



Test report No:
 NIE: 63185RRF.033

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_MQB_BTWIFI
Other identification of the product	HW version: X01 SW version: X464 PN: 654.035.869.B FCC ID: WUQ-MIB3HBTWIFI IC: 216R-MIB3HBTWIFI
(*) Features	Bluetooth, WLAN, FM, AM, DAB, USB
Applicant	PANASONIC AUTOMOTIVE SYSTEMS EUROPE GMBH Robert Bosch Str. 27-29 – 63225 Langen - Germany
Test method requested, standard	USA FCC Part 15.407 (10-1-19 Edition): Unlicensed National Information Infrastructure (U-NII) Devices. General technical requirements. USA FCC Part 15.209 (10-1-19 Edition): Radiated emission limits; general requirements. CANADA RSS-247 Issue 2 (February 2017). CANADA RSS-Gen Issue 5 (March 2019). - Out of Band Radiated Emissions - Band Edge Radiated Emissions 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 Martín EMC Consumer & RF Lab. Manager
Date of issue	2020-11-20
Report template No	FDT08_22 (*) "Data provided by the client"

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Competences and guarantees

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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.

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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 MIB3E_MQB_BTWIFI is 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 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
63185/003	Headunit with radio and Bluetooth	MIB3E_MQB_BT WIFI	PM6-00115 04 20413F0230	2020/05/05
51929B/119	RF Harness	--	--	2018/12/10

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⁾		
			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Supplementary information to the ports..... :							
Rated power supply	Voltage and Frequency		Reference poles				
			L1	L2	L3	N	PE
	<input type="checkbox"/>	AC:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/>	AC:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<input checked="" type="checkbox"/>	DC: 12 V					
<input type="checkbox"/>	DC:						
Rated Power							
Clock frequencies.....:							
Other parameters							

Software version	X464		
Hardware version	X01		
Dimensions in cm (W x H x D)			
Mounting position	<input type="checkbox"/>	Table top equipment	
	<input type="checkbox"/>	Wall/Ceiling mounted equipment	
	<input type="checkbox"/>	Floor standing equipment	
	<input type="checkbox"/>	Hand-held equipment	
	<input type="checkbox"/>	Other:	
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

⁽³⁾ 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)	2020-05-28
Date (finish)	2020-06-02

Document history

Report number	Date	Description
63185RRF.033	2020-11-20	First release

Environmental conditions

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

Temperature	Min. = 15 °C Max. = 35 °C
Relative humidity	Min. = 20 % Max. = 75 %
Air pressure	Min. = 860 mbar Max. = 1060 mbar

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

Temperature	Min. = 15 °C Max. = 35 °C
Relative humidity	Min. = 20 % Max. = 75 %
Air pressure	Min. = 860 mbar Max. = 1060 mbar

Remarks and comments

The tests have been performed by the technical personnel: Jaime Barranquero, Miguel Quesada, Victoria Olmedo, Antonio Manuel Sánchez.

Used instrumentation:

Radiated Measurements:

	Last Calibration	Due Calibration
1. Semianechoic Absorber Lined Chamber ALBATROSS P29419	2020/01	2023/01
2. Ultralog Antenna 30MHz-6GHz, ROHDE AND SCHWARZ HL562E_UPG	2019/10	2022/10
3. EMI Test Receiver 2Hz-44GHz, ROHDE AND SCHWARZ ESW44	2019/10	2021/10
4. Horn Antenna 1-18 GHz SCHWARZBECK MESS-ELEKTRONIK BBHA 9120 D	2019/11	2022/11
5. Broadband Horn Antenna 18 - 40 GHz SCHWARZBECK MESS-ELEKTRONIK BBHA 9170	2017/12	2020/12
6. Preamplifier 30dB 500MHz-18GHz, SCHWARZBECK BBV 9718 C	2020/01	2021/01
7. Pre-Amplifier G>30dB 18-40GHz BONN ELEKTRONIK BLMA 1840-3G	2019/11	2021/11
8. High Pass Filter 18-40 GHz TEMSTRON / TEMWELL ST-18-40G-3141HS	N.A.	N.A.

Testing verdicts

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

Summary

- Common requirements for all bands

FCC PART 15 PARAGRAPH / RSS-247			
Requirement – Test case		Verdict	Remark
FCC 15.35 (c) / RSS-Gen 6.10	Duty Cycle	N/M	(1)
RSS-Gen 6.7 / RSS-247 6.2.	Occupied bandwidth (or 99% emission bandwidth)	N/M	(1)
FCC 15.403 (i)	Transmitter 26 dB Emission Bandwidth (EBW)	N/M	(1)
FCC 15.407 (g) / RSS-Gen 6.11	Transmitter frequency stability (Temperature & Voltage Variation)	N/M	(2)
<u>Supplementary information and remarks:</u>			
(1) Test not requested.			
(2) The manufacturer is responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the user manual.			

A. 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	
RSS-247 6.2.1.1	Transmitter Maximum Equivalent Isotropically Radiated Power E.I.R.P.	N/M	
FCC 15.407 (a)(1)(iv)	Transmitter Maximum Power Spectral Density	N/M	
RSS-247 6.2.1.1	Transmitter E.I.R.P. Spectral Density	N/M	
FCC 15.407 (b)(1)(6) / RSS-247 6.2.1.2	Transmitter Out of Band Radiated Emissions	P	(1)
FCC 15.407 (b)(1) / RSS-247 6.2.1.2	Transmitter Band Edge Radiated Emissions	P	(1)
<u>Supplementary information and remarks:</u>			
(1) Only test requested.			

B. U-NII-3 Band 5.725 – 5.85 GHz

FCC PART 15 PARAGRAPH / RSS-247			
Requirement – Test case		Verdict	Remark
FCC 15.407 (e) / RSS-247 6.2.4.1	6 dB Bandwidth.	N/M	
FCC 15.407 (a)(3) / RSS-247 6.2.4.1	Transmitter Maximum conducted Output Power	N/M	
FCC 15.407 (a)(3) / RSS-247 6.2.4.1	Transmitter Maximum Power Spectral Density	N/M	
FCC 15.407 (b)(4) / RSS-247 6.2.4.2	Transmitter Band Edge Radiated Emissions	P	(1)
FCC 15.407 (b)(4)(6) / RSS-247 6.2.4.2	Transmitter Out of Band Radiated Emissions	P	(1)
<u>Supplementary information and remarks:</u>			
(1) Only test requested.			

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

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TEST CONDITIONS

POWER SUPPLY (V):

Vn: 12 Vdc

Type of Power Supply: DC external (car battery).

ANTENNAS:

Type of Antenna: Integral.

Maximum Declared Antenna Gain: +0.7 dBi

TEST FREQUENCIES:

Technology Tested:	WLAN (IEEE 802.11 a,n,ac) / U-NII-1	
Modes:	802.11a20: 6, 9, 12, 18, 24, 36, 48 & 54 Mbps	
	802.11n HT20: MCS0 to MCS23	
	802.11n HT40: MCS0 to MCS23	
	802.11ac VHT20: MCS0 to MCS9	
	802.11ac VHT40: MCS0 to MCS9	
	802.11ac VHT80: MCS0 to MCS9	
Setting of cores / ports:	One port.	
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:

- 802.11a20: 6 Mbps
- 802.11n HT20: MCS0
- 802.11n HT40: MCS0
- 802.11ac VHT20: MCS0
- 802.11ac VHT40: MCS0
- 802.11ac VHT80: MCS0

RADIATED MEASUREMENTS:

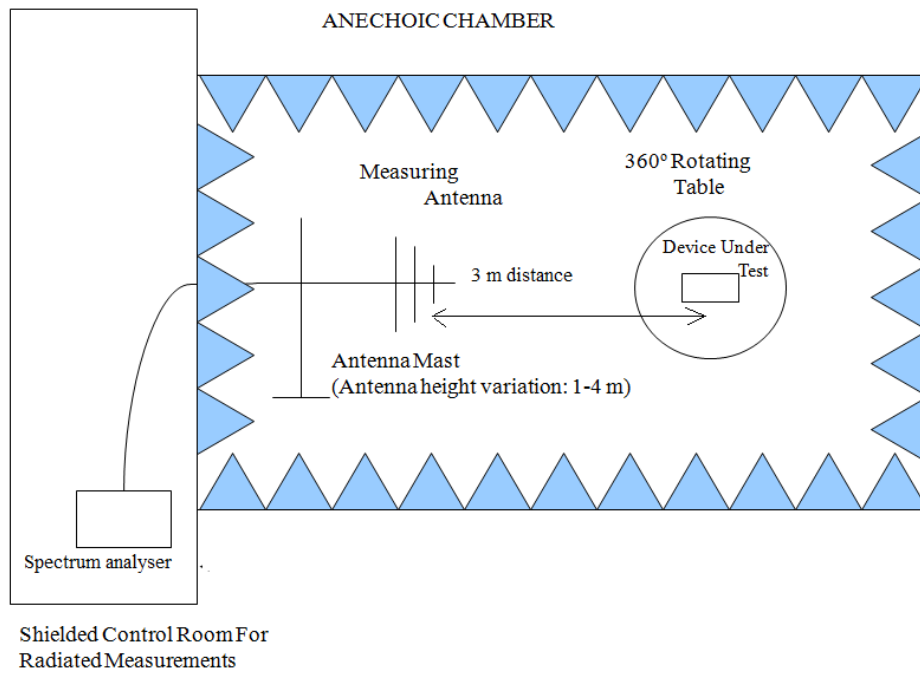
All radiated tests were performed in a semi-anechoic chamber. The measurement antenna (Bilog antenna for the range between 30 MHz to 1 GHz and 1 GHz-17 GHz Double ridge horn antenna) is situated at a distance of 3 m and at a distance of 1m for the frequency range 17 GHz-26 GHz (17 GHz-26 GHz horn antenna).

For radiated emissions in the range 17 GHz-26 GHz that is performed at a distance closer than the specified distance, an inverse proportionality factor of 20 dB per decade is used to normalize the measured data for determining compliance.

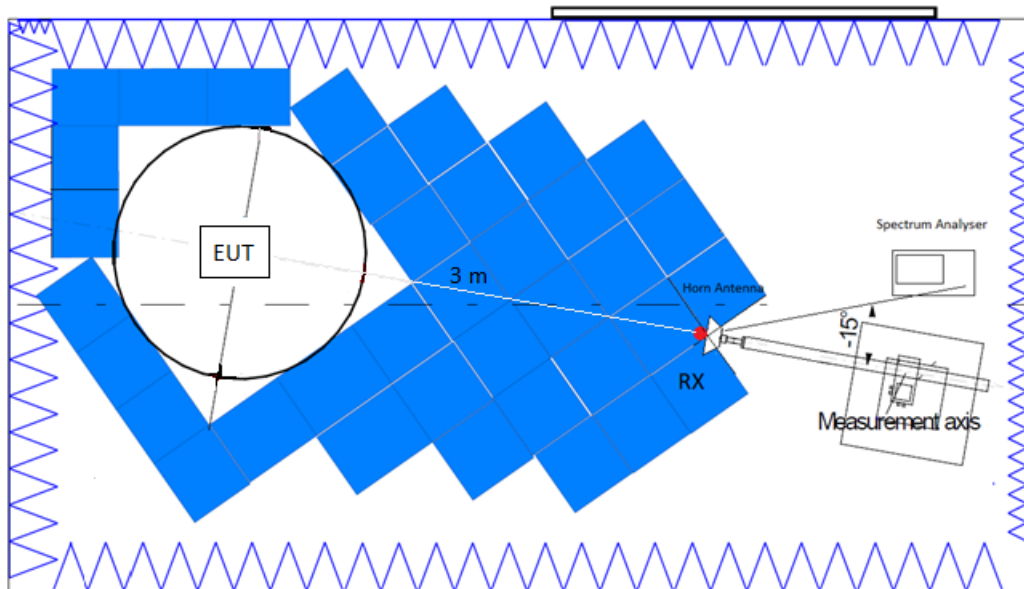
The equipment under test was set up on a non-conductive platform above the ground plane and the situation and orientation was varied to find the maximum radiated emission. It was also rotated 360° and the antenna height (Bilog antenna and Double ridge horn antenna) was varied from 1 to 4 meters to find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

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

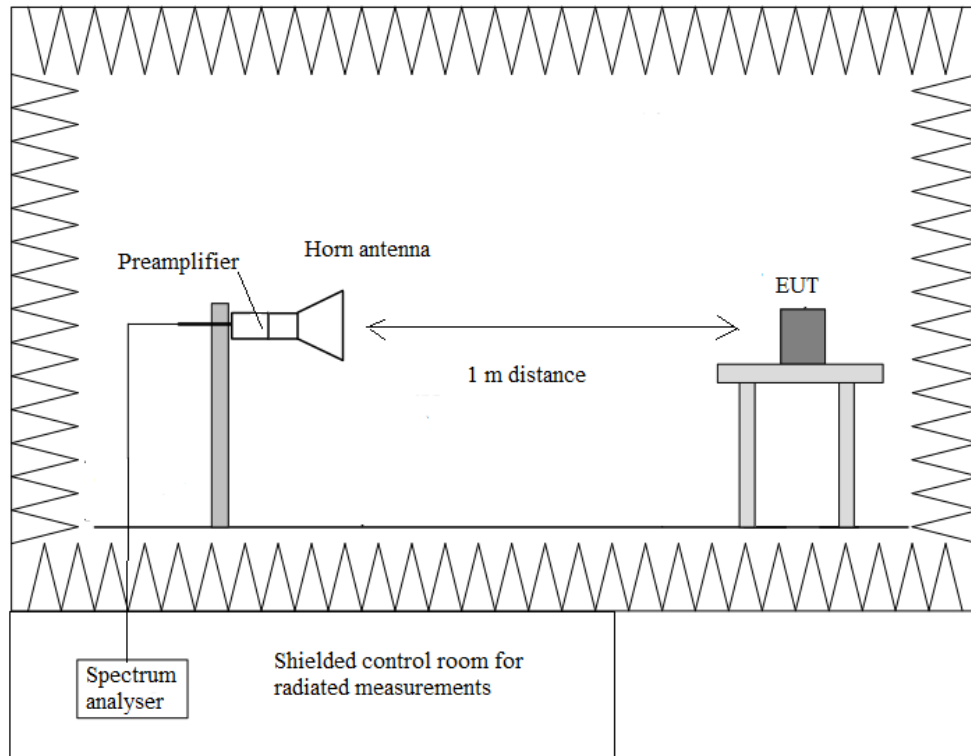
Radiated measurements setup from 30 MHz to 1 GHz:



Radiated measurements setup from 1 GHz to 17 GHz:



Radiated measurements setup $f > 17$ GHz:



FCC 15.407 (b)(1)(6) / RSS-247 6.2.1.2. 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 E.I.R.P. 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 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 17 GHz-40 GHz and a distance of 3m for frequency range 30MHz-17GHz.

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.

The worst case was determined by measuring the e.i.r.p. density (radiated).

- **Test performed on the worst case:** 802.11 a20, with a bit rate of 6 Mbps.

Frequency range 30 MHz - 1 GHz:

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

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

Spurious frequency (MHz)	Emission Level (dBµV/m)	Limit (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
31.2125	25.53	40	V	Quasi-Peak	<± 4.94
46.49	26.4	40	V	Quasi-Peak	<± 4.94
58.5665	23.57	40	V	Quasi-Peak	<± 4.94
227.4435	34.97	46	V	Quasi-Peak	<± 4.94
792.7111	26.14	46	V	Quasi-Peak	<± 4.94

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

Spurious frequency (GHz)	Emission Level (dBµV/m)	Limit (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
5.148	51.74	74	V	Peak	<± 4.6

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

Spurious frequency (GHz)	Emission Level (dBµV/m)	Limit (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
5.146	48.41	74	H	Peak	<± 4.6

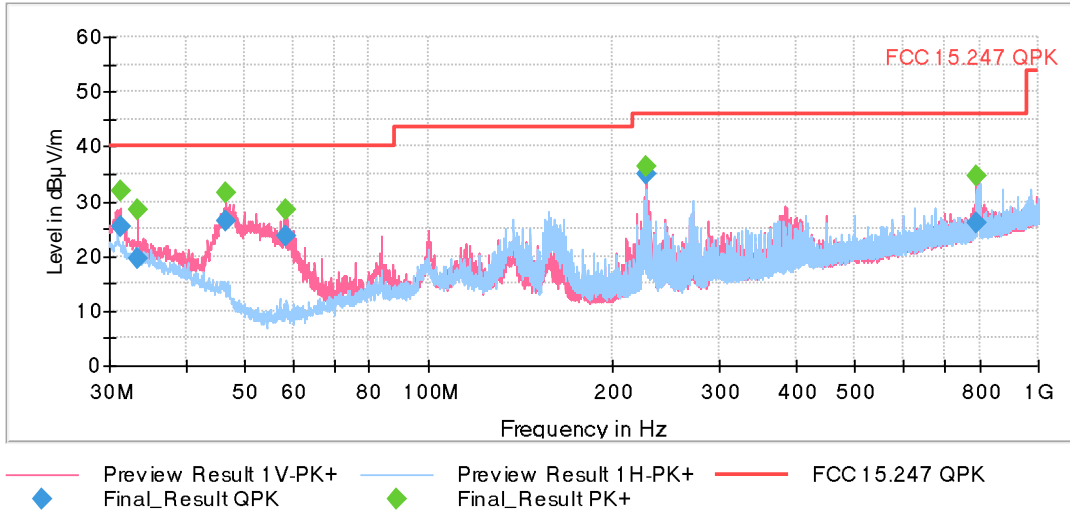
- HIGH CHANNEL. No spurious frequencies at less than 20 dB below the limit.

Measurement Uncertainty (dB): 1GHz-7GHz <± 4.6
 17GHz-26.5GHz <± 4.89
 26.5GHz-40GHz <± 5.14

Verdict: PASS

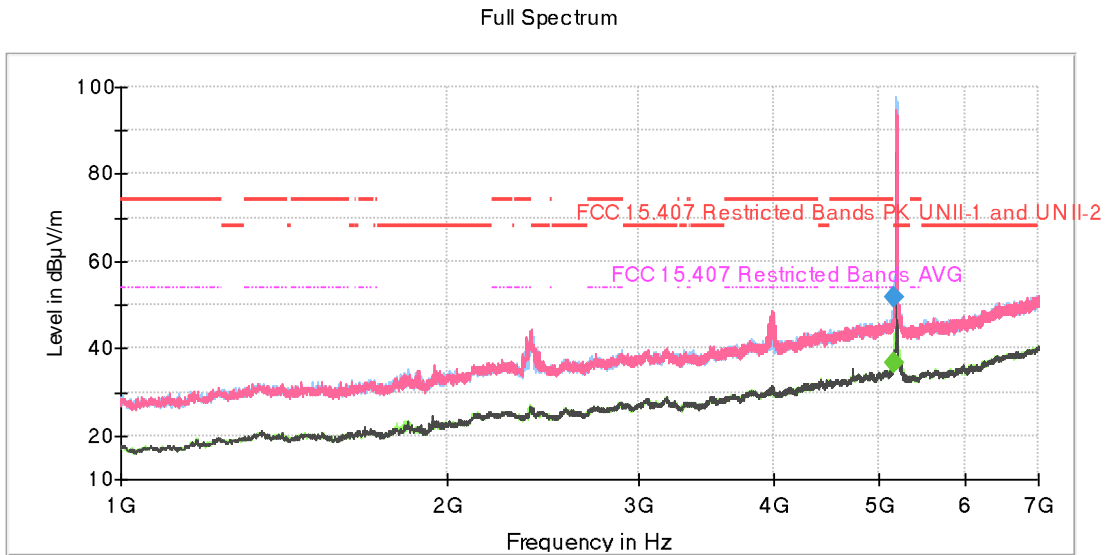
FREQUENCY RANGE 30 MHz - 1 GHz:

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



FREQUENCY RANGE 1 – 7 GHz (worst case)

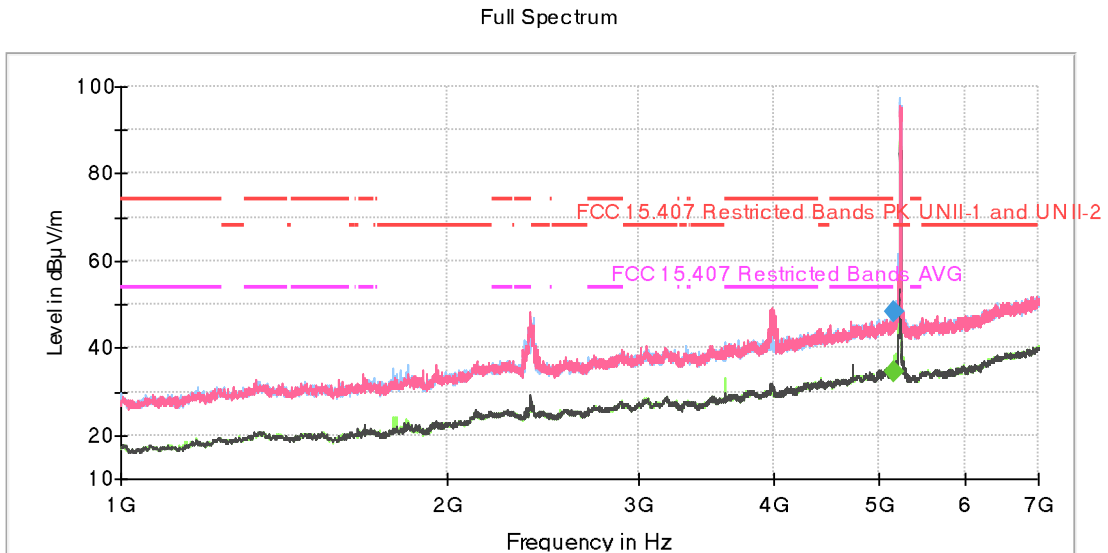
- Low Channel:



- 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

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

- Middle Channel:

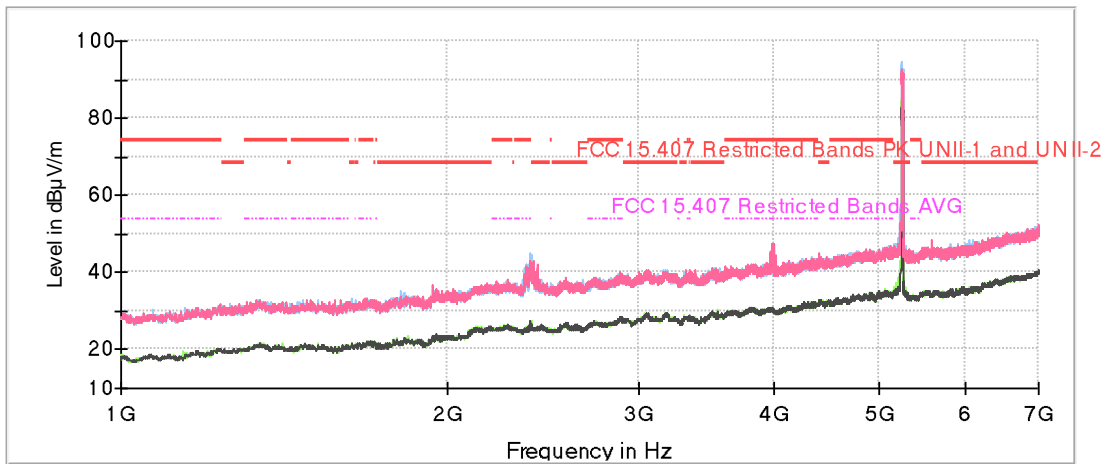


- Preview Result 2H-AVG
- Preview Result 1H-PK+
- Preview Result 2V-AVG
- Preview Result 1V-PK+
- - - FCC 15.407 Restricted Bands PK UNII-1 and UNII-2
- - - FCC 15.407 Restricted Bands AVG
- ◆ Final_Result PK+
- ◆ Final_Result AVG

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

- High Channel:

Full Spectrum

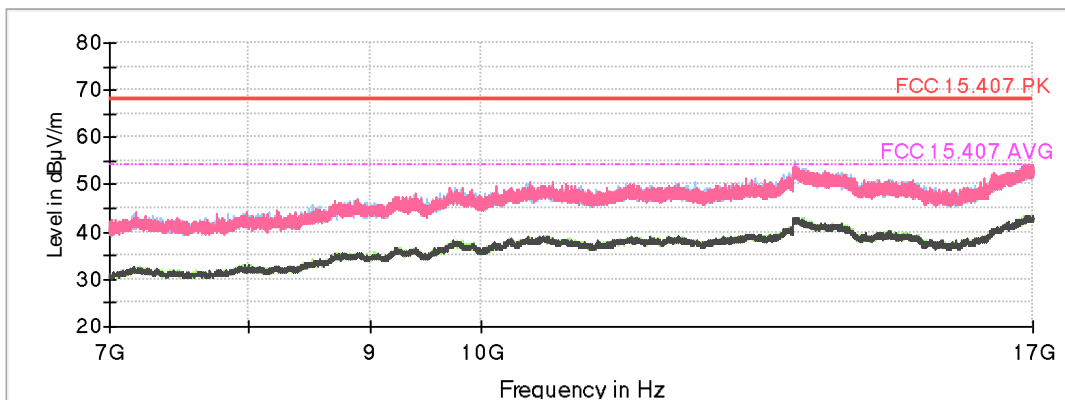


- Preview Result 2H-AVG
- Preview Result 1H-PK+
- Preview Result 2V-AVG
- Preview Result 1V-PK+
- Critical_Freqs AVG
- Critical_Freqs PK+
- FCC 15.407 Restricted Bands PK UNII-1 and UNII-2
- FCC 15.407 Restricted Bands AVG
- Final_Result PK+
- Final_Result AVG

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

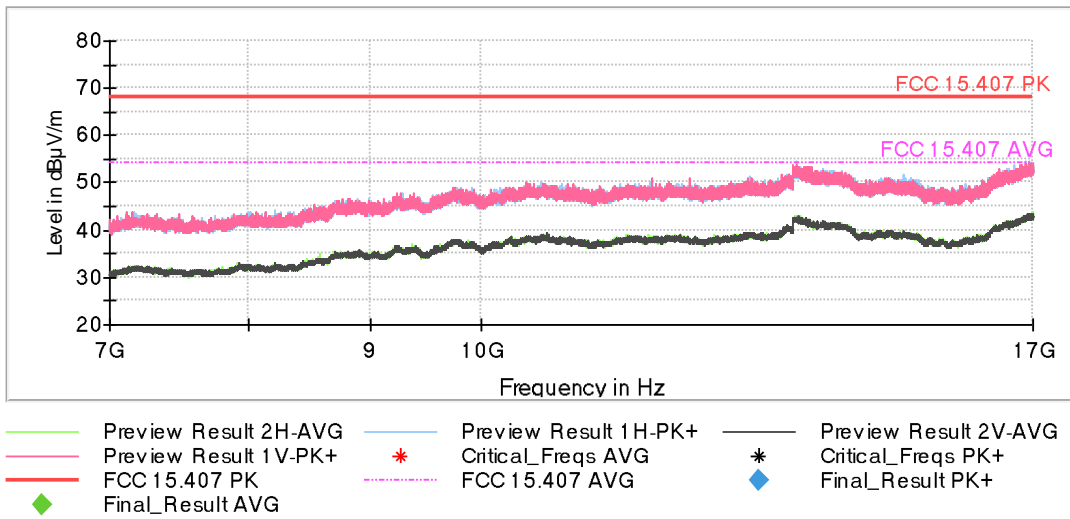
FREQUENCY RANGE 7 - 17 GHz. (worst case)

- Low Channel:

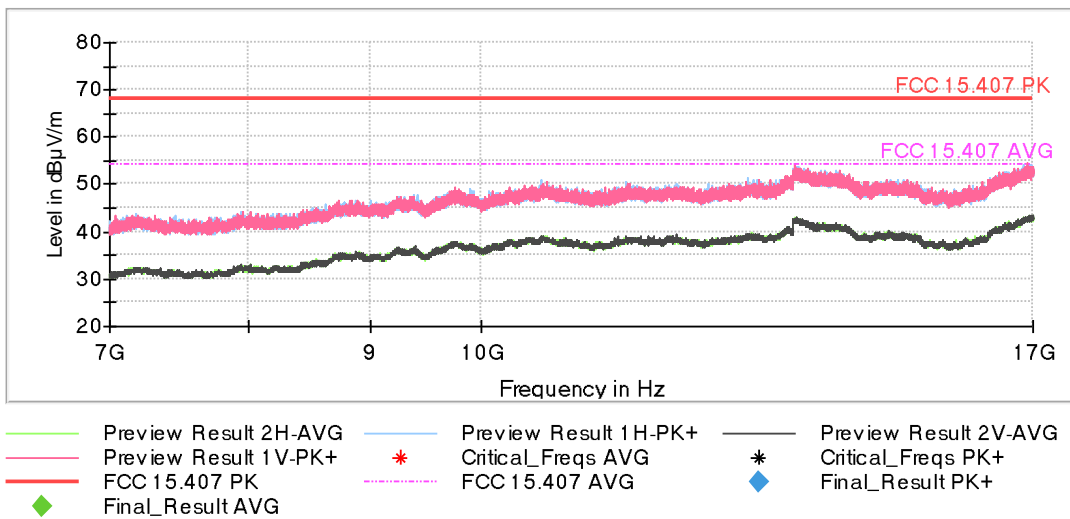


- Preview Result 2H-AVG
- Preview Result 1H-PK+
- Preview Result 2V-AVG
- Preview Result 1V-PK+
- Critical_Freqs AVG
- Critical_Freqs PK+
- FCC 15.407 PK
- FCC 15.407 AVG
- Final_Result PK+
- Final_Result AVG

- Middle Channel:

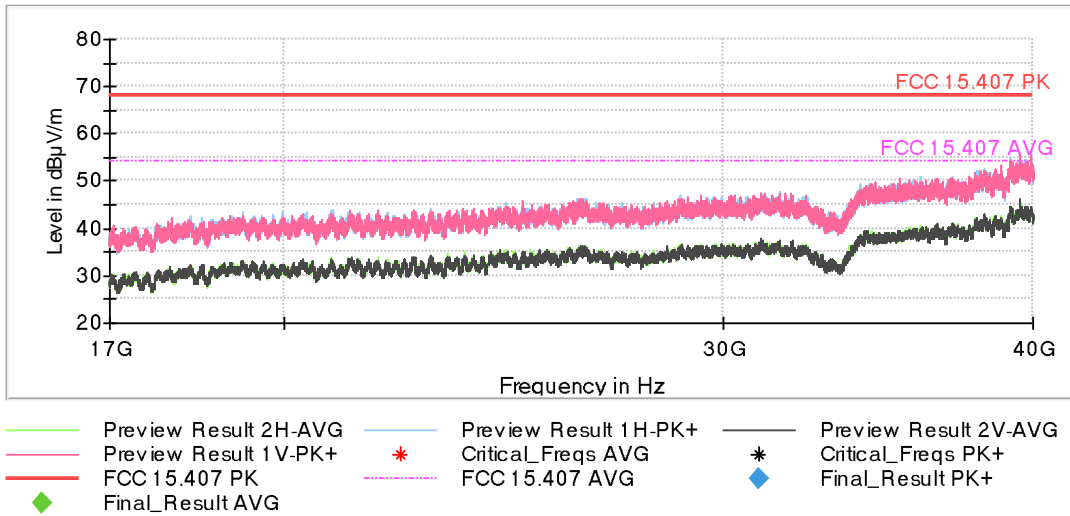


- High Channel:



FREQUENCY RANGE 17 - 40 GHz (worst case)

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



FCC 15.407 (b)(1) / RSS-247 6.2.1.2. 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 E.I.R.P. of –27 dBm/MHz (68.23 dBµV/m at 3 m distance).

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

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

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

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

RESULTS:

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

All emissions outside of the 5.15-5.35GHz band shall not exceed an E.I.R.P. 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 Mbps.
- 802.11n HT20: MCS0.
- 802.11ac VHT20: MCS0.
- 802.11n HT40: MCS0.
- 802.11ac VHT40: MCS0.
- 802.11ac VHT80: MCS0.

• **802.11 a20:**

- Lower Band Edge Channel 36 (5180 MHz): Inside 4.50-5.15 GHz.

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

Spurious frequency (GHz)	Emission Level (dBµV/m)	Limit (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
5.148	51.74	74	H	Peak	<± 4.6

- Upper Band Edge Channel 48 (5240 MHz): Inside 5.35-5.46 GHz.

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

• **802.11 n20:**

- Lower Band Edge Channel 36 (5180 MHz): Inside 4.50-5.15 GHz.

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

Spurious frequency (GHz)	Emission Level (dBµV/m)	Limit (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
5.149	54.61	74	H	Peak	<± 4.6
	37.99	54		Average	<± 4.6

- Upper Band Edge Channel 48 (5240 MHz): Inside 5.35-5.46 GHz.

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

• **802.11 ac20:**

- Lower Band Edge Channel 36 (5180 MHz): Inside 4.50-5.15 GHz.

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

Spurious frequency (GHz)	Emission Level (dBµV/m)	Limit (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
5.146	57.55	74	H	Peak	<± 4.6
	38.02	54		Average	<± 4.6

- Upper Band Edge Channel 48 (5240 MHz): Inside 5.35-5.46 GHz.

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

• **802.11 n40:**

- Lower Band Edge Channel 38 (5190 MHz): Inside 4.50-5.15 GHz.

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

Spurious frequency (GHz)	Emission Level (dBµV/m)	Limit (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
5.148	61.61	74	H	Peak	<± 4.6
	39.81	54		Average	<± 4.6

- Upper Band Edge Channel 46 (5230 MHz): Inside 5.35-5.46 GHz.

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

Measurement Uncertainty (dB): <±4.11

• **802.11 ac40:**

- Lower Band Edge Channel 38 (5190 MHz): Inside 4.50-5.15 GHz.

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

Spurious frequency (GHz)	Emission Level (dBµV/m)	Limit (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
5.142	60.02	74	H	Peak	<± 4.6
	37.33	54		Average	<± 4.6

- Upper Band Edge Channel 46 (5230 MHz): Inside 5.35-5.46 GHz.

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

Measurement Uncertainty (dB): <±4.11

• **802.11 ac80:**

- Lower Band Edge Channel 42 (5210 MHz): Inside 4.50-5.15 GHz.

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

Spurious frequency (GHz)	Emission Level (dBµV/m)	Limit (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
5.148	59	74	H	Peak	<± 4.6
	40.15	54		Peak	<± 4.6

- Upper Band Edge Channel 42 (5210 MHz): Inside 5.35-5.46 GHz.

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

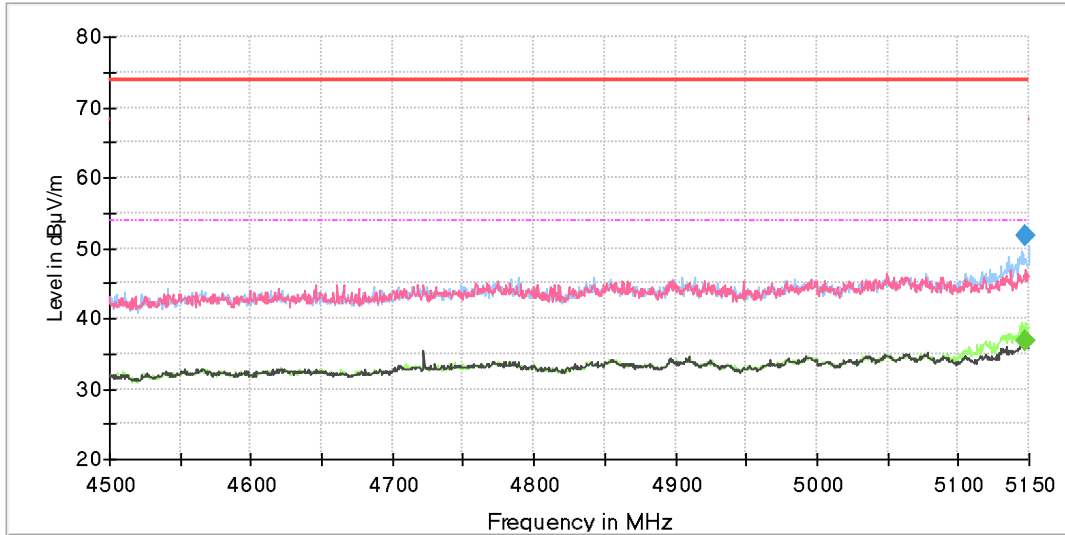
Measurement Uncertainty (dB): <± 4.6

Verdict: PASS

• 802.11 a20:

Radiated spurious emissions at band-edges and inside adjacent band 4.50 - 5.15 GHz

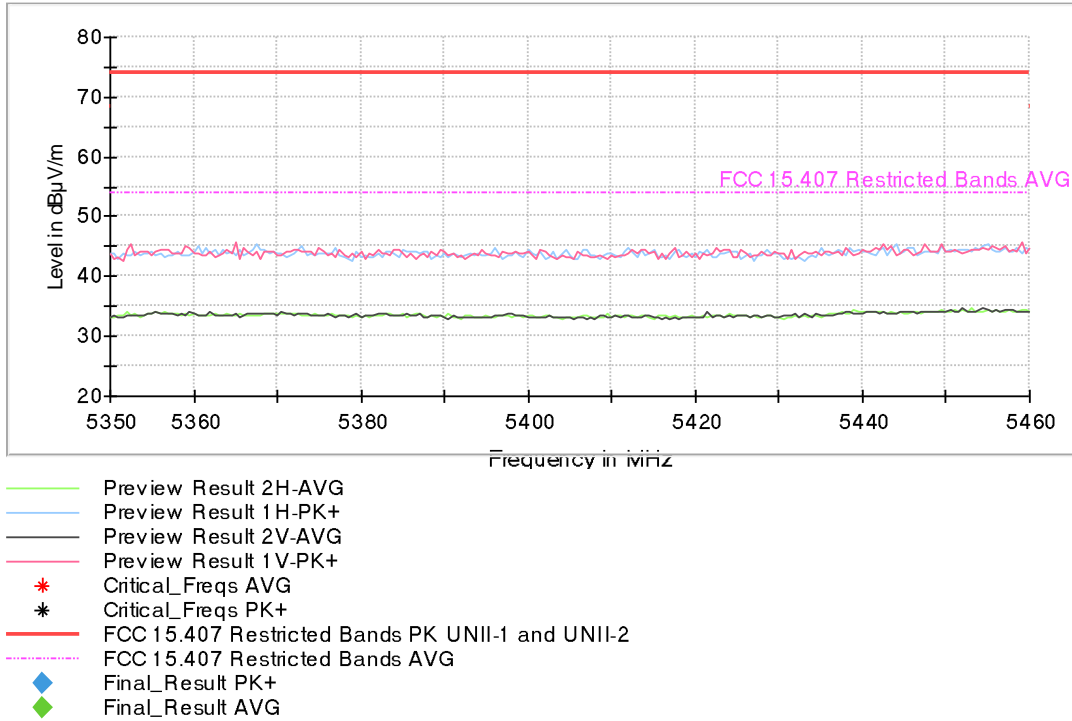
- Lower Band Edge Channel 36 (4500 to 5150 MHz)



- 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

Radiated spurious emissions at band-edges and inside adjacent band 5.35 - 5.46 GHz

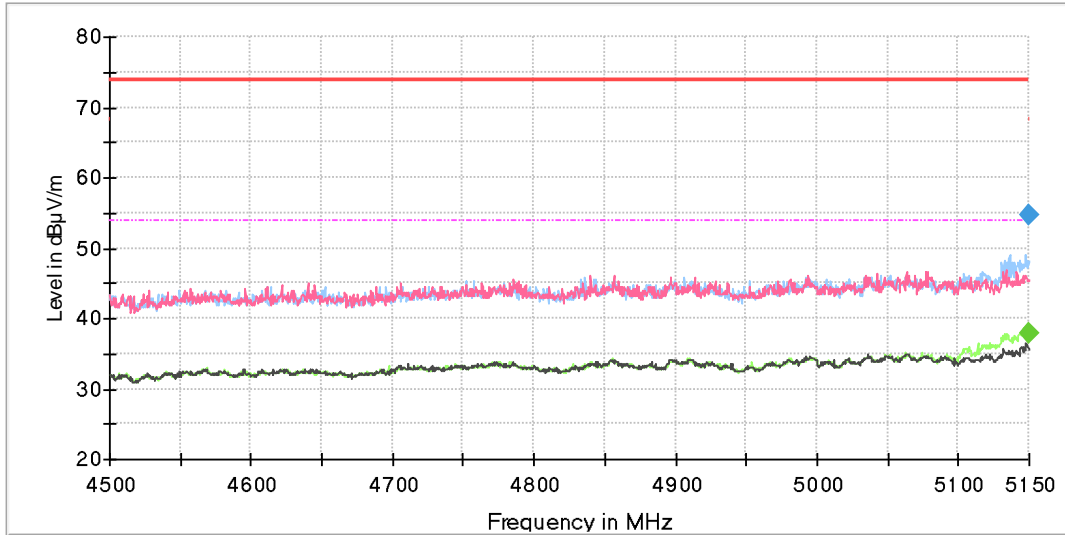
- Upper Band Edge Channel 48 (5350 to 5460 MHz)



• 802.11 n20:

Radiated spurious emissions at band-edges and inside adjacent band 4.50 - 5.15 GHz

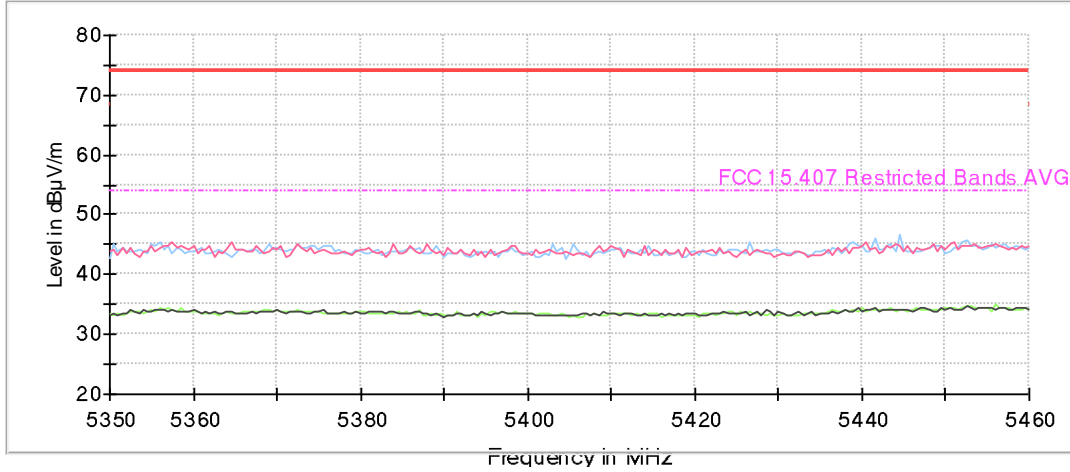
- Lower Band Edge Channel 36 (4500 to 5150 MHz)



- 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

Radiated spurious emissions at band-edges and inside adjacent band 5.35 - 5.46 GHz

- Upper Band Edge Channel 48 (5350 to 5460 MHz)

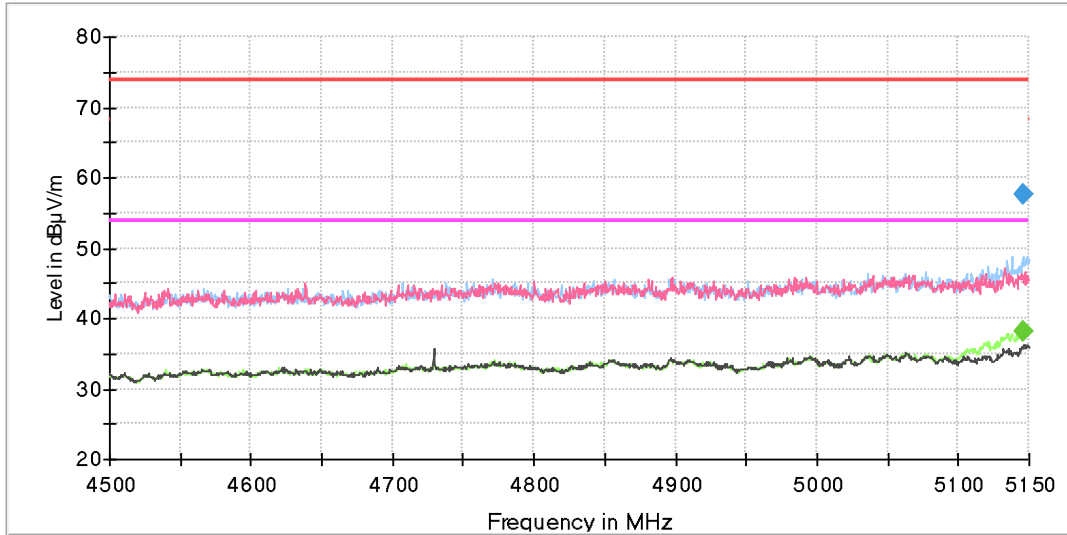


- Preview Result 2H-AVG
- Preview Result 1H-PK+
- Preview Result 2V-AVG
- Preview Result 1V-PK+
- * Critical_Freqs AVG
- * Critical_Freqs PK+
- FCC 15.407 Restricted Bands PK UNII-1 and UNII-2
- - - FCC 15.407 Restricted Bands AVG
- ◆ Final_Result PK+
- ◆ Final_Result AVG

• 802.11 ac20:

Radiated spurious emissions at band-edges and inside adjacent band 4.50 - 5.15 GHz

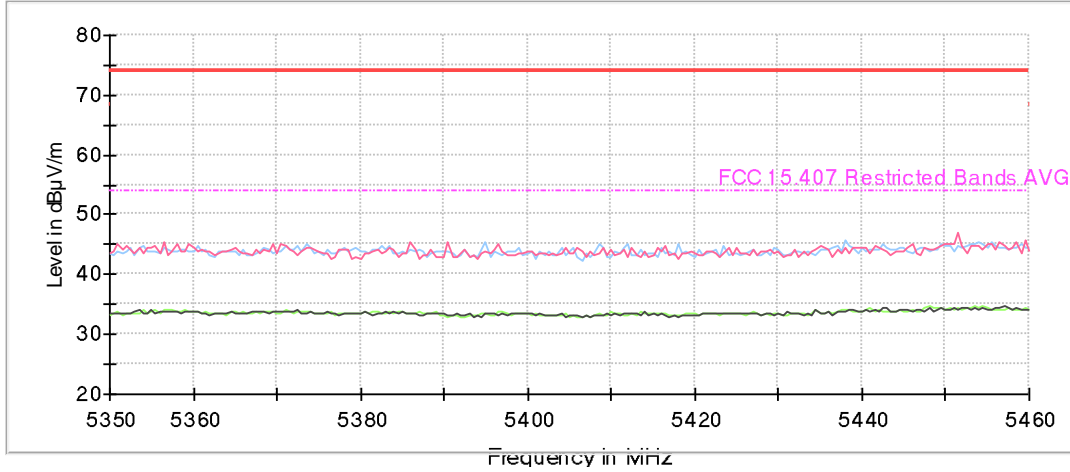
- Lower Band Edge Channel 36 (4500 to 5150 MHz)



- 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

Radiated spurious emissions at band-edges and inside adjacent band 5.35 - 5.46 GHz

- Upper Band Edge Channel 48 (5350 to 5460 MHz)

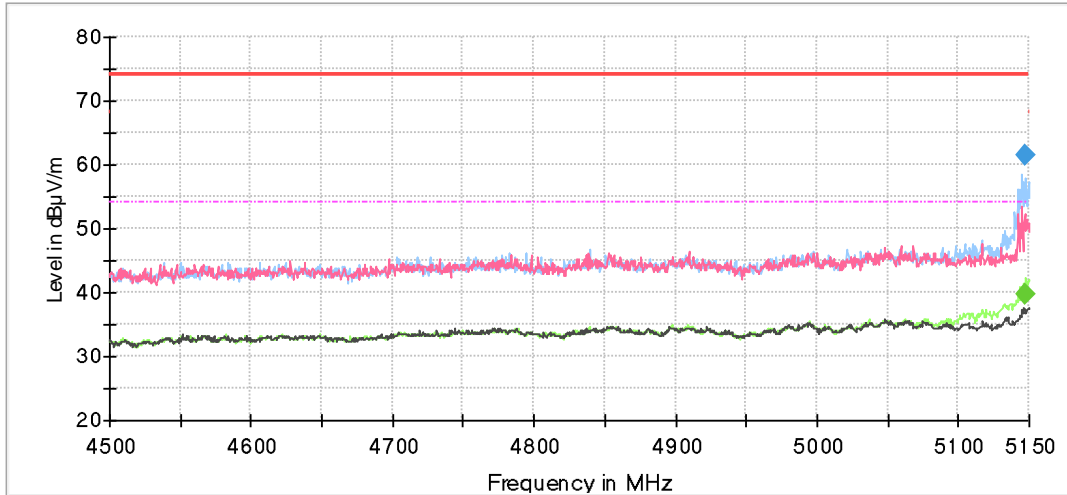


- Preview Result 2H-AVG
- Preview Result 1H-PK+
- Preview Result 2V-AVG
- Preview Result 1V-PK+
- * Critical_Freqs AVG
- * Critical_Freqs PK+
- FCC 15.407 Restricted Bands PK UNII-1 and UNII-2
- - - FCC 15.407 Restricted Bands AVG
- ◆ Final_Result PK+
- ◆ Final_Result AVG

• 802.11 n40:

Radiated spurious emissions at band-edges and inside adjacent band 4.50 - 5.15 GHz

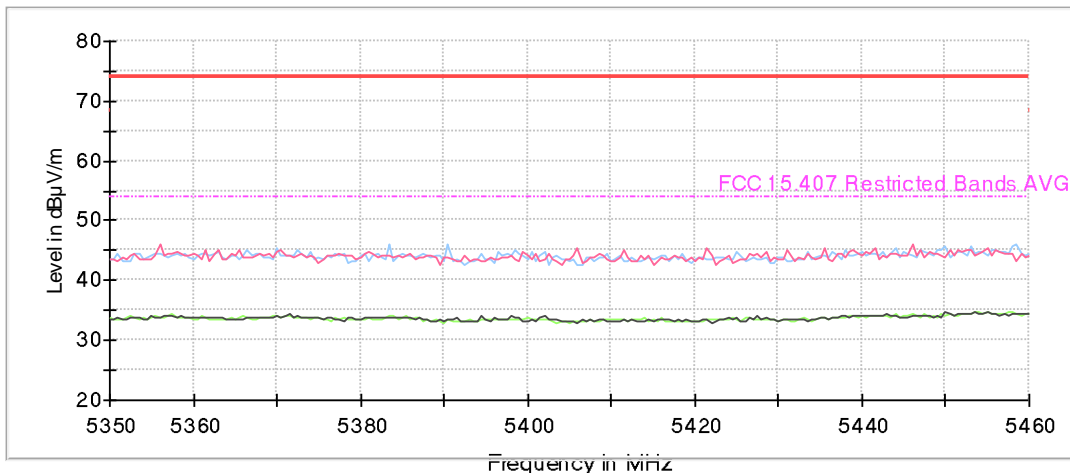
- Lower Band Edge Channel 38 (4500 to 5150 MHz)



- 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

Radiated spurious emissions at band-edges and inside adjacent band 5.35 - 5.46 GHz

- Upper Band Edge Channel 46 (5350 to 5460 MHz)

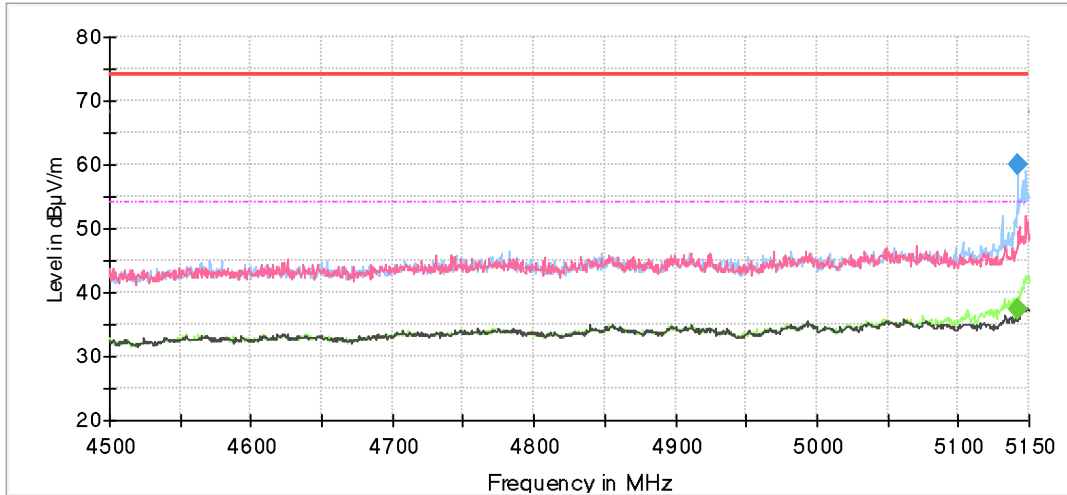


- Preview Result 2H-AVG
- Preview Result 1H-PK+
- Preview Result 2V-AVG
- Preview Result 1V-PK+
- * Critical_Freqs AVG
- * Critical_Freqs PK+
- FCC 15.407 Restricted Bands PK UNII-1 and UNII-2
- - - FCC 15.407 Restricted Bands AVG
- ◆ Final_Result PK+
- ◆ Final_Result AVG

• 802.11 ac40:

Radiated spurious emissions at band-edges and inside adjacent band 4.50 - 5.15 GHz

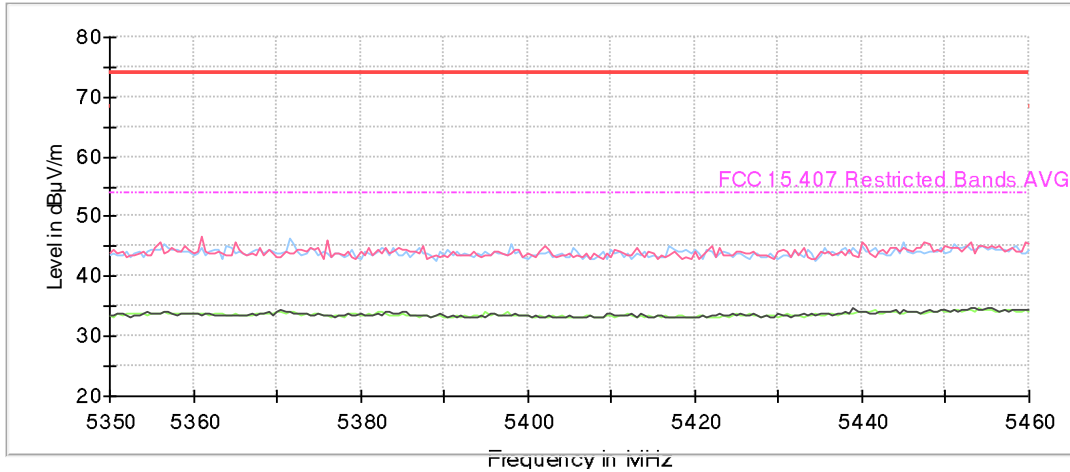
- Lower Band Edge Channel 38 (4500 to 5150 MHz)



- 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

Radiated spurious emissions at band-edges and inside adjacent band 5.35 - 5.46 GHz

- Upper Band Edge Channel 46 (5350 to 5460 MHz)

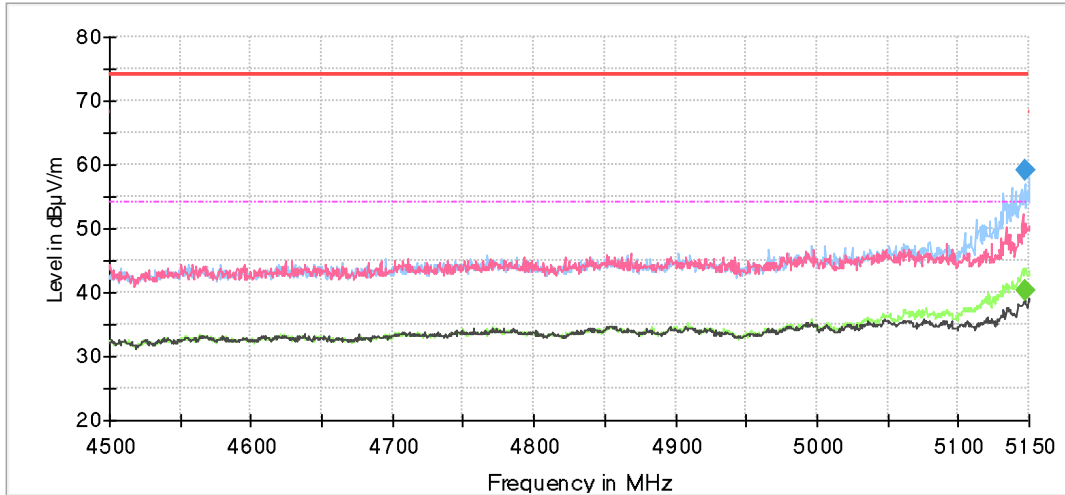


- Preview Result 2H-AVG
- Preview Result 1H-PK+
- Preview Result 2V-AVG
- Preview Result 1V-PK+
- * Critical_Freqs AVG
- * Critical_Freqs PK+
- FCC 15.407 Restricted Bands PK UNII-1 and UNII-2
- - - FCC 15.407 Restricted Bands AVG
- ◆ Final_Result PK+
- ◆ Final_Result AVG

- **802.11 ac80:**

Radiated spurious emissions at band-edges and inside adjacent band 4.50 - 5.15 GHz

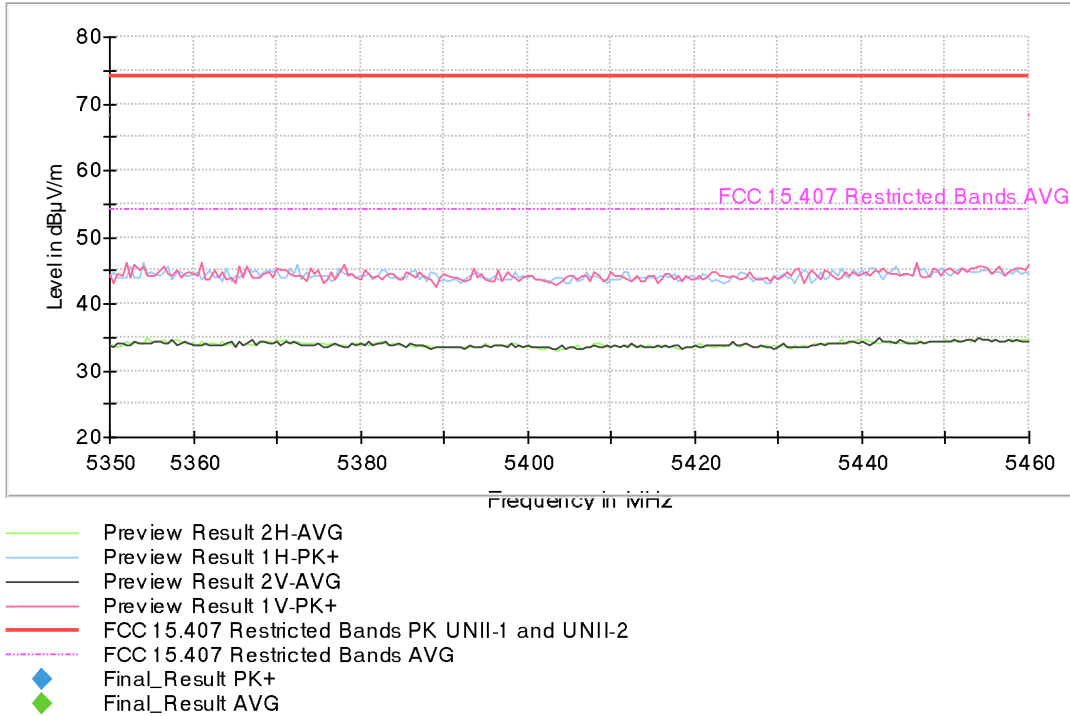
- Lower Band Edge Channel 42 (4500 to 5150 MHz)



- 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

Radiated spurious emissions at band-edges and inside adjacent band 5.35 - 5.46 GHz

- Upper Band Edge Channel 42 (5350 to 5460 MHz)



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

INDEX

TEST CONDITIONS	40
FCC 15.407 (b)(4)(6) / RSS-247 6.2.4.2. Out of Band Radiated Emissions and Band Edge Radiated Emissions	44

TEST CONDITIONS

POWER SUPPLY (V):

Vn: 12 Vdc

Type of Power Supply: DC external (car battery).

ANTENNAS:

Type of Antenna: Integral.

Maximum Declared Antenna Gain: +0.7 dBi

TEST FREQUENCIES:

Technology Tested:	WLAN (IEEE 802.11 a/n/ac): U-NII-3 band	
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	
Setting of cores / ports:	One port.	
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 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 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:

- 802.11a20: 6 Mbits
- 802.11n HT20: MCS0
- 802.11n HT40: MCS0
- 802.11ac VHT20: MCS0
- 802.11ac VHT40: MCS0
- 802.11ac VHT80: MCS0

RADIATED MEASUREMENTS:

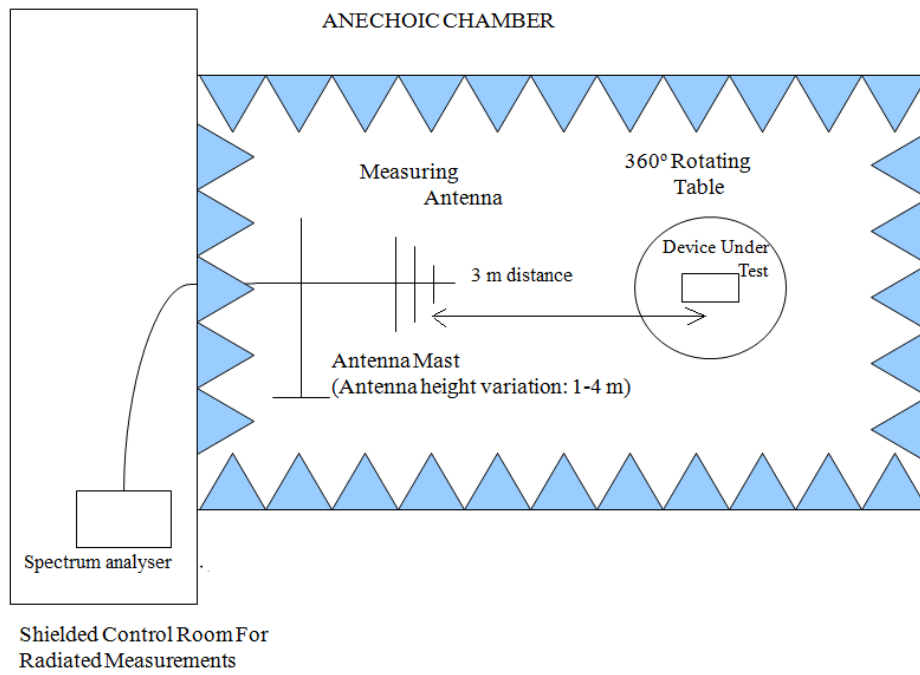
All radiated tests were performed in a semi-anechoic chamber. The measurement antenna (Bilog antenna for the range between 30 MHz to 1 GHz and 1 GHz-17 GHz Double ridge horn antenna) is situated at a distance of 3 m and at a distance of 1m for the frequency range 17 GHz-26 GHz (17 GHz-26 GHz horn antenna).

For radiated emissions in the range 17 GHz-26 GHz that is performed at a distance closer than the specified distance, an inverse proportionality factor of 20 dB per decade is used to normalize the measured data for determining compliance.

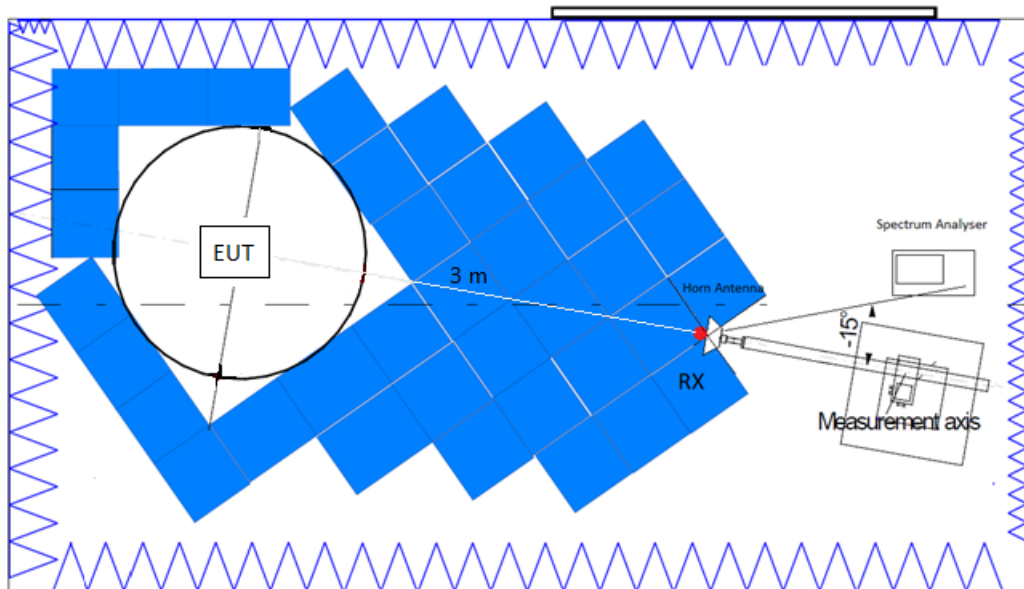
The equipment under test was set up on a non-conductive platform above the ground plane and the situation and orientation was varied to find the maximum radiated emission. It was also rotated 360° and the antenna height (Bilog antenna and Double ridge horn antenna) was varied from 1 to 4 meters to find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

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

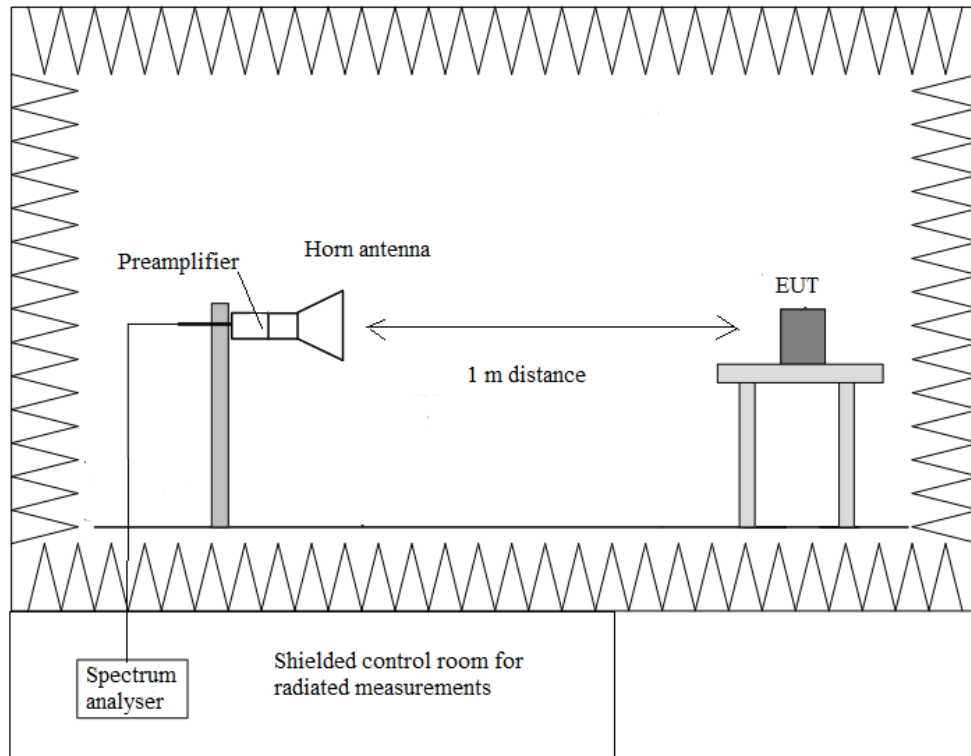
Radiated measurements setup from 30 MHz to 1 GHz:



Radiated measurements setup from 1 GHz to 17 GHz:



Radiated measurements setup $f > 17$ GHz:



FCC 15.407 (b)(4)(6) / RSS-247 6.2.4.2. Out of Band Radiated Emissions and 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 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 17 – 40 GHz and a distance of 3m for frequency range 30 MHz – 17 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.

The worst case was determined by measuring the e.i.r.p. density (radiated).

- **Test performed on the worst case: 802.11 n20**, with a bit rate index MCS0.

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) detected at less than 20 dB below the limit:

Spurious frequency (MHz)	Emission Level (dBμV/m)	Limit (dBμV/m)	Polarization	Detector	Measurement Uncertainty (dB)
30.8245	29.95	40	V	Quasi-Peak	<± 4.94
47.46	25.24	40	V	Quasi-Peak	<± 4.94
160.3195	34.89	43.5	V	Quasi-Peak	<± 4.94
227.4435	26.76	46	V	Quasi-Peak	<± 4.94
799.2585	34.89	46	H	Quasi-Peak	<± 4.94

Frequency range 1 - 40 GHz:

The results in the next tables show the maximum measured levels in the 1-40 GHz range including the 5.650 - 5.725 GHz and 5.850 - 5.925 GHz adjacent bands (see following plots).

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.

OUT OF BAND EMISSIONS: For outside emissions of the band 5.65 - 5.925 GHz, the OFDM worst mode case was determined after preliminary measurements. It was tested in the Low, Middle and High Channels.

BAND EDGE EMISSIONS: For band edge emissions of the bands 5.65 – 5.725 and 5.850 - 5.925 GHz, all modes were tested in the Low Middle and High Channels.

OUT OF BAND EMISSIONS. Spurious emissions out of 5.65 - 5.925 GHz:

• **802.11 n20 (worst case):**

- Low Channel:

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

- Middle Channel:

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

- High Channel:

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

Measurement Uncertainty (dB): 1GHz-17GHz $\leq \pm 4.6$
17GHz-26.5GHz $\leq \pm 4.89$
26.5GHz-40GHz $\leq \pm 5.14$

Verdict: PASS

BAND EDGE EMISSIONS. Spurious band edge emissions inside 5.65 – 5.925 GHz:

• **802.11 a20:**

- Low Channel 149 (5745 MHz):

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

- Middle Channel 157 (5785 MHz):

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

- High Channel 165 (5825 MHz):

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

• **802.11 n20 (worst case):**

- Low Channel 149 (5745 MHz):

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

- Middle Channel 157 (5785 MHz):

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

- High Channel 165 (5825 MHz):

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

• **802.11 ac20:**

- Low Channel 149 (5745 MHz):

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

- Middle Channel 157 (5785 MHz):

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

- High Channel 165 (5825 MHz):

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

- **802.11 n40:**

- Low Channel 151 (5755 MHz):

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

- High Channel 159 (5795 MHz):

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

- **802.11 ac40:**

- Low Channel 151 (5755 MHz):

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

- High Channel 159 (5795 MHz):

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

- **802.11 ac80:**

- Single Channel 155 (5775 MHz):

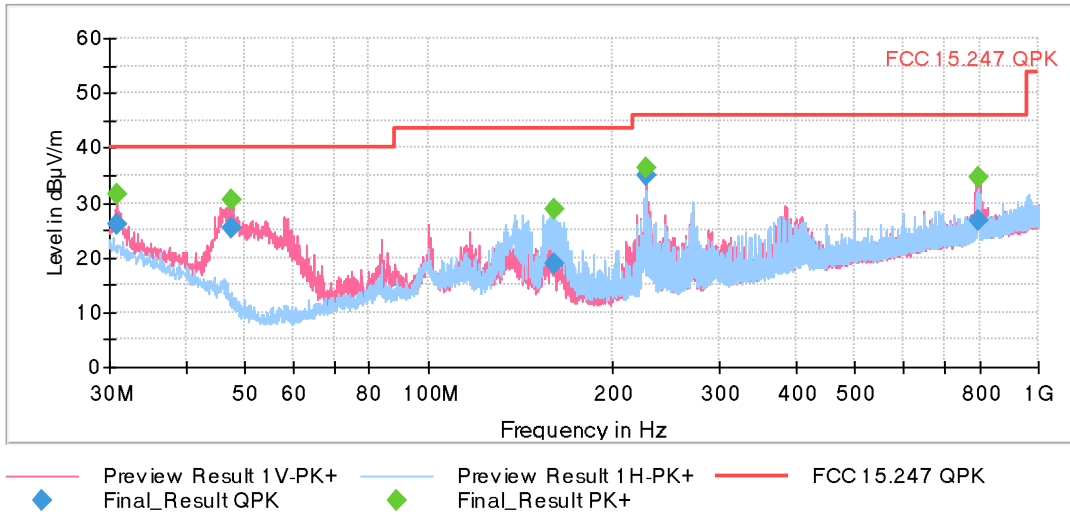
- No radiated spurious frequencies at less than 20 dB below the limit.

Verdict: PASS

OUT OF BAND EMISSIONS:

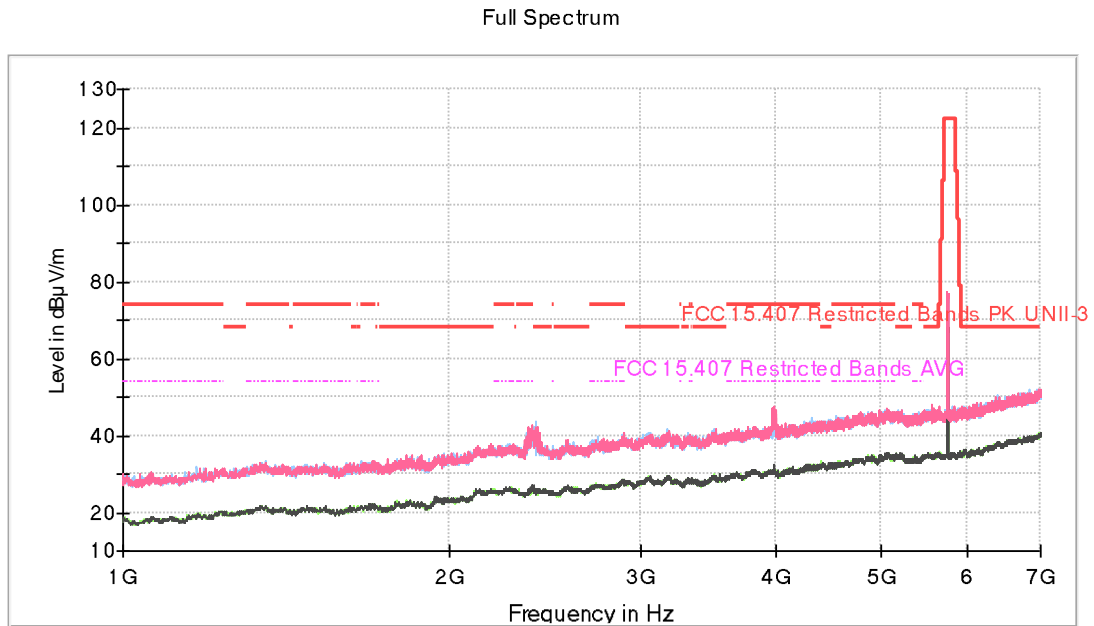
FREQUENCY RANGE 30 MHz - 1 GHz (worst case):

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



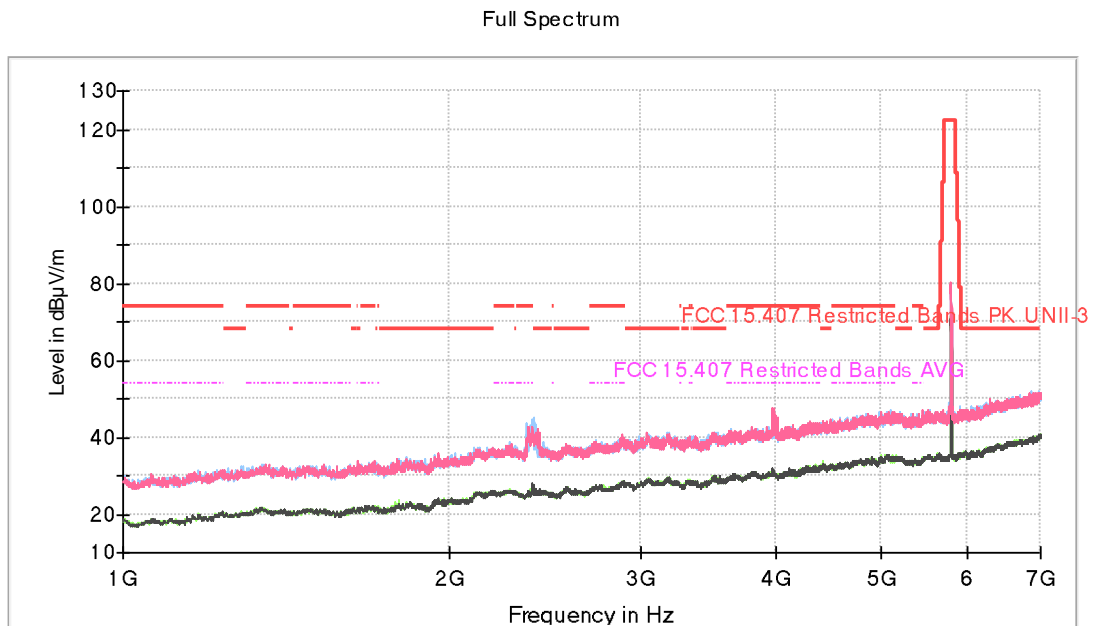
FREQUENCY RANGE 1 – 7 GHz (worst case):

- Low Channel:



- | | |
|---|-----------------------------------|
| — Preview Result 2H-AVG | — Preview Result 1H-PK+ |
| — Preview Result 2V-AVG | — Preview Result 1V-PK+ |
| * Critical_Freqs AVG | * Critical_Freqs PK+ |
| — FCC 15.407 Restricted Bands PK UNII-3 | — FCC 15.407 Restricted Bands AVG |
| ◆ Final_Result PK+ | ◆ Final_Result AVG |

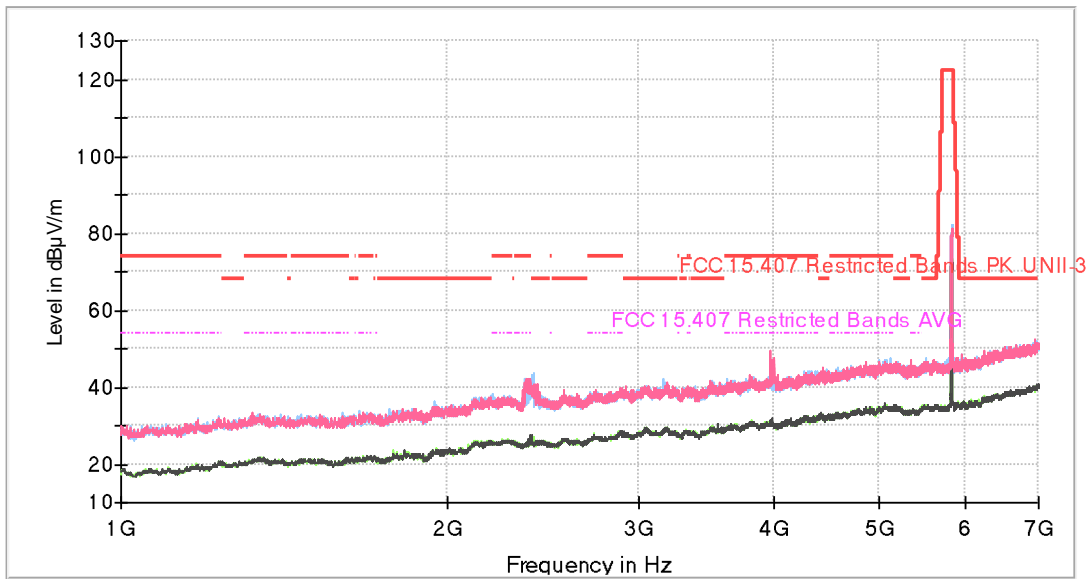
- Middle Channel:



- | | |
|---|-----------------------------------|
| — Preview Result 2H-AVG | — Preview Result 1H-PK+ |
| — Preview Result 2V-AVG | — Preview Result 1V-PK+ |
| * Critical_Freqs AVG | * Critical_Freqs PK+ |
| — FCC 15.407 Restricted Bands PK UNII-3 | — FCC 15.407 Restricted Bands AVG |
| ◆ Final_Result PK+ | ◆ Final_Result AVG |

- High Channel:

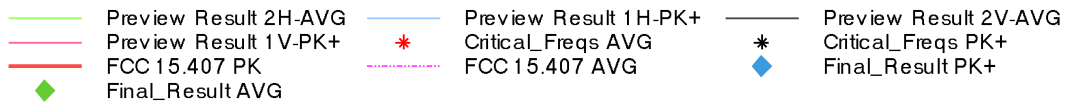
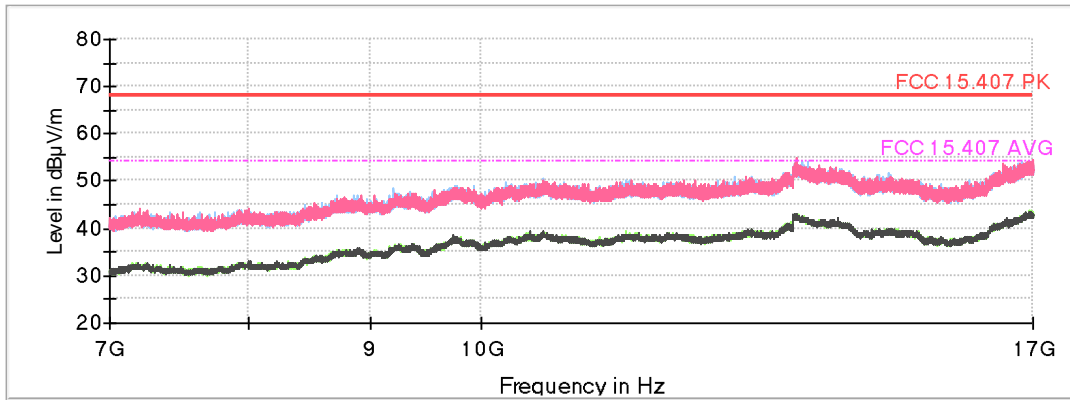
Full Spectrum



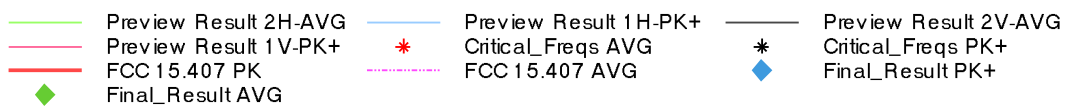
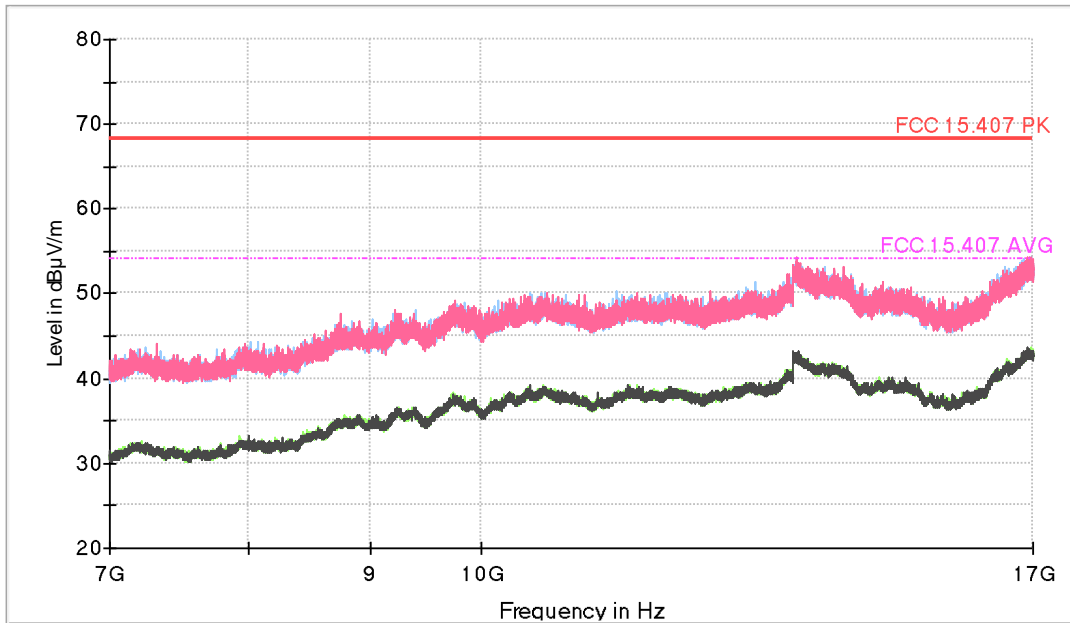
- Preview Result 2H-AVG
- Preview Result 2V-AVG
- * Critical_Freqs AVG
- ◆ Final Result PK+
- Preview Result 1H-PK+
- Preview Result 1V-PK+
- * Critical_Freqs PK+
- ◆ Final Result AVG

FREQUENCY RANGE 7 - 17 GHz (worst case):

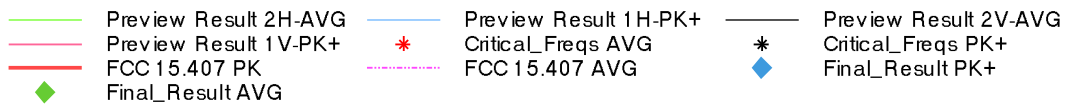
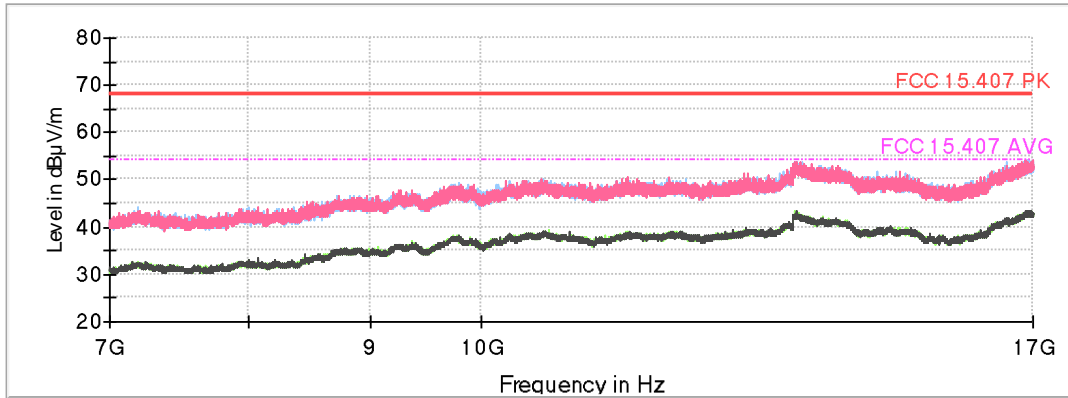
- Low Channel:



- Middle Channel:

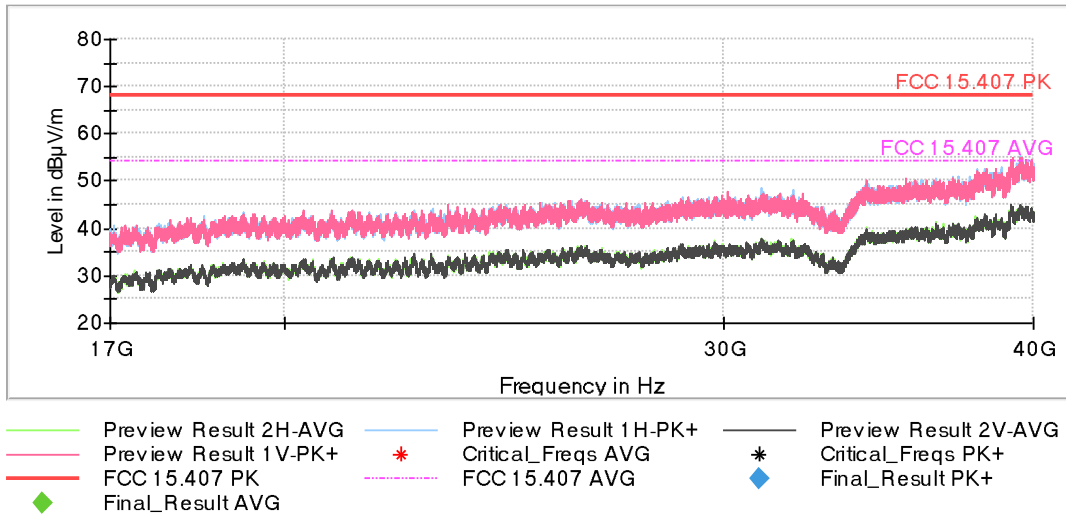


- High Channel:



FREQUENCY RANGE 17 - 40 GHz (worst case):

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

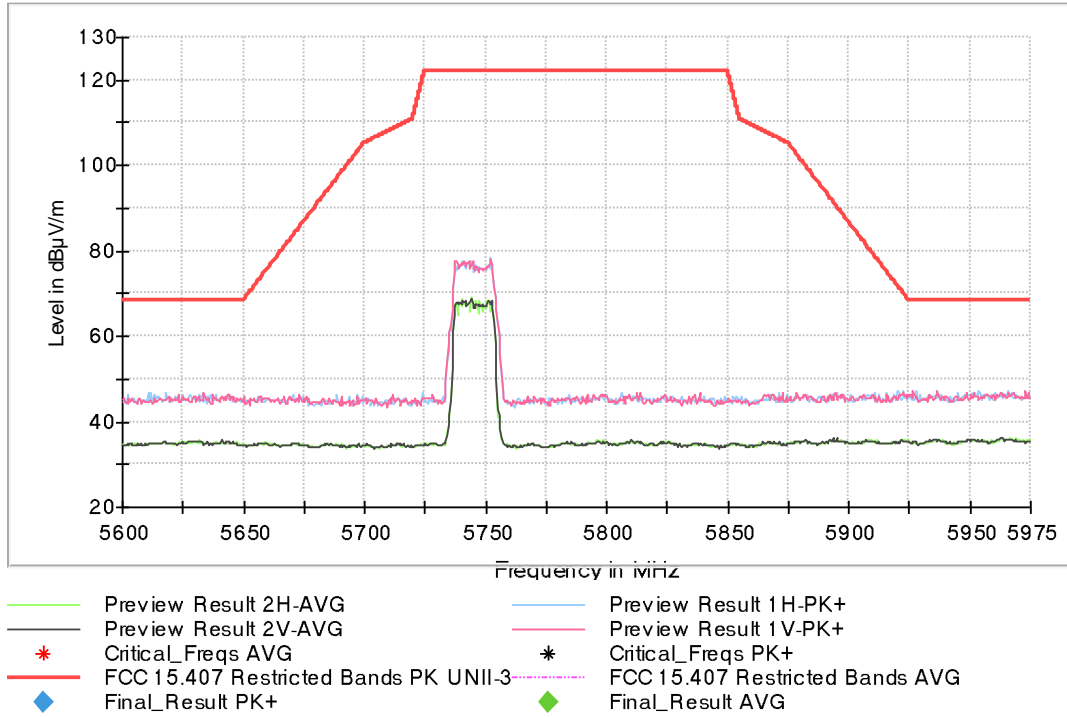


BAND EDGE EMISSIONS:

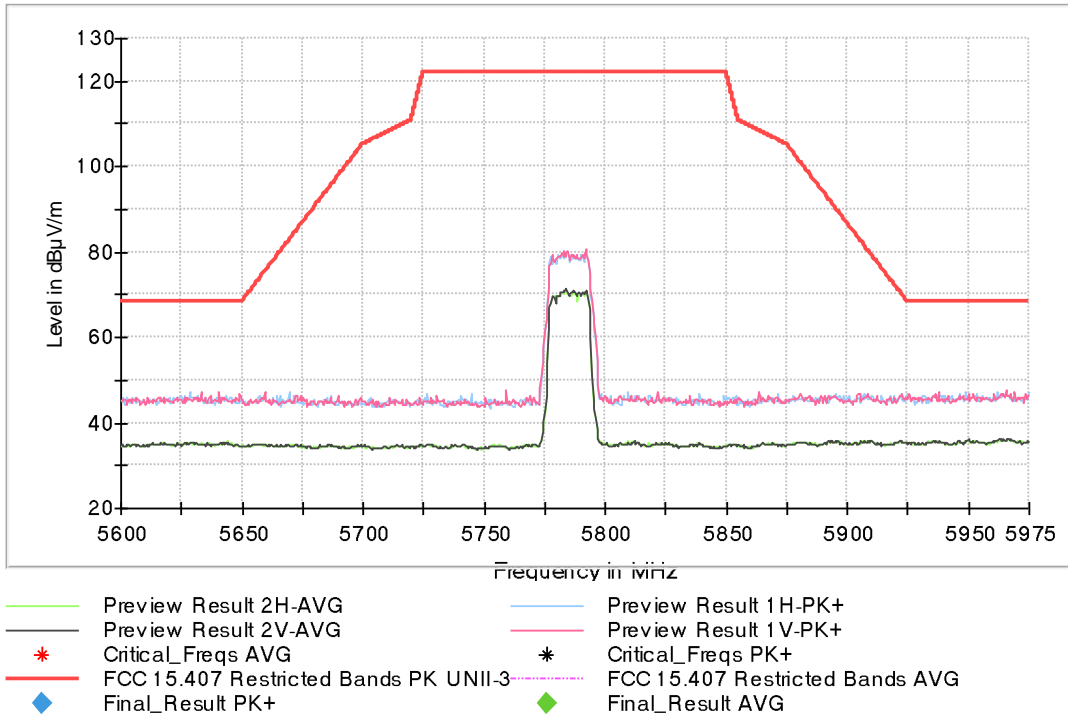
- 802.11 a20:

Radiated spurious emissions at band edges and inside adjacent band 5.65 – 5.925 GHz

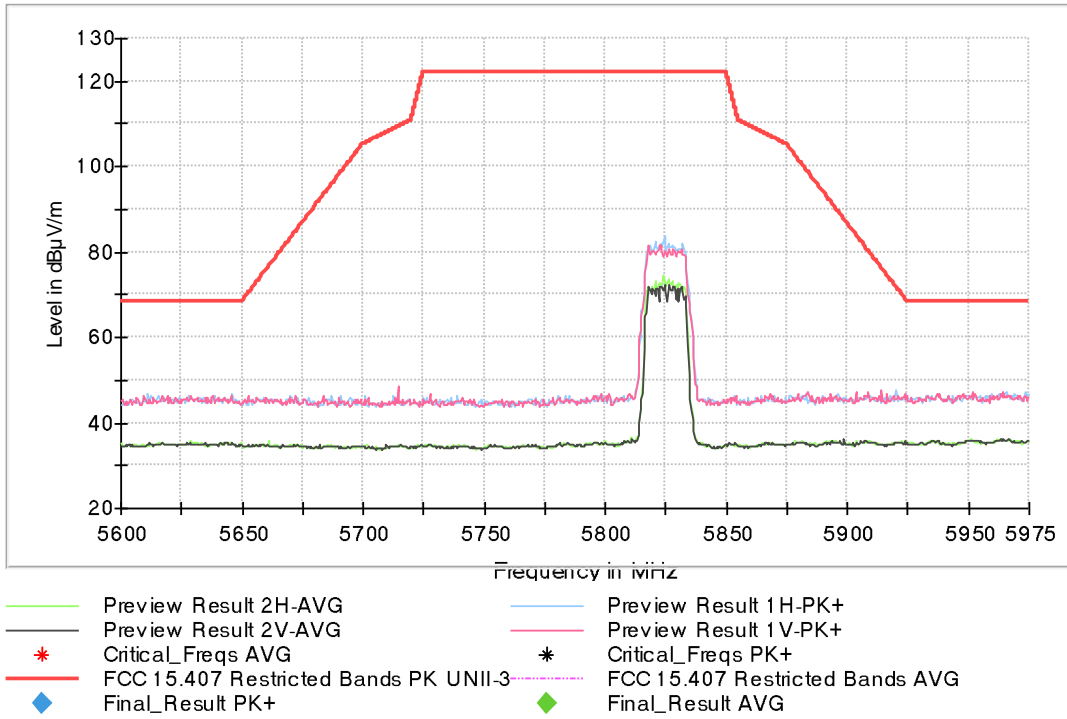
- Low Channel 149 (5745 MHz):



- Middle Channel 157 (5785 MHz):



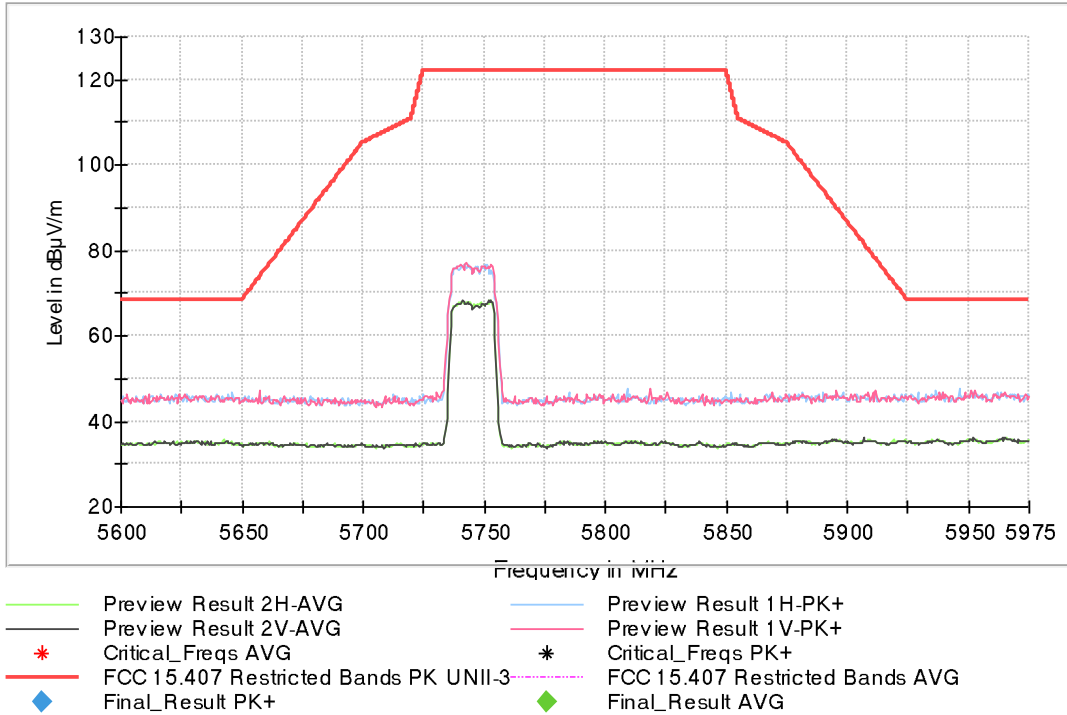
- High Channel 165 (5825 MHz):



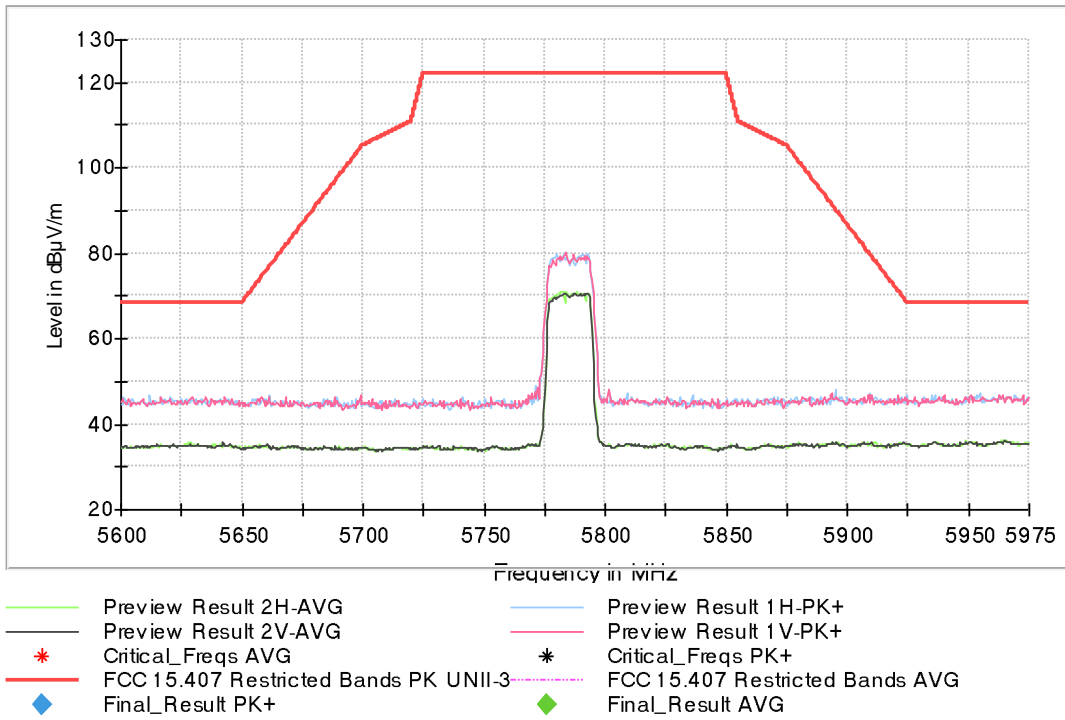
- **802.11 n20:**

Radiated spurious emissions at band edges and inside adjacent band 5.65 – 5.925 GHz

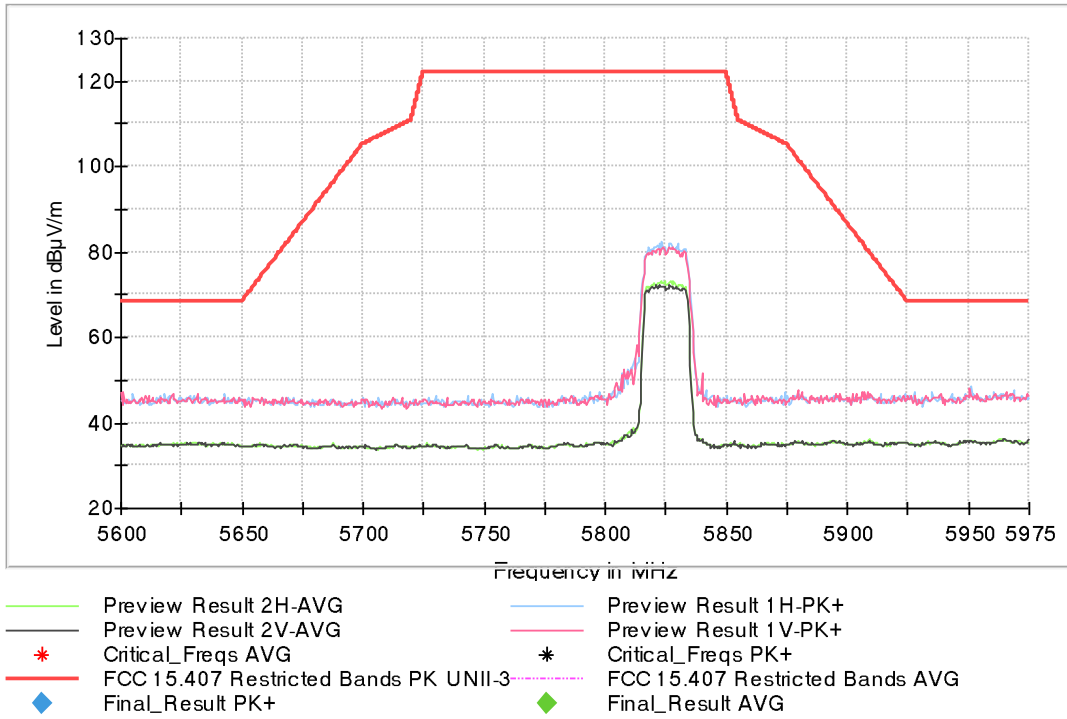
- Low Channel 149 (5745 MHz):



- Middle Channel 157 (5785 MHz):



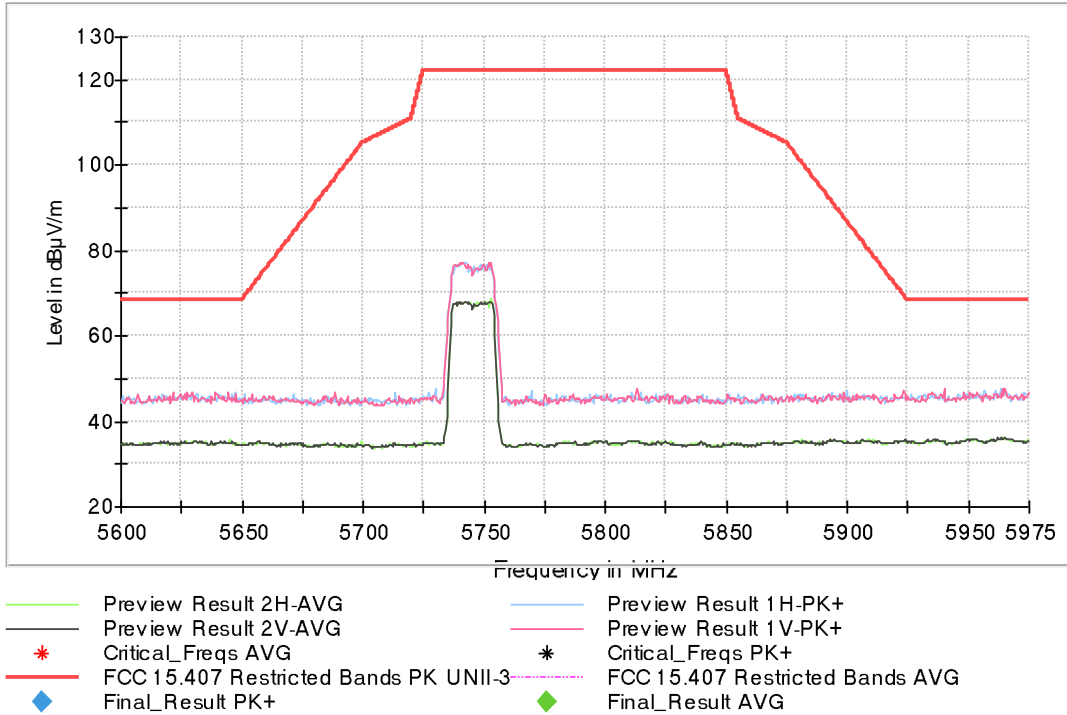
- High Channel 165 (5825 MHz):



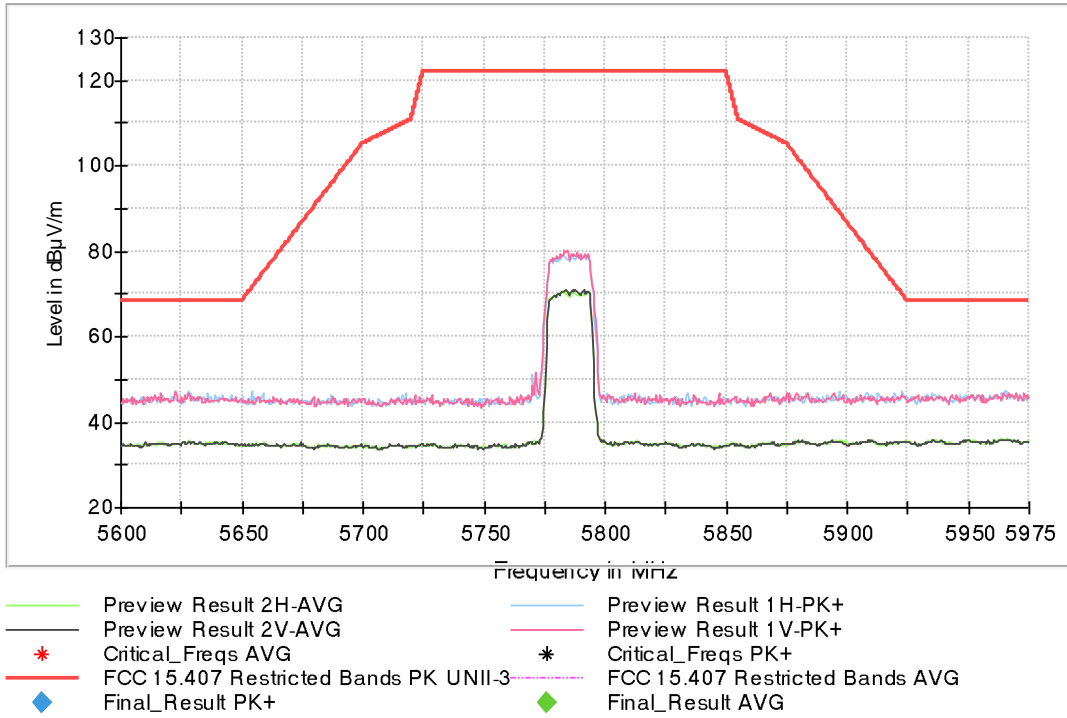
• 802.11 ac20:

Radiated spurious emissions at band edges and inside adjacent band 5.65 – 5.925 GHz

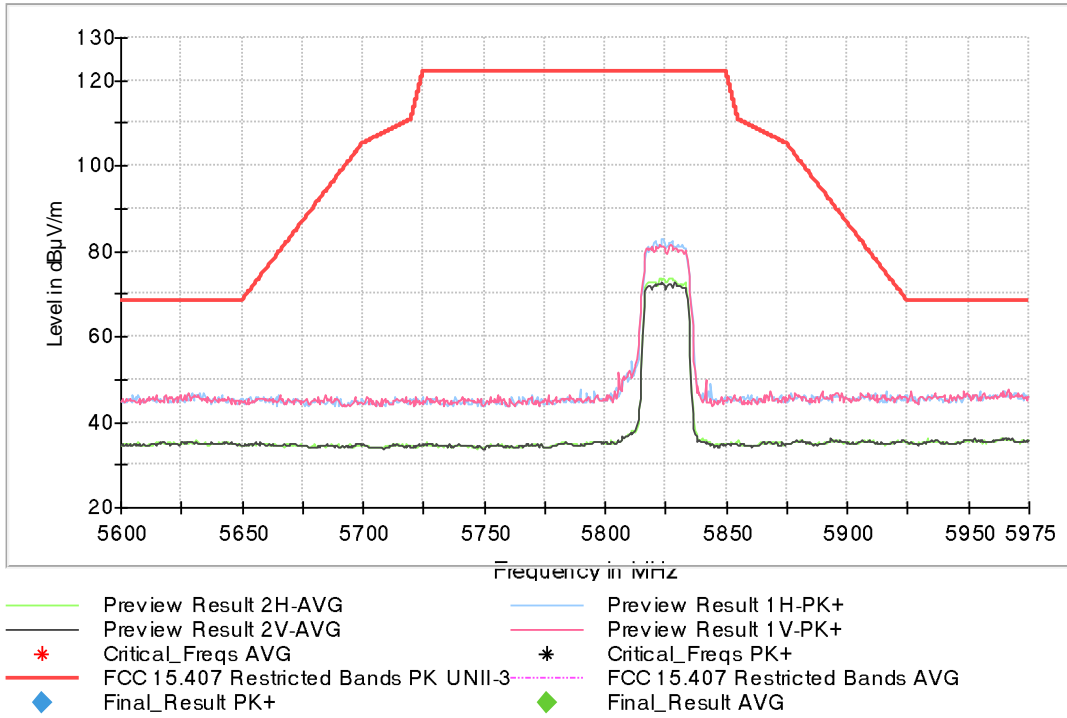
- Low Channel 149 (5745 MHz):



- Middle Channel 157 (5785 MHz):



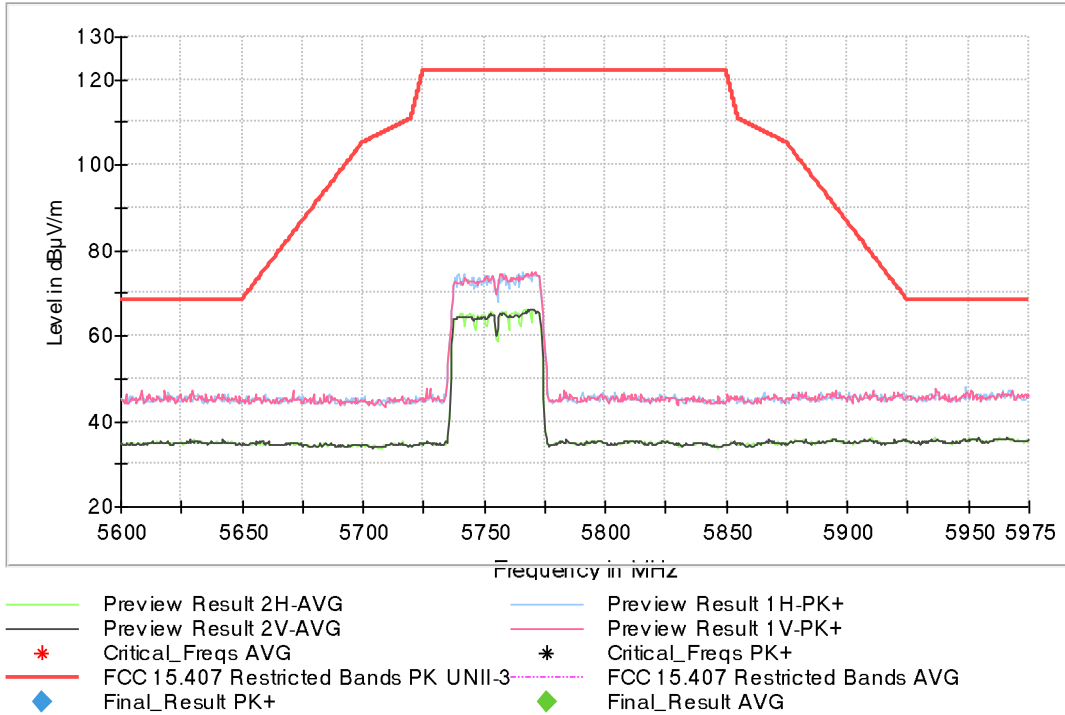
- High Channel 165 (5825 MHz):



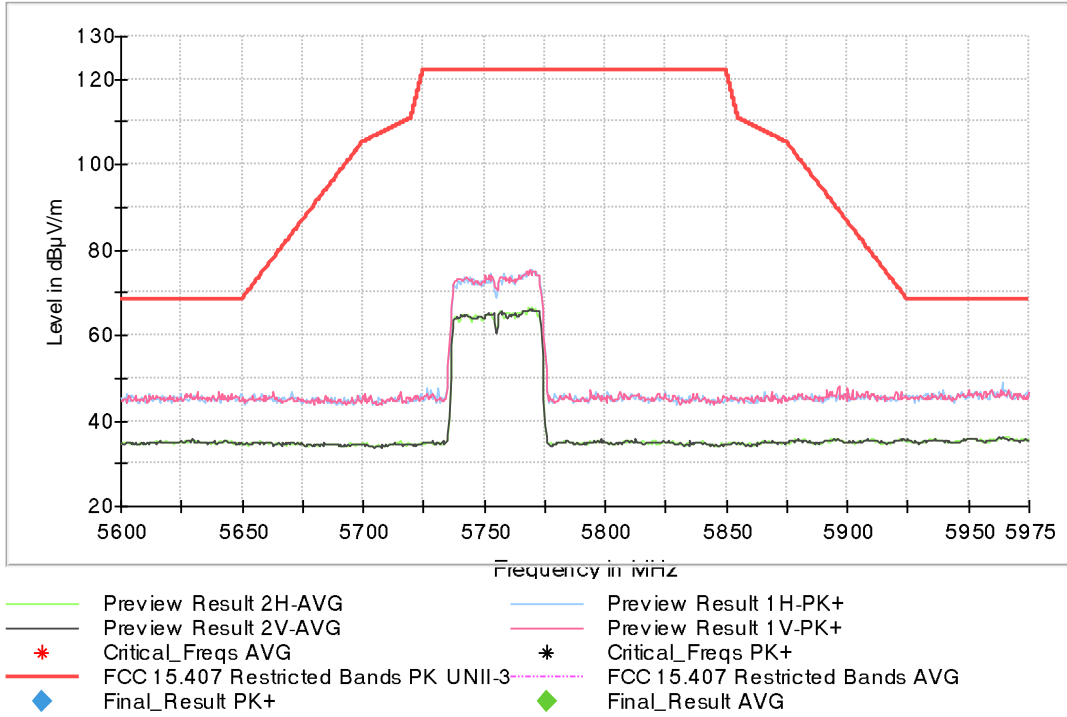
- **802.11 n40:**

Radiated spurious emissions at band edges and inside adjacent band 5.65 – 5.925 GHz

- Low Channel 151 (5755 MHz):



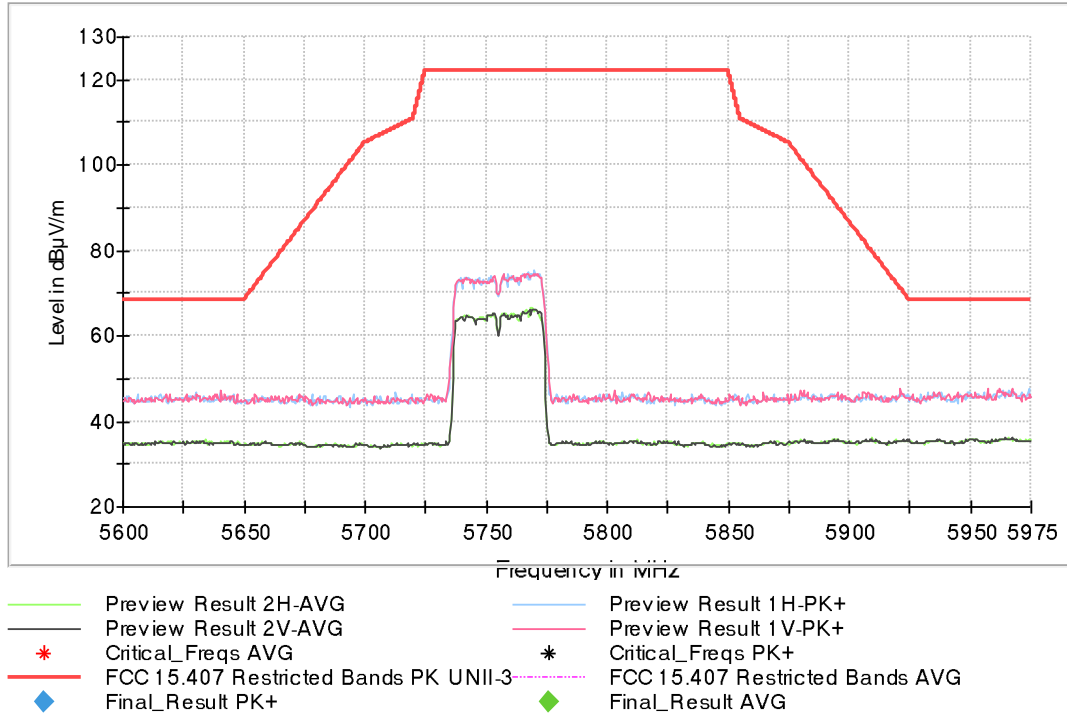
- High Channel 159 (5795 MHz):



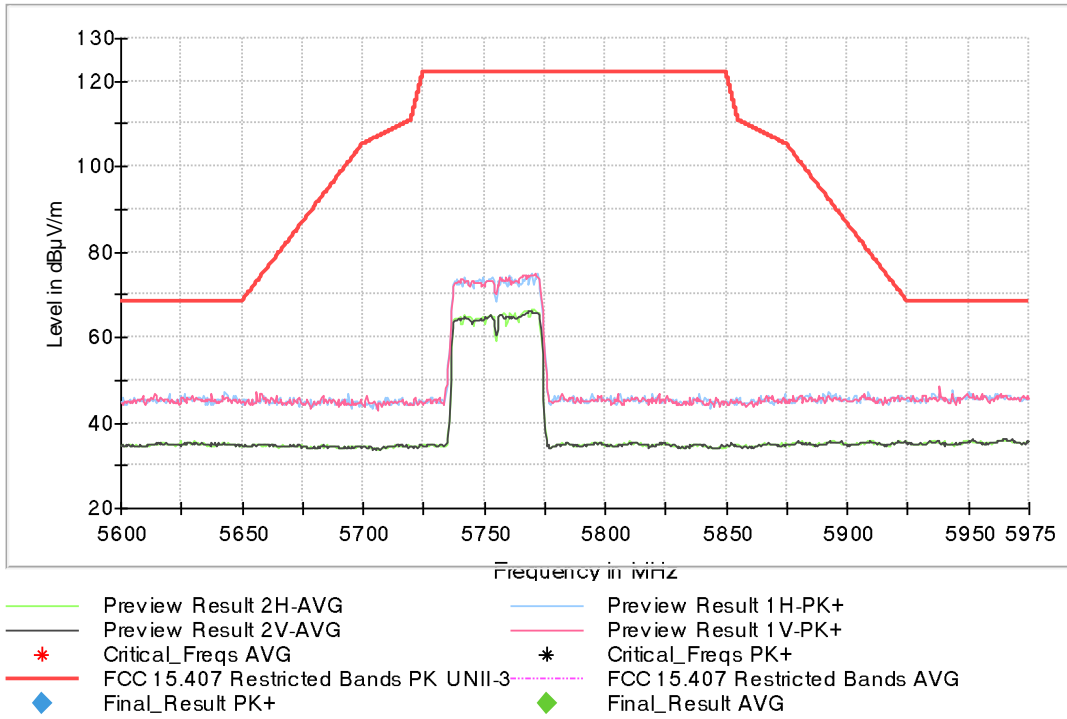
- **802.11 ac40:**

Radiated spurious emissions at band edges and inside adjacent band 5.65 – 5.925 GHz

- Low Channel 151 (5755 MHz):



- High Channel 159 (5795 MHz):



- **802.11 ac80:**

Radiated spurious emissions at band edges and inside adjacent band 5.65 – 5.925 GHz

- Middle Channel 155 (5775 MHz):

