



Test report No:  
NIE: 51929RRF.029

## 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	Headunit with radio and Bluetooth
(*) Trademark	Panasonic
(*) Model and /or type reference	MIB3E_MQB37w_BTWIFI
Other identification of the product	FCC ID: WUQ-MIB3VBTWIFI IC: 216R-MIB3VBTWIFI PN: 5FA.035.869 HW version: X85 SW version: X645
Features	Bluetooth, WLAN, FM, AM, DAB, USB.
(*) Features	PANASONIC AUTOMOTIVE SYSTEMS EUROPE GMBH Robert Bosch Str. 27-29 – 63225 Langen - Germany
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
Date of issue	2019-09-27
Report template No	FDT08_22 <small>(*) "Data provided by the client"</small>

## Index

Competences and guarantees .....	4
General conditions .....	4
Uncertainty .....	4
Data provided by the client.....	4
Usage of samples .....	5
Test sample description .....	5
Identification of the client.....	6
Testing period and place.....	6
Document history .....	6
Environmental conditions .....	6
Remarks and comments .....	7
Testing verdicts.....	7
Summary .....	8
Appendix A: Test result for 5.15GHz – 5.25GHz .....	9
Appendix B: Test result for 5.725GHz – 5.850GHz .....	32

## 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

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

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.

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

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

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

## 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.
4. This test report cannot be used partially or in full for publicity and/or promotional purposes without previous written permission of DEKRA Testing and Certification and the Accreditation Bodies.

## 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 consists of an Automotive head unit to be installed in cars with the following features: Bluetooth, WLAN, FM, AM, DAB, USB.

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
51929B/544	Head unit with radio and Bluetooth	MIB3E_MQB37w_BTWIFI	PM6-00121.02.19413E0002	2019/06/27
51292B/538	Harness	---	---	2019/06/05

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

## Test sample description

Ports.....:	Port name and description	Cable			
		Specified max length [m]	Attached during test	Shielded	Coupled to patient <sup>(3)</sup>
			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Rated power supply .....	Voltage and Frequency	Reference poles			
		L1	L2	L3	N PE
	<input checked="" type="checkbox"/> DC: 12 Vdc				
Rated Power .....					
Clock frequencies.....:					
Other parameters .....					
Software version .....	X645				
Hardware version .....	X85				
Dimensions in cm (W x H x D) ....:					
	<input checked="" type="checkbox"/> Other: Installed in cars				
Modules/parts.....:	Module/parts of test item		Type	Manufacturer	

Accessories (not part of the test item) .....	Description	Type	Manufacturer
Documents as provided by the applicant .....	Description	File name	Issue date

<sup>(3)</sup> Only for Medical Equipment

## Identification of the client

PANASONIC AUTOMOTIVE SYSTEMS EUROPE GMBH  
Robert Bosch Str. 27-29 – 63225 Langen - Germany

## Testing period and place

Test Location	DEKRA Testing and Certification S.A.U.
Date (start)	2019-08-26
Date (finish)	2019-08-28

## Document history

Report number	Date	Description
51929RRF.029	2019-09-27	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 %

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 %

## Remarks and comments

The tests have been performed by the technical personnel: Ignacio Cabra, Miguel Ángel Torres and José Gabriel Pendón.

Used instrumentation:

### Radiated Measurements:

		Last Calibration	Due Calibration
1.	Semianechoic Absorber Lined Chamber ETS FACT3 200STP	N.A.	N.A.
2.	EMI Test Receiver ROHDE AND SCHWARZ ESR7	2018/10	2020/10
3.	BiconicalLog antenna ETS LINDGREN 3142E	2017/09	2020/09
4.	RF Pre-amplifier 40 dB, 10 MHz-6 GHz BONN ELEKTRONIK BLNA 0160-01N	2019/02	2020/08
5.	Signal and Spectrum Analyzer ROHDE AND SCHWARZ FSV40	2018/02	2020/02
6.	Broadband Horn antenna 1-18 GHz SCHWARZBECK BBHA 9120 D	2018/01	2021/01
7.	RF Pre-amplifier 30 dB, 18 GHz-40 GHz BONN ELEKTRONIK BLMA 1840-1M	2019/02	2021/02
8.	Broadband Horn antenna 18-40 GHz SCHWARZBECK BBHA 9170	2018/07	2021/07
9.	DC Power Supply Keysight Technologies U8002A	---	---
10.	Digital multimeter FLUKE 179	2019/06	2020/06
11.	RF Pre-amplifier, 30 dB ,1-18 GHz BONN ELEKTRONIK BLMA 0118-3A	2019/04	2020/04

## Testing verdicts

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

## Summary

### A. 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	See (1)
FCC 15.403 (i)	Transmitter 26 dB Emission Bandwidth (EBW)	N/M	See (1)
FCC 15.35 (c) / RSS-Gen 6.10	Duty Cycle	N/M	See (1)
FCC 15.407 (g) / RSS-Gen 6.11	Transmitter Frequency Stability (Temperature & Voltage Variation)	N/M	See (1)
<u>Supplementary information and remarks:</u>			
(1) Test not requested.			

### B. 5.15 GHz – 5.25 GHz Band

FCC PART 15 PARAGRAPH / RSS-247			
	Requirement – Test case	Verdict	Remark
FCC 15.407 (a) (1) (iv)	Transmitter Maximum conducted Output Power	N/M	See (1)
RSS-247 6.2.1.1	Transmitter Maximum Equivalent Isotropically Radiated Power EIRP	N/M	See (1)
FCC 15.407 (a) (1) (iv)	Transmitter Maximum Power Spectral Density	N/M	See (1)
RSS-247 6.2.1.1	Transmitter EIRP Spectral Density	N/M	See (1)
FCC 15.407 (b) (1) (7)/ RSS-247 6.2.1.2	Transmitter Band Edge Radiated Emissions	P	
FCC 15.407 (b) (1) (6) (7) / RSS-247 6.2.1.2	Transmitter Out of Band Radiated Emissions	P	
<u>Supplementary information and remarks:</u>			
(1) Test not requested.			

### C. 5.725 GHz – 5.85 GHz Band

FCC PART 15 PARAGRAPH / RSS-247			
	Requirement – Test case	Verdict	Remark
FCC Part 15.407 (a) (3) / RSS-247 6.2.4.1	Transmitter Maximum conducted Output Power	N/M	See (1)
FCC 15.407 (e) / RSS-247 Clause 6.2.4.1	6 dB bandwidth.	N/M	See (1)
FCC 15.407 (a) (3) / RSS-247 Clause 6.2.4.1	Transmitter Maximum Power Spectral Density	N/M	See (1)
FCC 15.407 (b) (4) (7)/ RSS-247 6.2.4.2	Transmitter Band Edge Radiated Emissions	P	
FCC 15.407 (b) (4) (6) (7) / RSS-247 6.2.4.2	Transmitter Out of Band Radiated Emissions	P	
<u>Supplementary information and remarks:</u>			
(1) Test not requested.			

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

## INDEX

TEST CONDITIONS .....	11
FCC Section 15.407(b)(1)(6) /RSS-247 6.2.1.2. Transmitter Out of Band Radiated Emissions.....	14
FCC Section 15.407 Subclause (b) (1) / RSS-247 6.2.1.2. Transmitter Band Edge Radiated Emissions.....	23

## TEST CONDITIONS

Power supply (V):

Vnominal = 12 Vdc

Type of power supply = External power supply (Battery).

Type of antenna: External antenna.

Declared Gain:+ 0.7dBi

Technology Tested:	WLAN (IEEE 802.11 a,n,ac) / U-NII	
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	
Beamforming:	No	
Frequency Range:	5150 MHz to 5250 MHz	
Channel Spacing:	20 MHz	
Transmit Channels	Channel	Channel Frequency (MHz)
	Lowest: 36	5180
	Middle: 40	5200
	Highest: 48	5240
Channel Spacing:	40 MHz	
Transmit Channels	Channel	Channel Frequency (MHz)
	Lowest: 38	5190
	Highest: 46	5230
Channel Spacing:	80 MHz	
Transmit Channels	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 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
- 802.11n HT20: MCS0
- 802.11n HT40: MCS0
- 802.11ac VHT20: MCS0
- 802.11ac VHT40: MCS0
- 802.11ac VHT80: MCS0

### 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).

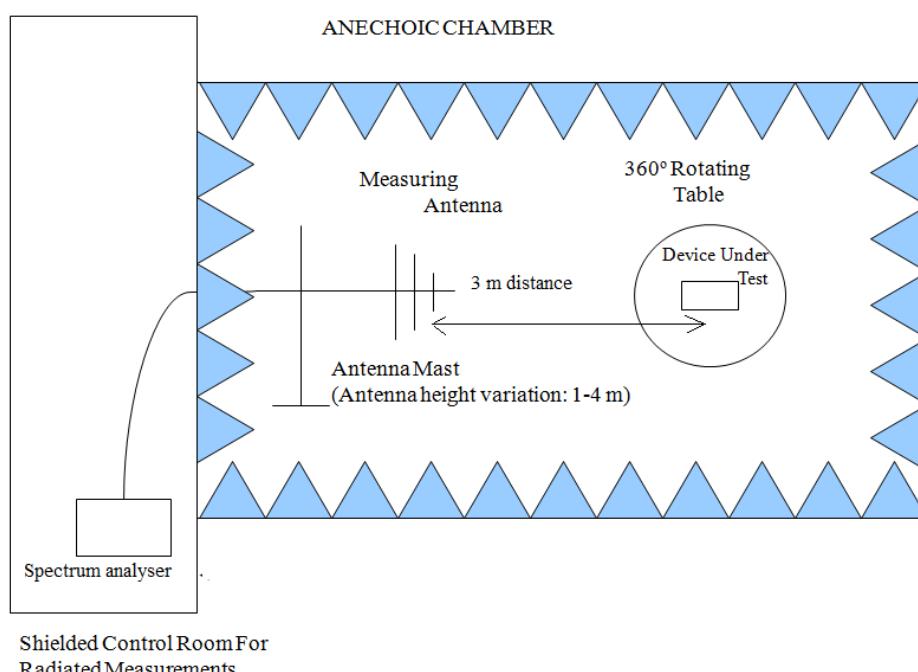
For radiated emissions in the range 1 GHz-40 GHz that is performed at a distance closer than the specified distance, an inverse proportionality factor of 20 dB per decade is used to normalize the measured data for determining compliance.

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 360° and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission.

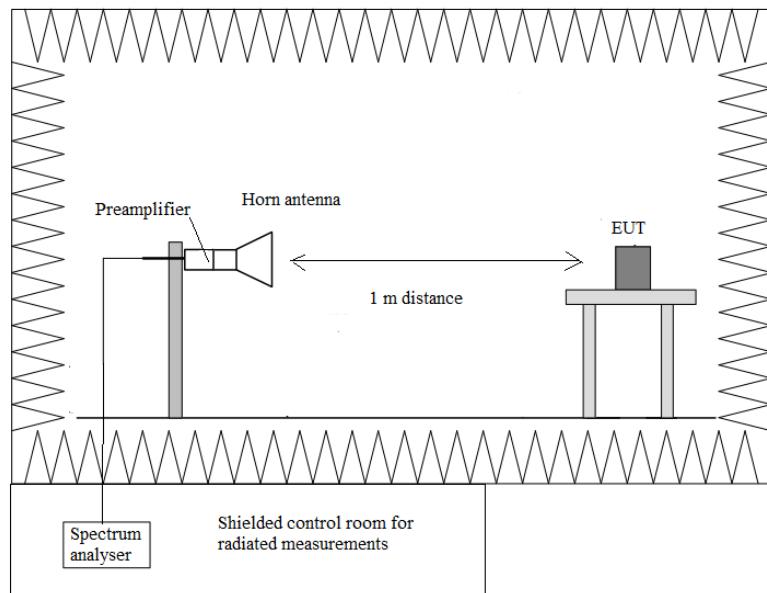
Measurements were made in both horizontal and vertical planes of polarization.

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

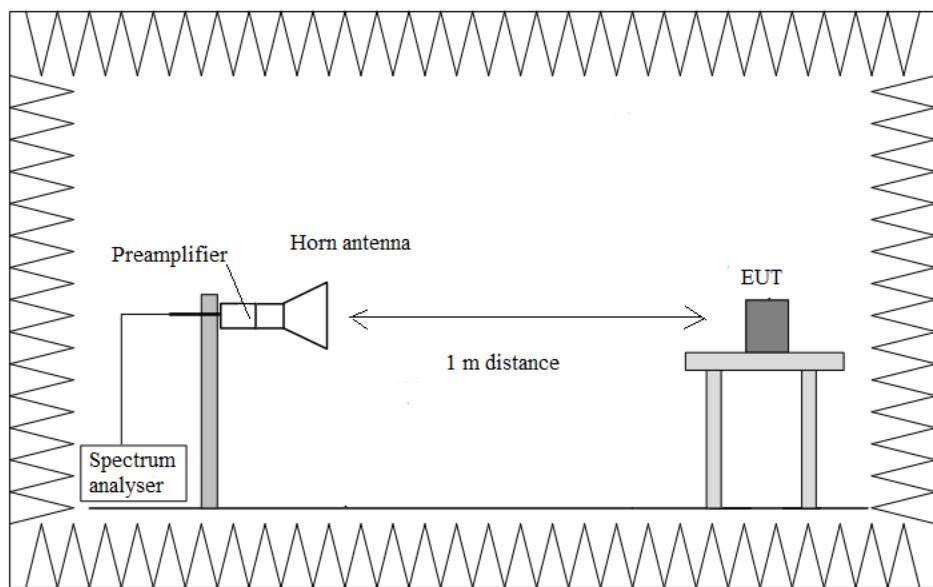
Radiated measurements setup f < 1 GHz.



Radiated measurements setup  $f > 1 \text{ GHz}$  up to 17 GHz.



Radiated measurements setup  $f > 17 \text{ GHz}$  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 dB $\mu$ V/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 ( $\mu$ V/m)	Field strength (dB $\mu$ V/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 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 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.

### Frequency range 30 MHz-1000 MHz.

Note: The spurious emissions below 1 GHz do not depend on either the operating channel or the modulation mode selected in the EUT.

Spurious levels operating (radiated) closest to limit.

Spurious frequency (MHz)	Polarization	Detector	Emission Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Measurement Uncertainty (dB)
350.019	Horizontal	Quasi-Peak	29.5	46	16.5	$\pm$ 3.88
550.001	Vertical	Quasi-Peak	28.8	46	17.2	$\pm$ 3.88
574.995	Vertical	Quasi-Peak	31.5	46	14.8	$\pm$ 3.88
617.707	Horizontal	Quasi-Peak	29.2	46	16.8	$\pm$ 3.88
644.511	Horizontal	Quasi-Peak	30.7	46	15.3	$\pm$ 3.88
646.354	Vertical	Quasi-Peak	30.2	46	15.8	$\pm$ 3.88
675.034	Horizontal	Quasi-Peak	27.1	46	18.9	$\pm$ 3.88

### Frequency range 1 GHz-40 GHz

The results in the next tables show the maximum measured levels in the 1-40 GHz frequency range.

The lowest, middle and highest channels were measured for out-of-band emissions for the worst mode.

Spurious signals with peak levels above the average limit (54 dB $\mu$ V/m at 3 m) are measured with an average detector for checking compliance with the average limit for spurious signals inside the restricted bands.

### Mode: 802.11n HT20– 20MHz (worst case)

Channel 36 (5180MHz): Out-of-band spurious emissions in the 1-40 GHz range.

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Measurement Uncertainty (dB)
1.86090	Vertical	Peak	48.10	68.23	20.13	$\pm$ 3.70
2.08150	Vertical	Peak	56.29	68.23	11.94	$\pm$ 3.70
		Average	53.49	54	0.51	$\pm$ 3.70
7.05517	Horizontal	Peak	41.82	68.23	26.41	$\pm$ 3.70
8.81900	Horizontal	Peak	43.3	68.23	24.93	$\pm$ 3.70
10.36000	Vertical	Peak	45.58	68.23	22.65	$\pm$ 3.70

Channel 40 (5200MHz): Out-of-band spurious emissions in the 1-40 GHz range.

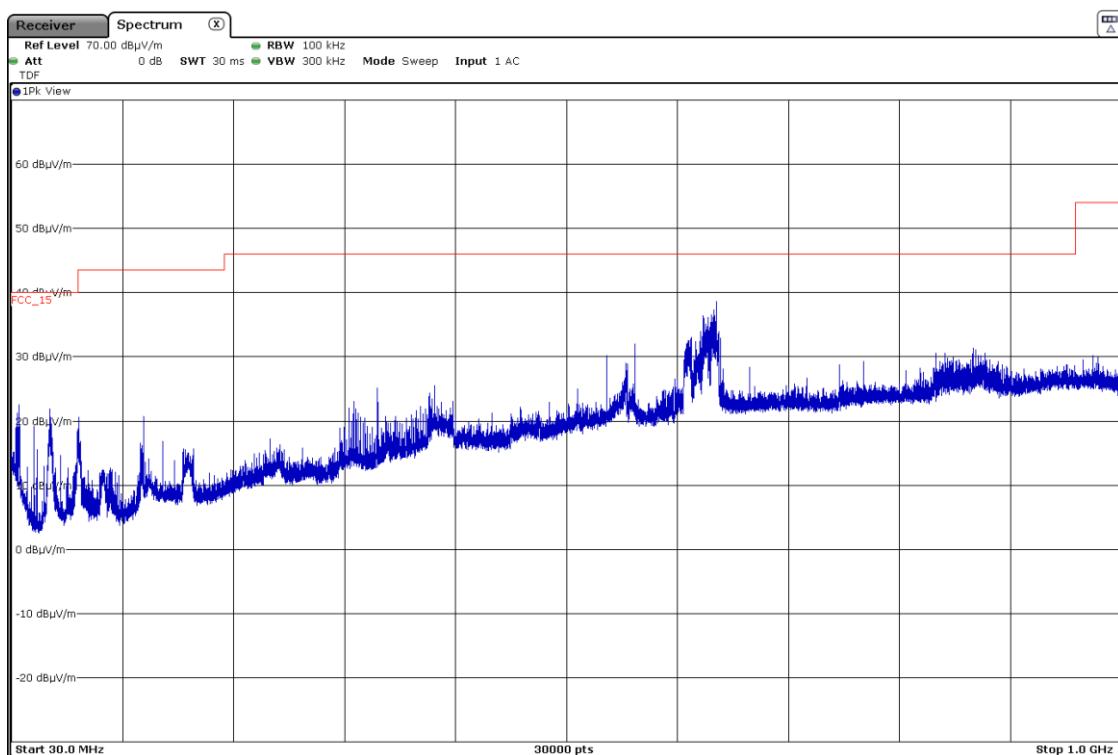
Spurious frequency (GHz)	Polarization	Detector	Emission Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Measurement Uncertainty (dB)
1.85370	Horizontal	Peak	50.15	68.23	18.08	$\pm$ 3.70
2.30230	Vertical	Peak	54.01	68.23	14.22	$\pm$ 3.70
		Average	53.03	54	0.97	$\pm$ 3.70
3.10550	Horizontal	Peak	48.59	68.23	19.64	$\pm$ 3.70
4.34290	Vertical	Peak	54.21	68.23	14.02	$\pm$ 3.70
		Average	42.42	54	11.58	$\pm$ 3.70
7.05533	Horizontal	Peak	42.17	68.23	26.06	$\pm$ 3.70
8.81933	Vertical	Peak	44.06	68.23	24.17	$\pm$ 3.70
10.39999	Vertical	Peak	45.77	68.23	22.49	$\pm$ 3.70

Channel 48 (5240MHz): Out-of-band spurious emissions in the 1-40 GHz range.

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Measurement Uncertainty (dB)
1.86910	Horizontal	Peak	48.08	68.23	20.15	$\pm$ 3.70
2.19190	Vertical	Peak	54.88	68.23	13.35	$\pm$ 3.70
		Average	53.90	54	0.10	$\pm$ 3.70
3.0989	Vertical	Peak	49.01	68.23	19.22	$\pm$ 3.70
4.34350	Horizontal	Peak	53.35	68.23	14.88	$\pm$ 3.70
7.05500	Horizontal	Peak	41.64	68.23	26.59	$\pm$ 3.70
8.81883	Vertical	Peak	43.84	68.23	24.39	$\pm$ 3.70

Verdict: PASS

## FREQUENCY RANGE 30 MHz-1000 MHz.

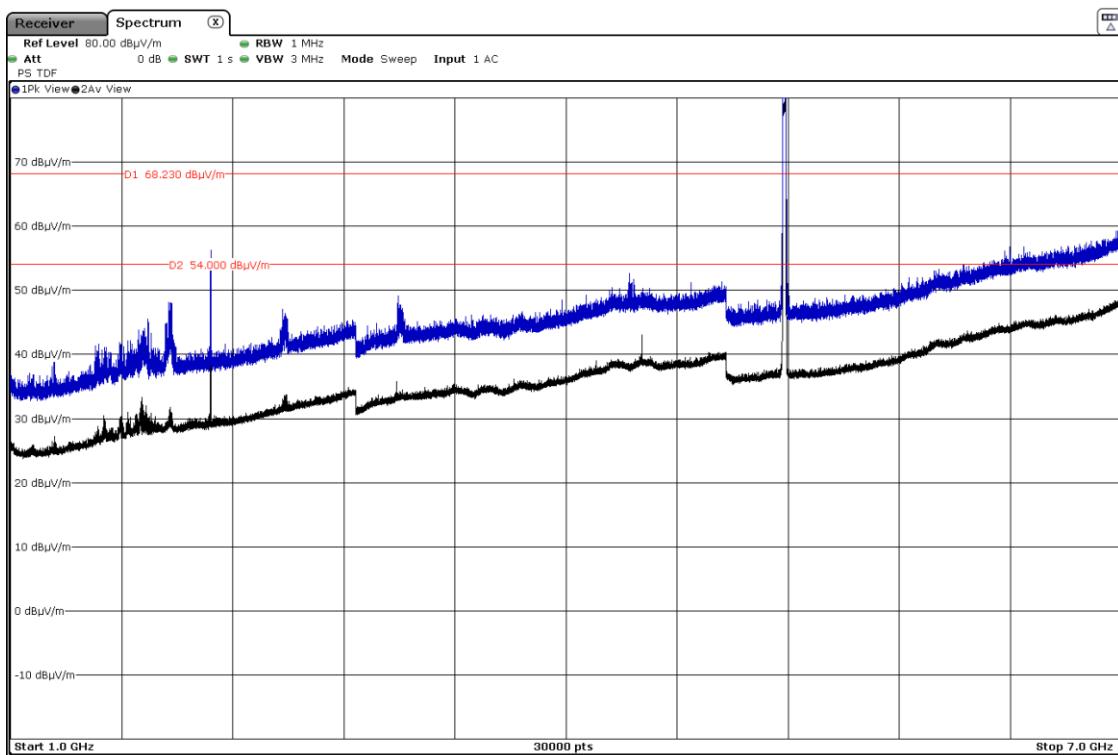


Note: This plot is valid for all channels and all modulation modes.

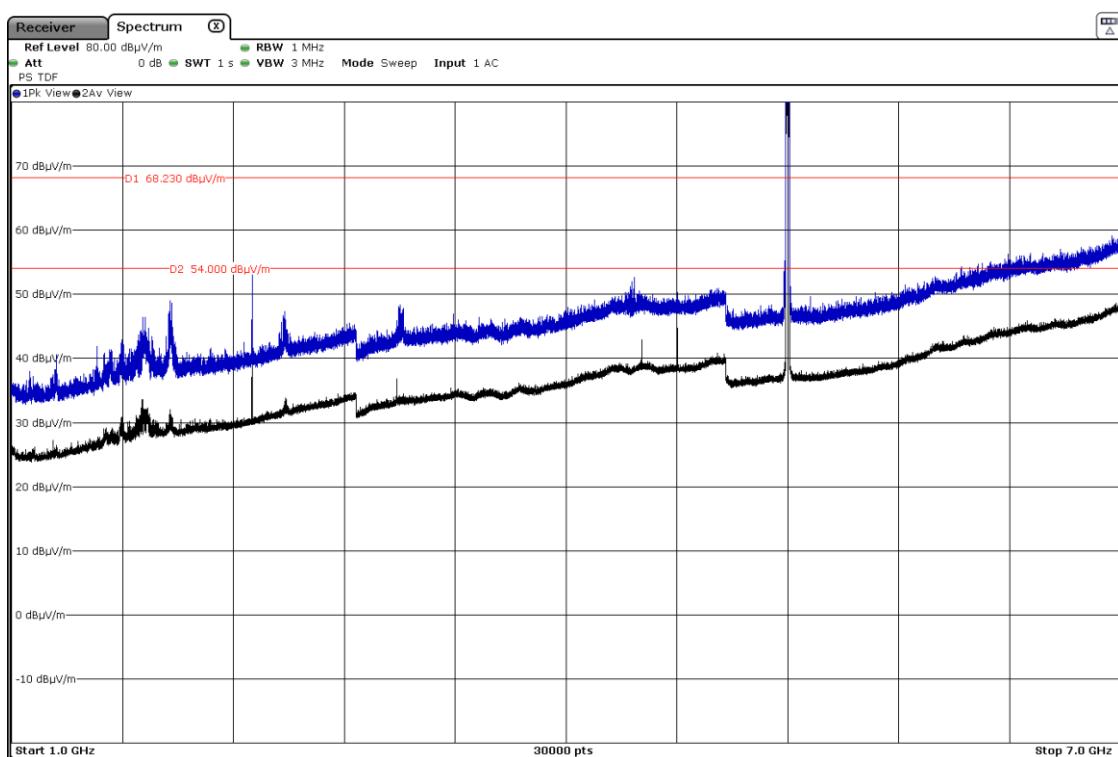
## FREQUENCY RANGE 1 GHz to 7 GHz. (worst case)

**Mode: 802.11n HT20– 20MHz**

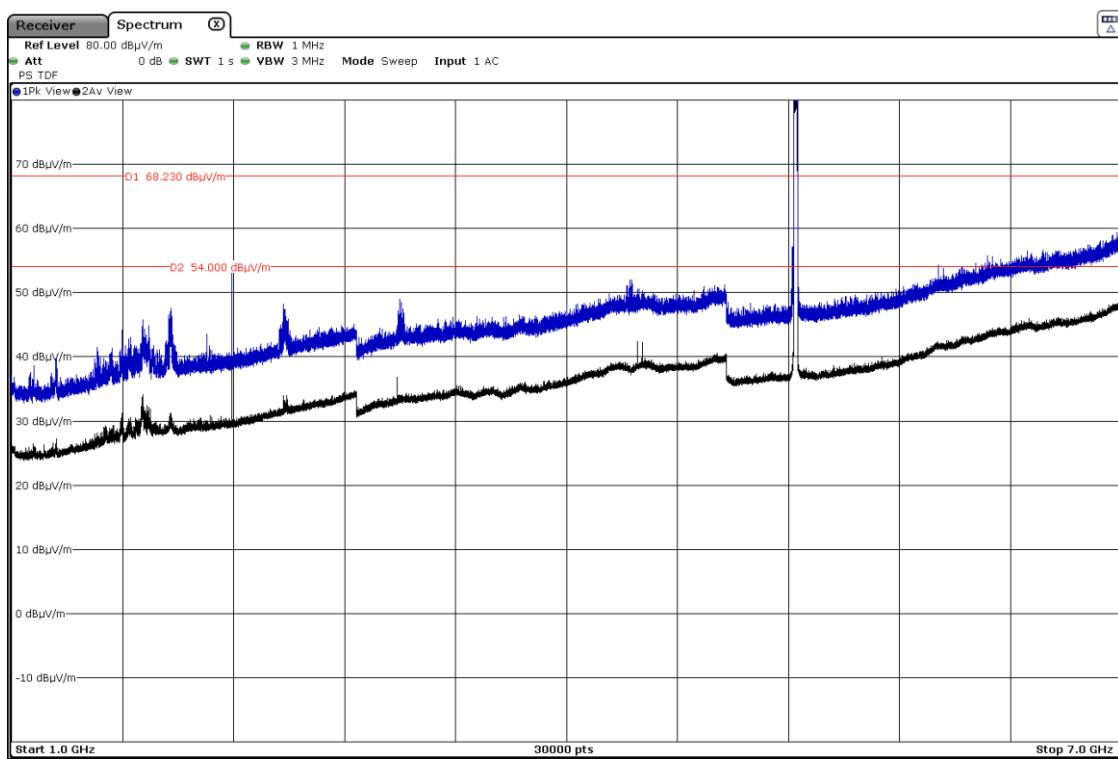
Channel 36 (5180MHz):



Channel 40 (5200MHz):



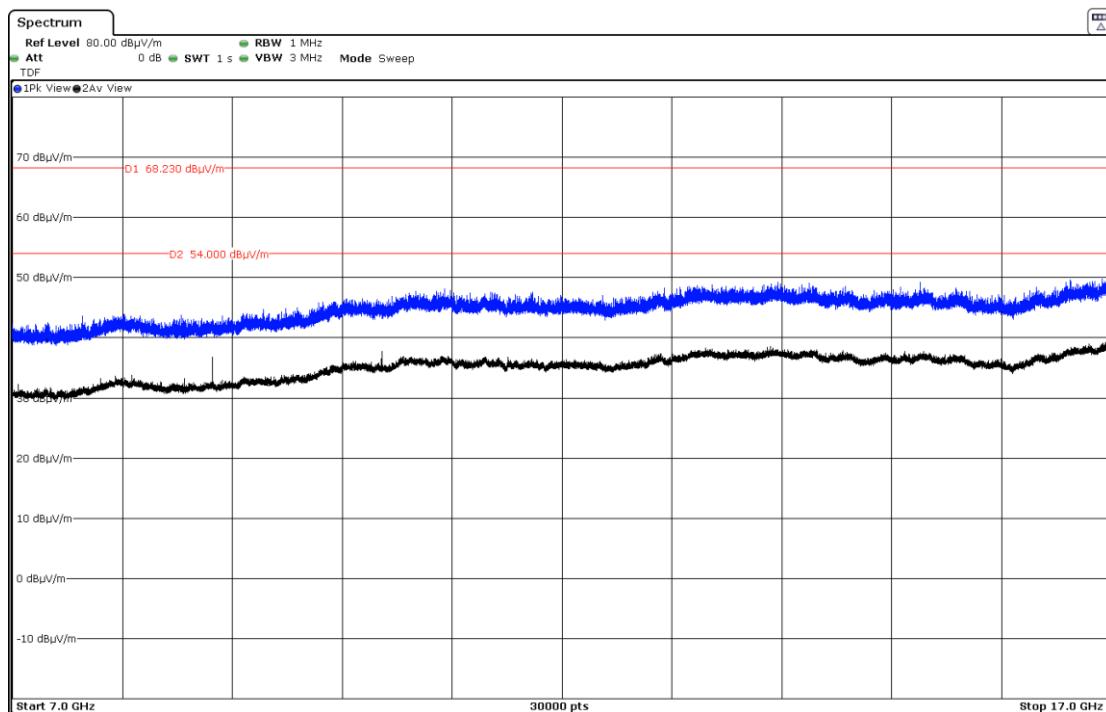
Channel 48 (5240MHz):



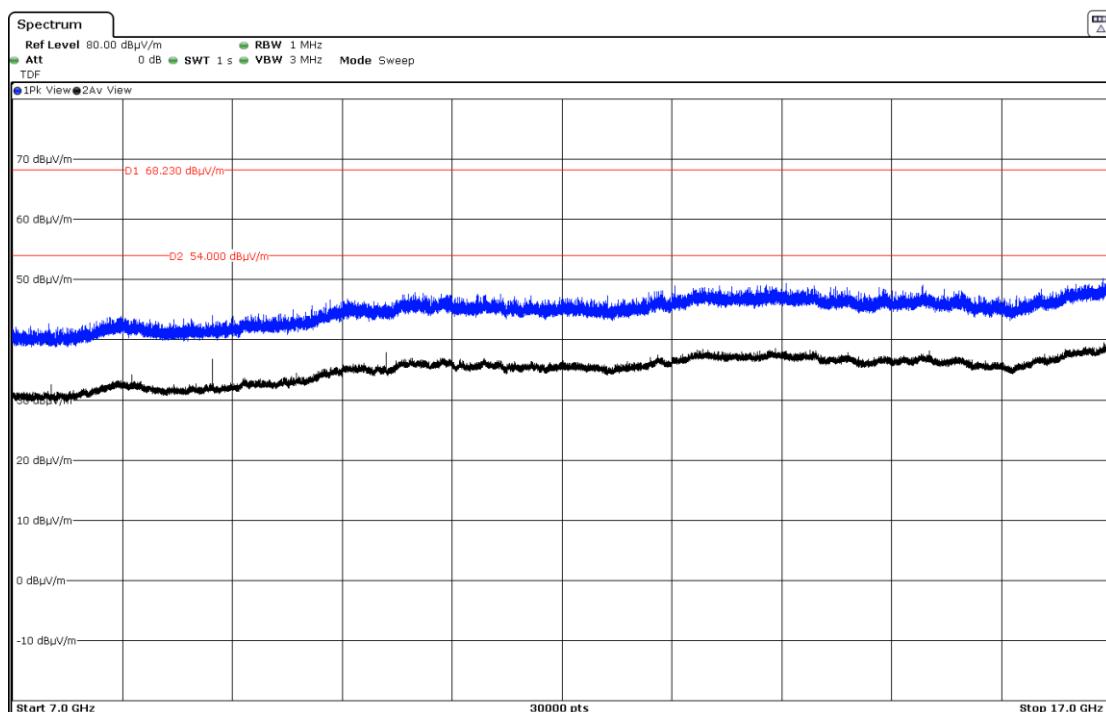
## FREQUENCY RANGE 7 GHz to 17 GHz. (worst case)

**Mode: 802.11n HT20 – 20MHz**

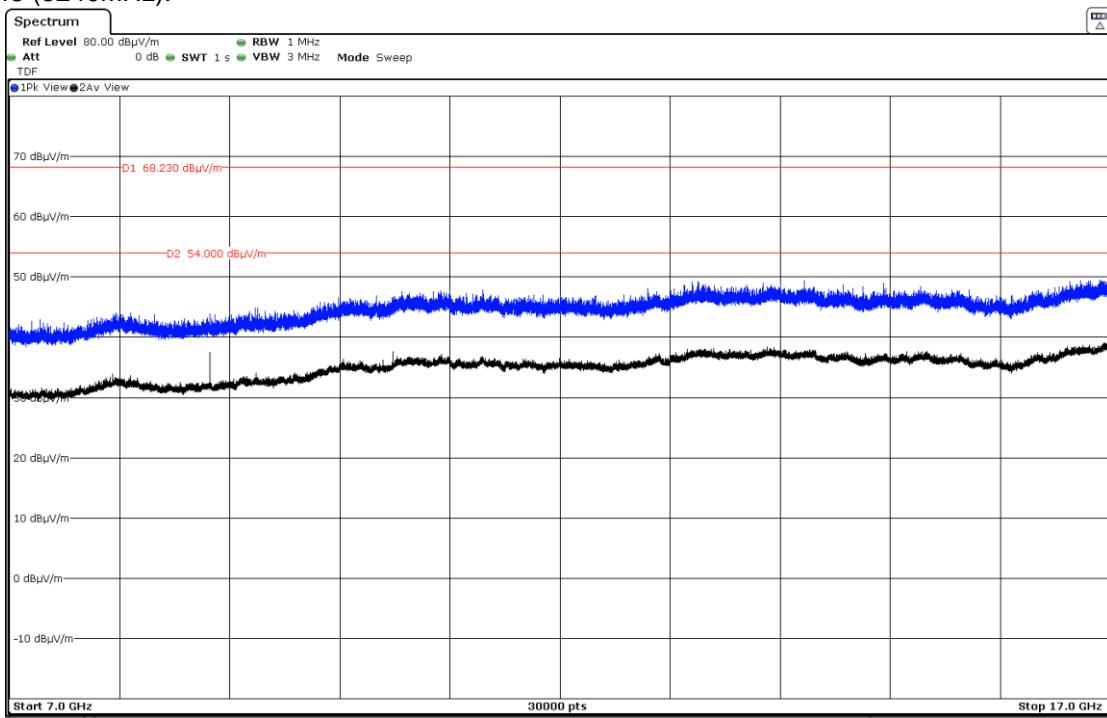
Channel 36 (5180MHz):



Channel 40 (5200MHz):

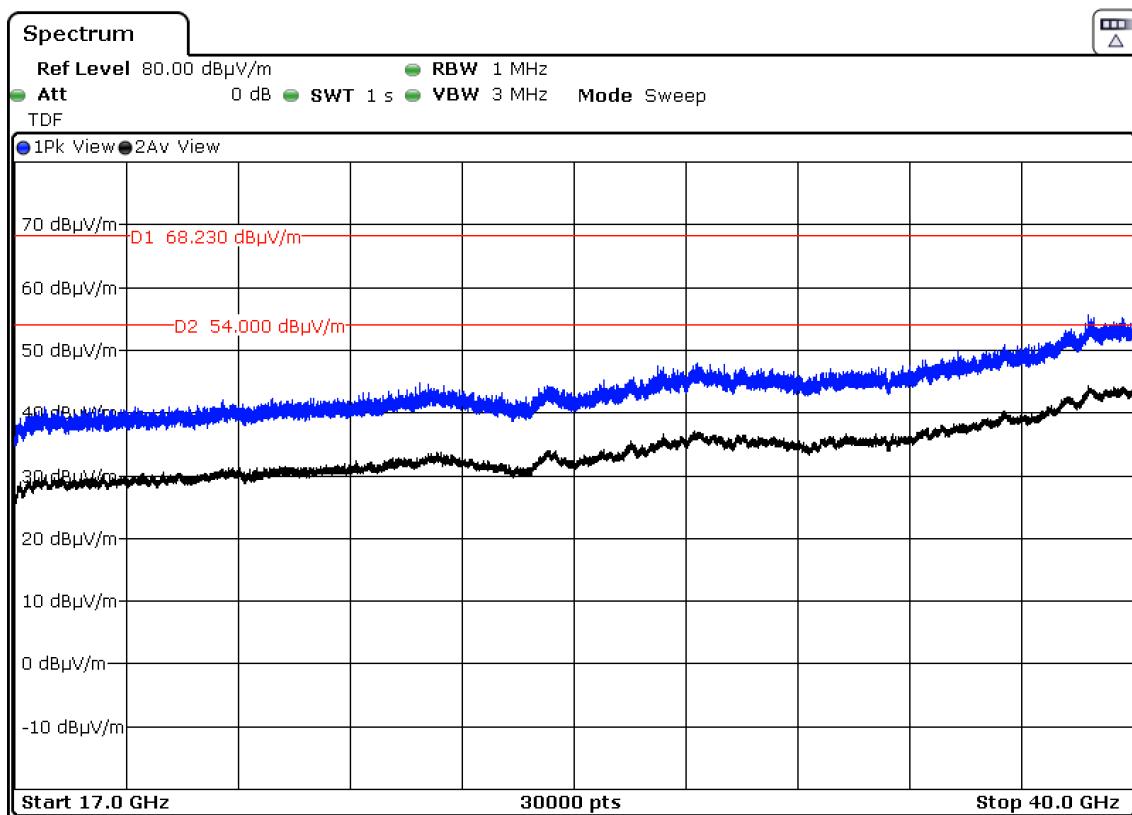


Channel 48 (5240MHz):



**FREQUENCY RANGE 17 GHz to 40 GHz.**

**Mode: 802.11n HT20 – 20MHz**



Note: This plot is valid for all 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 dB $\mu$ V/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 ( $\mu$ V/m)	Field strength (dB $\mu$ V/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 5.15-5.35GHz 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 5.35-5.46GHz therefore the provision of FCC Part 15.205 apply.

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

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

- 802.11a: 6 Mbits
- 802.11n HT20: MCS0
- 802.11n HT40: MCS0
- 802.11ac VHT20: MCS0
- 802.11ac VHT40: MCS0
- 802.11ac VHT80: MCS0

**Mode: 802.11a - 20MHz**

Channel 36 (5180MHz): spurious emissions in 4.50-5.15 GHz adjacent band.

No radiated spurious signals were detected.

Channel 48 (5240MHz): spurious emissions in 5.35-5.46 GHz adjacent band.

No radiated spurious signals were detected.

**Mode: 802.11ac VHT20 - 20MHz**

Channel 36 (5180MHz): spurious emissions in 4.50-5.15 GHz adjacent band.

No radiated spurious signals were detected.

Channel 48 (5240MHz): spurious emissions in 5.35-5.46 GHz adjacent band.

No radiated spurious signals were detected.

**Mode : 802.11n HT20 – 20MHz**

Channel 36 (5180MHz): spurious emissions in 4.50-5.15 GHz adjacent band.

No radiated spurious signals were detected.

Channel 48 (5240MHz): spurious emissions in 5.35-5.46 GHz adjacent band.

No radiated spurious signals were detected.

**Mode: 802.11ac VHT40 – 40MHz**

Channel 38 (5190MHz): spurious emissions in 4.50-5.15 GHz adjacent band.

No radiated spurious signals were detected.

Channel 46 (5230MHz): spurious emissions in 5.35-5.46 GHz adjacent band.

No radiated spurious signals were detected.

**Mode : 802.11n HT40– 40MHz**

Channel 38 (5190MHz): spurious emissions in 4.50-5.15 GHz adjacent band.

No radiated spurious signals were detected.

Channel 46 (5230MHz): spurious emissions in 5.35-5.46 GHz adjacent band.

No radiated spurious signals were detected.

**Mode : 802.11ac VHT80 – 80MHz**

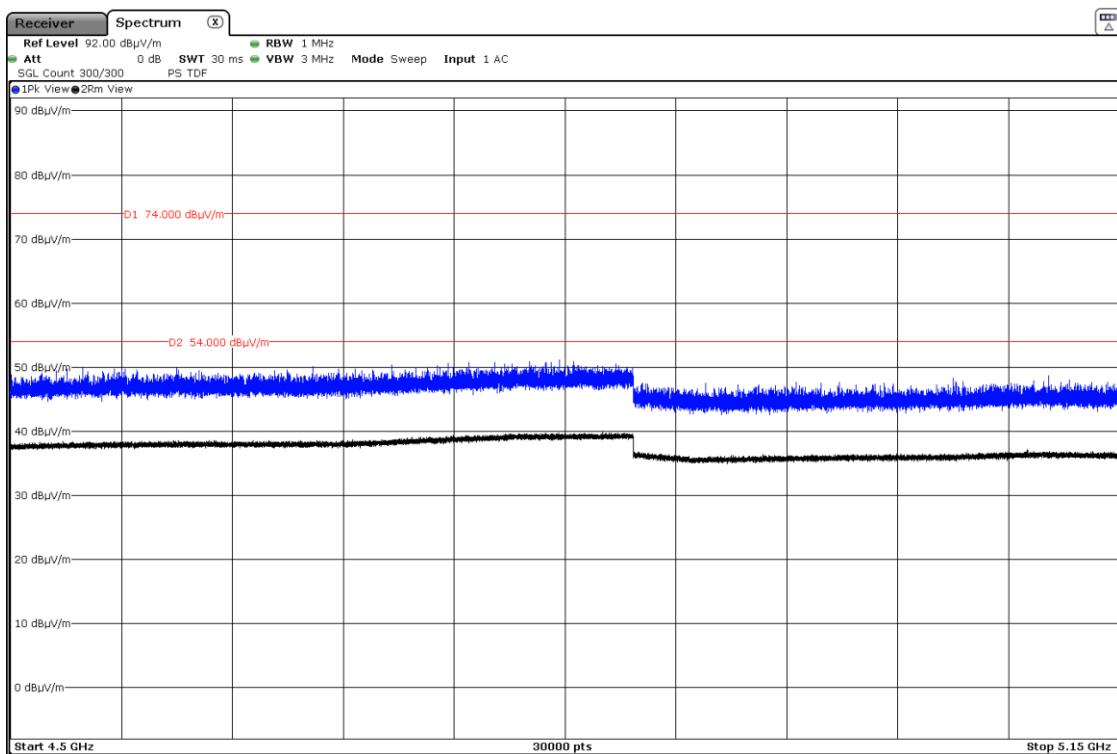
Channel 42 (5210MHz): spurious emissions in 4.50-5.15 GHz and 5.35-5.46 GHz adjacent band.

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Measurement Uncertainty (dB)
5.14594	Vertical	Peak	53.47	74	20.53	$\pm 3.70$
		Average	39.79	54	14.21	$\pm 3.70$

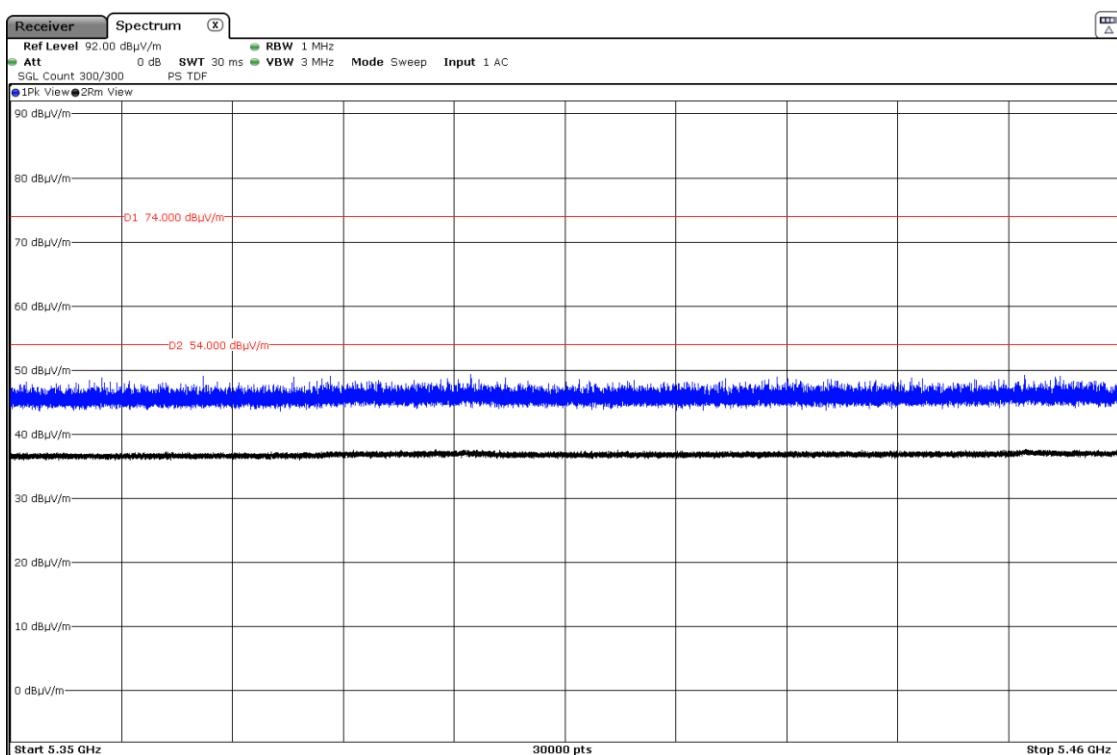
Verdict: PASS

## Mode: 802.11a - 20MHz

### 4500 MHz to 5150 MHz Lower Band Edge Channel 36

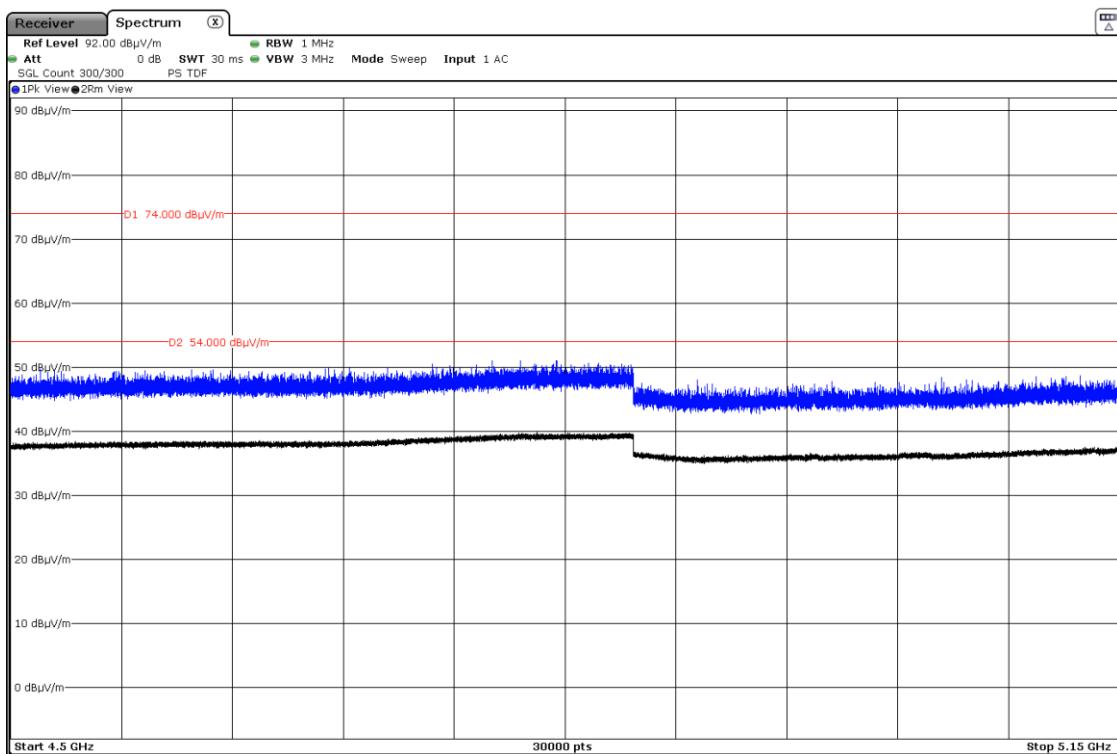


### 5350 MHz to 5460 MHz Upper Band Edge Channel 48

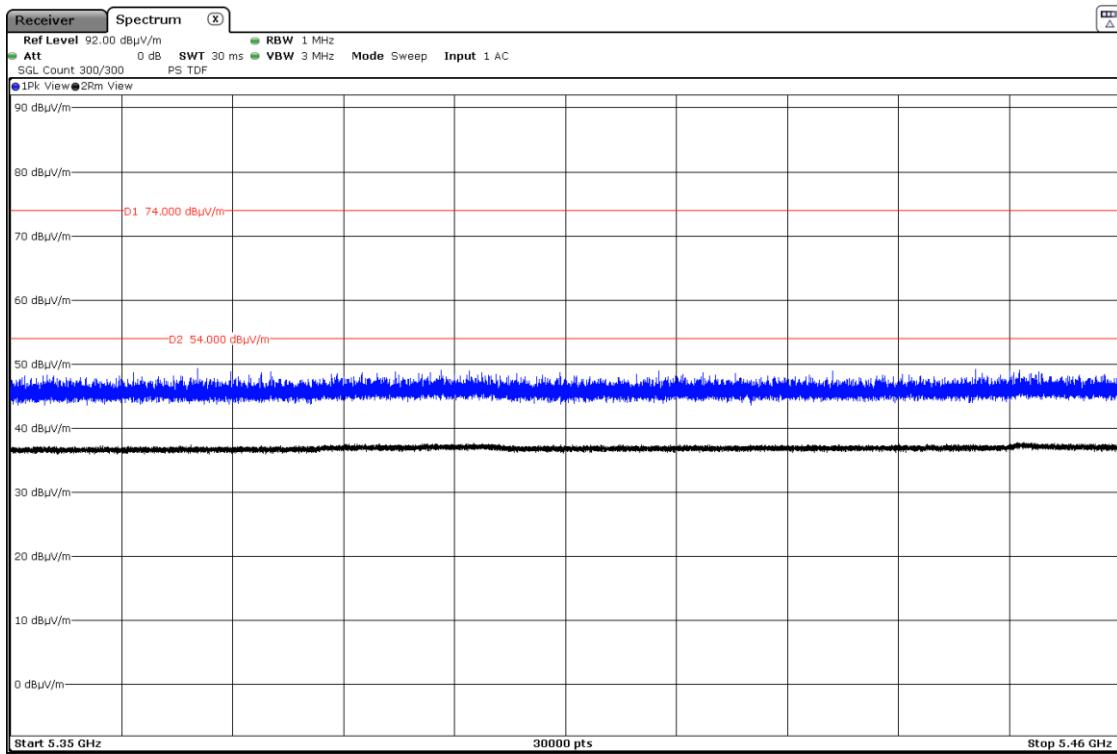


## Mode: 802.11ac VHT20 – 20MHz

### 4500 MHz to 5150 MHz Lower Band Edge Channel 36

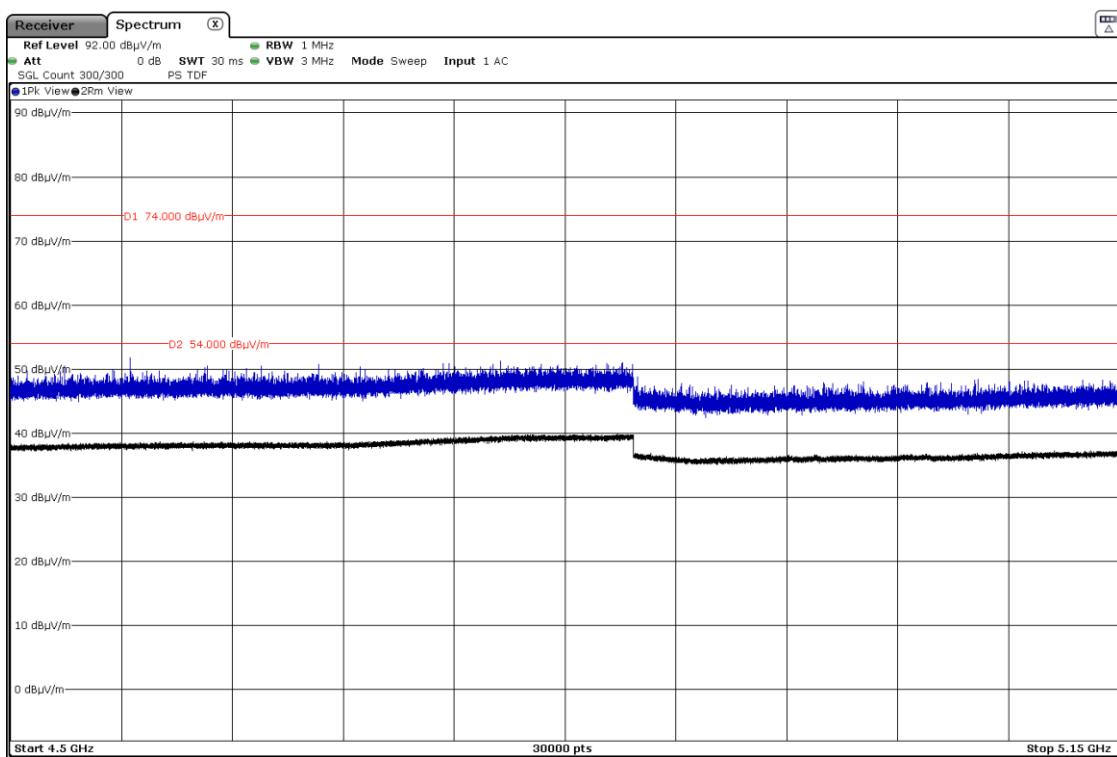


### 5350 MHz to 5460 MHz Upper Band Edge Channel 48

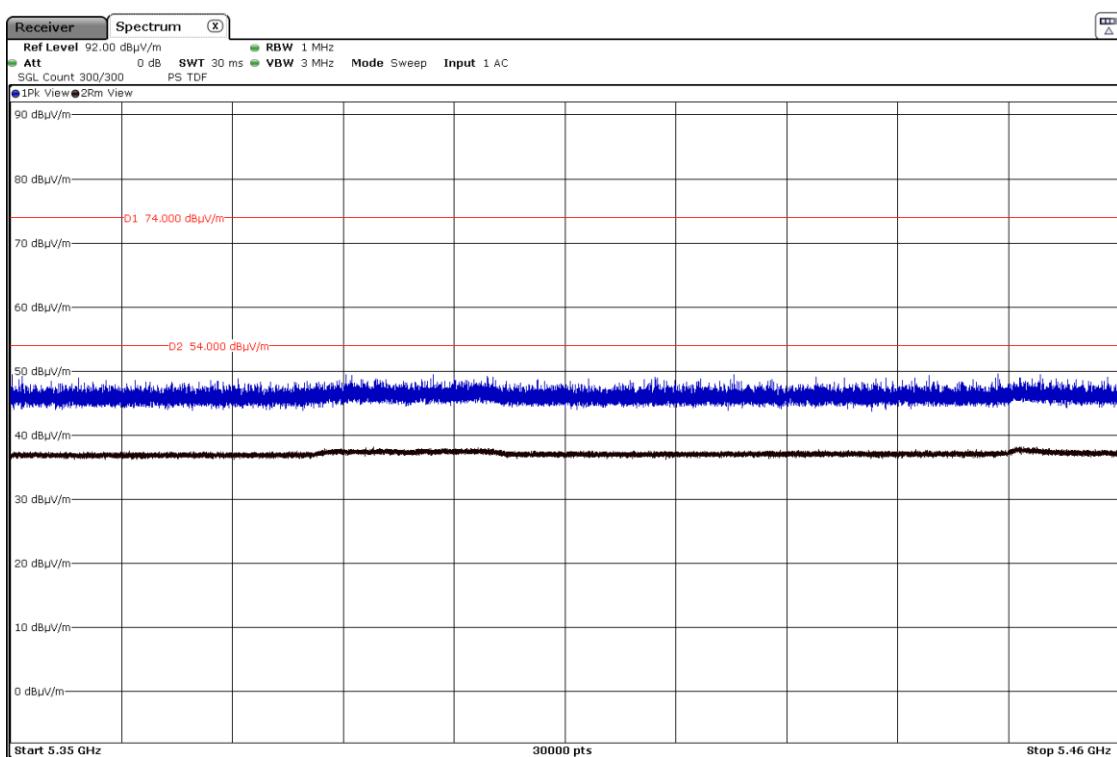


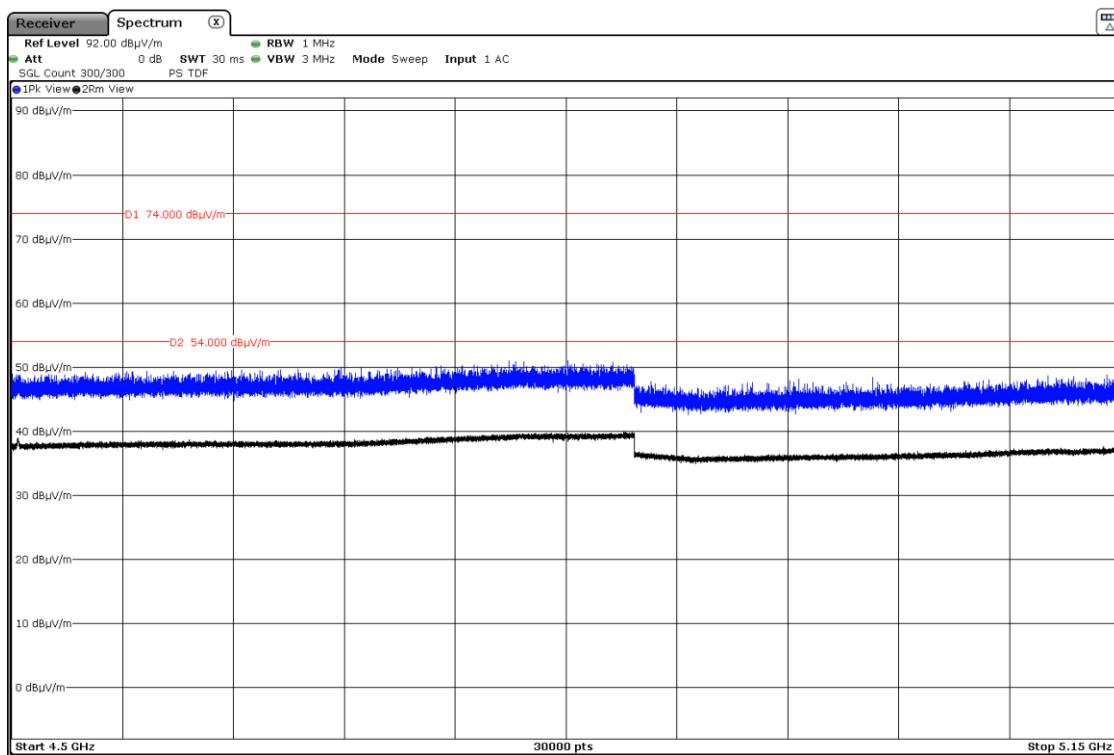
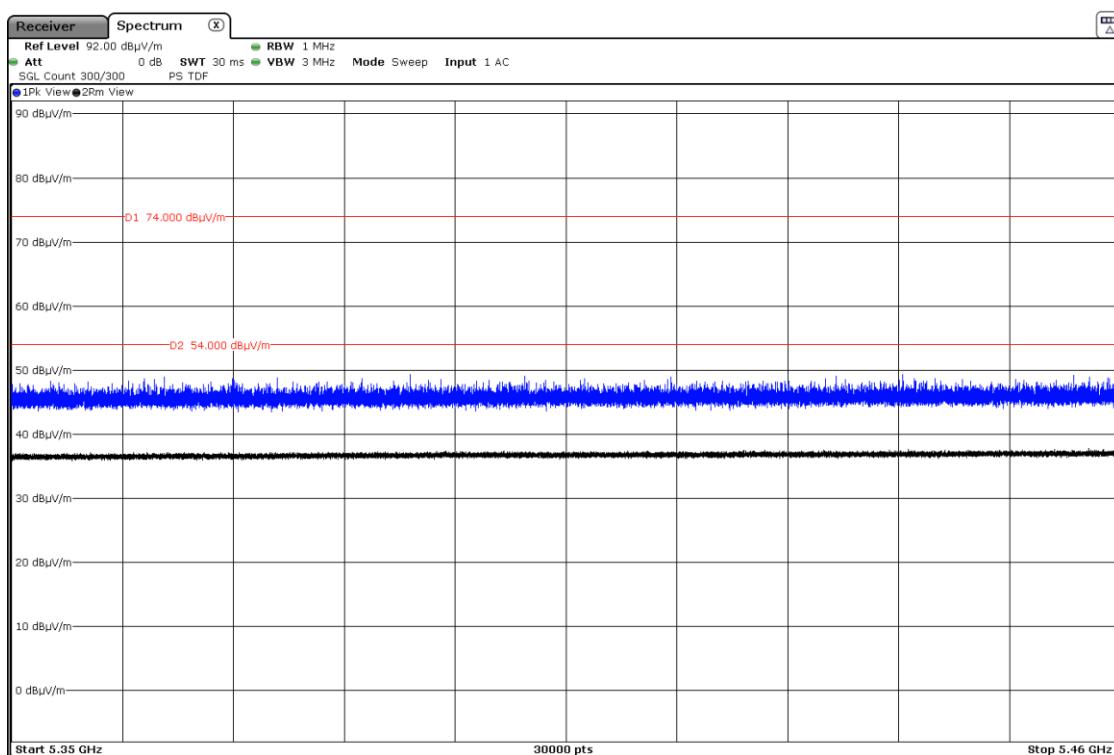
**Mode: 802.11n HT20– 20MHz**

**4500 MHz to 5150 MHz Lower Band Edge Channel 36**



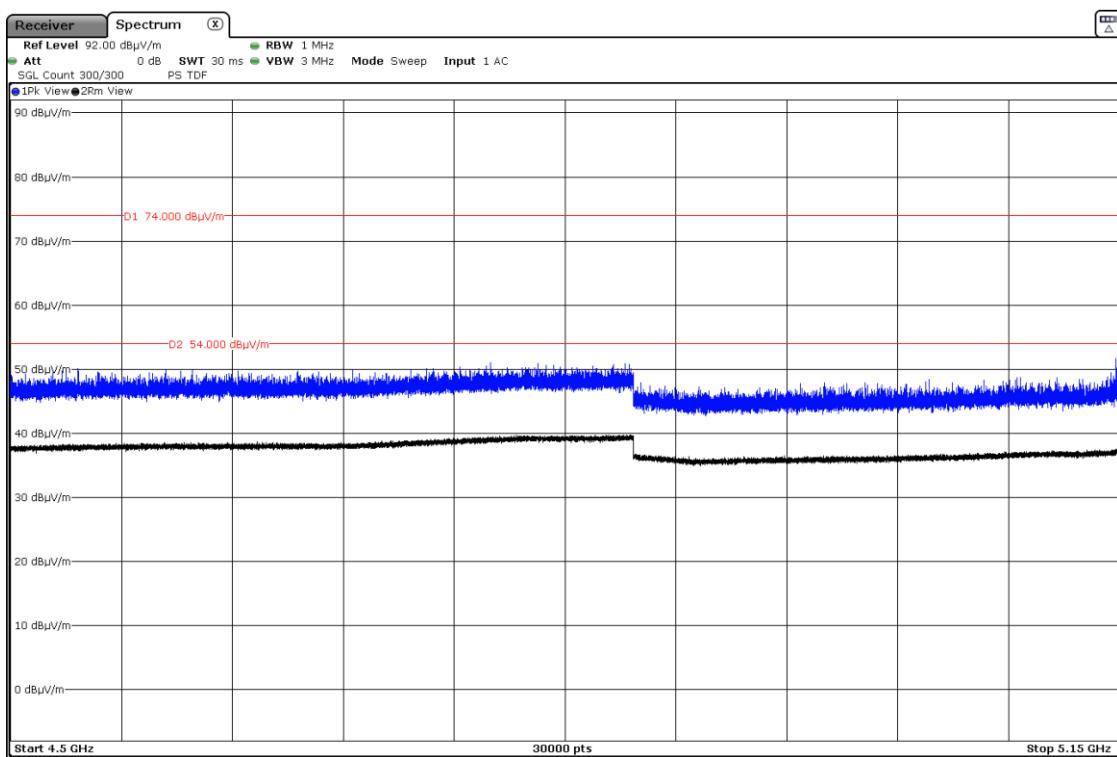
**5350 MHz to 5460 MHz Upper Band Edge Channel 48**



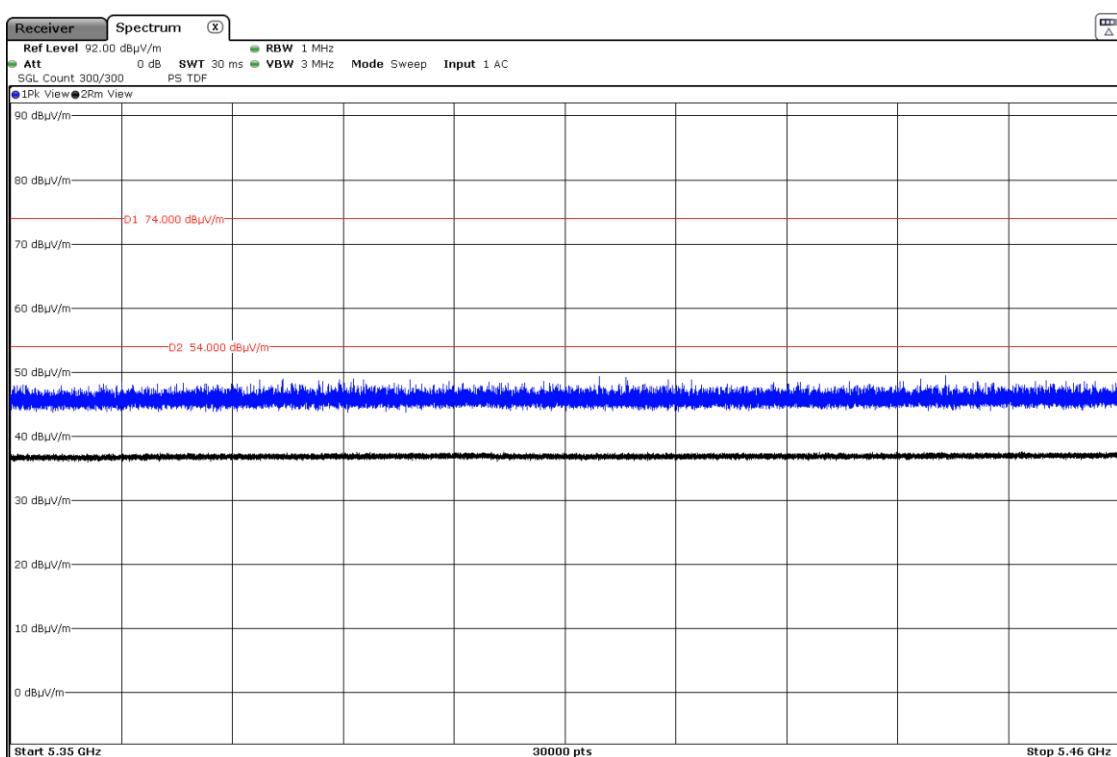
**Mode: 802.11ac VHT40 – 40MHz****4500 MHz to 5150 MHz Lower Band Edge Channel 38****5350 MHz to 5460 MHz Upper Band Edge Channel 46**

**Mode: 802.11n HT40 – 40MHz**

**4500 MHz to 5150 MHz Lower Band Edge Channel 38**

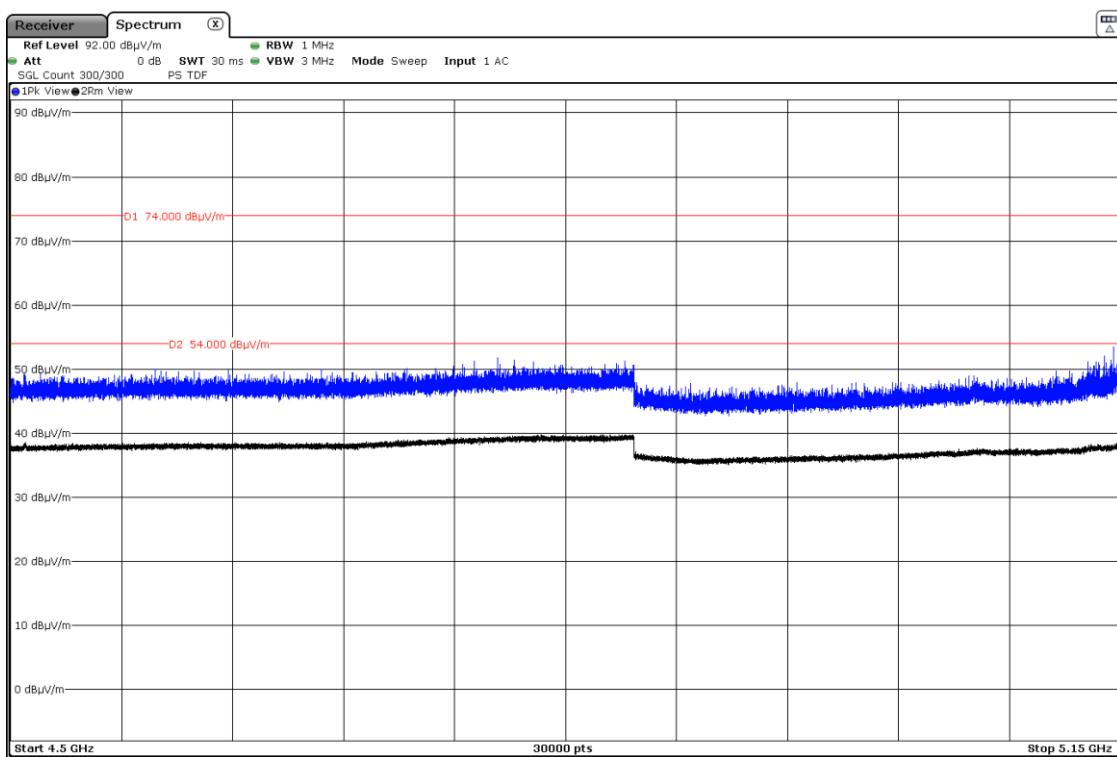


**5350 MHz to 5460 MHz Upper Band Edge Channel 46**

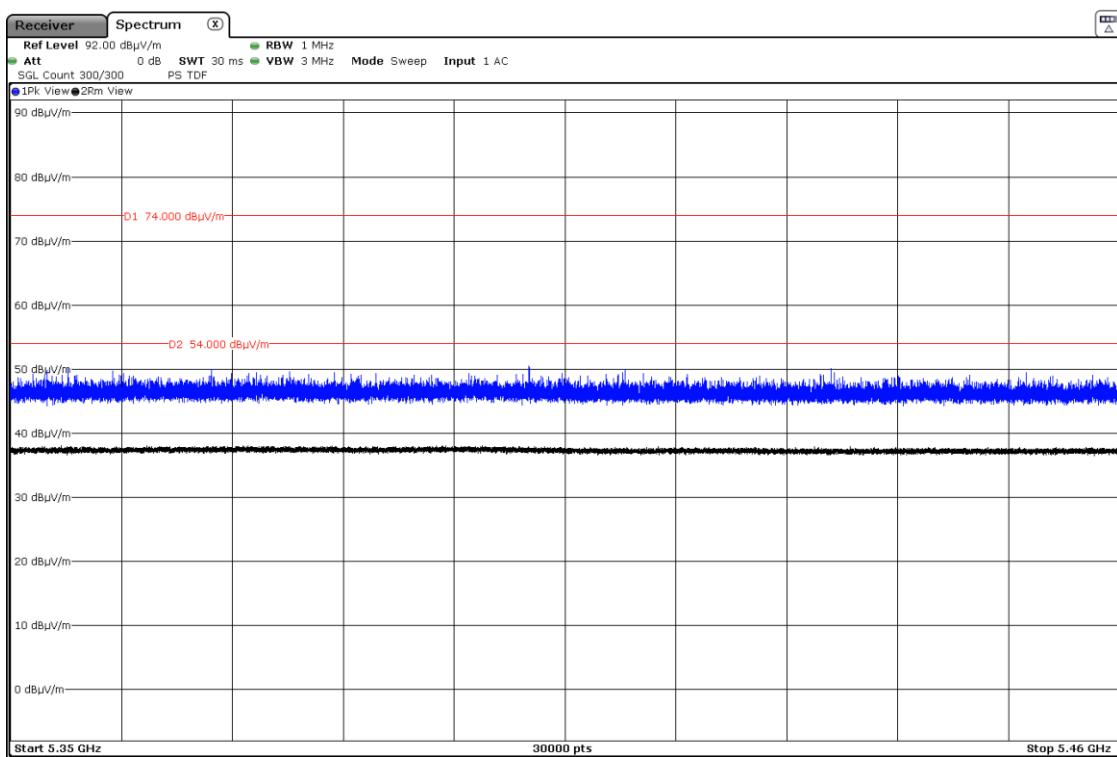


## Mode: 802.11ac VHT80 – 80MHz

### 4500 MHz to 5150 MHz Lower Band Edge Channel 42



### 5350 MHz to 5460 MHz Upper Band Edge Channel 42



## **Appendix B: Test result for 5.725GHz – 5.850GHz.**

## INDEX

TEST CONDITIONS .....	34
FCC Section 15.407(b)(4)(6) /RSS-247 6.2.4.2. Transmitter Out of Band Radiated Emissions.....	37
FCC Section 15.407 Subclause (b) (4) / RSS-247 6.2.4.2. Transmitter Band Edge Radiated Emissions.....	45

## TEST CONDITIONS

Power supply (V):

Vnominal = 12 Vdc

Type of power supply = External power supply (Battery).

Type of antenna: External antenna.

Declared Gain: + 0.7dBi

Technology Tested:	WLAN (IEEE 802.11 a,n,ac) / U-NII	
Modes:	802.11a: 6, 9, 12, 18, 24, 36, 48 & 54 Mbps 802.11n HT20: MCS0 to MCS7 802.11n HT40: MCS0 to MCS7 802.11ac VHT20: MCS0 to MCS8 802.11ac VHT40: MCS0 to MCS9 802.11ac VHT80: MCS0 to MCS9	
Beamforming:	No	
Frequency Range:	5725 MHz to 5850 MHz	
Channel Spacing:	20 MHz	
Transmit Channels	Channel	Channel Frequency (MHz)
	Lowest: 149	5745
	Middle: 157	5785
	Highest: 165	5825
Channel Spacing:	40 MHz	
Transmit Channels	Channel	Channel Frequency (MHz)
	Lowest: 151	5755
	Highest: 159	5795
Channel Spacing:	80 MHz	
Transmit Channels	Middle: 155	5775

The test set-up was made in accordance to the general provisions of ANSI C63.10: 2013 and FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01 dated 12/14/2017 and FCC KBD 662911 D01 Multiple Transmitter Output v02r01 dated 10/31/2013.

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 individually 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 scripts 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 Mbit/s
- 802.11n HT20: MCS0
- 802.11n HT40: MCS0
- 802.11ac VHT20: MCS0
- 802.11ac VHT40: MCS0
- 802.11ac VHT80: MCS0

### 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).

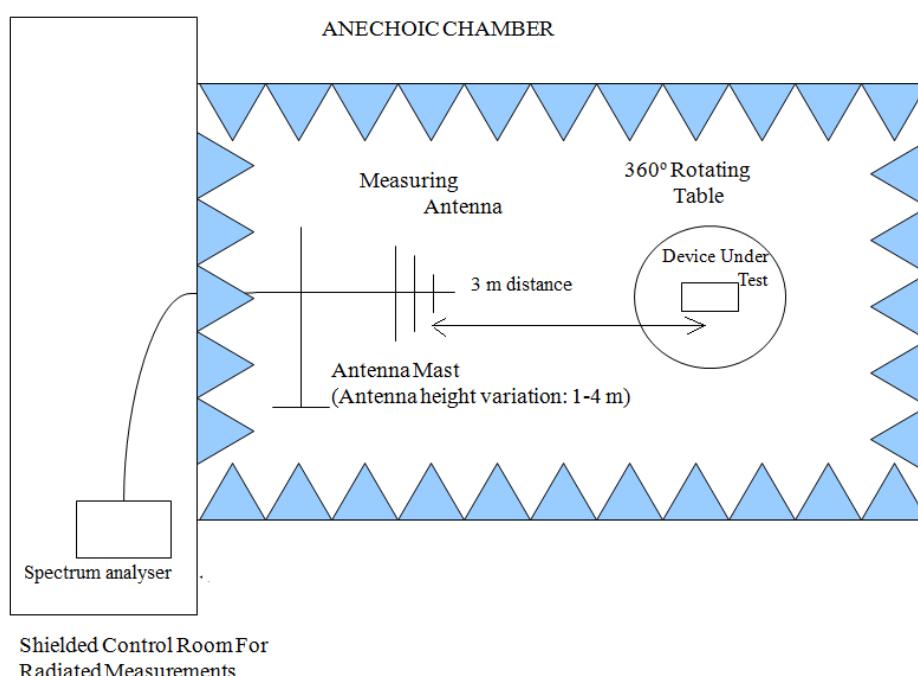
For radiated emissions in the range 1 GHz-40 GHz that is performed at a distance closer than the specified distance, an inverse proportionality factor of 20 dB per decade is used to normalize the measured data for determining compliance.

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 360° and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission.

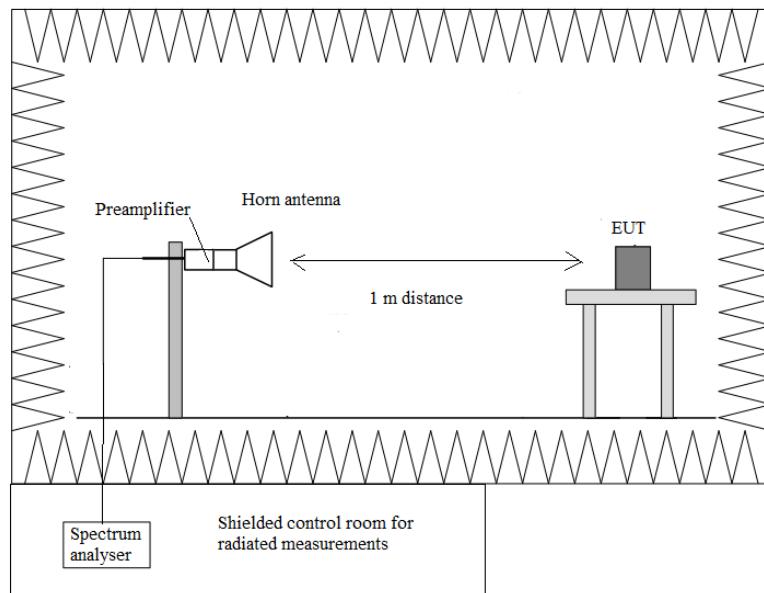
Measurements were made in both horizontal and vertical planes of polarization.

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

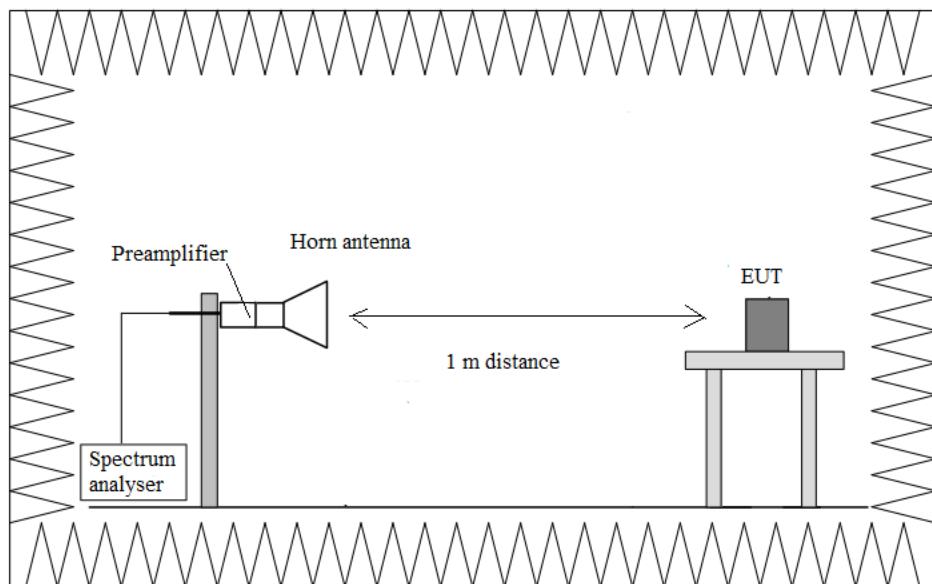
Radiated measurements setup f < 1 GHz



Radiated measurements setup  $f > 1 \text{ GHz}$  up to 17 GHz.



Radiated measurements setup  $f > 17 \text{ GHz}$  up to 40 GHz.



## FCC Section 15.407(b)(4)(6) /RSS-247 6.2.4.2. Transmitter Out of Band Radiated Emissions

### SPECIFICATION

For transmitters operating in the 5.725–5.85 GHz band:

All emissions shall be limited to a level of -27 dBm/MHz (68.23 dB $\mu$ V/m at 3 m distance) at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.

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 ( $\mu$ V/m)	Field strength (dB $\mu$ V/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 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 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.

### Frequency range 30 MHz-1000 MHz.

Note: The spurious emissions below 1 GHz do not depend on either the operating channel or the modulation mode selected in the EUT.

Spurious levels operating (radiated) closest to limit.

Spurious frequency (MHz)	Polarization	Detector	Emission Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Measurement Uncertainty (dB)
350.019	Horizontal	Quasi-Peak	29.5	46	16.5	$\pm$ 3.88
575.027	Vertical	Quasi-Peak	30.3	46	15.7	$\pm$ 3.88
619.582	Horizontal	Quasi-Peak	29.0	46	17.0	$\pm$ 3.88
644.123	Vertical	Quasi-Peak	28.8	46	17.2	$\pm$ 3.88
646.969	Horizontal	Quasi-Peak	29.2	46	16.8	$\pm$ 3.88
875.016	Vertical	Quasi-Peak	28.8	46	17.2	$\pm$ 3.88

### Frequency range 1 GHz-40 GHz

The results in the next tables show the maximum measured levels in the 1-40 GHz range except the 5.65-5.725 GHz and 5.85-5.925GHz adjacent bands. The results in the adjacent bands was evaluated on the next section.

The lowest, middle and highest channels were measured for out-of-band emissions for the worst mode.

Spurious signals with peak levels above the average limit (54 dB $\mu$ V/m at 3 m) are measured with an average detector for checking compliance with the average limit for emissions inside the restricted bands.

### Mode: 802.11n HT20– 20MHz (worst case)

Channel 149 (5745MHz):

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Measurement Uncertainty (dB)
1.85820	Horizontal	Peak	49.69	68.23	18.54	$\pm$ 3.70
2.09140	Vertical	Peak	56.18	68.23	12.05	$\pm$ 3.70
		Average	53.51	54	0.49	$\pm$ 3.70
3.10740	Vertical	Peak	48.26	68.23	19.97	$\pm$ 3.70
4.35200	Horizontal	Peak	54.57	68.23	13.66	$\pm$ 3.70
		Average	38.15	54	15.85	$\pm$ 3.70
4.40960	Vertical	Peak	50.92	68.23	17.31	$\pm$ 3.70
8.18870	Vertical	Peak	43.50	68.23	24.73	$\pm$ 3.70

## Channel 157 (5785MHz):

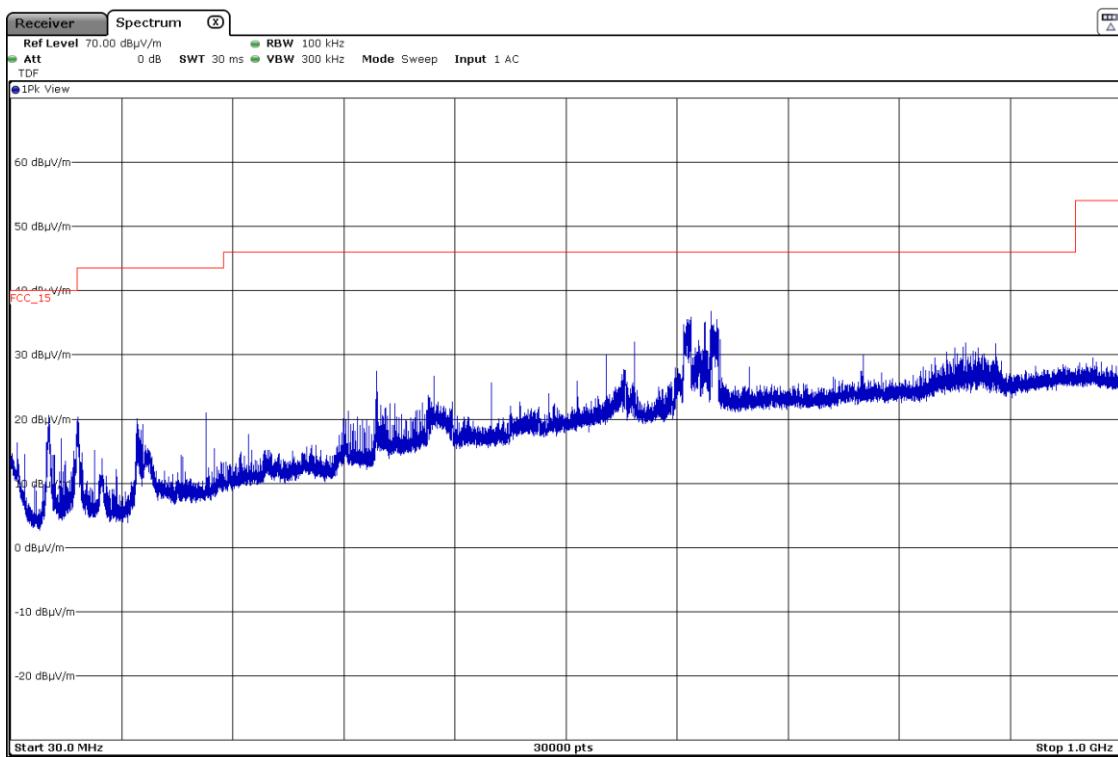
Spurious frequency (GHz)	Polarization	Detector	Emission Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Measurement Uncertainty (dB)
1.85590	Horizontal	Peak	49.34	68.23	18.89	$\pm 3.70$
2.07740	Vertical	Peak	56.67	68.23	11.56	$\pm 3.70$
		Average	53.53	54	0.47	$\pm 3.70$
3.10370	Vertical	Peak	48.64	68.23	19.59	$\pm 3.70$
4.4095	Horizontal	Peak	55.51	68.23	12.72	$\pm 3.70$
		Average	42.64	54	11.36	$\pm 3.70$
7.05561	Vertical	Peak	41.30	68.23	26.93	$\pm 3.70$
8.81883	Vertical	Peak	43.11	68.23	25.12	$\pm 3.70$

## Channel 165 (5825MHz):

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Measurement Uncertainty (dB)
1.85830	Horizontal	Peak	48.83	68.23	19.40	$\pm 3.70$
2.03950	Vertical	Peak	56.24	68.23	11.99	$\pm 3.70$
		Average	53.80	54	0.20	$\pm 3.70$
3.08790	Horizontal	Peak	48.71	68.23	19.52	$\pm 3.70$
4.4095	Horizontal	Peak	54.16	68.23	14.07	$\pm 3.70$
		Average	42.09	54	11.91	$\pm 3.70$
8.81897	Horizontal	Peak	42.97	68.23	25.26	$\pm 3.70$

Verdict: PASS

## FREQUENCY RANGE 30 MHz-1000 MHz.

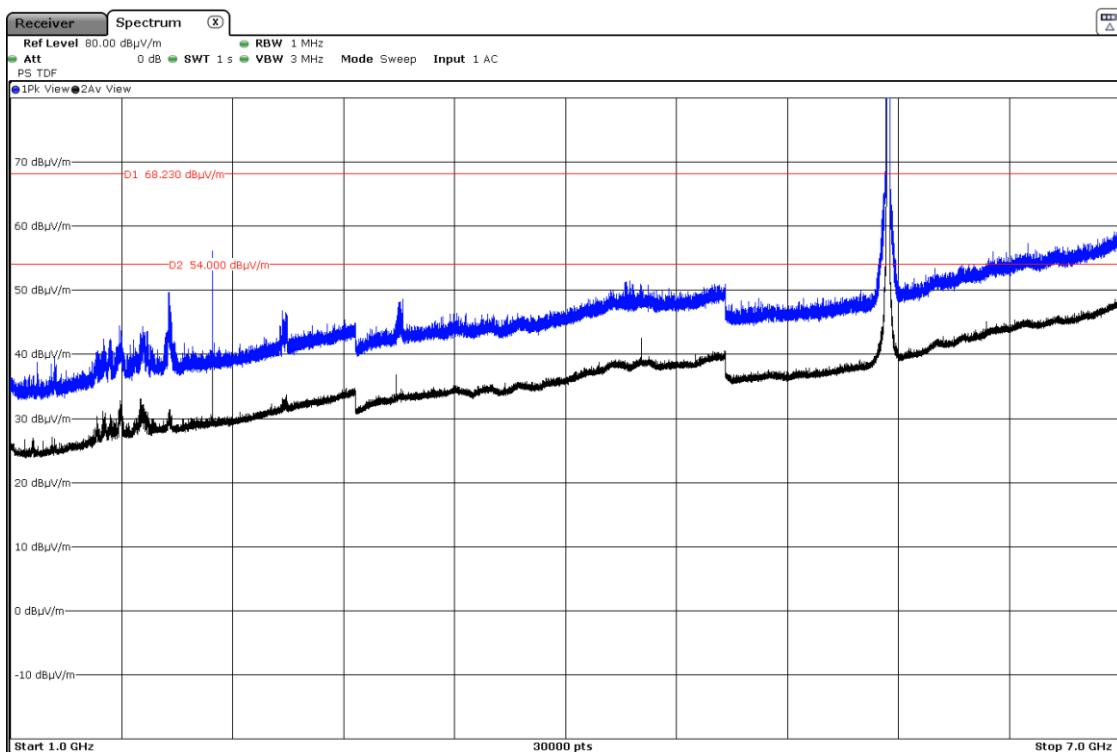


Note: This plot is valid for all channels and all modulation modes.

## Mode: 802.11n HT20– 20MHz (worst case)

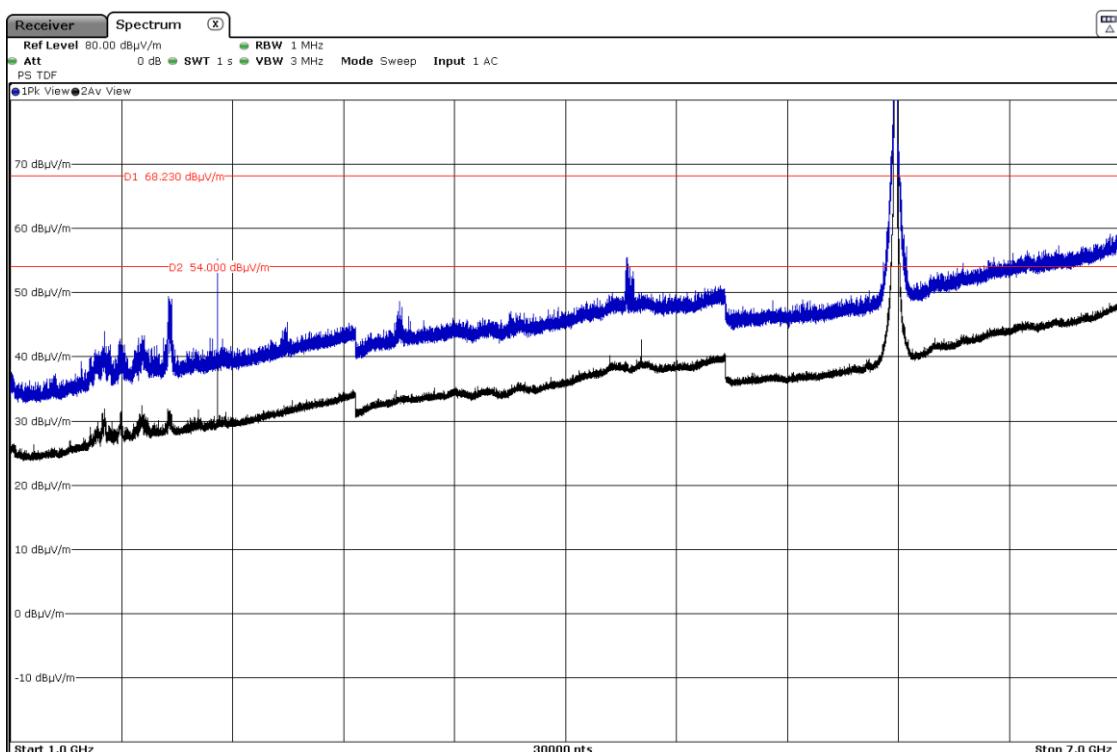
FREQUENCY RANGE 1 GHz to 7 GHz.

Channel 149 (5745MHz):



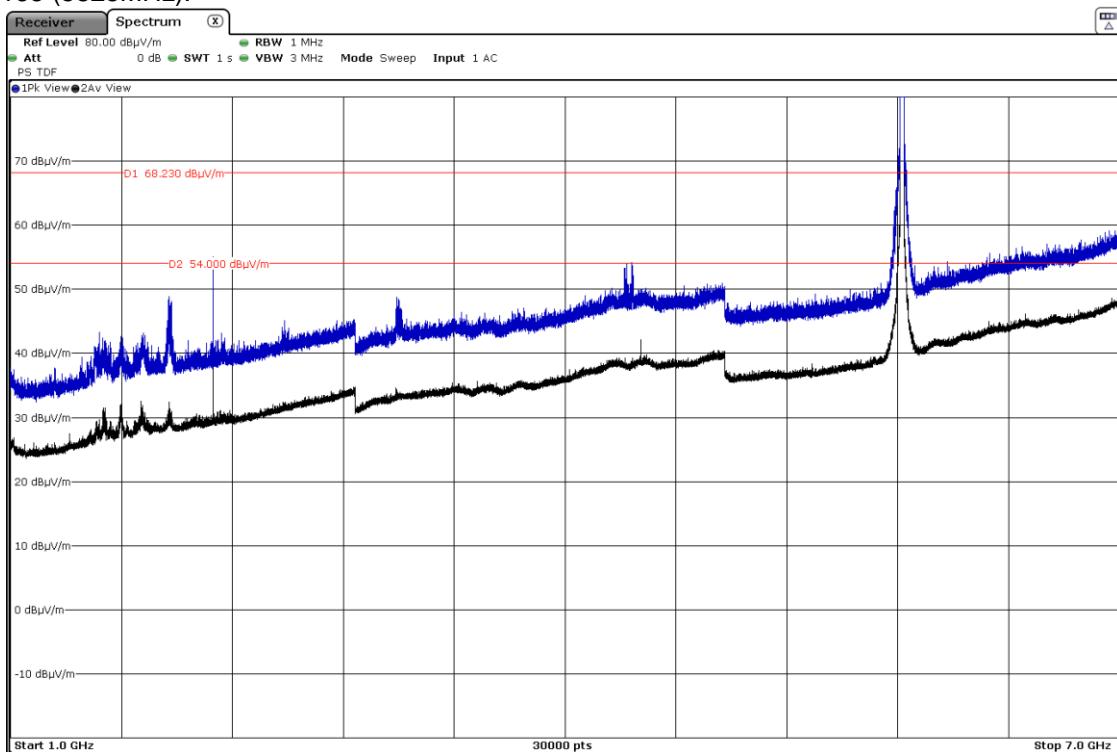
Note: The peaks shown in the plot above the limit are the carrier frequencies.

Channel 157 (5785MHz):



Note: The peaks shown in the plot above the limit are the carrier frequencies.

Channel 165 (5825MHz):

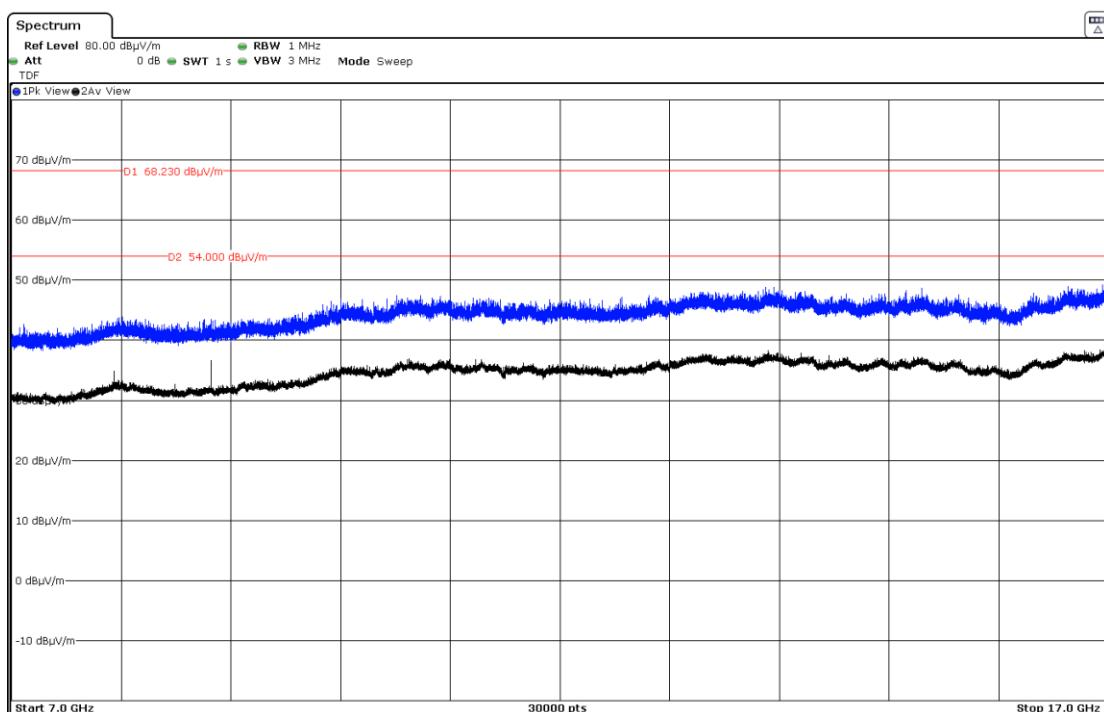


Note: The peaks shown in the plot above the limit are the carrier frequencies.

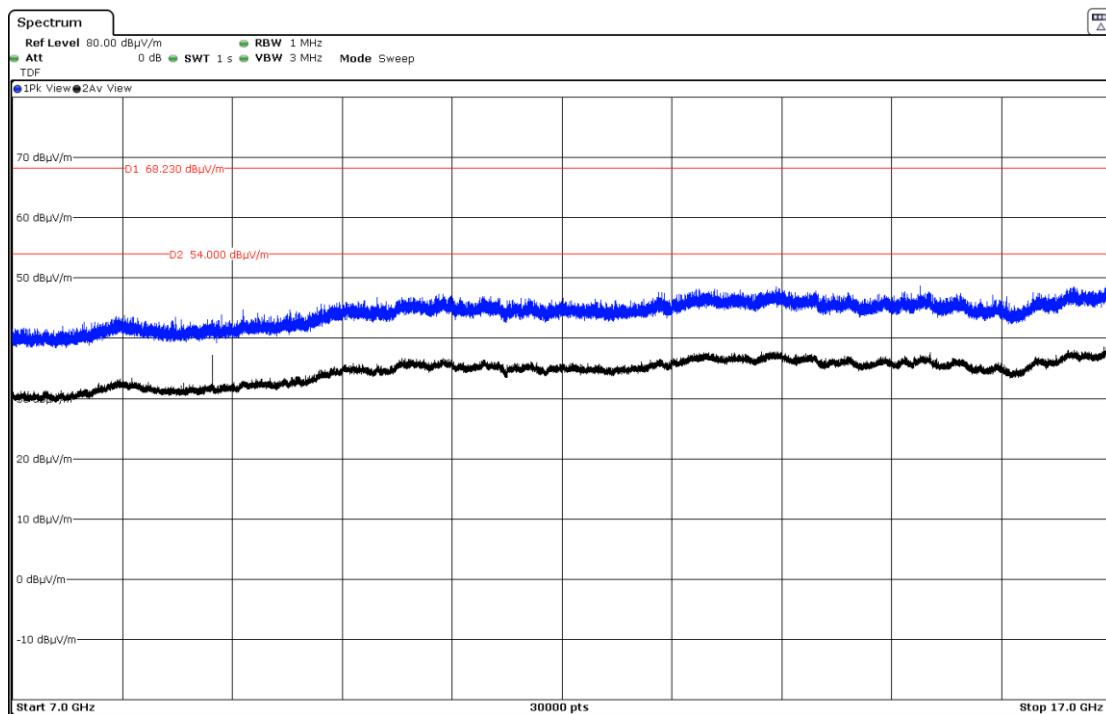
FREQUENCY RANGE 7 GHz to 17 GHz.

**Mode: 802.11n HT20– 20MHz**

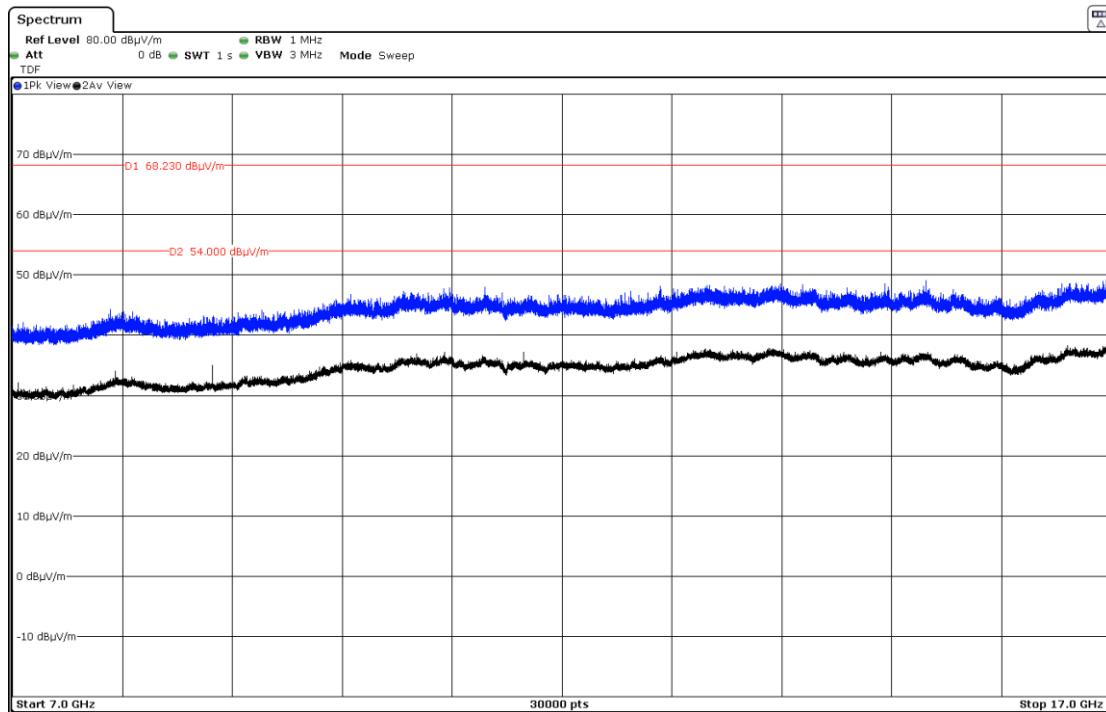
Channel 149 (5745MHz):



## Channel 157 (5785MHz):

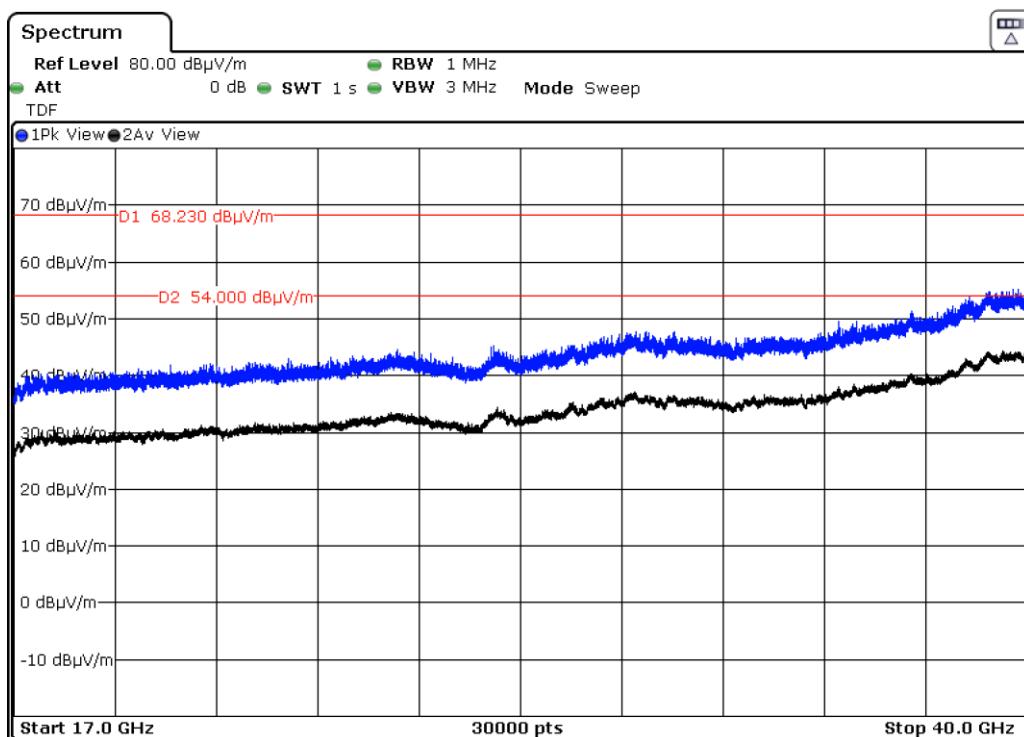


## Channel 165 (5825MHz):



**FREQUENCY RANGE 17 GHz to 40 GHz.**

**Mode: 802.11n HT20– 20MHz**



Note: This plot is valid for all channels.

## FCC Section 15.407 Subclause (b) (4) / RSS-247 6.2.4.2. Transmitter Band Edge Radiated Emissions.

### **SPECIFICATION**

For transmitters operating in the 5.725-5.85 GHz band: All emissions shall be limited to a level of -27 dBm/MHz (68.23 dB $\mu$ V/m at 3 m distance) at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.

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 ( $\mu$ V/m)	Field strength (dB $\mu$ V/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.

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

- 802.11a: 6 Mbits
- 802.11n HT20: MCS0
- 802.11n HT40: MCS0
- 802.11ac VHT20: MCS0
- 802.11ac VHT40: MCS0
- 802.11ac VHT80: MCS0

**Mode: 802.11a - 20MHz**

**Results: Peak / Channel 149**

No radiated spurious signals were detected outside the band-edge.

**Results: Peak / Channel 157**

No radiated spurious signals were detected outside the band-edge.

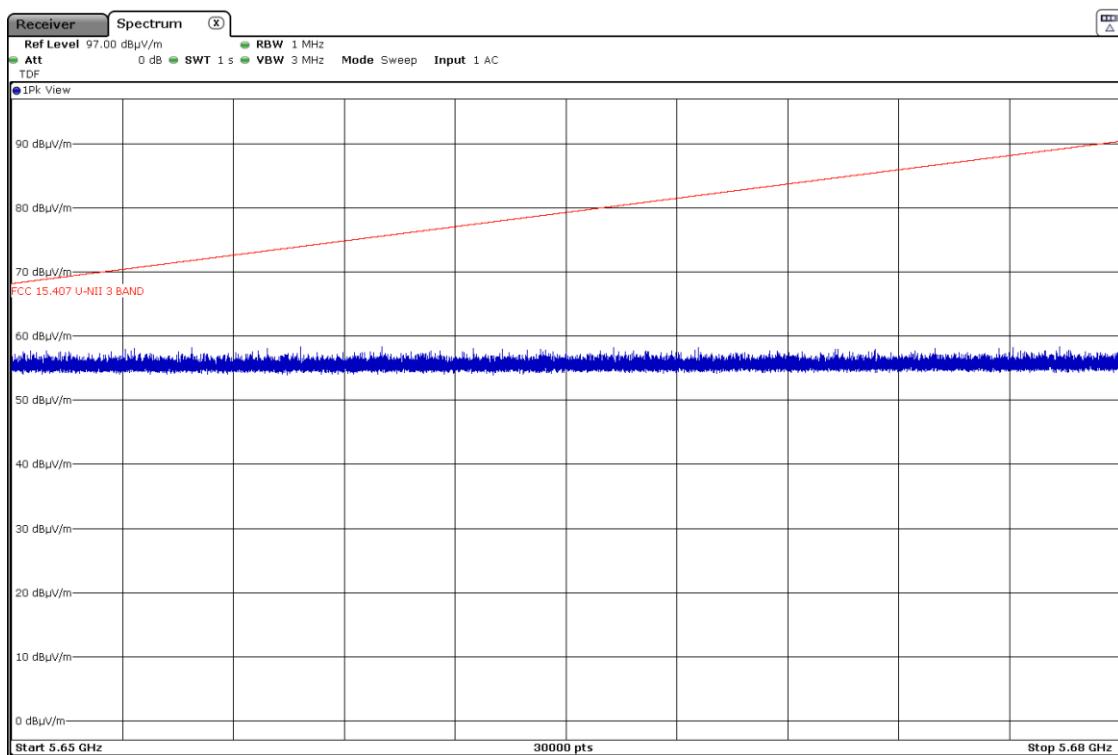
**Results: Peak / Channel 165**

No radiated spurious signals were detected outside the band-edge.

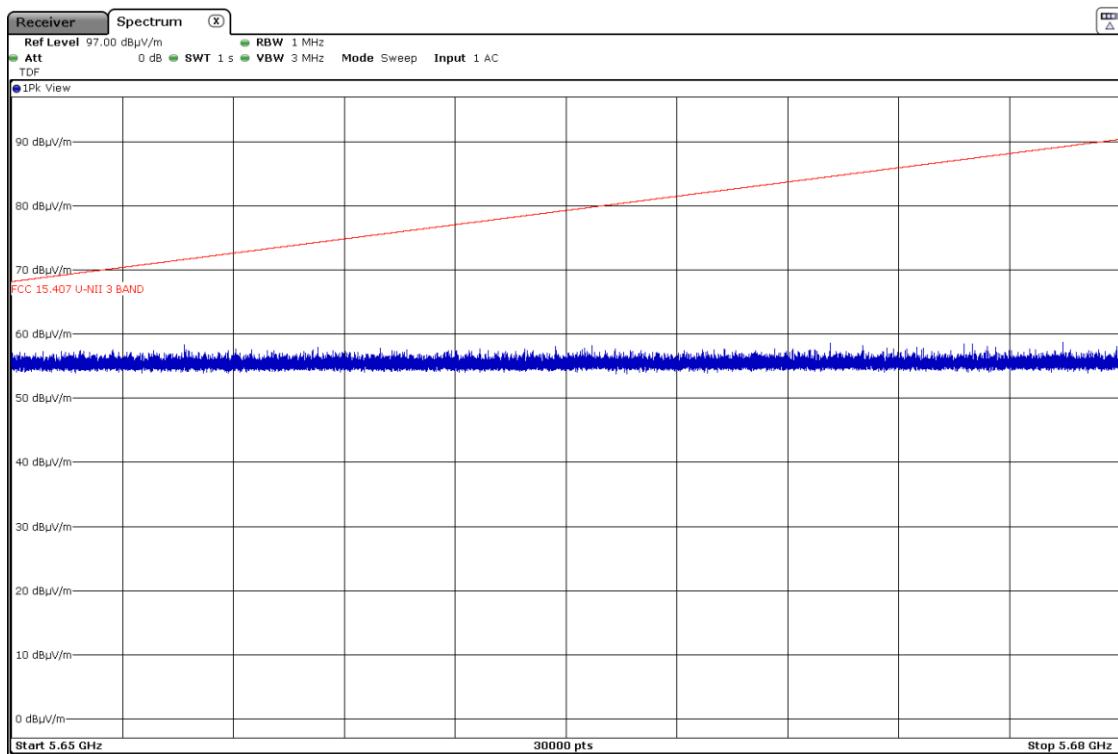
**Mode: 802.11a - 20MHz**

**Radiated spurious emissions inside adjacent band 5.65 – 5.68 GHz.**

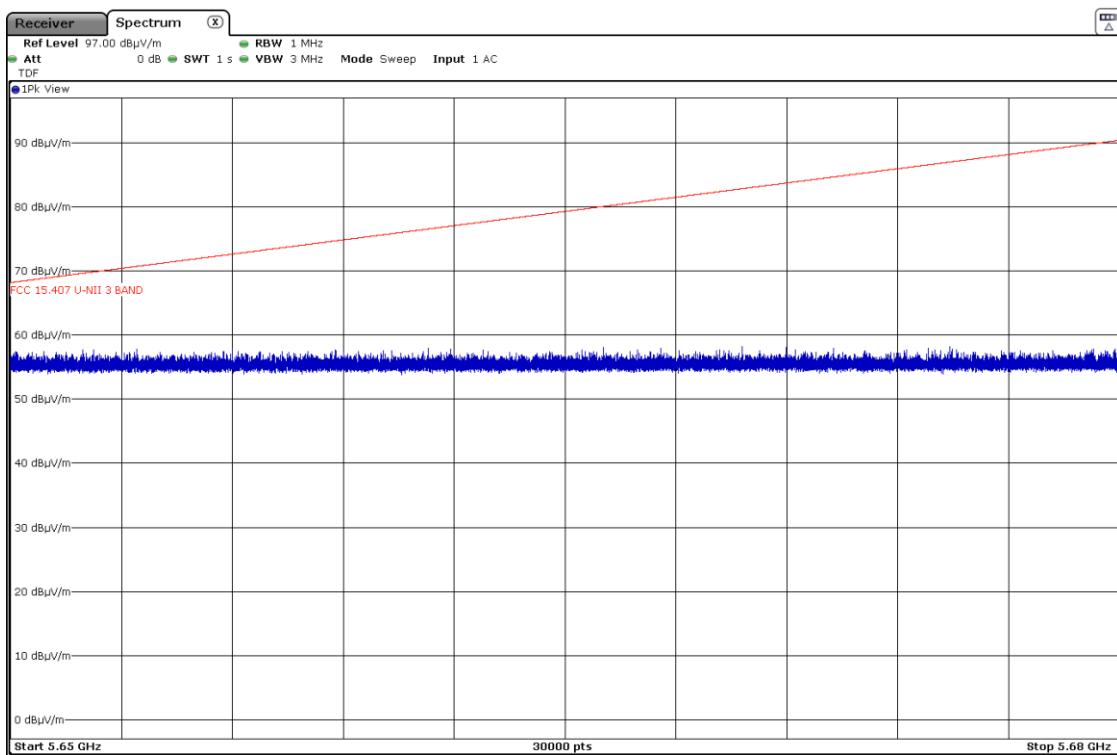
Channel 149 (5745MHz):



Channel 157 (5785MHz):

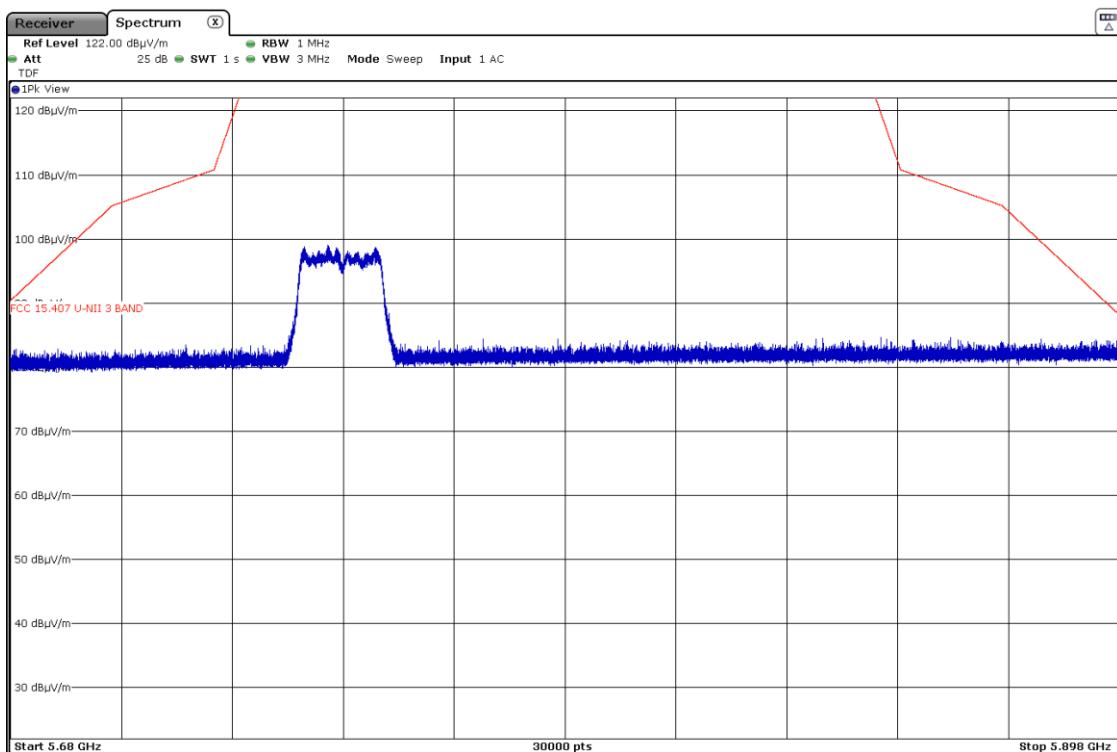


### Channel 165 (5825MHz):



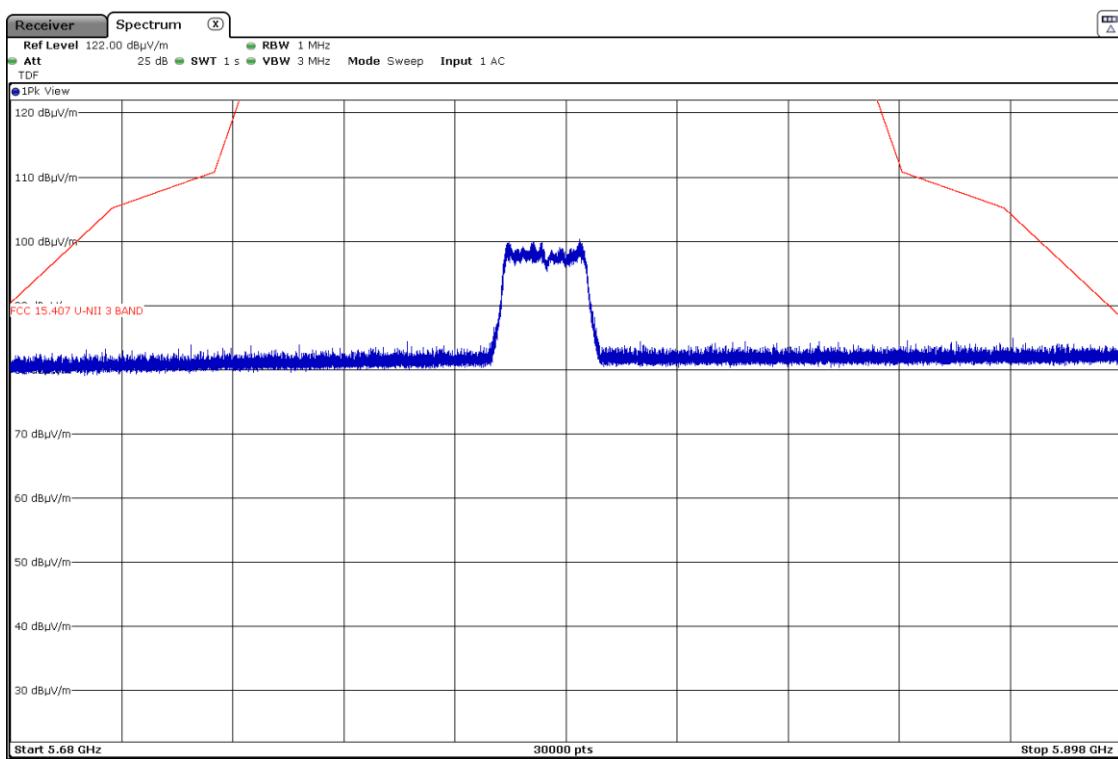
### Radiated spurious emissions inside band 5.68 – 5.898 GHz.

### Channel 149 (5745MHz):



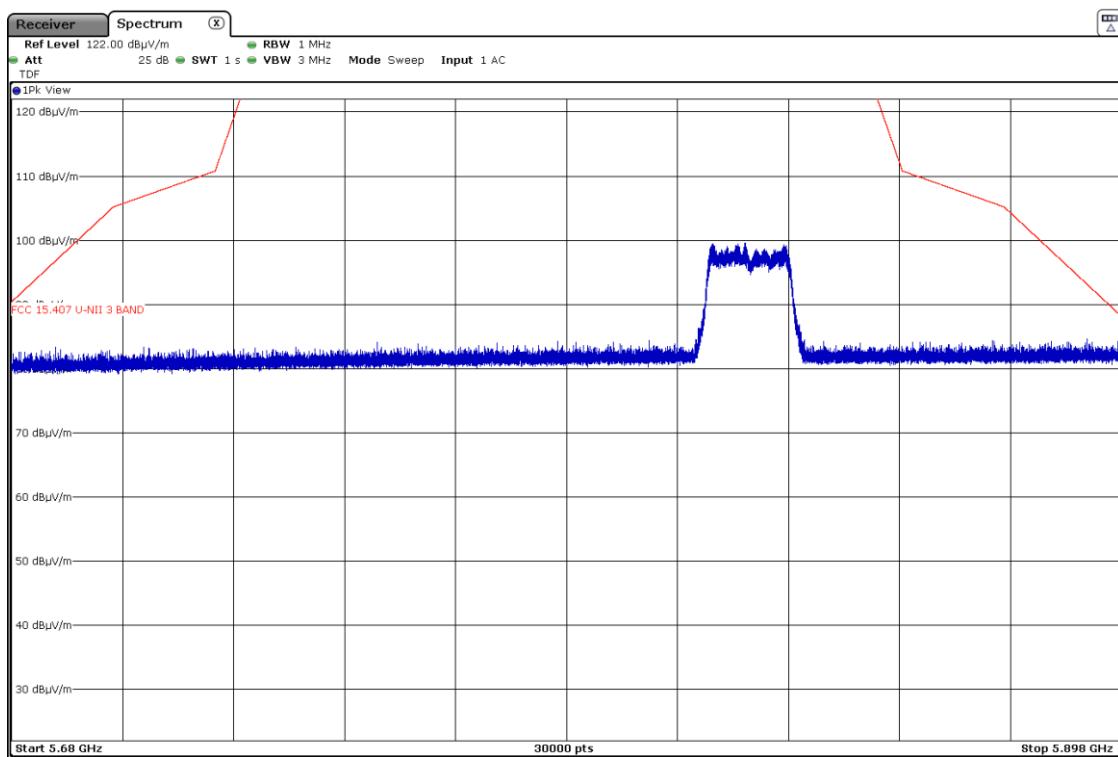
Note: The signal shown on the plot is the carrier frequency.

## Channel 157 (5785MHz):



Note: The signal shown on the plot is the carrier frequency.

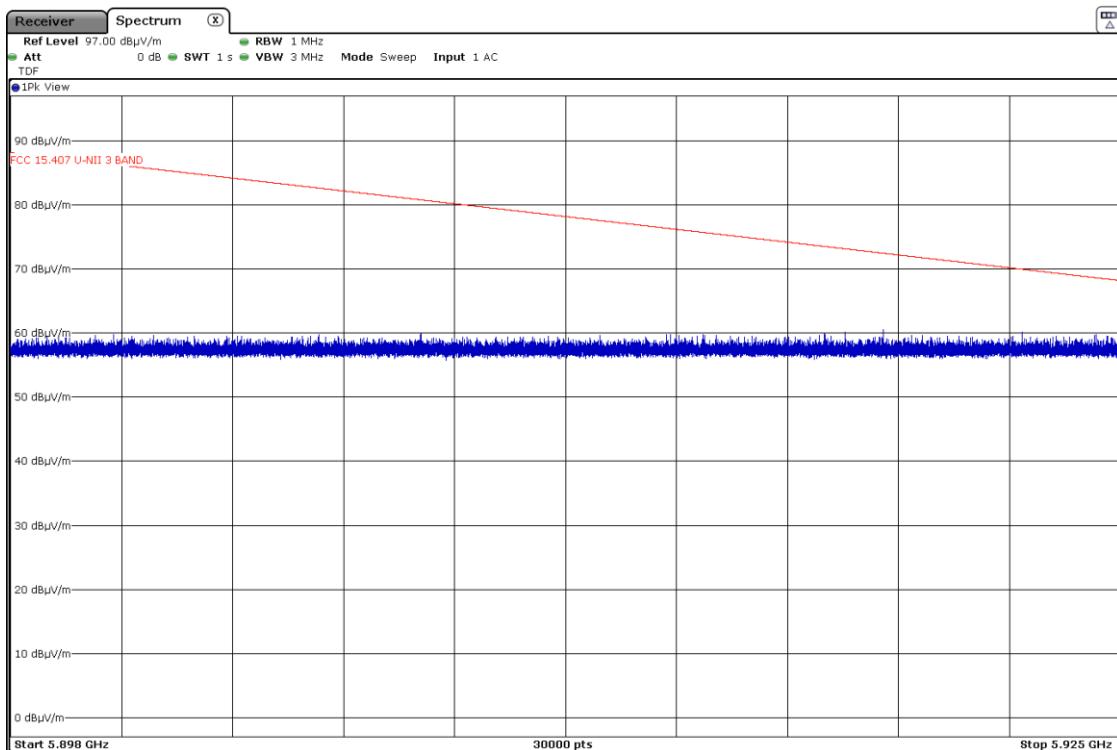
## Channel 165 (5825MHz):



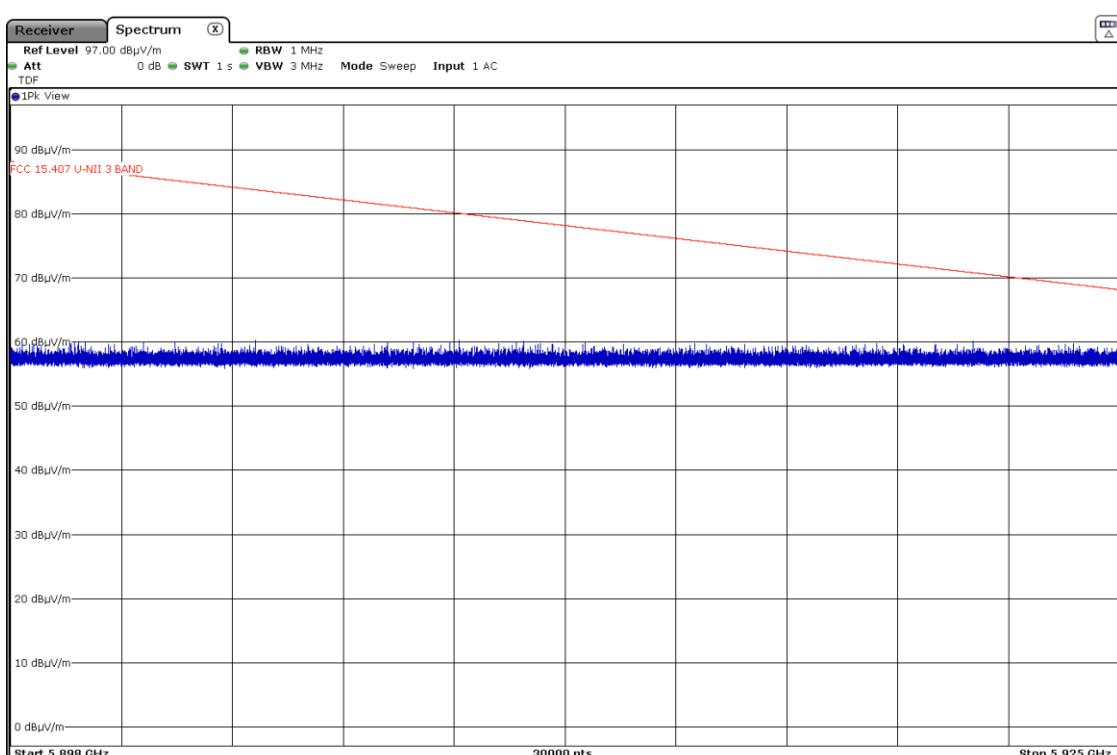
Note: The signal shown on the plot is the carrier frequency.

## Radiated spurious emissions inside adjacent band 5.898 – 5.925 GHz.

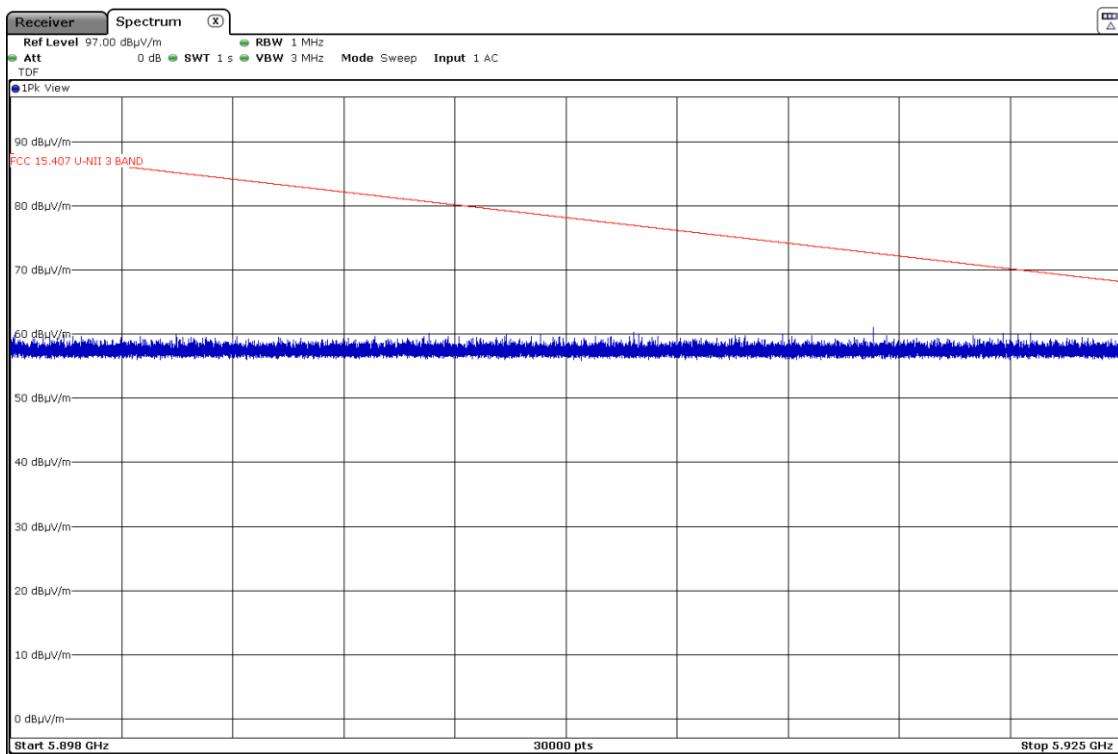
Channel 149 (5745MHz):



Channel 157 (5785MHz):



Channel 165 (5825MHz):



**Mode: 802.11ac VHT20 – 20MHz**

**Results: Peak / Channel 149**

No radiated spurious signals were detected outside the band-edge.

**Results: Peak / Channel 157**

No radiated spurious signals were detected outside the band-edge.

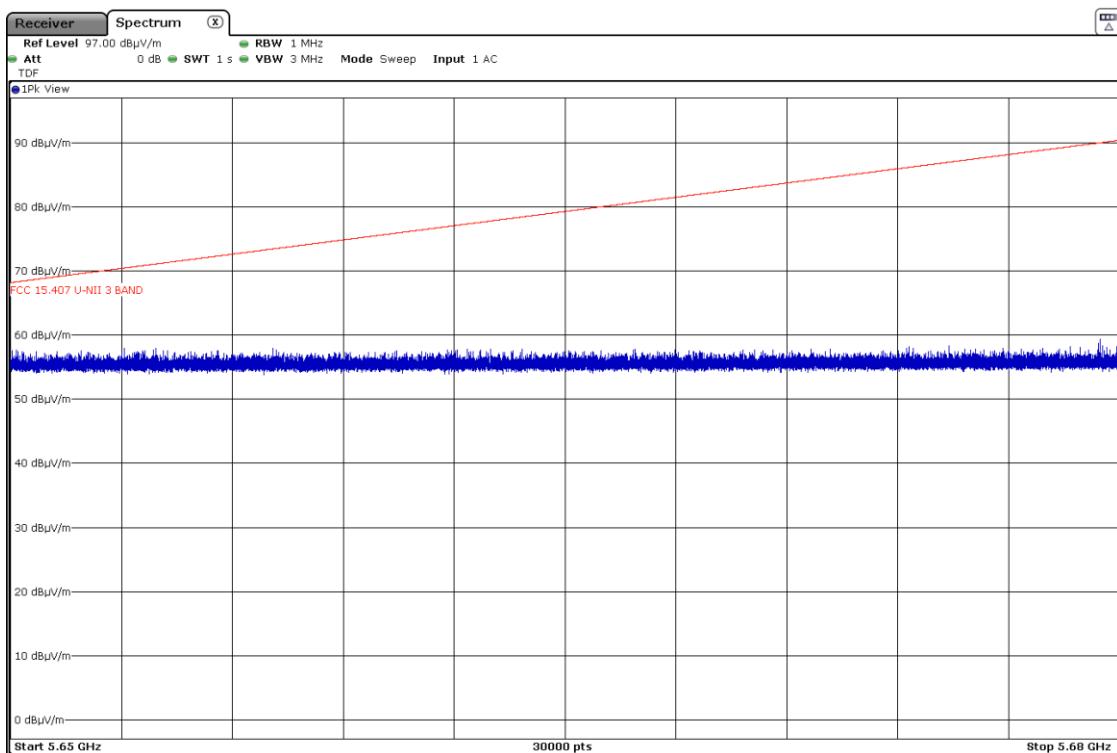
**Results: Peak / Channel 165**

No radiated spurious signals were detected outside the band-edge.

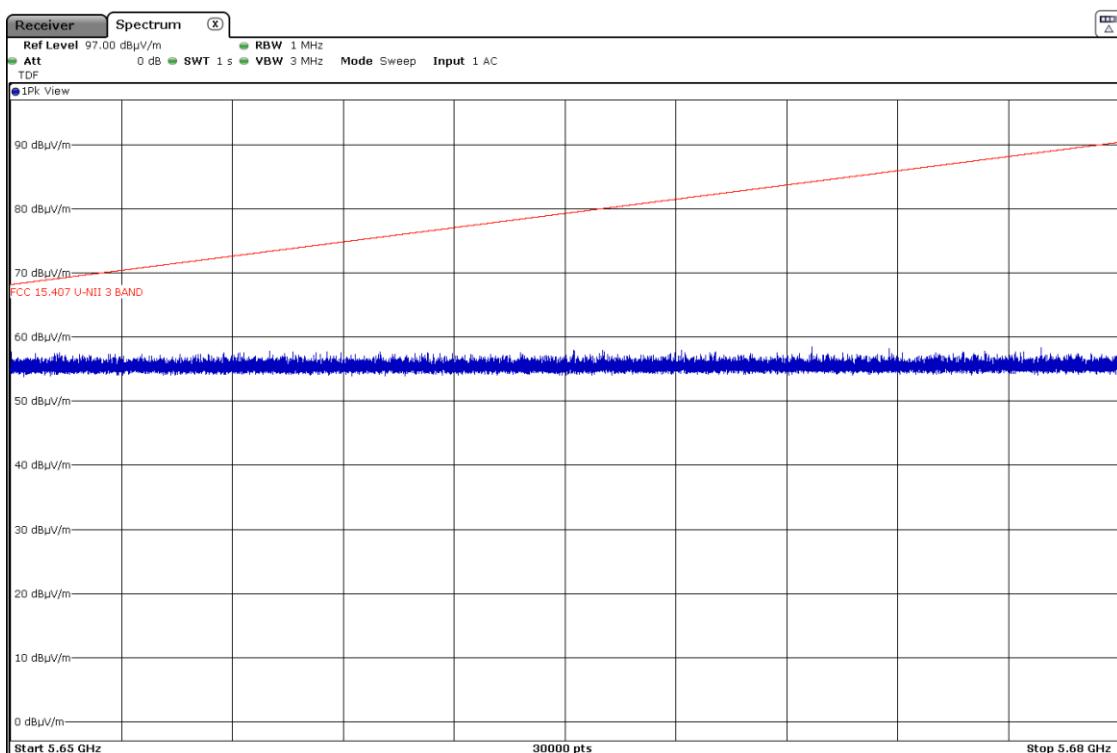
**Mode: 802.11ac VHT20 – 20MHz**

**Radiated spurious emissions inside adjacent band 5.65 – 5.68 GHz.**

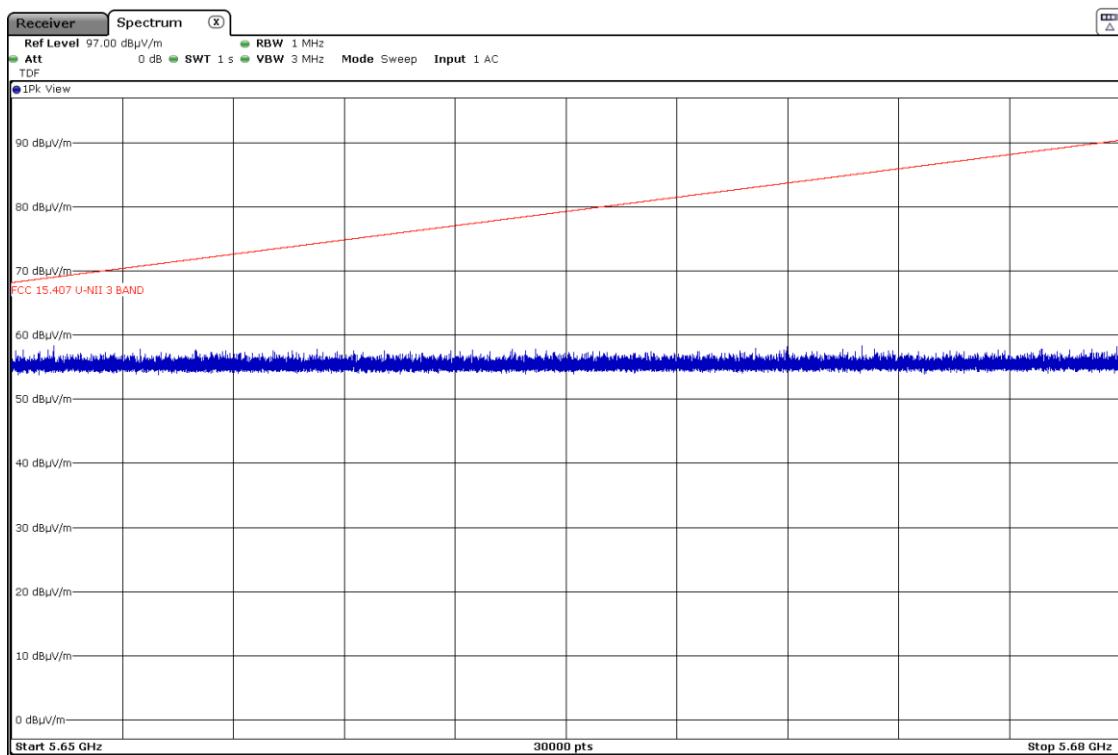
Channel 149 (5745MHz):



Channel 157 (5785MHz):

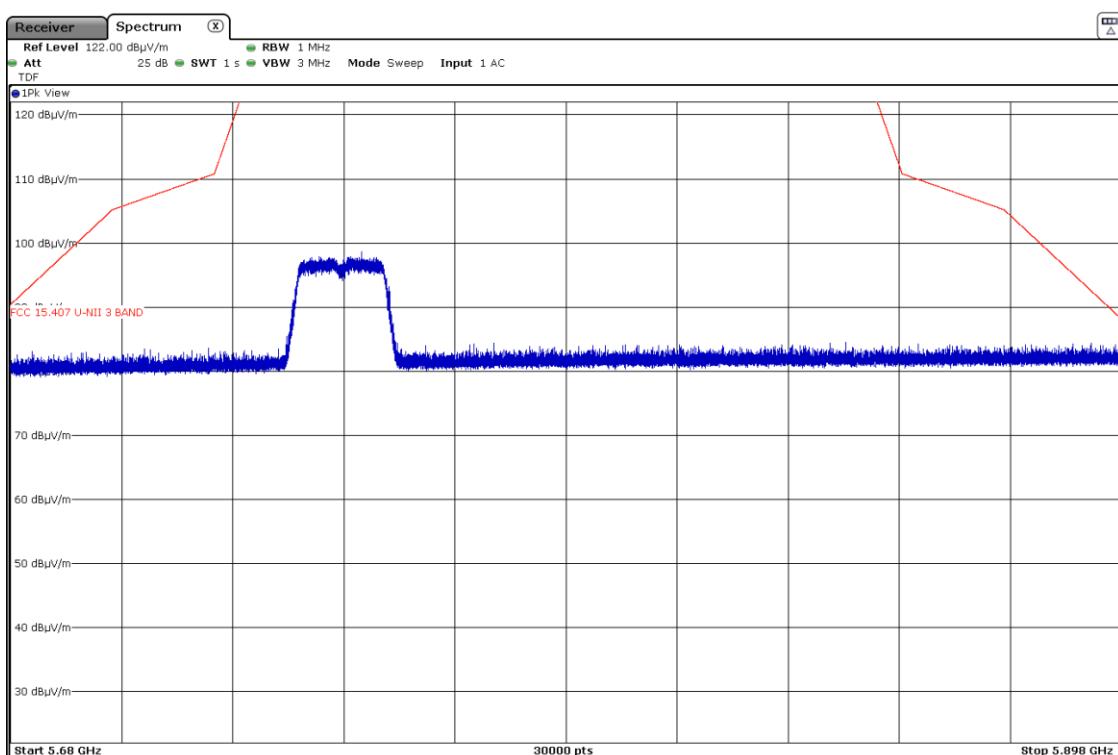


## Channel 165 (5825MHz):



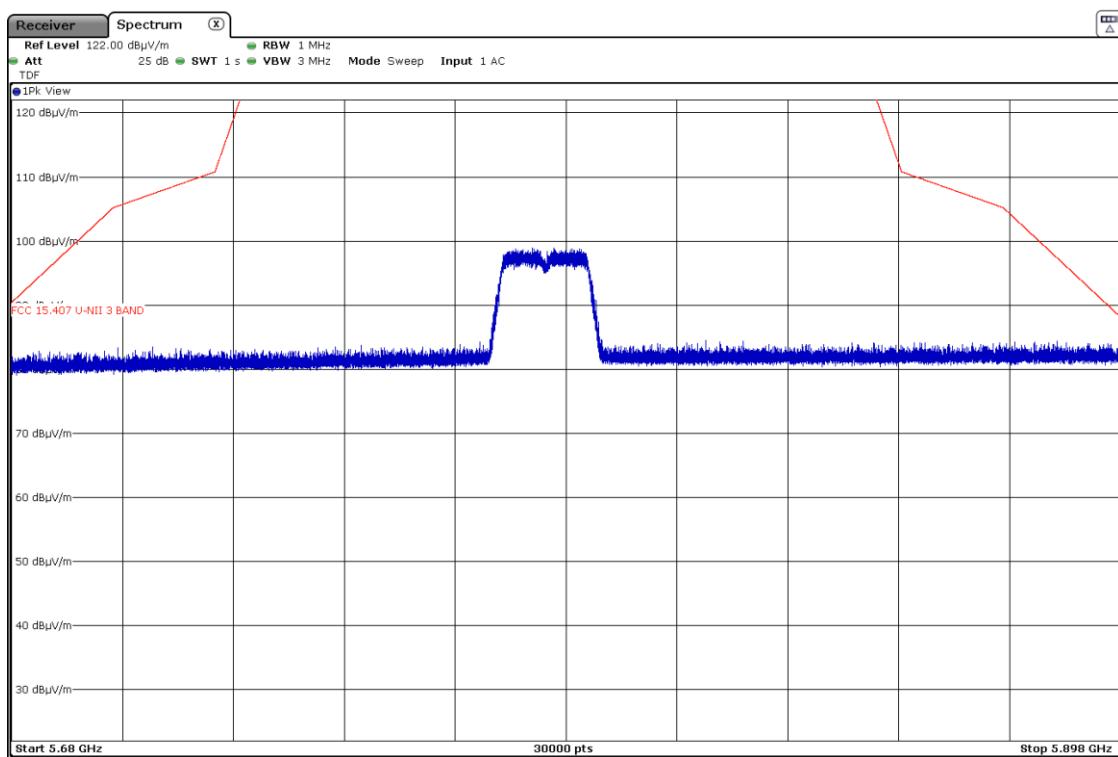
## Radiated spurious emissions inside band 5.68 – 5.898 GHz.

## Channel 149 (5745MHz):



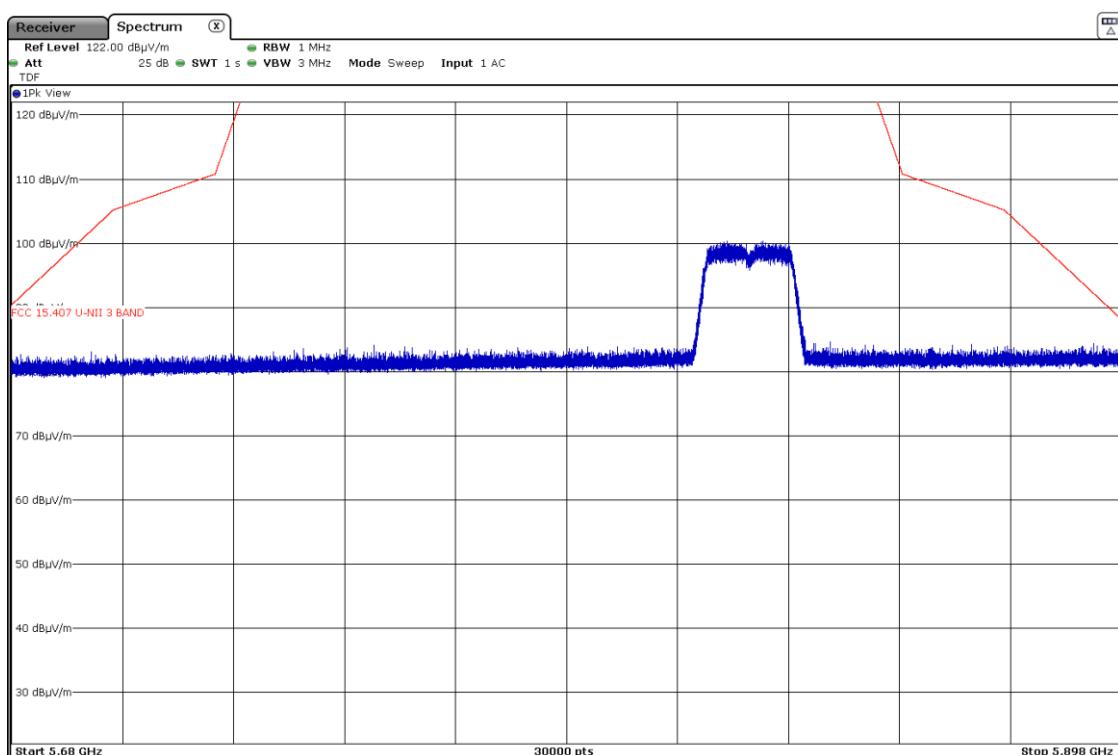
Note: The signal shown on the plot is the carrier frequency.

Channel 157 (5785MHz):



Note: The signal shown on the plot is the carrier frequency.

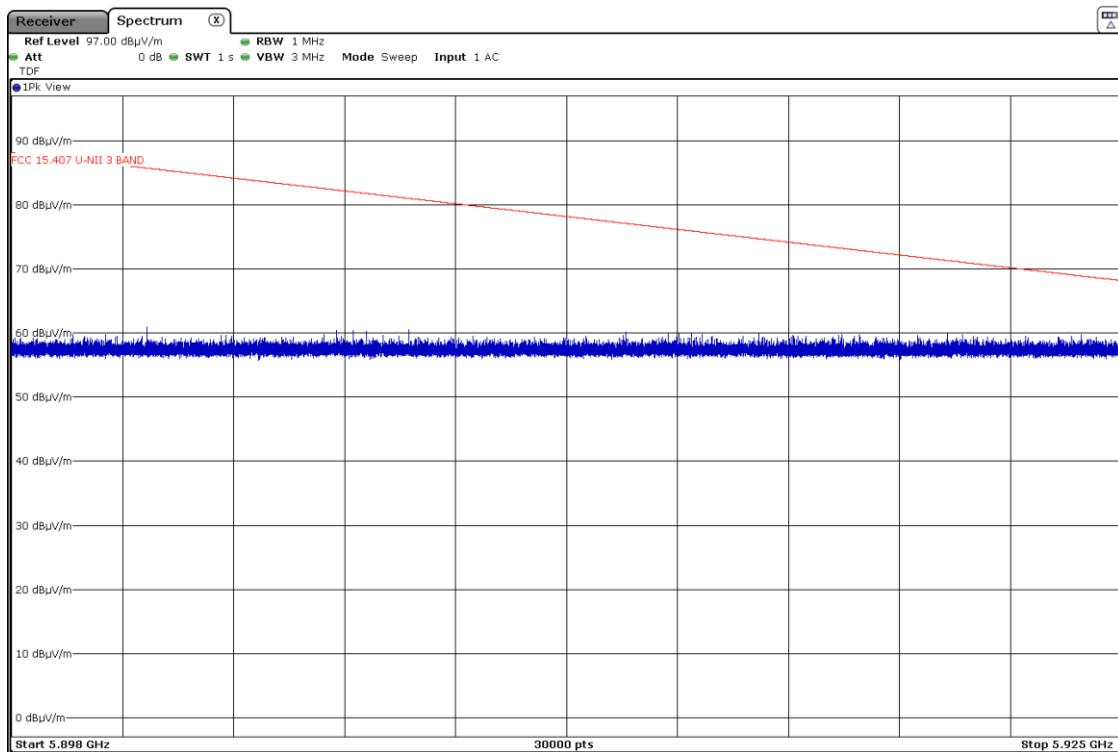
Channel 165 (5825MHz):



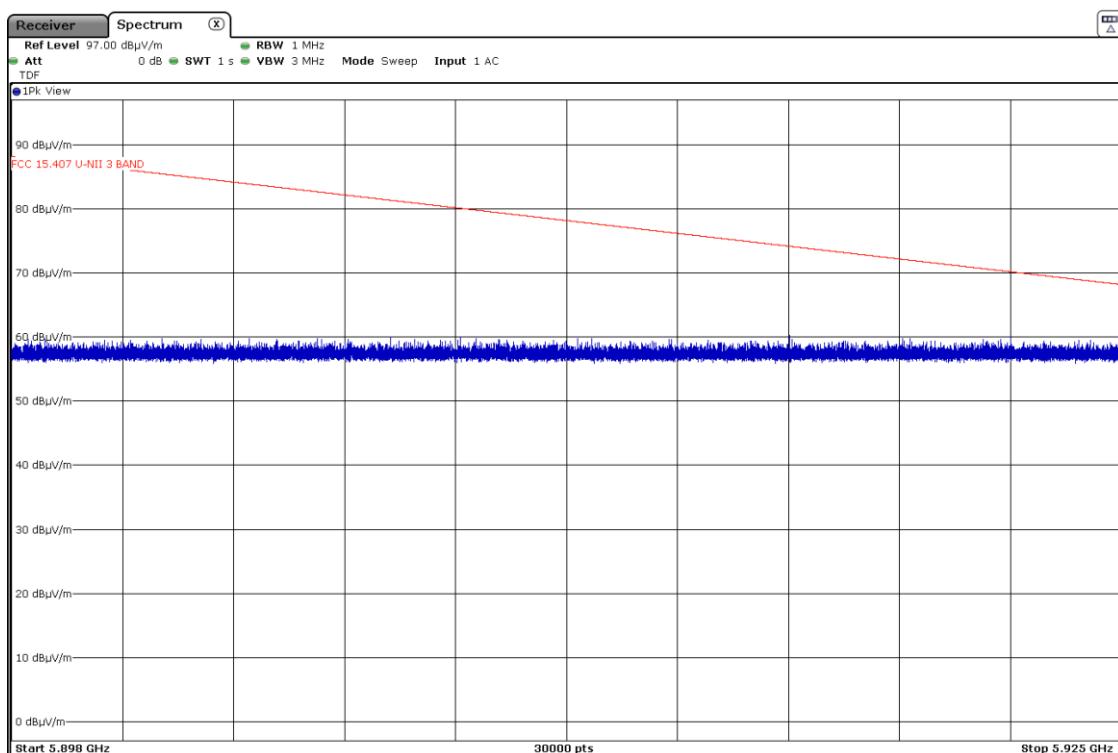
Note: The signal shown on the plot is the carrier frequency.

## Radiated spurious emissions inside adjacent band 5.898 – 5.925 GHz.

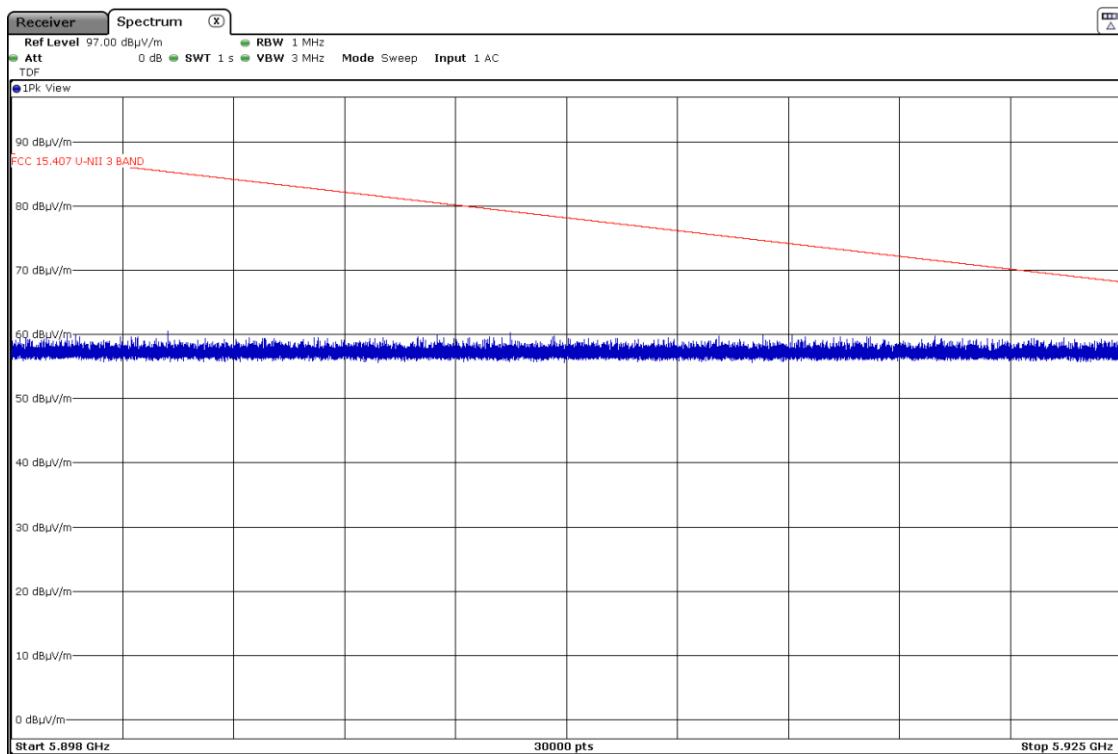
Channel 149 (5745MHz):



Channel 157 (5785MHz):



Channel 165 (5825MHz):



**Mode: 802.11n HT20– 20MHz**

**Results: Peak / Channel 149**

No radiated spurious signals were detected outside the band-edge.

**Results: Peak / Channel 157**

No radiated spurious signals were detected outside the band-edge.

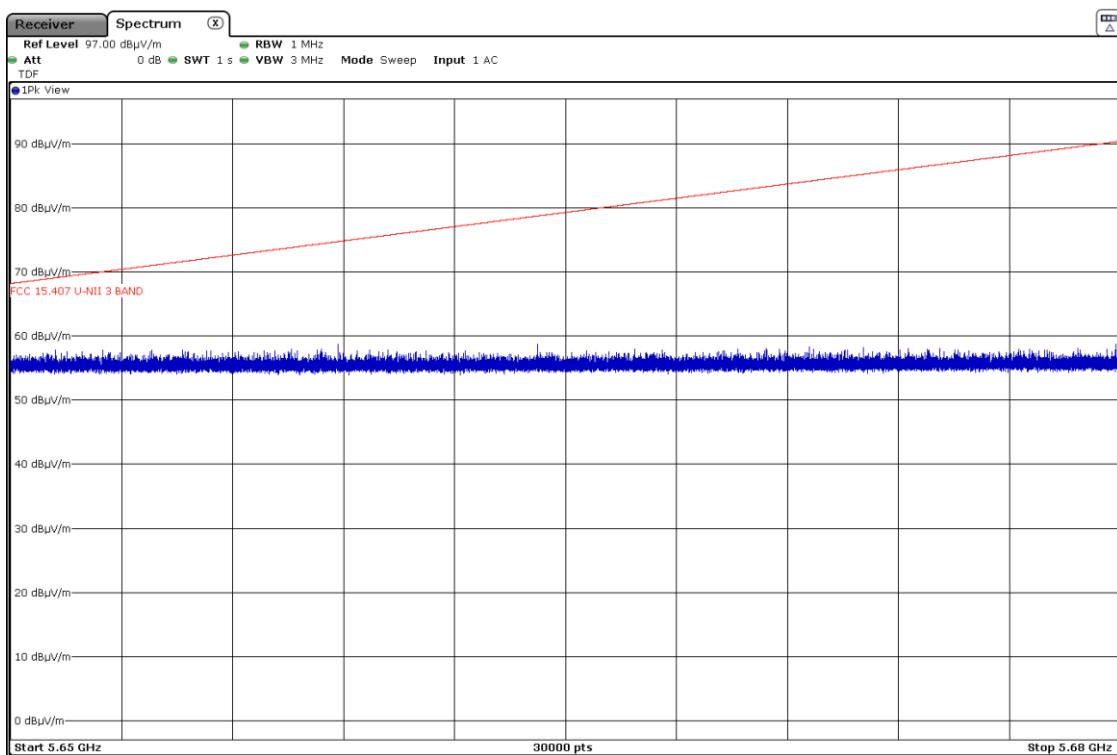
**Results: Peak / Channel 165**

No radiated spurious signals were detected outside the band-edge.

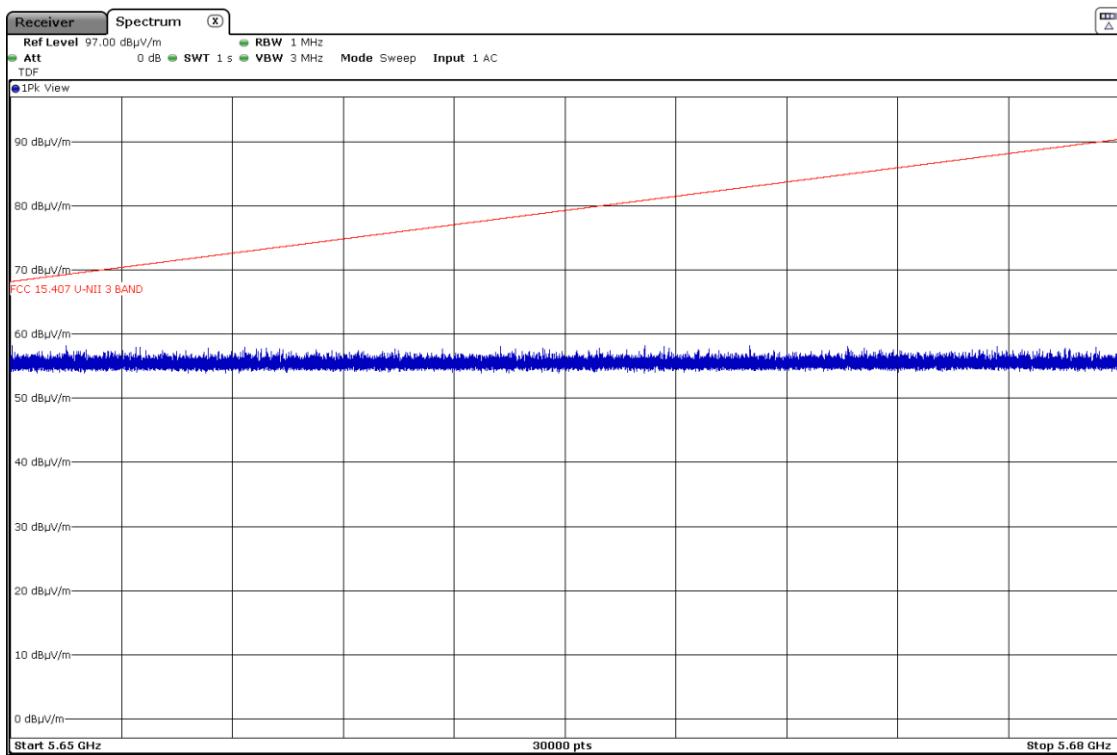
**Mode: 802.11n HT20– 20MHz**

**Radiated spurious emissions inside adjacent band 5.65 – 5.68 GHz.**

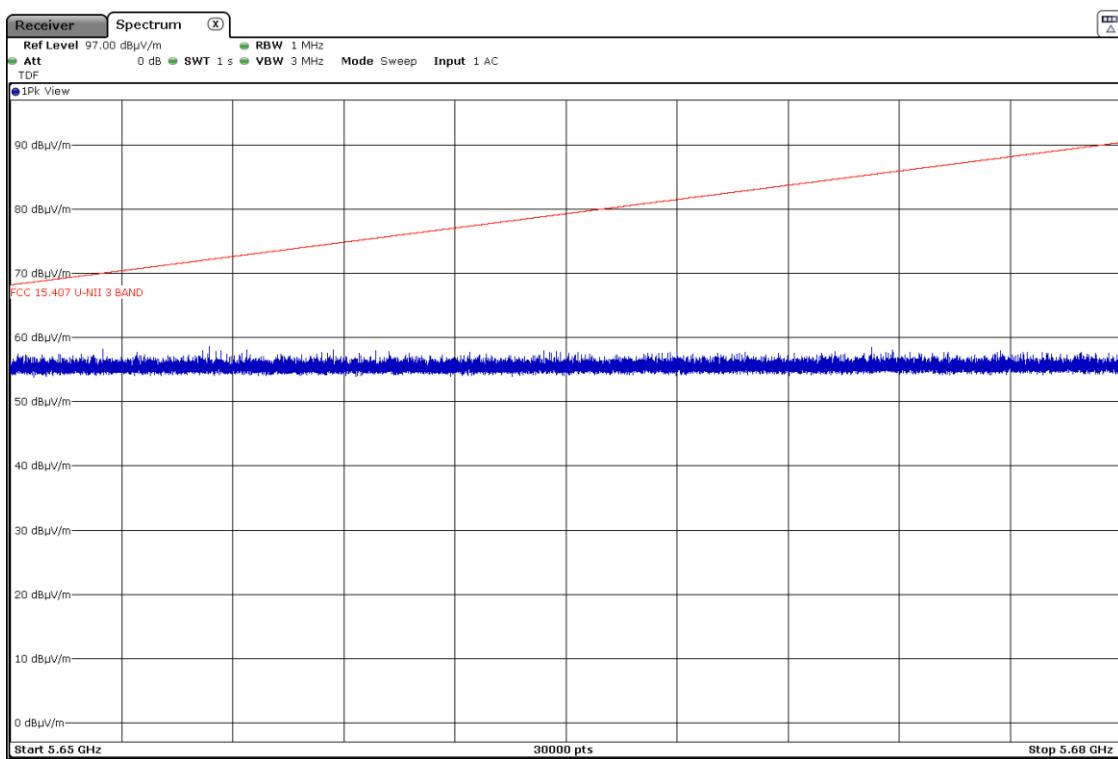
Channel 149 (5745MHz):



Channel 157 (5785MHz):

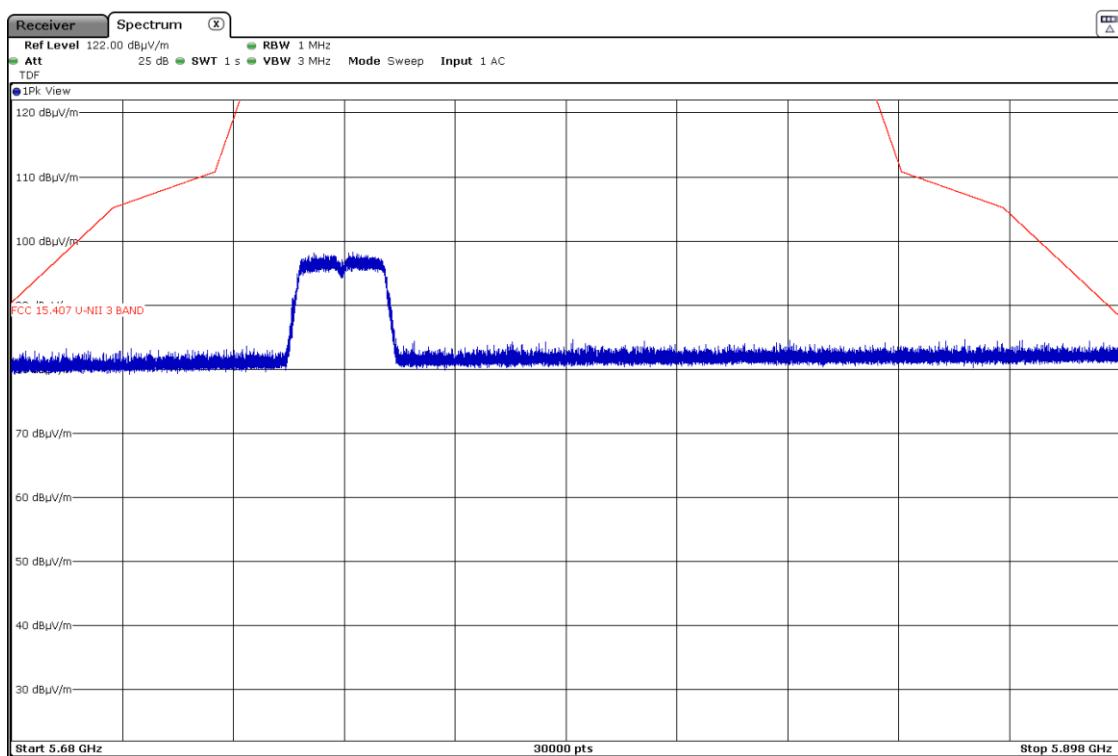


Channel 165 (5825MHz):



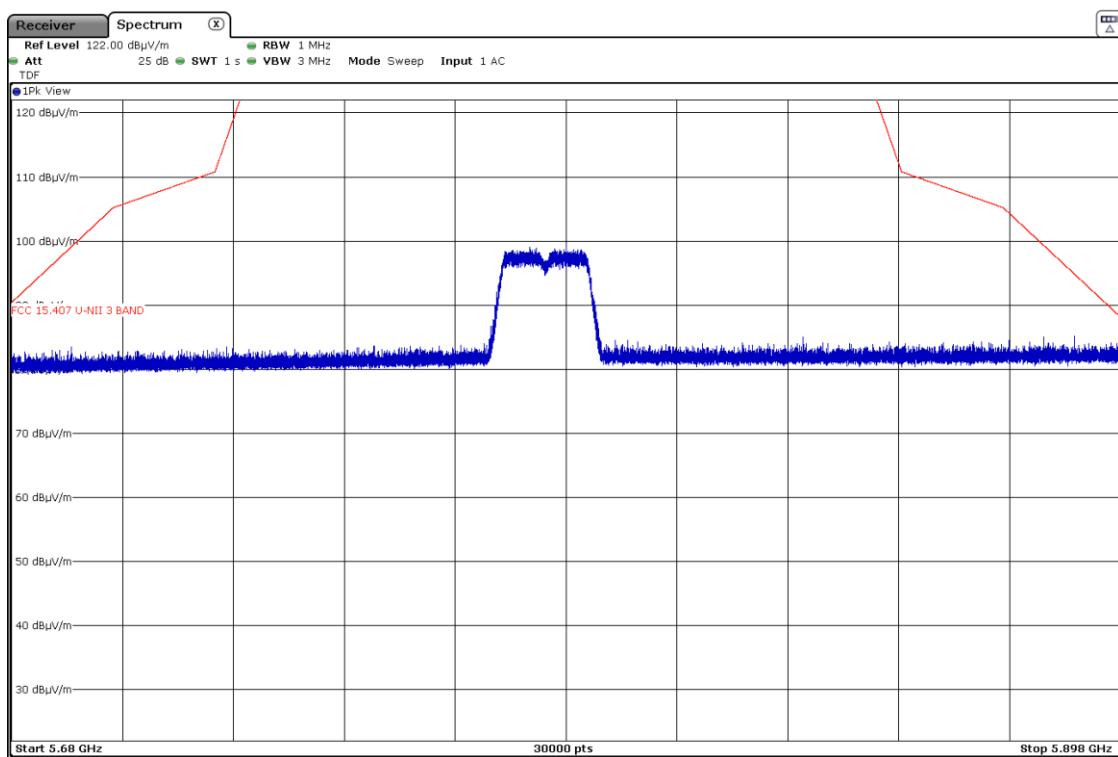
**Radiated spurious emissions inside band 5.68 – 5.898 GHz.**

Channel 149 (5745MHz):



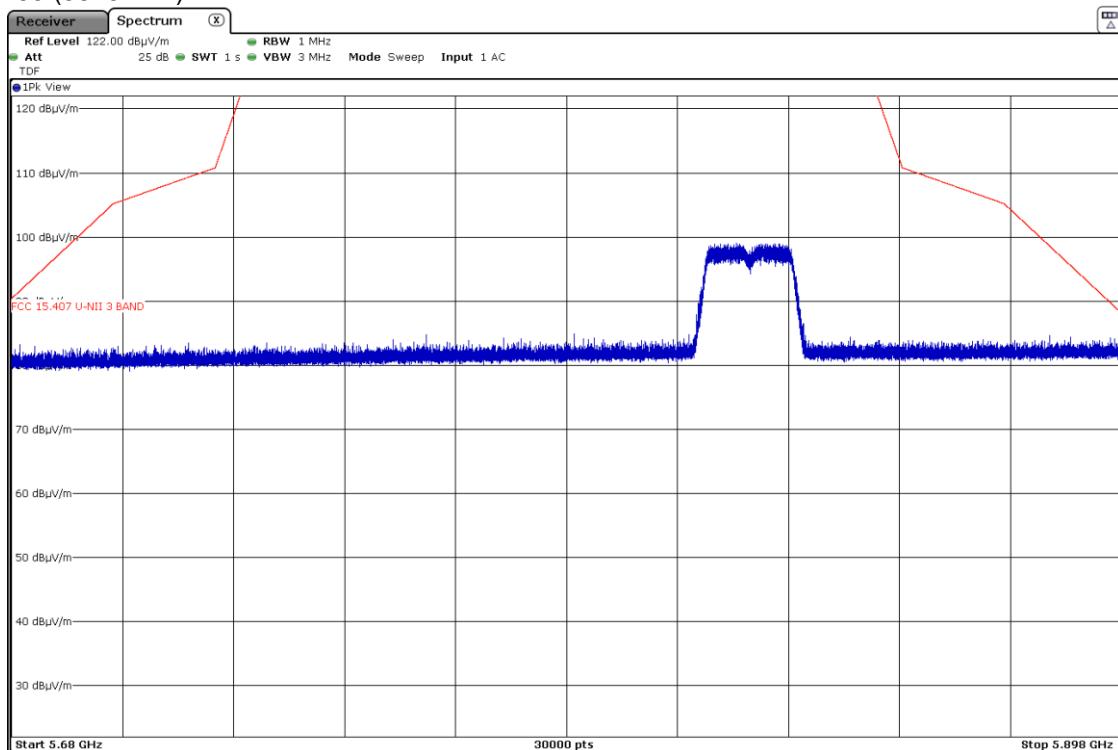
Note: The signal shown on the plot is the carrier frequency.

## Channel 157 (5785MHz):



Note: The signal shown on the plot is the carrier frequency.

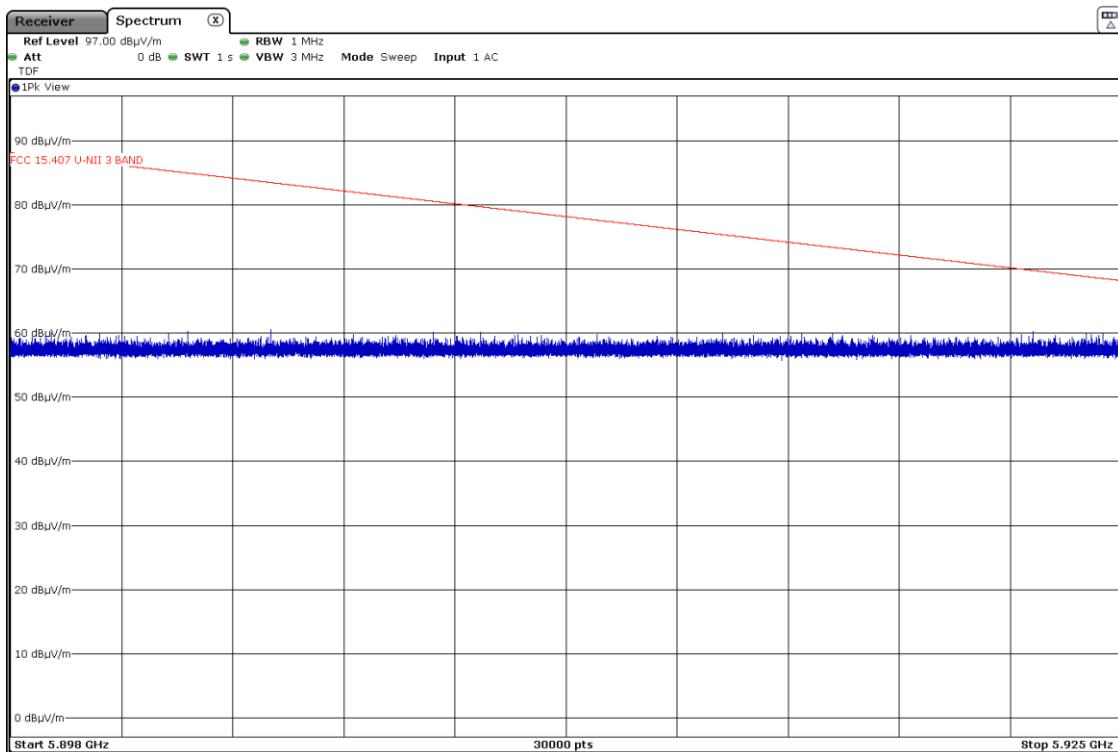
## Channel 165 (5825MHz):



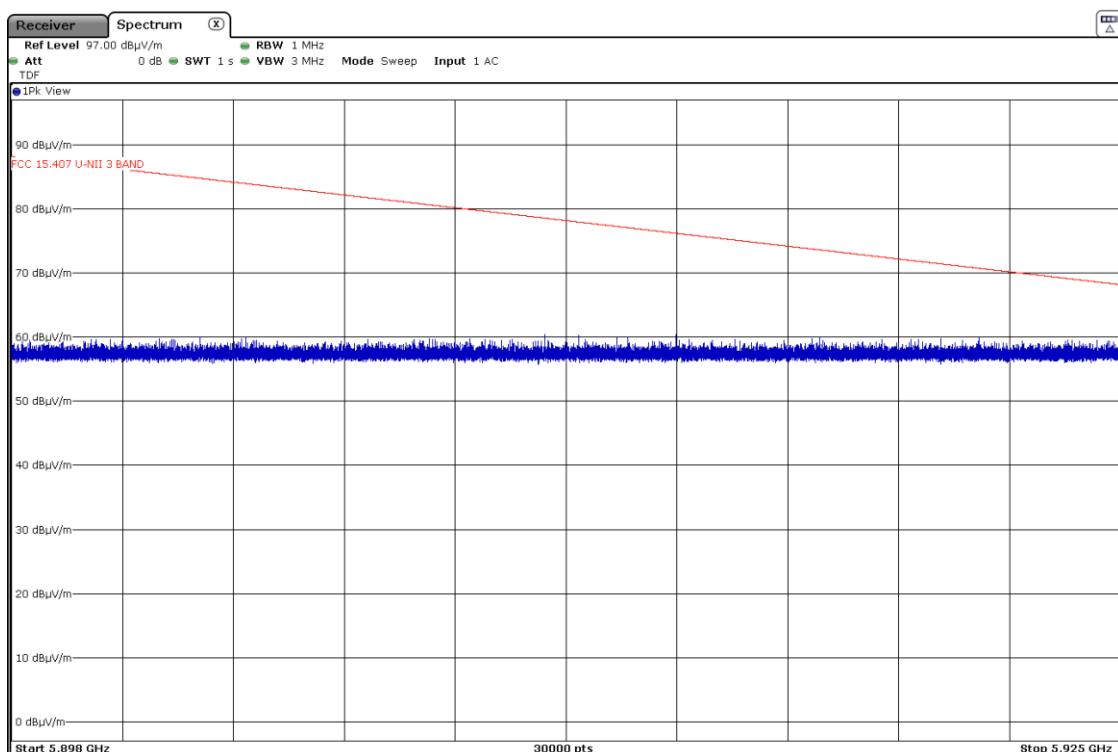
Note: The signal shown on the plot is the carrier frequency.

## Radiated spurious emissions inside adjacent band 5.898 – 5.925 GHz.

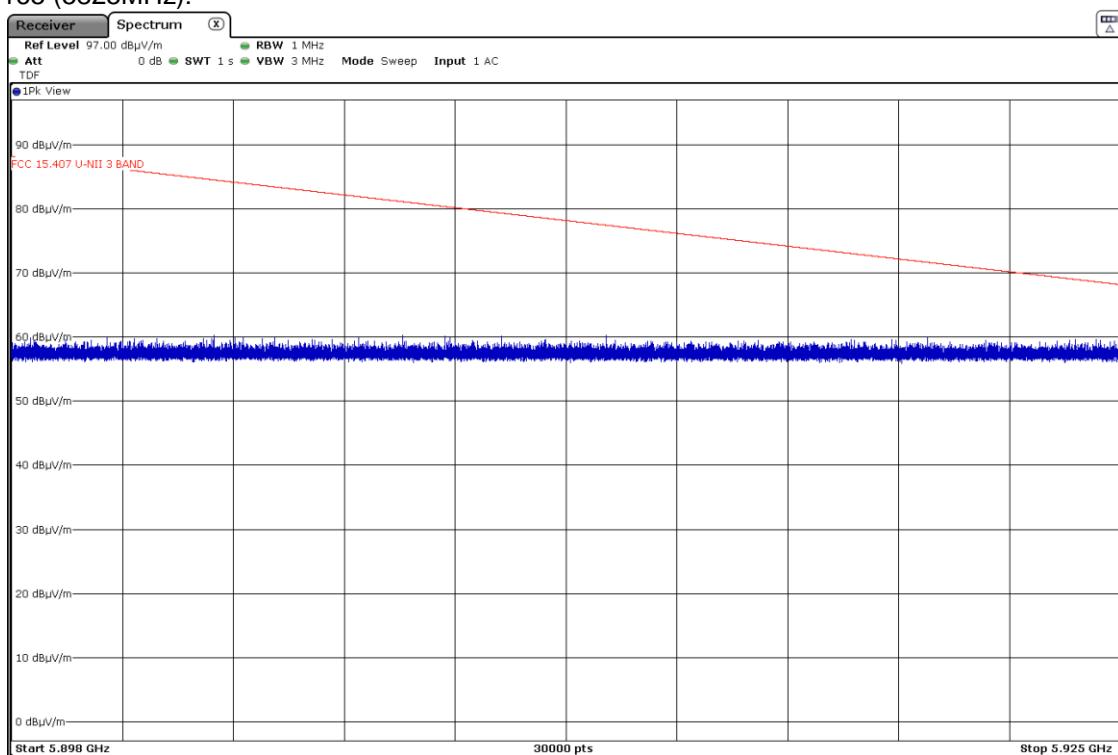
Channel 149 (5745MHz):



Channel 157 (5785MHz):



Channel 165 (5825MHz):



**Mode: 802.11ac VHT40- 40MHz**

**Results: Channel 151**

No radiated spurious signals were detected outside the band-edge.

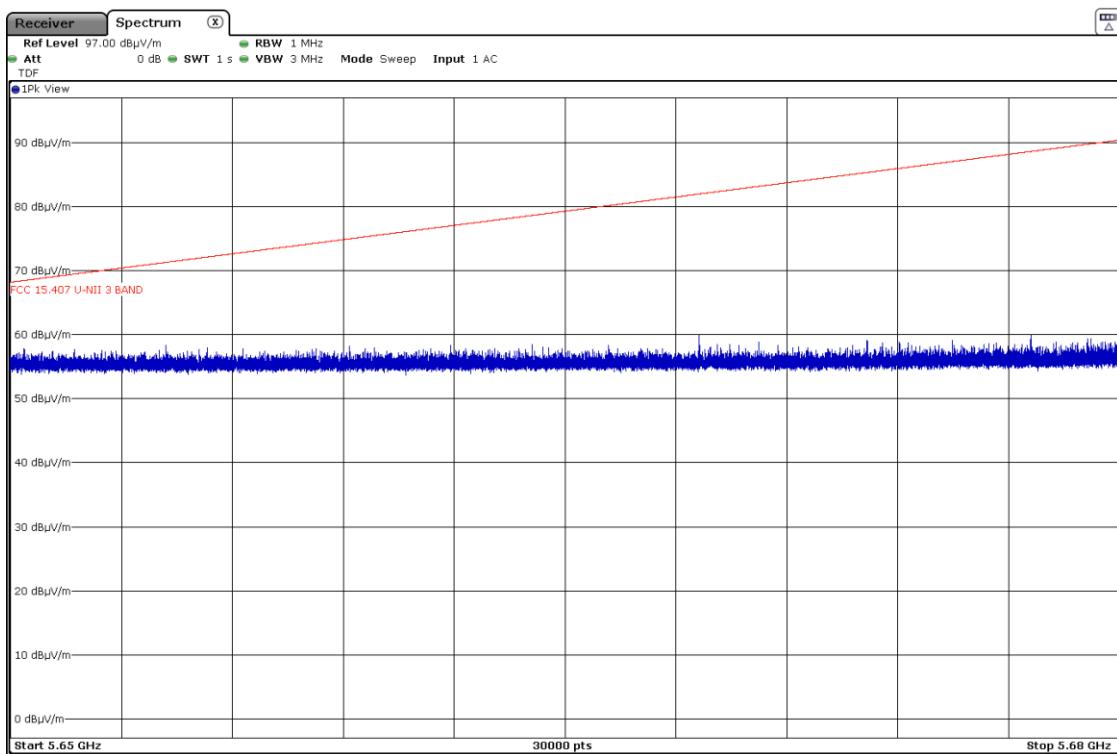
**Results: Channel 159**

No radiated spurious signals were detected outside the band-edge.

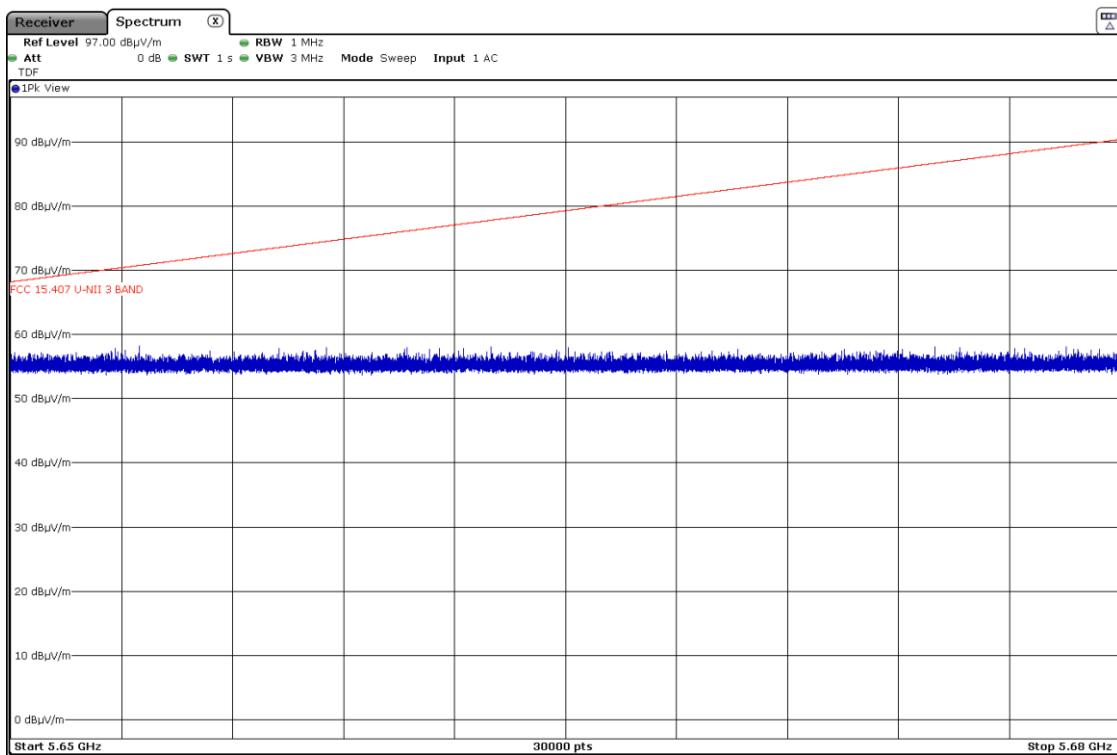
**Mode: 802.11ac VHT40 - 40MHz**

**Radiated spurious emissions inside adjacent band 5.65 – 5.68 GHz.**

Channel 151 (5755MHz):

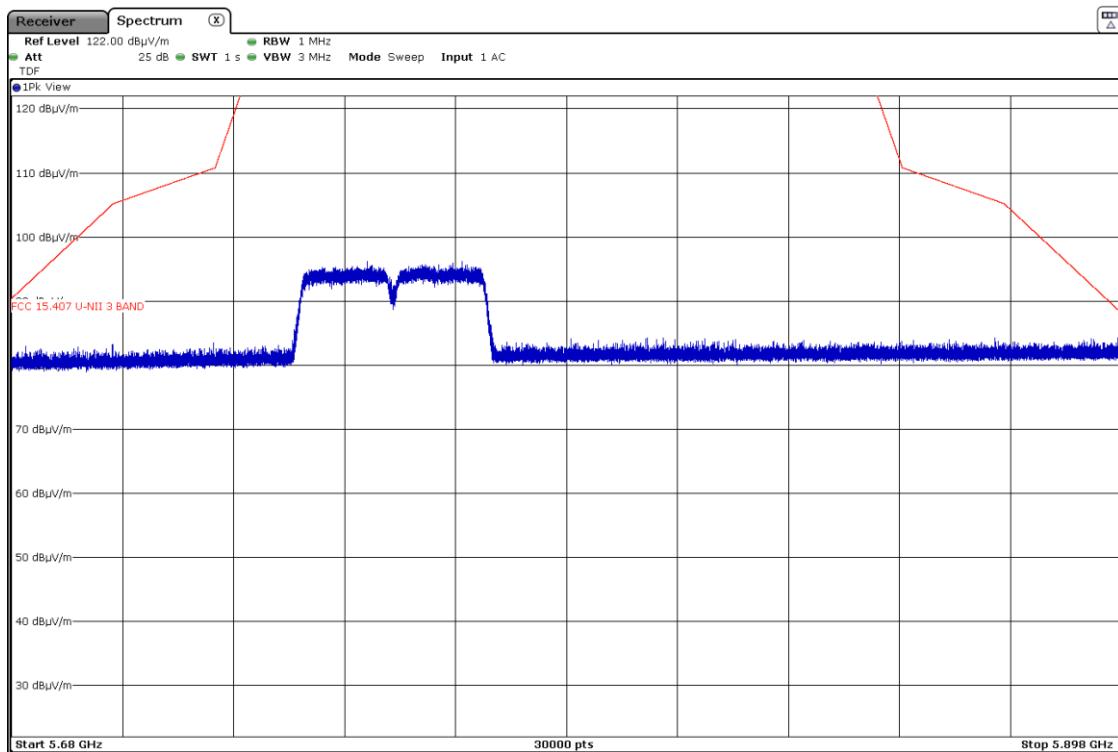


Channel 159 (5795MHz):



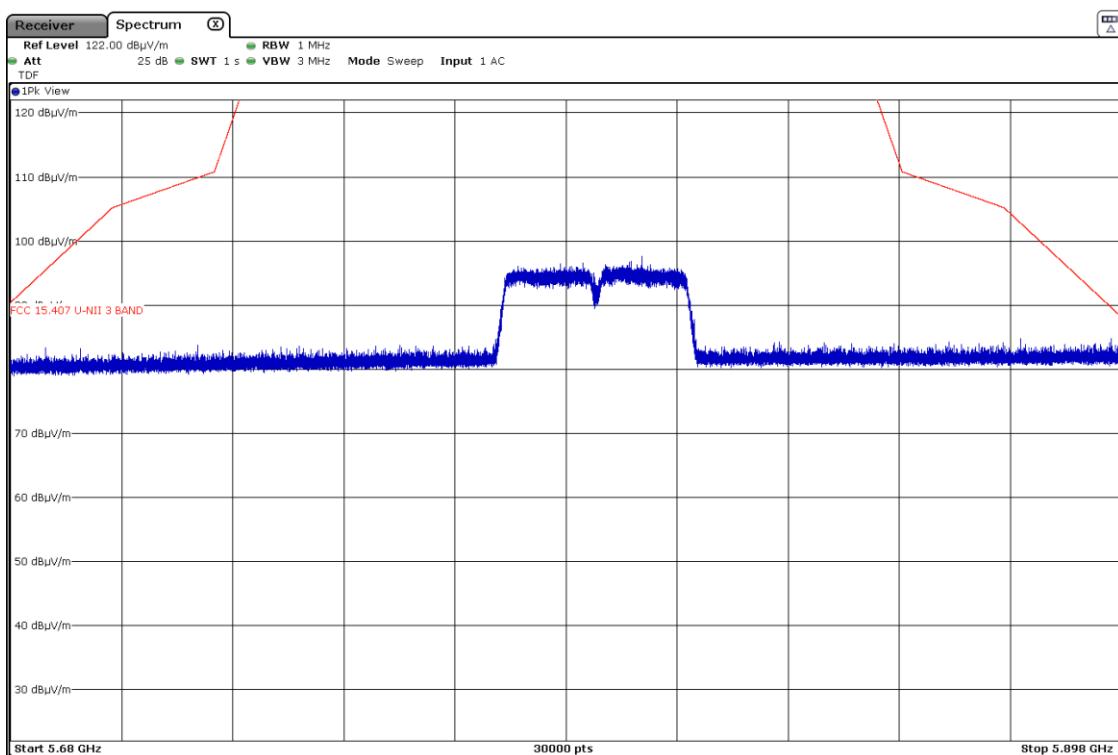
## Radiated spurious emissions inside band 5.68 – 5.898 GHz.

Channel 151 (5755MHz):



Note: The signal shown on the plot is the carrier frequency.

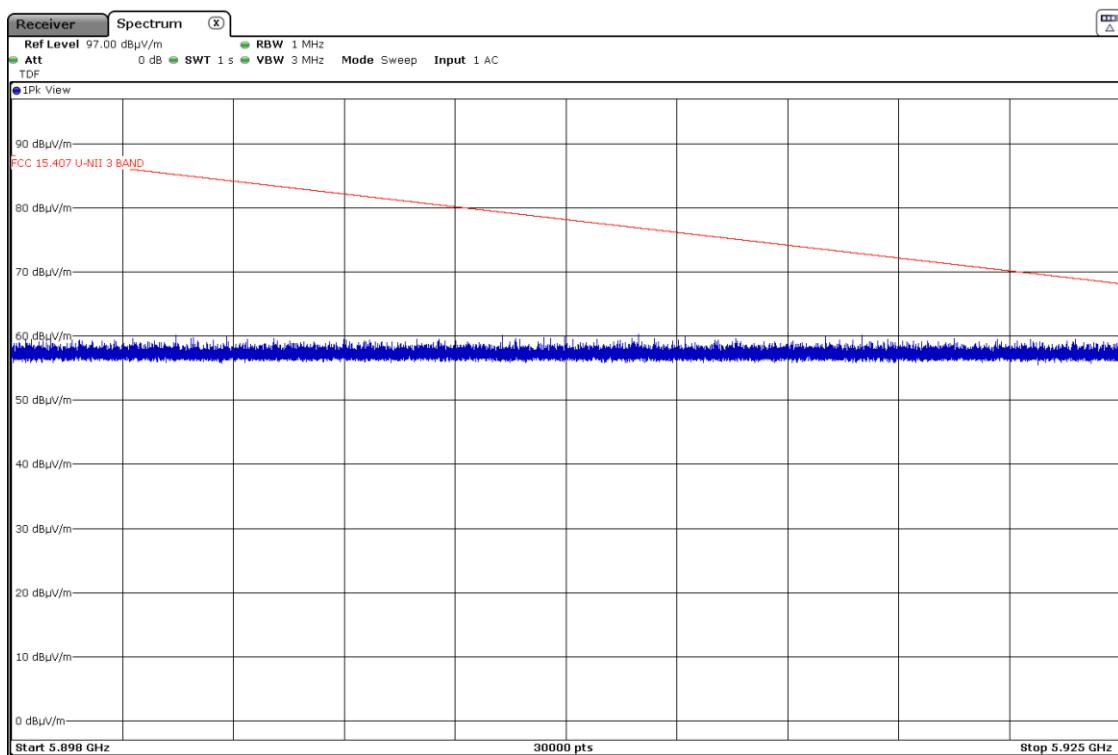
Channel 159 (5795MHz):



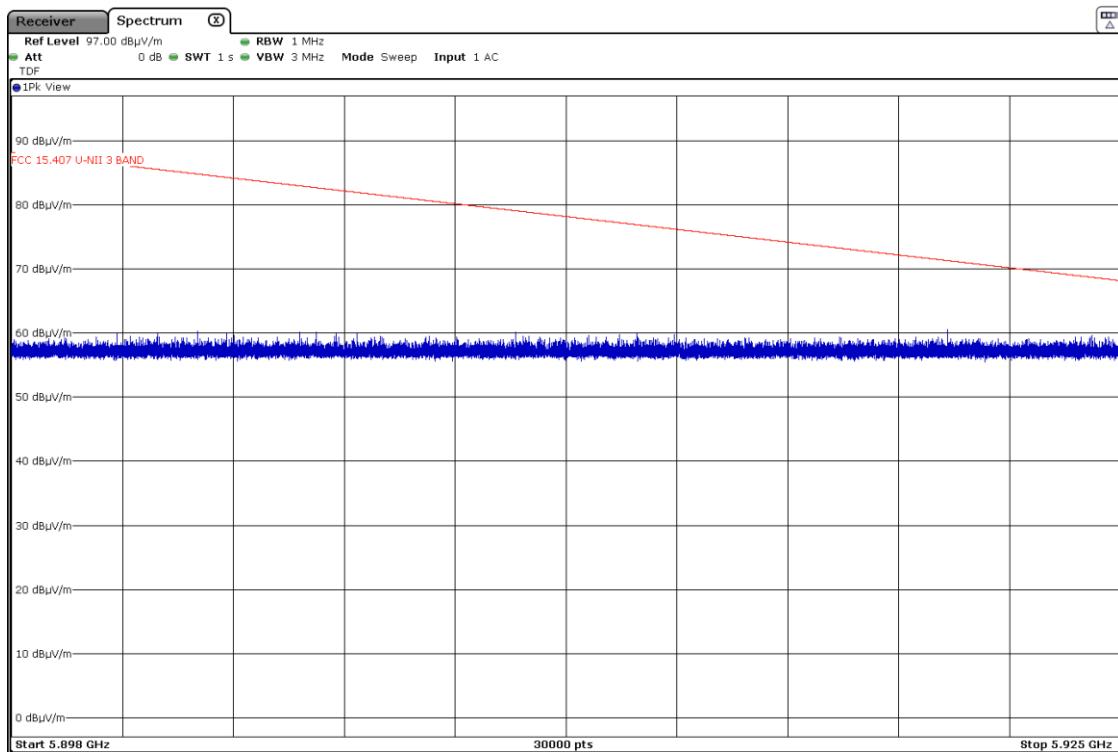
Note: The signal shown on the plot is the carrier frequency.

## Radiated spurious emissions inside adjacent band 5.898 – 5.925 GHz.

Channel 151 (5755MHz):



Channel 159 (5795MHz):



**Mode: 802.11n HT40- 40MHz**

**Results: Channel 151**

No radiated spurious signals were detected outside the band-edge

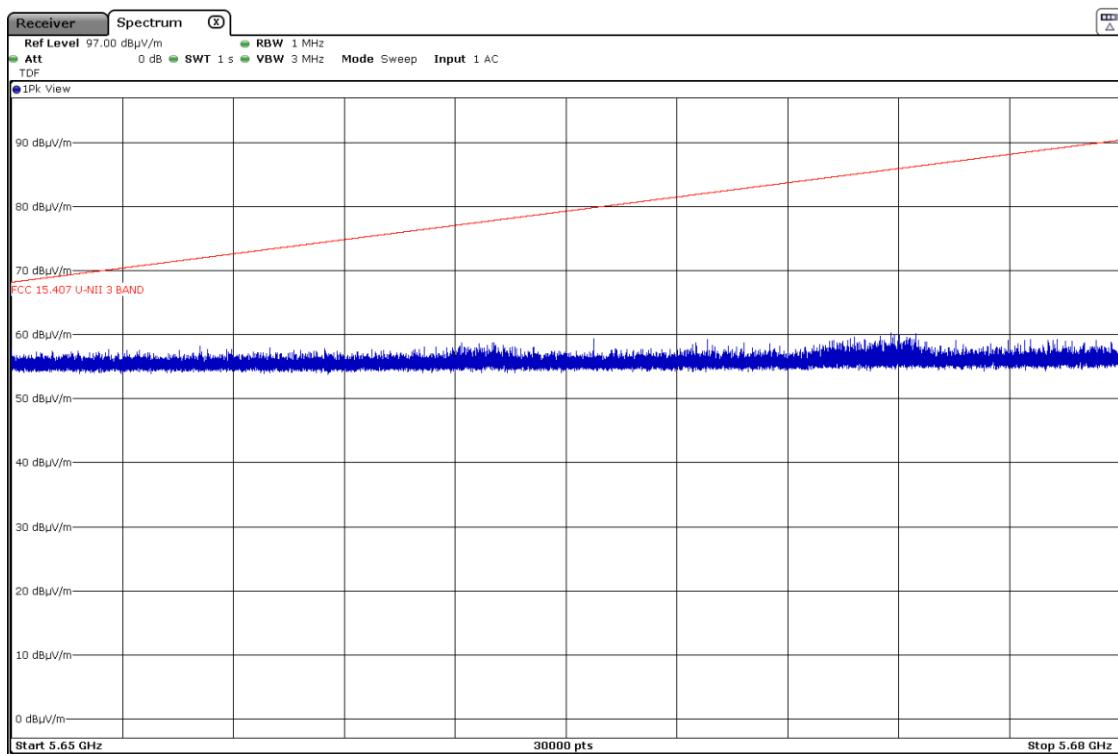
**Results: Channel 159**

No radiated spurious signals were detected outside the band-edge.

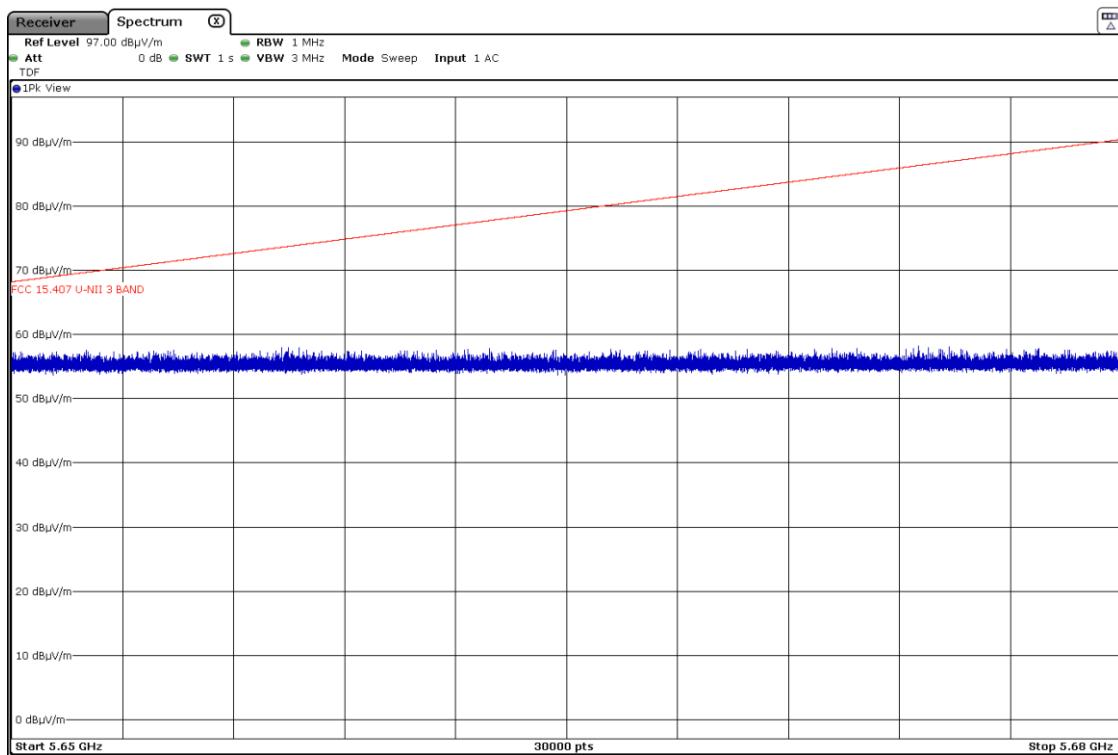
**Mode: 802.11n HT40 - 40MHz**

**Radiated spurious emissions inside adjacent band 5.65 – 5.68 GHz.**

Channel 151 (5755MHz):

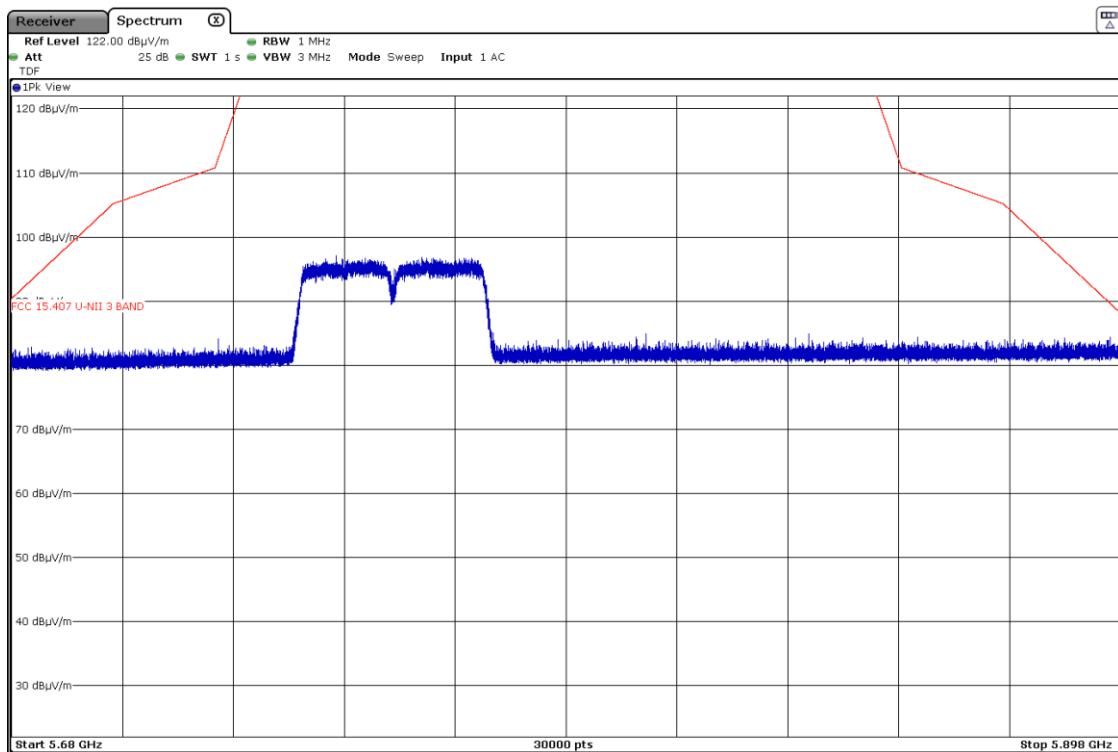


Channel 159 (5795MHz):



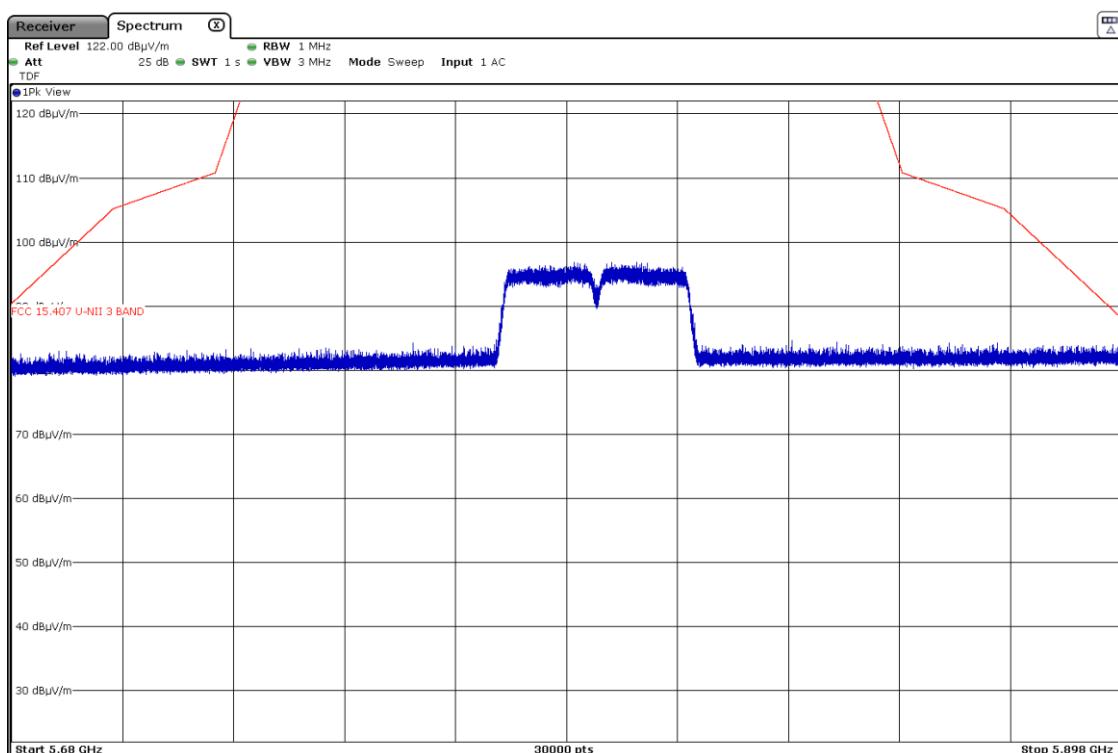
## Radiated spurious emissions inside band 5.68 – 5.898 GHz.

Channel 151 (5755MHz):



Note: The signal shown on the plot is the carrier frequency.

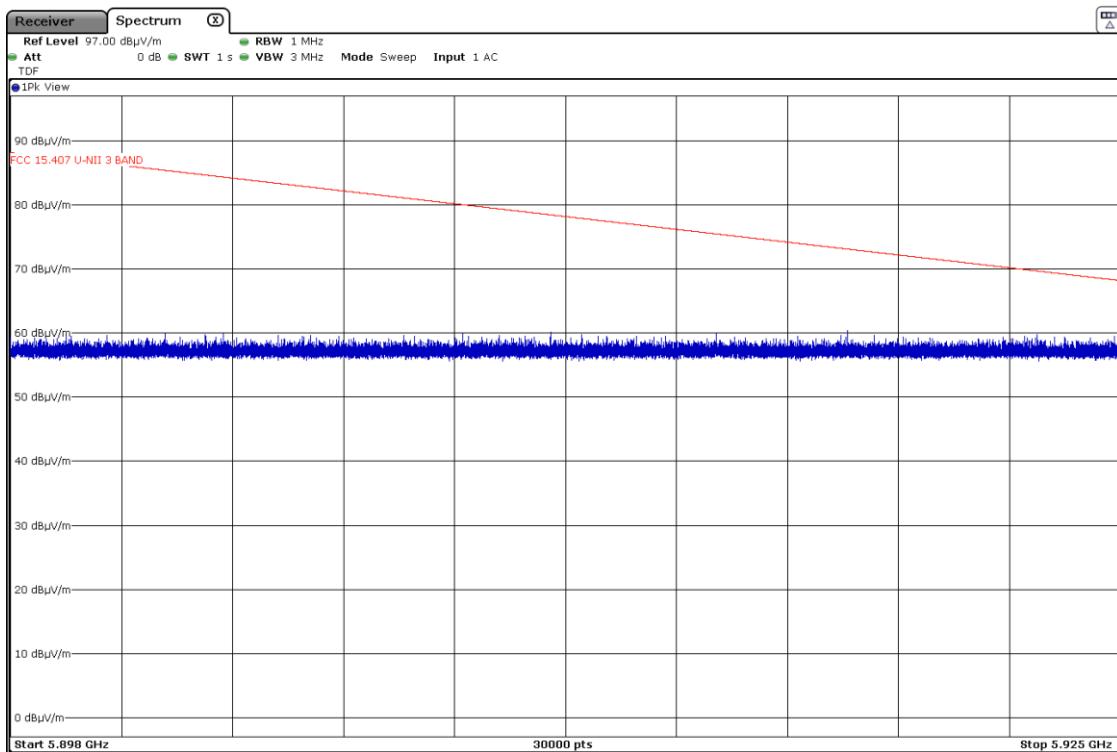
Channel 159 (5795MHz):



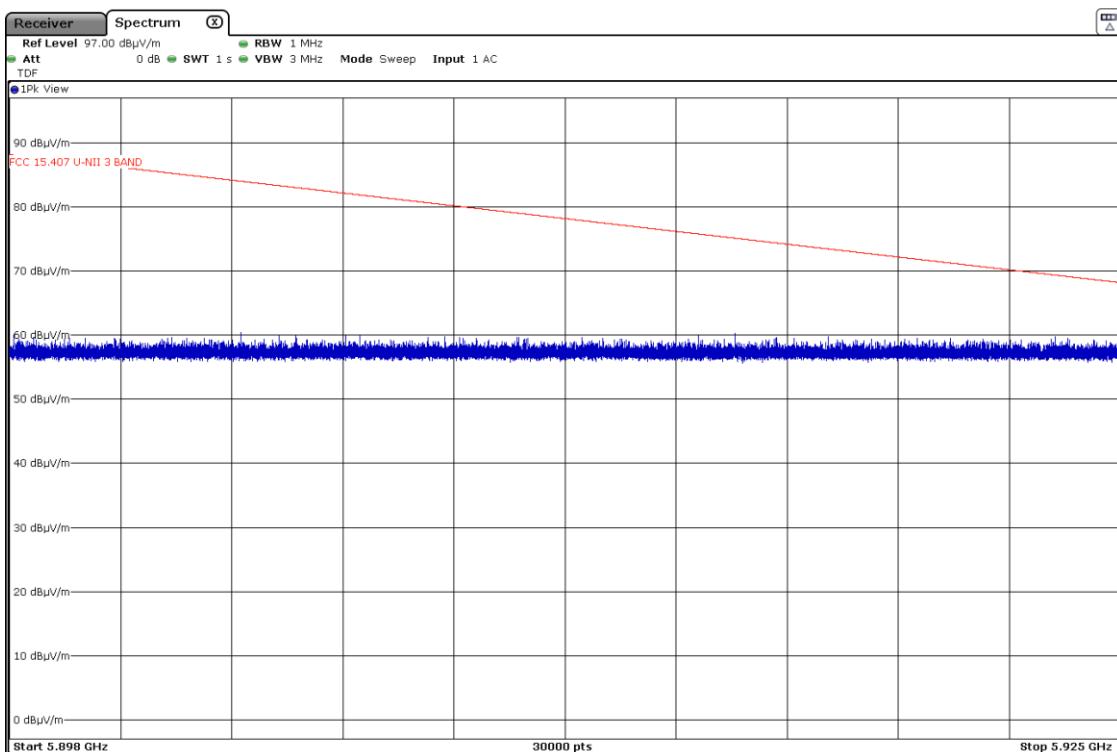
Note: The signal shown on the plot is the carrier frequency.

## Radiated spurious emissions inside adjacent band 5.898 – 5.925 GHz.

Channel 151 (5755MHz):



Channel 159 (5795MHz):



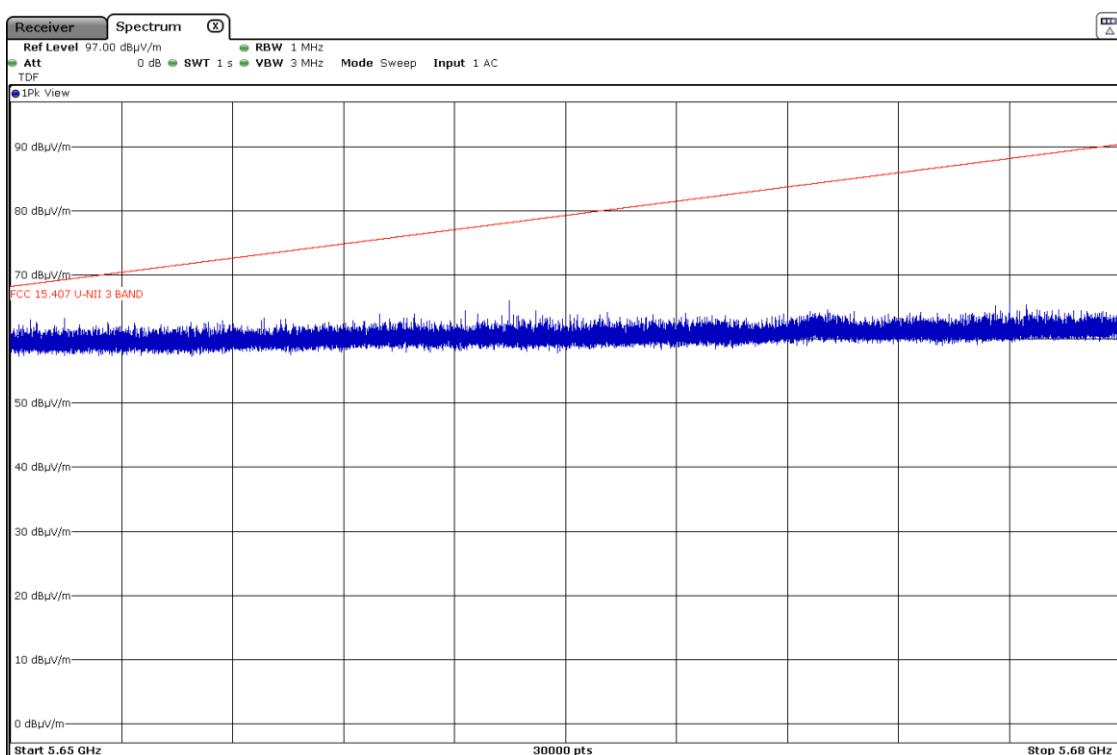
**Mode: 802.11ac VHT80 - 80MHz**

**Results: Channel 155**

No radiated spurious signals were detected outside the band-edge.

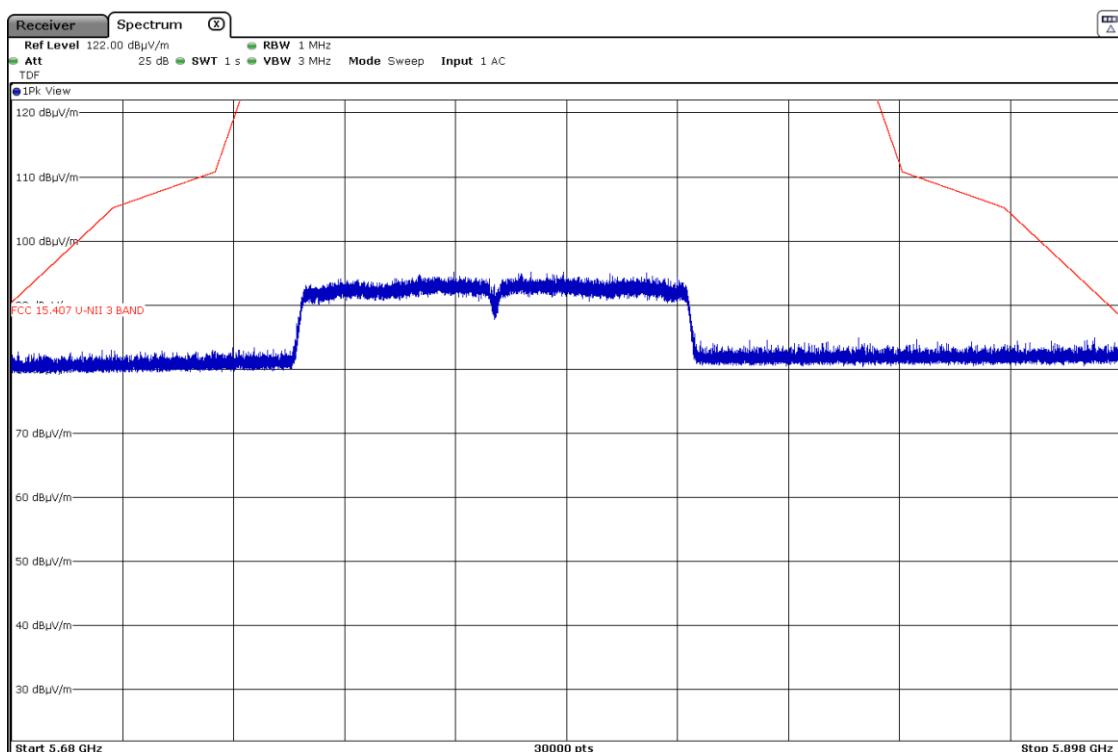
**Radiated spurious emissions inside adjacent band 5.65 – 5.68 GHz.**

Channel 155 (5775MHz):



## Radiated spurious emissions inside band 5.68 – 5.898 GHz.

Channel 155 (5775MHz):



Note: The signal shown on the plot is the carrier frequency.

## Radiated spurious emissions inside adjacent band 5.898 – 5.925 GHz.

Channel 155 (5775 MHz):

