

ISED CABid: ES1909

Test report No:
NIE: 63999RRF.002A1

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	e-bike user interface controller
(*) Trademark	Bosch
(*) Model and /or type reference	BRC3600
Other identification of the product	HW version: 5.0.2 SW version: 0.27.0-pi21-03-4-31-g8fb671f6 FCC ID: 2AWRC-BRC3600 IC: 26294-BRC3600
(*) Features	Bluetooth Low Energy
Manufacturer	Robert Bosch GmbH – eBike Systems Gerhard-Kindler-Strasse 3 72770 Reutlingen, Germany
Test method requested, standard	USA FCC Part 15.247 (10-1-19 Edition): Operation within the bands 902 - 928 MHz, 2400 -2483.5 MHz, and 5725 - 5850 MHz. USA FCC Part 15.209 (10-1-19 Edition): Radiated emission limits; general requirements. CANADA RSS-247 Issue 2 (February 2017). CANADA RSS-Gen Issue 5 Amendment 1 (March 2019). 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. D01 Meas Guidance v05 dated August 24, 2018. ANSI C63.10-2013: American National Standard for Testing Unlicensed Wireless Devices.
Summary	IN COMPLIANCE
Approved by (name / position & signature)	Jose Carlos Luque RF Lab. Supervisor
Date of issue	2021-07-02
Report template No	FDT08_23 (*) "Data provided by the client"

Index

Competences and guarantees3

General conditions.....3

Uncertainty.....3

Data provided by the client3

Usage of samples4

Test sample description.....5

Identification of the client5

Testing period and place6

Document history.....6

Environmental conditions6

Remarks and comments.....7

Testing verdicts.....8

Summary8

Appendix A: Test results. Bluetooth Low Energy9

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 S.A.U. is an FCC-recognized accredited testing laboratory with the appropriate scope of accreditation that covers the performed tests in this report.

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

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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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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 BCR3600 is an e-bike user interface controller with BLE.

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

Usage of samples

Samples undergoing test have been selected by: The client.

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

Control N°	Description	Model	Serial N°	Date of reception
63999B/013	e-bike user interface controller	BRC3600	07817-0096	2021/03/05

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

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

Control N°	Description	Model	Serial N°	Date of reception
63999B/012	e-bike user interface controller	BRC3600	07817-0072	2021/03/05

Sample S/02 has undergone the test(s): All Conducted tests indicated in Appendix A.

Test sample description

Ports..... :	Port name and description	Cable					
		Specified max length [m]	Attached during test	Shielded	Coupled to patient ⁽³⁾		
	USB service port (USB-C interface for service)	< 3m	☐	☐	☐		
	System cable connector (Supply+CAN FD) connected to ebike	< 3m	☒	☐	☐		
Supplementary information to the ports..... :	--						
Rated power supply	Voltage and Frequency		Reference poles				
			L1	L2	L3	N	PE
	☐	AC:	☐	☐	☐	☐	☐
	☒	DC: USB port, nom. 5VDC					
	☒	DC: System cable, nom. 13,5VDC					
Rated Power	System cable: max. 4,8W (16V/0,3A) / USB port: max. 3W (5V/0,6A)						
Clock frequencies.....	110MHz, 55MHz, 48MHz, 2MHz, 1.1MHz						
Other parameters	--						
Software version	0.27.0-pi21-03-4-31-g8fb671f6						
Hardware version	5.0.2						
Dimensions in cm (W x H x D)	72,8 x 53,2 x 34,3 mm						
Mounting position.....	☒ Other: Bicycle handlebar						
Modules/parts.....	Module/parts of test item		Type		Manufacturer		
	--						
Accessories (not part of the test item)	Description		Type		Manufacturer		
	--						
Documents as provided by the applicant.....	Description		File name		Issue date		
	--						

⁽³⁾ Only for Medical Equipment

Identification of the client

Bittium Wireless OY
Ritaharjuntie 1
90590 Oulu, Finland

Testing period and place

Test Location	DEKRA Testing and Certification S.A.U.
Date (start)	2021-03-15
Date (finish)	2021-03-26

Document history

Report number	Date	Description
63999RRF.002	2021-05-21	First release
63999RRF.002A1	2021-07-02	Second release: - Added the identifier CABid to the report. - This modification test report cancels and replaces the test report 63999RRF.002.

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 %

In the chamber for conducted measurements, 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:

Conducted Measurements:

		Last Calibration	Due Calibration
1.	Shielded Room	N.A.	N.A.
2.	Spectrum analyzer 9kHz – 6GHz ROHDE AND SCHWARZ FSL6	2017/10	2020/04
3.	DC power supply 30V/3A GW INSTEK GPS-3030D	N/A	N/A
4.	Digital multimeter FLUKE 175	2020/11	2021/11

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 ETS LINDGREN HL562E_UPG	2019/10	2022/10
4.	RF pre-amplifier, 30dB, 500 MHz-18 GHz SCHWARZBECK BBV 9718 C	2021/02	2022/02
5.	EMI Test Receiver 2Hz – 44GHz ROHDE AND SCHWARZ ESW44	2019/10	2021/10
6.	Horn Antenna 1-18 GHz SCHWARZBECK MESS-ELEKTRONIK BBHA 9120 D	2019/11	2022/11
7.	Horn Antenna 18-40 GHz SCHWARZBECK MESS-ELEKTRONIK BBHA 9170	2021/02	2024/02
8.	RF pre-amplifier, G>30dB, 18-40 GHz BONN ELEKTRONIK BLMA 1840-3G	2019/11	2021/11
9.	DC power supply 30V/3A GW INSTEK GPS-3030D	N/A	N/A
10.	Digital multimeter FLUKE 175	2020/11	2021/11

Testing verdicts

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

Summary

Bluetooth Low Energy

FCC PART 15 PARAGRAPH/ RSS-247			
Requirement – Test case		Verdict	Remark
Section 15.247 (a) (2) / RSS-247 5.2. (a)	6 dB Bandwidth	P	
Section 15.247 (b) / RSS-247 5.4. (d)	Maximum output power and antenna gain	P	
Section 15.247 (d) / RSS-247 5.5.	Band-edge emissions compliance (Transmitter)	P	
Section 15.247 (e) / RSS-247 5.2. (b)	Power spectral density	P	
Section 15.247 (d) / RSS-247 5.5.	Emission limitations radiated (Transmitter)	P	
<u>Supplementary information and remarks:</u>			
None.			

Appendix A: Test results. Bluetooth Low Energy

TEST CONDITIONS	11
Occupied Bandwidth	14
FCC Section 15.247 (a) (2) / RSS-247 5.2 (a) 6 dB Bandwidth.	16
FCC Section 15.247 (b) / RSS-247 5.4 (d) Maximum output power and antenna gain	18
FCC Section 15.247 (d) / RSS-247 5.5. Band-edge emissions compliance (Transmitter)	21
FCC Section 15.247 (e) / RSS-247 5.2. (b) Power spectral density	23
FCC Section 15.247 (d) / RSS-247 5.5. Emission limitations radiated (Transmitter).....	25

TEST CONDITIONS

POWER SUPPLY (V):

V nominal:	13.5 Vdc
Type of Power Supply:	Battery or System Cable 13.5Vdc
Type of Antenna:	Internal
Maximum Declared Antenna Gain:	+3.7 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

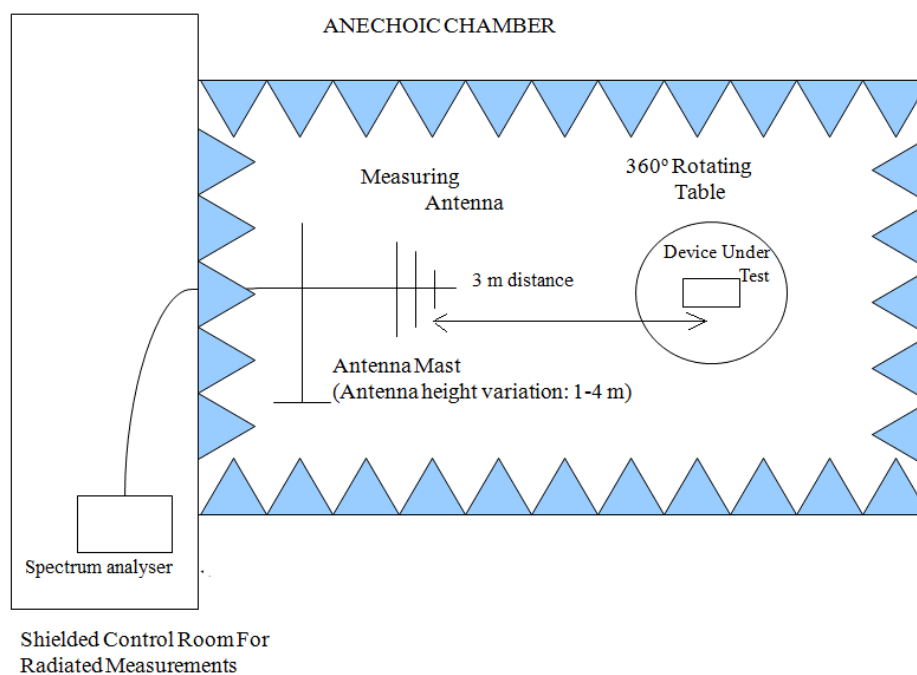
All radiated tests were performed in a semi-anechoic chamber. The measurement antenna (bilog antenna for the range between 30 MHz to 1000 MHz and 1 GHz-17 GHz double ridge horn antenna) is situated at a distance of 3 m and at a distance of 1 m for the frequency range 17 GHz-26 GHz (17 GHz-40 GHz horn 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.

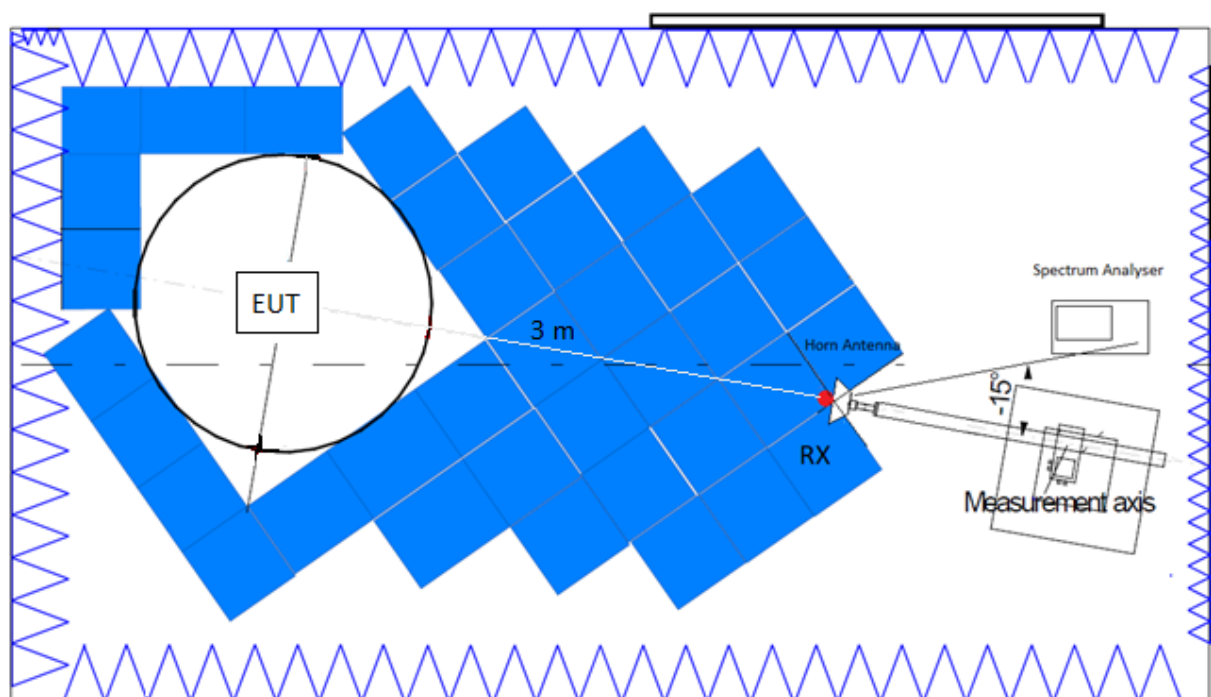
The equipment under test was set up on a non-conductive platform above the ground plane and the situation and orientation was varied to find the maximum radiated emission. It was also rotated 360° and the antenna height (Bilog antenna and Double ridge horn antenna) was varied from 1 to 4 meters to find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

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

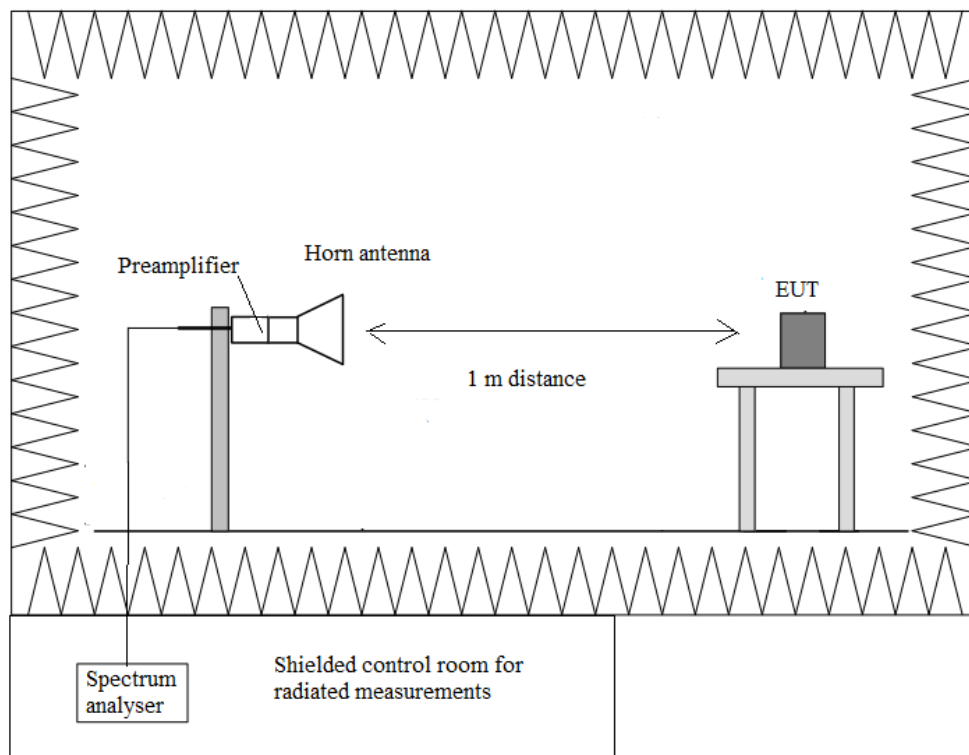
Radiated measurements setup from 30 MHz to 1 GHz:



Radiated measurements setup from 1GHz to 17 GHz:



Radiated measurements setup $f > 17$ GHz:



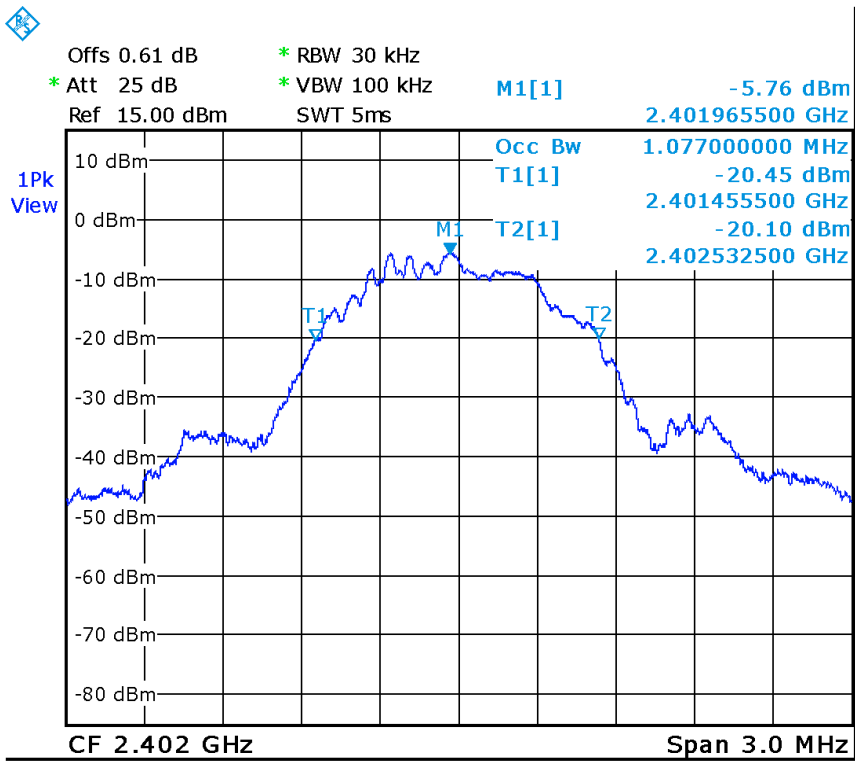
Occupied Bandwidth

RESULTS:

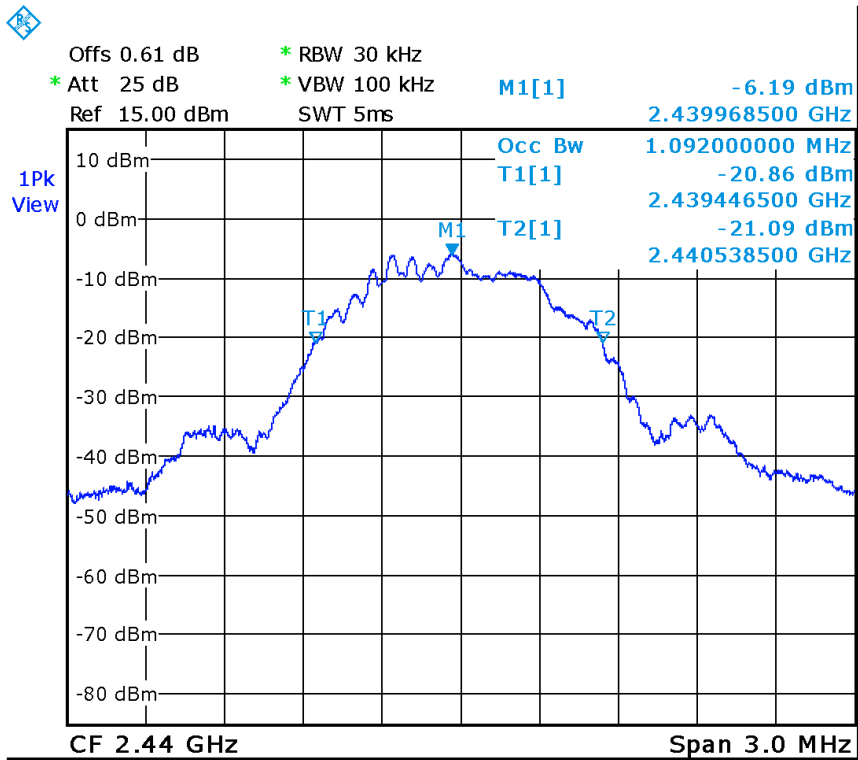
	Low Channel 2402 MHz	Middle Channel 2440 MHz	High Channel 2480 MHz
99% bandwidth (MHz)	1.077	1.092	1.089
Measurement uncertainty (%)	<± 6.35		

Verdict: PASS

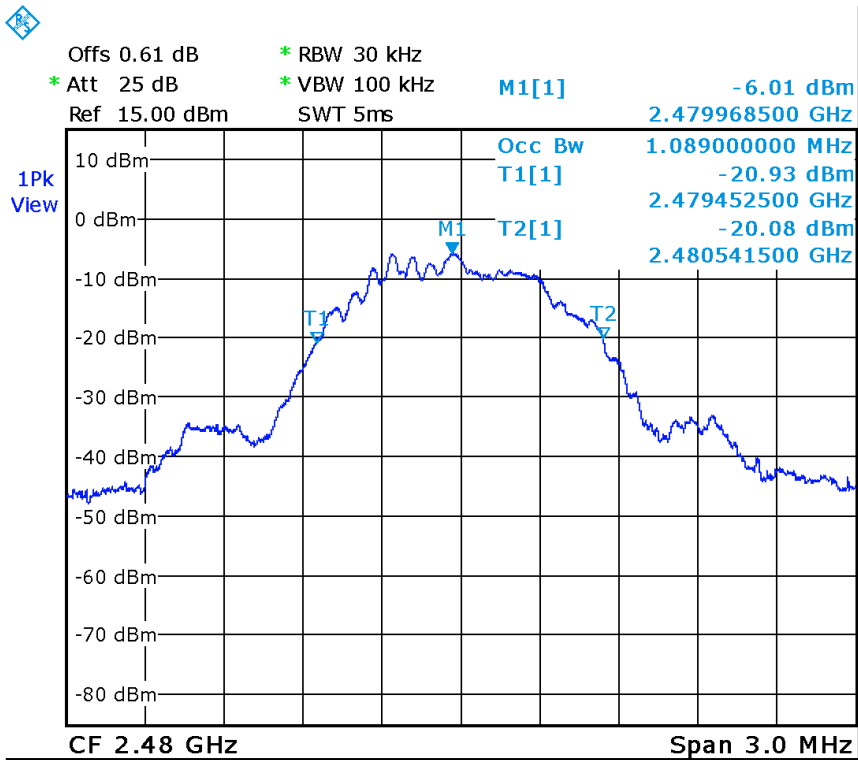
- Low Channel:



- Middle Channel:



- High Channel:



FCC Section 15.247 (a) (2) / RSS-247 5.2 (a) 6 dB Bandwidth.

SPECIFICATION:

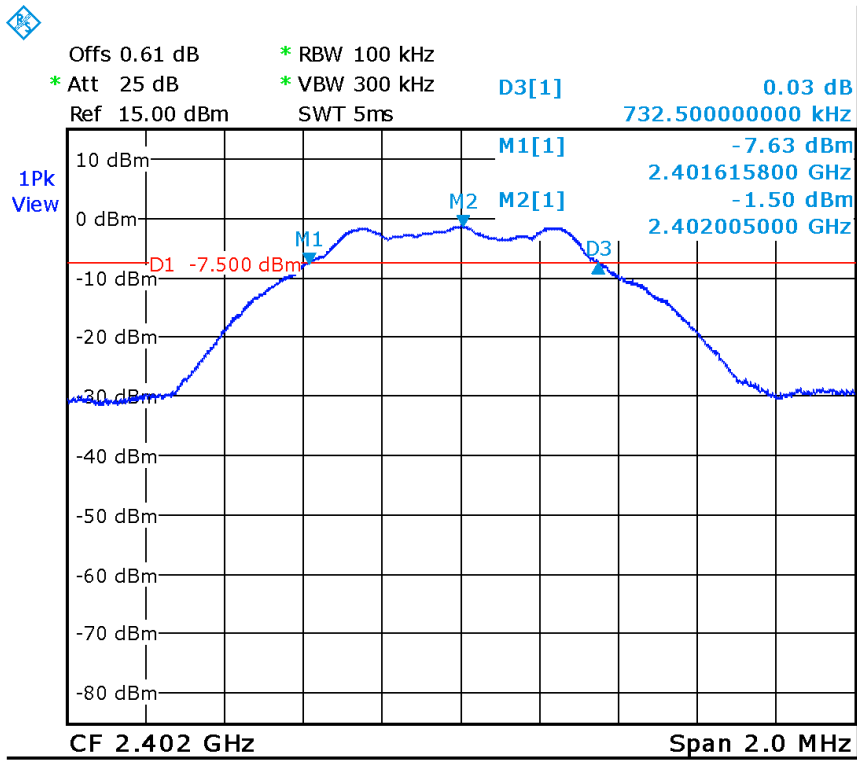
The minimum 6 dB bandwidth shall be at least 500 kHz.

RESULTS:

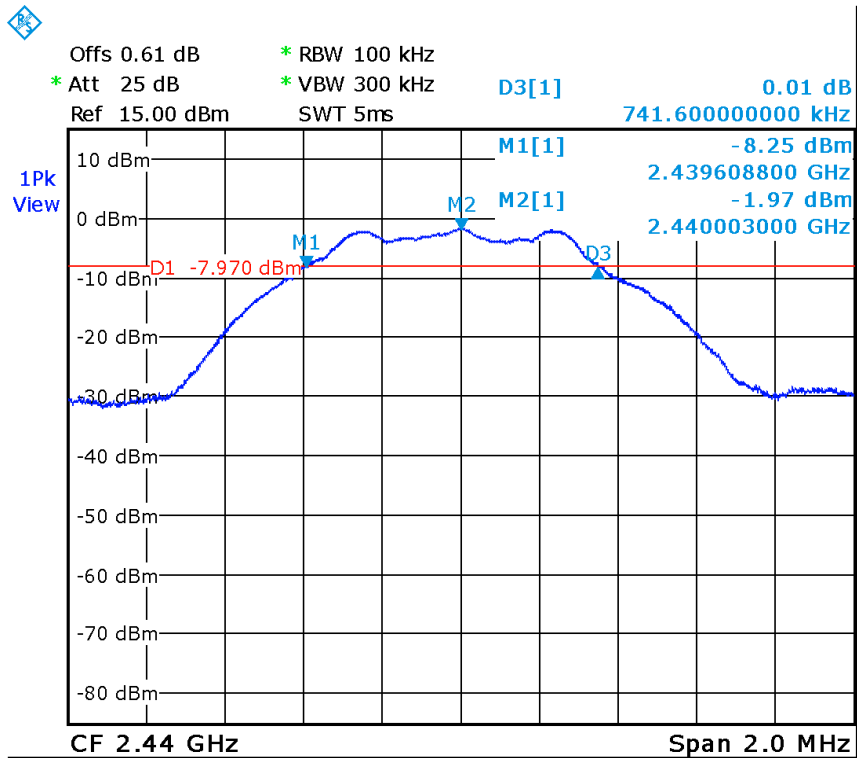
	Low Channel 2402 MHz	Middle Channel 2440 MHz	High Channel 2480 MHz
6 dB Spectrum bandwidth (kHz)	732.5	741.6	750.5
Measurement uncertainty (%)	<±13.86		

Verdict: PASS

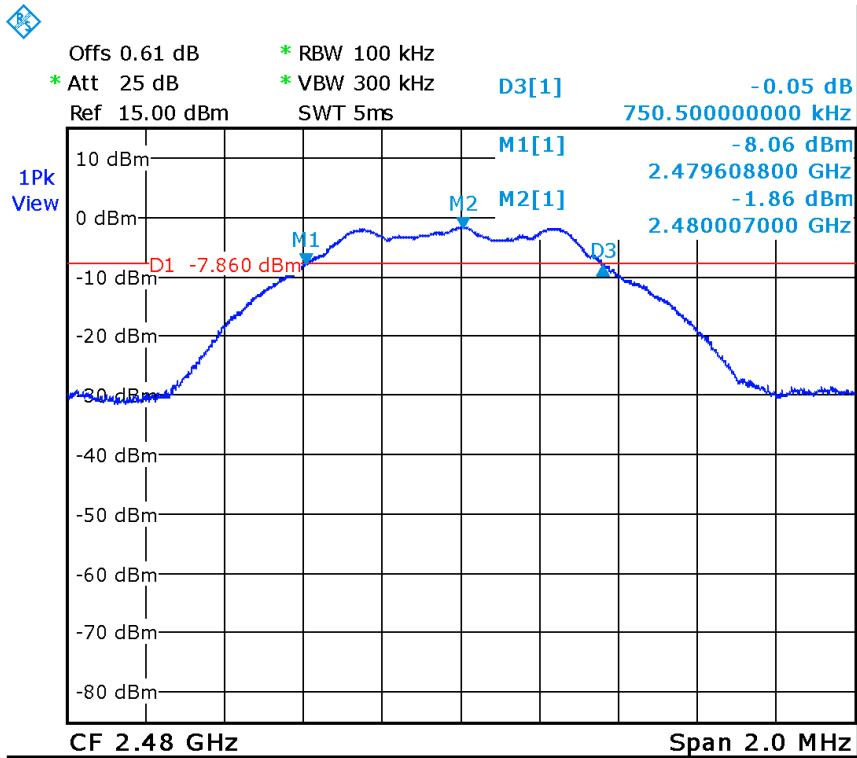
- Low Channel:



- Middle Channel:



- High Channel:



FCC Section 15.247 (b) / RSS-247 5.4 (d) Maximum output power and antenna gain

SPECIFICATION:

For systems using digital modulation in the 2400-2483.5 MHz band: 1 watt (30 dBm).

The e.i.r.p. shall not exceed 4 W (36 dBm) (Canada).

RESULTS:

The maximum peak conducted output power level in the fundamental emission was measured using the method according to point 11.9.1.1 "RBW $\geq$ DTS bandwidth" of ANSI C.63.10-2013.

The EIRP power (dBm) is calculated by adding the declared maximum antenna gain to the measured conducted power.

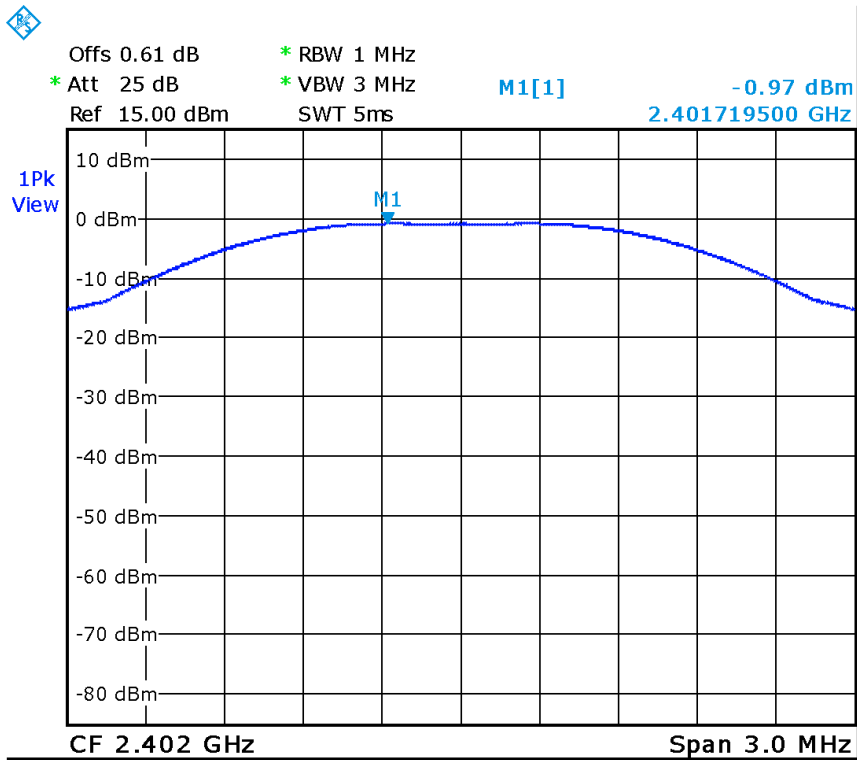
Maximum Declared Antenna Gain: +3.7 dBi

	Low Channel 2402 MHz	Middle Channel 2440 MHz	High Channel 2480 MHz
Maximum Conducted Power (dBm)	-0.97	-1.44	-1.32
Maximum EIRP Power (dBm)	2.73	2.26	2.38
Measurement uncertainty (dB)	< ± 1.951		

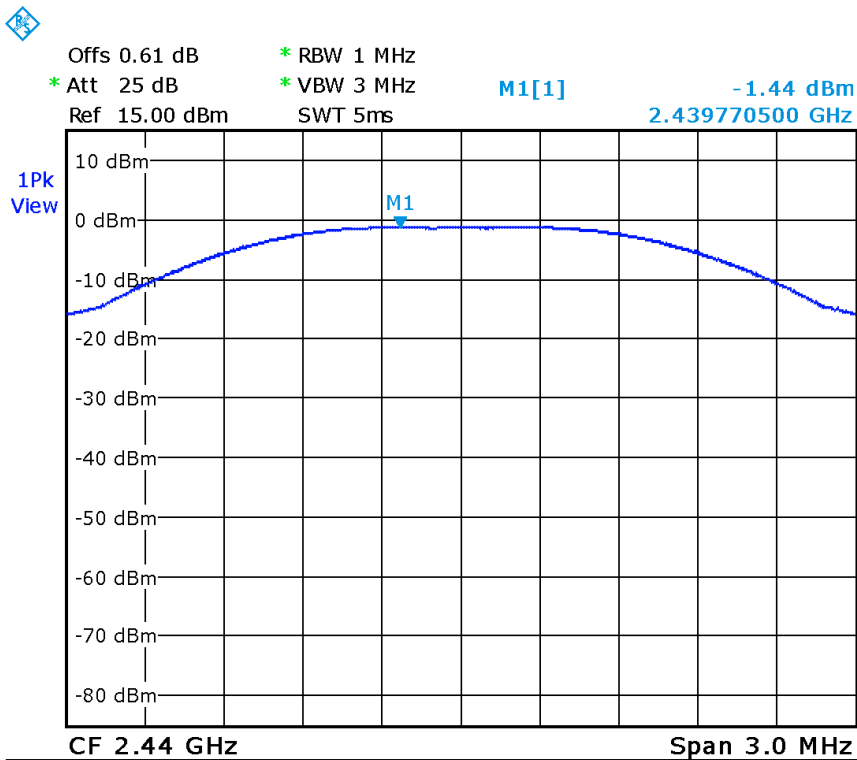
The maximum directional gain of the antenna is less than 6 dBi and therefore the maximum output power is not required to be reduced from the stated values.

Verdict: PASS

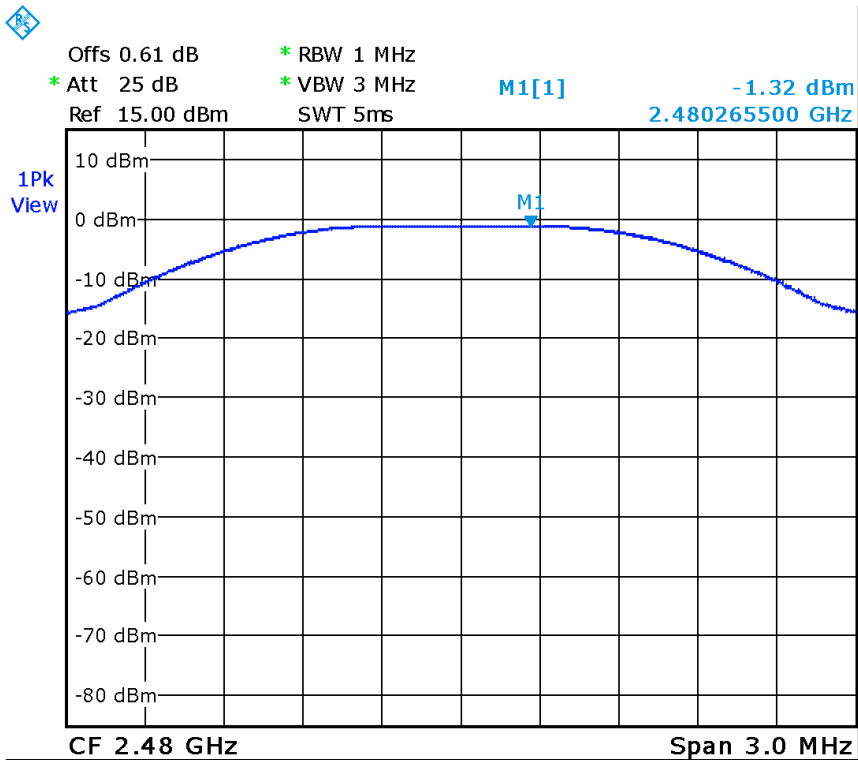
- Low Channel:



- Middle Channel:



- High Channel:



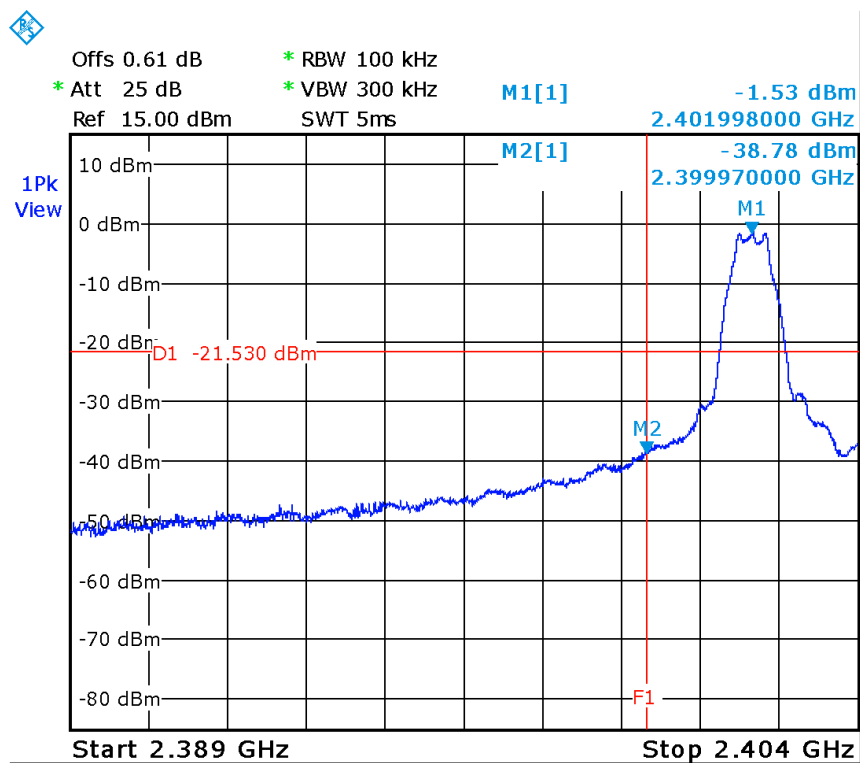
FCC Section 15.247 (d) / RSS-247 5.5. Band-edge emissions compliance (Transmitter)

SPECIFICATION:

In any 100 kHz bandwidths outside the frequency band in which the intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

RESULTS:

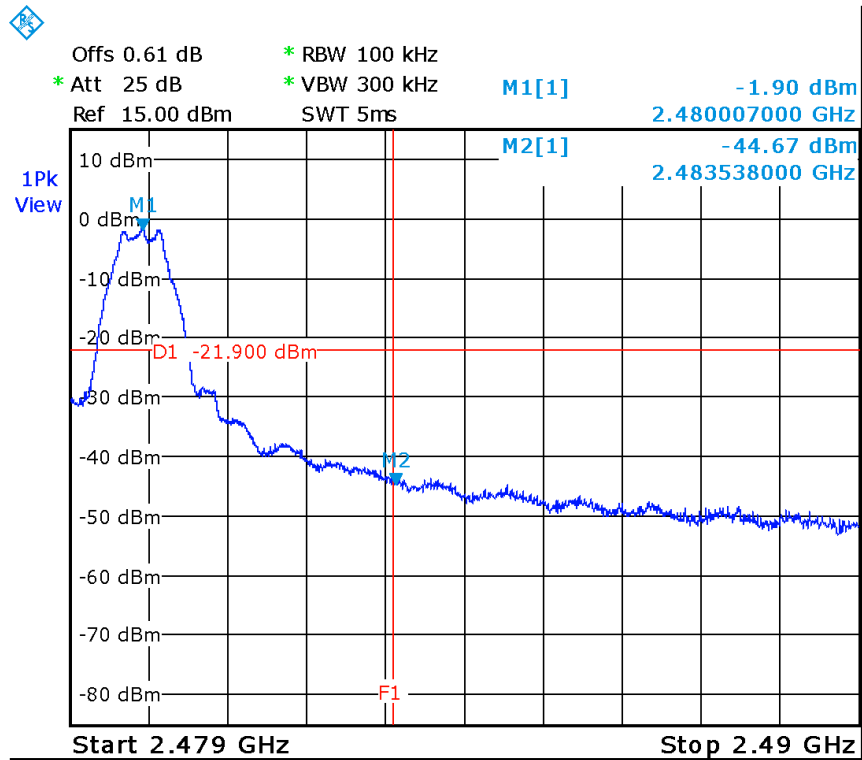
- Low Channel:



Measurement uncertainty (dB) $< \pm 2.574$

Verdict: PASS

- High Channel:



Measurement uncertainty (dB) <±2.574

Verdict: PASS

FCC Section 15.247 (e) / RSS-247 5.2. (b) Power spectral density

SPECIFICATION:

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

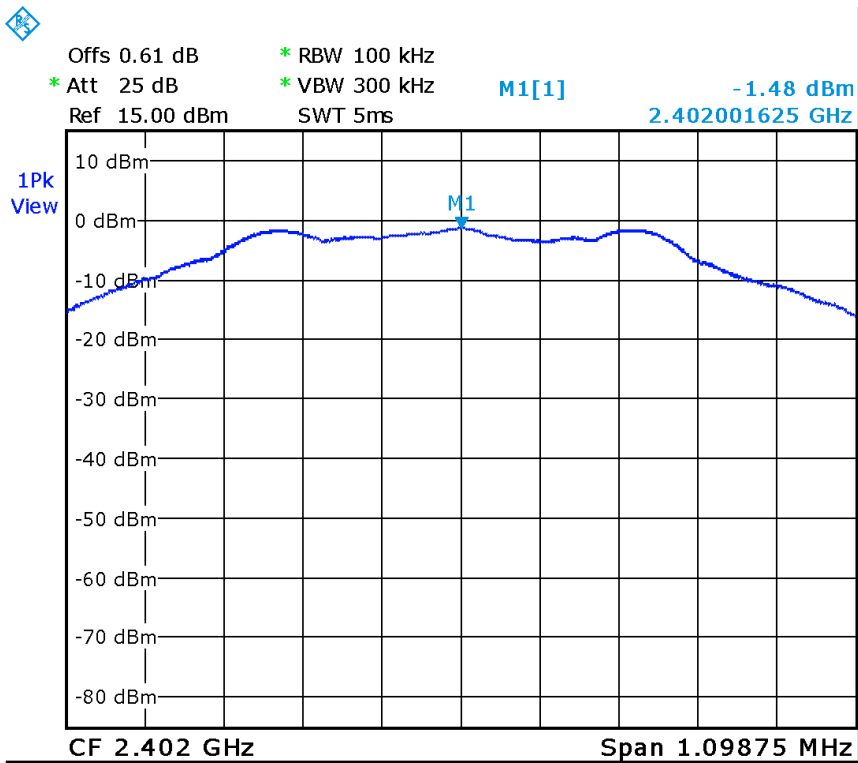
RESULTS:

The maximum power spectral density level in the fundamental emission was measured using the method according to point 11.10.2.” Method PKPSD (peak PSD)” of ANSI C.63.10-2013.

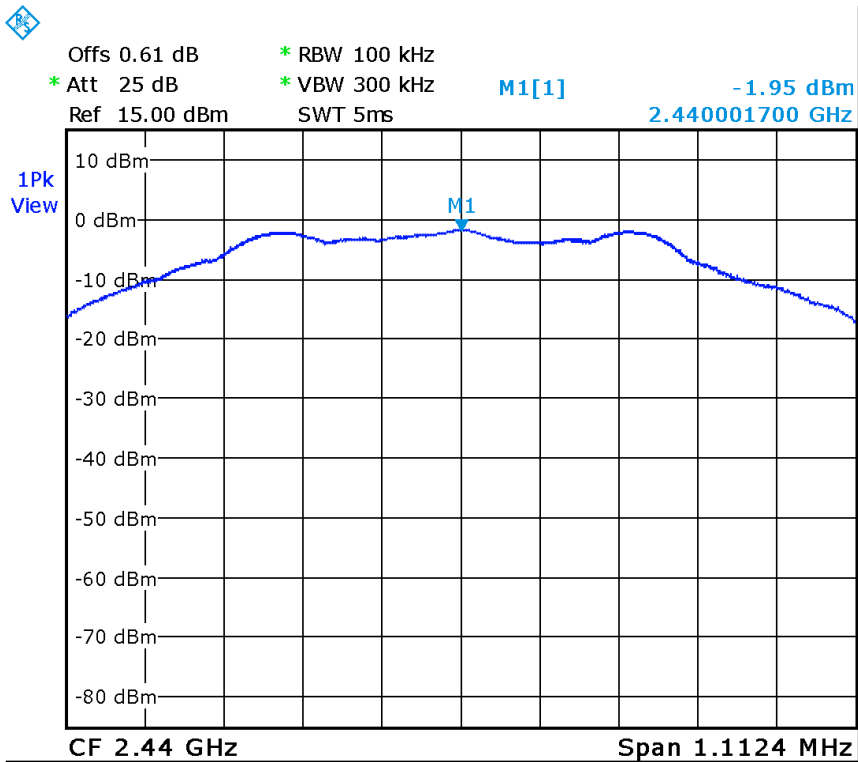
	Low Channel 2402 MHz	Middle Channel 2440 MHz	High Channel 2480 MHz
Power Spectral Density (dBm)	-1.48	-1.95	-1.83
Measurement uncertainty (dB)	<±2.008		

Verdict: PASS

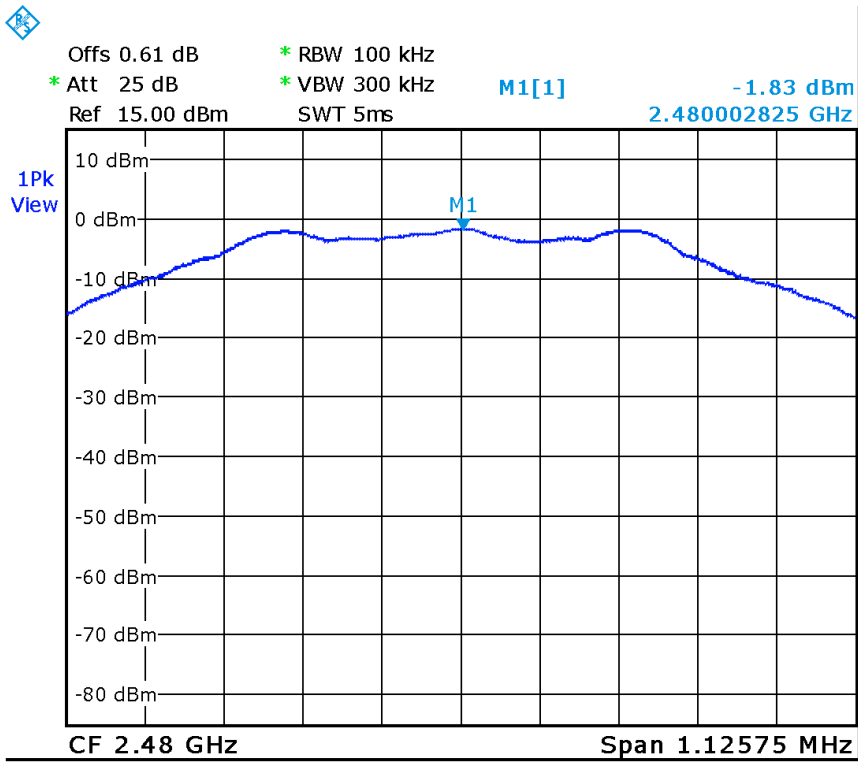
- Low Channel:



- Middle Channel:



- High Channel:



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:

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

Spurious Frequency (MHz)	Emission Level (dBμV/m)	Polarization	Detector	Measurement Uncertainty (dB)
47.9935	12.57	V	Quasi Peak	<± 5.10
59.9730	14.36	V	Quasi Peak	<± 5.10
66.0840	13.86	V	Quasi Peak	<± 5.10
70.0125	14.73	V	Quasi Peak	<± 5.10
78.0150	16.20	V	Quasi Peak	<± 5.10
81.9435	14.92	V	Quasi Peak	<± 5.10
88.9275	11.10	V	Quasi Peak	<± 5.10

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

Spurious Frequency (MHz)	Emission Level (dBμV/m)	Polarization	Detector	Measurement Uncertainty (dB)
47.9450	9.74	V	Quasi Peak	<± 5.10
62.0100	16.68	V	Quasi Peak	<± 5.10
68.0240	15.63	V	Quasi Peak	<± 5.10
78.5970	12.49	V	Quasi Peak	<± 5.10
81.0220	13.19	V	Quasi Peak	<± 5.10
82.9135	12.40	V	Quasi Peak	<± 5.10
87.0845	10.96	V	Quasi Peak	<± 5.10

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

Spurious Frequency (MHz)	Emission Level (dBμV/m)	Polarization	Detector	Measurement Uncertainty (dB)
59.9730	14.89	V	Quasi Peak	<± 5.10
65.8900	8.91	V	Quasi Peak	<± 5.10
67.9270	13.71	V	Quasi Peak	<± 5.10
77.9665	16.03	V	Quasi Peak	<± 5.10
80.9250	10.66	V	Quasi Peak	<± 5.10
86.0175	14.96	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 dB μ V/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 (dB μ V/m)	Polarization	Detector	Measurement Uncertainty (dB)
2.3893	56.84	H	Peak	< $\pm$ 3.98
	37.66		Average	
4.8040	47.81	V	Peak	< $\pm$ 4.60

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

Spurious Frequency (GHz)	Emission Level (dB μ V/m)	Polarization	Detector	Measurement Uncertainty (dB)
4.8800	47.37	V	Peak	< $\pm$ 4.60

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

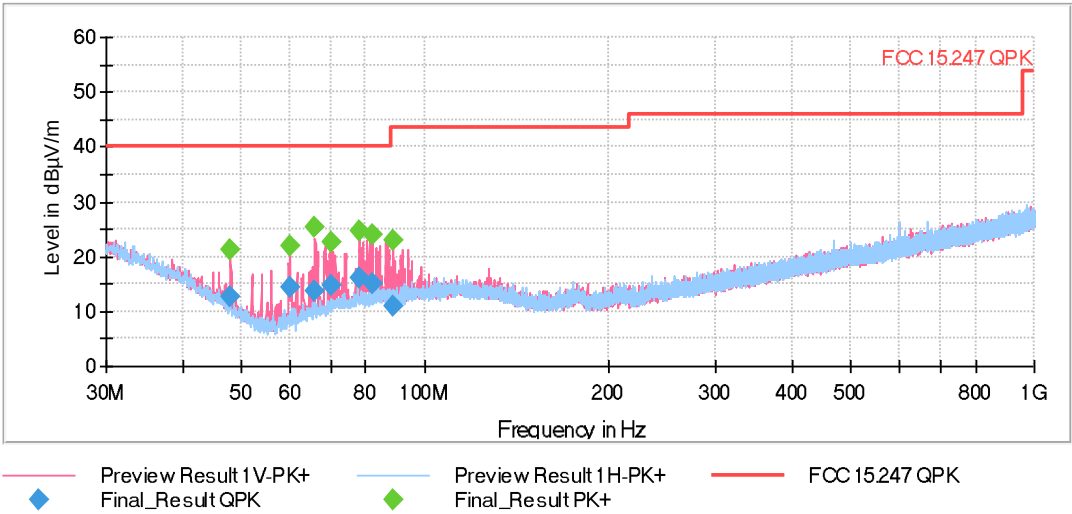
Spurious Frequency (GHz)	Emission Level (dB μ V/m)	Polarization	Detector	Measurement Uncertainty (dB)
2.4837	65.35	H	Peak	< $\pm$ 3.98
	38.49		Average	
4.4605	44.12	V	Peak	< $\pm$ 4.60

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

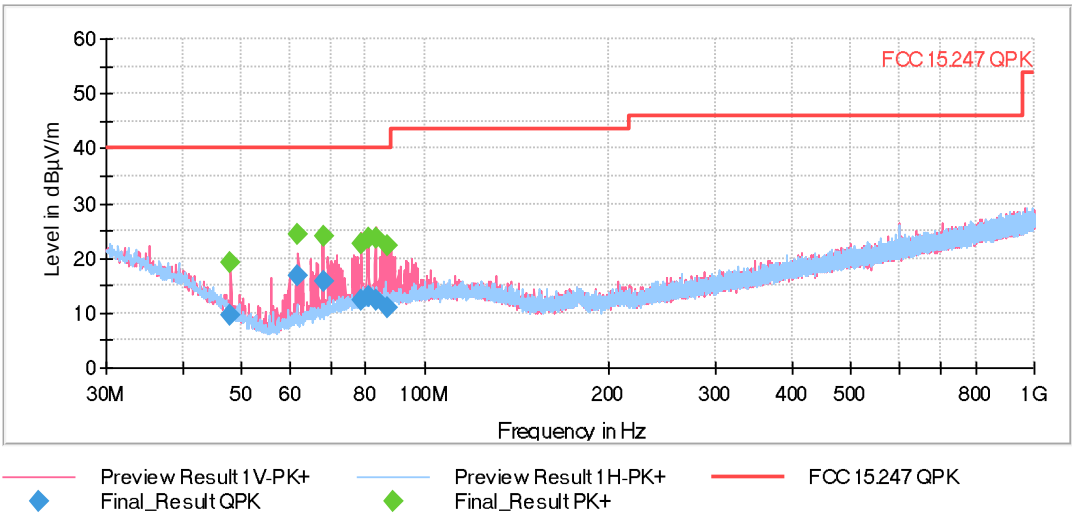
Verdict: PASS

FREQUENCY RANGE 30 MHz - 1 GHz:

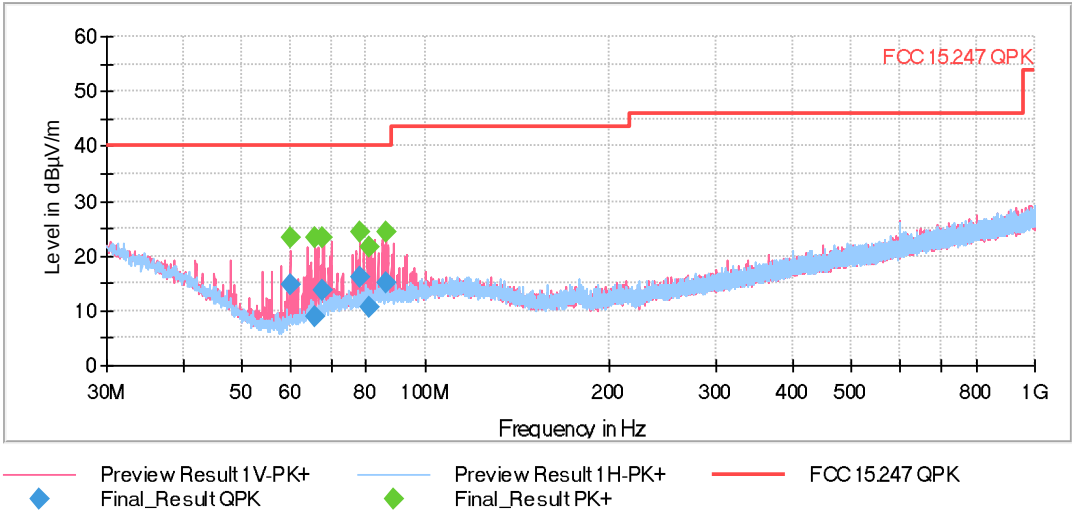
- Low Channel:



- Middle Channel:

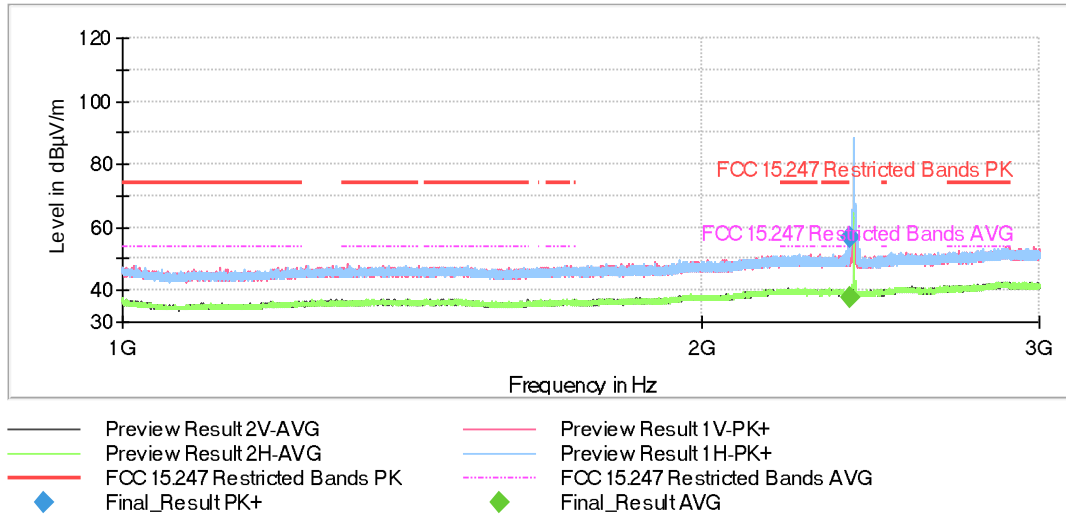


- High Channel:



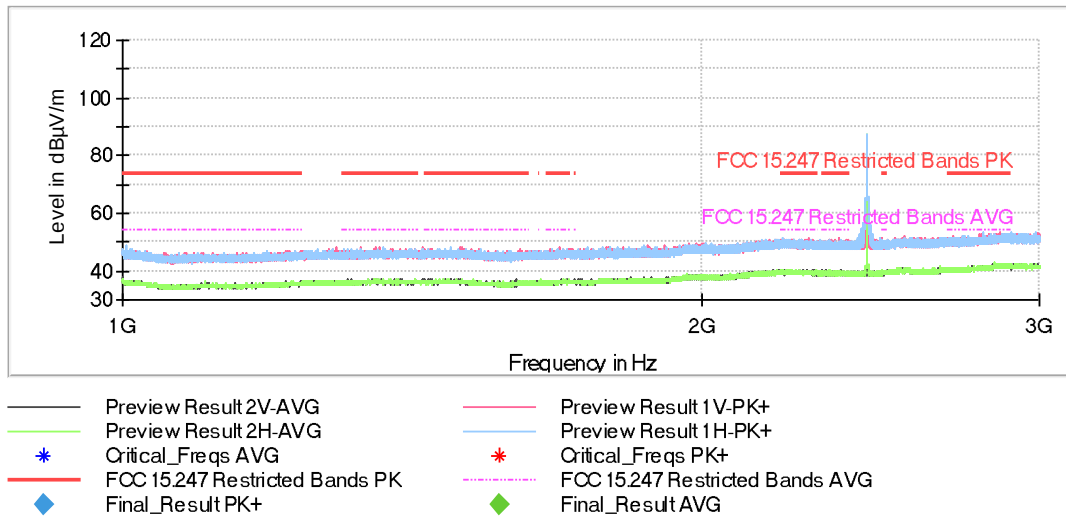
FREQUENCY RANGE 1 - 3 GHz:

- Low Channel:



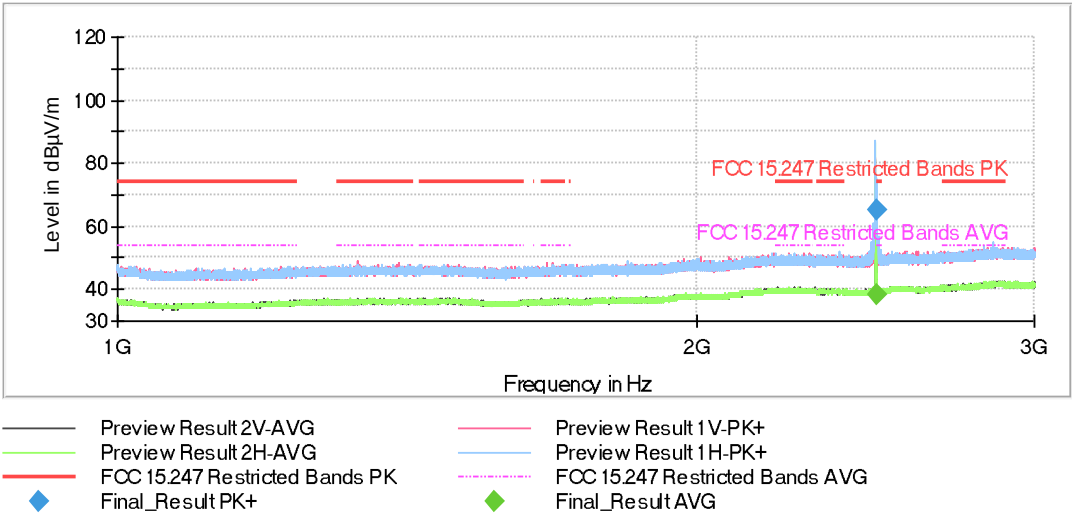
The peak above the limit is the carrier frequency.

- Middle Channel:



The peak above the limit is the carrier frequency.

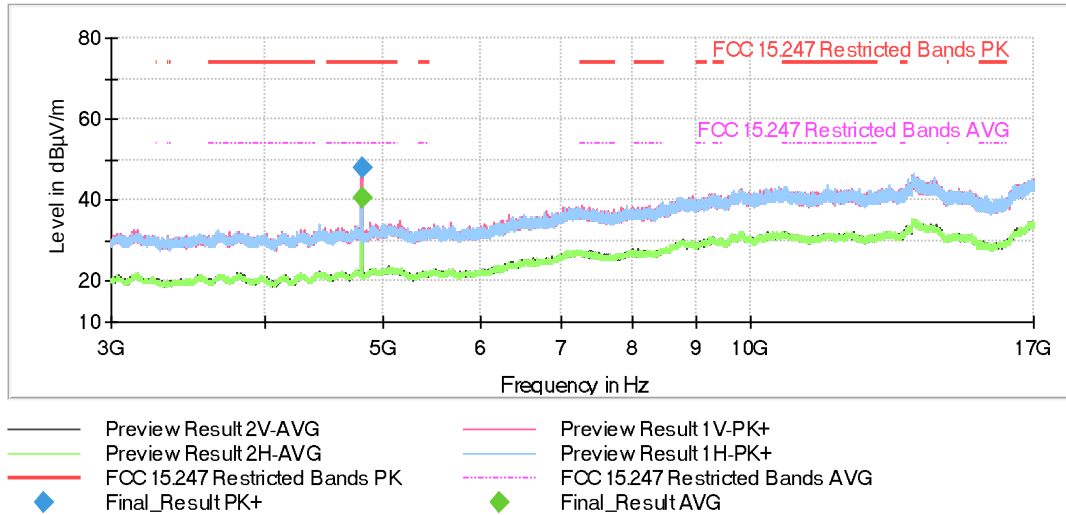
- High Channel:



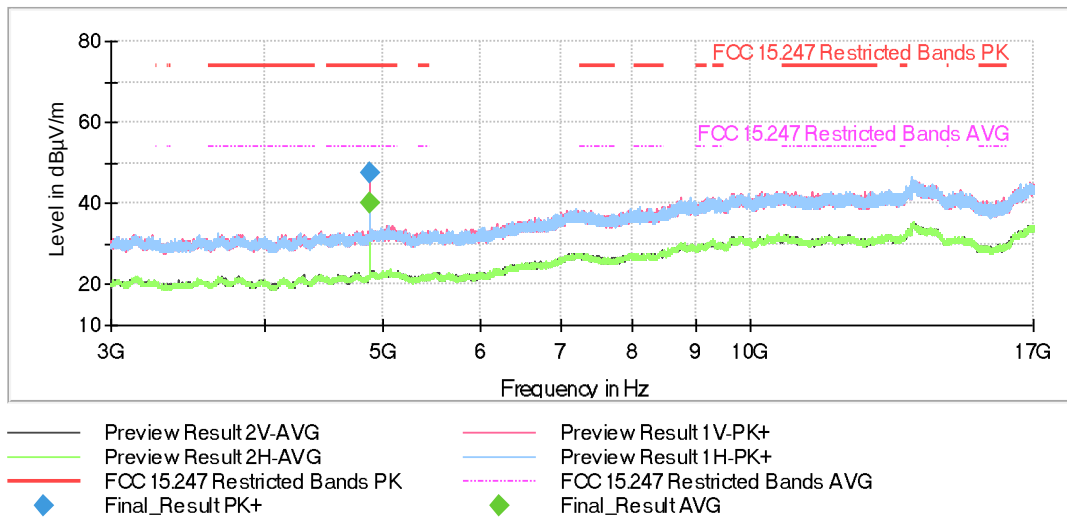
The peak above the limit is the carrier frequency.

FREQUENCY RANGE 3 - 17 GHz:

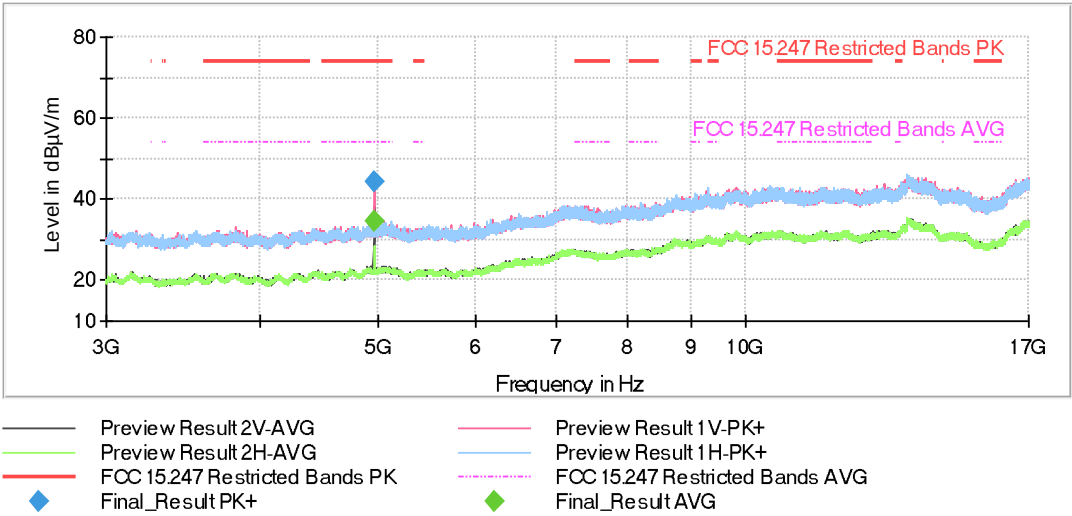
- Low Channel:



- Middle Channel:

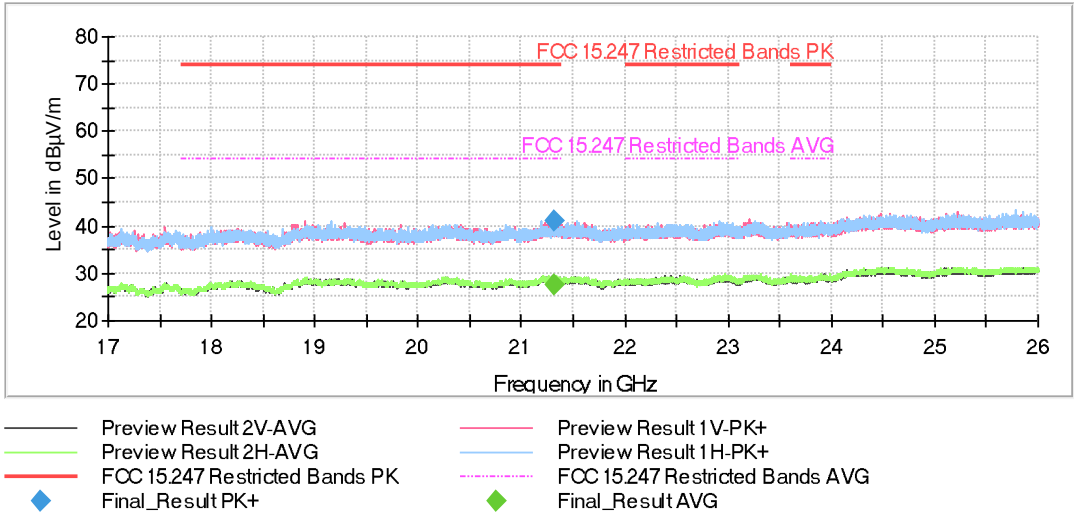


- High Channel:



FREQUENCY RANGE 17 - 26 GHz:

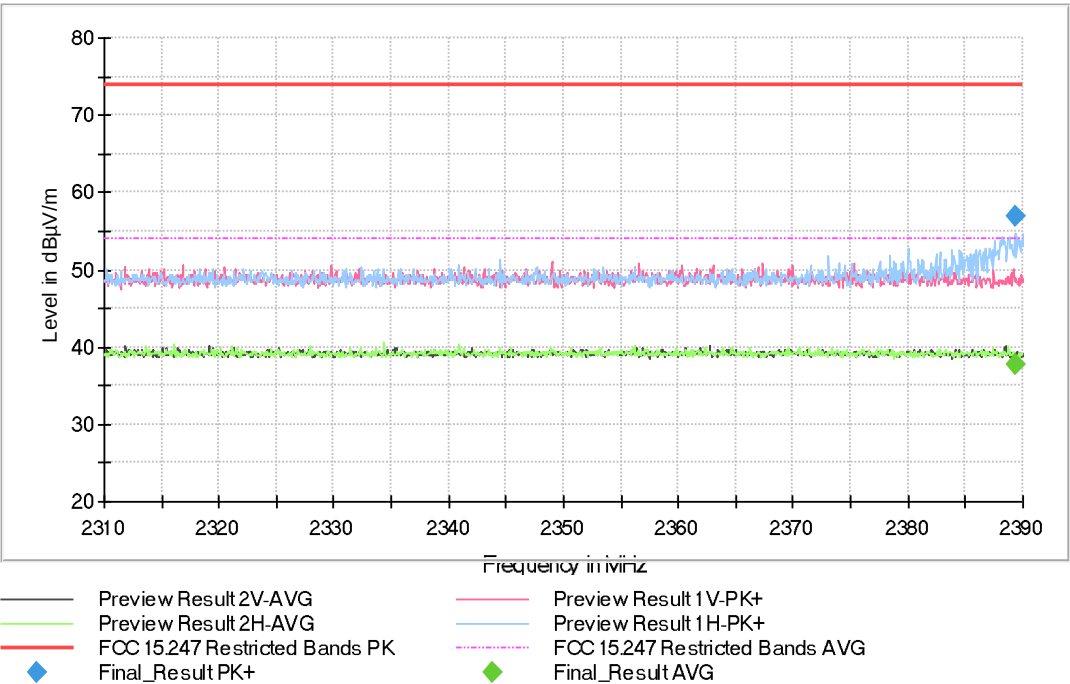
The spurious frequencies detected do not depend on the operating channel.



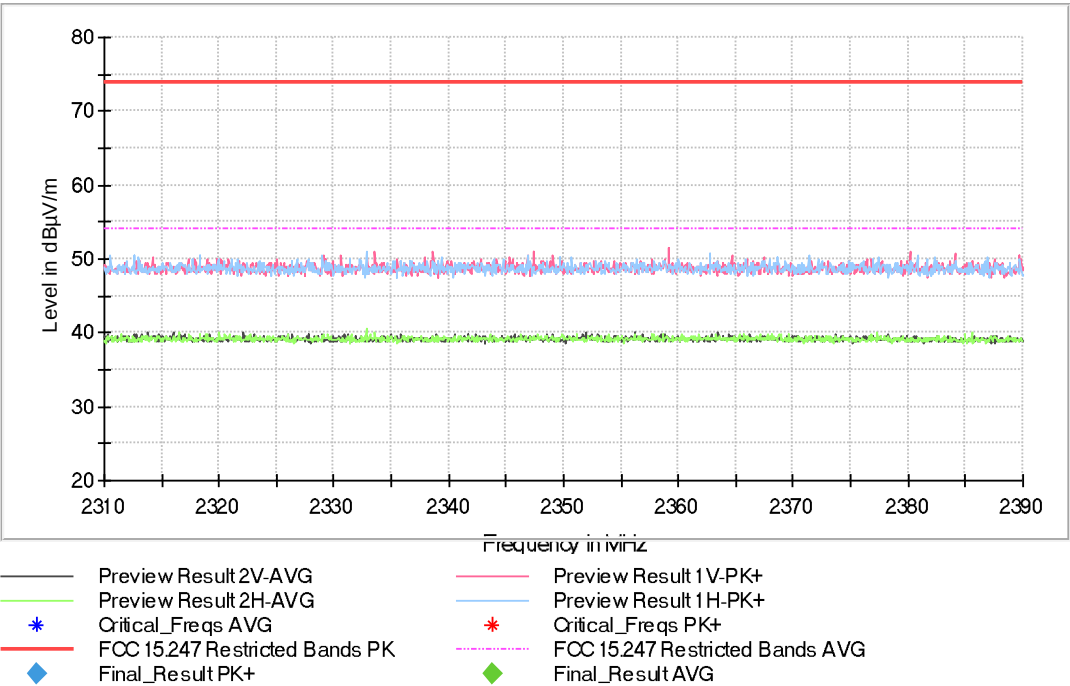
This plot is valid for the Low, Middle and High Channels.

FREQUENCY RANGE 2.31-2.39 GHz:

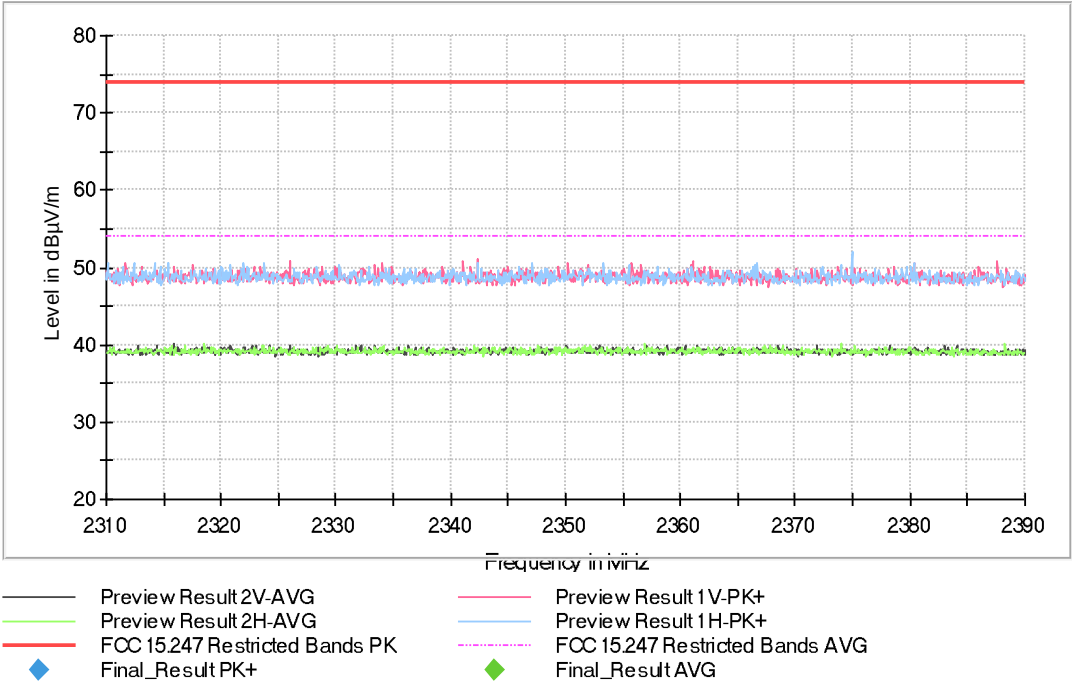
- Low Channel:



- Middle Channel:

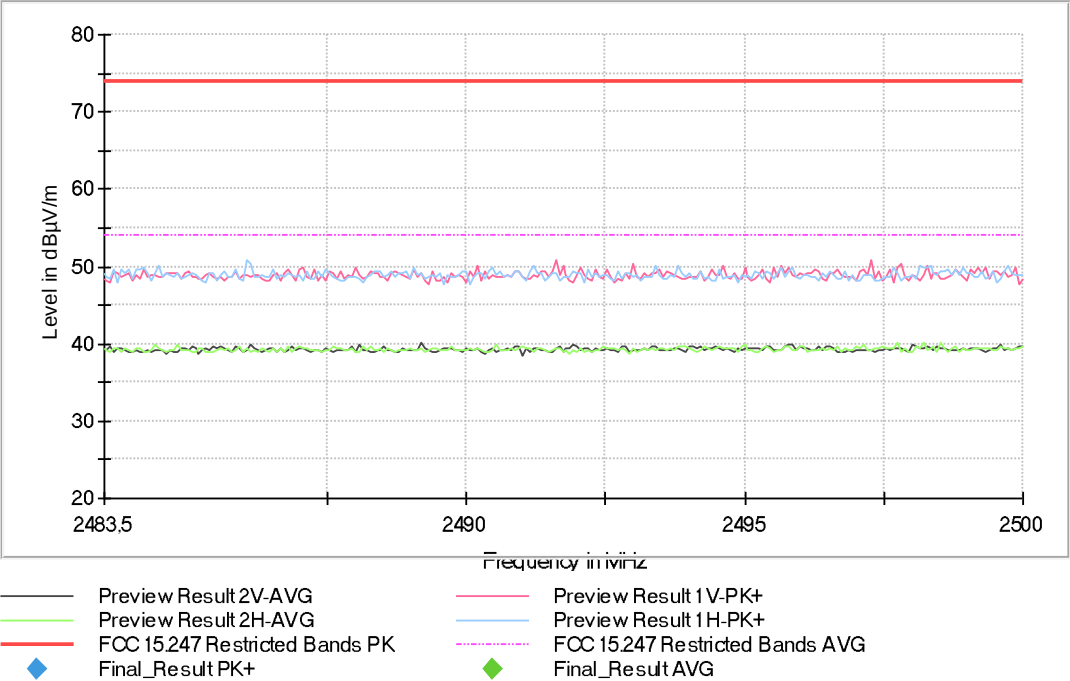


- High Channel:

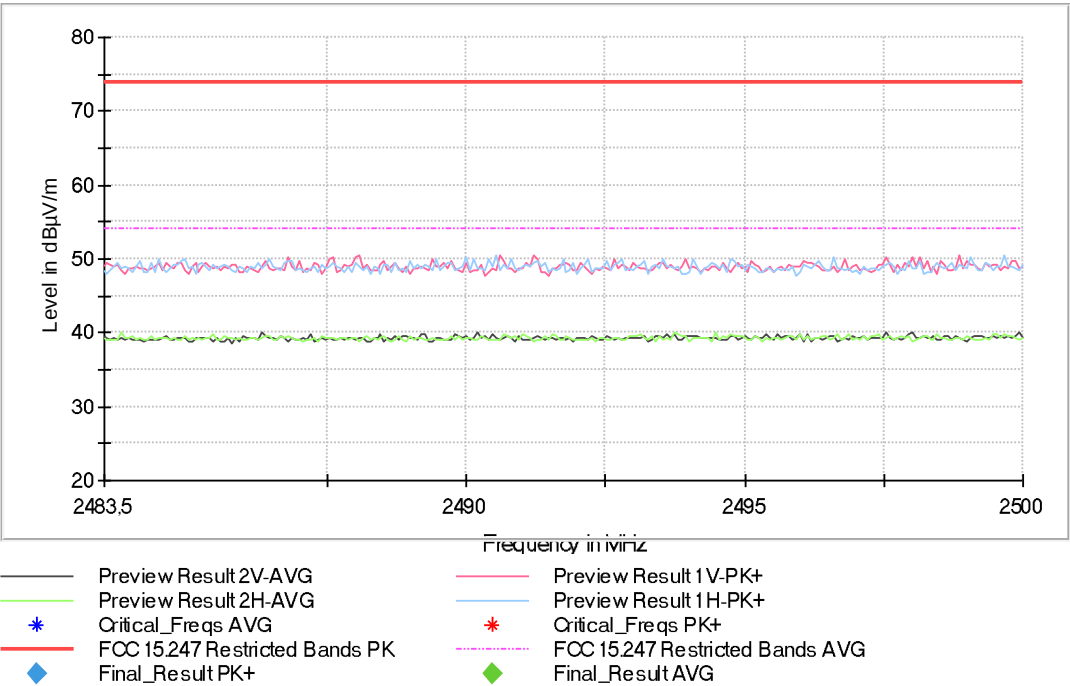


FREQUENCY RANGE 2.4835-2.5 GHz:

- Low Channel:



- Middle Channel:



- High Channel:

