



Test report No:
 NIE: 63185RRF.092

Partial Test Report

USA FCC Part 15.247, 15.209
 CANADA RSS-247, RSS-Gen

Radio Frequency Devices. Operation within the bands 902 - 928 MHz, 2400 - 2483.5 MHz, and 5725 - 5850 MHz.

Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices.

General Requirements and Information for the Certification of Radio Apparatus.

(*) Identification of item tested	Headunit with radio and Bluetooth
(*) Trademark	Panasonic
(*) Model and /or type reference	MIB3E_MQB37w_BTWIFI
Other identification of the product	HW version: X05 SW version: X765 Part Number: 5E3.035.869 FCC ID: WUQ-MIB3VBTWIFI IC: 216R-MIB3VBTWIFI
(*) 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 15.247 (10-1-19) Edition: Operation within the bands 902 - 928 MHz, 2400 -2483.5 MHz, and 5725 - 5850 MHz. 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). - Emission limitations radiated (Transmitter) Guidance for Performing Compliance Measurements on Digital Transmission System, Frequency Hopping Spread Spectrum System, and Hybrid Systems Devices Operating Under Section 15.247 of the FCC Rules. 558074 D01 Meas Guidance v05r02 dated April 2, 2019. Guidance for Emission Testing of Transmitters with Multiple Outputs in the Same Band 662911 D01 Multiple Transmitter Output v02r01 dated 10/31/2013. 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.

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

DEKRA Testing and Certification S.A.U. guarantees the reliability of the data presented in this report, which is the result of the measurements and the tests performed to the item under test on the date and under the conditions stated on the report and, it is based on the knowledge and technical facilities available at DEKRA Testing and Certification S.A.U. at the time of performance of the test.

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

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

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General conditions

1. This report is only referred to the item that has undergone the test.
2. This report does not constitute or imply on its own an approval of the product by the Certification Bodies or competent Authorities.
3. This document is only valid if complete; no partial reproduction can be made without previous written permission of DEKRA Testing and Certification S.A.U.
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 S.A.U. and the Accreditation Bodies.

Uncertainty

Uncertainty (factor $k=2$) was calculated according to the DEKRA Testing and Certification S.A.U. internal document PODT000.

Data provided by the client

The following data has been provided by the client:

1. Information relating to the description of the sample ("Identification of the item tested", "Trademark", "Model and/or type reference tested").
2. The sample of the model MIB3E_MQB37w_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
63185/001	Headunit with radio and Bluetooth	MIB3E_MQB37w_BTWIFI	PM6-00129.11.19413F0369	2020/04/21
51929B/450	RF Harness	--	--	2019/02/26

Auxiliary elements used with the sample S/01:

Control Nº	Description	Model	Serial Nº	Date of reception
51929B/117	USB Load	--	-	2018/12/10

Sample S/01 has undergone the following test(s): The tests indicated in the Appendix A and the Low Range (30 MHz – 1 GHz) Radiated Spurious Emissions tests indicated in the Appendix B.

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

Control Nº	Description	Model	Serial Nº	Date of reception
63185/001	Headunit with radio and Bluetooth	MIB3E_MQB37w_BTWIFI	PM6-00129.11.19413F0369	2020/04/21
51929B/228	RF Harness	--	--	2019/01/24

Sample S/02 has undergone the following test(s): The High Range (1 – 26 GHz) Radiated Spurious Emissions tests indicated in the Appendix B.

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"/>		
			<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	X765						
Hardware version	X05						
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)	2020-04-27
Date (finish)	2020-05-06

Document history

Report number	Date	Description
63185RRF.092	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, Daniel López, Antono Mael Sánchez, Javier Miguel Nadales, Victoria Olmedo.

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. Digital Multimeter FLUKE 175	2019/11	2020/11
5. Horn Antenna 1-18 GHz SCHWARZBECK MESS-ELEKTRONIK BBHA 9120 D	2019/11	2022/11
6. Preamplifier 30dB 500MHz-18GHz, SCHWARZBECK BBV 9718 C	2020/01	2021/01
7. High Pass Filter 3 - 18 GHz TEMSTRON / TEMWELL ST-3GA2833-HS	2020/02	2022/02

Testing verdicts

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

Summary

1. Bluetooth EDR

FCC PART 15 PARAGRAPH / RSS-247			
Requirement – Test case		Verdict	Remark
FCC 15.247 (a)(1) / RSS-247 5.1. (b)	20 dB Bandwidth and Carrier frequency separation	N/M	
FCC 15.247 (a)(1)(iii) / RSS-247 5.1 (d)	Number of hopping channels	N/M	
FCC 15.247 (a)(1)(iii) / RSS-247 5.1 (d)	Time of occupancy (Dwell Time)	N/M	
FCC 15.247 (b) / RSS-247 5.4. (b)	Maximum peak output power and antenna gain	N/M	
FCC 15.247 (d) / RSS-247 5.5.	Band-edge emissions compliance (Transmitter)	N/M	
FCC 15.247 (d) / RSS-247 5.5.	Emission limitations radiated (Transmitter)	P	(1)
<u>Supplementary information and remarks:</u>			
(1) Only test requested.			

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

FCC PART 15 PARAGRAPH / RSS-247			
Requirement – Test case		Verdict	Remark
FCC 15.247 (a)(2) / RSS-247 5.2. (a)	6 dB Bandwidth	N/M	
FCC 15.247 (b) / RSS-247 5.4. (d)	Maximum output power and antenna gain	N/M	
FCC 15.247 (d) / RSS-247 5.5.	Band-edge emissions compliance (Transmitter)	N/M	
FCC 15.247 (e) / RSS-247 5.2. (b)	Power spectral density	N/M	
FCC 15.247 (d) / RSS-247 5.5.	Emission limitations radiated (Transmitter)	P	(1)
<u>Supplementary information and remarks:</u>			
(1) Only test requested.			

Appendix A: Test results. Bluetooth EDR (GFSK, Pi/4 DQPSK, 8DPSK)

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TEST CONDITIONS

POWER SUPPLY (V):

V nominal:	12 Vdc.
Type of Power Supply:	DC external (car battery).

ANTENNA:

Type of Antenna:	Integral.
Maximum Declared Antenna Gain:	+1.3 dBi (Antenna gain plus antenna cable loss).

TEST FREQUENCIES:

Low Channel:	2402 MHz
Middle Channel:	2441 MHz
High Channel:	2480 MHz

RADIATED MEASUREMENTS:

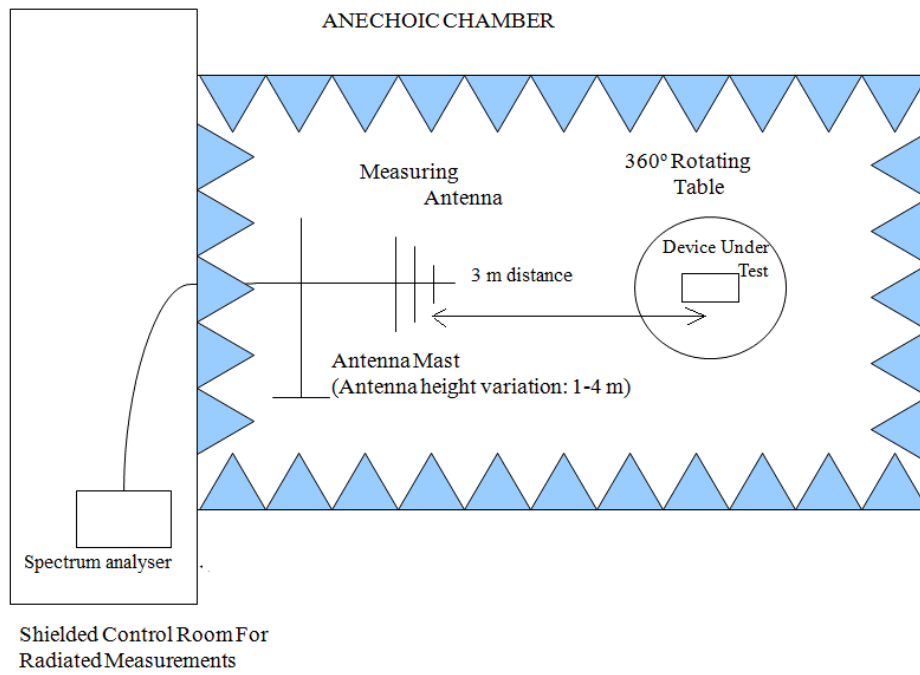
All radiated tests were performed in a semi-anechoic chamber. The measurement antenna (Bilog antenna for the range between 30 MHz to 1 GHz and 1 GHz-17 GHz Double ridge horn antenna) is situated at a distance of 3 m and at a distance of 1.5 m for the frequency range 17 GHz-26 GHz (17 GHz-26 GHz horn 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.

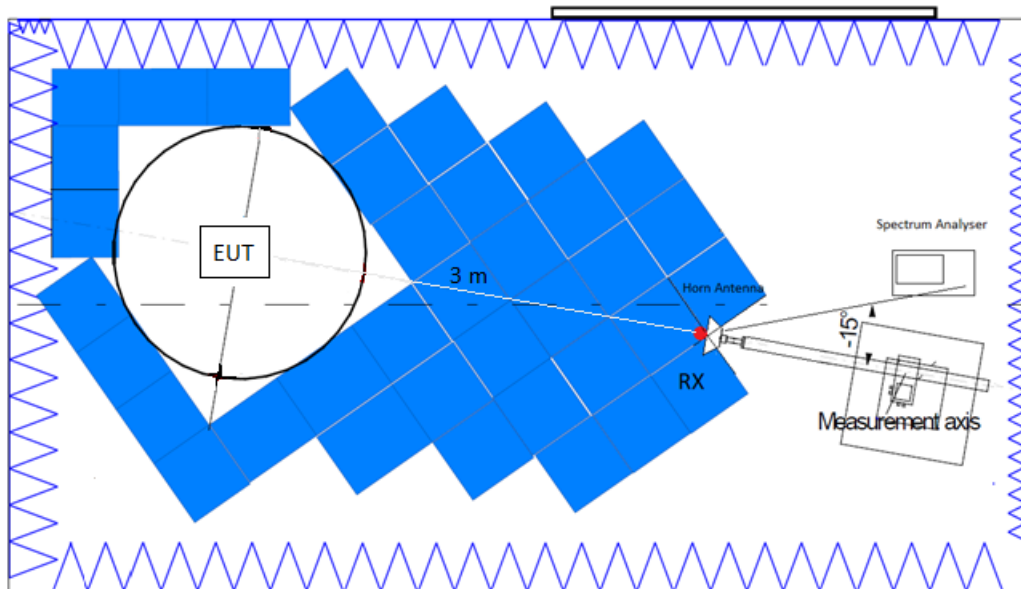
The equipment under test was set up on a non-conductive platform above the ground plane and the situation and orientation was varied to find the maximum radiated emission. It was also rotated 360° and the antenna height (Bilog antenna and Double ridge horn antenna) was varied from 1 to 4 meters to find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

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

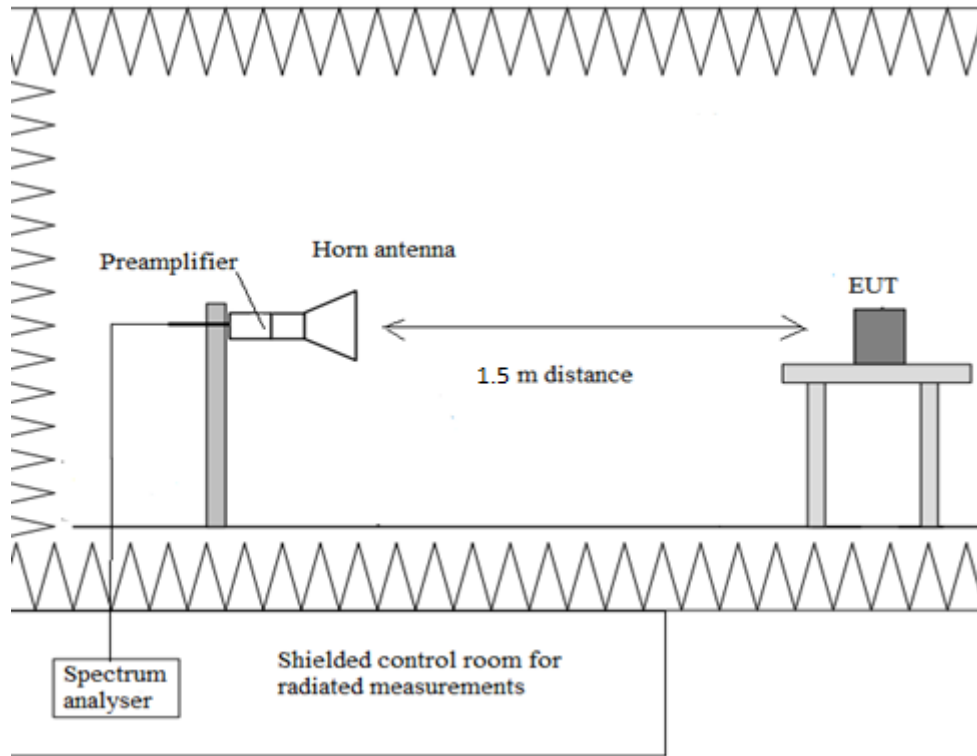
Radiated measurements setup from 30 MHz to 1 GHz:



Radiated measurements setup from 1 GHz to 17 GHz:



Radiated measurements setup $f > 17$ GHz:



FCC 15.247 (d) / RSS-247 5.5. Emission limitations radiated (Transmitter)

SPECIFICATION:

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)/RSS-Gen):

Frequency Range (MHz)	Field strength ($\mu\text{V}/\text{m}$)	Field strength ($\text{dB}\mu\text{V}/\text{m}$)	Measurement distance (m)
0.009-0.490	2400/F(kHz)	-	300
0.490-1.705	24000/F(kHz)	-	30
1.705 - 30.0	30	-	30
30 - 88	100	40	3
88 - 216	150	43.5	3
216 - 960	200	46	3
960 - 25000	500	54	3

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

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

RSS-247. Attenuation below the general field strength limits specified in RSS-Gen is not required.

RESULTS:

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

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

All tests were performed in a semi-anechoic chamber at a distance of 3 m for the frequency range 30 MHz-17 GHz and at distance of 1m for the frequency range 17 GHz-26 GHz.

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

Frequency range 30 MHz - 1 GHz:

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

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

Spurious frequency (MHz)	Emission Level (dBµV/m)	Limit (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
137.7185	24.36	43.5	V	Quasi peak	<± 4.94
243.4485	26.11	46	H	Quasi peak	<± 4.94
605.501	34.84	46	H	Quasi peak	<± 4.94
616.5105	40.67	46	H	Quasi peak	<± 4.94
620.439	41.43	46	H	Quasi peak	<± 4.94
637.6655	31.1	46	H	Quasi peak	<± 4.94

Frequency range 1 - 26 GHz:

The results in the next tables show the maximum measured levels in the 1-26 GHz range including the restricted bands 2.31-2.39 GHz and 2.4835-2.5 GHz.

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

• **GFSK modulation (DH5):**

- **LOW CHANNEL.** Spurious frequencies closest to the limit:

Spurious frequency (GHz)	Emission Level (dBµV/m)	Limit (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
2.872	54.81	74	V	Peak	<± 4.6
	42.36	54		Average	<± 4.6
2.877	55.43	74	V	Peak	<± 4.6
	42.43	54		Average	<± 4.6

RESTRICTED BANDS. Spurious frequencies closest to the limit:

Restricted Band: Channel	Spurious frequency (GHz)	Emission Level (dBµV/m)	Limit (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
RB1: CH1	2.389	52.56	74	V	Peak	<± 4.6
	2.3485	52.92	74	H	Peak	
RB2: CH11	2.4955	52.79	74	V	Peak	<± 4.6
	2.499	52.43	74	V	Peak	

- **MIDDLE CHANNEL.** Spurious frequencies closest to the limit:

Spurious frequency (GHz)	Emission Level (dBµV/m)	Limit (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
2.8905	55.12	74	V	Peak	<± 4.6
	42.46	54		Average	<± 4.6
2.8985	55.52	74	V	Peak	<± 4.6
	42.37	54		Average	<± 4.6
2.297	52.22	74	H	Peak	<± 4.6
	39.82	54		Average	<± 4.6
13.523	53.04	74	V	Peak	<± 4.6

RESTRICTED BANDS. Spurious frequencies closest to the limit:

Restricted Band: Channel	Spurious frequency (GHz)	Emission Level (dB μ V/m)	Limit (dB μ V/m)	Polarization	Detector	Measurement Uncertainty (dB)
RB1: CH1	2.3665	52.91	74	V	Peak	< \pm 4.6
RB2: CH11	2.4955	53.47	74	H	Peak	< \pm 4.6
	2.499	53.39	74	H	Peak	< \pm 4.6

- HIGH CHANNEL. Spurious frequencies closest to the limit:

Spurious frequency (GHz)	Emission Level (dB μ V/m)	Limit (dB μ V/m)	Polarization	Detector	Measurement Uncertainty (dB)
2.26	53.56	74	V	Peak	< \pm 4.6
2.877	55.27	74	H	Peak	< \pm 4.6
	42.45	54		Average	< \pm 4.6
2.8945	55.14	74	H	Peak	< \pm 4.6
	42.46	54		Average	< \pm 4.6
3.6075	44.32	74	H	Peak	< \pm 4.6

RESTRICTED BANDS. Spurious frequencies closest to the limit:

Restricted Band: Channel	Spurious frequency (GHz)	Emission Level (dB μ V/m)	Limit (dB μ V/m)	Polarization	Detector	Measurement Uncertainty (dB)
RB1: CH1	2.3465	52.76	74	V	Peak	< \pm 4.6
	2.3685	52.51	74	H	Peak	< \pm 4.6
RB2: CH11	2.4955	52.73	74	V	Peak	< \pm 4.6

Verdict: PASS

• Pi/4-DQPSK (2DH5):

- LOW CHANNEL. Spurious frequencies closest to the limit:

Spurious frequency (GHz)	Emission Level (dB μ V/m)	Limit (dB μ V/m)	Polarization	Detector	Measurement Uncertainty (dB)
2.2965	53.49	74	V	Peak	< \pm 4.6
2.235	53.35	74	H	Peak	< \pm 4.6
2.891	56.15	74	H	Peak	< \pm 4.6
	42.27	54		Average	< \pm 4.6
13.592	52.31	74	H	Peak	< \pm 4.6

RESTRICTED BANDS. Spurious frequencies closest to the limit:

Restricted Band: Channel	Spurious frequency (GHz)	Emission Level (dB μ V/m)	Limit (dB μ V/m)	Polarization	Detector	Measurement Uncertainty (dB)
RB1: CH1	2.385	52.96	74	H	Peak	< \pm 4.6
RB2: CH11	2.495	53.4	74	V	Peak	< \pm 4.6

- MIDDLE CHANNEL. Spurious frequencies closest to the limit:

Spurious frequency (GHz)	Emission Level (dB μ V/m)	Limit (dB μ V/m)	Polarization	Detector	Measurement Uncertainty (dB)
2.2815	53.36	74	H	Peak	< \pm 4.6
2.87	52.19	74	H	Peak	< \pm 4.6
3.103	48.53	74	V	Peak	< \pm 4.6
6.394	38.87	74	V	Peak	< \pm 4.6
4.3415	48.69	74	H	Peak	< \pm 4.6
5.575	45.86	74	H	Peak	< \pm 4.6

RESTRICTED BANDS. Spurious frequencies closest to the limit:

Restricted Band: Channel	Spurious frequency (GHz)	Emission Level (dB μ V/m)	Limit (dB μ V/m)	Polarization	Detector	Measurement Uncertainty (dB)
RB1: CH1	2.3835	52.81	74	V	Peak	< \pm 4.6
RB2: CH11	2.4975	52.9	74	H	Peak	< \pm 4.6

- HIGH CHANNEL. Spurious frequencies closest to the limit:

Spurious frequency (GHz)	Emission Level (dB μ V/m)	Limit (dB μ V/m)	Polarization	Detector	Measurement Uncertainty (dB)
2.873	55.46	74	V	Peak	< \pm 4.6
	42.37	54		Average	< \pm 4.6
2.2285	53.21	74	H	Peak	< \pm 4.6
3.5275	35.56	74	V	Peak	< \pm 4.6
4.4695	46.28	74	V	Peak	< \pm 4.6
6.704	42.98	74	H	Peak	< \pm 4.6

RESTRICTED BANDS. Spurious frequencies closest to the limit:

Restricted Band: Channel	Spurious frequency (GHz)	Emission Level (dB μ V/m)	Limit (dB μ V/m)	Polarization	Detector	Measurement Uncertainty (dB)
RB1: CH1	2.3125	53.18	74	V	Peak	< \pm 4.6
RB2: CH11	2.4975	52.95	74	H	Peak	< \pm 4.6

Verdict: PASS

• **8-DPSK modulation (3DH5):**

- **LOW CHANNEL.** Spurious frequencies closest to the limit:

Spurious frequency (GHz)	Emission Level (dB μ V/m)	Limit (dB μ V/m)	Polarization	Detector	Measurement Uncertainty (dB)
2.299	52.7	74	V	Peak	< \pm 4.6
2.8775	55.49	74	V	Peak	< \pm 4.6
	42.44	54		Average	< \pm 4.6
2.8915	55.28	74	V	Peak	< \pm 4.6
	42.49	54		Average	< \pm 4.6
3.5275	36.04	74	V	Peak	< \pm 4.6
4.7005	46.28	74	V	Peak	< \pm 4.6

RESTRICTED BANDS. Spurious frequencies closest to the limit:

Restricted Band: Channel	Spurious frequency (GHz)	Emission Level (dB μ V/m)	Limit (dB μ V/m)	Polarization	Detector	Measurement Uncertainty (dB)
RB1: CH1	2.3715	52.63	74	V	Peak	< \pm 4.6
RB2: CH11	2.5	52.6	74	H	Peak	< \pm 4.6

- **MIDDLE CHANNEL.** Spurious frequencies closest to the limit:

Spurious frequency (GHz)	Emission Level (dB μ V/m)	Limit (dB μ V/m)	Polarization	Detector	Measurement Uncertainty (dB)
2.290	52.8	74	V	Peak	< \pm 4.6
2.0695	52.88	74	H	Peak	< \pm 4.6
3.5275	36.87	74	V	Peak	< \pm 4.6
4.409	37.48	74	V	Peak	< \pm 4.6
6.2865	42.59	74	H	Peak	< \pm 4.6

RESTRICTED BANDS. Spurious frequencies closest to the limit:

Restricted Band: Channel	Spurious frequency (GHz)
RB1: CH1	None.
RB2: CH11	None.

- **HIGH CHANNEL.** Spurious frequencies closest to the limit:

Spurious frequency (GHz)	Emission Level (dB μ V/m)	Limit (dB μ V/m)	Polarization	Detector	Measurement Uncertainty (dB)
6.46	43.21	74	V	Peak	< \pm 4.6
3.5275	34.92	74	H	Peak	< \pm 4.6

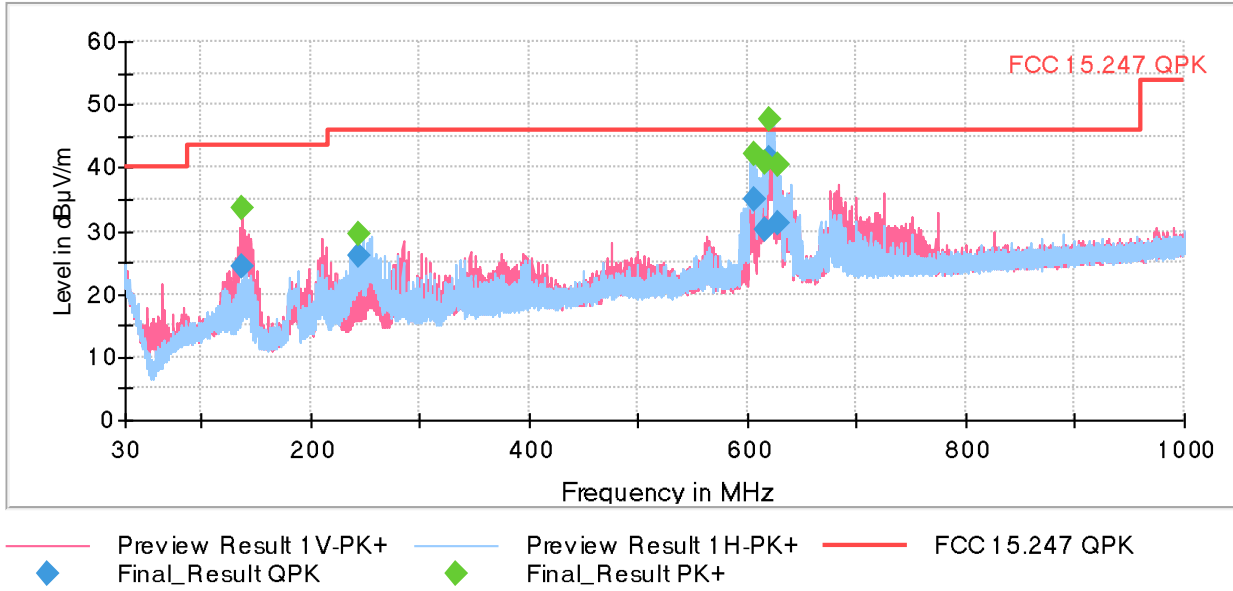
RESTRICTED BANDS. Spurious frequencies closest to the limit:

Restricted Band: Channel	Spurious frequency (GHz)	Emission Level (dB μ V/m)	Limit (dB μ V/m)	Polarization	Detector	Measurement Uncertainty (dB)
RB1: CH1	2.312	54.73	74	H	Peak	< \pm 4.6
		44.53	54		Average	
RB2: CH11	2.362	53.35	74	H	Peak	< \pm 4.6
	2.493	52.69	74	V	Peak	< \pm 4.6

Verdict: PASS

FREQUENCY RANGE 30 MHz - 1 GHz:

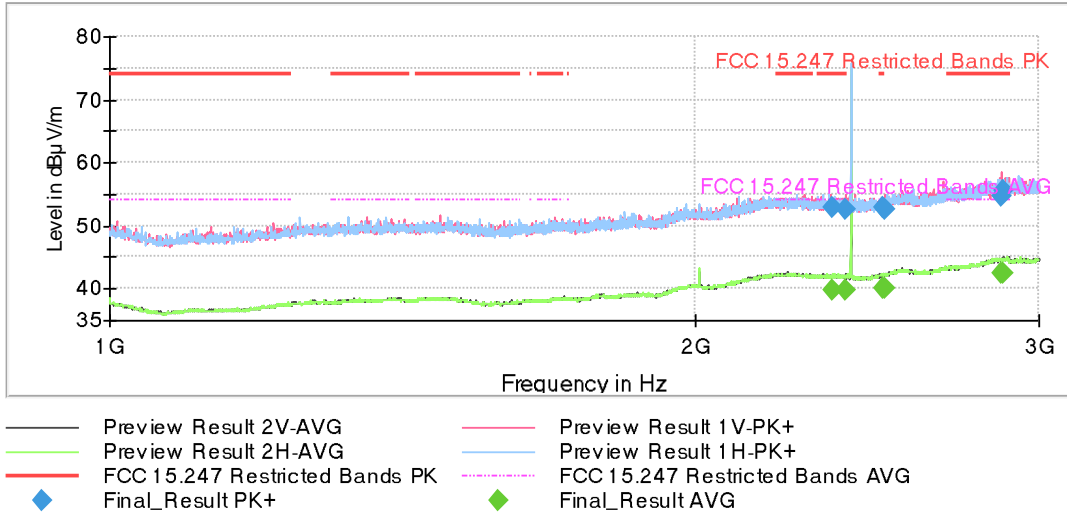
This plot is valid for the Low, Middle and High Channels and all the modulation modes.



FREQUENCY RANGE 1 - 3 GHz:

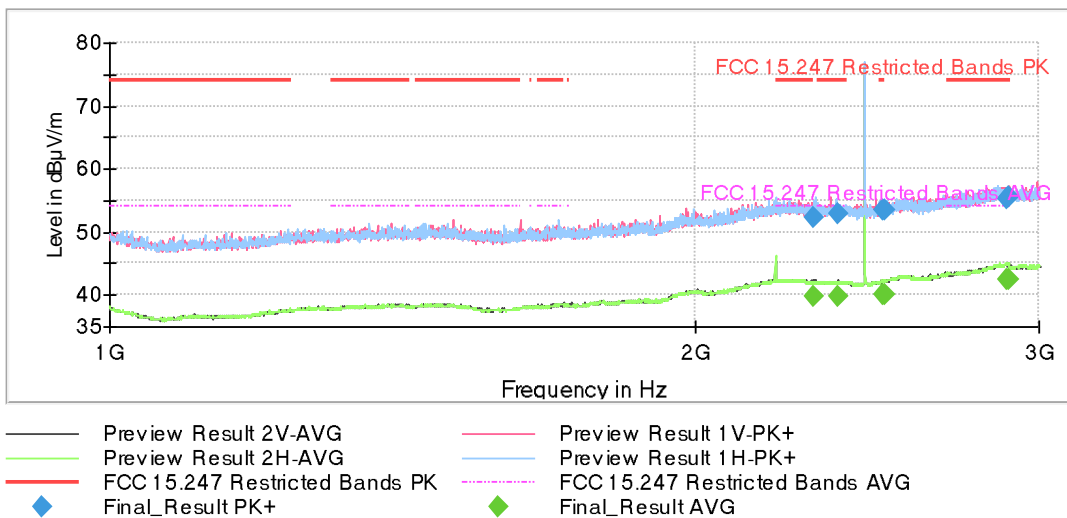
- GFSK modulation (DH5)**

- Low Channel (2402 MHz):



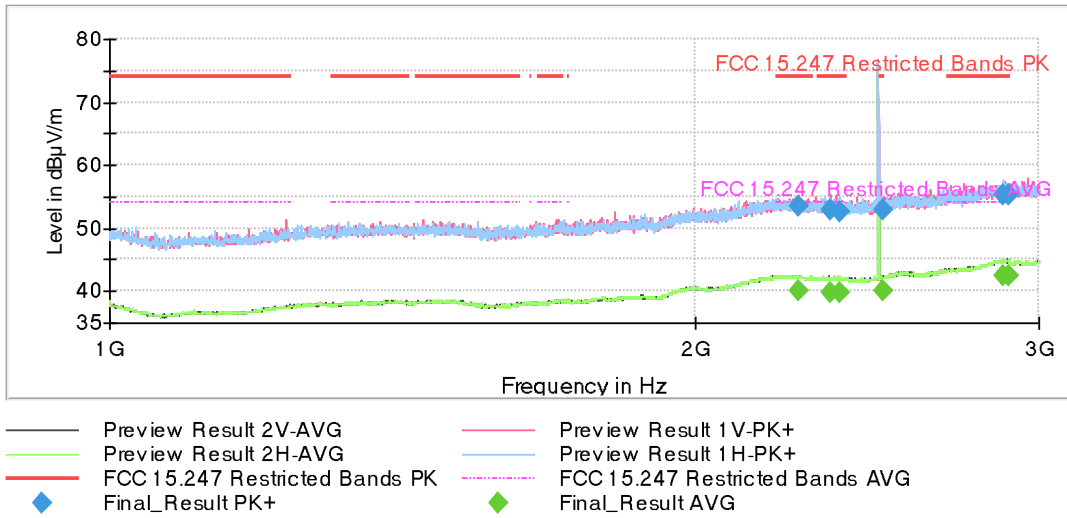
The peak above the limit is the carrier frequency.

- Middle Channel (2441 MHz):



The peak above the limit is the carrier frequency.

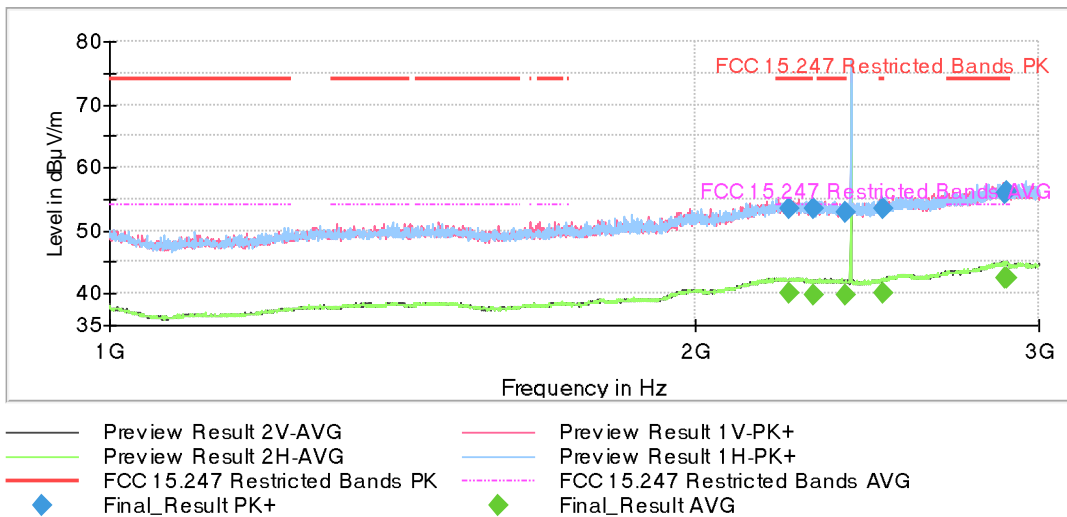
- High Channel (2480 MHz):



The peak above the limit is the carrier frequency.

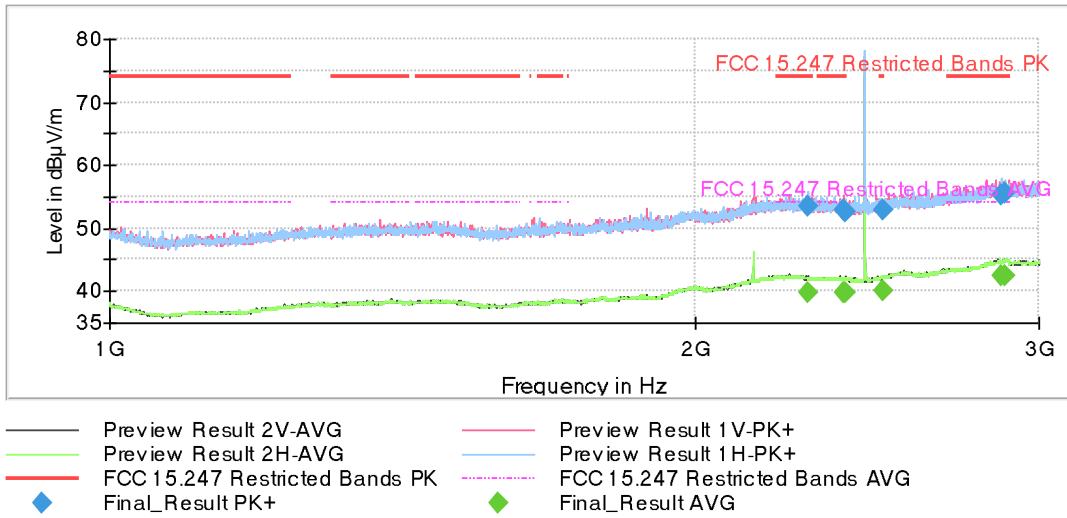
• Pi/4-DQPSK modulation (2DH5):

- Low Channel (2402 MHz):



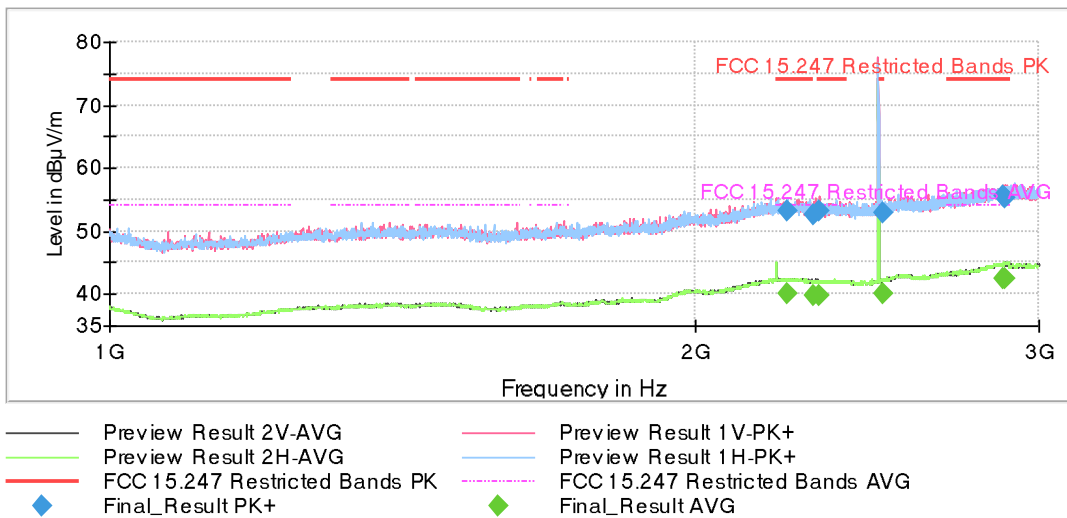
The peak above the limit is the carrier frequency.

- Middle Channel (2441 MHz):



The peak above the limit is the carrier frequency.

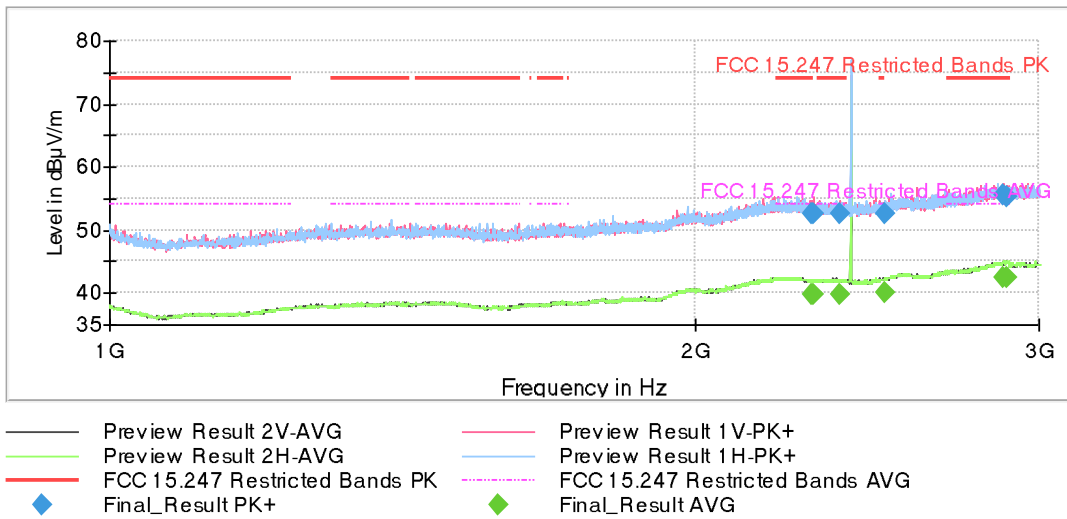
- High Channel (2480 MHz):



The peak above the limit is the carrier frequency.

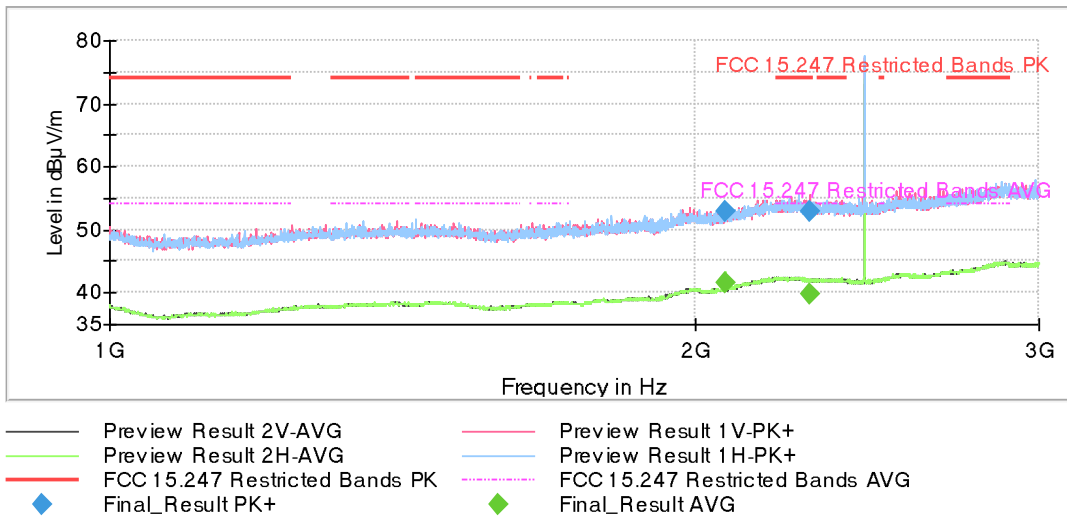
• **8-DPSK modulation (3DH5):**

- Low Channel (2402 MHz):



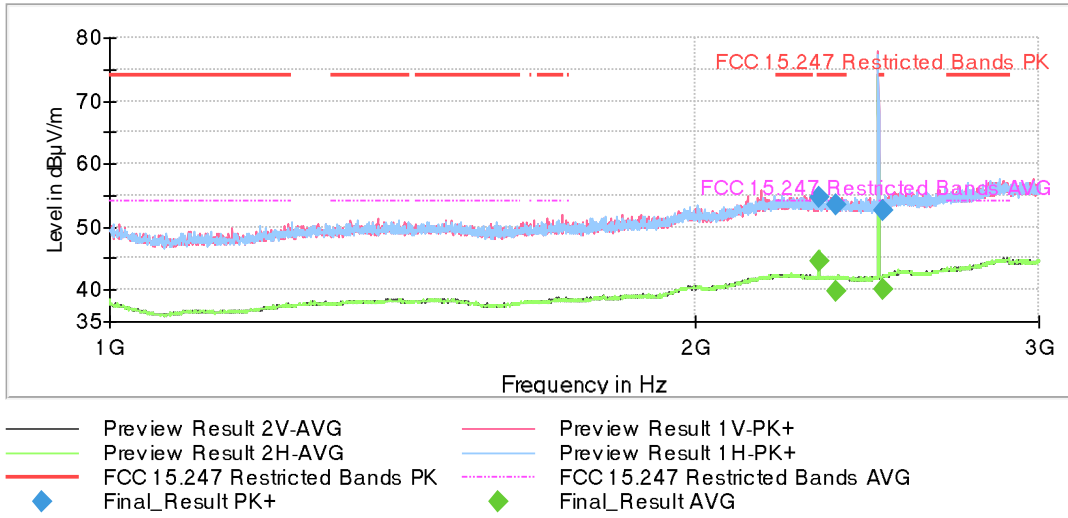
The peak above the limit is the carrier frequency.

- Middle Channel (2441 MHz):



The peak above the limit is the carrier frequency.

- High Channel (2480 MHz):

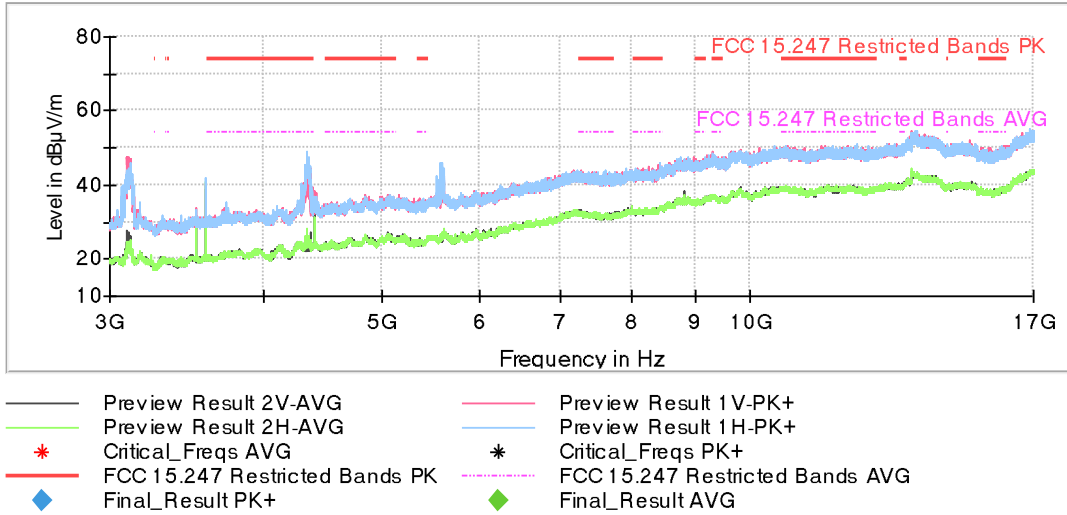


The peak above the limit is the carrier frequency.

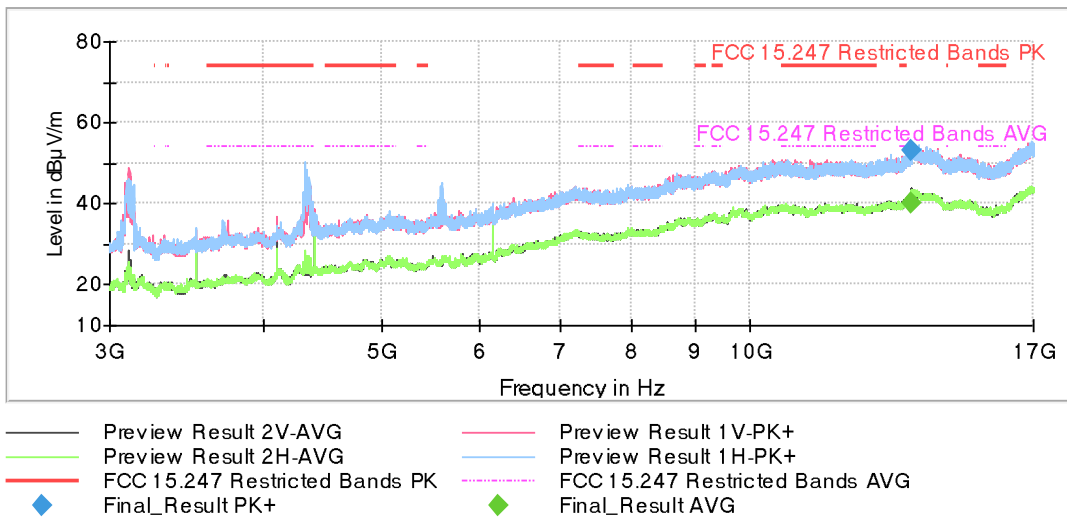
FREQUENCY RANGE 3 - 17 GHz:

• **GFSK modulation (DH5)**

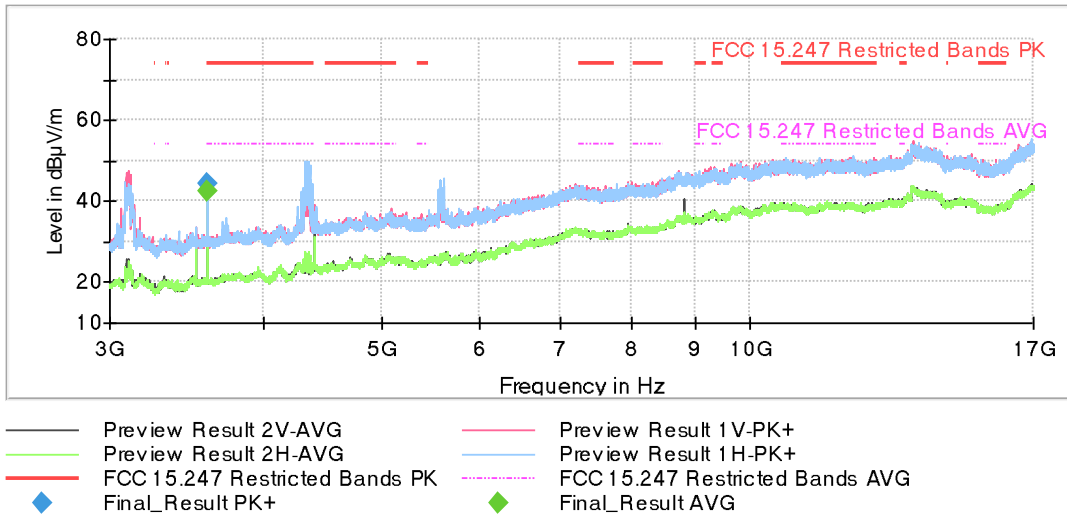
- Low Channel (2402 MHz):



- Middle Channel (2441 MHz):

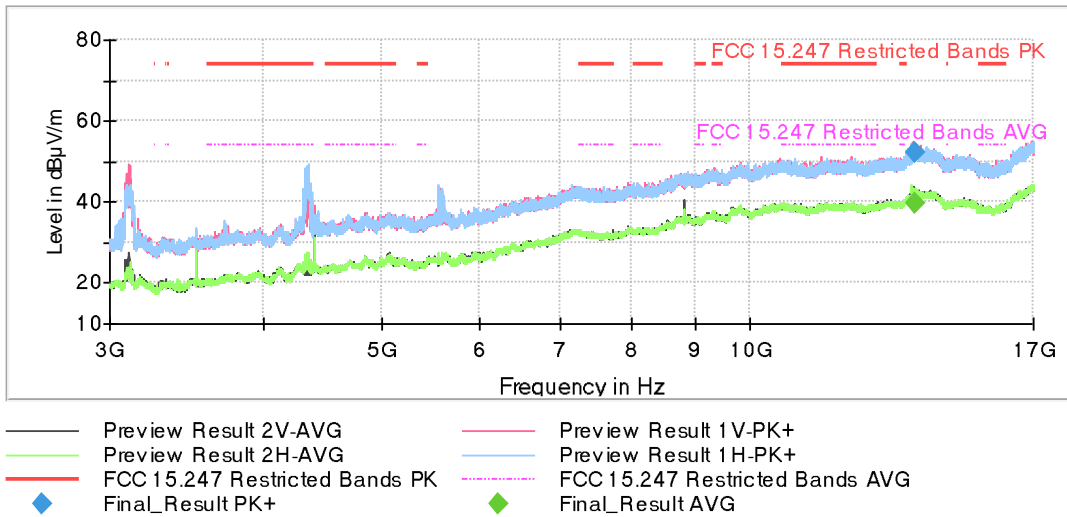


- High Channel (2480 MHz):

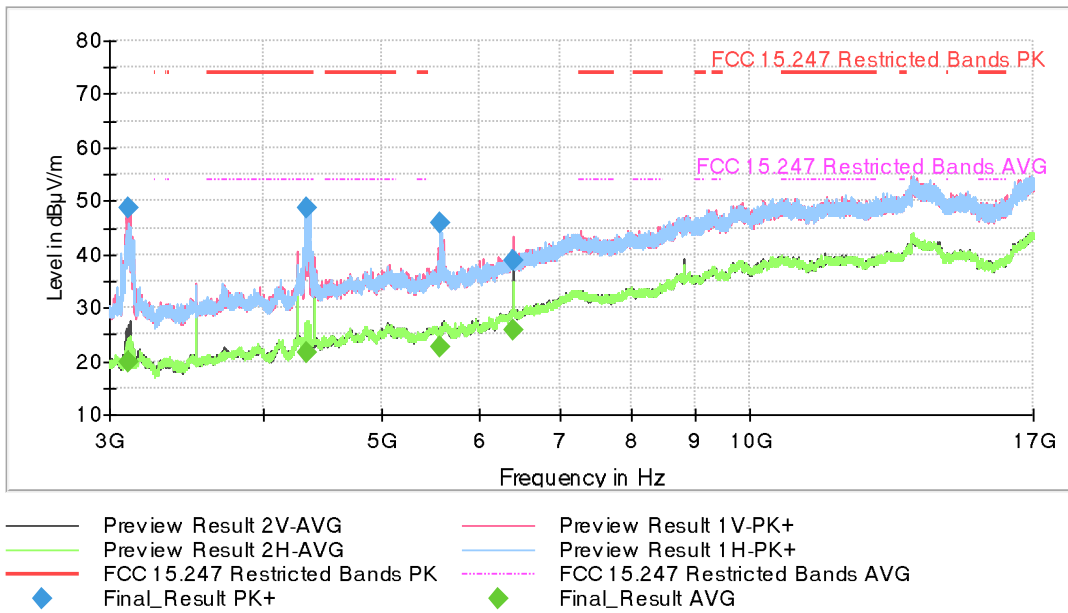


• Pi/4-DQPSK modulation (2DH5):

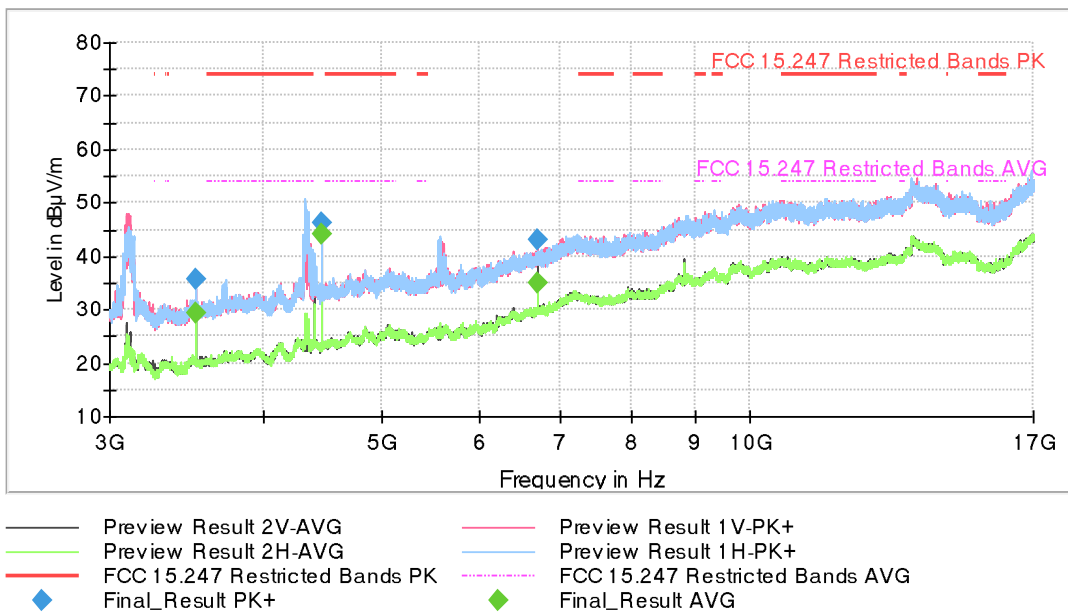
- Low Channel (2402 MHz):



- Middle Channel (2441 MHz):

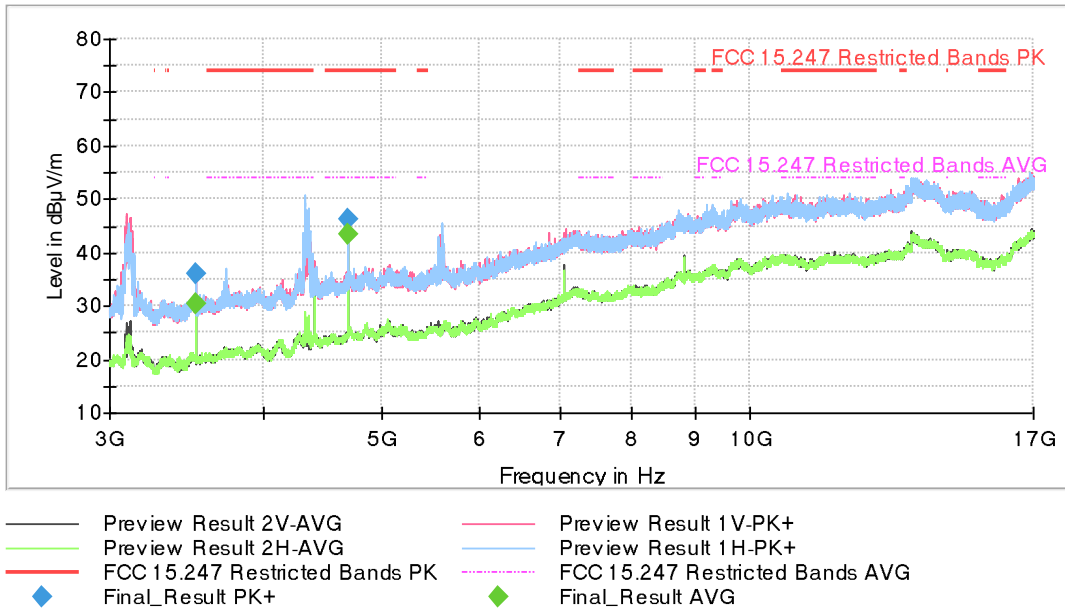


- High Channel (2480 MHz):

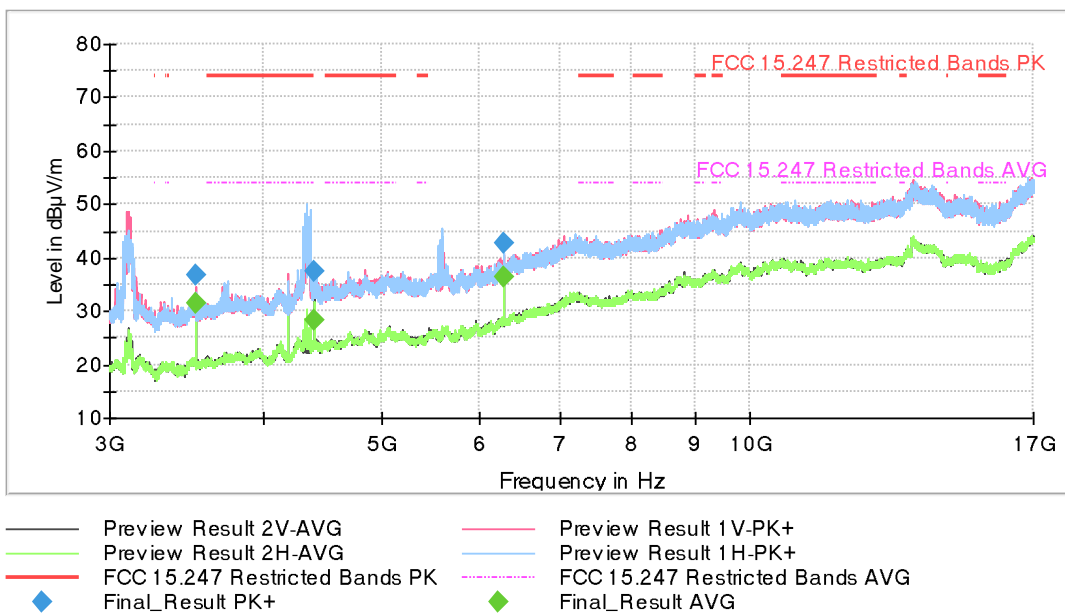


• 8-DPSK modulation (3DH5):

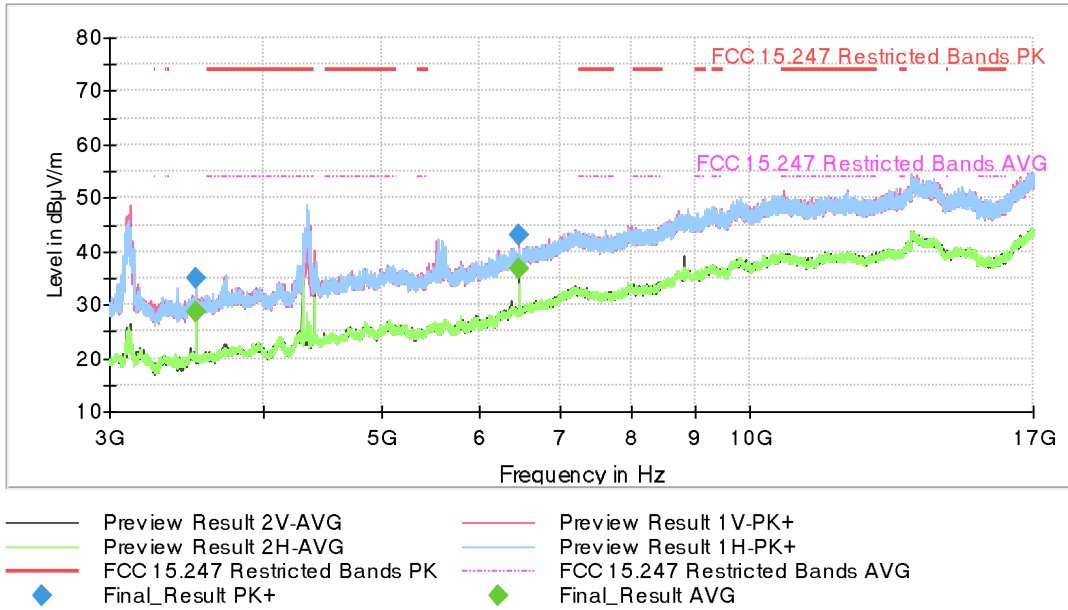
- Low Channel (2402 MHz):



- Middle Channel (2441 MHz):

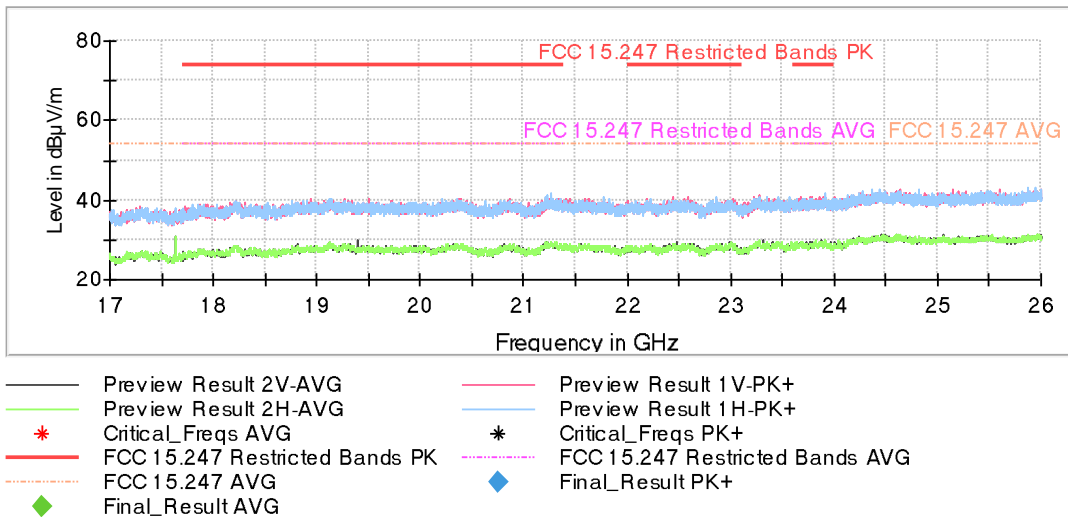


- High Channel (2480 MHz):



FREQUENCY RANGE 17 - 26 GHz:

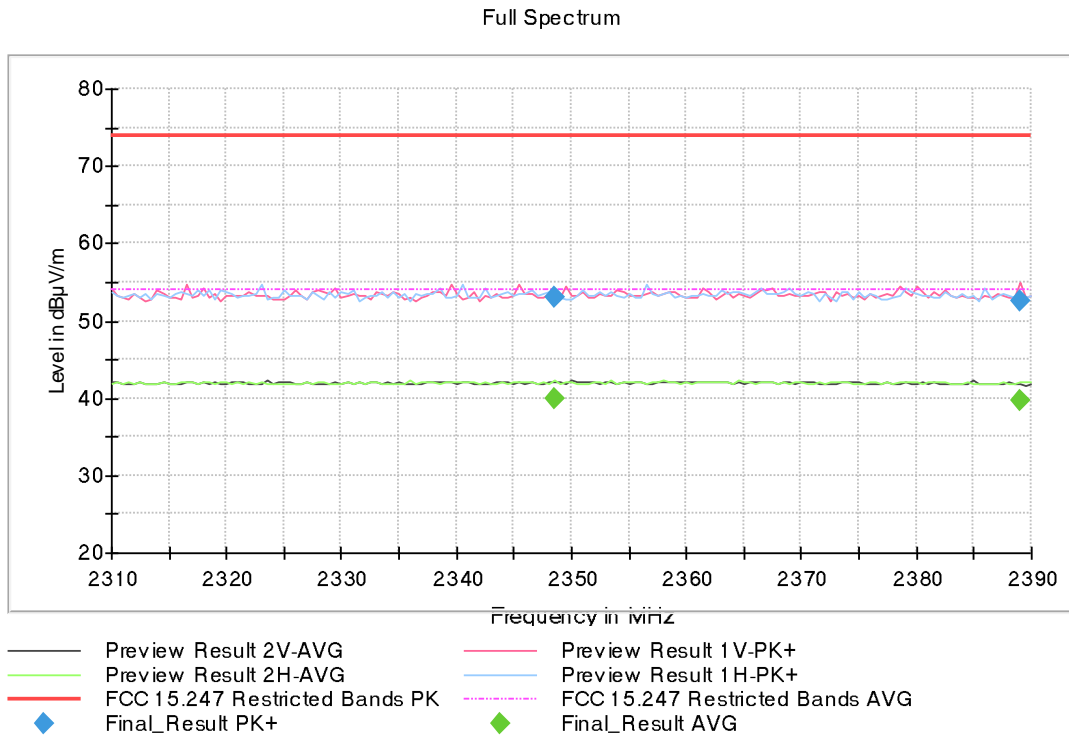
This plot is valid for the Low, Middle and High Channels and all the modulation modes.



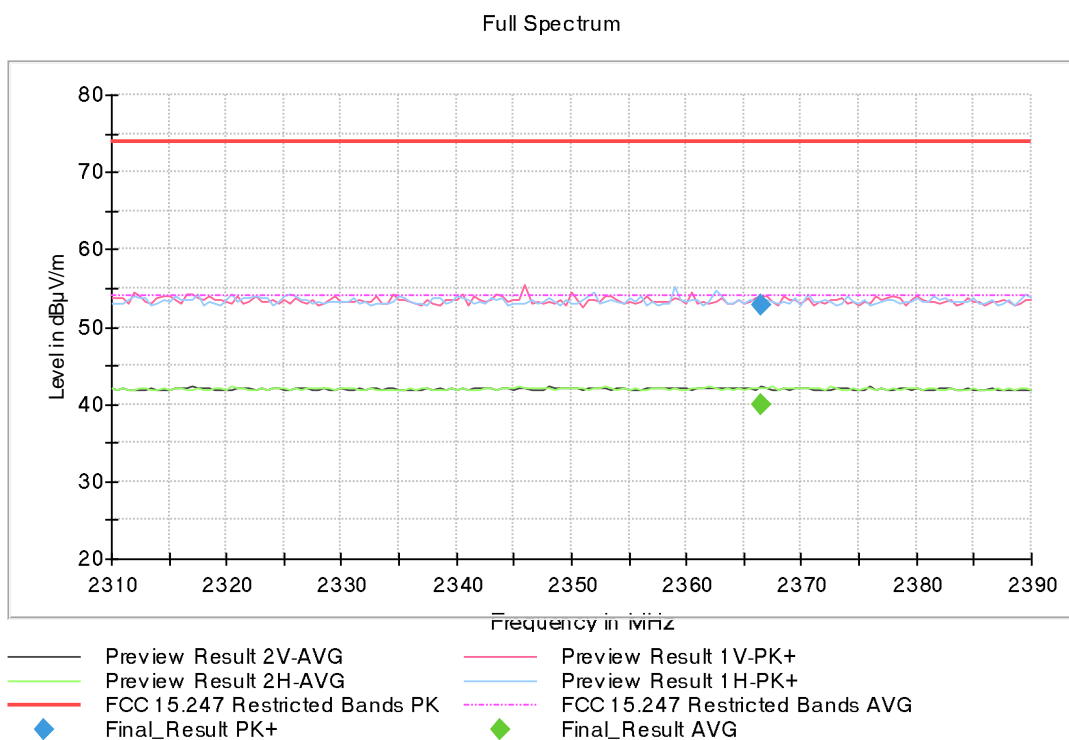
RESTRICTED BAND 2.31-2.39 GHz:

• **GFSK modulation (DH5):**

- Low Channel (2402 MHz):

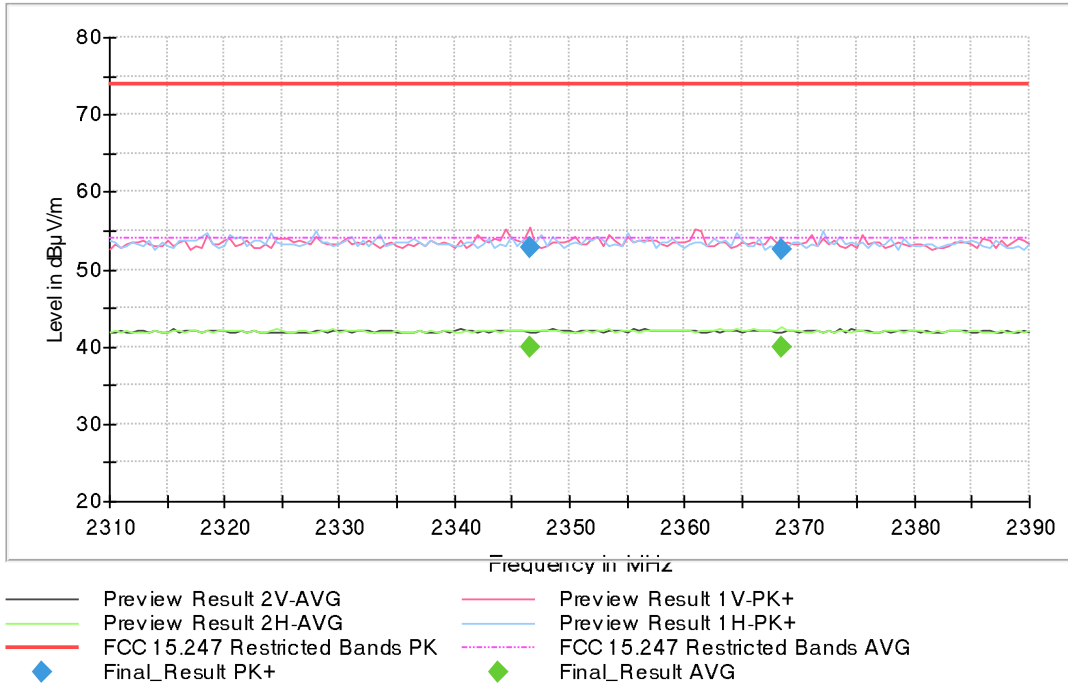


- Middle Channel (2441 MHz):



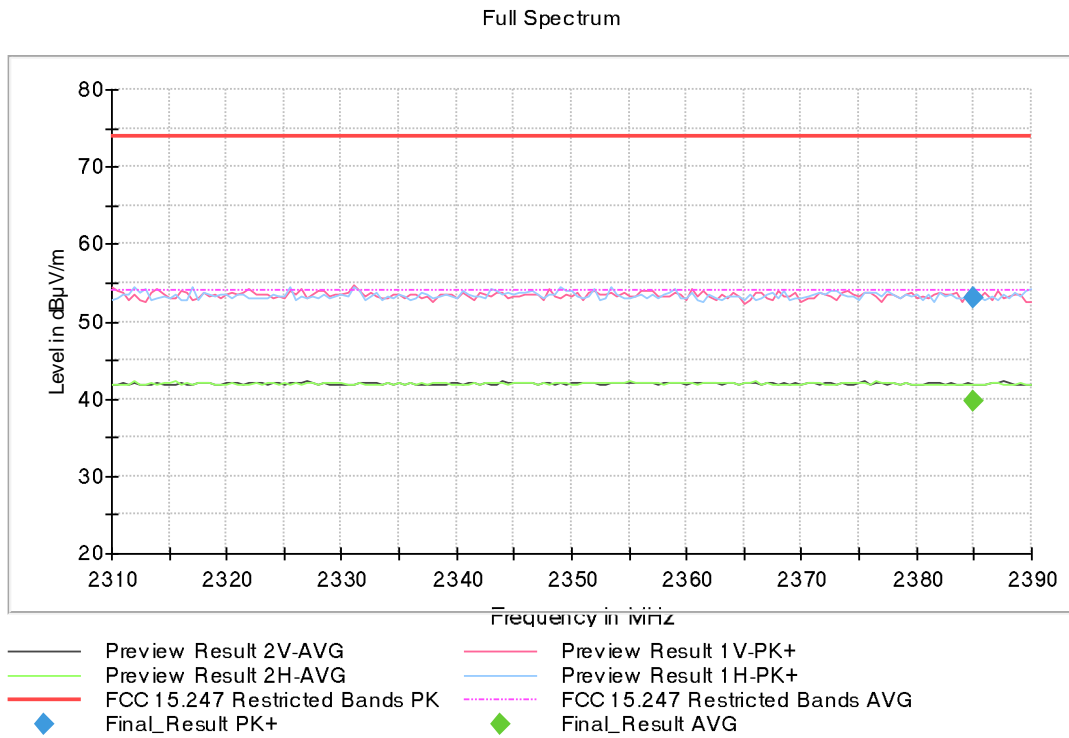
- High Channel (2480 MHz):

Full Spectrum

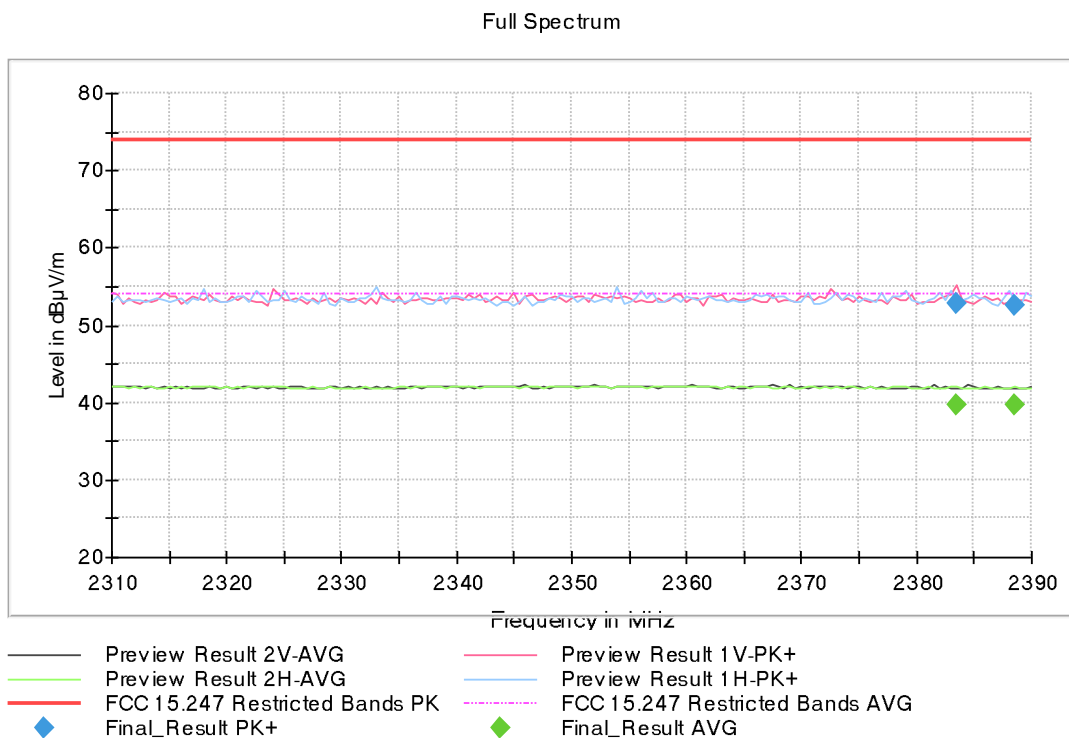


• **Pi/4-DQPSK modulation (2DH5):**

- Low Channel (2402 MHz):

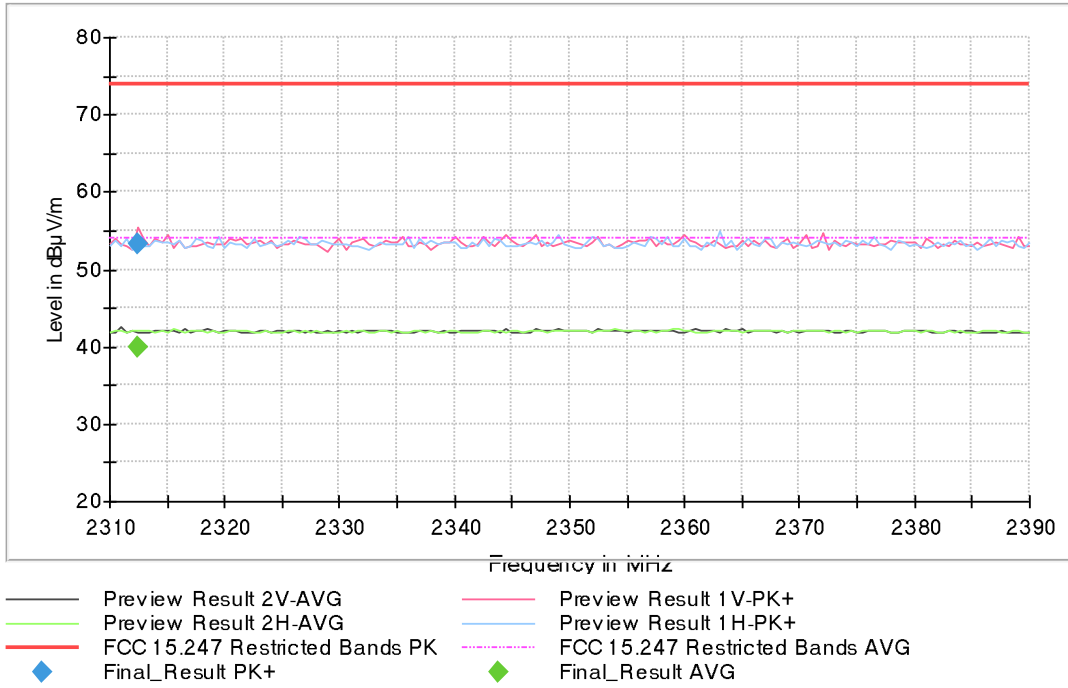


- Middle Channel (2441 MHz):



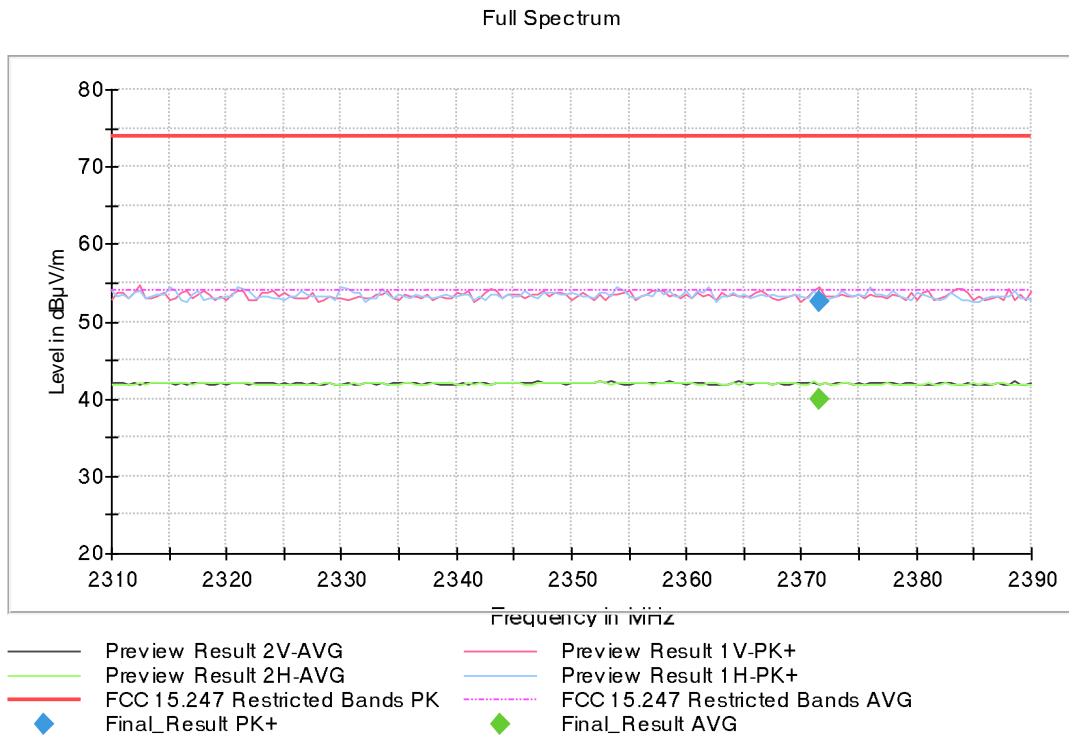
- High Channel (2480 MHz):

Full Spectrum

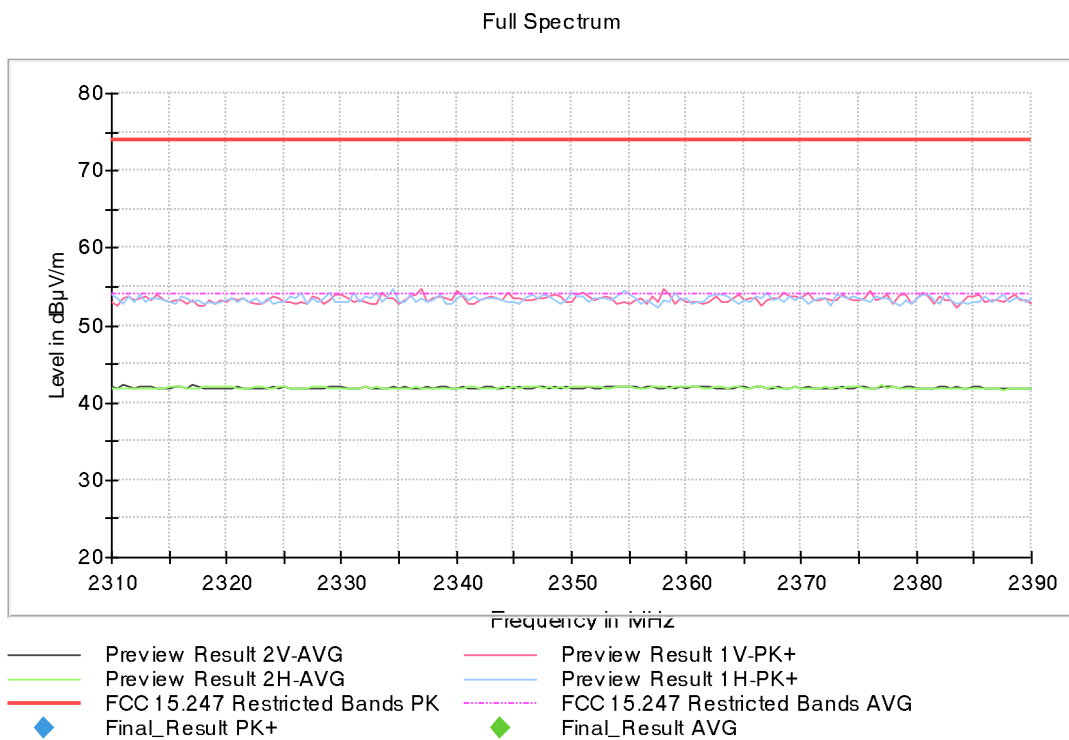


• **8-DPSK modulation (3DH5):**

- Low Channel (2402 MHz):

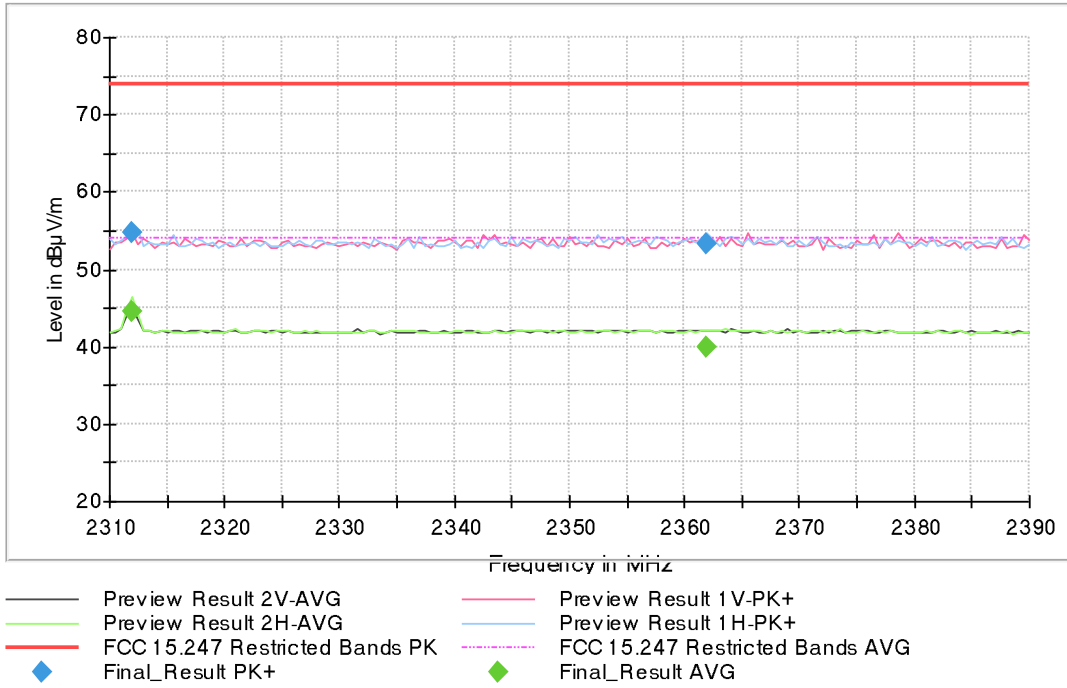


- Middle Channel (2441 MHz):



- High Channel (2480 MHz):

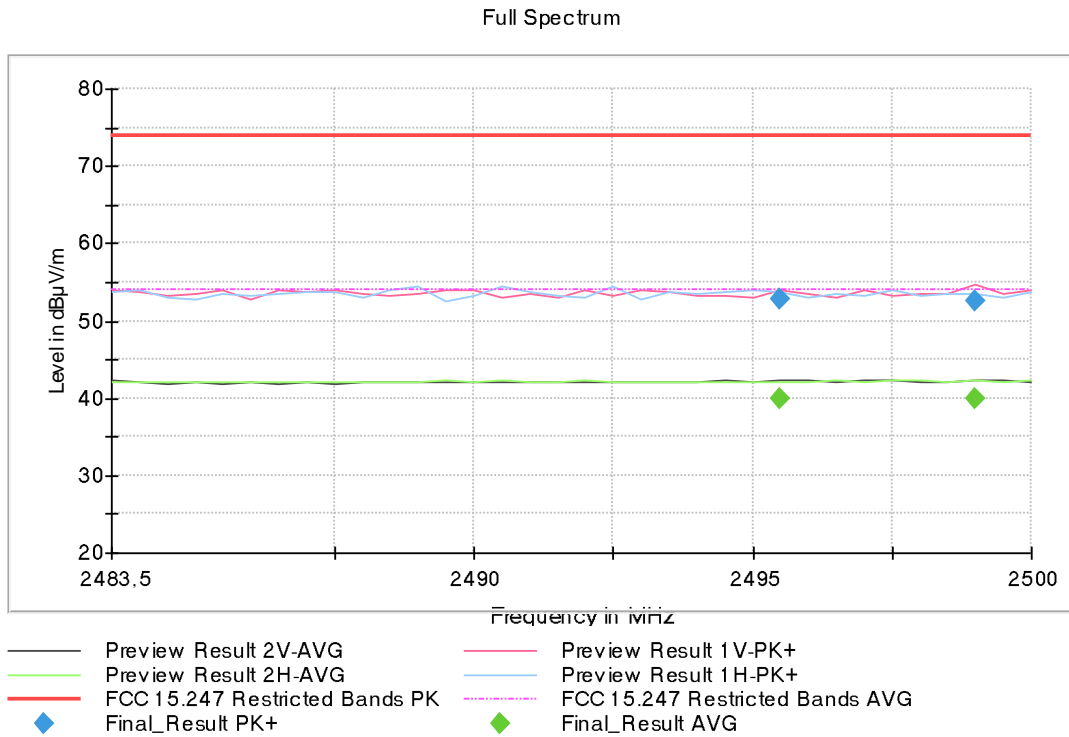
Full Spectrum



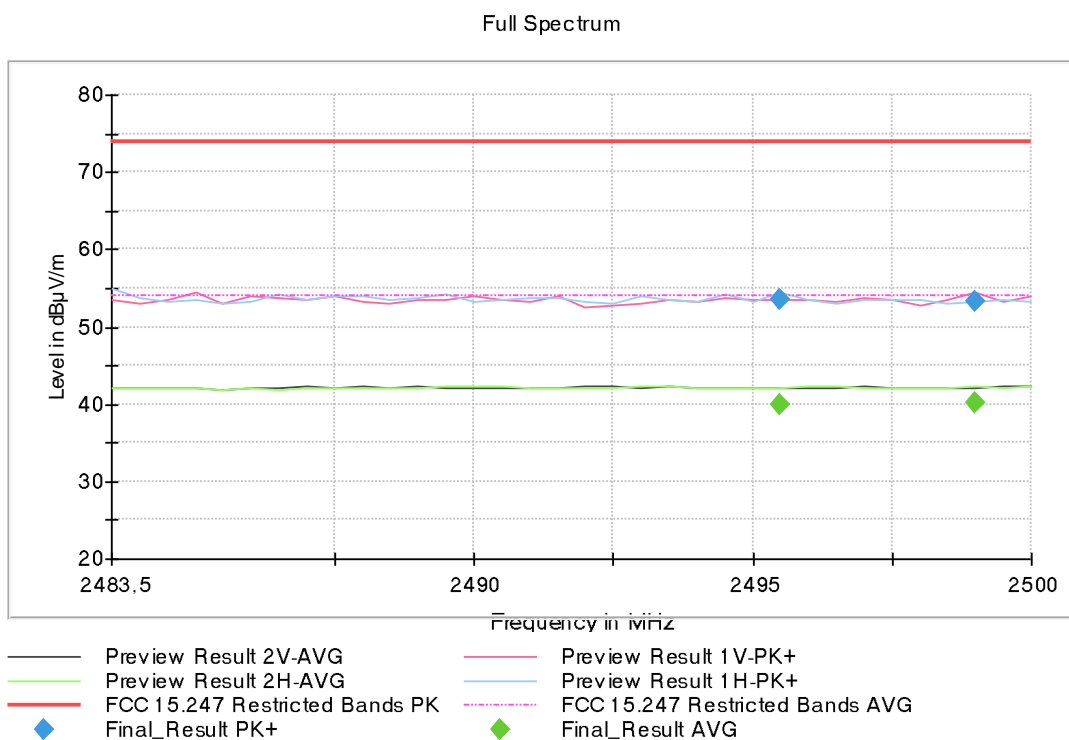
RESTRICTED BAND 2.4835-2.5 GHz:

• **GFSK modulation (DH5):**

- Low Channel (2402 MHz):

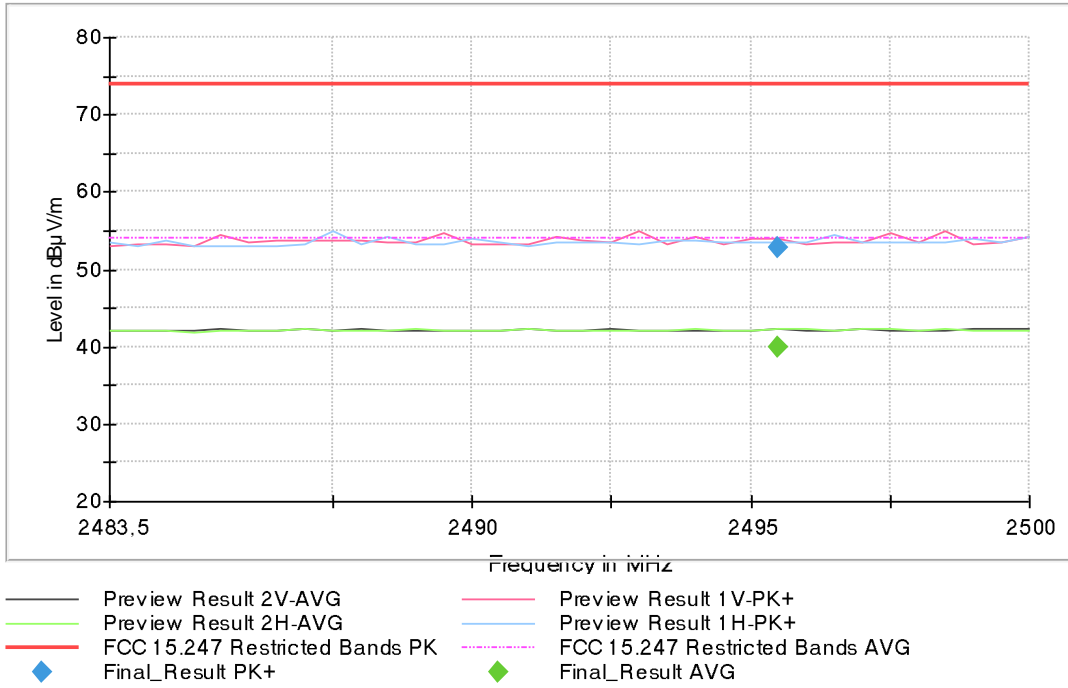


- Middle Channel (2441 MHz):



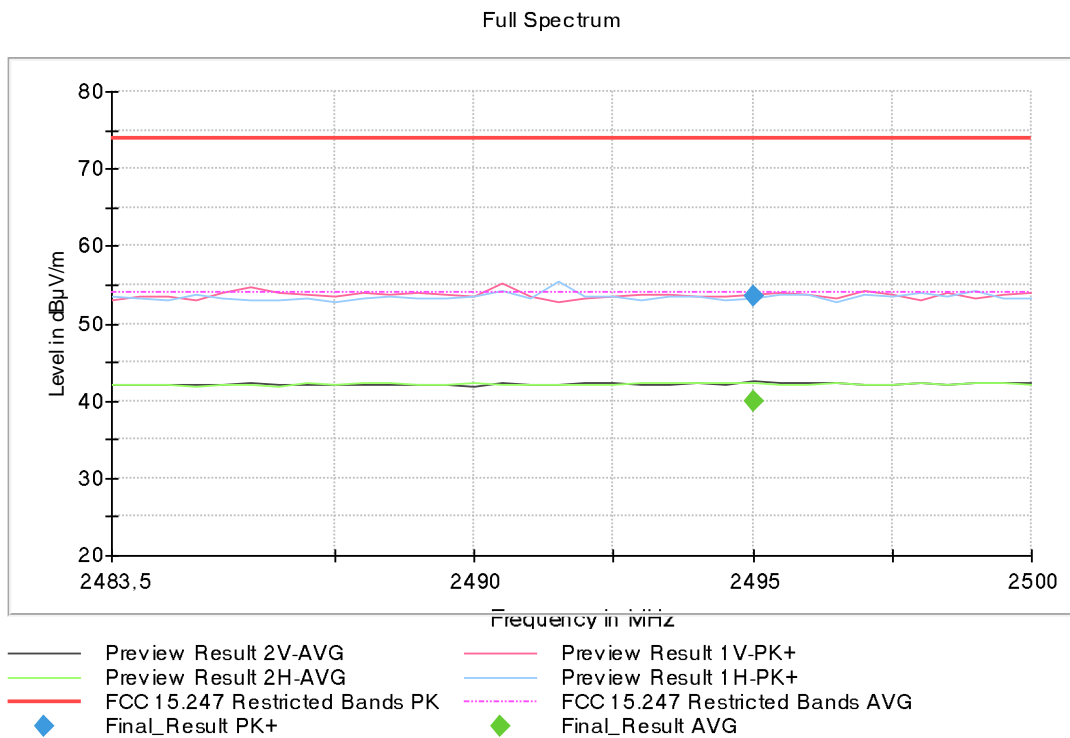
- High Channel (2480 MHz):

Full Spectrum

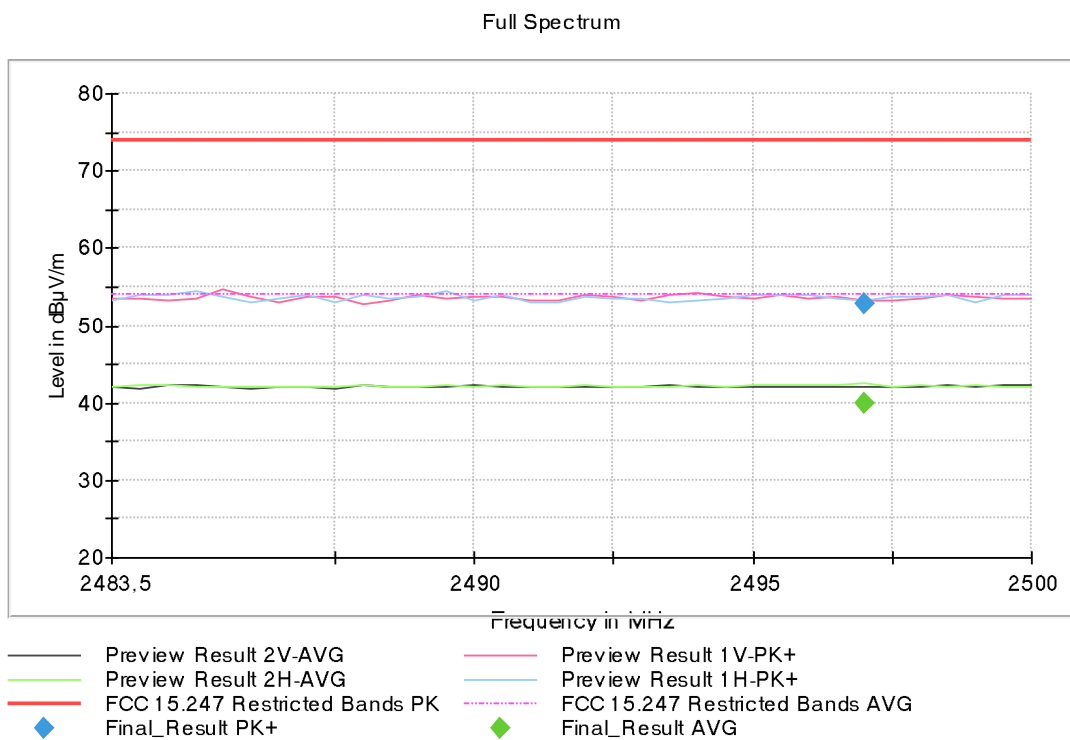


• **Pi/4-DQPSK modulation (2DH5):**

- Low Channel (2402 MHz):

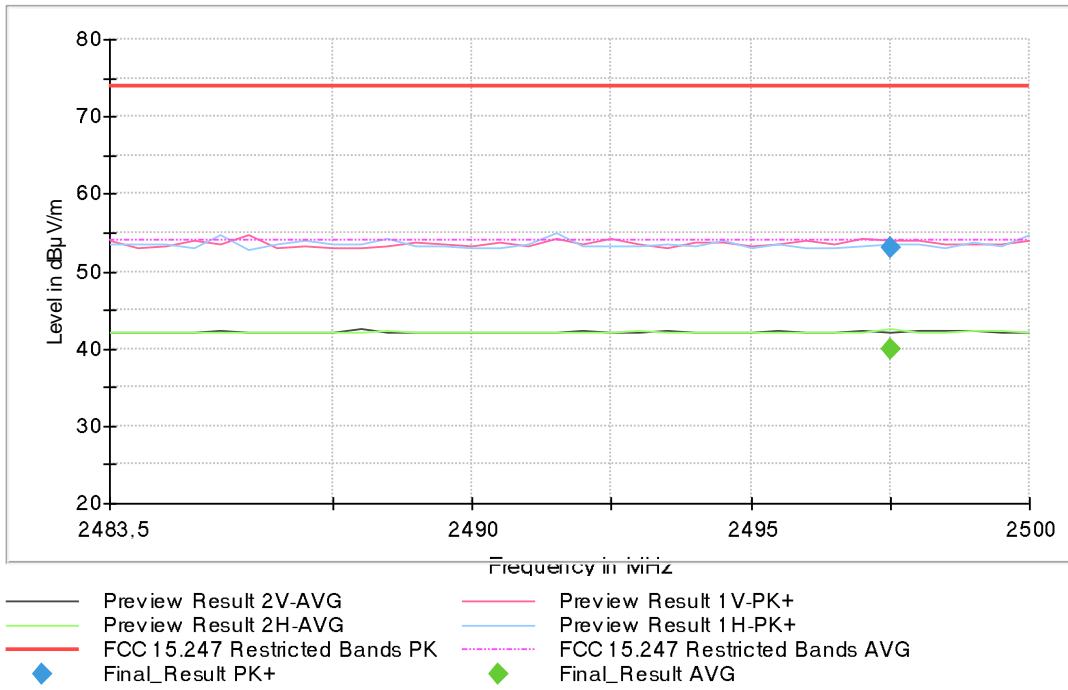


- Middle Channel (2441 MHz):



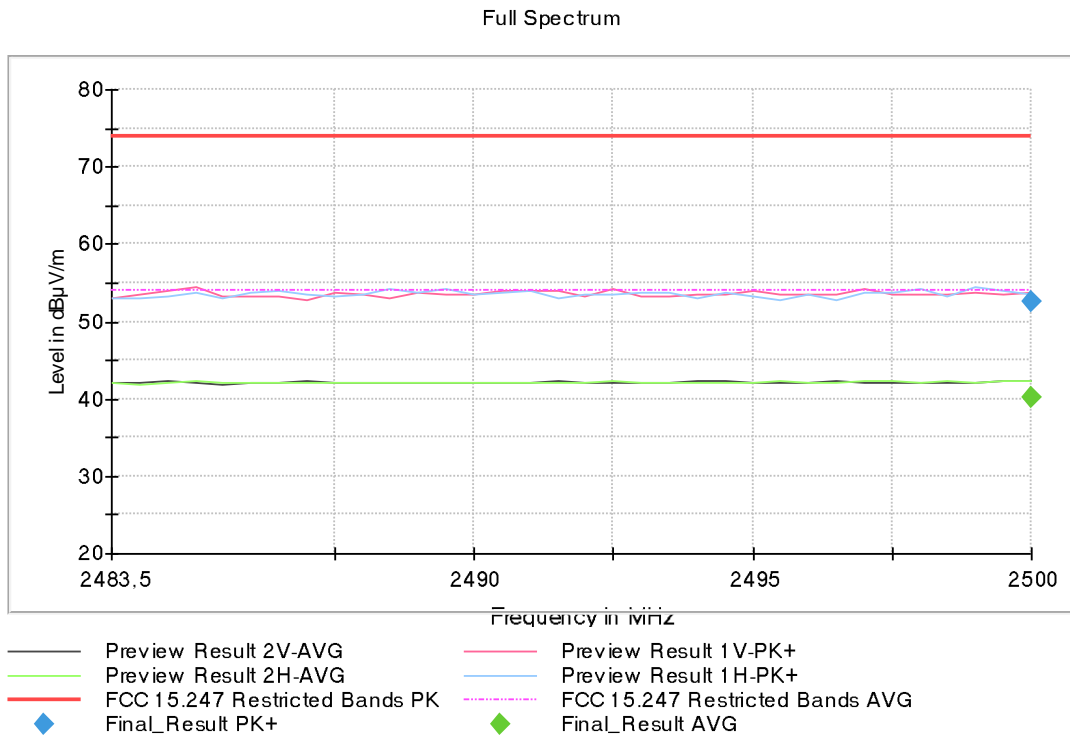
- High Channel (2480 MHz):

Full Spectrum

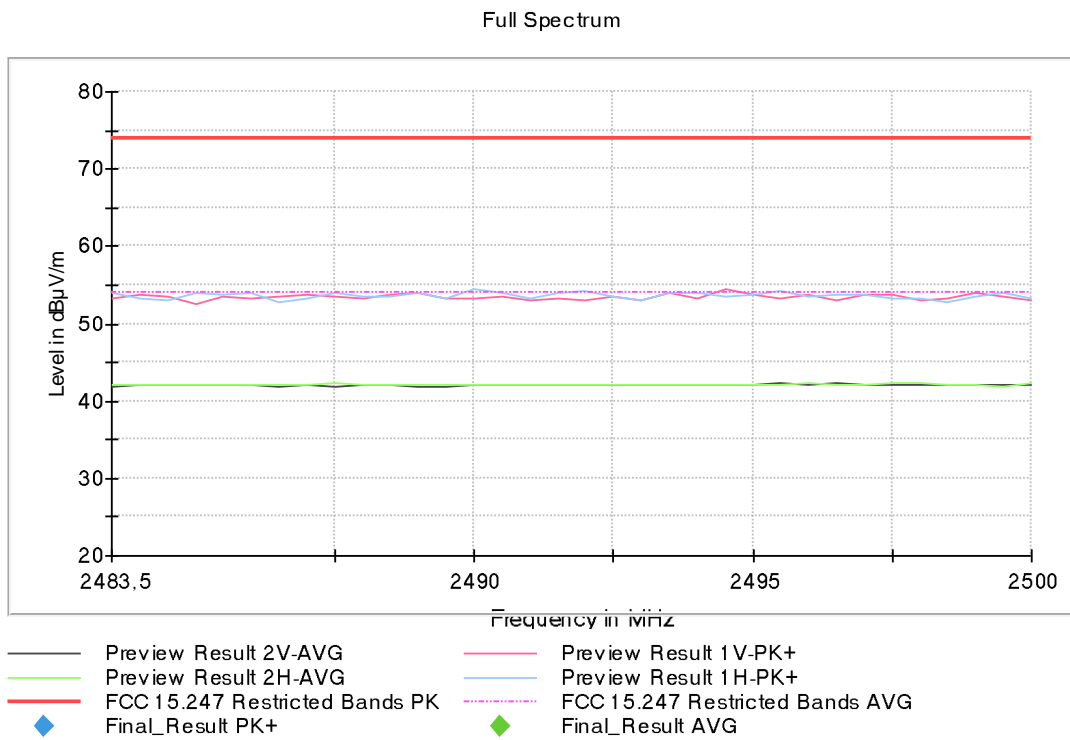


• **8-DPSK modulation (3DH5):**

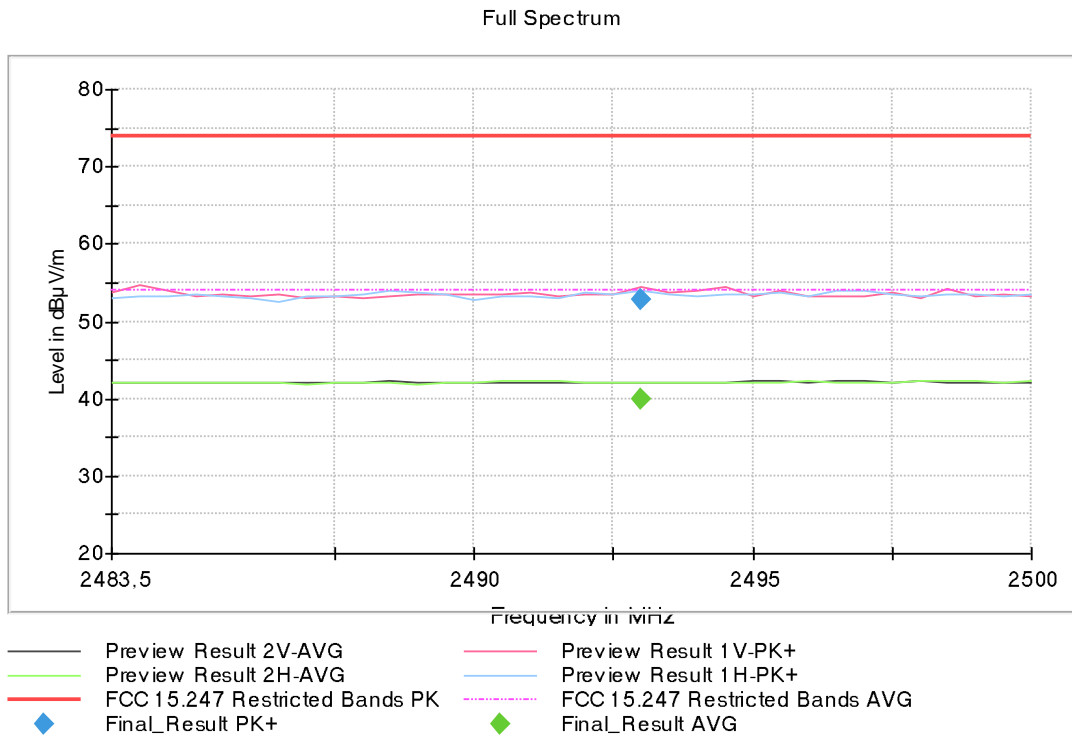
- Low Channel (2402 MHz):



- Middle Channel (2441 MHz):



- High Channel (2480 MHz):



Appendix B: Test results. 802.11 bgn20 1x1

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TEST CONDITIONS	45
FCC 15.247 (d) / RSS-247 5.5. Emission limitations radiated (Transmitter).....	45

TEST CONDITIONS

POWER SUPPLY (V):

V nominal:	12 Vdc.
Type of Power Supply:	DC external (car battery).

ANTENNA:

Type of Antenna:	Integral.
Maximum Declared Antenna Gain:	+0.4 dBi (Antenna gain plus antenna cable loss).

TEST FREQUENCIES:

Low Channel (1):	2412 MHz
Middle Channel (6):	2437 MHz
High Channel (11):	2462 MHz

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

The field strength at the band edges was evaluated for each mode for the channel under test.

During transmitter test the EUT was being controlled by the SW tool to operate in a continuous transmit mode on the test channel as required and in each of the different modulation modes.
The EUT has four separate antennas which correspond to one port of the equipment.

The data rates of 1 Mbps for 802.11 b, 6.5 Mbps for 802.11 g, and index MCS0 for 802.11 n HT20 were selected based on preliminary testing that identified those rates corresponding to the worst cases for output power and band edge levels at restricted bands.

RADIATED MEASUREMENTS:

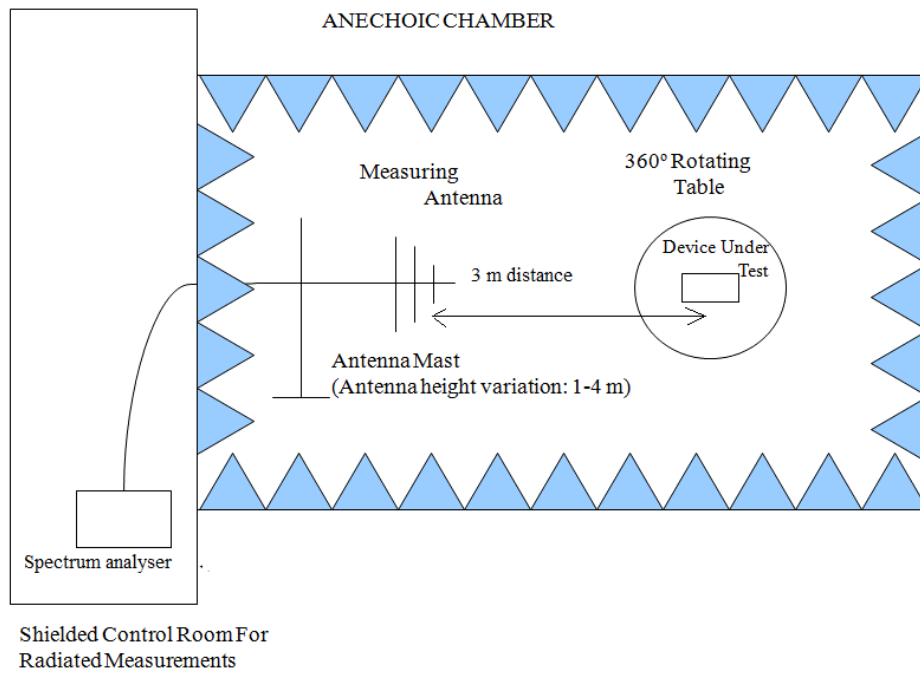
All radiated tests were performed in a semi-anechoic chamber. The measurement antenna (Bilog antenna for the range between 30 MHz to 1 GHz and 1 GHz-17 GHz Double ridge horn antenna) is situated at a distance of 3 m and at a distance of 1m for the frequency range 17 GHz-26 GHz (17 GHz-26 GHz horn antenna).

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.

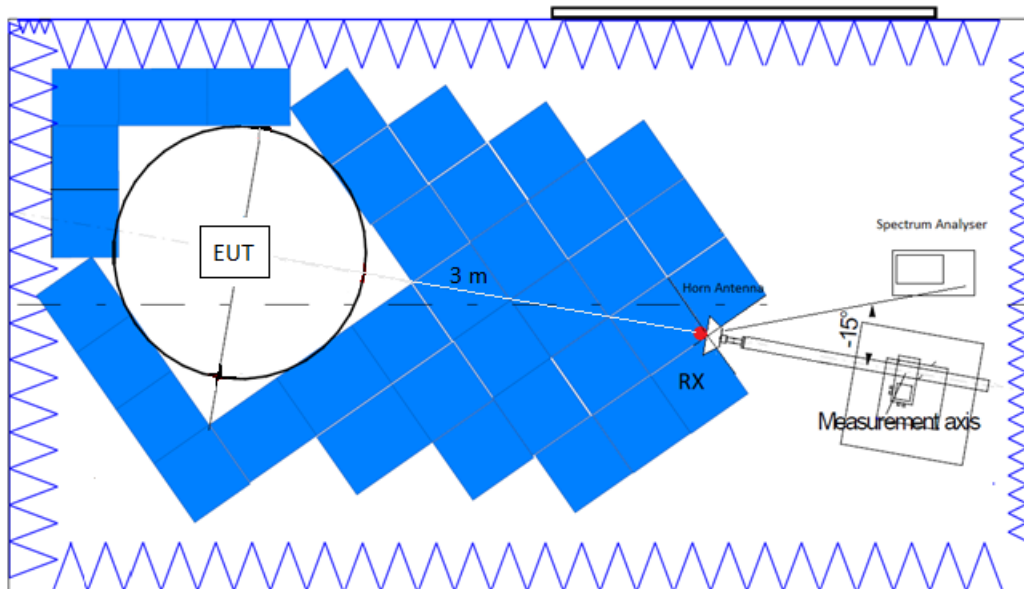
The equipment under test was set up on a non-conductive platform above the ground plane and the situation and orientation was varied to find the maximum radiated emission. It was also rotated 360° and the antenna height (Bilog antenna and Double ridge horn antenna) was varied from 1 to 4 meters to find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

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

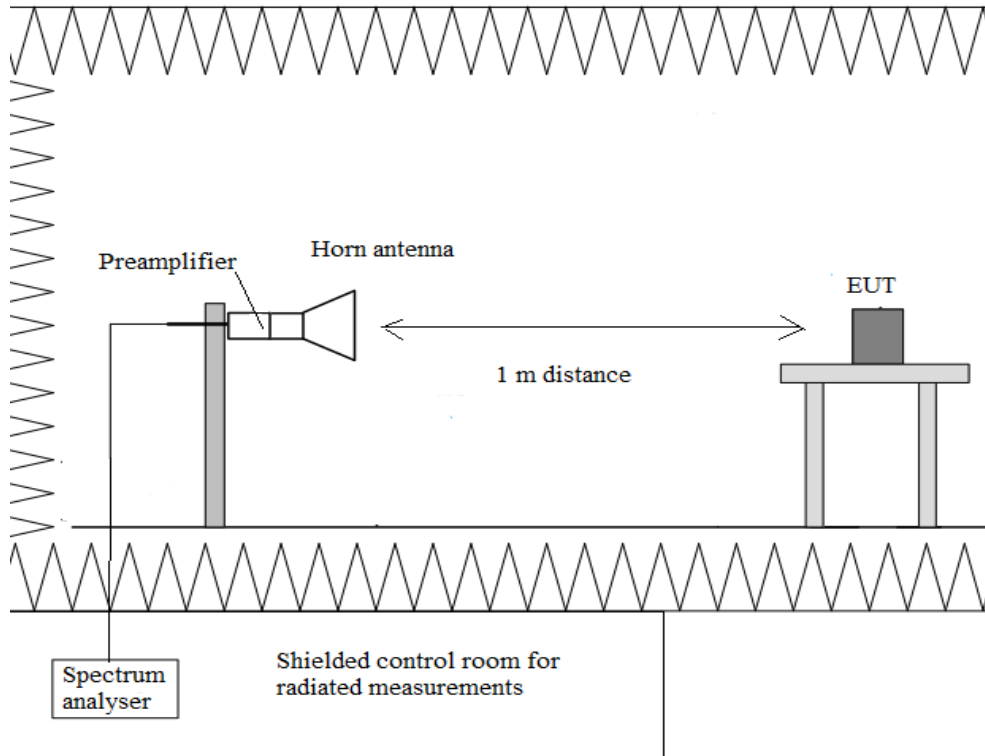
Radiated measurements setup from 30 MHz to 1 GHz:



Radiated measurements setup from 1 GHz to 17 GHz:



Radiated measurements setup $f > 17$ GHz:



FCC 15.247 (d) / RSS-247 5.5. Emission limitations radiated (Transmitter)

SPECIFICATION:

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) / RSS-Gen):

Frequency Range (MHz)	Field strength ($\mu\text{V}/\text{m}$)	Field strength ($\text{dB}\mu\text{V}/\text{m}$)	Measurement distance (m)
0.009-0.490	2400/F(kHz)	-	300
0.490-1.705	24000/F(kHz)	-	30
1.705 - 30.0	30	-	30
30 - 88	100	40	3
88 - 216	150	43.5	3
216 - 960	200	46	3
960 - 25000	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 3 m for the frequency range 30 MHz-17 GHz and at distance of 1m for the frequency range 17 GHz-26 GHz.

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

Frequency range 30 MHz - 1 GHz:

The spurious frequencies do not depend neither on the operating channel nor the modulation mode.

Spurious frequencies at less than 20 dB below the limit:

Spurious frequency (MHz)	Emission Level (dBµV/m)	Limit (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
142.423	23.45	43.5	V	Quasi peak	<± 5.1
606.762	30.7	46	H	Quasi peak	<± 5.1
624.0765	42.04	46	H	Quasi peak	<± 5.1
637.22	34.77	46	H	Quasi peak	<± 5.1
640.3725	37.52	46	H	Quasi peak	<± 5.1

- Mode 802.11 b:**

Frequency range 1 - 26 GHz:

The results in the next tables show the maximum measured levels in the 1-26 GHz range including the restricted bands 2.31-2.39 GHz and 2.4835-2.5 GHz.

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

- LOW CHANNEL. Spurious frequencies closest to the limit:

Spurious frequency (GHz)	Emission Level (dBµV/m)	Limit (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
2.1335	53.08	74	V	Peak	<± 4.6
4.4095	40.74	74	V	Peak	<± 4.6

- MIDDLE CHANNEL. Spurious frequencies closest to the limit:

Spurious frequency (GHz)	Emission Level (dBµV/m)	Limit (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
2.3045	54.83	74	V	Peak	<± 4.6
	44.83	54		Average	<± 4.6
4.4095	41.96	74	V	Peak	<± 4.6
14.098	52.42	74	H	Peak	<± 4.6

- HIGH CHANNEL. Spurious frequencies closest to the limit:

Spurious frequency (GHz)	Emission Level (dBµV/m)	Limit (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
2.0115	52.77	74	V	Peak	<± 4.6
4.4	44.65	74	V	Peak	<± 4.6
11.4905	48.69	74	H	Peak	<± 4.6

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

Verdict: PASS

OFDM modes:

For spurious emissions in the range 30 MHz - 26 GHz (except field strength at the band edges that was performed for all modes) a preliminary scan was performed to determine the worst case mode.

The following results and plots are for the worst case OFDM mode.

Spurious emissions in the Restricted Bands 2.31-2.39 GHz and 2.4835-2.5 GHz are measured for all modes.

- **Worst case OFDM mode: 802.11 n20.**

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

Frequency range 1 - 26 GHz:

The results in the next tables show the maximum measured levels in the 1-26 GHz range including the restricted bands 2.31-2.39 GHz and 2.4835-2.5 GHz.

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

- **LOW CHANNEL.** Spurious frequencies closest to the limit:

Spurious frequency (GHz)	Emission Level (dBµV/m)	Limit (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
2.0815	52.94	74	H	Peak	<± 4.6

- **MIDDLE CHANNEL.** Spurious frequencies closest to the limit:

Spurious frequency (GHz)	Emission Level (dBµV/m)	Limit (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
2.2	55.2	74	V	Peak	<± 4.6
	44.53	54		Average	<± 4.6
8.819	47.2	74	V	Peak	<± 4.6
13.513	53.07	74	H	Peak	<± 4.6

- **HIGH CHANNEL.** Spurious frequencies closest to the limit:

Spurious frequency (GHz)	Emission Level (dBµV/m)	Limit (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
2.2995	53.59	74	H	Peak	<± 4.6
6.7125	44.45	74	V	Peak	<± 4.6
8.819	49.19	74	H	Peak	<± 4.6

- **RESTRICTED BANDS.** No spurious frequencies at less than 20 dB below the limit.

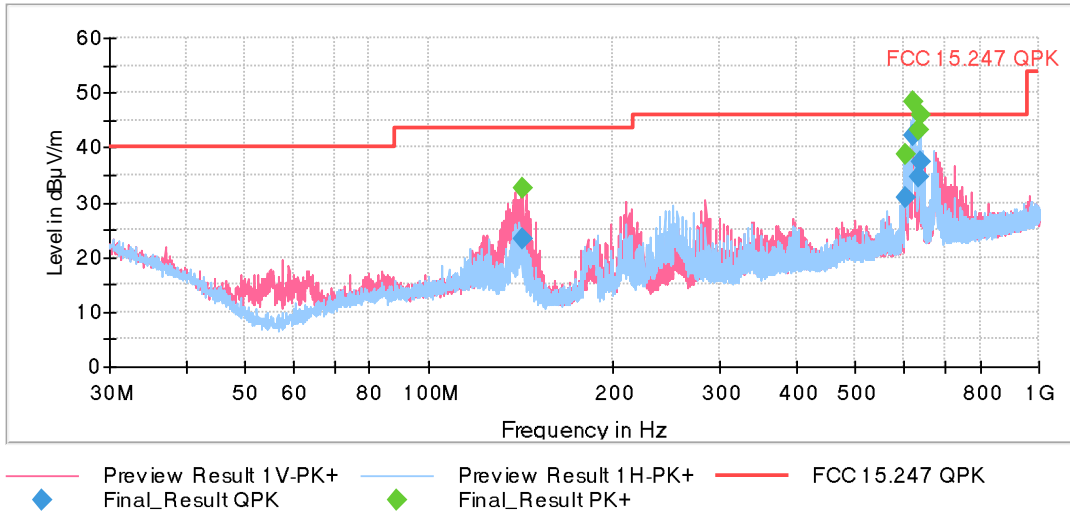
Verdict: PASS

- **Mode 802.11 g:**

The EUT does not transmit modulated in this modulation mode.

FREQUENCY RANGE 30 MHz - 1 GHz:

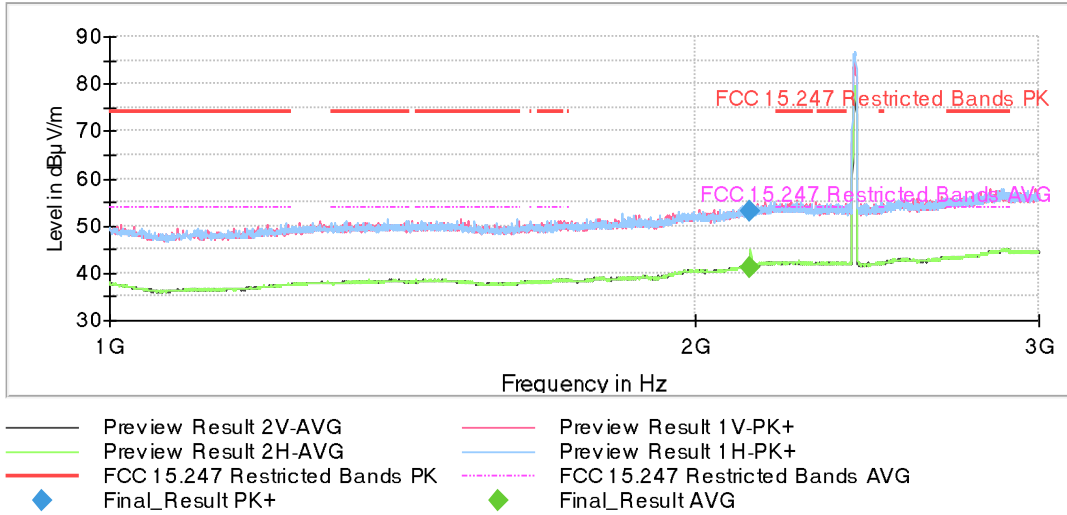
The spurious signals detected do not depend neither on the operating channel nor the modulation mode.



• **Mode 802.11 b:**

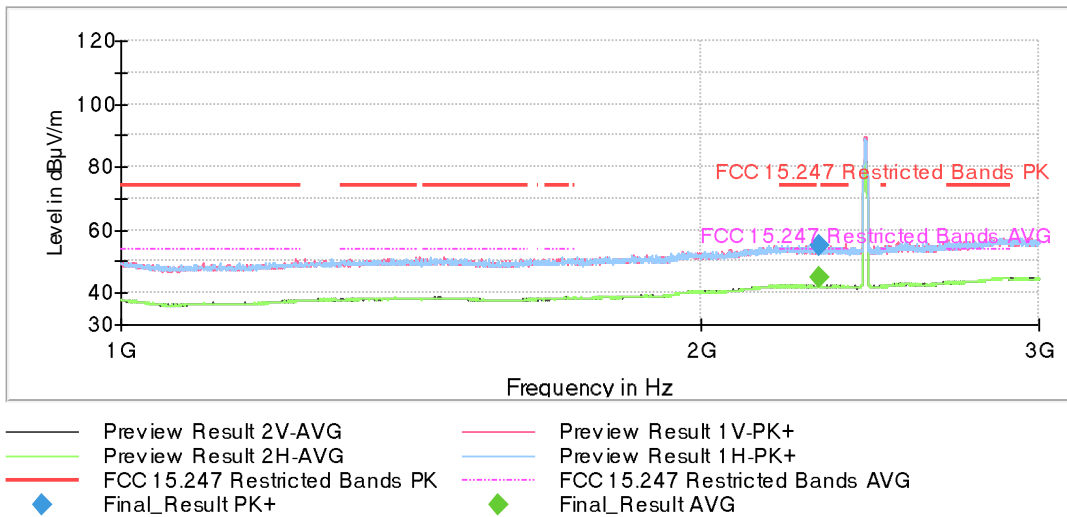
FREQUENCY RANGE 1 - 3 GHz:

- Low Channel:



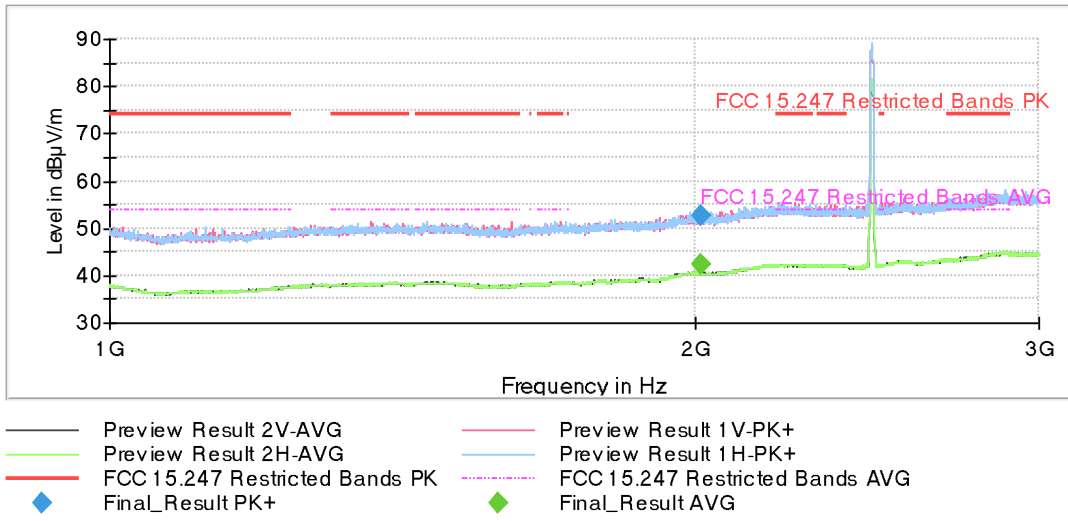
The peak above the limit is the carrier frequency.

- Middle Channel:



The peak above the limit is the carrier frequency.

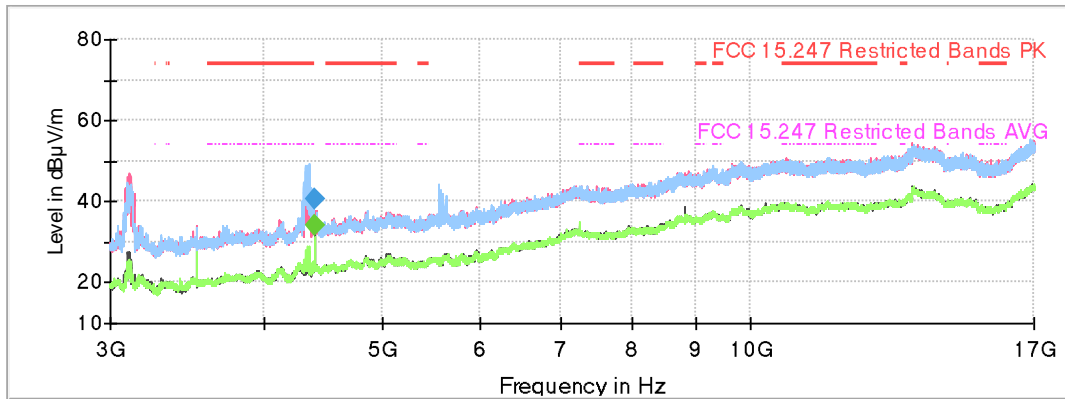
- High Channel:



The peak above the limit is the carrier frequency.

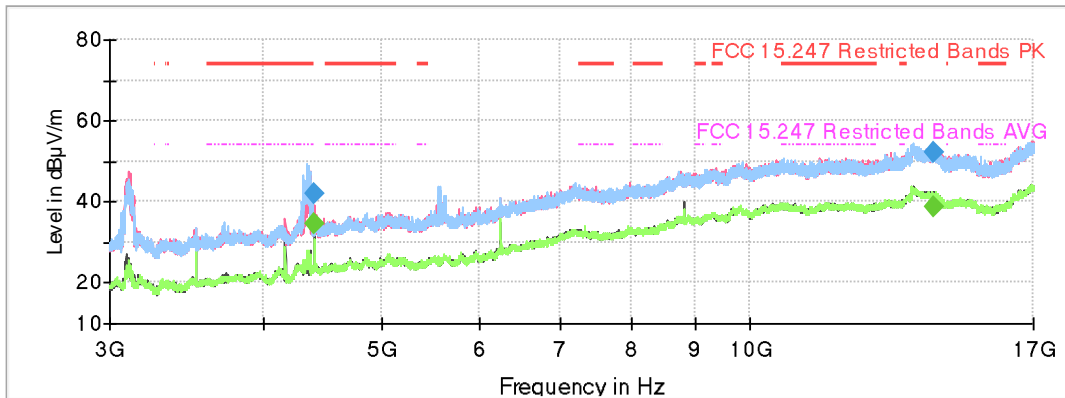
FREQUENCY RANGE 3 - 17 GHz:

- Low Channel:



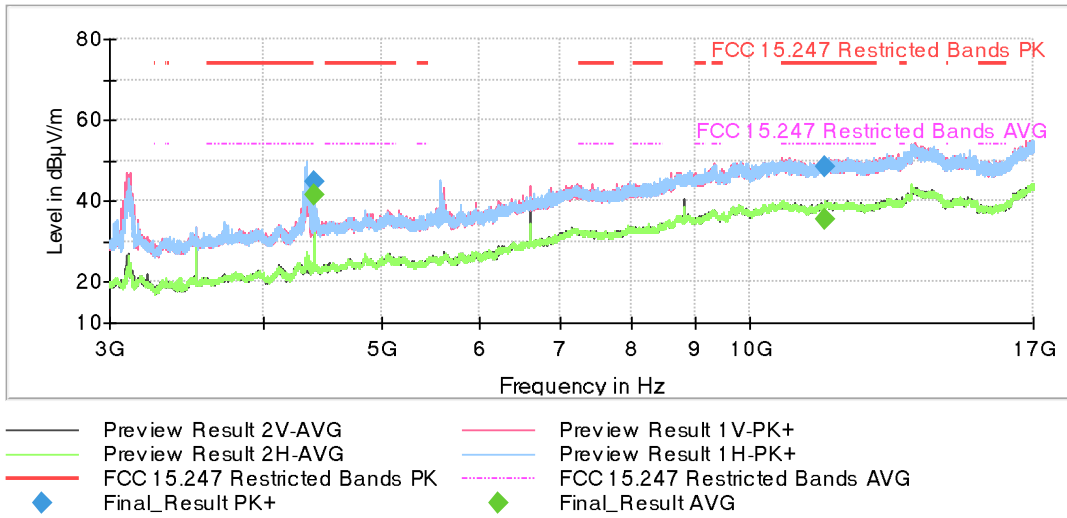
- Preview Result 2V-AVG
- Preview Result 2H-AVG
- FCC 15.247 Restricted Bands PK
- ◆ Final_Result PK+
- Preview Result 1V-PK+
- Preview Result 1H-PK+
- FCC 15.247 Restricted Bands AVG
- ◆ Final_Result AVG

- Middle Channel:



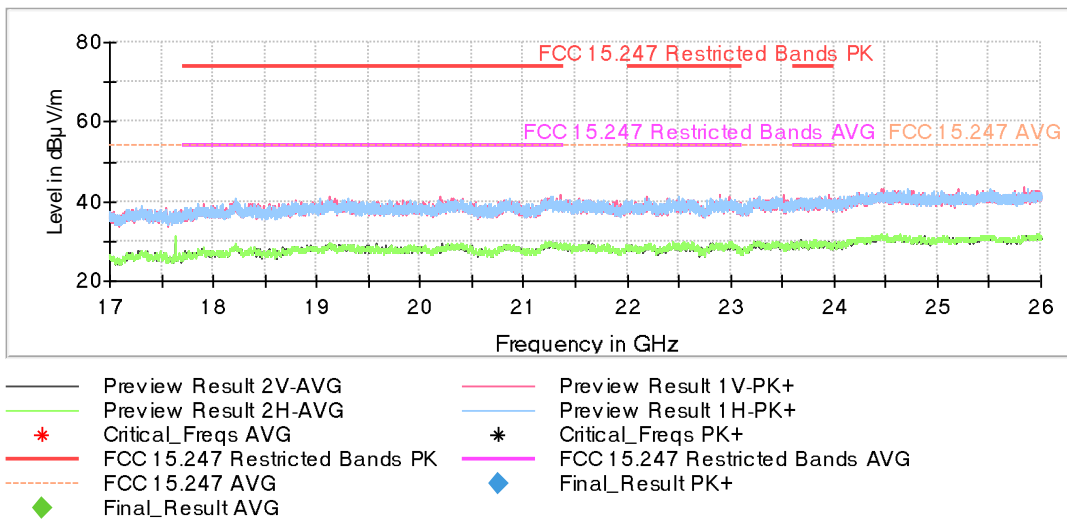
- Preview Result 2V-AVG
- Preview Result 2H-AVG
- FCC 15.247 Restricted Bands PK
- ◆ Final_Result PK+
- Preview Result 1V-PK+
- Preview Result 1H-PK+
- FCC 15.247 Restricted Bands AVG
- ◆ Final_Result AVG

- High Channel:



FREQUENCY RANGE 17 - 26 GHz:

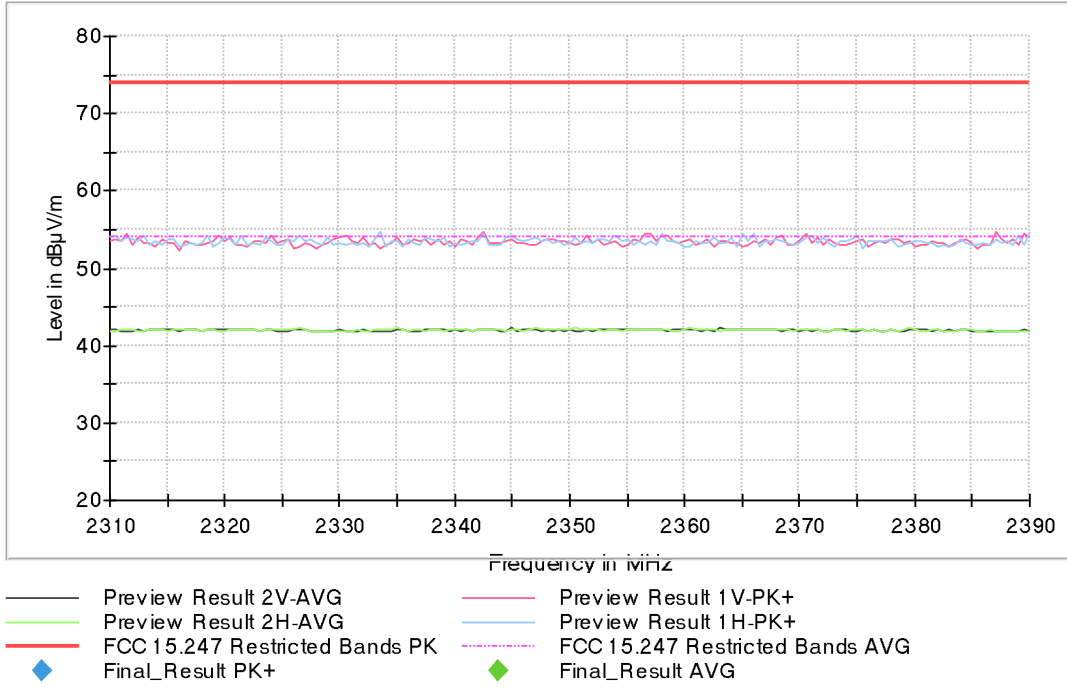
The spurious signals detected do not depend on the operating channel.



RESTRICTED BAND 2.31-2.39 GHz:

- Low Channel:

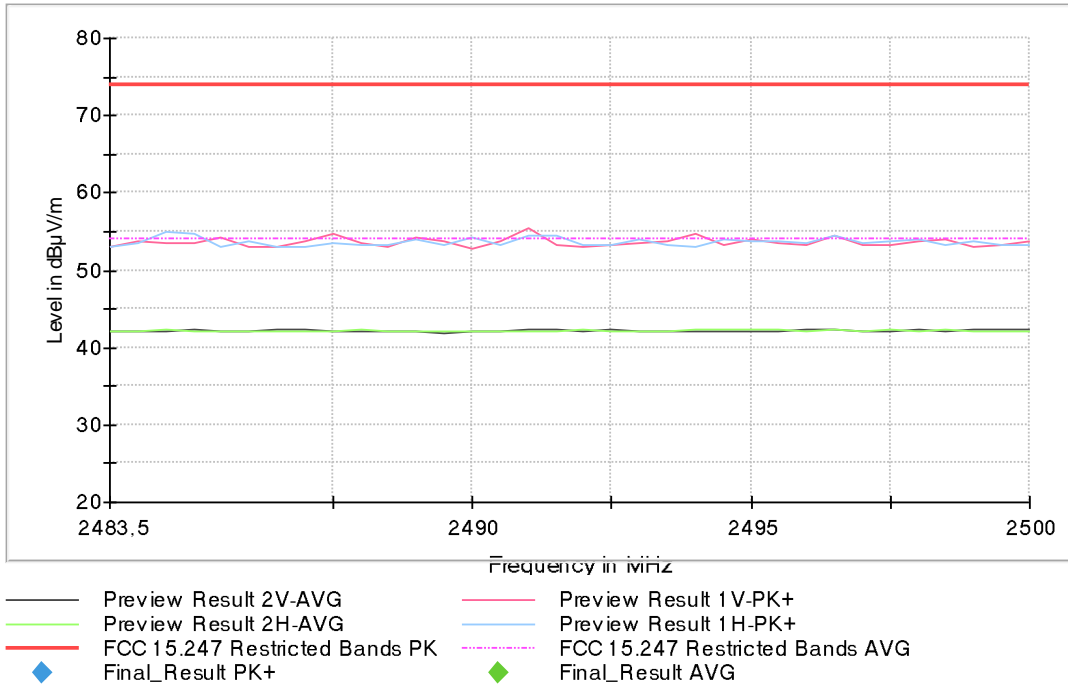
Full Spectrum



RESTRICTED BAND 2.4835-2.5 GHz:

- High Channel:

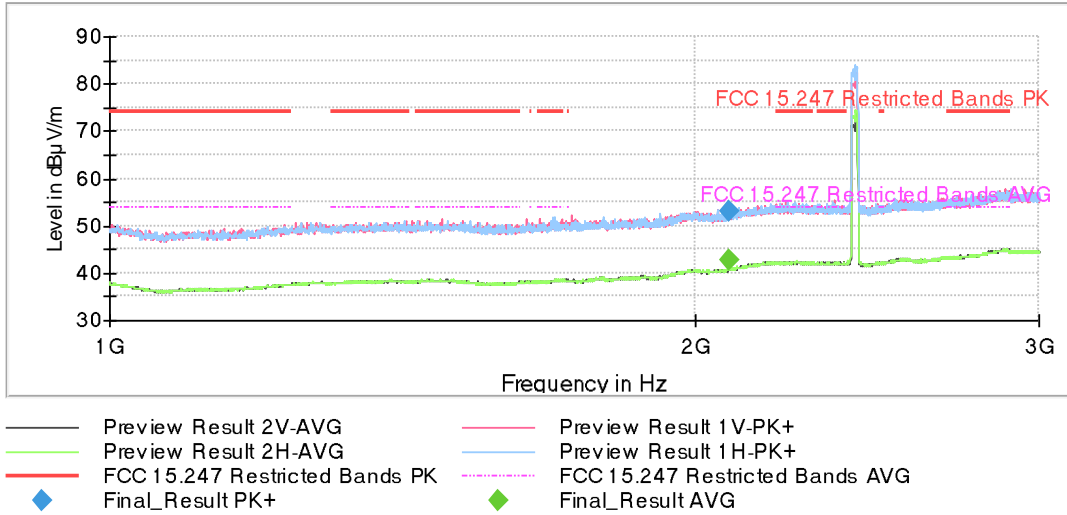
Full Spectrum



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

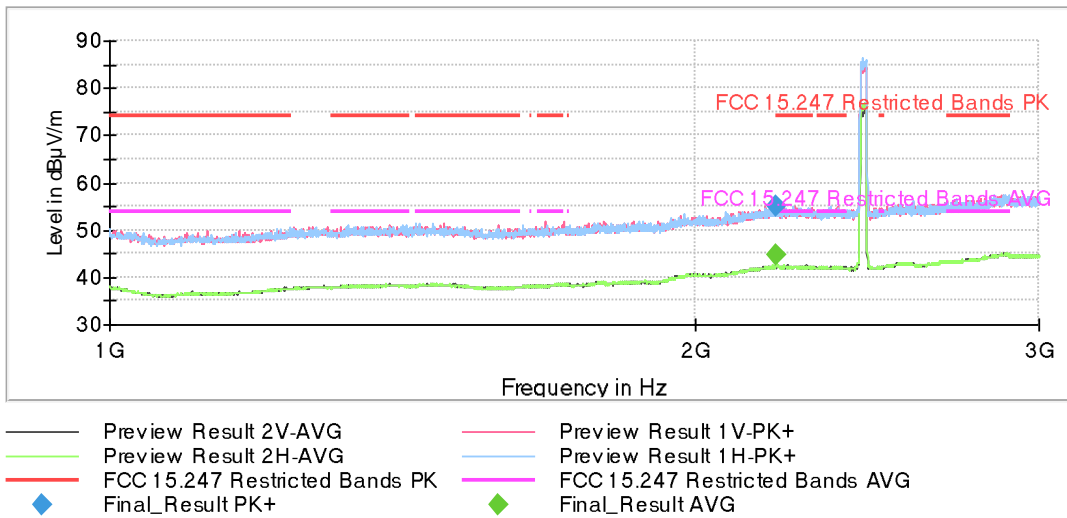
FREQUENCY RANGE 1 - 3 GHz:

- Low Channel:



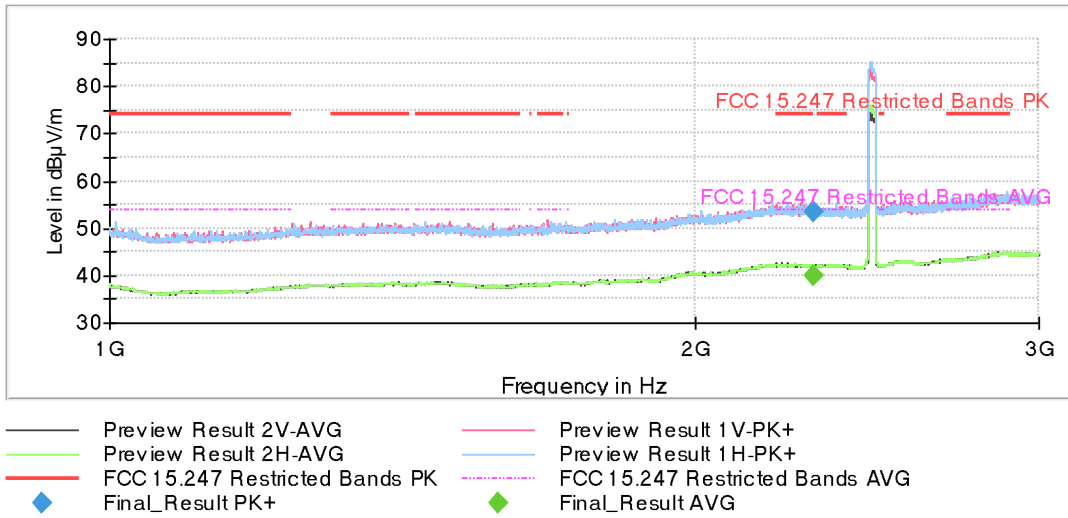
The peak above the limit is the carrier frequency.

- Middle Channel:



The peak above the limit is the carrier frequency.

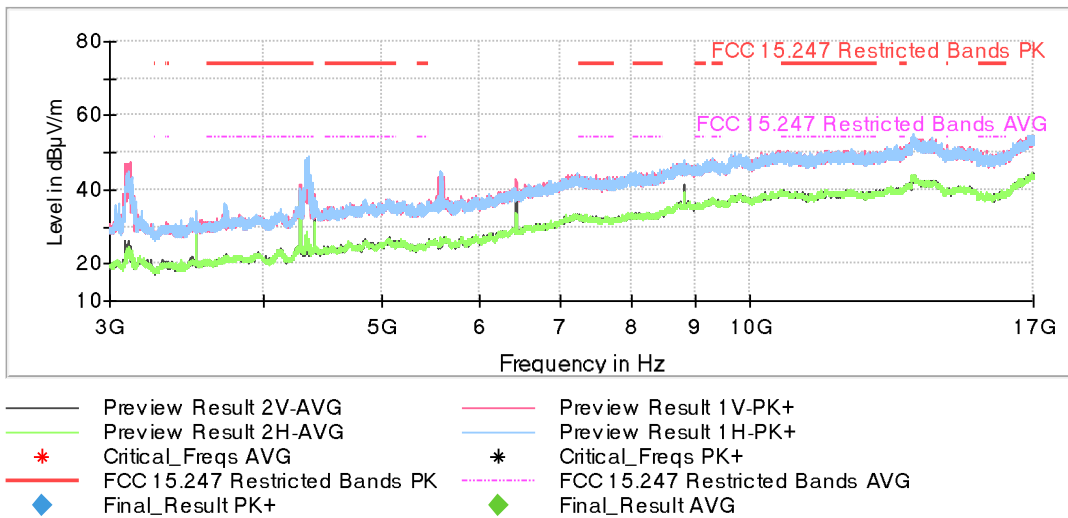
- High Channel:



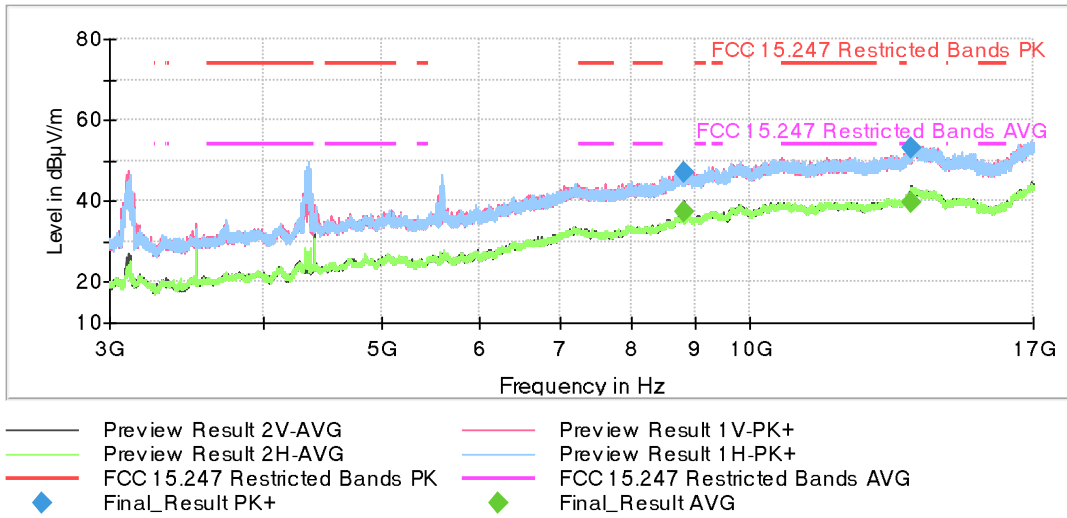
The peak above the limit is the carrier frequency.

FREQUENCY RANGE 3 - 17 GHz:

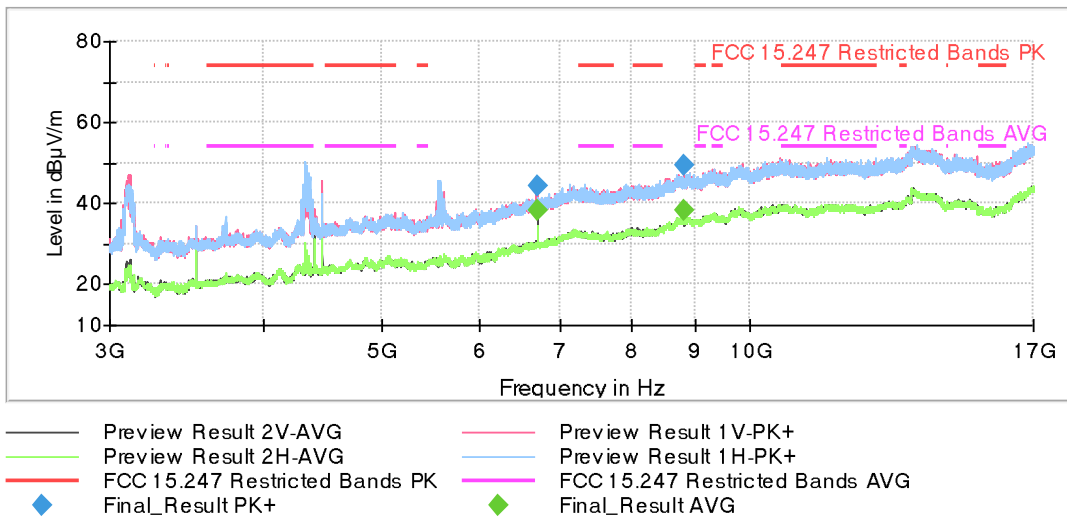
- Low Channel:



- Middle Channel:

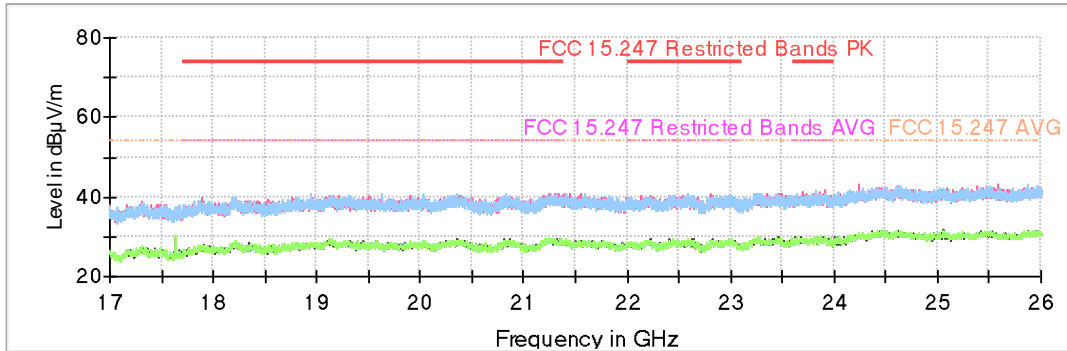


- High Channel:



FREQUENCY RANGE 17 - 26 GHz:

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

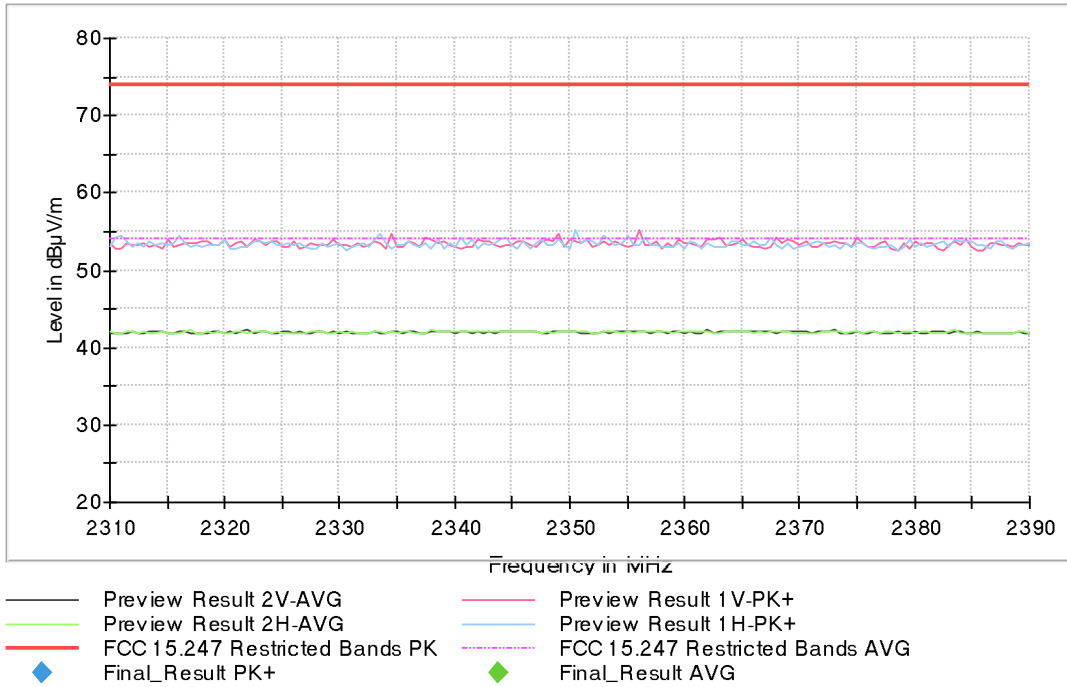


- | | | | |
|---|--------------------------------|---|---------------------------------|
| — | Preview Result 2V-AVG | — | Preview Result 1V-PK+ |
| — | Preview Result 2H-AVG | — | Preview Result 1H-PK+ |
| * | Critical_Freqs AVG | * | Critical_Freqs PK+ |
| — | FCC 15.247 Restricted Bands PK | — | FCC 15.247 Restricted Bands AVG |
| — | FCC 15.247 AVG | ◆ | Fina_Result PK+ |
| ◆ | Fina_Result AVG | | |

RESTRICTED BAND 2.31-2.39 GHz:

- Low Channel:

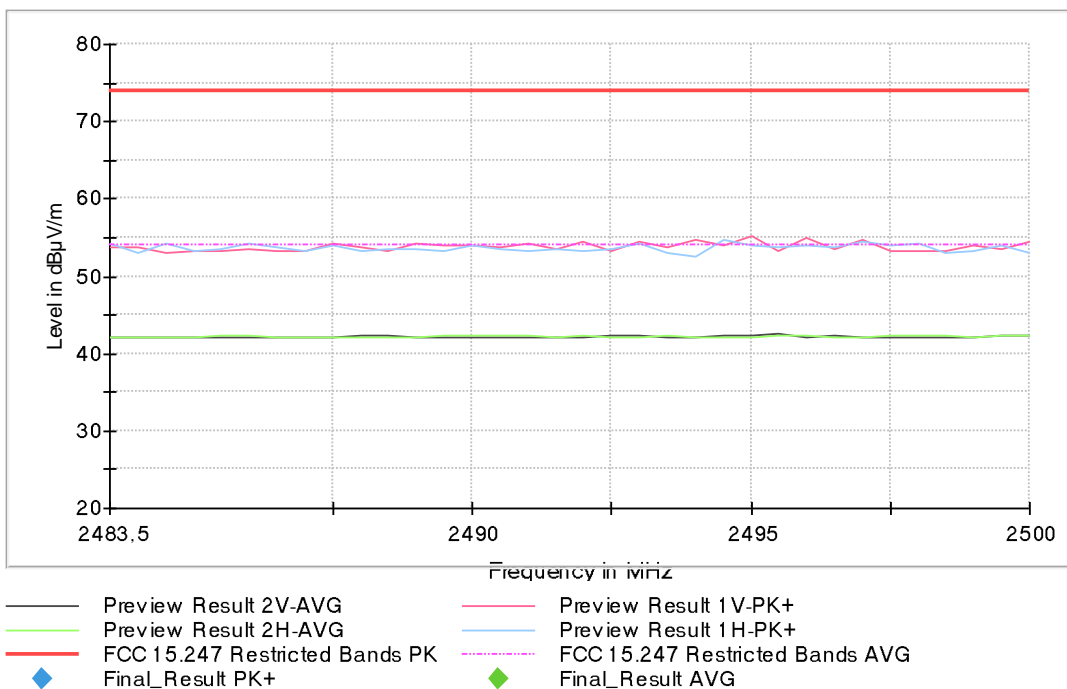
Full Spectrum



RESTRICTED BAND 2.4835-2.5 GHz:

- High Channel:

Full Spectrum



- **Mode 802.11 g:**

RESTRICTED BAND 2.31-2.39 GHz:

- Low Channel: The EUT does not transmit modulated in this modulation mode.

RESTRICTED BAND 2.4835-2.5 GHz:

- High Channel: The EUT does not transmit modulated in this modulation mode.