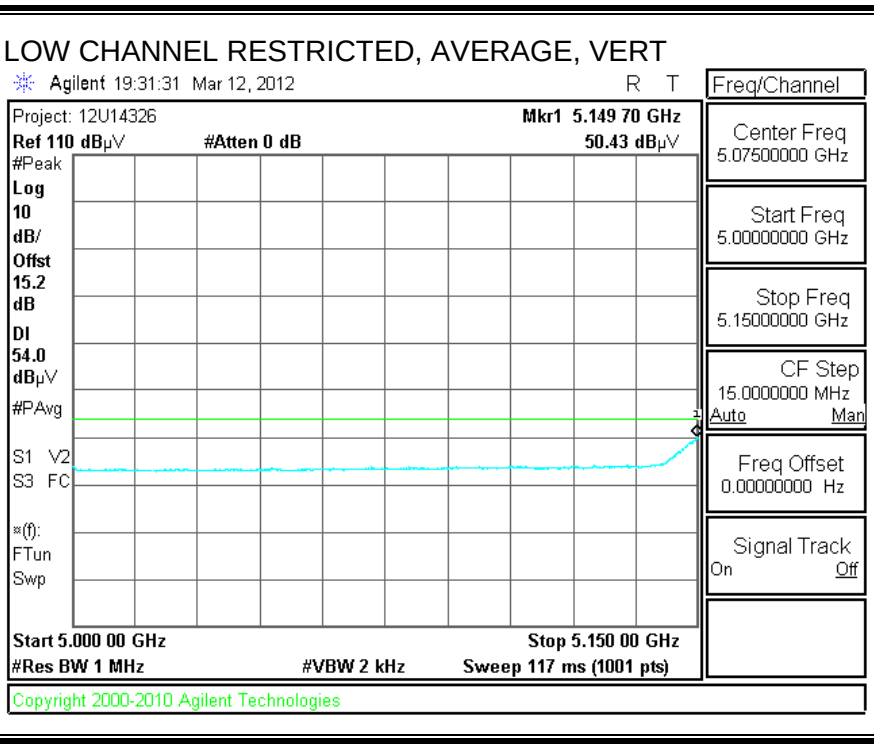




LOW CHANNEL RESTRICTED, PEAK, VERT



LOW CHANNEL RESTRICTED, AVERAGE, VERT



HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement
Compliance Certification Services, Fremont 5m Chamber

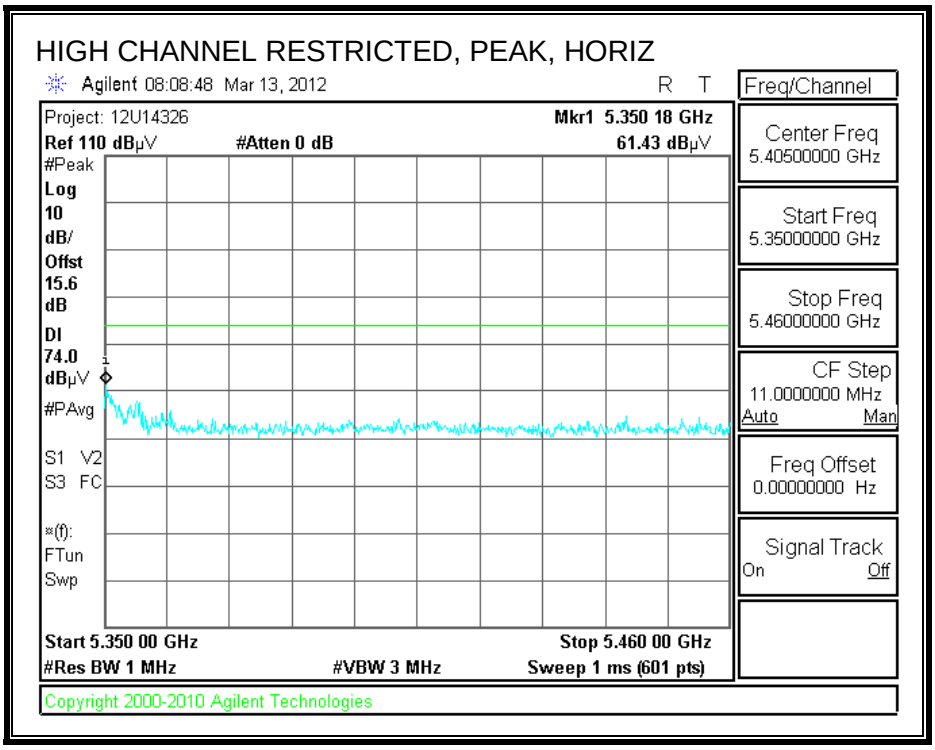
Test Engr: Tom Chen
Date: 03/22/12
Project #: 12U14326
Company: Apple
Test Target: FCC Class B
Mode Oper: 802.HT40, W52 TX mode

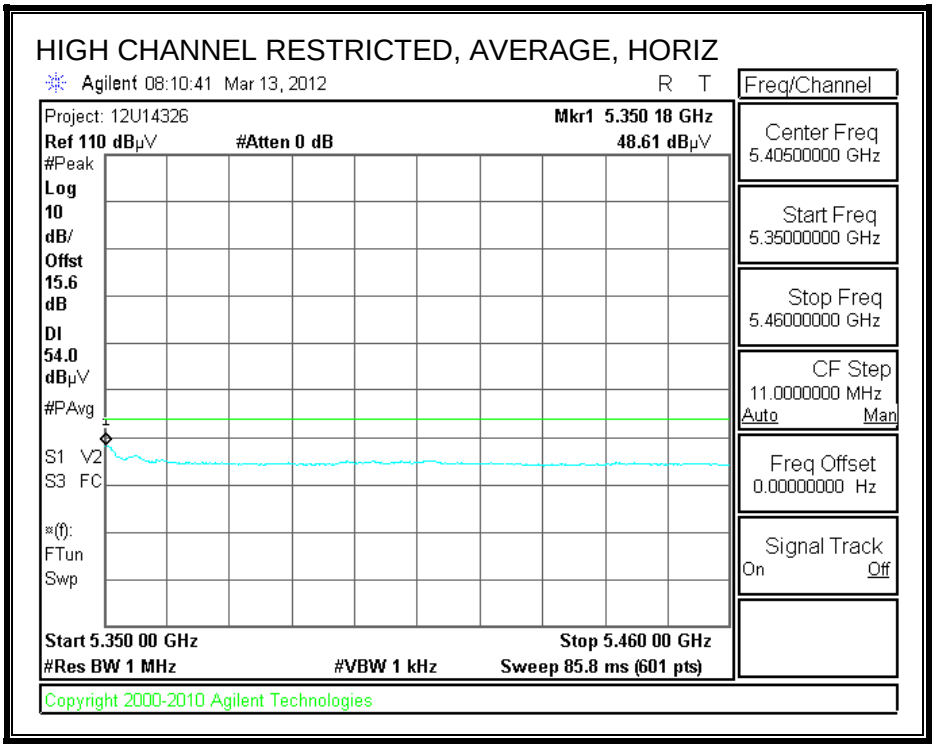
f	Measurement Frequency	Amp	Preamp Gain		Average Field Strength Limit
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters		Peak Field Strength Limit
Read	Analyzer Reading	Avg	Average Field Strength @ 3 m		Margin vs. Average Limit
AF	Antenna Factor	Peak	Calculated Peak Field Strength		Margin 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
5190MHz HT40													
15.570	3.0	35.6	39.0	12.5	-32.3	0.0	0.7	55.6	74.0	-18.4	H	P	
15.570	3.0	22.8	39.0	12.5	-32.3	0.0	0.7	42.8	54.0	-11.2	H	A	
5190MHz HT40													
15.570	3.0	34.6	39.0	12.5	-32.3	0.0	0.7	54.5	74.0	-19.5	V	P	
15.570	3.0	22.8	39.0	12.5	-32.3	0.0	0.7	42.8	54.0	-11.2	V	A	
5230MHz HT40													
15.690	3.0	35.8	38.6	12.6	-32.3	0.0	0.7	55.5	74.0	-18.5	V	P	
15.690	3.0	22.7	38.6	12.6	-32.3	0.0	0.7	42.4	54.0	-11.6	V	A	
5230MHz HT40													
15.690	3.0	35.2	38.6	12.6	-32.3	0.0	0.7	54.9	74.0	-19.1	H	P	
15.690	3.0	22.8	38.6	12.6	-32.3	0.0	0.7	42.4	54.0	-11.6	H	A	

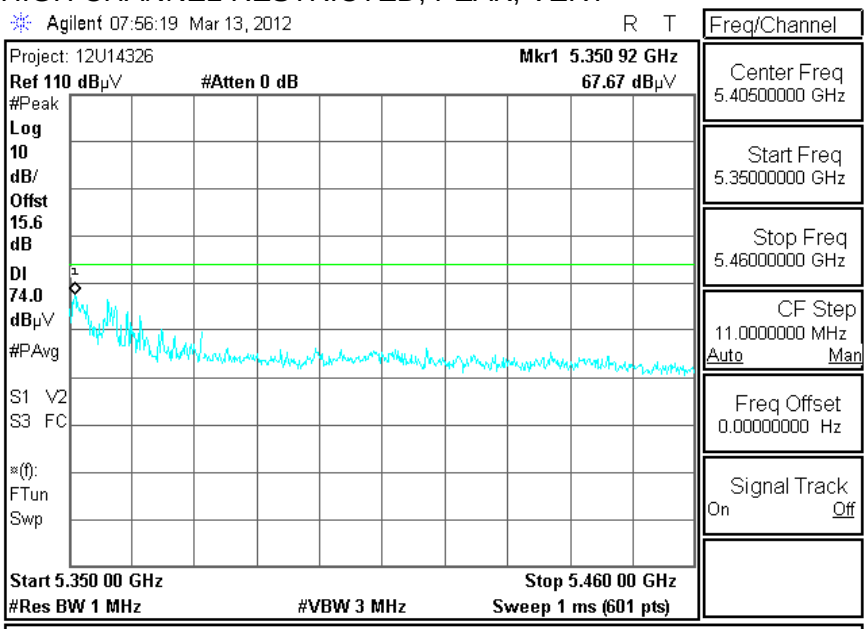
Rev. 4.1.2.7
Note: No other emissions were detected above the system noise floor.

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

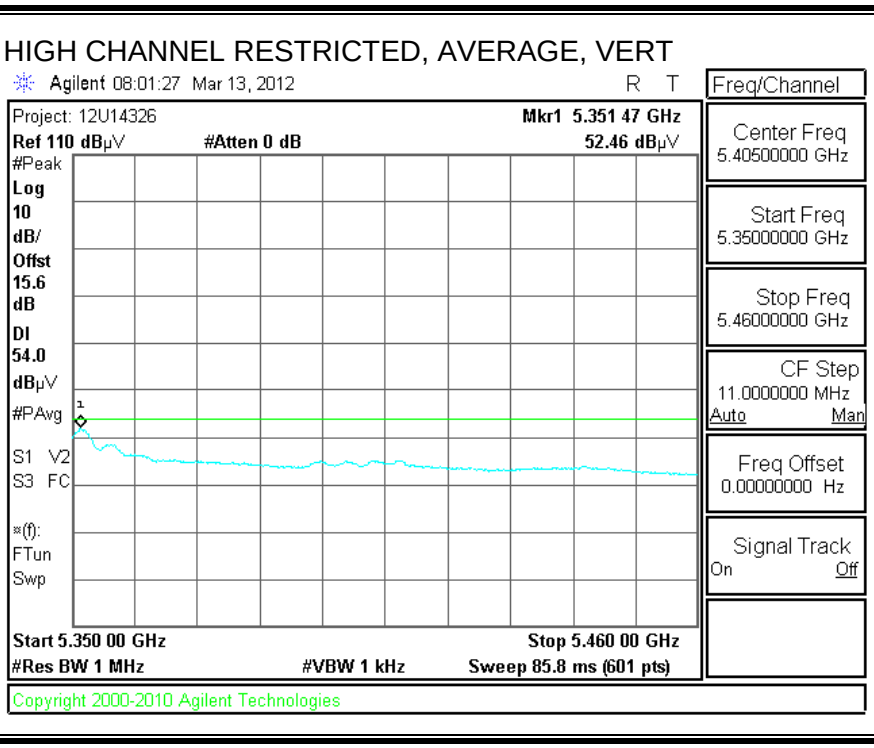




HIGH CHANNEL RESTRICTED, PEAK, VERT



HIGH CHANNEL RESTRICTED, AVERAGE, VERT



HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement
Compliance Certification Services, Fremont 5m Chamber

Test Engr: Tom Chen
Date: 03/20/12
Project #: 12U14326
Company: Apple
Test Target: FCC Class B
Mode Oper: 802.11a, W53 TX mode

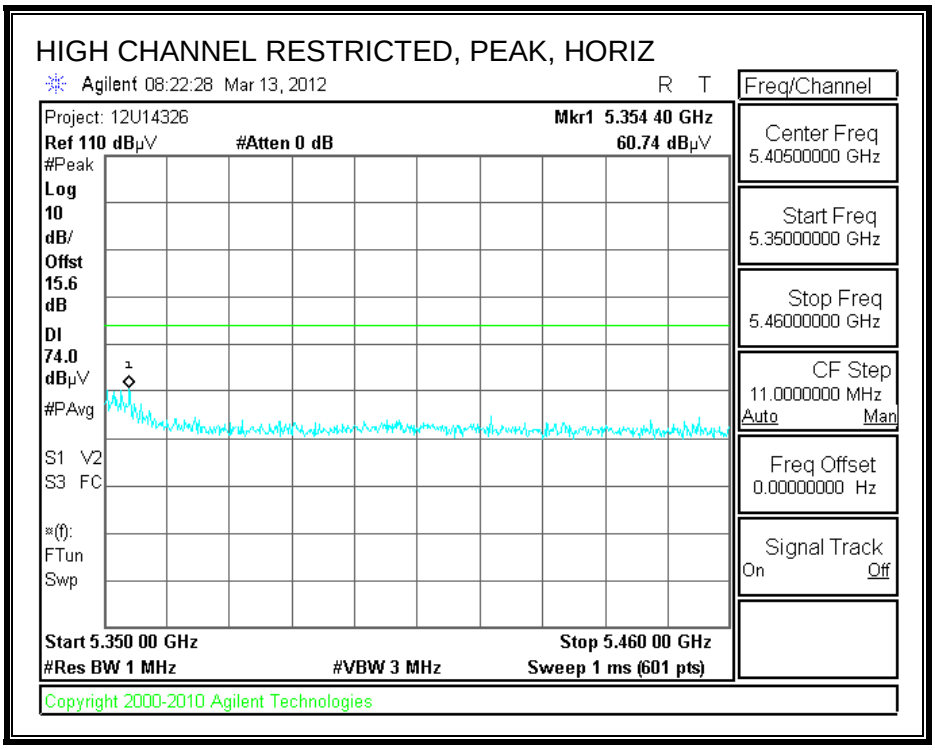
f	Measurement Frequency	Amp	Preamp Gain
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters
Read	Analyzer Reading	Avg	Average Field Strength @ 3 m
AF	Antenna Factor	Peak	Calculated Peak Field Strength
CL	Cable Loss	HPF	High Pass Filter

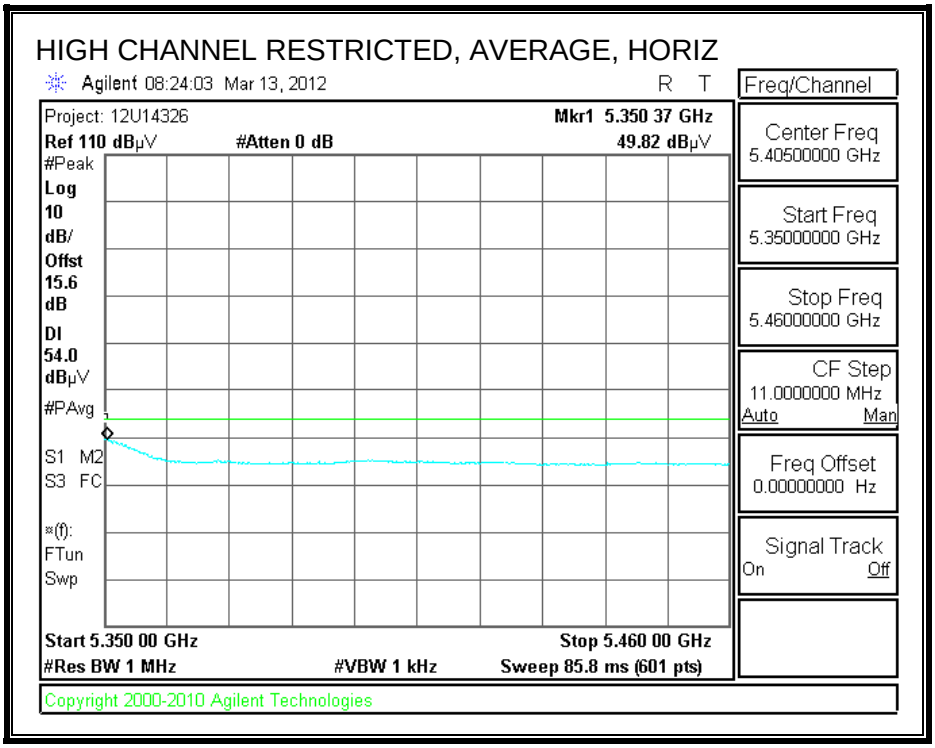
Average Field Strength Limit
Peak Field Strength Limit
Margin vs. Average Limit
Margin vs. Peak Limit

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
5260 MHz 11a													
15.780	3.0	35.1	38.3	12.6	-32.2	0.0	0.7	54.5	74.0	-19.5	V	P	
15.780	3.0	22.5	38.3	12.6	-32.2	0.0	0.7	41.9	54.0	-12.1	V	A	
5260 MHz 11a													
15.780	3.0	36.7	38.3	12.6	-32.2	0.0	0.7	56.1	74.0	-17.9	H	P	
15.780	3.0	22.6	38.3	12.6	-32.2	0.0	0.7	42.0	54.0	-12.0	H	A	
5300 MHz 11a													
10.600	3.0	38.6	38.1	9.7	-33.9	0.0	0.8	53.2	74.0	-20.8	H	P	
10.600	3.0	25.9	38.1	9.7	-33.9	0.0	0.8	40.5	54.0	-13.5	H	A	
15.900	3.0	35.5	37.9	12.7	-32.2	0.0	0.7	54.6	74.0	-19.4	H	P	
15.900	3.0	22.9	37.9	12.7	-32.2	0.0	0.7	42.1	54.0	-11.9	H	A	
5300 MHz 11a													
10.600	3.0	46.0	38.1	9.7	-33.9	0.0	0.8	60.6	74.0	-13.4	V	P	
10.600	3.0	31.5	38.1	9.7	-33.9	0.0	0.8	46.2	54.0	-7.8	V	A	
15.900	3.0	36.2	37.9	12.7	-32.2	0.0	0.7	55.3	74.0	-18.7	V	P	
15.900	3.0	23.7	37.9	12.7	-32.2	0.0	0.7	42.8	54.0	-11.2	V	A	
5320 MHz 11a													
10.640	3.0	44.9	38.2	9.7	-33.9	0.0	0.8	59.6	74.0	-14.4	V	P	
10.640	3.0	30.7	38.2	9.7	-33.9	0.0	0.8	45.4	54.0	-8.6	V	A	
10.640	3.0	39.4	38.2	9.7	-33.9	0.0	0.8	54.2	74.0	-19.8	H	P	
10.640	3.0	26.4	38.2	9.7	-33.9	0.0	0.8	41.1	54.0	-12.9	H	A	

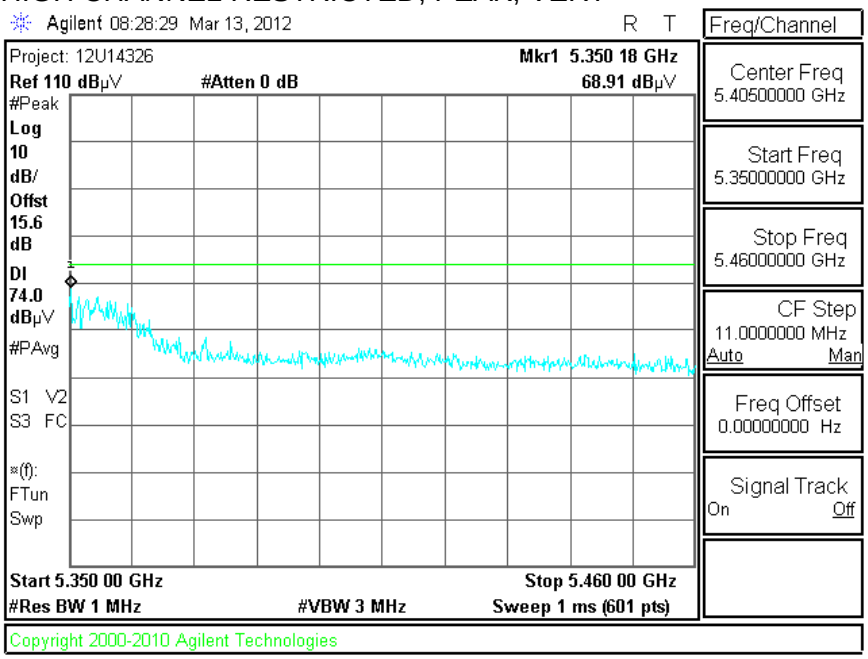
Rev. 4.1.2.7
Note: No other emissions were detected above the system noise floor.

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

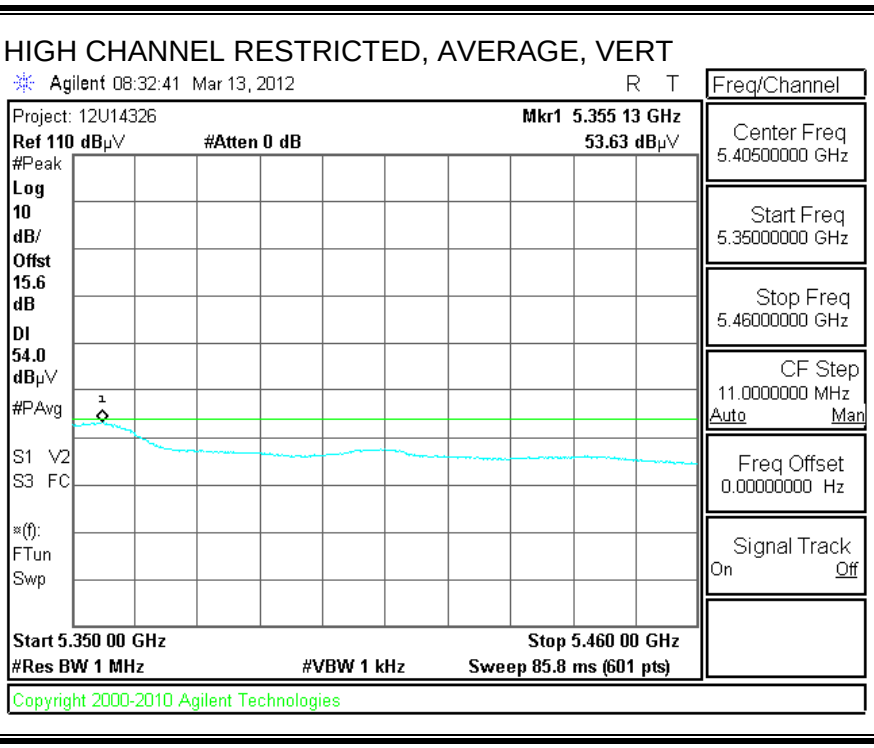




HIGH CHANNEL RESTRICTED, PEAK, VERT



HIGH CHANNEL RESTRICTED, AVERAGE, VERT



HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement
Compliance Certification Services, Fremont 5m Chamber

Test Engr: Tom Chen
Date: 03/20/12
Project #: 12U14326
Company: Apple
Test Target: FCC Class B
Mode Oper: 802.11n HT20, W53 TX mode

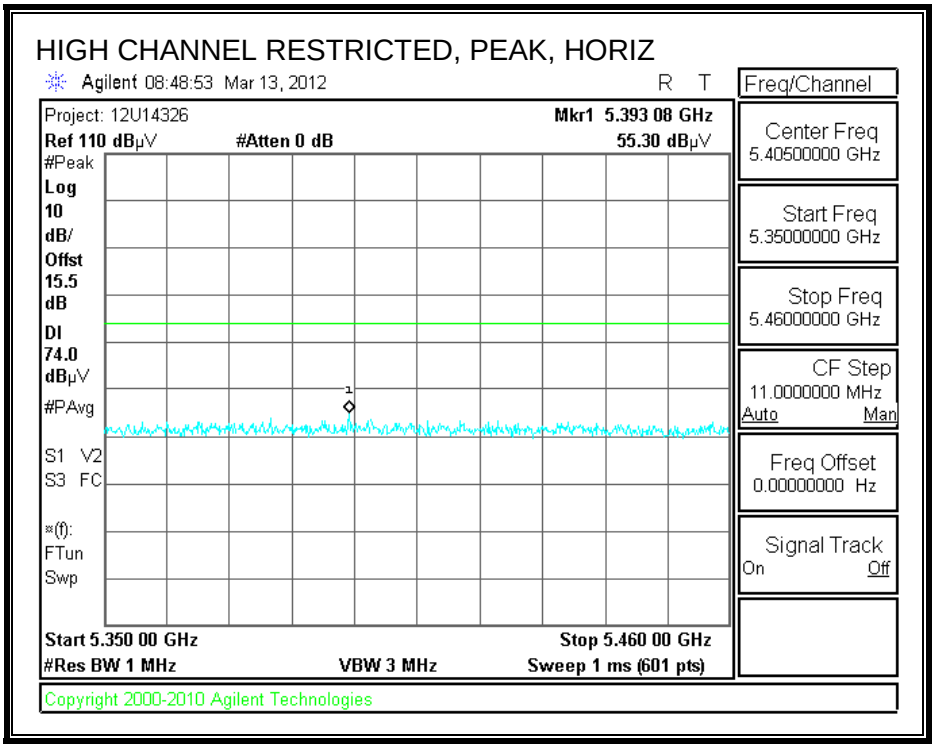
f	Measurement Frequency	Amp	Preamp Gain		Average Field Strength Limit
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters		Peak Field Strength Limit
Read	Analyzer Reading	Avg	Average Field Strength @ 3 m		Margin vs. Average Limit
AF	Antenna Factor	Peak	Calculated Peak Field Strength		Margin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

