

Test report No:
NIE: 63928RRF.001A1

Test Report

USA FCC Part 15.247, 15.209

CANADA RSS-247, RSS-Gen

Radio Frequency Devices. Operation within the bands 902 - 928 MHz, 2400 - 2483.5 MHz, and 5725 - 5850 MHz.

Digital Transmission Systems (DTSS), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices.

General Requirements and Information for the Certification of Radio Apparatus.

(*) Identification of item tested	Electronic Door-Opener
(*) Trademark	Hailo
(*) Model and /or type reference	Libero 3.0
Other identification of the product	HW version: 3.0 SW version: 3.0 FCC ID: 23468-LIBERO30 IC: 2ATCYLIBERO30
(*) Features	802.11 b/g/n (HT20) @ 2.4GHz
Applicant	Hailo-Werk Rudolf Loh GmbH Co. & KG Daimlerstraße 8 35708 Haiger, Germany
Test method requested, standard	USA FCC Part 15.247 (10-1-19) Edition: Operation within the bands 902 - 928 MHz, 2400 - 2483.5 MHz, and 5725 - 5850 MHz. USA FCC Part 15.209 (10-1-19) Edition: Radiated emission limits; general requirements. CANADA RSS-247 Issue 2 (February 2017). CANADA RSS-Gen Issue 5 Amendment 1 (March 2019). Guidance for Performing Compliance Measurements on Digital Transmission System, Frequency Hopping Spread Spectrum System, and Hybrid Systems Devices Operating Under Section 15.247 of the FCC Rules. 558074 D01 Meas Guidance v05r02 dated April 2, 2019. ANSI C63.10-2013: American National Standard for Testing Unlicensed Wireless Devices.
Summary	IN COMPLIANCE
Approved by (name / position & signature)	Rafael López EMC Consumer & RF Lab. Manager  2021.06.15 13:49:57 +02'00'
Date of issue	2021-06-15
Report template No	FDT08_23 (*) "Data provided by the client"

Index

Competences and guarantees3

General conditions.....3

Uncertainty.....3

Data provided by the client3

Usage of samples3

Test sample description.....5

Identification of the client6

Testing period and place6

Document history.....6

Environmental conditions6

Remarks and comments.....7

Testing verdicts.....8

Summary8

Appendix A: Test results. 802.11 bgn20 1x1.....9

Competences and guarantees

DEKRA Testing and Certification S.A.U. is a testing laboratory accredited by the National Accreditation Body (ENAC -Entidad Nacional de Acreditación), to perform the tests indicated in the Certificate No. 51/LE 147.

DEKRA Testing and Certification is a FCC-recognized accredited testing laboratory with appropriate scope of accreditation that include testing performed in this test report.

DEKRA Testing and Certification is an ISED-recognized accredited testing laboratory with appropriate scope of accreditation that include testing performed in this test report.

In order to assure the traceability to other national and international laboratories, DEKRA Testing and Certification S.A.U. has a calibration and maintenance program for its measurement equipment.

DEKRA Testing and Certification S.A.U. guarantees the reliability of the data presented in this report, which is the result of the measurements and the tests performed to the item under test on the date and under the conditions stated on the report and, it is based on the knowledge and technical facilities available at DEKRA Testing and Certification S.A.U. at the time of performance of the test.

DEKRA Testing and Certification S.A.U. is liable to the client for the maintenance of the confidentiality of all information related to the item under test and the results of the test.

The results presented in this Test Report apply only to the particular item under test established in this document.

IMPORTANT: No parts of this report may be reproduced or quoted out of context, in any form or by any means, except in full, without the previous written permission of DEKRA Testing and Certification S.A.U.

General conditions

1. This report is only referred to the item that has undergone the test.
2. This report does not constitute or imply on its own an approval of the product by the Certification Bodies or competent Authorities.
3. This document is only valid if complete; no partial reproduction can be made without previous written permission of DEKRA Testing and Certification S.A.U.
4. This test report cannot be used partially or in full for publicity and/or promotional purposes without previous written permission of DEKRA Testing and Certification S.A.U. and the Accreditation Bodies.

Uncertainty

Uncertainty (factor $k=2$) was calculated according to the DEKRA Testing and Certification S.A.U. internal document PODT000.

Data provided by the client

The following data has been provided by the client:

1. Information relating to the description of the sample ("Identification of the item tested", "Trademark", "Model and/or type reference tested").
2. The sample of the model Libero 3.0 is an electronic device for open kitchen door.

DEKRA Testing and Certification S.A.U. declines any responsibility with respect to the information provided by the client and that may affect the validity of result.

Usage of samples

Samples undergoing test have been selected by: The client.

- Sample S/01 is composed of the following elements:

Control N°	Description	Model	Serial N°	Date of reception
63928B/032	Electronic Door-Opener	Libero 3.0	V005	2021/03/05
63928B/028	AC/DC adapter	8K02G	--	2021/01/26
63928B/025	USB cable	---	---	2021/01/26

Sample S/01 has undergone the following test(s): All Radiated tests indicated in the Appendix A.

- Sample S/02 is composed of the following elements:

Control N°	Description	Model	Serial N°	Date of reception
63928B/010	Electronic Door-Opener	Libero 3.0	V006	2020/10/20
63928B/028	AC/DC adapter	8K02G	--	2021/01/26
63928B/025	USB cable	---	---	2021/01/26

Sample S/02 has undergone the following test(s): All Conducted tests indicated in the Appendix A.

Test sample description

Ports..... :	Port name and description	Cable					
		Specified max length [m]	Attached during test	Shielded	Coupled to patient ⁽³⁾		
	--		☐	☐	☐		
Supplementary information to the ports..... :							
Rated power supply	Voltage and Frequency		Reference poles				
			L1	L2	L3	N	PE
	☒	AC: 100-240V~50Hz/60Hz	☐	☐	☐	☐	☐
	☐	DC:					
Rated Power	5V 2A						
Clock frequencies..... :							
Other parameters							
Software version	3.0						
Hardware version	3.0						
Dimensions in cm (W x H x D)	Product dimensions 157 x 300 x 33						
Mounting position	☐	Table top equipment					
	☐	Wall/Ceiling mounted equipment					
	☐	Floor standing equipment					
	☐	Hand-held equipment					
	☒	Other: Mounts in forward cabinets section of bottom-panel					
Modules/parts..... :	Module/parts of test item		Type		Manufacturer		
	Libero 3.0		Libero 3.0		Hailo		
	AC/DC Adapter		SK02G		Starwell		
Accessories (not part of the test item)	Description		Type		Manufacturer		
Documents as provided by the applicant..... :	Description		File name		Issue date		

⁽³⁾ Only for Medical Equipment

Identification of the client

Hailo-Werk Rudolf Loh GmbH Co. & KG
Daimlerstraße 8
35708 Haiger, Germany

Testing period and place

Test Location	DEKRA Testing and Certification S.A.U.
Date (start)	2020-11-27
Date (finish)	2021-04-13

Document history

Report number	Date	Description
63928RRF.001	2021-04-15	First release
63928RRF.001A1	2021-06-15	Second release. First modification due to changes in FCC ID and IC. This modification test report cancels and replaces the test report 63928RRF.001

Environmental conditions

In the control chamber, the following limits were not exceeded during the test:

Temperature	Min. = 15 °C Max. = 35 °C
Relative humidity	Min. = 20 % Max. = 75 %

In the semianechoic chamber, the following limits were not exceeded during the test.

Temperature	Min. = 15 °C Max. = 35 °C
Relative humidity	Min. = 20 % Max. = 75 %

In the chamber for conducted measurements, the following limits were not exceeded during the test:

Temperature	Min. = 15 °C Max. = 35 °C
Relative humidity	Min. = 20 % Max. = 75 %

Remarks and comments

The tests have been performed by the technical personnel: Cristina Calle, Miguel Manuel Lopez, Pablo Redondo and Jaime Barranquero.

Used instrumentation:

Conducted Measurements:

		Last Calibration	Due Calibration
1.	Shielded Room ETS LINDGREN S101	N.A.	N.A.
2.	Signal and Spectrum Analyzer 9 kHz - 6 GHz ROHDE AND SCHWARZ FSL 6	2019/04	2021/04

Radiated Measurements:

		Last Calibration	Due Calibration
1.	Semianechoic Absorber Lined Chamber ETS LINDGREN FACT 3 200 STP	N.A.	N.A.
2.	Shielded Room ETS LINDGREN S101	N.A.	N.A.
3.	ULTRALOG Antenna 30 MHz - 6 GHz ROHDE AND SCHWARZ HL562E_UPG	2019/10	2022/10
4.	EMI Test Receiver 2Hz-44GHz ROHDE AND SCHWARZ ESW44	2019/10	2021/10
5.	Horn Antenna 1-18GHz SCHWARZBECK MESS- ELEKTRONIK BBHA 9120 D	2019/11	2022/11
6.	Broadband Horn Antenna 18 - 40 GHz SCHWARZBECK MESS-ELEKTRONIK BBHA 9170	2021/03	2024/03
7.	Pre-amplifier, G>30dB 500MHz-18GHz SCHWARZBECK BBV 9718 C	2021/02	2022/02
8.	Pre-amplifier G>30dB, 18 - 40 GHz BONN ELEKTRONIK BLMA 1840-3G	2019/11	2021/11

Testing verdicts

Not applicable:	N/A
Pass:	P
Fail:	F
Not measured:	N/M

Summary

WLAN 2.4 GHz (802.11 b/g/n20 1x1).

FCC PART 15 PARAGRAPH / RSS-247			
Requirement – Test case		Verdict	Remark
15.247 (a) (2) / RSS-247 5.2. (a)	6 dB Bandwidth	P	
15.247 (b) / RSS-247 5.4. (d)	Maximum output power and antenna gain	P	
15.247 (d) / RSS-247 5.5.	Band-edge emissions compliance (Transmitter)	P	
15.247 (e) / RSS-247 5.2. (b)	Power spectral density	P	
15.247 (d) / RSS-247 5.5.	Emission limitations radiated (Transmitter)	P	
<u>Supplementary information and remarks:</u> None.			

Appendix A: Test results. 802.11 bgn20 1x1

TEST CONDITIONS.....	11
Occupied Bandwidth.....	15
FCC 15.247 (a) (2) / RSS-247 5.2 (a) 6 dB Bandwidth	25
FCC 15.35 (c) / RSS-Gen 6.10. Transmitter Duty Cycle	31
FCC 15.247 (b) / RSS-247 5.4 (d) Maximum output power and antenna gain	34
FCC 15.247 (d) / RSS-247 5.5. Band-edge emissions compliance (Transmitter).....	40
FCC 15.247 (e) / RSS-247 5.2. (b) Power spectral density	44
FCC 15.247 (d) / RSS-247 5.5. Emission limitations radiated (Transmitter).....	50

TEST CONDITIONS

POWER SUPPLY (V):

V nominal:	115Vac.
Type of Power Supply:	AC/DC adapter.

ANTENNA:

Type of Antenna:	Internal.
Maximum Declared Antenna Gain:	3.77 dBi

TEST FREQUENCIES FOR 802.11 b/g/n20:

Low Channel (1):	2412 MHz
Middle Channel (6):	2437 MHz
High Channel (11):	2462 MHz

The EUT was tested in the following operating mode:

- Continuously transmitting with a modulated carrier at maximum power in all required channels using the supported data rates/modulations types.

The field strength at the band edges was evaluated for each mode on the lowest and highest channels at the rated power for the channel under test.

For all modes, the EUT was configured in test mode using a software application provide for the customer. The application was used to enable a continuous transmission and to select the test channels as required. The client supplied instructions to configure the EUT. The customer supplied a document containing the setup instructions.

The data rates of 1Mb/s for 802.11b, 6.5Mb/s for 802.11g, MSC0 for 802.11n20 were selected based on preliminary testing that identified those rates corresponding to the worst cases for output power and band edge levels at restricted bands.

High channel has been performed with power setting 5 to be in compliance according to the limit standard. It was selected in the software.

CONDUCTED MEASUREMENTS

The equipment under test was set up in a shielded room and it is connected to the spectrum analyser using a low loss RF cable. The reading of the spectrum analyser is corrected taking into account the cable loss.



The DC supply voltage is applied using an external calibrated power supply with a multimeter.

RADIATED MEASUREMENTS

All radiated tests were performed in a semi-anechoic chamber. The measurement antenna (Bilog antenna for the range between 30 MHz to 1000 MHz) and 1 GHz-18 GHz Double ridge horn antenna is situated at a distance of 3 m and a distance of 1m for the frequency range 17 GHz-26 GHz (18 GHz-40 GHz horn antenna).

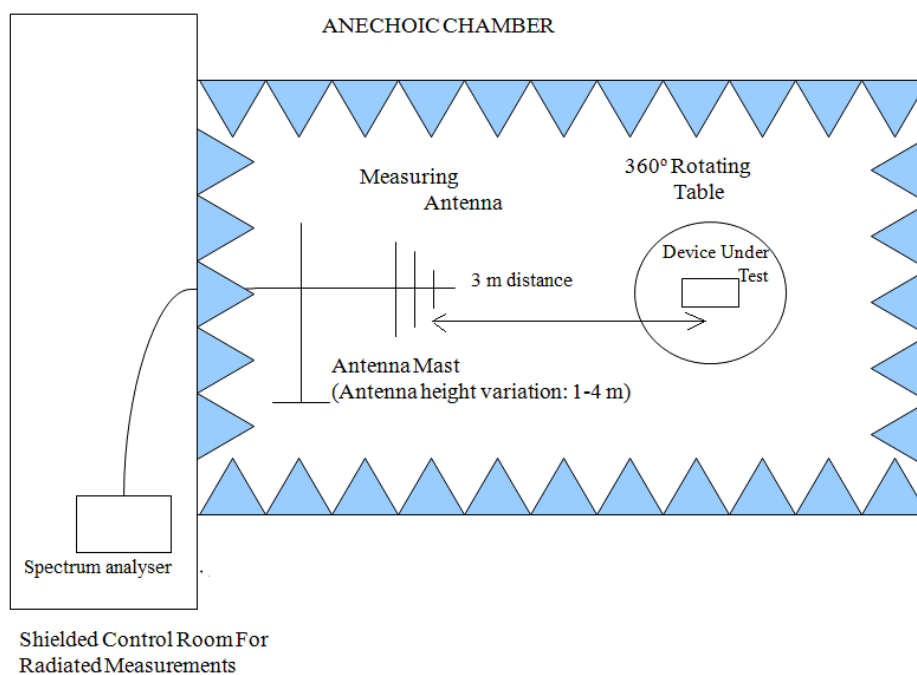
For radiated emissions in the range 17 GHz-26 GHz that is performed at a distance closer than the specified distance, an inverse proportionality factor of 20 dB per decade is used to normalize the measured data for determining compliance.

The equipment under test was set up on a non-conductive platform above the ground plane and the situation and orientation was varied to find the maximum radiated emission. It was also rotated 360° and the antenna height (Bilog antenna and Double ridge horn antenna) was varied from 1 to 4 meters to find the maximum radiated emission.

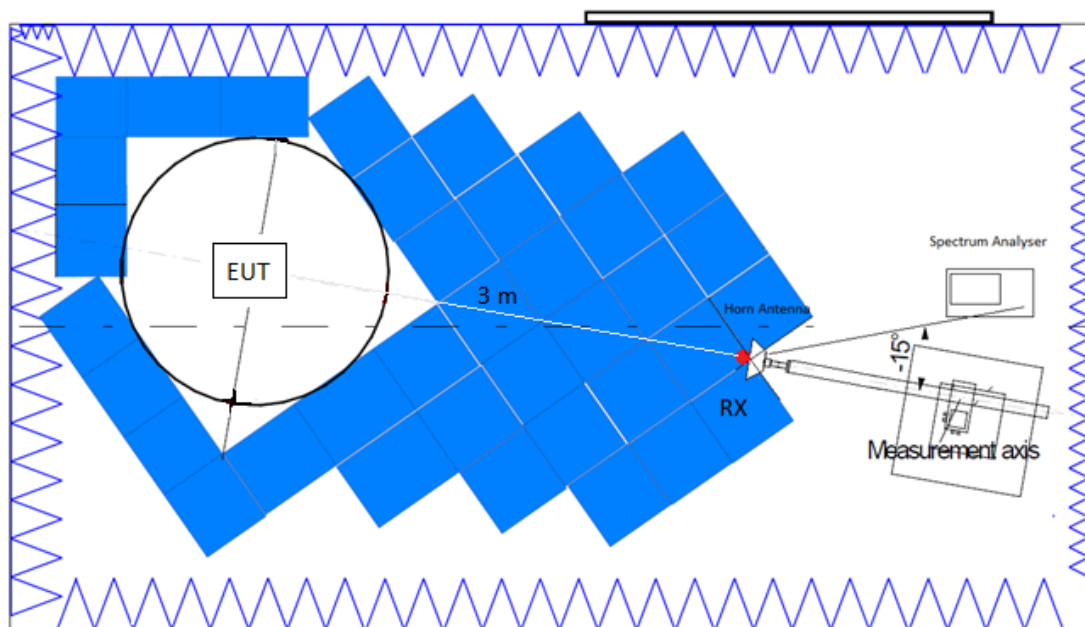
Measurements were made in both horizontal and vertical planes of polarization.

A resolution bandwidth/video bandwidth of 100 kHz/300 kHz was used for frequencies below 1 GHz and 1MHz/3MHz for frequencies above 1 GHz.

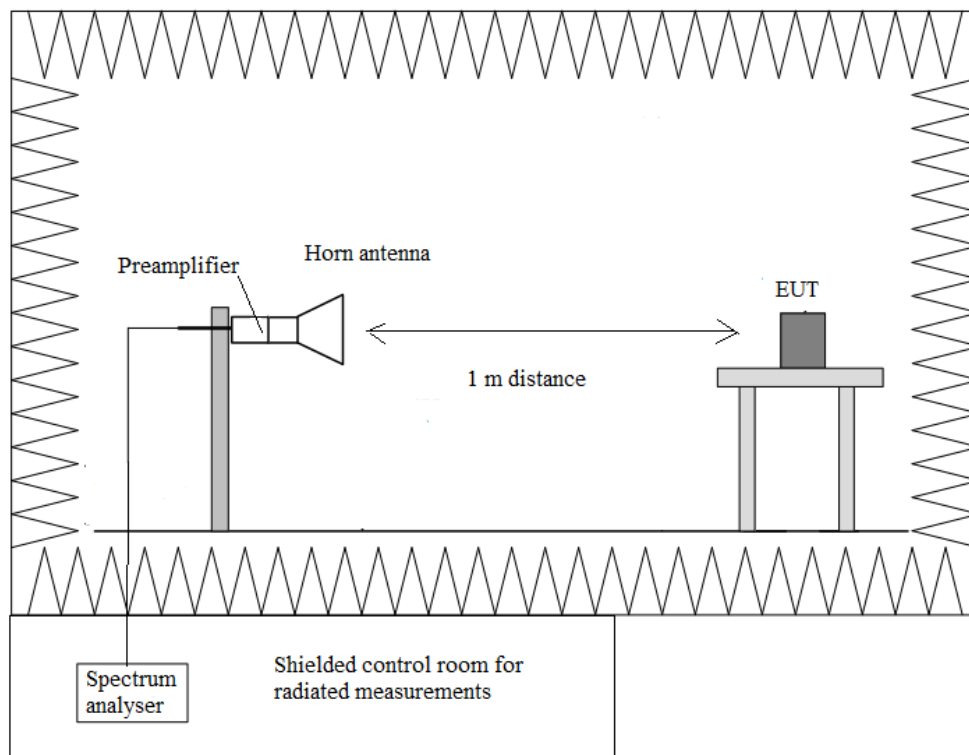
Radiated measurements setup from 30 MHz to 1 GHz:



Radiated measurements setup from 1 GHz to 17 GHz:



Radiated measurements setup $f > 17$ GHz:



Occupied Bandwidth

RESULTS:

- **Mode 802.11 b:**

	Low Channel 2412 MHz	Middle Channel 2437 MHz	High Channel 2462 MHz
99% bandwidth (MHz)	11.00	11.12	11.48
-26 dBc bandwidth (MHz)	13.952	14.223	14.271
Measurement uncertainty (kHz)	<± 57.76		

- **Mode 802.11 g:**

	Low Channel 2412 MHz	Middle Channel 2437 MHz	High Channel 2462 MHz
99% bandwidth (MHz)	16.64	16.64	16.72
-26 dBc bandwidth (MHz)	19.725	21.946	23.772
Measurement uncertainty (kHz)	<± 57.76		

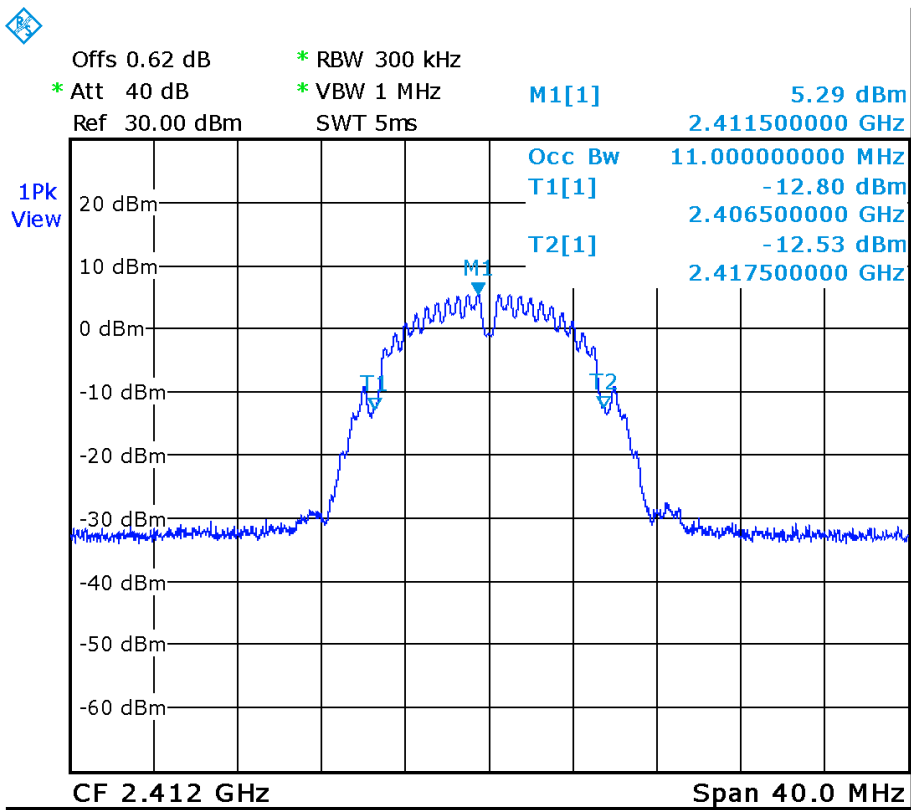
- **Mode 802.11 n20:**

	Low Channel 2412 MHz	Middle Channel 2437 MHz	High Channel 2462 MHz
99% bandwidth (MHz)	17.56	17.52	17.60
-26 dBc bandwidth (MHz)	20.683	20.933	24.271
Measurement uncertainty (kHz)	<± 57.76		

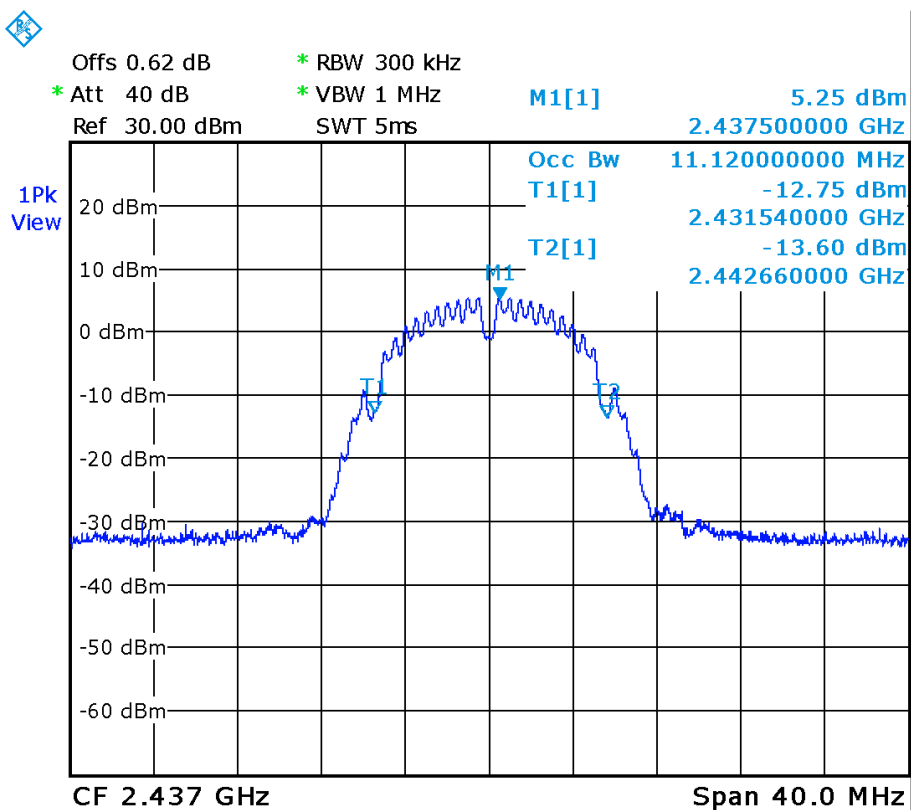
Verdict: PASS

Mode 802.11 b – Occupied Bandwidth

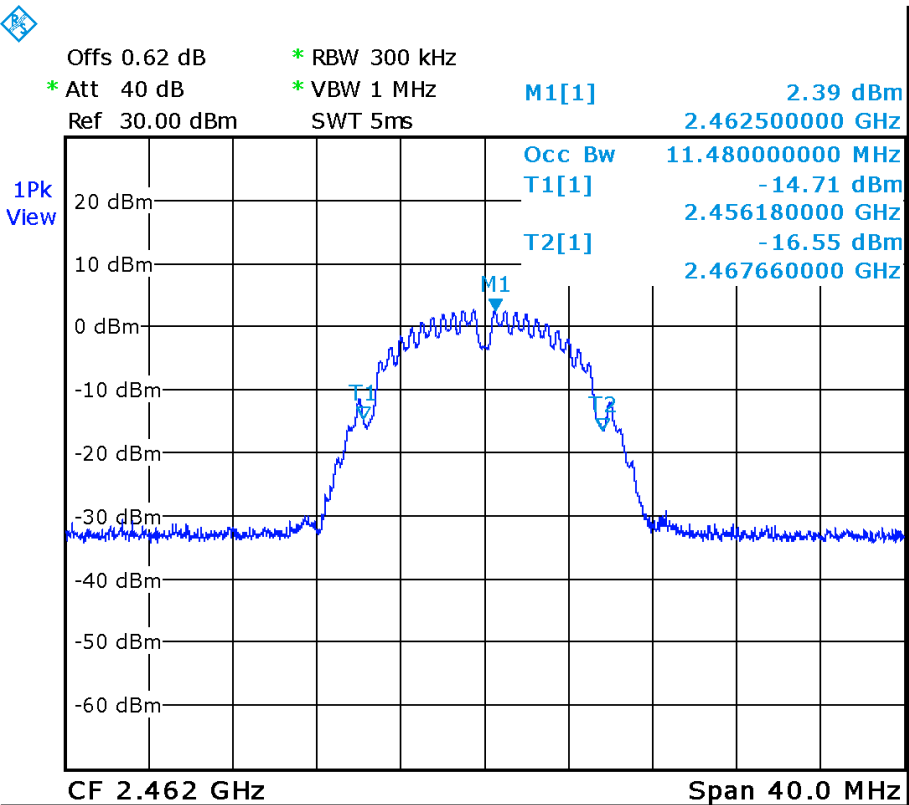
Low Channel



Middle Channel

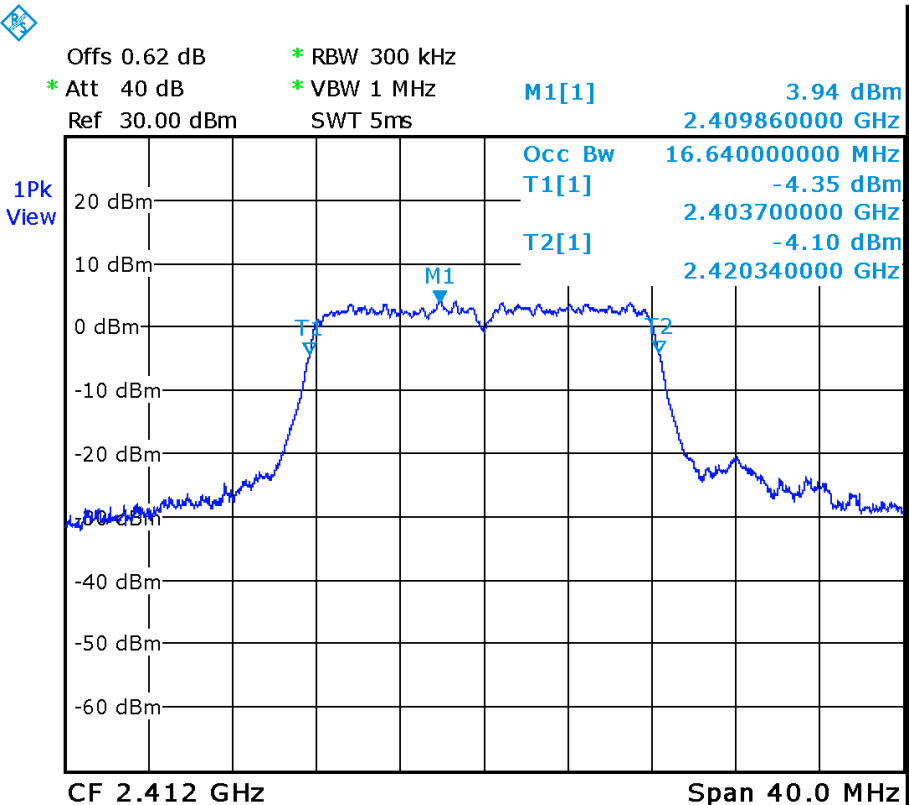


- High Channel

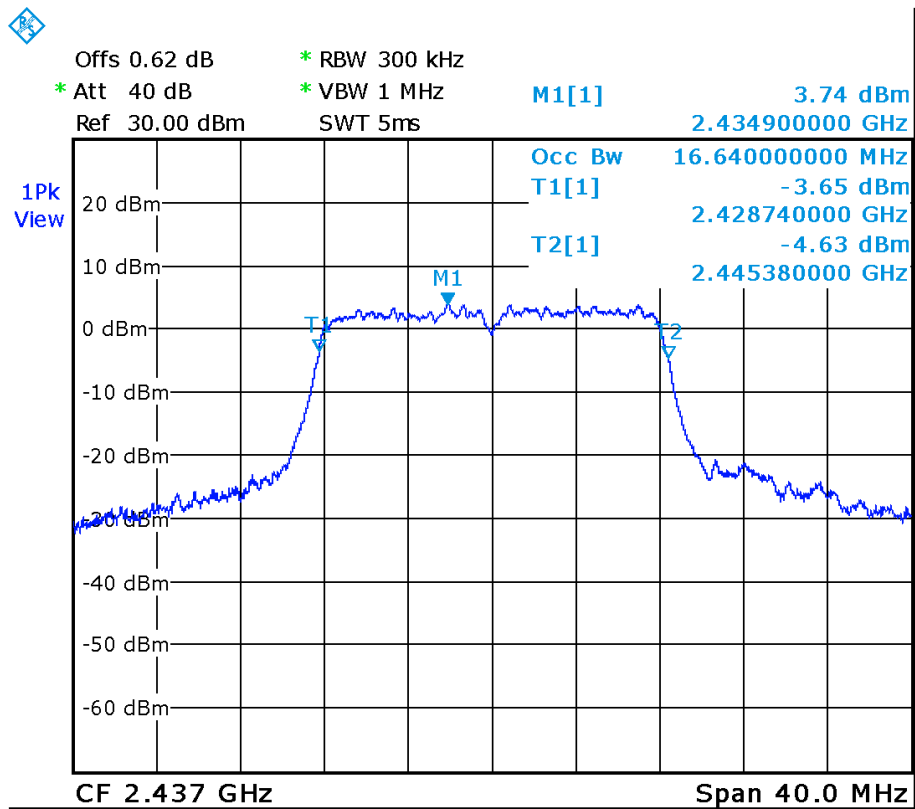


• Mode 802.11 g

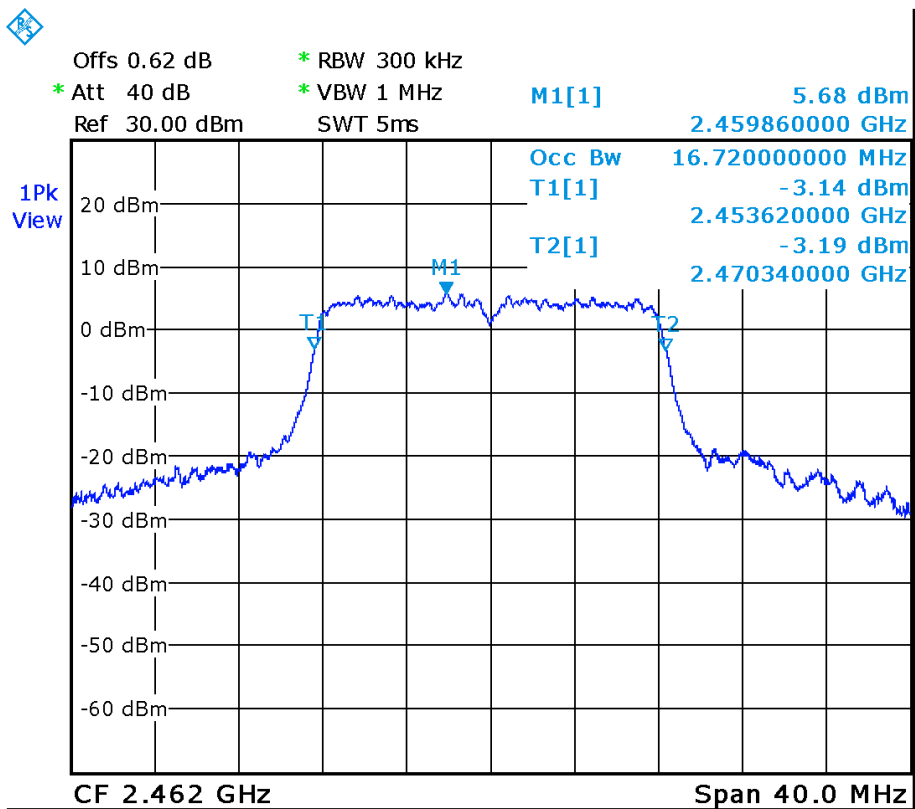
- Low Channel



- Middle Channel

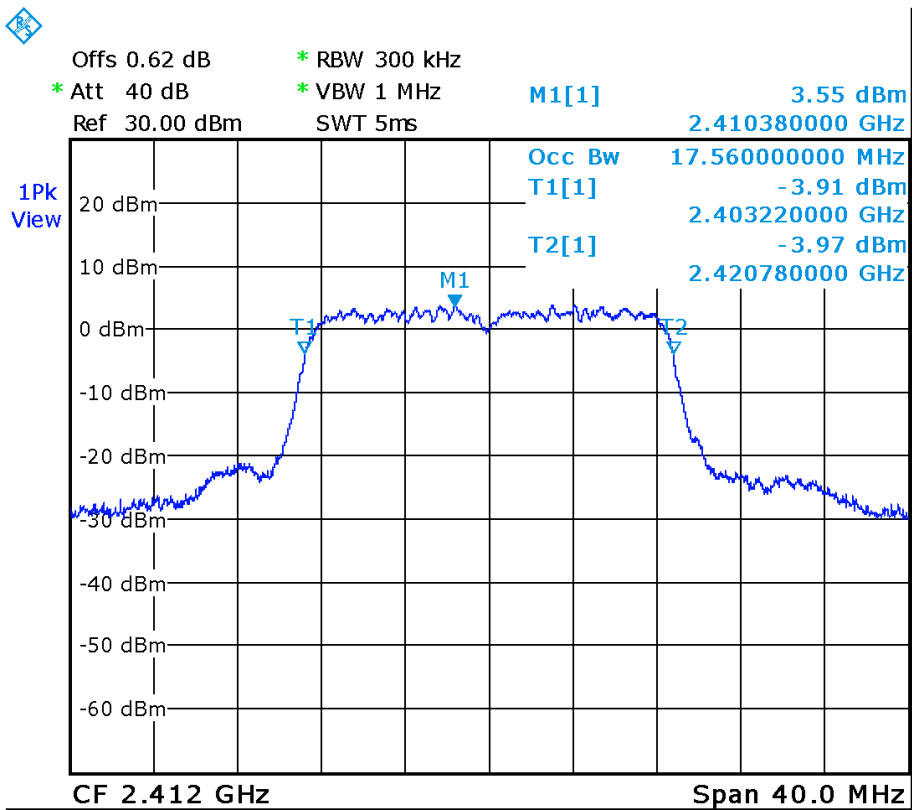


- High Channel

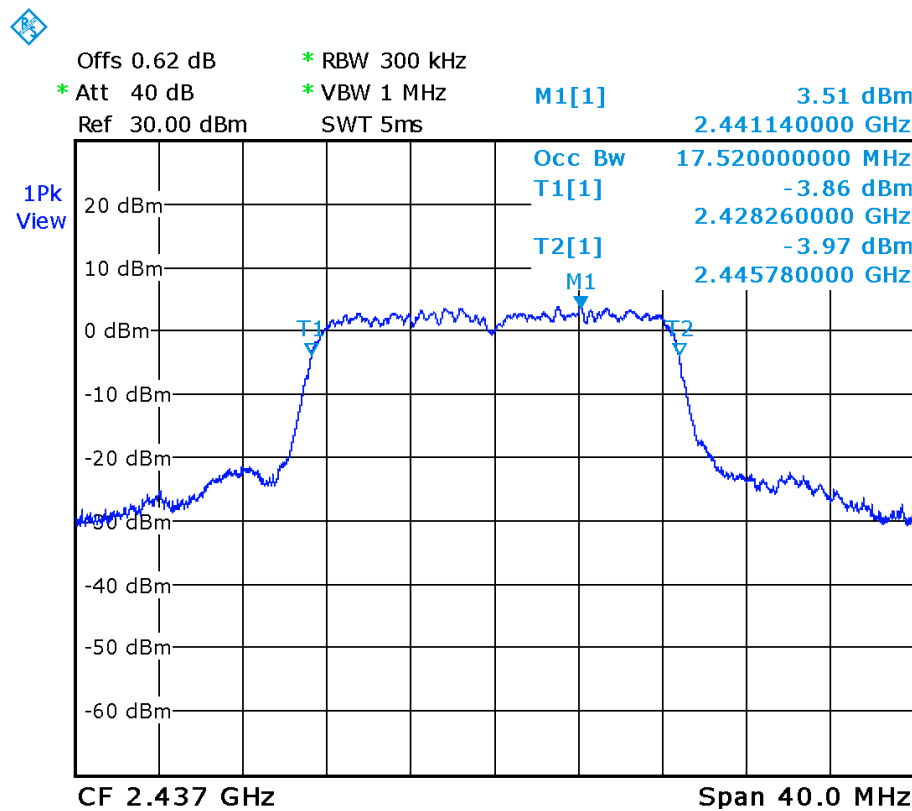


• Mode 802.11 n20

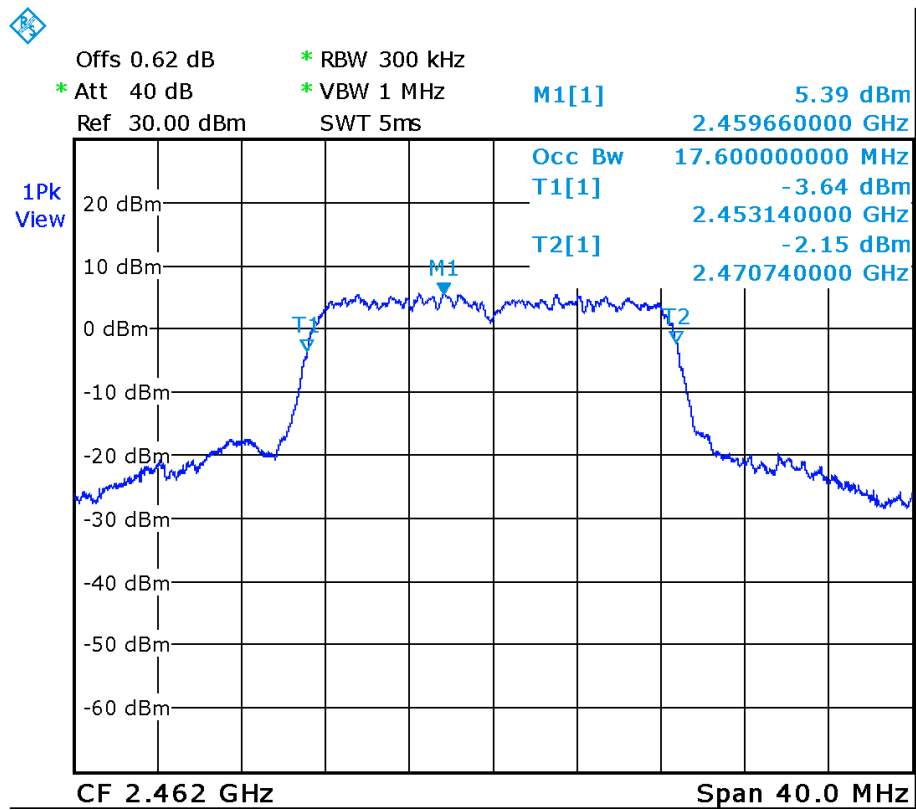
- Low Channel



- Middle Channel

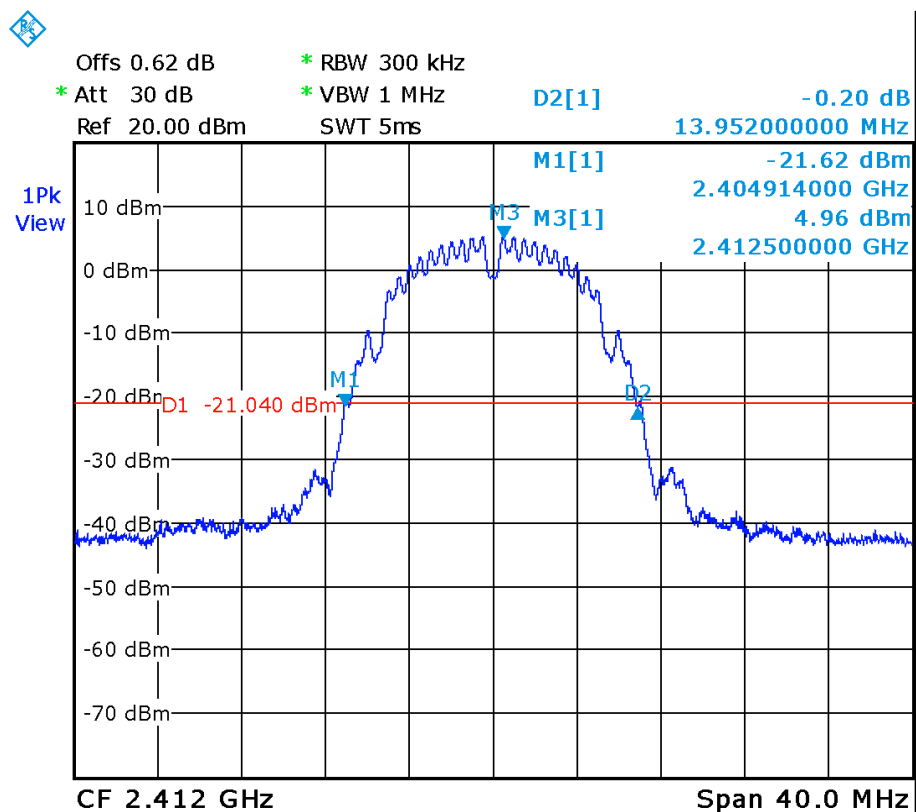


- High Channel

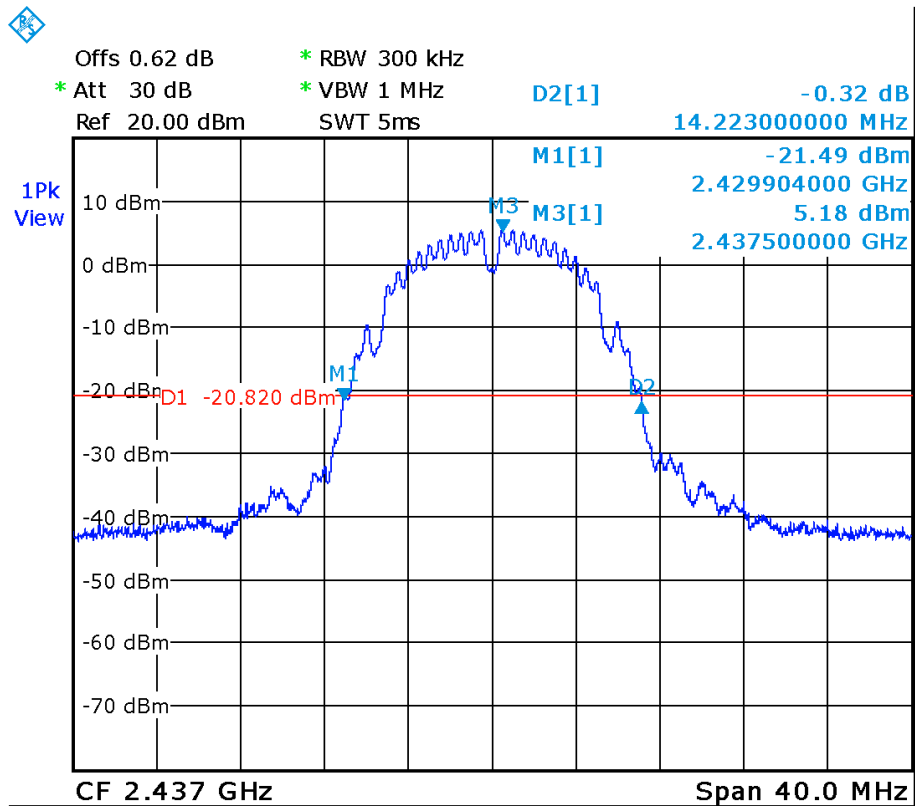


• Mode 802.11 b – -26dB Bandwidth

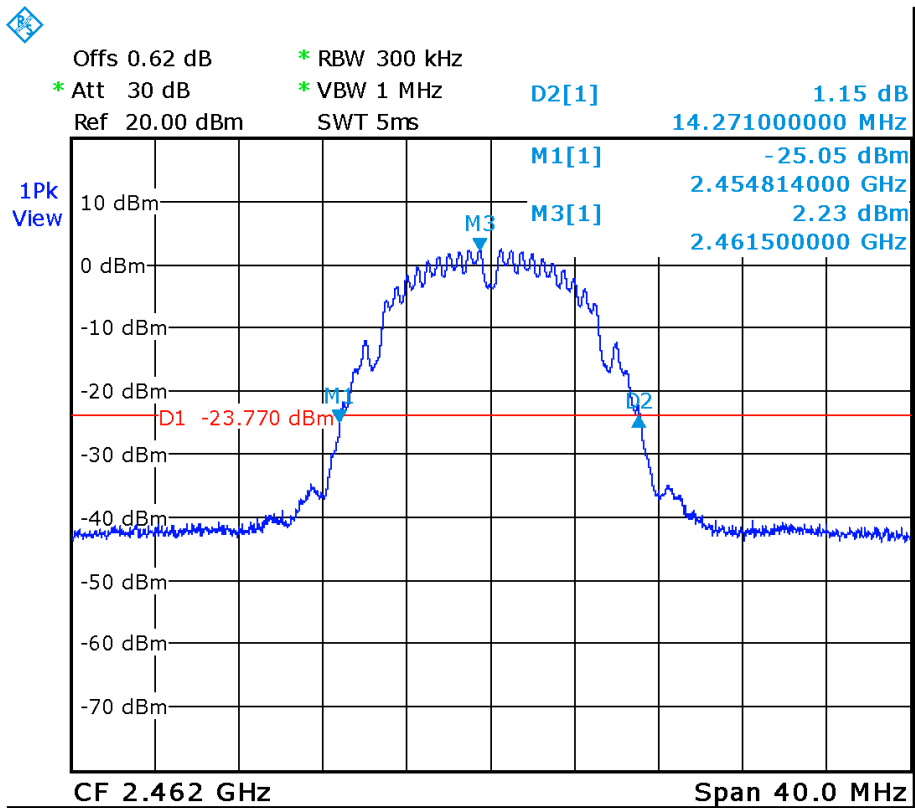
- Low Channel



- Middle Channel

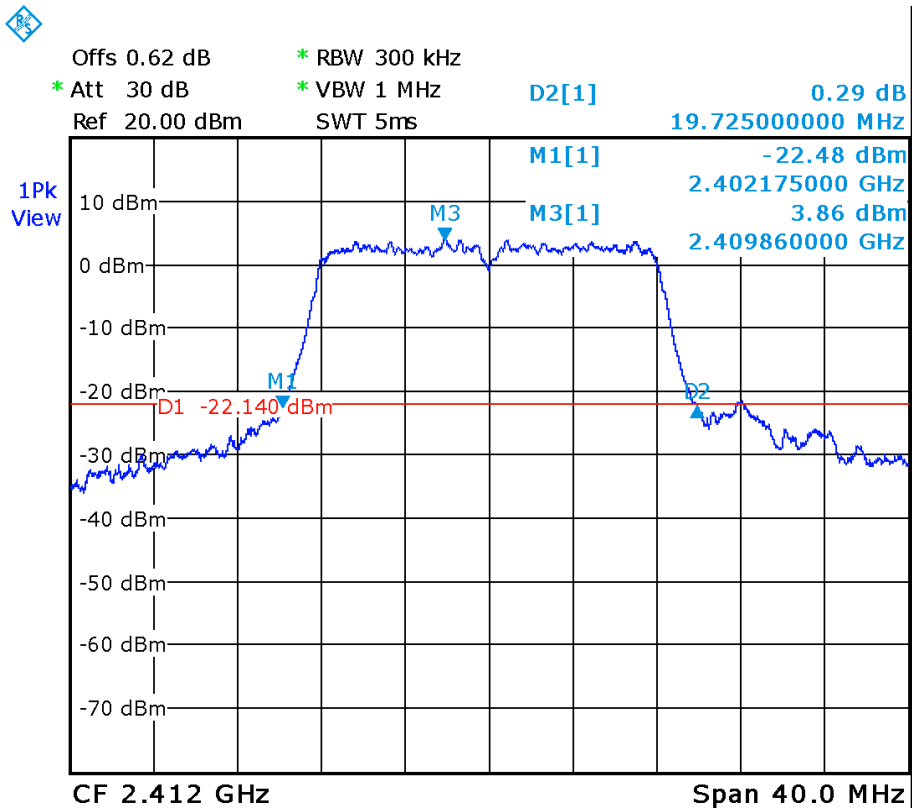


- High Channel

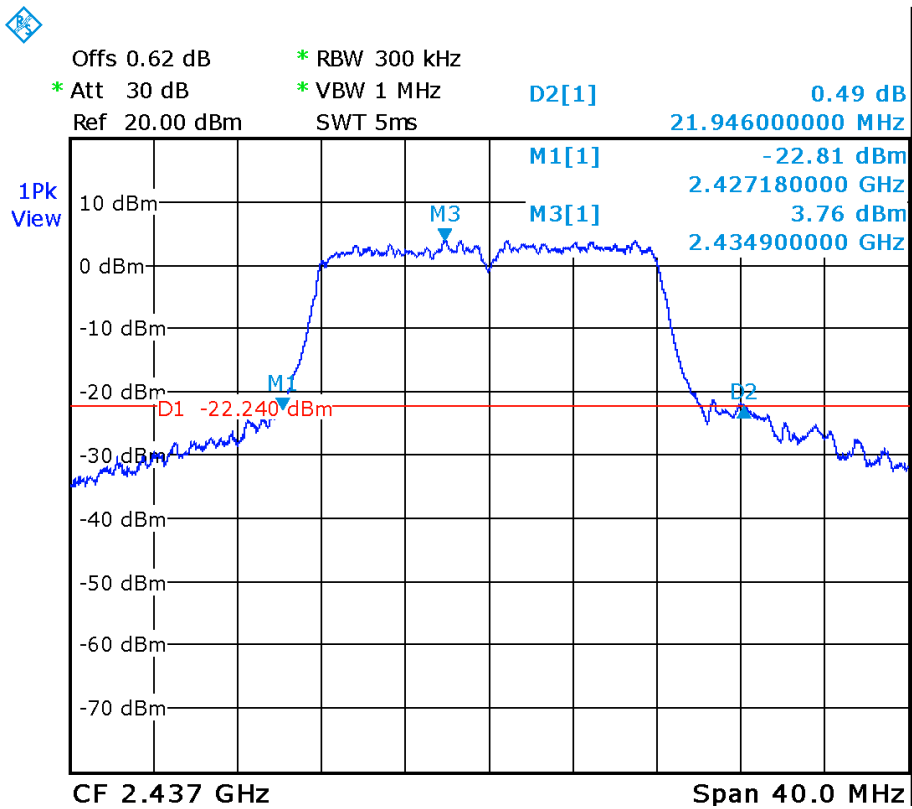


• Mode 802.11 g

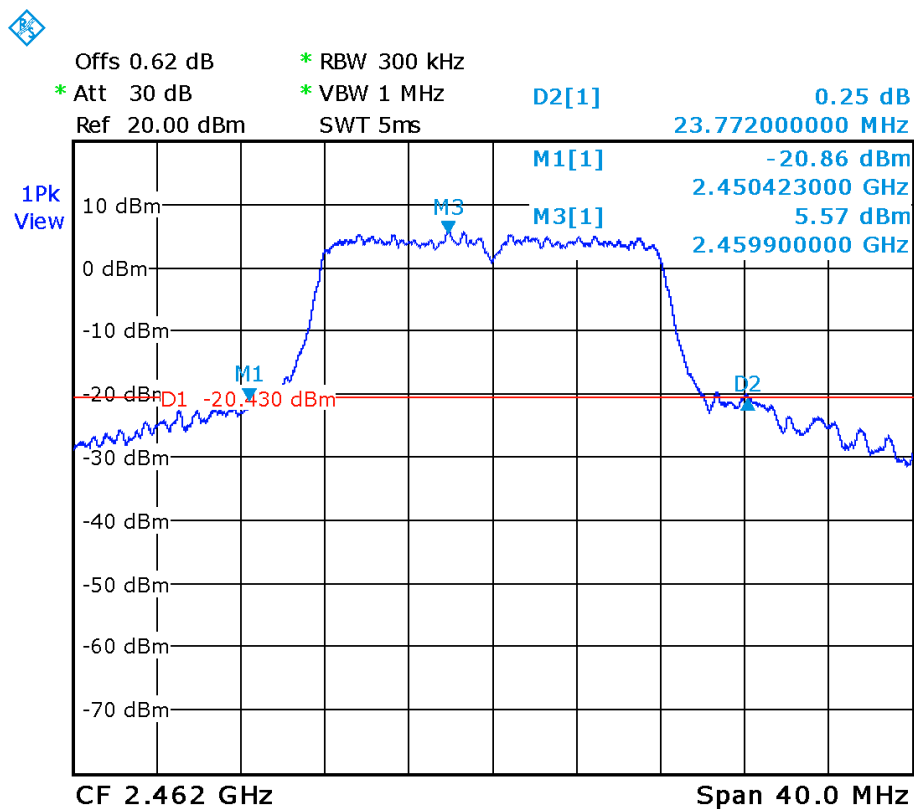
- Low Channel



- Middle Channel

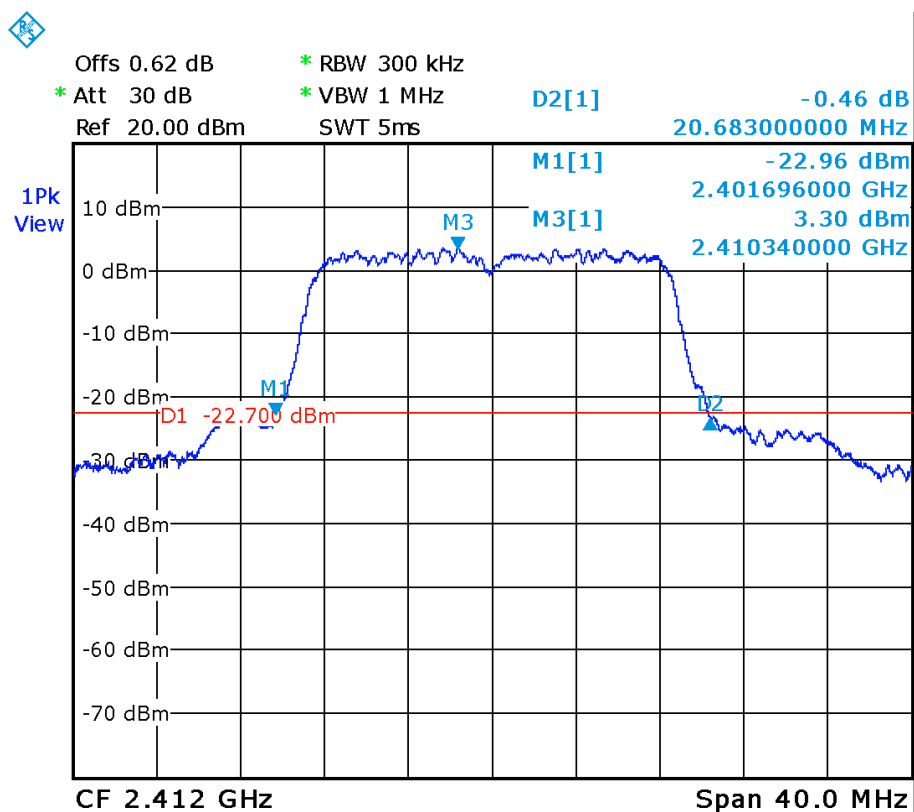


- High Channel

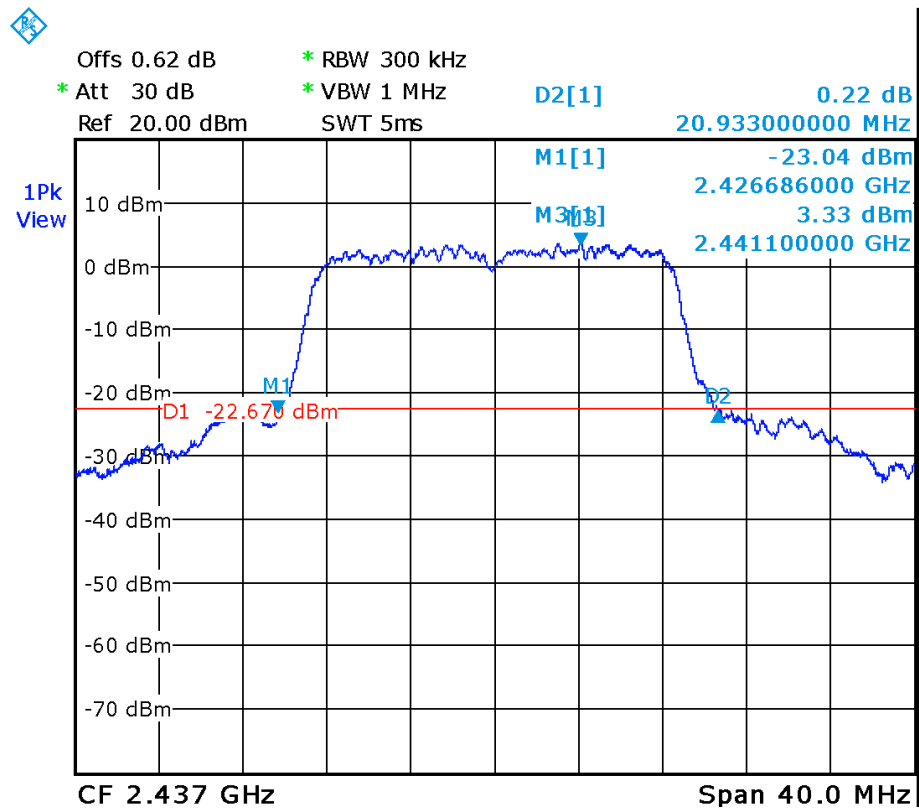


• Mode 802.11 n20

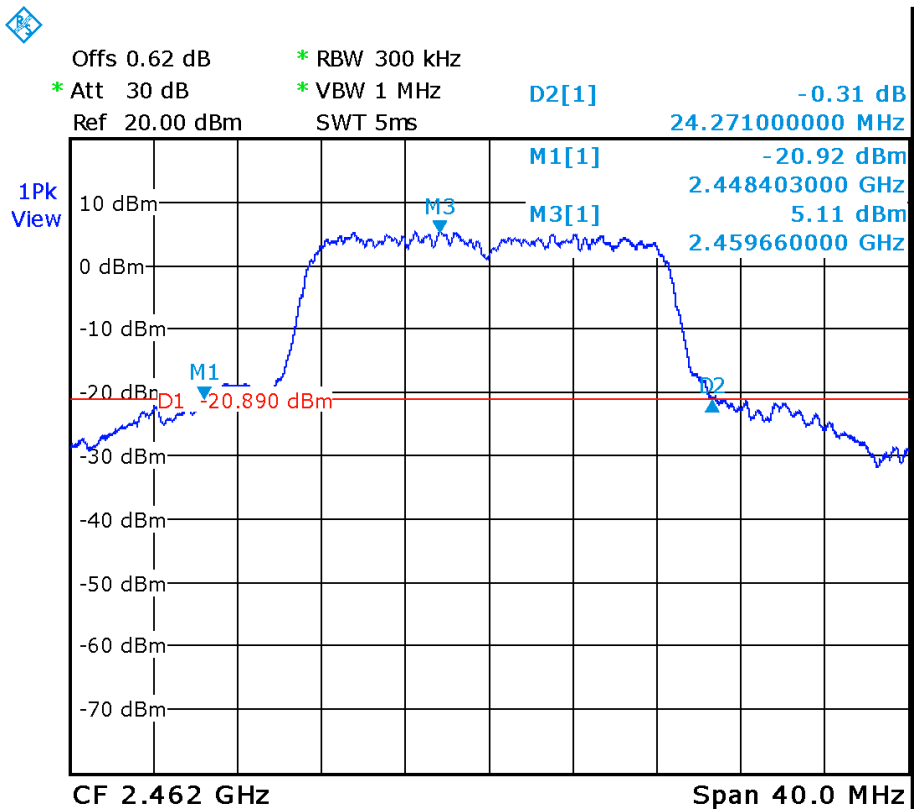
- Low Channel



- Middle Channel



- High Channel



FCC 15.247 (a) (2) / RSS-247 5.2 (a) 6 dB Bandwidth

SPECIFICATION:

The minimum 6 dB bandwidth shall be at least 500 kHz.

RESULTS:

- Mode 802.11 b**

	Low Channel 2412 MHz	Middle Channel 2437 MHz	High Channel 2462 MHz
6 dB Spectrum Bandwidth (kHz)	8164	8144	8144
Measurement uncertainty (kHz)	<± 23.11		

- Mode 802.11 g**

	Low Channel 2412 MHz	Middle Channel 2437 MHz	High Channel 2462 MHz
6 dB Spectrum Bandwidth (kHz)	16327	16088	16088
Measurement uncertainty (kHz)	<± 23.11		

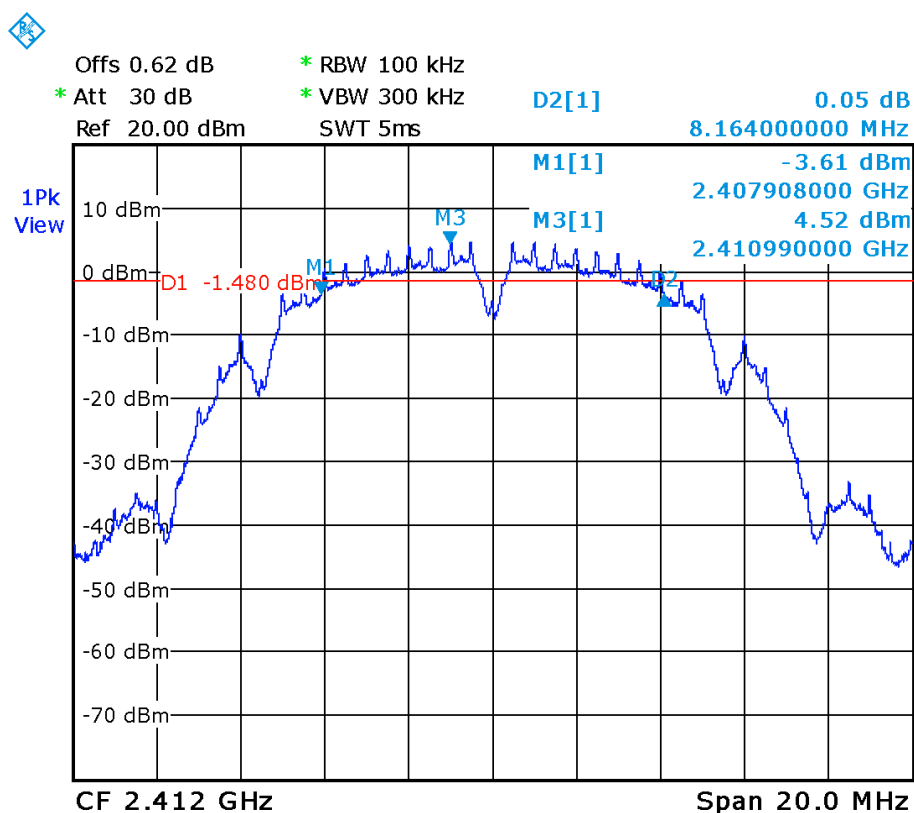
- Mode 802.11 n20**

	Low Channel 2412 MHz	Middle Channel 2437 MHz	High Channel 2462 MHz
6 dB Spectrum Bandwidth (kHz)	16567	16287	16128
Measurement uncertainty (kHz)	<± 23.11		

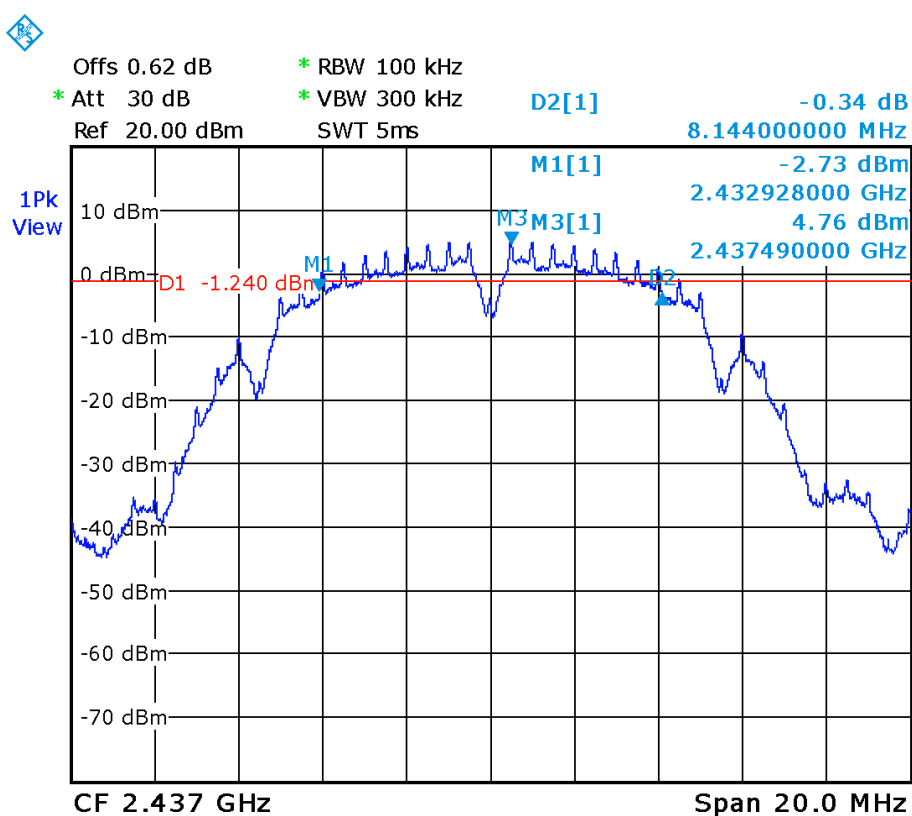
Verdict: PASS

- **Mode 802.11 b – 6 dB Bandwidth**

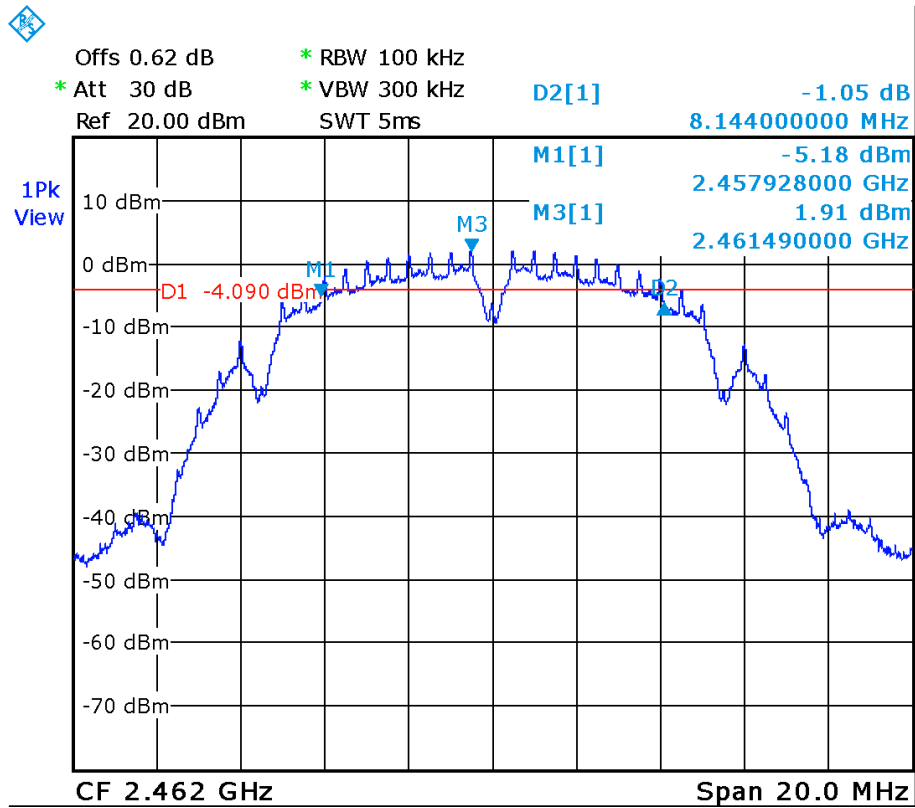
- Low Channel:



- Middle Channel:

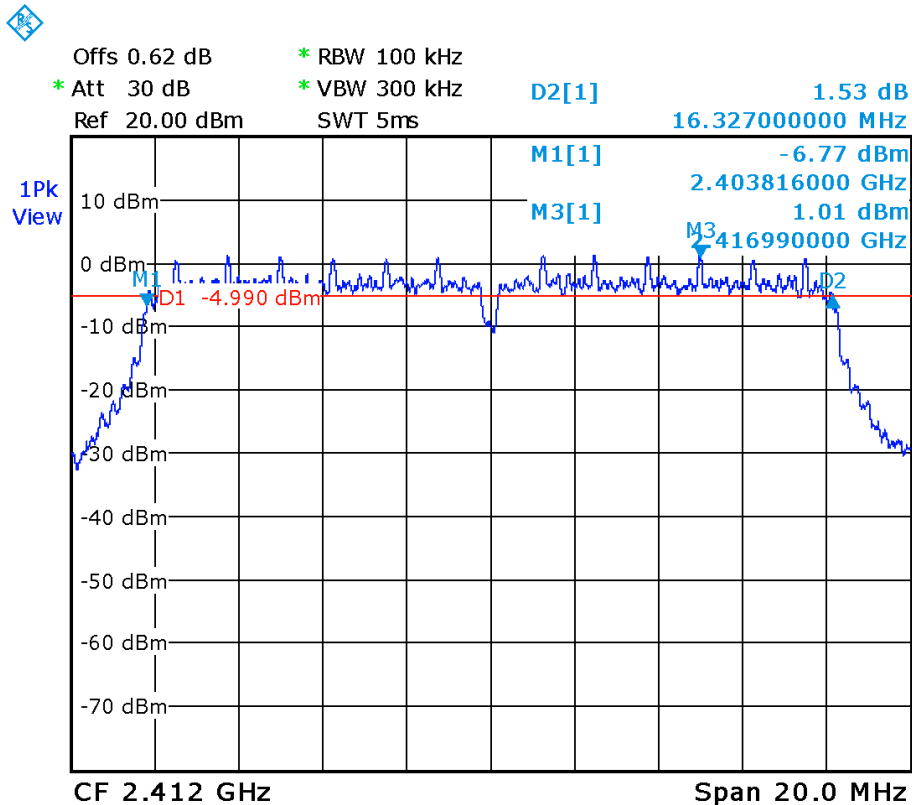


- High Channel:

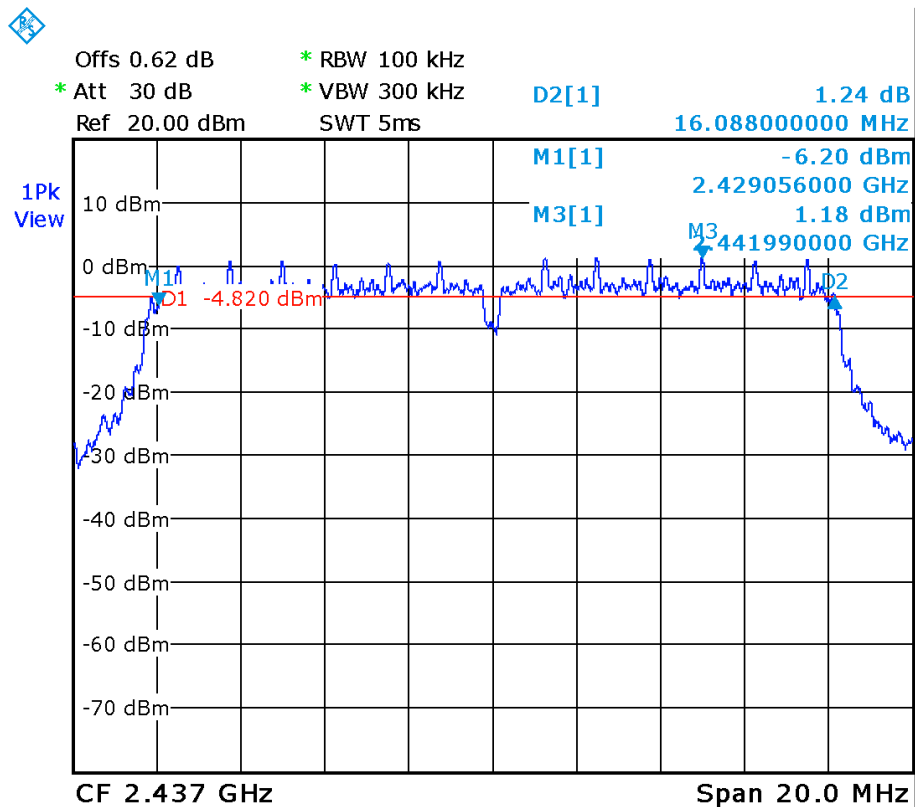


• Mode 802.11 g

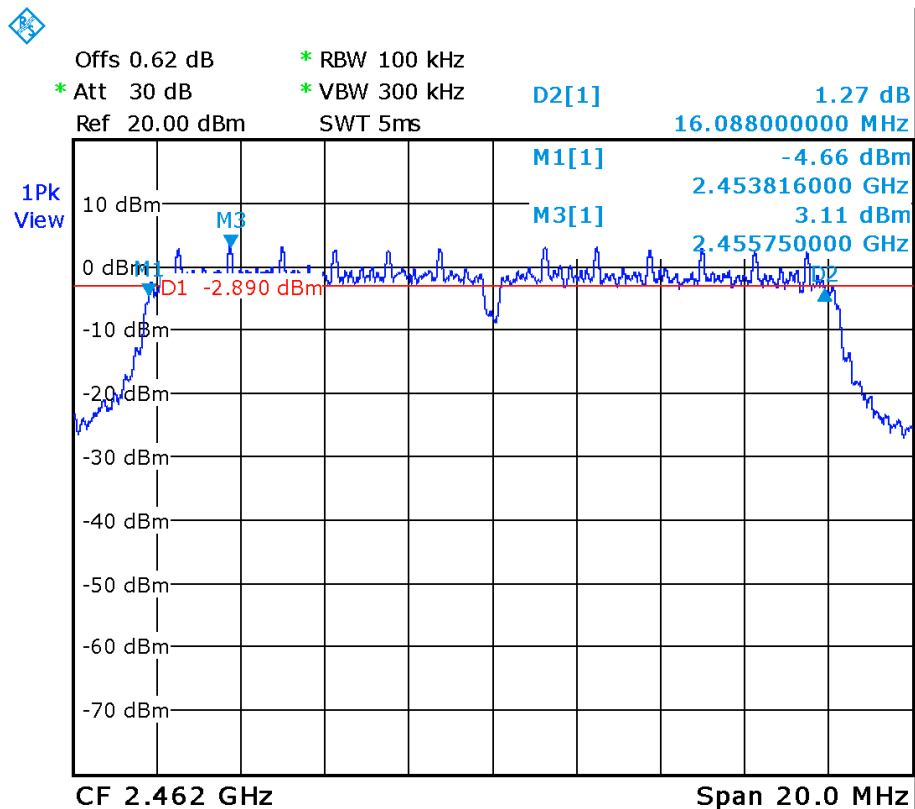
- Low Channel:



- Middle Channel:

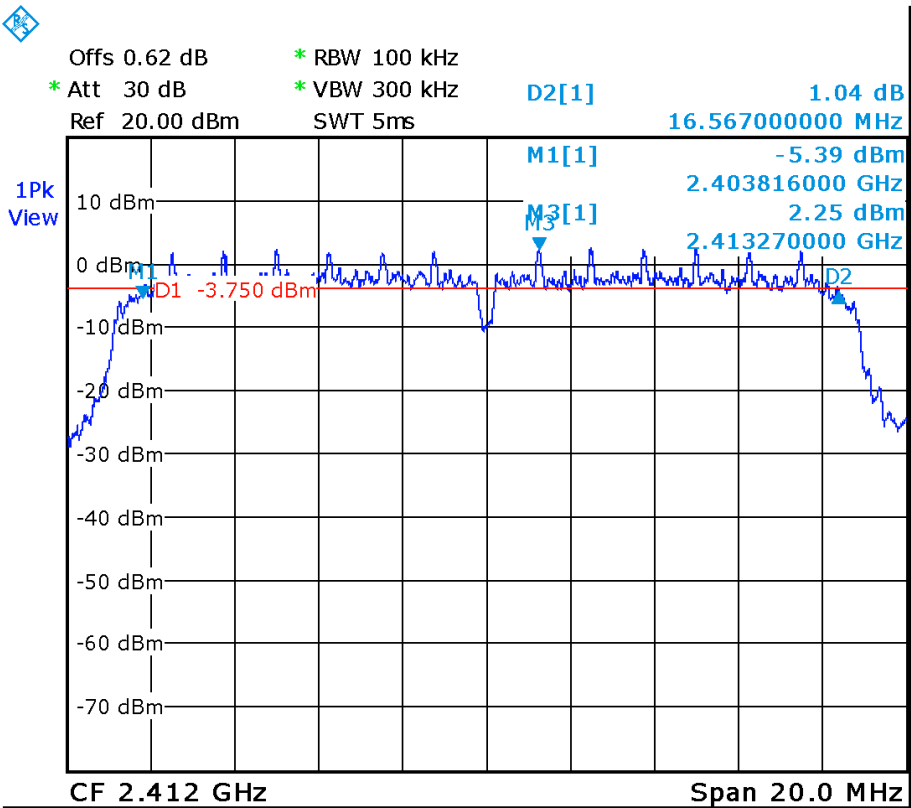


- High Channel:

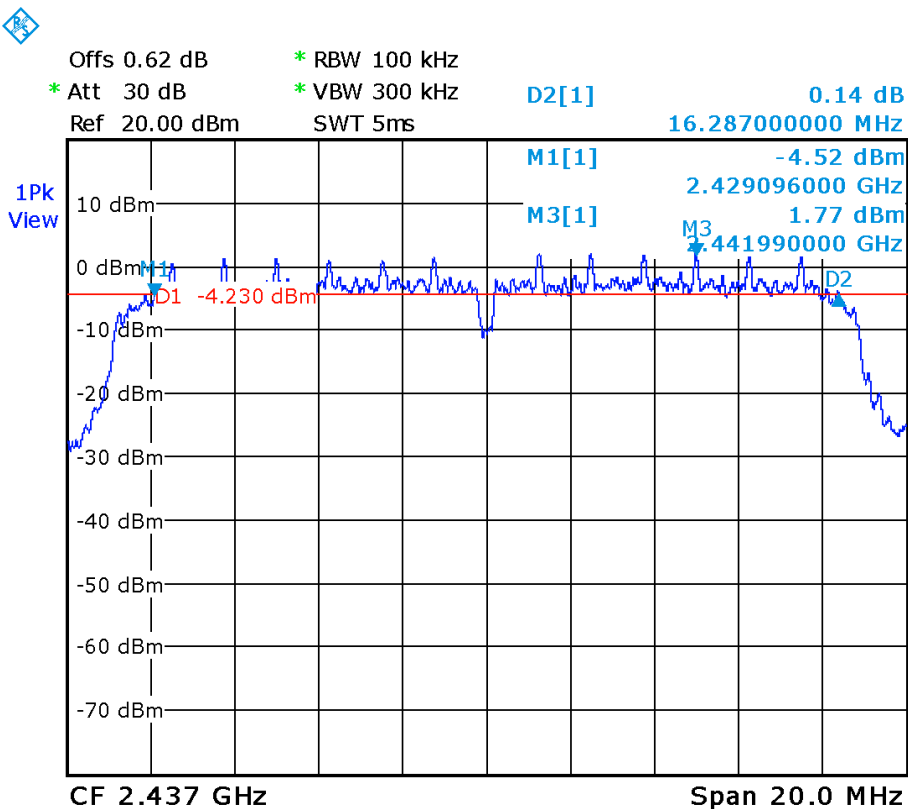


• Mode 802.11 n20

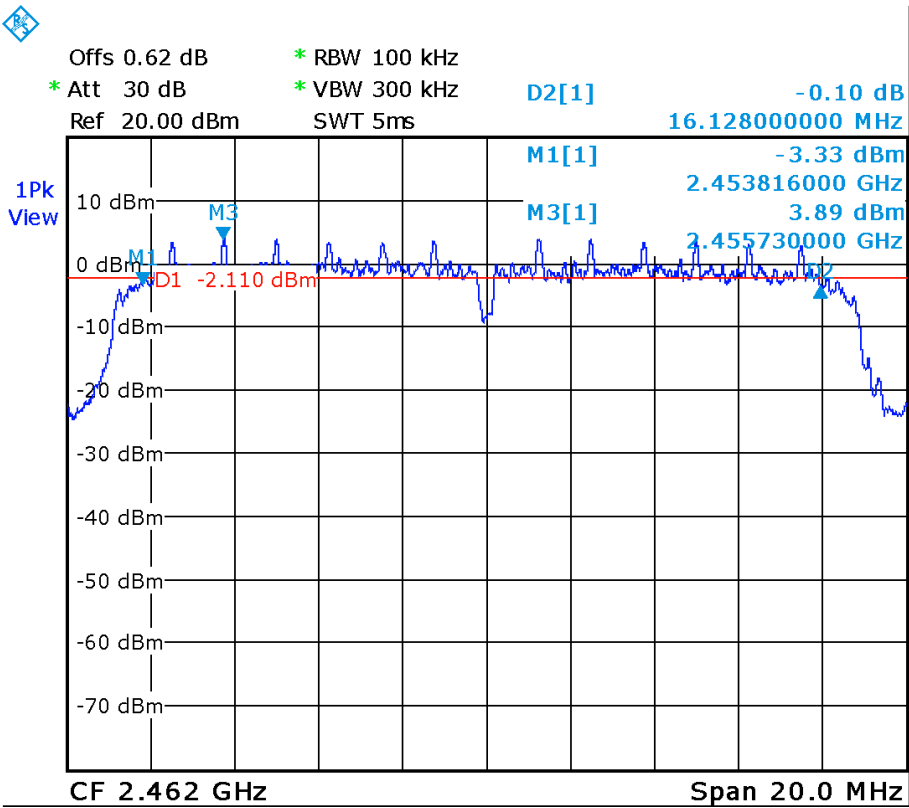
- Low Channel:



- Middle Channel:



- High Channel:



FCC 15.35 (c) / RSS-Gen 6.10. Transmitter Duty Cycle

SPECIFICATION:

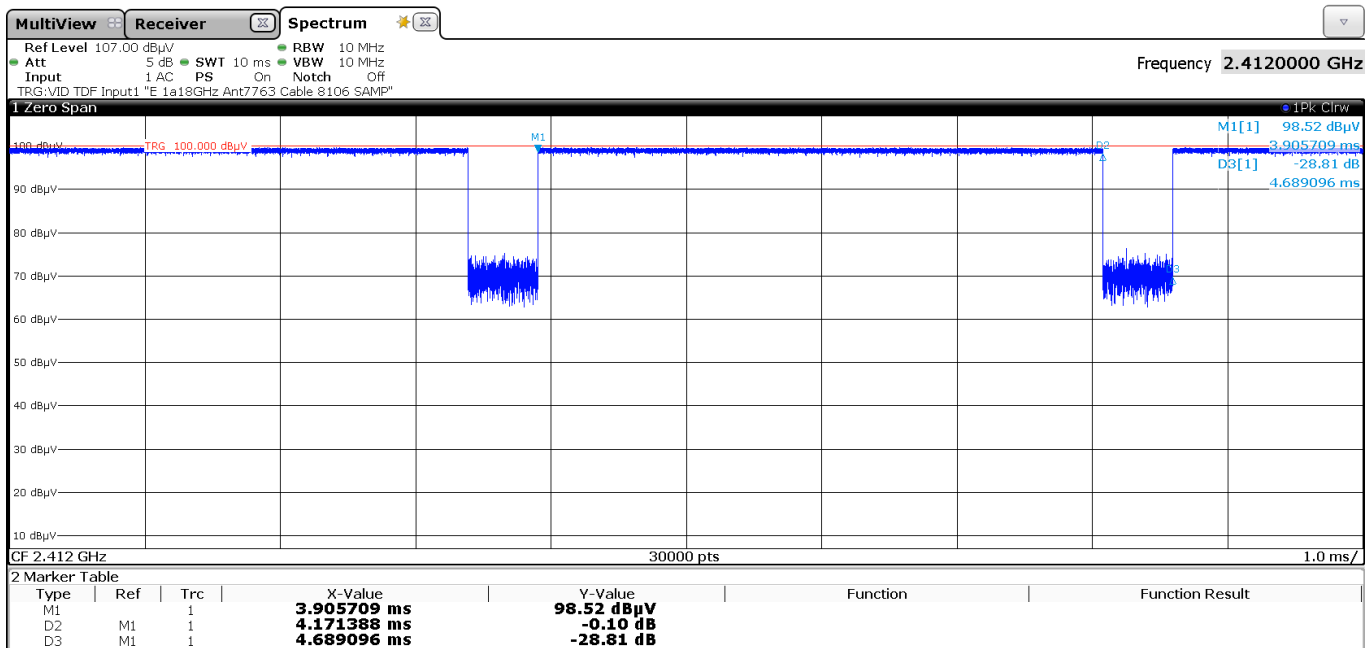
When the radiated emission limits are expressed in terms of the average value of the emission, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value.

RESULTS:

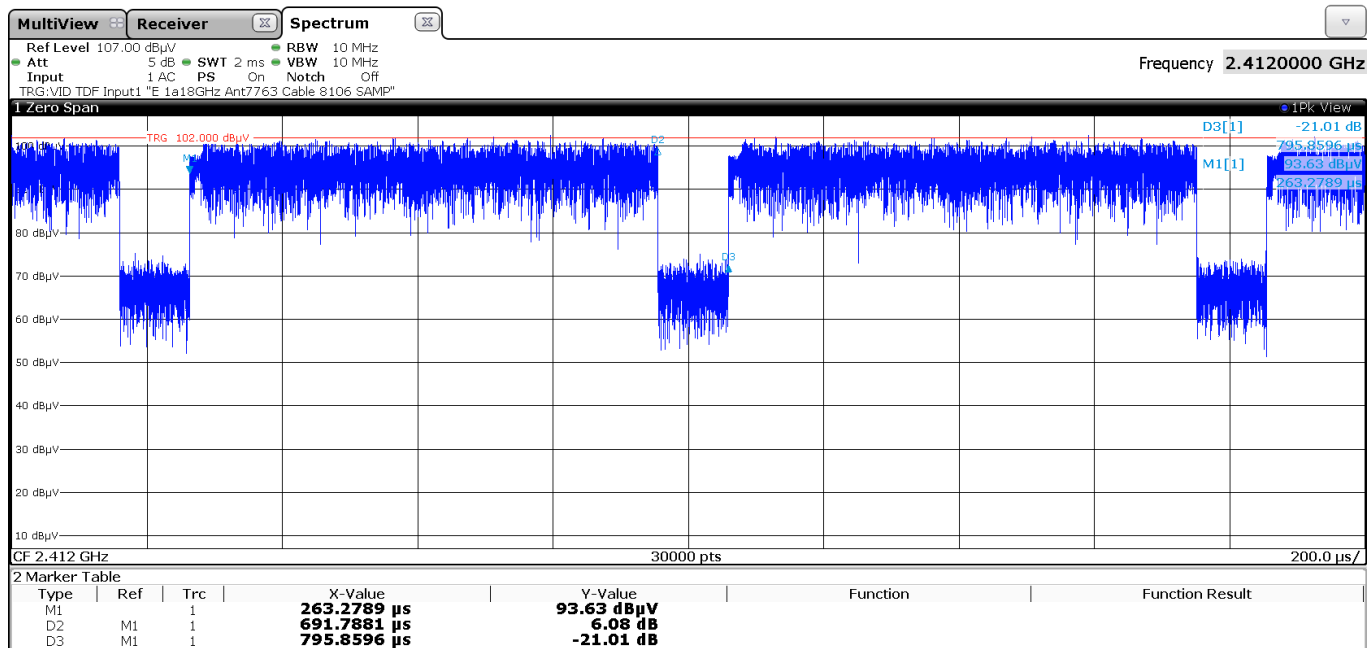
The results below are for data rates with a duty cycle less than 98%. The results for all rest of modes having a value > 98%.

Technique	Mode	Pulse Duration (ms)	Period (ms)	Duty Cycle Correction (dB)
SISO	802.11 b	4.1713	4.6890	0.51
SISO	802.11 g	0.6917	0.7958	0.61
SISO	802.11 n20	0.6559	0.7599	0.64

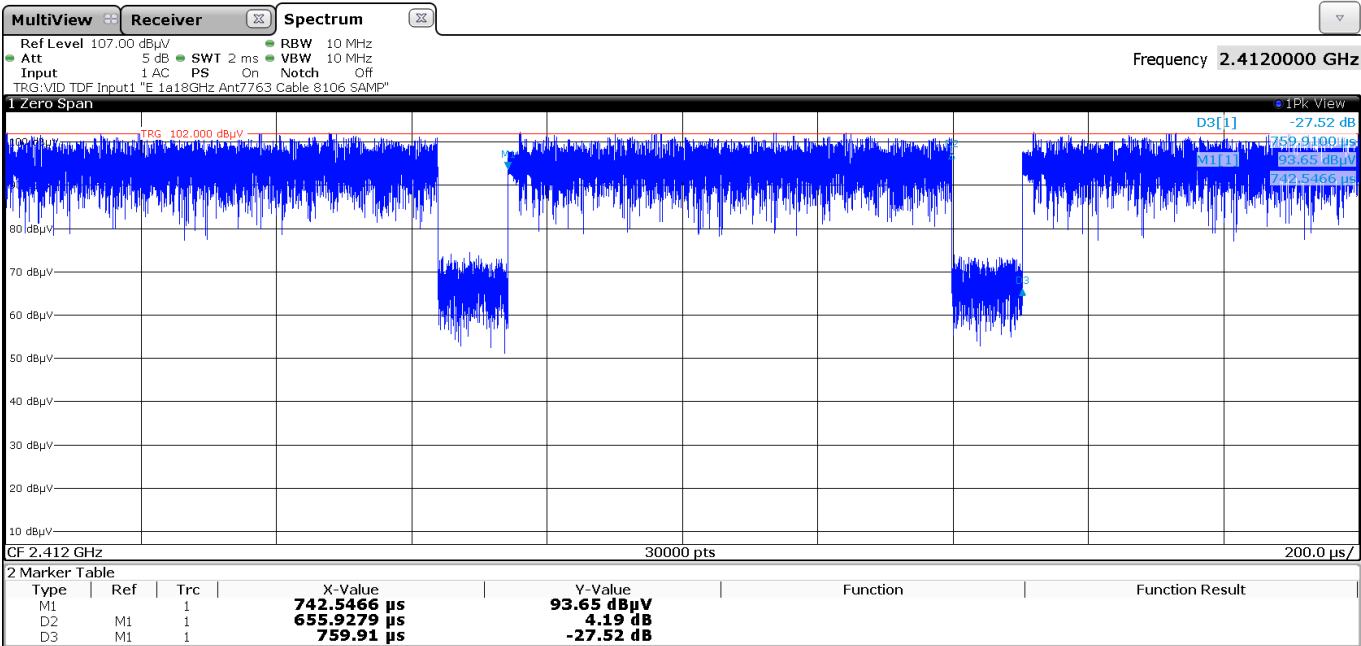
• Mode 802.11 b



• Mode 802.11 g



• Mode 802.11 n20



11:39:39 31.03.2021

FCC 15.247 (b) / RSS-247 5.4 (d) Maximum output power and antenna gain

SPECIFICATION:

For systems using digital modulation in the 2400-2483.5 MHz band: 1 watt (30 dBm).
The e.i.r.p. shall not exceed 4 W (36 dBm) (Canada).

RESULTS:

Maximum Declared Antenna Gain: 3.77 dBi

For modes b the maximum conducted output power was measured using the method according to point 11.9.2.2.2 "Method AVGSA-1" of ANSI C.63.10-2013.

The EIRP power (dBm) is calculated by adding the declared maximum antenna gain to the measured conducted power.

Maximum Average Conducted Power (dBm) corrected with Duty Cycle correction.

- **Mode 802.11 b**

	Low Channel 2412 MHz	Middle Channel 2437 MHz	High Channel 2462 MHz
Maximum Average Conducted Power (dBm)	8.59	8.29	6.69
Maximum EIRP Power (dBm)	12.36	12.06	10.47
Measurement uncertainty (dB)	<±2.57		

- **Mode 802.11 g**

	Low Channel 2412 MHz	Middle Channel 2437 MHz	High Channel 2462 MHz
Maximum Average Conducted Power (dBm)	8.41	8.24	10.06
Maximum EIRP Power (dBm)	12.18	12.01	13.83
Measurement uncertainty (dB)	<±2.57		

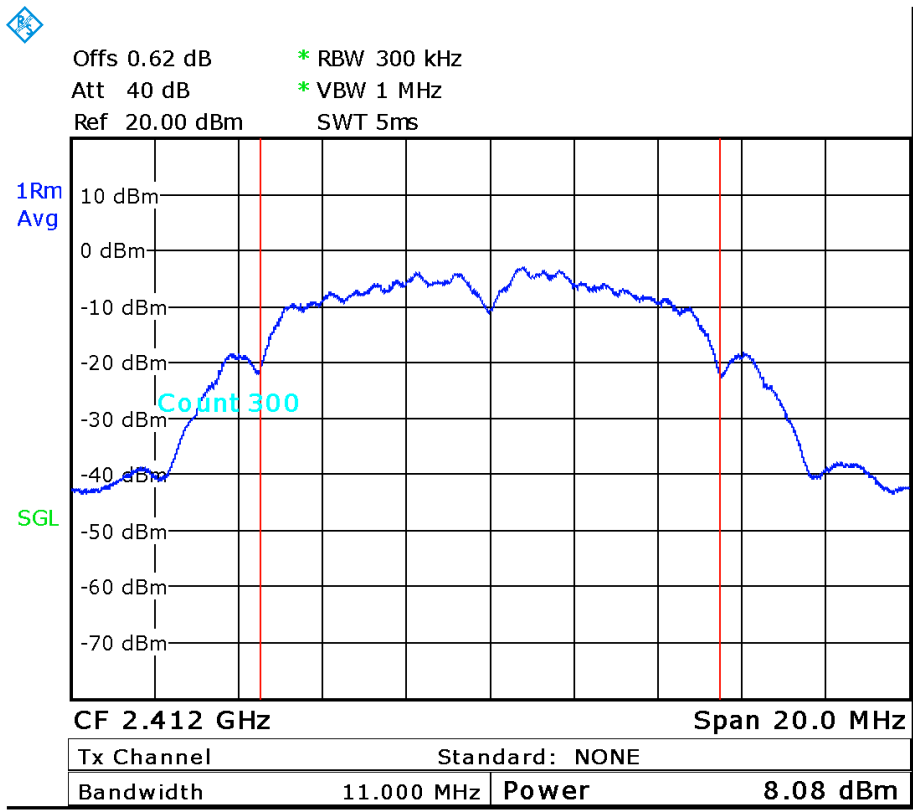
- **Mode 802.11 n20**

	Low Channel 2412 MHz	Middle Channel 2437 MHz	High Channel 2462 MHz
Maximum Average Conducted Power (dBm)	8.12	7.83	9.66
Maximum EIRP Power (dBm)	11.89	11.60	13.43
Measurement uncertainty (dB)	<±2.57		

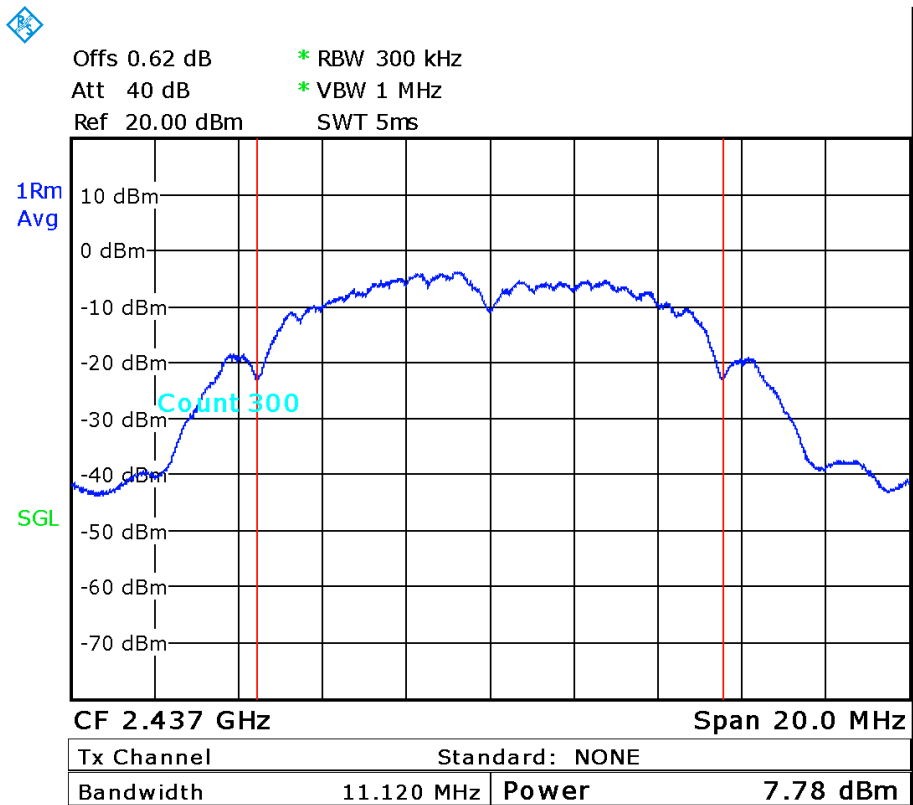
Verdict: PASS

• Mode 802.11 b

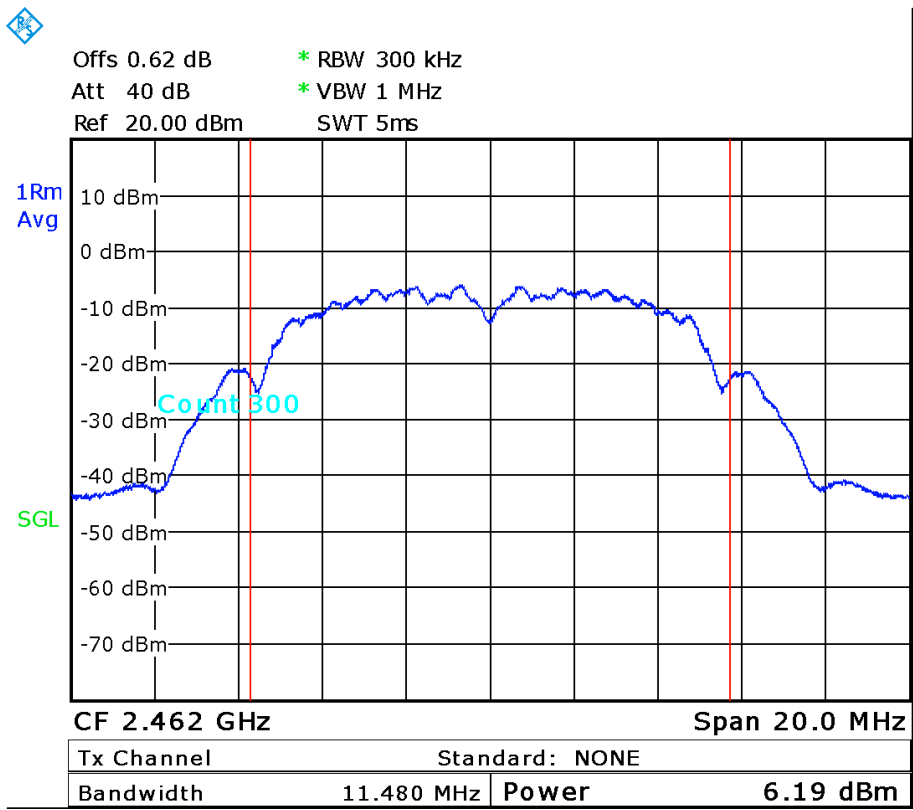
- Low Channel:



- Middle Channel:

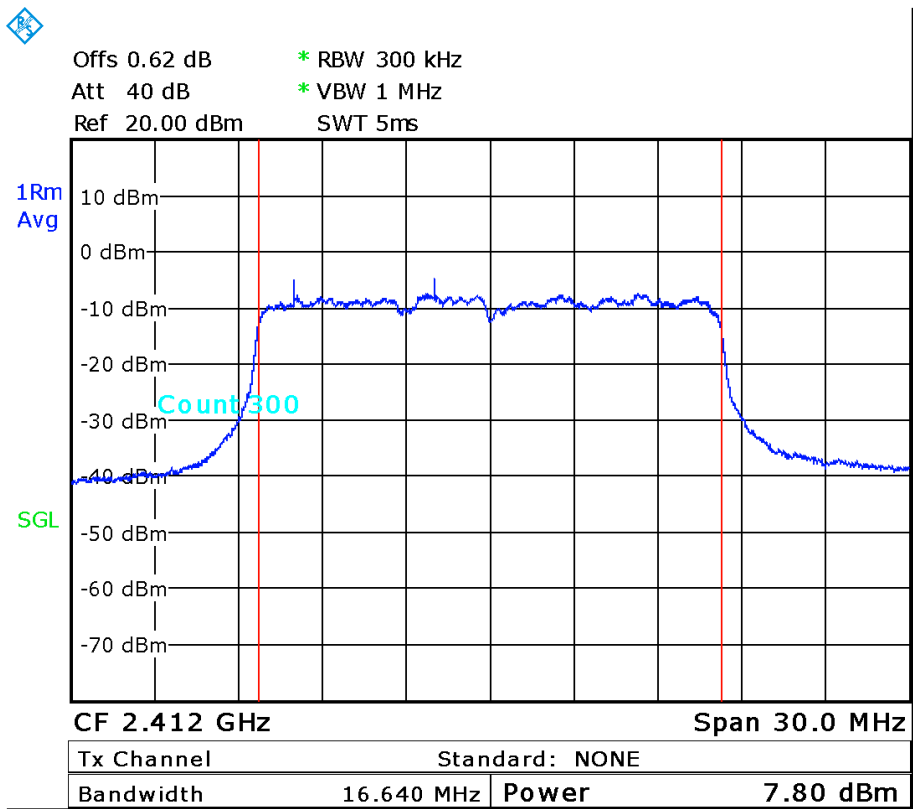


- High Channel:

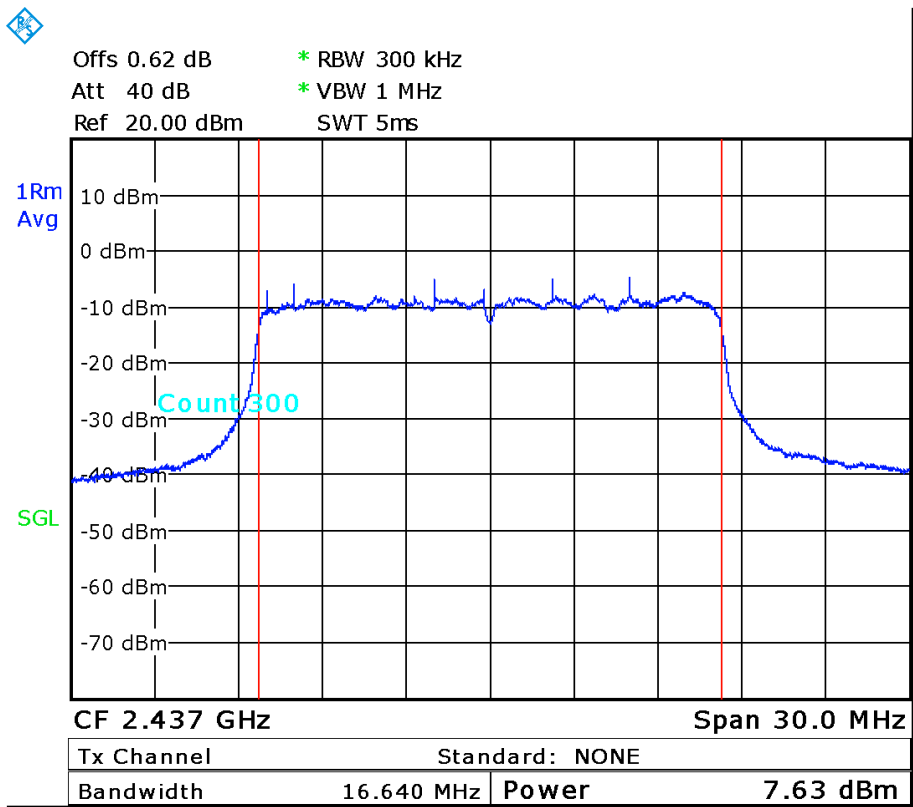


• Mode 802.11 g

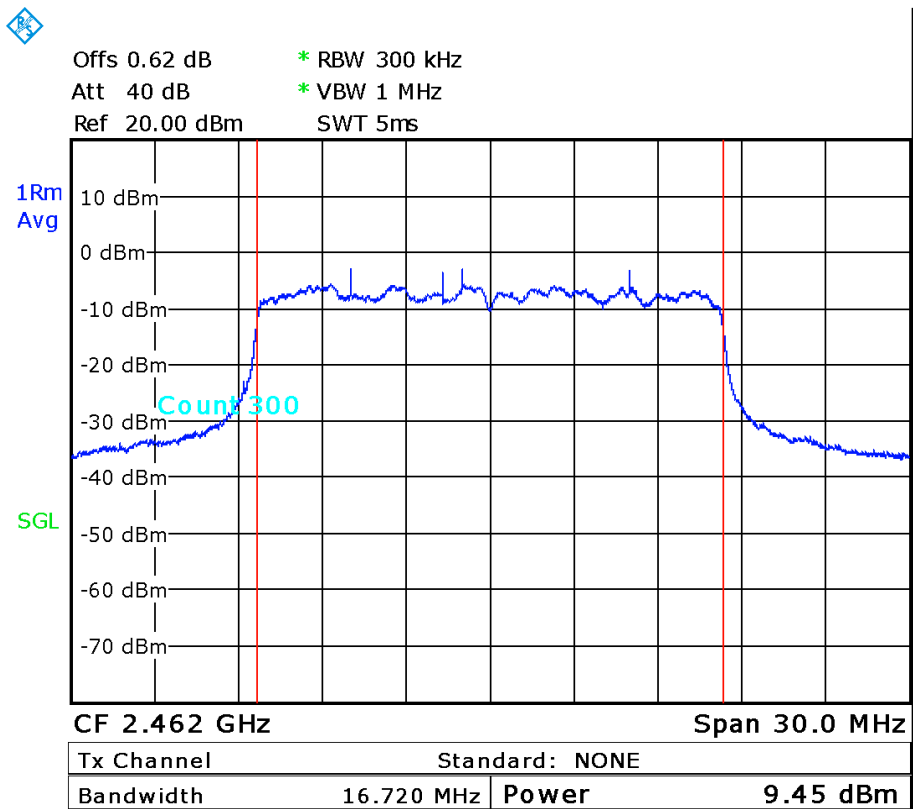
- Low Channel:



- Middle Channel:

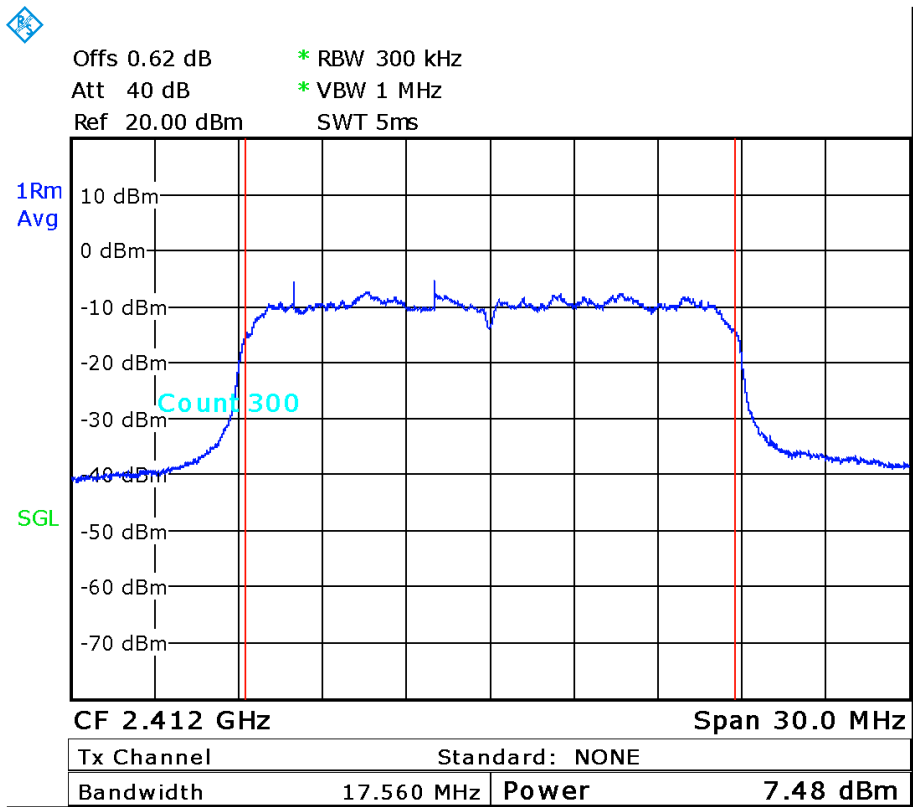


- High Channel:

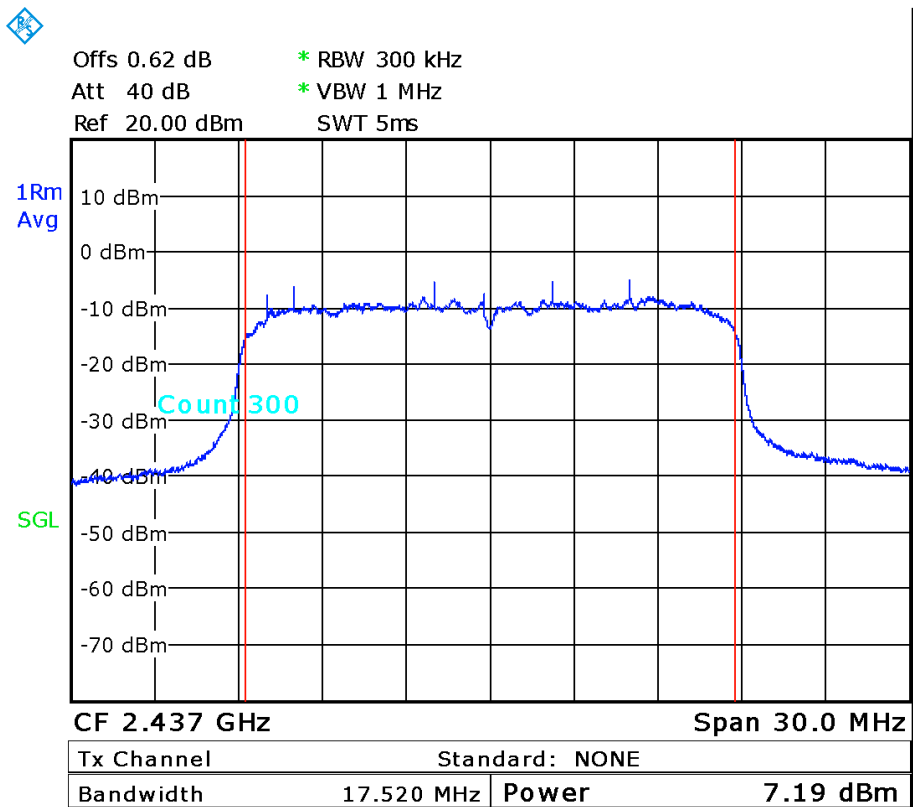


• Mode 802.11 n20

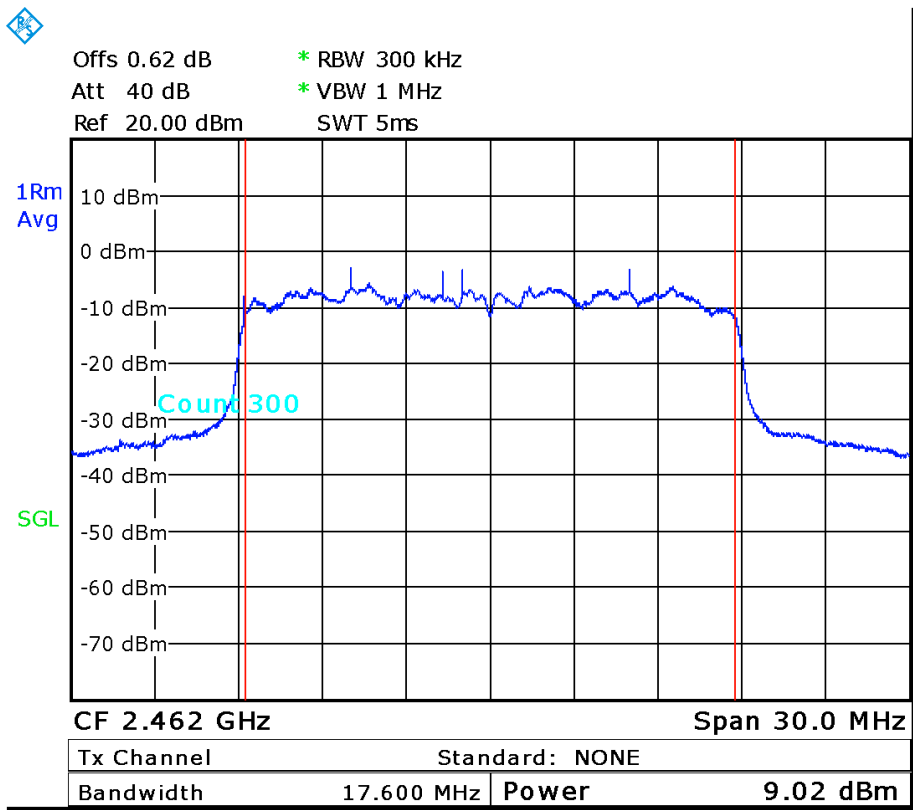
- Low Channel:



- Middle Channel:



- High Channel:



FCC 15.247 (d) / RSS-247 5.5. Band-edge emissions compliance (Transmitter)

SPECIFICATION:

In any 100 kHz bandwidths outside the frequency band in which the intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 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, provided the transmitter demonstrates compliance with the peak conducted power limits.

If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

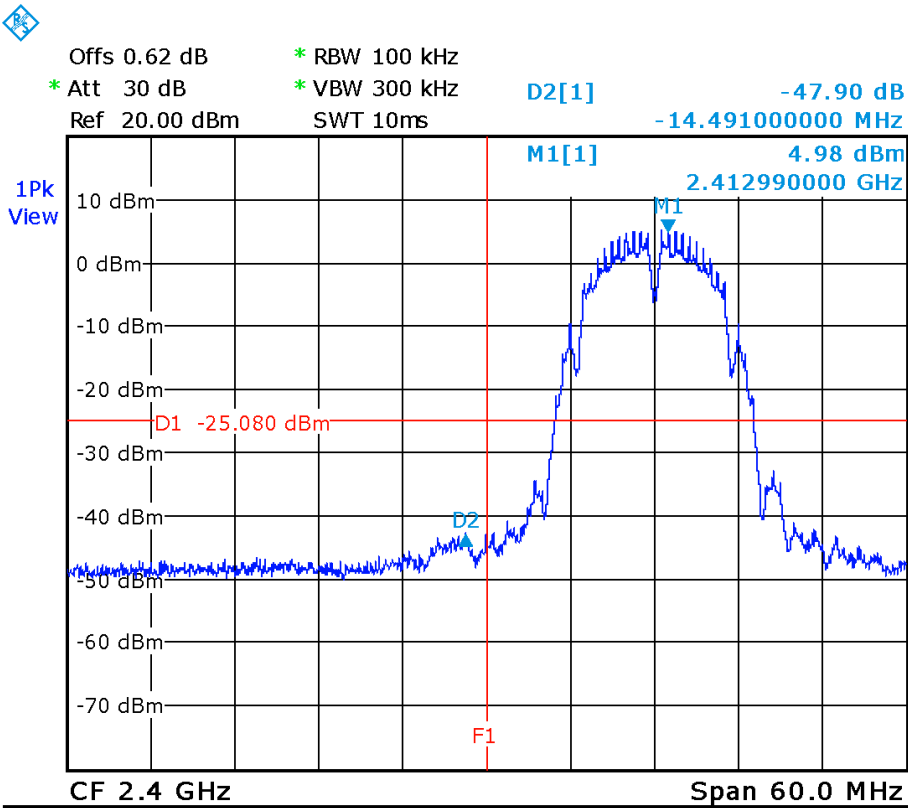
RESULTS:

Radiated measurements were used to show compliance with the limits in the restricted bands 2.31-2.39 GHz and 2.4835-2.5 GHz.

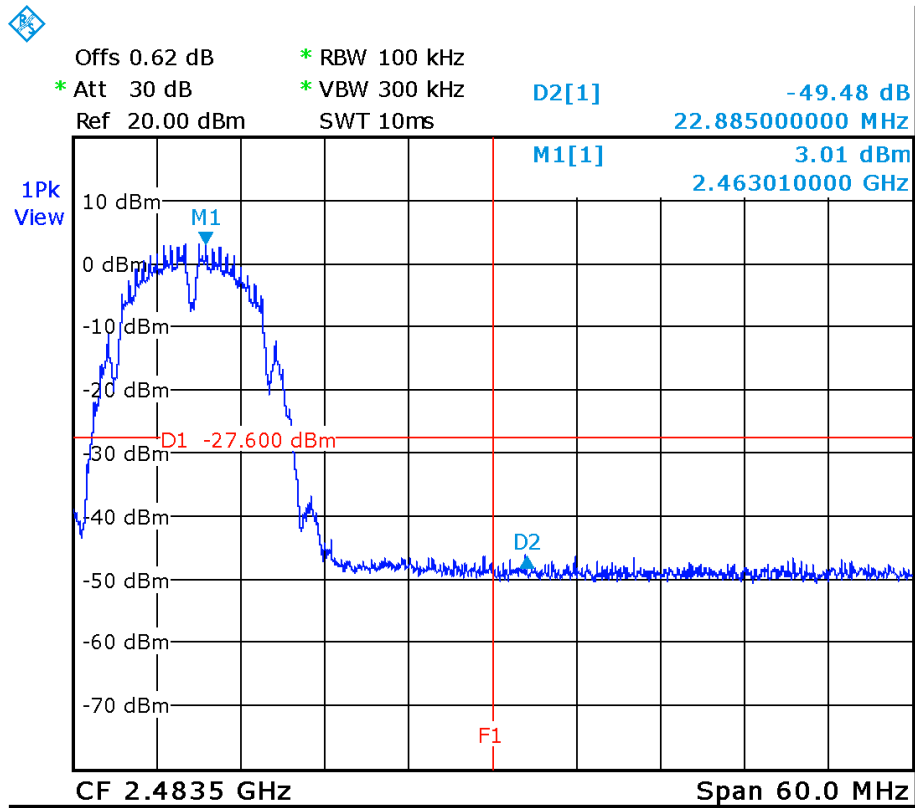
Measurement uncertainty (dB)	<±2.574
------------------------------	---------

Mode 802.11 b – Band-edge emissions compliance:

- Low Channel:

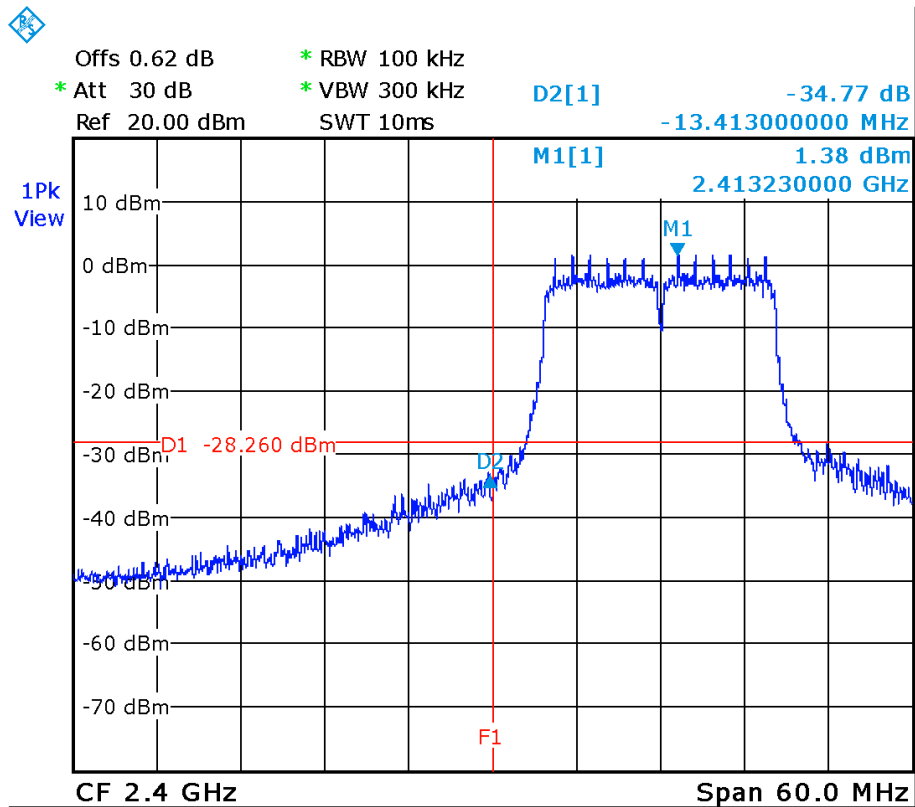


- High Channel:

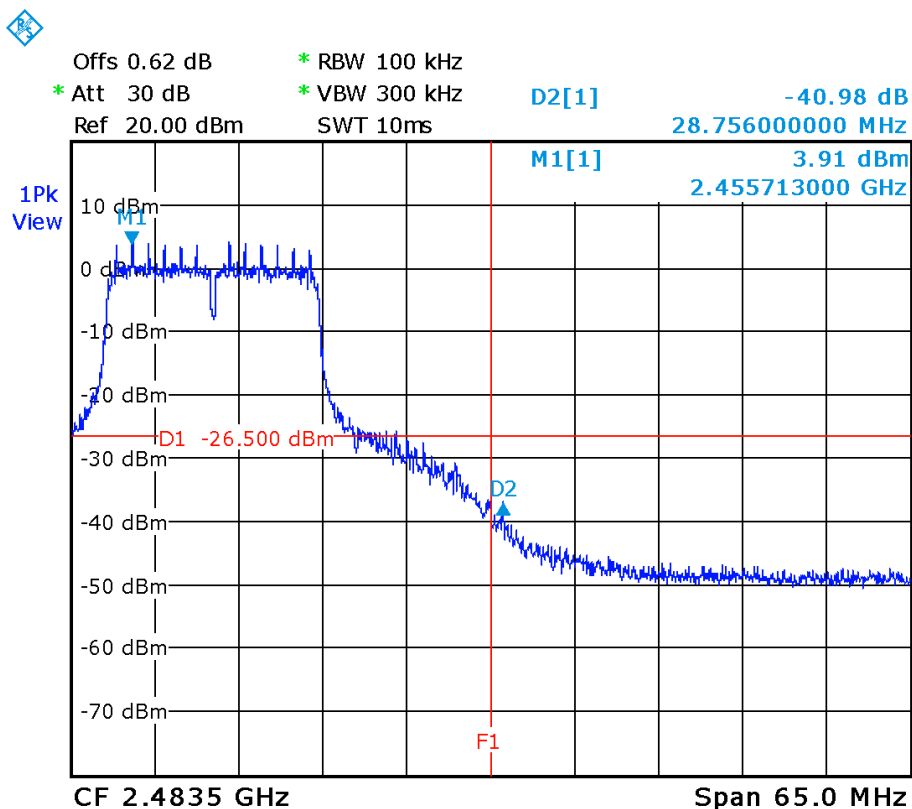


• Mode 802.11 g

- Low Channel:

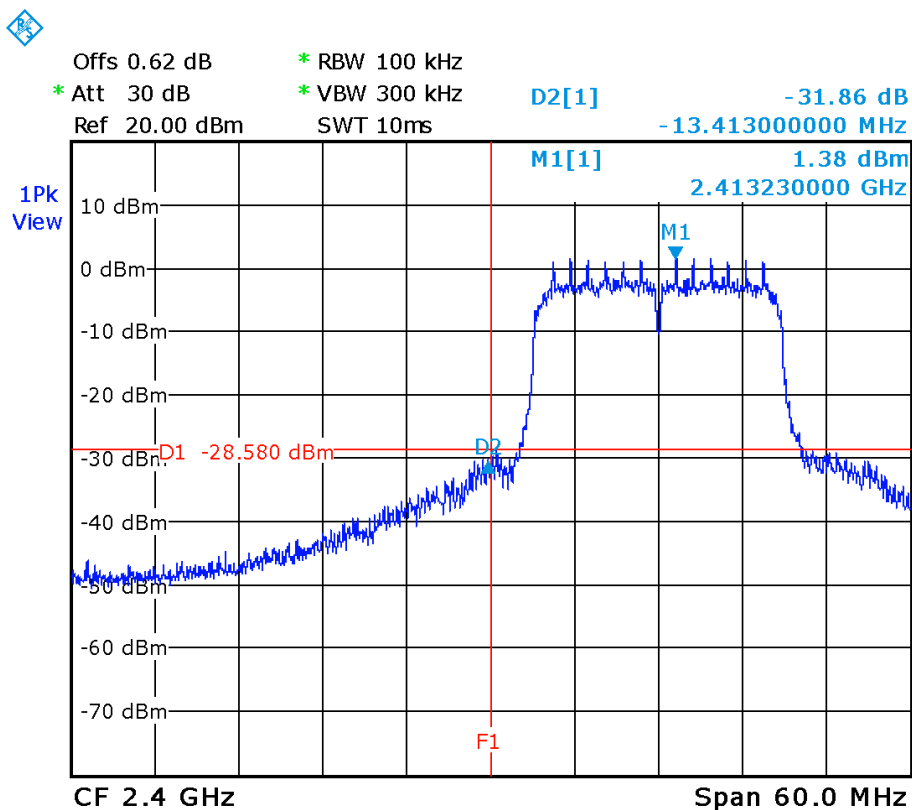


- High Channel:

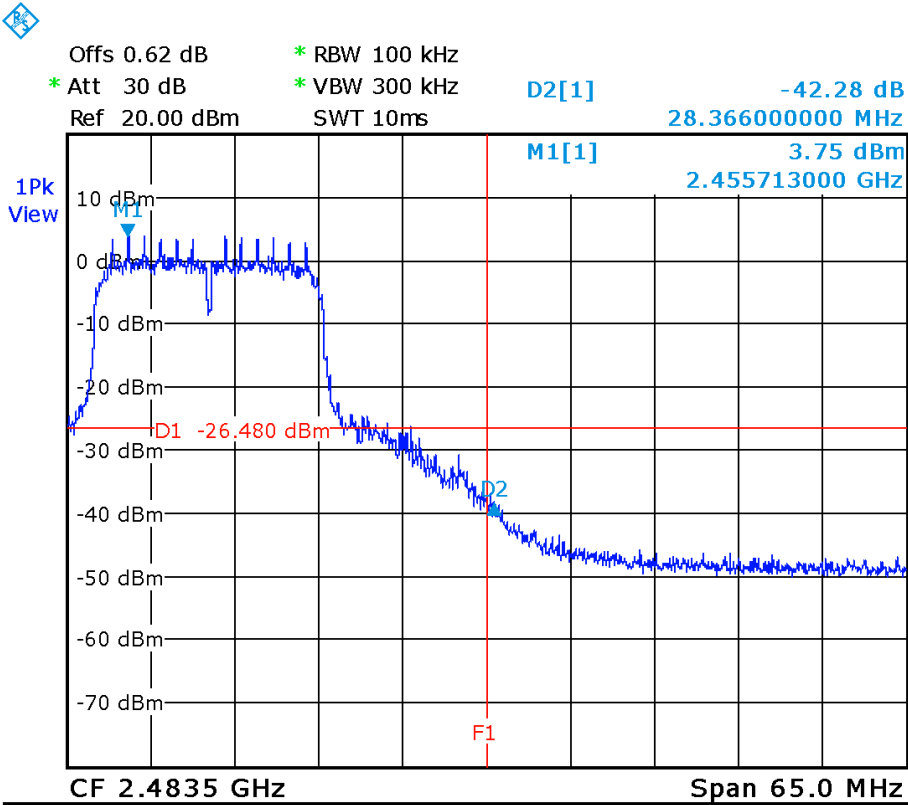


• Mode 802.11 n20

- Low Channel:



- High Channel:



Verdict: PASS

FCC 15.247 (e) / RSS-247 5.2. (b) Power spectral density

SPECIFICATION:

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

RESULTS:

The power spectral density was measured using the method according to point "11.10.5 Method AVGPS-2" of ANSI C.63.10-2013.

- Mode 802.11 b**

	Low Channel 2412 MHz	Middle Channel 2437 MHz	High Channel 2462 MHz
Average Power Spectral Density (dBm)	-3.75	-4.16	-6.74
Average Power Spectral Density with Duty Cycle Correction (dBm)	-3.24	-3.65	-6.23
Measurement uncertainty (dB)	<±2.57		

- Mode 802.11 g**

	Low Channel 2412 MHz	Middle Channel 2437 MHz	High Channel 2462 MHz
Average Power Spectral Density (dBm)	-7.35	-7.61	-5.41
Average Power Spectral Density with Duty Cycle Correction (dBm)	-6.74	-7.00	-4.80
Measurement uncertainty (dB)	<±2.57		

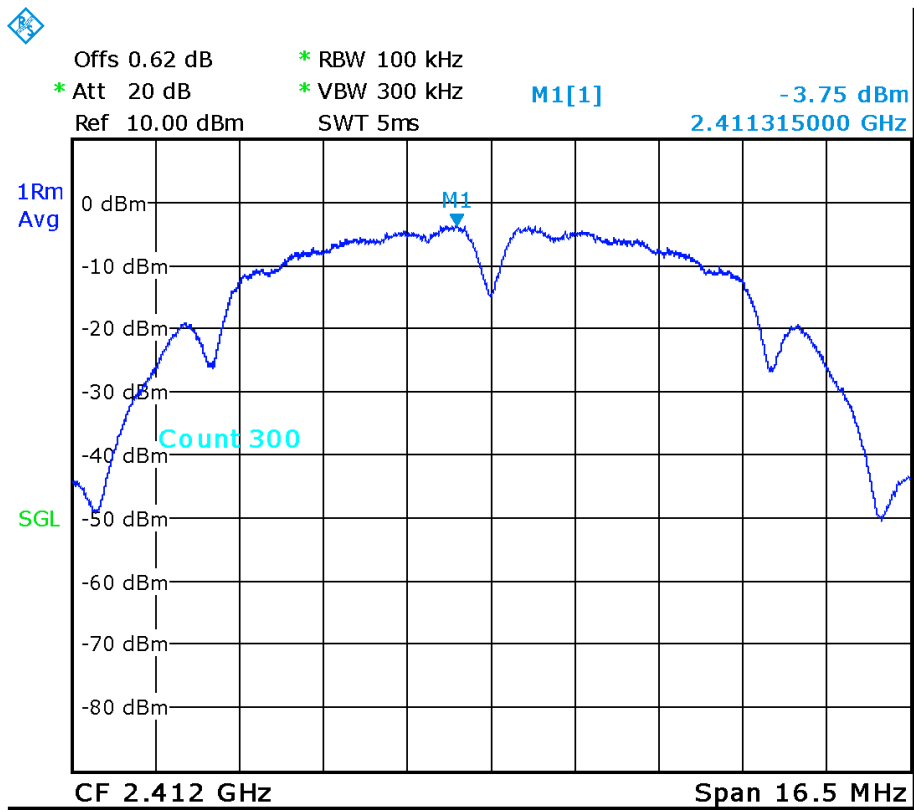
- Mode 802.11 n20**

	Low Channel 2412 MHz	Middle Channel 2437 MHz	High Channel 2462 MHz
Average Power Spectral Density (dBm)	-7.55	-7.49	-5.53
Average Power Spectral Density with Duty Cycle Correction (dBm)	-6.91	-6.85	-4.89
Measurement uncertainty (dB)	<±2.57		

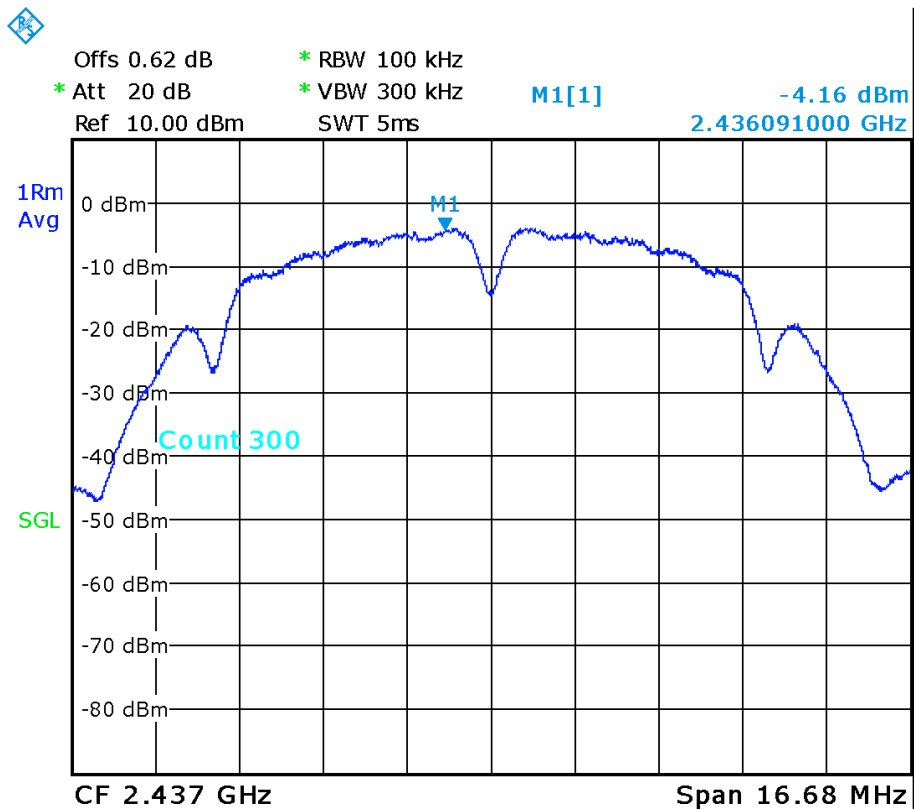
Verdict: PASS

- **Mode 802.11 b – Power Spectral Density**

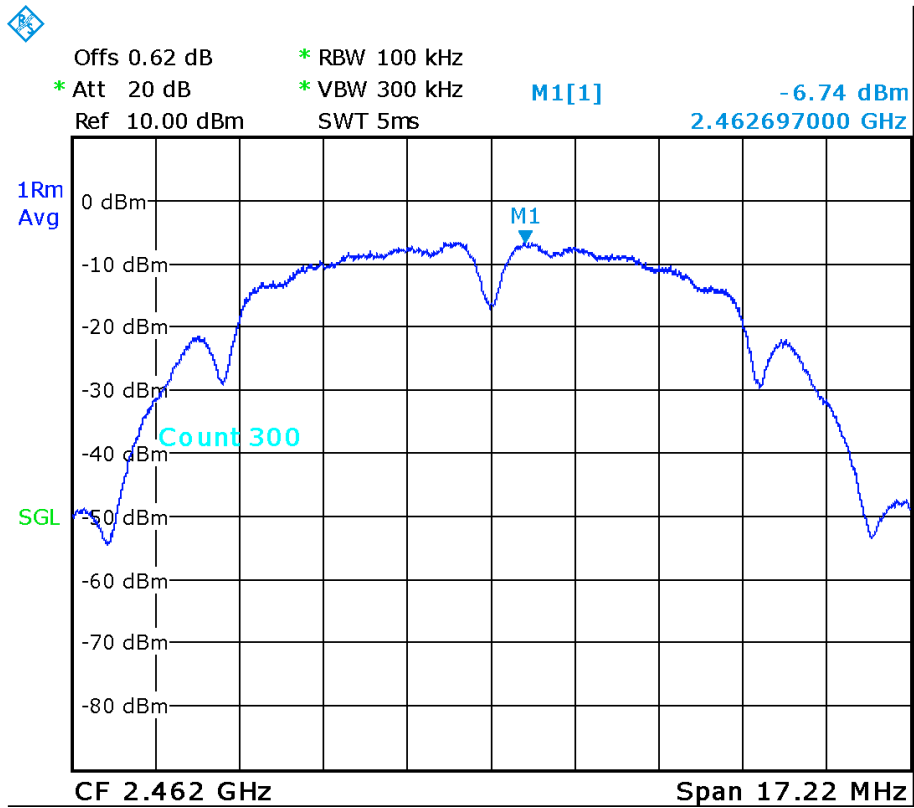
- Low Channel:



- Middle Channel:

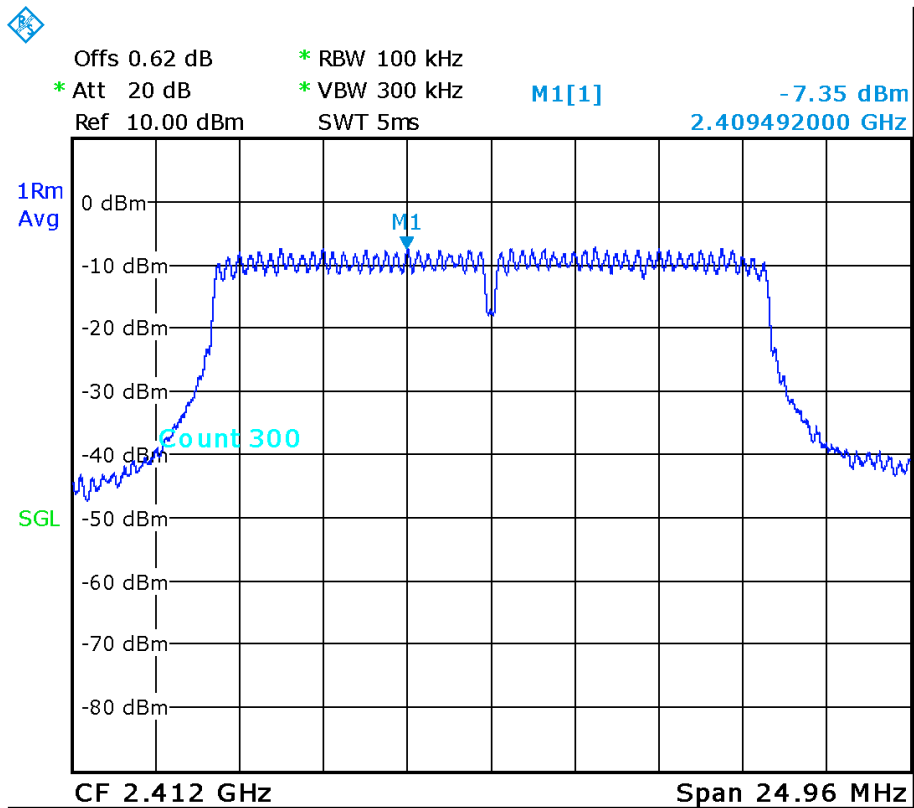


- High Channel:

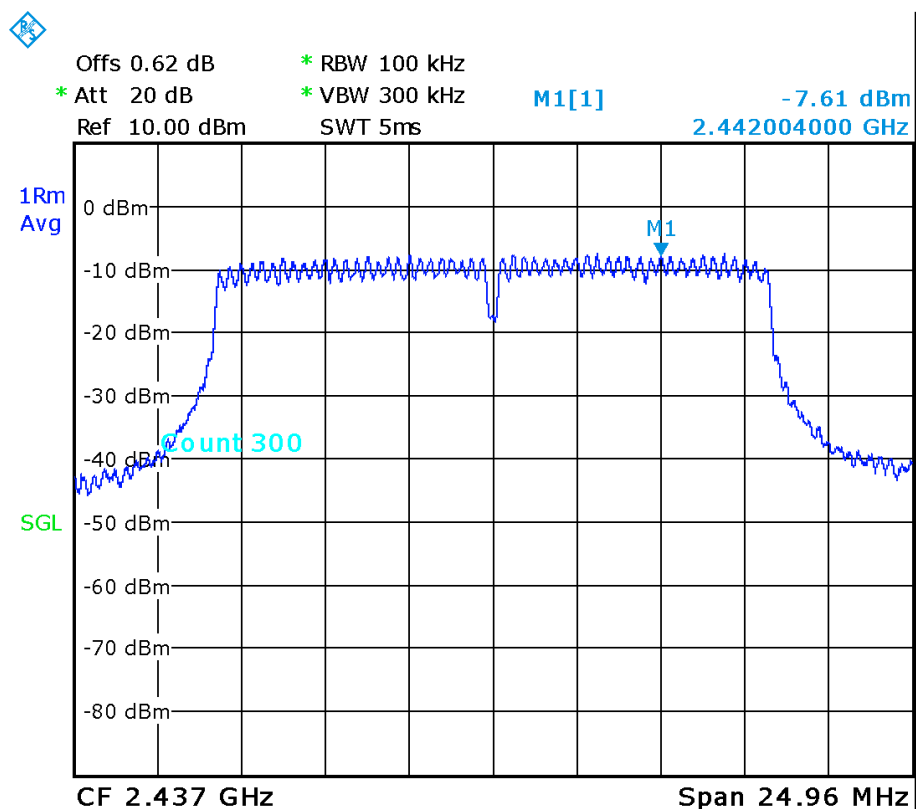


• Mode 802.11 g

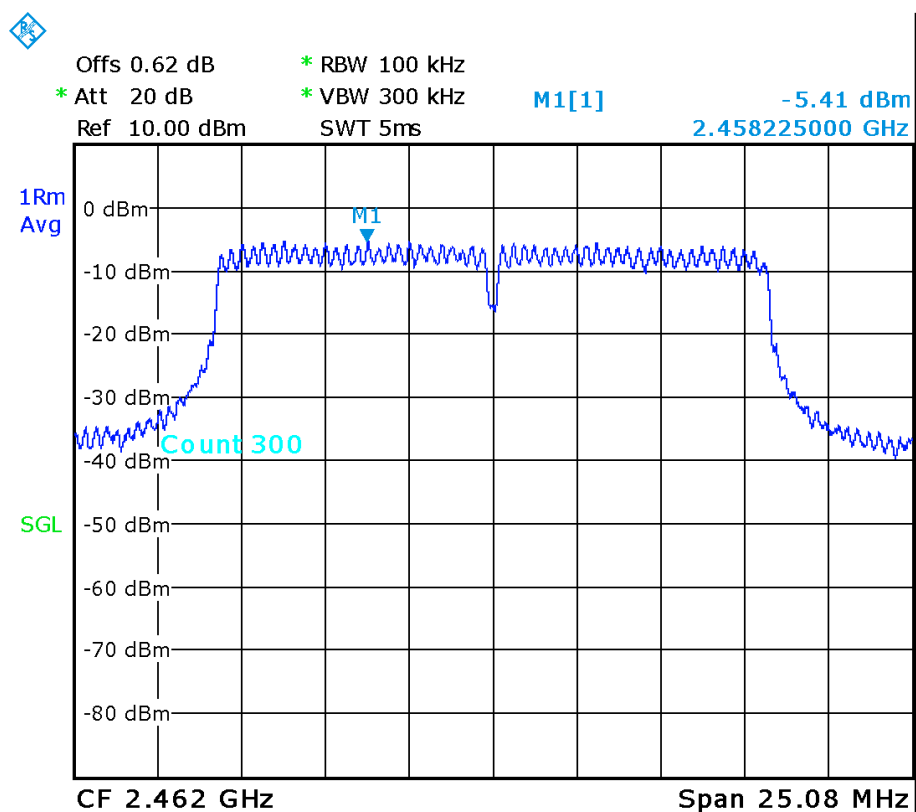
- Low Channel:



- Middle Channel:

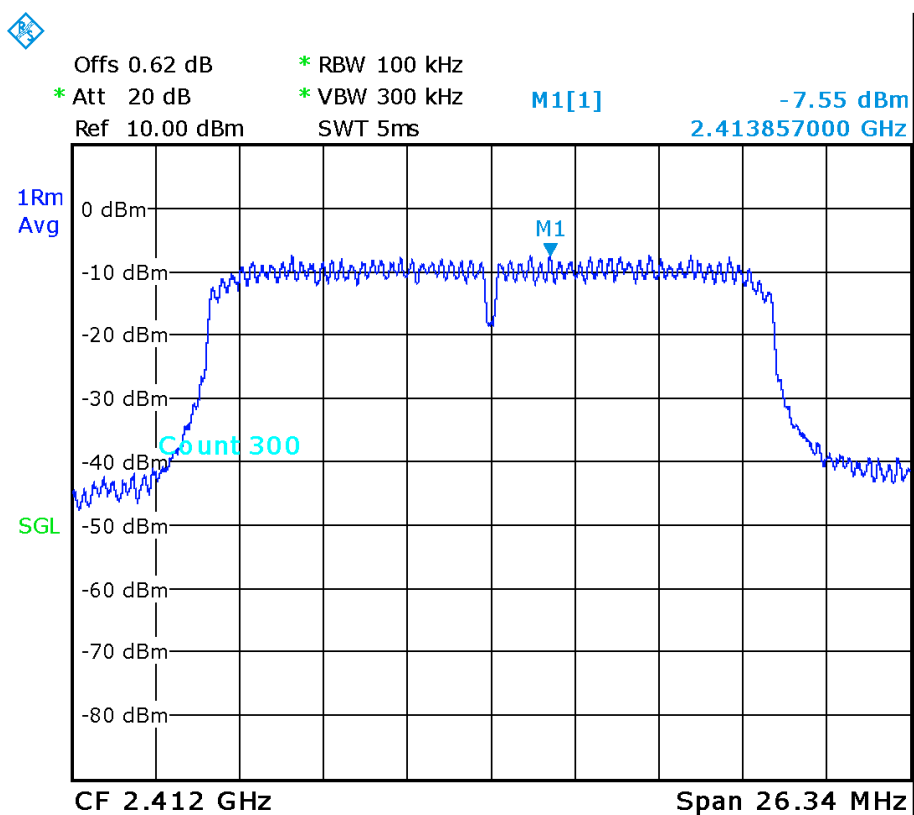


- High Channel:

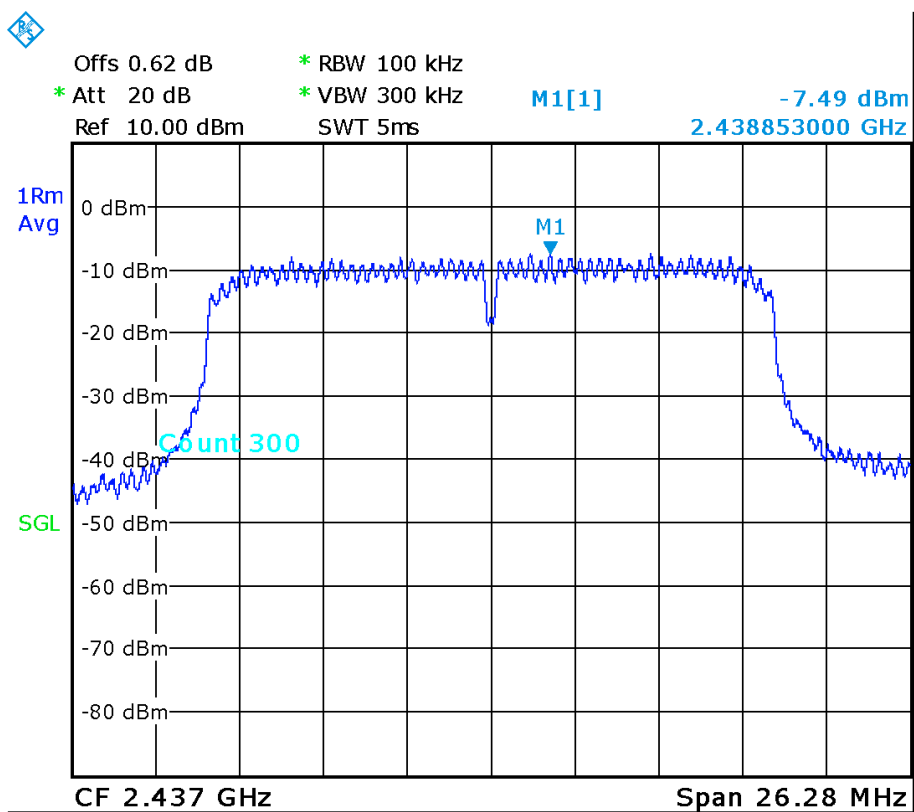


- **Mode 802.11 n20**

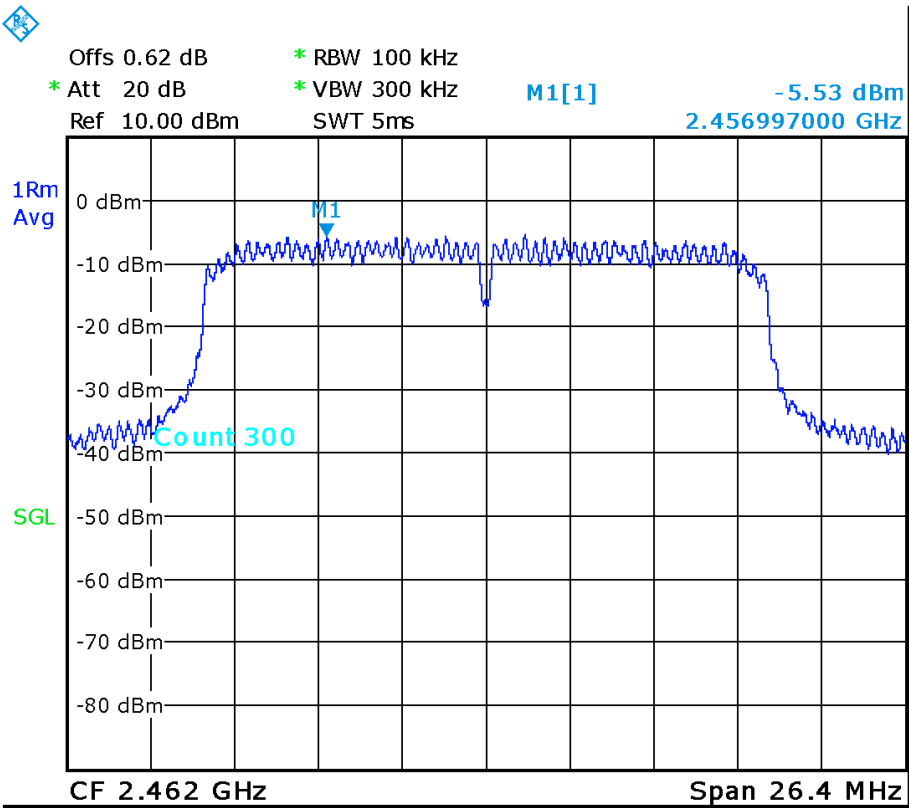
- Low Channel:



- Middle Channel:



- High Channel:



FCC 15.247 (d) / RSS-247 5.5. Emission limitations radiated (Transmitter)

SPECIFICATION:

Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c) / RSS-Gen):

Frequency Range (MHz)	Field strength (µV/m)	Field strength (dBµV/m)	Measurement distance (m)
0.009-0.490	2400/F(kHz)	-	300
0.490-1.705	24000/F(kHz)	-	30
1.705 - 30.0	30	-	30
30 - 88	100	40	3
88 - 216	150	43.5	3
216 - 960	200	46	3
960 - 25000	500	54	3

The emission limits shown in the above table are based on measurements employing CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.

For average radiated emission measurements above 1000 MHz, there is also a limit corresponding to 20 dB above the indicated values in the table is specified when measuring with peak detector function.

RESULTS:

The situation and orientation was varied to find the maximum radiated emission. It was also rotated 360° and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission.

Measurements were made in both horizontal and vertical planes of polarization.

All tests were performed in a semi-anechoic chamber at a distance of 3 m for the frequency range 30 MHz-17 GHz and at distance of 1m for the frequency range 17 GHz-26 GHz.

The field strength is calculated by adding correction factor to the measured level from the spectrum analyzer. This correction factor includes antenna factor, cable loss and pre-amplifiers gain.

Frequency range 30 MHz - 1 GHz:

The spurious frequencies detected do not depend on the operating channel neither modulation.

Spurious frequencies at less than 20 dB below the limit:

Spurious frequency (MHz)	Emission Level (dBμV/m)	Polarization	Detector	Measurement Uncertainty (dB)
37.8570	26.28	V	Quasi-Peak	<± 4.94
50.5640	25.56	V	Quasi-Peak	<± 4.94
128.2125	26.81	V	Quasi-Peak	<± 4.94
640.0330	32.13	V	Quasi-Peak	<± 4.94

- **Mode 802.11 b:**

Frequency range 1 - 26 GHz:

The results in the next tables show the maximum measured levels in the 1-26 GHz range including the restricted bands 2.31-2.39 GHz and 2.4835-2.5 GHz.

Spurious signals with peak levels above the average limit (54 dBμV/m at 3 m) are measured with average detector for checking compliance with the average limit.

- LOW CHANNEL. Spurious frequencies at less than 20 dB below the limit:

Spurious frequency (GHz)	Emission Level (dBμV/m)	Polarization	Detector	Measurement Uncertainty (dB)
2.38933	55.30	V	Peak	<± 3.98
	41.62		Average	
3.2160	47.09	V	Peak	<± 4.60
4.8240	56.42	V	Peak	<± 4.60
	53.86		Average	
7.2345	40.43	V	Peak	<± 4.60
9.6480	45.32	V	Peak	<± 4.60

- MIDDLE CHANNEL. Spurious frequencies at less than 20 dB below the limit:

Spurious frequency (GHz)	Emission Level (dBμV/m)	Polarization	Detector	Measurement Uncertainty (dB)
3.2490	46.59	V	Peak	<± 4.11
4.8735	52.93	H	Peak	<± 4.60
9.7480	44.61	V	Peak	<± 4.60

- HIGH CHANNEL. Spurious frequencies at less than 20 dB below the limit:

Spurious frequency (GHz)	Emission Level (dBμV/m)	Polarization	Detector	Measurement Uncertainty (dB)
2.4890	54.90	H	Peak	<± 3.98
	51.59		Average	
3.2825	51.81	V	Peak	<± 4.60
4.9240	56.08	V	Peak	<± 4.60
	52.92		Average	

OFDM modes:

For spurious emissions in the range 30 MHz - 26 GHz (except field strength at the band edges that was performed for all modes) a preliminary scan was performed to determine the worst case mode. Herein the results for the worst case mode: 802.11g.

Spurious emissions in the Restricted Bands 2.31-2.39 GHz and 2.4835-2.5 GHz are measured for all modes.

• Mode 802.11 g

The results in the next tables show the maximum measured levels in the 1-26 GHz range including the restricted bands 2.31-2.39 GHz and 2.4835-2.5 GHz.

Spurious signals with peak levels above the average limit (54 dB μ V/m at 3 m) are measured with average detector for checking compliance with the average limit.

- LOW CHANNEL. Spurious frequencies at less than 20 dB below the limit:

Spurious frequency (GHz)	Emission Level (dB μ V/m)	Polarization	Detector	Measurement Uncertainty (dB)
2.3813	62.34	V	Peak	< $\pm$ 3.98
	43.32		Average	
3.2155	45.22	V	Peak	< $\pm$ 4.60
4.8230	52.71	V	Peak	< $\pm$ 4.60
7.2365	40.52	V	Peak	< $\pm$ 4.60

- MIDDLE CHANNEL. Spurious frequencies at less than 20 dB below the limit:

Spurious frequency (GHz)	Emission Level (dB μ V/m)	Polarization	Detector	Measurement Uncertainty (dB)
3.2495	51.43	V	Peak	< $\pm$ 4.60
4.8795	58.31	V	Peak	< $\pm$ 4.60
	43.43		Average	
7.3160	48.27	V	Peak	< $\pm$ 4.60

- HIGH CHANNEL. Spurious frequencies at less than 20 dB below the limit:

Spurious frequency (GHz)	Emission Level (dB μ V/m)	Polarization	Detector	Measurement Uncertainty (dB)
2.4839	65.65	V	Peak	< $\pm$ 3.98
	47.59		Average	
3.2825	51.25	V	Peak	< $\pm$ 4.60
4.9225	59.04	V	Peak	< $\pm$ 4.60
	47.25		Average	

- **Mode 802.11 n20**

The results in the next tables show the maximum measured levels in the Restricted Bands 2.31-2.39 GHz and 2.4835-2.5 GHz.

Spurious frequencies with peak levels above the average limit (54 dBμV/m at 3 m) are measured with average detector for checking compliance with the average limit.

- LOW CHANNEL. Spurious frequencies at less than 20 dB below the limit:

Spurious frequency (GHz)	Emission Level (dBμV/m)	Polarization	Detector	Measurement Uncertainty (dB)
2.3896	64.16	V	Peak	<± 3.98
	46.86		Average	

- MIDDLE CHANNEL. No spurious detected at less than 20 dB below the limit:

- HIGH CHANNEL. Spurious frequencies at less than 20 dB below the limit:

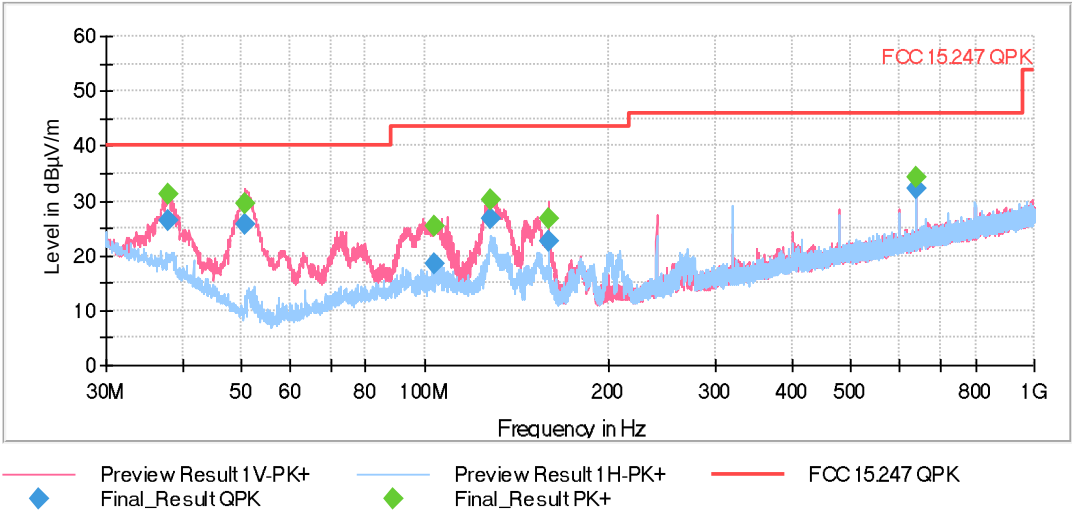
Spurious frequency (GHz)	Emission Level (dBμV/m)	Polarization	Detector	Measurement Uncertainty (dB)
2.4839	65.51	V	Peak	<± 3.98
	48.13		Average	

Measurement Uncertainty (dB): 1 GHz ≤ f ≤ 3 GHz: <± 4.11
3 GHz ≤ f ≤ 17 GHz: <± 5.13
17 GHz ≤ f ≤ 26 GHz: <± 4.82

Verdict: PASS

FREQUENCY RANGE 30 MHz - 1 GHz:

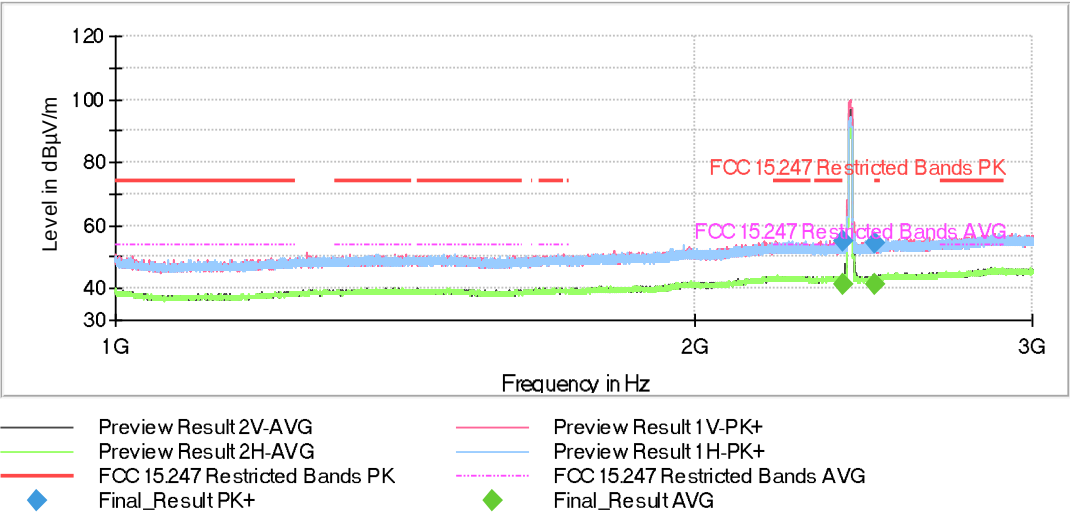
The spurious frequencies detected do not depend on the operating channel neither modulation.



• Mode 802.11 b

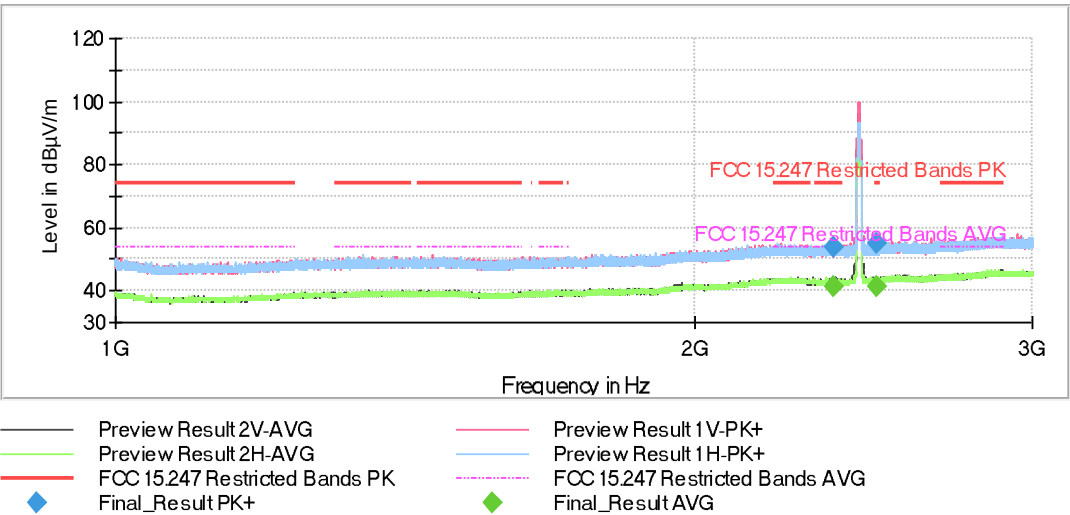
FREQUENCY RANGE 1 - 3 GHz:

- Low Channel:



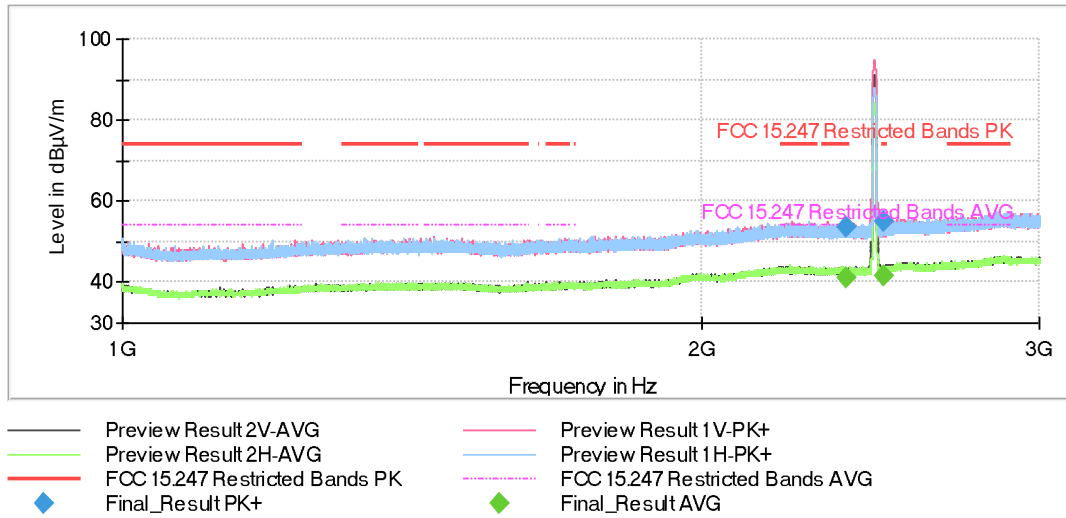
The peak above the limit is the carrier frequency.

- Middle Channel:



The peak above the limit is the carrier frequency.

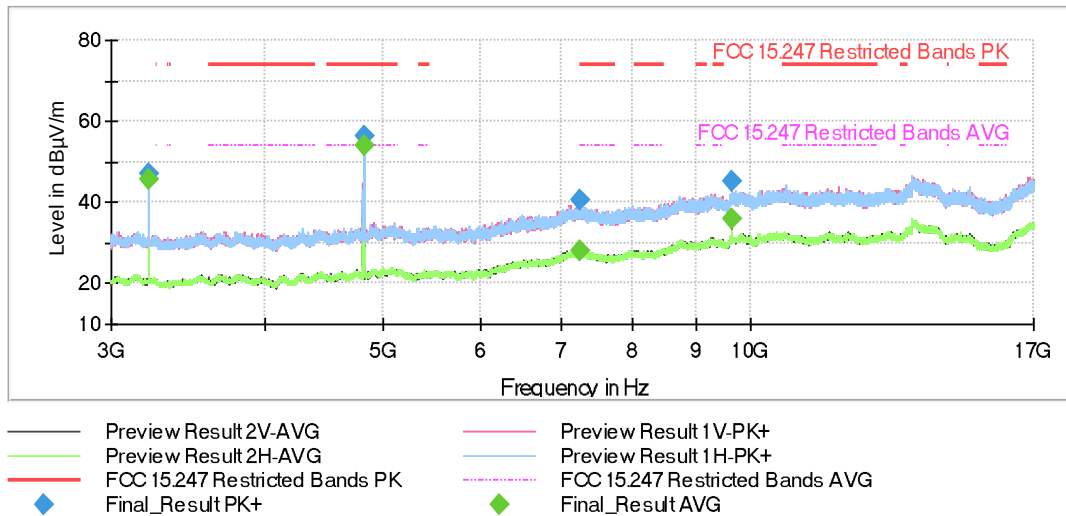
- High Channel:



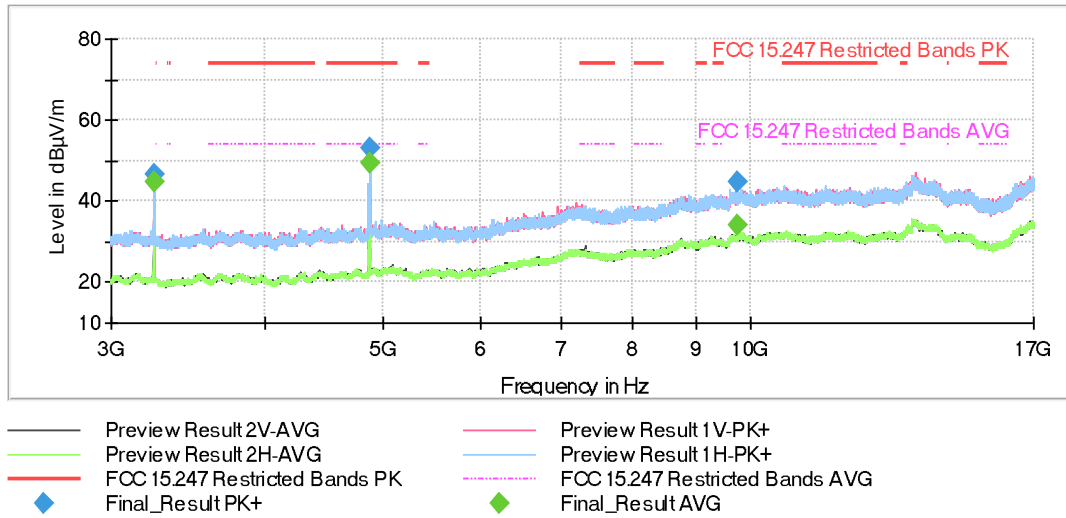
The peak above the limit is the carrier frequency.

FREQUENCY RANGE 3 - 17 GHz:

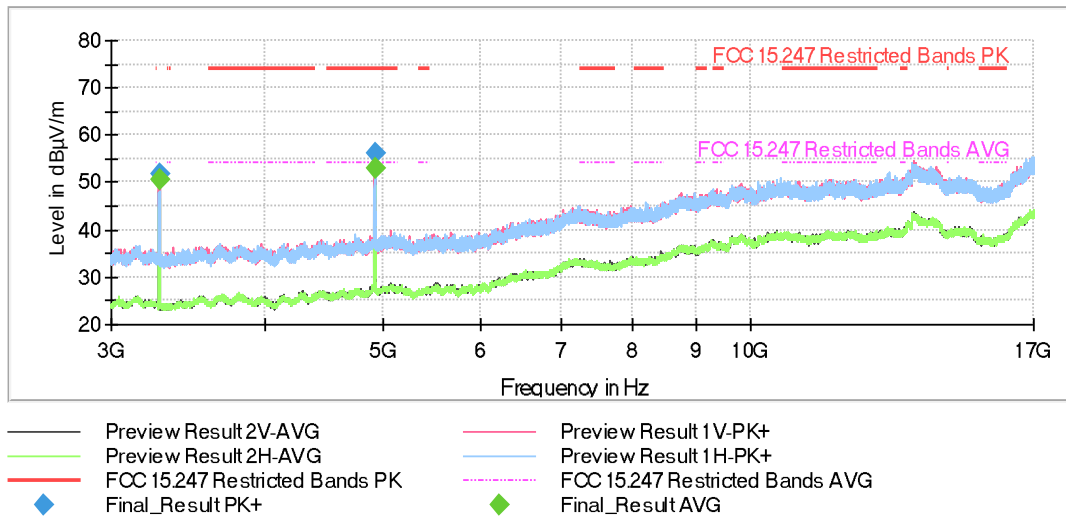
- Low Channel:



- Middle Channel:

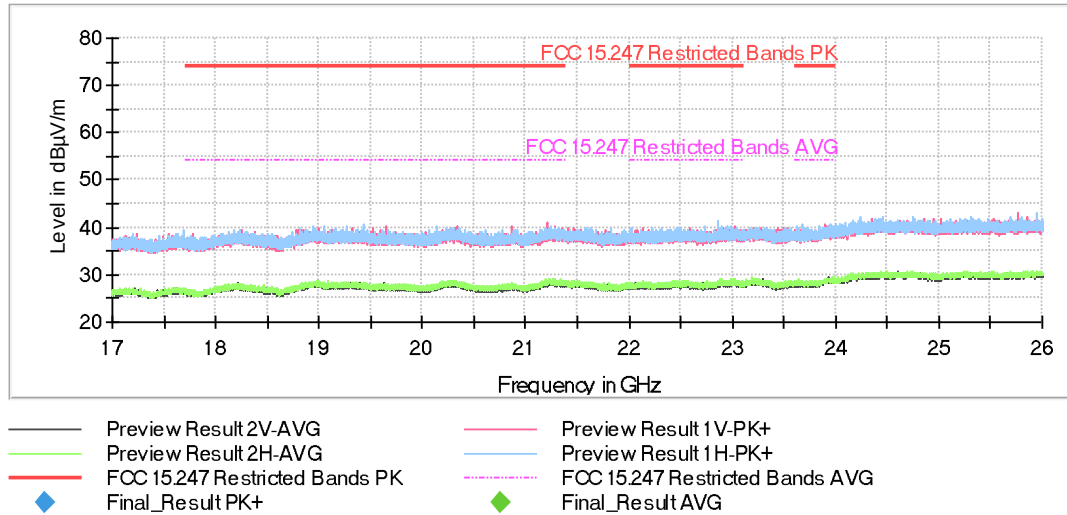


- High Channel:



FREQUENCY RANGE 17 - 26 GHz:

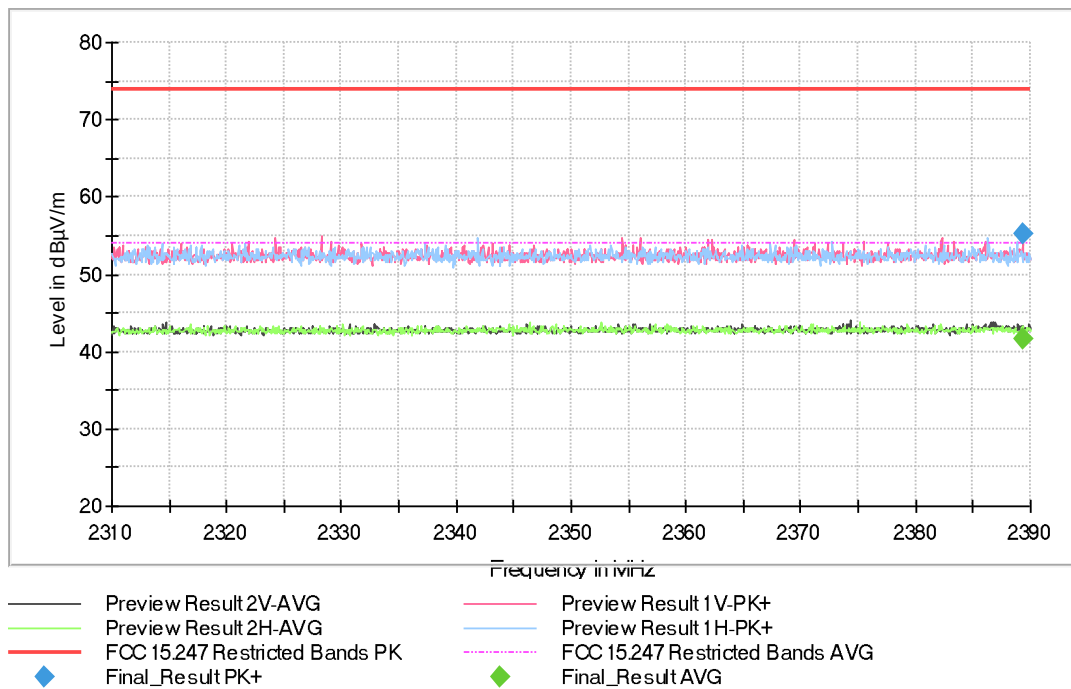
The spurious frequencies detected do not depend on the operating channel.



RESTRICTED BAND 2.31-2.39 GHz:

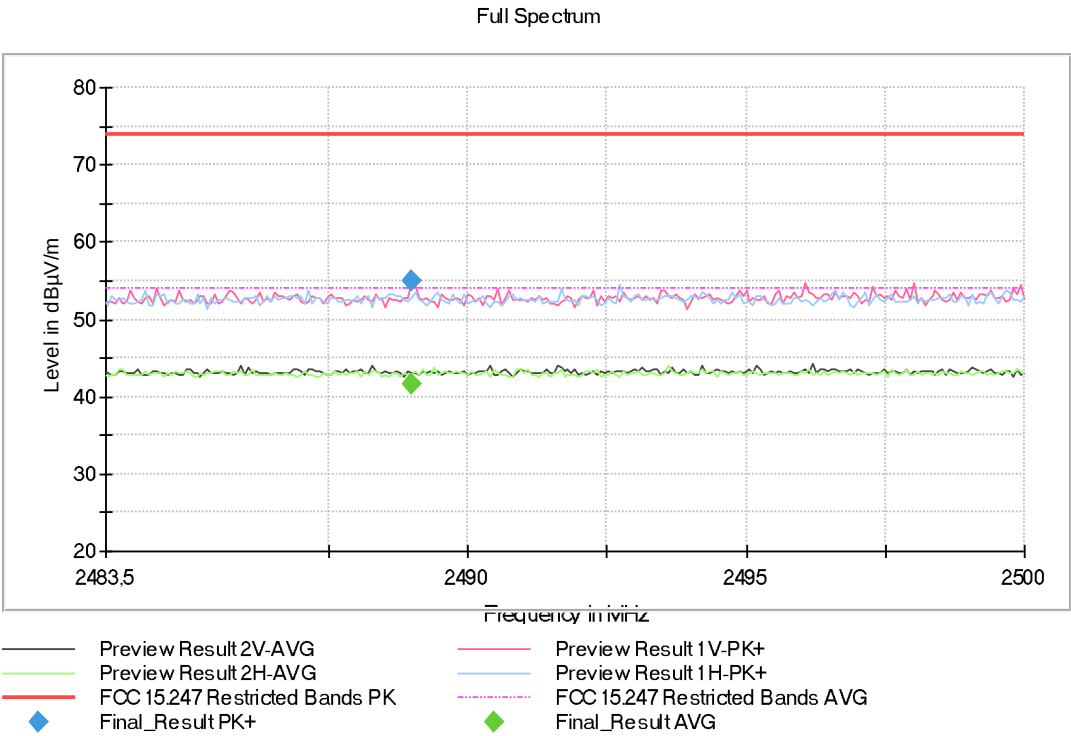
- Low Channel:

Full Spectrum



RESTRICTED BAND 2.4835-2.5 GHz:

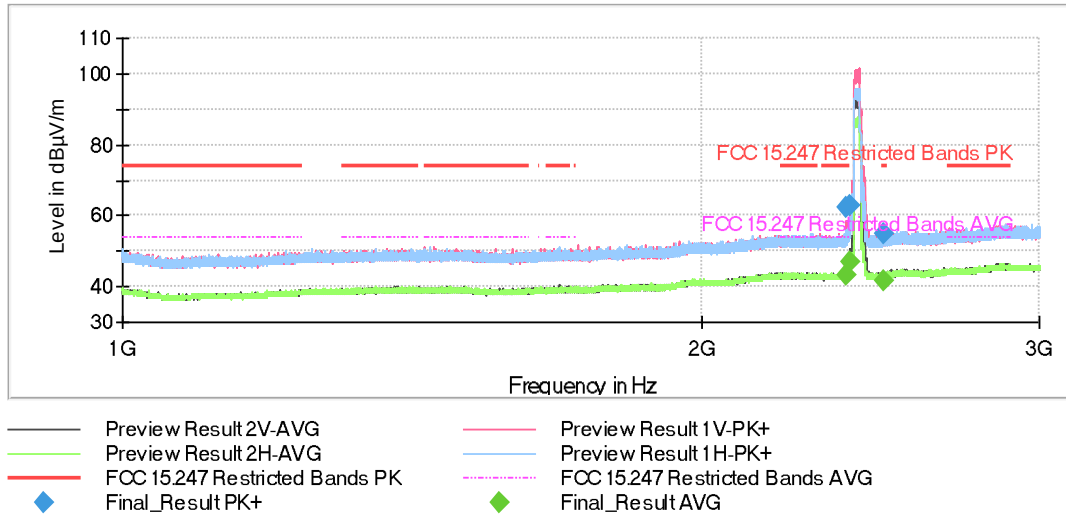
- High Channel:



- **Mode 802.11 g**

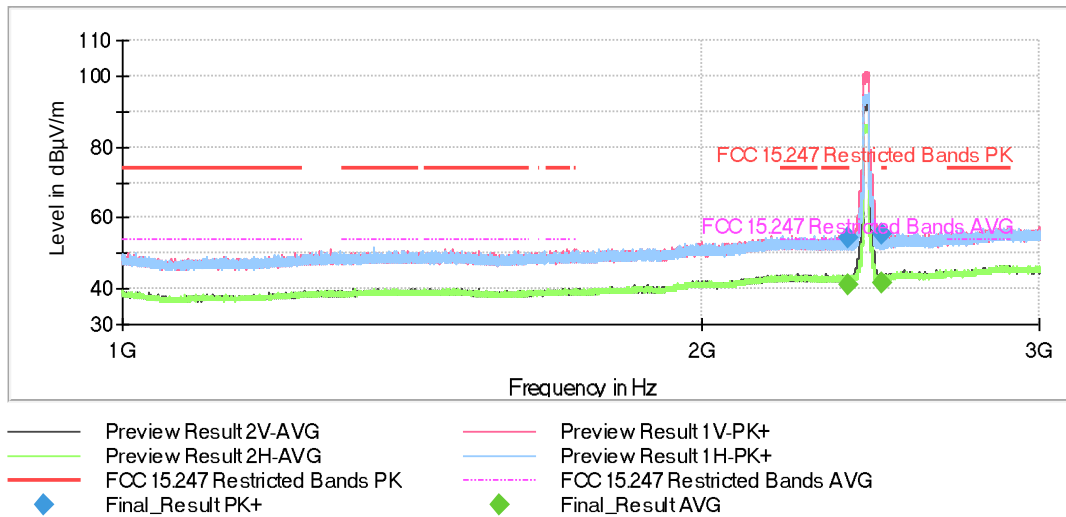
FREQUENCY RANGE 1 - 3 GHz:

- Low Channel:



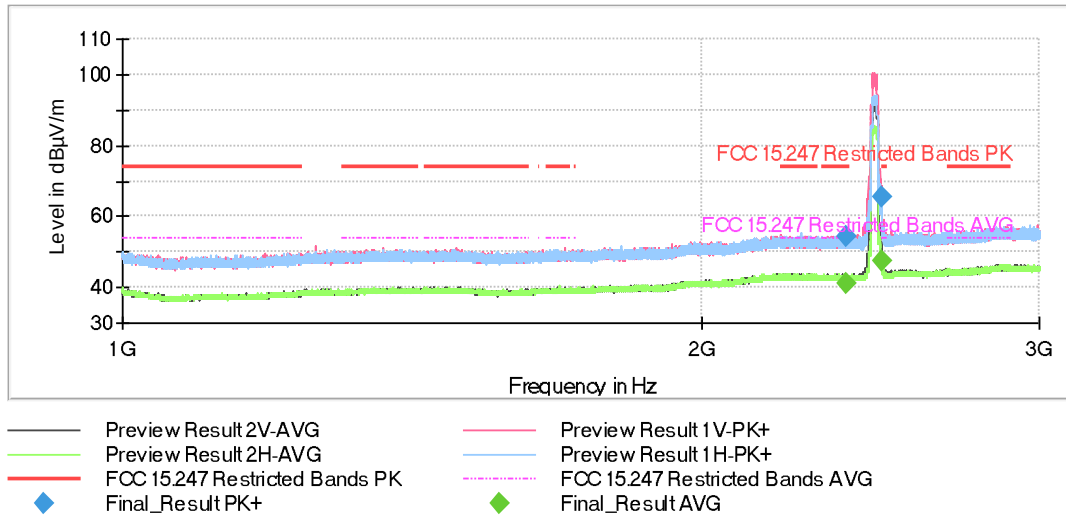
The peak above the limit is the carrier frequency.

- Middle Channel:



The peak above the limit is the carrier frequency.

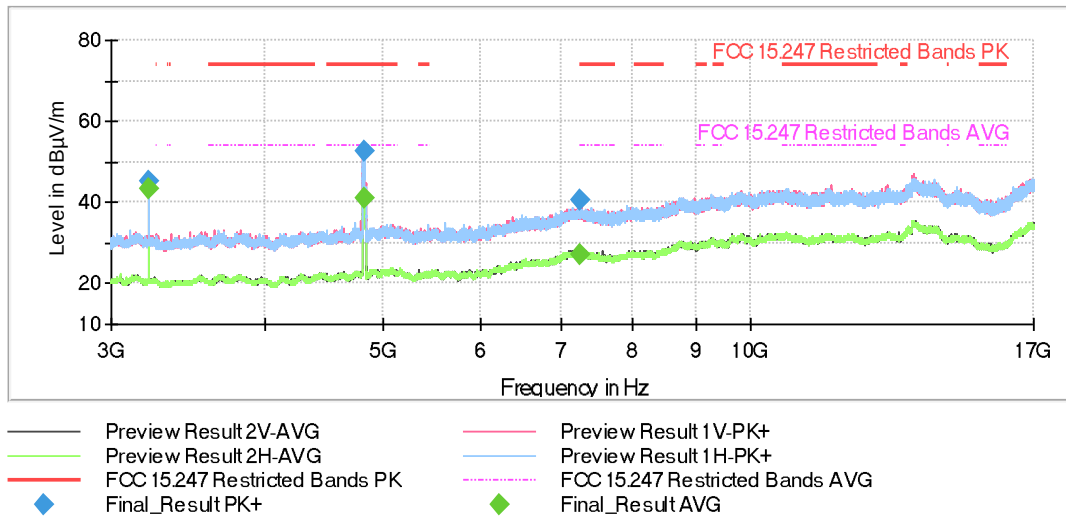
- High Channel:



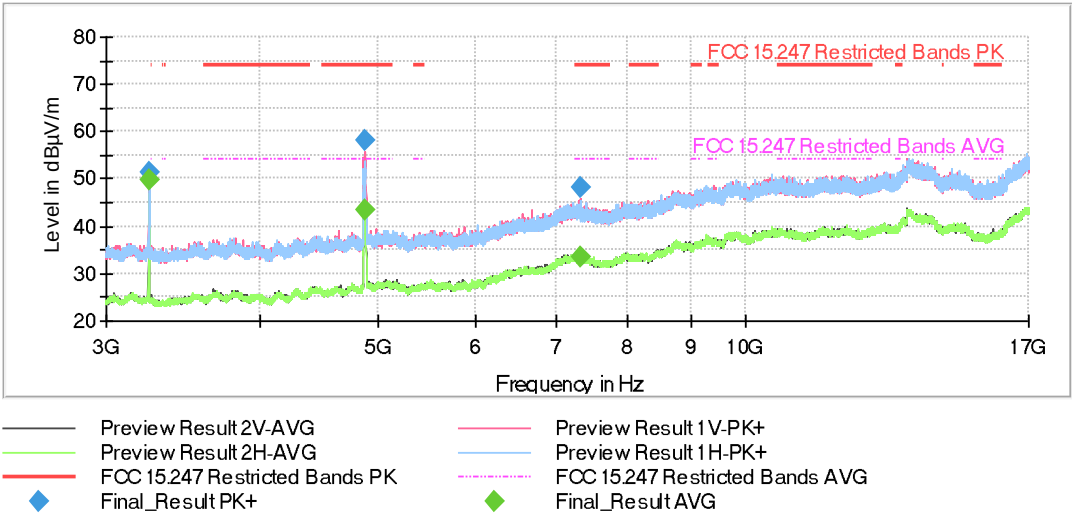
The peak above the limit is the carrier frequency.

FREQUENCY RANGE 3 - 17 GHz:

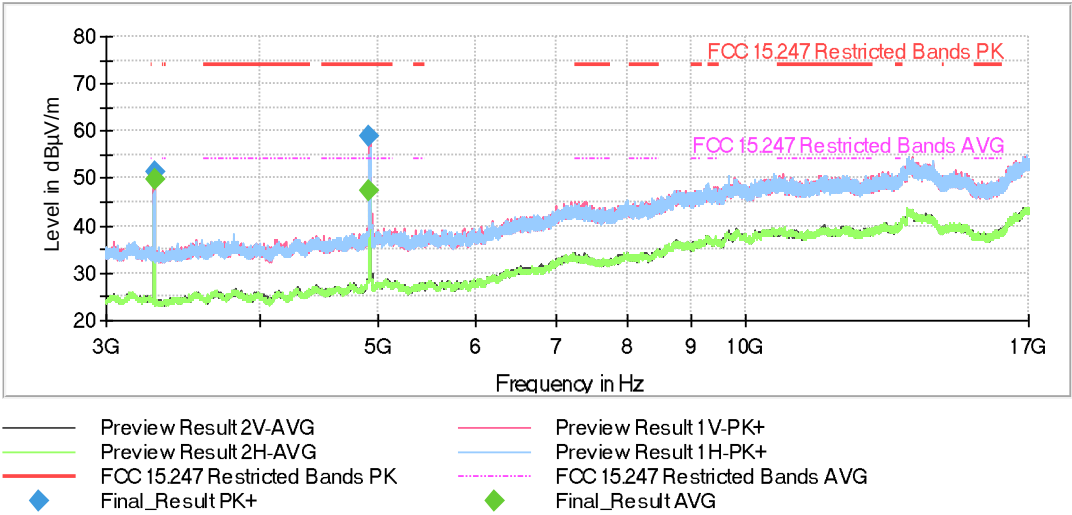
- Low Channel:



- Middle Channel:

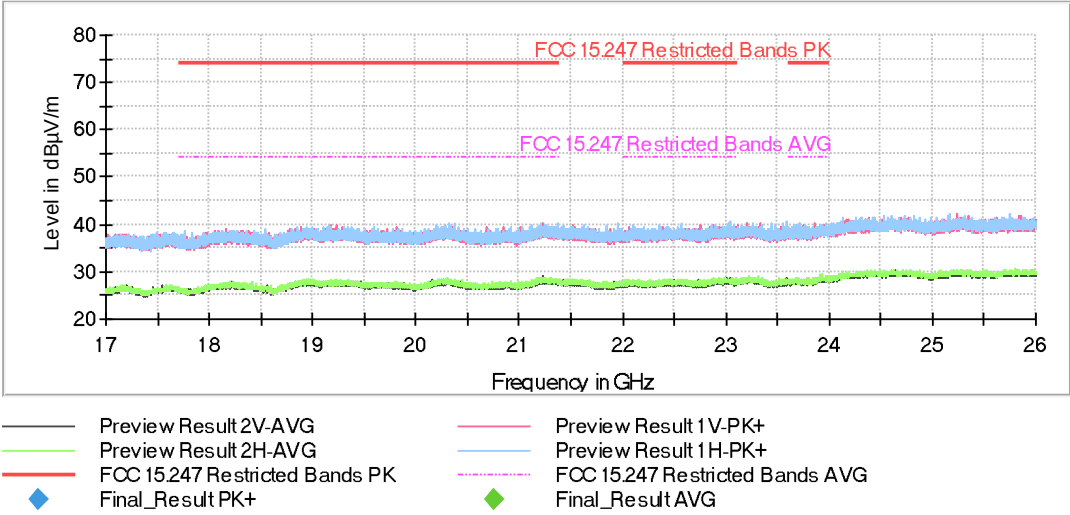


- High Channel:



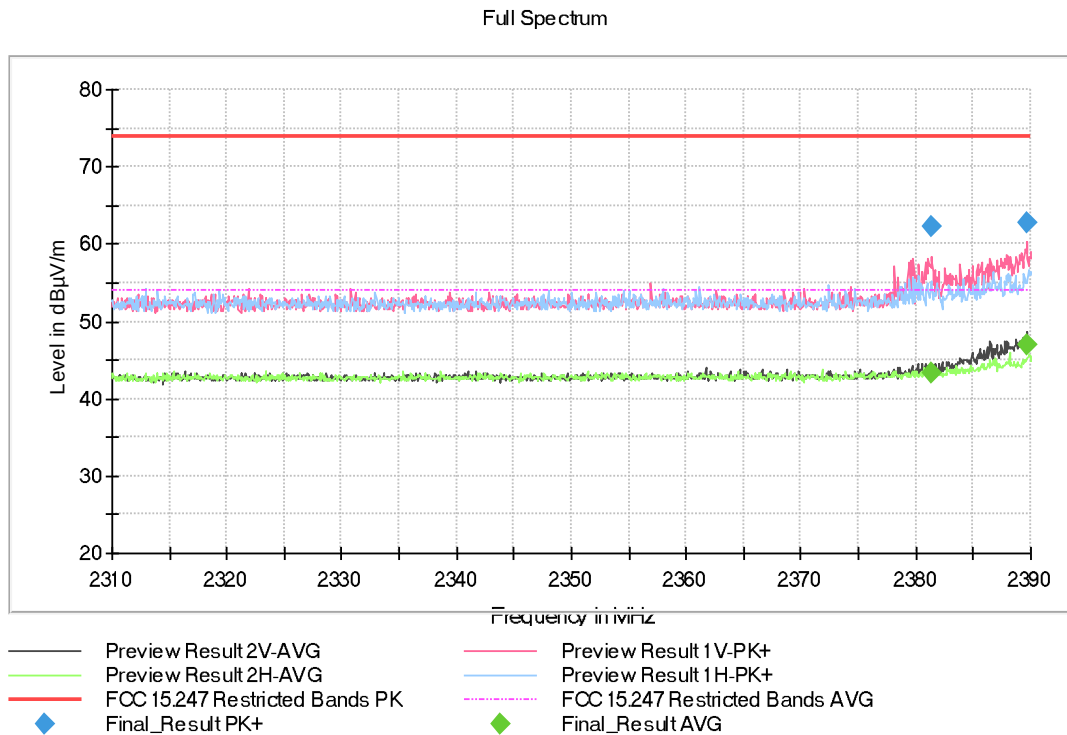
FREQUENCY RANGE 17 - 26 GHz:

The spurious frequencies detected do not depend on the operating channel.



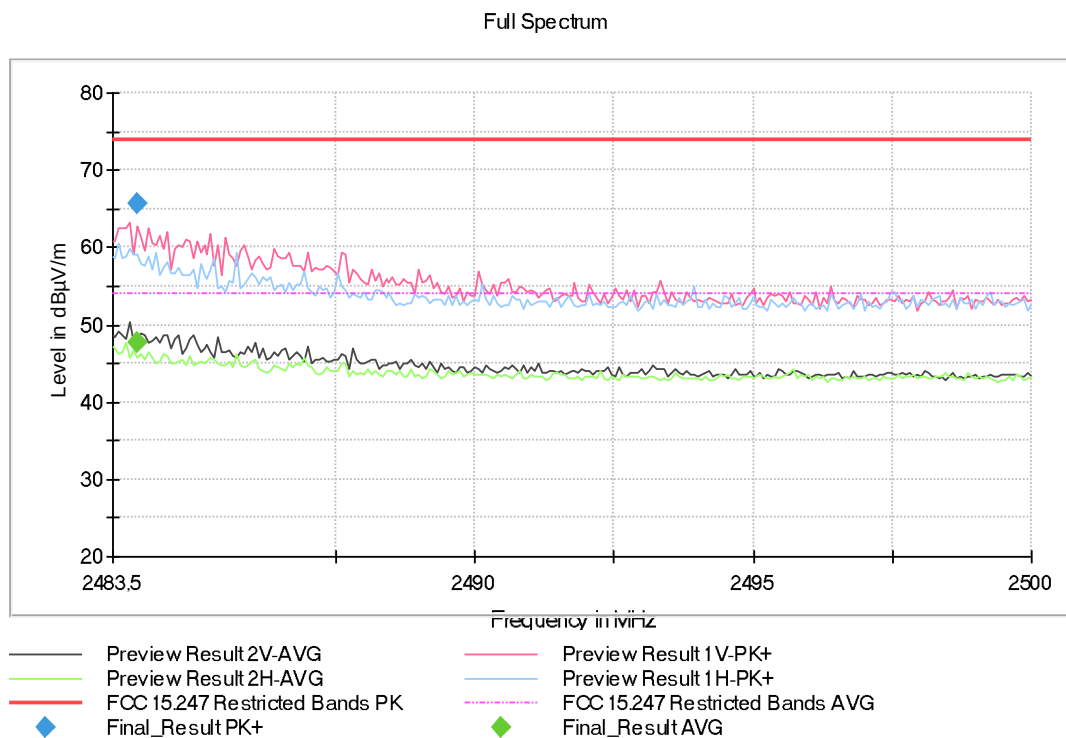
RESTRICTED BAND 2.31-2.39 GHz:

- Low Channel:



RESTRICTED BAND 2.4835-2.5 GHz:

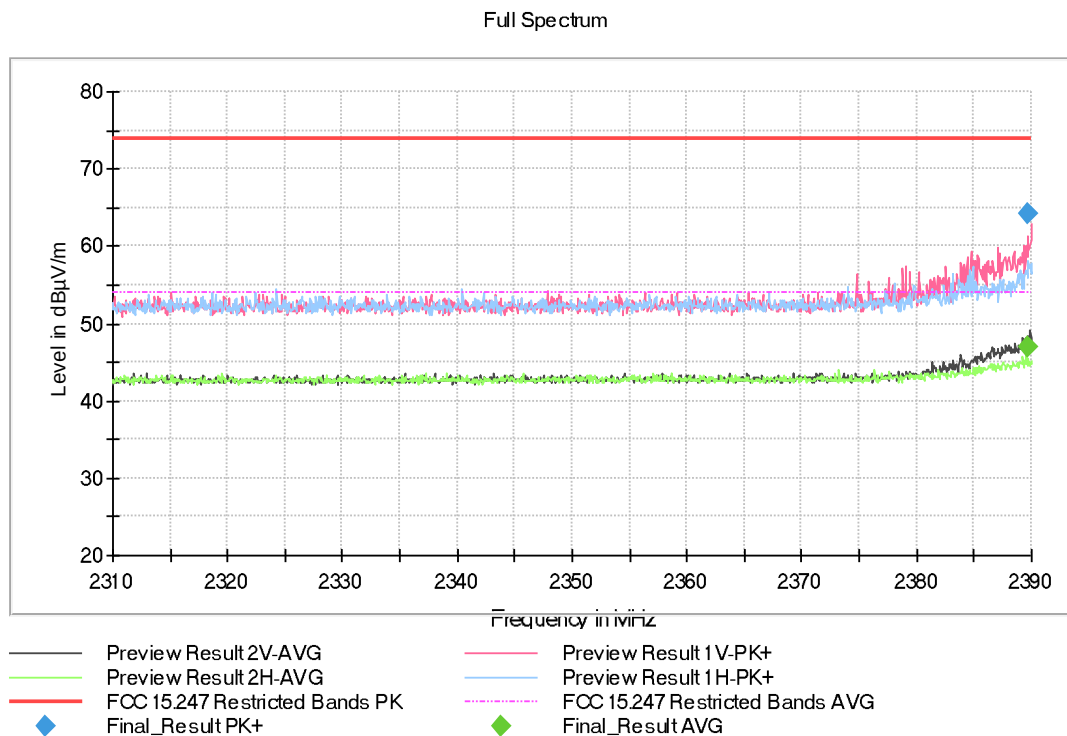
- High Channel:



• **Mode 802.11 n20**

RESTRICTED BAND 2.31-2.39 GHz:

- Low Channel:



RESTRICTED BAND 2.4835-2.5 GHz:

- High Channel:

