ENAC ENSAYOS Nº 51/LE147

Test report No:
NIE: 57478RRF.011

Partial Test report

USA FCC Part 15.407, 15.209
CANADA RSS-247, RSS-Gen

Unlicensed National Information Infrastructure (U-NII) Devices.
General technical requirements.
Radiated emission limits; general requirements.
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	Secure Smartphone
(*) Trademark	Bittium
(*) Model and /or type reference	Tough Mobile 2
Other identification of the product	HW Version: 0302 SW Version: 40.1 FCC ID: V27SD-61 IC: 3282B-SD61
(*) Features	LTE • 3GPP Rel12 • FDD/TDD Cat13/5, • DL 400Mbit/s, • UL 75 Mbit/s UMTS/HSPA • 3GPP rel8, HSPA+, • DL 42 Mbit/s, • UL 5.76 Mbit/s GSM/GPRS/EDGE Complementary Radios • Wi-Fi 802.11 a/b/g/n/ac (2.4 and 5 GHz), 2 x 2 MIMO • BT 5.0 • NFC
Applicant	BITTIUM WIRELESS OY Ritaharjuntie 1, 90590 Oulu, Finland
Test method requested, standard	USA FCC Part 15.407 10-1-18 Edition: Unlicensed National Information Infrastructure (U-NII) Devices. General technical requirements. - Transmitter Out of Band Radiated Emissions. - Transmitter Band Edge Radiated Emissions.

	USA FCC Part 15.209 10-1-18 Edition: Radiated. emission limits; general requirements. CANADA RSS-247 Issue 2 (February 2017). - Transmitter Out of Band Radiated Emissions. - Transmitter Band Edge Radiated Emissions. CANADA RSS-Gen Issue 5 (April 2018). Guidance for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices 789033 D02 General U-NII Test Procedures New Rules v02r01 dated Dec 14, 2017. ANSI C63.10-2013: American National Standard for Testing Unlicensed Wireless Devices.
Approved by (name / position & signature)	A. Llamas RF Lab. Manager Firmado digitalmente por ALEJANDRO LLAMAS RODRIGUEZ Fecha: 2019.08.12 14:53:09 +02'00'
Date of issue	2019-08-12
Report template No	FDT08_22 (*) "Data provided by the client"

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Competences and guarantees

DEKRA Testing and Certification 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.

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DEKRA Testing and Certification 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 at the time of performance of the test.

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

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Uncertainty

Uncertainty (factor k=2) was calculated according to the DEKRA Testing and Certification 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 Tough Mobile 2 consists of a Secure Smartphone targeted for professional use where High Security is required.

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
57478C/032	Mobile Phone	Tough Mobile 2	--	2018/11/26
57478C/033	USB Cable	--	--	2018/11/26
57478C/034	AC/DC Adaptor	--	--	2018/11/26
57478C/039	Headphones	--	--	2018/11/26

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

Test sample description

Ports…… :	Port name and description	Cable			
		Specified max length [m]	Attached during test	Shielded	Coupled to patient(3)
	Not provided data.		☐	☐	☐
Supplementary information to the ports…… :					
Rated power supply .....:	Voltage and Frequency	Reference poles			
		L1	L2	L3	N	PE
	☐ AC: -	☐	☐	☐	☐	☐
	☒ DC: 3.8V					
Rated Power .....:	Not provided data.					
Clock frequencies.....:	Not provided data.					
Other parameters .....:	FCC ID: V27SD-61 IC: 3282B-SD61					
Software version .....:	40.1.					
Hardware version .....:	0302.					
Dimensions in cm (W x H x D) ....:	Not provided data.					

Mounting position .....:	☐	Table top equipment		
	☐	Wall/Ceiling mounted equipment		
	☐	Floor standing equipment		
	☒	Hand-held equipment		
	☐	Other:		
Modules/parts.....:	Module/parts of test item		Type	Manufacturer
	Not provided data.			
Accessories (not part of the test item) .....:	Description		Type	Manufacturer
	Not provided data.			
Documents as provided by the applicant.....:	Description		File name	Issue date
	Not provided data.			

(3) Only for Medical Equipment

Identification of the client

BITTIUM WIRELESS OY

Ritaharjuntie 1, 90590 Oulu, Finland

Testing period and place

Test Location	DEKRA Testing and Certification S.A.U.
Date (start)	2019-01-09
Date (finish)	2019-01-24

Document history

Report number	Date	Description
57478RRF.011	2019-08-12	First release

Environmental conditions

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

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

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

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

Remarks and comments

The tests have been performed by the technical personnel: Francisco José Alcaide, Carolina Postigo, Jaime Barranquero, Ignacio Cabra and Miguel Ángel Torres.

Used instrumentation:

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.	EMI Receiver ROHDE AND SCHWARZ ESU26	2018/02	2020/02
4.	RF Pre-amplifier, 38 dB, 30 MHz-6 GHz BONN ELEKTRONIK BLNA 0360-01N	2018/07	2019/07
5.	Biconical/Log Antenna 30 MHz-6 GHz ETS LINDGREN 3142E	2017/04	2020/04
6.	Signal and Spectrum Analyzer ROHDE AND SCHWARZ FSV 40	2018/02	2020/02
7.	EMI Test Receiver 7 GHz ROHDE AND SCHWARZ ESR7	2018/10	2020/10
8.	RF Pre-amplifier G>30dB, 1-18GHz BONN ELEKTRONIK BLMA 0118-3A	2019/04	2020/04
9.	Broadband Horn antenna 1-18 GHz SCHWARZBECK MESS-ELEKTRONIK BBHA 9120 D	2018/01	2021/01
10.	RF Pre-amplifier 30 dB, 18 GHz-40 GHz BONN ELEKTRONIK BLMA 1840-1M	2019/02	2021/02
11.	Broadband Horn antenna 18-40 GHz SCHWARZBECK BBHA 9170	2018/07	2021/07
12.	Spectrum analyser Rohde & Schwarz FSW50	2018/02	2020/02

Testing verdicts

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

Summary

Common requirements for all bands

FCC PART 15 PARAGRAPH / RSS-247			
Requirement – Test case		Verdict	Remark
RSS-Gen 6.6 / RSS-247 6.2.	Transmitter 99% Occupied Bandwidth	N/M	(1)
FCC 15.403 (i)	Transmitter 26 dB Emission Bandwidth (EBW)	N/M	(1)
FCC 15.35 (c) / RSS-Gen 6.10	Duty Cycle	N/M	(1)
FCC 15.407 (g) / RSS-Gen 6.11	Transmitter Frequency Stability (Temperature & Voltage Variation)	N/M	(1), (2)
Supplementary information and remarks: (1) Test not requested. (2) The manufacturer is responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the user's manual.			

A. 5.15 – 5.25 GHz Band (U-NII-1)

FCC PART 15 PARAGRAPH / RSS-247			
Requirement – Test case		Verdict	Remark
FCC 15.407 (a) (1) (iv)	Transmitter Maximum conducted Output Power	N/M	(1)
RSS-247 6.2.1.1	Transmitter Maximum Equivalent Isotropically Radiated Power EIRP	N/M	(1)
FCC 15.407 (a) (1) (iv)	Transmitter Maximum Power Spectral Density	N/M	(1)
RSS-247 6.2.1.1	Transmitter EIRP Spectral Density	N/M	(1)
FCC 15.407 (b) (1) / RSS-247 6.2.1.2	Transmitter Band Edge Radiated Emissions	P	
FCC 15.407 (b) (1) (6) / RSS-247 6.2.1.2	Transmitter Out of Band Radiated Emissions	P	
Supplementary information and remarks: (1) Test not requested.			

B. 5.25 GHz – 5.35 GHz Band (U-NII-2A)

FCC PART 15 PARAGRAPH / RSS-247			
Requirement – Test case		Verdict	Remark
FCC 15.407 (a) (2) / RSS-247 6.2.2.1 (a)	Transmitter Maximum conducted Output Power	N/M	(1)
RSS-247 6.2.2.1 (b)	Transmitter Maximum Equivalent Isotropically Radiated Power EIRP	N/M	(1)
FCC 15.407 (a) (2) / RSS-247 6.2.2.1 (a)	Transmitter Maximum Power Spectral Density	N/M	(1)
FCC 15.407 (b) (2) / RSS-247 6.2.2.2	Transmitter Band Edge Radiated Emissions	P	
FCC 15.407 (b) (2) (6) / RSS-247 6.2.2.2	Transmitter Out of Band Radiated Emissions	P	
FCC 15.407 (h) (1) / RSS-247 6.2.2.1	Transmitter Power Control	N/A	
Supplementary information and remarks: (1) Test not requested.			

C. 5.47 GHz – 5.725 GHz Band (U-NII-2C)

FCC PART 15 PARAGRAPH / RSS-247			
Requirement – Test case		Verdict	Remark
FCC 15.407 (a) (2) / RSS-247 6.2.3.1	Transmitter Maximum conducted Output Power	N/M	(1)
RSS-247 6.2.3.1	Transmitter Maximum Equivalent Isotropically Radiated Power	N/M	(1)
FCC 15.407 (a) (2) / RSS-247 6.2.3.1	Transmitter Maximum Power Spectral Density	N/M	(1)
FCC 15.407 (b) (3) / RSS-247 6.2.3.2	Transmitter Band Edge Radiated Emissions	P	
FCC 15.407 (b) (3) (6) / RSS-247 6.2.3.2	Transmitter Out of Band Radiated Emissions	P	
FCC 15.407 (h) (1) / RSS-247 6.2.3.1	Transmitter Power Control	N/A	
Supplementary information and remarks: (1) Test not requested.			

Appendix A: Test result for 5.15GHz – 5.25GHz.

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TEST CONDITIONS

POWER SUPPLY (V):

V nonimal: 3.8 Vdc

Type of Power Supply: Rechargeable battery.

Type of Antenna: Internal:

CHAIN 0: Monopole.

CHAIN 1: Monopole with parasitic resonator.

Antennas Gain:

- CHAIN 0 – Maximum Declared Antenna Gain: -1.1 dBi
- CHAIN 1 – Maximum Declared Antenna Gain: -1.1 dBi
- MIMO – CHAIN 0 Antenna & CHAIN 1 Antenna.

TEST FREQUENCIES:

Technology Tested:	WLAN (IEEE 802.11 a20 / n2040 / ac204080 2x2) / U-NII-1	
Modes:	802.11a: 6, 9, 12, 18, 24, 36, 48 & 54 Mbps	
	802.11n HT20: MCS0 to MCS23	
	802.11n HT40: MCS0 to MCS23	
	802.11ac VHT20: MCS0 to MCS9	
	802.11ac VHT40: MCS0 to MCS9	
	802.11ac VHT80: MCS0 to MCS9	
Setting of cores / ports:	0+1.	
Beamforming:	No.	
Frequency Range:	5150 - 5250 MHz	
Operating Channel Bandwidth:	20 MHz	
Transmit Channels:	CHANNEL	CHANNEL FREQUENCY (MHz)
	Lowest: 36	5180
	Middle: 40	5200
	Highest: 48	5240
Operating Channel Bandwidth:	40 MHz	
Transmit Channels:	CHANNEL	CHANNEL FREQUENCY (MHz)
	Lowest: 38	5190
Operating Channel Bandwidth:	80 MHz	
Transmit Channel:	CHANNEL	CHANNEL FREQUENCY (MHz)
	Middle: 42	5210

The test set-up was made in accordance to the general provisions of FCC Unlicensed National Information Infrastructure (U-NII) Devices 789033 D02 General U-NII Test Procedures New Rules v02r01 dated Dec 14, 2017.

The sample was used to configure the EUT to continuously transmit at a specified output power in all channels with different modes and modulation schemes.

The EUT was tested in the following operating mode:

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

The field strength at the band edges was evaluated for each mode on the lowest and highest channels at the rated power for the channel under test
For all modes, the EUT was configured in test mode using a software application.
The application was used to enable a continuous transmission and to select the test channels as required.
The client supplied instructions to configure the EUT. The customer supplied a document containing the setup instructions.

The worst cases for testing were identified for output power and spurious levels at the band edges which were selected based on preliminary testing that correspond to next data rates:

- - 802.11a: 6 Mbits x1/ MIMO / 2Tx on CH 0 & CH 1.
  - 802.11n HT20: MCS0 x1/ MIMO / 2Tx on CH 0 & CH 1.
  - 802.11n HT40: MCS0 x1/ MIMO / 2Tx on CH 0 & CH 1.
  - 802.11ac VHT20: MCS0 x1/ MIMO / 2Tx on CH 0 & CH 1.
  - 802.11ac VHT40: MCS0 x1/ MIMO / 2Tx on CH 0 & CH 1.
  - 802.11ac VHT80: MCS0 x1/ MIMO / 2Tx on CH 0 & CH 1.

RADIATED MEASUREMENTS:

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

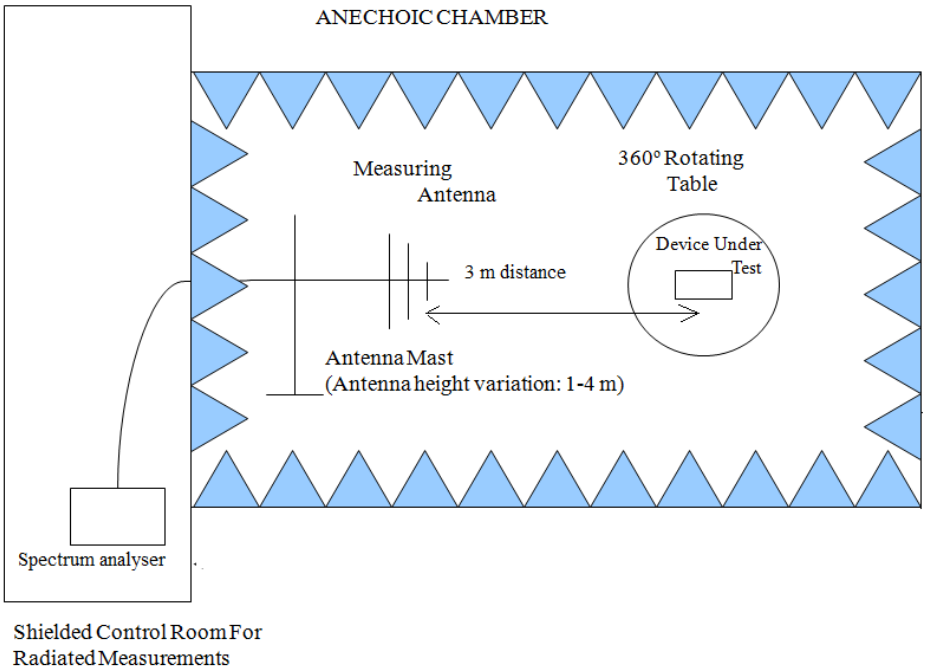
For radiated emissions in the range 1 GHz-40 GHz that is performed at a distance closer than the specified distance, an inverse proportionality factor of 20 dB per decade is used to normalize the measured data for determining compliance.

The EUT was placed at a height of 80 cm above the reference ground plane in the center of the chamber turntable to perform the measurements below 1GHz and The EUT was placed at a height of 1.5 meters above the test chamber floor in the center of the chamber turntable to perform the measurements above 1GHz. It was also rotated 360º and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission.

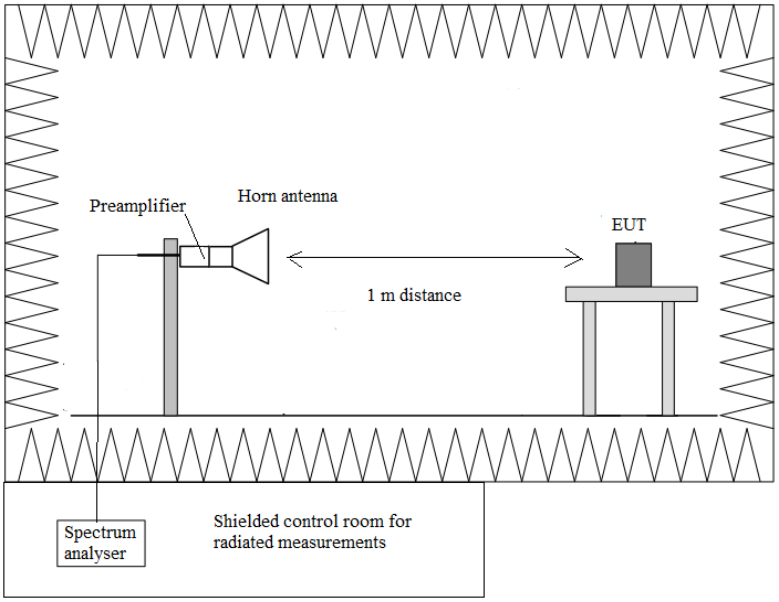
Measurements were made in both horizontal and vertical planes of polarization.

The final measured value, for the given emission, in the tables below incorporates the calibrated antenna factor and cable loss.

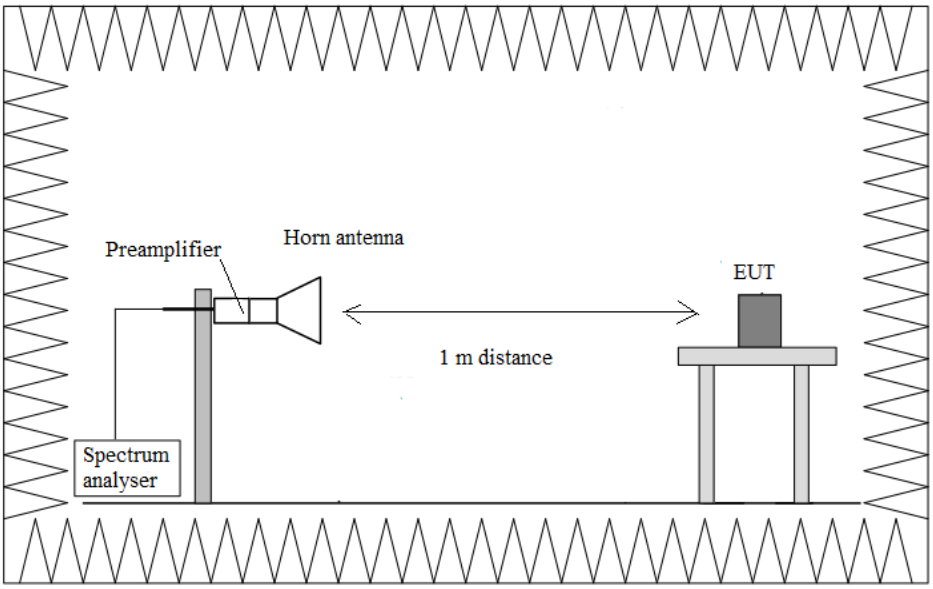
Radiated measurements setup f < 1 GHz:



Radiated measurements setup f > 1 GHz up to 18 GHz:



Radiated measurements setup f > 18 GHz up to 40 GHz:



FCC Section 15.407(b)(1)(6) /RSS-247 6.2.1.2. Transmitter Out of Band Radiated Emissions

SPECIFICATION:

For transmitters operating in the 5.15–5.25 GHz band: all emissions outside of the 5.15–5.35 GHz band shall not exceed an EIRP of –27 dBm/MHz (68.23 dBµV/m at 3 m distance).

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

Frequency Range (MHz)	Field strength (µV/m)	Field strength (dBµV/m)	Measurement distance (m)
0.009-0.490	2400/F(kHz)	-	300
0.490-1.705	24000/F(kHz)	-	300
1.705 - 30.0	30	-	30
30 - 88	100	40	3
88 - 216	150	43.5	3
216 - 960	200	46	3
960 - 40000	500	54	3

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

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

RESULTS:

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

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

All tests were performed in a semi-anechoic chamber at a distance of 1m for the frequency range 1 GHz-40 GHz and a distance of 3m for frequency range 30MHz-1GHz.

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.

Test performed on the following worst case:

- Mode 802.11a20 MCS0 / MIMO (2Tx) on CH 0 & CH 1:

  - Channel 36 (5180 MHz).
  - Channel 40 (5200 MHz).
  - Channel 48 (5240 MHz).

Frequency range 30 MHz - 1 GHz

The spurious emissions below 1 GHz do not depend on either the operating channel or the modulation mode.

Spurious levels operating (radiated) closest to the limit:

Spurious frequency (MHz)	Polarization	Detector	Emission Level (dBµV/m)	Limit (dBµV/m)	Measurement Uncertainty (dB)
30.2425	V	Quasi-Peak	29.3	40	± 2.16
42.2220	V	Quasi-Peak	26.1	40	± 2.16
74.4260	V	Quasi-Peak	20.6	40	± 2.16

Frequency range 1 - 40 GHz

Test performed on the worst case mode as preliminary test determined the highest Power Spectral Density.

- **Mode 802.11a20 – 20MHz – MIMO – CH 0 & CH 1:**

  - Lowest Channel 36 (5180 MHz):

    Radiated spurious signals detected at less than 20 dB below the limit:

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Limit (dBµV/m)	Measurement Uncertainty (dB)
20.71295	H	Peak	44.58	74	± 4.90
		Average	34.66	54	± 4.90

  - Middle Channel 40 (5200 MHz):

    Radiated spurious signals detected at less than 20 dB below the limit:

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Limit (dBµV/m)	Measurement Uncertainty (dB)
20.79275	H	Peak	45.58	74	± 4.90
		Average	35.18	54	± 4.90

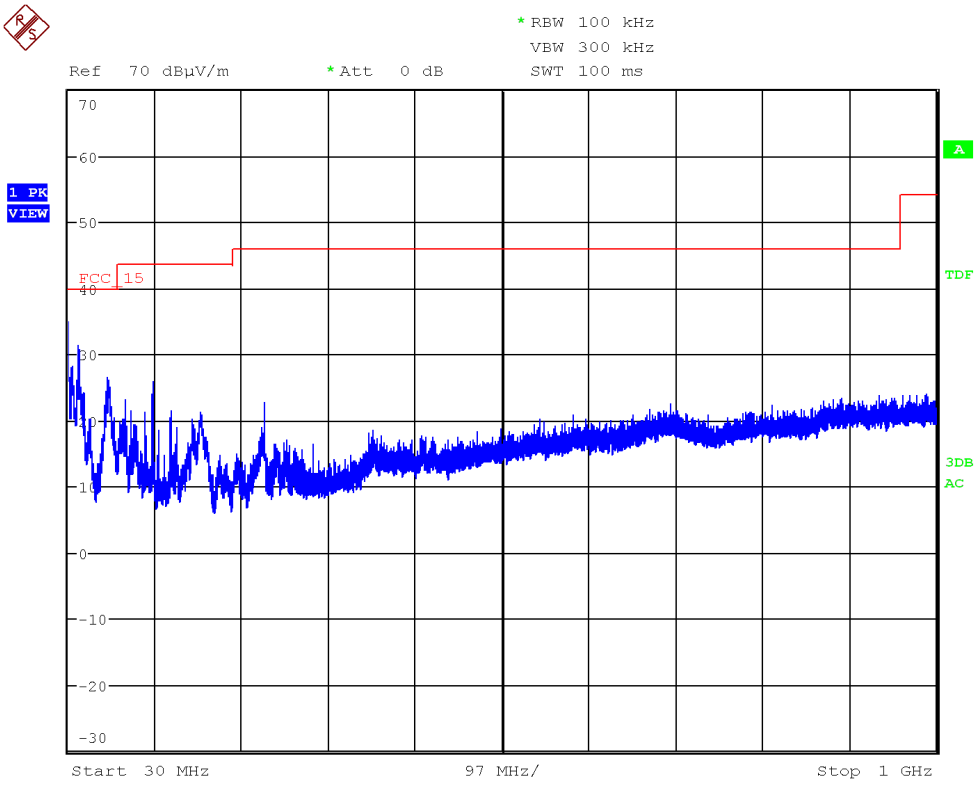
  - Highest Channel 48 (5240 MHz):

    Radiated spurious signals detected at less than 20 dB below the limit:

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Limit (dBµV/m)	Measurement Uncertainty (dB)
20.96195	H	Peak	44.34	74	± 4.90
		Average	34.70	54	± 4.90

Verdict: PASS

FREQUENCY RANGE 30 MHz - 1 GHz:

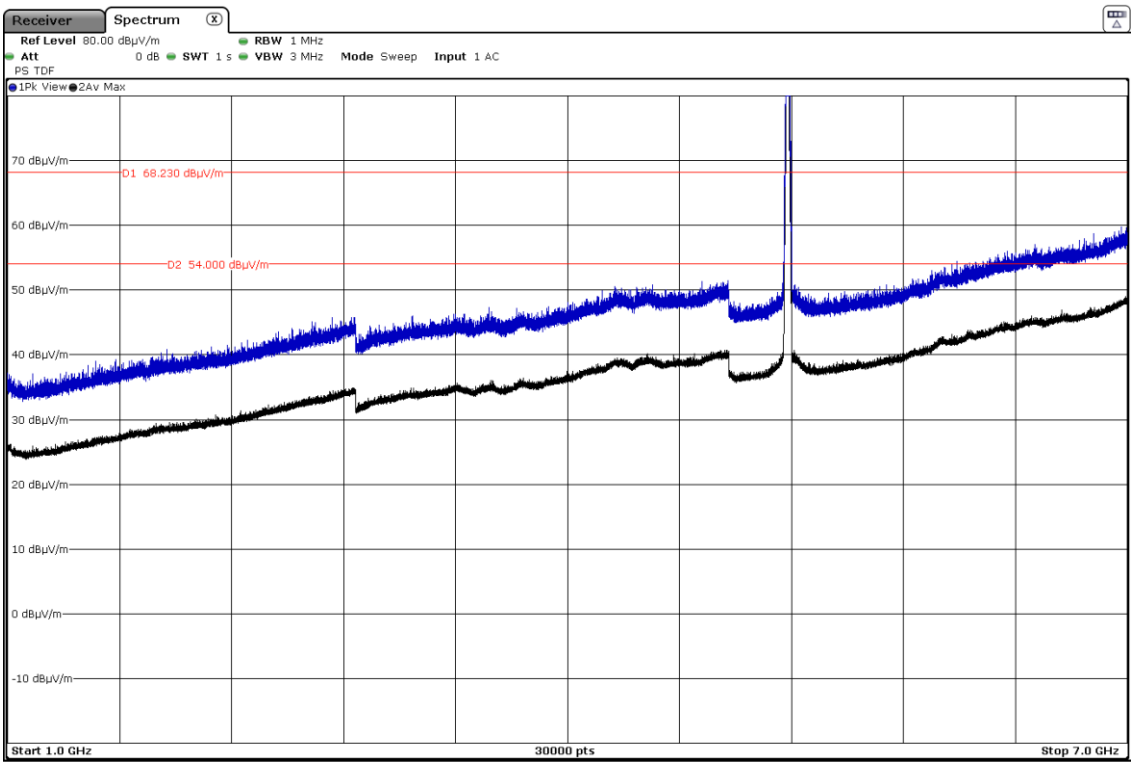


The spurious frequencies do not depend on the operating channel.
This plot is valid for the Lowest, Middle and Highest Channels.

FREQUENCY RANGE 1 - 7 GHz:

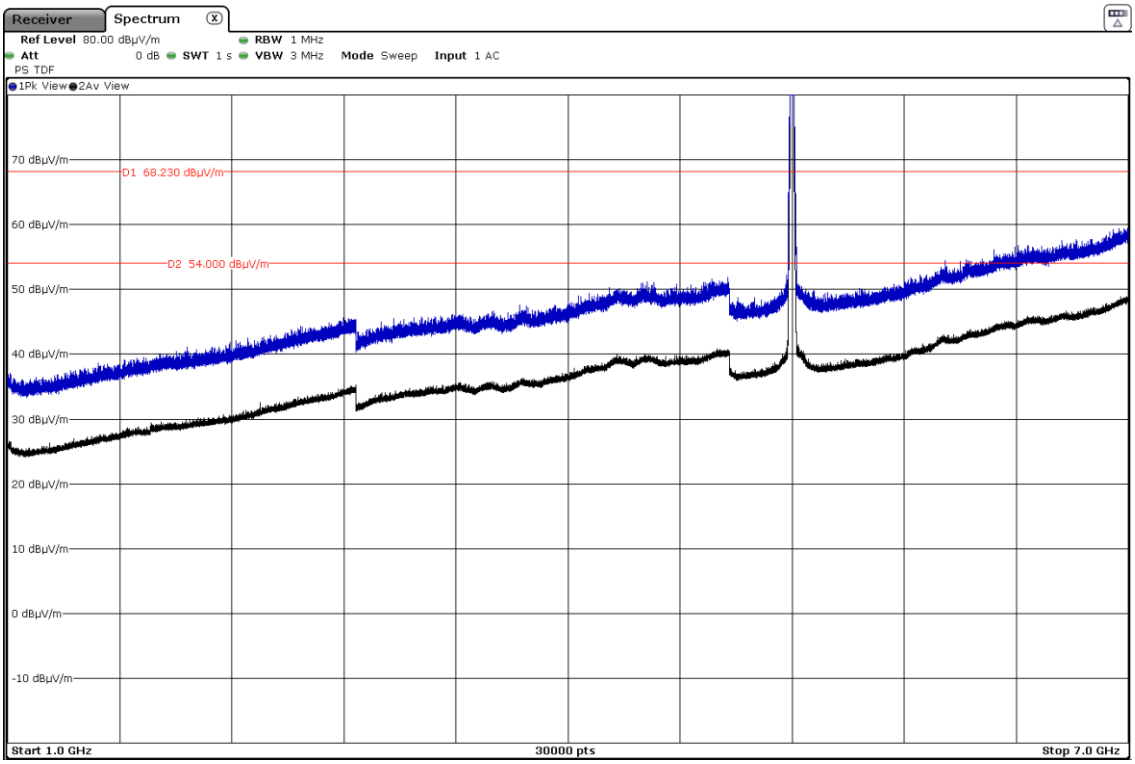
- **Mode 802.11a20 – 20MHz – MIMO – CH 0 & CH 1:**

Lowest Channel 36 (5180 MHz):



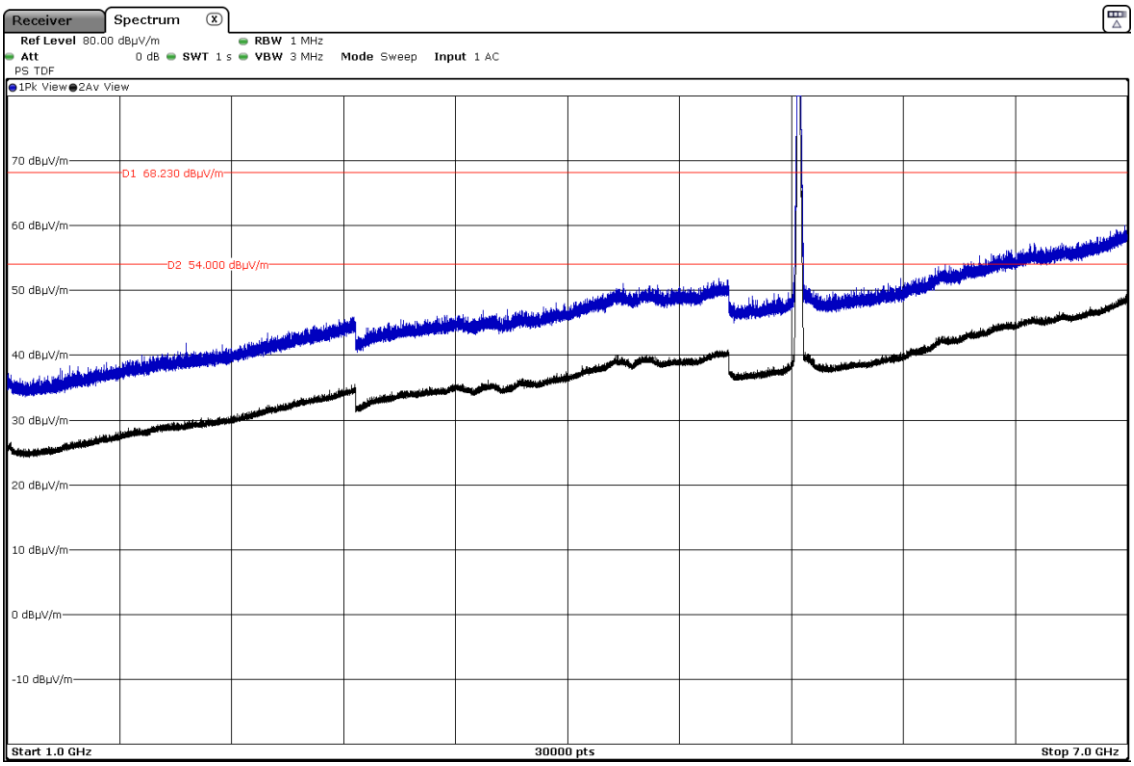
The peak shown in the plot above the limit is the carrier frequency.

Middle Channel 40 (5200 MHz):



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

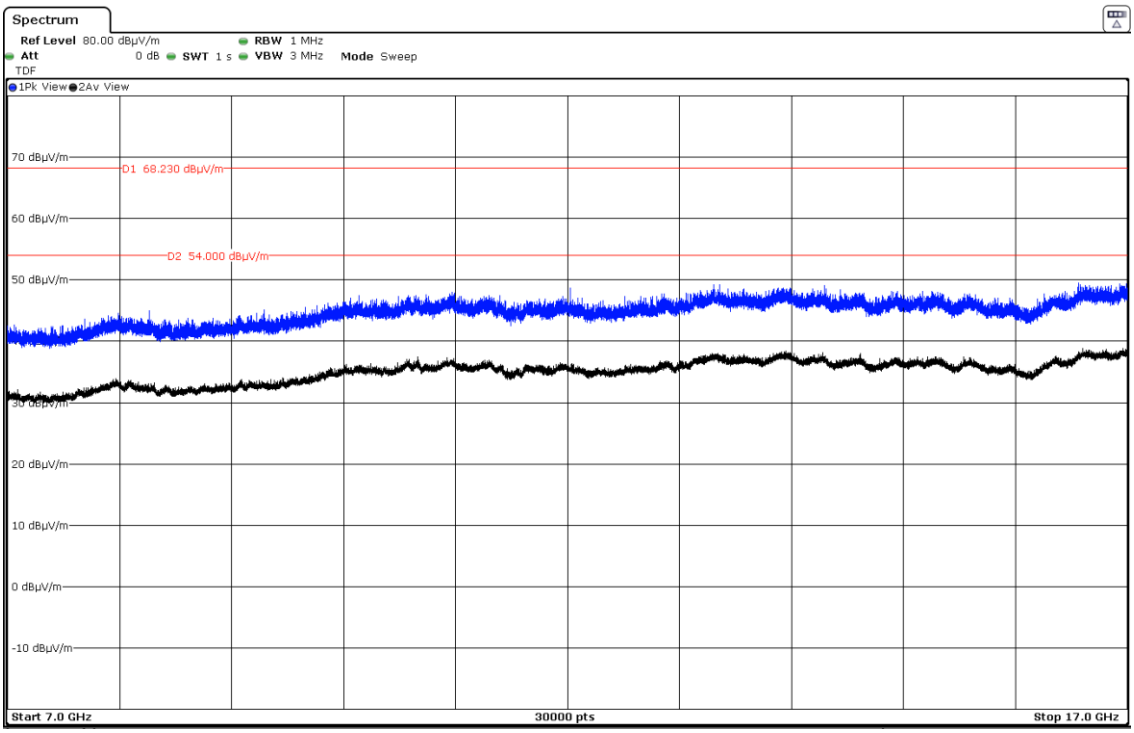
Highest Channel 48 (5240 MHz):



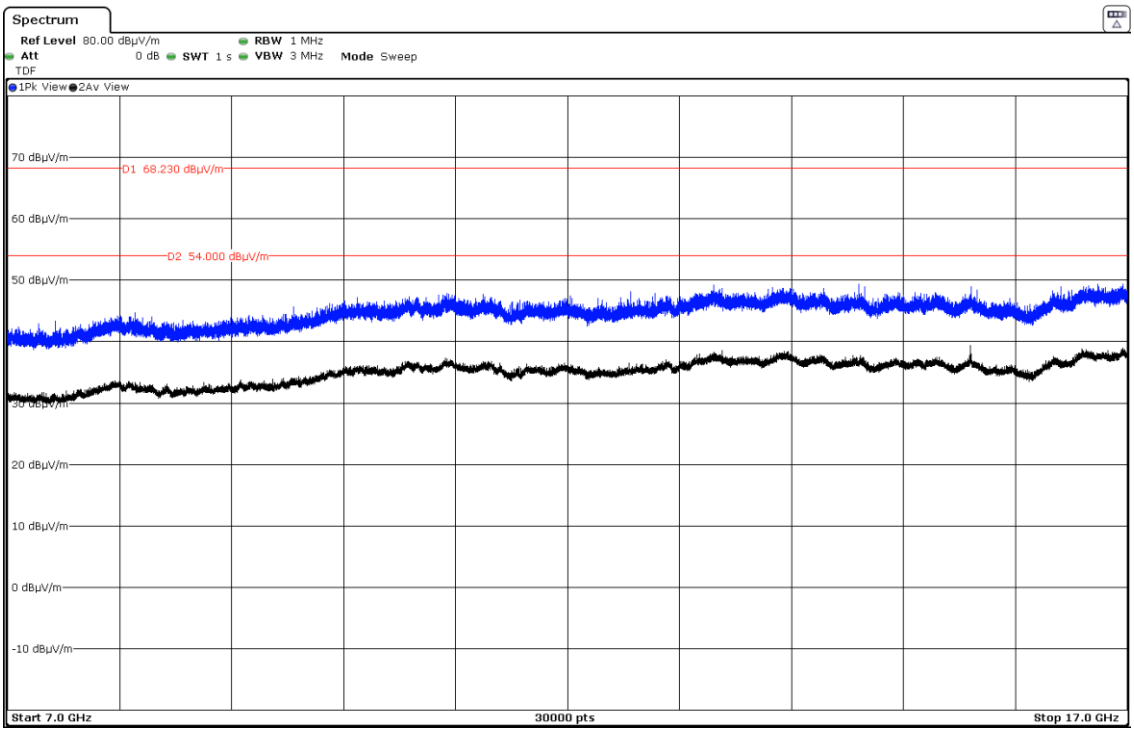
FREQUENCY RANGE 7 - 17 GHz:

- **Mode 802.11a20 – 20MHz – MIMO – CH 0 & CH 1:**

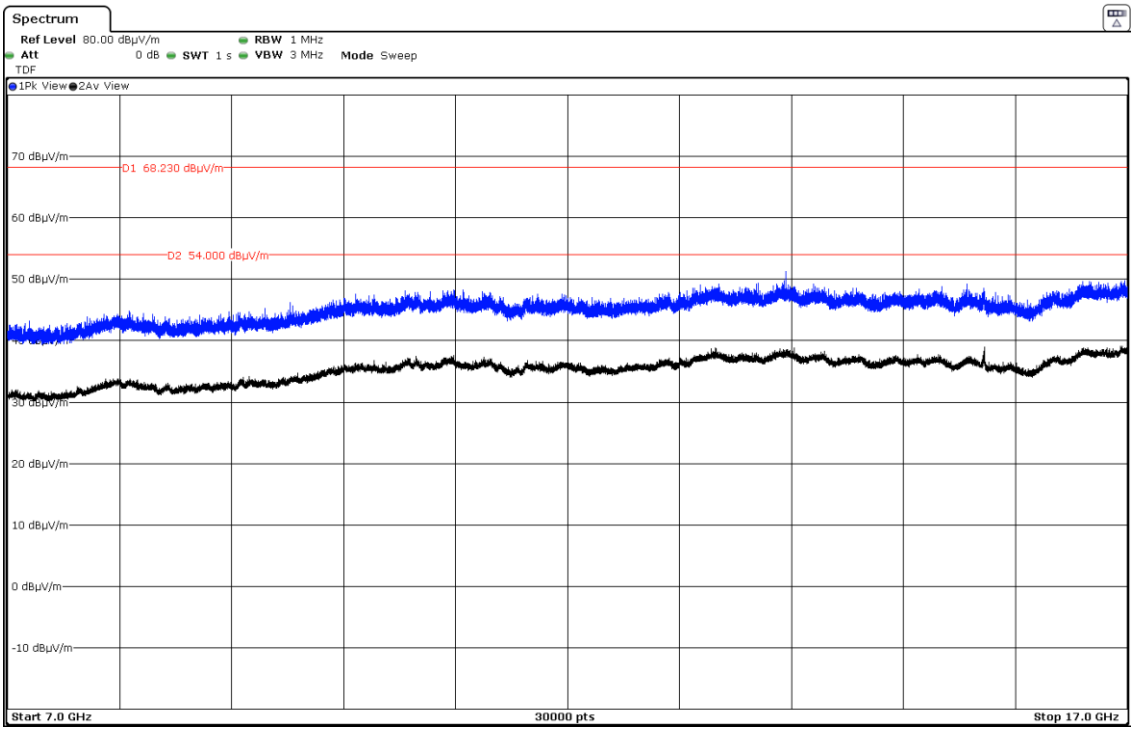
Lowest Channel 36 (5180 MHz):



Middle Channel 40 (5200 MHz):



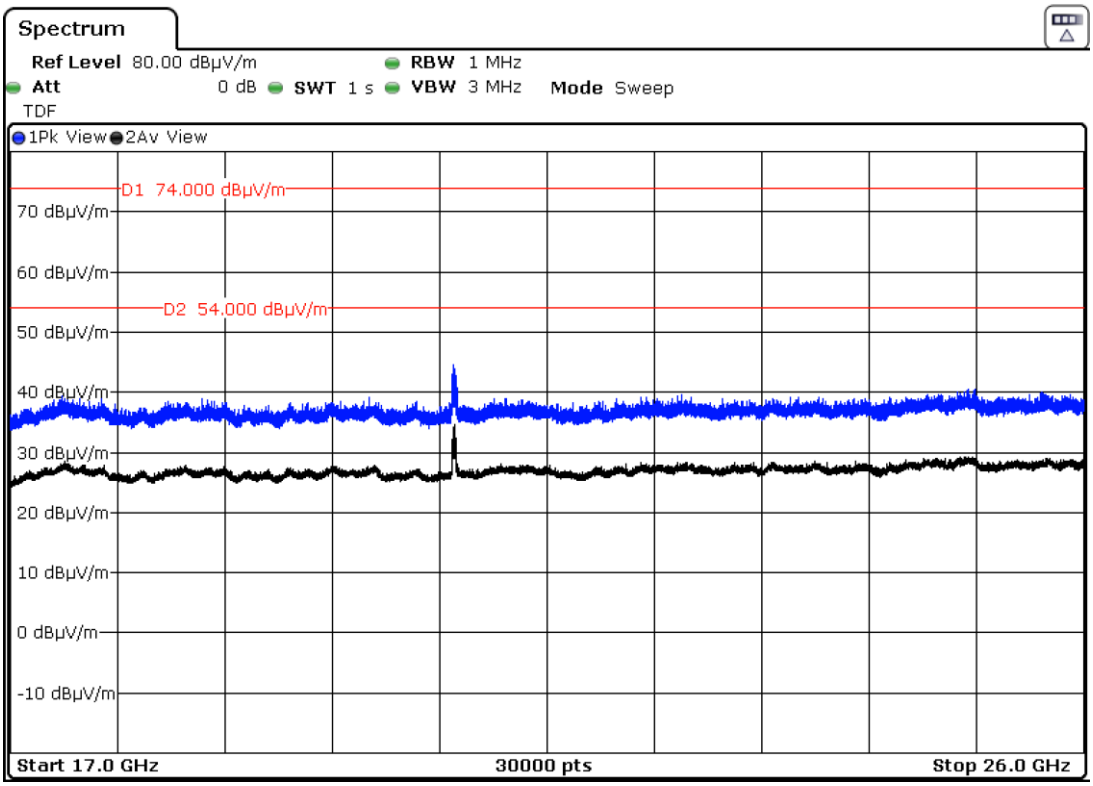
Highest Channel 48 (5240 MHz):



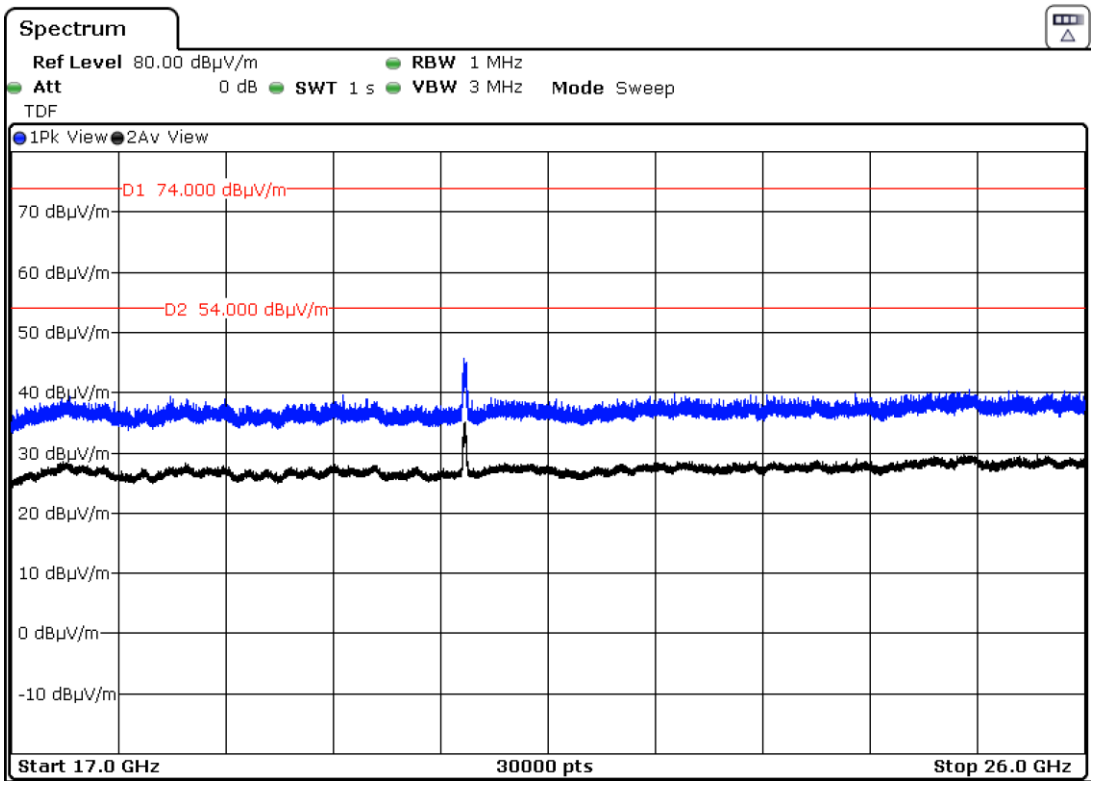
FREQUENCY RANGE 17 - 26 GHz:

- **Mode 802.11a20 – 20MHz – MIMO – CH 0 & CH 1:**

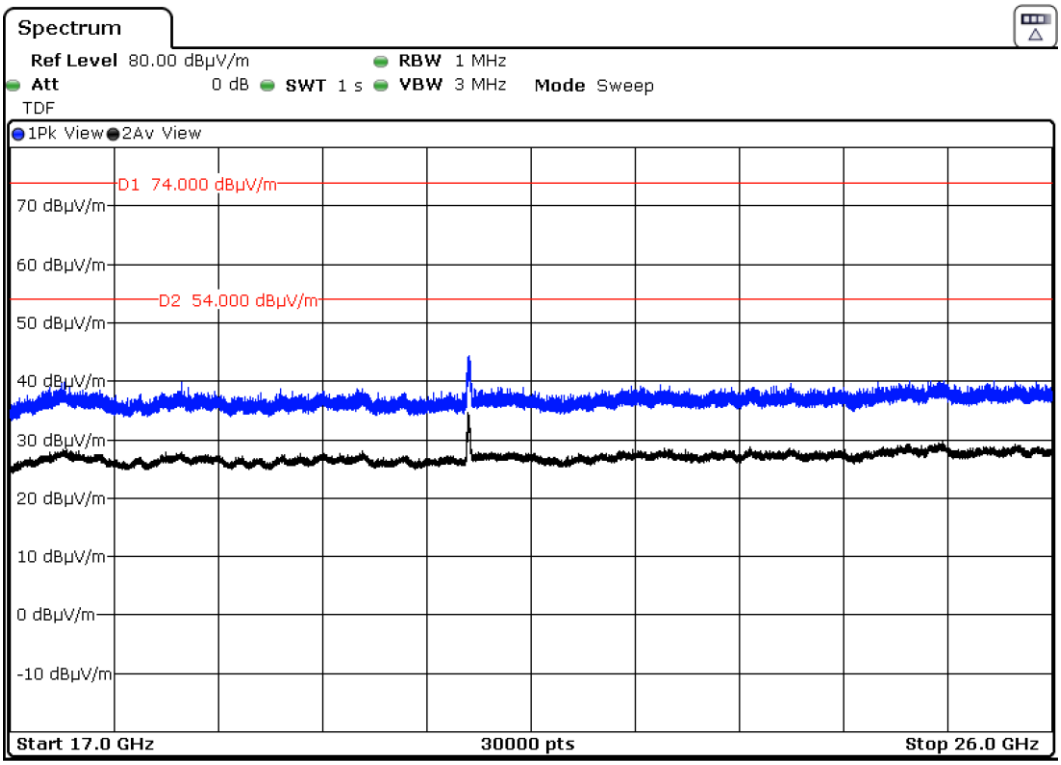
Lowest Channel 36 (5180 MHz):



Middle Channel 40 (5200 MHz):

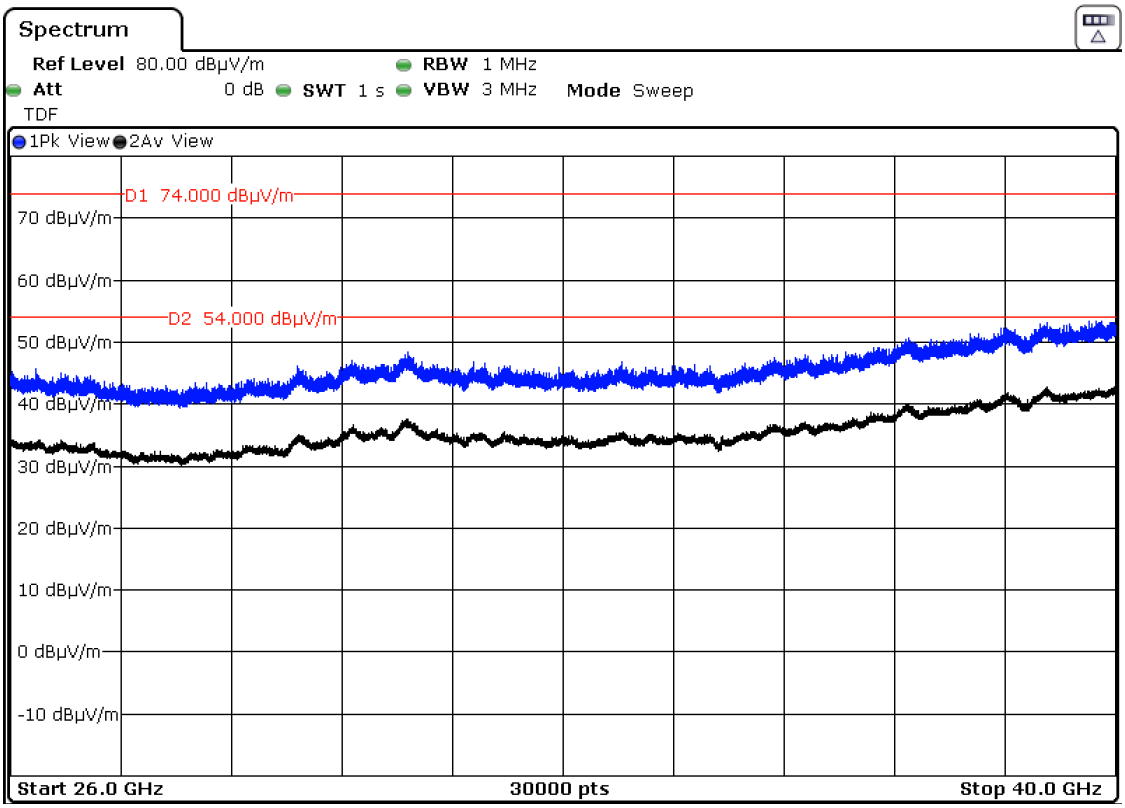


Highest Channel 48 (5240 MHz):



FREQUENCY RANGE 26 - 40 GHz:

- **Mode 802.11a20 – 20MHz – MIMO – CH 0 & CH 1:**



The spurious frequencies do not depend on the operating channel.
This plot is valid for the Lowest, Middle and Highest Channels.

FCC Section 15.407 Subclause (b) (1) / RSS-247 6.2.1.2. Transmitter Band Edge Radiated Emissions.

SPECIFICATION:

For transmitters operating in the 5.15–5.25 GHz band: all emissions outside of the 5.15–5.35 GHz band shall not exceed an EIRP of –27 dBm/MHz (68.20 dBµV/m at 3 m distance).

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

Frequency Range (MHz)	Field strength (µV/m)	Field strength (dBµV/m)	Measurement distance (m)
0.009-0.490	2400/F(kHz)	-	300
0.490-1.705	24000/F(kHz)	-	300
1.705 - 30.0	30	-	30
30 - 88	100	40	3
88 - 216	150	43.5	3
216 - 960	200	46	3
960 - 40000	500	54	3

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

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

RESULTS:

The 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.

All emissions outside of the 5.15-5.35 GHz band shall not exceed an EIRP of -27dBm/MHz.
There are restricted bands of operation below band edge at 4.5-5.15 GHz and also above the upper band edge at 5.35-5.46 GHz, therefore the provision of FCC Part 15.205 apply.

Field strength measurements using peak and average detector were performed in the restricted bands below 5.15 GHz and above 5.35 GHz.

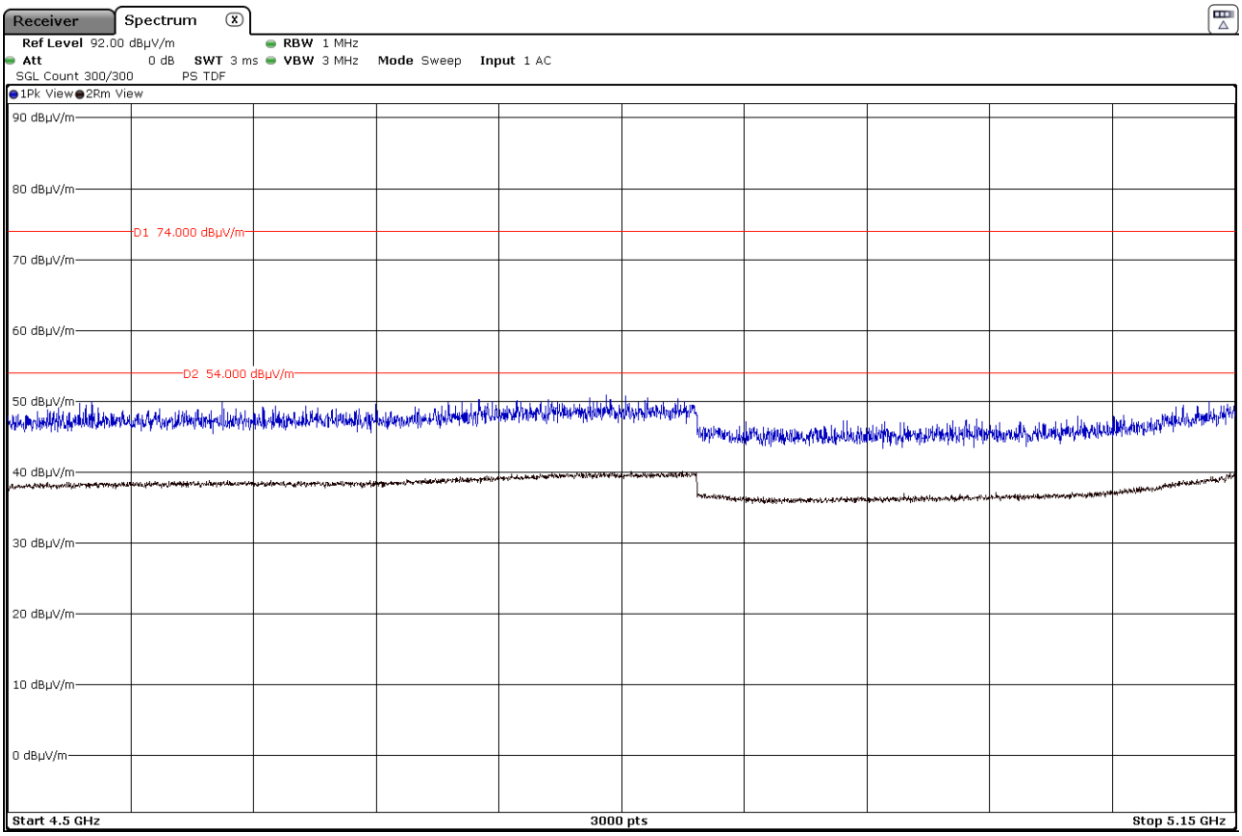
Test performed on the following worst cases modes in all relevant tests channels:

- 802.11a: 6 Mbits x1/ MIMO / 2Tx on CH 0 & CH 1.
- 802.11n HT20: MCS0 x1/ MIMO / 2Tx on CH 0 & CH 1.
- 802.11n HT40: MCS0 x1/ MIMO / 2Tx on CH 0 & CH 1.
- 802.11ac VHT20: MCS0 x1/ MIMO / 2Tx on CH 0 & CH 1.
- 802.11ac VHT40: MCS0 x1/ MIMO / 2Tx on CH 0 & CH 1.
- 802.11ac VHT80: MCS0 x1/ MIMO / 2Tx on CH 0 & CH 1.

- **Mode 802.11a20 – 20 MHz – MIMO – CH 0 & CH 1 – Lowest Channel (36):**

  RESTRICTED BAND 4.5-5.15 GHz: No spurious frequencies were detected.

LOWER BAND EDGE: Channel 36

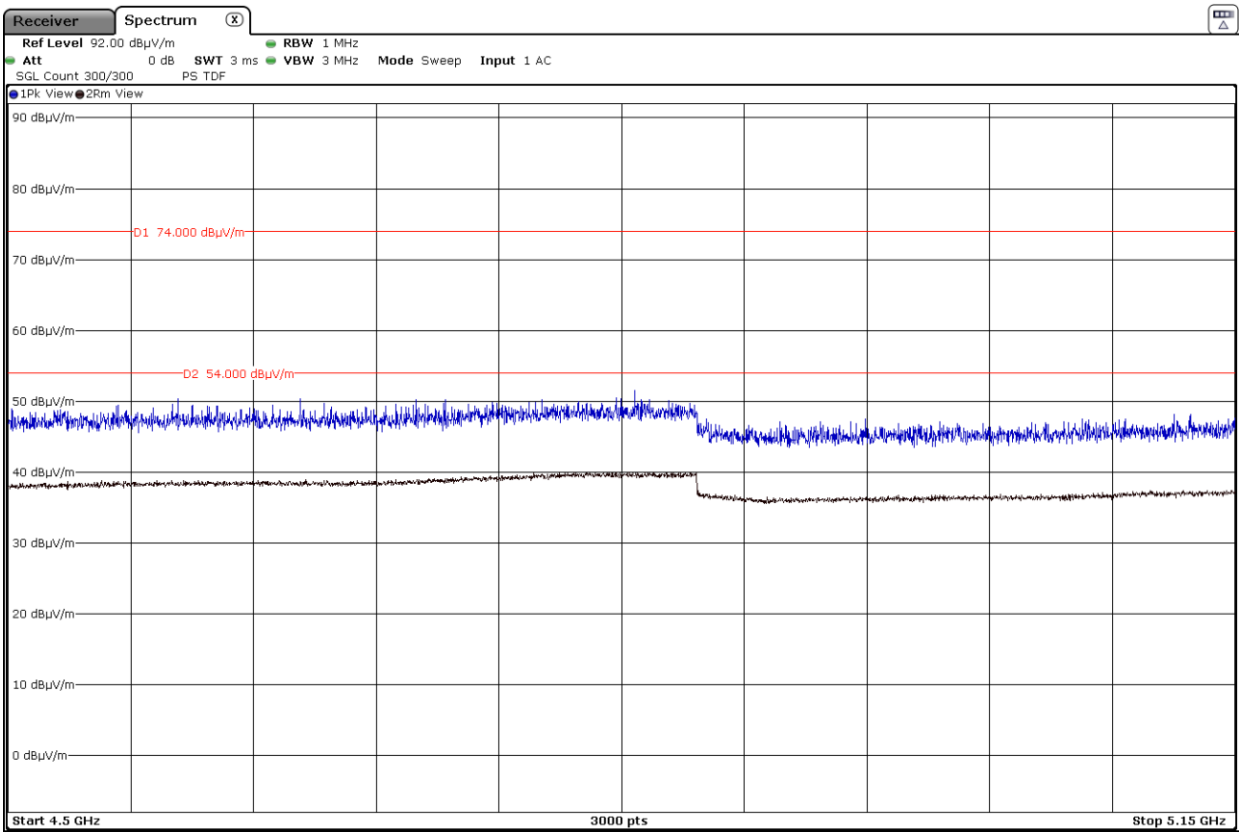


Measurement Uncertainty (dB)	<± 3.07

- **Mode 802.11n HT20 – 20 MHz – MIMO – CH 0 & CH 1 – Lowest Channel (36):**

  RESTRICTED BAND 4.5-5.15 GHz: No spurious frequencies were detected.

LOWER BAND EDGE: Channel 36



Measurement Uncertainty (dB)	<± 3.07

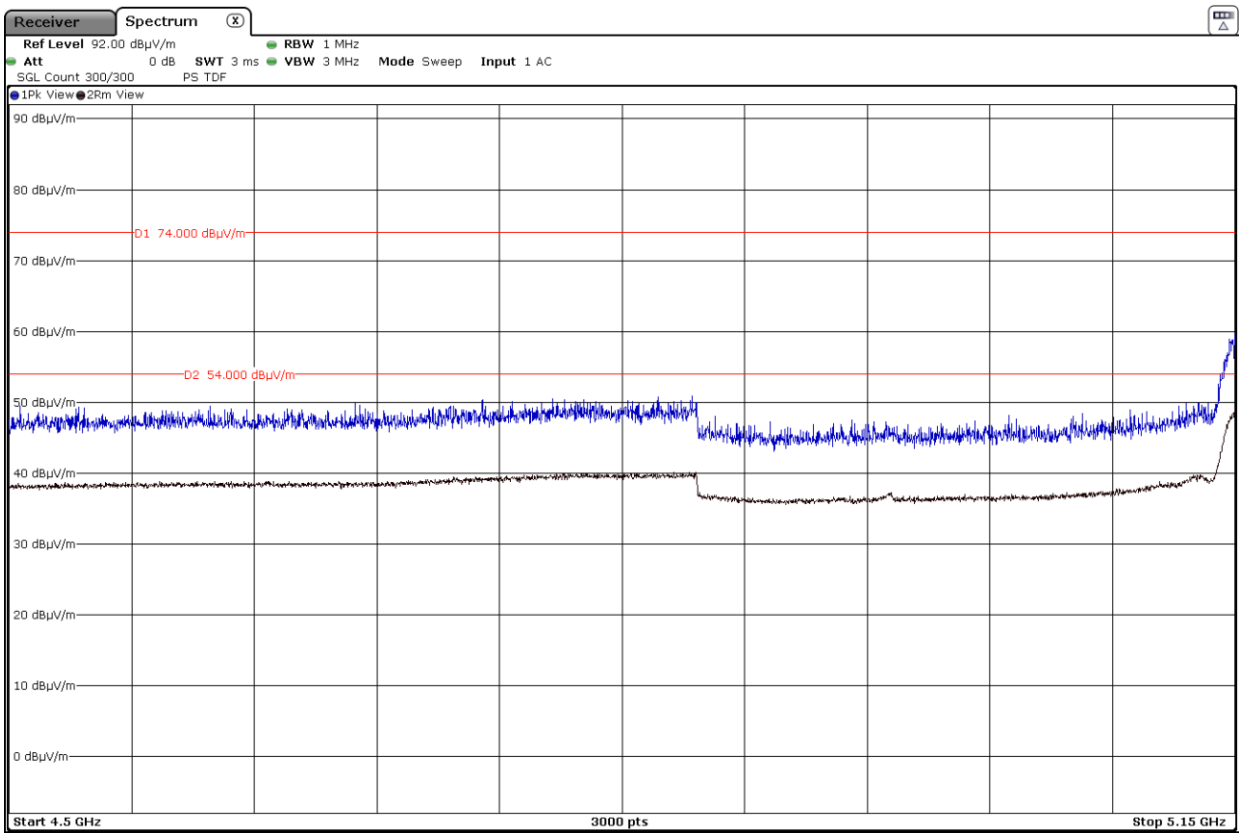
- **Mode 802.11n HT40 – 40 MHz – MIMO – CH 0 & CH 1 – Lowest Channel (38):**

  - Lowest Channel 38 (5190 MHz):

RESTRICTED BAND 4.5-5.15 GHz: Radiated spurious frequencies detected:

Frequency (GHz)	Detector	Polarization	E Level (dBuV/m)	Limit (dBuv/m)	Measurement uncertainty (dB)	Verdict
5.14968	Peak	H	59.65	74	<± 3.07	PASS
	Average		48.56	54	<± 3.07	PASS

LOWER BAND EDGE: Channel 38



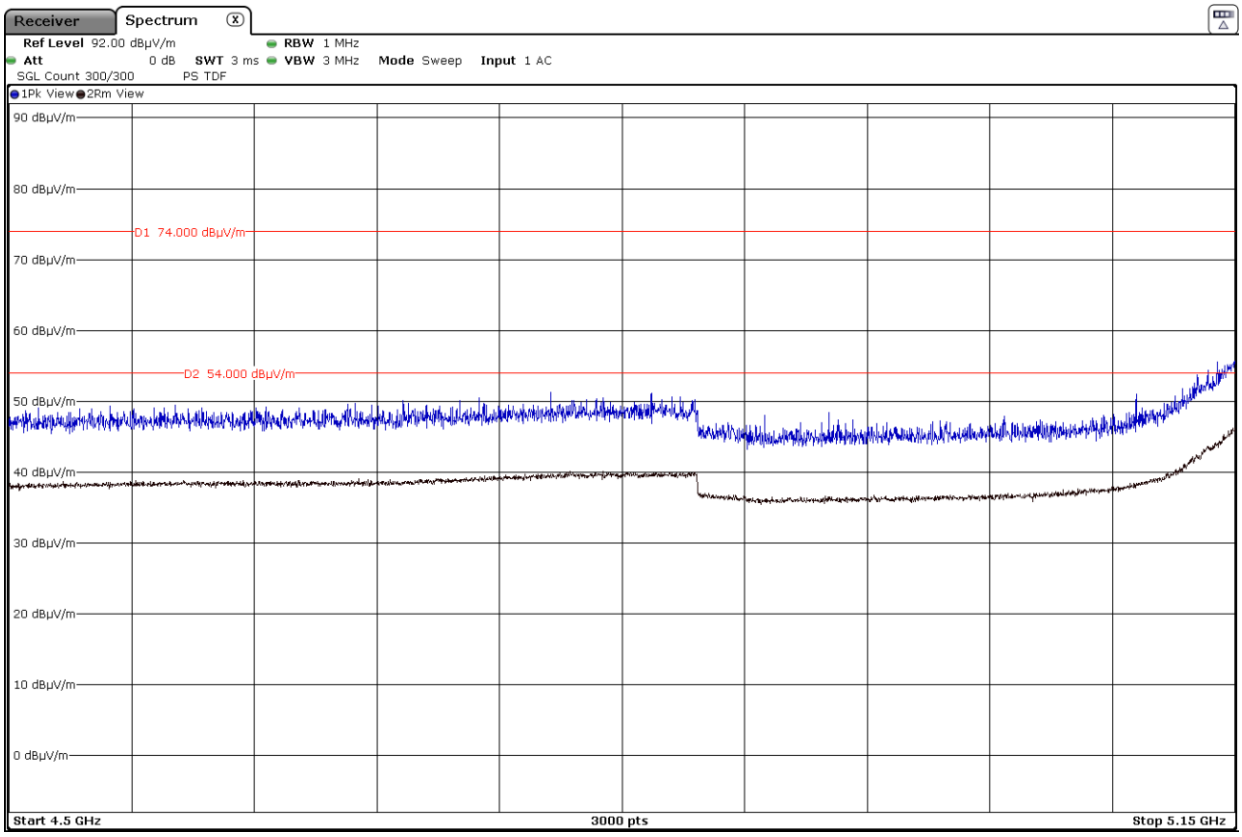
- **Mode 802.11ac VHT80 – 80 MHz – MIMO – CH 0 & CH 1 – Lowest Channel (42):**

  - Lowest Channel 42 (5210 MHz):

RESTRICTED BAND 4.5-5.15 GHz: Radiated spurious frequencies detected:

Frequency (GHz)	Detector	Polarization	E Level (dBuV/m)	Limit (dBuv/m)	Measurement uncertainty (dB)	Verdict
5.14968	Peak	H	55.74	74	<± 3.07	PASS
	Average		46.27	54	<± 3.07	PASS

LOWER BAND EDGE: Channel 42



Appendix B: Test result for 5.25GHz – 5.35GHz.

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FCC Section 15.407(b)(2)(6) /RSS-247 6.2.2.2. Transmitter Out of Band Radiated Emissions 35
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TEST CONDITIONS

POWER SUPPLY (V):

V nonimal: 3.8 Vdc

Type of Power Supply: Rechargeable battery.

Type of Antenna: Internal:

CHAIN 0: Monopole.

CHAIN 1: Monopole with parasitic resonator.

Antennas Gain:

- CHAIN 0 – Maximum Declared Antenna Gain: -1.1 dBi
- CHAIN 1 – Maximum Declared Antenna Gain: -1.1 dBi
- MIMO – CHAIN 0 Antenna & CHAIN 1 Antenna.

TEST FREQUENCIES:

Technology Tested:	WLAN (IEEE 802.11 a20 / n2040 / ac204080 2x2) / U-NII-2A	
Modes:	802.11a: 6, 9, 12, 18, 24, 36, 48 & 54 Mbps	
	802.11n HT20: MCS0 to MCS23	
	802.11n HT40: MCS0 to MCS23	
	802.11ac VHT20: MCS0 to MCS9	
	802.11ac VHT40: MCS0 to MCS9	
	802.11ac VHT80: MCS0 to MCS9	
Setting of cores / ports:	0+1.	
Beamforming:	No.	
Frequency Range:	5250 - 5350 MHz	
Operating Channel Bandwidth:	20 MHz	
Transmit Channels:	CHANNEL	CHANNEL FREQUENCY (MHz)
	Lowest: 52	5260
	Middle: 56	5280
	Highest: 64	5320
Operating Channel Bandwidth:	40 MHz	
Transmit Channels:	CHANNEL	CHANNEL FREQUENCY (MHz)
	Highest: 62	5310
Operating Channel Bandwidth:	80 MHz	
Transmit Channel:	CHANNEL	CHANNEL FREQUENCY (MHz)
	Middle: 58	5290

The test set-up was made in accordance to the general provisions of FCC Unlicensed National Information Infrastructure (U-NII) Devices 789033 D02 General U-NII Test Procedures New Rules v02r01 dated Dec 14, 2017.

The sample was used to configure the EUT to continuously transmit at a specified output power in all channels with different modes and modulation schemes.

The EUT was tested in the following operating mode:

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

The field strength at the band edges was evaluated for each mode on the lowest and highest channels at the rated power for the channel under test
For all modes, the EUT was configured in test mode using a software application.
The application was used to enable a continuous transmission and to select the test channels as required.
The client supplied instructions to configure the EUT. The customer supplied a document containing the setup instructions.

The worst cases for testing were identified for output power and spurious levels at the band edges which were selected based on preliminary testing that correspond to next data rates:

- 802.11a: 6 Mbits x1/ MIMO / 2Tx on CH 0 & CH 1.
- 802.11n HT20: MCS0 x1/ MIMO / 2Tx on CH 0 & CH 1.
- 802.11n HT40: MCS0 x1/ MIMO / 2Tx on CH 0 & CH 1.
- 802.11ac VHT20: MCS0 x1/ MIMO / 2Tx on CH 0 & CH1.
- 802.11ac VHT40: MCS0 x1/ MIMO / 2Tx on CH 0 & CH1.
- 802.11ac VHT80: MCS0 x1/ MIMO / 2Tx on CH 0 & CH 1.

RADIATED MEASUREMENTS:

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

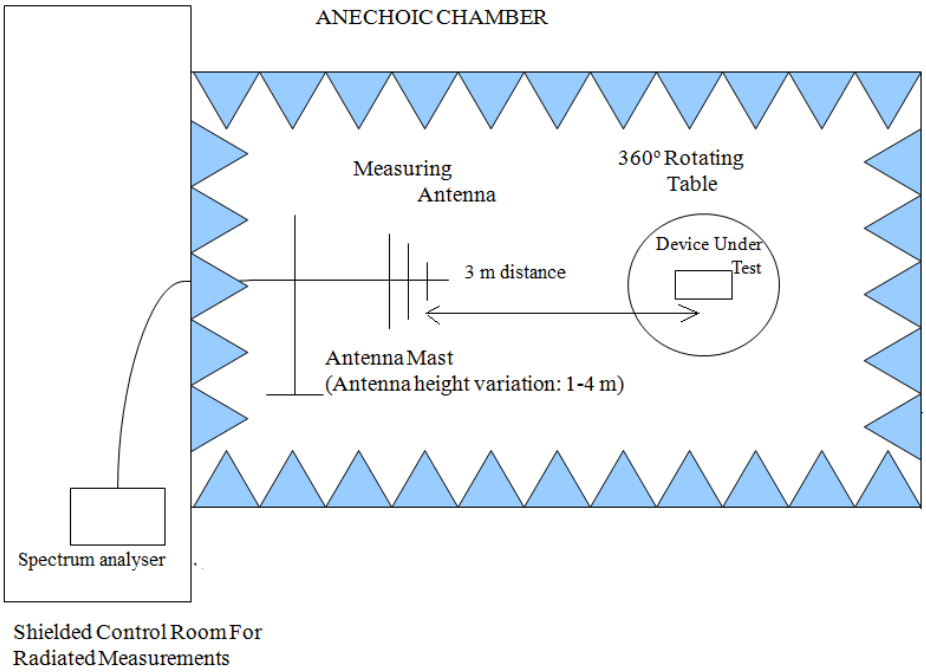
For radiated emissions in the range 1 GHz-40 GHz that is performed at a distance closer than the specified distance, an inverse proportionality factor of 20 dB per decade is used to normalize the measured data for determining compliance.

The EUT was placed at a height of 80 cm above the reference ground plane in the center of the chamber turntable to perform the measurements below 1GHz and The EUT was placed at a height of 1.5 meters above the test chamber floor in the center of the chamber turntable to perform the measurements above 1GHz. It was also rotated 360º and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission.

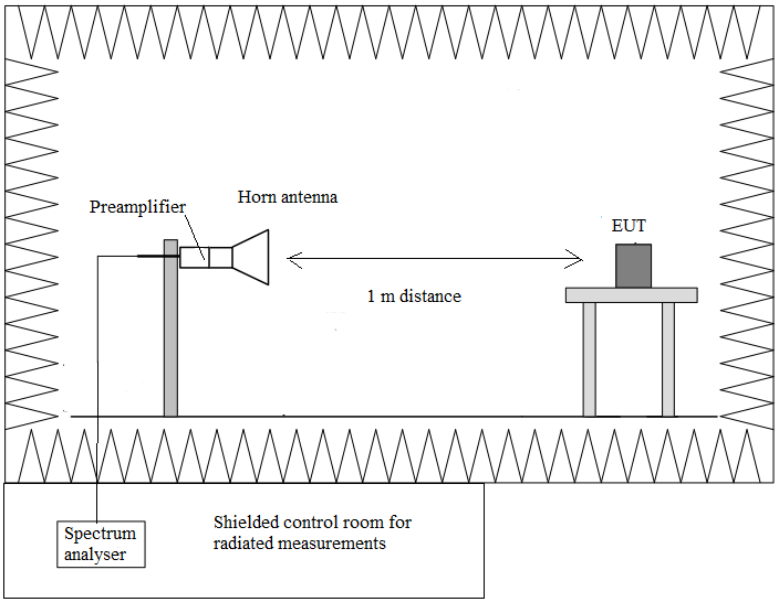
Measurements were made in both horizontal and vertical planes of polarization.

The final measured value, for the given emission, in the tables below incorporates the calibrated antenna factor and cable loss.

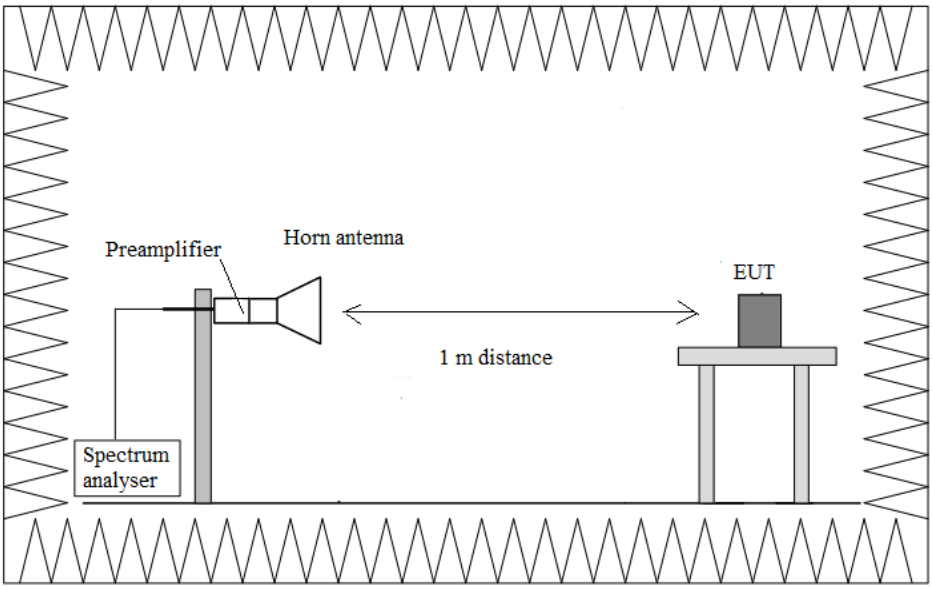
Radiated measurements setup f < 1 GHz:



Radiated measurements setup f > 1 GHz up to 18 GHz:



Radiated measurements setup f > 18 GHz up to 40 GHz:



FCC Section 15.407(b)(2)(6) /RSS-247 6.2.2.2. Transmitter Out of Band Radiated Emissions

SPECIFICATION:

For transmitters operating in the 5.25–5.35 GHz band: all emissions outside of the 5.15–5.35 GHz band shall not exceed an EIRP of –27 dBm/MHz (68.23 dBµV/m at 3 m distance).

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

Frequency Range (MHz)	Field strength (µV/m)	Field strength (dBµV/m)	Measurement distance (m)
0.009-0.490	2400/F(kHz)	-	300
0.490-1.705	24000/F(kHz)	-	300
1.705 - 30.0	30	-	30
30 - 88	100	40	3
88 - 216	150	43.5	3
216 - 960	200	46	3
960 - 40000	500	54	3

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

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

RESULTS:

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

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

All tests were performed in a semi-anechoic chamber at a distance of 1m for the frequency range 1 GHz-40 GHz and a distance of 3m for frequency range 30MHz-1GHz.

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.

Test performed on the following worst case mode:

- Mode 802.11a20 MCS0 / MIMO (2Tx) on CH 0 & CH 1:

Frequency range 30 MHz - 1 GHz

The spurious emissions below 1 GHz do not depend on either the operating channel or the modulation mode.

Spurious frequencies at less than 20 dB below the limit:

Spurious frequency (MHz)	Polarization	Detector	Emission Level (dBµV/m)	Limit (dBµV/m)	Measurement Uncertainty (dB)
30.00	V	Quasi-Peak	25.9	40	± 2.16
42.028	V	Quasi-Peak	26.2	40	± 2.16
124.769	V	Quasi-Peak	26.2	43.5	± 2.16

Frequency range 1 - 40 GHz

Test performed on the worst case mode as preliminary test determined it has the highest Power Spectral Density.

- **Mode 802.11a20 – 20MHz – MIMO – CH 0 & CH 1:**

- <u>Lowest Channel 52 (5260 MHz):</u>

  No spurious signals detected at less than 20 dB below the limit.

- <u>Middle Channel 56 (5280 MHz):</u>

  No spurious signals detected at less than 20 dB below the limit.

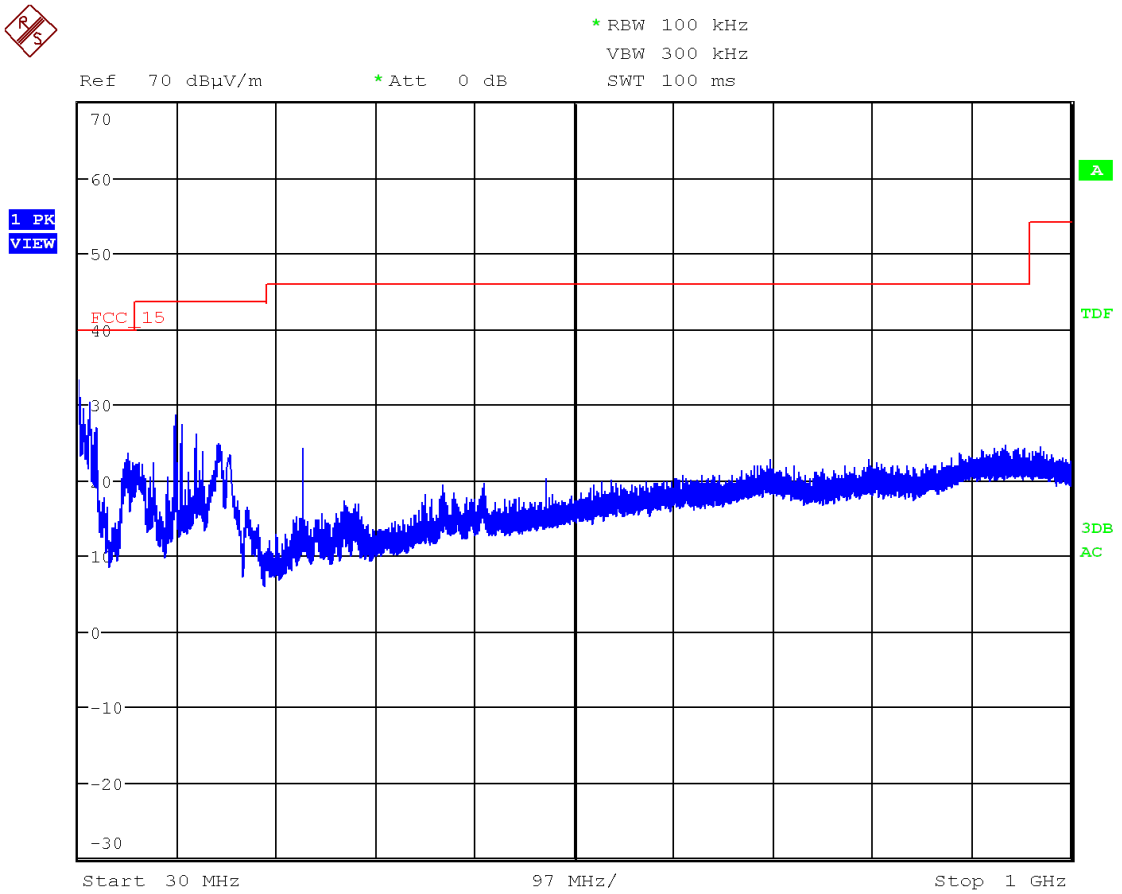
- <u>Highest Channel 64 (5320 MHz):</u>

  No spurious signals detected at less than 20 dB below the limit.

Measurement Uncertainty (dB)	<± 4.90

Verdict: PASS

FREQUENCY RANGE 30 MHz - 1 GHz:

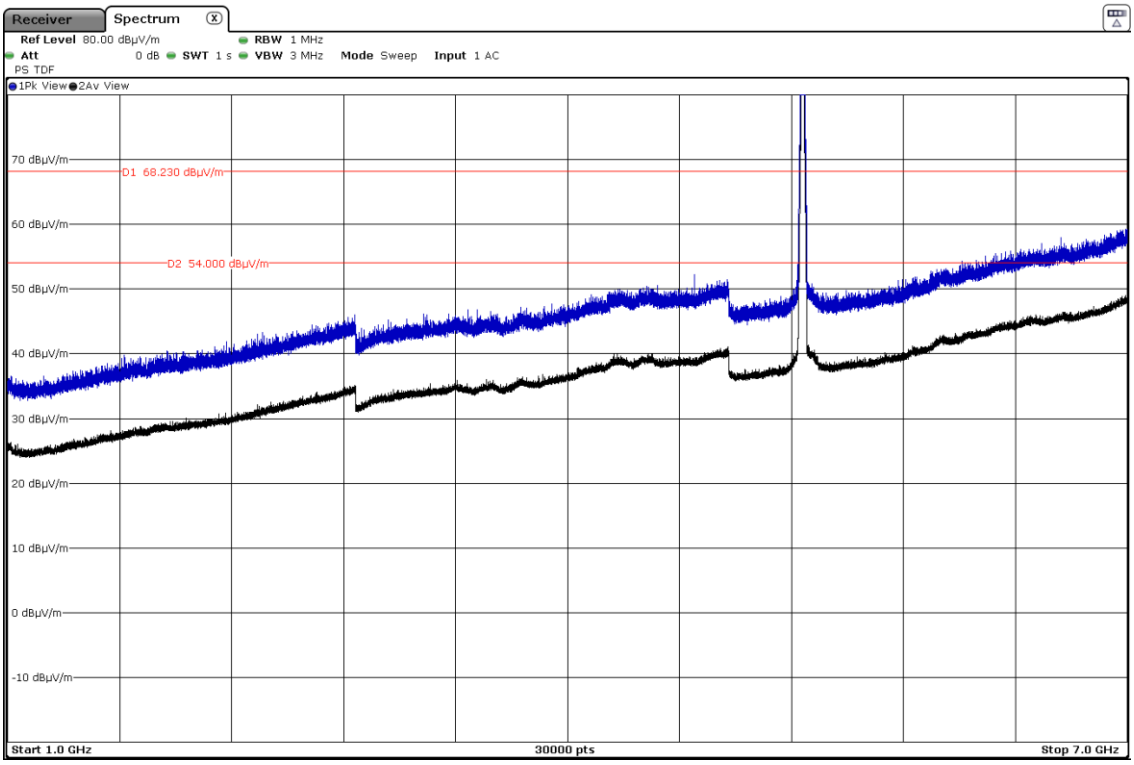


The spurious frequencies do not depend on the operating channel.
This plot is valid for the Lowest, Middle and Highest Channels.

FREQUENCY RANGE 1 - 7 GHz:

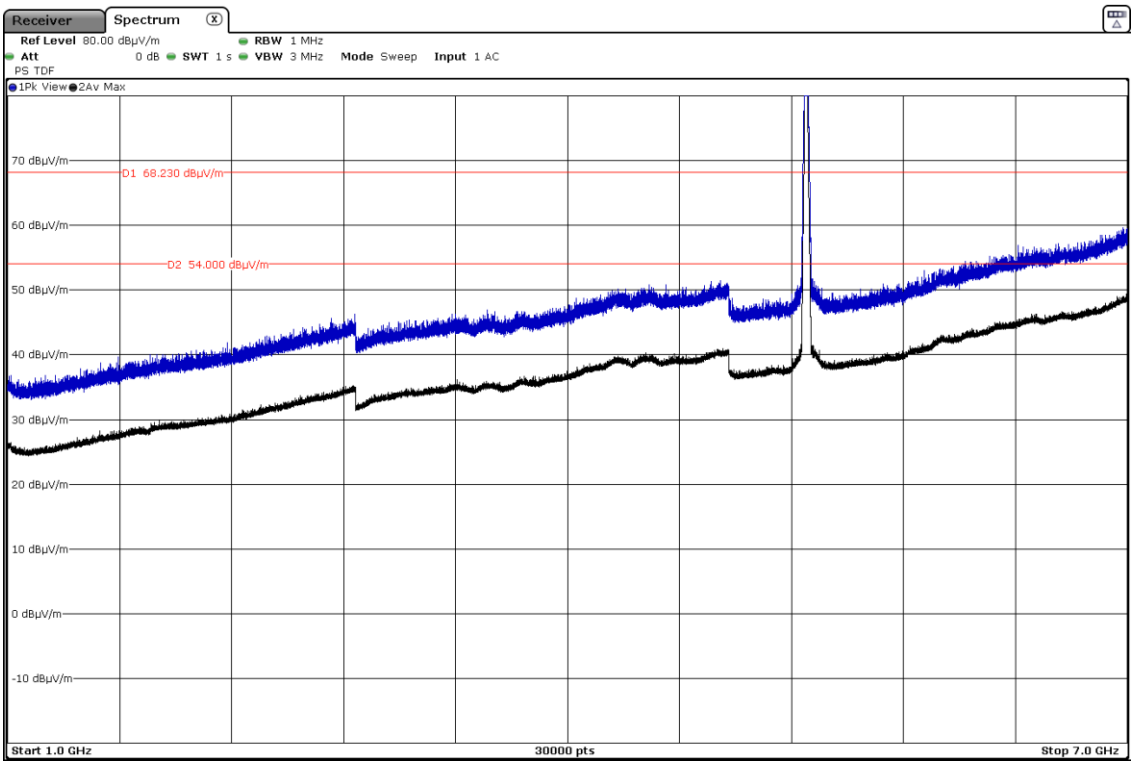
- **Mode 802.11a20 – 20MHz – MIMO – CH 0 & CH 1:**

Lowest Channel 52 (5260 MHz):



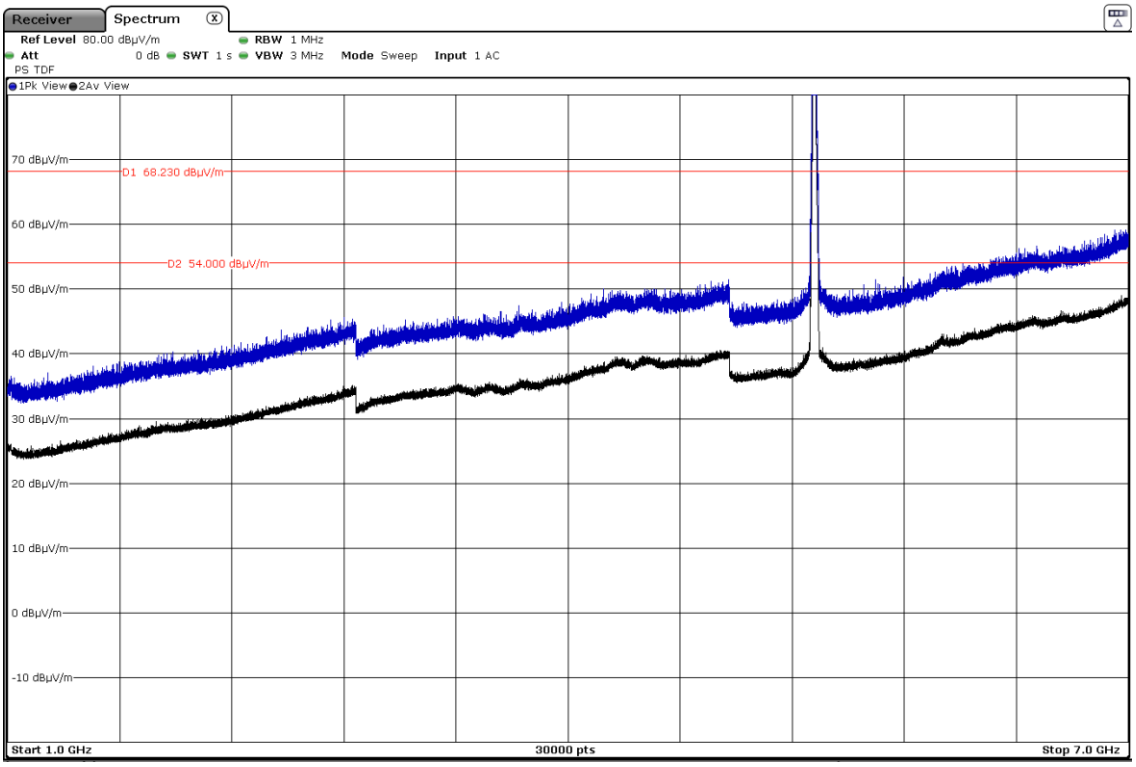
The peak shown in the plot above the limit is the carrier frequency.

Middle Channel 56 (5280 MHz):



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

Highest Channel 64 (5320 MHz):

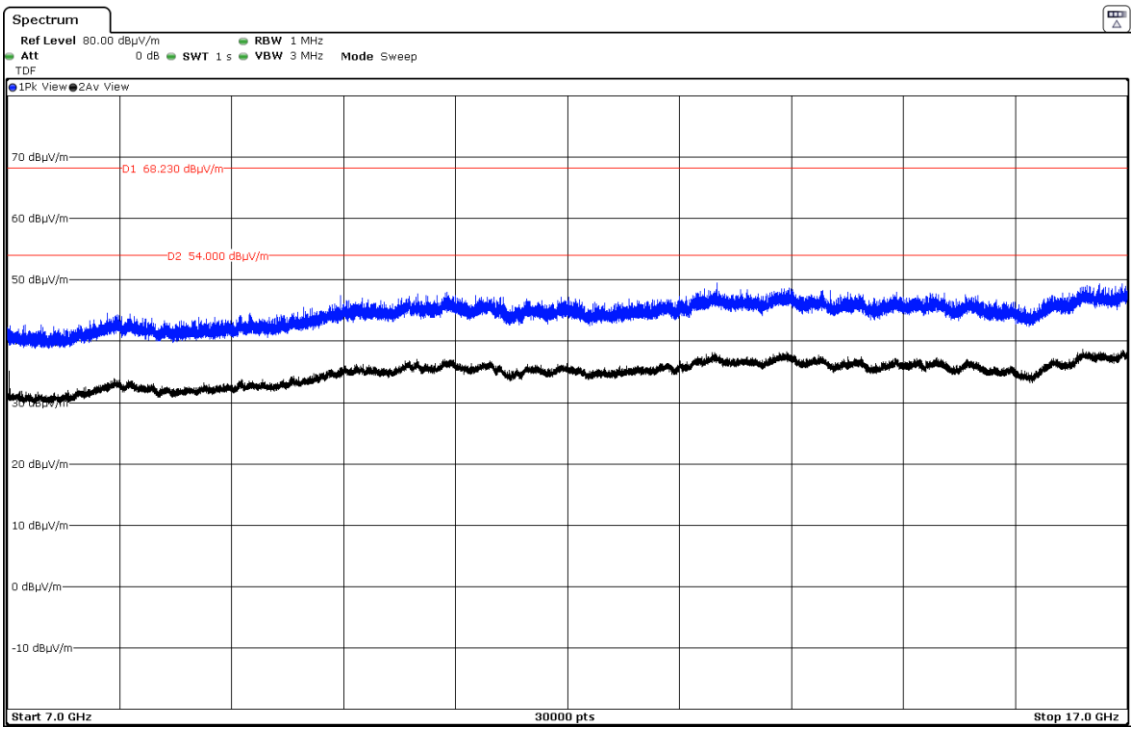


The peak shown in the plot above the limit is the carrier frequency.

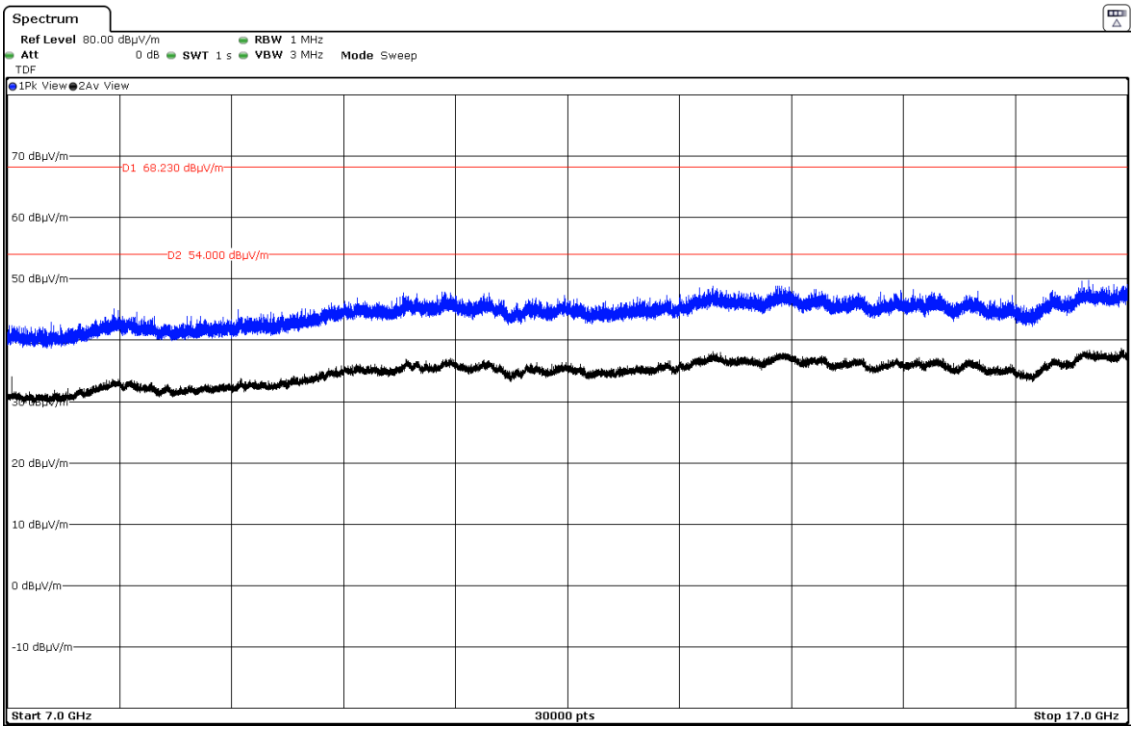
FREQUENCY RANGE 7 - 17 GHz:

- **Mode 802.11a20 – 20MHz – MIMO – CH 0 & CH 1:**

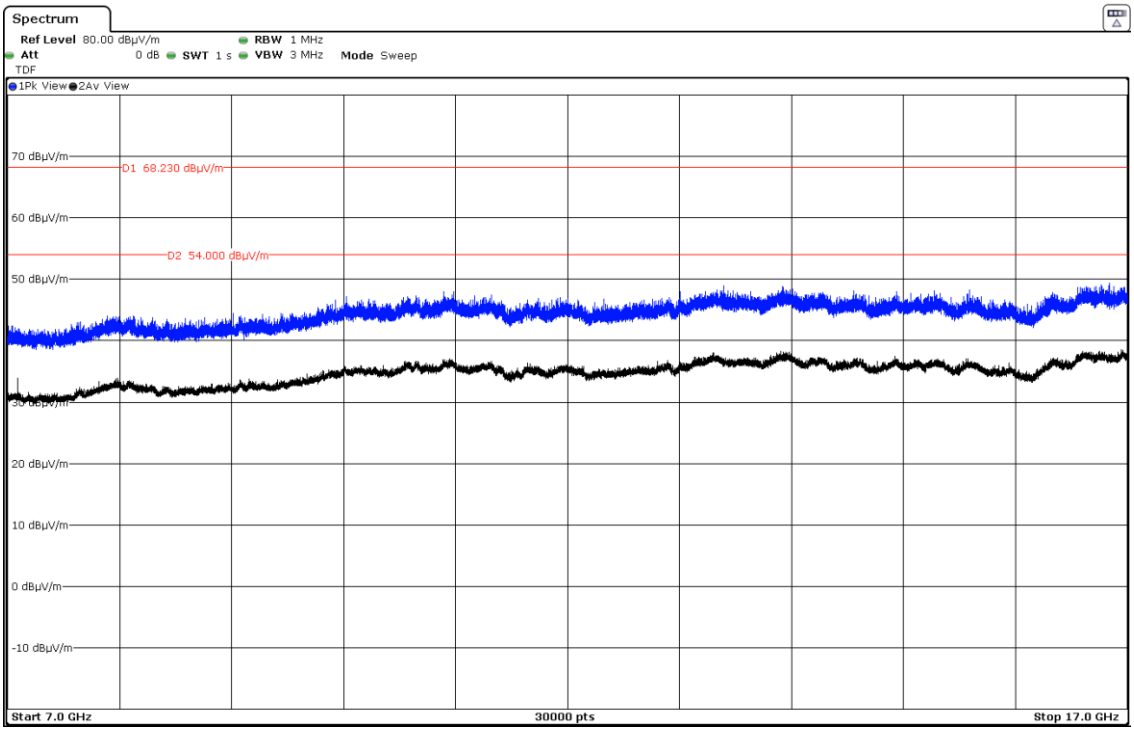
Lowest Channel 52 (5260 MHz):



Middle Channel 56 (5280 MHz):



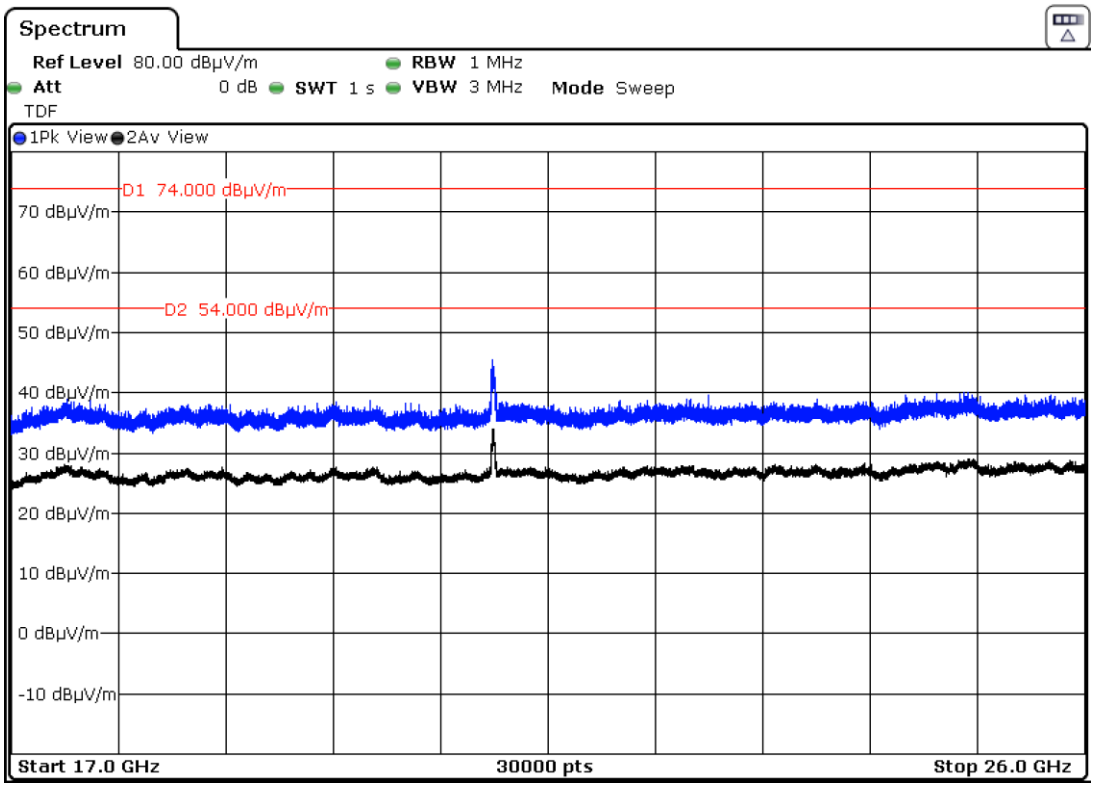
Highest Channel 64 (5320 MHz):



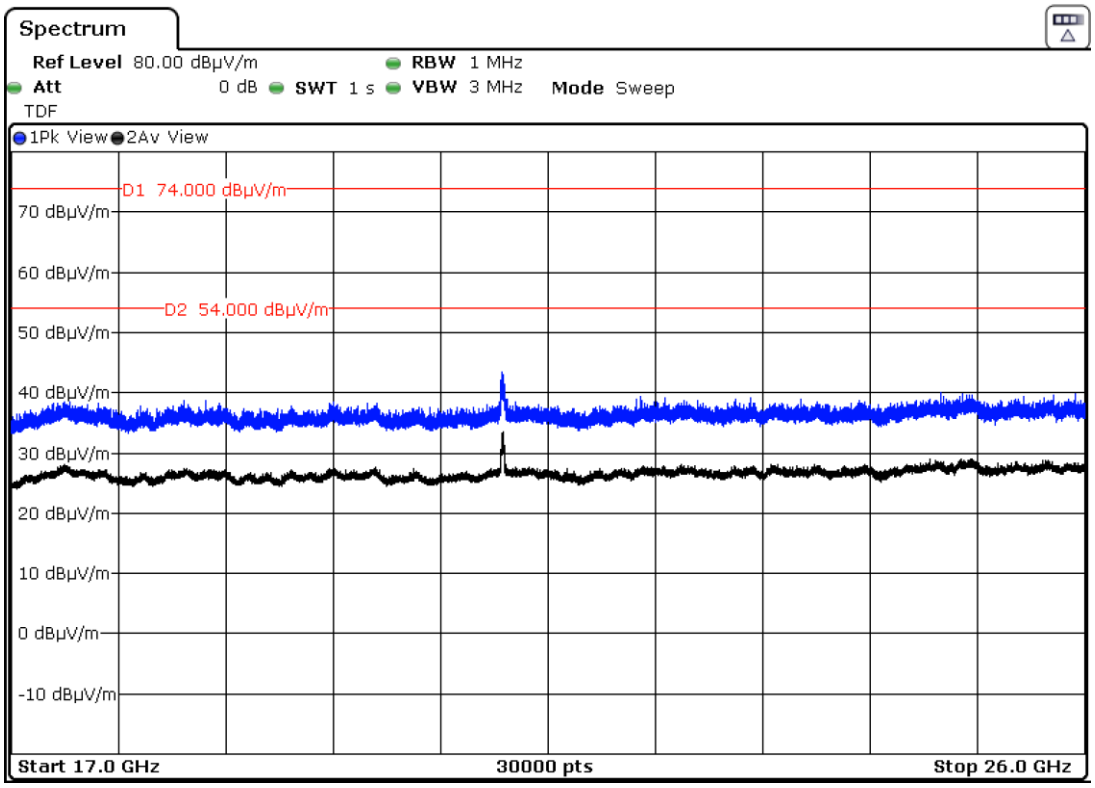
FREQUENCY RANGE 17 - 26 GHz:

- **Mode 802.11a20 – 20MHz – MIMO – CH 0 & CH 1:**

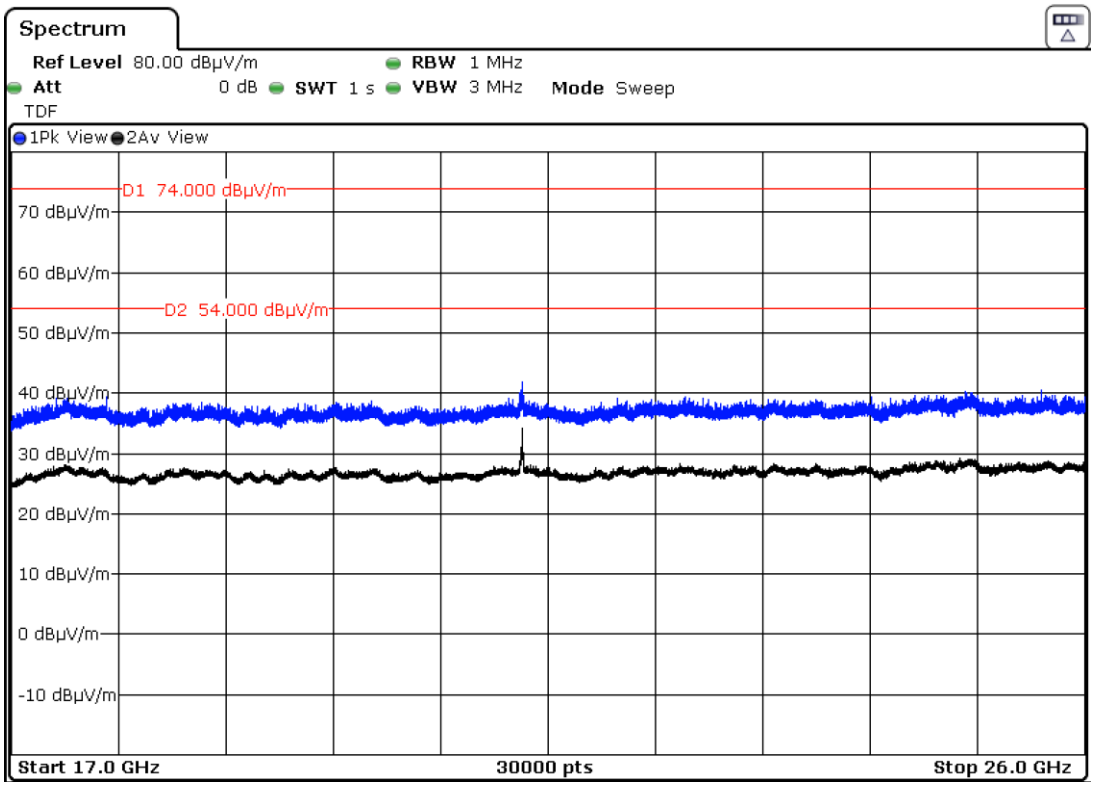
Lowest Channel 52 (5260 MHz):



Middle Channel 56 (5280 MHz):

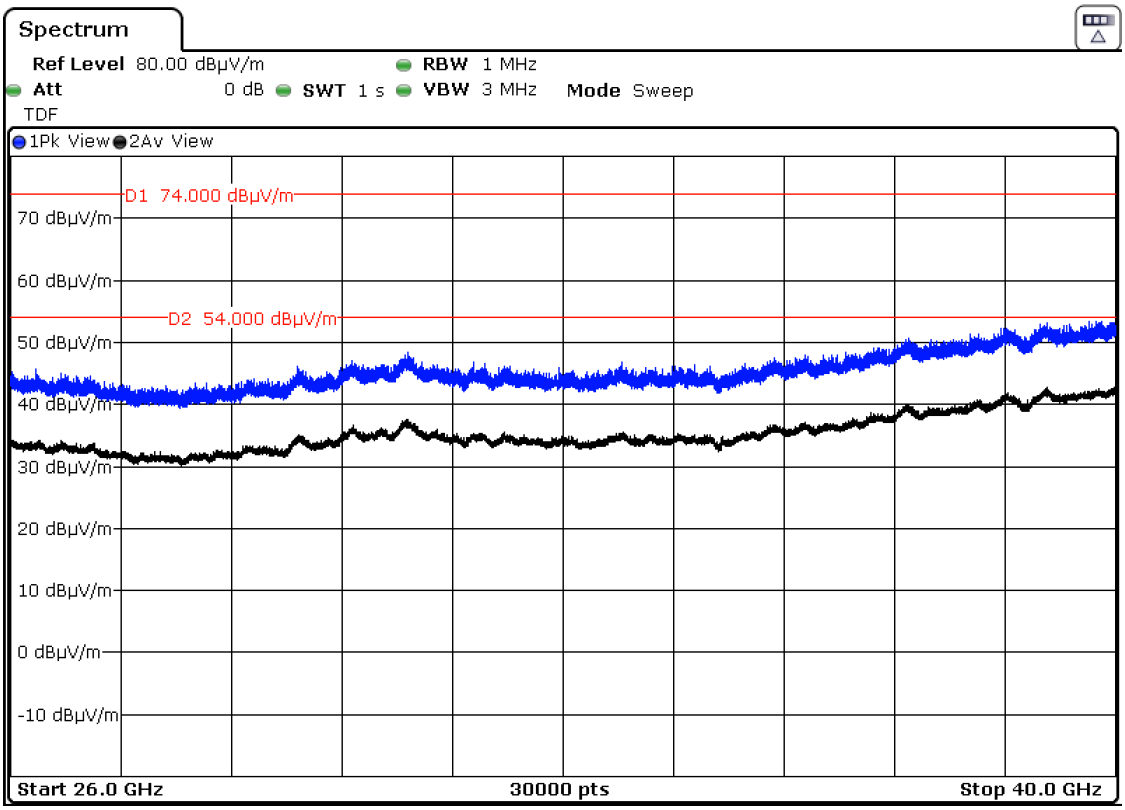


Highest Channel 64 (5320 MHz):



FREQUENCY RANGE 26 - 40 GHz:

- **Mode 802.11a20 – 20MHz – MIMO – CH 0 & CH 1:**



The spurious frequencies do not depend on the operating channel.
This plot is valid for the Lowest, Middle and Highest Channels.

FCC Section 15.407 Subclause (b) (2) / RSS-247 6.2.2.2. Transmitter Band Edge Radiated Emissions.

SPECIFICATION

For transmitters operating in the 5.25–5.35 GHz band: all emissions outside of the 5.15–5.35 GHz band shall not exceed an EIRP of –27 dBm/MHz (68.20 dBµV/m at 3 m distance).

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

Frequency Range (MHz)	Field strength (µV/m)	Field strength (dBµV/m)	Measurement distance (m)
0.009-0.490	2400/F(kHz)	-	300
0.490-1.705	24000/F(kHz)	-	300
1.705 - 30.0	30	-	30
30 - 88	100	40	3
88 - 216	150	43.5	3
216 - 960	200	46	3
960 - 40000	500	54	3

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

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

RESULTS:

The 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.

All emissions outside of the 5.15 - 5.35 GHz band shall not exceed an EIRP of -27dBm/MHz.
There are restricted bands of operation below band edge at 4.5 - 5.15 GHz also above the upper band edge at 5.35 - 5.46 GHz therefore the provision of FCC Part 15.205 apply.

Field strength measurements using peak and average detector were performed in the restricted bands below 5.15 GHz and above 5.35 GHz.

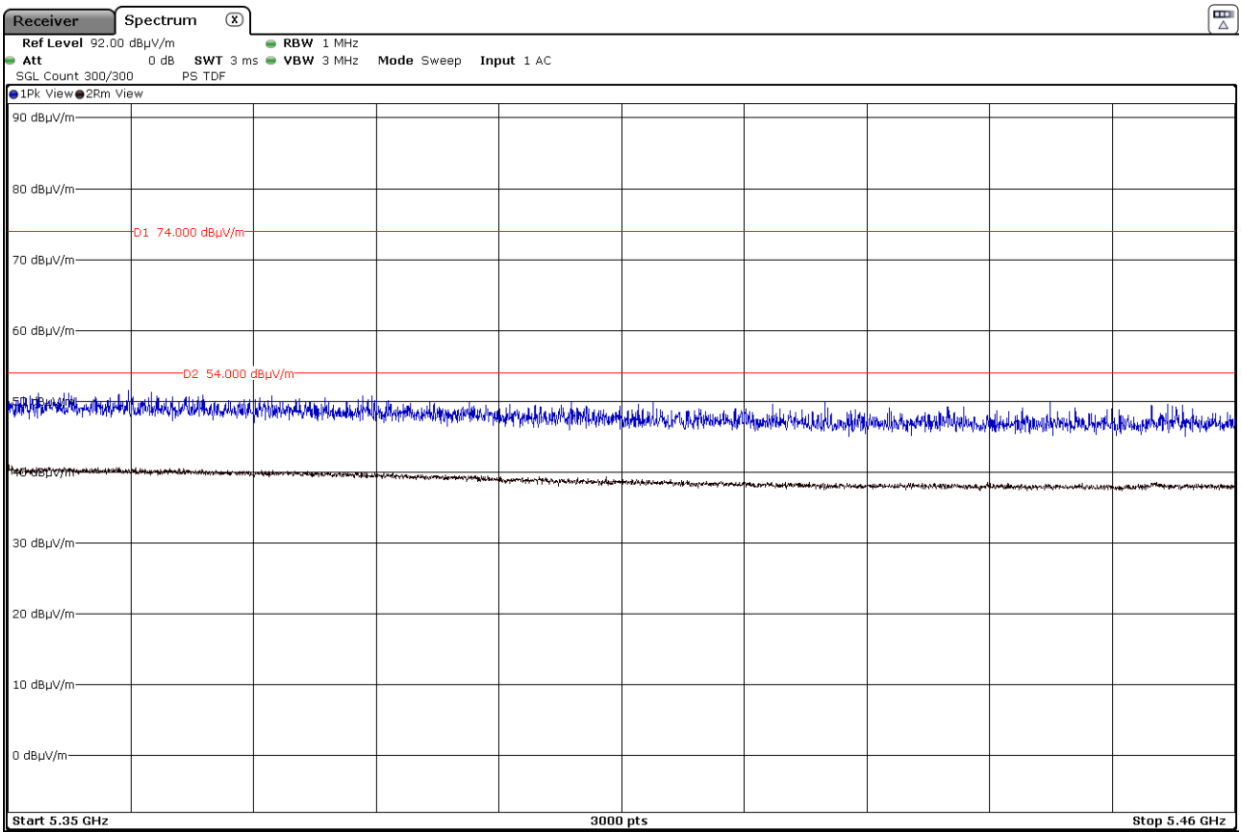
Test performed on the following worst cases modes in all relevant tests channels:

- Mode 802.11a20 MCS0 / MIMO (2Tx) on CH 0 & CH 1:
- Mode 802.11n HT20 MCS0 / MIMO (2Tx) on CH 0 & CH 1:
- Mode 802.11n HT40 MCS0 / MIMO (2Tx) on CH 0 & CH 1:
- Mode 802.11ac VHT80 MCS0 / MIMO (2Tx) on CH 0 & CH 1:

- **Mode 802.11a20 – 20 MHz – MIMO – CH 0 & CH 1 – Highest Channel (64):**

  RESTRICTED BAND 5.35-5.46 GHz: No spurious frequencies were detected.

UPPER BAND EDGE: Channel 64

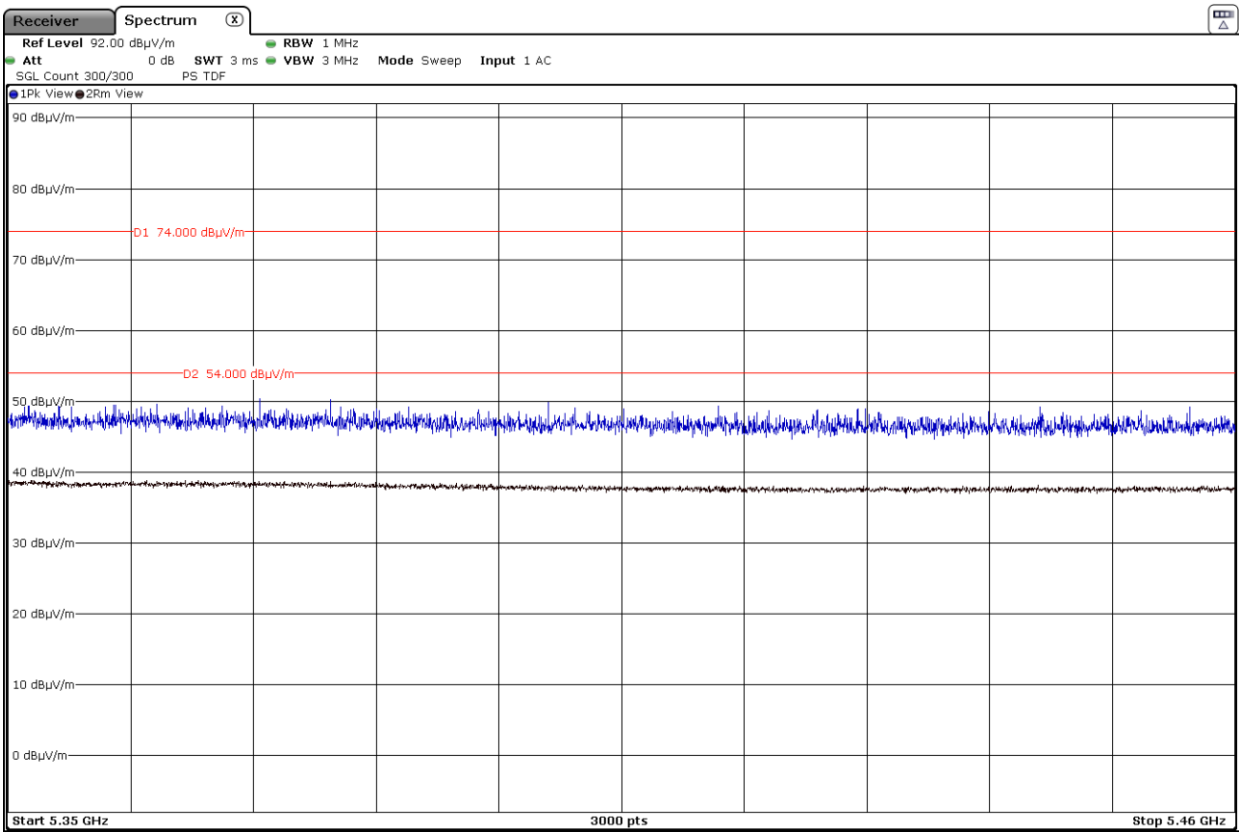


Measurement Uncertainty (dB)	<± 3.07

- **Mode 802.11n HT20 – 20 MHz – MIMO – CH 0 & CH 1 – Highest Channel (64):**

  RESTRICTED BAND 5.35-5.46 GHz: No spurious frequencies were detected.

UPPER BAND EDGE: Channel 64



Measurement Uncertainty (dB)	<± 3.07

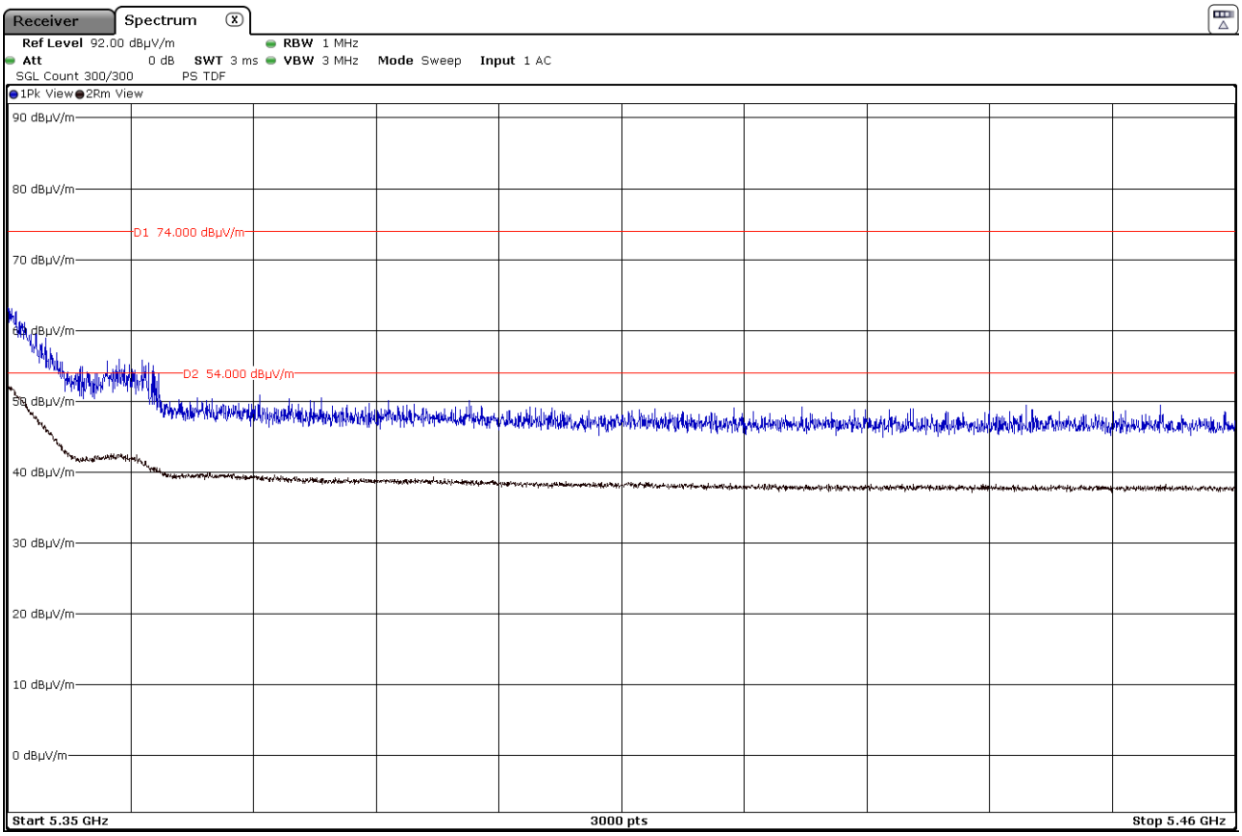
- **Mode 802.11n HT40 – 40 MHz – MIMO – CH 0 & CH 1 – Highest Channel (62):**

  - Lowest Channel 62 (5310 MHz):

RESTRICTED BAND 5.35-5.46 GHz: Radiated spurious frequencies detected at less than 20 dB below the limit:

Frequency (MHz)	Detector	Polarization	Peak Level (dBuV/m)	Limit (dBuv/m)	Measurement uncertainty (dB)	Verdict
5.35001	Peak	H	63.24	74	<± 3.07	PASS
	Average		52.37	54	<± 3.07	PASS

UPPER BAND EDGE: Channel 62



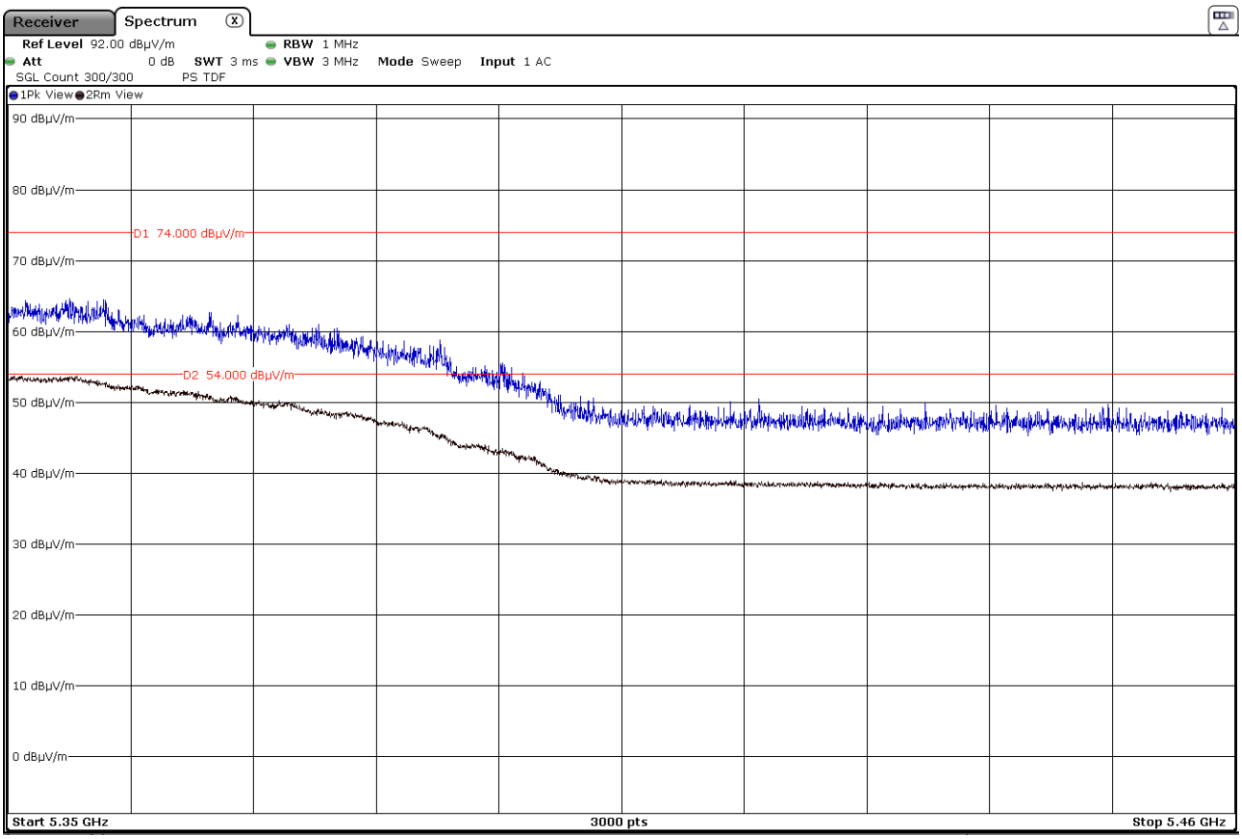
- **Mode 802.11ac VHT80 – 80 MHz – MIMO – CH 0 & CH 1 – Highest Channel (58):**

  - Lowest Channel 58 (5290 MHz):

RESTRICTED BAND 5.35-5.46 GHz: Radiated spurious frequencies detected at less than 20 dB below the limit:

Frequency (MHz)	Detector	Polarization	Peak Level (dBuV/m)	Limit (dBuv/m)	Measurement uncertainty (dB)	Verdict
5.350568	Peak	H	64.59	74	<± 3.07	PASS
	Average		53.71	54	<± 3.07	PASS

UPPER BAND EDGE: Channel 58



Appendix C: Test result for 5.47GHz – 5.725GHz.

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TEST CONDITIONS

POWER SUPPLY (V):

V nonimal: 3.8 Vdc

Type of Power Supply: Rechargeable battery.

Type of Antenna: Internal:

CHAIN 0: Monopole.

CHAIN 1: Monopole with parasitic resonator.

Antennas Gain:

- CHAIN 0 – Maximum Declared Antenna Gain: -1.1 dBi
- CHAIN 1 – Maximum Declared Antenna Gain: -1.1 dBi
- MIMO – CH 0 Antenna & CH 1 Antenna.

TEST FREQUENCIES:

Technology Tested:	WLAN (IEEE 802.11 a20 / n2040 / ac4080 2x2) / U-NII-2C	
Modes:	802.11a: 6, 9, 12, 18, 24, 36, 48 & 54 Mbps	
	802.11n HT20: MCS0 to MCS23	
	802.11n HT40: MCS0 to MCS23	
	802.11ac VHT20: MCS0 to MCS9	
	802.11ac VHT40: MCS0 to MCS9	
	802.11ac VHT80: MCS0 to MCS9	
Setting of cores / ports:	0+1.	
Beamforming:	No.	
Frequency Range:	5470 - 5725 MHz	
Operating Channel Bandwidth:	20 MHz	
Transmit Channels:	CHANNEL	CHANNEL FREQUENCY (MHz)
	Lowest: 100	5500
	Middle: 116	5580
	Highest: 140	5700
Channels that straddle the U-NII-2C and U-NII-3 bands at 5725 MHz	Straddle:144	5720
Operating Channel Bandwidth:	40 MHz	
Transmit Channels:	CHANNEL	CHANNEL FREQUENCY (MHz)
	Lowest: 102	5510
	Highest: 134	5670
Channels that straddle the U-NII-2C and U-NII-3 bands at 5725 MHz	Straddle:142	5710
Operating Channel Bandwidth:	80 MHz	
Transmit Channels:	CHANNEL	CHANNEL FREQUENCY (MHz)
	Lowest: 106	5530
	Highest: 122	5610
Channels that straddle the U-NII-2C and U-NII-3 bands at 5725 MHz	Straddle:138	5690

The test set-up was made in accordance to the general provisions of FCC Unlicensed National Information Infrastructure (U-NII) Devices 789033 D02 General U-NII Test Procedures New Rules v02r01 dated Dec 14, 2017.

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

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

The field strength at the band edges was evaluated for each mode on the lowest and highest channels at the rated power for the channel under test
For all modes, the EUT was configured in test mode using a software application.
The application was used to enable a continuous transmission and to select the test channels as required.
The client supplied instructions to configure the EUT. The customer supplied a document containing the setup instructions.

The worst cases for testing were identified for output power and spurious levels at the band edges which were selected based on preliminary testing that correspond to next data rates:

- 802.11a: 6 Mbits x1/ MIMO / 2Tx on CH 0 & CH 1.
- 802.11n HT20: MCS0 x1/ MIMO / 2Tx on CH 0 & CH 1.
- 802.11n HT40: MCS0 x1/ MIMO / 2Tx on CH 0 & CH 1.
- 802.11ac VHT20: MCS0 x1/ MIMO / 2Tx on CH 0 & CH 1.
- 802.11ac VHT40: MCS0 x1/ MIMO / 2Tx on CH 0 & CH 1.
- 802.11ac VHT80: MCS0 x1/ MIMO / 2Tx on CH 0 & CH 1.

RADIATED MEASUREMENTS:

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

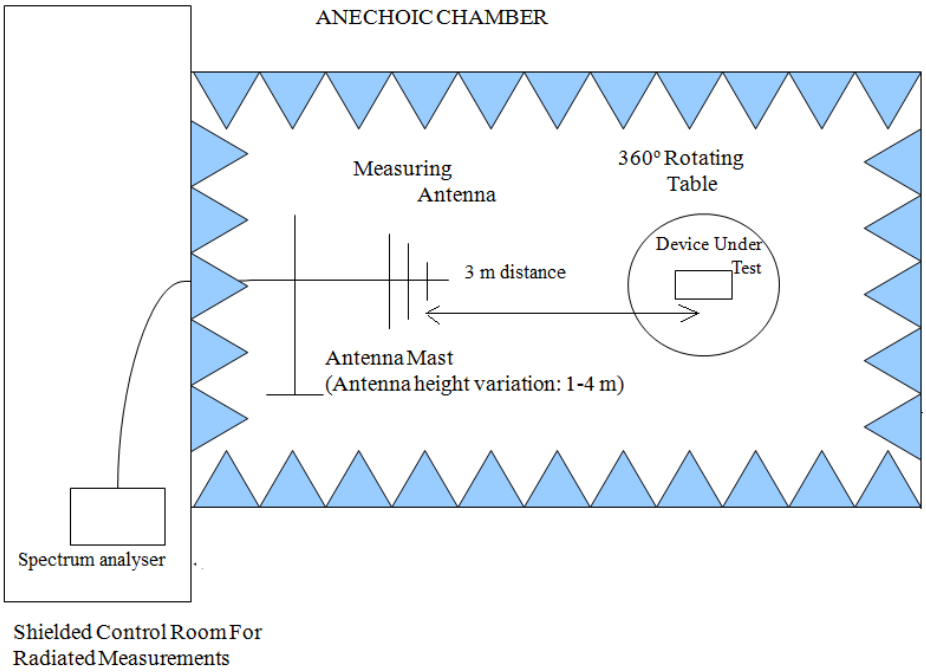
For radiated emissions in the range 1 GHz-40 GHz that is performed at a distance closer than the specified distance, an inverse proportionality factor of 20 dB per decade is used to normalize the measured data for determining compliance.

The EUT was placed at a height of 80 cm above the reference ground plane in the center of the chamber turntable to perform the measurements below 1GHz and The EUT was placed at a height of 1.5 meters above the test chamber floor in the center of the chamber turntable to perform the measurements above 1GHz. It was also rotated 360º and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission.

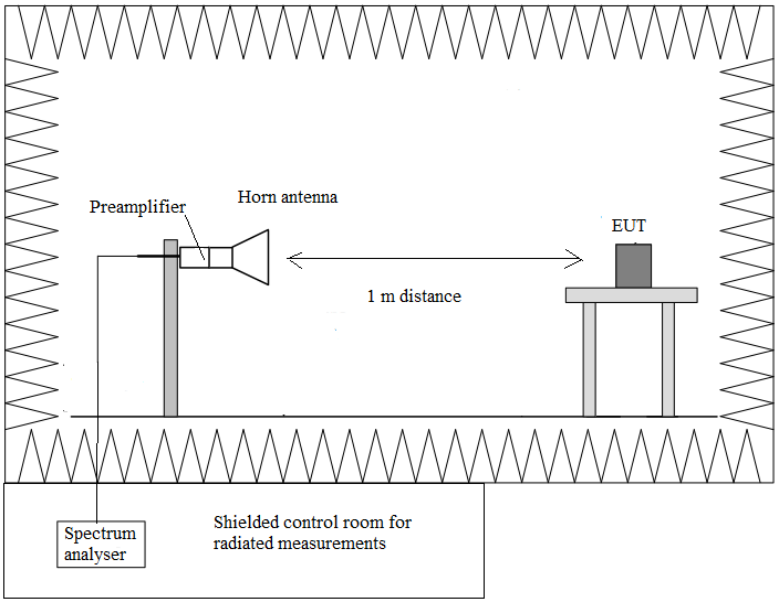
Measurements were made in both horizontal and vertical planes of polarization.

The final measured value, for the given emission, in the tables below incorporates the calibrated antenna factor and cable loss.

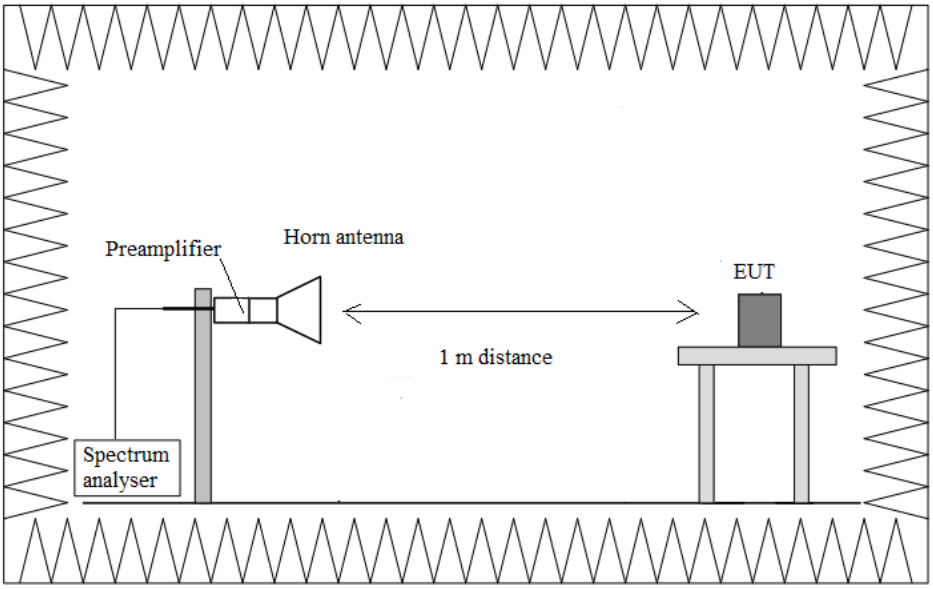
Radiated measurements setup f < 1 GHz:



Radiated measurements setup f > 1 GHz up to 18 GHz:



Radiated measurements setup f > 18 GHz up to 40 GHz:



FCC Section 15.407(b)(3)(6) /RSS-247 6.2.3.2. Transmitter Out of Band Radiated Emissions

SPECIFICATION:

For transmitters operating in the 5.47–5.725 GHz band: all emissions outside of the 5.47–5.725 GHz band shall not exceed an EIRP of –27 dBm/MHz (68.23 dBµV/m at 3 m distance).

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

Frequency Range (MHz)	Field strength (µV/m)	Field strength (dBµV/m)	Measurement distance (m)
0.009-0.490	2400/F(kHz)	-	300
0.490-1.705	24000/F(kHz)	-	300
1.705 - 30.0	30	-	30
30 – 88	100	40	3
88 – 216	150	43.5	3
216 – 960	200	46	3
960 – 40000	500	54	3

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

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

RESULTS:

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

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

All tests were performed in a semi-anechoic chamber at a distance of 1m for the frequency range 1 GHz-40 GHz and a distance of 3m for frequency range 30MHz-1GHz.

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.

Test performed on the following worst case mode:

- **Mode 802.11a20 – 20MHz – MCS0 – MIMO – CH 0 & CH 1:**

Frequency range 30 MHz - 1 GHz

The spurious emissions below 1 GHz do not depend on the operating channel.

Spurious levels operating (radiated) closest to the limit:

Spurious frequency (MHz)	Polarization	Detector	Emission Level (dBµV/m)	Limit (dBµV/m)	Measurement Uncertainty (dB)
30.3880	V	Quasi-Peak	25.9	40	± 2.16
41.7855	V	Quasi-Peak	25.3	40	± 2.16
124.8175	V	Quasi-Peak	25.9	43.5	± 2.16

Frequency range 1 - 40 GHz

Test performed on the worst case mode as preliminary test determined it has the highest Power Spectral Density.

- Lowest Channel 100 (5500 MHz):

  No spurious signals detected at less than 20 dB below the limit.

- Middle Channel 116 (5580 MHz):

  No spurious signals detected at less than 20 dB below the limit.

- Highest Channel 144 (5720 MHz):

  No spurious signals detected at less than 20 dB below the limit.

Measurement Uncertainty (dB)	<± 4.90

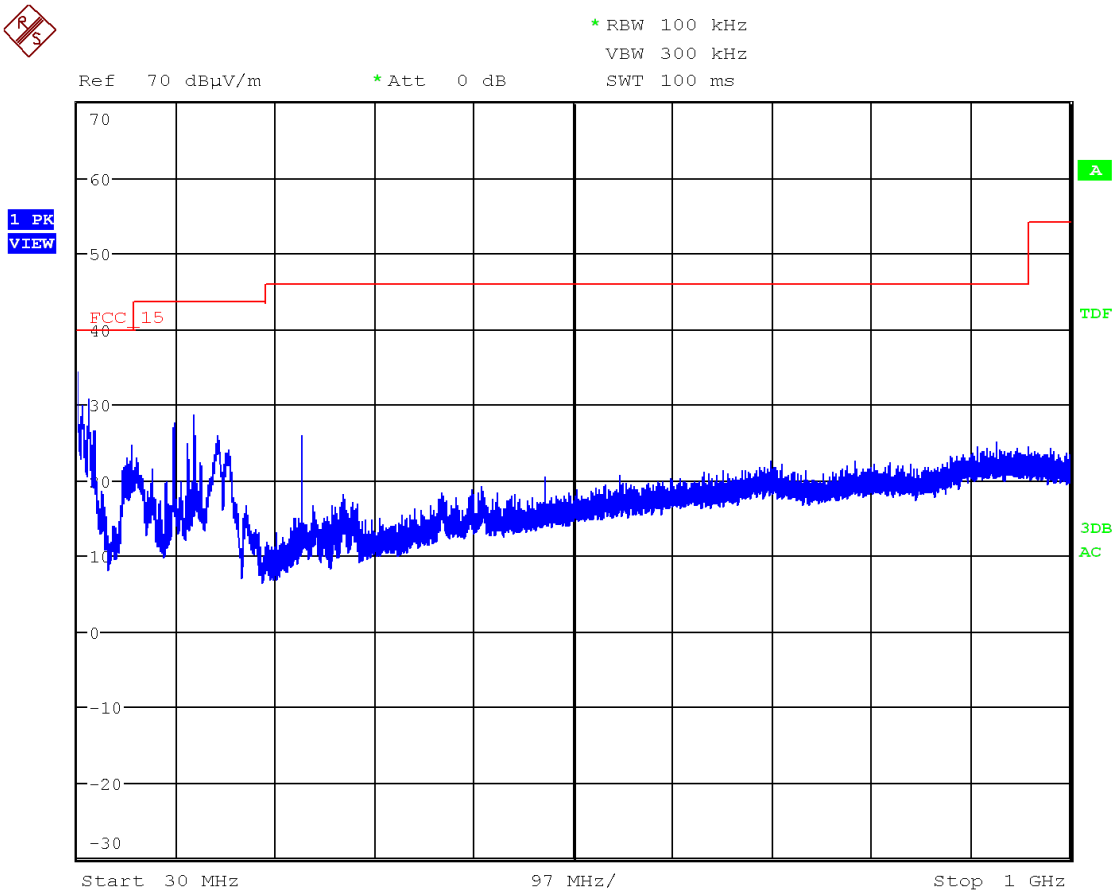
Verdict: PASS

- **Mode 802.11ac80 VHT80– 80MHz – MCS0 – MIMO – CH 0 & CH 1 (Worst case):**

RESTRICTED BAND 5.35-5.46 GHz: Radiated spurious signals detected at less than 20 dB below the limit:

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Limit (dBµV/m)	Measurement Uncertainty (dB)
5.450705	H	Peak	58.56	74	± 3.07
		Average	48.08	54	± 3.07

FREQUENCY RANGE 30 MHz - 1 GHz:

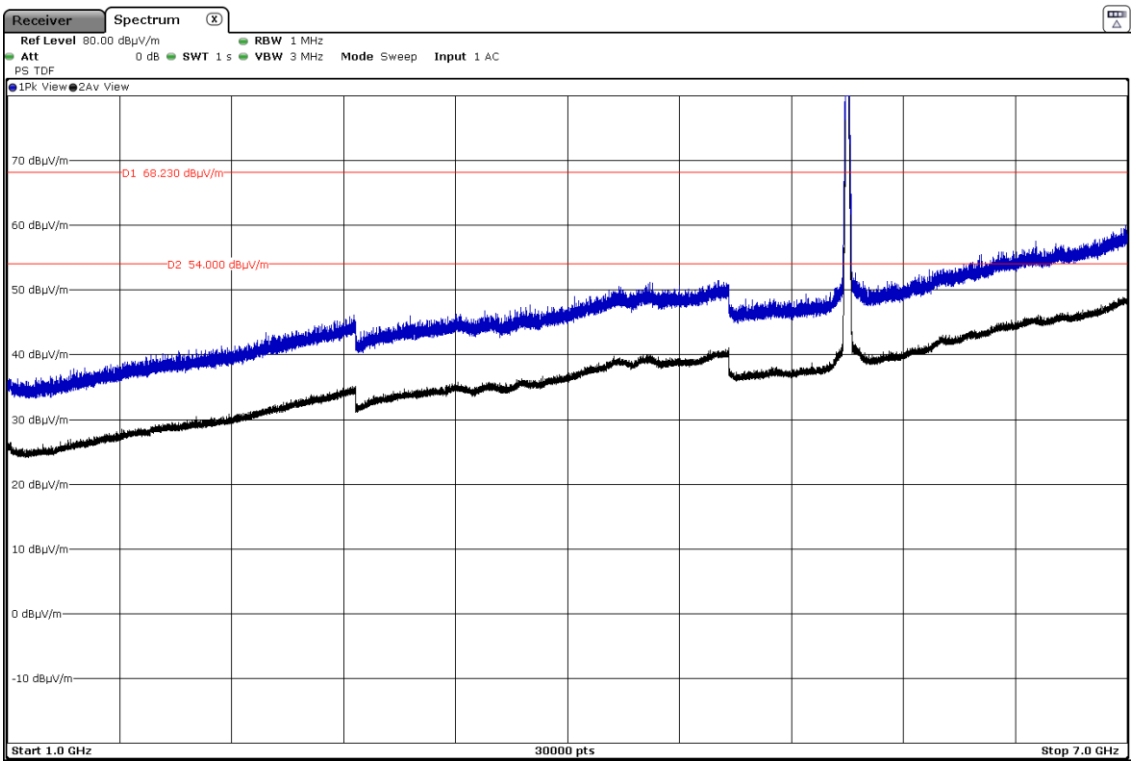


The spurious frequencies do not depend on the operating channel.
This plot is valid for the Lowest, Middle and Highest Channels.

FREQUENCY RANGE 1 - 7 GHz:

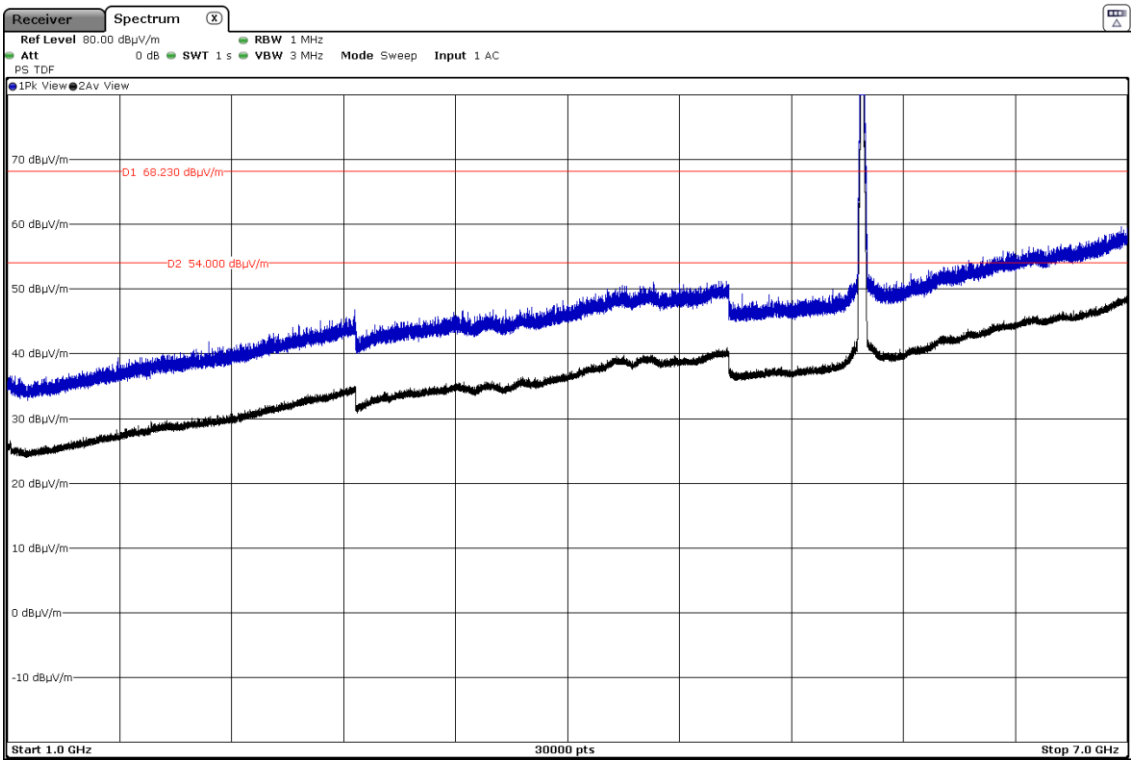
- **Mode 802.11a20 – 20MHz – MIMO – CH 0 & CH 1:**

Lowest Channel 100 (5500 MHz):



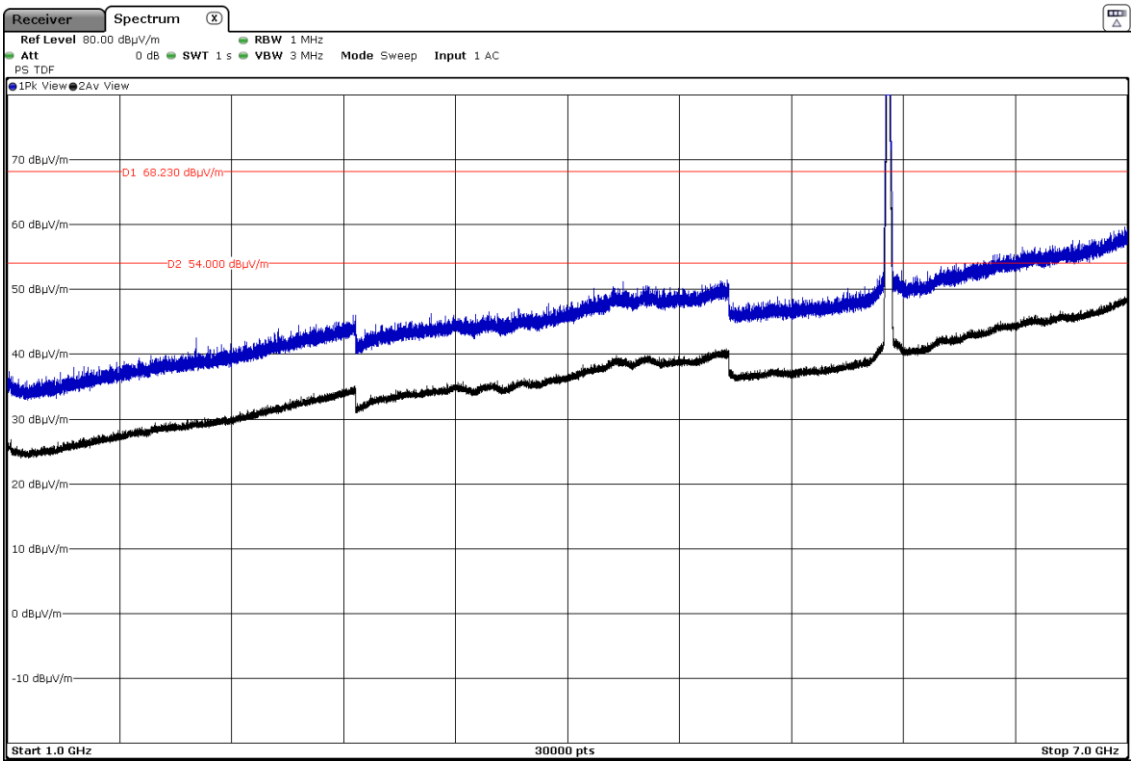
The peak shown in the plot above the limit is the carrier frequency.

Middle Channel 116 (5580 MHz):



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

Highest Channel 144 (5720 MHz):

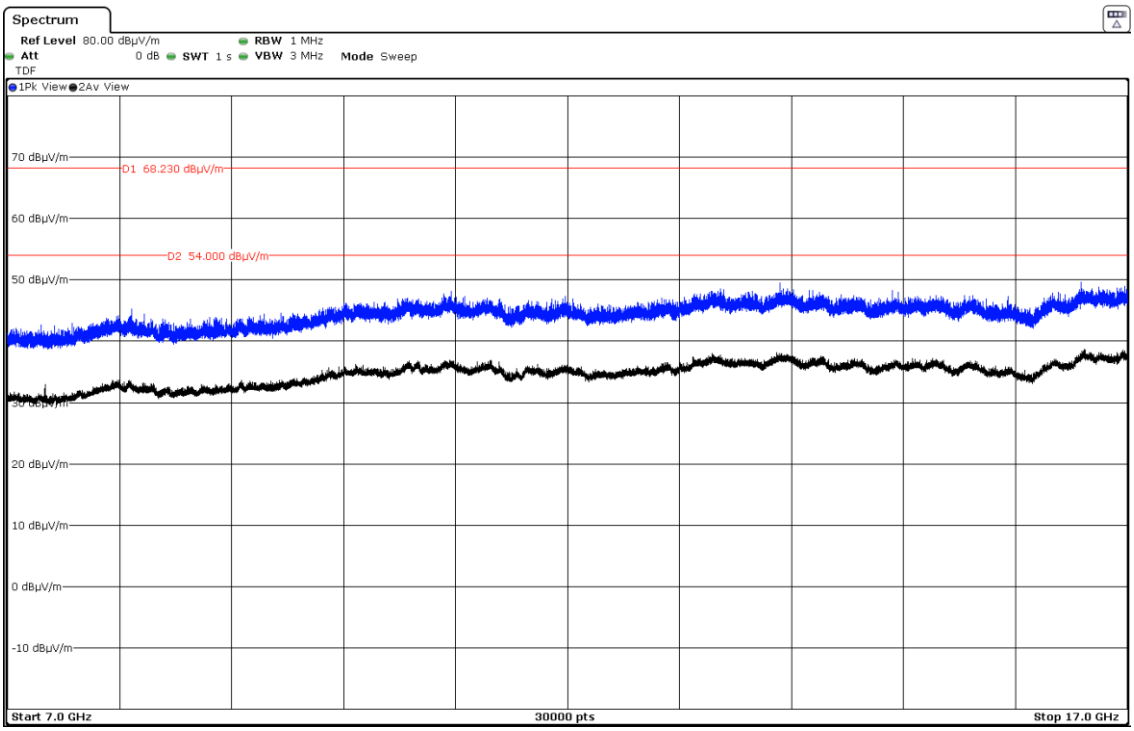


The peak shown in the plot above the limit is the carrier frequency

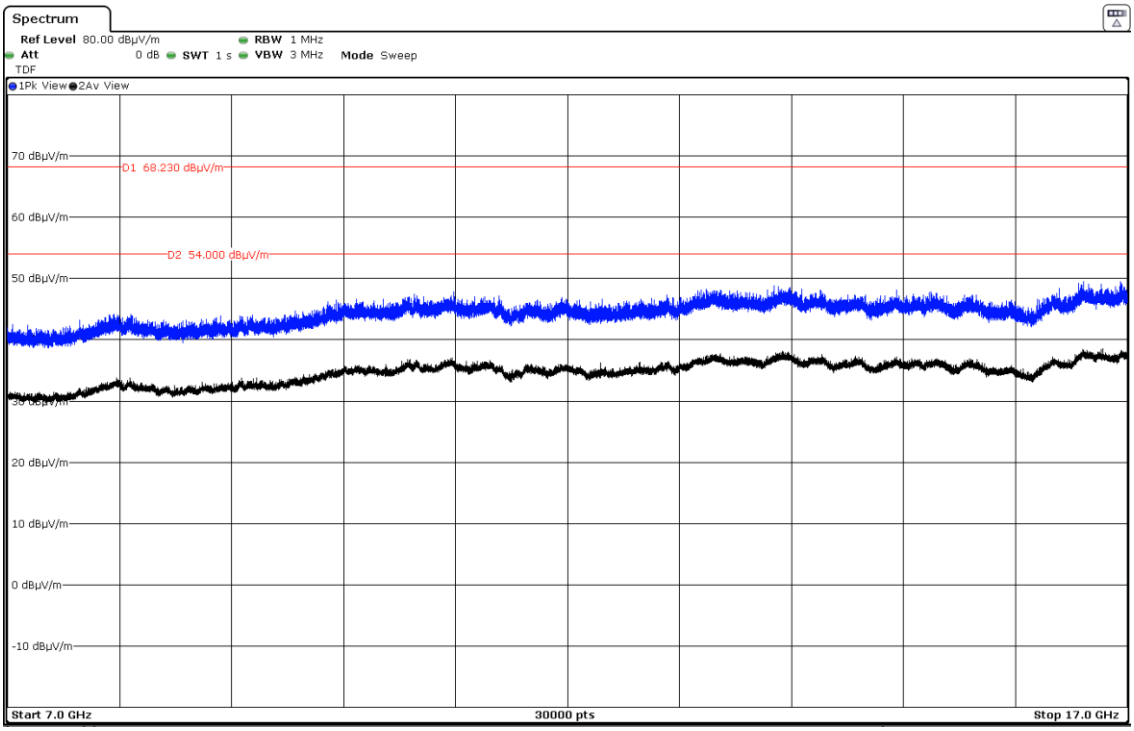
FREQUENCY RANGE 7 - 17 GHz:

- **Mode 802.11a20 – 20MHz – MIMO – CH 0 & CH 1:**

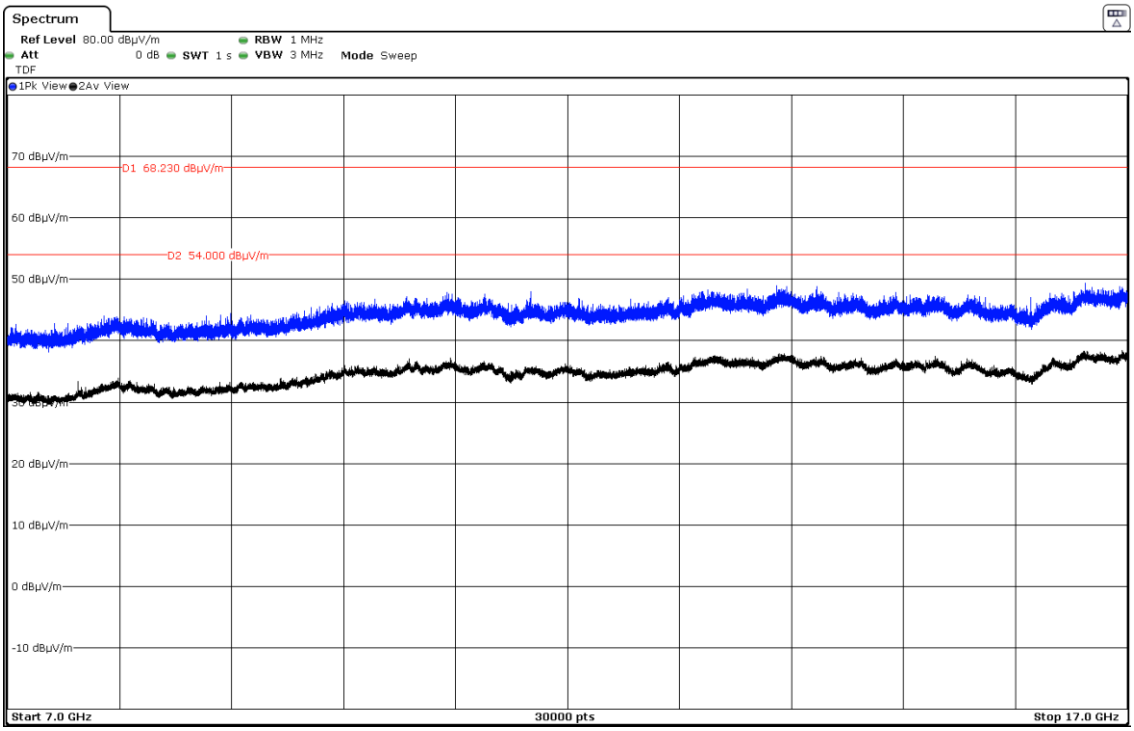
Lowest Channel 100 (5500 MHz):



Middle Channel 116 (5580 MHz):



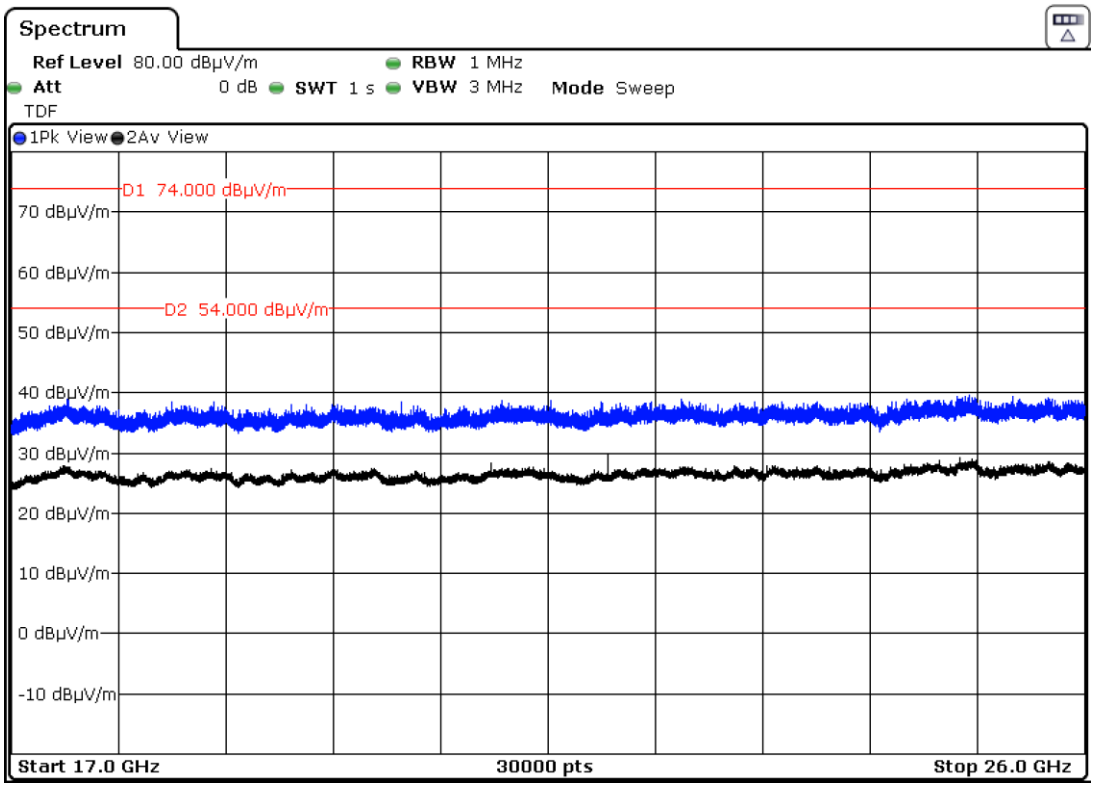
Highest Channel 144 (5720 MHz):



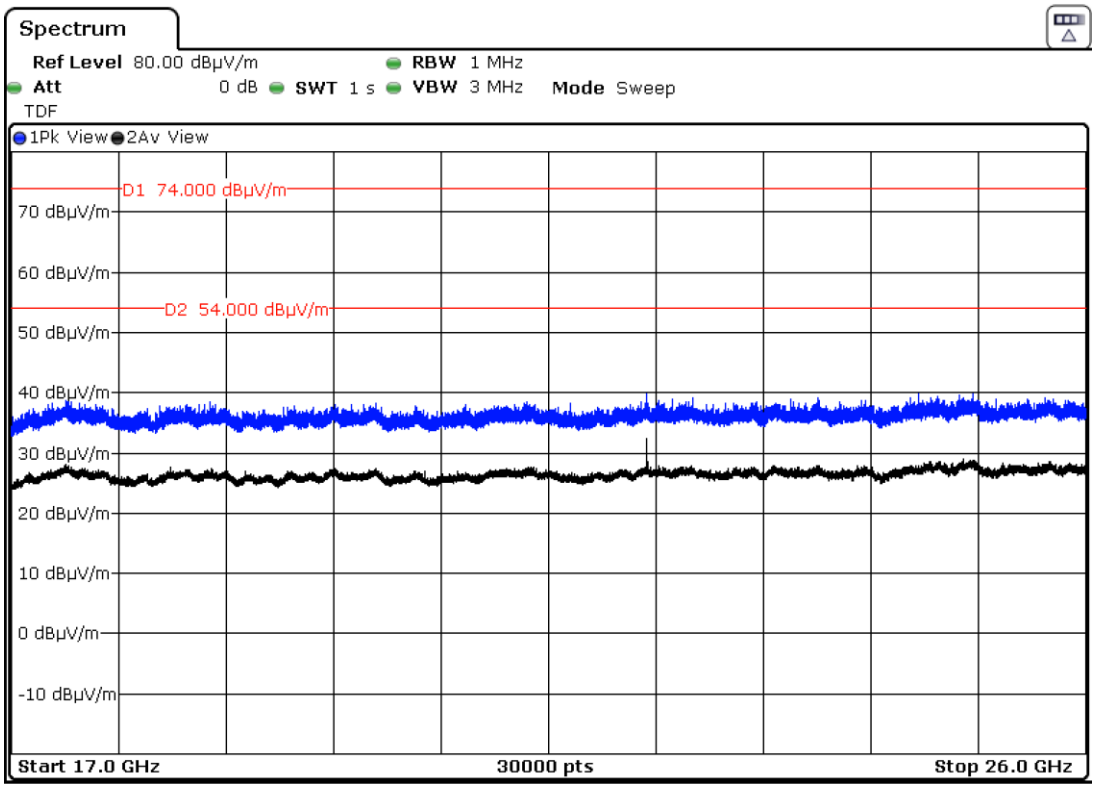
FREQUENCY RANGE 17 - 26 GHz:

- **Mode 802.11a20 – 20MHz – MIMO – CH 0 & CH 1:**

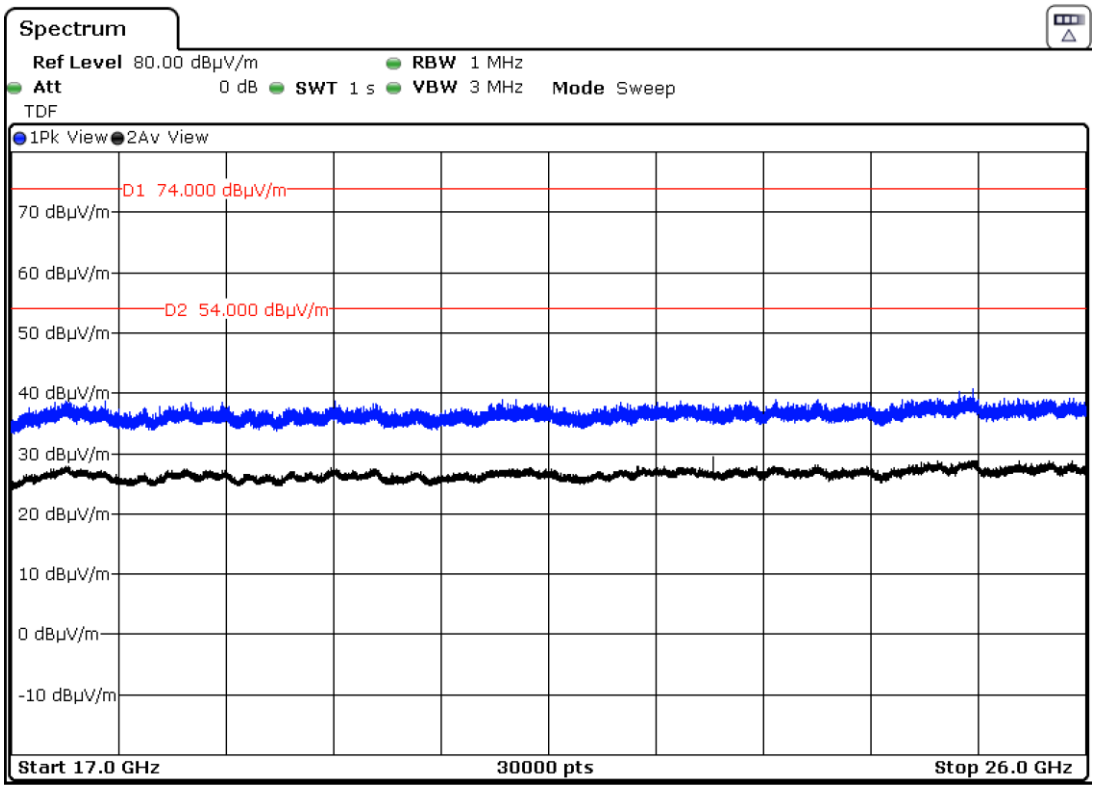
Lowest Channel 100 (5500 MHz):



Middle Channel 116 (5580 MHz):

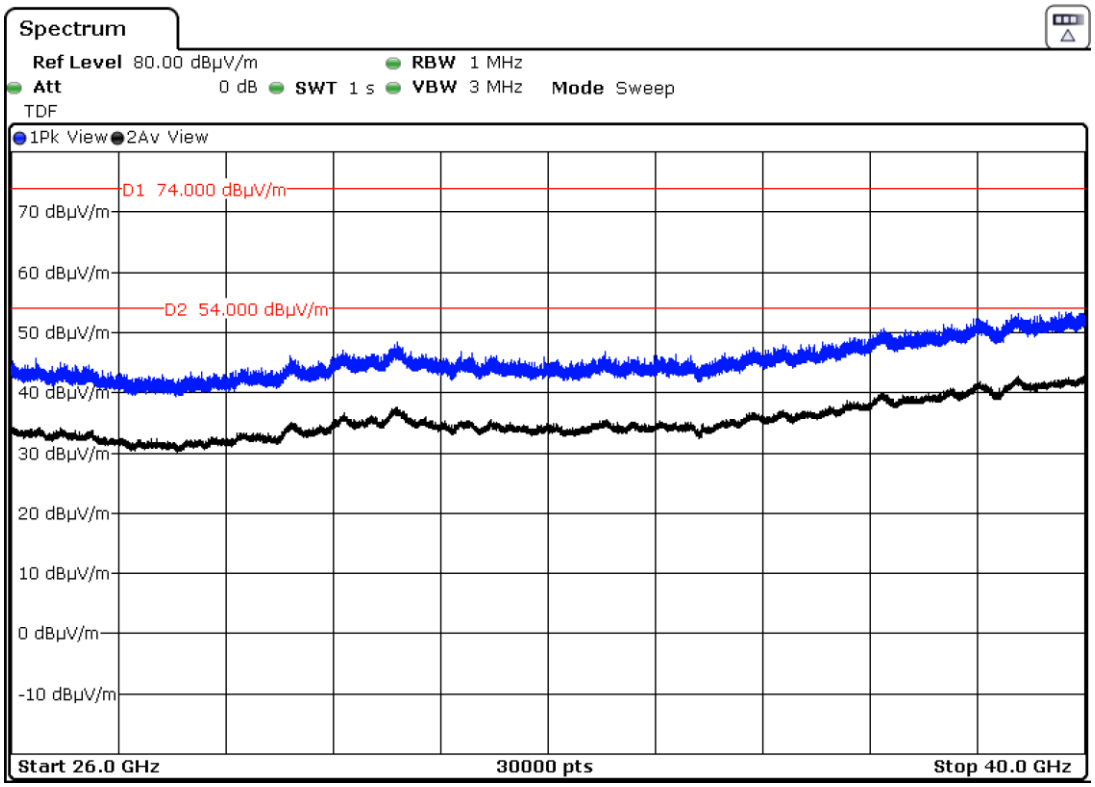


Highest Channel 144 (5720 MHz):



FREQUENCY RANGE 26 - 40 GHz:

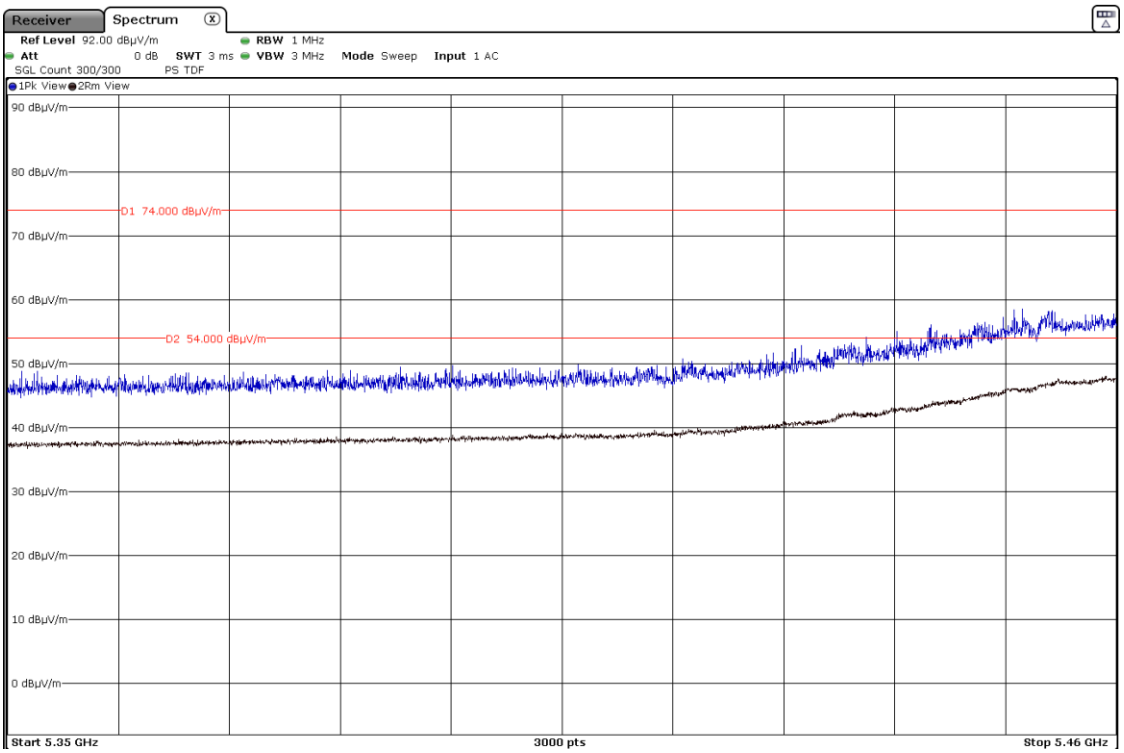
- **Mode 802.11a20 – 20MHz – MIMO – CH 0 & CH 1:**



The spurious frequencies do not depend on the operating channel.
This plot is valid for the Lowest, Middle and Highest Channels.

- **Mode 802.11ac80 VHT80 – 80MHz – MCS0 – MIMO – CH 0 & CH 1 (Worst case):**

RESTRICTED BAND 5.35-5.46 GHz:



FCC Section 15.407 Subclause (b) (2) / RSS-247 6.2.3.2. Transmitter Band Edge Radiated Emissions.

SPECIFICATION

For transmitters operating in the 5.47–5.725 GHz band: all emissions outside of the 5.47–5.725 GHz band shall not exceed an EIRP of –27 dBm/MHz (68.23 dBµV/m at 3 m distance).

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

Frequency Range (MHz)	Field strength (µV/m)	Field strength (dBµV/m)	Measurement distance (m)
0.009-0.490	2400/F(kHz)	-	300
0.490-1.705	24000/F(kHz)	-	300
1.705 - 30.0	30	-	30
30 - 88	100	40	3
88 - 216	150	43.5	3
216 - 960	200	46	3
960 - 40000	500	54	3

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

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

RESULTS:

The 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.

All emissions outside of the 5.47 - 5.725 GHz band shall not exceed an EIRP of -27dBm/MHz.
There are restricted bands of operation below band edge at 5.35 - 5.46 GHz therefore the provision of FCC Part 15.205 apply.

Field strength measurements using peak and average detector performed in the restricted bands below 5.47 GHz and above 5.725 GHz.

Test performed on the following worst cases modes in all relevant tests channels:

- Mode 802.11a20 MCS0 / MIMO (2Tx) on CH 0 & CH 1:
- Mode 802.11n HT20 MCS0 / MIMO (2Tx) on CH 0 & CH 1:
- Mode 802.11n HT40 MCS0 / MIMO (2Tx) on CH 0 & CH 1:
- Mode 802.11ac VHT80 MCS0 / MIMO (2Tx) on CH 0 & CH 1:

- **Mode 802.11a20 – 20 MHz – MIMO – CH 0 & CH 1:**

  - Lowest Channel 100 (5500 MHz):

    LOWER BAND EDGE: Radiated spurious signals detected at less than 20 dB below the limit:

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Limit (dBµV/m)	Measurement Uncertainty (dB)
5.46878	H	Peak	52.72	68.23	± 3.07

  - Highest Channel 140 (5700 MHz):

    UPPER BAND EDGE: Radiated spurious signals detected at less than 20 dB below the limit:

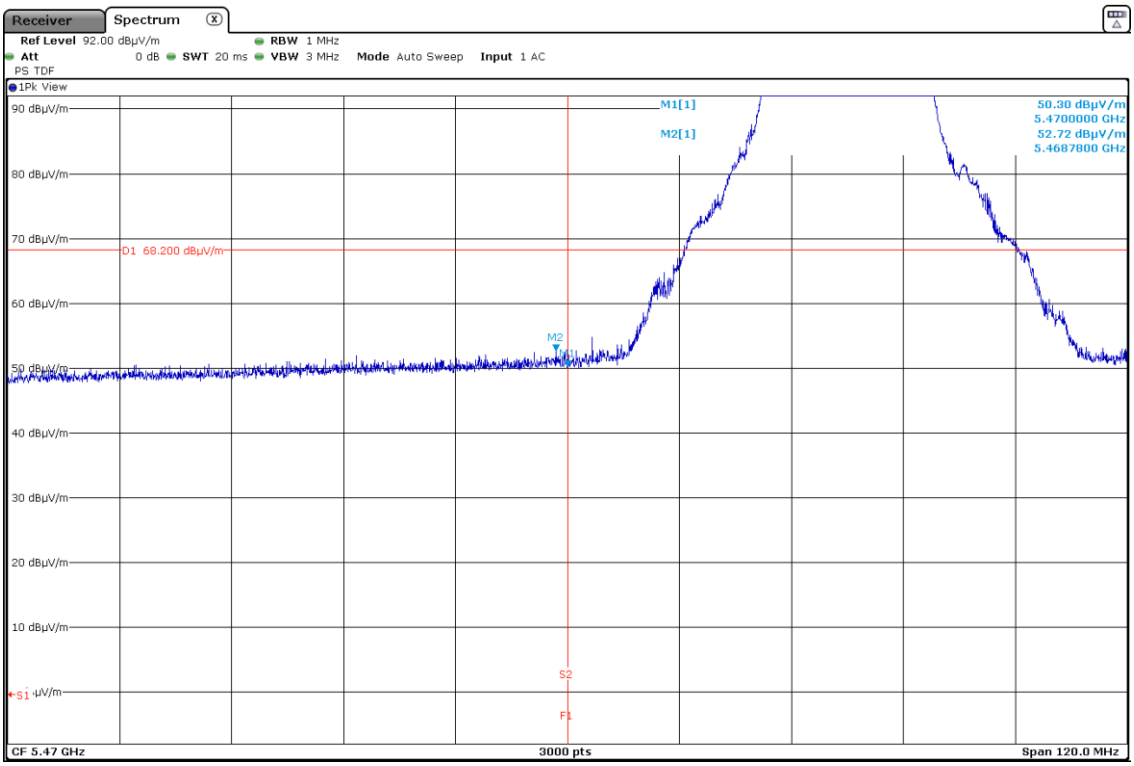
Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Limit (dBµV/m)	Measurement Uncertainty (dB)
5.74301	H	Peak	56.88	68.23	± 3.07

  - Straddle Channel 144 (5720 MHz):

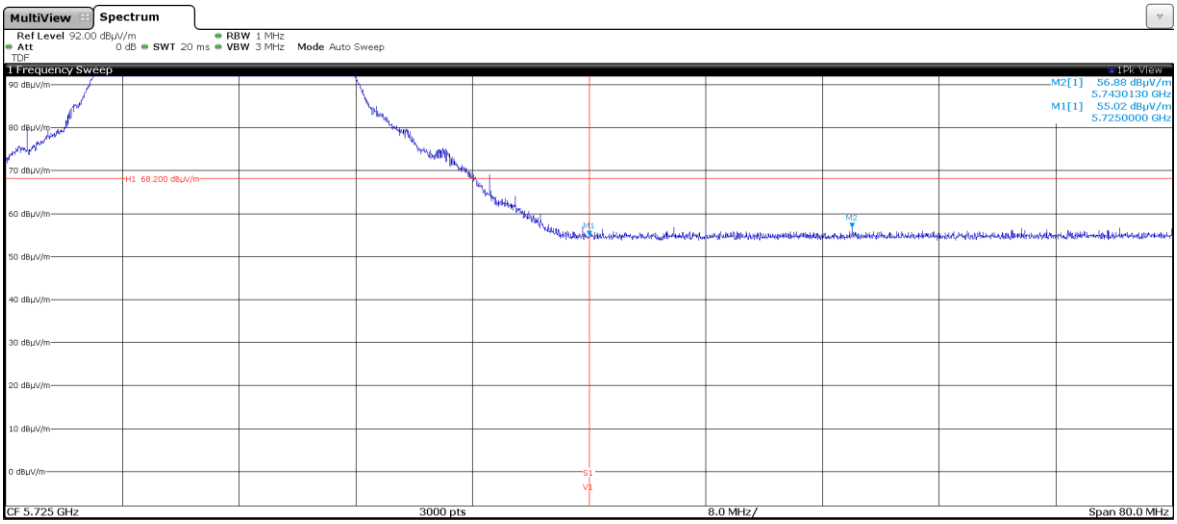
    LOWER BAND EDGE AND UPPER BAND EDGE Straddle Channel:

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Limit (dBµV/m)	Measurement Uncertainty (dB)
5.89474	H	Peak	60.86	68.23	± 3.07

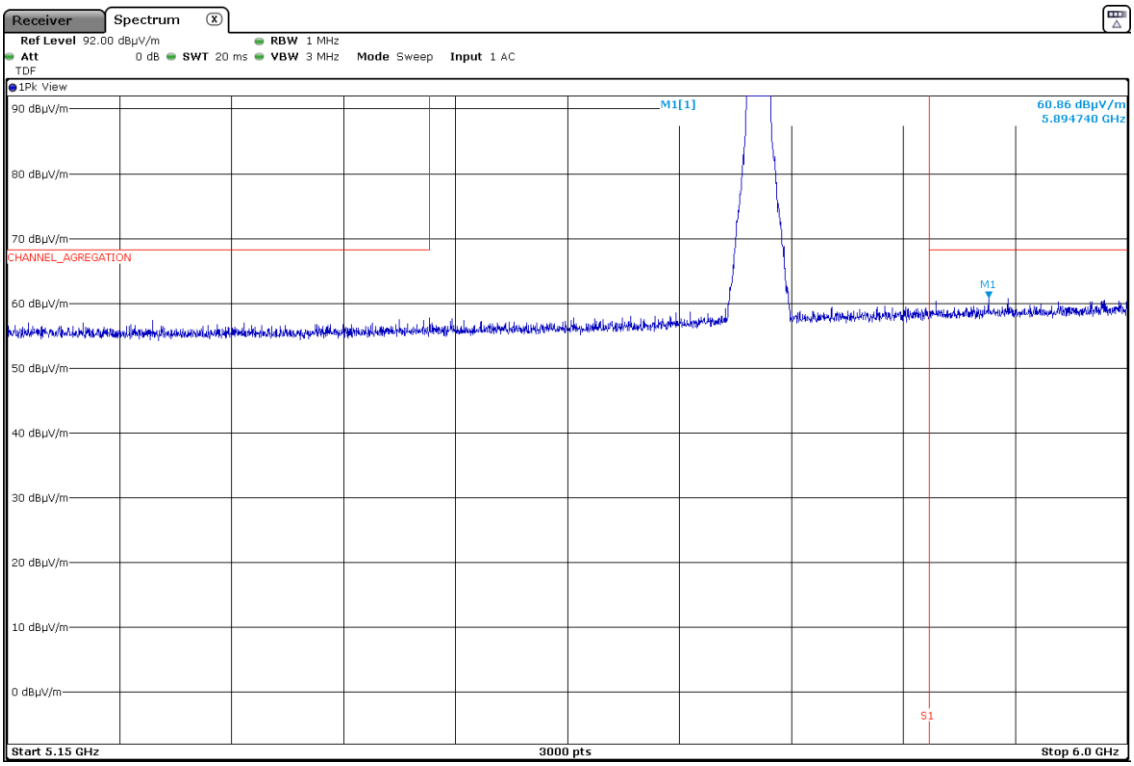
LOWER BAND EDGE: Channel 100



UPPER BAND EDGE: Channel 140



LOWER BAND EDGE and UPPER BAND EDGE: Straddle Channel 144



- **Mode 802.11n HT20 – 20 MHz – MIMO – CH 0 & CH 1:**

  - Lowest Channel 100 (5500 MHz):

    LOWER BAND EDGE: Radiated spurious signals detected at less than 20 dB below the limit:

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Limit (dBµV/m)	Measurement Uncertainty (dB)
5.4699	H	Peak	53.34	68.23	± 3.07

  - Highest Channel 140 (5700 MHz):

    UPPER BAND EDGE: Radiated spurious signals detected at less than 20 dB below the limit:

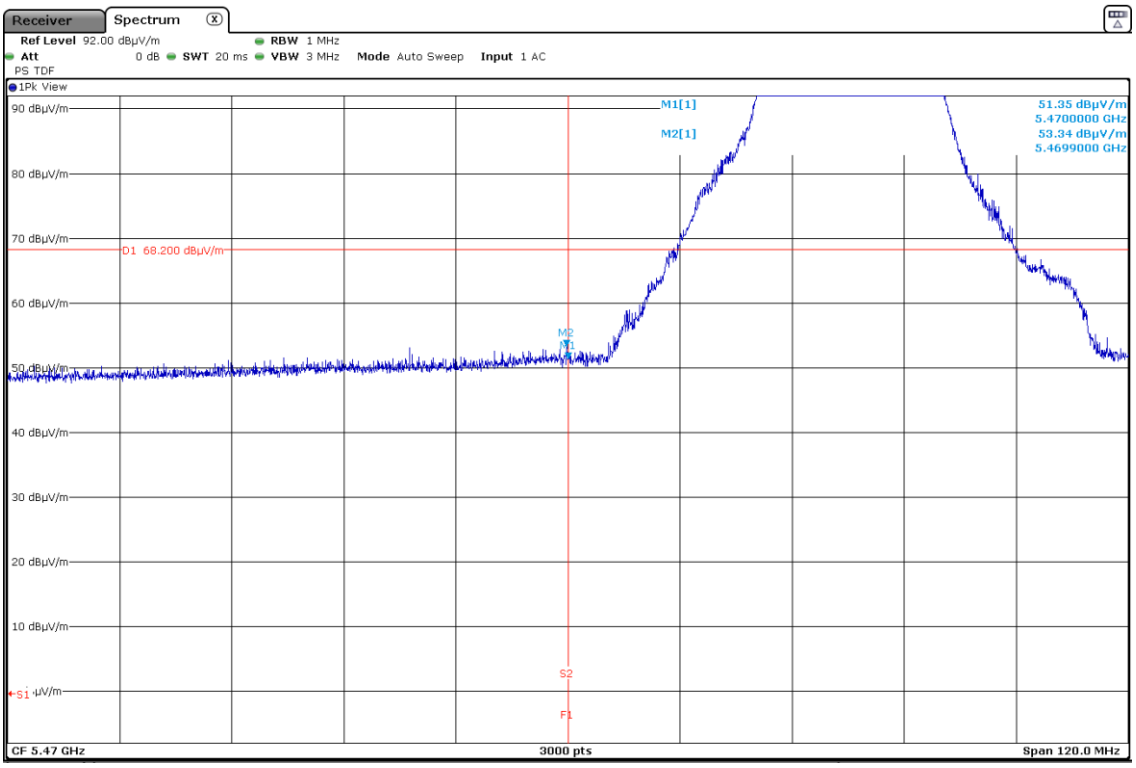
Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Limit (dBµV/m)	Measurement Uncertainty (dB)
5.74781	H	Peak	56.80	68.23	± 3.07

  - Straddle Channel 144 (5720 MHz):

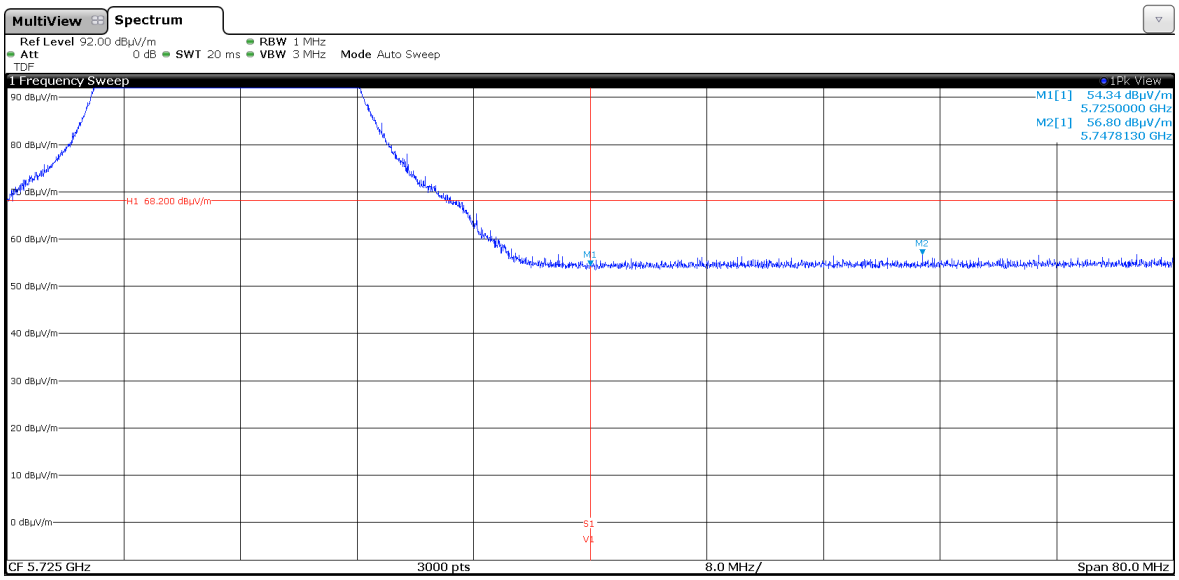
    LOWER BAND EDGE AND UPPER BAND EDGE Straddle Channel:

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Limit (dBµV/m)	Measurement Uncertainty (dB)
5.96784	H	Peak	61.23	68.23	± 3.07

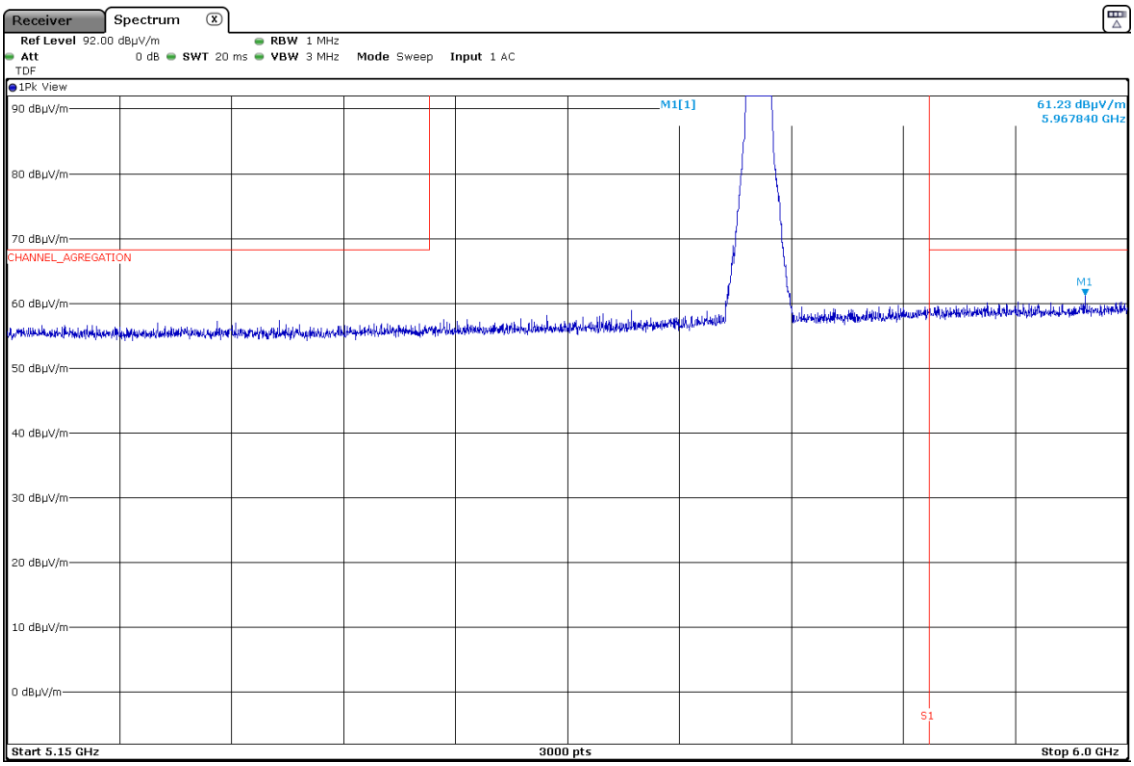
LOWER BAND EDGE: Channel 100



UPPER BAND EDGE: Channel 140



LOWER BAND EDGE and UPPER BAND EDGE: Straddle Channel 144



- **Mode 802.11n HT40 – 40MHz – MIMO – CH 0 & CH 1:**

  - Lowest Channel 102 (5510 MHz):

    LOWER BAND EDGE: Radiated spurious signals detected at less than 20 dB below the limit:

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Limit (dBµV/m)	Measurement Uncertainty (dB)
5.46994	V	Peak	63.82	68.23	± 3.07

  - Highest Channel 134 (5670 MHz):

    UPPER BAND EDGE: Radiated spurious signals detected at less than 20 dB below the limit:

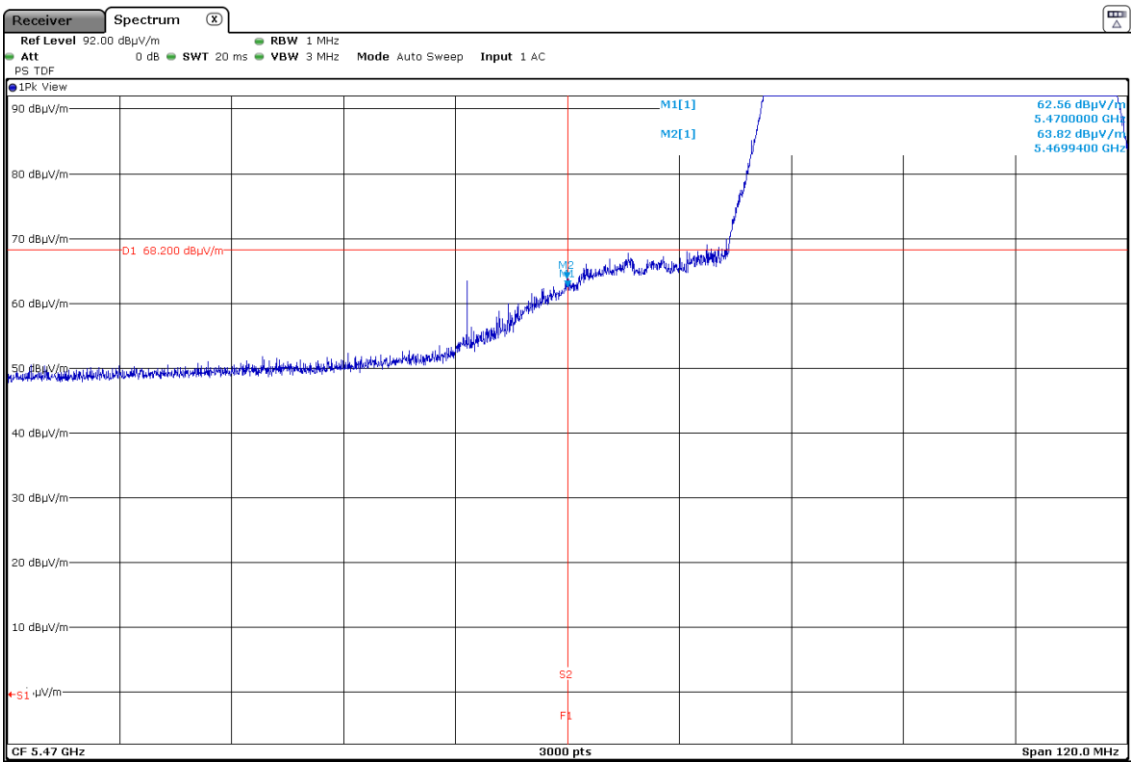
Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Limit (dBµV/m)	Measurement Uncertainty (dB)
5.77928	H	Peak	56.91	68.23	± 3.07

  - Straddle Channel 142 (5710 MHz):

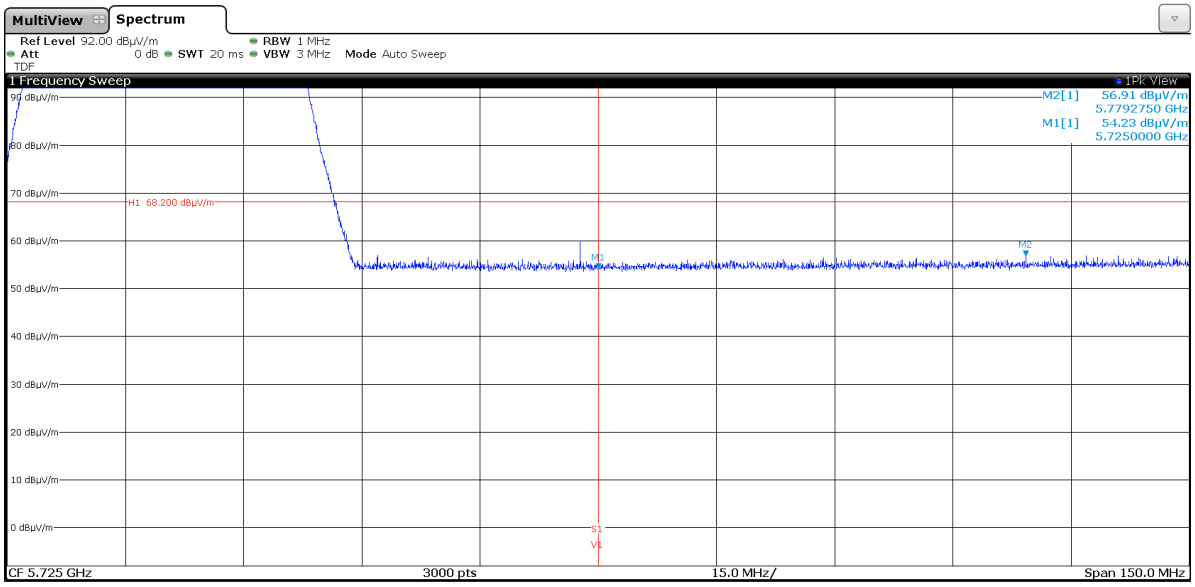
    LOWER BAND EDGE AND UPPER BAND EDGE Straddle Channel:

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Limit (dBµV/m)	Measurement Uncertainty (dB)
5.93951	H	Peak	60.37	68.23	± 3.07

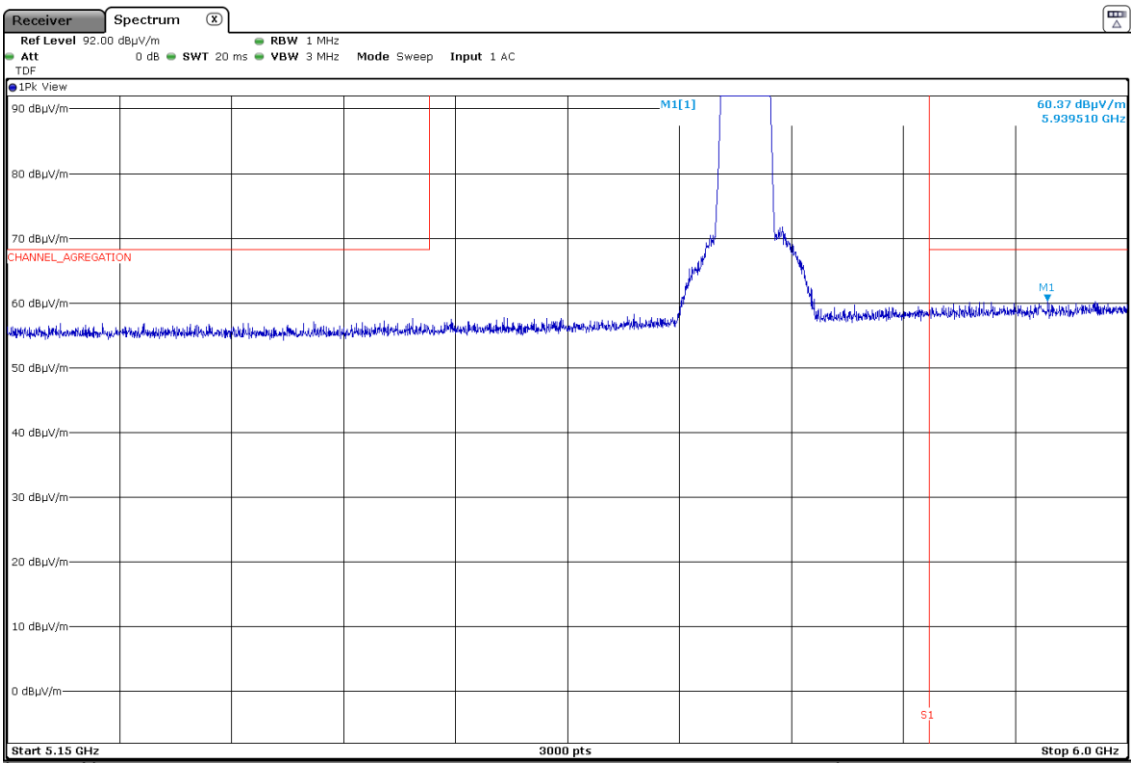
LOWER BAND EDGE: Channel 102



UPPER BAND EDGE: Channel 134



LOWER BAND EDGE and UPPER BAND EDGE: Straddle Channel 142



- **Mode 802.11ac VHT80 – 80MHz – MIMO – CH 0 & CH 1:**

  - Lowest Channel 106 (5530 MHz):

    LOWER BAND EDGE: Radiated spurious signals detected at less than 20 dB below the limit:

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Limit (dBµV/m)	Measurement Uncertainty (dB)
5.4603	H	Peak	61.45	68.23	± 3.07

  - Highest Channel 122 (5610 MHz):

    UPPER BAND EDGE: Radiated spurious signals detected at less than 20 dB below the limit:

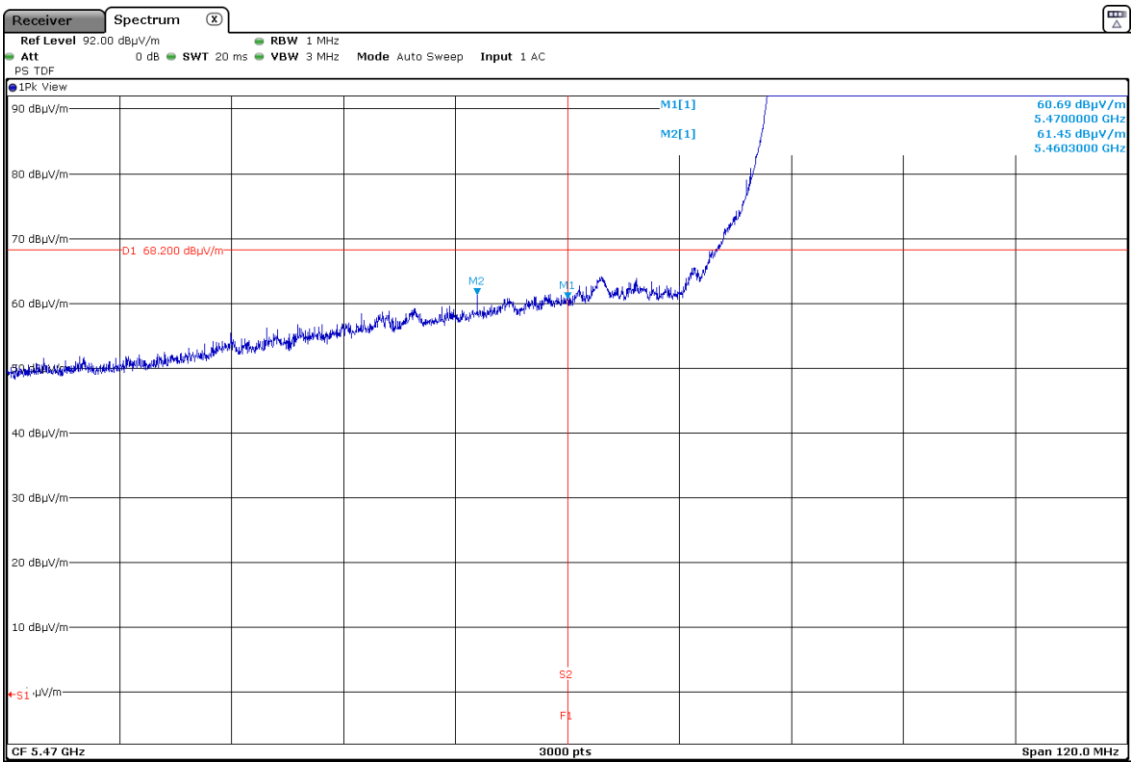
Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Limit (dBµV/m)	Measurement Uncertainty (dB)
5.73136	H	Peak	57.72	68.23	± 3.07

  - Straddle Channel 138 (5690 MHz):

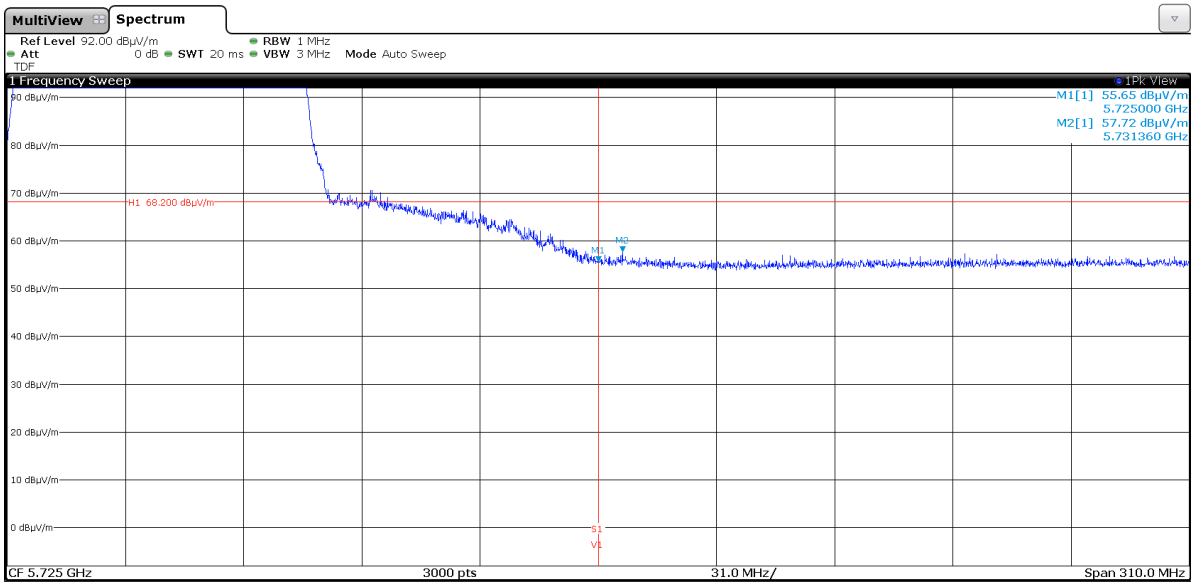
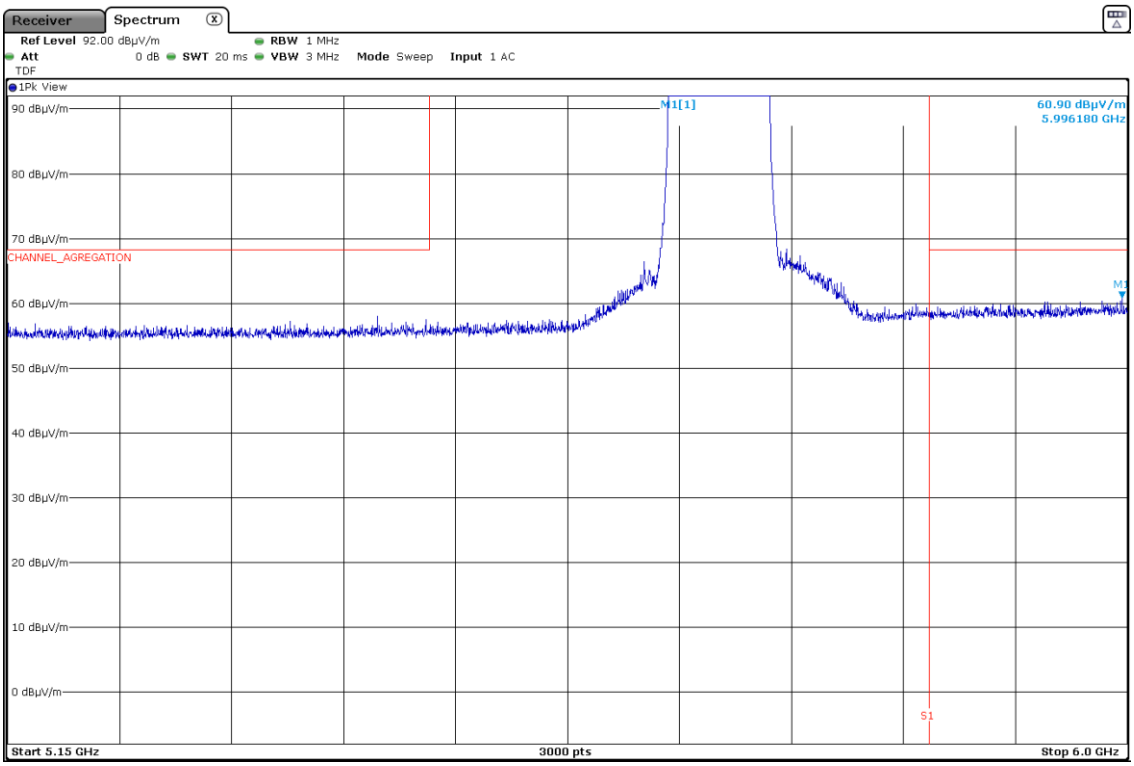
    LOWER BAND EDGE AND UPPER BAND EDGE Straddle Channel:

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Limit (dBµV/m)	Measurement Uncertainty (dB)
5.99618	H	Peak	60.90	68.23	± 3.07

LOWER BAND EDGE: Channel 106



UPPER BAND EDGE: Channel 122



LOWER BAND EDGE and UPPER BAND EDGE: Straddle Channel 138