FCC Section 15.247 Subclause (d) / RSS-247 Clause 5.5. Emission limitations conducted (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:

- **Mode 802.11 b**

	Low Channel 2412 MHz	Middle Channel 2437 MHz	High Channel 2462 MHz
Reference Level Measurement (dBm)	-2.17	-2.06	-0.97
Measurement uncertainty (dB)	<±1.56		

No spurious peaks were found at less than 20 dB below the limit.

- **Mode 802.11 g**

	Low Channel 2412 MHz	Middle Channel 2437 MHz	High Channel 2462 MHz
Reference Level Measurement (dBm)	-3.24	-2.86	-2.04
Measurement uncertainty (dB)	<±1.56		

No spurious peaks were found at less than 20 dB below the limit.

- **Mode 802.11 n20**

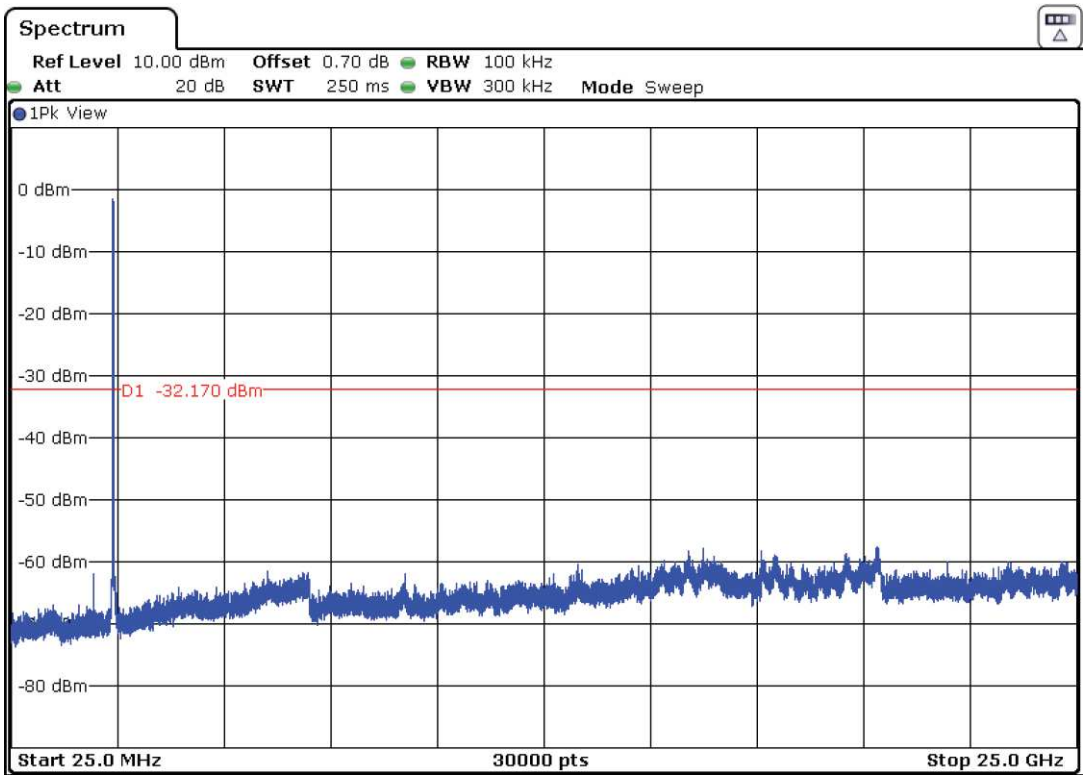
	Low Channel 2412 MHz	Middle Channel 2437 MHz	High Channel 2462 MHz
Reference Level Measurement (dBm)	-4.55	-3.87	-2.91
Measurement uncertainty (dB)	<±1.56		

No spurious peaks were found at less than 20 dB below the limit.

Verdict: PASS

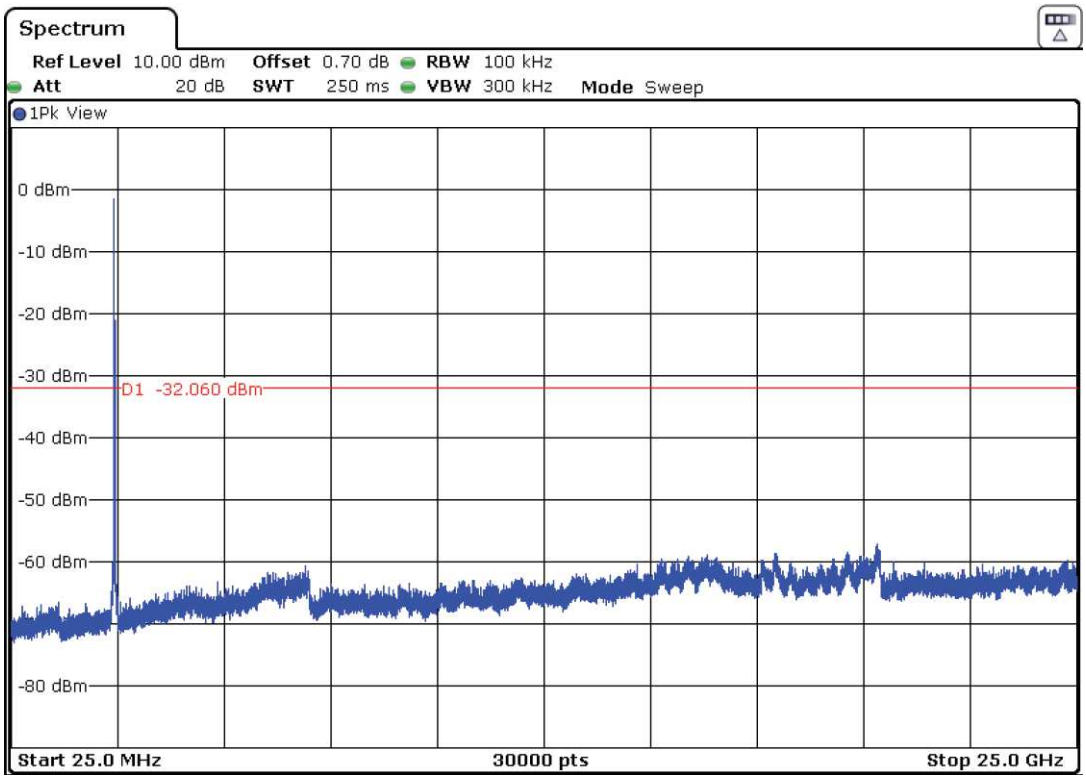
- **Mode 802.11 b – Emission limitations conducted**

- Low Channel:



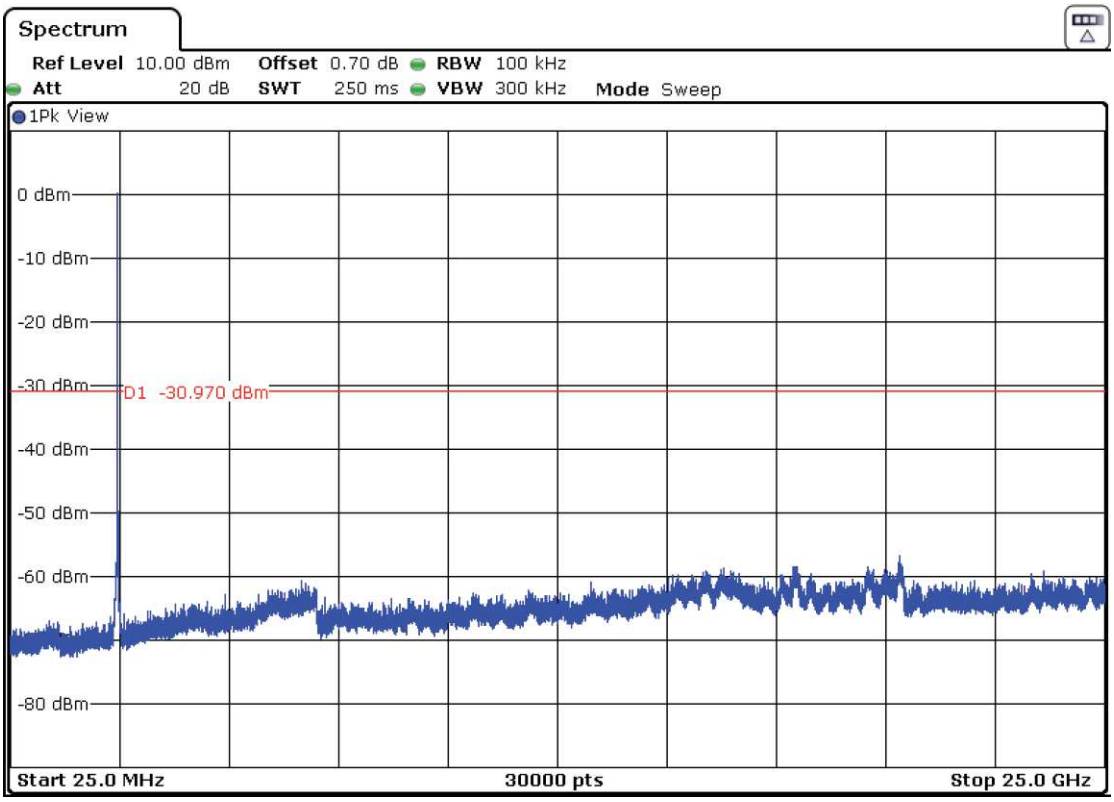
The peak shown in the plot above the limit is the carrier frequency.

- Middle Channel:



The peak shown in the plot above the limit is the carrier frequency.

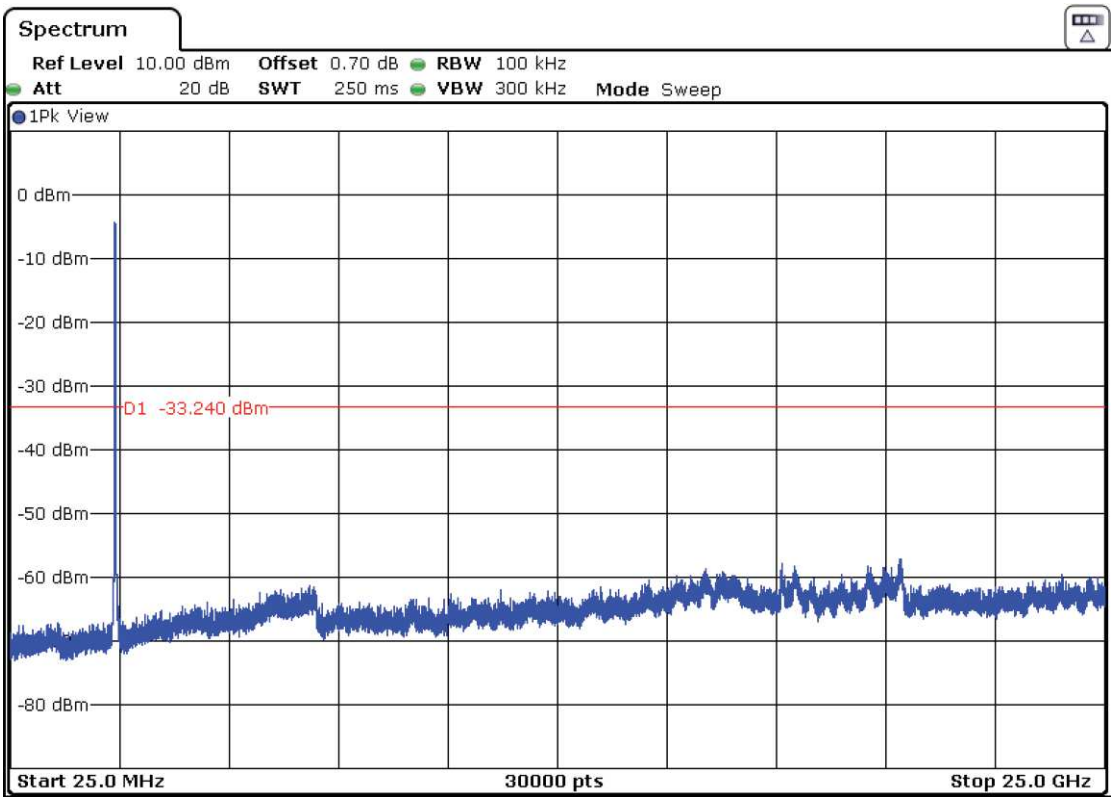
- High Channel:



The peak shown in the plot above the limit is the carrier frequency.

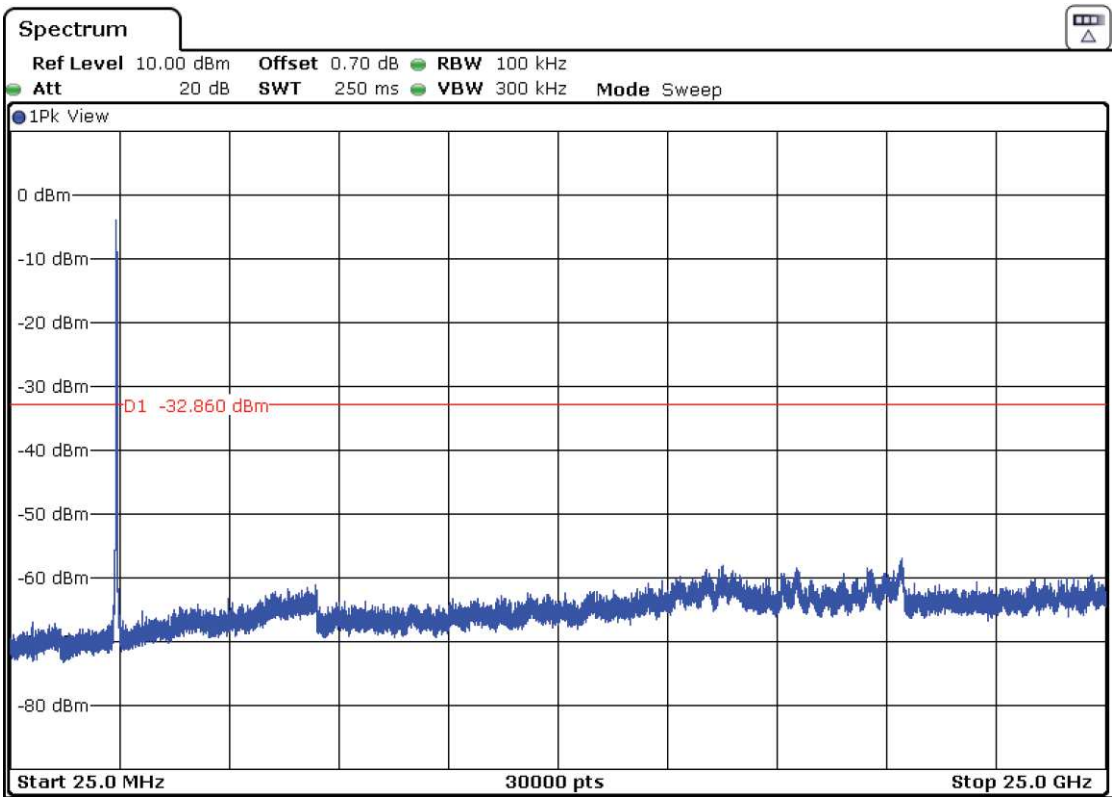
- **Mode 802.11 g – Emission limitations conducted**

- Low Channel:



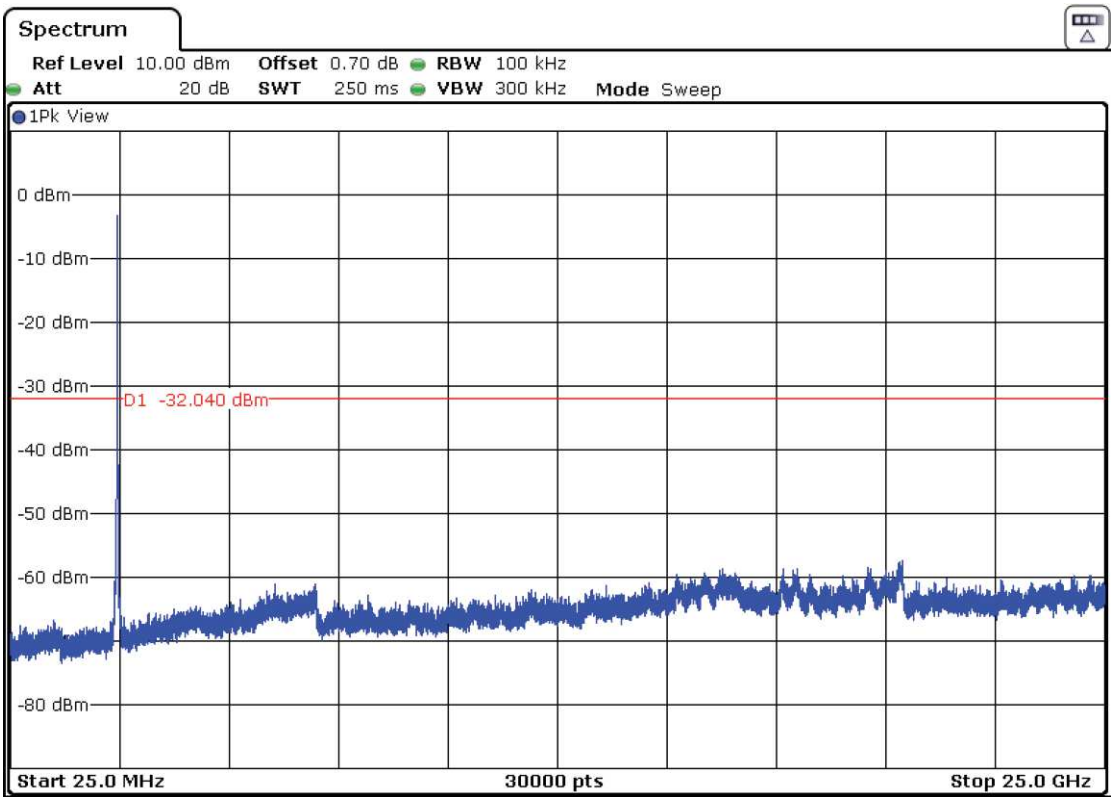
The peak shown in the plot above the limit is the carrier frequency.

- Middle Channel:



The peak shown in the plot above the limit is the carrier frequency.

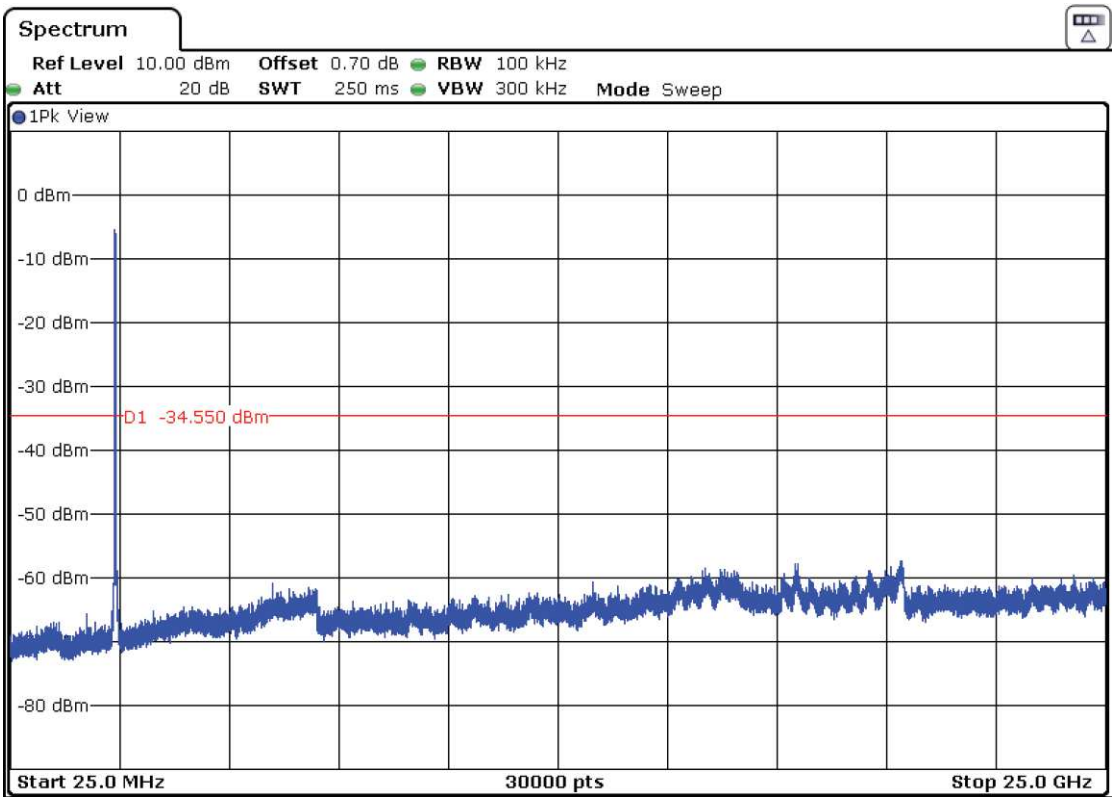
- High Channel:



The peak shown in the plot above the limit is the carrier frequency.

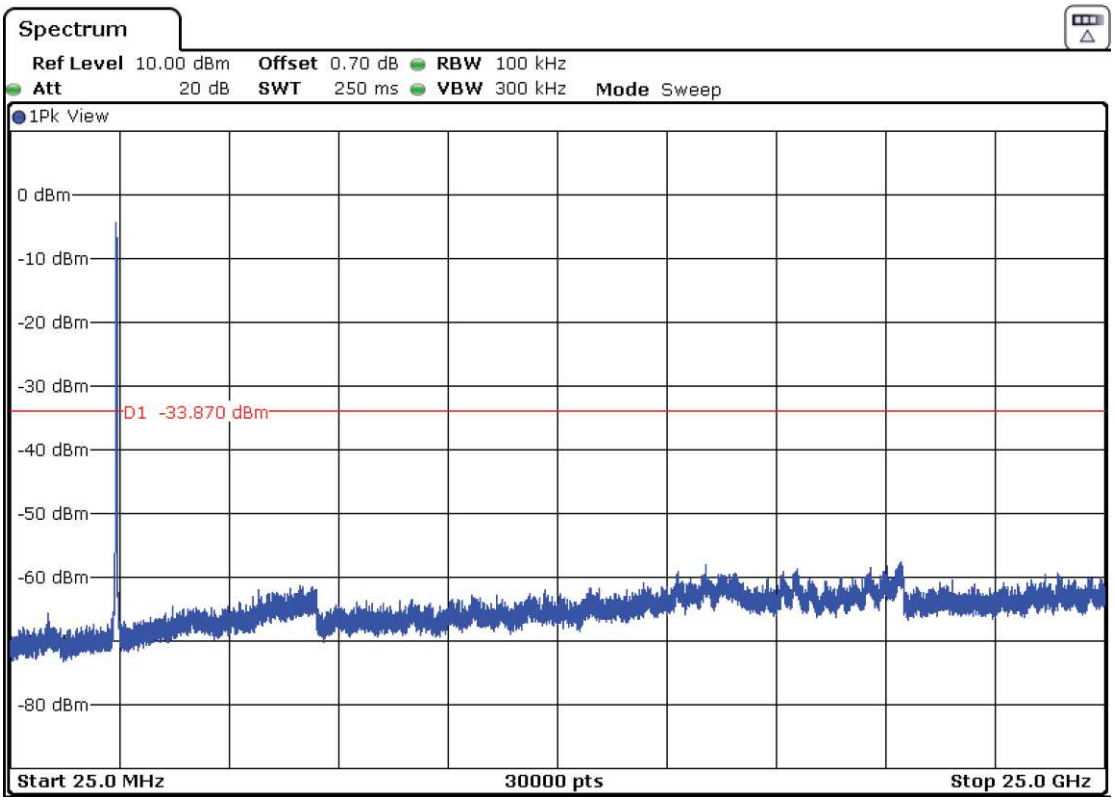
- **Mode 802.11 n20 – Emission limitations conducted**

- Low Channel:



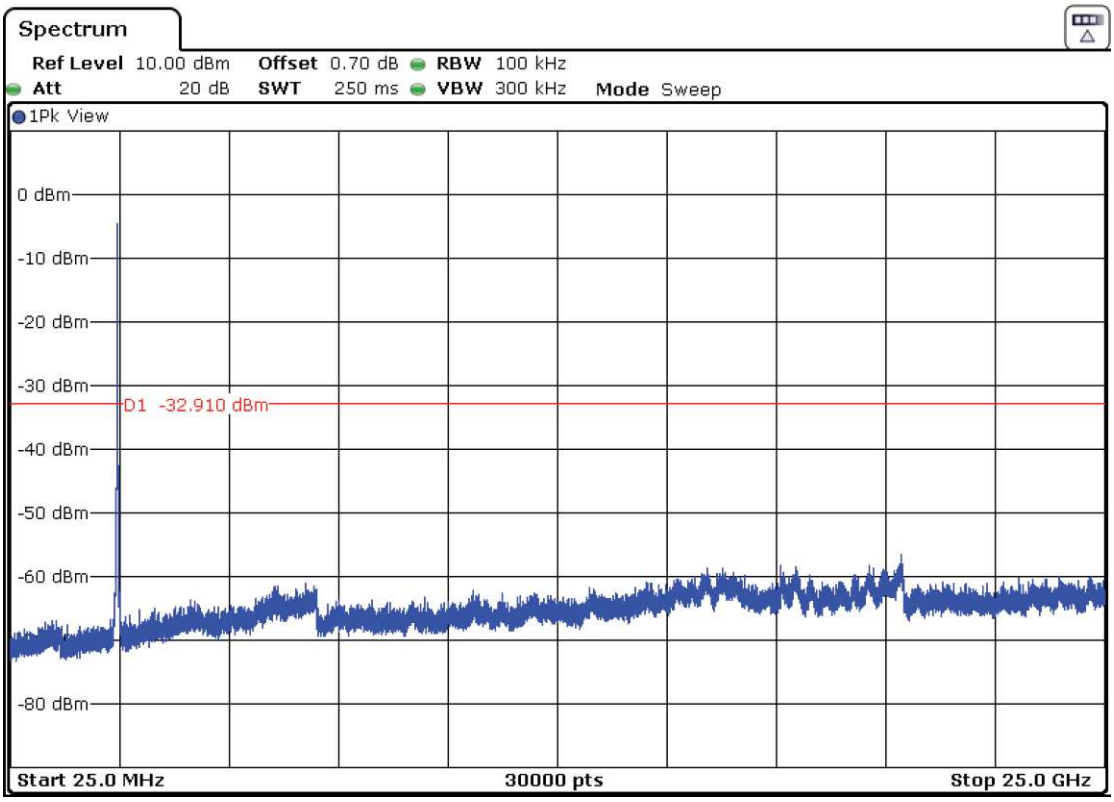
The peak shown in the plot above the limit is the carrier frequency.

- Middle Channel:



The peak shown in the plot above the limit is the carrier frequency.

- High Channel:



The peak shown in the plot above the limit is the carrier frequency.

FCC Section 15.247 Subclause (d) / RSS-247 Clause 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.

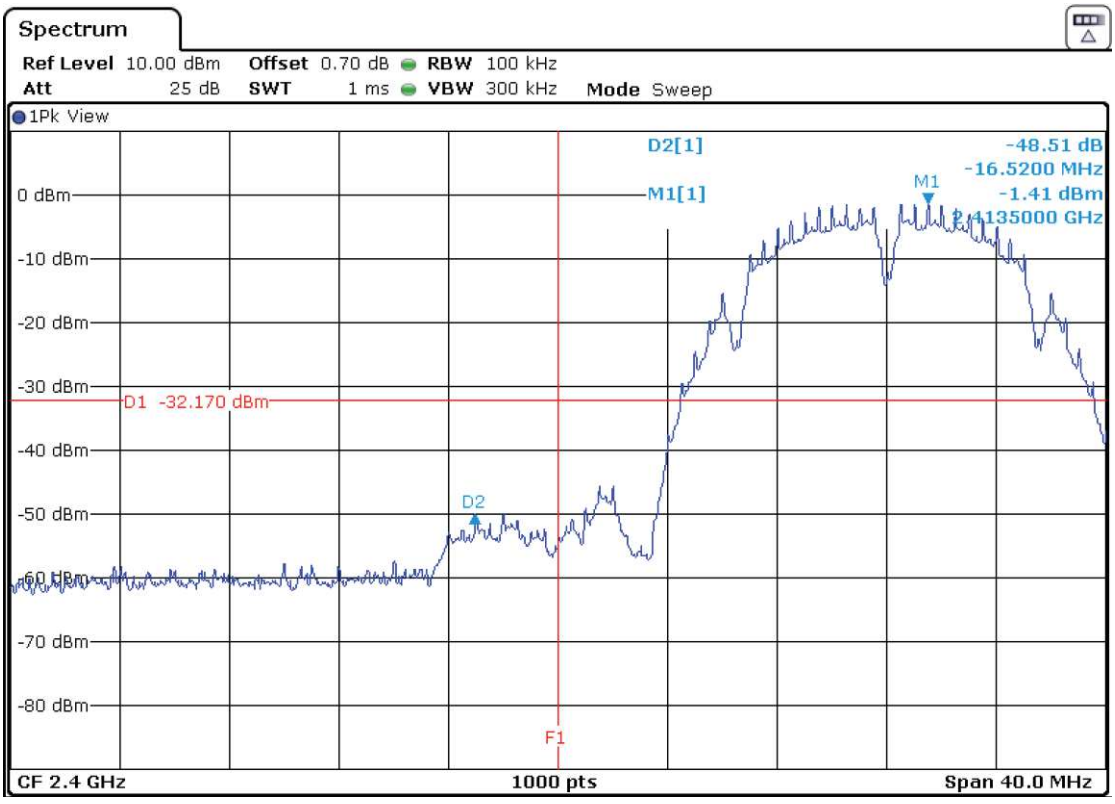
RESULTS:

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)	<±1.56

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

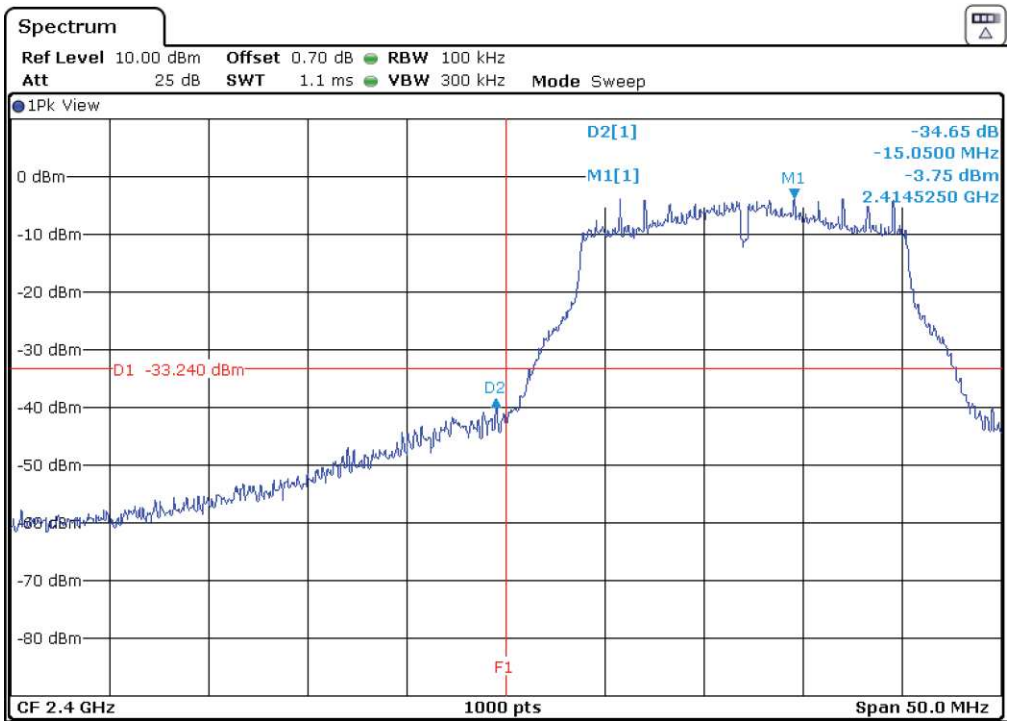
- Low Channel:



Verdict: PASS

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

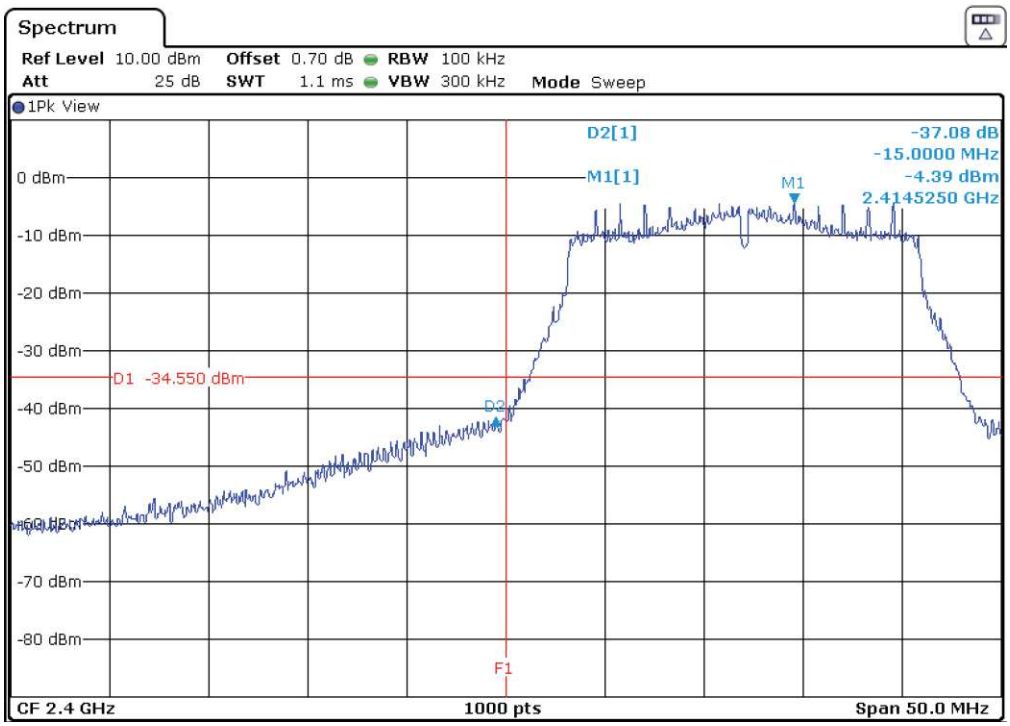
- Low Channel:



Verdict: PASS

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

- Low Channel:



Verdict: PASS

FCC Section 15.247 Subclause (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 maximum power spectral density level in the fundamental emission was measured using the method according to point 11.10.5." Method AVGPSD-2" of of ANSI C.63.10-2013.

- **Mode 802.11 b**

	Low Channel 2412 MHz	Middle Channel 2437 MHz	High Channel 2462 MHz
Power Spectral Density (dBm)	-10	-9.32	-8.25
Duty Cycle Correction Factor (dB)	0.172	0.172	0.172
Power Spectral Density corrected (dBm)	-9.828	-9.148	-8.078
Measurement uncertainty (dB)	<±0.78		

- **Mode 802.11 g**

	Low Channel 2412 MHz	Middle Channel 2437 MHz	High Channel 2462 MHz
Power Spectral Density (dBm)	-10.5	-10.21	-9.48
Duty Cycle Correction Factor (dB)	0.975	0.975	0.975
Power Spectral Density corrected (dBm)	-9.525	-9.235	-8.505
Measurement uncertainty (dB)	<±0.78		

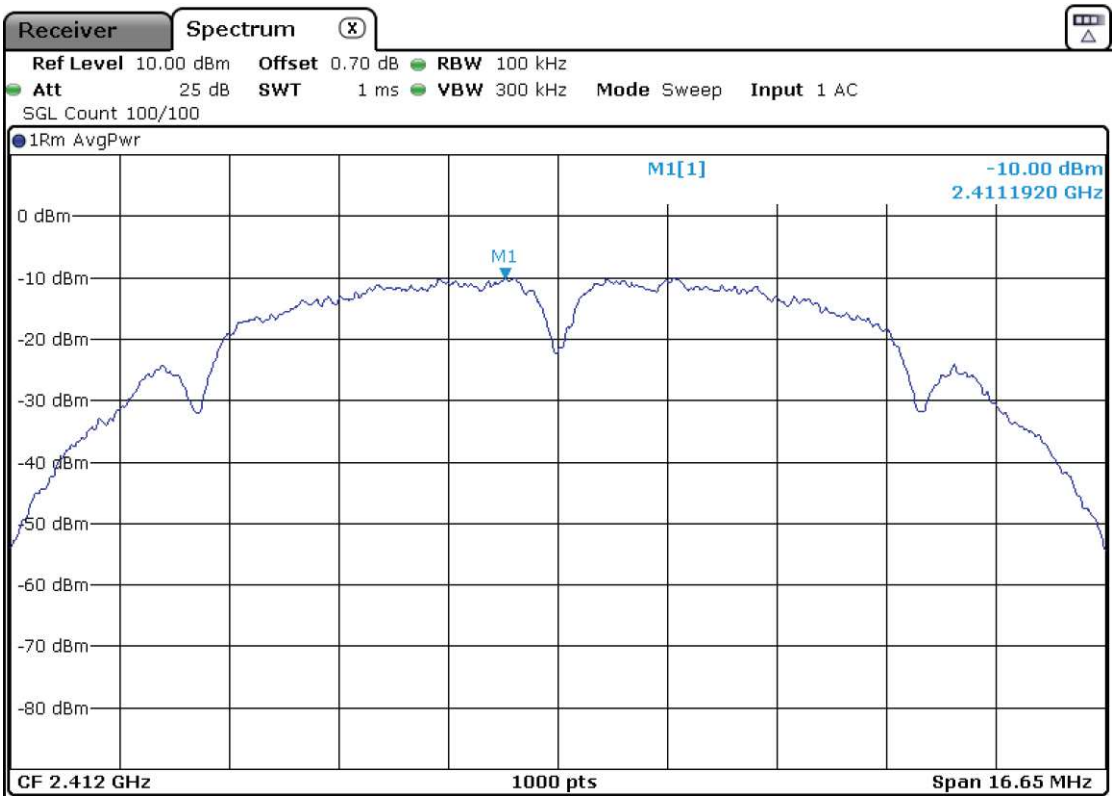
- **Mode 802.11 n20**

	Low Channel 2412 MHz	Middle Channel 2437 MHz	High Channel 2462 MHz
Power Spectral Density (dBm)	-11.75	-11.03	-9.97
Duty Cycle Correction Factor (dB)	1.038	1.038	1.038
Power Spectral Density corrected (dBm)	-10.712	-9.992	-8.932
Measurement uncertainty (dB)	<±0.78		

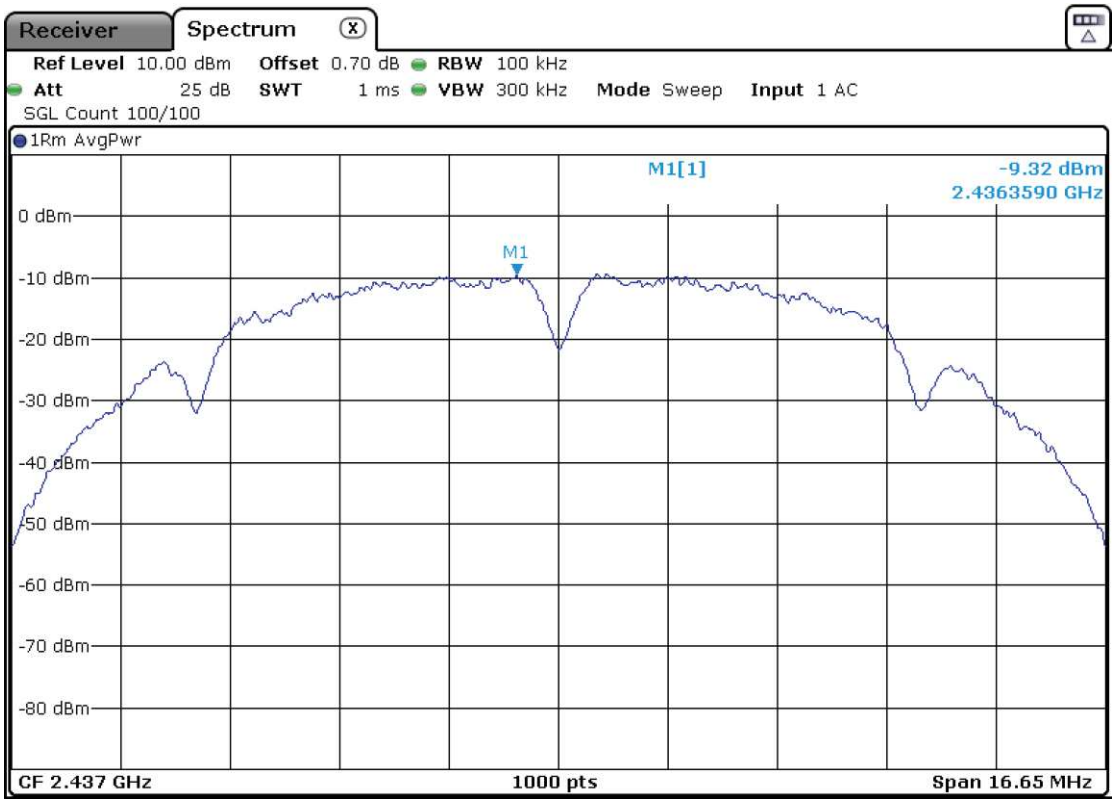
Verdict: PASS

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

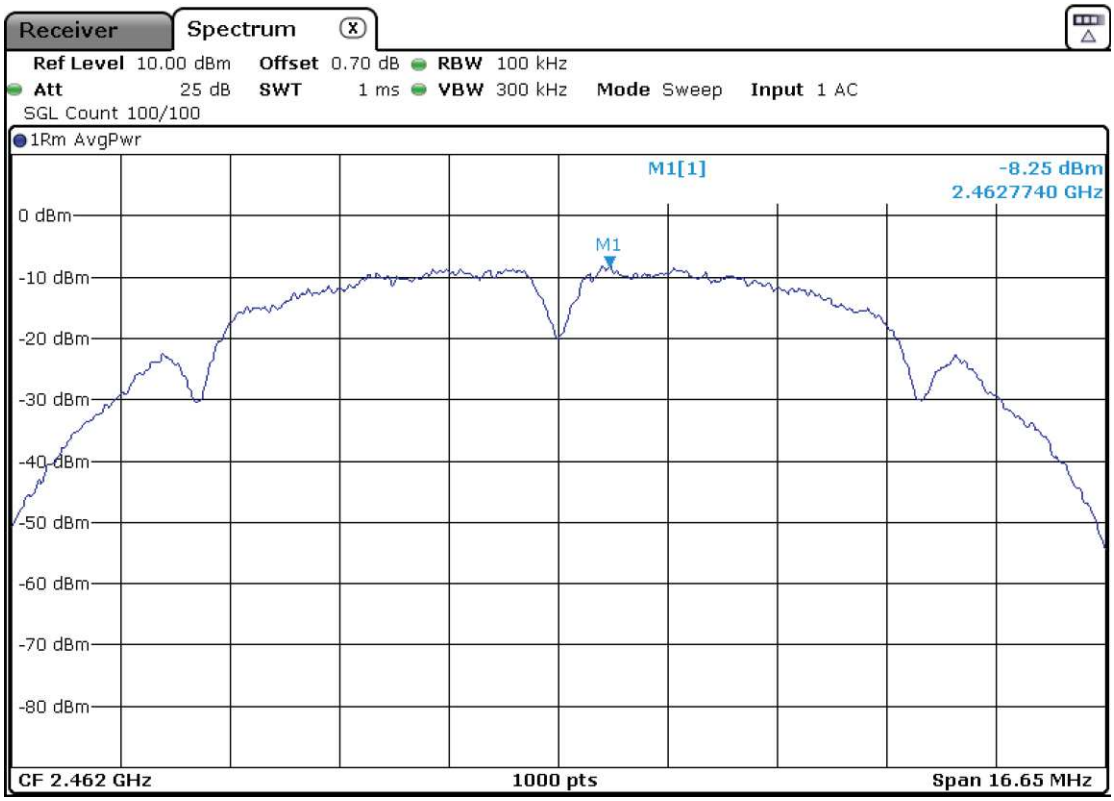
- Low Channel:



- Middle Channel:

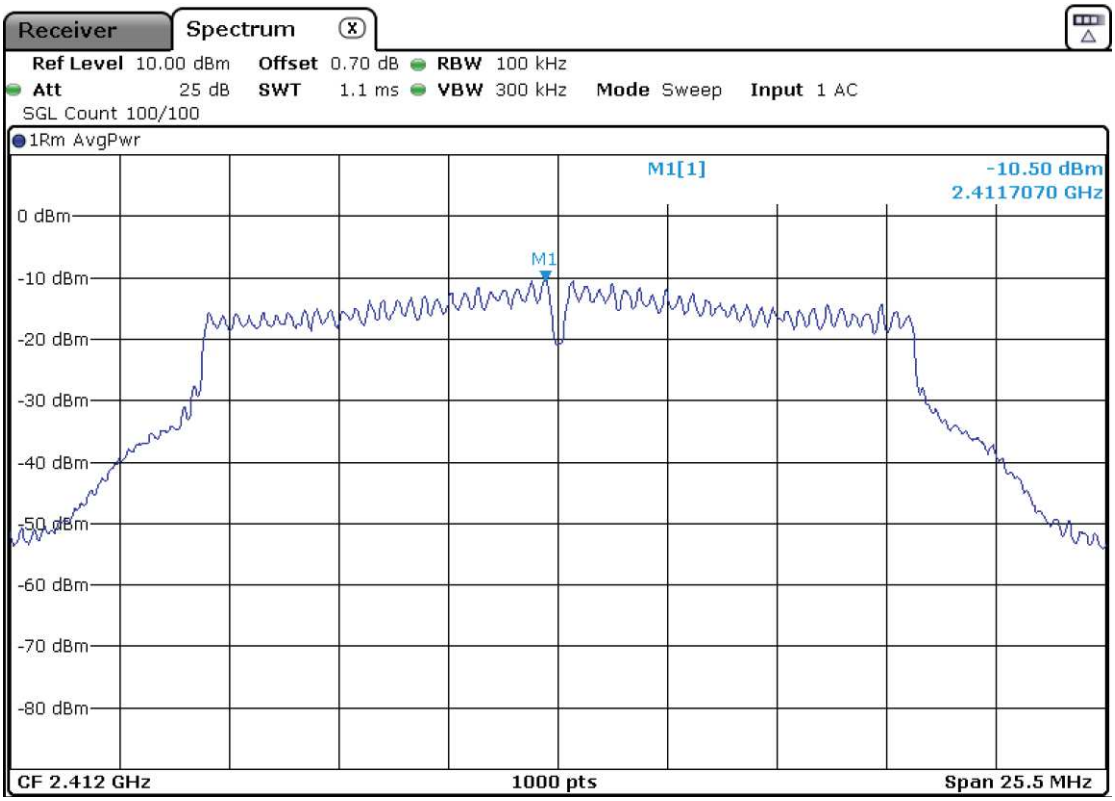


- High Channel:

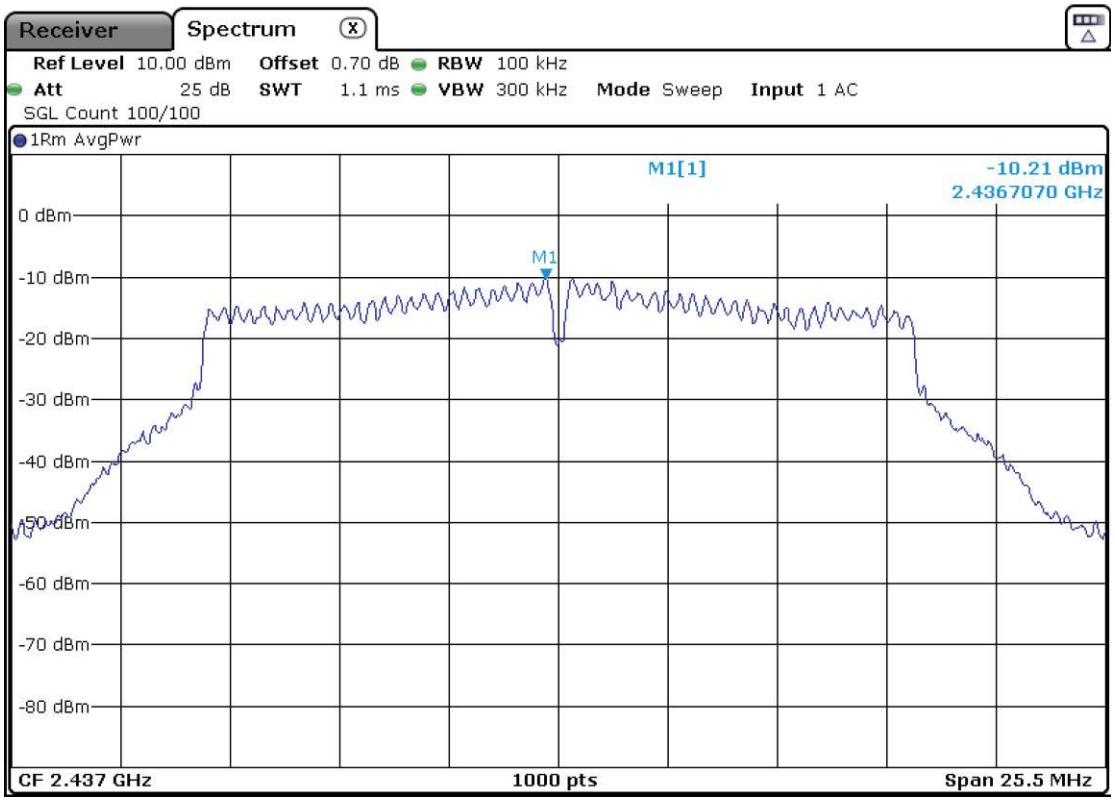


Mode 802.11 g – Power Spectral Density

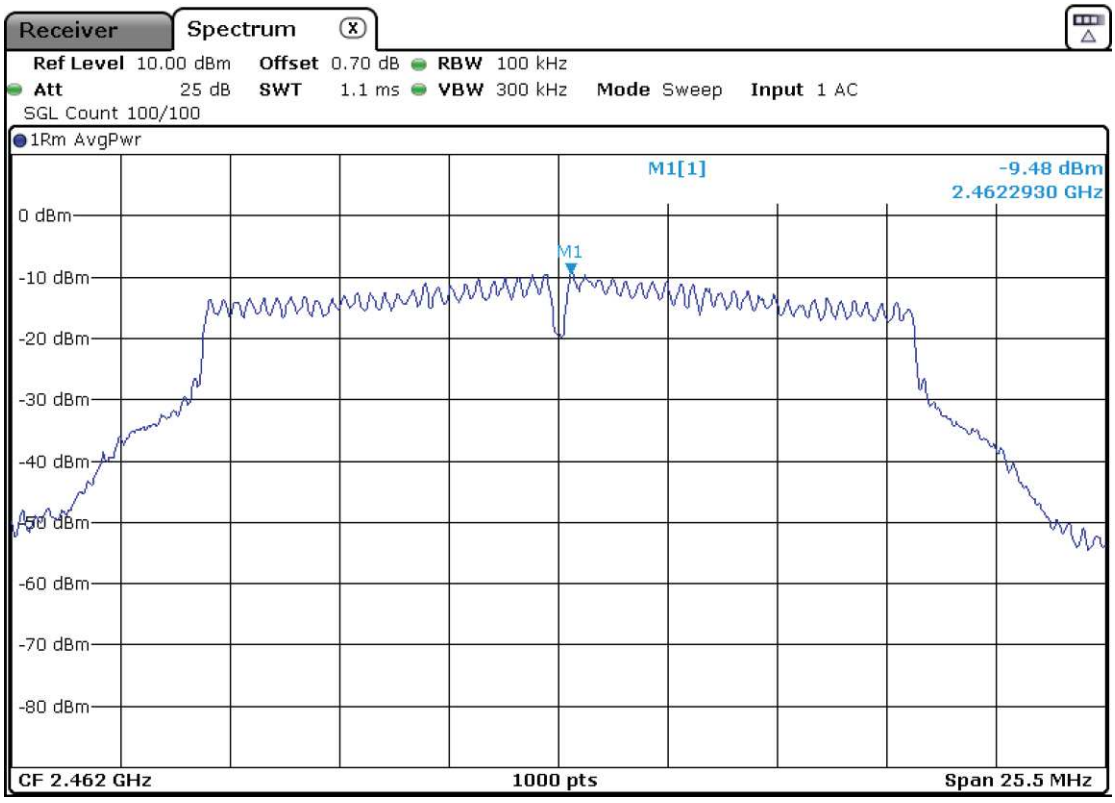
- Low Channel:



- Middle Channel:

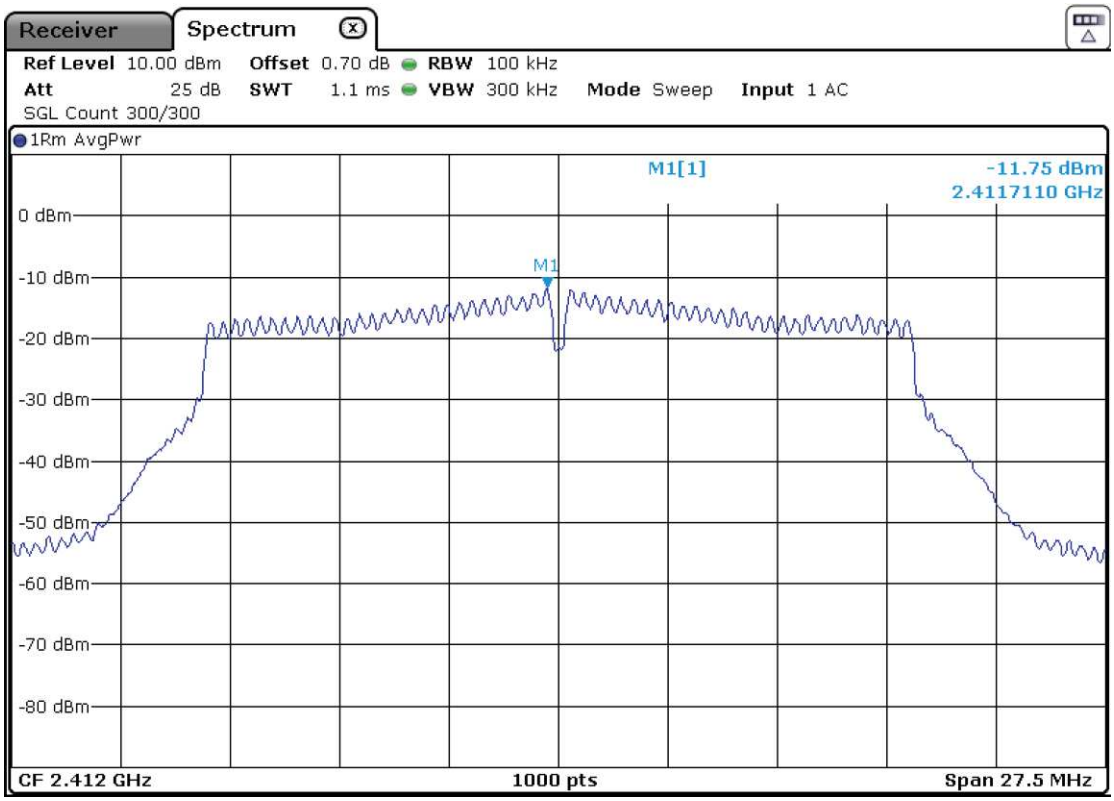


- High Channel:

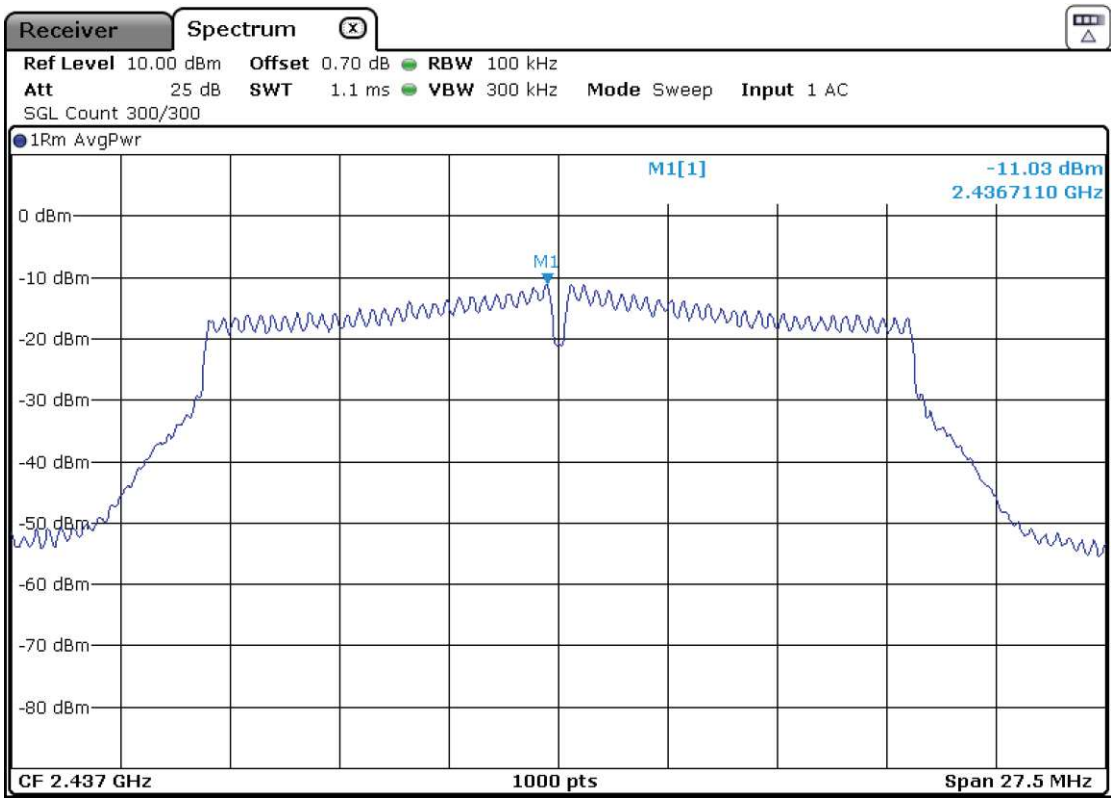


- **Mode 802.11 n20 – Power Spectral Density**

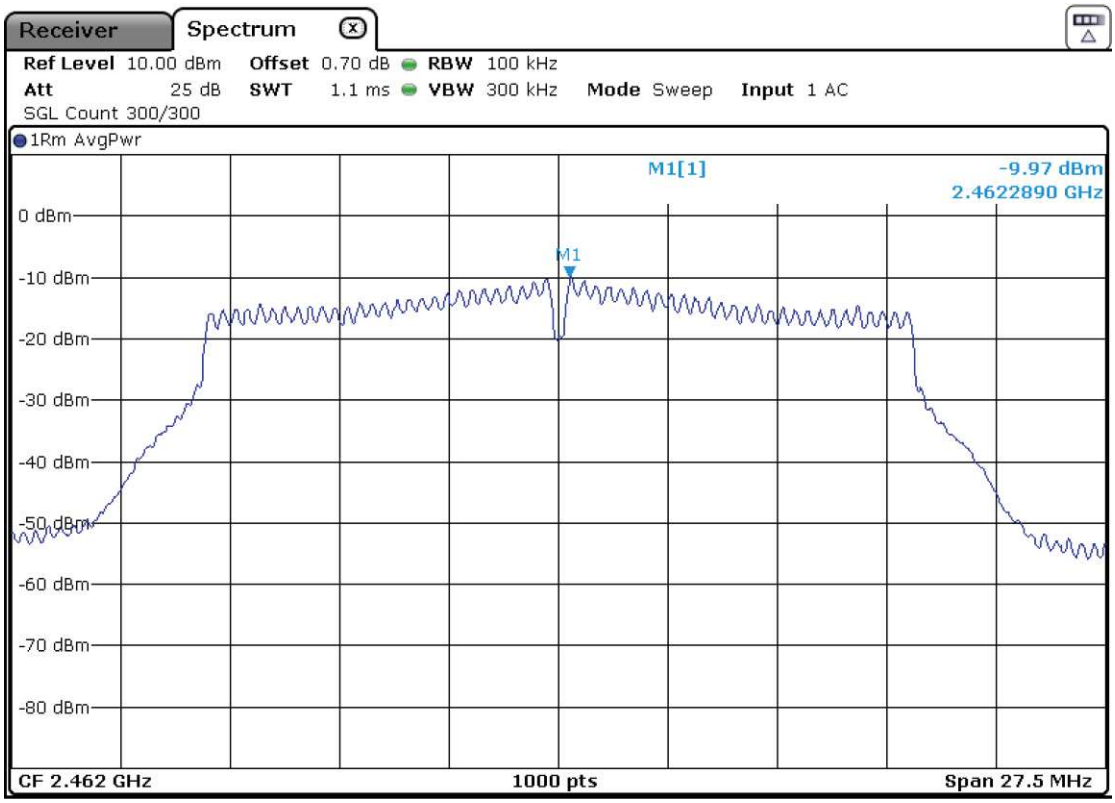
- Low Channel:



- Middle Channel:



- High Channel:



FCC Section 15.247 Subclause (d) / RSS-247 Clause 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-1000 MHz and at distance of 1m for the frequency range 1 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.

- **Mode 802.11 b**

Frequency range 30 MHz - 1 GHz:

The spurious frequencies do not depend on the operating channel.

Spurious levels operating (radiated) closest to limit.

Spurious frequency (MHz)	Detector	Emission Level (dBµV/m)	Polarization	Measurement Uncertainty (dB)
38.488	Quasi peak	31.40	V	<± 3.88
786.455	Quasi peak	29.90	V	<± 3.88
884.780	Quasi peak	34.40	H	<± 3.88
890.245	Quasi peak	35.60	H	<± 3.88

Frequency range 1 - 26 GHz:

The results in the next tables show the maximum measured levels in the 1-25 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 closest to the limit:

Spurious frequency (GHz)	Detector	Emission Level (dBµV/m)	Polarization	Measurement Uncertainty (dB)
3.56117	Peak	34.85	V	<± 3.70
4.89630	Peak	39.44	V	<± 3.70
5.37510	Peak	39.72	V	<± 3.70

- MIDDLE CHANNEL. Spurious frequencies closest to the limit:

Spurious frequency (GHz)	Detector	Emission Level (dBµV/m)	Polarization	Measurement Uncertainty (dB)
4.49403	Peak	42.24	V	<± 3.70
5.37463	Peak	39.52	V	<± 3.70

- HIGH CHANNEL. Spurious frequencies closest to the limit:

Spurious frequency (MHz)	Detector	Emission Level (dBµV/m)	Polarization	Measurement Uncertainty (dB)
4.48237	Peak	43.32	H	<± 3.70
5.37463	Peak	40.78	V	<± 3.70

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. Herein the results for the worst case mode: 802.11n20.

Spurious emissions in the Restricted Band 1 and Restricted Band 2 are measured for all modes.

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

Frequency range 30 MHz - 1 GHz:

The spurious frequencies do not depend on the operating channel.

Spurious levels operating (radiated) closest to limit.

Spurious frequency (MHz)	Detector	Emission Level (dBµV/m)	Polarization	Measurement Uncertainty (dB)
38.003	Quasi peak	31.78	V	<± 3.88
786.487	Quasi peak	26.10	V	<± 3.88
884.780	Quasi peak	34.70	V	<± 3.88
890.245	Quasi peak	31.20	V	<± 3.88

Frequency range 1 - 26 GHz:

The results in the next tables show the maximum measured levels in the 1-25 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 closest to the limit:

Spurious frequency (GHz)	Detector	Emission Level (dBµV/m)	Polarization	Measurement Uncertainty (dB)
4.48983	Peak	46.64	H	<± 3.70
5.37463	Peak	39.65	H	<± 3.70

- MIDDLE CHANNEL. Spurious frequencies closest to the limit:

Spurious frequency (GHz)	Detector	Emission Level (dBµV/m)	Polarization	Measurement Uncertainty (dB)
4.49637	Peak	46.93	H	<± 3.70
5.37463	Peak	40.32	H	<± 3.70

- HIGH CHANNEL.

Spurious frequency (GHz)	Detector	Emission Level (dBµV/m)	Polarization	Measurement Uncertainty (dB)
4.49030	Peak	46.60	H	<± 3.70
5.37463	Peak	39.45	H	<± 3.70

Verdict: PASS

- **Mode 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 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.

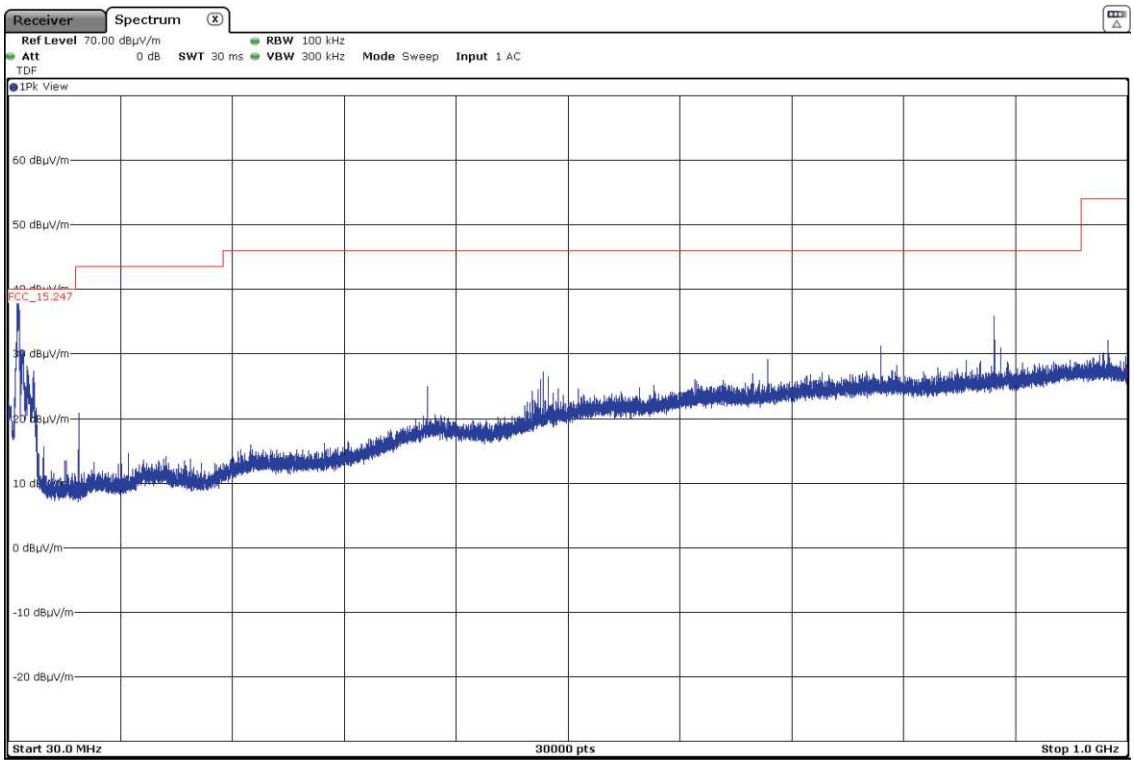
No spurious where detected at less than 20 dB from the limit.

Verdict: PASS

- **Mode 802.11 b**

FREQUENCY RANGE 30 MHz - 1 GHz:

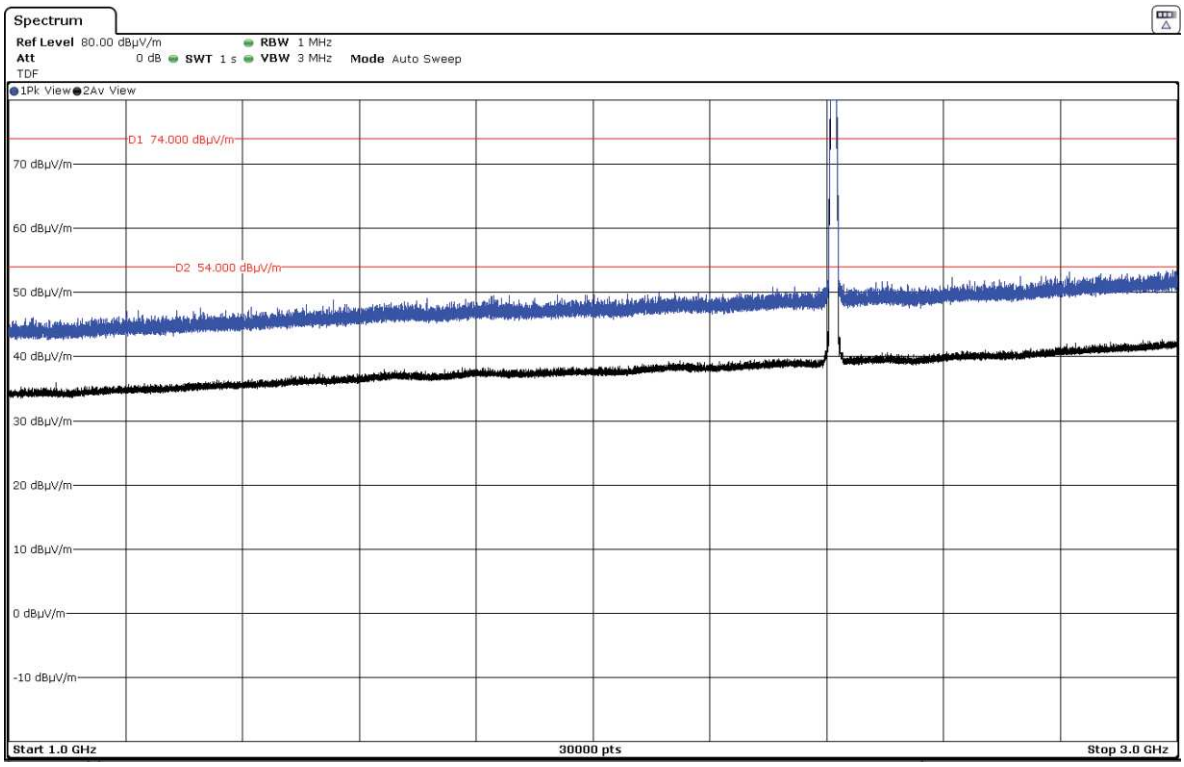
The spurious signals detected do not depend on the operating channel.



Note: This plot is valid for all three channels.

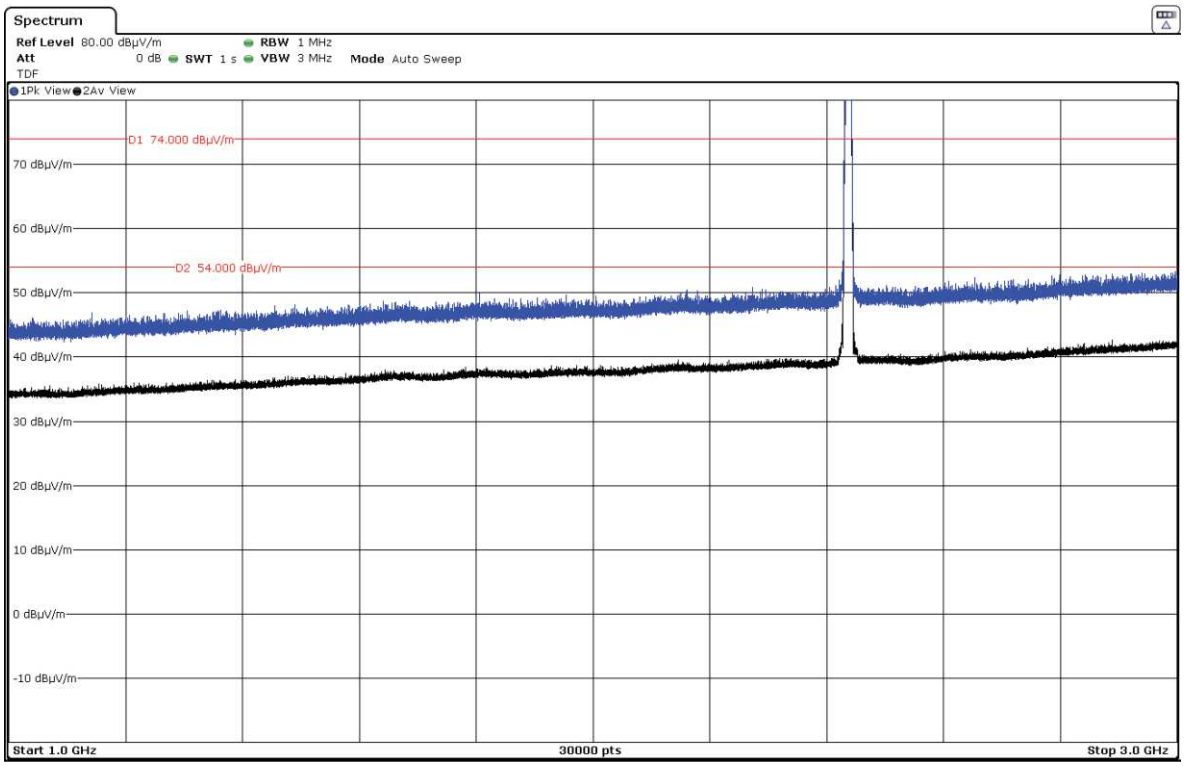
FREQUENCY RANGE 1 - 3 GHz:

- Low Channel:



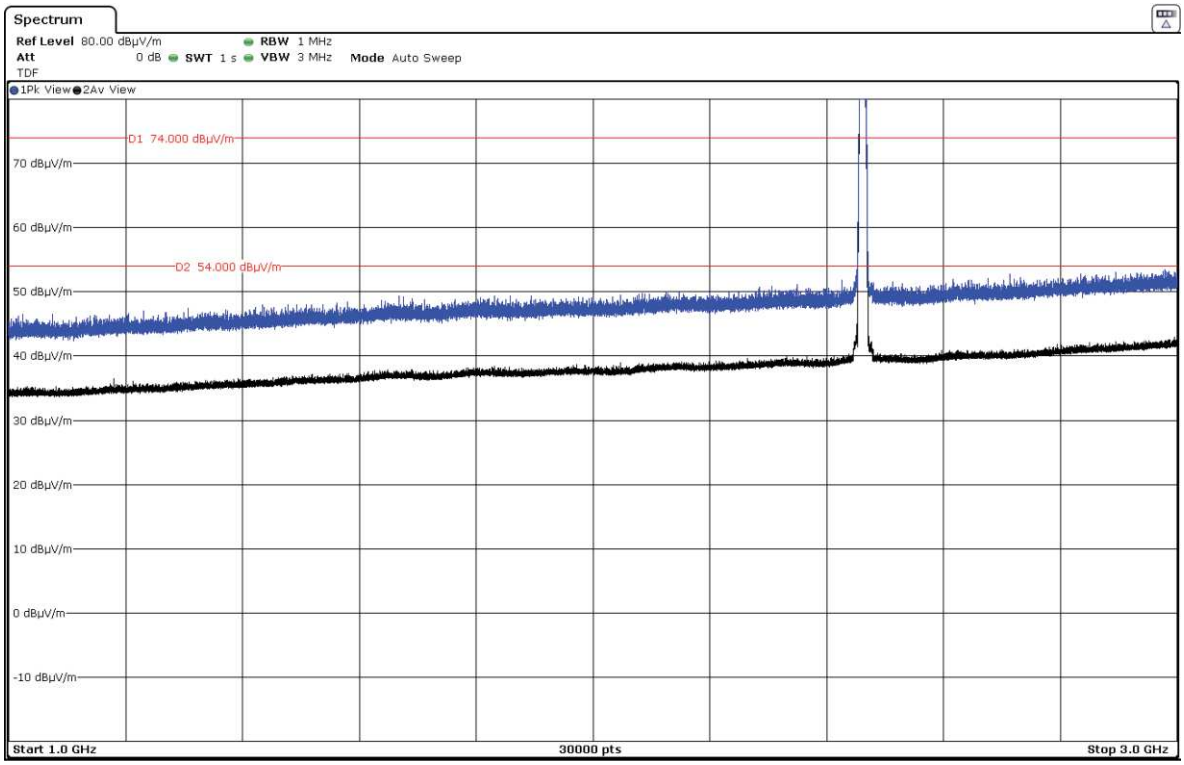
The peak above the limit is the carrier frequency.

- Middle Channel:



The peak above the limit is the carrier frequency.

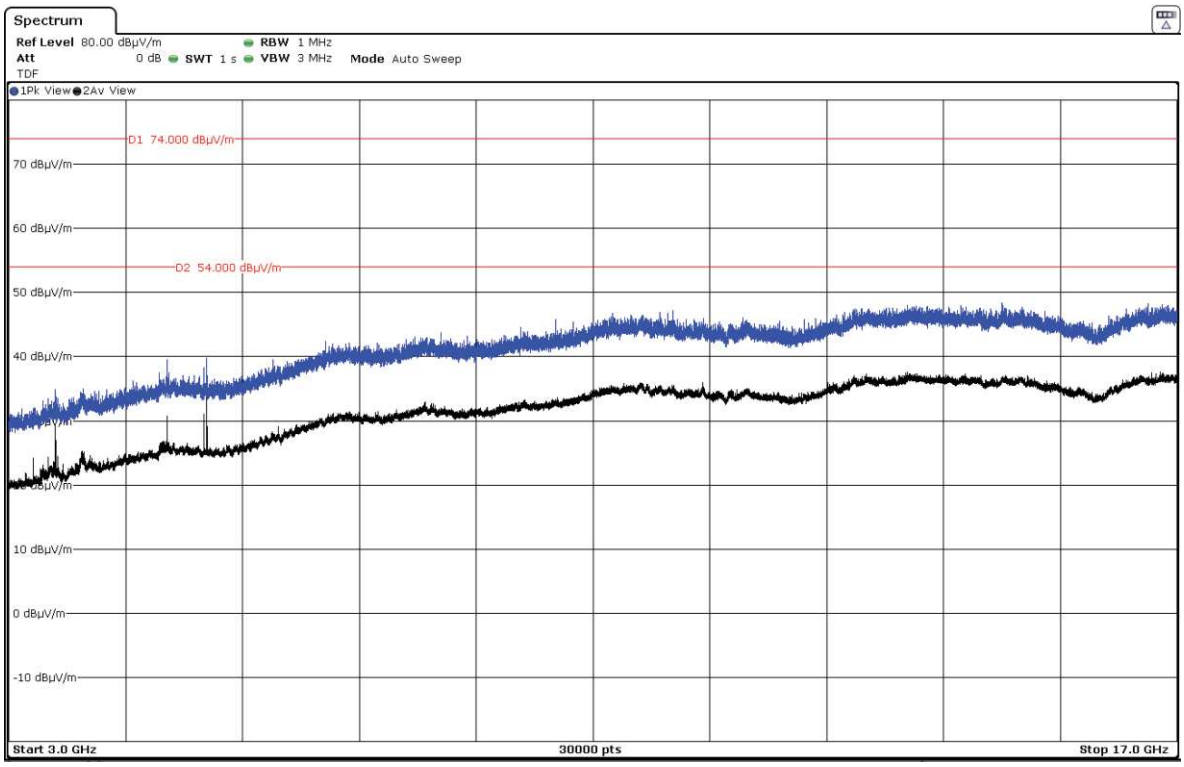
- High Channel:



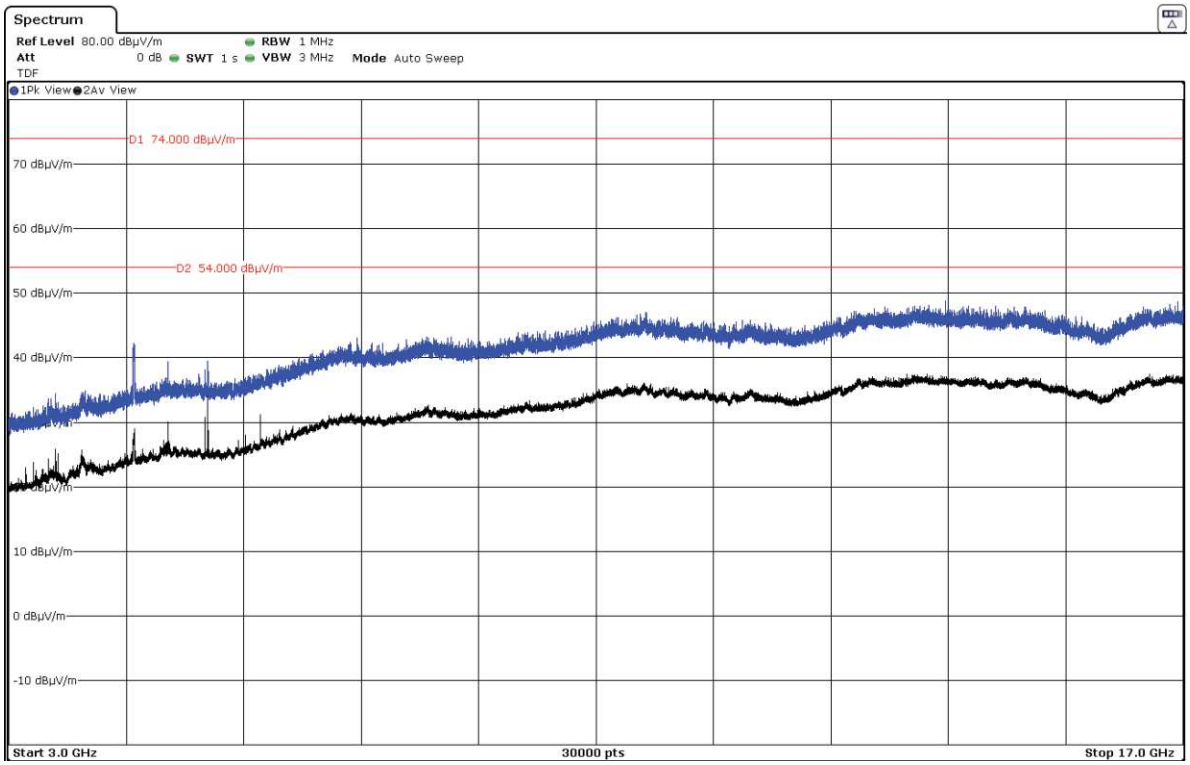
The peak above the limit is the carrier frequency.

FREQUENCY RANGE 3 - 17 GHz:

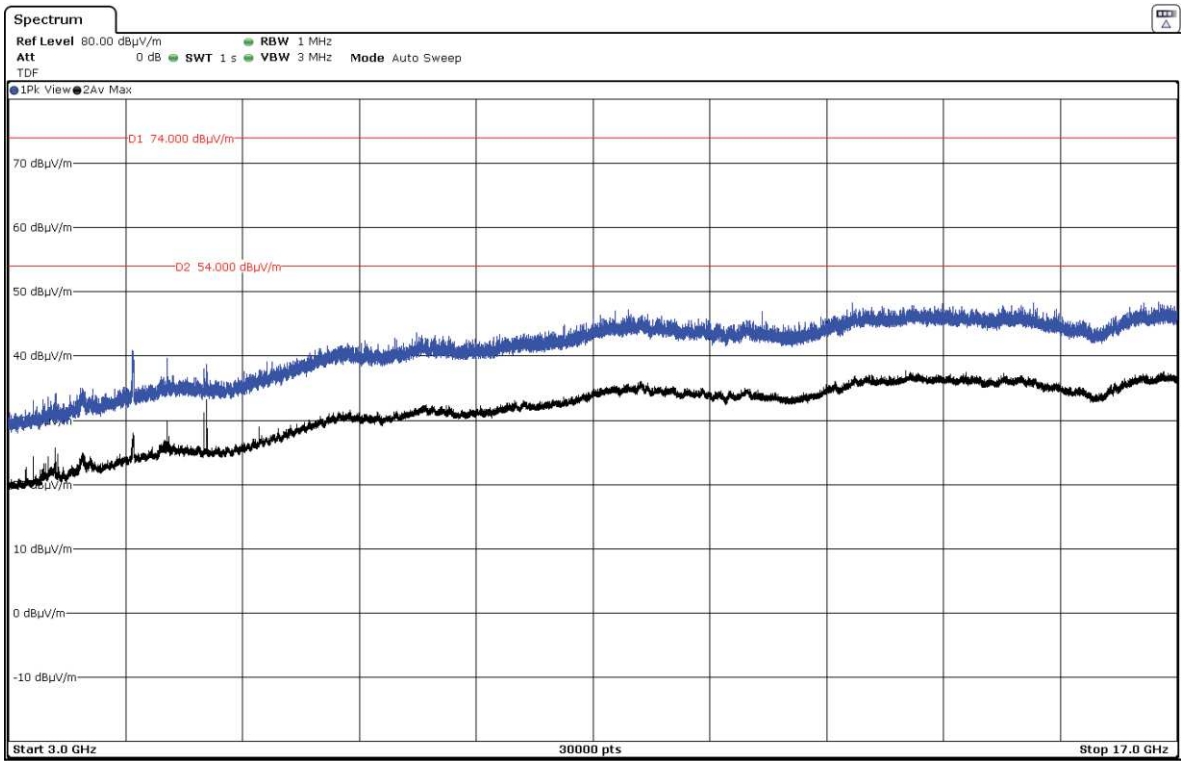
- Low Channel:



- Middle Channel:

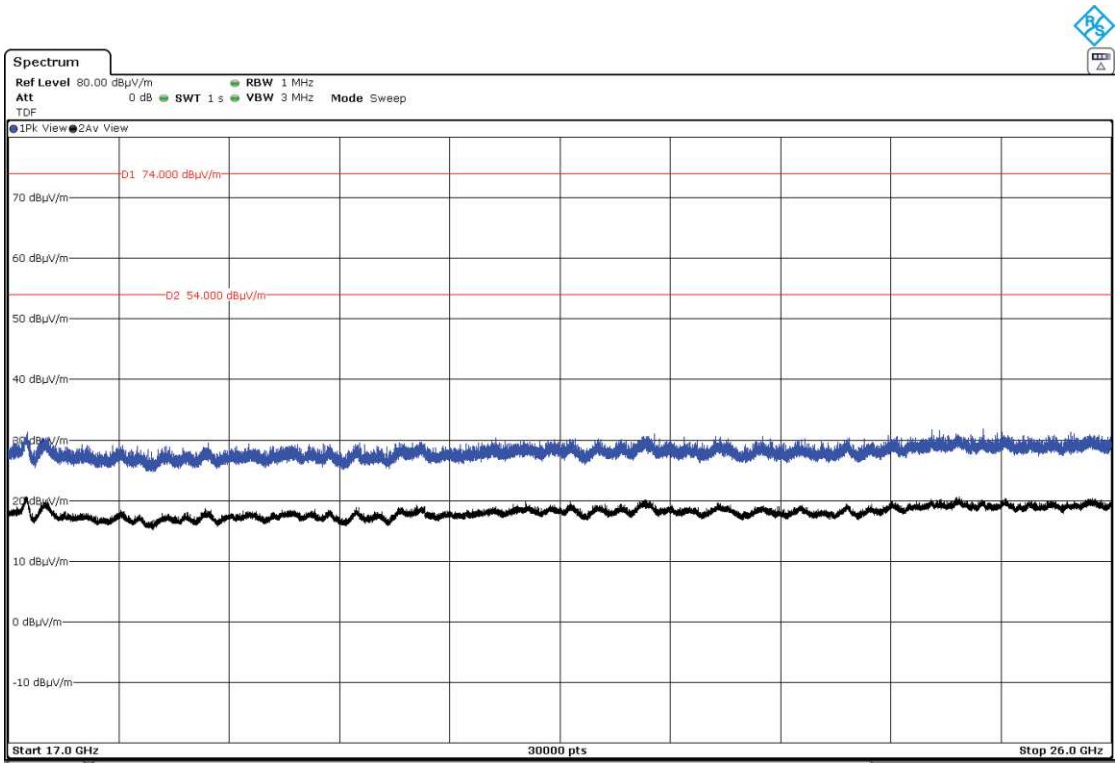


- High Channel:



FREQUENCY RANGE 17 - 26 GHz:

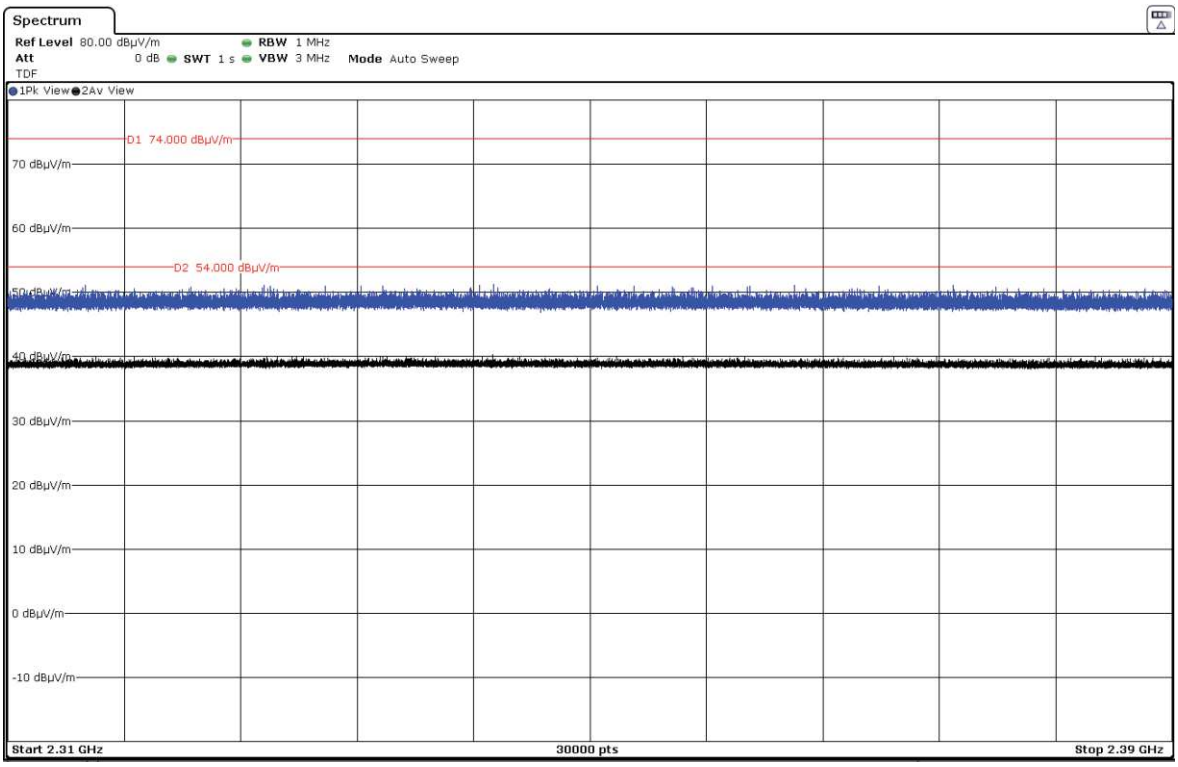
The spurious signals detected do not depend on the operating channel.



Note: This plot is valid for all three channels.

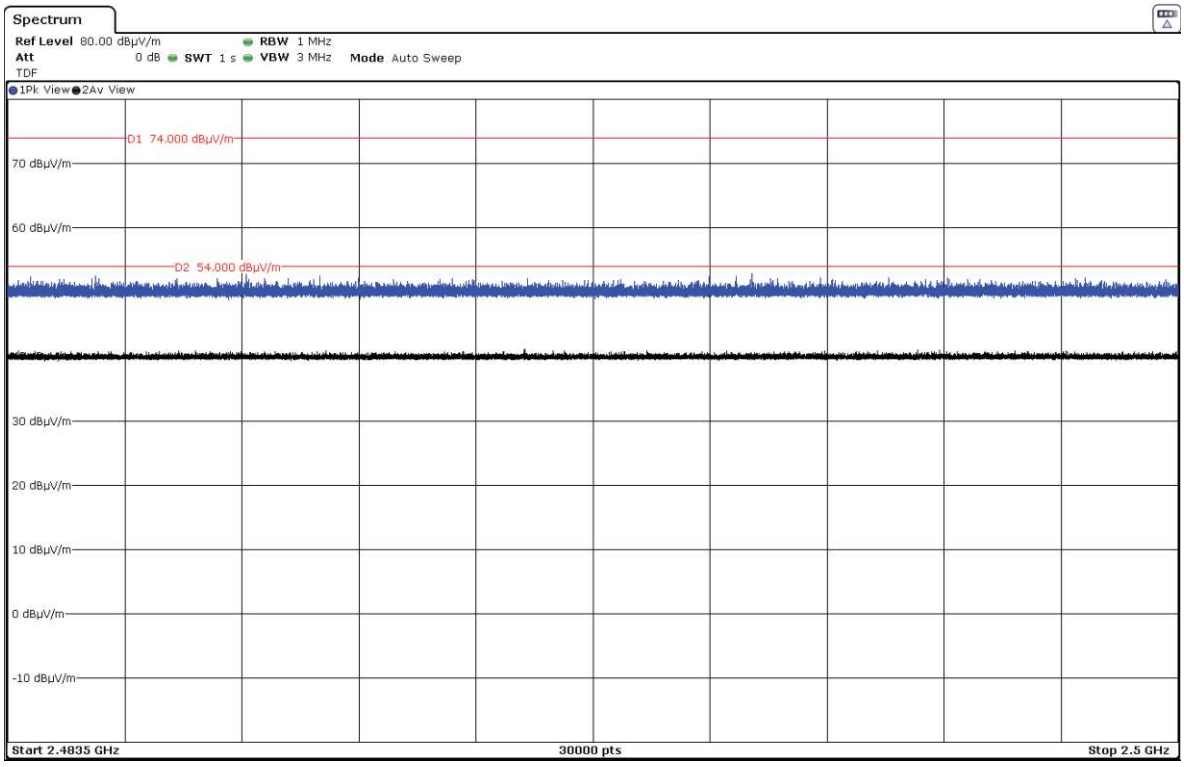
FREQUENCY RANGE 2.31-2.39 GHz (Restricted Band 1):

- Low Channel. CH 1:



FREQUENCY RANGE 2.4835-2.5 GHz (Restricted Band 2):

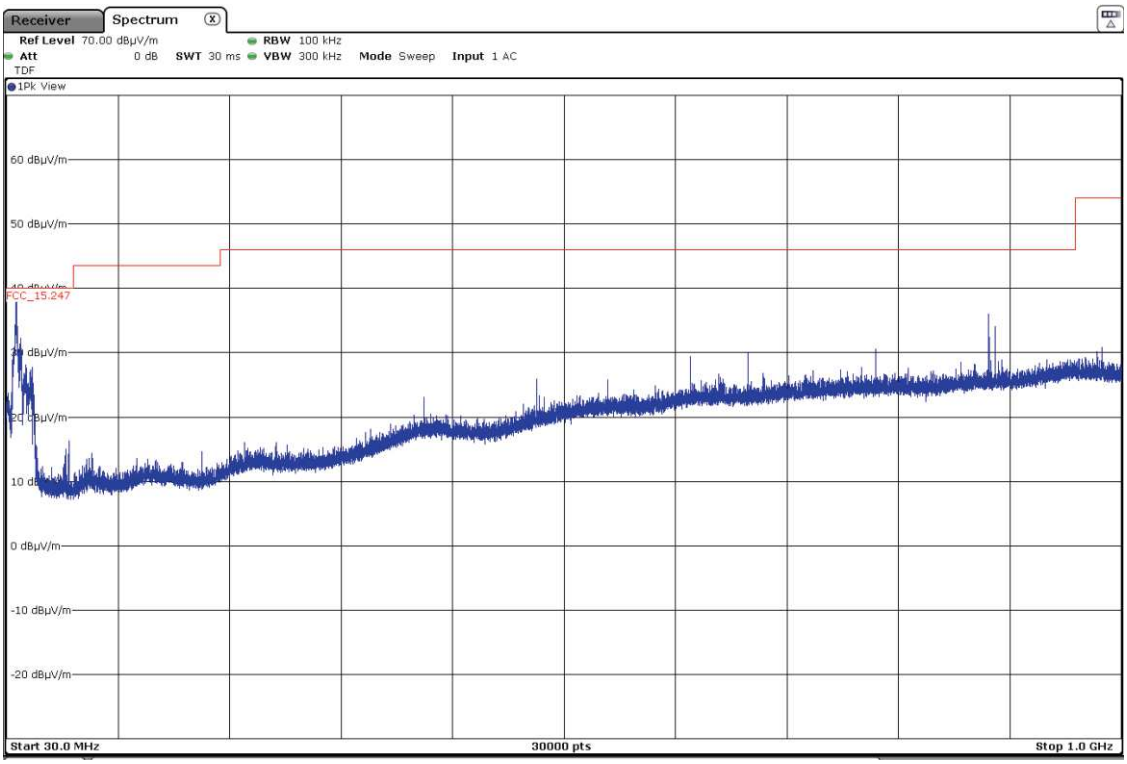
- High Channel. CH 11:



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

FREQUENCY RANGE 30 MHz - 1 GHz:

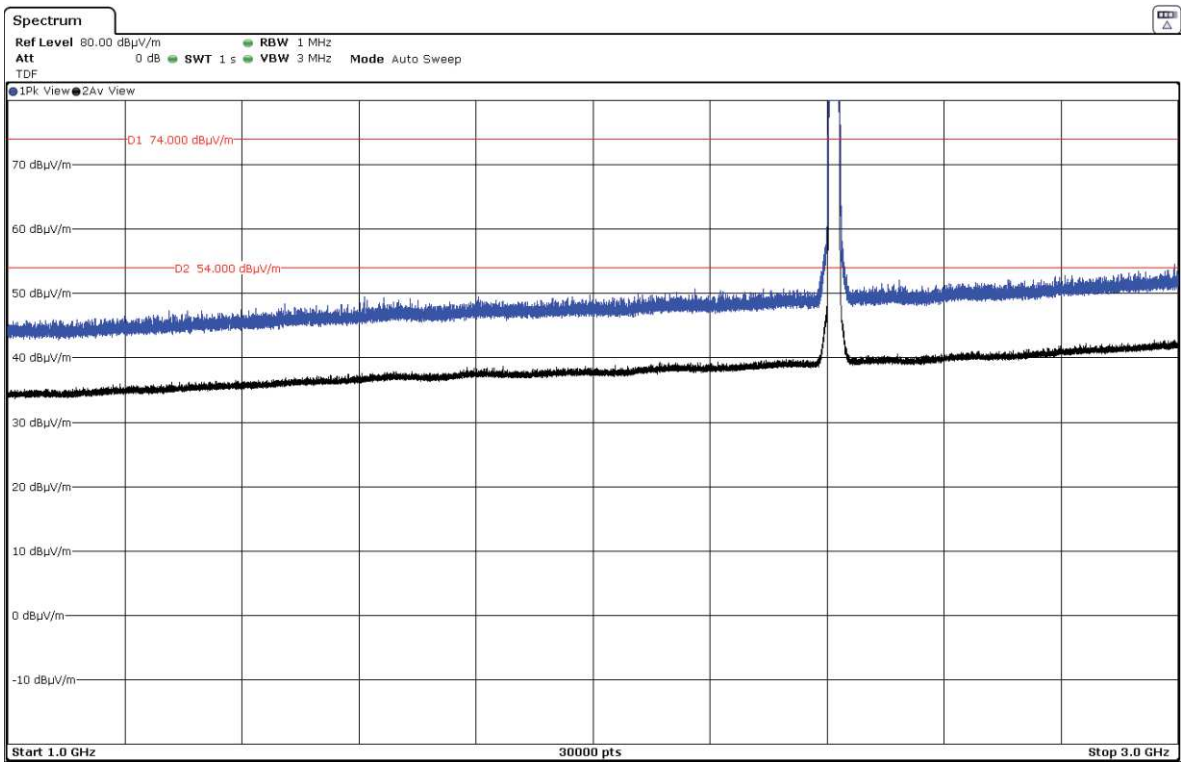
The spurious signals detected do not depend on the operating channel.



Note: This plot is valid for all three channels.

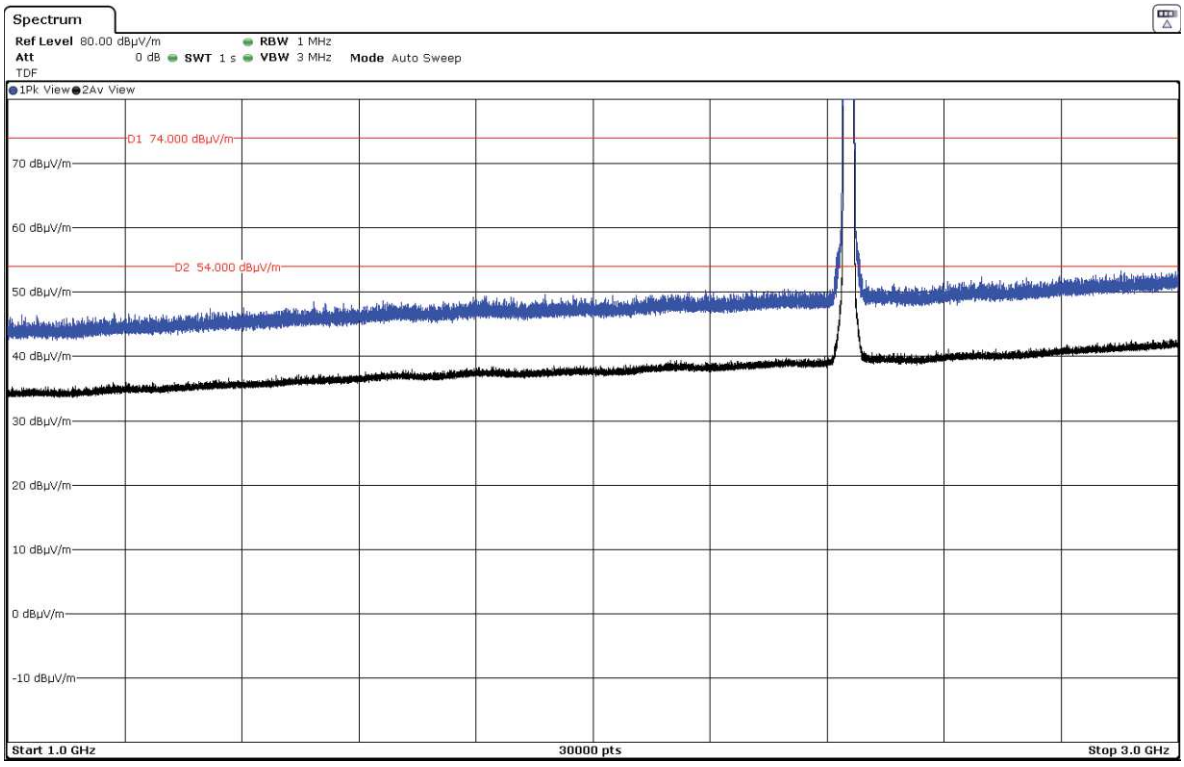
FREQUENCY RANGE 1 - 3 GHz:

- Low Channel:



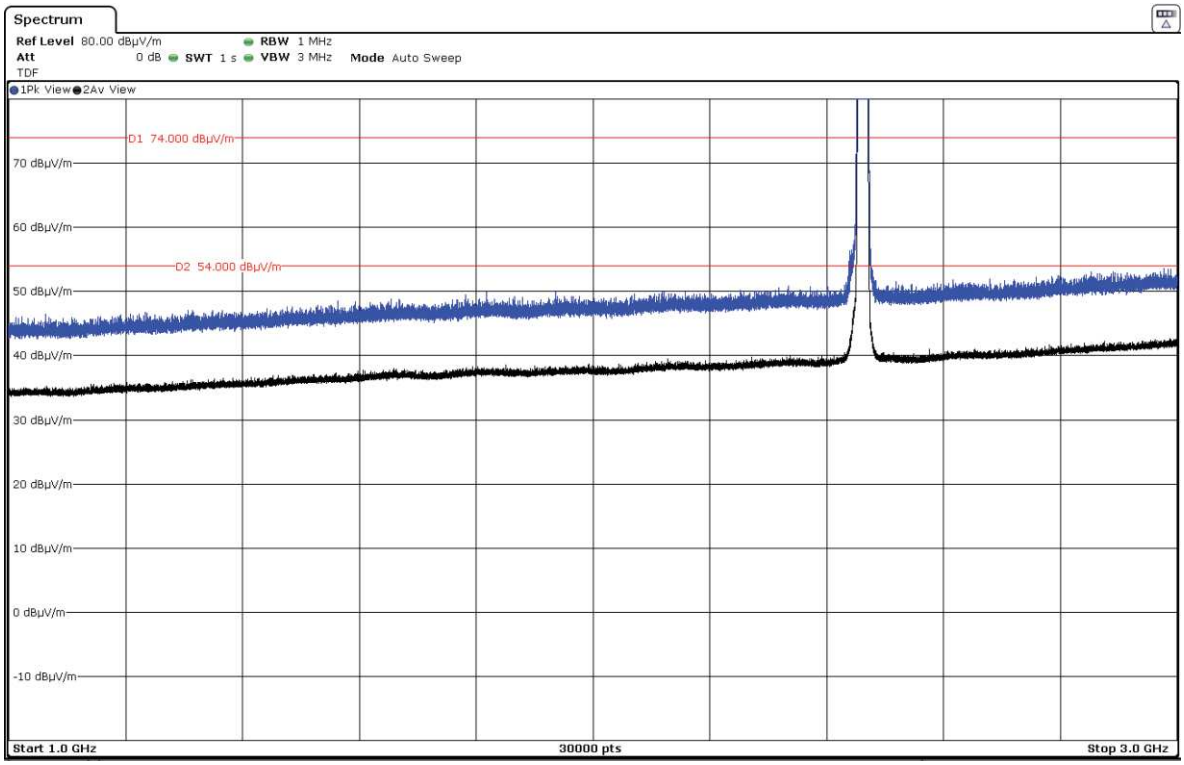
The peak above the limit is the carrier frequency.

- Middle Channel:



The peak above the limit is the carrier frequency.

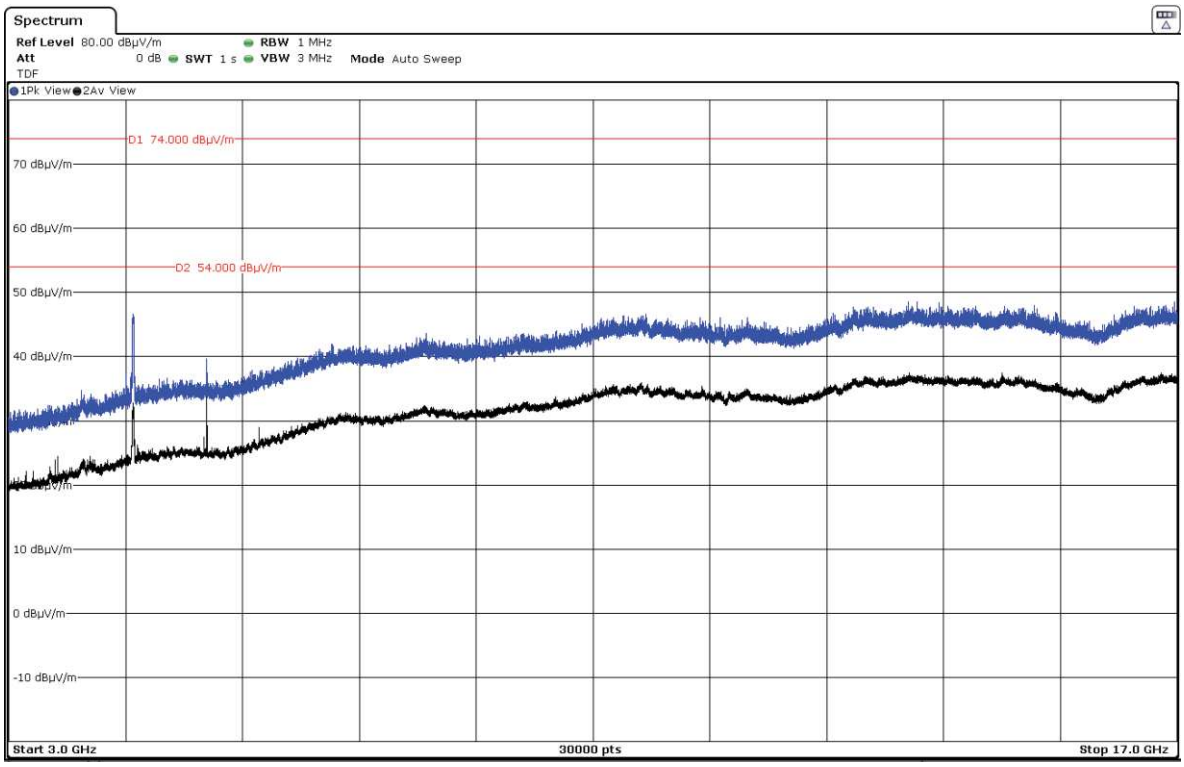
- High Channel:



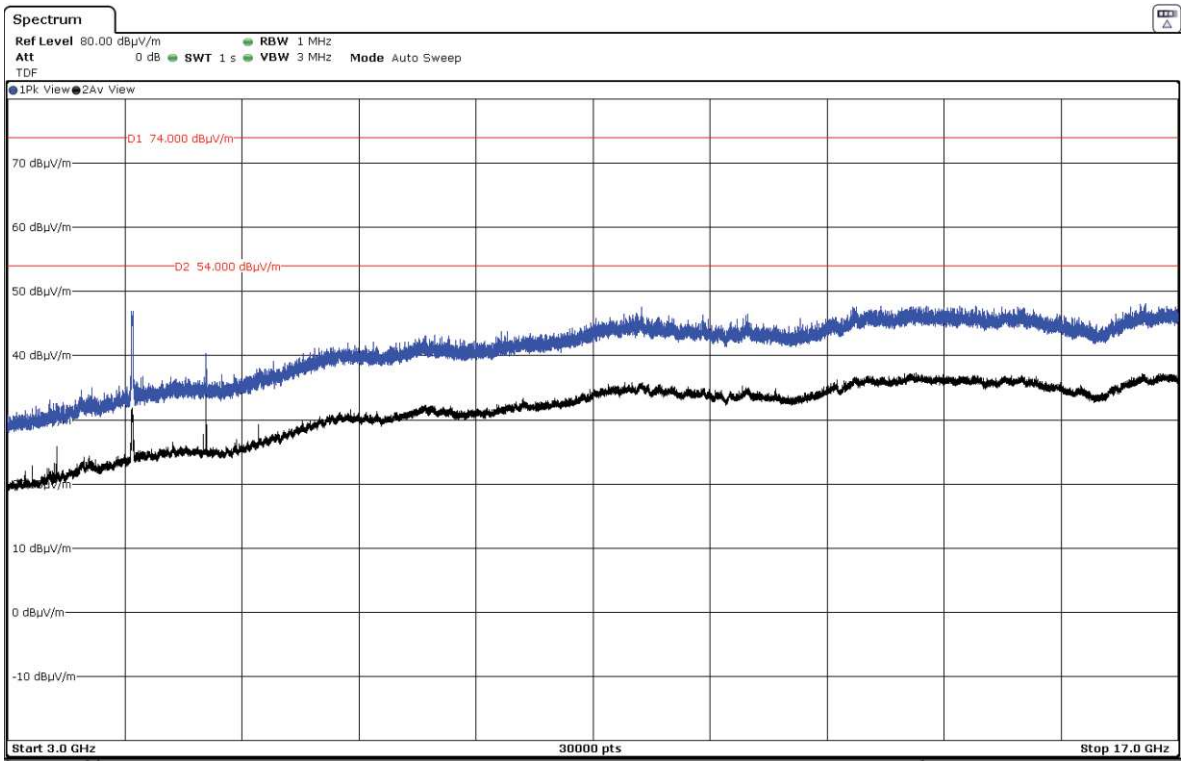
The peak above the limit is the carrier frequency.

FREQUENCY RANGE 3 - 17 GHz:

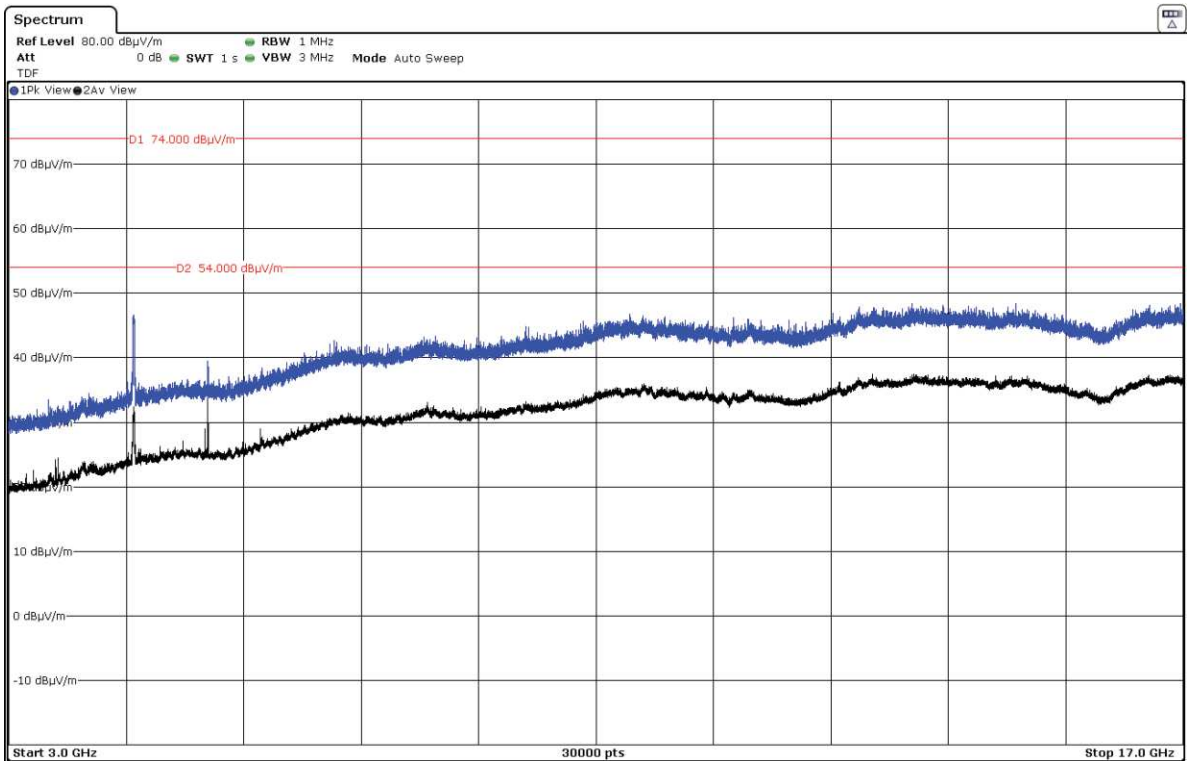
- Low Channel:



- Middle Channel:

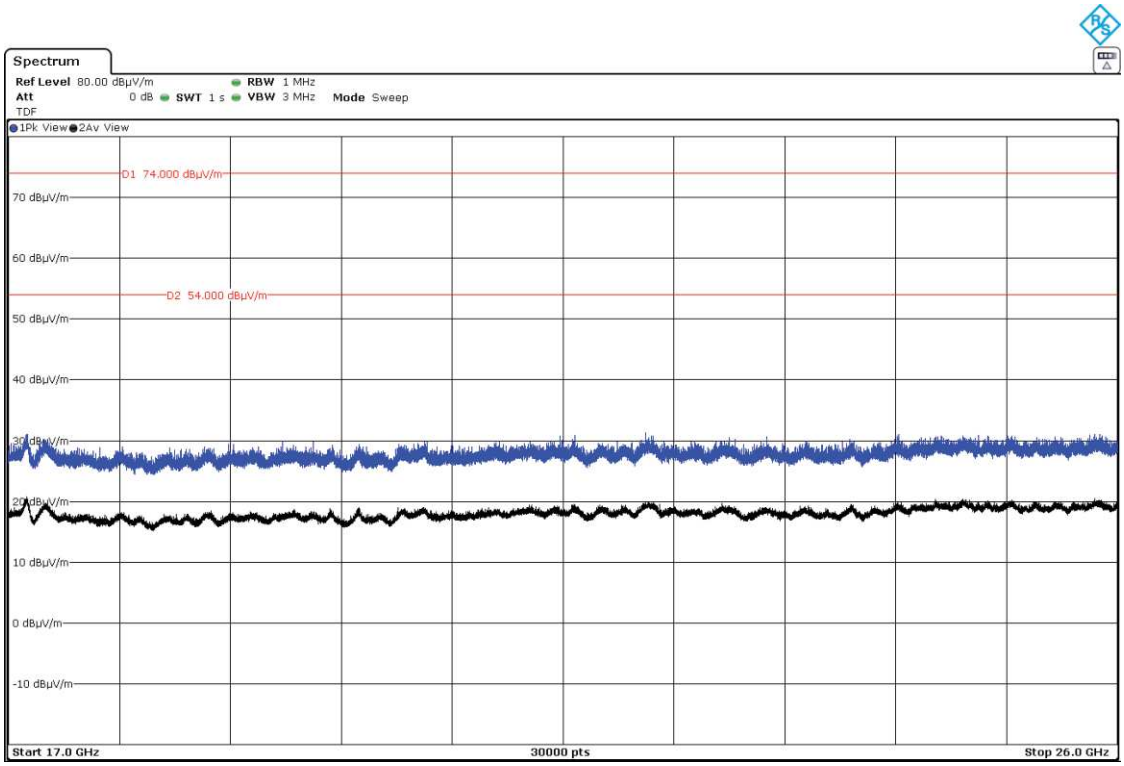


- High Channel:



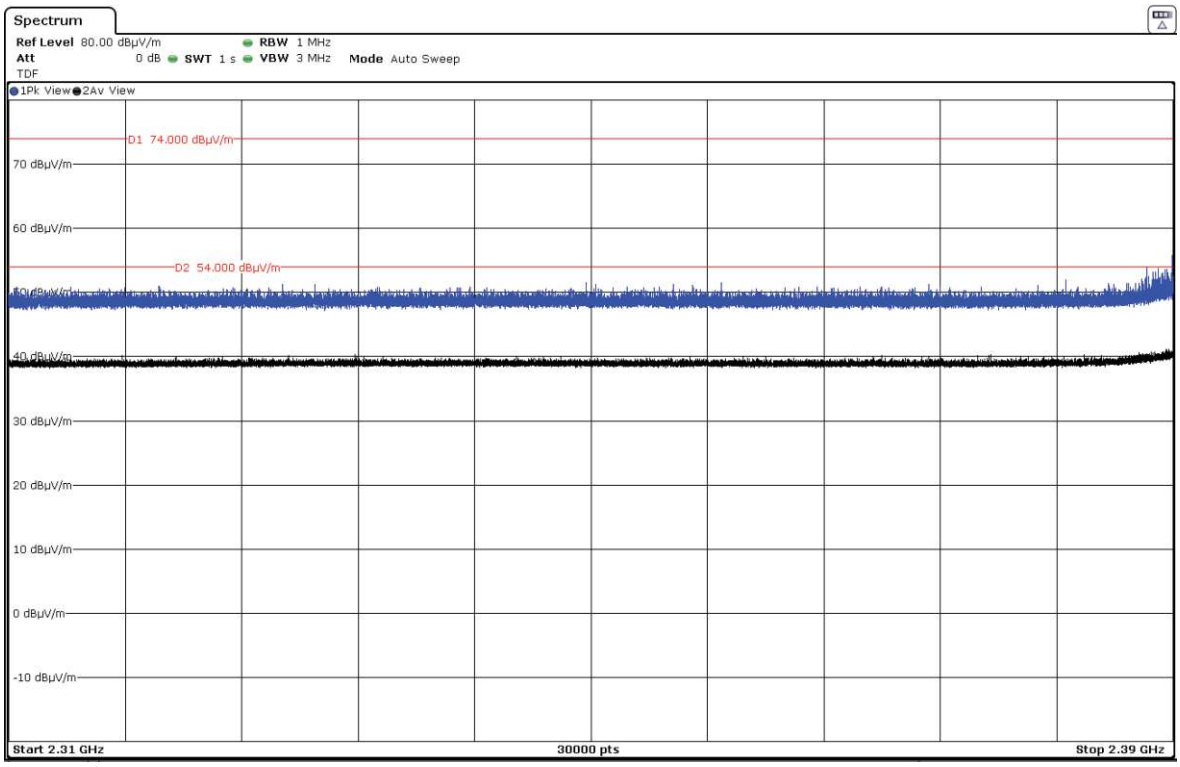
FREQUENCY RANGE 17 - 26 GHz:

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



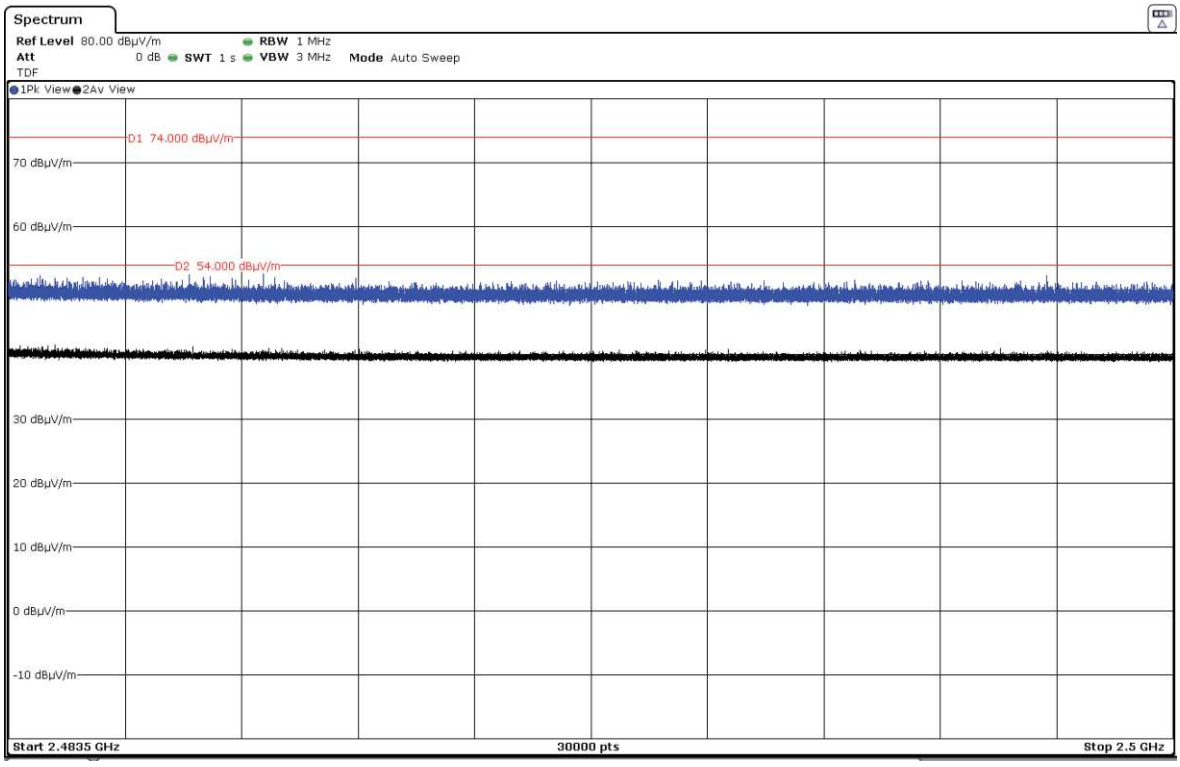
FREQUENCY RANGE 2.31-2.39 GHz (Restricted Band 1):

- Low Channel. CH 1:



FREQUENCY RANGE 2.4835-2.5 GHz (Restricted Band 2):

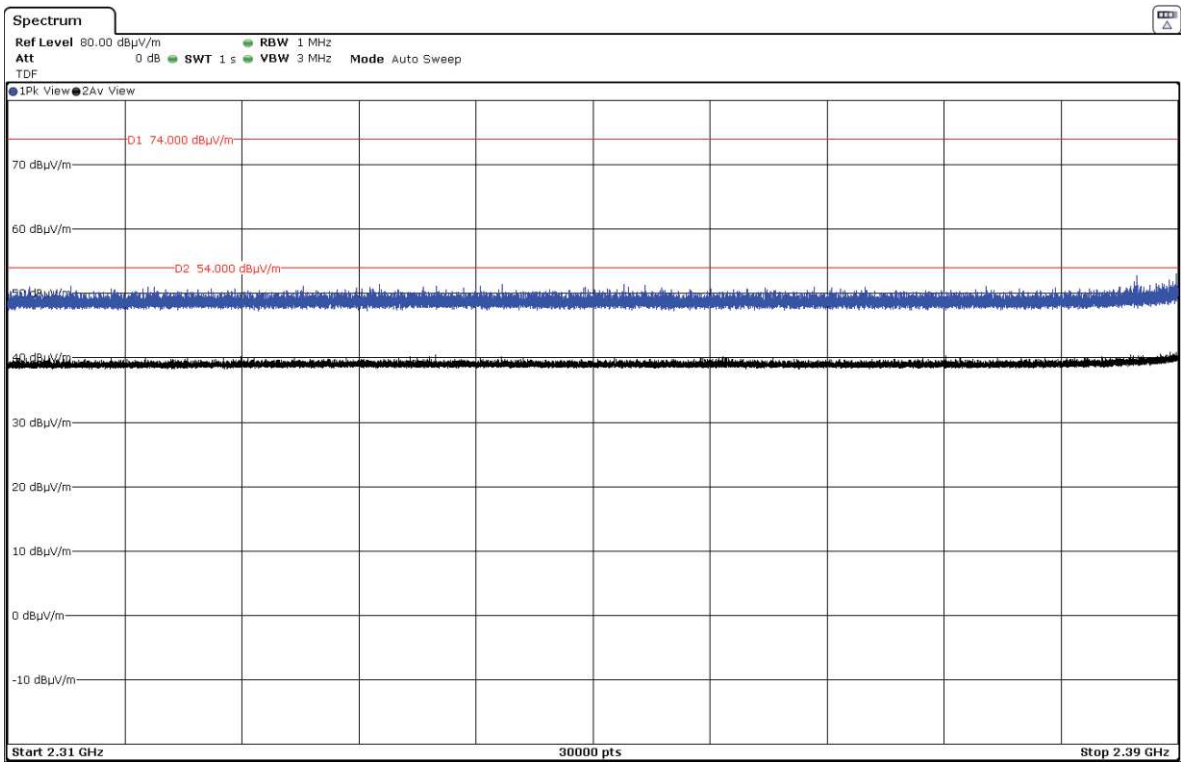
- High Channel. CH 11:



- **Mode 802.11 g**

FREQUENCY RANGE 2.31-2.39 GHz (Restricted Band 1):

- Low Channel. CH 1:



- FREQUENCY RANGE 2.4835-2.5 GHz (Restricted Band 2):

- High Channel. CH 11: