

RF TEST REPORT for UNII device
No. 150601199SHA-001

Applicant : Aruba Networks, Inc
1344 Crossman Ave. Sunnyvale, CA,94089
Manufacturer : Aruba Networks, Inc
1344 Crossman Ave. Sunnyvale, CA,94089
Product Name : Wireless Access Point
Type/Model : APIN0228

SUMMARY

The equipment complies with the requirements according to the following standard(s):

47CFR Part 15 (2015): Radio Frequency Devices

ANSI C63.10 (2013): American National Standard for Testing Unlicensed Wireless Devices

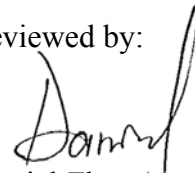
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Prepared by:



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Description of Test Facility

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Content

SUMMARY.....	1
DESCRIPTION OF TEST FACILITY.....	2
1. GENERAL INFORMATION	4
1.1 Applicant Information.....	4
1.2 Identification of the EUT	4
1.3 Technical specification	5
2. TEST SPECIFICATION	8
2.1 Instrument list	8
2.2 Test Standard	8
2.3 Mode of operation during the test / Test peripherals used.....	9
3. OCCUPIED BANDWIDTH & 26dB EMISSION BANDWIDTH.....	15
3.1 Test limit	15
3.2 Test Configuration	15
3.3 Test procedure and test setup.....	15
3.4 Test protocol	16
4. MAXIMUM CONDUCTED OUTPUT POWER & EIRP	49
4.1 Test limit	49
4.2 Test Configuration	50
4.3 Test procedure and test setup.....	50
4.4 Test protocol	51
5. POWER SPECTRAL DENSITY	55
5.1 Test limit	55
5.2 Test Configuration	55
5.3 Test procedure and test setup.....	56
5.4 Test Protocol	57
6. RADIATED EMISSION	125
6.1 Test limit	125
6.2 Test Configuration	126
6.3 Test procedure and test setup.....	127
6.4 Test protocol	128
7. POWER LINE CONDUCTED EMISSION	138
7.1 Limit.....	138
7.2 Test configuration	138
7.3 Test procedure and test set up.....	139
7.4 Test protocol	140
APPENDIX: TEST GRAPH OF DUTY CYCLE	142



1. General Information

1.1 Applicant Information

Applicant : Aruba Networks, Inc
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Email : rhastings@arubanetworks.com
Manufacturer : Aruba Networks, Inc
1344 Crossman Ave. Sunnyvale, CA,94089

1.2 Identification of the EUT

Product Name : Wireless Access Point
Type/model : APIN0228
FCC ID : Q9DAPIN0228
IC : 4675A-APIN0228

1.3 Technical specification

Operation Frequency	: 5250 - 5350 MHz;
Band	: 5470 - 5725MHz;
Type of Modulation	: OFDM(BPSK,QPSK,16QAM,64QAM,256QAM)
Transfer Rate	: 802.11a: 54.0/48.0/36.0/24.0/18.0/12.0/9.0/6.0Mbps 802.11n: up to 450Mbps 802.11ac: up to 1300.0Mbps
EUT Modes of Modulation	: 802.11a; 802.11n/ac 20, 40; 802.11ac 80
Channel Number	: For 5250-5350MHz Band: 52 – 64; For 5470-5725MHz Band: 100 – 144
Description of EUT	: The EUT is a wireless access point, the device is a MIMO product, it has one main mode of assembly ways with different antennas, Each assembly way have the same schematic diagram, PCB layout and electronic construction, also have same electric parameters except its antennas.
Port identification	: RJ45 ports 2; Console USB port 1.
Rating	: DC 48V,0.6A (PoE)
Declared Temperature range	: -40°C ~ 60°C
Category of EUT	: Class B
EUT type	: <input checked="" type="checkbox"/> Table top <input type="checkbox"/> Floor standing
Sample received date	: Oct. 13, 2015
Date of test	: Oct. 14, 2015 – Dec. 16, 2015

Antenna chosen and test plan:

By technical analysis and evaluation, the following models of antennas were chosen to perform the tests as representative.

Test Mode No.	Model	Type	Band(s)	Typical Gain	Conducted Test	Radiated Test
1	AP-ANT-1B	Omnidirectional	2.400 GHz - 2.500 GHz	3.8 dBi		
			4.900 GHz - 5.875 GHz	5.8 dBi		
2	AP-ANT-13B	Downtiltomni	2.400 GHz - 2.500 GHz	4.4dBi		
			4.900 GHz - 5.900 GHz	3.3dBi		
3	AP-ANT-16	Downtilt 3x3 MIMO omni	2.400 GHz - 2.500 GHz	3.9dBi		
			4.900 GHz - 5.900 GHz	4.7dBi		
4	AP-ANT-32	Omnidirectional	2.400-2.500 GHz	2.2 dBi		
			5.150-5.925 GHz	4.0 dBi		
5	AP-ANT-19	Dual band omni	2.400 GHz - 2.500 GHz	3.0 dBi		
			5.150 GHz - 5.875 GHz	6.0 dBi		
6	AP-ANT-20	Omnidirectional	2.400 GHz - 2.500 GHz	2.0 dBi		
			4.900 GHz - 5.875 GHz	2.0 dBi	√	√
7	AP-ANT-35	Multipolarized	4.9 GHz - 6.0 GHz	5 dBi min		
			2.4 GHz - 2.5 GHz			
8	AP-ANT-38	Multipolarized	4.9 GHz - 6.0 GHz	7.5 dBi min		
			2.4 GHz - 2.5 GHz			
9	AP-ANT-93	3x3 MIMO directional	5.150 GHz - 5.875 GHz	14.0 dBi		
10	ANT-3X3-D905	Multipolarized	2.4 GHz - 2.5 GHz	5 dBi min		
			4.9 GHz - 6.0 GHz			
11	ANT-3X3-D608	Multipolarized	2.4 GHz - 2.5 GHz	7.5 dBi min		
			4.9 GHz - 6.0 GHz			
12	ANT-3X3-2005	Omnidirectional	2.4 GHz - 2.5 GHz	5 dBi max		
13	ANT-3X3-5005	Omnidirectional	4.9 GHz - 5.875 GHz	5 dBi max		
14	ANT-3X3-5010	Omnidirectional	4.9 GHz - 5.875 GHz	10 dBi max		
15	ANT-3X3-5712	Multipolarized	4.900 GHz - 6.000 GHz	11.5 dBi min		
16	ANT-2X2-2314	Directional	2.400 GHz - 2.500 GHz	14.0 dBi		
17	ANT-2X2-5314	Directional	4.900 GHz - 5.875 GHz	14.0 dBi	√	
18	ANT-2X2-2714	2x2 MIMO directional	2.400 GHz - 2.483 GHz	14.0 dBi		
19	AP-ANT-35A	Multipolarized	4.9 GHz - 6.0 GHz	5 dBi min		
			2.4 GHz - 2.5 GHz			
20	AP-ANT-1W	Omnidirectional	2.400 GHz - 2.500 GHz	3.8 dBi		
			4.900 GHz - 5.875 GHz	5.8 dBi		
21	ANT-3X3-D100	multi polarized	4.9 GHz - 6.0 GHz	5 dBi min		
			2.4 GHz - 2.5 GHz			

MIMO Function Description:

Freq. Band	Modulation	Tx/Rx Function	Beam forming
5250 - 5350 MHz 5470 - 5725MHz	802.11a	3TX/3RX	NO
	802.11n/ac 20	3TX/3RX	YES
	802.11n/ac 40	3TX/3RX	YES
	802.11ac 80	3TX/3RX	YES

Test Mode No.	Model	Band(s)	Typical Gain	Bean Forming Gain(dBi)
1	AP-ANT-1B	2.400 GHz - 2.500 GHz	3.8 dBi	4.7
		4.900 GHz - 5.875 GHz	5.8 dBi	
2	AP-ANT-13B	2.400 GHz - 2.500 GHz	4.4dBi	4.7
		4.900 GHz - 5.900 GHz	3.3dBi	
3	AP-ANT-16	2.400 GHz - 2.500 GHz	3.9dBi	4.7
		4.900 GHz - 5.900 GHz	4.7dBi	
4	AP-ANT-32	2.400-2.500 GHz	2.2 dBi	4.7
		5.150-5.925 GHz	4.0 dBi	
5	AP-ANT-19	2.400 GHz - 2.500 GHz	3.0 dBi	4.7
		5.150 GHz - 5.875 GHz	6.0 dBi	
6	AP-ANT-20	2.400 GHz - 2.500 GHz	2.0 dBi	4.7
		4.900 GHz - 5.875 GHz	2.0 dBi	
7	AP-ANT-35	4.9 GHz - 6.0 GHz	5 dBi min	3
		2.4 GHz - 2.5 GHz		
8	AP-ANT-38	4.9 GHz - 6.0 GHz	7.5 dBi min	3
		2.4 GHz - 2.5 GHz		
9	AP-ANT-93	5.150 GHz - 5.875 GHz	14.0 dBi	3
10	ANT-3X3-D905	2.4 GHz - 2.5 GHz	5 dBi min	3
		4.9 GHz - 6.0 GHz		
11	ANT-3X3-D608	2.4 GHz - 2.5 GHz	7.5 dBi min	3
		4.9 GHz - 6.0 GHz		
12	ANT-3X3-2005	2.4 GHz - 2.5 GHz	5 dBi max	3
13	ANT-3X3-5005	4.9 GHz - 5.875 GHz	5 dBi max	3
14	ANT-3X3-5010	4.9 GHz - 5.875 GHz	10 dBi max	3
15	ANT-3X3-5712	4.900 GHz - 6.000 GHz	11.5 dBi min	3
16	ANT-2X2-2314	2.400 GHz - 2.500 GHz	14.0 dBi	3
17	ANT-2X2-5314	4.900 GHz - 5.875 GHz	14.0 dBi	3
18	ANT-2X2-2714	2.400 GHz - 2.483 GHz	14.0 dBi	3
19	AP-ANT-35A	4.9 GHz - 6.0 GHz	5 dBi min	3
		2.4 GHz - 2.5 GHz		
20	AP-ANT-1W	2.400 GHz - 2.500 GHz	3.8 dBi	4.7
		4.900 GHz - 5.875 GHz	5.8 dBi	
21	ANT-3X3-D100	4.9 GHz - 6.0 GHz	5 dBi min	3
		2.4 GHz - 2.5 GHz		

Note 1: For CDD transmissions, according KDB 662911 D01 Multiple Transmitter Output v02r01 f), the power measurements on IEEE 802.11 devices, $Array\ Gain = 0\ dB$ (i.e., no array gain) for $N_{ANT} \leq 4$.

Note 2: when 802.11n/ac have beamforming function the Beamforming gain should calculate according KDB 662911 D01 Multiple Transmitter Output v02r01 c) (ii).

2. Test Specification

2.1 Instrument list

Selected	Equipment	Type	Manu.	Internal no.	Cal. Date	Due date
<input checked="" type="checkbox"/>	PXA Analyzer	N9030A	Agilent	EC5338	2016/3/4	2017/3/3
<input checked="" type="checkbox"/>	Vector SG	N5182B	Agilent	EC5175	2016/3/4	2017/3/3
<input checked="" type="checkbox"/>	Power sensor	U2021XA	Agilent	EC5338-1	2016/3/4	2017/3/3
<input checked="" type="checkbox"/>	MXG Analog SG	N5181A	Agilent	EC5338-2	2016/3/4	2017/3/3
<input checked="" type="checkbox"/>	Power meter	N1911A/N1921A	Agilent	EC4318	2016/4/10	2017/4/9
<input checked="" type="checkbox"/>	EMI Receiver	ESCS 30	R&S	EC 2107	2015/10/20	2016/10/19
<input checked="" type="checkbox"/>	A.M.N.	ESH2-Z5	R&S	EC 3119	2015/12/16	2017/12/15
<input checked="" type="checkbox"/>	I.S.N.	FCC-TLISN-T8-02	FCC	EC3756	2016/2/16	2017/2/15
<input checked="" type="checkbox"/>	EMI chamber	3m	Albatross	EC 3048	2016/5/5	2017/5/4
<input checked="" type="checkbox"/>	Test Receiver	ESIB 26	R&S	EC 3045	2015/10/20	2016/10/19
<input checked="" type="checkbox"/>	Test Receiver	ESCI 7	R&S	EC4501	2016/2/24	2017/2/23
<input checked="" type="checkbox"/>	Bilog Antenna	CBL 6112D	TESEQ	EC 4206	2016/5/30	2017/5/29
<input checked="" type="checkbox"/>	Horn antenna	HF 906	R&S	EC 3049	2015/9/12	2016/9/11
<input checked="" type="checkbox"/>	Horn antenna	HAP18-26W	TOYO	EC 4792-3	2014/6/12	2017/6/11
<input checked="" type="checkbox"/>	Pre-amplifier	Pre-amp 18	R&S	EC 5262	2016/5/24	2017/5/23
<input checked="" type="checkbox"/>	Pre-amplifier	Tpa0118-40	R&S	EC 4792-2	2016/4/11	2017/4/10
<input checked="" type="checkbox"/>	Shielded room	-	Zhongyu	EC 2838	2016/1/9	2017/1/8

2.2 Test Standard

47CFR Part 15 (2015)

ANSI C63.10 (2013)

KDB 789033 D02 General UNII Test Procedures New Rules v01r02

KDB 662911 D01 Multiple Transmitter Output v02r01

2.3 Mode of operation during the test / Test peripherals used

While testing transmitting mode of EUT, the internal modulation and continuously transmission was applied.

Carrier Frequency and Channel:

Freq. Band	Channel	Frequency(MHz)	Channel	Frequency(MHz)
5250~5350MHz	52	5260	60	5300
	54	5270	62	5310
	56	5280	64	5320
5470~5725MHz	100	5500	124	5620
	102	5510	128	5640
	104	5520	132	5660
	108	5540	134	5670
	110	5550	136	5680
	112	5560	140	5700
	116	5580	144	5720
	120	5600	/	/

The lowest, middle and highest channel were tested as representatives.

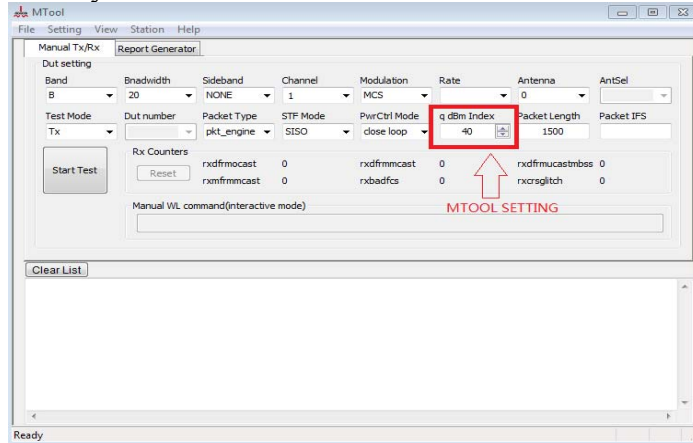
Freq. Band	Modulation	Lowest(MHz)	Middle(MHz)	Highest(MHz)
5250~5350MHz	802.11a	5260	5300	5320
	802.11n/ac20	5260	5300	5320
	802.11n/ac40	5270	/	5310
	802.11ac80	/	5290	/
5470~5725MHz	802.11a	5500	5600	5720
	802.11n/ac20	5500	5600	5720
	802.11n/ac40	5510	5590	5710
	802.11ac80	5530	5610	5690

Test peripherals used:

Item No	Name	Band and Model	Description	S/No
1	Laptop computer	HP ProBook 6470b	100-240V AC 50/60Hz	NA
2	Controller	Aruba 3600	100-240V AC 50/60Hz	NA
3	POE DC Power	PowerDsine PD-6555G300	Input:100-240Vac,50/60Hz,0.5A Output:57VDC 0.35A	NA
4	LAN Cable	/	1.5m un-shielding *2 10m un-shielding *4	NA

Test software setting:

The power level setting for 802.11a/n20/n40/ac20/ac40/ac80 is used with MTOOL software offered by the manufactory.



The power level setting for 802.11a/n20/n40/ac20/ac40/ac80 is used with the software offered by the manufactory.

Freq. Band	Mode	Frequency (MHz)	Software Setting
5250~5350MHz (2dBi gain)	802.11a	5260	60
		5300	65
		5320	60
	802.11 n/ac20	5260	63
		5300	65
		5320	63
	802.11 n/ac40	5270	70
		5310	70
	802.11 ac80	5290	75

Freq. Band	Mode	Frequency (MHz)	Software Setting
5470~5725MHz (2dBi gain)	802.11a	5500	60
		5600	63
		5720	63
	802.11 n/ac20	5500	63
		5600	60
		5720	60
	802.11 n/ac40	5510	70
		5590	73
		5710	73
	802.11 ac80	5530	73
		5610	75
		5690	75

Freq. Band	Mode	Frequency (MHz)	Software Setting
5250 ~ 5350MHz (14dBi gain)	802.11a	5260	22
		5300	22
		5320	22
	802.11 n/ac20	5260	26
		5300	27
		5320	27
	802.11 n/ac40	5270	31
		5310	30
	802.11 ac80	5290	31

Freq. Band	Mode	Frequency (MHz)	Software Setting
5470 ~ 5725MHz (14dBi gain)	802.11a	5500	22
		5600	22
		5720	23
	802.11 n/ac20	5500	27
		5600	27
		5720	27
	802.11 n/ac40	5510	30
		5590	30
		5710	30
	802.11 ac80	5530	31
		5610	31
		5690	31

Note:

1: When using different antennas, it has different power target setting (Mtool setting) by the manufactory to ensure compliance with the limit.

2: This is the function for conducted power with different antenna, max conducted power = min(max regulatory EIRP, board limit + antenna gain) – antenna gain, where the board limit is measured at the board so the antenna gain is not included.

Data rate VS Power

The pre-scan for the conducted power with all rates in each modulation and bands was used, and the worst case was found and used in all test cases.

802.11a	Data rate	6	9	12	18	24	36	48	54
	Port 0	24.05	23.54	24.03	24.02	23.98	23.94	23.93	23.91
	Port 1	23.96	23.77	23.9	23.87	23.84	23.81	23.79	23.75
	Port 2	24.00	23.91	23.84	23.82	23.8	23.78	23.78	23.77
802.11n/ac20	Data rate	MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
	Port 0+1+2	27.04	27.01	27.00	26.99	26.96	26.93	26.91	26.90
802.11n/ac40	Data rate	MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
	Port 0+1+2	27.73	27.70	26.98	26.96	26.95	26.94	26.93	26.90

802.11ac80	Data rate	NSS3									
		MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7	MCS8	MCS9
	Port 0+1+2	27.59	27.57	27.57	27.56	27.52	27.51	27.51	27.48	27.46	27.41

After this pre-scan, we choose the following table of the data rate as the worst case.

Modulation	Worst case data rate
802.11a	6Mbps
802.11n/ac 20	MCS0
802.11n/ac 40	MCS0
802.11ac 80	MCS0NSS3

Duty cycle:

Duty cycle	On(ms)	On+Off (ms)	Duty cycle(x)	Duty cycle factor (dB)
802.11a	2.08	2.18	0.95	0.20
802.11n/ac20	0.679	0.773	0.88	0.56
802.11n/ac40	0.355	0.453	0.78	1.06
802.11ac80	0.194	0.222	0.87	0.59

2.3 Test Summary

This report applies to tested sample only. This report shall not be reproduced in part without written approval of Intertek Testing Service Shanghai Limited.

TEST ITEM	FCC REFERANCE	RESULT
Maximum Conducted Output Power & EIRP	15.407(a)	Pass
Power spectral density	15.407(a)	Pass
Radiated emission	15.407 (b) 15.205, 15.209	Pass
Power line conducted emission	15.207	Pass
26 dB Bandwidth	15.403(i)	Tested
Emission Bandwidth (99%)	-	Tested

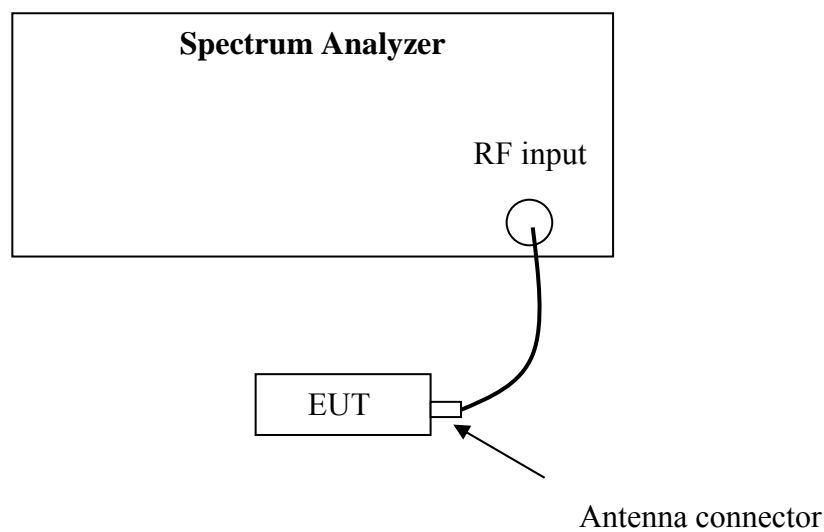
3. Occupied Bandwidth & 26dB Emission Bandwidth

Test Status: Tested

3.1 Test limit

None

3.2 Test Configuration



3.3 Test procedure and test setup

Occupied bandwidth: the trace data points are recovered and are directly summed in linear power level terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached and that frequency recorded. The process is repeated for the highest frequency data points (starting at the highest frequency, at the right side of the span, and going down in frequency). This frequency is then recorded. The difference between the two recorded frequencies is the 99% occupied bandwidth.

The 26 dB emission bandwidth is defined as the frequency range between two points, one above and one below the carrier frequency, at which the spectral density of the emission is attenuated 26 dB below the maximum in-band spectral density of the modulated signal

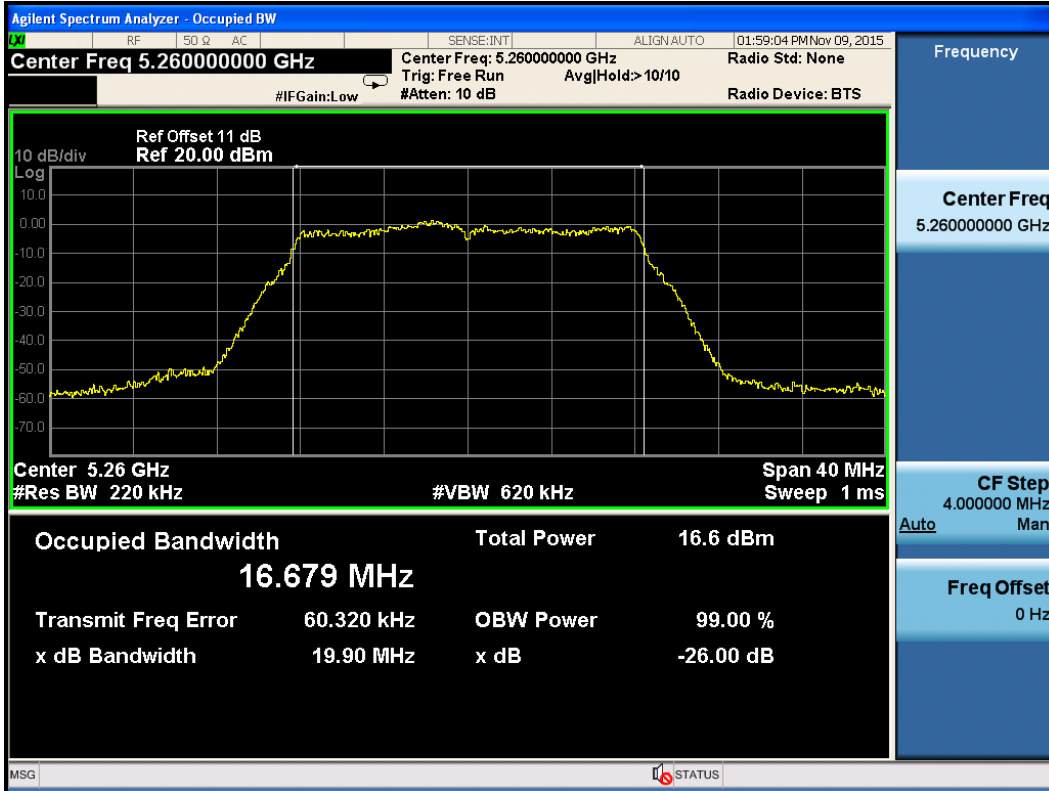
3.4 Test protocol

Temperature : 25 °C
 Relative Humidity: 55 %

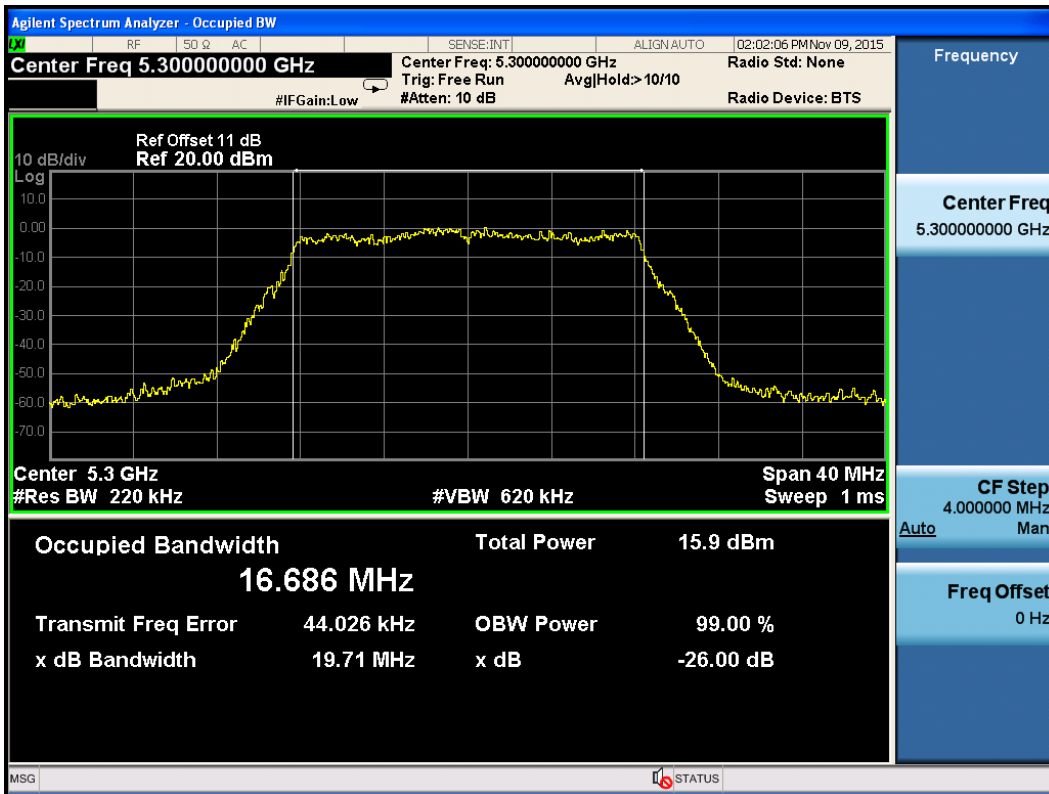
Bandwidth	Frequency (MHz)	26 dB BW (MHz)			99% dB BW (MHz)		
		Port 0	Port 1	Port 2	Port 0	Port 1	Port 2
802.11a	5260	19.90	19.91	19.65	16.679	16.674	16.642
	5300	19.71	19.72	20.05	16.686	16.690	16.633
	5320	19.72	19.79	20.07	16.645	16.675	16.676
802.11n20	5260	20.26	20.09	20.15	17.718	17.681	17.746
	5300	20.13	20.11	20.18	17.721	17.735	17.702
	5320	20.19	20.21	20.20	17.677	17.643	17.643
802.11n40	5270	39.84	39.59	39.47	36.376	36.290	36.316
	5310	39.26	39.20	39.46	36.326	36.235	36.262
802.11ac80	5290	81.15	81.68	81.49	75.707	75.697	75.721
802.11a	5500	19.86	20.21	20.13	16.591	16.668	16.683
	5600	19.79	20.10	19.73	16.649	16.655	16.669
	5720	19.99	19.98	19.82	16.612	16.636	16.602
802.11n20	5500	20.51	20.34	20.50	17.837	17.772	17.755
	5600	20.48	20.26	20.20	17.709	17.735	17.706
	5720	20.01	19.95	20.27	17.708	17.702	17.723
802.11n40	5510	39.18	39.45	39.51	36.280	36.277	36.200
	5590	39.55	39.33	39.55	36.247	36.280	36.260
	5710	39.88	39.28	39.33	36.258	36.174	36.189
802.11ac80	5530	82.11	81.35	82.33	75.774	75.681	75.824
	5610	81.95	81.87	80.81	75.711	75.839	75.672
	5690	81.44	82.11	81.08	75.836	75.783	75.743

Test plots see below:

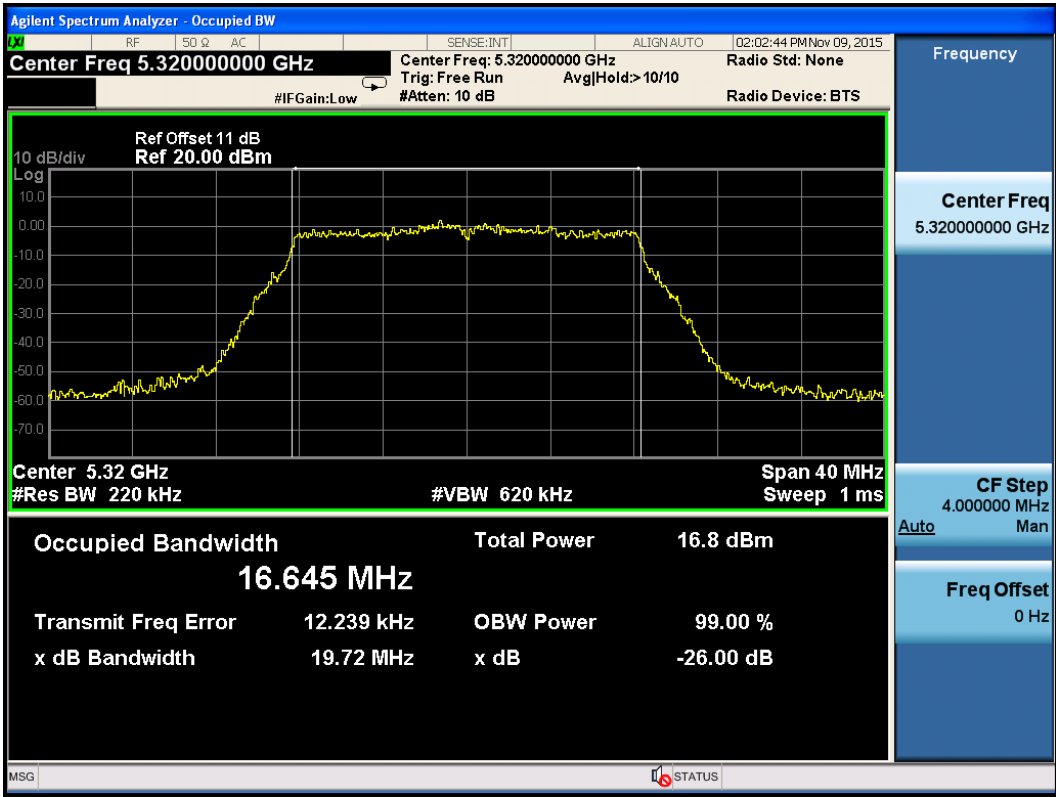
**802.11a
Channel 52 -Ant 0**



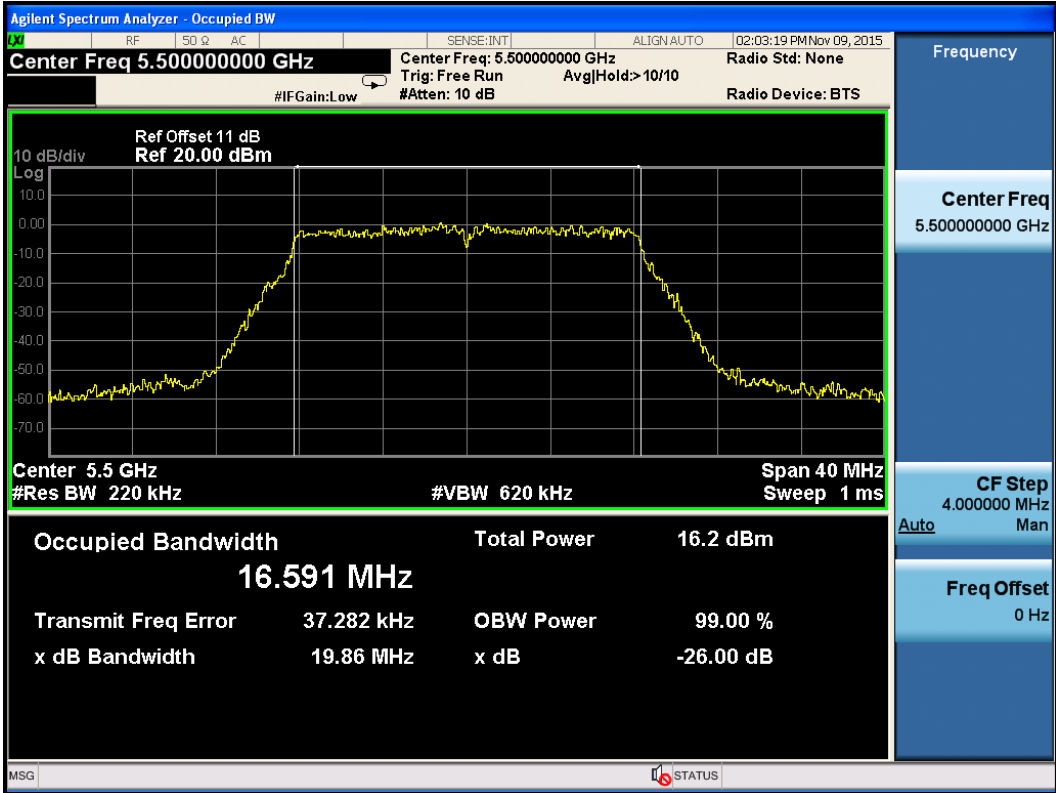
Channel 60 -Ant 0



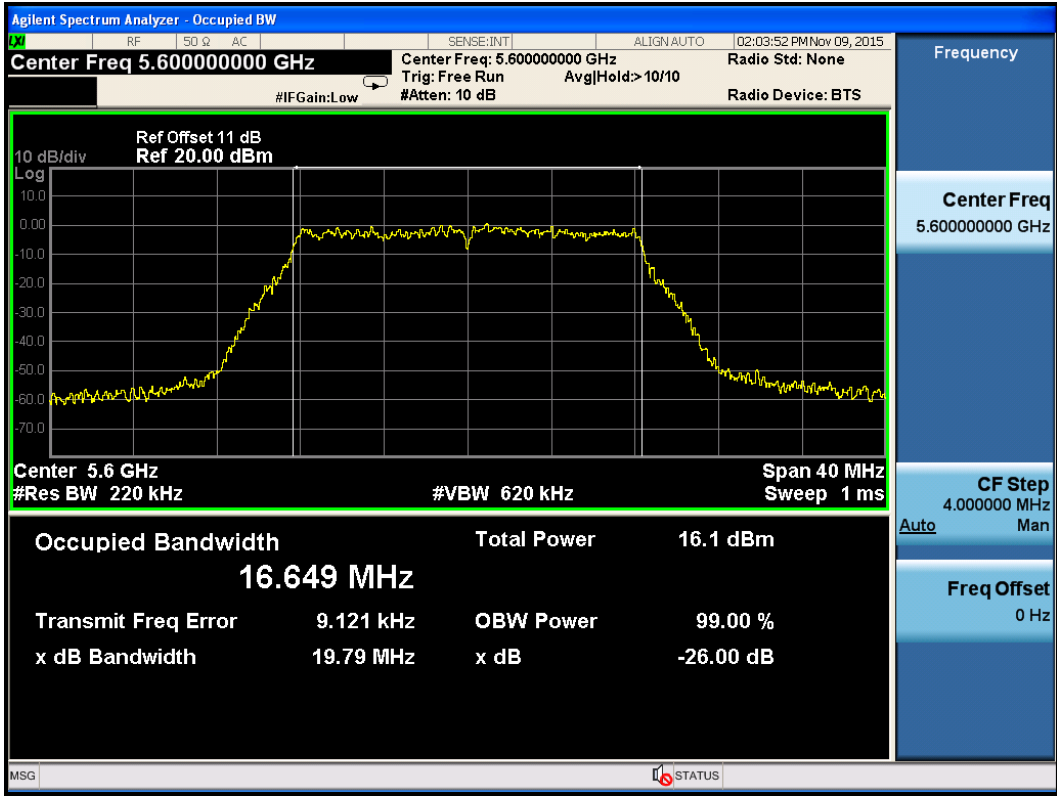
Channel 64 -Ant 0



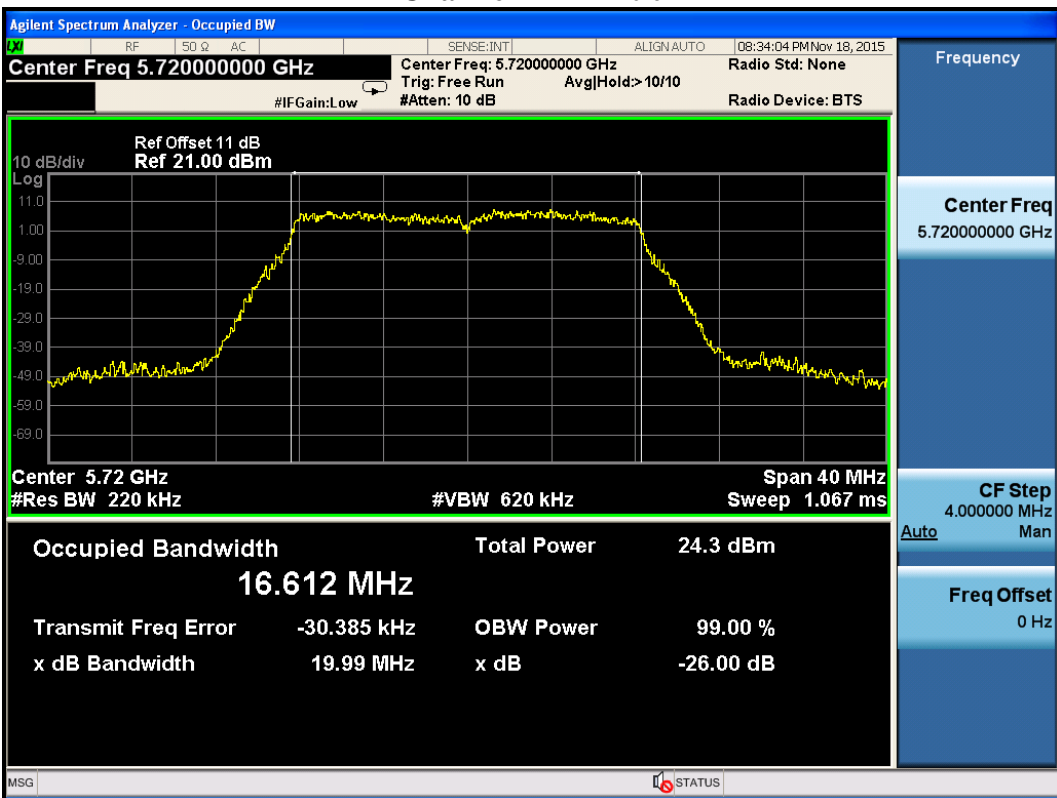
Channel 100 -Ant 0



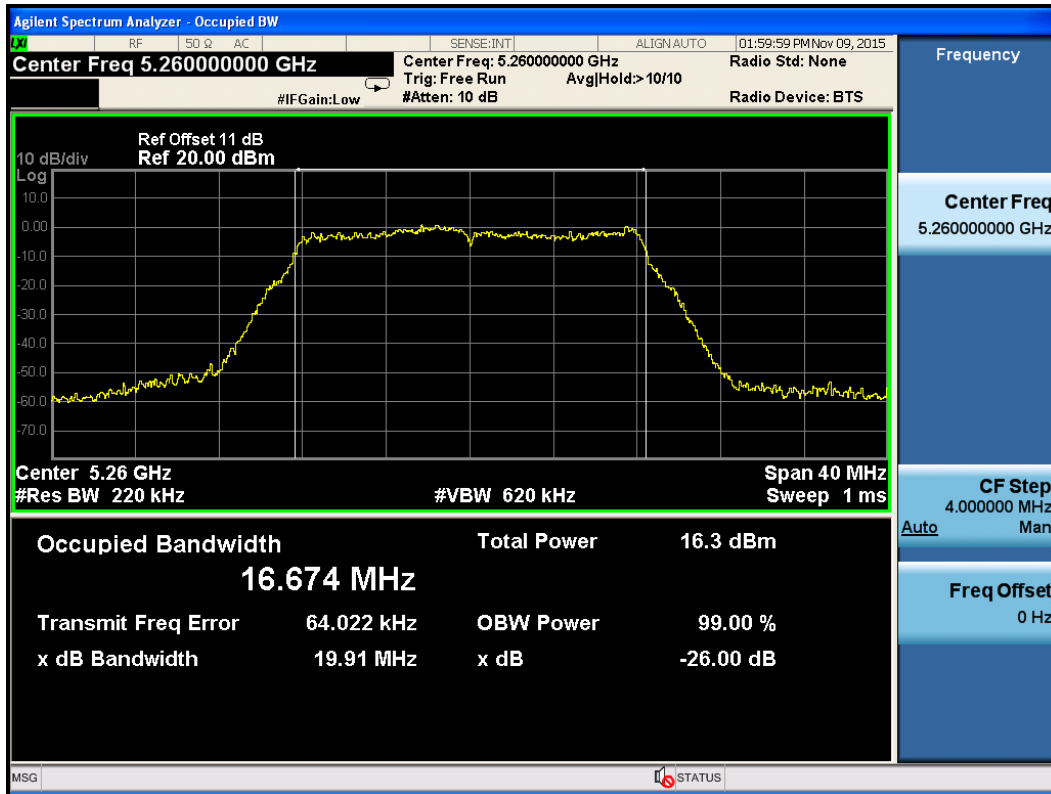
Channel 120 -Ant 0



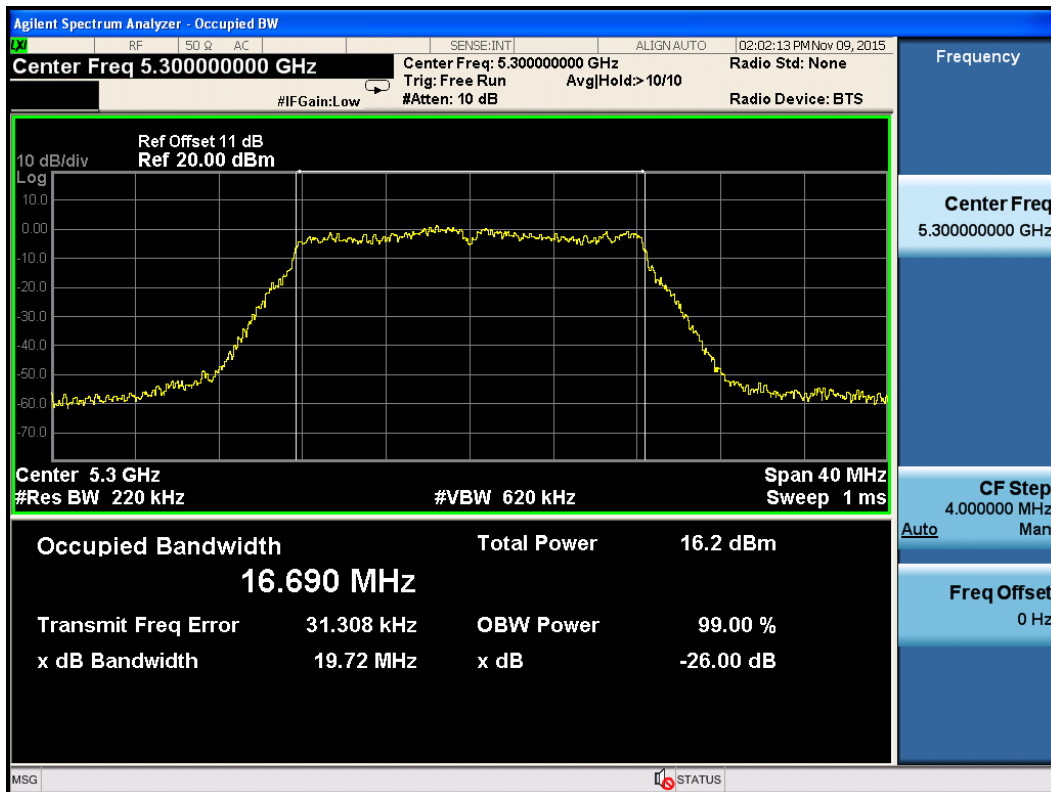
Channel 144 -Ant 0



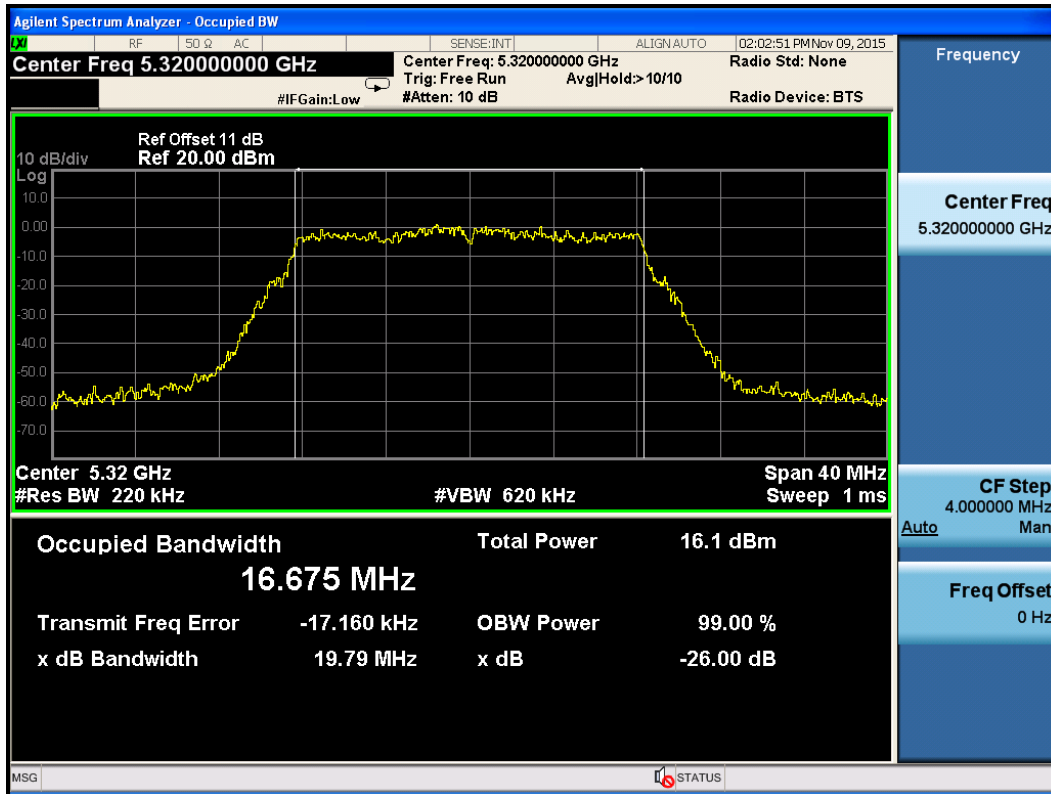
Channel 52 -Ant 1



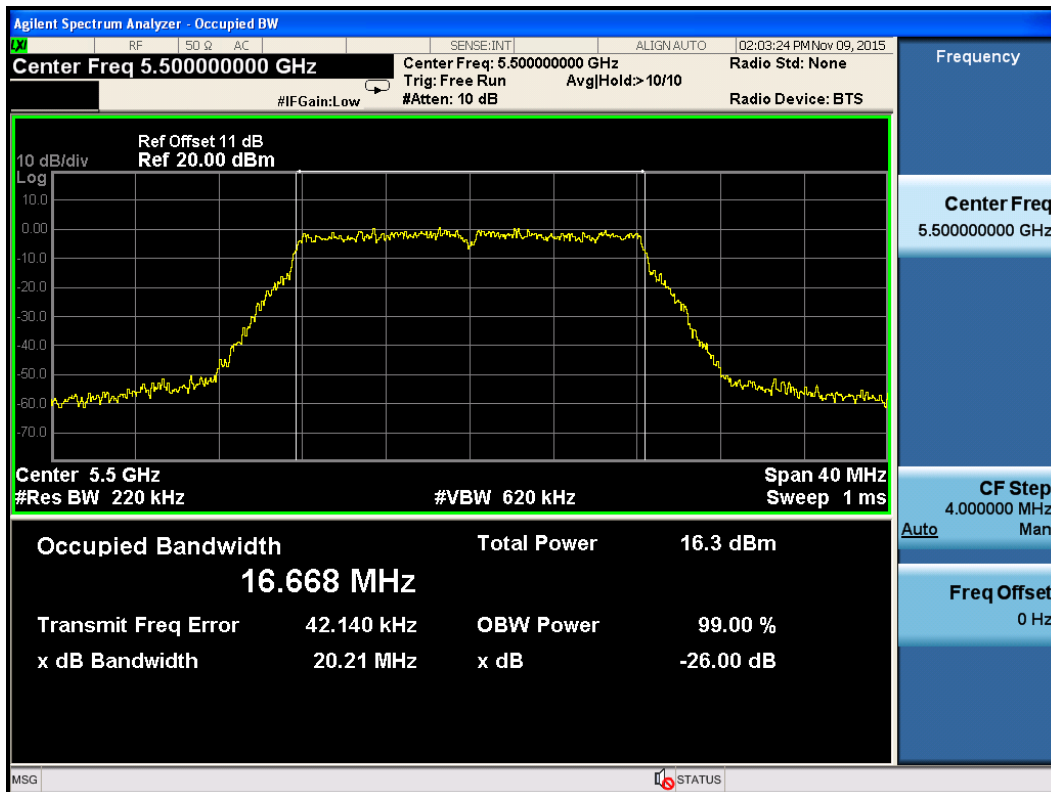
Channel 60 -Ant 1



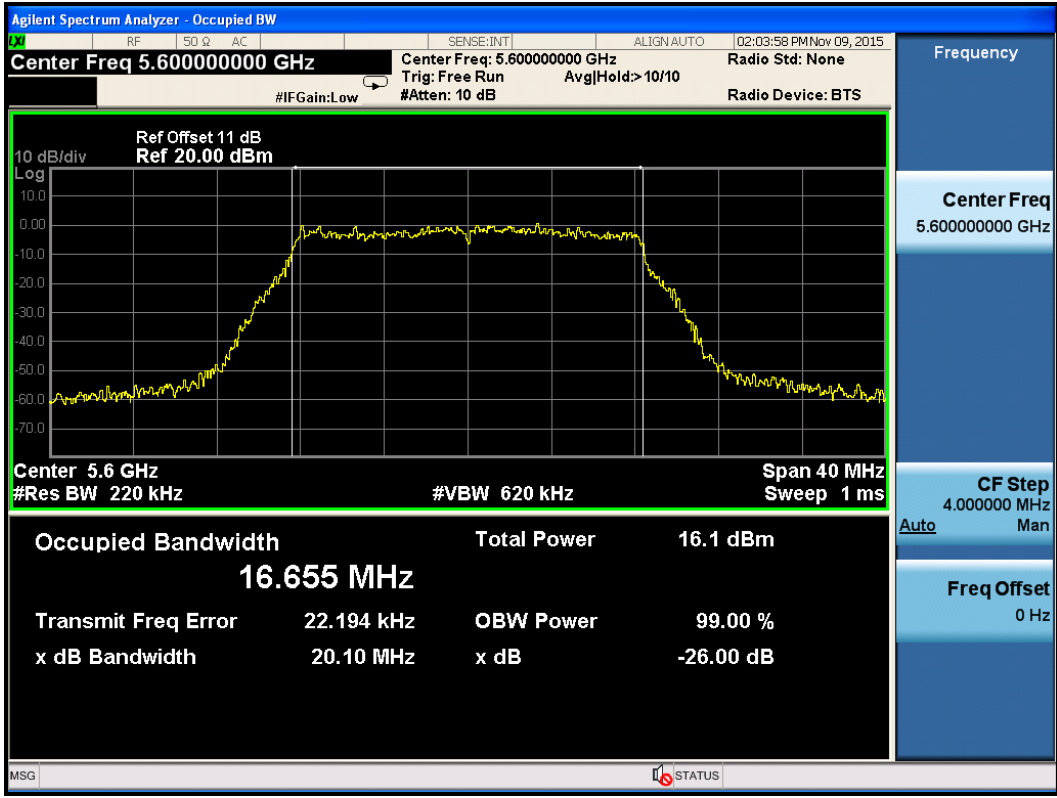
Channel 64 -Ant 1



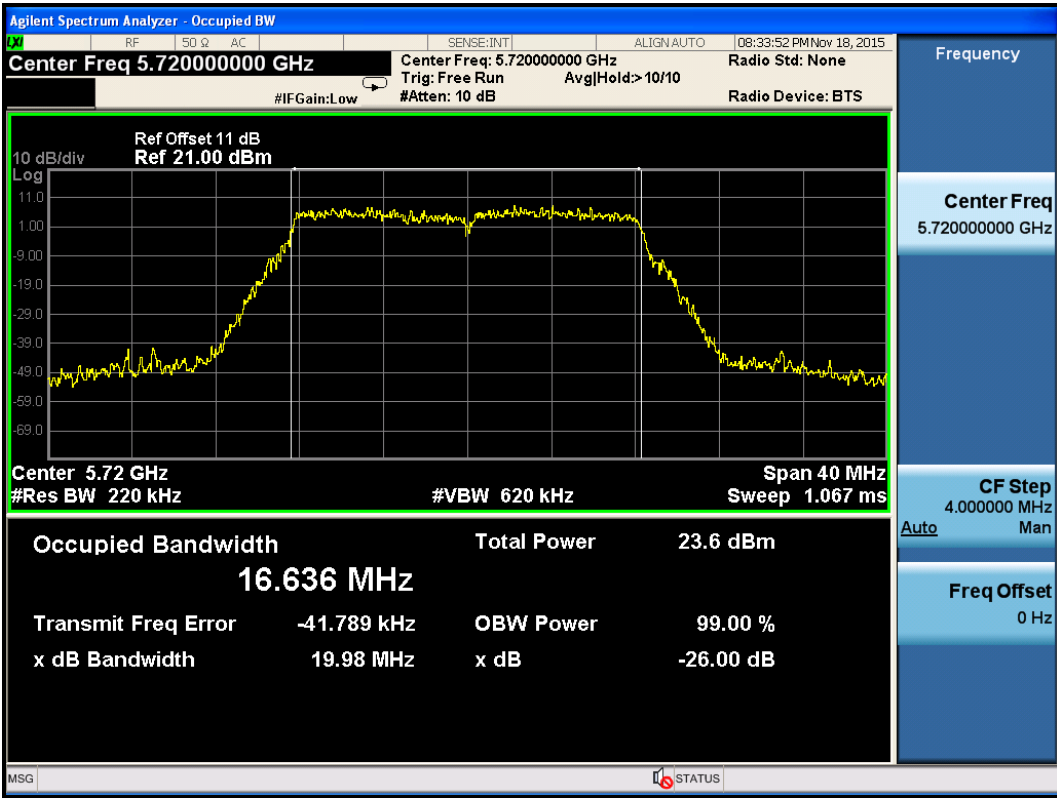
Channel 100 -Ant 1



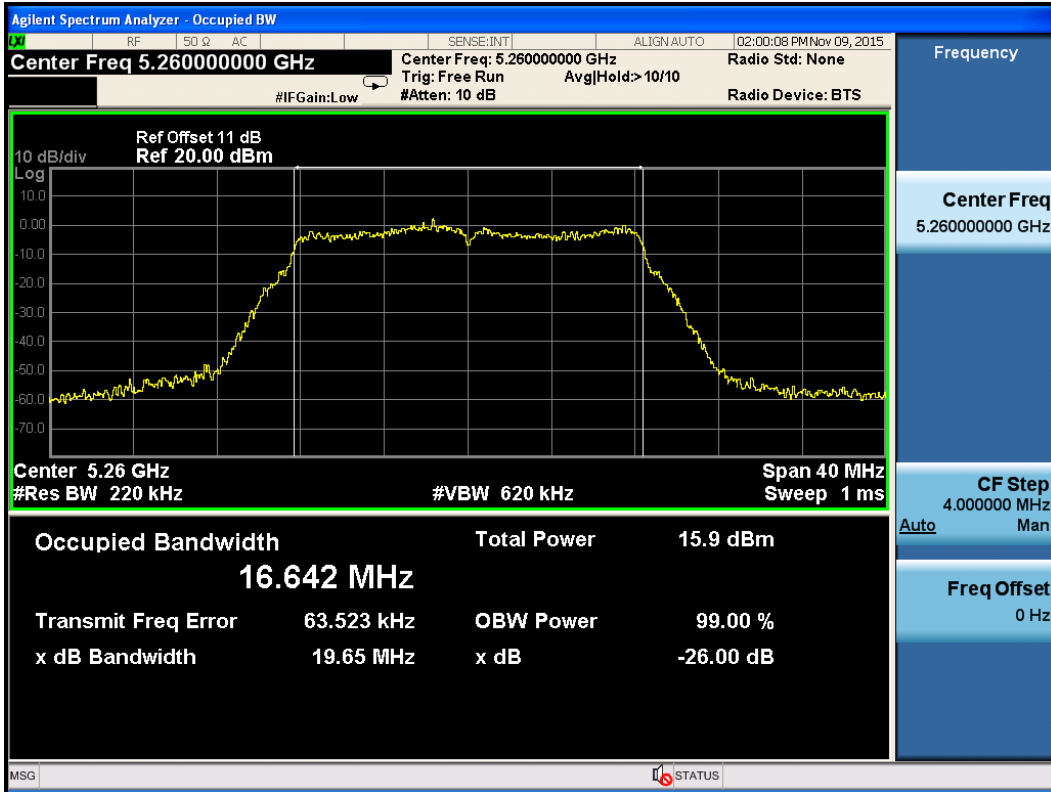
Channel 120 -Ant 1



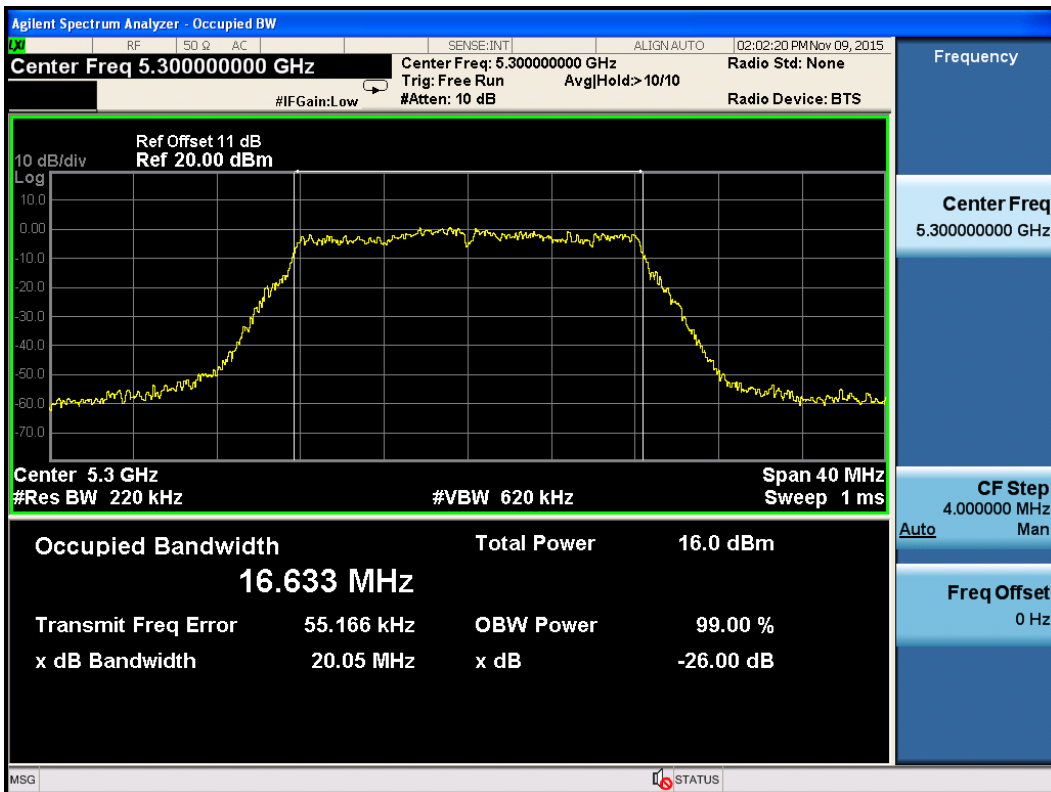
Channel 144 -Ant 1



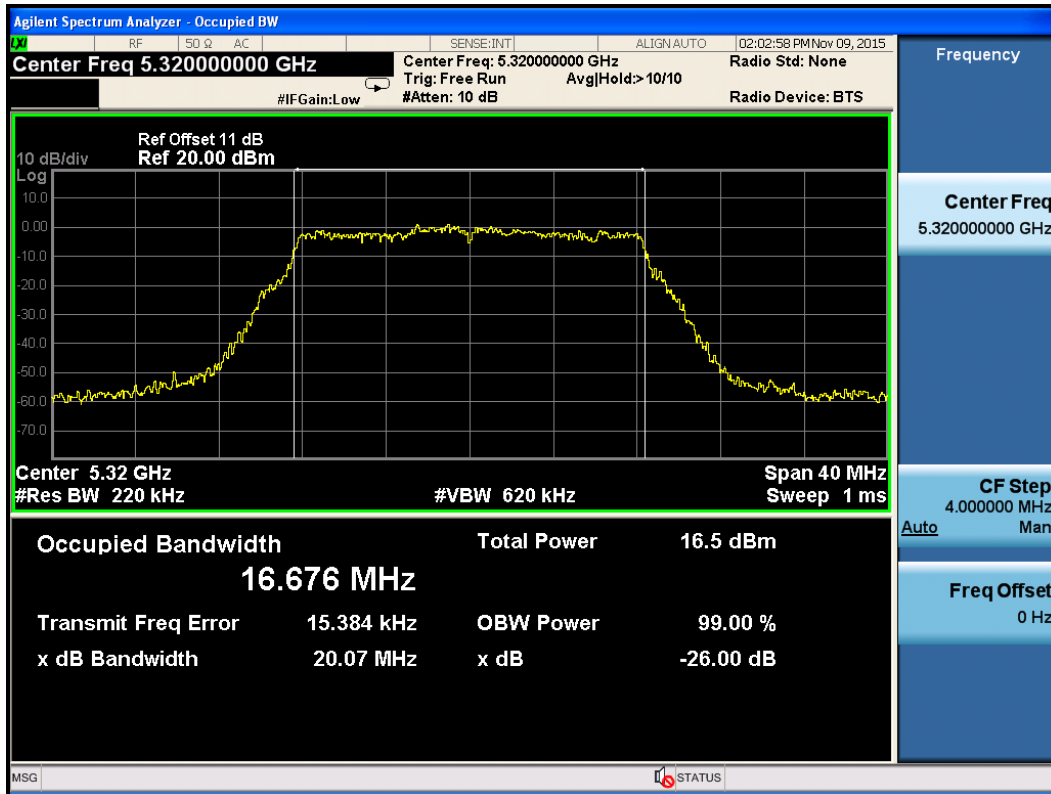
Channel 52 -Ant 2



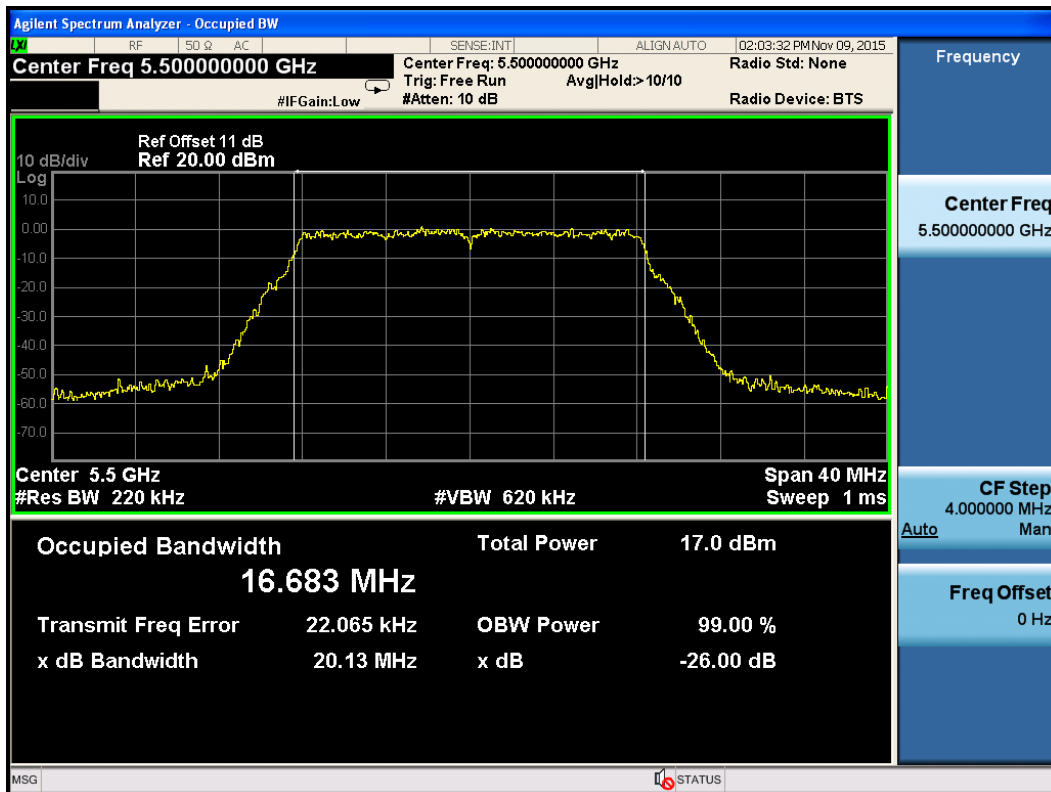
Channel 60 -Ant 2



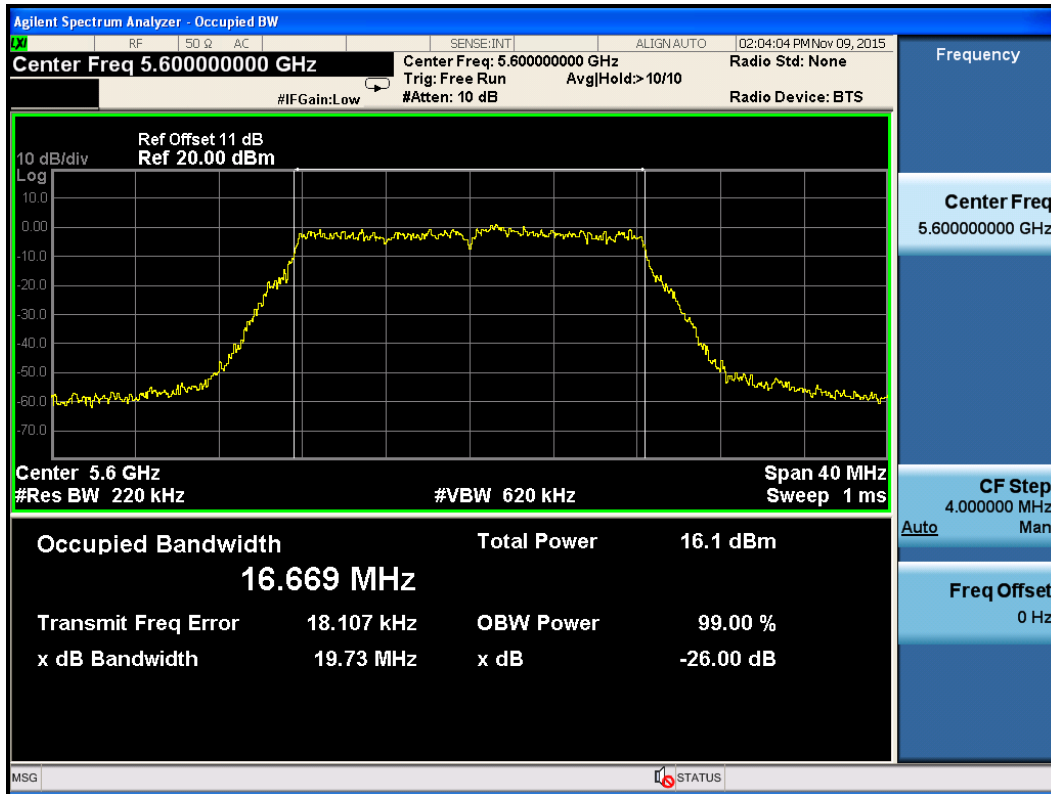
Channel 64 -Ant 2



Channel 100 -Ant 2



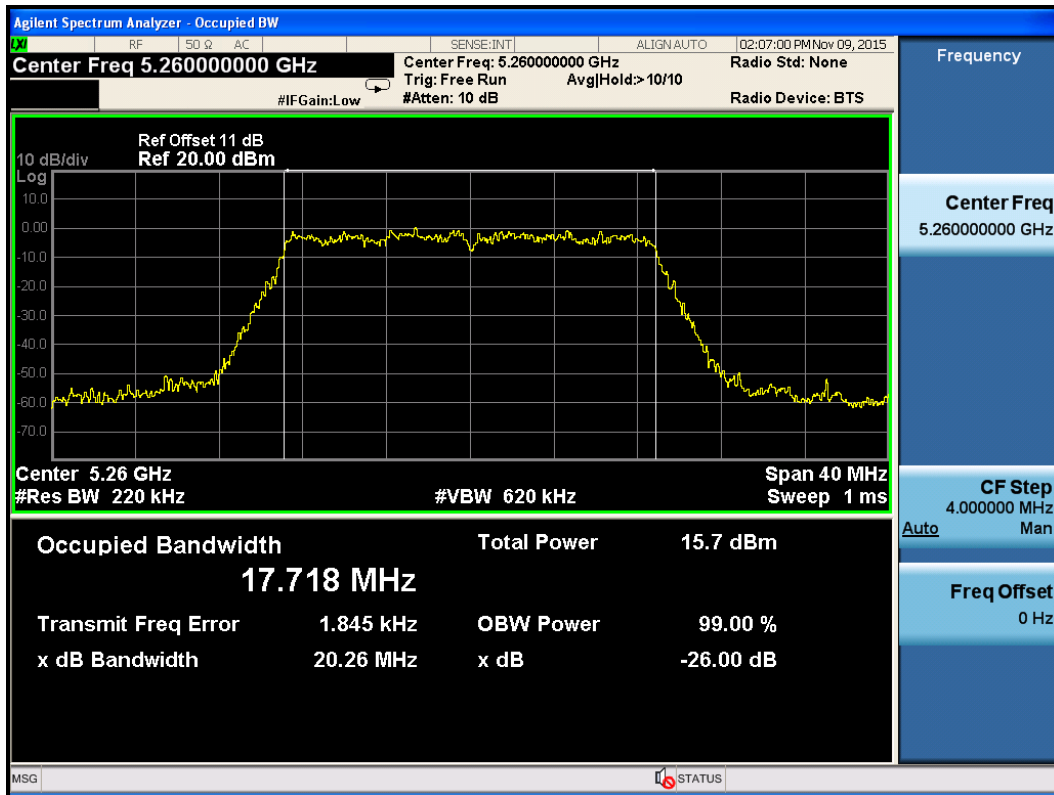
Channel 120 -Ant 2



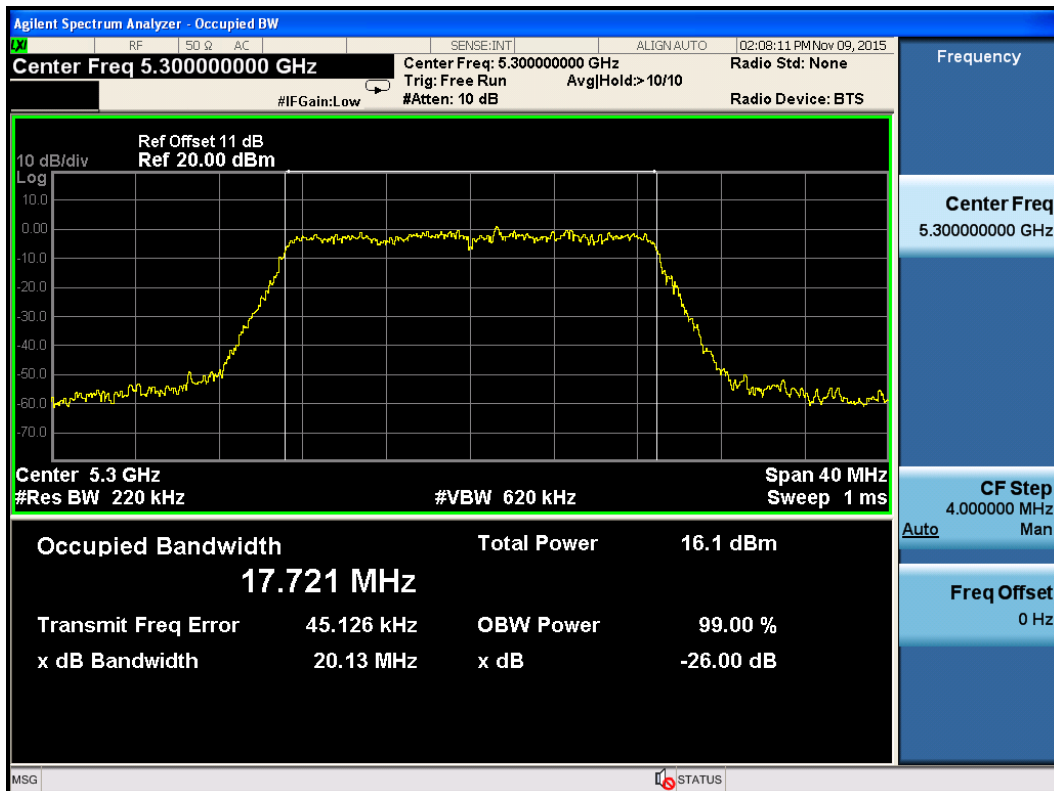
Channel 144 -Ant 2



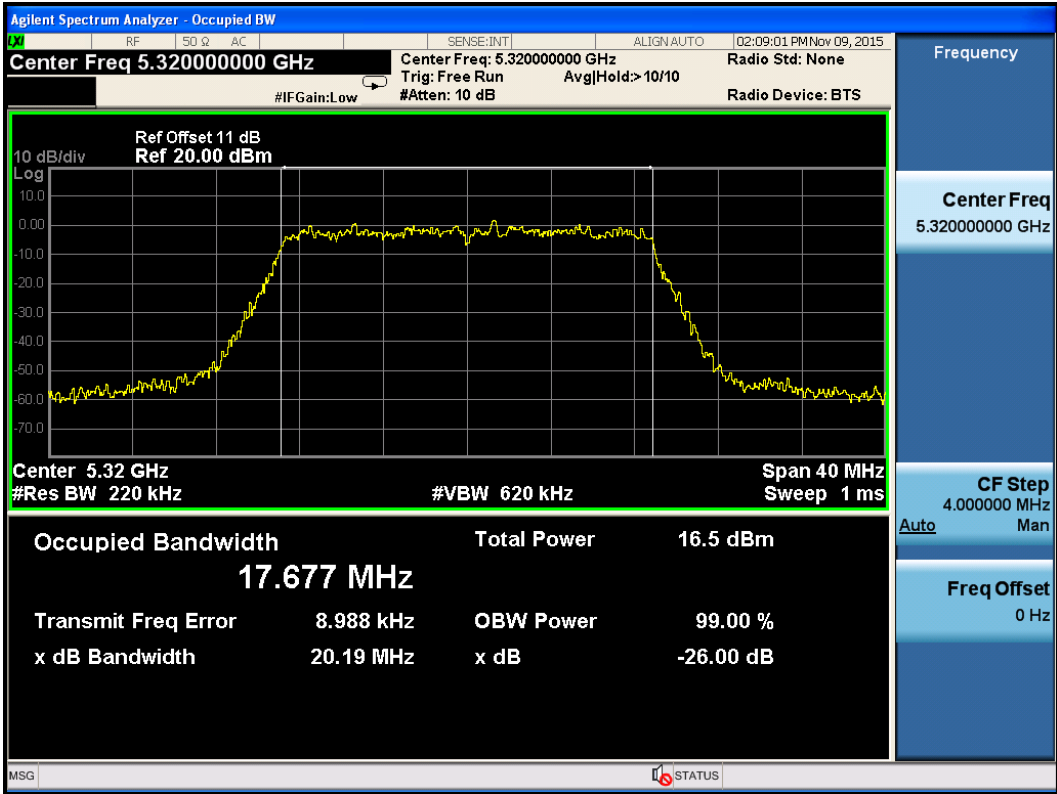
802.11n20 Channel 52 -Ant 0



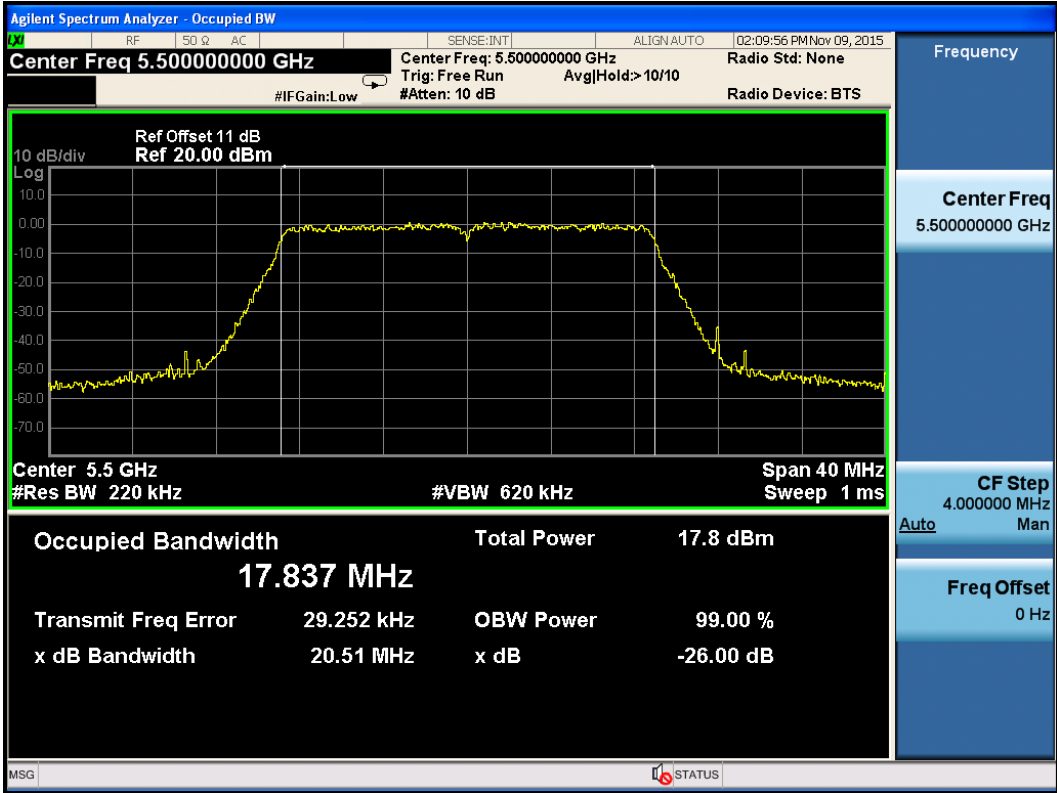
Channel 60 -Ant 0



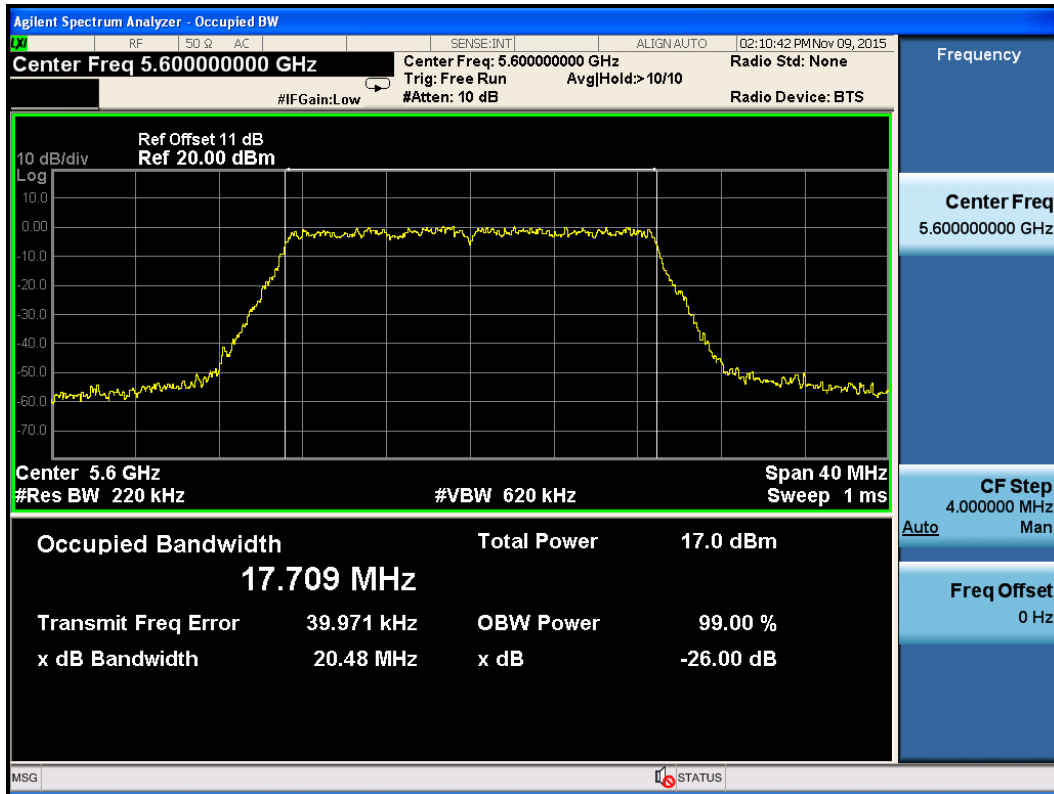
Channel 64 -Ant 0



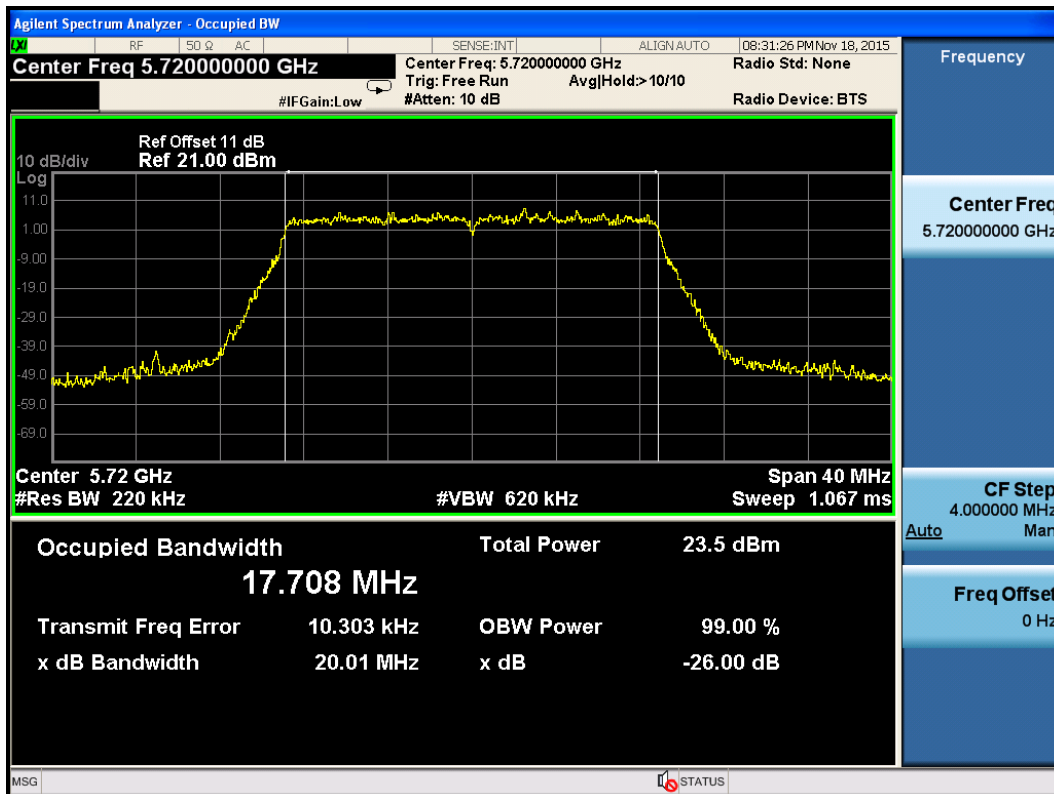
Channel 100 -Ant 0



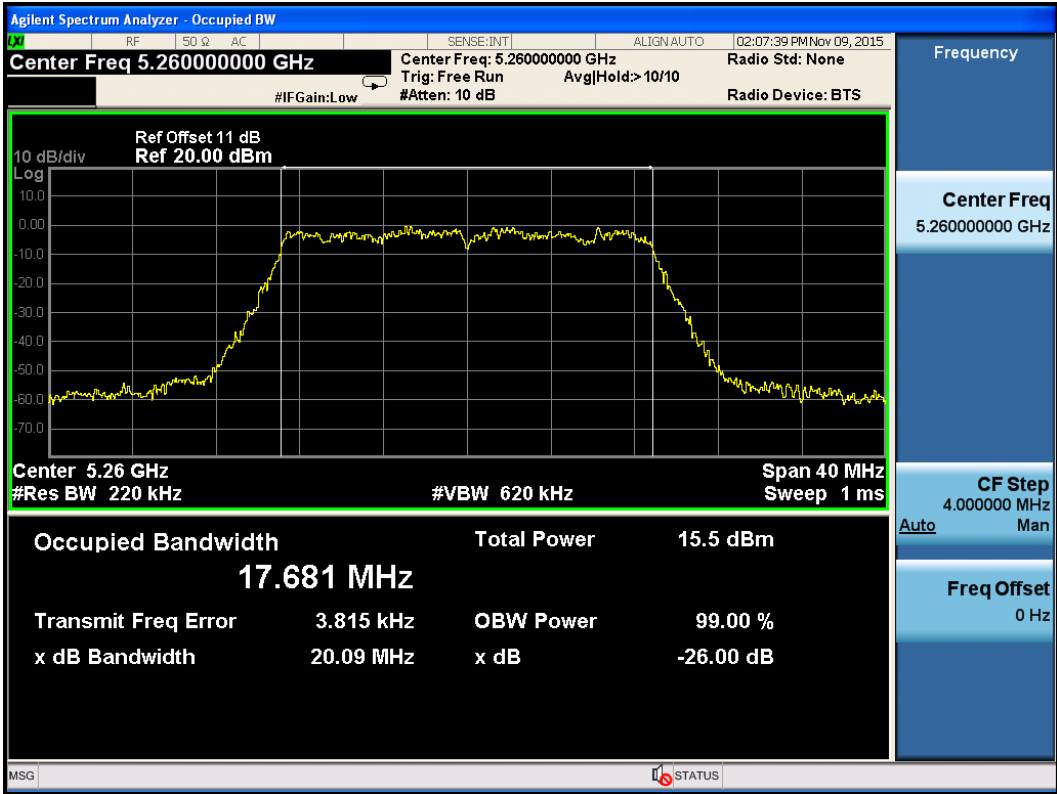
Channel 120 -Ant 0



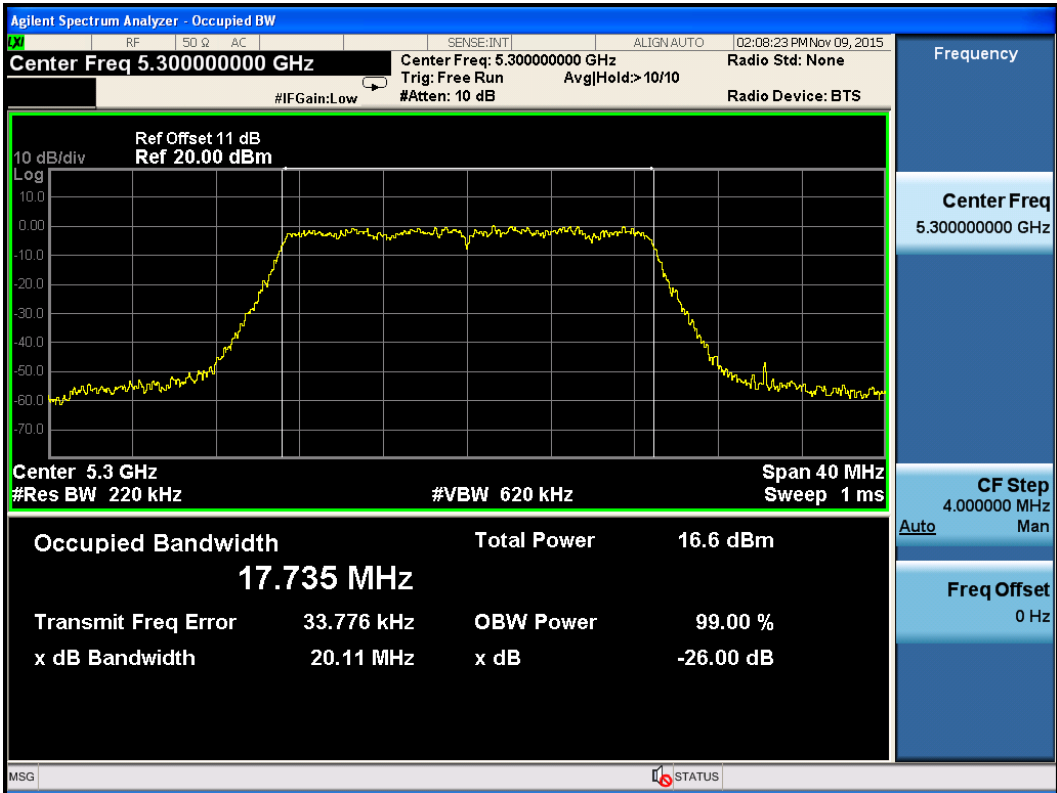
Channel 144 -Ant 0



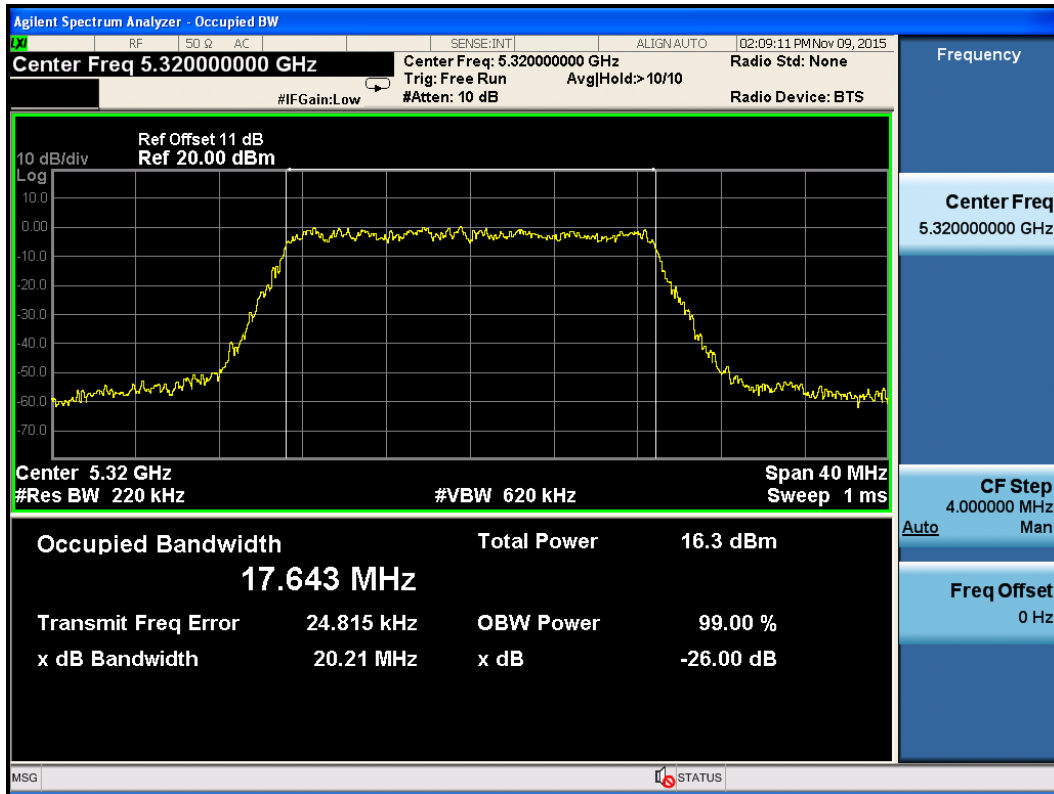
Channel 52 -Ant 1



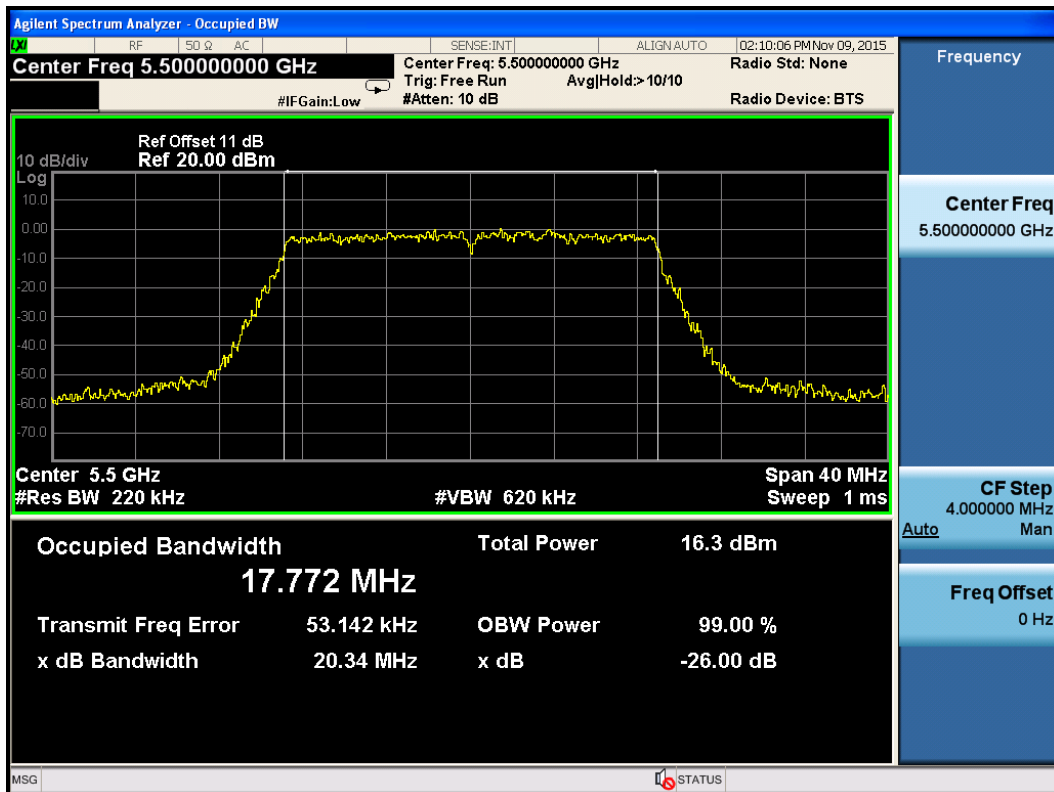
Channel 60 -Ant 1



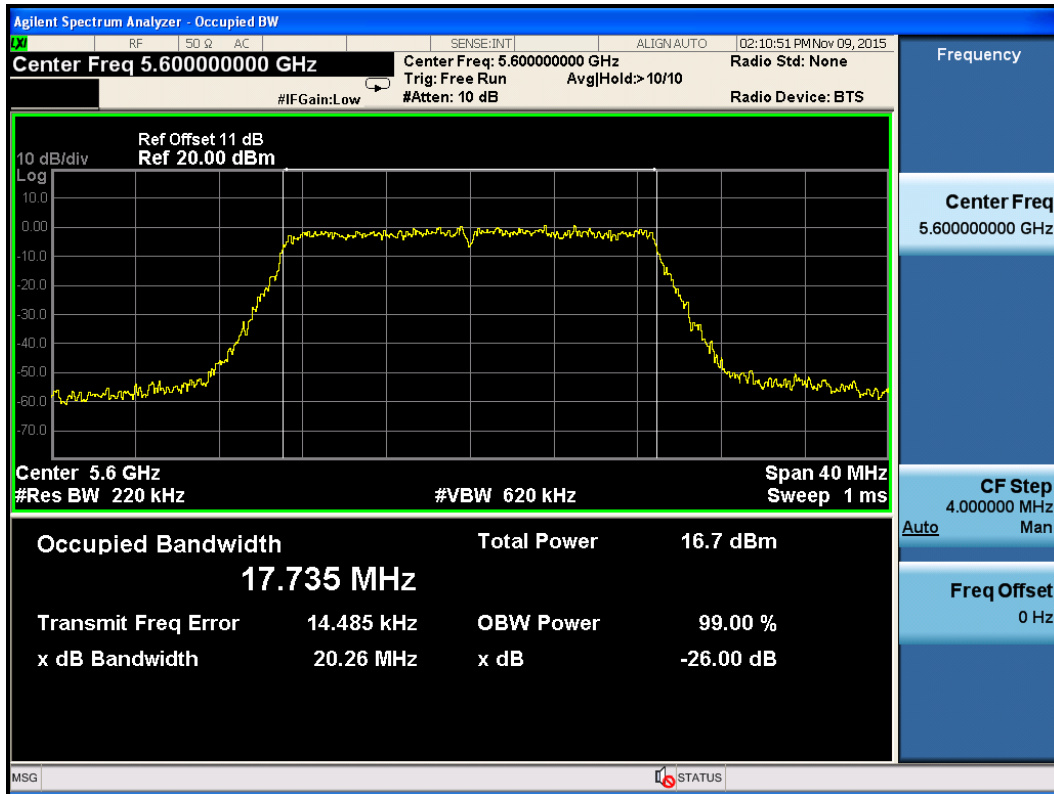
Channel 64 -Ant 1



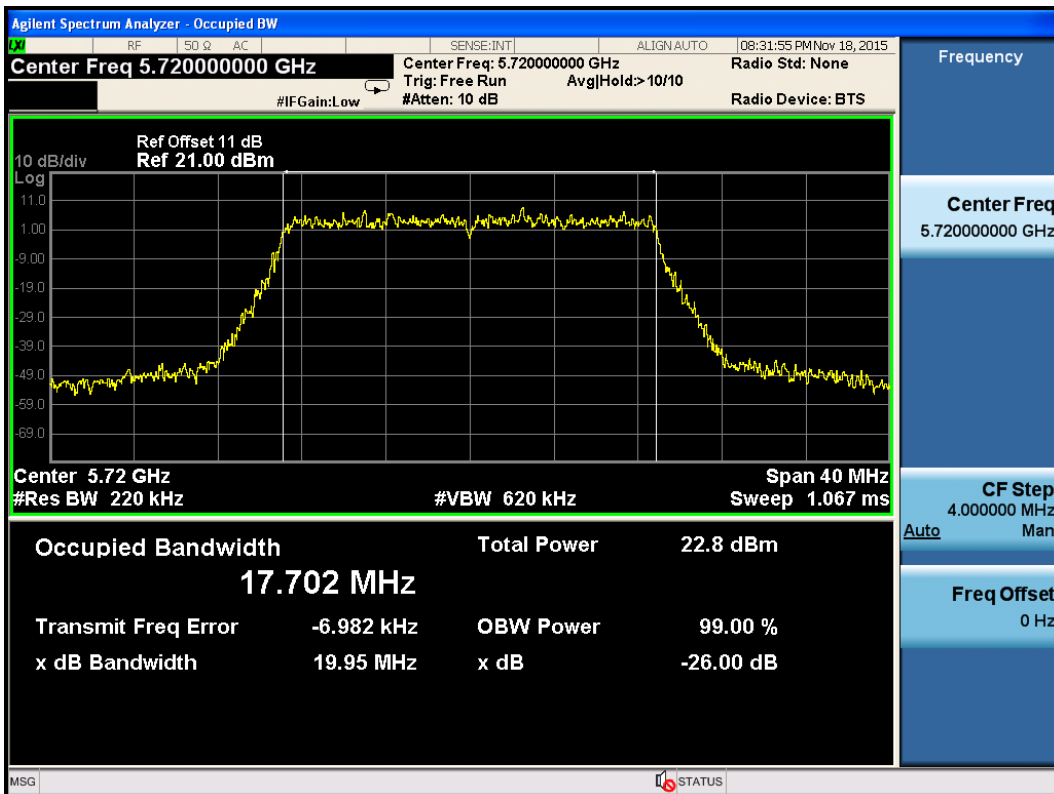
Channel 100 -Ant 1



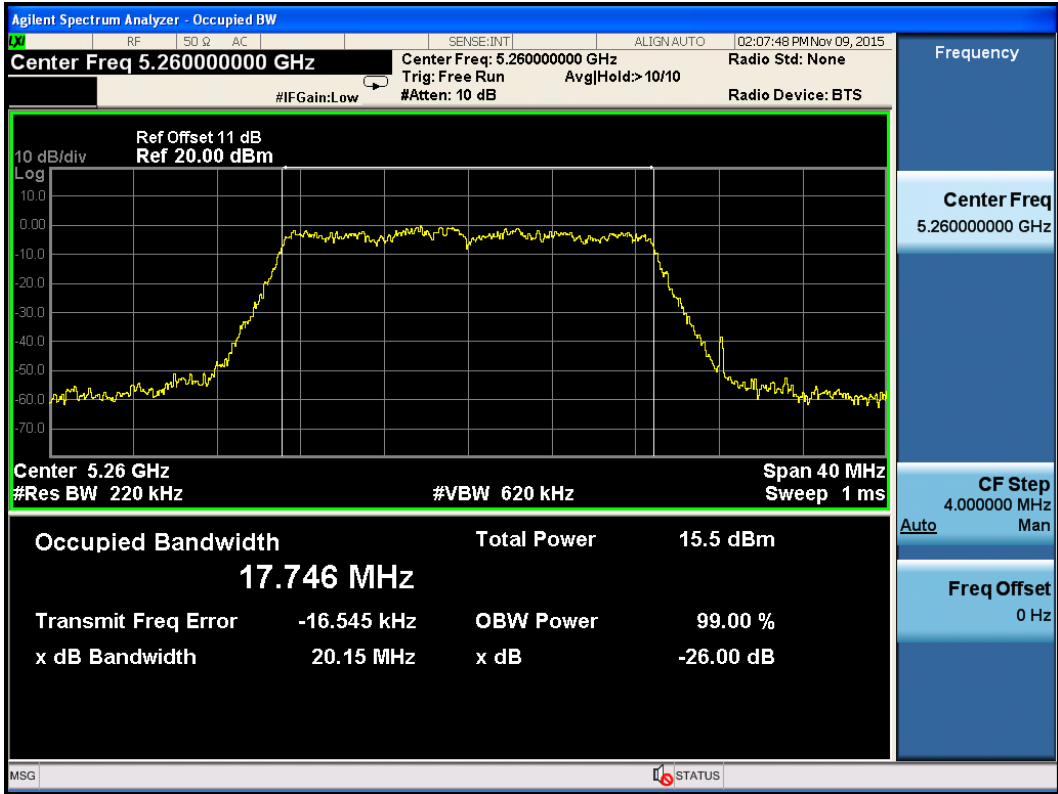
Channel 120 -Ant 1



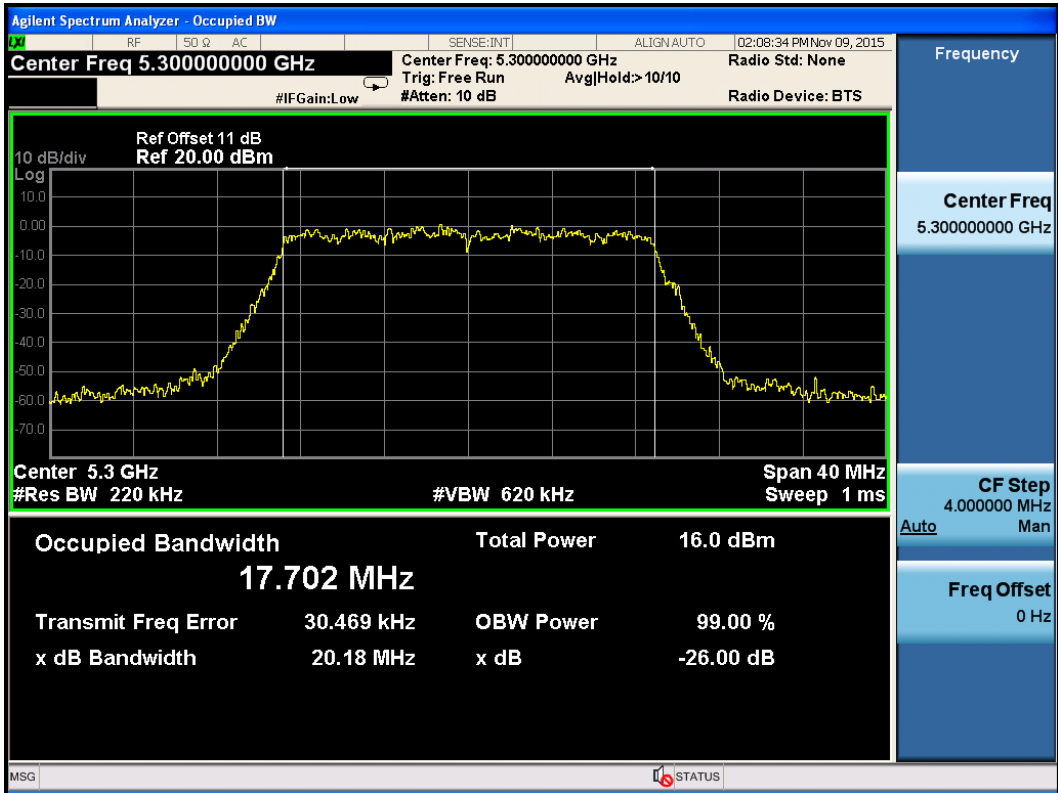
Channel 144 -Ant 1



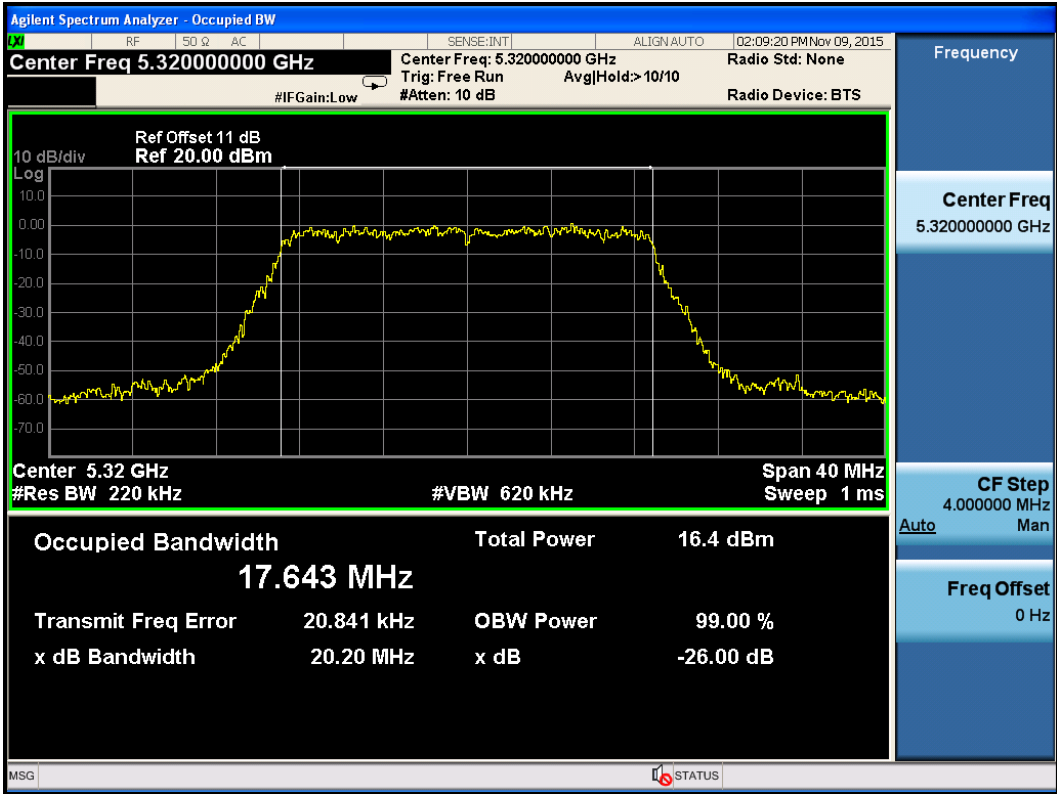
Channel 52 -Ant 2



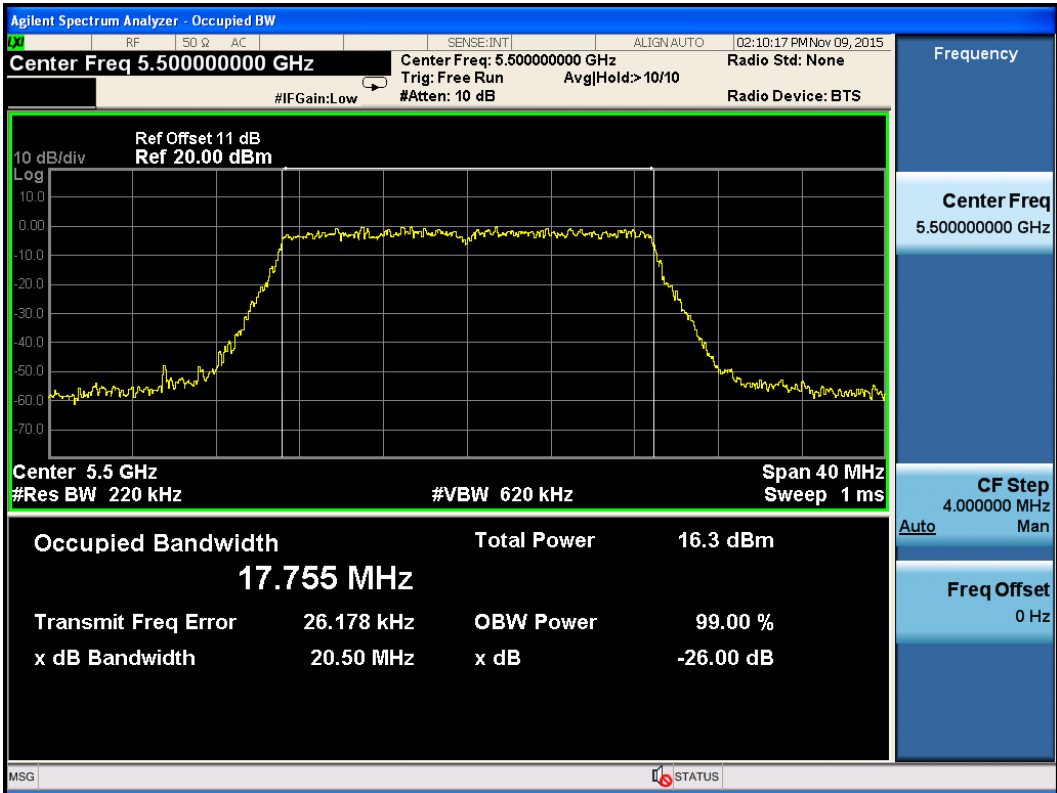
Channel 60 -Ant 2



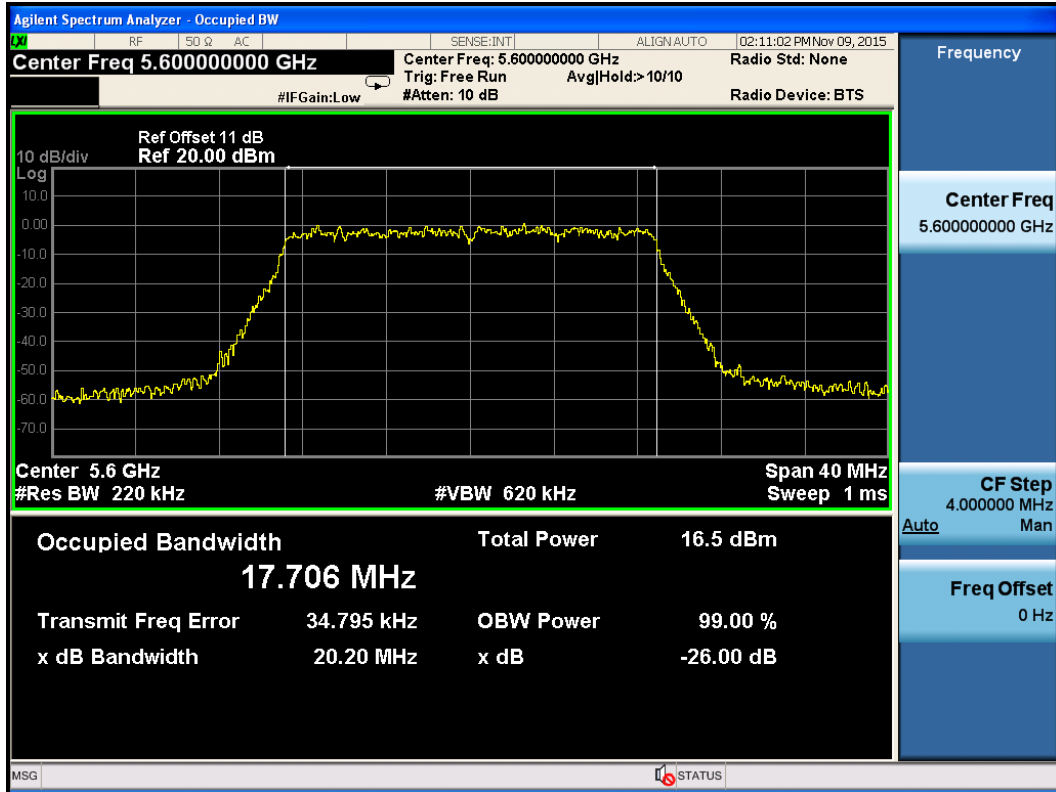
Channel 64 -Ant 2



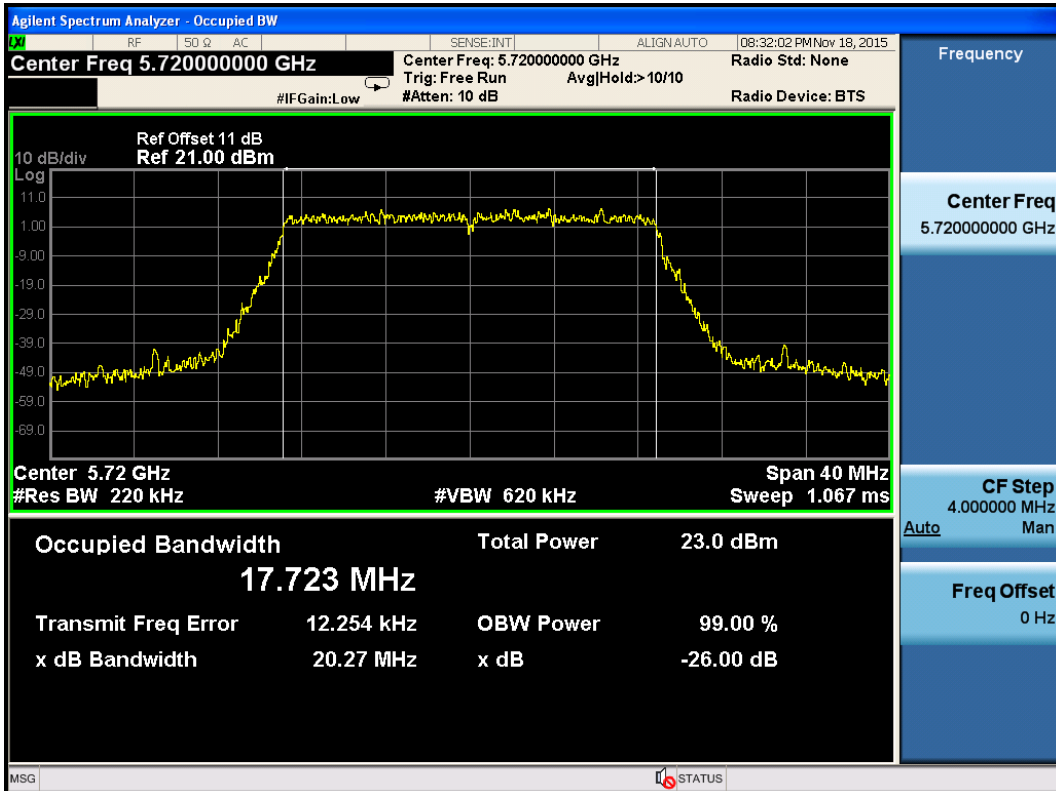
Channel 100 -Ant 2



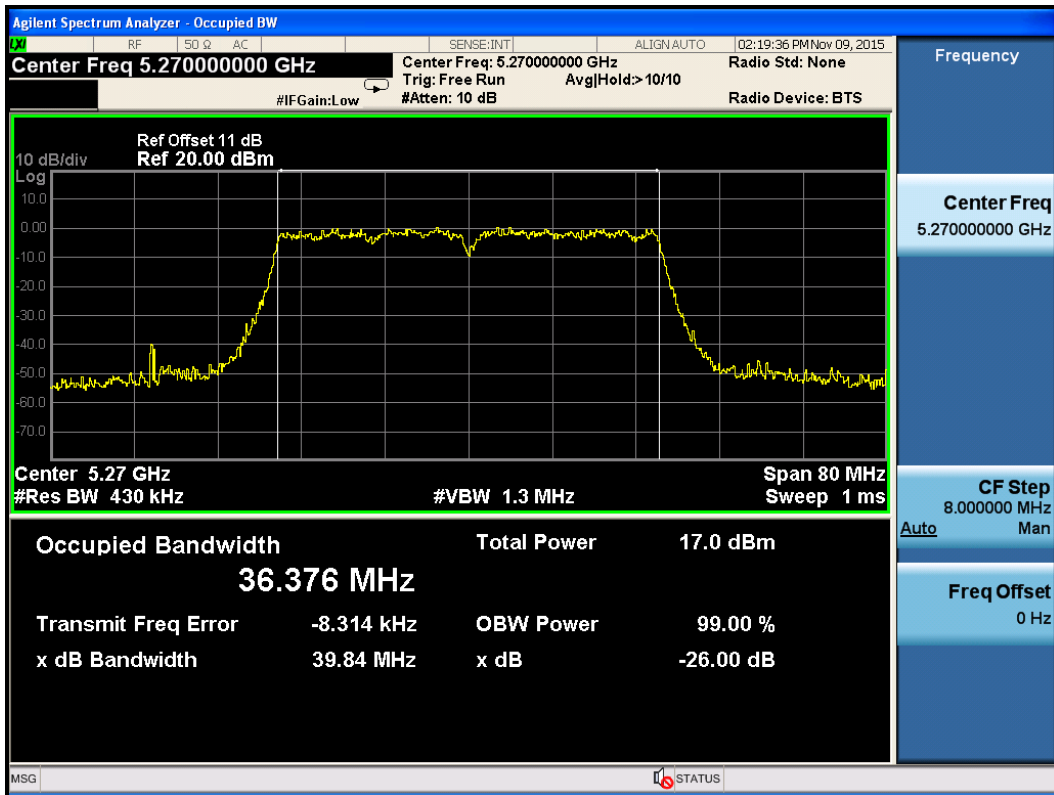
Channel 120 -Ant 2



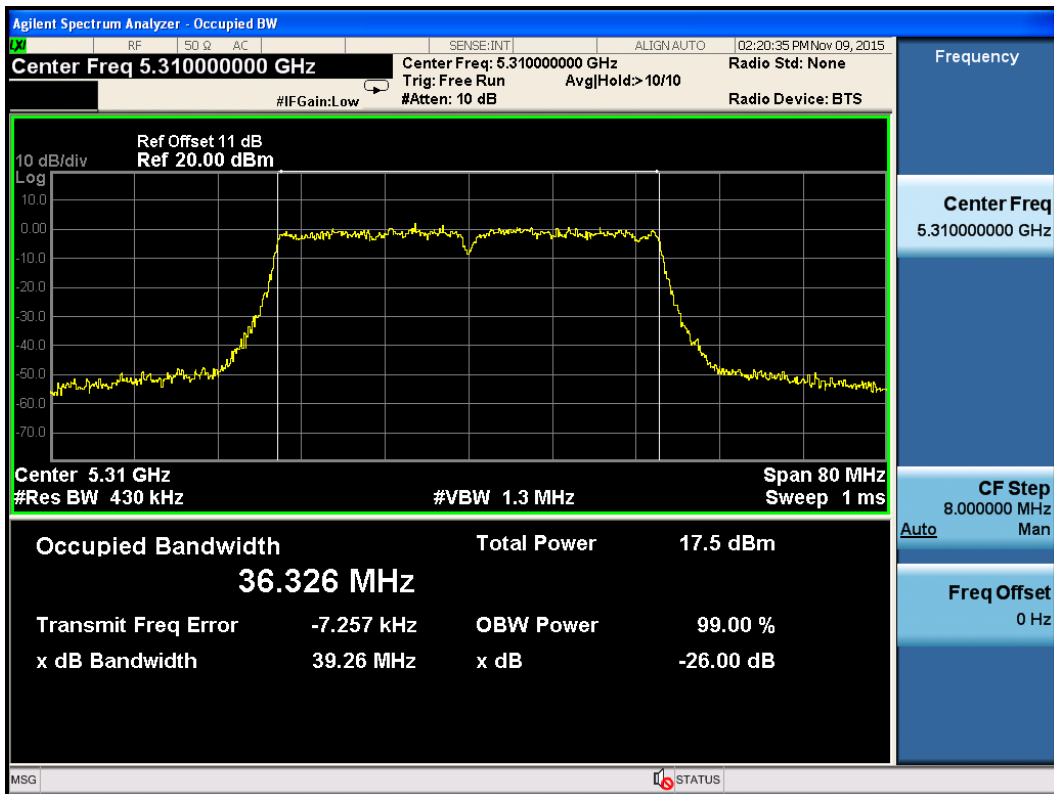
Channel 144 -Ant 2



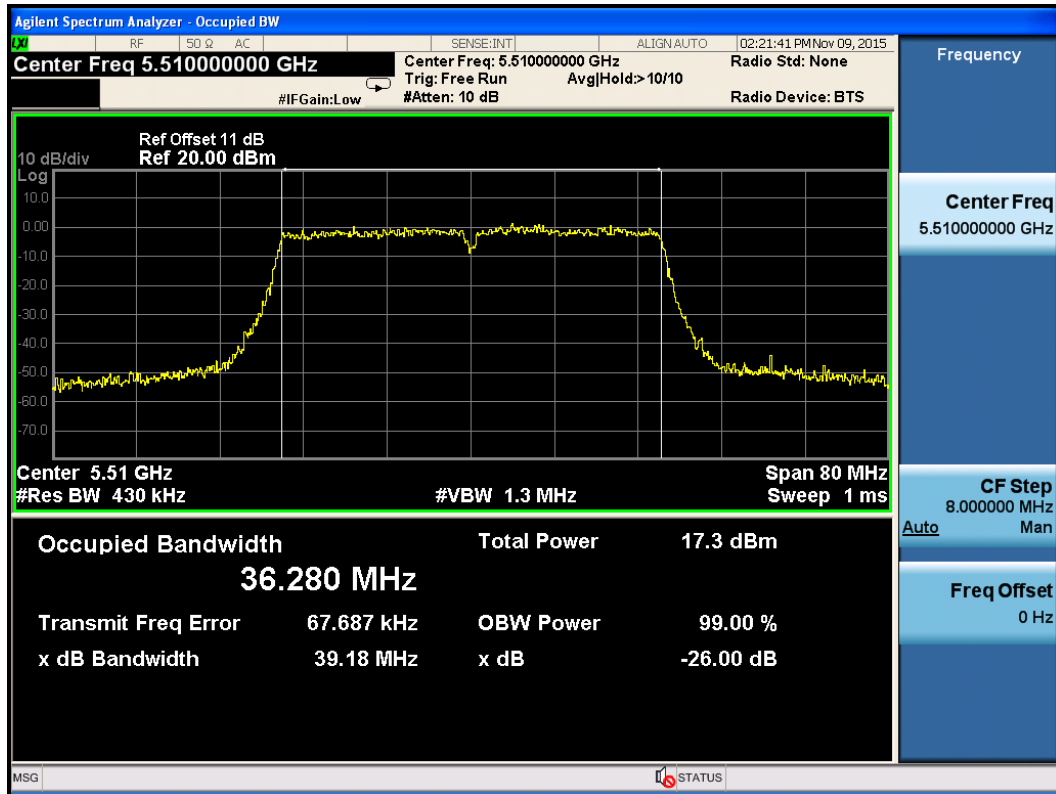
802.11n40
Channel 54 – Ant 0



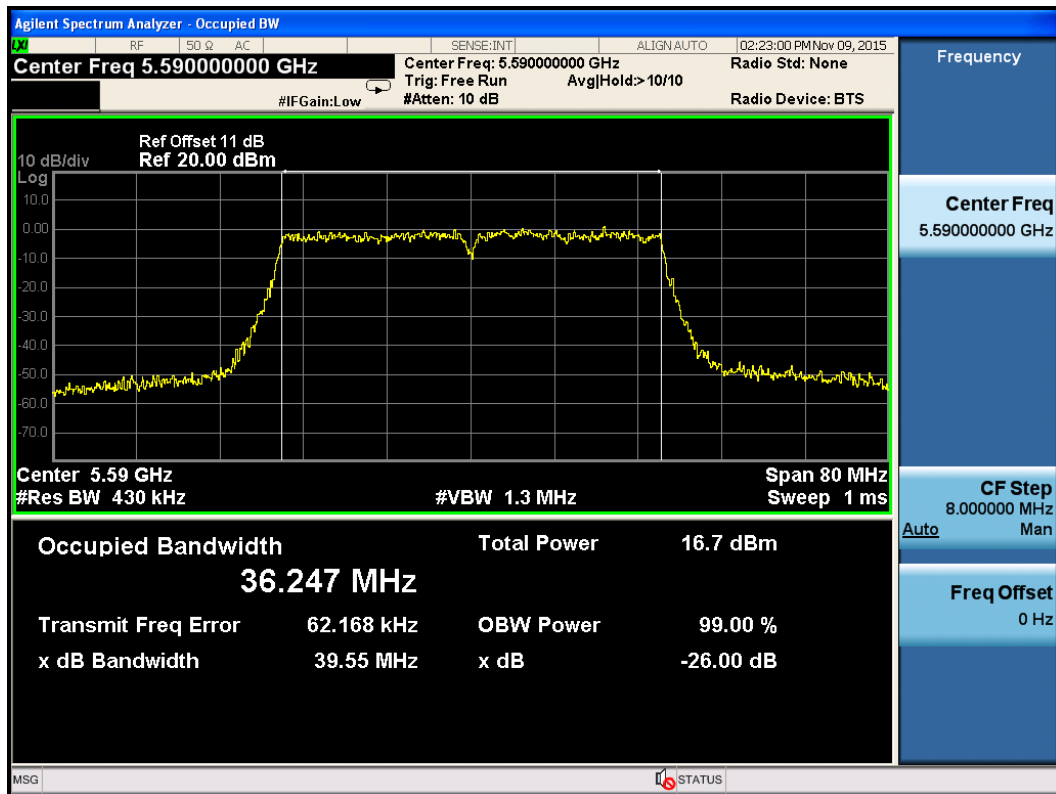
Channel 62 – Ant 0



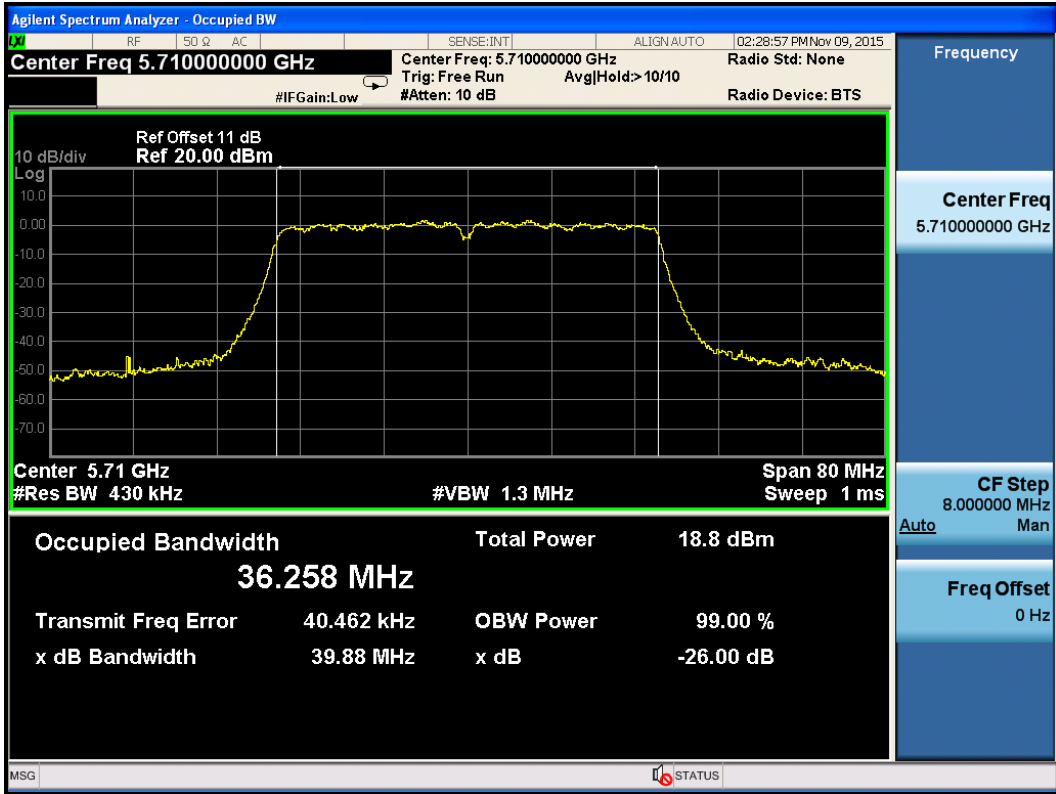
Channel 102 – Ant 0



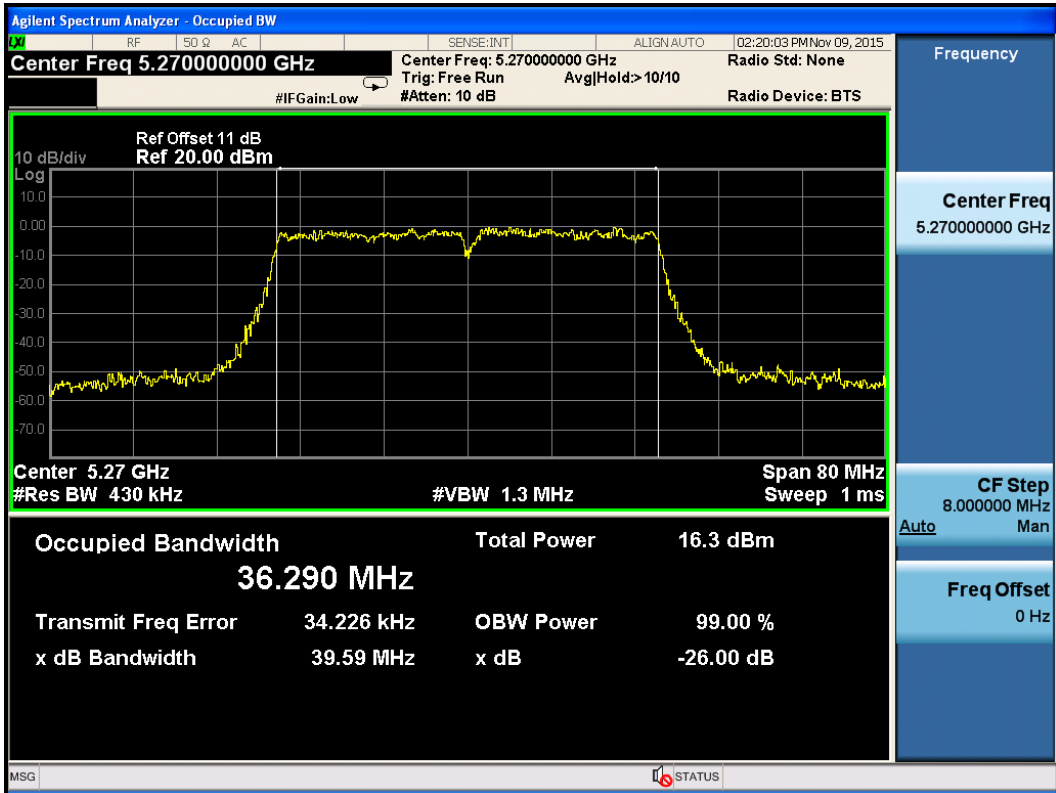
Channel 118 – Ant 0



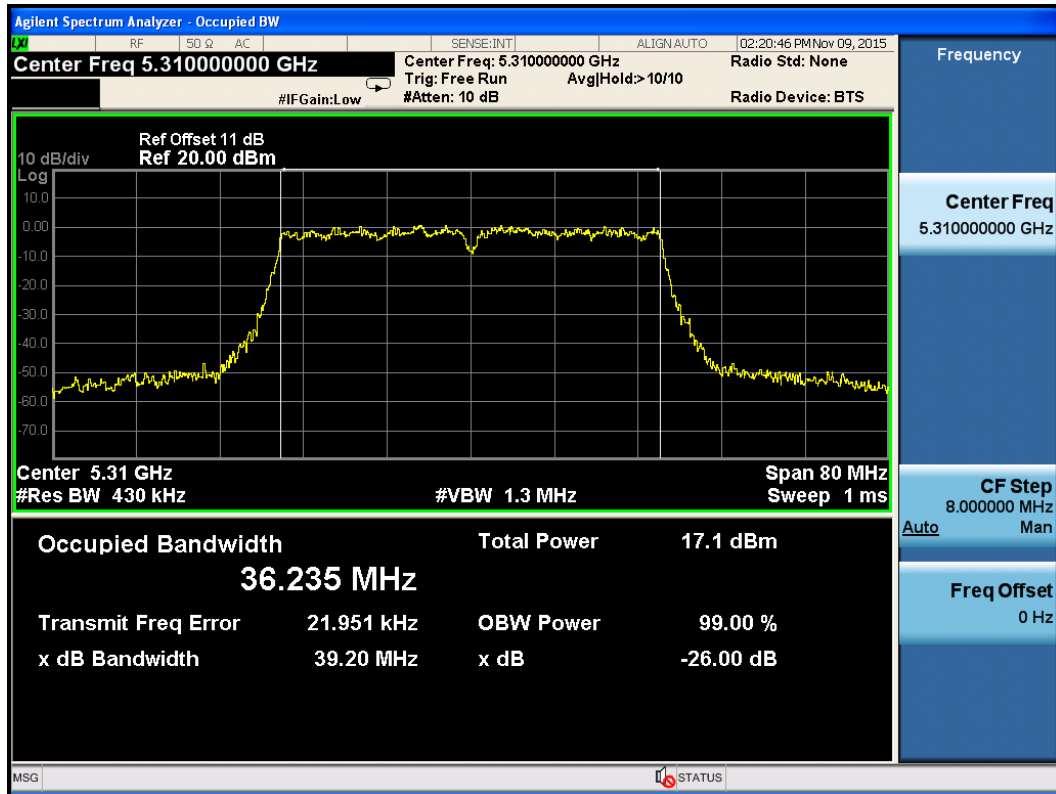
Channel 142- Ant 0



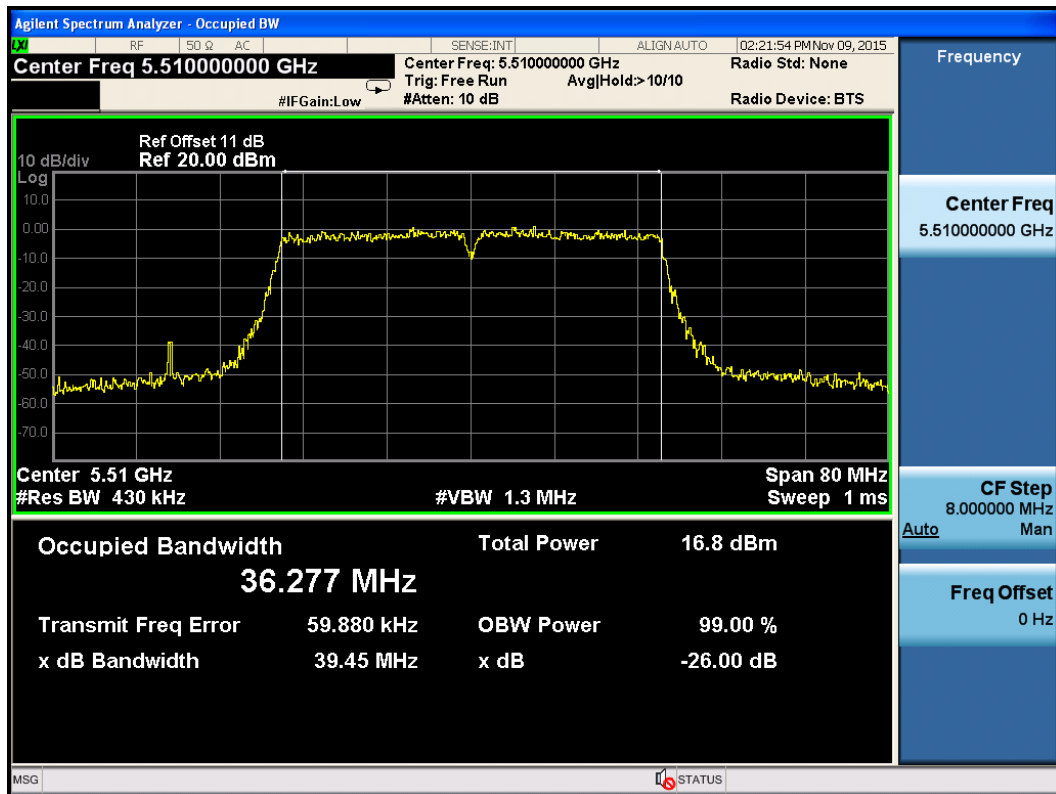
Channel 54 - Ant 1



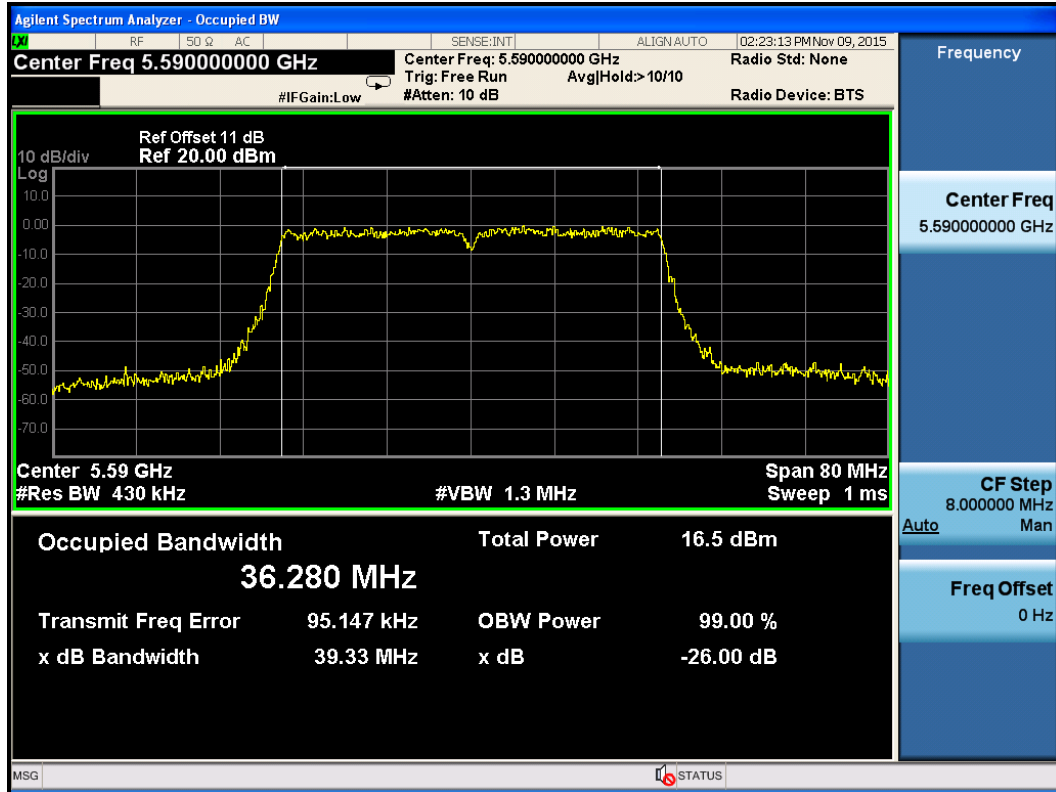
Channel 62 – Ant 1



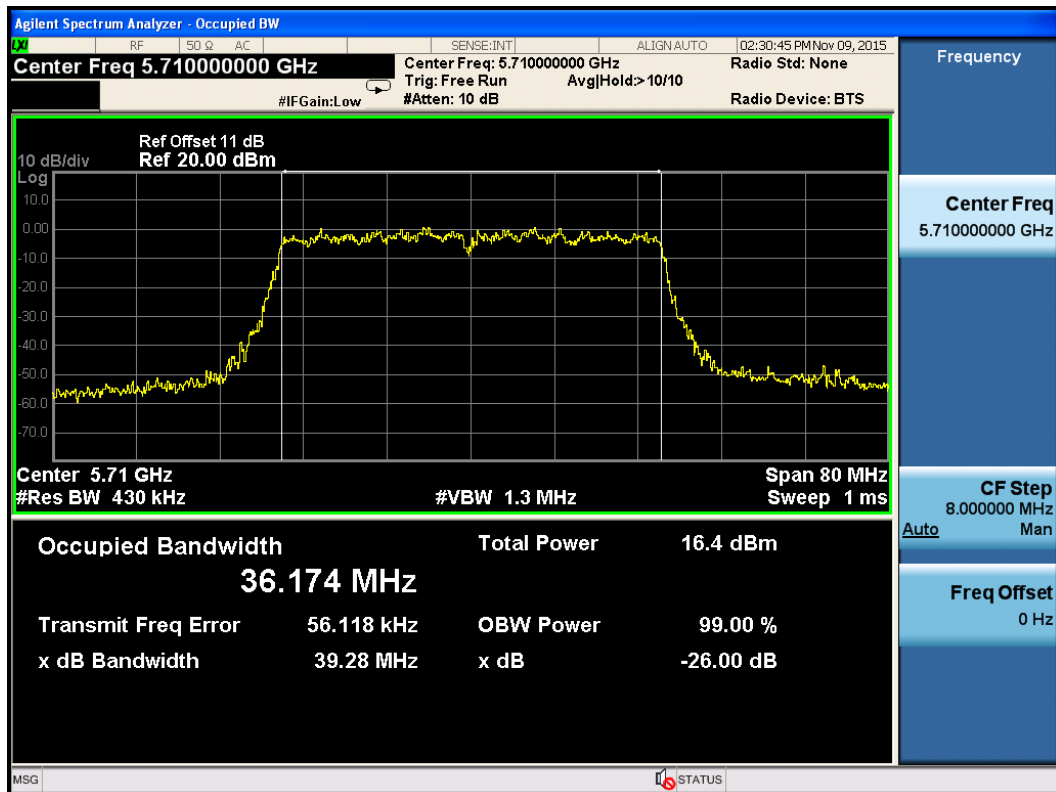
Channel 102 – Ant 1



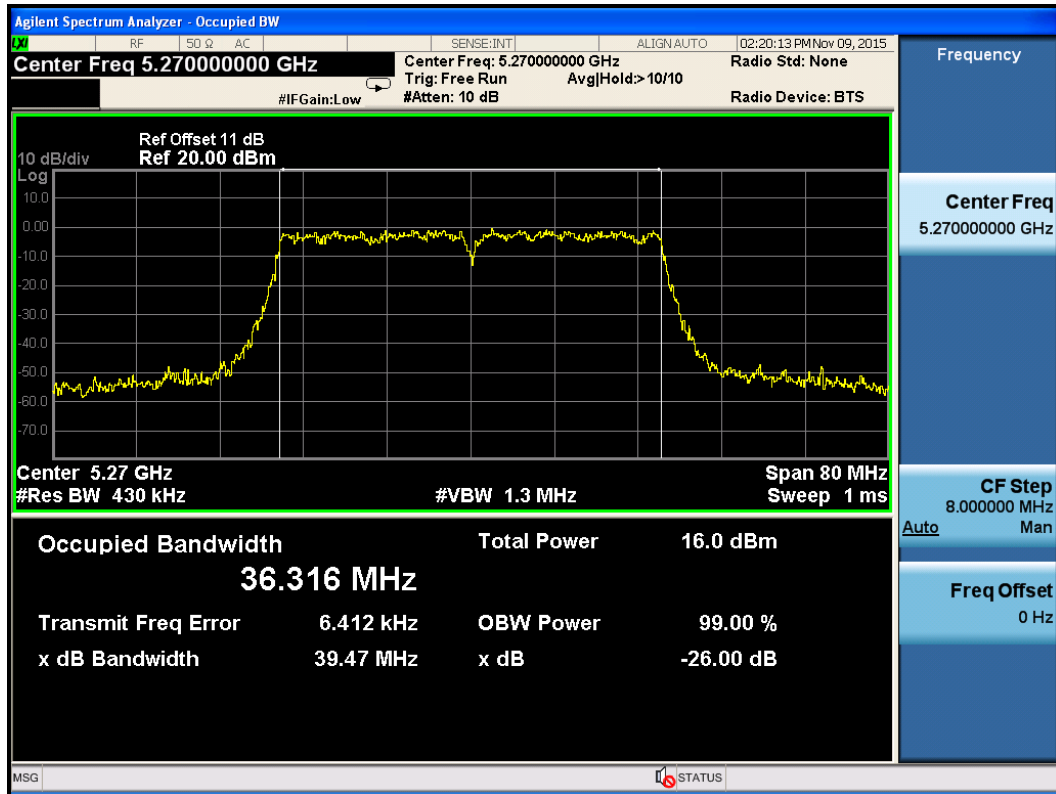
Channel 118 – Ant 1



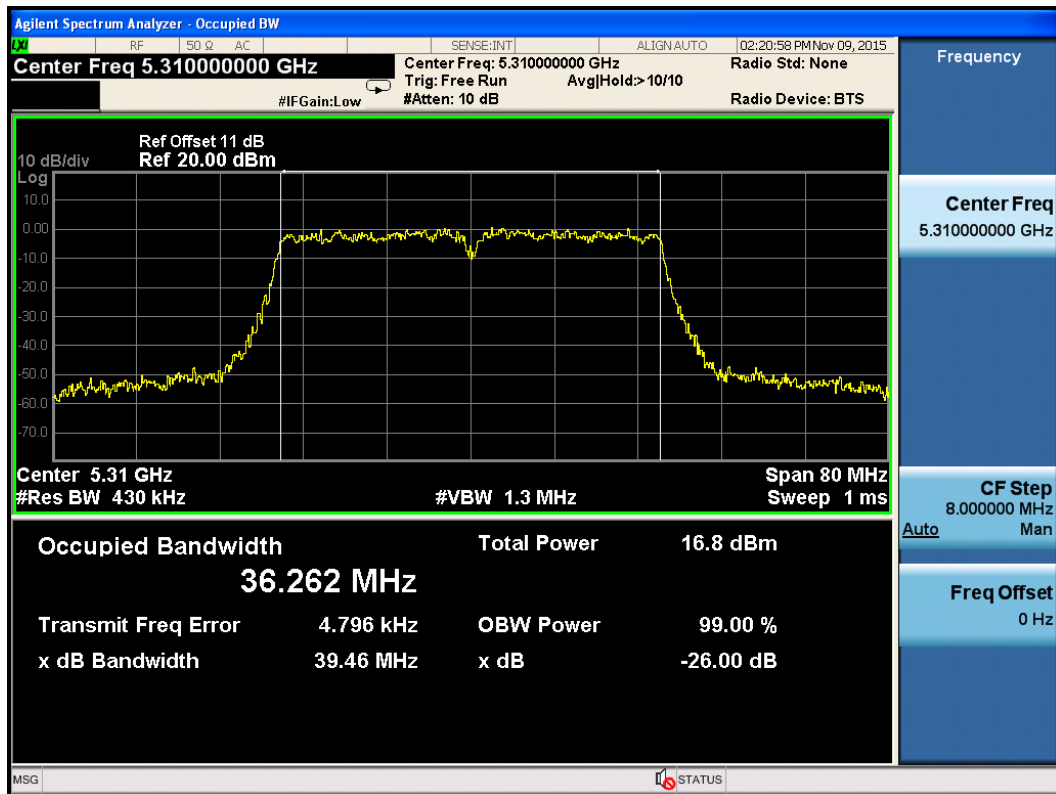
Channel 142 – Ant 1



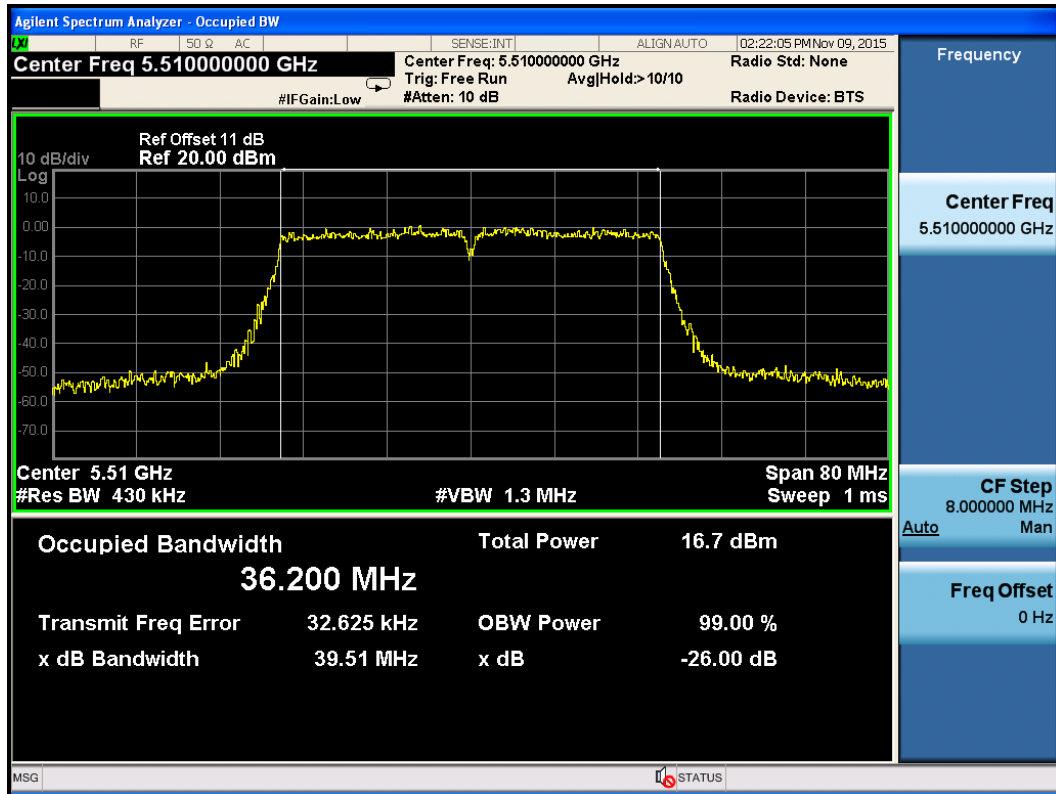
Channel 54 – Ant 2



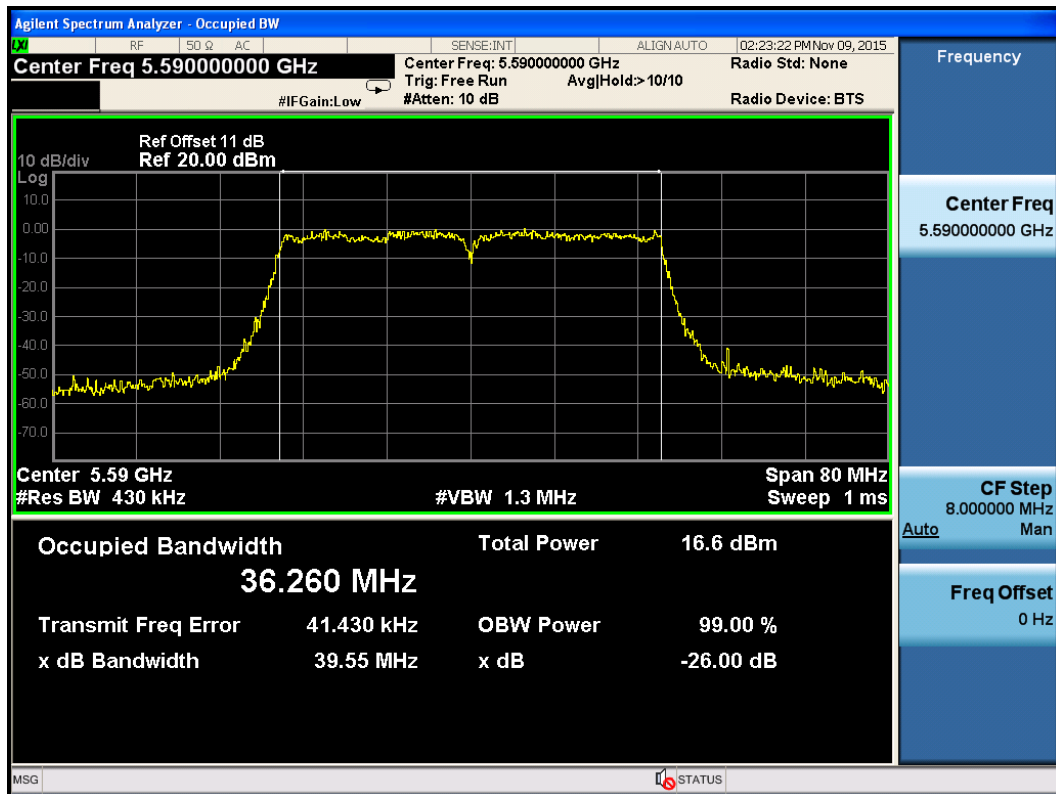
Channel 62 – Ant 2



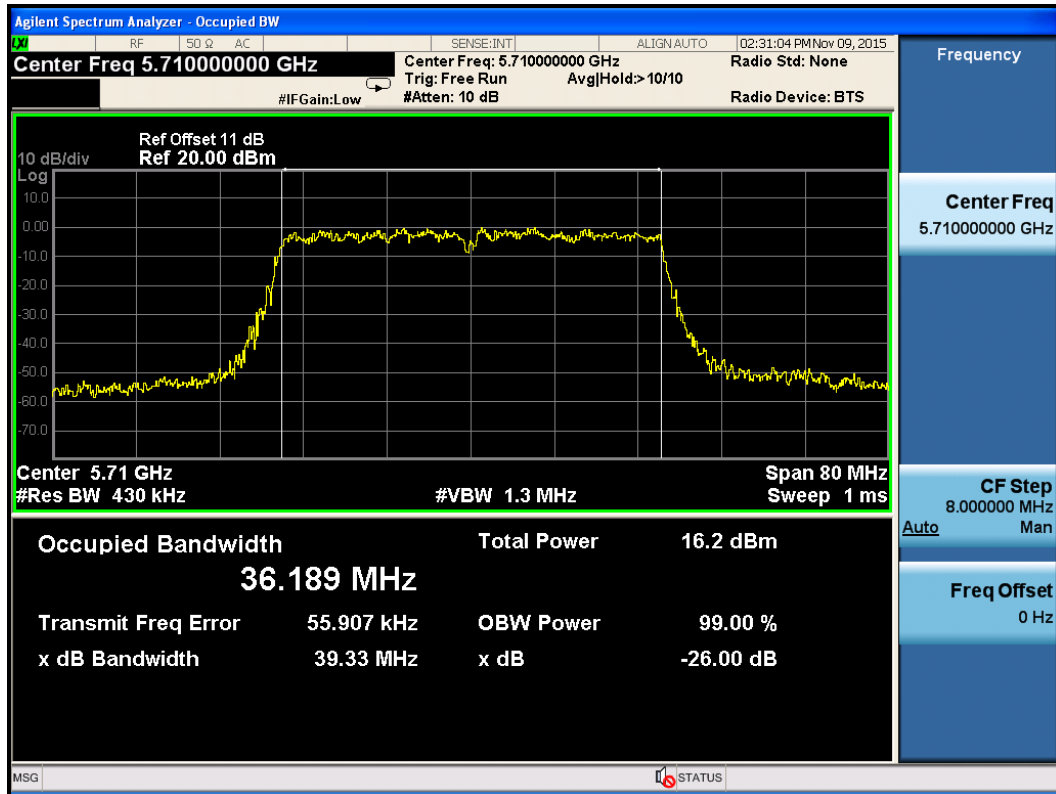
Channel 102 – Ant 2



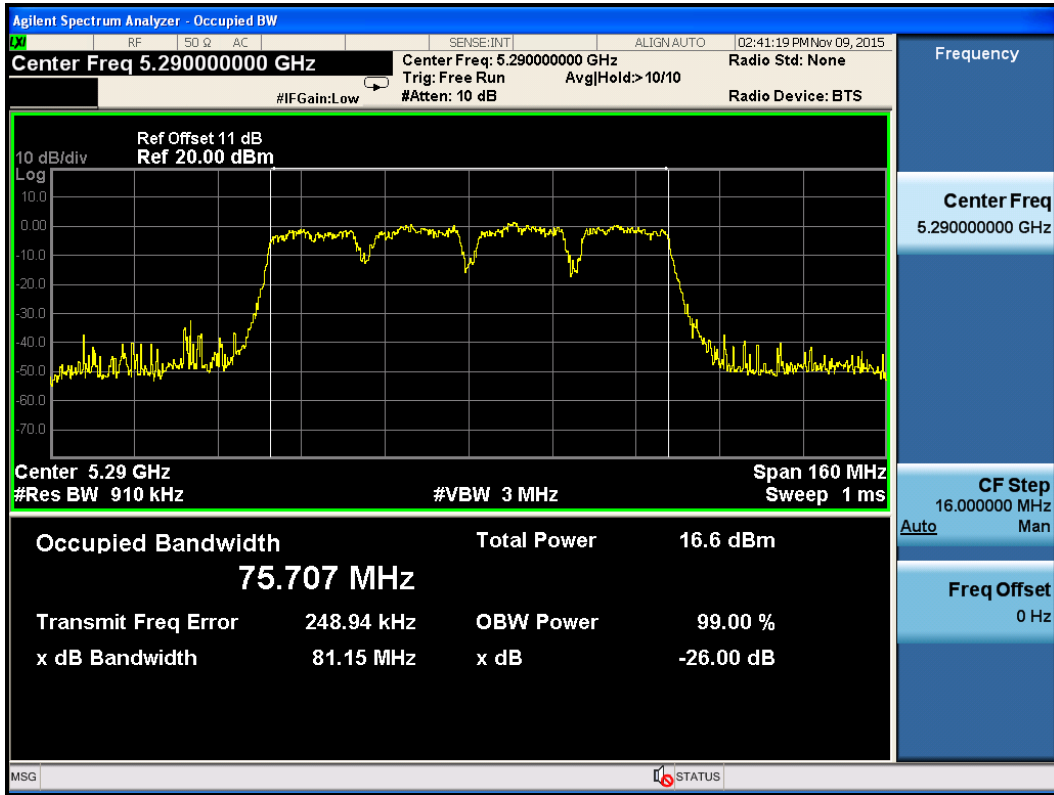
Channel 118 – Ant 2



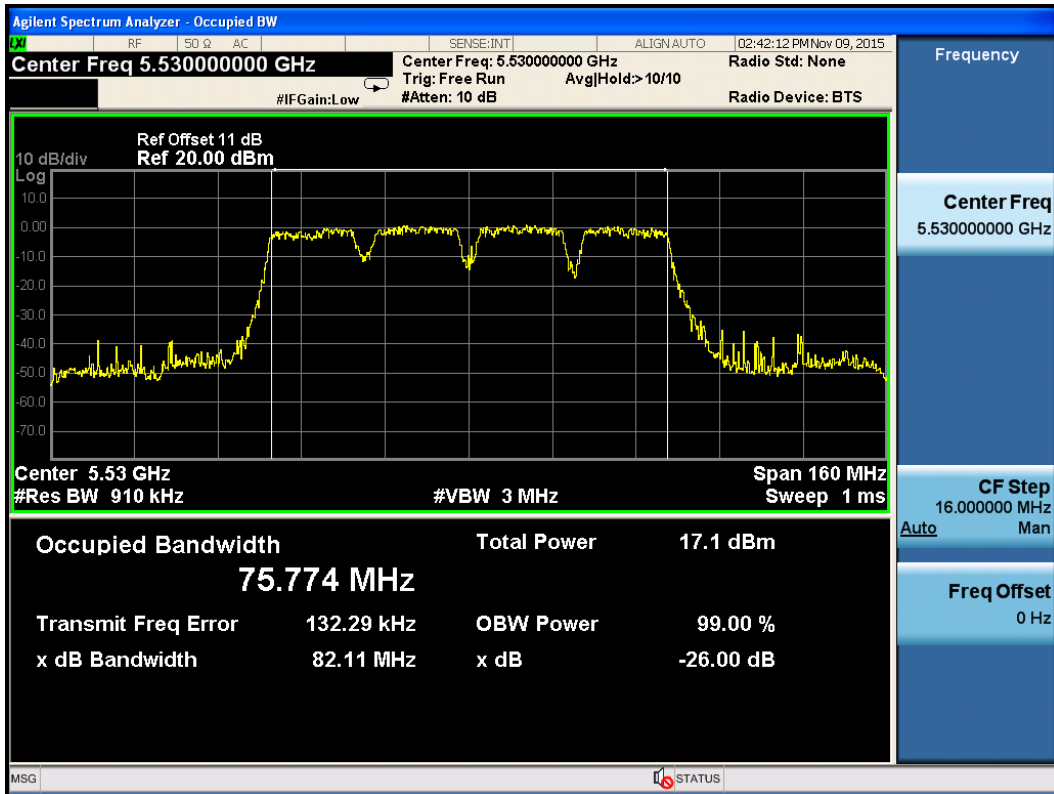
Channel 142 – Ant 2



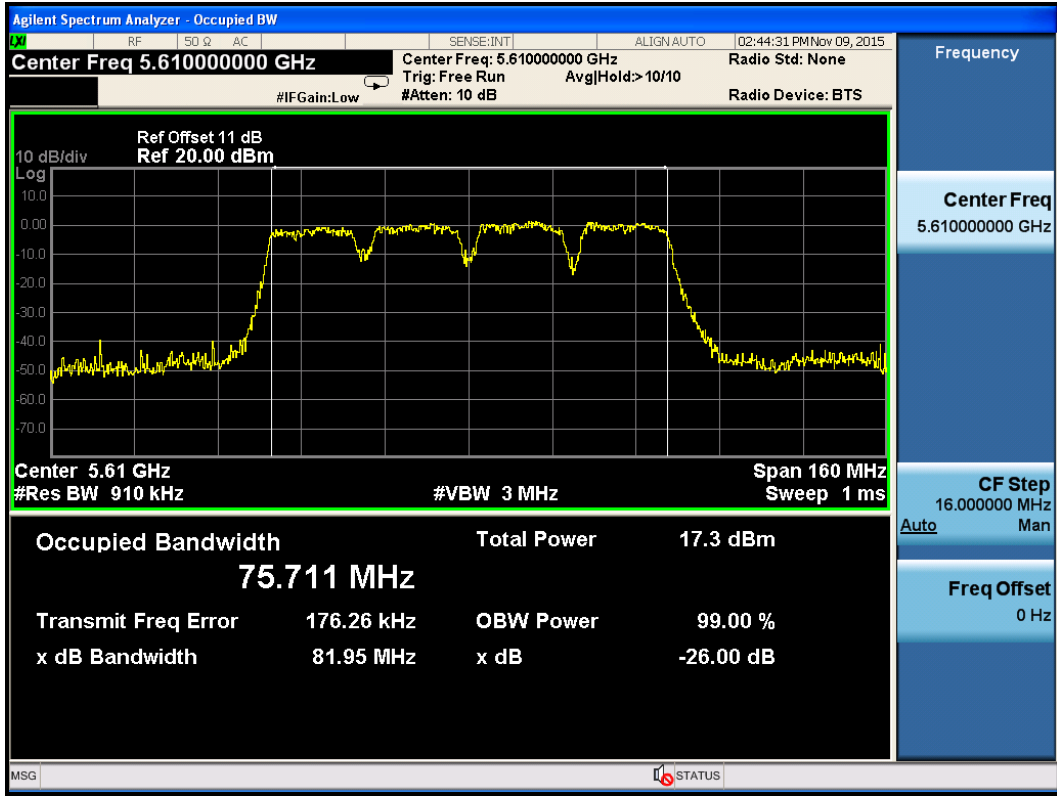
802.11ac80 Channel 58 – Ant 0



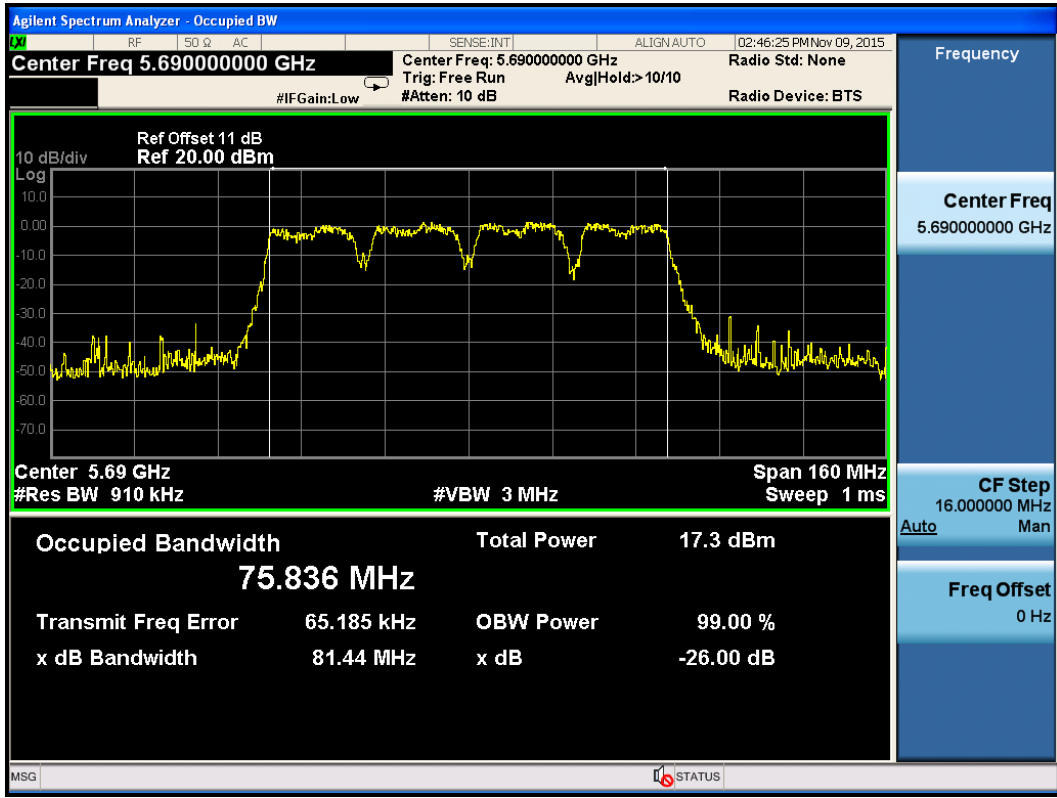
Channel 106 – Ant 0



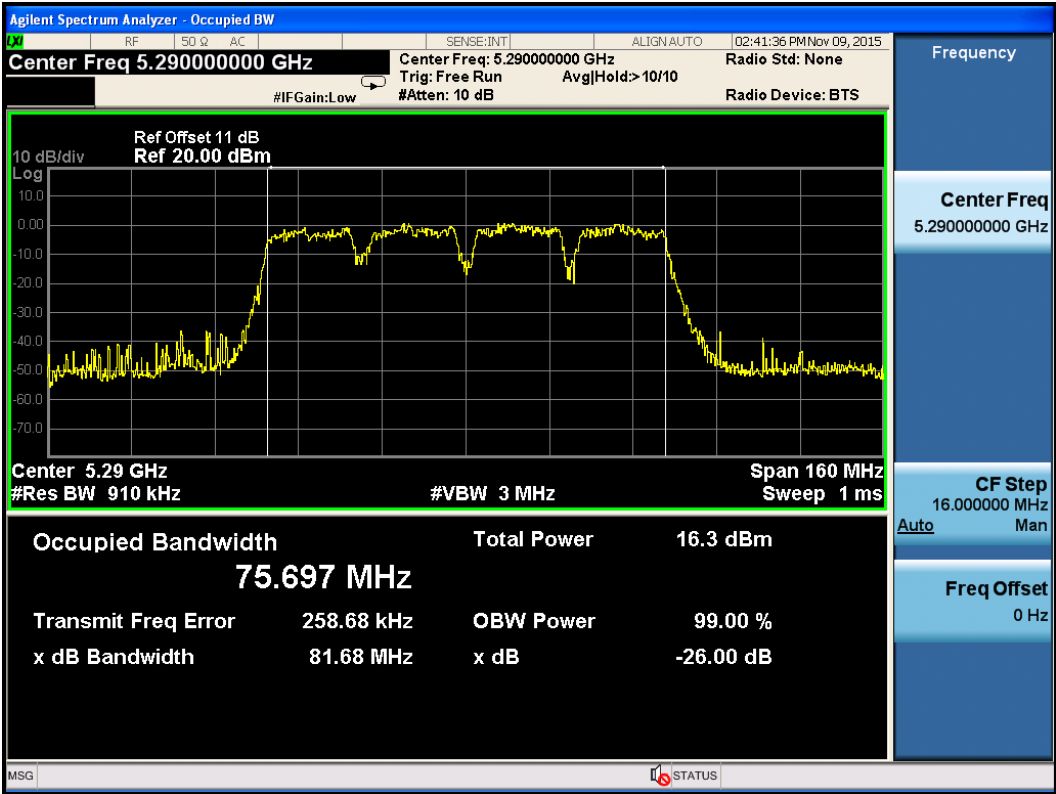
Channel 122 – Ant 0



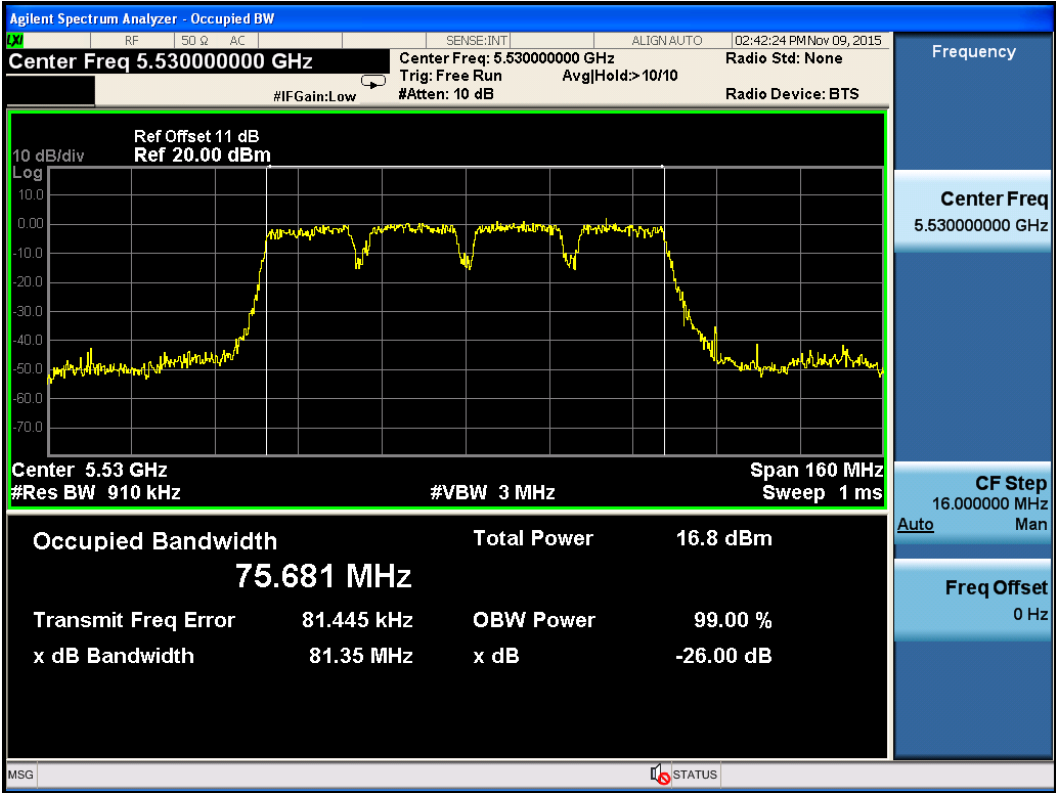
Channel 138 – Ant 0



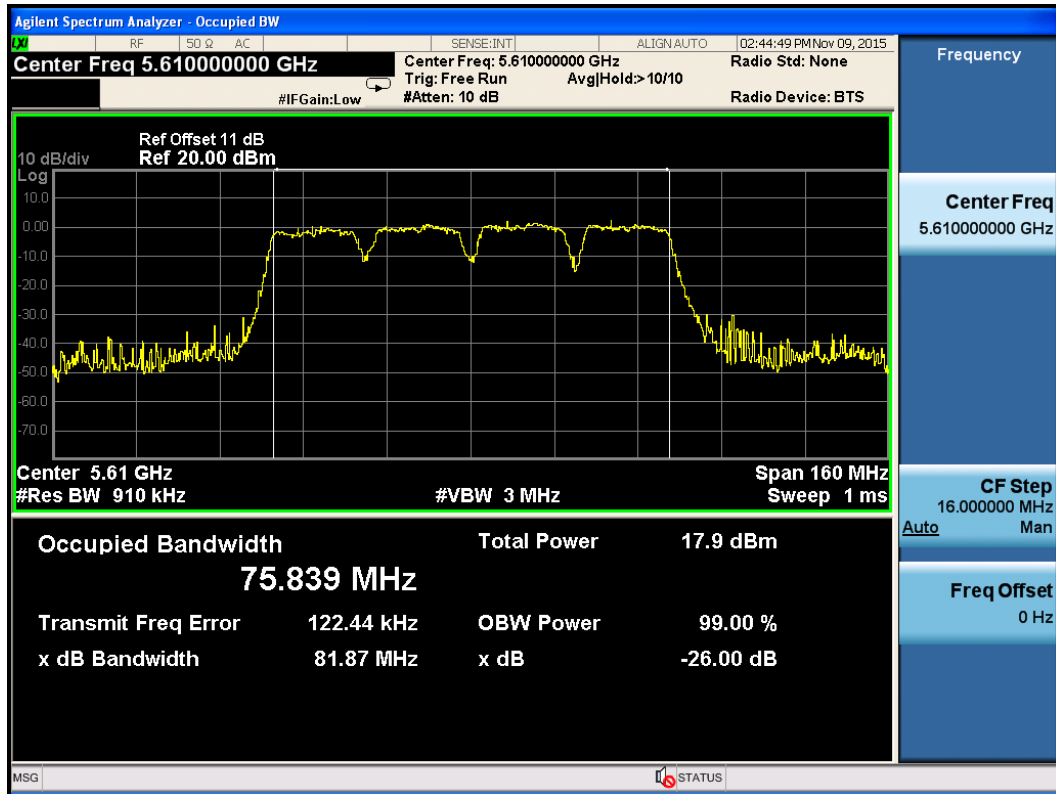
Channel 58 – Ant 1



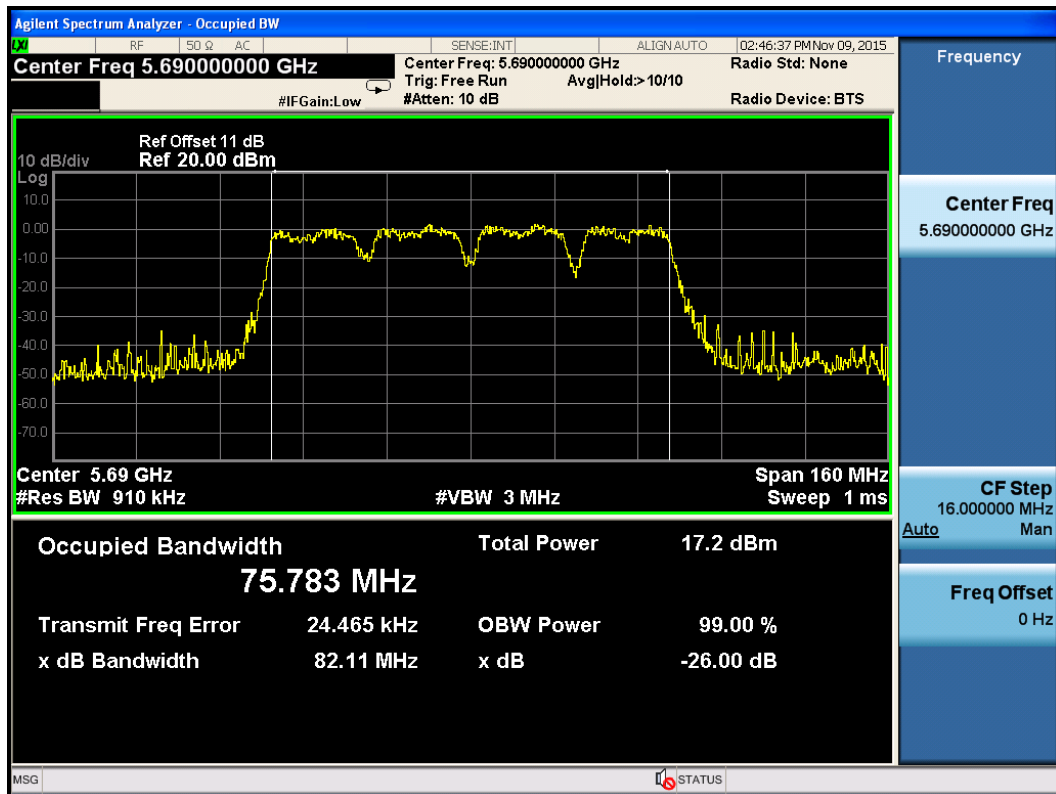
Channel 106 – Ant 1



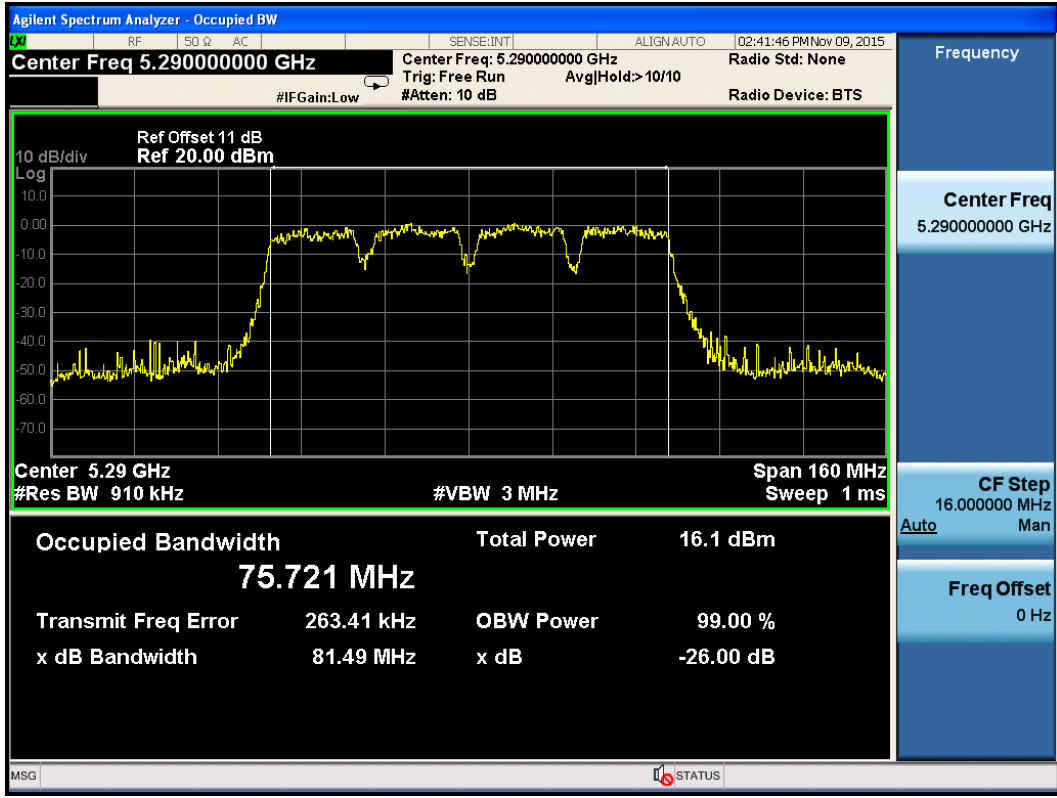
Channel 122 – Ant 1



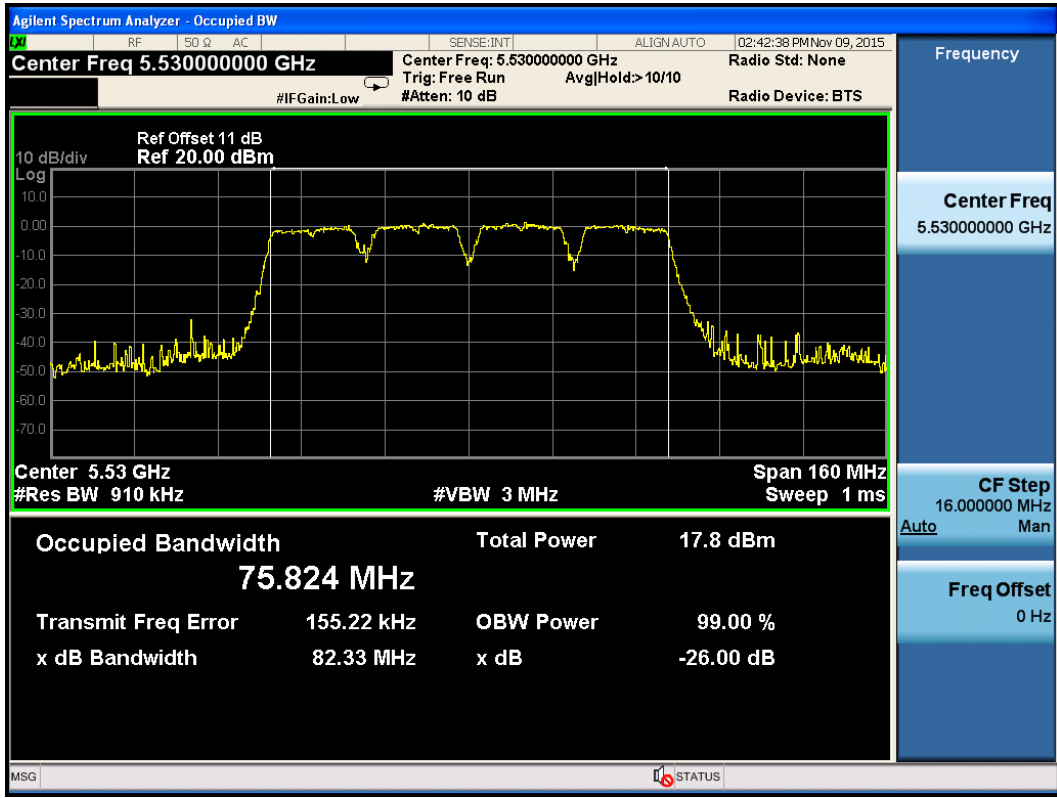
Channel 138 – Ant 1



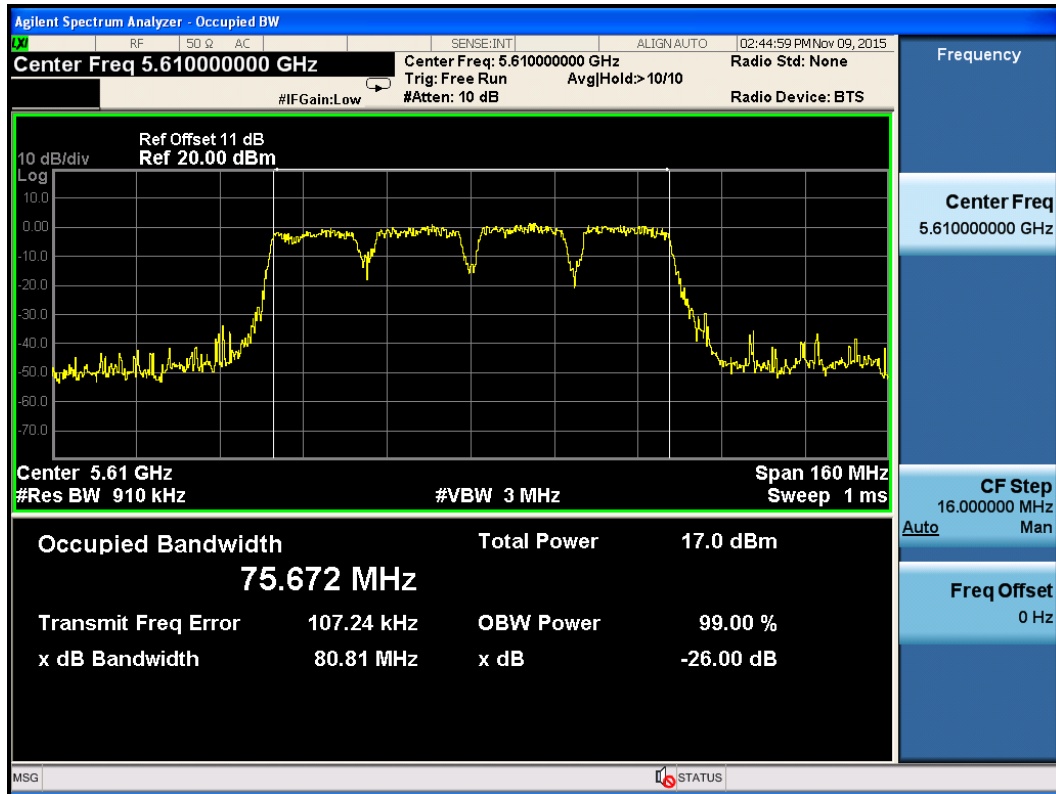
Channel 58 – Ant 2



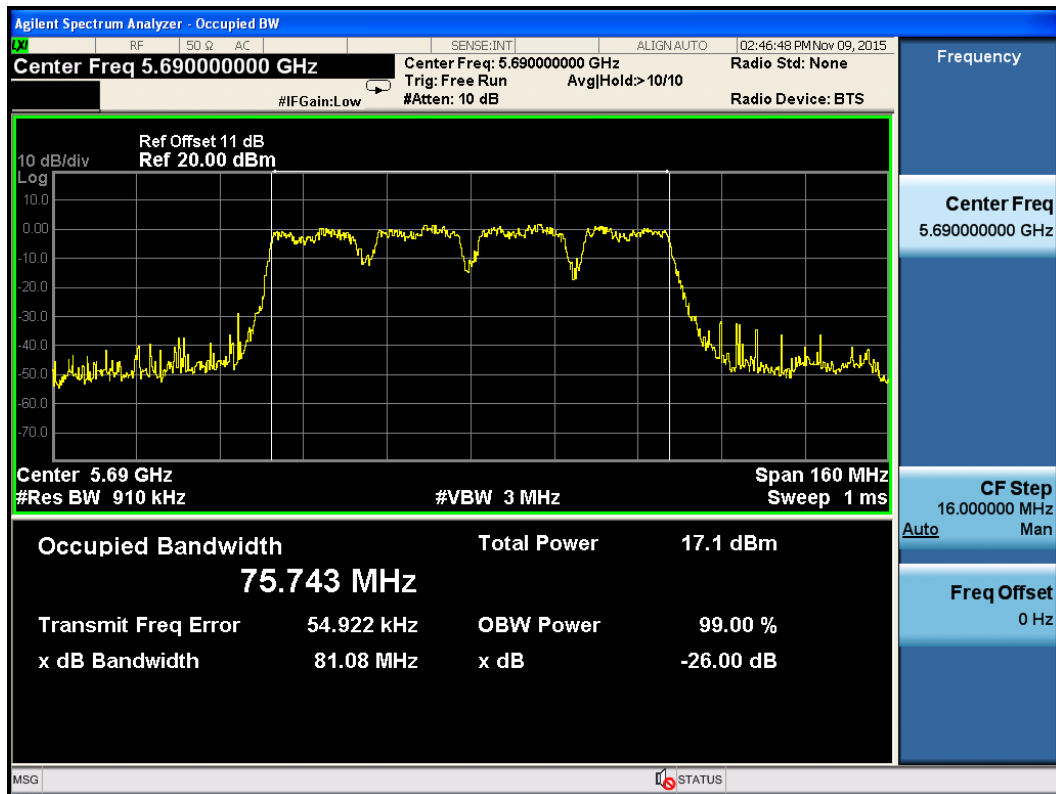
Channel 106 – Ant 2



Channel 122 – Ant 2



Channel 138 – Ant 2



4. Maximum Conducted Output Power & EIRP

Test result: Pass

4.1 Test limit

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.

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.

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.

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.

For Frequency Band 5150-5250 MHz, The maximum e.i.r.p. shall not exceed 200 mW or $10 + 10 \log_{10} B$, dBm, whichever power is less. B is the 99% emission bandwidth in megahertz.

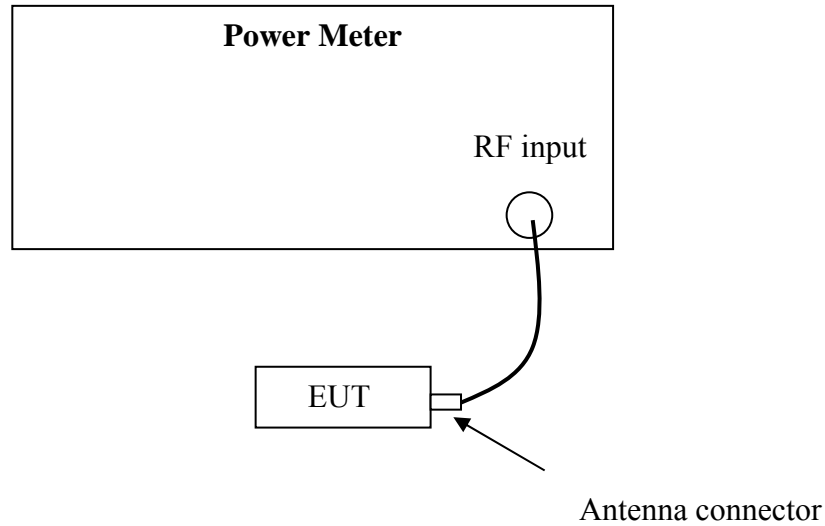
For the 5.25-5.35 GHz and 5.47-5.725 GHz bands, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW or $11 \text{ dBm} + 10 \log B$, where B is the 26 dB emission bandwidth in megahertz.

For the band 5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W.

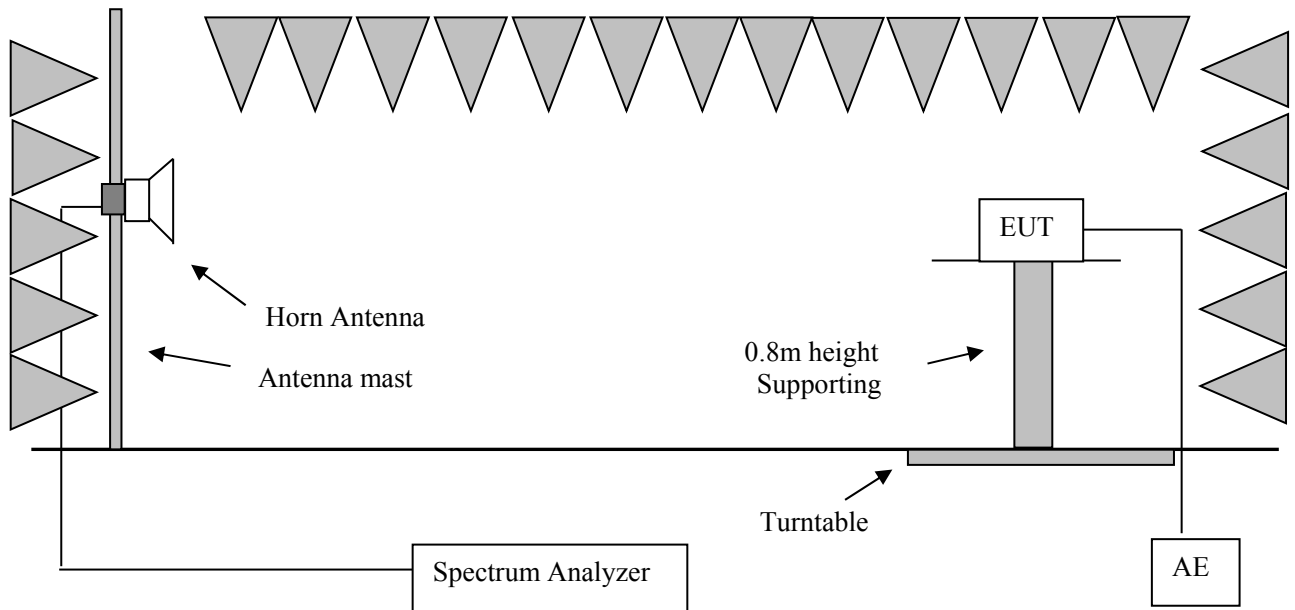
If transmitting antennas of directional gain greater than 6dBi are used, the maximum conducted output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

4.2 Test Configuration

- Maximum Conducted Output Power test



- Maximum EIRP test



4.3 Test procedure and test setup

The power output per FCC §15.407(a) was measured on the EUT using a 50 ohm RF cable connected to spectrum analyzer and the measurement method refer to KDB 789033D02 v01r02: Method PM.

The EIRP test is conducted at any elevation angle above 30 degrees as measured from the horizon.

4.4 Test protocol

Temperature : 25 °C
 Relative Humidity : 55 %

Conducted Power limit calculation for mode 6 (2.0dBi antenna):

Mode	Frequency (MHz)	Limit calculation		Chosen limit (dBm)	Antenna value (dBi)	Final limit (dBm)
		Min B _{26dB} (MHz)	11dBm + 10logB (dBm)			
U-NII-2 Band						
802.11a	5260	19.65	23.93	23.93	2.00	23.93
	5300	19.71	23.95	23.95	2.00	23.95
	5320	19.72	23.95	23.95	2.00	23.95
802.11n20	5260	20.09	24.03	24.00	6.70	23.30
	5300	20.11	24.03	24.00	6.70	23.30
	5320	20.19	24.05	24.00	6.70	23.30
802.11n40	5270	39.47	26.96	24.00	6.70	23.30
	5310	39.20	26.93	24.00	6.70	23.30
802.11ac80	5290	81.15	30.09	24.00	6.70	23.30
U-NII-3 Band						
802.11a	5500	19.86	23.98	23.98	2.00	23.98
	5600	19.73	23.95	23.95	2.00	23.95
	5720	19.82	23.97	23.97	2.00	23.97
802.11n20	5500	20.34	24.08	24.00	6.70	23.30
	5600	20.2	24.05	24.00	6.70	23.30
	5720	19.95	24.00	24.00	6.70	23.30
802.11n40	5510	39.18	26.93	24.00	6.70	23.30
	5590	39.33	26.95	24.00	6.70	23.30
	5710	39.28	26.94	24.00	6.70	23.30
802.11ac80	5530	81.35	30.10	24.00	6.70	23.30
	5610	80.81	30.07	24.00	6.70	23.30
	5690	81.08	30.09	24.00	6.70	23.30
Note: 1. Chosen limit is 24dBm or 11dBm + 10logB which is lesser; 2. Antenna value = Antenna gain + beamforming if applied; 3. Final limit is calculated as Chosen limit – Antenna value exceeding 6dBi.						

U-NII-2 Band:

Mode	Frequency (MHz)	Reading (dBm)			Duty cycle factor	Total Power (dBm)	Limit (dBm)	Margin (dB)
		Port0	Port 1	Port 2				
802.11a	5260	14.34	14.51	14.56	0.23	19.47	23.93	4.46
	5300	15.41	15.68	15.53	0.23	20.54	23.95	3.40
	5320	14.54	14.63	14.47	0.23	19.55	23.95	4.40
802.11n20	5260	14.84	15.44	15.18	0.56	20.49	23.30	2.81
	5300	15.31	15.62	15.59	0.56	20.84	23.30	2.46
	5320	15.15	15.31	15.08	0.56	20.51	23.30	2.79
802.11n40	5270	16.43	16.56	16.73	1.04	22.38	23.30	0.92
	5310	16.62	16.63	16.66	1.04	22.44	23.30	0.86
802.11ac80	5290	17.18	17.58	17.88	0.54	22.87	23.30	0.43

U-NII-3 Band

Mode	Frequency (MHz)	Reading (dBm)			Duty cycle factor	Total Power (dBm)	Limit (dBm)	Margin (dB)
		Port0	Port 1	Port 2				
802.11a	5500	14.31	14.34	13.86	0.23	19.18	23.98	4.80
	5600	15.07	15.01	14.66	0.23	19.92	23.95	4.03
	5720	15.21	15.26	15.18	0.23	20.22	23.97	3.75
802.11n20	5500	15.08	14.85	14.57	0.56	20.17	23.30	3.13
	5600	14.29	14.35	13.77	0.56	19.48	23.30	3.82
	5720	14.12	14.30	14.22	0.56	19.55	23.30	3.75
802.11n40	5510	17.07	17.05	17.22	1.04	22.92	23.30	0.38
	5590	17.58	17.36	17.17	1.04	23.18	23.30	0.12
	5710	17.24	17.39	17.22	1.04	23.09	23.30	0.21
802.11ac80	5530	17.14	17.53	17.89	0.54	22.84	23.30	0.46
	5610	17.37	17.36	17.29	0.54	22.65	23.30	0.65
	5690	17.09	17.26	17.35	0.54	22.55	23.30	0.75

Note: Total power = $10 * \log (10^{\text{port } 0 / 10} + 10^{\text{port } 1 / 10} + 10^{\text{port } 2 / 10}) + \text{Duty cycle factor}$

Conducted Power limit calculation for mode 17 (14.0dBi antenna):

Mode	Frequency (MHz)	Limit calculation		Chosen limit (dBm)	Antenna value (dBi)	Final limit (dBm)
		Min B _{26dB} (MHz)	11dBm + 10logB (dBm)			
U-NII-2 Band						
802.11a	5260	19.65	23.93	23.93	14.00	15.93
	5300	19.71	23.95	23.95	14.00	15.95
	5320	19.72	23.95	23.95	14.00	15.95
802.11n20	5260	20.09	24.03	24.00	17.00	13.00
	5300	20.11	24.03	24.00	17.00	13.00
	5320	20.19	24.05	24.00	17.00	13.00
802.11n40	5270	39.47	26.96	24.00	17.00	13.00
	5310	39.20	26.93	24.00	17.00	13.00
802.11ac80	5290	81.15	30.09	24.00	17.00	13.00
U-NII-3 Band						
802.11a	5500	19.86	23.98	23.98	14.00	15.98
	5600	19.73	23.95	23.95	14.00	15.95
	5720	19.82	23.97	23.97	14.00	15.97
802.11n20	5500	20.34	24.08	24.00	17.00	13.00
	5600	20.2	24.05	24.00	17.00	13.00
	5720	19.95	24.00	24.00	17.00	13.00
802.11n40	5510	39.18	26.93	24.00	17.00	13.00
	5590	39.33	26.95	24.00	17.00	13.00
	5710	39.28	26.94	24.00	17.00	13.00
802.11ac80	5530	81.35	30.10	24.00	17.00	13.00
	5610	80.81	30.07	24.00	17.00	13.00
	5690	81.08	30.09	24.00	17.00	13.00
<p>Note: 1. Chosen limit is 24dBm or 11dBm + 10logB which is lesser; 2. Antenna value = Antenna gain + beamforming if applied; 3. Final limit is calculated as Chosen limit – Antenna value exceeding 6dBi.</p>						

U-NII-2 Band:

Mode	Frequency (MHz)	Reading (dBm)			Duty cycle factor	Total Power (dBm)	Limit (dBm)	Margin (dB)
		Port0	Port 1	Port 2				
802.11a	5260	1.78	2.36	2.61	0.23	7.26	15.93	8.67
	5300	2.64	2.78	2.85	0.23	7.76	15.95	8.19
	5320	1.89	3.16	2.67	0.23	7.61	15.95	8.34
802.11n20	5260	3.88	4.29	5.27	0.56	9.85	13.00	3.15
	5300	4.34	4.31	5.47	0.56	10.07	13.00	2.93
	5320	4.25	4.37	5.46	0.56	10.06	13.00	2.94
802.11n40	5270	6.92	6.25	6.68	1.04	12.43	13.00	0.57
	5310	6.37	6.38	6.73	1.04	12.30	13.00	0.70
802.11ac80	5290	6.52	6.23	6.91	0.54	11.87	13.00	1.13

U-NII-3 Band

Mode	Frequency (MHz)	Reading (dBm)			Duty cycle factor	Total Power (dBm)	Limit (dBm)	Margin (dB)
		Port0	Port 1	Port 2				
802.11a	5500	3.09	2.65	3.04	0.23	7.93	15.98	8.05
	5600	2.13	2.32	2.84	0.23	7.44	15.95	8.51
	5720	2.96	3.10	3.85	0.23	8.32	15.97	7.65
802.11n20	5500	4.35	4.42	5.86	0.56	10.27	13.00	2.73
	5600	4.45	4.51	5.75	0.56	10.28	13.00	2.72
	5720	4.83	4.90	5.26	0.56	10.33	13.00	2.67
802.11n40	5510	6.11	6.35	6.25	1.04	12.05	13.00	0.95
	5590	5.66	5.82	5.06	1.04	11.33	13.00	1.67
	5710	5.66	6.65	5.03	1.04	11.64	13.00	1.36
802.11ac80	5530	6.57	6.11	6.87	0.54	11.84	13.00	1.16
	5610	6.24	6.63	6.11	0.54	11.64	13.00	1.36
	5690	5.92	6.54	5.85	0.54	11.43	13.00	1.57

Note: Total power = $10 * \log (10^{\text{port } 0 / 10} + 10^{\text{port } 1 / 10} + 10^{\text{port } 2 / 10}) + \text{Duty cycle factor}$

5. Power spectral density

Test result: Pass

5.1 Test limit

For an outdoor access point operating in the band 5.15-5.25 GHz, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band.

For an indoor access point operating in the band 5.15-5.25 GHz, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band.

For mobile and portable client devices in the 5.15-5.25 GHz band, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band.

For the 5.15-5.25 GHz The e.i.r.p. spectral density shall not exceed 10 dBm in any 1.0 MHz band.

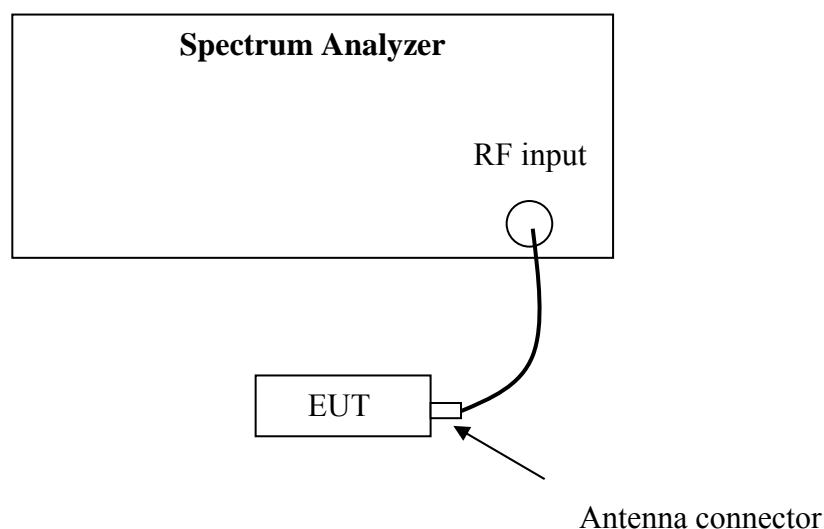
For the 5.25-5.35 GHz and 5.47-5.725 GHz bands, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band.

For the band 5.725-5.85 GHz, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band.

If the transmitting antenna of directional gain greater than 6dBi is used, the PSD shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

If there have a beamforming type, the limit should be the less of original and original + 6 – antenna gain-beamforming gain.

5.2 Test Configuration



5.3 Test procedure and test setup

The power spectral density per FCC §15.407(a) was measured from the antenna port of the EUT using a 50 ohm spectrum analyzer with the resolution bandwidth set at 1MHz, the video bandwidth set at 3 MHz (measurement method refer to KDB 789033D02 v01r02: section F).

Power spectral density was read directly and cable loss correction was added to the reading to obtain power at the EUT antenna terminals.

5.4 Test Protocol

Temperature : 25 °C
 Relative Humidity : 55 %

PSD limit calculation for mode 6 (2.0dBi antenna):

Mode	Frequency (MHz)	Chosen limit (dBm)	Antenna value (dBi)	Final limit (dBm)
U-NII-2 Band				
802.11a	5260	11.00	6.77	10.23
	5300	11.00	6.77	10.23
	5320	11.00	6.77	10.23
802.11n20	5260	11.00	6.70	10.30
	5300	11.00	6.70	10.30
	5320	11.00	6.70	10.30
802.11n40	5270	11.00	6.70	10.30
	5310	11.00	6.70	10.30
802.11ac80	5290	11.00	6.70	10.30
U-NII-3 Band				
802.11a	5500	11.00	6.77	10.23
	5600	11.00	6.77	10.23
	5720	11.00	6.77	10.23
802.11n20	5500	11.00	6.70	10.30
	5600	11.00	6.70	10.30
	5720	11.00	6.70	10.30
802.11n40	5510	11.00	6.70	10.30
	5590	11.00	6.70	10.30
	5710	11.00	6.70	10.30
802.11ac80	5530	11.00	6.70	10.30
	5610	11.00	6.70	10.30
	5690	11.00	6.70	10.30
Note: 1. Antenna value = Antenna gain + beamforming if applied; 2. For 802.11 a mode, the CDD Array Gain= 4.77dBi; 3. Final limit is calculated as Chosen limit – Antenna value exceeding 6dBi.				

PSD limit calculation for mode 17 (14.0dBi antenna):

Mode	Frequency (MHz)	Chosen limit (dBm)	Antenna value (dBi)	Final limit (dBm)
U-NII-2 Band				
802.11a	5260	11.00	18.77	-1.77
	5300	11.00	18.77	-1.77
	5320	11.00	18.77	-1.77
802.11n20	5260	11.00	17.00	0.00
	5300	11.00	17.00	0.00
	5320	11.00	17.00	0.00
802.11n40	5270	11.00	17.00	0.00
	5310	11.00	17.00	0.00
802.11ac80	5290	11.00	17.00	0.00
U-NII-3 Band				
802.11a	5500	11.00	18.77	-1.77
	5600	11.00	18.77	-1.77
	5720	11.00	18.77	-1.77
802.11n20	5500	11.00	17.00	0.00
	5600	11.00	17.00	0.00
	5720	11.00	17.00	0.00
802.11n40	5510	11.00	17.00	0.00
	5590	11.00	17.00	0.00
	5710	11.00	17.00	0.00
802.11ac80	5530	11.00	17.00	0.00
	5610	11.00	17.00	0.00
	5690	11.00	17.00	0.00
<p>Note: 1. Antenna value = Antenna gain + beamforming if applied; 2. For 802.11 a mode, the CDD Array Gain= 4.77dBi; 3. Final limit is calculated as Chosen limit – Antenna value exceeding 6dBi.</p>				

PSD results for mode 6 (2.0dBi antenna):

PSD	Frequency (MHz)	PSD (dBm/MHz)			Duty cycle factor	Total PSD (dBm/MHz)	Limit (dBm/MHz)	Margin (dB)
		Port 0	Port 1	Port 2				
802.11a	5260	4.694	4.701	4.515	0.23	9.64	10.23	0.59
	5300	4.872	5.258	3.960	0.23	9.73	10.23	0.50
	5320	4.903	5.032	4.177	0.23	9.72	10.23	0.51
802.11n20	5260	4.744	4.430	4.241	0.56	9.81	10.30	0.49
	5300	4.797	4.260	4.214	0.56	9.77	10.30	0.53
	5320	5.231	5.169	3.108	0.56	9.94	10.30	0.36
802.11n40	5270	3.315	3.029	4.538	1.04	9.49	10.30	0.81
	5310	3.548	3.187	4.253	1.04	9.49	10.30	0.81
802.11ac80	5290	4.923	4.880	4.476	0.54	10.08	10.30	0.22

PSD	Frequency (MHz)	PSD (dBm/MHz)			Duty cycle factor	Total PSD (dBm/MHz)	Limit (dBm/MHz)	Margin (dB)
		Port 0	Port 1	Port 2				
802.11a	5500	5.273	4.298	3.223	0.23	9.35	10.23	0.88
	5600	5.593	5.016	3.514	0.23	9.79	10.23	0.44
	5720	5.267	4.663	4.023	0.23	9.68	10.23	0.55
802.11n20	5500	5.663	4.538	3.631	0.56	10.02	10.30	0.28
	5600	5.488	4.691	3.249	0.56	9.91	10.30	0.39
	5720	4.247	3.598	3.438	0.56	9.11	10.30	1.19
802.11n40	5510	3.936	3.236	4.761	1.04	9.83	10.30	0.47
	5590	3.942	4.740	4.535	1.04	10.23	10.30	0.07
	5710	4.733	3.318	4.286	1.04	9.96	10.30	0.34
802.11ac80	5530	4.679	3.638	4.793	0.54	9.71	10.30	0.59
	5610	4.920	4.252	4.079	0.54	9.74	10.30	0.56
	5690	5.024	4.482	4.244	0.54	9.91	10.30	0.39

Note: Total PSD= 10 * log (10port 0 / 10 + 10port 1 / 10 + 10port 2 / 10) + Duty cycle factor

PSD results for mode 17 (14.0dBi antenna):

PSD	Frequency (MHz)	PSD (dBm/MHz)			Duty cycle factor	Total PSD (dBm/MHz)	Limit (dBm/MHz)	Margin (dB)
		Port 0	Port 1	Port 2				
802.11a	5260	-7.379	-8.538	-7.253	0.23	-2.69	-1.77	0.92
	5300	-6.583	-7.736	-7.528	0.23	-2.25	-1.77	0.48
	5320	-7.637	-7.130	-7.673	0.23	-2.47	-1.77	0.70
802.11n20	5260	-5.882	-6.651	-6.735	0.56	-1.07	0.00	1.07
	5300	-5.152	-5.806	-5.214	0.56	-0.05	0.00	0.05
	5320	-5.326	-5.966	-5.802	0.56	-0.36	0.00	0.36
802.11n40	5270	-6.621	-8.609	-5.084	1.04	-0.73	0.00	0.73
	5310	-5.558	-8.164	-5.657	1.04	-0.50	0.00	0.50
802.11ac80	5290	-8.012	-8.284	-8.751	0.54	-3.03	0.00	3.03

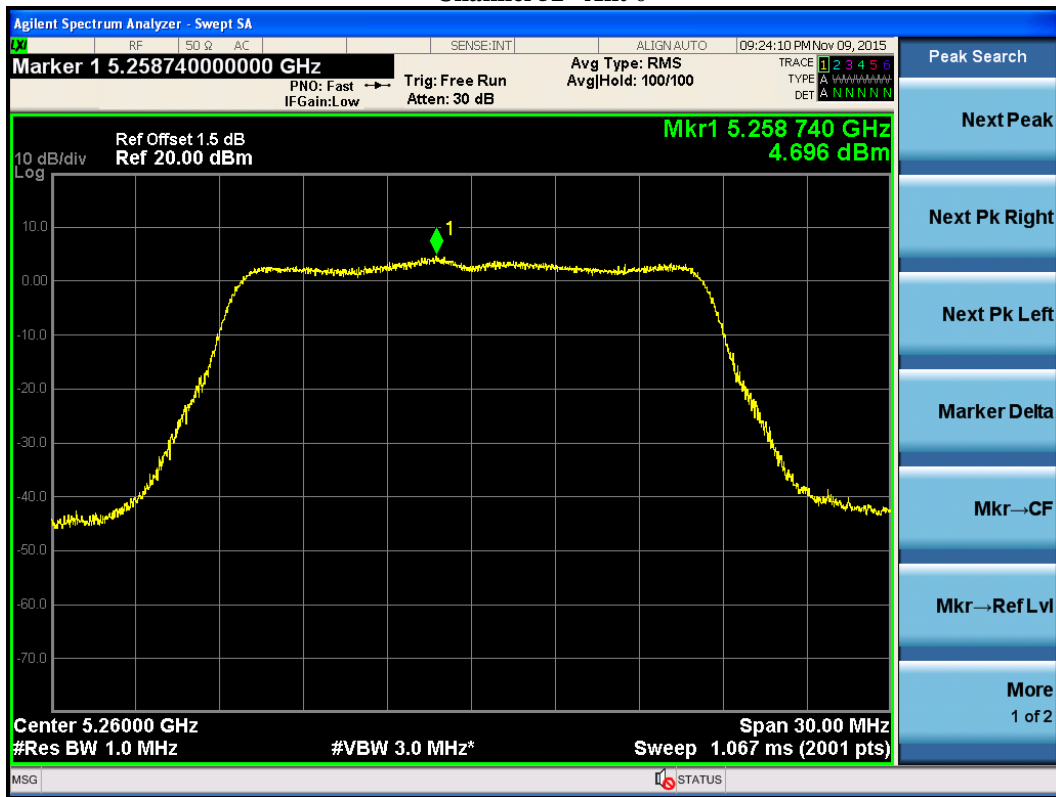
PSD	Frequency (MHz)	PSD (dBm/MHz)			Duty cycle factor	Total PSD (dBm/MHz)	Limit (dBm/MHz)	Margin (dB)
		Port 0	Port 1	Port 2				
802.11a	5500	-6.995	-7.950	-8.002	0.23	-2.62	-1.77	0.85
	5600	-7.504	-7.655	-7.560	0.23	-2.57	-1.77	0.80
	5720	-6.063	-6.985	-8.475	0.23	-2.06	-1.77	0.29
802.11n20	5500	-5.546	-5.626	-5.850	0.56	-0.34	0.00	0.34
	5600	-5.484	-5.343	-5.519	0.56	-0.11	0.00	0.11
	5720	-5.727	-5.578	-6.310	0.56	-0.53	0.00	0.53
802.11n40	5510	-5.162	-5.451	-7.895	1.04	-0.20	0.00	0.20
	5590	-5.892	-5.535	-8.784	1.04	-0.71	0.00	0.71
	5710	-5.597	-5.728	-8.015	1.04	-0.51	0.00	0.51
802.11ac80	5530	-5.866	-6.631	-7.583	0.54	-1.32	0.00	1.32
	5610	-6.437	-6.380	-7.583	0.54	-1.45	0.00	1.45
	5690	-5.039	-5.603	-6.665	0.54	-0.41	0.00	0.41

Note: Total PSD= 10 * log (10port 0 / 10 + 10port 1 / 10 + 10port 2 / 10) + Duty cycle factor

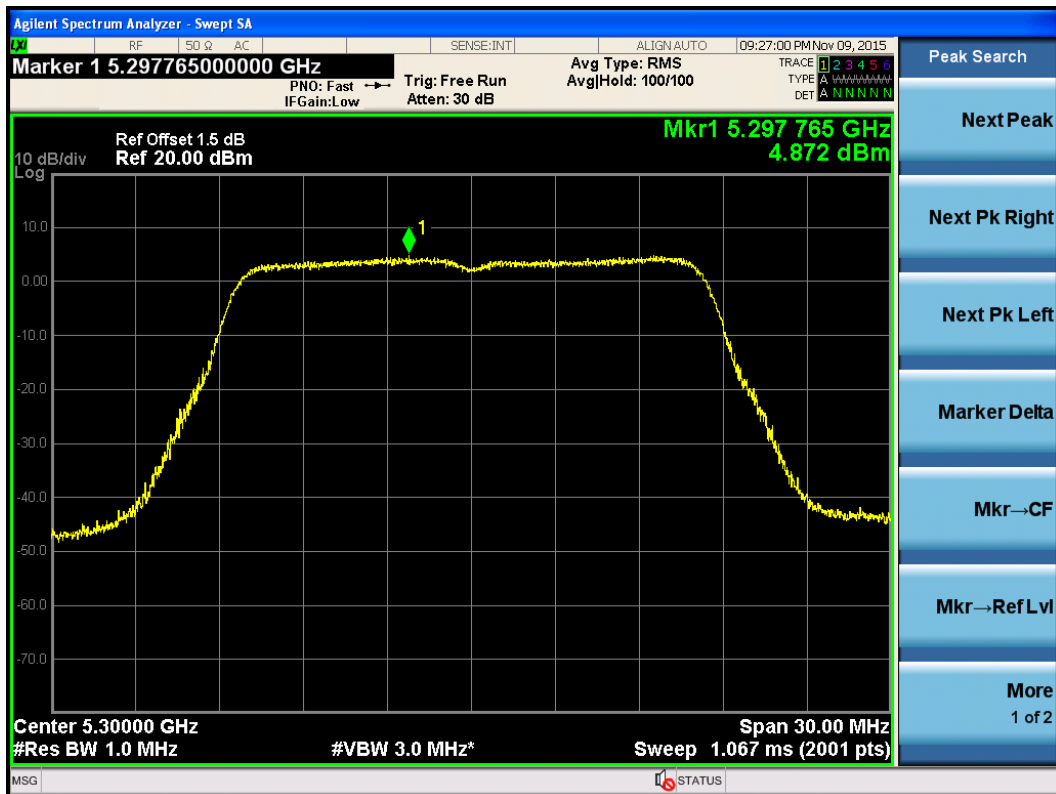
Test plots see below:

802.11a for mode 6 (2.0dBi antenna)

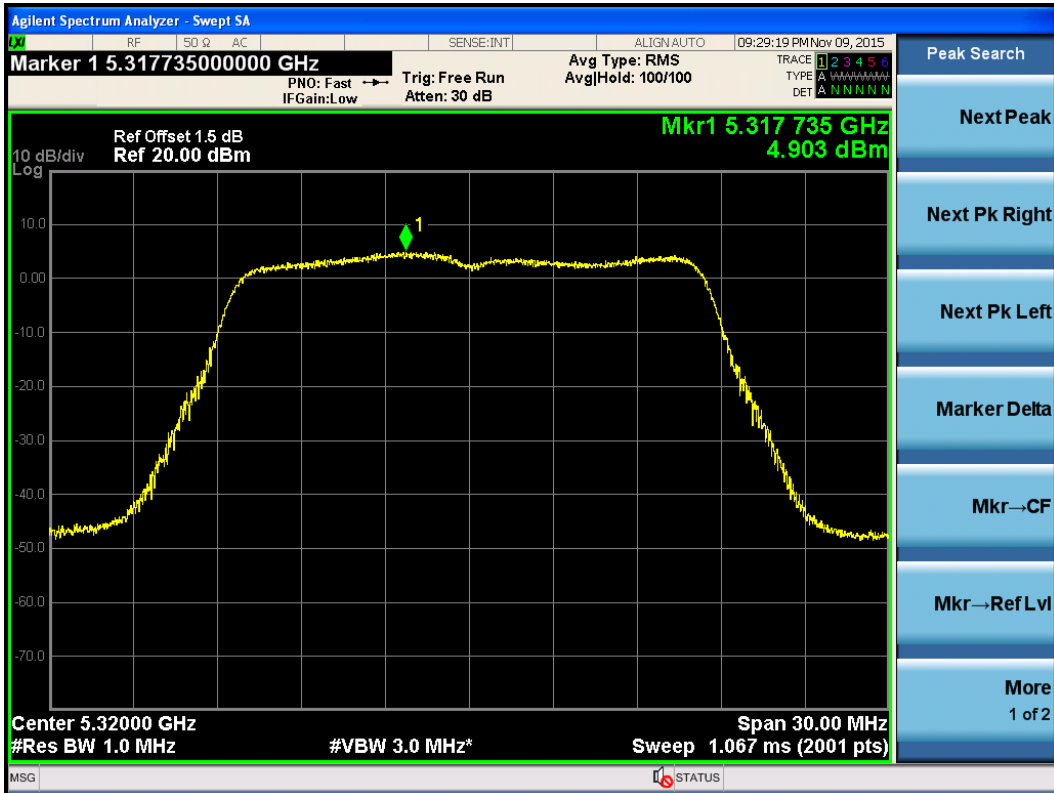
Channel 52- Ant 0



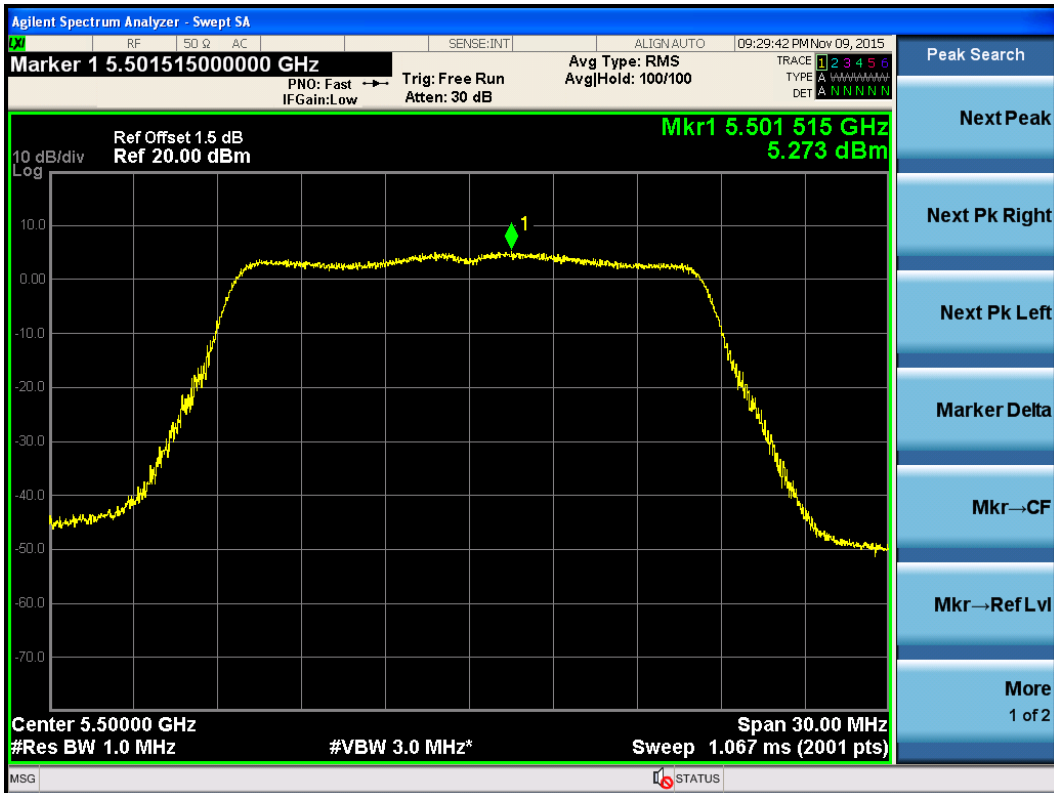
Channel 60- Ant 0



Channel 64- Ant 0



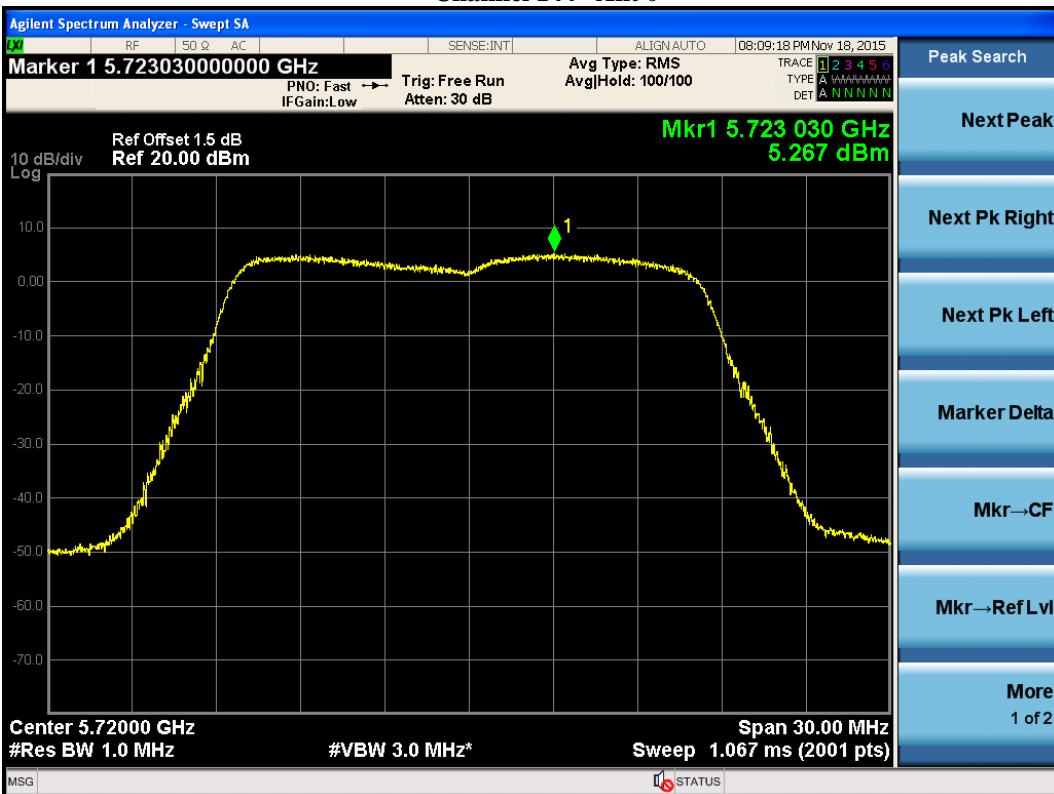
Channel 100- Ant 0



Channel 120- Ant 0



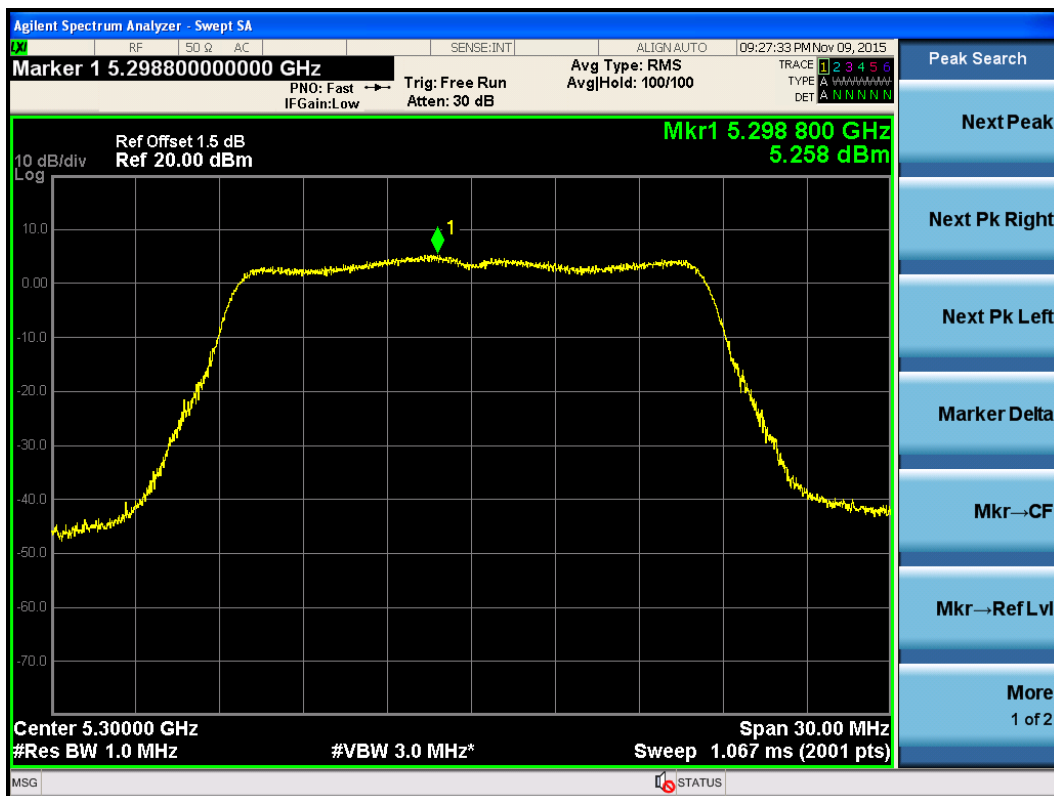
Channel 144- Ant 0



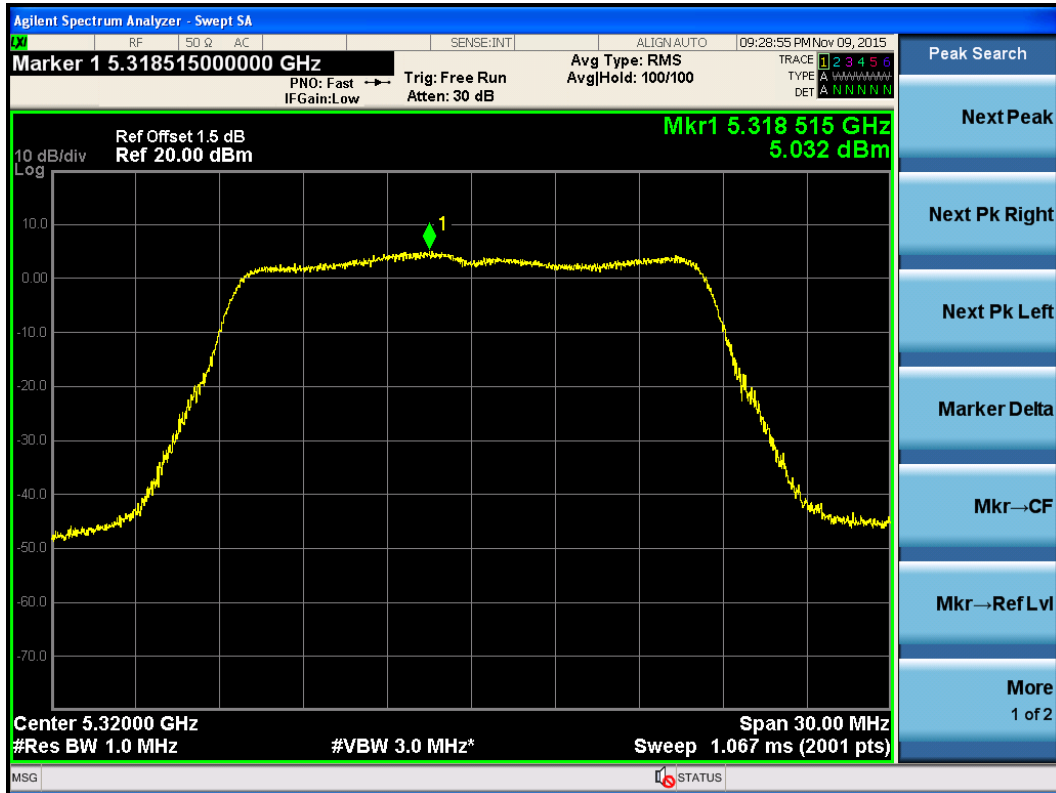
Channel 52- Ant 1



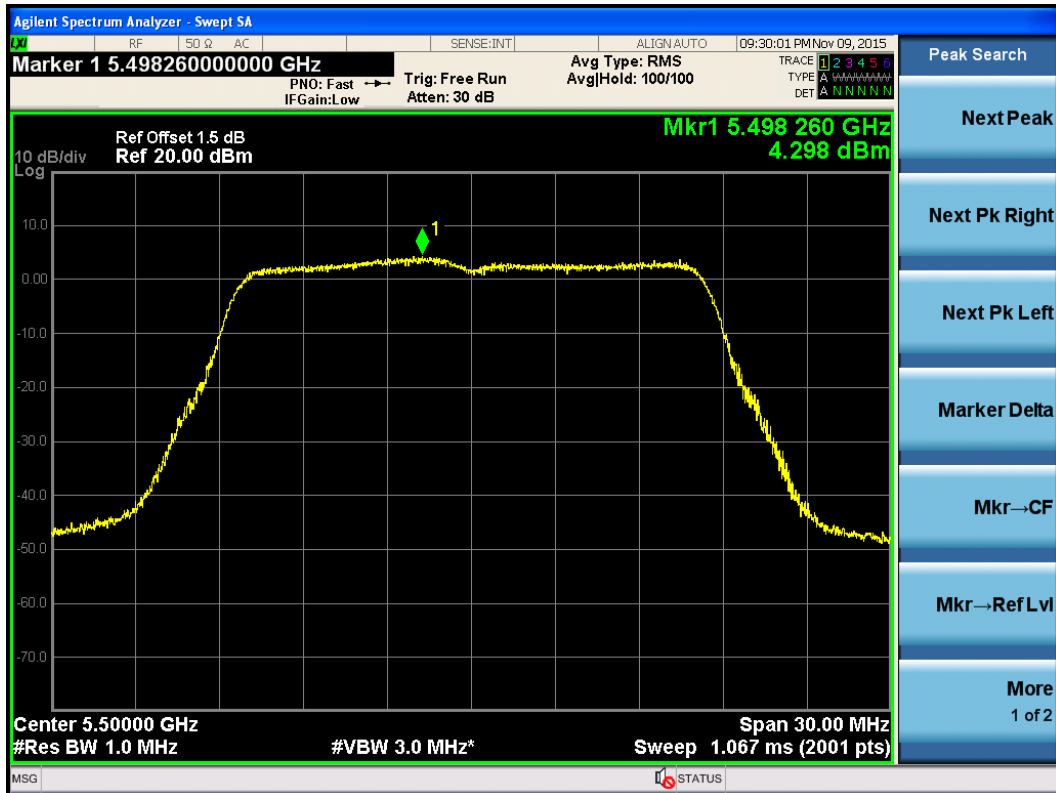
Channel 60- Ant 1



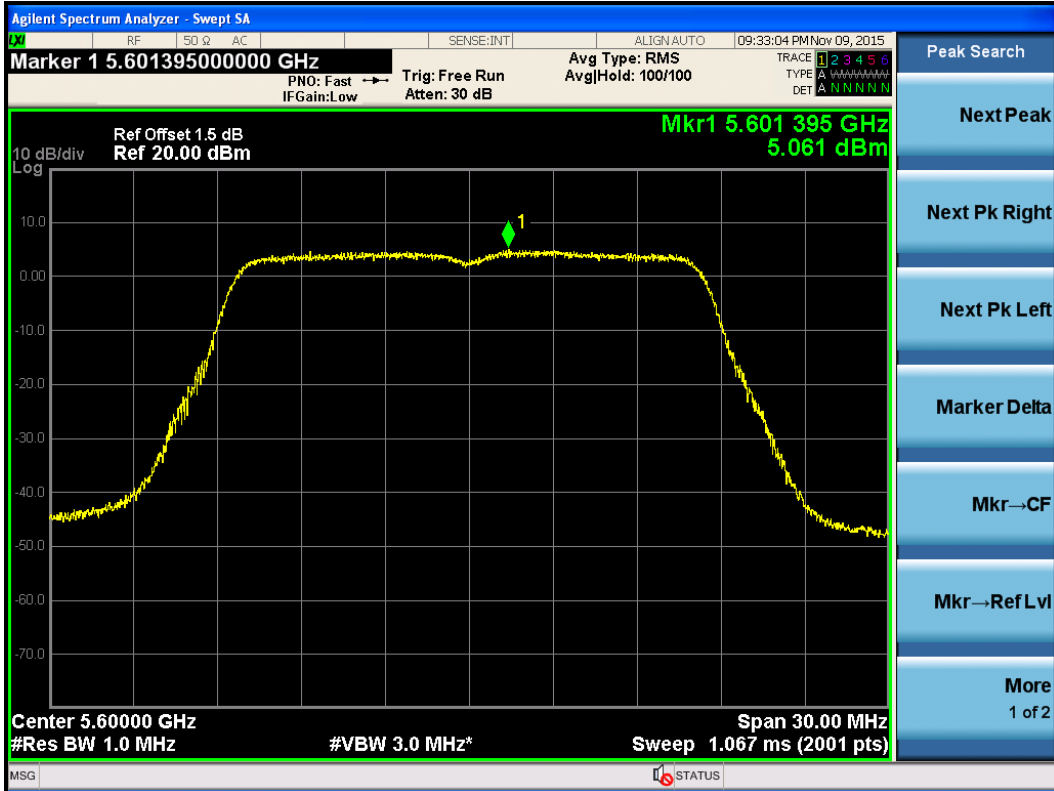
Channel 64- Ant 1



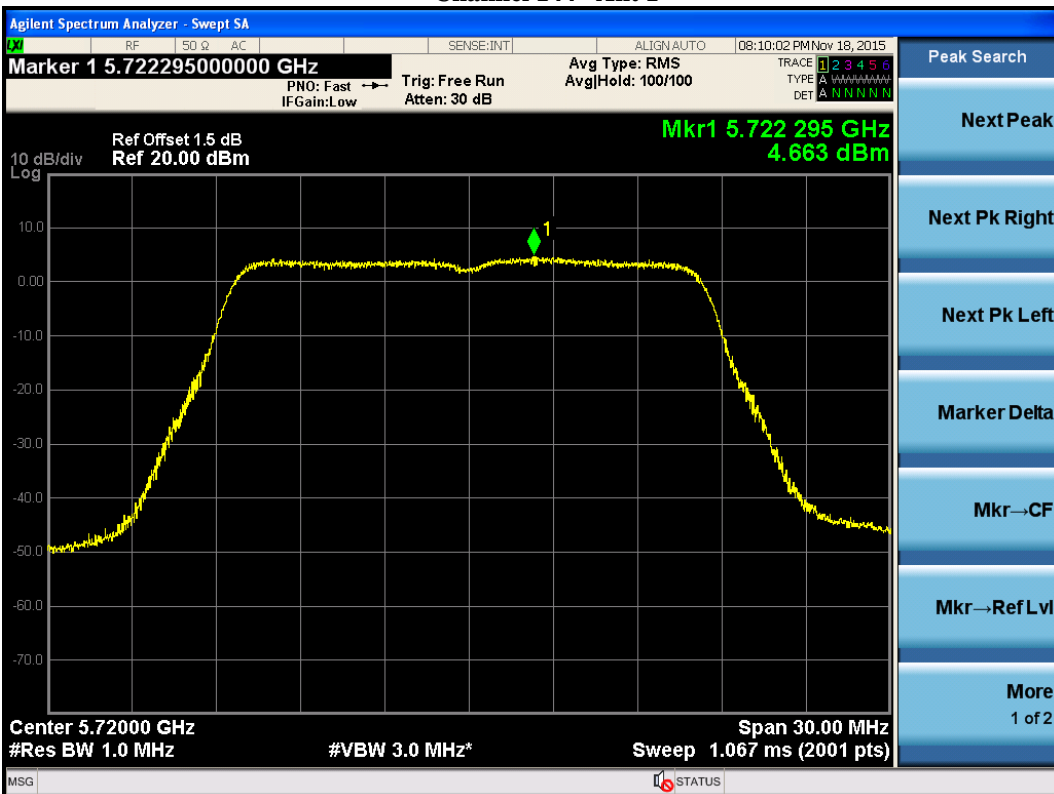
Channel 100- Ant 1



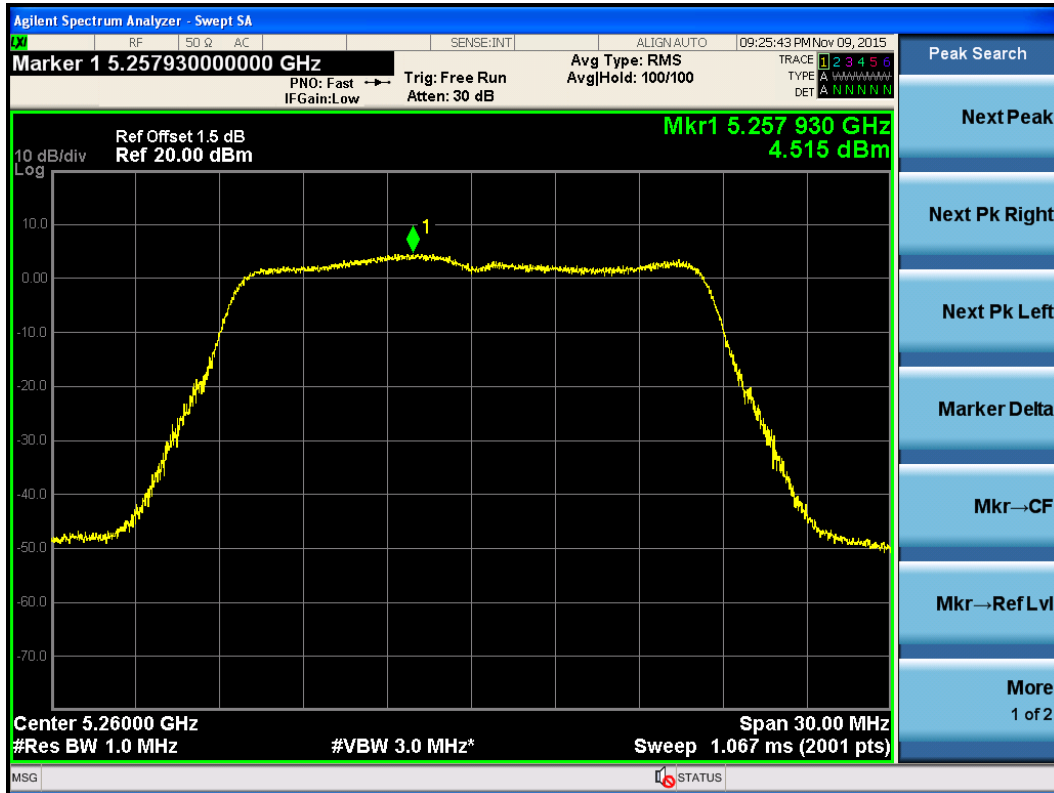
Channel 120- Ant 1



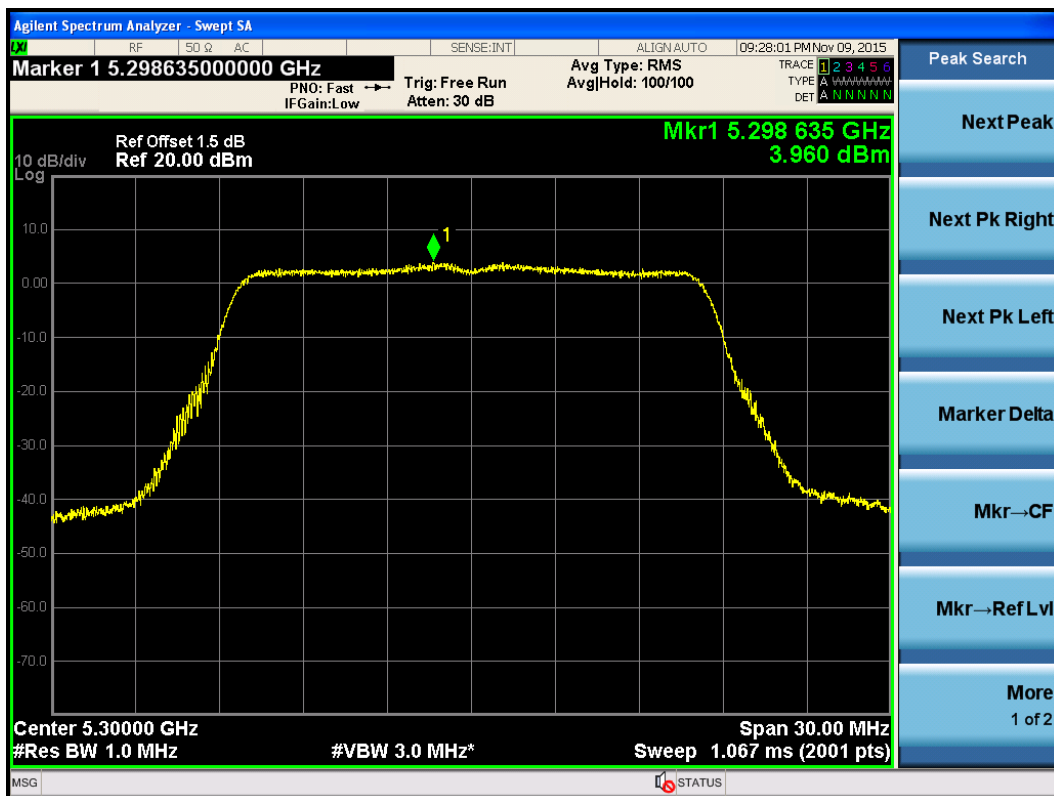
Channel 144- Ant 1



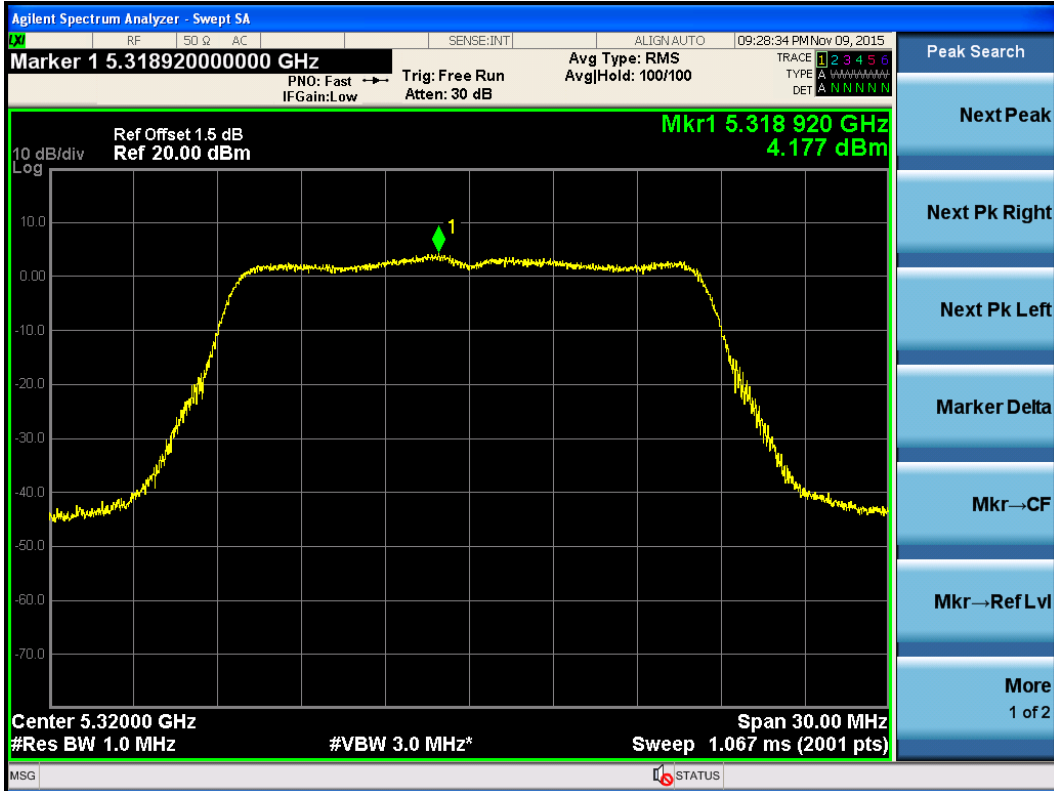
Channel 52- Ant 2



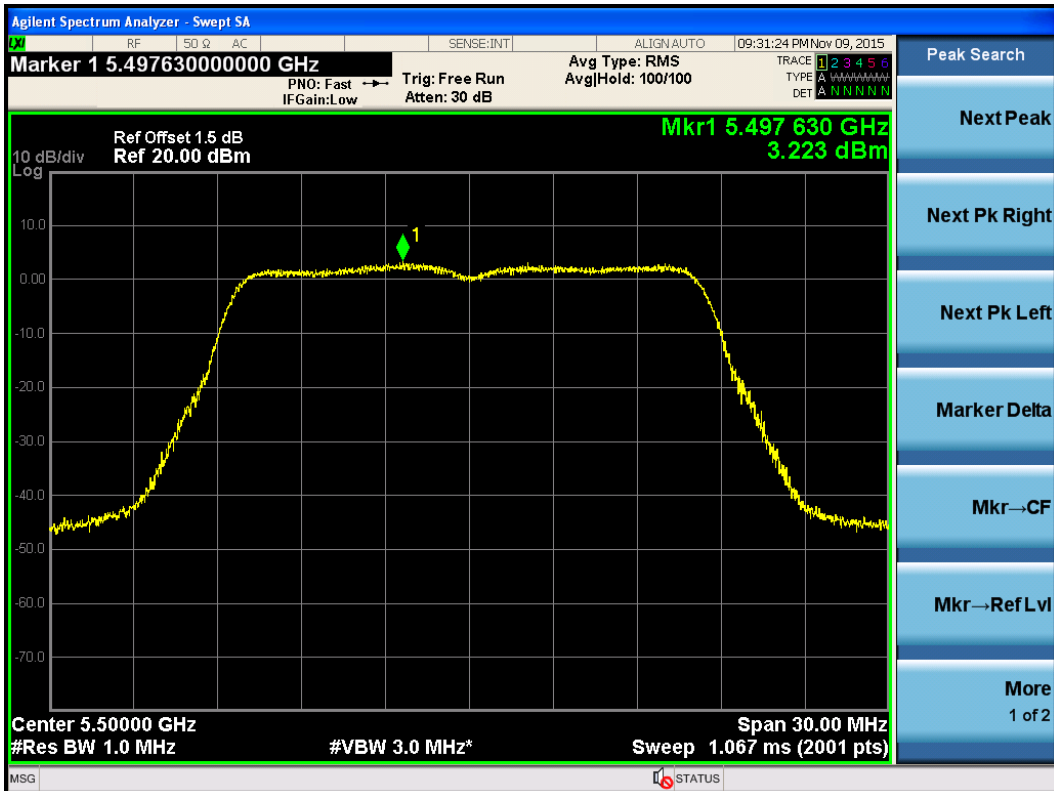
Channel 60- Ant 2



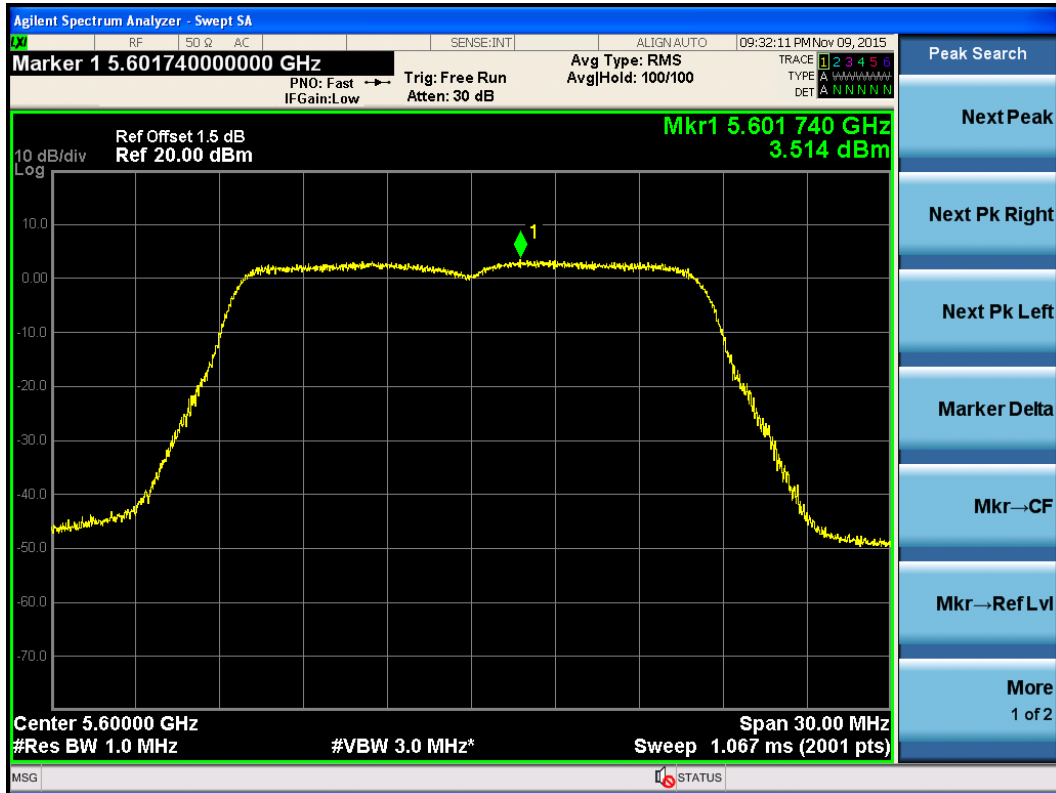
Channel 64- Ant 2



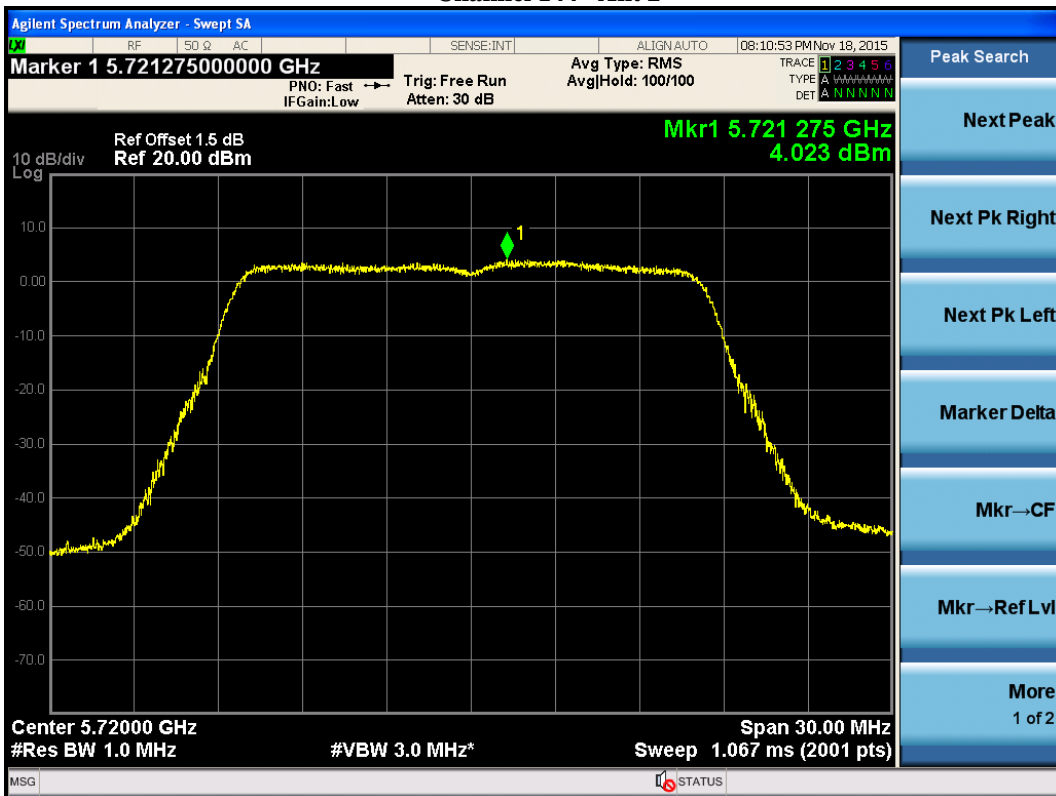
Channel 100- Ant 2



Channel 120- Ant 2

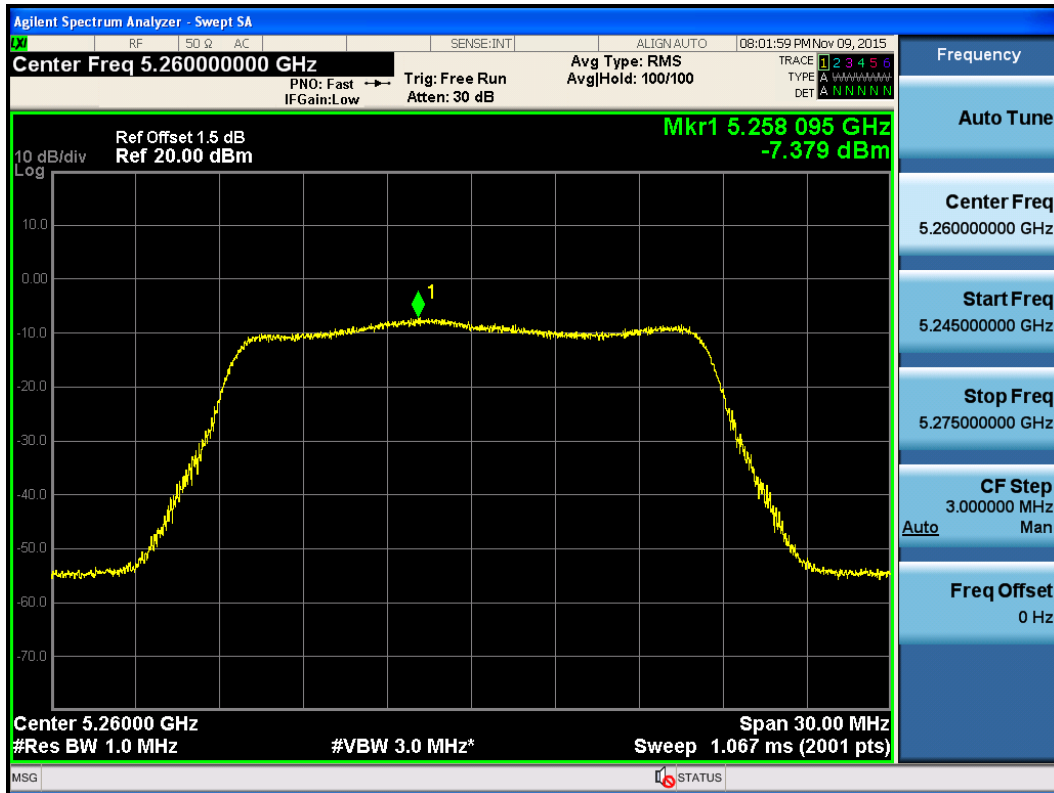


Channel 144- Ant 2

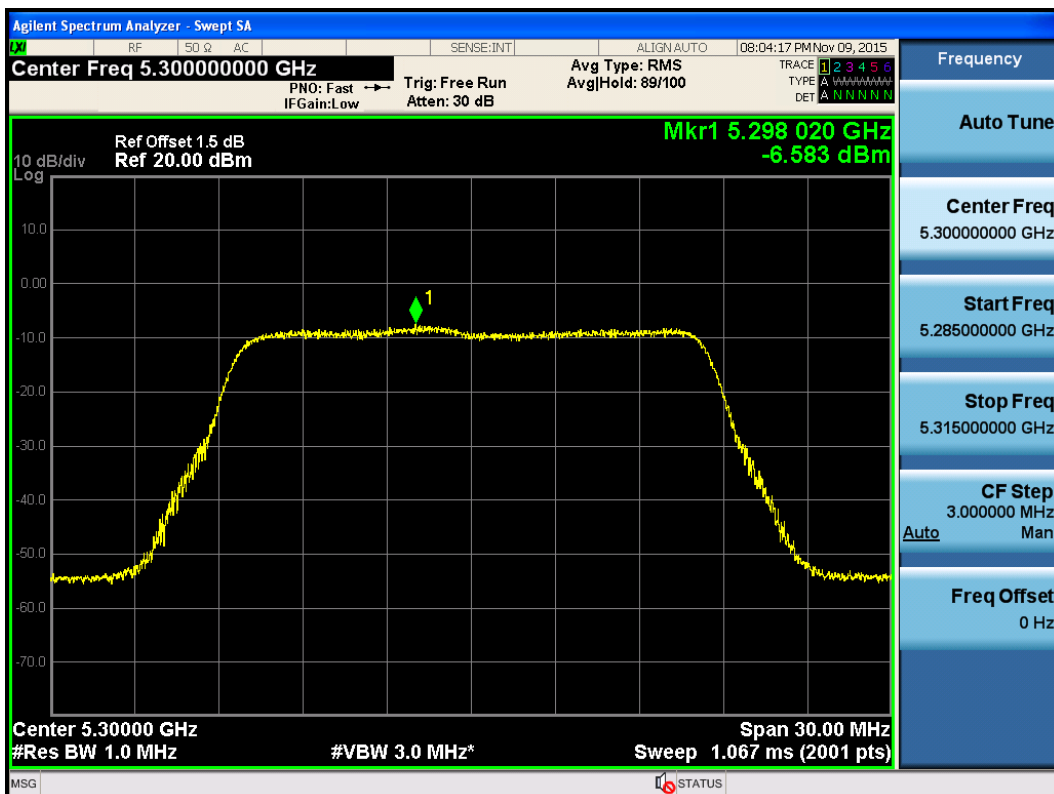


802.11a for mode 17 (14.0dBi antenna)

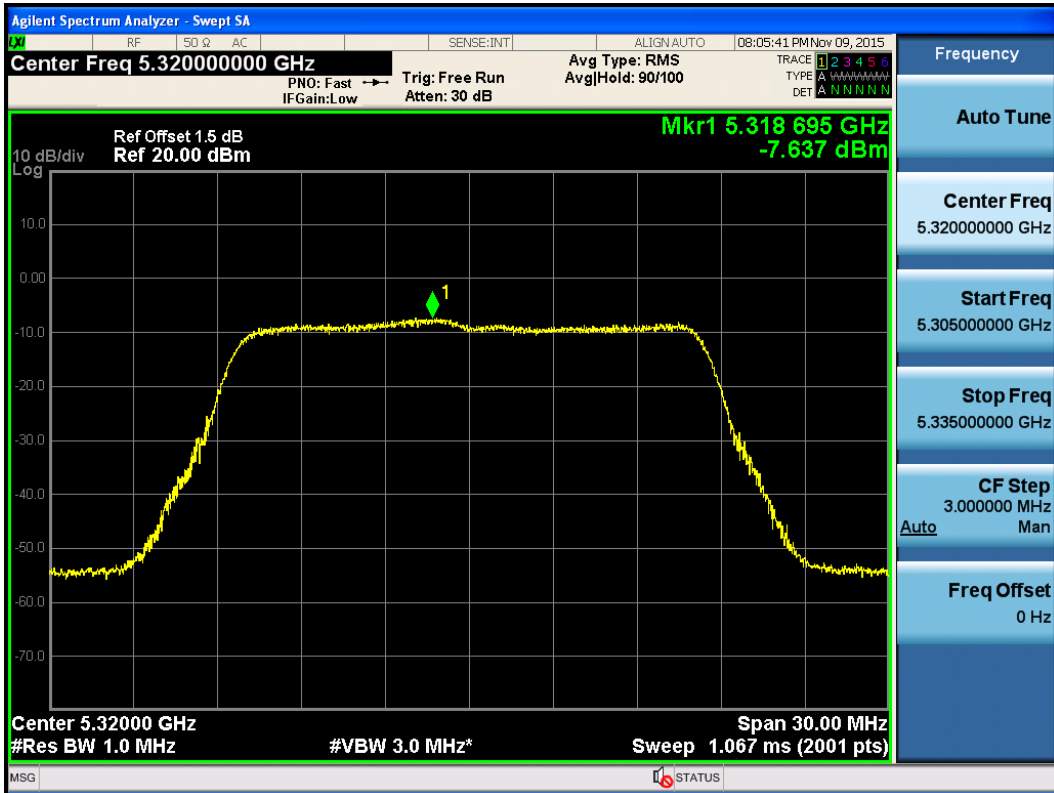
Channel 52- Ant 0



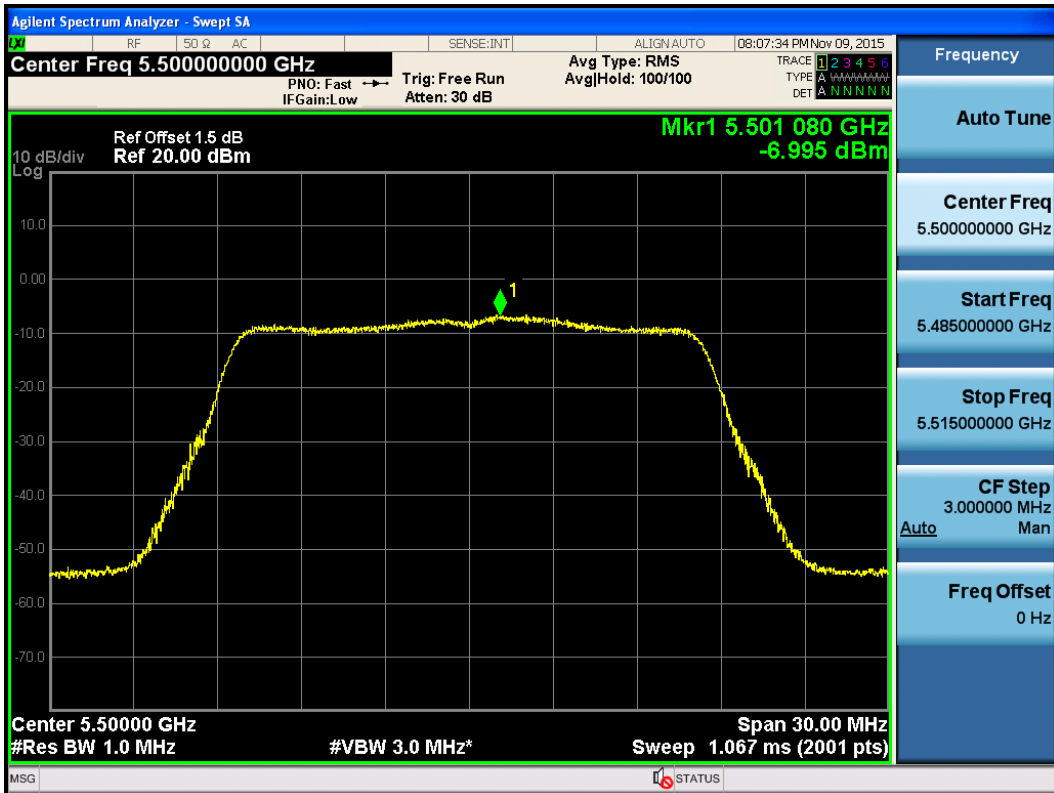
Channel 60- Ant 0



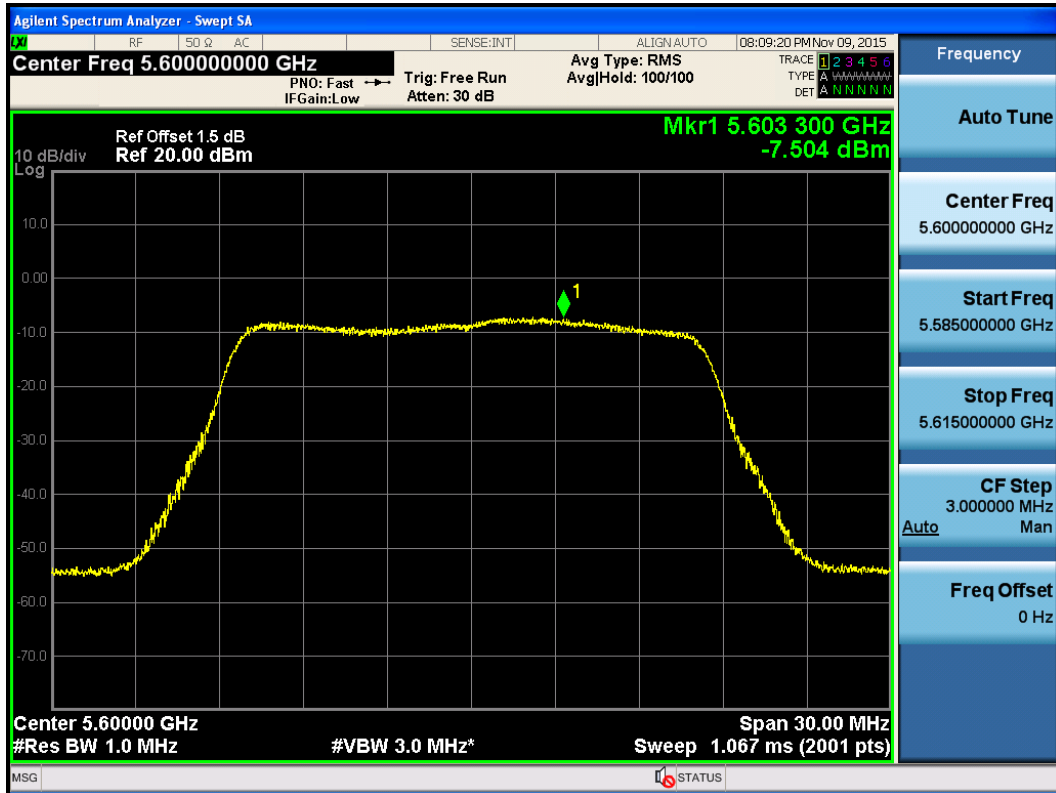
Channel 64- Ant 0



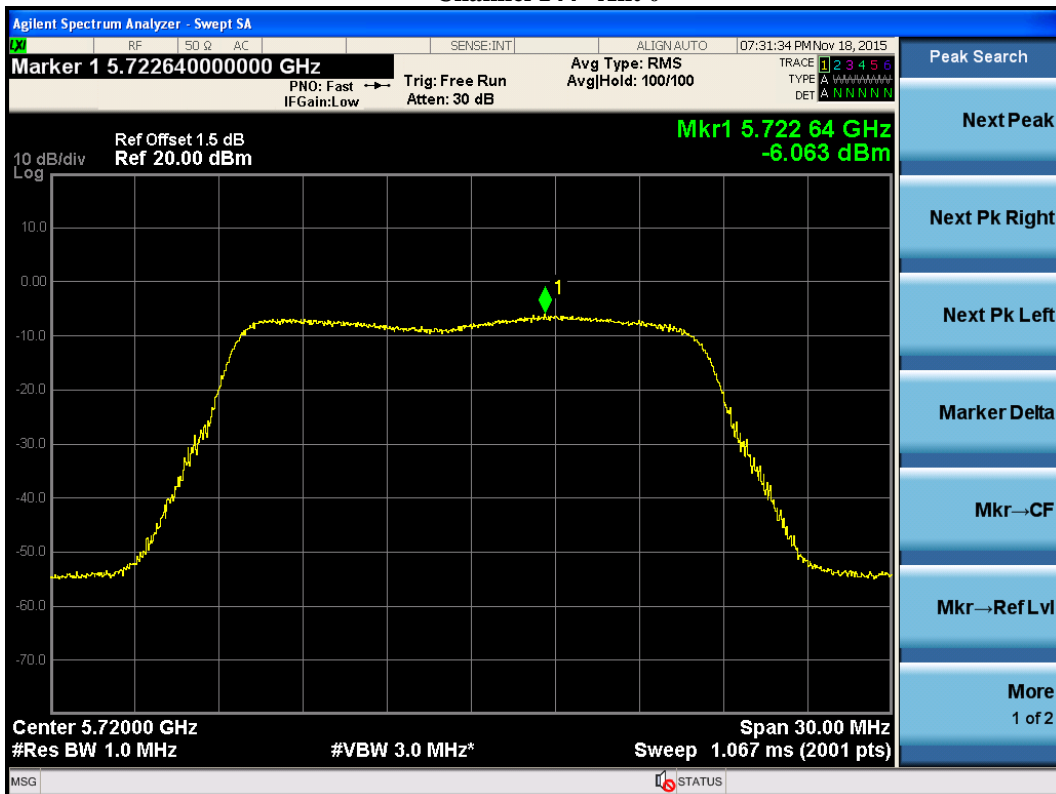
Channel 100- Ant 0



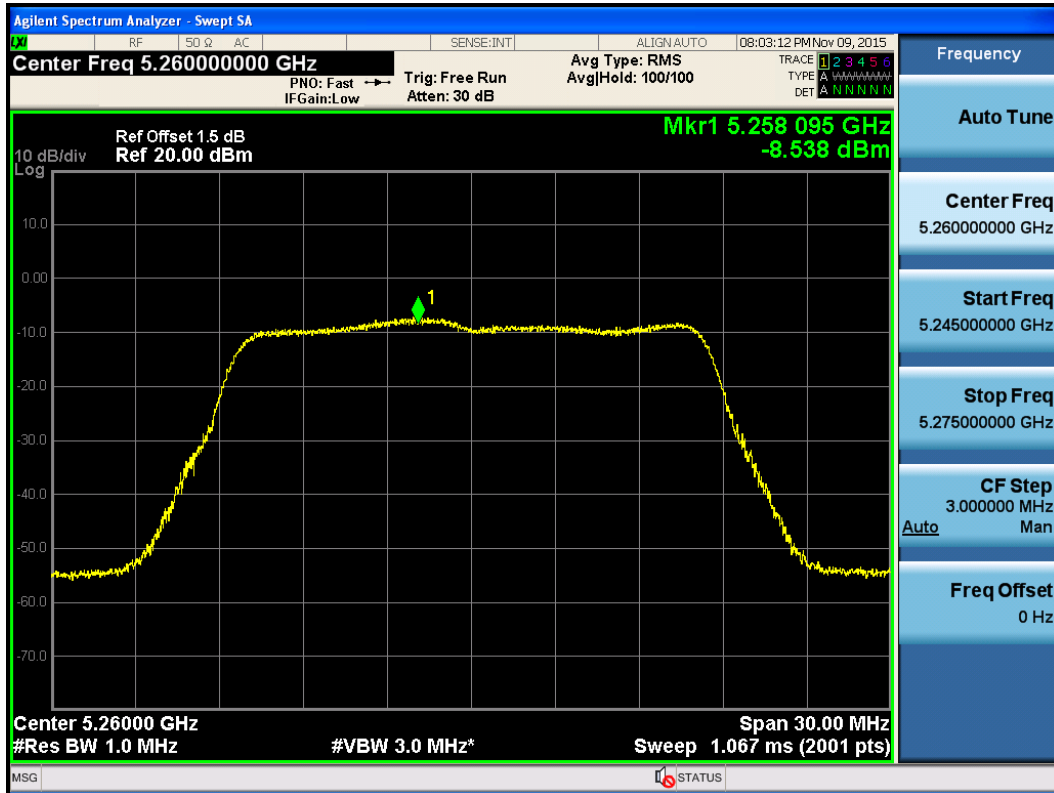
Channel 120- Ant 0



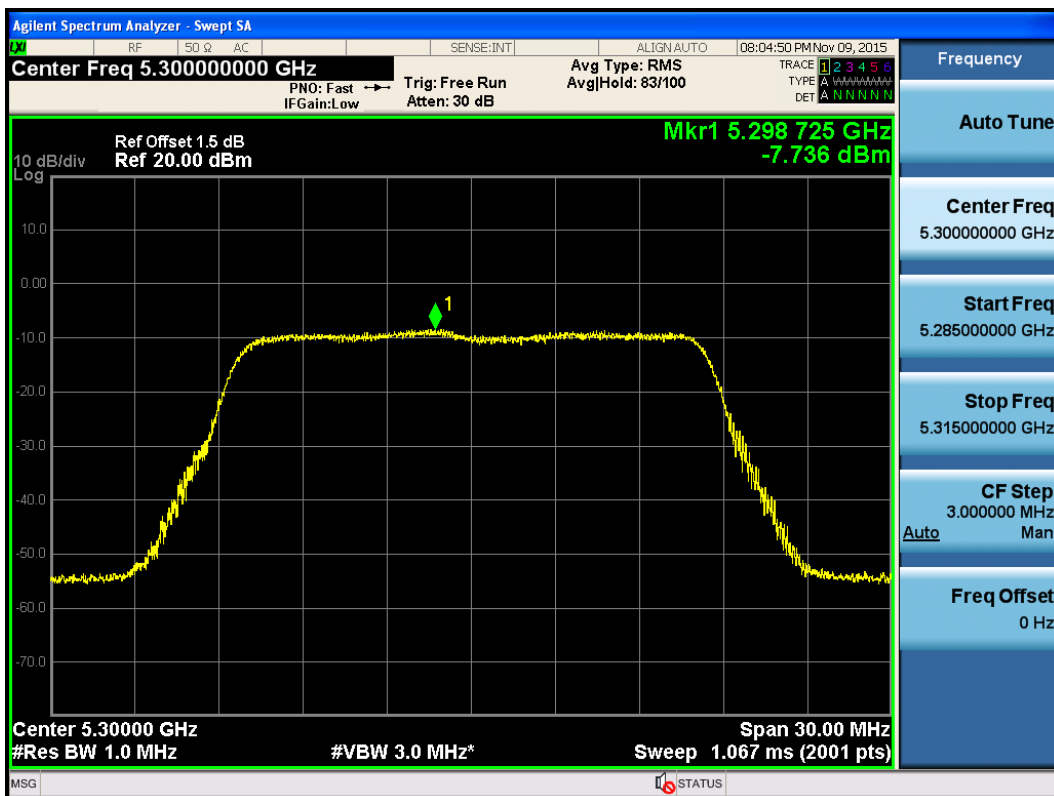
Channel 144- Ant 0



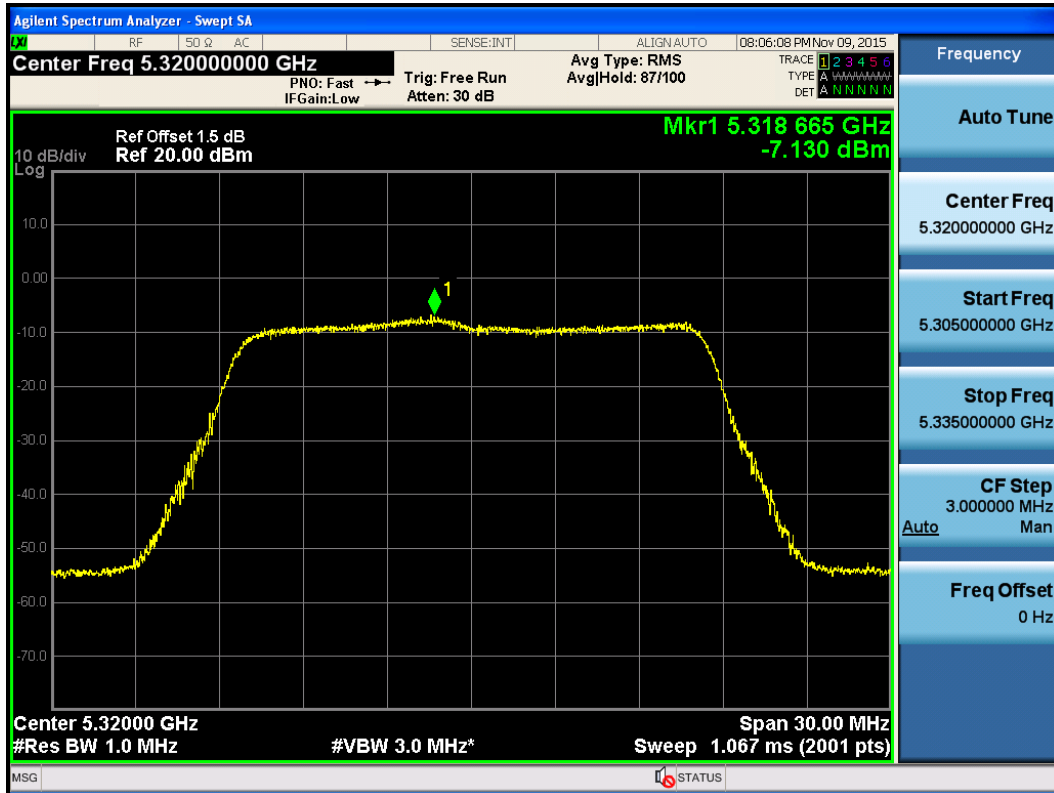
Channel 52- Ant 1



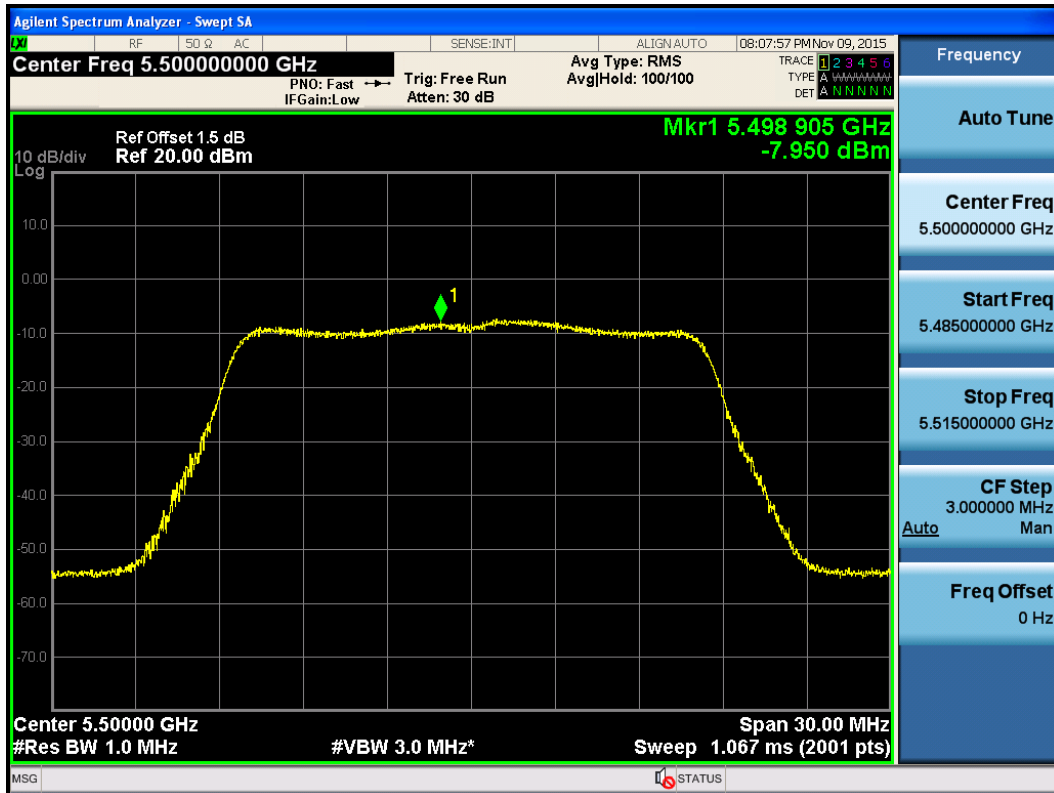
Channel 60- Ant 1



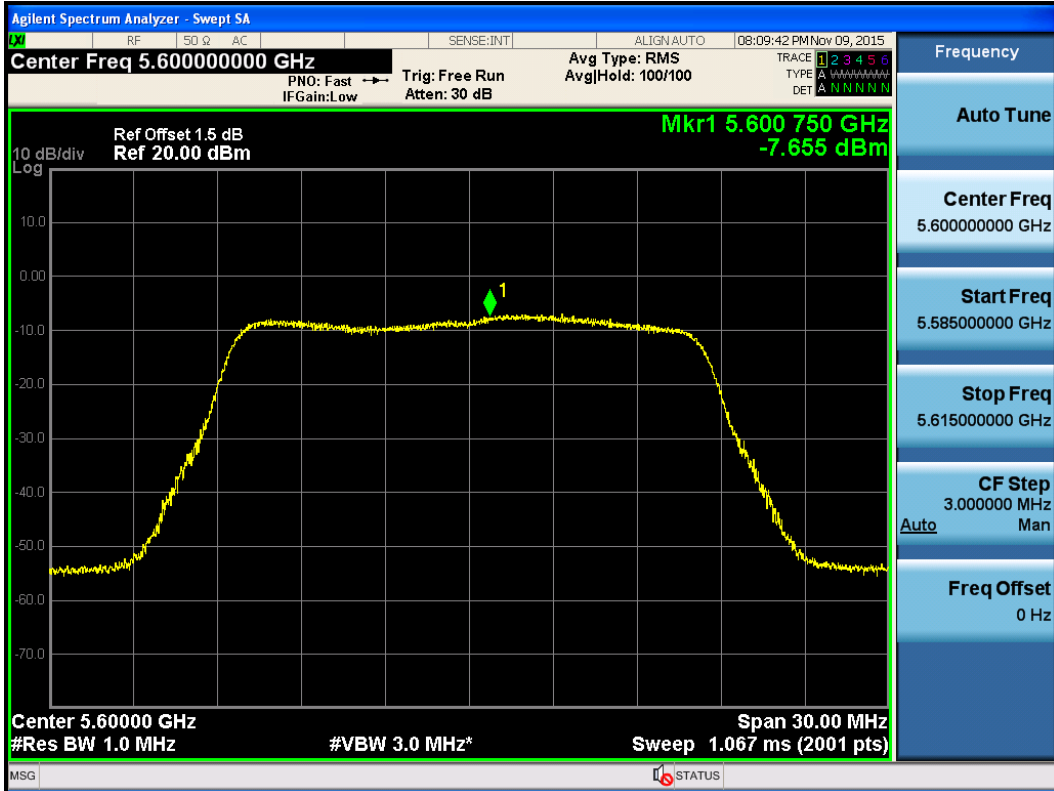
Channel 64- Ant 1



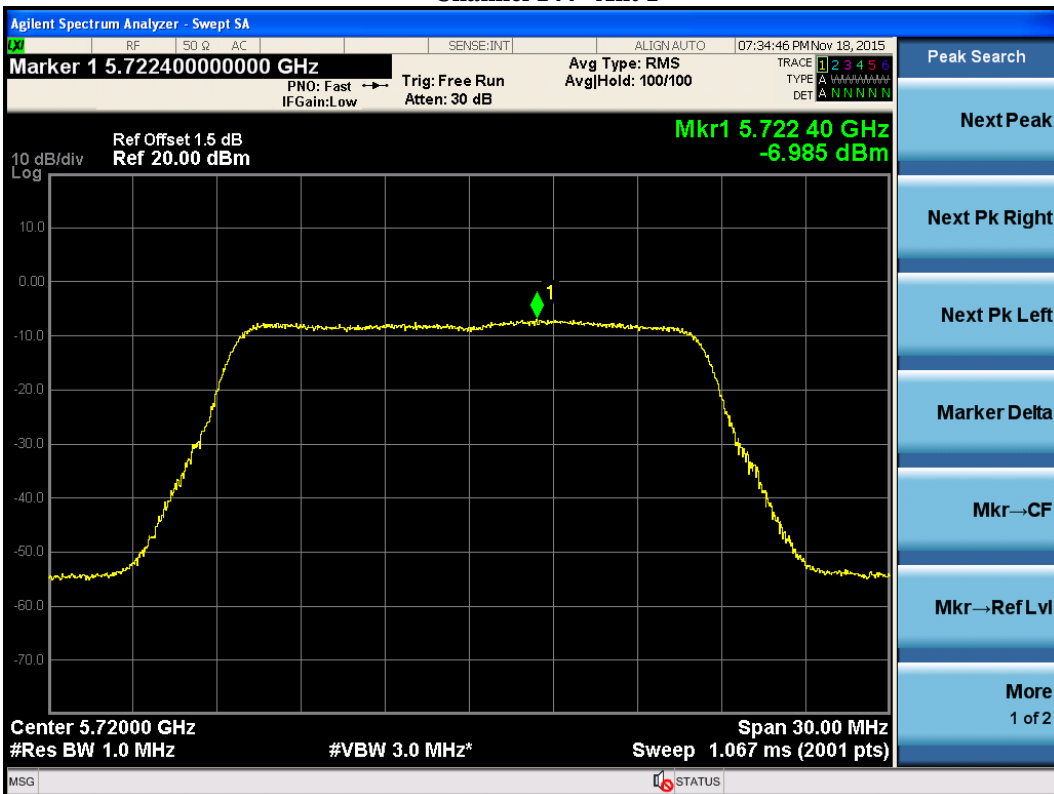
Channel 100- Ant 1



Channel 120- Ant 1



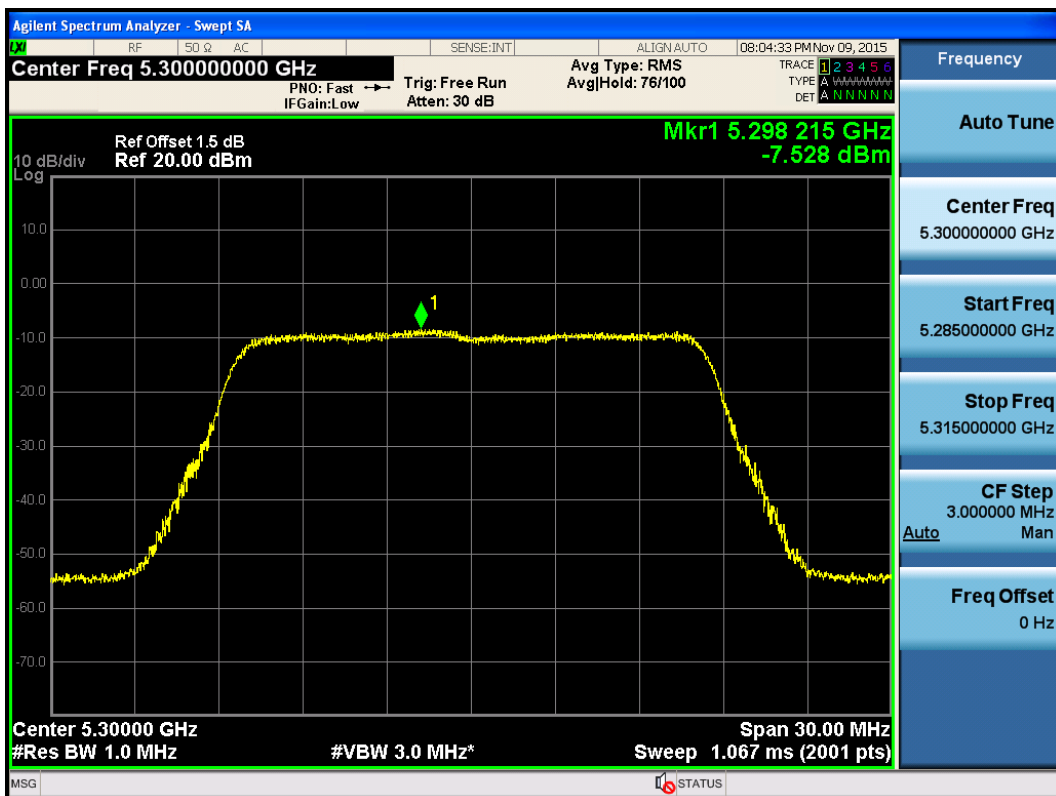
Channel 144- Ant 1



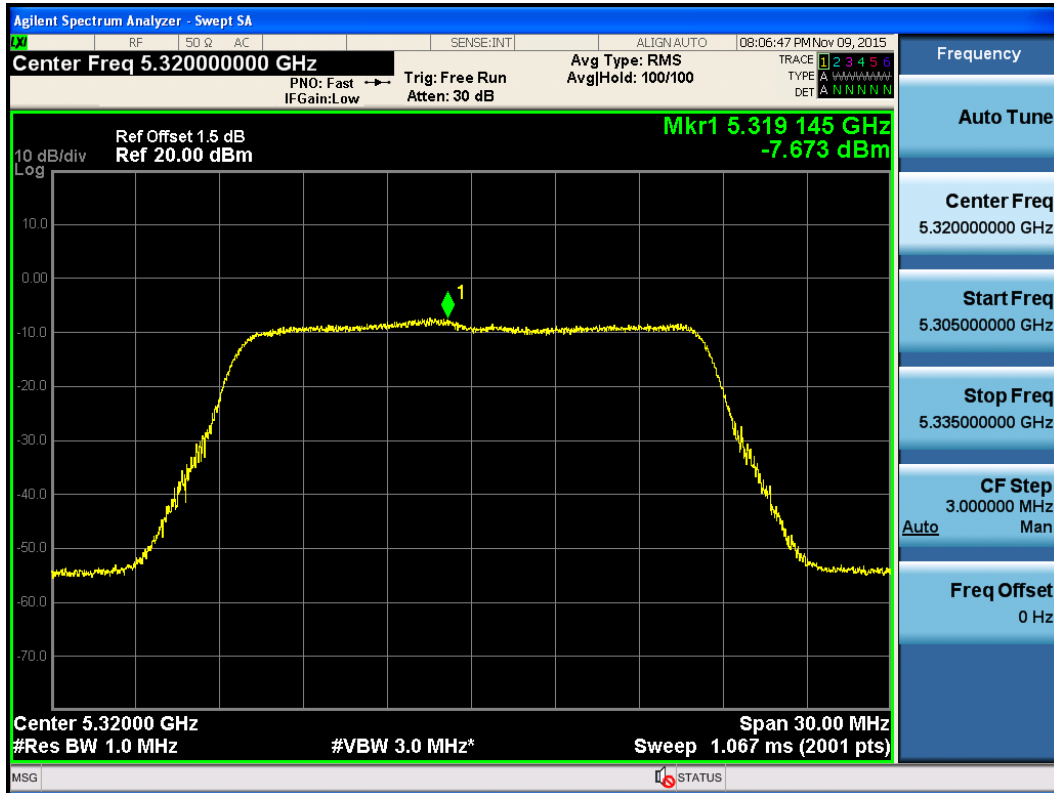
Channel 52- Ant 2



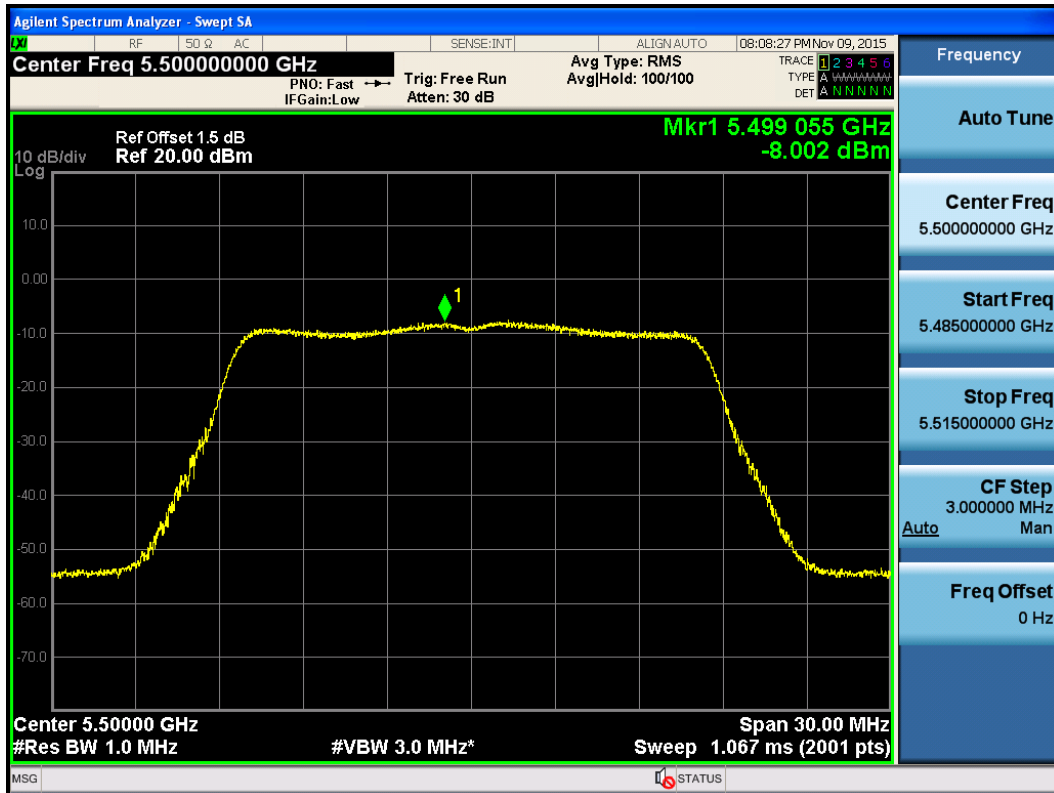
Channel 60- Ant 2



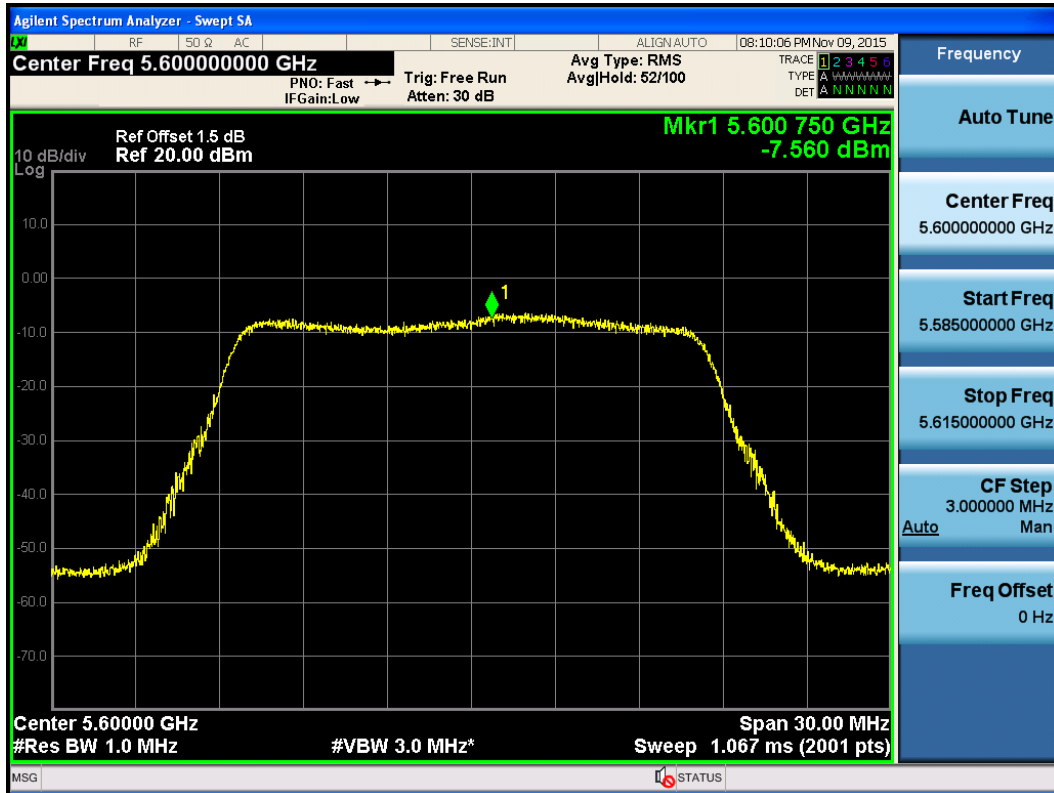
Channel 64- Ant 2



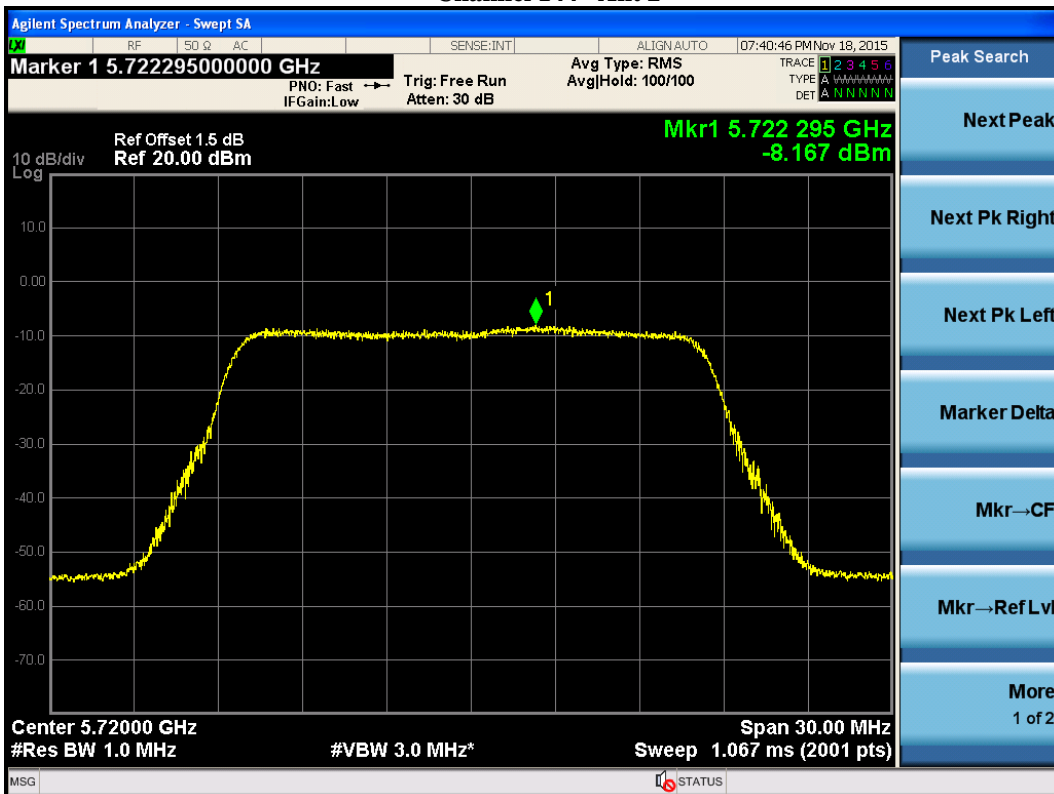
Channel 100- Ant 2



Channel 120- Ant 2

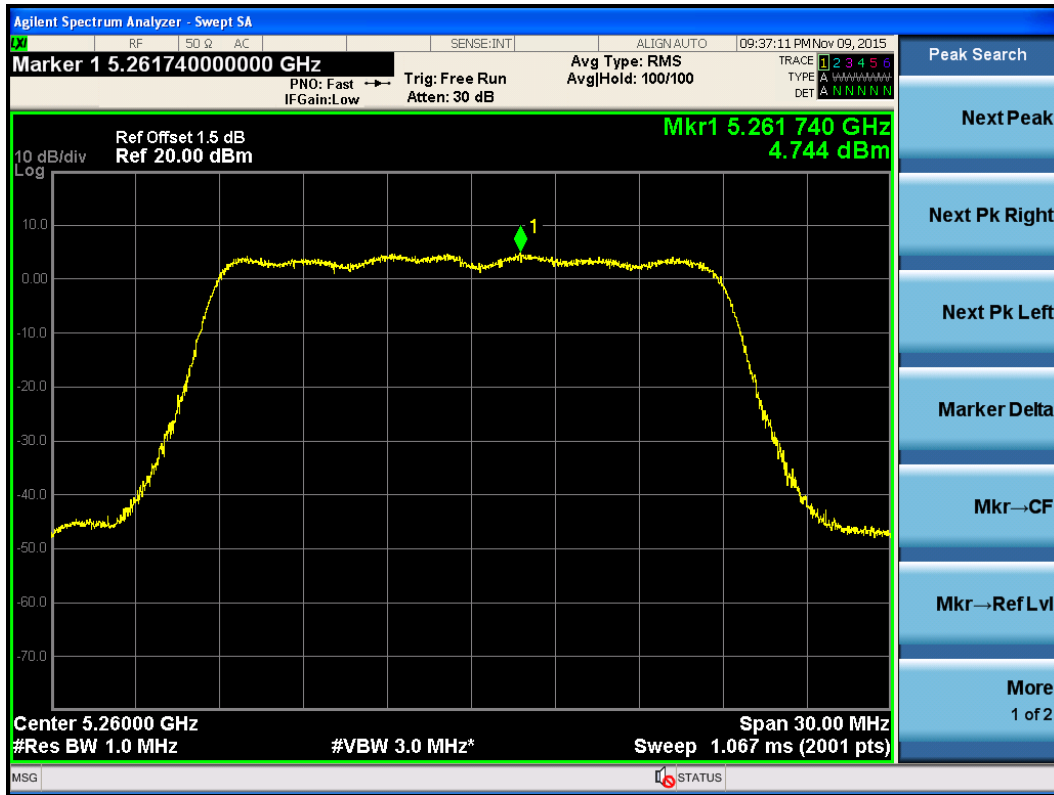


Channel 144- Ant 2

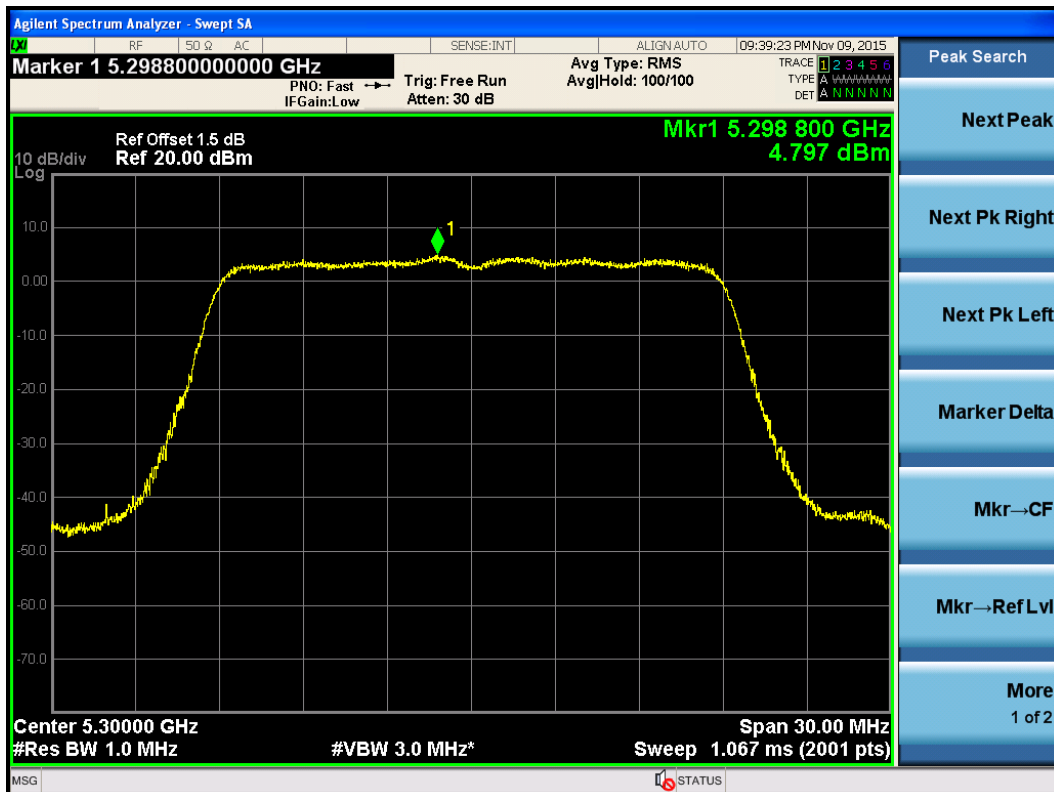


802.11n20 for mode 6 (2.0dBi antenna)

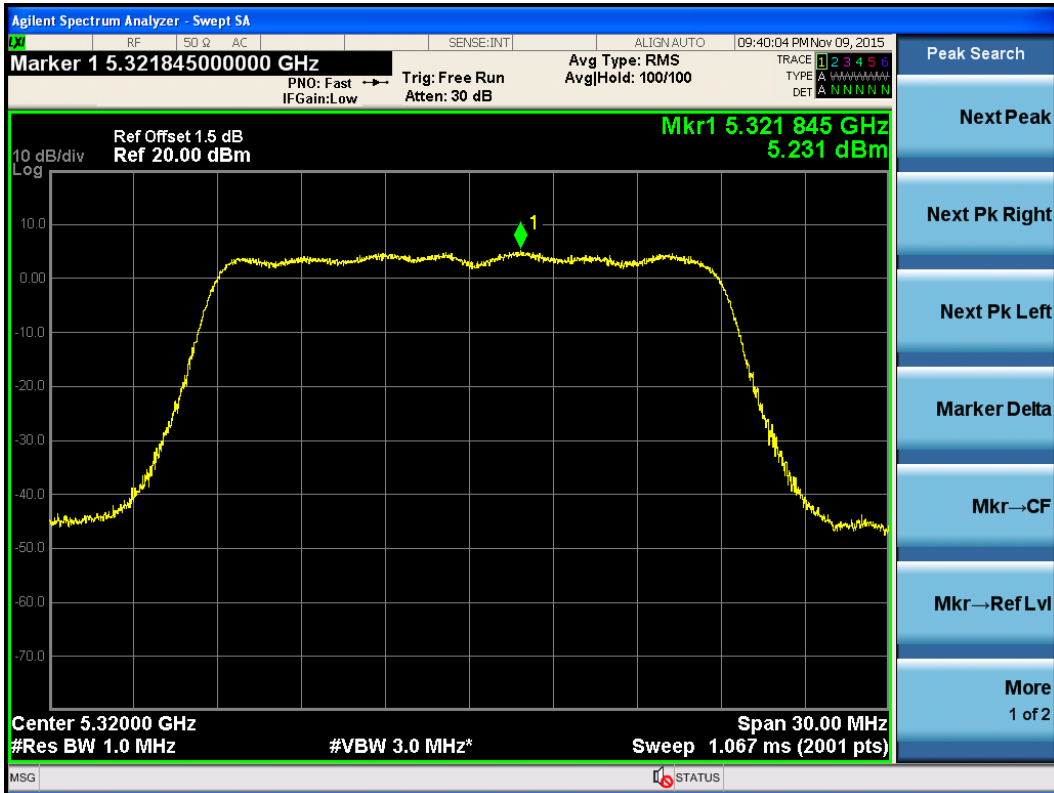
Channel 52- Ant 0



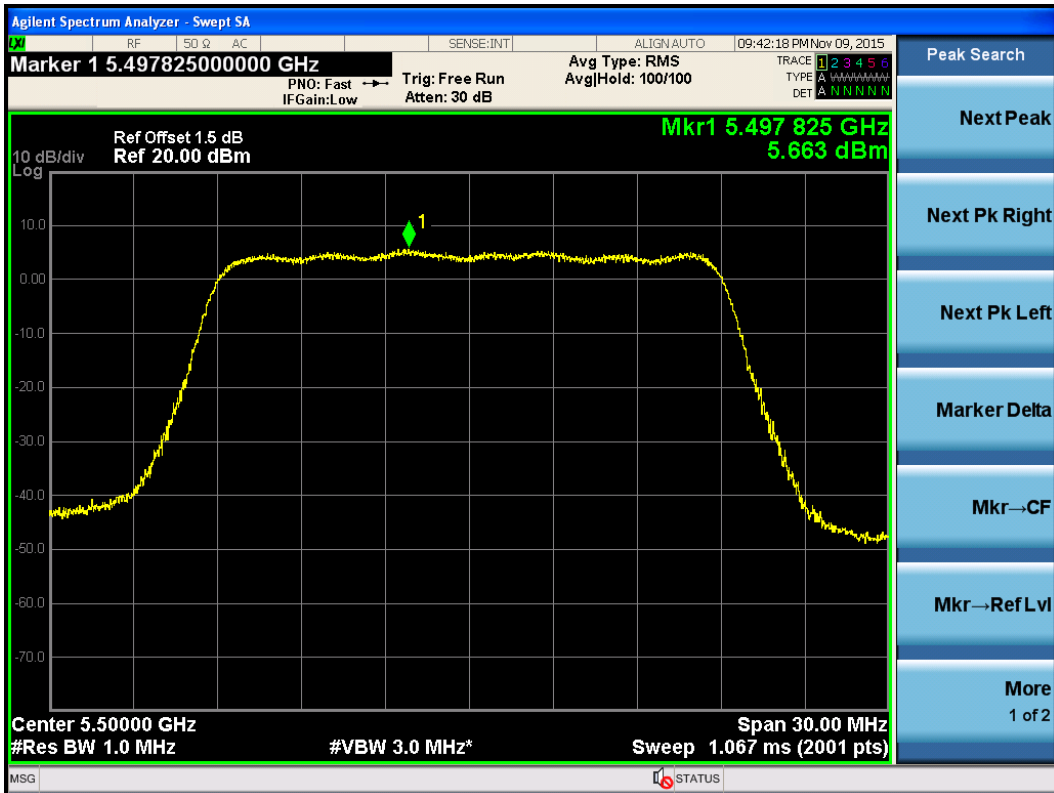
Channel 60- Ant 0



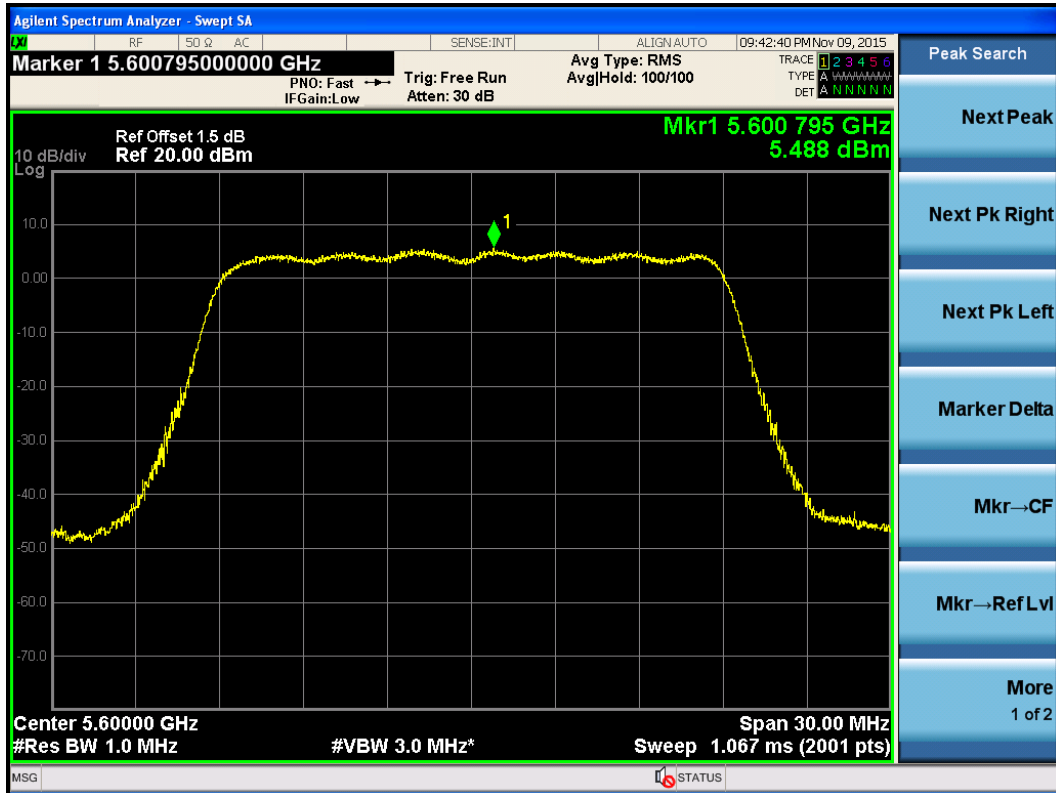
Channel 64- Ant 0



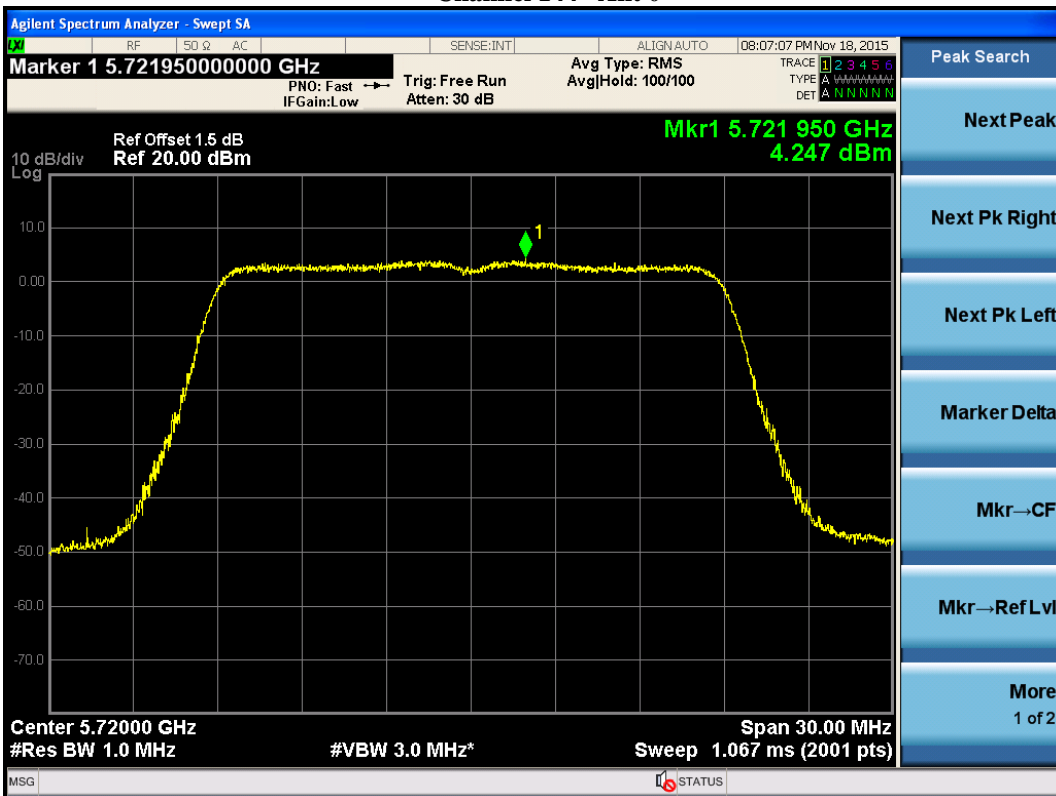
Channel 100- Ant 0



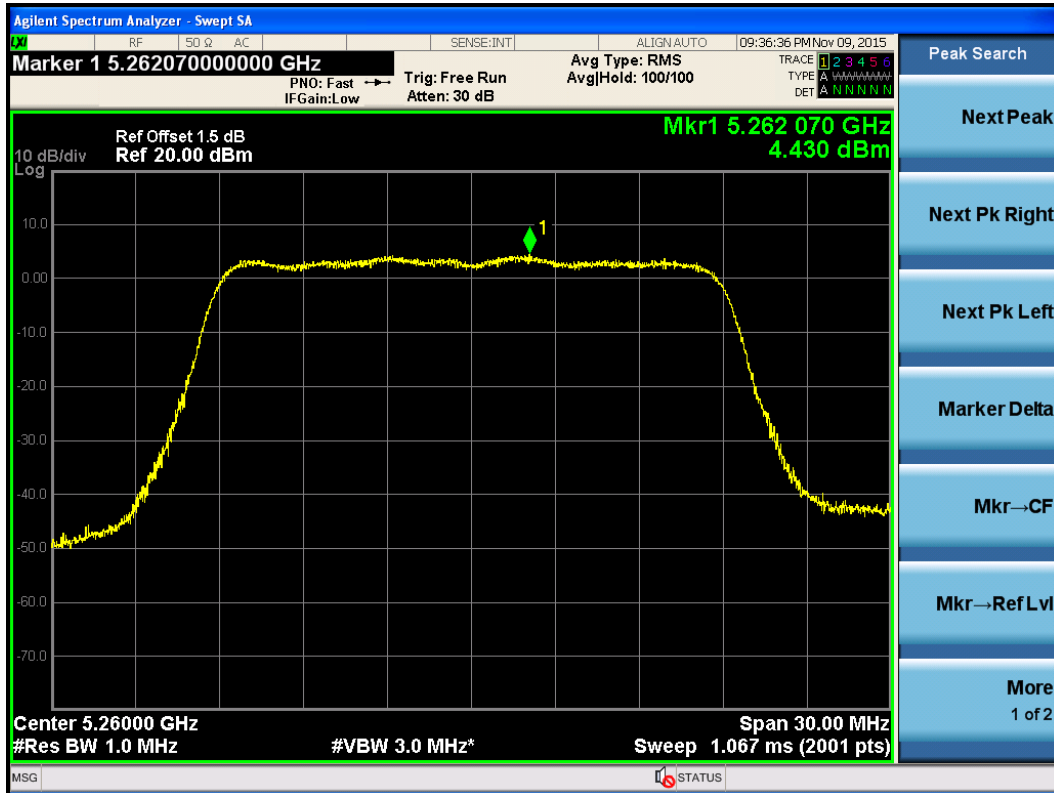
Channel 120- Ant 0



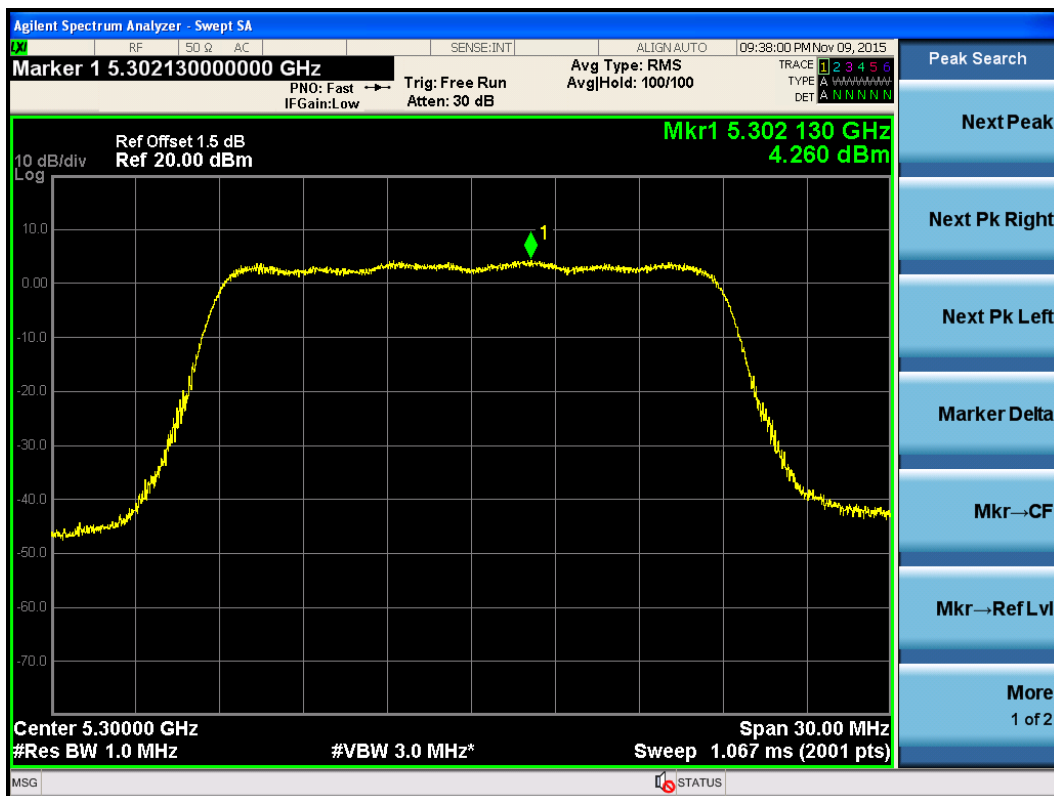
Channel 144- Ant 0



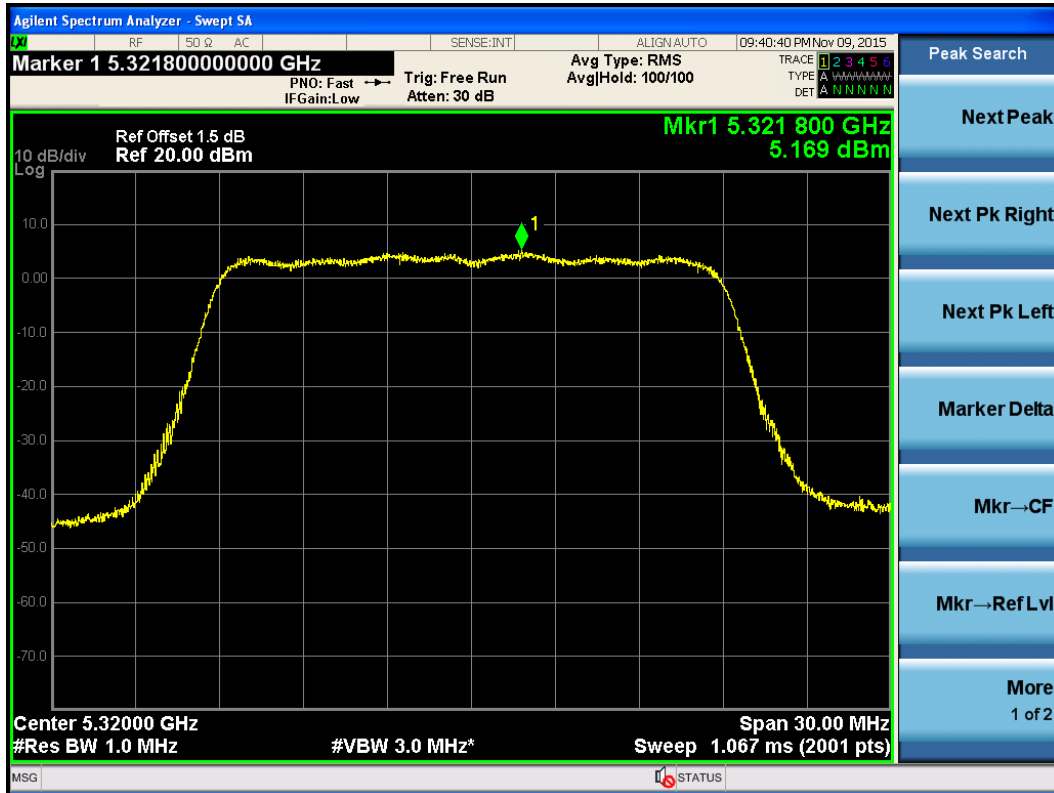
Channel 52- Ant 1



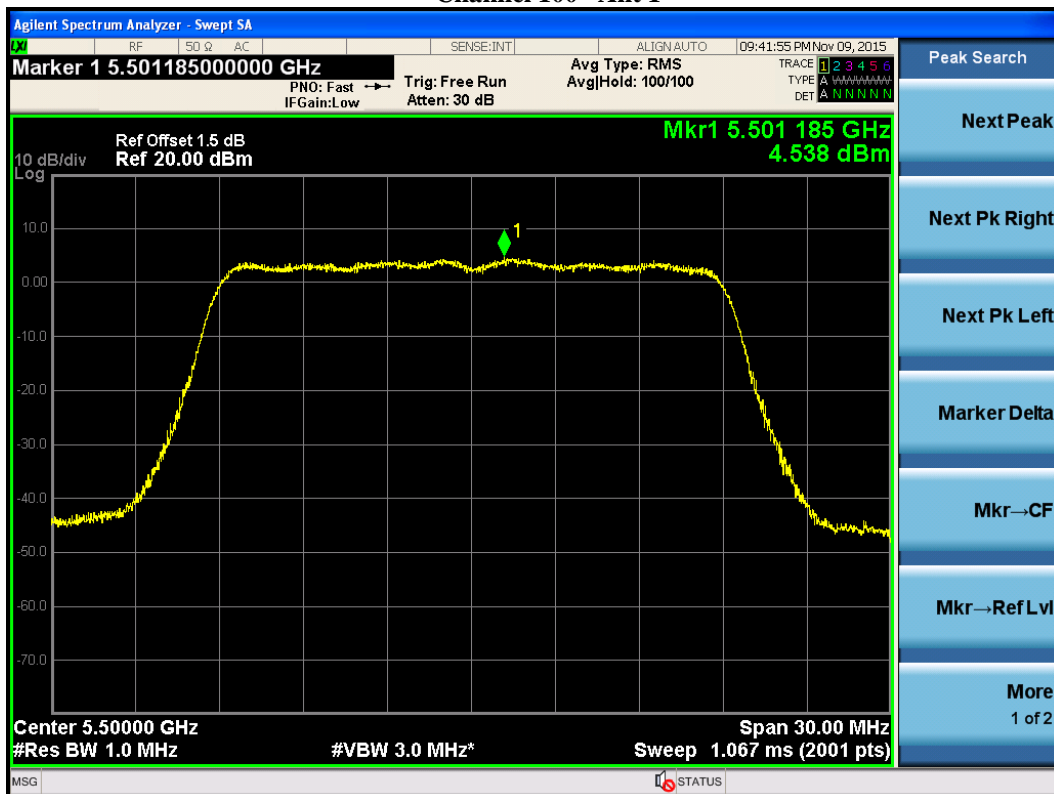
Channel 60- Ant 1



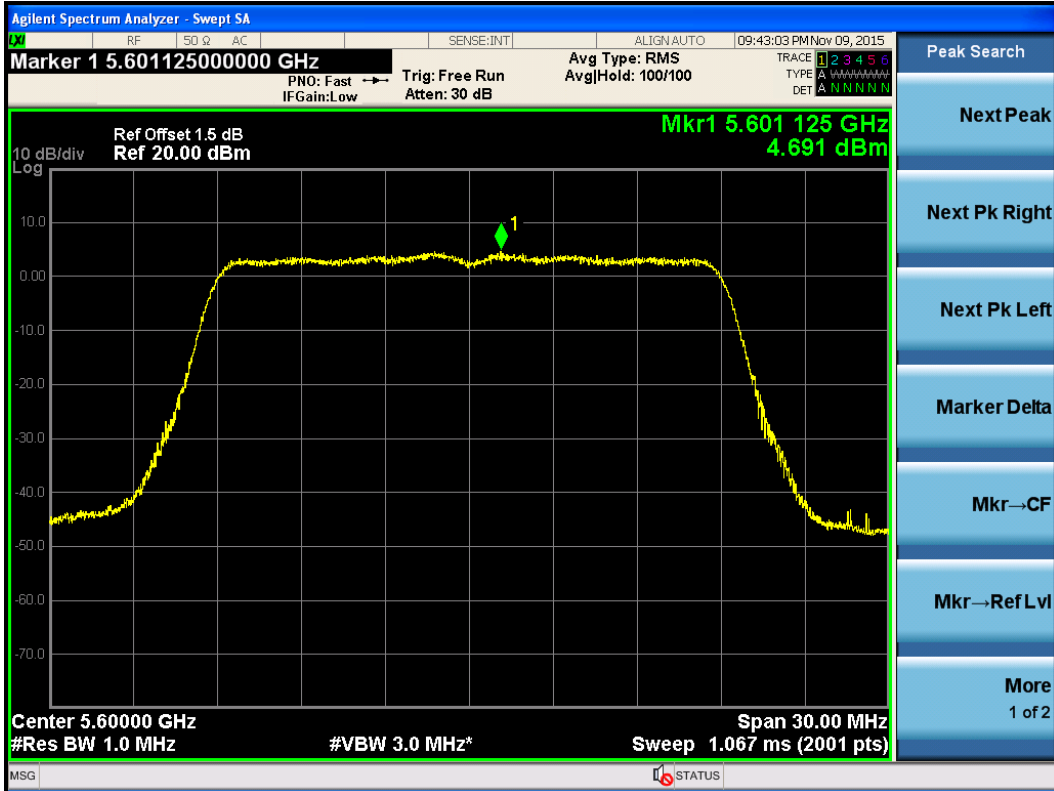
Channel 64- Ant 1



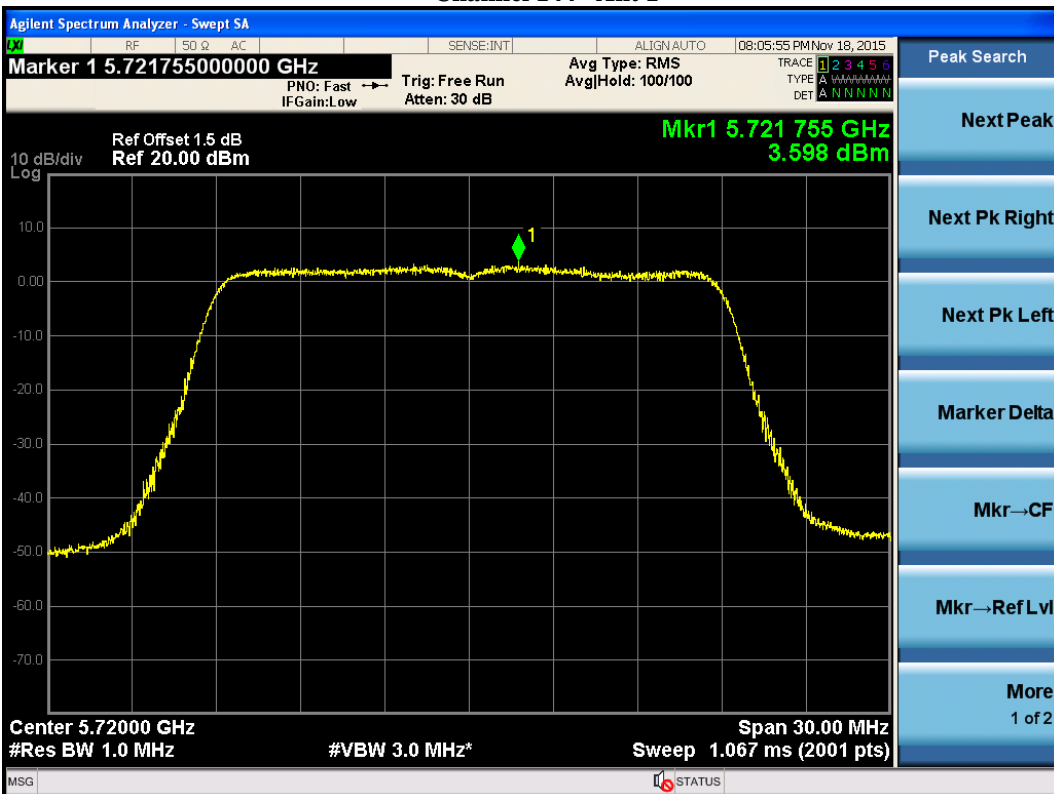
Channel 100- Ant 1



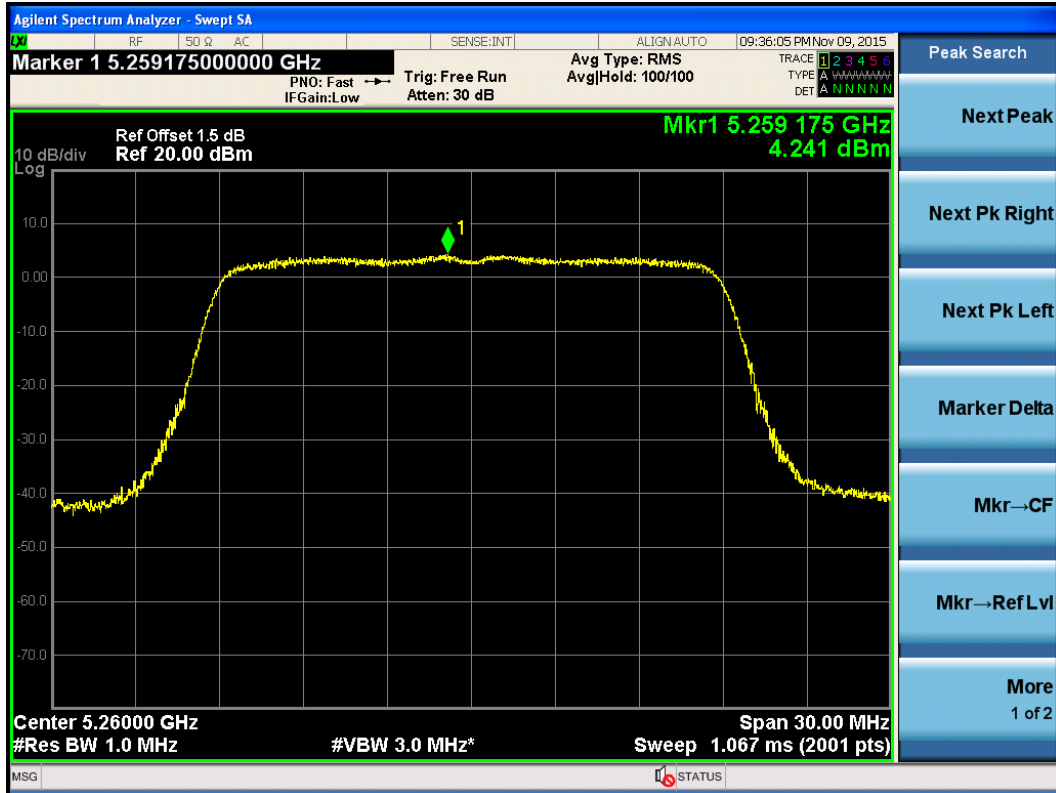
Channel 120- Ant 1



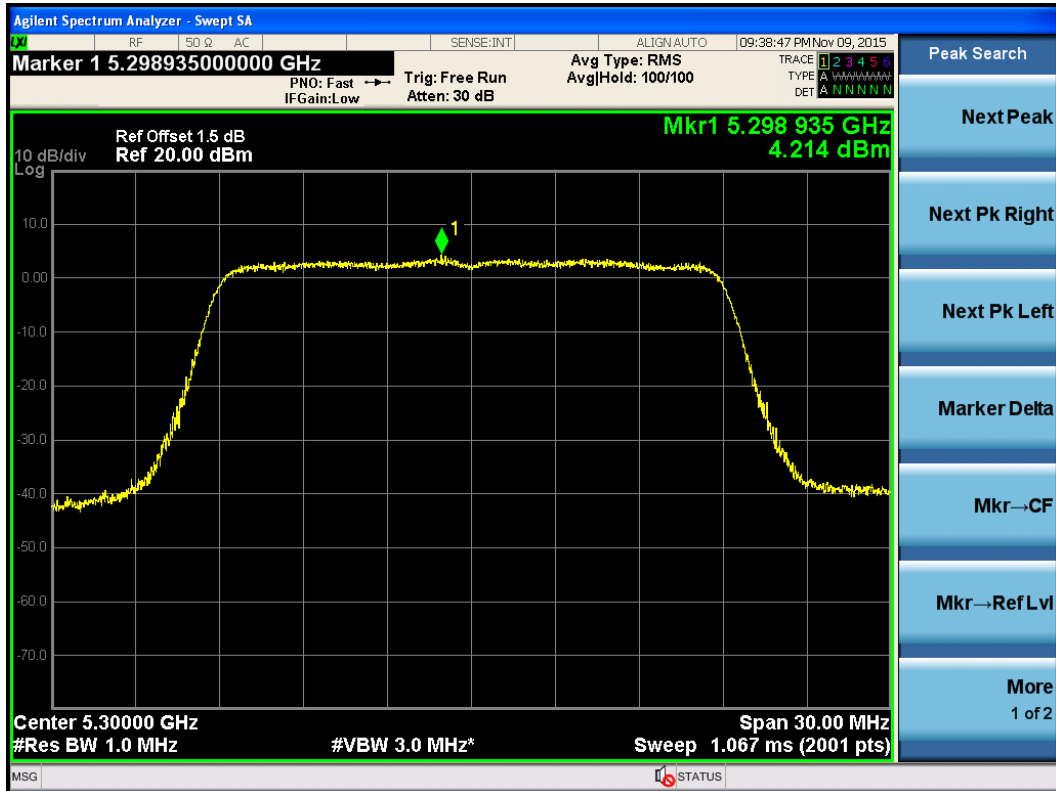
Channel 144- Ant 1



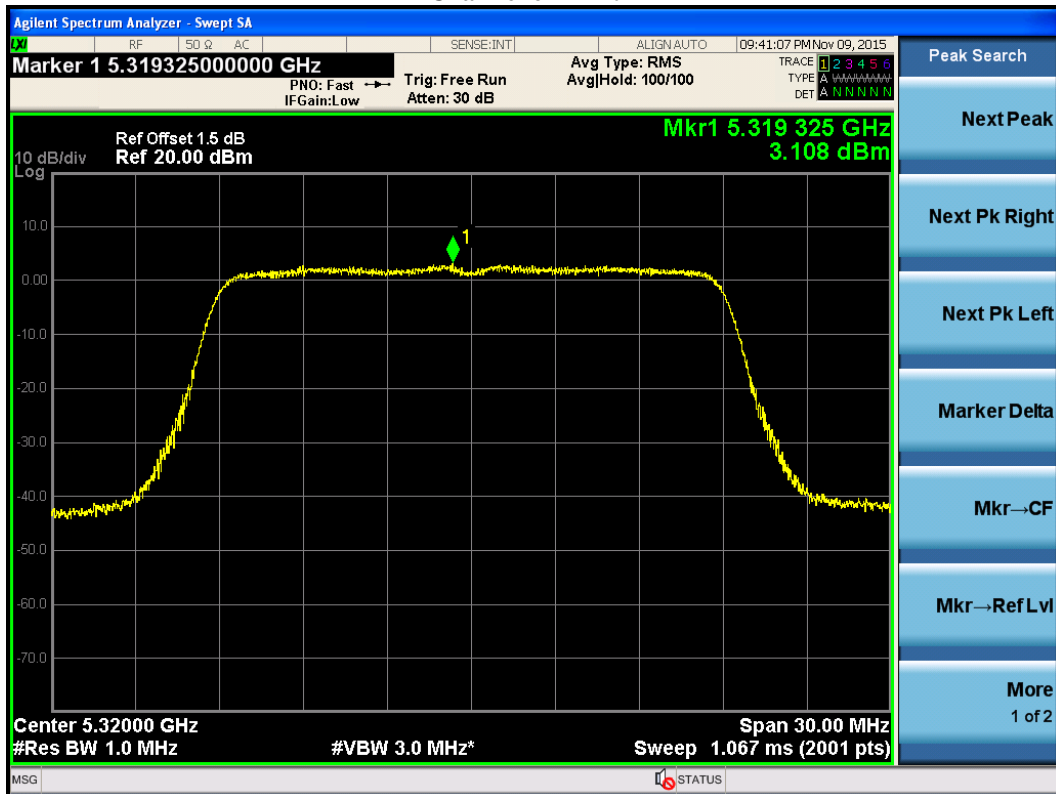
Channel 52- Ant 2



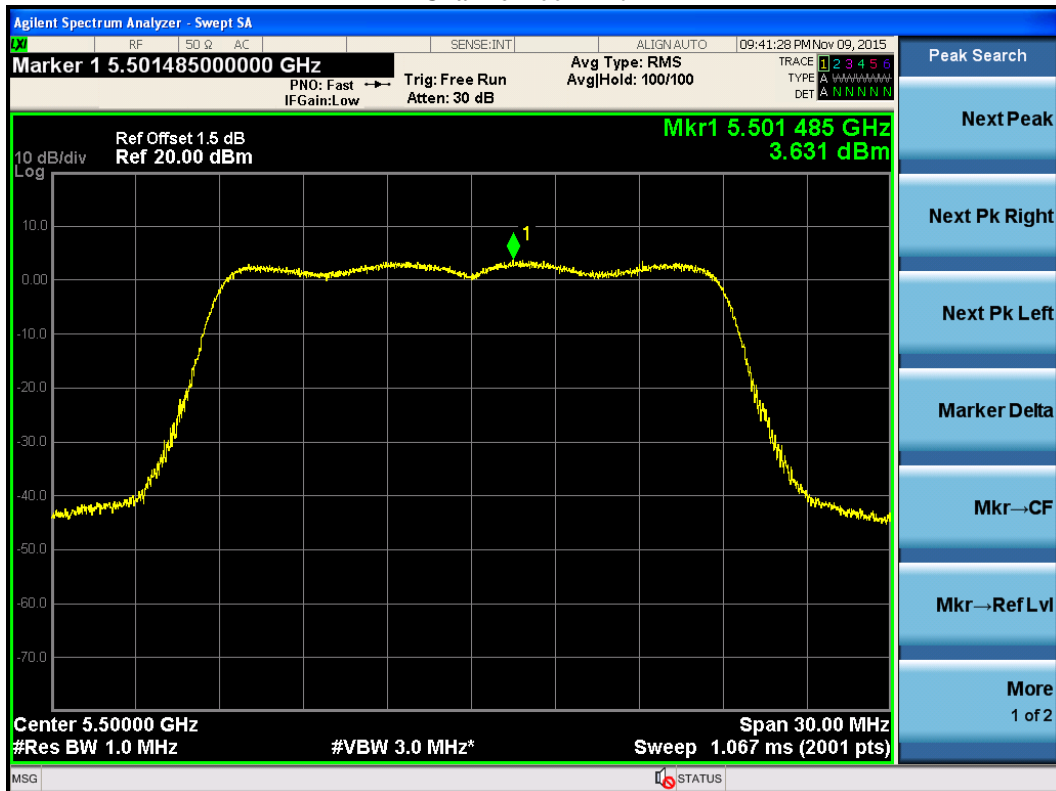
Channel 60- Ant 2



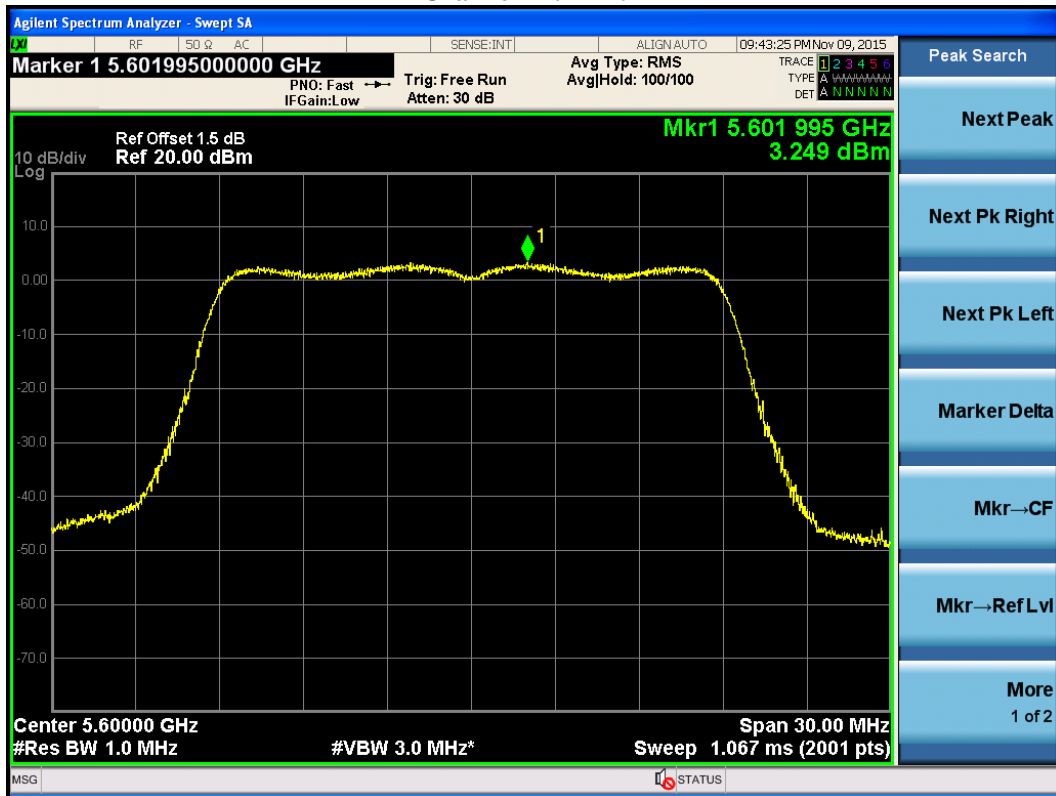
Channel 64- Ant 2



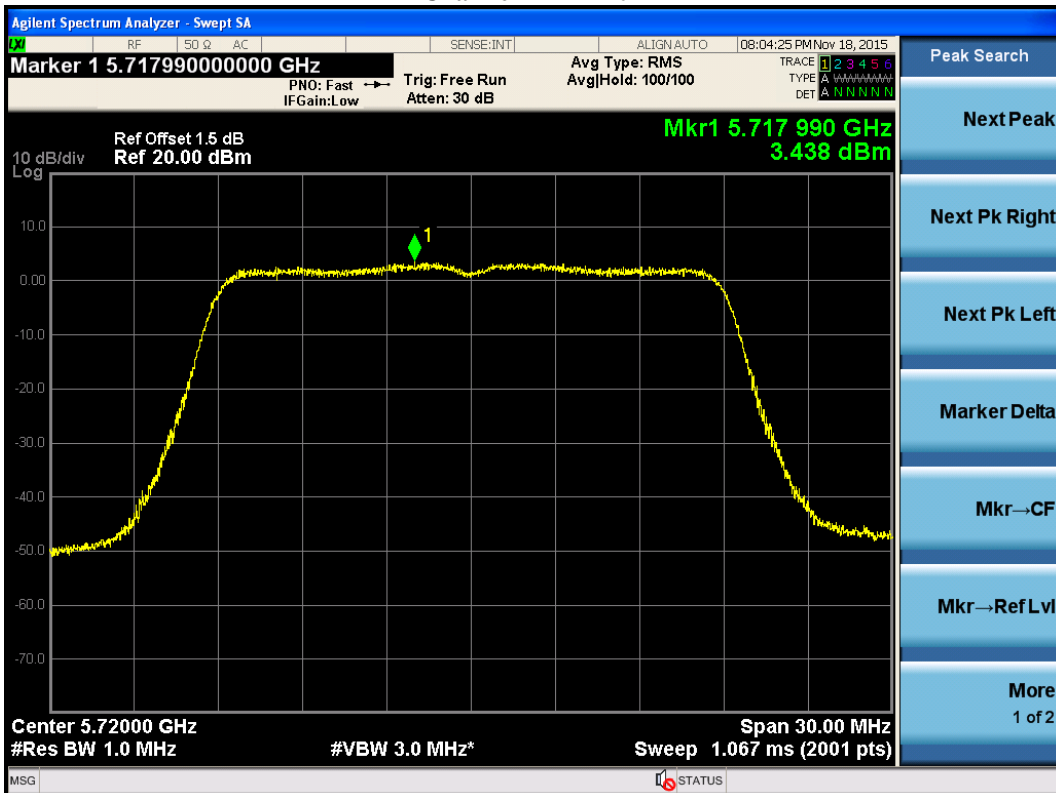
Channel 100- Ant 2



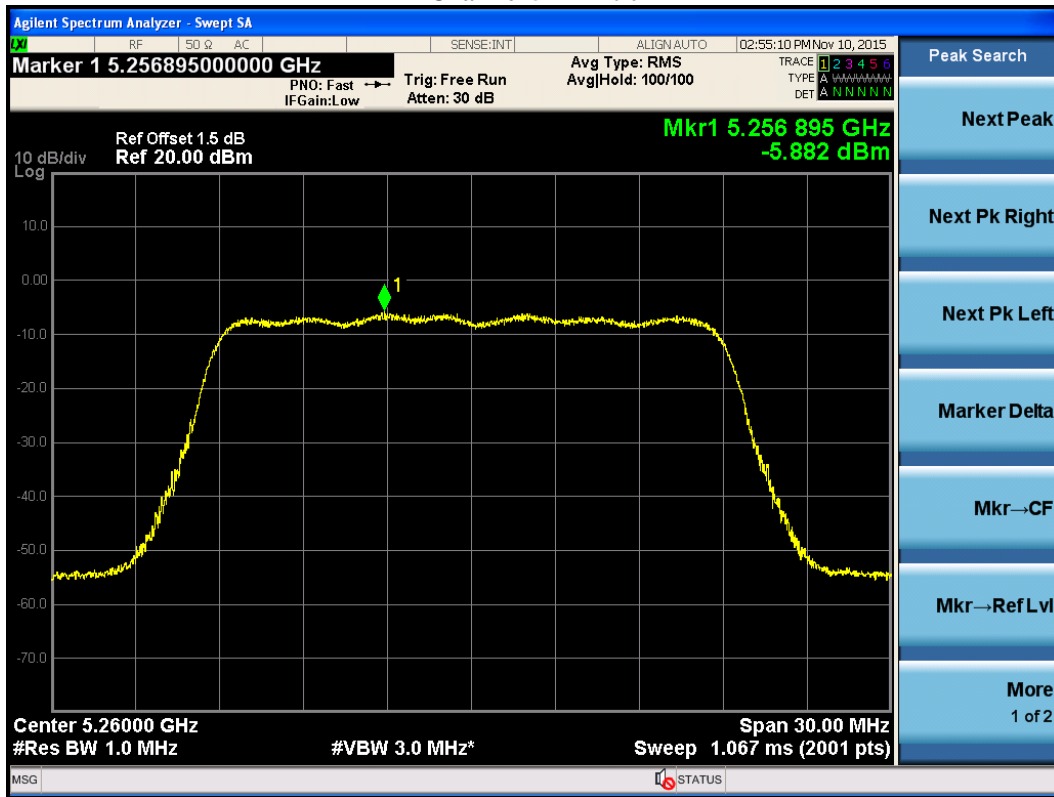
Channel 120- Ant 2



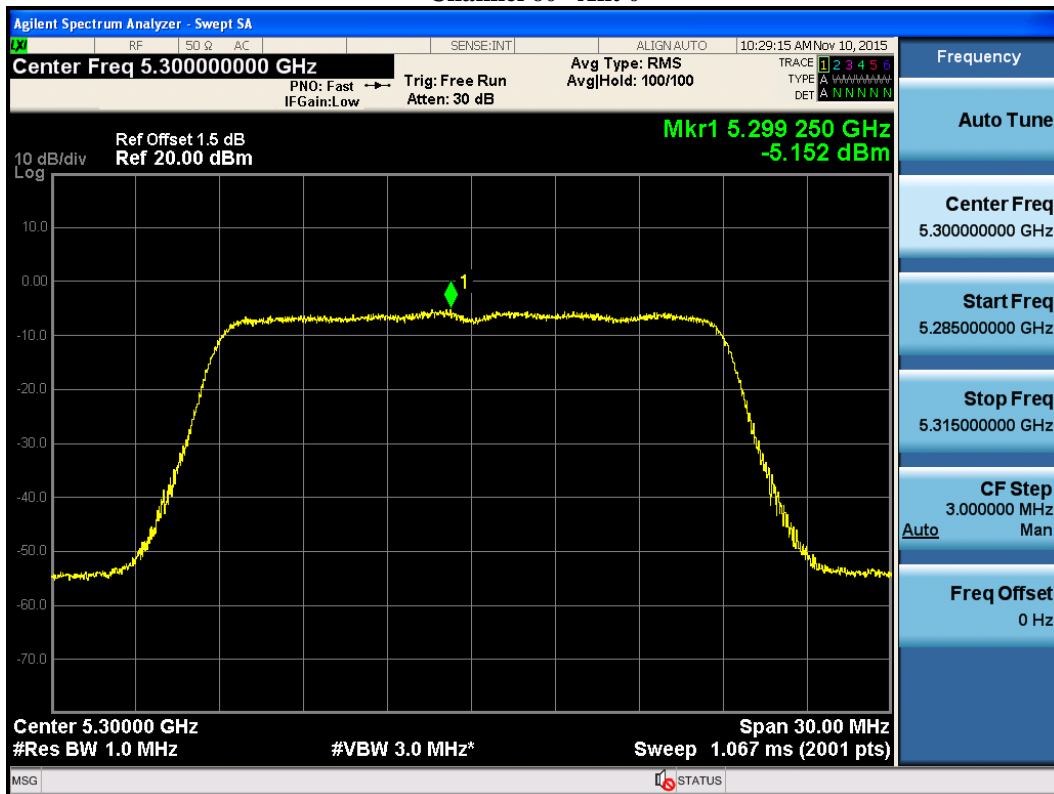
Channel 144- Ant 2



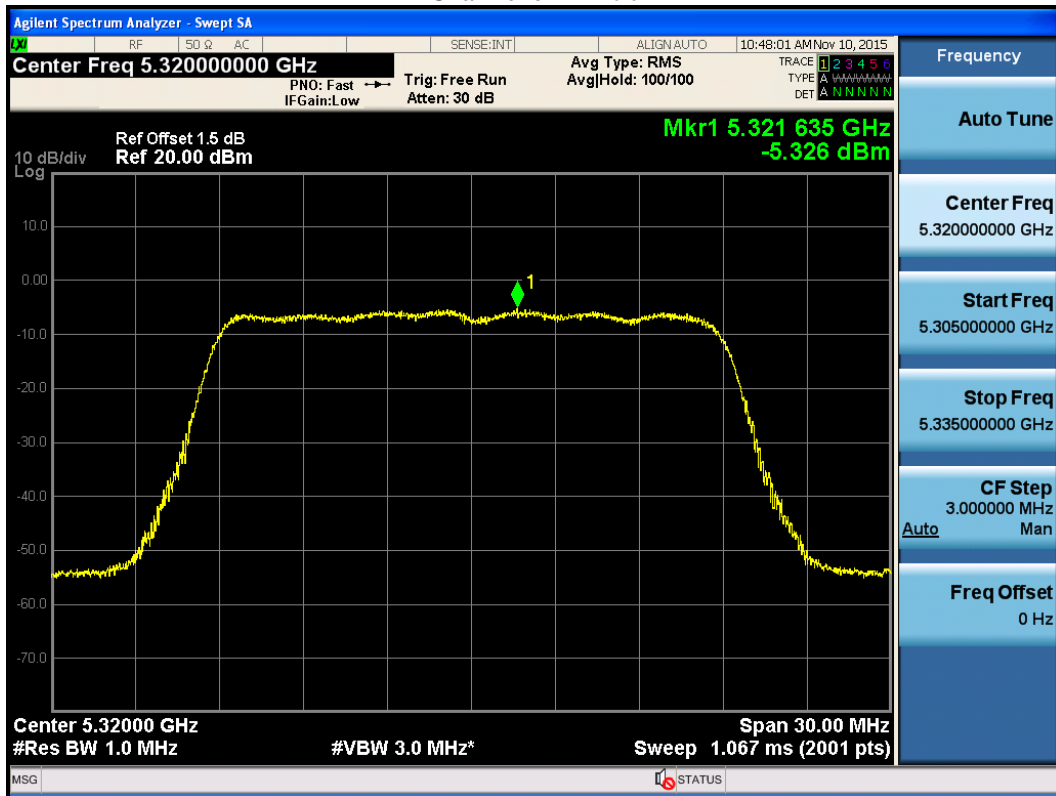
802.11n20 for mode 17 (14.0dBi antenna)
Channel 52- Ant 0



Channel 60- Ant 0



Channel 64- Ant 0



Channel 100- Ant 0