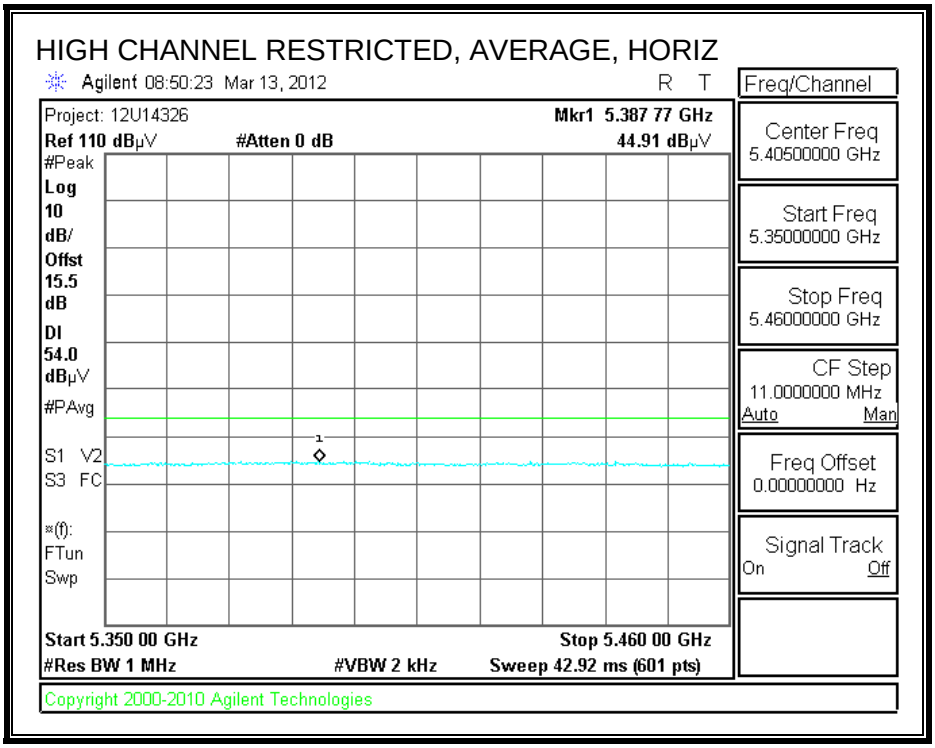
f GHz	Dist (m)	Read dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Corr. dBuV/m	Limit dBuV/m	Margin dB	Ant. Pol. V/H	Det. P/A/QP	Notes
5260 MHz HT20													
15.780	3.0	35.9	38.3	12.6	-32.2	0.0	0.7	55.3	74.0	-18.7	V	P	
15.780	3.0	23.3	38.3	12.6	-32.2	0.0	0.7	42.8	54.0	-11.2	V	A	
5260 MHz HT20													
15.780	3.0	35.8	38.3	12.6	-32.2	0.0	0.7	55.2	74.0	-18.8	H	P	
15.780	3.0	23.2	38.3	12.6	-32.2	0.0	0.7	42.6	54.0	-11.4	H	A	
5300 MHz HT20													
10.600	3.0	49.3	38.1	9.7	-33.9	0.0	0.8	63.9	74.0	-10.1	V	P	
10.600	3.0	35.7	38.1	9.7	-33.9	0.0	0.8	50.3	54.0	-3.7	V	A	
15.900	3.0	35.3	37.9	12.7	-32.2	0.0	0.7	54.4	74.0	-19.6	V	P	
15.900	3.0	23.2	37.9	12.7	-32.2	0.0	0.7	42.3	54.0	-11.7	V	A	
5300 MHz HT20													
10.600	3.0	45.7	38.1	9.7	-33.9	0.0	0.8	60.3	74.0	-13.7	H	P	
10.600	3.0	30.8	38.1	9.7	-33.9	0.0	0.8	45.5	54.0	-8.5	H	A	
15.900	3.0	34.8	37.9	12.7	-32.2	0.0	0.7	53.9	74.0	-20.1	H	P	
15.900	3.0	22.9	37.9	12.7	-32.2	0.0	0.7	42.0	54.0	-12.0	H	A	
5320 MHz HT20													
10.640	3.0	43.5	38.2	9.7	-33.9	0.0	0.8	58.2	74.0	-15.8	H	P	
10.640	3.0	29.8	38.2	9.7	-33.9	0.0	0.8	44.5	54.0	-9.5	H	A	
15.960	3.0	34.5	37.7	12.7	-32.2	0.0	0.7	53.4	74.0	-20.6	H	P	
15.960	3.0	22.9	37.7	12.7	-32.2	0.0	0.7	41.9	54.0	-12.1	H	A	
5320 MHz HT20													
10.640	3.0	49.7	38.2	9.7	-33.9	0.0	0.8	64.5	74.0	-9.6	V	P	
10.640	3.0	34.7	38.2	9.7	-33.9	0.0	0.8	49.4	54.0	-4.6	V	A	
15.960	3.0	34.7	37.7	12.7	-32.2	0.0	0.7	53.6	74.0	-20.4	V	P	
15.960	3.0	23.0	37.7	12.7	-32.2	0.0	0.7	42.0	54.0	-12.0	V	A	

Rev. 4.1.2.7
Note: No other emissions were detected above the system noise floor.

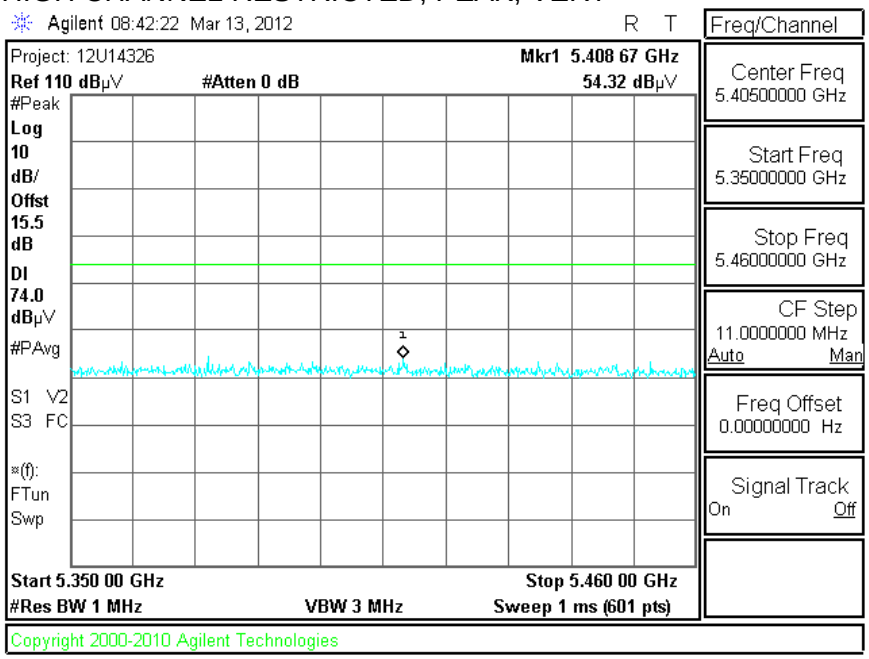
8.2.6. TX ABOVE 1 GHz 802.11n HT40 MODE IN THE 5.3 GHz BAND

RESTRICTED BANDEDGE (HIGH CHANNEL)

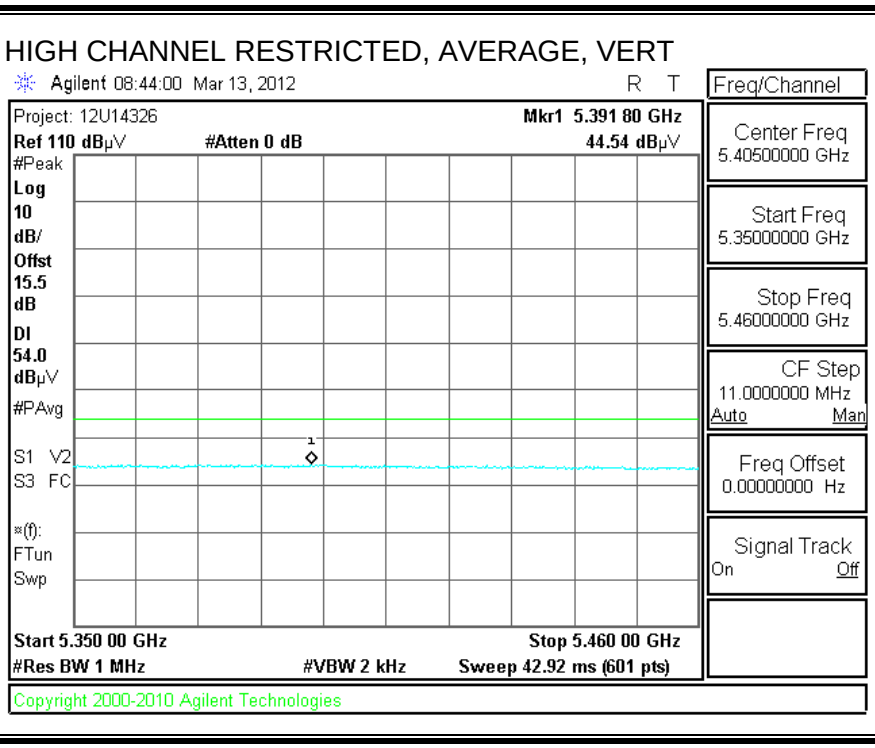




HIGH CHANNEL RESTRICTED, PEAK, VERT



HIGH CHANNEL RESTRICTED, AVERAGE, VERT



HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement
Compliance Certification Services, Fremont 5m Chamber

Test Engr: Tom Chen
Date: 03/20/12
Project #: 12U14326
Company: Apple
Test Target: FCC Class B
Mode Oper: 802.11n HT40, W53 TX mode

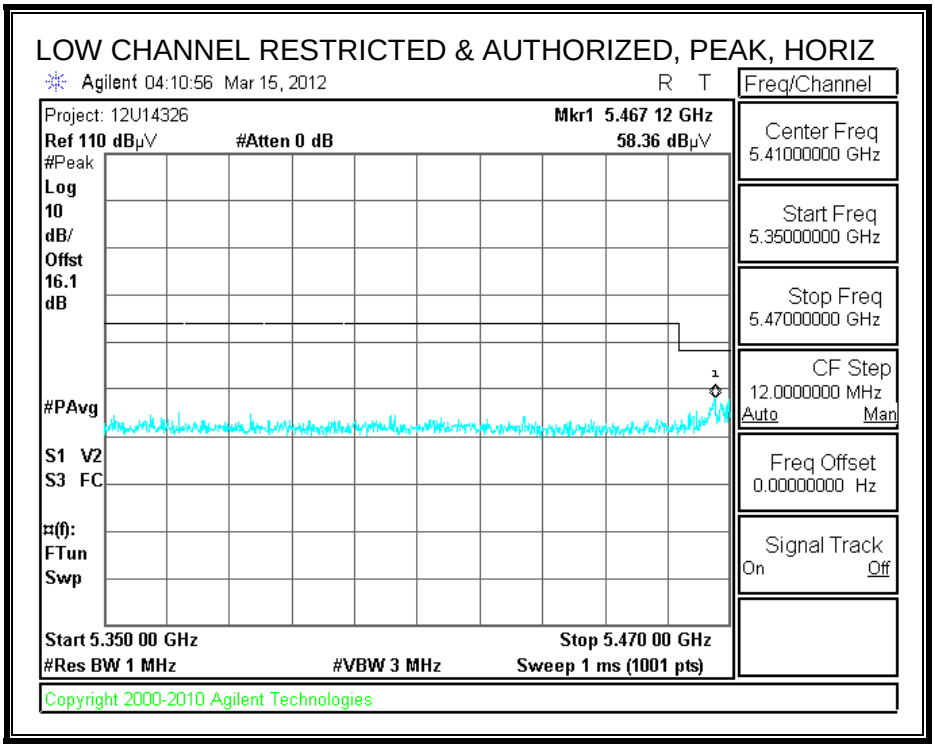
f	Measurement Frequency	Amp	Preamp Gain		Average Field Strength Limit
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters		Peak Field Strength Limit
Read	Analyzer Reading	Avg	Average Field Strength @ 3 m		Margin vs. Average Limit
AF	Antenna Factor	Peak	Calculated Peak Field Strength		Margin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

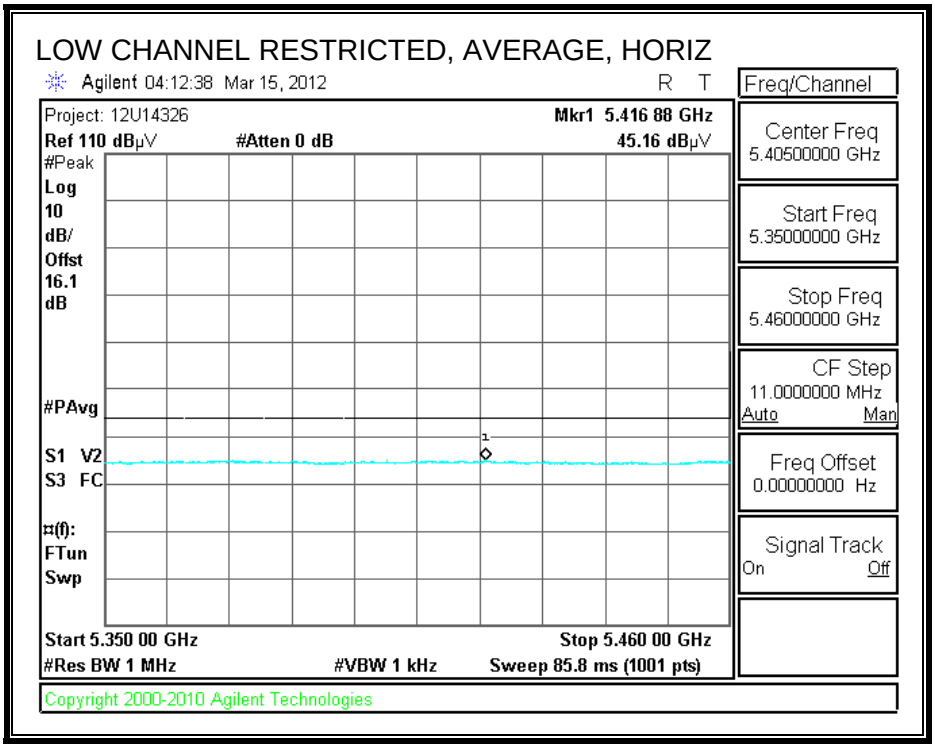
f GHz	Dist (m)	Read dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Corr. dBuV/m	Limit dBuV/m	Margin dB	Ant. Pol. V/H	Det. P/A/QP	Notes
5270 MHz HT40													
15.810	3.0	35.7	38.2	12.6	-32.2	0.0	0.7	55.0	74.0	-19.0	V	P	
15.810	3.0	23.7	38.2	12.6	-32.2	0.0	0.7	43.0	54.0	-11.0	V	A	
5270 MHz HT40													
15.810	3.0	35.8	38.2	12.6	-32.2	0.0	0.7	55.1	74.0	-18.9	H	P	
15.810	3.0	23.0	38.2	12.6	-32.2	0.0	0.7	42.3	54.0	-11.7	H	A	
5310 MHz HT40													
10.620	3.0	36.3	38.1	9.7	-33.9	0.0	0.8	51.0	74.0	-23.0	H	P	
10.620	3.0	23.9	38.1	9.7	-33.9	0.0	0.8	38.6	54.0	-15.4	H	A	
5310 MHz HT40													
10.620	3.0	37.3	38.1	9.7	-33.9	0.0	0.8	52.0	74.0	-22.0	V	P	
10.620	3.0	24.9	38.1	9.7	-33.9	0.0	0.8	39.6	54.0	-14.4	V	A	

Rev. 4.1.2.7
Note: No other emissions were detected above the system noise floor.

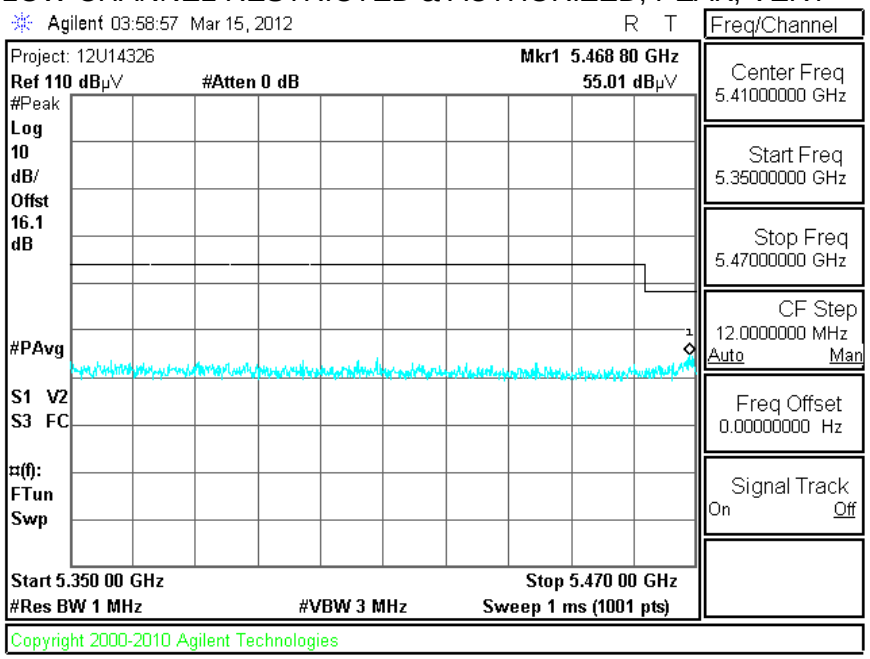
8.2.7. TX ABOVE 1 GHz 802.11a MODE IN THE 5.6 GHz BAND

RESTRICTED & AUTHORIZED BANDEDGE (LOW CHANNEL)

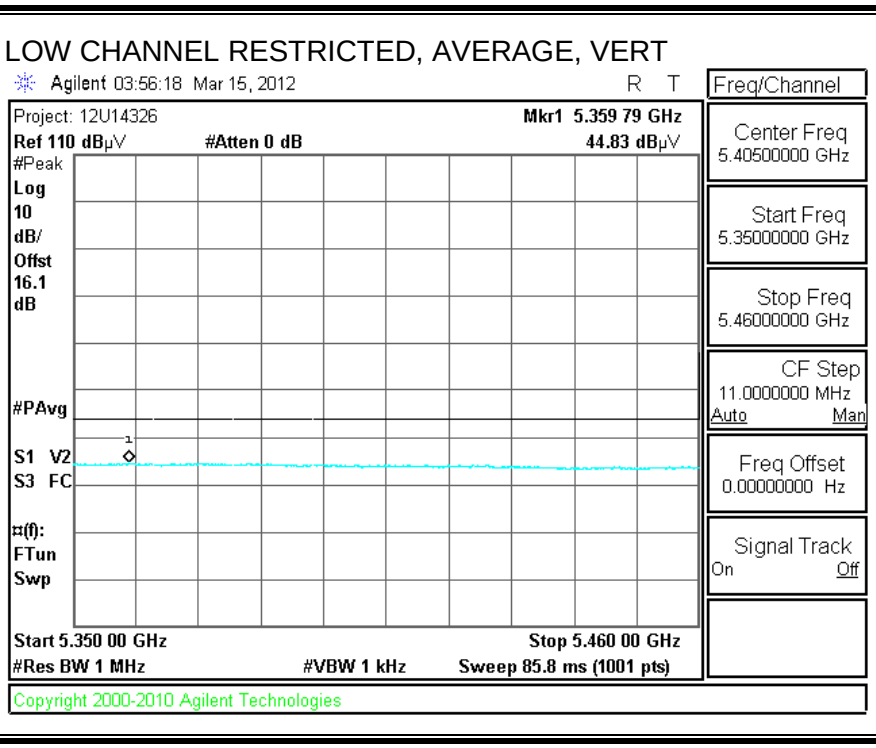




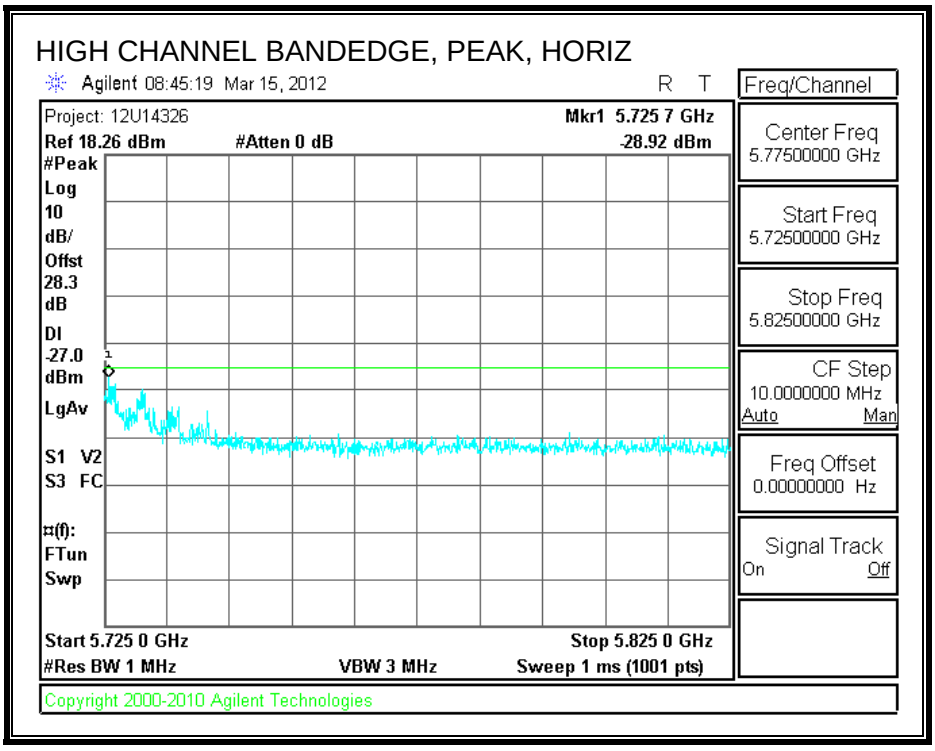
LOW CHANNEL RESTRICTED & AUTHORIZED, PEAK, VERT

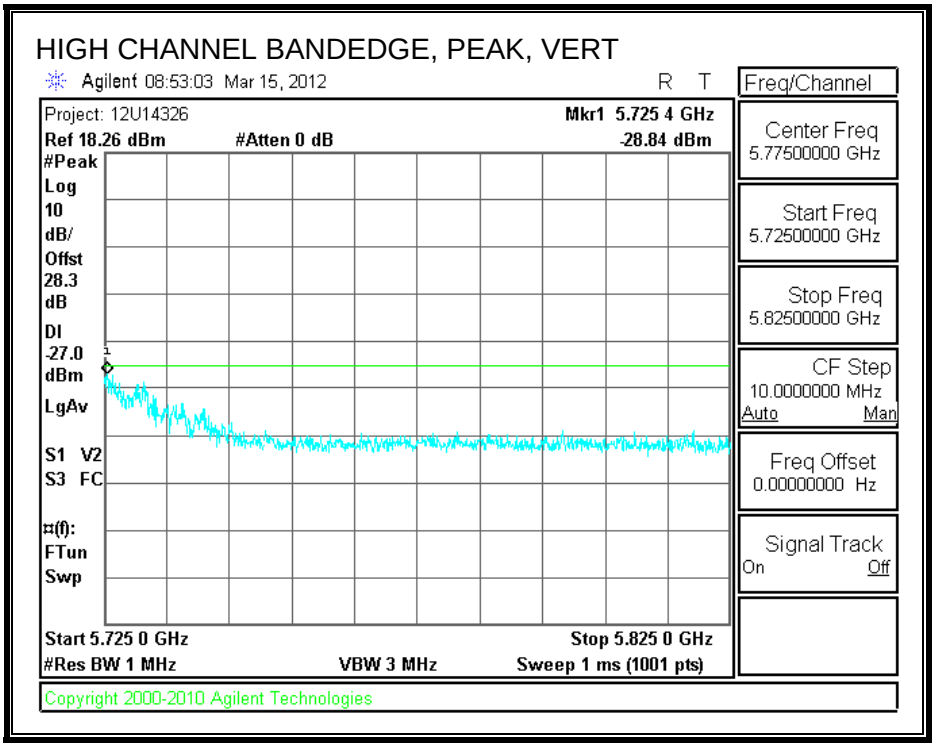


LOW CHANNEL RESTRICTED, AVERAGE, VERT



AUTHORIZED BANDEDGE (HIGH CHANNEL)





HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement
Compliance Certification Services, Fremont 5m Chamber

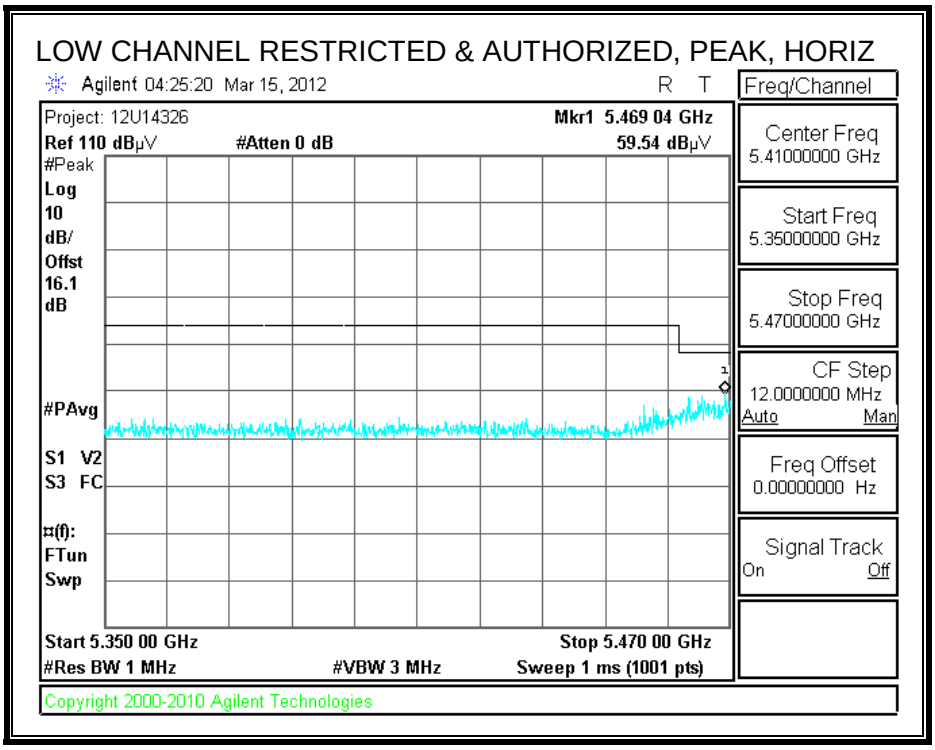
Test Engr: Tom Chen
Date: 03/21/12
Project #: 12U14326
Company: Apple
Test Target: FCC Class B
Mode Oper: 802.11a, W56 TX mode

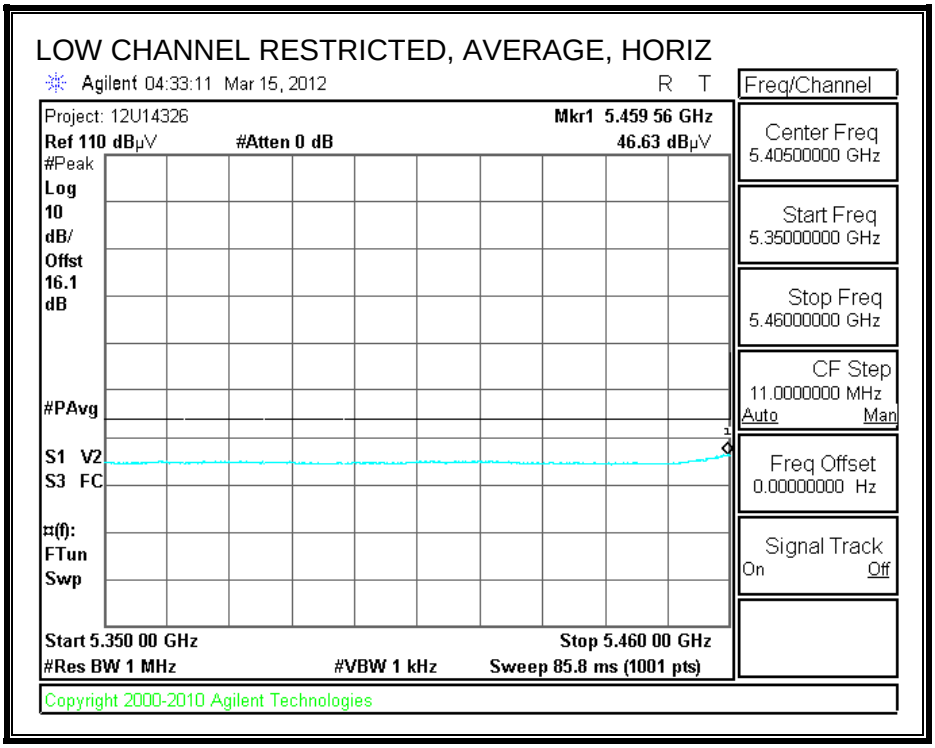
f	Measurement Frequency	Amp	Preamp Gain		Average Field Strength Limit
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters		Peak Field Strength Limit
Read	Analyzer Reading	Avg	Average Field Strength @ 3 m		Margin vs. Average Limit
AF	Antenna Factor	Peak	Calculated Peak Field Strength		Margin 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
5500MHz 11a													
11.000	3.0	44.8	38.3	10.1	-35.6	0.0	0.7	58.2	74.0	-15.8	V	P	
11.000	3.0	29.4	38.3	10.1	-35.6	0.0	0.7	42.9	54.0	-11.1	V	A	
5500MHz 11a													
11.000	3.0	38.5	38.3	10.1	-35.6	0.0	0.7	52.0	74.0	-22.0	H	P	
11.000	3.0	24.9	38.3	10.1	-35.6	0.0	0.7	38.4	54.0	-15.6	H	A	
5580MHz 11a													
11.160	3.0	38.7	38.5	10.2	-35.6	0.0	0.7	52.5	74.0	-21.5	H	P	
11.160	3.0	26.8	38.5	10.2	-35.6	0.0	0.7	40.6	54.0	-13.4	H	A	
5580MHz 11a													
11.160	3.0	44.8	38.5	10.2	-35.6	0.0	0.7	58.6	74.0	-15.4	V	P	
11.160	3.0	30.6	38.5	10.2	-35.6	0.0	0.7	44.4	54.0	-9.6	V	A	
5700MHz 11a													
11.400	3.0	42.7	38.7	10.4	-35.6	0.0	0.7	57.0	74.0	-17.0	V	P	
11.400	3.0	26.0	38.7	10.4	-35.6	0.0	0.7	40.4	54.0	-13.6	V	A	
5700MHz 11a													
11.400	3.0	35.6	38.7	10.4	-35.6	0.0	0.7	49.9	74.0	-24.1	H	P	
11.400	3.0	23.6	38.7	10.4	-35.6	0.0	0.7	37.9	54.0	-16.1	H	A	

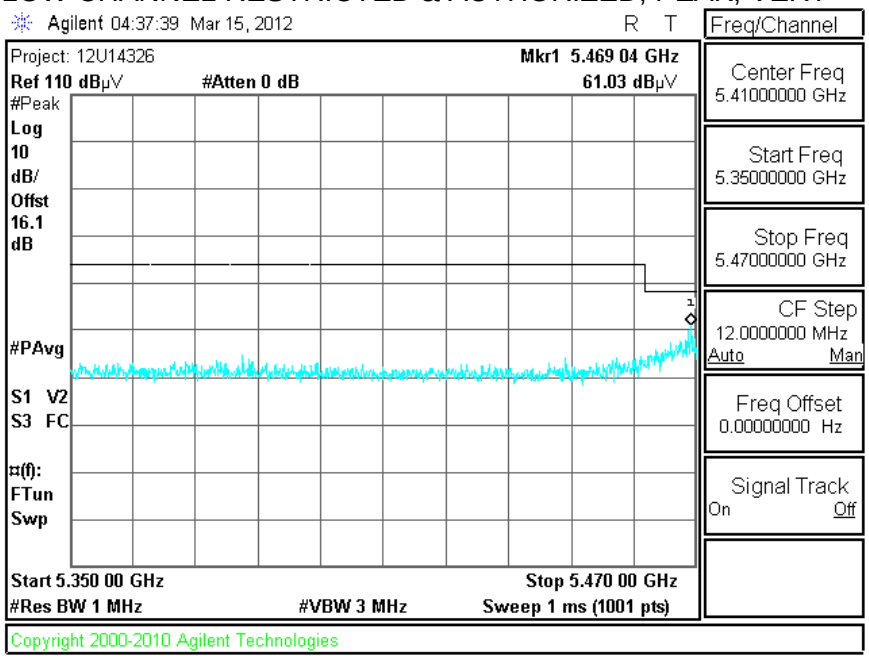
Rev. 4.1.2.7
Note: No other emissions were detected above the system noise floor.

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

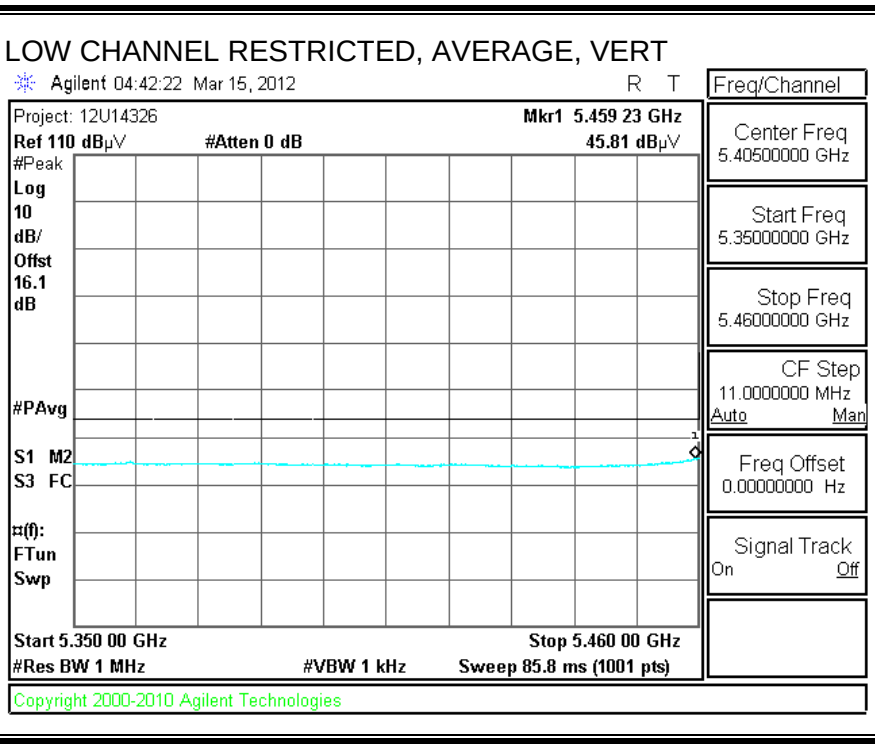




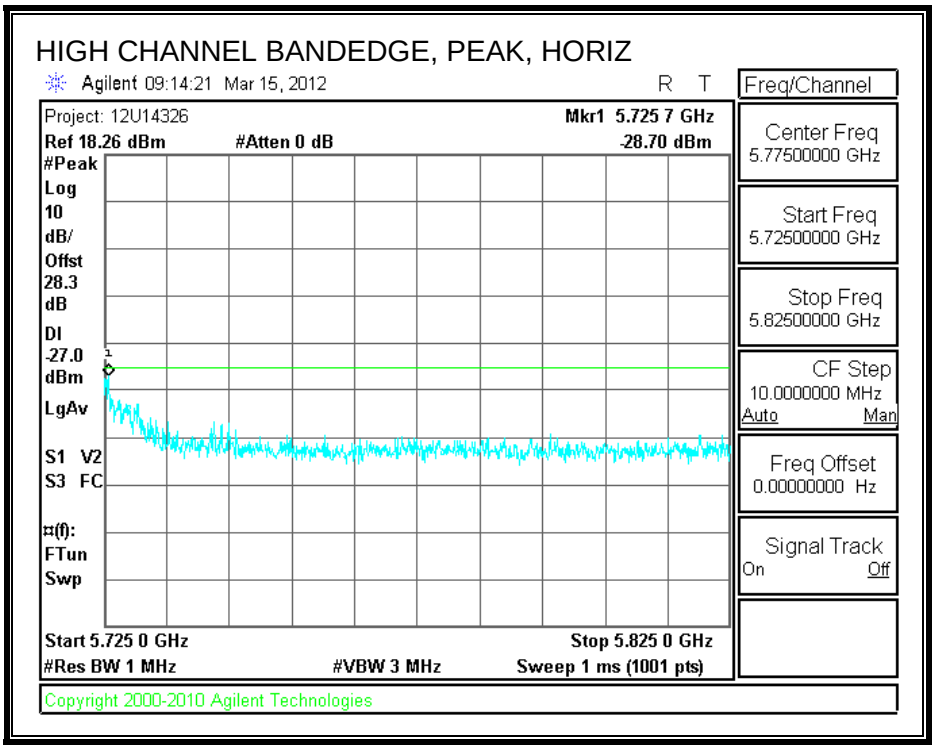
LOW CHANNEL RESTRICTED & AUTHORIZED, PEAK, VERT

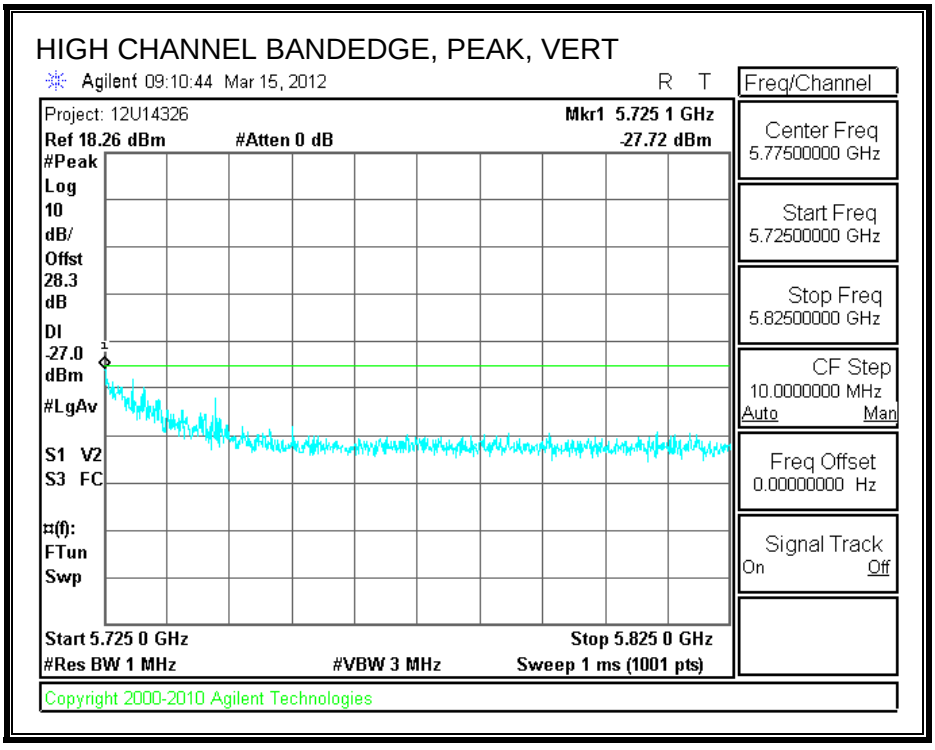


LOW CHANNEL RESTRICTED, AVERAGE, VERT



AUTHORIZED BANDEDGE (HIGH CHANNEL)





HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement
Compliance Certification Services, Fremont 5m Chamber

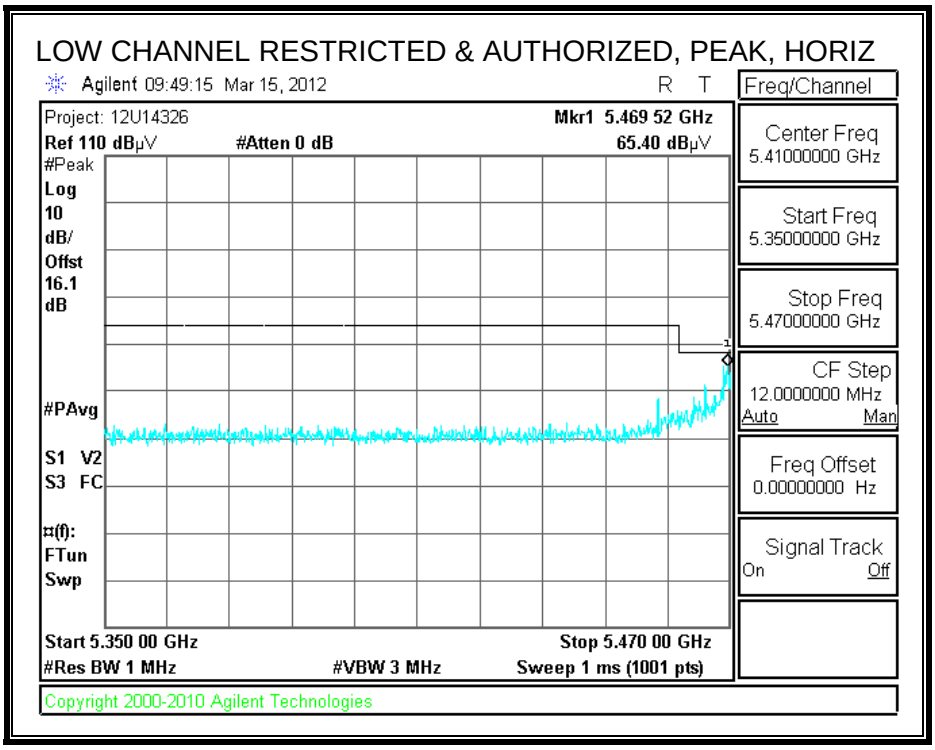
Test Engr: Tom Chen
Date: 03/21/12
Project #: 12U14326
Company: Apple
Test Target: FCC Class B
Mode Oper: 802.11n HT20, W56 TX mode

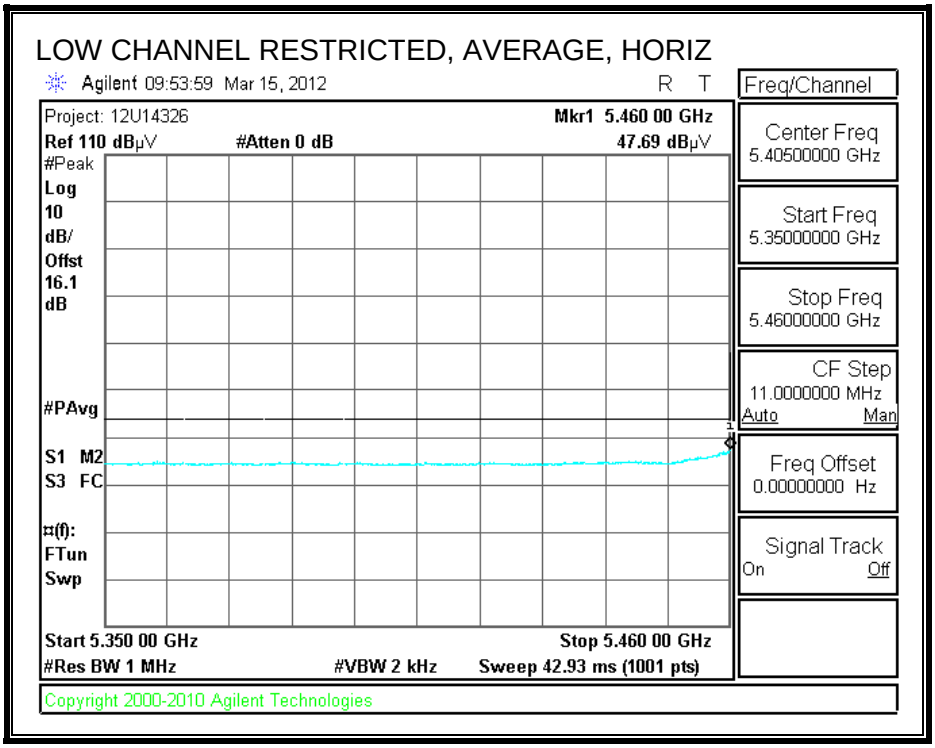
f	Measurement Frequency	Amp	Preamp Gain		Average Field Strength Limit
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters		Peak Field Strength Limit
Read	Analyzer Reading	Avg	Average Field Strength @ 3 m		Margin vs. Average Limit
AF	Antenna Factor	Peak	Calculated Peak Field Strength		Margin 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
5500MHz HT20													
11.000	3.0	46.1	38.3	10.1	-35.6	0.0	0.7	59.5	74.0	-14.5	V	P	
11.000	3.0	32.2	38.3	10.1	-35.6	0.0	0.7	45.6	54.0	-8.4	V	A	
5500MHz HT20													
11.000	3.0	36.9	38.3	10.1	-35.6	0.0	0.7	50.3	74.0	-23.7	H	P	
11.000	3.0	24.0	38.3	10.1	-35.6	0.0	0.7	37.4	54.0	-16.6	H	A	
5580MHz HT20													
11.160	3.0	40.9	38.5	10.2	-35.6	0.0	0.7	54.7	74.0	-19.3	H	P	
11.160	3.0	27.8	38.5	10.2	-35.6	0.0	0.7	41.6	54.0	-12.4	H	A	
5580MHz HT20													
11.160	3.0	44.2	38.5	10.2	-35.6	0.0	0.7	58.0	74.0	-16.0	V	P	
11.160	3.0	29.9	38.5	10.2	-35.6	0.0	0.7	43.7	54.0	-10.3	V	A	
5700MHz HT20													
11.400	3.0	35.5	38.7	10.4	-35.6	0.0	0.7	49.8	74.0	-24.2	H	P	
11.400	3.0	23.5	38.7	10.4	-35.6	0.0	0.7	37.8	54.0	-16.2	H	A	
5700MHz HT20													
11.400	3.0	41.1	38.7	10.4	-35.6	0.0	0.7	55.4	74.0	-18.6	V	P	
11.400	3.0	26.2	38.7	10.4	-35.6	0.0	0.7	40.5	54.0	-13.5	V	A	

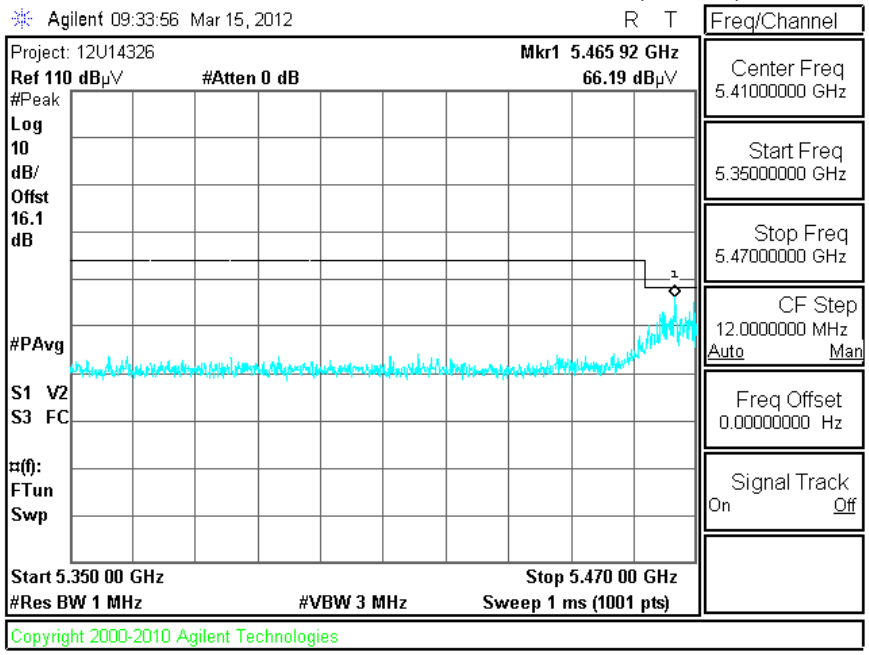
Rev. 4.1.2.7
Note: No other emissions were detected above the system noise floor.

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

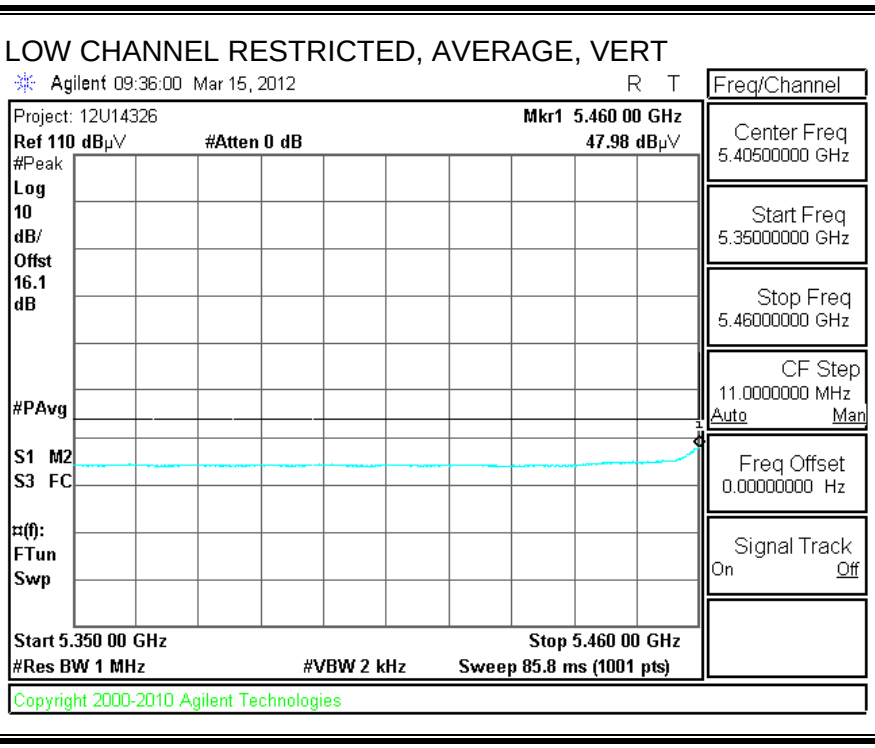




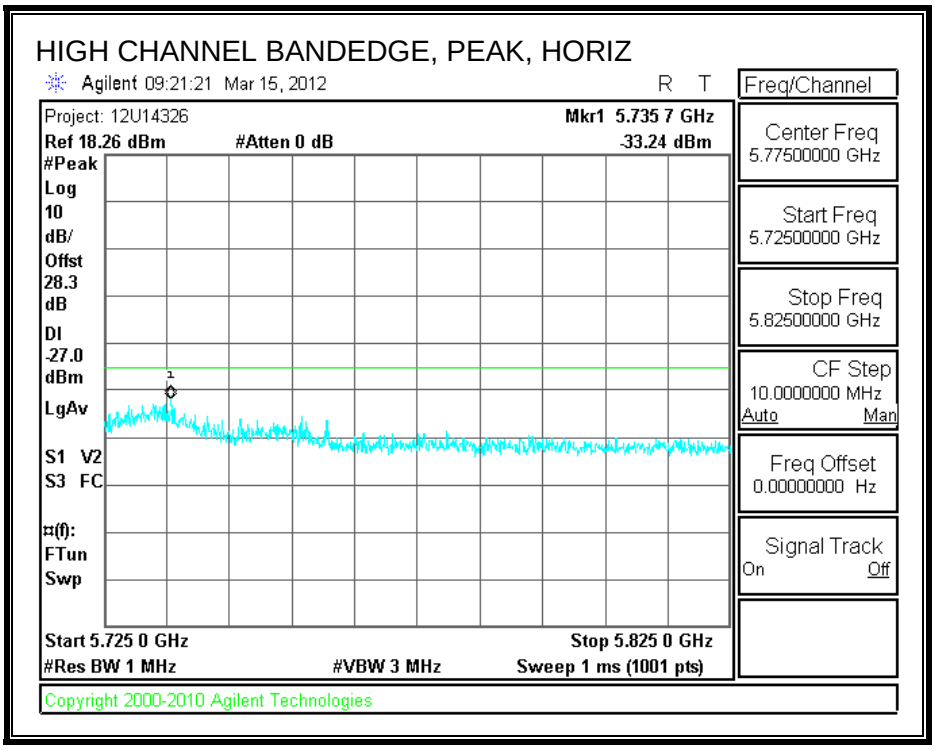
LOW CHANNEL RESTRICTED & AUTHORIZED, PEAK, VERT

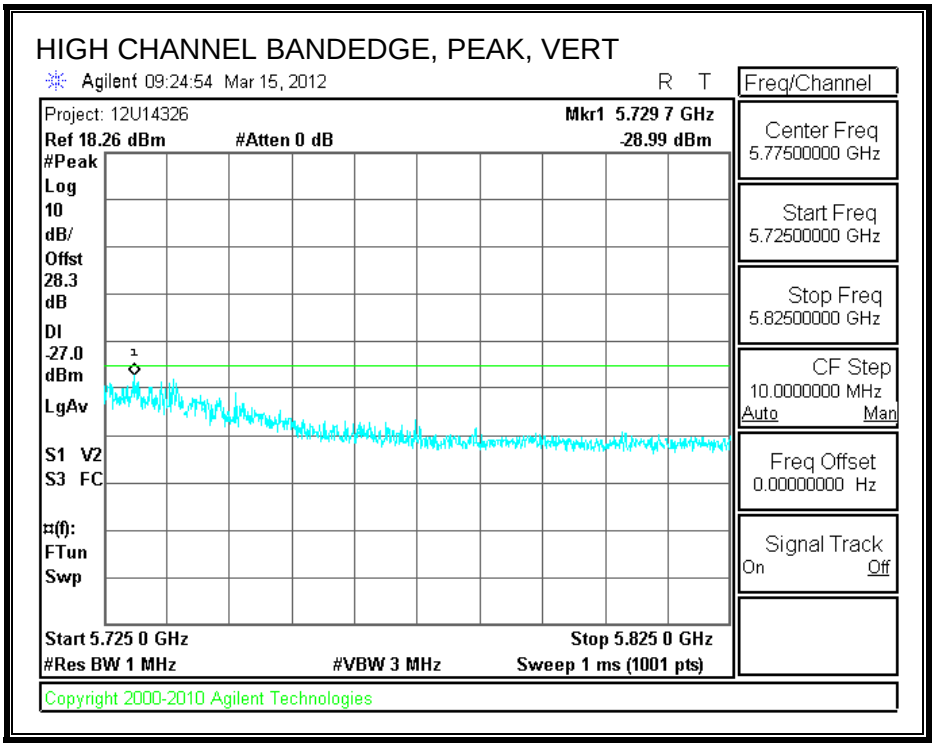


LOW CHANNEL RESTRICTED, AVERAGE, VERT



AUTHORIZED BANDEDGE (HIGH CHANNEL)





HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement
Compliance Certification Services, Fremont 5m Chamber

Test Engr: Tom Chen
Date: 03/21/12
Project #: 12U14326
Company: Apple
Test Target: FCC Class B
Mode Oper: 802.11n HT40, W56 TX mode

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

Average Field Strength Limit
Peak Field Strength Limit
Margin vs. Average Limit
Margin vs. Peak Limit

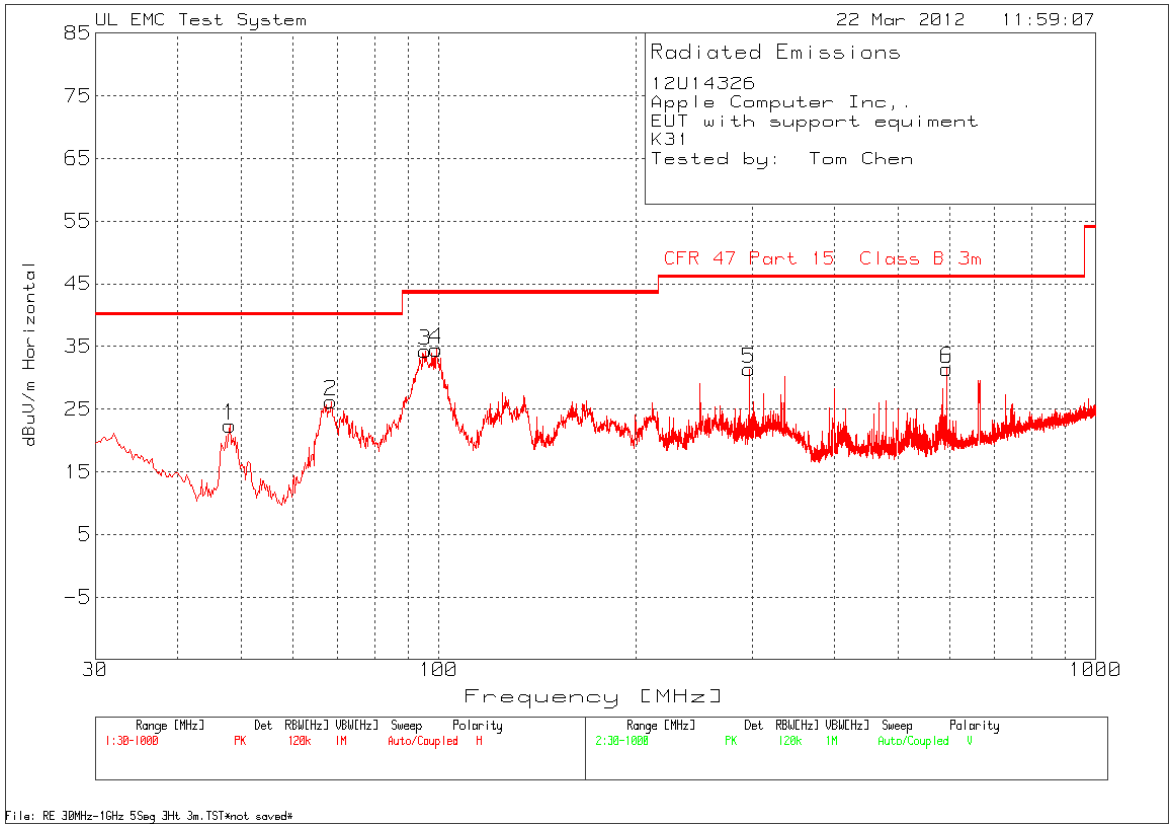
f GHz	Dist (m)	Read dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Corr. dBuV/m	Limit dBuV/m	Margin dB	Ant. Pol. V/H	Det. P/A/QP	Notes
5510MHz HT40													
11.020	3.0	40.0	38.3	10.1	-35.6	0.0	0.7	53.5	74.0	-20.5	V	P	
11.020	3.0	25.2	38.3	10.1	-35.6	0.0	0.7	38.7	54.0	-15.3	V	A	
5510MHz HT40													
11.020	3.0	35.5	38.3	10.1	-35.6	0.0	0.7	49.0	74.0	-25.0	H	P	
11.020	3.0	23.1	38.3	10.1	-35.6	0.0	0.7	36.6	54.0	-17.4	H	A	
5550MHz HT40													
11.100	3.0	35.8	38.4	10.1	-35.6	0.0	0.7	49.5	74.0	-24.5	H	P	
11.100	3.0	23.0	38.4	10.1	-35.6	0.0	0.7	36.7	54.0	-17.3	H	A	
5550MHz HT40													
11.100	3.0	34.8	38.4	10.1	-35.6	0.0	0.7	48.5	74.0	-25.5	V	P	
11.100	3.0	23.1	38.4	10.1	-35.6	0.0	0.7	36.8	54.0	-17.2	V	A	
5670MHz HT40													
11.340	3.0	41.9	38.7	10.4	-35.6	0.0	0.7	56.0	74.0	-18.0	V	P	
11.340	3.0	26.9	38.7	10.4	-35.6	0.0	0.7	41.1	54.0	-12.9	V	A	
5670MHz HT40													
11.340	3.0	36.0	38.7	10.4	-35.6	0.0	0.7	50.2	74.0	-23.8	H	P	
11.340	3.0	24.1	38.7	10.4	-35.6	0.0	0.7	38.3	54.0	-15.7	H	A	

Rev. 4.1.2.7
Note: No other emissions were detected above the system noise floor.

8.3. WORST-CASE BELOW 1 GHz

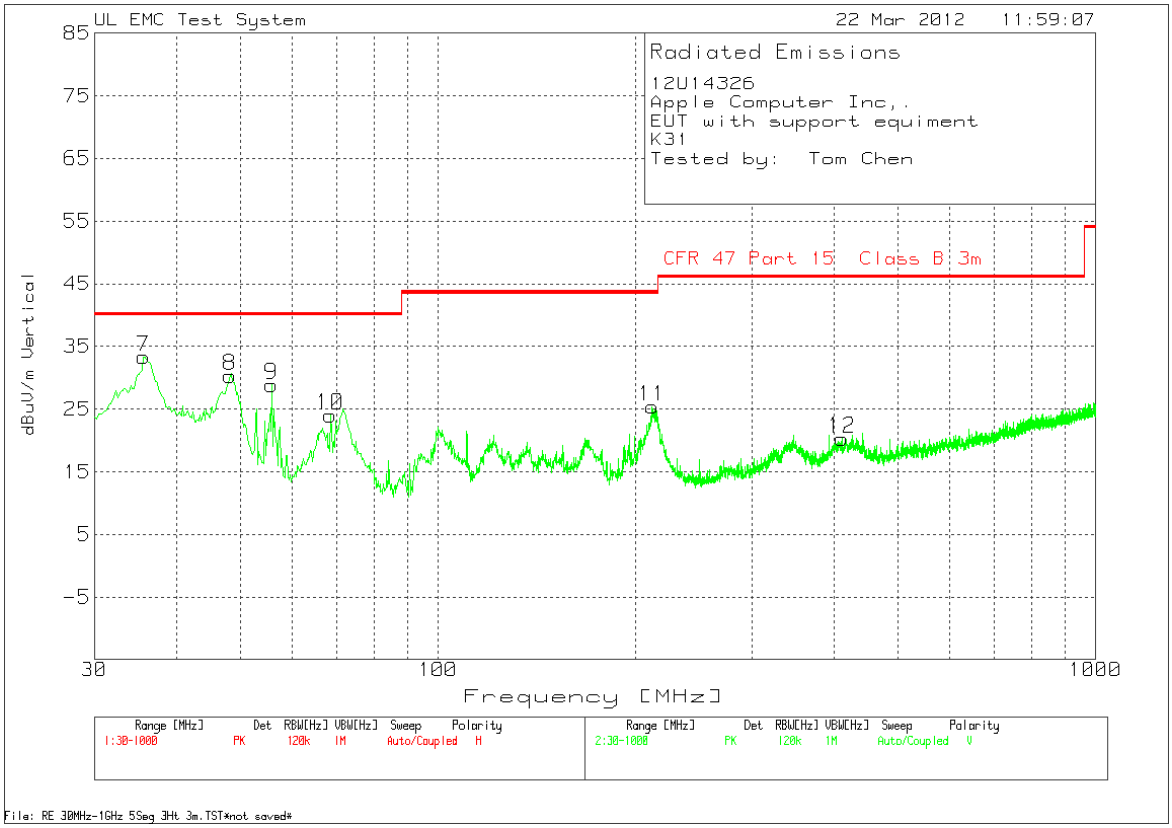
SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION, HORIZONTAL)

HORIZONTAL PLOT



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

VERTICAL PLOT



HORIZONTAL AND VERTICAL DATA

12U14326
Apple Computer Inc,.
EUT with support equiment
K31
Tested by: Tom Chen

Range 1 30 - 1000MHz

Test Frequency	Meter Reading	Detector	25MHz-1Ghz ChmbrB Amp [dB]	T130 Bilog Factors.TXT [dB]	dBuV/m	CFR 47 Part 15 Class B 3m	Polarity
48.0276	42.3	PK	-29.1	9.2	22.4	40	Horz
68.5751	46.92	PK	-28.9	8.2	26.22	40	Horz
95.3257	53.96	PK	-28.6	8.9	34.26	43.5	Horz
99.2026	53.23	PK	-28.6	9.9	34.53	43.5	Horz
296.9245	45.05	PK	-26.9	13.2	31.35	46	Horz
593.8949	39.97	PK	-26.7	18.2	31.47	46	Horz

Range 2 30 - 1000MHz

Test Frequency	Meter Reading	Detector	25MHz-1Ghz ChmbrB Amp [dB]	T130 Bilog Factors.TXT [dB]	dBuV/m	CFR 47 Part 15 Class B 3m	Polarity
35.6215	44.95	PK	-29.2	17.6	33.35	40	Vert
48.2214	50.3	PK	-29.1	9.1	30.3	40	Vert
55.7814	49.95	PK	-29	7.9	28.85	40	Vert
68.5751	44.71	PK	-28.9	8.2	24.01	40	Vert
211.6327	40.88	PK	-27.5	12	25.38	43.5	Vert
411.4868	32	PK	-26.9	15.2	20.3	46	Vert

9. AC POWER LINE CONDUCTED EMISSIONS

LIMITS

FCC §15.207 (a)

Frequency of Emission (MHz)	Conducted Limit (dBµV)	
	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:12U14326
Client Name:Apple computer Inc,.
Model/Device:K31
Test Volt/Freq:FCC Class B 120VAC 60 Hz
Test By:Tom Chen

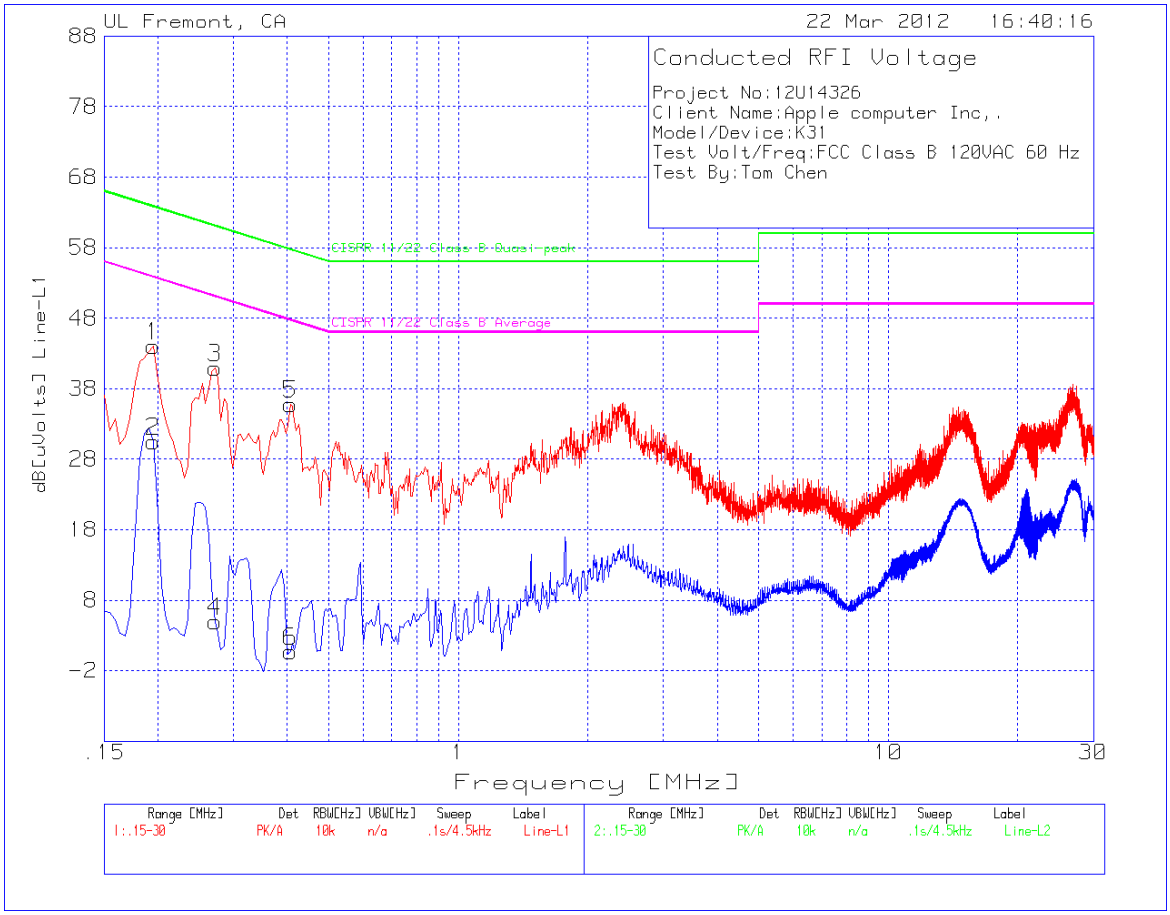
Line-L1 .15 - 30MHz

Test Frequency	Meter Reading	Detector	T24 IL L1.TXT [dB]	LC Cables 1&3.TXT [dB]	dB[uVolts]	CISPR 11/22 Class B Quasi-peak	Margin	CISPR 11/22 Class B Average	Margin
0.195	43.93	PK	0.1	0	44.03	63.8	-19.77	-	-
0.195	30.38	Av	0.1	0	30.48	-	-	53.8	-23.32
0.2715	40.8	PK	0.1	0	40.9	61.1	-20.2	-	-
0.2715	4.93	Av	0.1	0	5.03	-	-	51.1	-46.07
0.4065	35.72	PK	0.1	0	35.82	57.7	-21.88	-	-
0.4065	0.6	Av	0.1	0	0.7	-	-	47.7	-47

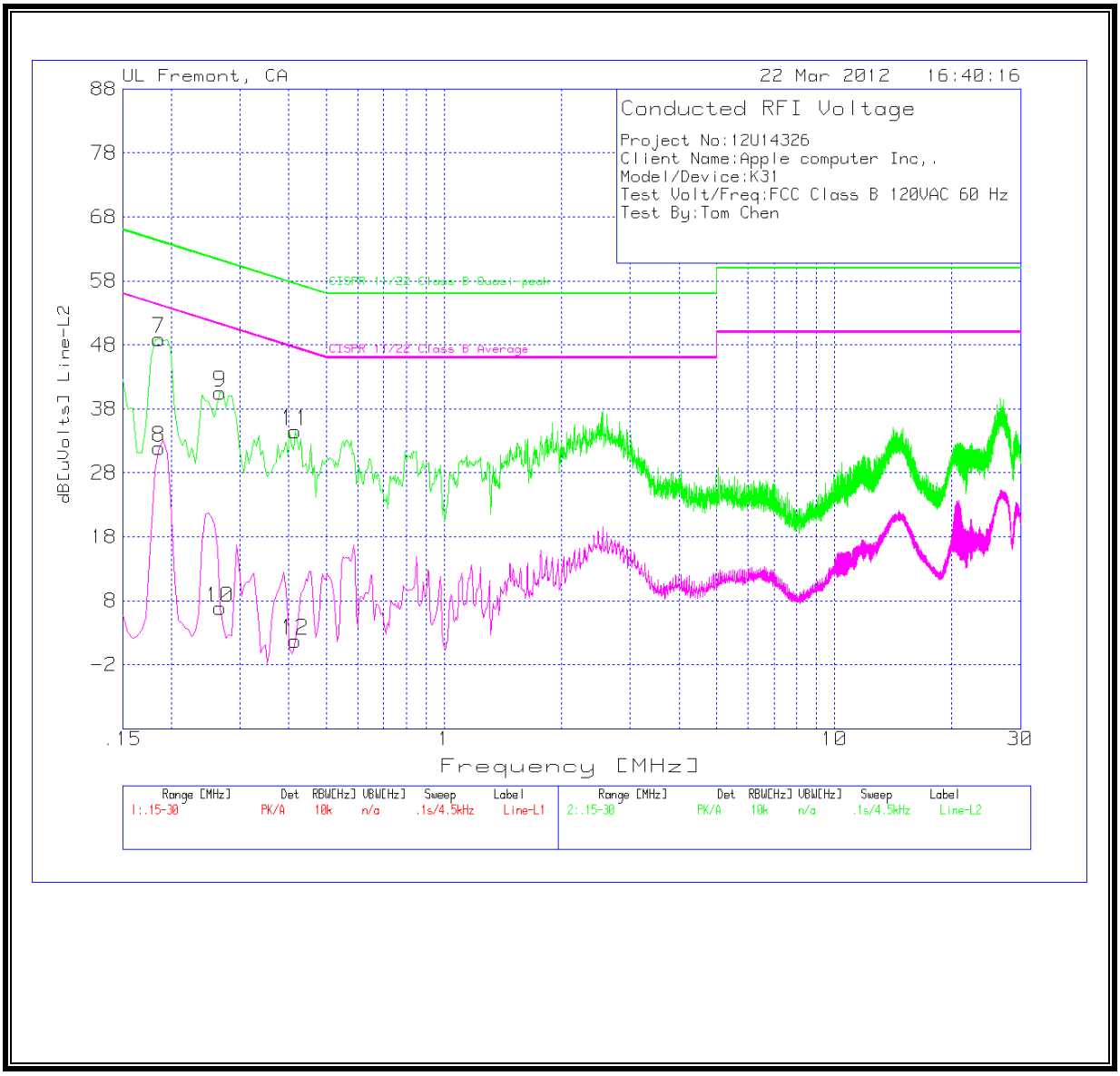
Line-L2 .15 - 30MHz

Test Frequency	Meter Reading	Detector	T24 IL L2.TXT [dB]	LC Cables 2&3.TXT [dB]	dB[uVolts]	CISPR 11/22 Class B Quasi-peak	Margin	CISPR 11/22 Class B Average	Margin
0.186	48.81	PK	0.1	0	48.91	64.2	-15.29	-	-
0.186	31.81	Av	0.1	0	31.91	-	-	54.2	-22.29
0.267	40.45	PK	0.1	0	40.55	61.2	-20.65	-	-
0.267	6.75	Av	0.1	0	6.85	-	-	51.2	-44.35
0.4155	34.38	PK	0.1	0	34.48	57.5	-23.02	-	-
0.4155	1.64	Av	0.1	0	1.74	-	-	47.5	-45.76

LINE 1 RESULTS



LINE 2 RESULTS



10. MAXIMUM PERMISSIBLE EXPOSURE

FCC RULES

§1.1310 The criteria listed in Table 1 shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in §1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of §2.1093 of this chapter.

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3–3.0	614	1.63	*(100)	6
3.0–30	1842/f	4.89/f	*($900/f^2$)	6
30–300	61.4	0.163	1.0	6
300–1500			f/300	6
1500–100,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*($180/f^2$)	30

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)—Continued

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
30–300	27.5	0.073	0.2	30
300–1500			f/1500	30
1500–100,000			1.0	30

f = frequency in MHz
* = Plane-wave equivalent power density
NOTE 1 TO TABLE 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.
NOTE 2 TO TABLE 1: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

EQUATIONS

POWER DENSITY

Power density is given by:

S = EIRP / (4 * Pi * D^2)

Where

S = Power density in mW/cm^2
EIRP = Equivalent Isotropic Radiated Power in mW
D = Separation distance in cm

Power density in units of mW/cm^2 is converted to units of W/m^2 by multiplying by 10.

DISTANCE

Distance is given by:

D = SQRT (EIRP / (4 * Pi * S))

Where

D = Separation distance in cm
EIRP = Equivalent Isotropic Radiated Power in mW
S = Power density in mW/cm^2

SOURCE-BASED DUTY CYCLE

Where applicable (for example, multi-slot cell phone applications) a duty cycle factor may be applied.

Source-based time-averaged EIRP = (DC / 100) * EIRP

Where

DC = Duty Cycle in %, as applicable
EIRP = Equivalent Isotropic Radiated Power in W

MIMO AND COLOCATED TRANSMITTERS (IDENTICAL LIMIT FOR ALL TRANSMITTERS)

For multiple chain devices, and colocated transmitters operating simultaneously in frequency bands where the limit is identical, the total power density is calculated using the total EIRP obtained by summing the EIRP (in linear units) of each transmitter.

Total EIRP = (EIRP1) + (EIRP2) + ... + (EIRPn)

where

EIRPx = Source-based time-averaged EIRP of chain x or transmitter x

The total EIRP is then used to calculate the Power Density or the Distance as applicable.

MIMO AND COLOCATED TRANSMITTERS

For multiple colocated transmitters operating simultaneously in frequency bands where different limits apply:

The Power Density at the specified separation distance is calculated for each transmitter chain or transmitter.

The fraction of the exposure limit is calculated for each chain or transmitter as
(Power Density of chain or transmitter) / (Limit applicable to that chain or transmitter).

The fractions are summed.

Compliance is established if the sum of the fractions is less than or equal to one.

10.1. LIMITS

VARIABLE LIMITS

For mobile radio equipment operating in the cellular phone band, the lowest power density limit is calculated using the lowest frequency:

824 MHz / 1500 = 0.55 mW/cm^2 (FCC)

FIXED LIMITS

For operation in the PCS band, the 2.4 GHz band and the 5 GHz bands:

From FCC §1.1310 Table 1 (B), the maximum value of S = 1.0 mW/cm^2

RESULTS

Multiple chain or colocated transmitters								
Band	**Mode**	**Chain for MIMO**	**Separation Distance (m)**	**Output AV Power (dBm)**	**Antenna Gain (dBi)**	**Duty Cycle (%)**	**IC Power Density (W/m^2)**	**FCC Power Density (mW/cm^2)**
5.3 GHz	WLAN	1		19.00	0.93	96.7		
5.3 GHz	WLAN	2		18.90	1.88	96.7		
Combined			0.20				0.42	0.042

Multiple chain or colocated transmitters									
Band	**Mode**	**Chain for MIMO**	**Separation Distance (m)**	**Output Power (dBm)**	**Antenna Gain (dBi)**	**EIRP (dBm)**	**EIRP (W)**	**IC Power Density (W/m^2)**	**FCC Power Density (mW/cm^2)**
2.4 GHz	WLAN	1		20.50	1.49	21.99	0.16		
2.4 GHz	WLAN	2		20.65	1.82	22.47	0.18		
5.3 GHz	WLAN	1		19.00	0.93	19.93	0.10		
5.3 GHz	WLAN	2		18.90	1.88	20.78	0.12		
Combined			0.20				0.55	1.10	0.110