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DEKRA

ENAC ENSAYOS Nº 51/LE147

Test report No:
NIE: 63937RRF.001

Test report

USA FCC Part 15.249, 15.209
CANADA RSS-210, RSS-Gen

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

(*) Identification of item tested	Hearing aid
(*) Trademark	UNITRON
(*) Model and /or type reference	HelloGO
Other identification of the product	HW version: Final SW version: Firmware Image 0.4.0.0 ,TrueFit 4.3.0.10171. and above FCC ID: KWC-HGO IC: 2262A-HGO
(*) Features	BT Classic, BLE, DM and Flora
Applicant	UNITRON (SONOVA AG) 20 Beasley Drive, Kitchener, Ontario, CANADA N2E 1Y6
Test method requested, standard	USA FCC Part 15.249 (10-1-19 Edition): Operation within the bands 902 - 928 MHz, 2400 -2483.5 MHz, 5725 - 5875 MHz, and 24.0 – 24.25 GHz. USA FCC Part 15.209 (10-1-19 Edition): Radiated emission limits; general requirements. CANADA RSS-210 Issue 10 (December 2019). Licence-Exempt Radio Apparatus: Category I Equipment CANADA RSS-Gen Issue 5 (March 2019) Amendment 1. General Requirements for Compliance of Radio Apparatus. ANSI C63.10-2013: American National Standard for Testing Unlicensed Wireless Devices.
Approved by (name / position & signature)	José Carlos Luque RF Lab. Supervisor 74841983Y JOSE CARLOS LUQUE (C:A29507456) Firmado digitalmente por 74841983Y JOSE CARLOS LUQUE (C:A29507456) Fecha: 2020.07.30 08:44:18 +02'00'
Date of issue	2020-07-30
Report template No	FDT08_22 (*) "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.
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 HelloGO is a Hearing Instrument that is considered one size fits all device with Microphone & Receiver located in the earpiece, electronics with Li-ion rechargeable battery in a behind the ear component and Bluetooth.

DEKRA Testing and Certification S.A.U. declines any responsibility with respect to the information provided by the client and that may affect the validity of results.

Usage of samples

Samples undergoing test have been selected by: The client.

- Sample S/01 is composed of the following elements:

Control Nº	Description	Model	Serial Nº	Date of reception
63937C/009	Hearing aid	HelloGO	---	2020/06/26
63937C/014	AA battery socket	--	---	2020/06/26

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

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

Control Nº	Description	Model	Serial Nº	Date of reception
63937C/029	Hearing aid	HelloGO	---	2020/06/26

Sample S/02 has undergone the following test(s): All Radiated tests indicated in Appendixes A, B, C, D.

Test sample description

Ports…… :	Port name and description	Cable			
		Specified max length [m]	Attached during test	Shielded	Coupled to patient(3)
	N/A		☐	☐	☐
Supplementary information to the ports…… :	-				
Rated power supply .....:	Voltage and Frequency				
	☒	DC: Vnom : 3.8V Li-Ion Rechargable type			
Rated Power .....:	-				
Clock frequencies.....:	-				
Other parameters .....:	-				
Software version .....:	Firmware Image 0.4.0.0, TrueFit 4.3.0.10171 and above				
Hardware version .....:	Final				
Dimensions in cm (W x H x D) ....:	-				
Mounting position .....:	☒	Other: Hearing Aid			

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
	-		

Identification of the client

UNITRON (SONOVA AG)
20 Beasley Drive, Kitchener, Ontario, CANADA N2E 1Y6

Testing period and place

Test Location	DEKRA Testing and Certification S.A.U.
Date (start)	2020-06-29
Date (finish)	2020-07-07

Document history

Report number	Date	Description
63937RRF.001	2020-07-30	First release

Environmental conditions

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

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

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

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

In the chamber for conducted measurements, the following limits were not exceeded during the test:

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

Remarks and comments

The tests have been performed by the technical personnel: Miguel Ángel Torres, Jose Gabriel Pendón and Cristina Calle.

Used instrumentation:

Conducted Measurements:

		Last Calibration	Due Calibration
1.	Shielded Room ETS LINDGREN S101	N.A.	N.A.
2.	Signal and Spectrum Analyzer 10 Hz - 40 GHz ROHDE AND SCHWARZ FSV40	2019/09	2021/09

Radiated Measurements:

		Last Calibration	Due Calibration
1.	Semianechoic Absorber Lined Chamber FRANKONIA SAC-3	N.A.	N.A.
2.	Shielded room FRANKONIA	N.A.	N.A.
3.	Hybrid bilog antenna 30MHz-6GHz ETS LINDGREN 3142E	2018/07	2021/07
4.	RF Pre-amplifier 40 dB, 10 MHz-6 GHz BONN ELEKTRONIK BLNA 0160-01N	2019/09	2020/09
5.	Pre-amplifier BOX	2019/09	2020/09
6.	EMI Test Receiver ROHDE AND SCHWARZ ESU26	2020/05	2022/05
7.	Broadband Horn antenna 1-18 GHz SCHWARZBECK MESS- ELEKTRONIK BBHA 9120 D	2018/06	2021/06
8.	RF Pre-amplifier 55 dB,1-18 GHz NARDA AMF-7D-01001800-22-10P	2020/05	2021/05
9.	EMI Test Receiver ROHDE AND SCHWARZ ESU40	2019/09	2021/09
10.	Broadband Horn antenna 18-40 GHz SCHWARZBECK BBHA 9170	2018/07	2021/07
11.	RF Pre-amplifier 30 dB,18-40GHz BONN ELEKTRONIK BLMA 1840-1M	2019/02	2021/02

Testing verdicts

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

Summary

1. Bluetooth Low Energy

FCC PART 15 PARAGRAPH / RSS-210			
Requirement – Test case		Verdict	Remark
15.249 (a) / RSS-210 B.10 (a)	Field strength of fundamental and harmonic emissions	P	
15.249 (d) / RSS-210 B.10 (b)	Emissions radiated outside of the specific frequency bands	P	
Supplementary information and remarks: None.			

2. Bluetooth Basic Rate

FCC PART 15 PARAGRAPH / RSS-210			
Requirement – Test case		Verdict	Remark
15.249 (a) / RSS-210 B.10 (a)	Field strength of fundamental and harmonic emissions	P	
15.249 (d) / RSS-210 B.10 (b)	Emissions radiated outside of the specific frequency bands	P	
Supplementary information and remarks: None.			

3. Proprietary protocol DM 2.4 GHz

FCC PART 15 PARAGRAPH / RSS-210			
Requirement – Test case		Verdict	Remark
15.249 (a) / RSS-210 B.10 (a)	Field strength of fundamental and harmonic emissions	P	
15.249 (d) / RSS-210 B.10 (b)	Emissions radiated outside of the specific frequency bands	P	
Supplementary information and remarks: None.			

4. Proprietary protocol Flora 2.4 GHz

FCC PART 15 PARAGRAPH / RSS-210			
Requirement – Test case		**Verdict**	**Remark**
15.249 (a) / RSS-210 B.10 (a)	Field strength of fundamental and harmonic emissions	P	
15.249 (d) / RSS-210 B.10 (b)	Emissions radiated outside of the specific frequency bands	P	
Supplementary information and remarks: None.			

Appendix A: Test results. Bluetooth Low Energy

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TEST CONDITIONS

POWER SUPPLY (V) and ANTENNA:

V nominal:	3.8 Vdc
Type of Power Supply:	Lithium-Ion rechargeable Battery
Max. RF output power (e.i.r.p.):	-5 dBm
Type of Antenna:	Integral.
Declared Antenna Gain:	-5 dBi

TEST FREQUENCIES:

Low Channel:	2402 MHz
Middle Channel:	2440 MHz
High Channel:	2480 MHz

CONDUCTED MEASUREMENTS

The equipment under test was set up in a shielded room and it is connected to the spectrum analyser using a low loss RF cable. The reading of the spectrum analyser is corrected taking into account the cable loss.

RADIATED MEASUREMENTS

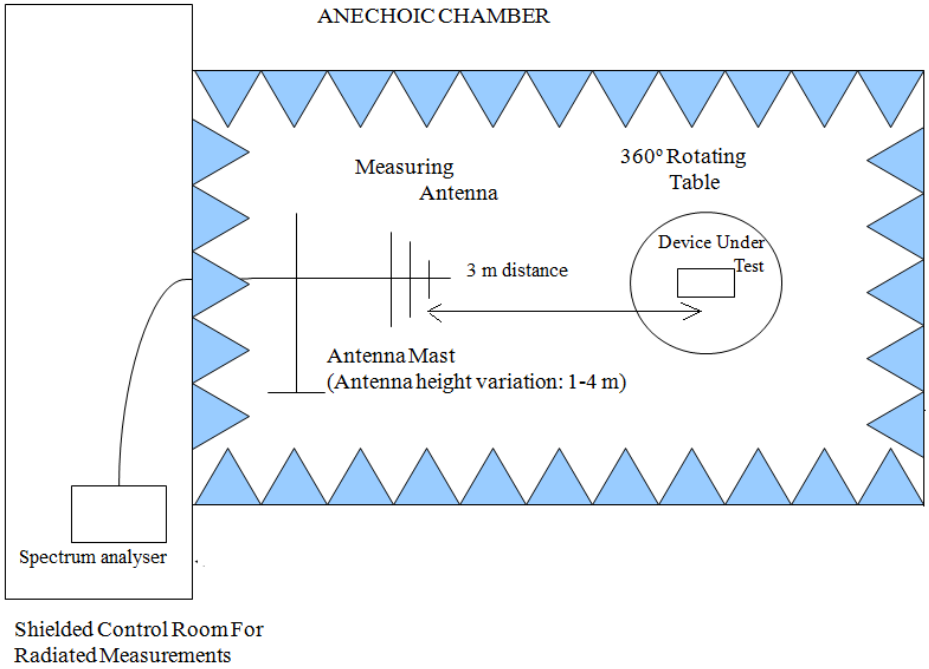
All radiated tests were performed in a semi-anechoic chamber. The measurement antenna is situated at a distance of 3 m for the frequency range 30 MHz-1000 MHz (30 MHz-1000 MHz Bilog antenna) and the frequency range 1 GHz-17 GHz (1 GHz-17 GHz Double ridge horn antenna) and at a distance of 1m for the frequency range 17-26 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.

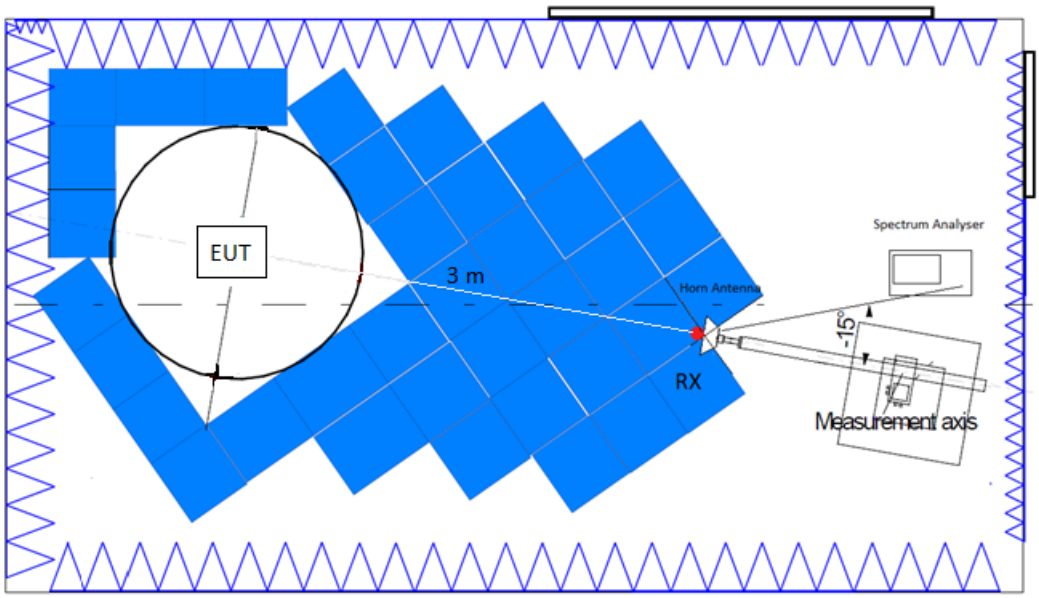
The equipment under test was set up on a non-conductive platform above the ground plane and the situation and orientation was varied to find the maximum radiated emission. It was also rotated 360º and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission.

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

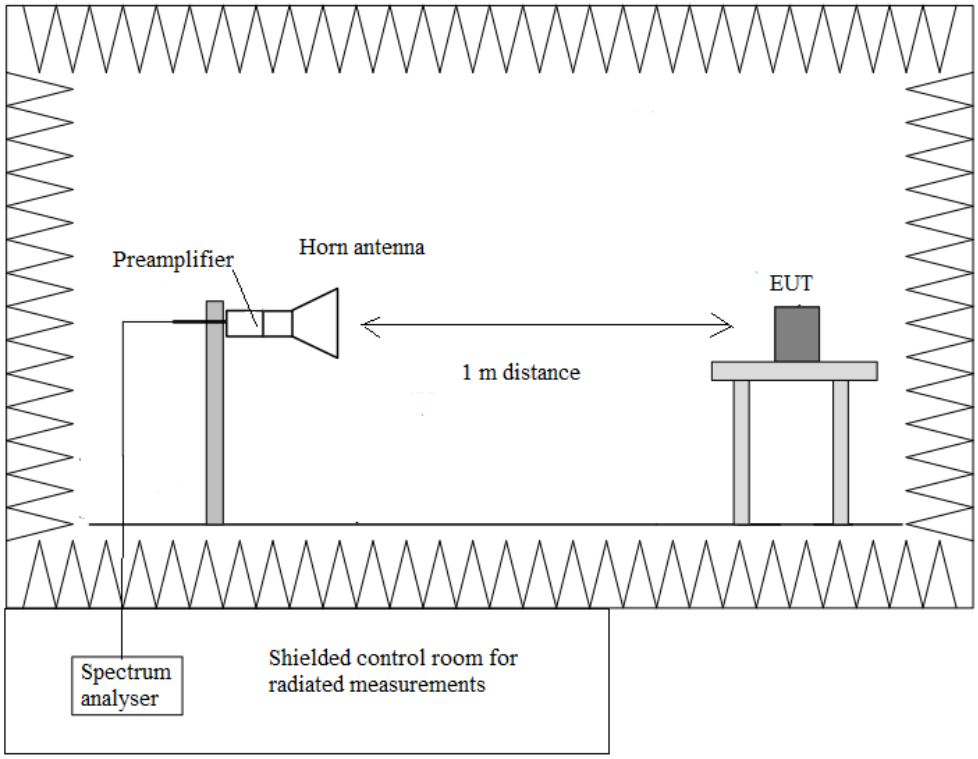
Radiated measurements setup f < 1 GHz:



Radiated measurements setup from 1 GHz to 17 GHz:



Radiated measurements setup f > 18 GHz:



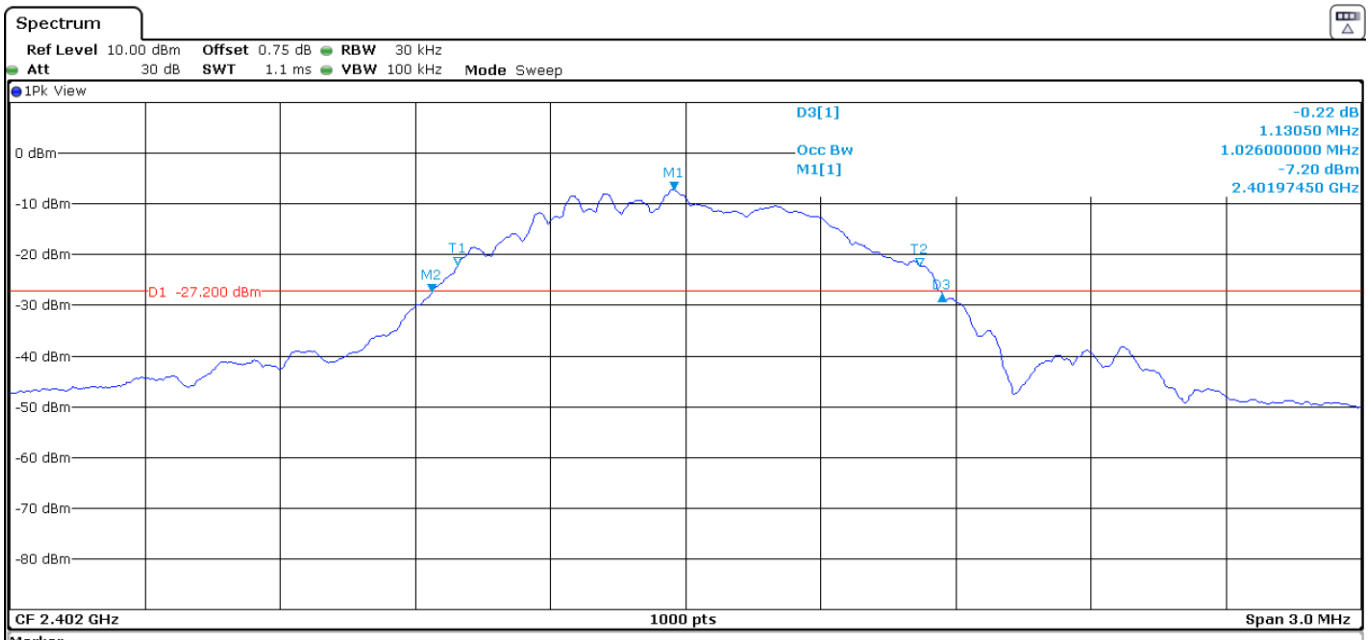
Occupied Bandwidth

RESULTS:

	Low Channel 2402 MHz	Middle Channel 2440 MHz	High Channel 2480 MHz
99% Bandwidth (MHz)	1.026	1.041	1.059
Measurement Uncertainty (kHz)	<±5.00		

Verdict: PASS

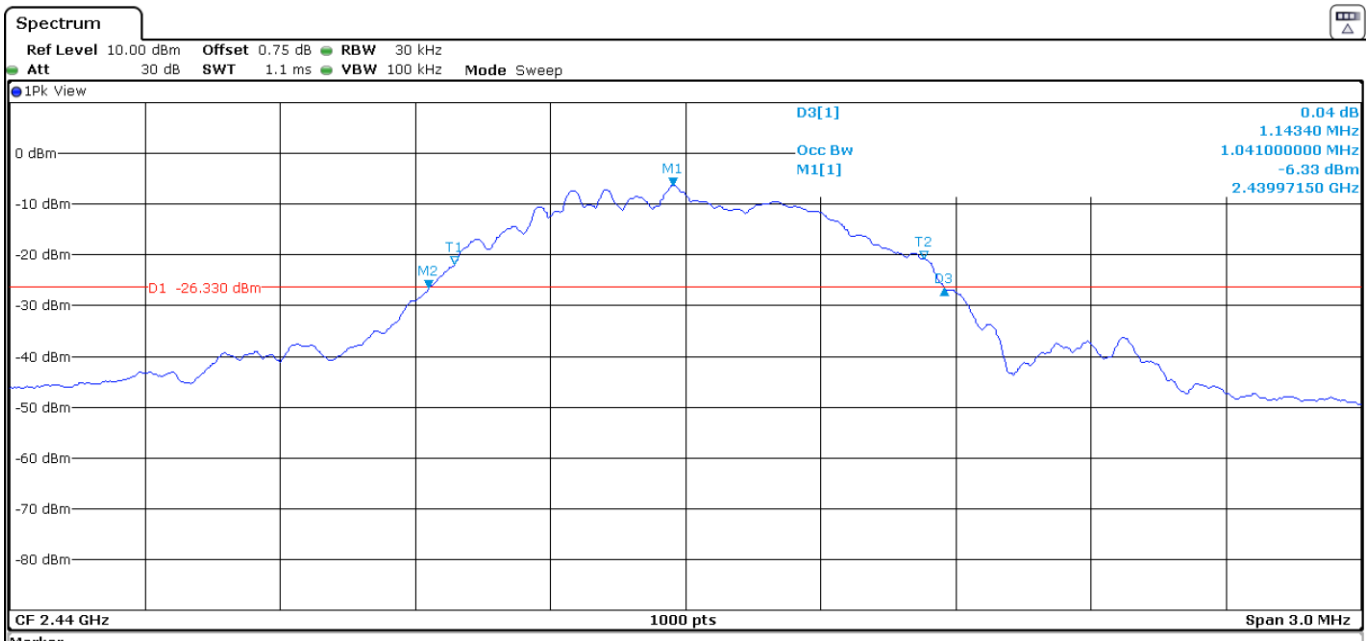
- Low Channel:



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4019745 GHz	-7.20 dBm		
T1		1	2.4014945 GHz	-22.12 dBm	Occ Bw	1.026 MHz
T2		1	2.4025205 GHz	-22.17 dBm		
M2		1	2.4014386 GHz	-27.42 dBm		
D3	M2	1	1.1305 MHz	-0.22 dB		

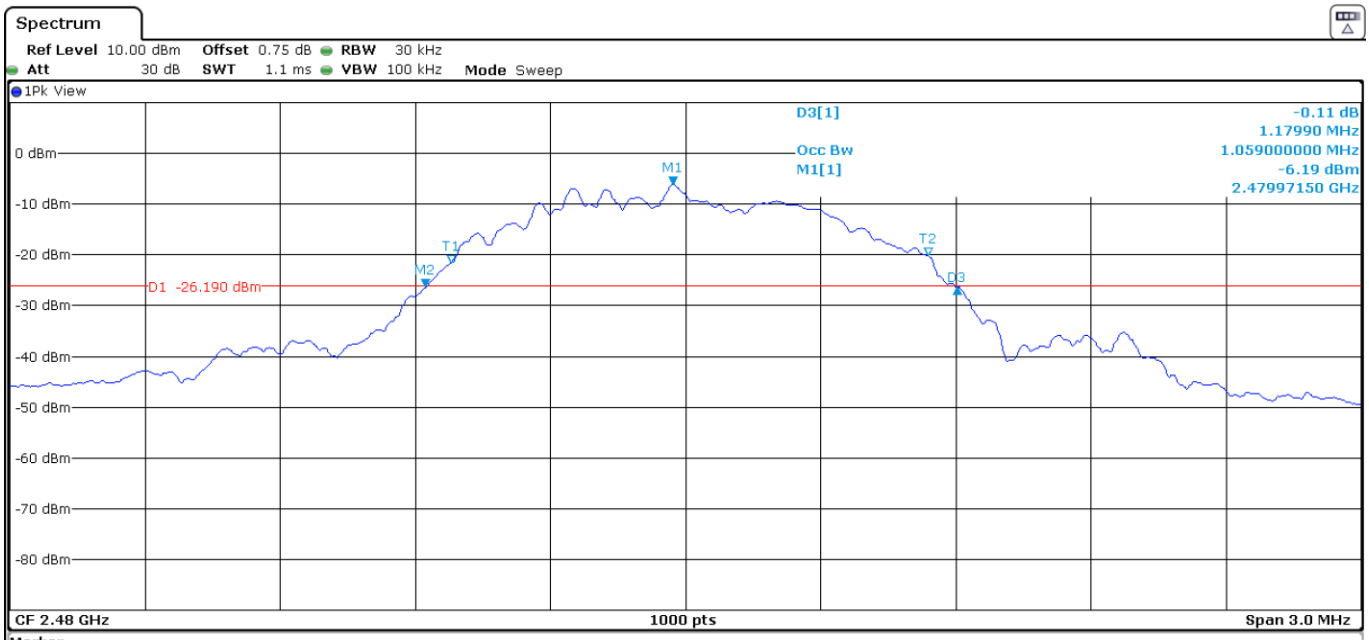
- Middle Channel:



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4399715 GHz	-6.33 dBm		
T1		1	2.4394885 GHz	-21.88 dBm	Occ Bw	1.041 MHz
T2		1	2.4405295 GHz	-20.72 dBm		
M2		1	2.4394315 GHz	-26.61 dBm		
D3	M2	1	1.1434 MHz	0.04 dB		

- High Channel:



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4799715 GHz	-6.19 dBm		
T1		1	2.4794795 GHz	-21.60 dBm	Occ Bw	1.059 MHz
T2		1	2.4805385 GHz	-20.21 dBm		
M2		1	2.479424 GHz	-26.20 dBm		
D3	M2	1	1.1799 MHz	-0.11 dB		

15.249 (a) / RSS-210 B.10 (a) Field strength of fundamental and harmonics emissions

SPECIFICATION:

The field strength of emissions from intentional radiators shall comply with the following

Fundamental frequency (MHz)	Field strength of fundamental (mV/m)	Field strength (dBµV/m)	Measurement distance (m)
902 - 928	50	93.98	3
2400 – 2483.5	50	93.98	3
5725 - 5875	50	93.98	3
24000-24250	250	107.96	3

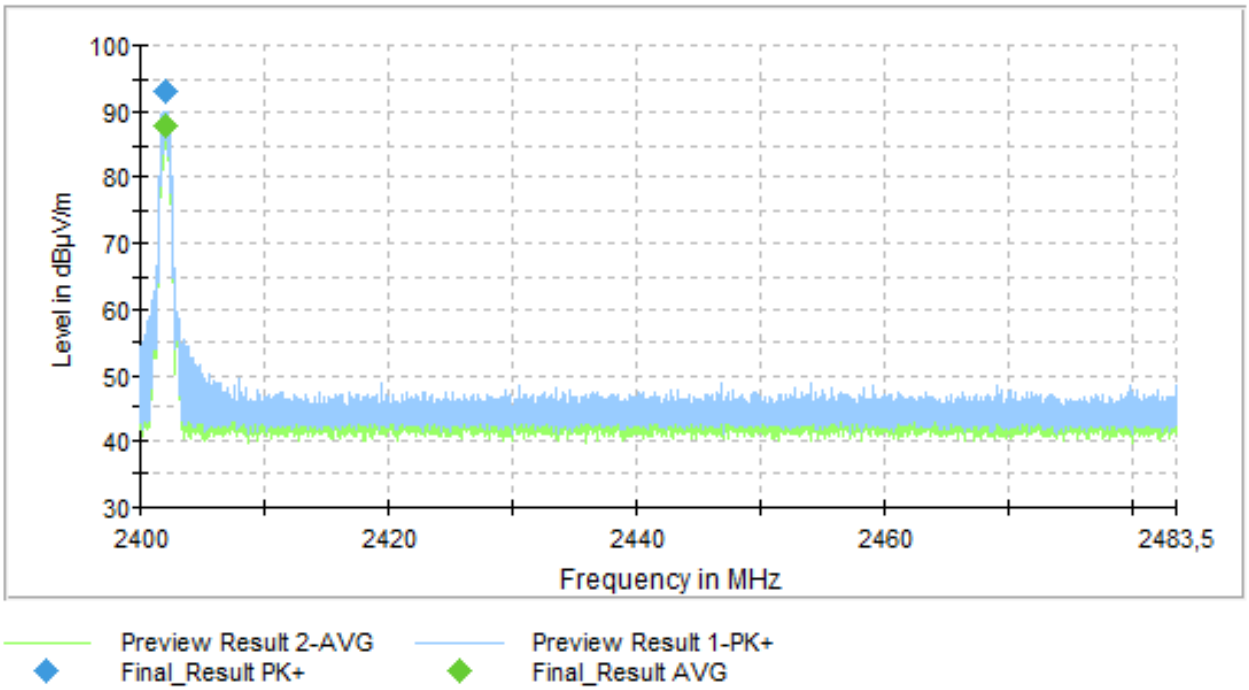
For frequencies above 1000 MHz, the above field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.

RESULTS:

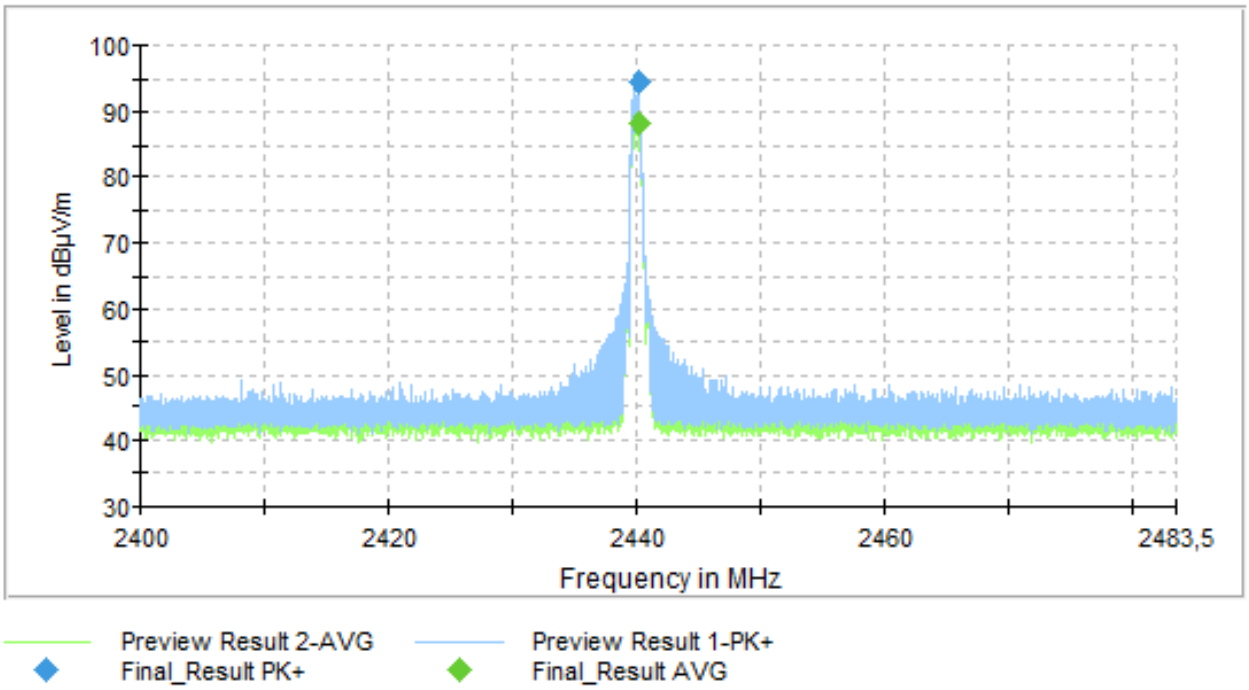
	Low Channel 2402 MHz	Middle Channel 2440 MHz	High Channel 2480 MHz
Average Field Strength (dBµV/m)	87.93	88.50	86.21
Peak Field Strength (dBµV/m)	93.09	94.37	92.22
Measurement Uncertainty (dB)	<±4.11		

Verdict: PASS

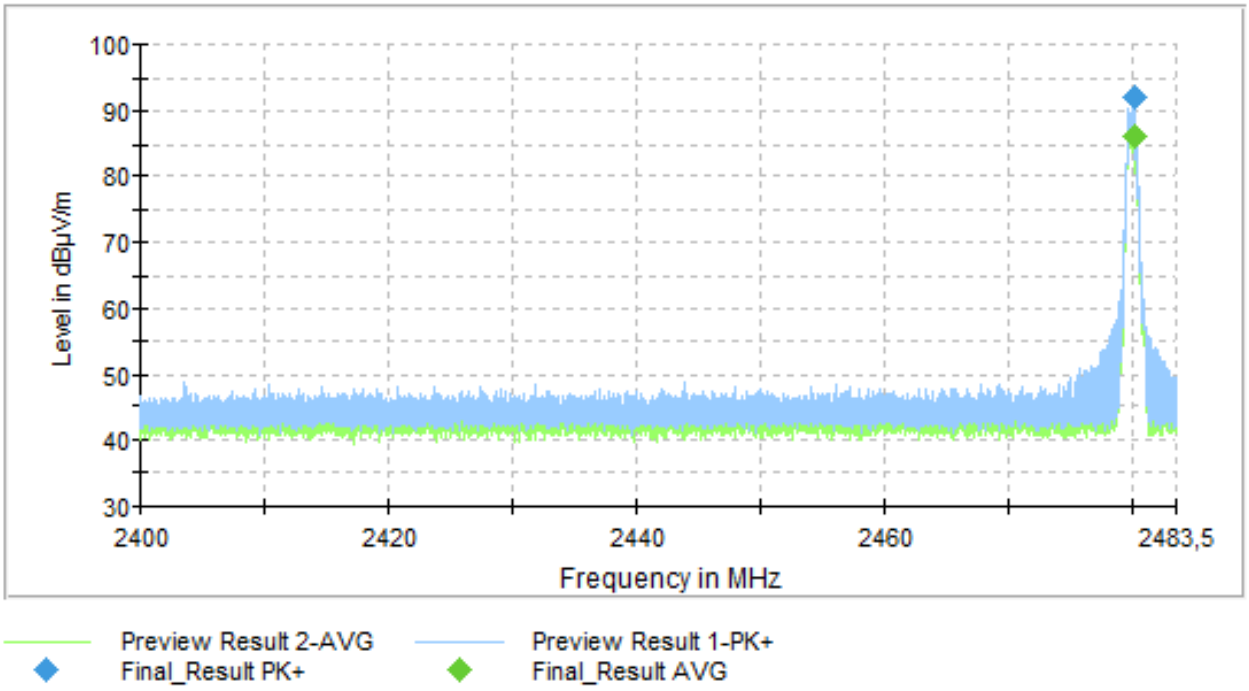
- Low Channel:



- Middle Channel:



- High Channel:



15.249 (d) / RSS-210 B.10 (b) Emissions radiated outside of the specific frequency bands

SPECIFICATION:

The field strength of harmonics from intentional radiators shall comply with the following

Fundamental frequency (MHz)	Field strength of harmonics (µV/m)	Field strength of harmonics (dBµV/m)	Measurement distance (m)
902 - 928	500	54	3
2400 – 2483.5	500	54	3
5725 - 5875	500	54	3
24000-24250	2500	67.96	3

Emissions radiated outside of the specific frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of fundamental or to the general radiated emission limits specified in section 15.209:

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)	-	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

Whichever is the lesser attenuation.

RESULTS:

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

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

All tests were performed in a semi-anechoic chamber at a distance of 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.

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

Measurement Uncertainty (dB) <±5.08

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 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 at less than 20 dB below the limit:

Spurious frequency (GHz)	Emission Level (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
2.38906	61.70	H	Peak	<± 4.11
	43.57		Average	<± 4.11
4.80350	44.81	V	Peak	<± 5.13
7.20600	50.71	V	Peak	<± 5.13
12.0090	48.20	H	Peak	<± 5.13
14.41050	53.30	V	Peak	<± 5.13

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

Spurious frequency (GHz)	Emission Level (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
4.09000	37.24	V	Peak	<± 5.13
4.87950	42.87	V	Peak	<± 5.13
7.32100	52.34	V	Peak	<± 5.13
12.20150	49.43	V	Peak	<± 5.13

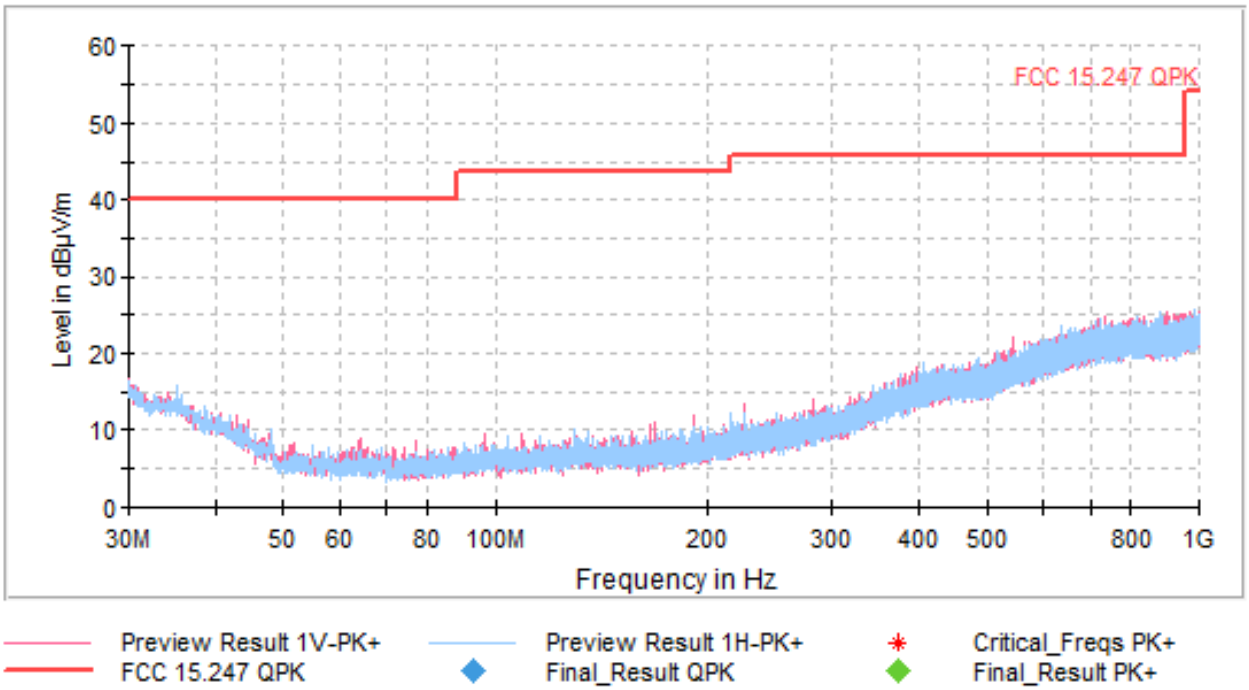
- High Channel. Spurious frequencies at less than 20 dB below the limit:

Spurious frequency (GHz)	Emission Level (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
2.48367	69.97	H	Peak	<± 4.11
	45.93		Average	<± 4.11
4.95950	47.03	V	Peak	<± 5.13
7.44050	49.04	V	Peak	<± 5.13
12.40100	47.99	H	Peak	<± 5.13

Verdict: PASS

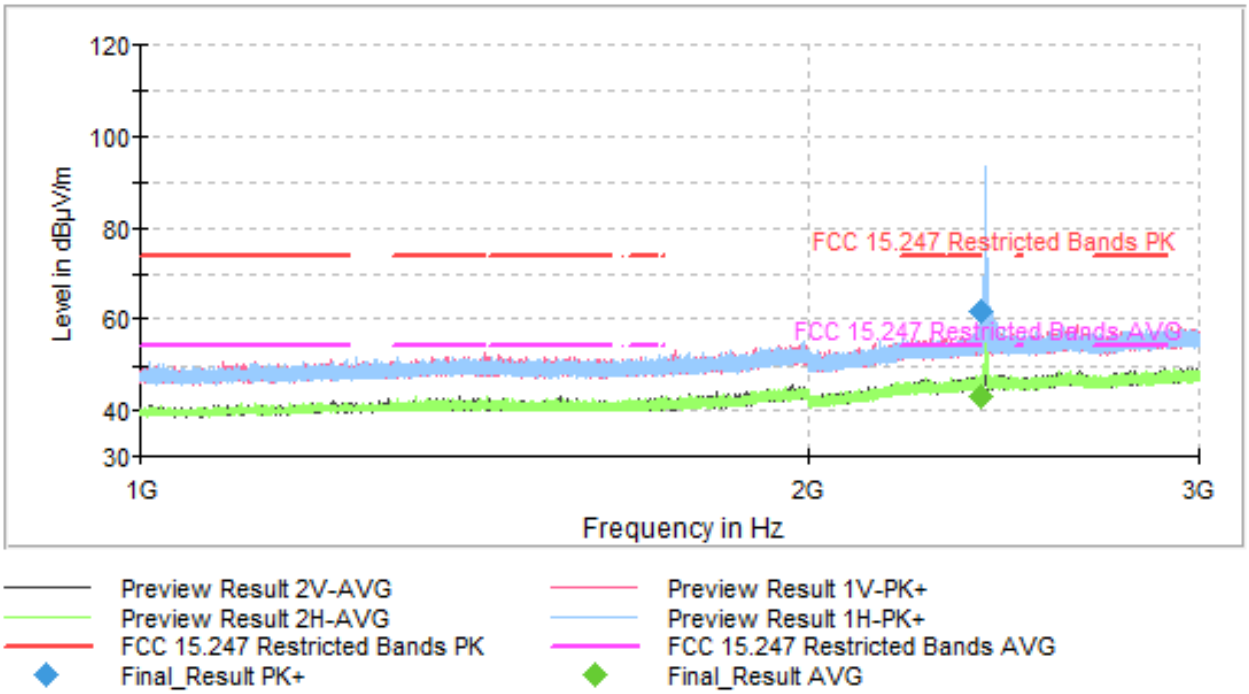
FREQUENCY RANGE 30 MHz - 1 GHz

This plot is valid for the Lowest, Middle and Highest Channels:



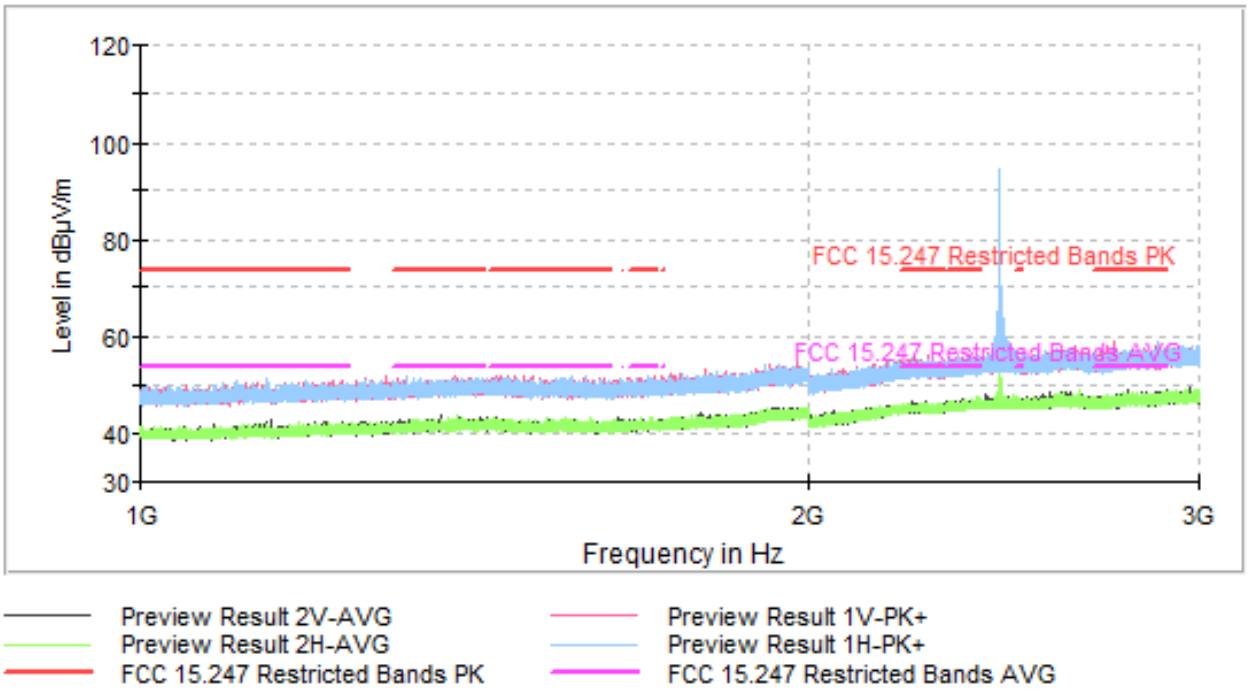
FREQUENCY RANGE 1 - 3 GHz

- Low Channel:



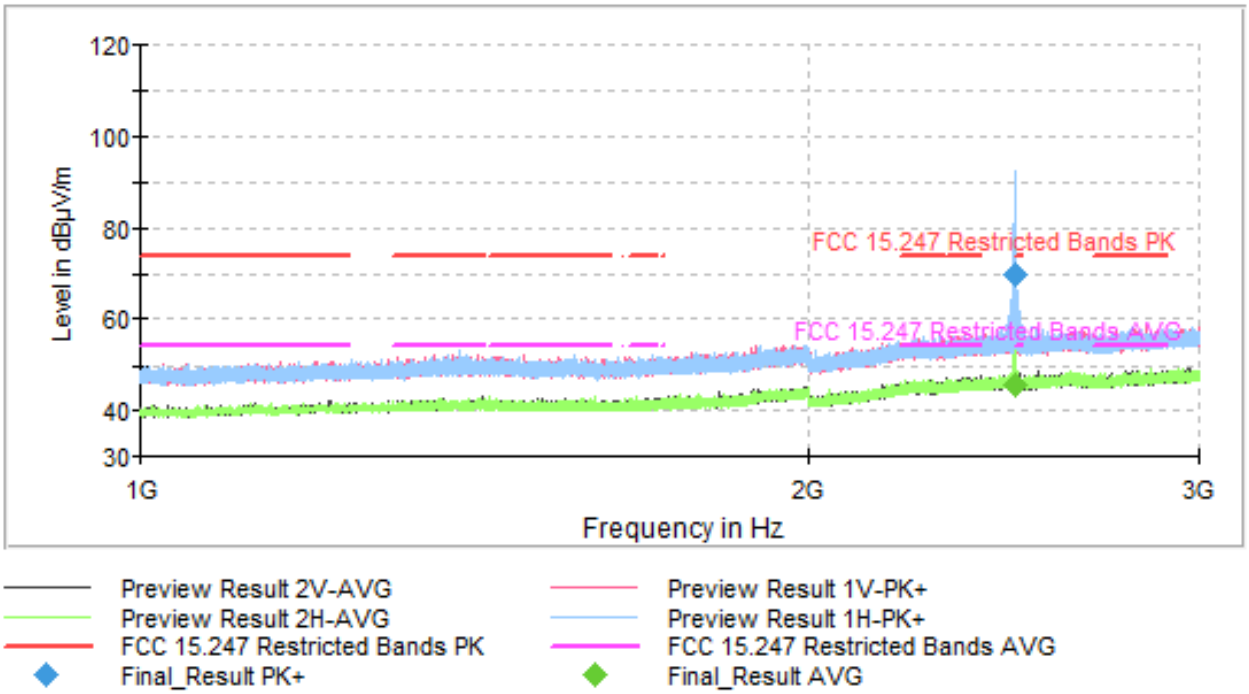
The peak shown in the plot above the limit is the carrier frequency.

- Middle Channel:



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

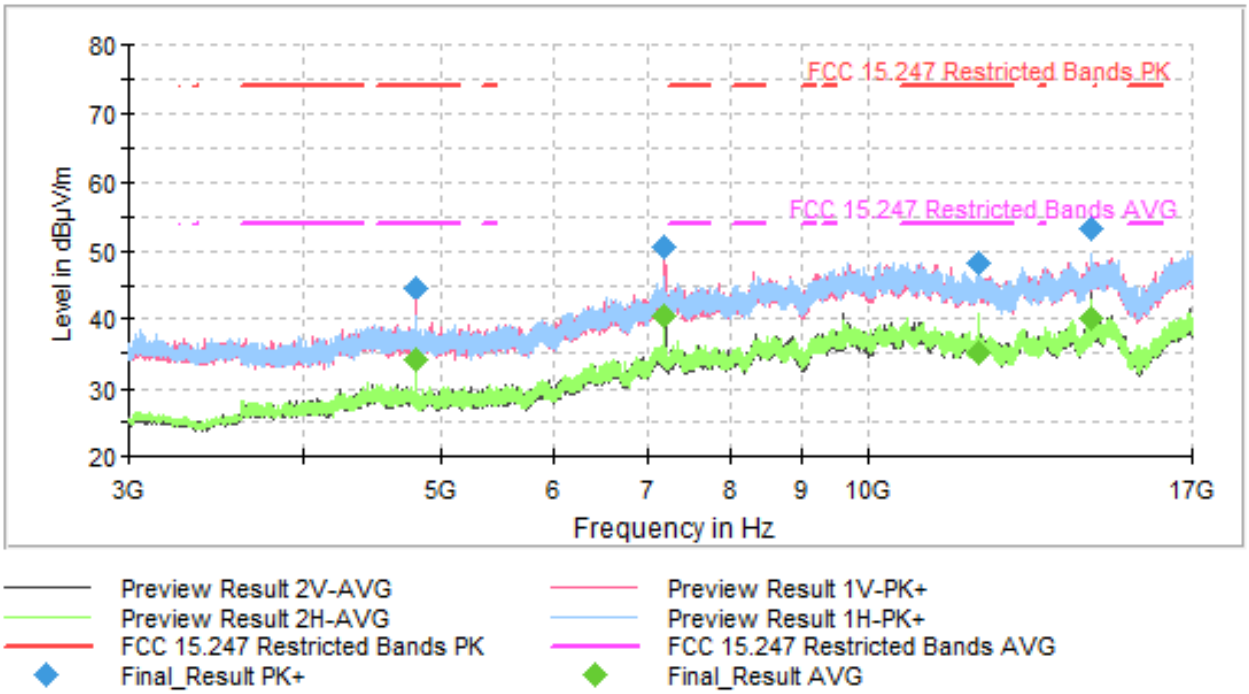
- High Channel:



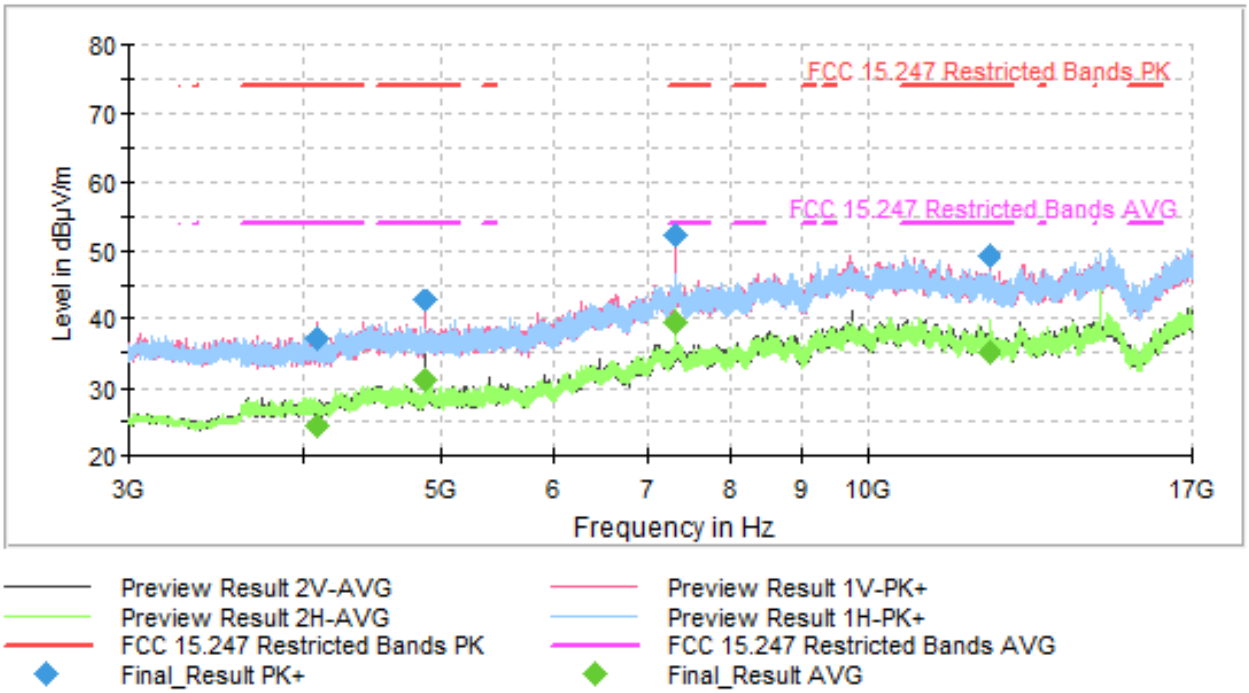
The peak shown in the plot above the limit is the carrier frequency.

FREQUENCY RANGE 3 - 17 GHz

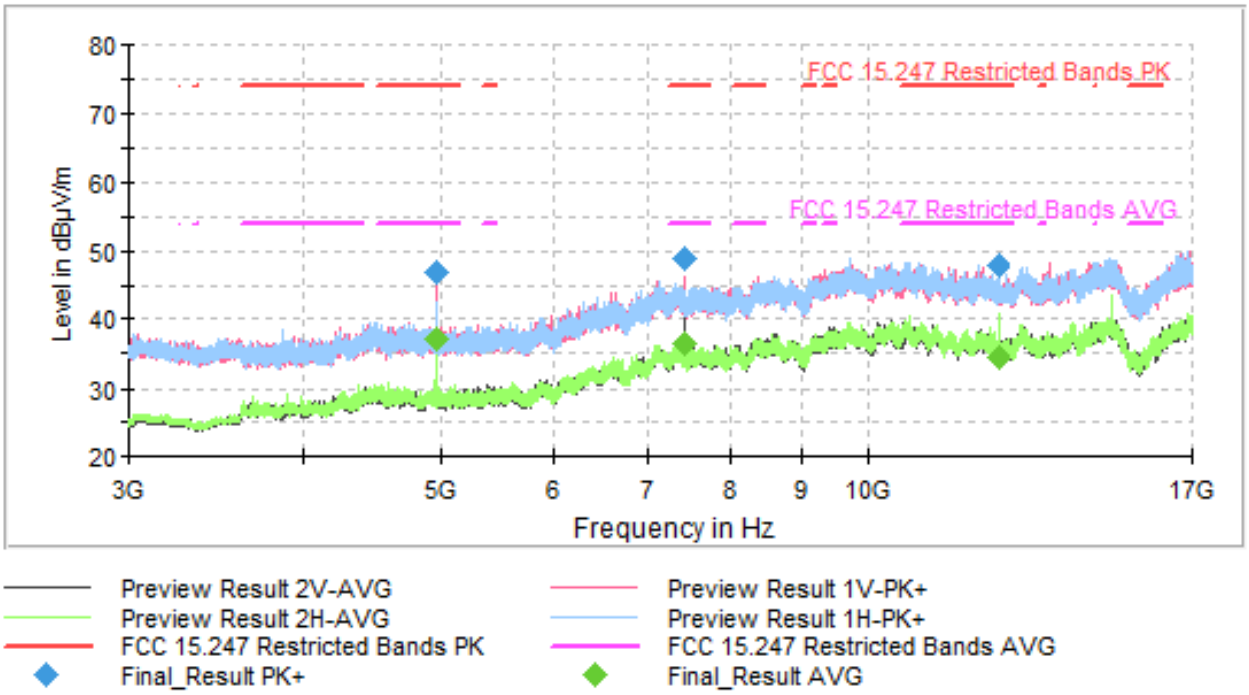
- Low Channel:



- Middle Channel:

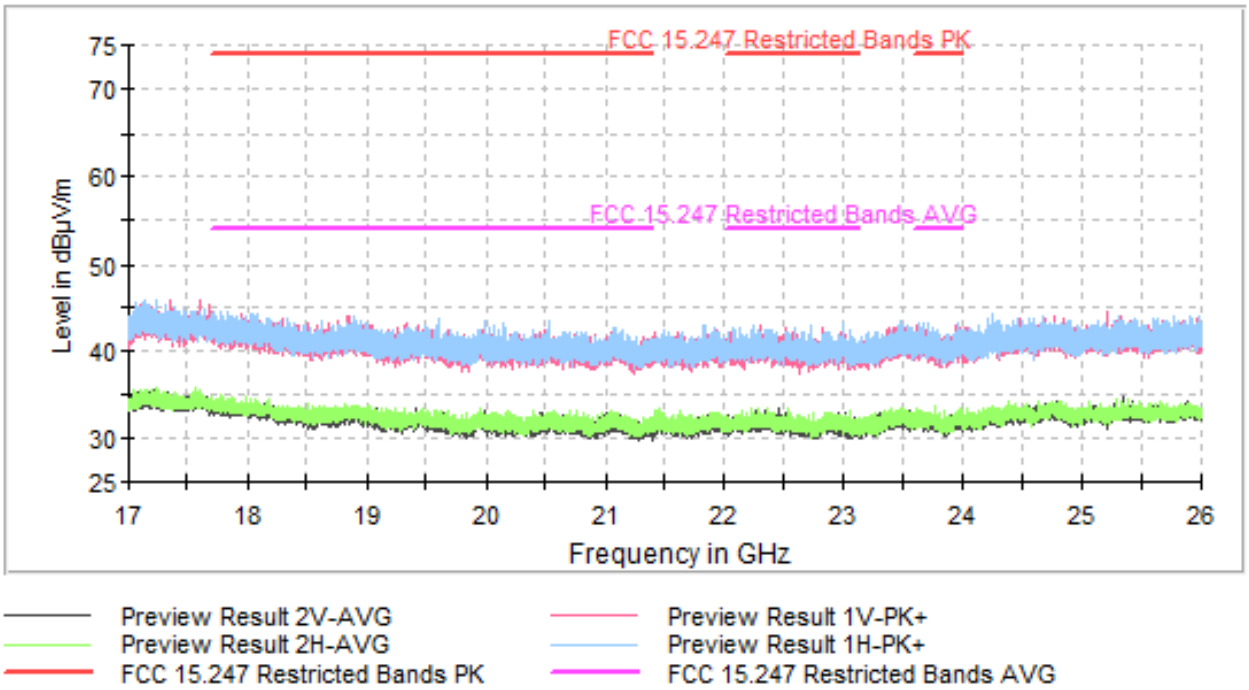


- High Channel:



FREQUENCY RANGE 17 - 26 GHz

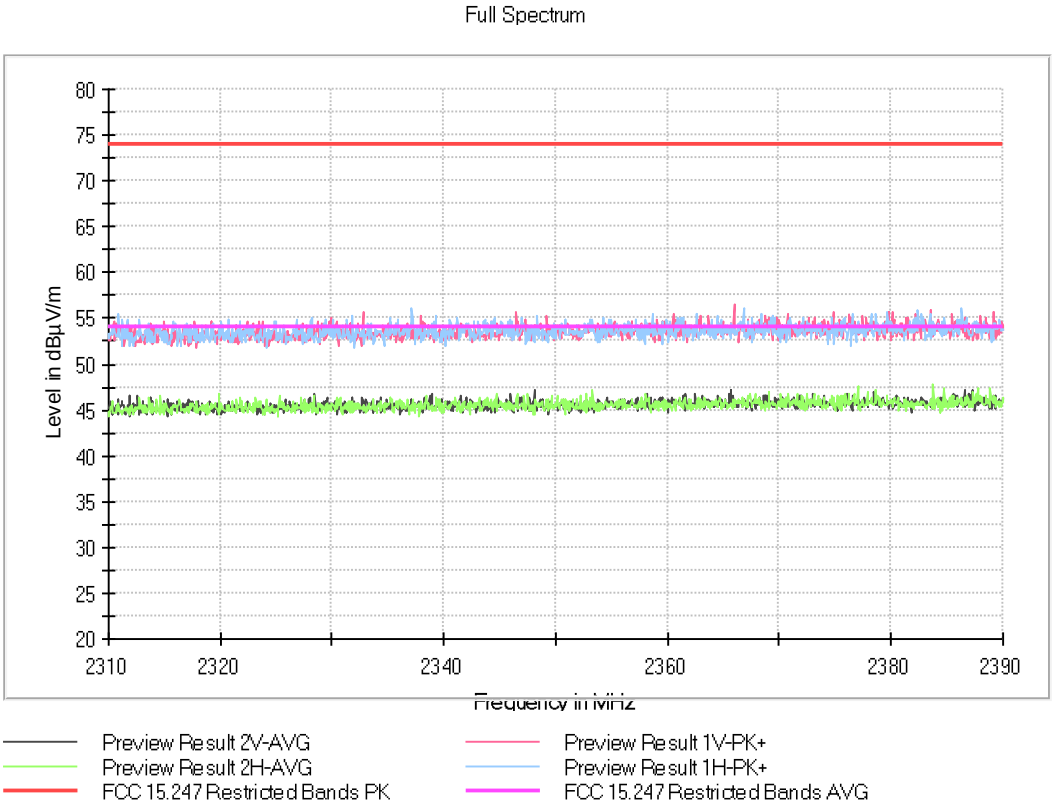
This plot is valid for the Lowest, Middle and Highest Channels:



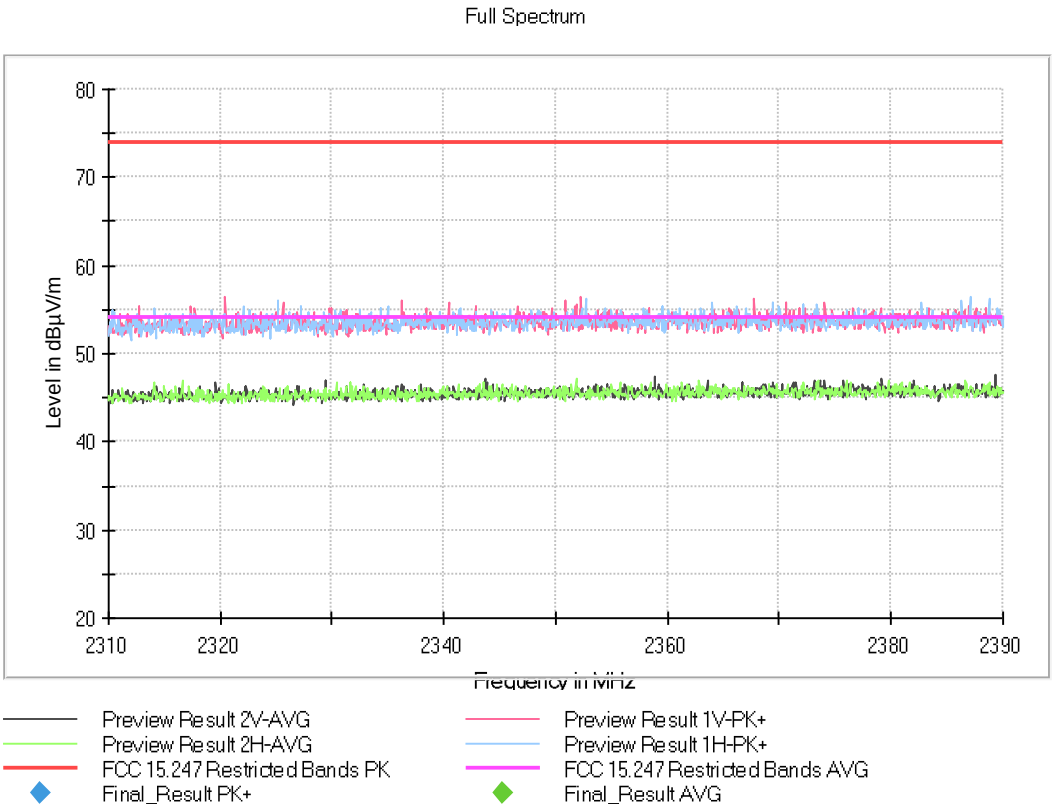
FREQUENCY RANGE 2.31 - 2.39 GHz

- Low Channel:

- Middle Channel:

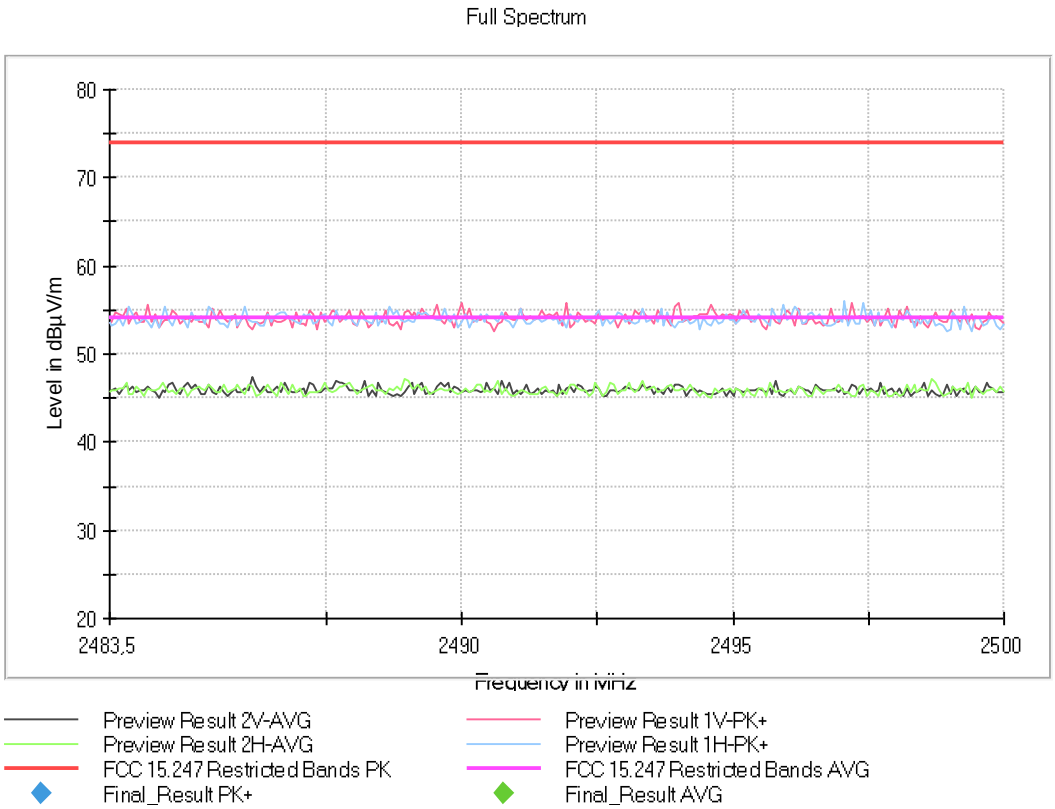


- High Channel:

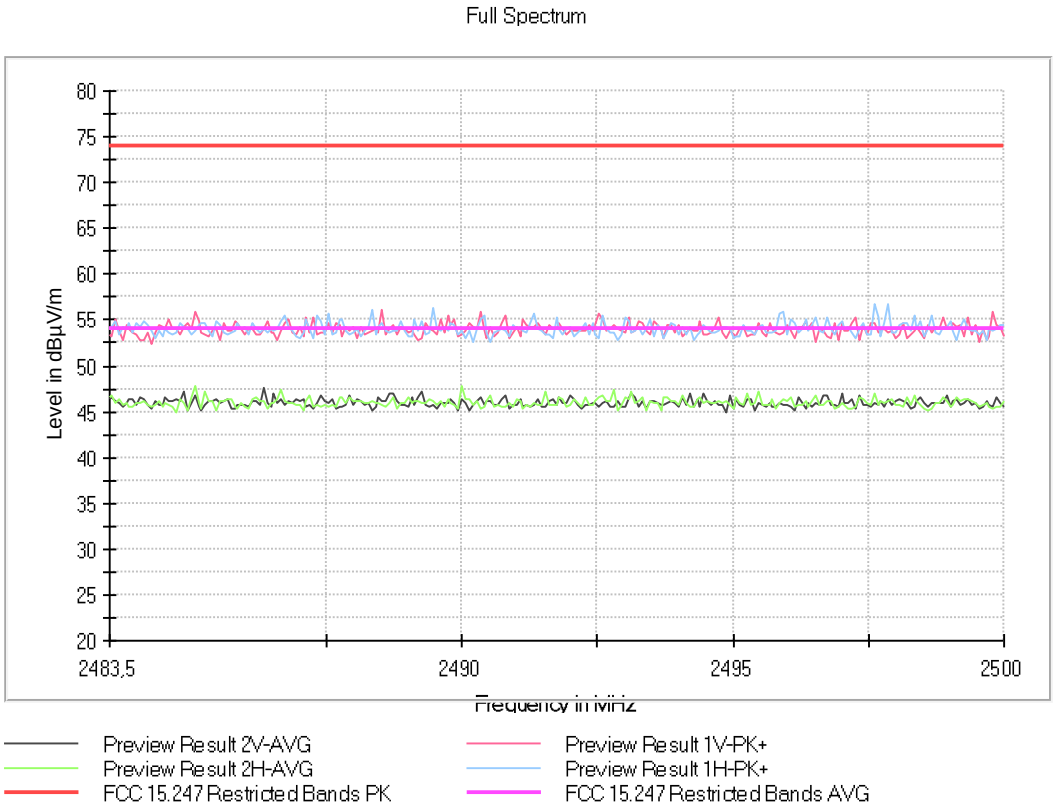


FREQUENCY RANGE 2.4835 - 2.5 GHz

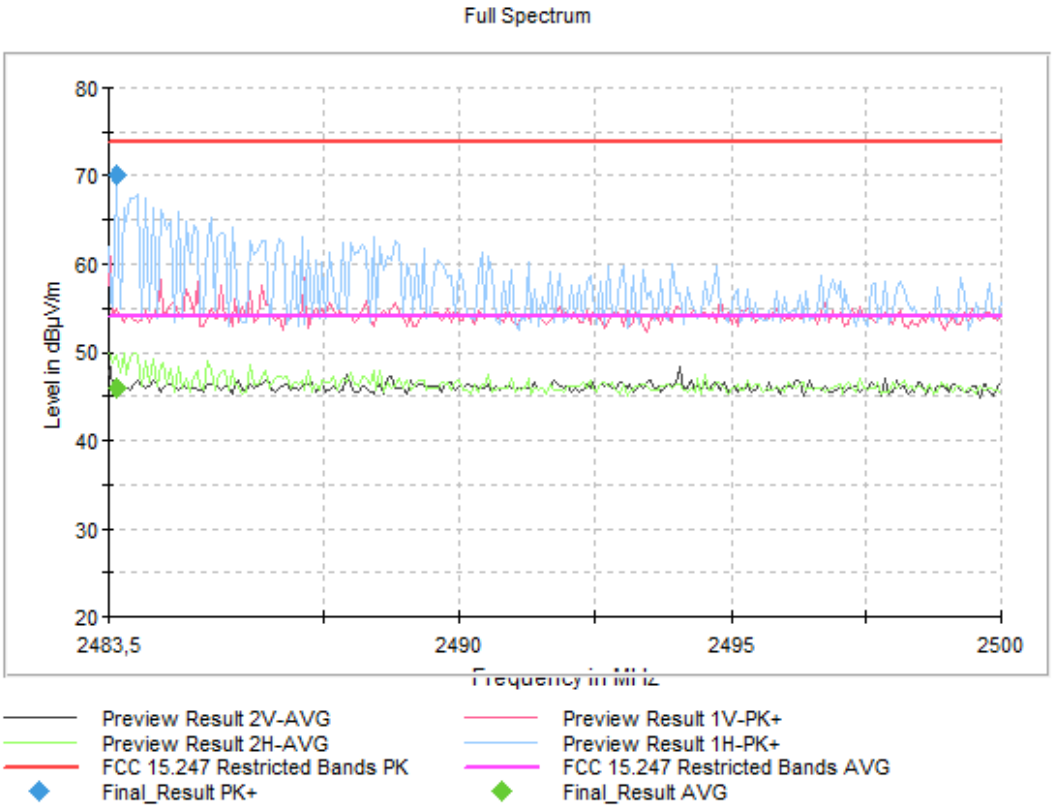
Low Channel:



- Middle Channel:



- High Channel:



Appendix B: Test results. Bluetooth Basic Rate

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TEST CONDITIONS

POWER SUPPLY (V) and ANTENNA:

V nominal:	3.8 Vdc
Type of Power Supply:	Lithium-Ion rechargeable Battery
Max. RF output power (e.i.r.p.):	-5 dBm
Type of Antenna:	Integral.
Declared Antenna Gain:	-5 dBi

TEST FREQUENCIES:

Low Channel:	2402 MHz
Middle Channel:	2440 MHz
High Channel:	2480 MHz

CONDUCTED MEASUREMENTS

The equipment under test was set up in a shielded room and it is connected to the spectrum analyser using a low loss RF cable. The reading of the spectrum analyser is corrected taking into account the cable loss.

RADIATED MEASUREMENTS

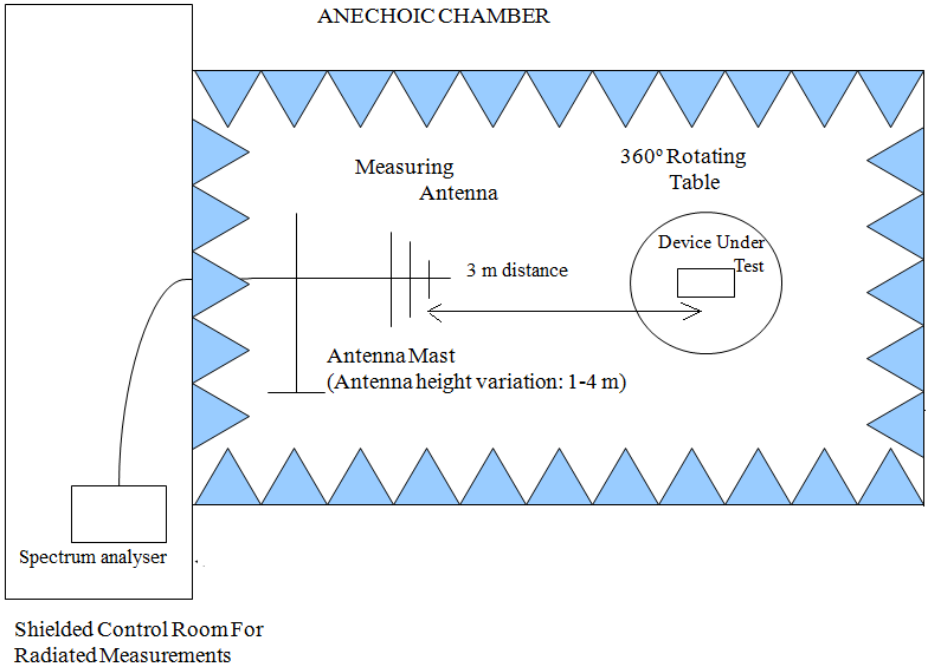
All radiated tests were performed in a semi-anechoic chamber. The measurement antenna is situated at a distance of 3 m for the frequency range 30 MHz-1000 MHz (30 MHz-1000 MHz Bilog antenna) and the frequency range 1 GHz-17 GHz (1 GHz-17 GHz Double ridge horn antenna) and at a distance of 1m for the frequency range 17-26 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.

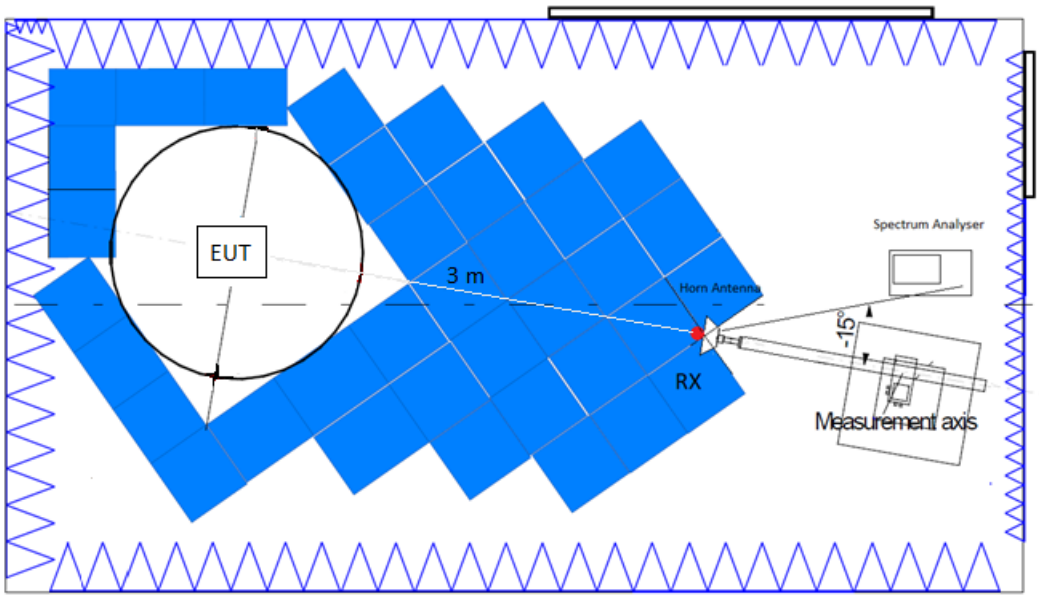
The equipment under test was set up on a non-conductive platform above the ground plane and the situation and orientation was varied to find the maximum radiated emission. It was also rotated 360º and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission.

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

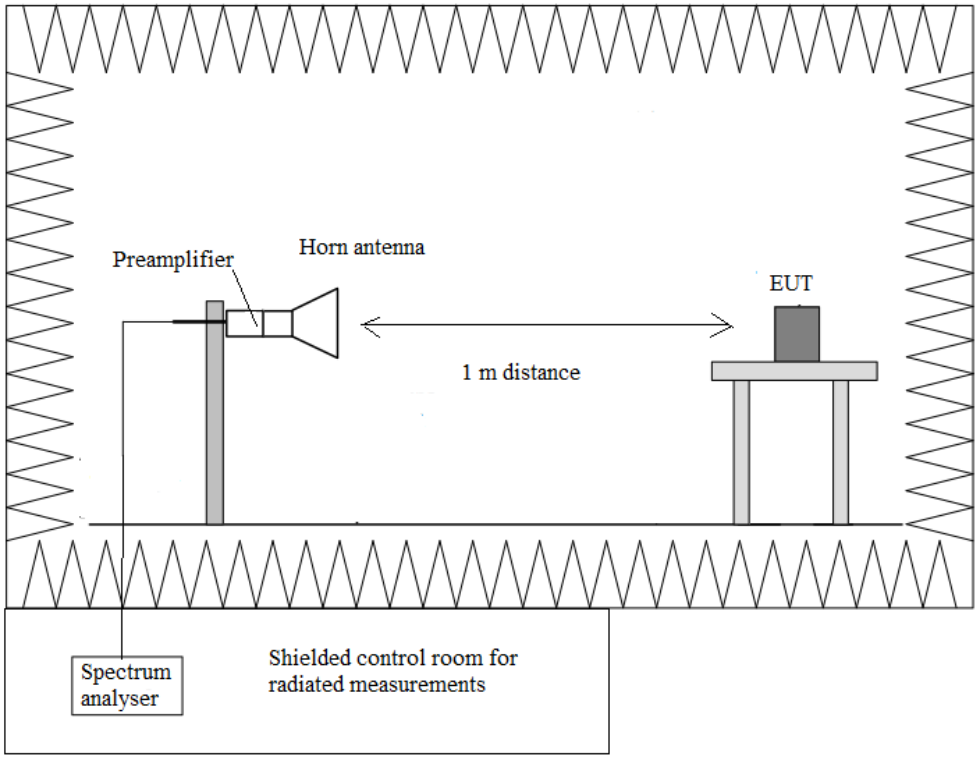
Radiated measurements setup f < 1 GHz:



Radiated measurements setup from 1 GHz to 17 GHz:



Radiated measurements setup f > 18 GHz:



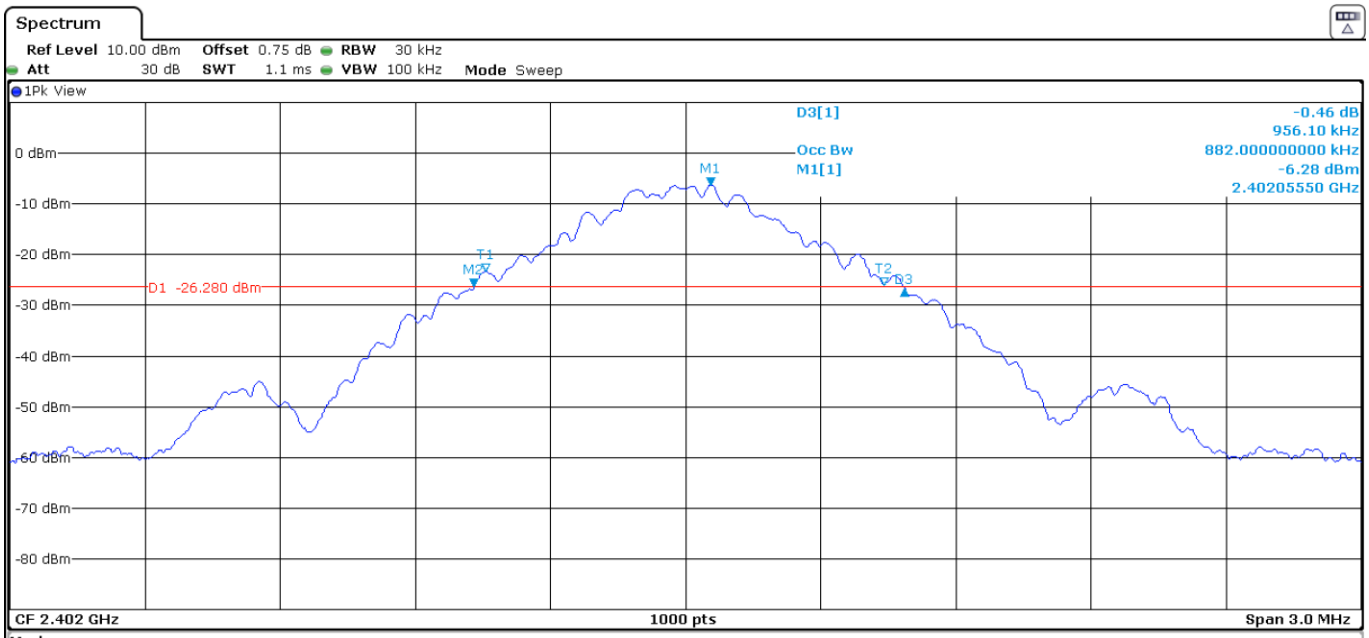
Occupied Bandwidth

RESULTS:

	Low Channel 2402 MHz	Middle Channel 2441 MHz	High Channel 2480 MHz
99% Bandwidth (MHz)	0.882	0.885	0.882
Measurement Uncertainty (kHz)	<±5.00		

Verdict: PASS

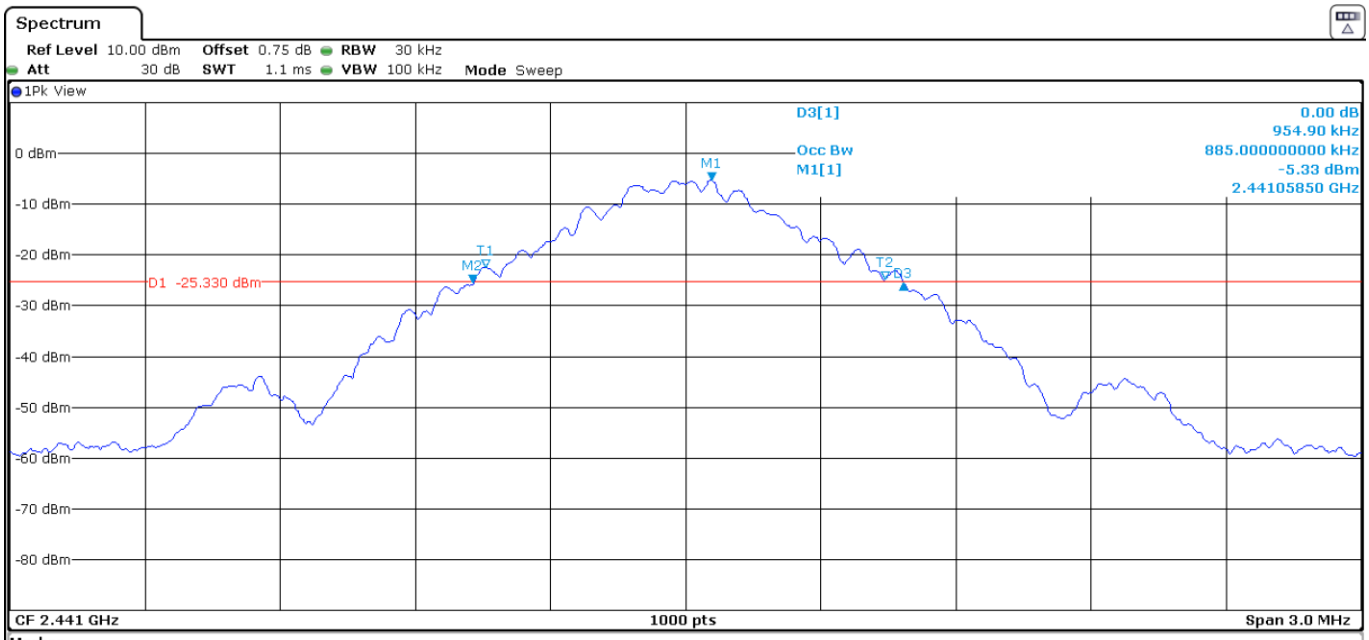
- Low Channel:



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4020555 GHz	-6.28 dBm		
T1		1	2.4015575 GHz	-23.34 dBm	Occ Bw	882.0 kHz
T2		1	2.4024395 GHz	-26.18 dBm		
M2		1	2.4015304 GHz	-26.32 dBm		
D3	M2	1	956.1 kHz	-0.46 dB		

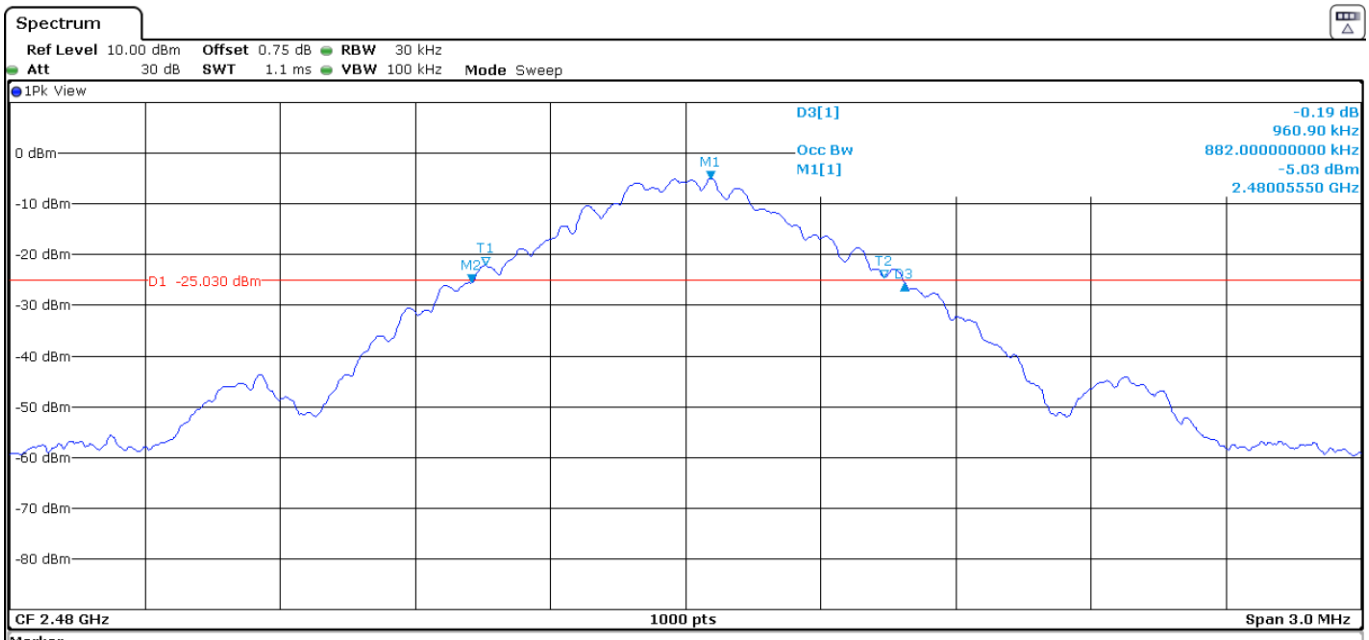
- Middle Channel:



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4410585 GHz	-5.33 dBm		
T1		1	2.4405575 GHz	-22.44 dBm	Occ Bw	885.0 kHz
T2		1	2.4414425 GHz	-24.85 dBm		
M2		1	2.4405294 GHz	-25.35 dBm		
D3	M2	1	954.9 kHz	-0.00 dB		

- High Channel:



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4800555 GHz	-5.03 dBm		
T1		1	2.4795575 GHz	-22.09 dBm	Occ Bw	882.0 kHz
T2		1	2.4804395 GHz	-24.68 dBm		
M2		1	2.479526 GHz	-25.42 dBm		
D3	M2	1	960.9 kHz	-0.19 dB		

15.249 (a) / RSS-210 B.10 (a) Field strength of fundamental and harmonics emissions

SPECIFICATION:

The field strength of emissions from intentional radiators shall comply with the following

Fundamental frequency (MHz)	Field strength of fundamental (mV/m)	Field strength (dBµV/m)	Measurement distance (m)
902 - 928	50	93.98	3
2400 – 2483.5	50	93.98	3
5725 - 5875	50	93.98	3
24000-24250	250	107.96	3

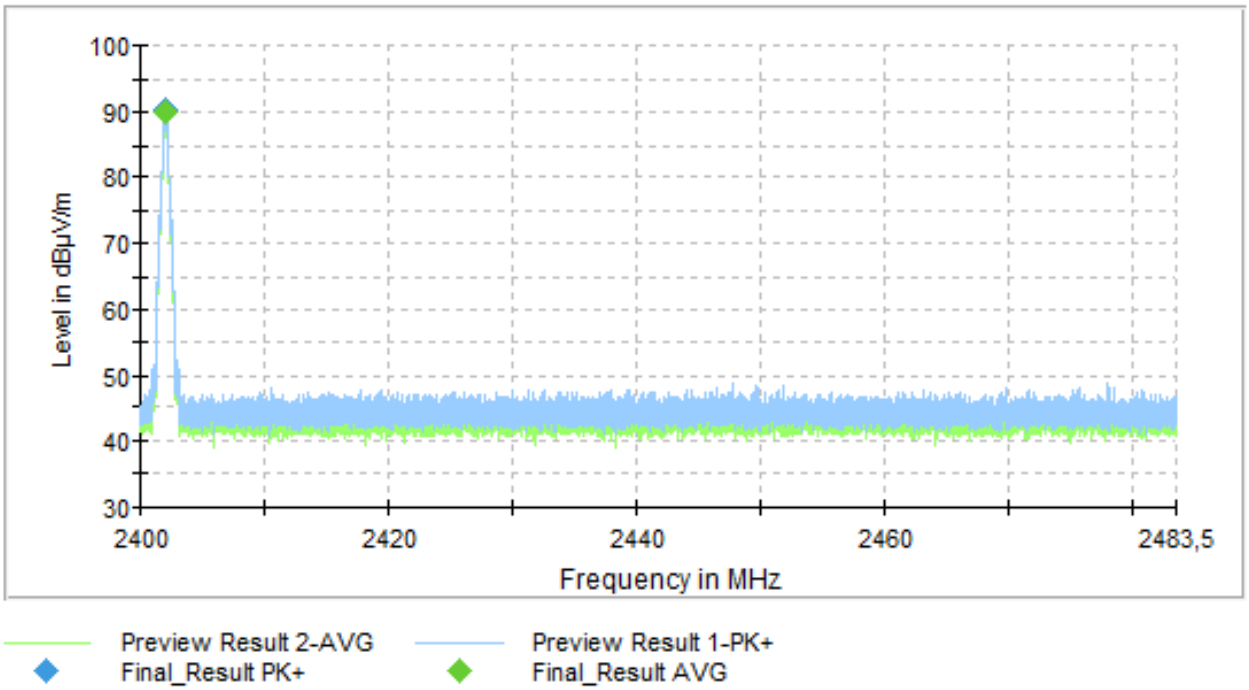
For frequencies above 1000 MHz, the above field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.

RESULTS:

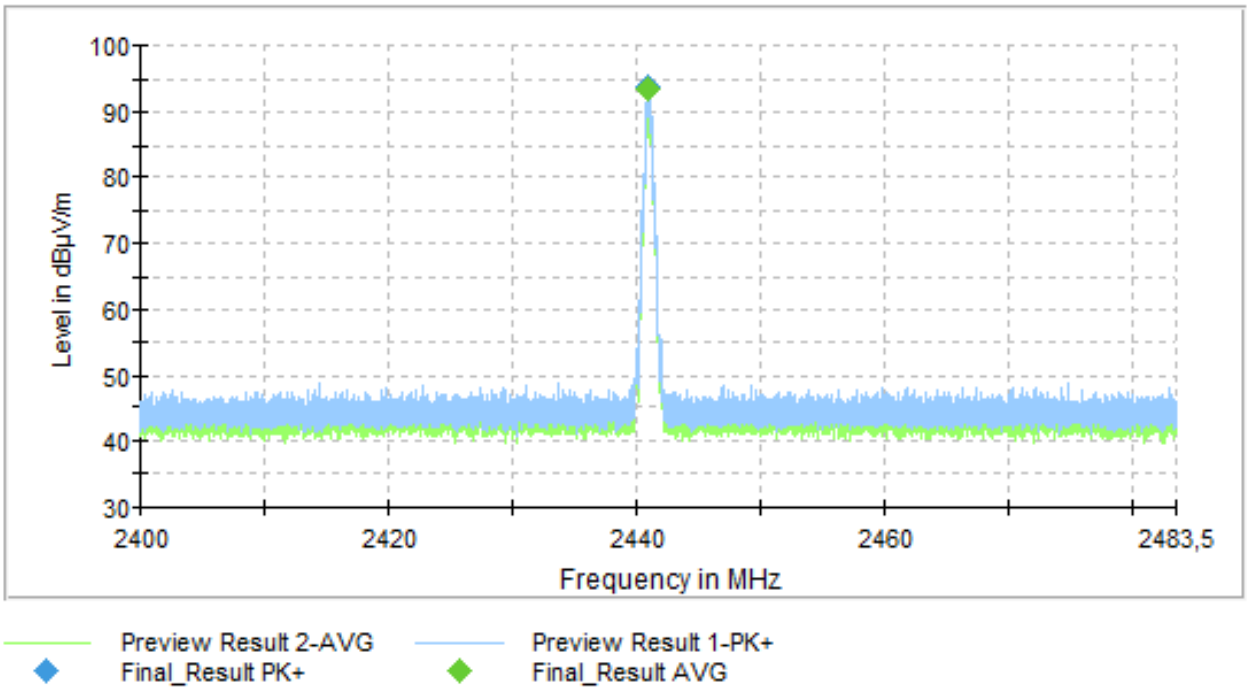
	Low Channel 2402 MHz	Middle Channel 2440 MHz	High Channel 2480 MHz
Average Field Strength (dBµV/m)	89.97	93.35	91.86
Peak Field Strength (dBµV/m)	90.40	93.81	92.25
Measurement Uncertainty (dB)	<±4.11		

Verdict: PASS

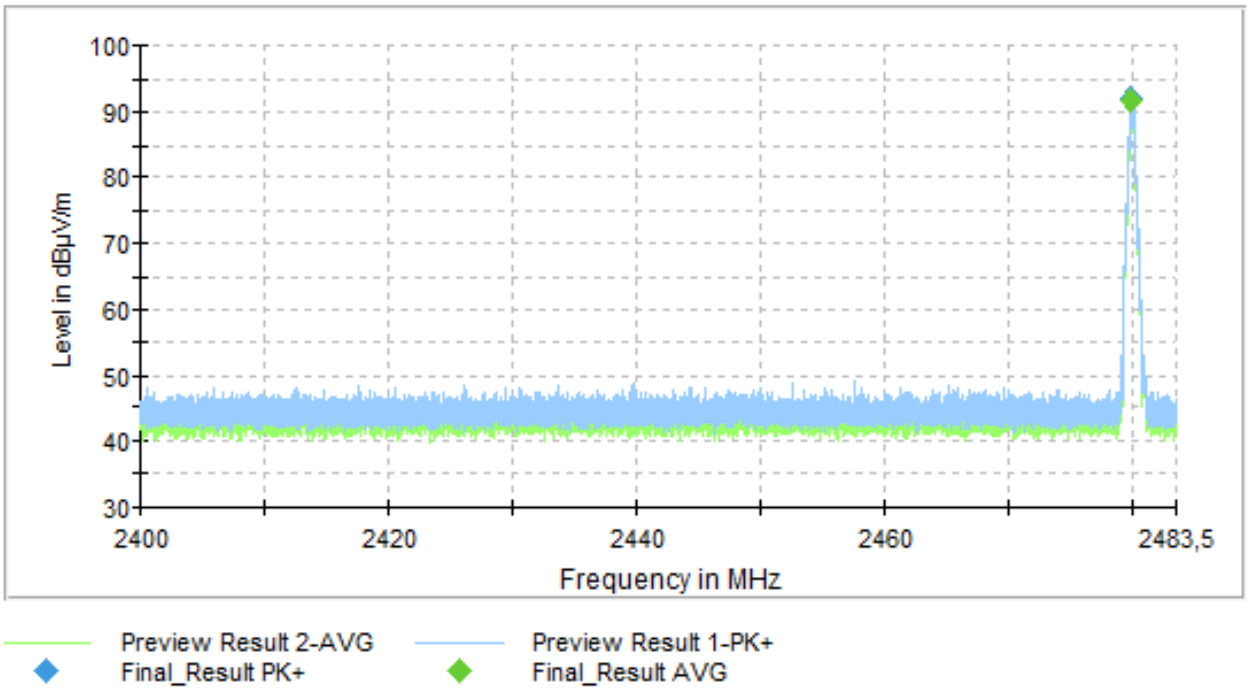
- Low Channel:



- Middle Channel:



- High Channel:



15.249 (d) / RSS-210 B.10 (b) Emissions radiated outside of the specific frequency bands

SPECIFICATION:

The field strength of harmonics from intentional radiators shall comply with the following

Fundamental frequency (MHz)	Field strength of harmonics (µV/m)	Field strength of harmonics (dBµV/m)	Measurement distance (m)
902 - 928	500	54	3
2400 – 2483.5	500	54	3
5725 - 5875	500	54	3
24000-24250	2500	67.96	3

Emissions radiated outside of the specific frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of fundamental or to the general radiated emission limits specified in section 15.209:

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)	-	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

Whichever is the lesser attenuation.

RESULTS:

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

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

All tests were performed in a semi-anechoic chamber at a distance of 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.

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

Measurement Uncertainty (dB) <±5.08

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 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 detected at less than 20 dB below the limit:

Spurious frequency (GHz)	Emission Level (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
2.36360	56.68	V	Peak	<± 4.11
	43.23		Average	<± 4.11
4.80400	44.88	V	Peak	<± 5.13
7.20650	51.12	V	Peak	<± 5.13
9.60800	50.42	V	Peak	<± 5.13
14.41150	50.37	V	Peak	<± 5.13

- 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)
4.88200	42.74	V	Peak	<± 5.13
7.32350	53.77	V	Peak	<± 5.13
9.76450	49.54	V	Peak	<± 5.13
12.20600	50.57	V	Peak	<± 5.13

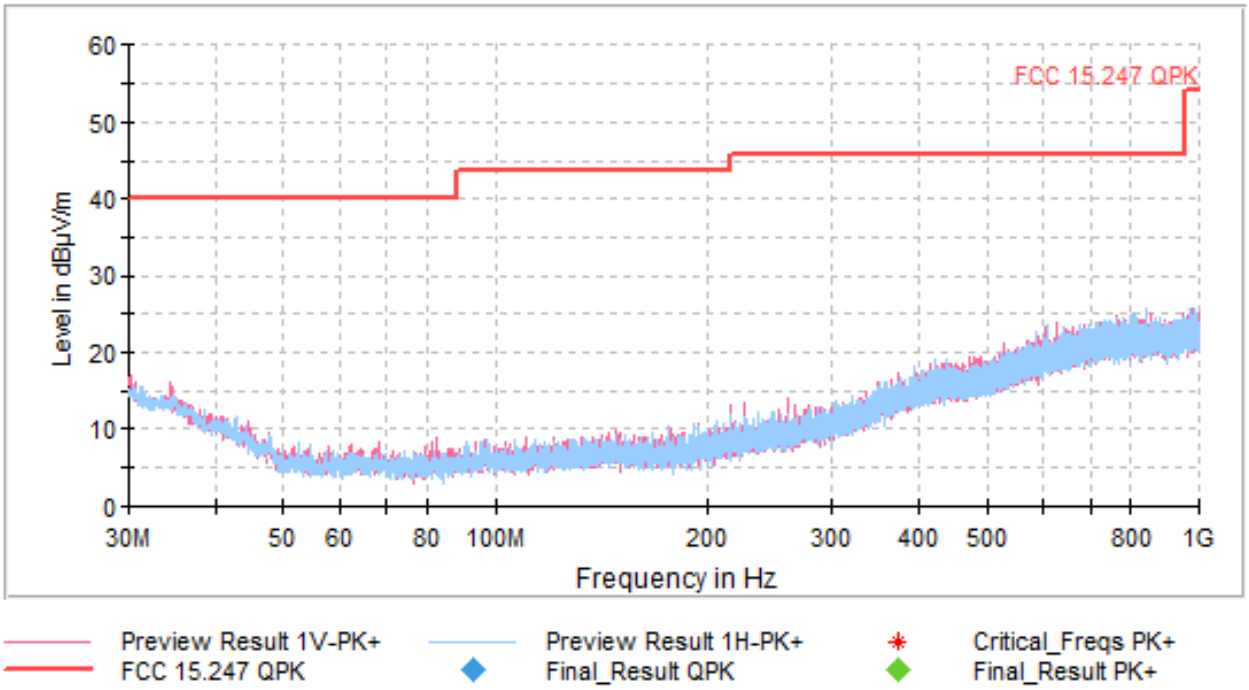
- High Channel. Spurious frequencies detected at less than 20 dB below the limit:

Spurious frequency (GHz)	Emission Level (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
2.48393	57.28	H	Peak	<± 4.11
	44.30		Average	<± 4.11
4.95950	46.00	V	Peak	<± 5.13
7.43900	47.54	V	Peak	<± 5.13
9.91950	49.98	V	Peak	<± 5.13
12.39950	47.75	V	Peak	<± 5.13

Verdict: PASS

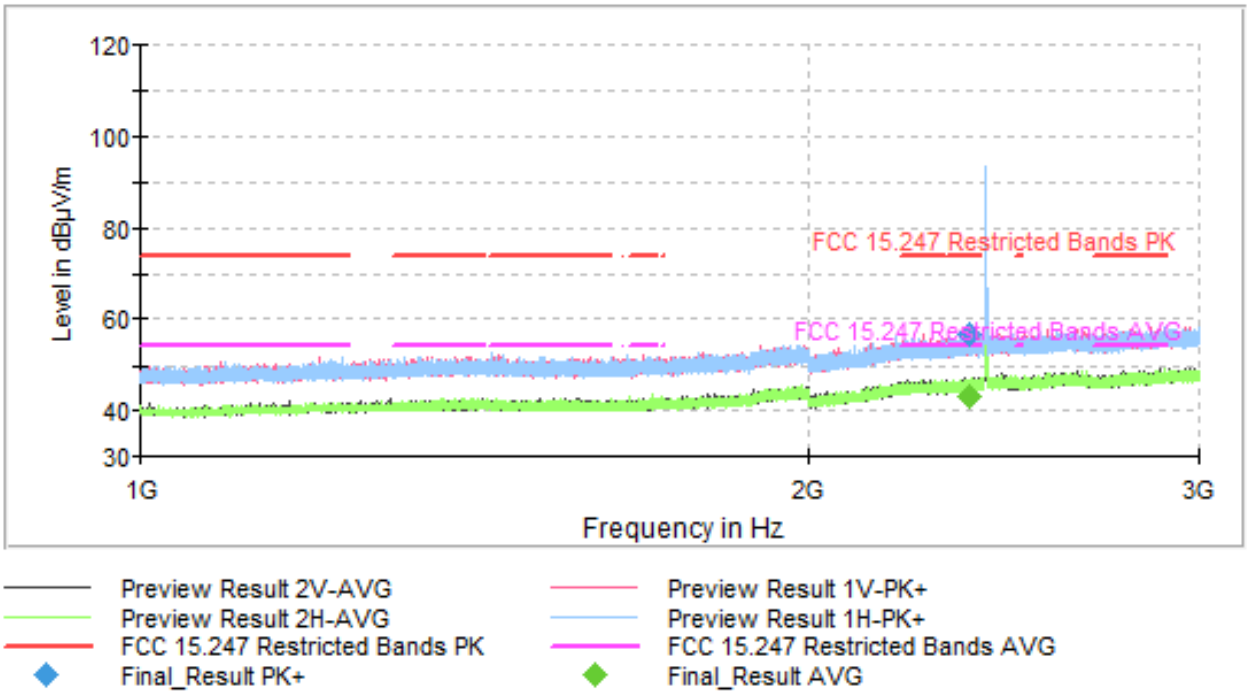
FREQUENCY RANGE 30 MHz - 1 GHz

This plot is valid for the Lowest, Middle and Highest Channels:



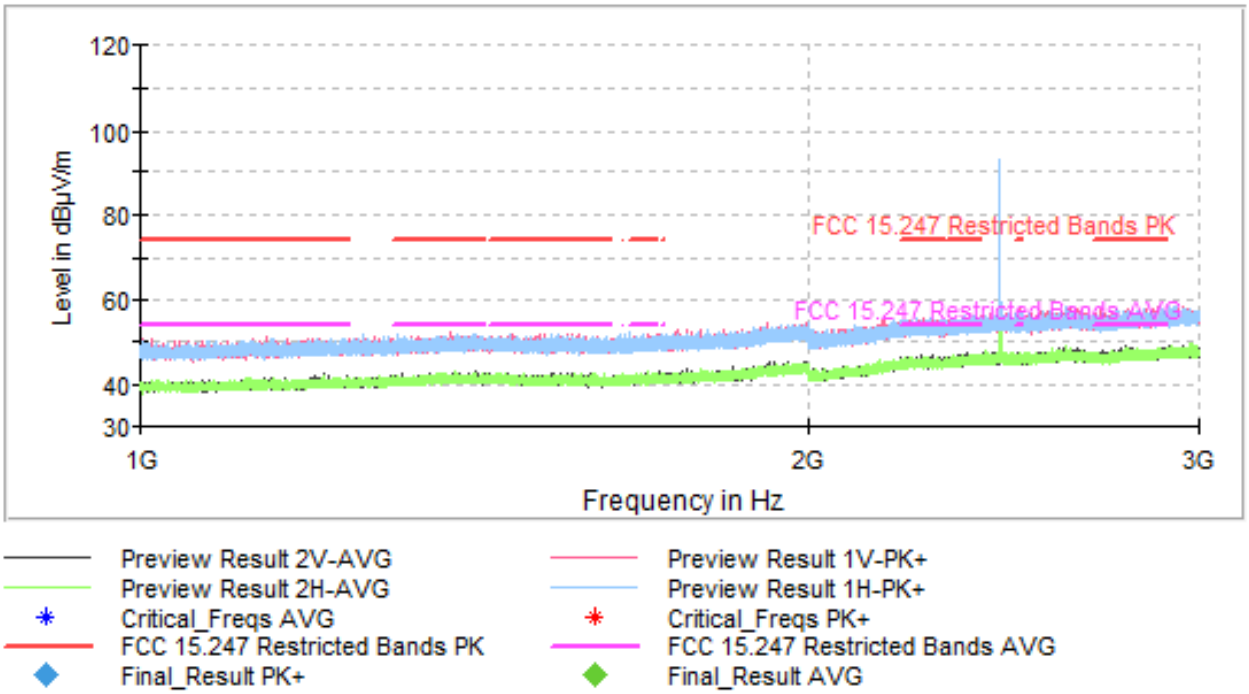
FREQUENCY RANGE 1 - 3 GHz

- Low Channel:



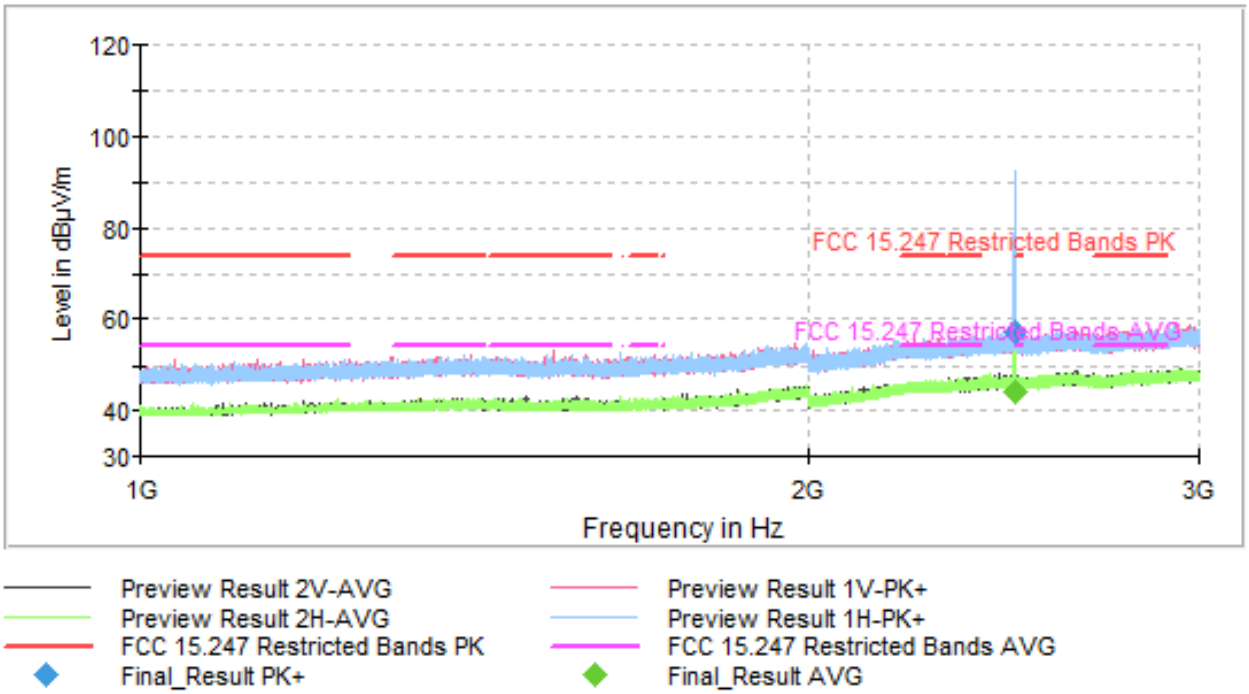
The peak shown in the plot above the limit is the carrier frequency.

- Middle Channel:



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

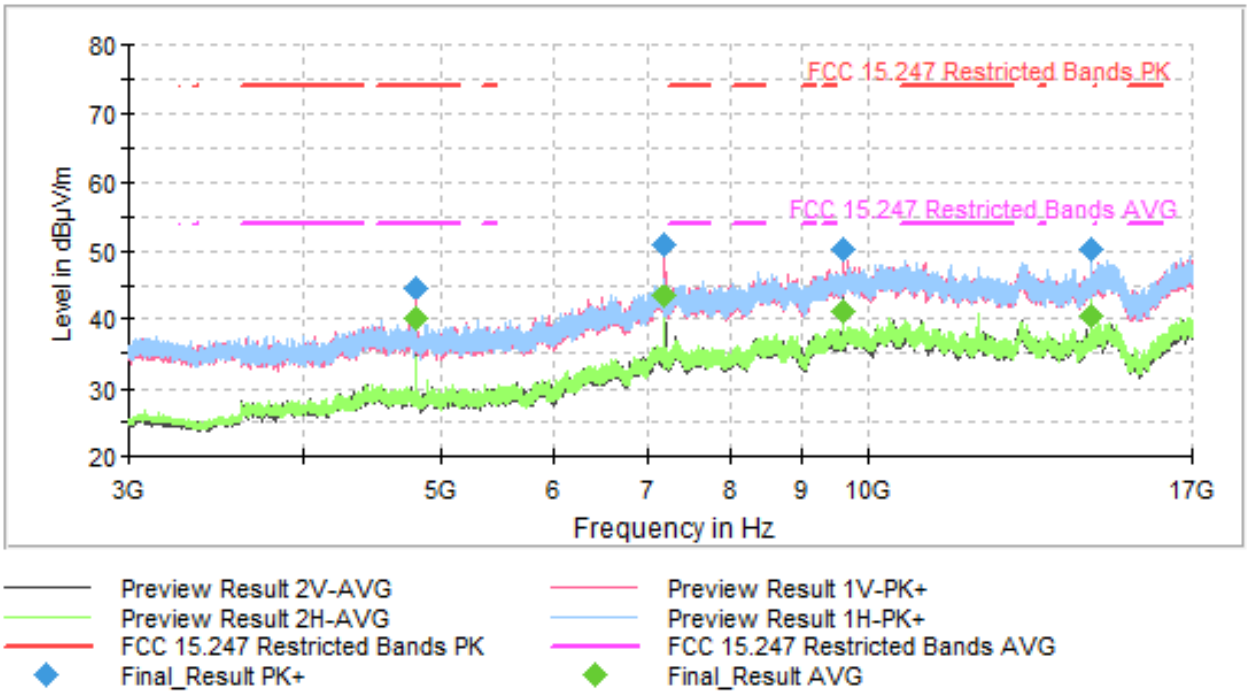
- High Channel:



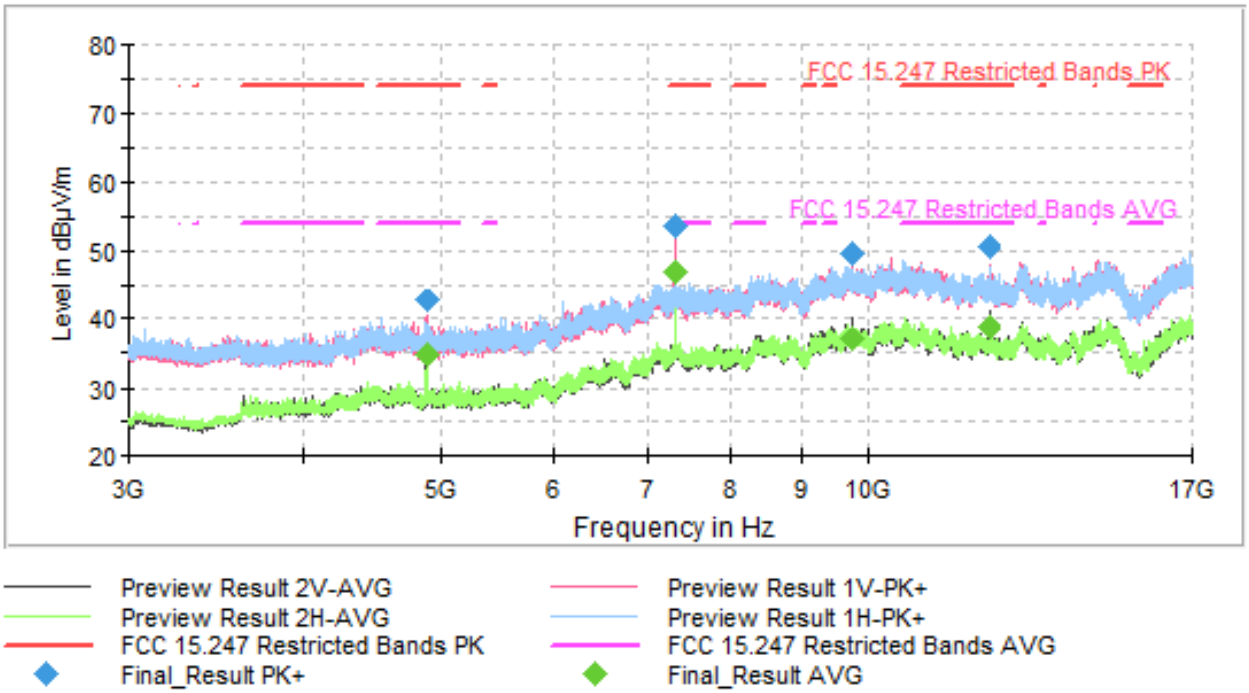
The peak shown in the plot above the limit is the carrier frequency.

FREQUENCY RANGE 3 - 17 GHz

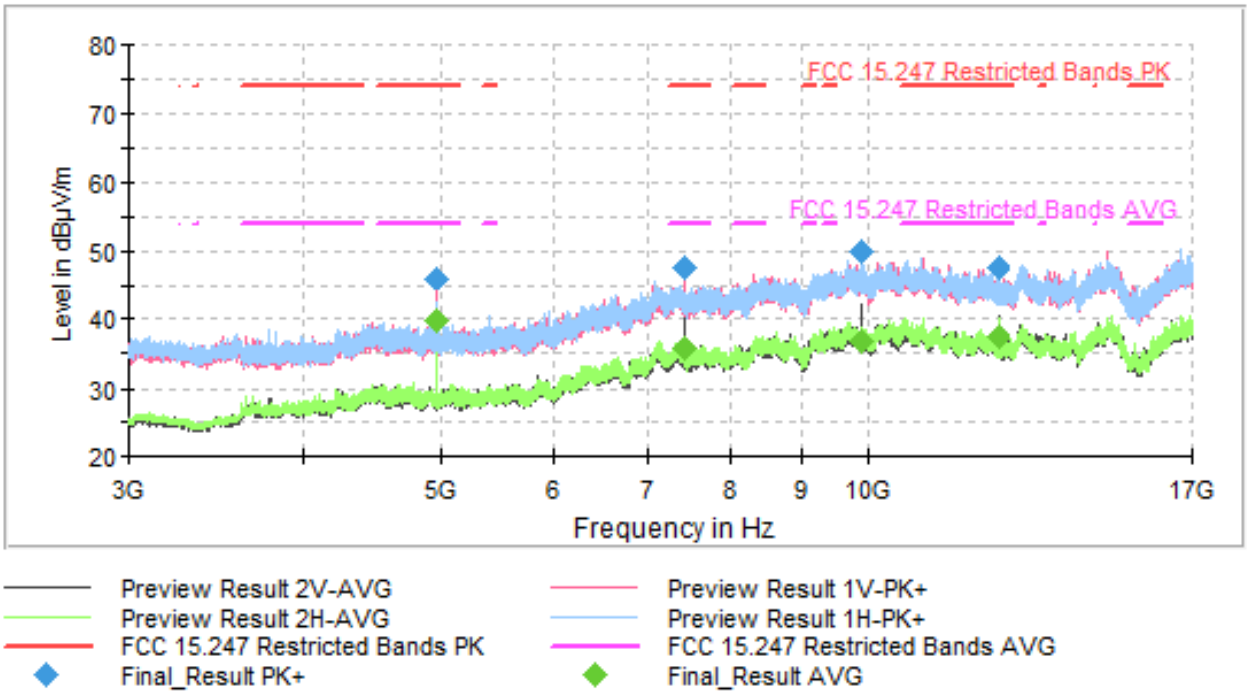
- Low Channel:



- Middle Channel:

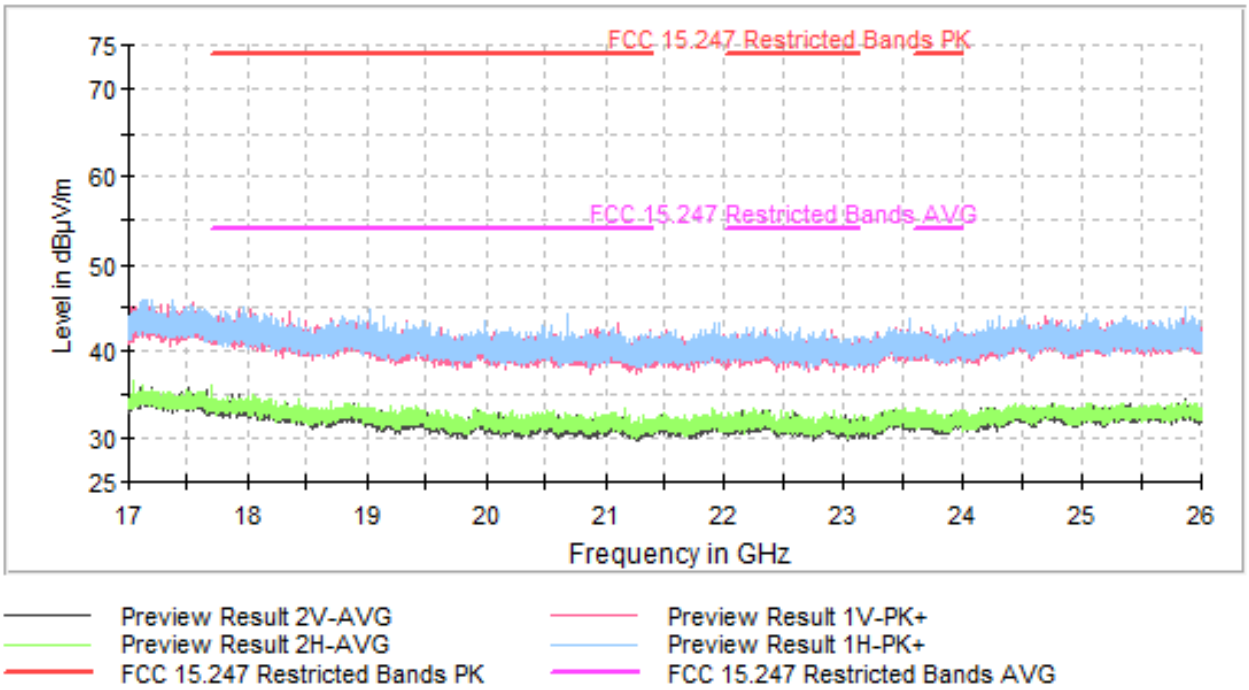


- High Channel:



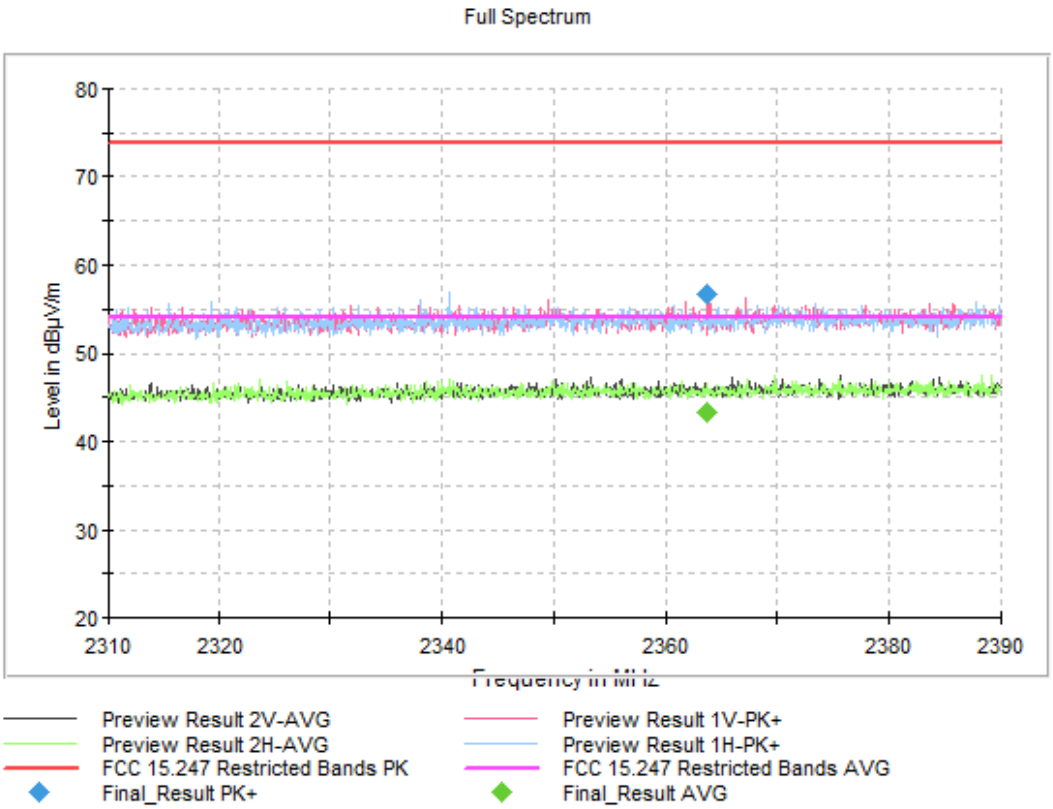
FREQUENCY RANGE 17 - 26 GHz

This plot is valid for the Lowest, Middle and Highest Channels:

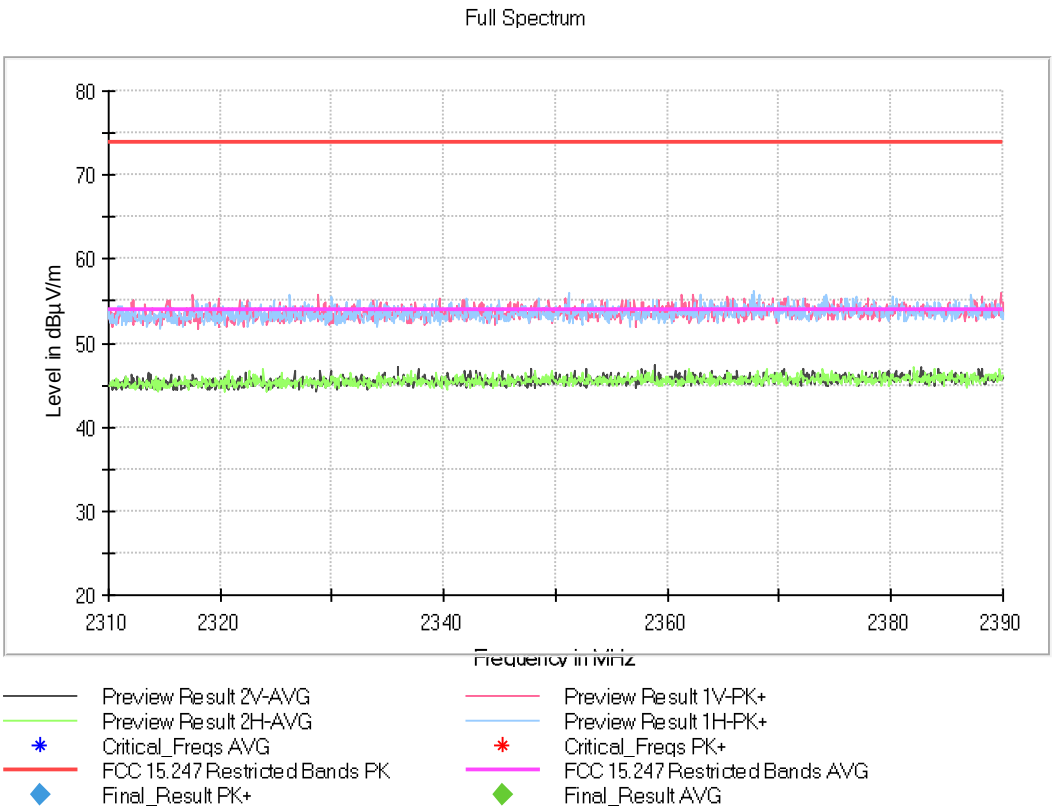


FREQUENCY RANGE 2.31 - 2.39 GHz

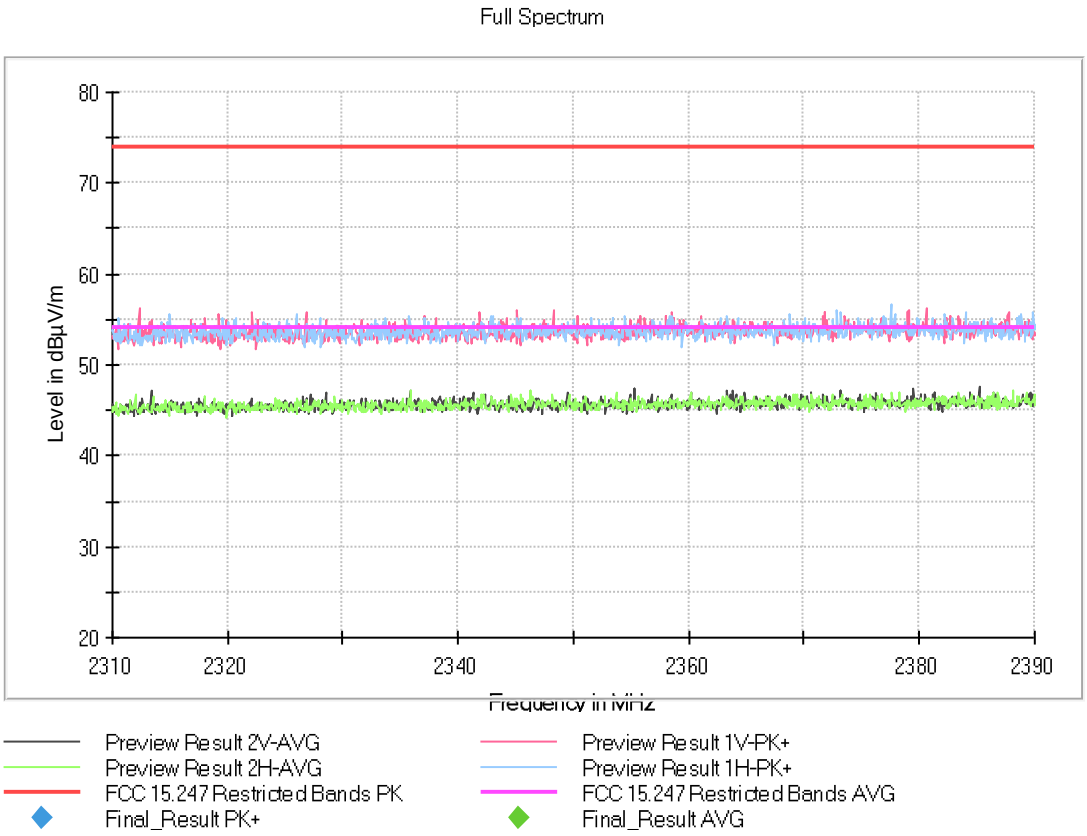
- Low Channel:



- Middle Channel:

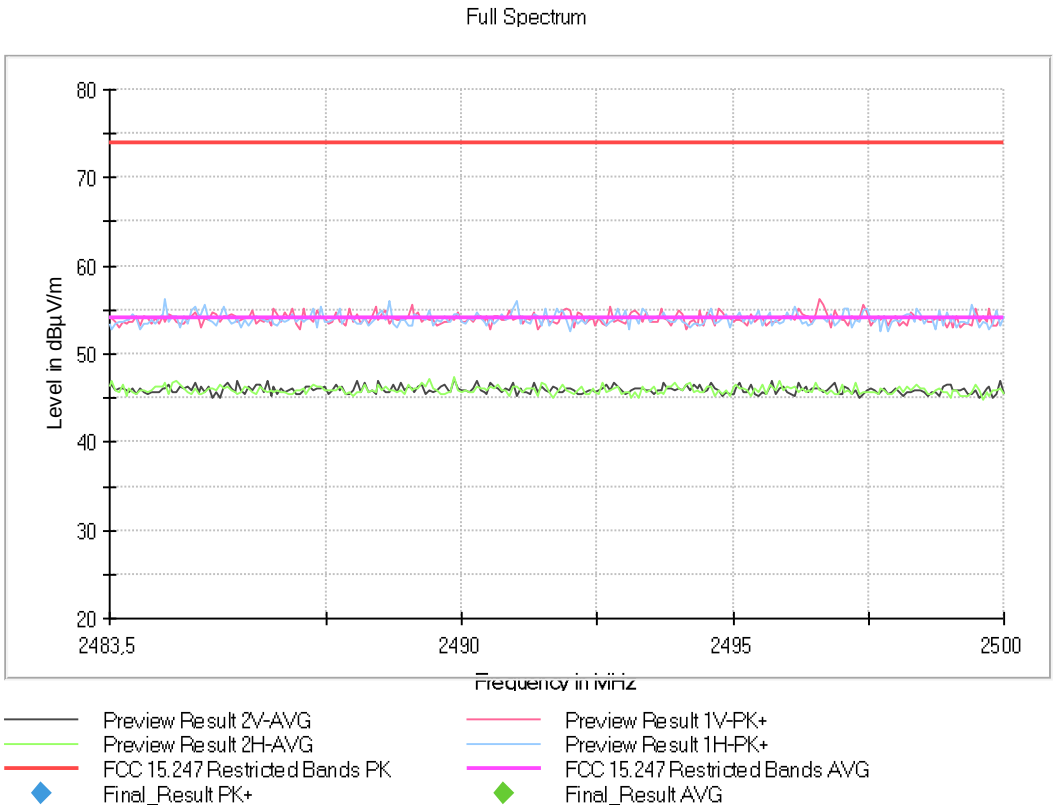


- High Channel:

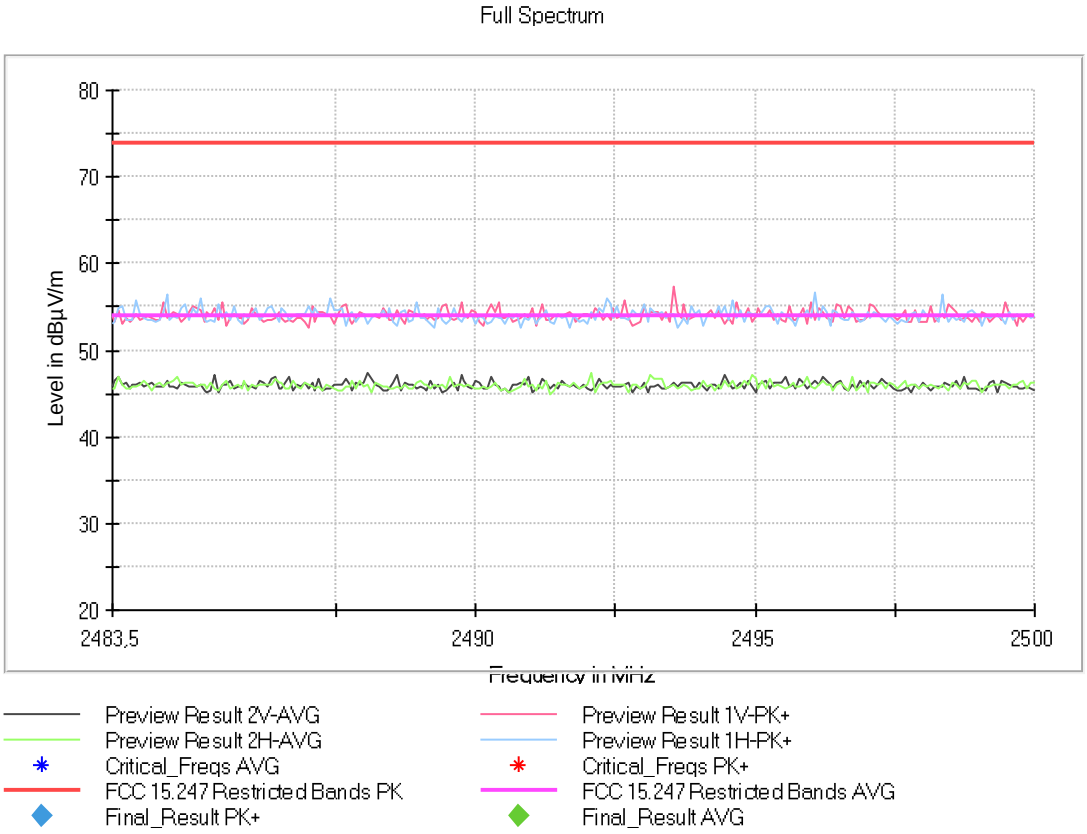


FREQUENCY RANGE 2.4835 - 2.5 GHz

- Low Channel:



- Middle Channel:



- High Channel:

Appendix C: Test results. Proprietary protocol DM 2.4 GHz

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15.249 (d) / RSS-210 B.10 (b) Emissions radiated outside of the specific frequency bands 64

TEST CONDITIONS

POWER SUPPLY (V) and ANTENNA:

V nominal:	3.8 Vdc
Type of Power Supply:	Lithium-Ion rechargeable Battery
Max. RF output power (e.i.r.p.):	-5 dBm
Type of Antenna:	Integral.
Declared Antenna Gain:	-5 dBi

TEST FREQUENCIES:

Low Channel:	2402 MHz
Middle Channel:	2440 MHz
High Channel:	2480 MHz

CONDUCTED MEASUREMENTS

The equipment under test was set up in a shielded room and it is connected to the spectrum analyser using a low loss RF cable. The reading of the spectrum analyser is corrected taking into account the cable loss.

RADIATED MEASUREMENTS

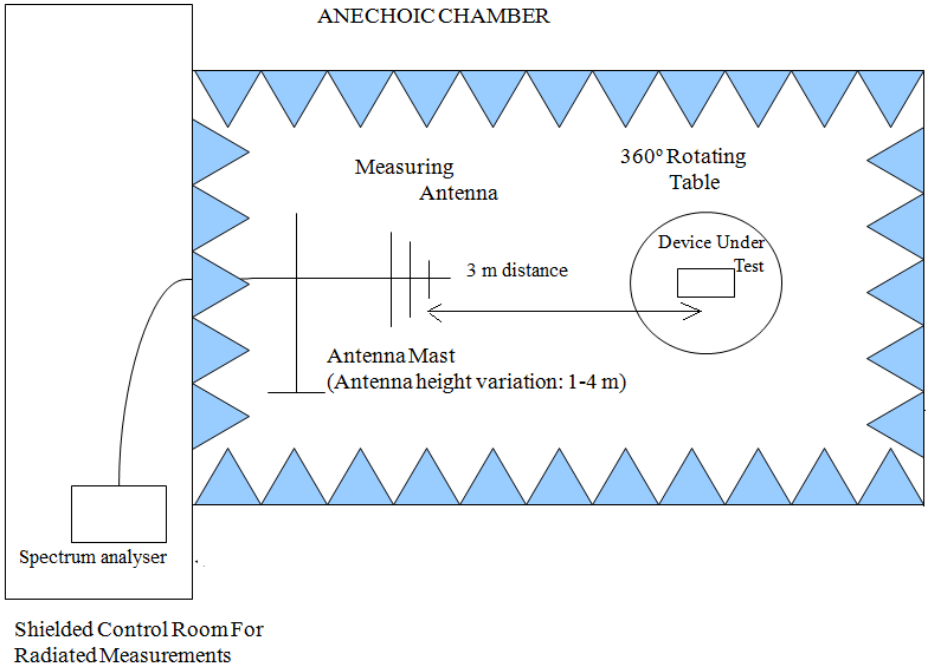
All radiated tests were performed in a semi-anechoic chamber. The measurement antenna is situated at a distance of 3 m for the frequency range 30 MHz-1000 MHz (30 MHz-1000 MHz Bilog antenna) and the frequency range 1 GHz-17 GHz (1 GHz-17 GHz Double ridge horn antenna) and at a distance of 1m for the frequency range 17-26 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.

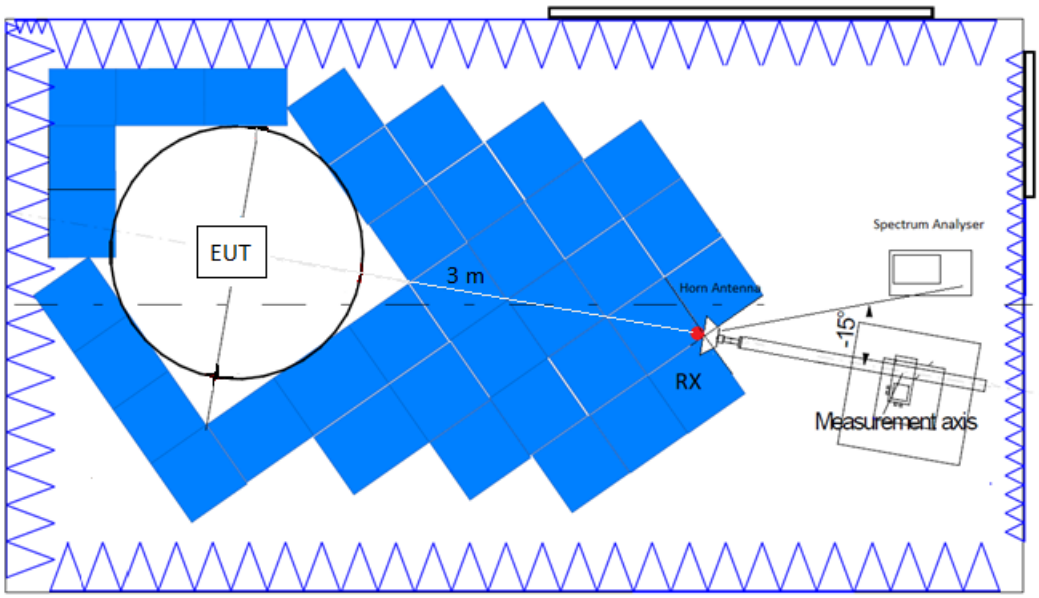
The equipment under test was set up on a non-conductive platform above the ground plane and the situation and orientation was varied to find the maximum radiated emission. It was also rotated 360º and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission.

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

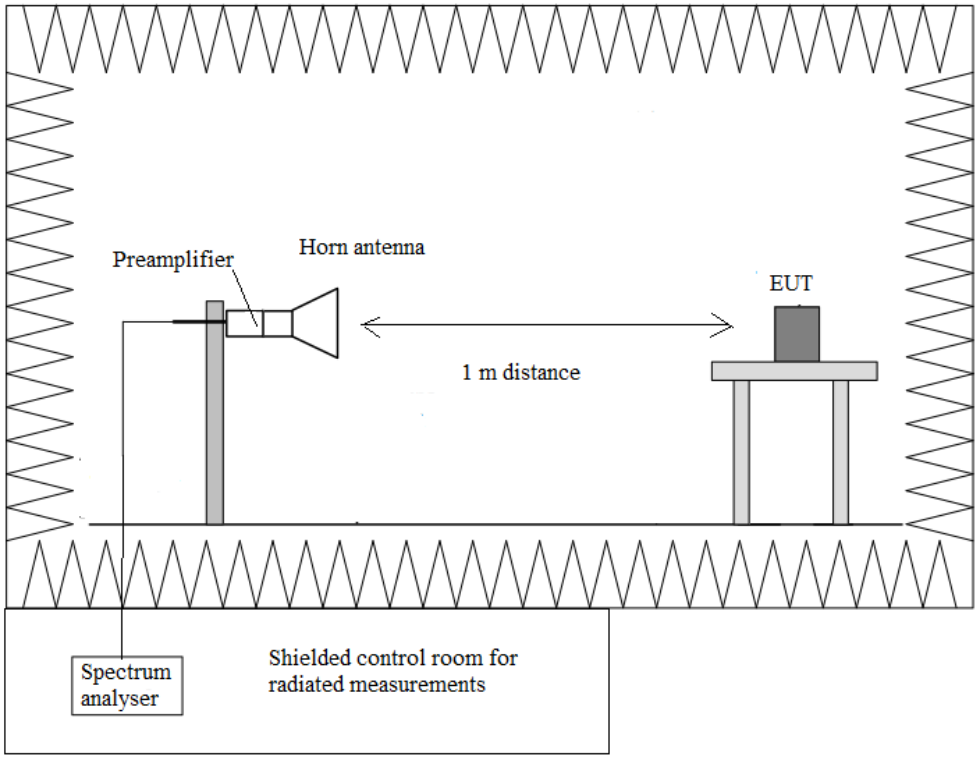
Radiated measurements setup f < 1 GHz:



Radiated measurements setup from 1 GHz to 17 GHz:



Radiated measurements setup f > 18 GHz:



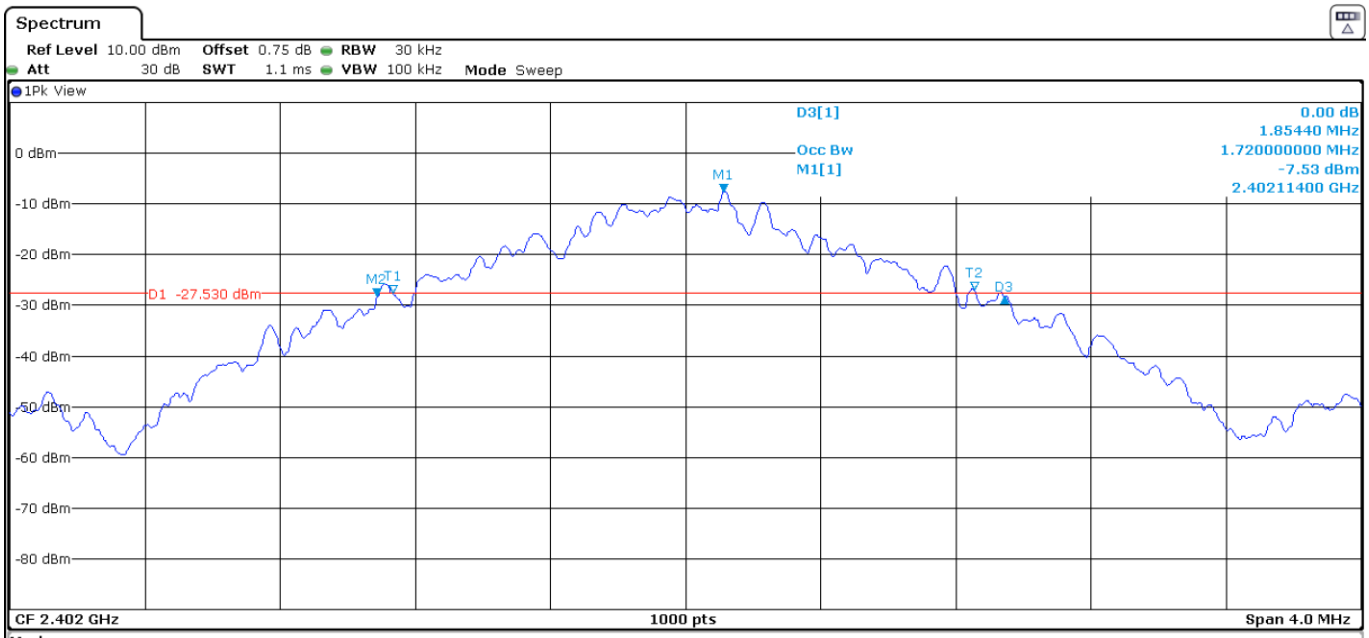
Occupied Bandwidth

RESULTS:

	Low Channel 2402 MHz	Middle Channel 2441 MHz	High Channel 2480 MHz
99% Bandwidth (MHz)	1.720	1.720	1.720
Measurement Uncertainty (kHz)	<±5.00		

Verdict: PASS

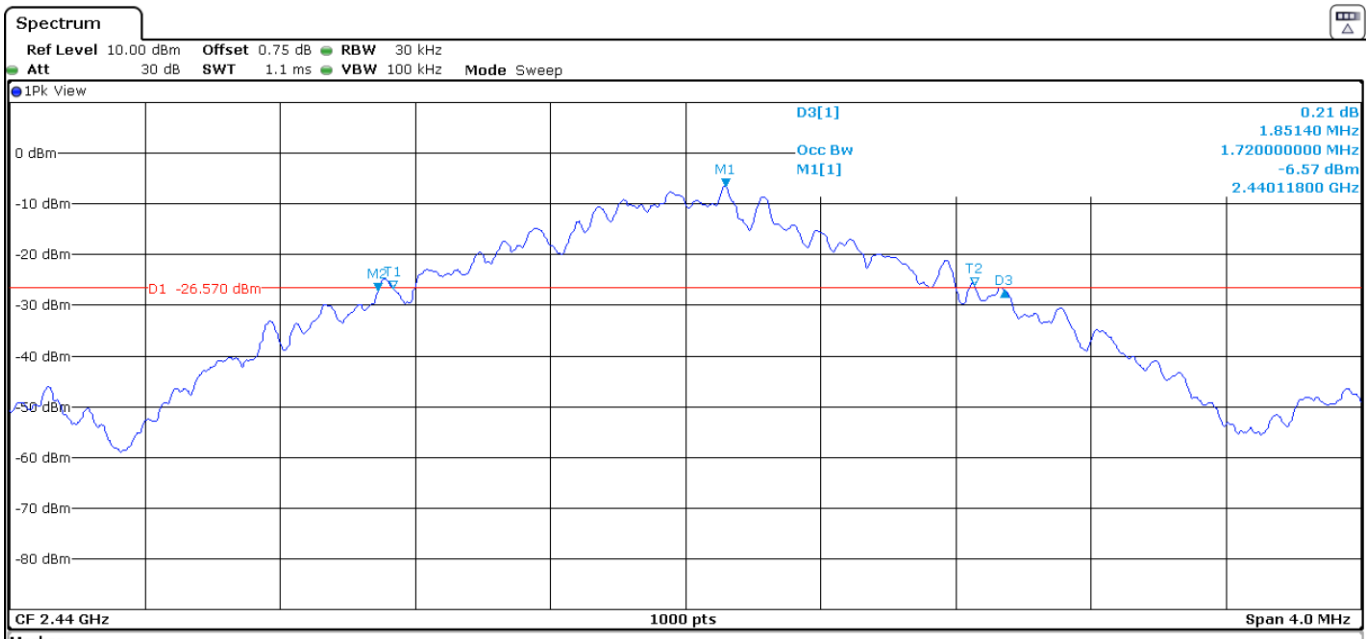
- Low Channel:



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.402114 GHz	-7.53 dBm		
T1		1	2.401134 GHz	-27.66 dBm	Occ Bw	1.72 MHz
T2		1	2.402854 GHz	-26.86 dBm		
M2		1	2.4010884 GHz	-28.22 dBm		
D3	M2	1	1.8544 MHz	-0.00 dB		

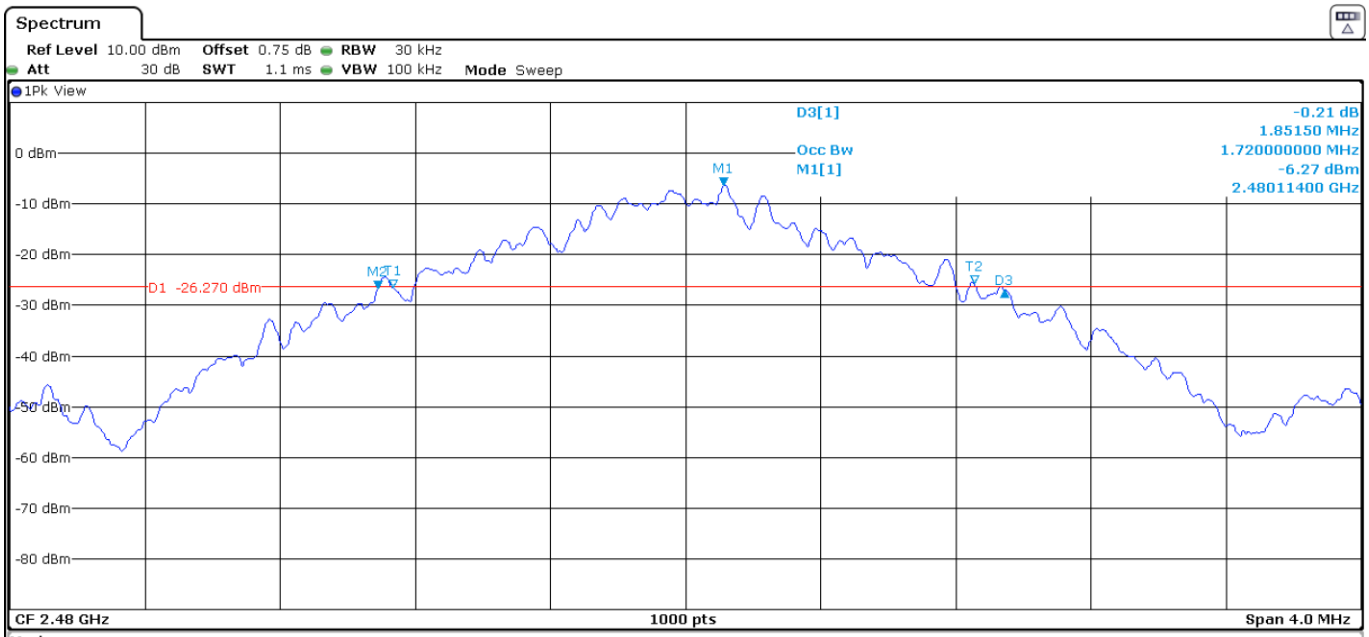
- Middle Channel:



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.440118 GHz	-6.57 dBm		
T1		1	2.439134 GHz	-26.72 dBm	Occ Bw	1.72 MHz
T2		1	2.440854 GHz	-26.00 dBm		
M2		1	2.4390915 GHz	-27.11 dBm		
D3	M2	1	1.8514 MHz	0.21 dB		

- High Channel:



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.480114 GHz	-6.27 dBm		
T1		1	2.479134 GHz	-26.43 dBm	Occ Bw	1.72 MHz
T2		1	2.480854 GHz	-25.77 dBm		
M2		1	2.4790918 GHz	-26.65 dBm		
D3	M2	1	1.8515 MHz	-0.21 dB		

15.249 (a) / RSS-210 B.10 (a) Field strength of fundamental and harmonics emissions

SPECIFICATION:

The field strength of emissions from intentional radiators shall comply with the following

Fundamental frequency (MHz)	Field strength of fundamental (mV/m)	Field strength (dBµV/m)	Measurement distance (m)
902 - 928	50	93.98	3
2400 – 2483.5	50	93.98	3
5725 - 5875	50	93.98	3
24000-24250	250	107.96	3

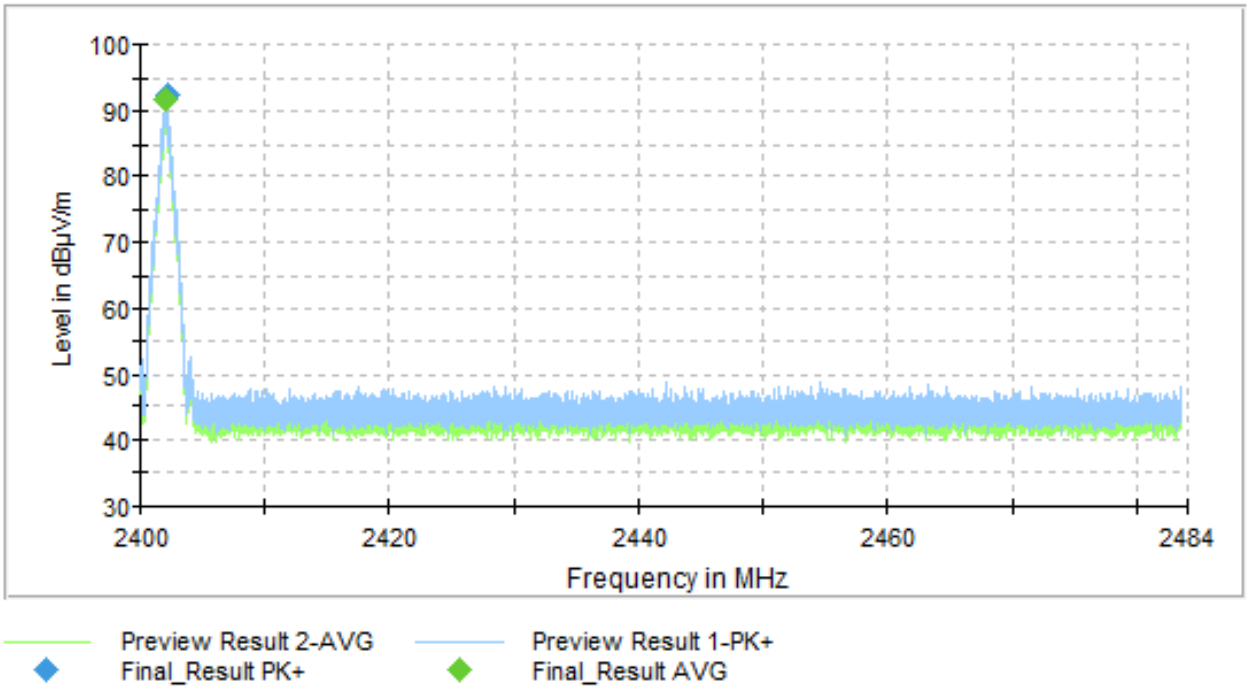
For frequencies above 1000 MHz, the above field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.

RESULTS:

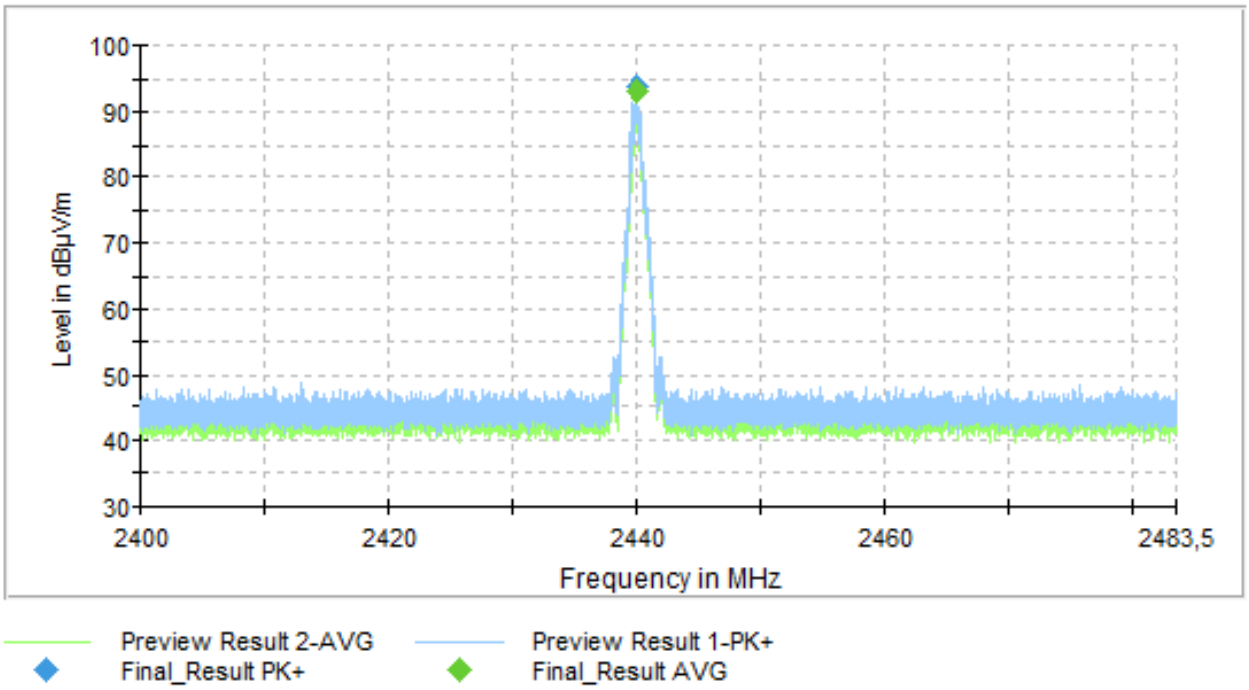
	Low Channel 2402 MHz	Middle Channel 2440 MHz	High Channel 2480 MHz
Average Field Strength (dBµV/m)	91.68	93.19	91.29
Peak Field Strength (dBµV/m)	92.38	93.86	92.02
Measurement Uncertainty (dB)	<±4.11		

Verdict: PASS

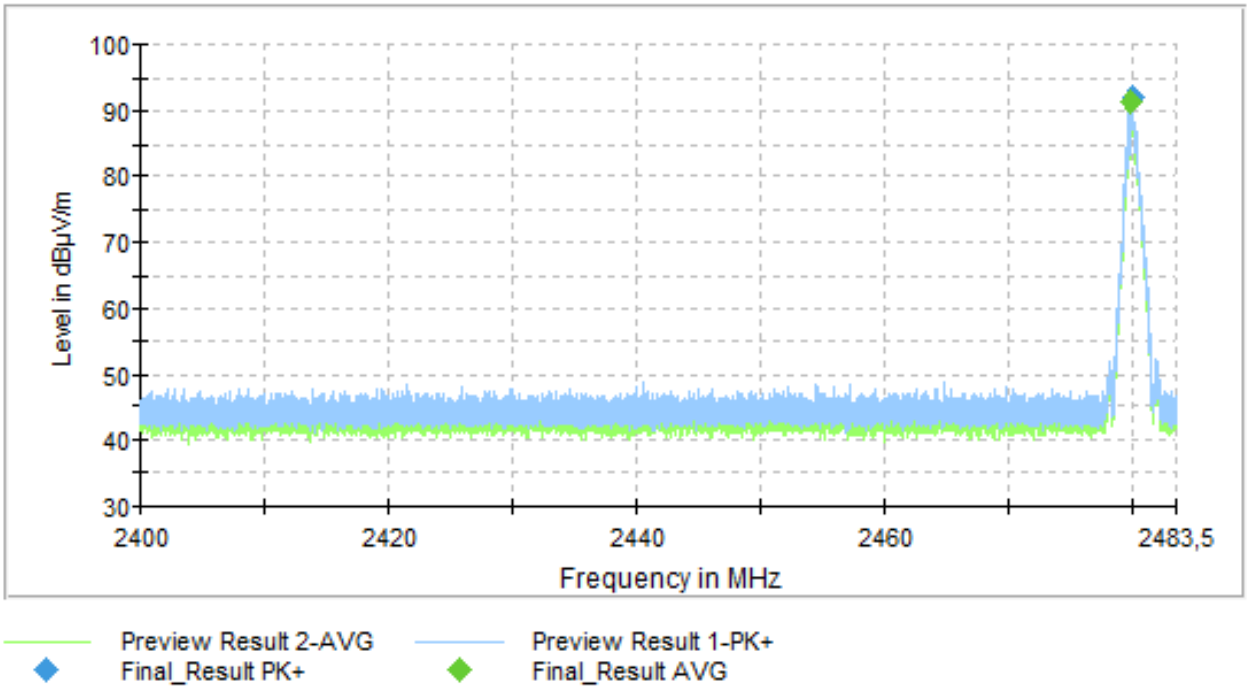
- Low Channel:



- Middle Channel:



- High Channel:



15.249 (d) / RSS-210 B.10 (b) Emissions radiated outside of the specific frequency bands

SPECIFICATION:

The field strength of harmonics from intentional radiators shall comply with the following

Fundamental frequency (MHz)	Field strength of harmonics (µV/m)	Field strength of harmonics (dBµV/m)	Measurement distance (m)
902 - 928	500	54	3
2400 – 2483.5	500	54	3
5725 - 5875	500	54	3
24000-24250	2500	67.96	3

Emissions radiated outside of the specific frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of fundamental or to the general radiated emission limits specified in section 15.209:

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)	-	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

Whichever is the lesser attenuation.

RESULTS:

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

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

All tests were performed in a semi-anechoic chamber at a distance of 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.

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

Measurement Uncertainty (dB) <±5.08

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 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 detected at less than 20 dB below the limit:

Spurious frequency (GHz)	Emission Level (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
4.80450	46.14	V	Peak	<± 5.13
7.20700	51.68	V	Peak	<± 5.13
9.60900	48.93	V	Peak	<± 5.13
11.99900	47.03	V	Peak	<± 5.13

- 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)
4.88050	42.09	V	Peak	<± 5.13
7.32100	52.30	V	Peak	<± 5.13
11.99500	46.43	V	Peak	<± 5.13

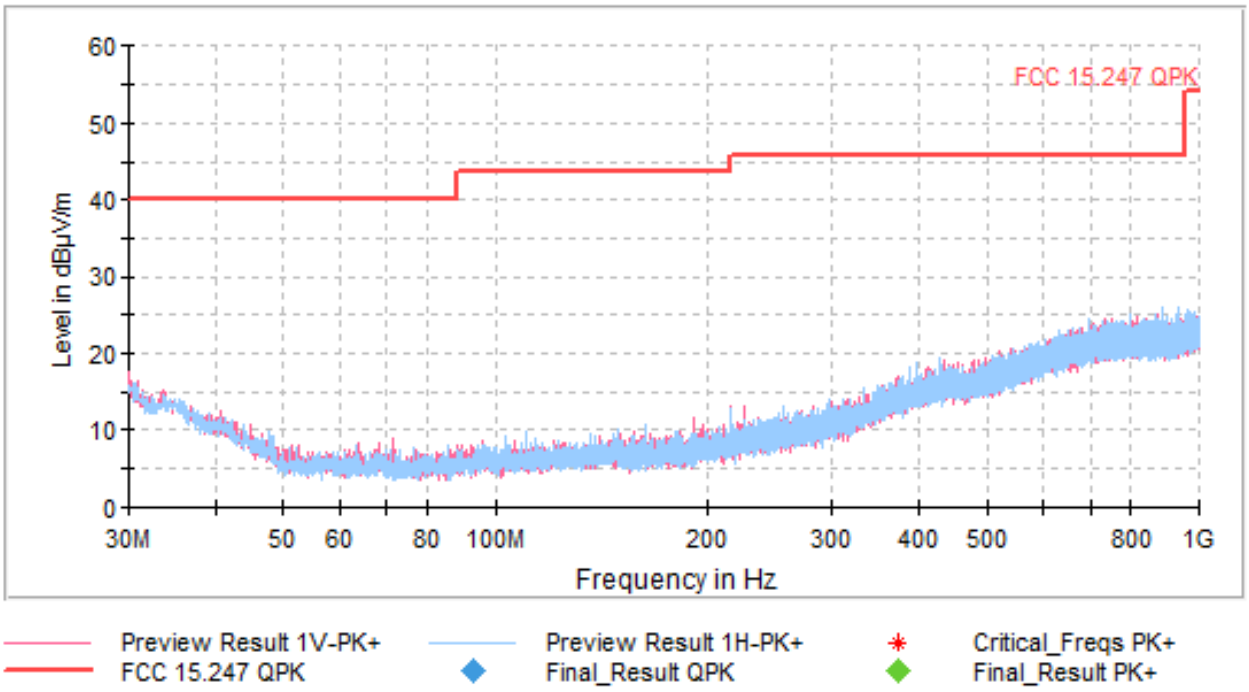
- High Channel. Spurious frequencies detected at less than 20 dB below the limit:

Spurious frequency (GHz)	Emission Level (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
2.48386	58.50	H	Peak	<± 4.11
	45.48		Average	<± 4.11
4.95950	46.22	V	Peak	<± 5.13
7.44100	47.87	V	Peak	<± 5.13

Verdict: PASS

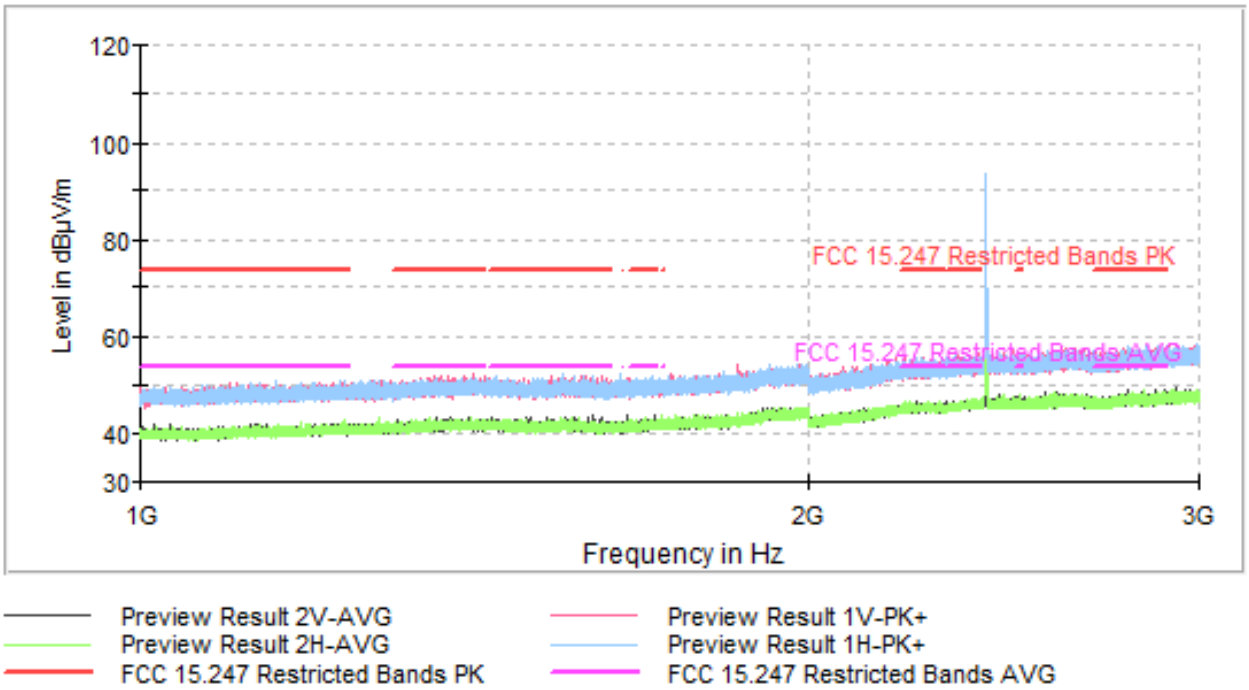
FREQUENCY RANGE 30 MHz - 1 GHz

This plot is valid for the Lowest, Middle and Highest Channels:



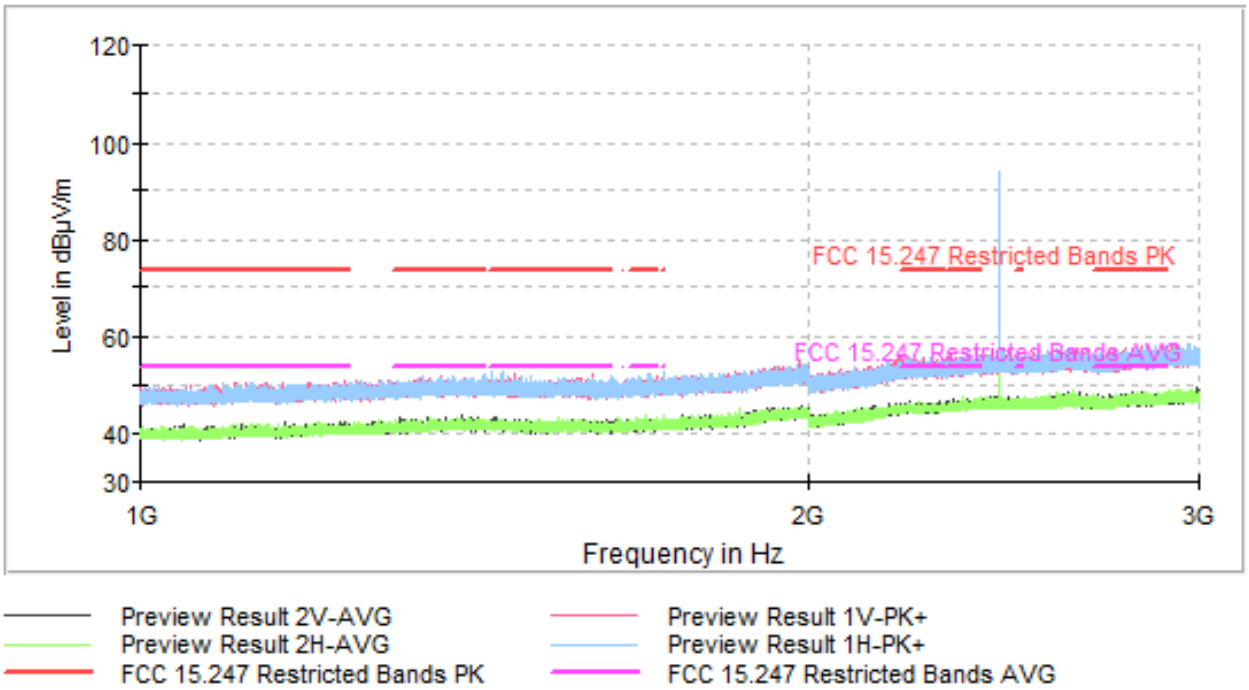
FREQUENCY RANGE 1 - 3 GHz

- Low Channel:



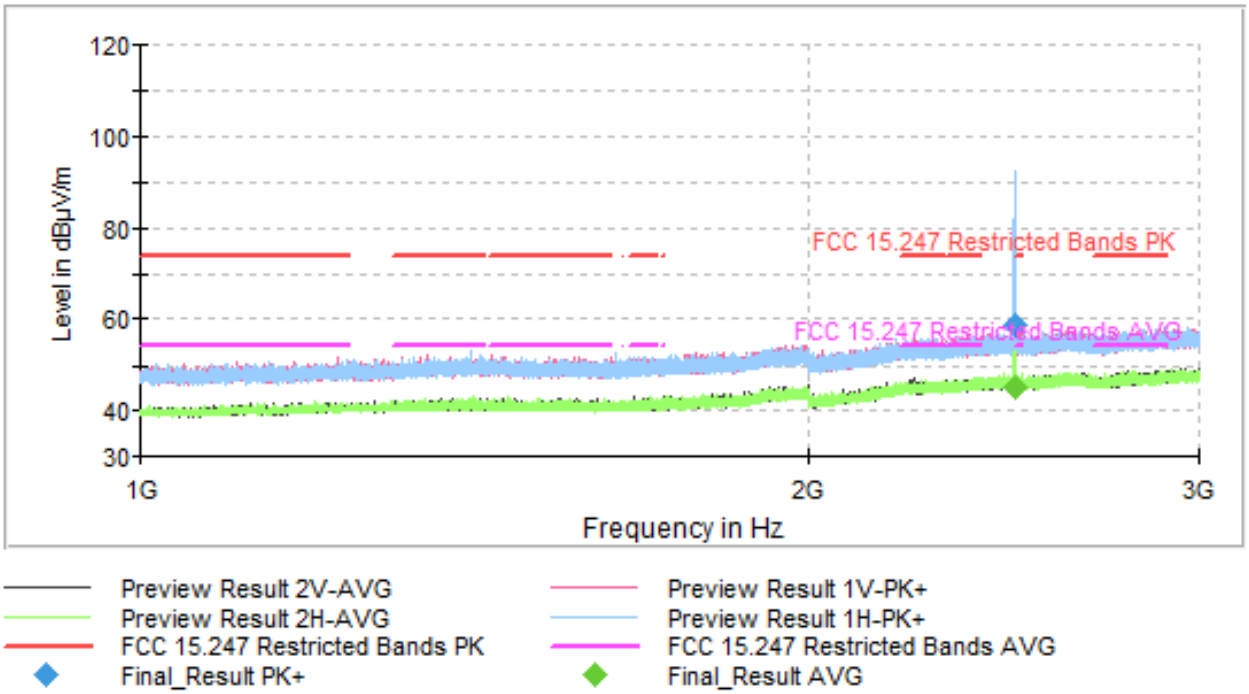
The peak shown in the plot above the limit is the carrier frequency.

- Middle Channel:



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

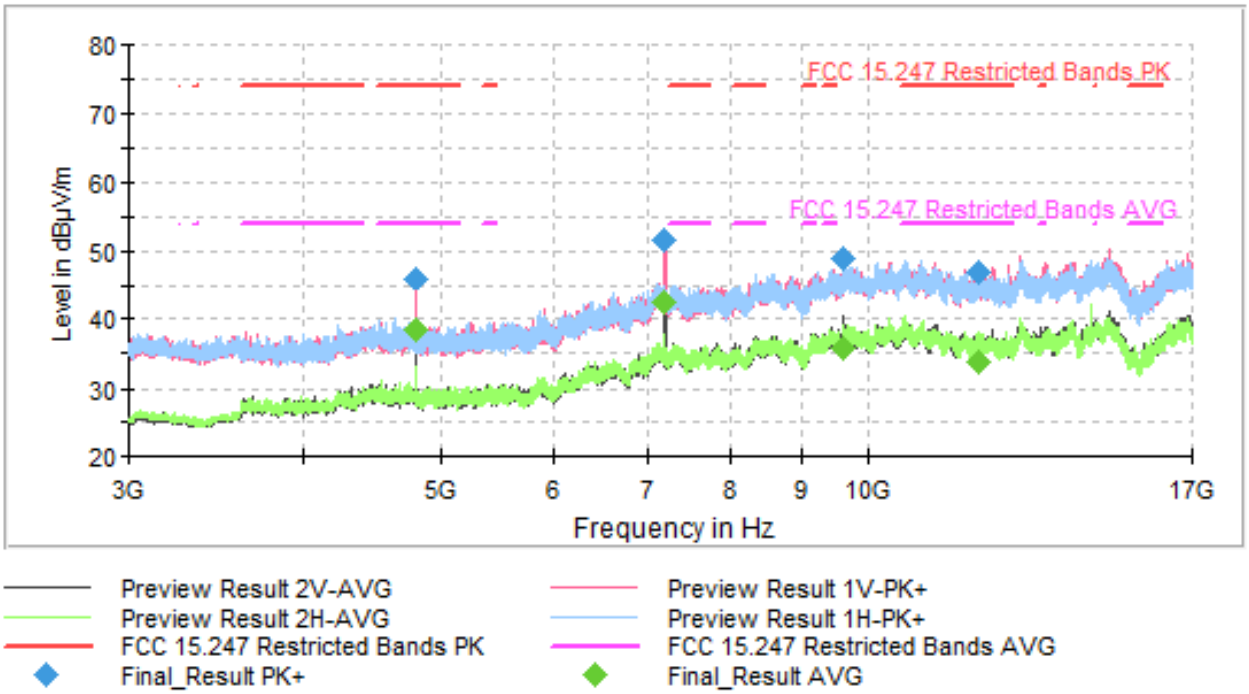
- High Channel:



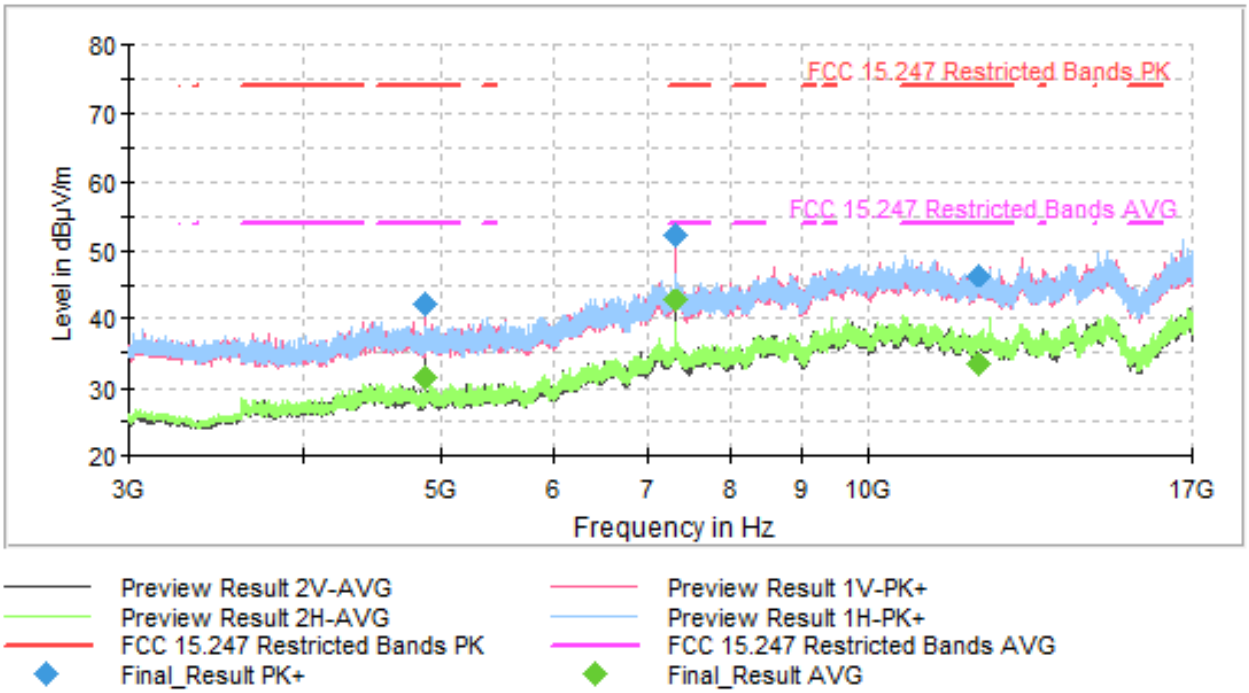
The peak shown in the plot above the limit is the carrier frequency.

FREQUENCY RANGE 3 - 17 GHz

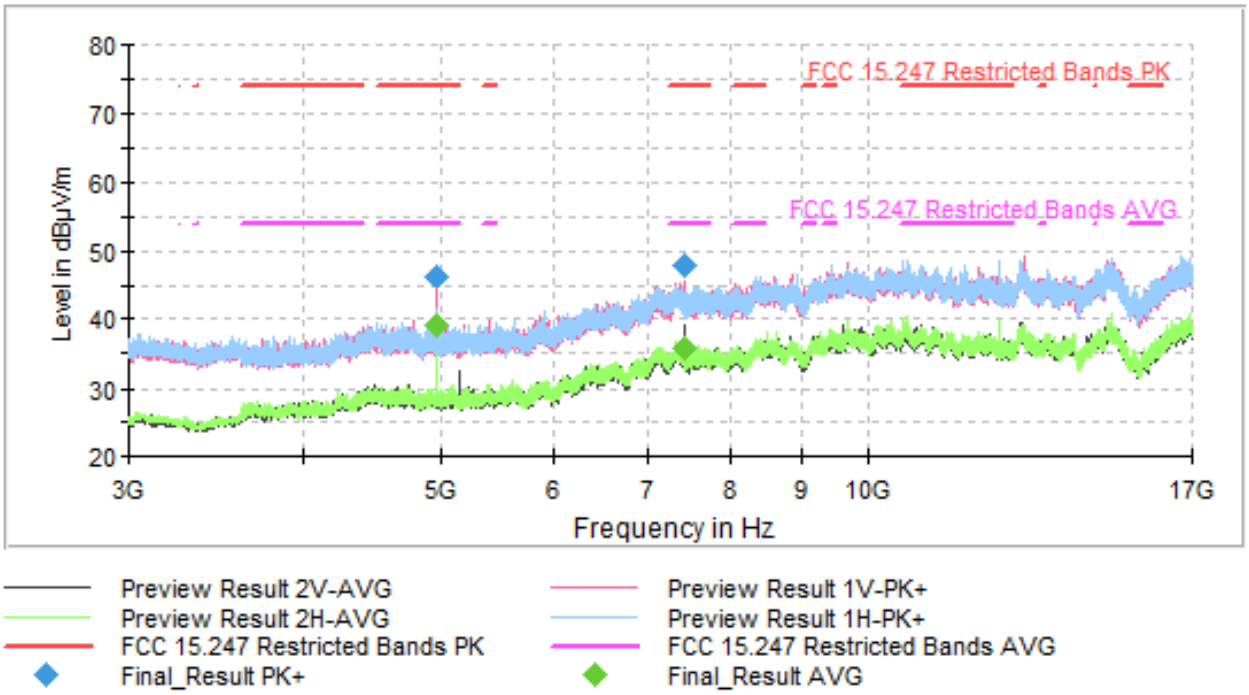
- Low Channel:



- Middle Channel:

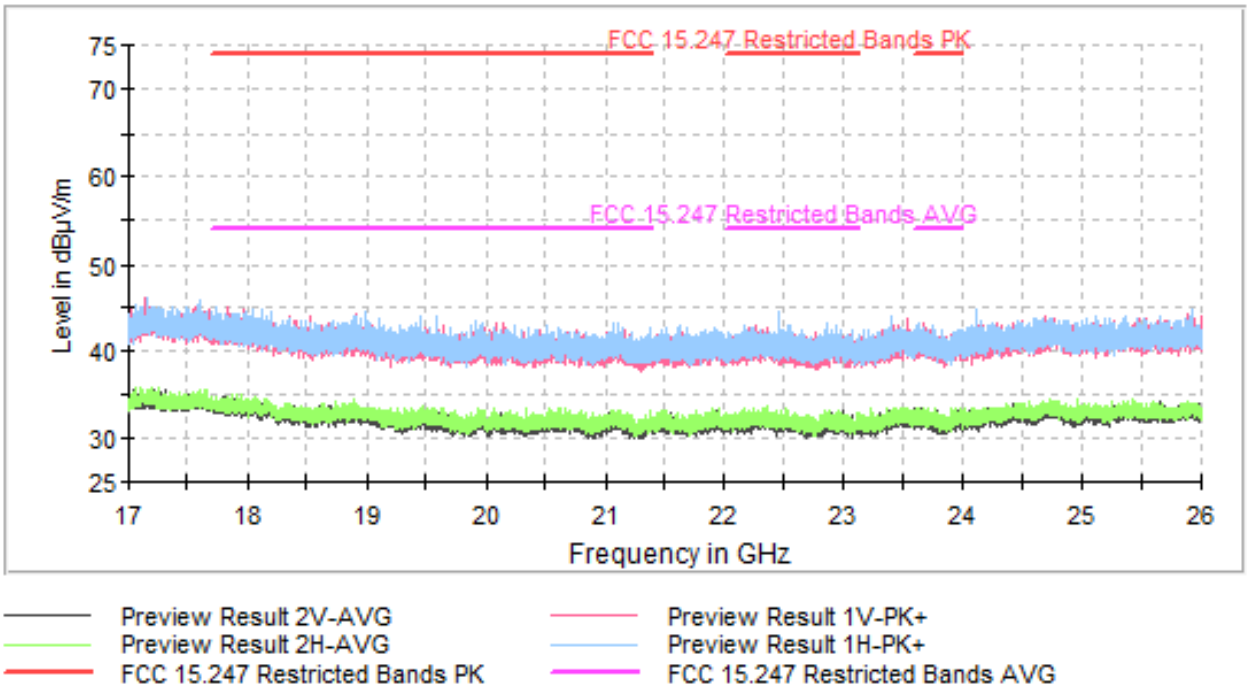


- High Channel:



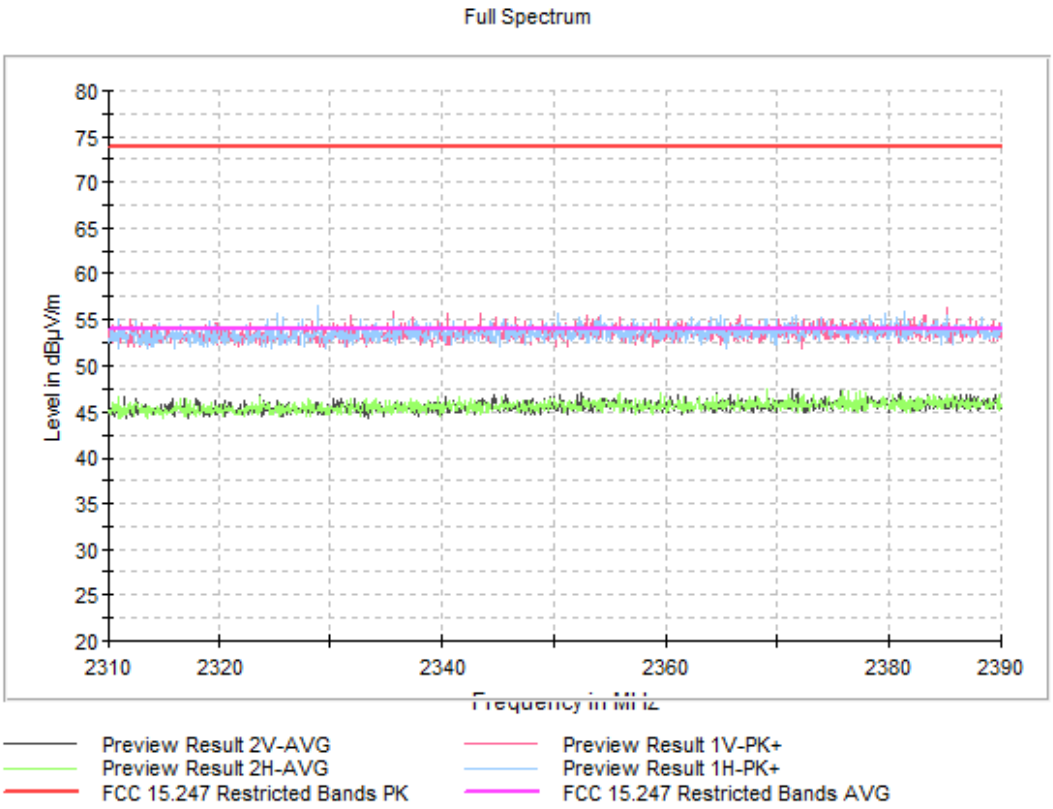
FREQUENCY RANGE 17 - 26 GHz

This plot is valid for the Lowest, Middle and Highest Channels:

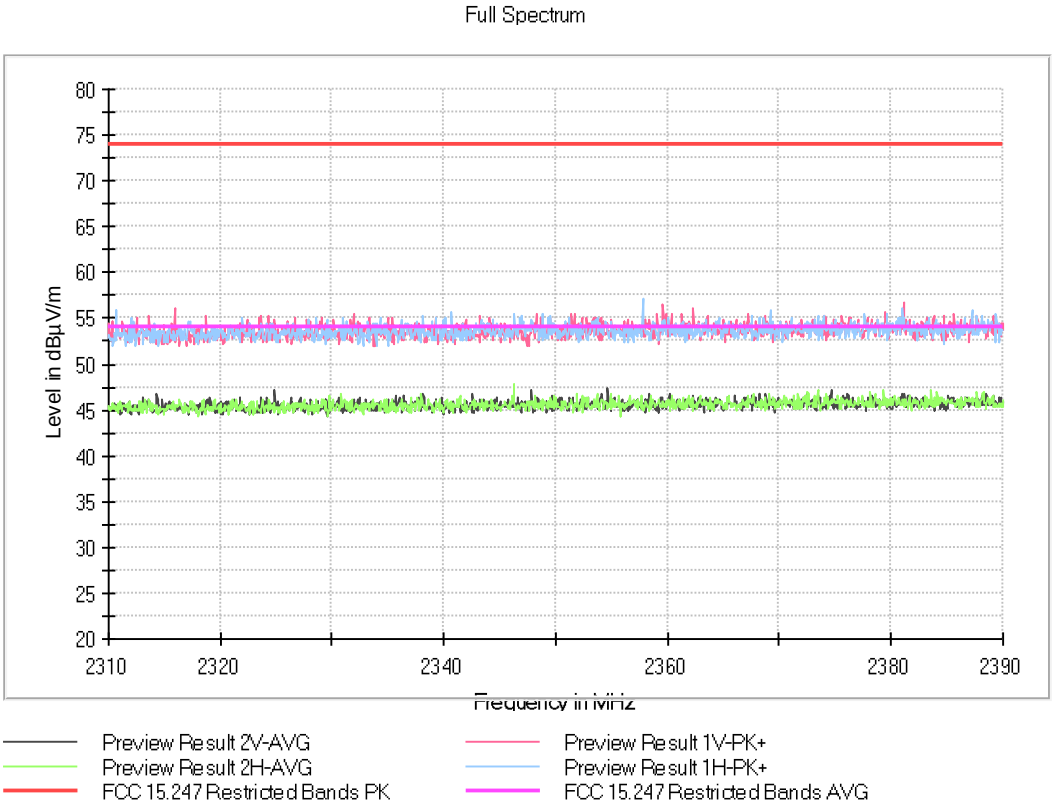


FREQUENCY RANGE 2.31 - 2.39 GHz

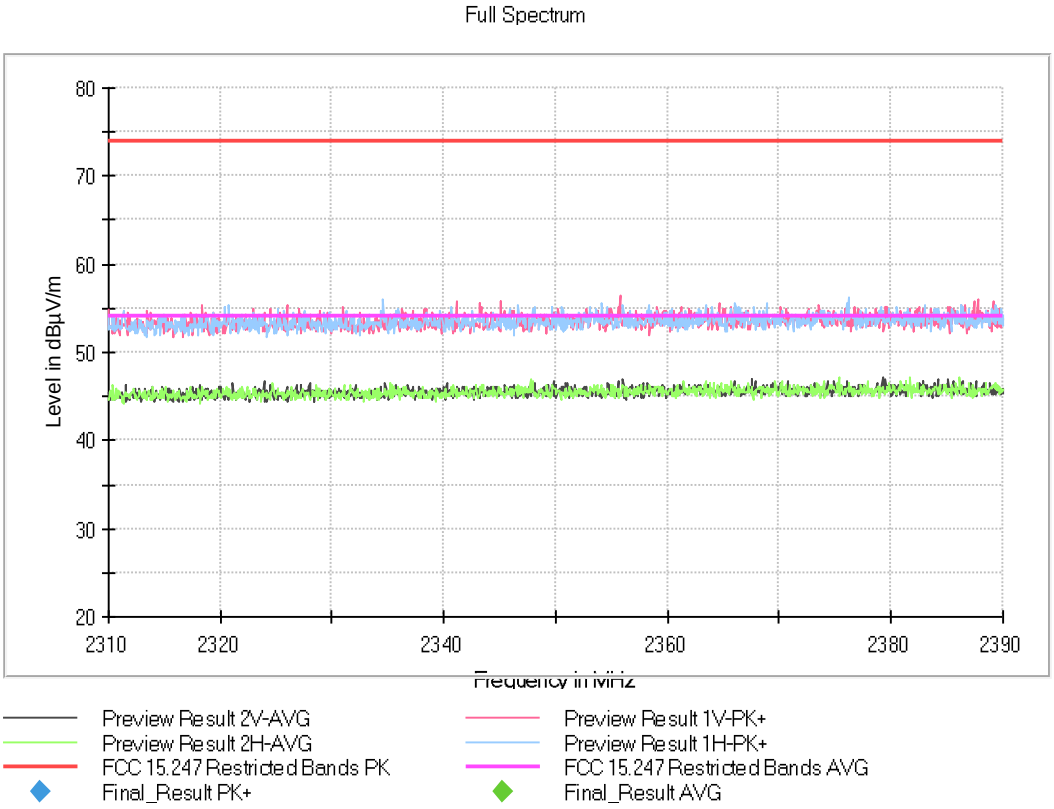
- Low Channel:



- Middle Channel:



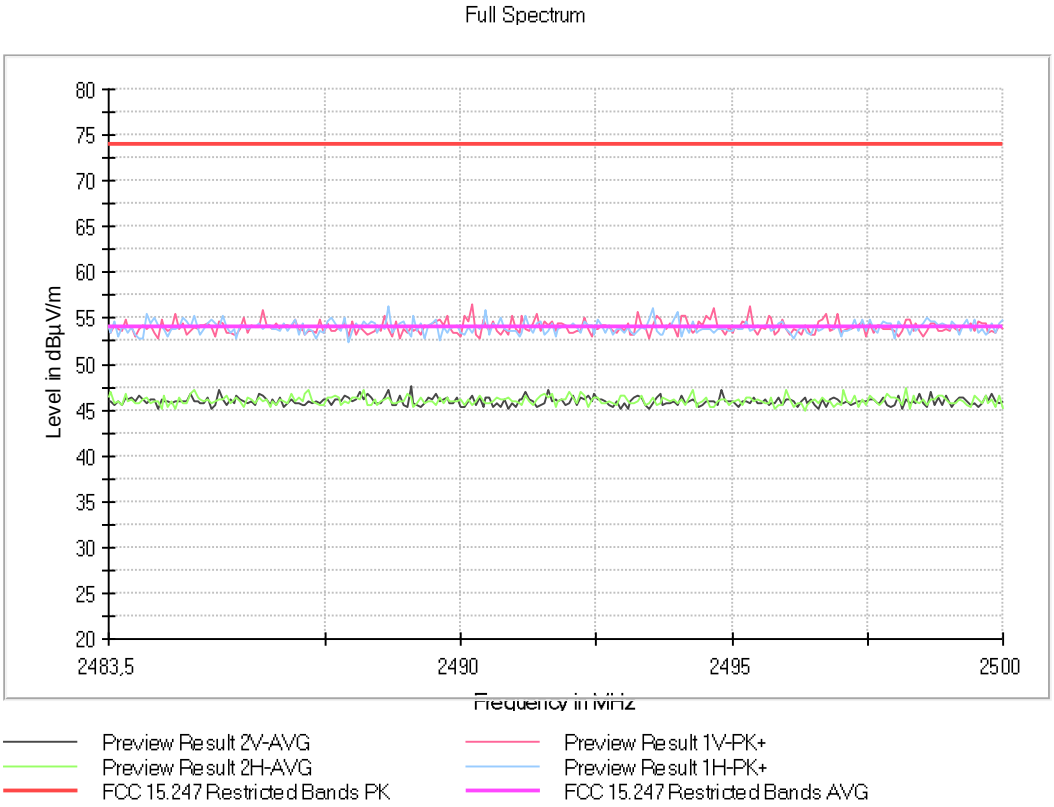
- High Channel:



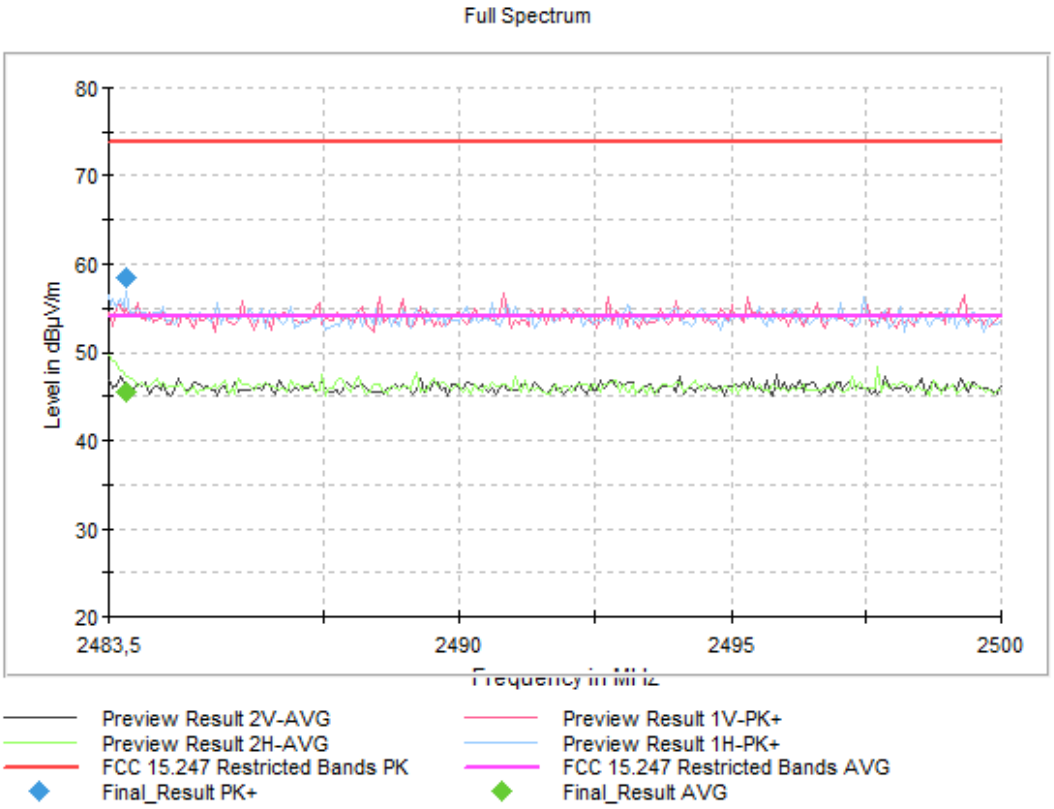
FREQUENCY RANGE 2.4835 - 2.5 GHz

- Low Channel:

- Middle Channel:



- High Channel:



Appendix D: Test results. Proprietary protocol Flora 2.4 GHz

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TEST CONDITIONS

POWER SUPPLY (V) and ANTENNA:

V nominal:	3.8 Vdc
Type of Power Supply:	Lithium-Ion rechargeable Battery
Max. RF output power (e.i.r.p.):	-5 dBm
Type of Antenna:	Integral.
Declared Antenna Gain:	-5 dBi

TEST FREQUENCIES:

Low Channel:	2402 MHz
Middle Channel:	2440 MHz
High Channel:	2480 MHz

CONDUCTED MEASUREMENTS

The equipment under test was set up in a shielded room and it is connected to the spectrum analyser using a low loss RF cable. The reading of the spectrum analyser is corrected taking into account the cable loss.

RADIATED MEASUREMENTS

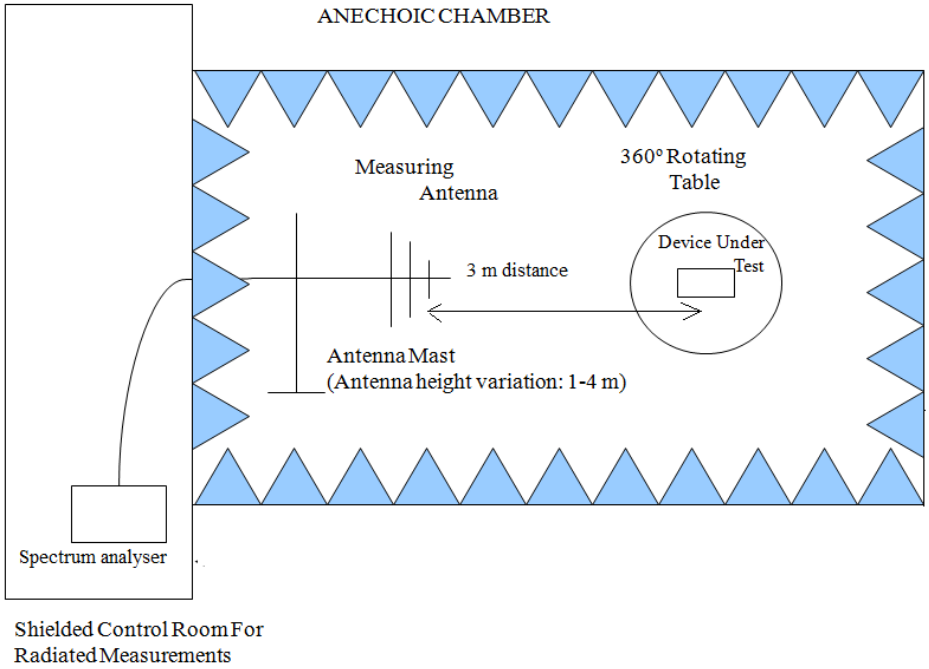
All radiated tests were performed in a semi-anechoic chamber. The measurement antenna is situated at a distance of 3 m for the frequency range 30 MHz-1000 MHz (30 MHz-1000 MHz Bilog antenna) and the frequency range 1 GHz-17 GHz (1 GHz-17 GHz Double ridge horn antenna) and at a distance of 1m for the frequency range 17-26 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.

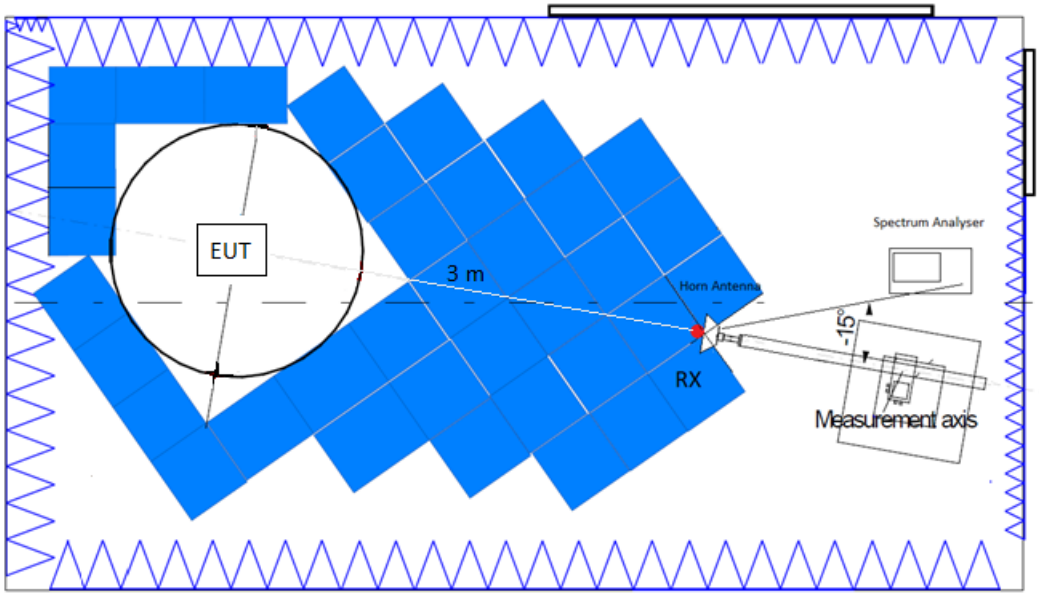
The equipment under test was set up on a non-conductive platform above the ground plane and the situation and orientation was varied to find the maximum radiated emission. It was also rotated 360º and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission.

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

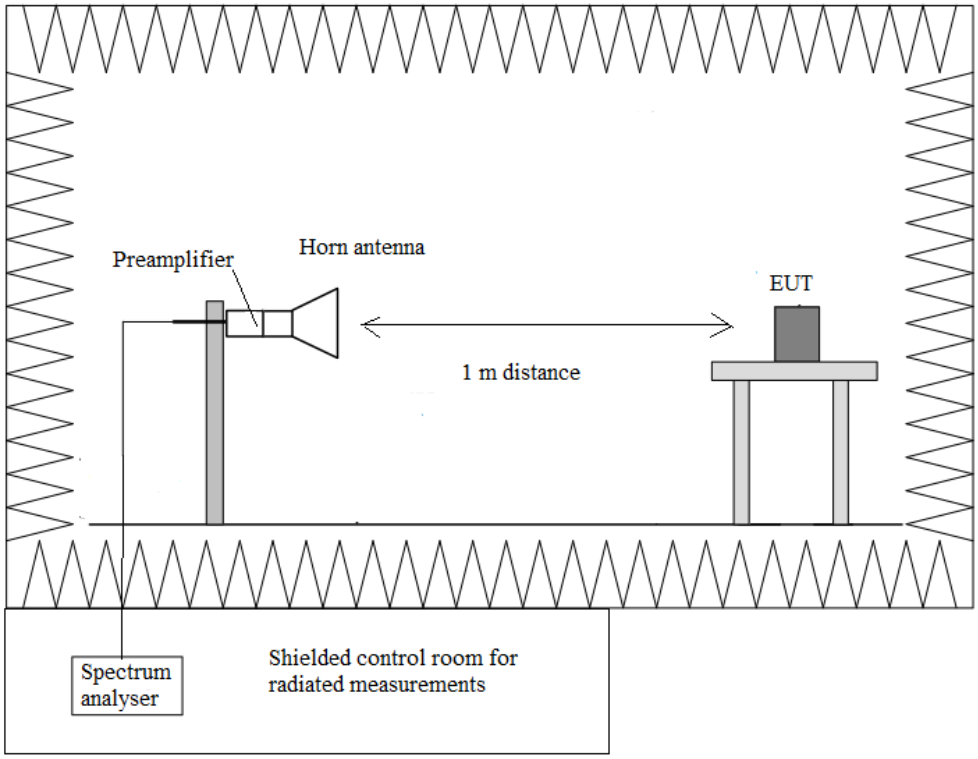
Radiated measurements setup f < 1 GHz:



Radiated measurements setup from 1 GHz to 17 GHz:



Radiated measurements setup f > 18 GHz:



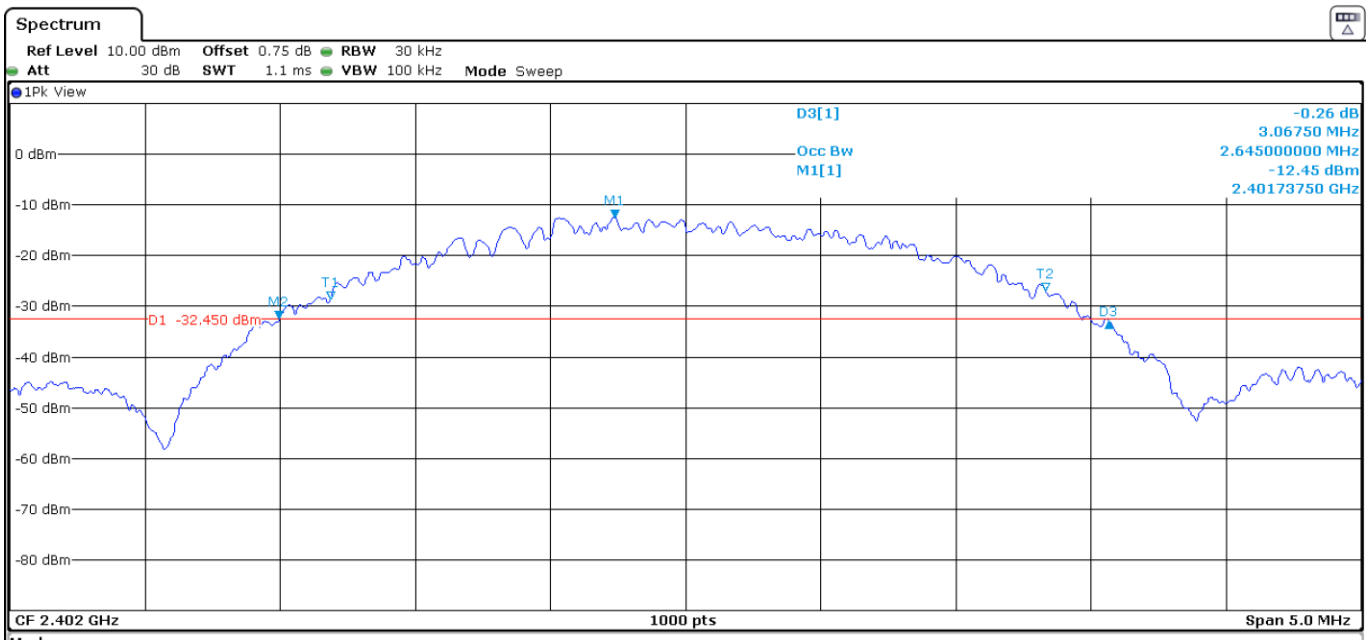
Occupied Bandwidth

RESULTS:

	Low Channel 2402 MHz	Middle Channel 2441 MHz	High Channel 2480 MHz
99% Bandwidth (MHz)	2.645	2.645	2.64
Measurement Uncertainty (kHz)	<±5.00		

Verdict: PASS

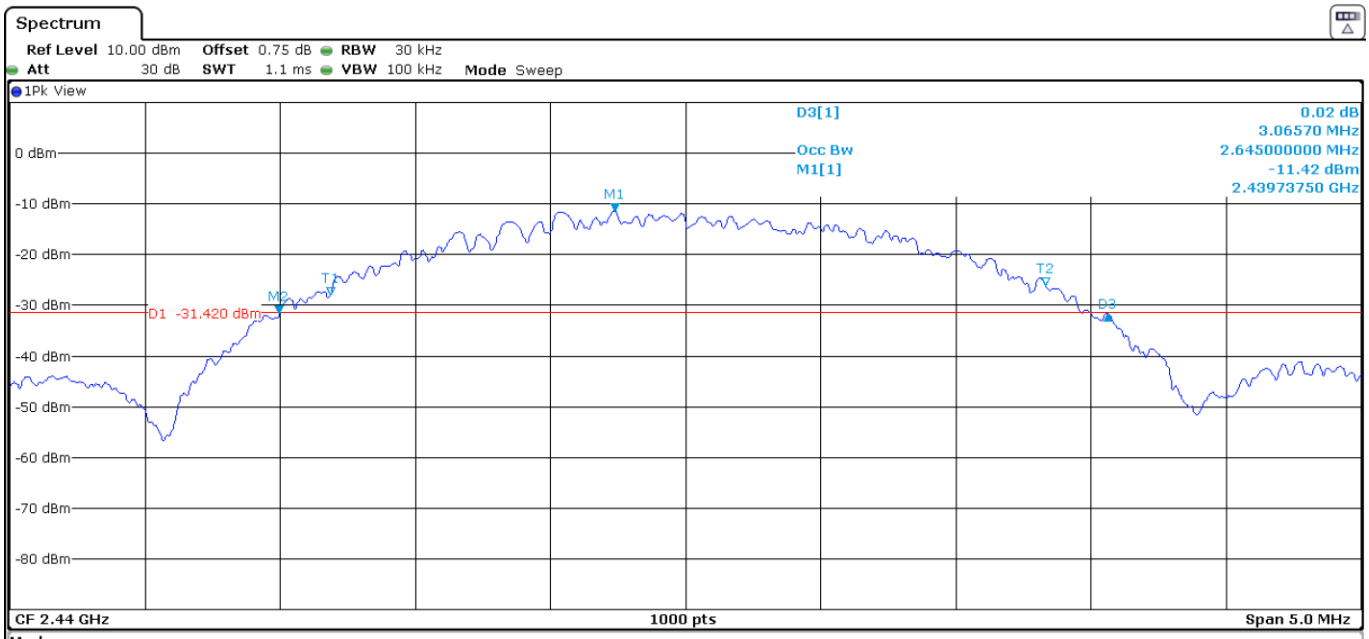
- Low Channel:



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4017375 GHz	-12.45 dBm		
T1		1	2.4006875 GHz	-28.74 dBm	Occ Bw	2.645 MHz
T2		1	2.4033325 GHz	-27.04 dBm		
M2		1	2.4004979 GHz	-32.54 dBm		
D3	M2	1	3.0675 MHz	-0.26 dB		

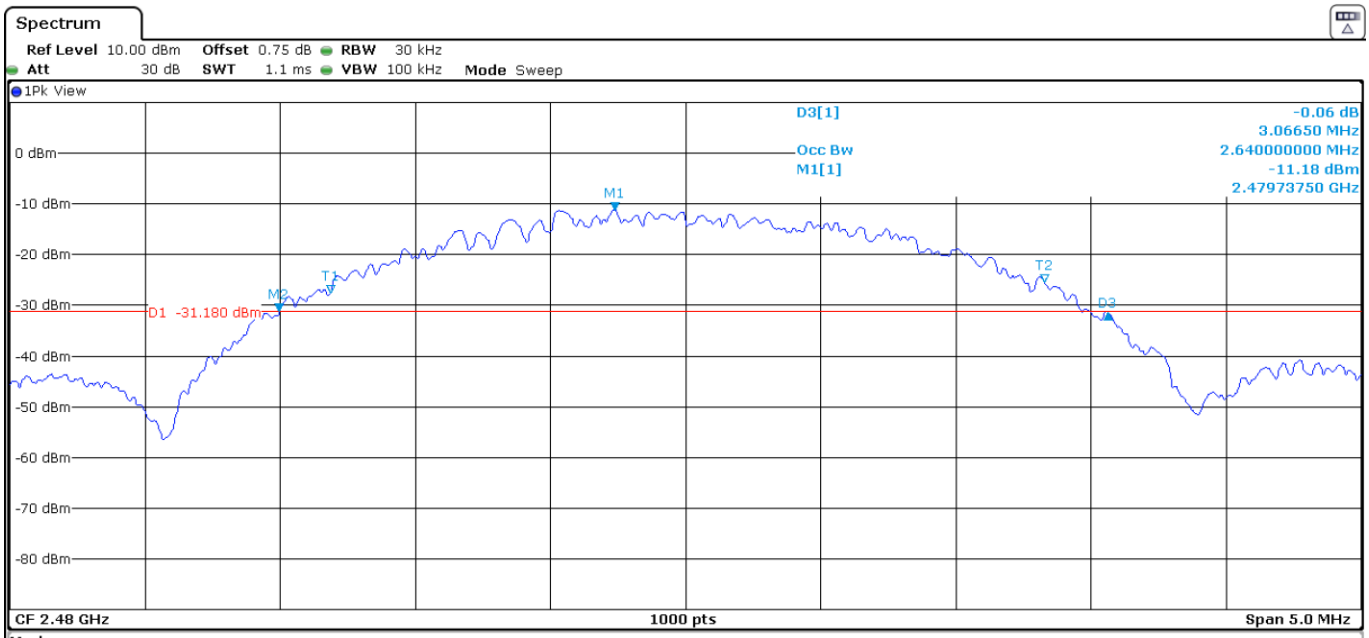
- Middle Channel:



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4397375 GHz	-11.42 dBm		
T1		1	2.4386875 GHz	-27.94 dBm	Occ Bw	2.645 MHz
T2		1	2.4413325 GHz	-26.17 dBm		
M2		1	2.4384964 GHz	-31.61 dBm		
D3	M2	1	3.0657 MHz	0.02 dB		

- High Channel:



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4797375 GHz	-11.18 dBm		
T1		1	2.4786875 GHz	-27.65 dBm	Occ Bw	2.64 MHz
T2		1	2.4813275 GHz	-25.48 dBm		
M2		1	2.4784969 GHz	-31.26 dBm		
D3	M2	1	3.0665 MHz	-0.06 dB		

15.249 (a) / RSS-210 B.10 (a) Field strength of fundamental and harmonics emissions

SPECIFICATION:

The field strength of emissions from intentional radiators shall comply with the following

Fundamental frequency (MHz)	Field strength of fundamental (mV/m)	Field strength (dBµV/m)	Measurement distance (m)
902 - 928	50	93.98	3
2400 – 2483.5	50	93.98	3
5725 - 5875	50	93.98	3
24000-24250	250	107.96	3

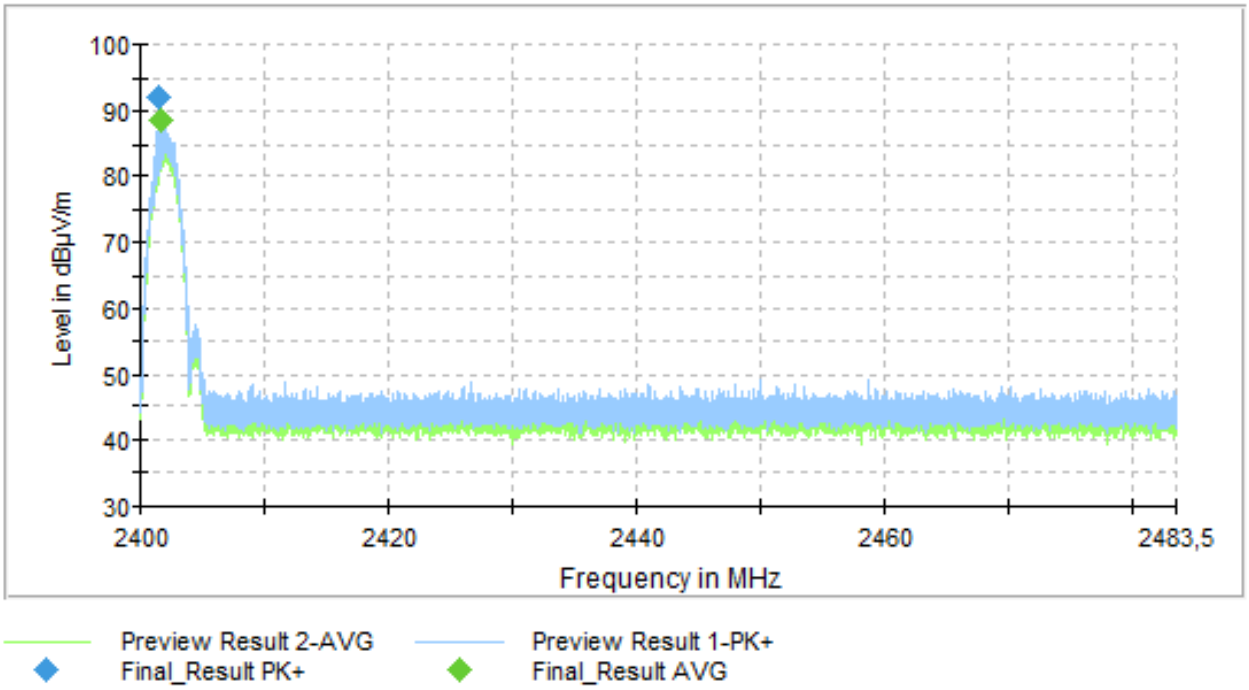
For frequencies above 1000 MHz, the above field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.

RESULTS:

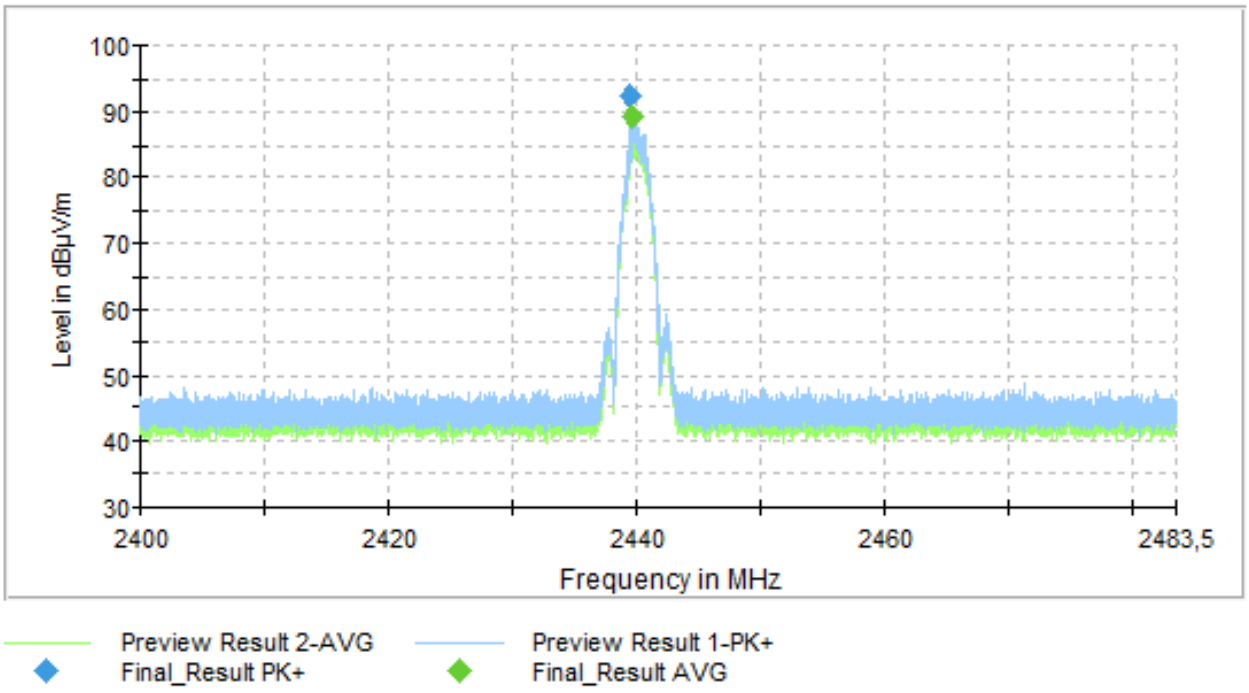
	Low Channel 2402 MHz	Middle Channel 2440 MHz	High Channel 2480 MHz
Average Field Strength (dBµV/m)	88.83	89.25	86.58
Peak Field Strength (dBµV/m)	92.15	92.44	91.1
Measurement Uncertainty (dB)	<±4.11		

Verdict: PASS

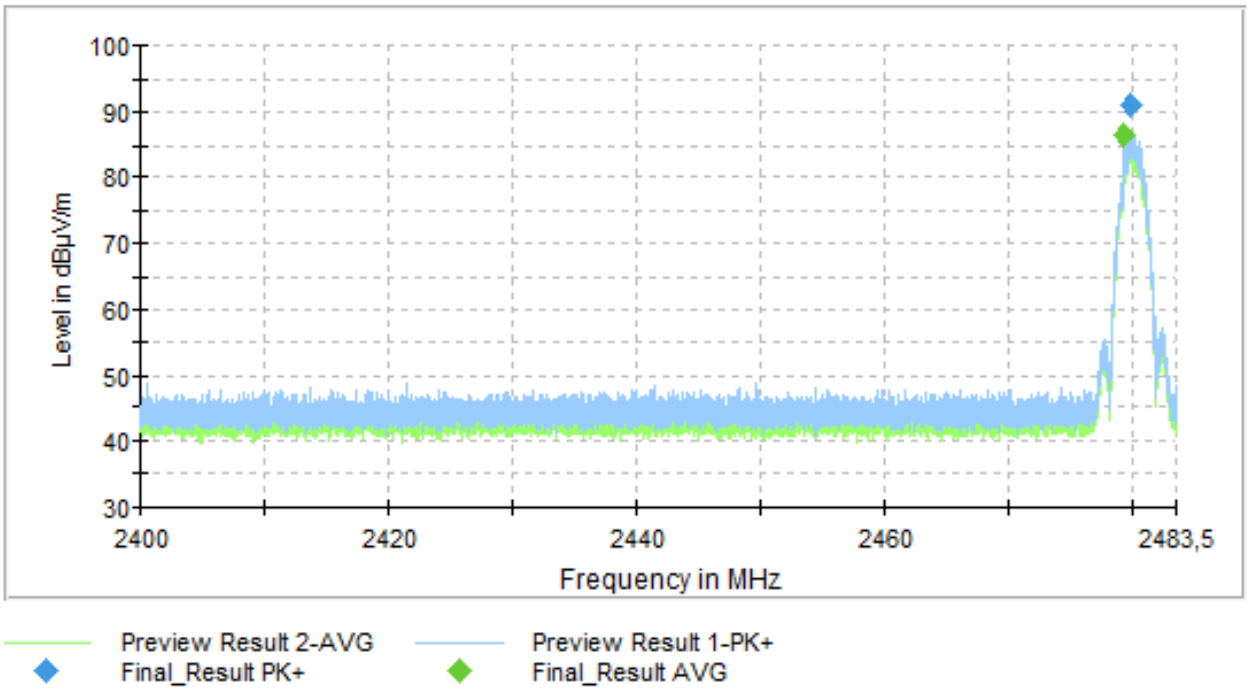
- Low Channel:



- Middle Channel:



- High Channel:



15.249 (d) / RSS-210 B.10 (b) Emissions radiated outside of the specific frequency bands

SPECIFICATION:

The field strength of harmonics from intentional radiators shall comply with the following

Fundamental frequency (MHz)	Field strength of harmonics (µV/m)	Field strength of harmonics (dBµV/m)	Measurement distance (m)
902 - 928	500	54	3
2400 – 2483.5	500	54	3
5725 - 5875	500	54	3
24000-24250	2500	67.96	3

Emissions radiated outside of the specific frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of fundamental or to the general radiated emission limits specified in section 15.209:

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)	-	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

Whichever is the lesser attenuation.

RESULTS:

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

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

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

RADIATED:

Frequency range 30 MHz - 1 GHz:

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

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

Measurement Uncertainty (dB) <±5.08

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 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 detected at less than 20 dB below the limit:

Spurious frequency (GHz)	Emission Level (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
4.80550	44.88	V	Peak	<± 5.13
7.20400	50.08	V	Peak	<± 5.13
9.60600	49.34	V	Peak	<± 5.13
14.41600	52.75	H	Peak	<± 5.13

- **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)
4.87850	41.73	V	Peak	<± 5.13
7.32200	52.79	V	Peak	<± 5.13
12.91550	47.06	V	Peak	<± 5.13

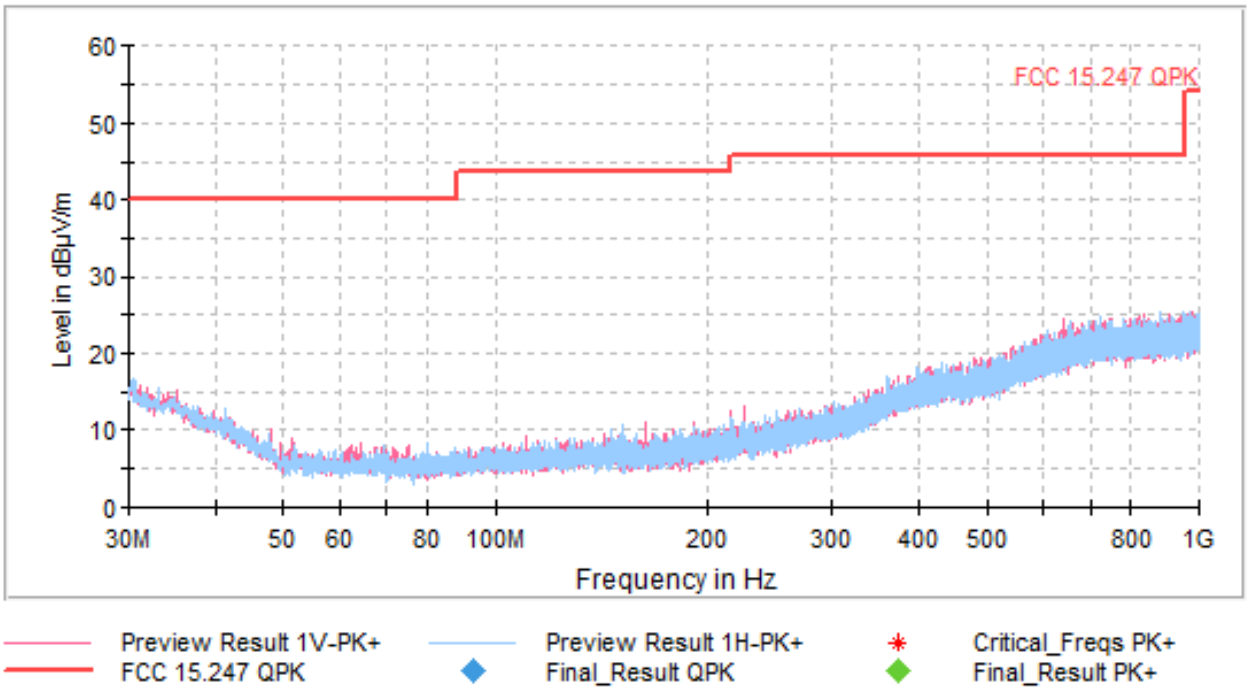
- **High Channel.** Spurious frequencies detected at less than 20 dB below the limit:

Spurious frequency (GHz)	Emission Level (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
2.48353	62.18	V	Peak	<± 4.11
	51.34		Average	<± 4.11
4.96100	45.15	V	Peak	<± 5.13
7.43800	47.00	V	Peak	<± 5.13

Verdict: PASS

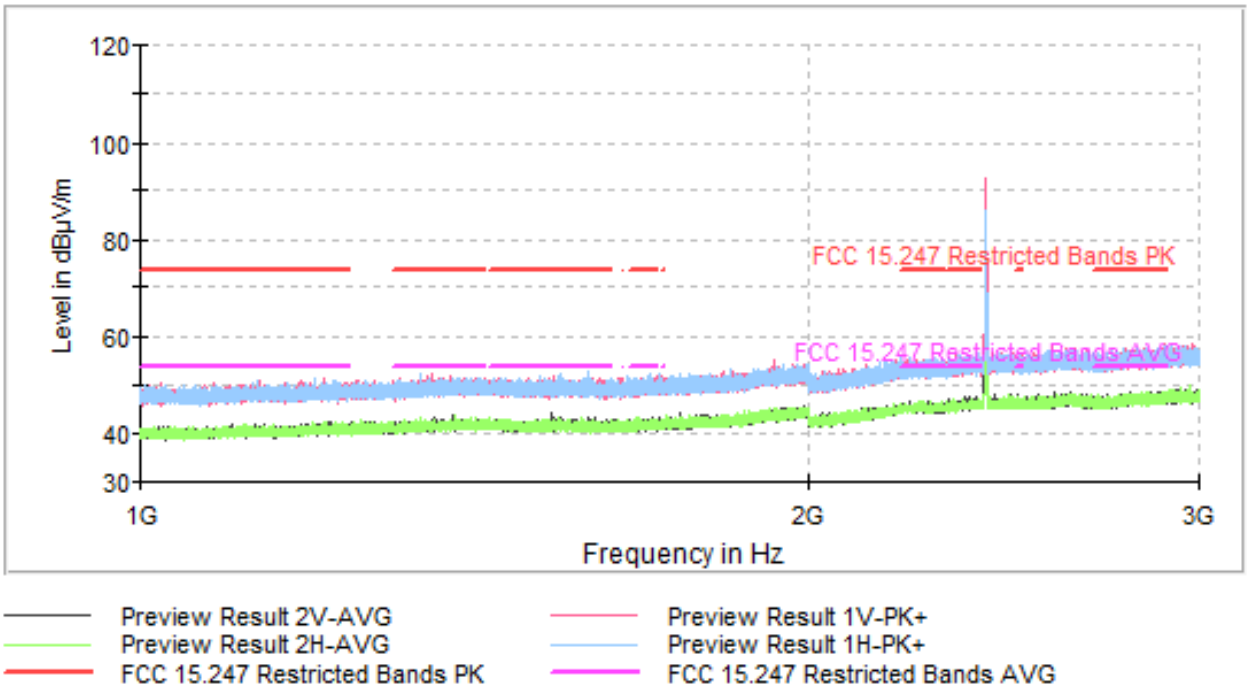
FREQUENCY RANGE 30 MHz - 1 GHz

This plot is valid for the Lowest, Middle and Highest Channels:



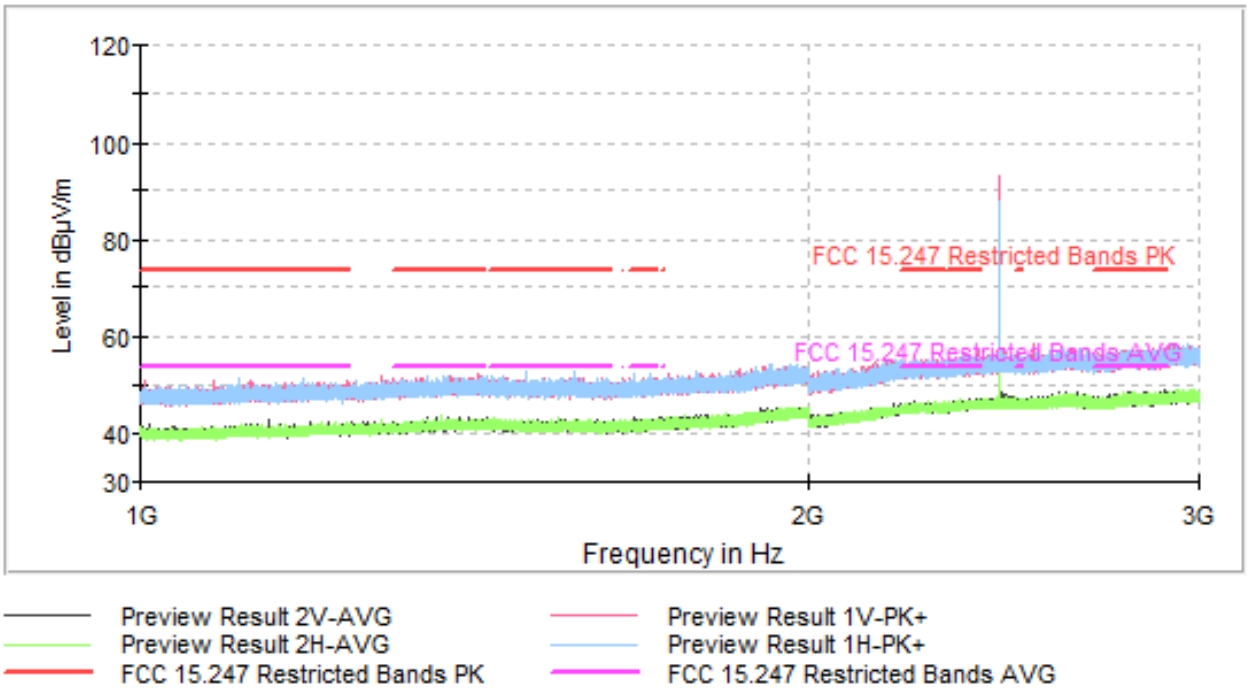
FREQUENCY RANGE 1 - 3 GHz

- Low Channel:



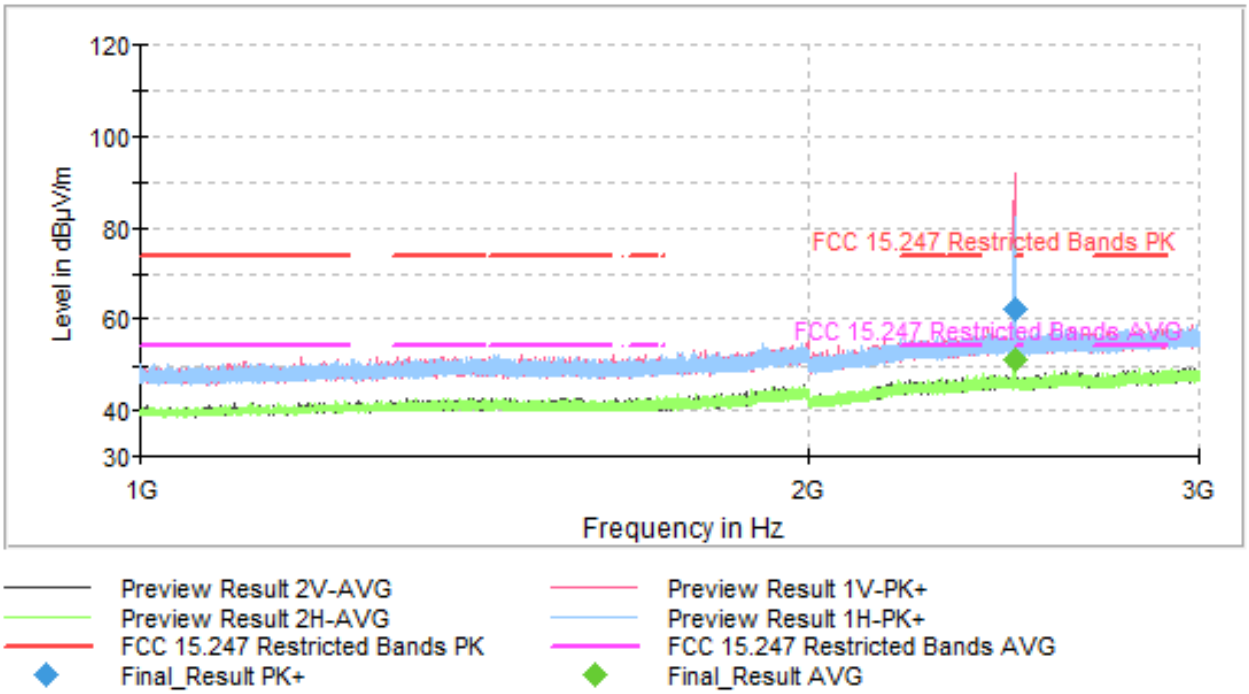
The peak shown in the plot above the limit is the carrier frequency.

- Middle Channel:



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

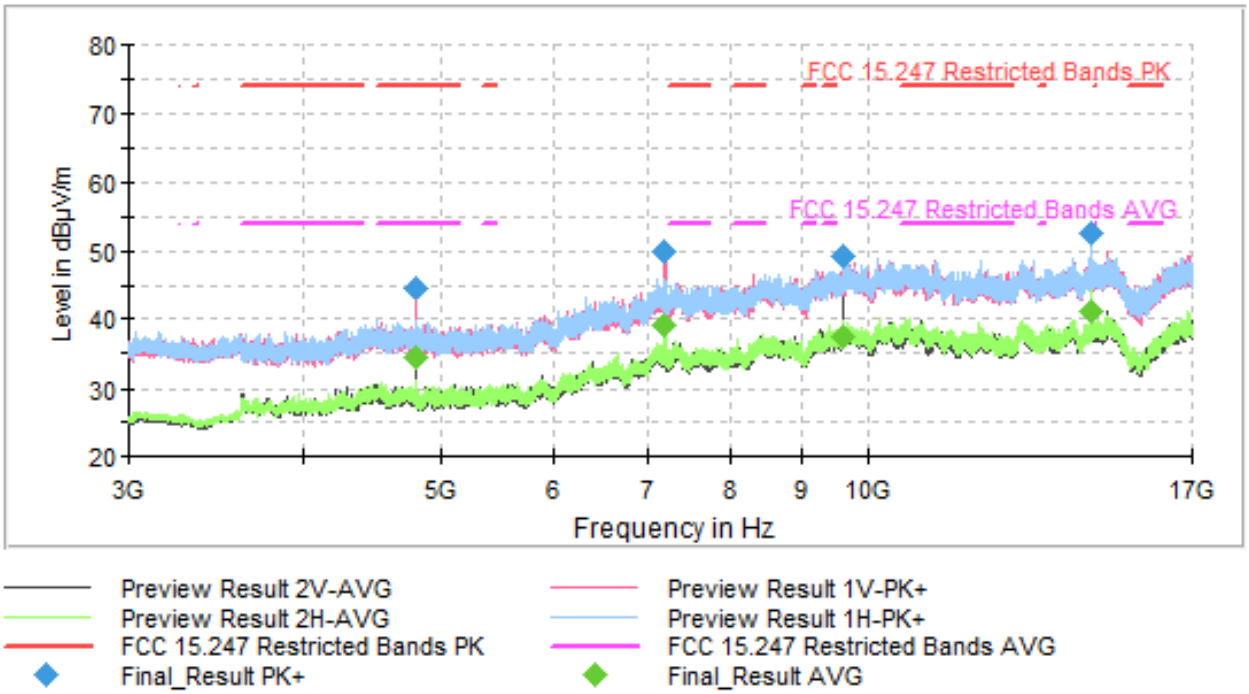
- High Channel:



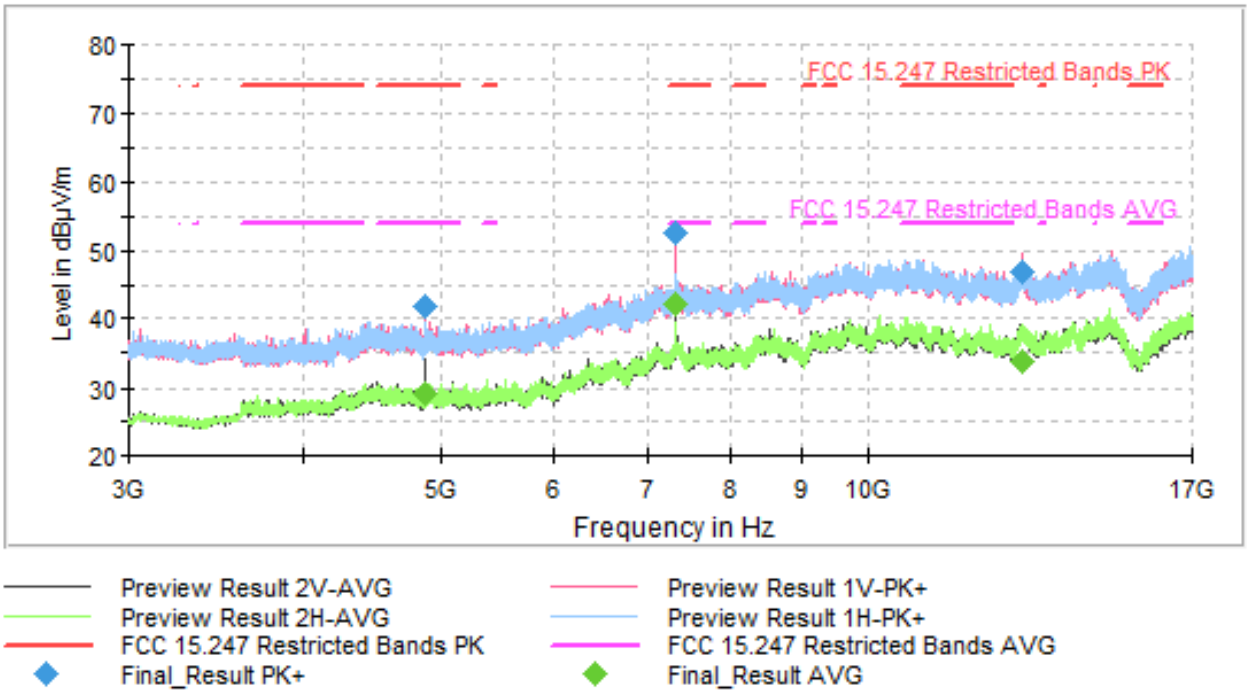
The peak shown in the plot above the limit is the carrier frequency.

FREQUENCY RANGE 3 - 17 GHz

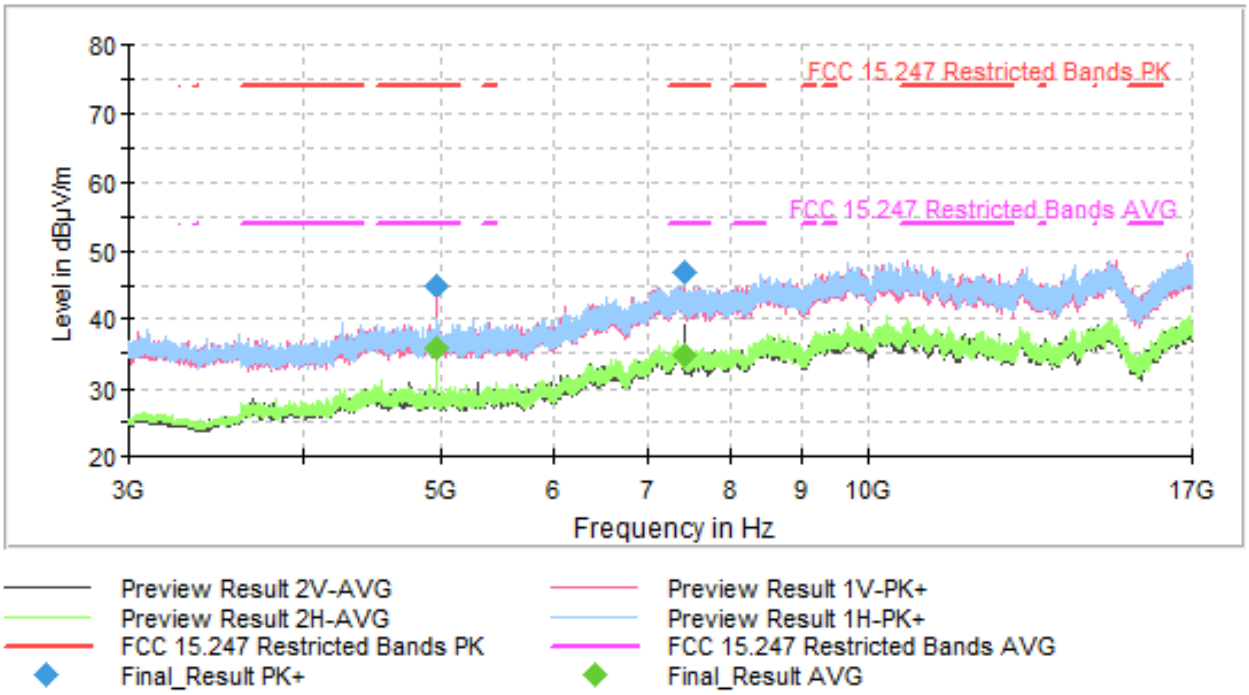
- Low Channel:



- Middle Channel:

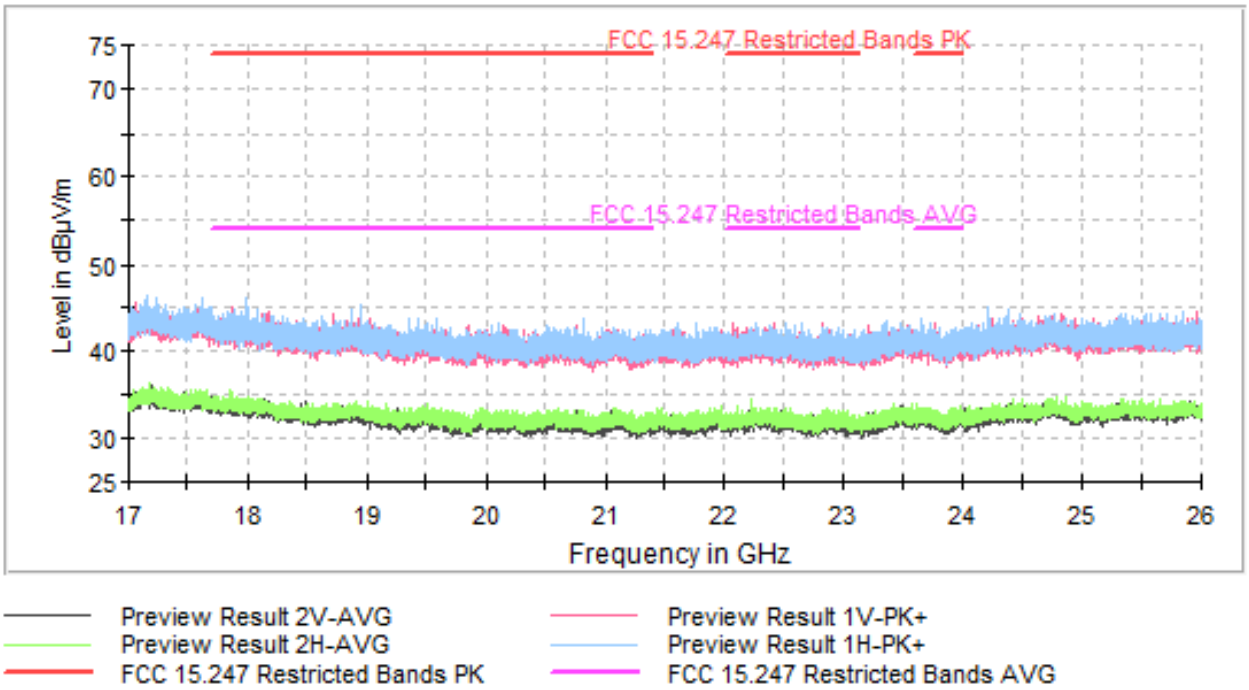


- High Channel:



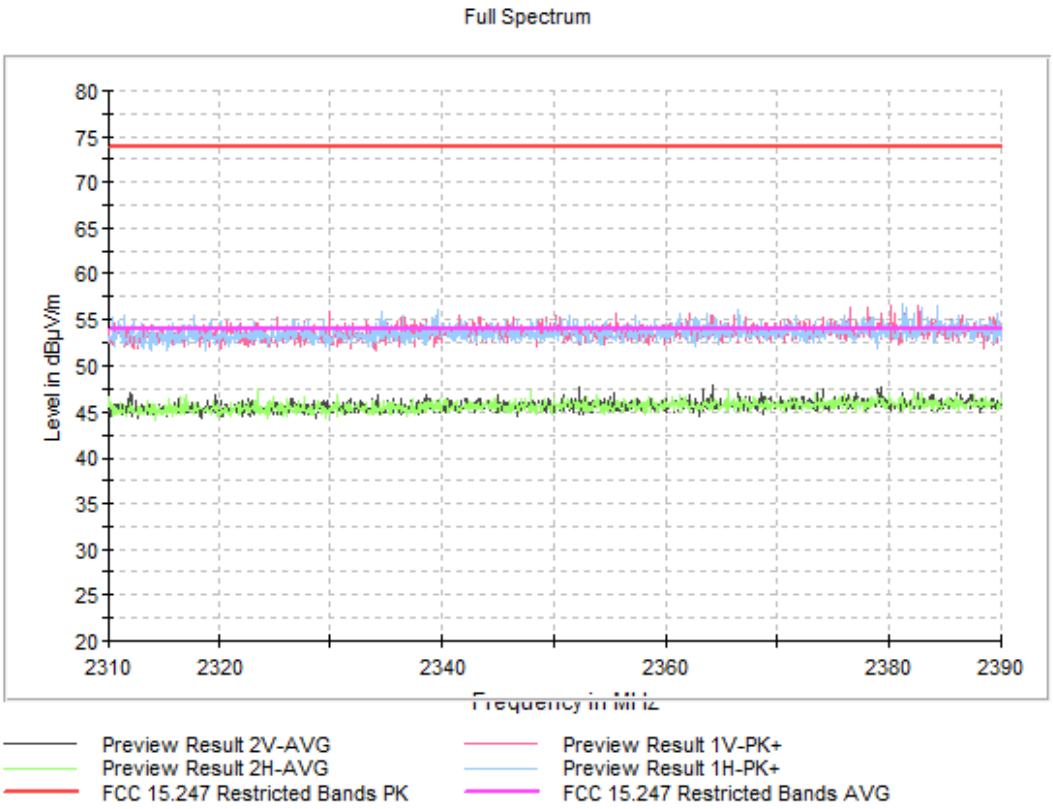
FREQUENCY RANGE 17 - 26 GHz

This plot is valid for the Lowest, Middle and Highest Channels:

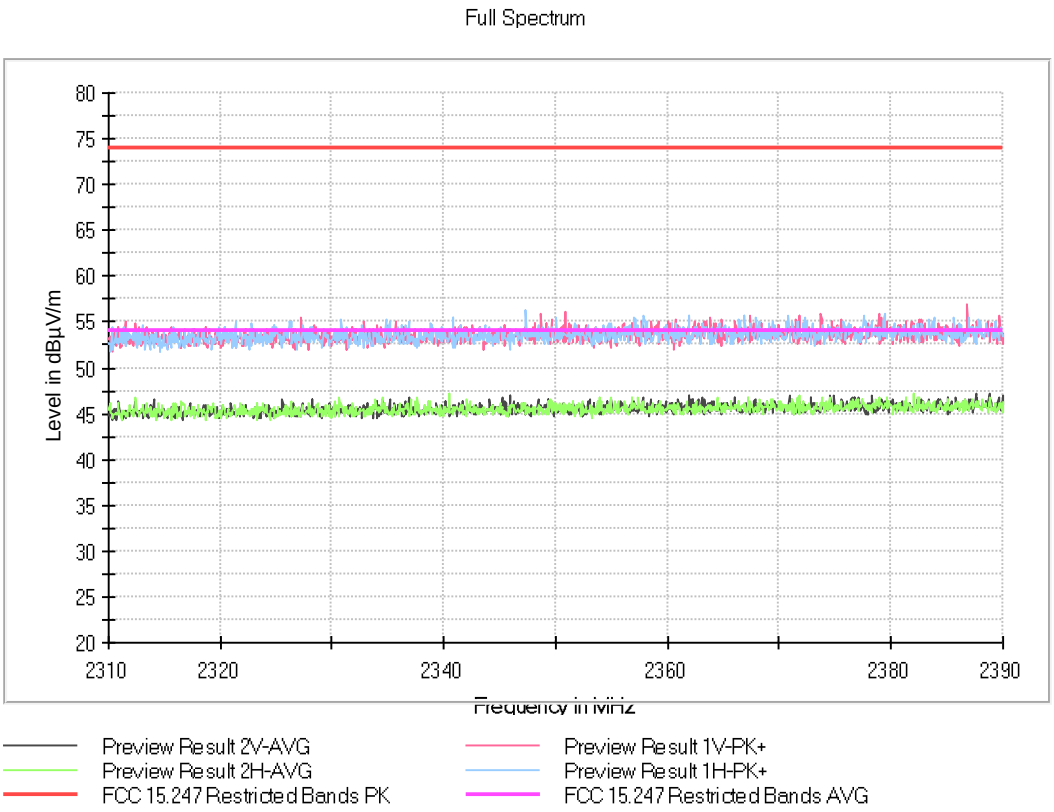


FREQUENCY RANGE 2.31 - 2.39 GHz

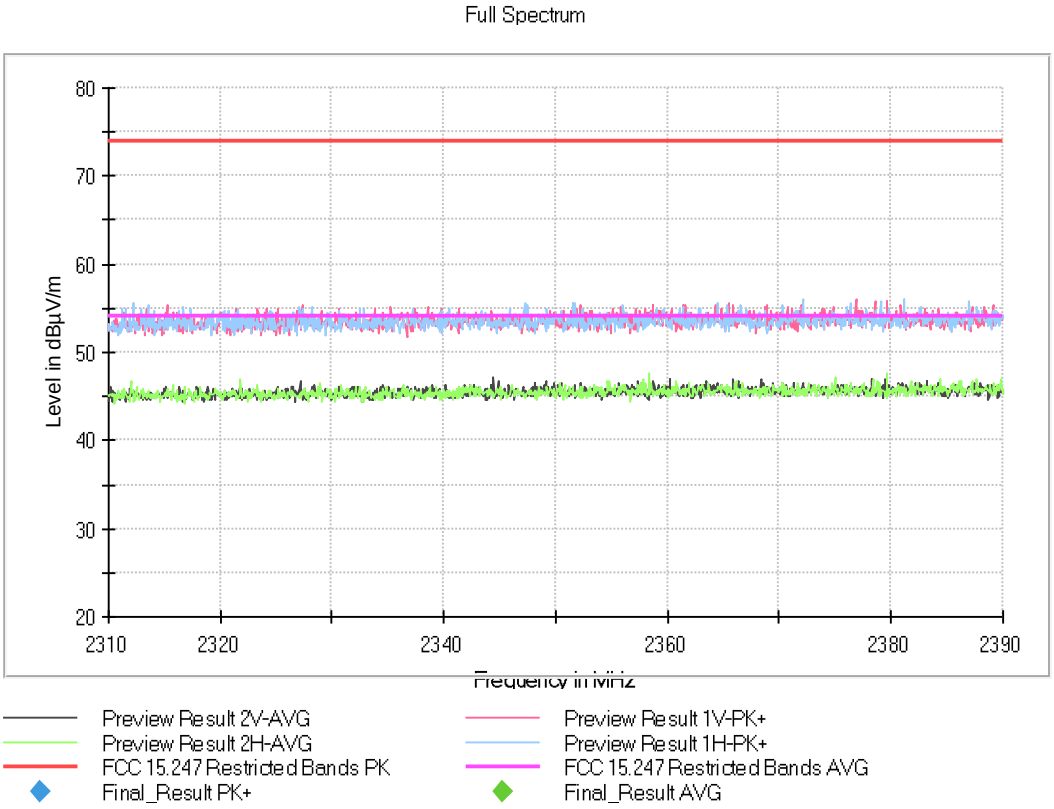
- Low Channel:



- Middle Channel:



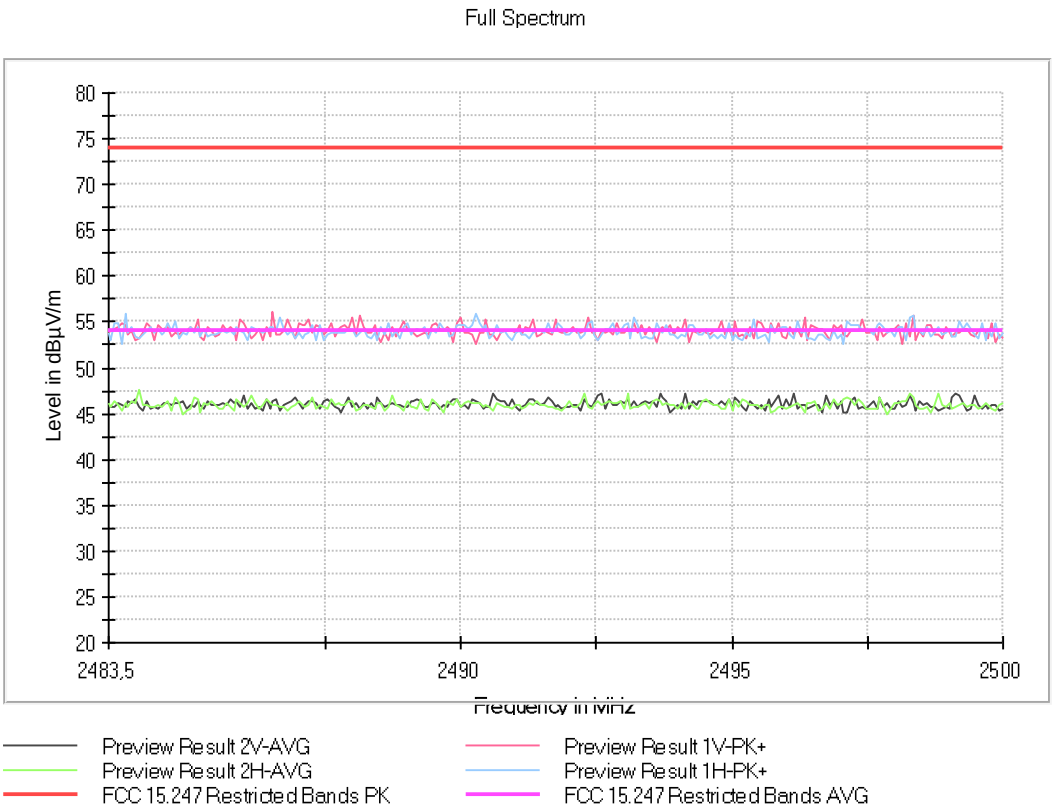
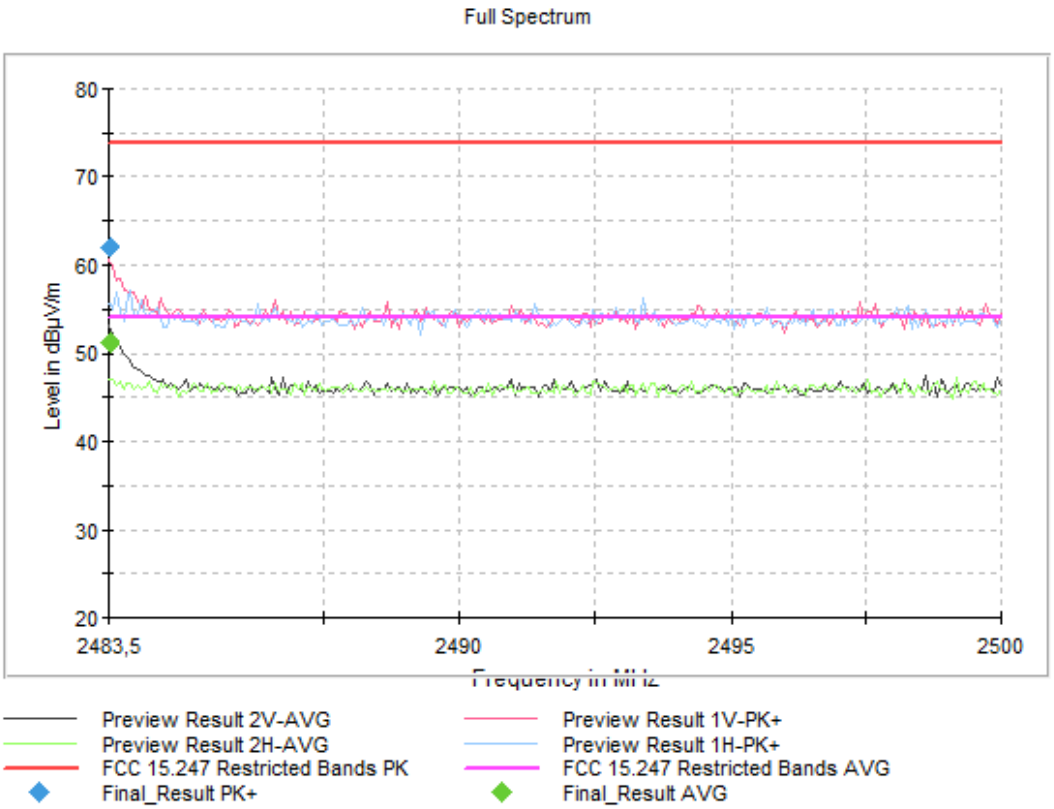
- High Channel:



FREQUENCY RANGE 2.4835 - 2.5 GHz

- Low Channel:

- Middle Channel:



- High Channel: