



FCC Test Report (WIFI)

FCC ID : 2AF3ZX1

Applicant : Echobox Audio, LLC.

10900 NE 4th Street, Suite 1430, Bellevue WA98004, USA.

Sample Description

Product Name : Streaming Music Player

Model No. : X1, X2, E1, E2

Trademark : EchoBox

Receipt Date : 2015-09-23

Test Date : 2015-09-24 to 2015-09-29

Issue Date : 2015-09-29

Test Standard(s) : FCC CFR Title 47 Part 15 Subpart C Section 15.247

Conclusions : PASSED*

*In the configuration tested, the EUT complied with the standards specified above.

Test/Witness Engineer :

Approved & Authorized :

This report details the results of the testing carried out on one sample. The results contained in this test report do not relate to other samples of the same product. The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in the report.



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1. General Information

1.1 Client Information

Applicant	:	Echobox Audio,LLC.
Address	:	10900 NE 4th Street, Suite 1430, Bellevue WA98004, USA.
Manufacturer	:	Echobox Audio,LLC.
Address	:	10900 NE 4th Street, Suite 1430, Bellevue WA98004, USA.

1.2 General Description of EUT (Equipment Under Test)

Product Name	:	Streaming Music Player
Models No.	:	X1, X2, E1, E2
Trademark	:	EchoBox
Remark: All above models are identical in schematic, structure and critical components except for different model number and appearance; We choose X1 for test.		
Product Description	Operation Frequency:	2412MHz~2462MHz (802.11b/802.11g/802.11n(H20)) 2422MHz-2452MHz (802.11n(H40))
	Transfer Rate:	802.11b: 1/ 2/ 5.5/ 11Mbps 802.11g: 6/ 9/ 12/ 18/ 24/ 36/, 48/54 Mbps 802.11n: Up to 65Mbps
	Number of Channel:	11 for 802.11b/802.11g/802.11(H20) 7 for 802.11n(H40)
	Channel separation	5MHz
	Modulation Technology:	802.11b:DSSS 802.11g/ 802.11n:OFDM
	Antenna Type:	Integral Antenna
	Antenna Gain:	2.0 dBi
Power Supply	:	USB DC 5V from PC, DC 3.7V from Li-ion battery

Note:

- (1) For a more detailed features description, please refer to the manufacturer's specifications or the User's Manual.



(2) Channel List:

CH 01~CH 11 for 802.11b/ g/ n(20M)

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
01	2412	05	2432	09	2452
02	2417	06	2437	10	2457
03	2422	07	2442	11	2462
04	2427	08	2447		

CH 03~CH 09 for 802.11b/ g/ n(40M)

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
		05	2432	09	2452
		06	2437		
03	2422	07	2442		
04	2427	08	2447		

1.3 Description of Test Mode

To investigate the maximum EMI emission characteristics generates from EUT, the test system was pre-scanning tested base on the consideration of following EUT operation mode or test configuration mode which possible have effect on EMI emission level. Each of these EUT operation mode(s) or test configuration mode(s) mentioned follow was evaluated respectively.

Test Mode	Description
Transmitting mode	Keep the EUT in continuous transmitting with modulation

Remark: The sample was placed 0.8m above the ground plane of 3m chamber. Measurements in both horizontal and vertical polarities were performed. During the test, each emission was maximized by: having the EUT continuously working, investigated all operating modes, rotated about all 3 axis (X, Y & Z) and considered typical configuration to obtain worst position, manipulating interconnecting cables, rotating the turntable, varying antenna height from 1m to 4m in both horizontal and vertical polarizations. The emissions worst-case are shown in Test Results of the following pages.

We have verified the construction and function in typical operation. All the test modes were carried out with the EUT in transmitting operation, which was shown in this test report and defined as follows:



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Per-scan all kind of data rate in lowest channel, and found the follow list which it was worst case.	
Mode	Data rate
802.11b	1Mbps
802.11g	6Mbps
802.11n(H20)	6.5Mbps
802.11n(H40)	13.5 Mbps
Final Test Mode:	
According to ANSI C63.4 standards, the test results are both the “worst case” and “worst setup” 1Mbps for 802.11b, 6Mbps for 802.11g, 6.5Mbps for 802.11n(H20) and 13.5 Mbps for 802.11n(H40). Duty cycle setting during the transmission is 100% with maximum power setting for all modulations.	



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1.4 Test Instruments List

	Test Equipment	Manufacturer	Model No.	Cal. Date	Cal. Due date
1	Bilog Antenna	SCHWARZBECK MESS-ELEKTRONIK	VULB9163	May 23, 2015	May 22, 2016
2	Double -ridged waveguide horn	SCHWARZBECK MESS-ELEKTRONIK	BBHA9120D	May 28, 2015	May 27, 2016
3	Coaxial Cable	N/A	N/A	Mar. 30, 2015	Mar. 29, 2016
4	Coaxial Cable	N/A	N/A	Mar. 30, 2015	Mar. 29, 2016
5	Coaxial cable	N/A	N/A	Mar. 30, 2015	Mar. 29, 2016
6	Coaxial Cable	N/A	N/A	Mar. 30, 2015	Mar. 29, 2016
7	Coaxial Cable	N/A	N/A	Mar. 30, 2015	Mar. 29, 2016
8	Amplifier (10kHz-1.3GHz)	HP	8447D	Mar. 30, 2015	Mar. 29, 2016
9	Amplifier (1GHz-18GHz)	Compliance Direction Systems Inc.	PAP-1G18	Jun. 08, 2015	Jun. 07, 2016
10	Pre-amplifier (18-26GHz)	Rohde & Schwarz	AFS33-18002 650-30-8P-44	Mar. 30, 2015	Mar. 29, 2016
11	Horn Antenna	ETS-LINDGREN	3160	Mar. 30, 2015	Mar. 29, 2016
12	Positioning Controller	UC	UC3000	N/A	N/A
13	Spectrum analyzer 9kHz-30GHz	Rohde & Schwarz	FSP	May 28, 2015	May 27, 2016
14	EMI Test Receiver	Rohde & Schwarz	ESPI	Mar. 30, 2015	Mar. 29, 2016
15	Loop antenna	Laplace instrument	RF300	May 24, 2015	May 23, 2016
16	Universal radio communication tester	Rhode & Schwarz	CMU200	May 28, 2015	May 27, 2016
17	Signal Analyzer	Rohde & Schwarz	FSIQ3	May 28, 2015	May 27, 2016
18	L.I.S.N.#1	Rohde & Schwarz	NSLK8126	May 28, 2015	May 27, 2016
19	L.I.S.N.#2	Rohde & Schwarz	ENV216	May 28, 2015	May 27, 2016
20	Power Meter	Anritsu	ML2487A	May 28, 2015	May 27, 2016
21	Power sensor	Anritsu	MA2491A	May 28, 2015	May 27, 2016



1.5 Laboratory Location

Shenzhen TOBY technology Co., Ltd

Address: 1 A/F., Bldg.6, Yusheng Industrial Zone The National Road No.107 Xixiang Section 467,
Xixiang, Bao'an, Shenzhen, Guangdong, 518057, China

At the time of testing, the Laboratory is accredited. It is listed in the United States of American Federal Communications Commission (FCC), and the registration number is 811562 7.

Tel:0086-755-26509301 Fax: 0086-755-26509195



2. Test Summary

Standard Section	Test Item	Judgment
15.203/15.247(c)	Antenna Requirement	PASSED
15.207	Conducted Emission	PASSED
15.247(b)(3)	Conducted Peak Output Power	PASSED
15.247(a)(2)	99% OBW and 6dB Emission Bandwidth	PASSED
15.247(e)	Power Spectral Density	PASSED
15.247(d)	Band Edge	PASSED
15.205/15.209	Spurious Emission	PASSED



3. Antenna Requirement

3.1. Standard Requirement

3.1.1 Test standard

FCC Part15 Section 15.203 /247(c)

3.1.2 Requirement

1) 15.203 requirement:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

2) 15.247(c) (1)(i) requirement:

Systems operating in the 2400-2483.5 MHz band that is used exclusively for fixed. Point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

3.2. Antenna Connected Construction

The antenna is an integral antenna which permanently attached, and the best case gain of the antenna is 2.0dBi. It complies with the standard requirement.



4. Conducted Emission Test

4.1 Test Standard and Limit

4.1.1 Test Standard

FCC Part15 Section 15.207

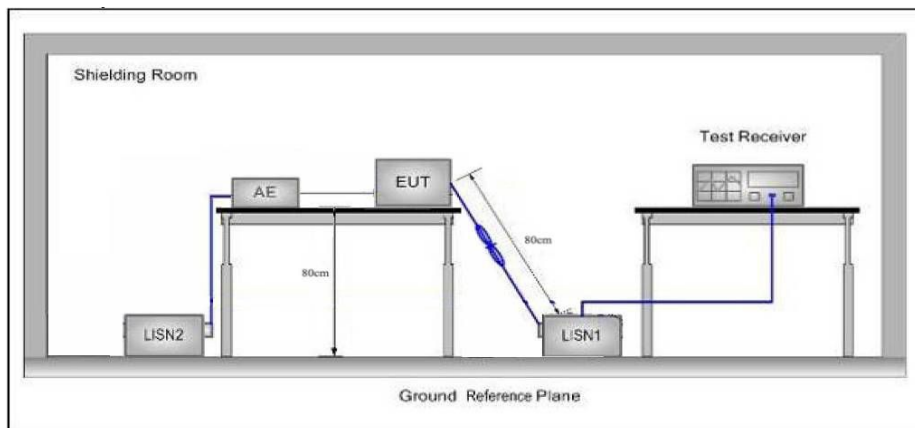
4.1.2 Test Limit

Conducted Emission Test Limit

Frequency	Maximum RF Line Voltage (dB μ V)	
	Quasi-peak Level	Average Level
150kHz~500kHz	66 ~ 56 *	56 ~ 46 *
500kHz~5MHz	56	46
5MHz~30MHz	60	50

Remark: (1) *Decreasing linearly with logarithm of the frequency.
(2) The lower limit shall apply at the transition frequencies.

4.2 Test Setup



4.3 Test Procedure

- 1) The EUT was connected to AC power source through a LISN 1 (Line Impedance Stabilization Network) which provides a $50 \Omega / 50 \mu\text{H} + 5 \Omega$ linear impedance. The power cables of all other units of the EUT were connected to a second LISN 2, which was bonded to the ground reference plane in the same way as the LISN 1 for the unit being measured. A multiple socket outlet strip was used to connect multiple power cables to a single LISN provided the rating of the LISN was not exceeded.
- 2) The tabletop EUT was placed upon a non-metallic table 0.8m above the ground reference plane. And for floor-standing arrangement, the EUT was placed on the horizontal ground reference plane.

The test was performed with a vertical ground reference plane. The rear of the EUT shall be 0.4 m from the vertical ground reference plane. The vertical ground reference plane was bonded to the horizontal



ground reference plane. The LISN 1 was placed 0.8 m from the boundary of the unit under test and bonded to a ground reference plane for LISNs mounted on top of the ground reference plane. This distance was between the closest points of the LISN 1 and the EUT. All other units of the EUT and associated equipment was at least 0.8 m from the LISN 2.

4.4 Test Data

Please refer to the following pages



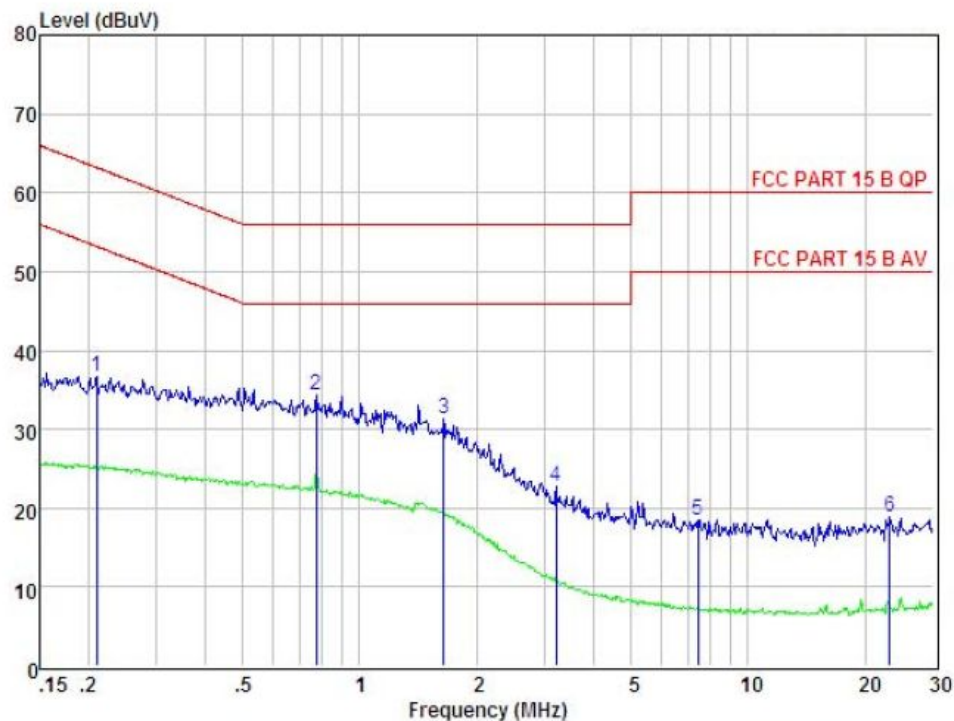
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Conducted Emission Test Data

EUT: Streaming Music Player M/N: X1
Operating Condition: WIFI mode
Test Site: Shielded room
Operator: Tom
Test Specification: AC 120V/60Hz
Polarization: Line
Note: Tem:25°C Hum:50%



Condition		: FCC PART 15 B QP				POL: LINE		Temp:20.1 °C Hum:45 %	
Item	Freq	Read	LISN	Preamp	Cable	Level	Limit	Margin	Remark
	MHz	dBuV	Factor	Factor	Loss	dBuV	dBuV	dBuV	
			dB	dB	dB				
1	0.211	26.93	0.03	-9.72	0.10	36.78	63.18	-26.40	Peak
2	0.775	24.41	0.00	-9.71	0.10	34.22	56.00	-21.78	Peak
3	1.645	21.48	0.05	-9.71	0.10	31.34	56.00	-24.66	Peak
4	3.207	12.78	0.07	-9.69	0.12	22.66	56.00	-33.34	Peak
5	7.446	8.64	0.14	-9.51	0.15	18.44	60.00	-41.56	Peak
6	23.140	8.53	0.42	-9.55	0.43	18.93	60.00	-41.07	Peak

Remarks: Level = Read + LISN Factor - Preamp Factor + Cable loss



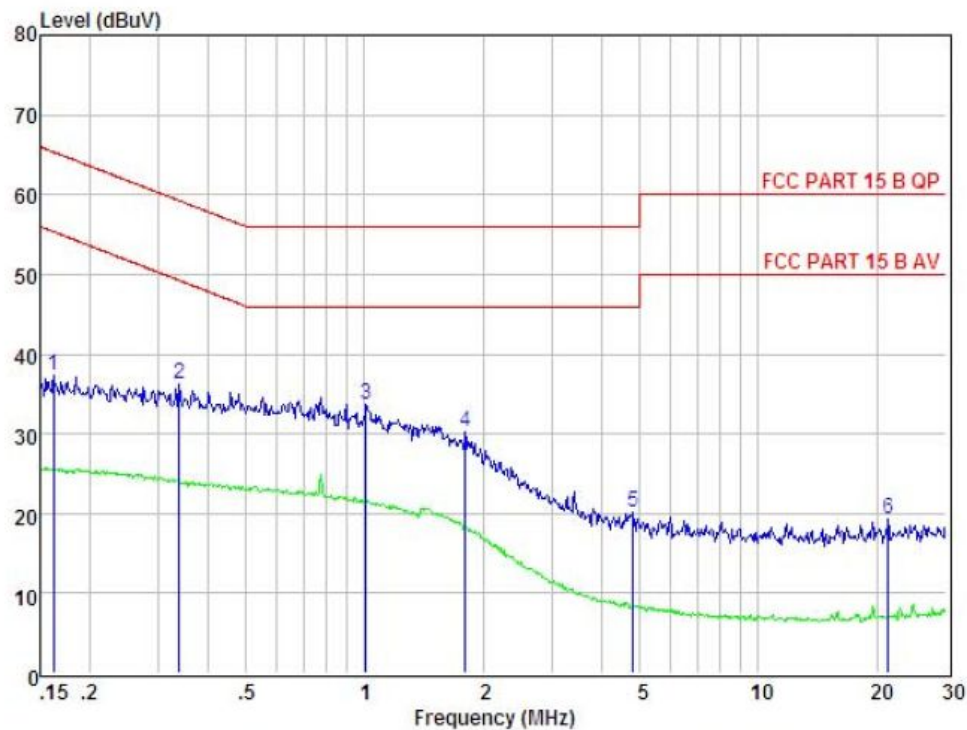
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Conducted Emission Test Data

EUT: Streaming Music Player M/N: X1
Operating Condition: WIFI mode
Test Site: Shielded room
Operator: Tom
Test Specification: AC 120V/60Hz
Polarization: Neutral
Note: Tem:25°C Hum:50%



Condition : FCC PART 15 B QP									
POL: NEUTRAL Temp:20.1 °C Hum:45 %									
Item	Freq	Read	LISN	Preamp	Cable	Level	Limit	Margin	Remark
	MHz	dBuV	Factor	Factor	Loss	dBuV	dBuV	dBuV	
1	0.162	27.51	0.03	-9.72	0.10	37.36	65.34	-27.98	Peak
2	0.339	26.47	0.03	-9.72	0.10	36.32	59.22	-22.90	Peak
3	1.010	23.78	0.04	-9.71	0.10	33.63	56.00	-22.37	Peak
4	1.800	20.44	0.05	-9.70	0.10	30.29	56.00	-25.71	Peak
5	4.822	10.28	0.10	-9.68	0.12	20.18	56.00	-35.82	Peak
6	21.373	9.09	0.36	-9.52	0.38	19.35	60.00	-40.65	Peak

Remarks: Level = Read + LISN Factor - Preamp Factor + Cable loss



5. Peak Output Power Test

5.1. Test Standard and Limit

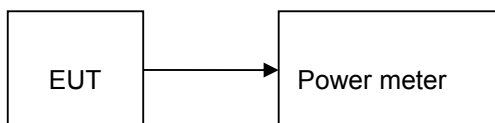
5.1.1 Test Standard

FCC Part15 C Section 15.247 (b)(3)

5.1.2 Test Limit

FCC Part 15 Subpart C(15.247)		
Test Item	Limit	Frequency Range (MHz)
Peak Output Power	1 Watt or 30 dBm	2400~2483.5

5.2. Test Setup



5.3. Test Procedure

- (1) The EUT was directly connected to peak power meter and antenna output port as show in the block diagram above.
- (2) Measure out each mode and each bands peak output power of EUT.
- (3) The EUT was set to continuously transmitting in the max power during the test.

5.4. Test Data

Test CH	Maximum Conducted Output Power (dBm)				Limit(dBm)	Result
	802.11b	802.11g	802.11n(H20)	802.11n(H40)		
Lowest	9.77	9.57	9.48	9.18	30.00dBm	PASSED
Middle	9.75	9.47	9.42	9.26		PASSED
Highest	9.69	9.35	9.29	9.22		PASSED
Remark: Test plot as follows						



6. Occupy Bandwidth Test

6.1. Test Standard and Limit

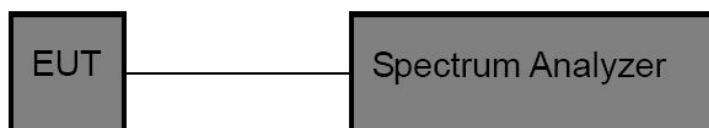
6.1.1 Test Standard

FCC Part15 C Section 15.247 (a)(2)

6.1.2 Test Limit

FCC Part 15 Subpart C(15.247)		
Test Item	Limit	Frequency Range
Bandwidth	>500 kHz (6dB bandwidth)	2400~2483.5(MHz)

6.2. Test Setup



6.3. Test Procedure

- (1) The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram above.
- (2) The bandwidth is measured at an amplitude level reduced 6dB from the reference level. The reference level is the level of the highest amplitude signal observed from the transmitter at the fundamental frequency. Once the reference level is established, the equipment is conditioned with typical modulating signal to produce the worst –case (i.e the widest) bandwidth.
- (3) Spectrum Setting:
Bandwidth: RBW=100 kHz, VBW=300 kHz, detector= Peak

6.4. Test Data

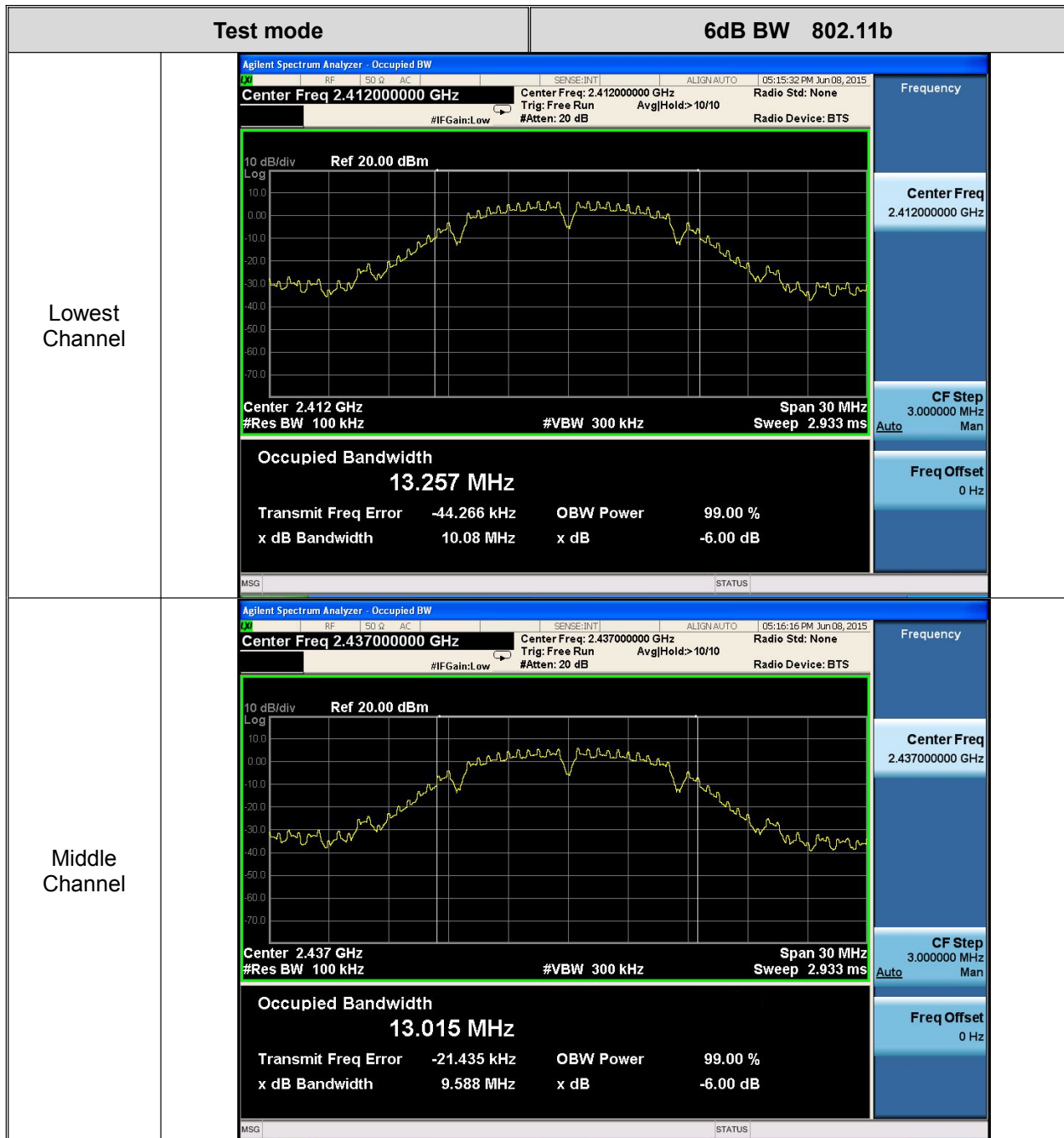
Test CH	6dB Occupy Bandwidth (MHz)				Limit (kHz)	Result
	802.11b	802.11g	802.11n(H20)	802.11n(H40)		
Lowest	10.08	15.16	16.91	35.24	>=500 kHz	PASSED
Middle	9.588	15.16	16.28	25.22		PASSED
Highest	9.593	15.15	15.15	15.24		PASSED
Remark: Test plot as follows						



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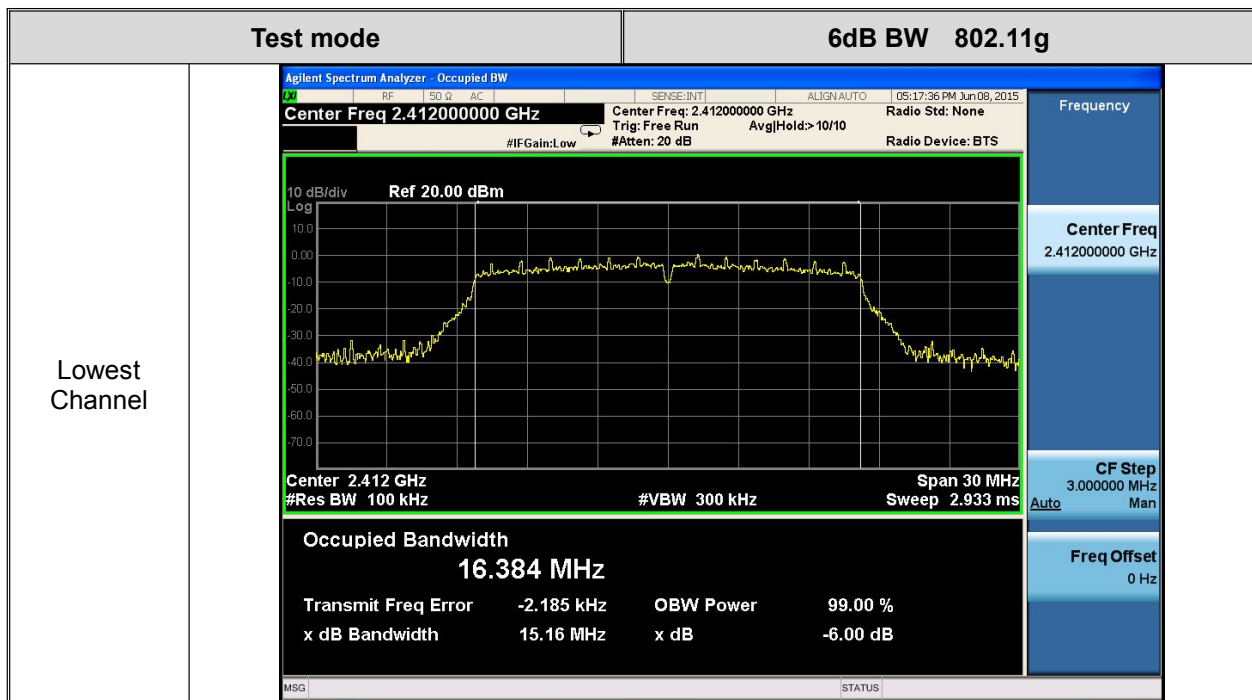




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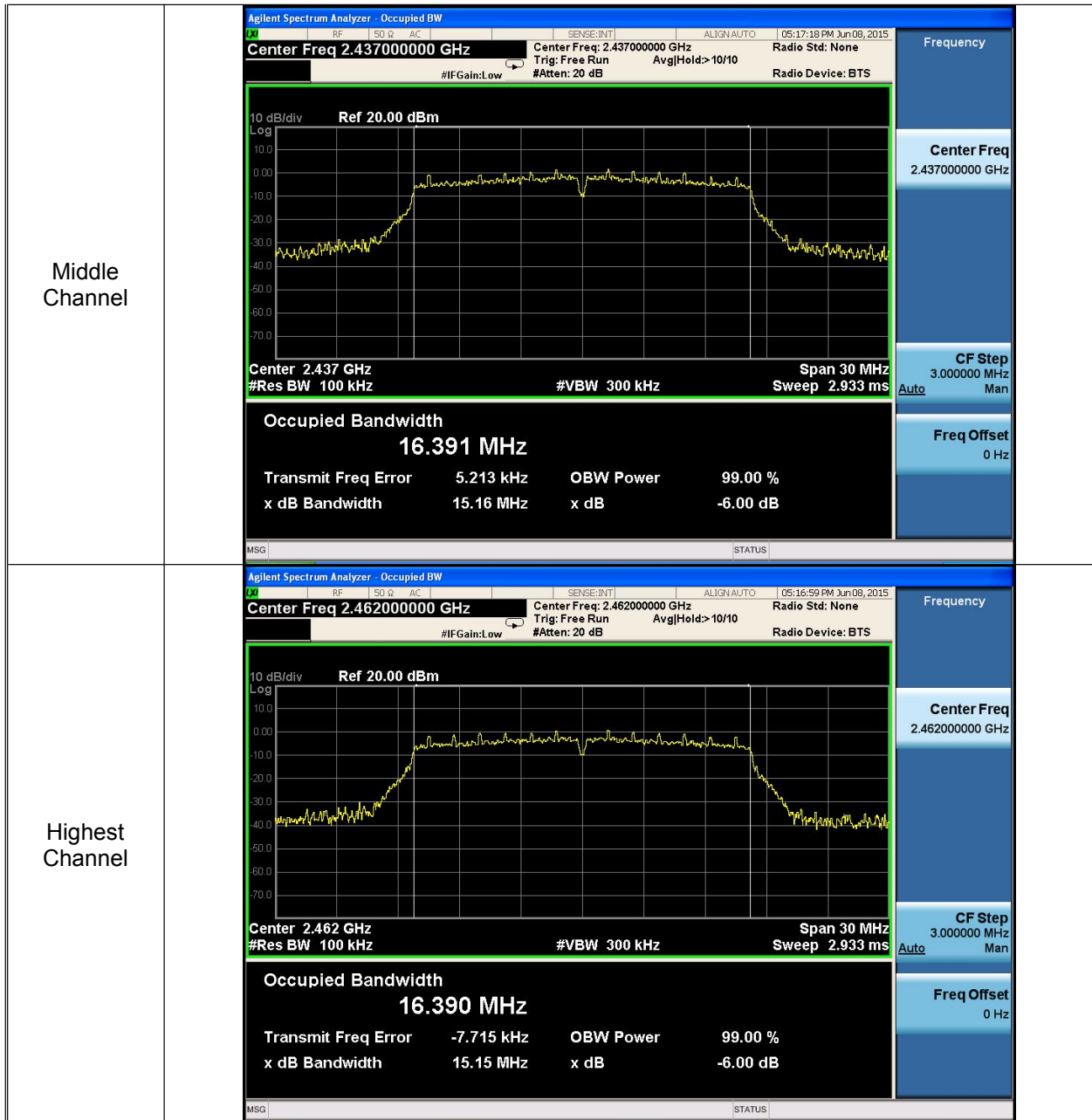




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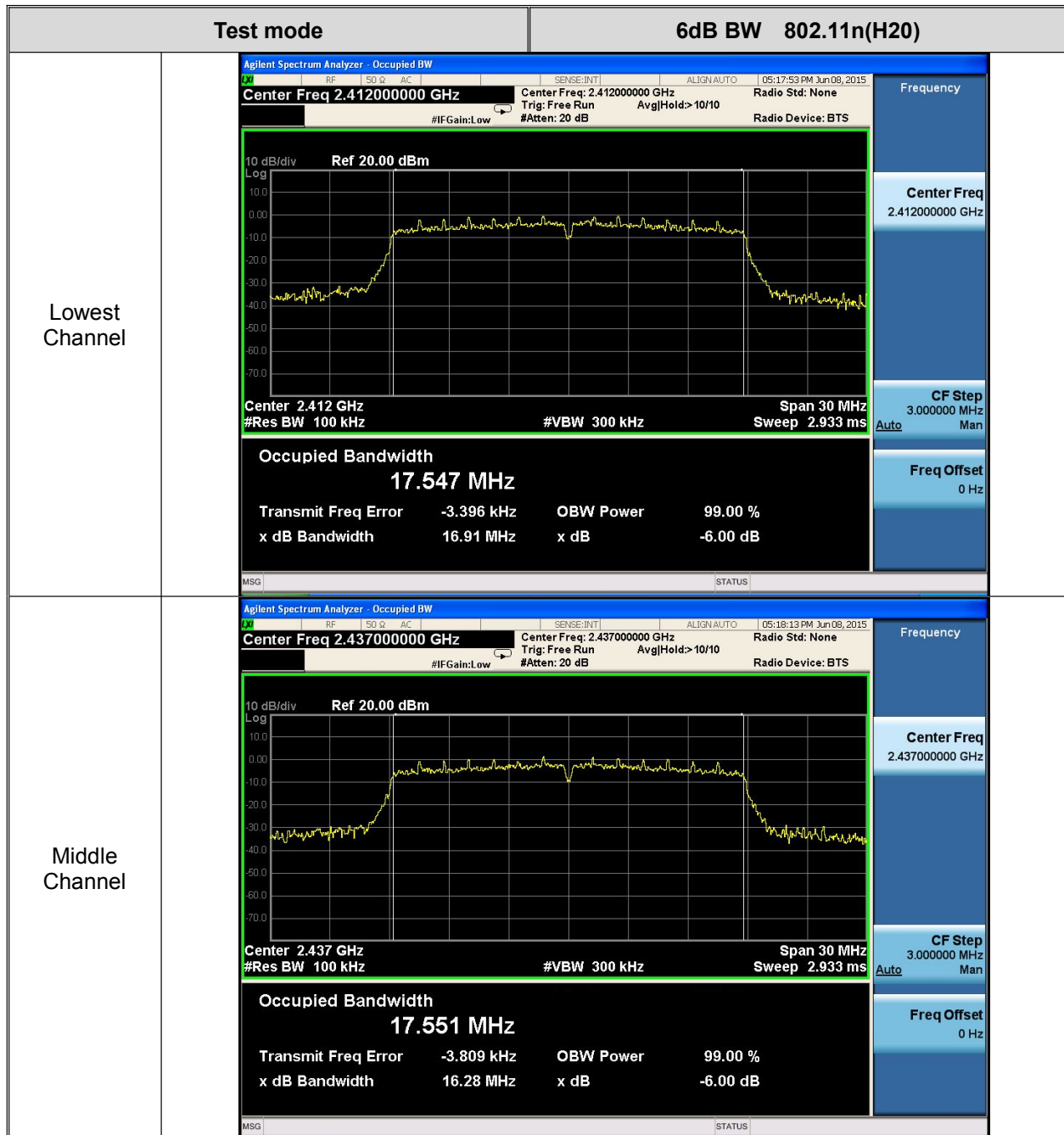




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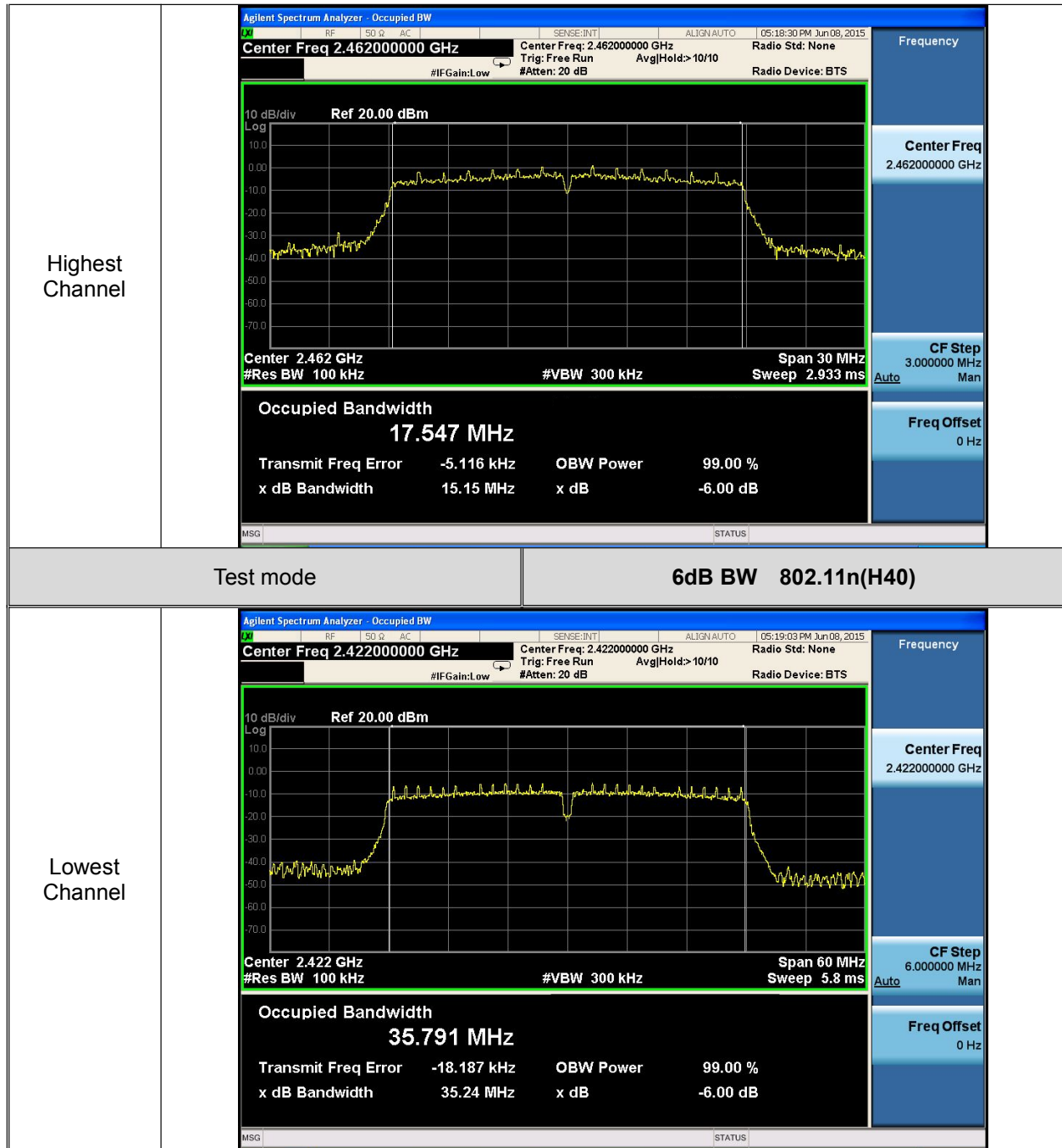




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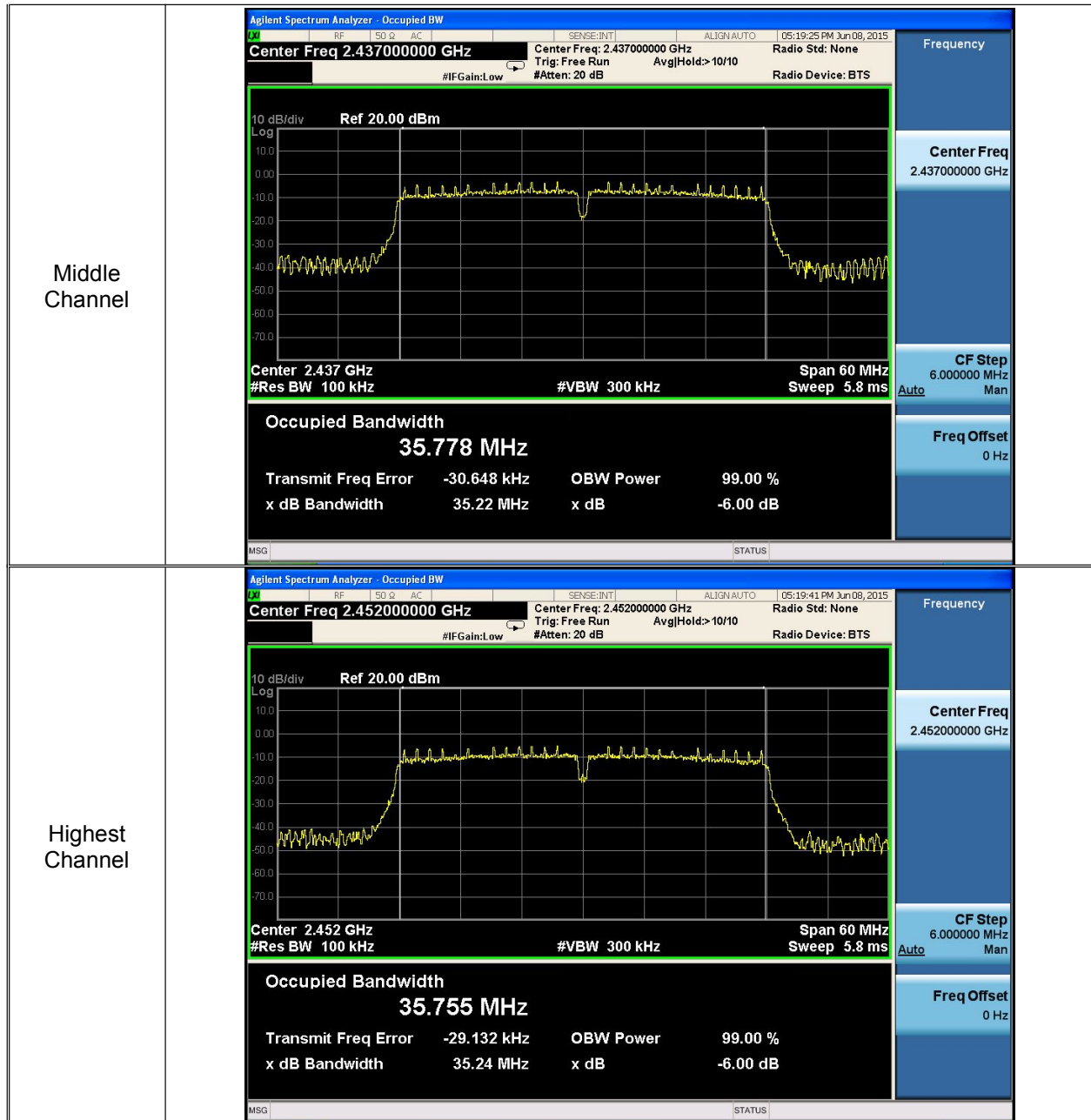




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7. Power Spectral Density Test

7.1. Test Standard and Limit

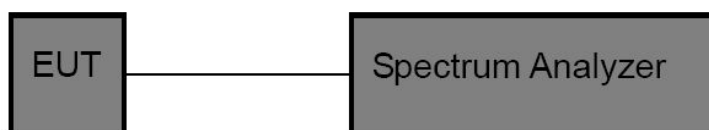
7.1.1 Test Standard

FCC Part15 C Section 15.247 (e)

7.1.2 Test Limit

FCC Part 15 Subpart C(15.247)		
Test Item	Limit	Frequency Range (MHz)
Power Spectral Density	8dBm(in any 3 kHz)	2400~2483.5

7.2. Test Setup



7.3. Test Procedure

- (1) The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram above.
- (2)Measure the spectral power density the spectrum analyzer was set to Resolution Bandwidth=3kHz, and Video Bandwidth=10 kHz, Detector= Peak, Span to 1.5 times the DTS bandwidth, Sweep time auto.
- (3)Allow trace to fully stabilize, and then use the peak marker function to determine the maximum PSD level.

7.4. Test Data

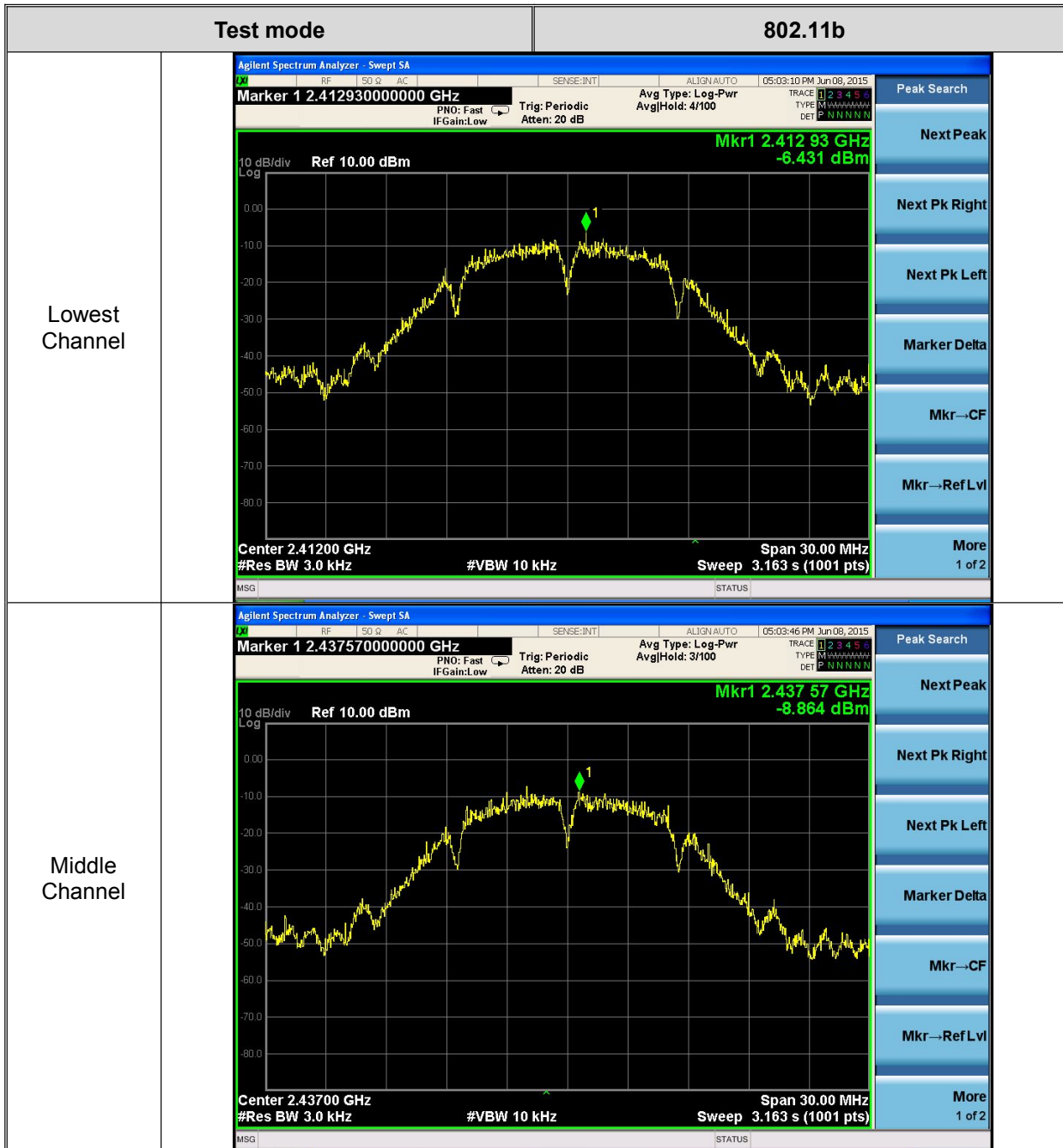
Test CH	Power Spectral Density (dBm)				Limit (dBm)	Result
	802.11b	802.11g	802.11n(H20)	802.11n(H40)		
Lowest	-6.431	-14.813	-14.797	-19.631	8.00	PASSED
Middle	-8.864	-12.850	-13.062	-17.746		PASSED
Highest	-8.748	-13.011	-13.587	-18.415		PASSED
Remark: Test plot as follows						



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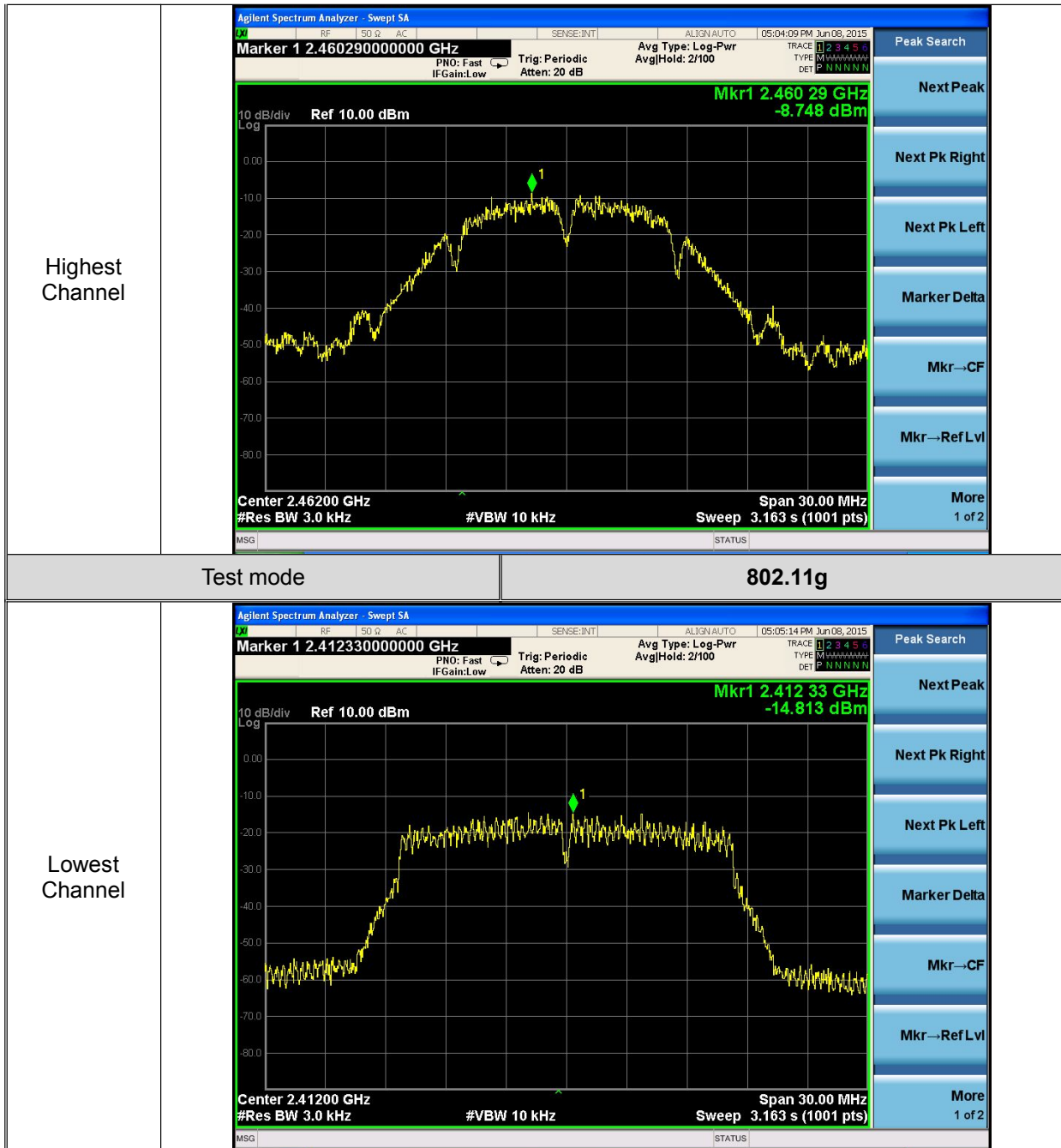




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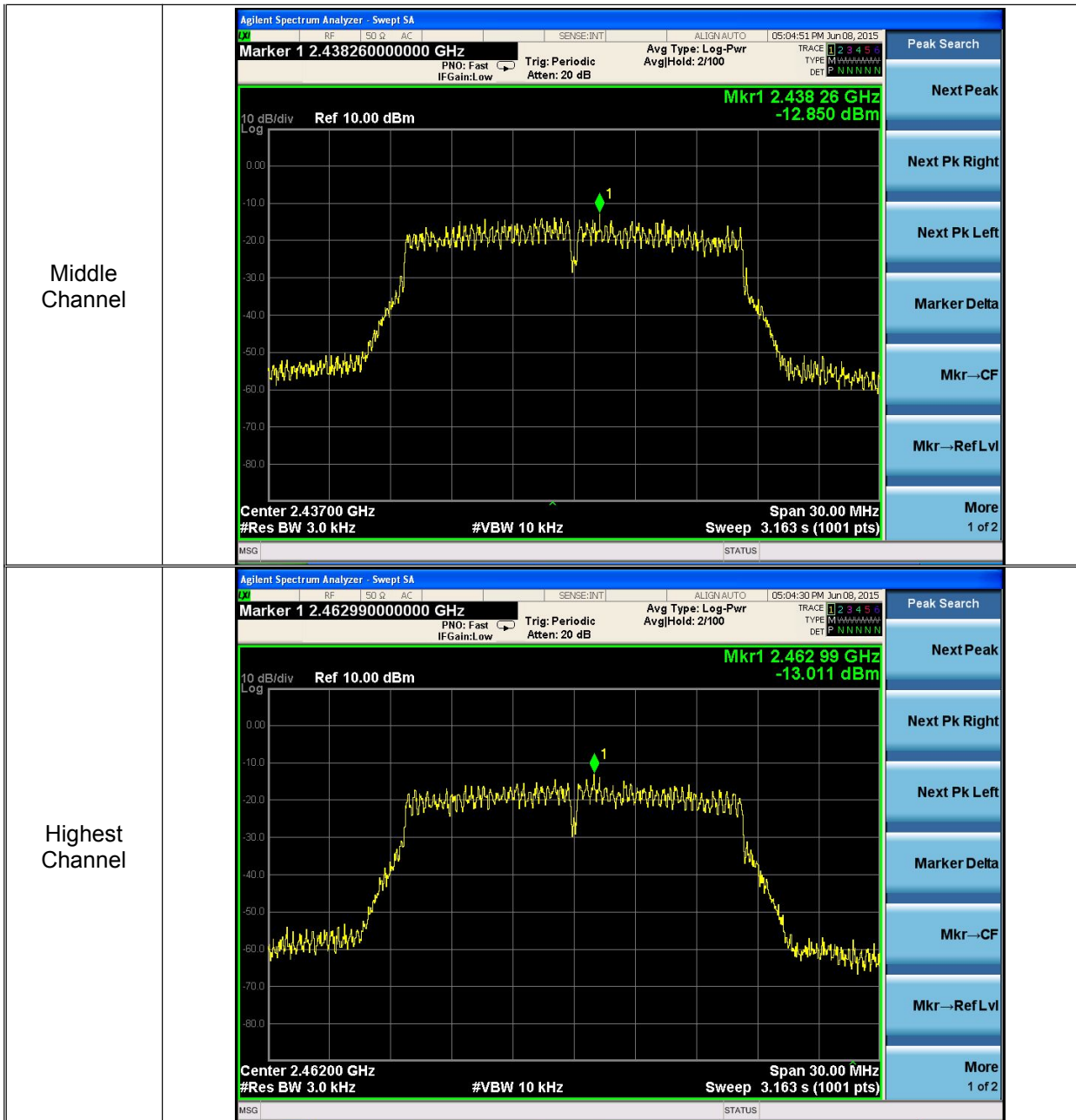




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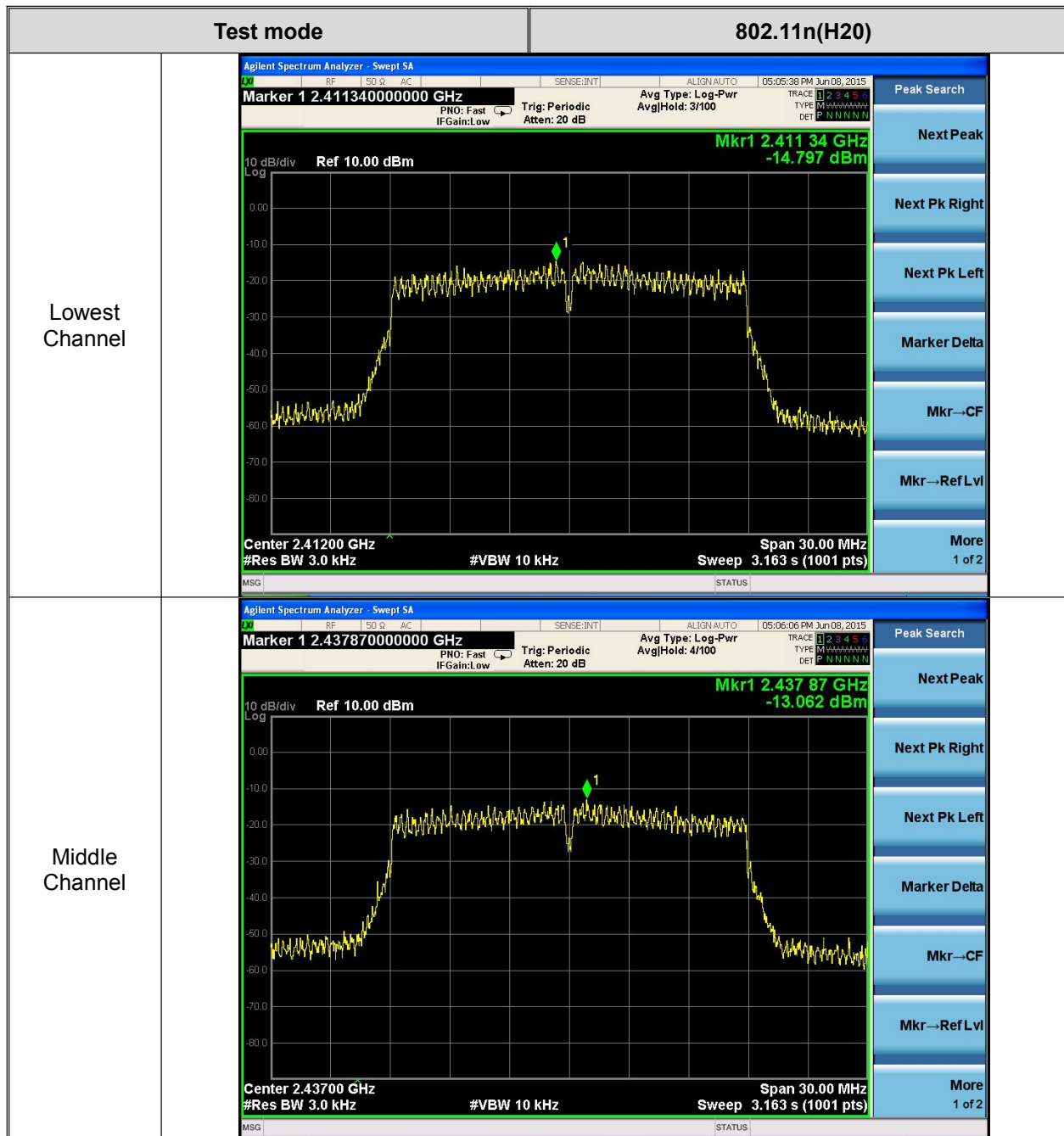




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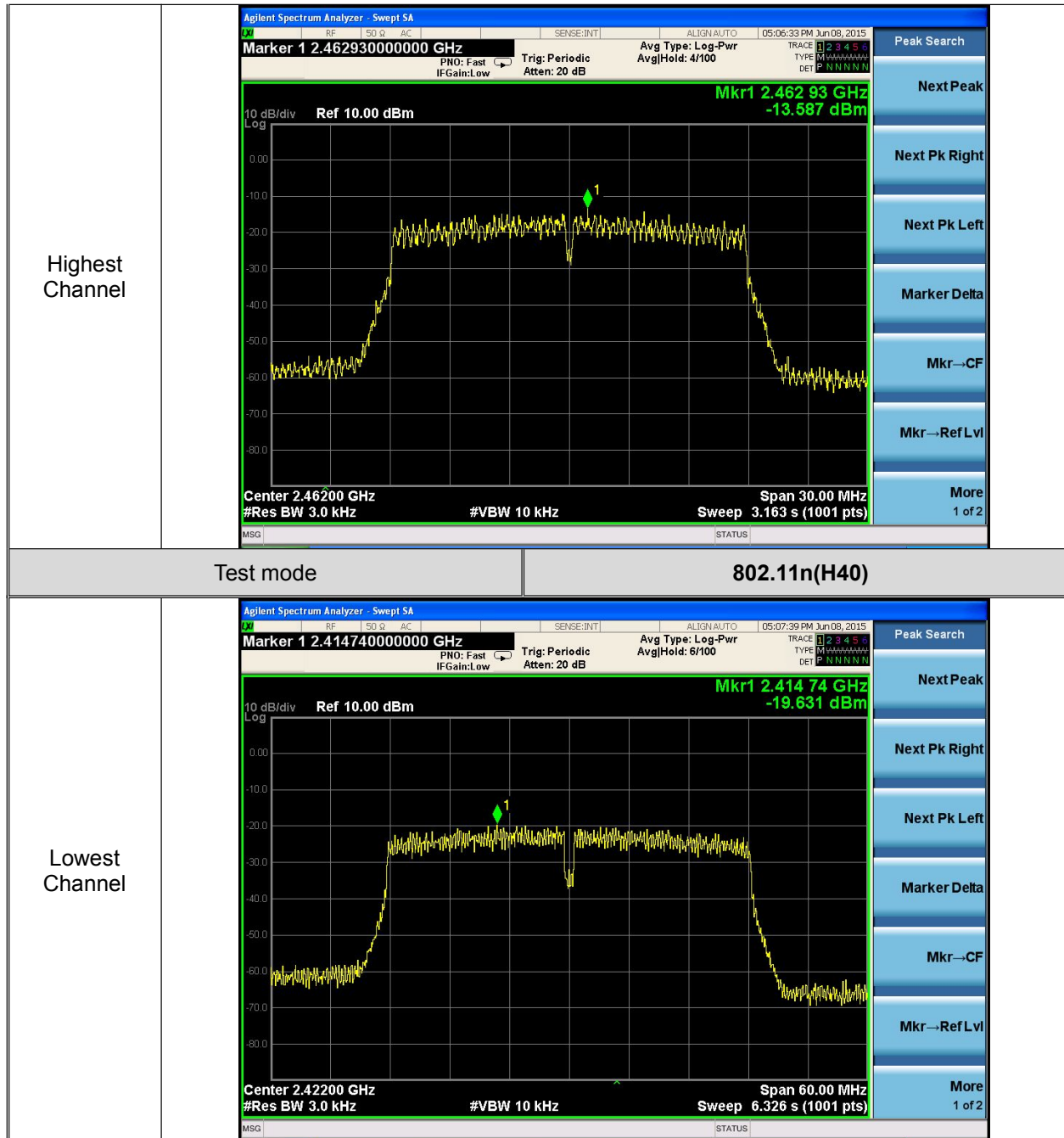




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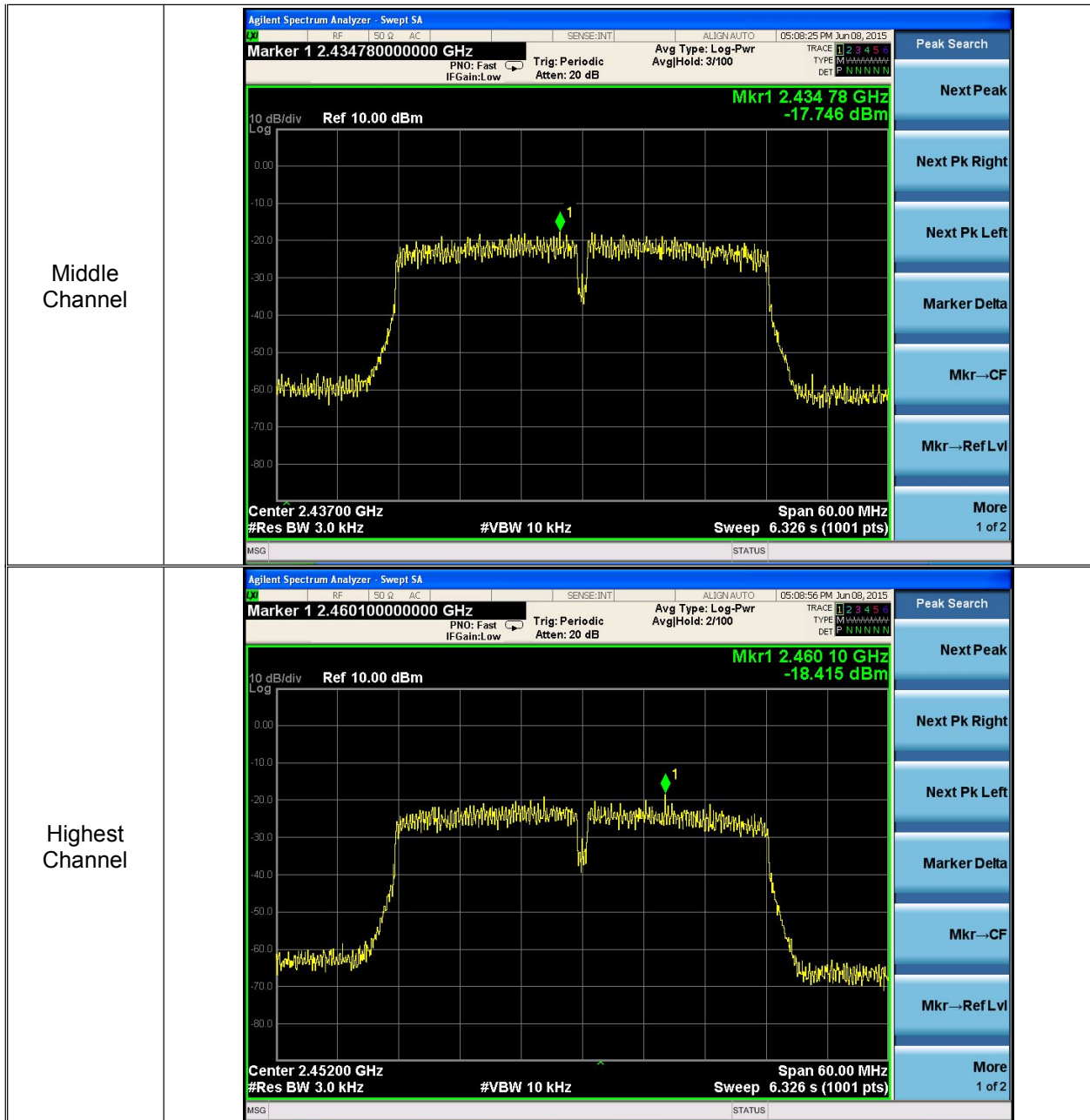




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8. Band Edge Requirement (Conducted Emission Method)

8.1. Test Standard and Limit

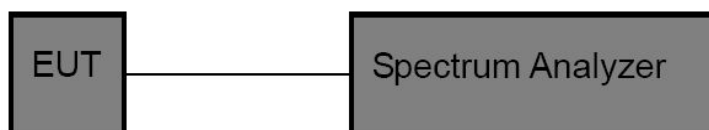
8.1.1 Test Standard

FCC Part15 C Section 15.247 (d)

8.1.2 Test Limit

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 30 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.

8.2. Test Setup



8.3. Test Procedure

(1) The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram above.

(2) Spectrum Setting: RBW=100 kHz, VBW=300 kHz, Detector=Peak

8.4. Test Data

Test plot as follows