

# FCC 47 CFR PART 15 SUBPART E

# **CERTIFICATION TEST REPORT**

FOR

## PORTABLE COMPUTING DEVICE

## **MODEL NUMBER: 1724**

## FCC ID: C3K1724B

# REPORT NUMBER: R10880568-E2CV2

**ISSUE DATE: 2015-10-08** 

Prepared for MICROSOFT CORPORATION ONE MICROSOFT WAY REDMOND, WA 98052, U.S.A.

Prepared by UL LLC 12 LABORATORY DR. RESEARCH TRIANGLE PARK, NC 27709 USA TEL: (919) 549-1400

NVLAP Lab code: 200246-0

#### **Revision History**

Ver.	lssue Date	Revisions	Revised By
1	2015-10-02	Initial Issue	J. Moser
2	2015-10-08	Update- DFS Data	F. de Anda

UL LLC FORM NO: 03-EM-F00858 12 Laboratory Dr., RTP, NC 27709 TEL: (919) 549-1400 *This report shall not be reproduced except in full, without the written approval of UL LLC.* 

Page 2 of 437

# **TABLE OF CONTENTS**

1.	ATTE	STATION OF TEST RESULTS	. 7
2.	TEST	METHODOLOGY	. 8
3.	FACIL	ITIES AND ACCREDITATION	. 8
4.	CALIE	BRATION AND UNCERTAINTY	. 8
4	.1. N	EASURING INSTRUMENT CALIBRATION	. 8
4	.2. S	AMPLE CALCULATION	. 8
4	.3. N	EASUREMENT UNCERTAINTY	. 9
5.	EQUI	PMENT UNDER TEST	10
5	.1. D	ESCRIPTION OF EUT	10
5	.2. N	AXIMUM OUTPUT POWER	10
5	.3. D	ESCRIPTION OF AVAILABLE ANTENNAS	11
5	. <i>4.</i> S	OFTWARE AND FIRMWARE	11
5	. <i>5.</i> И	ORST-CASE CONFIGURATION AND MODE	12
5	.6. D	ESCRIPTION OF TEST SETUP	13
6.	TEST	AND MEASUREMENT EQUIPMENT	17
7	MFAS		19
7.			
8.	ANTE	NNA PORT TEST RESULTS	20
<b>8.</b> 8	<b>ANTE</b> 2.1. C	NNA PORT TEST RESULTS	<b>20</b> 20
<b>8.</b> 8	<b>ANTE</b> 2.1. C	NNA PORT TEST RESULTS N TIME AND DUTY CYCLE 02.11a MODE IN THE 5.2 GHz BAND	<b>20</b> 20 23
<b>8.</b> 8	<b>ANTE</b> 2.1. C 2.2. 8 8.2.1. 8.2.2.	NNA PORT TEST RESULTS N TIME AND DUTY CYCLE 02.11a MODE IN THE 5.2 GHz BAND 26 dB BANDWIDTH 99% BANDWIDTH	<b>20</b> 20 23 23 27
<b>8.</b> 8	<b>ANTE</b> 2.1. C 8.2. 8 8.2.1. 8.2.2. 8.2.3.	NNA PORT TEST RESULTS N TIME AND DUTY CYCLE 02.11a MODE IN THE 5.2 GHz BAND 26 dB BANDWIDTH 99% BANDWIDTH OUTPUT POWER AND PSD	<b>20</b> 23 23 27 31
<b>8.</b> 8	<b>ANTE</b> 2.1. C 8.2. 8 8.2.1. 8.2.2. 8.2.3. 8.3. 8	NNA PORT TEST RESULTS	<b>20</b> 23 23 27 31 37
<b>8.</b> 8	<b>ANTE</b> 2.1. C 8.2. 8 8.2.1. 8.2.2. 8.2.3. 8.3.1. 8.3.1. 8.3.2.	NNA PORT TEST RESULTS	<b>20</b> 23 23 27 31 37 37 41
<b>8.</b> 8 8	ANTE 2.1. C 2.2. 8 8.2.1. 8.2.2. 8.2.3. 8.3.3. 8.3.1. 8.3.2. 8.3.3.	NNA PORT TEST RESULTS	<b>20</b> 23 23 27 31 37 37 41 45
<b>8.</b> 8 8	ANTE 2.1. C 2.2. 8 8.2.1. 8.2.2. 8.2.3. 8.3.1. 8.3.2. 8.3.2. 8.3.3. 8.3.5. 8.3.5. 8.3.5. 8.5.5. 8.5.5. 8.5.5.5. 8.5.5.5.5. 8.5.5.5.5.5.5.5.5.5.5.5.5.5.5.5.5.5.5.5	NNA PORT TEST RESULTS	<b>20</b> 23 23 27 31 37 37 41 45 51
<b>8.</b> 8 8	ANTE 2.1. C 2.2. 8 8.2.1. 8.2.2. 8.2.3. 8.3.1. 8.3.2. 8.3.3. 8.3.3. 8.3.3. 8.3.3. 8.3.1. 8.3.2. 8.3.3. 8.3.1. 8.3.2. 8.3.3. 8.3.1. 8.3.2. 8.3.1. 8.3.2. 8.3.1. 8.3.2. 8.3.1. 8.3.2. 8.3.1. 8.3.2. 8.3.1. 8.3.2. 8.3.1. 8.3.2. 8.3.3. 8.3.4.1. 8.4.2.	NNA PORT TEST RESULTS	<b>20</b> 23 23 27 31 37 37 41 45 51 51
8. 8 8 8	ANTE 2. 8 8.2.1. 8.2.2. 8.2.3. 8.3.1. 8.3.2. 8.3.3. 8.3.3. 8.3.3. 8.3.3. 8.3.1. 8.3.2. 8.3.3. 8.3.3. 8.3.1. 8.3.2. 8.3.3.5. 8.3.5. 8.3.5. 8.3.5. 8.3.5. 8.5.5. 8.5.5. 8.5.5.5.5.5.5.5.5.5.5.5.5.5.5.5.5.5.5.5	NNA PORT TEST RESULTS	<b>20</b> 23 23 27 31 37 45 51 51 54 57
8. 8 8 8	ANTE 2.1. C 2.2. 8 8.2.1. 8.2.2. 8.2.3. 8.3.1. 8.3.2. 8.3.3. 8.3.3. 8.3.3. 8.3.1. 8.3.2. 8.3.3. 8.3.3. 8.3.3. 8.3.4. 8.4.1. 8.4.2. 8.4.3. 8.4.3. 8.5. 8	NNA PORT TEST RESULTS	<b>20</b> 23 23 27 31 37 41 45 51 51 51 57 62
8. 8 8 8	ANTE 2. 8 8.2.1. 8.2.2. 8.2.3. 8.3.1. 8.3.2. 8.3.3. 8.3.3. 8.3.3. 8.3.3. 8.3.1. 8.3.2. 8.3.3. 8.3.3. 8.3.1. 8.3.2. 8.3.3.3. 8.3.3.5. 8.3.5.	NNA PORT TEST RESULTS       And DUTY CYCLE         D2.11a MODE IN THE 5.2 GHz BAND       26 dB BANDWIDTH         D9% BANDWIDTH       29% BANDWIDTH         OUTPUT POWER AND PSD       20         D2.11n HT20 MODE IN THE 5.2 GHz BAND       26 dB BANDWIDTH         D9% BANDWIDTH       20         D2.11n HT20 MODE IN THE 5.2 GHz BAND       20         D2.11n HT40 MODE IN THE 5.2 GHz BAND       20         D2.11n HT40 MODE IN THE 5.2 GHz BAND       20         D2.11n HT40 MODE IN THE 5.2 GHz BAND       20         D2.11n HT40 MODE IN THE 5.2 GHz BAND       20         D2.11n HT40 MODE IN THE 5.2 GHz BAND       20         D2.11n HT40 MODE IN THE 5.2 GHz BAND       20         D2.11n HT40 MODE IN THE 5.2 GHz BAND       20         D2.11n HT40 MODE IN THE 5.2 GHz BAND       20         D3% BANDWIDTH       20         D4 BANDWIDTH       20         D50       20         D6 BANDWIDTH       20         D7       20         D8       20         D9% BANDWIDTH       20         D9% BANDWIDTH	<b>20</b> 23 23 27 31 37 37 45 51 554 57 62 62 64
8. 8 8 8 8 8	ANTE 2.1. C 2.2. 8 8.2.1. 8.2.2. 8.2.3. 8.3.1. 8.3.2. 8.3.3. 2.4. 8 8.4.1. 8.4.2. 8.4.3. 8.4.3. 8.5.1. 8.5.2. 8.5.3.	NNA PORT TEST RESULTS	<b>20</b> 23237 3737 45 51 57 62 62 64 66
8. 8 8 8 8 8	ANTE 2.1. C 2.2. 8 8.2.1. 8.2.2. 8.2.3. 8.3.1. 8.3.2. 8.3.3. 2.4. 8 8.4.1. 8.4.2. 8.4.3. 8.4.3. 8.5.1. 8.5.2. 8.5.3.	NNA PORT TEST RESULTS       And DUTY CYCLE         D2.11a MODE IN THE 5.2 GHz BAND       26 dB BANDWIDTH         D9% BANDWIDTH       29% BANDWIDTH         OUTPUT POWER AND PSD       20         D2.11n HT20 MODE IN THE 5.2 GHz BAND       26 dB BANDWIDTH         D9% BANDWIDTH       20         D2.11n HT20 MODE IN THE 5.2 GHz BAND       20         D2.11n HT40 MODE IN THE 5.2 GHz BAND       20         D2.11n HT40 MODE IN THE 5.2 GHz BAND       20         D2.11n HT40 MODE IN THE 5.2 GHz BAND       20         D2.11n HT40 MODE IN THE 5.2 GHz BAND       20         D2.11n HT40 MODE IN THE 5.2 GHz BAND       20         D2.11n HT40 MODE IN THE 5.2 GHz BAND       20         D2.11n HT40 MODE IN THE 5.2 GHz BAND       20         D2.11n HT40 MODE IN THE 5.2 GHz BAND       20         D3% BANDWIDTH       20         D4 BANDWIDTH       20         D50       20         D6 BANDWIDTH       20         D7       20         D8       20         D9% BANDWIDTH       20         D9% BANDWIDTH	<b>20</b> 23 237 31 377 311 551 554 557 622 664 66 70

Page 3 of 437

8.6.2.       99% BANDWIDTH	78
8.7.       802.11n HT20 MODE IN THE 5.3 GHz BAND       80         8.7.1.       26 dB BANDWIDTH       80         8.7.2.       99% BANDWIDTH       80         8.7.3.       OUTPUT POWER AND PSD       90         8.7.4.       TPC POWER       90	35 39 93
8.8.       802.11n HT40 MODE IN THE 5.3 GHz BAND       100         8.8.1.       26 dB BANDWIDTH       100         8.8.2.       99% BANDWIDTH       100         8.8.3.       OUTPUT POWER AND PSD       100         8.8.4.       TPC POWER       100	)0 )3 )6
8.9.       802.11ac VHT80 MODE IN THE 5.3 GHz BAND       11.         8.9.1.       26 dB BANDWIDTH       11.         8.9.2.       99% BANDWIDTH       11.         8.9.3.       OUTPUT POWER AND PSD       110.         8.9.4.       TPC POWER       120.	2  4  6
8.10.       802.11a MODE IN THE 5.6 GHz BAND       12         8.10.1.       26 dB BANDWIDTH       12         8.10.2.       99% BANDWIDTH       12         8.10.3.       OUTPUT POWER AND PSD       13         8.10.4.       TPC POWER       14	22 29 86
8.11.       802.11n HT20 MODE IN THE 5.6 GHz BAND.       14         8.11.1.       26 dB BANDWIDTH       14         8.11.2.       99% BANDWIDTH       15         8.11.3.       OUTPUT POWER AND PSD       16         8.11.4.       TPC POWER       17	19 56 53
8.12.       802.11n HT40 MODE IN THE 5.6 GHz BAND.       17         8.12.1.       26 dB BANDWIDTH       17         8.12.2.       99% BANDWIDTH       18         8.12.3.       OUTPUT POWER AND PSD       18         8.12.4.       TPC POWER       19	76 31 36
8.13.       802.11ac VHT80 MODE IN THE 5.6 GHz BAND.       19         8.13.1.       26 dB BANDWIDTH       19         8.13.2.       99% BANDWIDTH       20         8.13.3.       OUTPUT POWER AND PSD       20         8.13.4.       TPC POWER       21	)8 )3 )8
8.14.       802.11a MODE IN THE 5.8 GHz BAND       21         8.14.1.       6 dB BANDWIDTH       21         8.14.2.       26 dB BANDWIDTH       22         8.14.3.       99% BANDWIDTH       22         8.14.4.       OUTPUT POWER       23         8.14.5.       Maximum Power Spectral Density (PSD)       23	19 23 27 31
8.15.       802.11n HT20 MODE IN THE 5.8 GHz BAND	38 12

# UL LLC

8.15.4. 8.15.5.	OUTPUT POWER Maximum Power Spectral Density (PSD)	
8.16.1. 8.16.2. 8.16.3. 8.16.4. 8.16.5.	02.11n HT40 MODE IN THE 5.2 GHz BAND 6 dB BANDWIDTH 26 dB BANDWIDTH 99% BANDWIDTH OUTPUT POWER	257 260 263 266 268
8.17.1. 8.17.2. 8.17.3. 8.17.4. 8.17.5.	02.11ac VHT80 MODE IN THE 5.8 GHz BAND 6 dB BANDWIDTH 26 dB BANDWIDTH 99% BANDWIDTH OUTPUT POWER Maximum Power Spectral Density (PSD)	272 274 276 278 280
-	ITS AND PROCEDURE	-
9.2. TR/ 9.2.1. 9.2.2. 9.2.3. 9.2.4. 9.2.5. 9.2.6. 9.2.7. 9.2.8. 9.2.9. 9.2.10. 9.2.11. 9.2.12. 9.2.13. 9.2.14. 9.2.15. 9.2.16. 9.3. WC	ANSMITTER ABOVE 1 GHz TX ABOVE 1 GHz 802.11a MODE IN THE 5.2 GHz BAND TX ABOVE 1 GHz 802.11n HT20 MODE IN THE 5.2 GHz BAND TX ABOVE 1 GHz 802.11n HT40 MODE IN THE 5.2 GHz BAND TX ABOVE 1 GHz 802.11ac VHT80 MODE IN THE 5.2 GHz BAND TX ABOVE 1 GHz 802.11a MODE IN THE 5.3 GHz BAND TX ABOVE 1 GHz 802.11n HT20 MODE IN THE 5.3 GHz BAND TX ABOVE 1 GHz 802.11n HT20 MODE IN THE 5.3 GHz BAND TX ABOVE 1 GHz 802.11n HT40 MODE IN THE 5.3 GHz BAND TX ABOVE 1 GHz 802.11ac VHT80 MODE IN THE 5.3 GHz BAND TX ABOVE 1 GHz 802.11a MODE IN THE 5.6 GHz BAND TX ABOVE 1 GHz 802.11a MODE IN THE 5.6 GHz BAND TX ABOVE 1 GHz 802.11n HT20 MODE IN THE 5.6 GHz BAND TX ABOVE 1 GHz 802.11n HT40 MODE IN THE 5.6 GHz BAND TX ABOVE 1 GHz 802.11a MODE IN THE 5.6 GHz BAND TX ABOVE 1 GHz 802.11a MODE IN THE 5.6 GHz BAND TX ABOVE 1 GHz 802.11a MODE IN THE 5.8 GHz BAND TX ABOVE 1 GHz 802.11a MODE IN THE 5.8 GHz BAND TX ABOVE 1 GHz 802.11a MODE IN THE 5.8 GHz BAND TX ABOVE 1 GHz 802.11a MODE IN THE 5.8 GHz BAND TX ABOVE 1 GHz 802.11a MODE IN THE 5.8 GHz BAND TX ABOVE 1 GHz 802.11a MODE IN THE 5.8 GHz BAND TX ABOVE 1 GHz 802.11a MODE IN THE 5.8 GHz BAND TX ABOVE 1 GHz 802.11a MODE IN THE 5.8 GHz BAND TX ABOVE 1 GHz 802.11a MODE IN THE 5.8 GHz BAND TX ABOVE 1 GHz 802.11a MODE IN THE 5.8 GHz BAND TX ABOVE 1 GHz 802.11a WHT80 MODE IN THE 5.8 GHz BAND TX ABOVE 1 GHz 802.11a CVHT80 MODE IN THE 5.8 GHz BAND TX ABOVE 1 GHz 802.11ac VHT80 MODE IN THE 5.8 GHz BAND TX ABOVE 1 GHz 802.11ac VHT80 MODE IN THE 5.8 GHz BAND TX ABOVE 1 GHz 802.11ac VHT80 MODE IN THE 5.8 GHz BAND TX ABOVE 1 GHz 802.11ac VHT80 MODE IN THE 5.8 GHz BAND PRST-CASE 18-40GHz	
10. AC P	OWER LINE CONDUCTED EMISSIONS	
	MIC FREQUENCY SELECTION	
11.1.1. 11.1.2.	LIMITS	
11.2.1. 11.2.2.	ESULTS FOR 20 MHz BANDWIDTH TEST CHANNEL RADAR WAVEFORM AND TRAFFIC OVERLAPPING CHANNEL TESTS Page 5 of 437	405 405

# UL LLC

FORM NO: 03-EM-F00858 TEL: (919) 549-1400

12 Laboratory Dr., RTP, NC 27709 TEL: (919) 549-1 *This report shall not be reproduced except in full, without the written approval of UL LLC.* 

11.2.4.	MOVE AND CLOSING TIME	408
11.3. R	ESULTS FOR 40 MHz BANDWIDTH	
11.3.1.	TEST CHANNEL	
11.3.2.	RADAR WAVEFORM AND TRAFFIC	412
11.3.3.	OVERLAPPING CHANNEL TESTS	415
11.3.4.	MOVE AND CLOSING TIME	415
11.3.5.	10-MINUTE BEACON MONITORING PERIOD	419
11.4. R	ESULTS FOR 80 MHz BANDWIDTH	
11.4.1.	TEST CHANNEL	
11.4.2.	RADAR WAVEFORM AND TRAFFIC	
11.4.3.	OVERLAPPING CHANNEL TESTS	
11.4.4.	MOVE AND CLOSING TIME	
11.4.5.	10-MINUTE BEACON MONITORING PERIOD	427
12. SETU	P PHOTOS	428

Page 6 of 437

# 1. ATTESTATION OF TEST RESULTS

COMPANY NAME:	MICROSOFT CORPORATION ONE MICROSOFT WAY REDMOND, WA 98052, U.S.A.			
<b>EUT DESCRIPTION:</b> PORTABLE COMPUTING DEVICE				
MODEL:	1724			
SERIAL NUMBER:	012785552253 (RF1), 012756752253 (RF2), 012810252253 (RF3)			
DATE TESTED:	August 03-17, 2015			
APPLICABLE STANDARDS				
STANDARD TEST RESULTS				
CFR 47 Part 15 Subpart E PASS				

UL LLC 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 LLC 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 LLC and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL LLC 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 LLC By:

deauole

Francisco de Anda Project Lead UL Verification services Inc.

Reviewed By:

Jeffrey Moser EMC Program Manager UL – Consumer Technology Division

Prepared By:

Jeff Cabrera Laboratory Technician UL – Consumer Technology Division

Page 7 of 437

# 2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC CFR 47 Part 2, FCC CFR 47 Part 15, FCC 06-96, FCC KDB 789033, ANSI C63.10-2013.

# 3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 12 Laboratory Dr., Research Triangle Park, NC 27709, USA and 2800 Suite B Perimeter Park Dr., Morrisville, NC 27560.

12 Laboratory Dr., RTP, NC 27709
Chamber A
Chamber C

2800 Suite B Perimeter Park Dr.,		
Morrisville, NC 27560		
Chamber NORTH		
Chamber SOUTH		

UL LLC (RTP) is accredited by NVLAP, Laboratory Code 200246-0. The full scope of accreditation can be viewed at <u>http://www.nist.gov/nvlap/</u>.

# 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

Page 8 of 437

UL LLC FORM NO: 03-EM-F00858 12 Laboratory Dr., RTP, NC 27709 TEL: (919) 549-1400 *This report shall not be reproduced except in full, without the written approval of UL LLC.* 

# 4.3. MEASUREMENT UNCERTAINTY

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

PARAMETER	UNCERTAINTY
Total RF power, conducted	±0.45 dB
RF power density, conducted	±1.5 dB
Spurious emissions, conducted	±1.46 dB
Radiated Emissions (30-1000 MHz)	+/- 6.04 dB (3m)
Radiated Emissions (1-6 GHz)	+/- 5.96 dB
Radiated Emissions (6-18 GHz)	+/- 6.10 dB
Radiated Emissions (18-26 GHz)	+/- 6.81 dB
Temperature	±0.07°C
Humidity	±2.26% RH
DC and low frequency voltages	±1.27%

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

UL LLC FORM NO: 03-EM-F00858 12 Laboratory Dr., RTP, NC 27709 TEL: (919) 549-1400 *This report shall not be reproduced except in full, without the written approval of UL LLC.* 

Page 9 of 437

# 5. EQUIPMENT UNDER TEST

#### 5.1. **DESCRIPTION OF EUT**

The EUT is a handheld computing device with 802.11 2x2, a/b/g/n/ac WLAN, Bluetooth, Bluetooth LE. This report covers 5 GHz 802.11. All other technologies are covered by separate reports.

#### 5.2. MAXIMUM OUTPUT POWER

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

Frequency Range Mode (MHz)		Output Power (dBm)	Output Power (mW)			
5.2 GHz Band	5.2 GHz Band					
5180 - 5240 802.11a		16.72	46.99			
5180 - 5240	802.11n HT20	16.54	45.08			
5190 - 5230	802.11n HT40	13.95	24.83			
5210	802.11ac VHT80	10.36	10.86			
5.3 GHz Band						
5260 - 5320	802.11a	16.65	46.24			
5260 - 5320	802.11n HT20	16.62	45.92			
5270 - 5310	802.11n HT40	13.99	25.06			
5290	802.11ac VHT80	10.68	11.69			
5.6 GHz Band						
5500 - 5700	802.11a	16.82	48.08			
5720 Straddle	802.11a	16.30	42.66			
5500 - 5700	802.11n HT20	16.93	49.32			
5720 Straddle	802.11n HT20	15.95	39.36			
5510 - 5670	802.11n HT40	14.06	25.47			
5710 Straddle	802.11n HT40	14.00	25.12			
5530-5610	802.11ac VHT80	10.25	10.59			
5690 Straddle	802.11ac VHT80	10.31	10.74			
5.8 GHz Band						
5745-5825	802.11a	16.87	48.64			
5720 Straddle	802.11a	10.04	10.09			
5745-5825	802.11n HT20	16.76	47.42			
5720 Straddle	802.11n HT20	10.24	10.57			
5755-5795	802.11n HT40	14.11	25.76			
5710 Straddle	802.11n HT40	3.57	2.28			
5775	802.11ac VHT80	10.67	11.67			
5690 Straddle	802.11ac VHT80	-3.51	0.45			

UL LLC

Page 10 of 437

# 5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes an integrated antenna, with a maximum gain as follows:

Frequency Range (MHz)	MAIN Antenna Wi-Fi Main/BT Peak Gain (dBi) Chain B	MIMO Antenna Wi-Fi MIMO Peak Gain (dBi) Chain A
5.15 to 5.25 GHz	2.0	2.2
5.25 to 5.35 GHz	2.2	2.4
5.47 to 5.725 GHz	2.1	2.3
5.725 to 5.85 GHz	1.4	1.7

# 5.4. SOFTWARE AND FIRMWARE

The EUT driver software installed during testing was Mte OS 1.416.0.

The test utility software used during testing was WiFi tool v2.7.4.

Page 11 of 437

# 5.5. WORST-CASE CONFIGURATION AND MODE

Radiated emission and power line conducted emission were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario.

The fundamental of the EUT was investigated in three orthogonal orientations X,Y,Z and an additional one employing its kickstand, it was determined that the Z orientation was the worst-case orientation; therefore, all final radiated testing was performed with the EUT in the Z orientation.

Based on the baseline scan, the worst-case data rates were:

802.11a mode: 6 Mbps 802.11n HT20mode: MCS0 802.11n HT40mode: MCS0 802.11ac VHT80mode: MCS0

Radiated emissions for EUT with antenna was performed and passed; therefore, antenna port spurious was not performed.

Page 12 of 437

# 5.6. DESCRIPTION OF TEST SETUP

#### SUPPORT EQUIPMENT

Support Equipment List					
Description	Manufacturer	Model	Serial Number	FCC ID	
Laptop	Lenovo	E545	MP-06P9HP	DoC	
Laptop AC/DC adapter	Lenovo	42T4430	11S42T4430Z1ZGWE25Y1ET	DoC	
Ethernet to USB Adapter	Linksys	USB300M	C8D719E76E21	N/A	
EUT AC/DC adapter	Microsoft	1625	0D130C07VLN51	DoC	
Ear buds	-	Generic	-	N/A	

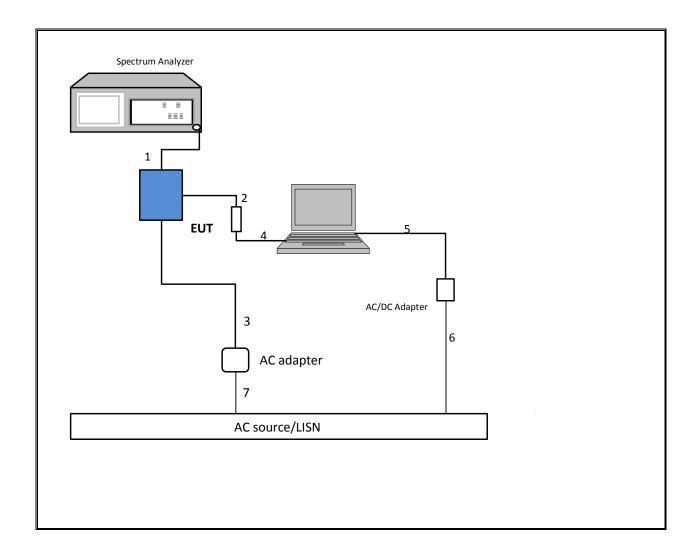
## I/O CABLES

	I/O Cable List					
Cable	Port	# of identical	Connector	Cable Type	Cable	Remarks
No		ports	Туре		Length (m)	
1	Antenna	1	SMA	Un-Shielded	0.3	To spectrum Analyzer
2	USB	1	USB	Shielded	0.2	To EUT
3	DC	1	DC	Un-shielded	1.8	N/A
4	Ether cable	1	RJ45- USB	Un-shielded	1	To laptop
5	DC	1	DC	Un-shielded	0.8	N/A
6	AC	1	2-Prong	Un-shielded	1.5	N/A
7	AC	1	2-Prong	Un-Shielded	0.5	N/A
8	Audio	1	3.5mm	Un-Shielded	1.1	N/A
			stereo			

## **TEST SETUP- CONDUCTED PORT**

The EUT was tested connected to a host Laptop via RJ45/USB cable and spectrum analyzer to antenna port. Test software exercised the EUT.

#### SETUP DIAGRAM

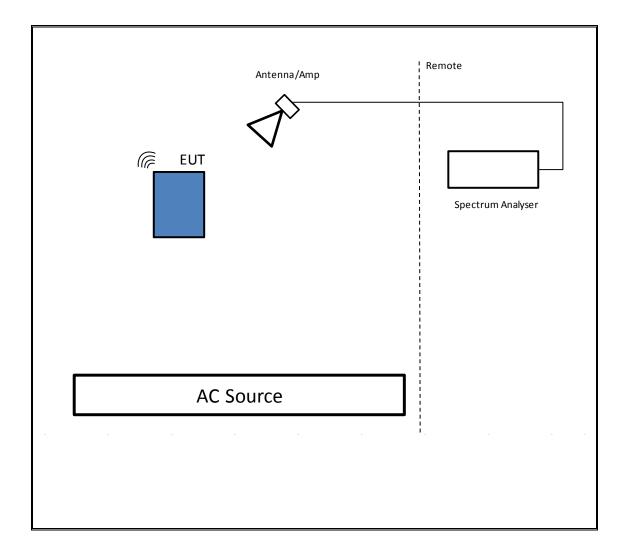


Page 14 of 437

## TEST SETUP- RADIATED-ABOVE 1 GHZ

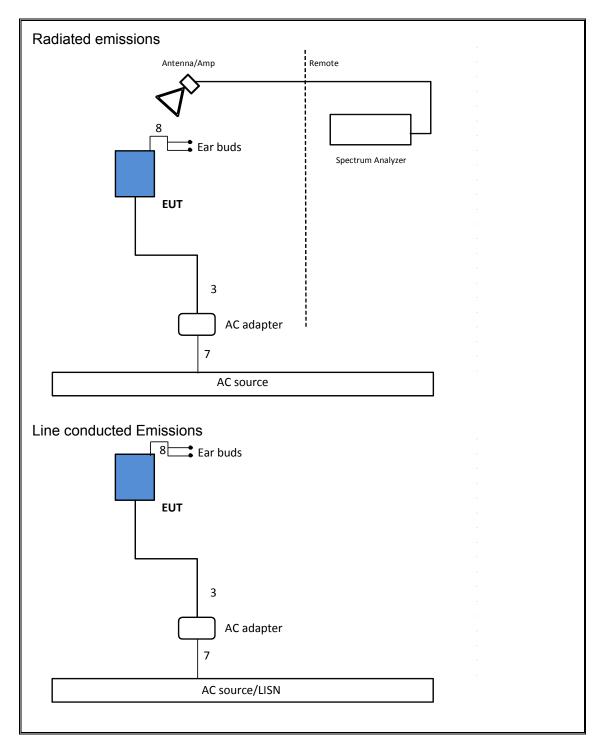
The EUT was tested battery powered. Test software exercised the EUT.

#### SETUP DIAGRAM



#### TEST SETUP - BELOW 1GHZ & AC LINE CONDUCTED TESTS

#### SETUP DIAGRAM



UL LLC FORM NO: 03-EM-F00858 12 Laboratory Dr., RTP, NC 27709 TEL: (919) 549-1400 This report shall not be reproduced except in full, without the written approval of UL LLC.

Page 16 of 437

# 6. TEST AND MEASUREMENT EQUIPMENT

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

Equip. ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
AT0073	Hybrid Broadband Antenna, 30-1000MHz	Sunol Sciences Corp.	JB3	2015-06-10	2016-06-30
AT0072	Double-Ridged Waveguide Horn Antenna, 1 to 18 GHz	ETS Lindgren	3117	2015-02-17	2016-02-29
SAC_N_Hybrid (30-1000MHz)	Gain-Loss string for Hybrid antenna	Various	Various	2015-06-25	2016-06-30
SAC_N_Horn (1-18GHz)	Gain-Loss string for Horn antenna	Various	Various	2015-06-25	2016-06-30
AT0053	Horn Antenna, 18- 26.5GHz	ARA	SWH-28 (S/N 1004)		
	Horn Antenna, 25.5- 40GHz	ARA	SWH-29 (S/N 1003)		
	Amplifier (S/Ns 859993, 860112, 859864)	Miteq	JSD42-1800400- 30-5A	2015-07-28	2016-07-31
	Cable (S/N 204158- 001)	Micro-coax	UFA147A-0-1181- 200200		
SA0026	Spectrum Analyzer	Agilent	N9030A	2015-03-27	2016-03-31
SOFTEMI	EMI Software	UL	Version 9.5	NA	NA
43733	Temp/Humid/Pressure Meter	Cole Parmer	99760-00	2014-03-24	2016-03-24

Radiated Disturbance Emissions Test Equipment (Morrisville - North Chamber)

# Antenna-port Test Measurement Equipment

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
	Common Equipment				
T189	Spectrum Analyzer	Agilent Technologies	E4440A	2015-05-13	2016-05-31
PWM002	RF Power Meter	Keysight Technologies	N1911A	2015-06-08	2017-06-08
PWS004	Power Sensor, 50MHz to 6 GHz	Keysight Technologies	E9323A	2015-06-05	2016-06-05
43733	Temp/Humid/Pressure Meter	Cole Parmer	99760-00	2014-03-24	2016-03-24

## Line Conducted Test Equipment

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
$S\Delta nn21$	EMI Test Receiver 9kHz- 3.6GHz	Rohde & Schwarz	ESR3	2015-07-08	2016-07-31
ATA508	Transient Limiter, 0.009 to 100 MHz	Electro- Metrics	EM 7600	2015-08-03	2016-08-31
ATA509	Coaxial cable, 20 ft., BNC - male to BNC-male	UL	RG-223	2015-08-03	2016-08-31
HI0069	Temp/Humid/Pressure Meter	Cole-Parmer	99760-00	2015-07-01	2016-07-31
SOFTEMI	EMI Software	UL	Version 9.5	NA	NA
LISN002	LISN, 50-ohm/50-uH, 2- conductor, 25A	Fischer Custom Com.	FCC-LISN-50-25-2- 01-550V	2014-09-04	2015-09-30

Page 18 of 437

# 7. MEASUREMENT METHODS

26 dB Emission BW: KDB 789033 D02 v01, Section C.

<u>99% Occupied BW</u>: KDB 789033 D02 v01, Section D.

<u>Conducted Output Power</u>: KDB 789033 D02 v01, Section E.3.a (Method PM) and Section E.2.b (Method SA-1).

Power Spectral Density: KDB 789033 D02 v01, Section F (Method SA-2).

<u>Unwanted emissions in restricted bands</u>: KDB 789033 D02 v01, Sections G.3, G.4, G.5, and G.6.

<u>Unwanted emissions in non-restricted bands</u>: KDB 789033 D02 v01, Sections G.3, G.4, and G.5.

Page 19 of 437

# 8. ANTENNA PORT TEST RESULTS

# 8.1. ON TIME AND DUTY CYCLE

## **LIMITS**

None; for reporting purposes only.

## PROCEDURE

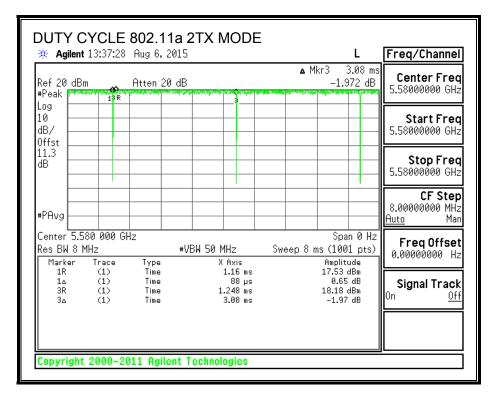
KDB 789033 Zero-Span Spectrum Analyzer Method.

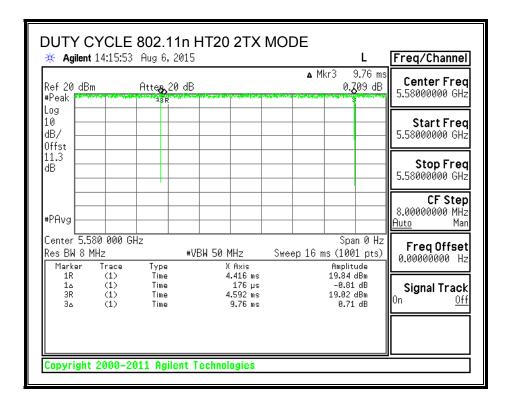
## ON TIME AND DUTY CYCLE RESULTS

Mode	<b>ON Time</b>	Period	<b>Duty Cycle</b>	Duty	Duty Cycle	1/B
	В		x	Cycle	<b>Correction Factor</b>	Minimum VBW
	(msec)	(msec)	(linear)	(%)	(dB)	(kHz)
802.11a 2TX	3.080	3.168	0.972	97.22%	0.12	0.325
802.11n HT20 2TX	9.760	9.936	0.982	98.23%	0.00	0.010
802.11n HT40 2TX	4.720	4.808	0.982	98.17%	0.00	0.010
802.11ac VHT80 2TX	2.2160	2.2600	0.981	98.05%	0.00	0.010

Page 20 of 437

## **DUTY CYCLE PLOTS**

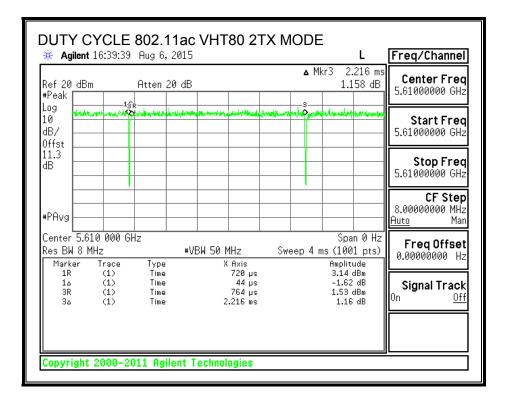




FORM NO: 03-EM-F00858 12 Laboratory Dr., RTP, NC 27709 TEL: (919) 549-1400 This report shall not be reproduced except in full, without the written approval of UL LLC.

UL LLC

	-	Aug 6, 201	HT40 2TX	MODE	L	Freq/Channel
Ref 20 dB #Peak	m	Atten 20 d	B Wind Mark Land Market Market Market Market		1kr3 4.72 ms 5.765 dB	Center Freq 5.55000000 GHz
Log 10 dB/ Offst						Start Freq 5.55000000 GHz
11.3 dB						<b>Stop Freq</b> 5.55000000 GHz
#PAvg						<b>CF Step</b> 8.00000000 MHz <u>Auto</u> Man
Center 5.5 Res BW 8 Marker			VBW 50 MHz X Axis	Sweep 8	Span 0 Hz ms (1001 pts) Amplitude	FreqOffset 0.00000000 Hz
1R 1∆ 3R 3∆	(1) (1) (1) (1)	Time Time Time Time	2.224 ms 88 µs 2.312 ms 4.72 ms		12.67 dBm -1.86 dB 10.81 dBm 5.76 dB	<b>Signal Track</b> <sup>On <u>Off</u></sup>



Page 22 of 437

UL LLC

# 8.2. 802.11a MODE IN THE 5.2 GHz BAND

# 8.2.1. 26 dB BANDWIDTH

#### **LIMITS**

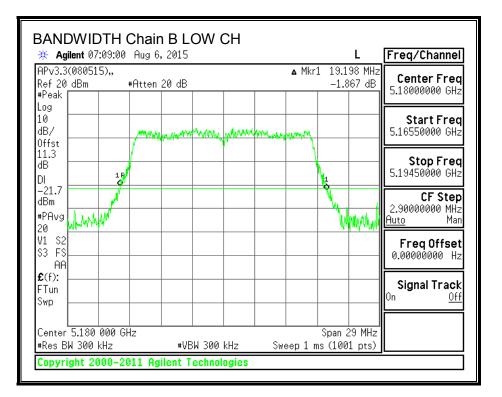
None; for reporting purposes only.

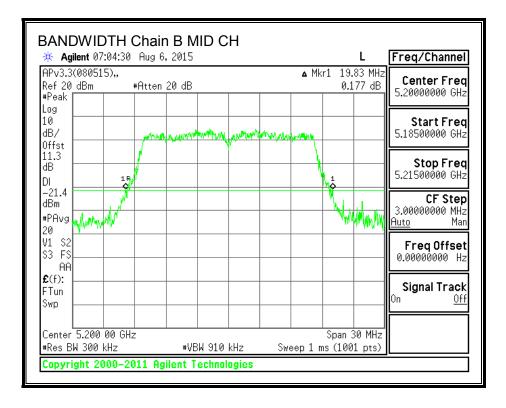
## <u>RESULTS</u>

Channel	Frequency	26 dB BW	26 dB BW
		Chain B	Chain A
	(MHz)	(MHz)	(MHz)
Low	5180	19.20	19.62
Mid	5200	19.83	19.38
High	5240	19.95	19.29

Page 23 of 437

#### 26 dB BANDWIDTH, Chain B

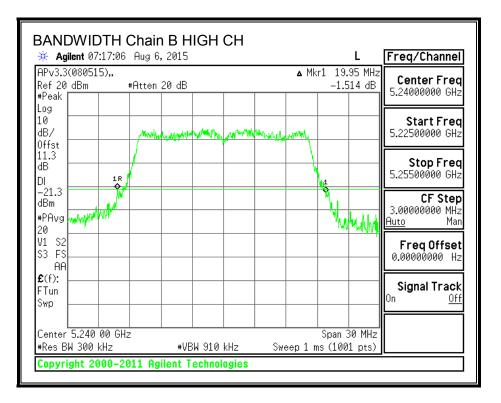




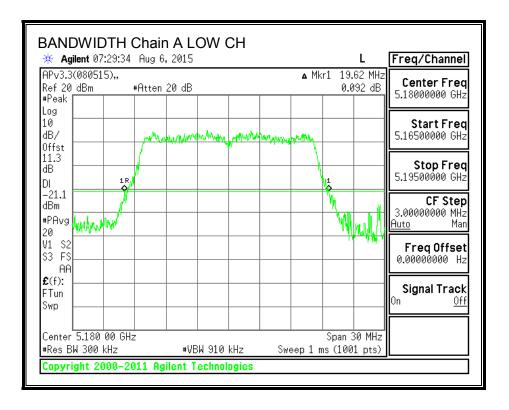
Page 24 of 437 FORM NO: 03-EM-F00858 TP. NC 27709 TEL: (919) 549-1400

12 Laboratory Dr., RTP, NC 27709 TEL: (919) 549-1400 This report shall not be reproduced except in full, without the written approval of UL LLC.

UL LLC

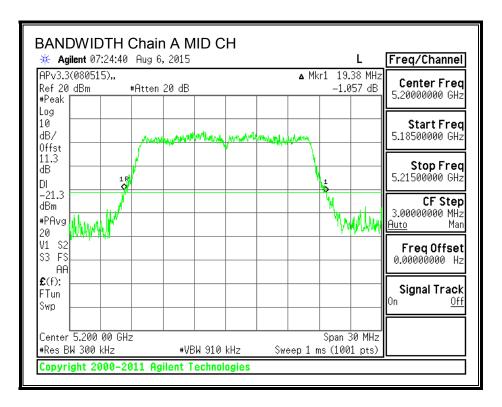


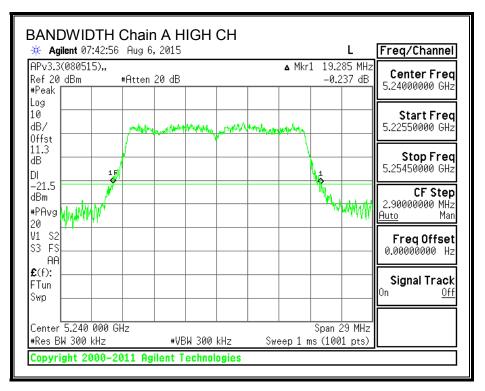
## 26 dB BANDWIDTH, Chain A



Page 25 of 437

UL LLC FORM NO: 03-EM-F00858 12 Laboratory Dr., RTP, NC 27709 TEL: (919) 549-1400 *This report shall not be reproduced except in full, without the written approval of UL LLC.* 





Page 26 of 437

# 8.2.2. 99% BANDWIDTH

## LIMITS

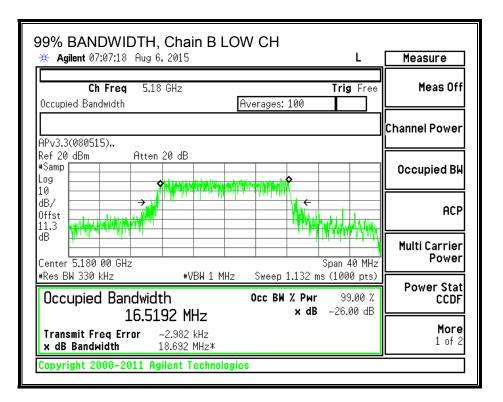
None; for reporting purposes only.

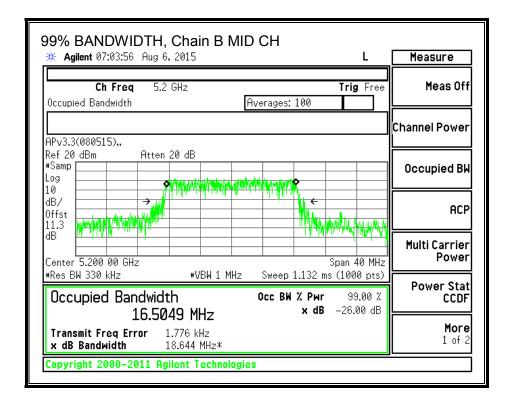
## <u>RESULTS</u>

Channel	Frequency	99% BW	99% BW
		Chain B	Chain A
	(MHz)	(MHz)	(MHz)
Low	5180	16.5192	16.5123
Mid	5200	16.5049	16.5067
High	5240	16.5125	16.5129

Page 27 of 437

## 99% BANDWIDTH, Chain B

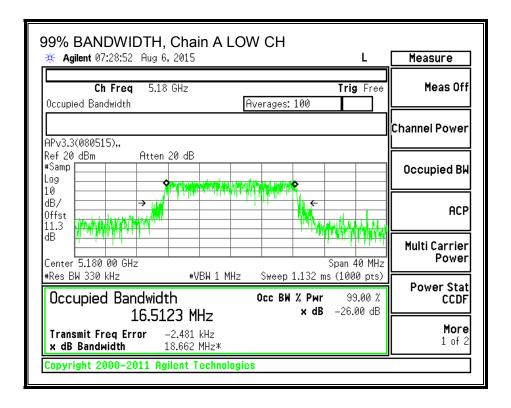




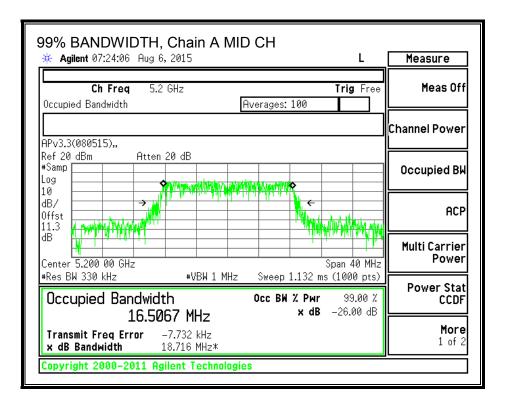
Page 28 of 437

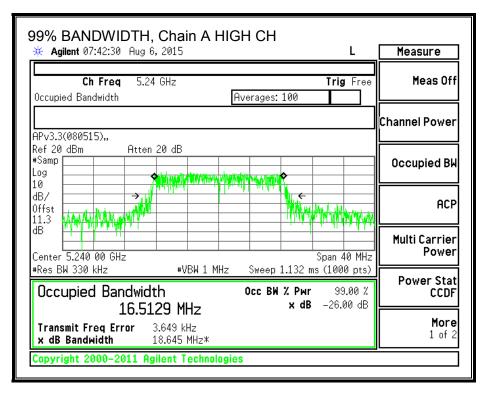
99% BANDWIDTH, Chain B HIGH CH	
✤ Agilent 07:16:28 Aug 6, 2015	Measure
Ch Freq 5.24 GHz Trig Free Occupied Bandwidth Averages: 100	Meas Off
	Channel Power
APv3.3(080515),, Ref 20 dBm Atten 20 dB	
#Samp Log	Occupied BW
dB/ dFst 11.3 drawn 10 11 11 11 11 11 11 11 11 11 11 11 11	ACP
dB regime regim	Multi Carrier Power
#Res BW 330 kHz         #VBW 1 MHz         Sweep 1.132 ms (1000 pts)	Power Stat
Оссиріеd Bandwidth осс ви % Рыг 99.00 % 16.5125 MHz × dB –26.00 dB	CCDF
Transmit Freq Error     1.093 kHz       x dB Bandwidth     18.697 MHz*	More 1 of 2
Copyright 2000–2011 Agilent Technologies	

## 99% BANDWIDTH, Chain A



Page 29 of 437





Page 30 of 437

# 8.2.3. OUTPUT POWER AND PSD

#### 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-topoint 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.

ULIC

Page 31 of 437

## DIRECTIONAL ANTENNA GAIN

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

Chain B	Chain A	<b>Uncorrelated Chains</b>
Antenna	Antenna	Directional
Gain	Gain	Gain
(dBi)	(dBi)	(dBi)
2.00	2.20	2.10

Page 32 of 437

## **RESULTS**

#### Antenna Gain and Limits

Channel	Frequency	Directional	Directional	Power	PSD
		Gain	Gain	Limit	Limit
		for Power	for PSD		
	(MHz)	(dBi)	(dBi)	(dBm)	(dBm)
Low	5180	2.10	2.10	24.00	11.00
Mid	5200	2.10	2.10	24.00	11.00
High	5240	2.10	2.10	24.00	11.00

Duty Cycle CF (dB) 0.12 Inc
-----------------------------

cluded in Calculations of Corr'd Power & PSD

#### **Output Power Results**

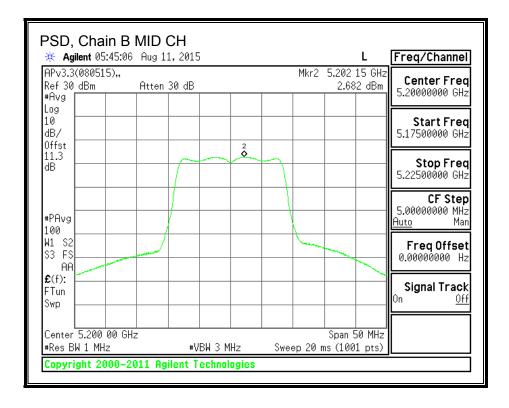
Channel	Frequency	Chain B	Chain A	Total	Power	Power
		Meas	Meas	Corr'd	Limit	Margin
		Power	Power	Power		
	(MHz)	(dBm)	(dBm)	(dBm)	(dBm)	(dB)
Low	5180	13.64	13.26	16.58	24.00	-7.42
Mid	5200	13.53	13.40	16.60	24.00	-7.40
High	5240	13.68	13.50	16.72	24.00	-7.28

#### **PSD Results**

Channel	Frequency	Chain B	Chain A	Total	PSD	PSD
		Meas	Meas	Corr'd	Limit	Margin
		PSD	PSD	PSD		
	(MHz)	(dBm)	(dBm)	(dBm)	(dBm)	(dB)
Low	5180	3.09	2.55	5.96	11.00	-5.04
Mid	5200	2.68	2.74	5.84	11.00	-5.16
High	5240	3.04	2.90	6.10	11.00	-4.90

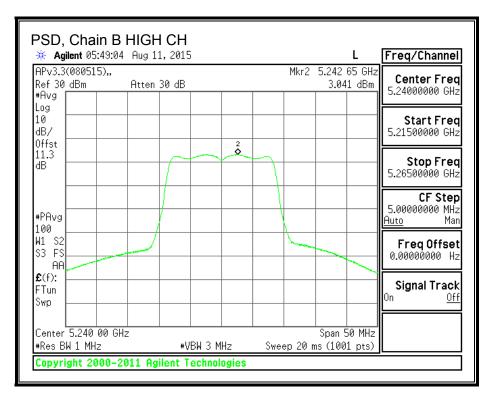
## PSD, Chain B

PSD, Chain B LOW			
🔆 🔆 Agilent 05:38:24 Aug 1	1,2015	L	Freq/Channel
#Avg	30 dB	Mkr2 5.177 40 GH: 3.088 dBm	
Log 10 dB/ 0ffst	2		<b>Start Freq</b> 5.15500000 GHz
dB	2		Stop Freq 5.20500000 GHz
#PAvg			<b>CF Step</b> 5.00000000 MHz <u>Auto</u> Man
W1 S2 S3 FS АА			FreqOffset 0.00000000 Hz
£(f): FTun Swp			Signal Track <sup>On <u>Off</u></sup>
Center 5.180 00 GHz #Res BW 1 MHz	#VBW 3 MHz	Span 50 MHz Sweep 20 ms (1001 pts)	
Copyright 2000-2011 Ag	ilent Technologies		

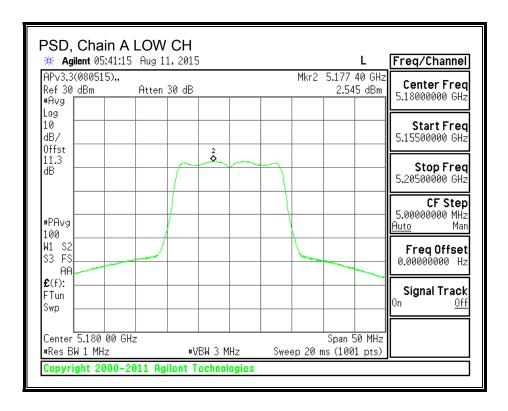


Page 34 of 437

UL LLC FORM NO: 03-EM-F00858 12 Laboratory Dr., RTP, NC 27709 TEL: (919) 549-1400 *This report shall not be reproduced except in full, without the written approval of UL LLC.* 

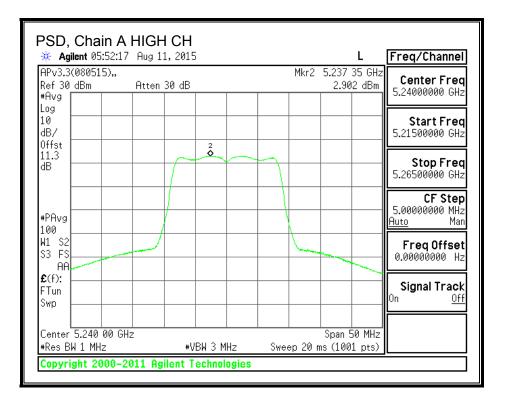


## PSD, Chain A



Page 35 of 437

🔆 Agilent 05:46:54	4 Aug 11, 2015			L	Freq/Channel
APv3.3(080515)" Ref 30 dBm #Avg	Atten 30 dB		Mkr2	5.202 35 GHz 2.736 dBm	Center Freq 5.20000000 GHz
Log 10 dB/					Start Freq 5.17500000 GHz
0ffst 11.3 dB		2	$\neg$		<b>Stop Freq</b> 5.22500000 GHz
#PAvg					<b>CF Step</b> 5.00000000 MHz <u>Auto</u> Man
W1 S2 S3 FS AA					FreqOffset 0.00000000 Hz
£(f): FTun Swp					<b>Signal Track</b> <sup>On <u>Off</u></sup>
Center 5.200 00 GH #Res BW 1 MHz	 Hz ₩VBW 3	 3 MHz	 Sweep 20 m	Span 50 MHz s (1001 pts)	



Page 36 of 437

# 8.3. 802.11n HT20 MODE IN THE 5.2 GHz BAND

## 8.3.1. 26 dB BANDWIDTH

#### <u>LIMITS</u>

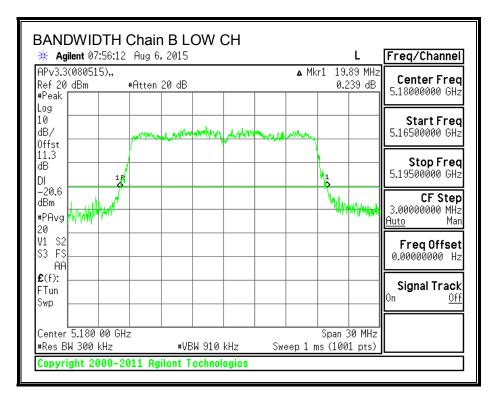
None; for reporting purposes only.

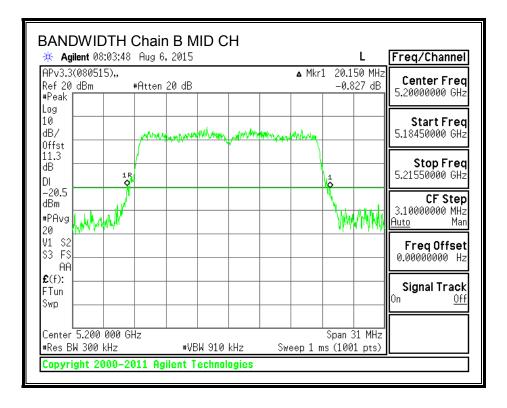
#### **RESULTS**

Channel	Frequency	26 dB BW	26 dB BW
		Chain B	Chain A
	(MHz)	(MHz)	(MHz)
Low	5180	19.89	19.74
Mid	5200	20.15	19.95
High	5240	19.86	19.86

Page 37 of 437

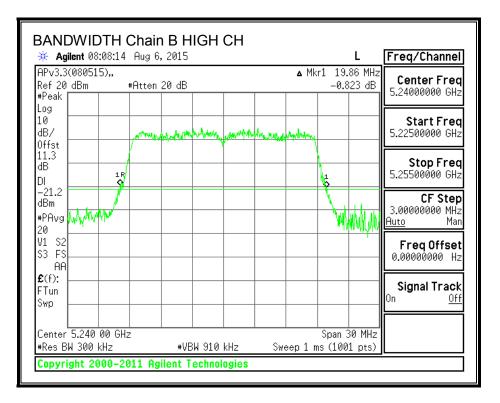
#### 26 dB BANDWIDTH, Chain B



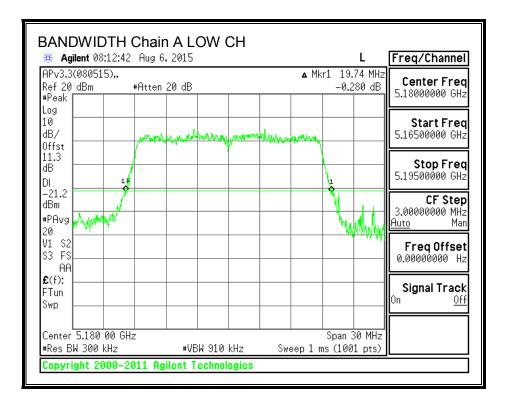


Page 38 of 437

UL LLC FORM NO: 03-EM-F00858 12 Laboratory Dr., RTP, NC 27709 TEL: (919) 549-1400 *This report shall not be reproduced except in full, without the written approval of UL LLC.* 

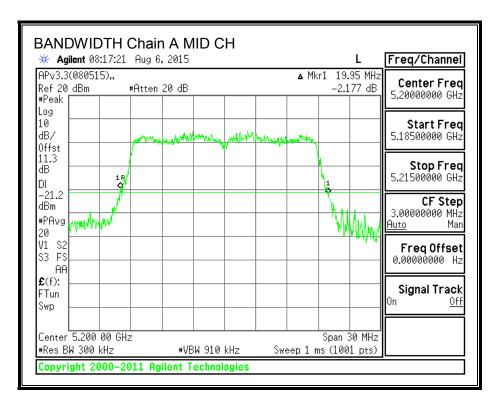


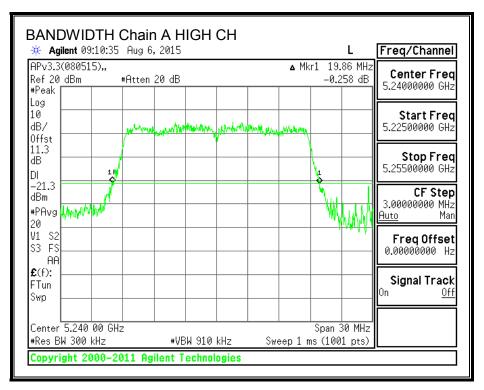
### 26 dB BANDWIDTH, Chain A



Page 39 of 437

UL LLC FORM NO: 03-EM-F00858 12 Laboratory Dr., RTP, NC 27709 TEL: (919) 549-1400 *This report shall not be reproduced except in full, without the written approval of UL LLC.* 





Page 40 of 437

## 8.3.2. 99% BANDWIDTH

### LIMITS

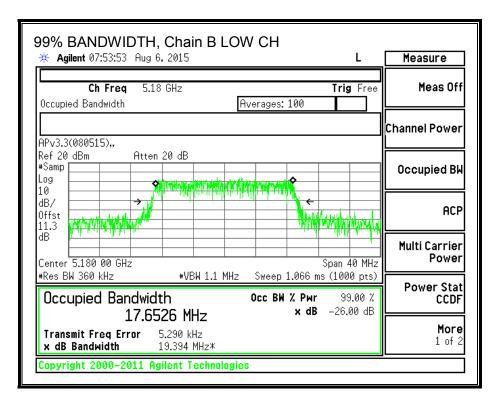
None; for reporting purposes only.

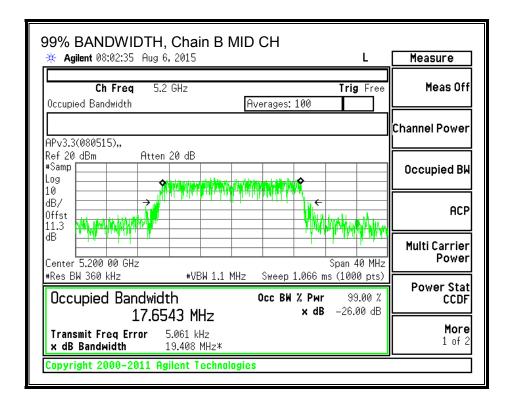
### **RESULTS**

Channel	Frequency	99% BW	99% BW	
		Chain B	Chain A	
	(MHz)	(MHz)	(MHz)	
Low	5180	17.6526	17.6739	
Mid	5200	17.6543	17.6708	
High	5240	17.6487	17.6306	

Page 41 of 437

## 99% BANDWIDTH, Chain B

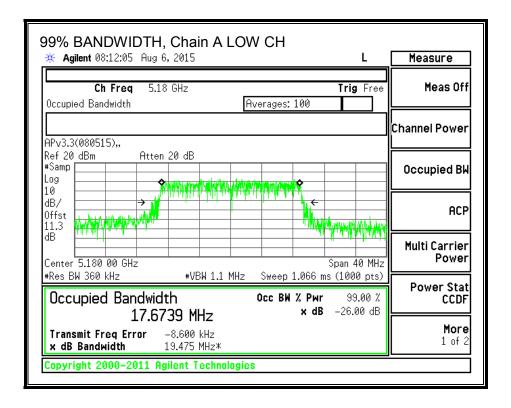




Page 42 of 437

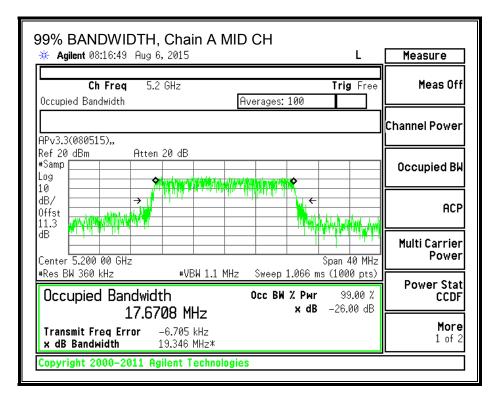
99% BANDWIDTH, Chain B H	HGH CH	
🔆 Agilent 08:07:11 Aug 6, 2015	L	Measure
Ch Freq 5.24 GHz Occupied Bandwidth	Trig Free Averages: 100	Meas Off
		Channel Power
APv3.3(080515),, Ref 20 dBm Atten 20 dB		
#Samp		Occupied BW
Log 10 dB/ 0fst 11.3		ACP
dB	Span 40 MHz	Multi Carrier Power
#Res BW 360 kHz #VBW 1.1 M	Hz Sweep 1.066 ms (1000 pts)	Power Stat
Occupied Bandwidth 17.6487 MHz	Осс ВЖ % Рwr 99.00 % × dB –26.00 dB	CCDF
Transmit Freq Error 4.206 kHz × dB Bandwidth 19.380 MHz*		More 1 of 2
Copyright 2000–2011 Agilent Technolo	gies	_

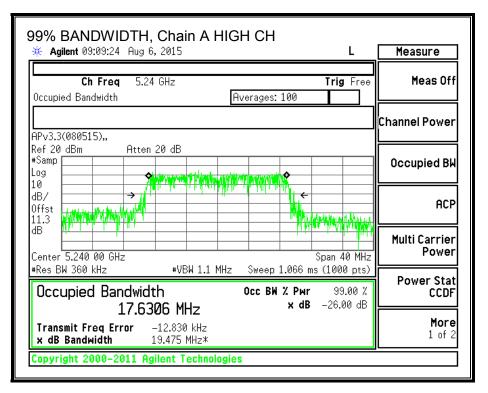
### 99% BANDWIDTH, Chain A



Page 43 of 437

UL LLC





Page 44 of 437

UL LLC FORM NO: 03-EM-F00858 12 Laboratory Dr., RTP, NC 27709 TEL: (919) 549-1400 *This report shall not be reproduced except in full, without the written approval of UL LLC.* 

## 8.3.3. OUTPUT POWER AND PSD

#### 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-topoint 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.

ULIC

Page 45 of 437

#### DIRECTIONAL ANTENNA GAIN

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

Chain B	Chain A	<b>Uncorrelated Chains</b>	
Antenna	Antenna	Directional	
Gain	Gain	Gain	
(dBi)	(dBi)	(dBi)	
2.00	2.20	2.10	

UL LLC FORM NO: 03-EM-F00858 12 Laboratory Dr., RTP, NC 27709 TEL: (919) 549-1400 *This report shall not be reproduced except in full, without the written approval of UL LLC.* 

Page 46 of 437

### **RESULTS**

#### Antenna Gain and Limits

Channel	Frequency	Directional	Directional	Power	PSD
		Gain	Gain	Limit	Limit
		for Power	for PSD		
	(MHz)	(dBi)	(dBi)	(dBm)	(dBm)
Low	5180	2.10	2.10	24.00	11.00
Mid	5200	2.10	2.10	24.00	11.00
High	5240	2.10	2.10	24.00	11.00

Duty Cycle CF (dB)	0.00	
--------------------	------	--

Included in Calculations of Corr'd Power & PSD

### **Output Power Results**

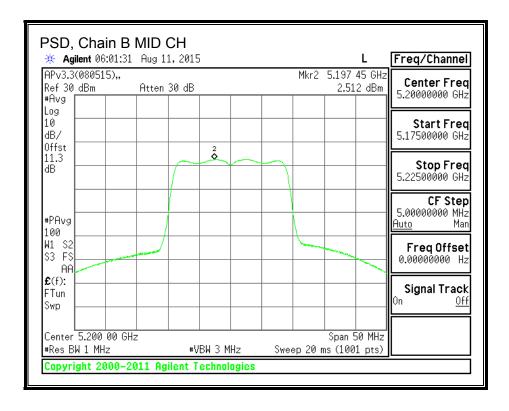
Channel	Frequency	Chain B	Chain A	Total	Power	Power
		Meas	Meas	Corr'd	Limit	Margin
		Power	Power	Power		
	(MHz)	(dBm)	(dBm)	(dBm)	(dBm)	(dB)
Low	5180	13.69	13.37	16.54	24.00	-7.46
Mid	5200	13.42	13.32	16.38	24.00	-7.62
High	5240	13.38	13.52	16.46	24.00	-7.54

#### **PSD Results**

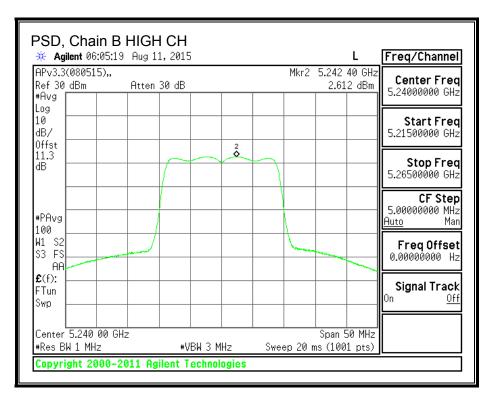
Channel	Frequency	Chain B	Chain A	Total	PSD	PSD
		Meas	Meas	Corr'd	Limit	Margin
		PSD	PSD	PSD		
	(MHz)	(dBm)	(dBm)	(dBm)	(dBm)	(dB)
Low	5180	2.60	2.44	5.53	11.00	-5.47
Mid	5200	2.51	2.35	5.44	11.00	-5.56
High	5240	2.61	2.48	5.56	11.00	-5.44

## PSD, Chain B

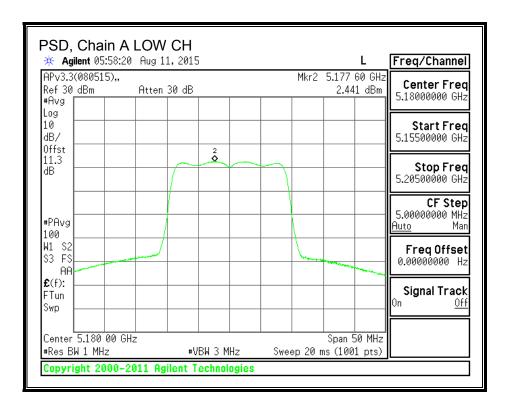
PSD, Chain B LOW				
🔆 🔆 Agilent 05:55:55 Aug 11	1,2015		L	Freq/Channel
APv3.3(080515),, Ref 30 dBm Atten 3 #Avg	30 dB		177 50 GHz 2.597 dBm	Center Freq 5.18000000 GHz
Log 10 dB/ 0ffst	2			<b>Start Freq</b> 5.15500000 GHz
dB	Ó			<b>Stop Freq</b> 5.20500000 GHz
#PAvg				<b>CF Step</b> 5.00000000 MHz <u>Auto</u> Man
W1 S2 S3 FS ӨӨ		- Comment		FreqOffset 0.00000000 Hz
£(f): FTun Swp				<b>Signal Track</b> On <u>Off</u>
Center 5.180 00 GHz #Res BW 1 MHz	#VBW 3 MHz	Sweep 20 ms v	oan 50 MHz (1001 pts)	
Copyright 2000-2011 Agi	ilent Technologies			



Page 48 of 437

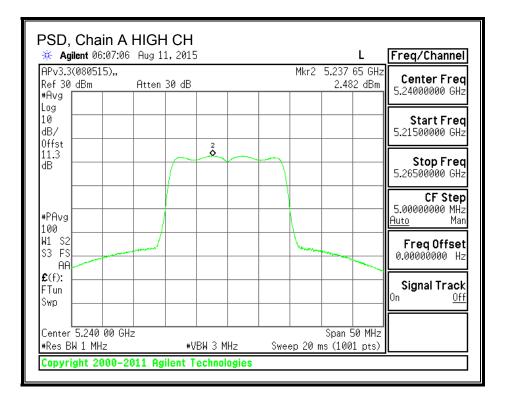


#### PSD, Chain A



Page 49 of 437

PSD, Chain A MI 🔆 Agilent 06:03:28 Au			ιſ	Freq/Channel
#Avg	en 30 dB	Mkr2 5.19	97 45 GHz .353 dBm	Center Freq 5.20000000 GHz
Log 10 dB/ 0ffst				<b>Start Freq</b> 5.17500000 GHz
dB	2			Stop Freq 5.22500000 GHz
#PAvg				<b>CF Step</b> 5.00000000 MHz <u>Auto</u> Man
100 W1 S2 S3 FS	4		-	Freq Offset 0.00000000 Hz
£(f): FTun Swp				<b>Signal Track</b> On <u>Off</u>
Center 5.200 00 GHz #Res BW 1 MHz	#VBW 3 MHz	Spa Sweep 20 ms (1	n 50 MHz 001 pts)	



Page 50 of 437

UL LLC FORM NO: 03-EM-F00858 12 Laboratory Dr., RTP, NC 27709 TEL: (919) 549-1400 *This report shall not be reproduced except in full, without the written approval of UL LLC.* 

# 8.4. 802.11n HT40 MODE IN THE 5.2 GHz BAND

## 8.4.1. 26 dB BANDWIDTH

#### **LIMITS**

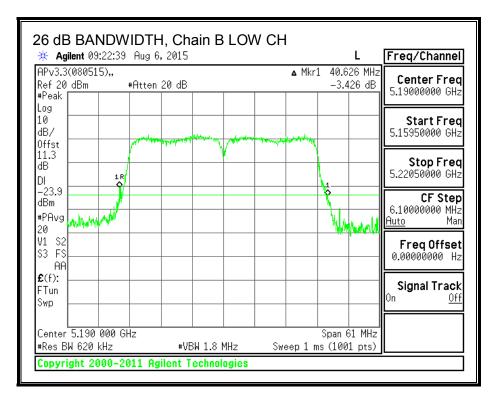
None; for reporting purposes only.

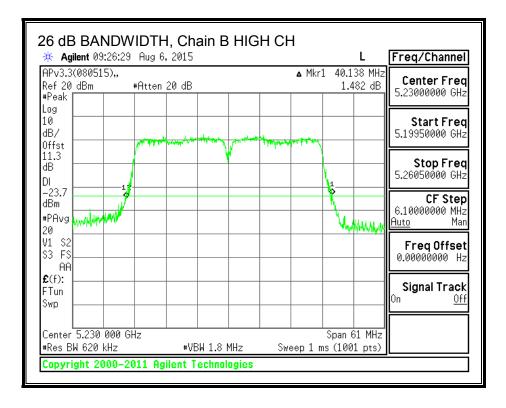
## **RESULTS**

Channel	Frequency	26 dB BW	26 dB BW
		Chain B	Chain A
	(MHz)	(MHz)	(MHz)
Low	5190	40.63	40.32
High	5230	40.14	40.50

Page 51 of 437

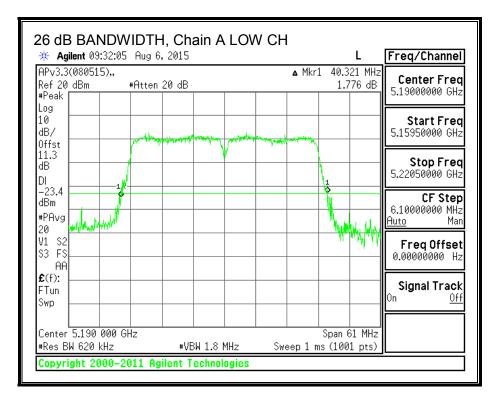
### 26 dB BANDWIDTH, Chain B

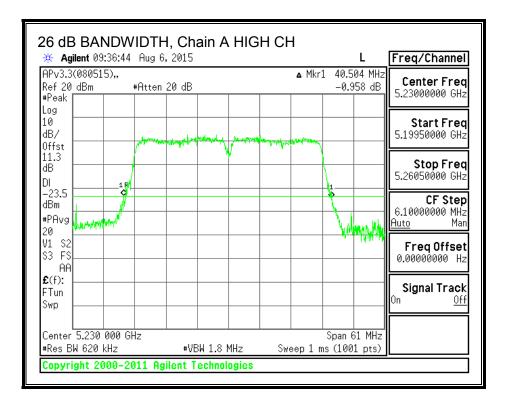




Page 52 of 437 UL LLC FORM NO: 03-EM-F00858 12 Laboratory Dr., RTP, NC 27709 TEL: (919) 549-1400 This report shall not be reproduced except in full, without the written approval of UL LLC.

#### 26 dB BANDWIDTH, Chain A





Page 53 of 437

## 8.4.2. 99% BANDWIDTH

### LIMITS

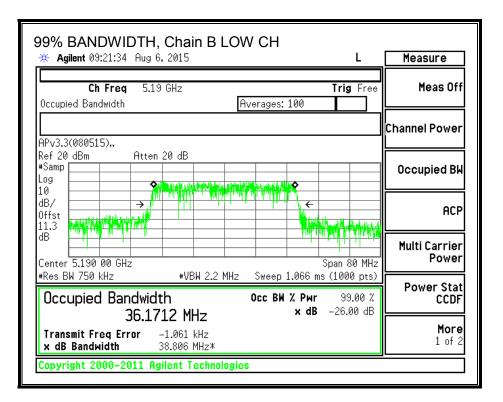
None; for reporting purposes only.

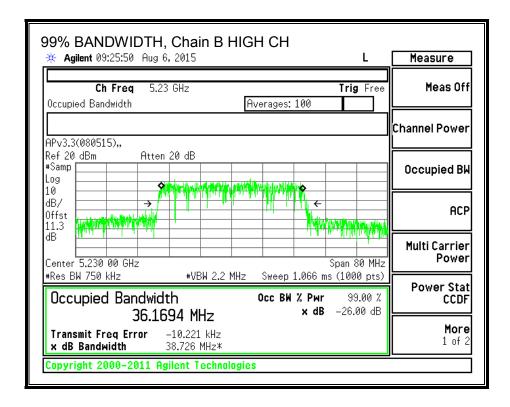
### **RESULTS**

Channel	Frequency	99% BW	99% BW
		Chain B	Chain A
	(MHz)	(MHz)	(MHz)
Low	5190	36.1712	36.1725
High	5230	36.1694	36.1590

Page 54 of 437

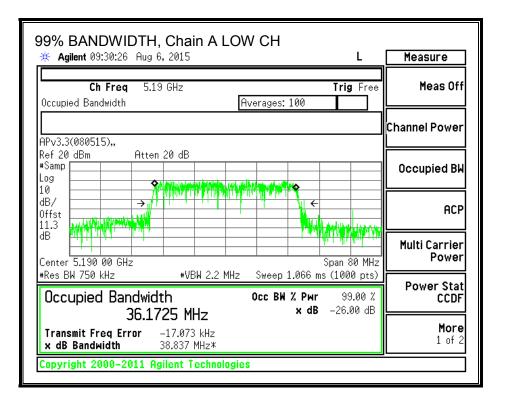
## 99% BANDWIDTH, Chain B

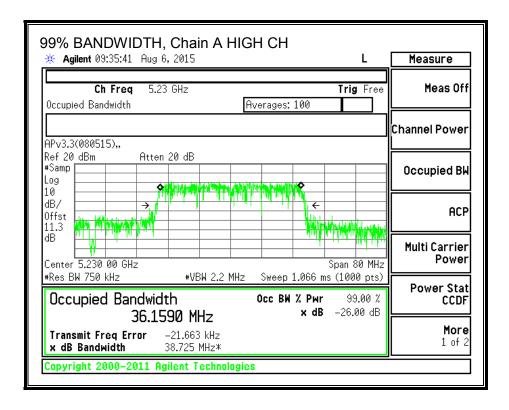




Page 55 of 437

#### 99% BANDWIDTH, Chain A





Page 56 of 437

UL LLC FORM NO: 03-EM-F00858 12 Laboratory Dr., RTP, NC 27709 TEL: (919) 549-1400 *This report shall not be reproduced except in full, without the written approval of UL LLC.* 

## 8.4.3. OUTPUT POWER AND PSD

#### 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-topoint 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.

ULIC

Page 57 of 437

### DIRECTIONAL ANTENNA GAIN

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

Chain B	Chain A	<b>Uncorrelated Chains</b>
Antenna	Antenna	Directional
Gain	Gain	Gain
(dBi)	(dBi)	(dBi)
2.00	2.20	2.10

Page 58 of 437

## **RESULTS**

#### Antenna Gain and Limits

Channel	Frequency	Directional	Directional	Power	PSD
		Gain	Gain	Limit	Limit
		for Power	for PSD		
	(MHz)	(dBi)	(dBi)	(dBm)	(dBm)
Low	5190	2.10	2.10	24.00	11.00
High	5230	2.10	2.10	24.00	11.00

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

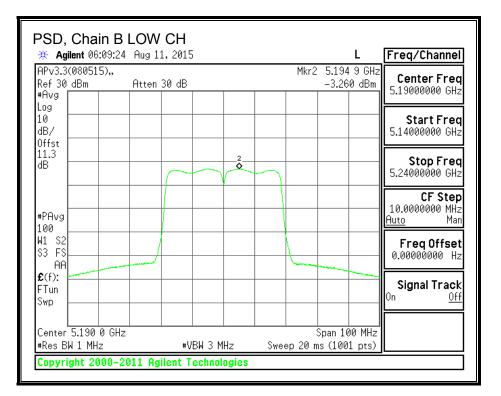
### **Output Power Results**

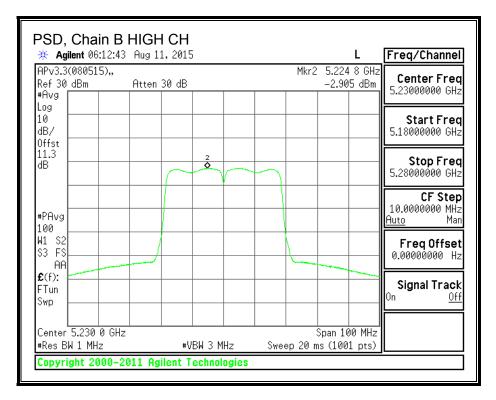
Channel	Frequency	Chain B	Chain A	Total	Power	Power
		Meas	Meas	Corr'd	Limit	Margin
		Power	Power	Power		
	(MHz)	(dBm)	(dBm)	(dBm)	(dBm)	(dB)
Low	5190	10.91	10.97	13.95	24.00	-10.05
High	5230	10.77	11.04	13.92	24.00	-10.08

## **PSD Results**

Channel	Frequency	Chain B	Chain A	Total	PSD	PSD
		Meas	Meas	Corr'd	Limit	Margin
		PSD	PSD	PSD		
	(MHz)	(dBm)	(dBm)	(dBm)	(dBm)	(dB)
Low	5190	-3.26	-3.15	-0.20	11.00	-11.20
High	5230	-2.91	-3.11	0.00	11.00	-11.00

## PSD, Chain B

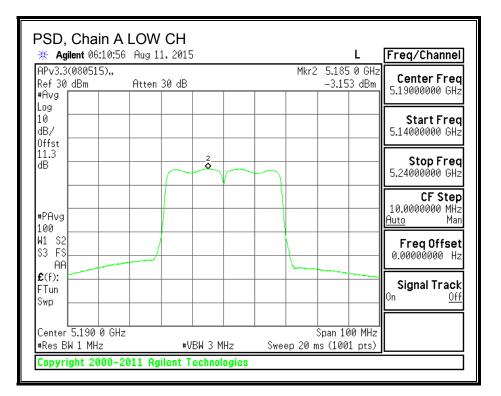


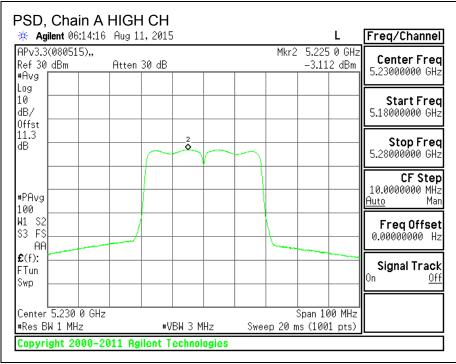


Page 60 of 437

UL LLC FORM NO: 03-EM-F00858 12 Laboratory Dr., RTP, NC 27709 TEL: (919) 549-1400 *This report shall not be reproduced except in full, without the written approval of UL LLC.* 

## PSD, Chain A





Page 61 of 437 UL LLC FORM NO: 03-EM-F00858 12 Laboratory Dr., RTP, NC 27709 TEL: (919) 549-1400 This report shall not be reproduced except in full, without the written approval of UL LLC.

# 8.5. 802.11ac VHT80 MODE IN THE 5.2 GHz BAND

## 8.5.1. 26 dB BANDWIDTH

#### **LIMITS**

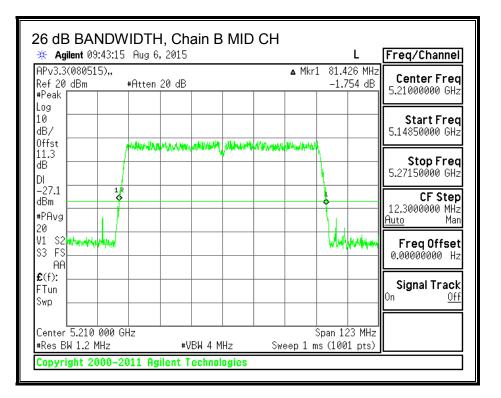
None; for reporting purposes only.

#### **RESULTS**

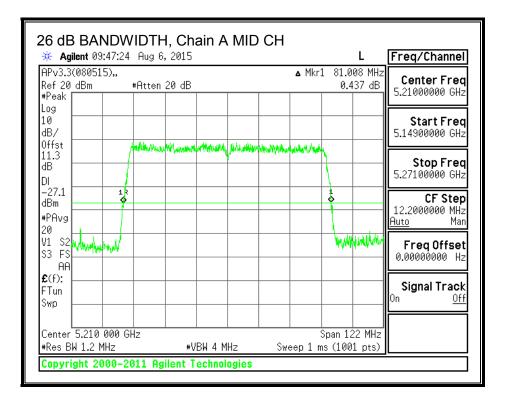
Channel	Frequency	26 dB BW	26 dB BW	
		Chain B	Chain A	
	(MHz)	(MHz)	(MHz)	
Mid	5210	81.43	81.01	

Page 62 of 437

#### 26 dB BANDWIDTH, Chain B



#### 26 dB BANDWIDTH, Chain A



Page 63 of 437

UL LLC

FORM NO: 03-EM-F00858 12 Laboratory Dr., RTP, NC 27709 TEL: (919) 549-1400 This report shall not be reproduced except in full, without the written approval of UL LLC.

## 8.5.2. 99% BANDWIDTH

### LIMITS

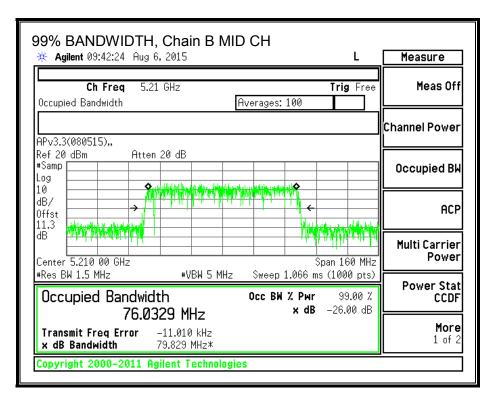
None; for reporting purposes only.

### <u>RESULTS</u>

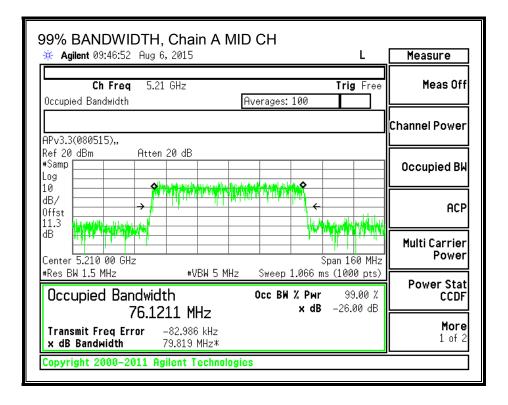
Channel	Frequency	99% BW	99% BW
		Chain B	Chain A
	(MHz)	(MHz)	(MHz)
Mid	5210	76.0329	76.1211

Page 64 of 437

## 99% BANDWIDTH, Chain B



#### 99% BANDWIDTH, Chain A



Page 65 of 437

UL LLC

FORM NO: 03-EM-F00858 12 Laboratory Dr., RTP, NC 27709 TEL: (919) 549-1400 This report shall not be reproduced except in full, without the written approval of UL LLC.

## 8.5.3. OUTPUT POWER AND PSD

#### 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-topoint 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.

ULIC

Page 66 of 437

### DIRECTIONAL ANTENNA GAIN

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

Chain B	Chain A	<b>Uncorrelated Chains</b>
Antenna	Antenna	Directional
Gain	Gain	Gain
(dBi)	(dBi)	(dBi)
2.00	2.20	2.10

Page 67 of 437

## **RESULTS**

#### Antenna Gain and Limits

Channel	Frequency	Directional	Directional	Power	PSD
		Gain	Gain	Limit	Limit
		for Power	for PSD		
	(MHz)	(dBi)	(dBi)	(dBm)	(dBm)
Mid	5210	2.10	2.10	24.00	11.00

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

#### **Output Power Results**

Channel	Frequency	Chain B	Chain A	Total	Power	Power
		Meas	Meas	Corr'd	Limit	Margin
		Power	Power	Power		
	(MHz)	(dBm)	(dBm)	(dBm)	(dBm)	(dB)
Mid	5210	7.36	7.34	10.36	24.00	-13.64

#### **PSD Results**

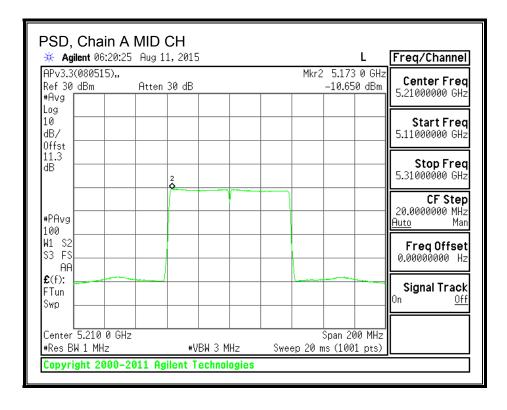
Channel	Frequency	Chain B	Chain A	Total	PSD	PSD
		Meas	Meas	Corr'd	Limit	Margin
		PSD	PSD	PSD		
	(MHz)	(dBm)	(dBm)	(dBm)	(dBm)	(dB)
Mid	5210	-10.70	-10.65	-7.67	11.00	-18.67

UL LLC

### PSD, Chain B

SD, Chain B Agilent 06:17:55			L	Freq/Channel
Pv3.3(080515),, ef 30 dBm Avg	Atten 30 dB		5.212 2 GHz -10.704 dBm	Center Freq 5.21000000 GHz
og 0 B/ ffst				<b>Start Freq</b> 5.11000000 GHz
1.3 B		2		<b>Stop Freq</b> 5.31000000 GHz
PAvg				<b>CF Step</b> 20.0000000 MHz <u>Auto</u> Man
1 S2 3 FS AA				Freq Offset 0.00000000 Hz
:(f): Tun wp				<b>Signal Track</b> <sup>On <u>Off</u></sup>
enter 5.210 0 GHz Res BW 1 MHz	#VBW 3	3 MHz	pan 200 MHz s (1001 pts)	

#### PSD, Chain A



Page 69 of 437

FORM NO: 03-EM-F00858 TEL: (919) 549-1400 12 Laboratory Dr., RTP, NC 27709 This report shall not be reproduced except in full, without the written approval of UL LLC.

UL LLC

# 8.6. 802.11a MODE IN THE 5.3 GHz BAND

## 8.6.1. 26 dB BANDWIDTH

#### **LIMITS**

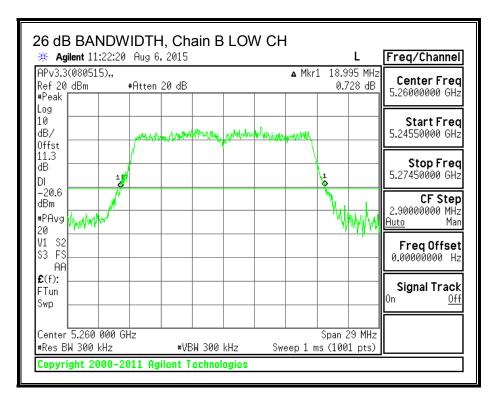
None; for reporting purposes only.

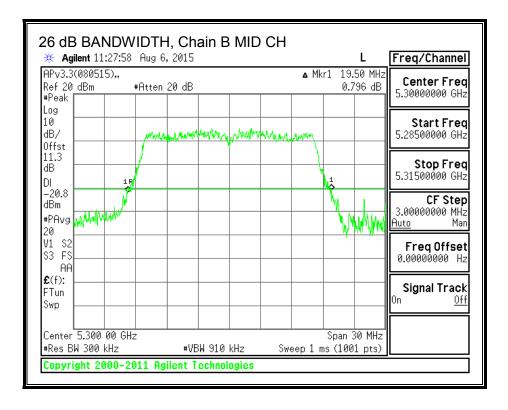
## **RESULTS**

Channel	Frequency	26 dB BW	26 dB BW
		Chain B	Chain A
	(MHz)	(MHz)	(MHz)
Low	5260	19.00	19.71
Mid	5300	19.50	19.47
High	5320	19.38	19.83

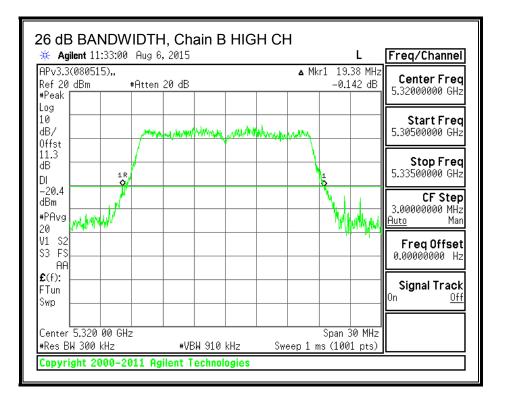
Page 70 of 437

#### 26 dB BANDWIDTH, Chain B

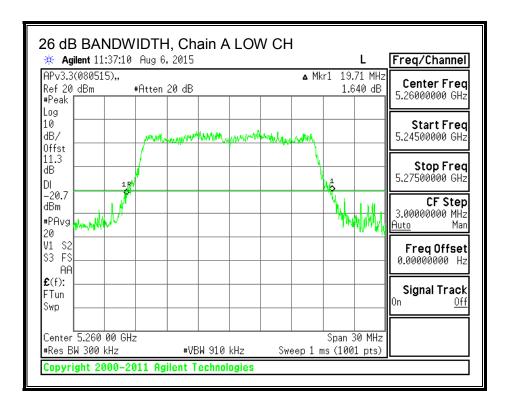




Page 71 of 437 UL LLC FORM NO: 03-EM-F00858 12 Laboratory Dr., RTP, NC 27709 TEL: (919) 549-1400 This report shall not be reproduced except in full, without the written approval of UL LLC.

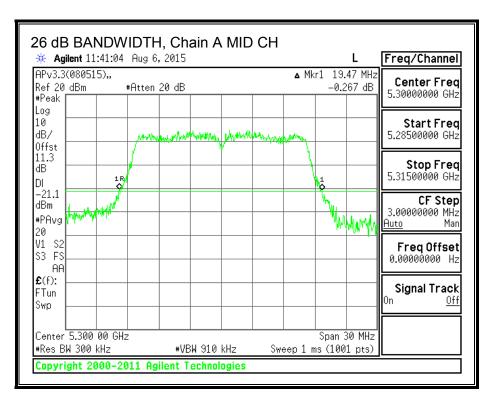


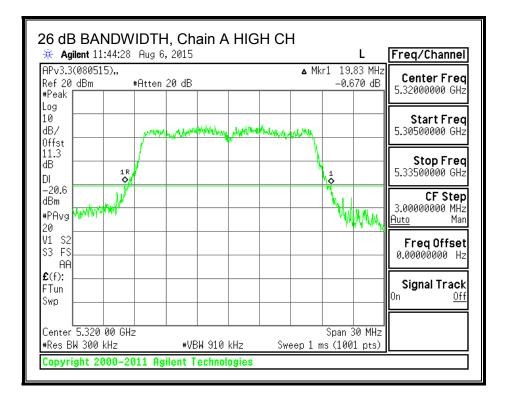
### 26 dB BANDWIDTH, Chain A



Page 72 of 437

UL LLC FORM NO: 03-EM-F00858 12 Laboratory Dr., RTP, NC 27709 TEL: (919) 549-1400 *This report shall not be reproduced except in full, without the written approval of UL LLC.* 





Page 73 of 437

# 8.6.2. 99% BANDWIDTH

# LIMITS

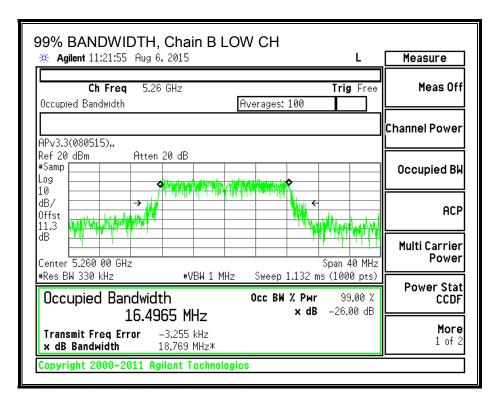
None; for reporting purposes only.

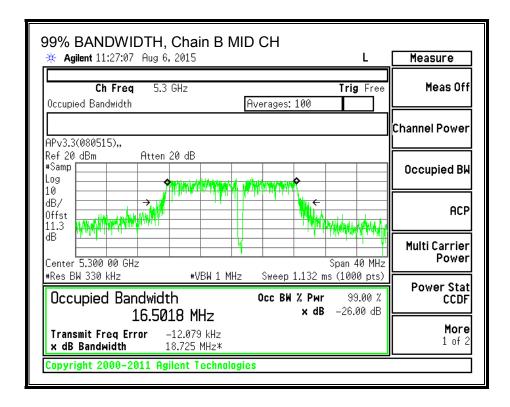
# **RESULTS**

Channel	Frequency	99% BW	99% BW
		Chain B	Chain A
	(MHz)	(MHz)	(MHz)
Low	5260	16.4965	16.5111
Mid	5300	16.5018	16.5134
High	5320	16.5095	16.5228

Page 74 of 437

# 99% BANDWIDTH, Chain B

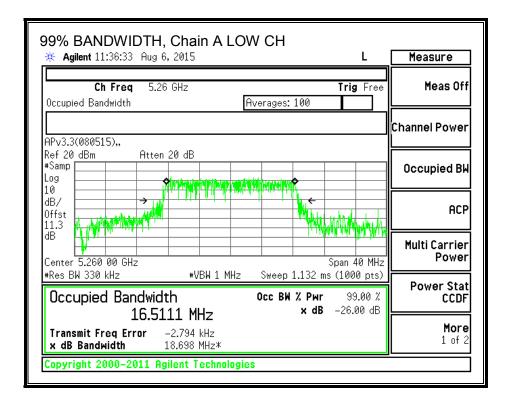




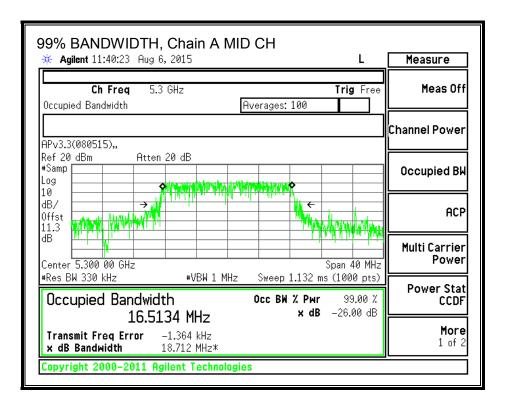
Page 75 of 437

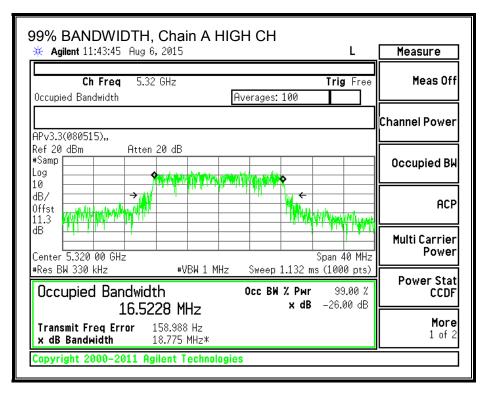
99% BANDWIDTH, Chain B HIGH CH	
₩ Agilent 11:31:48 Aug 6, 2015 L	Measure
Ch Freq 5.32 GHz Trig Free Occupied Bandwidth Averages: 100	Meas Off
APv3.3(080515),	Channel Power
Hrv3.3080915),, Ref 20 dBm Atten 20 dB #Samp Log	Occupied BW
dB/ Offst 11.3 material and a start of the start of th	ACP
dB         ************************************	Multi Carrier Power
Image: Start Start         Image: Start Start         Image: Start         Image: Start Start	Power Stat CCDF
Transmit Freq Error10.233 kHzx dB Bandwidth18.716 MHz*	<b>More</b> 1 of 2
Copyright 2000–2011 Agilent Technologies	

# 99% BANDWIDTH, Chain A



Page 76 of 437





Page 77 of 437 FORM NO: 03-EM-F00858 12 Laboratory Dr., RTP, NC 27709 TEL: (919) 549-1400 This report shall not be reproduced except in full, without the written approval of UL LLC.

# 8.6.3. OUTPUT POWER AND PSD

#### <u>LIMITS</u>

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 B	Chain A	<b>Uncorrelated Chains</b>
Antenna	Antenna	Directional
Gain	Gain	Gain
(dBi)	(dBi)	(dBi)
2.20	2.40	2.30

Page 78 of 437

## **RESULTS**

#### Bandwidth, Antenna Gain, and Limits

Channel	Frequency	Min	Directional	Directional	Power	PSD
		26 dB	Gain	Gain	Limit	Limit
		BW	for Power	for PSD		
	(MHz)	(MHz)	(dBi)	(dBi)	(dBm)	(dBm)
Low	5260	19.00	2.30	2.30	23.79	11.00
Mid	5300	19.47	2.30	2.30	23.89	11.00
High	5320	19.38	2.30	2.30	23.87	11.00

#### Duty Cycle CF (dB) 0.12 Included in Calculations of Corr'd Power & PSD

# **Output Power Results**

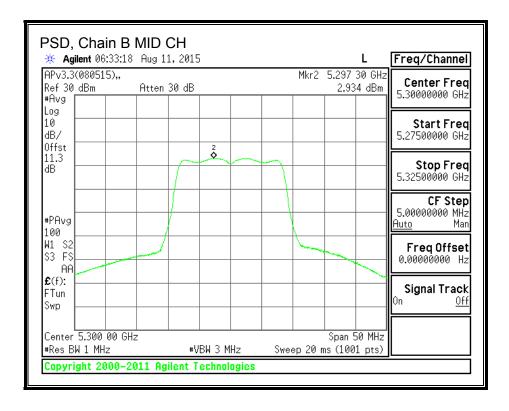
Channel	Frequency	Chain B	Chain A	Total	Power	Power
		Meas	Meas	Corr'd	Limit	Margin
		Power	Power	Power		
	(MHz)	(dBm)	(dBm)	(dBm)	(dBm)	(dB)
Low	5260	13.70	13.33	16.65	23.79	-7.14
Mid	5300	13.52	13.25	16.52	23.89	-7.38
High	5320	13.45	13.17	16.44	23.87	-7.43

# **PSD** Results

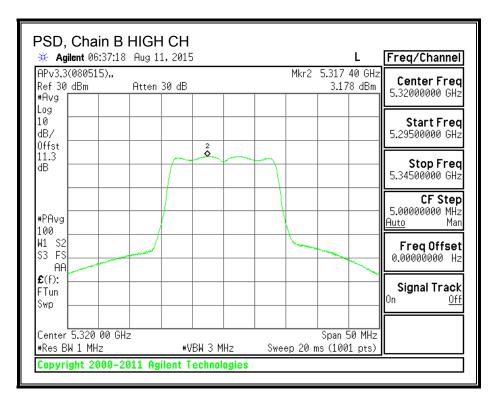
Channel	Frequency	Chain B	Chain A	Total	PSD	PSD
		Meas	Meas	Corr'd	Limit	Margin
		PSD	PSD	PSD		
	(MHz)	(dBm)	(dBm)	(dBm)	(dBm)	(dB)
Low	5260	2.95	2.63	5.92	11.00	-5.08
Mid	5300	2.93	2.52	5.86	11.00	-5.14
High	5320	3.18	2.86	6.15	11.00	-4.85

# PSD, Chain B

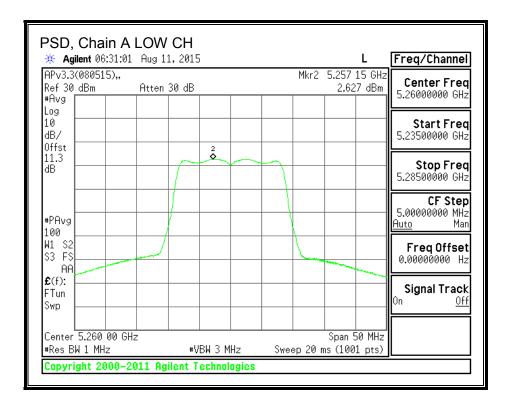
PSD, Chain B L	OW CH			
🔆 🔆 Agilent 06:28:51	Aug 11, 2015		L	Freq/Channel
#Avg	Atten 30 dB	Mkr2	5.257 65 GHz 2.946 dBm	Center Freq 5.26000000 GHz
Log 10 dB/ Offst	2			<b>Start Freq</b> 5.23500000 GHz
11.3 dB	2 <b>0</b>			<b>Stop Freq</b> 5.28500000 GHz
#PAvg				<b>CF Step</b> 5.0000000 MHz <u>Auto</u> Man
W1 S2 S3 FS AA				FreqOffset 0.00000000 Hz
£(f): FTun Swp				<b>Signal Track</b> <sup>On <u>Off</u></sup>
Center 5.260 00 GHz #Res BW 1 MHz	#VBW 3 M		Span 50 MHz ms (1001 pts)	
Copyright 2000-201	LI HGHENT LECHNON	ogies		



Page 80 of 437

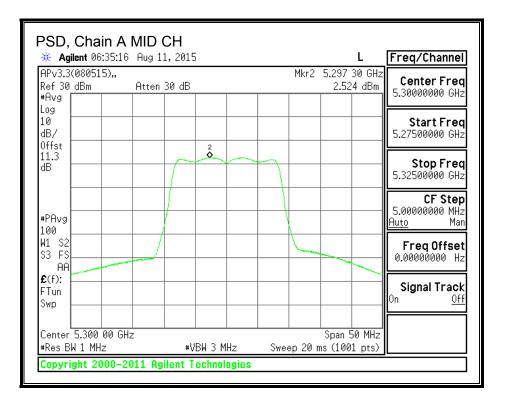


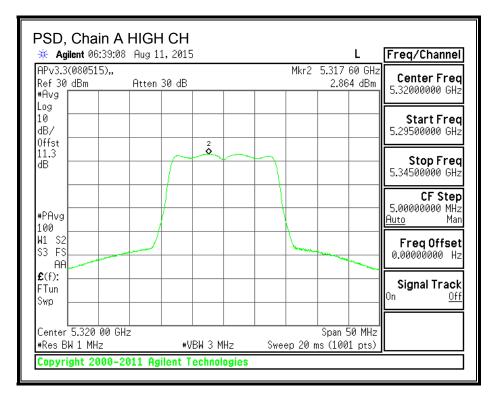
#### PSD, Chain A



Page 81 of 437

FORM NO: 03-EM-F00858 12 Laboratory Dr., RTP, NC 27709 TEL: (919) 549-1400 This report shall not be reproduced except in full, without the written approval of UL LLC.





Page 82 of 437 UL LLC FORM NO: 03-EM-F00858 12 Laboratory Dr., RTP, NC 27709 TEL: (919) 549-1400 This report shall not be reproduced except in full, without the written approval of UL LLC.

# 8.6.4. TPC POWER

# LIMITS

FCC §15.407 (h) (1)

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

# **DIRECTIONAL ANTENNA GAIN**

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

Chain B	Chain A	<b>Uncorrelated Chains</b>
Antenna	Antenna	Directional
Gain	Gain	Gain
(dBi)	(dBi)	(dBi)
2.20	2.40	2.30

Page 83 of 437

#### **RESULTS**

#### **TPC Limits**

Channel	Frequency	Limit	Directional	Limit
		EIRP	Gain	Cond
	(MHz)	(dBm)	(dBi)	(dBm)
Low	5260	24	2.30	21.70
Mid	5300	24	2.30	21.70
High	5320	24	2.30	21.70

Duty Cycle CF (dB) 0.12 Included in Calculations of Corr'd Power

# **TPC Output Power Results**

Channel	Frequency	Chain B	Chain A	Total	Cond	Margin
		Meas	Meas	Corr'd	Power	
		Power	Power	Power	Limit	
	(MHz)	(dBm)	(dBm)	(dBm)	(dBm)	(dB)
Low	5260	13.70	13.33	16.65	21.70	-5.05
Mid	5300	13.52	13.25	16.52	21.70	-5.18
High	5320	13.45	13.17	16.44	21.70	-5.26

Page 84 of 437

# 8.7. 802.11n HT20 MODE IN THE 5.3 GHz BAND

# 8.7.1. 26 dB BANDWIDTH

#### LIMITS

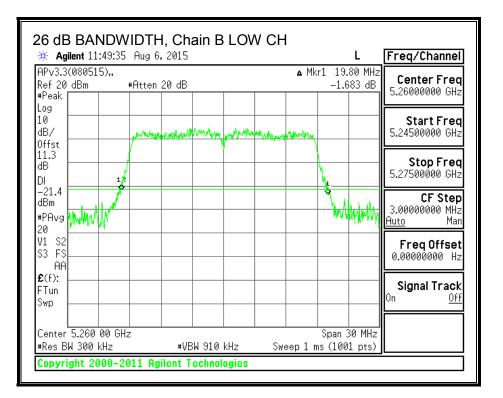
None; for reporting purposes only.

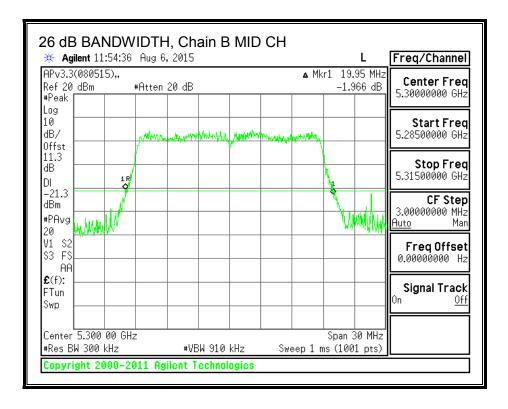
# **RESULTS**

Channel	Frequency	26 dB BW	26 dB BW
		Chain B	Chain A
	(MHz)	(MHz)	(MHz)
Low	5260	19.80	19.71
Mid	5300	19.95	20.06
High	5320	19.92	19.95

Page 85 of 437

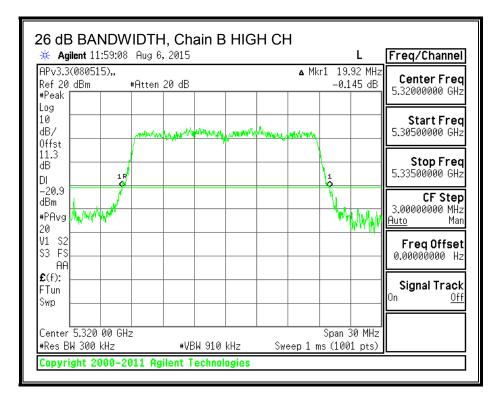
## 26 dB BANDWIDTH, Chain B



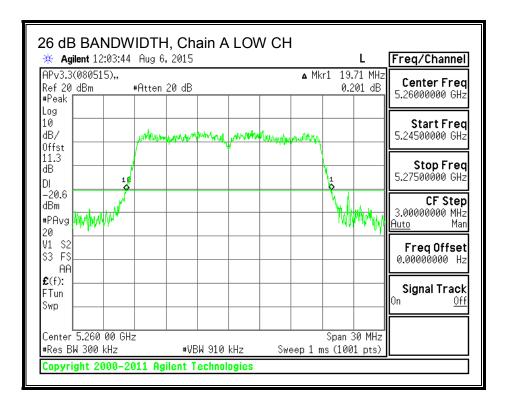


Page 86 of 437

UL LLC FORM NO: 03-EM-F00858 12 Laboratory Dr., RTP, NC 27709 TEL: (919) 549-1400 *This report shall not be reproduced except in full, without the written approval of UL LLC.* 

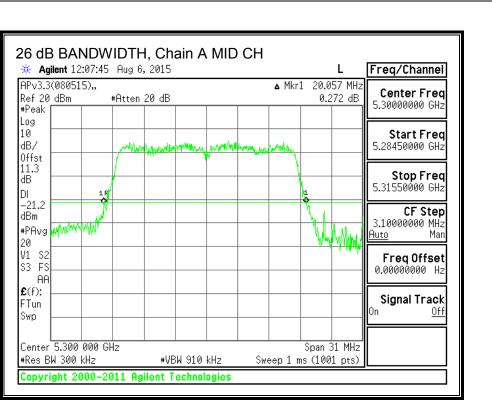


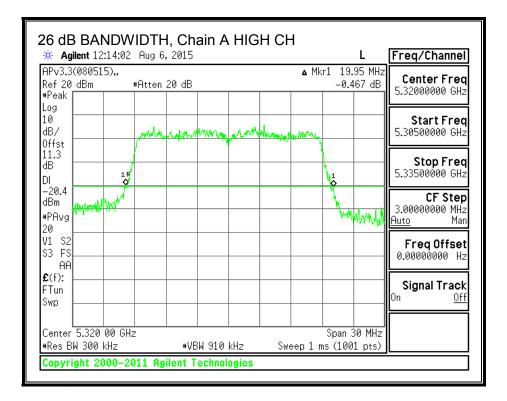
#### 26 dB BANDWIDTH, Chain A



Page 87 of 437

UL LLC FORM NO: 03-EM-F00858 12 Laboratory Dr., RTP, NC 27709 TEL: (919) 549-1400 *This report shall not be reproduced except in full, without the written approval of UL LLC.* 





DATE: 2015-10-08

Page 88 of 437

FORM NO: 03-EM-F00858 12 Laboratory Dr., RTP, NC 27709 TEL: (919) 549-1400 This report shall not be reproduced except in full, without the written approval of UL LLC.

# 8.7.2. 99% BANDWIDTH

# LIMITS

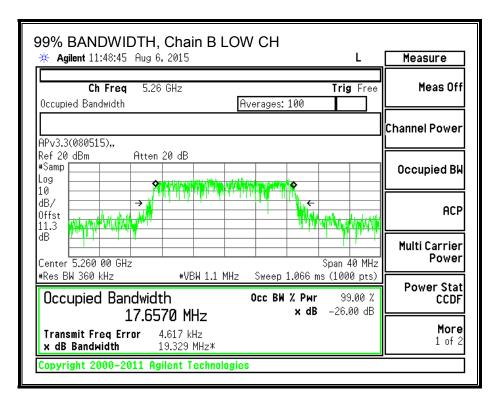
None; for reporting purposes only.

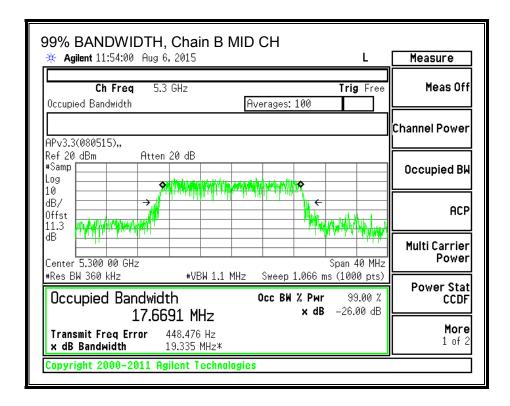
# **RESULTS**

Channel	Frequency	99% BW	99% BW
		Chain B	Chain A
	(MHz)	(MHz)	(MHz)
Low	5260	17.6570	17.6675
Mid	5300	17.6691	17.6585
High	5320	17.6502	17.6626

Page 89 of 437

# 99% BANDWIDTH, Chain B

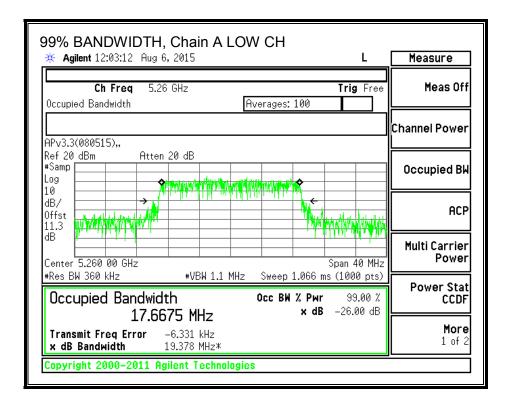




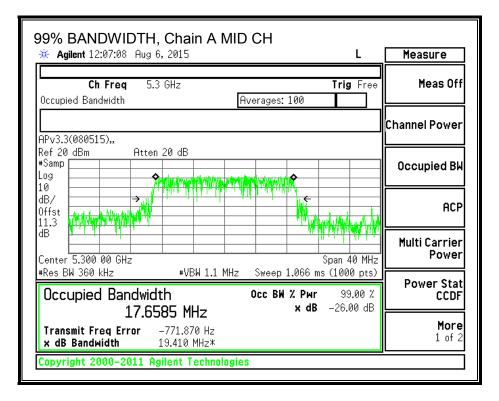
Page 90 of 437

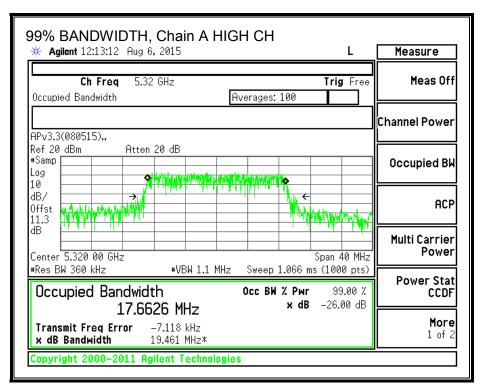
99% BANDWIDTH, Chain B HIGH CH	
ዡ Agilent 11:58:33 Aug 6, 2015	Measure
Ch Freq 5.32 GHz Trig Free Occupied Bandwidth Averages: 100	Meas Off
APv3.3(080515).	Channel Power
Ref 20 dBm Atten 20 dB *Samp	Occupied BW
dB/ dFst 11.3 manual ma Manual manual manu manual manual m manual manual man	ACP
dB         mmmmmm         mmmmm         mmmmm         mmmmm         mmmmm         mmmm         mmm         mmm <thmm< td="" th<=""><td>Multi Carrier Power</td></thmm<>	Multi Carrier Power
Image: Second KH2         #VDW 1.1 MH2         Sweep 1.000 ms (1000 pts)           Occupied Bandwidth         Occ BW % Pwr         99.00 %           17.6502 MHz         × dB         -26.00 dB	Power Stat CCDF
Transmit Freq Error     -11.509 kHz       x dB Bandwidth     19.440 MHz*	<b>More</b> 1 of 2
Copyright 2000–2011 Agilent Technologies	

# 99% BANDWIDTH, Chain A



Page 91 of 437





Page 92 of 437

FORM NO: 03-EM-F00858 12 Laboratory Dr., RTP, NC 27709 TEL: (919) 549-1400 This report shall not be reproduced except in full, without the written approval of UL LLC.

# 8.7.3. OUTPUT POWER AND PSD

#### <u>LIMITS</u>

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 B	Chain A	<b>Uncorrelated Chains</b>
Antenna	Antenna	Directional
Gain	Gain	Gain
(dBi)	(dBi)	(dBi)
2.20	2.40	2.30

Page 93 of 437

## **RESULTS**

# Bandwidth, Antenna Gain, and Limits

Channel	Frequency	Min	Directional	Directional	Power	PSD
		26 dB	Gain	Gain	Limit	Limit
		BW	for Power	for PSD		
	(MHz)	(MHz)	(dBi)	(dBi)	(dBm)	(dBm)
Low	5260	19.71	2.30	2.30	23.95	11.00
Mid	5300	19.95	2.30	2.30	24.00	11.00
High	5320	19.92	2.30	2.30	23.99	11.00

Duty Cycle CF (dB) 0.00

Included in Calculations of Corr'd Power & PSD

#### **Output Power Results**

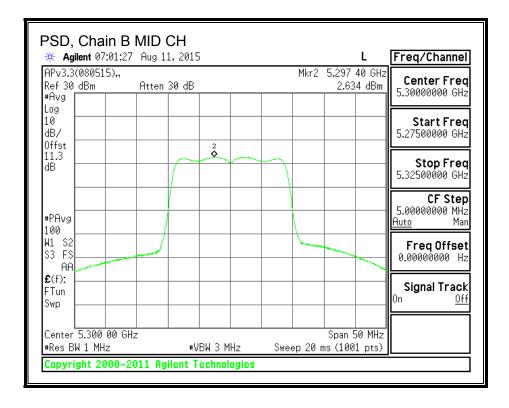
Channel	Frequency	Chain B	Chain A	Total	Power	Power
		Meas	Meas	Corr'd	Limit	Margin
		Power	Power	Power		
	(MHz)	(dBm)	(dBm)	(dBm)	(dBm)	(dB)
Low	5260	13.75	13.46	16.62	23.95	-7.33
Mid	5300	13.64	13.24	16.45	24.00	-7.54
High	5320	13.53	13.42	16.49	23.99	-7.51

# **PSD Results**

Channel	Frequency	Chain B	Chain A	Total	PSD	PSD
		Meas	Meas	Corr'd	Limit	Margin
		PSD	PSD	PSD		
	(MHz)	(dBm)	(dBm)	(dBm)	(dBm)	(dB)
Low	5260	2.92	2.69	5.82	11.00	-5.18
Mid	5300	2.63	2.60	5.63	11.00	-5.37
High	5320	2.83	2.35	5.61	11.00	-5.39

# PSD, Chain B

PSD, Chain B LC		L	Freq/Channel
#Avg	ten 30 dB	Mkr2 5.257 80 GHz 2.918 dBm	Center Freq 5.26000000 GHz
Log 10 dB/ 0ffst	2		Start Freq 5.23500000 GHz
11.3 dB	Ō		<b>Stop Freq</b> 5.28500000 GHz
#PAvg			<b>CF Step</b> 5.00000000 MHz <u>Auto</u> Man
W1 S2 S3 FS АА			Freq Offset 0.00000000 Hz
£(f): FTun Swp			<b>Signal Track</b> On <u>Off</u>
Center 5.260 00 GHz #Res BW 1 MHz	#VBW 3 MHz	Span 50 MHz Sweep 20 ms (1001 pts)	

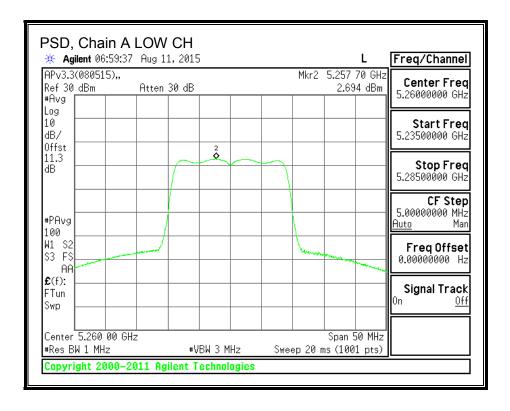


DATE: 2015-10-08

Page 95 of 437

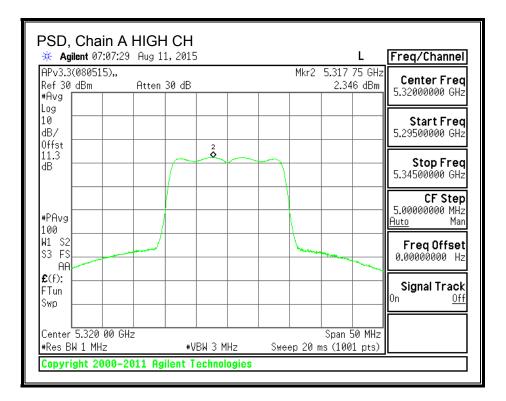
🖗 Agilent 07:05:57 Aug	11,2015		L	Freq/Channel
Avg	en 30 dB		317 65 GHz 2.830 dBm	Center Freq 5.32000000 GHz
og Ø IB/				Start Freq 5.29500000 GHz
B	2			<b>Stop Fred</b> 5.34500000 GHz
PAvg				<b>CF Step</b> 5.00000000 MHz <u>Auto</u> Mar
00 1 S2 3 FS				FreqOffset 0.00000000 Hz
t(f): Tun Wp				<b>Signal Track</b> On <u>Off</u>
Center 5.320 00 GHz Res BW 1 MHz	#VBW 3 MHz	Sp Sweep 20 ms (	an 50 MHz 1001 nts)	

#### PSD, Chain A



Page 96 of 437

🔆 Agilent 07:03:26 Aug	11,2015		L	Freq/Channel
#Avg	en 30 dB	Mkr2 5.	297 60 GHz 2.597 dBm	Center Freq 5.30000000 GHz
Log 10 dB/ Offst				Start Freq 5.27500000 GHz
dB		$\uparrow \downarrow \downarrow$		<b>Stop Freq</b> 5.32500000 GHz
#PAvg				<b>CF Step</b> 5.00000000 MHz <u>Auto</u> Man
100 N1 S2 S3 FS AA				Freq Offset 0.00000000 Hz
E(f): FTun Swp				<b>Signal Track</b> <sup>On <u>Off</u></sup>
Center 5.300 00 GHz #Res BW 1 MHz	#VBW 3 MHz	Sweep 20 ms	oan 50 MHz (1001 nts)	



Page 97 of 437

# 8.7.4. TPC POWER

# LIMITS

FCC §15.407 (h) (1)

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

# **DIRECTIONAL ANTENNA GAIN**

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

Chain B	Chain A	<b>Uncorrelated Chains</b>
Antenna	Antenna	Directional
Gain	Gain	Gain
(dBi)	(dBi)	(dBi)
2.20	2.40	2.30

Page 98 of 437

#### **RESULTS**

#### **TPC Limits**

Channel	Frequency	Limit	Directional	Limit
		EIRP	Gain	Cond
	(MHz)	(dBm)	(dBi)	(dBm)
Low	5260	24	2.30	21.70
Mid	5300	24	2.30	21.70
High	5320	24	2.30	21.70

0.00

Duty Cycle CF (dB)

Included in Calculations of Corr'd Power

# **TPC Output Power Results**

Channel	Frequency	Chain B	Chain A	Total	Cond	Margin
		Meas	Meas	Corr'd	Power	
		Power	Power	Power	Limit	
	(MHz)	(dBm)	(dBm)	(dBm)	(dBm)	(dB)
Low	5260	13.75	13.46	16.62	21.70	-5.08
Mid	5300	13.64	13.24	16.45	21.70	-5.25
High	5320	13.53	13.42	16.49	21.70	-5.21

Page 99 of 437

# 8.8. 802.11n HT40 MODE IN THE 5.3 GHz BAND

# 8.8.1. 26 dB BANDWIDTH

#### LIMITS

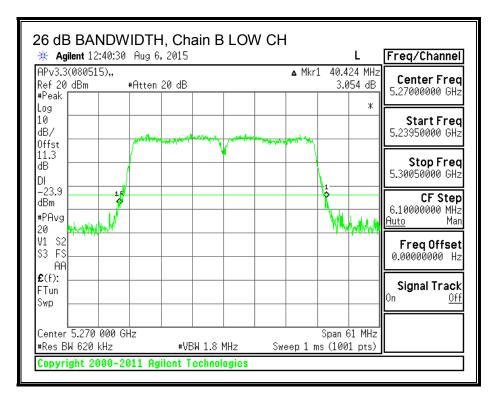
None; for reporting purposes only.

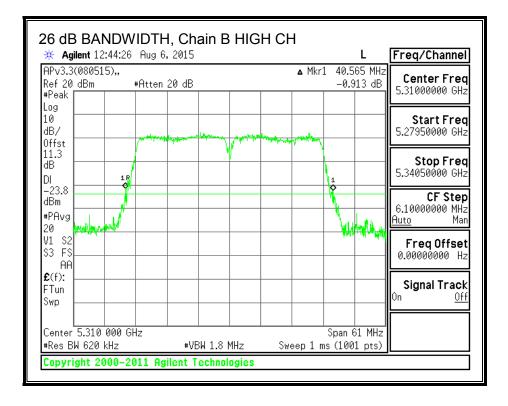
#### **RESULTS**

Channel	Frequency	26 dB BW	26 dB BW
		Chain B	Chain A
	(MHz)	(MHz)	(MHz)
Low	5270	40.42	40.32
High	5310	40.57	39.87

Page 100 of 437

# 26 dB BANDWIDTH, Chain B

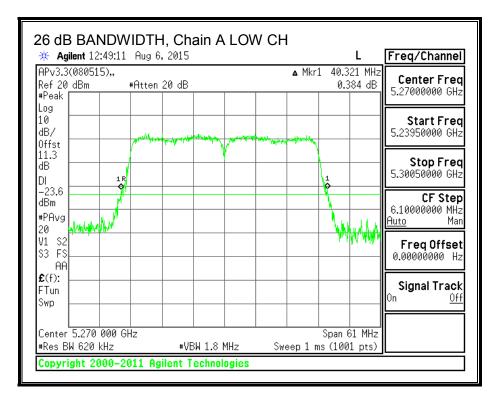


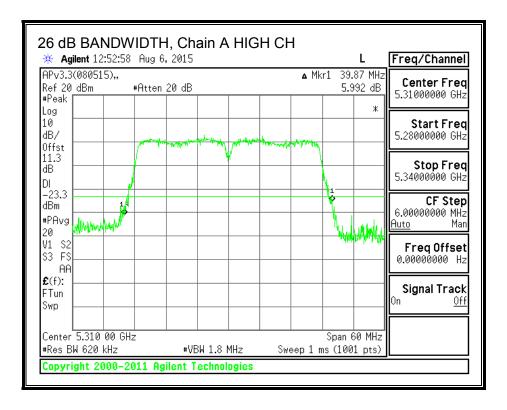


Page 101 of 437

FORM NO: 03-EM-F00858 12 Laboratory Dr., RTP, NC 27709 TEL: (919) 549-1400 This report shall not be reproduced except in full, without the written approval of UL LLC.

#### 26 dB BANDWIDTH, Chain A





Page 102 of 437

UL LLC FORM NO: 03-EM-F00858 12 Laboratory Dr., RTP, NC 27709 TEL: (919) 549-1400 *This report shall not be reproduced except in full, without the written approval of UL LLC.* 

# 8.8.2. 99% BANDWIDTH

## LIMITS

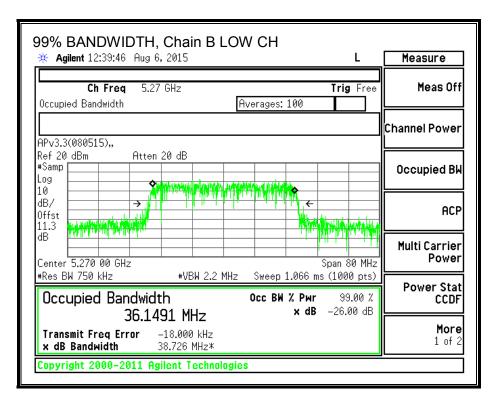
None; for reporting purposes only.

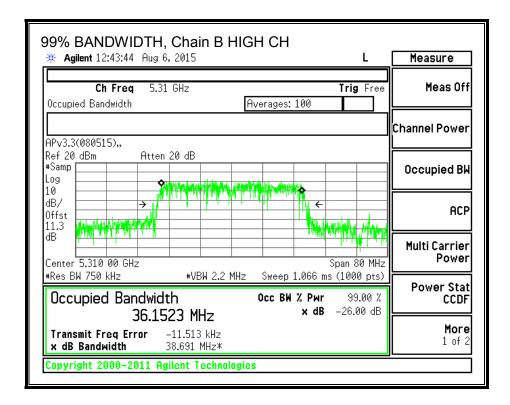
## <u>RESULTS</u>

Channel	Frequency	99% BW	99% BW	
		Chain B	Chain A	
	(MHz)	(MHz)	(MHz)	
Low	5270	36.1491	36.1688	
High	5310	36.1523	36.1398	

Page 103 of 437

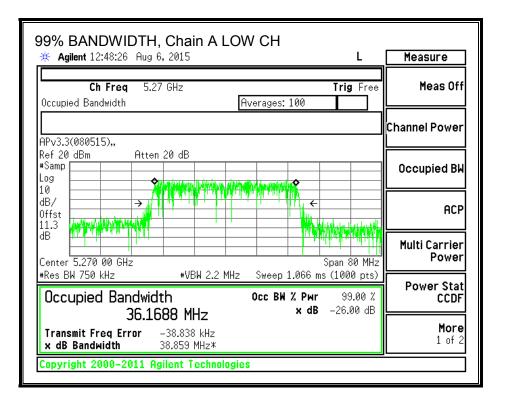
# 99% BANDWIDTH, Chain B

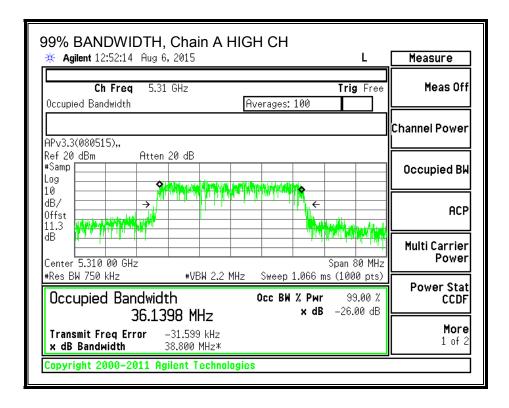




Page 104 of 437

#### 99% BANDWIDTH, Chain A





Page 105 of 437

UL LLC FORM NO: 03-EM-F00858 12 Laboratory Dr., RTP, NC 27709 TEL: (919) 549-1400 *This report shall not be reproduced except in full, without the written approval of UL LLC.* 

# 8.8.3. OUTPUT POWER AND PSD

#### **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 B	Chain A	<b>Uncorrelated Chains</b>
Antenna	Antenna	Directional
Gain	Gain	Gain
(dBi)	(dBi)	(dBi)
2.20	2.40	2.30

Page 106 of 437

## **RESULTS**

#### Bandwidth, Antenna Gain, and Limits

Channel	Frequency	Min	Directional	Directional	Power	PSD
		26 dB	Gain	Gain	Limit	Limit
		BW	for Power	for PSD		
	(MHz)	(MHz)	(dBi)	(dBi)	(dBm)	(dBm)
Low	5270	40.32	2.30	2.30	24.00	11.00
High	5310	39.87	2.30	2.30	24.00	11.00

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

#### **Output Power Results**

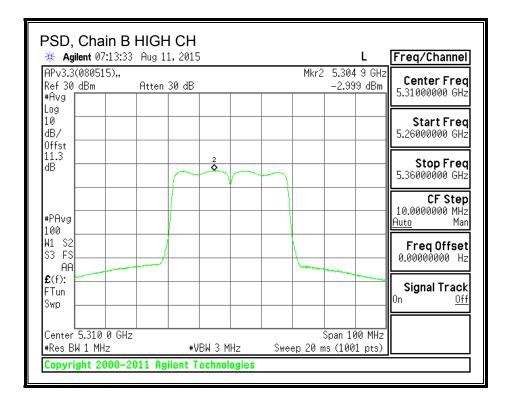
Channel	Frequency	Chain B	Chain A	Total	Power	Power
		Meas	Meas	Corr'd	Limit	Margin
		Power	Power	Power		
	(MHz)	(dBm)	(dBm)	(dBm)	(dBm)	(dB)
Low	5270	10.79	11.16	13.99	24.00	-10.01
High	5310	10.73	10.92	13.84	24.00	-10.16

#### **PSD Results**

Channel	Frequency	Chain B	Chain A	Total	PSD	PSD
		Meas	Meas	Corr'd	Limit	Margin
		PSD	PSD	PSD		
	(MHz)	(dBm)	(dBm)	(dBm)	(dBm)	(dB)
Low	5270	-3.26	-3.24	-0.24	11.00	-11.24
High	5310	-3.00	-3.14	-0.06	11.00	-11.06

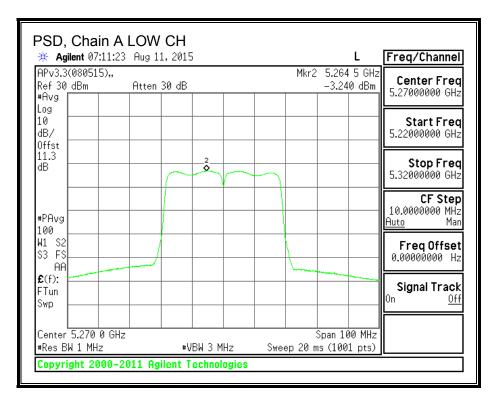
# PSD, Chain B

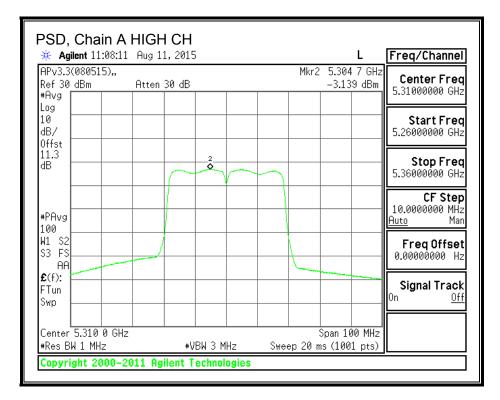
PSD, Chain B LOW ☀ Agilent 07:09:35 Aug 1			L Freq/Channel
#Avg	30 dB	Mkr2 5.265 -3.25	5 0 GHz 6 dBm 5.27000000 GHz
Log 10 dB/ Offst			Start Freq 5.22000000 GHz
11.3 dB	2		Stop Freq 5.32000000 GHz
#PAvg			CF Step 10.000000 MHz <u>Auto</u> Man
W1 S2 S3 FS АА			Freq Offset 0.00000000 Hz
£(f): FTun Swp			Signal Track
Center 5.270 0 GHz #Res BW 1 MHz	#VBW 3 MHz	Span 1 Span 1 Sweep 20 ms (100	



Page 108 of 437

UL LLC FORM NO: 03-EM-F00858 12 Laboratory Dr., RTP, NC 27709 TEL: (919) 549-1400 *This report shall not be reproduced except in full, without the written approval of UL LLC.* 





Page 109 of 437

UL LLC FORM NO: 03-EM-F00858 12 Laboratory Dr., RTP, NC 27709 TEL: (919) 549-1400 *This report shall not be reproduced except in full, without the written approval of UL LLC.* 

## 8.8.4. TPC POWER

## LIMITS

FCC §15.407 (h) (1)

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

## **DIRECTIONAL ANTENNA GAIN**

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

Chain B	Chain A	<b>Uncorrelated Chains</b>
Antenna	Antenna	Directional
Gain	Gain	Gain
(dBi)	(dBi)	(dBi)
2.20	2.40	2.30

Page 110 of 437

### **TPC Limits**

Channel	Frequency	Limit	Directional	Limit
		EIRP	Gain	Cond
	(MHz)	(dBm)	(dBi)	(dBm)
Low	5270	24	2.30	21.70
High	5310	24	2.30	21.70

## **TPC Output Power Results**

Channel	Frequency	Chain B	Chain A	Total	Cond	Margin
		Meas	Meas	Corr'd	Power	
		Power	Power	Power	Limit	
	(MHz)	(dBm)	(dBm)	(dBm)	(dBm)	(dB)
Low	5270	10.79	11.16	13.99	21.70	-7.71
High	5310	10.73	10.92	13.84	21.70	-7.86

## 8.9. 802.11ac VHT80 MODE IN THE 5.3 GHz BAND

## 8.9.1. 26 dB BANDWIDTH

## LIMITS

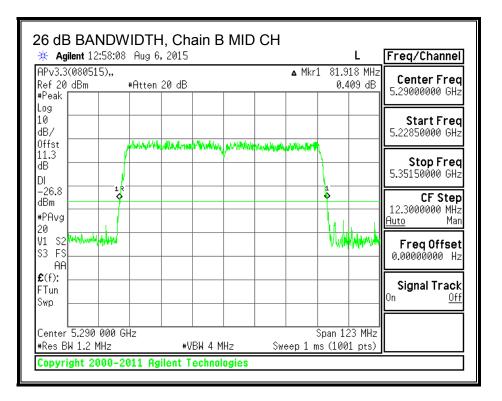
None; for reporting purposes only.

## **RESULTS**

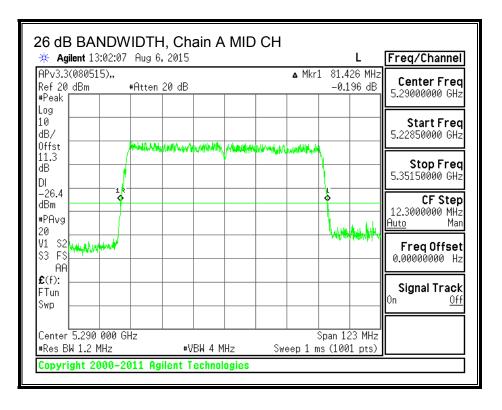
Channel	Frequency	26 dB BW	26 dB BW
		Chain B	Chain A
	(MHz)	(MHz)	(MHz)
Mid	5290	81.92	81.43

Page 112 of 437

## 26 dB BANDWIDTH, Chain B



#### 26 dB BANDWIDTH, Chain A



Page 113 of 437

UL LLC

## 8.9.2. 99% BANDWIDTH

## LIMITS

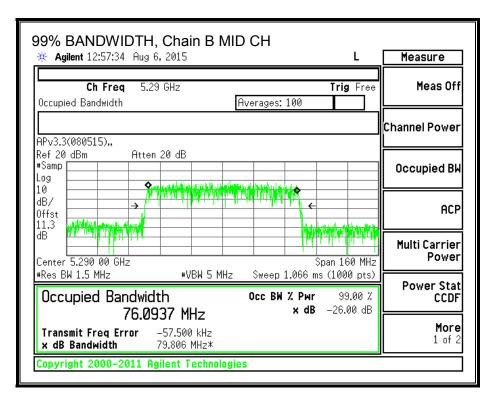
None; for reporting purposes only.

## <u>RESULTS</u>

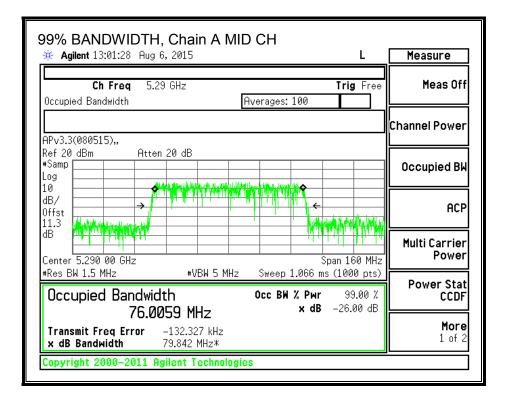
Channel	Frequency	99% BW	99% BW
		Chain B	Chain A
	(MHz)	(MHz)	(MHz)
Mid	5290	76.0937	76.0059

Page 114 of 437

## 99% BANDWIDTH, Chain B



### 99% BANDWIDTH, Chain A



Page 115 of 437

UL LLC

FORM NO: 03-EM-F00858 12 Laboratory Dr., RTP, NC 27709 TEL: (919) 549-1400 This report shall not be reproduced except in full, without the written approval of UL LLC.

## 8.9.3. OUTPUT POWER AND PSD

### <u>LIMITS</u>

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 B	Chain A	<b>Uncorrelated Chains</b>
Antenna	Antenna	Directional
Gain	Gain	Gain
(dBi)	(dBi)	(dBi)
2.20	2.40	2.30

Page 116 of 437

## **RESULTS**

## Bandwidth, Antenna Gain, and Limits

Channel	Frequency	Min	Directional	Directional	Power	PSD
		26 dB	Gain	Gain	Limit	Limit
		BW	for Power	for PSD		
	(MHz)	(MHz)	(dBi)	(dBi)	(dBm)	(dBm)
Mid	5290	81.43	2.30	2.30	24.00	11.00

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

### **Output Power Results**

Channel	Frequency	Chain B	Chain A	Total	Power	Power
		Meas	Meas	Corr'd	Limit	Margin
		Power	Power	Power		
	(MHz)	(dBm)	(dBm)	(dBm)	(dBm)	(dB)
Mid	5290	7.49	7.84	10.68	24.00	-13.32

#### **PSD Results**

Channel	Frequency	Chain B	Chain A	Total	PSD	PSD
		Meas	Meas	Corr'd	Limit	Margin
		PSD	PSD	PSD		
	(MHz)	(dBm)	(dBm)	(dBm)	(dBm)	(dB)
Mid	5290	-6.48	-6.06	-3.25	11.00	-14.25

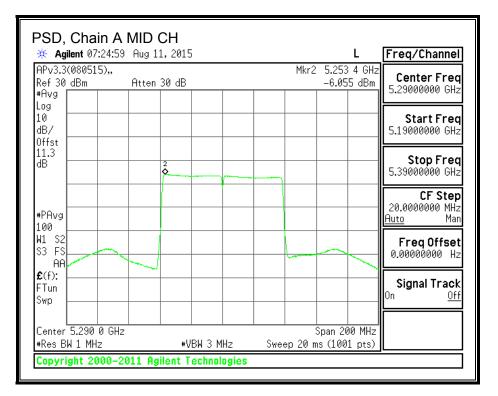
Page 117 of 437

## PSD, Chain B

PSD, Chain B MI			
🔆 🔆 Agilent 07:21:53 Au	g 11, 2015	L	Freq/Channel
#Avg	:en 30 dB	Mkr2 5.254 0 Gł –6.477 dBi	II Contor Frod
Log 10 dB/ 0ffst			Start Freq 5.19000000 GHz
11.3 dB	2 \$		<b>Stop Freq</b> 5.39000000 GHz
#PAvg			<b>CF Step</b> 20.0000000 MHz <u>Auto</u> Man
W1 S2 S3 FS АА			FreqOffset 0.00000000 Hz
£(f): FTun Swp			Signal Track
Center 5.290 0 GHz #Res BW 1 MHz	#VBW 3 MHz	Span 200 MH Sweep 20 ms (1001 pts	
Copyright 2000-2011	Hglient lechnologies		

Page 118 of 437

## PSD, Chain A



Page 119 of 437

## 8.9.4. TPC POWER

## LIMITS

FCC §15.407 (h) (1)

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

## **DIRECTIONAL ANTENNA GAIN**

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

Chain B	Chain A	<b>Uncorrelated Chains</b>
Antenna	Antenna	Directional
Gain	Gain	Gain
(dBi)	(dBi)	(dBi)
2.20	2.40	2.30

Page 120 of 437

### **RESULTS**

**TPC Limits** 

Channel	Frequency	Limit	Directional	Limit
		EIRP	Gain	Cond
	(MHz)	(dBm)	(dBi)	(dBm)
Mid	5290	24	2.30	21.70

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

**TPC Output Power Results** 

Channel	Frequency	Chain B	Chain A	Total	Cond	Margin
		Meas	Meas	Corr'd	Power	
		Power	Power	Power	Limit	
	(MHz)	(dBm)	(dBm)	(dBm)	(dBm)	(dB)
Mid	5290	7.49	7.84	10.68	21.70	-11.02

Page 121 of 437

# 8.10. 802.11a MODE IN THE 5.6 GHz BAND

## 8.10.1. 26 dB BANDWIDTH

## LIMITS

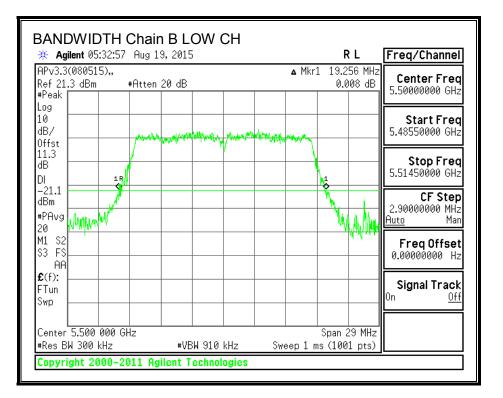
None; for reporting purposes only.

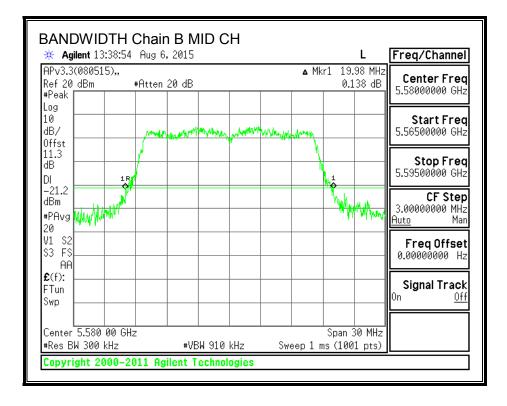
### **RESULTS**

Channel	Frequency	26 dB BW	26 dB BW
		Chain B	Chain A
	(MHz)	(MHz)	(MHz)
Low	5500	19.26	19.80
Mid	5580	19.98	19.56
High Ch 136	5680	19.38	19.35
High Ch 140	5700	19.53	19.38
144	5720	19.83	19.74

Page 122 of 437

## 26 dB BANDWIDTH, Chain B

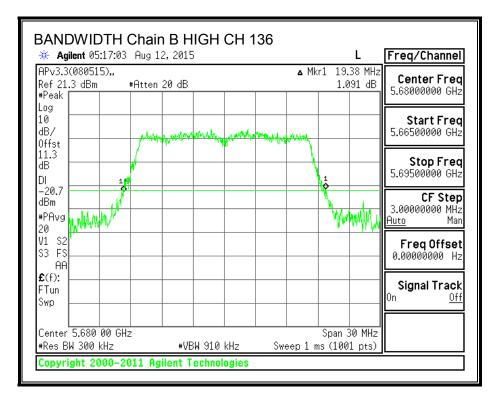


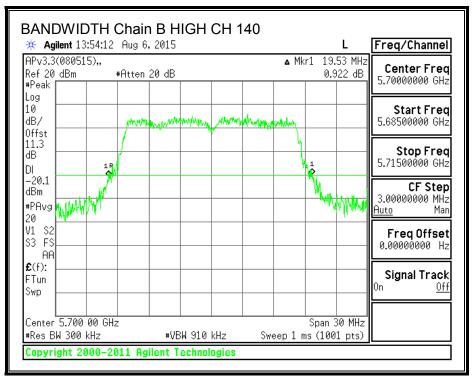


Page 123 of 437

UL LLC FORM NO: 03-EM-F00858 12 Laboratory Dr., RTP, NC 27709 TEL: (919) 549-1400 *This report shall not be reproduced except in full, without the written approval of UL LLC.* 



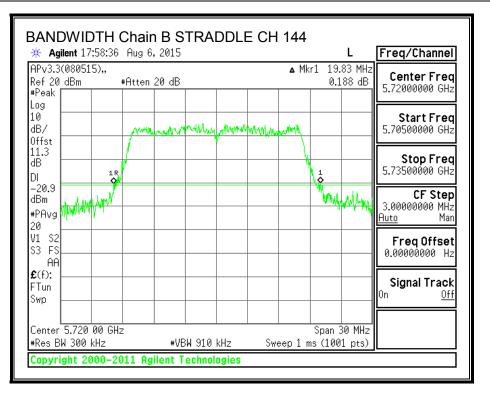




Page 124 of 437

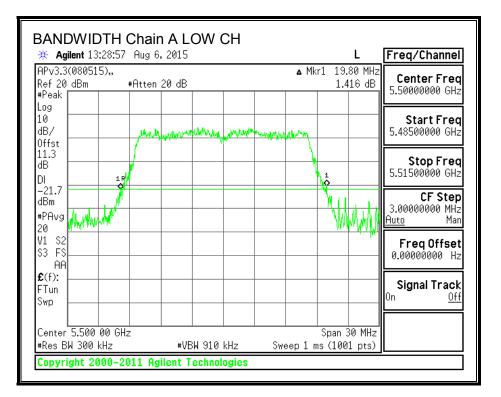
FORM NO: 03-EM-F00858 12 Laboratory Dr., RTP, NC 27709 TEL: (919) 549-1400 This report shall not be reproduced except in full, without the written approval of UL LLC.

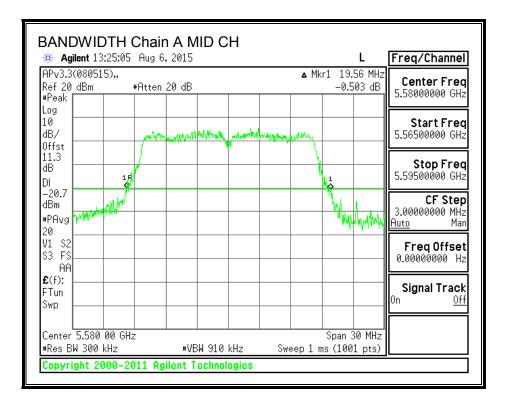
UL LLC



Page 125 of 437

## 26 dB BANDWIDTH, Chain A

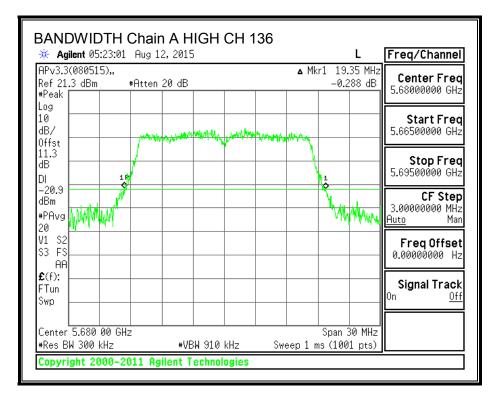


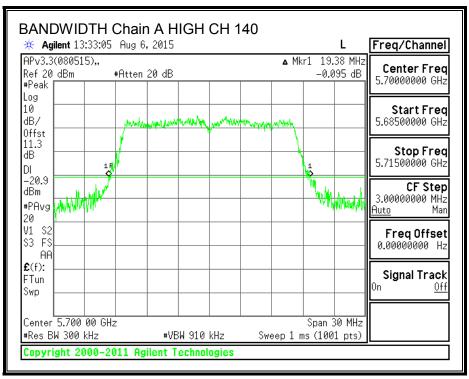


Page 126 of 437

UL LLC FORM NO: 03-EM-F00858 12 Laboratory Dr., RTP, NC 27709 TEL: (919) 549-1400 *This report shall not be reproduced except in full, without the written approval of UL LLC.* 



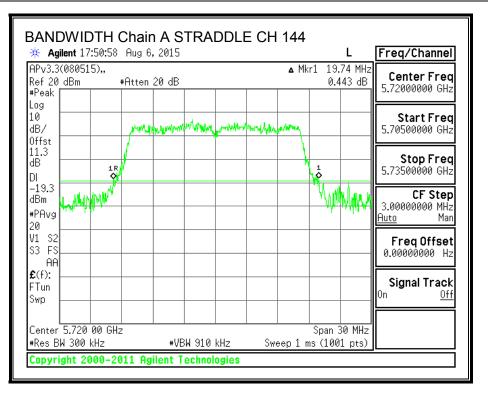




Page 127 of 437

FORM NO: 03-EM-F00858 12 Laboratory Dr., RTP, NC 27709 TEL: (919) 549-1400 This report shall not be reproduced except in full, without the written approval of UL LLC.

UL LLC



Page 128 of 437

## 8.10.2. 99% BANDWIDTH

## LIMITS

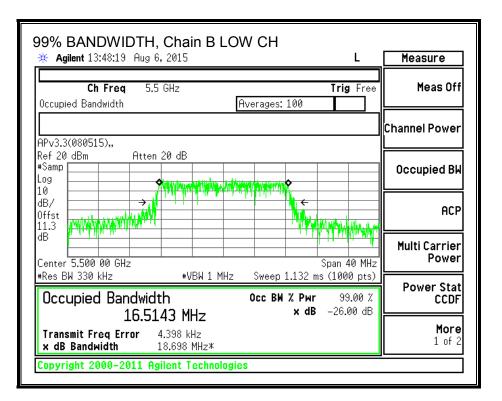
None; for reporting purposes only.

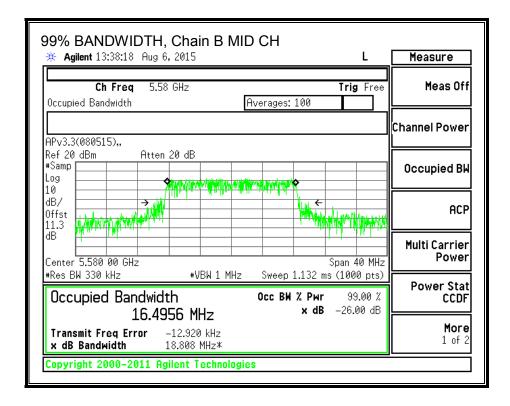
## <u>RESULTS</u>

Channel	Frequency	99% BW	99% BW
		Chain B	Chain A
	(MHz)	(MHz)	(MHz)
Low	5500	16.5143	16.5123
Mid	5580	16.4956	16.5159
High CH 136	5680	16.5206	16.5132
High CH 140	5700	16.4998	16.5060
144	5720	16.5233	16.5167

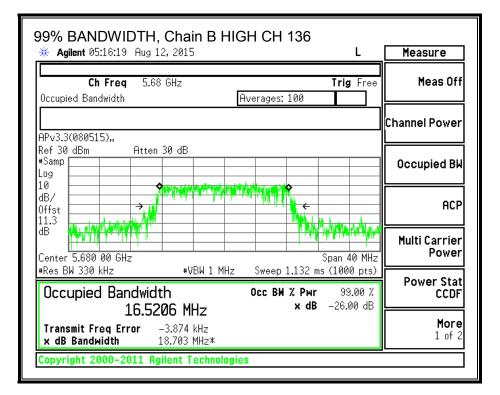
Page 129 of 437

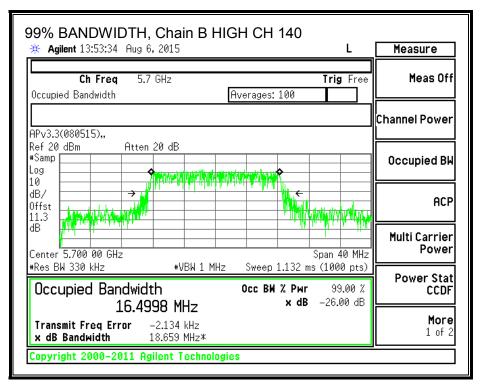
## 99% BANDWIDTH, Chain B





Page 130 of 437





Page 131 of 437

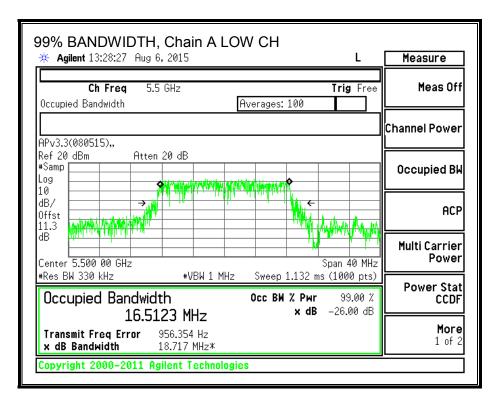
UL LLC 12 Laboratory Dr., RTP, NC 27709

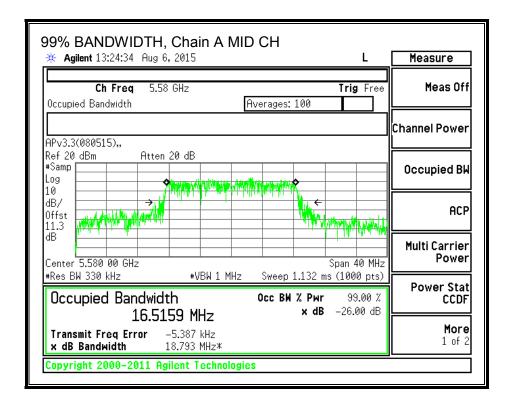
FORM NO: 03-EM-F00858 TEL: (919) 549-1400 This report shall not be reproduced except in full, without the written approval of UL LLC.

99% BANDWIDTH, Chain B STRADDLE CH 144	Measure
Ch Freq 5.72 GHz Trig Free Occupied Bandwidth Averages: 100	Meas Off
	Channel Power
Ref 20 dBm Atten 20 dB #Samp Log 10 Professional Attention of the second	Occupied BW
dB/	ACP
dB         Image: Center 5.720 00 GHz         Span 40 MHz           #Res BW 330 kHz         #VBW 1 MHz         Sweep 1.132 ms (1000 pts)	Multi Carrier Power
Image: Weak of the second se	Power Stat CCDF
Transmit Freq Error     656.820 Hz       x dB Bandwidth     18.837 MHz*	<b>More</b> 1 of 2
Copyright 2000–2011 Agilent Technologies	

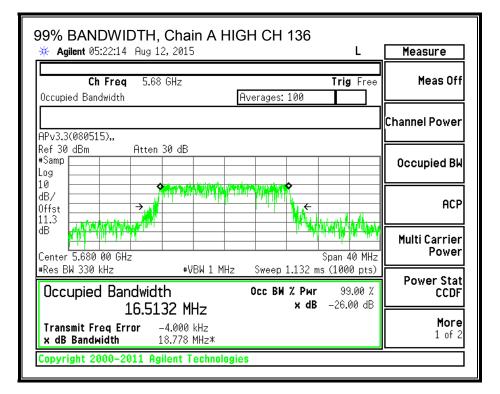
Page 132 of 437

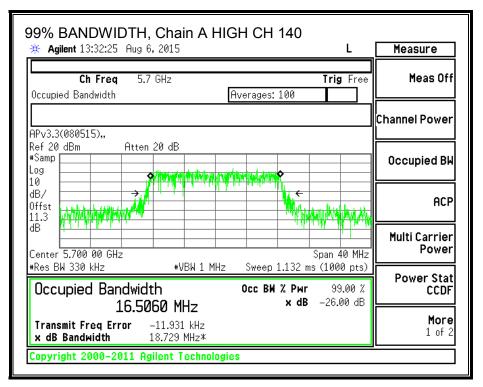
## 99% BANDWIDTH, Chain A





Page 133 of 437





Page 134 of 437

99% BANDWIDTH, Chain A STRADDLE CH 144	Measure
Ch Freq 5.72 GHz Trig Free Occupied Bandwidth Averages: 100	Meas Off
APv3.3(080515),	Channel Power
Ref 20 dBm Atten 20 dB #Samp Log <b>Attended attended attended attended</b>	Occupied BW
10 dB/ 0ffst 11.3	ACP
dB Center 5.720 00 GHz Span 40 MHz	Multi Carrier Power
#Res BW 330 kHz         #VBW 1 MHz         Sweep 1.132 ms (1000 pts)           Occupied Bandwidth         Occ BW % Pwr         99.00 %           16.5167 MHz         × dB         -26.00 dB	Power Stat CCDF
LO.JLO7 MINZ Transmit Freq Error 8.315 kHz x dB Bandwidth 18.387 MHz*	<b>More</b> 1 of 2
Copyright 2000–2011 Agilent Technologies	

Page 135 of 437

## 8.10.3. OUTPUT POWER AND PSD

## 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	Chain 1	<b>Uncorrelated Chains</b>
Antenna	Antenna	Directional
Gain	Gain	Gain
(dBi)	(dBi)	(dBi)
2.10	2.30	2.20

Page 136 of 437

## **RESULTS**

## Bandwidth, Antenna Gain, and Limits

Channel	Frequency	Min	Directional	Directional	Power	PSD
		26 dB	Gain	Gain	Limit	Limit
		BW	for Power	for PSD		
	(MHz)	(MHz)	(dBi)	(dBi)	(dBm)	(dBm)
Low	5500	19.26	2.20	2.20	23.85	11.00
Mid	5580	19.56	2.20	2.20	23.91	11.00
High CH 136	5680	19.35	2.20	2.20	23.87	11.00
High CH 140	5700	19.38	2.20	2.20	23.87	11.00

#### Duty Cycle CF (dB) 0.12

### Included in Calculations of Corr'd Power & PSD

## **Output Power Results**

Channel	Frequency	Chain B	Chain A	Total	Power	Power
		Meas	Meas	Corr'd	Limit	Margin
		Power	Power	Power		
	(MHz)	(dBm)	(dBm)	(dBm)	(dBm)	(dB)
Low	5500	13.72	13.53	16.76	23.85	-7.09
Mid	5580	13.68	13.20	16.58	23.91	-7.34
High CH 136	5680	14.01	13.35	16.82	23.87	-7.04
High CH 140	5700	13.01	12.98	16.13	23.87	-7.75

#### **PSD Results**

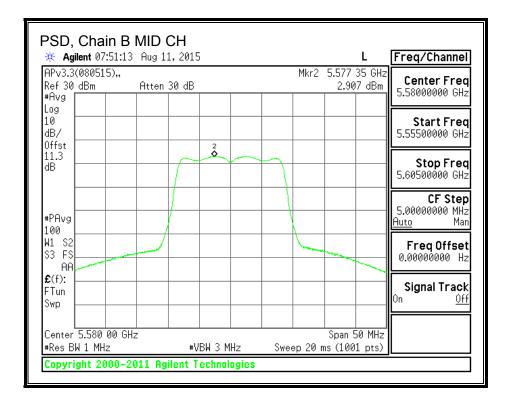
Channel	Frequency	Chain B	Chain A	Total	PSD	PSD
		Meas	Meas	Corr'd	Limit	Margin
		PSD	PSD	PSD		
	(MHz)	(dBm)	(dBm)	(dBm)	(dBm)	(dB)
Low	5500	2.74	2.67	5.83	11.00	-5.17
Mid	5580	2.91	2.85	6.01	11.00	-4.99
High CH 136	5680	2.97	2.59	5.92	11.00	-5.08
High CH 140	5700	2.30	1.81	5.19	11.00	-5.81

UL LLC 12 Laboratory Dr., RTP, NC 27709

FORM NO: 03-EM-F00858 TEL: (919) 549-1400 This report shall not be reproduced except in full, without the written approval of UL LLC.

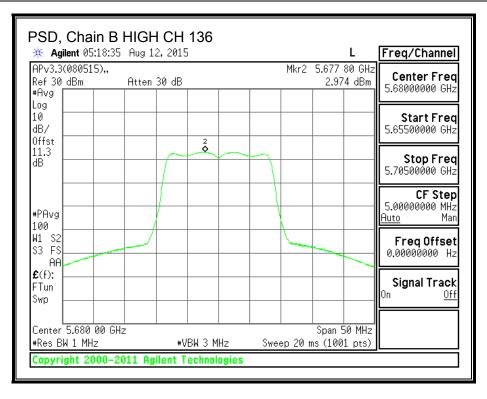
## PSD, Chain B

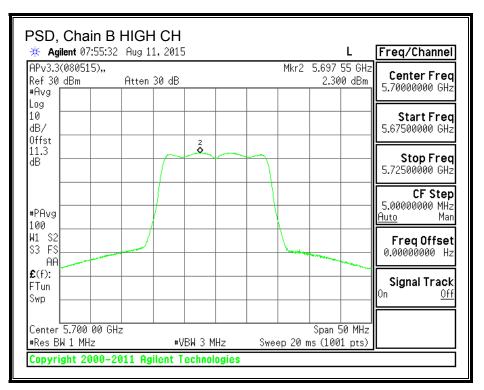
PSD, Chain B LOV * Agilent 07:47:00 Aug		L	Freq/Channel
#Avg	n 30 dB	Mkr2 5.502 45 GF 2.736 dBr	Z Contor From
Log 10 dB/ 0ffst			Start Freq 5.47500000 GHz
11.3 dB			Stop Freq 5.52500000 GHz
#PAvg			<b>CF Step</b> 5.00000000 MHz <u>Auto</u> Man
W1 S2 S3 FS AA			Freq Offset 0.00000000 Hz
<b>£</b> (f): FTun Swp			Signal Track
Center 5.500 00 GHz #Res BW 1 MHz	#VBW 3 MHz	Span 50 MH Sweep 20 ms (1001 pts	
Copyright 2000-2011 A	gilent Technologies		



Page 138 of 437

UL LLC FORM NO: 03-EM-F00858 12 Laboratory Dr., RTP, NC 27709 TEL: (919) 549-1400 *This report shall not be reproduced except in full, without the written approval of UL LLC.* 





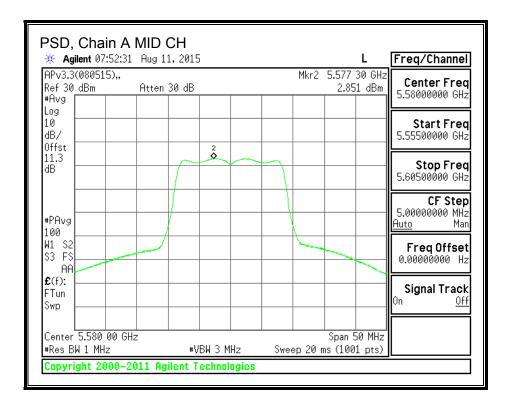
Page 139 of 437

FORM NO: 03-EM-F00858 12 Laboratory Dr., RTP, NC 27709 TEL: (919) 549-1400 This report shall not be reproduced except in full, without the written approval of UL LLC.

UL LLC

## PSD, Chain A

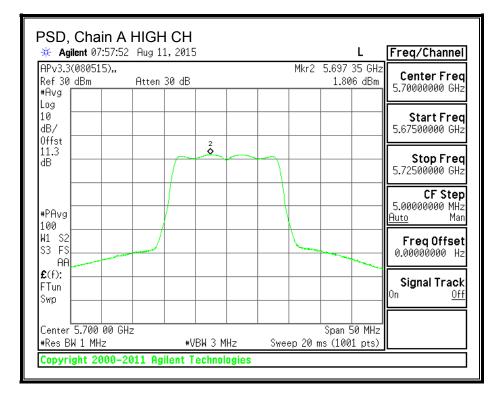
PSD, Chain A LOW			
🔆 🔆 Agilent 07:49:20 Aug 11	1,2015	L	Freq/Channel
APv3.3(080515),, Ref 30 dBm Atten #Avg	30 dB	Mkr2 5.502 35 G 2.670 dB	
Log 10 dB/ 0ffst			Start Freq 5.47500000 GHz
dB	2 <b>O</b>		Stop Freq 5.52500000 GHz
#PAvg			<b>CF Step</b> 5.00000000 MHz <u>Auto</u> Man
W1 S2 S3 FS AA			Freq Offset 0.00000000 Hz
<b>£</b> (f): FTun Swp			Signal Track
Center 5.500 00 GHz #Res BW 1 MHz	#VBW 3 MHz	Span 50 M Span 50 M Sweep 20 ms (1001 pt:	
Copyright 2000-2011 Ag	lient l'echnologies		



Page 140 of 437

UL LLC FORM NO: 03-EM-F00858 12 Laboratory Dr., RTP, NC 27709 TEL: (919) 549-1400 *This report shall not be reproduced except in full, without the written approval of UL LLC.* 

PSD, Chain A HIG⊦ ☀ Agilent 05:25:05 Aug 1			L	Freq/Channel
APv3.3(080515),, Ref 30 dBm Atten #Avg	30 dB	Mkr2 5.677 2.5	7 55 GHz 592 dBm	Center Freq 5.68000000 GHz
Log 10 dB/ 0ffst				Start Freq 5.65500000 GHz
dB				<b>Stop Freq</b> 5.70500000 GHz
#PAvg				<b>CF Step</b> 5.00000000 MHz <u>Auto</u> Man
ИП 52 S3 FS ӨӨ				Freq Offset 0.00000000 Hz
£(f): FTun Swp				<b>Signal Track</b> <sup>On <u>Off</u></sup>
Center 5.680 00 GHz #Res BW 1 MHz	#VBW 3 MHz		50 MHz 101 pts)	



Page 141 of 437

UL LLC FORM NO: 03-EM-F00858 12 Laboratory Dr., RTP, NC 27709 TEL: (919) 549-1400 *This report shall not be reproduced except in full, without the written approval of UL LLC.* 

#### STRADDLE CHANNEL 144 RESULTS

#### UNII-2C BAND

#### Bandwidth, Antenna Gain, and Limits

Channel	Frequency	Min	Directional	Directional	Power	PSD
		26 dB	Gain	Gain	Limit	Limit
		BW	for Power	for PSD		
	(MHz)	(MHz)	(dBi)	(dBi)	(dBm)	(dBm)
144	5720	19.74	2.20	2.20	23.95	11.00

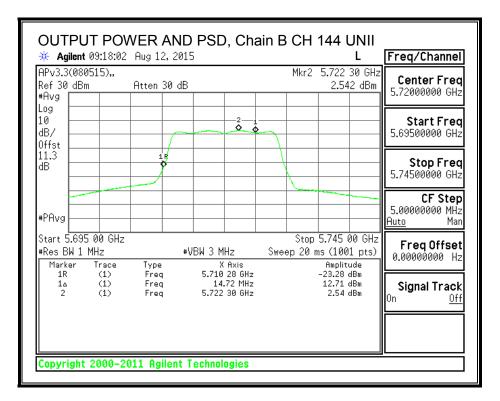
## Duty Cycle CF (dB) 0.12 Included in Calculations of Corr'd Power & PSD

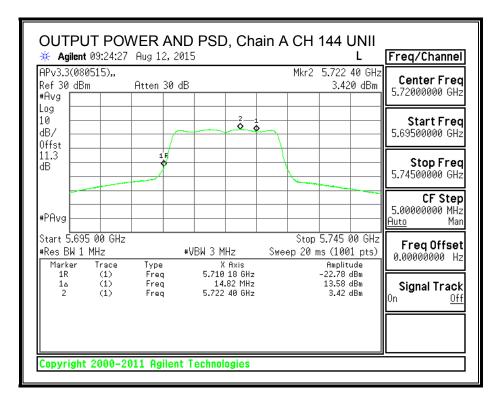
#### **Output Power Results**

Channel	Frequency	Chain B	Chain A	Total	Power	Power
		Meas	Meas	Corr'd	Limit	Margin
		Power	Power	Power		
	(MHz)	(dBm)	(dBm)	(dBm)	(dBm)	(dB)
144	5720	12.71	13.58	16.30	23.95	-7.66

#### **PSD Results**

Channel	Frequency	Chain B	Chain A	Total	PSD	PSD
		Meas	Meas	Corr'd	Limit	Margin
		PSD	PSD	PSD		
	(MHz)	(dBm)	(dBm)	(dBm)	(dBm)	(dB)
144	5720	2.54	3.42	6.13	11.00	-4.87





Page 143 of 437

FORM NO: 03-EM-F00858 TEL: (919) 549-1400 This report shall not be reproduced except in full, without the written approval of UL LLC.

## UNII-3 BAND

#### Antenna Gain and Limit

Channel	Frequency	Directional	Directional	Power	PSD
		Gain	Gain	Limit	Limit
		for Power	for PSD		
	(MHz)	(dBi)	(dBi)	(dBm)	(dBm)
144	5720	2.20	2.20	30.00	30.00

Duty Cycle CF (dB)	0.12	Included in Calculations of Corr'd Power & PSD
--------------------	------	--

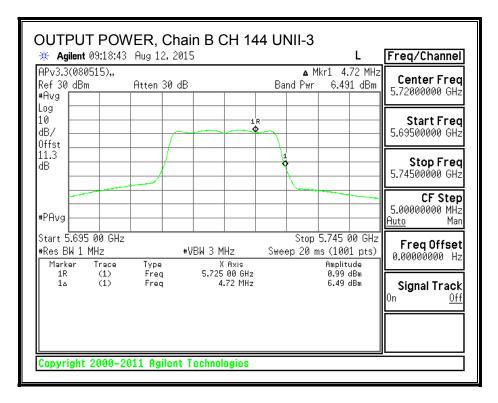
### **Output Power Results**

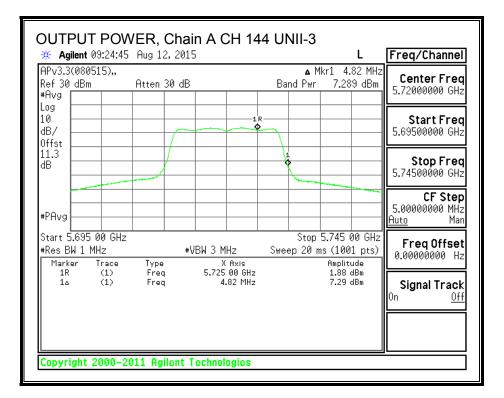
Channel	Frequency	Chain B	Chain A	Total	Power	Power
		Meas	Meas	Corr'd	Limit	Margin
		Power	Power	Power		
	(MHz)	(dBm)	(dBm)	(dBm)	(dBm)	(dB)
144	5720	6.49	7.29	10.04	30.00	-19.96

### **PSD Results**

Channel	Frequency	Chain B	Chain A	Total	PSD	PSD
		Meas	Meas	Corr'd	Limit	Margin
		PSD	PSD	PSD		
	(MHz)	(dBm)	(dBm)	(dBm)	(dBm)	(dB)
144	5720	-0.88	-0.02	2.70	30.00	-27.30

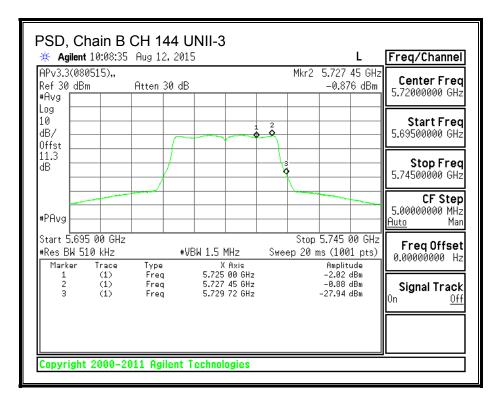
Page 144 of 437

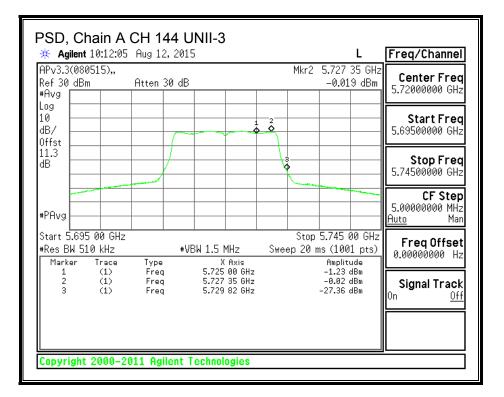




Page 145 of 437

FORM NO: 03-EM-F00858 TEL: (919) 549-1400





Page 146 of 437

UL LLC

## 8.10.4. TPC POWER

## LIMITS

FCC §15.407 (h) (1)

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

### **DIRECTIONAL ANTENNA GAIN**

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

Chain B	Chain A	<b>Uncorrelated Chains</b>
Antenna	Antenna	Directional
Gain	Gain	Gain
(dBi)	(dBi)	(dBi)
2.10	2.30	2.20

Page 147 of 437

### **RESULTS**

## **TPC Limits**

Channel	Frequency	Limit	Directional	Limit
		EIRP Gain		Cond
	(MHz)	(dBm)	(dBi)	(dBm)
Low	5500	24	2.20	21.80
Mid	5580	24	2.20	21.80
High Ch 136	5680	24	2.20	21.80
High Ch 140	5700	24	2.20	21.80

### Duty Cycle CF (dB) 0.12 Included in Calculations of Corr'd Power

## **TPC Output Power Results**

Channel	Frequency	Chain B	Chain A	Total	Cond	Margin
		Meas Power	Meas Power	Corr'd Power	Power Limit	
	(MHz)	(dBm)	(dBm)	(dBm)	(dBm)	(dB)
Low	5500	13.72	13.53	16.76	21.80	-5.04
Mid	5580	13.68	13.20	16.58	21.80	-5.22
High Ch 136	5680	14.01	13.35	16.82	21.80	-4.98
High Ch 140	5700	13.01	12.98	16.13	21.80	-5.67

Page 148 of 437

## 8.11. 802.11n HT20 MODE IN THE 5.6 GHz BAND

## 8.11.1. 26 dB BANDWIDTH

#### LIMITS

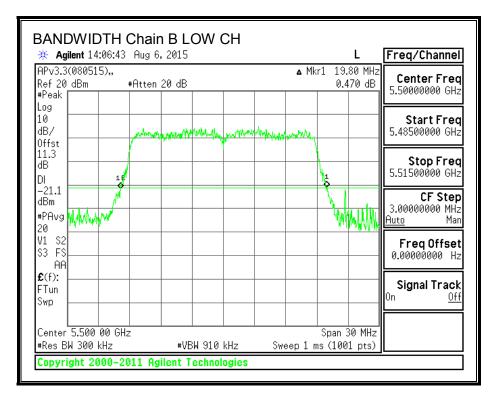
None; for reporting purposes only.

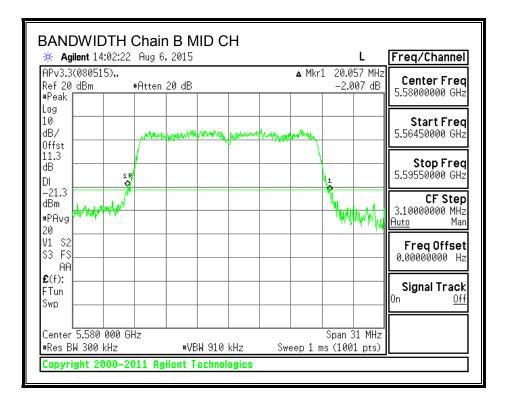
### **RESULTS**

Channel	Frequency	26 dB BW	26 dB BW	
		Chain B	Chain A	
	(MHz)	(MHz)	(MHz)	
Low	5500	19.80	19.92	
Mid	5580	20.06	20.46	
High Ch 136	5680	19.92	19.92	
High Ch 140	5700	19.83	20.43	
144	5720	19.89	19.74	

Page 149 of 437

## 26 dB BANDWIDTH, Chain B





Page 150 of 437

UL LLC FORM NO: 03-EM-F00858 12 Laboratory Dr., RTP, NC 27709 TEL: (919) 549-1400 *This report shall not be reproduced except in full, without the written approval of UL LLC.*