



Test report No:
 NIE: 59830RRF.005

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	TCAM: Telematics and Connectivity Antenna Module
(*) Trademark	Continental
(*) Model and /or type reference	TCAM1NA0
Other identification of the product	HW version: E4.2 SW version: PI007.1 FCC ID: KR5TCAM1NA0 IC: 7812D-TCAM1NA0
(*) Features	2G, 3G, LTE, GNSS, WLAN, BLE, ISM Receiver
Applicant	Continental Automotive GmbH Siemensstrasse 12, 93055 Regensburg, Germany
Test method requested, standard	USA FCC Part 15.247 (10-1-18) Edition: Operation within the bands 902 - 928 MHz, 2400 -2483.5 MHz, and 5725 - 5850 MHz. USA FCC Part 15.209 (10-1-18) Edition: Radiated emission limits; general requirements. CANADA RSS-247 Issue 2 (February 2017). CANADA RSS-Gen Issue 5 (April 2018). 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)	J. Carlos Luque RF Lab. Supervisor

Date of issue	2020-04-03
Report template No	FDT08_22 (* "Data provided by the client")

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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.

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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.
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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 Telematics and Connectivity Antenna Module (TCAM) model Continental TCAM1NA0 is a vehicle antenna module for telematic and connectivity purposes.

It consists of a fin antenna with integrated telematics transceivers for different wireless services as well as several interfaces to the vehicle.

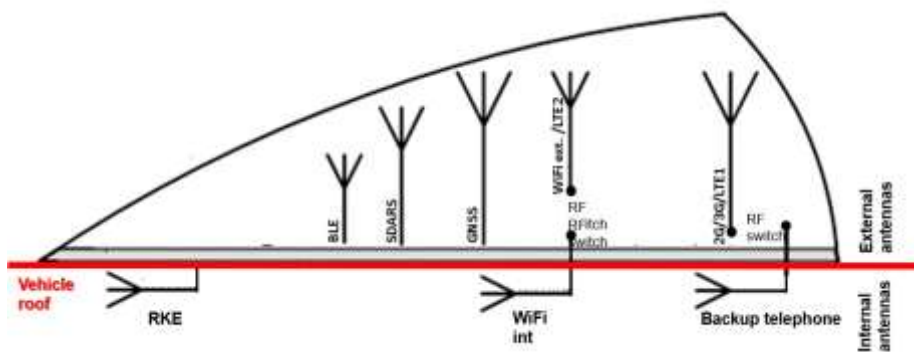
The TCAM1NA0 main parts are:

Antennas for cellular, WLAN, BLE, ISM receiver (RKE), SDARS with LNA
GNSS with LNA for Navigation: Beidou, Galileo, GPS, Glonass
Antenna selection via RF switches
TCAM internal antennas (all are TCAM internal, no extern antenna connections):
Tel1 ant: 2G, 3G, 4G/LTE1 (vehicle outside)
Tel2 ant: LTE2 (Rx only) (vehicle outside)
MIMO with LTE1- and LTE2-antenna. LTE2 is Rx only
Backup telephone antenna: 2G, 3G, 4G/LTE (vehicle inside)
Wi-Fi internal antenna (vehicle inside)
Wi-Fi external antenna (vehicle outside)
BLE antenna (vehicle outside)
Stacked patch antenna featuring GNSS
ISM receiver antenna
SDARS antenna

CAT4 NAD with 2G/3G/4G/LTE and GNSS, FCC certified
VoLTE
ISM receiver module (434MHz) for: RKE (Remote Keyless Entry), PASE (Passive Start and Entry, TPMS (Tire Pressure Monitoring System), FCC tested
Wi-Fi chip
BLE chip
1st internal embedded Sim-IC
Service calls

External interfaces:

Main power supply
External backup battery
External SIM card slot (2nd private customer SIM, optional)
External microphone in the OHC (Overhead Compartment)
A2B
External backup speaker
BroadR-Reach
CEM connection (K-Line)
Infotainment CAN
Airbag input
Debug interfaces (USB, UART)



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
59830B/052	Telematics and Connectivity Antenna Module	Continental TCAM1NA0	SNRD004262	2020/01/31
59830B/034	Harness	--	--	2019/11/11

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

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

Control Nº	Description	Model	Serial Nº	Date of reception
59830B/054	Telematics and Connectivity Antenna Module	Continental TCAM1NA0	SNRD004273	2020/02/11
59830B/034	Harness	--	--	2019/11/11

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

- Sample S/03 is composed of the following elements:

Control Nº	Description	Model	Serial Nº	Date of reception
59830B/017	Telematics and Connectivity Antenna Module	Continental TCAM1NA0	SNRD004296	2019/10/22
61475C/010	Laptop	ZBook	--	2019/08/26
59830B/025	Harness	--	--	2019/10/29
59830B/028	CAN-Box TCAM	CAN-STIN3	00047	2019/10/30

Sample S/03 has undergone the following test(s): All RADIATED tests indicated in Appendix B.

- Sample S/04 is composed of the following elements:

Control Nº	Description	Model	Serial Nº	Date of reception
59830B/019	Telematics and Connectivity Antenna Module	Continental TCAM1NA0	SNRD004297	2019/10/22
59830B/032	Harness	--	--	2019/11/11
59830B/030	CAN-Box TCAM	CAN-STIM3	00266	2019/11/11
61475C/010	Laptop	ZBook	--	2019/08/26

Sample S/04 has undergone the following test(s): All CONDUCTED tests indicated in Appendix B.

Test sample description

Ports..... :	Port name and description	Cable					
		Specified max length [m]	Attached during test	Shielded	Coupled to patient ⁽³⁾		
	<i>USB diagnostic</i>	~3m	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
	<i>UART diagnostic</i>	~3m	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
	<i>BRR diagnostic</i>	~3m	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Supplementary information to the ports..... :							
Rated power supply	Voltage and Frequency		Reference poles				
			L1	L2	L3	N	PE
	<input type="checkbox"/>	AC:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/>	AC:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<input checked="" type="checkbox"/>	DC: 12V					
<input type="checkbox"/>	DC:						
Rated Power	4.2 W dc (cellular, Wi-Fi, BLE, GNSS active)						
Clock frequencies.....	32.768kHz, 16MHz, 19.2MHz, 24MHz, 25MHz, 27.6MHz, 48MHz						
Other parameters	Operating temperature Range: -40°C to 85°C Supply Voltage Range: 8 V to 16 V DC						
Software version	PI007.1						
Hardware version	E4.2						
Dimensions in cm (W x H x D)	10.5cm x 15.5cm x 9cm						
Mounting position	<input type="checkbox"/>	Table top equipment					
	<input type="checkbox"/>	Wall/Ceiling mounted equipment					
	<input type="checkbox"/>	Floor standing equipment					
	<input type="checkbox"/>	Hand-held equipment					

	<input checked="" type="checkbox"/>	Other: Vehicular environment equipment	
Modules/parts.....:	Module/parts of test item	Type	Manufacturer
	Network Access Device (NAD), (cellular, GNSS)	Model: BL28NA-001	Continental Automotive Systems
	ISM/RKE 434 MHz RF receiver module	Model: A2C38291300	Continental Automotive GmbH
Accessories (not part of the test item)	Description	Type	Manufacturer
	bracket		
	1x harness w/o USB		
	3x harness w USB		
	Inlay disc		
	Design cap		
Documents as provided by the applicant.....:	Description	File name	Issue date
	TCAM_Testhouse_Manual_29Oct2019_V1		

⁽³⁾ Only for Medical Equipment

Identification of the client

Continental Automotive GmbH
 Siemensstrasse 12, 93055 Regensburg, Germany

Testing period and place

Test Location	DEKRA Testing and Certification S.A.U.
Date (start)	2019-11-13
Date (finish)	2020-02-13

Document history

Report number	Date	Description
59830RRF.005	2020-04-03	First release

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 %
Air pressure	Min. = 860 mbar Max. = 1060 mbar

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 %
Air pressure	Min. = 860 mbar Max. = 1060 mbar

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. = 35 %
Air pressure	Min. = 860 mbar Max. = 1060 mbar

Remarks and comments

The tests have been performed by the technical personnel: Pablo Redondo, José Gabriel Pendón, José Manuel Jiménez, Verónica García, Javier Miguel Nadales, José Carlos Moreno, Nicolás Salguero.

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	2019/09	2021/09
3. DC Power Supply, 30V, 5A KEYSIGHT TECHNOLOGIES U8002A	N.A.	N.A.
4. Signal and Spectrum Analyzer ROHDE AND SCHWARZ FSV40	2019/09	2021/09
5. DC Power Supply 30V/5A 150W AGILENT TECHNOLOGIES, U8002A	N.A.	N.A.
6. Signal and Spectrum Analyzer ROHDE AND SCHWARZ FSV40	2019/10	2021/10
7. Digital multimeter FLUKE 179	2019/06	2020/06

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. Low Pass Filter DC-410 MHz, WAINWRIGHT INSTRUMENTS WLK410- 6SS	2019/05	2021/05
4. EMI Test Receiver 7 GHz ROHDE AND SCHWARZ ESR7	2018/10	2020/10
5. RF Pre-amplifier 40 dB, 10 MHz - 6 GHz BONN ELEKTRONIK BLNA 0160-01N	2019/02	2020/08
6. Biconical/Log Antenna 30MHz - 6GHz ETS LINDGREN 3142E	2017/09	2020/09
7. High Pass Filter 3 - 18 GHz TEMSTRON /TEMWELL ST-3GA2833-HS	2019/10	2020/10
8. Signal and Spectrum Analyzer ROHDE AND SCHWARZ FSV40	2018/02	2020/02
9. RF Pre-amplifier G>30dB, 1-18GHz BONN ELEKTRONIK BLMA 0118-3A	2019/04	2020/04
10. Broadband Horn antenna 1-18 GHz SCHWARZBECK MESS-ELEKTRONIK BBHA 9120 D	2018/01	2021/01
11. Low Pass Filter DC - 1 GHz WAINWRIGHT INSTRUMENTS WLK1000-6SS	2018/06	2020/06
12. Low Noise Amplifier G>30dB, 18 - 40 GHz BONN ELEKTRONIK BLMA 1840-1M	2018/02	2020/02
13. Broadband Horn Antenna 18 - 40 GHz SCHWARZBECK MESS-ELEKTRONIK BBHA 9170	2018/07	2021/07

Testing verdicts

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

Summary

1. Bluetooth Low Energy

FCC PART 15.247 PARAGRAPH		Verdict	Remark
Requirement – Test case			
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.			

2. WLAN 2.4 GHz (802.11 b/g/n20/n40 1x1).

FCC PART 15 PARAGRAPH / RSS-247		Verdict	Remark
Requirement – Test case			
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	
<u>Supplementary information and remarks:</u> None.			

Appendix A: Test results. Bluetooth Low Energy

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TEST CONDITIONS

POWER SUPPLY (V):

V nominal:	12 Vdc
Type of Power Supply:	External power supply (Car Battery).

ANTENNA:

Type of Antenna:	Internal (3D).
Gain of Antenna:	+1.7 dBi

TEST FREQUENCIES:

Low Channel:	2402 MHz
Middle Channel:	2440 MHz
High Channel:	2480 MHz

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

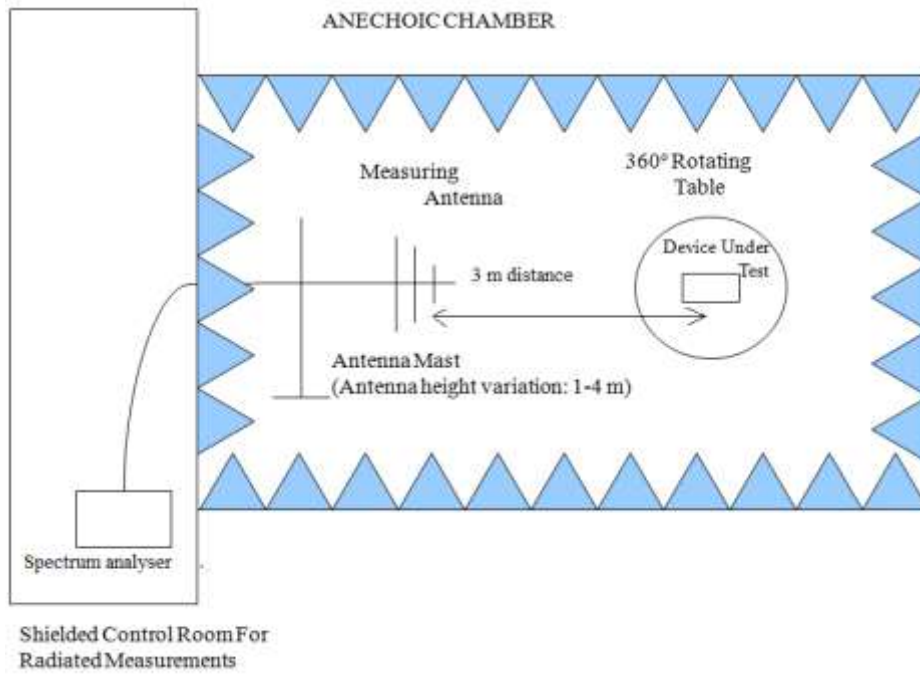
All radiated tests were performed in a semi-anechoic chamber. The measurement antenna (Bilog antenna for the range between 30 MHz to 1000 MHz) is situated at a distance of 3 m and at a distance of 1m for the frequency range 1 GHz-26 GHz (1 GHz-18 GHz Double ridge horn antenna and 18 GHz-40 GHz horn antenna).

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.

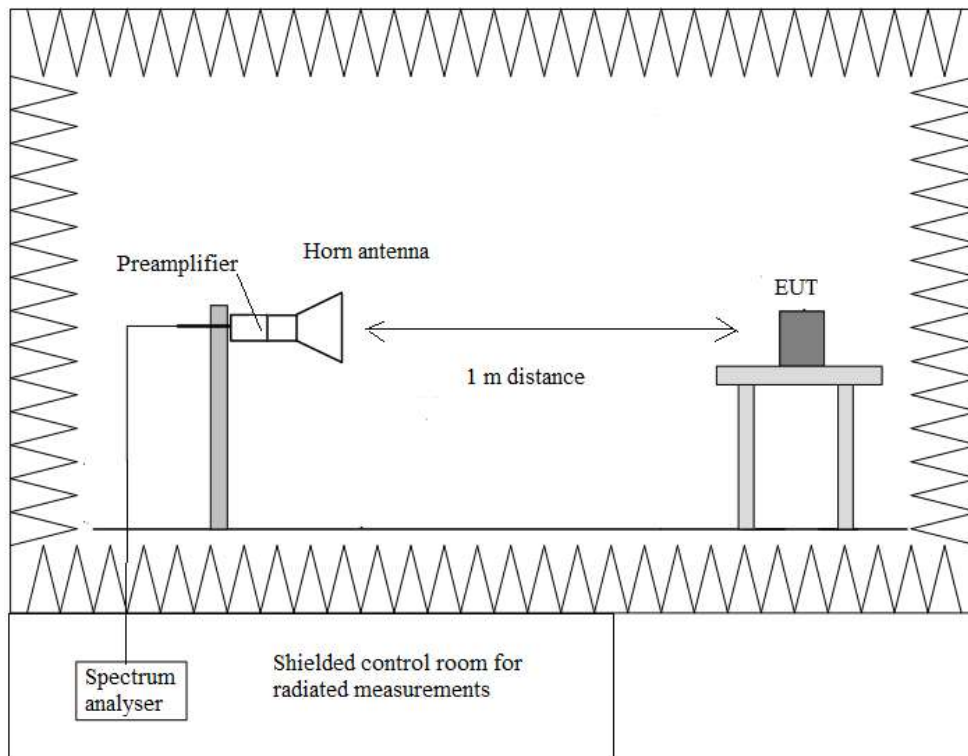
The equipment under test was set up on a non-conductive platform above the ground plane and the situation and orientation was varied to find the maximum radiated emission. It was also rotated 360° and the antenna height (Bilog antenna and Double ridge horn antenna) was varied from 1 to 4 meters to find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

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

Radiated measurements setup from 30 MHz to 1 GHz:



Radiated measurements setup $f > 1$ GHz:

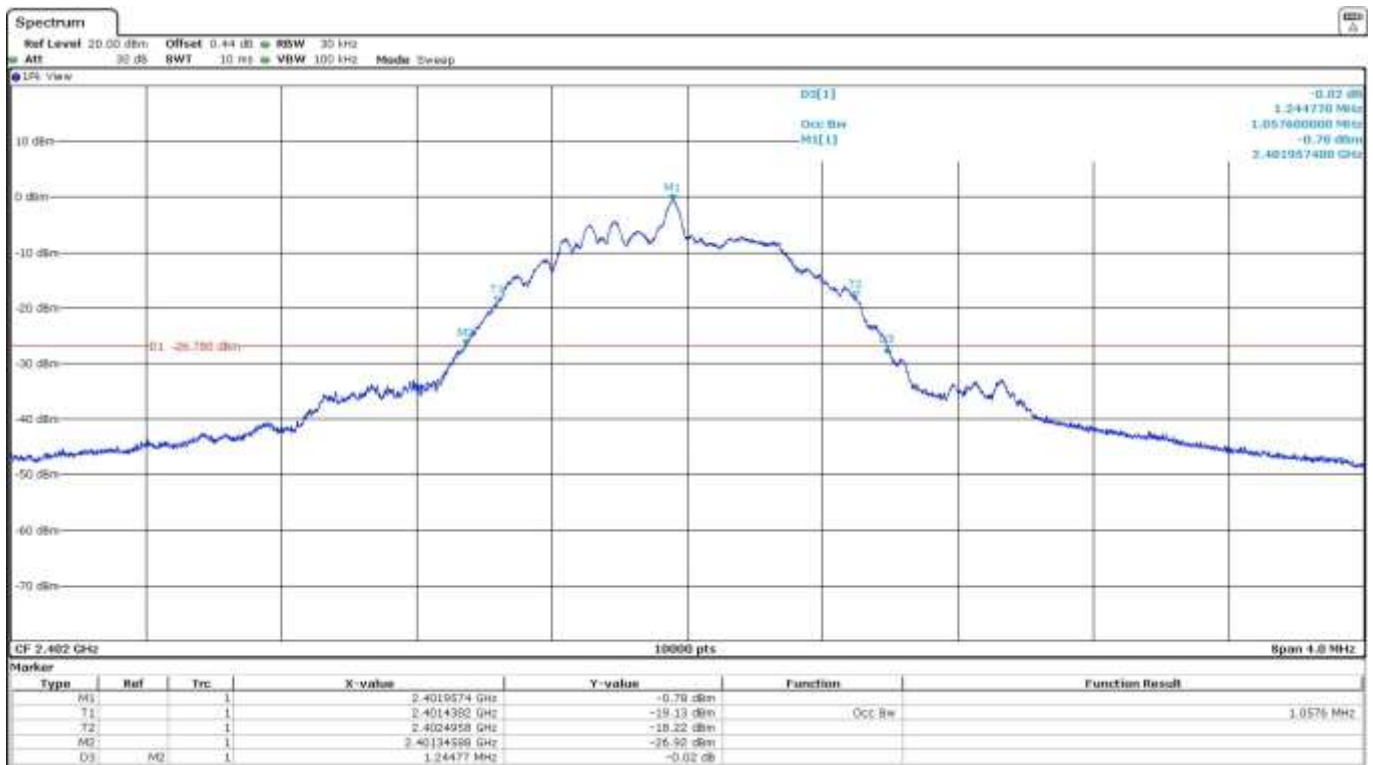


Occupied Bandwidth

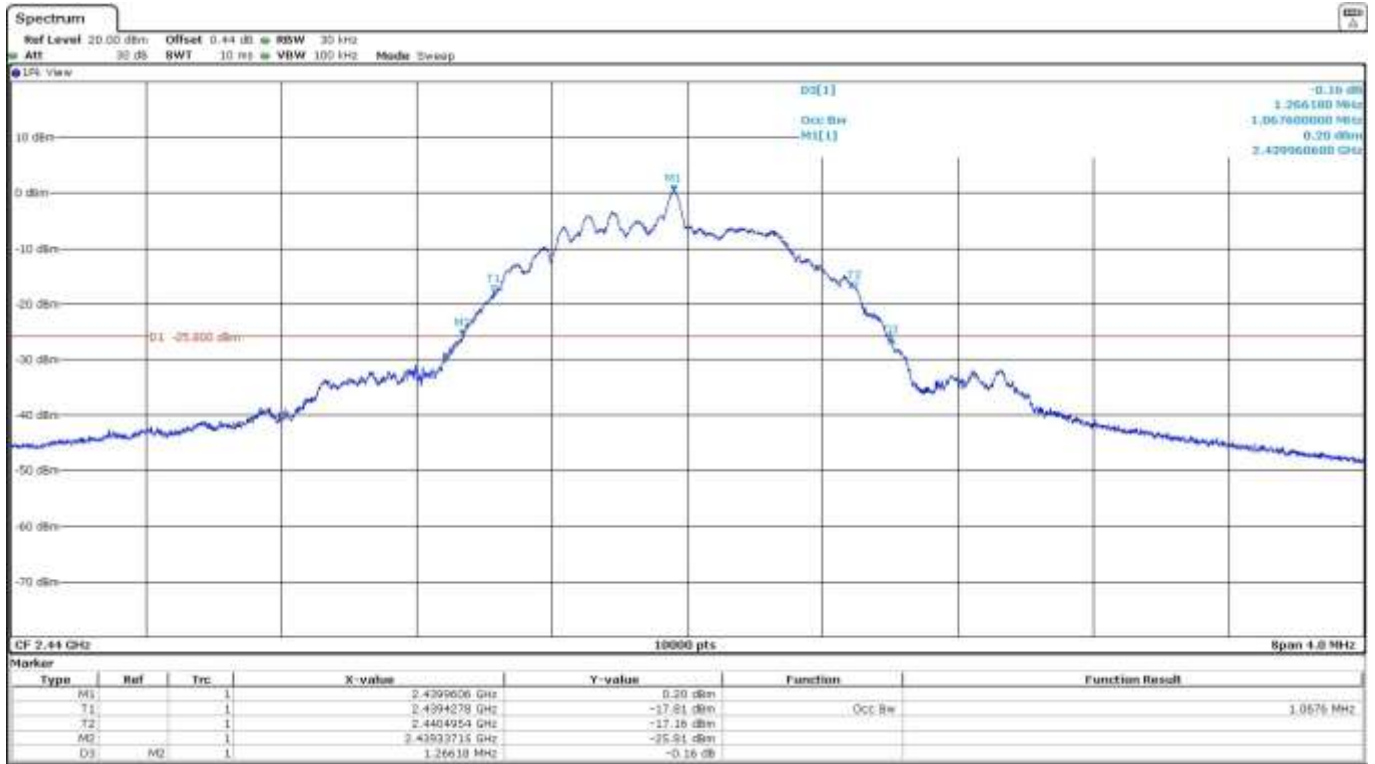
RESULTS:

	Low Channel 2402 MHz	Middle Channel 2440 MHz	High Channel 2480 MHz
99% bandwidth (MHz)	1.0576	1.0676	1.0816
-26 dB bandwidth (MHz)	1.2448	1.2662	1.2799
Measurement uncertainty (kHz)	<± 0.50		

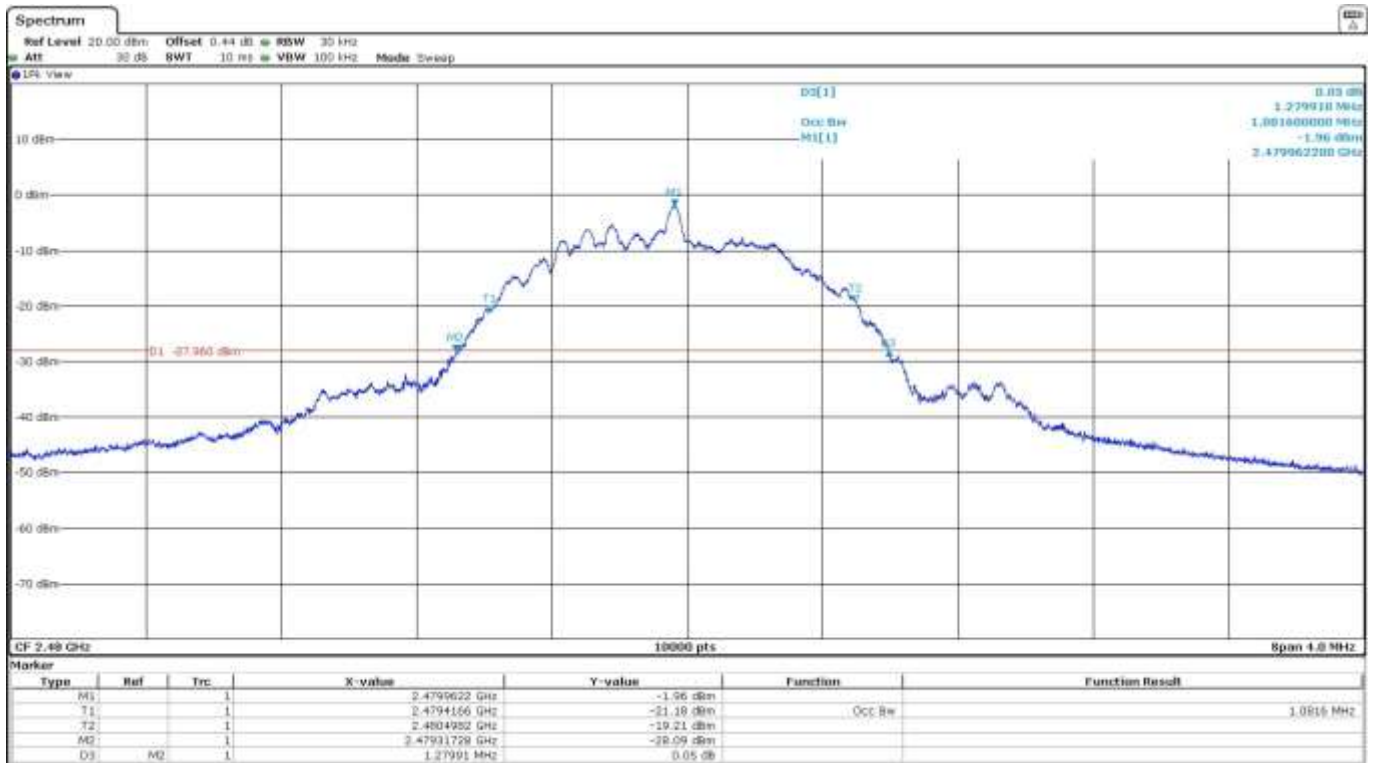
- Low Channel:



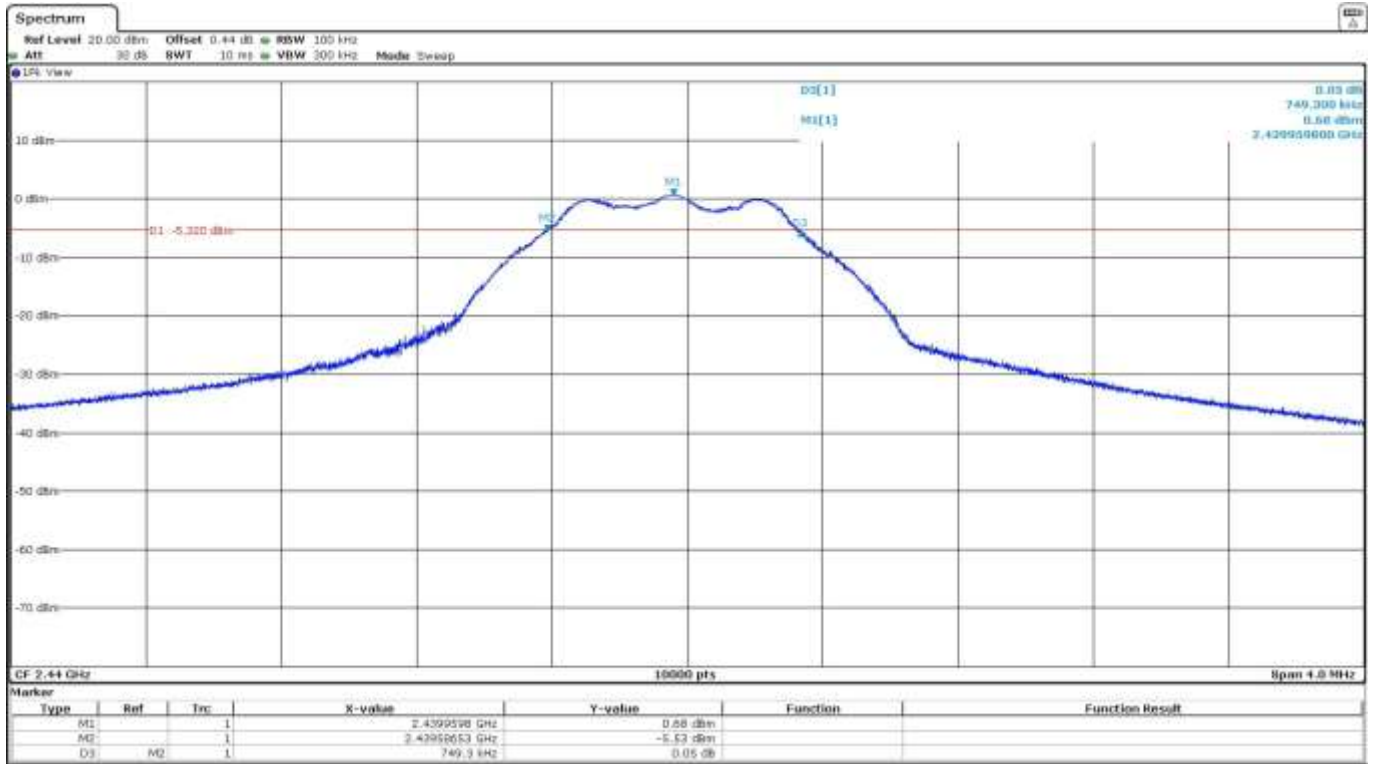
- Middle Channel:



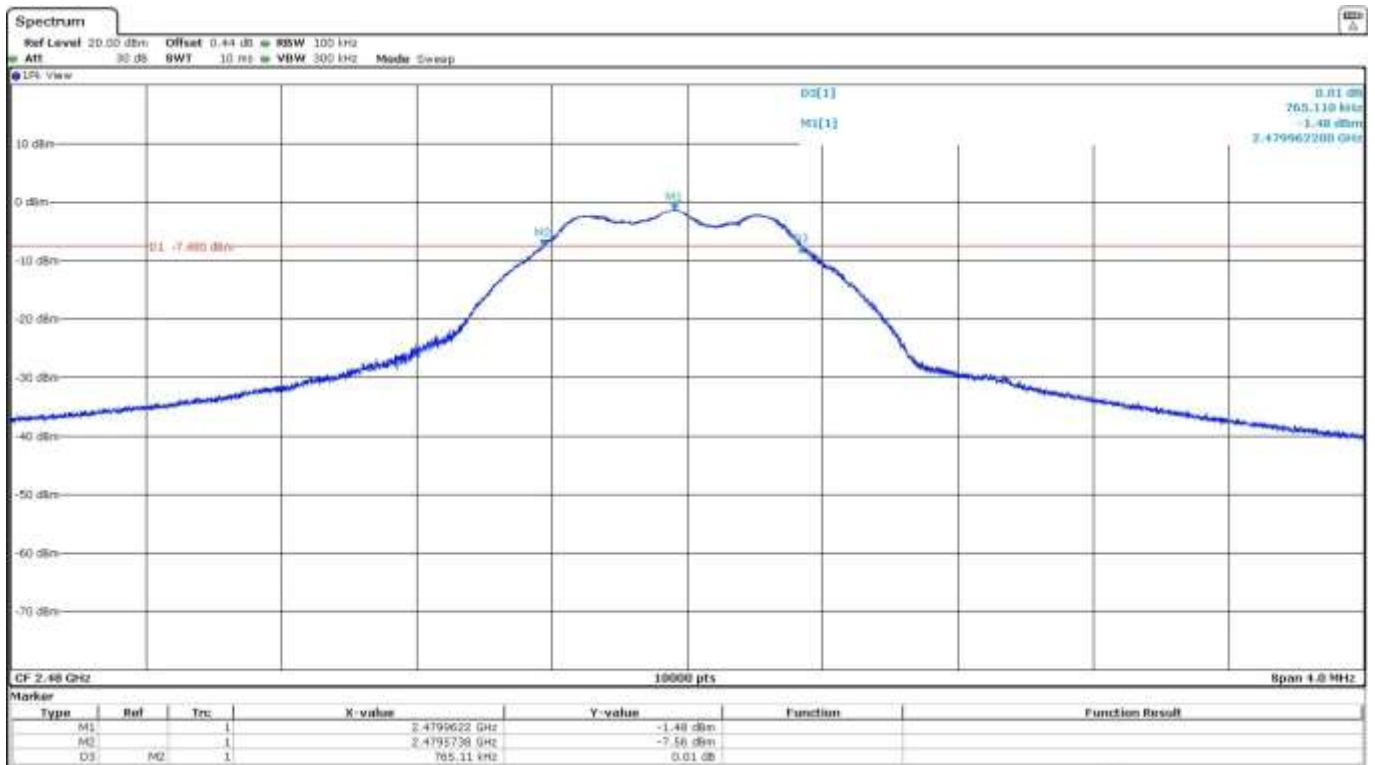
- High Channel:



- Middle Channel:



- High Channel:



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:

The maximum peak conducted output power level in the fundamental emission was measured using the method according to point 11.9.1.1 "RBW \geq DTS bandwidth" of ANSI C.63.10-2013.

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

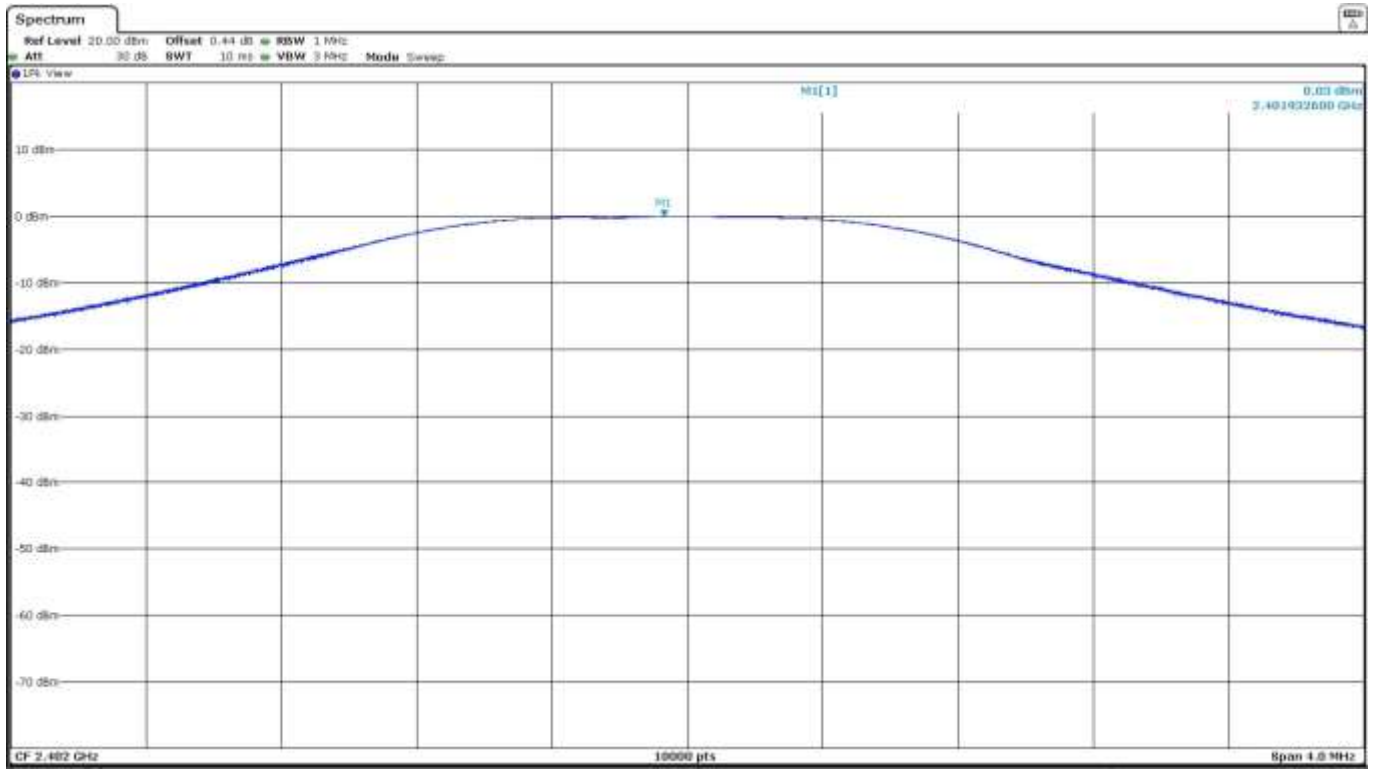
Declared Maximum Antenna Gain: +1.7 dBi

	Low Channel 2402 MHz	Middle Channel 2440 MHz	High Channel 2480 MHz
Maximum Conducted Power (dBm)	0.03	1.01	-1.08
Maximum EIRP Power (dBm)	1.73	2.71	0.62
Measurement uncertainty (dB)	< \pm 1.20		

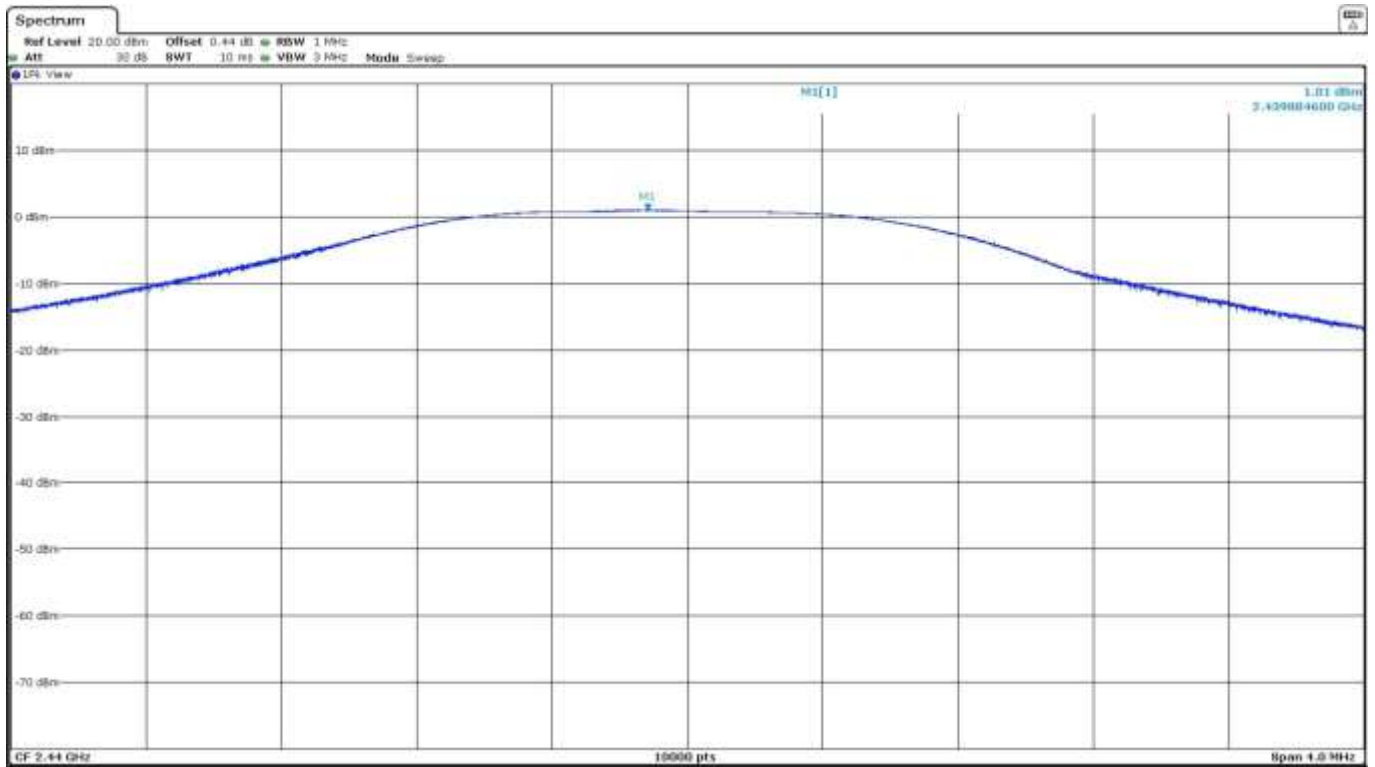
The maximum directional gain of the antenna is less than 6 dBi and therefore the maximum output power is not required to be reduced from the stated values.

Verdict: PASS

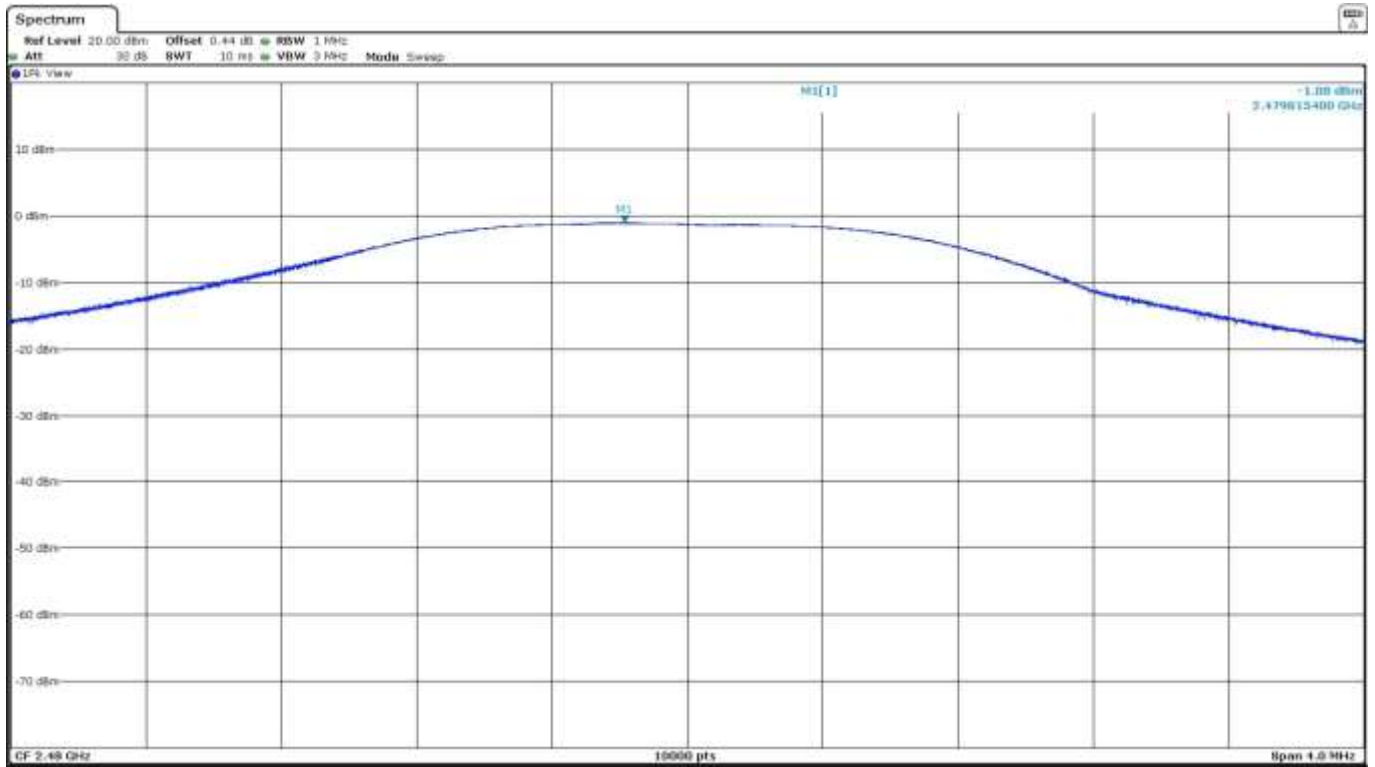
- Low Channel:



- Middle Channel:



- High Channel:



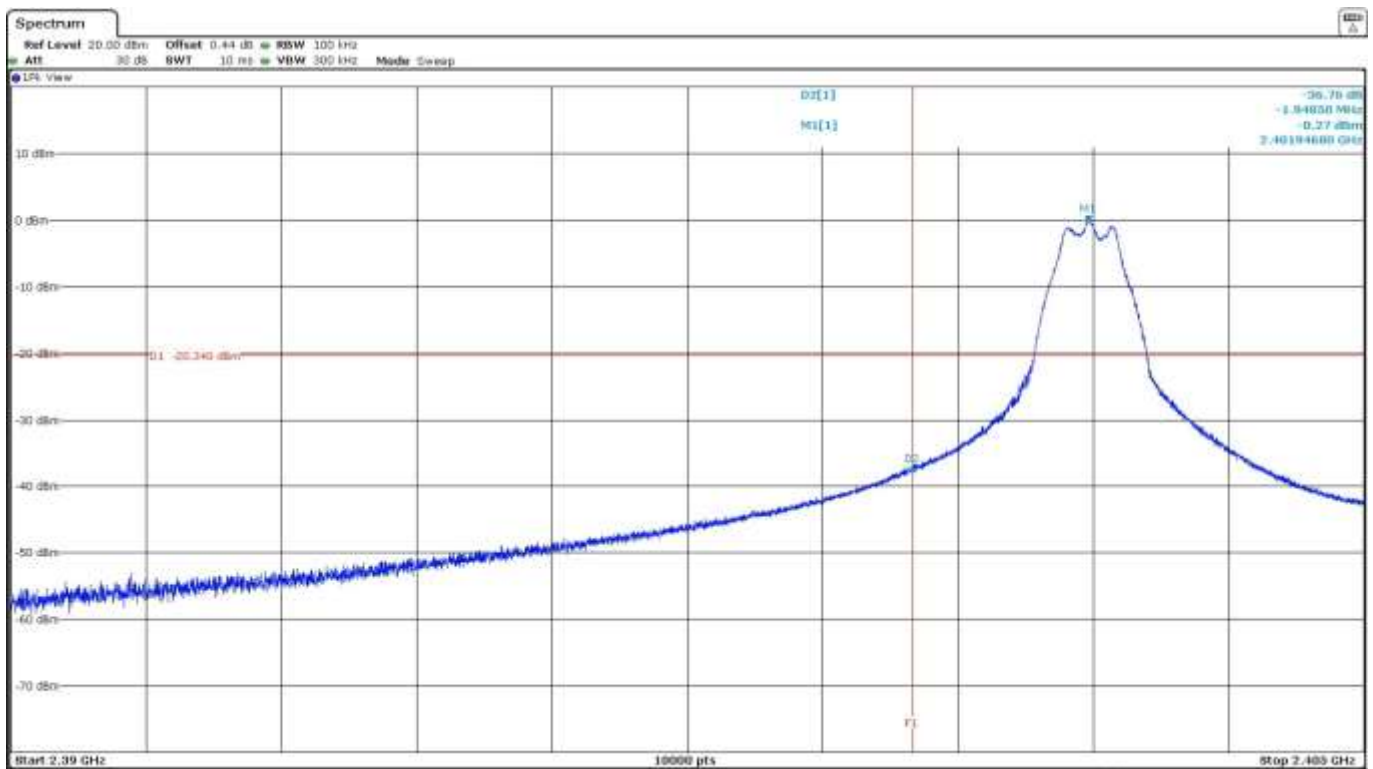
FCC 15.247 (d) / RSS-247 5.5. Band-edge emissions compliance (Transmitter)

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.

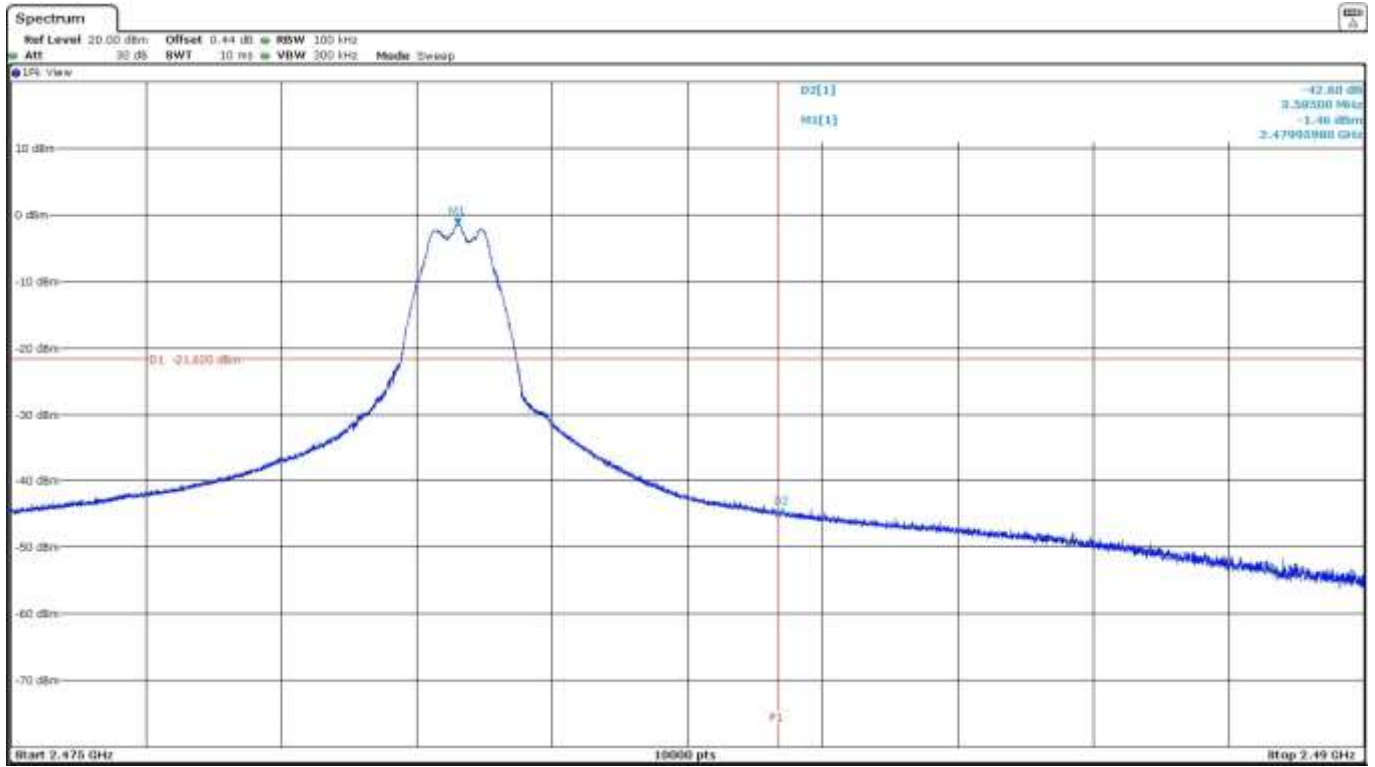
RESULTS:

- Low Channel:



Verdict: PASS

- High Channel:



Measurement uncertainty (dB)	<±1.56
------------------------------	--------

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.

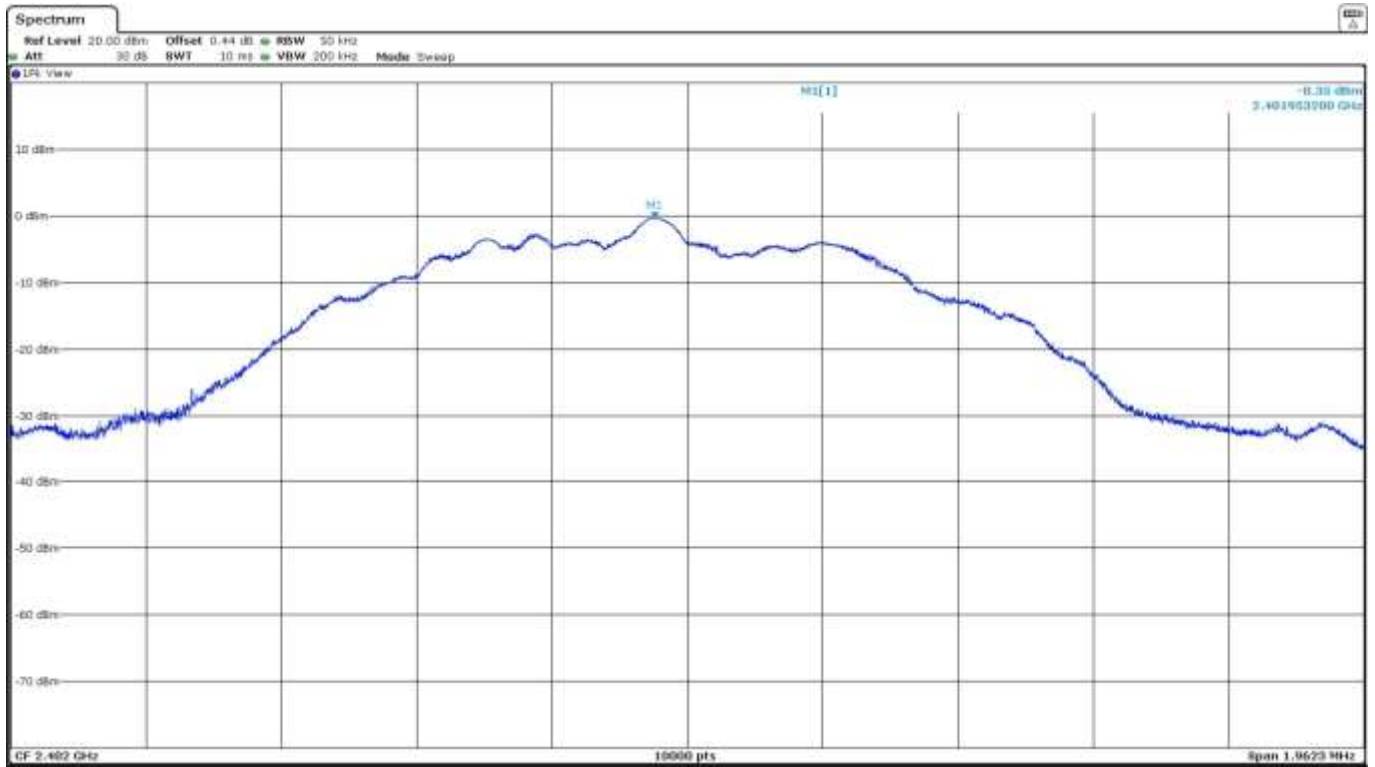
RESULTS:

The maximum power spectral density level in the fundamental emission was measured using the method according to point 11.10.2." Method PKPSD (peak PSD)" of ANSI C.63.10-2013.

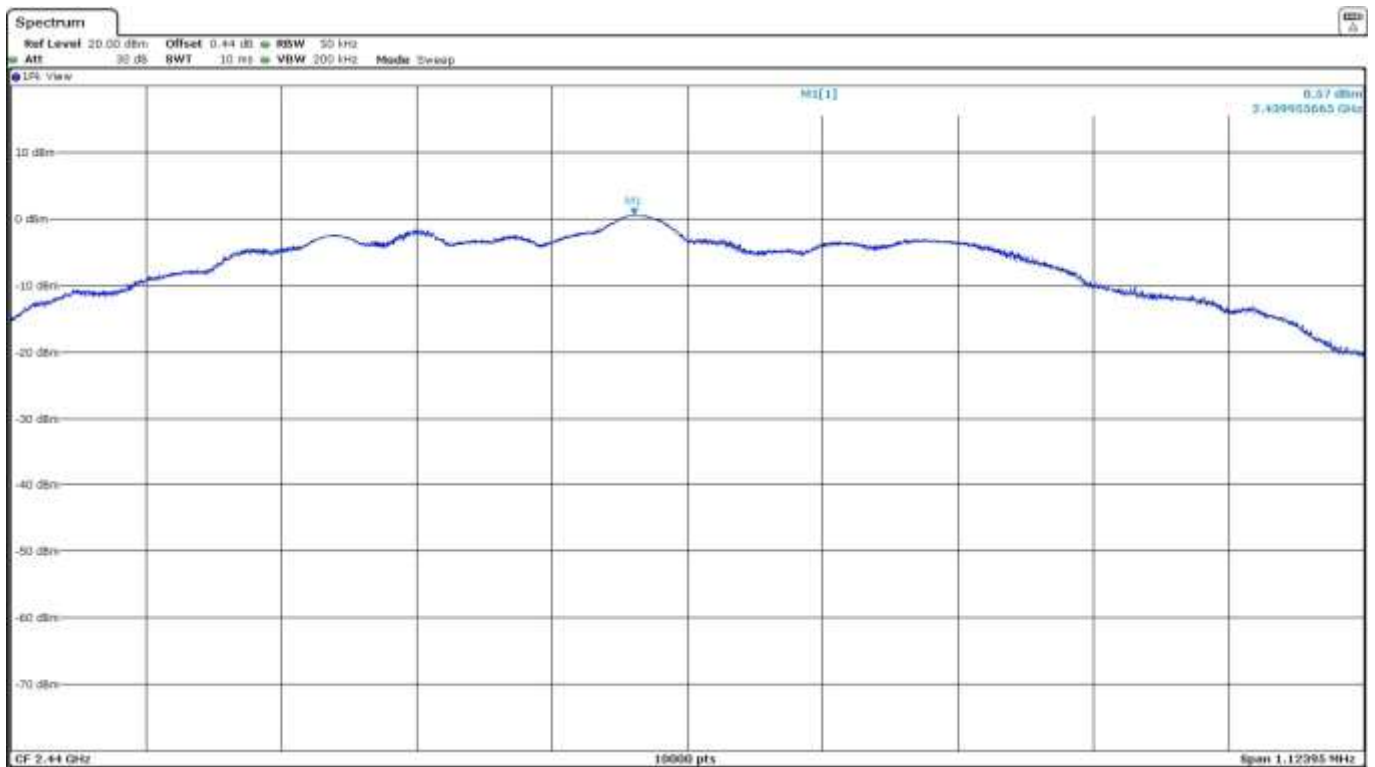
	Low Channel 2402 MHz	Middle Channel 2440 MHz	High Channel 2480 MHz
Power Spectral Density (dBm)	-0.35	0.57	-1.6
Measurement uncertainty (dB)	<±1.20		

Verdict: PASS

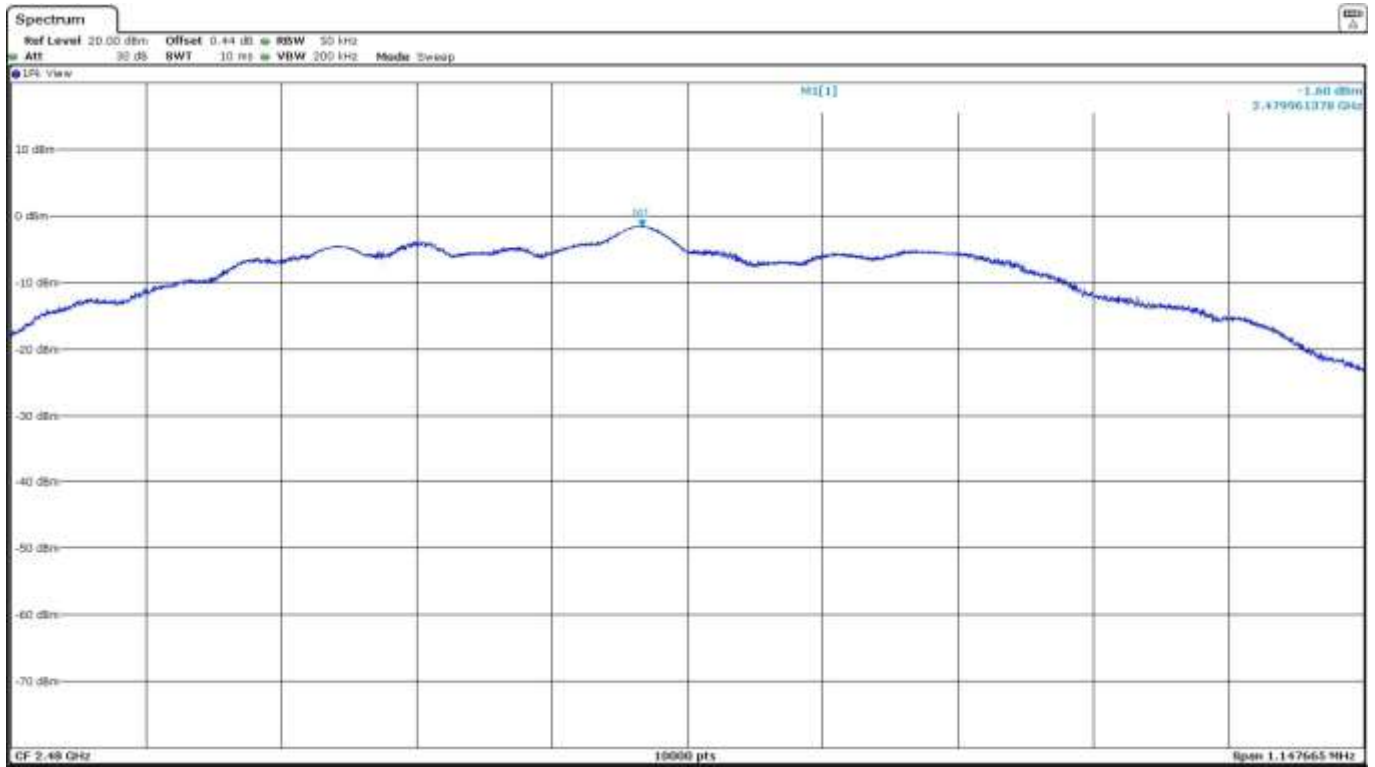
- Low Channel:



- 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 ($\mu\text{V/m}$)	Field strength ($\text{dB}\mu\text{V/m}$)	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 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-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.

Frequency range 30 MHz - 1 GHz:

The spurious frequencies do not depend on the operating channel.

Spurious frequencies detected at less than 20 dB below the limit:

Spurious frequency (MHz)	Detector	Emission Level ($\text{dB}\mu\text{V/m}$)	Polarization	Measurement Uncertainty (dB)
101.02	Quasi peak	24.9	V	< \pm 3.88
288.004	Quasi peak	30.7	H	< \pm 3.88

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 detected at less than 20 dB below the limit:

Spurious frequency (GHz)	Detector	Emission Level (dBµV/m)	Polarization	Measurement Uncertainty (dB)
4.80343	Peak	41.79	V	<± 4.88
7.2049 (*)	Peak	58.87	V	<± 4.88
	Average	54.31		<± 4.88
9.6087	Peak	45.85	V	<± 4.88

(*): This spurious frequency is outside the restricted bands as defined in §15.205(a). The measured maximum carrier level at 3 m was 88.54 dBµV/m (Peak) so the spurious level is more than 20 dB below the carrier level.

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

Spurious frequency (GHz)	Detector	Emission Level (dBµV/m)	Polarization	Measurement Uncertainty (dB)
4.87997	Peak	37.11	V	<± 4.88
7.31923	Peak	53.34	H	<± 4.88
9.75897	Peak	42.77	V	<± 4.88

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

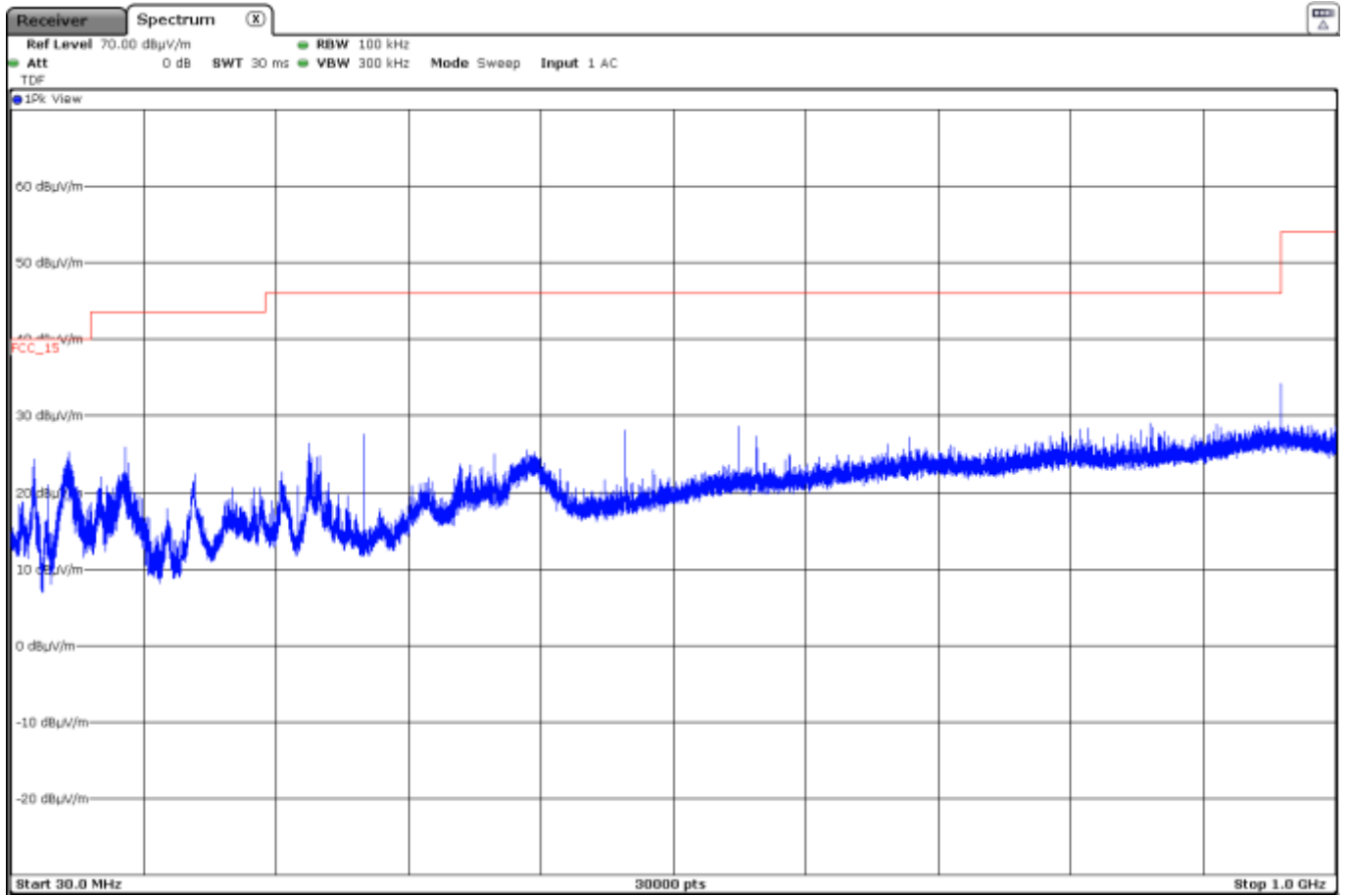
Spurious frequency (GHz)	Detector	Emission Level (dBµV/m)	Polarization	Measurement Uncertainty (dB)
2.48354	Peak	67.99	V	<± 3.04
	Average	41.94		<± 3.04
4.95977	Peak	46.01	V	<± 4.88
7.44057	Peak	51.23	H	<± 4.88
9.9209	Peak	45.96	V	<± 4.88

Verdict: PASS

FREQUENCY RANGE 30 MHz - 1 GHz:

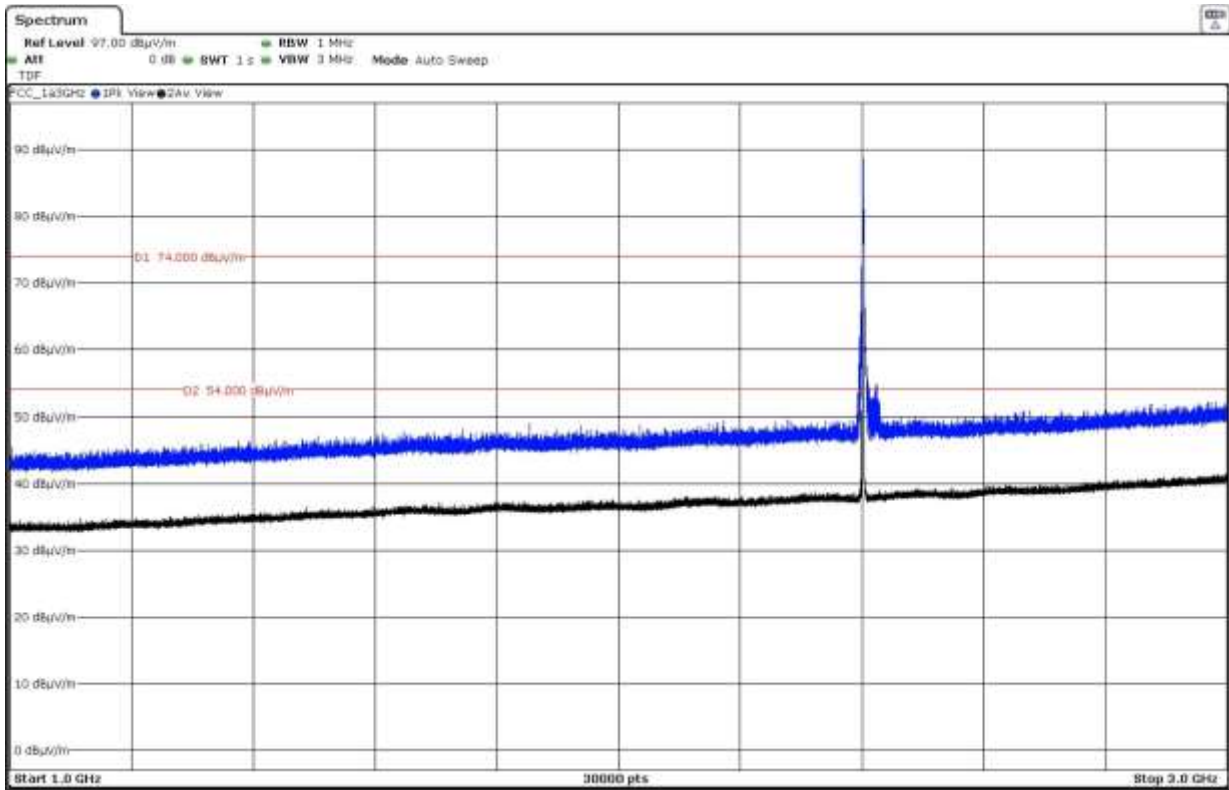
The spurious frequencies do not depend on the operating channel.

This plot is valid for the Low, Middle and High Channels:



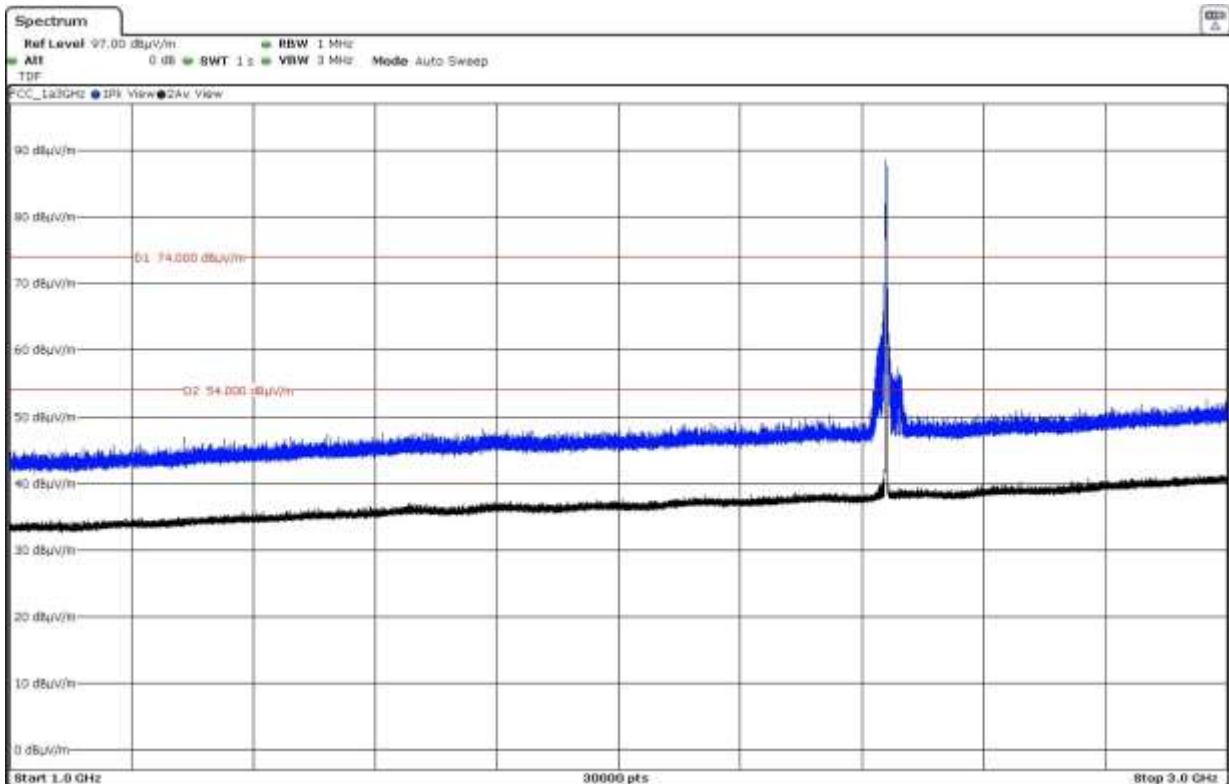
FREQUENCY RANGE 1 - 3 GHz:

- Low Channel:



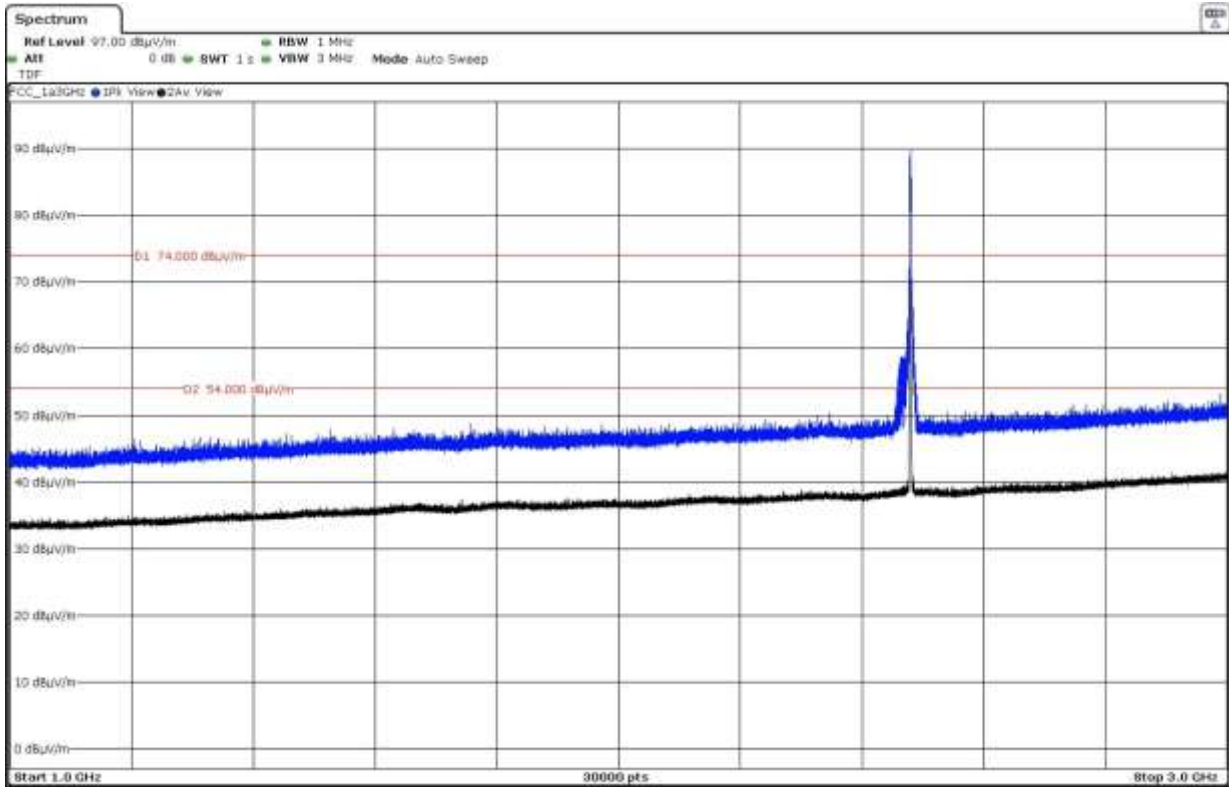
The peak above the limit is the carrier frequency.

- Middle Channel:



The peak above the limit is the carrier frequency.

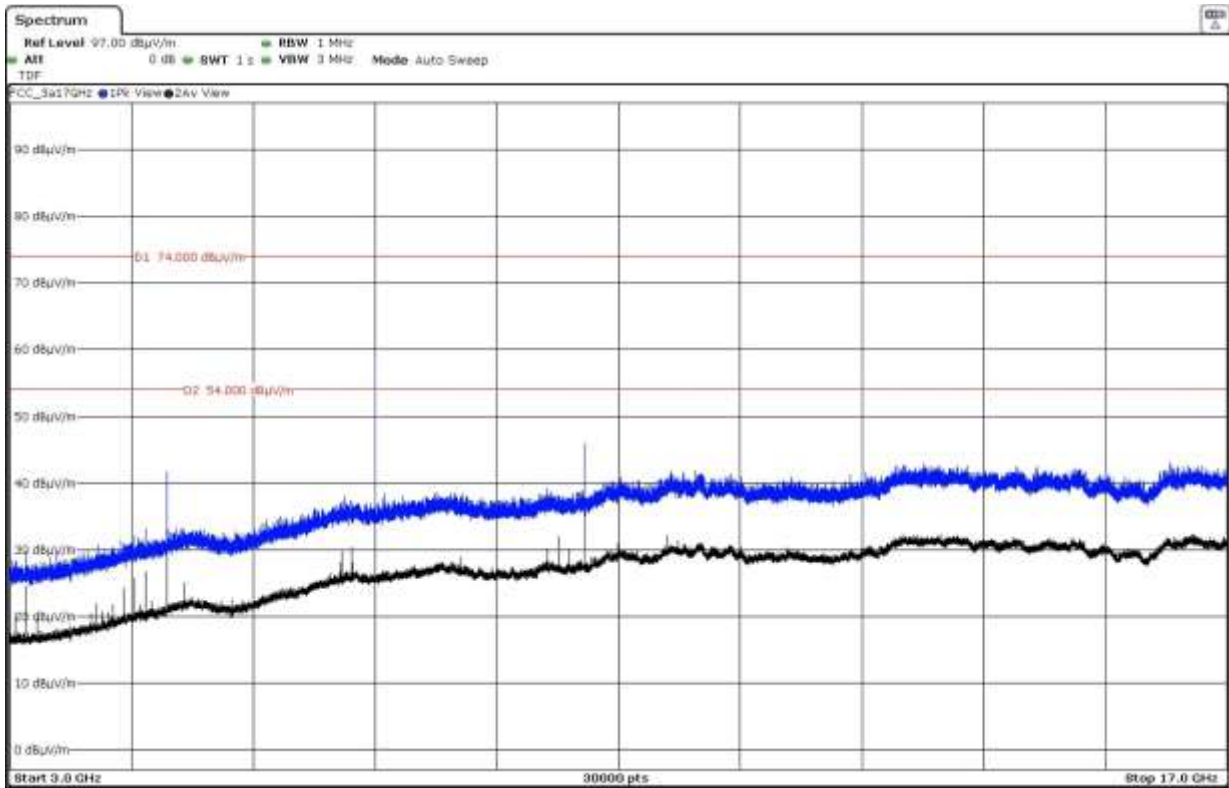
- High Channel:



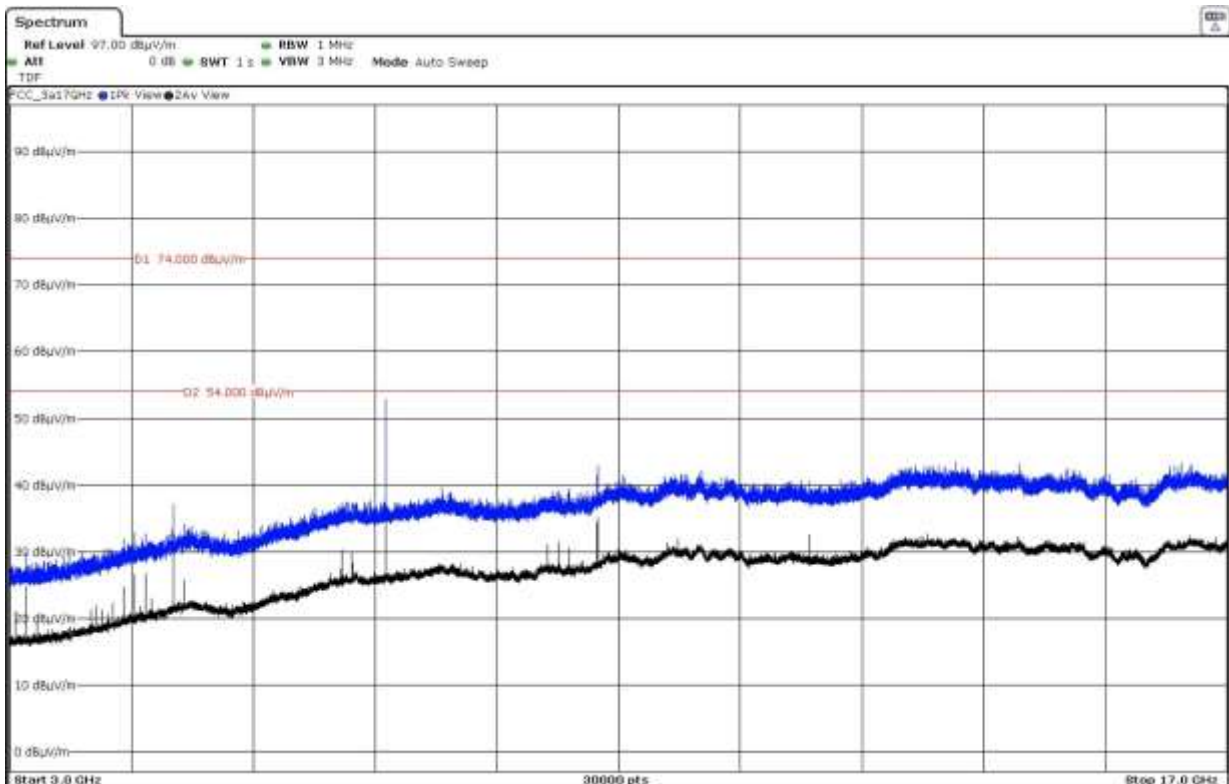
The peak above the limit is the carrier frequency.

FREQUENCY RANGE 3 - 17 GHz:

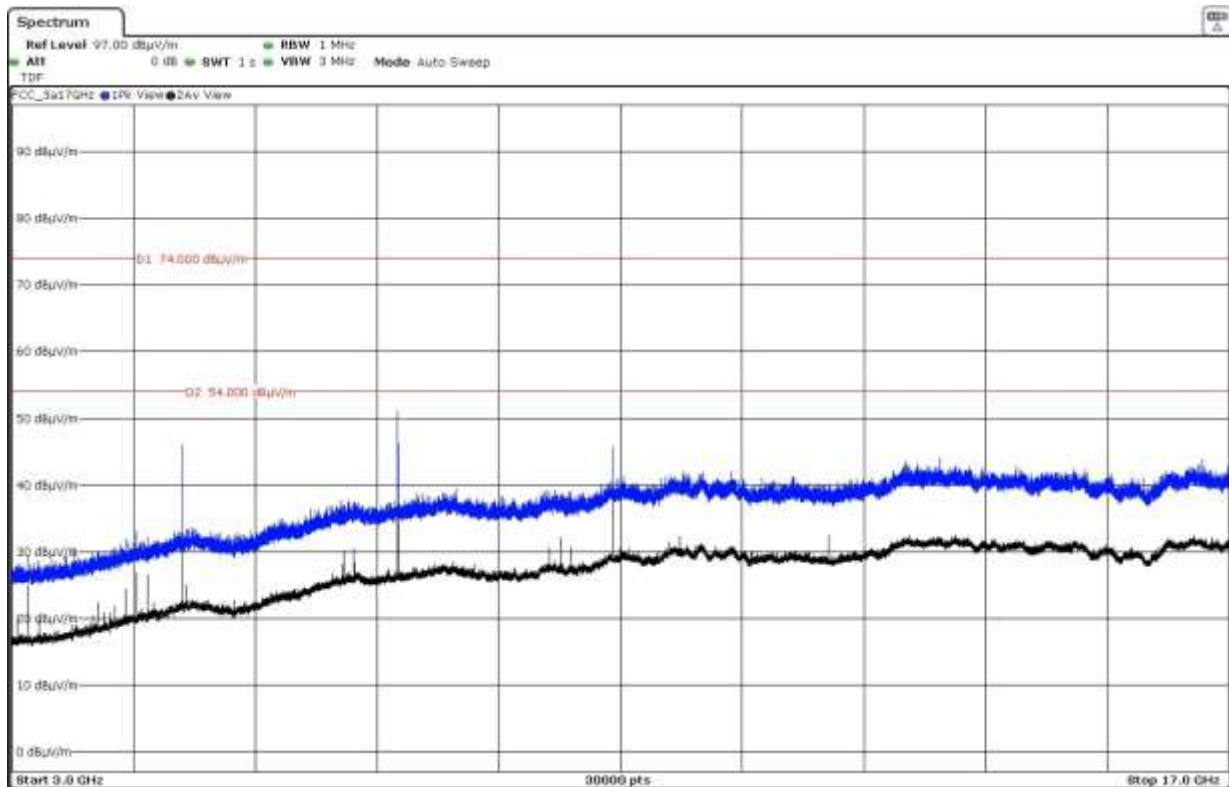
- Low Channel:



- Middle Channel:

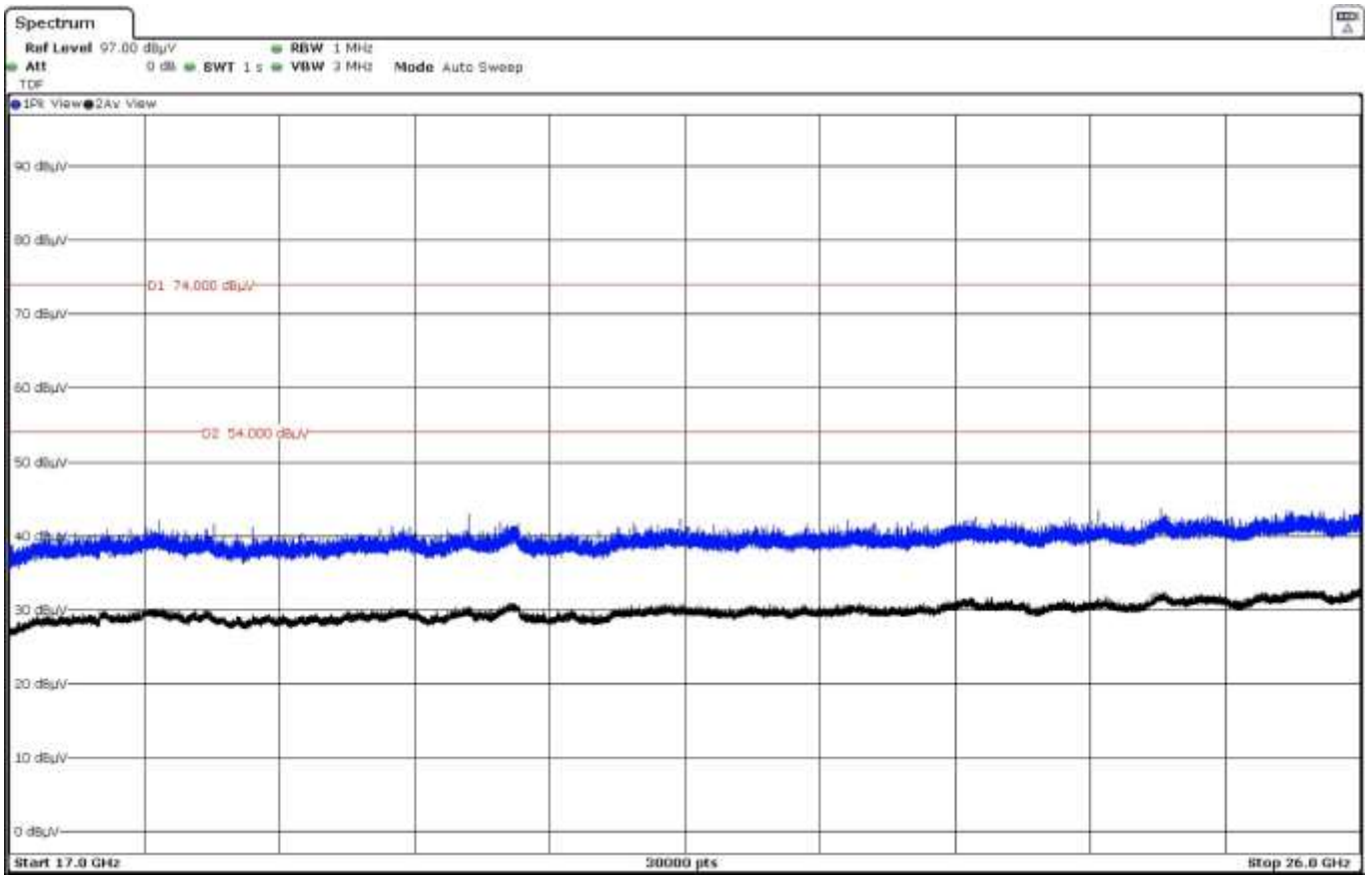


- High Channel:



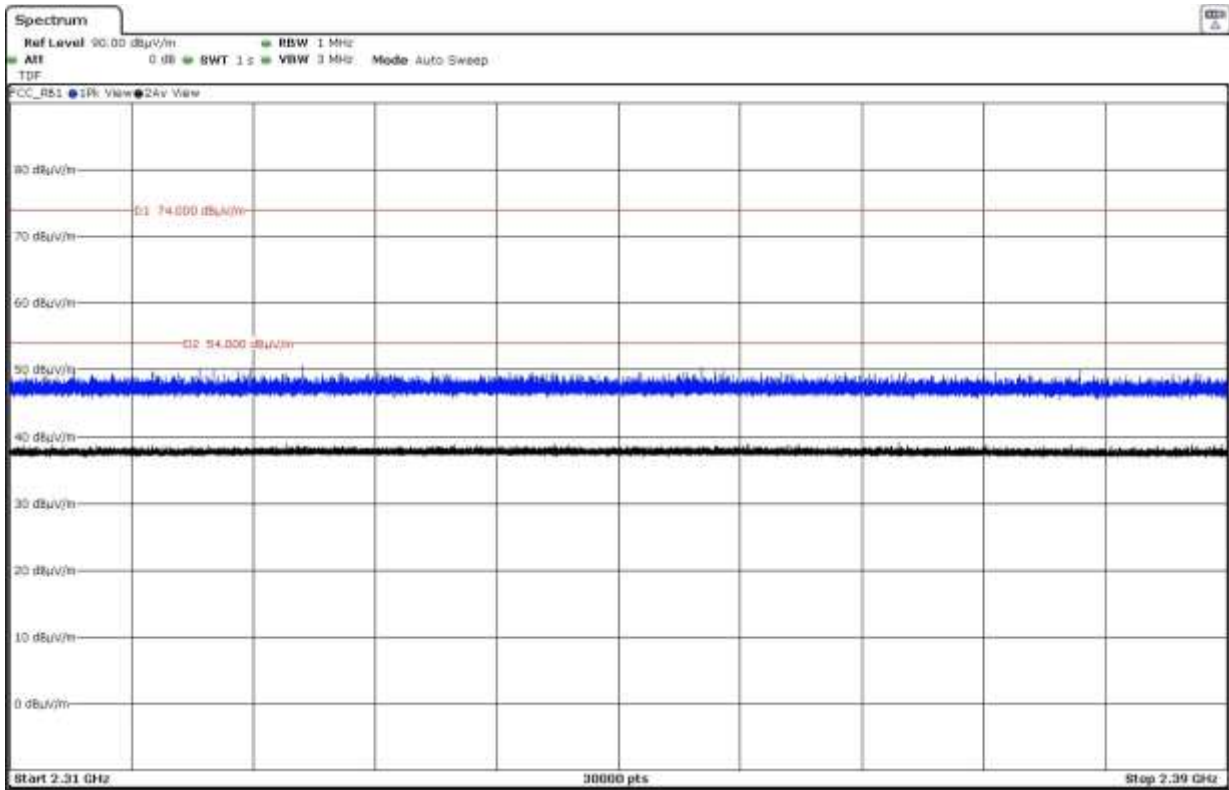
FREQUENCY RANGE 17 - 26 GHz:

This plot is valid for the Low, Middle and High Channels:

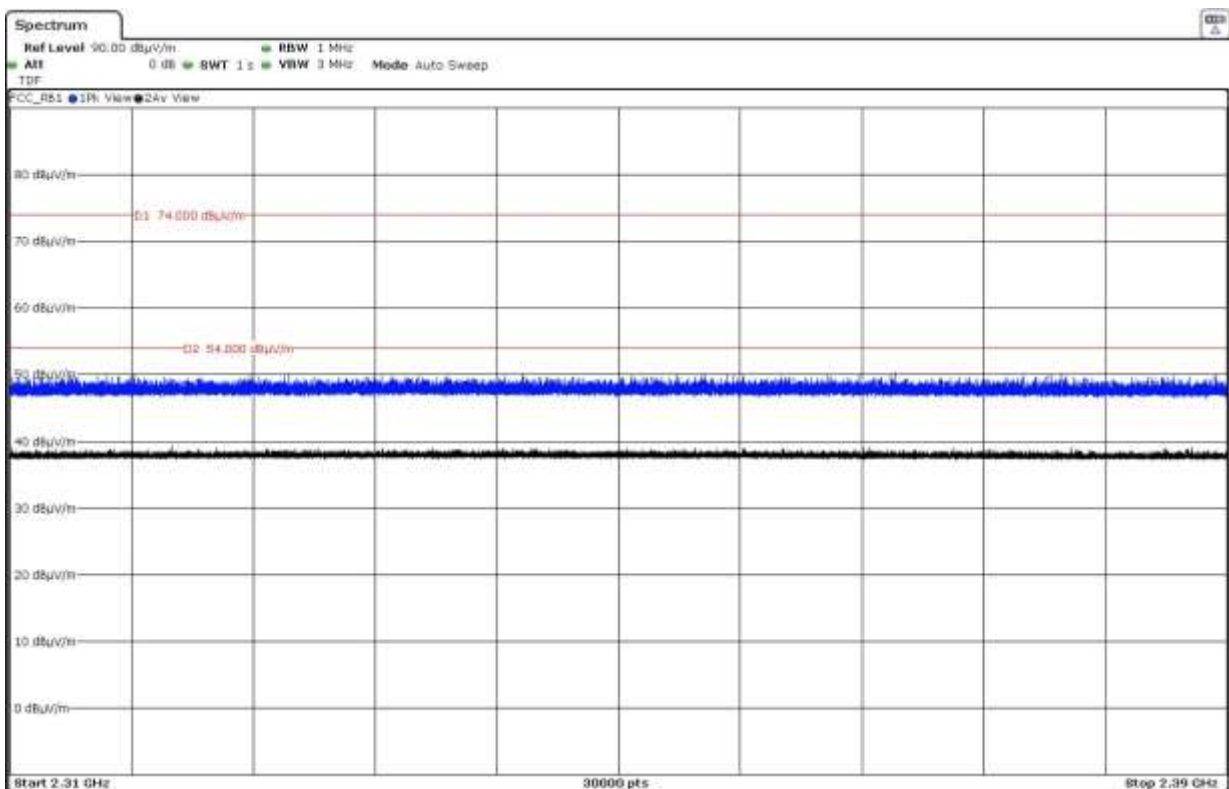


FREQUENCY RANGE 2.31-2.39 GHz (Restricted Band):

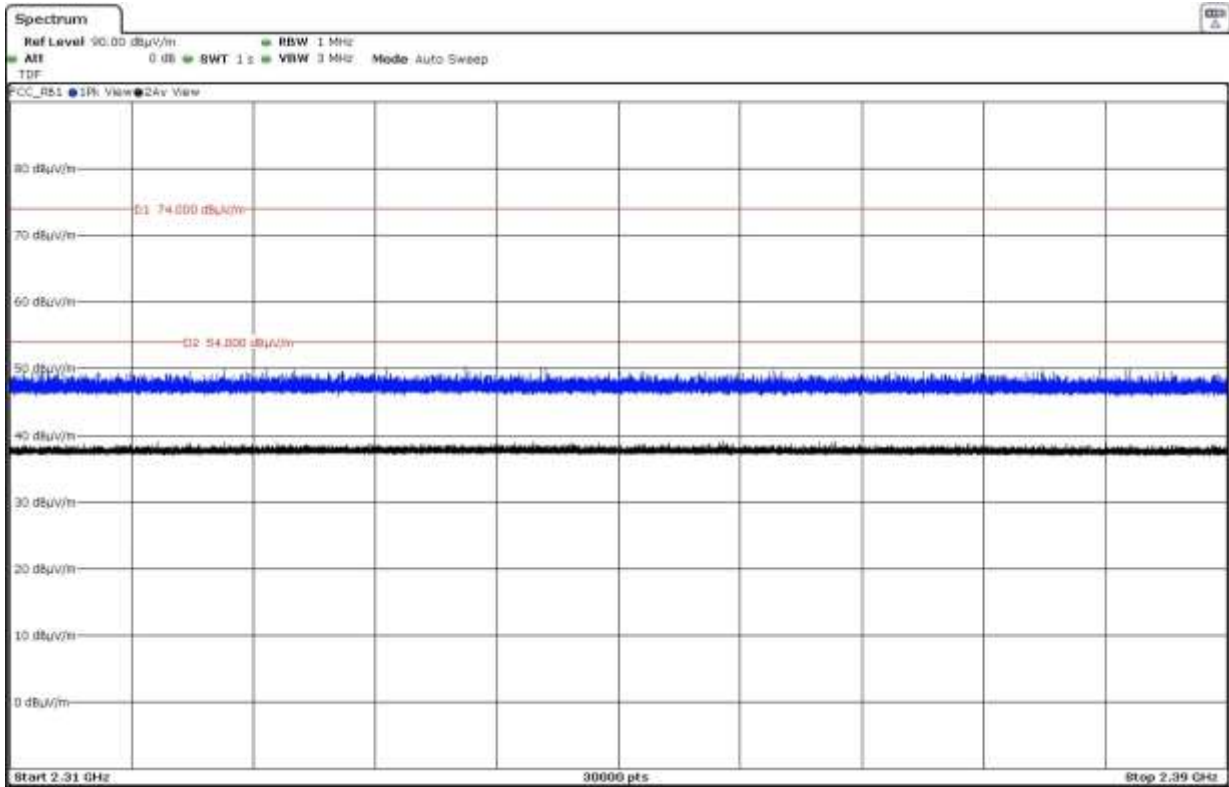
- Low Channel:



- Middle Channel:

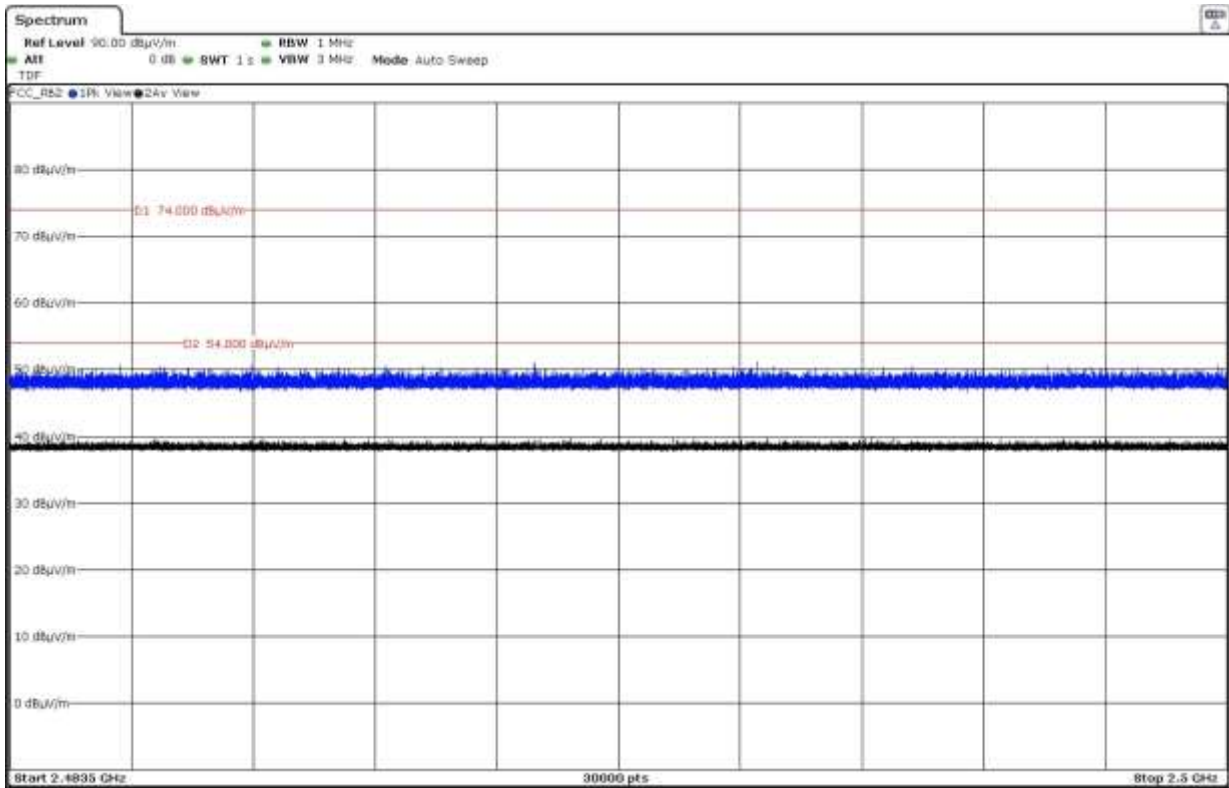


- High Channel:

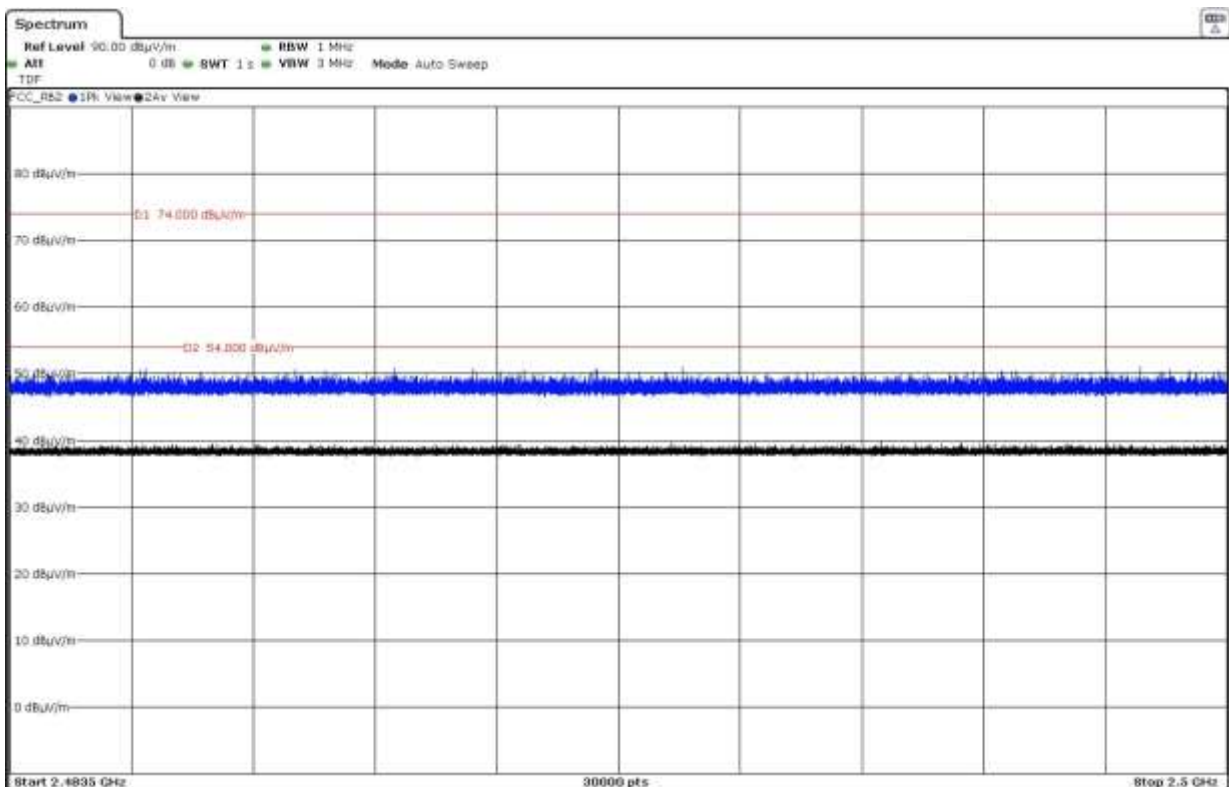


FREQUENCY RANGE 2.4835-2.5 GHz (Restricted Band):

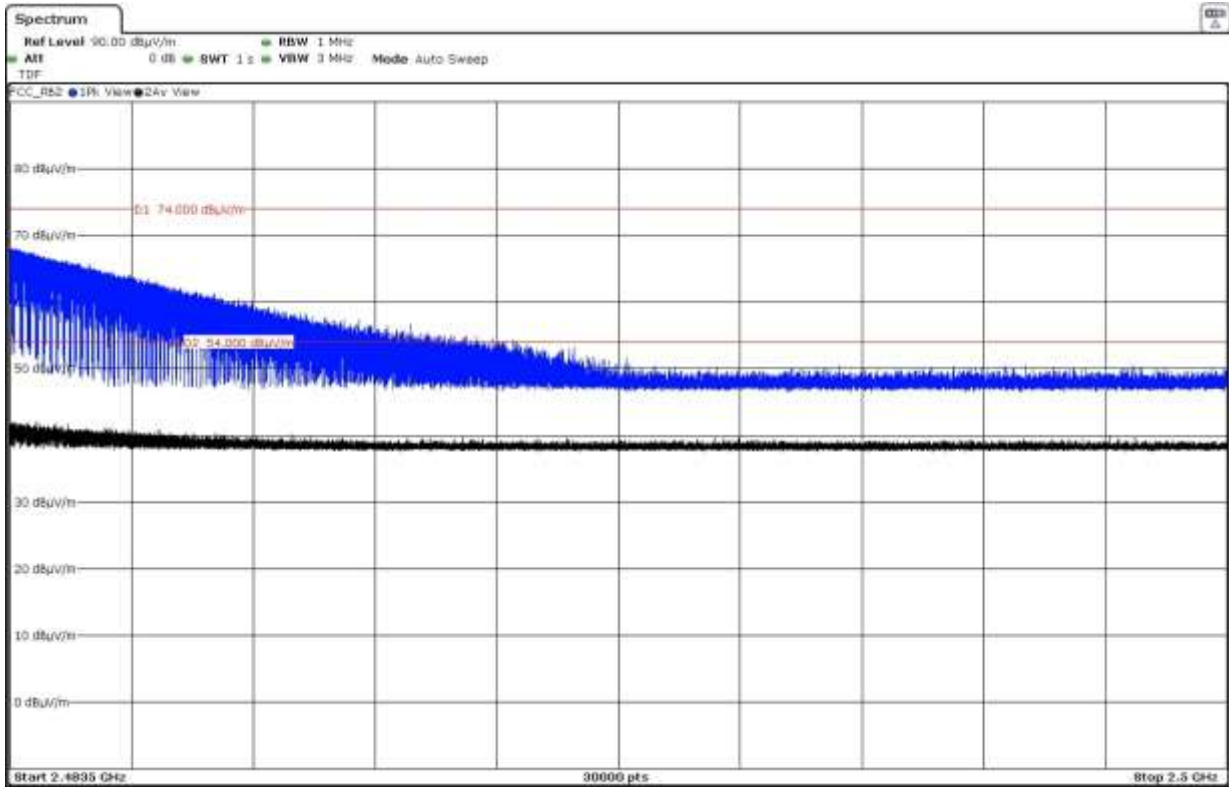
- Low Channel:



- Middle Channel:



- High Channel:



Appendix B: Test results. 802.11 bgn2040 1x1.

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TEST CONDITIONS

POWER SUPPLY (V):

V nominal:	12 Vdc.
Type of Power Supply:	External power supply (Car Battery).

ANTENNA:

Type of Antenna:	Indoor the vehicle.
	Outdoor the vehicle.
Gain:	Indoor: +5.9 dBi. (Antenna gain plus antenna cable loss).
	Outdoor: +3.7 dBi. (Antenna gain plus antenna cable loss).

TEST FREQUENCIES:

802.11 bgn20:

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

802.11 n40:

Low Channel:	2422 MHz
Middle Channel:	2437 MHz
High Channel:	2452 MHz

802.11 b:	Adjustment of Maximum RF Output Power (e.i.r.p.):	+13 dBm
802.11 g:	Adjustment of Maximum RF Output Power (e.i.r.p.):	+15 dBm
802.11 n20:	Adjustment of Maximum RF Output Power (e.i.r.p.):	+14 dBm
802.11 n40:	Adjustment of Maximum RF Output Power (e.i.r.p.):	+12 dBm

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

- 802.11a: 6 Mbit/s / SISO on Antenna Indoor.
- 802.11n HT20: MCS0 / SISO on Antenna Indoor.
- 802.11n HT40: MCS0 / SISO on Antenna Indoor.

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

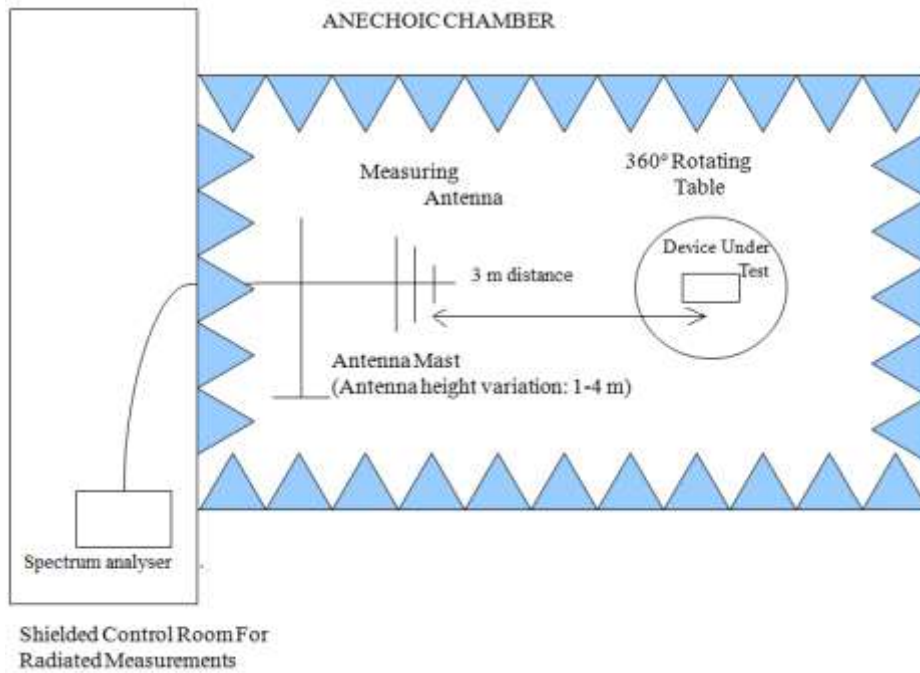
All radiated tests were performed in a semi-anechoic chamber. The measurement antenna (Bilog antenna for the range between 30 MHz to 1000 MHz) is situated at a distance of 3 m and at a distance of 1m for the frequency range 1 GHz-26 GHz (1 GHz-18 GHz Double ridge horn antenna and 18 GHz-40 GHz horn antenna).

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.

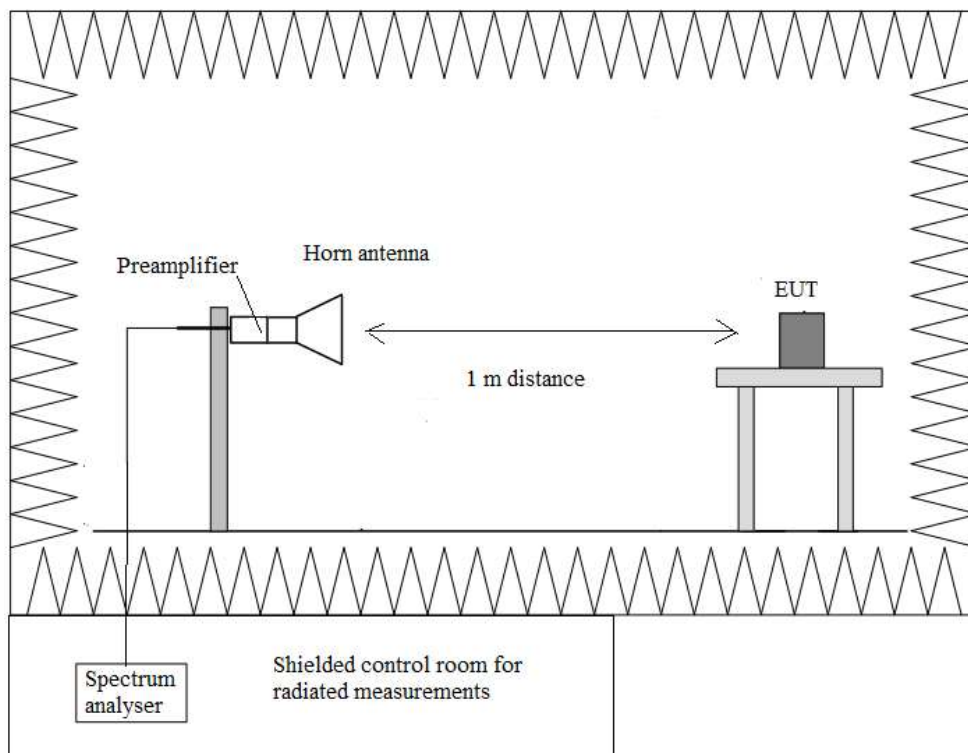
The equipment under test was set up on a non-conductive platform above the ground plane and the situation and orientation was varied to find the maximum radiated emission. It was also rotated 360° and the antenna height (Bilog antenna and Double ridge horn antenna) was varied from 1 to 4 meters to find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

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

Radiated measurements setup from 30 MHz to 1 GHz:



Radiated measurements setup $f > 1$ GHz:



Occupied Bandwidth

RESULTS:

- 802.11 b mode:**

	Low Channel 2412 MHz	Middle Channel 2437 MHz	High Channel 2462 MHz
99% bandwidth (MHz)	13.000	13.012	12.960
-26 dBc bandwidth (MHz)	17.154	17.170	16.773
Measurement uncertainty (kHz)	<± 5.00		

- 802.11 g mode:**

	Low Channel 2412 MHz	Middle Channel 2437 MHz	High Channel 2462 MHz
99% bandwidth (MHz)	16.484	16.496	16.524
-26 dBc bandwidth (MHz)	20.711	21.091	20.228
Measurement uncertainty (kHz)	<± 5.00		

- 802.11 n20 mode:**

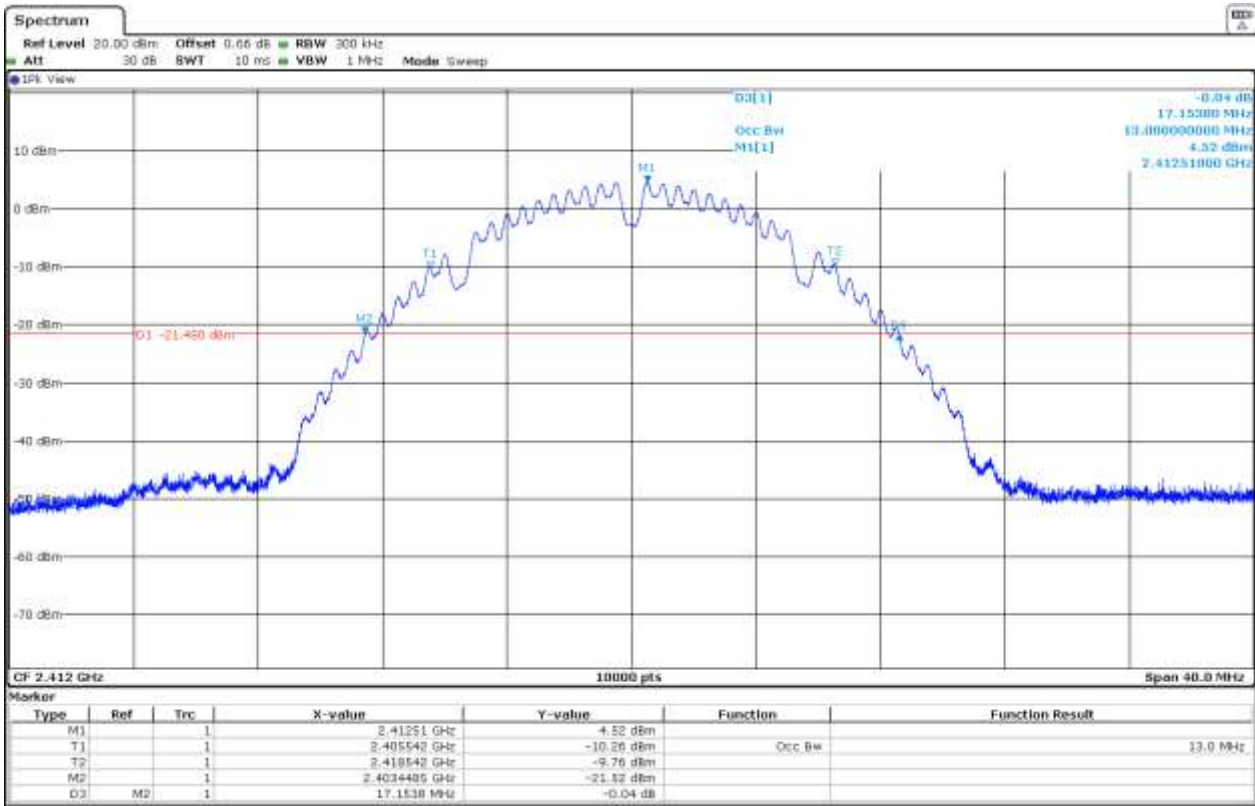
	Low Channel 2412 MHz	Middle Channel 2437 MHz	High Channel 2462 MHz
99% bandwidth (MHz)	17.600	17.600	17.620
-26 dBc bandwidth (MHz)	21.188	21.304	21.428
Measurement uncertainty (kHz)	<± 5.00		

- 802.11 n40 mode:**

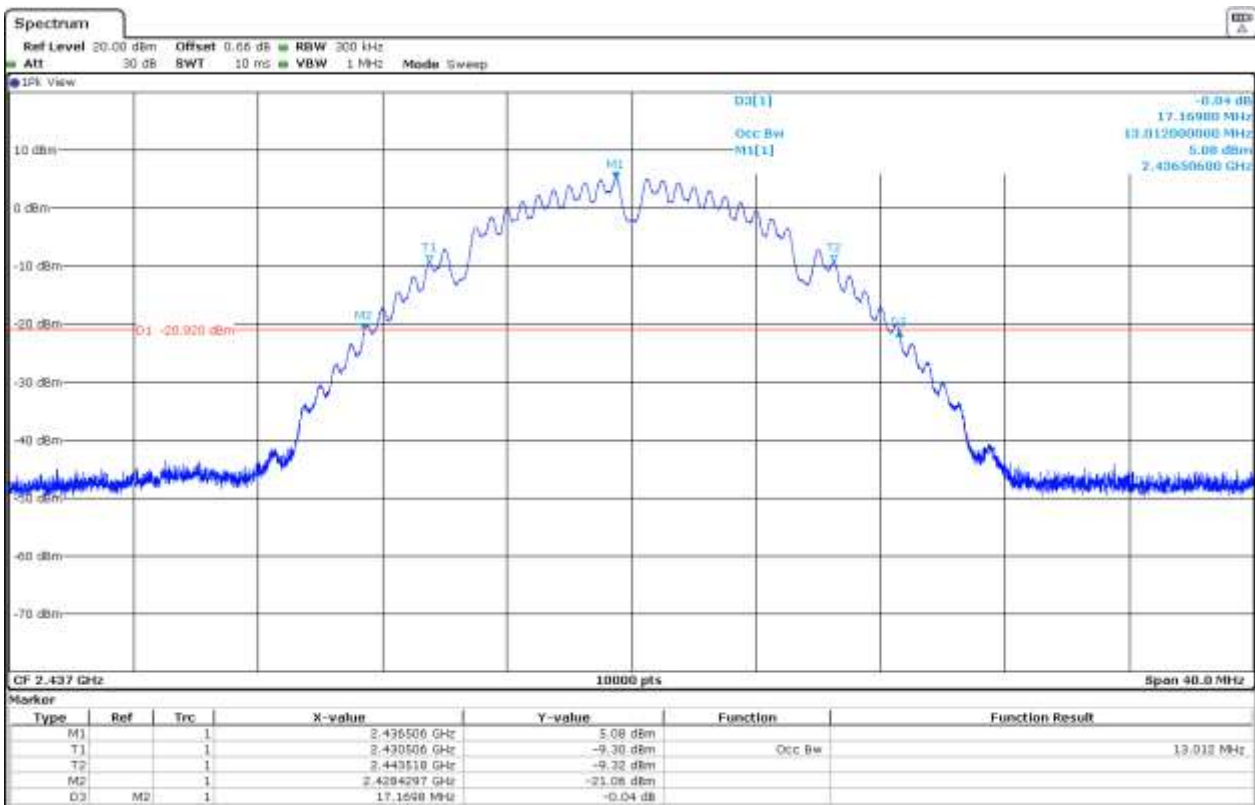
	Low Channel 2422 MHz	Middle Channel 2437 MHz	High Channel 2452 MHz
99% bandwidth (MHz)	36.616	36.544	36.528
-26 dBc bandwidth (MHz)	45.152	44.889	44.960
Measurement uncertainty (kHz)	<± 14.00		

• 802.11 b mode – Occupied Bandwidth

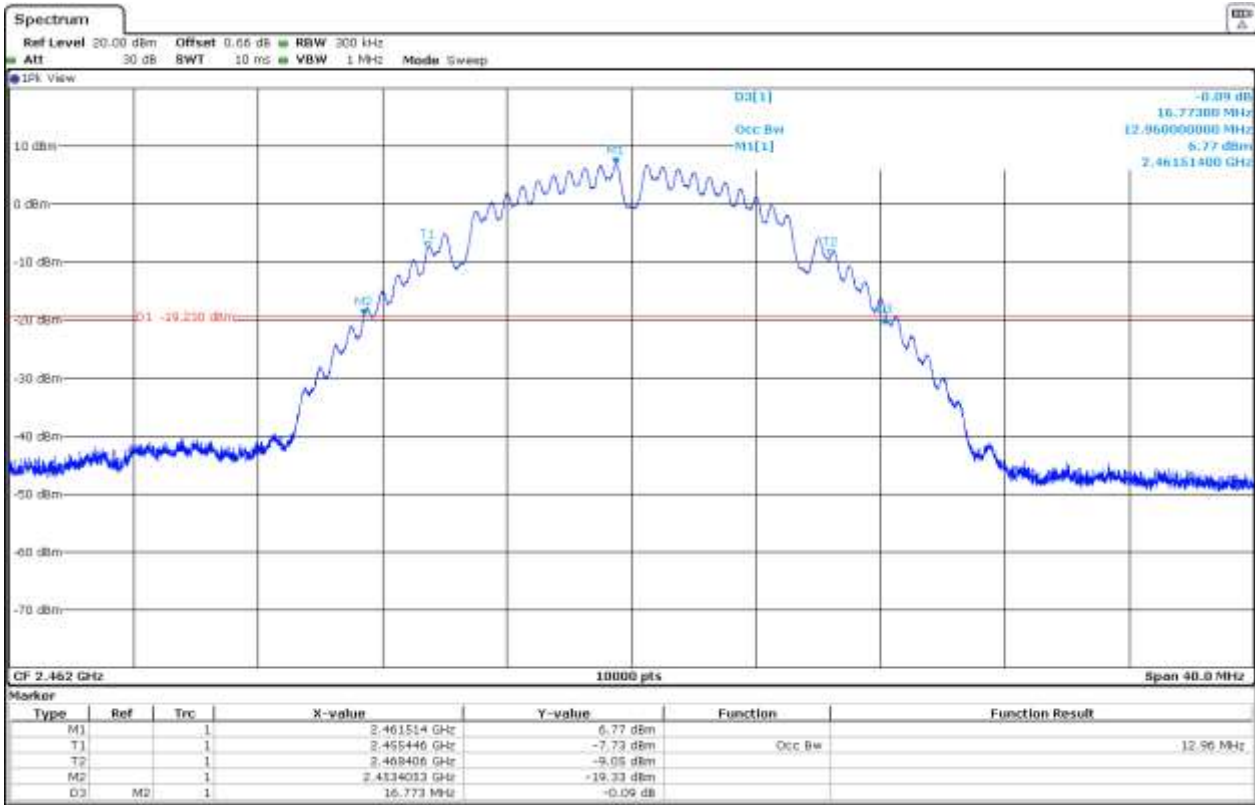
- Low Channel:



- Middle Channel:

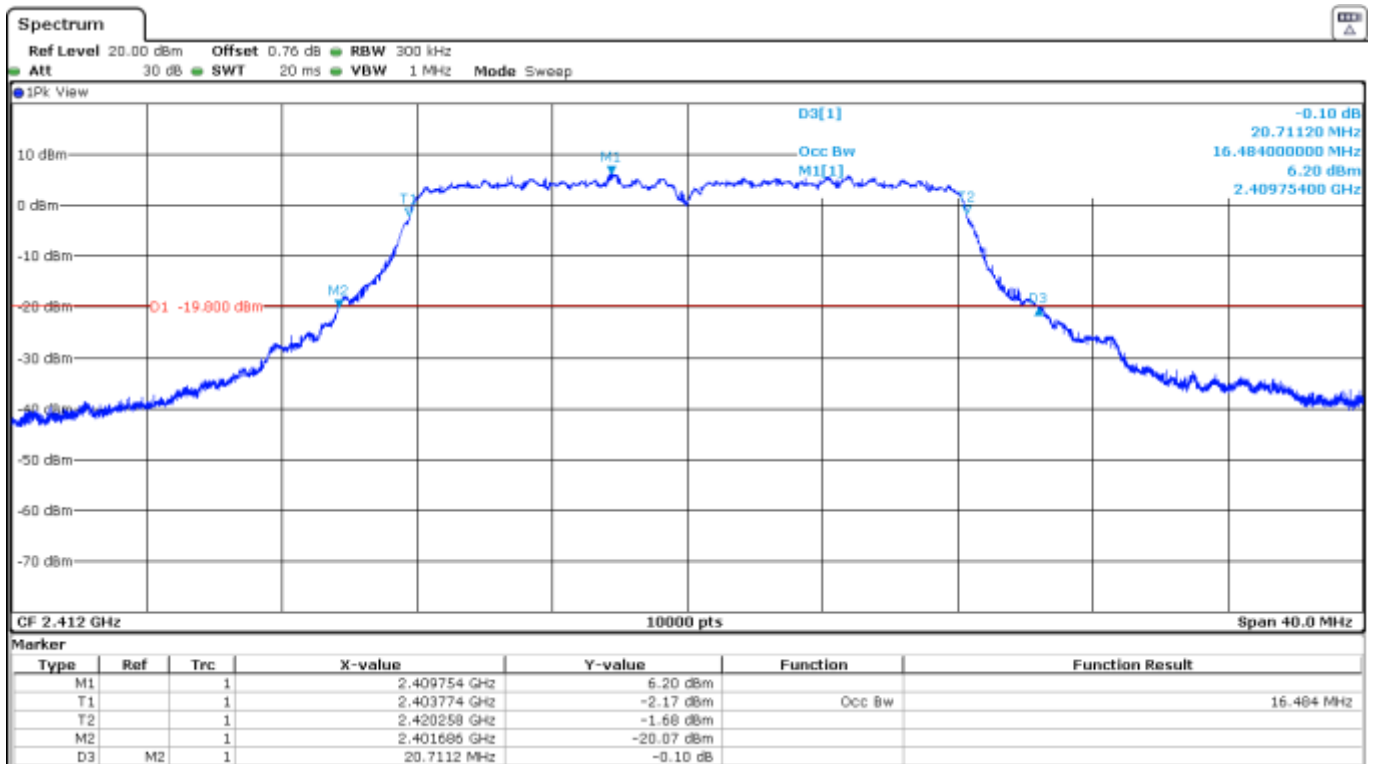


- High Channel:

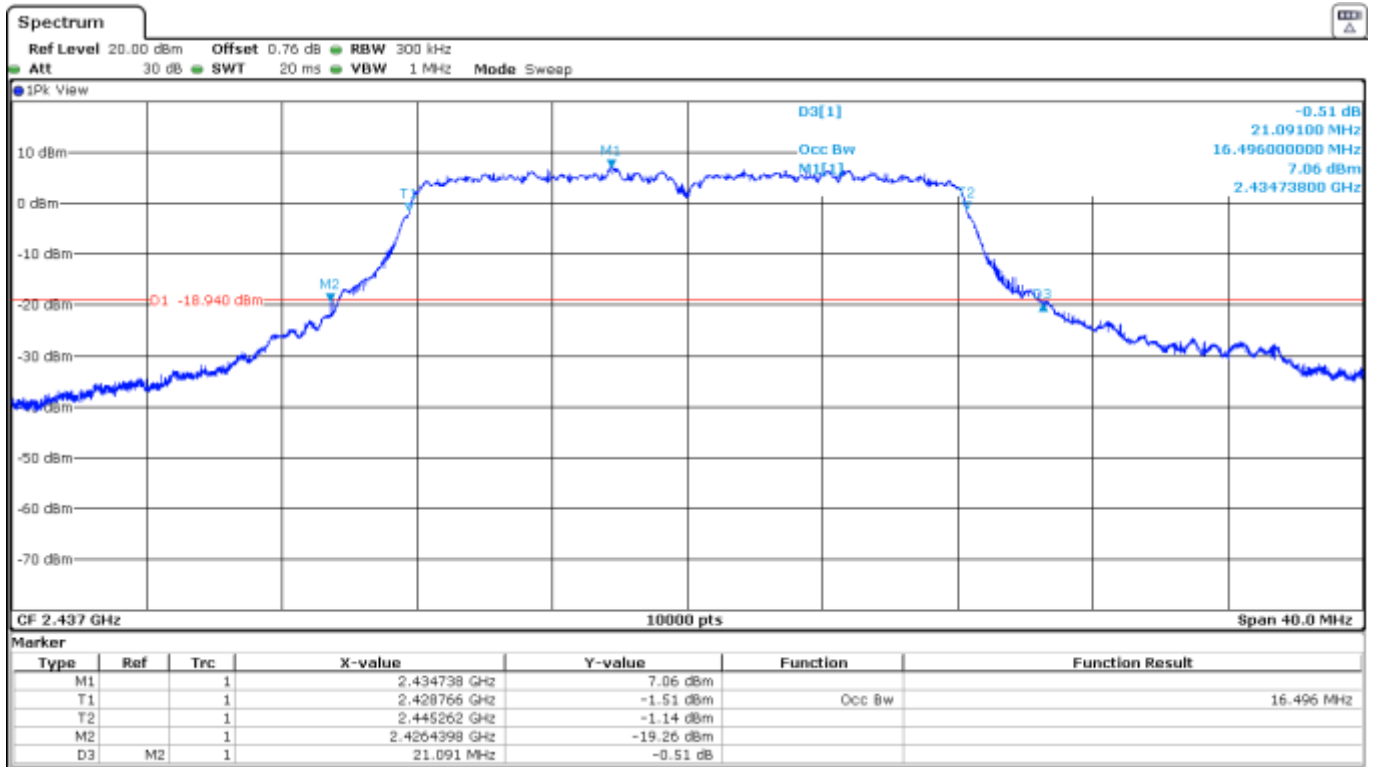


• 802.11 g mode – Occupied Bandwidth

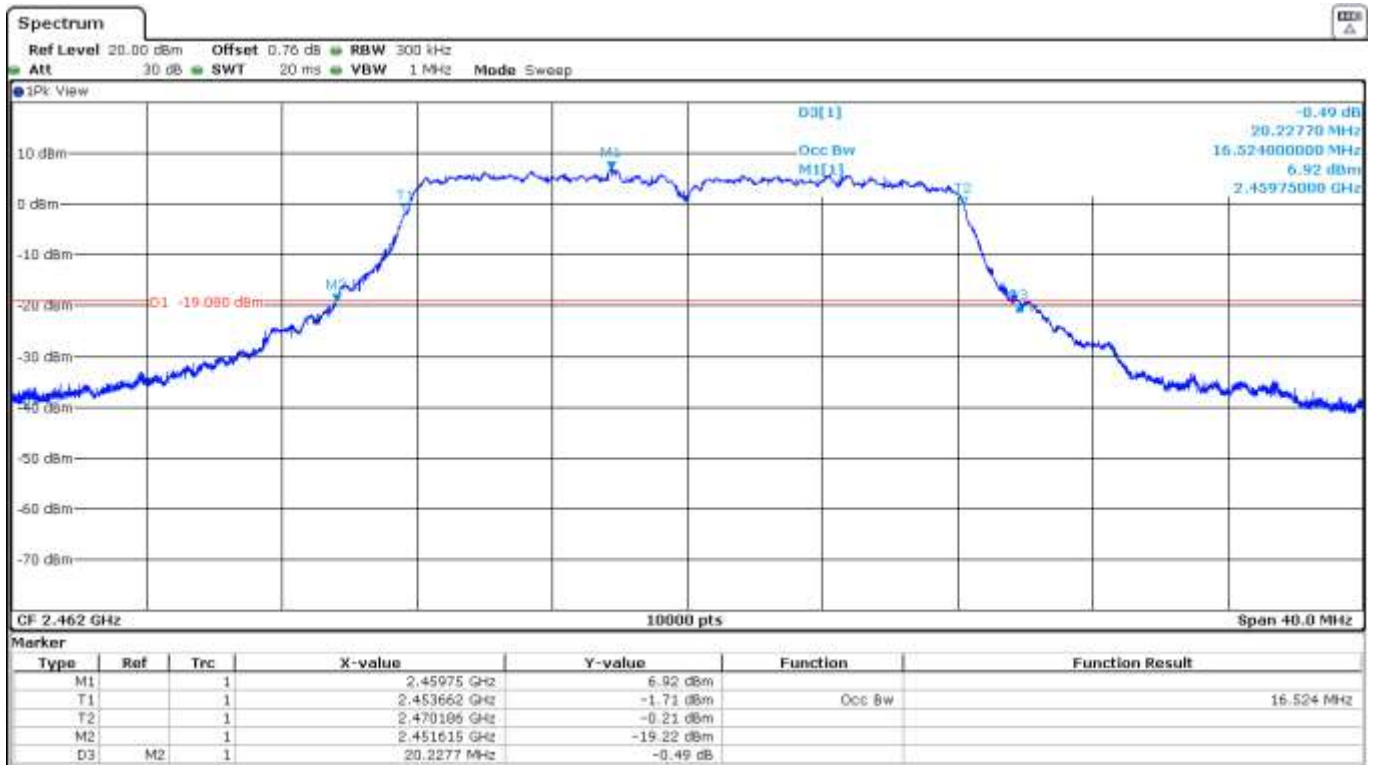
- Low Channel:



- Middle Channel:

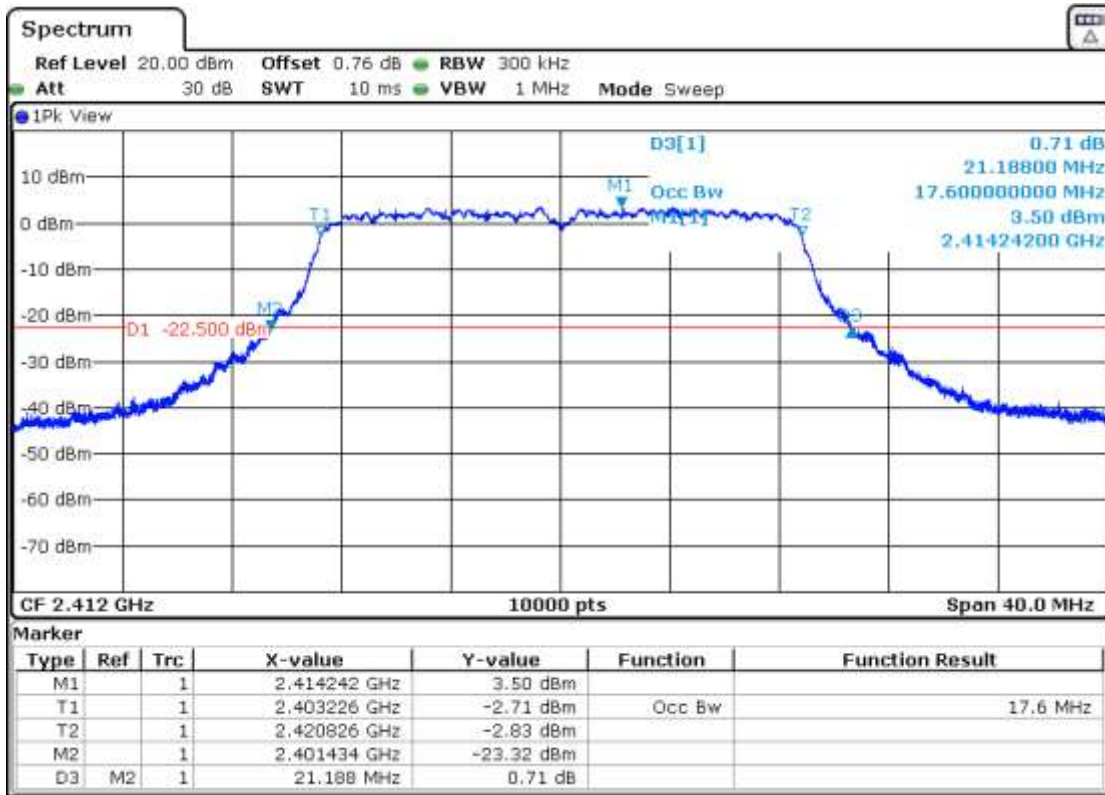


- High Channel:

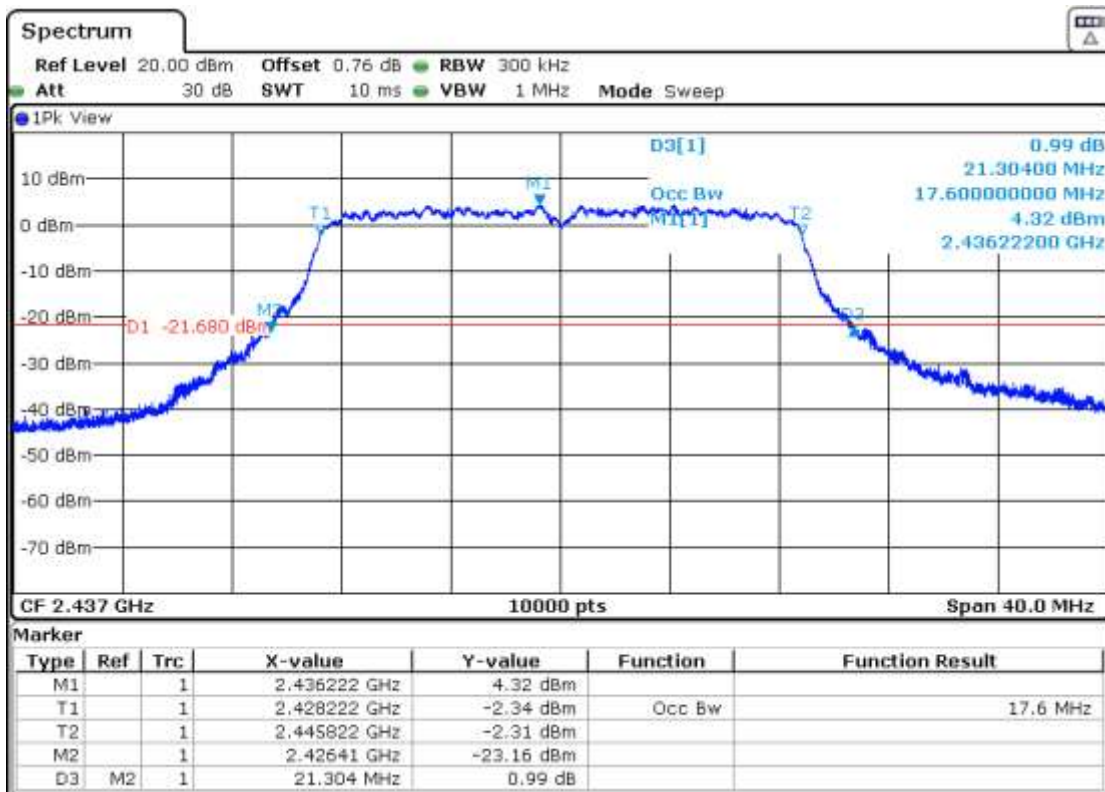


• 802.11 n20 mode – Occupied Bandwidth

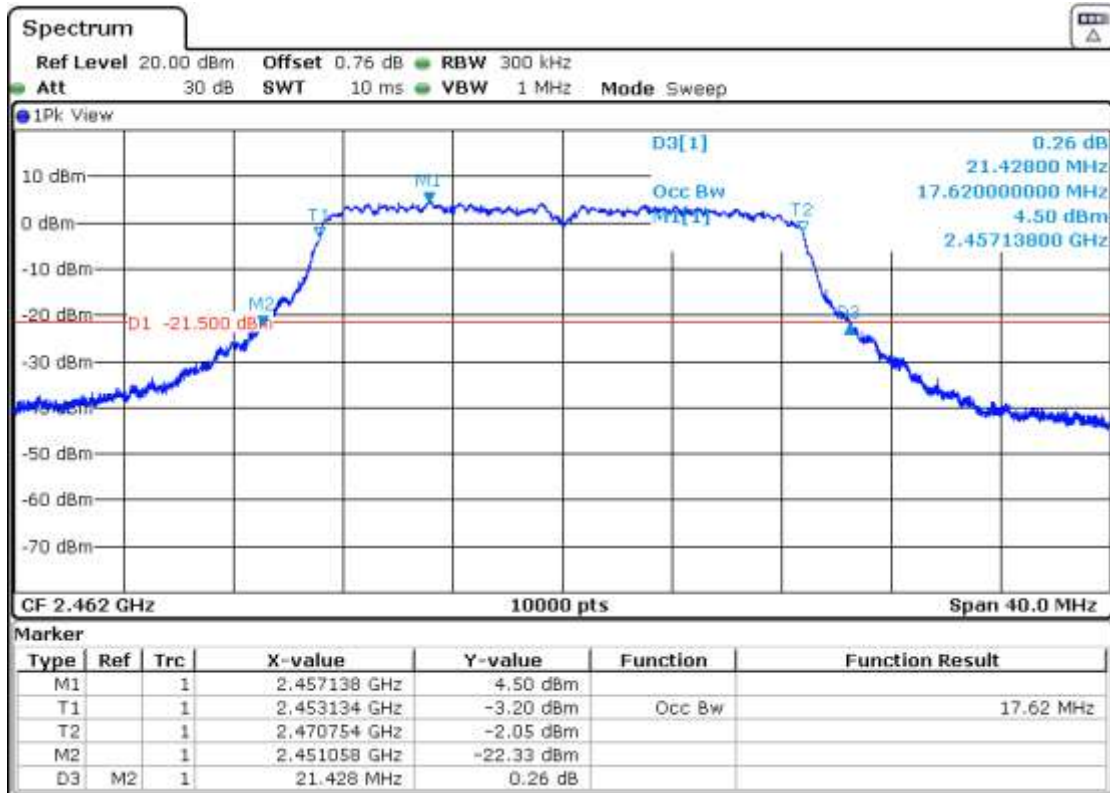
- Low Channel:



- Middle Channel:

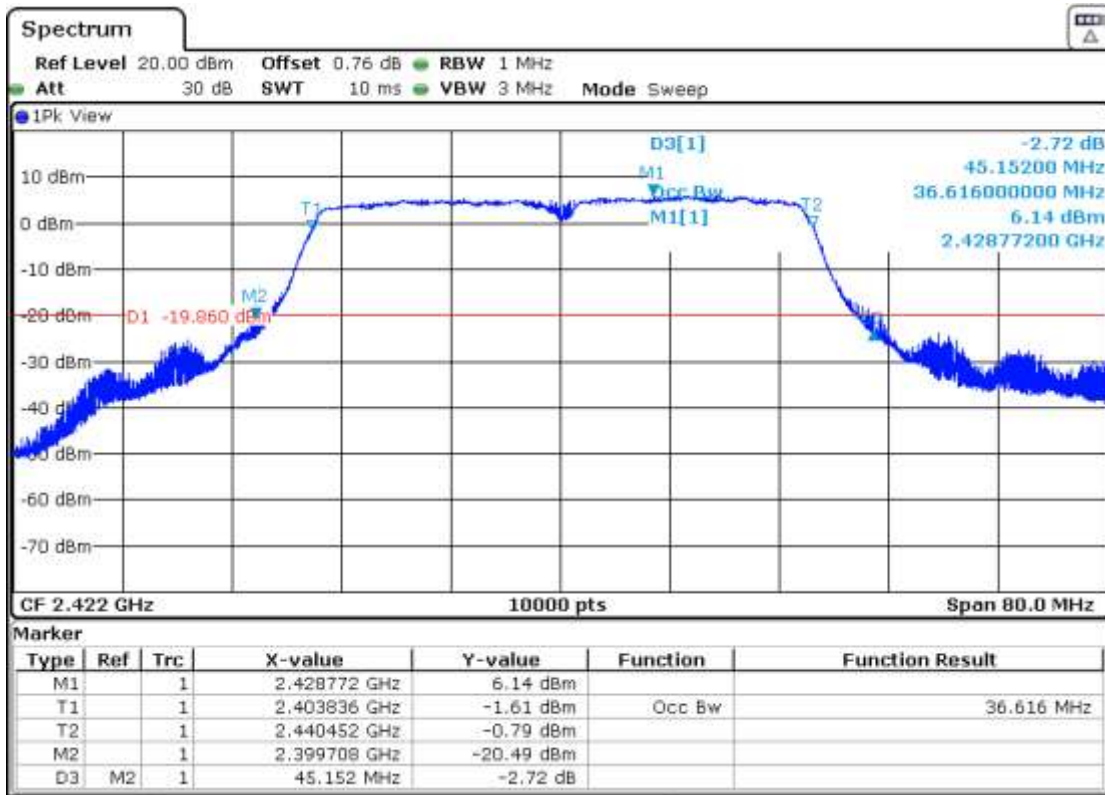


- High Channel:

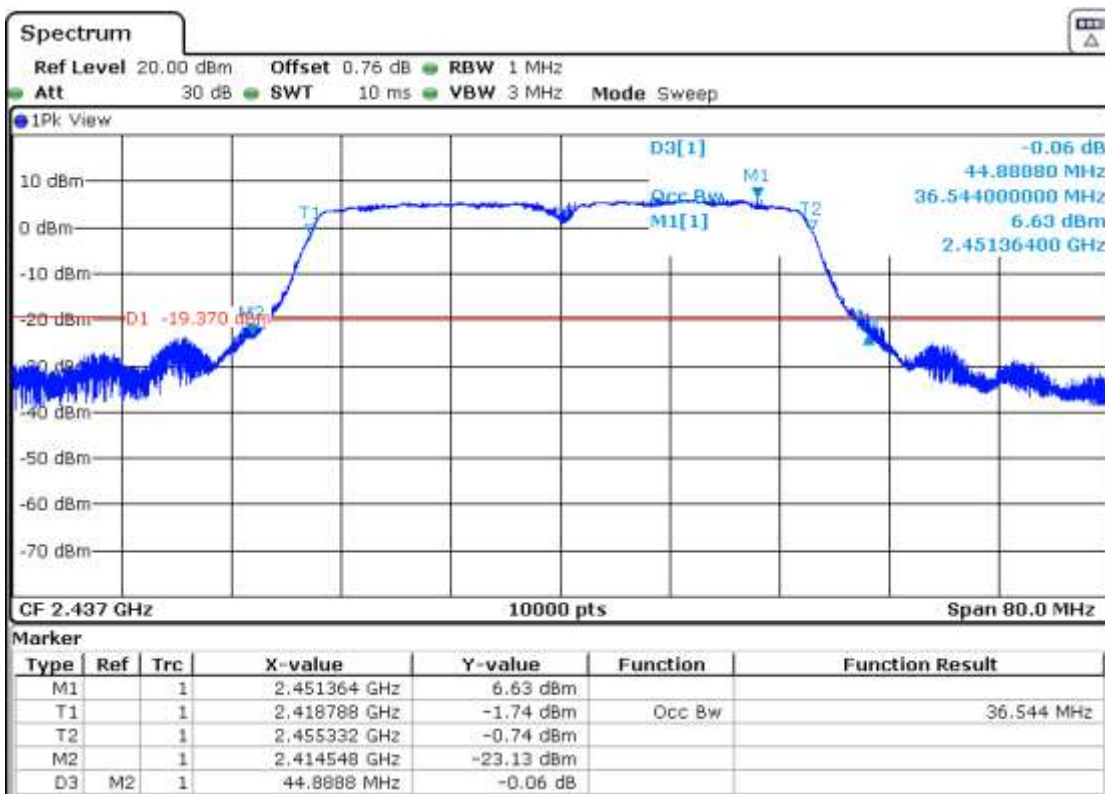


• 802.11 n40 mode – Occupied Bandwidth

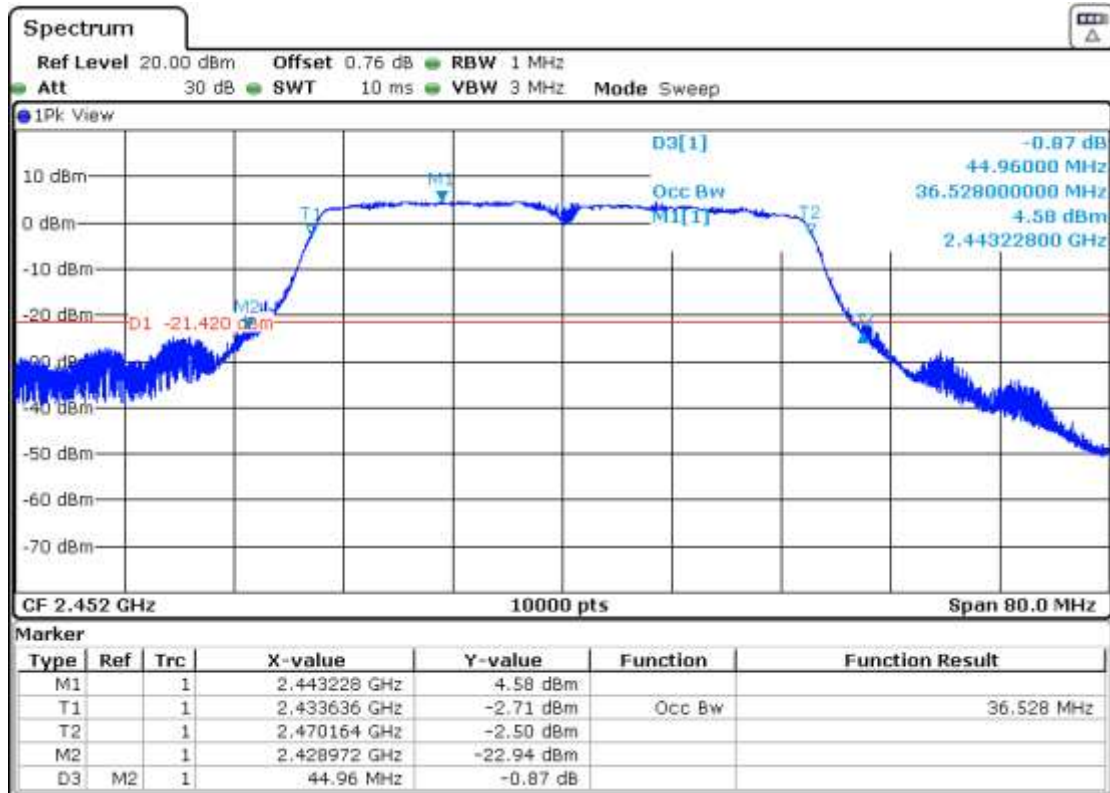
- Low Channel:



- 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 mode:**

	Low Channel 2412 MHz	Middle Channel 2437 MHz	High Channel 2462 MHz
6 dB Spectrum Bandwidth (MHz)	7.571	8.057	8.061
Measurement uncertainty (kHz)	<±3.00		

- 802.11 g mode:**

	Low Channel 2412 MHz	Middle Channel 2437 MHz	High Channel 2462 MHz
6 dB Spectrum Bandwidth (MHz)	16.043	16.269	15.929
Measurement uncertainty (kHz)	<±3.00		

- 802.11 n20 mode:**

	Low Channel 2412 MHz	Middle Channel 2437 MHz	High Channel 2462 MHz
6 dB Spectrum Bandwidth (MHz)	16.816	16.812	16.336
Measurement uncertainty (kHz)	<±3.00		

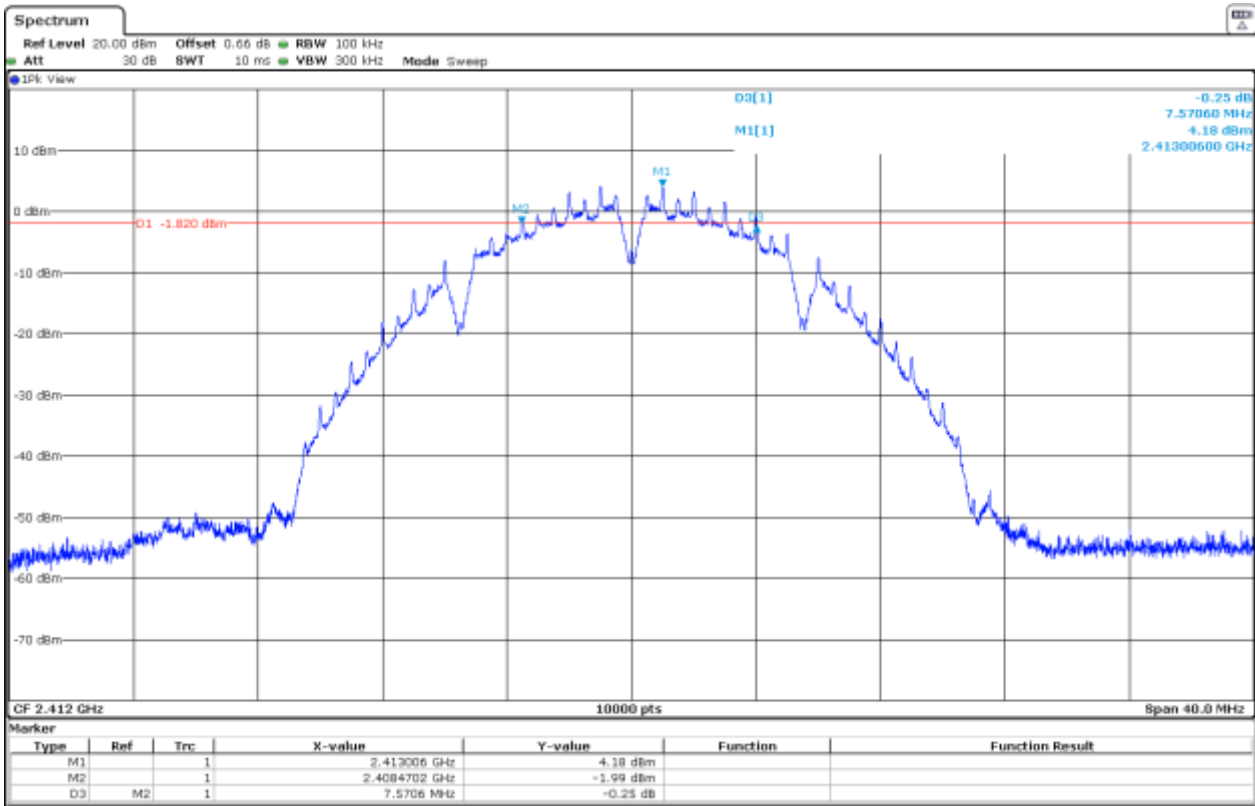
- 802.11 n40 mode:**

	Low Channel 2422 MHz	Middle Channel 2437 MHz	High Channel 2452 MHz
6 dB Spectrum Bandwidth (MHz)	35.328	35.152	35.733
Measurement uncertainty (kHz)	<±14.00		

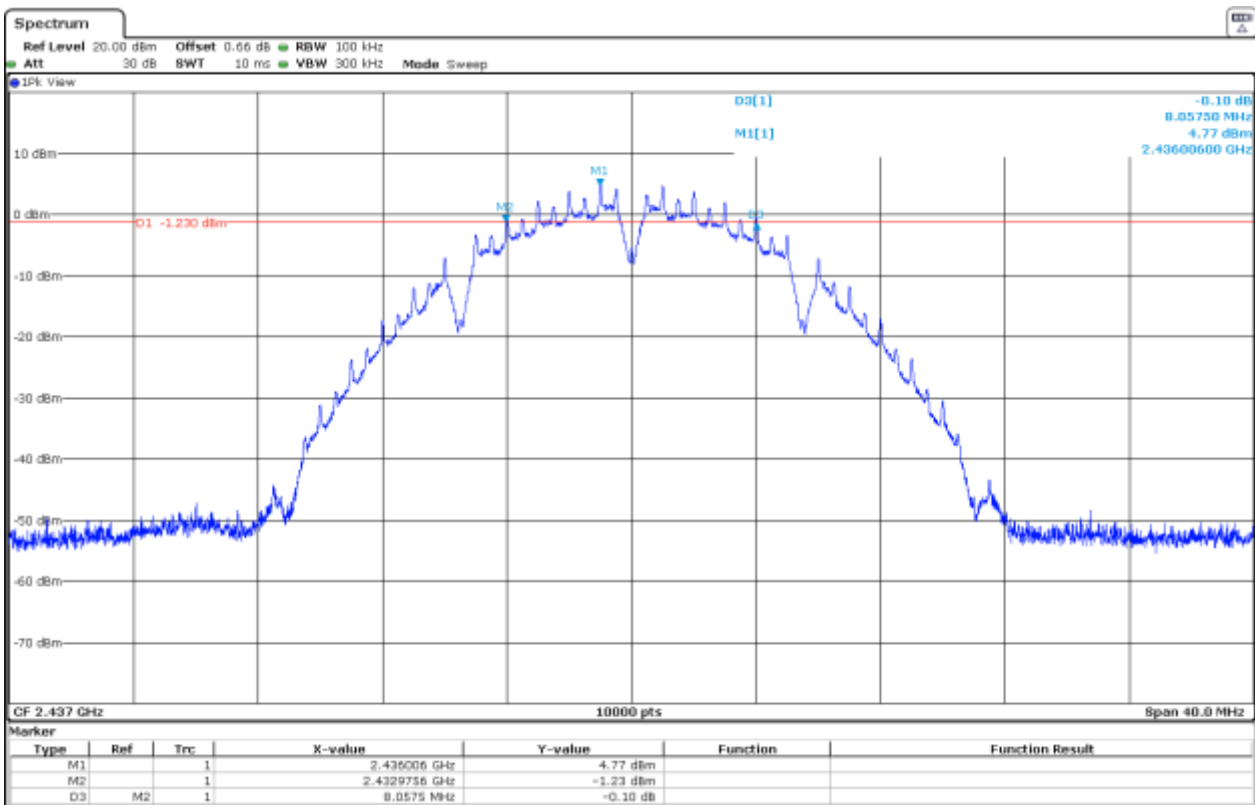
Verdict: PASS

• 802.11 b mode – 6 dB Bandwidth

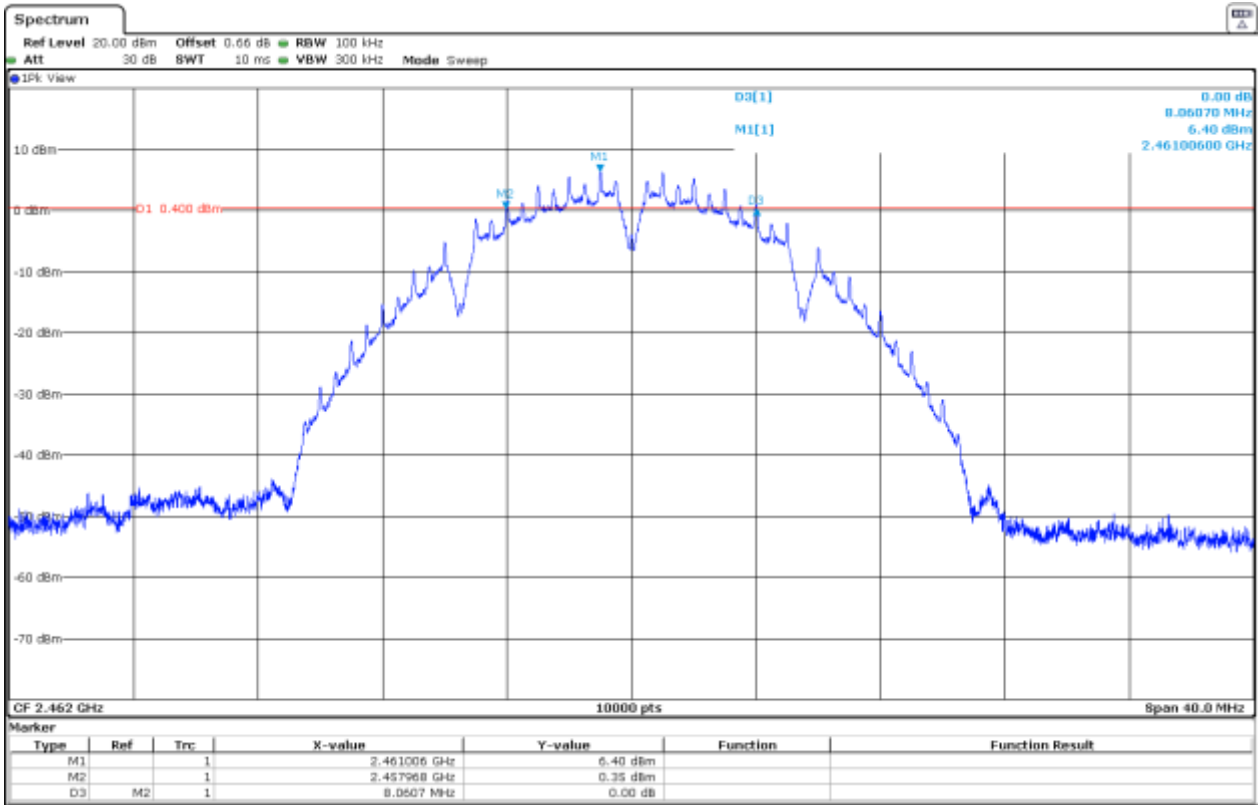
- Low Channel:



- Middle Channel:

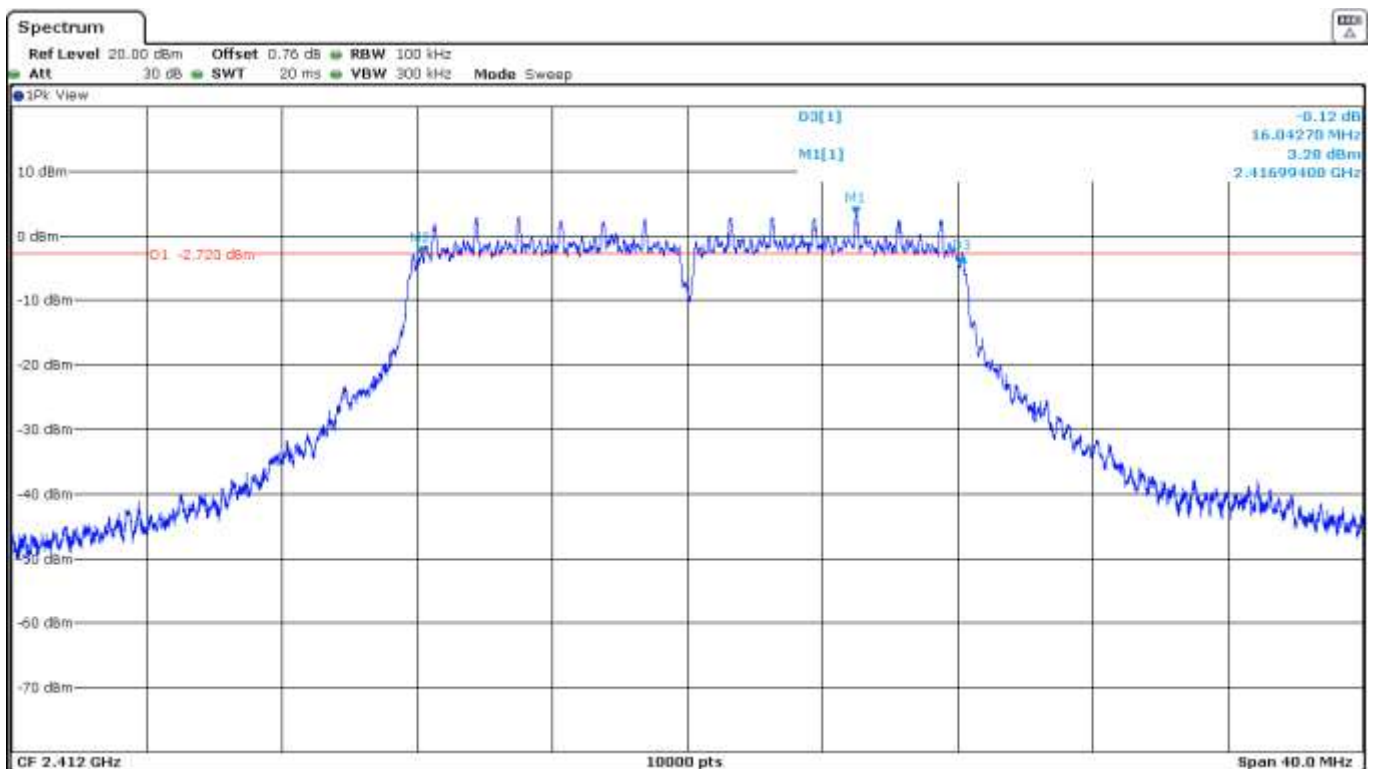


- High Channel:

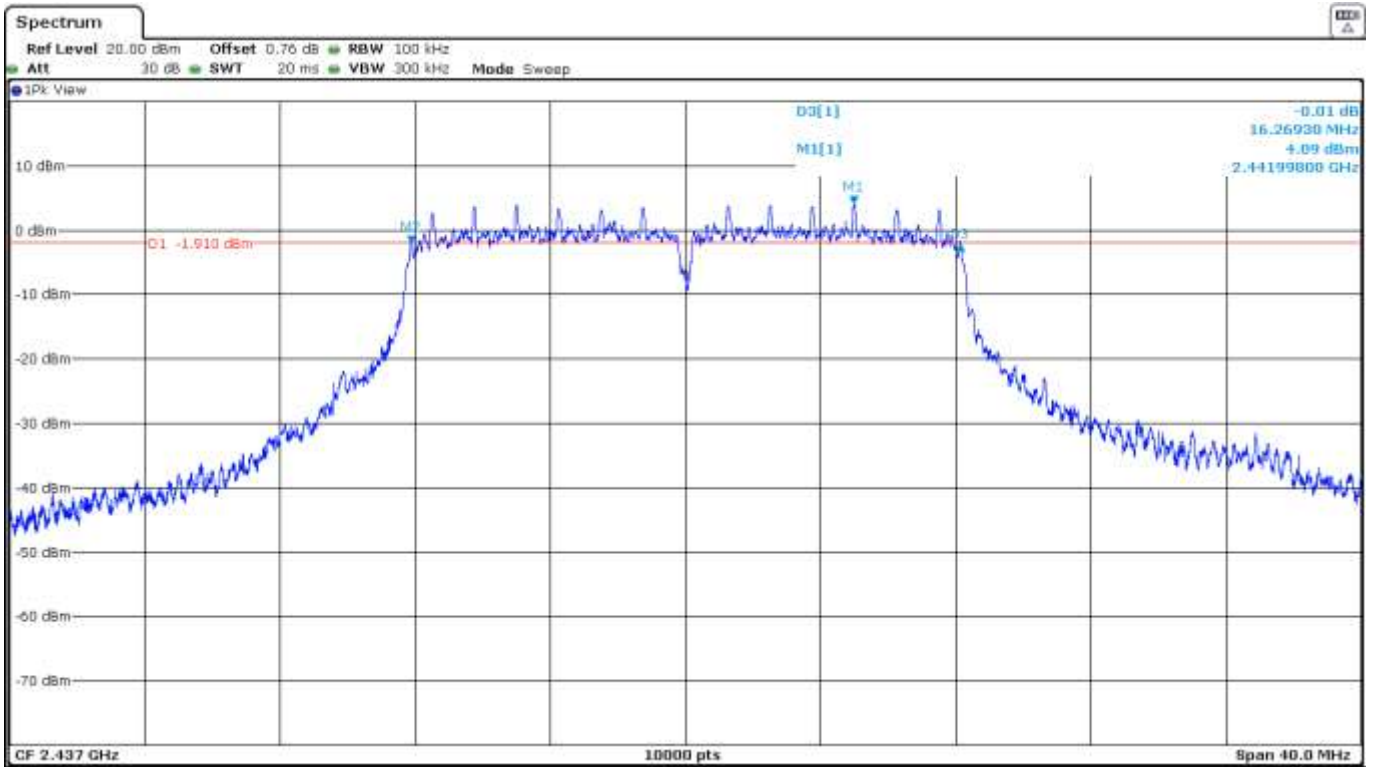


- 802.11 g mode – 6 dB Bandwidth

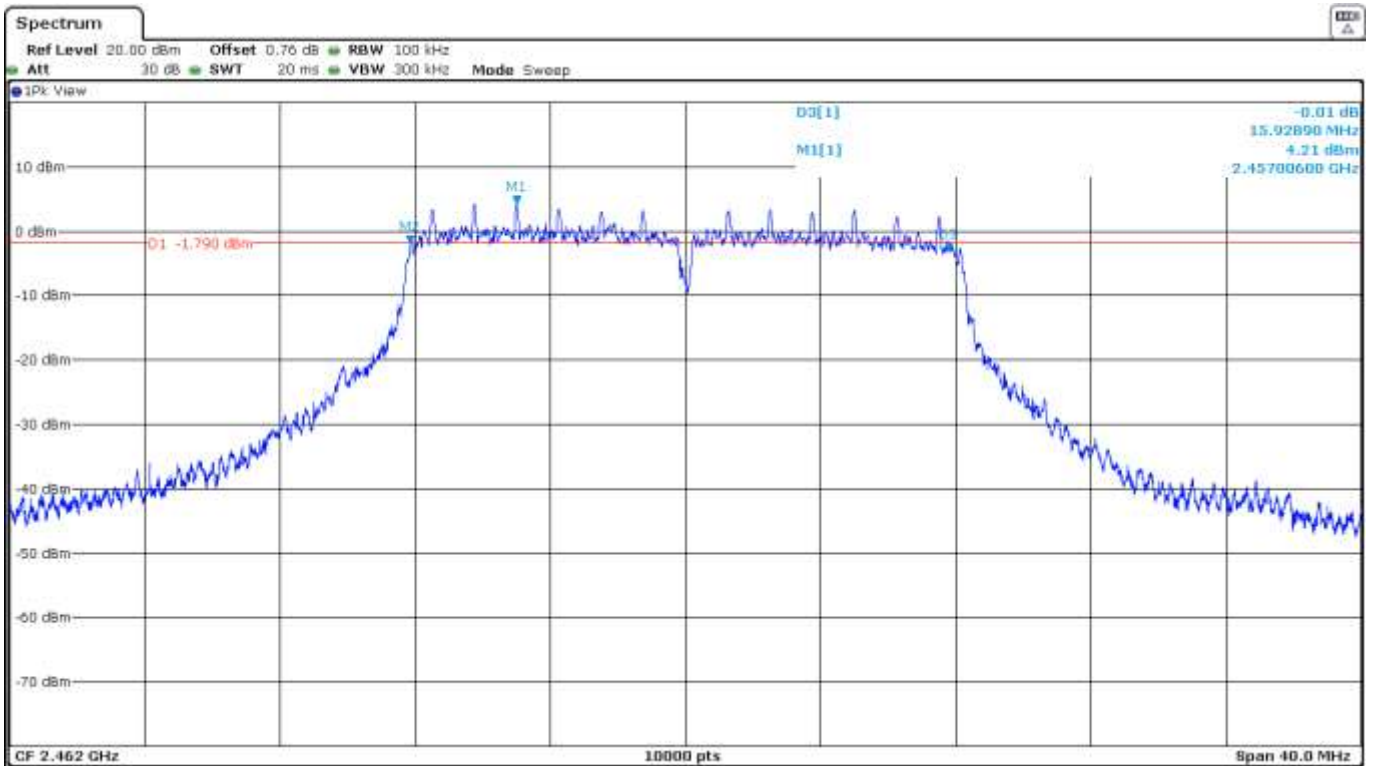
- Low Channel:



- Middle Channel:

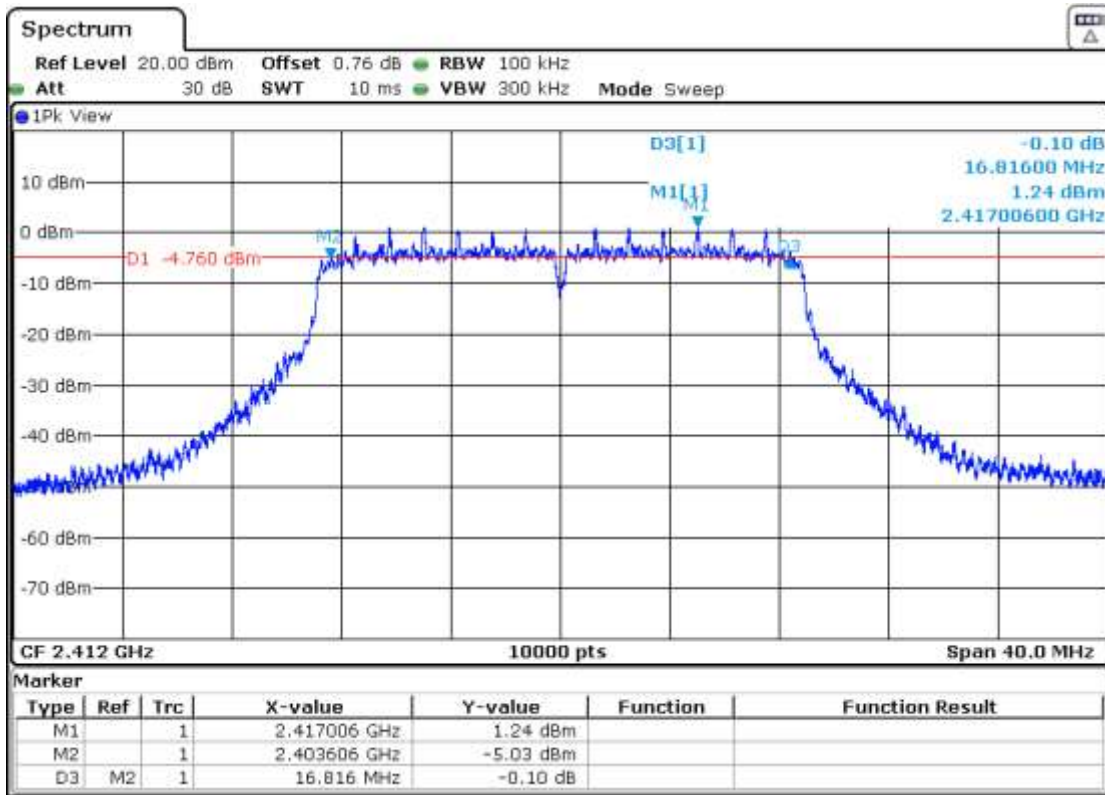


- High Channel:

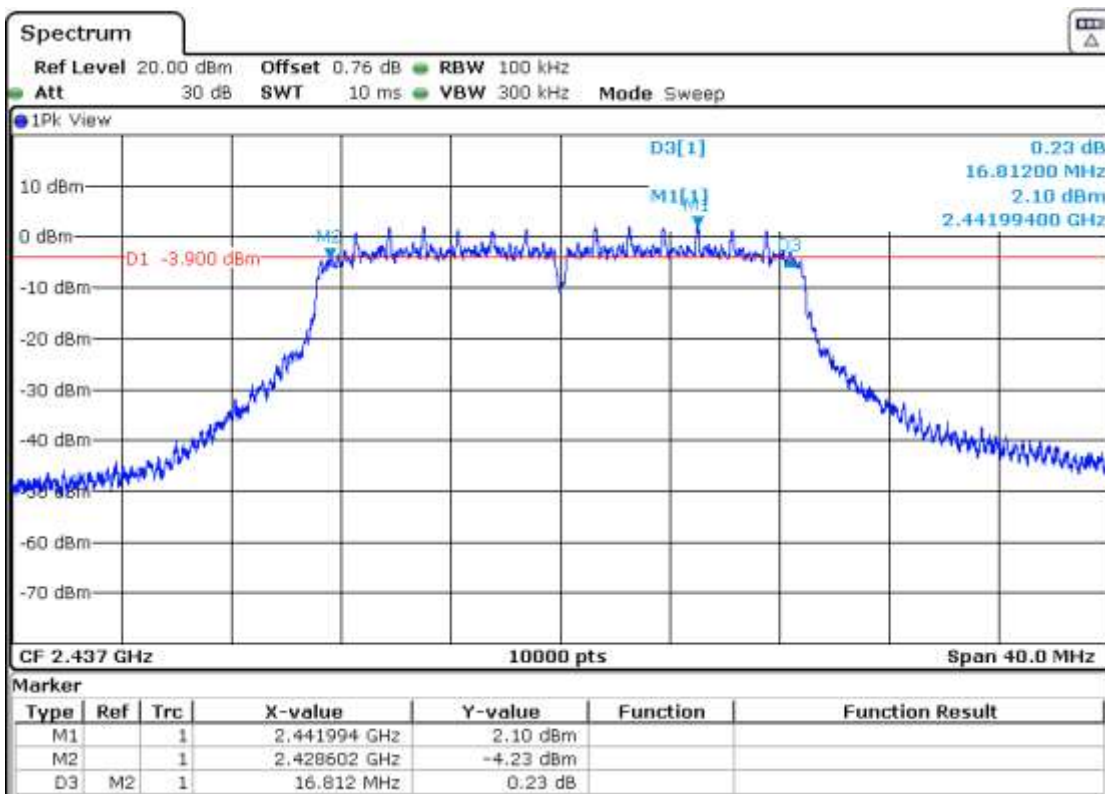


• 802.11 n20 mode – 6 dB Bandwidth

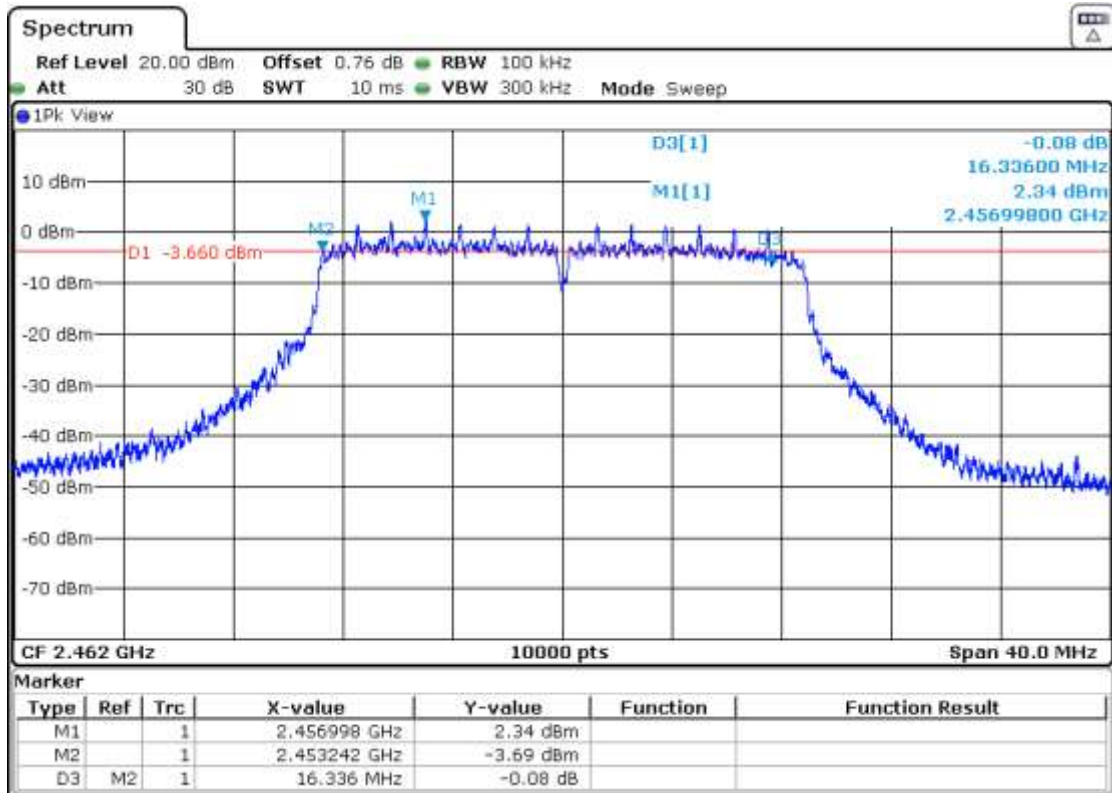
- Low Channel:



- Middle Channel:

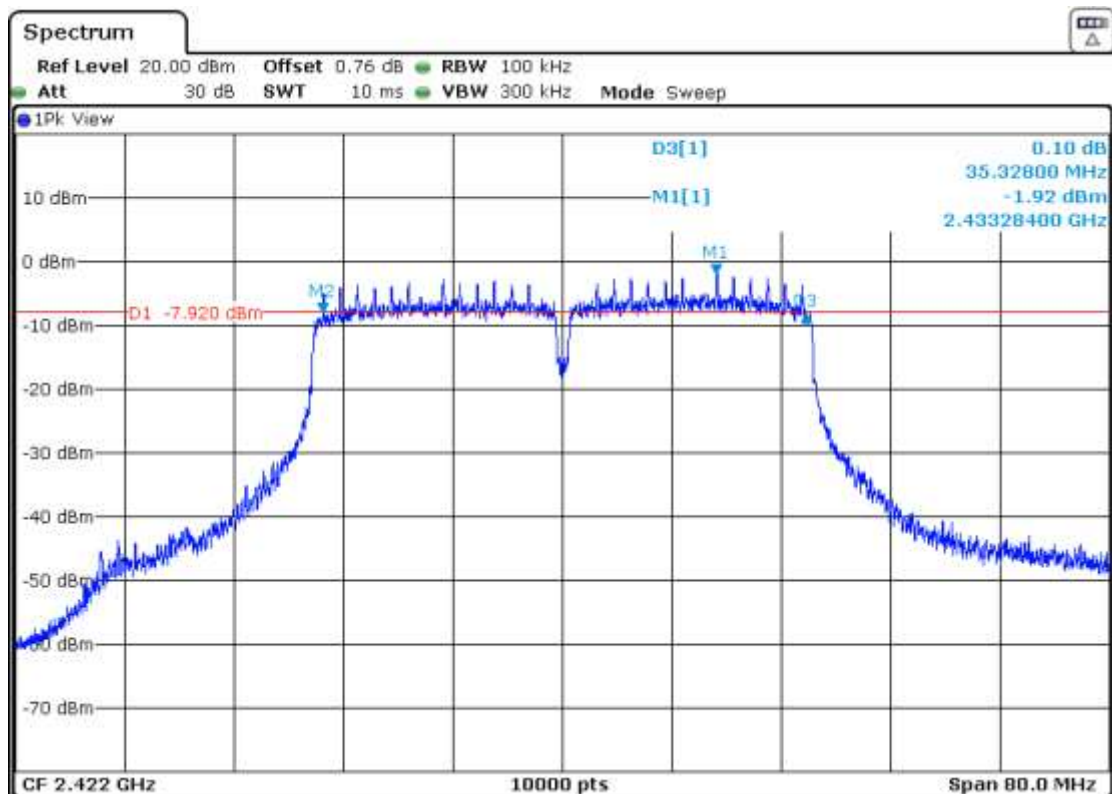


- High Channel:

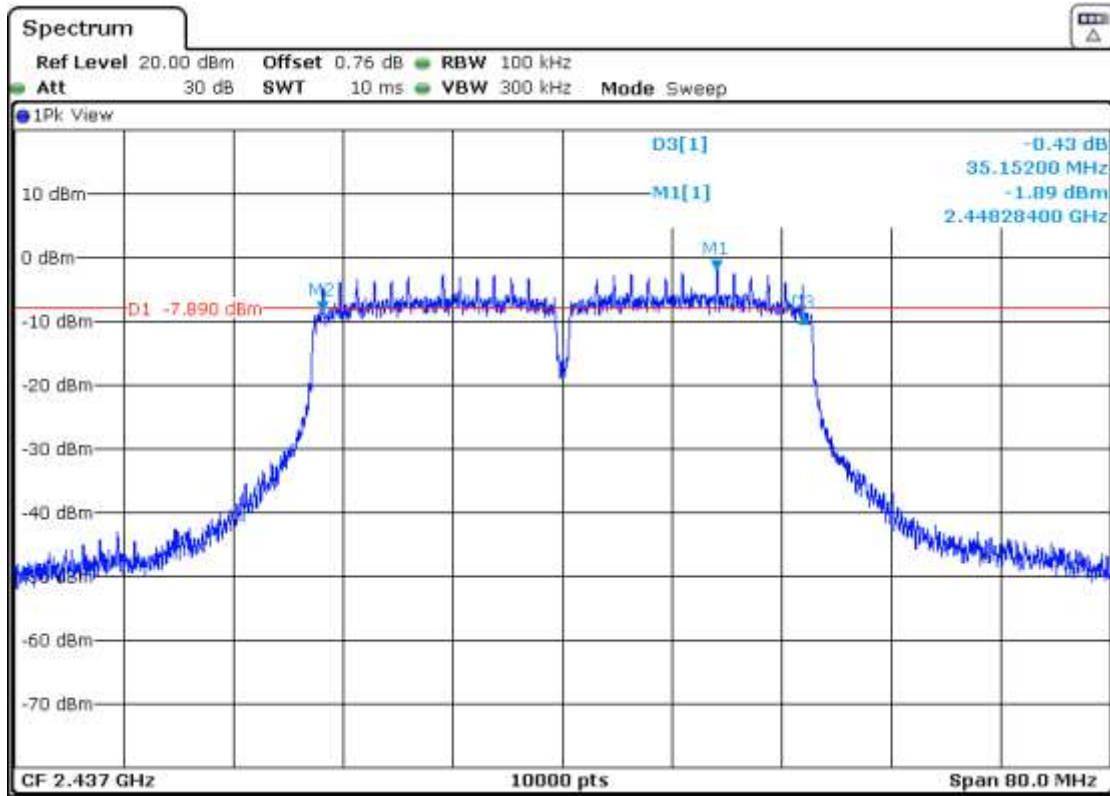


• 802.11 n40 mode – 6 dB Bandwidth

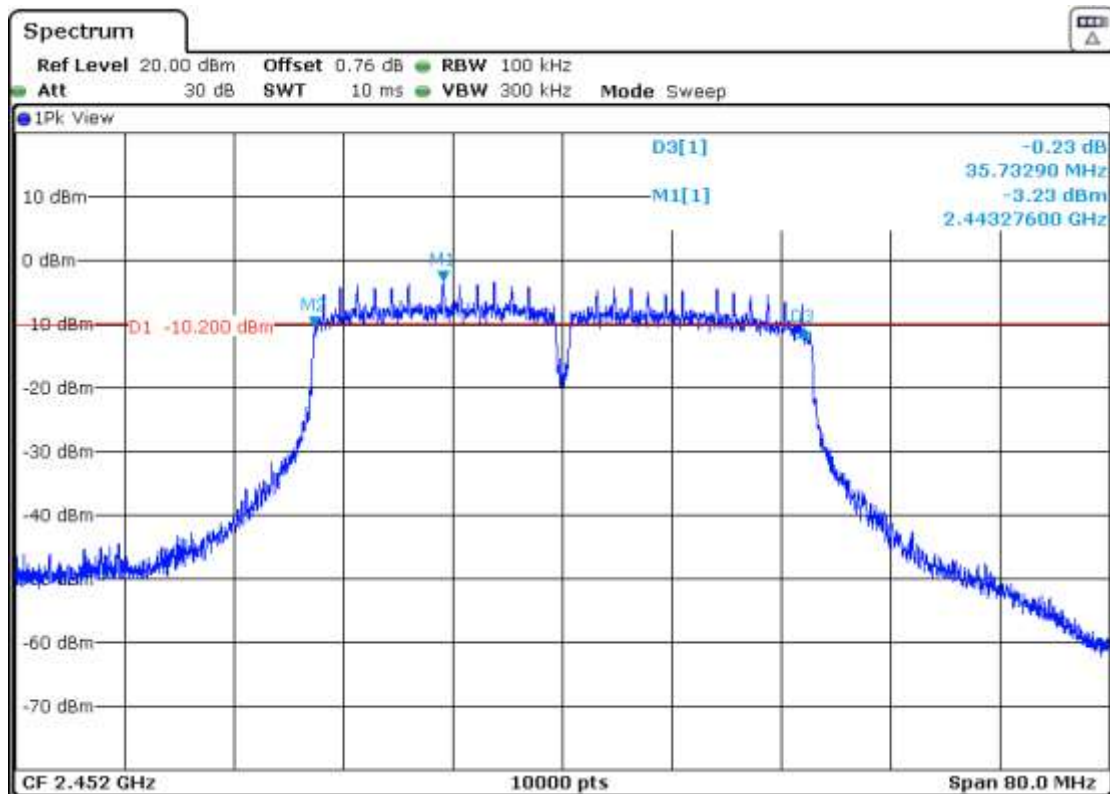
- Low Channel:



- Middle Channel:



- High Channel:



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

SPECIFICATION:

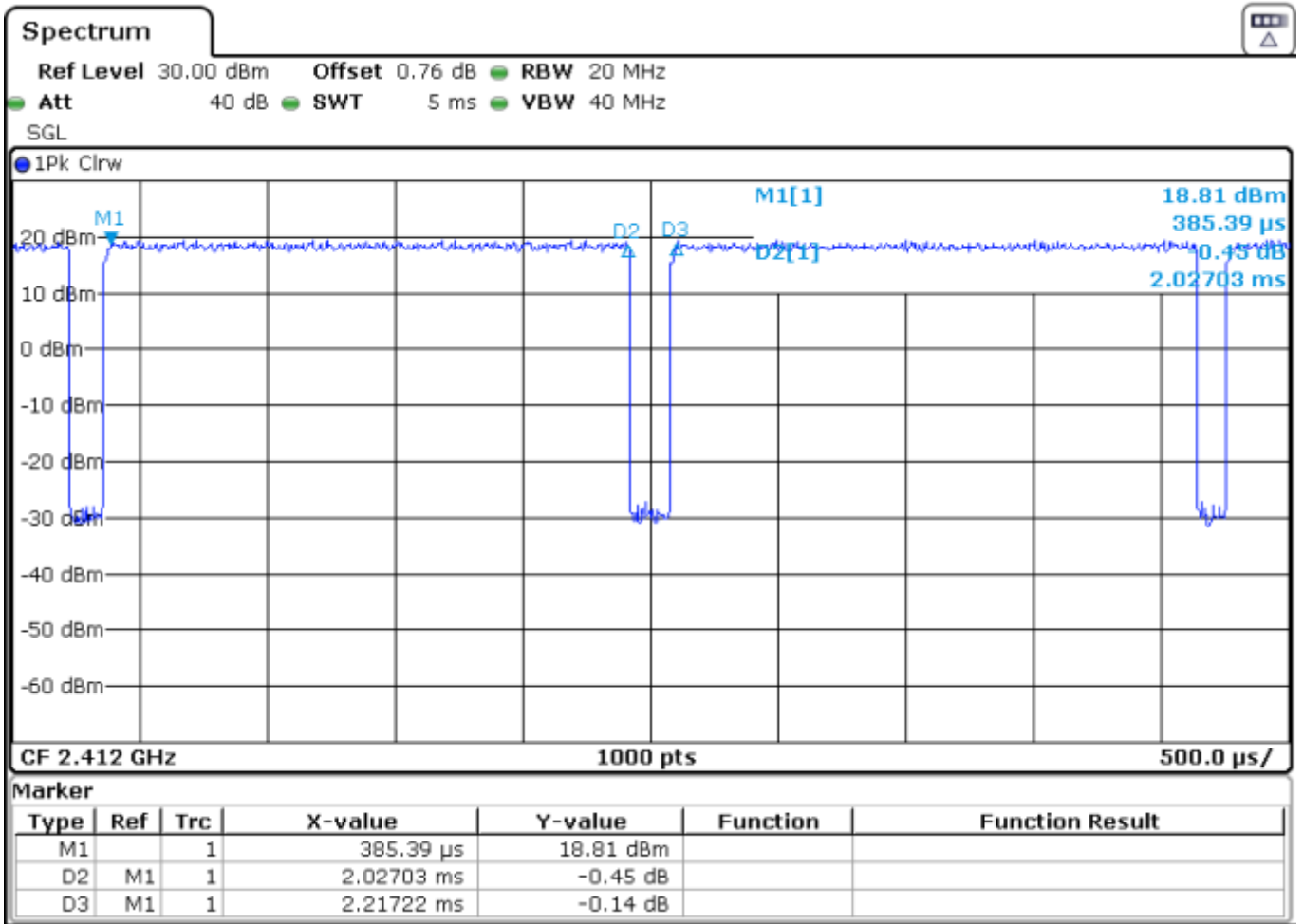
When the radiated emission limits are expressed in terms of the average value of the emission, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 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:

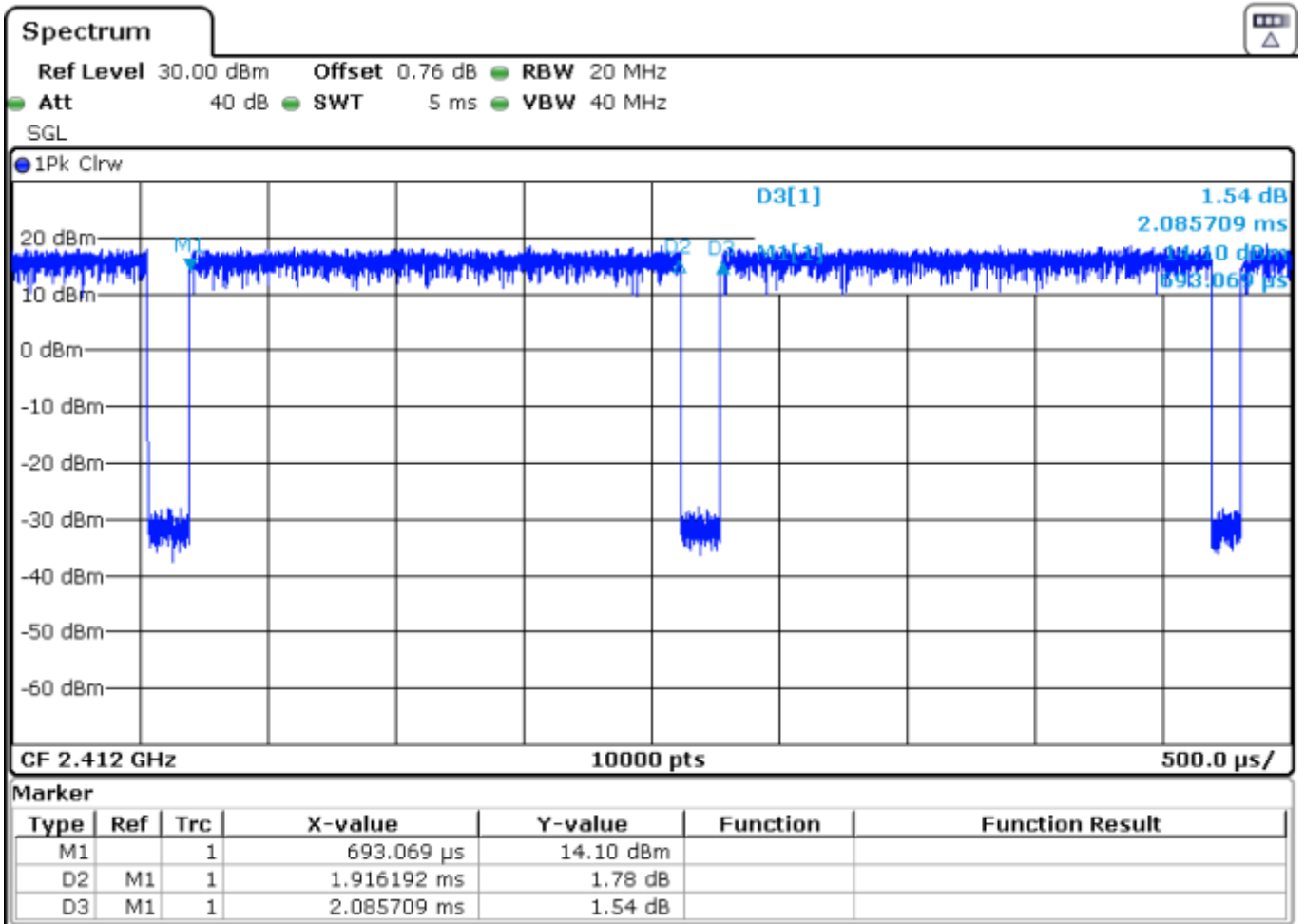
The results below are for data rates with a duty cycle less than 98%. The results for all rest of modes having a value > 98%.

Technique	Mode	Pulse Duration (ms)	Period (ms)	Duty Cycle Correction (dB)
SISO	802.11 g	2.02703	2.21722	0.389486111
SISO	802.11 n20	1.916192	2.085709	0.368146925
SISO	802.11 n40	0.913	1.1263	0.911833066

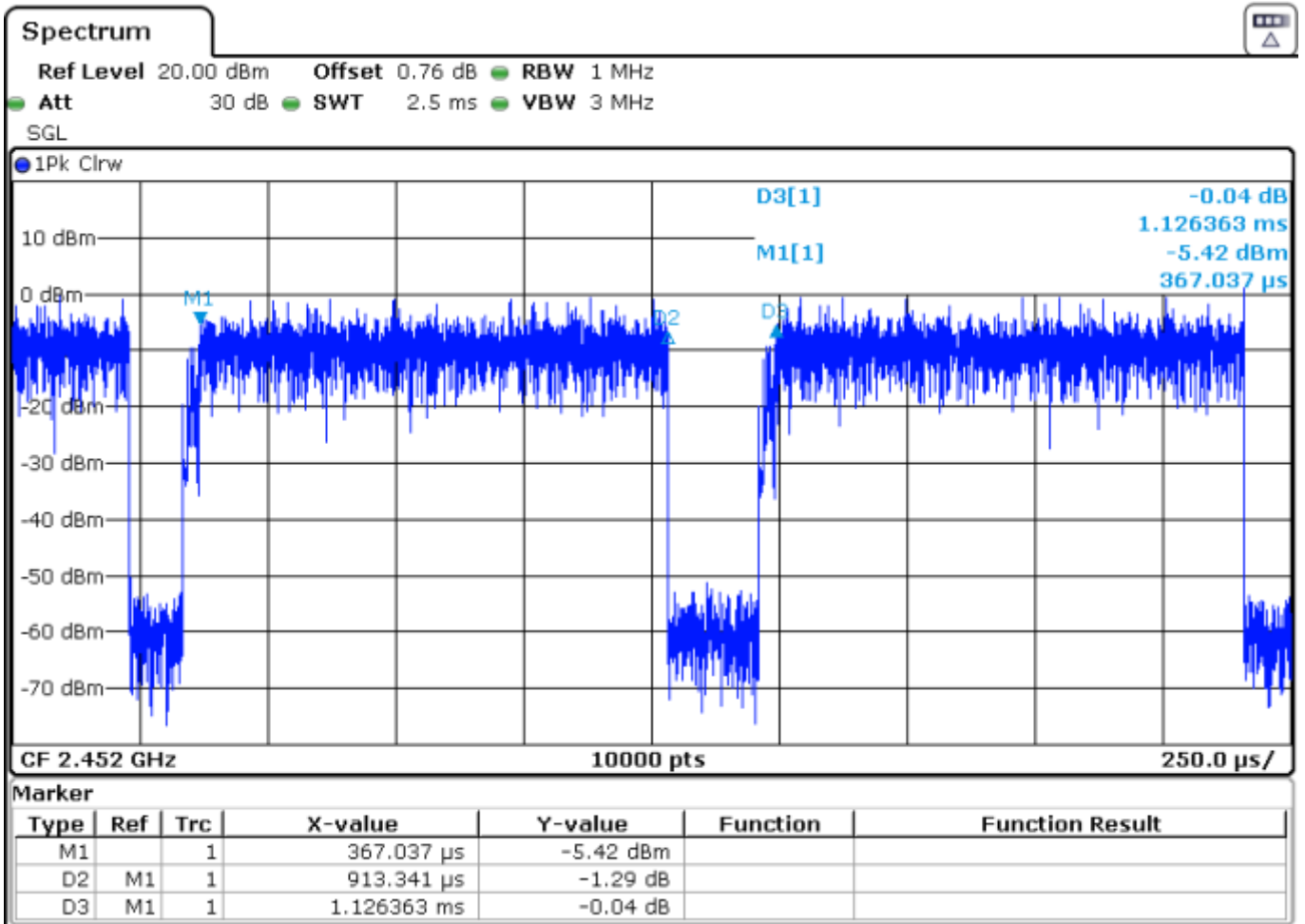
802.11 g:



802.11 n20:



802.11 n40:



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:

INDOOR ANTENNA: Maximum Declared Assembly Antenna Gain: +5.9 dBi (Antenna gain plus antenna cable loss).

OUTDOOR ANTENNA: Maximum Declared Assembly Antenna Gain: +3.7 dBi (Antenna gain plus antenna cable loss).

For modes b, g, n20 and n40, the maximum conducted output power was measured using the method according to point 11.9.2.3.1 "Method AVGPM" of ANSI C.63.10-2013.

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

- **Mode 802.11 b (Indoor antenna)**

	Low Channel 2412 MHz	Middle Channel 2437 MHz	High Channel 2462 MHz
Maximum Average Conducted Power (dBm)	12.09	12.53	14.27
Maximum EIRP Power (dBm)	17.99	18.43	20.17
Measurement uncertainty (dB)	<±1.20		

- **Mode 802.11 b (Outdoor antenna)**

	Low Channel 2412 MHz	Middle Channel 2437 MHz	High Channel 2462 MHz
Maximum Average Conducted Power (dBm)	12.09	12.53	14.27
Maximum EIRP Power (dBm)	15.79	16.23	17.97
Measurement uncertainty (dB)	<±1.20		

- **Mode 802.11 g (Indoor antenna)**

	Low Channel 2412 MHz	Middle Channel 2437 MHz	High Channel 2462 MHz
Maximum Average Conducted Power (dBm)	12.97	13.81	13.56
Duty Cycle Correction (dB)	0.3895		
Maximum Average Conducted Power Corrected (dBm)	13.36	14.20	13.95
Maximum EIRP Power with Duty Cycle Correction (dBm)	19.26	19.71	19.85
Measurement uncertainty (dB)	<±0.79		

- **Mode 802.11 g (Outdoor antenna)**

	Low Channel 2412 MHz	Middle Channel 2437 MHz	High Channel 2462 MHz
Maximum Average Conducted Power (dBm)	12.97	13.81	13.56
Duty Cycle Correction (dB)	0.3895		
Maximum Average Conducted Power Corrected (dBm)	13.36	14.20	13.95
Maximum EIRP Power with Duty Cycle Correction (dBm)	17.06	17.51	17.65
Measurement uncertainty (dB)	<±0.79		

- **Mode 802.11 n20 (Indoor antenna)**

	Low Channel 2412 MHz	Middle Channel 2437 MHz	High Channel 2462 MHz
Maximum Average Conducted Power (dBm)	11.77	12.36	12.44
Duty Cycle Correction (dB)	0.368		
Maximum Average Conducted Power Corrected (dBm)	12.14	12.73	12.81
Maximum EIRP Power with Duty Cycle Correction (dBm)	18.04	18.63	18.71
Measurement uncertainty (dB)	<±1.20		

- **Mode 802.11 n20 (Outdoor antenna)**

	Low Channel 2412 MHz	Middle Channel 2437 MHz	High Channel 2462 MHz
Maximum Average Conducted Power (dBm)	11.77	12.36	12.44
Duty Cycle Correction (dB)	0.368		
Maximum Average Conducted Power Corrected (dBm)	12.14	12.73	12.81
Maximum EIRP Power with Duty Cycle Correction (dBm)	15.84	16.43	16.51
Measurement uncertainty (dB)	<±1.20		

- **Mode 802.11 n40 (Indoor antenna)**

	Low Channel 2422 MHz	Middle Channel 2442 MHz	High Channel 2482 MHz
Maximum Average Conducted Power (dBm)	11.07	11.12	9.76
Duty Cycle Correction (dB)	0.912		
Maximum Average Conducted Power Corrected (dBm)	11.98	12.03	10.67
Maximum EIRP Power with Duty Cycle Correction (dBm)	17.88	17.93	16.57
Measurement uncertainty (dB)	<±1.20		

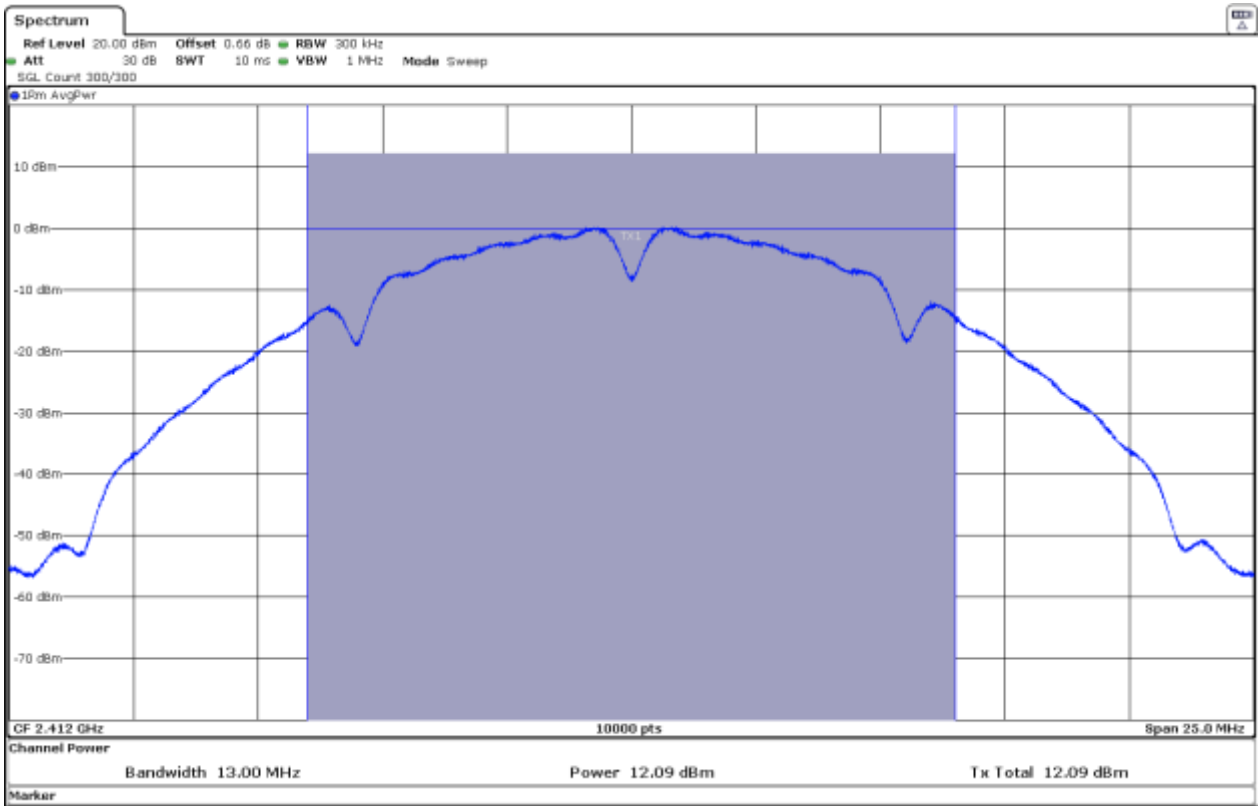
- **Mode 802.11 n40 (Outdoor antenna)**

	Low Channel 2422 MHz	Middle Channel 2442 MHz	High Channel 2482 MHz
Maximum Average Conducted Power (dBm)	11.07	11.12	9.76
Duty Cycle Correction (dB)	0.912		
Maximum Average Conducted Power Corrected (dBm)	11.98	12.03	10.67
Maximum EIRP Power with Duty Cycle Correction (dBm)	15.68	15.73	14.37
Measurement uncertainty (dB)	<±1.20		

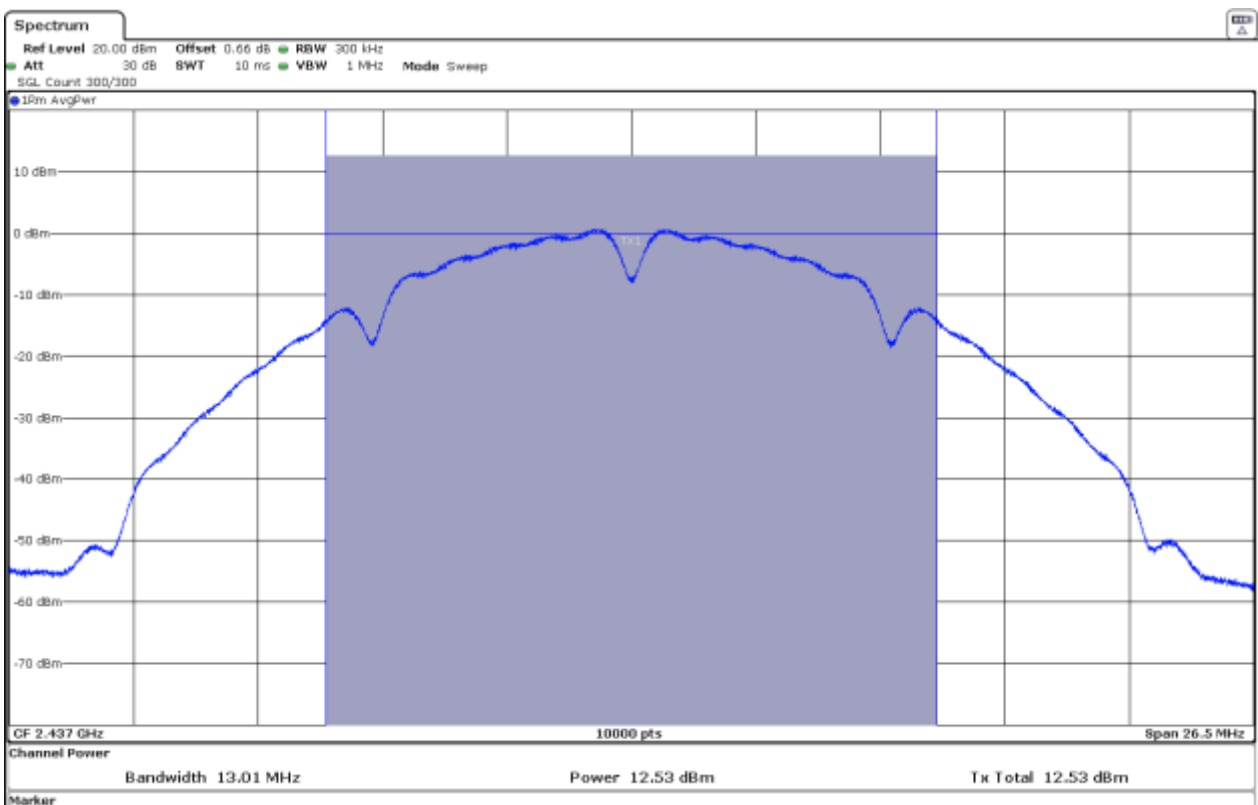
Verdict: PASS

- **Mode 802.11 b**

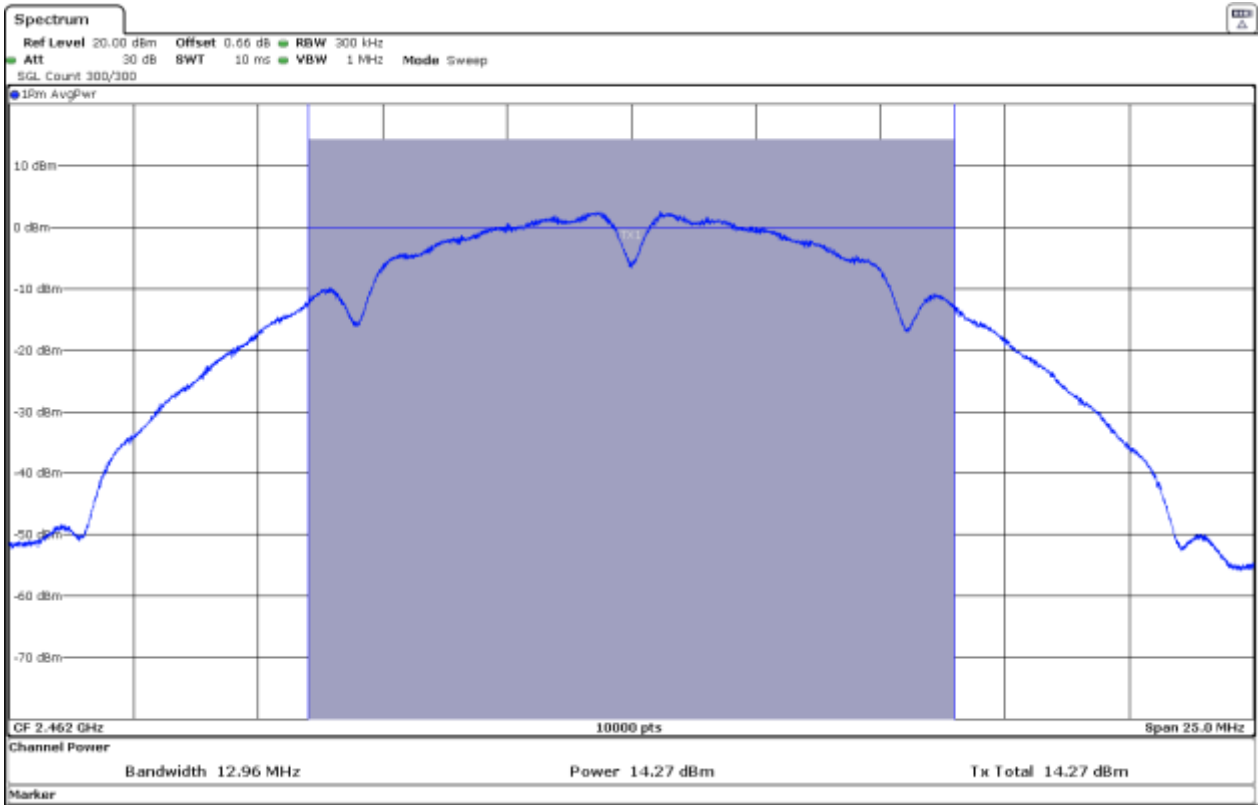
- Low Channel:



- Middle Channel:

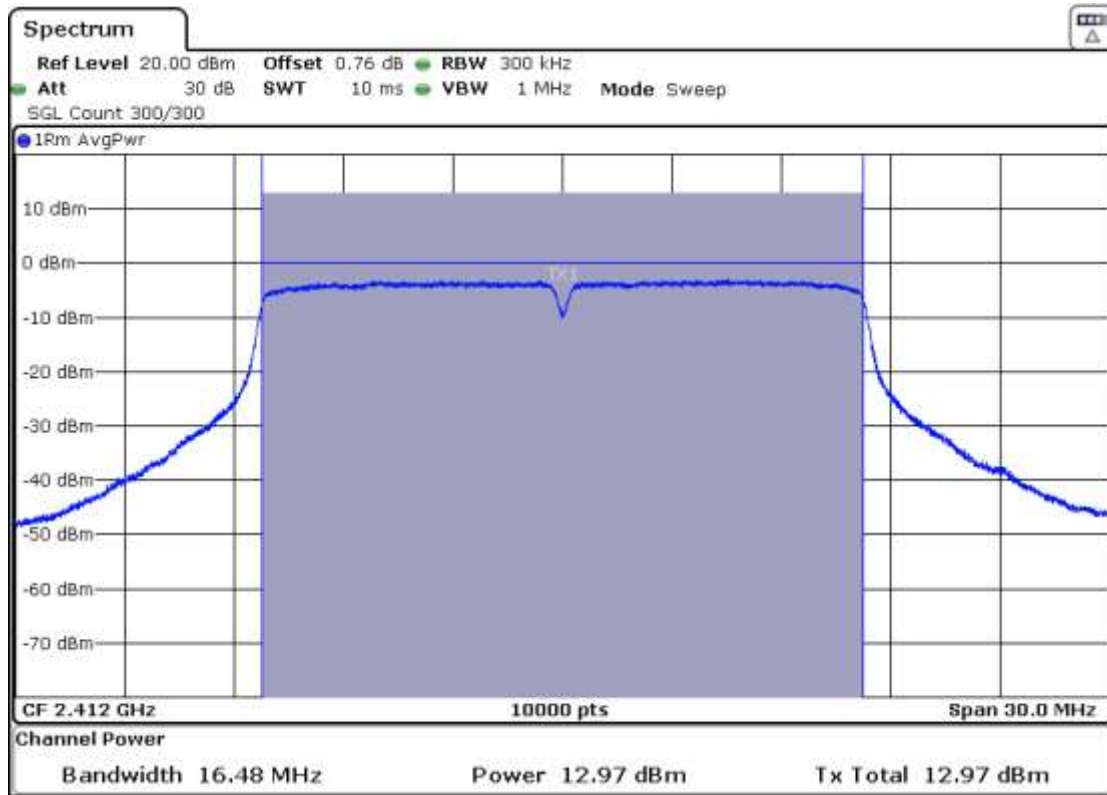


- High Channel:

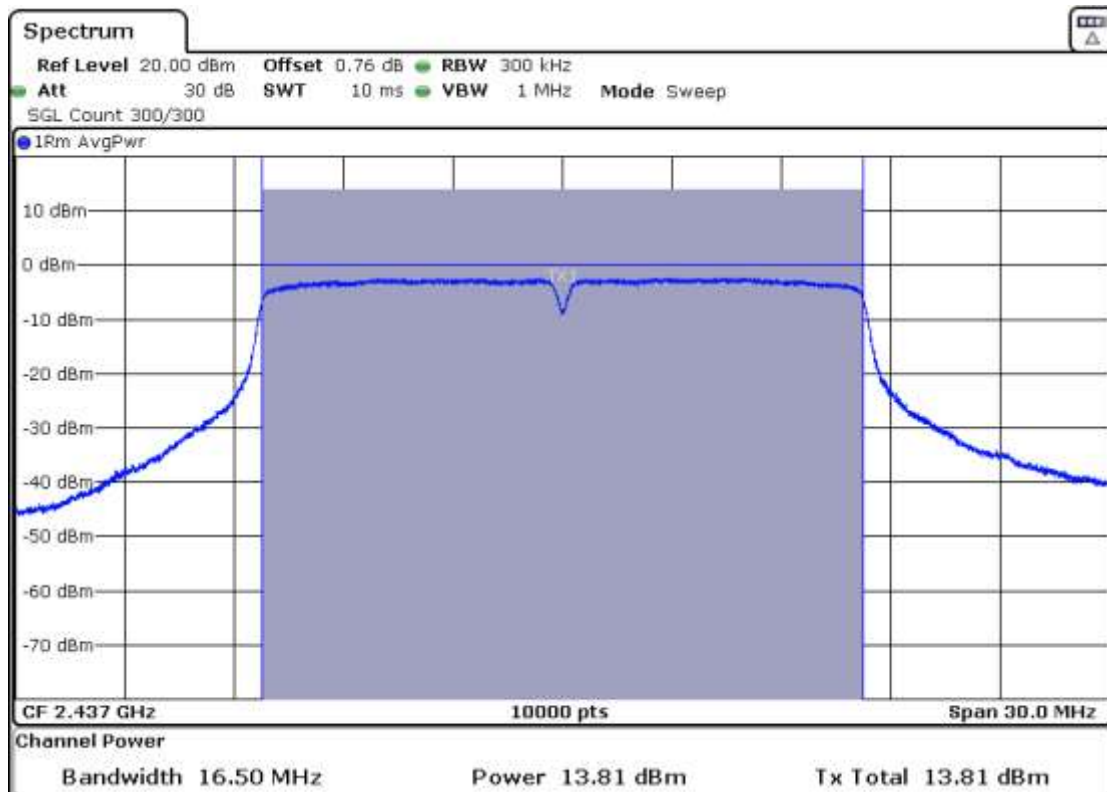


- **Mode 802.11 g**

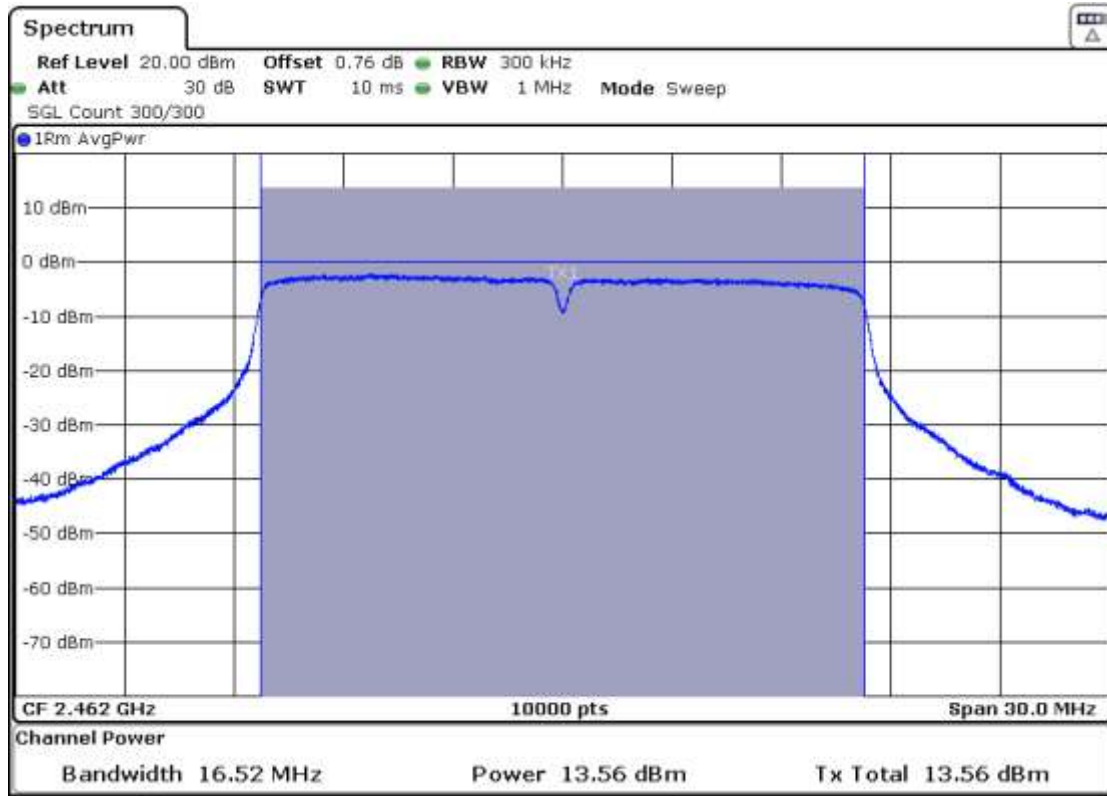
- Low Channel:



- Middle Channel:

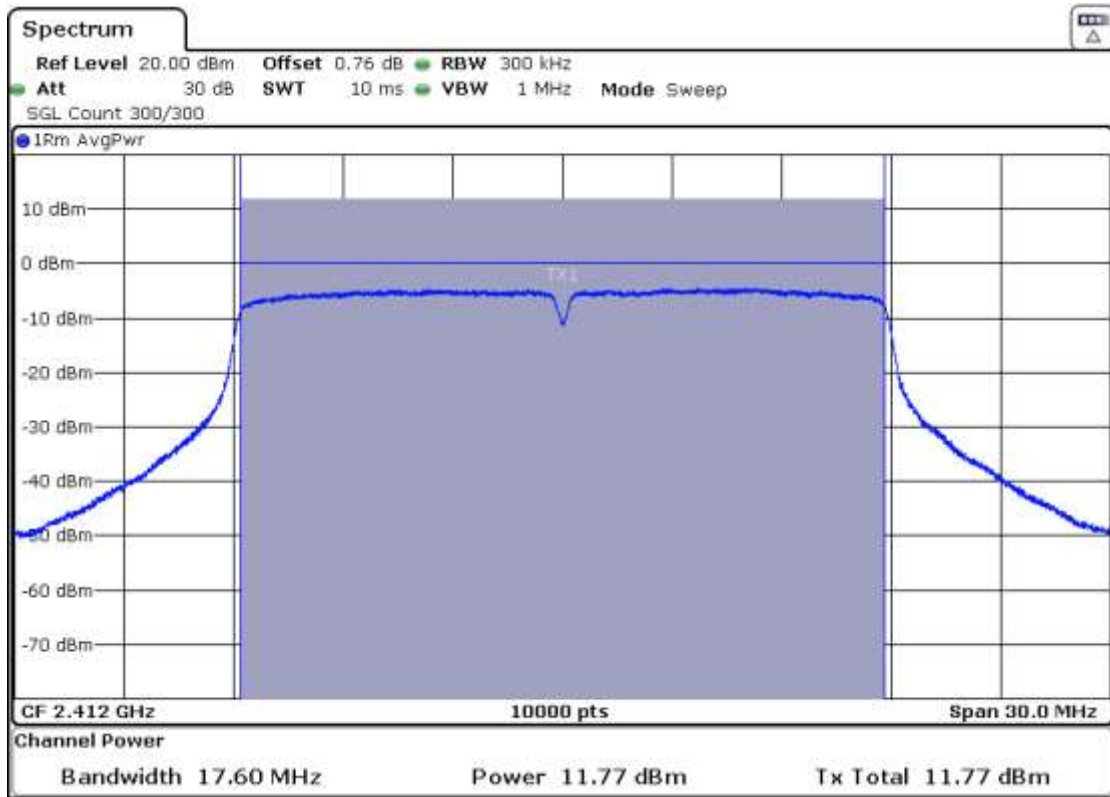


- High Channel:

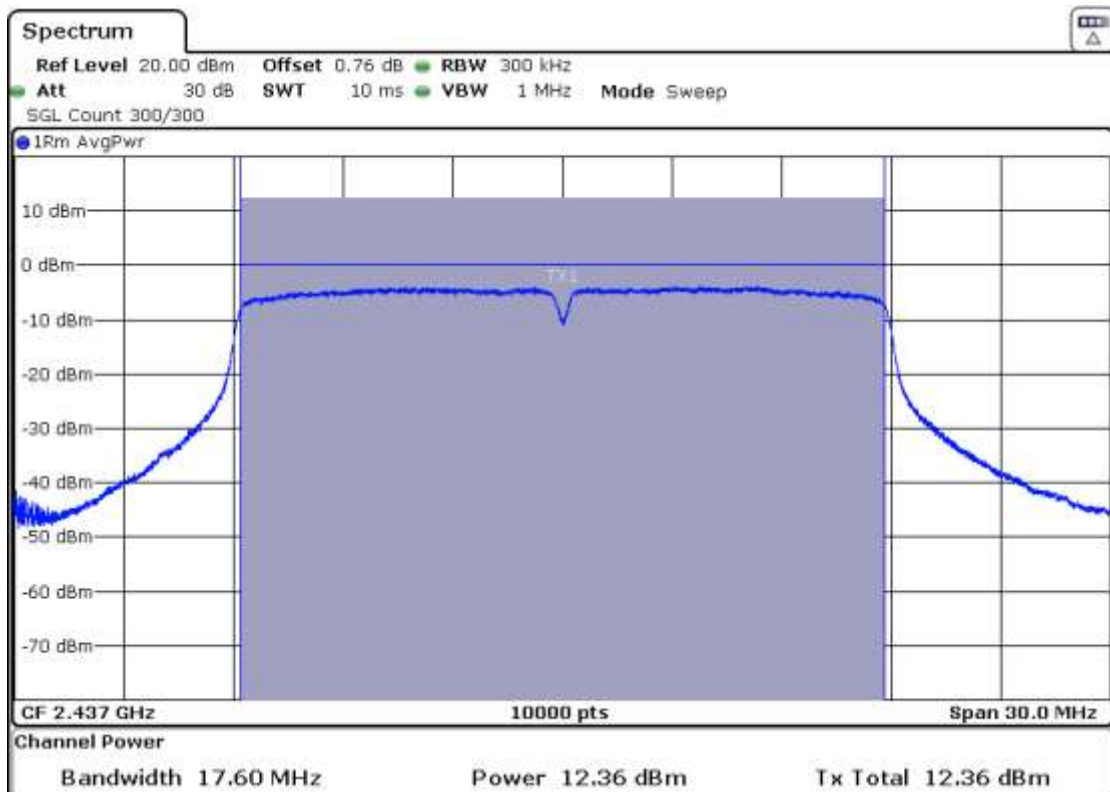


- **Mode 802.11 n20**

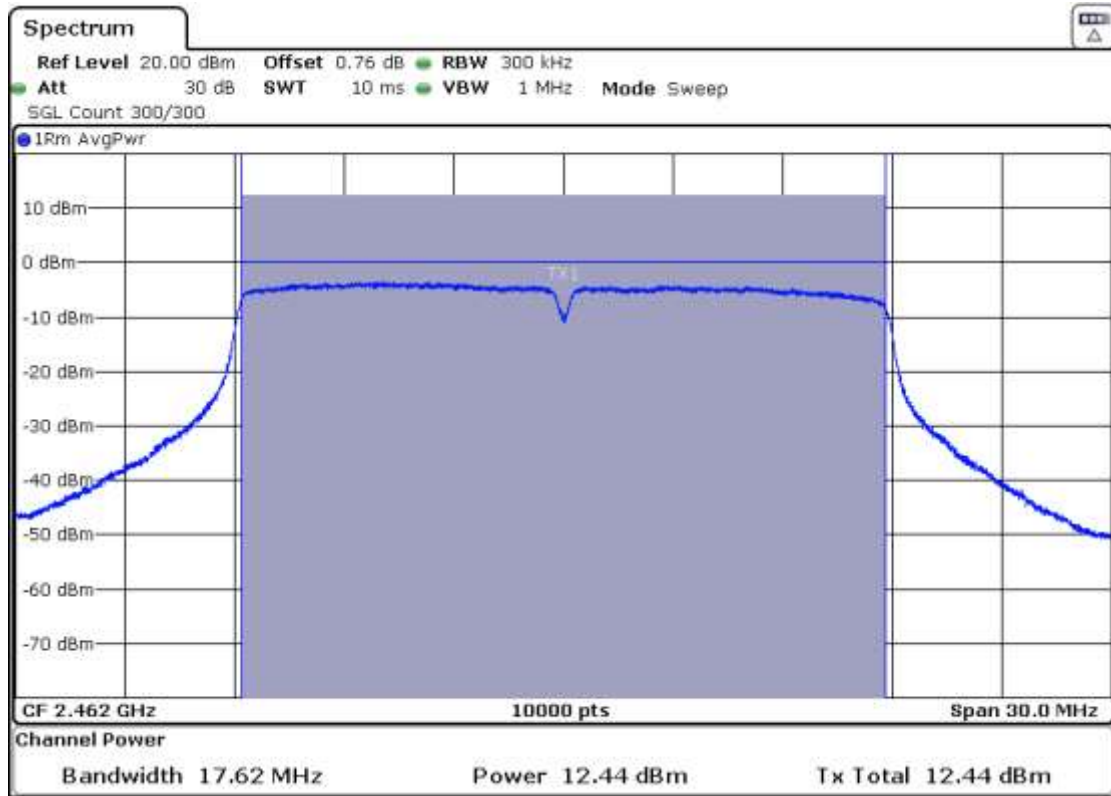
- Low Channel:



- Middle Channel:

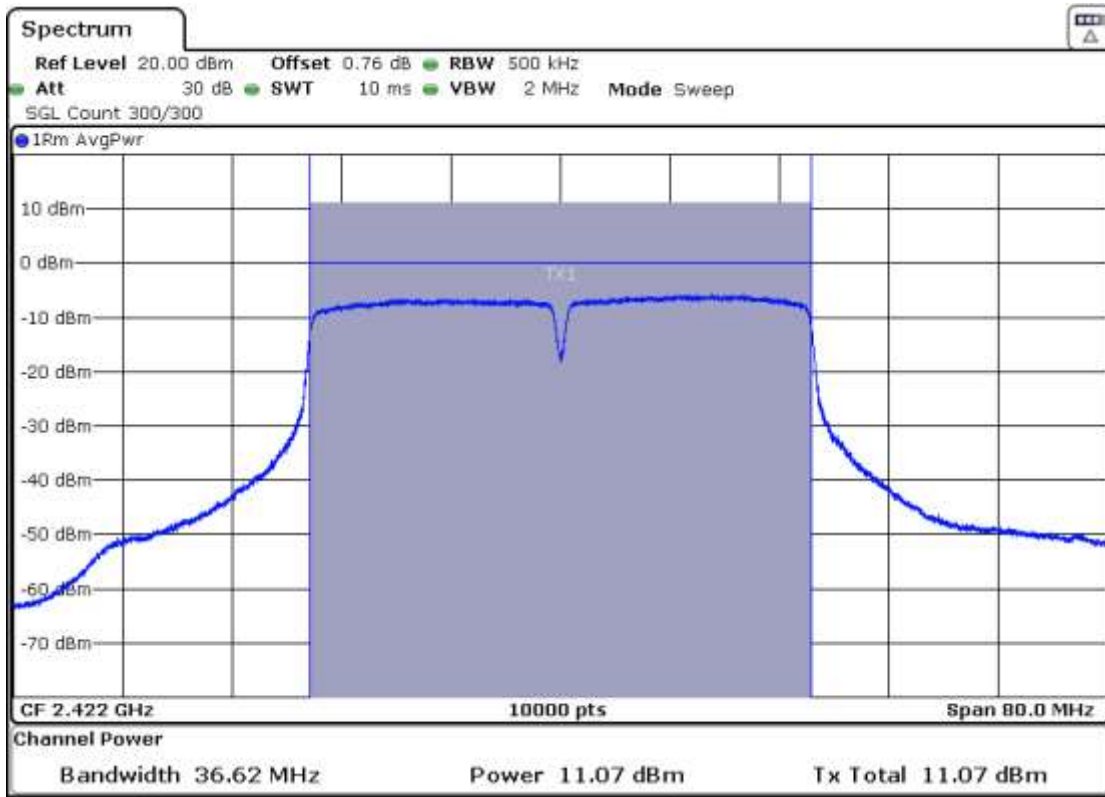


- High Channel:

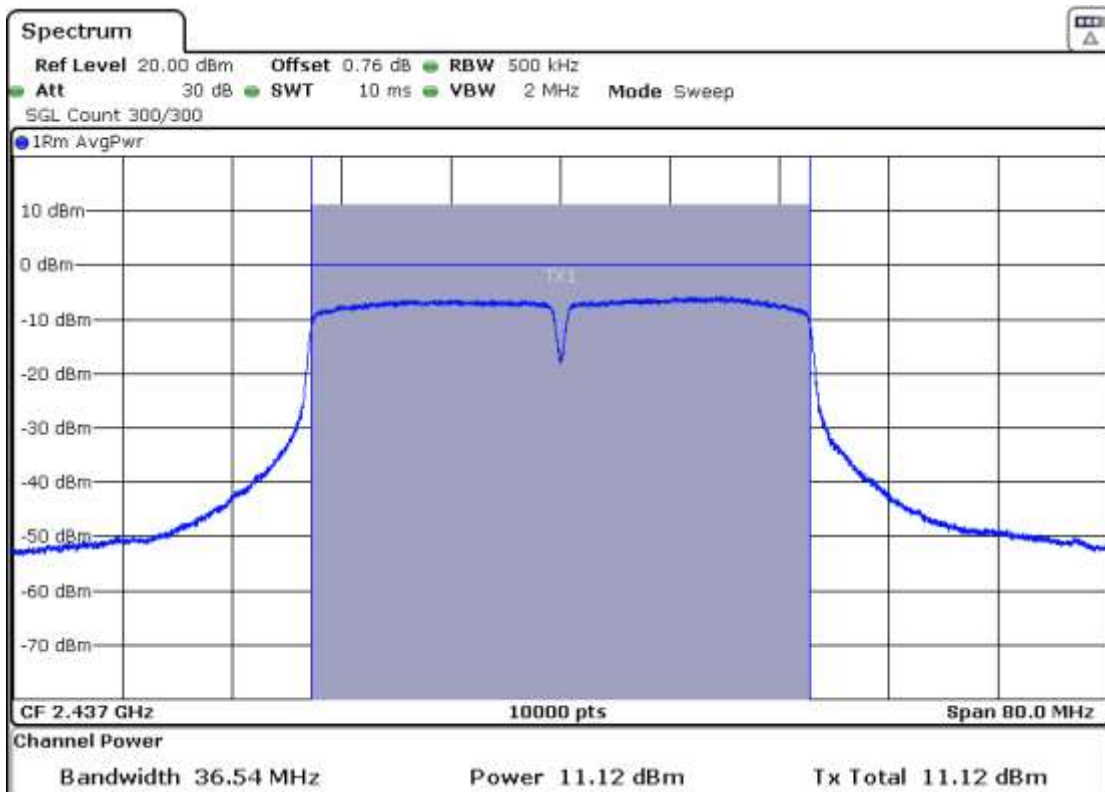


- **Mode 802.11 n40**

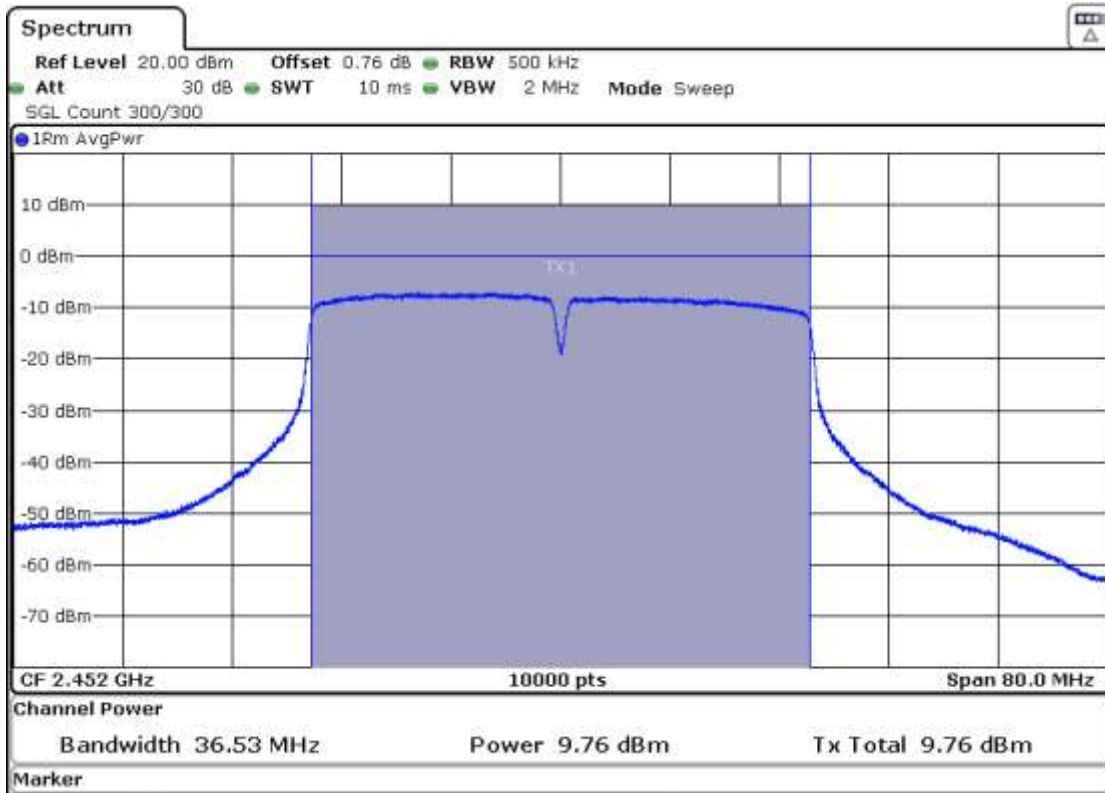
- Low Channel:



- 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.

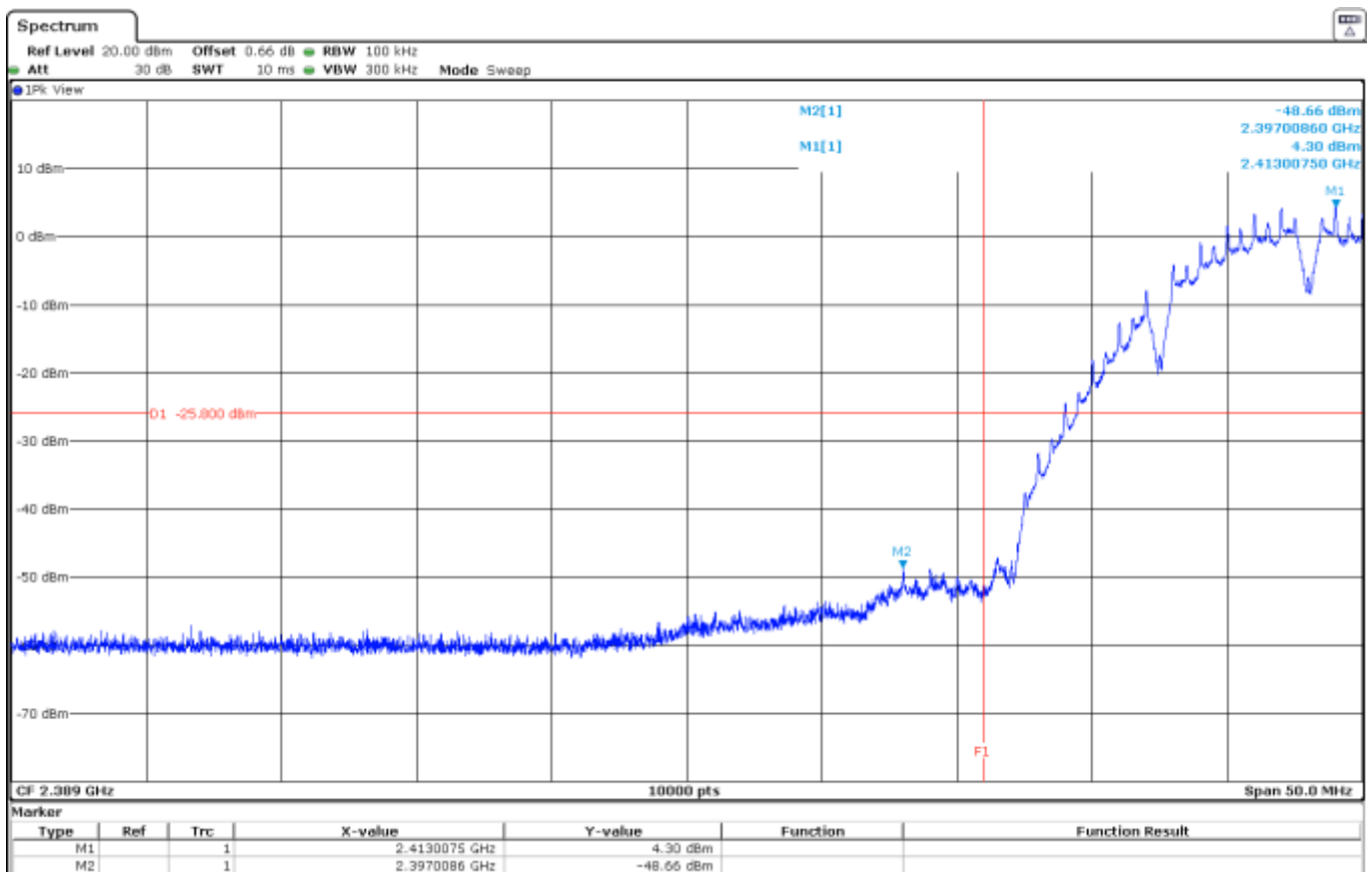
RESULTS:

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)	<±1.56
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- 802.11 b mode – Band-edge emissions compliance**

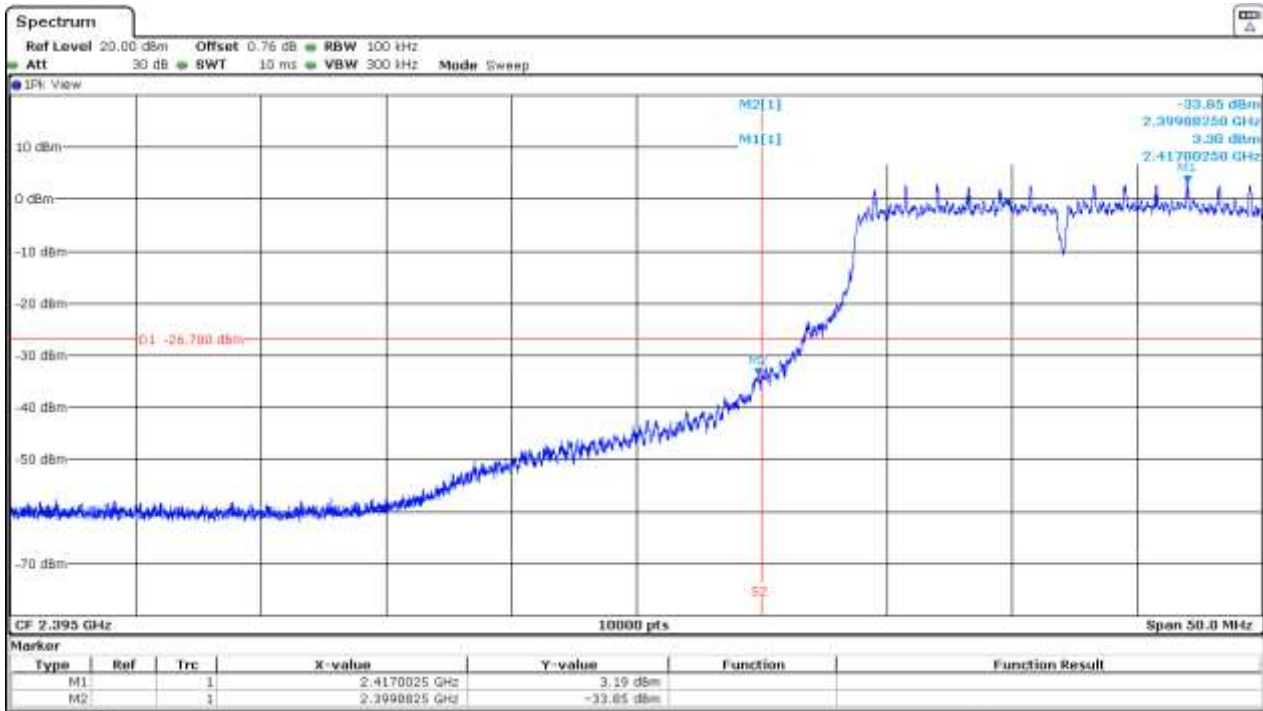
- Low Channel:



Verdict: PASS

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

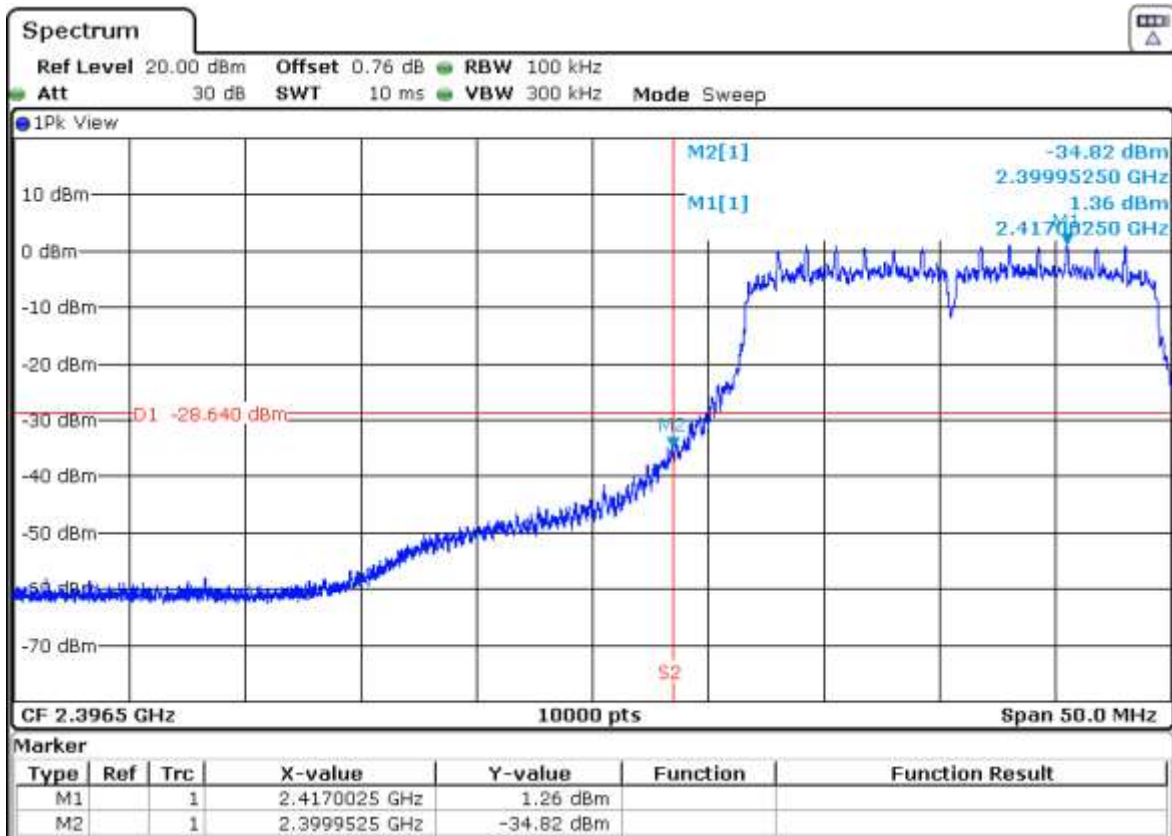
- Low Channel:



Verdict: PASS

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

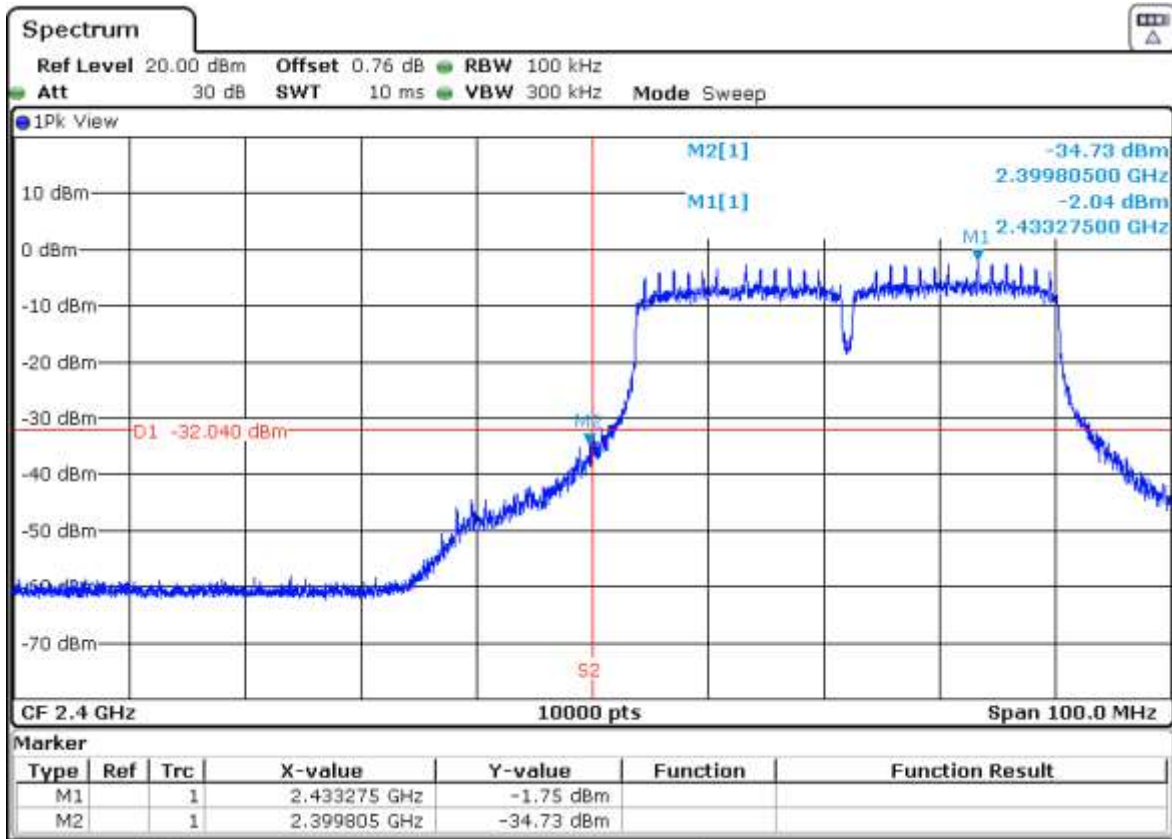
- Low Channel:



Verdict: PASS

- 802.11 n40 mode – Band-edge emissions compliance

- Low 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 b, g, n20 and n40, the power spectral density was measured using the method according to point 11.10.3 "Method AVGPS-1" of ANSI C.63.10-2013.

INDOOR ANTENNA: Maximum Declared Assembly Antenna Gain: +5.9 dBi (Antenna gain plus antenna cable loss).

OUTDOOR ANTENNA: Maximum Declared Assembly Antenna Gain: +3.7 dBi (Antenna gain plus antenna cable loss).

- **Mode 802.11 b**

	Low Channel 2412 MHz	Middle Channel 2437 MHz	High Channel 2462 MHz
Average Power Spectral Density (dBm)	-6.63	-6.73	-4.89
Measurement uncertainty (dB)	<±1.56		

- **Mode 802.11 g**

	Low Channel 2412 MHz	Middle Channel 2437 MHz	High Channel 2462 MHz
Average Power Spectral Density (dBm)	-8.54	-8.02	-7.76
Duty Cycle (dB)	0.3895		
Average Power Spectral Density corrected (dBm)	-8.15	-7.63	-7.37
Measurement uncertainty (dB)	<±1.56		

- **Mode 802.11 n20**

	Low Channel 2412 MHz	Middle Channel 2437 MHz	High Channel 2462 MHz
Average Power Spectral Density (dBm)	-10.99	-10.06	-9.88
Duty Cycle (dB)	0.368		
Average Power Spectral Density corrected (dBm)	-10.62	-9.69	-10.25
Measurement uncertainty (dB)	<±1.56		

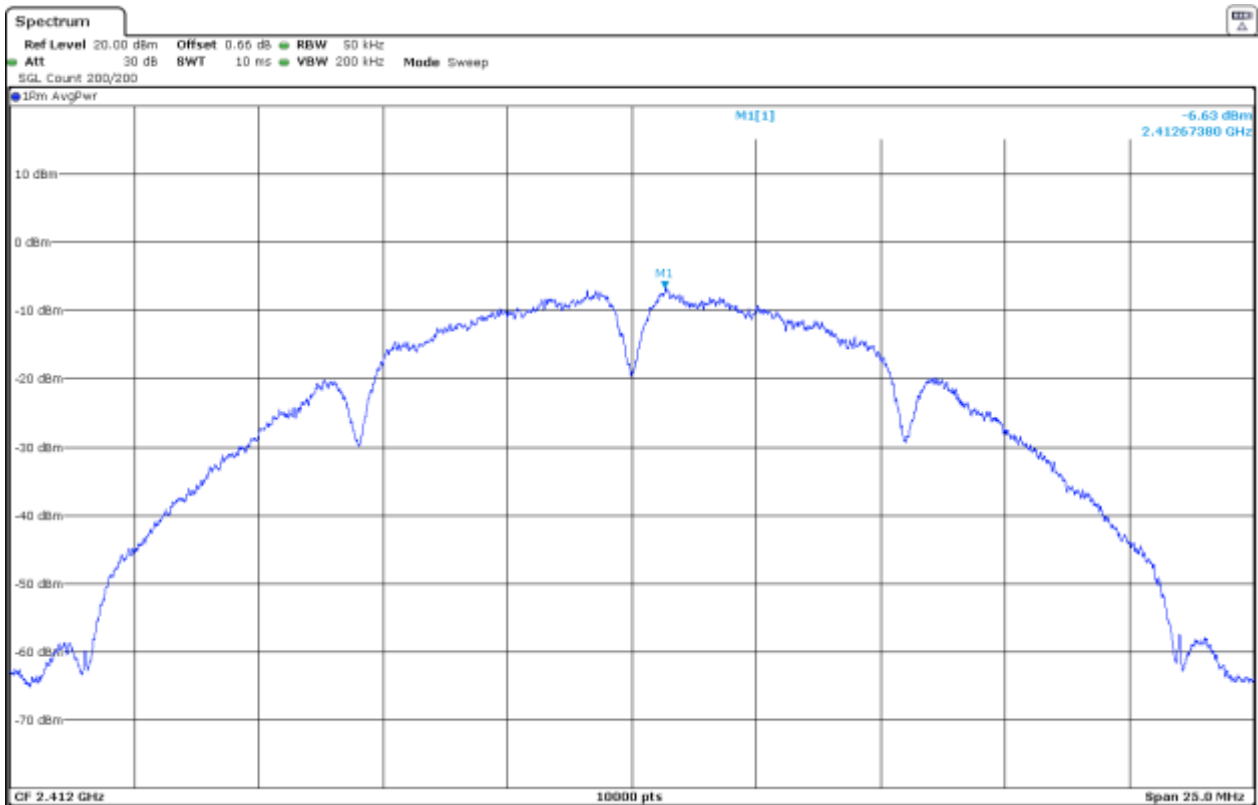
• **Mode 802.11 n40**

	Low Channel 2412 MHz	Middle Channel 2437 MHz	High Channel 2462 MHz
Average Power Spectral Density (dBm)	-14.23	-14.34	-15.65
Duty Cycle (dB)	0.912		
Average Power Spectral Density corrected (dBm)	-13.32	-13.43	-14.74
Measurement uncertainty (dB)	<±1.56		

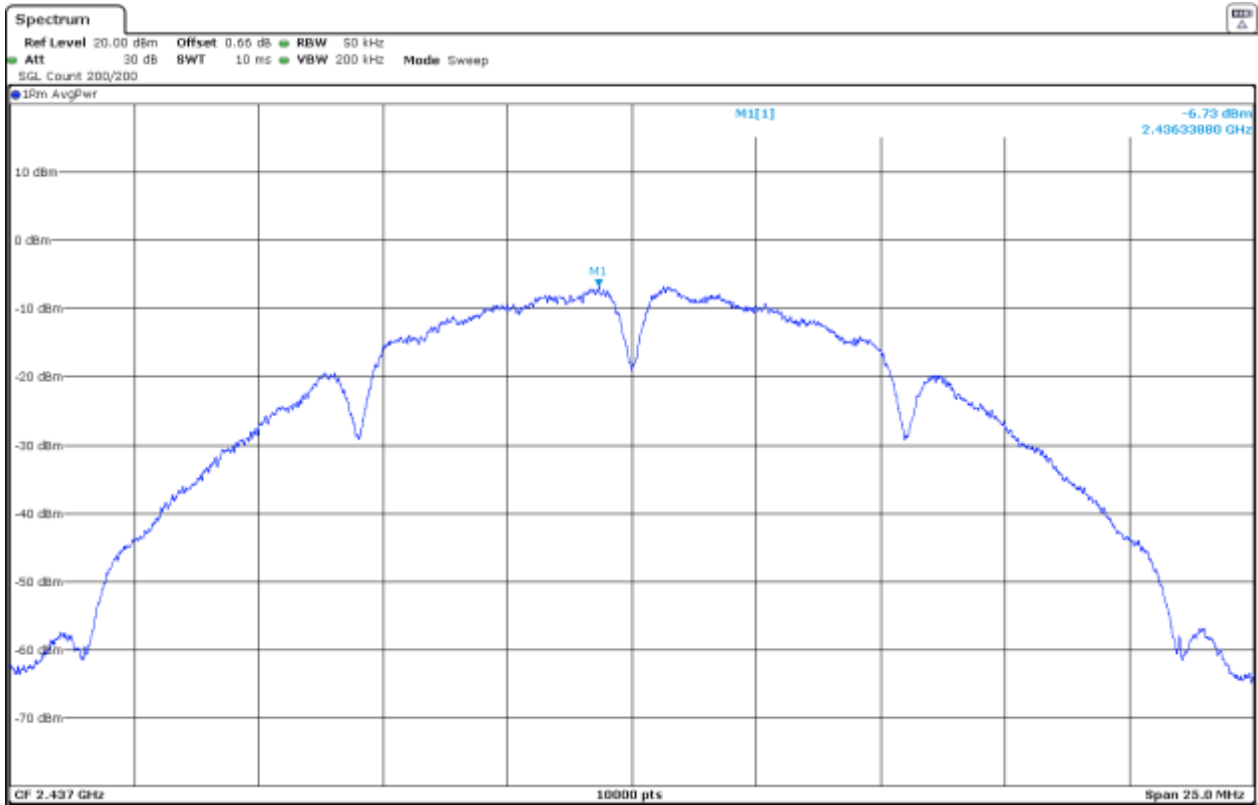
Verdict: PASS

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

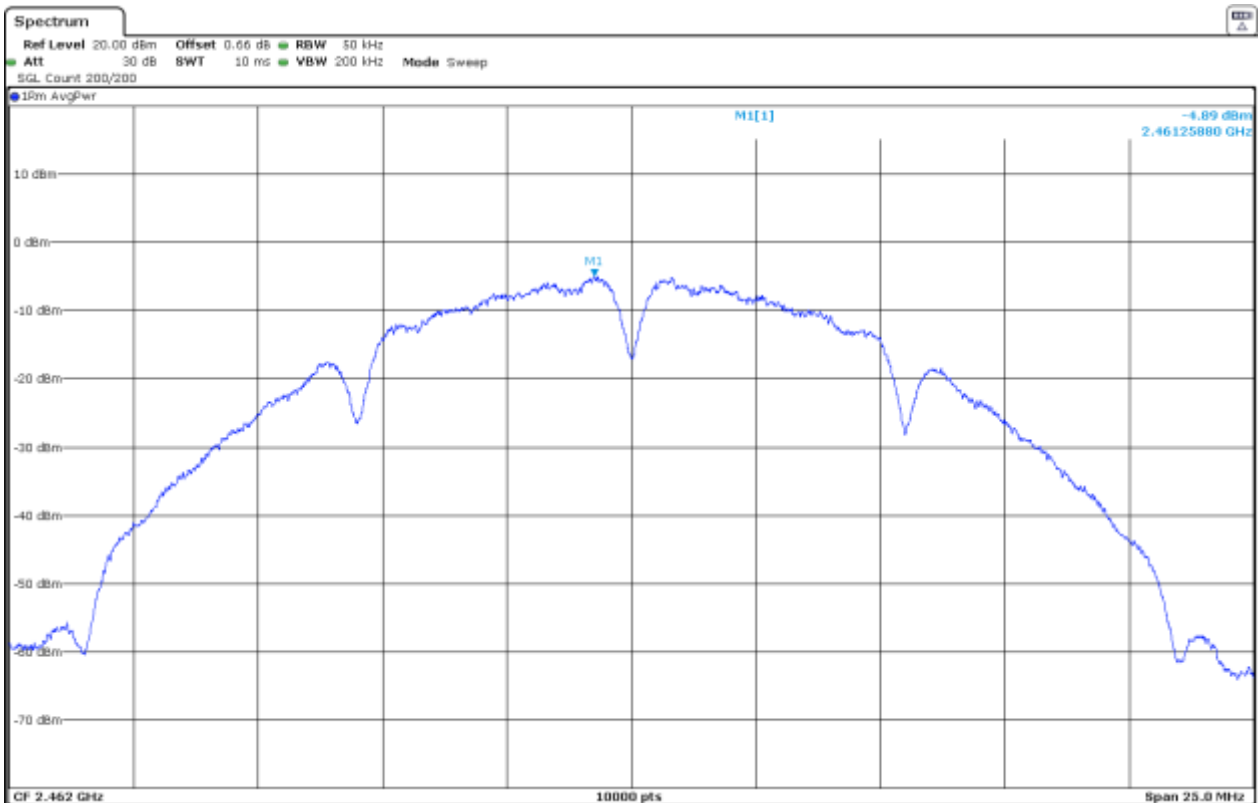
- Low Channel:



- Middle Channel:

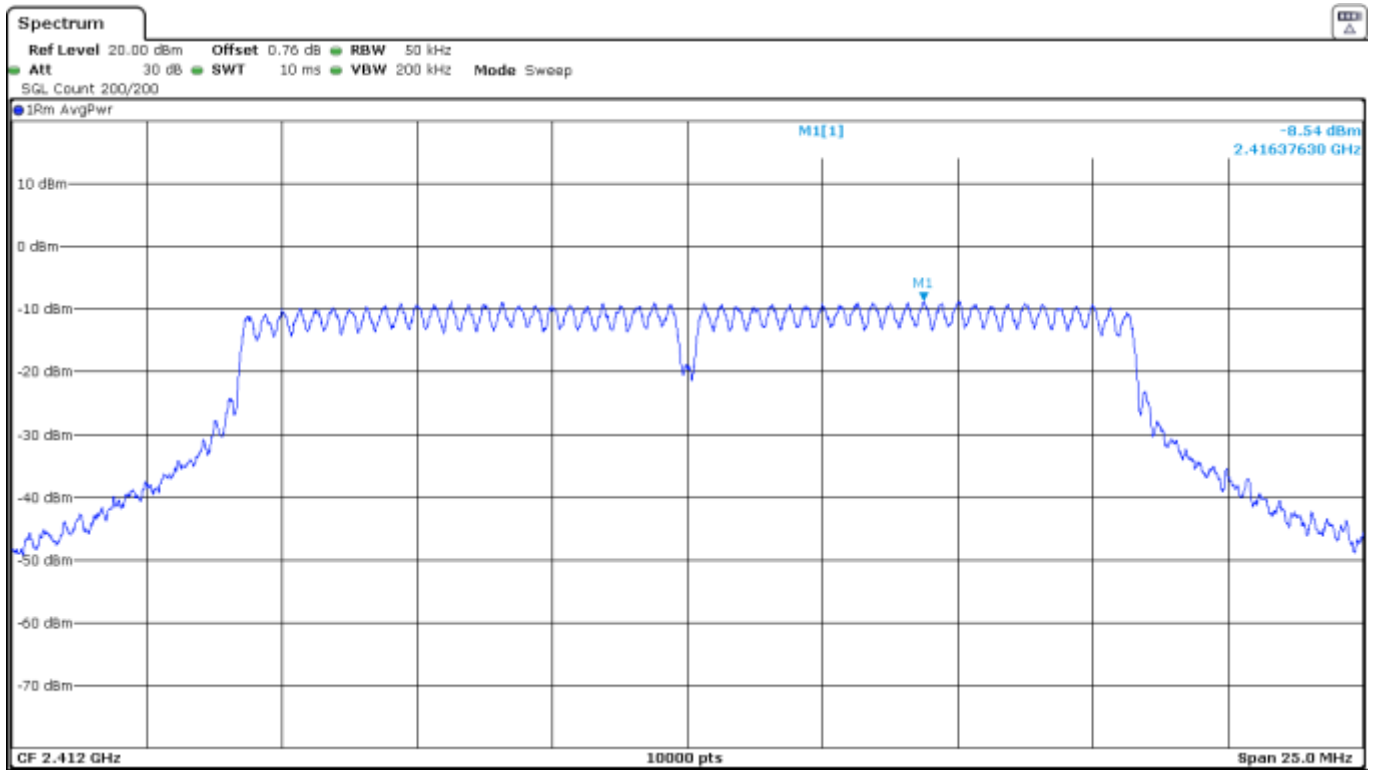


- High Channel:

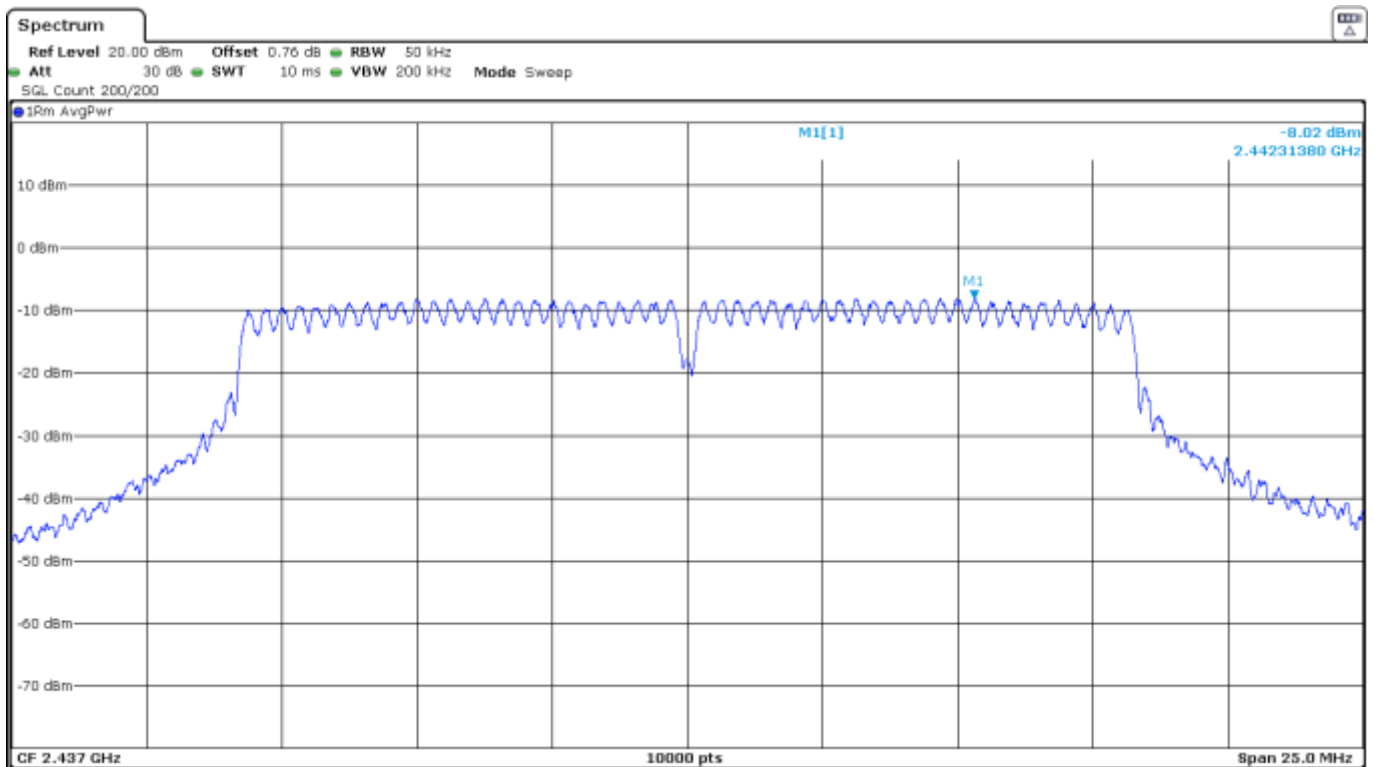


- **Mode 802.11 g – Power Spectral Density**

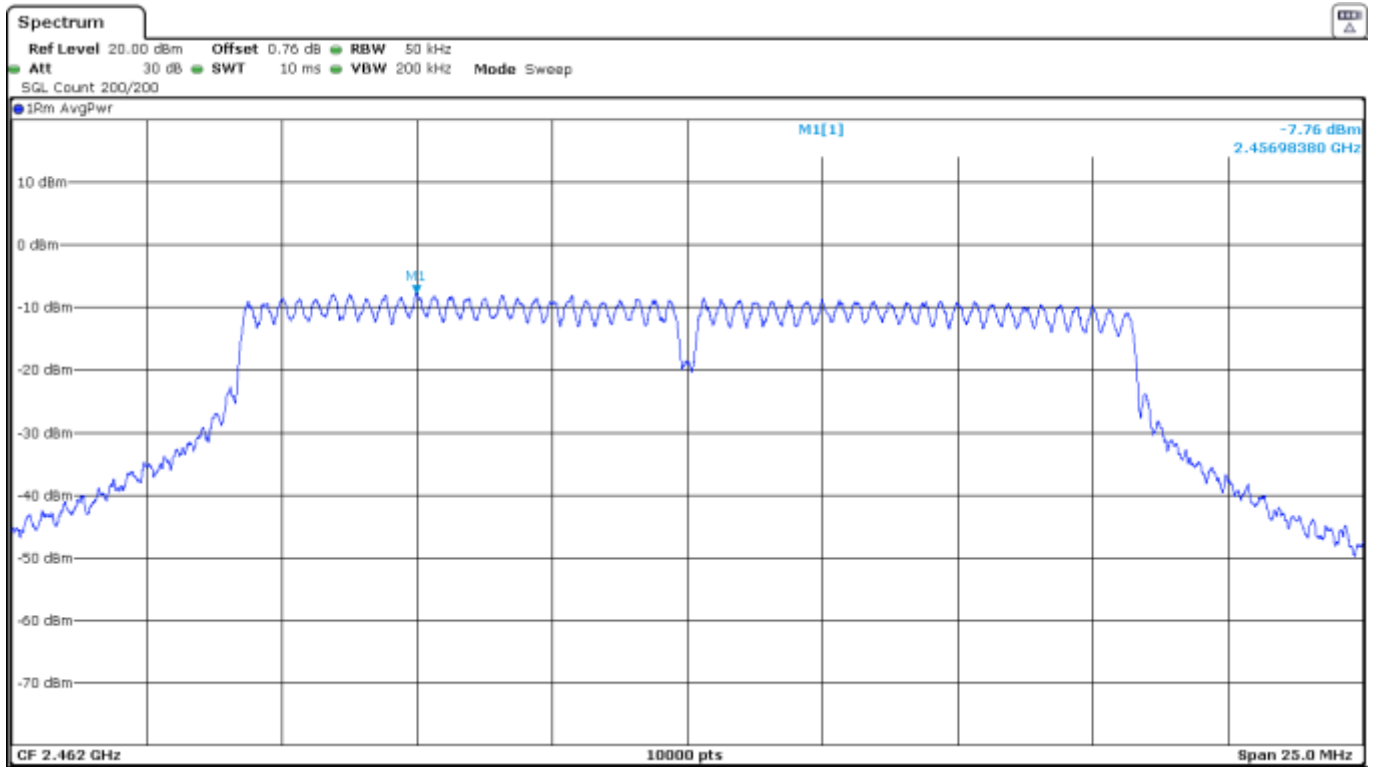
- Low Channel:



- Middle Channel:

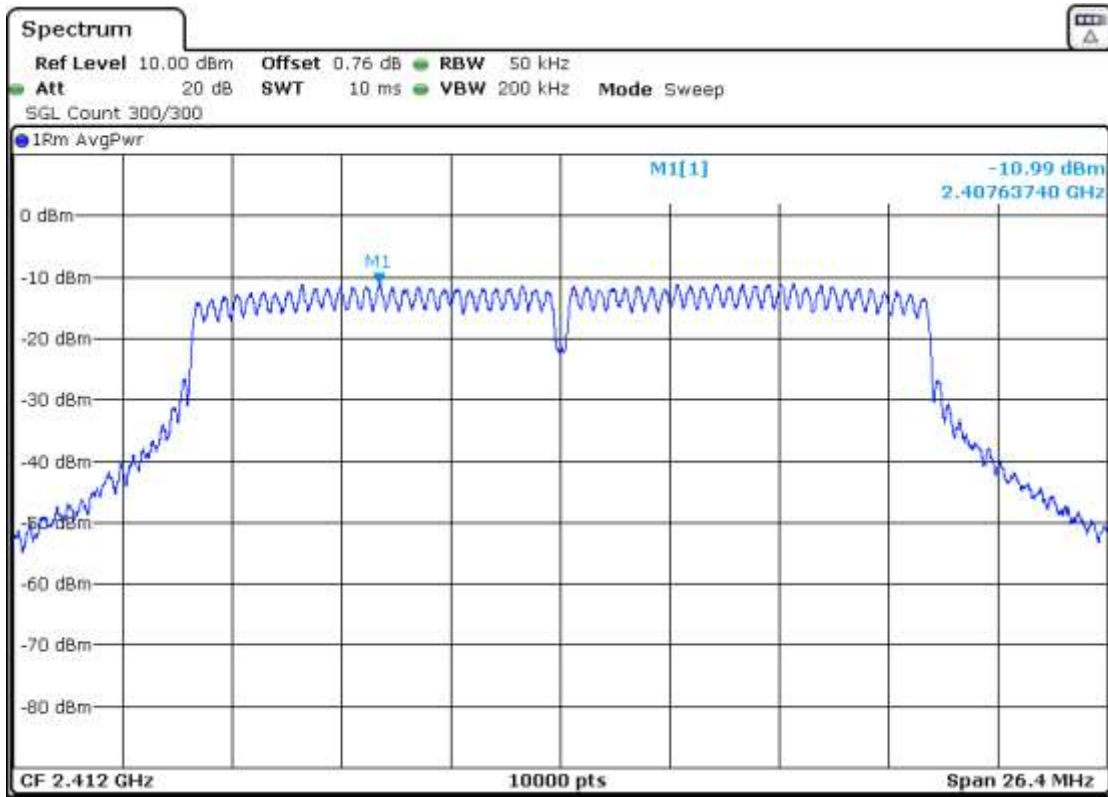


- High Channel:

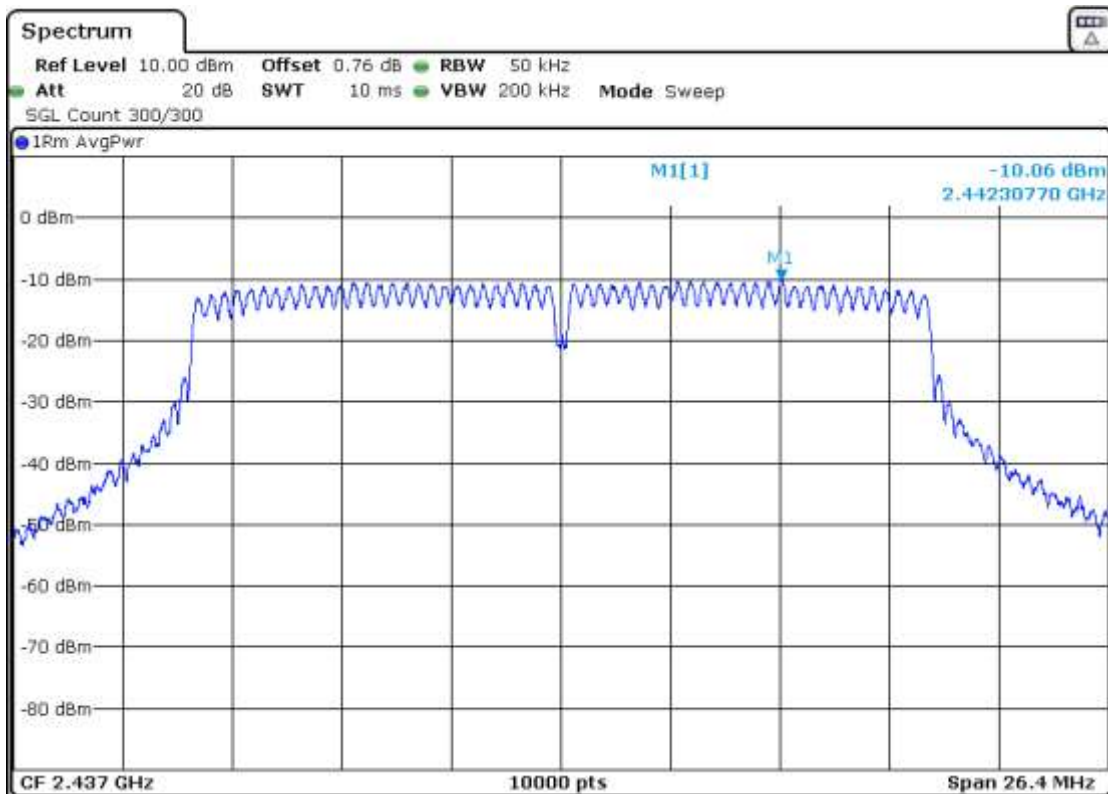


- **Mode 802.11 n20 – Power Spectral Density**

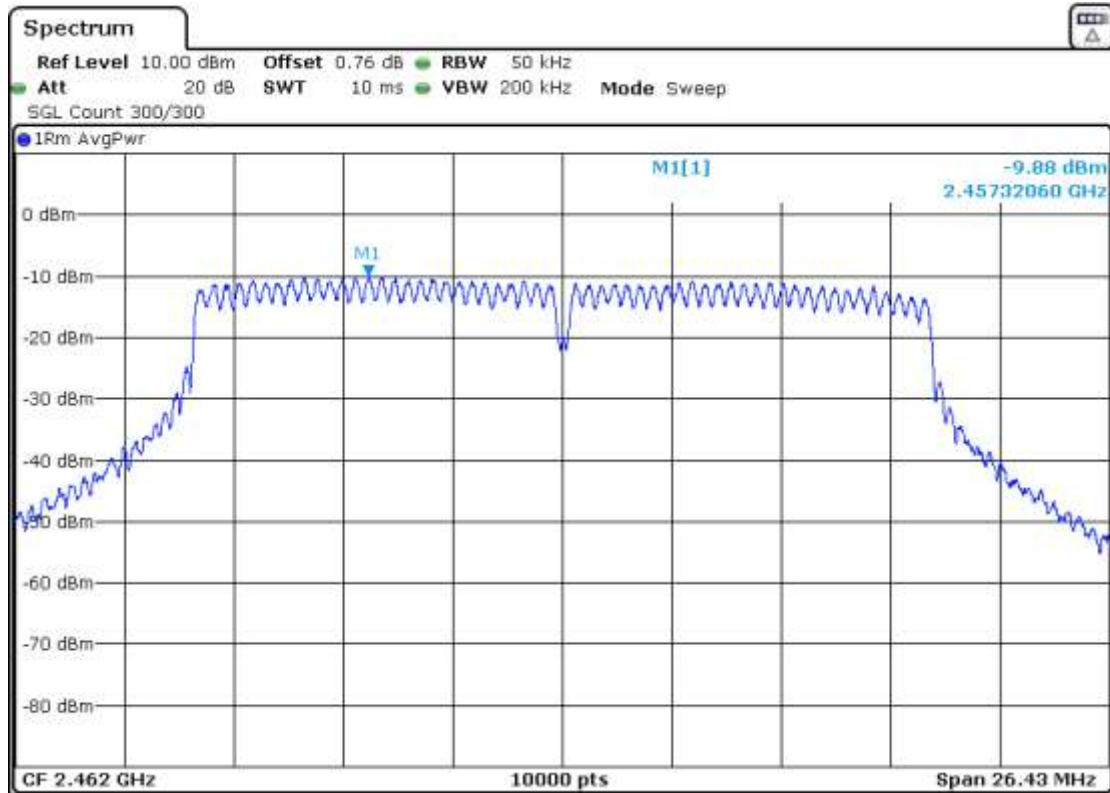
- Low Channel:



- Middle Channel:

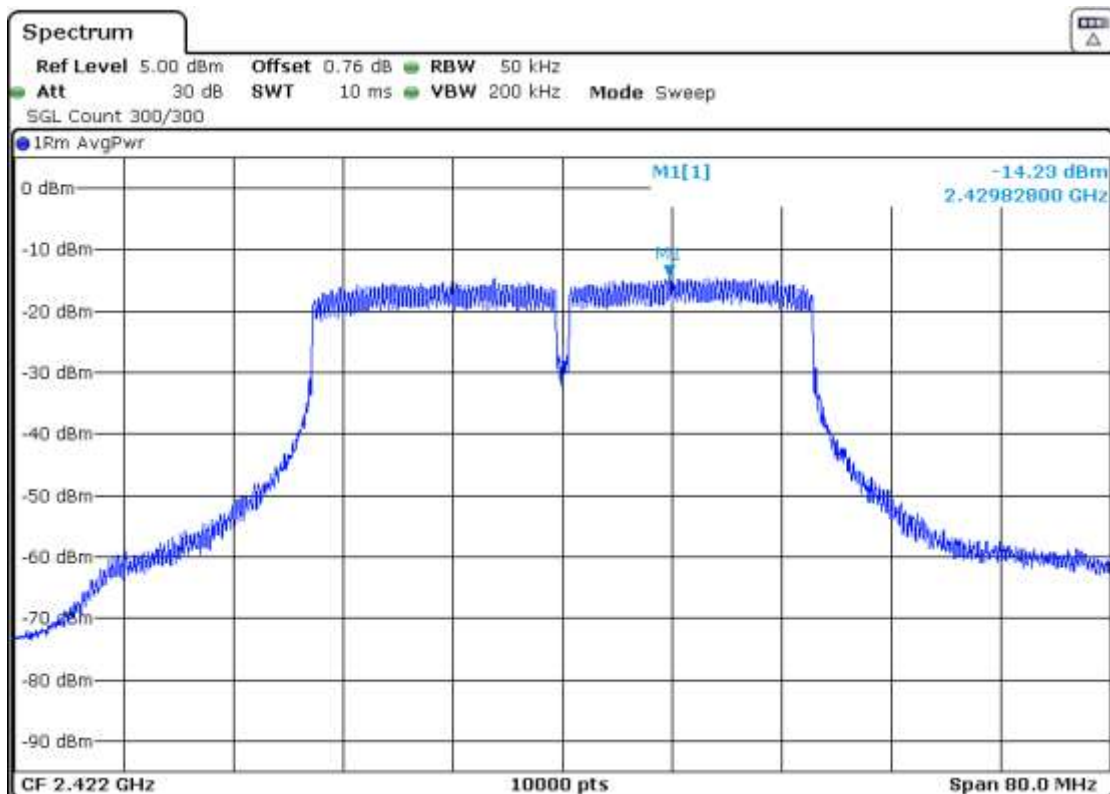


- High Channel:

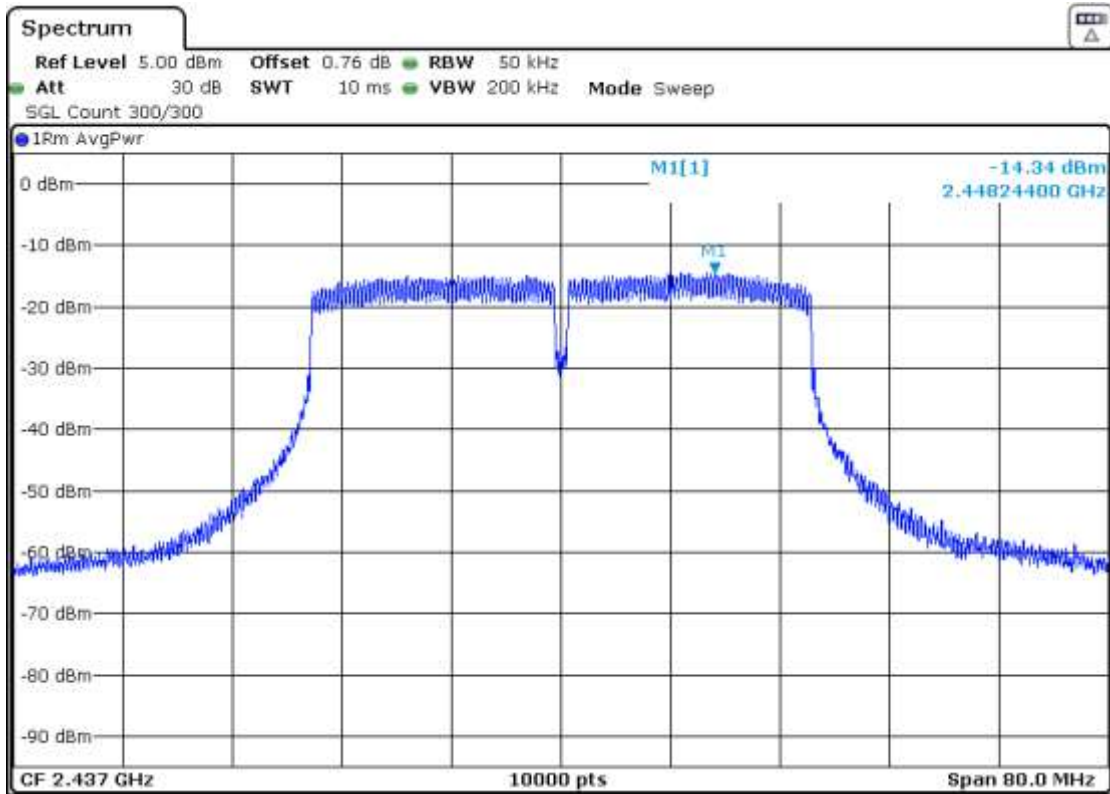


- Mode 802.11 n40 – Power Spectral Density

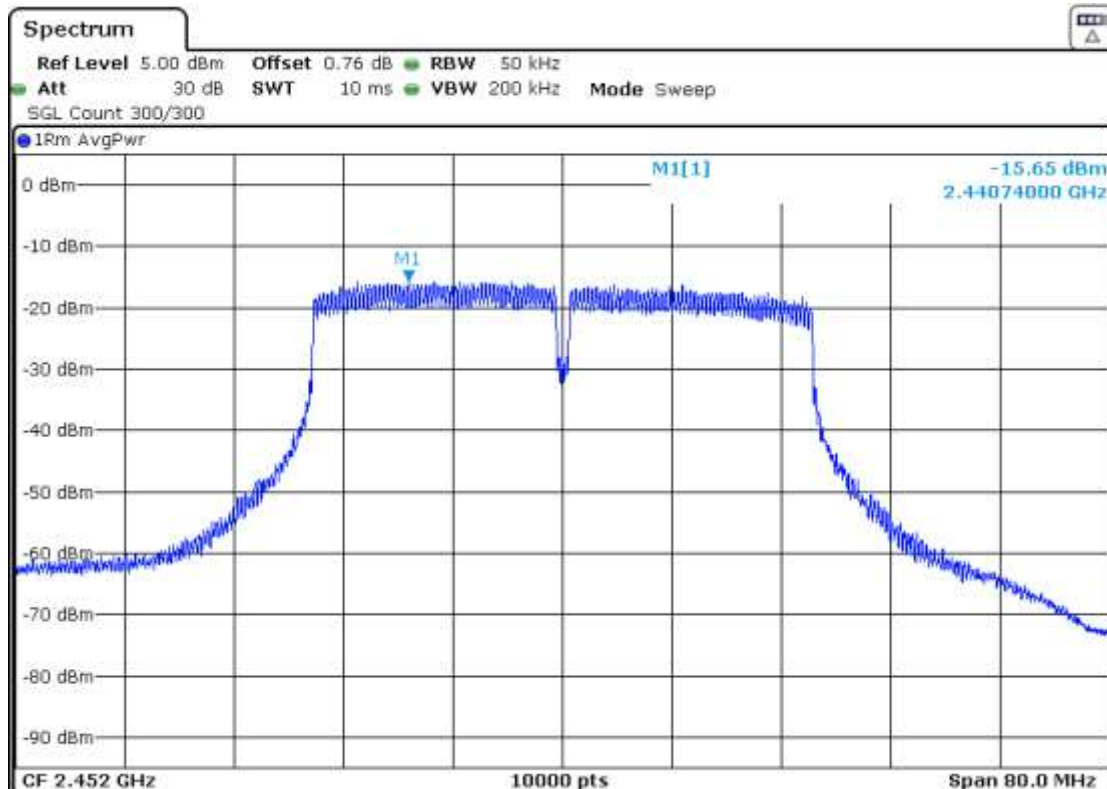
- Low Channel:



- 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 ($\mu\text{V/m}$)	Field strength ($\text{dB}\mu\text{V/m}$)	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 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-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.

INDOOR ANTENNA: Maximum Declared Assembly Antenna Gain: +5.9 dBi (Antenna gain plus antenna cable loss).

DSSS mode:

- **802.11 b mode:**

Frequency range 30 MHz - 1 GHz:

The spurious frequencies detected below 1 GHz do not depend on either the operating channel or the modulation mode selected in the EUT

Spurious frequencies operating at less than 20 dB below the limit:

Spurious frequency (MHz)	Detector	Emission Level (dBµV/m)	Polarization	Measurement Uncertainty (dB)
51.777	Quasi peak	25.6	V	<± 2.07

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 operating at less than 20 dB below the limit:

Spurious frequency (GHz)	Detector	Emission Level (dBµV/m)	Polarization	Measurement Uncertainty (dB)
2.389612	Peak	53.09	V	<±3.70
4.82397	Peak	40.65	V	<± 4.88
7.23477	Peak	51.88	V	<± 4.88
9.6479	Peak	46.4	V	<± 4.88

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

Spurious frequency (GHz)	Detector	Emission Level (dBµV/m)	Polarization	Measurement Uncertainty (dB)
4.8739	Peak	43.59	V	<± 4.88
7.3127	Peak	48.08	V	<± 4.88
9.74823	Peak	45.86	V	<± 4.88

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

Spurious frequency (MHz)	Detector	Emission Level (dB μ V/m)	Polarization	Measurement Uncertainty (dB)
2.48359103	Peak	55.23	V	< \pm 3.70
	Average	45.51		< \pm 3.70
4.92383	Peak	44.68	V	< \pm 4.88
7.38457	Peak	56.35	V	< \pm 4.88
	Average	52.17		< \pm 4.88
9.8481	Peak	48.63	V	< \pm 4.88

Verdict: PASS

OFDM modes:

- **802.11 g:**

Frequency range 30 MHz - 1 GHz:

The spurious frequencies detected below 1 GHz do not depend on either the operating channel.

Spurious frequencies operating at less than 20 dB below the limit:

Spurious frequency (MHz)	Detector	Emission Level (dBµV/m)	Polarization	Measurement Uncertainty (dB)
52.262	Quasi peak	26.7	V	<± 2.07

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 operating at less than 20 dB below the limit:

Spurious frequency (GHz)	Detector	Emission Level (dBµV/m)	Duty cycle Correction (dB)	Corrected Emission Level (dBµV/m)	Polarization	Measurement Uncertainty (dB)
2.38998	Peak	59.59	-	59.59	V	<±3.70
	Average	48.34	0.389	48.73		<±3.70
4.81697	Peak	43.49	-	43.49	V	<± 4.88
7.23197	Peak	47.54	-	47.54	V	<± 4.88
9.64767	Peak	46.52	-	46.52	V	<± 4.88

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

Spurious frequency (GHz)	Detector	Emission Level (dBµV/m)	Polarization	Measurement Uncertainty (dB)
4.85753	Peak	46.48	V	<± 4.88
7.31970	Peak	46.34	V	<± 4.88
9.74777	Peak	46.37	V	<± 4.88

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

Spurious frequency (MHz)	Detector	Emission Level (dBµV/m)	Duty cycle Correction (dB)	Corrected Emission Level (dBµV/m)	Polarization	Measurement Uncertainty (dB)
2.48405	Peak	57.46	-	57.46	V	<±3.70
	Average	46.3	0.389	46.69		<±3.70
4.92477	Peak	48.38	-	48.38	V	<± 4.88
7.38177	Peak	45.86	-	45.86	V	<± 4.88
9.84810	Peak	49.11	-	49.11	V	<± 4.88

Verdict: PASS

- **802.11 n20 mode:**

Frequency range 30 MHz - 1 GHz:

The spurious frequencies detected below 1 GHz do not depend on either the operating channel.

Spurious frequencies operating at less than 20 dB below the limit:

Spurious frequency (MHz)	Detector	Emission Level (dBµV/m)	Polarization	Measurement Uncertainty (dB)
52.262	Quasi peak	26.7	V	<± 2.07

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 operating at less than 20 dB below the limit:

Spurious frequency (GHz)	Detector	Emission Level (dBµV/m)	Duty cycle Correction (dB)	Corrected Emission Level (dBµV/m)	Polarization	Measurement Uncertainty (dB)
2.38996	Peak	61.36	-	61.36	V	<±3.70
	Average	49.7	0.368	50.07		<±3.70
7.24223	Peak	50.17	-	50.17	V	<± 4.88
9.64773	Peak	46.19	-	46.19	V	<± 4.88

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

Spurious frequency (GHz)	Detector	Emission Level (dBµV/m)	Polarization	Measurement Uncertainty (dB)
7.31783	Peak	53.36	V	<± 4.88
9.74777	Peak	46.5	V	<± 4.88

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

Spurious frequency (GHz)	Detector	Emission Level (dBµV/m)	Duty cycle Correction (dB)	Corrected Emission Level (dBµV/m)	Polarization	Measurement Uncertainty (dB)
2.48378793	Peak	61.56	-	61.56	V	<±3.70
	Average	50.44	0.368	50.81		<±3.70
4.91777	Peak	45.79	-	45.79	V	<± 4.88
7.37383	Peak	50.11	-	50.11	V	<± 4.88
9.8481	Peak	48.99	-	48.99	H	<± 4.88

Verdict: PASS

- **802.11 n40 mode:**

Frequency range 30 MHz - 1 GHz:

The spurious frequencies detected below 1 GHz do not depend on either the operating channel or the modulation mode selected in the EUT

Spurious frequencies operating at less than 20 dB below the limit:

Spurious frequency (MHz)	Detector	Emission Level (dBµV/m)	Polarization	Measurement Uncertainty (dB)
52.262	Quasi peak	26.4	V	<± 2.07
812.677	Quasi peak	26.4	H	<± 2.07

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 operating at less than 20 dB below the limit:

Spurious frequency (GHz)	Detector	Emission Level (dBµV/m)	Duty cycle Correction (dB)	Corrected Emission Level (dBµV/m)	Polarization	Measurement Uncertainty (dB)
2.38934	Peak	62.41	-	62.14	V	<±3.70
	Average	51.33	0.912	52.24		<±3.70

- MIDDLE CHANNEL.

No spurious frequencies found at less than 20dB the limit.

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

Spurious frequency (GHz)	Detector	Emission Level (dBµV/m)	Duty cycle Correction (dB)	Corrected Emission Level (dBµV/m)	Polarization	Measurement Uncertainty (dB)
2.48493	Peak	57.68	-	57.68	V	<±3.70
	Average	42.90	0.912	43.81		<±3.70
9.80798	Peak	47.97	-	47.97	V	<± 4.88

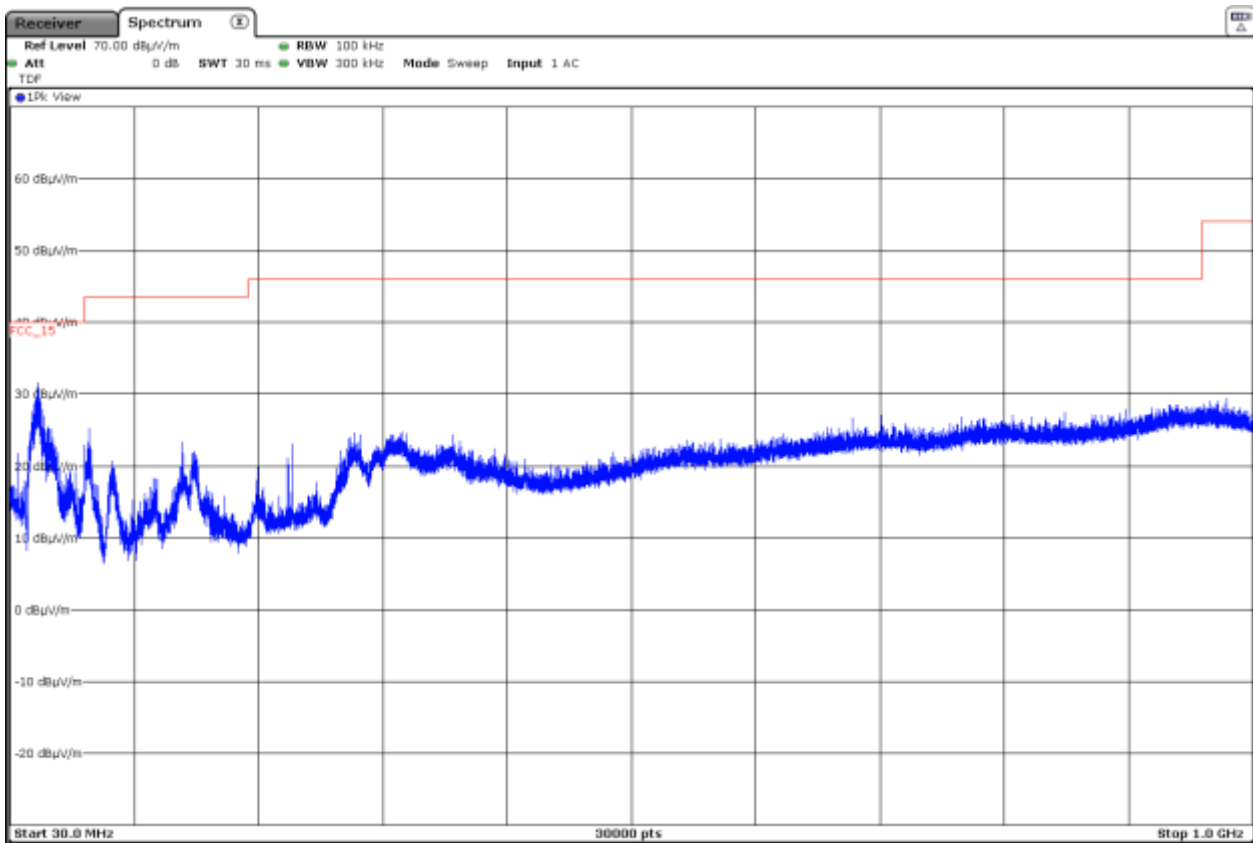
Verdict: PASS

- **802.11 b mode:**

FREQUENCY RANGE 30 MHz - 1 GHz:

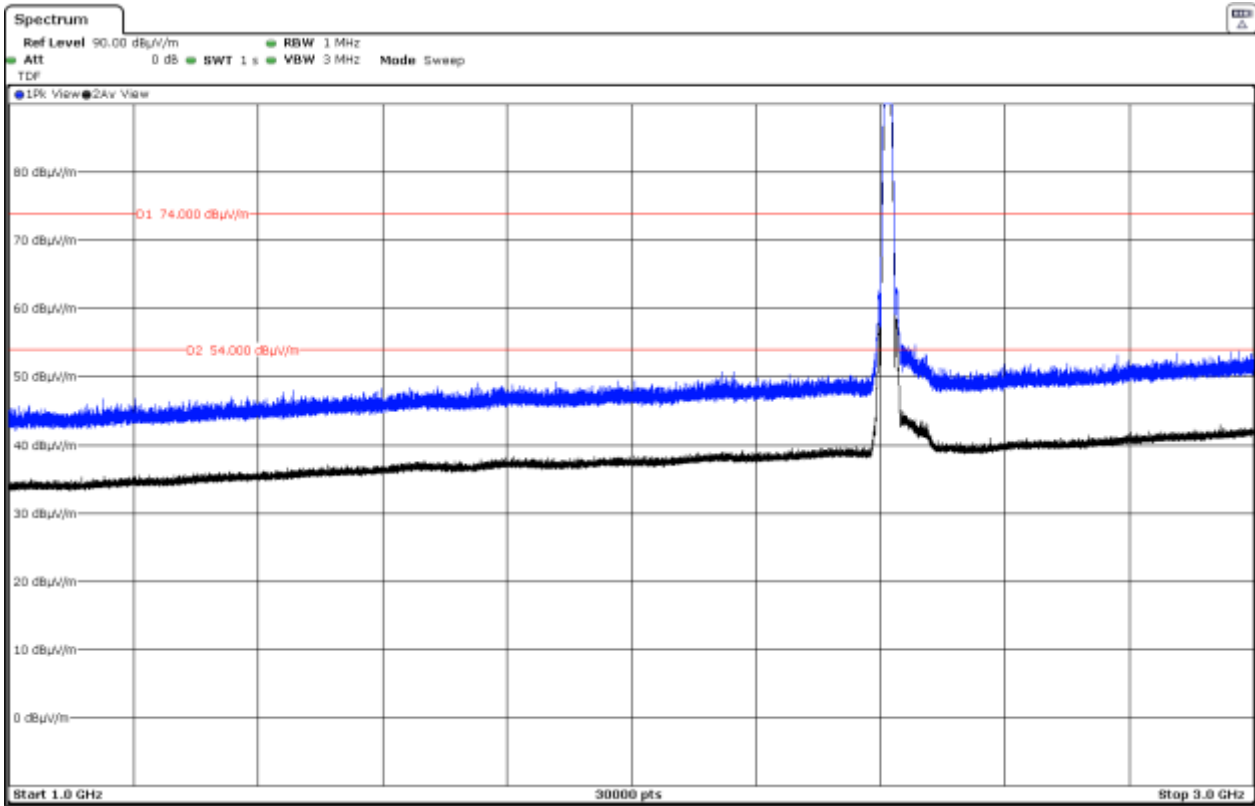
The spurious frequencies detected do not depend on the operating channel.

This plot is valid for the Low. Middle and High Channels.



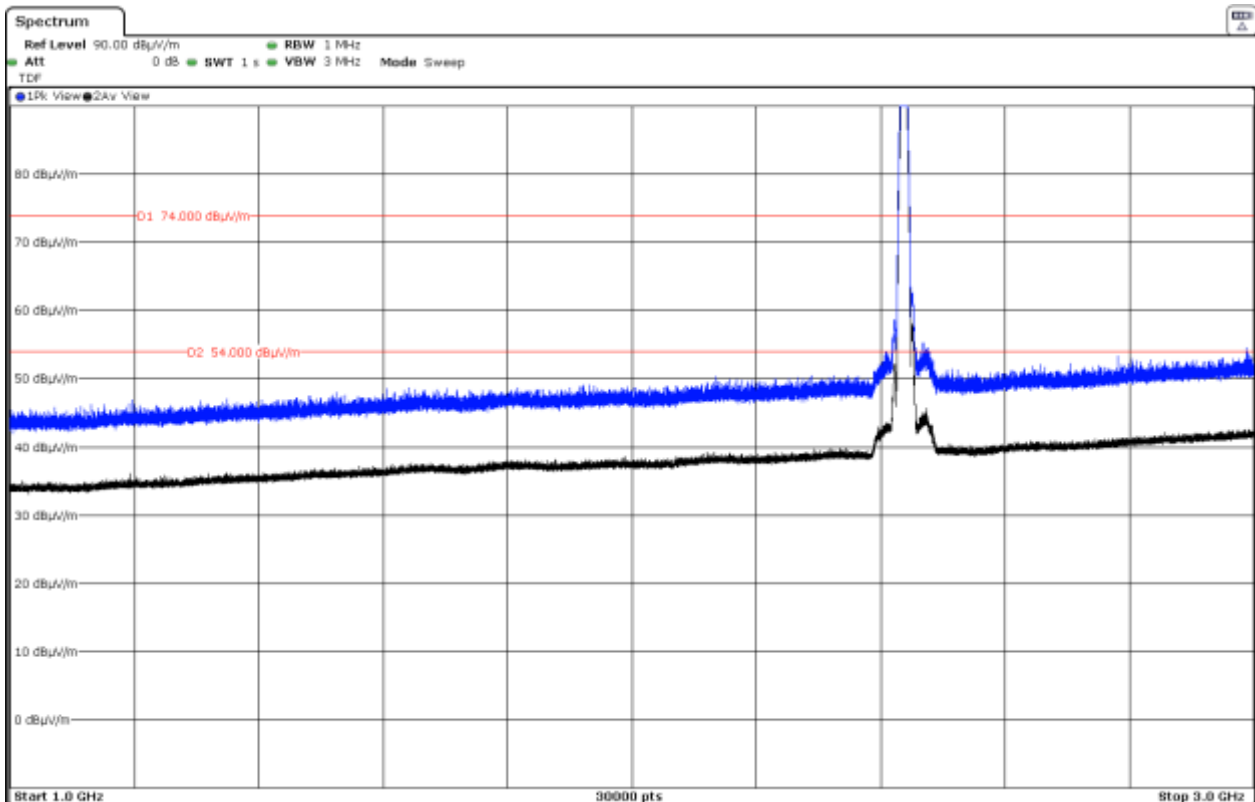
FREQUENCY RANGE 1 - 3 GHz:

- Low Channel:



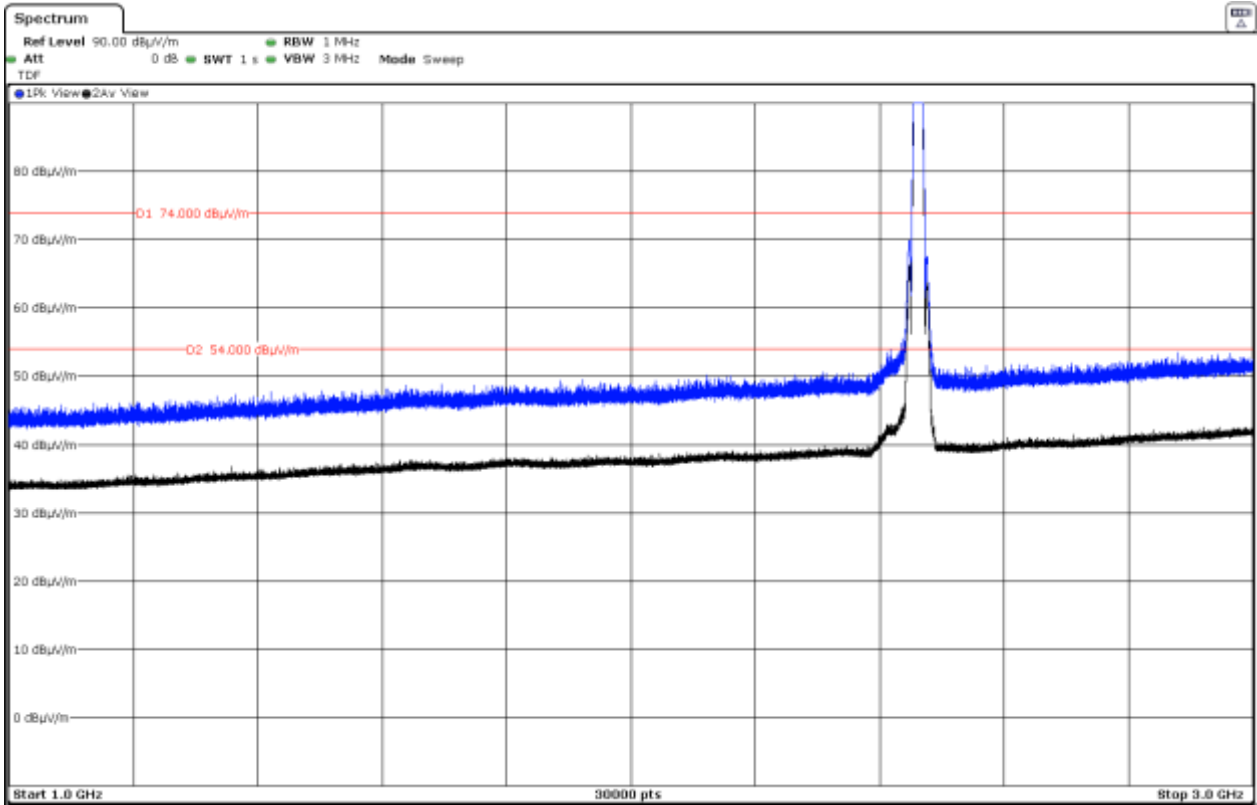
The peak above the limit is the carrier frequency.

- Middle Channel:



The peak above the limit is the carrier frequency.

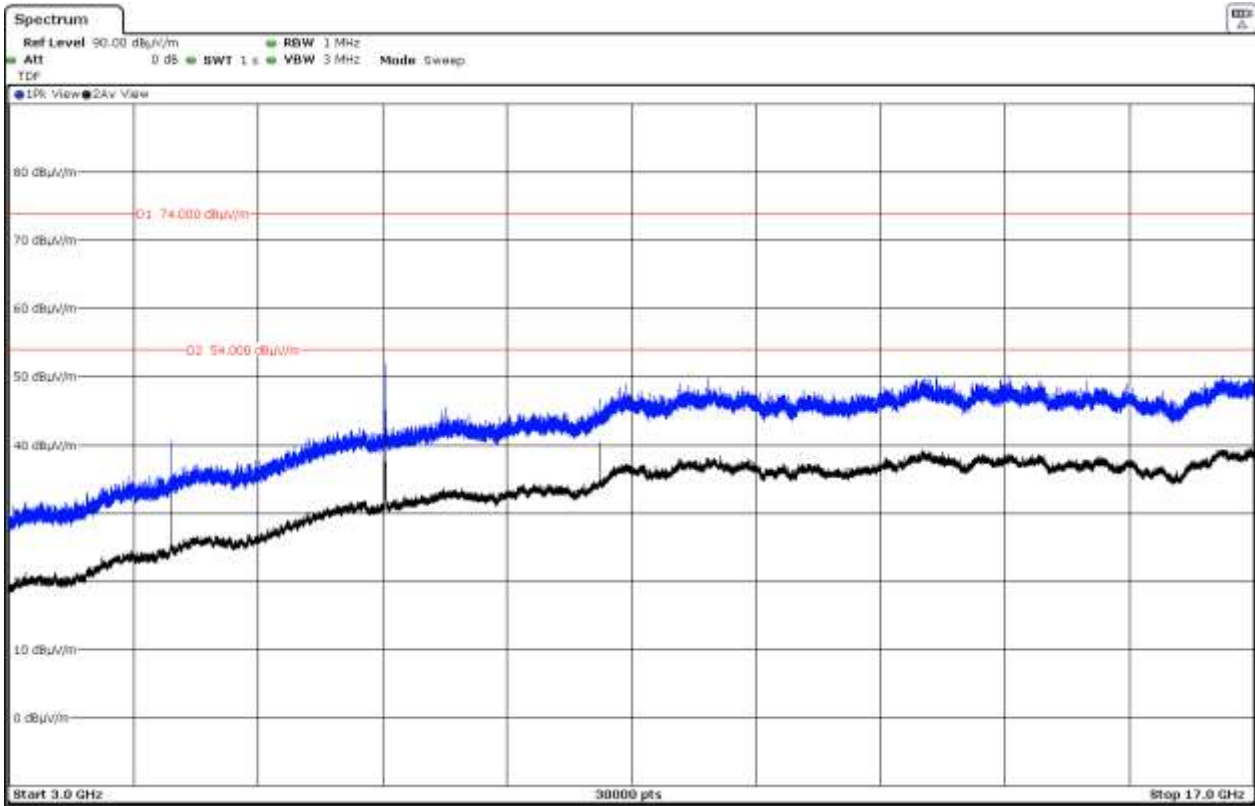
- High Channel:



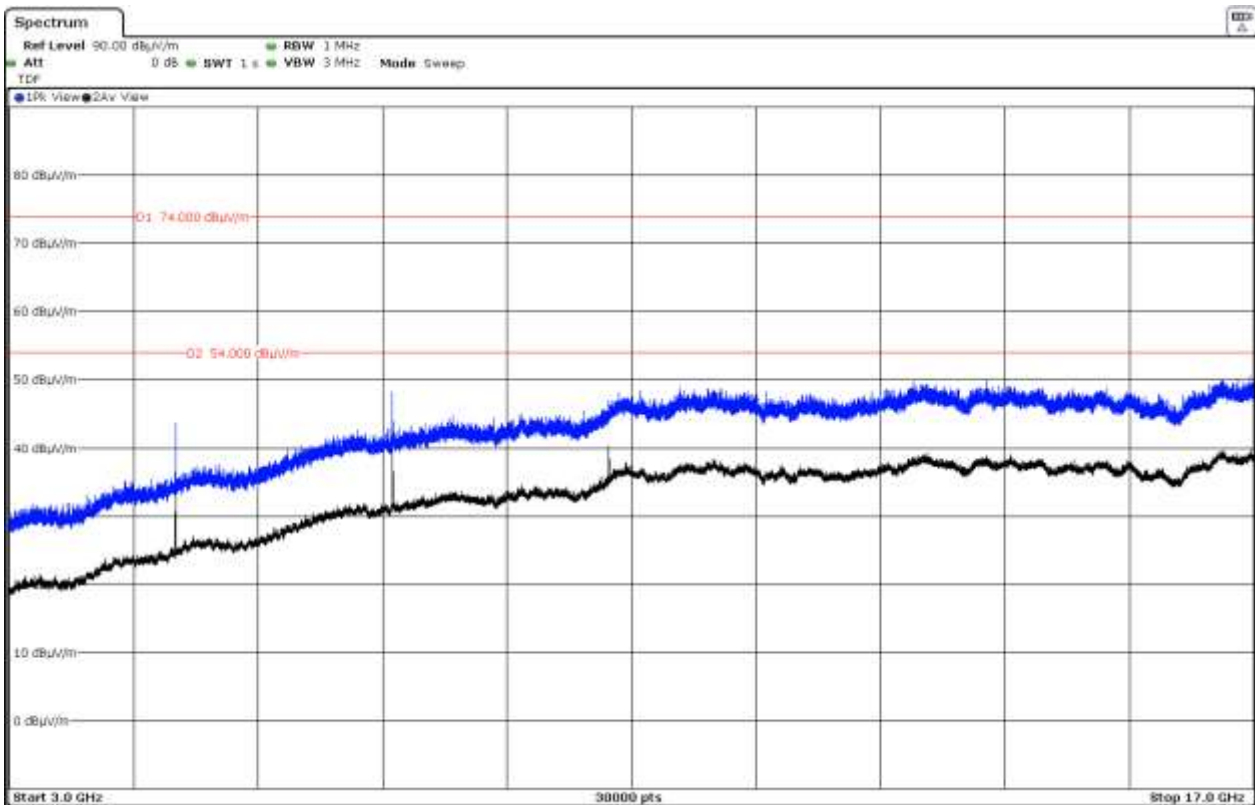
The peak above the limit is the carrier frequency.

FREQUENCY RANGE 3 - 17 GHz:

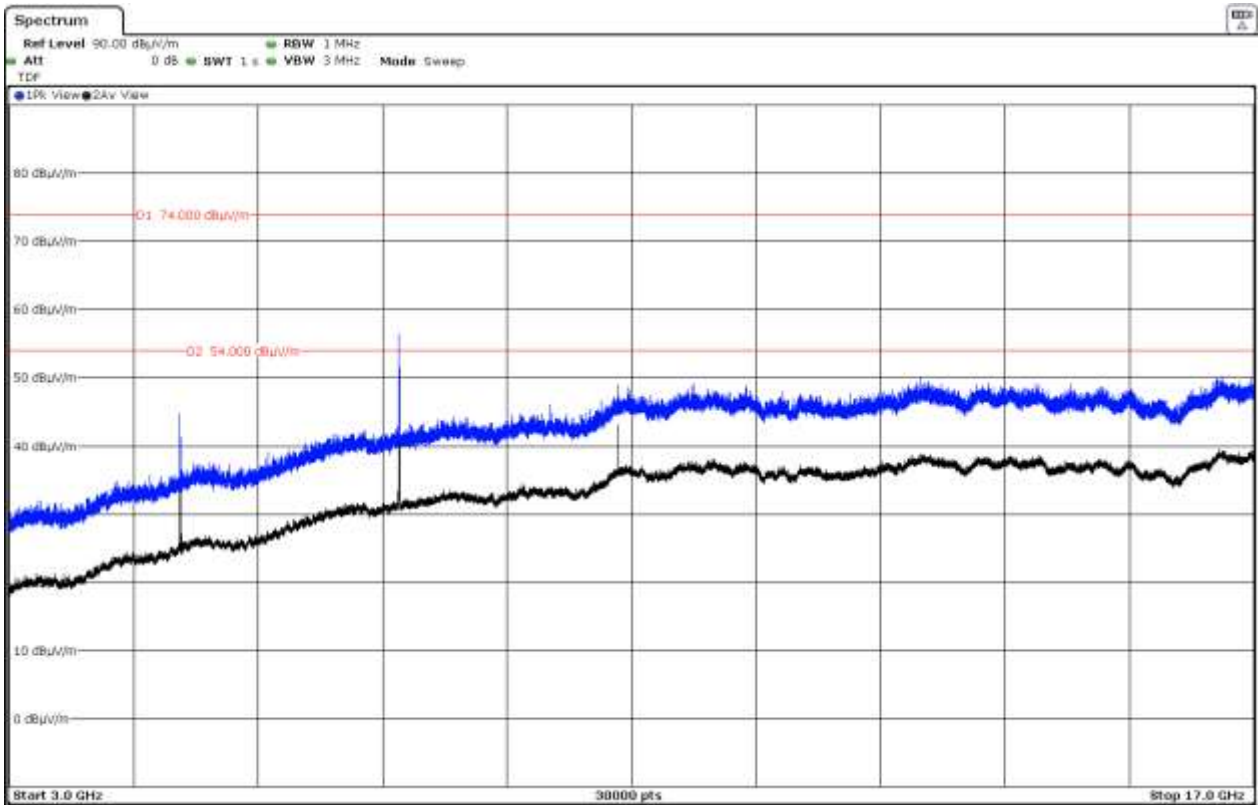
- Low Channel:



- Middle Channel:

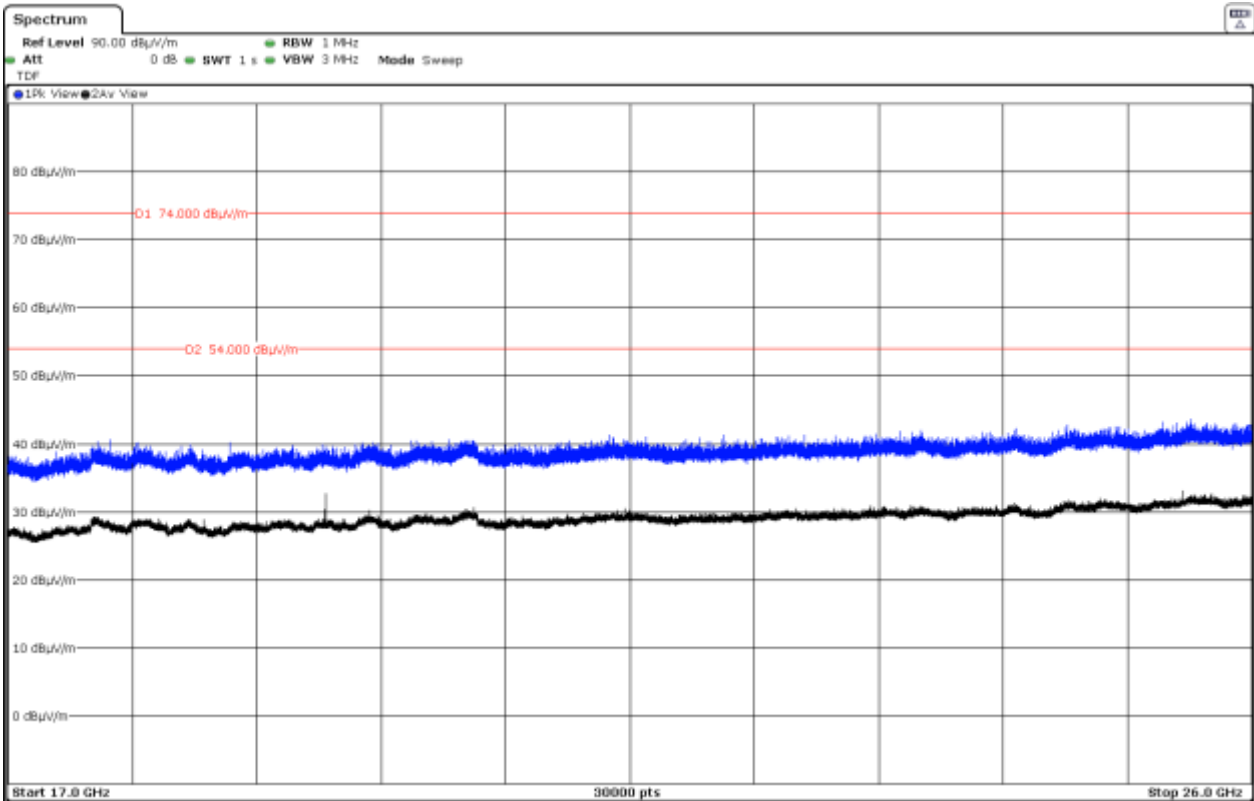


- High Channel:

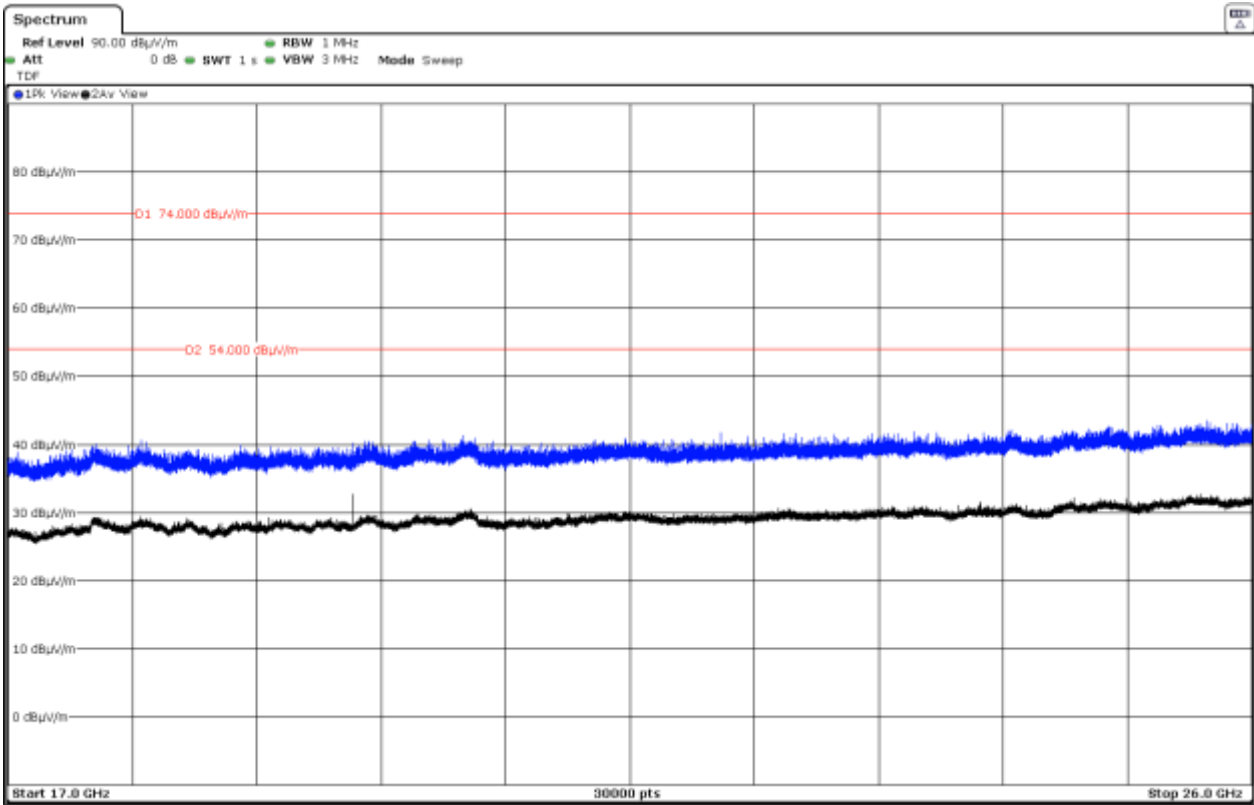


FREQUENCY RANGE 17 - 26 GHz:

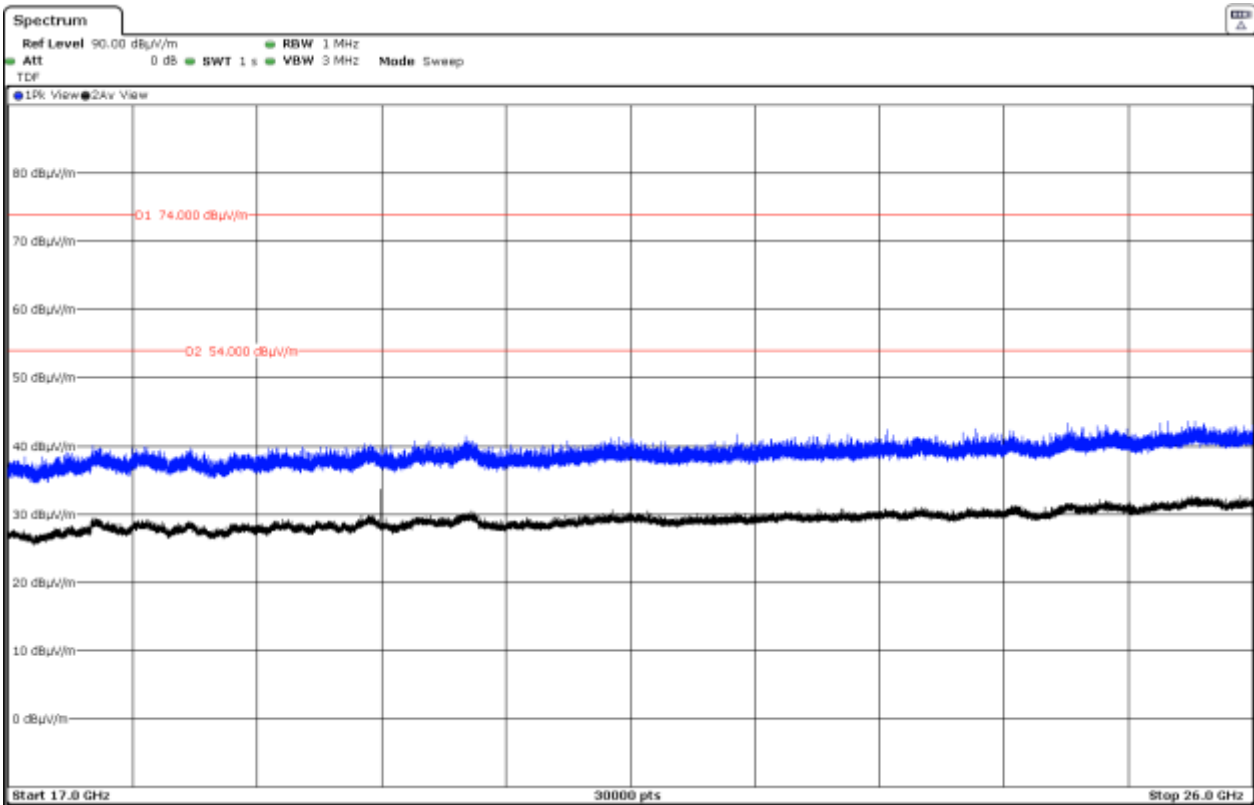
- Low Channel:



- Middle Channel:

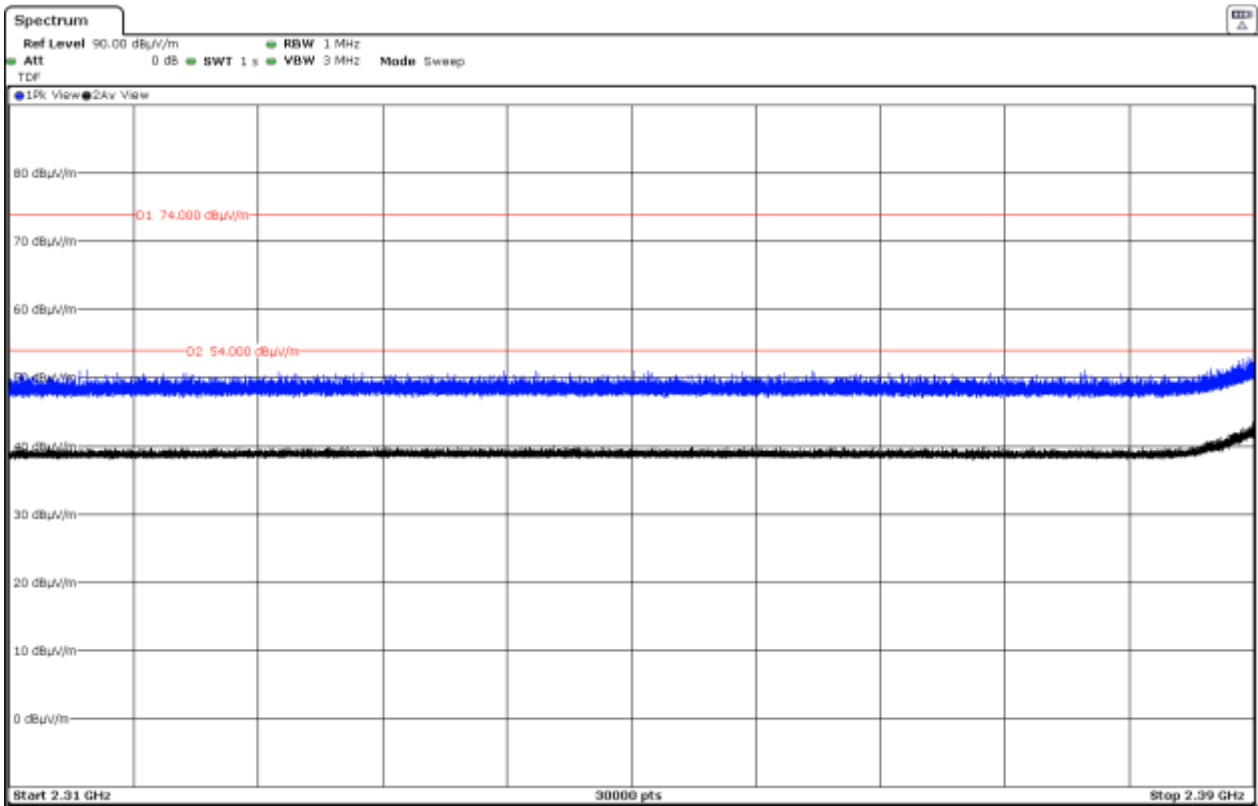


- High Channel:



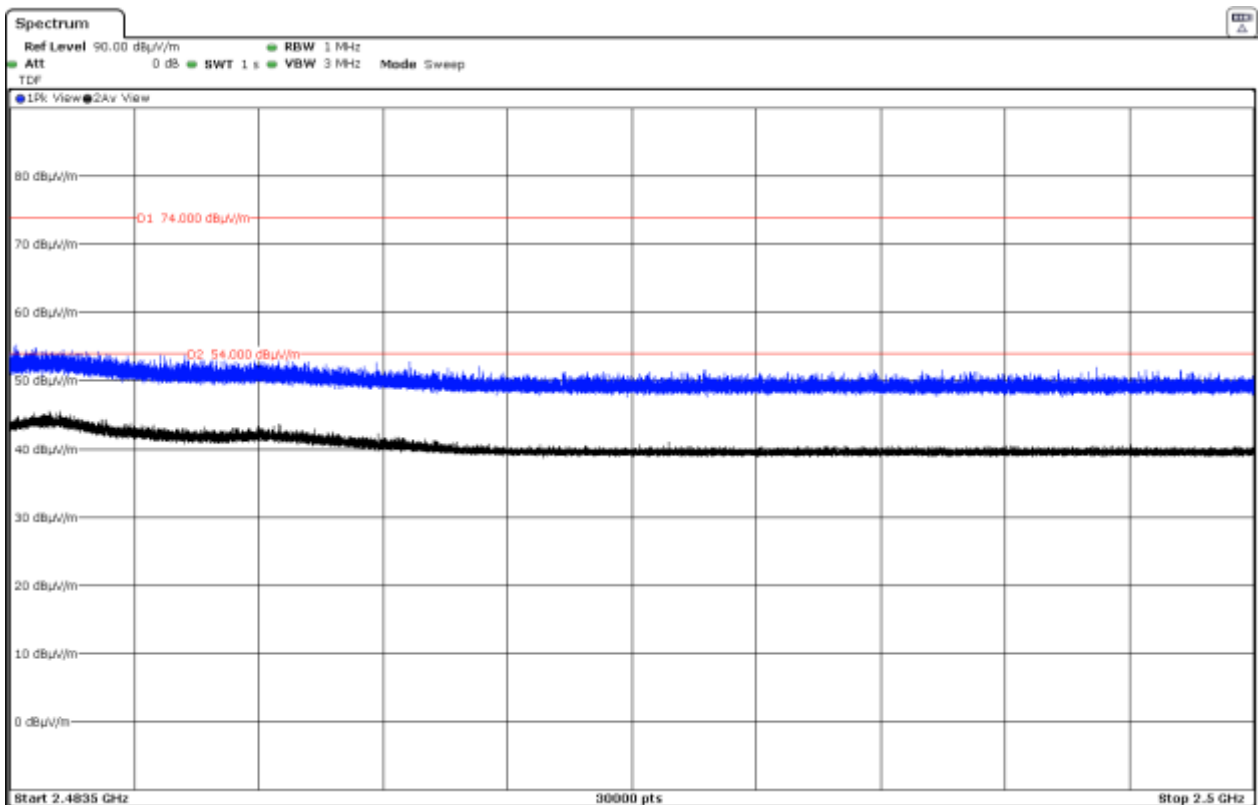
FREQUENCY RANGE 2.31-2.39 GHz: Restricted Band

- Low Channel.



FREQUENCY RANGE 2.4835-2.5 GHz: Restricted Band.

- High Channel.

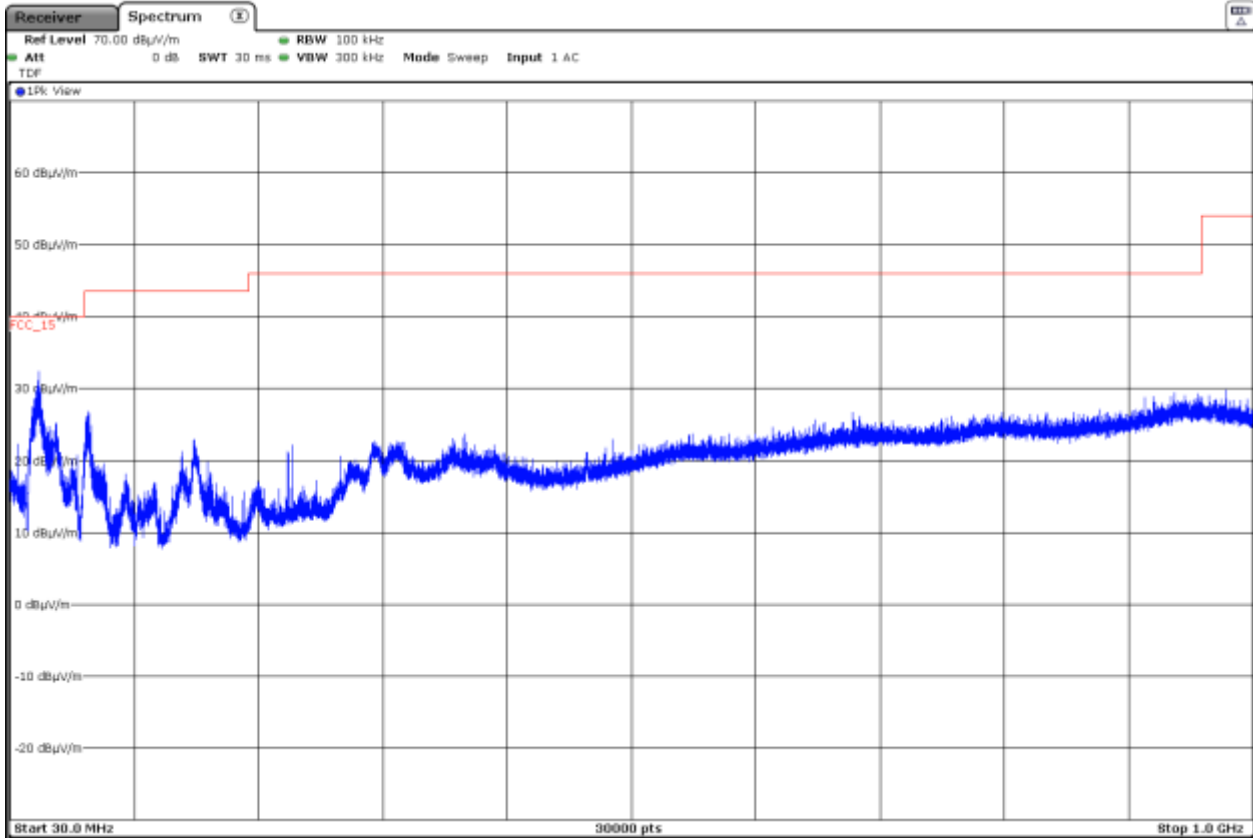


- **802.11 g mode:**

FREQUENCY RANGE 30 MHz - 1 GHz:

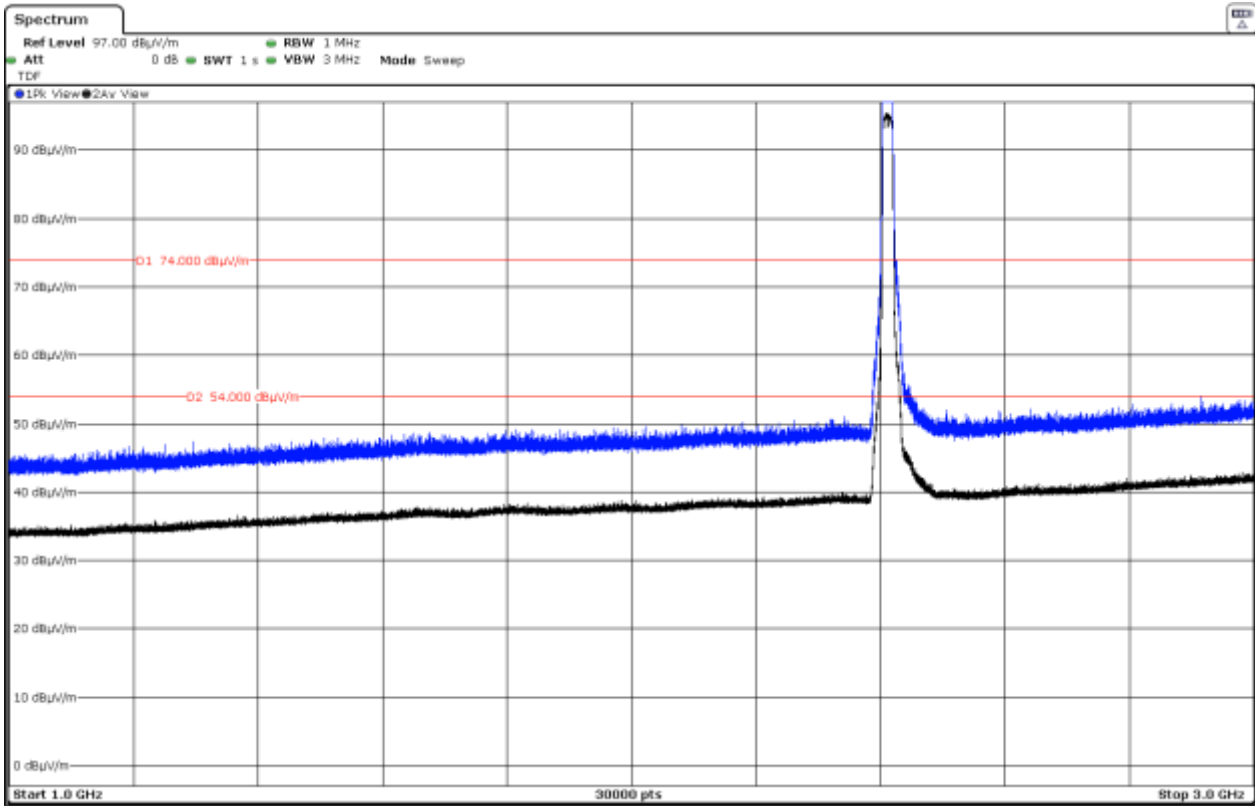
The spurious frequencies detected do not depend on the operating channel.

This plot is valid for the Low, Middle and High Channels.



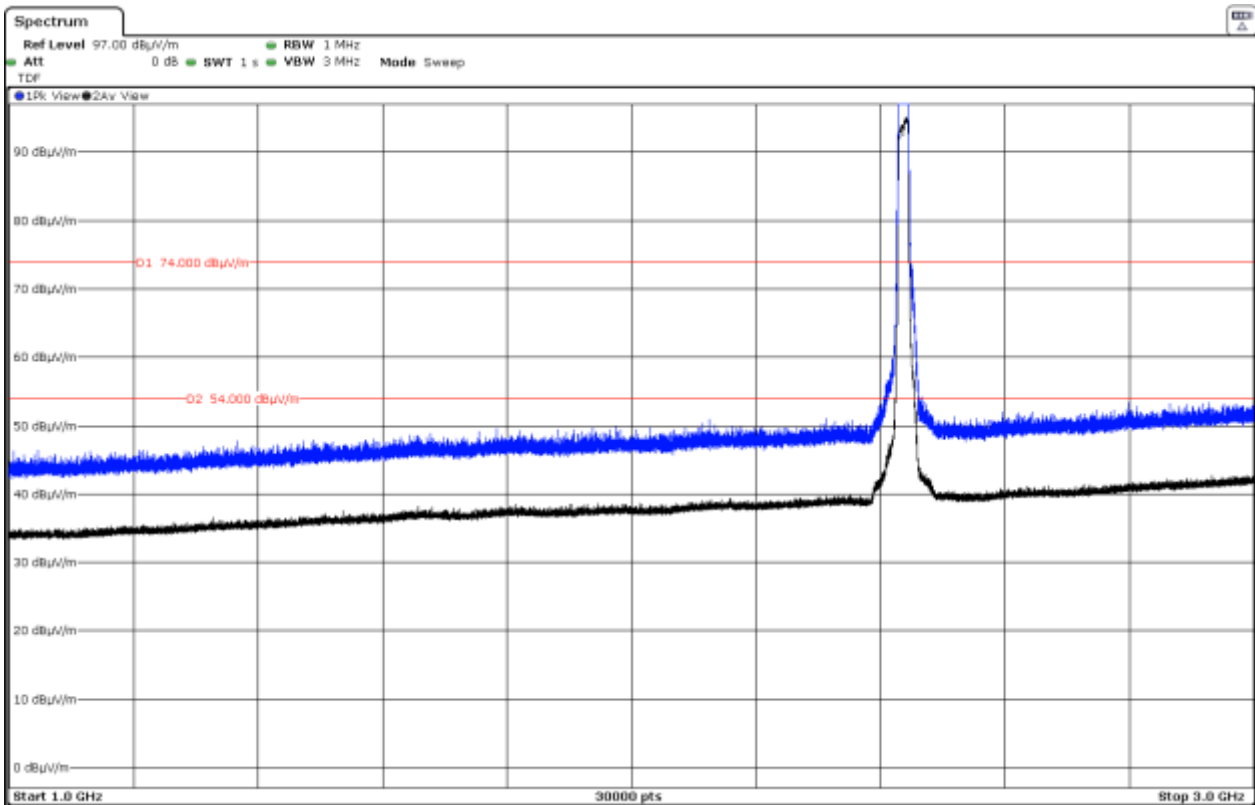
FREQUENCY RANGE 1 - 3 GHz:

- Low Channel:



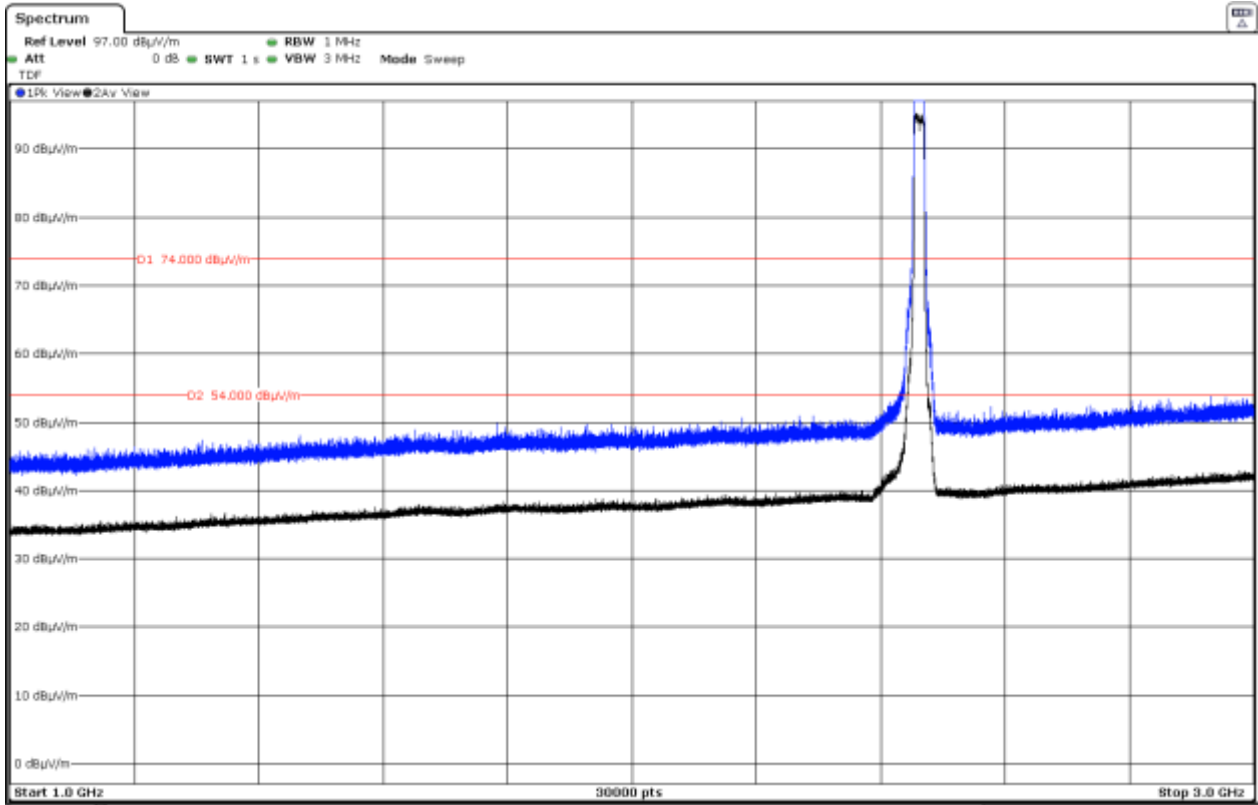
The peak above the limit is the carrier frequency.

- Middle Channel:



The peak above the limit is the carrier frequency.

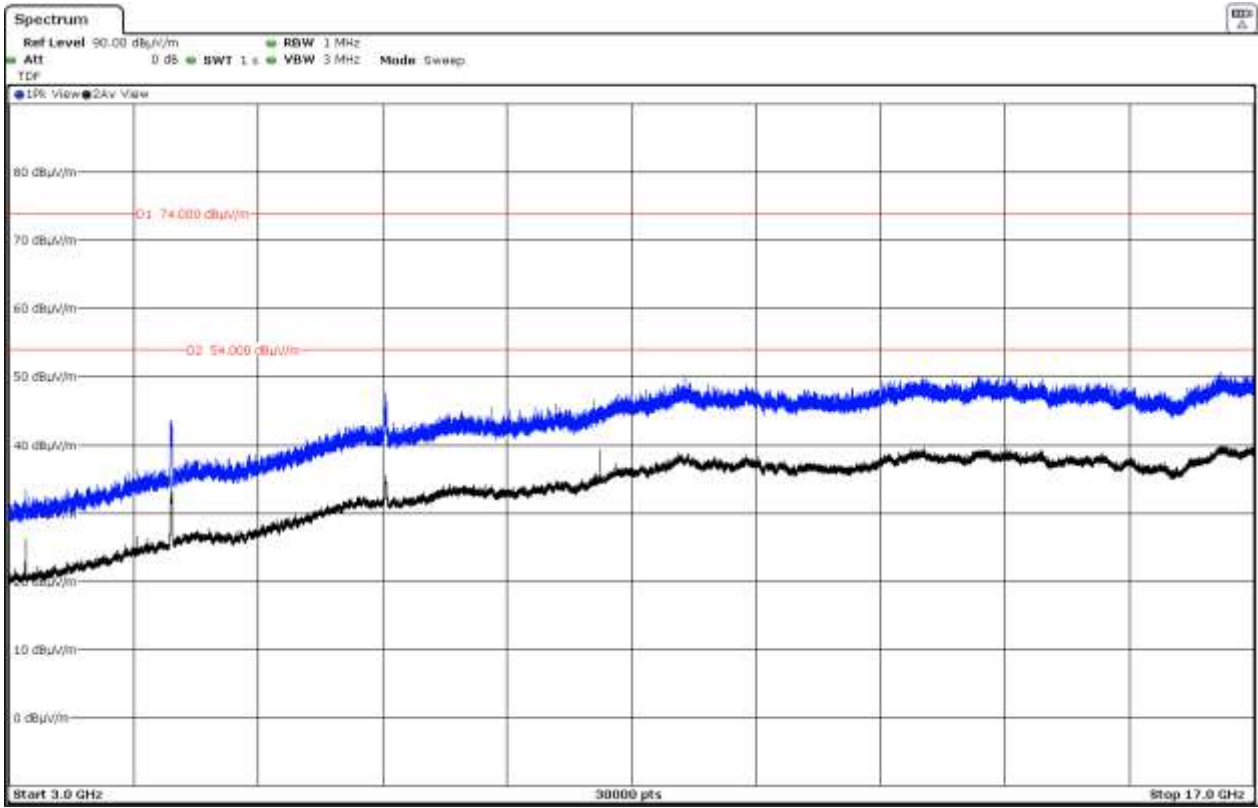
- High Channel:



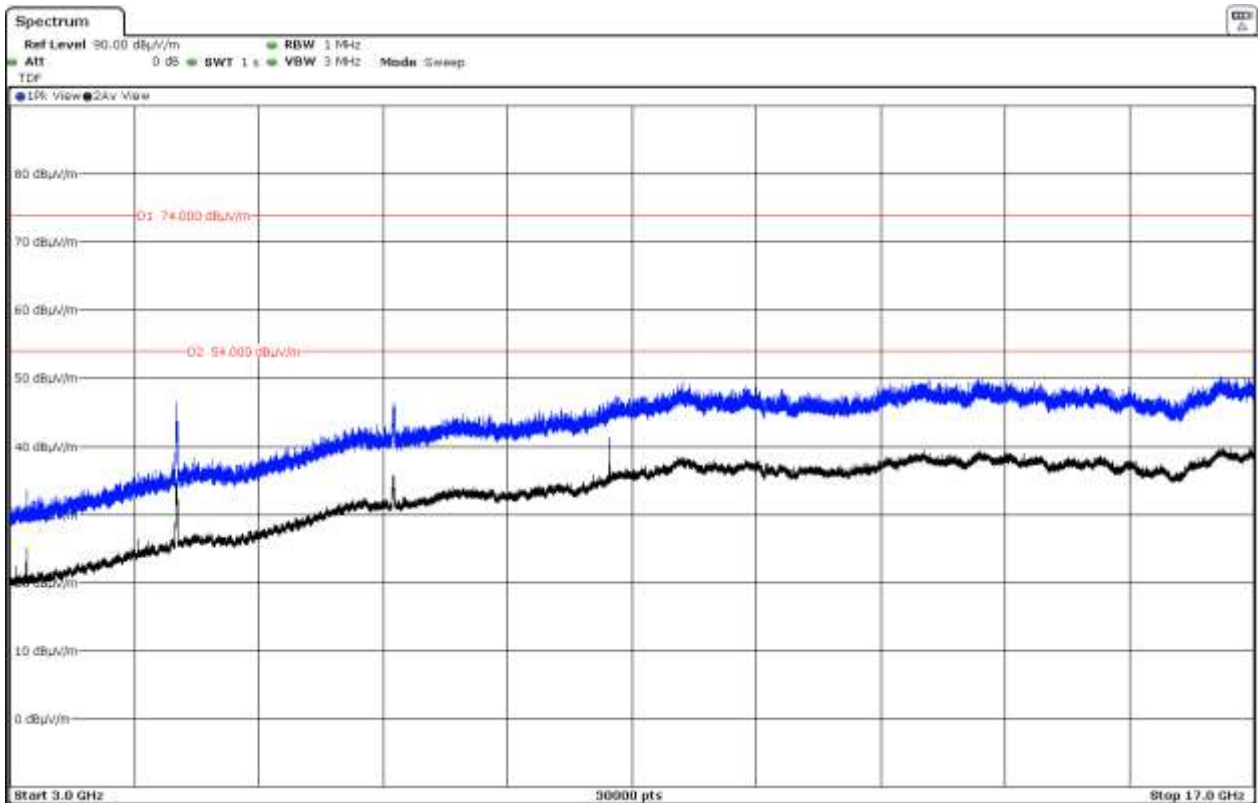
The peak above the limit is the carrier frequency.

FREQUENCY RANGE 3 - 17 GHz:

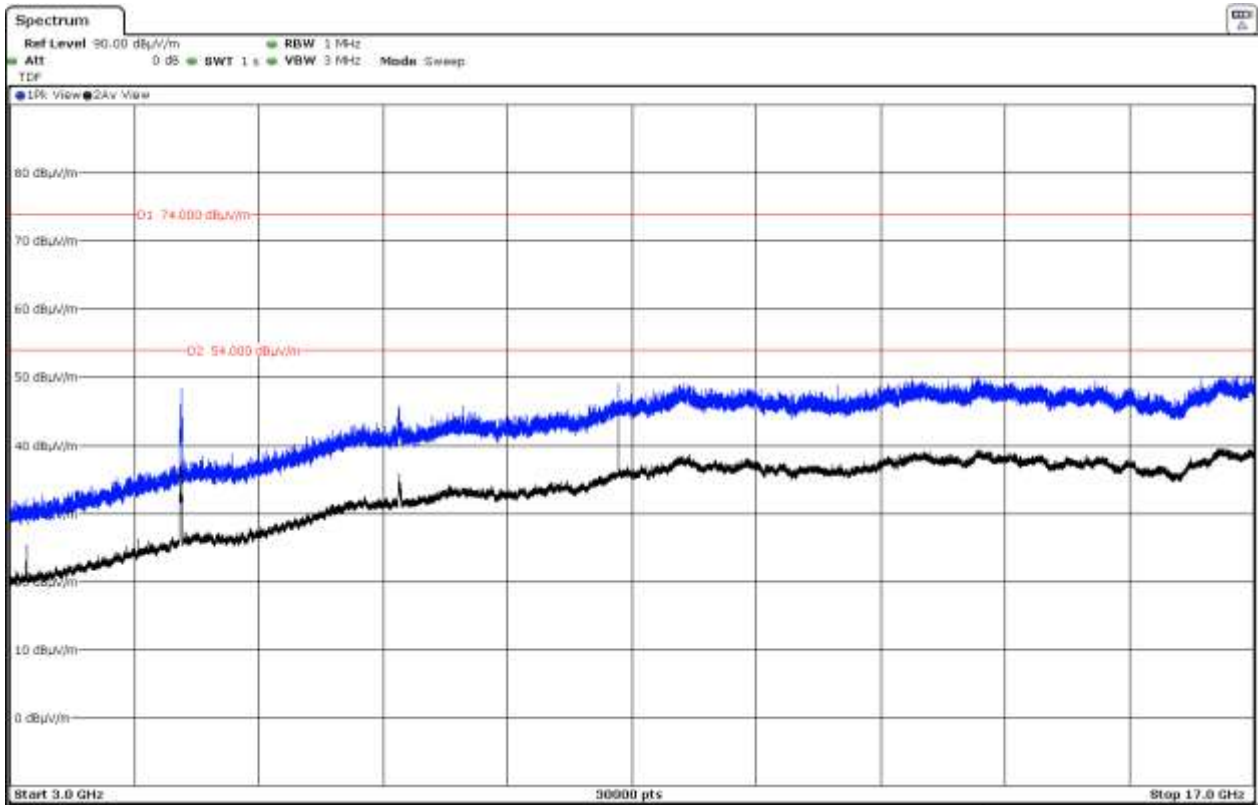
- Low Channel:



- Middle Channel:

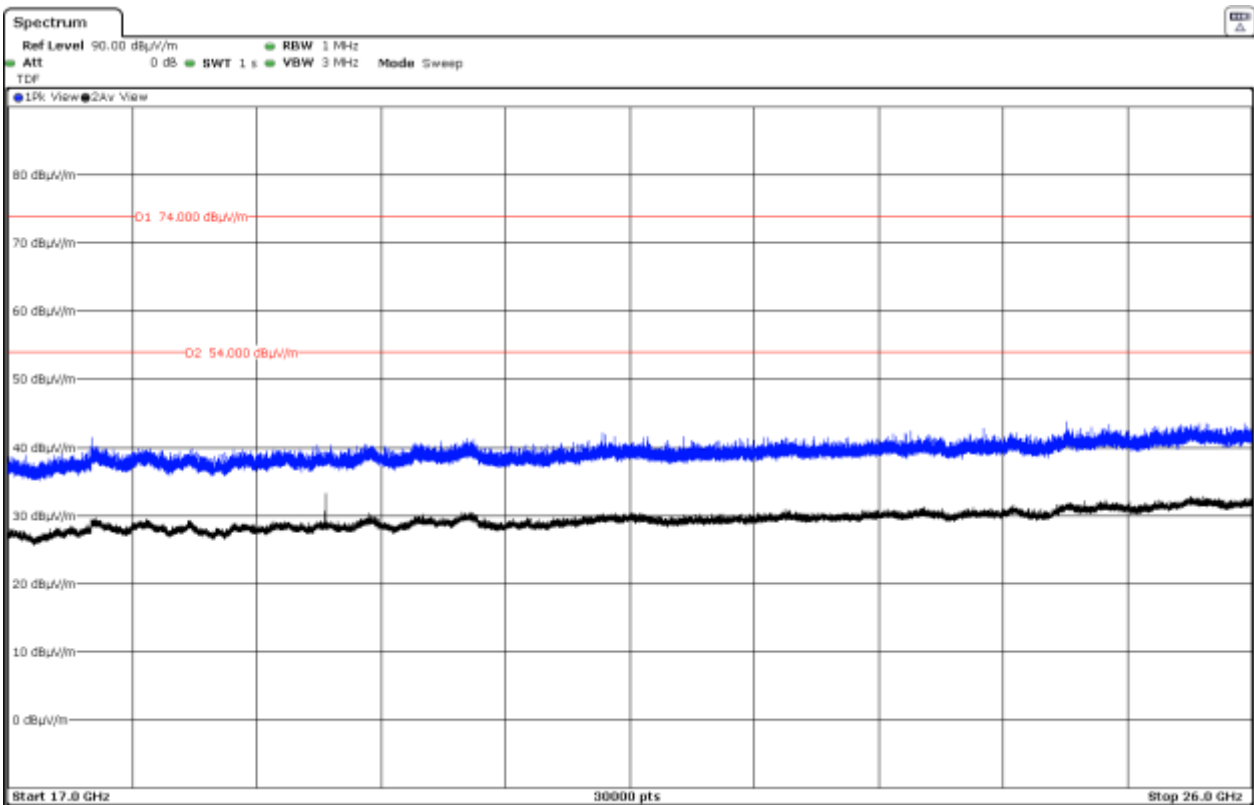


- High Channel:

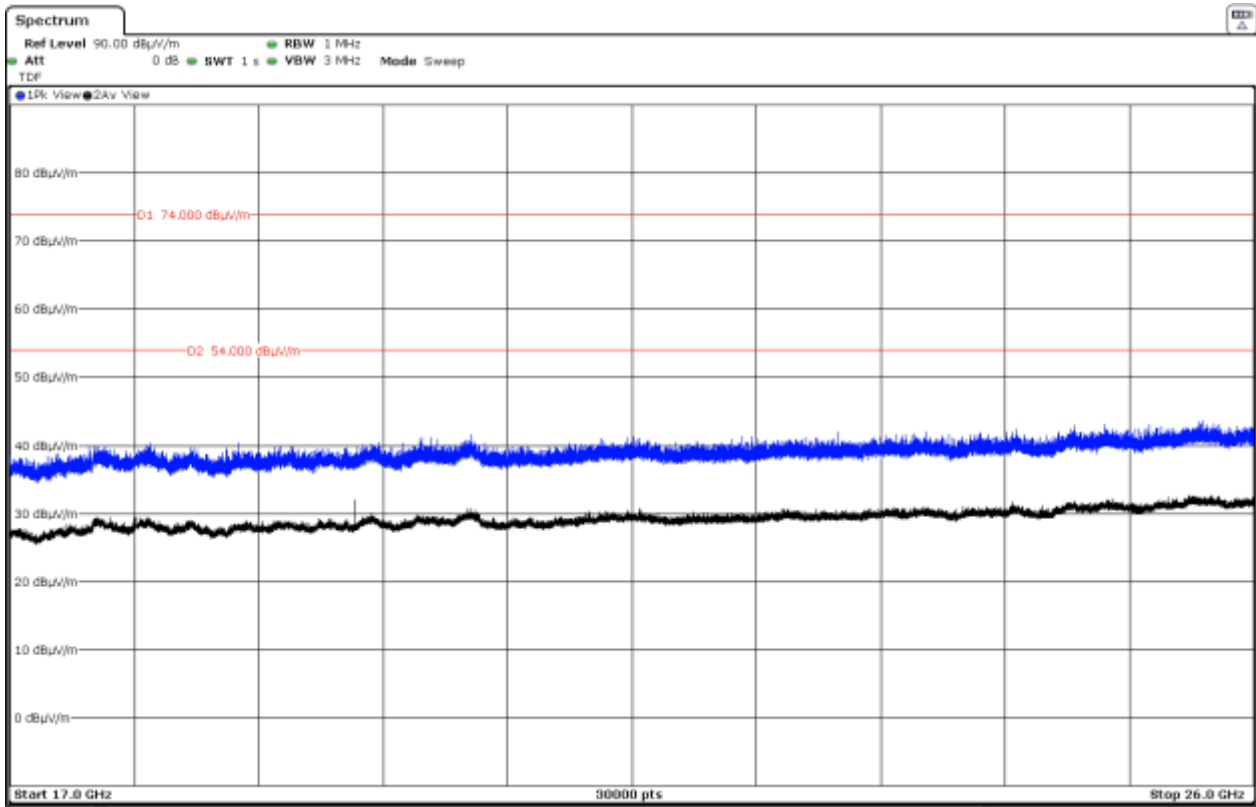


FREQUENCY RANGE 17 - 26 GHz:

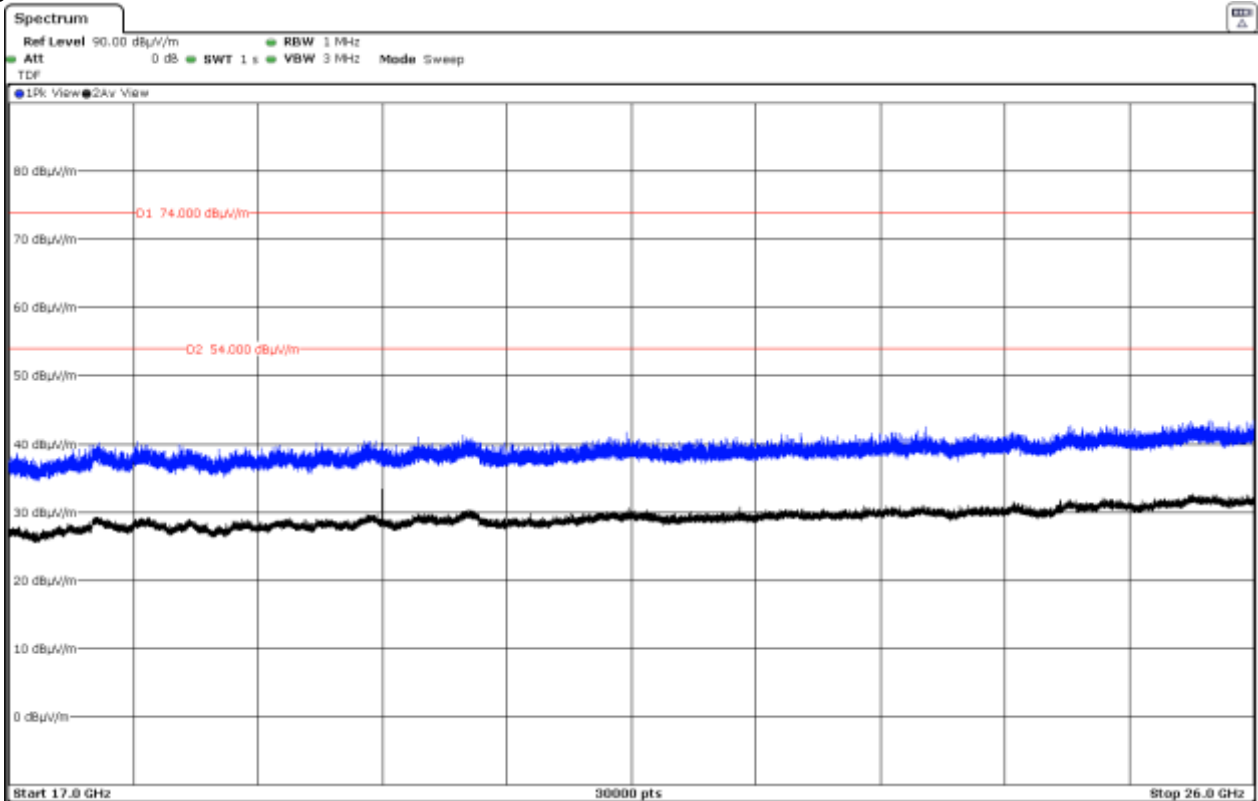
- Low Channel:



- Middle Channel:

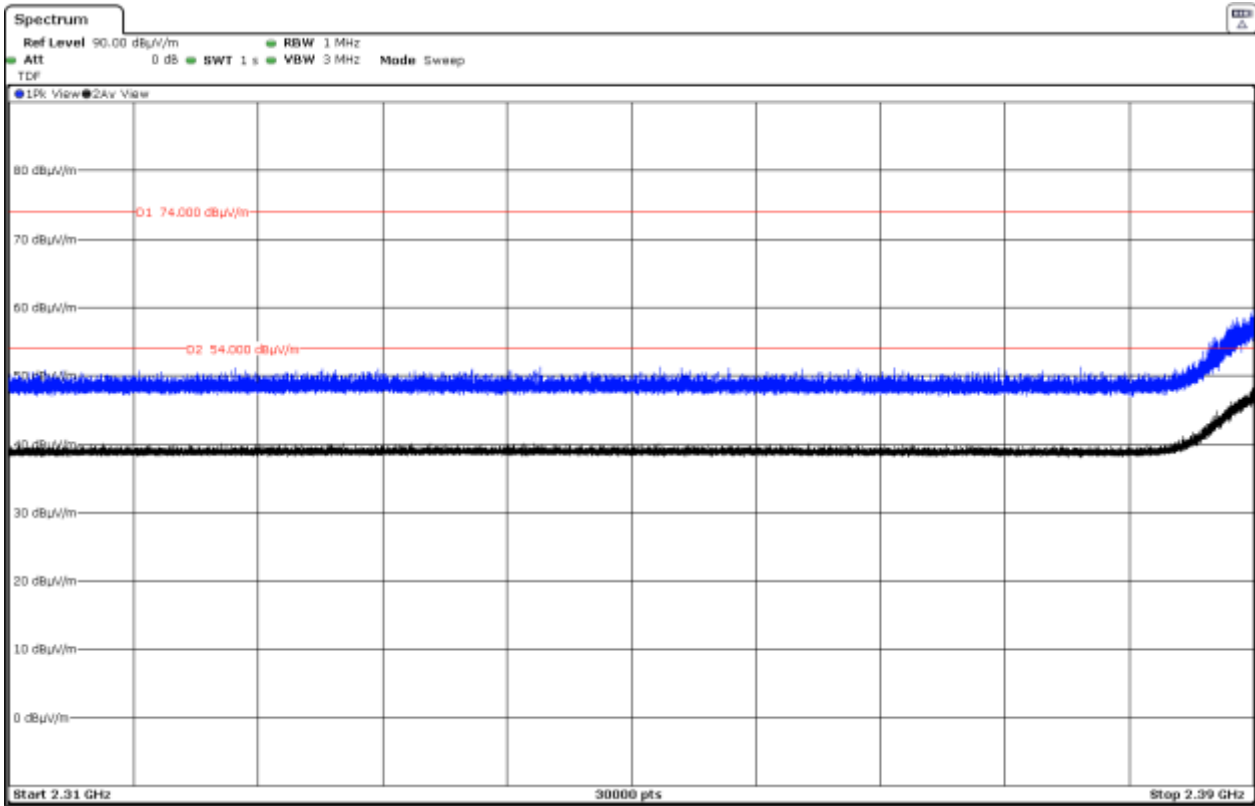


- High Channel:



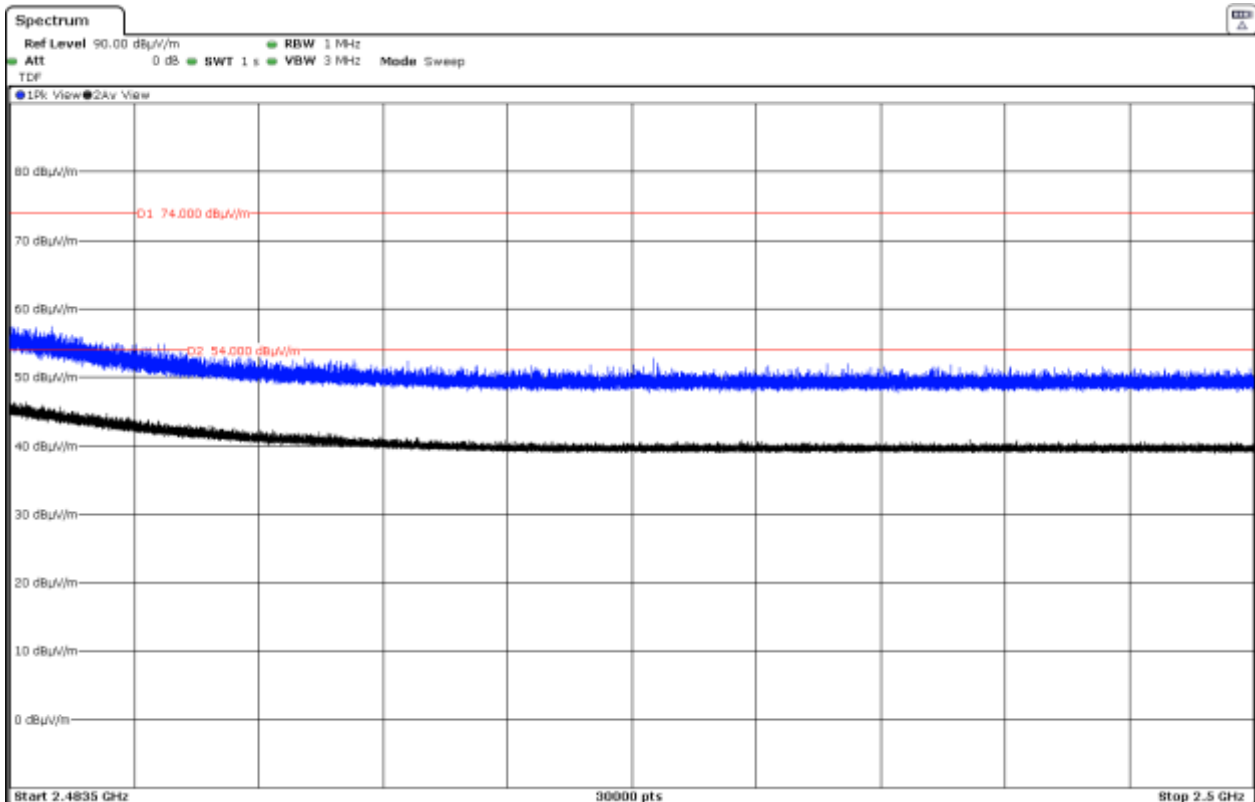
FREQUENCY RANGE 2.31-2.39 GHz: Restricted Band.

- Low Channel.



FREQUENCY RANGE 2.4835-2.5 GHz: Restricted Band.

- High Channel.

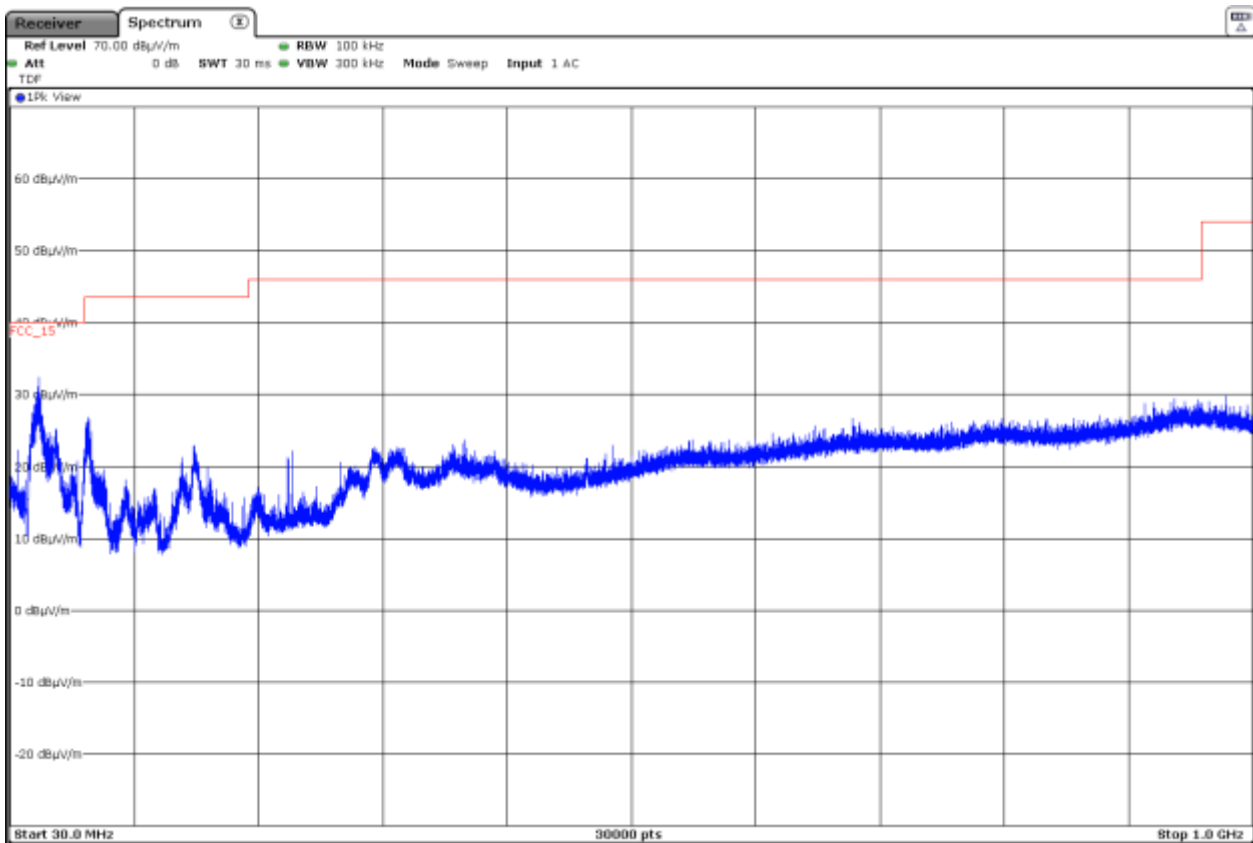


- **802.11 n20 mode (OFDM worst case for spurious emissions):**

FREQUENCY RANGE 30 MHz - 1 GHz:

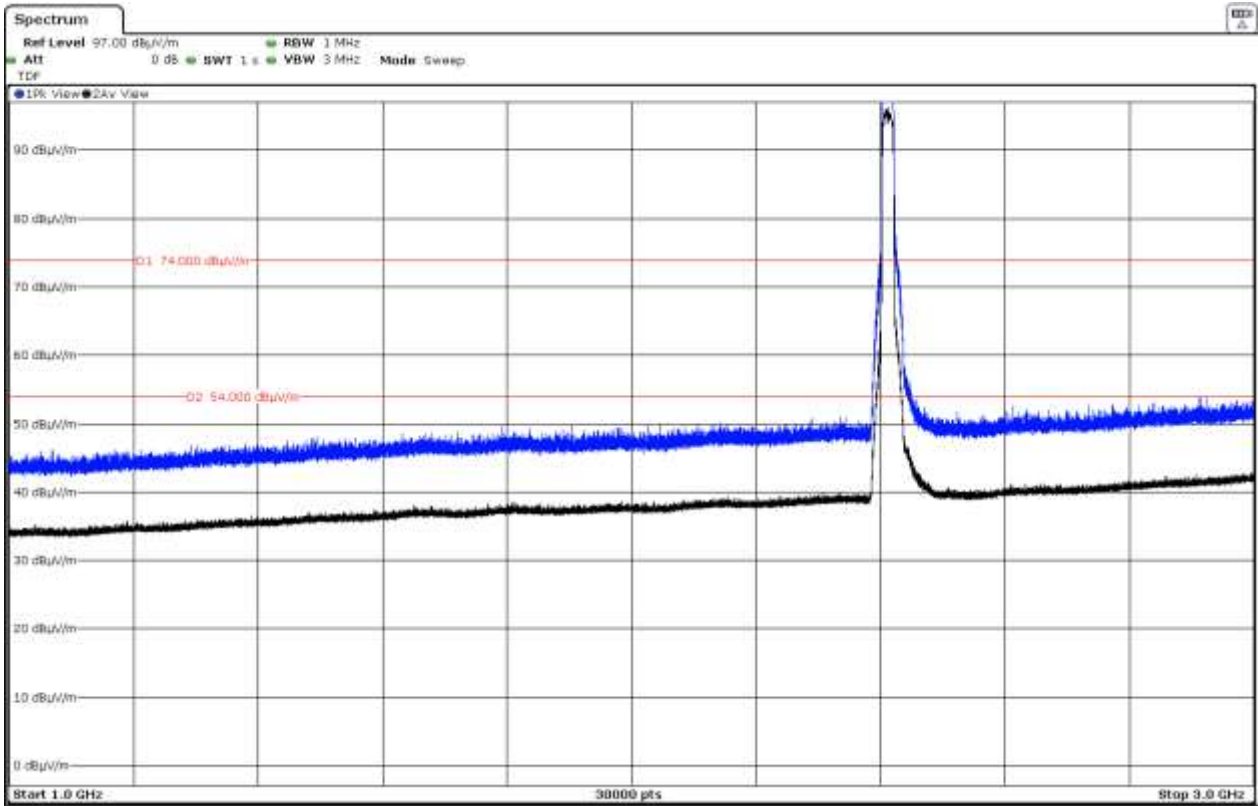
The spurious frequencies detected do not depend on the operating channel.

This plot is valid for the Low, Middle and High Channels.



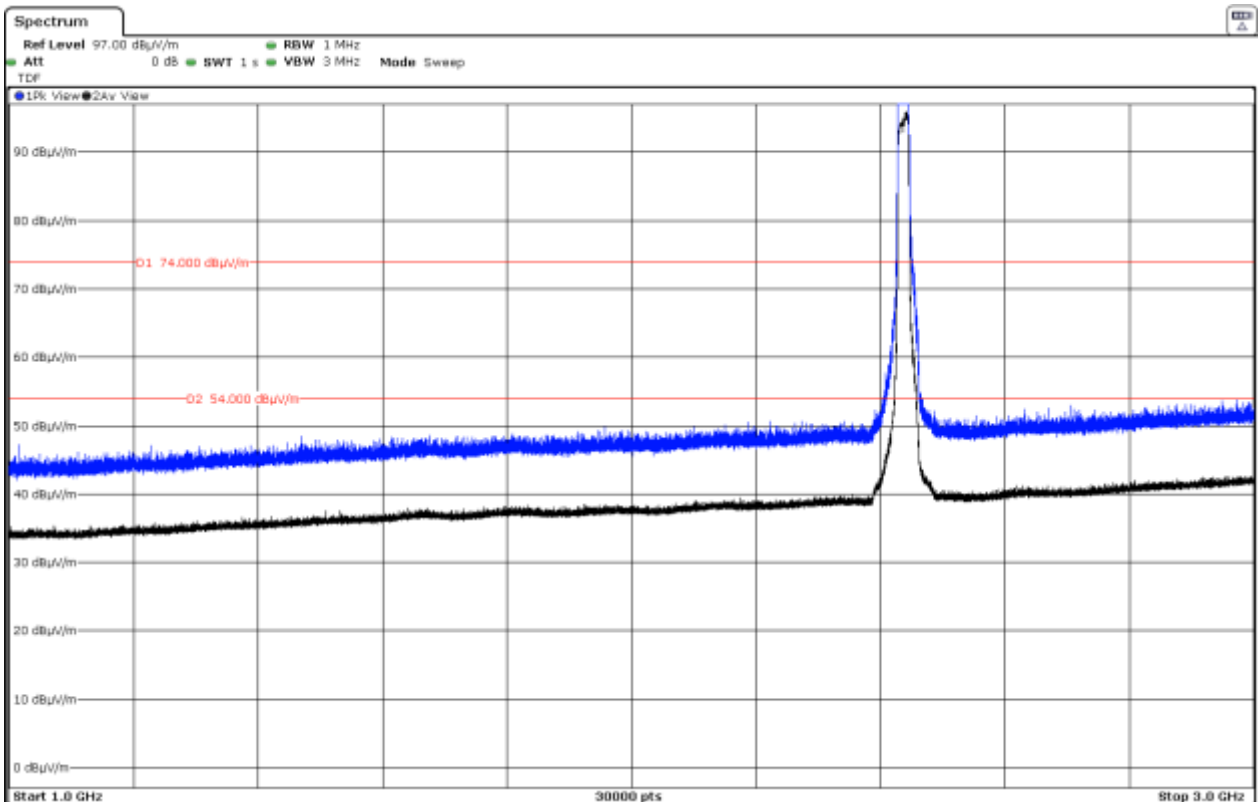
FREQUENCY RANGE 1 - 3 GHz:

- Low Channel:



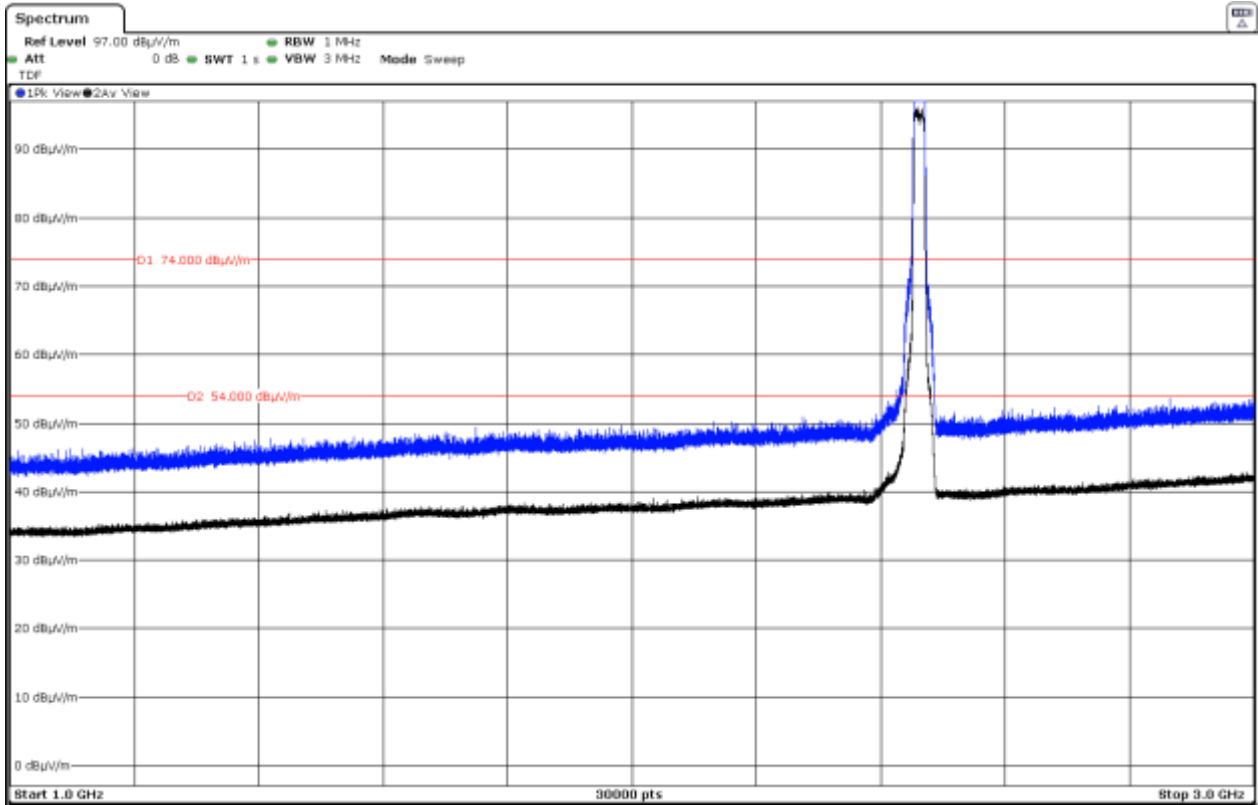
The peak above the limit is the carrier frequency.

- Middle Channel:



The peak above the limit is the carrier frequency.

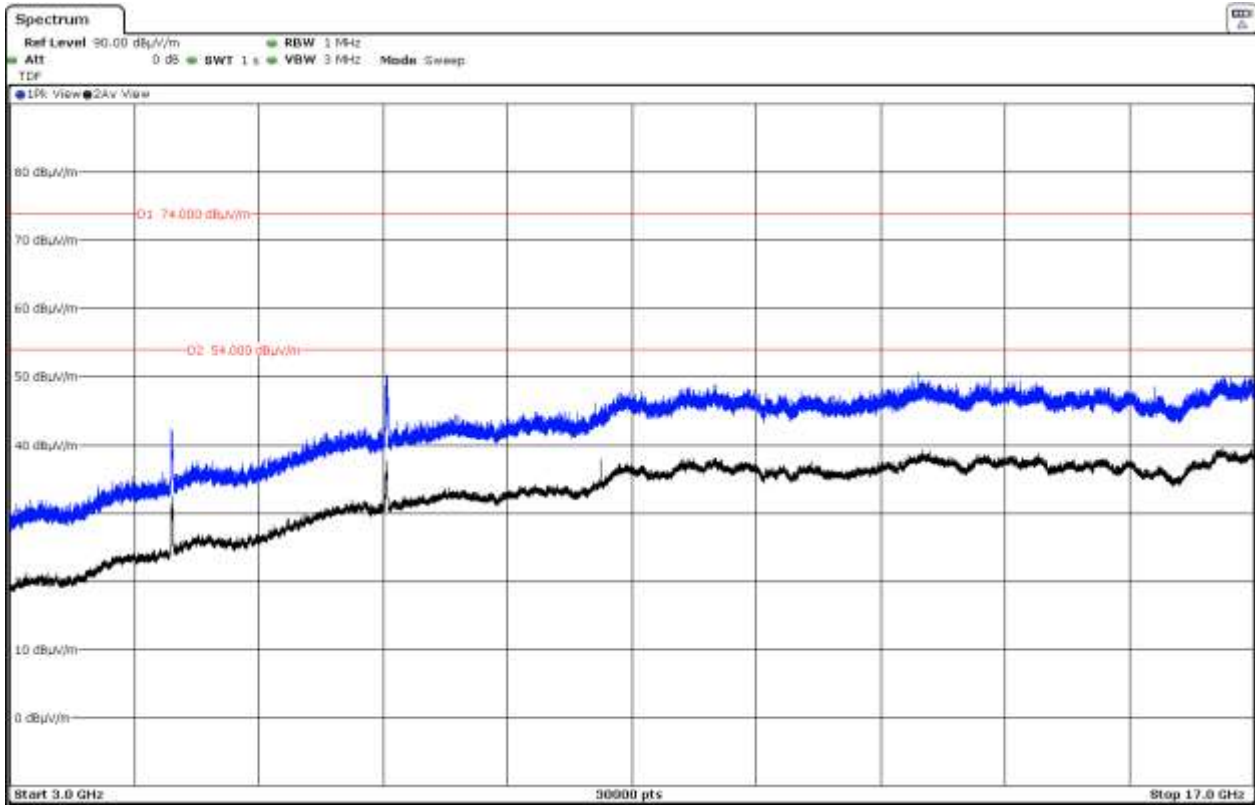
- High Channel:



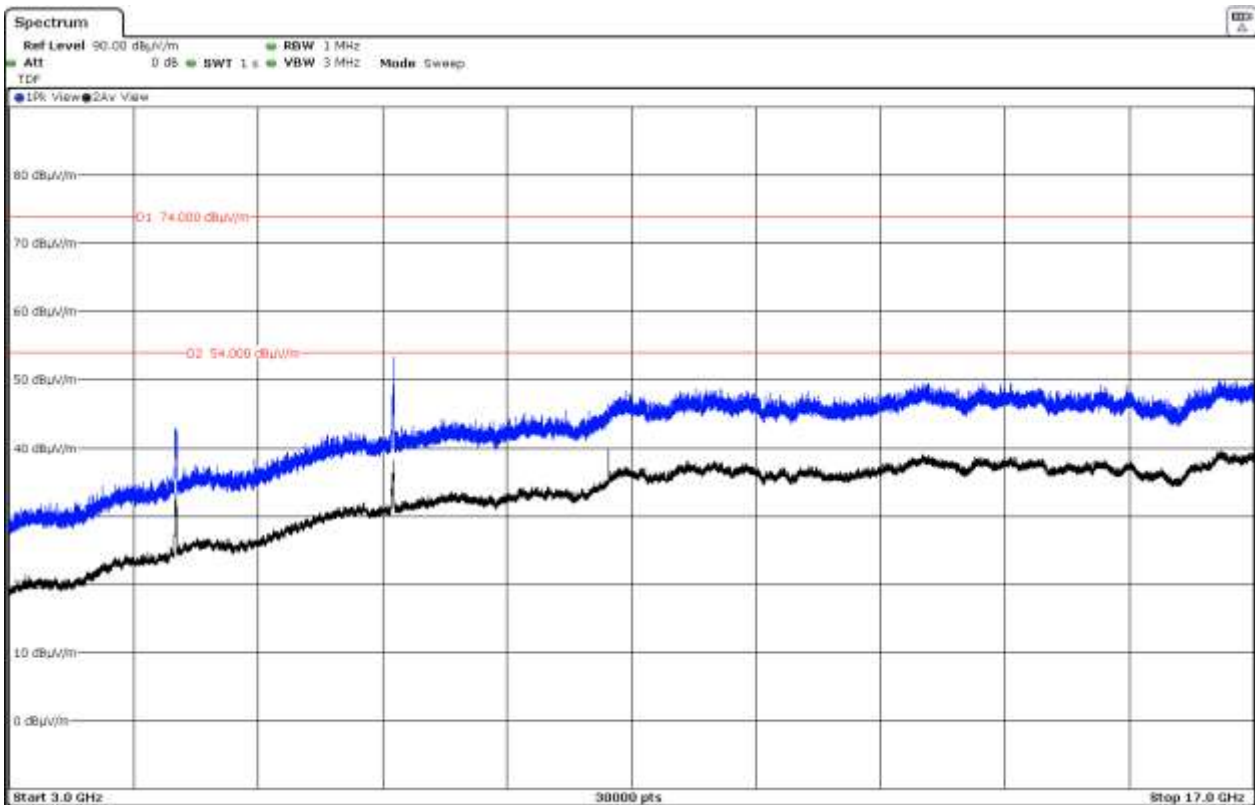
The peak above the limit is the carrier frequency.

FREQUENCY RANGE 3 - 17 GHz:

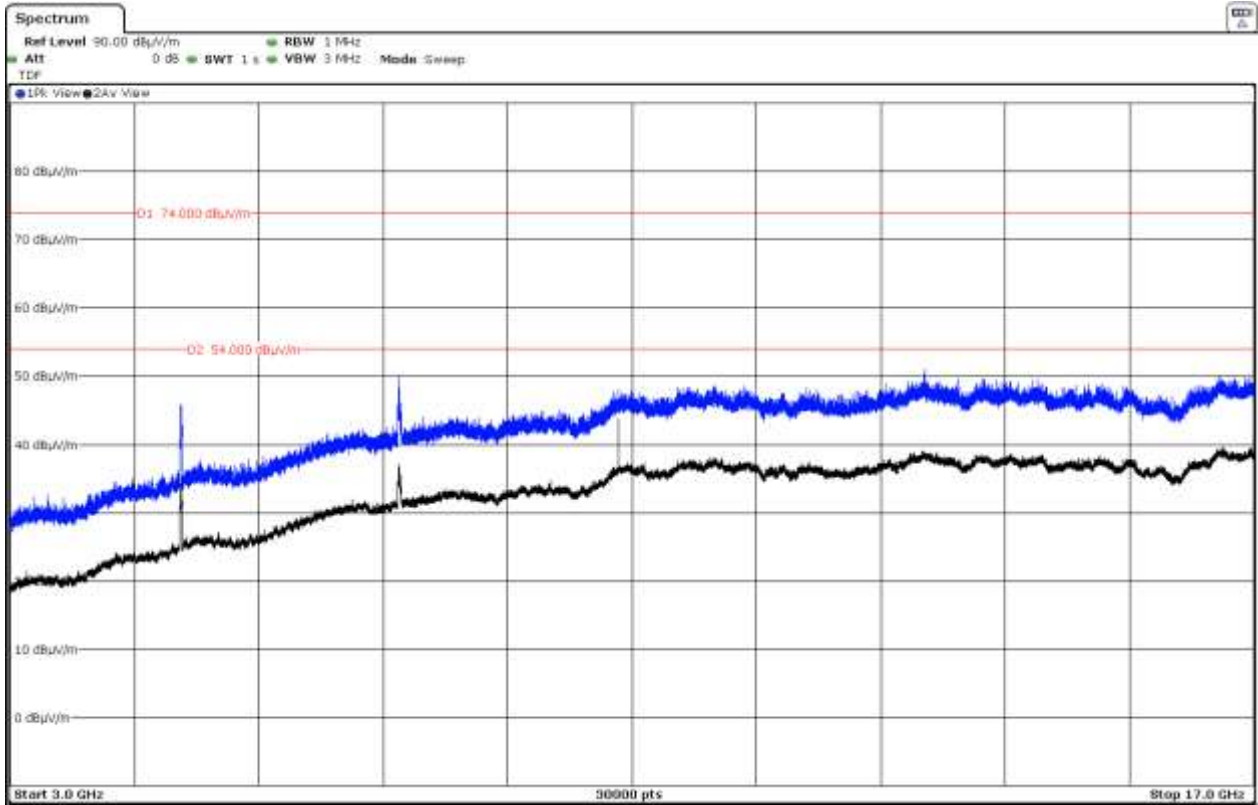
- Low Channel:



- Middle Channel:

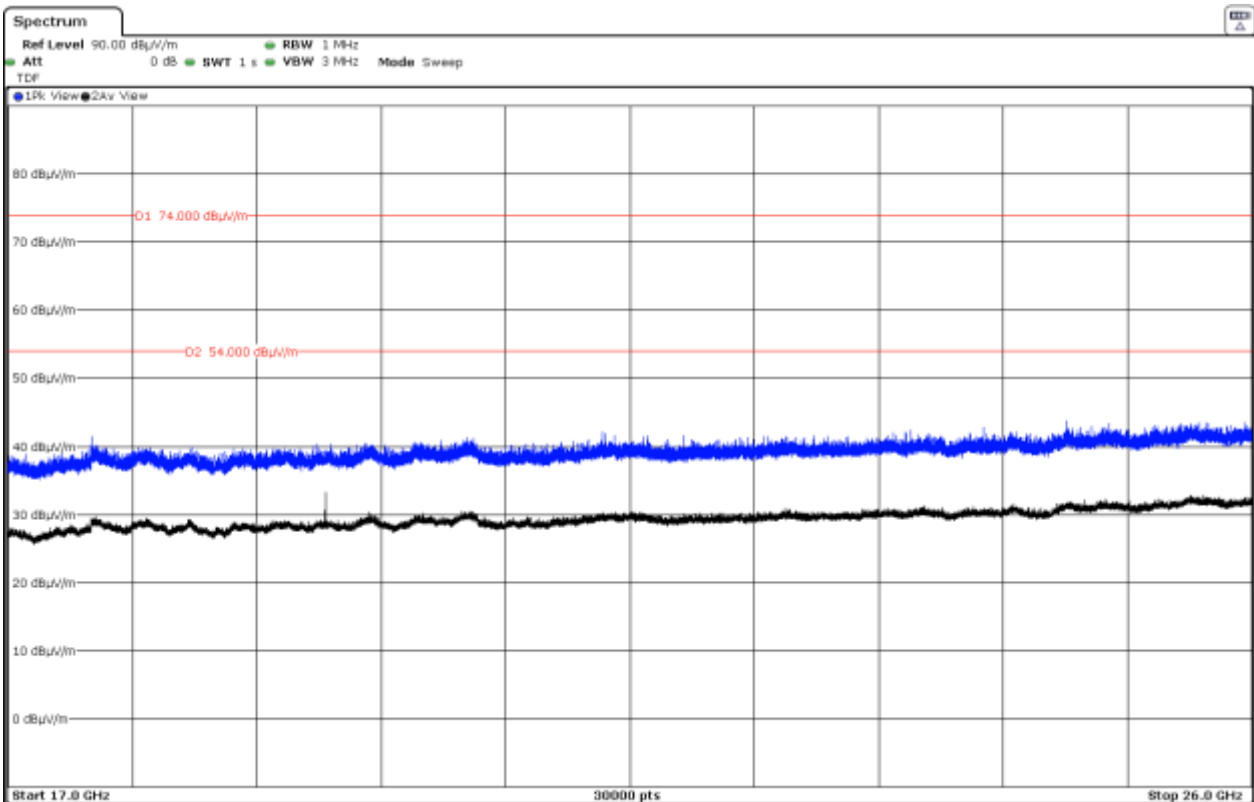


- High Channel:

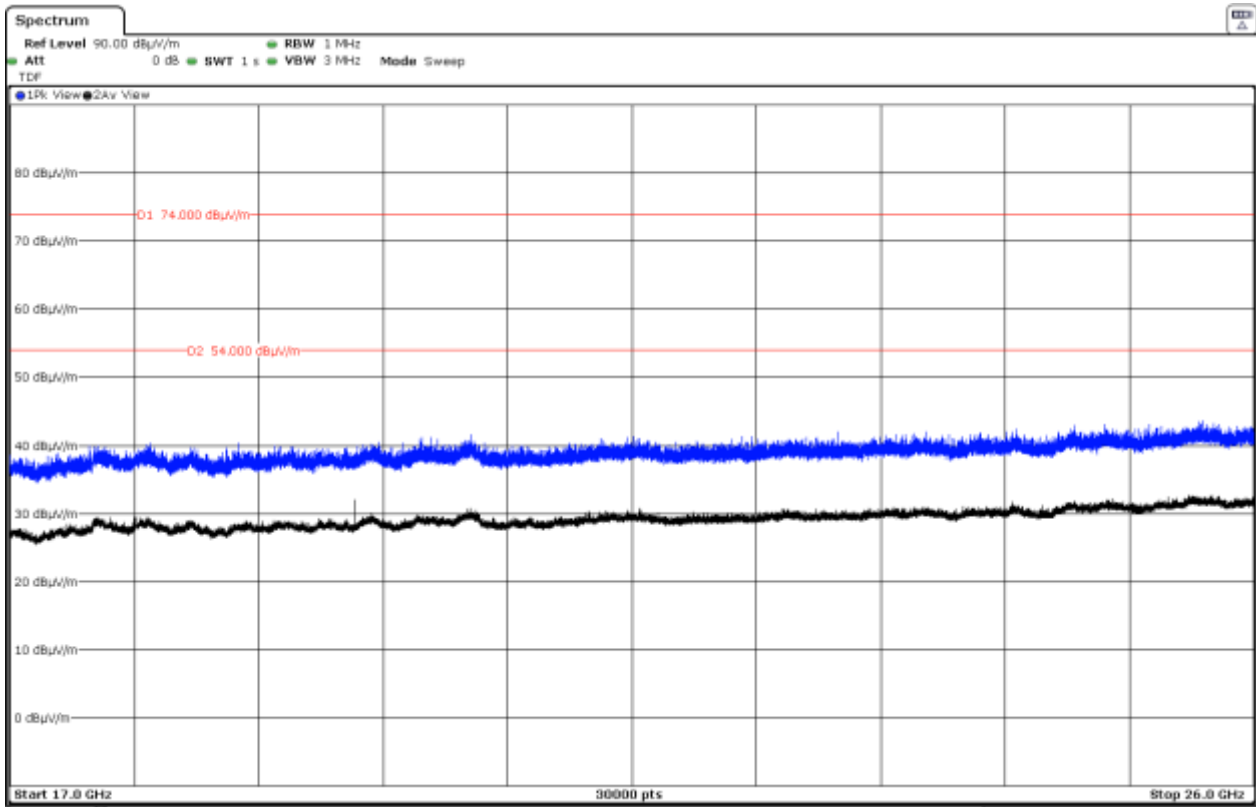


FREQUENCY RANGE 17 - 26 GHz:

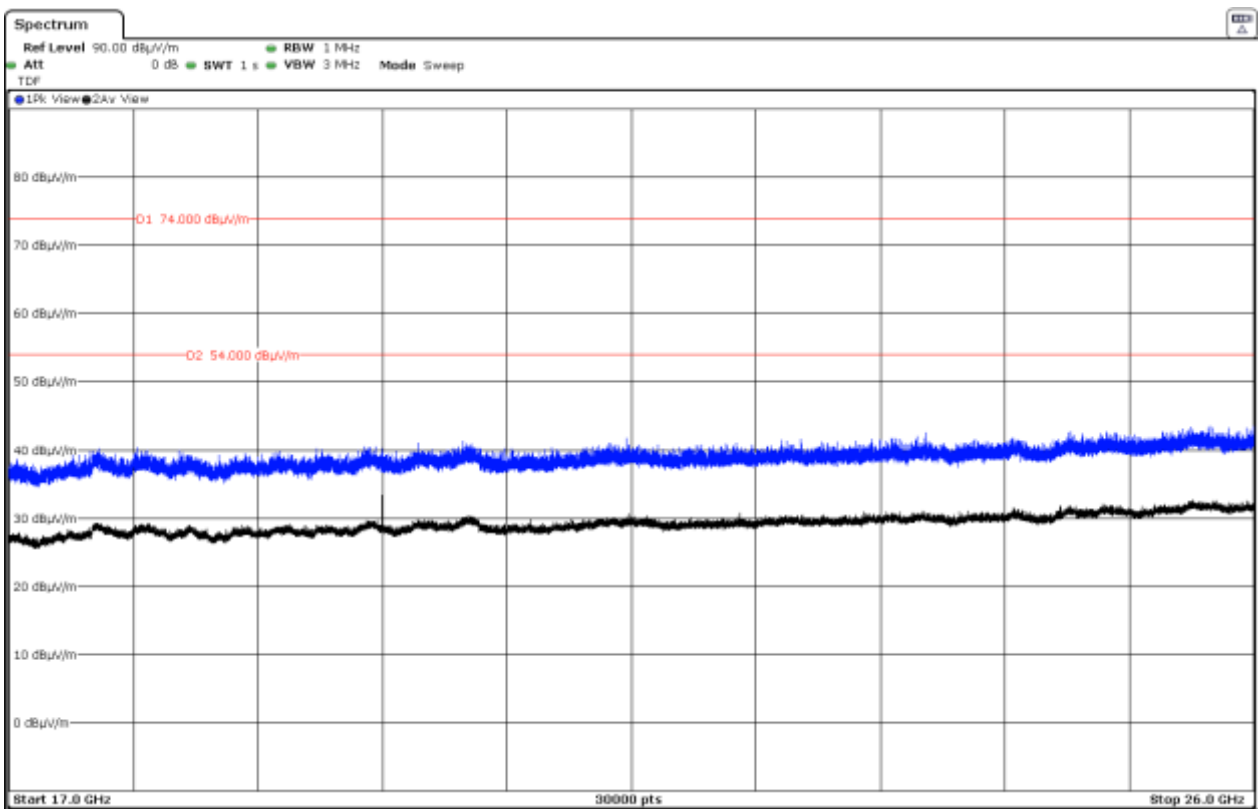
- Low Channel:



- Middle Channel:

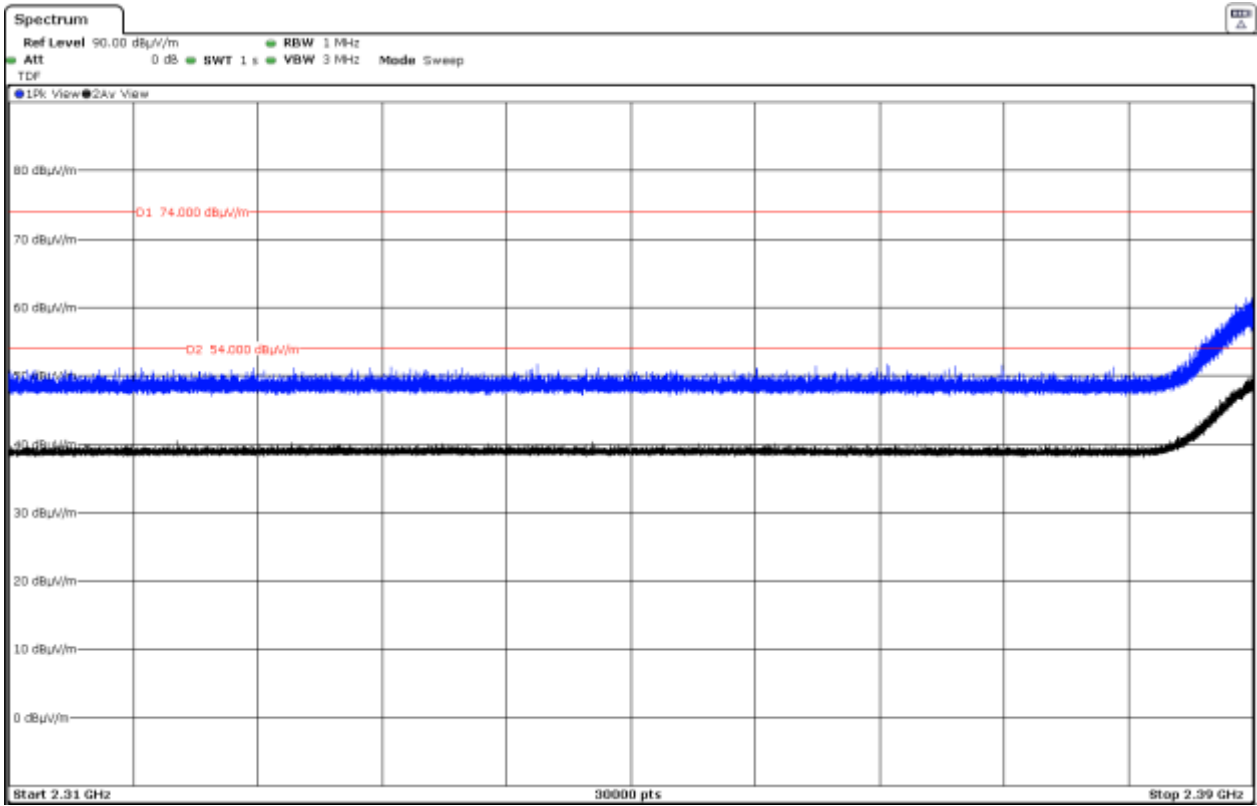


- High Channel:



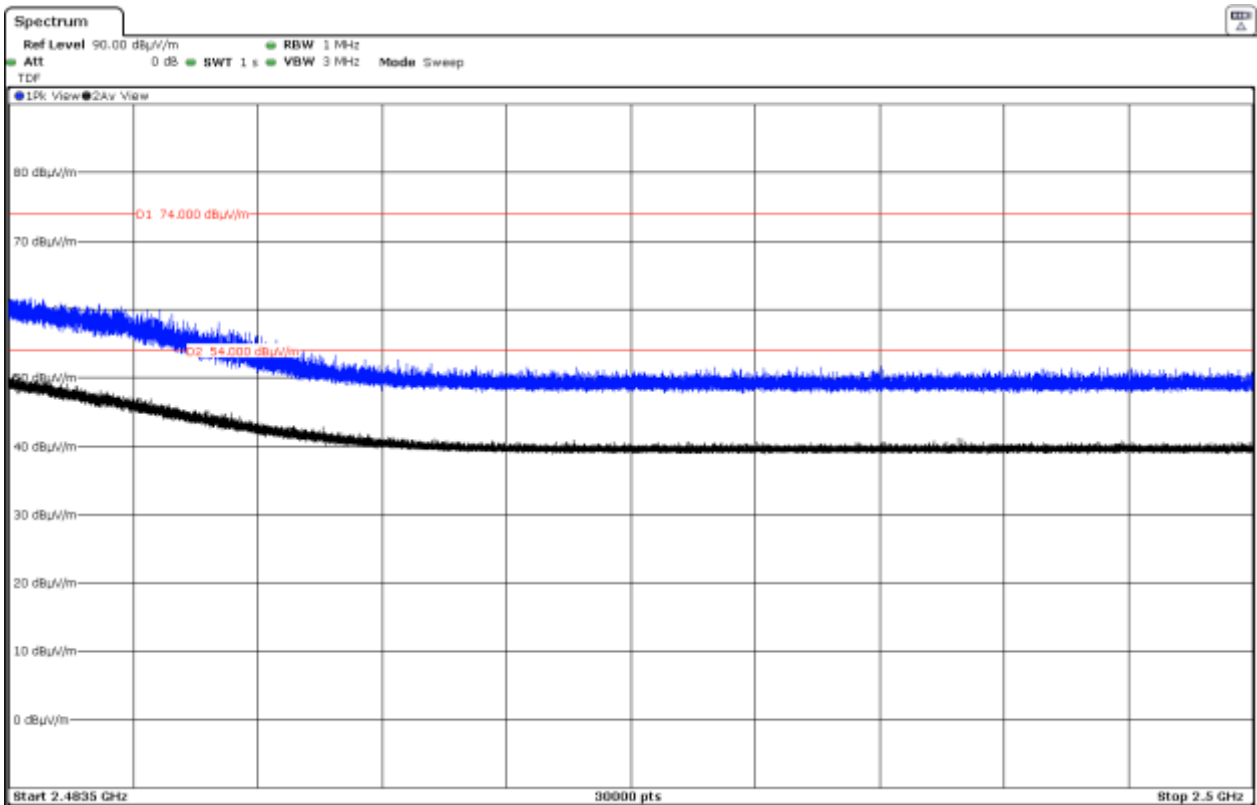
FREQUENCY RANGE 2.31-2.39 GHz: Restricted Band.

- Low Channel.



FREQUENCY RANGE 2.4835-2.5 GHz: Restricted Band.

- High Channel.

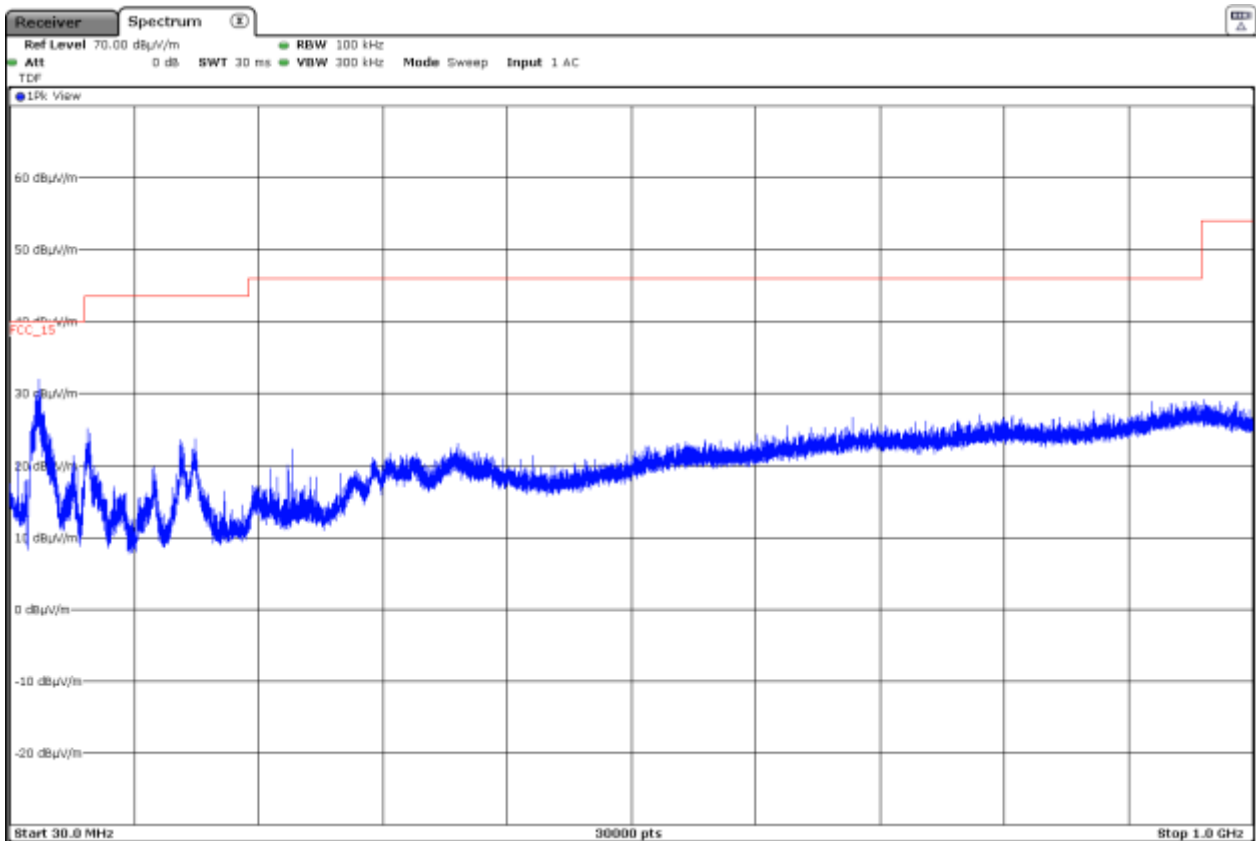


- **802.11 n40 mode:**

FREQUENCY RANGE 30 MHz - 1 GHz:

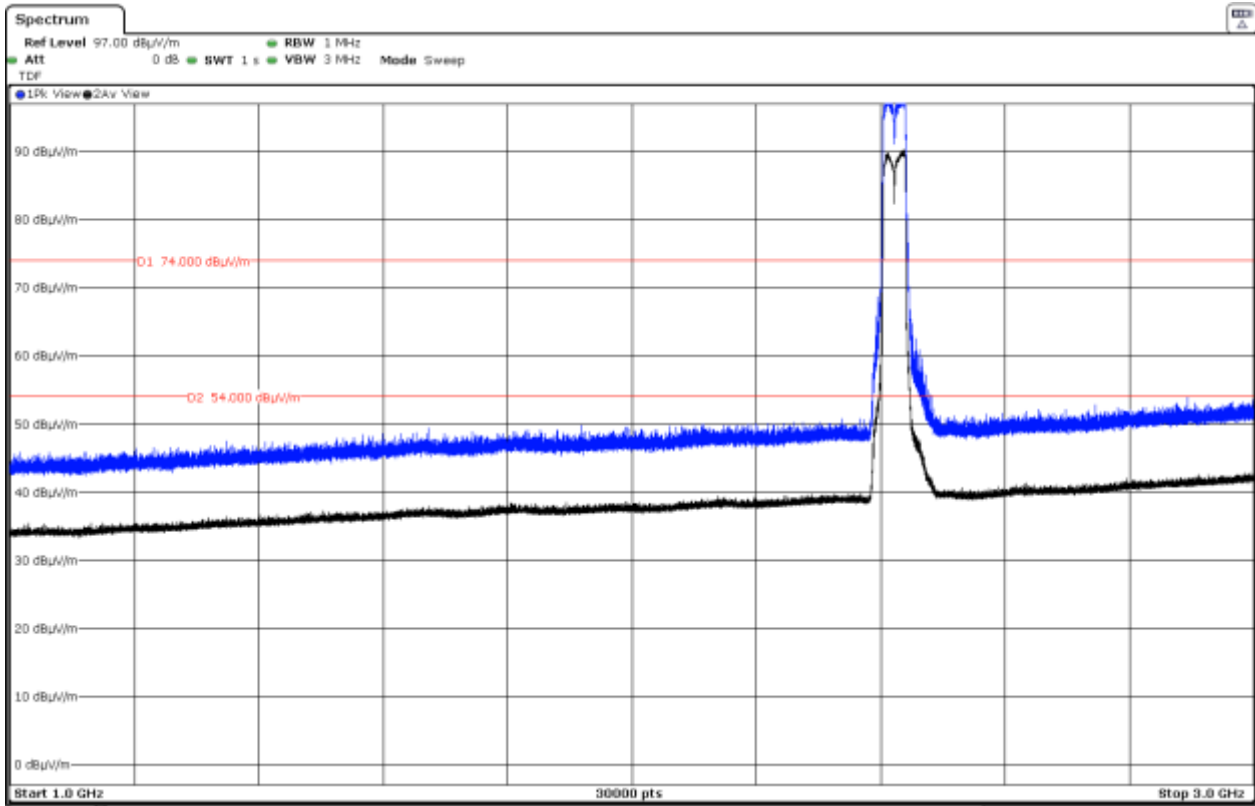
The spurious frequencies detected do not depend on the operating channel.

This plot is valid for the Low. Middle and High Channels.



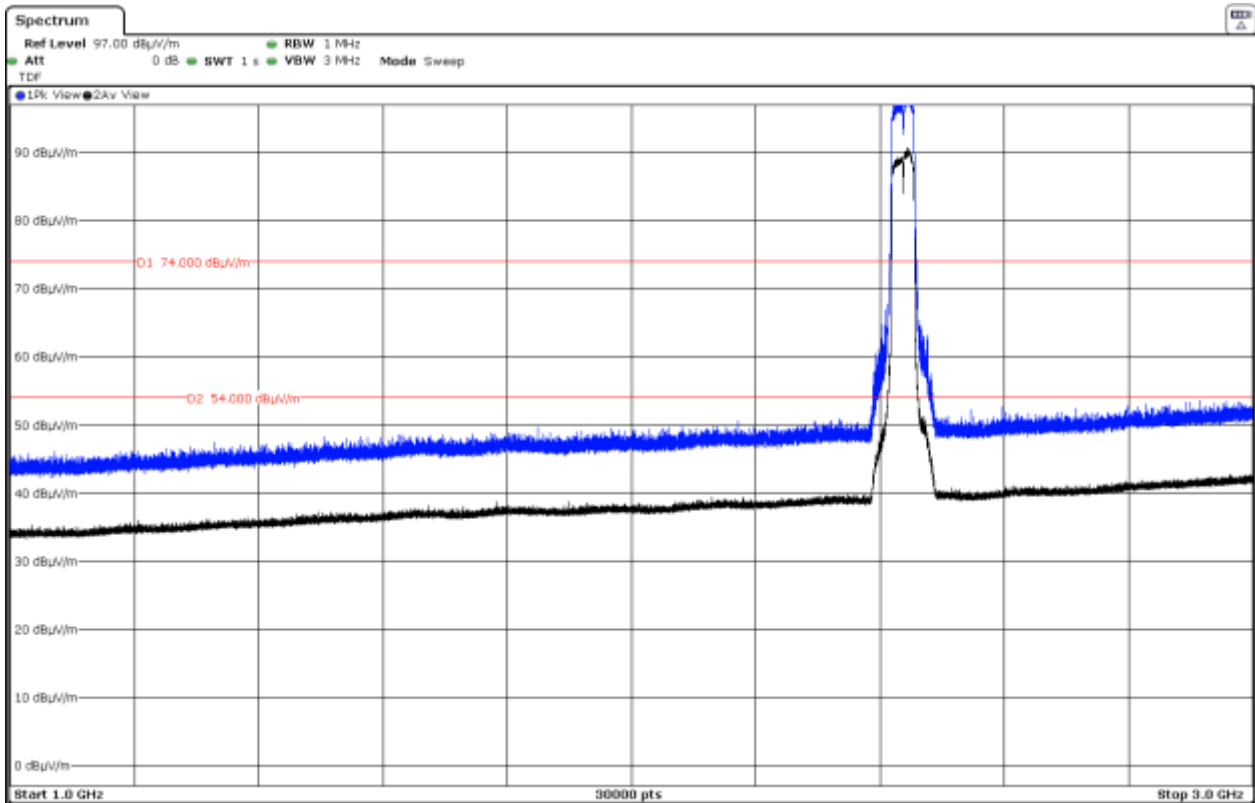
FREQUENCY RANGE 1 - 3 GHz:

- Low Channel:



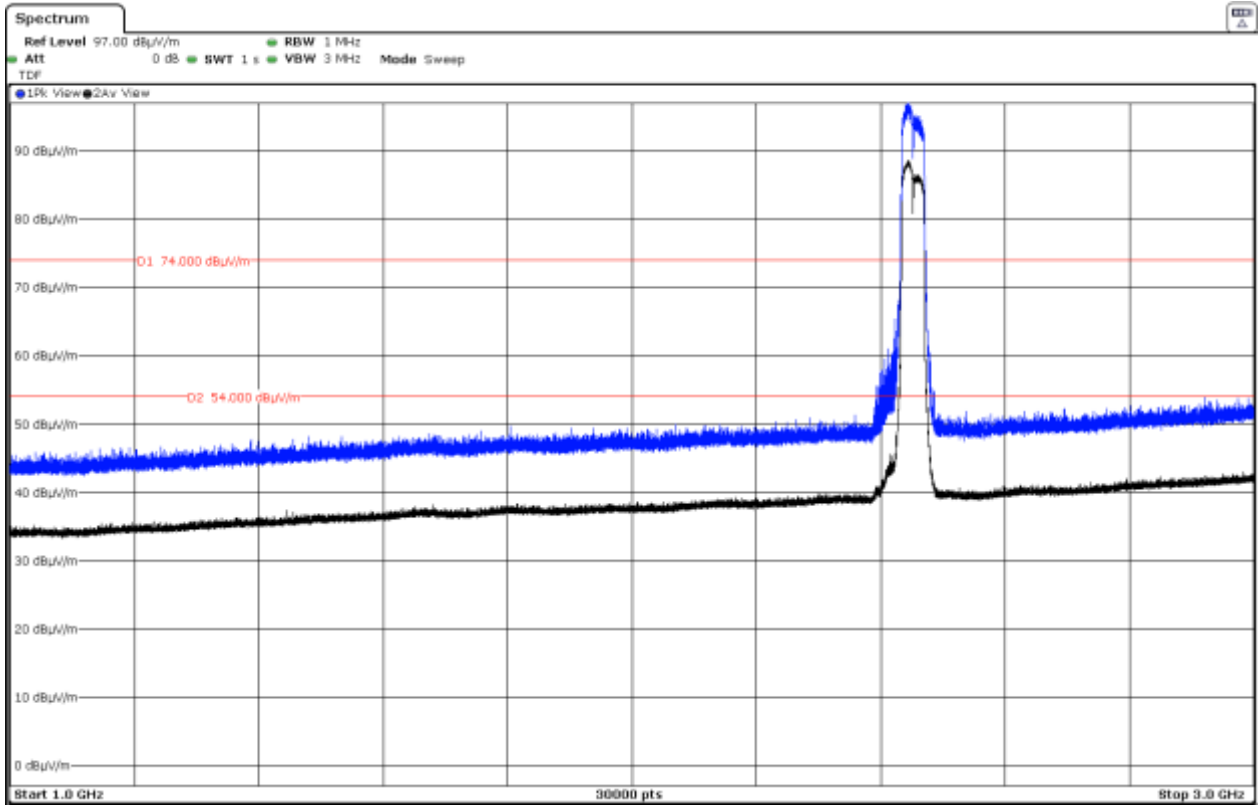
The peak above the limit is the carrier frequency.

- Middle Channel:



The peak above the limit is the carrier frequency.

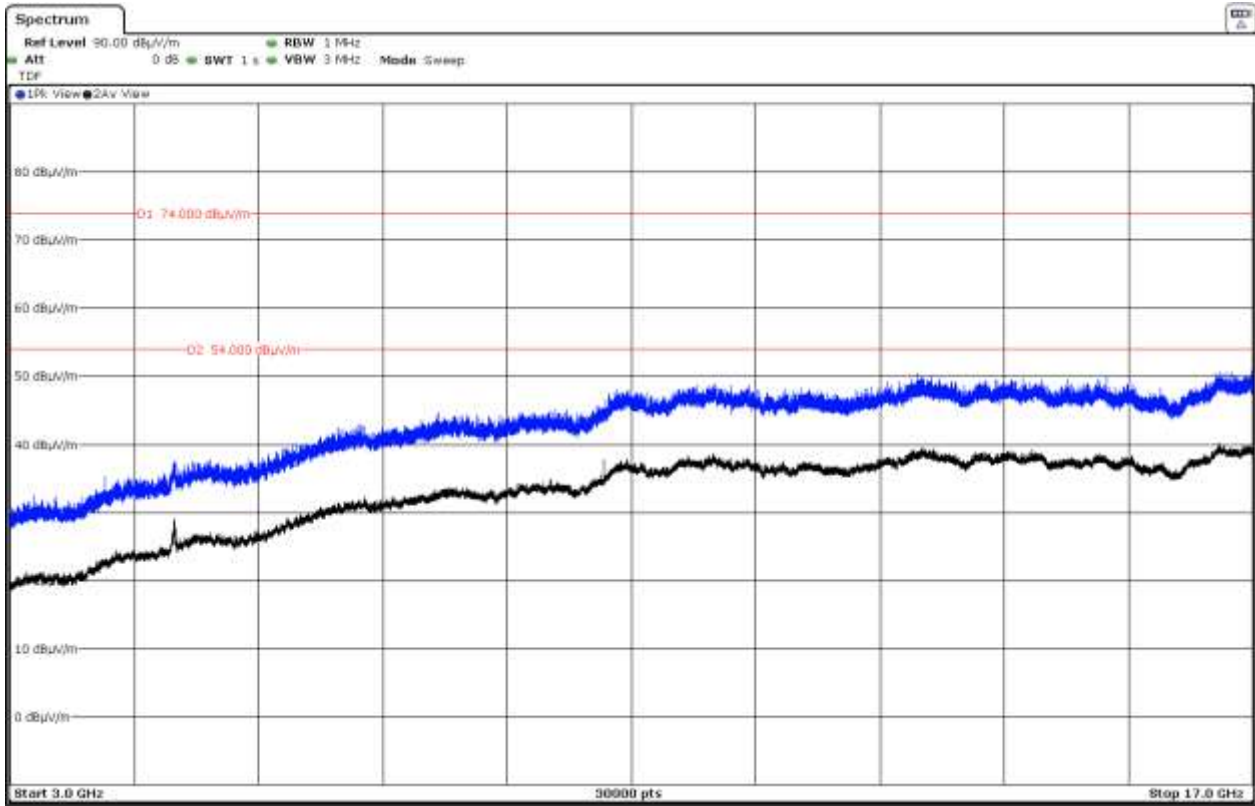
- High Channel:



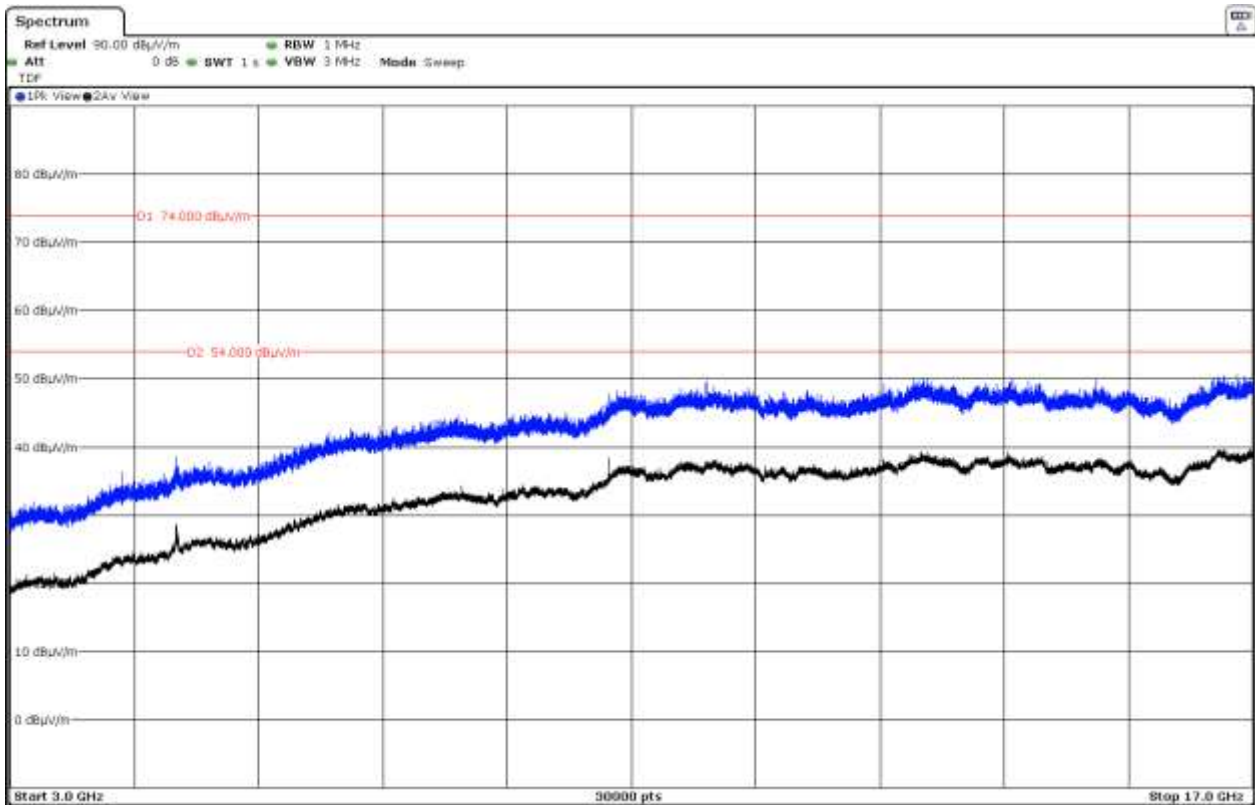
The peak above the limit is the carrier frequency.

FREQUENCY RANGE 3 - 17 GHz:

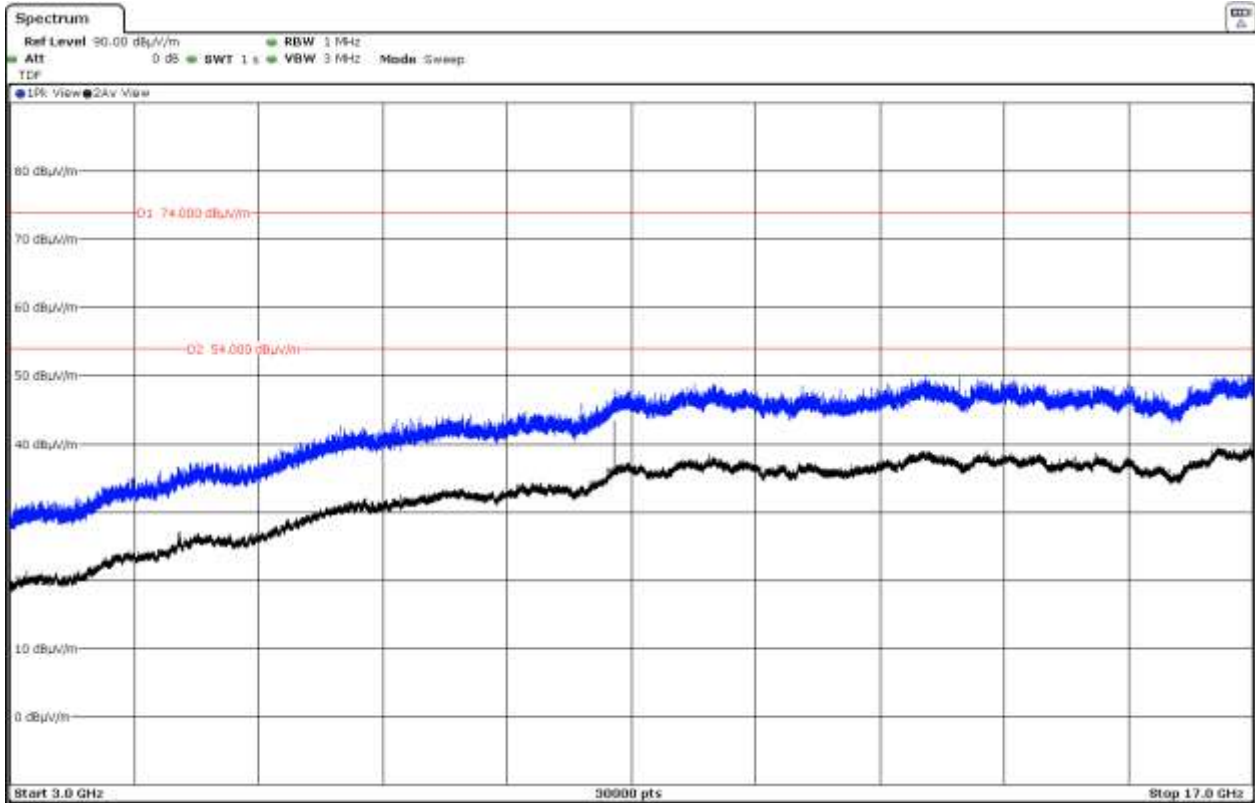
- Low Channel:



- Middle Channel:

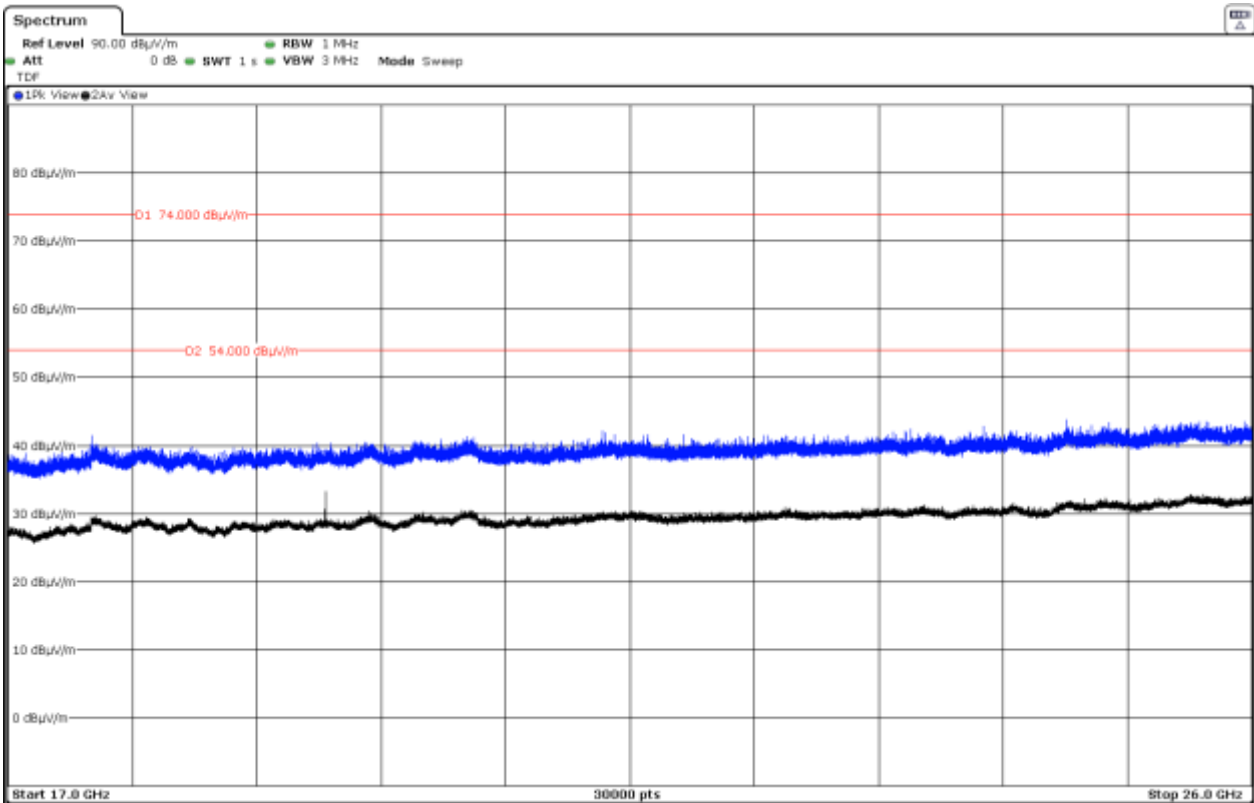


- High Channel:

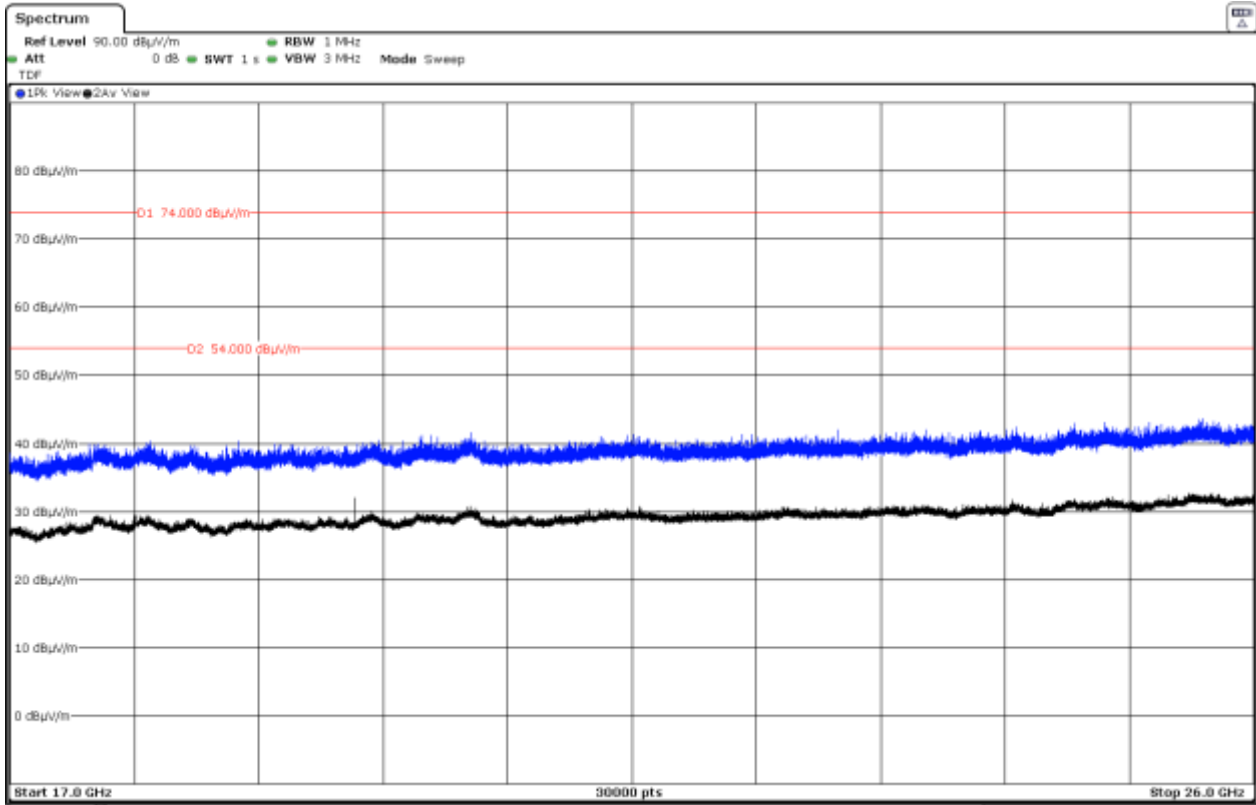


FREQUENCY RANGE 17 - 26 GHz:

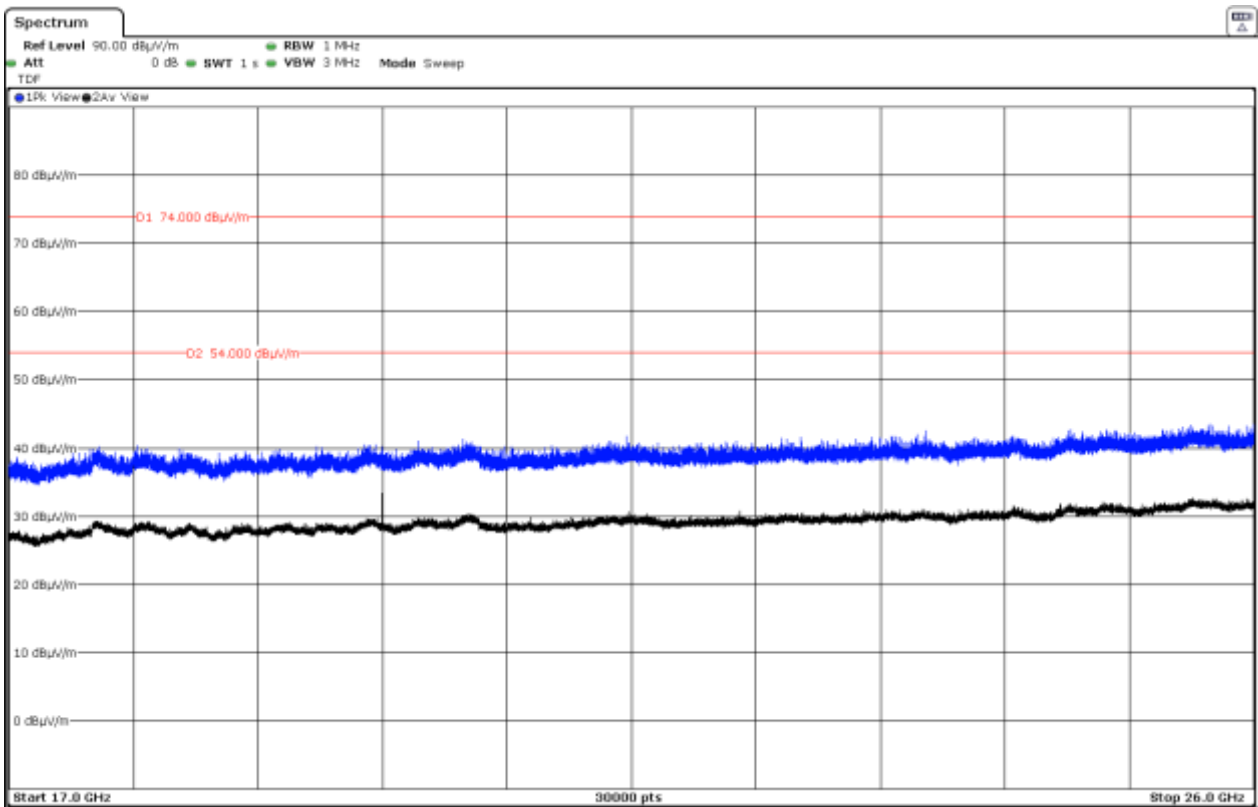
- Low Channel:



- Middle Channel:

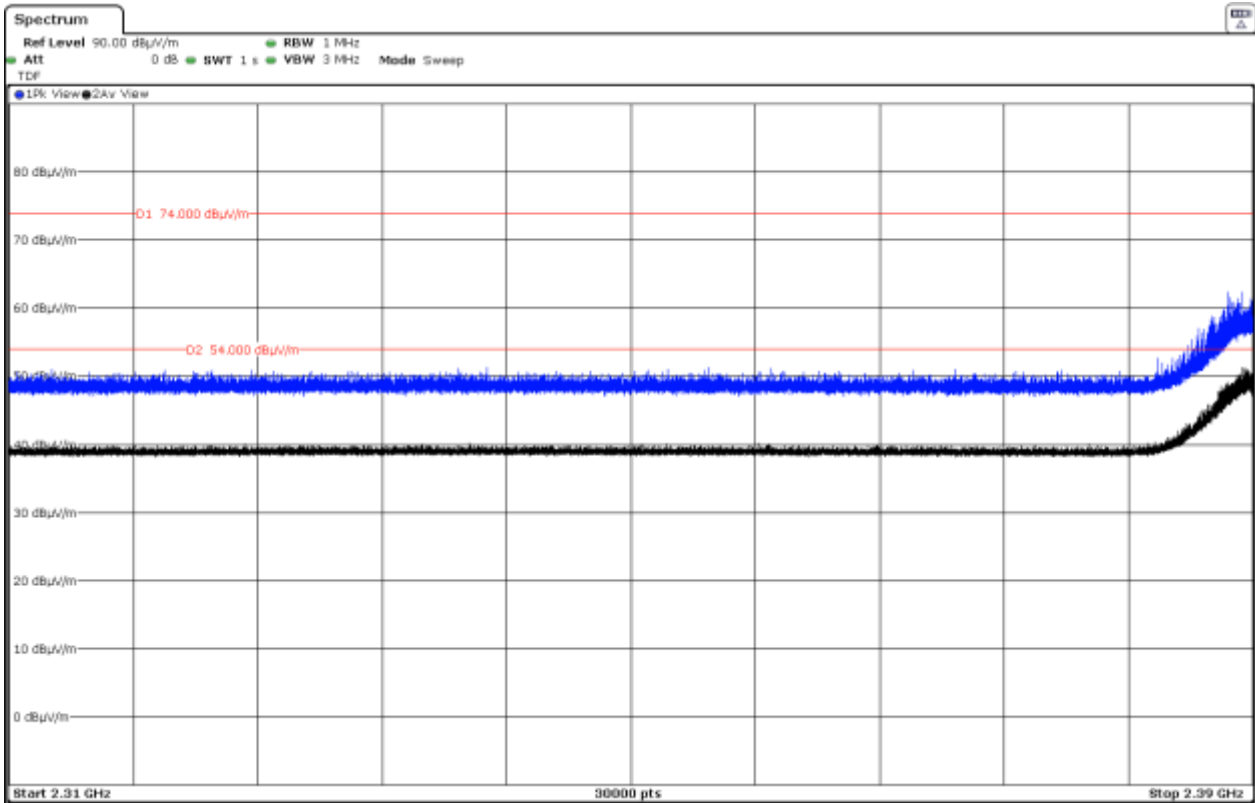


- High Channel:



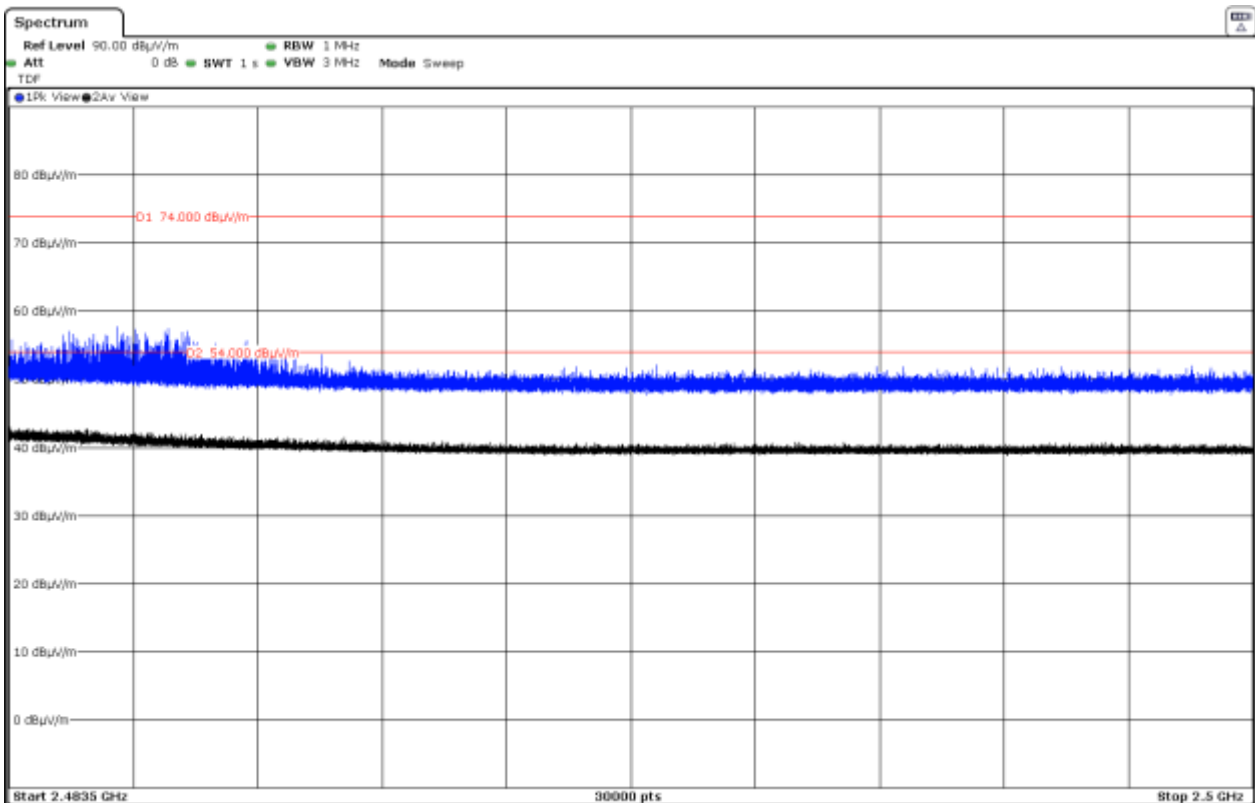
FREQUENCY RANGE 2.31-2.39 GHz: Restricted Band

- Low Channel.



FREQUENCY RANGE 2.4835-2.5 GHz: Restricted Band

- High Channel.



OUTDOOR ANTENNA: Maximum Declared Assembly Antenna Gain: +3.7 dBi (Antenna gain plus antenna cable loss).

DSSS mode:

- **802.11 b mode:**

Frequency range 30 MHz - 1 GHz:

The spurious frequencies detected below 1 GHz do not depend on either the operating channel or the modulation mode selected in the EUT

Spurious frequencies operating at less than 20 dB below the limit:

Spurious frequency (MHz)	Detector	Emission Level (dBµV/m)	Polarization	Measurement Uncertainty (dB)
51.269	Quasi peak	25.7	V	<± 2.07
812.677	Quasi peak	26.7	H	<± 2.07

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 operating at less than 20 dB below the limit:

Spurious frequency (GHz)	Detector	Emission Level (dBµV/m)	Polarization	Measurement Uncertainty (dB)
2.38975	Peak	51.54	V	<±3.70
4.82397	Peak	45.65	V	<± 4.88
7.23523	Peak	49.78	V	<± 4.88
9.64790	Peak	42.98	V	<± 4.88

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

Spurious frequency (GHz)	Detector	Emission Level (dBµV/m)	Polarization	Measurement Uncertainty (dB)
4.8739	Peak	42.12	V	<± 4.88
7.3099	Peak	54.45	V	<± 4.88
	Average	49.87		<± 4.88
9.7482	Peak	39.10	V	<± 4.88

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

Spurious frequency (MHz)	Detector	Emission Level (dBµV/m)	Polarization	Measurement Uncertainty (dB)
2.48396	Peak	56.71	V	<±3.70
	Average	49.33		<±3.70
4.92383	Peak	47.23	V	<± 4.88
7.38690	Peak	57.88	V	<± 4.88
	Average	53.06		<± 4.88
9.8481	Peak	50.65	V	<± 4.88
12.3112	Peak	45.12	V	<± 4.88
17.23295	Peak	45.11	V	<± 4.88
19.69625	Peak	43.07	V	<± 4.88

Verdict: PASS

OFDM modes:

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

Frequency range 30 MHz - 1 GHz:

The spurious frequencies detected below 1 GHz do not depend on either the operating channel.

Spurious frequencies operating at less than 20 dB below the limit:

Spurious frequency (MHz)	Detector	Emission Level (dBµV/m)	Polarization	Measurement Uncertainty (dB)
52.262	Quasi peak	25.3	V	<± 2.07

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 operating at less than 20 dB below the limit:

Spurious frequency (GHz)	Detector	Emission Level (dBµV/m)	Polarization	Measurement Uncertainty (dB)
2.38999	Peak	54.97	V	<± 3.70
	Average	44.05		<± 3.70
7.24317	Peak	53.44	V	<± 4.88
9.64790	Peak	44.93	V	<± 4.88

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

Spurious frequency (GHz)	Detector	Emission Level (dBµV/m)	Polarization	Measurement Uncertainty (dB)
7.29917	Peak	57.06	H	<± 4.88
	Average	44.88		<± 4.88
9.74769	Peak	48.25	V	<± 4.88

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

Spurious frequency (MHz)	Detector	Emission Level (dBµV/m)	Polarization	Measurement Uncertainty (dB)
2.48371 (*)	Peak	69.71	V	<± 3.70
	Average	53.29		<± 3.70
7.39203	Peak	62.48	H	<± 4.88
	Average	51.10		<± 4.88
9.84857	Peak	52.01	V	<± 4.88

(*) For emissions in restricted band, the integration method was used according to ANSI C63.10-2013 Section 11.13.3.

Verdict: PASS

- **802.11 n20 mode:**

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 dB μ V/m at 3 m) are measured with average detector for checking compliance with the average limit.

- RESTRICTED BAND 2.31 - 2.39 GHz. Spurious frequencies operating at less than 20 dB below the limit:

LOW CHANNEL:

Spurious frequency (GHz)	Detector	Emission Level (dB μ V/m)	Polarization	Measurement Uncertainty (dB)
2.389972	Peak	56.4	V	< \pm 3.70
	Average	43.52		< \pm 3.70

- RESTRICTED BAND 2.4835 - 2.5 GHz. Spurious frequencies operating at less than 20 dB below the limit:

HIGH CHANNEL:

Spurious frequency (GHz)	Detector	Emission Level (dB μ V/m)	Polarization	Measurement Uncertainty (dB)
2.48367188	Peak	67.82	V	< \pm 3.70
	Average	53.45		< \pm 3.70

(*) For emissions in restricted band, the integration method was used according to ANSI C63.10-2013 Section 11.13.3.

Verdict: PASS

- **802.11 n40 mode:**

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 dB μ V/m at 3 m) are measured with average detector for checking compliance with the average limit.

- RESTRICTED BAND 2.31 - 2.39 GHz. Spurious frequencies operating at less than 20 dB below the limit:

LOW CHANNEL:

Spurious frequency (GHz)	Detector	Emission Level (dB μ V/m)	Polarization	Measurement Uncertainty (dB)
2.3898333	Peak	59.77	V	< \pm 3.70
	Average	51		< \pm 3.70

- RESTRICTED BAND 2.4835 - 2.5 GHz. Spurious frequencies operating at less than 20 dB below the limit:

HIGH CHANNEL:

Spurious frequency (GHz)	Detector	Emission Level (dB μ V/m)	Polarization	Measurement Uncertainty (dB)
2.48367353 (*)	Peak	65.14	V	< \pm 3.70
	Average	50.53		< \pm 3.70

(*) For emissions in restricted band, the integration method was used according to ANSI C63.10-2013 Section 11.13.3.

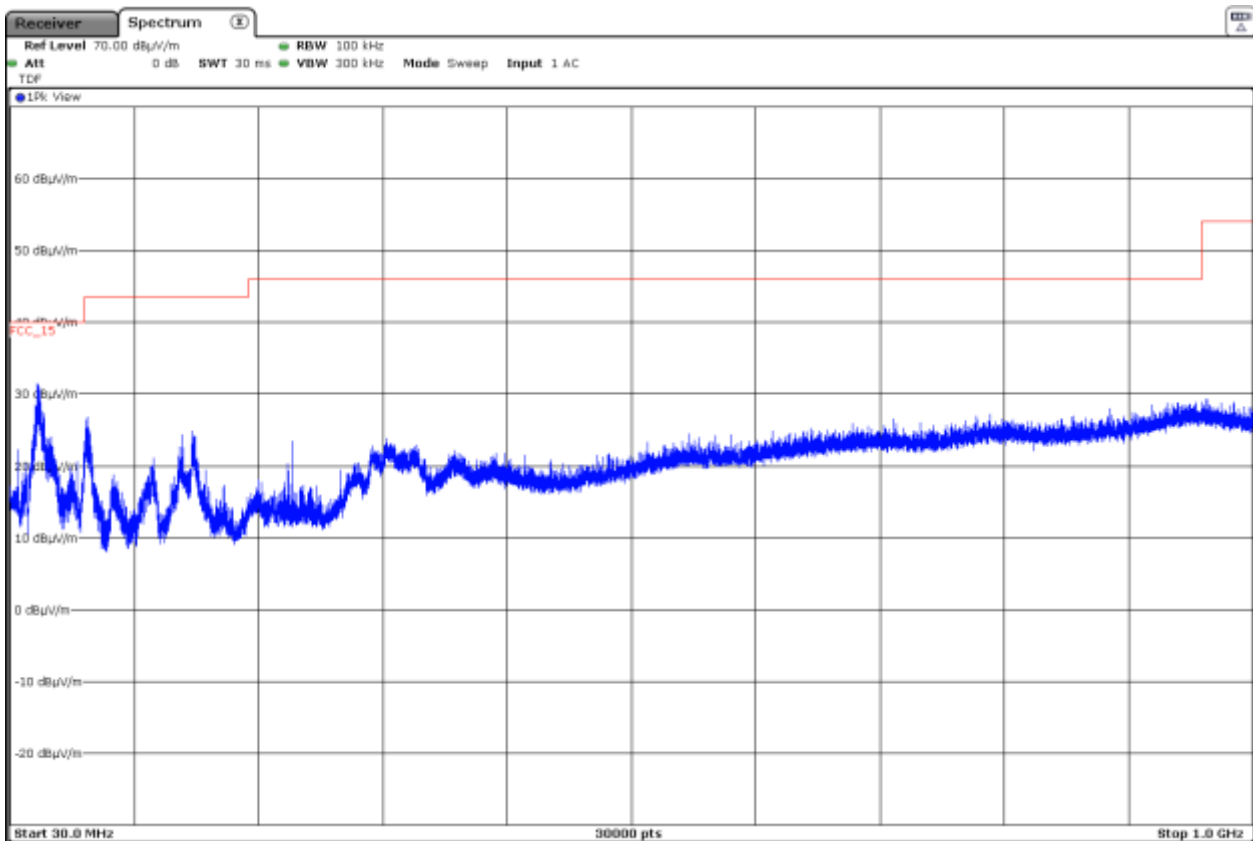
Verdict: PASS

- **802.11 b mode:**

FREQUENCY RANGE 30 MHz - 1 GHz:

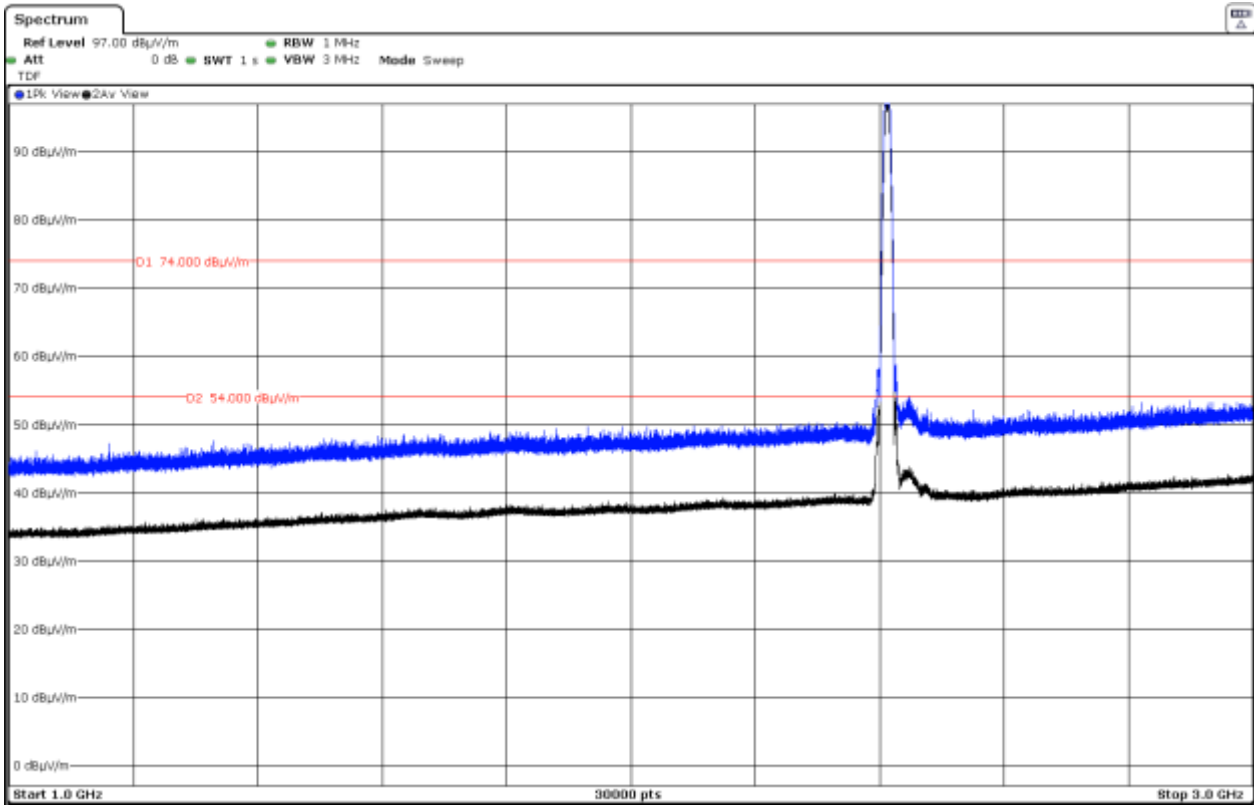
The spurious frequencies detected do not depend on the operating channel.

This plot is valid for the Low, Middle and High Channels.



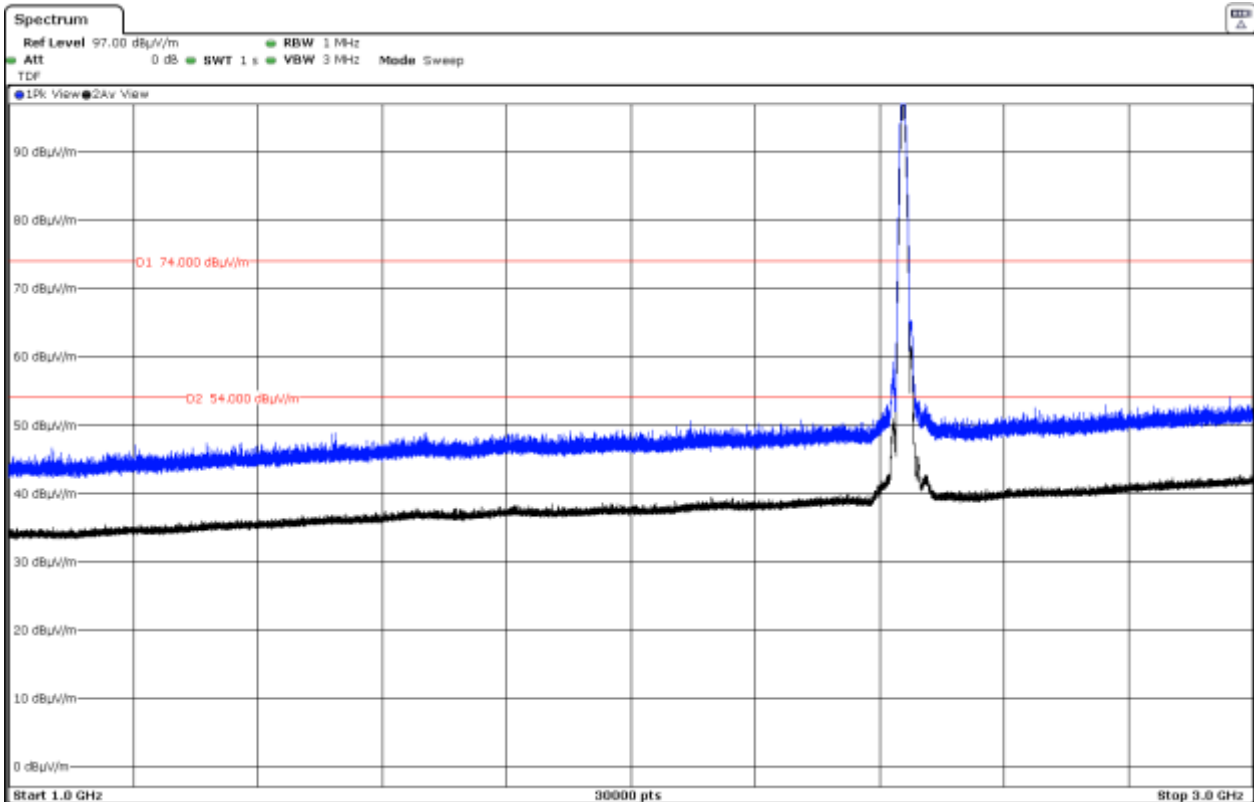
FREQUENCY RANGE 1 - 3 GHz:

- Low Channel:



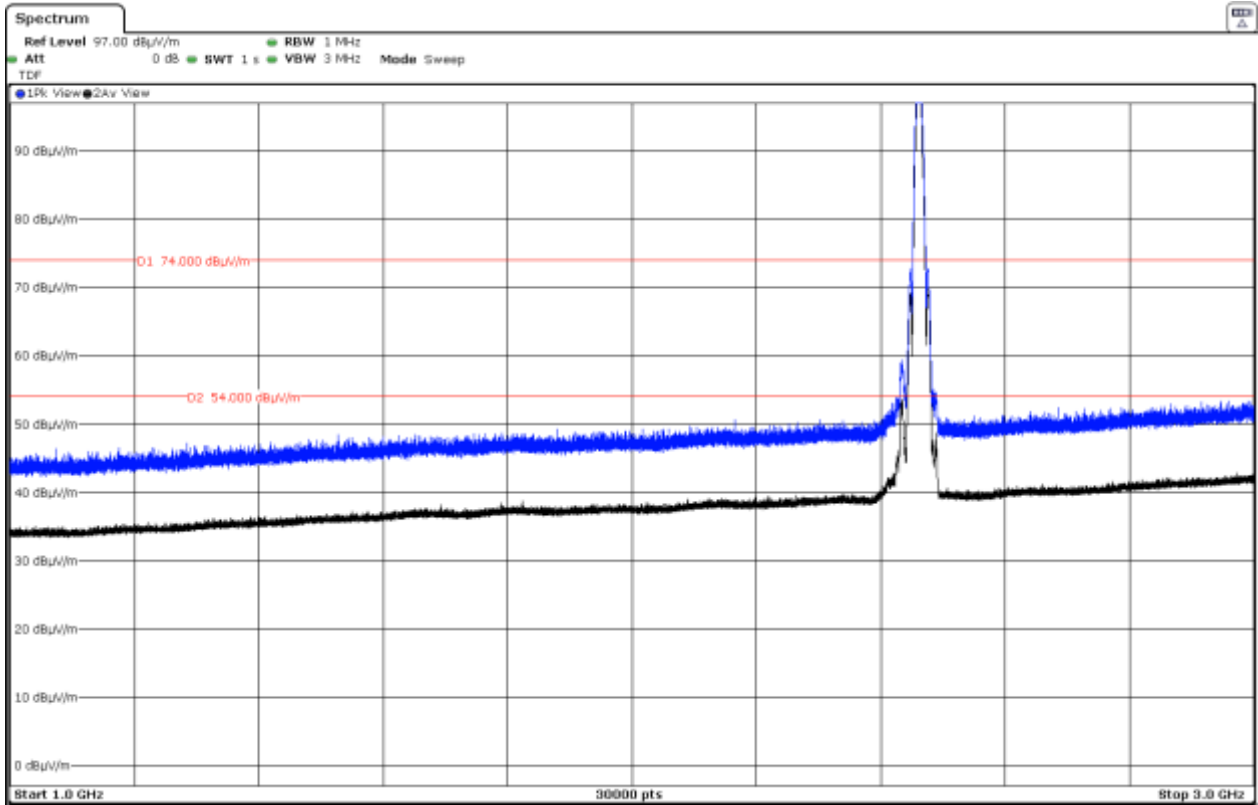
The peak above the limit is the carrier frequency.

- Middle Channel:



The peak above the limit is the carrier frequency.

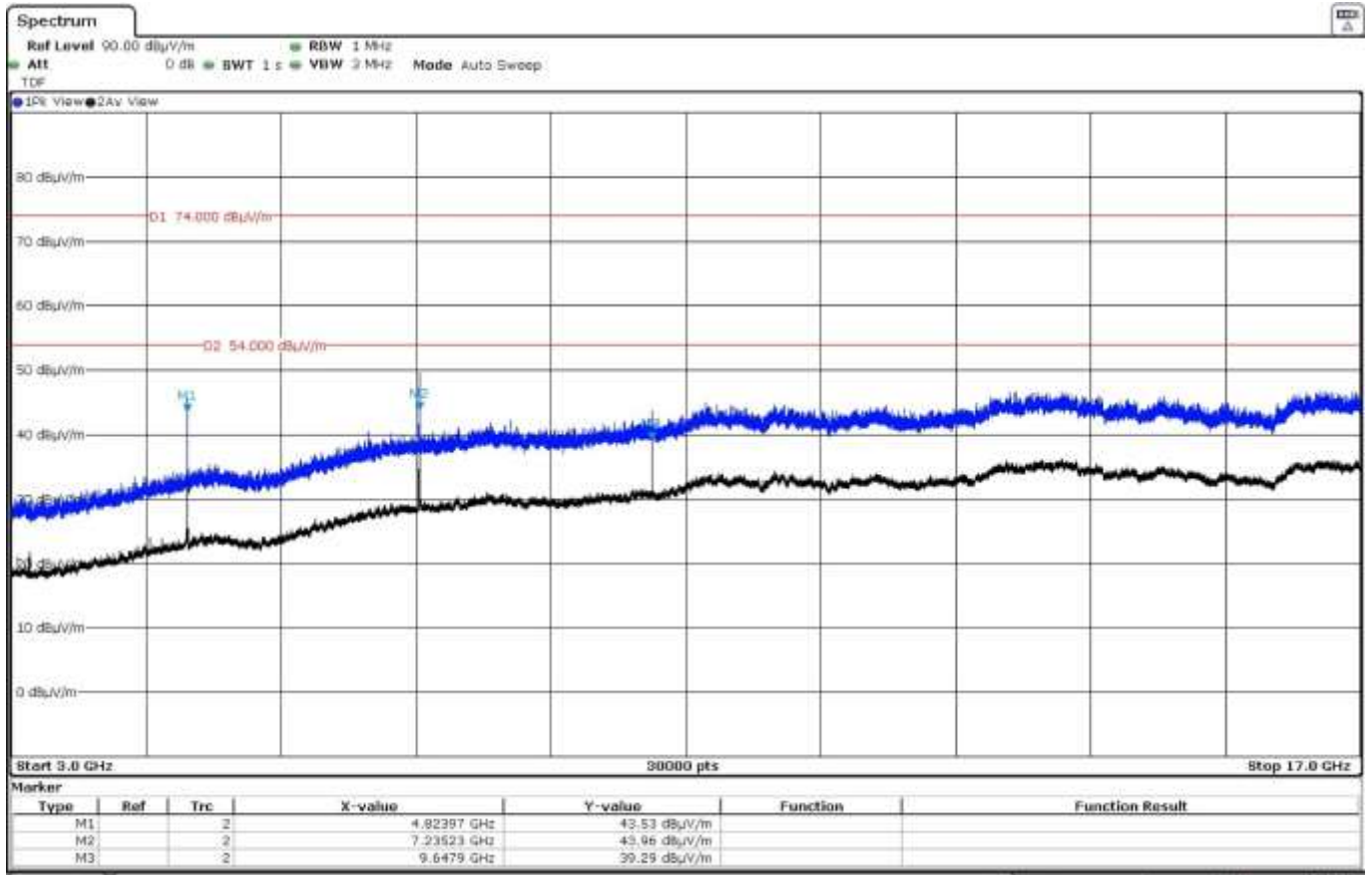
- High Channel:



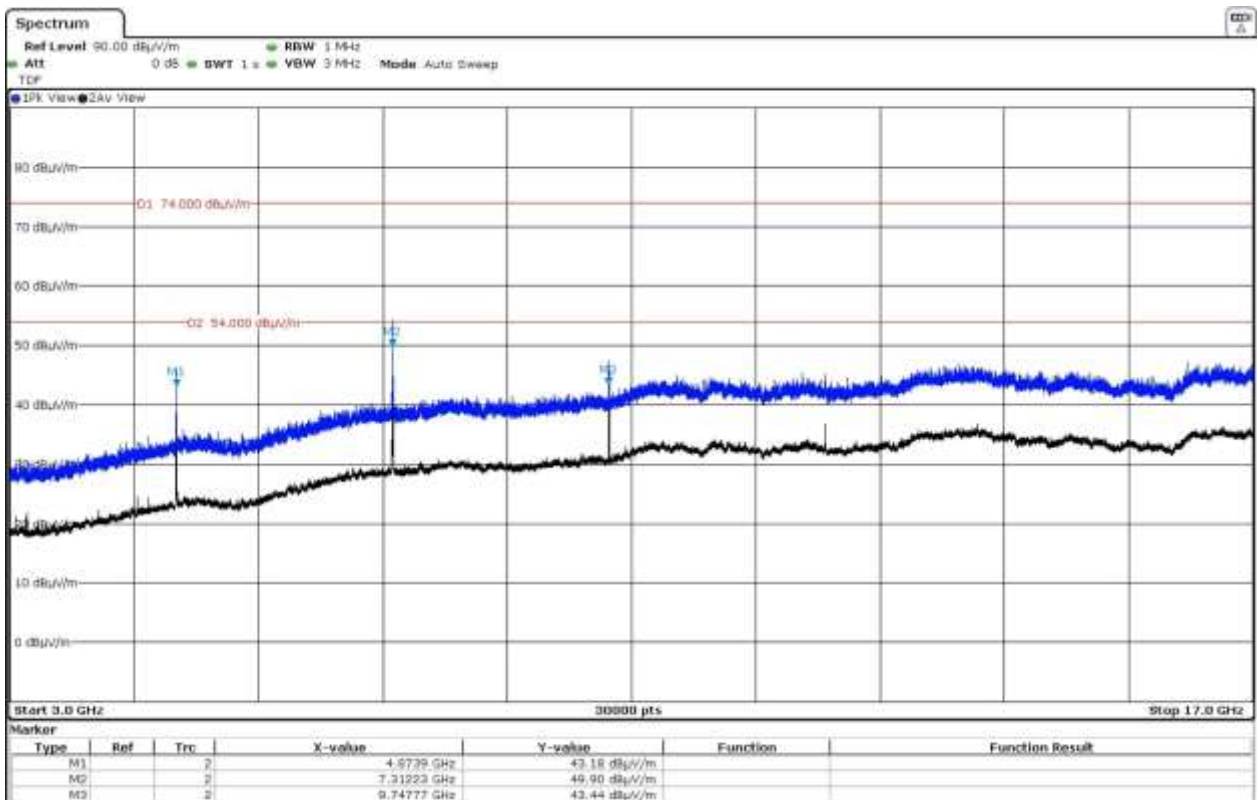
The peak above the limit is the carrier frequency.

FREQUENCY RANGE 3 - 17 GHz:

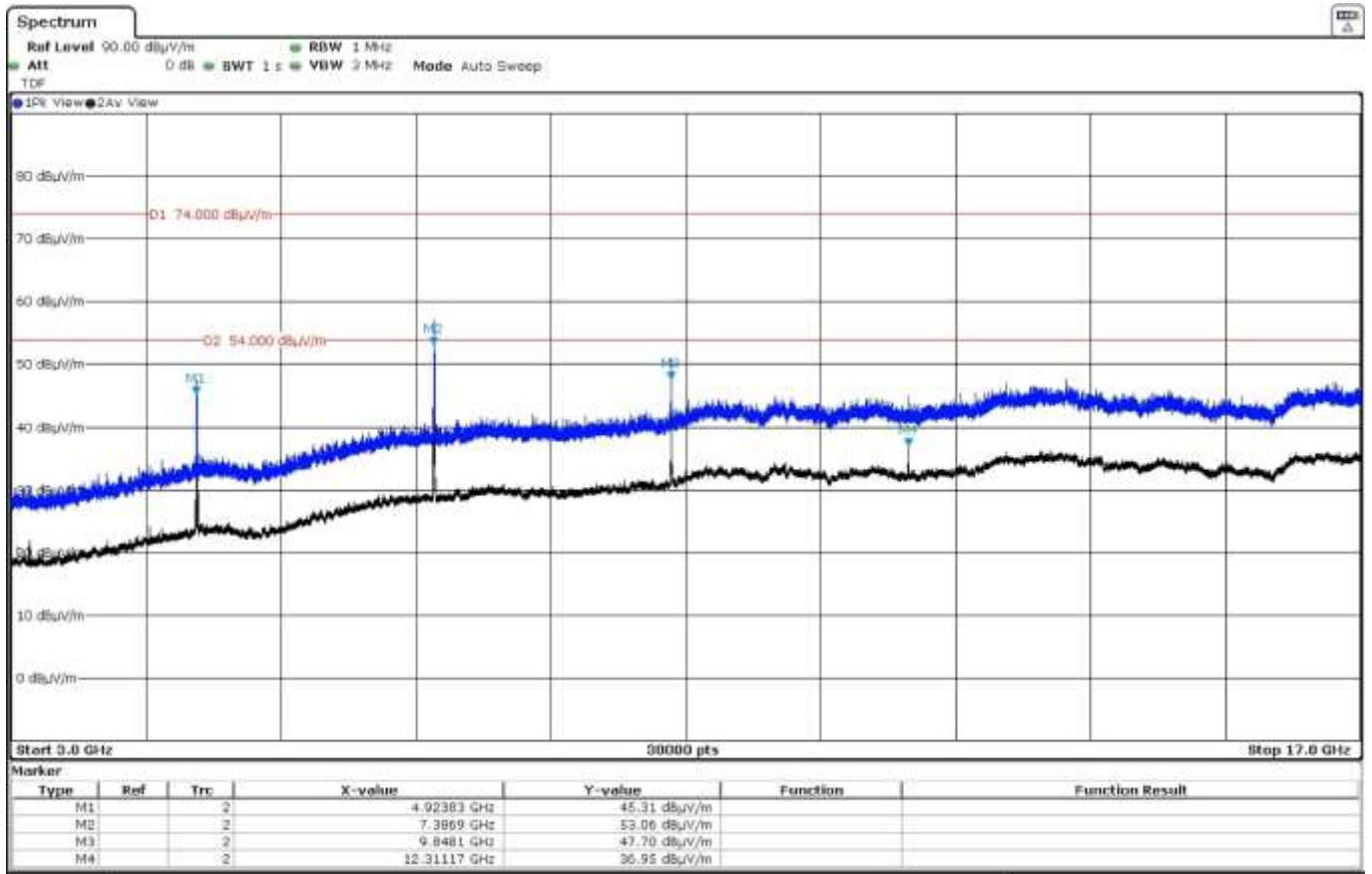
- Low Channel:



- Middle Channel:

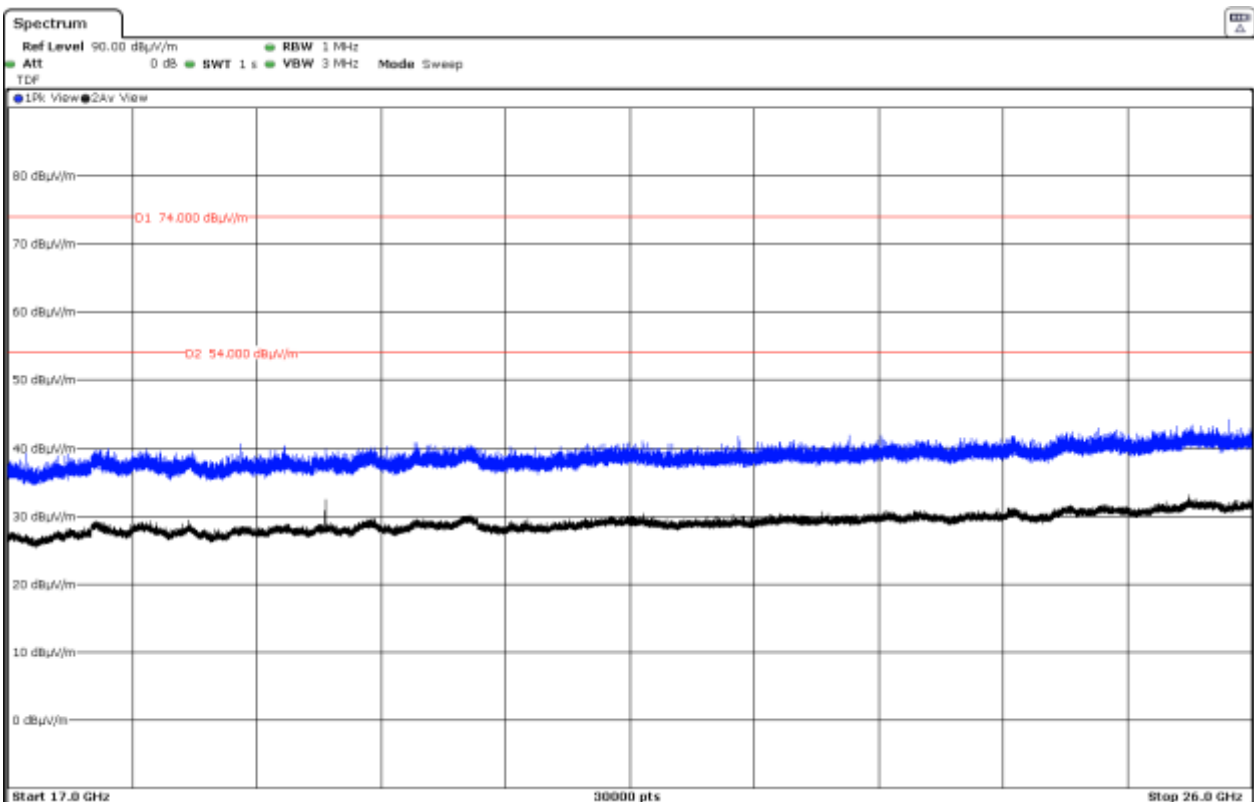


- High Channel:

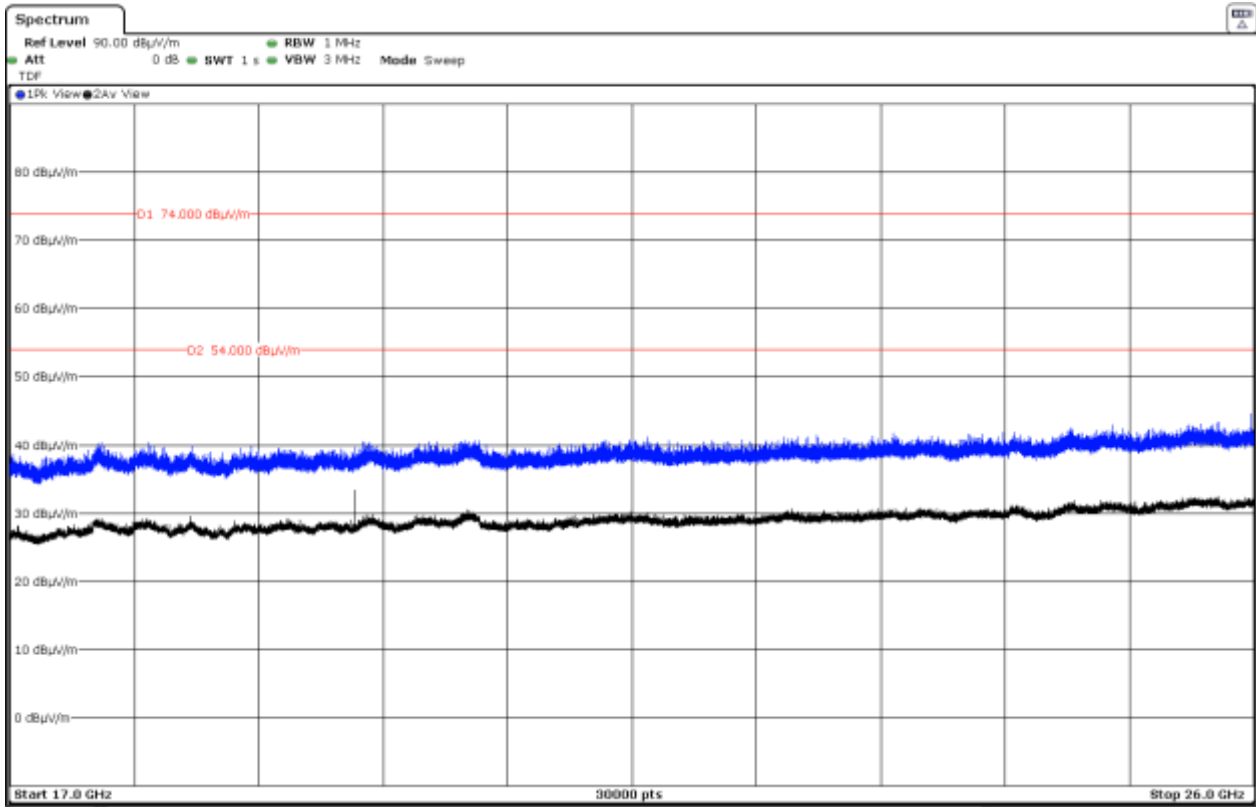


FREQUENCY RANGE 17 - 26 GHz:

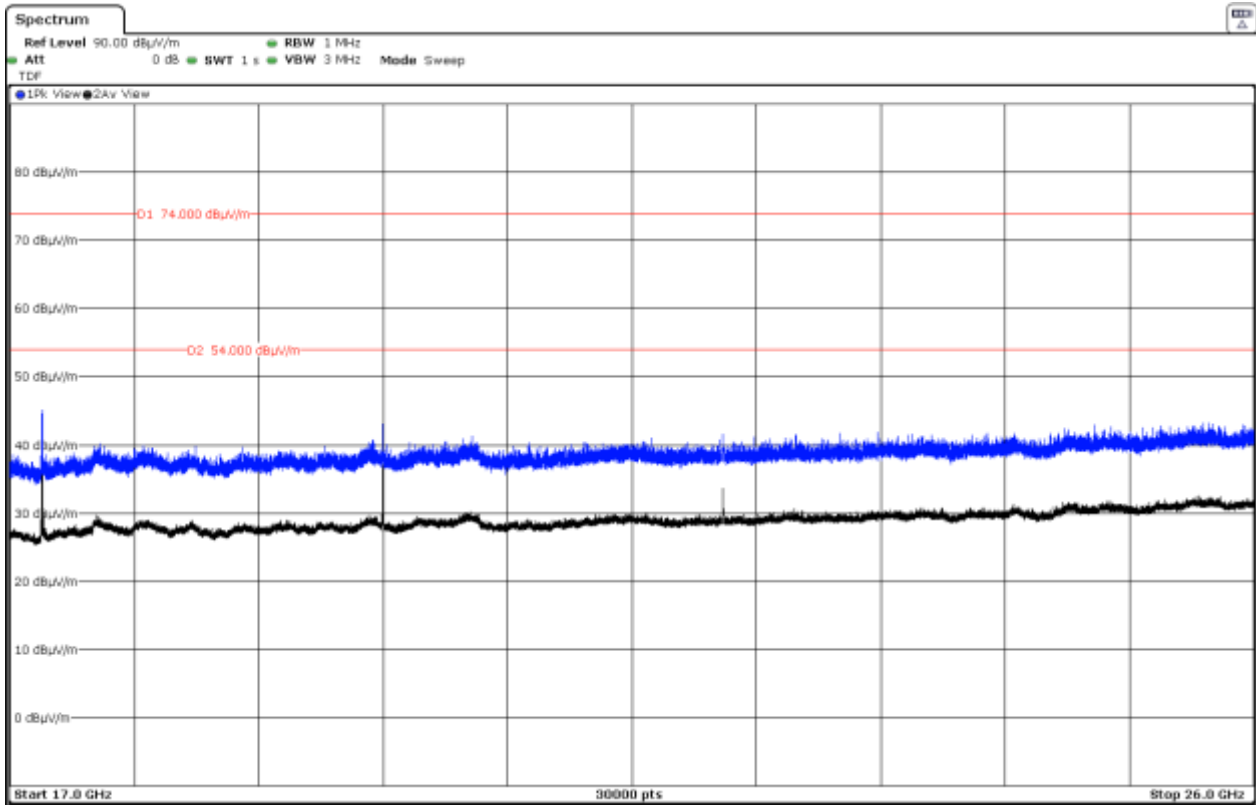
- Low Channel:



- Middle Channel:

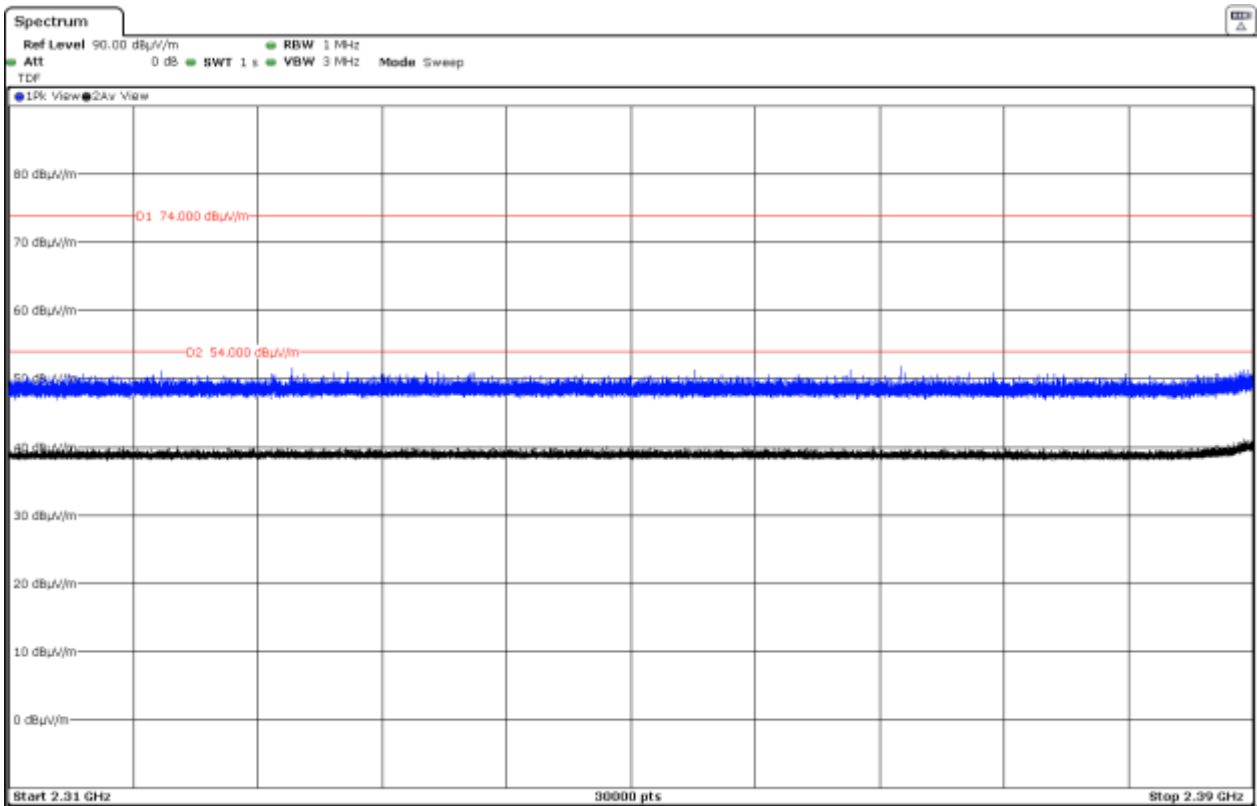


- High Channel:



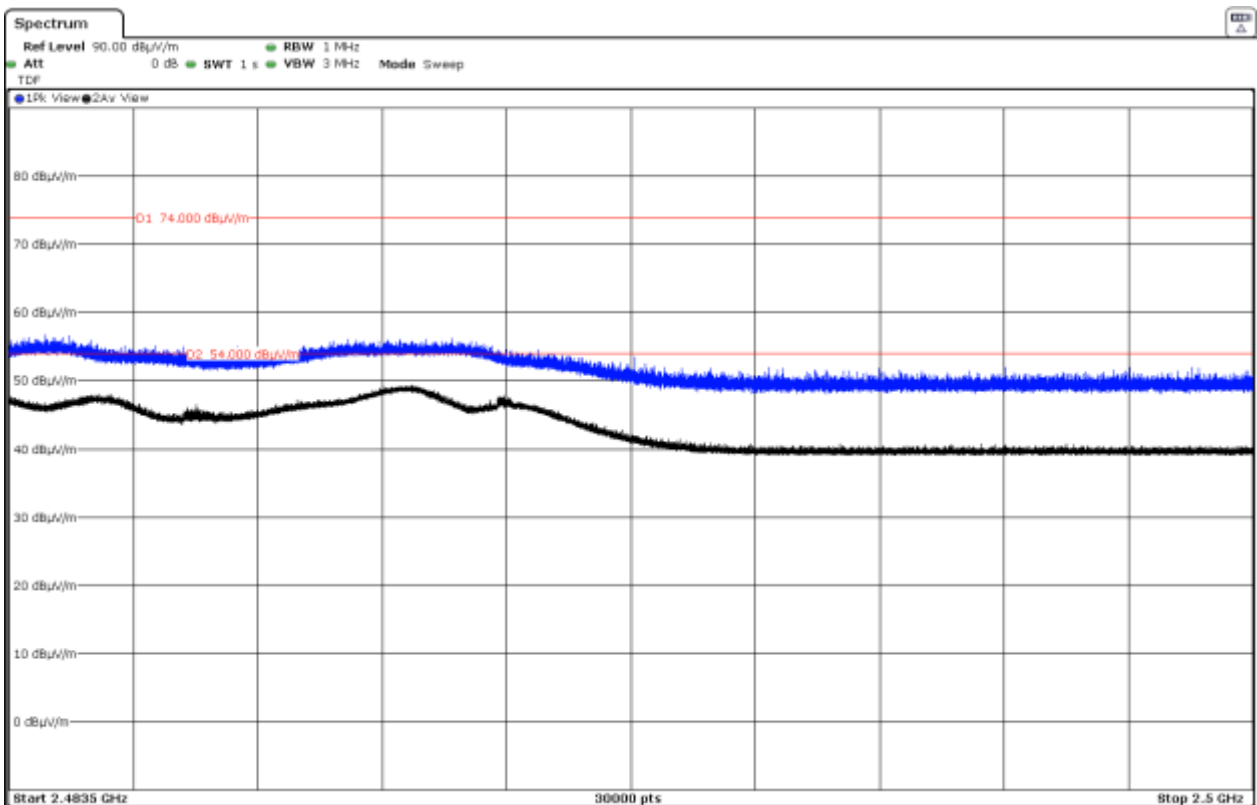
FREQUENCY RANGE 2.31-2.39 GHz: Restricted Band.

- Low Channel.



FREQUENCY RANGE 2.4835-2.5 GHz: Restricted Band.

- High Channel.

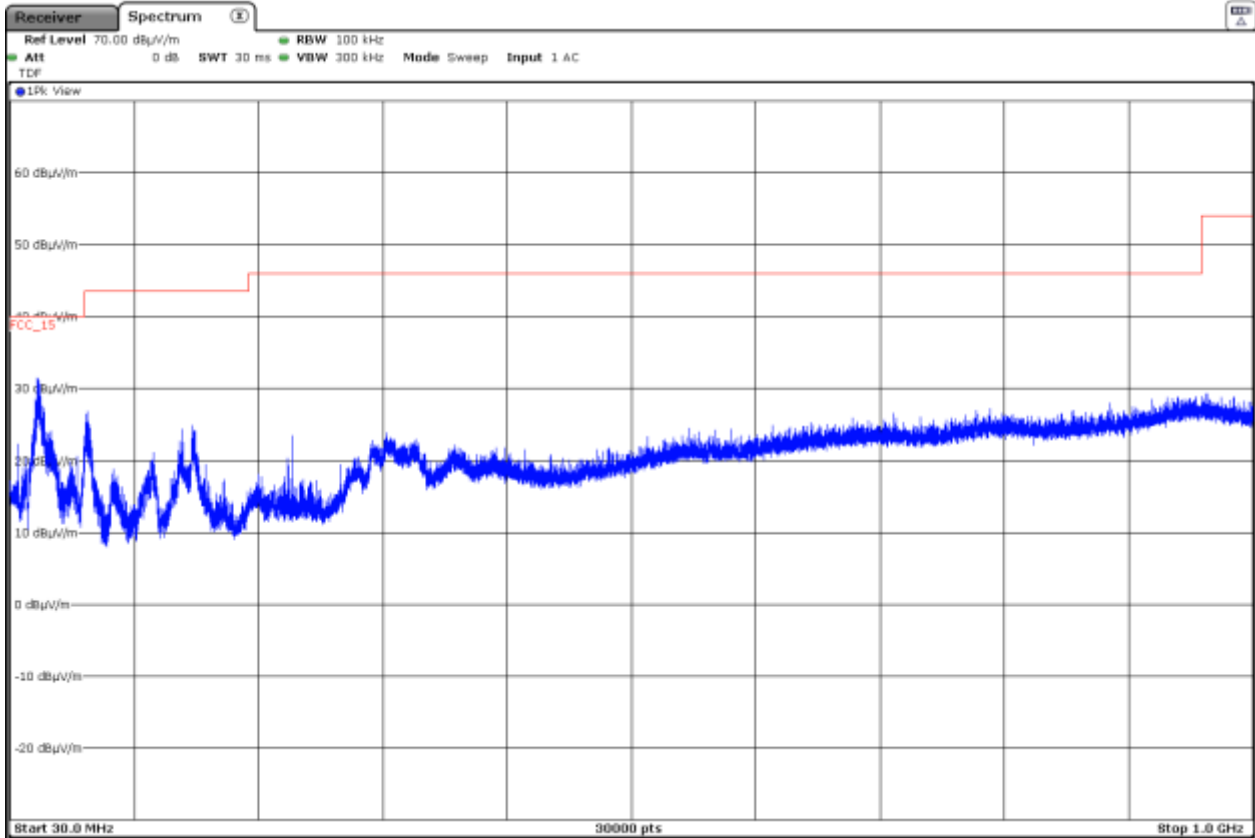


- **802.11 g mode (OFDM worst case for spurious emissions):**

FREQUENCY RANGE 30 MHz - 1 GHz:

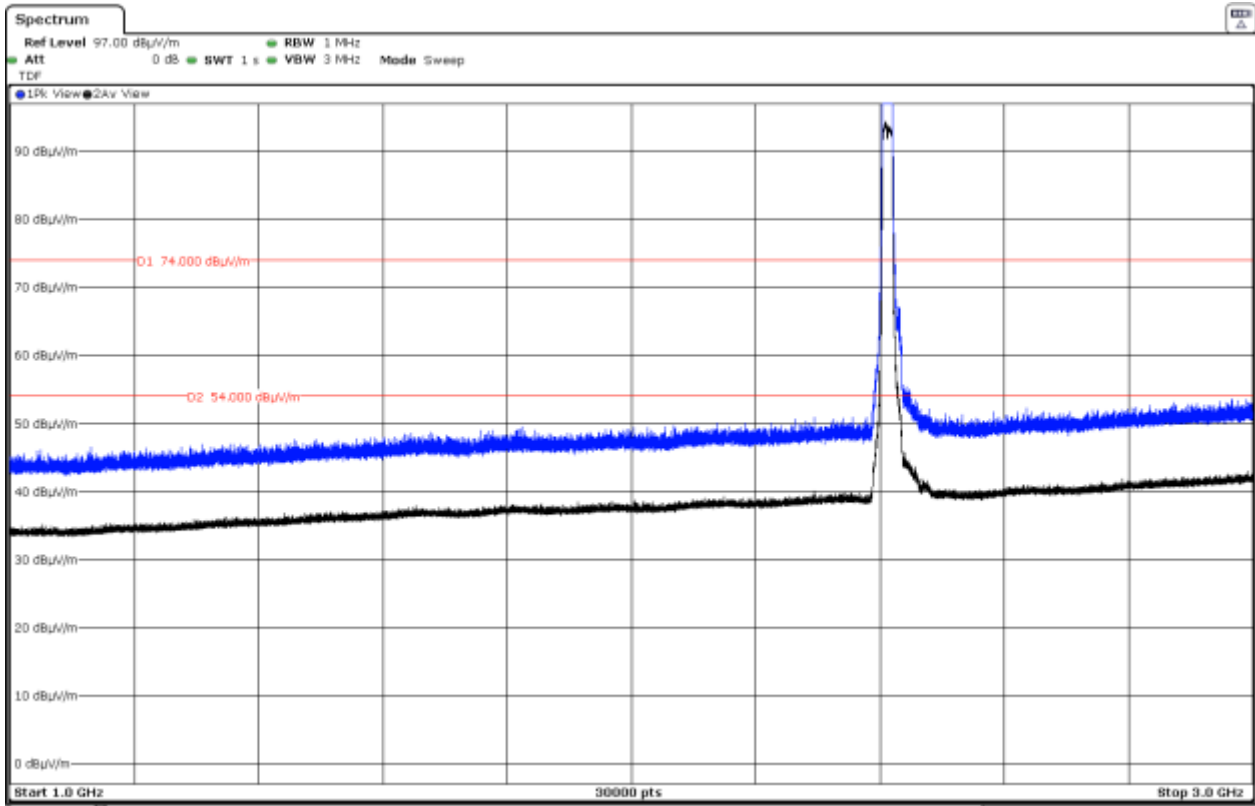
The spurious frequencies detected do not depend on the operating channel.

This plot is valid for the Low, Middle and High Channels.



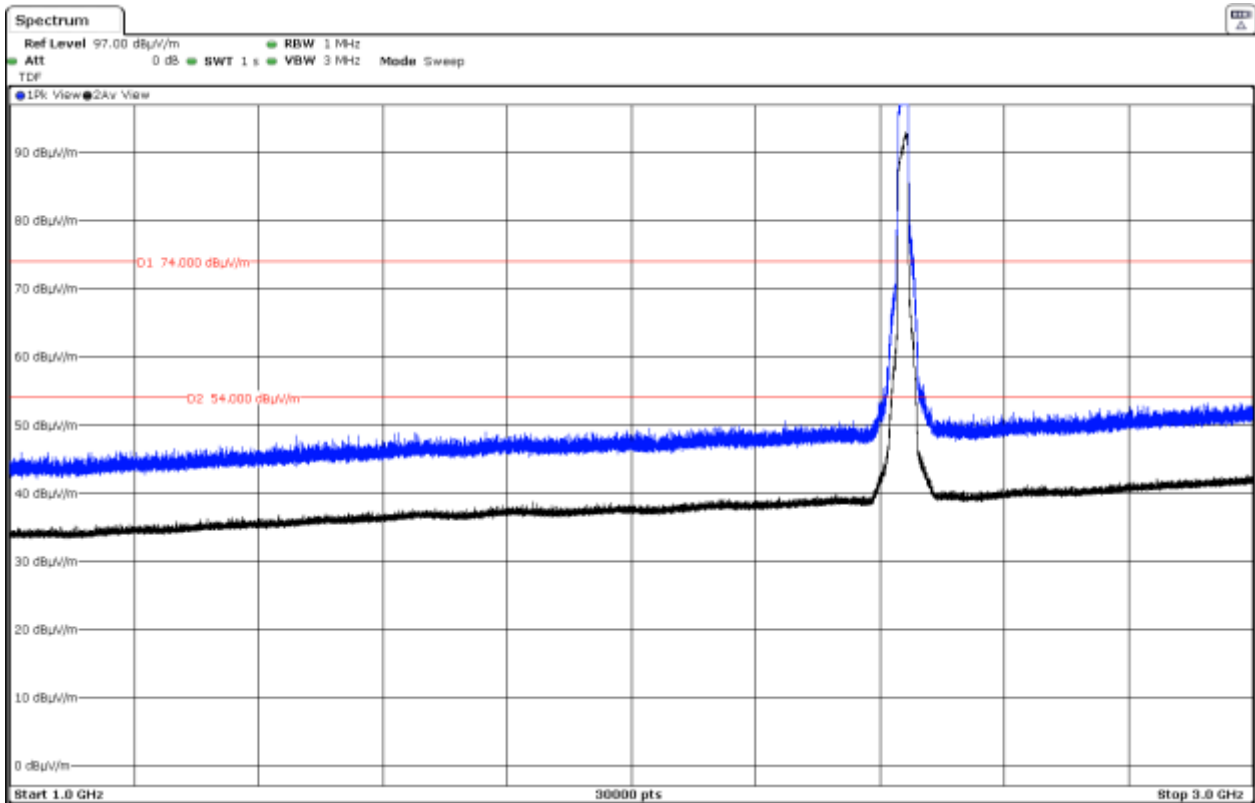
FREQUENCY RANGE 1 - 3 GHz:

- Low Channel:



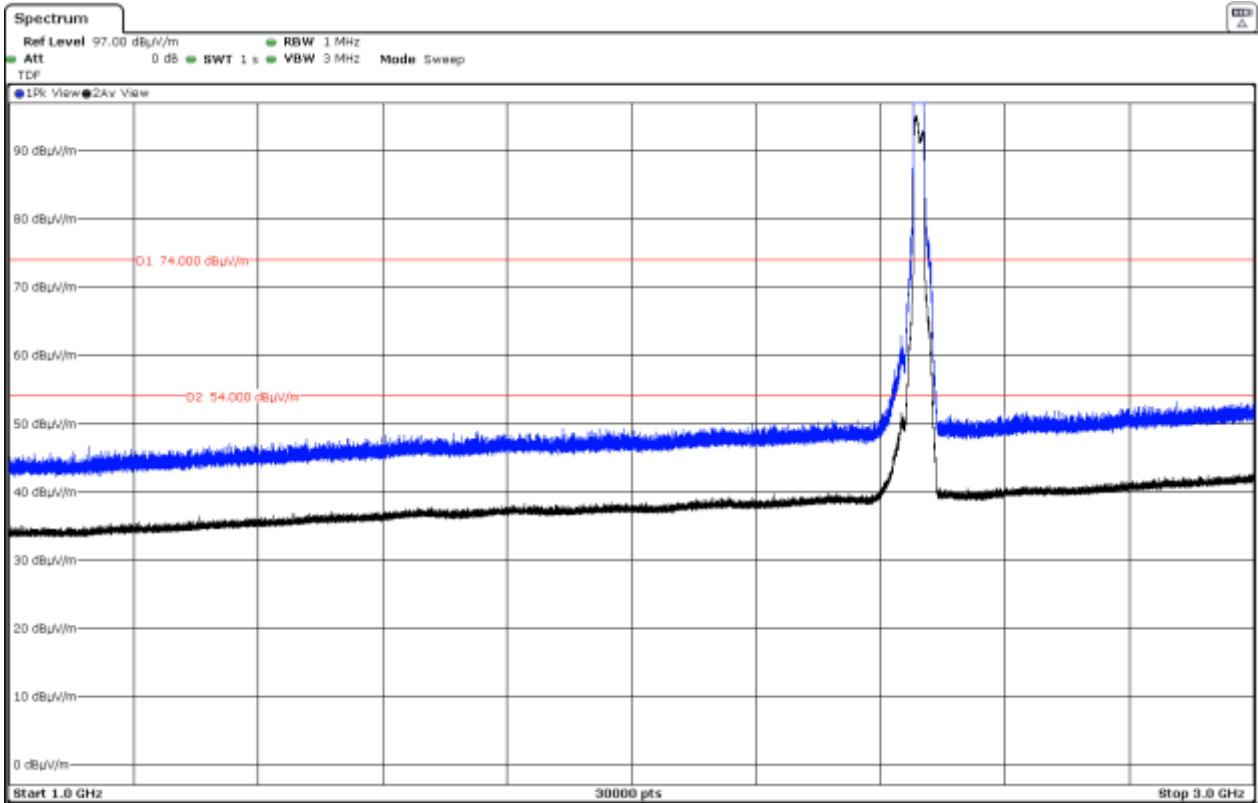
The peak above the limit is the carrier frequency.

- Middle Channel:



The peak above the limit is the carrier frequency.

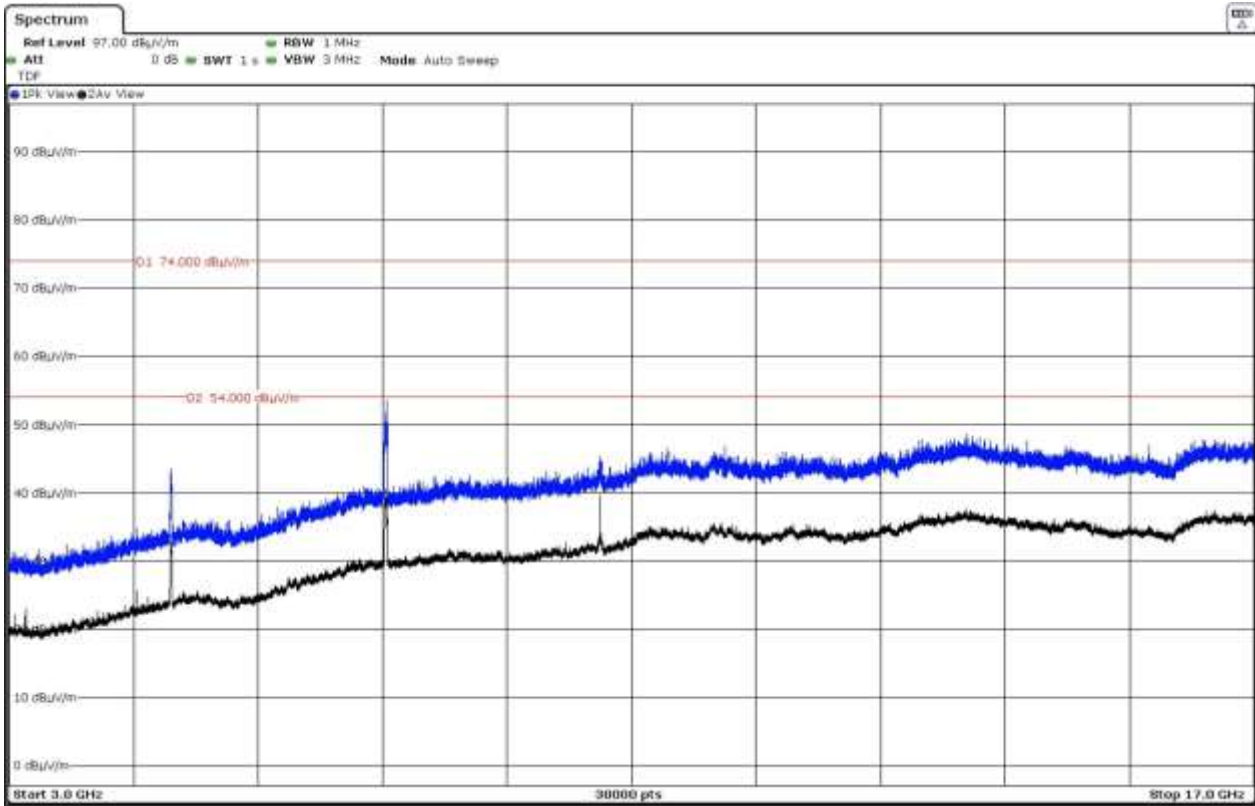
- High Channel:



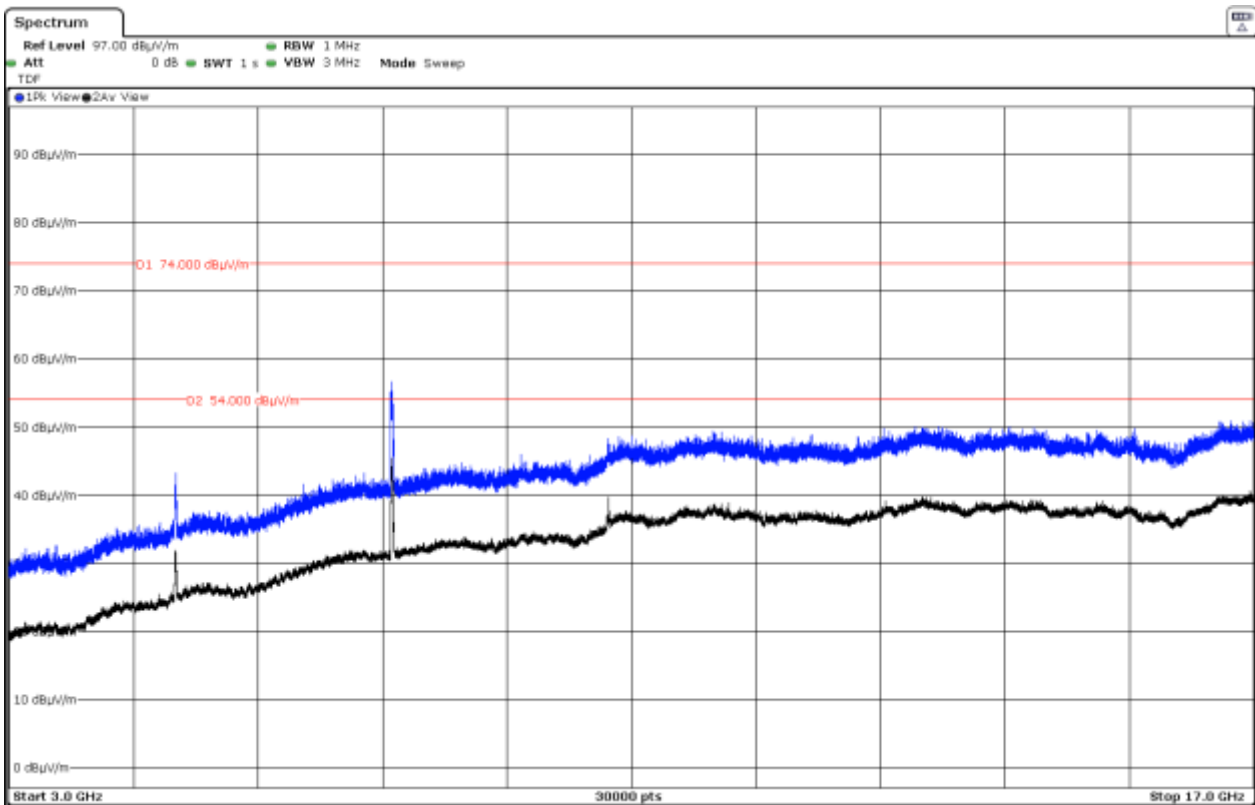
The peak above the limit is the carrier frequency.

FREQUENCY RANGE 3 - 17 GHz:

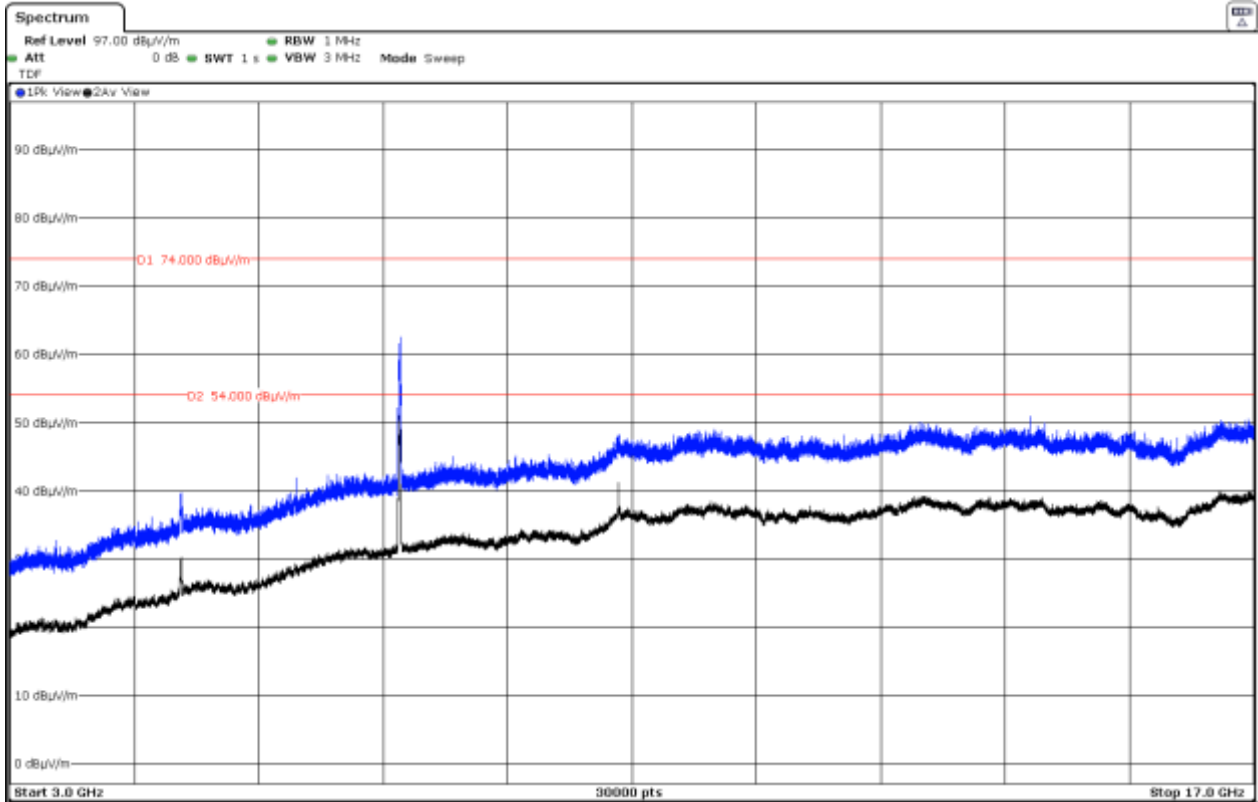
- Low Channel:



- Middle Channel:

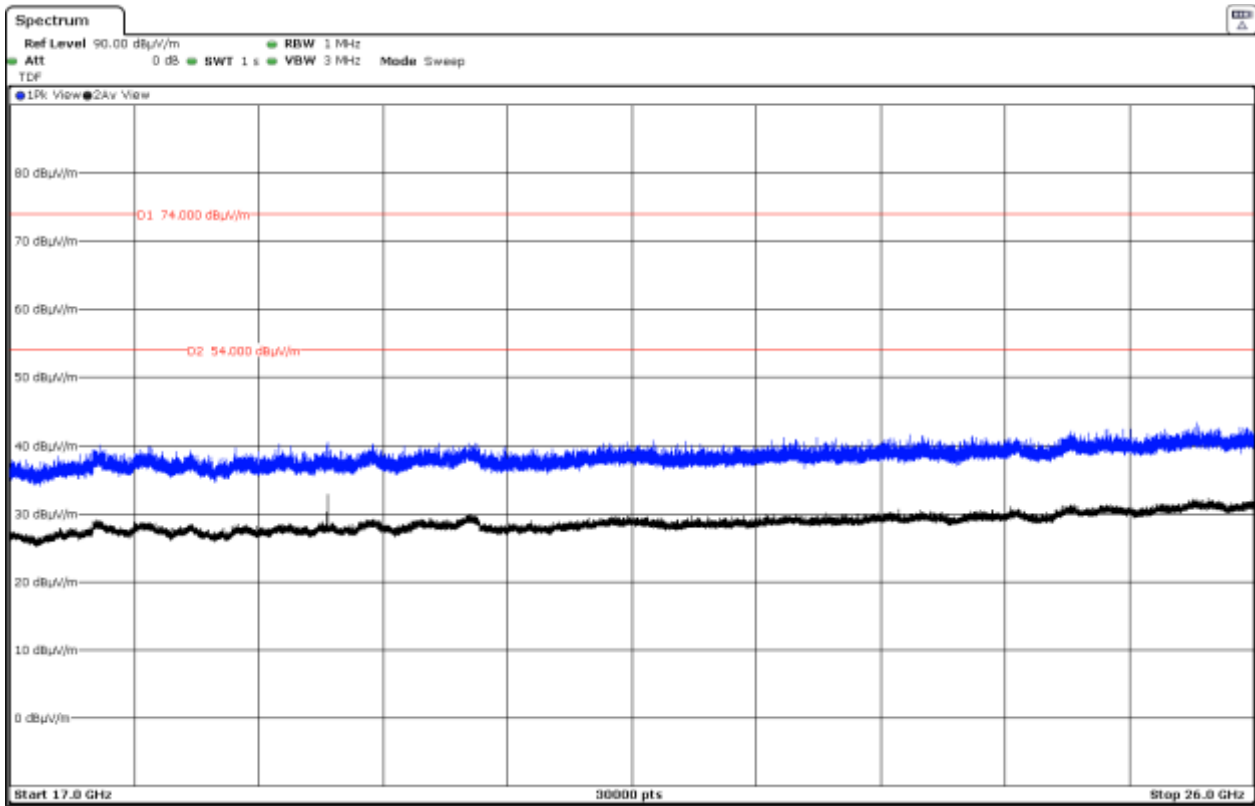


- High Channel:

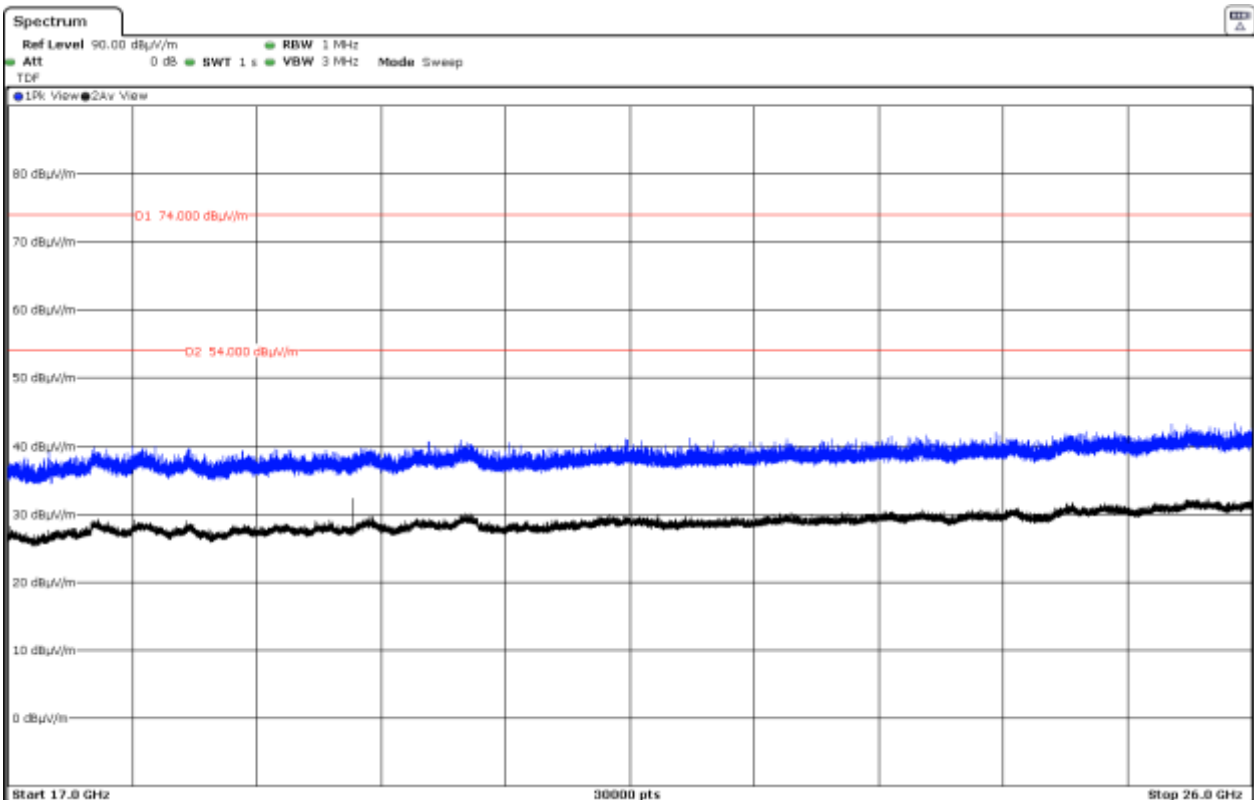


FREQUENCY RANGE 17 - 26 GHz:

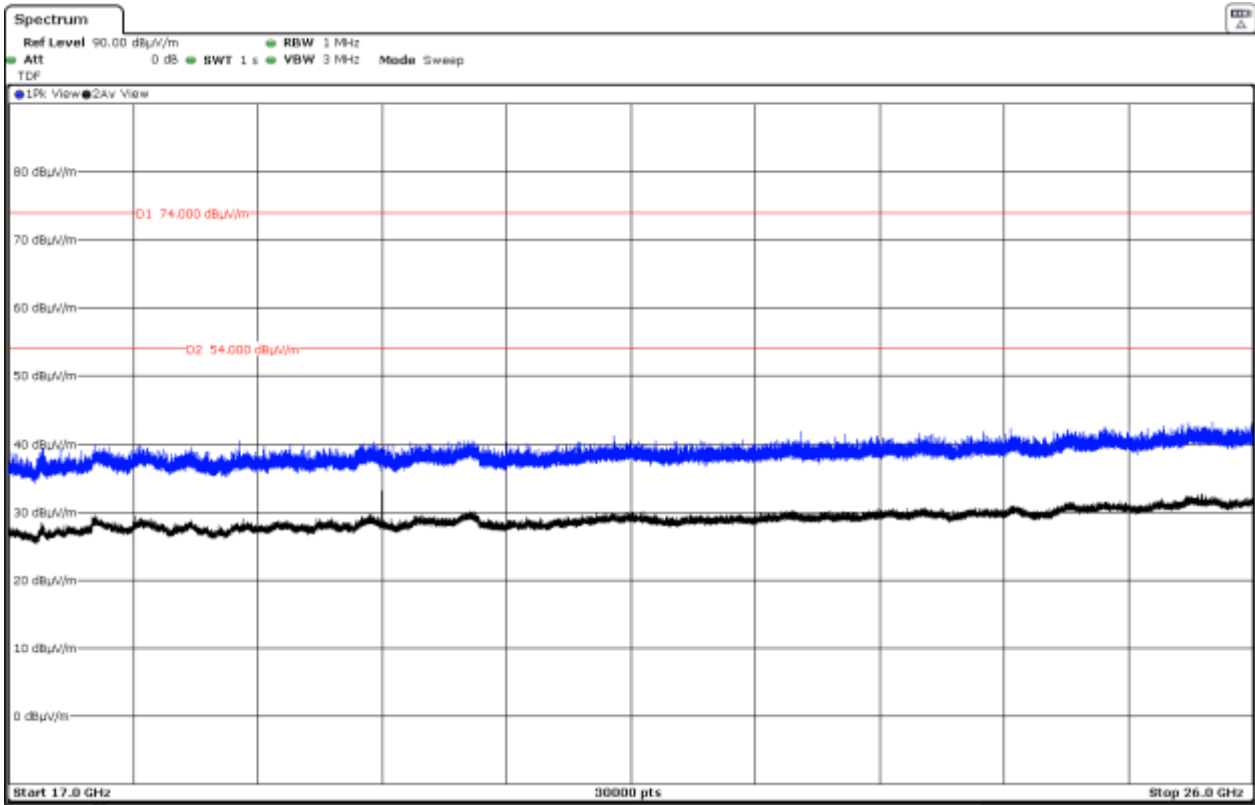
Low channel:



Middle channel:

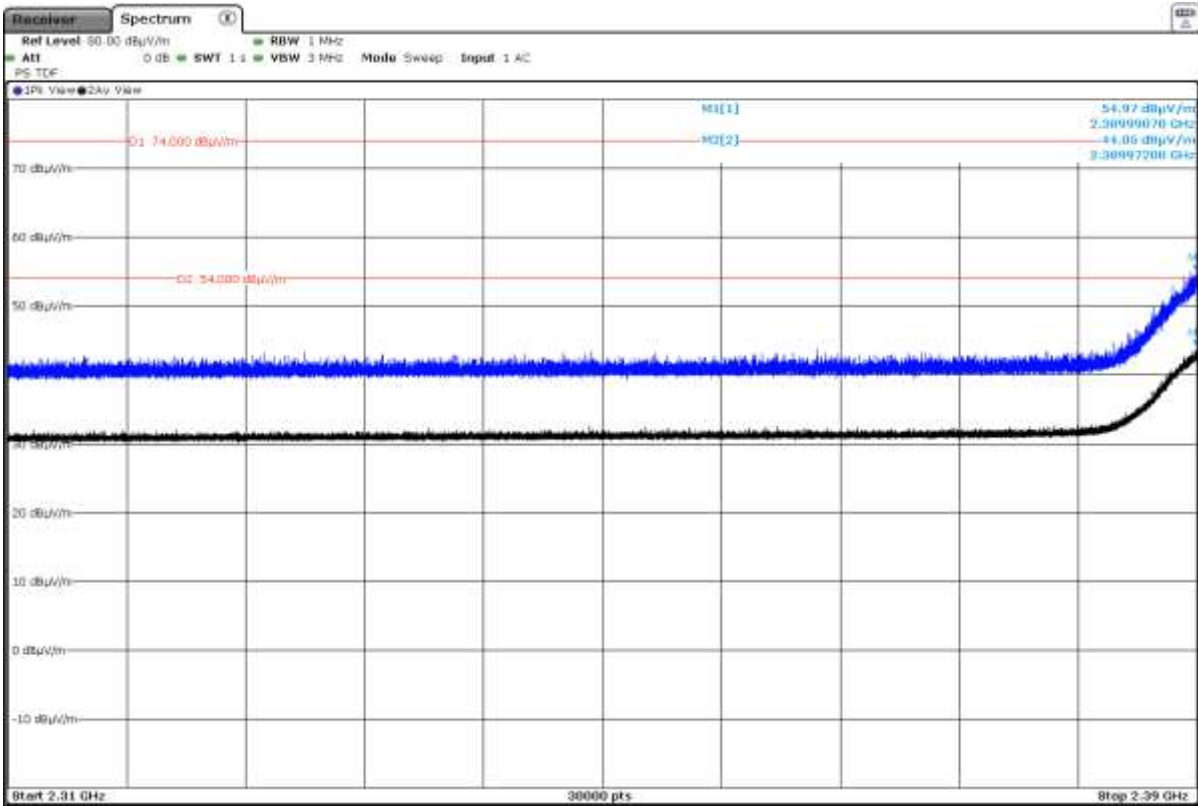


High channel:



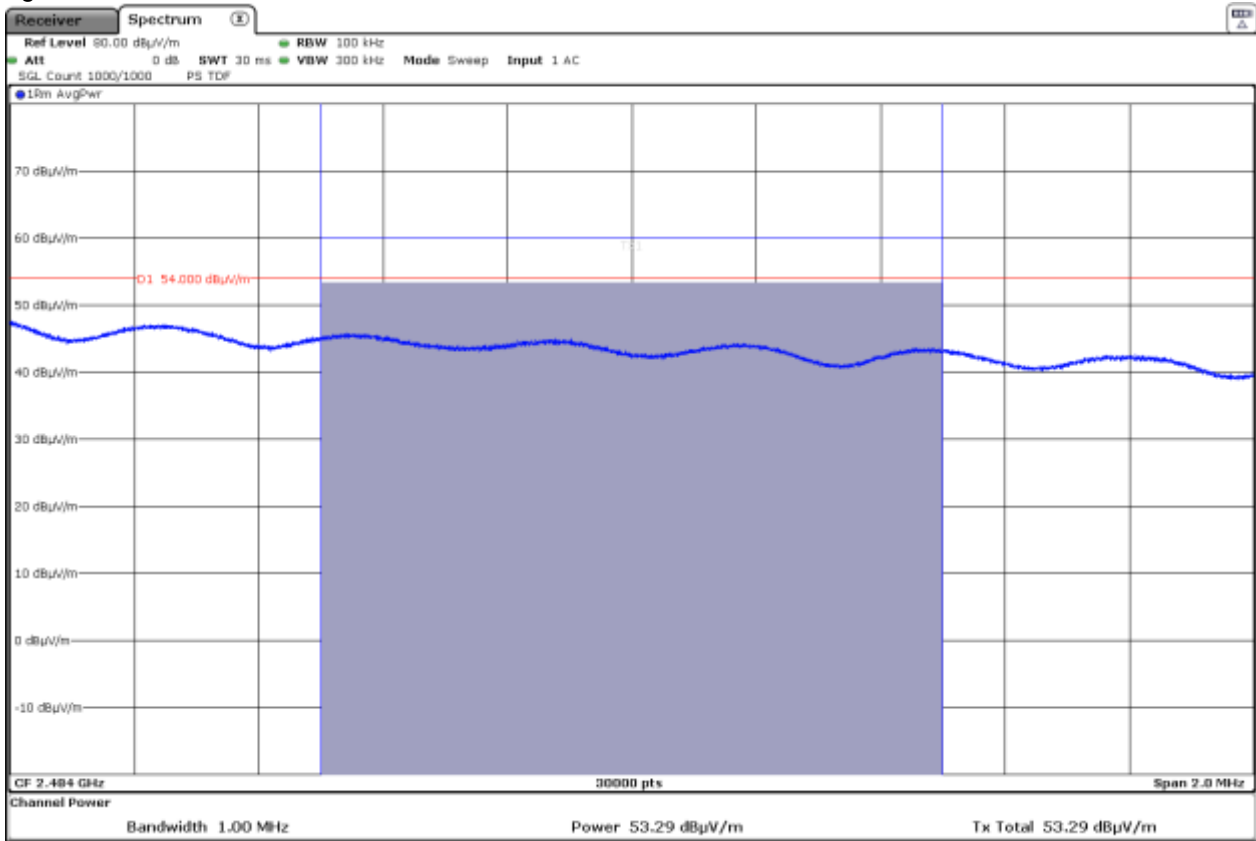
FREQUENCY RANGE 2.31-2.39 GHz: Restricted Band.

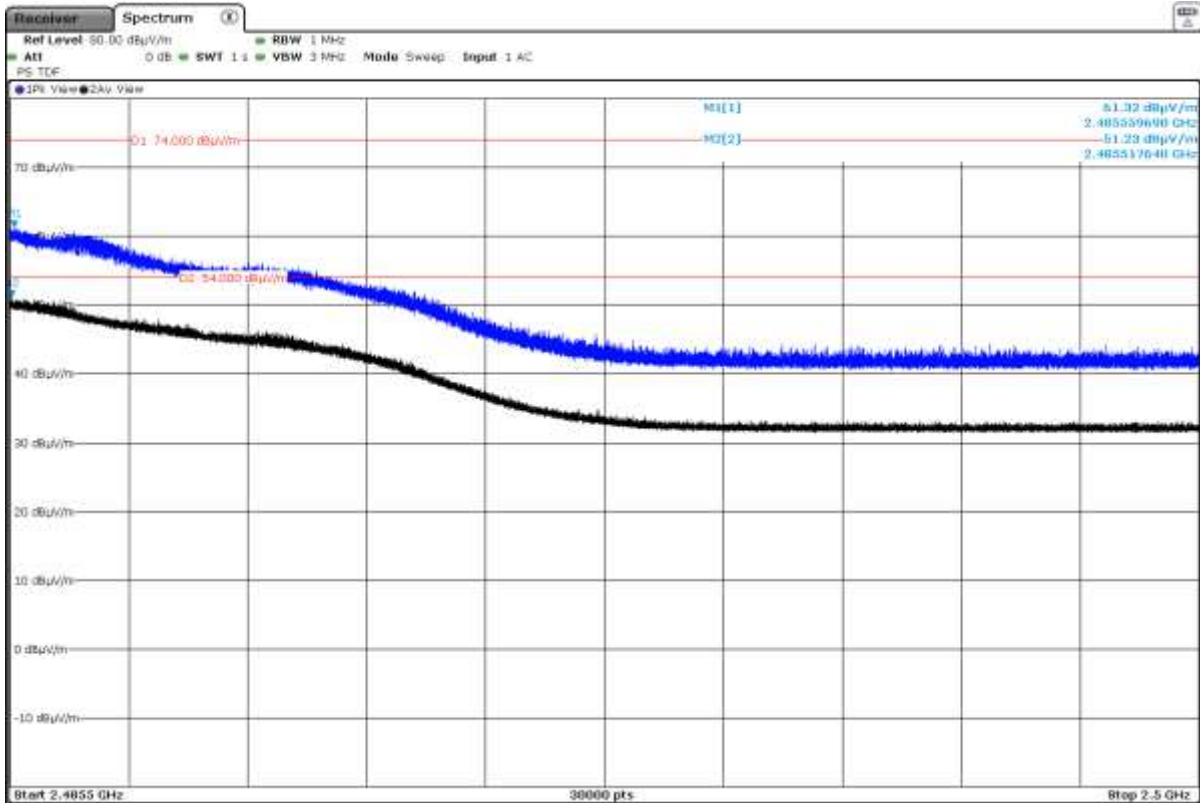
- Low Channel.



FREQUENCY RANGE 2.4835-2.5 GHz: Restricted Band

- High Channel.

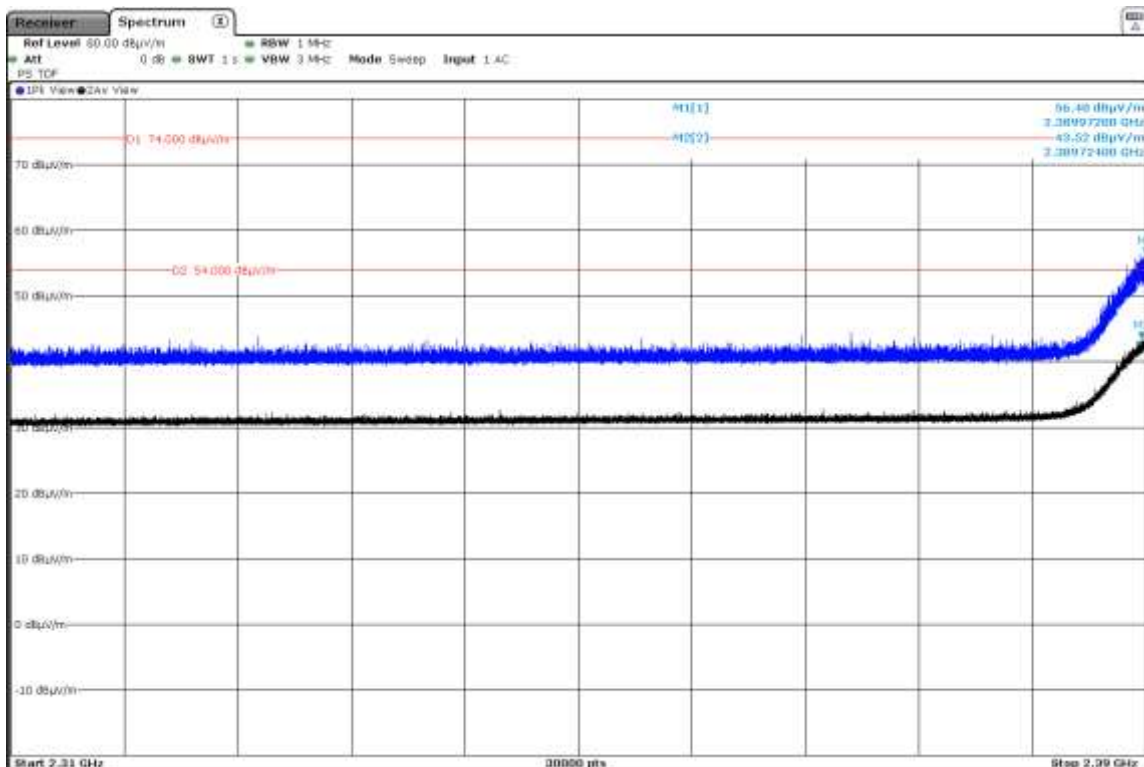




- 802.11 n20 mode:

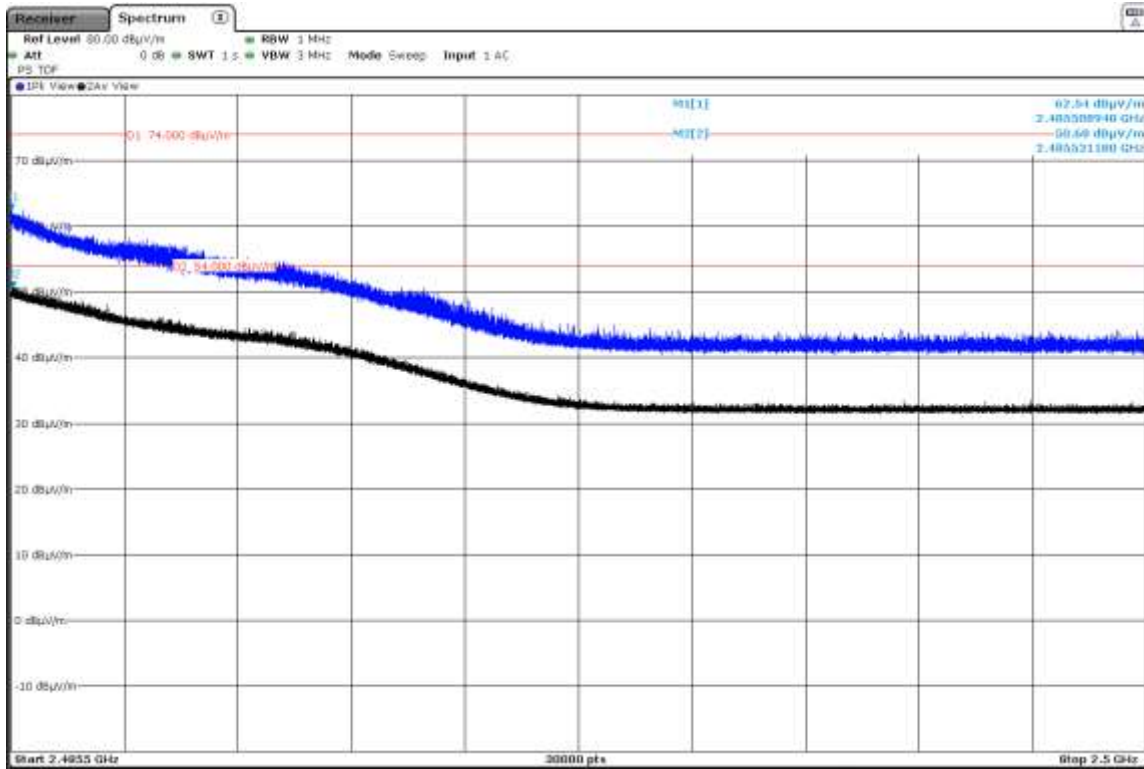
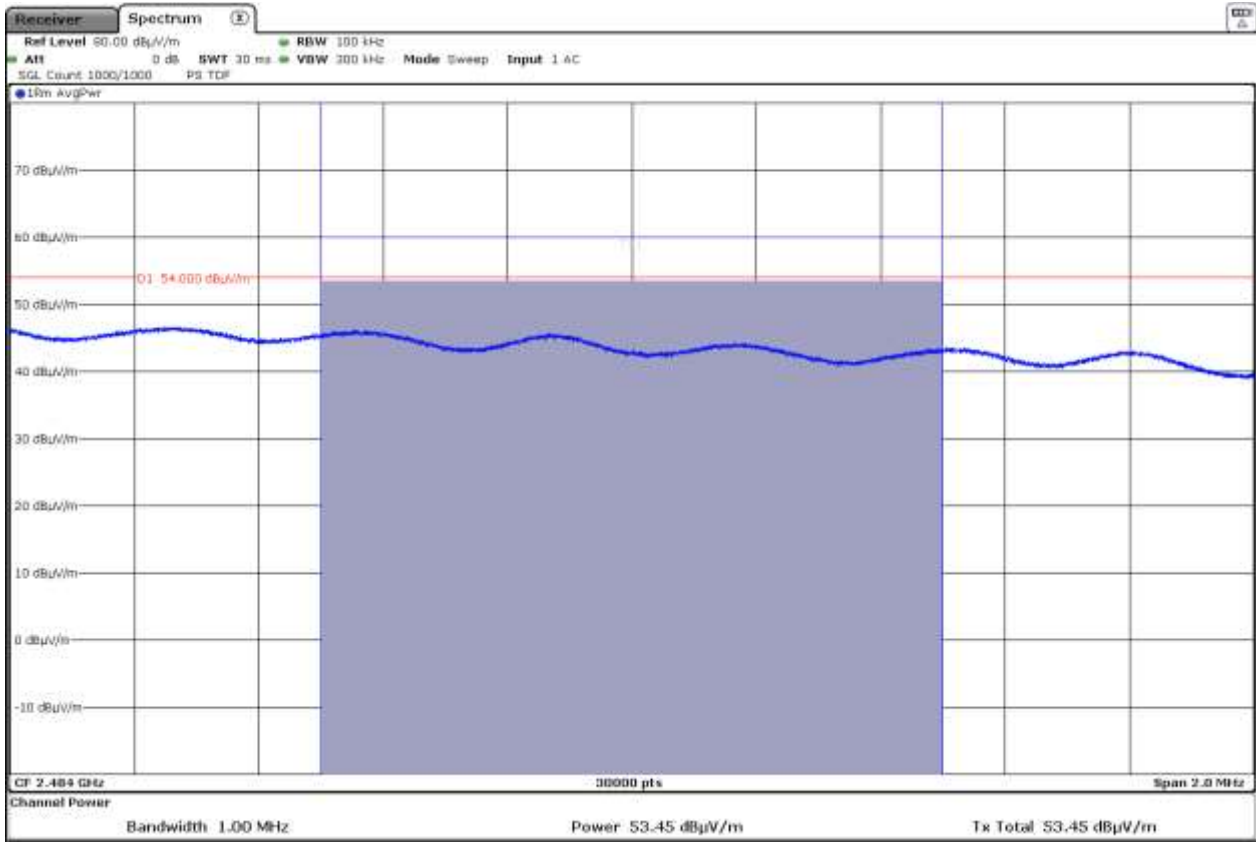
FREQUENCY RANGE 2.31-2.39 GHz: Restricted Band

- Low Channel.



FREQUENCY RANGE 2.4835-2.5 GHz: Restricted Band.

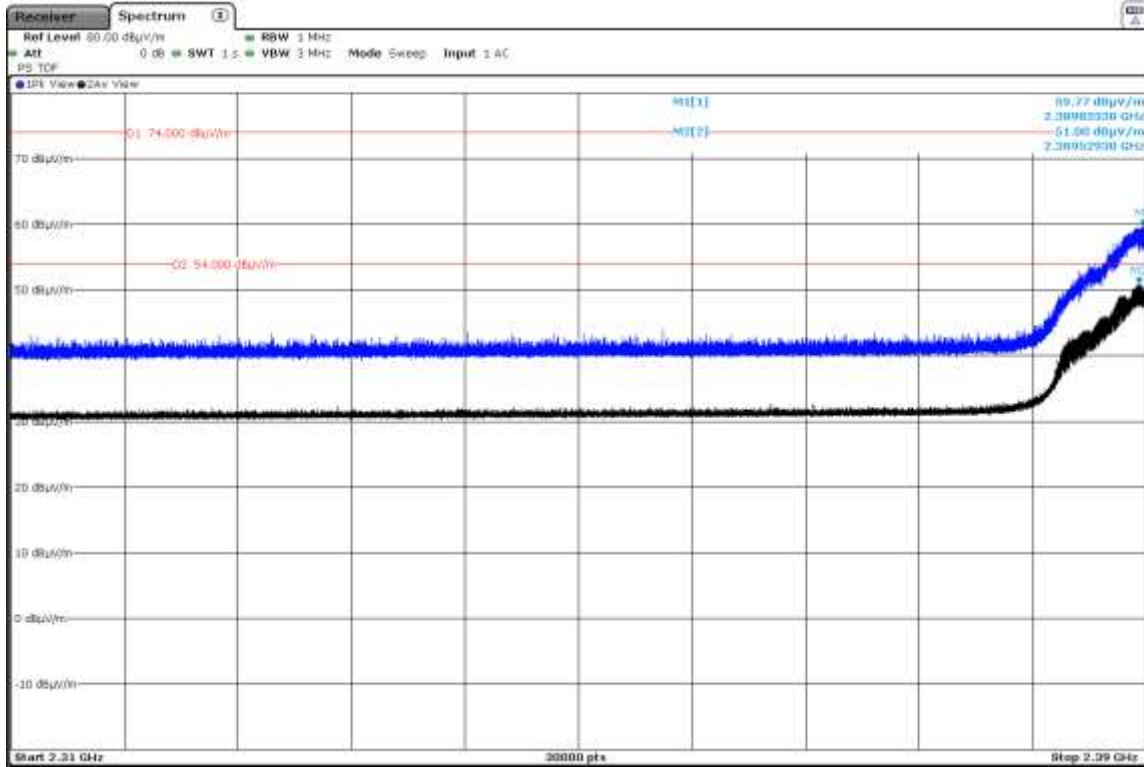
- High Channel.



- **802.11 n40 mode:**

FREQUENCY RANGE 2.31-2.39 GHz: Restricted Band.

- Low Channel.



FREQUENCY RANGE 2.4835-2.5 GHz: Restricted Band.

- High Channel.

