



Test report No:
NIE: 65644RRF.002

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	Temperature logger with external PT100 probe
(*) Trademark	ELPRO
(*) Model and /or type reference	LIBERO CE
(*) Derived model not tested	LIBERO CH; LIBERO CL
Other identification of the product	HW version: V04 SW version: V9.11 RC31 FCC ID: Z45LIBEROCEHL IC: 9954A-LIBEROCEHL
(*) Features	Bluetooth LE 4.2
Applicant	ELPRO-BUCHS AG Langäulistrasse 45, 9470 Buchs SG, St. Gallen, 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 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. ANSI C63.10-2013: American National Standard for Testing Unlicensed Wireless Devices.
Summary	IN COMPLIANCE
Approved by (name / position & signature)	Rafael López Martín EMC Consumer & RF Lab. Manager  RAFAEL LÓPEZ MARTÍN 2020.11.14 13:47:48 +01'00'
Date of issue	2020-11-11
Report template No	FDT08_22 (*) "Data provided by the client"

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Competences and guarantees

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

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

In order to assure the traceability to other national and international laboratories, DEKRA Testing and Certification 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" and "Derived model not tested").
2. Derived model not tested. These models have been declared by the supplier of the sample as being the same as the model under test.
3. The sample of the data logger model LIBERO CE is a device for temperature monitoring using an external PT100 probe. It saves temperature measurement values and is able to generate a PDF report when connected to a USB port on your computer. Features Bluetooth Low Energy (BLE) and usage of liberoAPP.



Date: October 27th, 2020

DEKRA Testing and Certification, S.A.U.
Parque Tecnológico de Andalucía
Severo Ochoa, 2 & 6
29590 Málaga
Spain

Ref: Declaration of Similarity

To whom it may concern:

We, ELPRO-Buchs AG, located in 9470 Buchs; Switzerland declare under our sole responsibility that the products LIBERO CH and LIBERO CL listed below are electrically and mechanically identical, and the only difference is the type of the digital temperature sensor chip, and that this change doesn't affect in EMC and Safety Testing.

Type of equipment: internal temperature or relative humidity data loggers
Trade name: ELPRO
Models name: LIBERO CH, LIBERO CL

Because of 100% identical BLE (RF-Part), test results of LIBERO CE with an external temperature sensor remain applicable, valid and representative for the models LIBERO CH and LIBERO CL in case of Full RF Testing as well as RF Exposure Testing.

Type of equipment: internal or external temperature or relative humidity data loggers
Trade name: ELPRO
Models name: LIBERO CE, LIBERO CH, LIBERO CL

And as evidence thereof, I hereby issue this letter in Buchs SG / Switzerland on 2020/10/26.

Authorized Signature by:

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9470 Buchs SG | Switzerland
T +41 81 552 08 08 | www.elpro.com

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Department | R&D

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27.10.2020


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

Usage of samples

Samples undergoing test have been selected by: The client.

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

Control Nº	Description	Model	Serial Nº	Date of reception
65644/007	Temperature logger with external PT100 probe	LIBERO CE	--	2020/08/31

Auxiliary elements used with the Sample S/01:

Control Nº	Description	Model	Serial Nº	Date of reception
65644/013	Connector Cable-DTM	--	--	2020/08/31

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

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

Control Nº	Description	Model	Serial Nº	Date of reception
65466/011	Temperature logger with external PT100 probe	LIBERO CE	--	2020/08/31

Sample S/02 has undergone the following 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⁾								
	LIBERO CE Sensor Cable	<3.0m	☒	☐	☐								
			☐	☐	☐								
			☐	☐	☐								
			☐	☐	☐								
			☐	☐	☐								
			☐	☐	☐								
Supplementary information to the ports..... :													
Rated power supply	Voltage and Frequency		Reference poles										
			L1	L2	L3	N	PE						
	☐	AC:	☐	☐	☐	☐	☐						
	☐	AC:	☐	☐	☐	☐	☐						
	☒	DC: Battery CR2450 3.0V											
	☐	DC:											
Rated Power	30 mW												
Clock frequencies													
Other parameters..... :													
Software version	V9.11 RC31												
Hardware version..... :	V04												
Dimensions in cm (W x H x D)..... :	9.5 x 4.5 x 1.1												
Mounting position..... :	☐	Table top equipment											
	☒	Wall/Ceiling mounted equipment											
	☐	Floor standing equipment											
	☐	Hand-held equipment											

	☐	Other:	
Modules/parts	Module/parts of test item	Type	Manufacturer
Accessories (not part of the test item)	Description	Type	Manufacturer
	LIBERO CE Sensor Cable	PT100 4 Wire	Various
Documents as provided by the applicant.....	Description	File name	Issue date

⁽³⁾ Only for Medical Equipment

Identification of the client

ELPRO-BUCHS AG
Langäulistrasse 45, 9470 Buchs SG, St. Gallen, Switzerland

Testing period and place

Test Location	DEKRA Testing and Certification S.A.U.
Date (start)	2020-08-31
Date (finish)	2020-09-04

Document history

Report number	Date	Description
65644RRF.002	2020-11-11	First release

Environmental conditions

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

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

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: Alfonso Gutiérrez, Pablo Redondo and Javier Miguel Nadales.

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
3. Open Switch Unit ROHDE AND SCHWARZ OSP120	2019/10	2021/10
4. Open Switch Unit up to 18 GHz ROHDE AND SCHWARZ OSP 150	2019/09	2021/09
5. Analog Power Supply DC 40V/40A ROHDE AND SCHWARZ NGPE 40/40	--	--
6. Digital Multimeter FLUKE 175	2019/10	2020/10

Radiated Measurements:

	Last Calibration	Due Calibration
1. Semianechoic Absorber Lined Chamber ETS LINDGREN FACT 3 200 STP	N.A.	N.A.
2. Shielded Room ETS LINDGREN S101	N.A.	N.A.
3. Biconical/Log Antenna 30MHz - 6GHz ETS LINDGREN 3142E	2017/09	2020/09
4. RF Preamplifier 40 dB, 10 MHz - 6 GHz BONN ELEKTRONIK BLNA 0160-01N	2020/02	2021/02
5. EMI Test Receiver 7 GHz ROHDE AND SCHWARZ ESR7	2018/10	2020/10
6. DC Power Supply 30V/5A KEYSIGHT TECHNOLOGIES U8002A	N.A.	N.A.
7. Digital Multimeter, FLUKE 175	2019/10	2020/10
8. Horn Antenna 1-18GHz, HEWLETT PACKARD 11966E	2018/10	2021/10
9. Broadband Horn Antenna 18 - 40 GHz SCHWARZBECK MESS-ELEKTRONIK BBHA 9170	2018/07	2021/07
10. RF Preamplifier G>30dB, 1-18GHz BONN ELEKTRONIK BLMA 0118-3A	2019/11	2020/11
11. Preamplifier G>30dB 18-40GHz BONN ELEKTRONIK BLMA 1840-3G	2019/11	2021/11
12. Signal and Spectrum Analyzer 10 Hz - 40 GHz ROHDE AND SCHWARZ FSV40	2019/10	2021/10

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	P	
FCC 15.247 (b) / RSS-247 5.4. (d)	Maximum output power and antenna gain	P	
FCC 15.247 (d) / RSS-247 5.5.	Band-edge emissions compliance (Transmitter)	P	
FCC 15.247 (e) / RSS-247 5.2. (b)	Power spectral density	P	
FCC 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

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FCC 15.247 (b) / RSS-247 5.4. (d) Maximum output power and antenna gain	20
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FCC 15.247 (d) / RSS-247 5.5. Emission limitations radiated (Transmitter).....	26

TEST CONDITIONS

POWER SUPPLY (V):

V nominal:	3 Vdc
Type of Power Supply:	Battery CR2450.

ANTENNA:

Type of Antenna:	Internal PCB.
Maximum Declared Antenna Gain:	+5.08 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 a distance of 1 m for the frequency range 17 GHz-26 GHz (18 GHz-40 GHz horn antenna).

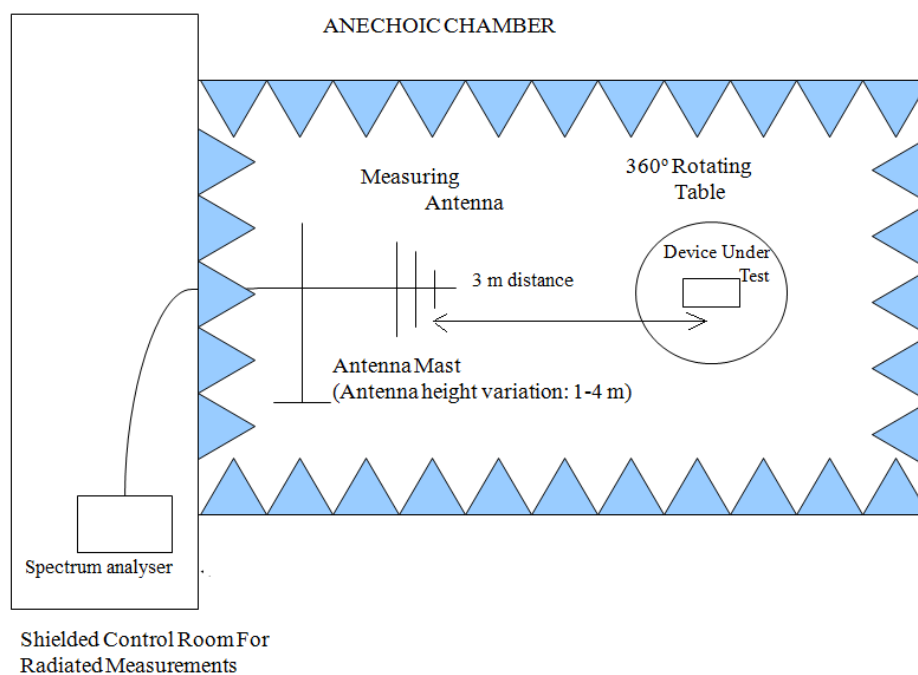
For radiated emissions in the range 17 GHz-26 GHz that is performed at a distance closer than the specified distance, an inverse proportionality factor of 20 dB per decade is used to normalize the measured data for determining compliance.

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.

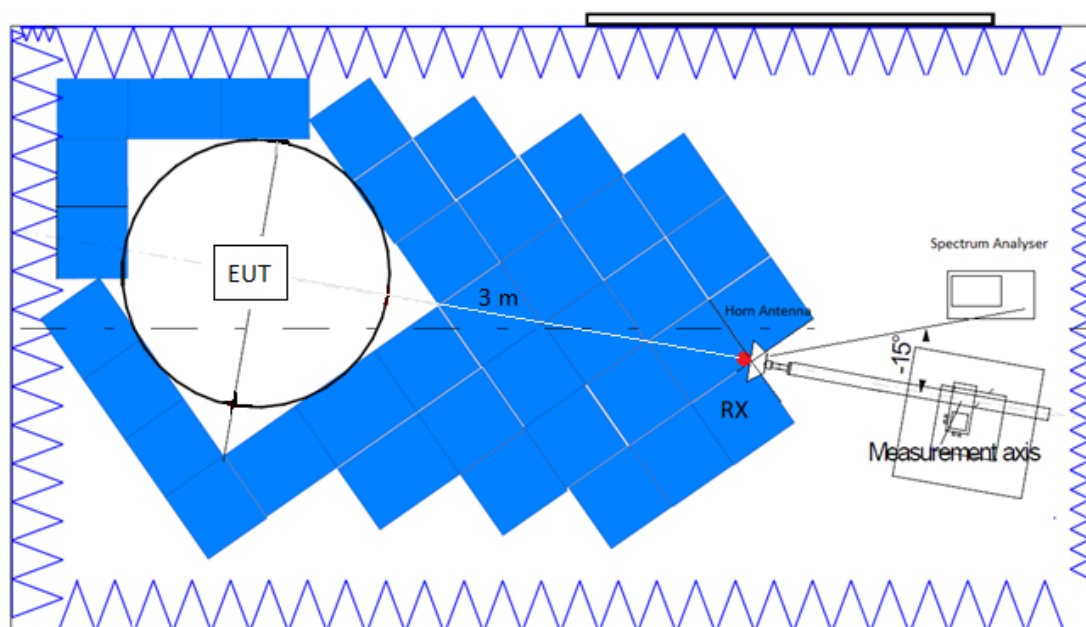
Measurements were made in both horizontal and vertical planes of polarization.

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

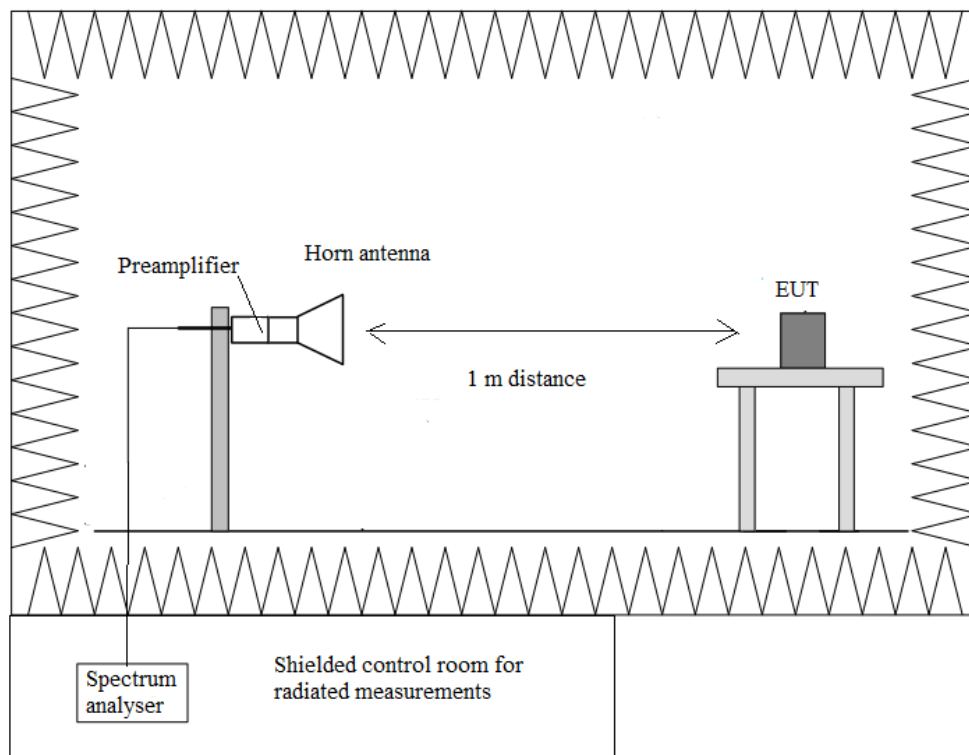
Radiated measurements setup from 30 MHz to 1 GHz:



Radiated measurements setup from 1 GHz to 17 GHz:



Radiated measurements setup $f > 17$ GHz:

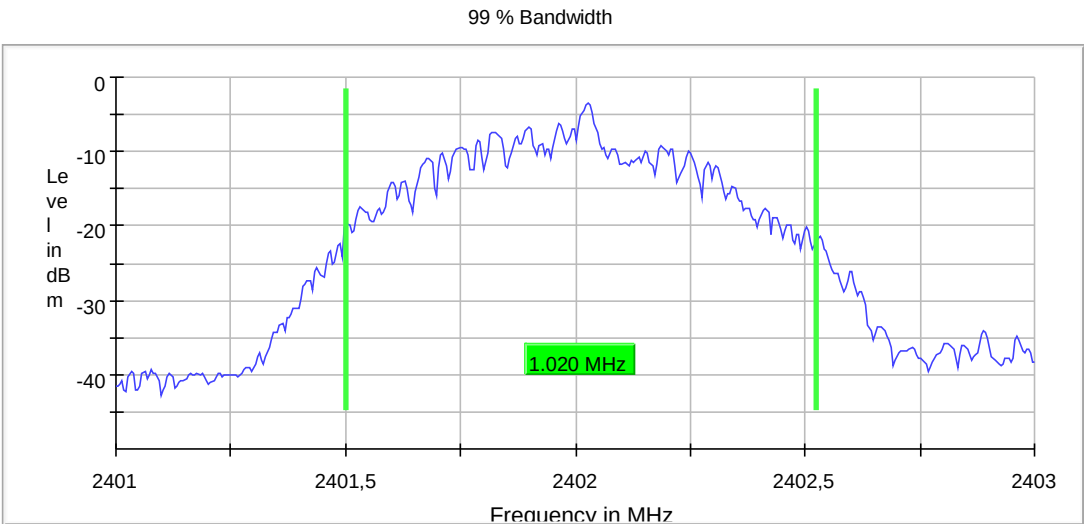


Occupied Bandwidth

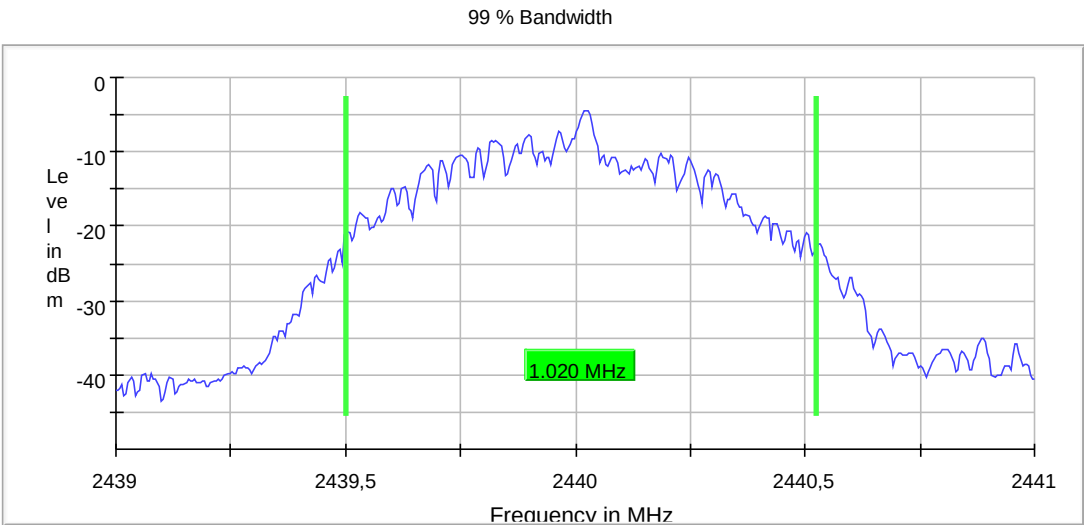
RESULTS:

	Low Channel 2402 MHz	Middle Channel 2440 MHz	High Channel 2480 MHz
99% bandwidth (MHz)	1.020000	1.020000	1.015000
Measurement uncertainty (%)	<± 2.08		

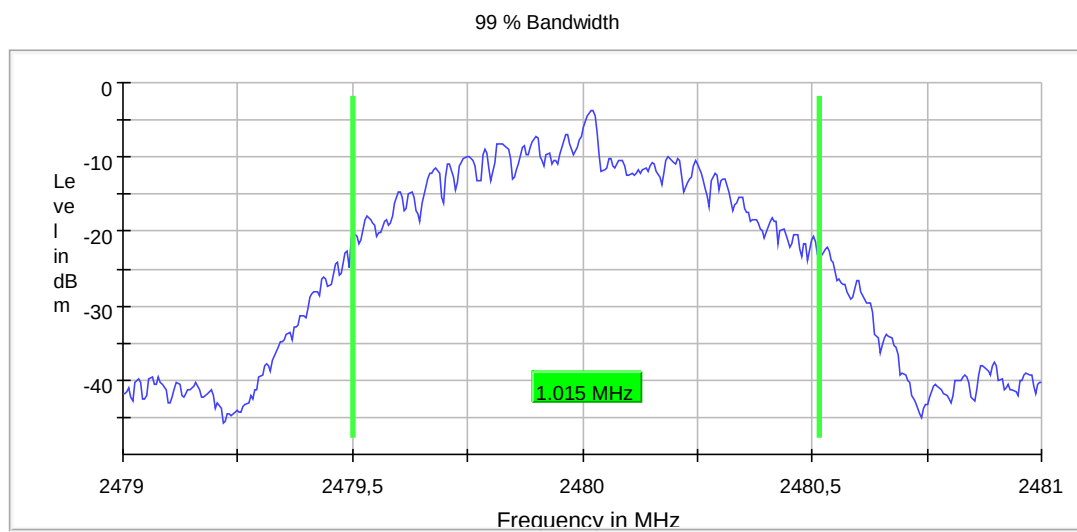
- Low Channel:



- Middle Channel:



- High Channel:



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

SPECIFICATION:

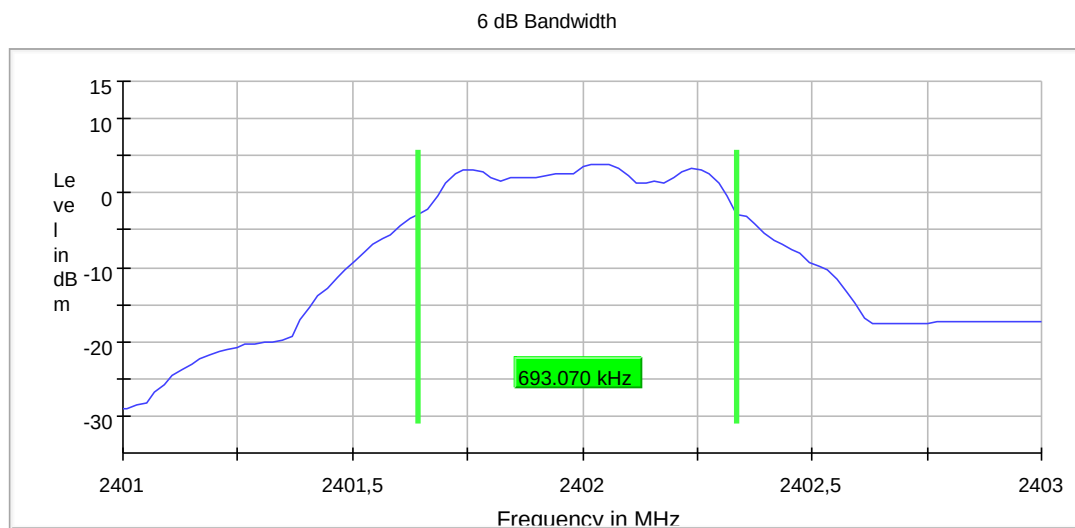
The minimum 6 dB bandwidth shall be at least 500 kHz.

RESULTS:

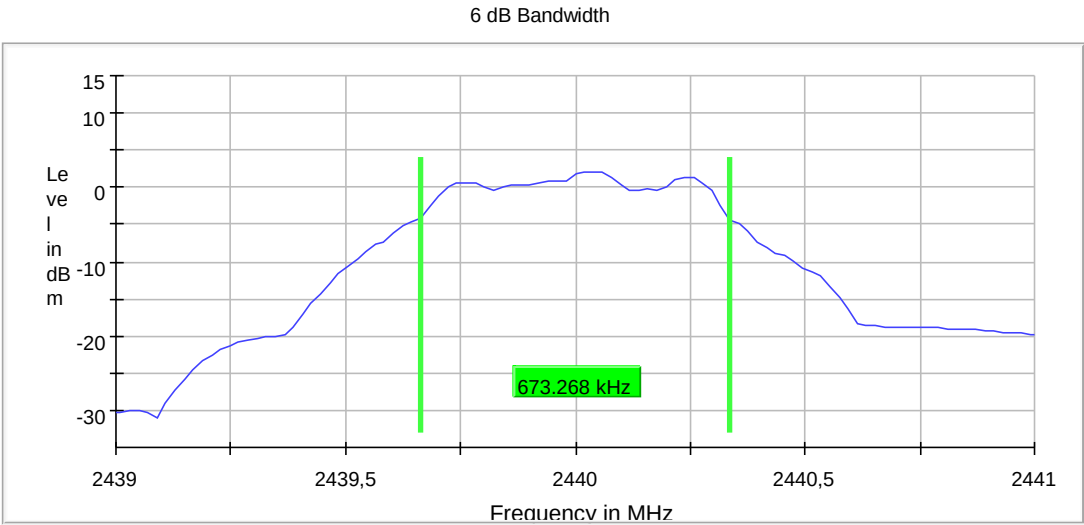
	Low Channel 2402 MHz	Middle Channel 2440 MHz	High Channel 2480 MHz
6 dB Bandwidth (kHz)	693.070	673.268	673.268
Measurement uncertainty (%)	<±2.08		

Verdict: PASS

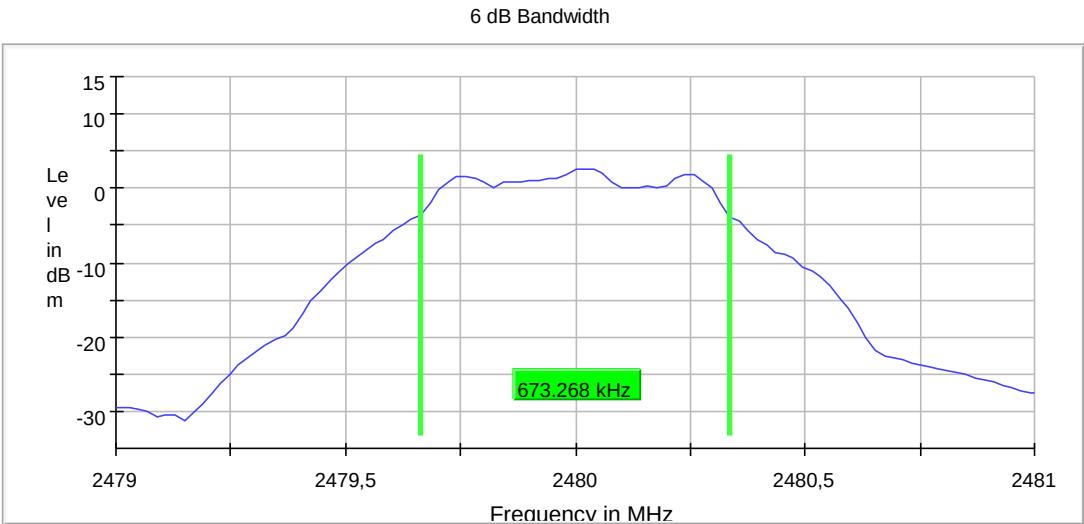
- Low Channel:



- Middle Channel:



- High Channel:



FCC 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.

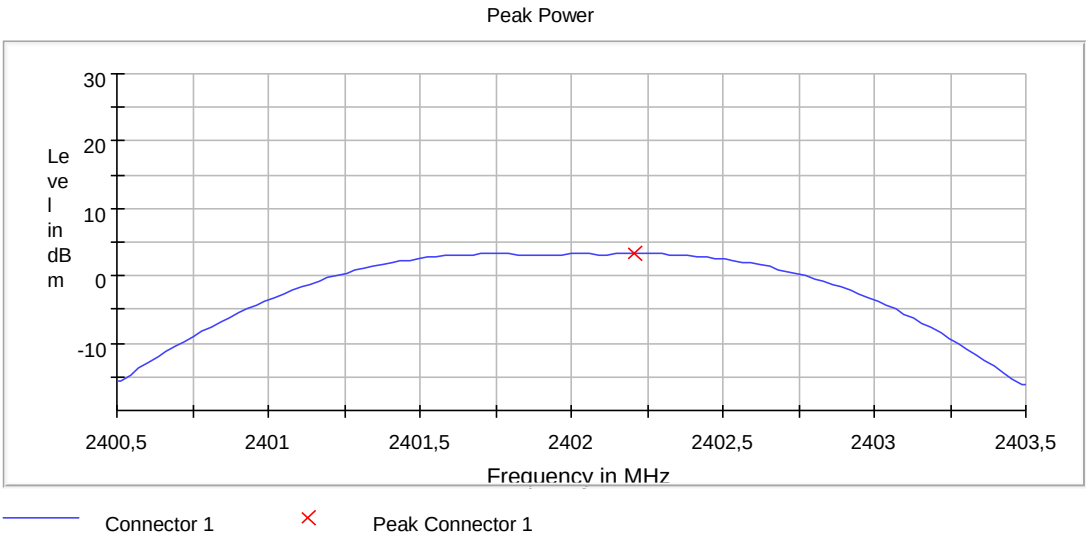
Maximum Declared Antenna Gain: +5.08 dBi

	Low Channel 2402 MHz	Middle Channel 2440 MHz	High Channel 2480 MHz
Maximum Conducted Power (dBm)	3.3	2.2	2.6
Maximum EIRP Power (dBm)	8.38	7.28	7.68
Measurement uncertainty (dB)	< $\pm$ 0.99		

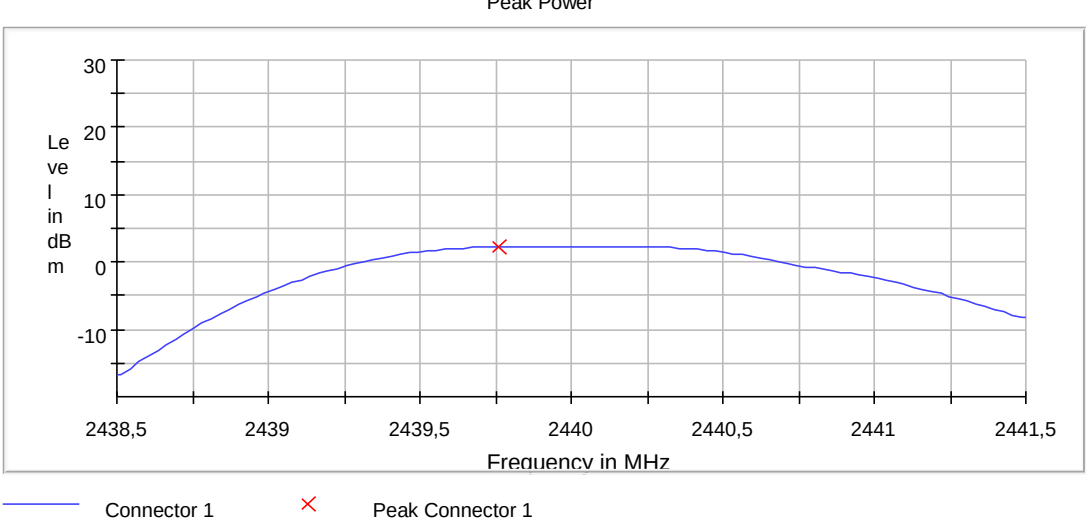
The maximum directional gain of the antenna is less than 6 dBi and therefore the maximum output power is not required to be reduced from the stated values.

Verdict: PASS

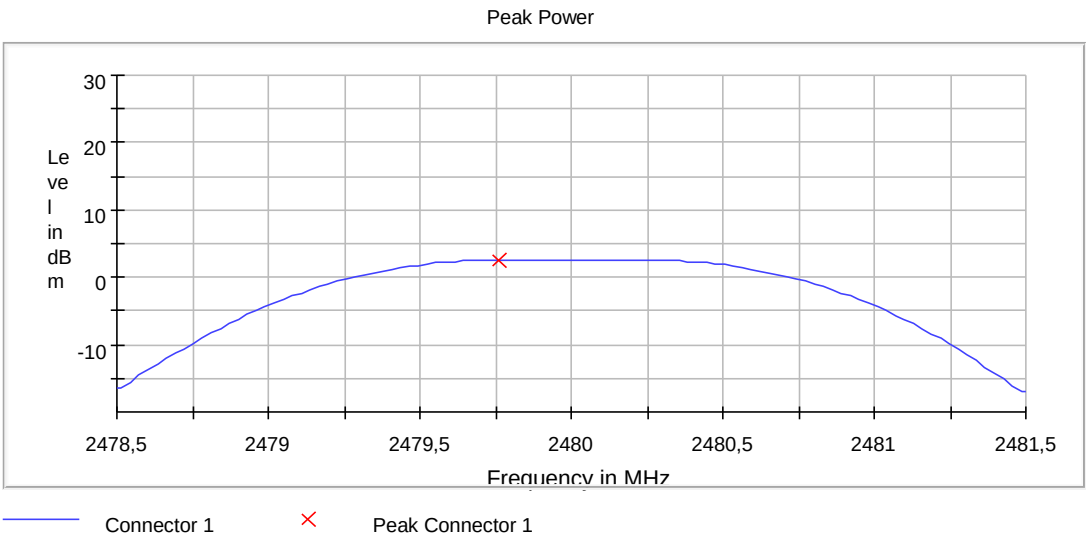
- Low Channel:



- Middle Channel:



- High Channel:



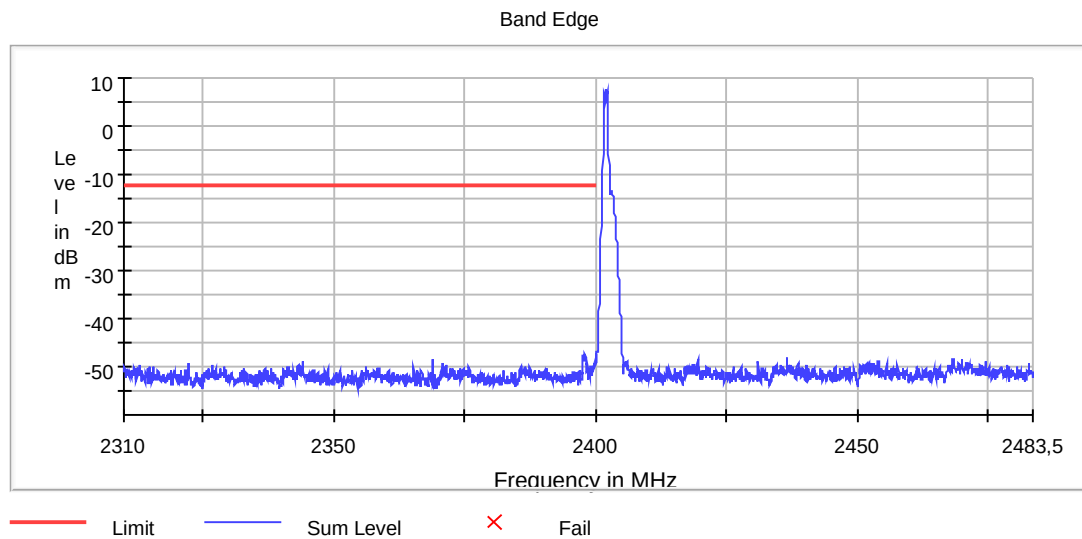
FCC 15.247 (d) / RSS-247 5.5. Band-edge emissions compliance (Transmitter)

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:

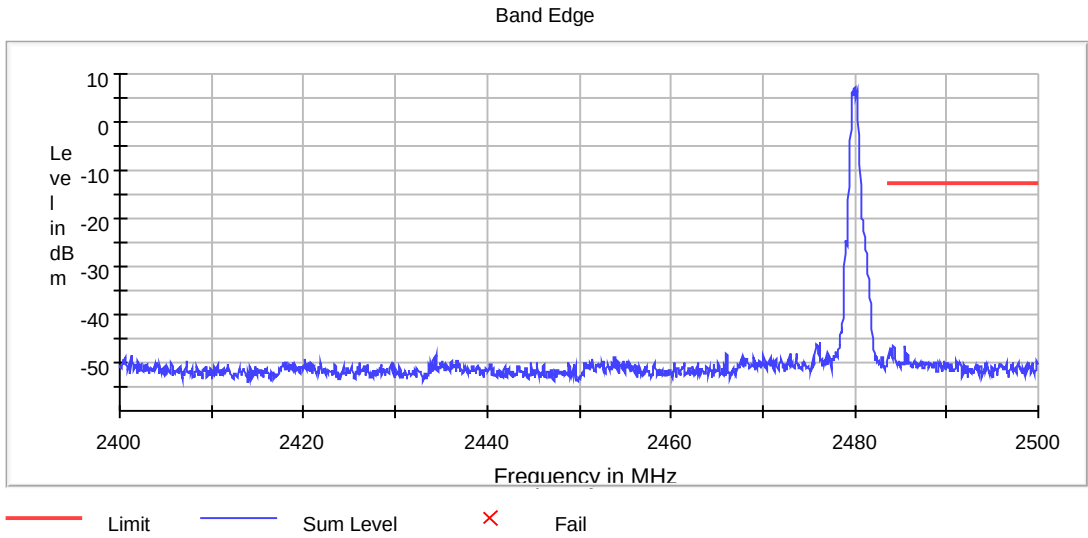
- Low Channel:



Measurement uncertainty (dB)	<±0.89
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Verdict: PASS

- High Channel:



Measurement uncertainty (dB)	<±0.89
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Verdict: PASS

FCC 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.

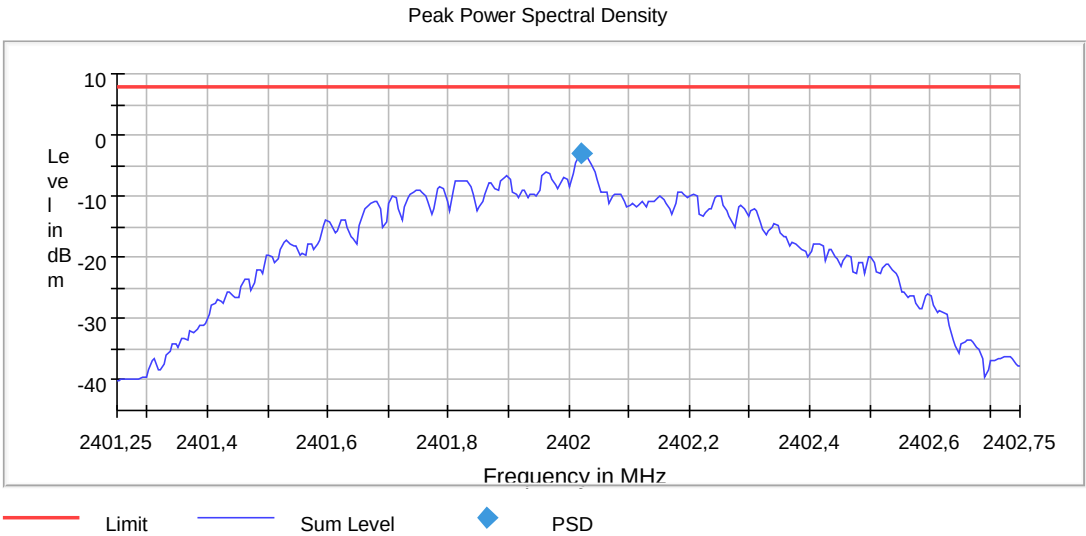
RESULTS:

The maximum power spectral density level in the fundamental emission was measured using the method according to FCC title 47 part 15 §15.247(a),(e), KDB 558074 D01 DTS Meas Guidance v05 F and ANSI C.63.10-2013.

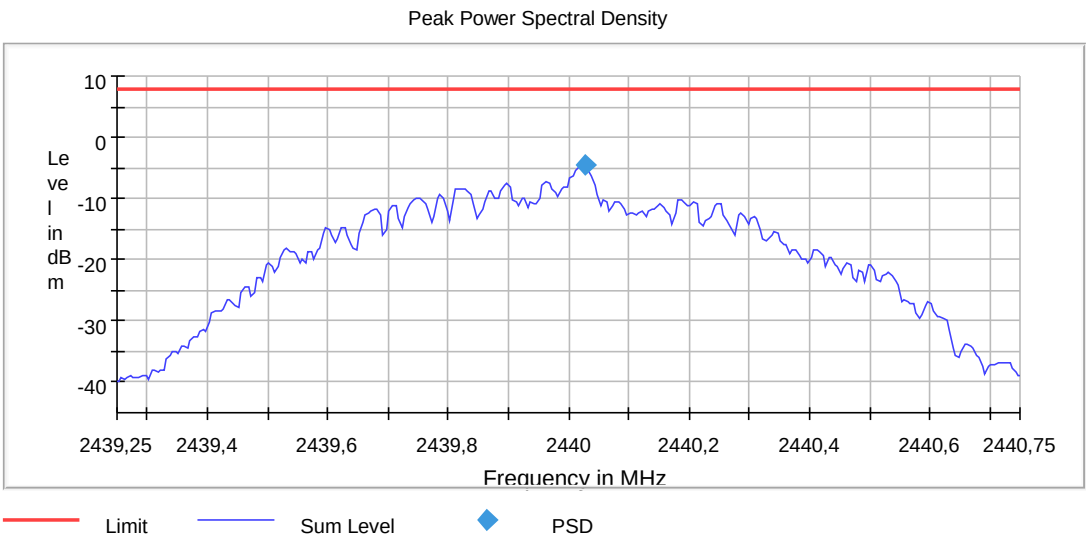
	Low Channel 2402 MHz	Middle Channel 2440 MHz	High Channel 2480 MHz
Power Spectral Density (dBm)	-3.073	-4.359	-3.593
Measurement uncertainty (dB)	<±0.99		

Verdict: PASS

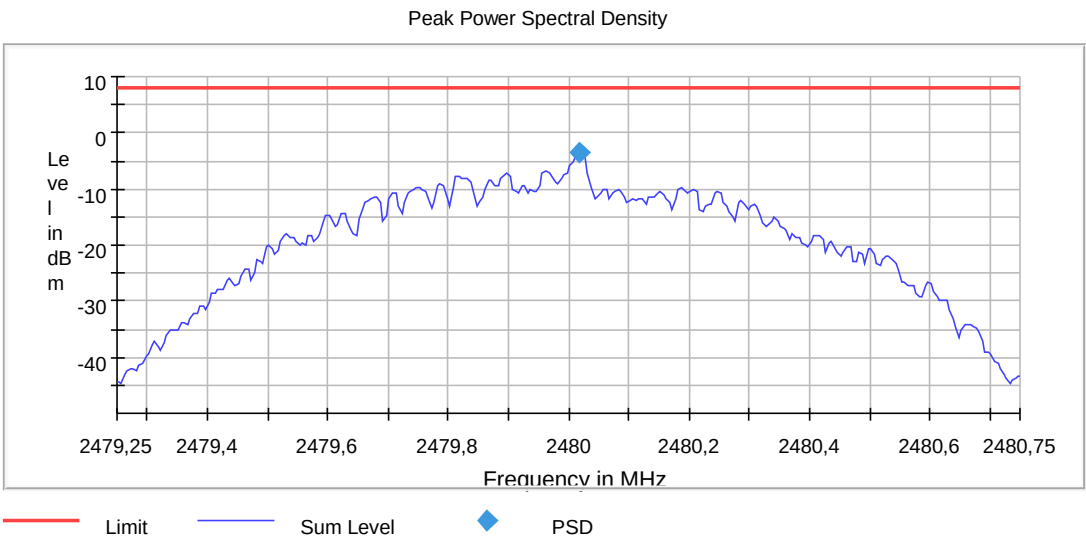
- Low Channel:



- Middle Channel:



- High Channel:



FCC 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 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 do not depend neither on the operating channel nor the modulation mode.

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

Measurement Uncertainty (dB): $<\pm 5.08$

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.

Duty cycle correction +1.82 dB

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

Spurious Frequency (GHz)	Emission Level (dB μ V/m)	Corrected Emission Level (dB μ V/m)	Polarization	Detector	Measurement Uncertainty (dB)
2.3697	57.89	57.89	H	Peak	< $\pm$ 4.11
	44.89	46.71		Average	
2.4999	58.55	58.55	H	Peak	< $\pm$ 4.11
	45.67	47.49		Average	
2.8865	60.66	60.66	V	Peak	< $\pm$ 4.11
	47.48	49.30		Average	
4.8040	53.66	53.66	V	Peak	< $\pm$ 4.11
	47.11	48.93		Average	
12.0100	52.42	52.42	V	Peak	< $\pm$ 5.13
	38.85	40.67		Average	

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

Spurious Frequency (GHz)	Emission Level (dB μ V/m)	Corrected Emission Level (dB μ V/m)	Polarization	Detector	Measurement Uncertainty (dB)
2.3791	57.73	57.73	H	Peak	< $\pm$ 4.11
	44.86	46.68		Average	
2.4995	58.89	58.89	H	Peak	< $\pm$ 4.11
	45.67	47.49		Average	
2.8575	61.04	61.04	V	Peak	< $\pm$ 4.11
	47.75	49.57		Average	
4.8800	55.57	55.57	V	Peak	< $\pm$ 4.11
	49.34	51.16		Average	
12.1990	57.10	57.10	H	Peak	< $\pm$ 5.13
	45.90	47.72		Average	

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

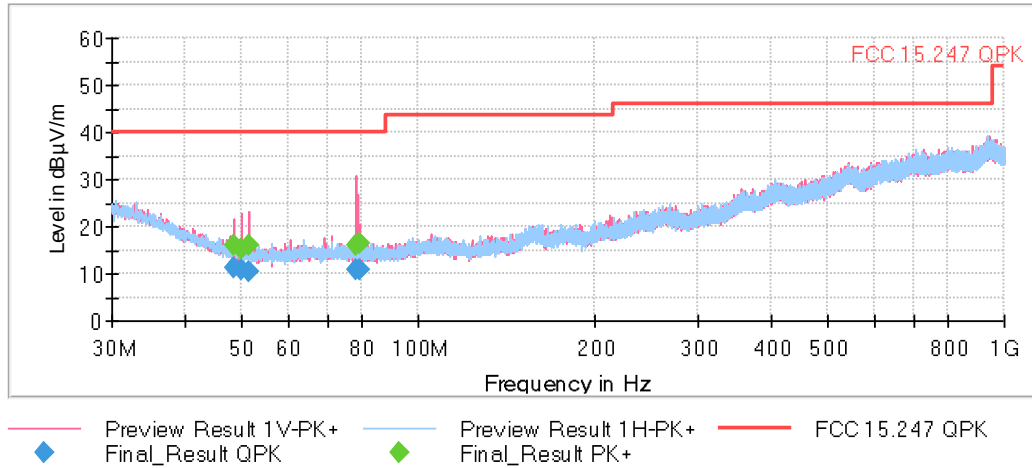
Spurious Frequency (GHz)	Emission Level (dBμV/m)	Corrected Emission Level (dBμV/m)	Polarization	Detector	Measurement Uncertainty (dB)
2.3815	57.40	57.40	H	Peak	<± 4.11
	44.87	46.69		Average	
2.4951	58.60	58.60	H	Peak	<± 4.11
	45.66	47.48		Average	
2.8933	60.56	60.56	H	Peak	<± 4.11
	47.51	49.33		Average	
4.9600	56.95	56.95	V	Peak	<± 4.11
	50.74	52.56		Average	
12.4000	60.53	60.53	H	Peak	<± 5.13
	47.53	49.35		Average	

Measurement Uncertainty (dB): 17 GHz - 26 GHz <± 4.82

Verdict: PASS

FREQUENCY RANGE 30 MHz - 1 GHz:

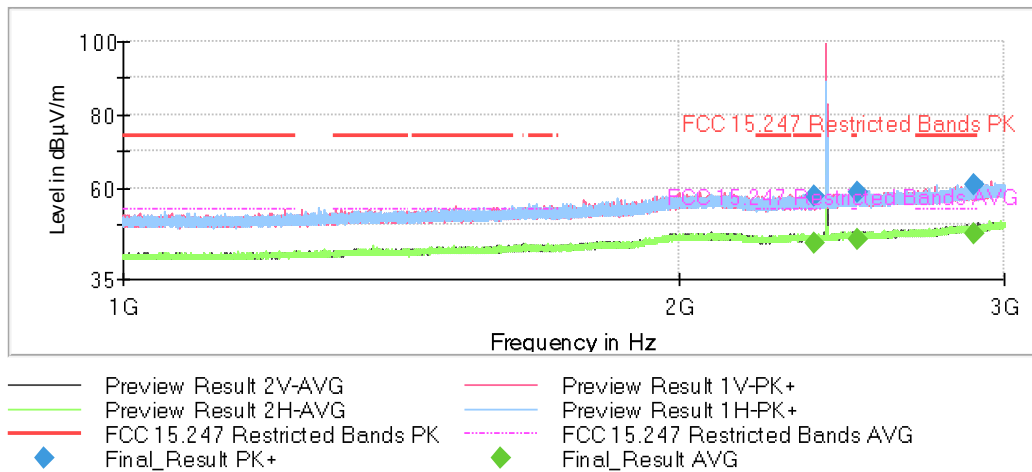
The spurious frequencies detected do not depend neither on the operating channel nor the modulation mode.
This plot is valid for the Low, Middle and High Channels.



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

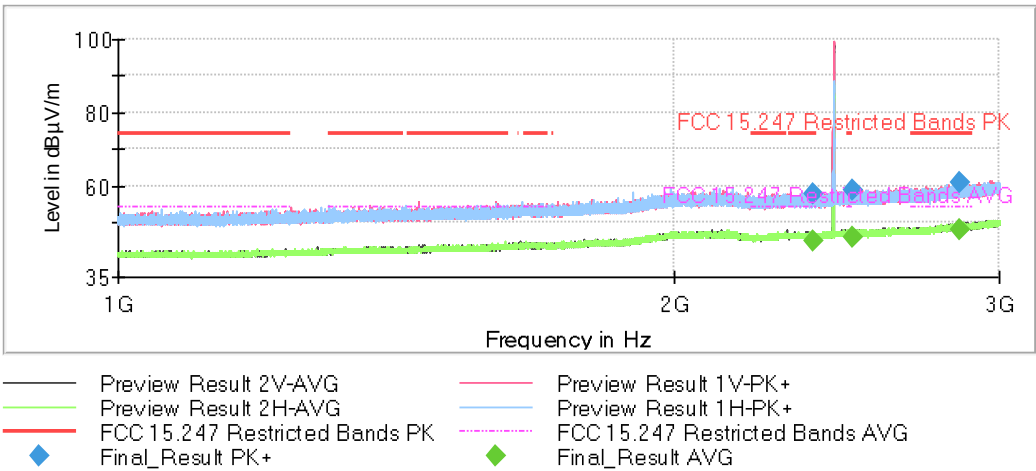
FREQUENCY RANGE 1 - 3 GHz:

- Low Channel:



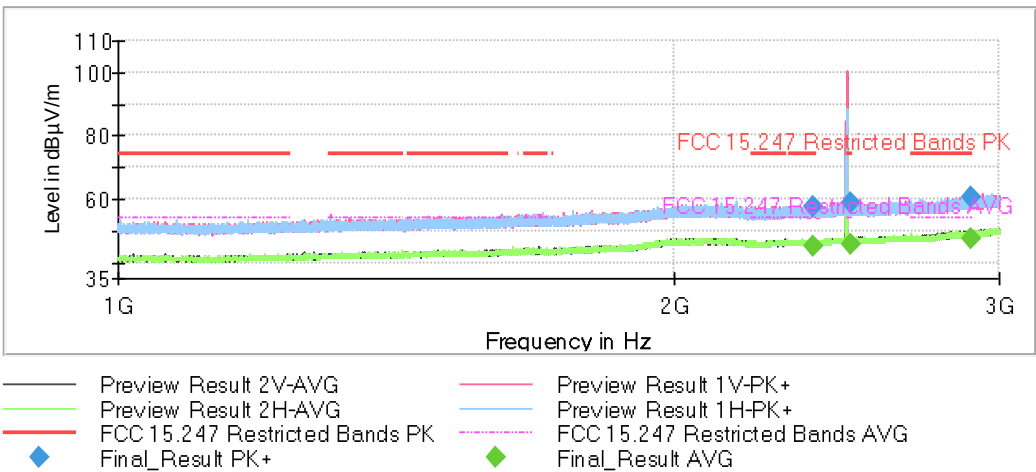
The peak above the limit is the carrier frequency.

- Middle Channel:



The peak above the limit is the carrier frequency.

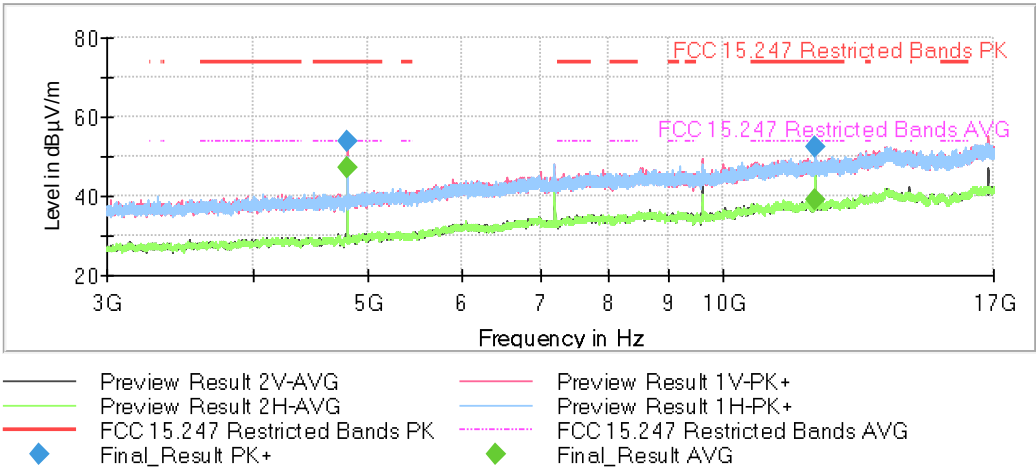
- High Channel:



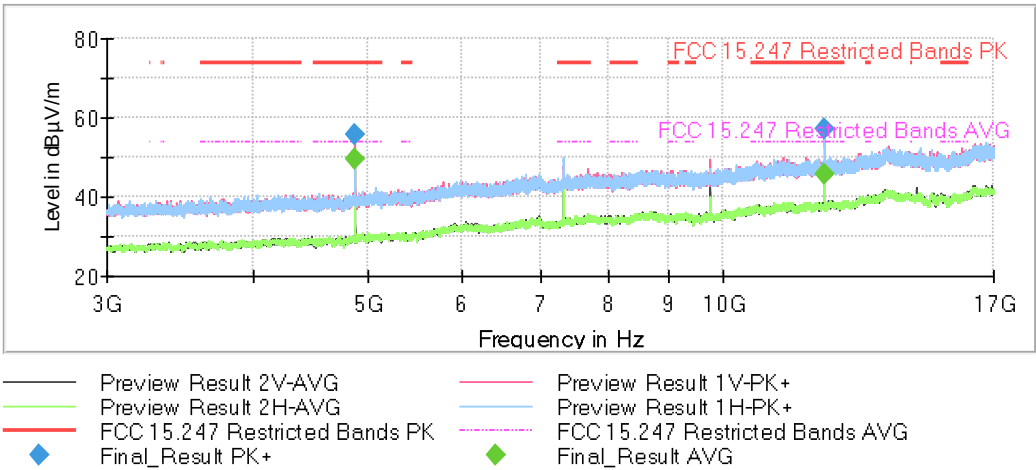
The peak above the limit is the carrier frequency.

FREQUENCY RANGE 3 - 17 GHz:

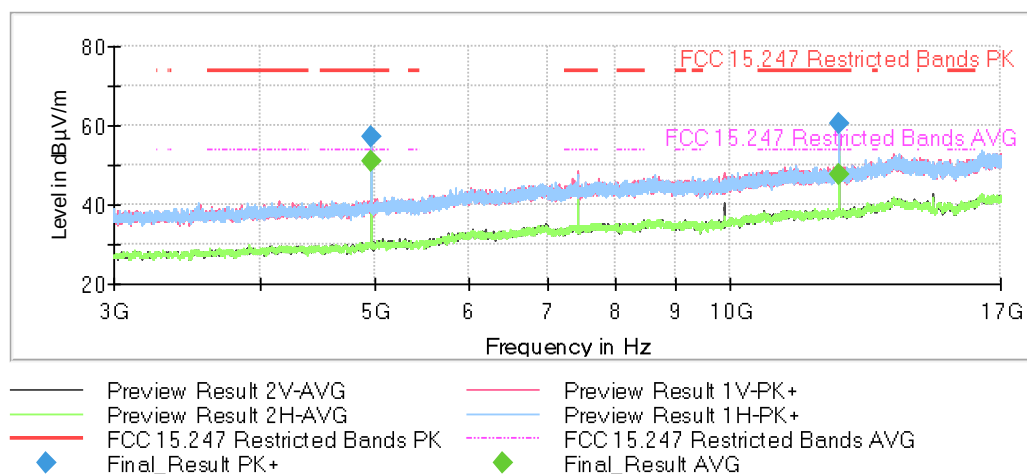
- Low Channel:



- Middle Channel:

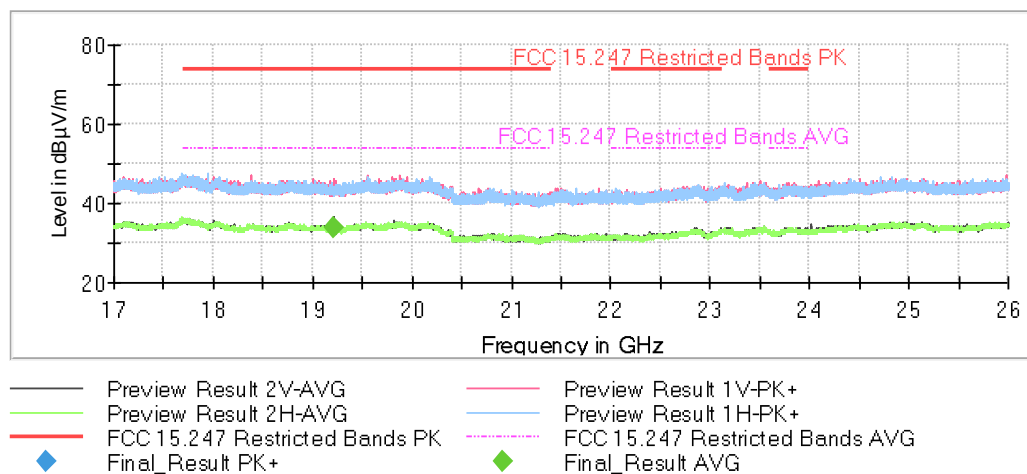


- High Channel:

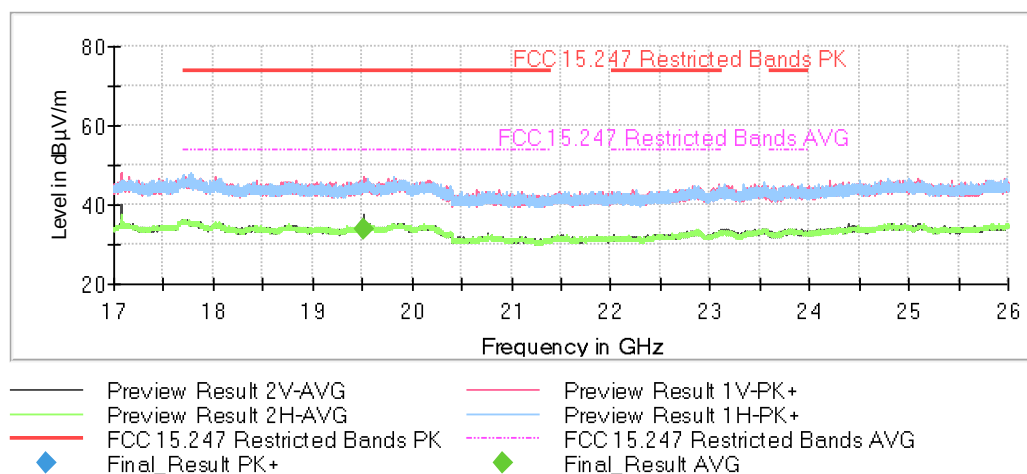


FREQUENCY RANGE 17 - 26 GHz:

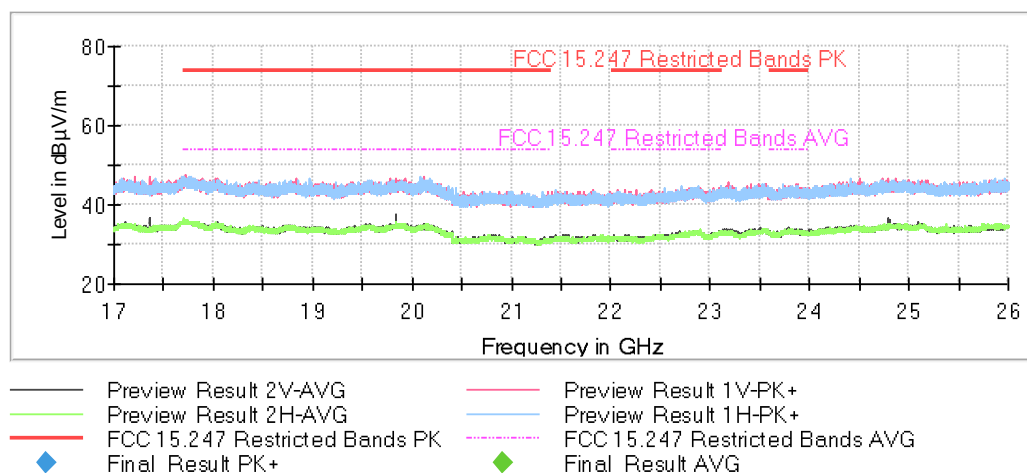
- Low Channel:



- Middle Channel:

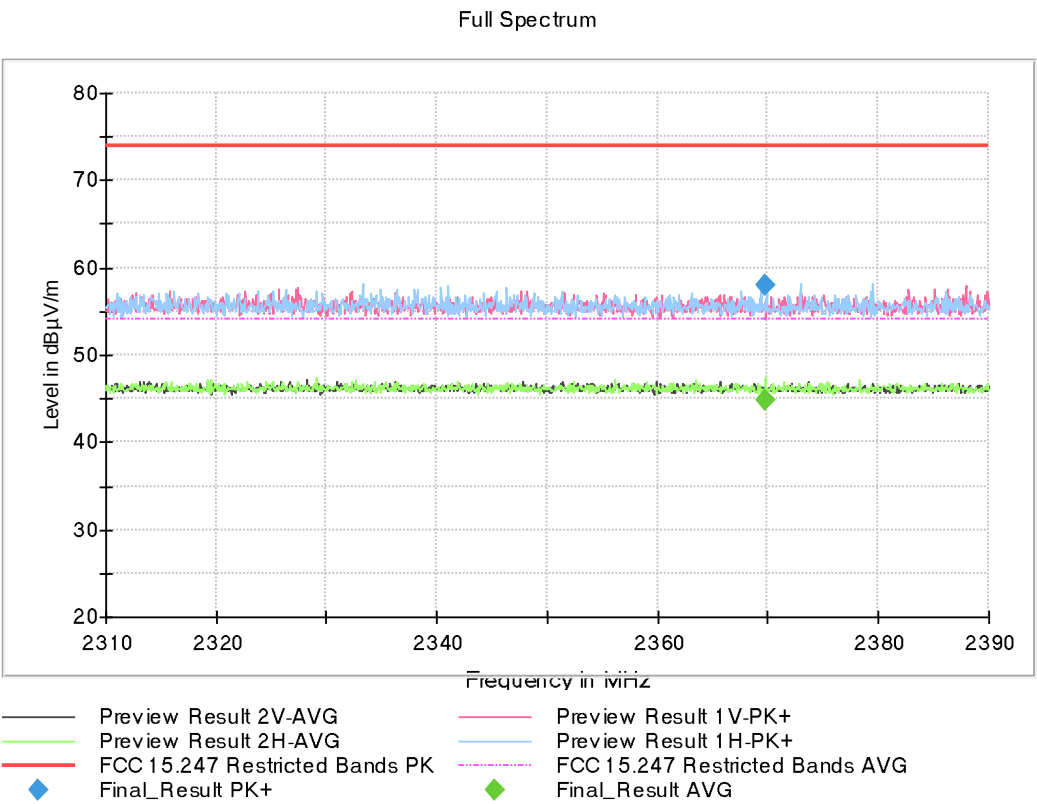


- High Channel:

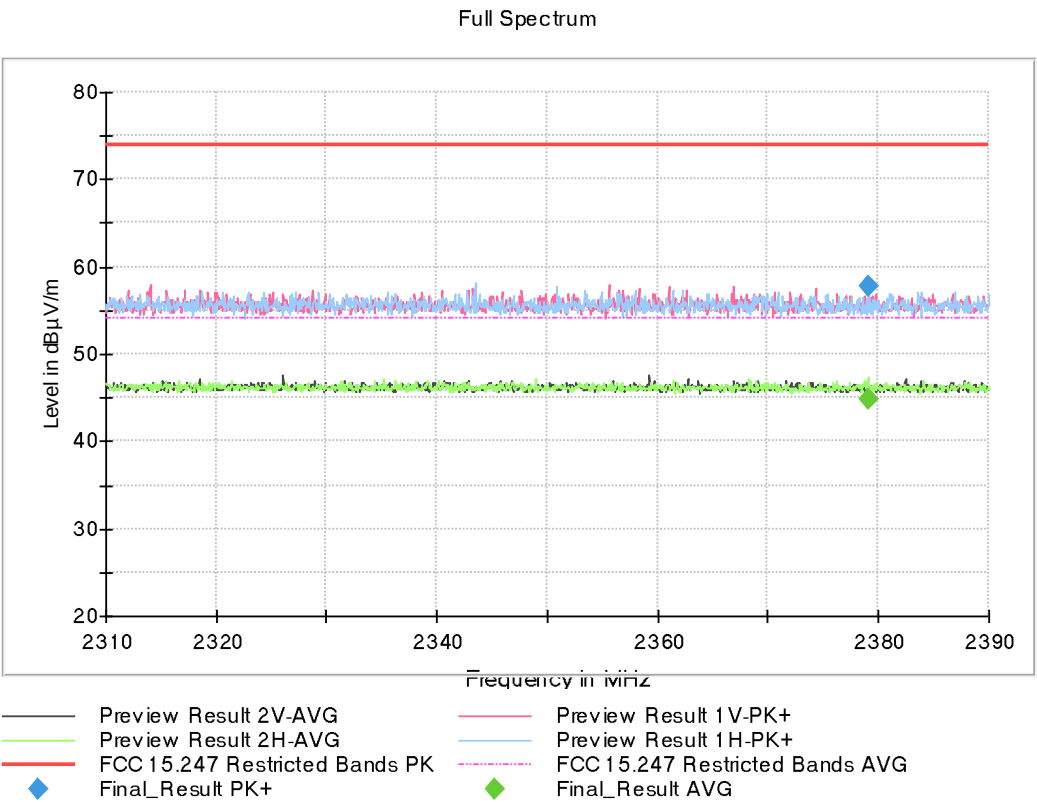


FREQUENCY RANGE 2.31-2.39 GHz:

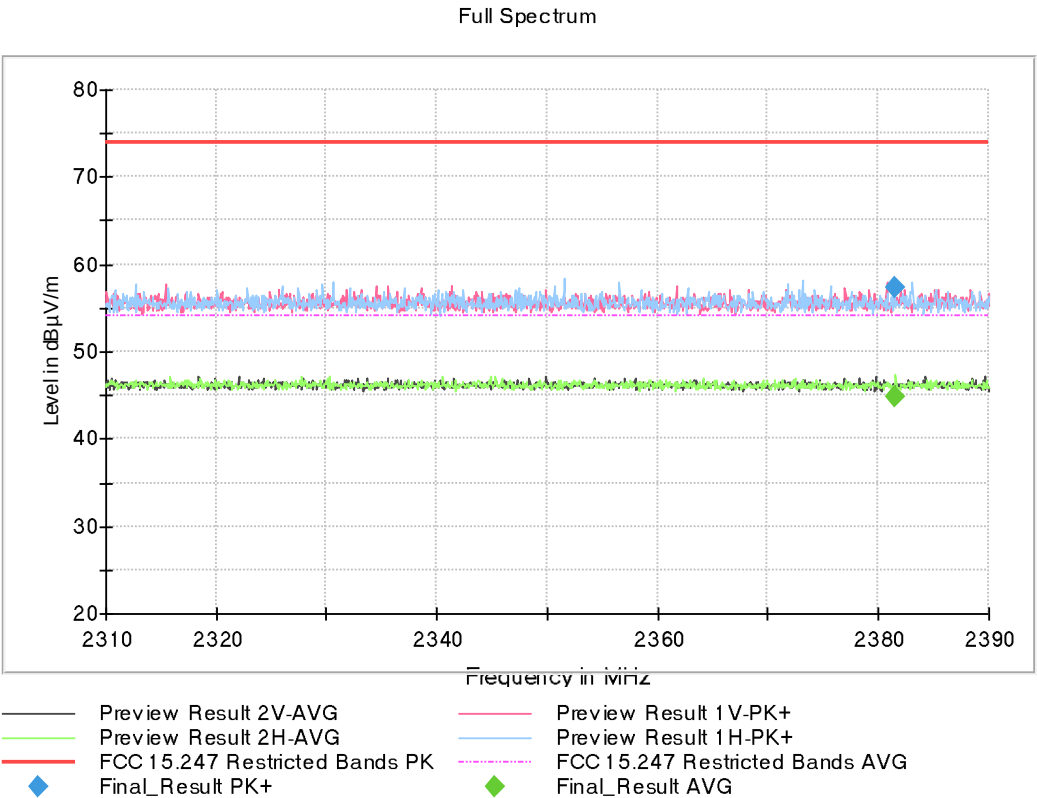
- Low Channel:



- Middle Channel:

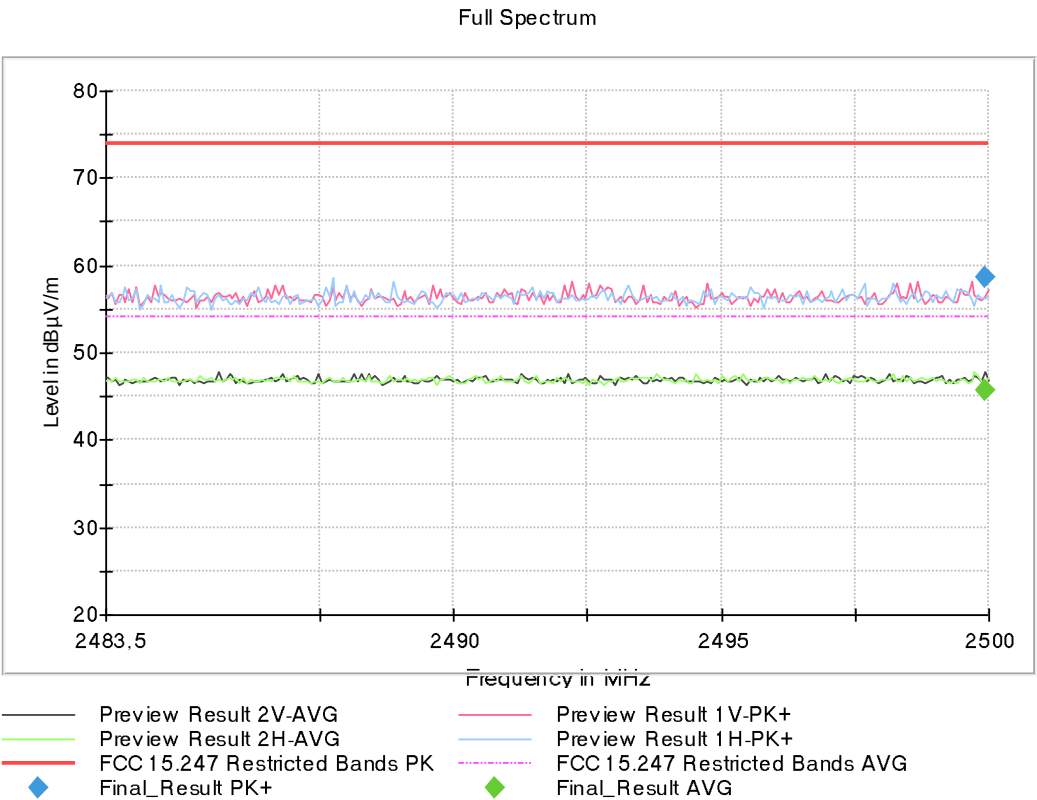


- High Channel:

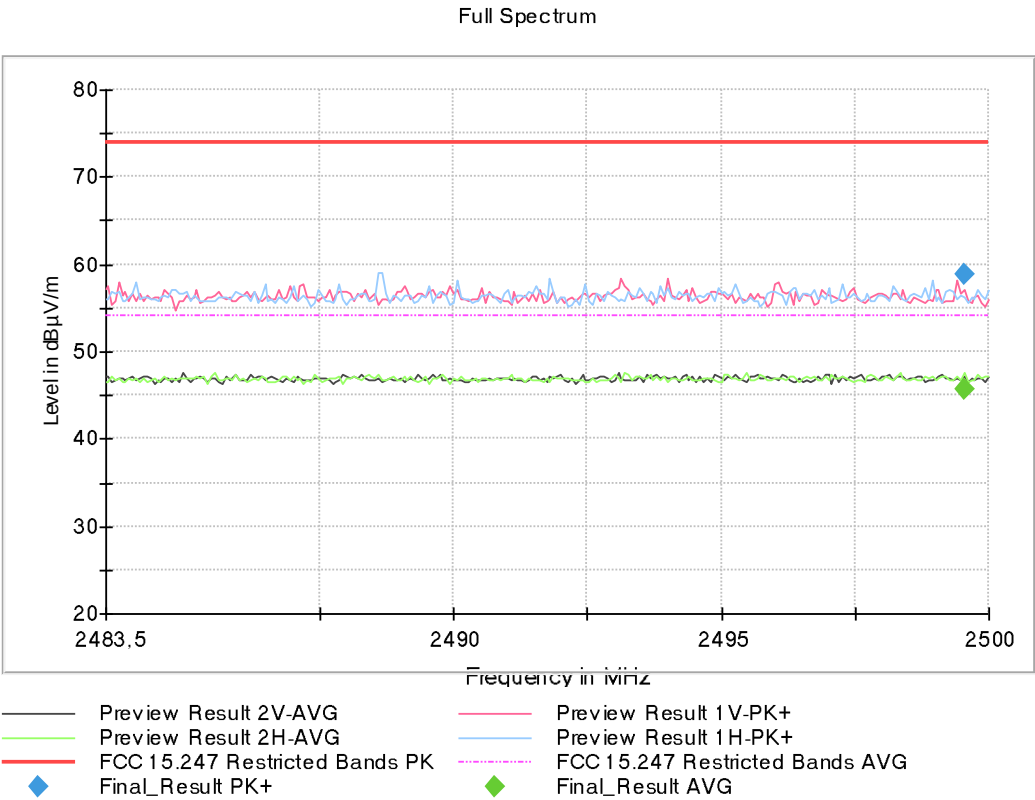


FREQUENCY RANGE 2.4835-2.5 GHz:

- Low Channel:



- Middle Channel:



- High Channel:

