DEKRA Testing and Certification, S.A.U.
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C.I.F. A29507456

ISED CABid: ES1909

Test Report No:
NIE: 64670RRF.003A2

Test Report
USA FCC Part 15.247, 15.209
CANADA RSS-247, RSS-Gen

(*) Identification of item tested	Smart Cooking Sensor
(*) Trademark	Safera
(*) Model and /or type reference	Sense Pro (Model code: IFU10B-PRO)
Other identification of the product	HW Version: B SW Version: 1.0.25 FCC ID: 2AT88-2000021194
(*) Features	Bluetooth LE, 802.15.4 (ZigBee-type), Wi-Fi 802.11 b/g/n (HT20)
Applicant	SAFERA OY Tekniikantie 4 B, FI-02150 Espoo, Finland.
Test method requested, standard	USA FCC Part 15.247 (10-1-20) Edition: Operation within the bands 902 - 928 MHz, 2400 -2483.5 MHz, and 5725 - 5850 MHz. USA FCC Part 15.209 (10-1-20) Edition: Radiated emission limits; general requirements. CANADA RSS-247 Issue 2 (February 2017). CANADA RSS-Gen Issue 5, Amendment 2 (February 2021). 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 2022.06.14 13:37:30 +02'00'
Date of issue	2022-06-14
Report template No	FDT08_24 (*) "Data provided by the client"

Index

Competences and guarantees 3
General conditions 3
Uncertainty 3
Data provided by the client 3
Usage of samples 3
Test sample description 5
Identification of the client 6
Testing period and place 6
Document history 6
Environmental conditions 6
Remarks and comments 7
Testing verdicts 8
Summary 8
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 covers the performed tests in this report.

DEKRA Testing and Certification is an ISED-recognized accredited testing laboratory, CABid: ES1909, with the appropriate scope of accreditation that covers the performed tests in this 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.

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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 Safera Sense is a Smart Cooking Sensor with the following main features:
   Sensors for monitoring the stove area and detecting cooking processes, as well as estimating indoor air quality. Processor and algorithms for detecting stove overheating, which will result in an audible alarm. Support for Bluetooth communication to smartphones and iOS / Android application in order to visualize data. Support for proprietary 802.15.4 based radio protocol for controlling some Safera Accessories (for example Power Control Unit for Stove). Support for Wi-Fi for connection to Safera Cloud or other Internet of Things -services.

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 results.

Usage of samples

Samples undergoing test have been selected by: The client.

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

Control Nº	Description	Model	Serial Nº	Date of reception
64670/004	Smart Cooking Sensor	Sense Pro	--	2020-04-17

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

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

Control Nº	Description	Model	Serial Nº	Date of reception
64670/003	Smart Cooking Sensor	Sense Pro	--	2020-04-17

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

Test sample description

Ports……. :	Port name and description		Cable				
			Specified length [m]	Attached during test		Shielded	
	N/A			☐		☐	
Rated power supply ……:	Voltage and Frequency		Reference poles				
			L1	L2	L3	N	PE
	☐	AC:	☐	☐	☐	☐	☐
	☒	DC: For the final product: 3 x AA Alkaline batteries as power supply. Operational voltage from 3.0 V to 5.0 V. For testing purposes, power is wired externally to some sample units. This is done to make it possible to use an external power supply. When using an external power supply, allowed voltages are 3.0 VDC to 5.0 VDC.					
Rated Power ……:	Normal operating mode: approx. 0.1 mA average Max. short term current consumption 150 mA Max. very short peak current consumption approx. 400 mA (ms level)						
Clock frequencies ……:	64 MHz main processor clock (nRF52840) 80-160 MHz auxiliary network processor clock (ESP8285) 32.768 kHz RTC auxiliary clock						
Other parameters……:	Not provided data						
Software version ……:	1.0.25						
Hardware version……:	B						
Dimensions in mm (W x H x D)…:	Not provided data						
Mounting position……:	☐	Table top equipment					
	☒	Wall/Ceiling mounted equipment					
	☐	Floor standing equipment					
	☐	Hand-held equipment					
	☐	Other:					
Modules/parts ……:	Module/parts of test item		Type		Manufacturer		
	Sensor Unit				Safera		
Accessories (not part of the test item) ……:	Description		Type		Manufacturer		
	Power supply						
	Batteries						
Documents as provided by the applicant……:	Description		File name		Issue date		
	User Manual						

(3) Only for Medical Equipment

Identification of the client

SAFERA OY
Tekniikantie 4 B, FI-02150 Espoo, Finland.

Testing period and place

Test Location	DEKRA Testing and Certification S.A.U.
Date (start)	2020-08-06
Date (finish)	2020-10-13

Document history

Report number	Date	Description
64670RRF.003	2021-12-23	First release.
64670RRF.003A1	2022-06-08	Second release. Updating equipment settings.This modification test report cancels and replaces the test report 64670RRF.003.
64670RRF.003A2	2022-06-14	Thrid release. Updating band-edge for high channel. This modification test report cancels and replaces the test report 64670RRF.003A1.

Environmental conditions

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

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

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

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

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

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

Remarks and comments

The tests have been performed by the technical personnel: Pablo Redondo, Nicolás Salguero, Cristina Calle, Jose Manuel Jiménez, Javier Miguel Nadales and Alfonso Gutiérrez.

Used instrumentation:

Conducted Measurements:

		Last Calibration	Due Calibration
1.	Shielded Room ETS LINDGREN S101	N/A	N/A
2.	Signal and Spectrum Analyzer 10 Hz - 40 GHz ROHDE AND SCHWARZ FSV40	2021/02	2023/02
3.	Open Switch Unit up to 40 GHz ROHDE AND SCHWARZ OSP-B157Wx	N.A.	N.A.
4.	Open Switch Unit up to 7.5GHz ROHDE AND SCHWARZ OSP-B157W8 PLUS	2021/08	2023/08
5.	Analog Power Supply DC 40V/40A NGPE 40/40 Rohde and Schwarz	N/A	N/A
6.	Digital multimeter FLUKE 179	2021/06	2022/06

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.	Biconical/Log Antenna 30 MHz - 6 GHz ETS LINDGREN 3142E	2020/04	2023/04
4.	Preamplifier G>40dB 10MHz-6GHz, BONN ELEKTRONIK, BLNA 0160-01N	2021/03	2022/03
5.	EMI Test Receiver 7 GHz ROHDE AND SCHWARZ ESR7	2021/11	2023/11
6.	DC Power Supply, 30V/5A KEYSIGHT TECHNOLOGIES U8002A	N/A	N/A
7.	Digital Multimeter FLUKE 175	2021/11	2022/11
8.	Horn Antenna 1-18 GHz SCHWARZBECK MESS-ELEKTRONIK BBHA 9120 D	2019/11	2022/11
9.	Horn Antenna 18-40 GHz SCHWARZBECK MESS-ELEKTRONIK BBHA 9170	2020/05	2023/05
10.	RF Preamplifier, 40 dB ,1-18 GHz BONN ELEKTRONIK BLMA 0118-1M	2021/06	2022/06
11.	RF Preamplifier, G>30 dB ,18-40 GHz BONN ELEKTRONIK BLMA 1840-3G	2019/11	2021/11
12.	Signal and Spectrum Analyzer 10 Hz - 40 GHz ROHDE AND SCHWARZ FSV40	2021/10	2023/10

Testing verdicts

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

Summary

1. WLAN 2.4 GHz: 802.11 bgn20 1x1.

FCC PART 15 PARAGRAPH / RSS-247			
Requirement – Test case		**Verdict**	**Remark**
15.35 (c) / RSS-Gen 8.2.	Transmitter Duty Cycle	P	
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	
Supplementary information and remarks: None.			

Appendix A: Test results. 802.11 bgn20 1x1

INDEX

TEST CONDITIONS....11
Occupied Bandwidth....14
FCC 15.247 (a) (2) / RSS-247 5.2 (a) 6 dB Bandwidth....20
FCC 15.35 (c) / RSS-Gen 8.2. Transmitter Duty Cycle....26
FCC 15.247 (b) / RSS-247 5.4 (d) Maximum output power and antenna gain....29
FCC 15.247 (d) / RSS-247 5.5. Band-edge emissions compliance (Transmitter)....35
FCC 15.247 (e) / RSS-247 5.2. (b) Power spectral density....39
FCC 15.247 (d) / RSS-247 5.5. Emission limitations radiated (Transmitter)....46

TEST CONDITIONS

(*): Data provided by the Applicant.

POWER SUPPLY (*):

V nonimal:	4.5 Vdc.
Type of Power Supply:	External power supply.

ANTENNA (*):

Type of Antenna:	Ceramic Chip Antenna
Maximum Declared Antenna Gain:	1.5dBi

TEST FREQUENCIES (*):

802.11 bgn20 1x1:

Low Channel:	2412 MHz
Middle Channel:	2437 MHz
High Channel:	2462 MHz

RF OUTPUT POWER ADJUSTMENTS (*****):

Attenuation power setting: 7.5

WORST-CASES: The following modes and data rates were selected based on preliminary testing that identified those corresponding to the worst-cases:

- 802.11 b: 1 Mbit/s / SISO on Indoor Antenna.
- 802.11 g: 6 Mbit/s / SISO on Indoor Antenna.
- 802.11 n HT20: MCS0 / SISO on Indoor Antenna.

The test set-up was made in accordance to the general provisions of 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.

The EUT was tested in the following operating mode(s):

- Non-TxBF modes: 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 for the channel under test.
During transmitter test the EUT was being controlled by the SW tool to operate in a continuous transmit mode on the test channel as required and in each of the different modulation modes.

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

The conducted test sample has only one antenna connector. The client provided the antenna gains for both antennas (including the losses of lines and switches). The client considered the transmission lines and rf switches as part of the indoor and outdoor antenna.

The client supplied U.FL RF cables with the EUT in order to perform conducted measurements. The measured additional path loss was included in any path loss calculations.

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 range 1GHz to 17GHz (1 GHz-18 GHz Double ridge horn antenna) are situated at a distance of 3 m and at a distance of 1m for the frequency range 17 GHz-26 GHz (18 GHz-40 GHz horn antenna).

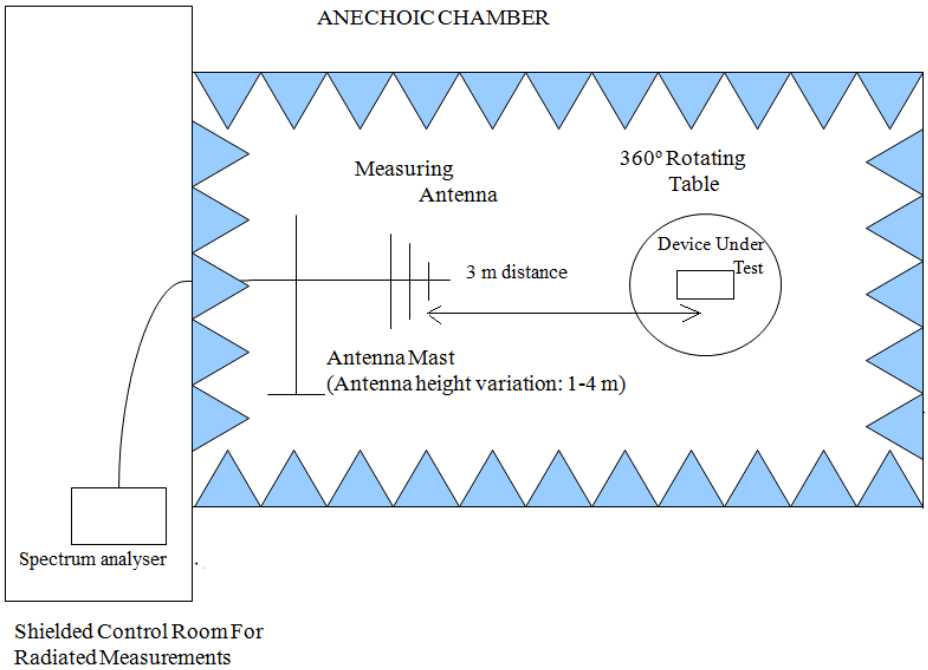
For radiated emissions in the range 1 GHz-26 GHz that is performed at a distance closer than the specified distance. an inverse proportionality factor of 20 dB per decade is used to normalize the measured data for determining compliance.

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 360º and the antenna height (Bilog antenna and Double ridge horn antenna) was varied from 1 to 4 meters to find the maximum radiated emission.

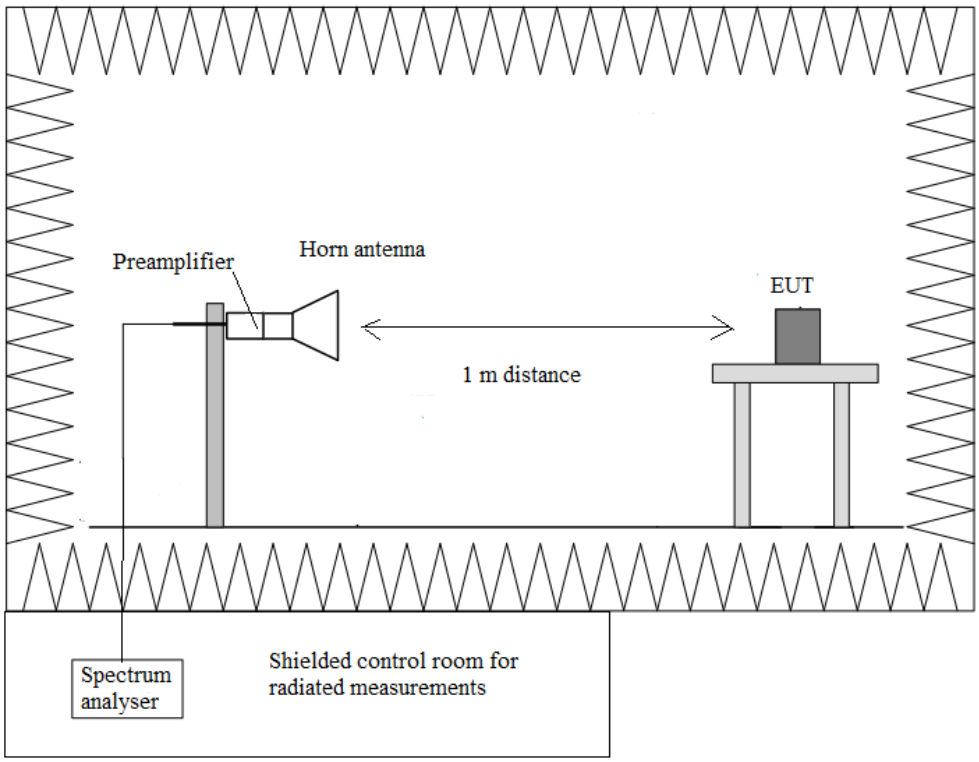
A resolution bandwidth/video bandwidth of 100 kHz/300 kHz was used for frequencies below 1 GHz and 1MHz/3MHz for frequencies above 1 GHz.

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

Radiated measurements setup from 30 MHz to 1 GHz:



Radiated measurements setup f > 1 GHz:



Occupied Bandwidth

RESULTS:

- **802.11 b:**

	Low Channel 2412 MHz	Middle Channel 2437 MHz	High Channel 2462 MHz
99% bandwidth (MHz)	10.50	10.50	10.50
Measurement uncertainty (%)	<± 1.40		

- **802.11 g:**

	Low Channel 2412 MHz	Middle Channel 2437 MHz	High Channel 2462 MHz
99% bandwidth (MHz)	16.40	16.50	16.50
Measurement uncertainty (%)	<± 1.40		

- **802.11 n20:**

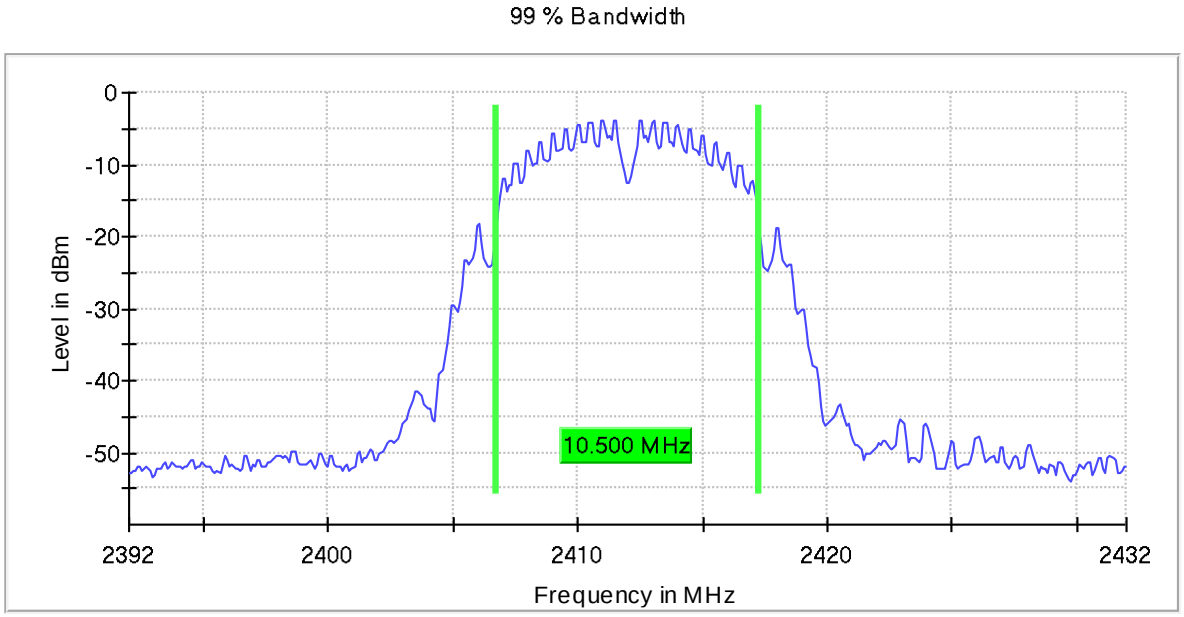
	Low Channel 2412 MHz	Middle Channel 2437 MHz	High Channel 2462 MHz
99% bandwidth (MHz)	17.50	17.50	17.50
Measurement uncertainty (%)	<± 1.40		

Spectrum analyzer settings:

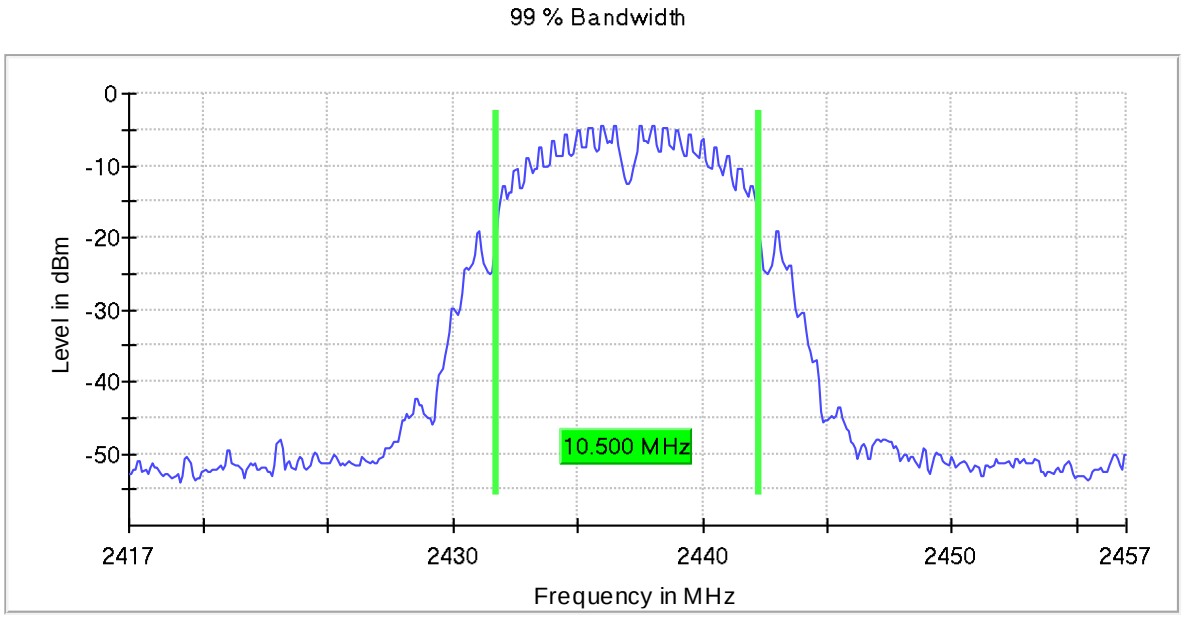
Setting	802.11 b	802.11 g	802.11 n20
Span	**40.000 MHz**	**40.000 MHz**	**40.000 MHz**
RBW	**200.000 kHz**	**200.000 kHz**	**200.000 kHz**
VBW	**1.000 MHz**	**1.000 MHz**	**1.000 MHz**
SweepPoints	**400**	**400**	**400**
Sweeptime	**28.477 µs**	**28.477 µs**	**28.477 µs**
Reference Level	**0.000 dBm**	**0.000 dBm**	**0.000 dBm**
Detector	**MaxPeak**	**MaxPeak**	**MaxPeak**
Trace Mode	**Max Hold**	**Max Hold**	**Max Hold**

- **802.11 b – Occupied Bandwidth**

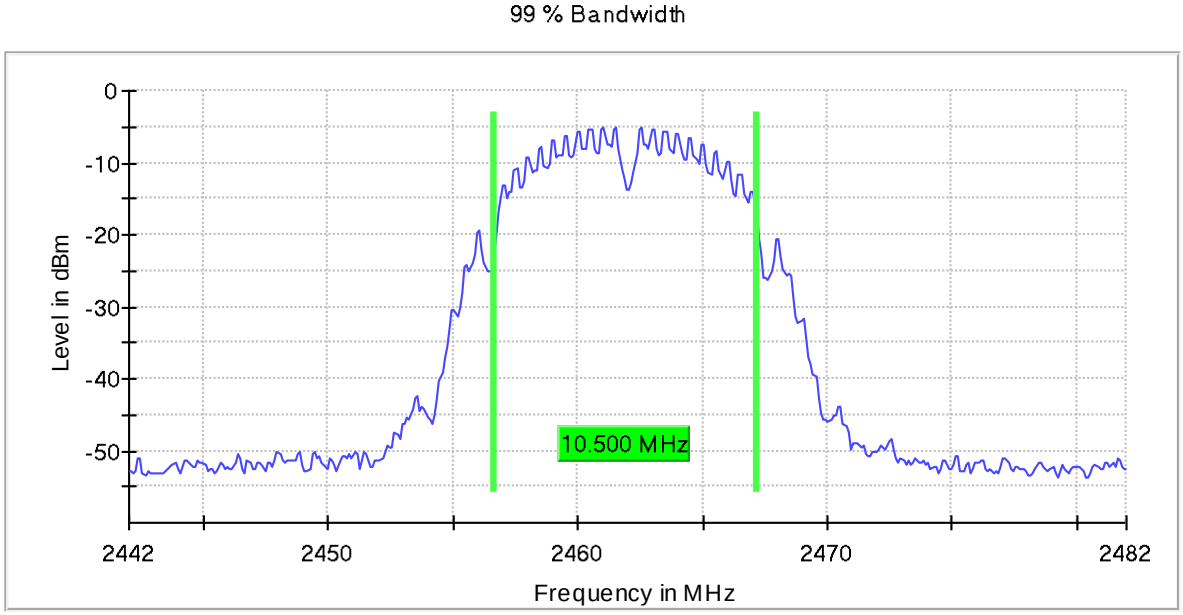
- Low Channel:



- Middle Channel:

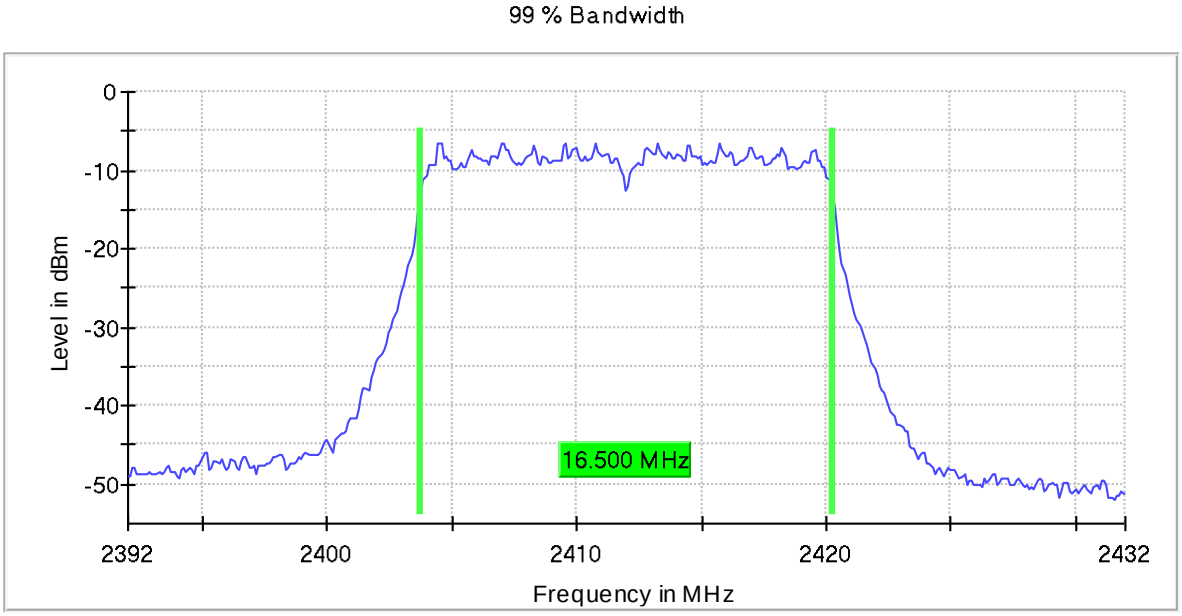


- High Channel:

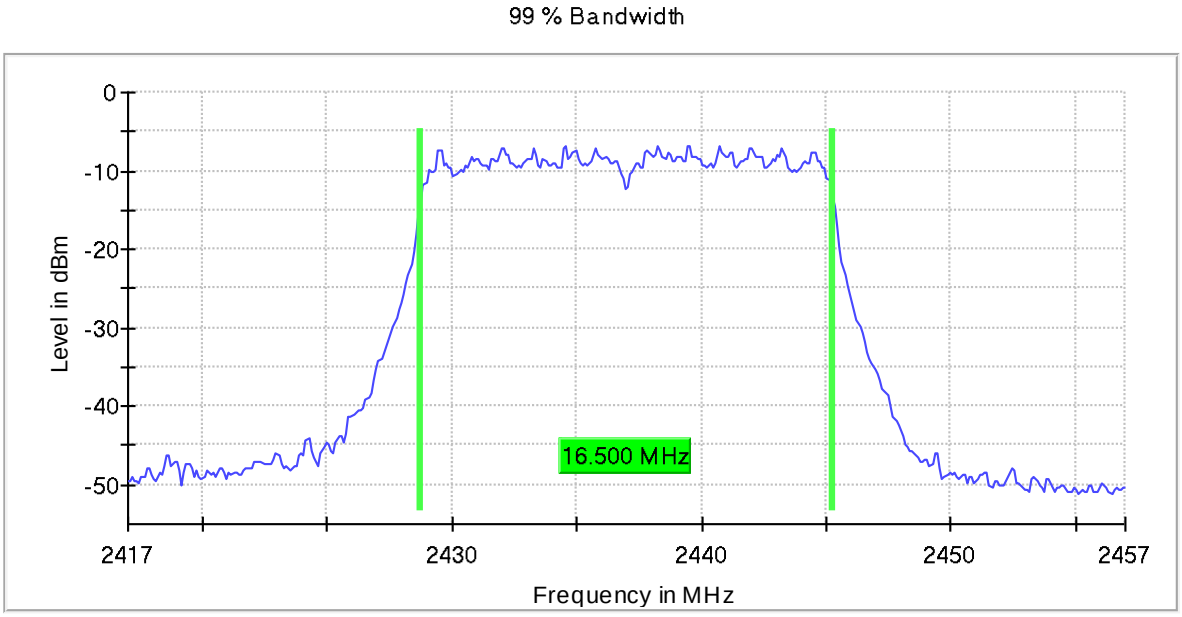


- **802.11 g – Occupied Bandwidth**

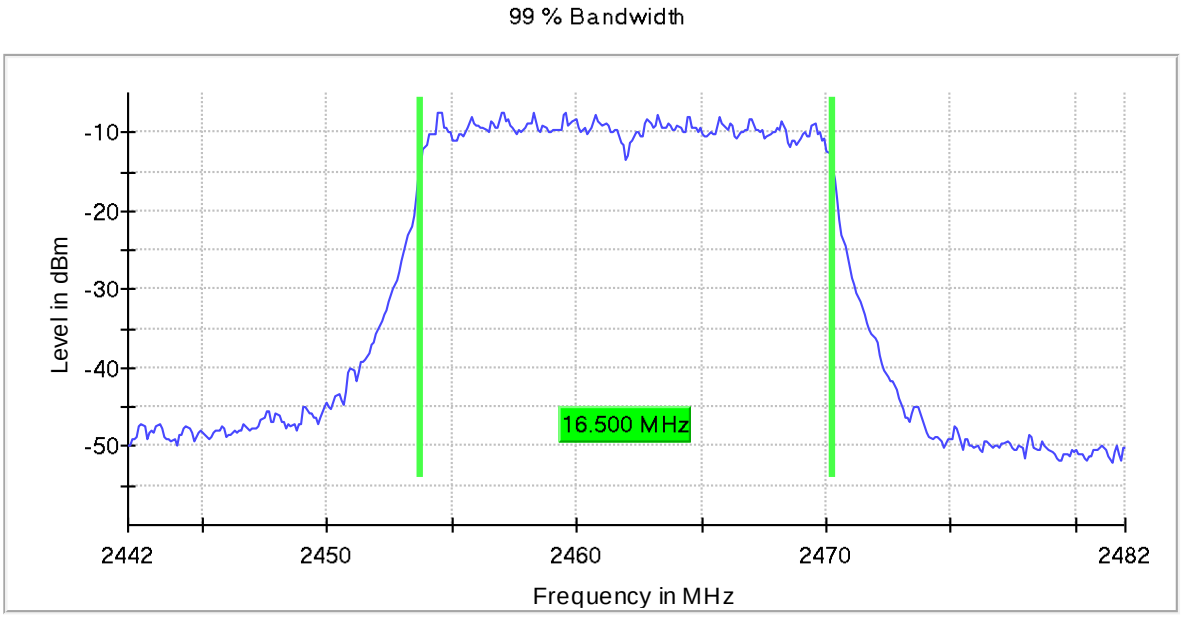
- Low Channel:



- Middle Channel:

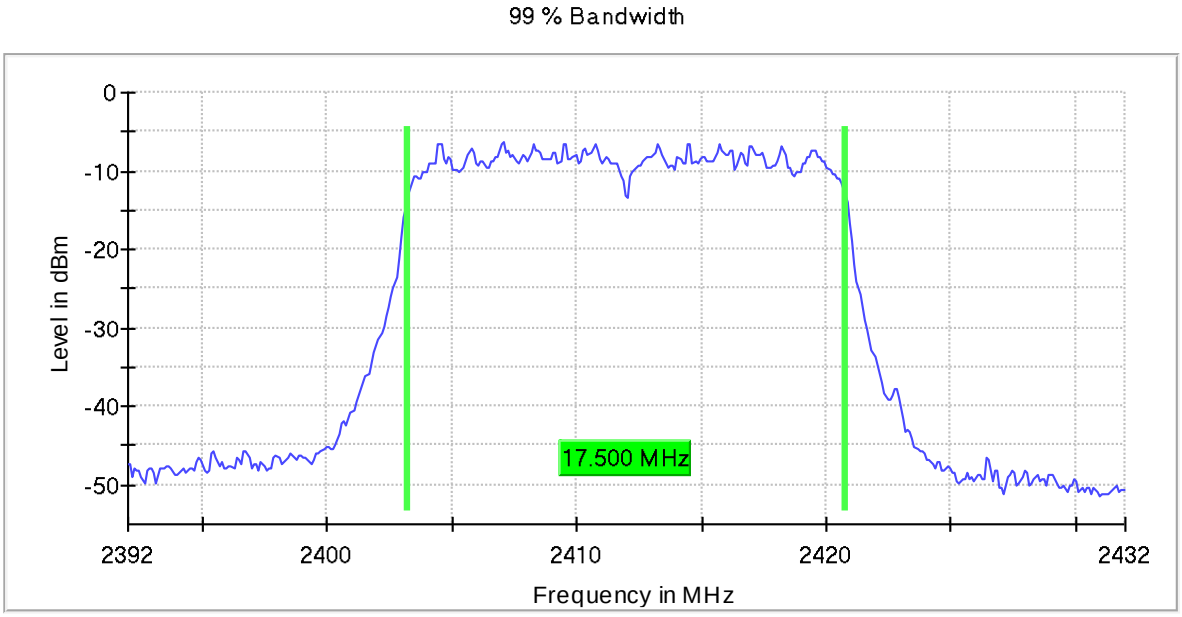


- High Channel:

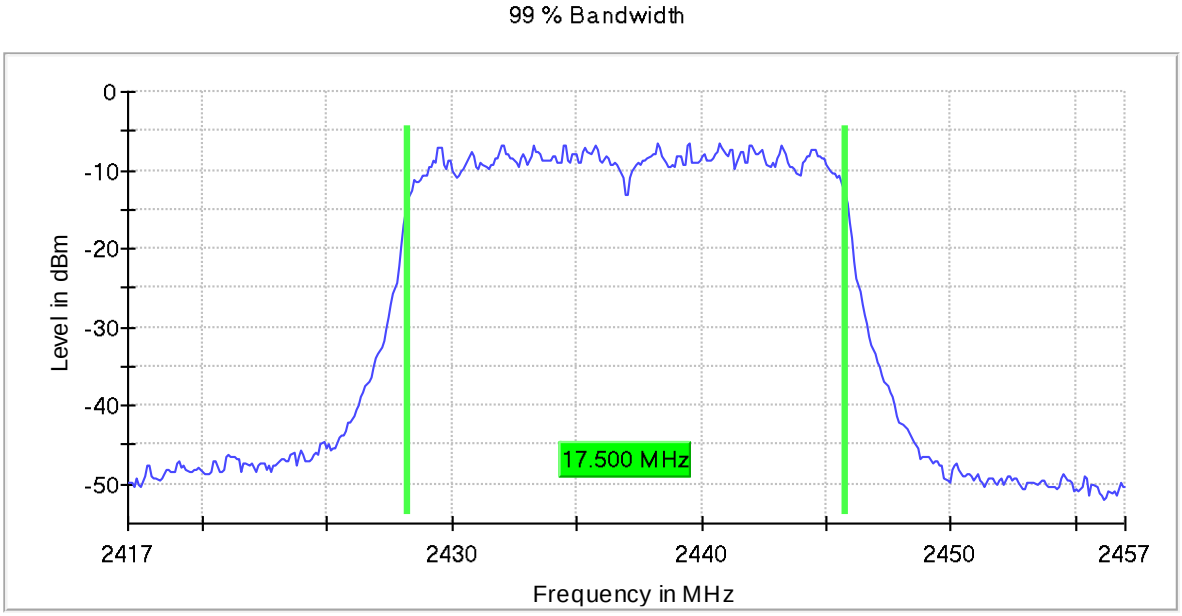


- **802.11 n20 – Occupied Bandwidth**

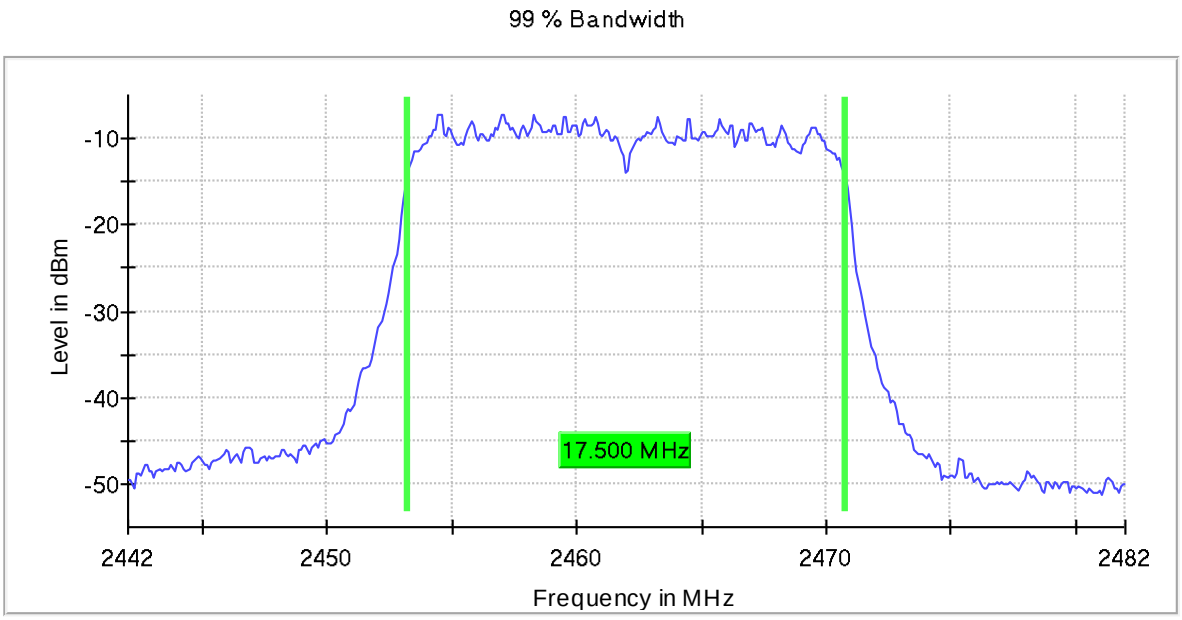
- Low Channel:



- 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:

- **802.11 b:**

	Low Channel 2412 MHz	Middle Channel 2437 MHz	High Channel 2462 MHz
6 dB Spectrum Bandwidth (MHz)	8.60	8.15	8.65
Measurement uncertainty (%)	<± 1.40		

- **802.11 g:**

	Low Channel 2412 MHz	Middle Channel 2437 MHz	High Channel 2462 MHz
6 dB Spectrum Bandwidth (MHz)	16.40	16.40	16.15
Measurement uncertainty (%)	<± 1.40		

- **802.11 n20:**

	Low Channel 2412 MHz	Middle Channel 2437 MHz	High Channel 2462 MHz
6 dB Spectrum Bandwidth (MHz)	16.65	16.70	16.40
Measurement uncertainty (%)	<± 1.40		

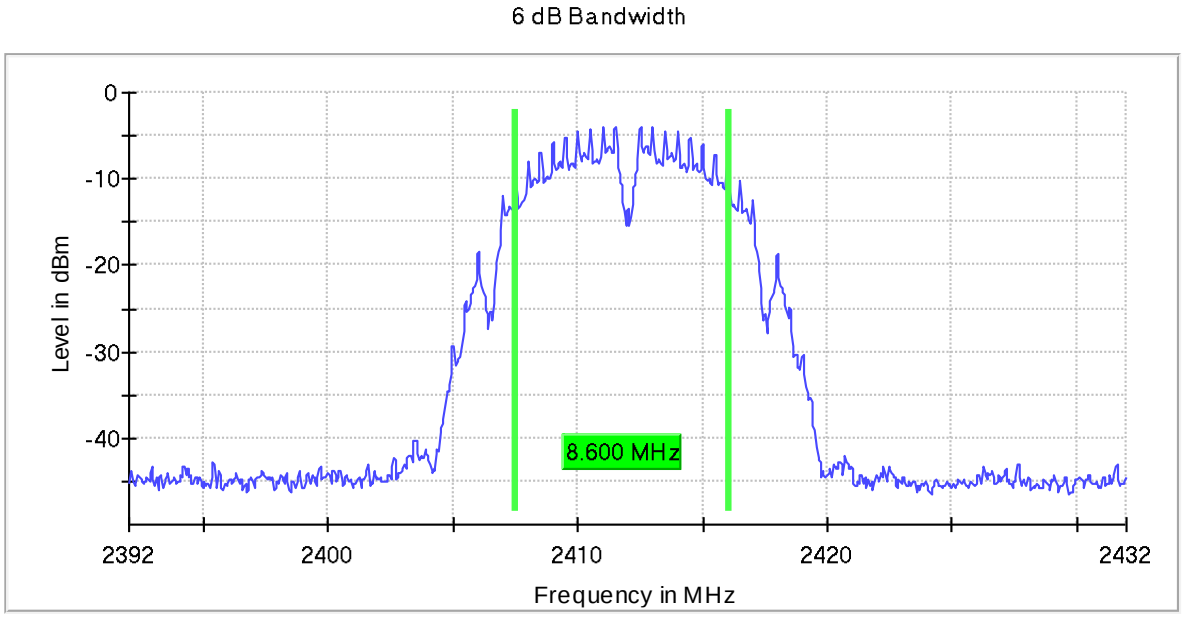
Verdict: PASS

Spectrum analyzer settings:

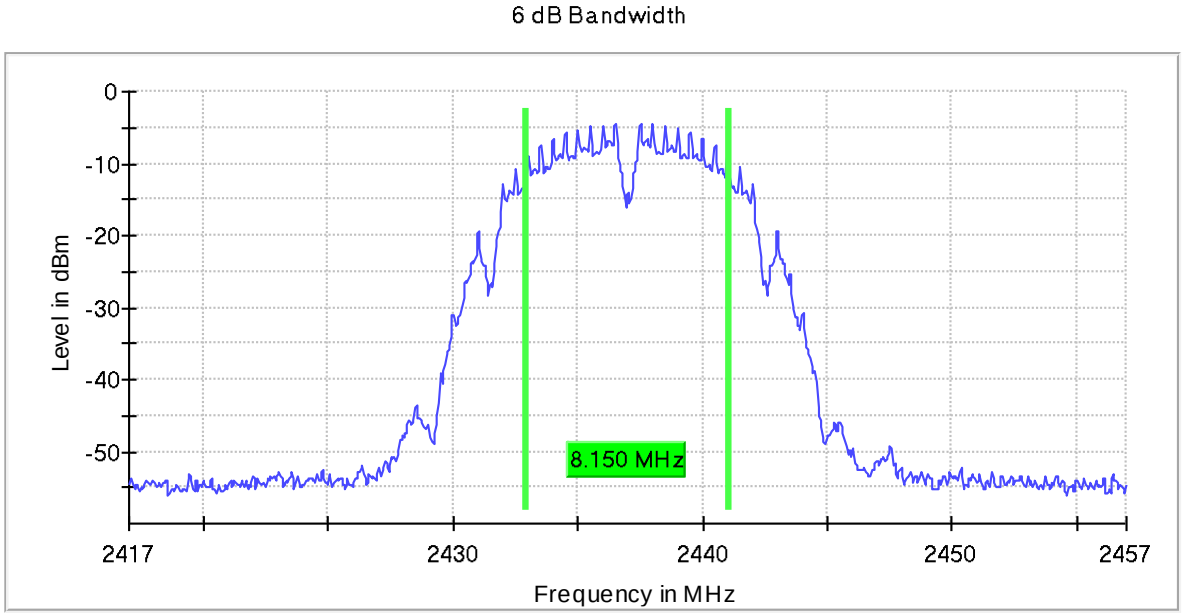
Setting	802.11 b	802.11 g	802.11 n20
Span	**40.000 MHz**	**40.000 MHz**	**40.000 MHz**
RBW	**100.000 kHz**	**100.000 kHz**	**100.000 kHz**
VBW	**300.000 kHz**	**300.000 kHz**	**300.000 kHz**
SweepPoints	**800**	**800**	**800**
Sweeptime	**56.836 µs**	**56.836 µs**	**56.836 µs**
Reference Level	**10.000 dBm**	**10.000 dBm**	**10.000 dBm**
Detector	**MaxPeak**	**MaxPeak**	**MaxPeak**
Trace Mode	**Max Hold**	**Max Hold**	**Max Hold**

- **802.11 b – 6 dB Bandwidth**

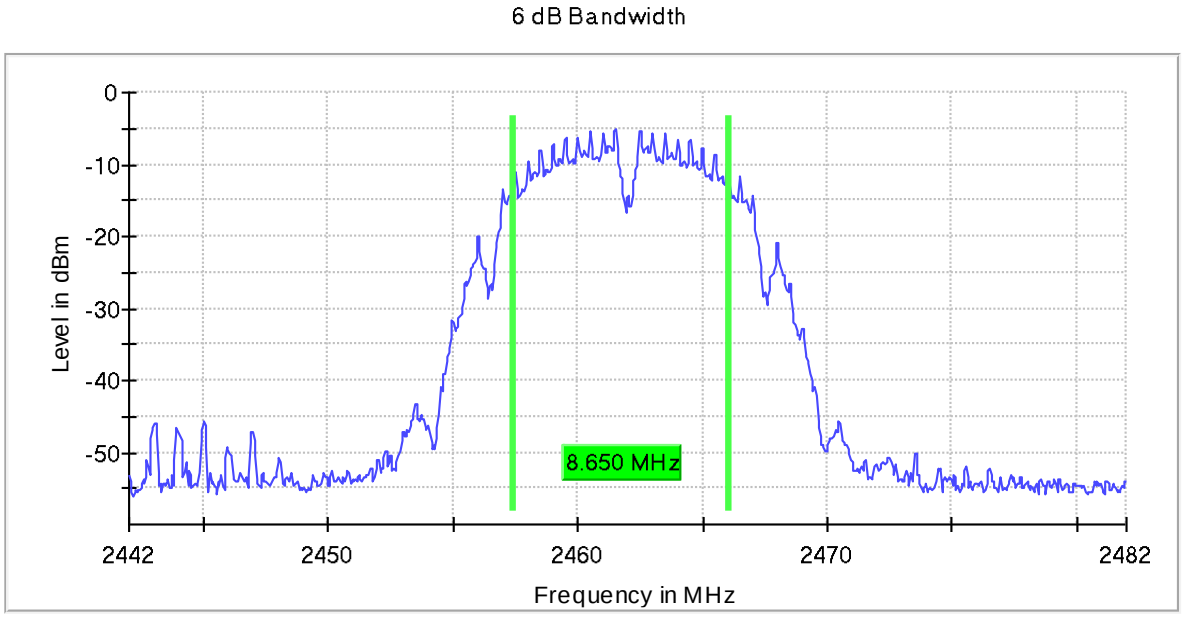
- Low Channel:



- Middle Channel:

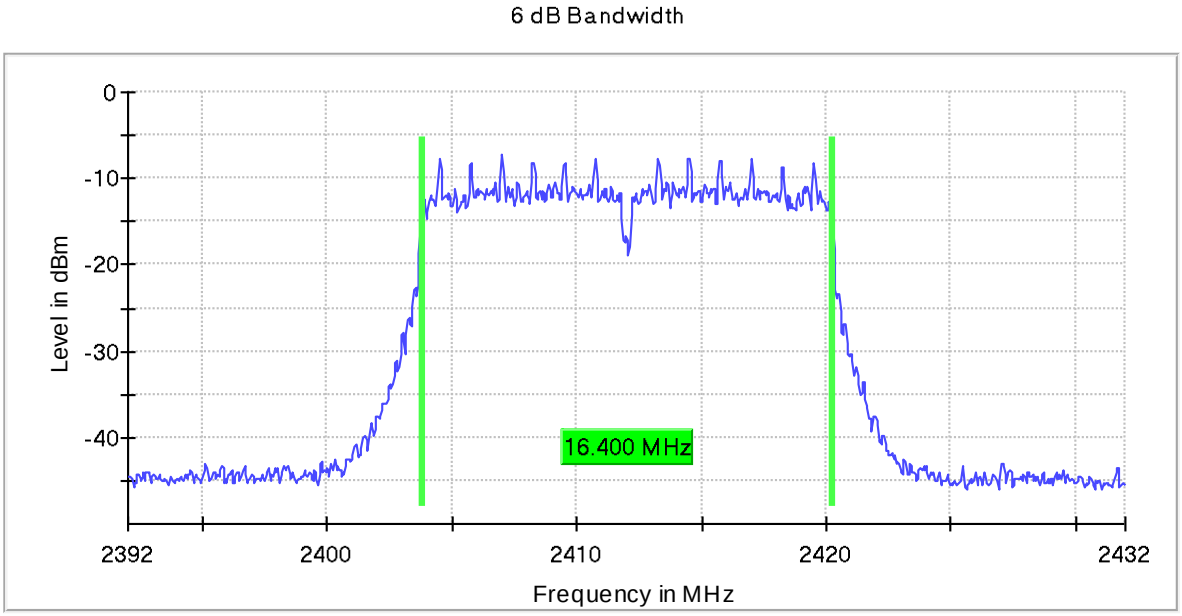


- High Channel:

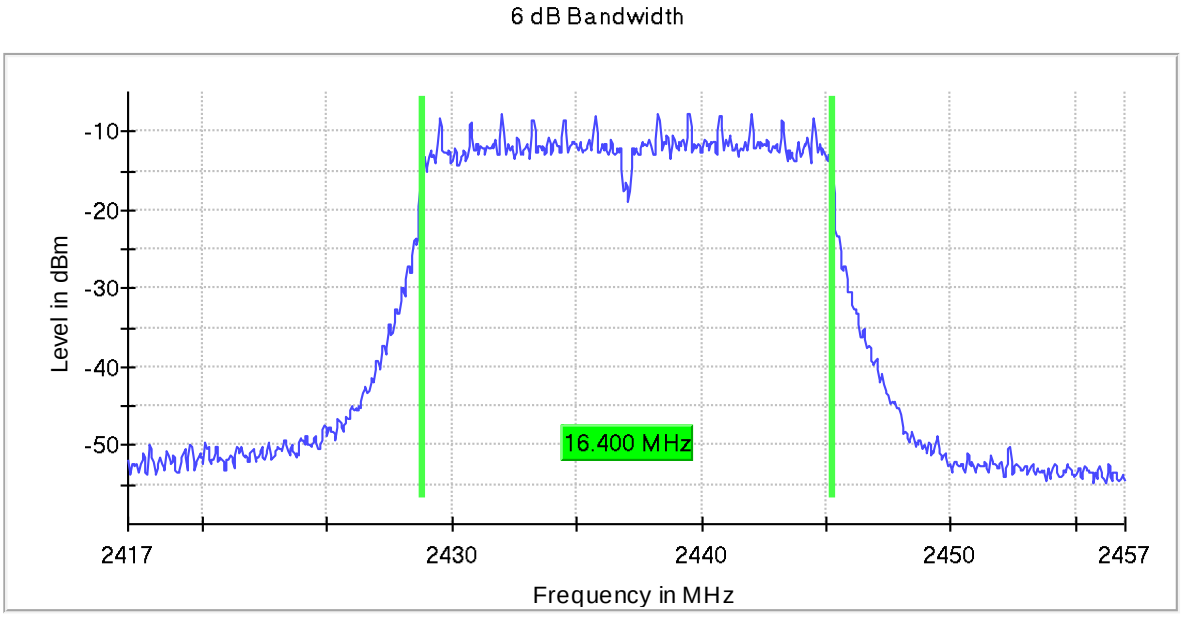


- **802.11 g – 6 dB Bandwidth**

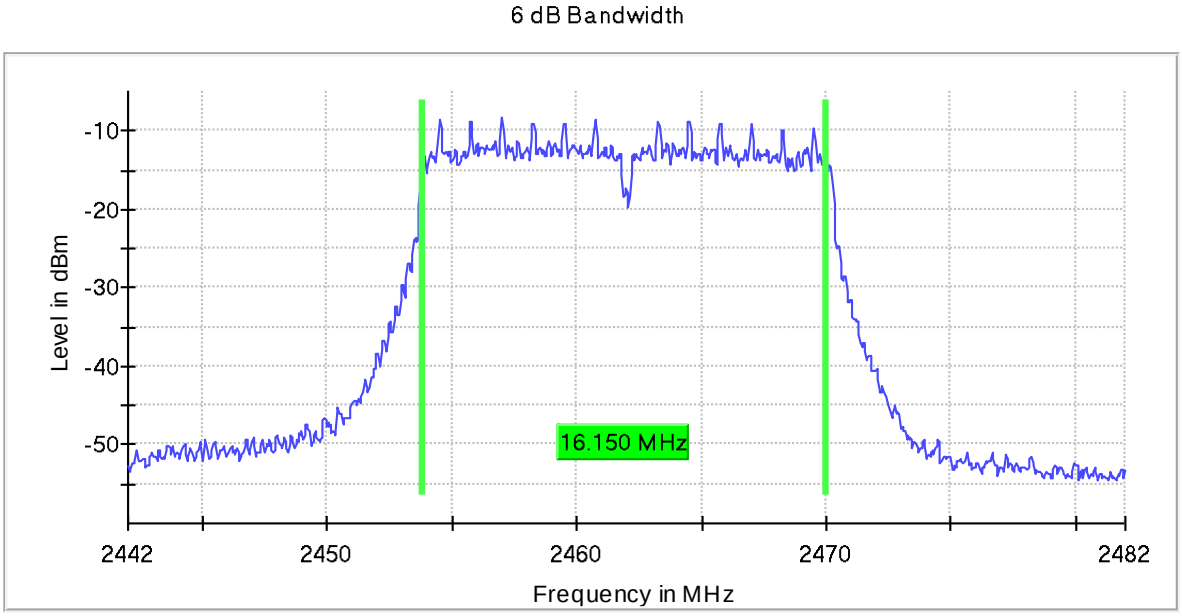
- Low Channel:



- Middle Channel:

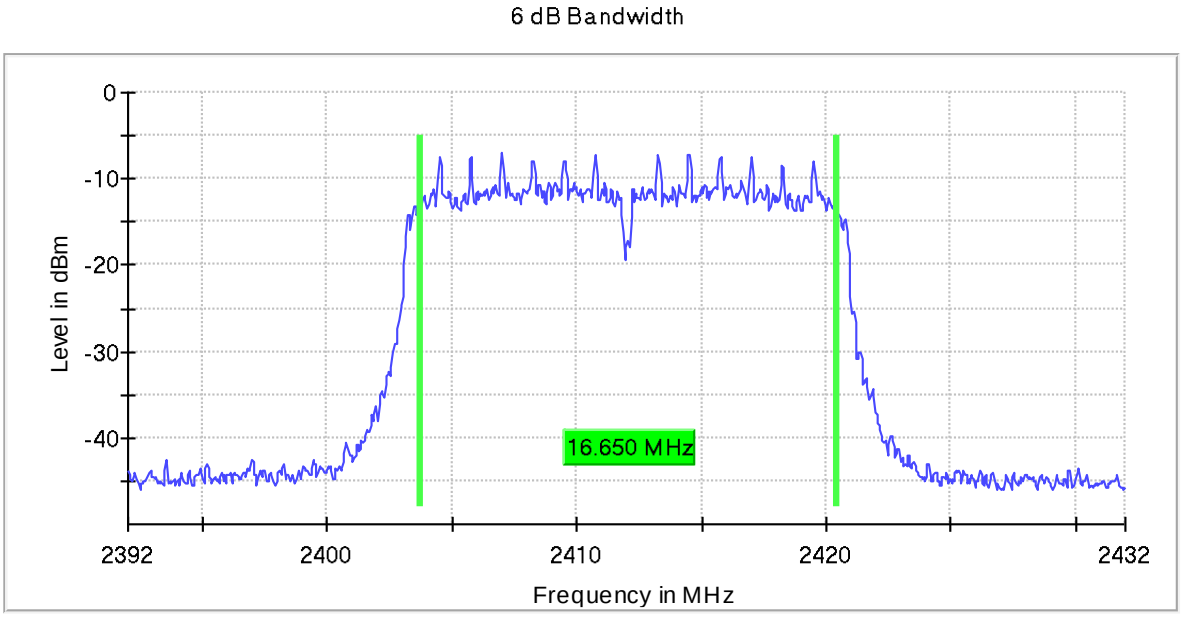


- High Channel:

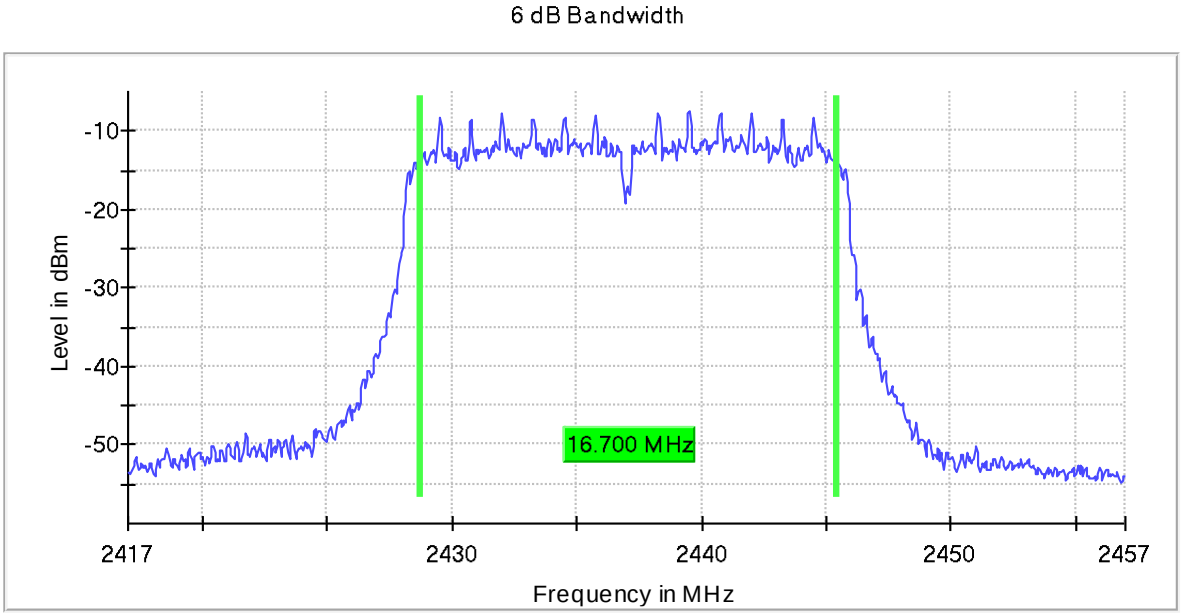


- **802.11 n20 – 6 dB Bandwidth**

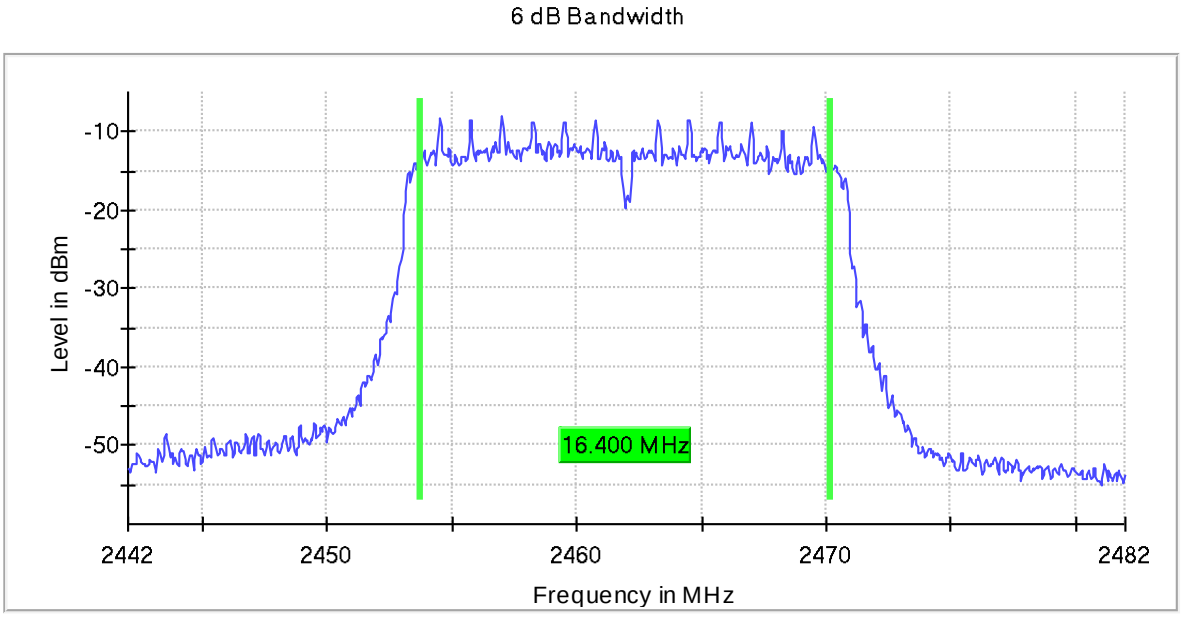
- Low Channel:



- Middle Channel:



- High Channel:



FCC 15.35 (c) / RSS-Gen 8.2. Transmitter Duty Cycle

SPECIFICATION:

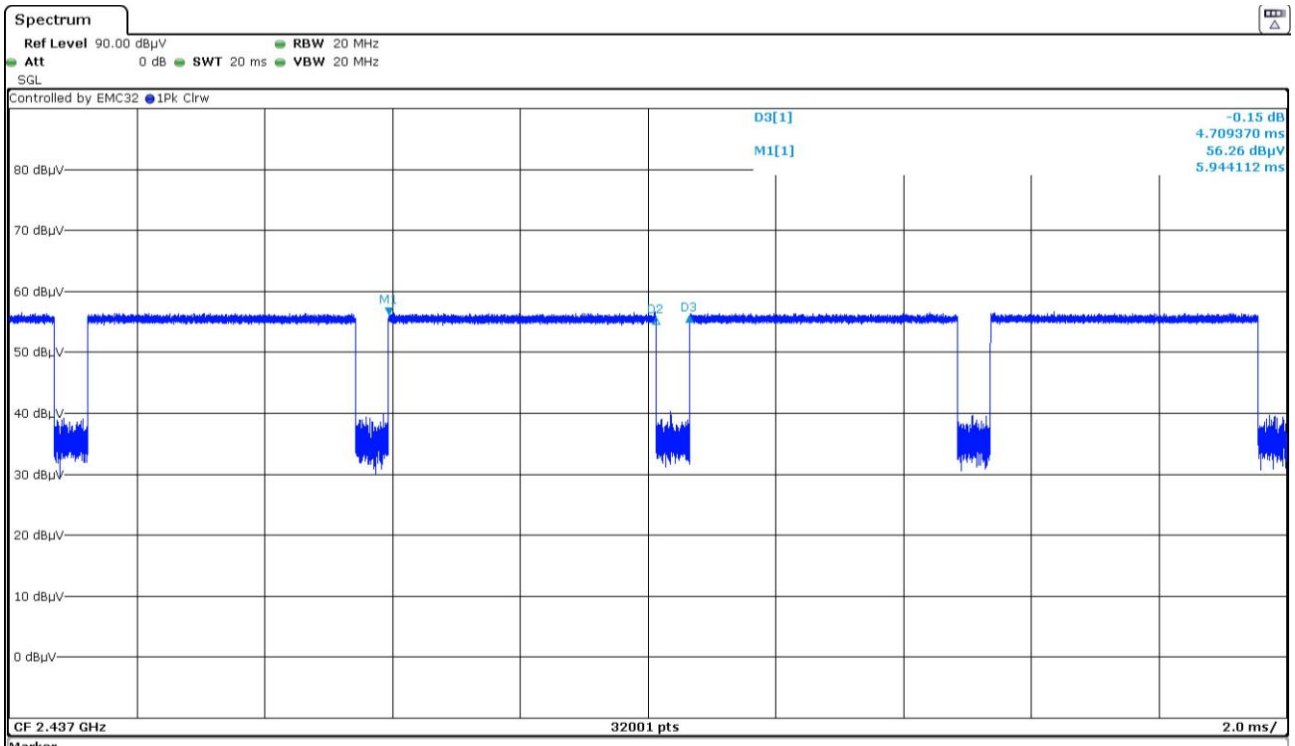
When the radiated emission limits are expressed in terms of the average value of the emission, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 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	4.1815	4.7093	0.52
SISO	802.11 g	0.6494	0.7709	0.74
SISO	802.11 n20	0.6201	0.7348	0.74

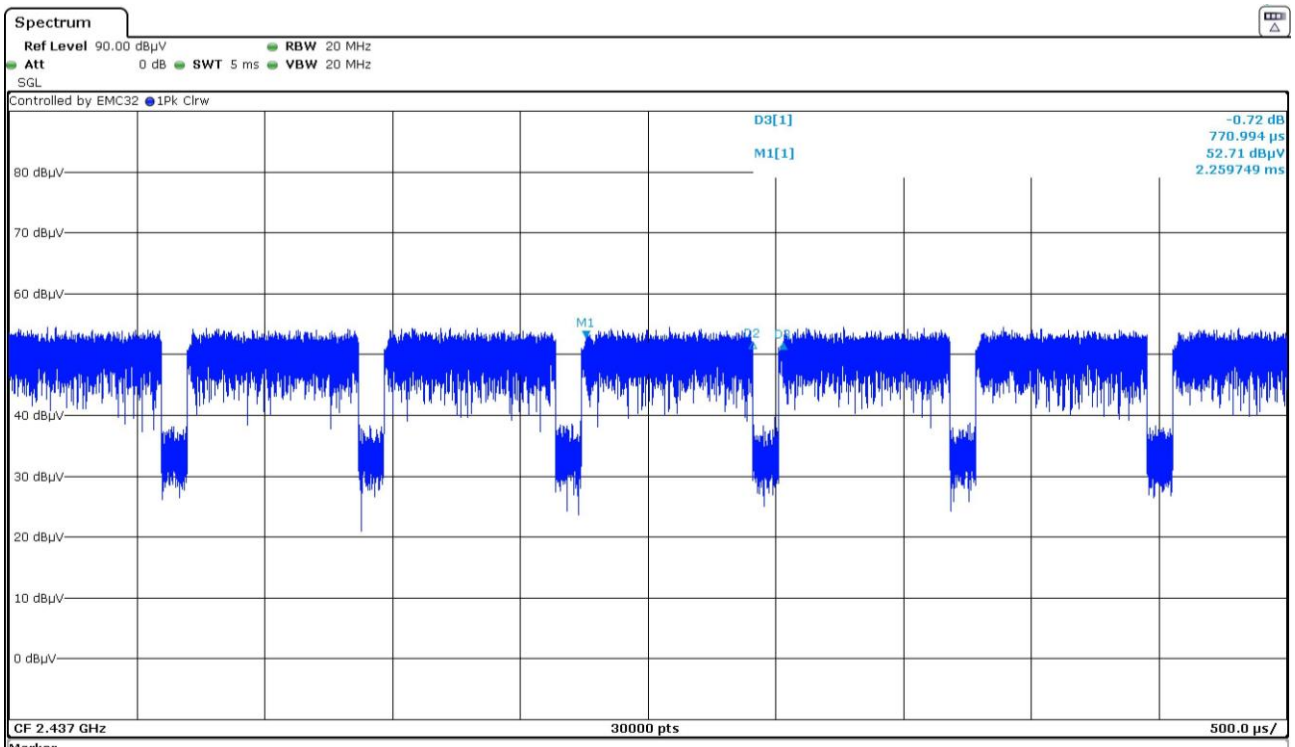
802.11 b:



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	5.944112 ms	56.26 dBµV		
D2	M1	1	4.181513 ms	-0.60 dB		
D3	M1	1	4.70937 ms	-0.15 dB		

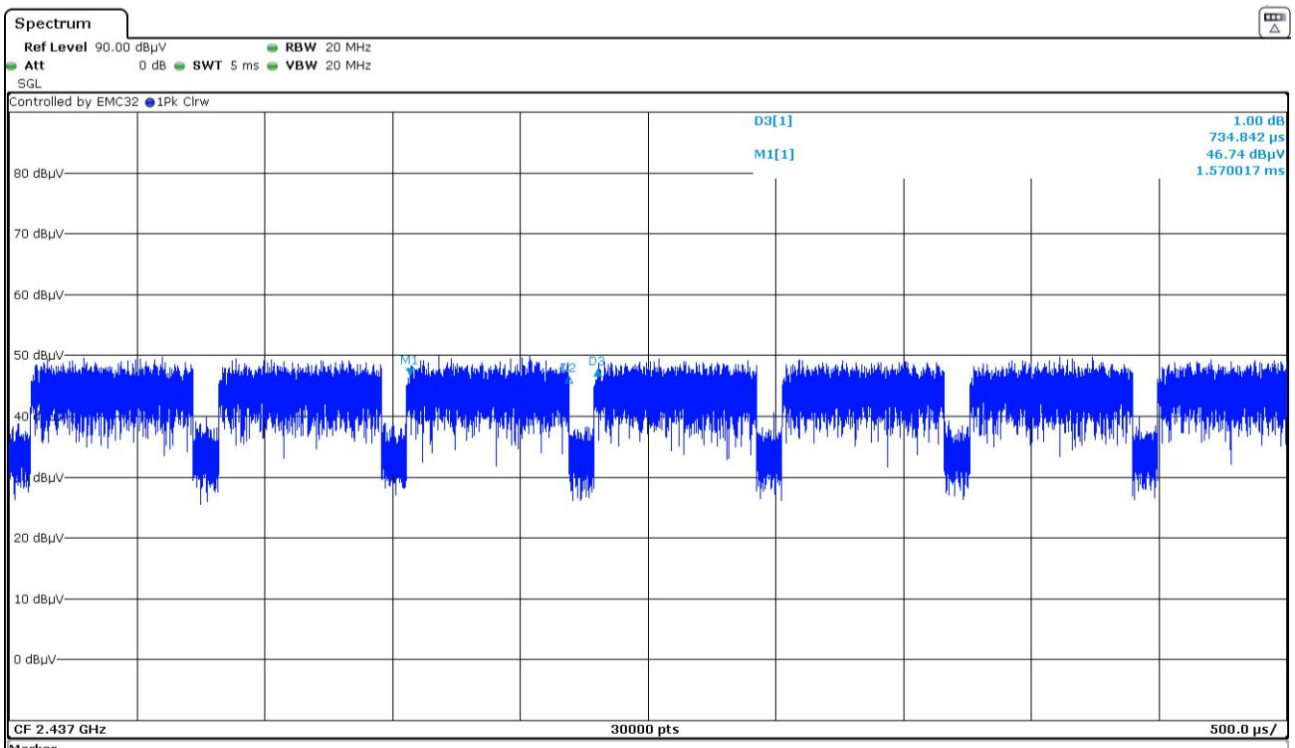
802.11 g:



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.259749 ms	52.71 dBµV		
D2	M1	1	649.446 µs	-0.61 dB		
D3	M1	1	770.994 µs	-0.72 dB		

802.11 n20:



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	1.570017 ms	46.74 dBµV		
D2	M1	1	620.148 µs	-0.10 dB		
D3	M1	1	734.842 µs	1.00 dB		

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 Assembly Antenna Gain: +1.5 dBi.

For modes b, g, n20, the maximum conducted output power was measured using the method according to point 11.9.2.3.2 “Method AVGPM-G” of ANSI C.63.10-2013.

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

- **802.11 b:**

Channels	Low Channel 2412 MHz	Middle Channel 2437 MHz	High Channel 2462 MHz
Maximum Corrected Conducted Power (dBm)	5.46	4.85	4.57
Maximum EIRP Corrected Conducted Power (dBm)	6.96	6.35	6.07
Measurement uncertainty (dB)	<± 0.99		

- **802.11 g:**

Channels	Low Channel 2412 MHz	Middle Channel 2437 MHz	High Channel 2462 MHz
Maximum Corrected Conducted Power (dBm)	5.28	4.59	4.30
Maximum EIRP Corrected Conducted Power (dBm)	6.78	6.09	5.80
Measurement uncertainty (dB)	<± 0.99		

- **802.11 n20:**

Channels	Low Channel 2412 MHz	Middle Channel 2437 MHz	High Channel 2462 MHz
Maximum Corrected Conducted Power (dBm)	5.21	4.53	4.21
Maximum EIRP Corrected Conducted Power (dBm)	6.71	6.03	5.71
Measurement uncertainty (dB)	<± 0.99		

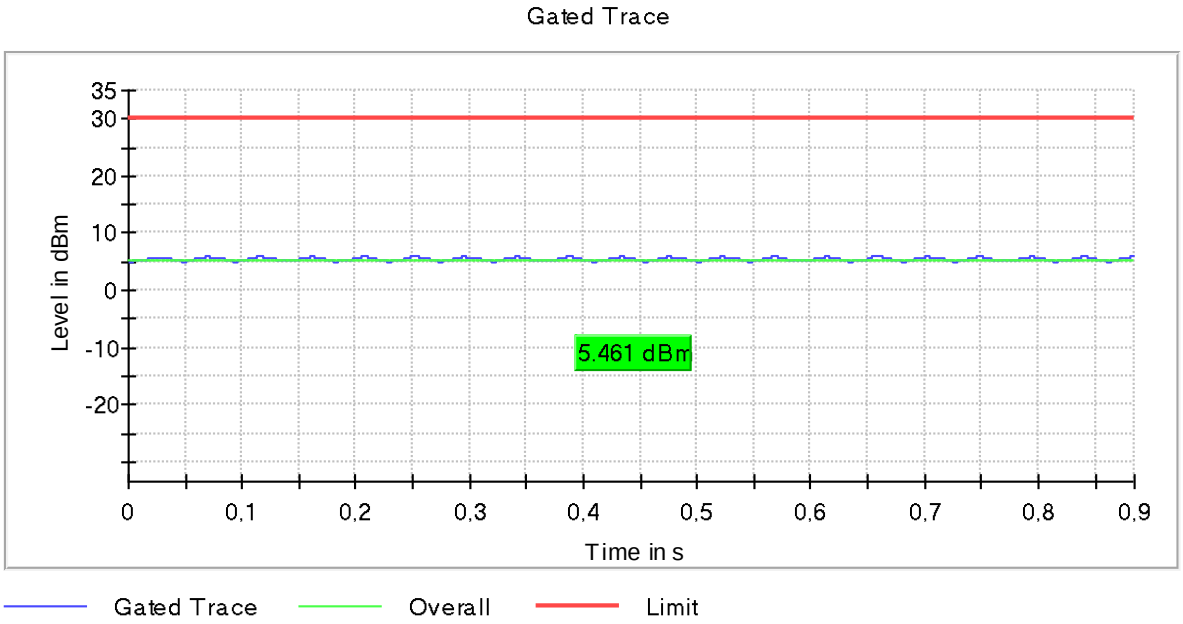
Verdict: PASS

Power meter settings:

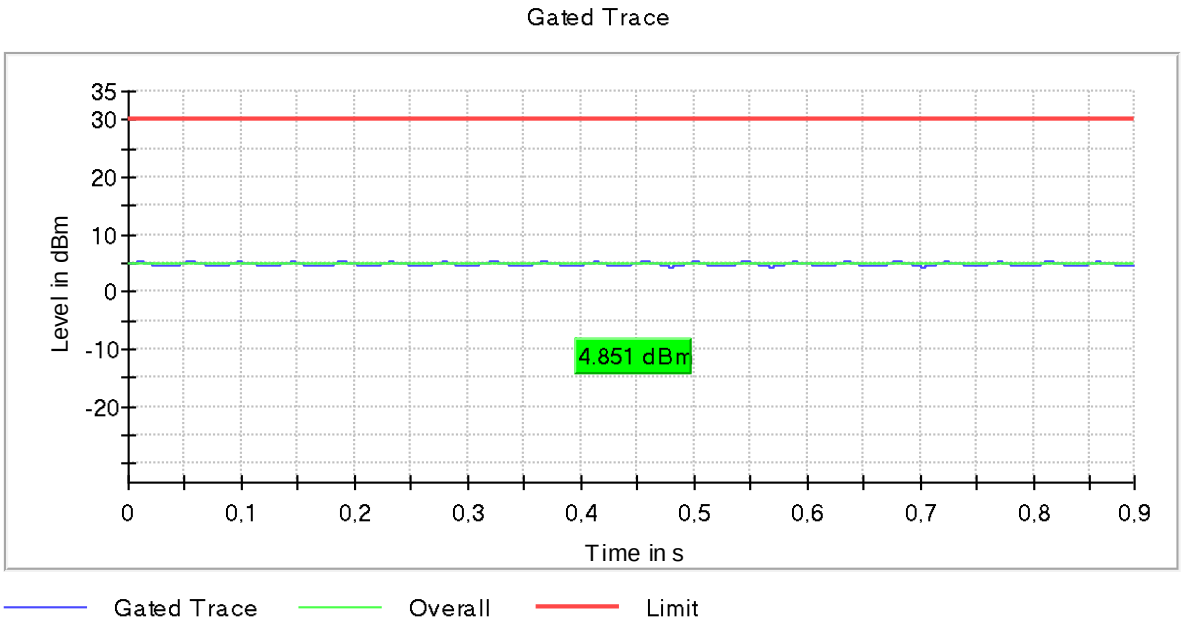
Setting	802.11 b	802.11 g	802.11 n20
Measurement Time	**1.000 s**	**1.000 s**	**1.000 s**
Points	**1000000**	**1000000**	**1000000**
Time resolution	**1.000 µs**	**1.000 µs**	**1.000 µs**

- **802.11 b:**

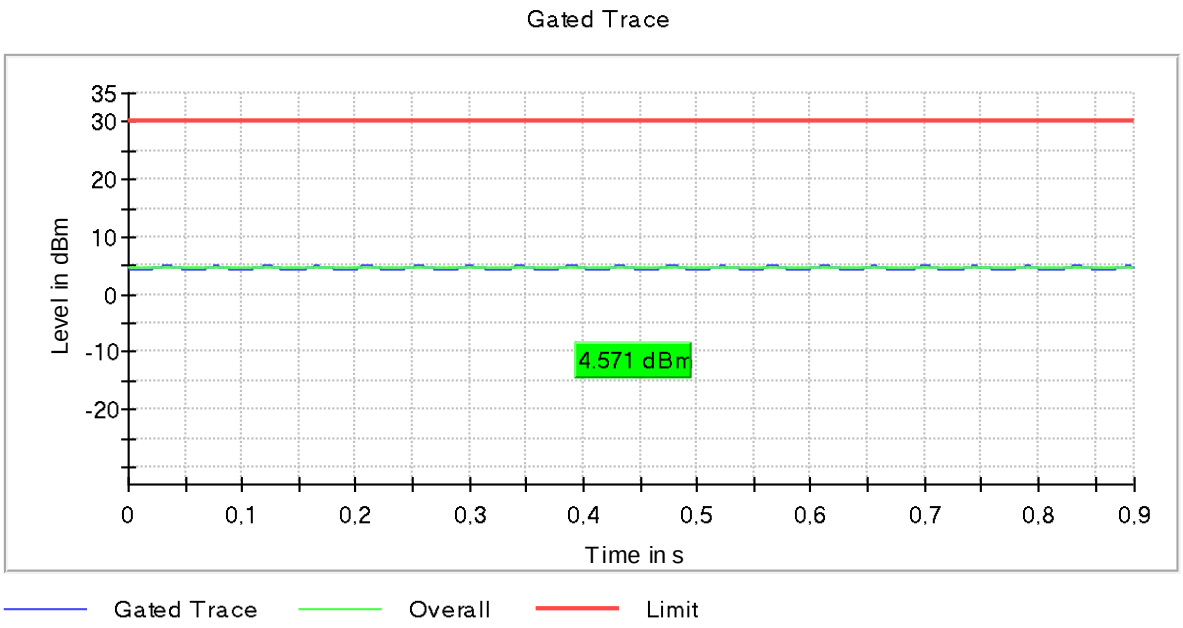
- Low Channel:



- Middle Channel:

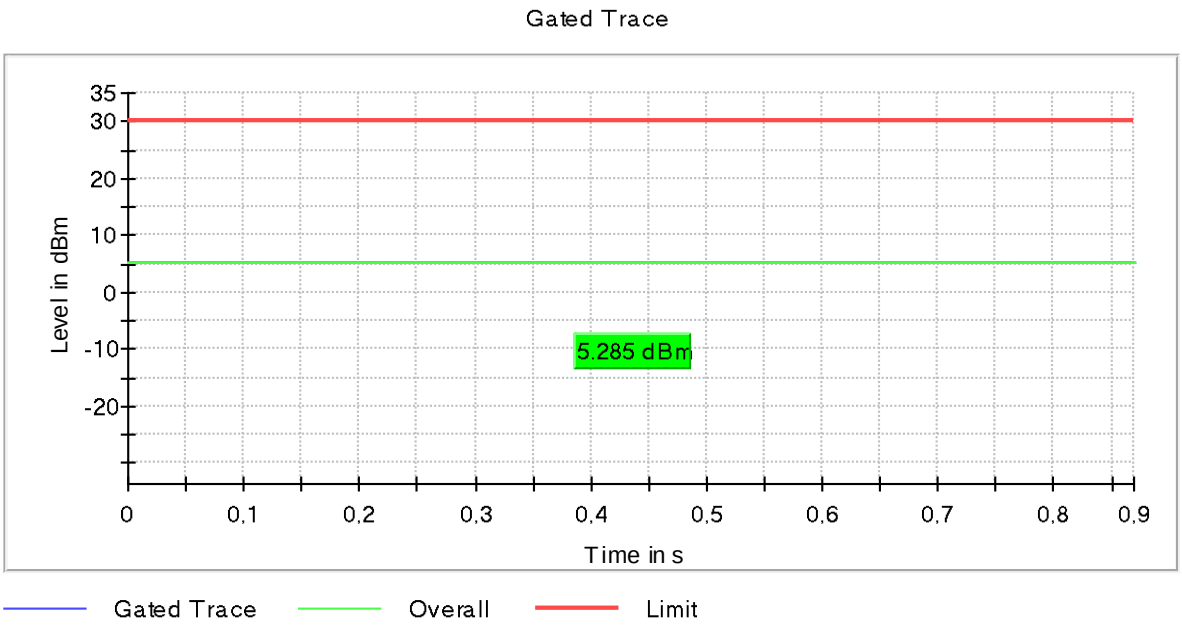


- High Channel:

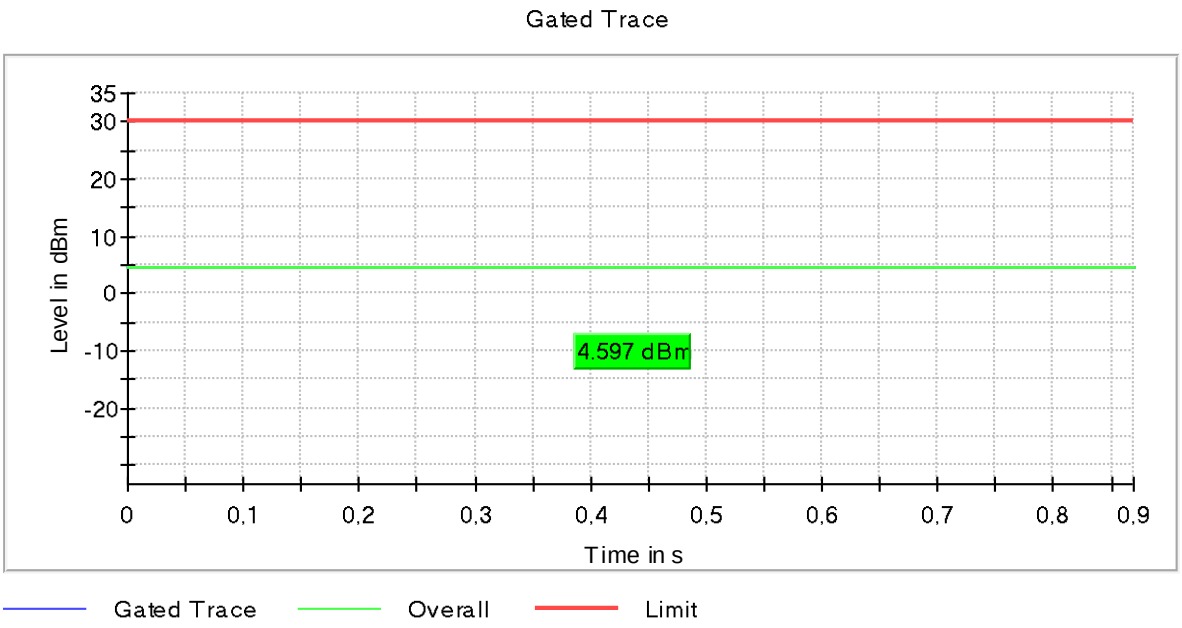


- **802.11 g:**

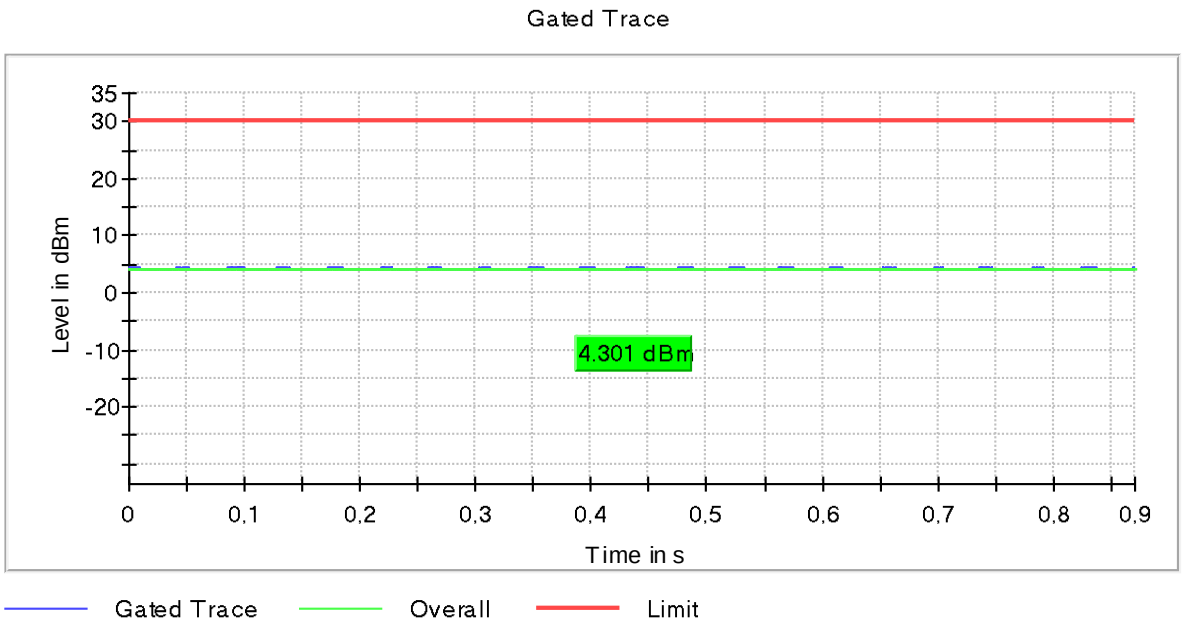
- Low Channel:



- Middle Channel:

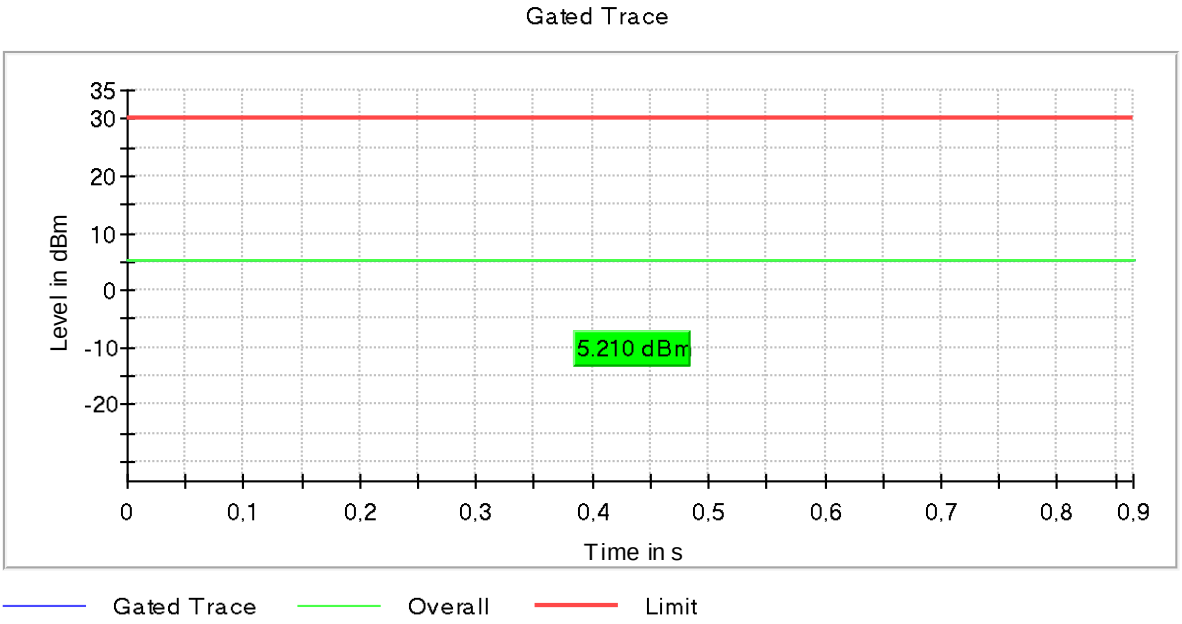


- High Channel:

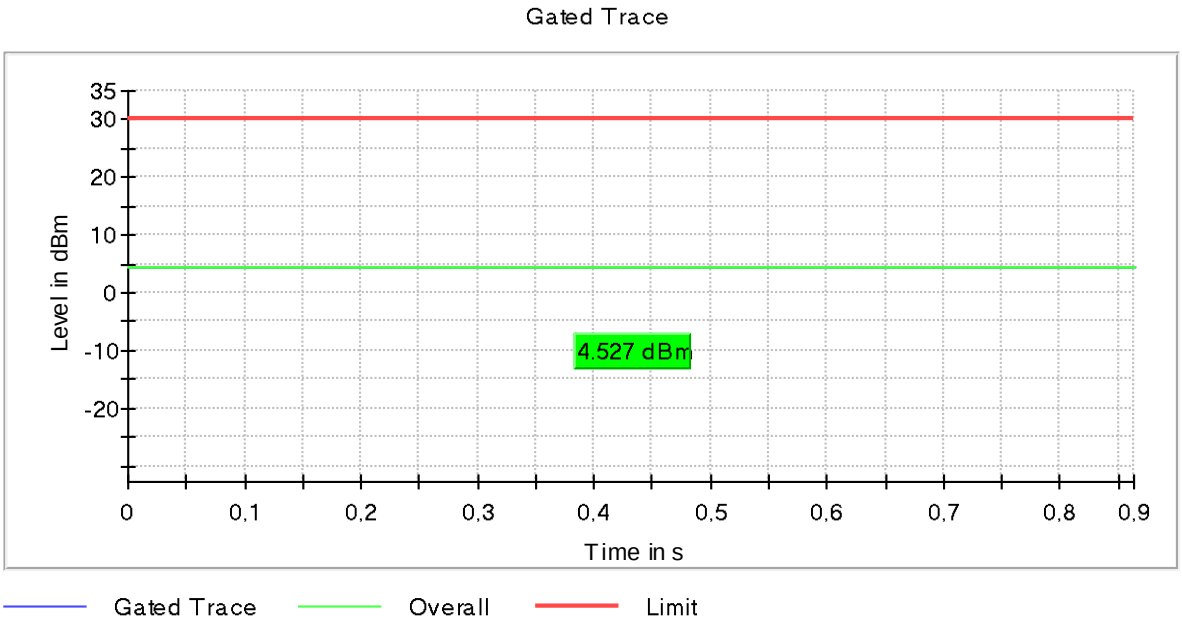


- **802.11 n20:**

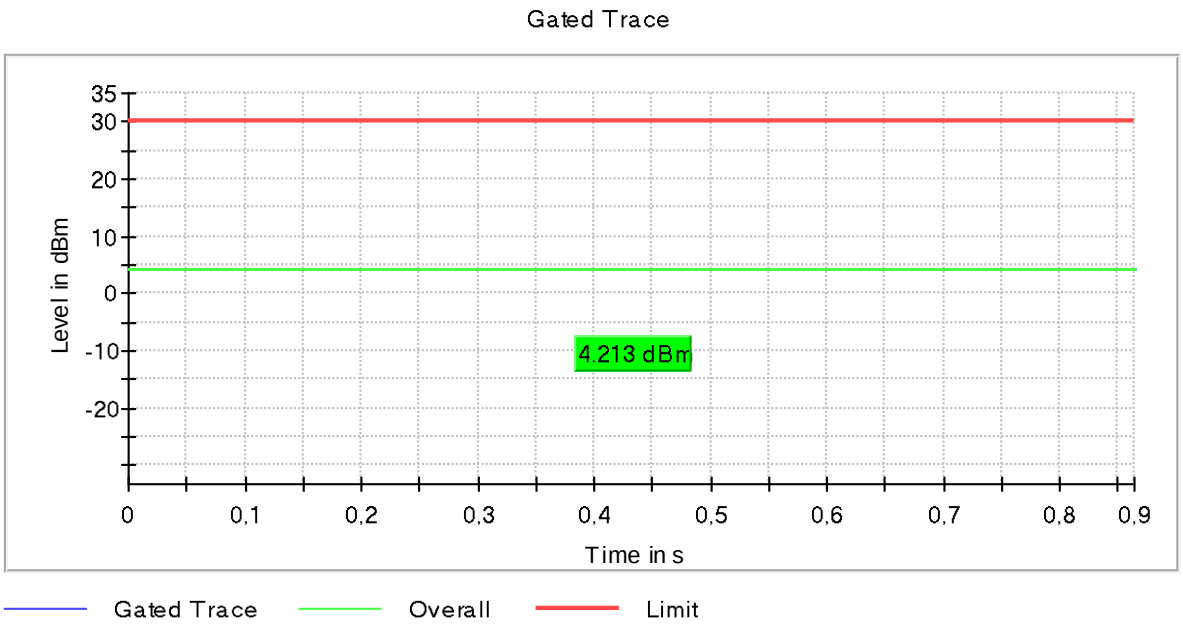
- Low Channel:



- 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.

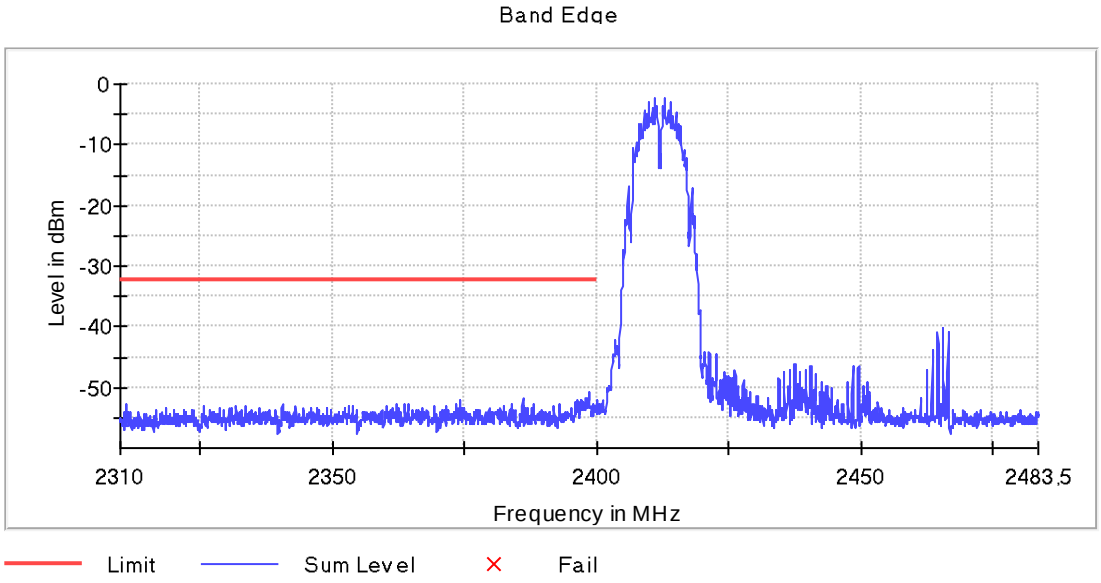
Measurement uncertainty (dB)	<±0.89

Spectrum analyzer settings:

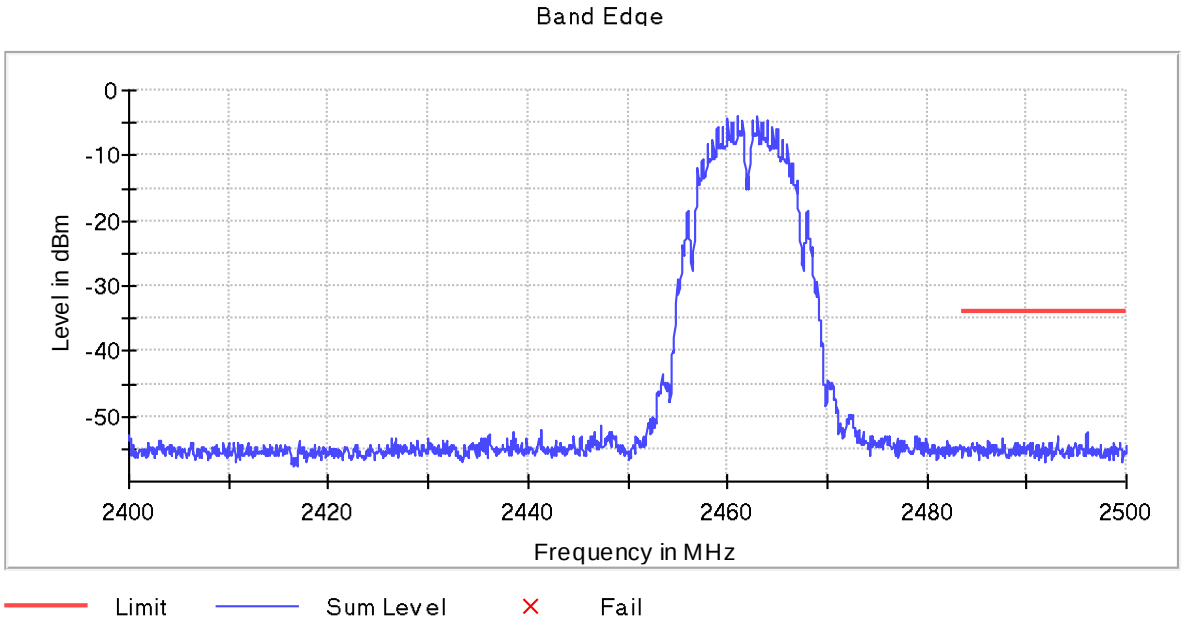
Setting	802.11 b/g/n20 (Low Channel)		802.11 b/g/n20 (High Channel)	
	Measurement 1	Measurement 2	Measurement 1	Measurement 2
Start Frequency	2.31000 GHz	2.40000 GHz	2.40000 GHz	2.48350 GHz
Stop Frequency	2.40000 GHz	2.48350 GHz	2.48350 GHz	2.50000 GHz
Span	90.000 MHz	83.500 MHz	83.500 MHz	16.500 MHz
RBW	100.000 kHz	100.000 kHz	100.000 kHz	100.000 kHz
VBW	300.000 kHz	300.000 kHz	300.000 kHz	300.000 kHz
SweepPoints	1800	1670	1670	330
Sweeptime	113.672 µs	94.727 µs	94.727 µs	18.945 µs
Reference Level	10.000 dBm	10.000 dBm	10.000 dBm	10.000 dBm
Detector	MaxPeak	MaxPeak	MaxPeak	MaxPeak
Trace Mode	Max Hold	Max Hold	Max Hold	Max Hold

- **802.11 b – Band-edge emissions compliance**

  - Low Channel:

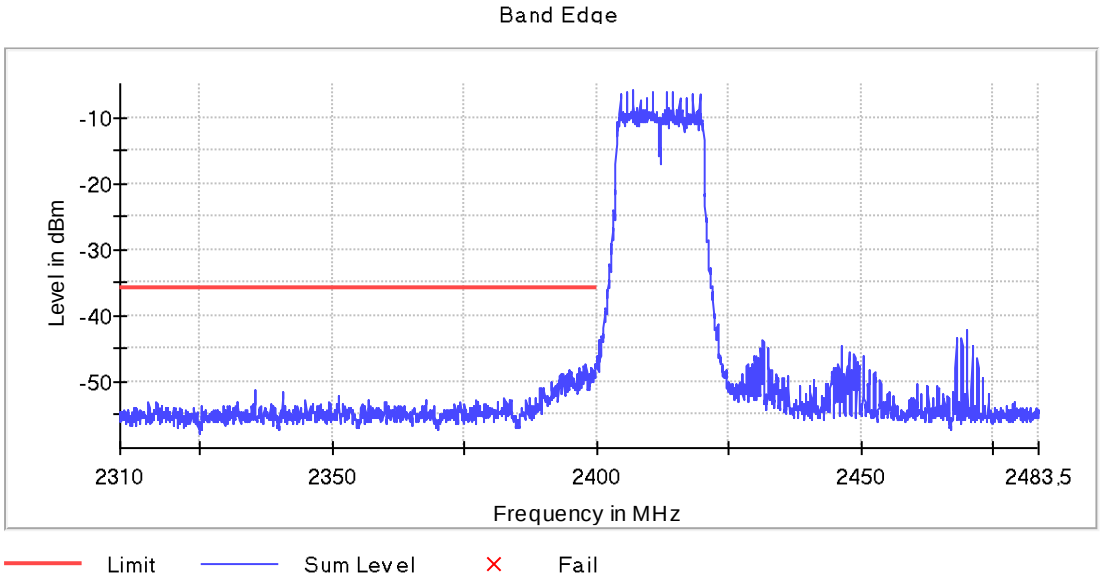


  - High Channel:

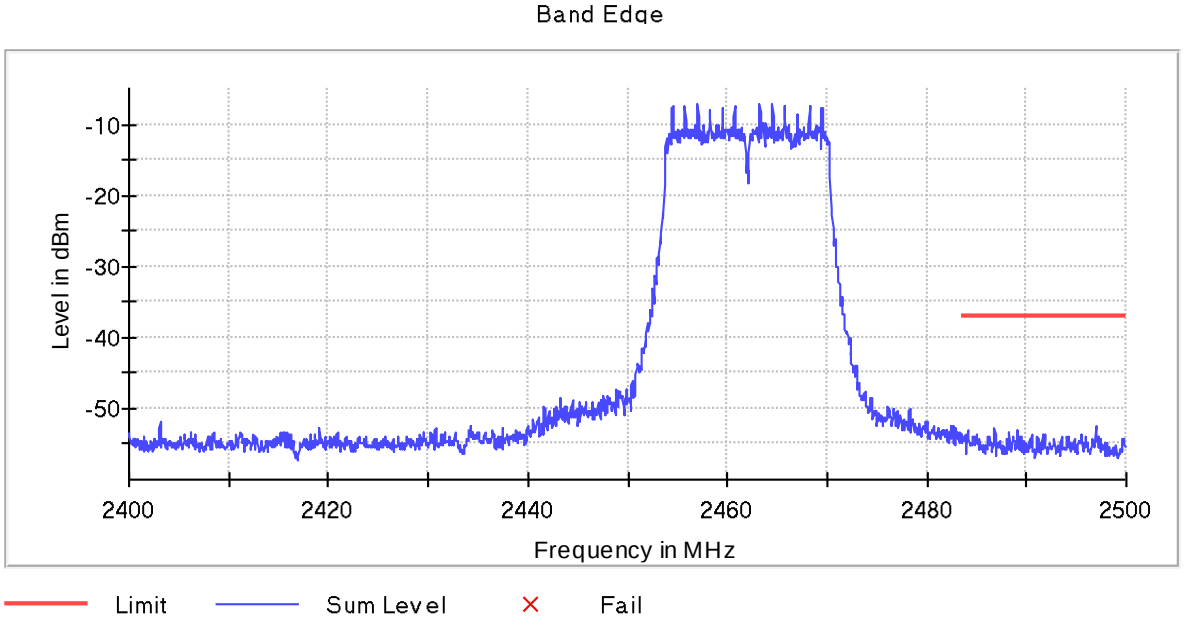


- **802.11 g – Band-edge emissions compliance**

  - Low Channel:

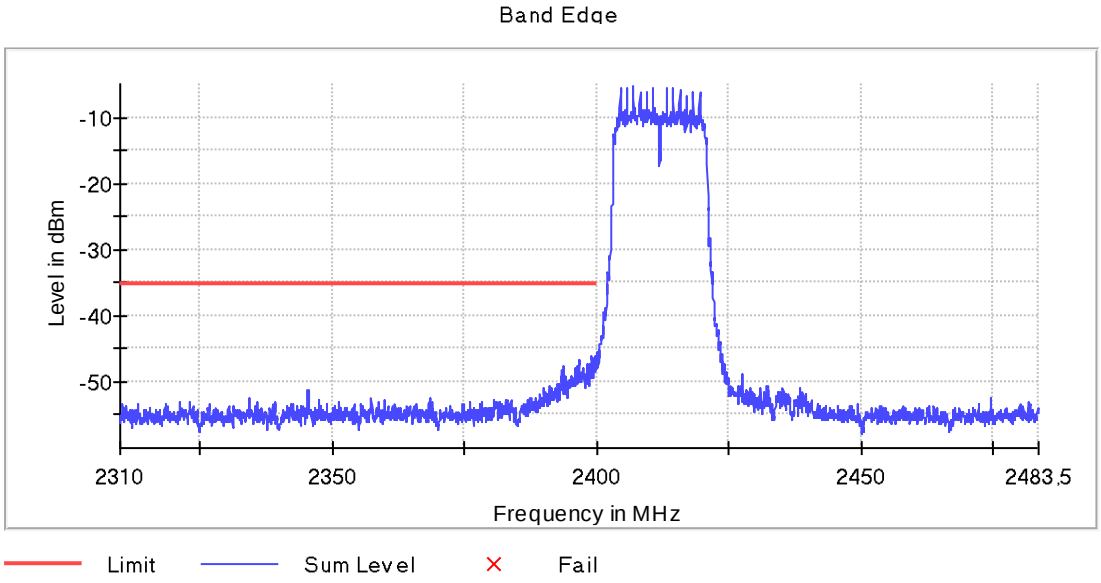


  - High Channel:

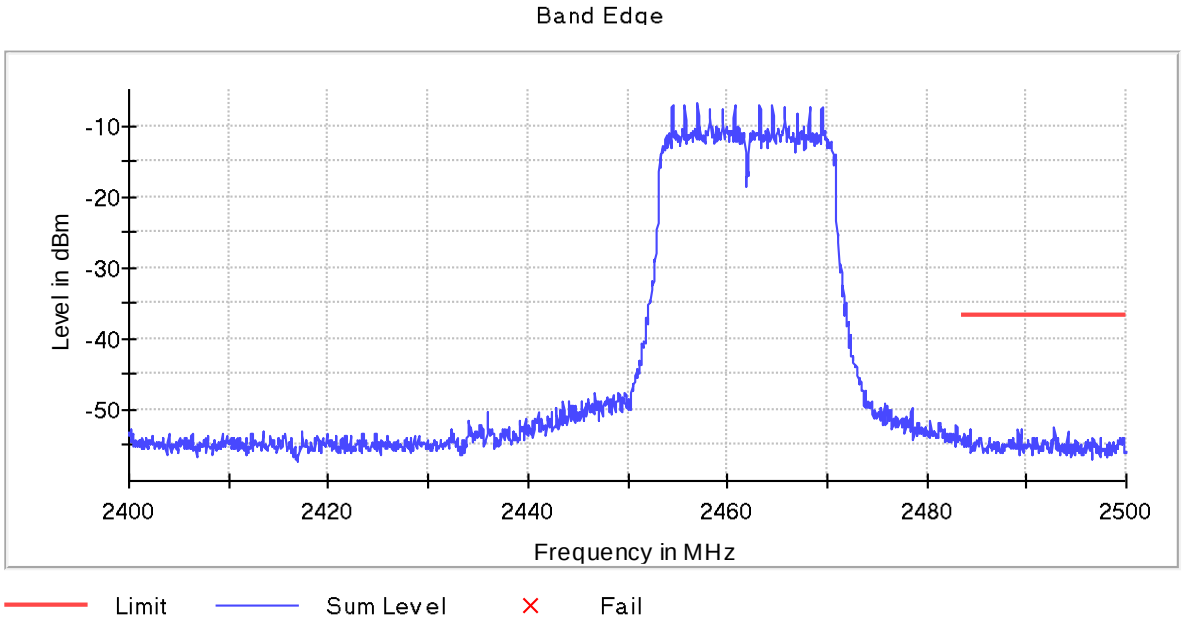


- **802.11 n20 – Band-edge emissions compliance**

  - 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:

For modes 802.11 b, g, n20, the power spectral density was measured using the method according to point 11.10.3 “Method AVGPSD-1” of ANSI C.63.10-2013.

Maximum Declared Assembly Antenna Gain: +1.5 dBi.

- **802.11 b:**

Channels	Low Channel 2412 MHz	Middle Channel 2437 MHz	High Channel 2462 MHz
Maximum Corrected Conducted PSD (dBm)	-13.19	-13.80	-14.33
Measurement uncertainty (dB)	<±0.99		

- **802.11 g:**

Channels	Low Channel 2412 MHz	Middle Channel 2437 MHz	High Channel 2462 MHz
Maximum Corrected Conducted PSD (dBm)	-16.59	-16.63	-17.09
Measurement uncertainty (dB)	<±0.99		

- **802.11 n20:**

Channels	Low Channel 2412 MHz	Middle Channel 2437 MHz	High Channel 2462 MHz
Maximum Corrected Conducted PSD (dBm)	-16.48	-16.67	-17.57
Measurement uncertainty (dB)	<±0.99		

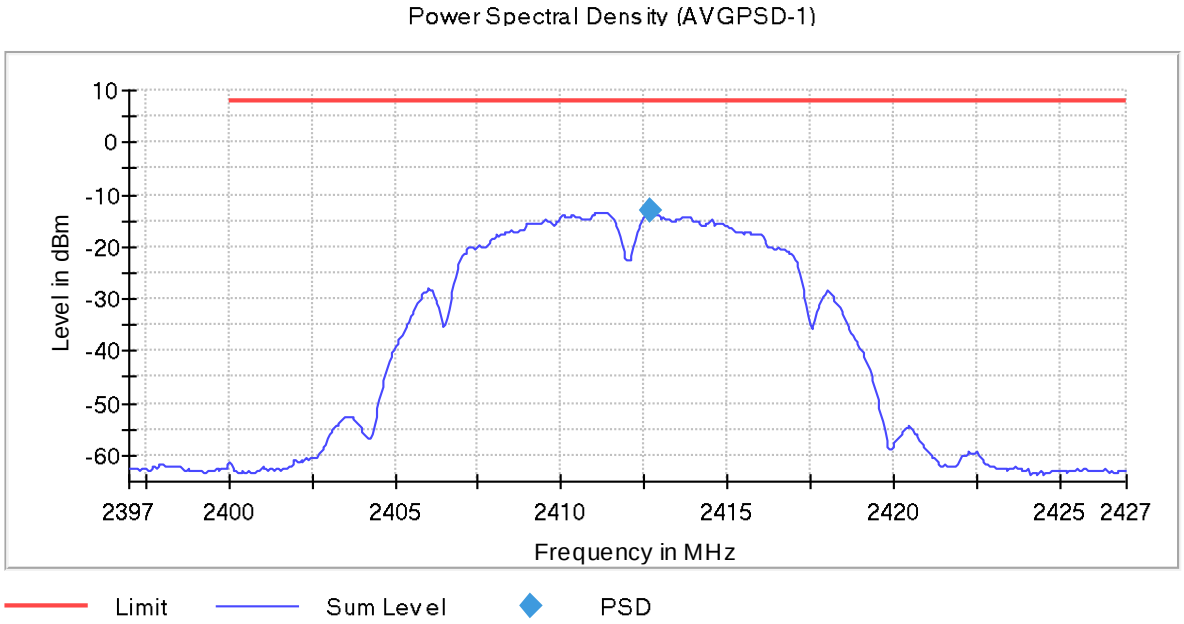
Verdict: PASS

Spectrum analyzer settings:

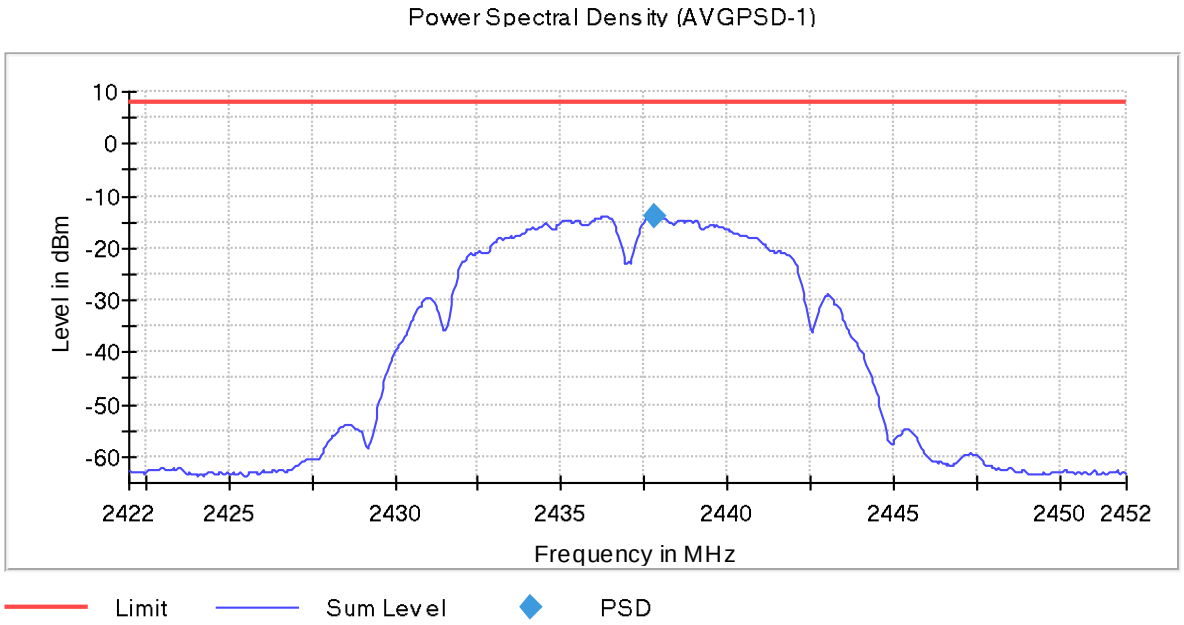
Setting	802.11 b	802.11 g	802.11 n20
Span	**30.000 MHz**	**30.000 MHz**	**30.000 MHz**
RBW	**100.000 kHz**	**100.000 kHz**	**100.000 kHz**
VBW	**300.000 kHz**	**300.000 kHz**	**300.000 kHz**
SweepPoints	**600**	**600**	**600**
Sweeptime	**1.040 ms**	**1.040 ms**	**1.040 ms**
Reference Level	**0.000 dBm**	**0.000 dBm**	**0.000 dBm**
Detector	**RMS**	**RMS**	**RMS**
Trace Mode	**Average Power**	**Average Power**	**Average Power**

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

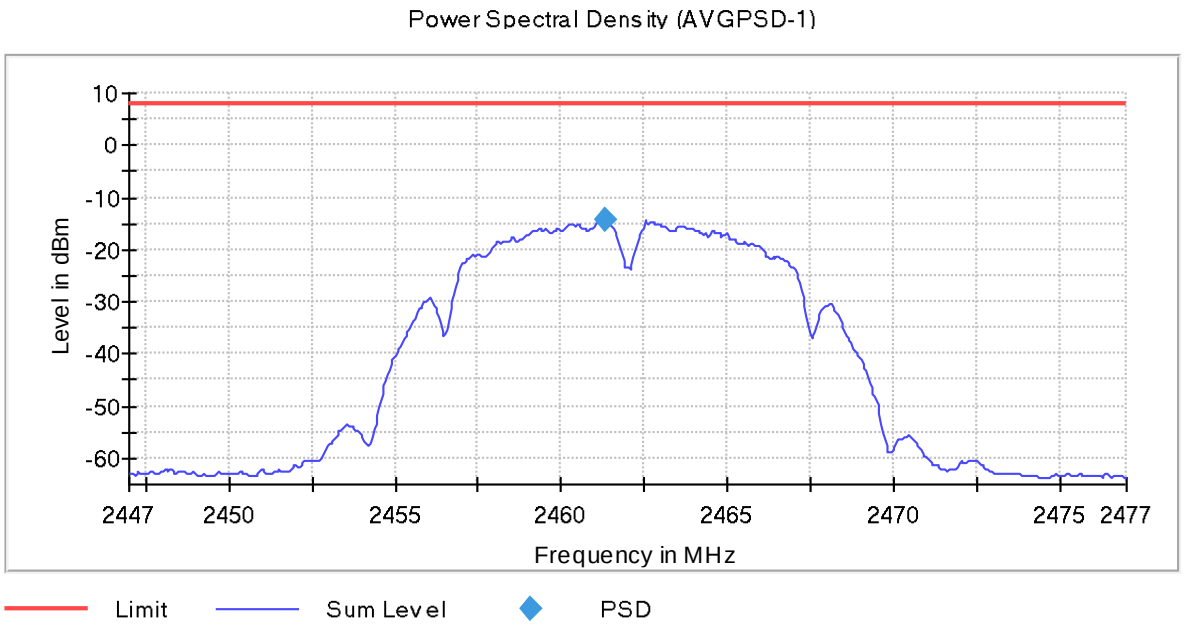
- Low Channel:



- Middle Channel:

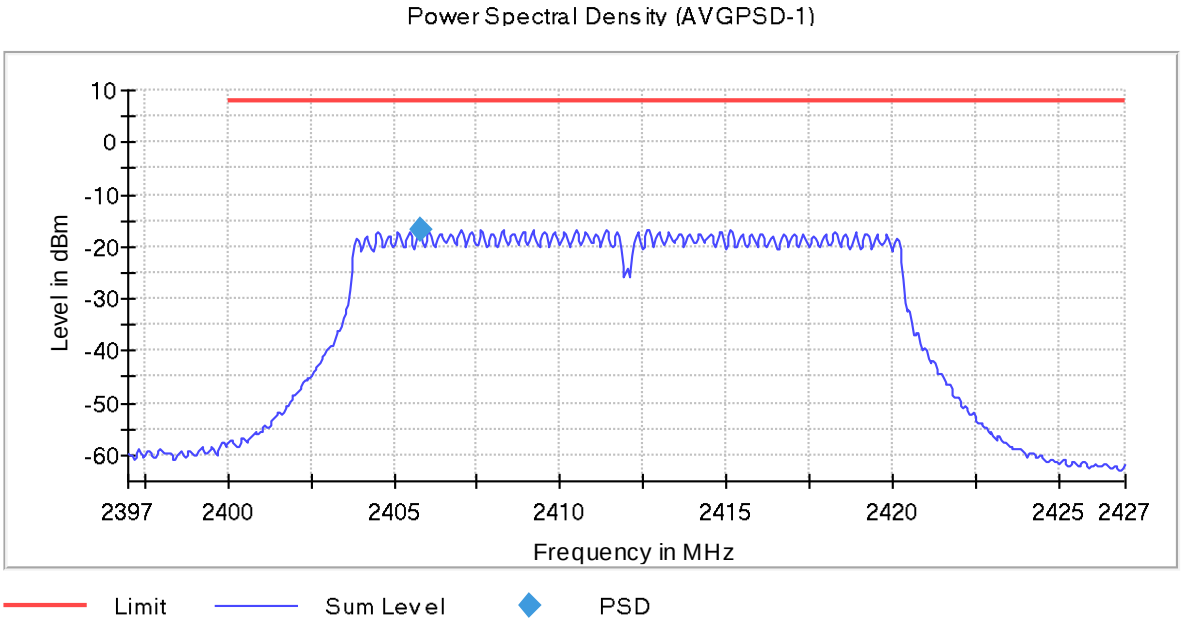


- High Channel:

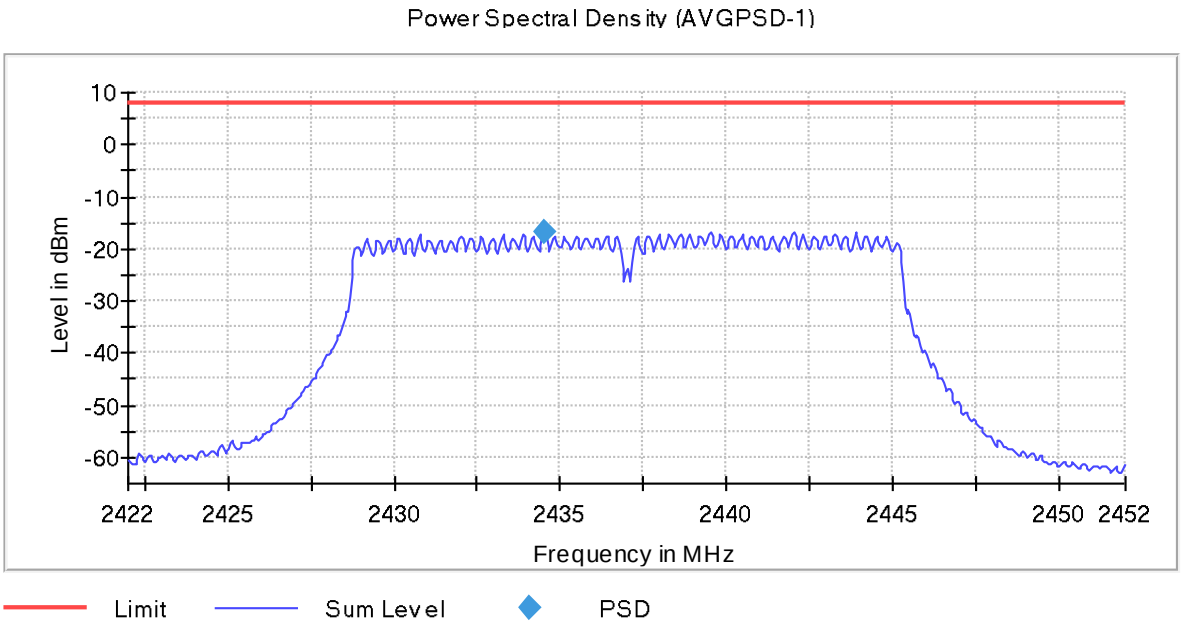


- **802.11 g – Power Spectral Density:**

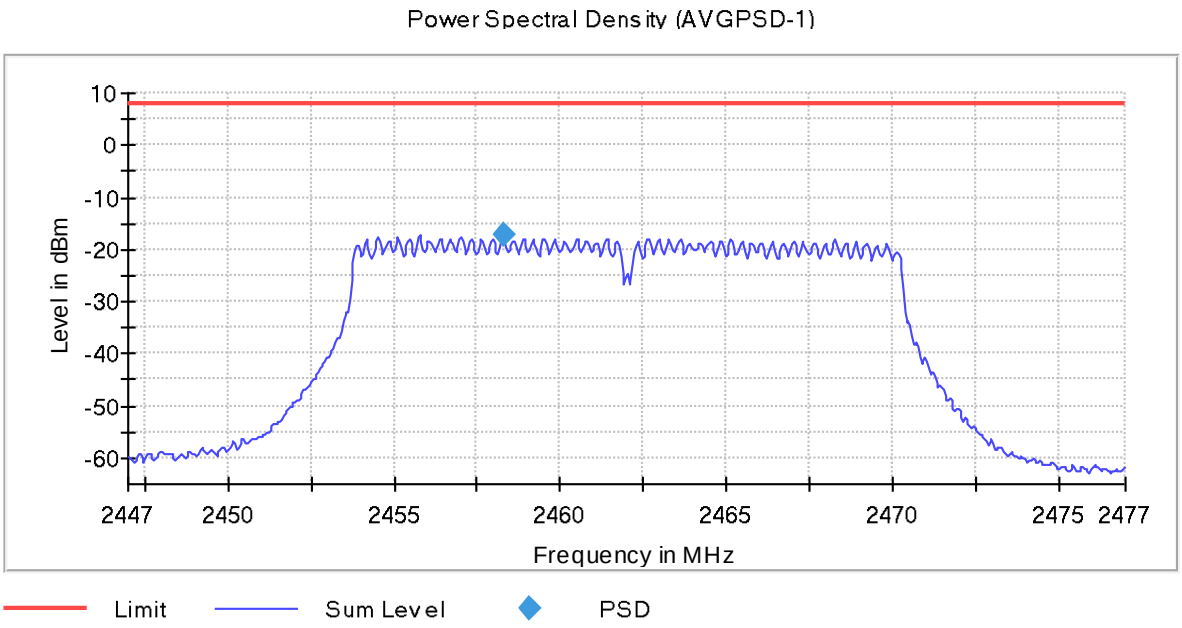
- Low Channel:



- Middle Channel:

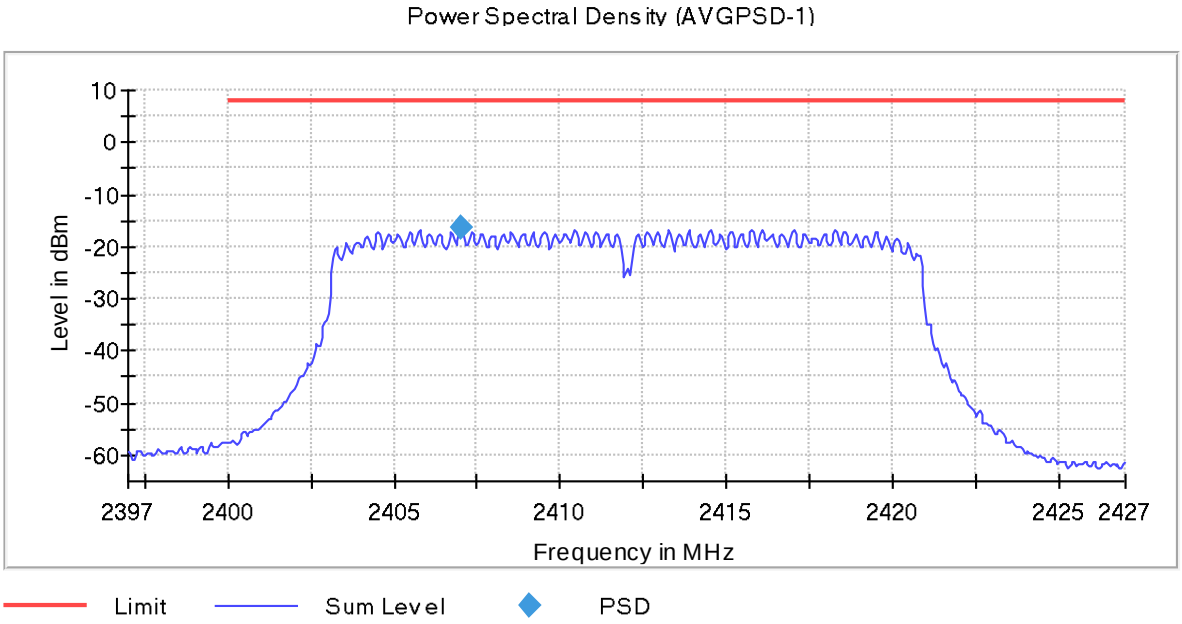


- High Channel:

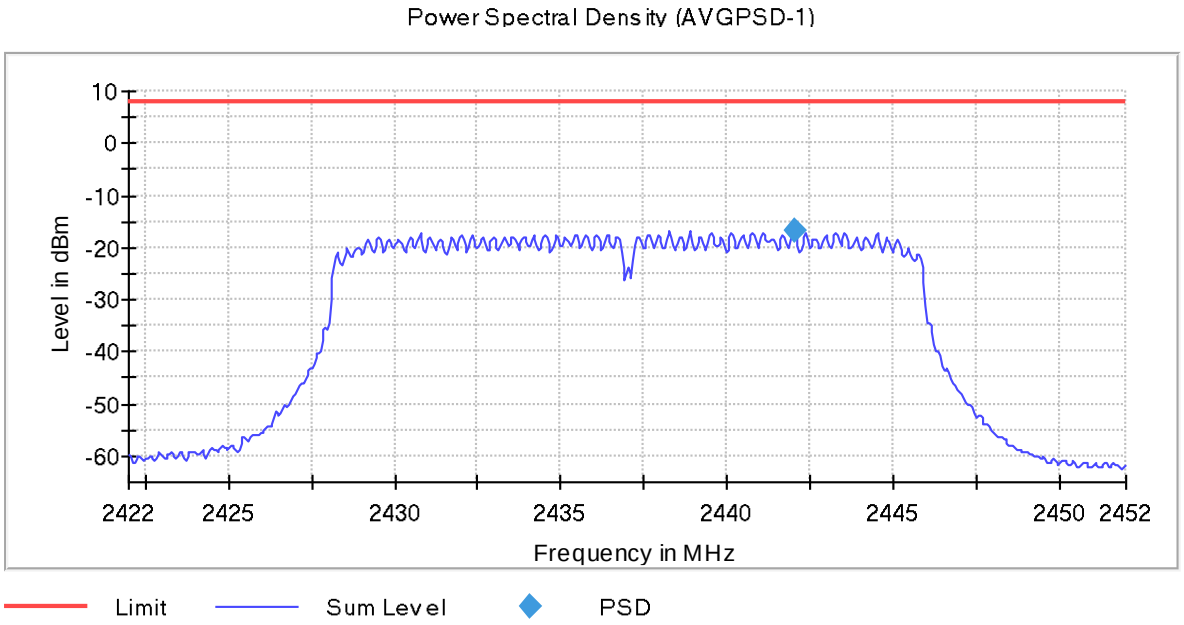


- **802.11 n20 – Power Spectral Density:**

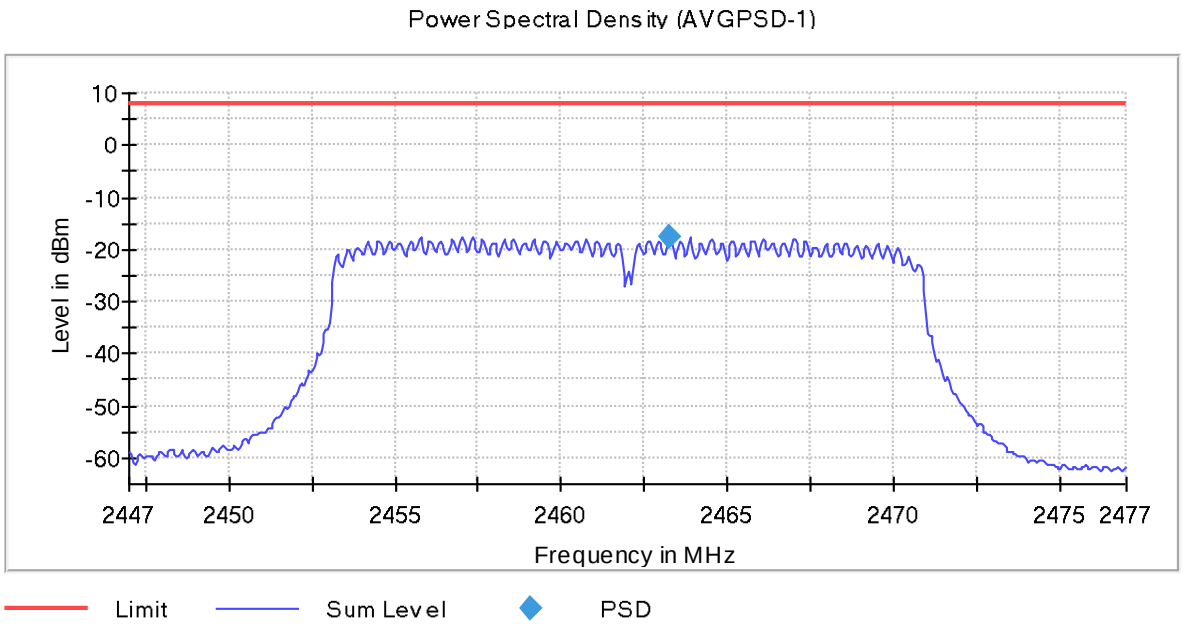
- Low Channel:



- 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 Section 15.205(a). must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 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 - 10000	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.

RSS-247: Attenuation below the general field strength limits specified in RSS-Gen is not required.

RESULTS:

The situation and orientation was varied to find the maximum radiated emission. It was also rotated 360º 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 1 m 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.

Maximum Declared Assembly Antenna Gain: +1.5 dBi.

Frequency range 30 MHz - 1 GHz:

The spurious frequencies do not depend neither on the operating channel nor the modulation mode.

No spurious frequencies at less than 20 dB below the limit:

Measurement Uncertainty <± 4.99 dB

- **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 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.

** Duty Cycle Correction Factor (dB): 0.52*

- LOW CHANNEL. Spurious frequencies closest to the limit:

Spurious frequency (MHz)	Emission Level (dBµV/m)	Polarization	Detector
4824.000000	51.53	V	Peak

- MIDDLE CHANNEL. Spurious frequencies closest to the limit:

Spurious frequency (MHz)	Emission Level (dBµV/m)	Polarization	Detector
4874.000000	51.66	V	Peak

- HIGH CHANNEL. Spurious frequencies closest to the limit:

Spurious frequency (MHz)	Emission Level (dBµV/m)	Polarization	Detector
4924.000000	52.49	V	Peak
9848.000000	52.12	V	Peak

- RESTRICTED BAND 2.31-2.39 GHz. LOW CHANNEL. No spurious frequencies at less than 20 dB below the limit.

- RESTRICTED BAND 2.4835-2.5 GHz. HIGH CHANNEL. No spurious frequencies at less than 20 dB below the limit.

Measurement Uncertainty (dB): 1 GHz ≤ f ≤ 17 GHz: <± 4.98
17 GHz ≤ f ≤ 26 GHz: <± 5.08

Verdict: PASS

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.

Spurious emissions in the Restricted Bands 2.31-2.39 GHz and 2.4835-2.5 GHz are measured for all modes.
The following results and plots are for the worst-case OFDM mode.

- **Worst-case OFDM mode: 802.11 n20.**
  - **802.11 n20 (OFDM worst-case for spurious emissions):**

    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 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.

** Duty Cycle Correction Factor (dB): 0.74*

- LOW CHANNEL. Spurious frequencies closest to the limit:

Spurious frequency (MHz)	Emission Level (dBµV/m)	Polarization	Detector
4822.000000	54.61	V	Peak
	39.40		AVG

- MIDDLE CHANNEL. Spurious frequencies closest to the limit:

Spurious frequency (MHz)	Emission Level (dBµV/m)	Polarization	Detector
4872.000000	53.13	H	Peak

- HIGH CHANNEL. Spurious frequencies closest to the limit:

Spurious frequency (MHz)	Emission Level (dBµV/m)	Polarization	Detector
4922.000000	51.54	V	Peak

- RESTRICTED BAND 2.31-2.39 GHz. LOW CHANNEL. No spurious frequencies at less than 20 dB below the limit.

- RESTRICTED BAND 2.4835-2.5 GHz. HIGH CHANNEL. No spurious frequencies at less than 20 dB below the limit.

Measurement Uncertainty (dB): 1 GHz $\leq$ f $\leq$ 17 GHz: <± 4.98
17 GHz $\leq$ f $\leq$ 26 GHz: <± 5.08

Verdict: PASS

- **802.11 g:**

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.

** Duty Cycle Correction Factor (dB): 0.74*

- RESTRICTED BAND 2.31-2.39 GHz. LOW CHANNEL. No spurious frequencies at less than 20 dB below the limit.

- RESTRICTED BAND 2.4835-2.5 GHz. HIGH CHANNEL. No spurious frequencies at less than 20 dB below the limit.

Measurement Uncertainty (dB): 1 GHz ≤ f ≤ 17 GHz: <± 4.98
17 GHz ≤ f ≤ 26 GHz: <± 5.08

Measurement Uncertainty (dB): 1 GHz ≤ f ≤ 17 GHz: <± 4.98
17 GHz ≤ f ≤ 26 GHz: <± 5.08

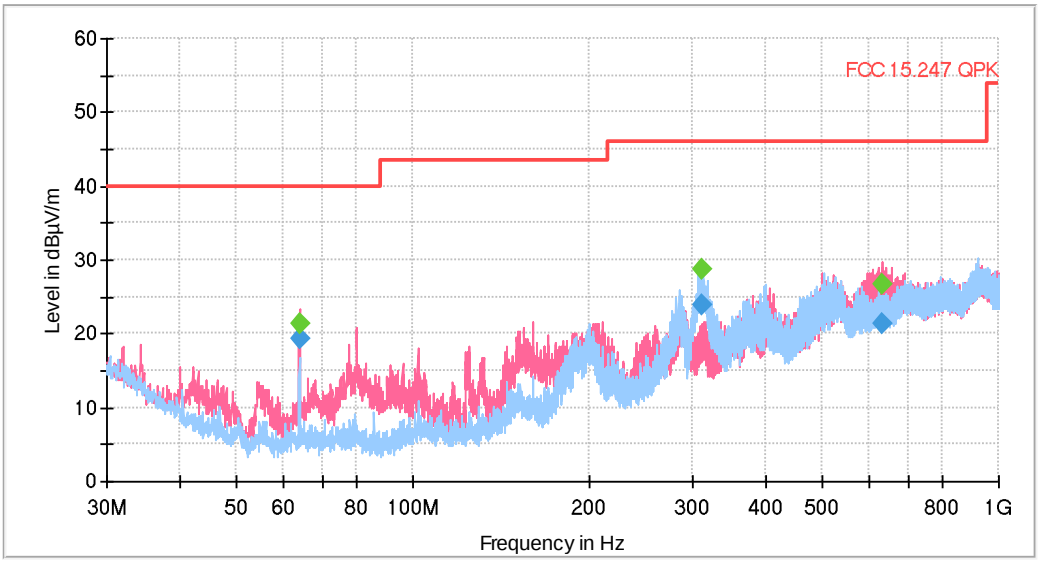
Verdict: PASS

Spectrum analyzer settings for all mode:

Setting	30 MHz – 1 GHz	1 GHz – 3 GHz	3 GHz – 17GHz	17 GHz – 26 GHz
Start Frequency	**30.000 MHz**	**1.000 GHz**	**3.000 GHz**	**17.000 GHz**
Stop Frequency	**1000.000 MHz**	**3.000 GHz**	**17.000 GHz**	**26.000 GHz**
RBW	**100.000 kHz**	**1.000 MHz**	**1.000 MHz**	**1.000 MHz**
VBW	**300.000 kHz**	**3.000 MHz**	**3.000 MHz**	**3.000 MHz**
SweepPoints	**20001.000**	**30001.000**	**28001.000**	**28001.000**
Sweeptime	**1.000 s**	**1.000 s**	**1.000 s**	**1.000 s**
Detector 1	**Peak**	**Peak**	**Peak**	**Peak**
Detector 2	**N/A**	**Average**	**Average**	**Average**
Trace Mode	**Max Hold**	**Max Hold**	**Max Hold**	**Max Hold**

FREQUENCY RANGE 30 MHz - 1 GHz:

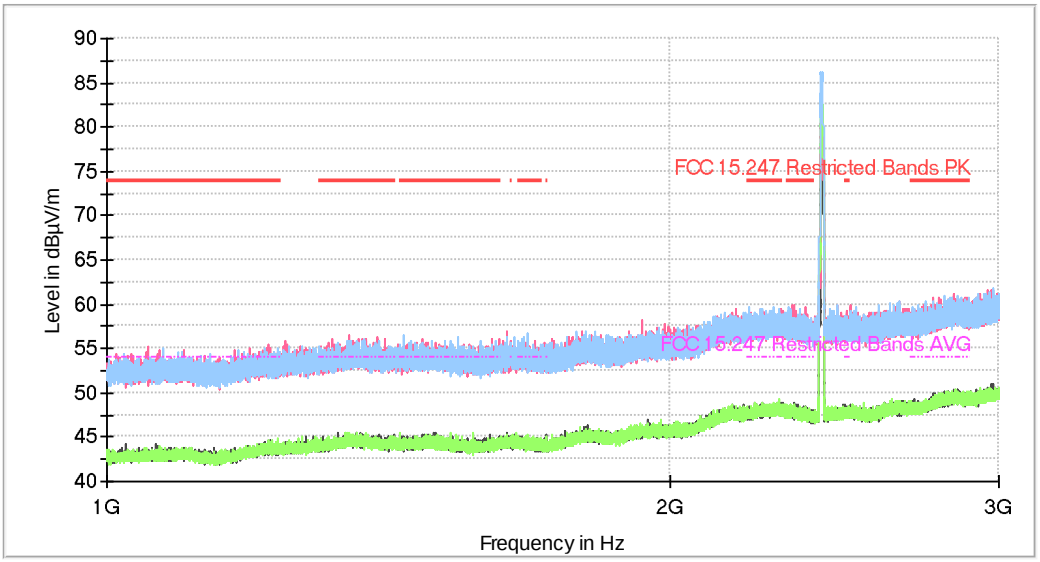
The spurious frequencies detected do not depend neither on the operating channel nor the modulation mode.



- **802.11 b:**

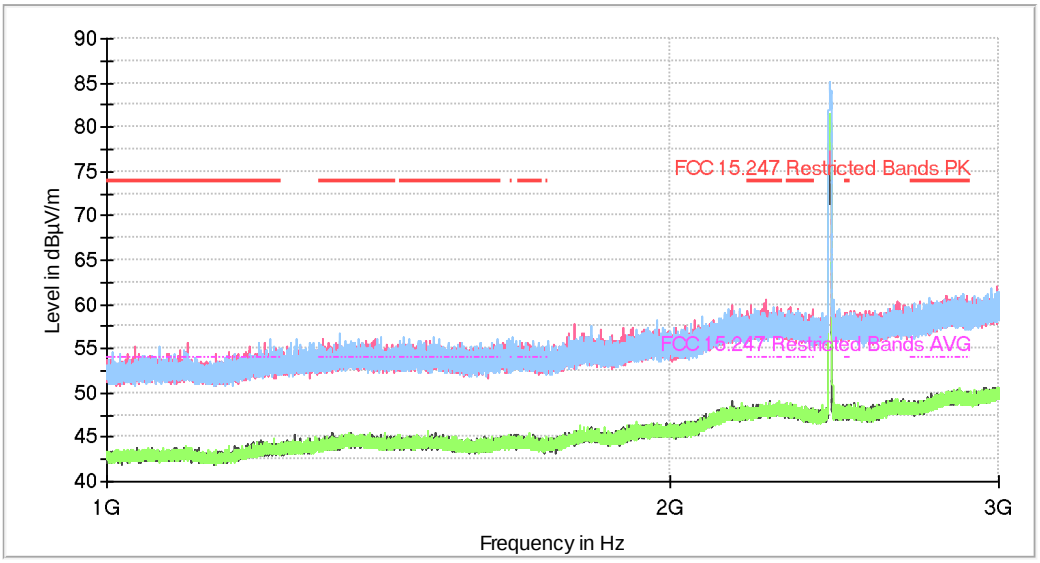
FREQUENCY RANGE 1 - 3 GHz:

- Low Channel:



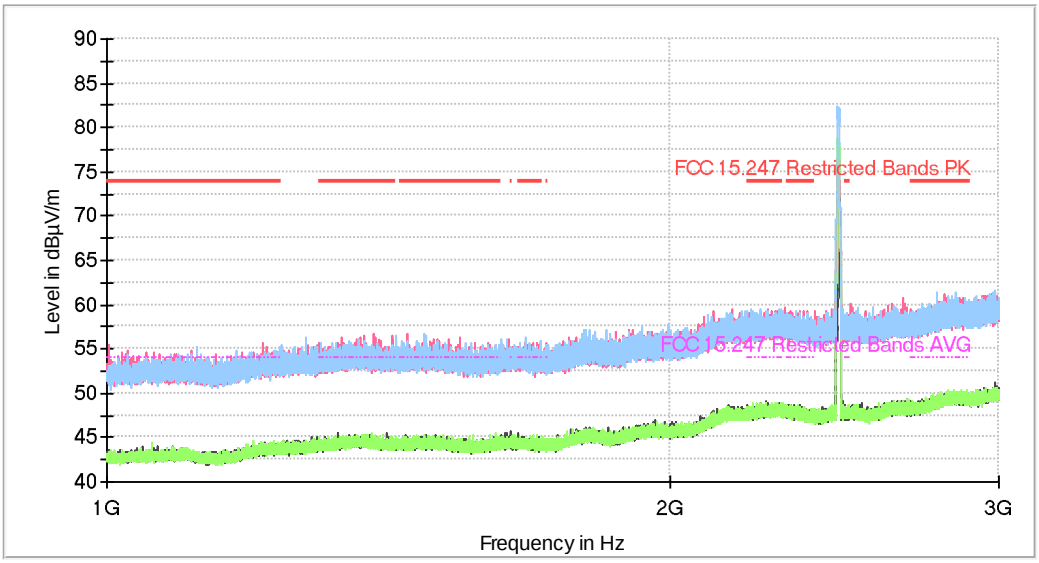
The peak above the limit is the carrier frequency.

- Middle Channel:



The peak above the limit is the carrier frequency.

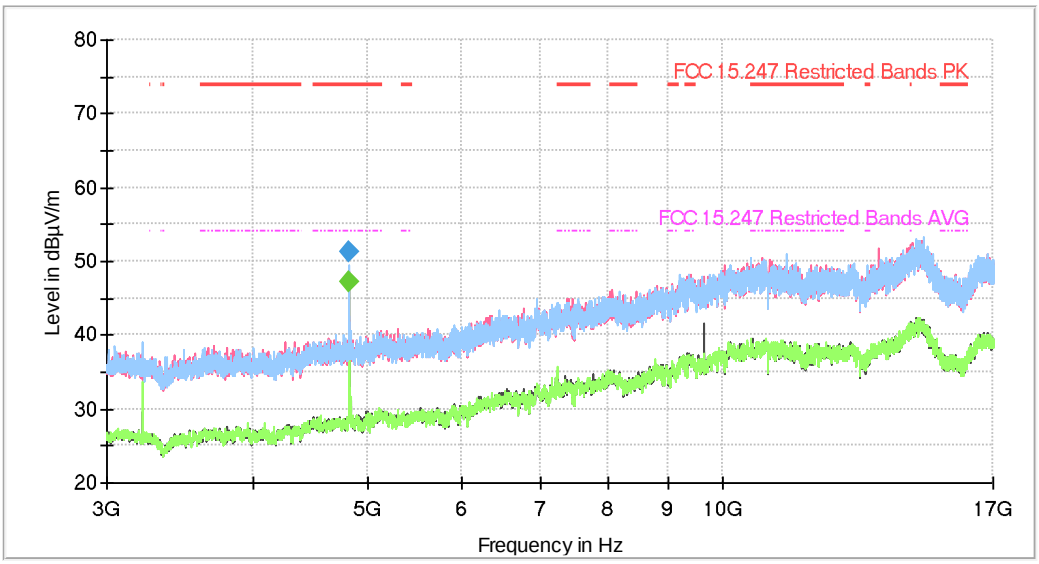
- High Channel:



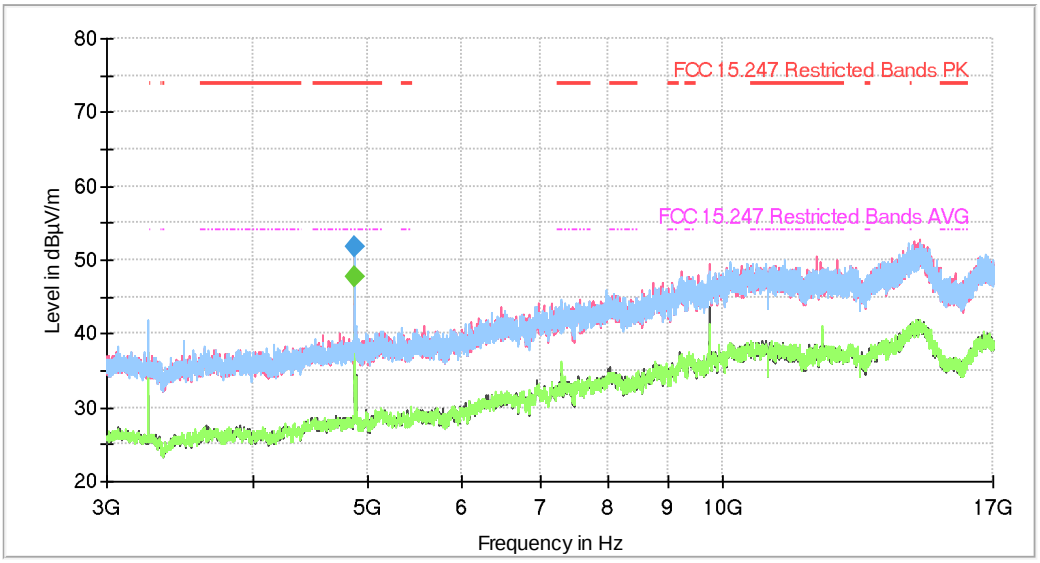
The peak above the limit is the carrier frequency.

FREQUENCY RANGE 3 - 17 GHz:

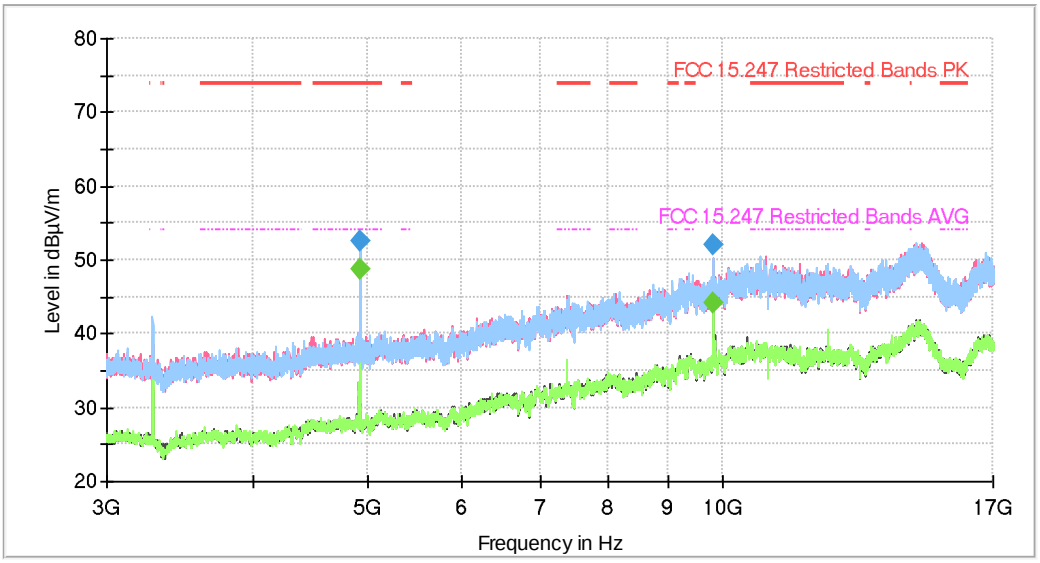
- Low Channel:



- Middle Channel:

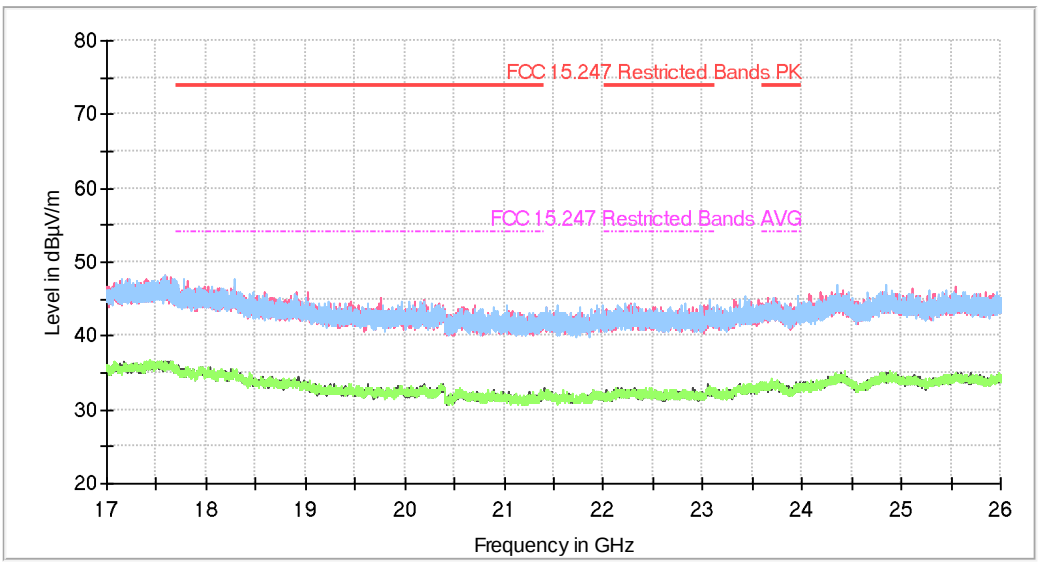


- High Channel:



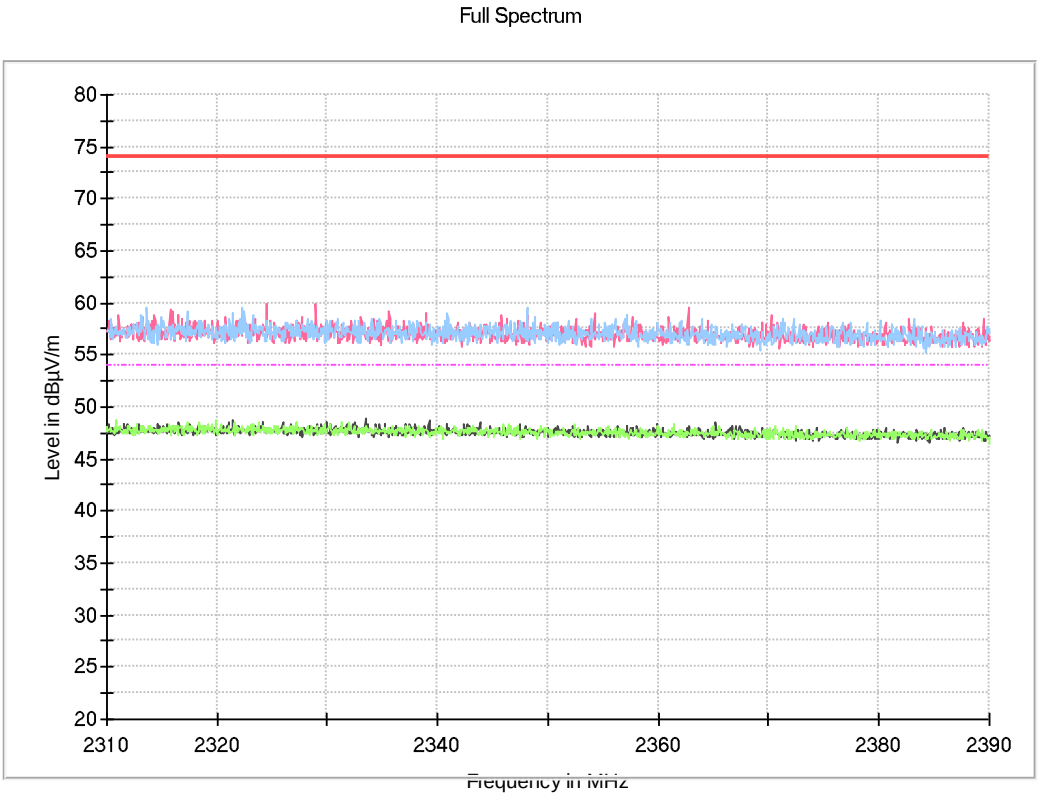
FREQUENCY RANGE 17 - 26 GHz:

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



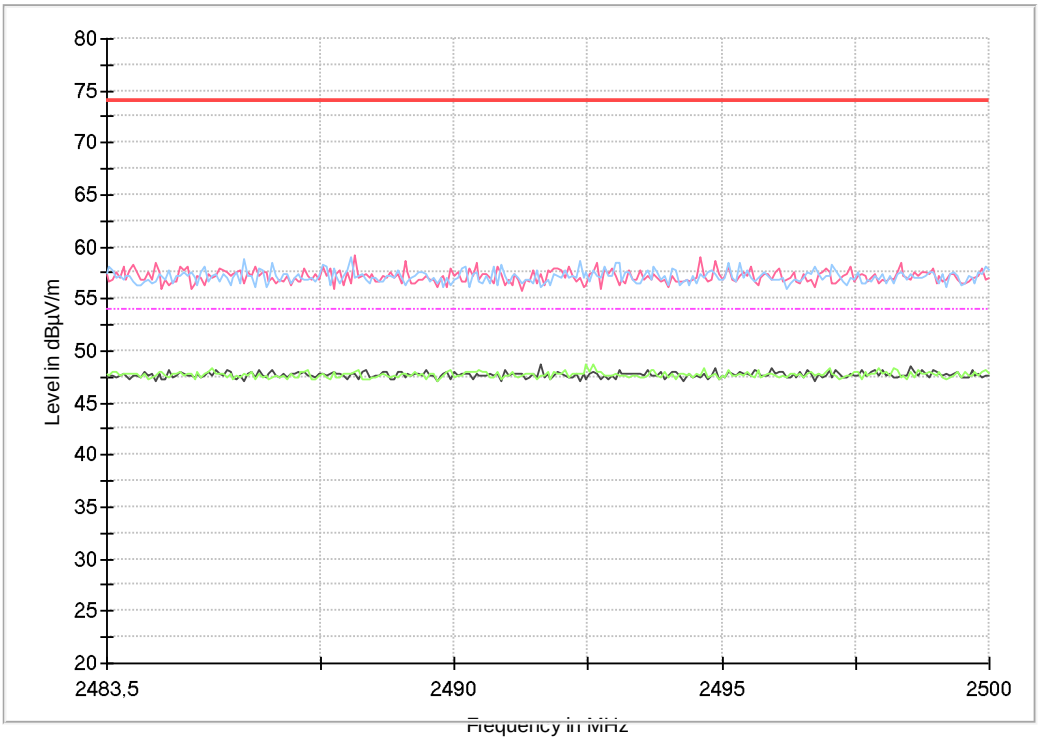
RESTRICTED BAND 2.31-2.39 GHz:

- Low Channel:



RESTRICTED BAND 2.4835-2.5 GHz:

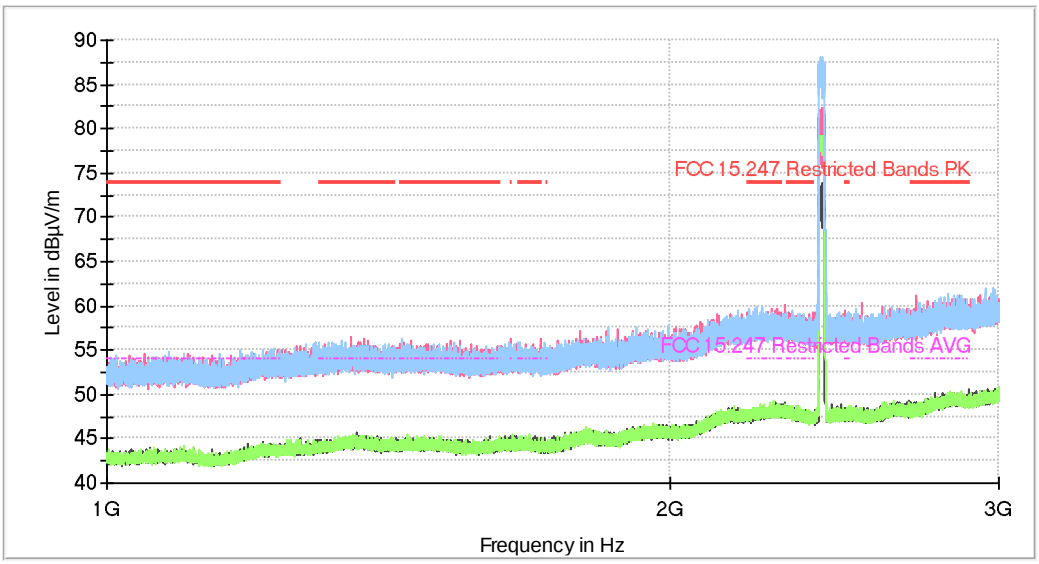
- High Channel:



- **802.11 n20 (OFDM worst-case for spurious emissions):**

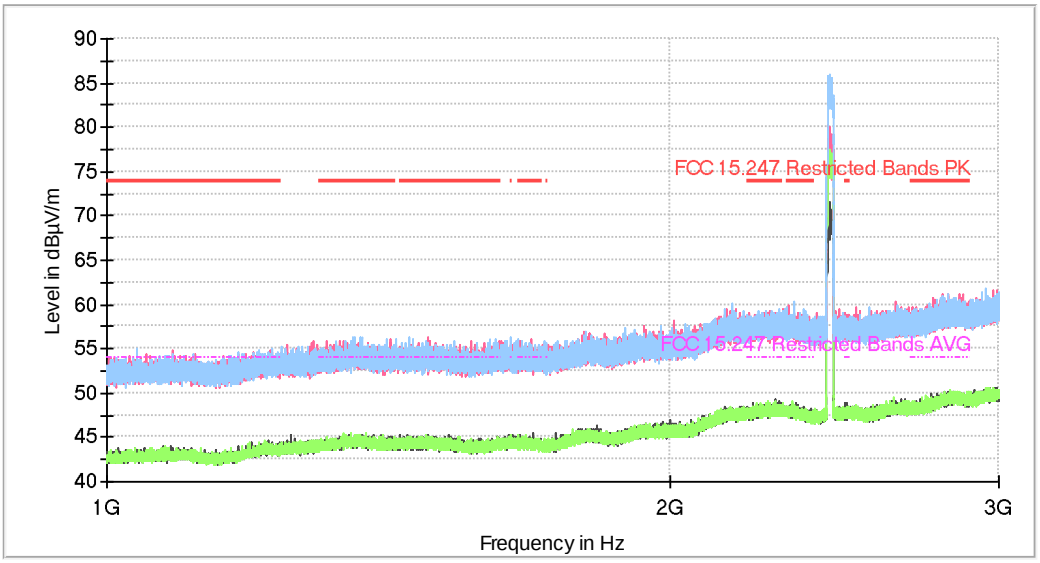
FREQUENCY RANGE 1 - 3 GHz:

- Low Channel:



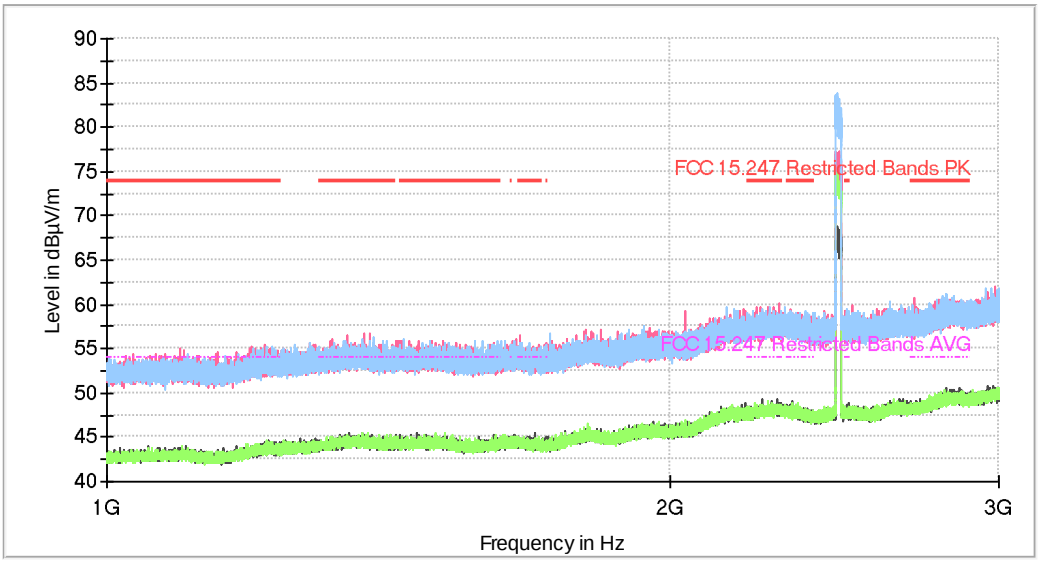
The peak above the limit is the carrier frequency.

- Middle Channel:



The peak above the limit is the carrier frequency.

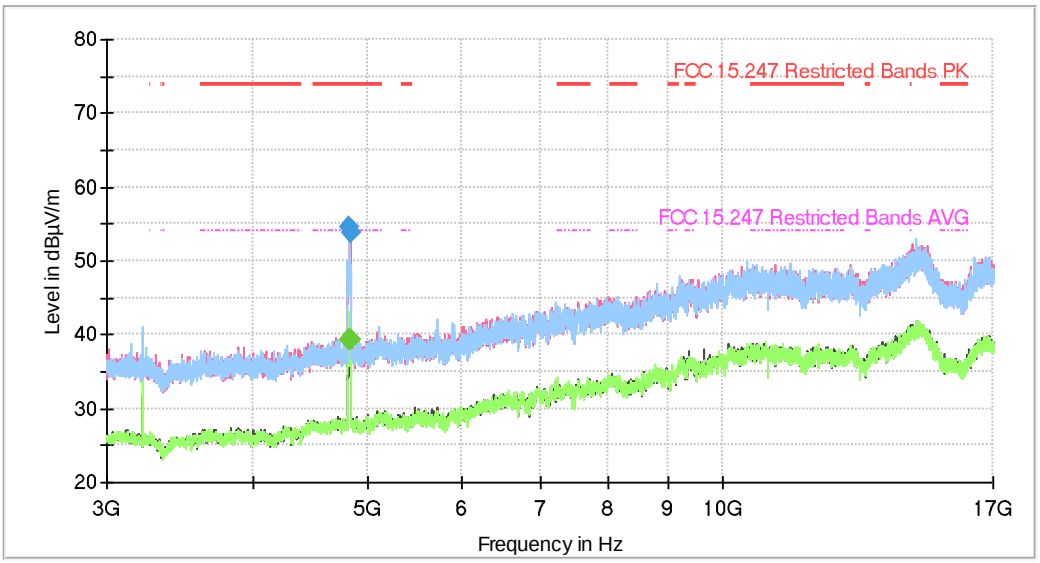
- High Channel:



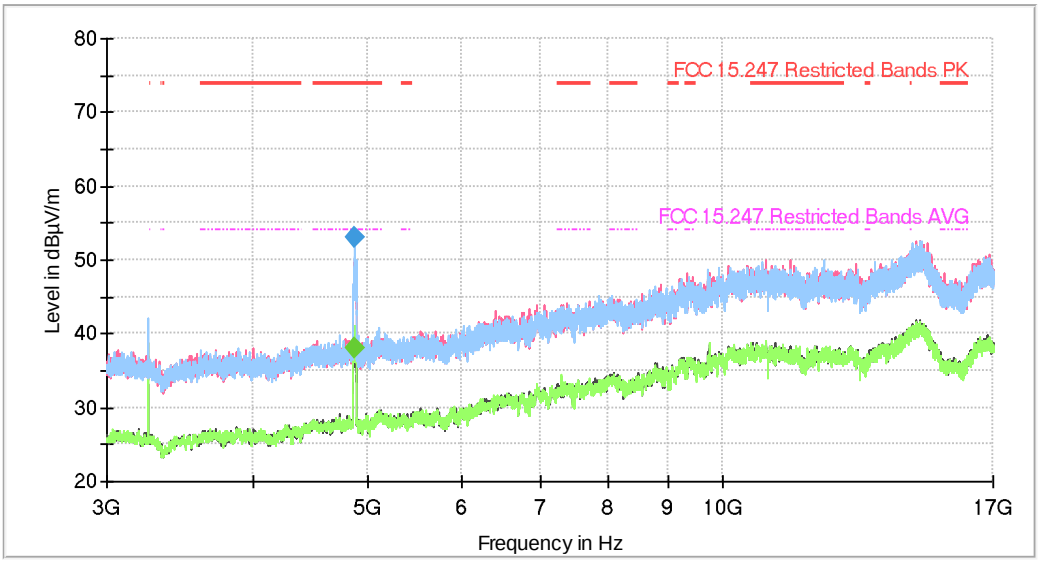
The peak above the limit is the carrier frequency.

FREQUENCY RANGE 3 - 17 GHz:

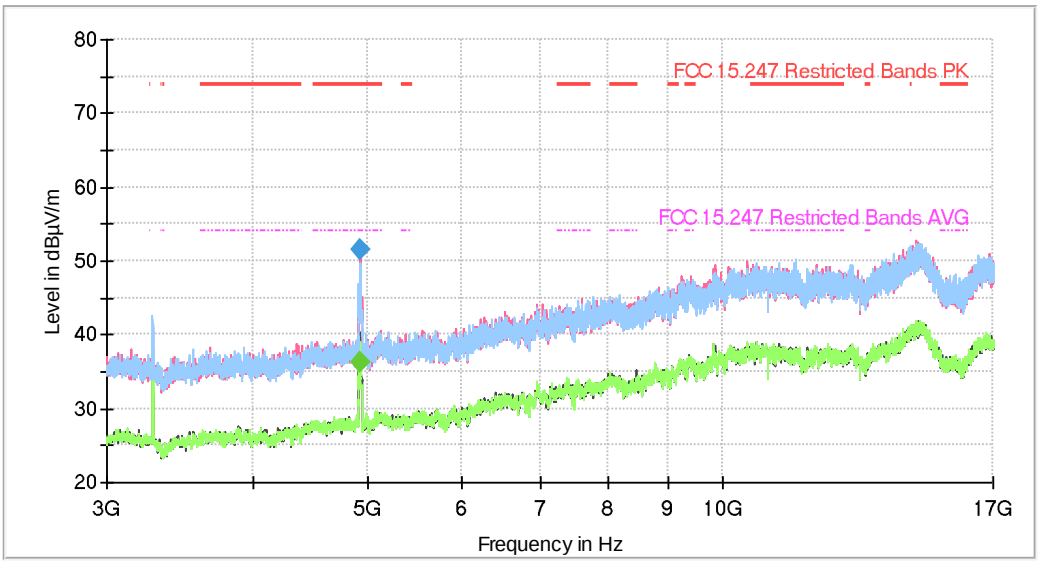
- Low Channel:



- Middle Channel:

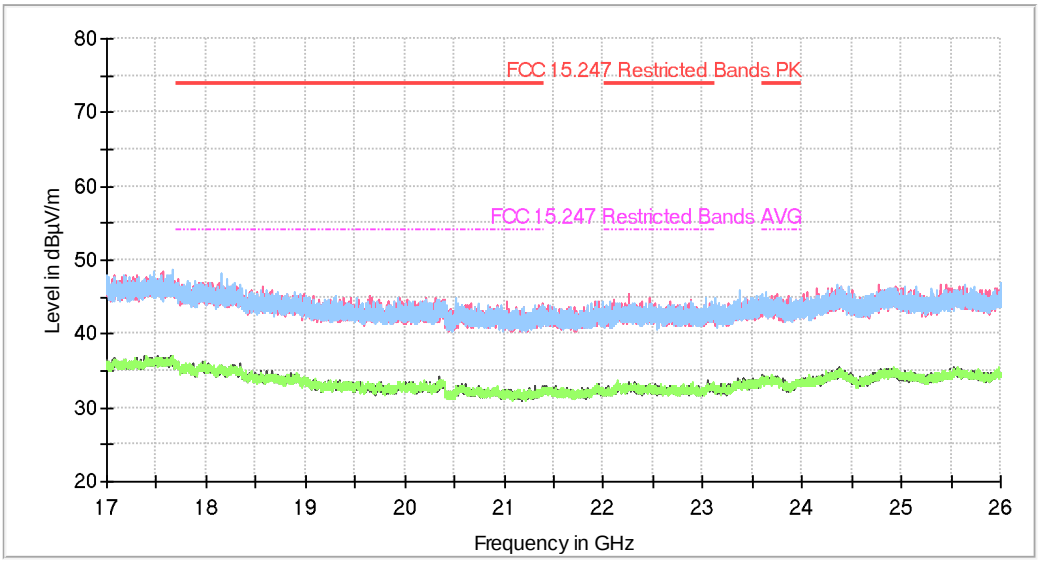


- High Channel:



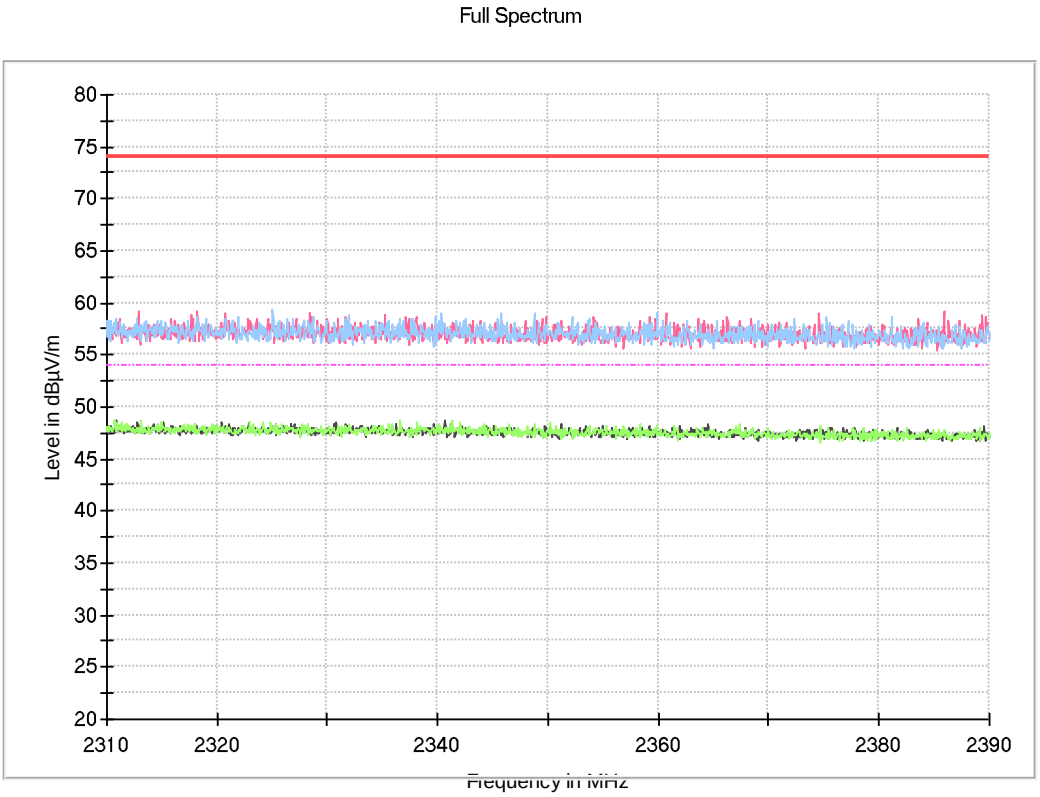
FREQUENCY RANGE 17 - 26 GHz:

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



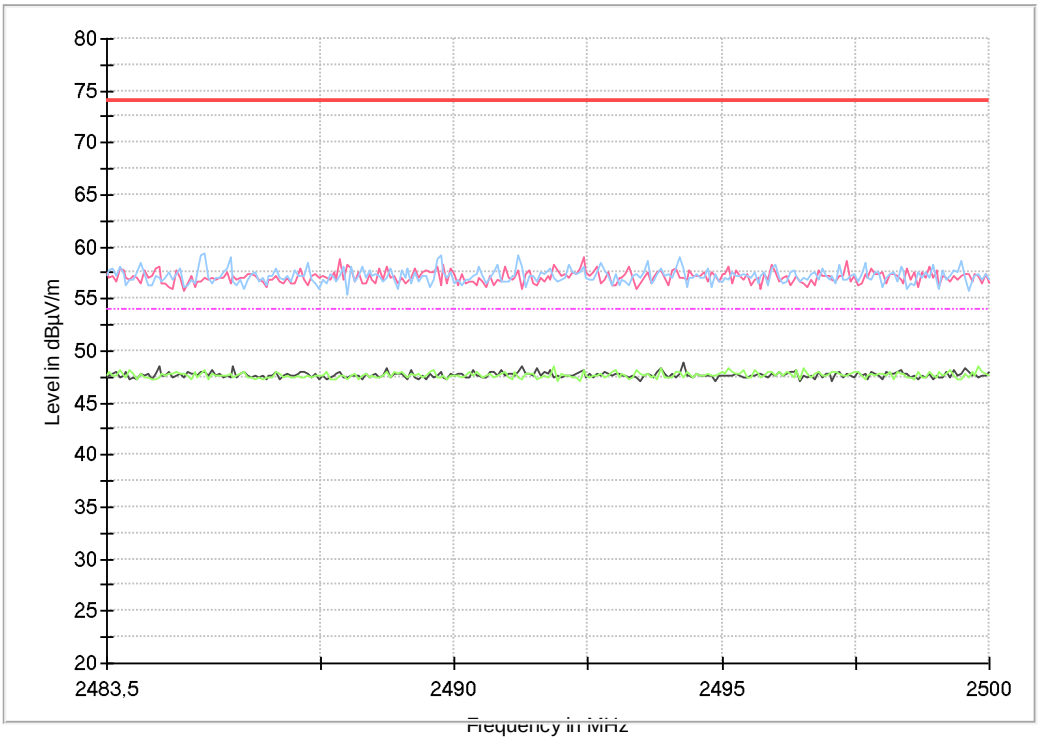
RESTRICTED BAND 2.31-2.39 GHz:

- Low Channel:



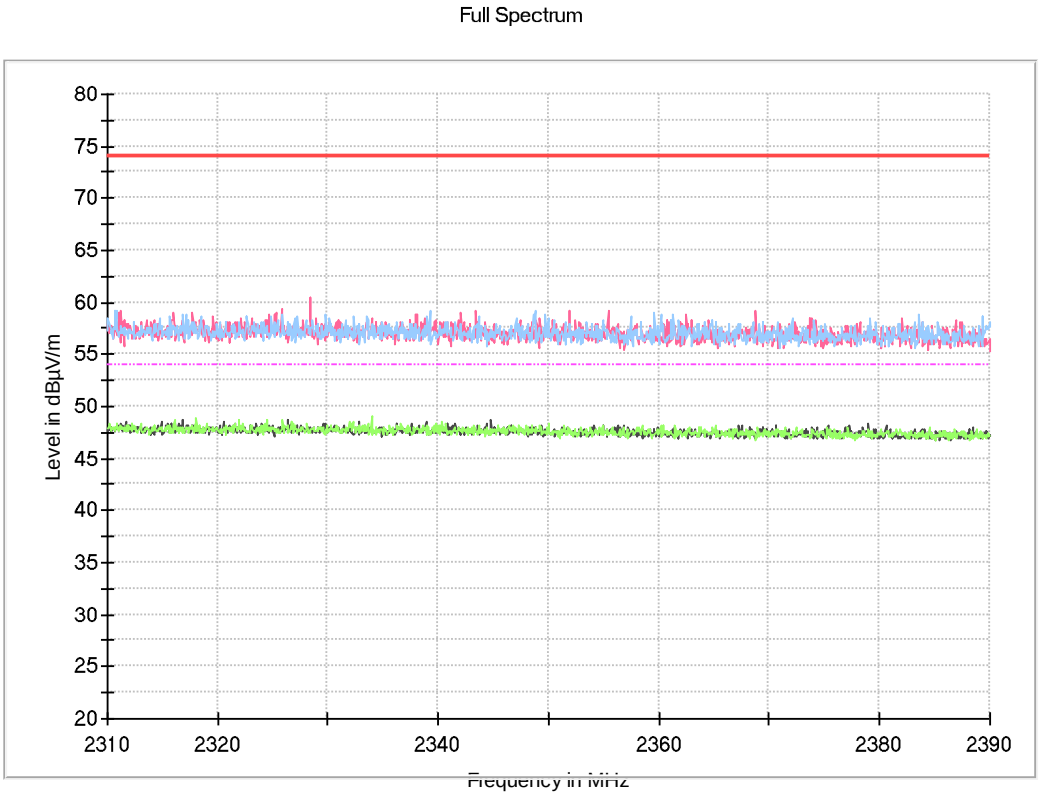
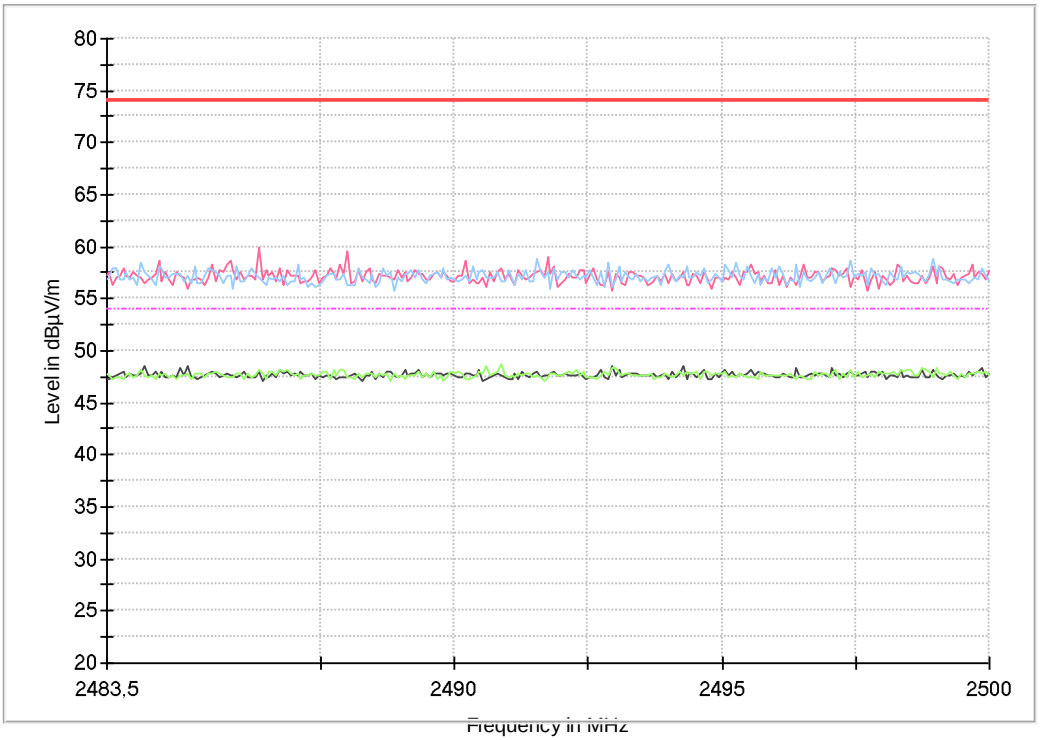
RESTRICTED BAND 2.4835-2.5 GHz:

- High Channel:



- **802.11 g:**

RESTRICTED BAND 2.31-2.39 GHz:
- Low Channel:



RESTRICTED BAND 2.4835-2.5 GHz:
- High Channel: