DEKRA Testing and Certification, S.A.U.
Parque Tecnológico de Andalucía,
c/ Severo Ochoa nº 2 · 29590 Campanillas · Málaga · España
C.I.F. A29507456

ISED CABid: ES1909

Test Report No:
NIE: 69535RRF.011

Partial Test Report

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

(*) Identification of item tested	Automotive infotainment System
(*) Trademark	Mercedes-Benz
(*) Model and /or type reference	NTG7Q HIGH
Other identification of the product	FCC ID: T8GNTG7QHIGH IC: 6434A-NTG7QHIGH
(*) Features	FM/AM/DAB, USB, Bluetooth, WLAN, GNSS HW version: D11 SW version: E329
Applicant	HARMAN BECKER AUTOMOTIVE SYSTEMS GMBH Becker-Goering-Str. 16 76307, Karlsbad, GERMANY
Test method requested, standard	USA FCC Part 15.407 (10-1-21) Edition: Unlicensed National Information Infrastructure (U-NII) Devices. General technical requirements. USA FCC Part 15.209 (10-1-21) Edition: Radiated emission limits; general requirements. CANADA RSS-247 Issue 2 (February 2017). CANADA RSS-Gen Issue 5 (March 2019). 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)	Rafael López EMC Consumer & RF Lab. Manager 2022.09.20 14:14:06 +02'00'
Date of issue	2022-09-16
Report template No	FDT08_24 (*) "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 covers the performed tests in this report.

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

In order to assure the traceability to other national and international laboratories, DEKRA Testing and Certification 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.

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General conditions

1. This report is only referred to the item that has undergone the test.
2. This report does not constitute or imply on its own an approval of the product by the Certification Bodies or competent Authorities.
3. This document is only valid if complete; no partial reproduction can be made without previous written permission of DEKRA Testing and Certification.
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 of the model NTG7Q HIGH is an automotive head unit to be installed in cars with the following features: FM/AM/DAB, USB, Bluetooth, WLAN and GNSS.

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 result.

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
69535/021	Automotive infotainment System	NTG7Q HIGH	HBM609N4884007	2022/06/13
69535/017	RF Harness	--	--	2022/06/13

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

Test sample description

Ports……:	Port name and description		Cable						
			Specified max length [m]	Attached during test	Shielded	Coupled to patient(3)			
	Car Connector A		>3m	☒	☐	☐			
	Car Connector B		>3m	☒	☐	☐			
	Display Connector CID / PIP / RVC		>3m	☒	☒	☐			
	USB Connector		<3m	☒	☒	☐			
	Eth Connector		>3m	☒	☐	☐			
	BT/WLAN-Antenna		>3m	☒	☒	☐			
Supplementary information to the ports……:	GNSS Antenna >3m								
Rated power supply ..... :	Voltage and Frequency		Reference poles						
			L1	L2	L3	N	PE		
	☐	AC:	☐	☐	☐	☐	☐		
	☐	AC:	☐	☐	☐	☐	☐		
	☒	DC: 12V car battery /attenuator (9,5-15,5v normal operation)							
	☐	DC:							
Rated Power..... :	12V								
Clock frequencies..... :	-								
Other parameters ..... :	-								
Software version..... :	-								
Hardware version ..... :	-								
Dimensions in cm (W x H x D) ... :	-								
Mounting position ..... :	☐	Table top equipment							
	☐	Wall/Ceiling mounted equipment							
	☐	Floor standing equipment							
	☐	Hand-held equipment							
	☒	Other: automotive							
Modules/parts..... :	Module/parts of test item			Type		Manufacturer			
	-								
	-								

	-		
Accessories (not part of the test item) ..... :	Description	Type	Manufacturer
	HARMANeco (with Display or headless)	HARMANeco	HARMAN
	Cable harness	harness	HARMAN
	Display	different suppliers	different versions
	BT/WLAN-Antenna	OEM-Antenna	HIRSCHMANN
	-		
	-		
Documents as provided by the applicant ..... :	Description	File name	Issue date
	Technical description	Technical Description NTG7_A20 200717 SOP2 AllVariant.pdf	A20
	Testing Guide	NTG7-TestsetupScript_191209 HU+RSU_v2.0.pdf	v2.0
	-		
	-		

(3) Only for Medical Equipment

Identification of the client

HARMAN BECKER AUTOMOTIVE SYSTEMS GMBH

Becker-Goering-Str. 16
76307, Karlsbad, GERMANY

Testing period and place

Test Location	DEKRA Testing and Certification S.A.U.
Date (start)	2022-07-11
Date (finish)	2022-07-22

Document history

Report number	Date	Description
69535RRF.011	2022-09-16	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: Miguel Manuel López, Rafael Fernández.

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.	Biconical/Log Antenna 30 MHz - 6 GHz ETS LINDGREN 3142E	2020/10	2023/10
4.	RF Preamplifier, G>38dB 30MHz-6GHz BONN ELEKTRONIK BLNA 0360-01N	2022/06	2023/06
5.	EMI Test Receiver 2Hz-44GHz, ROHDE AND SCHWARZ ESW44	2021/12	2023/12
6.	DC Power Supply 30V/5A, KEYSIGHT TECHNOLOGIES U8002A	N/A	N/A
7.	Digital Multimeter, FLUKE 175	2021/11	2022/11
8.	EMC/RF Testing SW ROHDE AND SCHWARZ EMC32	N/A	N/A
9.	Horn Antenna 1-18 GHz SCHWARZBECK MESS-ELEKTRONIK BBHA 9120 D	2020/08	2023/08
10.	RF Preamplifier G>30dB, 1-18GHz BONN ELEKTRONIK BLMA 0118-3A	2021/12	2022/12
11.	Broadband Horn antenna 18 - 40 GHz SCHWARZBECK MESS-ELEKTRONIK BBHA 9170	2020/05	2023/05
12.	Pre-amplifier, G>30 dB, 18-40 GHz BONN ELEKTRONIK BLMA 1840-4A	2021/09	2023/09
13.	Signal and Spectrum Analyzer 40 GHz Rohde and Schwarz FSV40	2021/10	2023/10

Testing verdicts

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

Summary

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	(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)
Supplementary information and remarks: (1) Test not requested			

B. U-NII-1 Band: 5.15 - 5.25 GHz

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)(6) / RSS-247 6.2.1.2	Transmitter Out of Band Radiated Emissions	P	
FCC 15.407 (b)(1) / RSS-247 6.2.1.2	Transmitter Band Edge Radiated Emissions	P	
FCC 15.407 (h)(1) / RSS-247 6.2.1.1	Transmitter Power Control	N/M	(1)
Supplementary information and remarks: (1) Test not requested			

C. U-NII-3 Band: 5.725 - 5.85 GHz

FCC PART 15 PARAGRAPH / RSS-247			
Requirement – Test case		**Verdict**	**Remark**
FCC 15.407 (a)(3) / RSS-247 6.2.4.1	Transmitter Maximum conducted Output Power	N/M	(1)
FCC 15.407 (e) / RSS-247 Clause 6.2.4.1	6 dB bandwidth.	N/M	(1)
FCC 15.407 (a)(3) / RSS-247 Clause 6.2.4.1	Transmitter Maximum Power Spectral Density	N/M	(1)
FCC 15.407 (b)(4) / RSS-247 6.2.4.2	Transmitter Band Edge Radiated Emissions	P	
FCC 15.407 (b)(4)(6) / RSS-247 6.2.4.2	Transmitter Out of Band Radiated Emissions	P	
FCC 15.40 (h)(1) / RSS-247 6.2.4.1	Transmitter Power Control	N/A	
Supplementary information and remarks: (1) Test not requested			

Appendix A: Tests results for the U-NII-1 Band 5.15 – 5.25 GHz

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TEST CONDITIONS

(*): Supplied by the Applicant.

POWER SUPPLY (*):

Vnominal: 12 Vdc
Type of Power Supply: External DC (Vehicle battery).

ANTENNA (*):

Type of Antenna: External.
Maximum Declared Assembly Antenna Gain: +2.5 dBi

TEST FREQUENCIES:

Technology Tested:	WLAN (IEEE 802.11 a,n,ac) / U-NII-1	
Modes:	802.11 a20: 6, 9, 12, 18, 24, 36, 48 & 54 Mbps	
	802.11 n HT20: MCS0 to MCS7	
	802.11 n HT40: MCS0 to MCS7	
	802.11 ac VHT20: MCS0 to MCS9	
	802.11 ac VHT40: MCS0 to MCS9	
	802.11 ac VHT80: MCS0 to MCS9	
Beamforming:	No.	
Frequency Range:	5150 MHz to 5250 MHz	
Channel Spacing:	20 MHz	
Transmit Channels	Channel	Channel Frequency (MHz)
	Low: 36	5180
	Middle: 40	5200
	High: 48	5240
Channel Spacing:	40 MHz	
Transmit Channels	Channel	Channel Frequency (MHz)
	Low: 38	5190
	High: 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 Low and High 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:

- 802.11 a20: 6 Mbit/s
- 802.11 n HT20: MCS0
- 802.11 n HT40: MCS0
- 802.11 ac VHT20: MCS0
- 802.11 ac VHT40: MCS0
- 802.11 ac VHT80: MCS0

RADIATED MEASUREMENTS

All radiated tests were performed in a semi-anechoic chamber. The measurement antenna (Bilog antenna for the range between 30 MHz to 1000 MHz and 1 GHz-17 GHz Double ridge horn antenna) is situated at a distance of 3 m and at a distance of 1.5 m for the frequency range 17 GHz-40 GHz (17 GHz-40 GHz horn antenna).

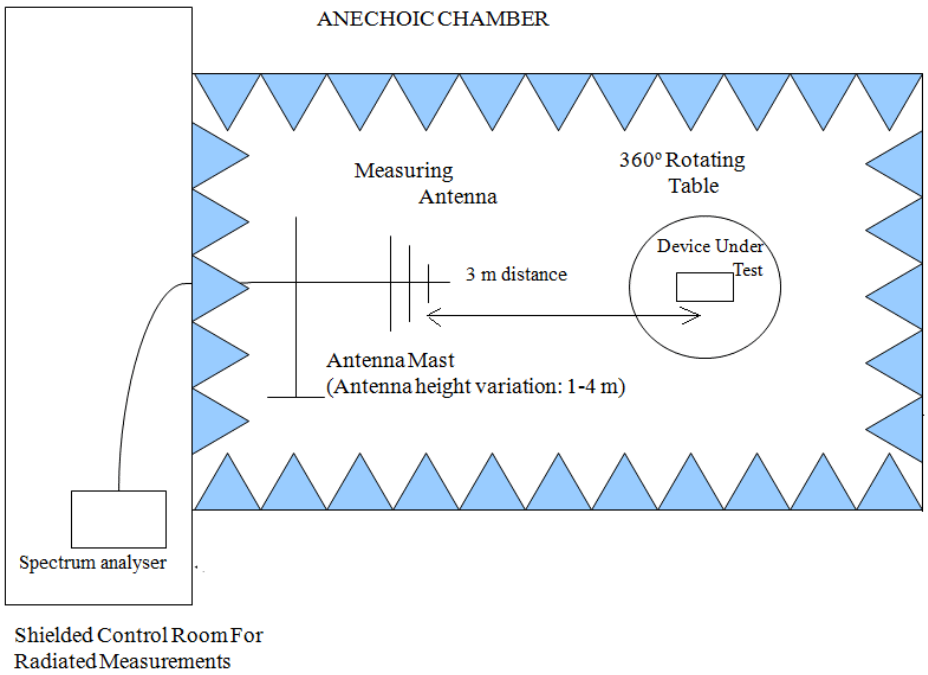
For radiated emissions in the range 17 GHz-40 GHz that is performed at a distance closer than the specified distance, an inverse proportionality factor of 20 dB per decade is used to normalize the measured data for determining compliance.

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.

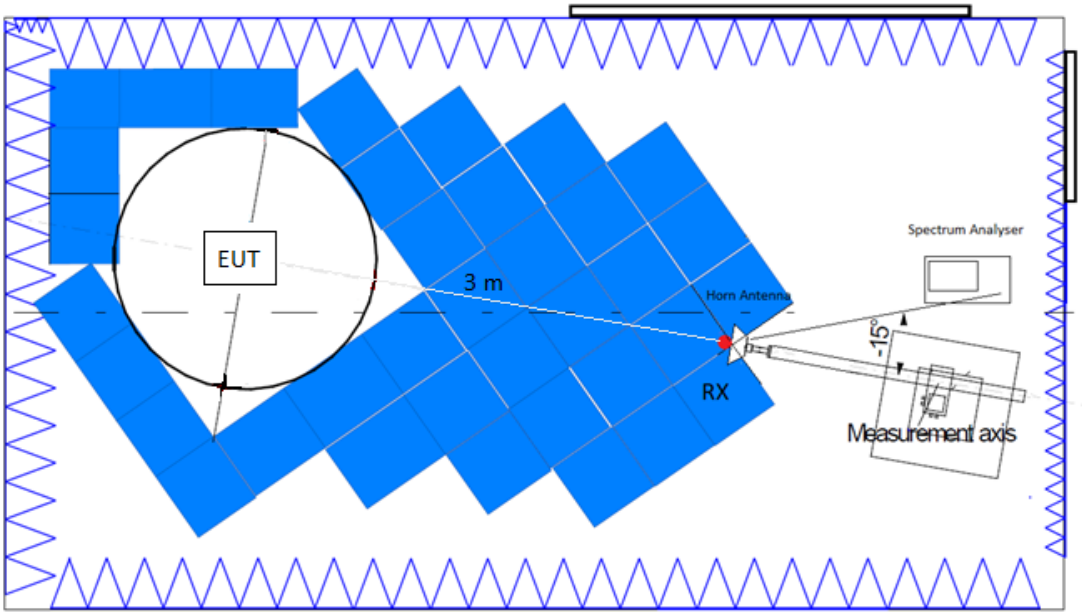
Measurements were made in both horizontal and vertical planes of polarization.

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

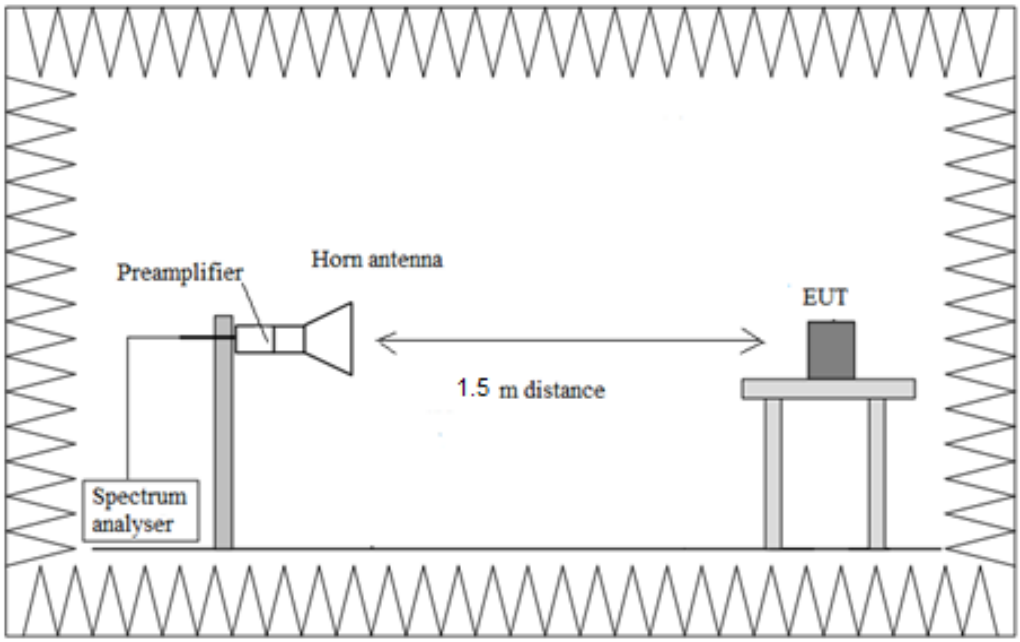
Radiated measurements setup f < 1 GHz.



Radiated measurements setup f > 1 GHz up to 17 GHz.



Radiated measurements setup f > 17 GHz up to 40 GHz.



FCC 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 3m for the frequency range 30 MHz - 17 GHz and a distance of 1m for frequency range 17 GHz - 40 GHz.

The field strength is calculated by adding correction factor to the measured level from the spectrum analyzer. This correction factor includes antenna factor, cable loss and pre-amplifiers gain.

- Test performed on the worst-case: 802.11 a20 (6 Mbps).

The worst-case was determined by measuring the eirp density (radiated).

Frequency range 30 MHz - 1 GHz

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

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

Spurious frequency (MHz)	Emission Level (dBµV/m)	Polarization	Detector
624.973750	22.84	V	Quasi-peak
874.991250	26.48	H	Quasi-peak

Measurement Uncertainty (dB) <± 5.08

Frequency range 1 - 40 GHz

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

The Low, Middle and High Channels were measured for out-of-band emissions for the worst mode.

Spurious frequencies in the restricted bands with peak levels above the average limit (54 dBµV/m at 3 m) are measured with an average detector for checking compliance with the average limit.

- **802.11 a20 (worst-case):**

  - LOW CHANNEL. No spurious frequencies closest to the limit.
  - MIDDLE CHANNEL. No spurious frequencies closest to the limit.
  - HIGH CHANNEL. No spurious frequencies closest to the limit.

Measurement Uncertainty (dB) <±5.13

Verdict: PASS

The setting for each range of frequency is indicated in the following tables:

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
Receiver: [ESW 44]					
30 MHz - 1 GHz	30,312 kHz	PK+	100 kHz	1 s	30 dB

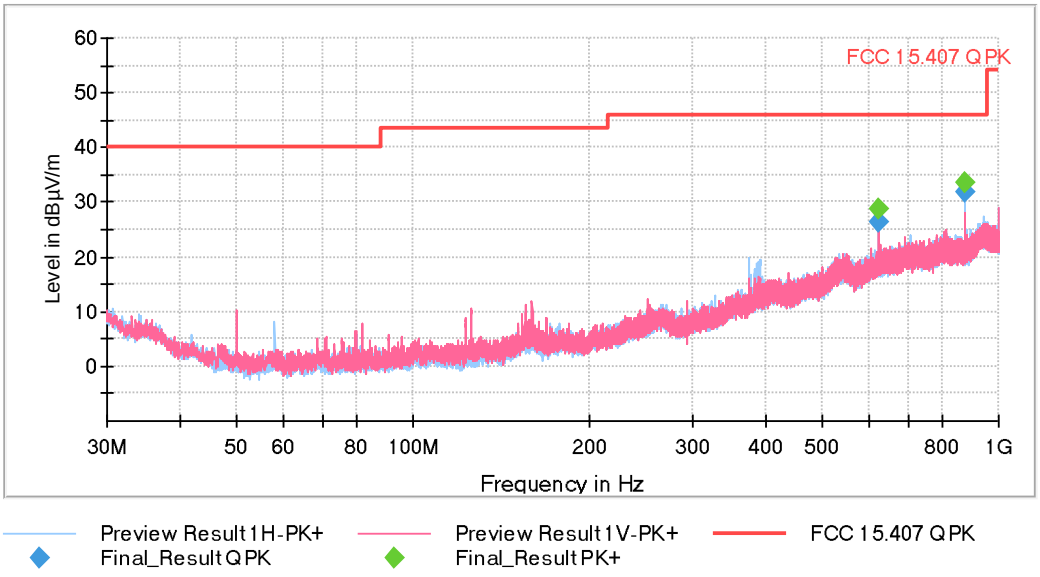
Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
Receiver: [ESW 44]					
1 GHz - 6,5 GHz	100 kHz	PK+ ; AVG	1 MHz	1 s	0 dB

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
Receiver: [ESW 44]					
6,5 GHz - 17 GHz	105 kHz	PK+ ; AVG	1 MHz	1 s	30 dB

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
Receiver: [FSV 40]					
17 GHz - 28,5 GHz	359,375 kHz	PK+ ; AVG	1 MHz	1 s	0 dB
28,5 GHz - 40 GHz	359,375 kHz	PK+ ; AVG	1 MHz	1 s	0 dB

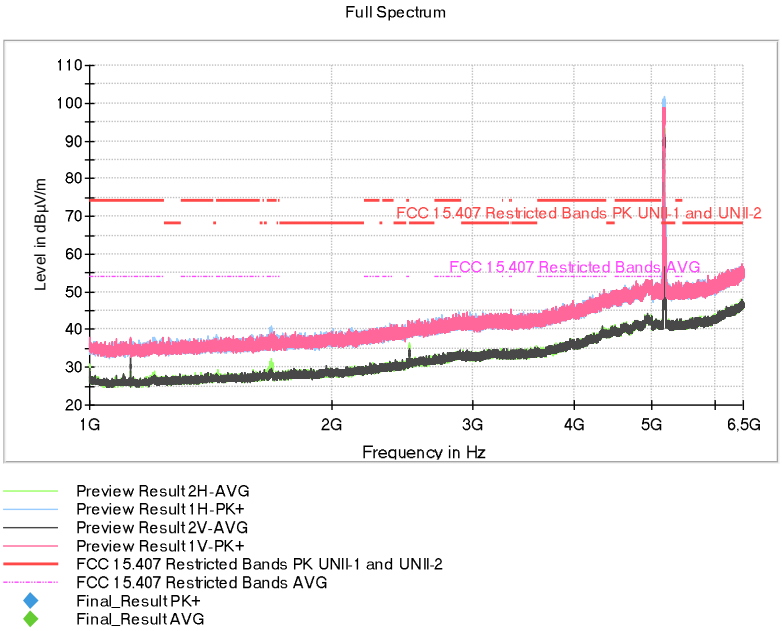
FREQUENCY RANGE 30 MHz - 1 GHz

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



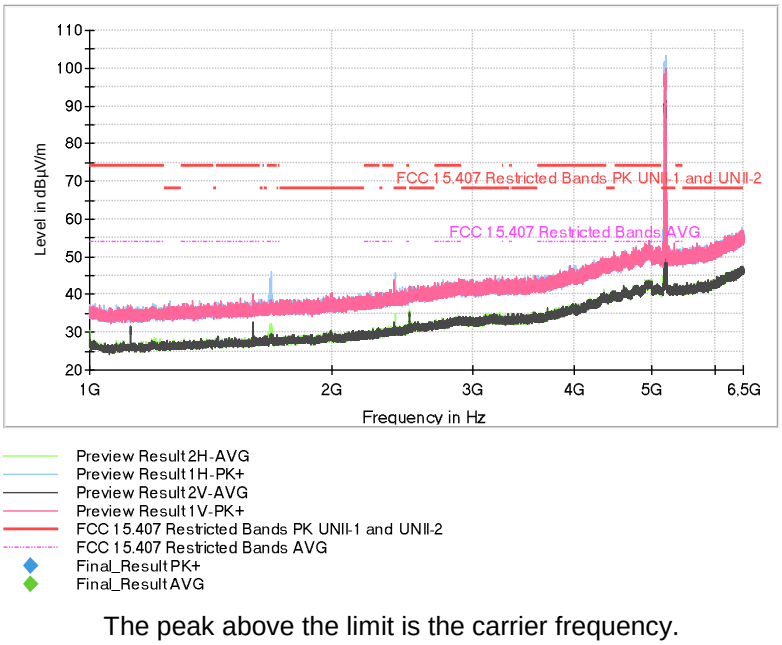
FREQUENCY RANGE 1 – 7 GHz (worst mode)

- Low Channel:



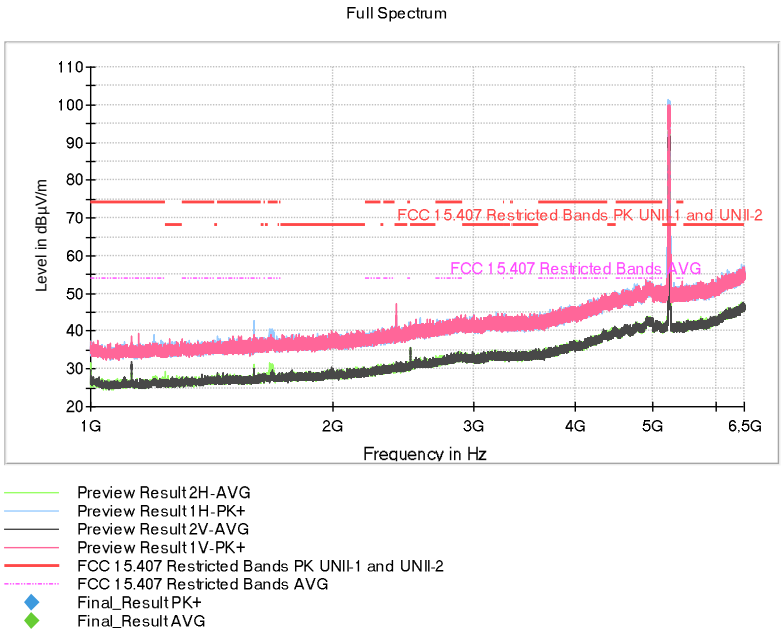
The peak above the limit is the carrier frequency.

- Middle Channel:



The peak above the limit is the carrier frequency.

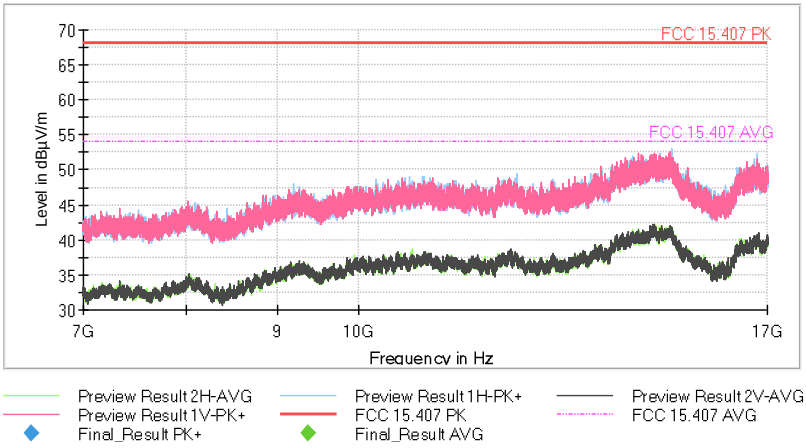
- High Channel:



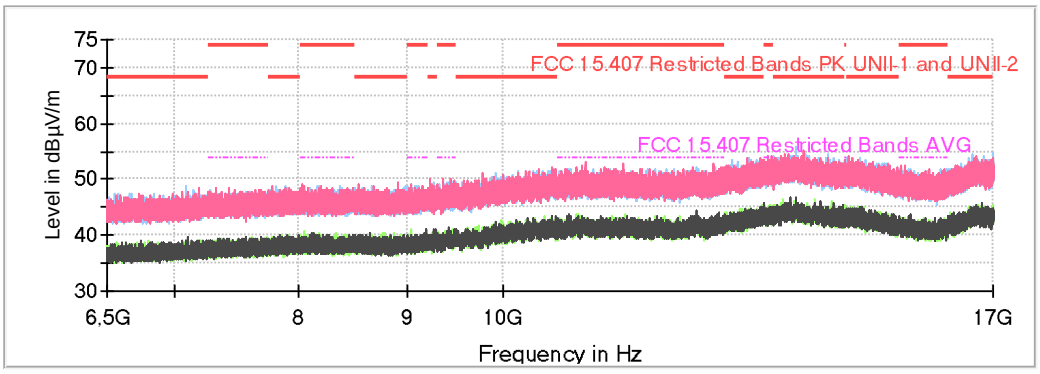
The peak above the limit is the carrier frequency.

FREQUENCY RANGE 7 - 17 GHz. (worst mode)

- Low Channel:

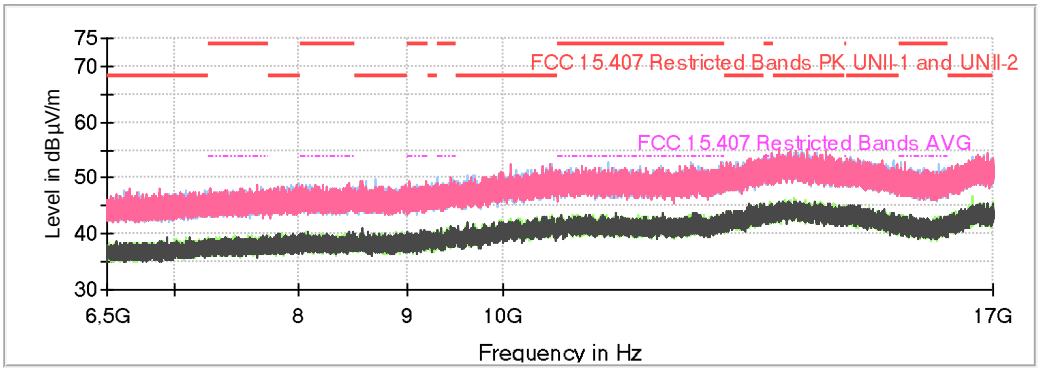


- Middle Channel:



Preview Result 2H-AVG
Preview Result 1H-PK+
Preview Result 2V-AVG
Preview Result 1V-PK+
FCC 15.407 Restricted Bands PK UNII-1 and UNII-2
FCC 15.407 Restricted Bands AVG
Final_Result PK+
Final_Result AVG

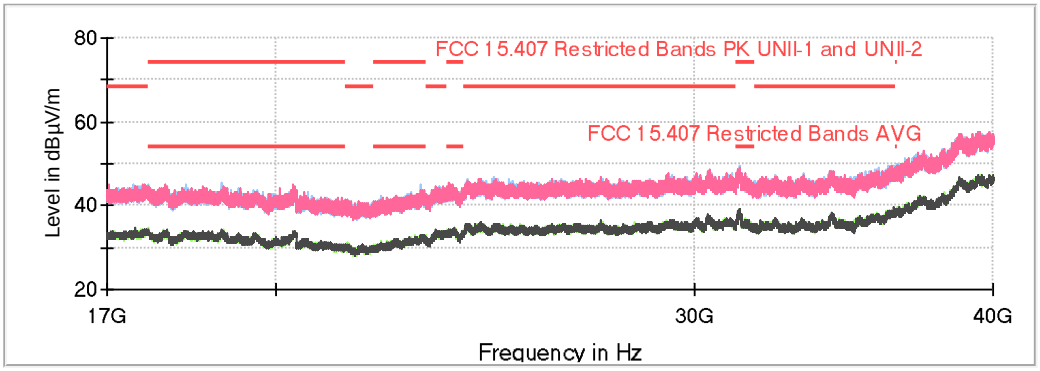
- High Channel:



Preview Result 2H-AVG
Preview Result 1H-PK+
Preview Result 2V-AVG
Preview Result 1V-PK+
FCC 15.407 Restricted Bands PK UNII-1 and UNII-2
FCC 15.407 Restricted Bands AVG
Final_Result PK+
Final_Result AVG

FREQUENCY RANGE 17 - 40 GHz

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



Preview Result 2H-AVG
Preview Result 1H-PK+
Preview Result 2V-AVG
Preview Result 1V-PK+
FCC 15.407 Restricted Bands PK UNII-1 and UNII-2
FCC 15.407 Restricted Bands AVG
Final_Result PK+
Final_Result AVG

FCC 15.407 (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 (68.23 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)
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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.

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

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:

- 802.11 a: 6 Mbit/s.
- 802.11 n HT20: MCS0.
- 802.11 ac VHT20: MCS0.
- 802.11 n HT40: MCS0.
- 802.11 ac VHT40: MCS0.
- 802.11 ac VHT80: MCS0.

- **802.11 a20:**

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

No spurious signals at less than 20 dB below the limit

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

No spurious signals at less than 20 dB below the limit

- **802.11 n20:**

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

Spurious frequency (MHz)	Emission Level (dBµV/m)	Limit (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
5149.903	54.01	74	H	Peak	<±4.11
	36.94	54		Average	<±4.11

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

No spurious signals at less than 20 dB below the limit

- **802.11 ac20:**

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

No spurious signals at less than 20 dB below the limit

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

No spurious signals at less than 20 dB below the limit

- **802.11 n40:**

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

Spurious frequency (MHz)	Emission Level (dBµV/m)	Limit (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
5147.5	60.78	74	H	Peak	<±4.11
	45.64	54		Average	<±4.11
5149.7	66.62	74	H	Peak	<±4.11
	44.27	54		Average	<±4.11

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

No spurious signals at less than 20 dB below the limit

- **802.11 ac40:**

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

Spurious frequency (MHz)	Emission Level (dBµV/m)	Limit (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
5145.1	62.77	74	H	Peak	<±4.11
	45.34	54		Average	<±4.11
5149.9	62.69	74	H	Peak	<±4.11
	44.13	54		Average	<±4.11

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

No spurious signals at less than 20 dB below the limit

- **802.11 ac80:**

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

Spurious frequency (MHz)	Emission Level (dBµV/m)	Limit (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
5121.9	62.35	74	H	Peak	<±4.11
	48.80	54		Average	<±4.11
5144.7	63.67	74	H	Peak	<±4.11
	48.77	54		Average	<±4.11

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

No spurious signals at less than 20 dB below the limit

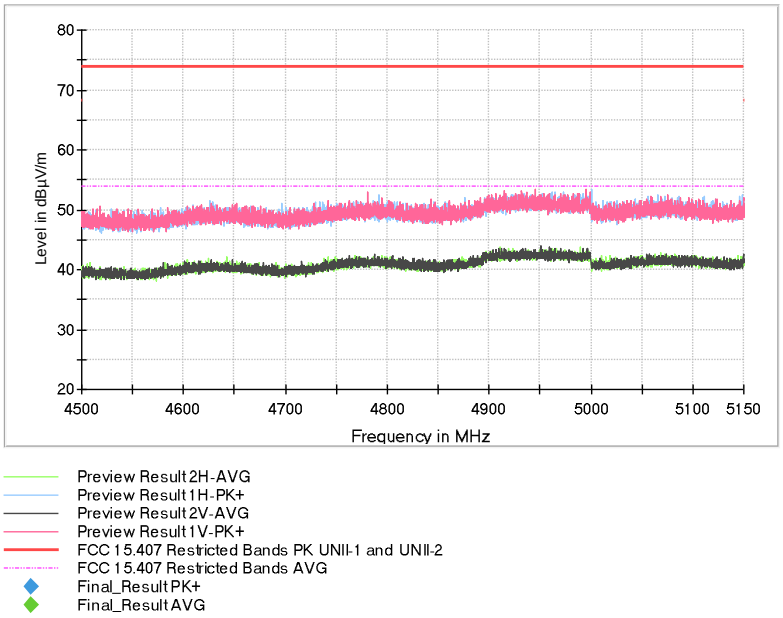
Verdict: PASS

The setting for each range of frequency is indicated in the following tables:

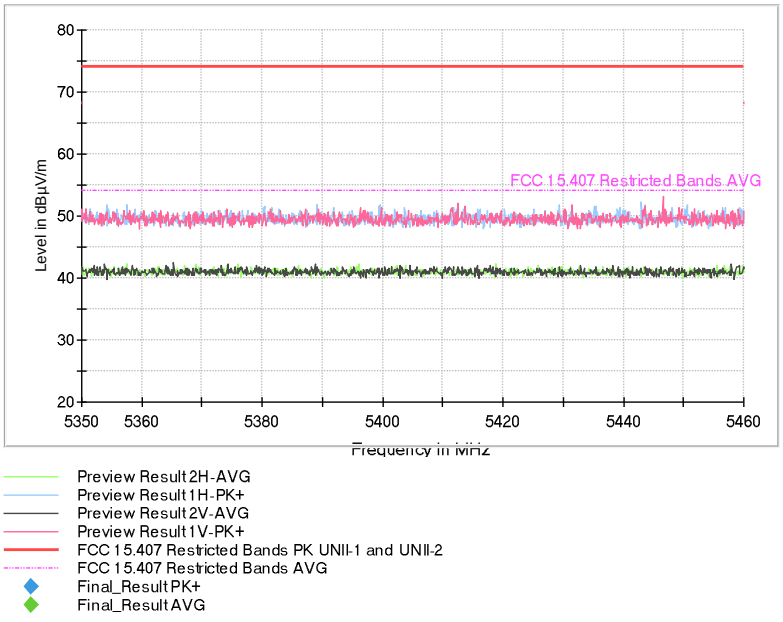
Subrange	**Step Size**	**Detectors**	**Bandwidth**	**Sweep Time**	**Preamp**
Receiver: [ESW 44]					
1 GHz - 6,5 GHz	100 kHz	PK+ ; AVG	1 MHz	1 s	0 dB

- **802.11 a20:**

  - Lower Band Edge Channel 36 (4.50-5.15 GHz)

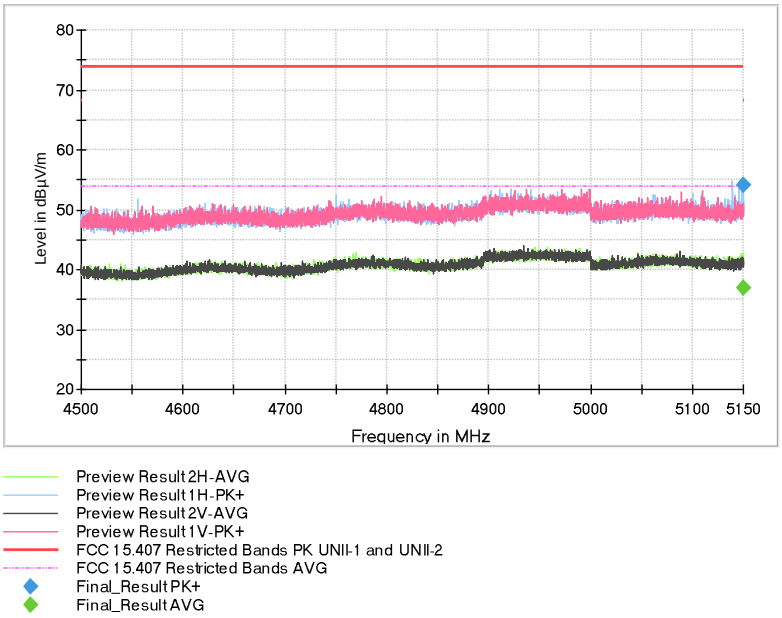


  - Upper Band Edge Channel 48 (5.35-5.46 GHz)

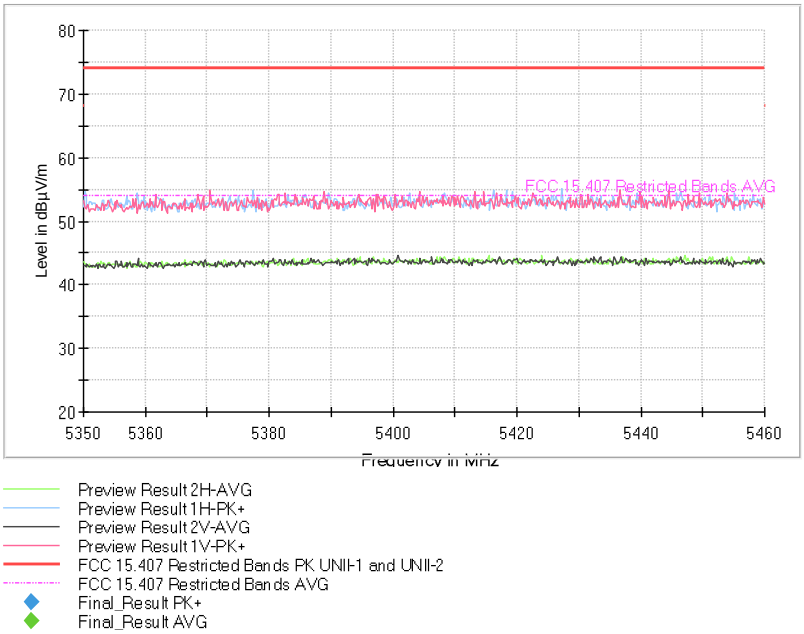


- **802.11 n20:**

  - Lower Band Edge Channel 36 (4.50-5.15 GHz)

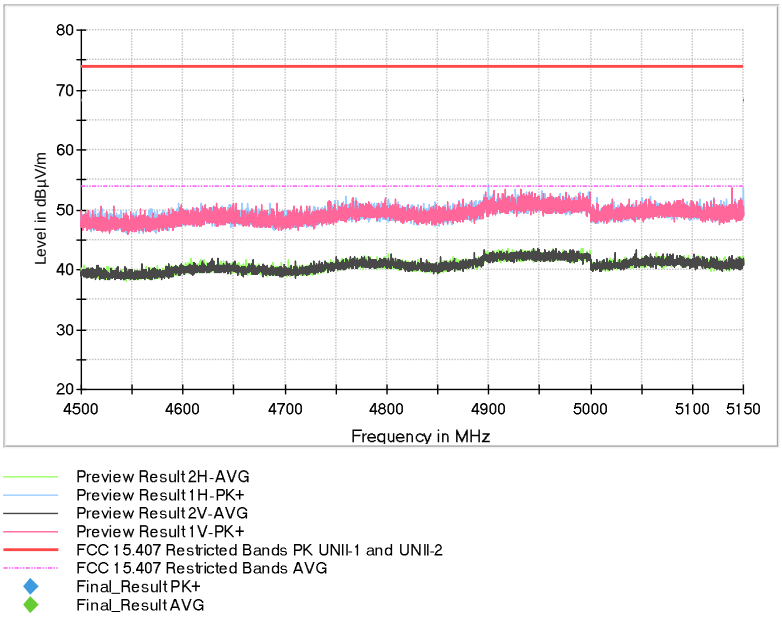


  - Upper Band Edge Channel 48 (5.35-5.46 GHz)

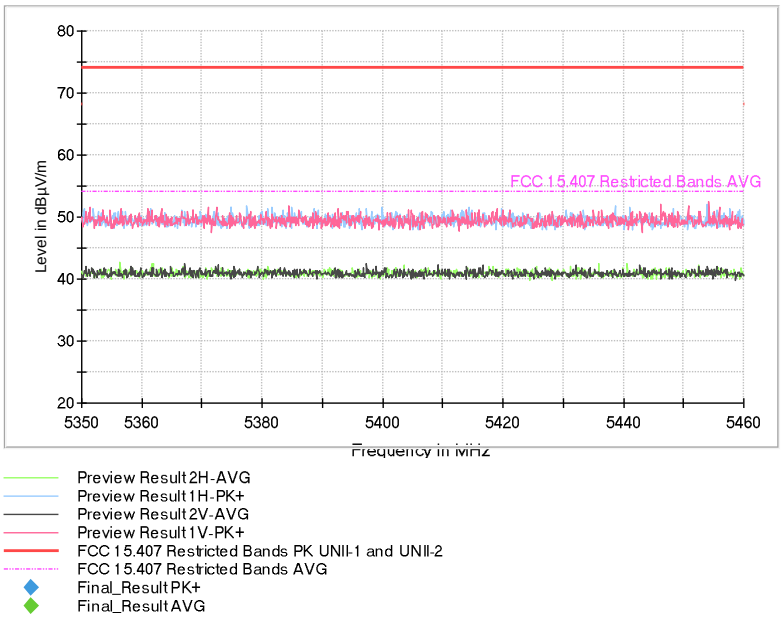


- **802.11 ac20:**

  - Lower Band Edge Channel 36 (4.50-5.15 GHz)

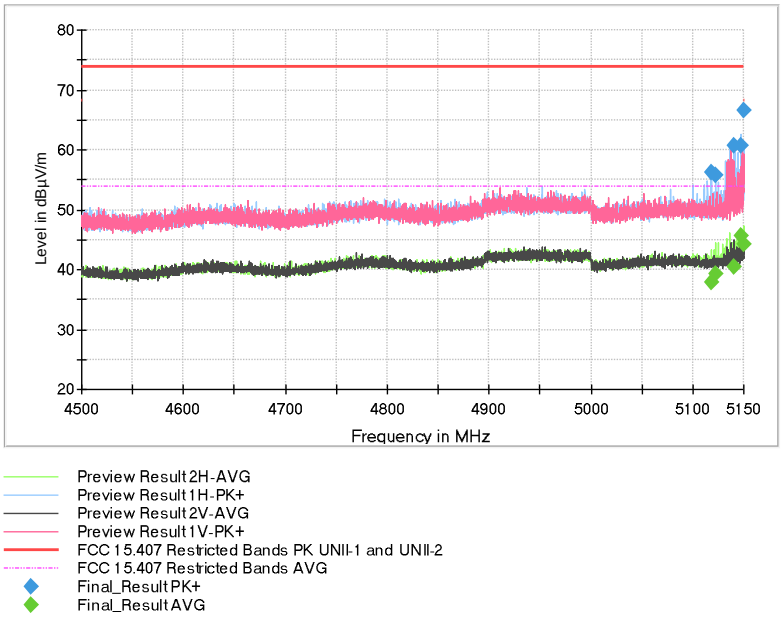


  - Upper Band Edge Channel 48 (5.35-5.46 GHz)

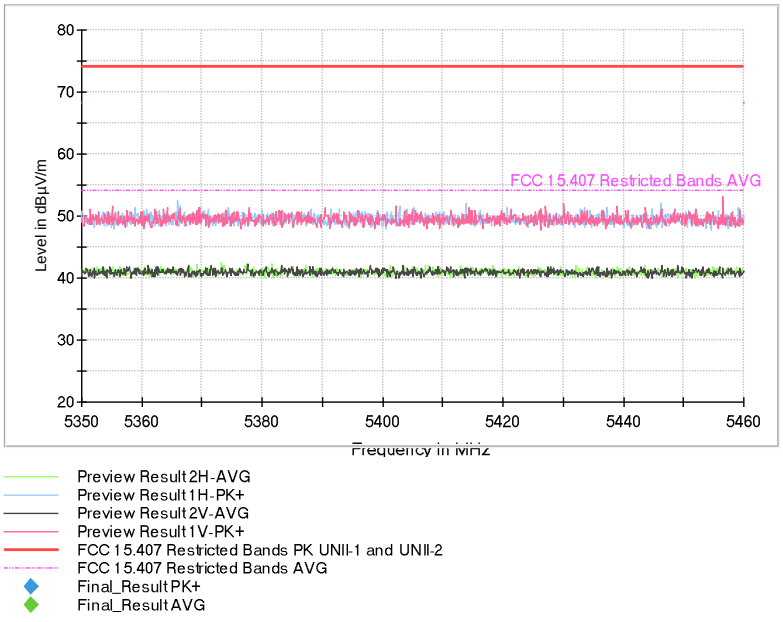


- **802.11 n40:**

  - Lower Band Edge Channel 38 (4.50-5.15 GHz)

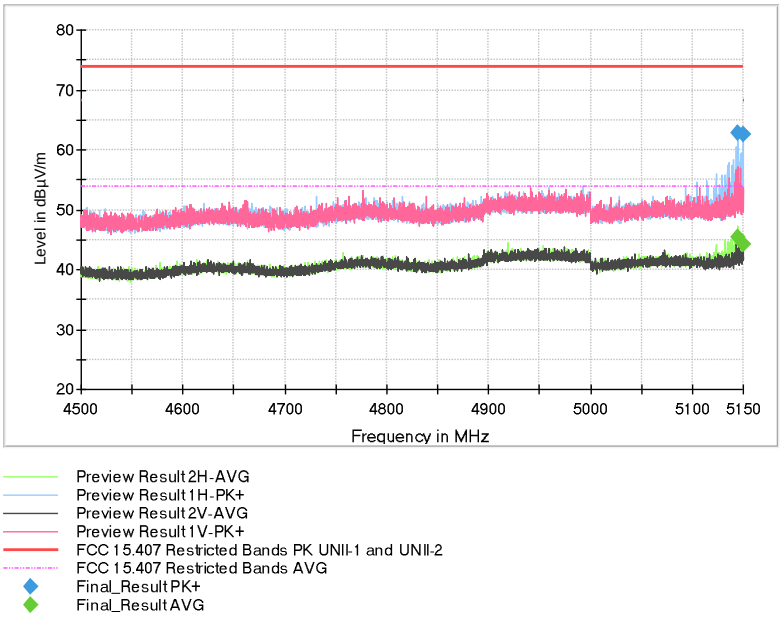


  - Upper Band Edge Channel 46 (5.35-5.46 GHz)

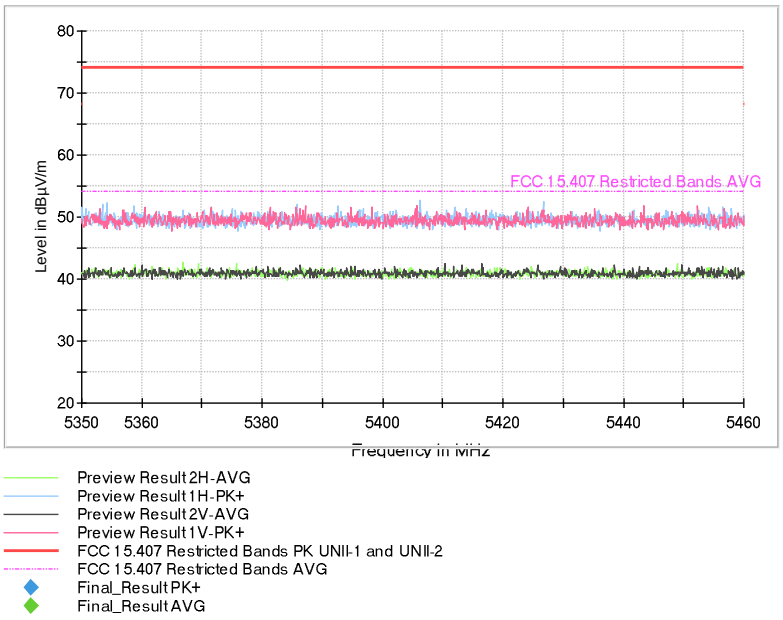


- **802.11 ac40:**

  - Lower Band Edge Channel 38 (4.50-5.15 GHz)

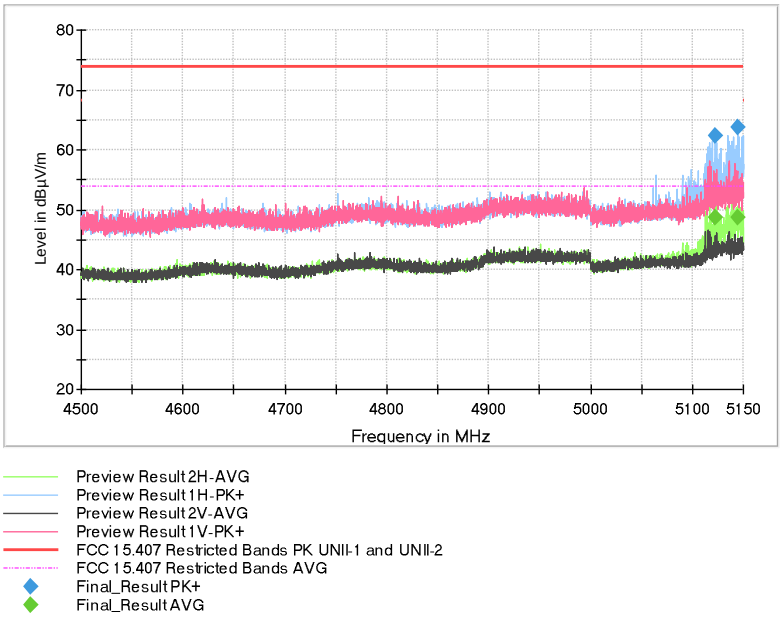


  - Upper Band Edge Channel 46 (5.35-5.46 GHz)

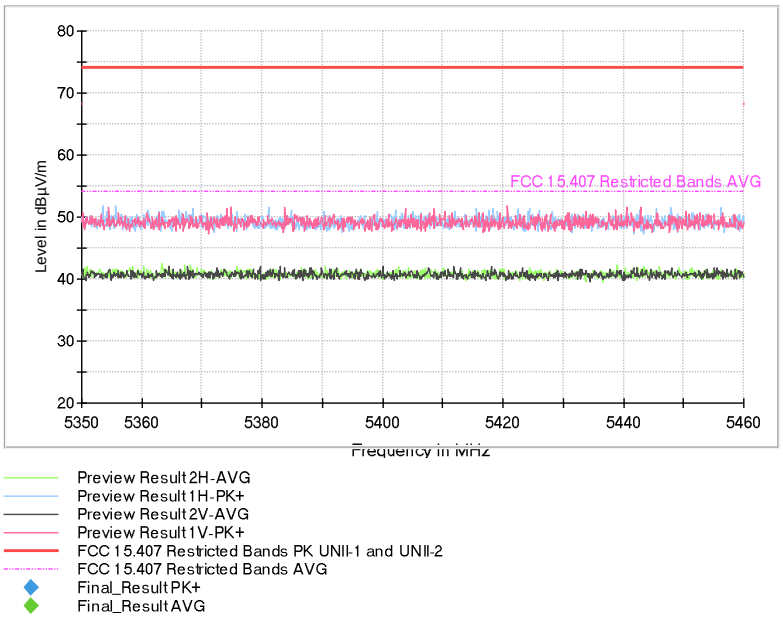


- **802.11 ac80:**

  - Lower Band Edge Channel 42 (4.50-5.15 GHz)



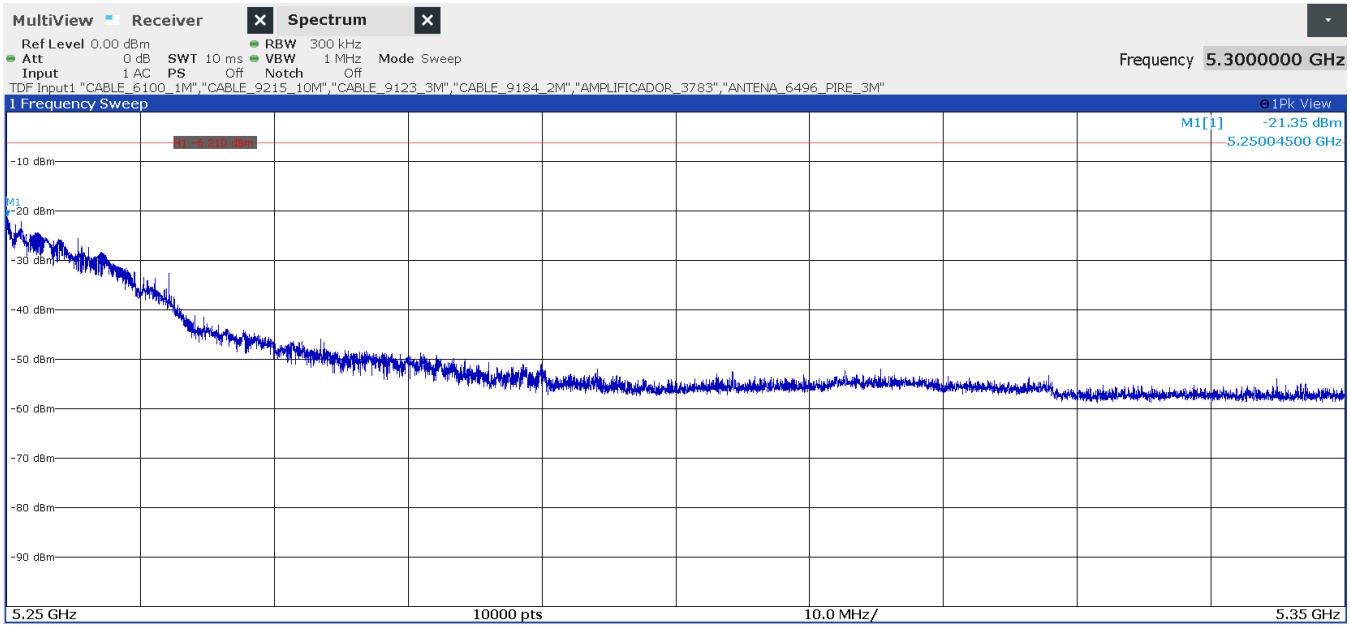
  - Upper Band Edge Channel 42 (5.35-5.46 GHz)



RSS-247, RSS-Gen:

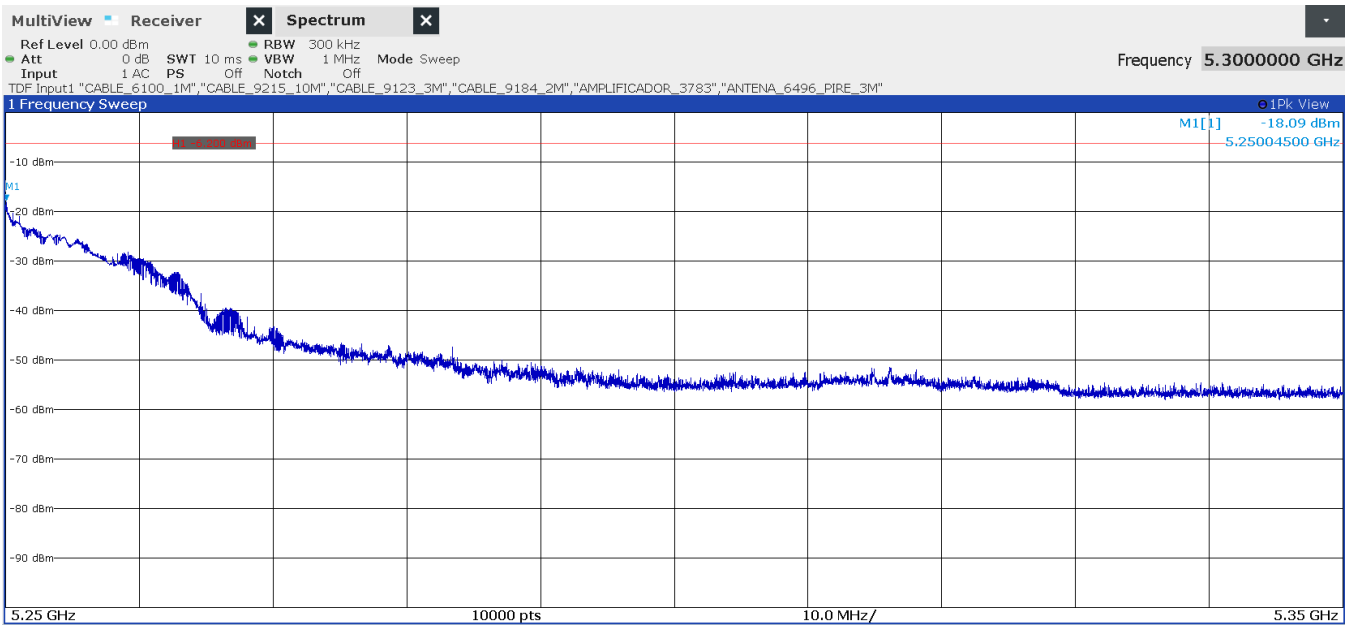
- **802.11 a20:**

  - Upper Band Edge Channel 48 (5.25-5.35 GHz)



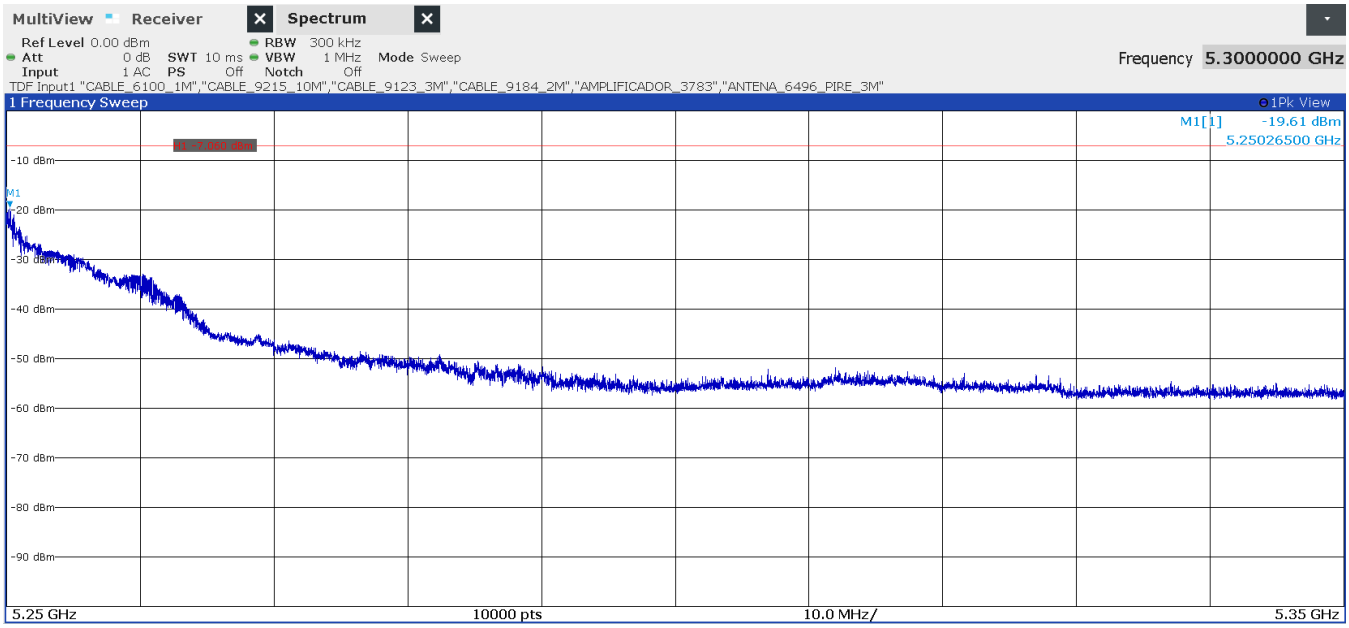
- **802.11 n20:**

  - Upper Band Edge Channel 48 (5.25-5.35 GHz)



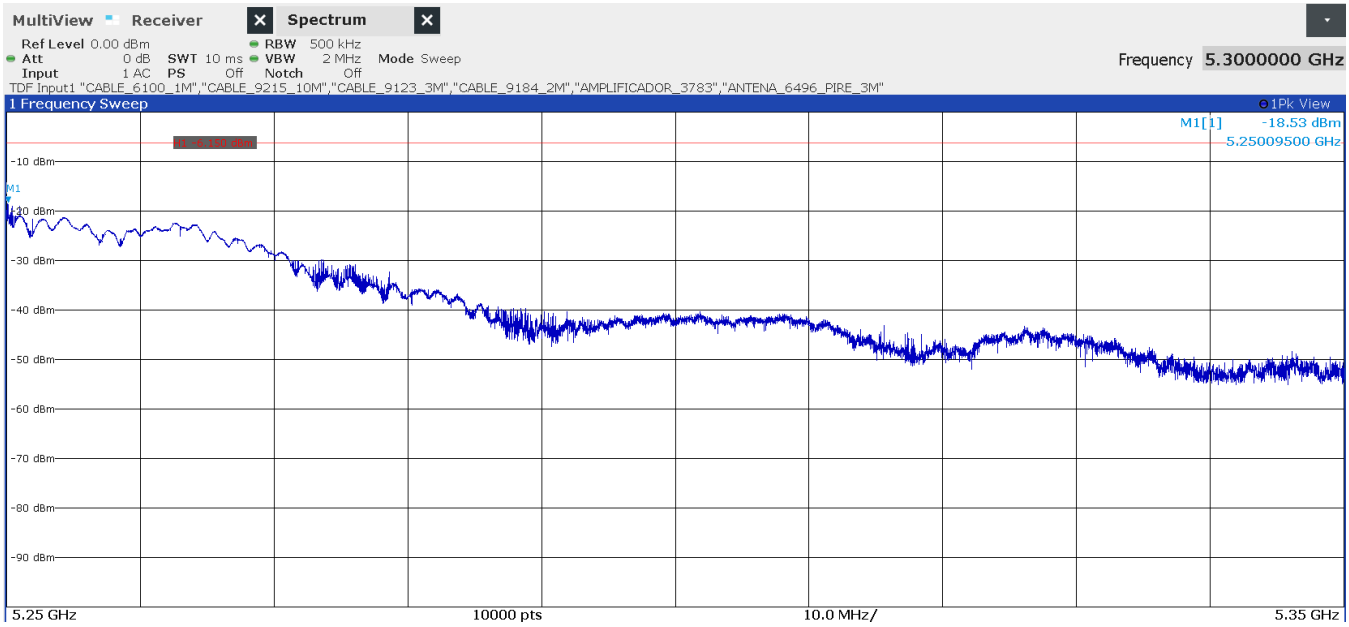
- **802.11 ac20:**

  - Upper Band Edge Channel 48 (5.25-5.35 GHz)



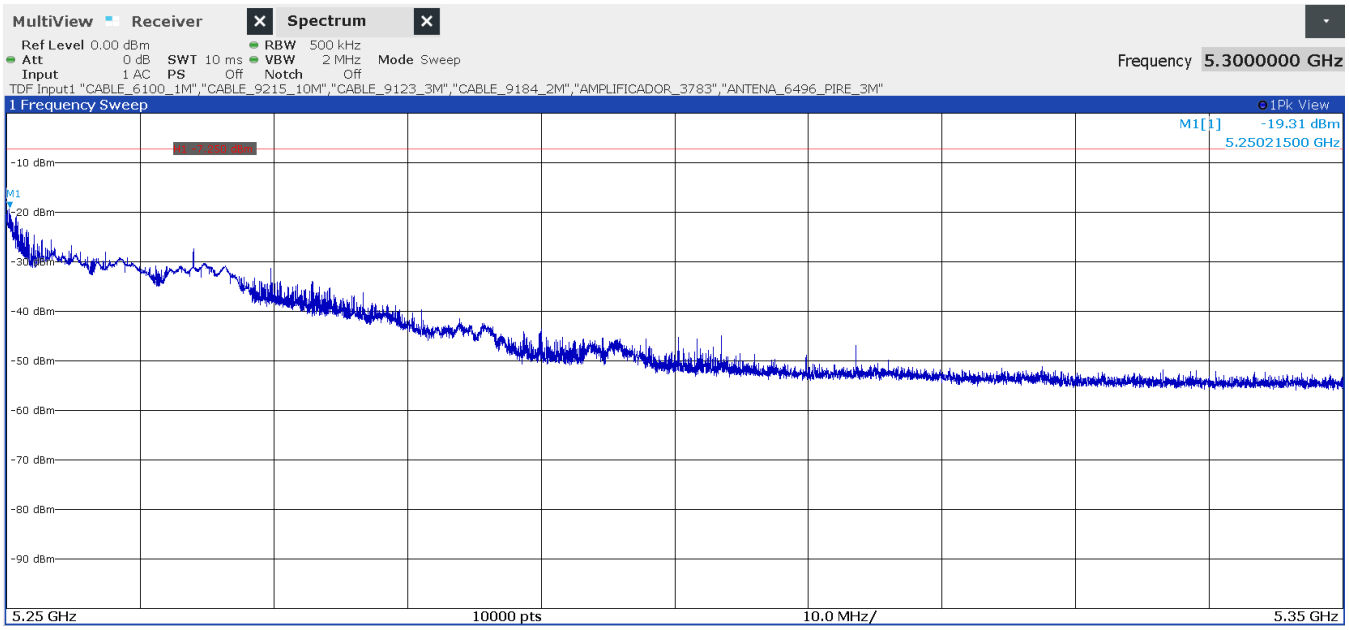
- **802.11 n40:**

  - Upper Band Edge Channel 46 (5.25-5.35 GHz)



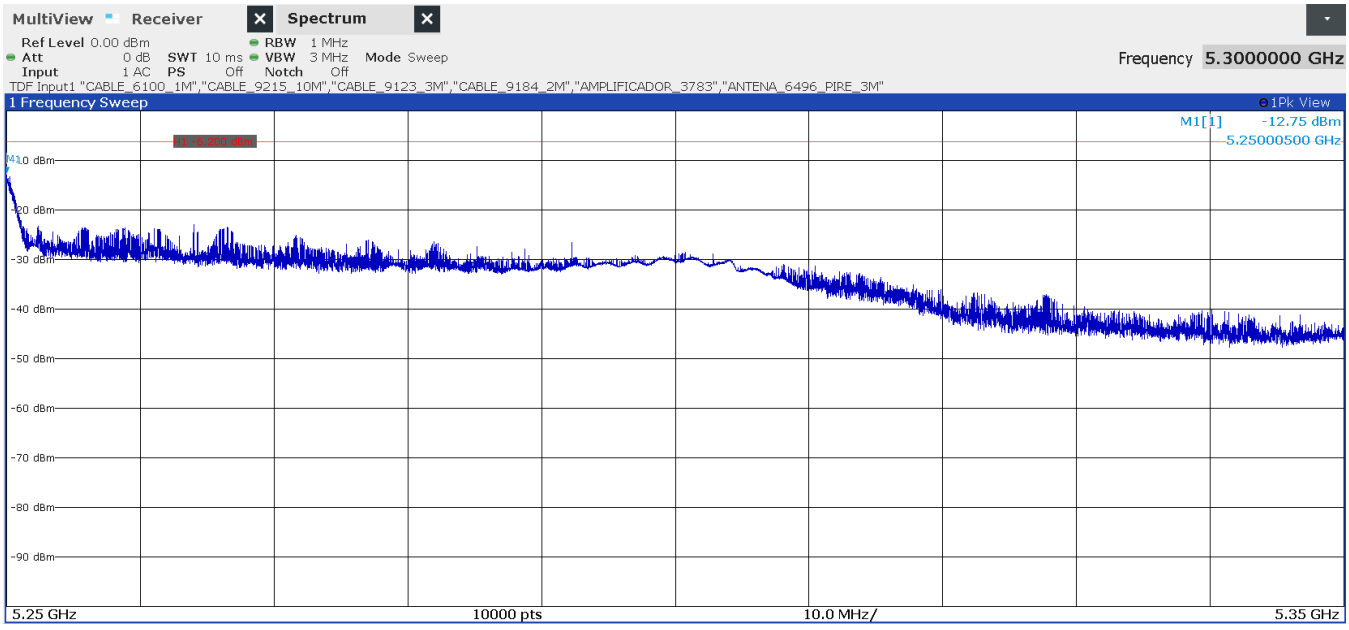
- **802.11 ac40:**

  - Upper Band Edge Channel 46 (5.25-5.35 GHz)



- **802.11 ac80:**

  - Upper Band Edge Channel 42 (5.25-5.35 GHz)



Appendix B: Tests results for the U-NII-3 Band 5.725 – 5.85 GHz

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TEST CONDITIONS 36
FCC 15.407 (b)(4)(6) / RSS-247 6.2.4.2. Transmitter Out of Band Radiated Emissions 39
FCC 15.407 (b)(4) / RSS-247 6.2.4.2. Transmitter Band Edge Radiated Emissions 46

TEST CONDITIONS

(*): Supplied by the Applicant.

POWER SUPPLY (*):

Vnominal: 12 Vdc
Type of Power Supply: External DC (Vehicle battery).

ANTENNA (*):

Type of Antenna: External.
Maximum Declared Assembly Antenna Gain: +2.5 dBi

TEST FREQUENCIES:

Technology Tested:	WLAN (IEEE 802.11 a/n/ac): U-NII-3 band	
Modes:	802.11 a: 6, 9, 12, 18, 24, 36, 48 & 54 Mbps	
	802.11 n HT20: MCS0 to MCS7	
	802.11 n HT40: MCS0 to MCS7	
	802.11 ac VHT20: MCS0 to MCS8	
	802.11 ac VHT40: MCS0 to MCS9	
	802.11 ac VHT80: MCS0 to MCS9	
Beamforming:	No	
Frequency Range:	5725 MHz to 5850 MHz	
Channel Spacing:	20 MHz	
Transmit Channels	Channel	Channel Frequency (MHz)
	Low: 149	5745
	Middle: 157	5785
	High: 165	5825
Channel Spacing:	40 MHz	
Transmit Channels	Channel	Channel Frequency (MHz)
	Low: 151	5755
	High: 159	5795
Channel Spacing:	80 MHz	
Transmit Channels	Middle: 155	5775

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 individually on the Low and High 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:

- 802.11a20: 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).

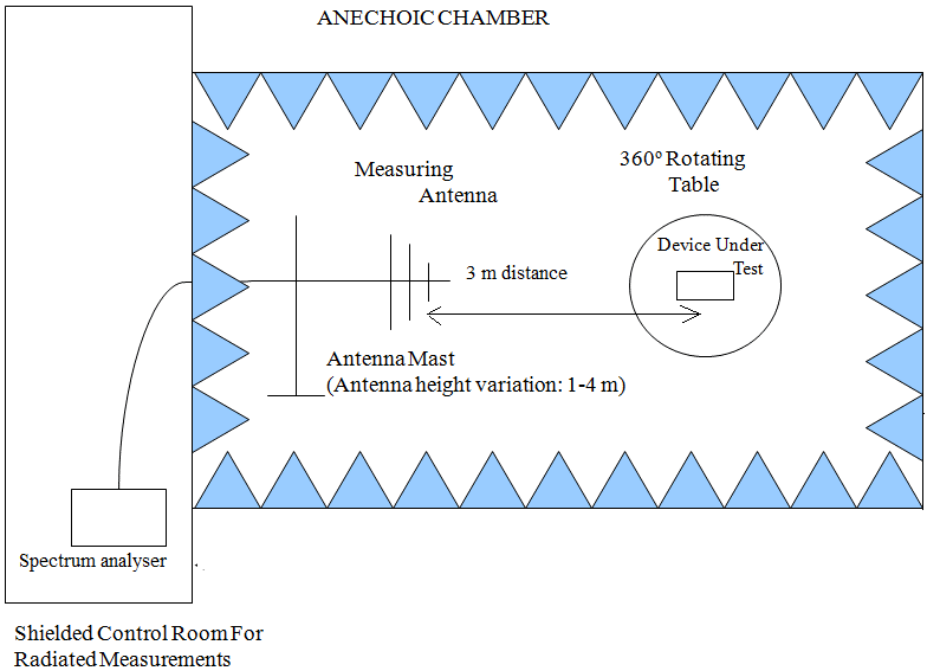
For radiated emissions in the range 1 GHz-40 GHz that is performed at a distance closer than the specified distance, an inverse proportionality factor of 20 dB per decade is used to normalize the measured data for determining compliance.

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

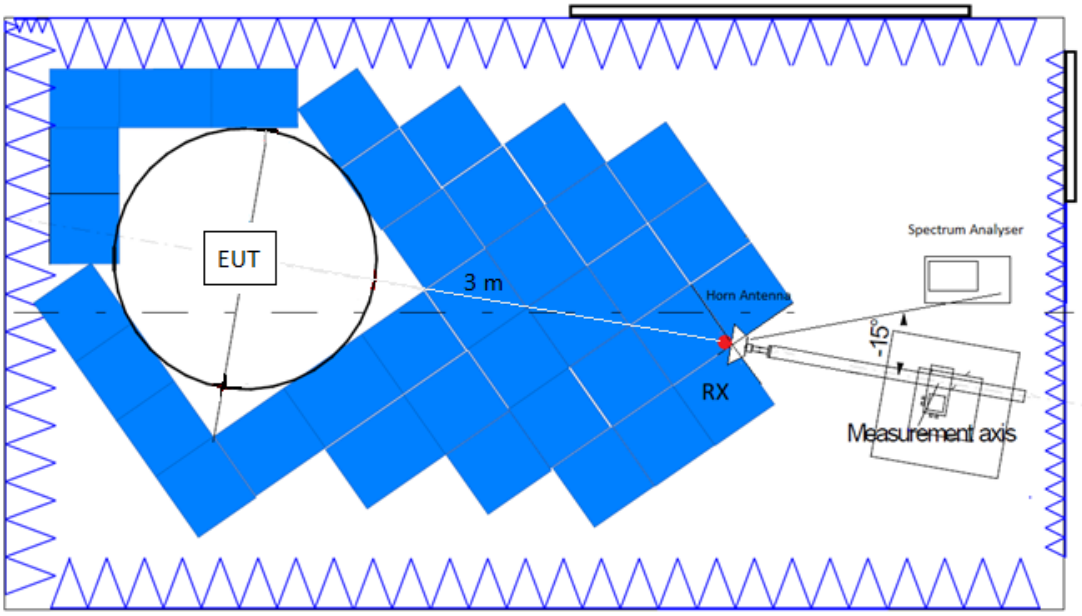
Measurements were made in both horizontal and vertical planes of polarization.

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

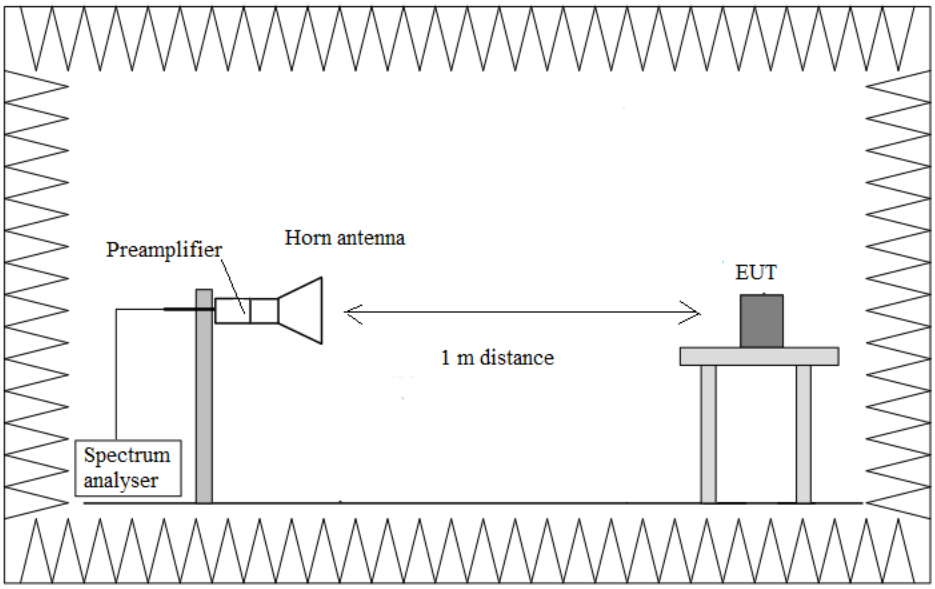
Radiated measurements setup f < 1 GHz:



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



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



FCC 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 dBµV/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 (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 39nalyser. This correction factor includes antenna factor, cable loss and pre-amplifiers gain.

- Test performed on the worst-case: 802.11 a20 (6 Mbps).

The worst-case was determined by measuring the eirp density (radiated).

Frequency range 30 MHz – 1 GHz

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

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

Spurious frequency (MHz)	Emission Level (dBµV/m)	Polarization	Detector
874.991250	30.84	H	Quasi-Peak

Measurement Uncertainty (dB) <± 5.08

Frequency range 1 - 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 Low, Middle and High Channels were measured for out-of-band emissions for the worst mode.

Spurious frequencies with peak levels above the average limit (54 dBµV/m at 3 m) are measured with an average detector for checking compliance with the average limit.

- **802.11 a20 (worst-case):**

  - LOW CHANNEL. No spurious frequencies closest to the limit.

  - MIDDLE CHANNEL. No spurious frequencies closest to the limit.

  - HIGH CHANNEL. No spurious frequencies closest to the limit:

Measurement Uncertainty (dB) <± 5.08

Verdict: PASS

The setting for each range of frequency is indicated in the following tables:

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
Receiver: [ESW 44]					
30 MHz - 1 GHz	30,312 kHz	PK+	100 kHz	1 s	30 dB

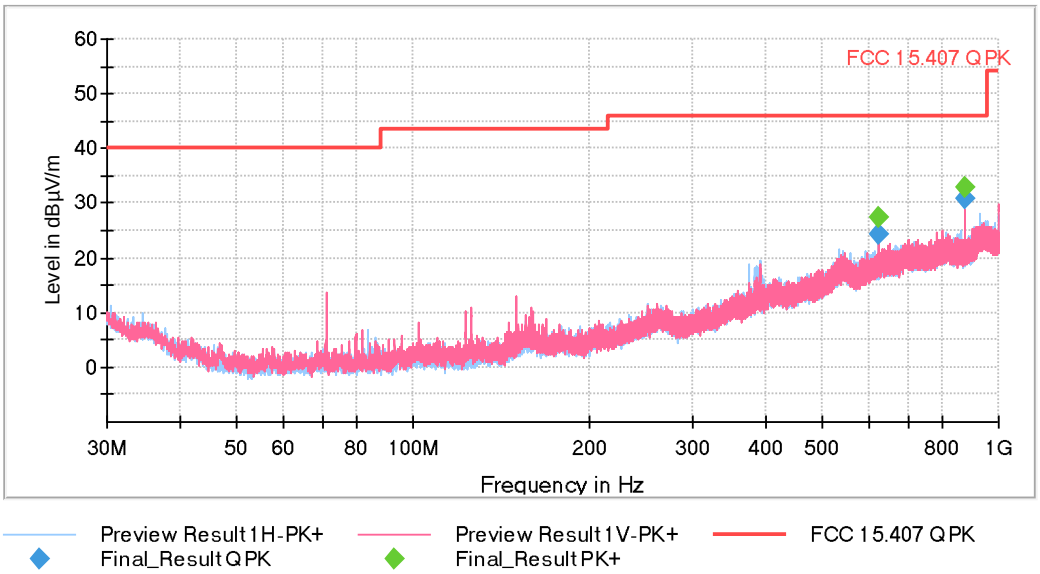
Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
Receiver: [FSV 40]					
1 GHz - 7 GHz	187,5 kHz	PK+ ; AVG	1 MHz	1 s	0 dB

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
Receiver: [FSV 40]					
7 GHz - 17 GHz	312,5 kHz	PK+ ; AVG	1 MHz	1 s	0 dB

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
Receiver: [FSV 40]					
17 GHz - 28,5 GHz	359,375 kHz	PK+ ; AVG	1 MHz	1 s	0 dB
28,5 GHz - 40 GHz	359,375 kHz	PK+ ; AVG	1 MHz	1 s	0 dB

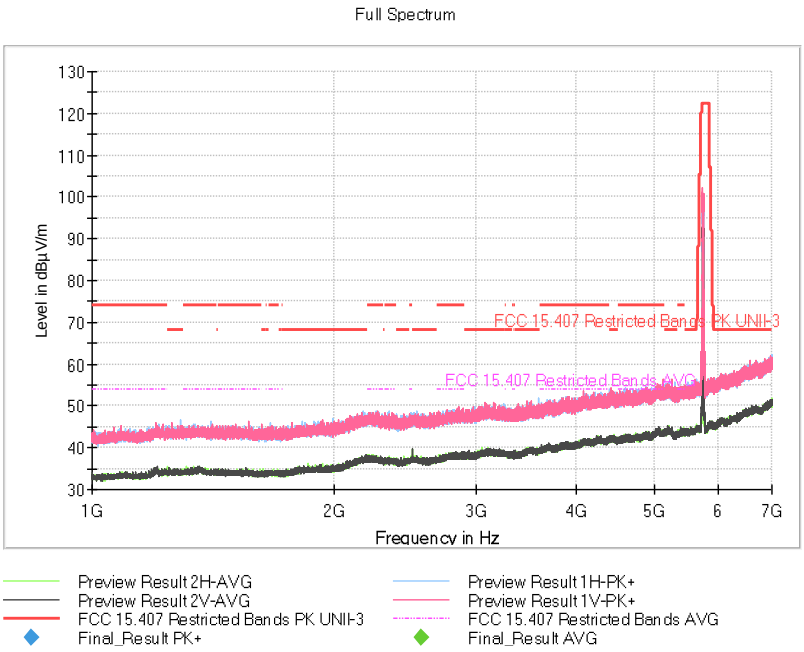
FREQUENCY RANGE 30 MHz - 1 GHz

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



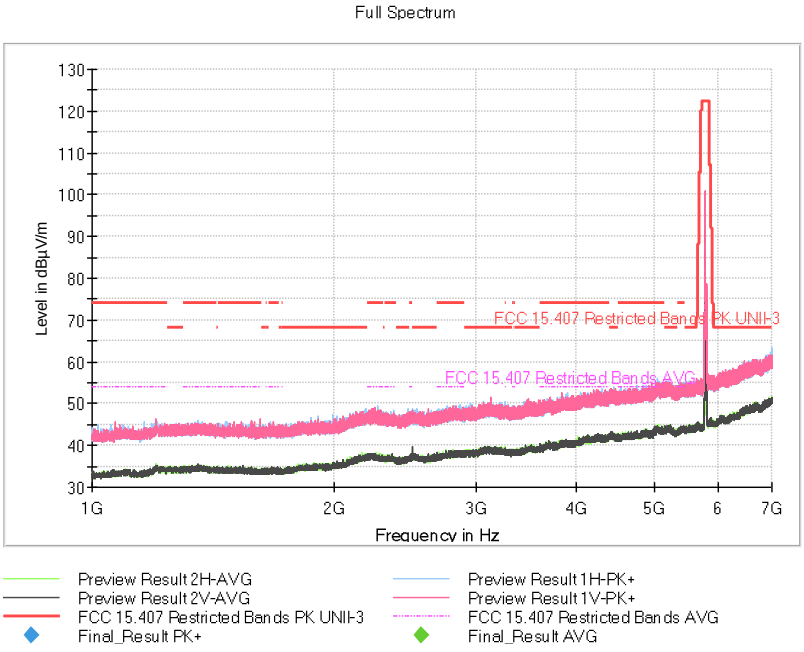
REQUENCY RANGE 1 – 7 GHz (worst-case)

- Low Channel:



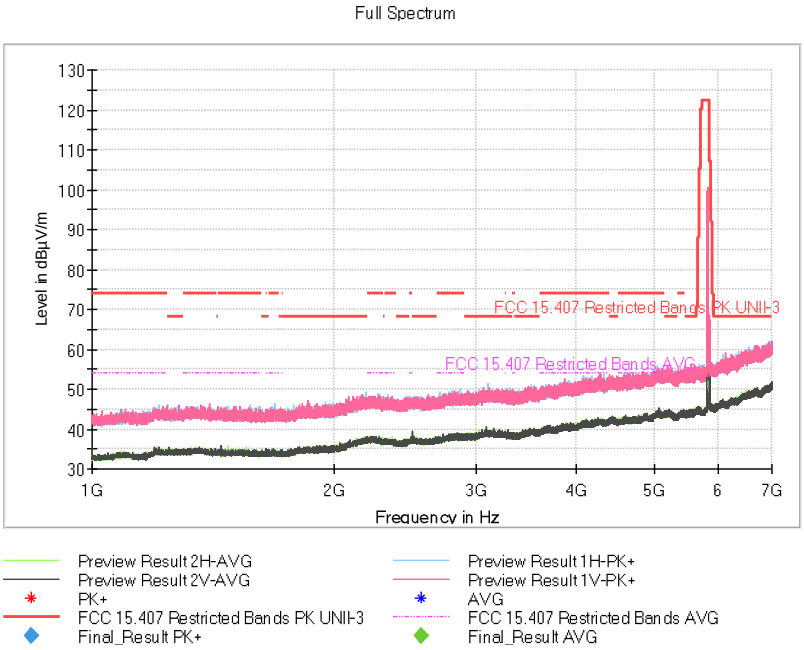
The peak above the limit is the carrier frequency.

- Middle Channel:



The peak above the limit is the carrier frequency.

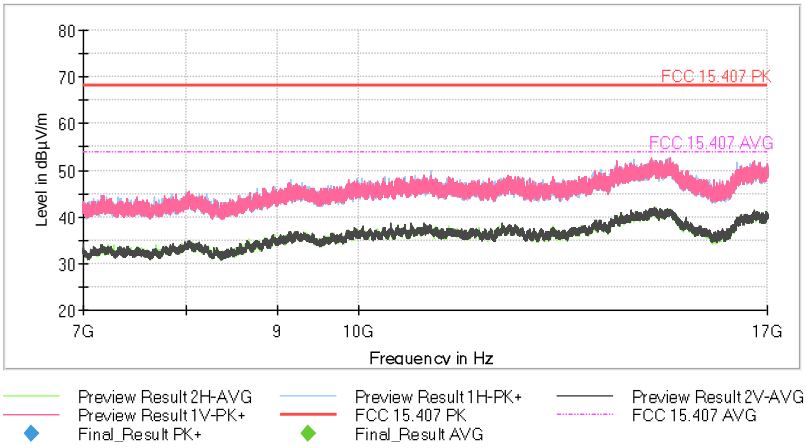
- High Channel:



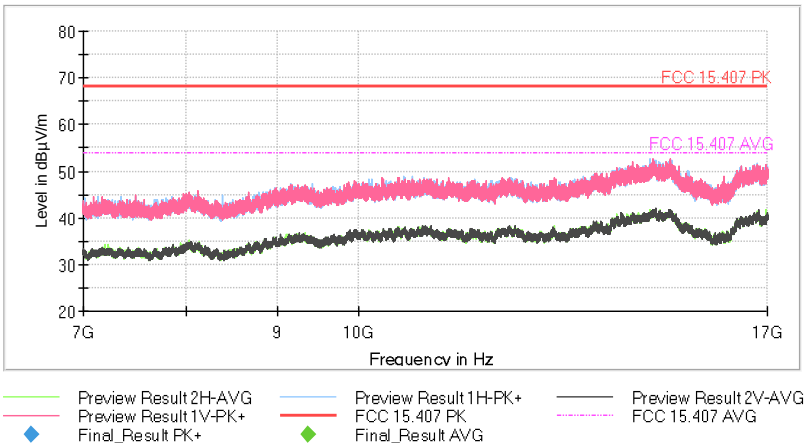
The peak above the limit is the carrier frequency.

FREQUENCY RANGE 7 - 17 GHz (worst-case)

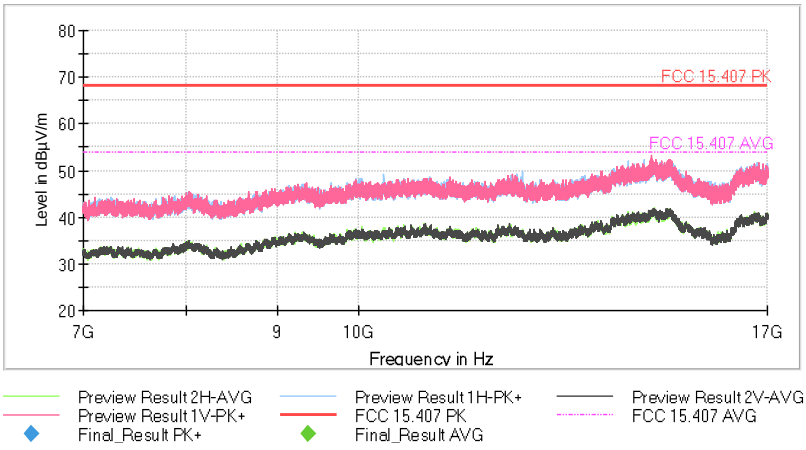
- Low Channel:



- Middle Channel:

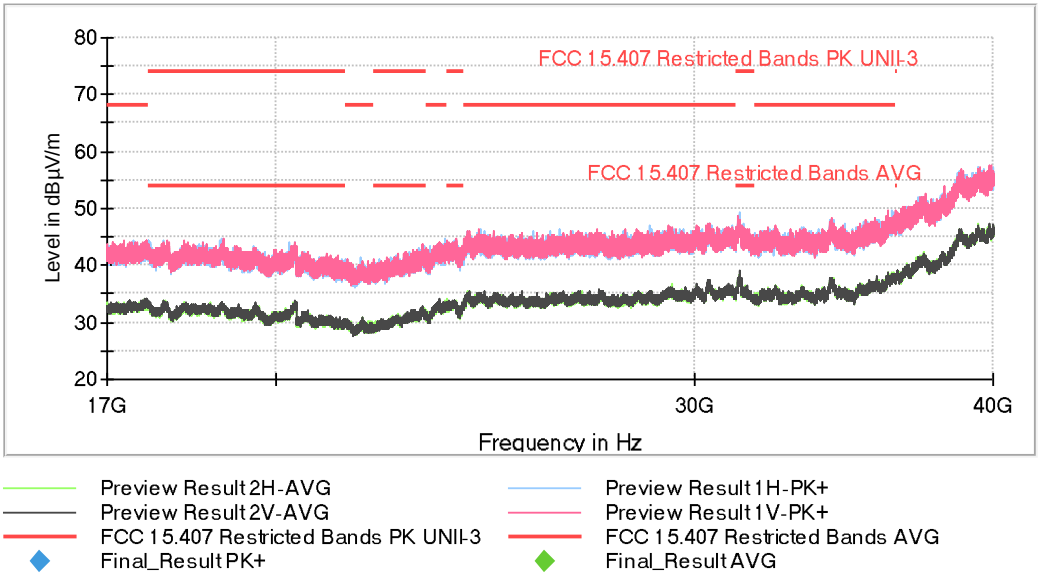


- High Channel:



FREQUENCY RANGE 17 - 40 GHz

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



FCC 15.407 (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 dBµV/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 (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.

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

- 802.11 a20: 6 Mbits
- 802.11 n HT20: MCS0
- 802.11 n HT40: MCS0
- 802.11 ac VHT40: MCS0
- 802.11 ac VHT80: MCS0

- **802.11 a20:**

Inside band spurious emissions in 5.65-5.925 GHz adjacent band.

- Lower Channel 149 (5745 MHz):

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

- Middle Channel 157 (5785 MHz):

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

- High Channel 165 (5825 MHz):

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

The measurement uncertainly (dB) is <±4.11

- **802.11 n20:**

Inside band spurious emissions in 5.65-5.925 GHz adjacent band.

- Low Channel 149 (5745 MHz):

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

- Middle Channel 157 (5785 MHz):

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

- High Channel 165 (5825 MHz):

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

The measurement uncertainly (dB) is <±4.11

- **802.11 ac20:**

Inside band spurious emissions in 5.65-5.925 GHz adjacent band.

- Low Channel 149 (5745 MHz):

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

- Middle Channel 157 (5785 MHz):

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

- High Channel 165 (5825 MHz):

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

The measurement uncertainly (dB) is <±4.11

- **802.11 n40:**

Inside band spurious emissions in 5.65-5.925 GHz adjacent band.

- Low Channel 151 (5755 MHz):

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

- High Channel 159 (5795 MHz):

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

Spurious frequency (MHz)	Emission Level (dBµV/m)	Polarization	Detector
2491.562500	52.82	V	Peak

The measurement uncertainly (dB) is <±4.11

- **802.11 ac40:**

Inside band spurious emissions in 5.65-5.925 GHz adjacent band.

- Low Channel 151 (5755 MHz):

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

- High Channel 159 (5795 MHz):

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

The measurement uncertainly (dB) is <±4.11

- **802.11 ac80:**

Inside band spurious emissions in 5.65-5.925 GHz adjacent band.

- Middle Channel 155 (5775 MHz):

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

The measurement uncertainly (dB) is <±4.11

Verdict: PASS

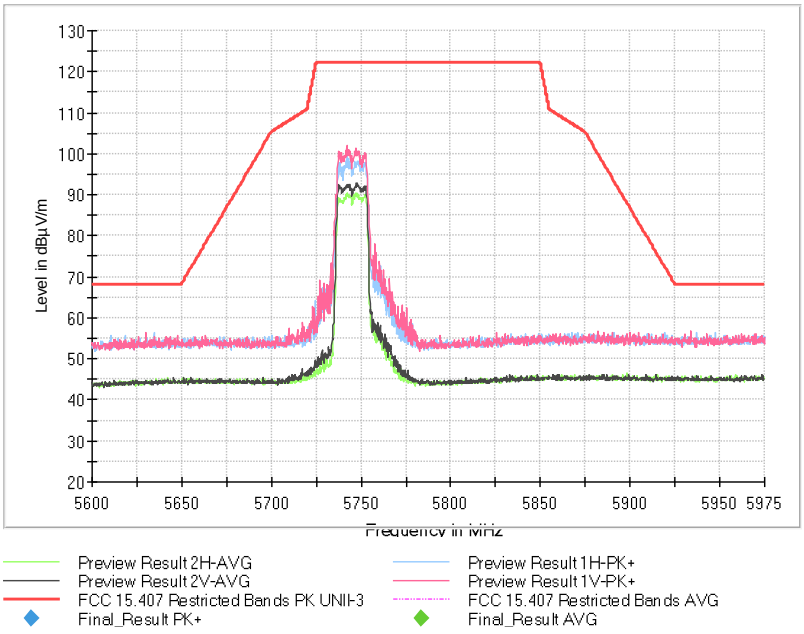
The setting for the mask 5.65-5.925 GHz is indicated in the following table:

Subrange	**Step Size**	**Detectors**	**Bandwidth**	**Sweep Time**	**Preamp**
Receiver: [FSV 40]					
1 GHz - 7 GHz	187,5 kHz	PK+ ; AVG	1 MHz	1 s	0 dB

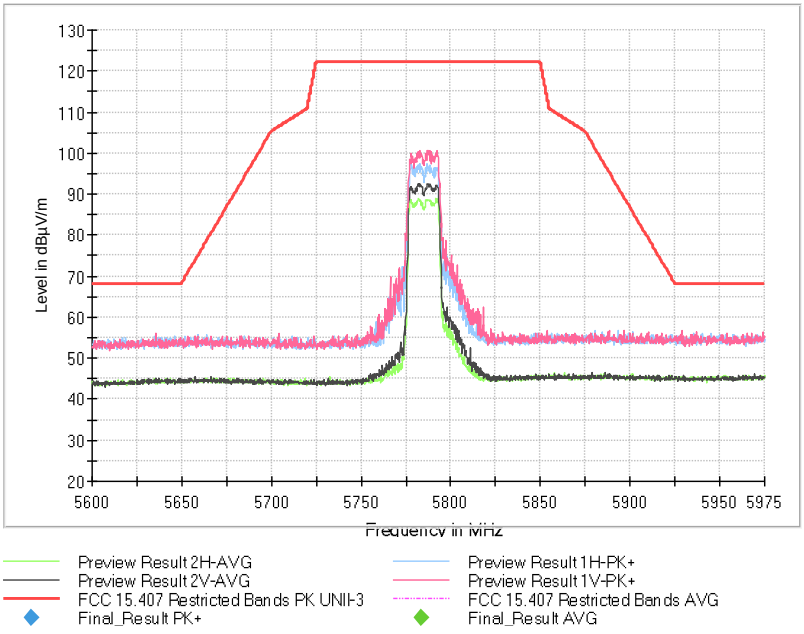
- **802.11 a20:**

  Radiated spurious emissions at band-edges:

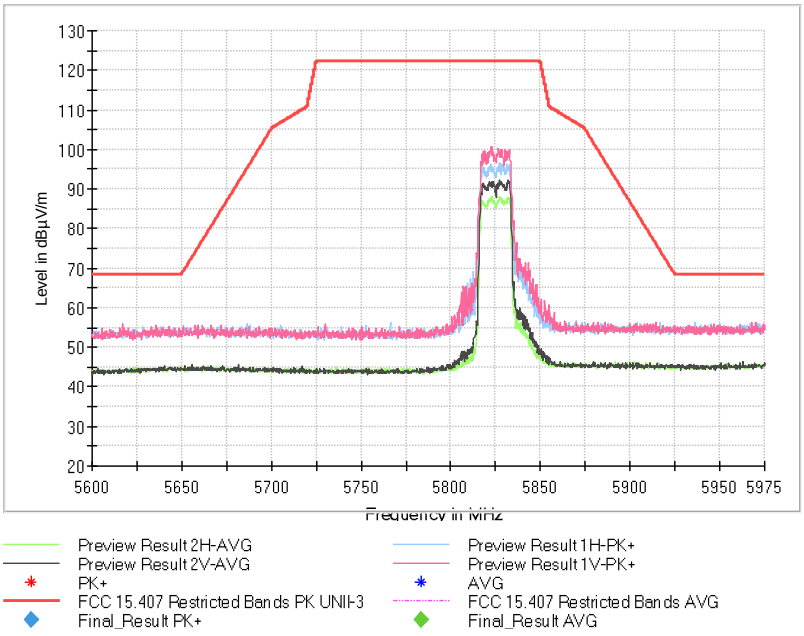
  - Low Channel 149 (5745 MHz):



  - Middle Channel 157 (5785 MHz):



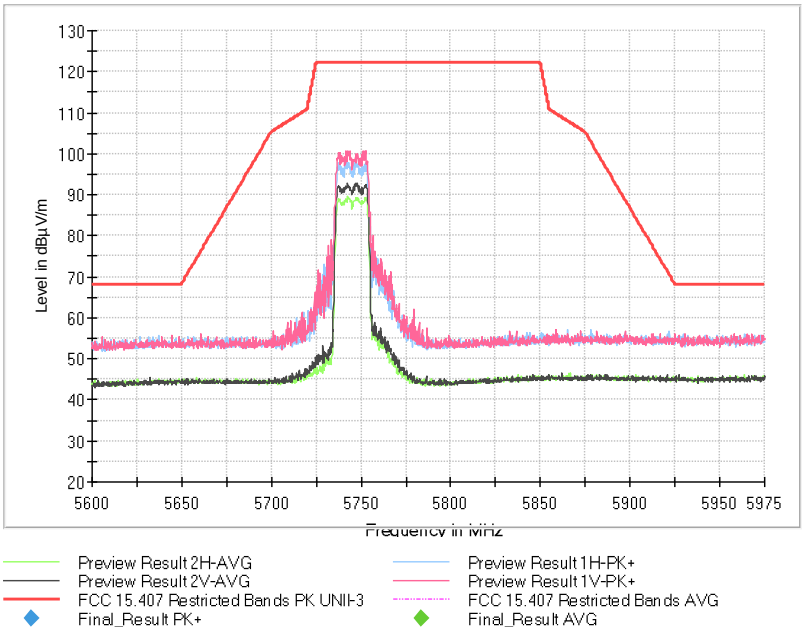
- High Channel 165 (5825 MHz):



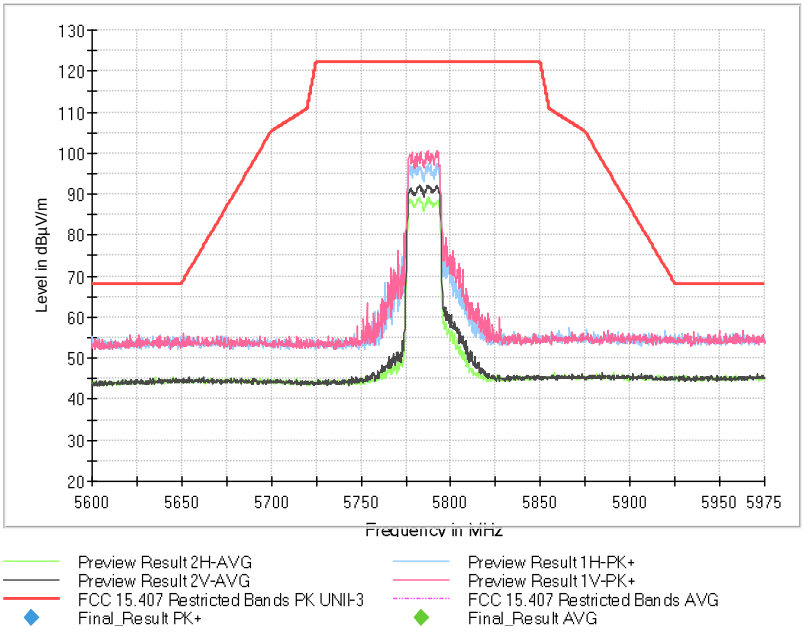
- **802.11 n20:**

  Radiated spurious emissions at band-edges:

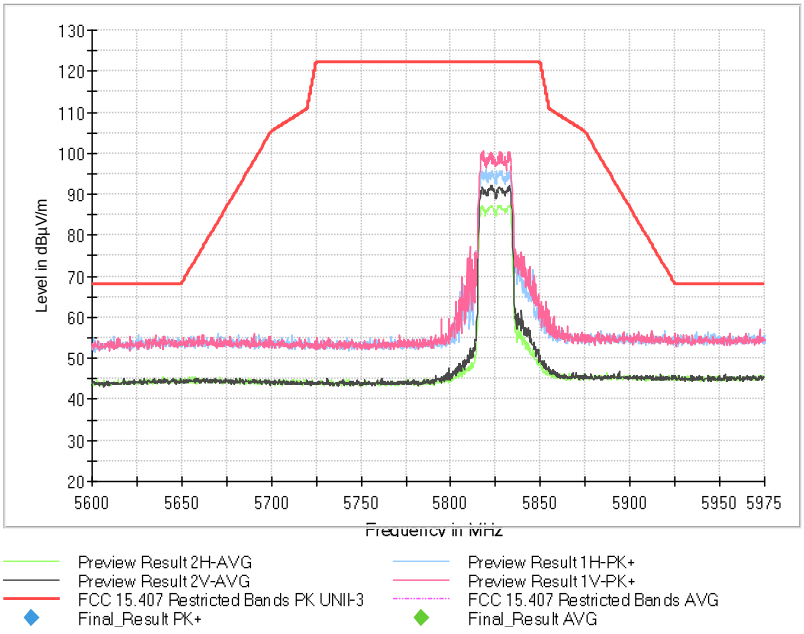
  - Low Channel 149 (5745 MHz):



  - Middle Channel 157 (5785 MHz):



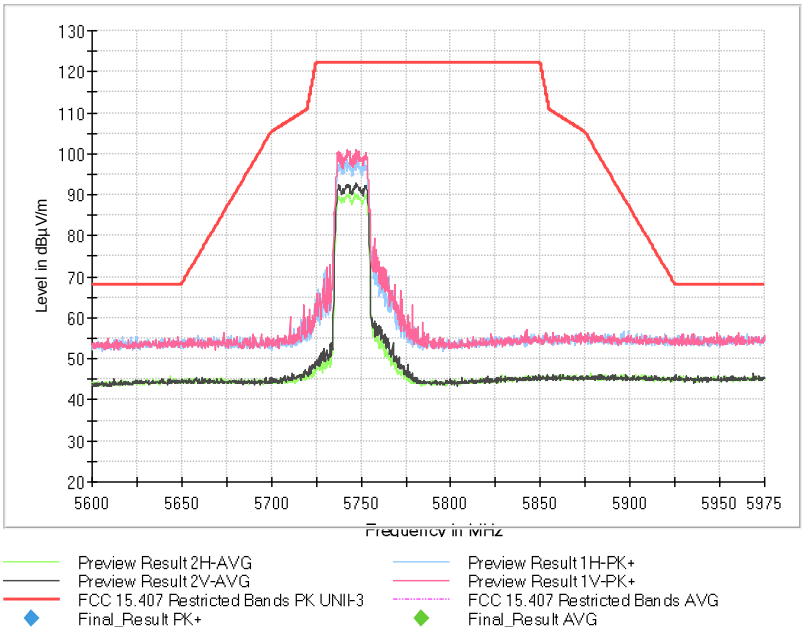
- High Channel 165 (5825 MHz):



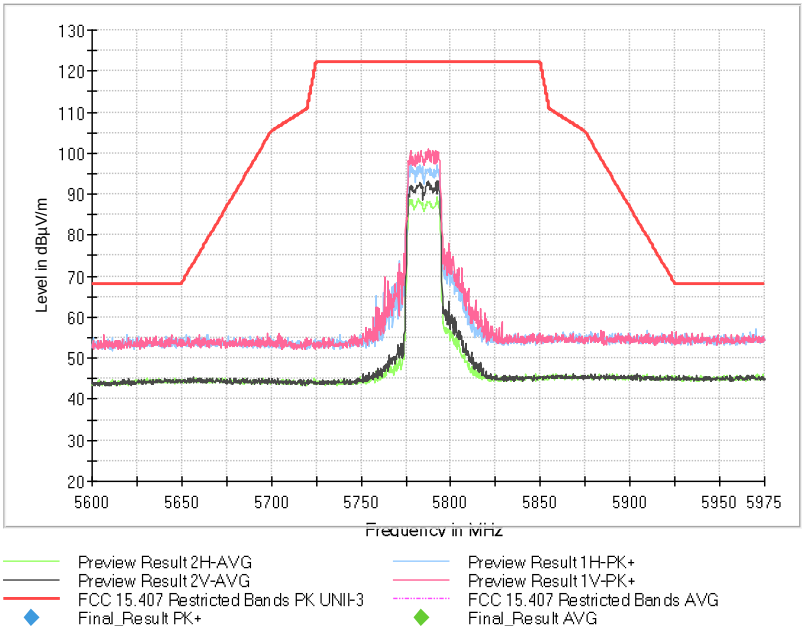
- **802.11 ac20:**

  Radiated spurious emissions at band-edges:

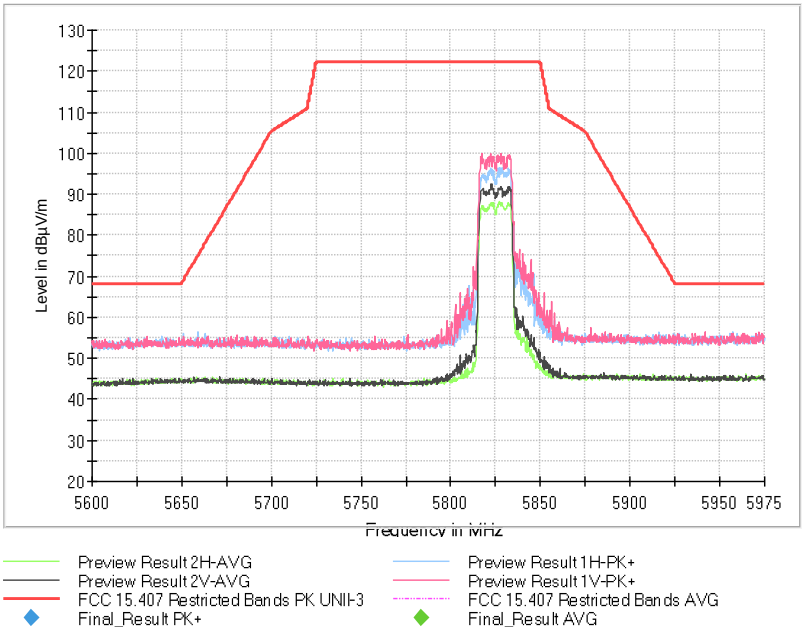
  - Low Channel 149 (5745 MHz):



  - Middle Channel 157 (5785 MHz):



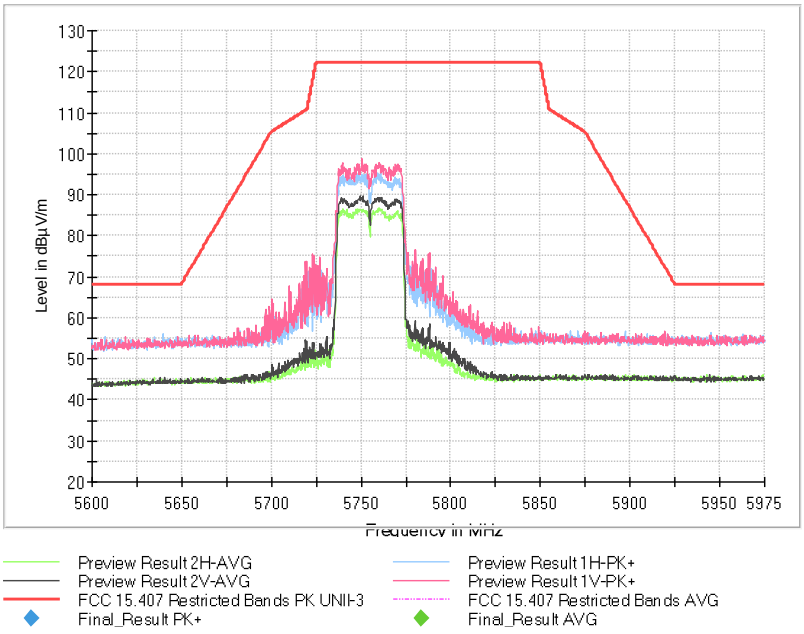
- High Channel 165 (5825 MHz):



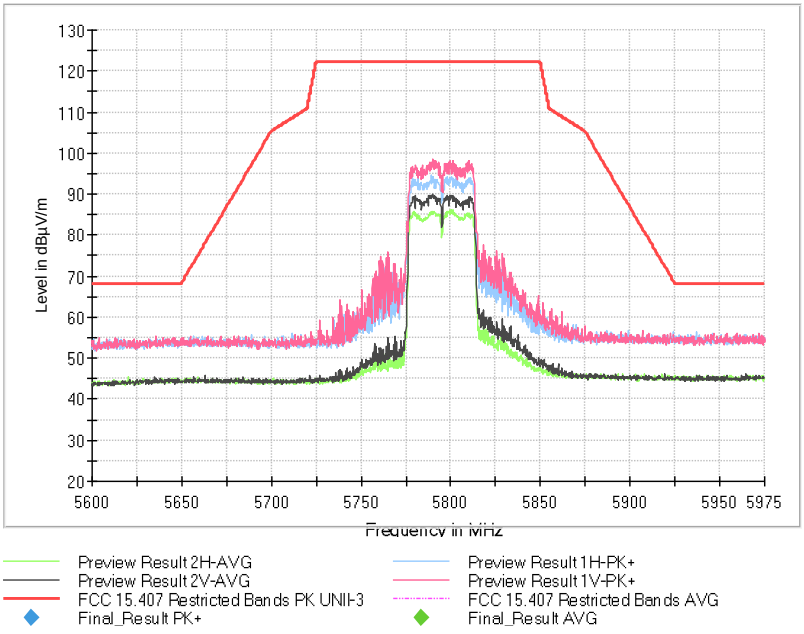
- **802.11 n40:**

  Radiated spurious emissions at band-edges:

  - Low Channel 151 (5755 MHz):



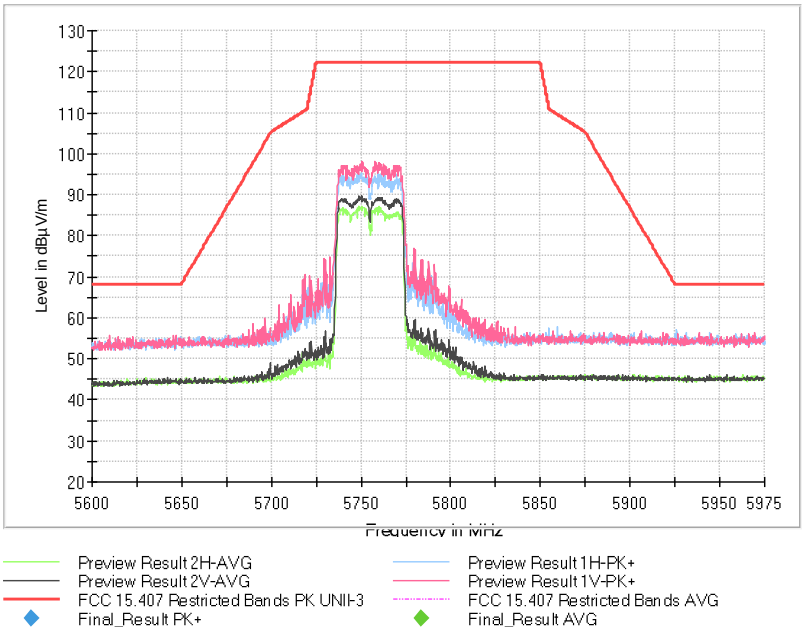
  - High Channel 159 (5795 MHz):



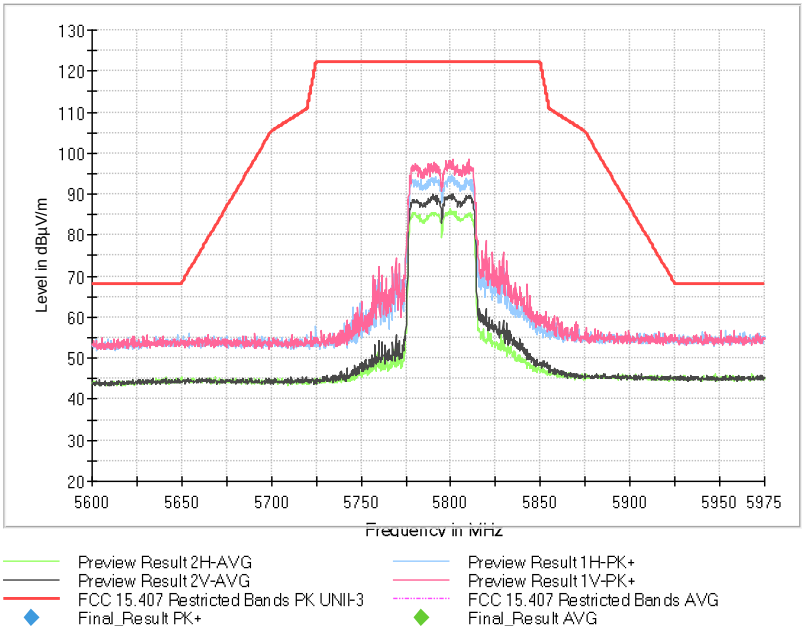
- **802.11 ac40:**

  Radiated spurious emissions at band-edges:

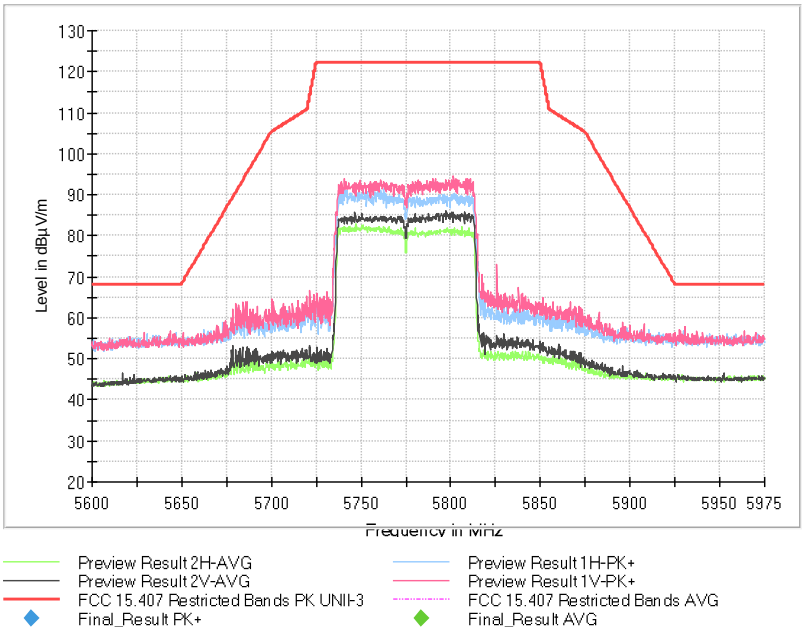
  - Low Channel 149 (5745 MHz):



  - High Channel 165 (5825 MHz):



- **802.11 ac80:**

  Radiated spurious emissions at band-edges:

  - Single Channel 155 (5775 MHz):