

Test report No:
NIE: 61876RRF.002A1

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	Wireless headphone
(*) Trademark	Unity
(*) Model and /or type reference	UAR-100
Other identification of the product	HW version: C4.5.4 SW version: 0.28.6 FCC ID: 2AYFG001 IC: 26790-001
(*) Features	Bluetooth, Bluetooth LE, WIFI
Applicant	HED Technologies CTN, Chemin Des Aulx, 18 (3rd floor) CH-1228 Plan-Les-Ouates, Geneva, Switzerland
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) Amendment 1. - 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. ANSI C63.10-2013: American National Standard for Testing Unlicensed Wireless Devices.
Approved by (name / position & signature)	Rafael López EMC Consumer & RF Lab. Manager
Date of issue	2021-04-16
Report template No	FDT08_23 (*) "Data provided by the client"

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Competences and guarantees

DEKRA Testing and Certification S.A.U. is a testing laboratory accredited by the National Accreditation Body (ENAC -Entidad Nacional de Acreditación), to perform the tests indicated in the Certificate No. 51/LE 147.

DEKRA Testing and Certification is a FCC-recognized accredited testing laboratory with appropriate scope of accreditation that include testing performed in this test report.

DEKRA Testing and Certification is an ISED-recognized accredited testing laboratory with appropriate scope of accreditation that include testing performed in this test report.

In order to assure the traceability to other national and international laboratories, DEKRA Testing and Certification 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.
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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 UAR-100x is a none foldable with an adjustable headband based on WIFI and Bluetooth technologies.

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 under 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
61876C/001	Wireless headphone	UAR-100	047 001 AA0L 00067	2021/01/05

Auxiliary elements used with sample S/01:

Control Nº	Description	Model	Serial Nº	Date of reception
65857B/005	TTL cable	---	---	2020/08/25
65857B/006	BTLE TTL cable	---	---	2020/08/25

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

Test sample description

Ports..... :	Port name and description		Cable				
			Specified max length [m]	Attached during test	Shielded	Coupled to patient	
	N/A						
Supplementary information to the ports..... :	N/A						
Rated power supply	Voltage and Frequency			Reference poles			
				L1	L2	L3	N
	☐	AC:					
	☒	DC: 5 Vdc (Internal battery). Battery charge by means of an AC/DC.					
Rated Power	Not provided data						
Clock frequencies..... :	Not provided data						
Other parameters	Not provided data						
Software version	0.28.6						
Hardware version	C4.5.4						
PCB versions..... :	- Left Carrier: C4.5.4 - Right audio: C4.5.3 - Left USB: C4.5.1 - Left mics: C4.5.0 - Right mics: C4.5.0 - Top mics: C4.5.0						
Dimensions in cm (W x H x D)	Not provided data						
Mounting position	X	Other: Wearable device					
Modules/parts..... :	Module/parts of test item			Type		Manufacturer	
	N/A						
Accessories (not part of the test item)	Description			Type		Manufacturer	
	N/A						
Documents as provided by the applicant..... :	Description			File name		Issue date	
	N/A						

Identification of the client

HED Technologies
CTN, Chemin Des Aulx, 18 (3rd floor)
CH-1228 Plan-Les-Ouates, Geneva, Switzerland

Testing period and place

Test Location	DEKRA Testing and Certification S.A.U.
Date (start)	2021-01-15
Date (finish)	2021-01-19

Document history

Report number	Date	Description
61876RRF.002	2021-04-16	First release
61876RRF.002A1	2021-04-16	The Model name, FCC ID and IC of the device have been corrected: Model name: UAR-100 FCC ID: 2AYFG001 IC: 26790-001

Environmental conditions

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

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

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

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

Remarks and comments

The tests have been performed by the technical personnel: Jaime Barranquero.

Used instrumentation:

Radiated Measurements:

		Last Calibration	Due Calibration
1.	Semianechoic Absorber Lined Chamber ALBATROSS P29419	N.A.	N.A.
2.	Shielded Room ALBATROSS P29419	N.A.	N.A.
3.	Ultralog Antenna 30MHz-6GHz, ROHDE AND SCHWARZ HL562E_UPG	2019/10	2022/10
4.	EMI Test Receiver 2Hz-44GHz, ROHDE AND SCHWARZ ESW44	2019/10	2021/10
7.	Horn Antenna 1-18 GHz SCHWARZBECK MESS-ELEKTRONIK BBHA 9120 D	2019/11	2022/11
8.	Horn Antenna 18 - 40 GHz SCHWARZBECK MESS-ELEKTRONIK BBHA 9170	2021/01	2024/01
9.	Preamplifier 30dB 500MHz-18GHz, SCHWARZBECK BBV 9718 C	2021/02	2022/02
10.	PRE-AMPLIFIER G>30dB 18-40GHz BONN ELEKTRONIK BLMA 1840-3G	2019/11	2021/11

Testing verdicts

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

Summary

1. Bluetooth Low Energy

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	(1)
FCC 15.247 (b) / RSS-247 5.4. (d)	Maximum output power and antenna gain	N/M	(1)
FCC 15.247 (d) / RSS-247 5.5.	Band-edge emissions compliance (Transmitter)	N/M	(1)
FCC 15.247 (e) / RSS-247 5.2. (b)	Power spectral density	N/M	(1)
FCC 15.247 (d) / RSS-247 5.5.	Emission limitations radiated (Transmitter)	P	
<u>Supplementary information and remarks:</u>			
(1) Test not requested.			

2. 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	(1)
FCC 15.247 (a)(1)(iii) / RSS-247 5.1 (d)	Number of hopping channels	N/M	(1)
FCC 15.247 (a)(1)(iii) / RSS-247 5.1 (d)	Time of occupancy (Dwell Time)	N/M	(1)
FCC 15.247 (b) / RSS-247 5.4. (b)	Maximum peak output power and antenna gain	N/M	(1)
FCC 15.247 (d) / RSS-247 5.5.	Band-edge emissions conducted compliance (Transmitter)	N/M	(1)
FCC 15.247 (d) / RSS-247 5.5.	Emission limitations radiated (Transmitter)	P	
<u>Supplementary information and remarks:</u>			
(1) Test not requested.			

3. 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	(1)
FCC 15.247 (b) / RSS-247 5.4. (d)	Maximum output power and antenna gain	N/M	(1)
FCC 15.247 (d) / RSS-247 5.5.	Band-edge emissions conducted compliance (Transmitter)	N/M	(1)
FCC 15.247 (e) / RSS-247 5.2. (b)	Power spectral density	N/M	(1)
FCC 15.247 (d) / RSS-247 5.5.	Emission limitations radiated (Transmitter)	P	
<u>Supplementary information and remarks:</u>			
(1) Test not requested.			

Appendix A: Test results. Bluetooth Low Energy

TEST CONDITIONS	12
FCC Section 15.247 (d) / RSS-247 5.5. Emission limitations radiated (Transmitter).....	15

TEST CONDITIONS

POWER SUPPLY (V):

V nominal:	5 Vdc.
Type of Power Supply:	Battery or AC/DC adapter.

ANTENNA:

Type of Antenna:	Internal.
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TEST FREQUENCIES:

Low Channel:	2402 MHz
Middle Channel:	2440 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 1000 MHz and 1 GHz-17 GHz double ridge horn antenna) is situated at a distance of 3 m and at a distance of 1 m for the frequency range 17 GHz-26 GHz (17 GHz-40 GHz horn antenna).

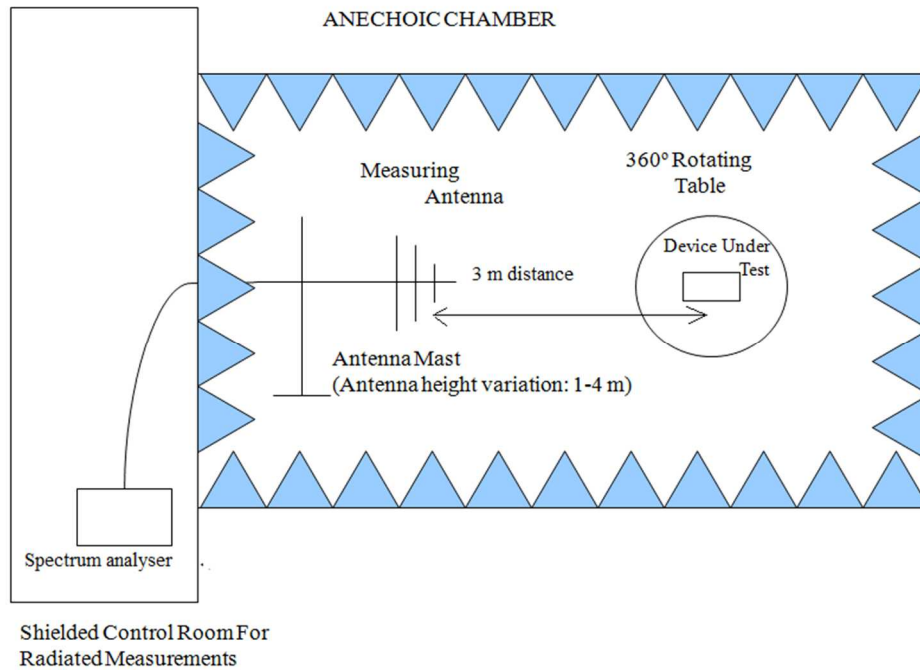
For radiated emissions in the range 17 GHz-26 GHz that is performed at a distance closer than the specified distance, an inverse proportionality factor of 20 dB per decade is used to normalize the measured data for determining compliance.

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.

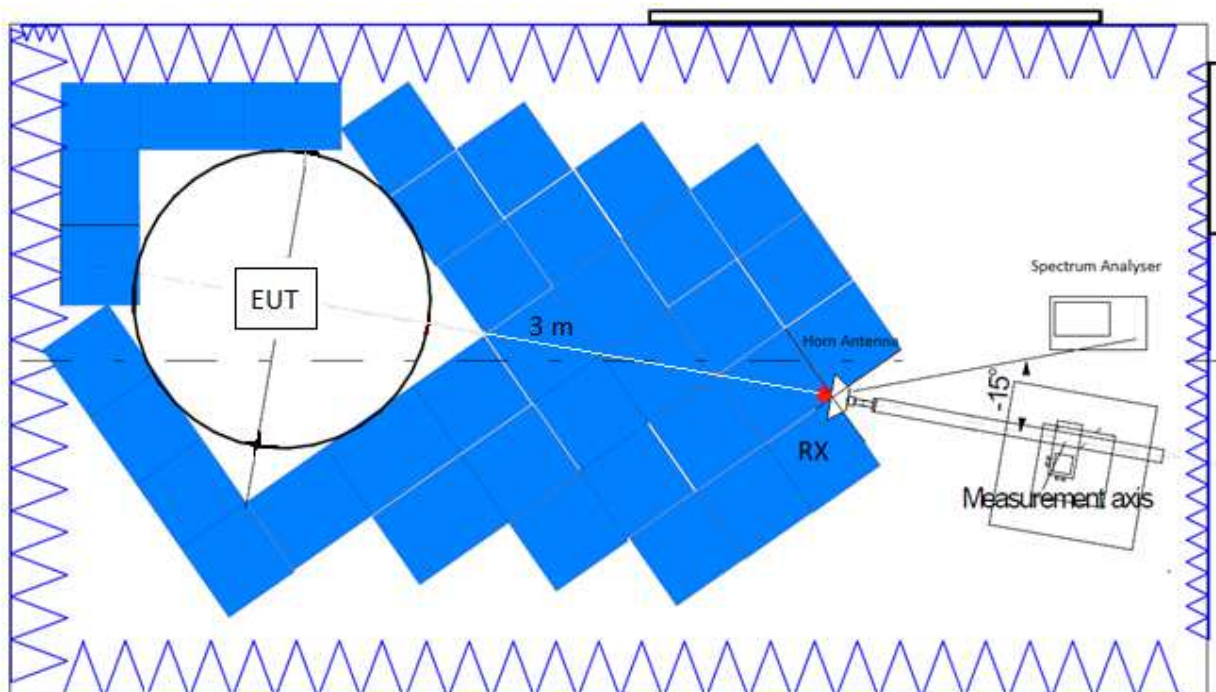
Measurements were made in both horizontal and vertical planes of polarization.

A resolution bandwidth / video bandwidth of 100 kHz / 300 kHz was used for frequencies below 1 GHz and 1 MHz / 3 MHz for frequencies above 1 GHz.

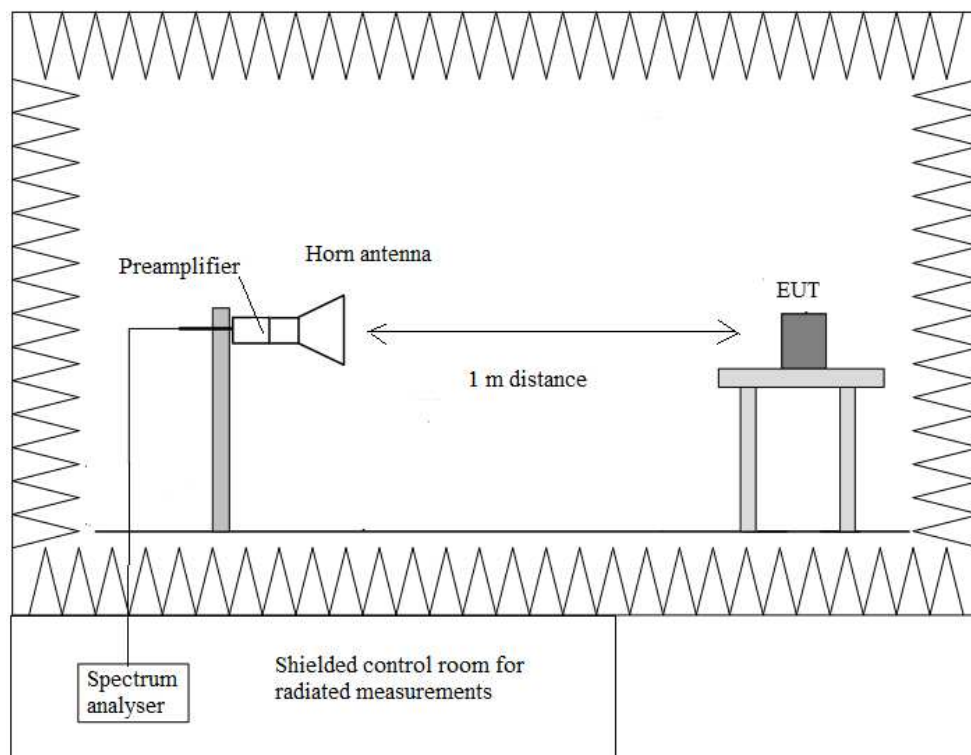
Radiated measurements setup from 30 MHz to 1 GHz:



Radiated measurements setup from 1GHz to 17 GHz:



Radiated measurements setup $f > 17$ GHz:



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

SPECIFICATION:

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

Frequency Range (MHz)	Field strength ($\mu\text{V/m}$)	Field strength ($\text{dB}\mu\text{V/m}$)	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 - 10000	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 signals detected do not depend on the operating channel.

Spurious emissions at less than 20 dB from the limit:

Spurious Frequency (MHz)	Emission Level (dBμV/m)	Polarization	Detector	Measurement Uncertainty (dB)
283.7520	29.10	V	Quasi Peak	<± 5.10

Verdict: PASS

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.

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

Spurious Frequency (GHz)	Emission Level (dBμV/m)	Polarization	Detector	Measurement Uncertainty (dB)
4.8040	44.22	H	Peak	<± 4.60

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

Spurious Frequency (GHz)	Emission Level (dBμV/m)	Polarization	Detector	Measurement Uncertainty (dB)
4.8800	44.38	H	Peak	<± 4.60

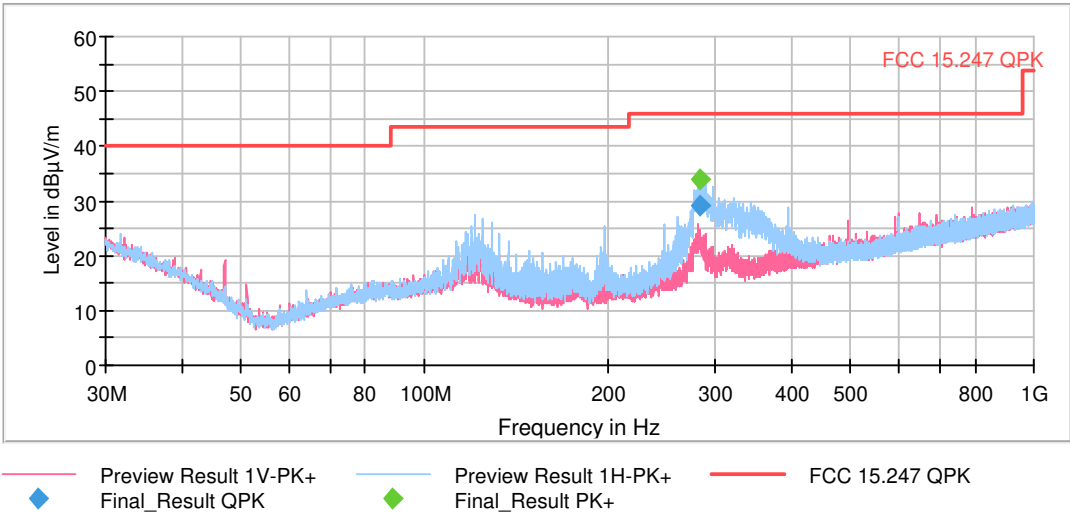
- HIGH CHANNEL. Spurious frequencies detected at less than 20 dB below the limit:

Spurious Frequency (GHz)	Emission Level (dBμV/m)	Polarization	Detector	Measurement Uncertainty (dB)
4.9595	43.17	H	Peak	<± 4.60
7.4390	46.80	V	Peak	<± 4.60

Measurement Uncertainty (dB): 1-3 GHz < ± 3.98
3-17 GHz < ± 4.60
17-26 GHz < ± 4.89

Verdict: PASS

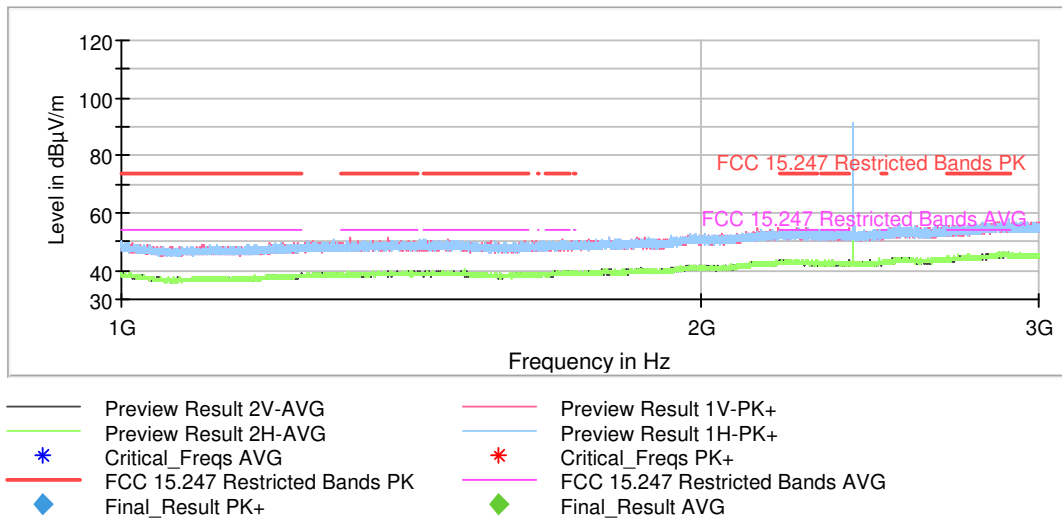
FREQUENCY RANGE 30 MHz - 1 GHz:



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

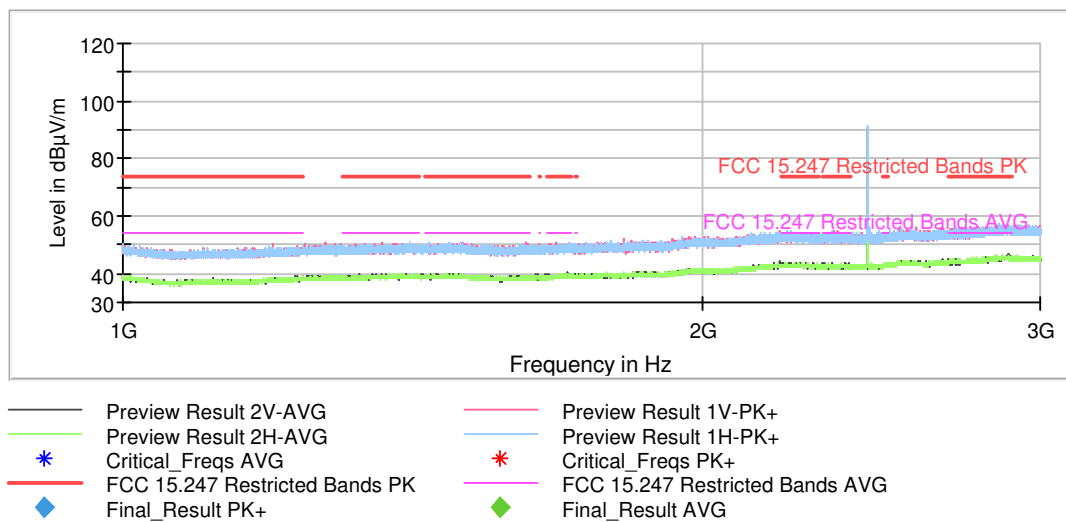
FREQUENCY RANGE 1 - 3 GHz:

- Low Channel:



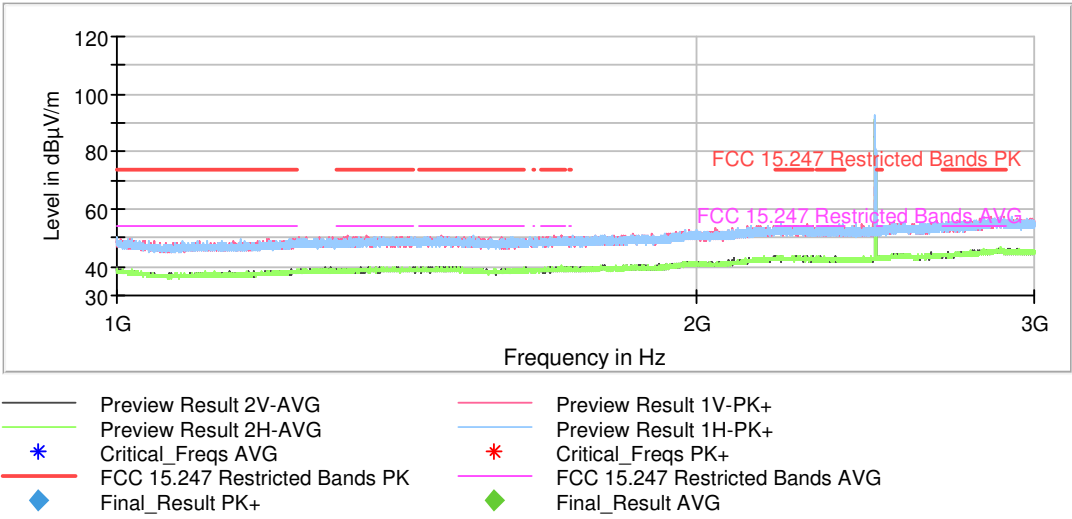
The peak above the limit is the carrier frequency.

- Middle Channel:



The peak above the limit is the carrier frequency.

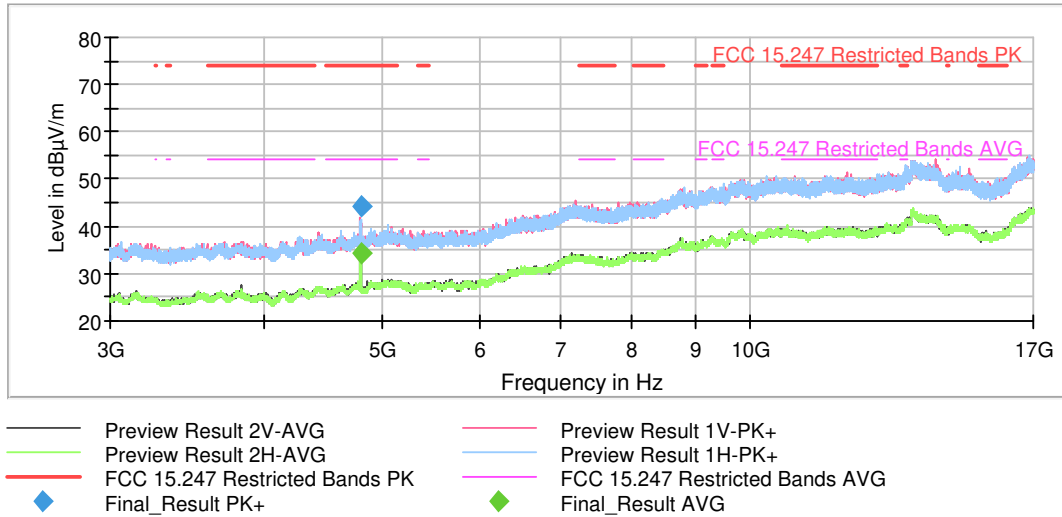
- High Channel:



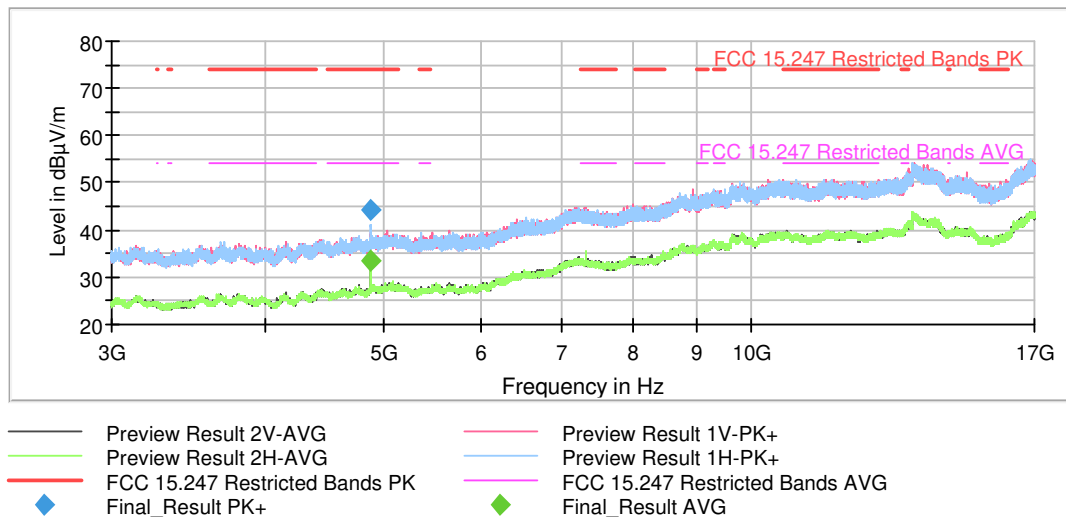
The peak above the limit is the carrier frequency.

FREQUENCY RANGE 3 - 17 GHz:

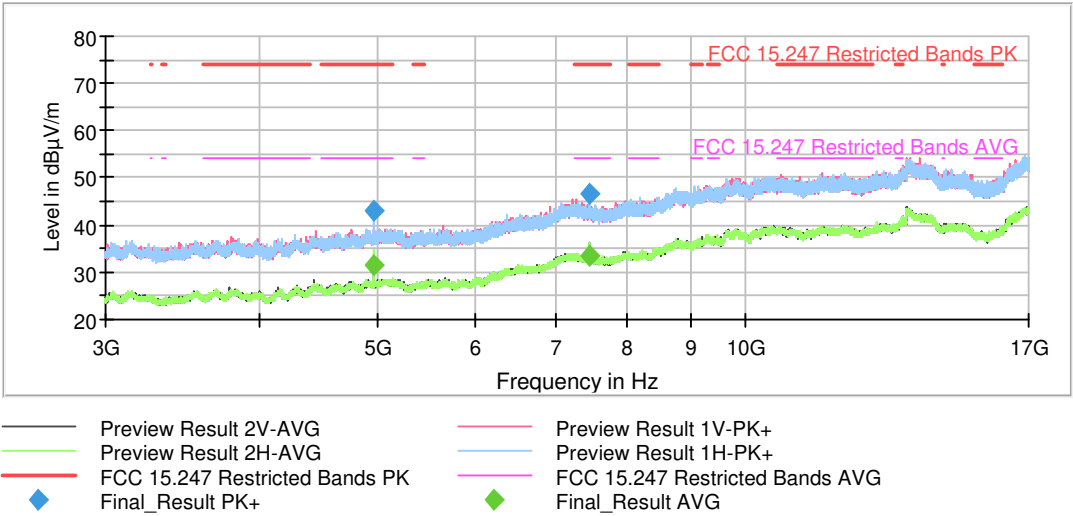
- Low Channel:



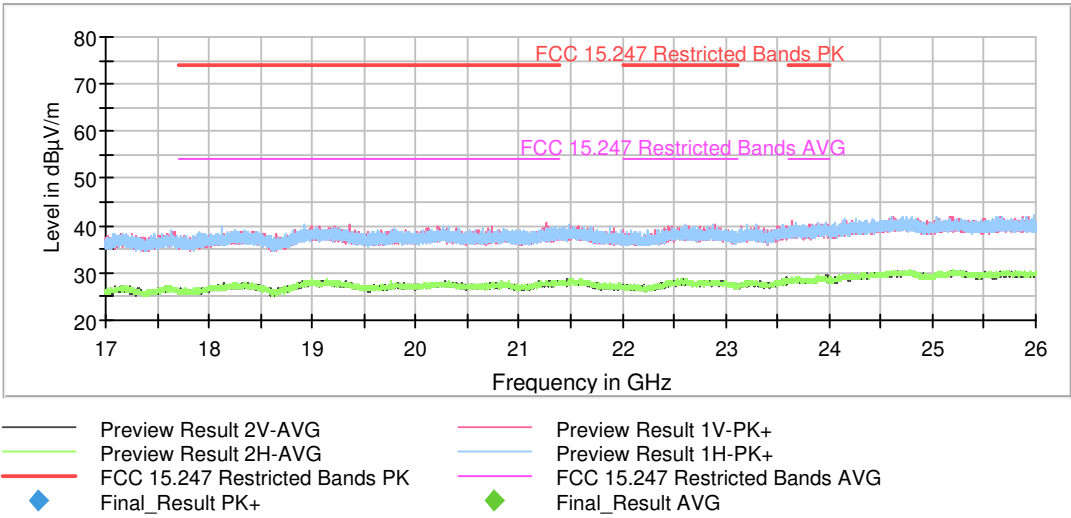
- Middle Channel:



- High Channel:



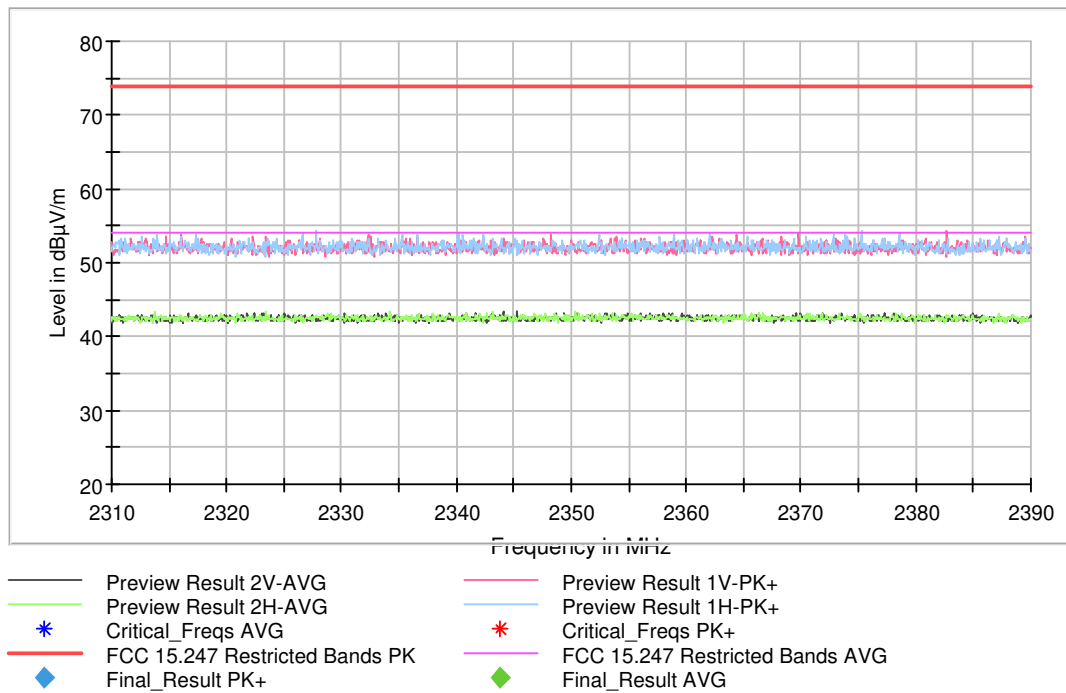
FREQUENCY RANGE 17 - 26 GHz:



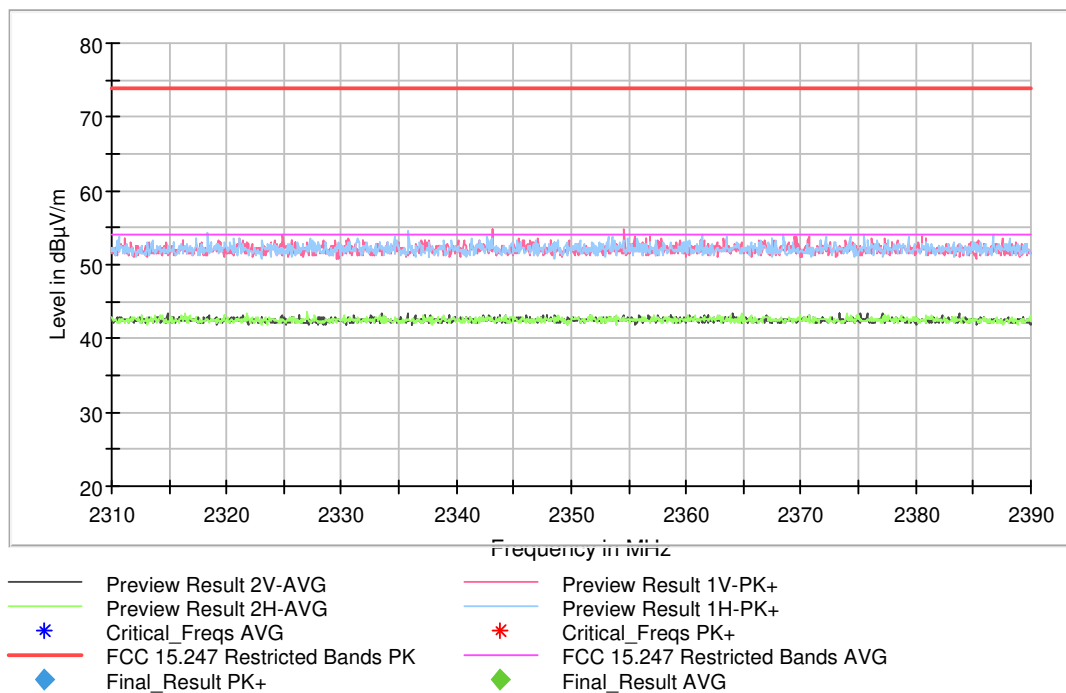
This plot is valid for the Low, Middle and High Channels.

FREQUENCY RANGE 2.31-2.39 GHz:

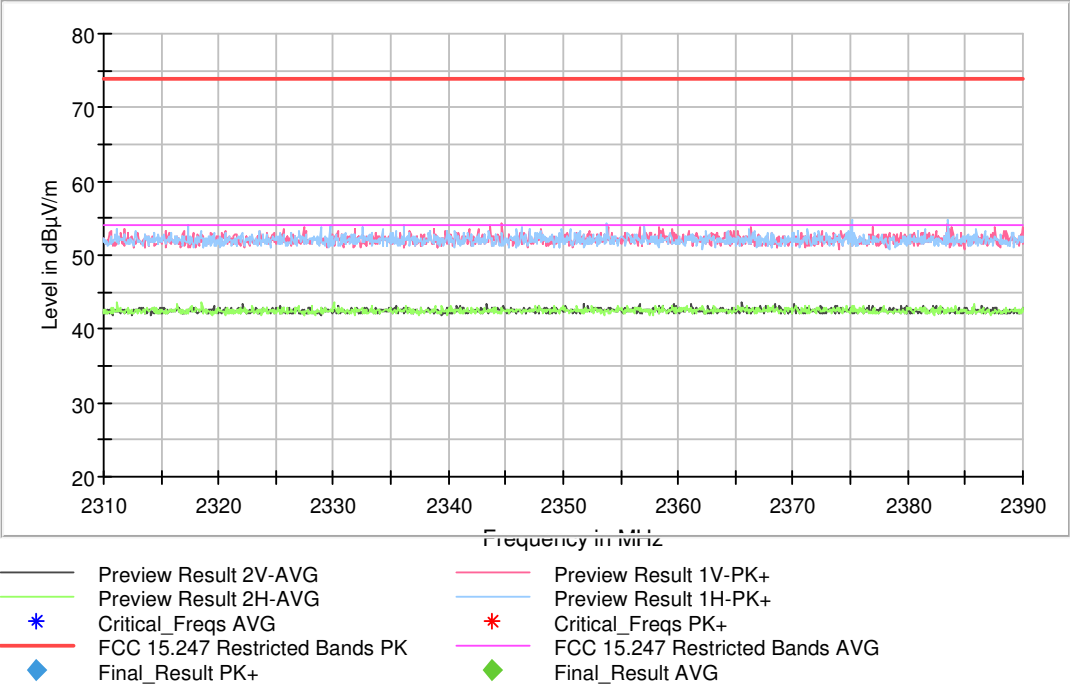
- Low Channel:



- Middle Channel:

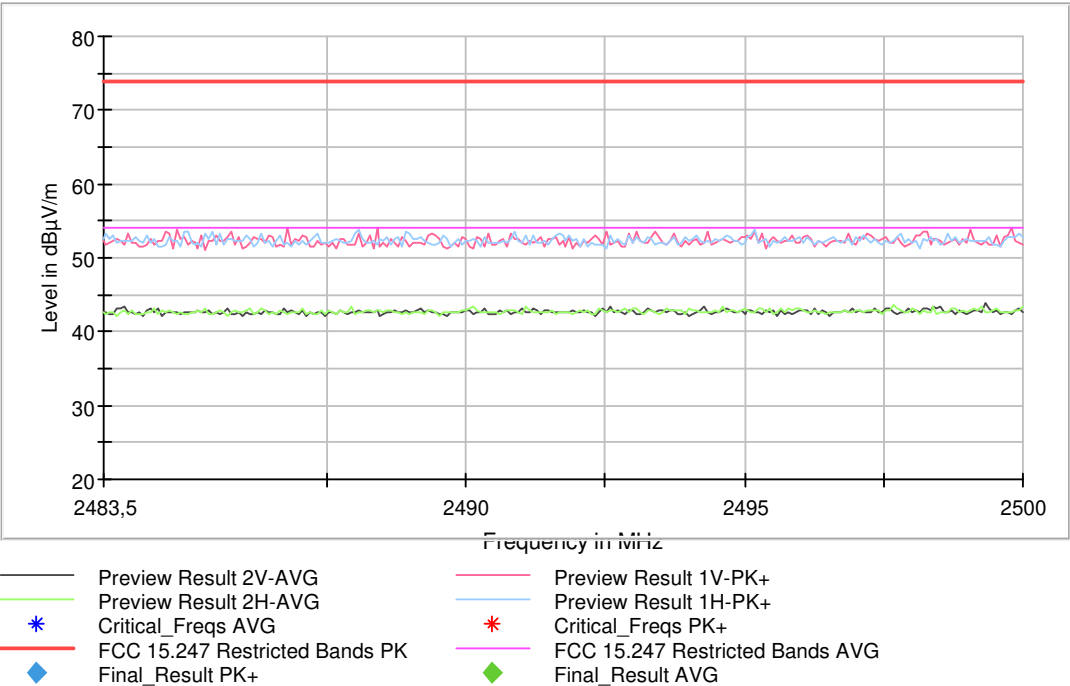


- High Channel:

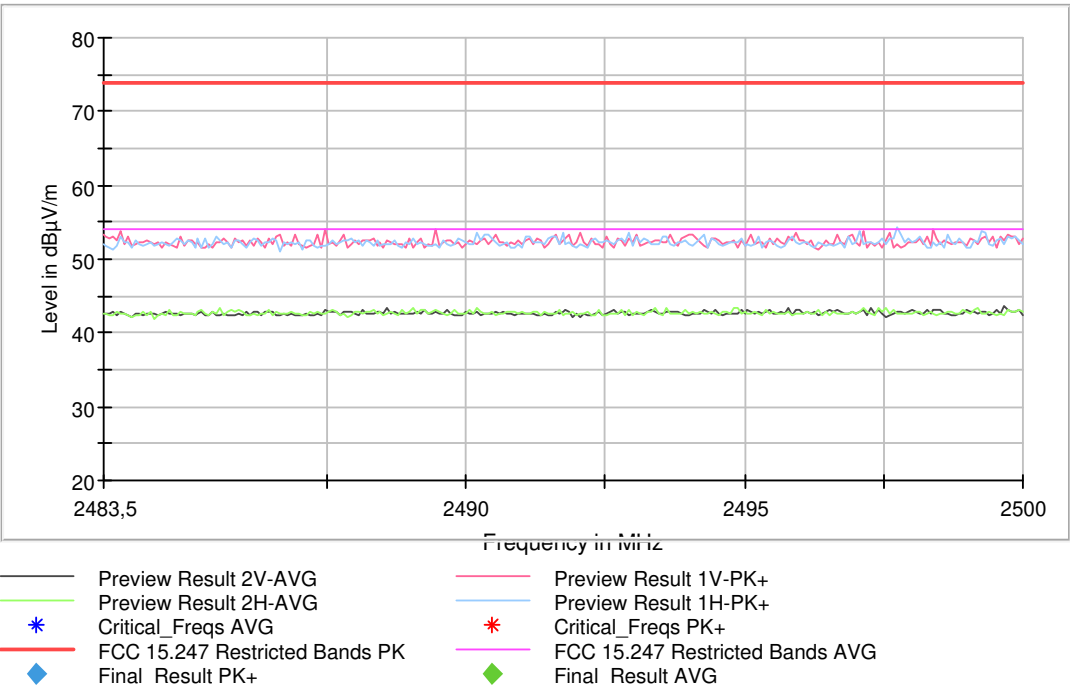


FREQUENCY RANGE 2.4835-2.5 GHz:

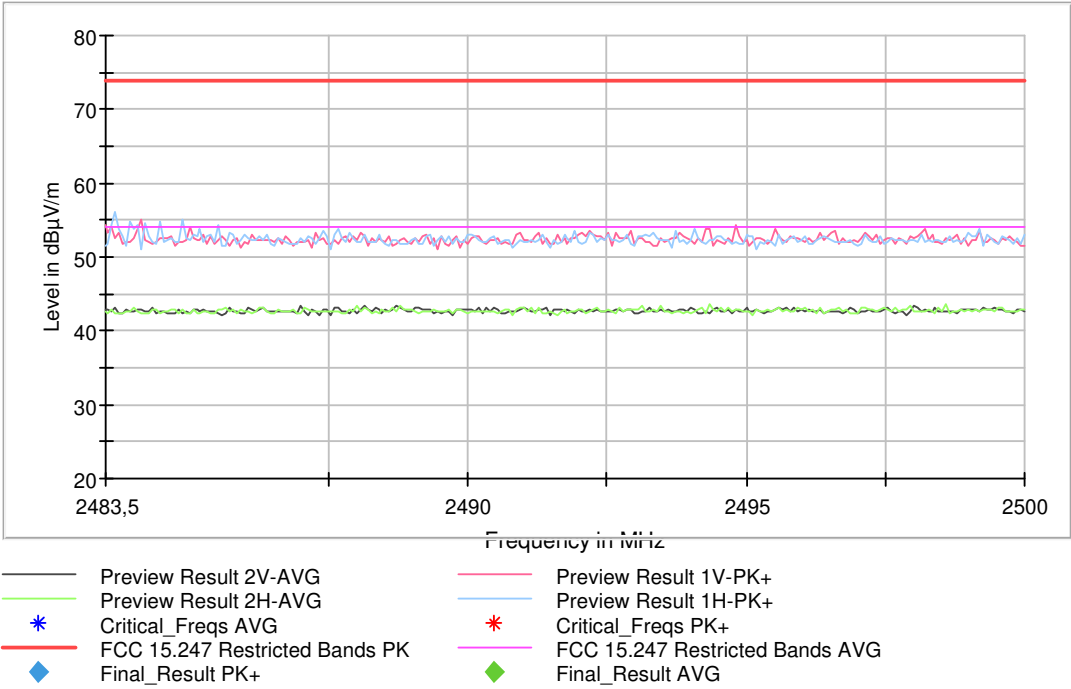
- Low Channel:



- Middle Channel:



- High Channel:



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

TEST CONDITIONS	29
FCC 15.247 (d) / RSS-247 5.5. Emission limitations radiated (Transmitter).....	29

TEST CONDITIONS

POWER SUPPLY (V):

V nominal:	5 Vdc.
Type of Power Supply:	Battery or AC/DC adapter.

ANTENNA:

Type of Antenna:	Internal.
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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 m for the frequency range 17 GHz-26 GHz (17 GHz-26 GHz horn antenna).

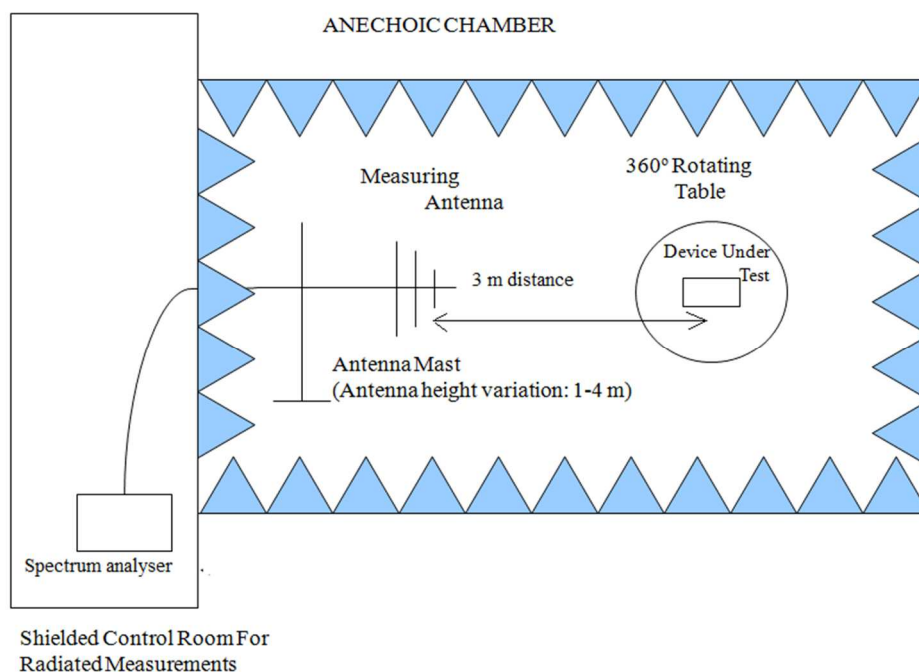
For radiated emissions in the range 17 GHz-26 GHz that is performed at a distance closer than the specified distance, an inverse proportionality factor of 20 dB per decade is used to normalize the measured data for determining compliance.

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.

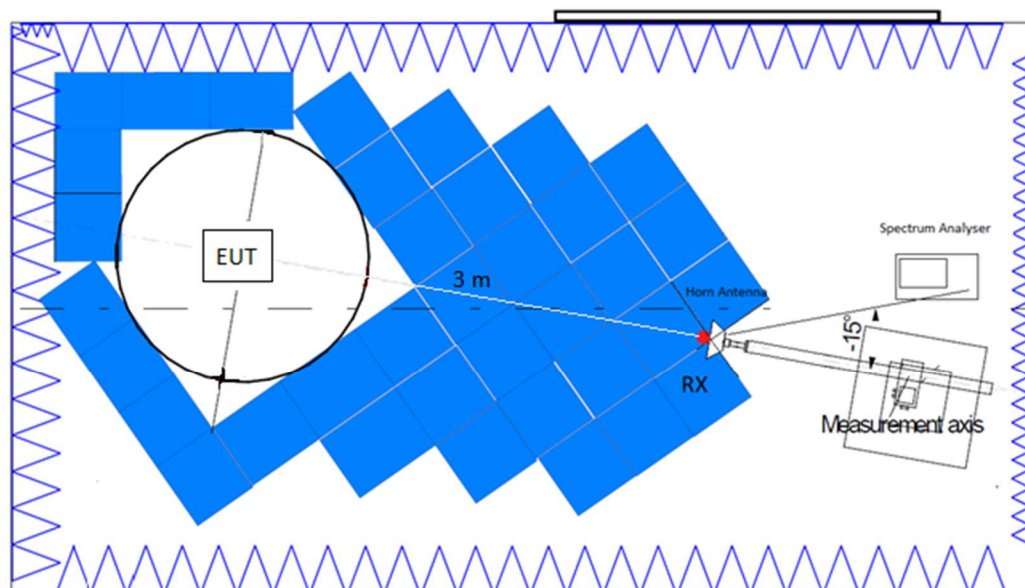
Measurements were made in both horizontal and vertical planes of polarization.

A resolution bandwidth / video bandwidth of 100 kHz / 300 kHz was used for frequencies below 1 GHz and 1 MHz / 3 MHz for frequencies above 1 GHz.

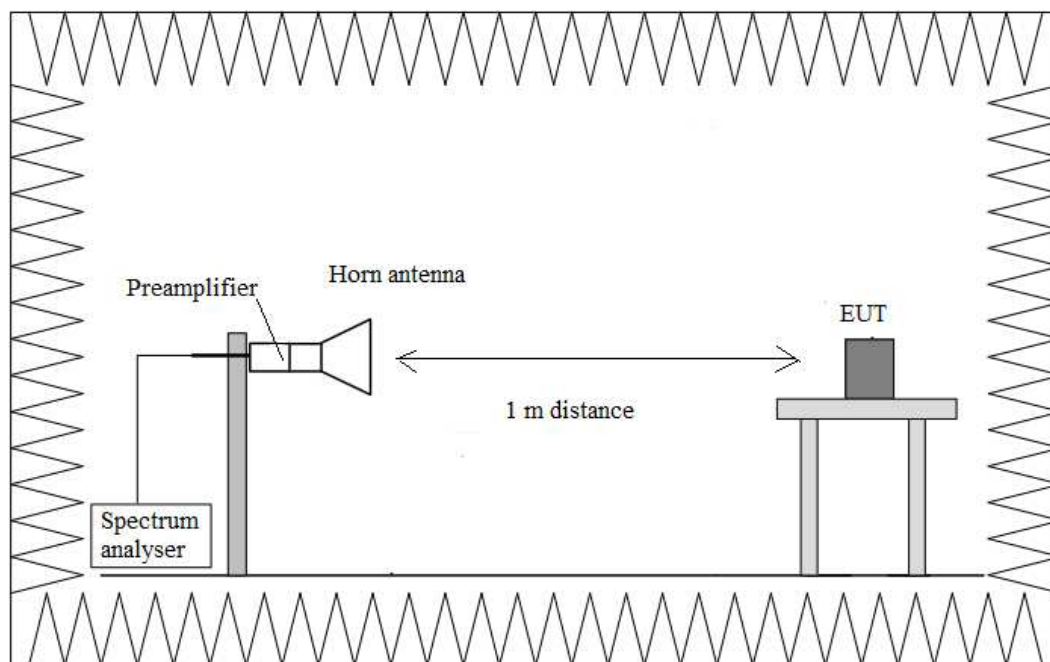
Radiated measurements setup from 30 MHz to 1 GHz:



Radiated measurements setup from 1 GHz to 17 GHz:



Radiated measurements setup $f > 17$ GHz up to 26 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 ($\mu\text{V/m}$)	Field strength ($\text{dB}\mu\text{V/m}$)	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 1 m 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 ($\text{dB}\mu\text{V/m}$)	Polarization	Detector	Measurement Uncertainty (dB)
120.7920	25.49	H	Quasi-Peak	$<\pm 5.10$
282.0060	26.22	H	Quasi-Peak	$<\pm 5.10$
346.4625	27.29	H	Quasi-Peak	$<\pm 5.10$
395.9810	27.67	H	Quasi-Peak	$<\pm 5.10$

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 dB μ V/m at 3 m) are measured with average detector for checking compliance with the average limit.

- **GFSK modulation (DH5):**

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

Verdict: PASS

- **PI/4-DQPSK (2DH5):**

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

Verdict: PASS

- **8-DPSK modulation (3DH5):**

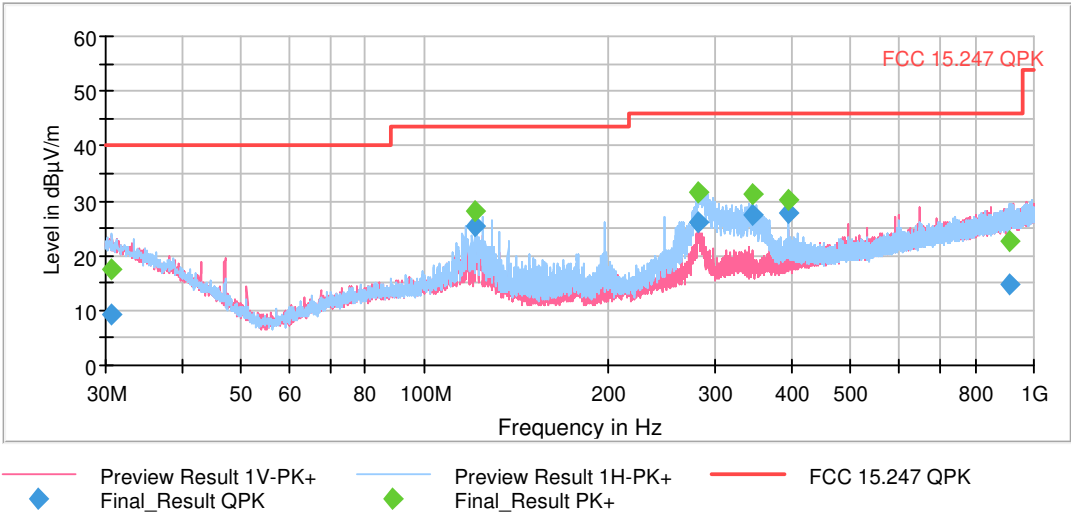
- LOW CHANNEL. No spurious frequencies at less than 20 dB below the limit.
- MIDDLE CHANNEL. No spurious frequencies at less than 20 dB below the limit.
- HIGH CHANNEL. No spurious frequencies at less than 20 dB below the limit.

Measurement Uncertainty (dB):	1 GHz - 3 GHz $\leq \pm 3.98$
	3 GHz - 17 GHz $\leq \pm 4.60$
	17 GHz - 26 GHz $\leq \pm 4.89$

Verdict: PASS

FREQUENCY RANGE 30 MHz - 1 GHz:

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

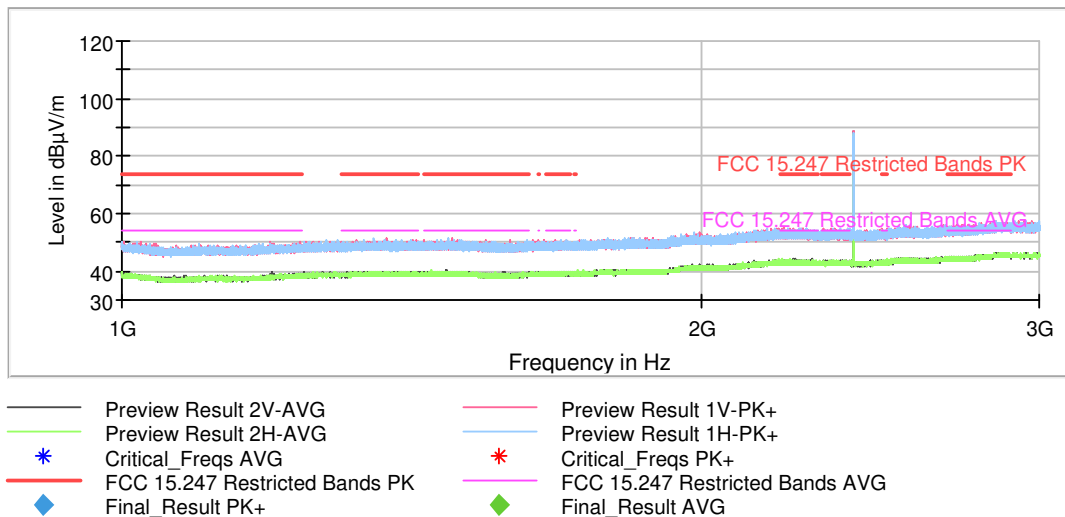


The above plot shows the results of the scan using peak detector.

FREQUENCY RANGE 1 - 3 GHz:

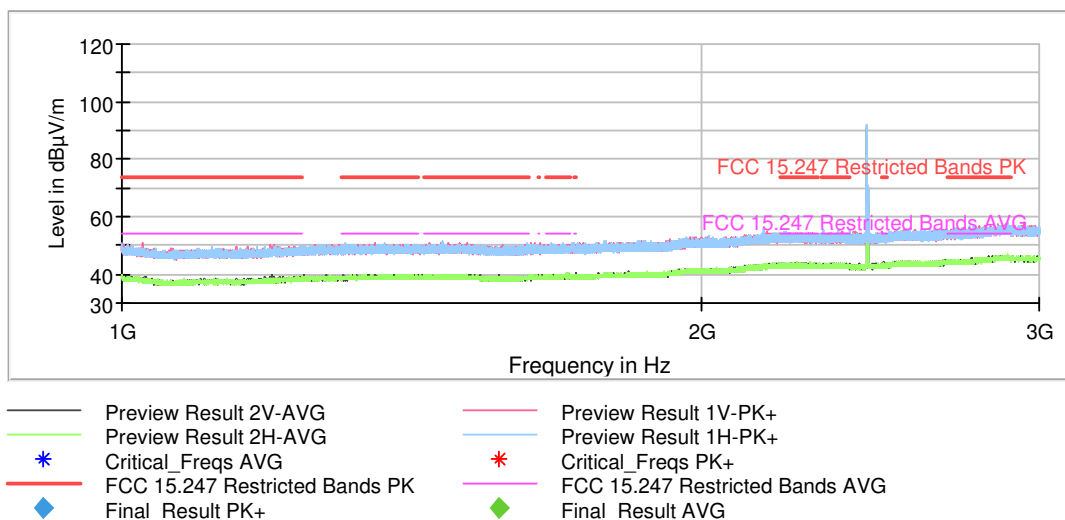
- GFSK modulation (DH5)**

- Low Channel:



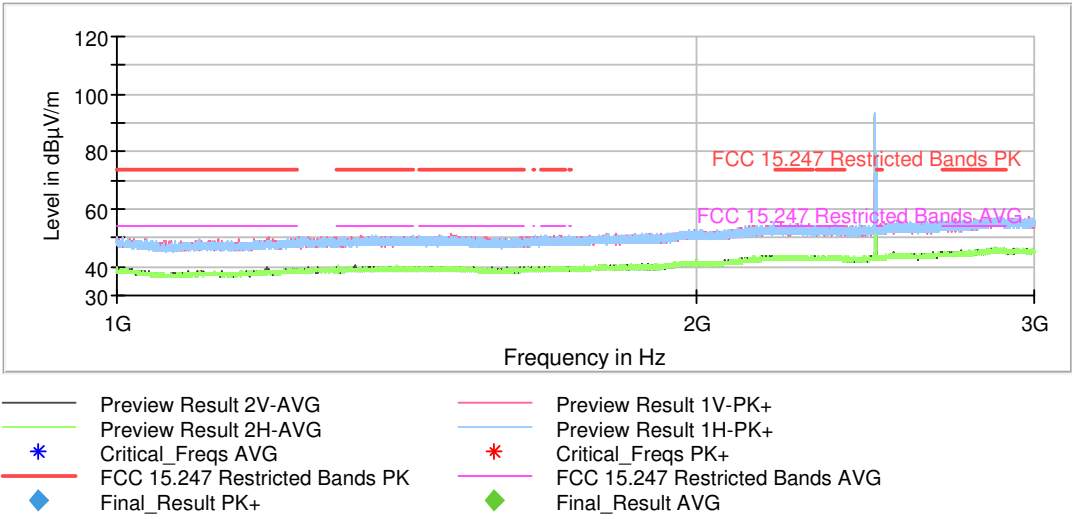
The peak above the limit is the carrier frequency.

- Middle Channel:



The peak above the limit is the carrier frequency.

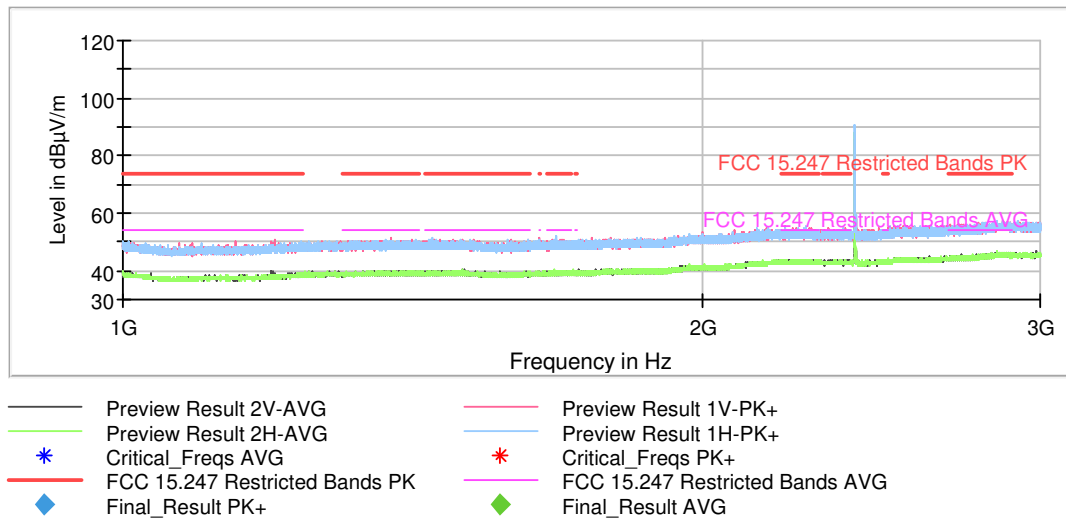
- High Channel:



The peak above the limit is the carrier frequency.

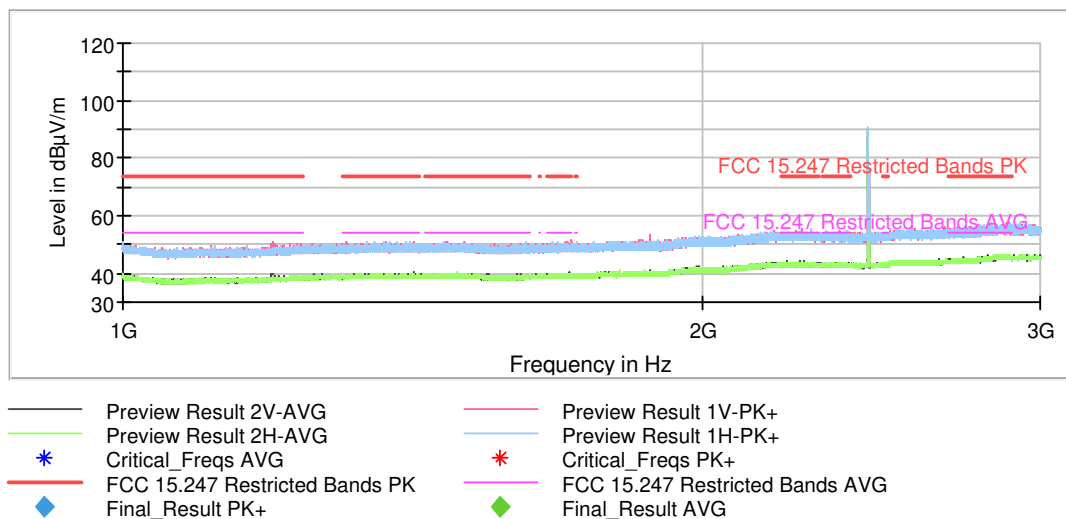
- **Pi/4-DQPSK modulation (2DH5):**

- Low Channel:



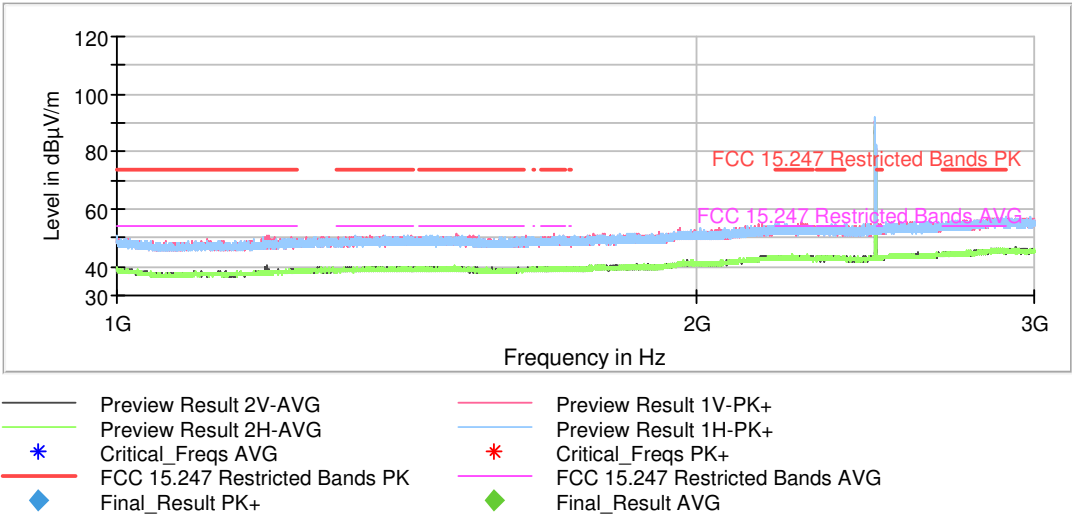
The peak above the limit is the carrier frequency.

- Middle Channel:



The peak above the limit is the carrier frequency.

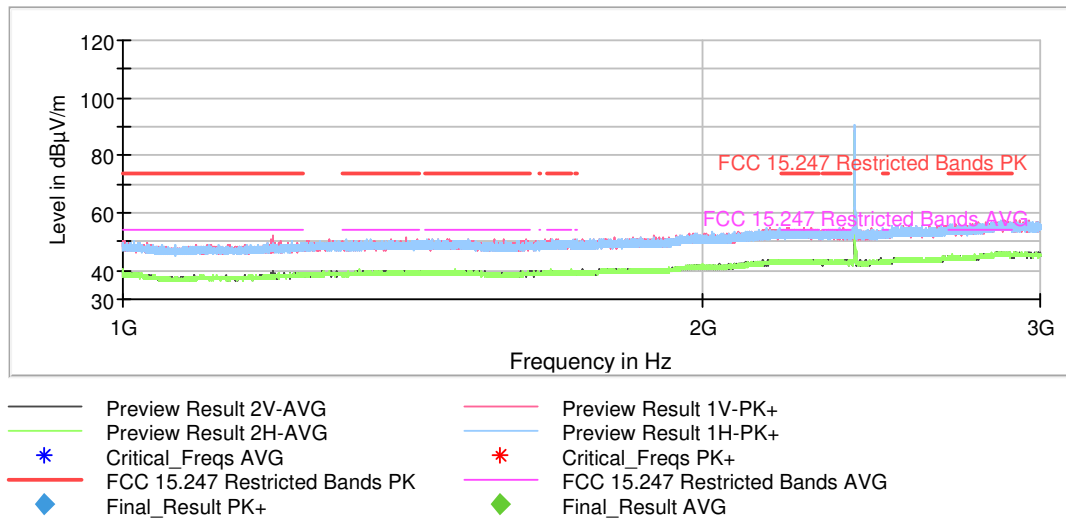
- High Channel:



The peak above the limit is the carrier frequency.

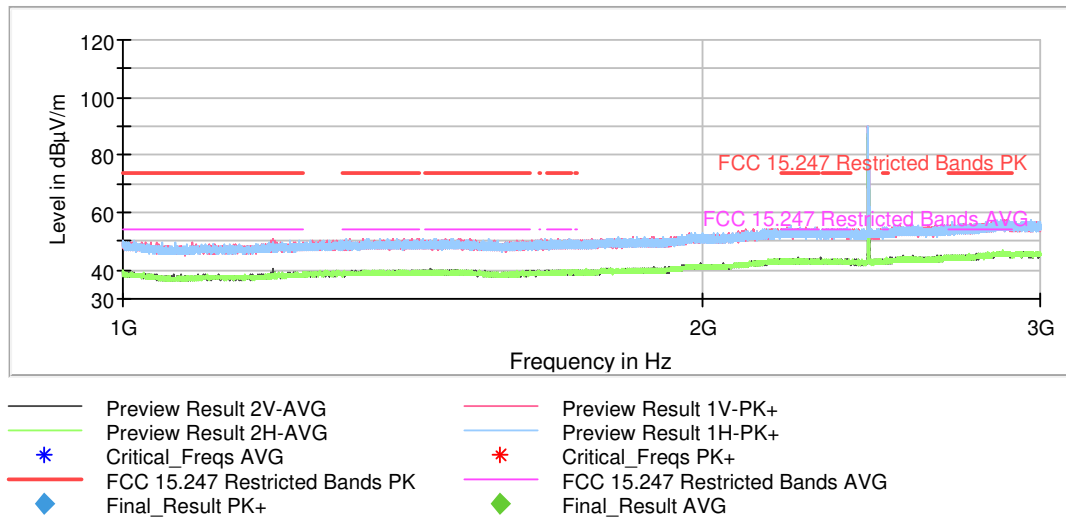
- 8-DPSK modulation (3DH5):

- Low Channel:



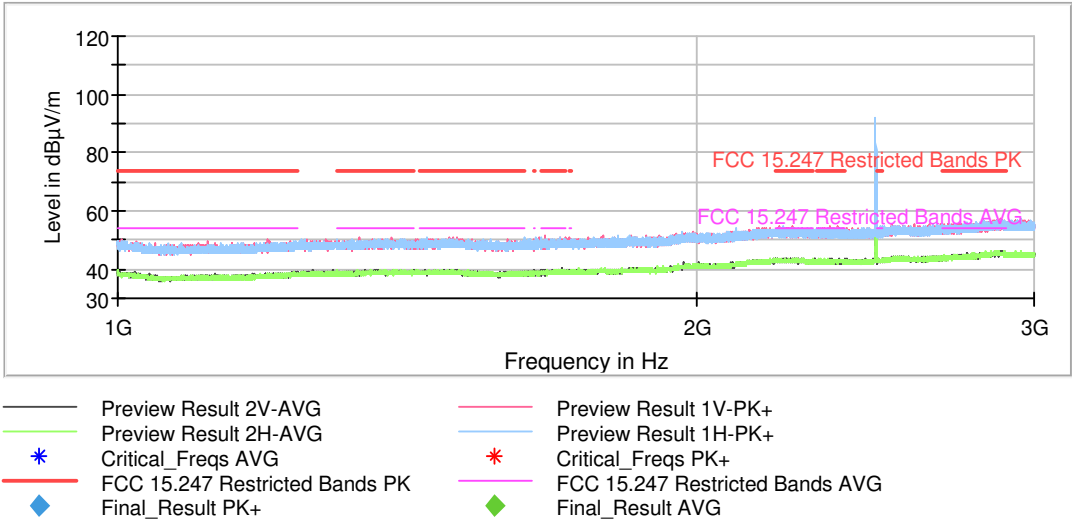
The peak above the limit is the carrier frequency.

- Middle Channel:



The peak above the limit is the carrier frequency.

- High Channel:

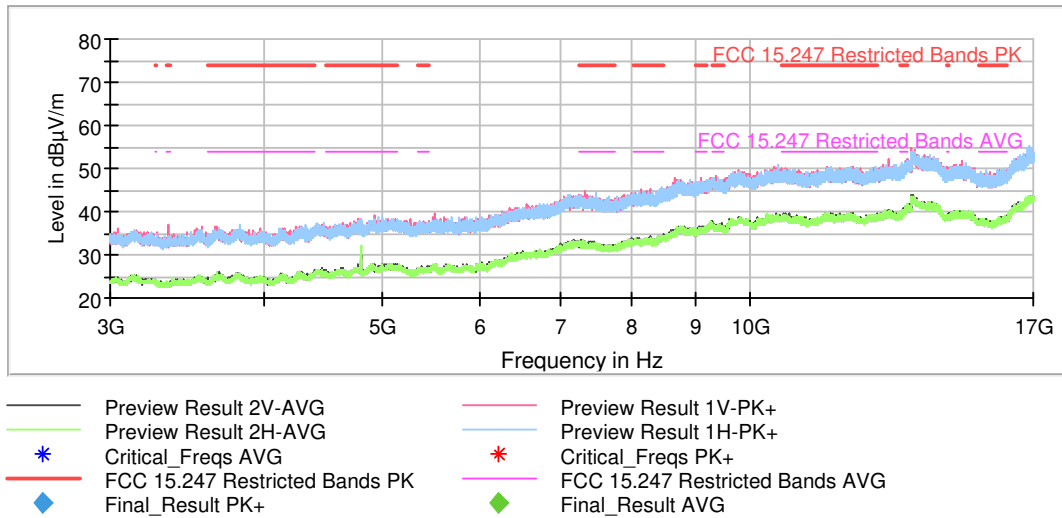


The peak above the limit is the carrier frequency.

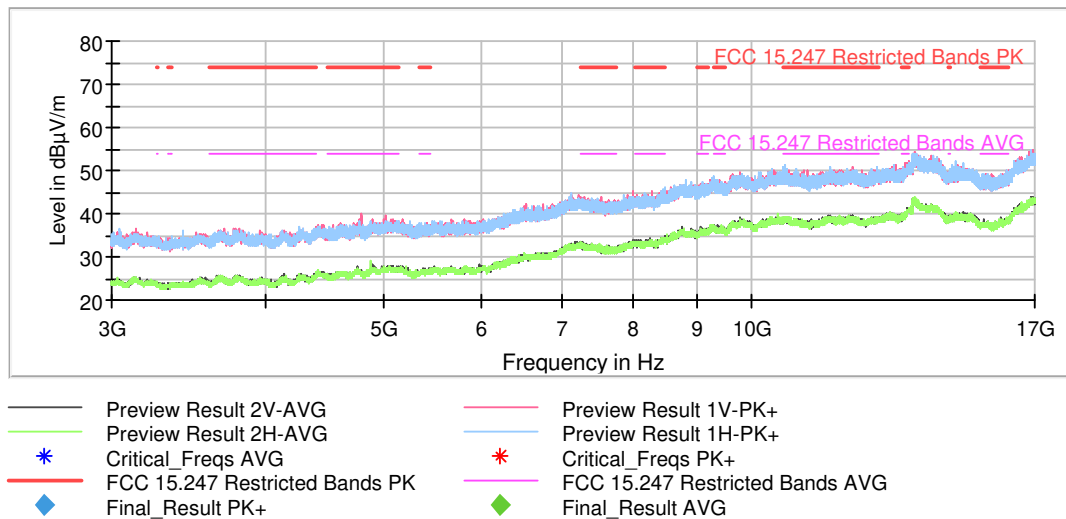
FREQUENCY RANGE 3 - 17 GHz:

- GFSK modulation (DH5)**

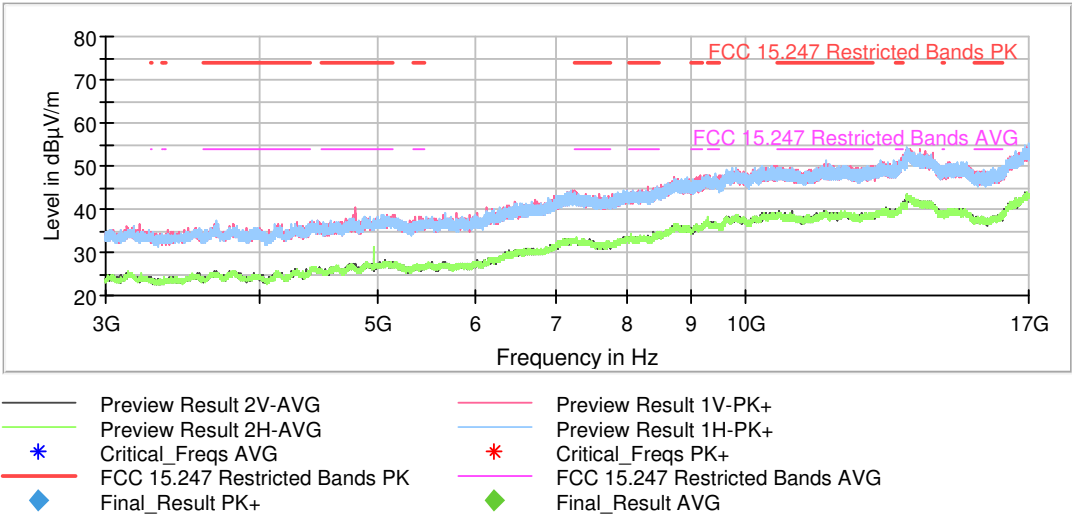
- Low Channel:



- Middle Channel:

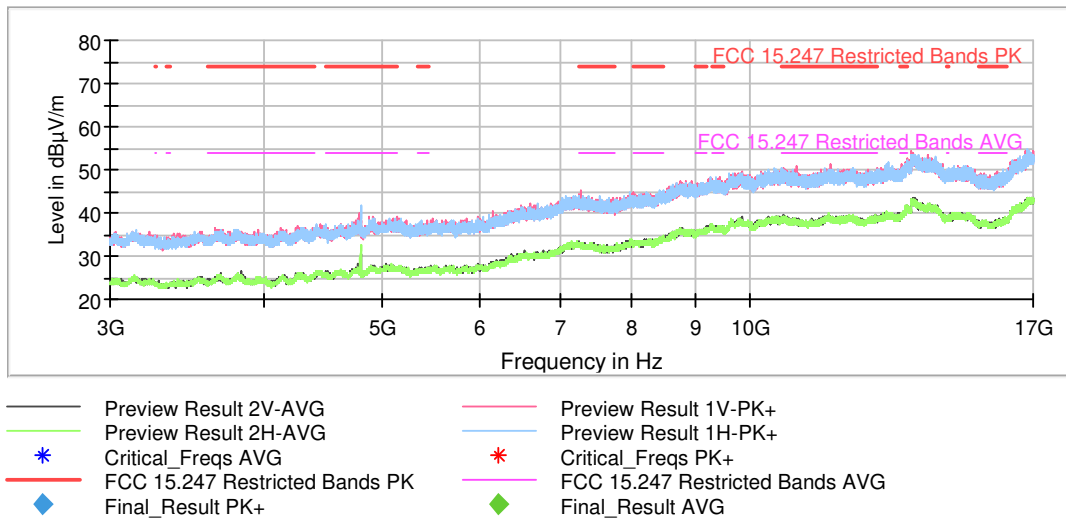


- High Channel:

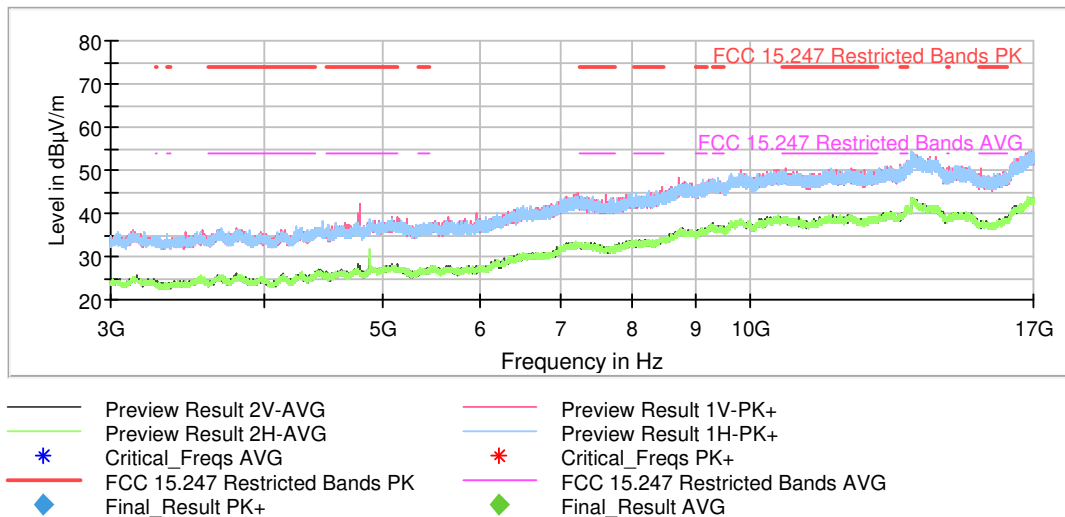


- **Pi/4-DQPSK modulation (2DH5):**

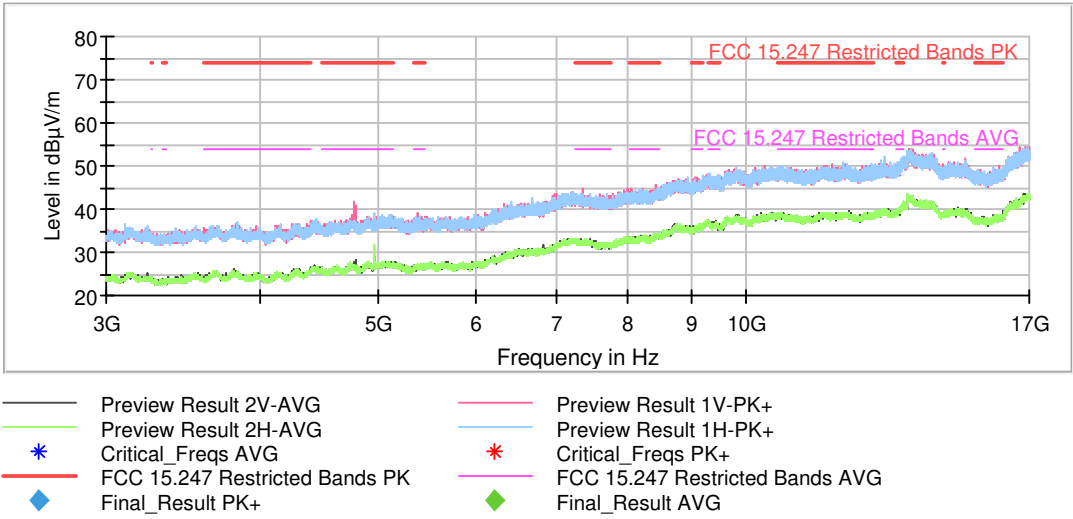
- Low Channel:



- Middle Channel:

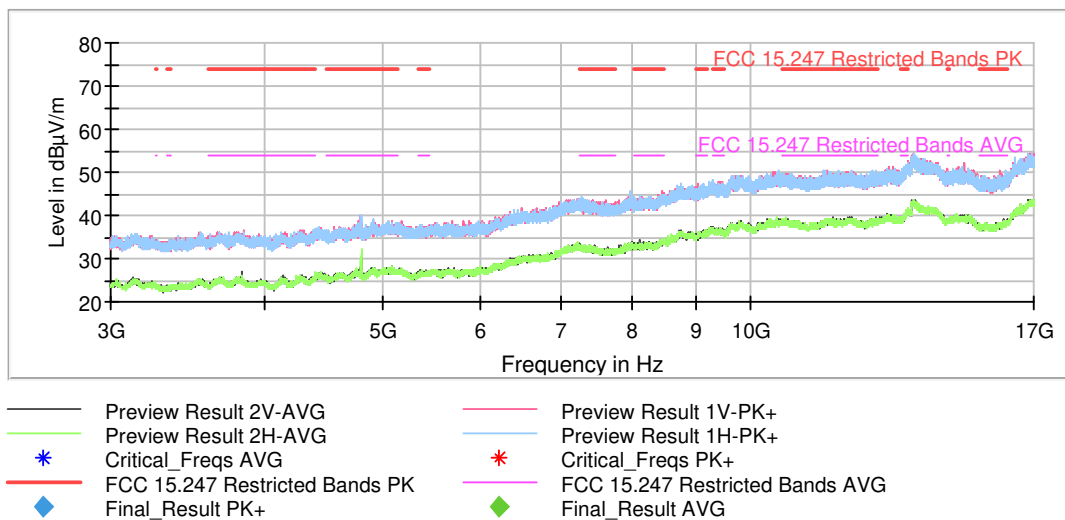


- High Channel:

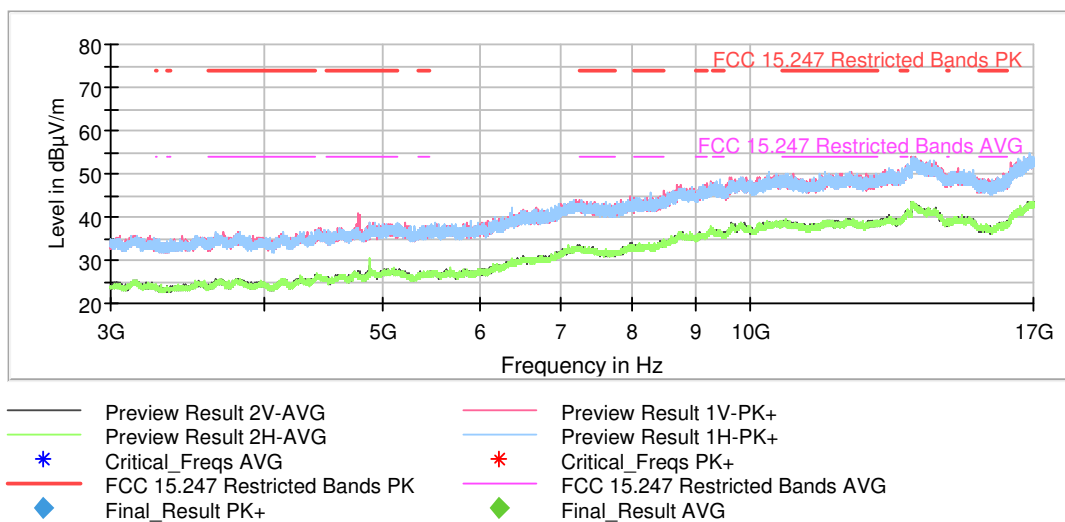


- 8-DPSK modulation (3DH5):

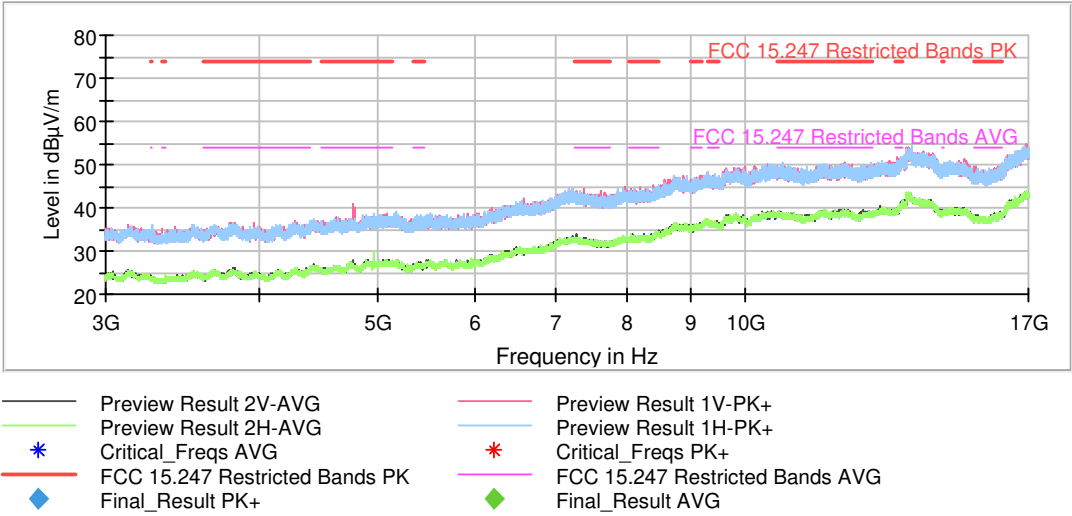
- Low Channel:



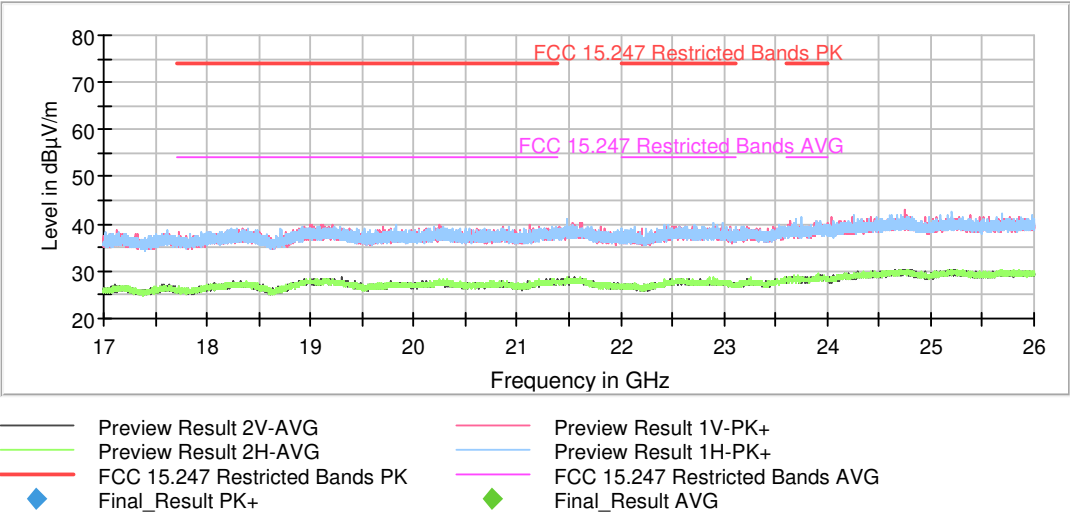
- Middle Channel:



- High Channel:



FREQUENCY RANGE 17 - 26 GHz:

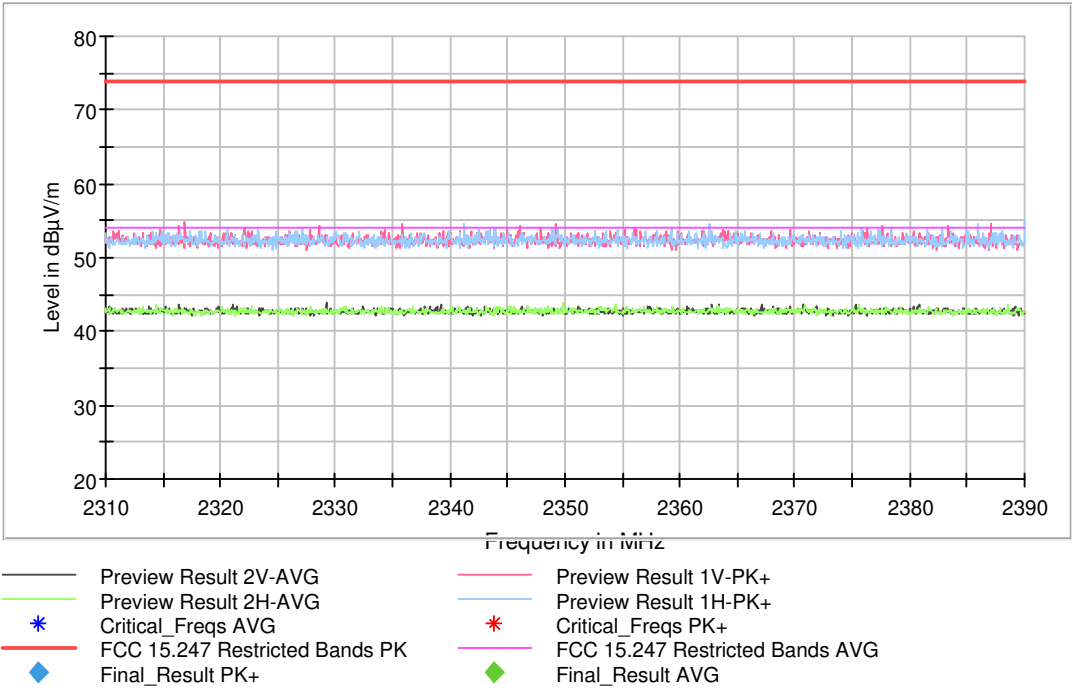


This plot is valid for the Low, Middle and High Channels and all the modulation modes.

RESTRICTED BAND 2.31-2.39 GHz:

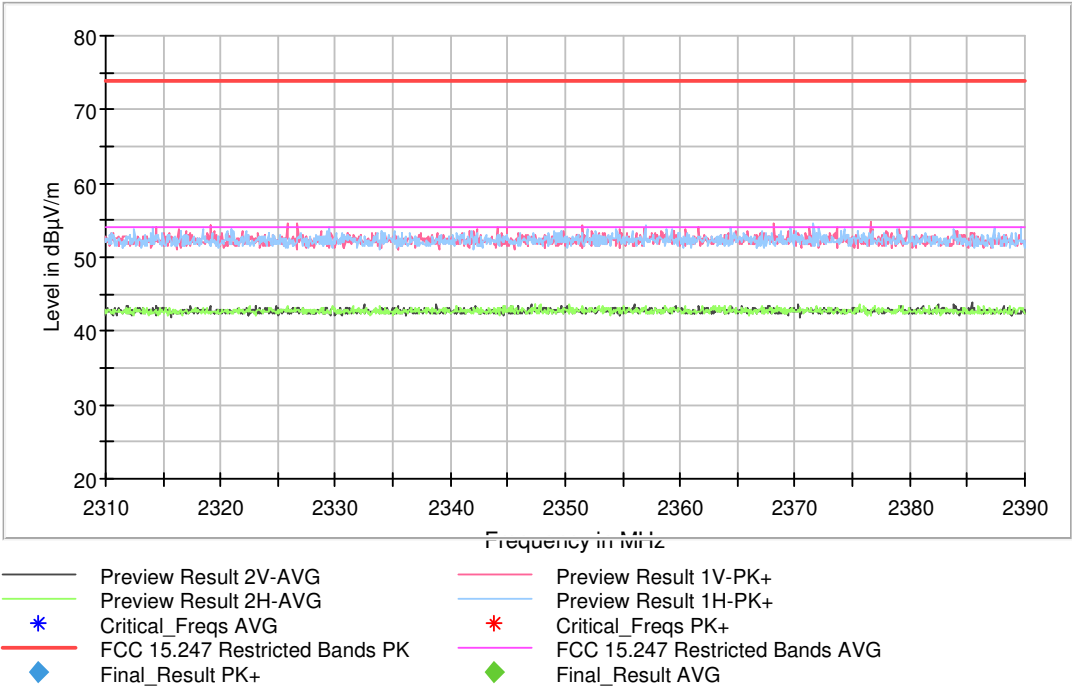
- GFSK modulation (DH5):

- Low Channel:



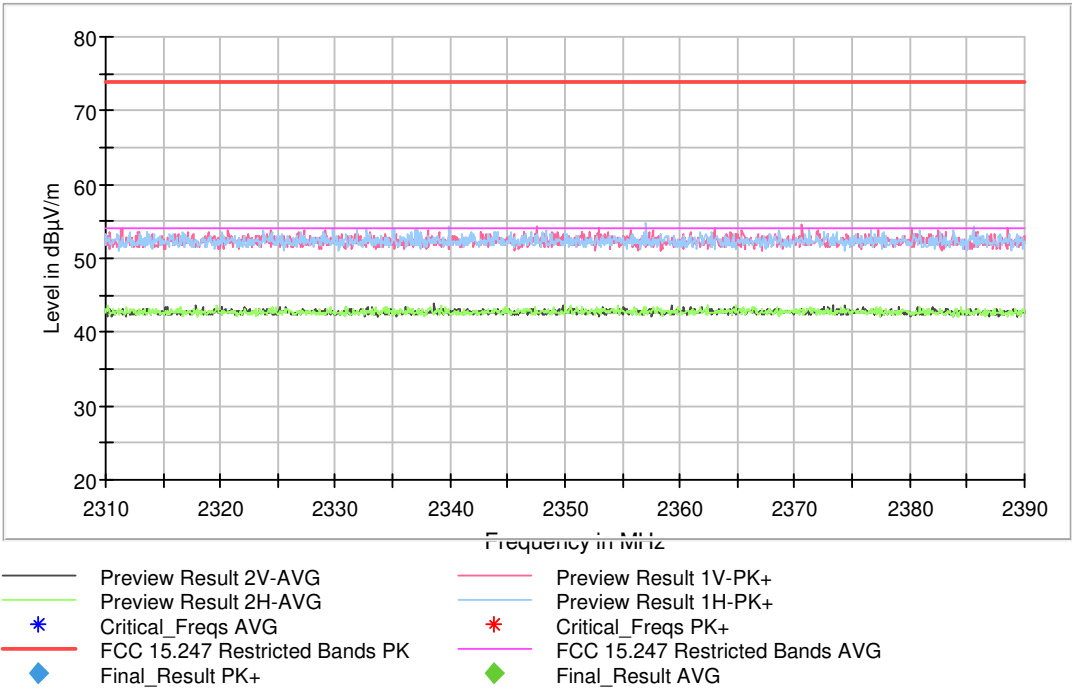
- **Pi/4-DQPSK modulation (2DH5):**

- Low Channel:



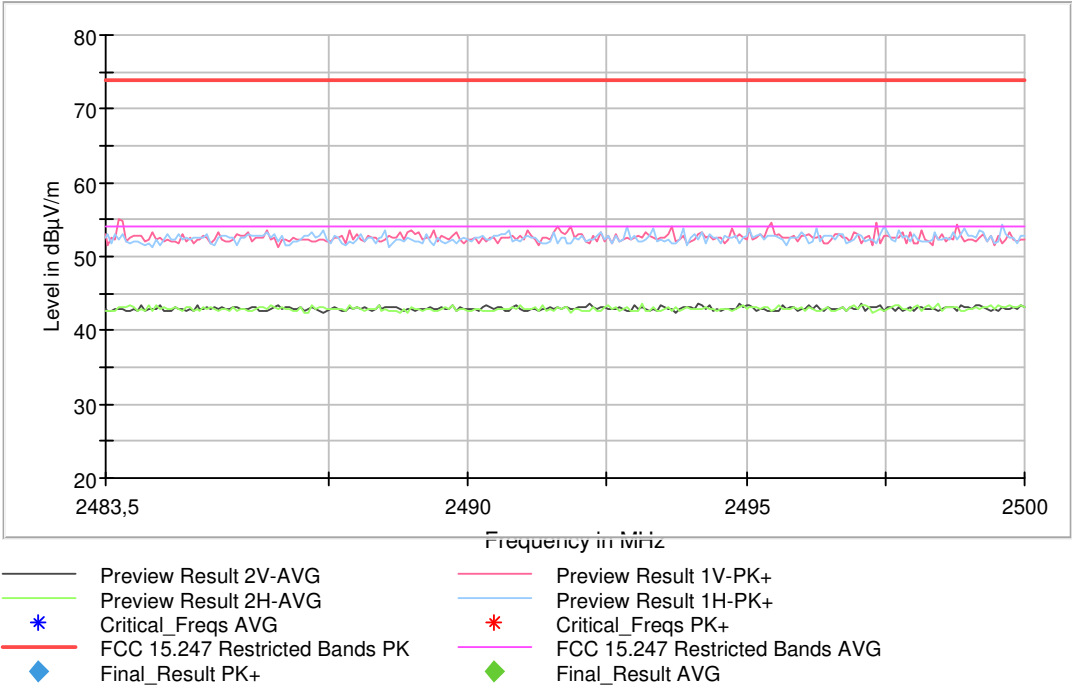
- 8-DPSK modulation (3DH5):

- Low Channel:



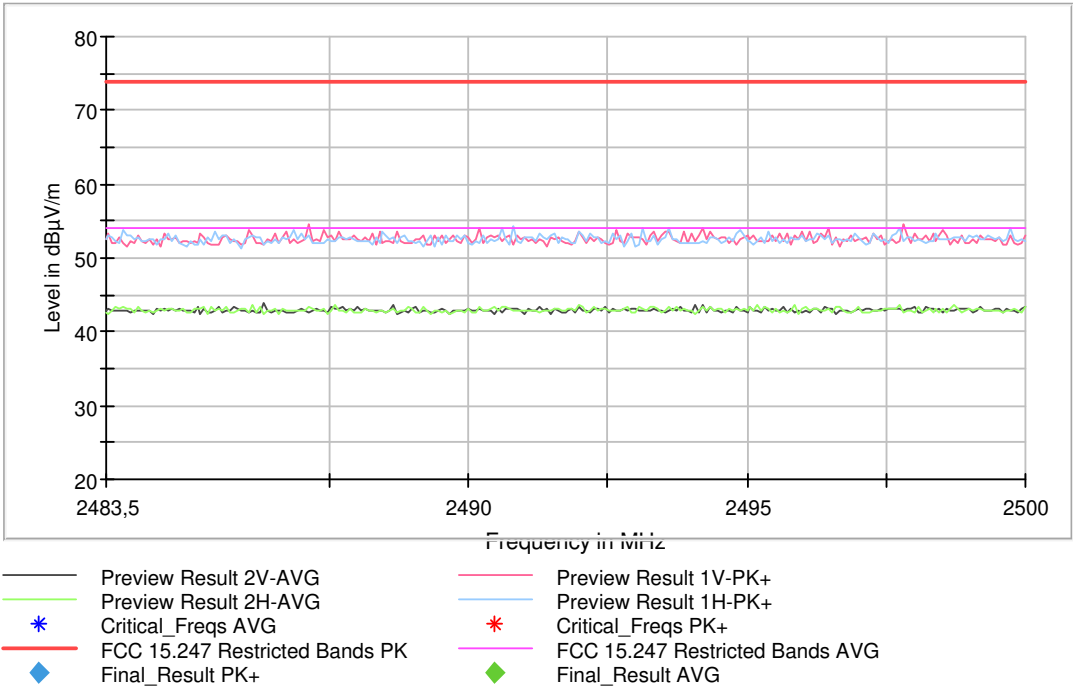
RESTRICTED BAND 2.4835-2.5 GHz:

- GFSK modulation (DH5):
 - High Channel:



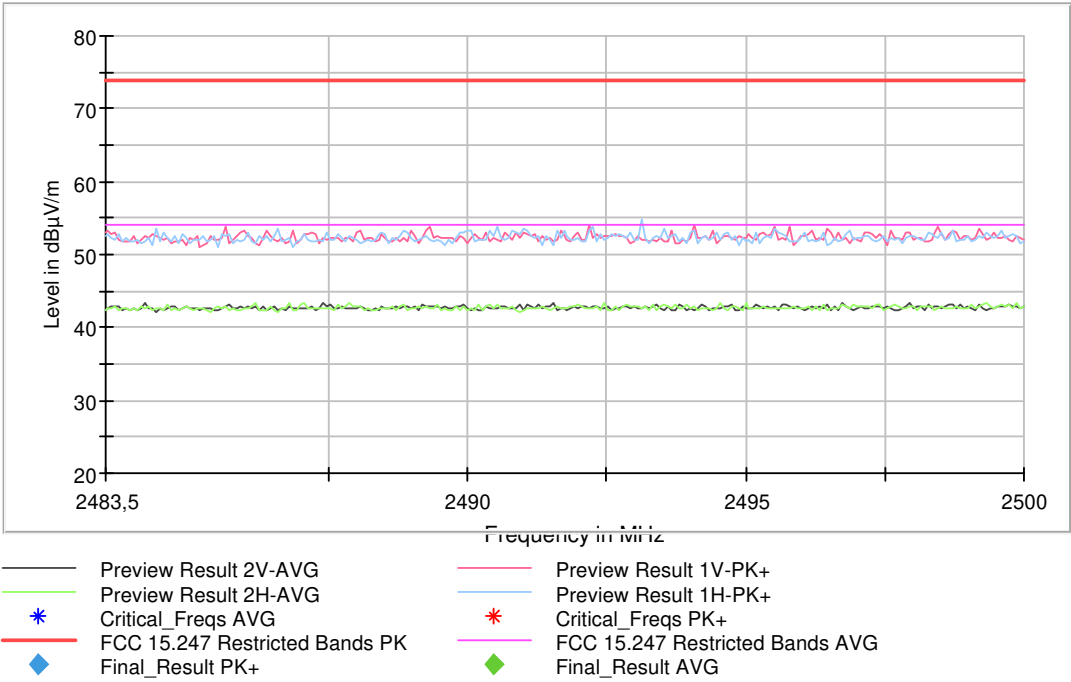
- **Pi/4-DQPSK modulation (2DH5):**

- High Channel:



• 8-DPSK modulation (3DH5):

- High Channel:



Appendix C: Test results. 802.11 bgn20 1x1

TEST CONDITIONS	56
FCC 15.247 (d) / RSS-247 5.5. Emission limitations radiated (Transmitter).....	57

TEST CONDITIONS

POWER SUPPLY (V):

V nominal: 5 Vdc.
Type of Power Supply: Battery or AD/DC adapter

ANTENNA:

Type of Antenna: Integral

TEST FREQUENCIES:

802.11 bgn20:
Low Channel: 2412 MHz
Middle Channel: 2437 MHz
High Channel: 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 tests have been performed in the worst case of Modulation, bandwidth, data rate and power:

Mode b: DSSS to 1Mbps.

Mode g: OFDM to 6 Mbps.

Mode n20: OFDM to MCS0.

Doing a preliminary scan of spurious emissions, it was determined that worst case in OFDM modulation is mode 802.11 g.

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 m for the frequency range 17 GHz-26 GHz (17 GHz-26 GHz horn antenna).

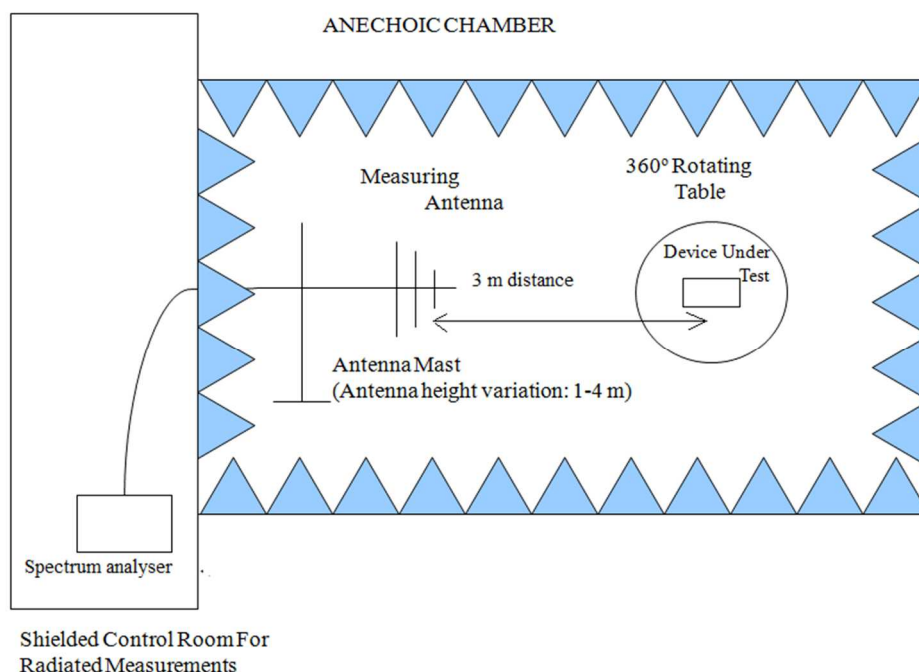
For radiated emissions in the range 17 GHz-26 GHz that is performed at a distance closer than the specified distance, an inverse proportionality factor of 20 dB per decade is used to normalize the measured data for determining compliance.

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.

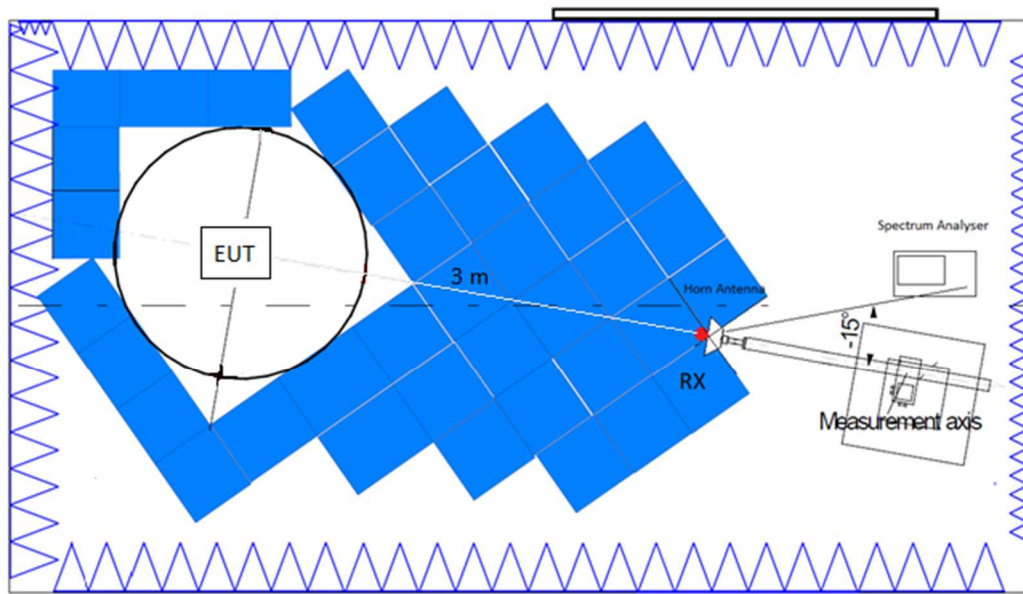
Measurements were made in both horizontal and vertical planes of polarization.

A resolution bandwidth / video bandwidth of 100 kHz / 300 kHz was used for frequencies below 1 GHz and 1 MHz / 3 MHz for frequencies above 1 GHz.

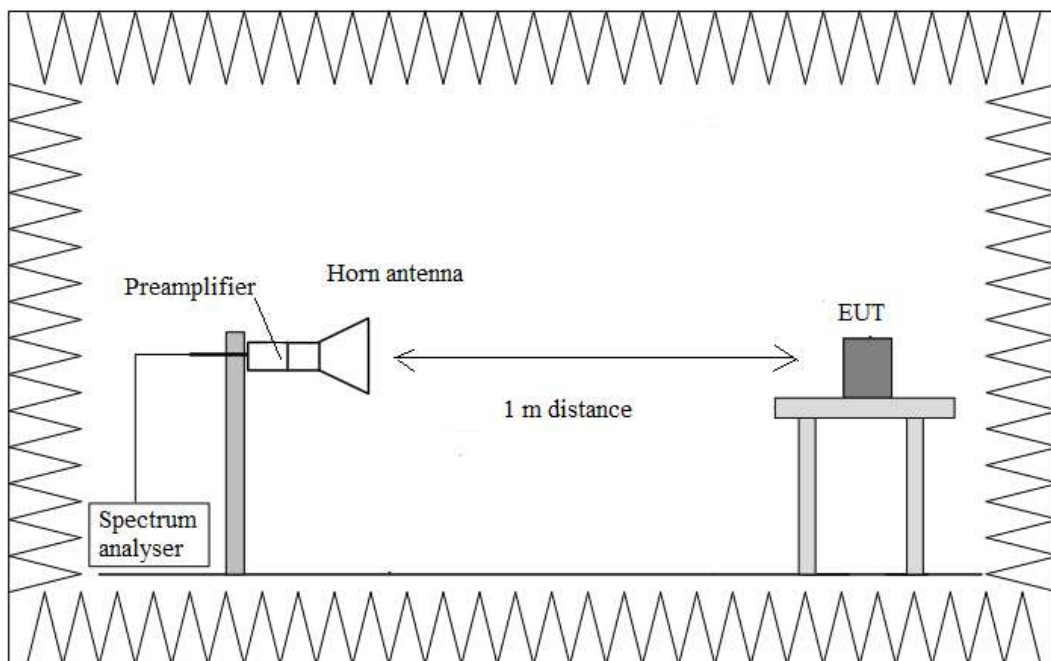
Radiated measurements setup from 30 MHz to 1 GHz:



Radiated measurements setup from 1 GHz to 17 GHz:



Radiated measurements setup $f > 17$ GHz up to 26 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 ($\mu\text{V/m}$)	Field strength ($\text{dB}\mu\text{V/m}$)	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 1 m 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 ($\text{dB}\mu\text{V/m}$)	Polarization	Detector	Measurement Uncertainty (dB)
198.0040	33.73	H	Quasi-peak	$<\pm 5.10$
247.4740	38.03	H	Quasi-peak	$<\pm 5.10$
296.9925	37.07	H	Quasi-peak	$<\pm 5.10$
346.4625	30.01	H	Quasi-peak	$<\pm 5.10$
649.9755	36.18	V	Quasi-peak	$<\pm 5.10$

Veredic: Pass

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

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

- RESTRICTED BAND 2.31-2.39 GHz. LOW CHANNEL. No spurious frequencies at less than 20 dB below the limit.
- RESTRICTED BAND 2.4835-2.5 GHz. HIGH CHANNEL. No spurious frequencies at less than 20 dB below the limit.

Measurement Uncertainty (dB):	1 GHz - 3 GHz $<\pm 3.98$
	3 GHz - 17 GHz $<\pm 4.60$
	17 GHz - 26 GHz $<\pm 4.89$

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.

Spurious emissions in the Restricted Bands 2.31-2.39 GHz and 2.4835-2.5 GHz are measured for all modes. The following results and plots are for the worst case OFDM mode.

Worst case OFDM mode: 802.11 g.

- **802.11 g (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 frequencies with peak levels above the average limit (54 dB μ V/m at 3 m) are measured with average detector for checking compliance with the average limit.

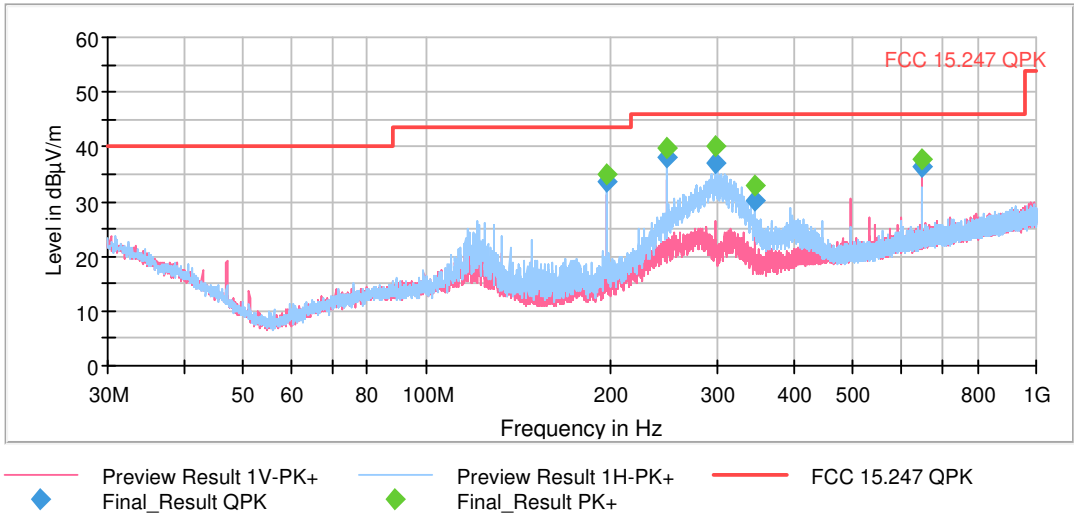
- LOW CHANNEL. No spurious frequencies at less than 20 dB below the limit.
- MIDDLE CHANNEL. No spurious frequencies at less than 20 dB below the limit.
- HIGH CHANNEL. No spurious frequencies at less than 20 dB below the limit.
- RESTRICTED BAND 2.31-2.39 GHz. LOW CHANNEL. No spurious frequencies at less than 20 dB below the limit.
- RESTRICTED BAND 2.4835-2.5 GHz. HIGH CHANNEL. No spurious frequencies at less than 20 dB below the limit.

Measurement Uncertainty (dB):	1 GHz - 3 GHz $<\pm$ 3.98
	3 GHz - 17 GHz $<\pm$ 4.60
	17 GHz - 26 GHz $<\pm$ 4.89

Verdict: PASS

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

The spurious frequencies detected do not depend on either the operating channel or the modulation mode.

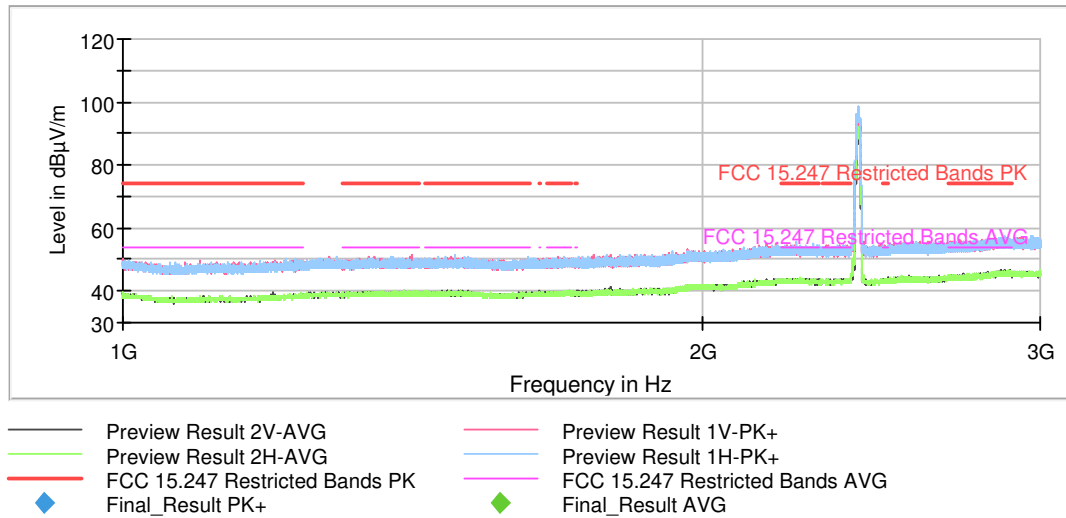


The above plot shows the results of the scan using peak detector.

• 802.11 b:

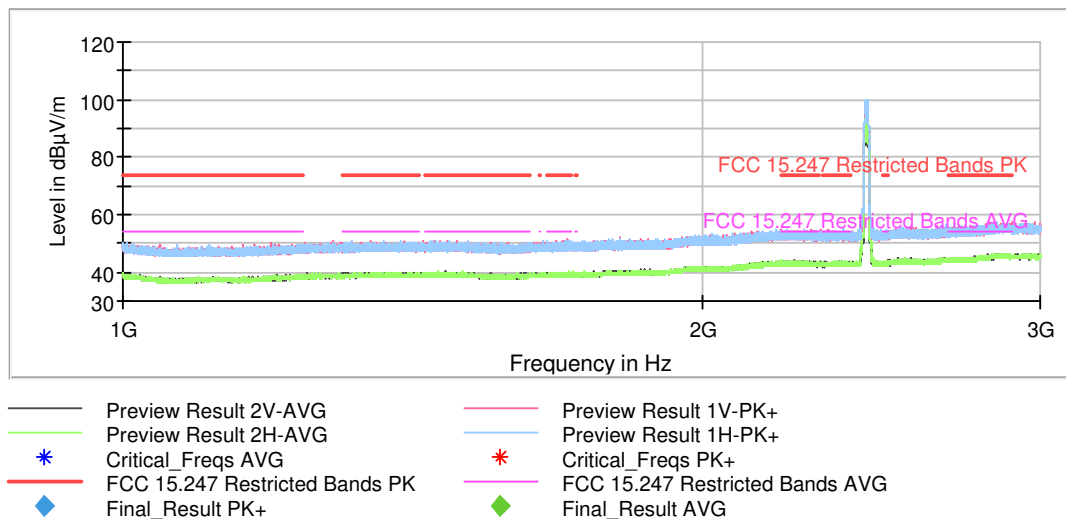
FREQUENCY RANGE 1 - 3 GHz:

- Low Channel:



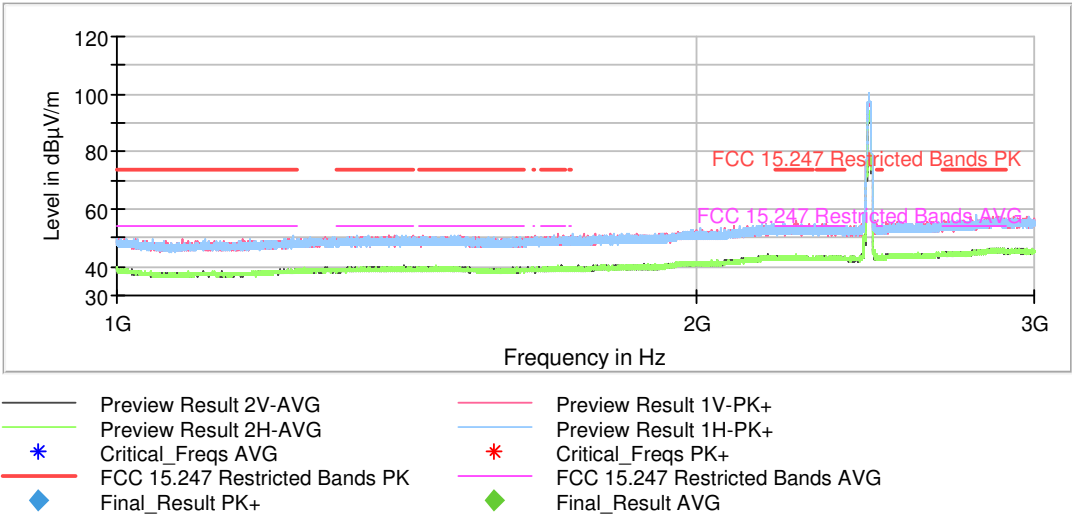
The peak above the limit is the carrier frequency.

- Middle Channel:



The peak above the limit is the carrier frequency.

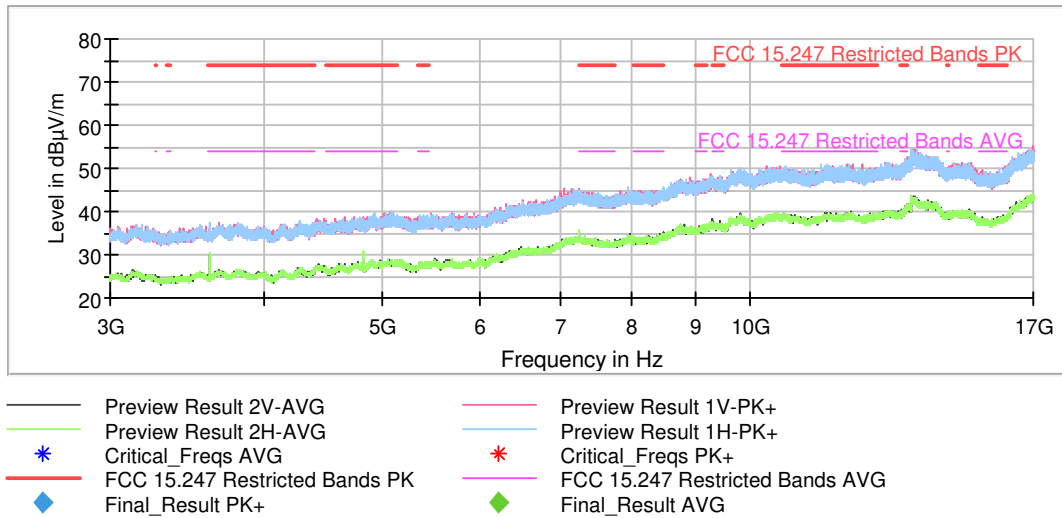
- High Channel:



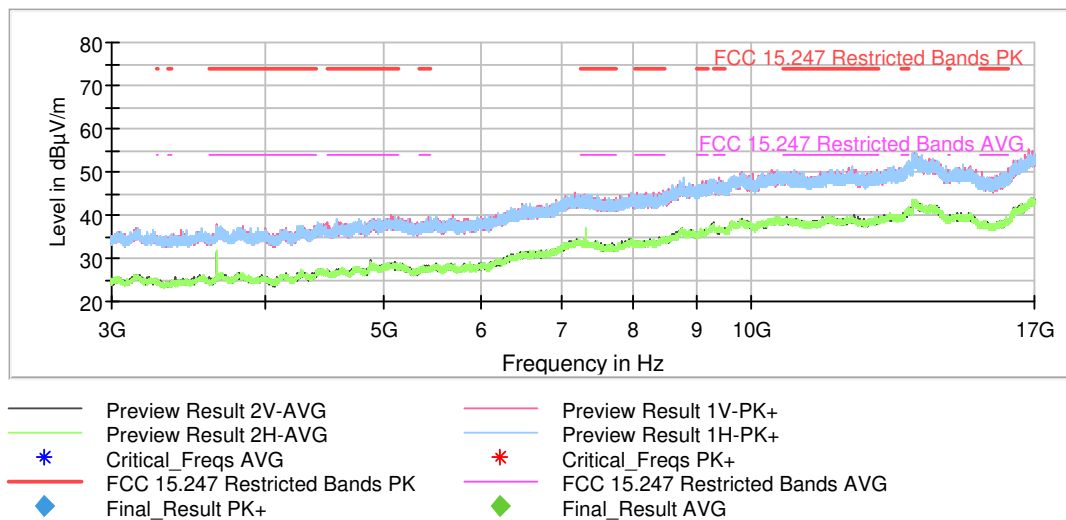
The peak above the limit is the carrier frequency.

FREQUENCY RANGE 3 - 17 GHz:

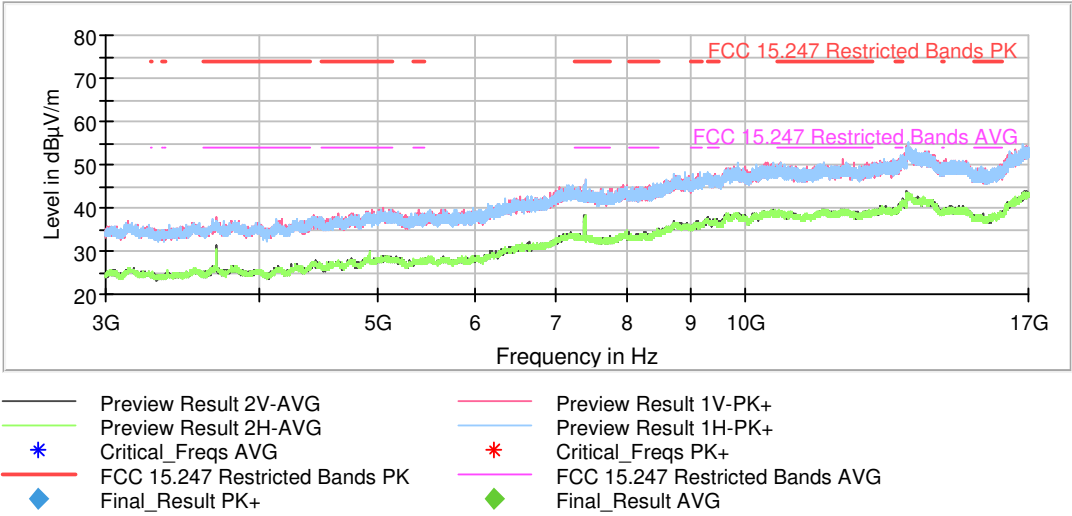
- Low Channel:



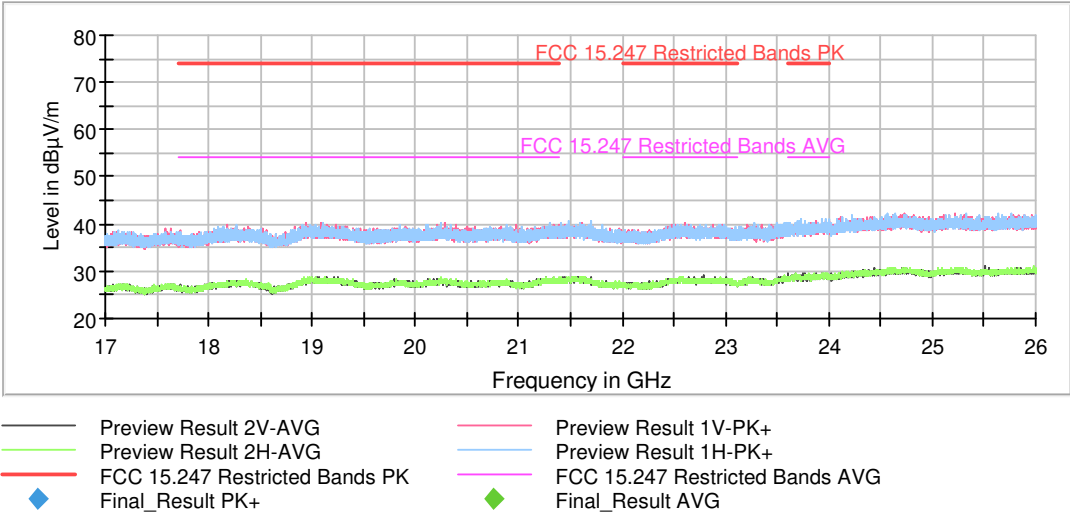
- Middle Channel:



- High Channel:



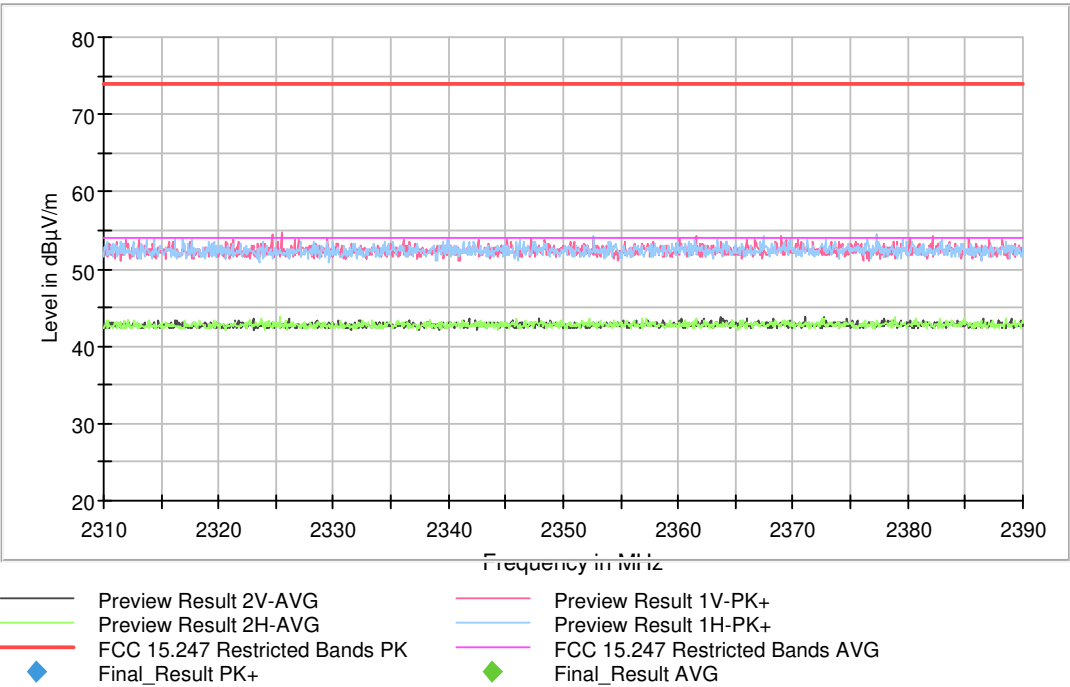
FREQUENCY RANGE 17 - 26 GHz:



This plot is valid for the Low, Middle and High Channels

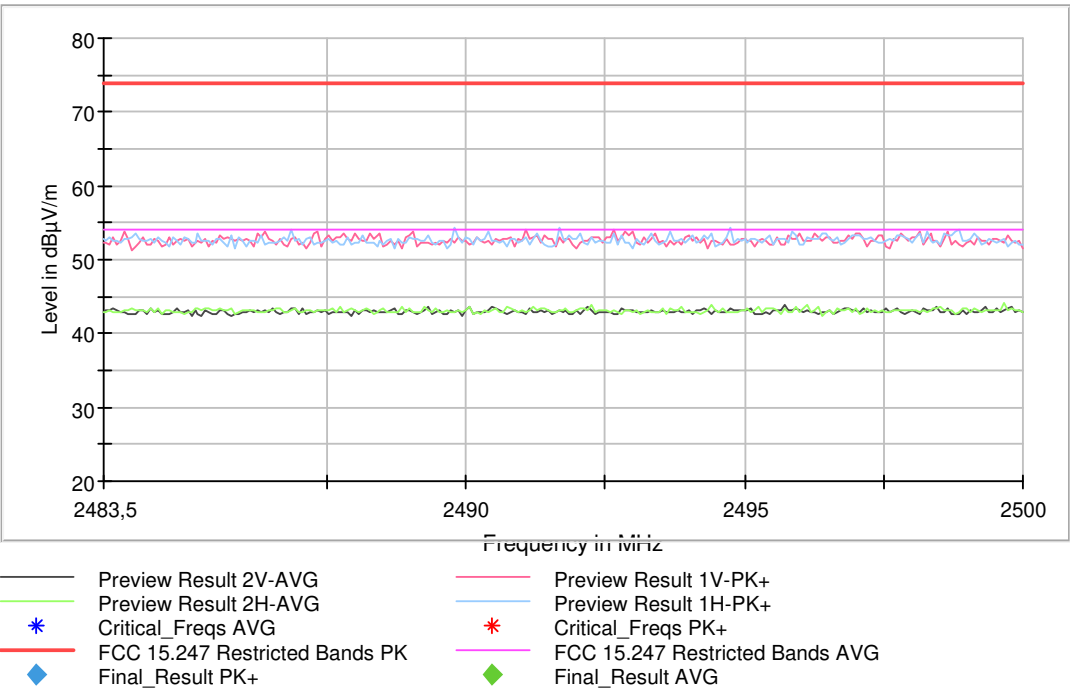
RESTRICTED BAND 2.31-2.39 GHz:

- Low Channel:



RESTRICTED BAND 2.4835-2.5 GHz:

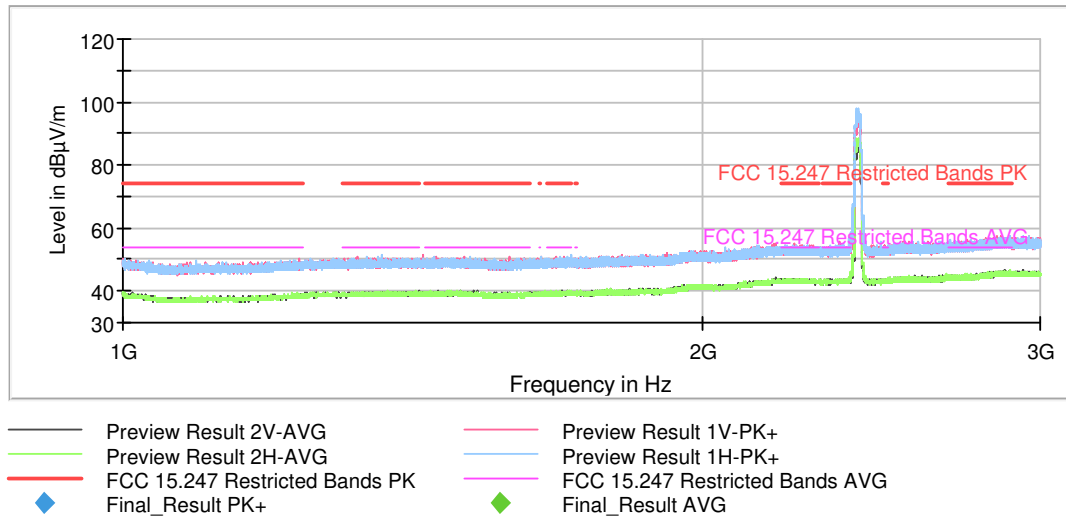
- High Channel:



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

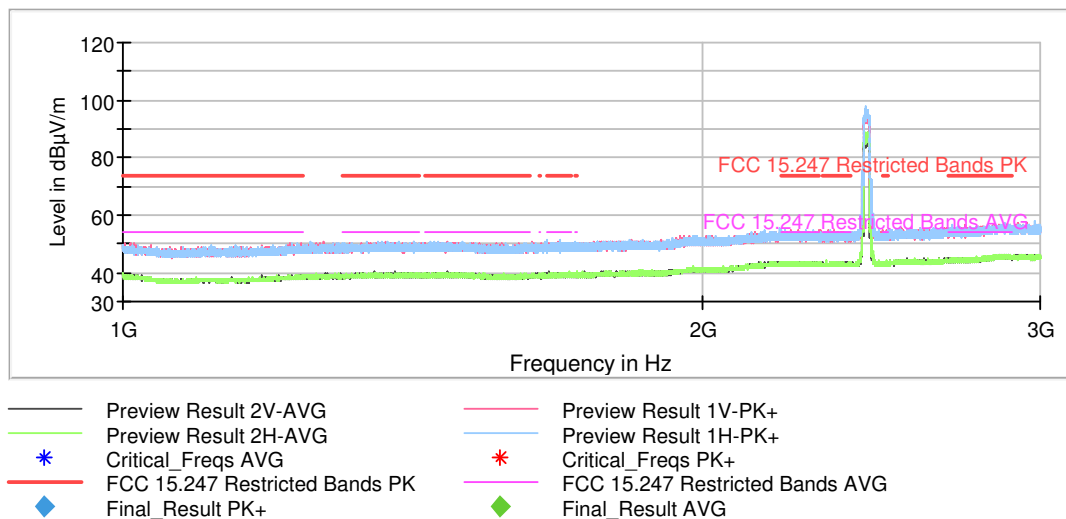
FREQUENCY RANGE 1 - 3 GHz:

- Low Channel:



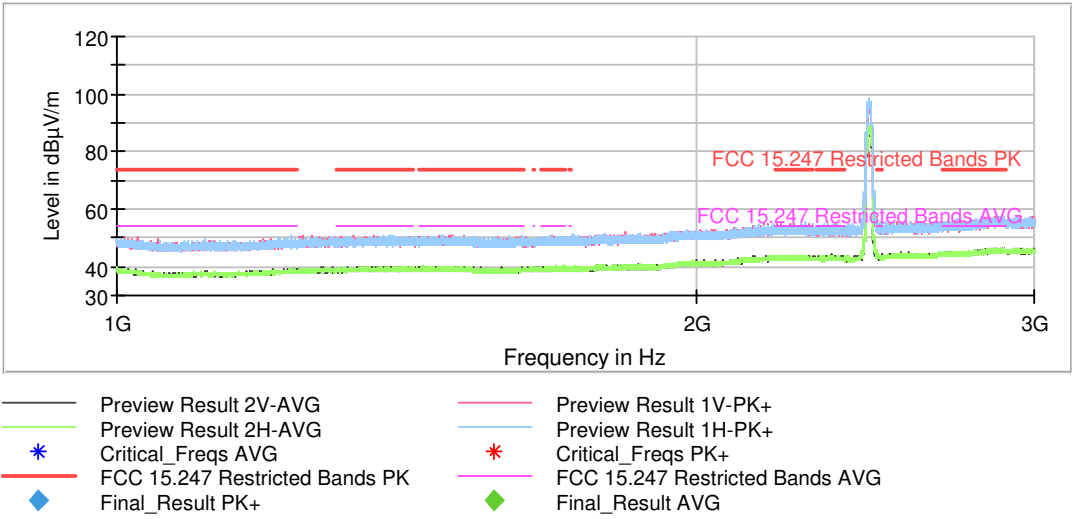
The peak above the limit is the carrier frequency.

- Middle Channel:



The peak above the limit is the carrier frequency.

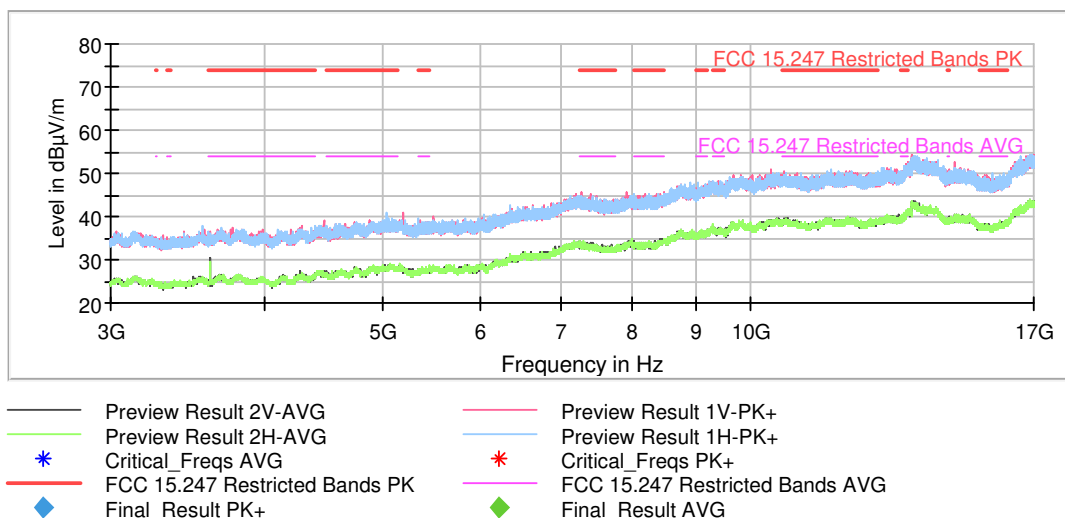
- High Channel:



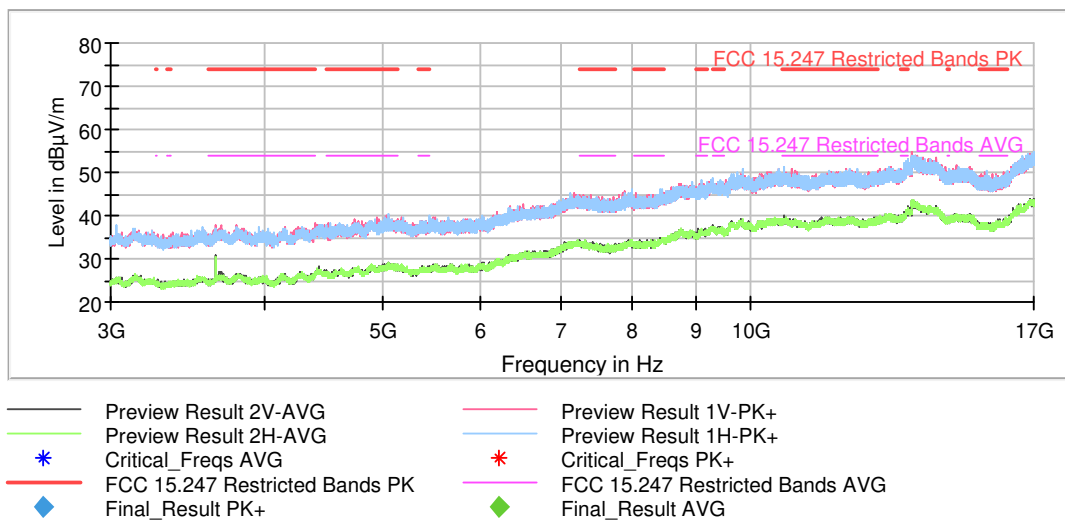
The peak above the limit is the carrier frequency.

FREQUENCY RANGE 3 - 17 GHz:

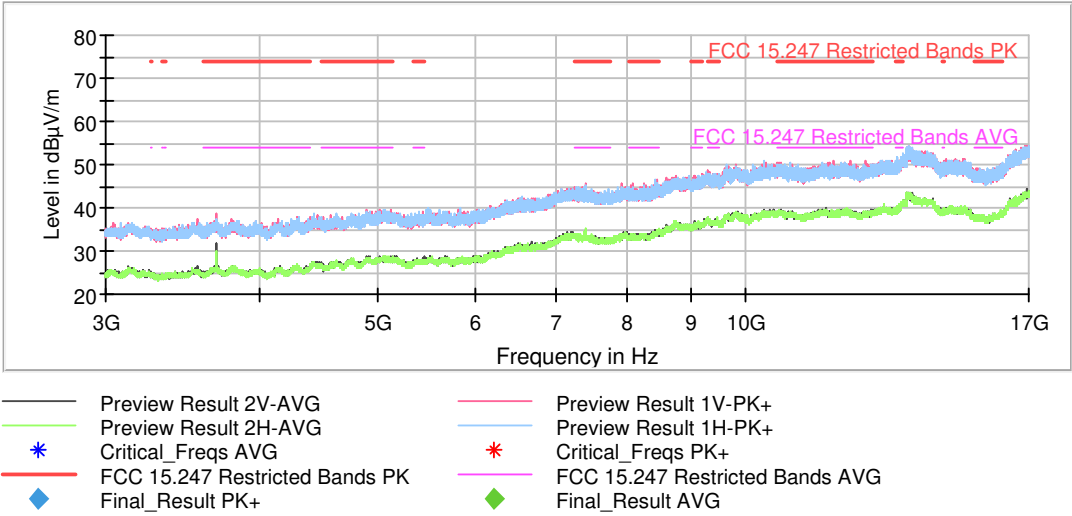
- Low Channel:



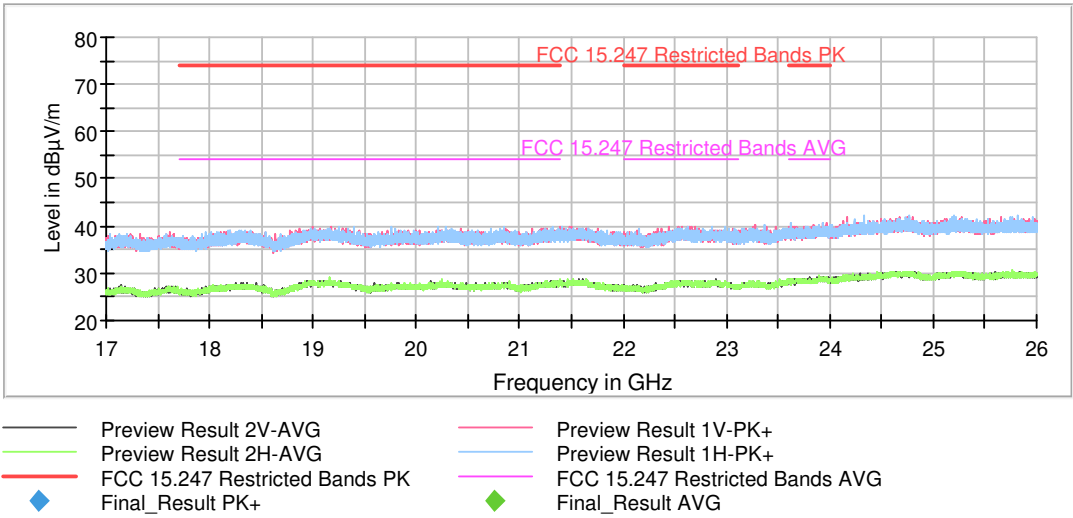
- Middle Channel:



- High Channel:



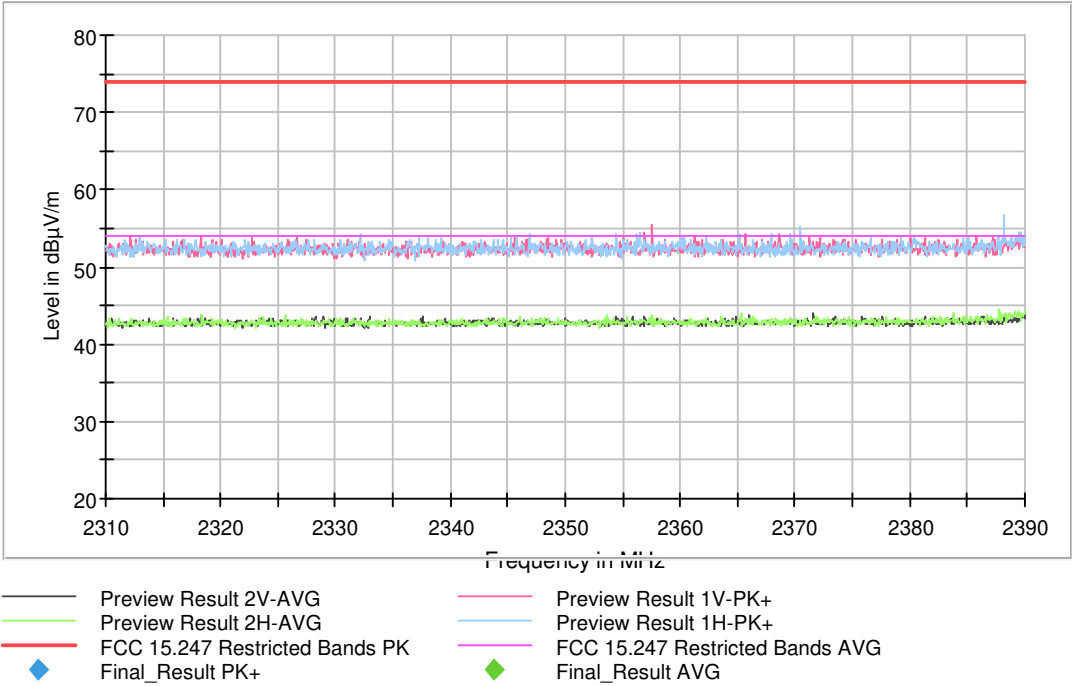
FREQUENCY RANGE 17 - 26 GHz:



This plot is valid for the Low, Middle and High Channels

RESTRICTED BAND 2.31-2.39 GHz:

- Low Channel:



RESTRICTED BAND 2.4835-2.5 GHz:

- High Channel:

