

ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

INTENTIONAL RADIATOR CERTIFICATION TO FCC PART 15 SUBPART E REQUIREMENT AND INDUSTRY CANADA RSS 210

OF

Product Name: AirMax AP
Brand Name: UBIQUITI
Model No.: NBE-M5-19
Model Difference: N/A
FCC ID: SWX-NBEM5
IC: 6545A-NBEM5
Report No.: E2/2013/A0029
Issue Date: Nov. 21, 2013
FCC Rule Part: §15.407
IC Rule Part: RSS-210 issue 8:2010, Annex 9
Prepared for FCC: Ubiquiti Networks, Inc.
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 Taipei 110, Taiwan
Prepared for IC: UBIQUITI NETWORKS
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VERIFICATION OF COMPLIANCE

Applicant for FCC: Ubiquiti Networks, Inc.
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Applicant for IC: UBIQUITI NETWORKS
12F, No. 105, Song Ren Rd., Sin Yi District, Taipei 110, Taiwan

Product Name: AirMax AP

Brand Name: UBIQUITI

Model No.: NBE-M5-19

Model Difference: N/A

FCC ID: SWX-NBEM5

IC: 6545A-NBEM5

File Number: E2/2013/A0029

Date of test: Oct. 22, 2013 ~ Nov. 18, 2013

Date of EUT Received:

We hereby certify that:

The above equipment was tested by SGS Taiwan Ltd. Electronics & Communication Laboratory. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.4:2009 and the energy emitted by the sample EUT tested as described in this report is in compliance with conducted and radiated emission limits of FCC Rules Part 15.407 and RSS-210 issue 8: 2010 Annex 9. The test results of this report relate only to the tested sample identified in this report.

Test By:

Jazz Huang

Date:

Nov. 21, 2013

Jazz Huang / Sr. Engineer

Prepared By:

Judy Hsu

Date:

Nov. 21, 2013

Judy Hsu / Clerk

Approved By:

Jim Chang

Date:

Nov. 21, 2013

Jim Chang / Supervisor

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Version

Version No.	Date	Description
00	Nov. 21, 2013	Initial creation of document

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Table of Contents

1. GENERAL INFORMATION.....	7
1.1. Product Description.....	7
1.2. Related Submittal(s) / Grant (s)	11
1.3. Test Methodology.....	11
1.4. Test Facility	11
1.5. Special Accessories	11
1.6. Equipment Modifications	11
2. SYSTEM TEST CONFIGURATION.....	12
2.1. EUT Configuration.....	12
2.2. EUT Exercise	12
2.3. Test Procedure	12
2.4. Configuration of Tested System	13
3. SUMMARY OF TEST RESULT	14
4. DESCRIPTION OF TEST MODES	15
5. MEASUREMENT UNCERTAINTY	20
6. CONDUCTED EMISSION TEST	21
6.1. Standard Applicable	21
6.2. Measurement Equipment Used:	21
6.3. EUT Setup.....	21
6.4. Test SET-UP (Block Diagram of Configuration)	22
6.5. Measurement Procedure.....	22
6.6. Measurement Result.....	22
7. 26dB and 99%EMISSION BANDWIDTH MEASUREMENT	25
7.1 Standard Applicable	25
7.2 Measurement Procedure.....	25
7.3 Measurement Equipment Used:	26
7.4 Test Set-up:.....	26
7.5 Measurement Result.....	27
7.6 Measurement Result.....	37
8. The MAXIMUM OUTPUT POWER MEASUREMENT	47
8.1 Standard Applicable	47
8.2 Measurement Procedure.....	49
8.3 Measurement Equipment Used:	50
8.4 Test Set-up:.....	50

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8.5	Measurement Result.....	51
9.	PEAK POWER SPECTRAL DENSITY.....	63
9.1	Standard Applicable.....	63
9.2	Measurement Procedure (following procedure F, & E) d) method SA-2 in KDB789033 D01).....	65
9.3	Measurement Equipment Used:.....	65
9.4	Test Set-up:.....	65
9.5	Measurement Result.....	66
10.	PEAK EXCURSION MEASUREMENT.....	72
10.1	Standard Applicable.....	72
10.2	Measurement Procedure (following procedure G in KDB789033).....	72
	<i>Note: The test mode to be performed is circle in red as presents above.....</i>	75
10.3	Measurement Equipment Used:.....	75
10.4	Test Set-up:.....	75
10.5	Test Results:.....	76
11.	UNDESIRABLE EMISSION - CONDUCTED MEASUREMENT.....	96
11.1	Standard Applicable.....	96
11.2	Measurement Procedure.....	97
11.3	Measurement Equipment Used:.....	97
11.4	Test Set-up:.....	97
11.5	Measurement Result:.....	97
12.	UNDESIRABLE EMISSION - RADIATED MEASUREMENT.....	117
12.1	Standard Applicable.....	117
12.2	EUT Setup.....	123
12.3	Measurement Procedure.....	123
12.4	Test SET-UP (Block Diagram of Configuration).....	124
12.5	Measurement Equipment Used:.....	125
12.6	Field Strength Calculation.....	126
12.7	Measurement Result.....	126
13.	TRANSMISSION IN THE ABSENCE OF DATA.....	146
13.1	Standard Applicable.....	146
13.2	Result:.....	146
14.	FREQUENCY STABILITY.....	147
14.1	Standard Applicable.....	147
14.2	Result:.....	147
15.	ANTENNA REQUIREMENT.....	150

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15.1 Standard Applicable 150
15.2 Antenna Connected Construction 150

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1. GENERAL INFORMATION

1.1. Product Description

General:

Product Name:	AirMax AP	
Brand Name:	UBIQUITI	
Model No.:	NBE-M5-19	
Model Difference:	N/A	
Hardware Version:	N/A	
Software Version:	N/A	
Power Supply:	24Vdc from AC/DC adapter	
	Adapter:	Model No.: GP-A240-050; Supplier: UBIQUITI

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WLAN 5GHz:

Wi-Fi	Frequency Range	Channels	Rated Power (Avg.) / Average Rated Power(EIRP)	Modulation Technology	Type of Emission
11a	5150~5250	4	Avg. Power: (Main)12.58dBm (Aux) 13.61dBm EIRP: (Main)14.89dBm (Aux) 19.02dBm	OFDM	16M5D1D
11n	HT20 5150~5250	4	Avg. Power: (Main)11.03dBm (Aux) 12.32dBm (MIMO Chain 0): 8.82dBm (MIMO Chain 1): 10.78dBm (MIMO Chain 0+1): 12.92dBm EIRP: (Main)13.34dBm (Aux) 17.73dBm (MIMO Chain 0):18.07dBm (MIMO Chain 1): 20.03dBm (MIMO Chain 0+1): 22.17dBm	OFDM	17M8D1D
11n	HT40 5150-5250	2	Avg. Power: (Main)5.15dBm (Aux) 6.73dBm (MIMO Chain 0): 5.68dBm (MIMO Chain 1): 6.34dBm (MIMO Chain 0+1): 9.02dBm EIRP (Main)7.46dBm (Aux) 12.14dBm (MIMO Chain 0):14.93dBm (MIMO Chain 1): 15.59dBm (MIMO Chain 0+1): 18.27dBm	OFDM	36M2D1D
Antenna Designation			Array of patch Antenna 5GHz Gain(Main): 2.31dBi (5150MHz-5250MHz) 5GHz Gain(Aux) : 5.41dBi (5150MHz-5250MHz) 5GHz Gain(MIMO):9.25 dBi (5150MHz-5250MHz)		
Modulation type			64QAM, 16QAM, QPSK, BPSK for OFDM		
Transition Rate:			802.11 a: 6/9/12/18/24/36/48/54 Mbps 802.11 n_20MHz: 6.5 – 144Mbps 802.11 n_40MHz: 13.5 – 300Mbps		

This report applies for frequency bands 5150MHz-5250MHz.

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IEEE 802.11n Spec:

MCS Index	Nss	Modulation	R	NBPS	NCBPS		NDBPS		Datarate(Mbps)			
					20MHz	40MHz	20MHz	40MHz	800nsGI		400nsGI	
									20MHz	40MHz	20MHz	40MHz
0	1	BPSK	1/2	1	52	108	26	54	6.5	13.5	7.200	15
1	1	QPSK	1/2	2	104	216	52	108	13.0	27.0	14.400	30
2	1	QPSK	3/4	2	104	216	78	162	19.5	40.5	21.700	45
3	1	16-QAM	1/2	4	208	432	104	216	26.0	54.0	28.900	60
4	1	16-QAM	3/4	4	208	432	156	324	39.0	81.0	43.300	90
5	1	64-QAM	2/3	6	312	648	208	432	52.0	108.0	57.800	120
6	1	64-QAM	3/4	6	312	648	234	486	58.5	121.5	65.000	135
7	1	64-QAM	5/6	6	312	648	260	540	65.0	135.0	72.200	150

Symbol	Explanation
NSS	Number of spatial streams
R	Code rate
NBPS	Number of coded bite per single carrier
NCBPS	Number of coded bite per symbol
NDBPS	Number of data bite per symbol
GI	Guard interval

802.11n_HT20 MCS8 -15

MCS Index	Modulation	R	NBPS <i>(iSS)</i>	N _{SD}	N _{SP}	N _{CBPS}	N _{DBPS}	Data rate (Mb/s)	
								800 ns GI	400 ns GI (see NOTE)
8	BPSK	1/2	1	52	4	104	52	13.0	14.4
9	QPSK	1/2	2	52	4	208	104	26.0	28.9
10	QPSK	3/4	2	52	4	208	156	39.0	43.3
11	16-QAM	1/2	4	52	4	416	208	52.0	57.8
12	16-QAM	3/4	4	52	4	416	312	78.0	86.7
13	64-QAM	2/3	6	52	4	624	416	104.0	115.6
14	64-QAM	3/4	6	52	4	624	468	117.0	130.0
15	64-QAM	5/6	6	52	4	624	520	130.0	144.4

NOTE—The 400 ns GI rate values are rounded to 1 decimal place.

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802.11n_HT40 MCS8 -15

MCS Index	Modulation	R	$N_{BPSCS(i_{SS})}$	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	Data rate (Mb/s)	
								800 ns GI	400 ns GI
8	BPSK	1/2	1	108	6	216	108	27.0	30.0
9	QPSK	1/2	2	108	6	432	216	54.0	60.0
10	QPSK	3/4	2	108	6	432	324	81.0	90.0
11	16-QAM	1/2	4	108	6	864	432	108.0	120.0
12	16-QAM	3/4	4	108	6	864	648	162.0	180.0
13	64-QAM	2/3	6	108	6	1296	864	216.0	240.0
14	64-QAM	3/4	6	108	6	1296	972	243.0	270.0
15	64-QAM	5/6	6	108	6	1296	1080	270.0	300.0

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1.2. Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended for **FCC ID: SWX-NBEM5** filing to comply with Section 15.407 of the FCC Part 15, Subpart C Rules. And **IC: 6545A-NBEM5** filing to comply with Industry Canada RSS-210 issue 8: 2010 Annex 9. The composite system (digital device) is compliance with Subpart B is authorized under a DoC procedure.

1.3. Test Methodology

Both conducted and radiated testing were performed according to the procedures in ANSI C63.4:2009 & KDB 789033 D01 published on 04, 08, 2013. Radiated testing was performed at an antenna to EUT distance 3 meters.

Tested in accordance with FCC KDB789033 D01 for compliance to FCC 47CFR 15.407 requirements.

1.4. Test Facility

The measurement facilities used to collect the 3m Radiated Emission and AC power line conducted data are located on the address of SGS Taiwan Ltd. Electronics & Communication Laboratory No.2, Keji 1st Rd., Guishan Township, Taoyuan County, Taiwan 333 which are constructed and calibrated to meet the FCC requirements in documents ANSI C63.4:2009. FCC Registration Number is: 990257. Canada Registration Number: 4620A-4.

The 10 m Open Area Test Sites located on the address of SGS Taiwan Ltd. Electronics & Communication Laboratory No. 29, Pau-Tou-Tsuo Valley Chia-Pau Tsuen, Linkou Hsiang, Taipei county, which is constructed and calibrated to meet the CISPR 22/EN 55022 requirements. SGS Site No. 1(3 &10 meters) and FCC Registration Number: 94644.

1.5. Special Accessories

There are no special accessories used while test was conducted.

1.6. Equipment Modifications

There was no modification incorporated into the EUT.

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2. SYSTEM TEST CONFIGURATION

2.1. EUT Configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner which intends to maximize its emission characteristics in a continuous normal application.

2.2. EUT Exercise

An engineering test mode (software/firmware) that applicant provided was utilized to manipulate the EUT into transmit, selection of the test channel, and modulation scheme.

2.3. Test Procedure

2.3.1 Conducted Emissions

The EUT is placed on a turn table which is 0.8 m above ground plane. According to the general criterion in Section 7.1 of ANSI C63.4:2009. Conducted emissions from the EUT are measured in the frequency range between 0.15 MHz and 30MHz, and the measurement procedure 7.3 in ANSI 63.4:2009 & 6.2.2, is followed to carry out the test. The CISPR -Peak and Average detector mode is employed according to §15.107

2.3.2 Radiated Emissions

The EUT is placed on a turn table which is 0.8 m above ground plane. The turn table shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of this hand-held transmitter (EUT) was rotated through three orthogonal axes and measurement procedures for electric field radiated emissions above 1 GHz the EUT measurement is to be made “while keeping the antenna in the ‘cone of radiation’ from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response.” is still within the 3dB illumination BW of the measurement antenna according to the requirements in Section 8 and 13 and of ANSI C63.4:2009 and DA 00-705.

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2.4. Configuration of Tested System

Fig. 2-1 Radiated Emission & Conducted (Antenna Port) Configuration

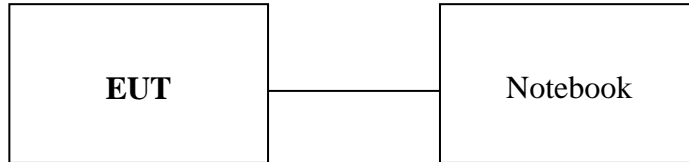


Fig. 2-3 AC Power Line Conducted Emission

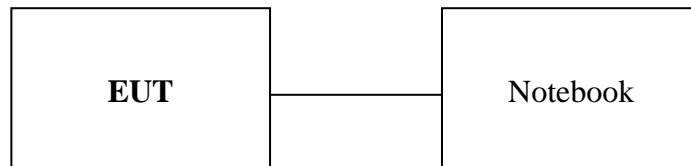


Table 2-1 Equipment Used in Tested System

Item	Equipment	Mfr/Brand	Model/Type No.	Series No.	Data Cable	Power Cord
1.	WLAN Test Software	N/A	N/A	N/A	N/A	N/A
2.	Notebook	Lenovo	L430	LR-7HXZA	Shielding	Un-Shielding

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3. SUMMARY OF TEST RESULT

FCC/IC Rules	Description Of Test	Result
§15.207 RSS-Gen §7.2.4	AC Power Line Conducted Emission	Compliant
§15.407(a) (1) (2) RSS 210 A9.2 RSS-Gen §4.6.1	26 dB and 99% Emission Bandwidth	Compliant
§15.407(a) (1) (2) RSS 210 A9.2(1)(2)(3)	The Maximum Output Power Measurement	Compliant
§15.407(a) (5) RSS 210 A9.2(1)(2)(3)	Peak Power Spectral Density Measurement	Compliant
15.407(a)(6)	Peak Excursion Measurement	Compliant
§15.407(b) (1) (2) (3) RSS 210 A9.2(1)(2)(3)	Undesirable Emission – Conducted Measurement	Compliant
§15.407(b) (1) (2) (3)(6) (7) RSS 210 A9.2 (1) (2)(3) RSS-Gen 7.2.5	Undesirable Emission – Radiated Measurement	Compliant
§15.407(c) RSS 210 A9.4(4)	Transmission in case of Absence of Information	Compliant
§15.407(g)	Frequency Stability	Compliant
§15.203 RSS-Gen 7.1.2	Antenna Requirement	Compliant
§15.407(h) RSS 210 A9.3	TPC and DFS Measurement	Compliant

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4. DESCRIPTION OF TEST MODES

The EUT has been tested under operating condition.

Test program used to control the EUT for staying in continuous transmitting mode is programmed.

a mode:

5150MHz-5250MHz: Channel lowest(5180MHz) 、Mid(5220MHz) and Highest(5240MHz).
with 6Mbps data rate are chosen for full testing.

n HT 20 mode:

5150MHz-5250MHz: Channel lowest(5180MHz) 、Mid(5220MHz) and Highest(5240MHz).
with 6.5Mbps data rate are chosen for full testing

n HT 40 mode:

5150MHz-5250MHz: Channel lowest (5190MHz) and Highest (5230MHz).
with 13.5Mbps data rate are chosen for full testing

The worst case is determined by the output power that generates the highest emission. As examined in the section of output power measurement, the section 7.5, the lowest data rate at a/b/g/n_HT20/n_HT40 resulted the highest level of fundamental emission, and therefore, the lowest data rate is chosen as the worst-case to conduct the remaining of other mandatory test cases.

The field strength of radiation emission was measured as EUT stand-up position (H mode) and lie down position (E1, E2 mode) for 802.11a/n WLAN Transmitter for channel Low, Mid and High, the worst case E1 position was reported.

Pre-scanned was done on Main antenna and Aux antenna , and Aux antenna results higher emission at 5GHz. Therefore, the completed set of measurement was done on Aux antenna to be presented on this test report.

For radiation spurious emission test relevant n_HT20&HT40, MIMO mode that generates the higher emission is chosen to be tested in comparison with transmission at SISO mode.

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Duty Cycle Analysis:

Pre-analysis Check: While conducting average power measurement, duty cycle of each mode (a/n_ht20/n_ht40) shall be checked to ensure its duty cycle in order to compensate for the loss due to insufficient ratio of duty cycle. All duty cycle is pre-scanned, resulted as obtained below, and showed only the most representative ones

Tabular results as indicates below entails the results of duty factor for all supported modes.

Formula:

$$\text{Duty Cycle} = \text{Ton} / (\text{Ton} + \text{Toff})$$

Test Procedure:

Set span = 0, RBW = 8MHz, the largest as possible, VBW = 8MHz, Detector = Peak, and RBW, and VBW = the highest RBW the spectrum is capable of, where zero-span is permissible, that > 50/T, where T is ~ 4.3ms

Duty Cycle:

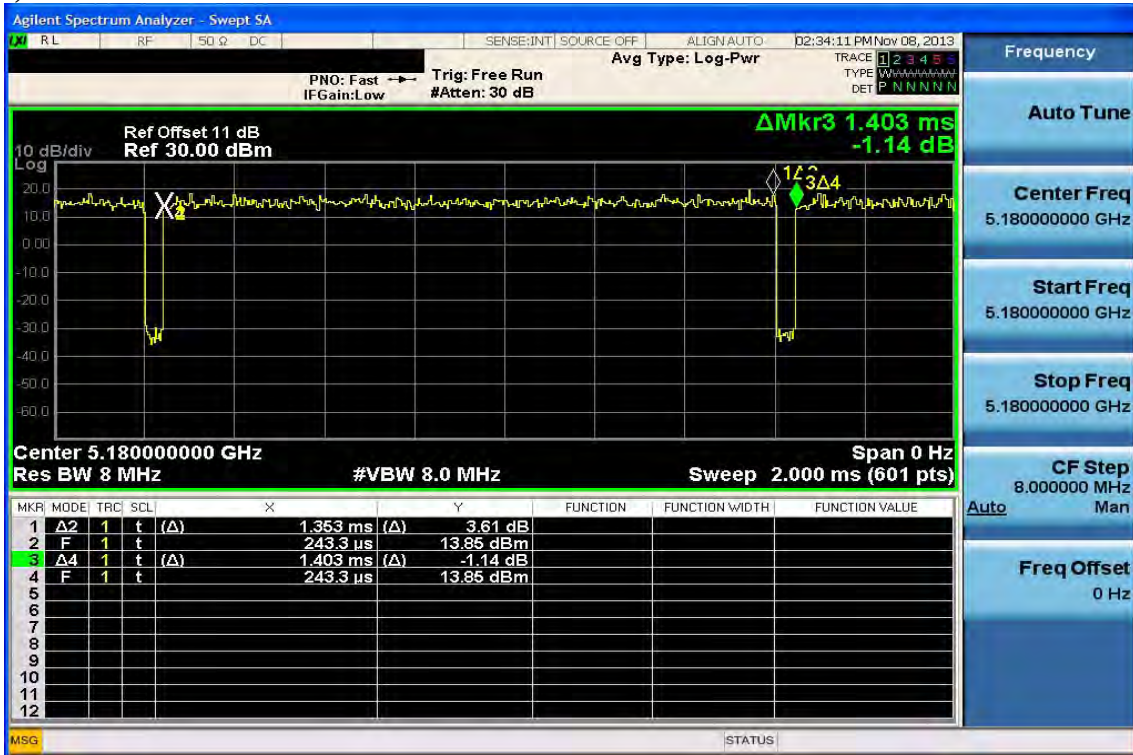
5150-5725MHz	Antenna	Duty Cycle	Duty Factor (dB)
802.11a	Single- Aux	0.961	0.1734
802.11n_20	MIMO-Main	0.915	0.3834
	MIMO-Aux	0.915	0.3834
802.11n_40	MIMO-Main	0.916	0.3789
	MIMO-Aux	0.916	0.3789

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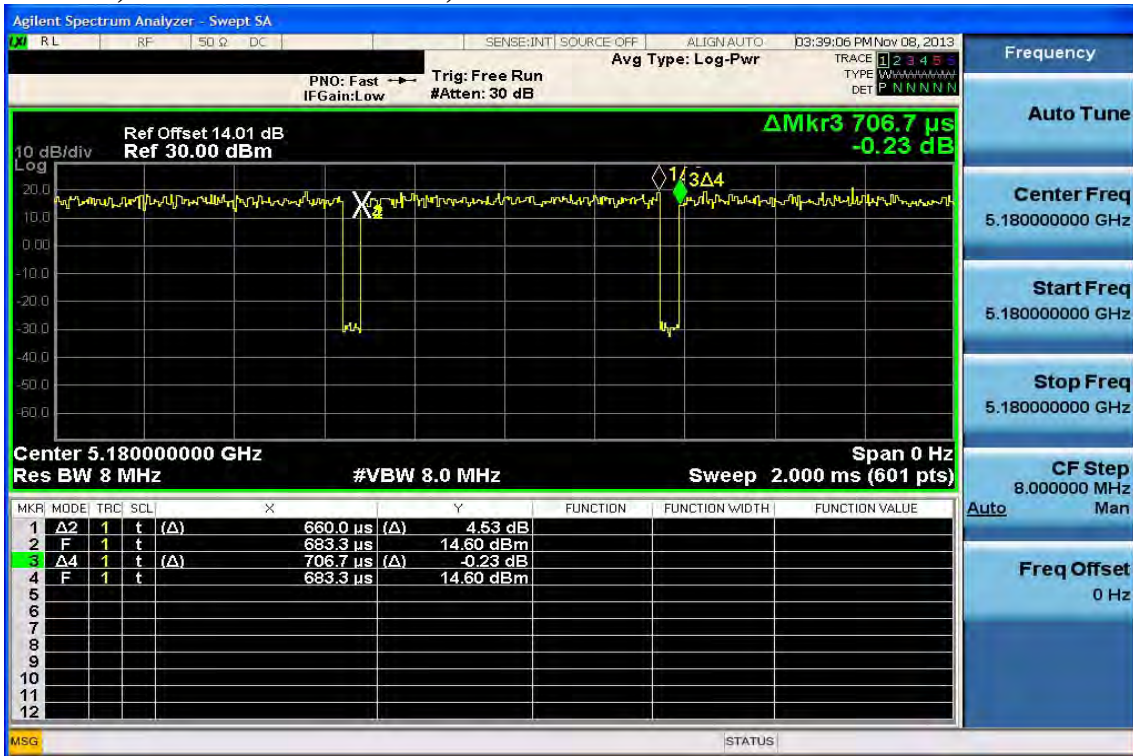
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DUTY CYCLE OF TEST SIGNAL 802.11a, CH Low 5180 MHz



802.11n HT20, CH Low 5180 MHz, MIMO-Main



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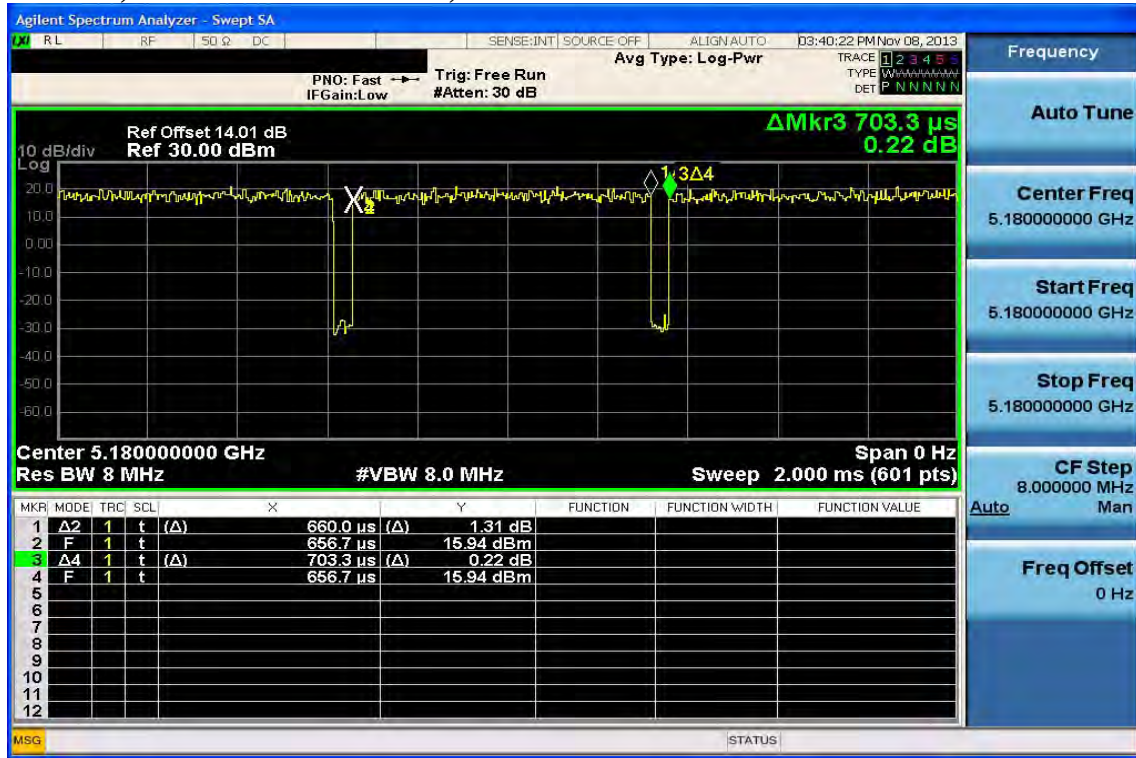
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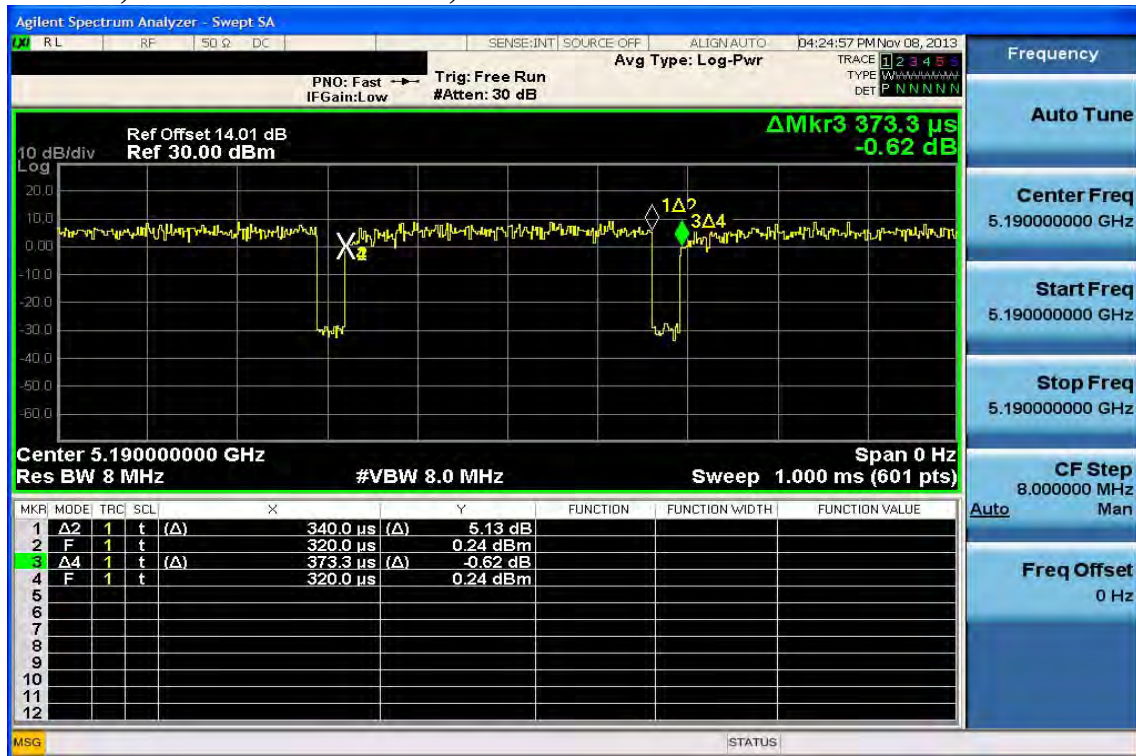
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802.11n HT20, CH Low 5180 MHz, MIMO-Aux



802.11n HT40, CH Low 5190 MHz, MIMO-Main



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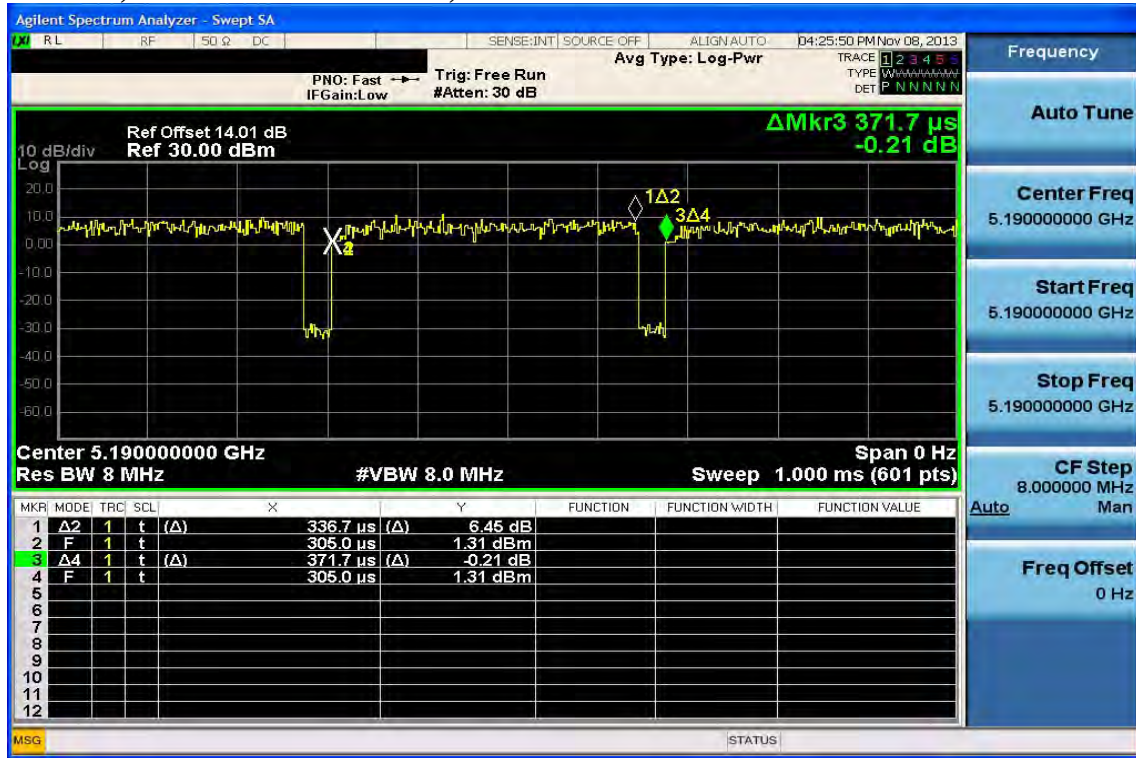
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802.11n HT40, CH Low 5190 MHz, MIMO-Aux



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5. MEASUREMENT UNCERTAINTY

Test Items	Uncertainty
AC Power Line Conducted Emission	+/- 2.586 dB
26 dB and 99% Emission Bandwidth	+/- 123.36 Hz
The Maximum Output Power Measurement	+/- 1.42 dB
Peak Power Spectral Density Measurement	+/- 1.55 dB
Peak Excursion Measurement	+/- 1.55 dB
Undesirable Emission – Conducted Measurement	+/- 1.55 dB
Transmission in case of Absence of Information	+/- 1.55 dB
Frequency Stability	+/- 123.36 Hz
TPC and DFS Measurement	+/- 123.36 Hz
Temperature	+/- 0.8 °C
Humidity	+/- 4.7 %
DC / AC Power Source	DC= +/- 1%, AC= +/- 0.2%

Radiated Spurious Emission:

Measurement uncertainty (Polarization : Vertical)	30MHz - 180MHz: +/- 3.37dB
	180MHz -417MHz: +/- 3.19dB
	0.417GHz-1GHz: +/- 3.19dB
	1GHz - 18GHz: +/- 4.04dB
	18GHz - 40GHz: +/- 4.04dB

Measurement uncertainty (Polarization : Horizontal)	30MHz - 167MHz: +/- 4.22dB
	167MHz -500MHz: +/- 3.44dB
	0.5GHz-1GHz: +/- 3.39dB
	1GHz - 18GHz: +/- 4.08dB
	18GHz - 40GHz: +/- 4.08dB

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

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6. CONDUCTED EMISSION TEST

6.1. Standard Applicable

According to §15.207 and RSS-Gen §7.2.4, frequency range within 150 KHz to 30 MHz shall not exceed the Limit table as below.

Frequency range MHz	Limits dB(uV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50

Note

- The lower limit shall apply at the transition frequencies
- The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.

6.2. Measurement Equipment Used:

SGS Conducted Emission Test Site No.A					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
EMI Test Receiver	R&S	ESCI 7	100924	05/10/2013	05/09/2014
Coaxial Cables	N/A	N30N30-1042-150cm	N/A	02/07/2013	02/06/2014
LISN	SCHWARZBEC K	NSLK 8127	8127-648	06/17/2012	06/16/2014
Pulse Limit	narda	PL01	1110X30602	08/14/2013	08/13/2014
Test Software	Farad	EZ-EMC	Ver. SGS-03A1	N.C.R.	N.C.R.

6.3. EUT Setup

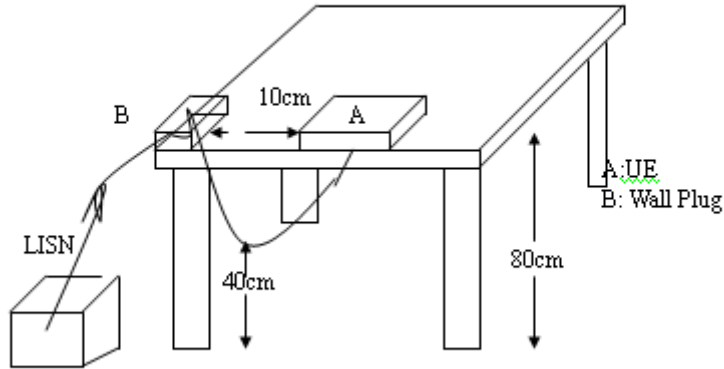
- The conducted emission tests were performed in the test site, using the setup in accordance with the ANSI C63.4:2009.
- The AC/DC Power adaptor of EUT was plug-in LISN. The rear of the EUT and peripherals were placed flushed with the rear of the tabletop.
- The LISN was connected with 120Vac/60Hz power source.

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6.4. Test SET-UP (Block Diagram of Configuration)



6.5. Measurement Procedure

1. The EUT was placed on a table which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all phases of power being supplied by given UE are completed

6.6. Measurement Result

Note: Refer to next page for measurement data and plots.

Note2: The * reveals the worst-case results that that closet to the limit

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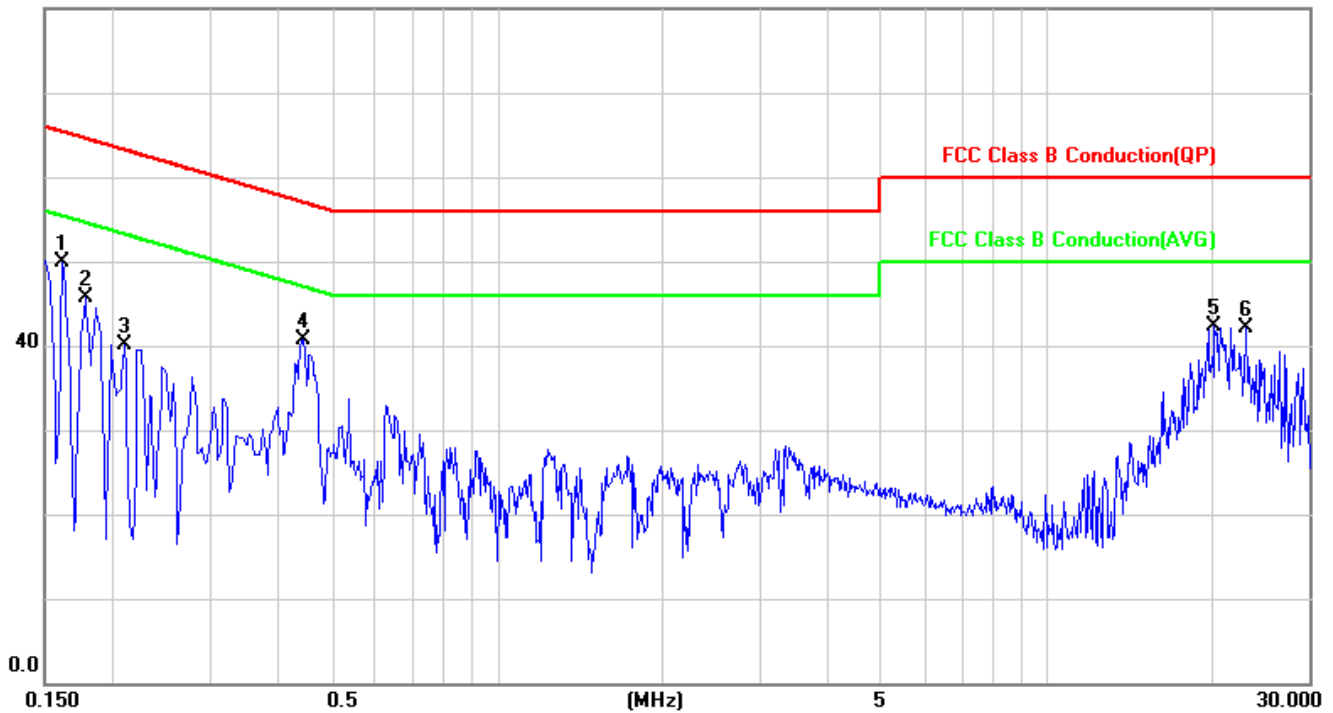
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AC POWER LINE CONDUCTED EMISSION TEST DATA

Operation Mode:	Operation mode	Test Date:	Nov. 15, 2013
Temperature:	26 °C	Humidity:	60 %
		Test By:	Vito
		Probe:	L1/N

80.0 dBuV



No.	Alt.	Freq.	Reading	Factor	Measurement	Limit	Over	Detector	Comment
		(MHz)	dBuV	(dB)	(dBuV)	(dBuV)	(dB)		
1	*	0.1620	49.35	0.52	49.87	65.36	-15.49	peak	
2		0.1780	45.17	0.52	45.69	64.58	-18.89	peak	
3		0.2100	39.54	0.51	40.05	63.21	-23.16	peak	
4		0.4420	40.08	0.53	40.61	57.02	-16.41	peak	
5		20.2580	40.69	1.54	42.23	60.00	-17.77	peak	
6		23.1260	40.27	1.78	42.05	60.00	-17.95	peak	

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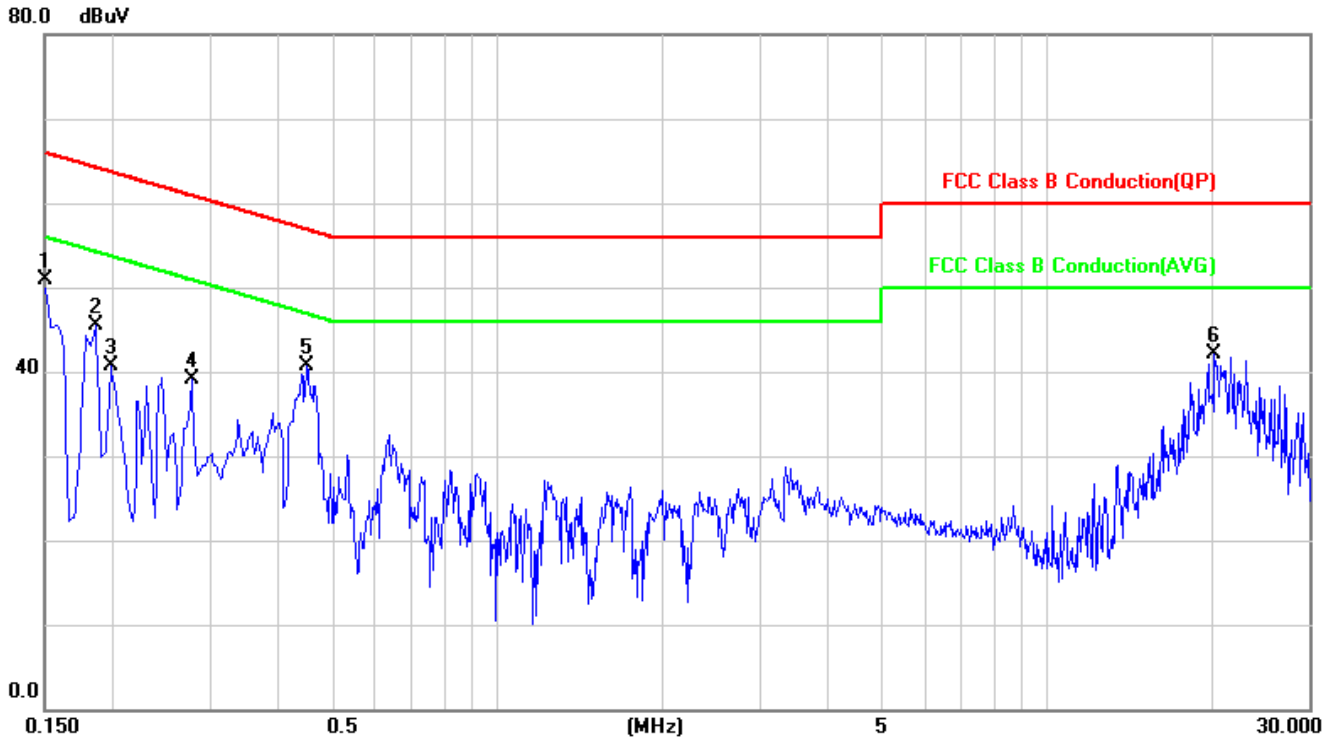
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No.	MHz	Freq. (MHz)	Reading dBuV	Factor (dB)	Measurement (dBuV)	Limit (dBuV)	Over (dB)	Detector	Comment
1	*	0.1500	50.81	0.16	50.97	66.00	-15.03	QP	
2		0.1860	45.41	0.16	45.57	64.21	-18.64	QP	
3		0.1980	40.56	0.16	40.72	63.69	-22.97	QP	
4		0.2780	38.97	0.16	39.13	60.88	-21.75	QP	
5		0.4500	40.54	0.18	40.72	56.88	-16.16	QP	
6		20.2580	41.15	0.93	42.08	60.00	-17.92	QP	

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7. 26dB and 99%EMISSION BANDWIDTH MEASUREMENT

7.1 Standard Applicable

According to §15.407(a). No Limit required.

According to RSS 210 A9.2 (1), No Limit required

RSS-Gen §4.6, the transmitter shall be operated at its maximum carrier power measured under normal test conditions. The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts. The resolution bandwidth shall be set to as close to 1% of the selected span as is possible without being below 1%. The video bandwidth shall be set to 3 times the resolution bandwidth. Video averaging is not permitted. Where practical, a sampling detector shall be used since a peak or, peak hold, may produce a wider bandwidth than actual.

The trace data points are recovered and are directly summed in linear 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. This frequency is recorded.

7.2 Measurement Procedure

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the Antenna port to the spectrum analyzer.
3.
 - a. 26dB Band width Measurement: Set the spectrum analyzer as 1% of emission BW Sweep=auto, Detector = Peak, Trace Mode = Max Hold, Manually readjust RBW until the RBW/EBW ratio is 1% based on EBW as observed on the result of pre-sequence measurement.
 - b. A) 99% Bandwidth Measurement: set resolution BW as close to 1% of the selected span without it is being lower than 1%, & VBW = 3 XRBW. Detector = Peak or Sample, where sample must be selected whenever it is appropriate, Trace Mode = Max Hold
B) Mark the peak frequency and -26dB (upper and lower) frequency.
4. Repeat the procedures as list above until all test default channels (low, middle, and high) are completed.

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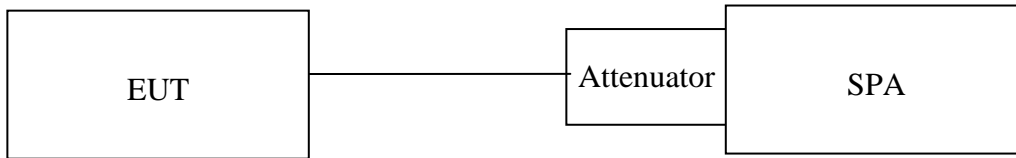
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7.3 Measurement Equipment Used:

SGS Conducted Room					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	Agilent	N9010A	MY51440121	02/13/2012	02/12/2014
Power Meter	Anritsu	ML2495A	1326001	01/28/2012	01/27/2014
Power Sensor	Anritsu	MA2411B	917032	02/08/2012	02/07/2014
DC Power Supply	HOLA	DP-3003	001	N.C.R.	N.C.R.
Coaxial Cable	WOKEN	conducted #2	001	12/21/2012	12/20/2013
DC Block	Mini-Circuits	BLK-18-S+	002	12/21/2012	12/20/2013
Splitter	RF-LAMBAD	RFLT2W1G18 G	11-JSPF412-01 8	12/21/2012	12/20/2013
Attenuator	Mini-Circuits	BW-S10W2+	002	12/21/2012	12/20/2013
Temperature Chamber	TERCHY	MHK-120LK	1020582	06/20/2013	06/19/2014

7.4 Test Set-up:



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7.5 Measurement Result

26dB Bandwidth

802.11a, 5150~5250 MHz

Frequency (MHz)	26dB Bandwidth (B) (MHz)	10 Log (B) (dB)
5180	21.51	13.33
5220	21.71	13.37
5240	21.95	13.41

802.11n HT20, 5150~5250 MHz MIMO-Main

Frequency (MHz)	26dB Bandwidth (B) (MHz)	10 Log (B) (dB)
5180	21.63	13.35
5220	21.47	13.32
5240	21.53	13.33

802.11n HT20, 5150~5250 MHz MIMO-Aux

Frequency (MHz)	26dB Bandwidth (B) (MHz)	10 Log (B) (dB)
5180	21.45	13.31
5220	21.55	13.33
5240	21.04	13.23

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802.11n HT40, 5150~5250 MHz MIMO-Main

Frequency (MHz)	26dB Bandwidth (B) (MHz)	10 Log (B) (dB)
5190	43.49	16.38
5230	43.70	16.40

802.11n HT40, 5150~5250 MHz MIMO-Aux

Frequency (MHz)	26dB Bandwidth (B) (MHz)	10 Log (B) (dB)
5190	42.950	16.33
5230	43.610	16.40

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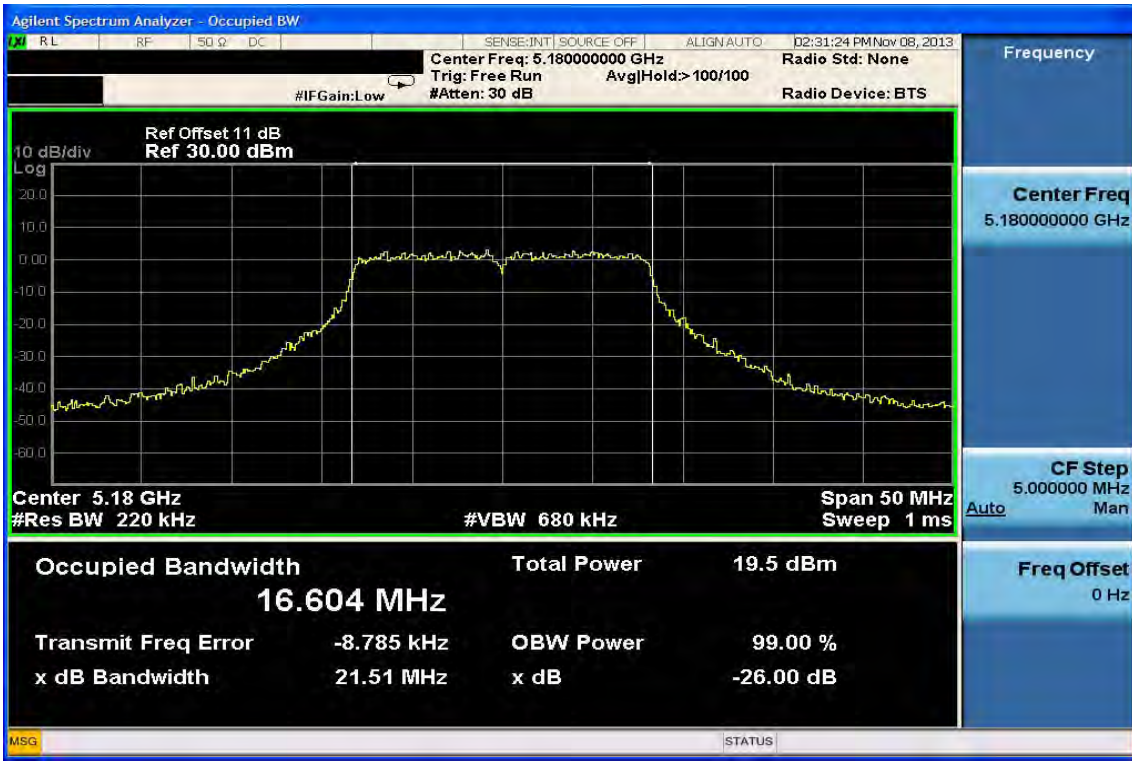
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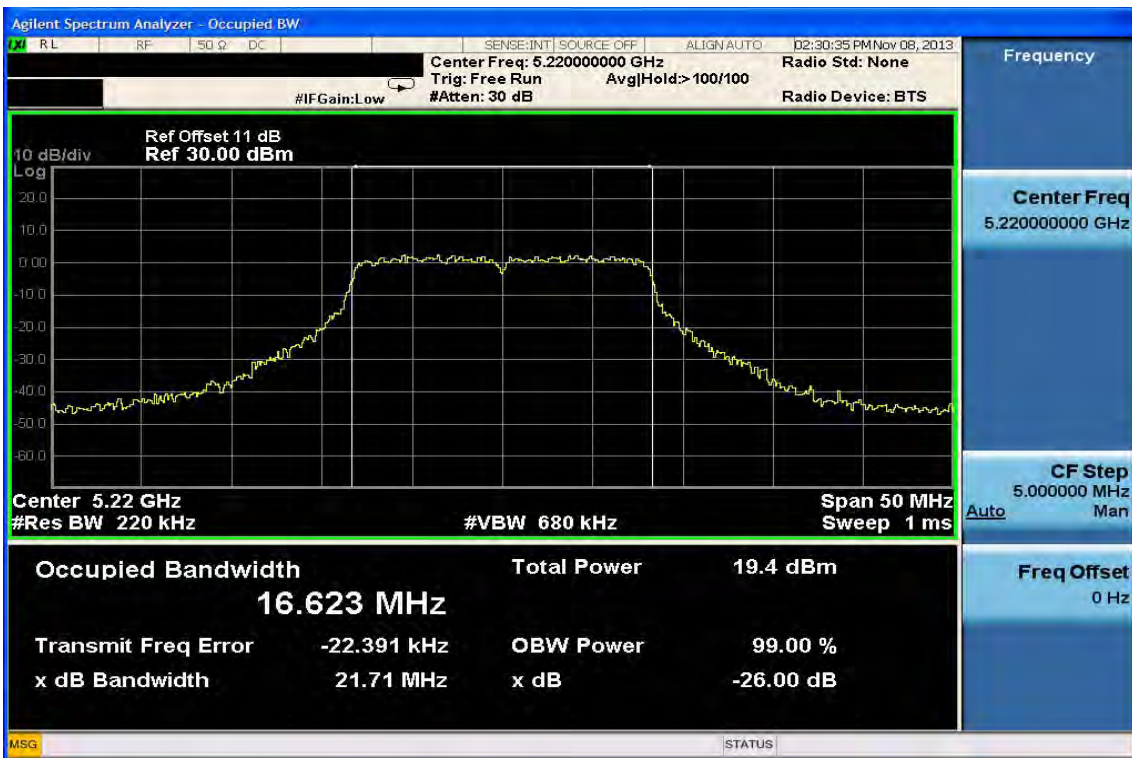
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802.11a, 5150~5250 MHz
26dB Band Width Test Data CH-Low (5180MHz)



26dB Band Width Test Data CH-Mid (5220MHz)



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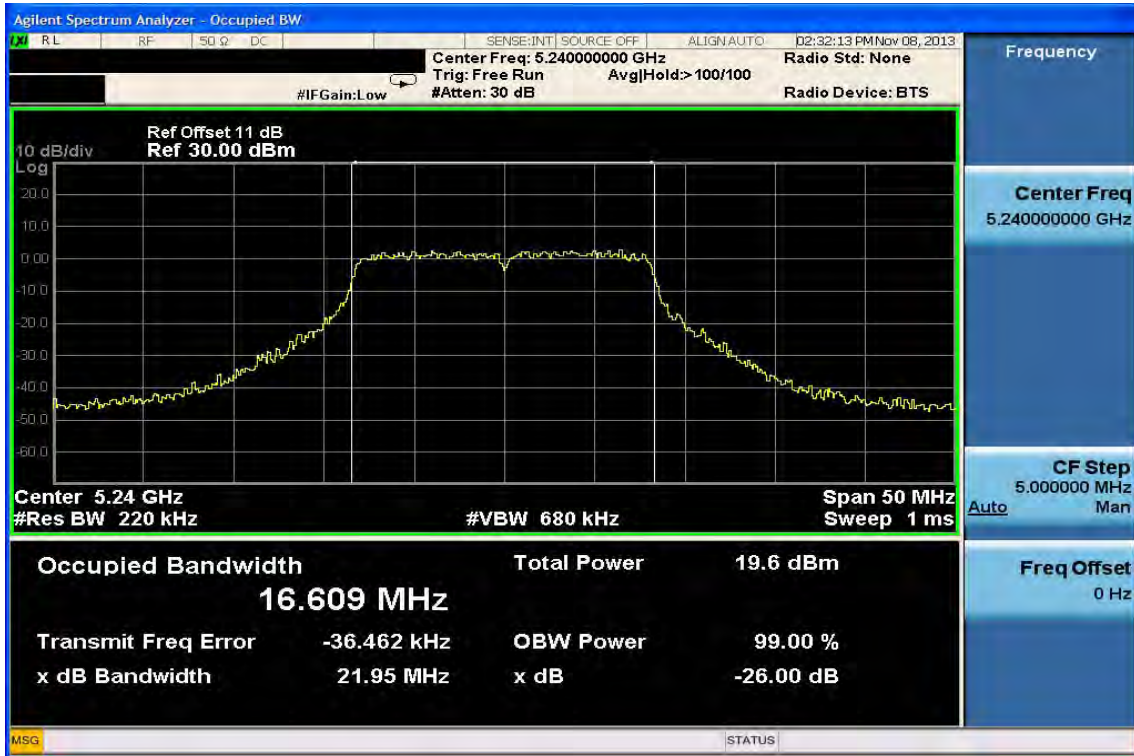
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26dB Band Width Test Data CH-High (5240MHz)



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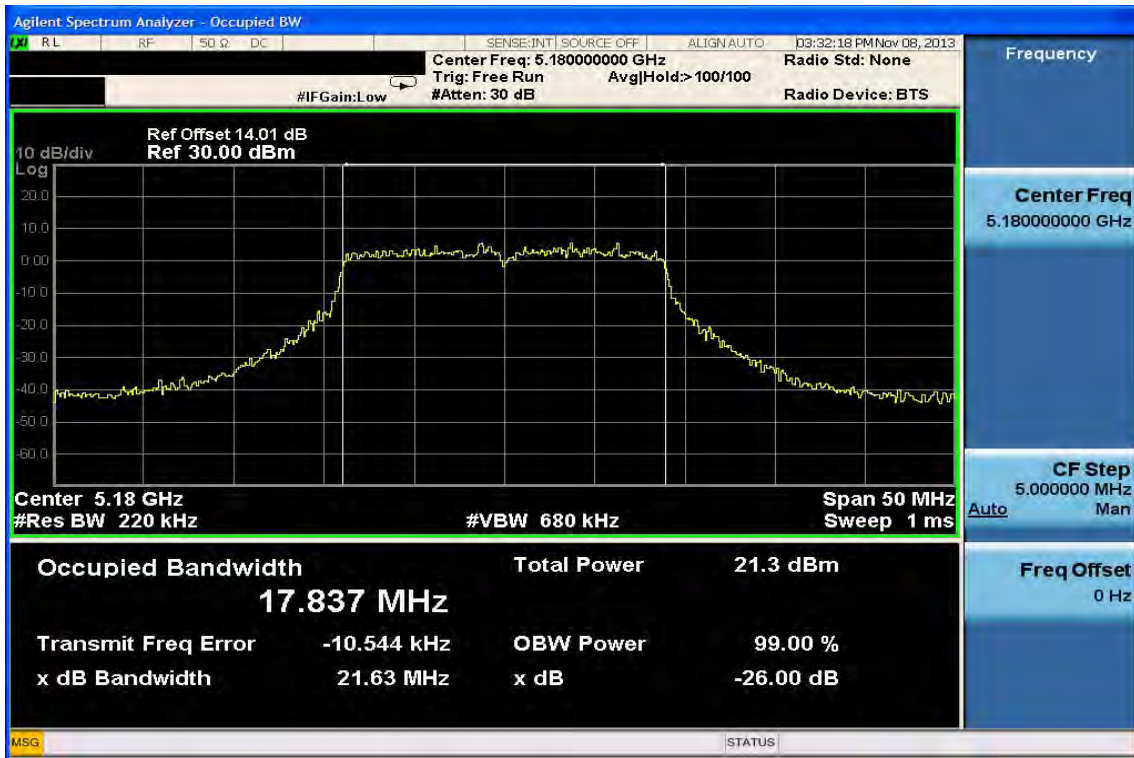
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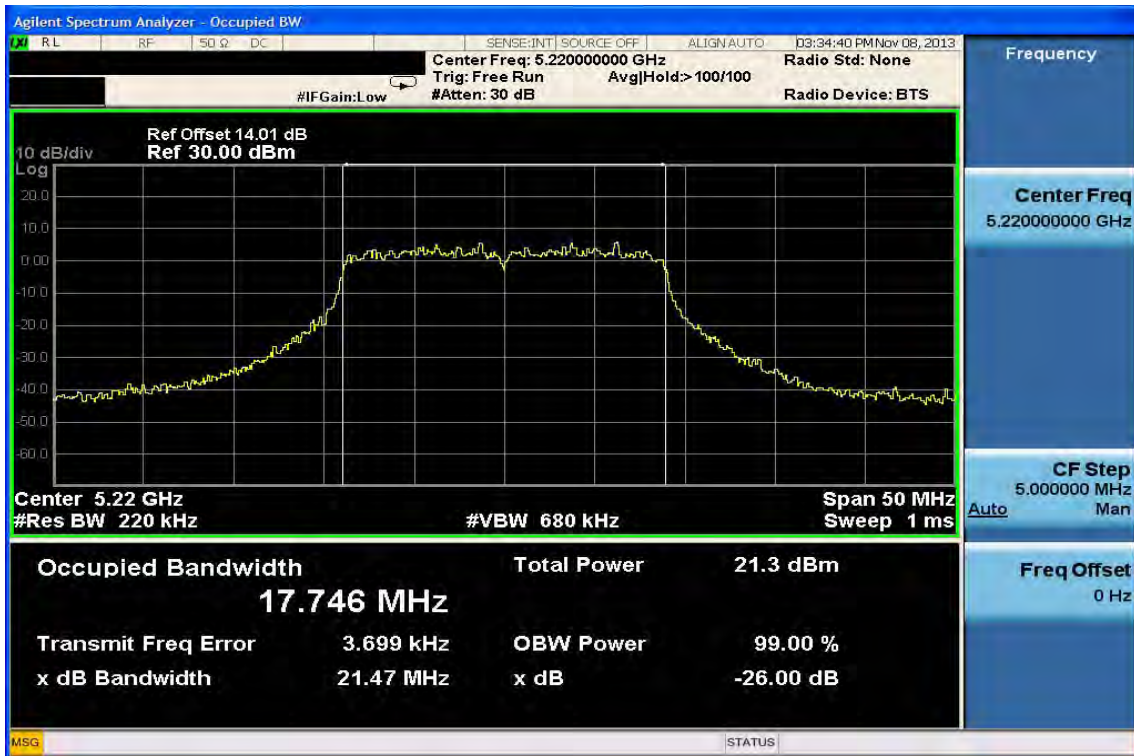
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802.11n HT20, 5150~5250 MHz, MIMO-Main 26dB Band Width Test Data CH-Low (5180 MHz)



26dB Band Width Test Data CH-Mid (5220 MHz)



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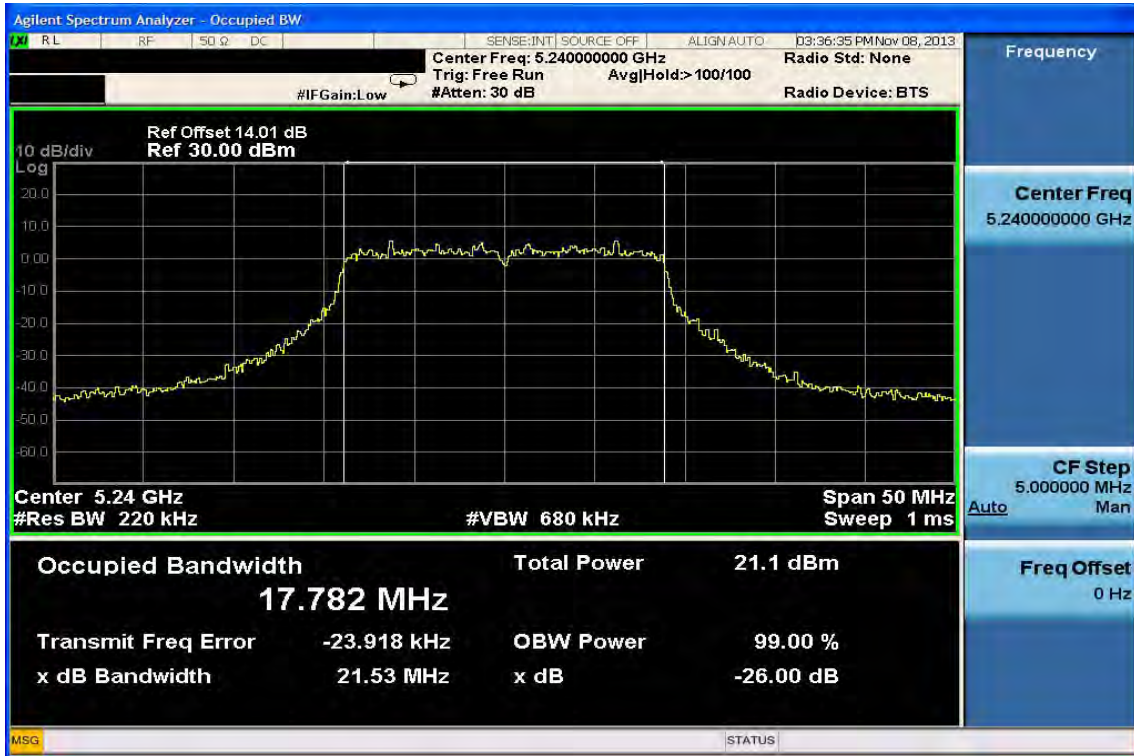
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26dB Band Width Test Data CH-High (5240 MHz)



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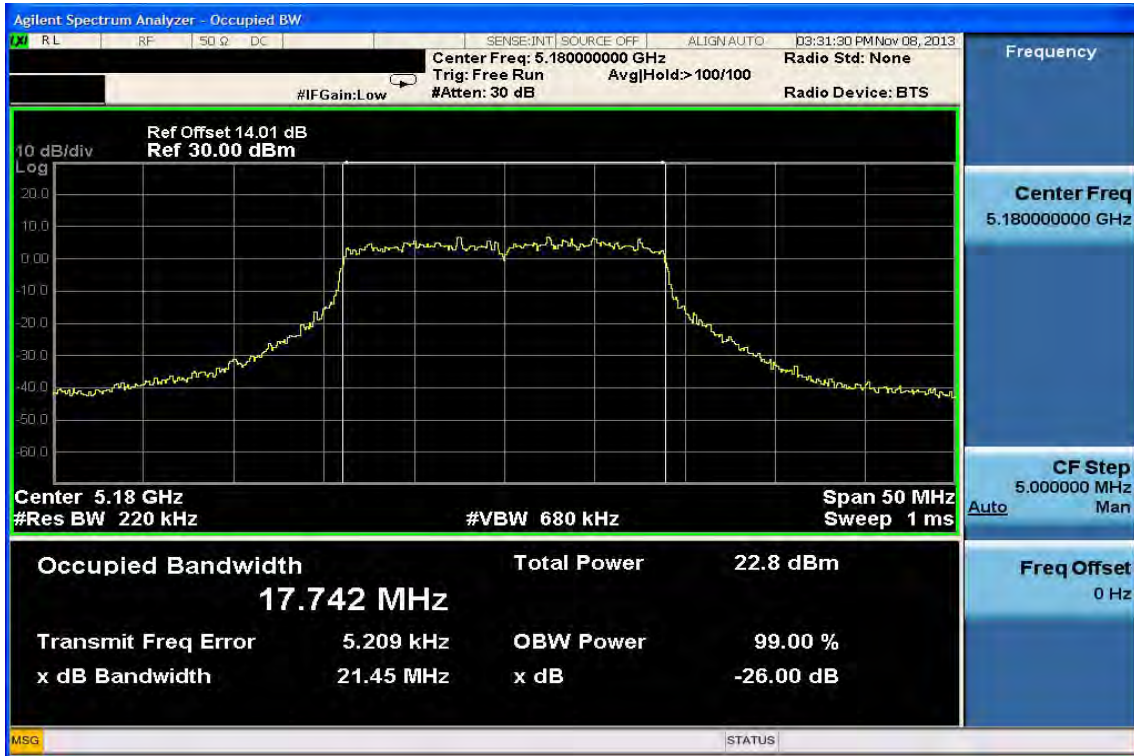
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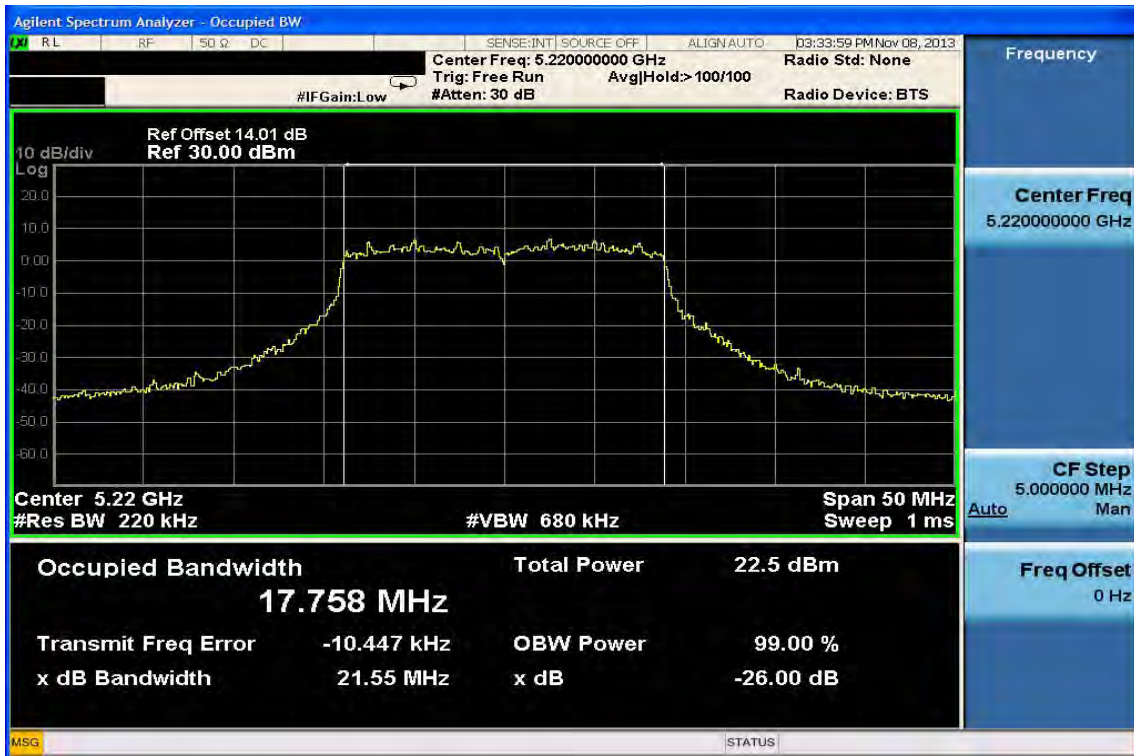
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**802.11n HT20, 5150~5250 MHz, MIMO-Aux
26dB Band Width Test Data CH-Low (5180 MHz)**



26dB Band Width Test Data CH-Mid (5220 MHz)



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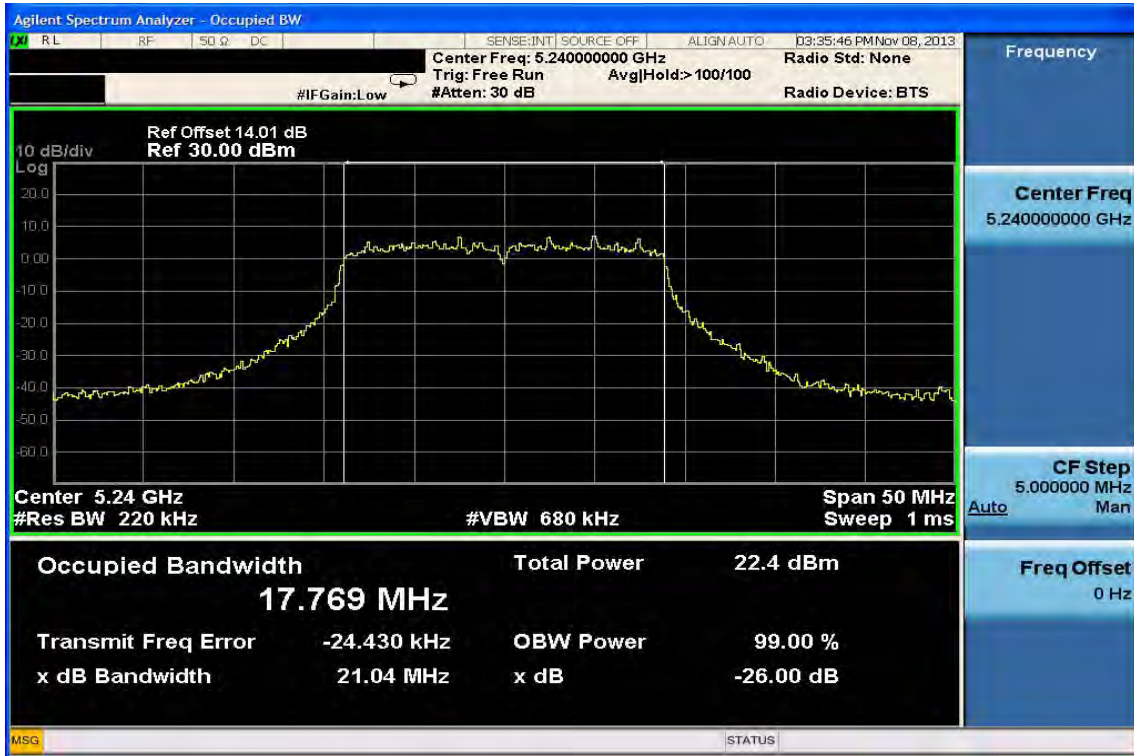
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26dB Band Width Test Data CH-High (5240 MHz)



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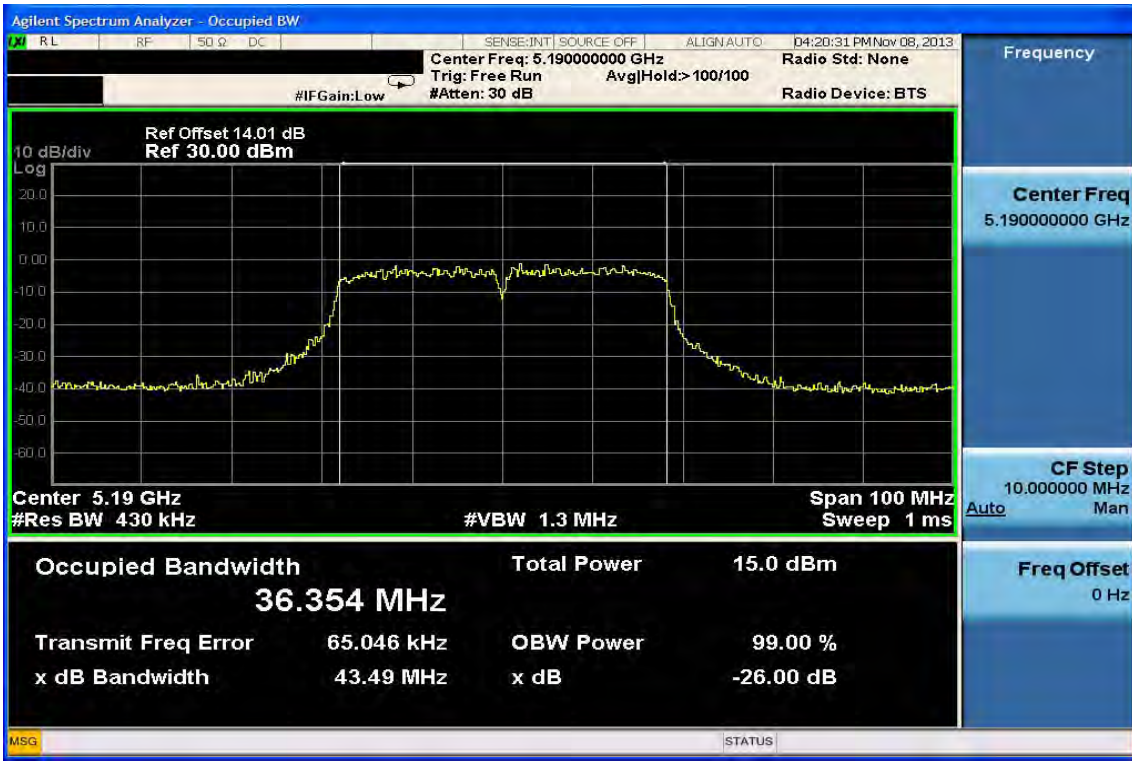
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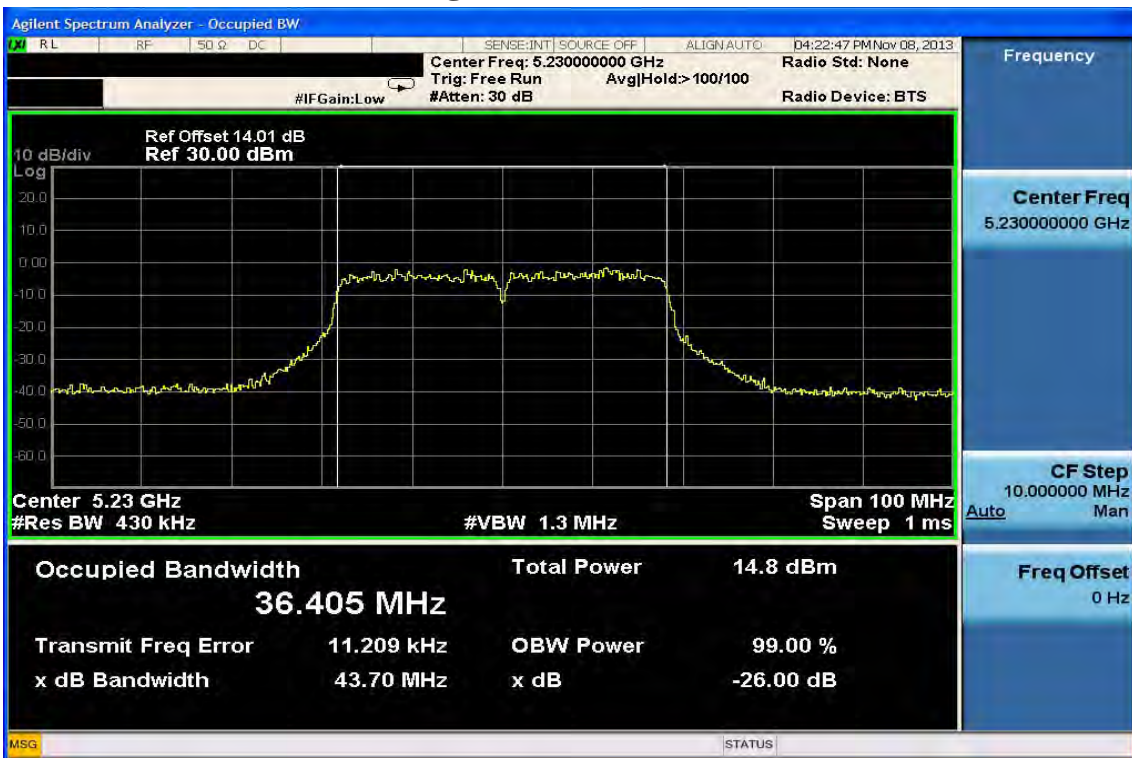
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802.11n HT40, 5150~5250 MHz, MIMO-Main
26dB Band Width Test Data CH-Low (5190 MHz)



26dB Band Width Test Data CH-High (5230 MHz)



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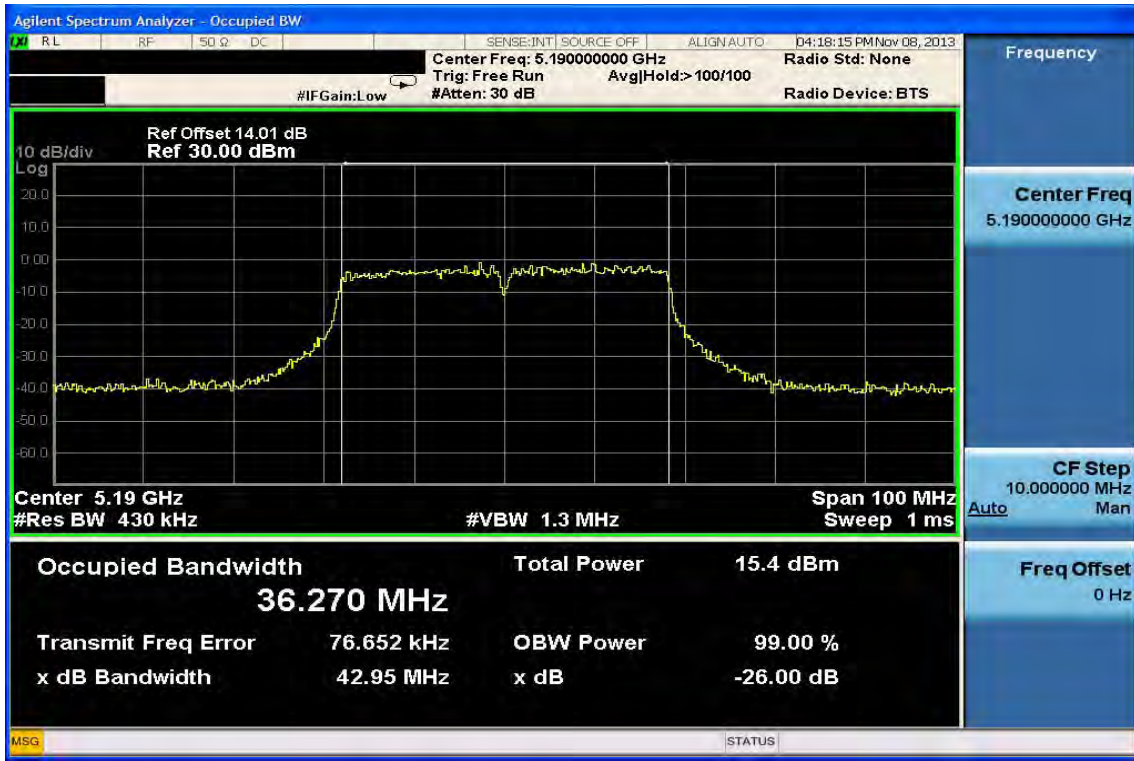
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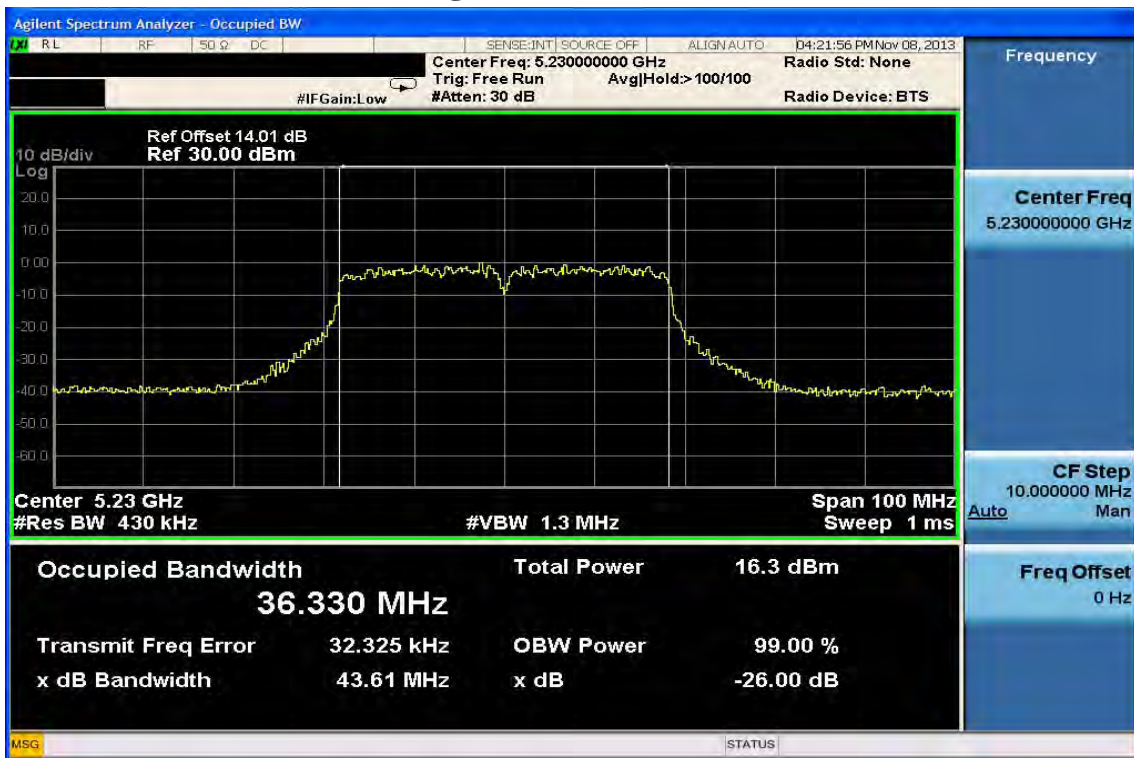
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802.11n HT40, 5150~5250 MHz, MIMO-Aux
26dB Band Width Test Data CH-Low (5190 MHz)



26dB Band Width Test Data CH-High (5230 MHz)



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7.6 Measurement Result

99% Bandwidth

802.11a, 5150~5250 MHz

Frequency (MHz)	99% Bandwidth (MHz)	10 Log (B) (dB)
5180	16.419	12.15
5220	16.381	12.14
5240	16.474	12.17

802.11n HT20, 5150~5250 MHz, MIMO-Main

Frequency (MHz)	99% Bandwidth (MHz)	10 Log (B) (dB)
5180	17.748	12.49
5220	17.597	12.45
5240	17.497	12.43

802.11n HT20, 5150~5250 MHz, MIMO-Aux

Frequency (MHz)	99% Bandwidth (MHz)	10 Log (B) (dB)
5180	16.481	12.17
5220	17.787	12.50
5240	17.717	12.48

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802.11n HT40, 5150~5250 MHz, MIMO-Main

Frequency (MHz)	99% Bandwidth (MHz)	10 Log (B) (dB)
5190	36.223	15.59
5230	36.202	15.59

802.11n HT40, 5150~5250 MHz, MIMO-Aux

Frequency (MHz)	99% Bandwidth (MHz)	10 Log (B) (dB)
5190	36.127	15.58
5230	36.234	15.59

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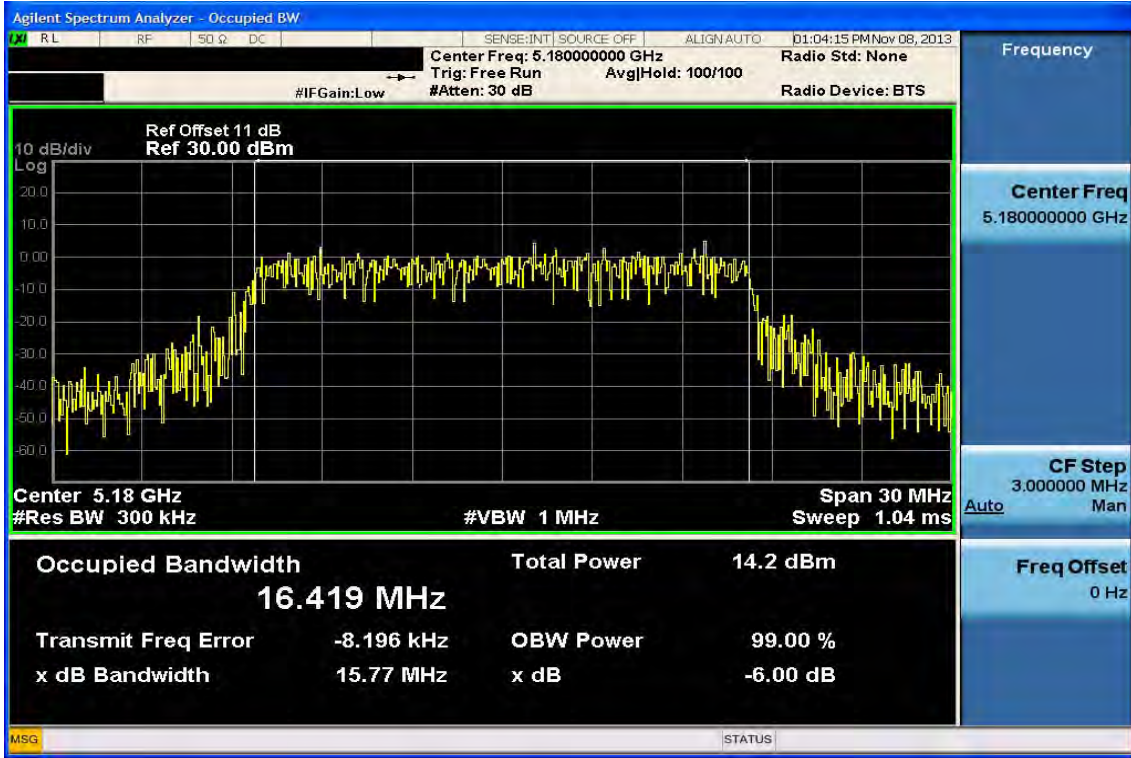
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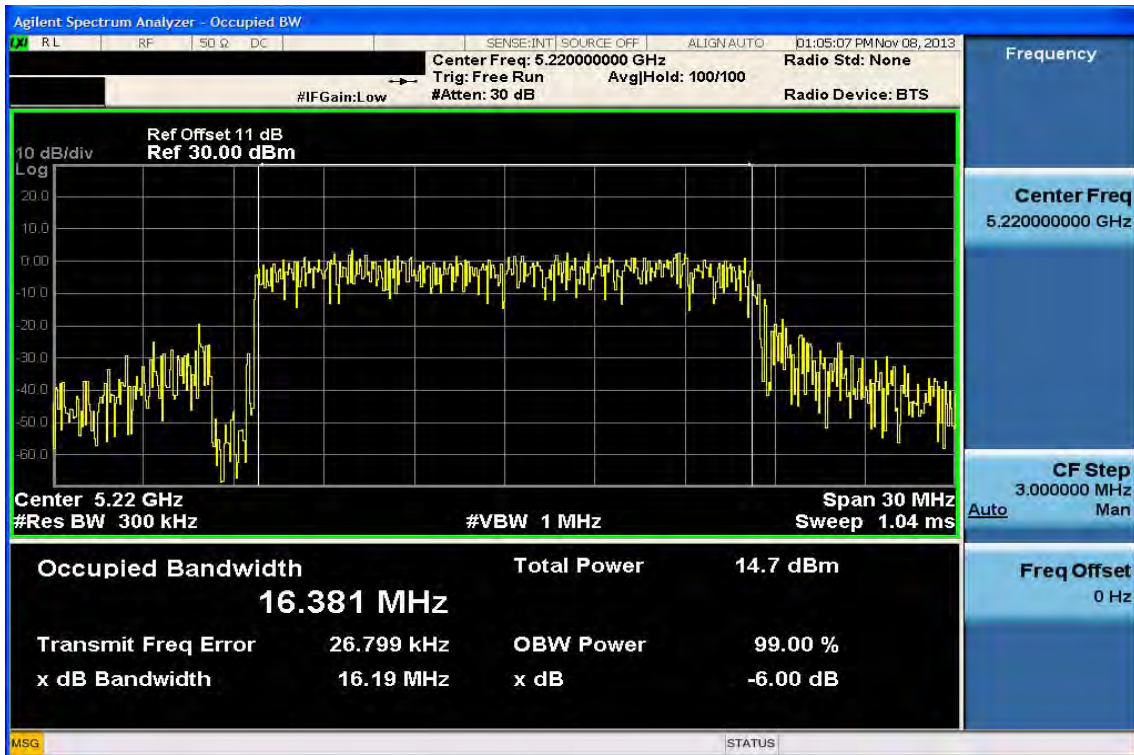
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802.11a, 5150~5250 MHz

99% Band Width Test Data CH-Low (5180MHz)



99% Band Width Test Data CH-Mid (5220MHz)



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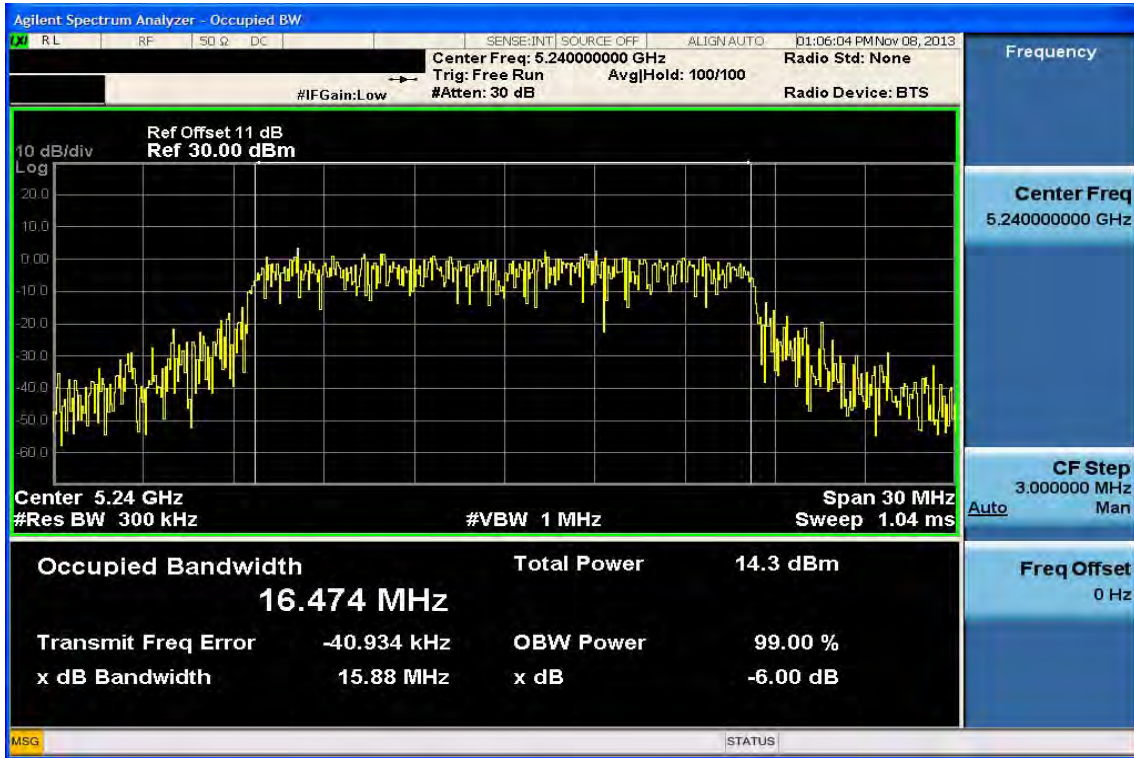
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99% Band Width Test Data CH-High (5240MHz)



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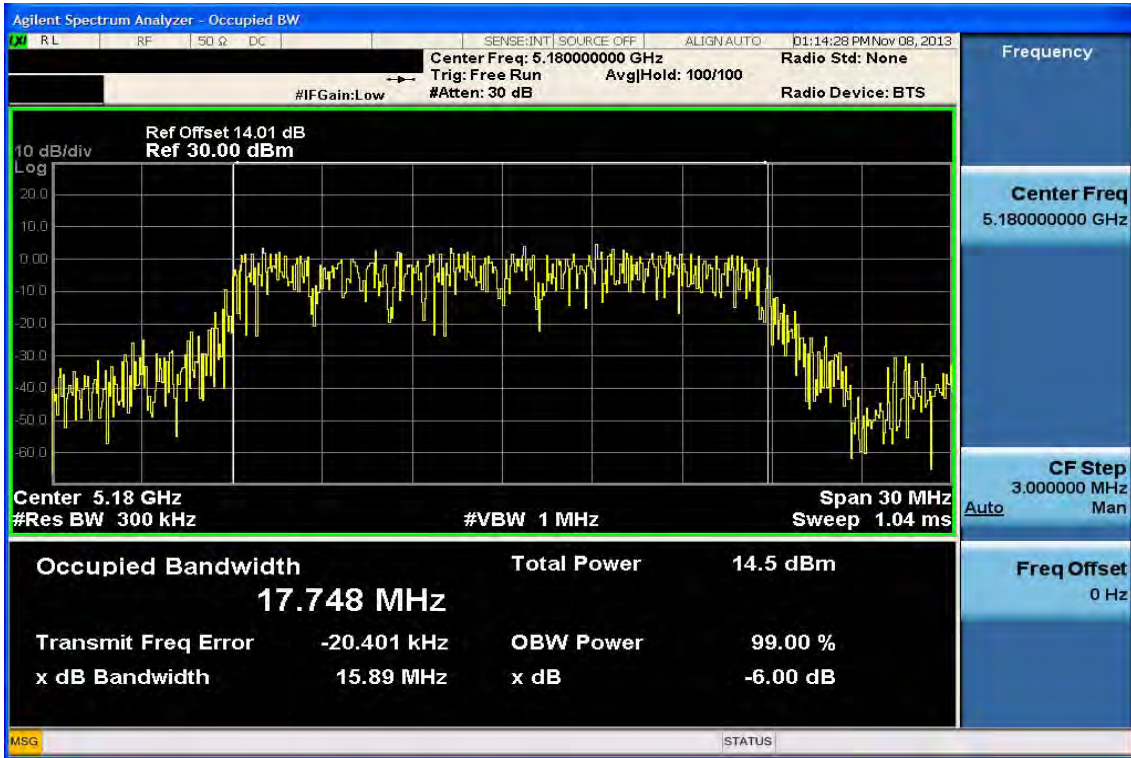
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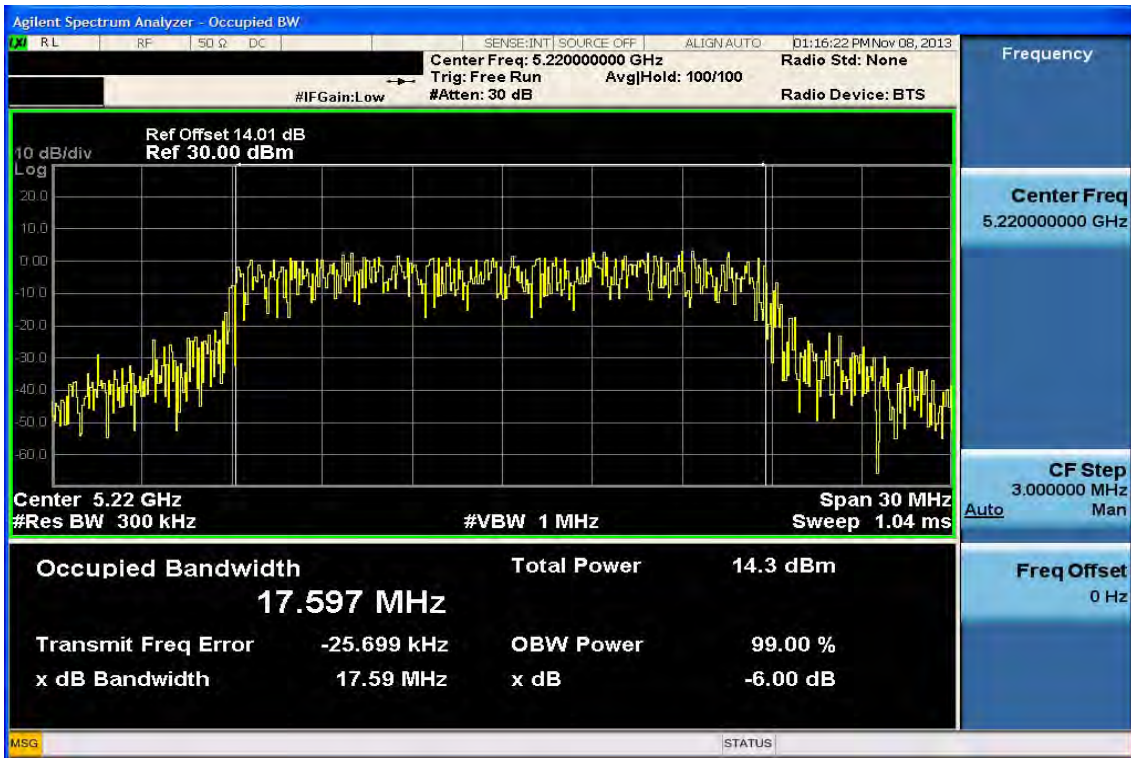
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802.11n HT20, 5150~5250 MHz, MIMO-Main
99% Band Width Test Data CH-Low (5180 MHz)



99% Band Width Test Data CH-Mid (5220 MHz)



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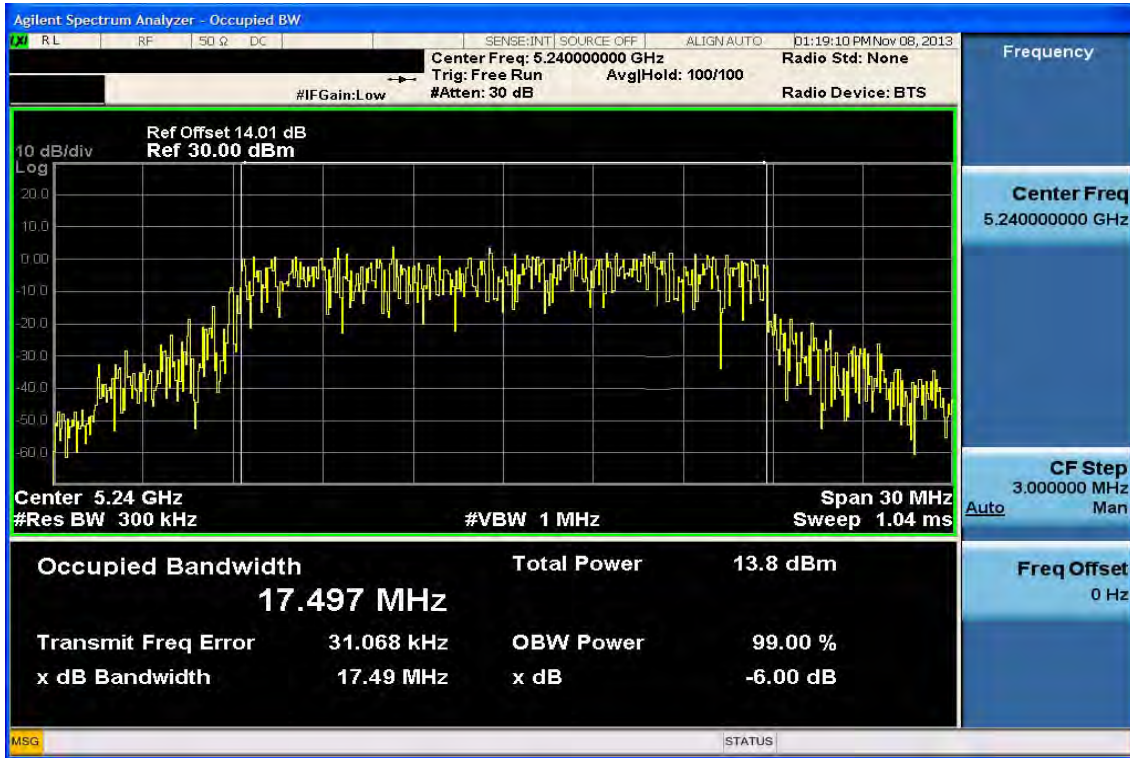
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99% Band Width Test Data CH-High (5240 MHz)



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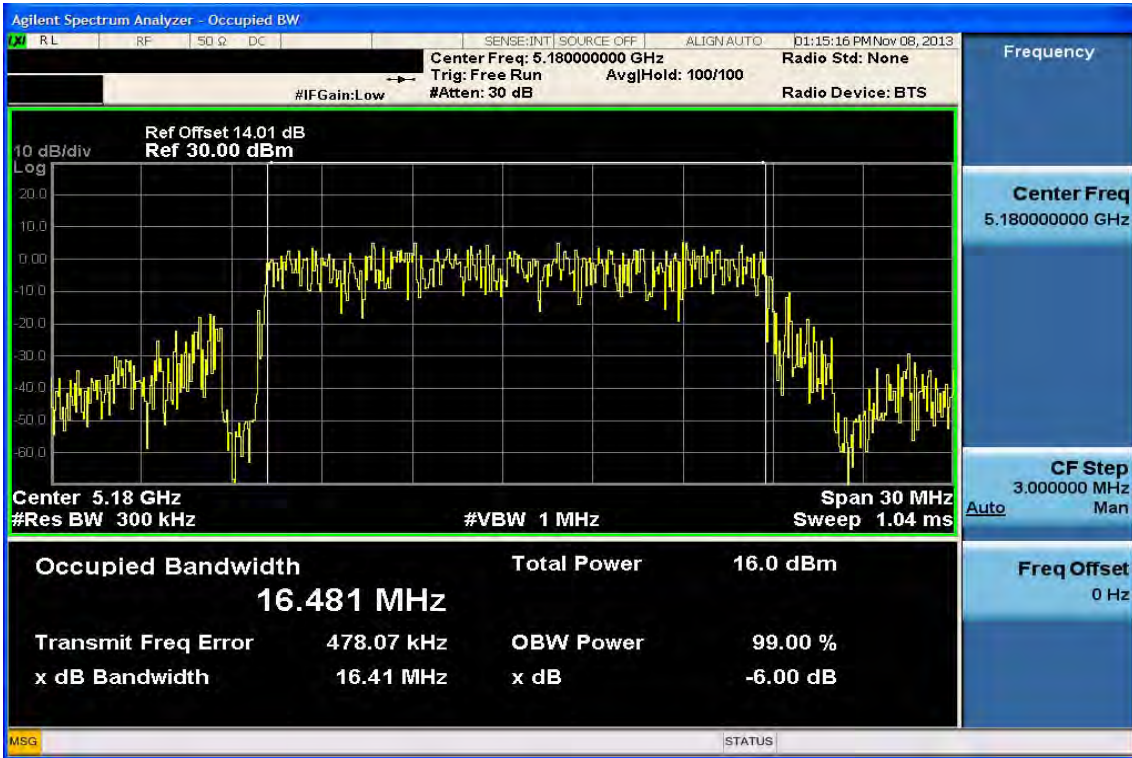
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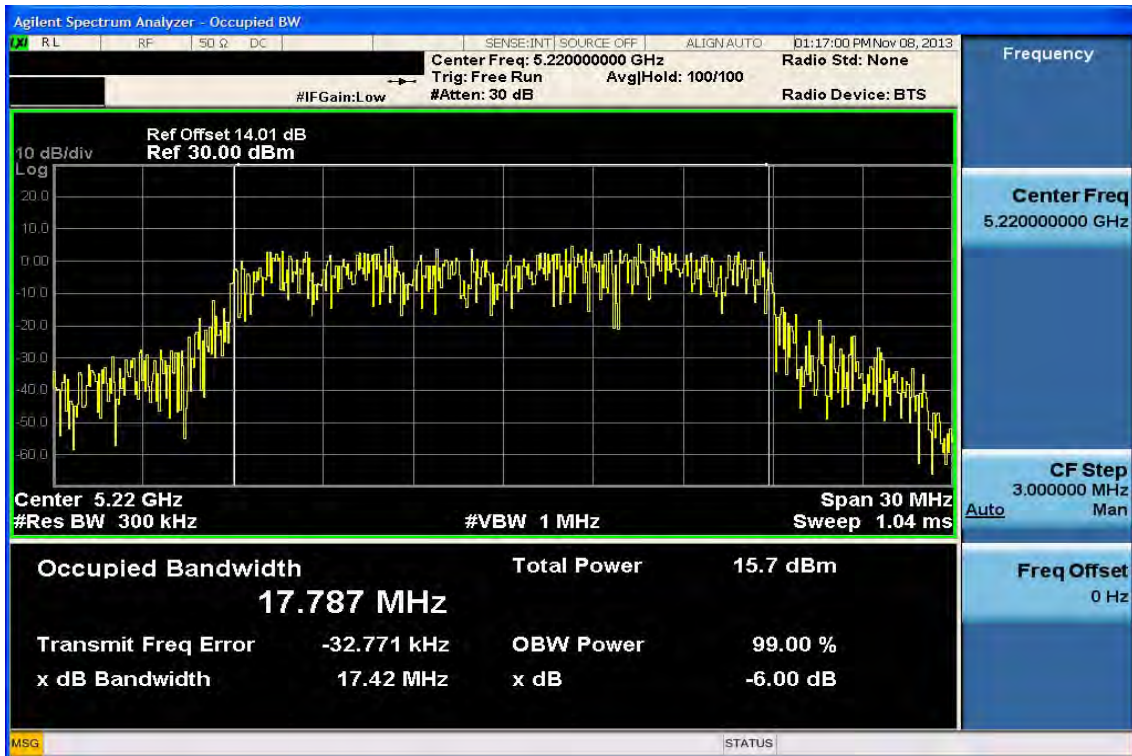
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802.11n HT20, 5150~5250 MHz, MIMO-Aux
99% Band Width Test Data CH-Low (5180 MHz)



99% Band Width Test Data CH-Mid (5220 MHz)



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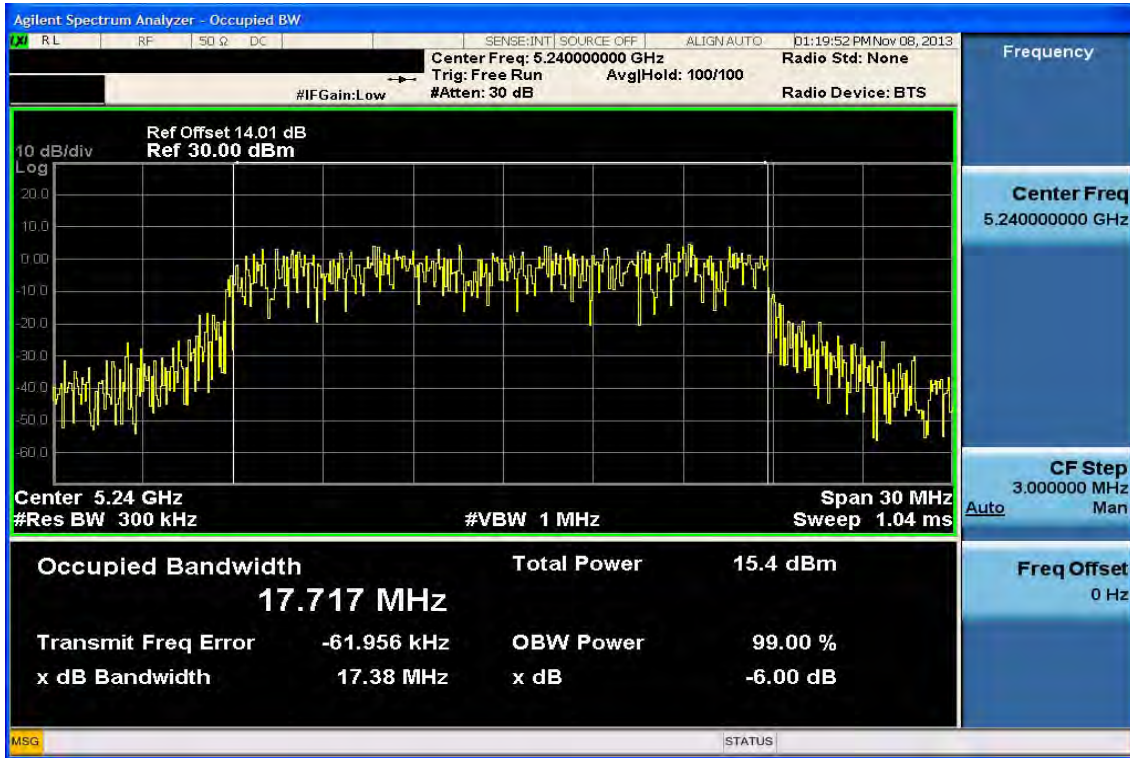
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99% Band Width Test Data CH-High (5240 MHz)



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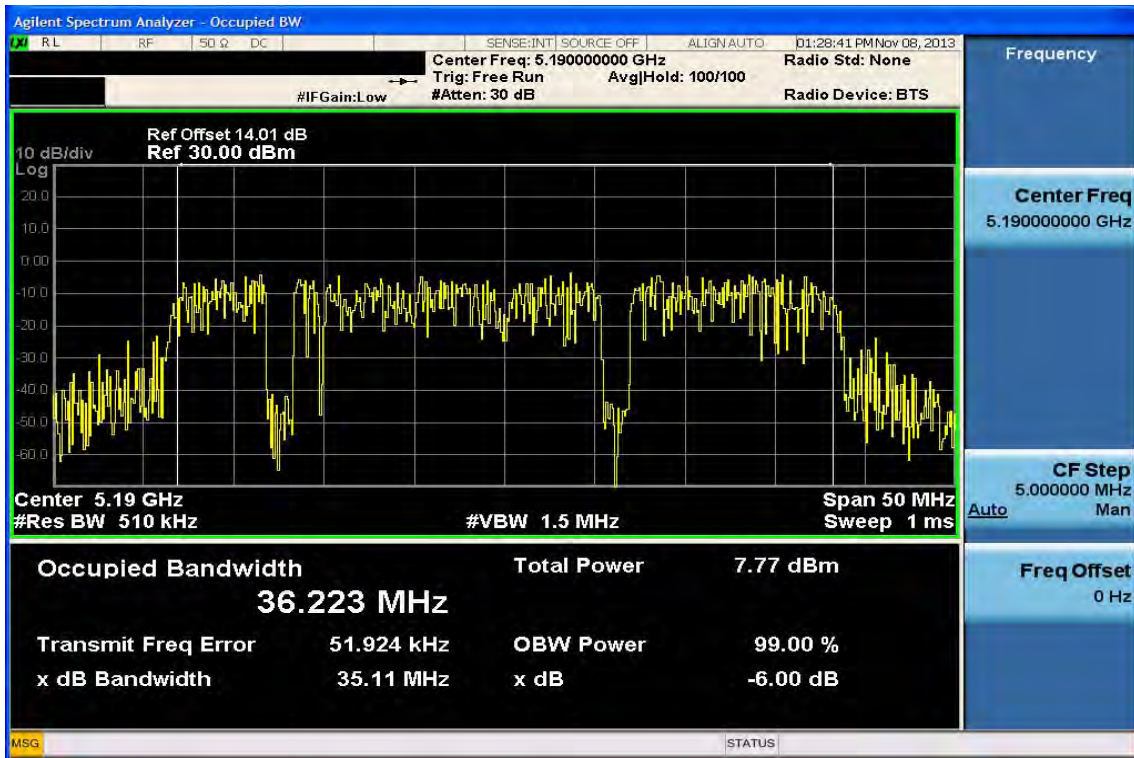
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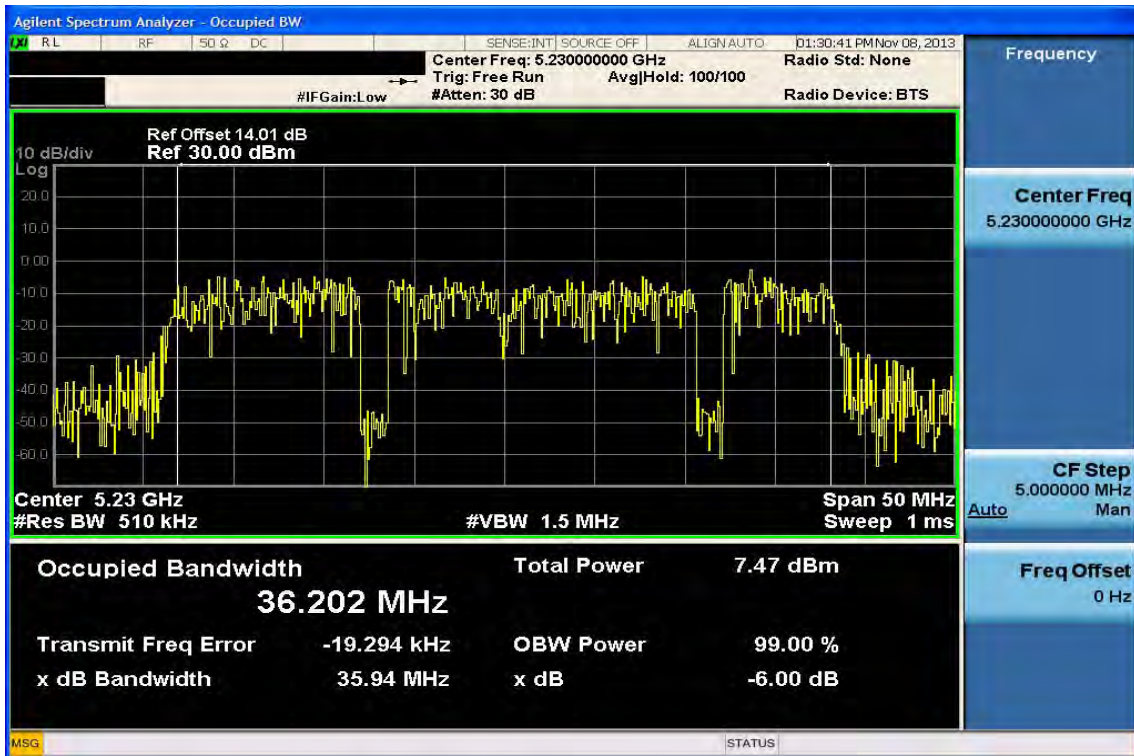
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99% Band Width Test Data CH-Low (5190 MHz)



99% Band Width Test Data CH-High (5230 MHz)



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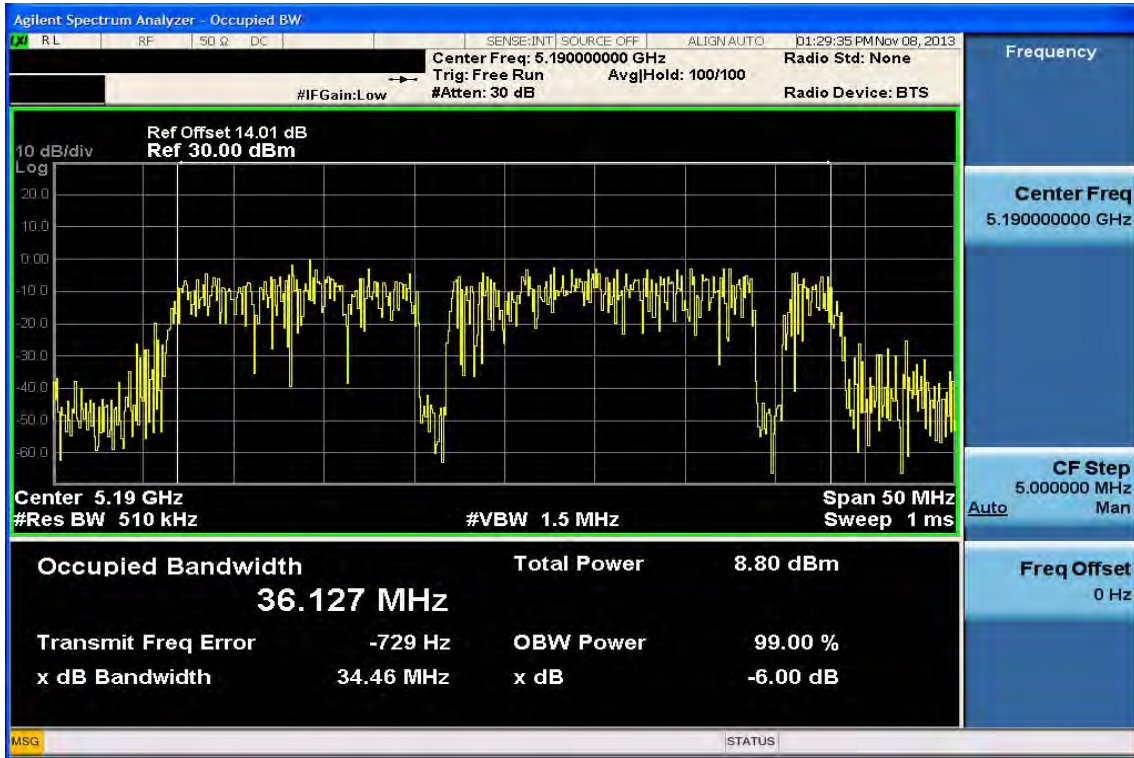
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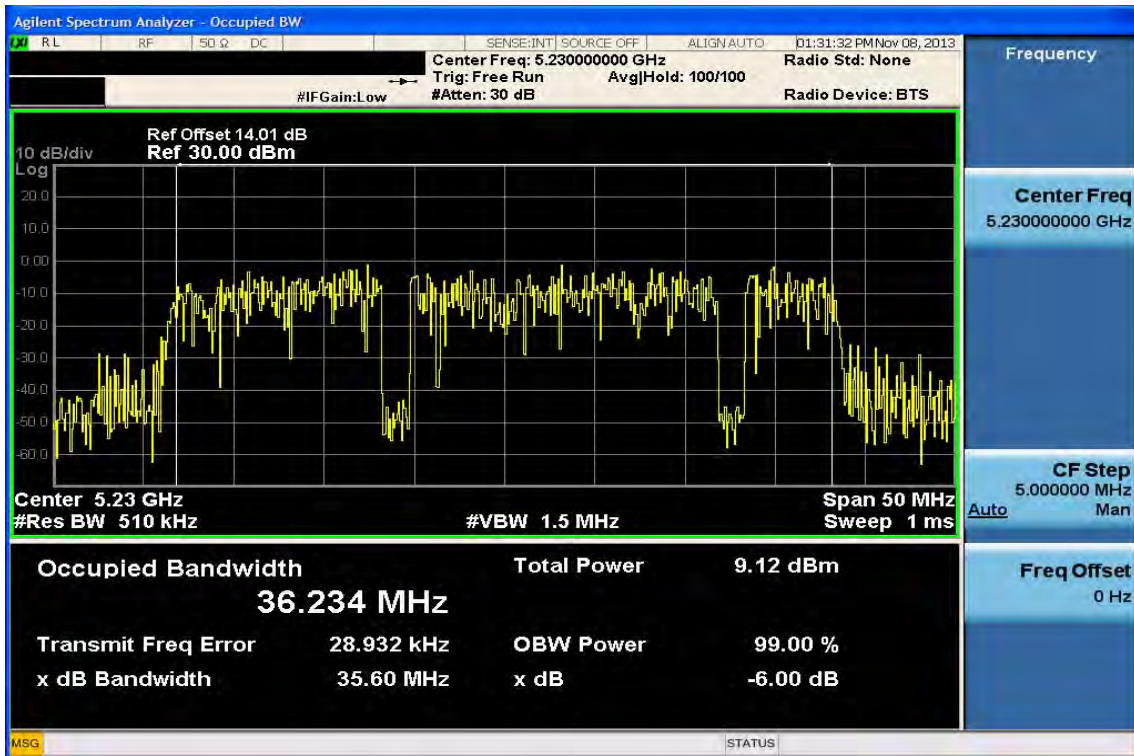
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8. The MAXIMUM OUTPUT POWER MEASUREMENT

8.1 Standard Applicable

According to §15.407(a)

1. For the band 5.15-5.25 GHz, the maximum conducted power over the frequency of operation shall not exceed the lesser of 50 mW (17dBm) or 4 dBm + 10log B.
2. For the band 5.25-5.35 GHz and 5.47-5.725GHz, the maximum conducted power over the frequency of operation shall not exceed the lesser of 250 mW (24dBm) or 11 dBm + 10log B.
3. For the band 5.725-5.825 GHz, the maximum conducted power over the frequency of operation shall not exceed the lesser of 1W (30dBm) or 17 dBm + 10log B.

According to RSS-210 A9.2

1. For the band 5150-5250 MHz, the maximum equivalent isotropically radiated power (e.i.r.p.) shall not exceed 200 mW or 10 + 10 log₁₀ B, dBm, whichever power is less. B is the 99% emission bandwidth in MHz. The e.i.r.p. spectral density shall not exceed 10 dBm in any 1.0 MHz band.
2. For the bands 5250-5350 MHz and 5470-5725 MHz, the maximum conducted output power shall not exceed 250 mW or 11 + 10 log₁₀ B, dBm, whichever power is less. The power spectral density shall not exceed 11 dBm in any 1.0 MHz band. The maximum e.i.r.p. shall not exceed 1.0 W or 17 + 10 log₁₀ B, dBm, whichever power is less. B is the 99% emission bandwidth in MHz.

In addition, devices with maximum e.i.r.p. greater than 500 mW shall implement TPC in order to have the capability to operate at least 6 dB below the maximum permitted e.i.r.p. of 1 W.

In addition to the above requirements, devices operating in the band 5250-5350 MHz with maximum e.i.r.p. greater than 200 mW shall comply with the following e.i.r.p. elevation mask where θ is the angle above the local horizontal plane (of the earth) as shown below:

- (i) -13 dB(W/MHz) for $0^\circ \leq \theta < 8^\circ$
- (ii) $-13 - 0.716 (\theta - 8)$ dB(W/MHz) for $8^\circ \leq \theta < 40^\circ$
- (iii) $-35.9 - 1.22 (\theta - 40)$ dB(W/MHz) for $40^\circ \leq \theta \leq 45^\circ$
- (iv) -42 dB(W/MHz) for $\theta > 45^\circ$

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3. For the band 5725-5825 MHz, the maximum conducted output power shall not exceed 1.0 W or $17 + 10 \log_{10} B$, dBm, whichever power is less. The power spectral density shall not exceed 17 dBm in any 1.0 MHz band. The maximum e.i.r.p. shall not exceed 4.0 W or $23 + 10 \log_{10} B$, dBm, whichever power is less. B is the 99% emission bandwidth in MHz.

Fixed point-to-point systems for this band are permitted to have an e.i.r.p. greater than 4 W, provided that the higher e.i.r.p. is achieved by employing higher gain antennas, but not higher transmitter output powers. Point-to-multipoint systems, omni-directional applications and multiple co-located transmitters transmitting the same information are prohibited from exceeding 4 W e.i.r.p. However, remote stations of point-to-multipoint systems shall be permitted to operate at greater than 4 W e.i.r.p., under the same conditions as for point-to-point systems.

where B is the 26dB emission bandwidth in MHz.

If transmitting antennas of directional gain greater than 6 dBi are used, both the peak transmit power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

5180-5240 MHz

Antenna Gain: $9.25\text{dBi} - 6\text{dBi} = 3.25$

$$1 + (3.26/6) = 1.542$$

Limit: $50\text{mW} = 16.99\text{dBm}$

$$16.99 - 1.542 = 15.448\text{dBm} = 35.06\text{mW}$$

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8.2 Measurement Procedure

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the power meter
3. Set the offset $10 \cdot \log(1/x)$, $n_{HT20}=0.10$, $n_{HT40}=0.12$
4. Record the max. reading.
5. Repeat above procedures until all frequency (low, middle, and high channel) measured were complete.
6. Employing step 1 to 4 obtaining per-chain basis in MIMO operation, and sum the power in linear to result the output of MIMO operation at frequency of interest (, where MIMO is applicable).

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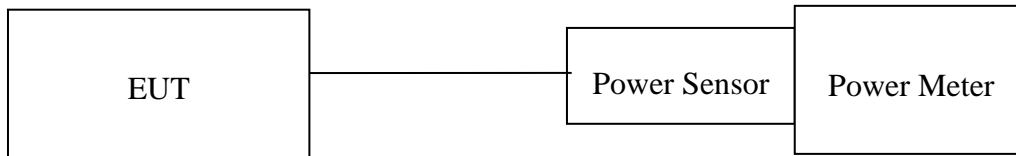
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Note: For EIRP/ERP measurement complying with RSS-210 9.2, the formula as deduced in 1.3.2 of KDB 412172 D01 is used to calculate. $ERP/EIRP = P_t + G_t - L_c$, where P_t = transmitter output power measured directly at antenna port, expressing in dBm, and G_t = gain of the transmitting antenna in dBi that can be referred in antenna spec provided by the manufacturer in section 1.1, L_c = signal attenuation in the cable between the transmitting port and antenna.

8.3 Measurement Equipment Used:

Refer to section 7.3 for details.

8.4 Test Set-up:



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8.5 Measurement Result

802.11a (Main)

Cable loss = 0		The Maximum Output Power								
CH	Frequency (MHz)	Data Rate								Required Limit
		6	9	12	18	24	36	48	54	
36	5180	12.58	12.35	12.29	11.93	11.90	11.62	11.55	11.53	16.99dBm or 4+10log(B) = 17.33dBm
44	5220	12.56	12.23	11.96	11.82	11.65	11.53	11.31	11.18	16.99dBm or 4+10log(B) = 17.37dBm
48	5240	12.16	12.03	11.76	11.68	11.56	11.43	11.26	11.07	16.99dBm or 4+10log(B) = 17.31dBm

Note1: Limit is re-adjusted in terms of dBm

$$10 \cdot \log(50mW) = 16.99dBm \text{ for the limit on the band of } 5150 \sim 5250MHz$$

Note2: Cable loss is 11dB is set as the offset on the spectrum to compensate the loss causing by cable

802.11a (Aux)

Cable loss = 0		The Maximum Output Power								
CH	Frequency (MHz)	Data Rate								Required Limit
		6	9	12	18	24	36	48	54	
36	5180	13.61	13.55	13.50	13.38	13.21	13.08	12.78	12.55	16.99dBm or 4+10log(B) = 17.33dBm
44	5220	13.47	13.41	13.32	13.11	12.96	12.73	12.55	12.45	16.99dBm or 4+10log(B) = 17.37dBm
48	5240	13.53	13.38	13.24	13.10	12.96	12.76	12.68	12.61	16.99dBm or 4+10log(B) = 17.31dBm

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802.11n (5GHz) 20M (Main)

Cable loss = 0		The Maximum Output Power								
CH	Frequency (MHz)	Data Rate								Required Limit
		MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7	
36	5180	11.03	10.83	10.72	10.68	10.57	10.28	10.17	10.06	16.99dBm or 4+10log(B) = 17.35dBm
44	5220	10.82	10.78	10.62	10.53	10.47	10.24	10.16	10.02	16.99dBm or 4+10log(B) = 17.32dBm
48	5240	10.79	10.70	10.63	10.48	10.31	10.24	10.03	9.84	16.99dBm or 4+10log(B) = 17.33dBm

802.11n (5GHz) 20M (Aux)

Cable loss = 0		The Maximum Output Power								
CH	Frequency (MHz)	Data Rate								Required Limit
		MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7	
36	5180	11.98	11.82	11.75	11.66	11.23	11.01	10.87	10.81	16.99dBm or 4+10log(B) = 17.31dBm
44	5220	12.31	12.26	12.24	12.11	11.98	11.76	11.54	11.30	16.99dBm or 4+10log(B) = 17.33dBm
48	5240	12.32	12.27	12.21	12.11	11.89	11.82	11.72	11.63	16.99dBm or 4+10log(B) = 17.23dBm

Note: Offset 11dB

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802.11n (5GHz)_20M MIMO Chain 0

Cable loss = 0		The Maximum Output Power (CH 0)								
CH	Frequency (MHz)	Data Rate								Required Limit
		MCS8	MCS9	MCS10	MCS11	MCS12	MCS13	MCS14	MCS15	
36	5180	8.80	8.72	8.61	8.23	8.11	7.99	7.74	7.53	15.45dBm or 4+10log(B) = 17.35dBm
44	5220	8.82	8.71	8.54	8.31	8.12	8.09	7.98	7.87	15.45dBm or 4+10log(B) = 17.32dBm
48	5240	8.81	8.69	8.51	8.32	8.14	7.98	7.74	7.53	15.45dBm or 4+10log(B) = 17.33dBm

802.11n (5GHz)_20M MIMO Chain 1

Cable loss = 0		The Maximum Output Power (CH 1)								
CH	Frequency (MHz)	Data Rate								Required Limit
		MCS8	MCS9	MCS10	MCS11	MCS12	MCS13	MCS14	MCS15	
36	5180	10.13	10.08	9.74	9.52	9.23	9.01	8.72	8.51	15.45dBm or 4+10log(B) = 17.35dBm
44	5220	10.26	10.04	9.87	9.65	9.42	9.13	9.02	8.85	15.45dBm or 4+10log(B) = 17.32dBm
48	5240	10.78	10.64	10.52	10.34	10.13	9.73	9.65	9.32	15.45dBm or 4+10log(B) = 17.33dBm

Note: Offset 11dB

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802.11n (5GHz)_20M MIMO Chain 0+ Chain1

Cable loss = 0		The Maximum Output Power (CH 0 + CH 1)								
CH	Frequency (MHz)	Data Rate								Required Limit
		MCS8	MCS9	MCS10	MCS11	MCS12	MCS13	MCS14	MCS15	
36	5180	12.53	12.46	12.22	11.93	11.72	11.54	11.27	11.06	15.45dBm or 4+10log(B) = 17.35dBm
44	5220	12.61	12.44	12.27	12.04	11.83	11.65	11.54	11.40	15.45dBm or 4+10log(B) = 17.32dBm
48	5240	12.92	12.78	12.64	12.46	12.26	11.95	11.81	11.53	15.45dBm or 4+10log(B) = 17.33dBm

802.11n (5GHz)_40M (Main)

Cable loss = 0		The Maximum Output Power								
CH	Frequency (MHz)	Data Rate								Required Limit
		MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7	
38	5190	5.15	5.06	4.87	4.66	4.53	4.38	4.27	4.11	16.99dBm or 4+10log(B) = 20.38dBm
46	5230	5.12	5.03	4.92	4.77	4.55	4.43	4.22	4.03	16.99dBm or 4+10log(B) = 20.40dBm

Note: Offset 11dB

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802.11n (5GHz)_40M (Aux)

Cable loss = 0		The Maximum Output Power								
CH	Frequency (MHz)	Data Rate								Required Limit
		MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7	
38	5190	6.17	6.04	5.96	5.77	5.64	5.43	5.27	5.15	16.99dBm or 4+10log(B) = 20.33dBm
46	5230	6.73	6.43	6.28	6.12	6.01	5.89	5.73	5.61	16.99dBm or 4+10log(B) = 20.40dBm

802.11n (5GHz)_40M MIMO Chain 0

Cable loss = 0		The Maximum Output Power (CH 0)								
CH	Frequency (MHz)	Data Rate								Required Limit
		MCS8	MCS9	MCS10	MCS11	MCS12	MCS13	MCS14	MCS15	
38	5190	5.68	5.61	5.43	5.26	4.97	4.64	4.32	4.11	15.45dBm or 4+10log(B) = 20.38dBm
46	5230	5.28	5.13	4.96	4.73	4.51	4.27	3.96	3.71	15.45dBm or 4+10log(B) = 20.40dBm

802.11n (5GHz)_40M MIMO Chain 1

Cable loss = 0		The Maximum Output Power (CH 1)								
CH	Frequency (MHz)	Data Rate								Required Limit
		MCS8	MCS9	MCS10	MCS11	MCS12	MCS13	MCS14	MCS15	
38	5190	6.32	6.11	5.87	5.65	5.32	5.12	4.76	4.59	15.45dBm or 4+10log(B) = 20.38dBm
46	5230	6.34	6.28	6.21	6.13	5.87	5.62	5.34	5.16	15.45dBm or 4+10log(B) = 20.40dBm

Note: Offset 11dB

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802.11n (5GHz)_40M MIMO Chain 0+Chain 1

Cable loss = 0		The Maximum Output Power (CH 0+CH 1)								
CH	Frequency (MHz)	Data Rate								Required Limit
		MCS8	MCS9	MCS10	MCS11	MCS12	MCS13	MCS14	MCS15	
38	5190	9.02	8.88	8.67	8.47	8.16	7.90	7.56	7.37	15.45dBm or $4+10\log(B) = 20.38\text{dBm}$
46	5230	8.85	8.75	8.64	8.50	8.25	8.01	7.71	7.51	15.45dBm or $4+10\log(B) = 20.40\text{dBm}$

Note: Offset 11dB

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ERP/EIRP Measurement:

802.11a (Main)

Cable loss = 0		EIRP								Required Limit
CH	Frequency (MHz)	Data Rate								
		6	9	12	18	24	36	48	54	
36	5180	14.89	14.66	14.60	14.24	14.21	13.93	13.86	13.84	23.01dBm or 10+10log(B) = 22.15dBm
44	5220	14.87	14.54	14.27	14.13	13.96	13.84	13.62	13.49	23.01dBm or 10+10log(B) = 22.14dBm
48	5240	14.47	14.34	14.07	13.99	13.87	13.74	13.57	13.38	23.01dBm or 10+10log(B) = 22.17dBm

Note1: Limit is re-adjusted in terms of dBm $10 \cdot \log(200mW) = 23.01dBm$ for the limit on the band of 5150~5250MHz

EIRP = Conducted Power + antenna Gain of respective frequency band

Note2: Cable loss is 11dB is set as the offset on the spectrum to compensate the loss causing by cable.

802.11a (Aux)

Cable loss = 0		EIRP								Required Limit
CH	Frequency (MHz)	Data Rate								
		6	9	12	18	24	36	48	54	
36	5180	19.02	18.96	18.91	18.79	18.62	18.49	18.19	17.96	23.01dBm or 10+10log(B) = 22.15dBm
44	5220	18.88	18.82	18.73	18.52	18.37	18.14	17.96	17.86	23.01dBm or 10+10log(B) = 22.14dBm
48	5240	18.94	18.79	18.65	18.51	18.37	18.17	18.09	18.02	23.01dBm or 10+10log(B) = 22.17dBm

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802.11n (5GHz)_20M (Main)

Cable loss = 0		EIRP								Required Limit
CH	Frequency (MHz)	Data Rate								
		MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7	
36	5180	13.34	13.14	13.03	12.99	12.88	12.59	12.48	12.37	23.01dBm or 10+10log(B) = 22.49dBm
44	5220	13.13	13.09	12.93	12.84	12.78	12.55	12.47	12.33	23.01dBm or 10+10log(B) = 22.45dBm
48	5240	13.10	13.01	12.94	12.79	12.62	12.55	12.34	12.15	23.01dBm or 10+10log(B) = 22.43dBm

802.11n (5GHz)_20M (Aux)

Cable loss = 0		EIRP								Required Limit
CH	Frequency (MHz)	Data Rate								
		MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7	
36	5180	17.39	17.23	17.16	17.07	16.64	16.42	16.28	16.22	23.01dBm or 10+10log(B) = 22.17dBm
44	5220	17.72	17.67	17.65	17.52	17.39	17.17	16.95	16.71	23.01dBm or 10+10log(B) = 22.450dBm
48	5240	17.73	17.68	17.62	17.52	17.30	17.23	17.13	17.04	23.01dBm or 10+10log(B) = 22.48dBm

Note: Offset 11dB

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802.11n (5GHz)_20M MIMO Chain 0

Cable loss = 0		EIRP (CH 0)								
CH	Frequency (MHz)	Data Rate								Required Limit
		MCS8	MCS9	MCS10	MCS11	MCS12	MCS13	MCS14	MCS15	
36	5180	18.05	17.97	17.86	17.48	17.36	17.24	16.99	16.78	23.01dBm or 10+10log(B) = 22.49dBm
44	5220	18.07	17.96	17.79	17.56	17.37	17.34	17.23	17.12	23.01dBm or 10+10log(B) = 22.45dBm
48	5240	18.06	17.94	17.76	17.57	17.39	17.23	16.99	16.78	23.01dBm or 10+10log(B) = 22.43dBm

802.11n (5GHz)_20M MIMO Chain 1

Cable loss = 0		EIRP (CH 1)								
CH	Frequency (MHz)	Data Rate								Required Limit
		MCS8	MCS9	MCS10	MCS11	MCS12	MCS13	MCS14	MCS15	
36	5180	19.38	19.33	18.99	18.77	18.48	18.26	17.97	17.76	23.01dBm or 10+10log(B) = 22.49dBm
44	5220	19.51	19.29	19.12	18.90	18.67	18.38	18.27	18.10	23.01dBm or 10+10log(B) = 22.45dBm
48	5240	20.03	19.89	19.77	19.59	19.38	18.98	18.90	18.57	23.01dBm or 10+10log(B) = 22.43dBm

Note: Offset 11dB

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802.11n (5GHz)_20M MIMO Chain 0+ Chain1

Cable loss = 0		EIRP (CH 0 + CH 1)								
CH	Frequency (MHz)	Data Rate								Required Limit
		MCS8	MCS9	MCS10	MCS11	MCS12	MCS13	MCS14	MCS15	
36	5180	21.78	21.71	21.47	21.18	20.97	20.79	20.52	20.31	23.01dBm or 10+10log(B) = 22.49dBm
44	5220	21.86	21.69	21.52	21.29	21.08	20.90	20.79	20.65	23.01dBm or 10+10log(B) = 22.45dBm
48	5240	22.17	22.03	21.89	21.71	21.51	21.20	21.06	20.78	23.01dBm or 10+10log(B) = 22.43dBm

802.11n (5GHz)_40M (Main)

Cable loss = 0		EIRP								
CH	Frequency (MHz)	Data Rate								Required Limit
		MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7	
38	5190	7.46	7.37	7.18	6.97	6.84	6.69	6.58	6.42	23.01dBm or 10+10log(B) = 25.59dBm
46	5230	7.43	7.34	7.23	7.08	6.86	6.74	6.53	6.34	23.01dBm or 10+10log(B) = 25.59dBm

Note: Offset 11dB

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802.11n (5GHz)_40M (Aux)

Cable loss = 0		EIRP								
CH	Frequency (MHz)	Data Rate								Required Limit
		MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7	
38	5190	11.58	11.45	11.37	11.18	11.05	10.84	10.68	10.56	23.01dBm or 10+10log(B) = 25.58dBm
46	5230	12.14	11.84	11.69	11.53	11.42	11.30	11.14	11.02	23.01dBm or 10+10log(B) = 25.59dBm

802.11n (5GHz)_40M MIMO Chain 0

Cable loss = 0		EIRP (CH 0)								
CH	Frequency (MHz)	Data Rate								Required Limit
		MCS8	MCS9	MCS10	MCS11	MCS12	MCS13	MCS14	MCS15	
38	5190	14.93	14.86	14.68	14.51	14.22	13.89	13.57	13.36	23.01dBm or 10+10log(B) = 25.59dBm
46	5230	14.53	14.38	14.21	13.98	13.76	13.52	13.21	12.96	23.01dBm or 10+10log(B) = 25.59dBm

Note: Offset 11dB

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802.11n (5GHz)_40M MIMO Chain 1

Cable loss = 0		EIRP (CH1)								Required Limit
CH	Frequency (MHz)	Data Rate								
		MCS8	MCS9	MCS10	MCS11	MCS12	MCS13	MCS14	MCS15	
38	5190	15.57	15.36	15.12	14.90	14.57	14.37	14.01	13.84	23.01dBm or 10+10log(B) = 25.59dBm
46	5230	15.59	15.53	15.46	15.38	15.12	14.87	14.59	14.41	23.01dBm or 10+10log(B) = 25.59dBm

802.11n (5GHz)_40M MIMO Chain 0+Chain 1

Cable loss = 0		EIRP (CH 0 + CH 1)								Required Limit
CH	Frequency (MHz)	Data Rate								
		MCS8	MCS9	MCS10	MCS11	MCS12	MCS13	MCS14	MCS15	
38	5190	18.27	18.13	17.92	17.72	17.41	17.15	16.81	16.62	23.01dBm or 10+10log(B) = 25.59dBm
46	5230	18.10	18.00	17.89	17.75	17.50	17.26	16.96	16.76	23.01dBm or 10+10log(B) = 25.59dBm

Note: Offset 11dB

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9. PEAK POWER SPECTRAL DENSITY

9.1 Standard Applicable

According to §15.407(a)

1. For the band 5.15-5.25 GHz, the peak power spectral density shall not exceed 4 dBm in any 1-MHz band.
2. For the band 5.25-5.35 GHz and 5.47-5.725GHz, the peak power spectral density shall not exceed 11 dBm in any 1-MHz band.

If transmitting antennas of directional gain greater than 6 dBi are used, both the peak transmit power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

If transmitting antennas of directional gain greater than 6 dBi are used, both the peak transmit power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

5180-5240 MHz

Antenna Gain: 9.25dBi -6dBi = 3.25

$$1+(3.26/6)=1.542$$

Limit: 4dBm-1.542 = 2.458dBm

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According to RSS-210 A9.2

1. For the band 5150-5250 MHz, the maximum equivalent isotropically radiated power (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 MHz. The e.i.r.p. spectral density shall not exceed 10 dBm in any 1.0 MHz band.
2. For the bands 5250-5350 MHz and 5470-5725 MHz, the maximum conducted output power shall not exceed 250 mW or $11 + 10 \log_{10} B$, dBm, whichever power is less. The power spectral density shall not exceed 11 dBm in any 1.0 MHz band. The maximum e.i.r.p. shall not exceed 1.0 W or $17 + 10 \log_{10} B$, dBm, whichever power is less. B is the 99% emission bandwidth in MHz.

In addition, devices with maximum e.i.r.p. greater than 500 mW shall implement TPC in order to have the capability to operate at least 6 dB below the maximum permitted e.i.r.p. of 1 W.

In addition to the above requirements, devices operating in the band 5250-5350 MHz with maximum e.i.r.p. greater than 200 mW shall comply with the following e.i.r.p. elevation mask where θ is the angle above the local horizontal plane (of the earth) as shown below:

- (i) -13 dB (W/MHz) for $0^\circ \leq \theta < 8^\circ$
- (ii) $-13 - 0.716 (\theta - 8)$ dB (W/MHz) for $8^\circ \leq \theta < 40^\circ$
- (iii) $-35.9 - 1.22 (\theta - 40)$ dB (W/MHz) for $40^\circ \leq \theta \leq 45^\circ$
- (iv) -42 dB (W/MHz) for $\theta > 45^\circ$

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9.2 Measurement Procedure (following procedure F, & E) d) method SA-2 in KDB789033 D01)

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to Spectrum.
3. Set RBW=1MHz, VBW=3MHz, Span=50MHz/80MHz (Base Mode), where span is enough to capture the entire bandwidth, Sweep time = Auto (601 pts), detector = sample, traces 100 sweeps of video averaging. (SA-2 with the omission of procedure x, the integration with 26dB EBW bandwidth)
4. Use the cursor on spectrum to peak search the highest level of trace
5. Add offset, duty factor $n_{HT20}=0.38$, $n_{HT40}=0.38$
6. Record the max. reading.
7. Repeat above procedures until all default test channel (low, middle, and high) was complete.
8. For MIMO mode, add the appropriate offset.

9.3 Measurement Equipment Used:

Refer to section 7.3 for details.

9.4 Test Set-up:

Refer to section 7.4 for details.

Remark: as per KDB 662291, MIMO mode is accomplished by the addition of $10 \log(N)$, where $N = 2$ as the simultaneous emission of PSD

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9.5 Measurement Result

802.11a, 5150~5250 MHz

Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dB)
5180	-1.337	2.46	-3.80
5220	-0.835	2.46	-3.29
5240	-3.219	2.46	-5.68

Note: Offset 11dB (5150~5250MHz)

802.11n HT20, 5150~5250 MHz

Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dB)
5180	-0.633	2.46	-3.09
5220	0.941	2.46	-1.52
5240	-0.602	2.46	-3.06

Note: Offset 14.01dB (5150~5250MHz), where = cable loss + attenuator + duty factor + MIMO factor)

MIMO factor = $10 * \log(2) = 3\text{dB}$, attenuator = 10dB, cable loss + duty factor = 1.01dB

802.11n HT40, 5150~5250 MHz

Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dB)
5190	-10.984	2.46	-13.44
5230	-9.611	2.46	-12.07

Note: Offset 14.01dB (5150~5250MHz), where = cable loss + attenuator + duty factor + MIMO factor

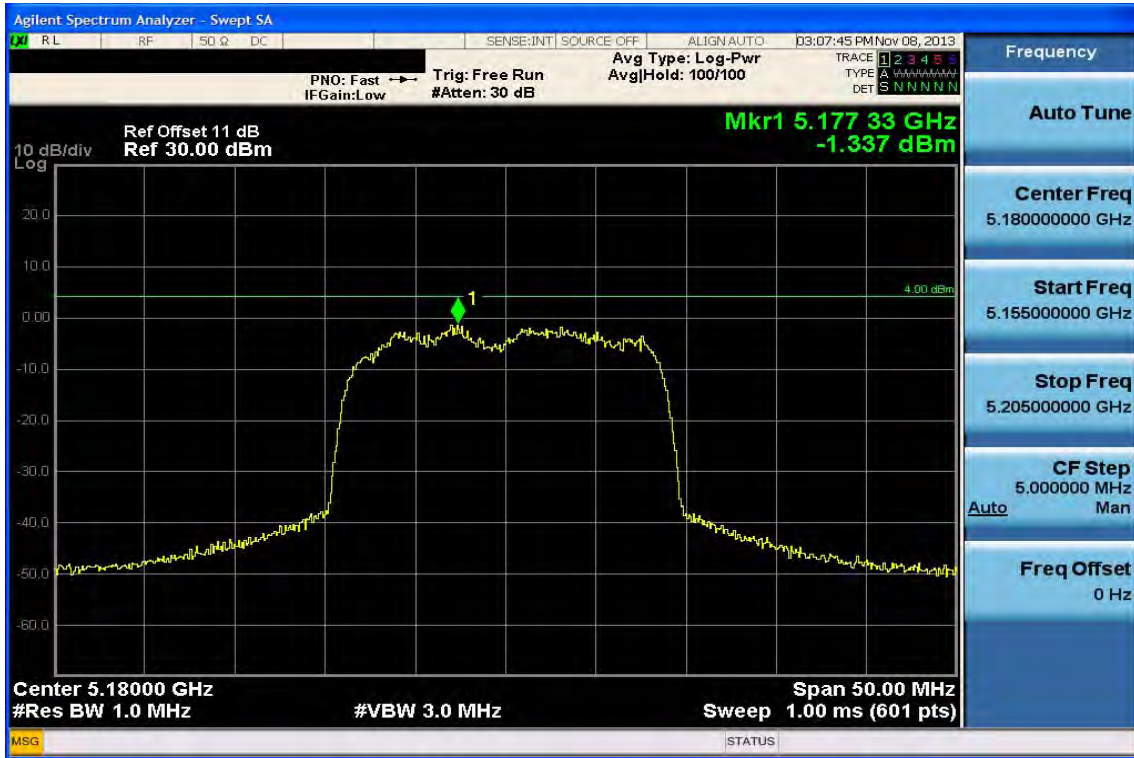
MIMO factor = $10 * \log(2) = 3\text{dB}$, attenuator = 10dB, cable loss + duty factor = 1.01dB

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802.11a, 5150~5250 MHz
Peak Power Spectral Density Data Plot (CH Low 5180 MHz)



Peak Power Spectral Density Data Plot (CH Mid 5220 MHz)



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Peak Power Spectral Density Data Plot (CH High 5240 MHz)



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802.11n HT20, 5150~5250 MHz

Peak Power Spectral Density Data Plot (CH Low 5180 MHz)



Peak Power Spectral Density Data Plot (CH Mid 5220 MHz)



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Peak Power Spectral Density Data Plot (CH High 5240 MHz)



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802.11n HT40, 5150~5250 MHz
Peak Power Spectral Density Data Plot (CH Low 5190 MHz)



Peak Power Spectral Density Data Plot (CH High 5230 MHz)



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10. PEAK EXCURSION MEASUREMENT

10.1 Standard Applicable

15.407(a)(6) The ratio of the peak excursion of the modulation envelope (measured using a peak hold function) to the peak transmit power (measured as specified above) shall not exceed 13 dB across any 1 MHz bandwidth or the emission bandwidth whichever is less.

10.2 Measurement Procedure (following procedure G in KDB789033)

1. Pre-evaluation in selection for test mode based on KDB789033
2. Tests mode selection is based on the variations in signal structure,
 - (i) All signal types - OFDM;
 - (ii) All modulation types (BPSK, QPSK, 16-QAM, 64-QAM);
 - (iii) All bandwidth modes (20MHz, and 40MHz for 802.11n);
 - (iv) All variations in signal parameters (inapplicable);
 - (v) Error-correction coding rate (not required);
3. Place the EUT on the table and set it in transmitting mode.
4. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to spectrum.
5. Set RBW=1MHz, VBW = 3MHz, span =enough to capture the signal of the interest, Max. Hold, Detector = peak
6. use the procedure specified in KDB 789033 F) to determine the PPSD
7. compute the ratio of the maximum of the peak-max-hold spectrum to the PPSD by the subtraction
Adjust the appropriate offset factor to the spectrum, where *Offset 14.01dB (5150~5250MHz, where = cable loss + attenuator + duty factor + MIMO factor, MIMO factor = $10 * \log(2) = 3dB$, attenuator = 10dB, cable loss+ duty factor = 1.01dB*
8. Repeat above procedures until all default test mode of default frequency band of the test is completed.

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802.11a

Table 18-4—Modulation-dependent parameters

Modulation	Coding rate (R)	Coded bits per subcarrier (N_{BPSC})	Coded bits per OFDM symbol (N_{CBPS})	Data bits per OFDM symbol (N_{DBPS})	Data rate (Mb/s) (20 MHz channel spacing)	Data rate (Mb/s) (10 MHz channel spacing)	Data rate (Mb/s) (5 MHz channel spacing)
BPSK	1/2	1	48	24	6	3	1.5
BPSK	3/4	1	48	36	9	4.5	2.25
QPSK	1/2	2	96	48	12	6	3
QPSK	3/4	2	96	72	18	9	4.5
16-QAM	1/2	4	192	96	24	12	6
16-QAM	3/4	4	192	144	36	18	9
64-QAM	2/3	6	288	192	48	24	12
64-QAM	3/4	6	288	216	54	27	13.5

802.11n_20

Table 20-30—MCS parameters for mandatory 20 MHz, $N_{SS} = 1$, $N_{ES} = 1$

MCS Index	Modulation	R	$N_{BPSCs}(i_{SS})$	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	Data rate (Mb/s)	
								800 ns GI	400 ns GI (see NOTE)
0	BPSK	1/2	1	52	4	52	26	6.5	7.2
1	QPSK	1/2	2	52	4	104	52	13.0	14.4
2	QPSK	3/4	2	52	4	104	78	19.5	21.7
3	16-QAM	1/2	4	52	4	208	104	26.0	28.9
4	16-QAM	3/4	4	52	4	208	156	39.0	43.3
5	64-QAM	2/3	6	52	4	312	208	52.0	57.8
6	64-QAM	3/4	6	52	4	312	234	58.5	65.0
7	64-QAM	5/6	6	52	4	312	260	65.0	72.2

NOTE—Support of 400 ns GI is optional on transmit and receive.

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802.11n_40

Table 20-34—MCS parameters for optional 40 MHz, $N_{SS} = 1$, $N_{ES} = 1$

MCS Index	Modulation	R	$N_{BPSCS}(i_{SS})$	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	Data rate (Mb/s)	
								800 ns GI	400 ns GI
0	BPSK	1/2	1	108	6	108	54	13.5	15.0
1	QPSK	1/2	2	108	6	216	108	27.0	30.0
2	QPSK	3/4	2	108	6	216	162	40.5	45.0
3	16-QAM	1/2	4	108	6	432	216	54.0	60.0
4	16-QAM	3/4	4	108	6	432	324	81.0	90.0
5	64-QAM	2/3	6	108	6	648	432	108.0	120.0
6	64-QAM	3/4	6	108	6	648	486	121.5	135.0
7	64-QAM	5/6	6	108	6	648	540	135.0	150.0

802.11n_20_MIMO

MCS Index	Modulation	R	$N_{BPSCS}(i_{SS})$	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	Data rate (Mb/s)	
								800 ns GI	400 ns GI (see NOTE)
8	BPSK	1/2	1	52	4	104	52	13.0	14.4
9	QPSK	1/2	2	52	4	208	104	26.0	28.9
10	QPSK	3/4	2	52	4	208	156	39.0	43.3
11	16-QAM	1/2	4	52	4	416	208	52.0	57.8
12	16-QAM	3/4	4	52	4	416	312	78.0	86.7
13	64-QAM	2/3	6	52	4	624	416	104.0	115.6
14	64-QAM	3/4	6	52	4	624	468	117.0	130.0
15	64-QAM	5/6	6	52	4	624	520	130.0	144.4

NOTE—The 400 ns GI rate values are rounded to 1 decimal place.

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802.11n_40_MIMO

MCS Index	Modulation	R	$N_{BPSCS(i_{SS})}$	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	Data rate (Mb/s)	
								800 ns GI	400 ns GI
8	BPSK	1/2	1	108	6	216	108	27.0	30.0
9	QPSK	1/2	2	108	6	432	216	54.0	60.0
10	QPSK	3/4	2	108	6	432	324	81.0	90.0
11	16-QAM	1/2	4	108	6	864	432	108.0	120.0
12	16-QAM	3/4	4	108	6	864	648	162.0	180.0
13	64-QAM	2/3	6	108	6	1296	864	216.0	240.0
14	64-QAM	3/4	6	108	6	1296	972	243.0	270.0
15	64-QAM	5/6	6	108	6	1296	1080	270.0	300.0

Note: The test mode to be performed is circle in red as presents above

10.3 Measurement Equipment Used:

Refer to section 7.3 for details.

Remark: as per KDB 662291, MIMO mode is accomplished by the addition of $10 \log(N)$, where $N = 2$ as the simultaneous emission of Peak Excursion.

10.4 Test Set-up:

Refer to section 7.4 for details.

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10.5 Test Results:

Modulation Type: BPSK

Coding Rate: 1/2

802.11a, 5150~5250 MHz

Channel	Frequency (MHz)	Peak Value(dBm)	PPSD (dBm)	Peak Excursion (dB)	Limit (dB)
Mid	5220	9.54	-0.835	10.37	13.00

802.11n HT20, 5150~5250 MHz_MIMO

Channel	Frequency (MHz)	Peak Value(dBm)	PPSD (dBm)	Peak Excursion (dB)	Limit (dB)
Mid	5220	12.83	0.941	11.89	13.00

802.11n HT40, 5150~5250 MHz_MIMO

Channel	Frequency (MHz)	Peak Value(dBm)	PPSD (dBm)	Peak Excursion (dB)	Limit (dB)
Low	5190	1.06	-10.984	12.04	13.00

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Modulation Type: QPSK

Coding Rate: 1/2

802.11a, 5150~5250 MHz

Channel	Frequency (MHz)	Peak Value(dBm)	PPSD (dBm)	Peak Excursion (dB)	Limit (dB)
Mid	5220	9.33	-2.383	11.71	13.00

802.11n HT20, 5150~5250 MHz_MIMO

Channel	Frequency (MHz)	Peak Value(dBm)	PPSD (dBm)	Peak Excursion (dB)	Limit (dB)
Mid	5220	11.85	-0.607	12.45	13.00

802.11n HT40, 5150~5250 MHz_MIMO

Channel	Frequency (MHz)	Peak Value(dBm)	PPSD (dBm)	Peak Excursion (dB)	Limit (dB)
Low	5190	1.26	-11.551	12.81	13.00

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Modulation Type: 16-QAM

Coding Rate: 1/2

802.11a, 5150~5250 MHz

Channel	Frequency (MHz)	Peak Value(dBm)	PPSD (dBm)	Peak Excursion (dB)	Limit (dB)
Mid	5220	9.05	-3.665	12.71	13.00

802.11n HT20, 5150~5250 MHz_MIMO

Channel	Frequency (MHz)	Peak Value(dBm)	PPSD (dBm)	Peak Excursion (dB)	Limit (dB)
Mid	5220	11.05	-1.512	12.56	13.00

802.11n HT40, 5150~5250 MHz_MIMO

Channel	Frequency (MHz)	Peak Value(dBm)	PPSD (dBm)	Peak Excursion (dB)	Limit (dB)
Low	5190	1.40	-11.511	12.92	13.00

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Modulation Type: 64-QAM

Coding Rate: 2/3

802.11a, 5150~5250 MHz

Channel	Frequency (MHz)	Peak Value(dBm)	PPSD (dBm)	Peak Excursion (dB)	Limit (dB)
Mid	5220	9.72	-3.111	12.83	13.00

802.11n HT20, 5150~5250 MHz_MIMO

Channel	Frequency (MHz)	Peak Value(dBm)	PPSD (dBm)	Peak Excursion (dB)	Limit (dB)
Mid	5220	11.18	-1.177	12.35	13.00

802.11n HT40, 5150~5250 MHz_MIMO

Channel	Frequency (MHz)	Peak Value(dBm)	PPSD (dBm)	Peak Excursion (dB)	Limit (dB)
Low	5190	0.90	-12.069	12.97	13.00

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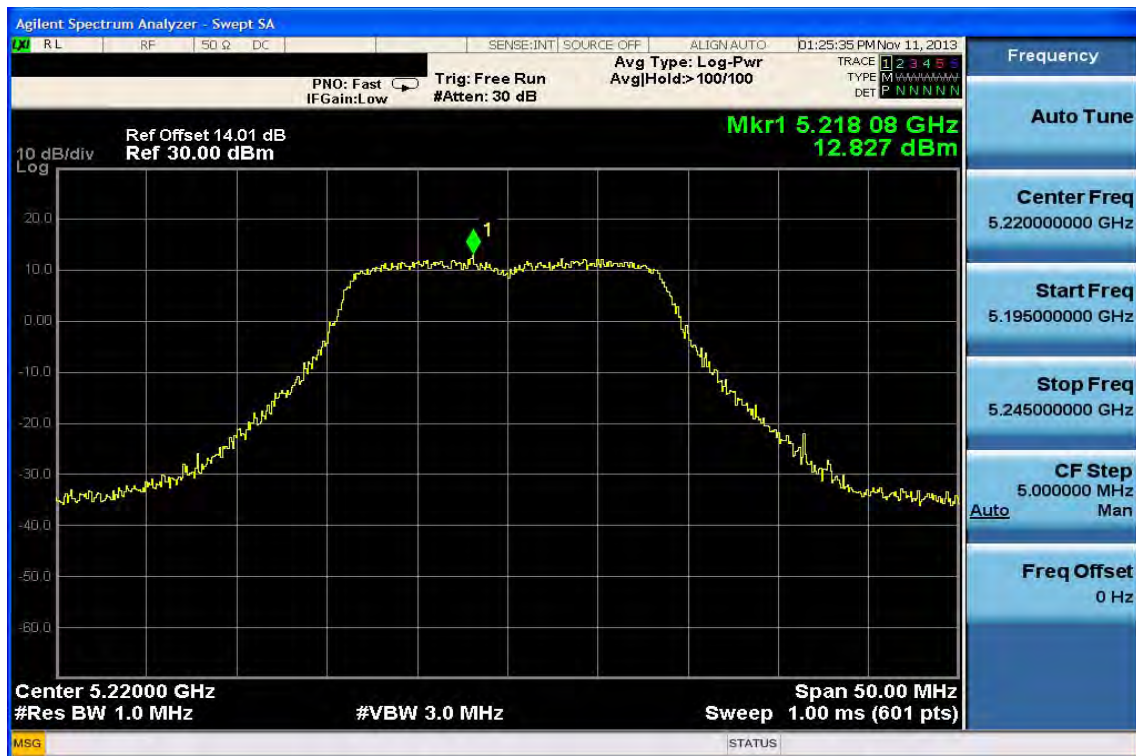
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Modulation Type: BPSK, Coding Rate: 1/2
802.11a, 5150~5250 MHz, Peak Value Data Plot (CH Mid 5220 MHz)



802.11n HT20, 5150~5250 MHz, Peak Value Data Plot (CH Mid 5220 MHz)



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802.11n HT40, 5150~5250 MHz, Peak Value Data Plot (CH Low 5190 MHz)



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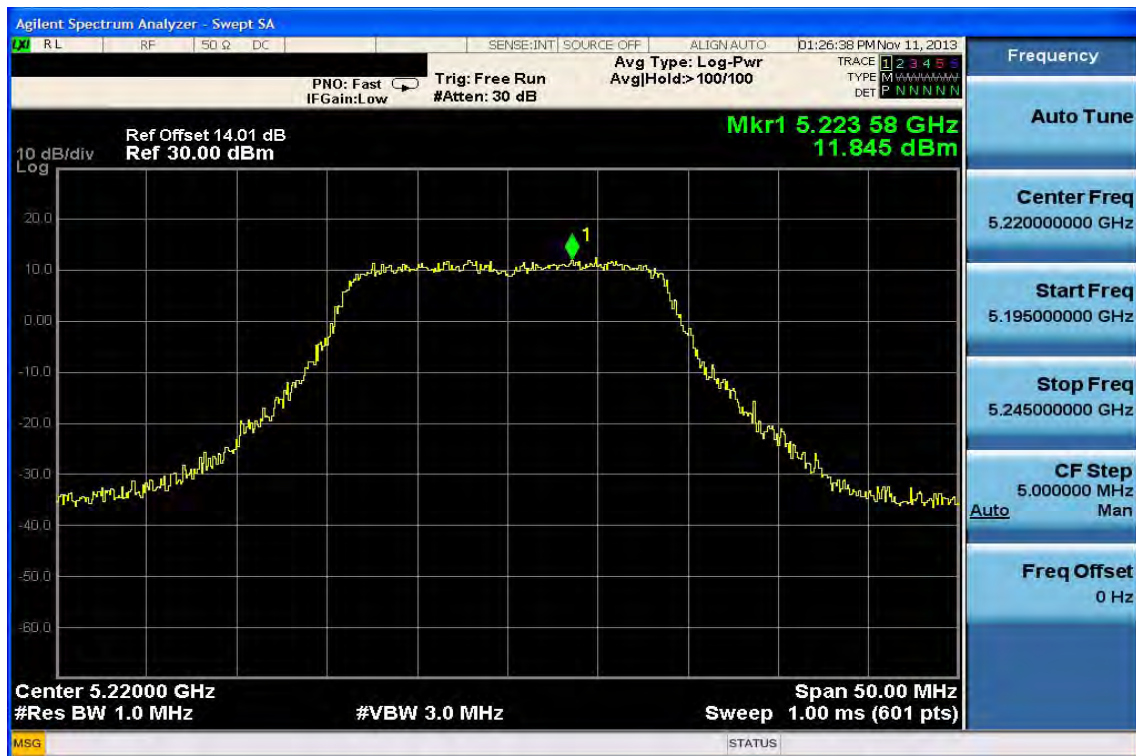
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Modulation Type: QPSK, Coding Rate: 1/2
802.11a, 5150~5250 MHz, Peak Value Data Plot (CH Mid 5220 MHz)



802.11n HT20, 5150~5250 MHz, Peak Value Data Plot (CH Mid 5220 MHz)



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802.11n HT40, 5150~5250 MHz, Peak Value Data Plot (CH Low 5190 MHz)



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Modulation Type: 16-QAM, Coding Rate: 1/2
802.11a, 5150~5250 MHz, Peak Value Data Plot (CH Mid 5220 MHz)



802.11n HT20, 5150~5250 MHz, Peak Value Data Plot (CH Mid 5220 MHz)



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802.11n HT40, 5150~5250 MHz, Peak Value Data Plot (CH Low 5190 MHz)



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Modulation Type: 64-QAM, Coding Rate: 2/3
802.11a, 5150~5250 MHz, Peak Value Data Plot (CH Mid 5220 MHz)



802.11n HT20, 5150~5250 MHz, Peak Value Data Plot (CH Mid 5220 MHz)



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802.11n HT40, 5150~5250 MHz, Peak Value Data Plot (CH Low 5190 MHz)



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Modulation Type: BPSK, Coding Rate: 1/2
PPSD Data Plot (CH Mid 5220 MHz)



802.11n HT20, 5150~5250 MHz, PPSD Data Plot (CH Mid 5220 MHz)



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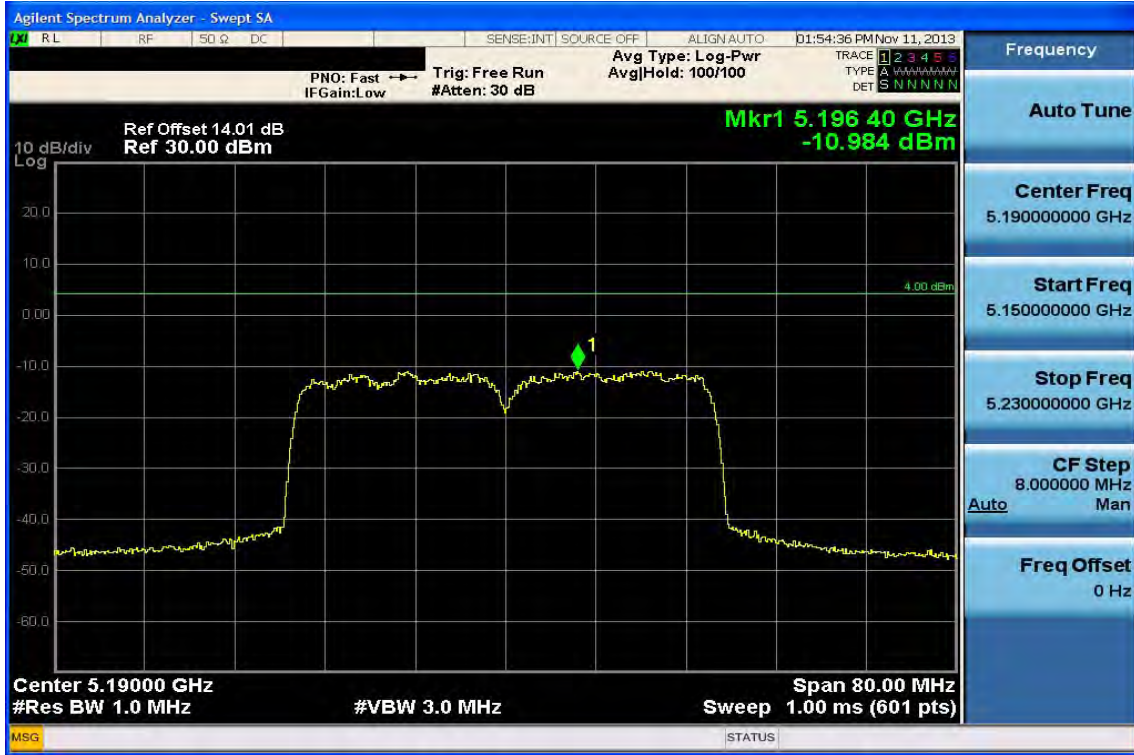
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802.11n HT40, 5150~5250 MHz, PPSD Data Plot (CH Low 5190 MHz)



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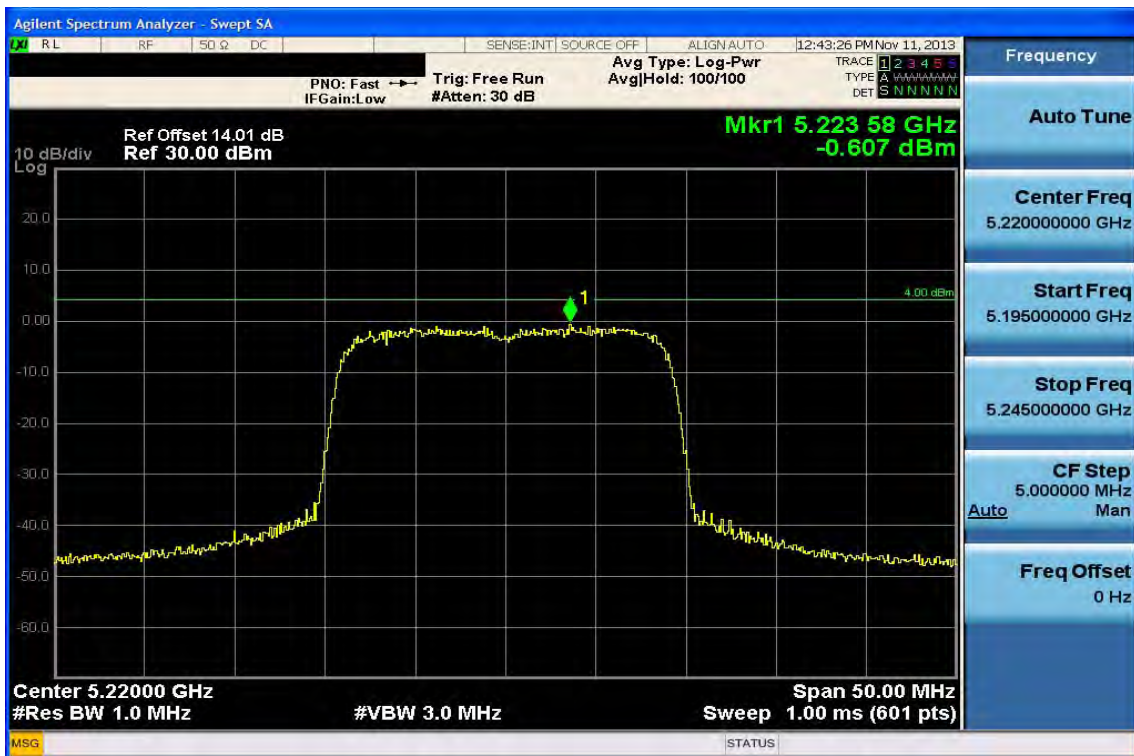
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Member of SGS Group

Modulation Type: QPSK, Coding Rate: 1/2
PPSD Data Plot (CH Mid 5220 MHz)



802.11n HT20, 5150~5250 MHz, PPSD Data Plot (CH Mid 5220 MHz)



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台灣檢驗科技股份有限公司

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Member of SGS Group

802.11n HT40, 5150~5250 MHz, PPSD Data Plot (CH Low 5190 MHz)



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Modulation Type: 16-QAM, Coding Rate: 1/2
PPSD Data Plot (CH Mid 5220 MHz)



802.11n HT20, 5150~5250 MHz, PPSD Data Plot (CH Mid 5220 MHz)



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802.11n HT40, 5150~5250 MHz, PPSD Data Plot (CH Low 5190 MHz)



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Modulation Type: 64-QAM, Coding Rate: 2/3
PPSD Data Plot (CH Mid 5220 MHz)



802.11n HT20, 5150~5250 MHz, PPSD Data Plot (CH Mid 5220 MHz)



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802.11n HT40, 5150~5250 MHz, PPSD Data Plot (CH Low 5190 MHz)



The end of Part I

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