

TEST REPORT



CTK Co., Ltd.
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Report No.:
CTK-2017-02075
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1. Client

- Name : Samsung Electronics Co., Ltd.
- Address : 129, Samsung-ro, Yeongtong-gu Suwon-si, Gyeonggi-do, 16677 Republic of Korea
- Date of Receipt : 2017-10-13

2. Manufacturer

- Name : Samsung Electronics Co., Ltd.
- Address : 129, Samsung-ro, Yeongtong-gu Suwon-si, Gyeonggi-do, 16677 Republic of Korea

3. Use of Report : For FCC / ISED Certification

4. Test Sample / Model: Wi-Fi Transceiver / WDN220M

5. Date of Test : 2017-10-15 to 2017-11-01

6. Test Standard(method) used : FCC 47 CFR part 15 subpart C 15.247 ISED RSS-247

7. Testing Environment: Temp.: (25 ± 5) °C, Humidity: (50 ± 3) % R.H.

8. Test Results : Compliance

The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This Test Report cannot be reproduced, except in full.

Affirmation	Tested by	Technical Manager
	Ji-Hye, Kim: (Signature)	Won-Jae, Hwang: (Signature)

2017-11-02

Republic of KOREA **CTK Co., Ltd.**



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REPORT REVISION HISTORY

Date	Revision	Page No
2017-11-02	Issued (CTK-2017-02075)	all

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1.0 General Product Description





FCC ID	A3LWDN220M		
Certification Number ISED	649E-WDN220M		
Equipment model name	WDN220M		
Serial number	Prototype		
EUT condition	Pre-production, not damaged		
Frequency Range	802.11b/g/n_HT20 : 2 412 MHz – 2 472 MHz 802.11n_HT40 : 2 422 MHz – 2 462 MHz		
Frequency Range(MHz)	2 412 - 2 472		
Mode	802.11b	802.11g	802.11n_20
RF output power	19.50	21.42	20.98
Frequency Range(MHz)	2 422 - 2 462		
Mode	802.11n_40		
RF output power	19.30		
Number of channels	802.11b/g/n_HT20 : 13 802.11n_HT40 : 9		
Transfer Rate	802.11b : 11 / 5.5 / 2 / 1 Mbps 802.11g : 54 / 48 / 36 / 24 / 18 / 12 / 9 / 6 Mbps 802.11n : up to 300 Mbps		
Type of Modulation	802.11b : DSSS 802.11g/n : OFDM		
Power Source	DC 5 V		
Duty Cycle	802.11b : 100 % 802.11g : 100 % 802.11n_HT20 : 100 %		
Antenna Type	Metal Antenna		
Antenna Gain	ANT0 : 1.83 dBi ANT1 : 1.67 dBi		
Hardware Rev	2017.10.19(V1.5)		
Software Rev	FC3		

2.0 Facility and Accreditations

2.1 Test Facility

The measurement facility is located at (Ho-dong), 113, Yejik-ro, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea. The sites are constructed in conformance with the requirements of ANSI C63.7, ANSI C63.4 and CISPR Publication 22.

2.2 Laboratory Accreditations and Listings

Country	Agency	Scope of Accreditation	Registration Number	Logo
USA	FCC	FCC Part 15 & 18 EMI (Electromagnetic Interference / Emission)	KR0025 (805871)	
CANADA	ISED	ISED EMI (3/10m test site)	8737A-2	
JAPAN	VCCI	VCCI V-3 EMI (Electromagnetic Interference / Emission)	C-986 T-1843 R-3627 G-387	
KOREA	MSIP	EMI (Electromagnetic Interference / Emission) EMS (Electromagnetic Susceptibility / Immunity)	KR0025	

2.3 Calibration Details of Equipment Used for Measurement

Test equipment and test accessories are calibrated on regular basis. The maximum time between calibrations is one year or what is recommended by the manufacturer, whichever is less. All test equipment calibrations are traceable to the Korea Research Institute of Standards and Science (KRISS), therefore, all test data recorded in this report is traceable to KRISS.



3.0 Test Specifications

3.1 Standards

FCC Part Section(s)	Requirement(s)	Limit	Status (Note 1)	Test Condition
15.247(a)	6 dB Bandwidth	> 500 kHz	C	Conducted
15.247(b)	Maximum Output Power	< 1 Watt	C	
15.247(d)	Conducted Spurious emission	> 30 dBc	C	
15.247(d)	Band Edge	> 30 dBc	C	
15.247(e)	Transmitter Power Spectral Density	< 8 dBm @ 3 kHz	C	
15.209	Field Strength of Harmonics	15.209(a)	C	Radiated
15.207	AC Conducted Emissions	15.207(a)	C	Line Conducted
<i>Note 1:</i> C=Complies NC=Not Complies NT=Not Tested NA=Not Applicable				
<i>Note 2:</i> The data in this test report are traceable to the national or international standards.				

ISED Part Section(s)	Requirement(s)	Limit	Status (Note 1)	Test Condition
RSS-Gen 4.6.1	6 dB Bandwidth	NA	C	Conducted
RSS-247 5.4(d)	Maximum Output Power	< 1 Watt	C	
RSS-Gen 6.13	Conducted Spurious emission	RSS-247 5.5	C	
RSS-Gen 6.13	Band Edge	RSS-247 5.5	C	
RSS-247 5.2(b)	Transmitter Power Spectral Density	< 8 dBm @ 3 kHz	C	
RSS-Gen 6.13	Field Strength of Harmonics	RSS-247 5.5	C	Radiated
RSS-Gen 5	Receiver Spurious Emissions	RSS-Gen 7.1.2	C	
RSS-Gen 8.8	AC Conducted Emissions	RSS-Gen 8.8	C	Line Conducted
<i>Note 1:</i> C=Complies NC=Not Complies NT=Not Tested NA=Not Applicable				
<i>Note 2:</i> The data in this test report are traceable to the national or international standards.				

The sample was tested according to the following specification:
 FCC Part 15.247, ANSI C63.10-2013, RSS-247 Issue 2

The tests were performed according to the method of measurements prescribed in
 KDB No.558074.



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3.2 Mode of operation during the test

The EUT is operated in a manner representative of the typical of the equipments. During at testing, system components were manipulated within the confines of typical usage to maximize each emission. For WLAN function, the engineering test program was provided and enabled to make EUT continuous transmit/receive. All modulation modes were tests. The results are only attached worst cases.

Test mode

Test Item	Modulation	Data Rate
6 dB Bandwidth Maximum Output Power Conducted Spurious emission Band Edge Power Spectral Density Radiated Emissions Above 1GHz	802.11b	1 Mbps
	802.11g	6 Mbps
	802.11n	MCS 0
AC Conducted Emissions	Nomal Mode	Auto

Test Frequency

- 802.11b, 802.11g, 802.11n_HT20

1	2	3	6	11	12	13
2 412 MHz	2 417 MHz	2 422 MHz	2 437 MHz	2 462 MHz	2 467 MHz	2 472 MHz

- 802.11n_HT40

3	4	6	8	9	10	11
2 422 MHz	2 427 MHz	2 437 MHz	2 447 MHz	2 452 MHz	2 457 MHz	2 462 MHz

3.3 Device Modifications

The following modifications were necessary for compliance:

Not applicable



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3.4 Peripheral Devices

Device	Manufacturer	Model No.	Serial No.
Note Computer	HP	ProBook 650 G1	5CG5114KD2
AC/DC Adapter	HP	PPP012D-S	-

3.5 Maximum Measurement Uncertainty

The value of the measurement uncertainty for the measurement of each parameter.
Coverage factor $k = 2$, Confidence levels of 95 %

Description	Uncertainty
Conducted RF Output Power	± 1.5 dB
Power Spectral Density	± 1.5 dB
Occupied Bandwidth	± 0.1 MHz
Unwanted Emission(conducted)	± 3.0 dB
Radiated Emissions ($f \leq 1$ GHz)	± 4.0 dB
Radiated Emissions ($f > 1$ GHz)	± 5.0 dB

3.6 Test Software

Conducted Test	Ics Pro Ver. 6.0.3
Radiated Test	TOYO EMI software EP5RE Ver. 5.1.0
Line Conducted Test	ESCI7, ESCI3 : EMC32 Ver. 8.50.0 ESR7 : EMC32 Ver. 8.53.0



4.0 Technical Characteristic Test

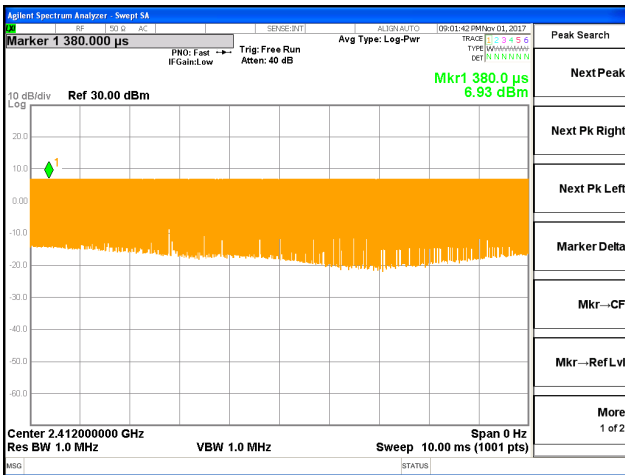
4.1 ON Time, Duty Cycle

Test Procedures

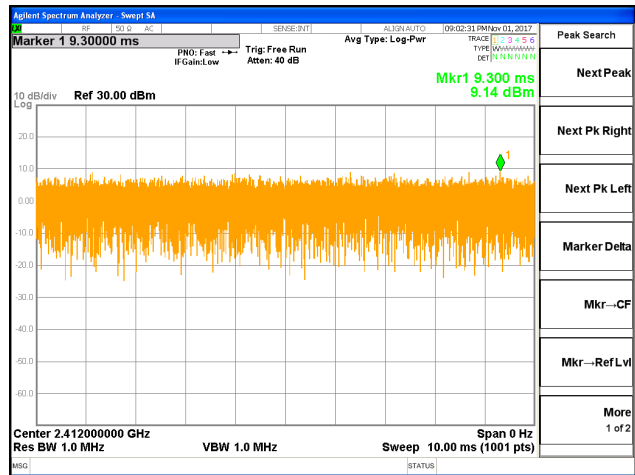
KDB 558074 Zero-Span Spectrum Analyzer Method.

Test Data:

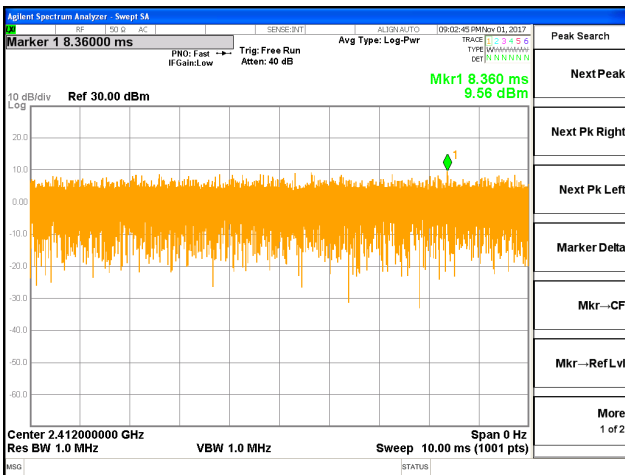
	ON Time (ms)	Period (ms)	TX OFF (ms)	Duty Cycle (linear)	Duty Cycle (%)
802.11b	10.00	10.00	0	1.00	100
802.11g	10.00	10.00	0	1.00	100
802.11n_HT20	10.00	10.00	0	1.00	100
802.11n_HT40	10.00	10.00	0	1.00	100



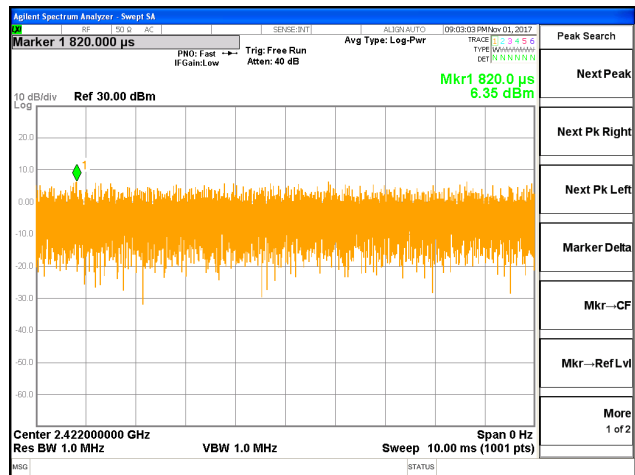
Duty Cycle_802.11b



Duty Cycle_802.11g



Duty Cycle_802.11n_HT20



Duty Cycle_802.11n_HT40



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4.2 6dB Bandwidth

Test Procedures (ANSI C63.10-2013 6.9.2)

Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

Test Procedures (ANSI C63.10-2013 6.9.3)

The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission.

Use the 99% power bandwidth function of the instrument and report the measured bandwidth.

Test Settings :

Center frequency = the highest, middle and the lowest channels

- a) RBW = 100 kHz
- b) VBW $\geq 3 \times$ RBW
- c) Detector = peak
- d) Trace mode = Max hold
- e) Sweep = auto couple
- f) Allow trace to fully stabilize
- g) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

Minimum Standard:

6 dB Bandwidth > 500kHz



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Test Data:

[ANT0]

	6 dB Bandwidth and 99% Bandwidth (MHz)					
Mode	802.11b		802.11g		802.11n HT20	
Frequency	6dB	99%	6dB	99%	6dB	99%
2 412 MHz	9.135	14.105	16.320	16.375	17.590	17.555
2 417 MHz	9.585	14.139	16.350	16.395	17.380	17.574
2 422 MHz	9.583	14.159	16.120	16.429	17.390	17.560
2 437 MHz	9.577	14.141	16.310	16.422	17.570	17.585
2 462 MHz	9.143	14.094	16.350	16.382	17.390	17.564
2 467 MHz	9.138	14.054	16.350	16.386	17.570	17.548
2 472 MHz	9.129	14.045	16.350	16.389	17.180	17.546

	6 dB Bandwidth and 99% Bandwidth (MHz)	
Mode	802.11n HT40	
Frequency	6dB	99%
2 422 MHz	35.820	35.877
2 427 MHz	35.700	35.851
2 437 MHz	35.800	35.865
2 447 MHz	35.910	35.868
2 452 MHz	35.890	35.863
2 457 MHz	35.890	35.868
2 462 MHz	35.860	35.857



[ANT1]

	6 dB Bandwidth and 99% Bandwidth (MHz)					
Mode	802.11b		802.11g		802.11n HT20	
Frequency	6dB	99%	6dB	99%	6dB	99%
2 412 MHz	9.567	14.063	15.760	16.344	16.920	17.556
2 417 MHz	9.572	14.101	16.330	16.359	17.570	17.556
2 422 MHz	9.574	14.072	16.350	16.398	17.560	17.587
2 437 MHz	9.125	14.055	16.340	16.376	17.590	17.575
2 462 MHz	10.010	14.082	16.350	16.352	17.590	17.549
2 467 MHz	9.138	14.067	16.340	16.340	17.320	17.541
2 472 MHz	9.138	14.057	16.310	16.329	16.980	17.538

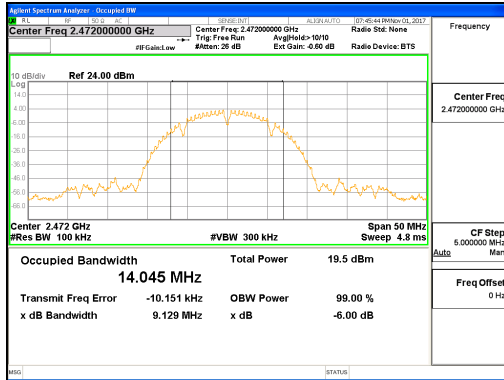
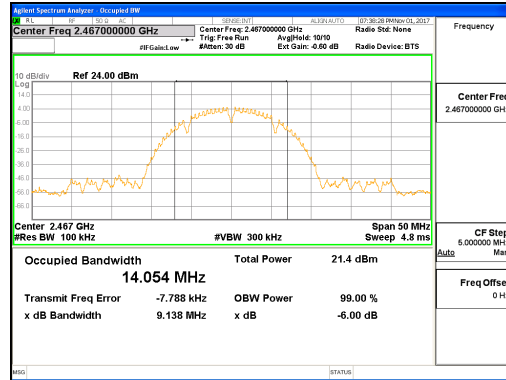
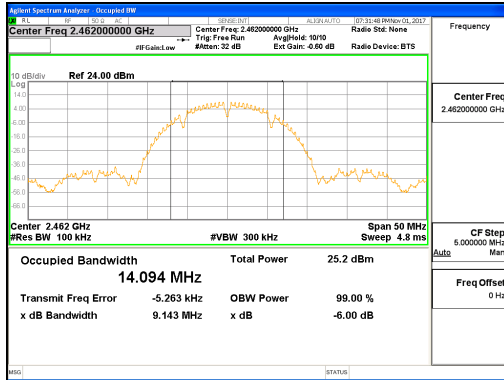
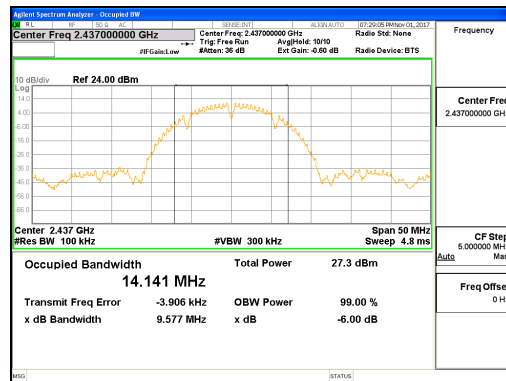
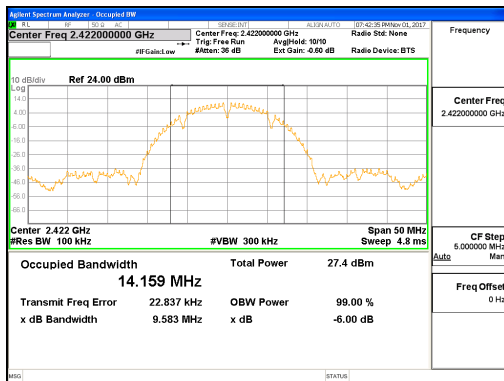
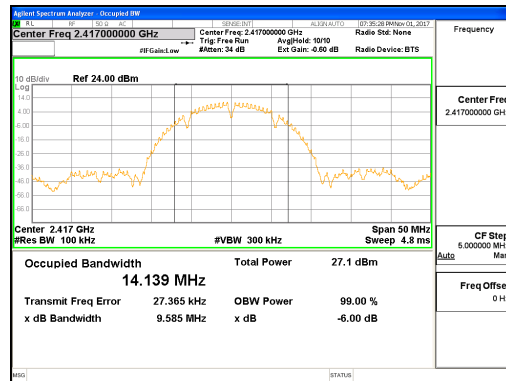
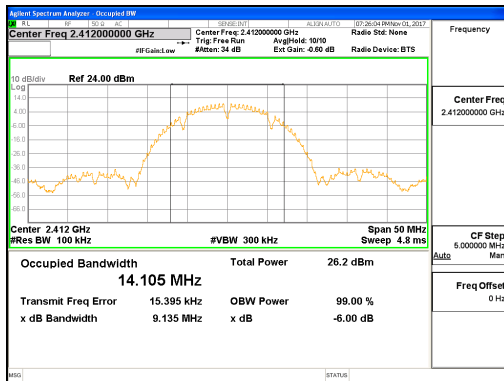
	6 dB Bandwidth and 99% Bandwidth (MHz)	
Mode	802.11n HT40	
Frequency	6dB	99%
2 422 MHz	35.300	35.844
2 427 MHz	35.100	35.860
2 437 MHz	35.080	35.881
2 447 MHz	35.150	35.906
2 452 MHz	35.100	35.889
2 457 MHz	35.080	35.856
2 462 MHz	35.660	35.849

See next pages for actual measured spectrum plots.



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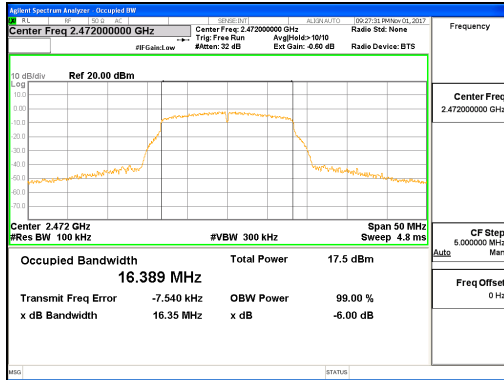
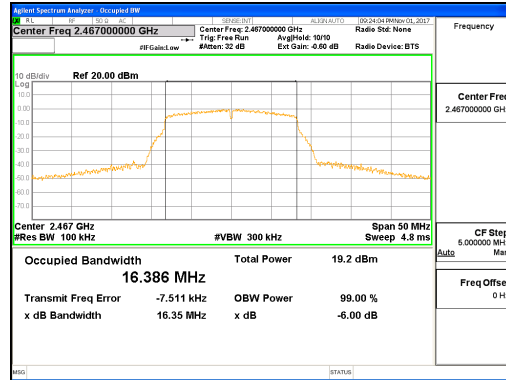
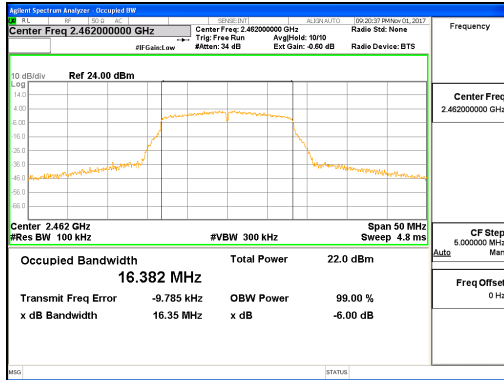
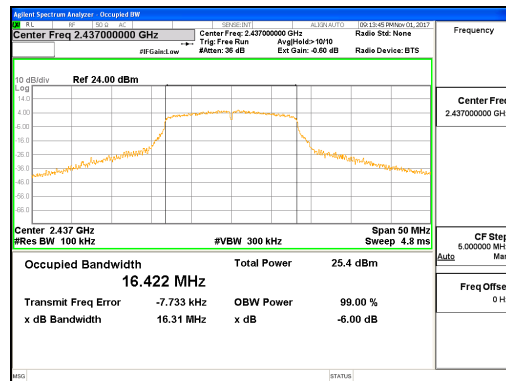
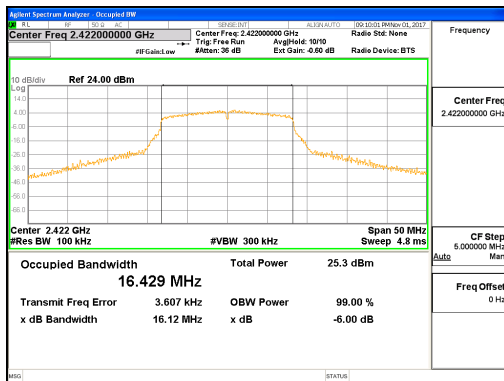
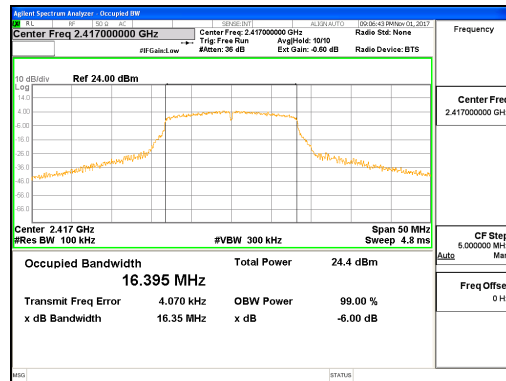
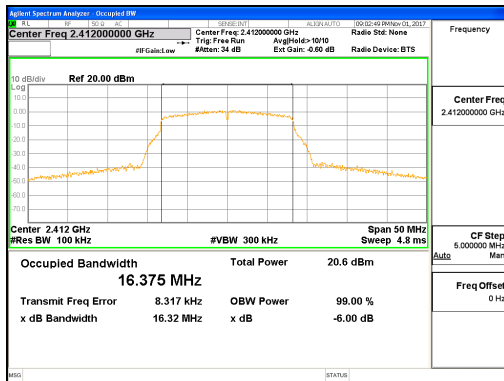


802.11b_ANT0



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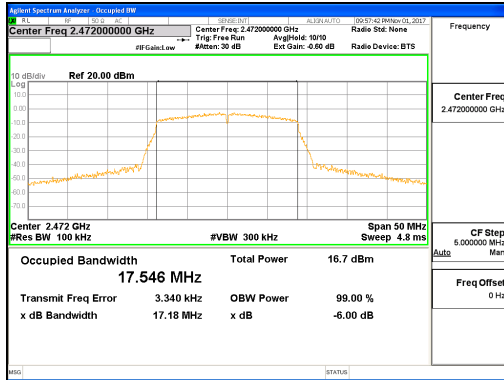
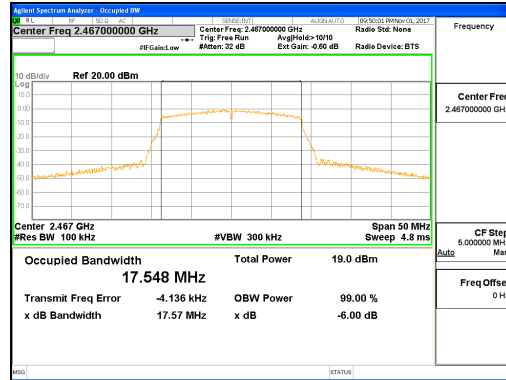
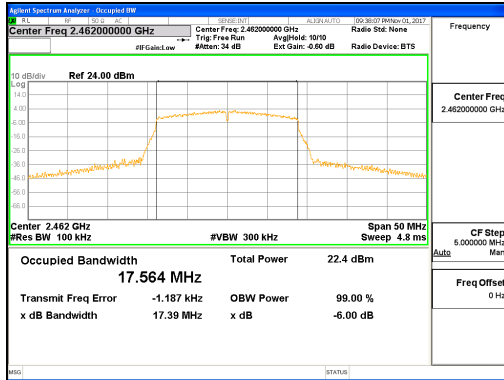
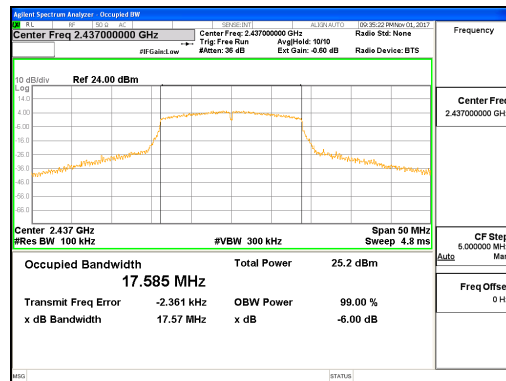
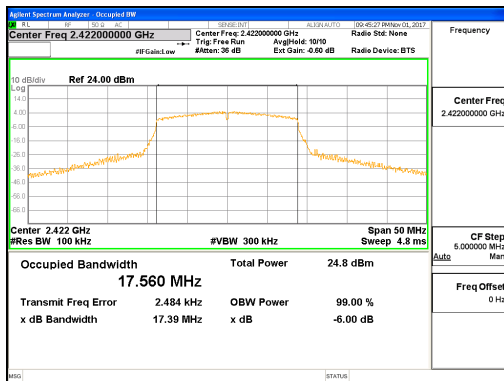
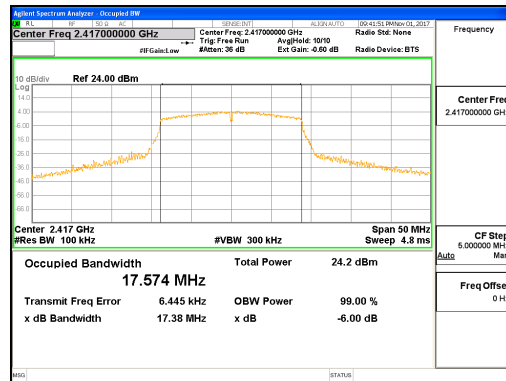
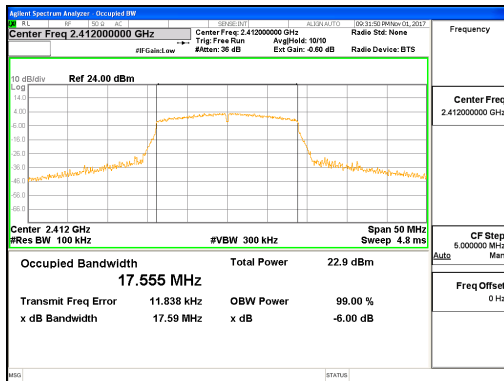


802.11g_ANT0



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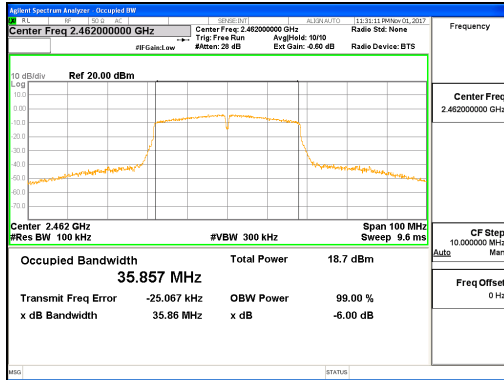
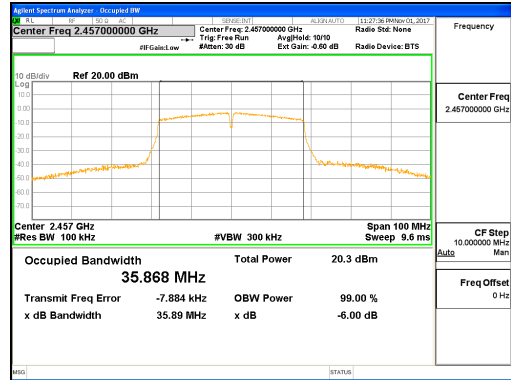
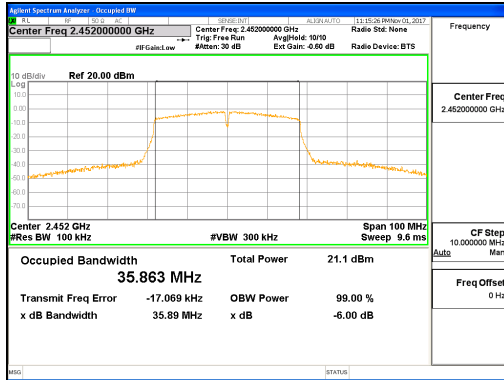
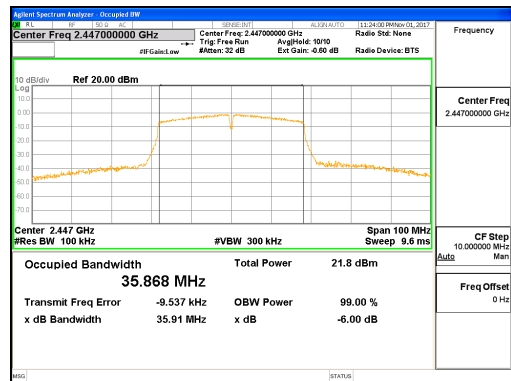
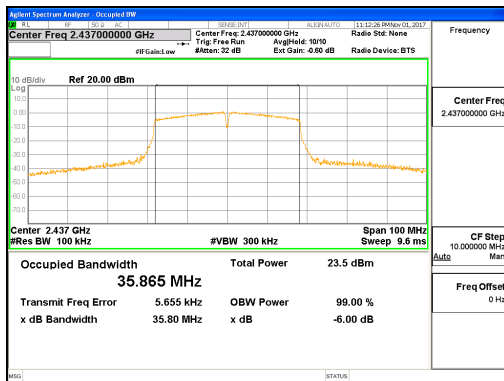
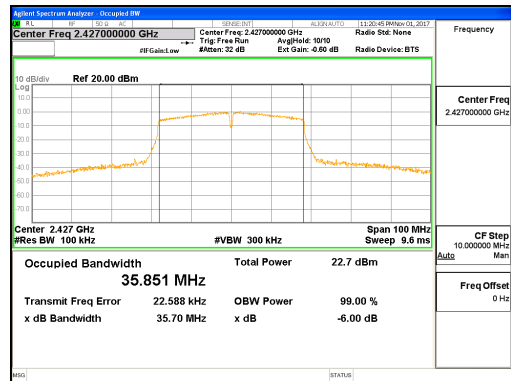
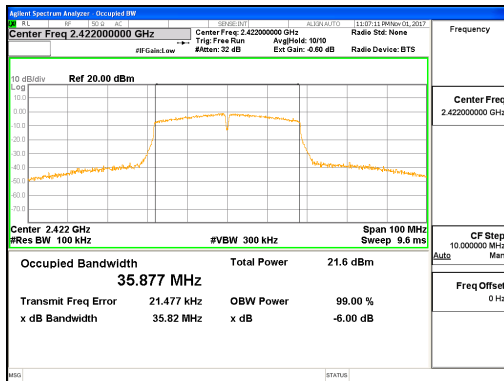


802.11n_HT20_ANT0



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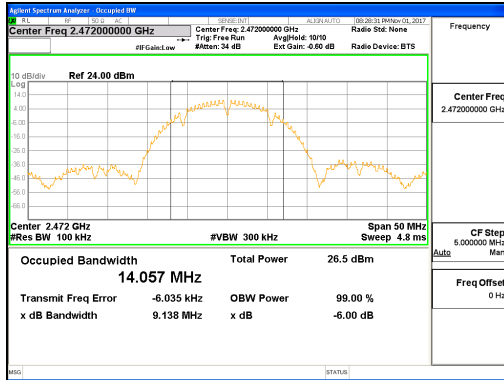
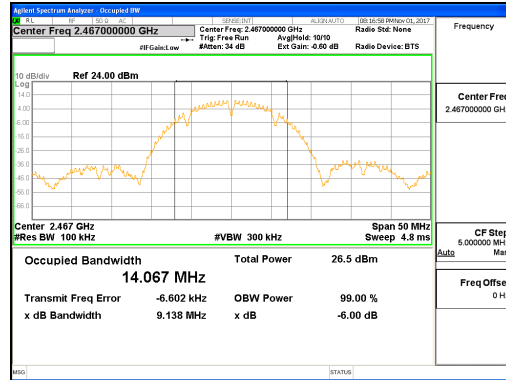
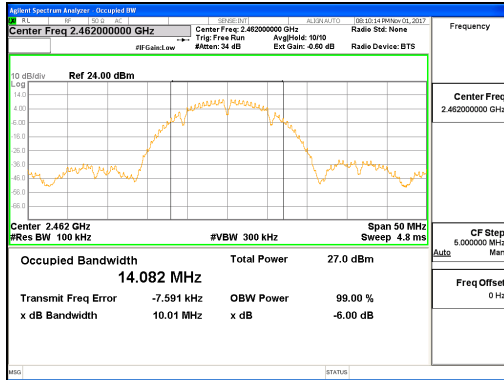
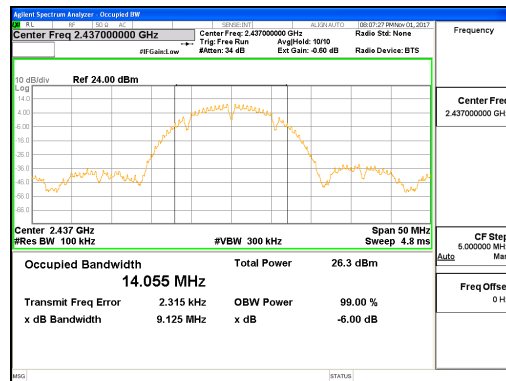
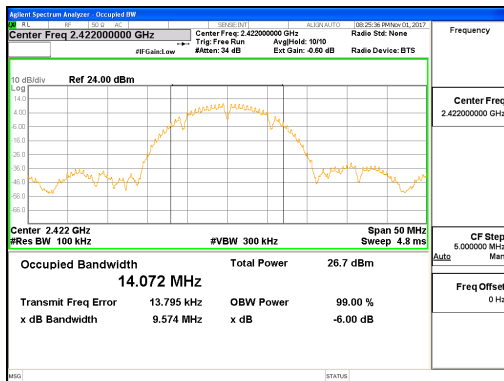
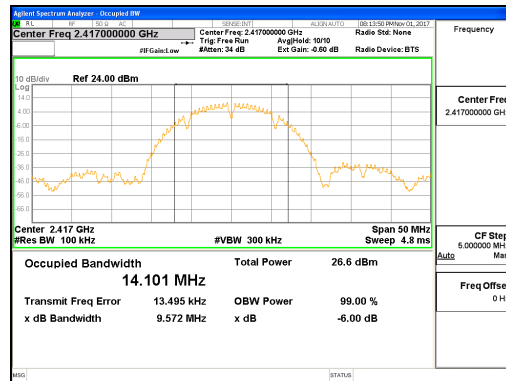
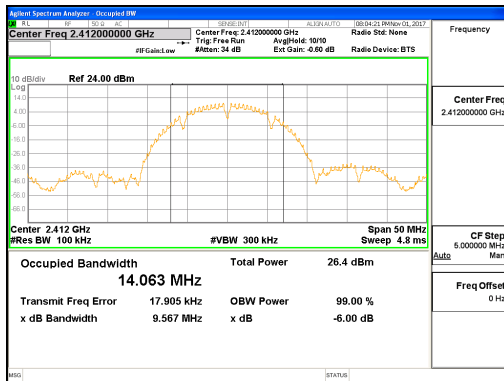


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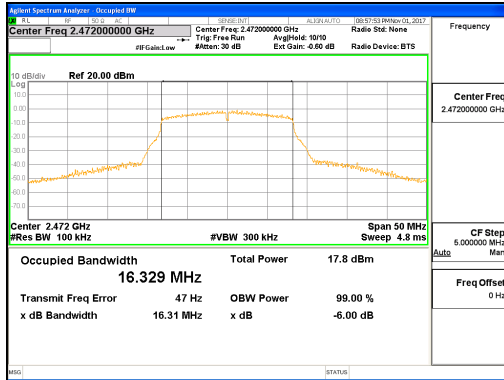
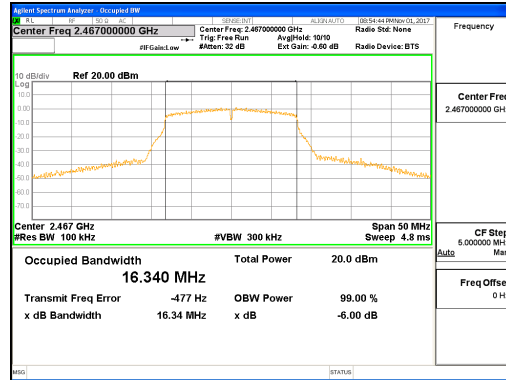
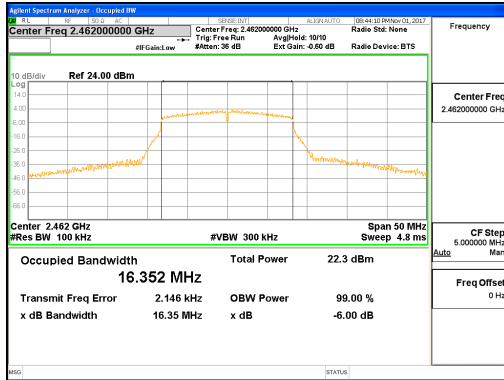
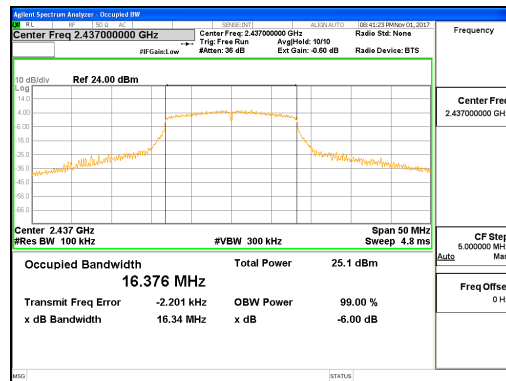
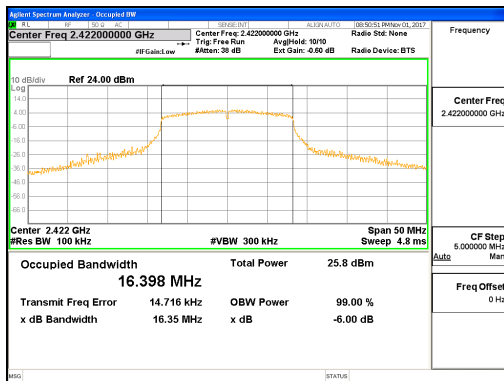
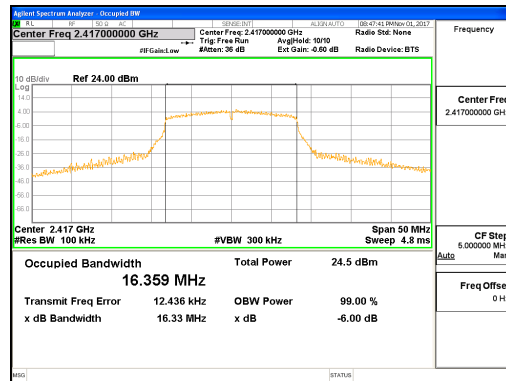
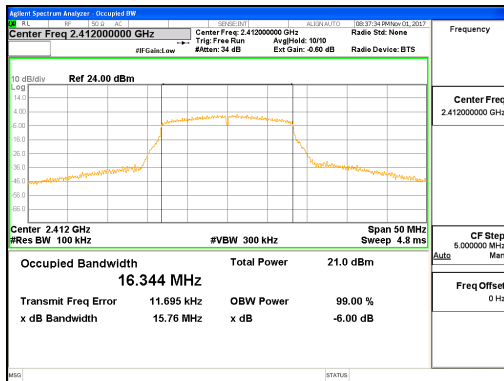


802.11b_ANT1



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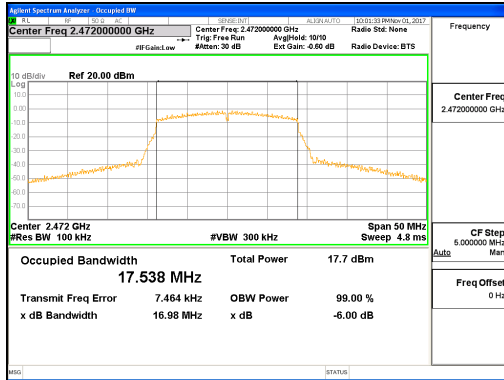
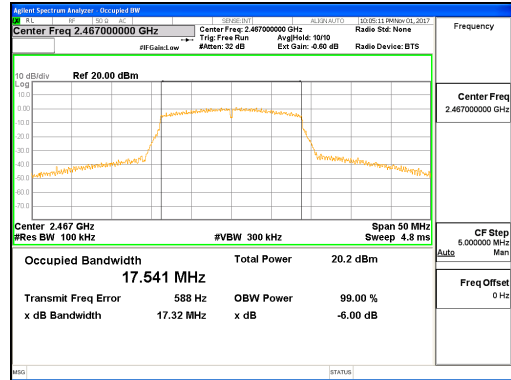
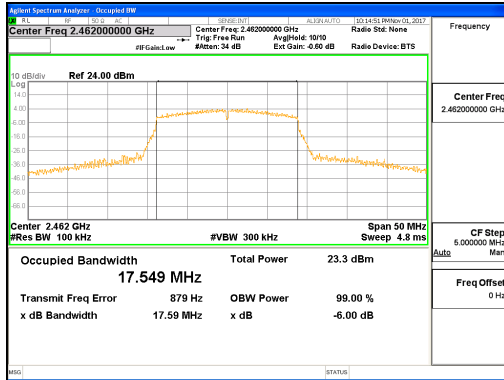
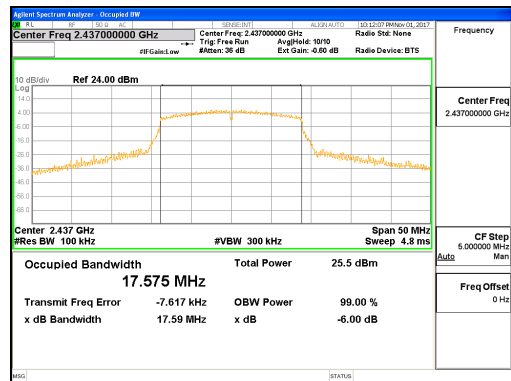
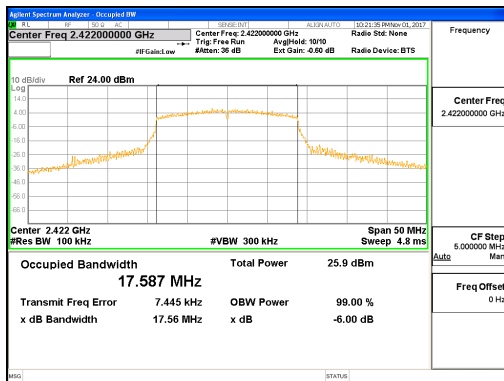
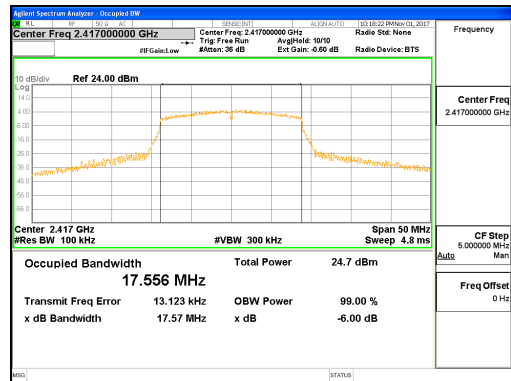
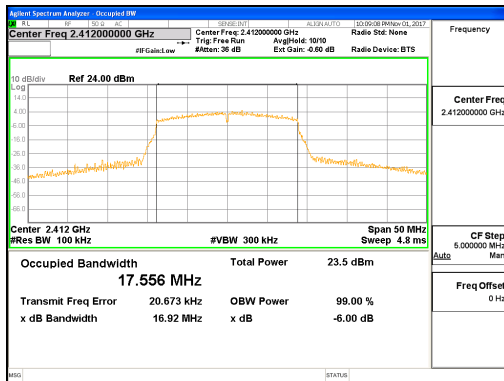


802.11g_ANT1



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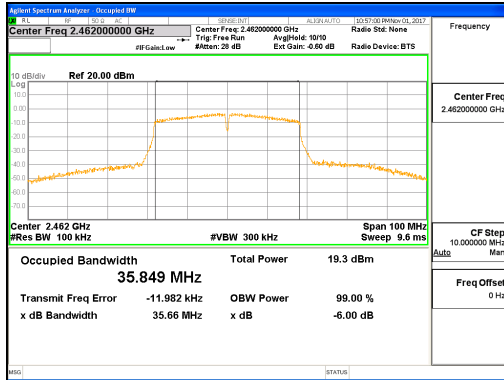
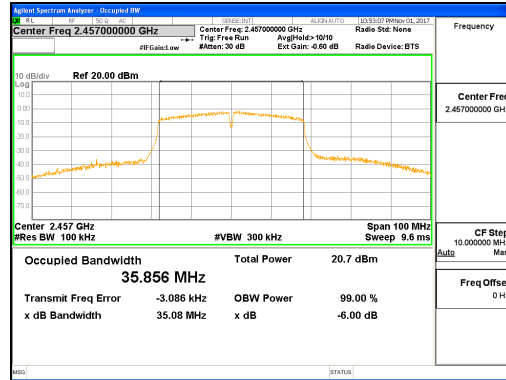
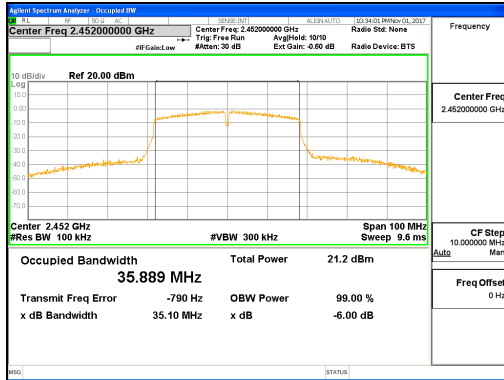
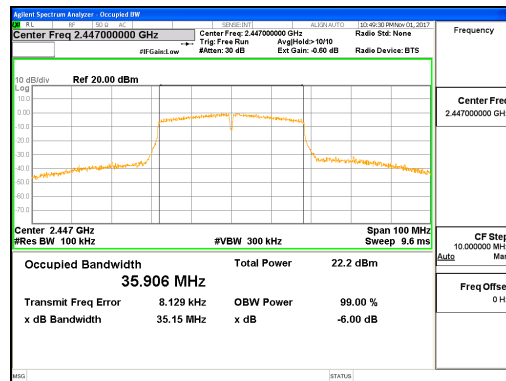
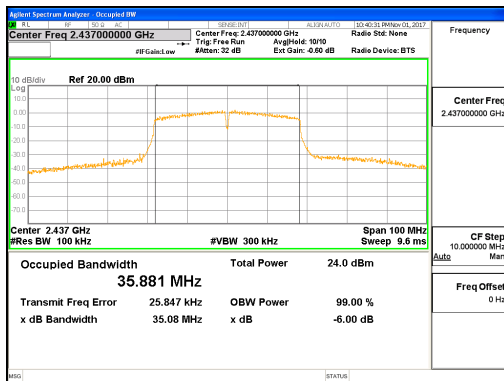
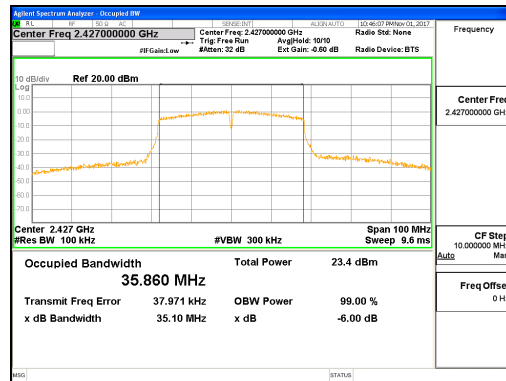
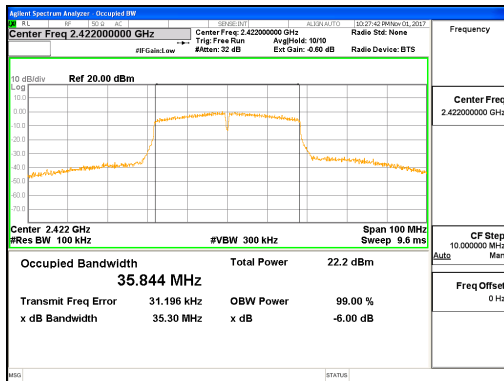


802.11n_HT20_ANT1



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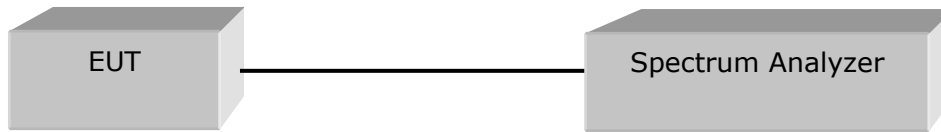
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4.3 OUTPUT POWER

Test Procedures

Average Power(Procedure 9.2.2.2 in KDB 558074, Method AVGSA-1)

The transmitter output is connected to a spectrum analyzer and the analyzer's internal channel power integration function is used to integrate the power over a bandwidth greater than or equal to the 99% bandwidth.



Test Settings:

Center frequency = the highest, middle and the lowest channels

- | | |
|--------------------------------------|-------------------------|
| a) span $\geq 1.5 \times \text{OBW}$ | b) RBW = 1 MHz |
| c) VBW $\geq 3 \times \text{RBW}$ | d) Sweep time = auto |
| e) Detector = RMS | f) average at least 100 |

Limit

Operating Mode	Mode	ANT Configuration	ANT Gain (dBi)	Limit (dBm)	
				FCC	IC
SISO	802.11b/g/n	ANT0	1.83	30	36
SISO	802.11b/g/n	ANT1	1.67	30	36
MIMO (2Tx)	802.11g/n	ANT0 + ANT1	4.76	30	36



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Test Data

Test Mode : 802.11b_ANT0

Frequency (MHz)	Measured Output Power (dBm)		
	Result (dBm)	Limit (dBm)	Margin (dB)
2 412	18.45	30	11.55
2 417	19.34	30	10.66
2 422	19.50	30	10.50
2 437	19.49	30	10.51
2 462	17.42	30	12.58
2 467	13.57	30	16.43
2 472	11.72	30	18.28

Test Mode : 802.11g_ANT0

Frequency (MHz)	Measured Output Power (dBm)		
	Result (dBm)	Limit (dBm)	Margin (dB)
2 412	13.49	30	16.51
2 417	17.18	30	12.82
2 422	18.15	30	11.85
2 437	18.17	30	11.83
2 462	14.94	30	15.06
2 467	12.16	30	17.84
2 472	10.33	30	19.67

Test Mode : 802.11n_HT20_ANT0

Frequency (MHz)	Measured Output Power (dBm)		
	Result (dBm)	Limit (dBm)	Margin (dB)
2 412	15.74	30	14.26
2 417	17.01	30	12.99
2 422	17.61	30	12.39
2 437	18.02	30	11.98
2 462	15.26	30	14.74
2 467	11.83	30	18.17
2 472	9.59	30	20.41

Test Mode : 802.11n_HT40_ANT0

Frequency (MHz)	Measured Output Power (dBm)		
	Result (dBm)	Limit (dBm)	Margin (dB)
2 422	14.26	30	15.74
2 427	15.46	30	14.54
2 437	16.27	30	13.73
2 447	14.60	30	15.40
2 452	13.88	30	16.12
2 457	13.08	30	16.92
2 462	11.43	30	18.57



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Test Mode : 802.11b_ANT1

Frequency (MHz)	Measured Output Power (dBm)		
	Result (dBm)	Limit (dBm)	Margin (dB)
2 412	18.59	30	11.41
2 417	18.84	30	11.16
2 422	18.92	30	11.08
2 437	18.50	30	11.50
2 462	19.24	30	10.76
2 467	18.69	30	11.31
2 472	18.68	30	11.32

Test Mode : 802.11g_ANT1

Frequency (MHz)	Measured Output Power (dBm)		
	Result (dBm)	Limit (dBm)	Margin (dB)
2 412	13.80	30	16.20
2 417	17.29	30	12.71
2 422	18.65	30	11.35
2 437	17.99	30	12.01
2 462	15.23	30	14.77
2 467	12.76	30	17.24
2 472	10.63	30	19.37

Test Mode : 802.11n_HT20_ANT1

Frequency (MHz)	Measured Output Power (dBm)		
	Result (dBm)	Limit (dBm)	Margin (dB)
2 412	15.79	30	14.21
2 417	17.10	30	12.90
2 422	18.26	30	11.74
2 437	17.92	30	12.08
2 462	15.57	30	14.43
2 467	12.58	30	17.42
2 472	10.06	30	19.94

Test Mode : 802.11n_HT40_ANT1

Frequency (MHz)	Measured Output Power (dBm)		
	Result (dBm)	Limit (dBm)	Margin (dB)
2 422	14.53	30	15.47
2 427	15.64	30	14.36
2 437	16.30	30	13.70
2 447	14.38	30	15.62
2 452	13.43	30	16.57
2 457	12.90	30	17.10
2 462	11.40	30	18.60



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Test Mode : 802.11g ANT0+ANT1

Frequency (MHz)	Measured Output Power (dBm)		
	Result (dBm)	Limit (dBm)	Margin (dB)
2 412	16.66	30	13.34
2 417	20.25	30	9.75
2 422	21.42	30	8.58
2 437	21.09	30	8.91
2 462	18.10	30	11.90
2 467	15.48	30	14.52
2 472	13.49	30	16.51

Test Mode : 802.11n HT20_ ANT0+ANT1

Frequency (MHz)	Measured Output Power (dBm)		
	Result (dBm)	Limit (dBm)	Margin (dB)
2 412	18.78	30	11.22
2 417	20.07	30	9.93
2 422	20.96	30	9.04
2 437	20.98	30	9.02
2 462	18.43	30	11.57
2 467	15.23	30	14.77
2 472	12.84	30	17.16

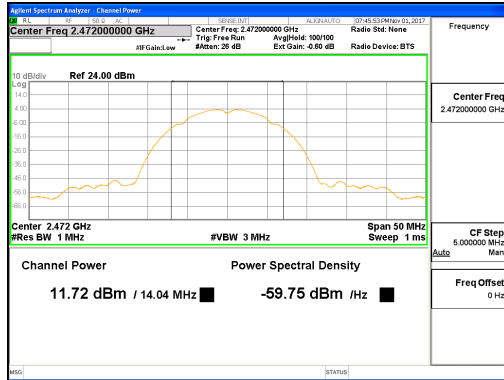
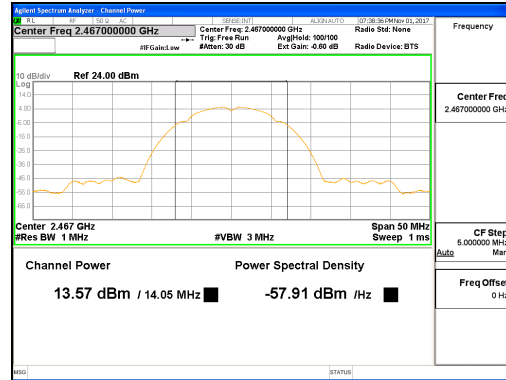
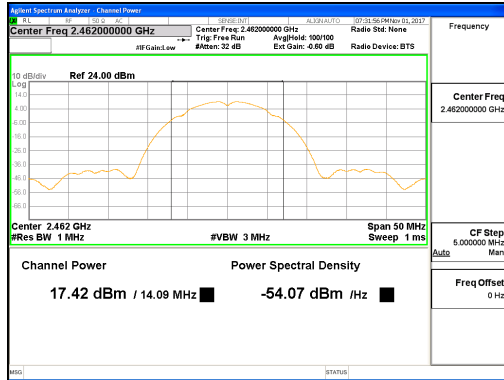
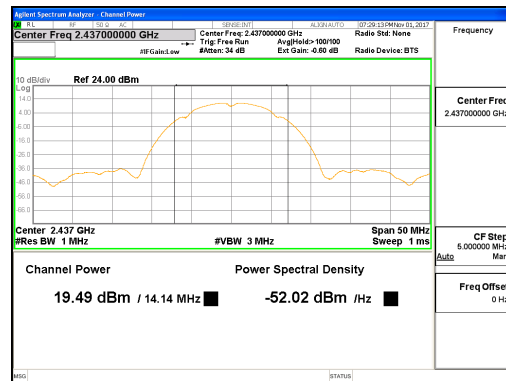
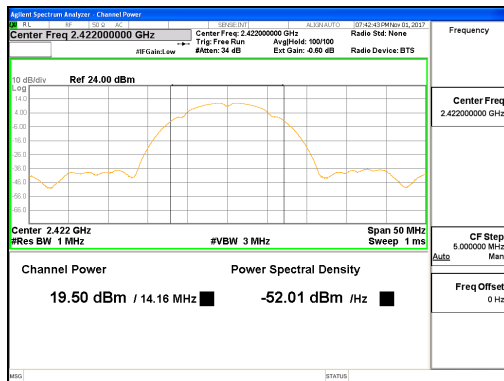
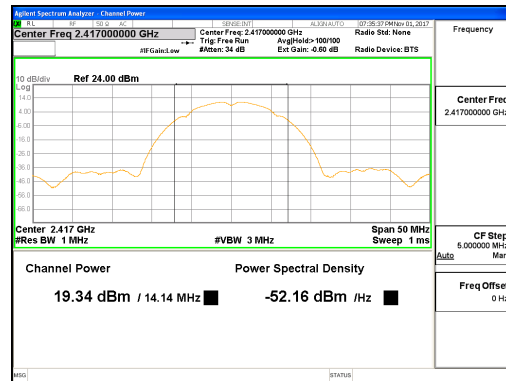
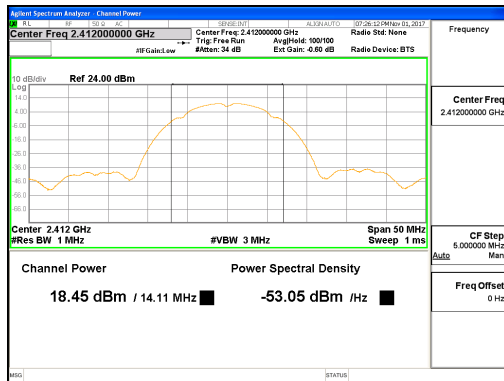
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Frequency (MHz)	Measured Output Power (dBm)		
	Result (dBm)	Limit (dBm)	Margin (dB)
2 422	17.41	30	12.59
2 427	18.56	30	11.44
2 437	19.30	30	10.70
2 447	17.50	30	12.50
2 452	16.67	30	13.33
2 457	16.00	30	14.00
2 462	14.43	30	15.57



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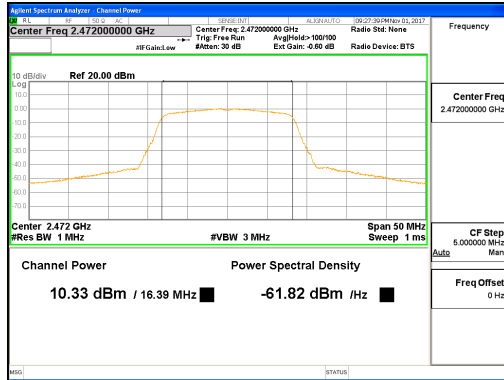
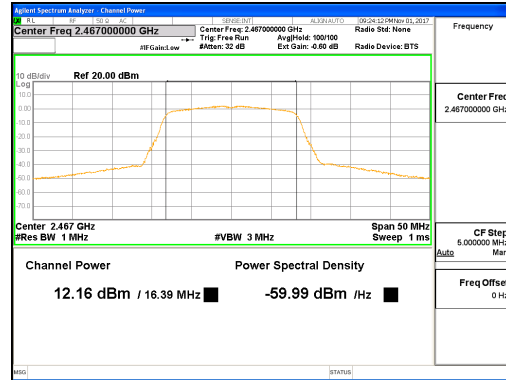
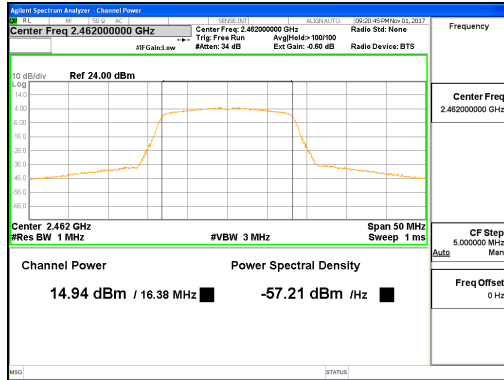
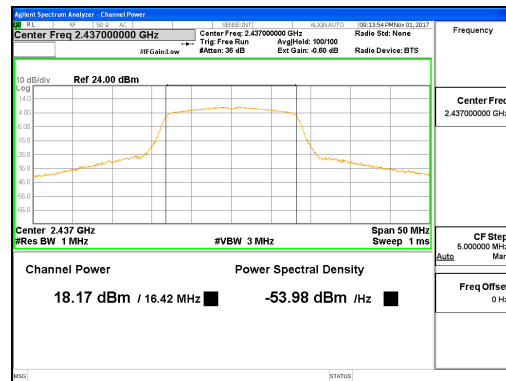
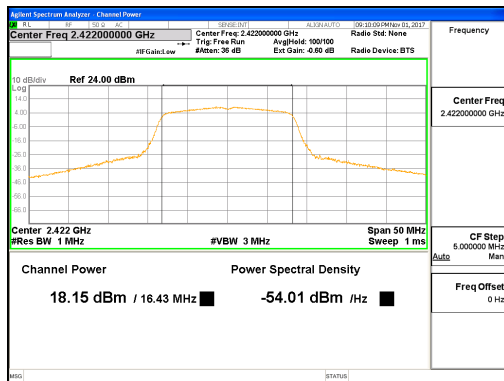
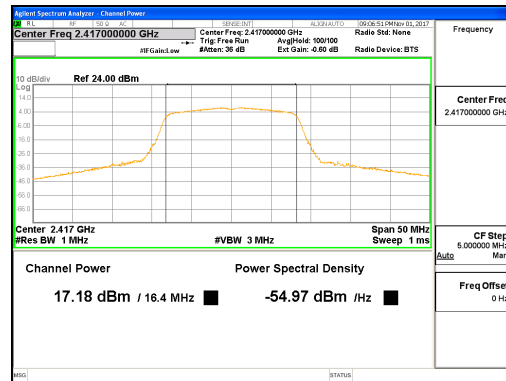
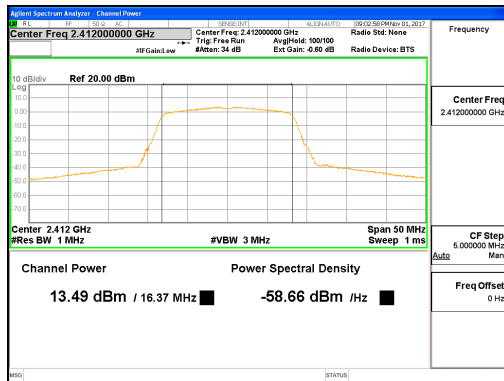


802.11b_ANT0



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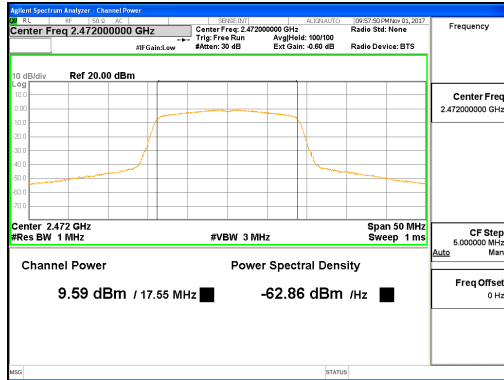
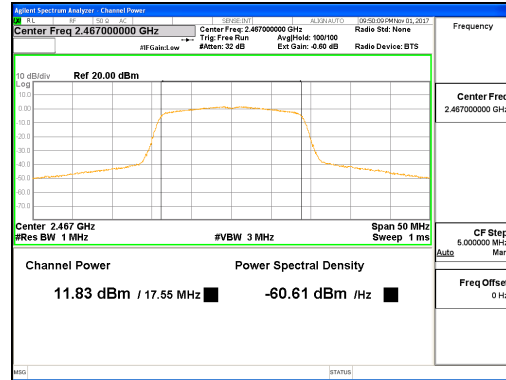
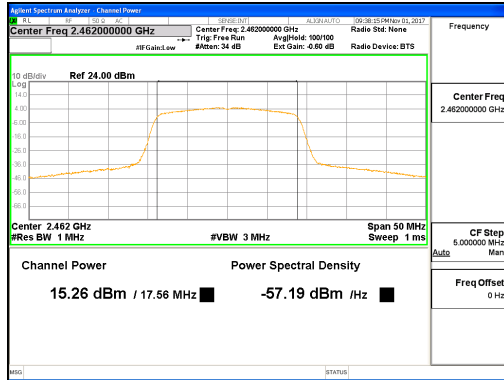
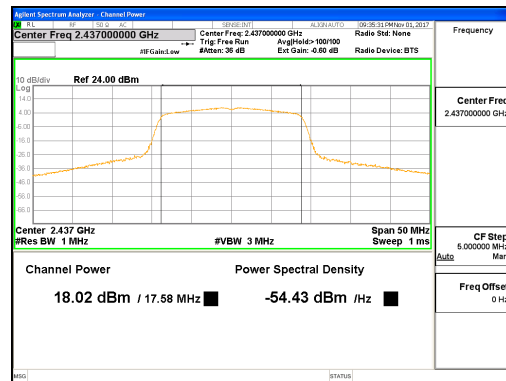
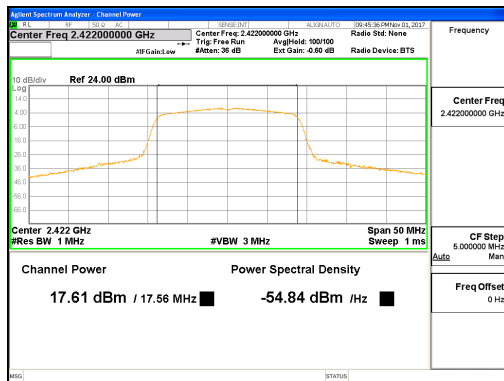
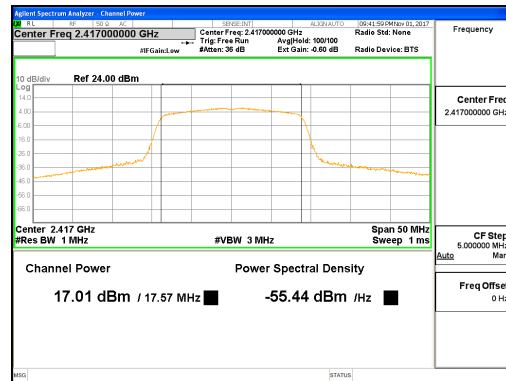
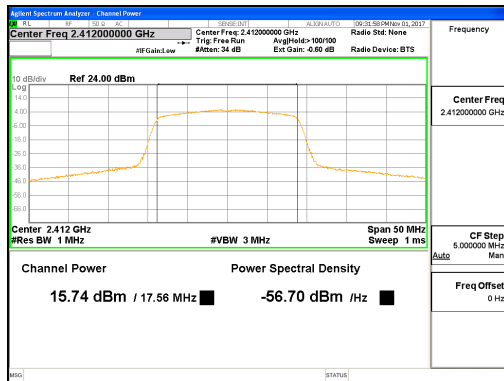


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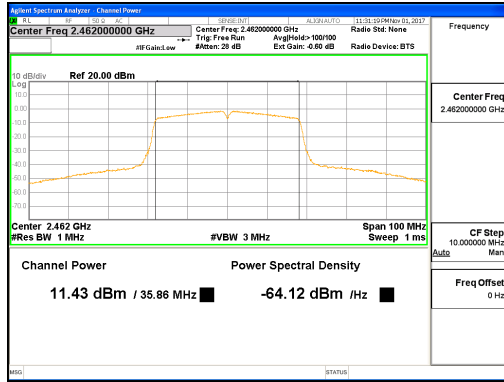
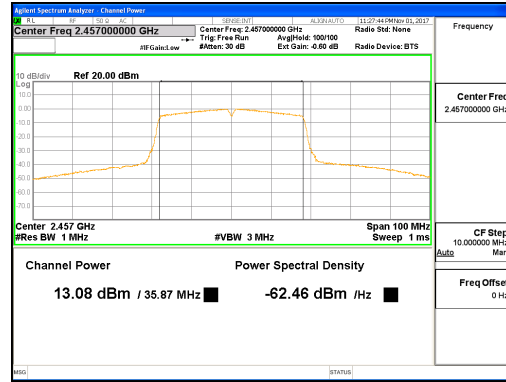
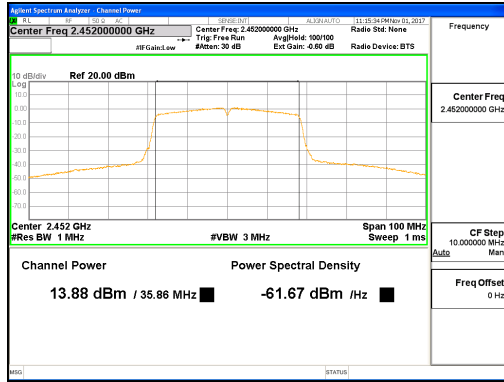
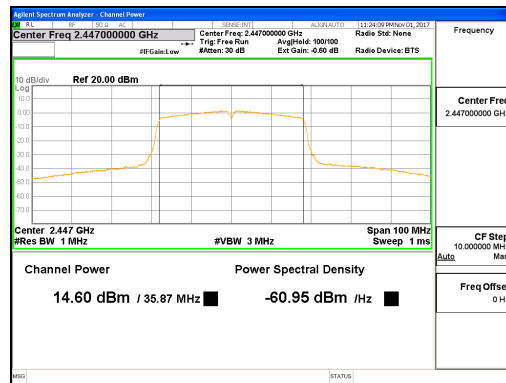
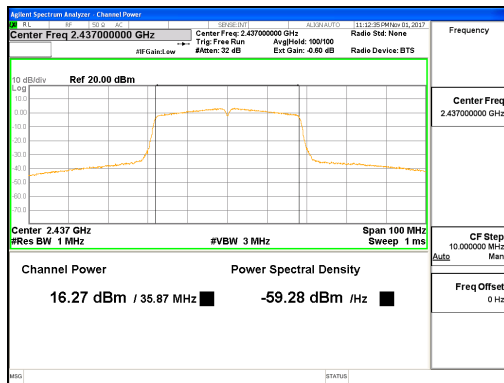
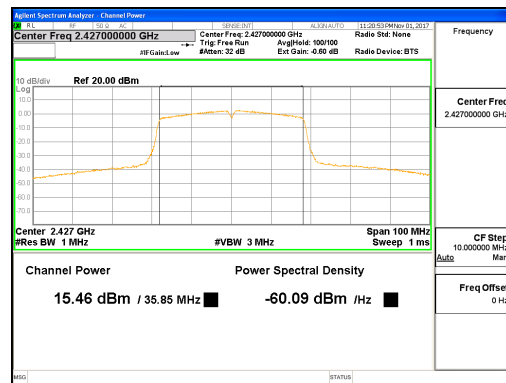
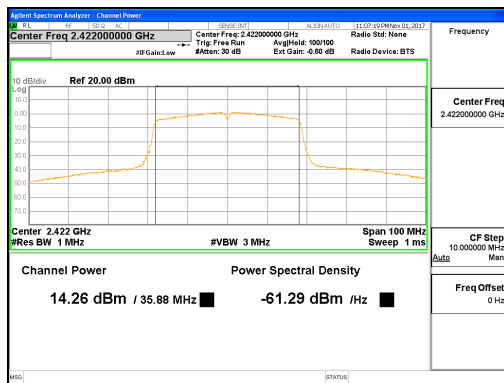


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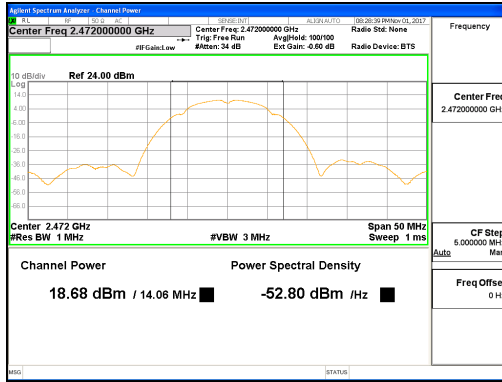
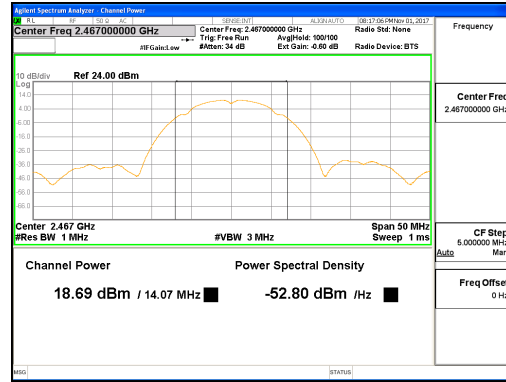
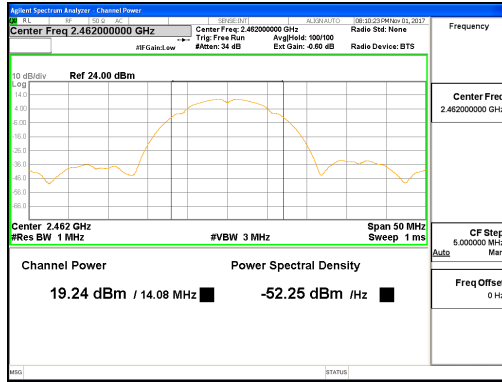
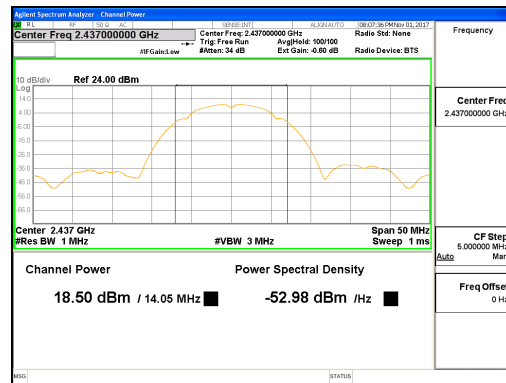
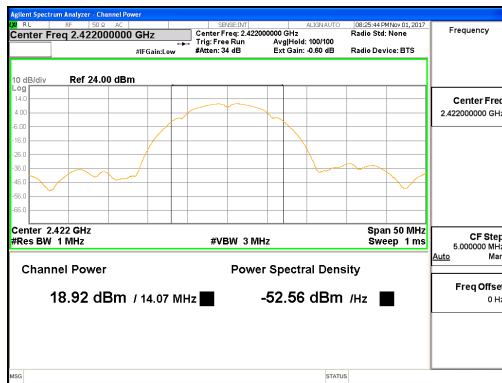
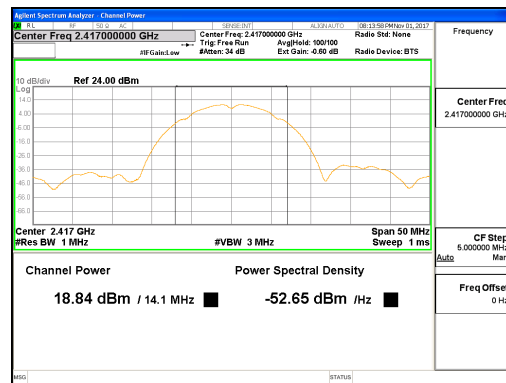
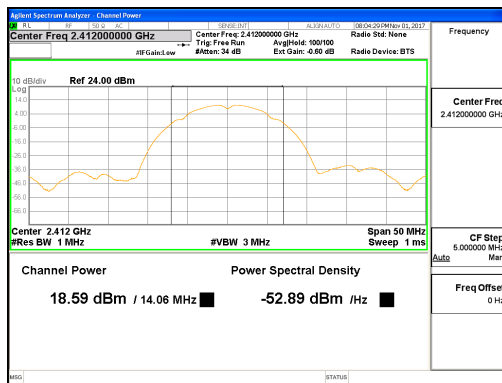


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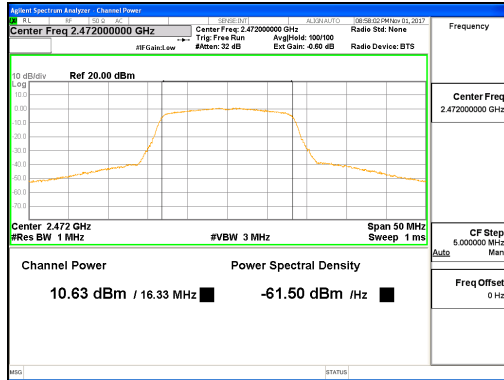
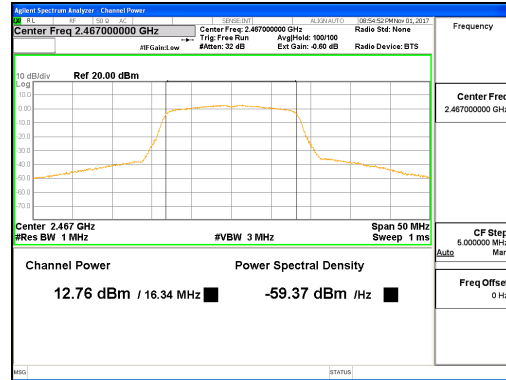
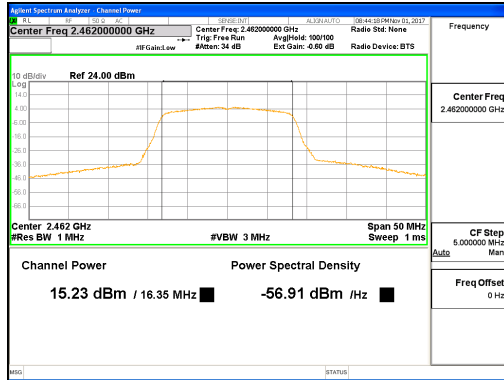
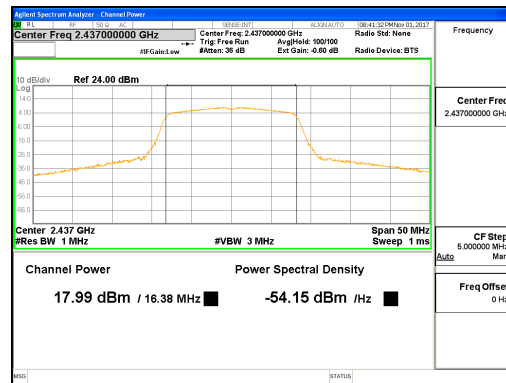
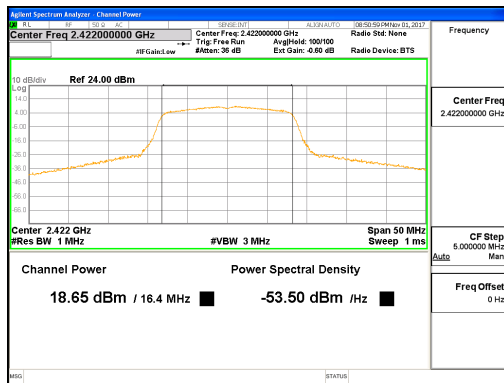
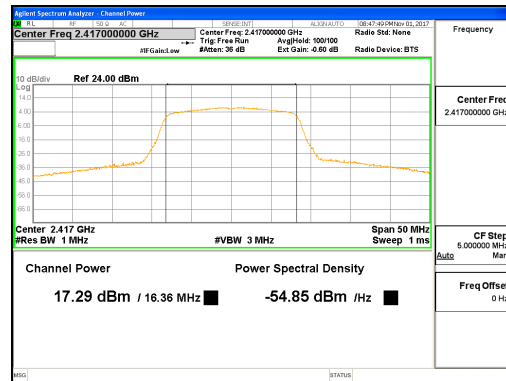
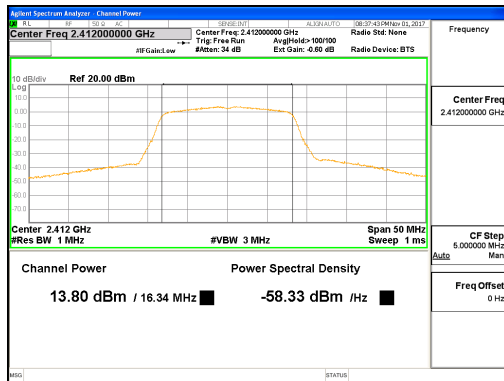


802.11b_ANT1



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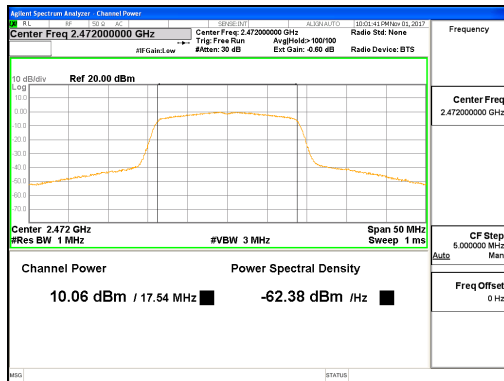
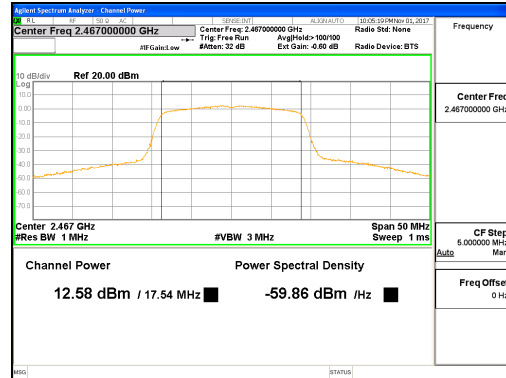
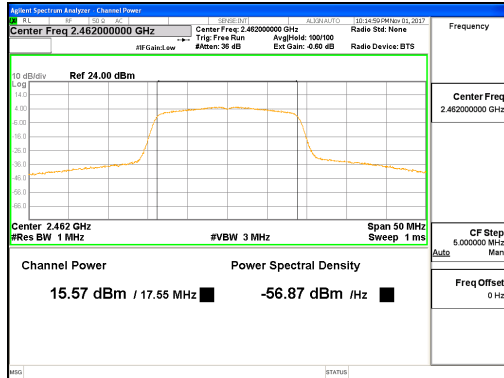
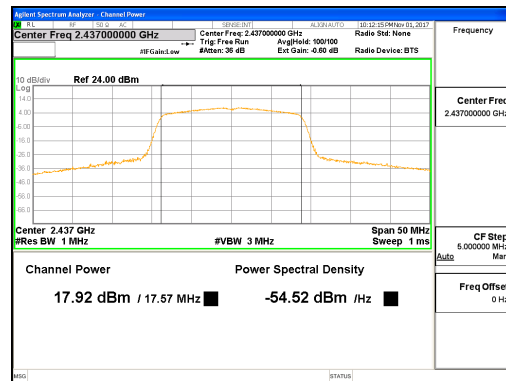
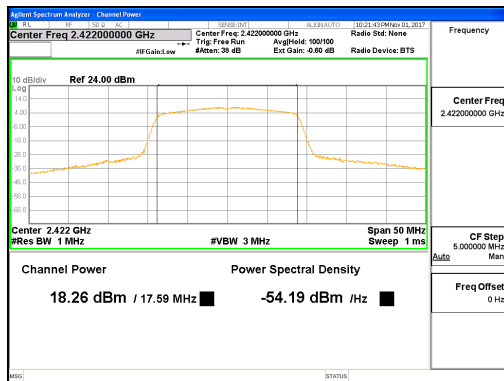
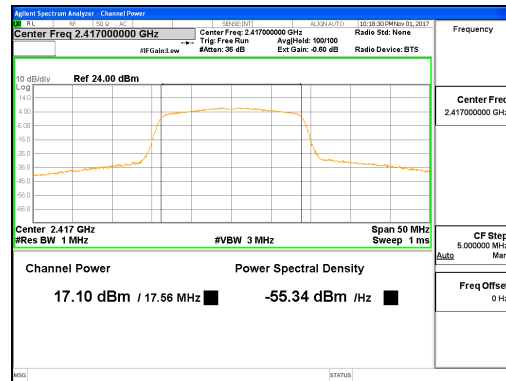
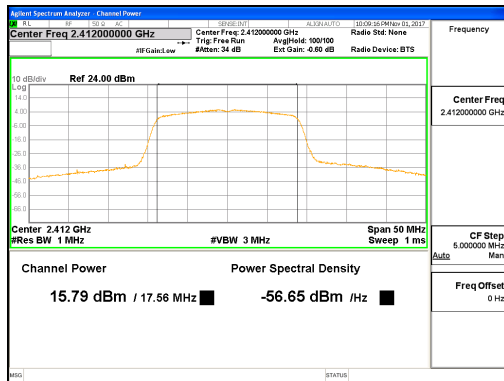


802.11g_ANT1



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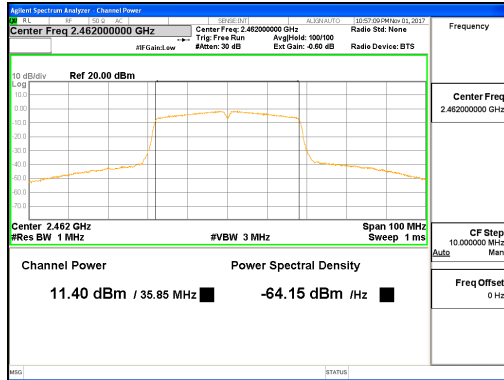
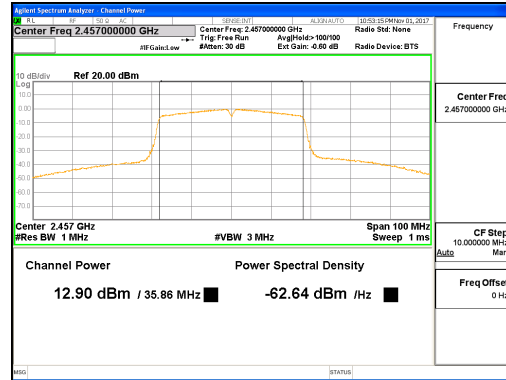
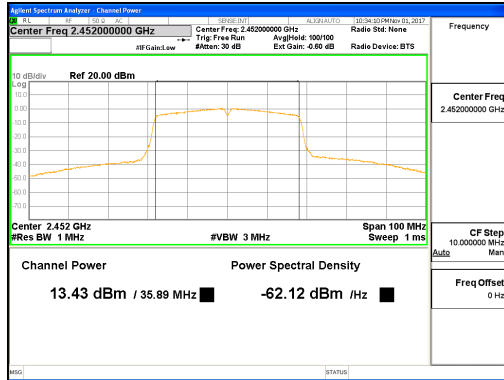
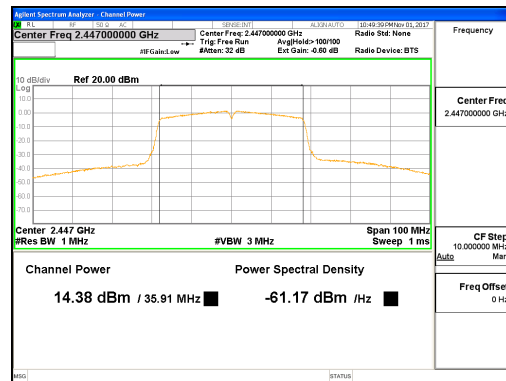
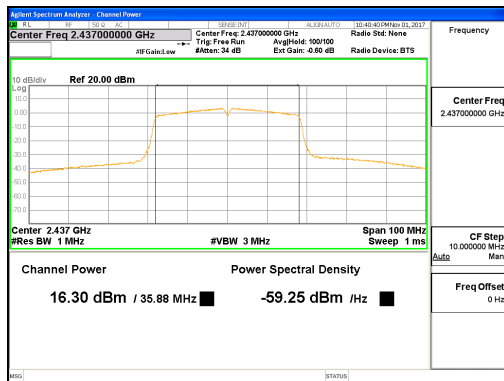
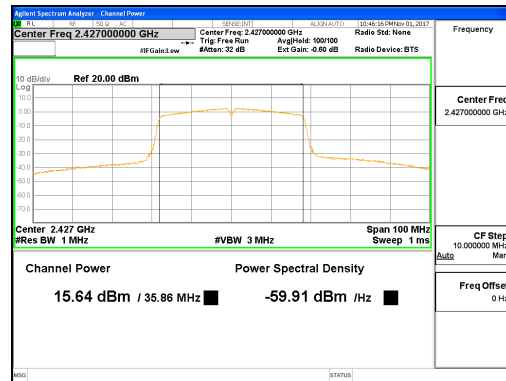
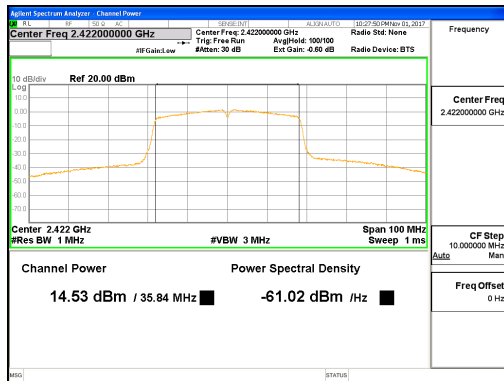


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