

ISED CABid: ES1909

Test report No:
NIE: 69304RRF.001

Test Report

USA FCC Part 15.247, 15.209

CANADA RSS-247, RSS-Gen

(*) Identification of item tested	WEARABLE BIOSIGNALS MONITOR
(*) Trademark	ACUPEBBLE
(*) Model and /or type reference	ACUPEBBLE 100
Other identification of the product	HW version: C04 SW version: 1.1.0 FCC ID: 2A258-AP100C04 IC: Not provided
(*) Features	Bluetooth LE
Applicant	Acurable Limited Finsgate, 5-7 Cranwood Street, London EC1V 9EE, United Kingdom
Test method requested, standard	USA FCC Part 15.247 (10-1-20 Edition): Operation within the bands 902 - 928 MHz, 2400 -2483.5 MHz, and 5725 - 5850 MHz. USA FCC Part 15.209 (10-1-20 Edition): Radiated emission limits; general requirements. CANADA IC RSS-247 Issue 2 (February 2017). CANADA IC RSS-Gen Issue 5 (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)	Rafael López Martín EMC Consumer & RF Lab. Manager
Date of issue	2021-11-18
Report template No	FDT08_23 (*) "Data provided by the client"

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Competences and guarantees

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

DEKRA Testing and Certification 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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General conditions

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2. This report does not constitute or imply on its own an approval of the product by the Certification Bodies or competent Authorities.
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4. This test report cannot be used partially or in full for publicity and/or promotional purposes without previous written permission of DEKRA Testing and Certification S.A.U. and the Accreditation Bodies.

Uncertainty

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

Data provided by the client

The following data has been provided by the client:

1. Information relating to the description of the sample ("Identification of the item tested", "Trademark", "Model and/or type reference tested").

2. The sample of the model ACUPEBBLE 100 is a AcuPebble is a miniature electronic wireless wearable device, enclosed in a plastic case which is intended to be worn attached to the body with double coated medical tape. AcuPebble aims to capture body sounds. The sensed acoustic signal is interfaced with very low power electronic blocks which optimize both the quality of the signal and the wireless transmission to commercially existing mobile base stations (for example mobile phone or tablet which are Bluetooth Low Energy compatible). Transmission is carried out using a commercial Bluetooth Low Energy (BLE) integrated circuit. AcuPebble operates with a small Li-Po battery (80mAh capacity), which has been tested for safety as per EN62133:2013. In continuous operation, the system can function for over 23 hours (although note that for the intended purpose less than half of this is needed). Hence the average current through the system is less than 4mA. The device can be recharged using a standard micro-USB connector.connectivity.

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
69304/008	WEARABLE BIOSIGNALS MONITOR	ACUPEBBLE 100	--	2021/08/23

Sample S/01 has undergone the following test(s): All RADIATED tests indicated in the Appendix A for Low Channel (2402 MHz).

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

Control N°	Description	Model	Serial N°	Date of reception
69304/010	WEARABLE BIOSIGNALS MONITOR	ACUPEBBLE 100	--	2021/08/23

Sample S/02 has undergone the following test(s): All RADIATED tests indicated in the Appendix A for Middle Channel (2440 MHz).

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

Control N°	Description	Model	Serial N°	Date of reception
69304/012	WEARABLE BIOSIGNALS MONITOR	ACUPEBBLE 100	--	2021/08/23

Sample S/01 has undergone the following test(s): All RADIATED tests indicated in the Appendix A for High Channel (2480 MHz).

- Sample S/04 is composed of the following elements:

Control N°	Description	Model	Serial N°	Date of reception
69304/002	WEARABLE BIOSIGNALS MONITOR	ACUPEBBLE 100	--	2021/08/23

Sample S/04 has undergone the following test(s): All CONDUCTED tests indicated in the Appendix A for Low Channel (2402 MHz).

- Sample S/05 is composed of the following elements:

Control N°	Description	Model	Serial N°	Date of reception
69304/004	WEARABLE BIOSIGNALS MONITOR	ACUPEBBLE 100	--	2021/08/23

Sample S/05 has undergone the following test(s): All CONDUCTED tests indicated in the Appendix A for Middle Channel (2440 MHz).

- Sample S/06 is composed of the following elements:

Control N°	Description	Model	Serial N°	Date of reception
69304/006	WEARABLE BIOSIGNALS MONITOR	ACUPEBBLE 100	--	2021/08/23

Sample S/06 has undergone the following test(s): All CONDUCTED tests indicated in the Appendix A for High Channel (2480 MHz).

Test sample description

Ports..... :	Port name and description	Cable					
		Specified max length [m]	Attached during test	Shielded	Coupled to patient ⁽³⁾		
	--		☐	☐	☐		
Supplementary information to the ports..... :	--						
Rated power supply	Voltage and Frequency		Reference poles				
			L1	L2	L3	N	PE
	☐	AC:	☐	☐	☐	☐	☐
	☒	DC: 3.7 Vdc					
Rated Power	Avg power: 14.1 mW						
Clock frequencies..... :	32.768 kHz, 32.0 MHz						
Other parameters	--						
Software version	1.1.0						
Hardware version	C04						
Dimensions in cm (W x H x D)	Circle with a diameter of 29.5 mm (2.95cm)						
Mounting position	☒	Other: Body worn equipment					
Modules/parts..... :	Module/parts of test item		Type		Manufacturer		
	--						
Accessories (not part of the test item)	Description		Type		Manufacturer		
	Apple iPhone SE for receiving data				Apple		
Documents as provided by the applicant..... :	Description		File name		Issue date		
	--						

⁽³⁾ Only for Medical Equipment

Identification of the client

Acurable Limited
Finsgate, 5-7 Cranwood Street,
London EC1V 9EE, United Kingdom

Testing period and place

Test Location	DEKRA Testing and Certification S.A.U.
Date (start)	2021-09-14
Date (finish)	2021-09-17

Document history

Report number	Date	Description
69304RRF.001	2021-11-18	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: Jaime Barranquero.

Used instrumentation:

Conducted Measurements:

		Last Calibration	Due Calibration
1.	Shielded Room ALBATROSS PROJECTS GMBH P29419	N.A.	N.A.
2.	Spectrum Analyzer ROHDE AND SCHWARZ FSW50	2021/07	2023/07
3.	DC Power supply 30V/3A 90W 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	2020/01	2023/01
2.	Shielded Room ALBATROSS PROJECTS GMBH P29419	N.A.	N.A.
3.	EMI Test Receiver 2 Hz - 44 GHz Rhode and Schwarz ESW44	2019/10	2021/10
4.	Ultralog Antenna 30MHz-6GHz, ROHDE AND SCHWARZ HL562E_UPG	2019/10	2022/10
5.	Horn Antenna 1-18 GHz SCHWARZBECK MESS-ELEKTRONIK BBHA 9120 D	2019/11	2022/11
6.	Preamplifier 30dB 500MHz-18GHz, SCHWARZBECK BBV 9718 C	2021/02	2022/02
7.	Horn Antenna 18-40 GHz SCHWARZBECK BBHA 9170	2021/03	2024/03
8.	Pre-amplifier G>30dB 18-40 GHz BONN ELEKTRONIK BLMA 1840-3G	2019/11	2021/11
9.	DC Power supply 30V/3A 90W 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 1M

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 5.0 (only 1M)

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FCC 15.247 (d) / RSS-247 5.5. Emission limitations radiated (Transmitter).....25

TEST CONDITIONS

POWER SUPPLY (V):

V nominal:	3.7 Vdc
Type of Power Supply:	DC power supply.

ANTENNA:

Type of Antenna:	Chip antenna.
Maximum Declared Antenna Gain:	-0.5 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 (Bilog antenna for the range between 30 MHz to 1000 MHz) and 1 GHz-18 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).

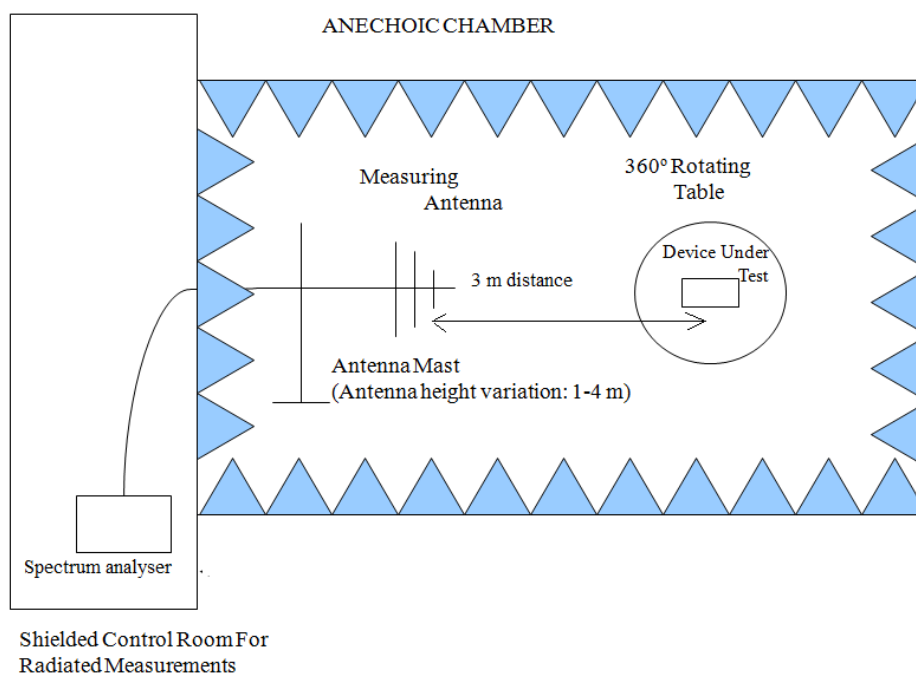
For radiated emissions in the range 17 GHz-26 GHz that is performed at a distance closer than the specified distance, an inverse proportionality factor of 20 dB per decade is used to normalize the measured data for determining compliance.

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.

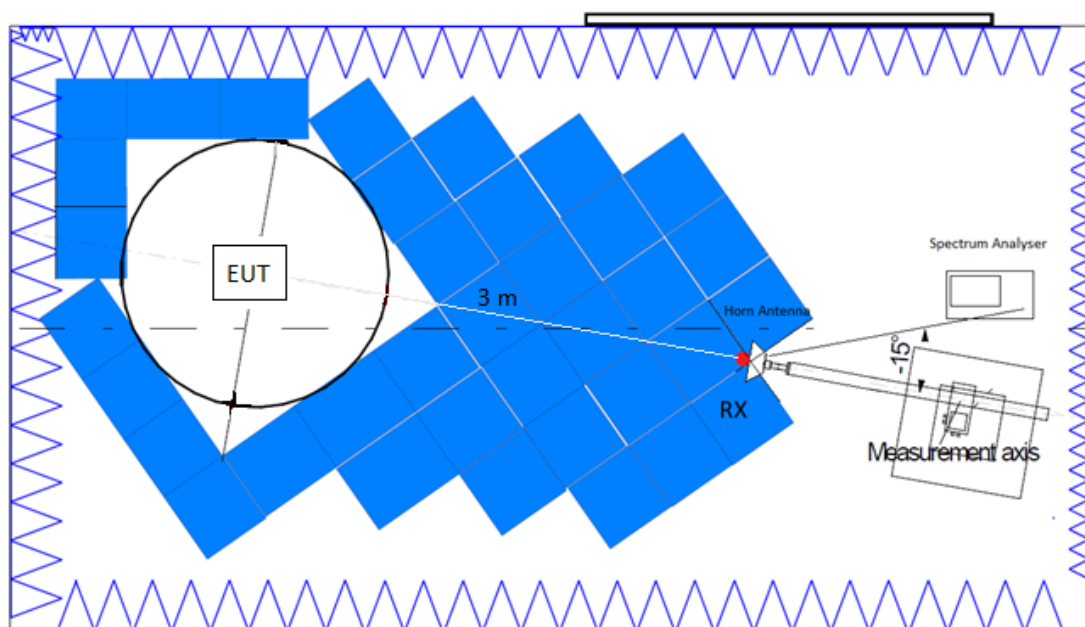
Measurements were made in both horizontal and vertical planes of polarization.

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

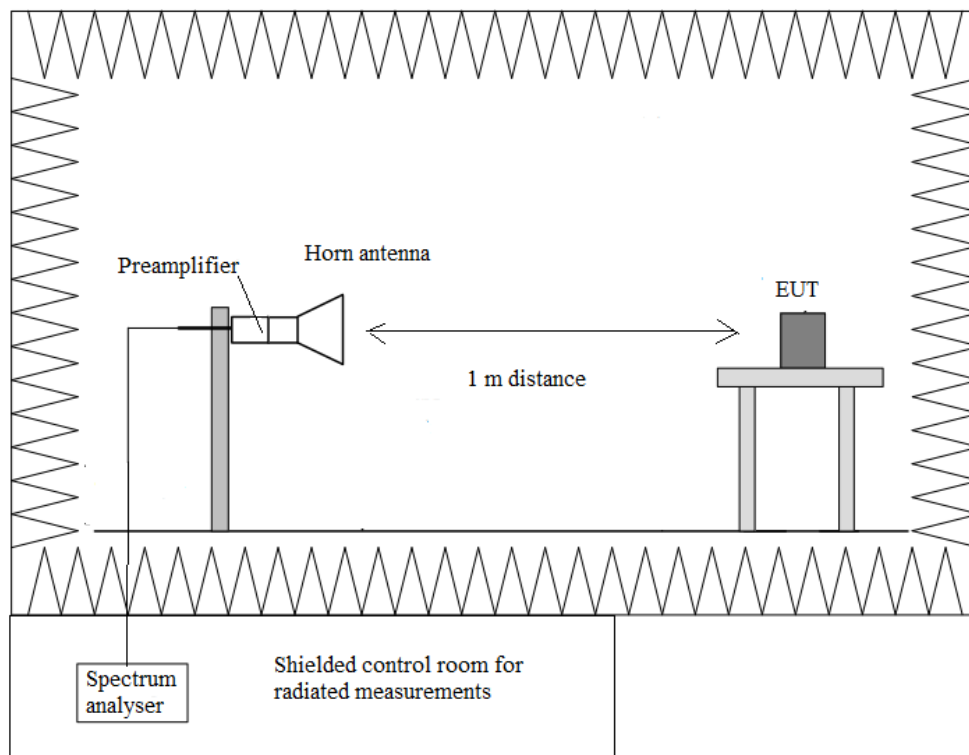
Radiated measurements setup from 30 MHz to 1 GHz:



Radiated measurements setup from 1 GHz to 17 GHz:



Radiated measurements setup $f > 17$ GHz:



Occupied Bandwidth

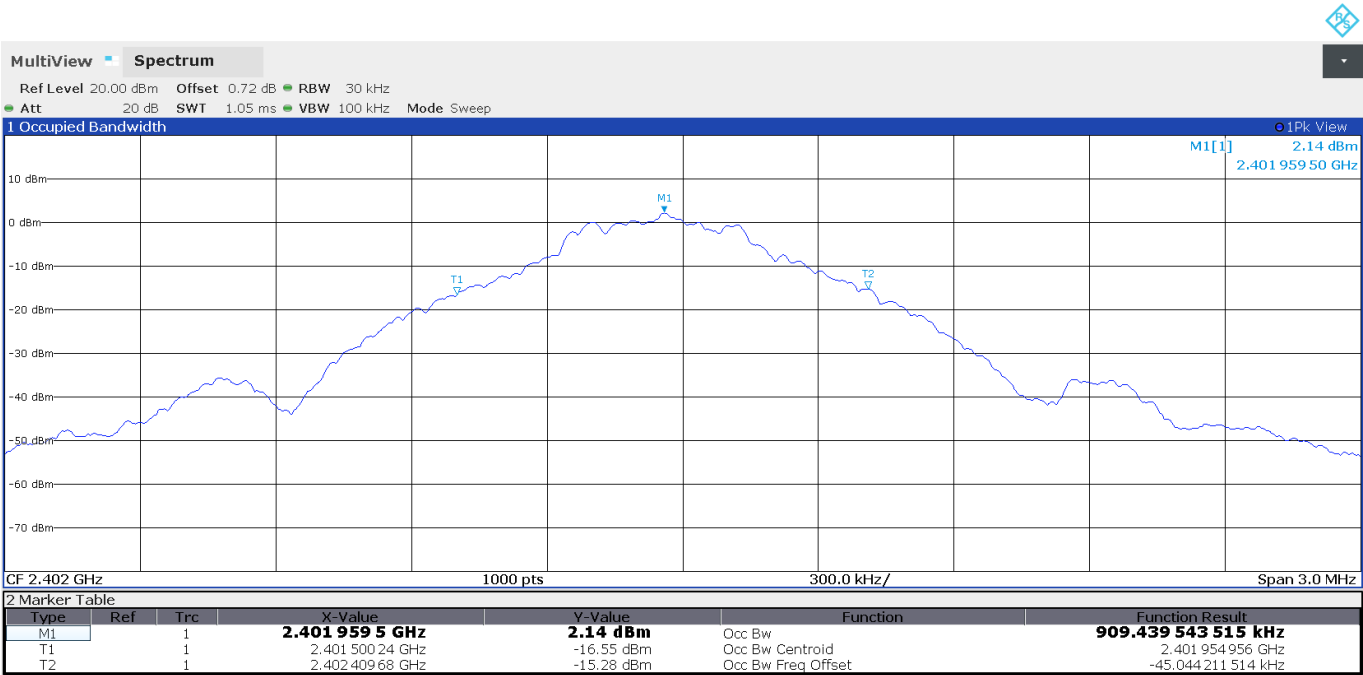
RESULTS:

1M modulation:

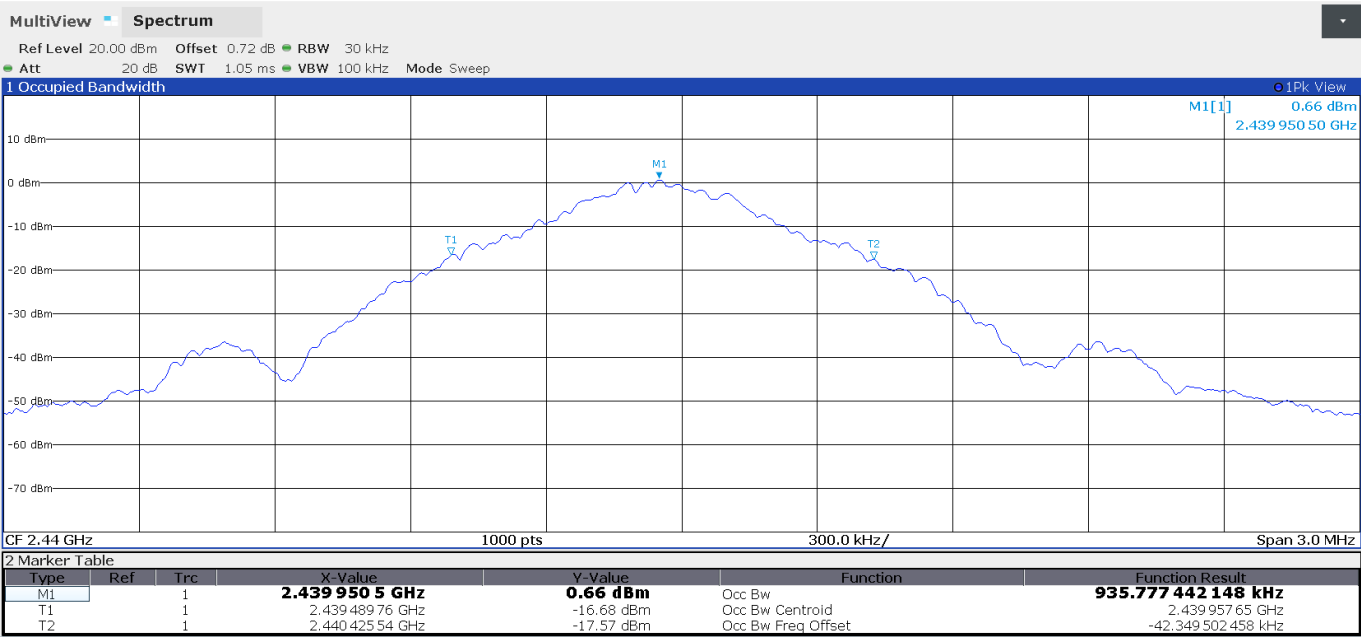
	Low Channel 2402 MHz	Middle Channel 2440 MHz	High Channel 2480 MHz
99% bandwidth (MHz)	0.90	0.93	0.91
Measurement uncertainty (kHz)	<± 5.20		

Verdict: PASS

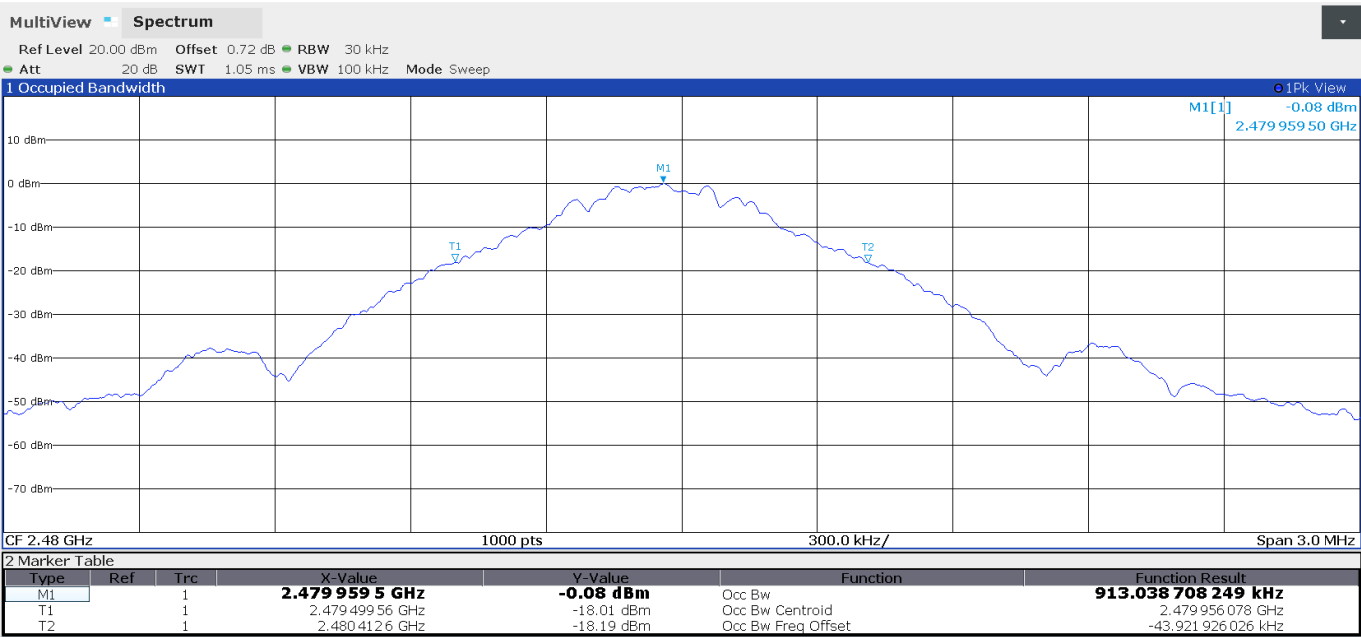
- Low Channel:



- 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:

- 1M modulation:

	Low Channel 2402 MHz	Middle Channel 2440 MHz	High Channel 2480 MHz
6 dB Bandwidth (kHz)	501.50	500.50	500.50
Measurement uncertainty (kHz)	<± 12.75		

Verdict: PASS

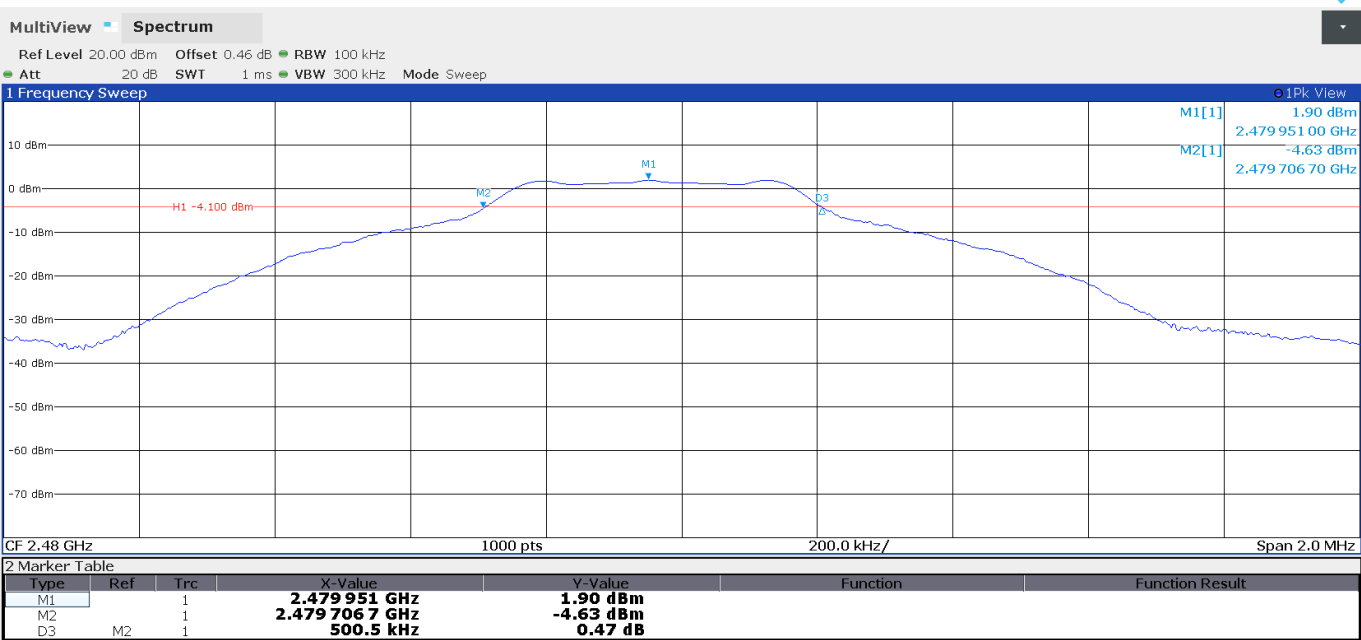
- Low Channel:



- 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: -0.5 dBi

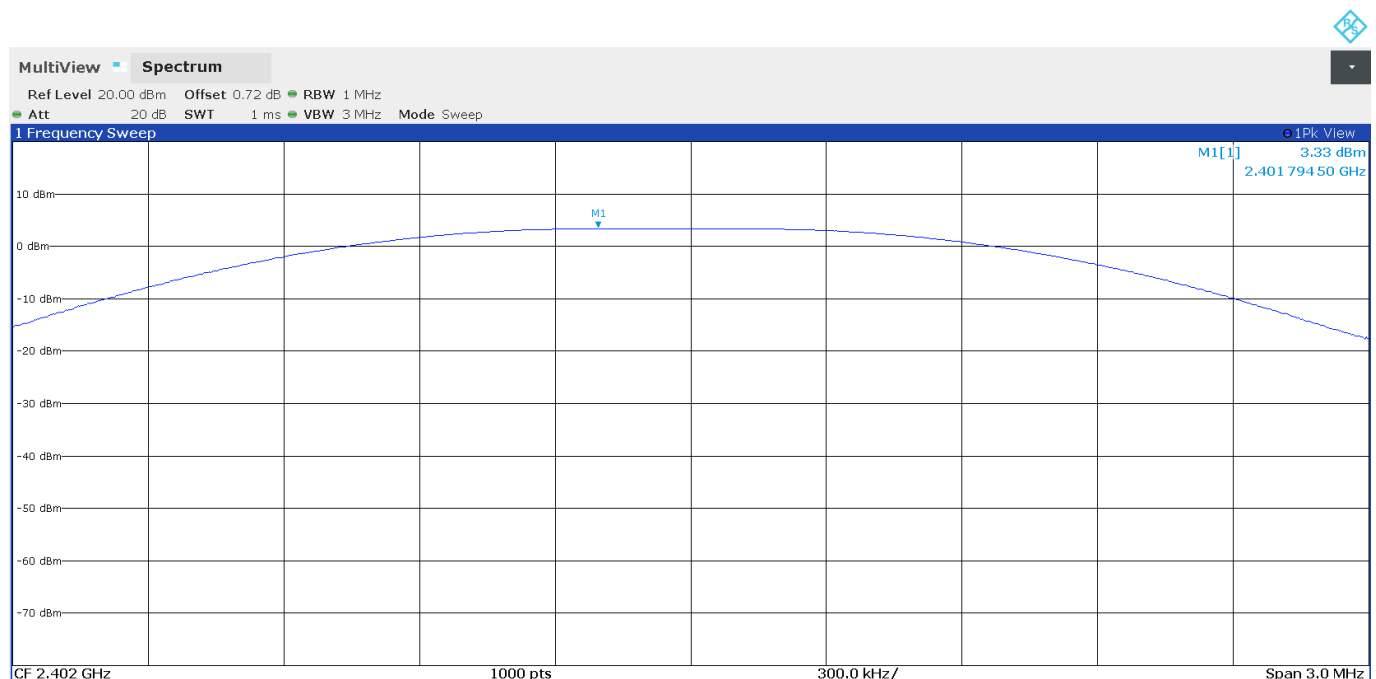
• 1M modulation:

	Low Channel 2402 MHz	Middle Channel 2440 MHz	High Channel 2480 MHz
Maximum conducted power (dBm)	3.33	1.79	1.91
Maximum EIRP Power (dBm)	2.83	1.29	1.41
Measurement uncertainty (dB)	< $\pm$ 0.99		

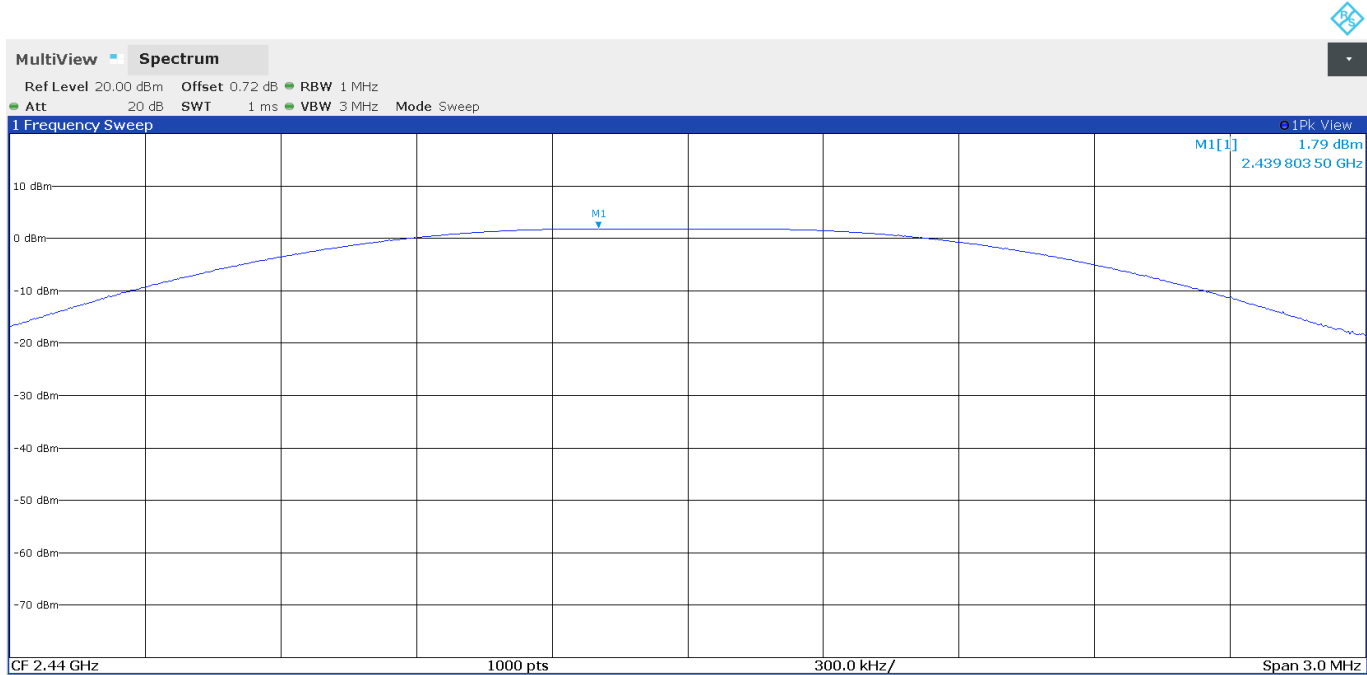
The maximum directional gain of the antenna is less than 6 dBi and therefore the maximum output power is not required to be reduced from the stated values.

Verdict: PASS

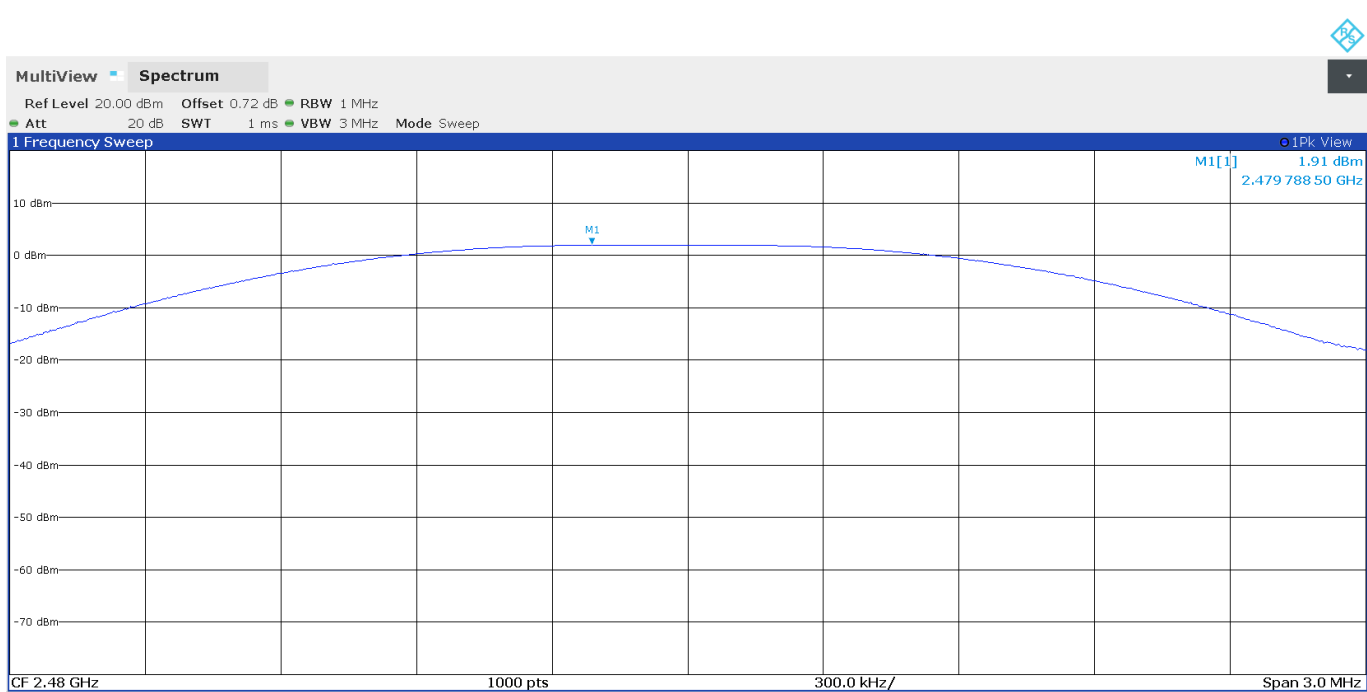
- Low Channel:



- Middle Channel:



- High Channel:



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

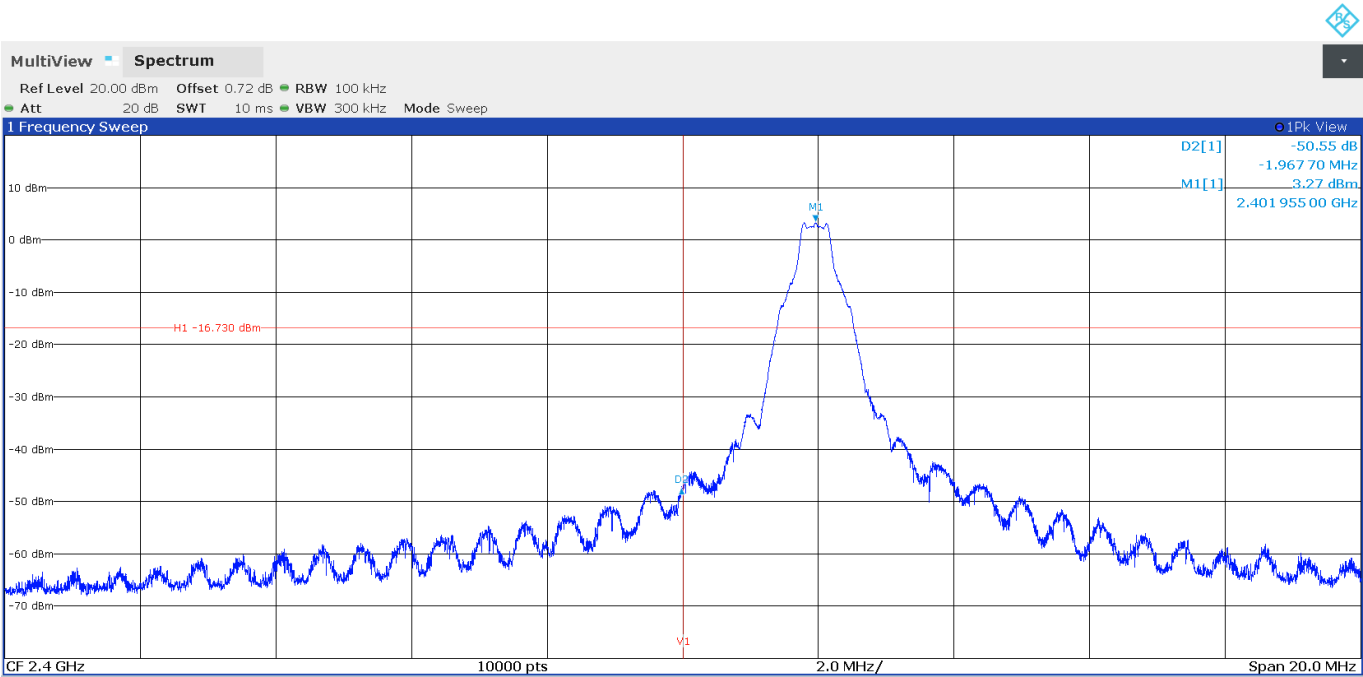
SPECIFICATION:

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:

- 1M modulation:

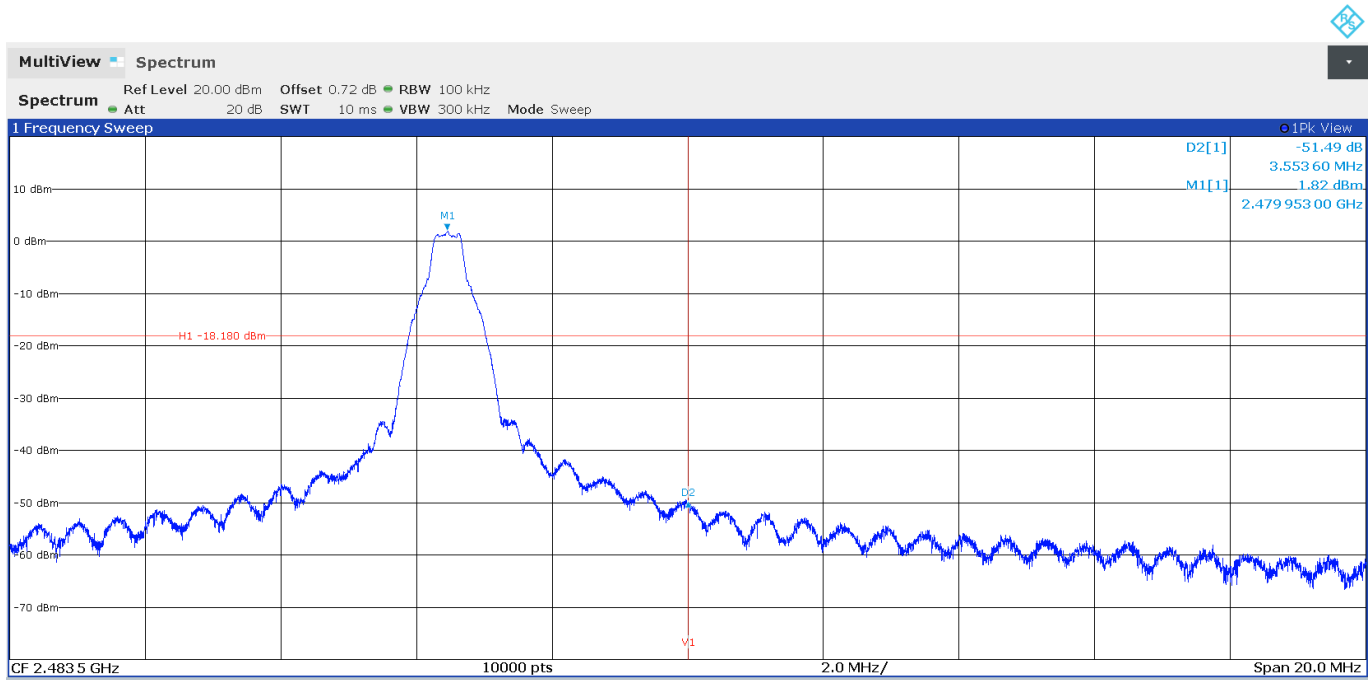
- Low Channel:



Measurement uncertainty (dB) <± 2.53

Verdict: PASS

- High Channel:



Measurement uncertainty (dB) <± 2.53

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:

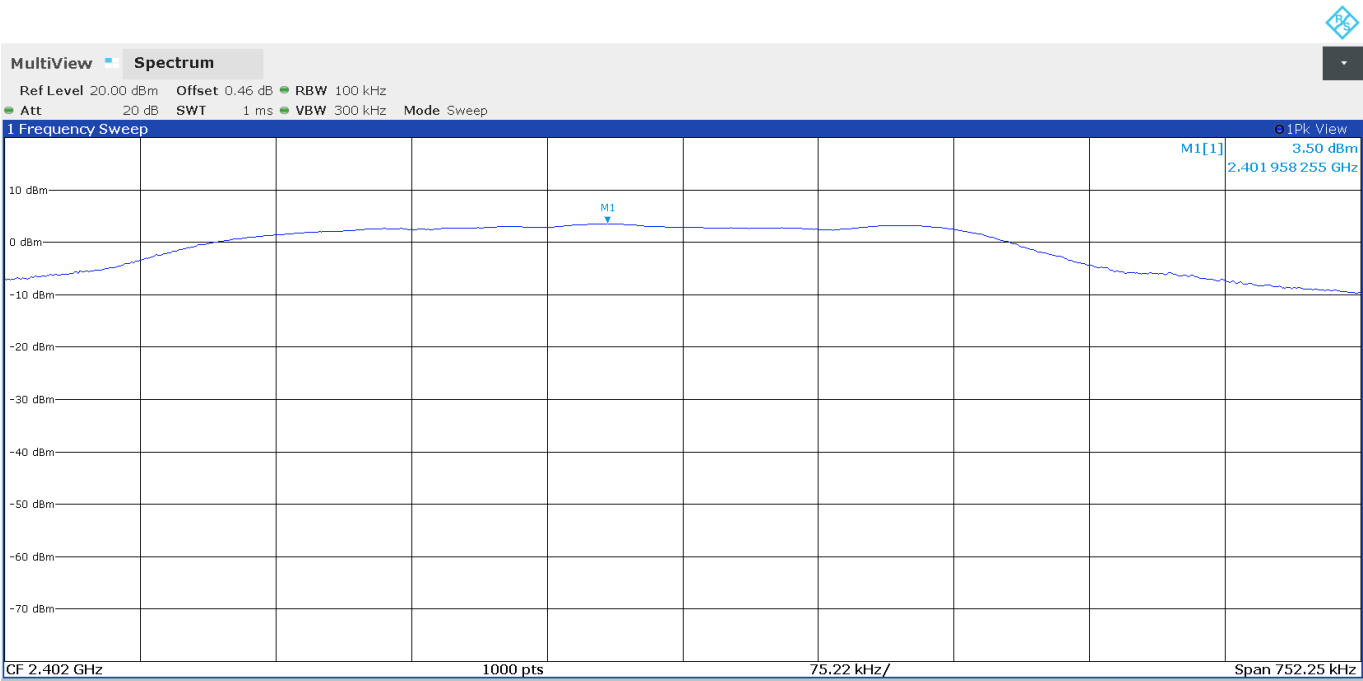
The maximum power spectral density level in the fundamental emission was measured using the method according to point 11.10.2.” Method PKPSD (peak PSD)” of ANSI C.63.10-2013.

1M modulation:

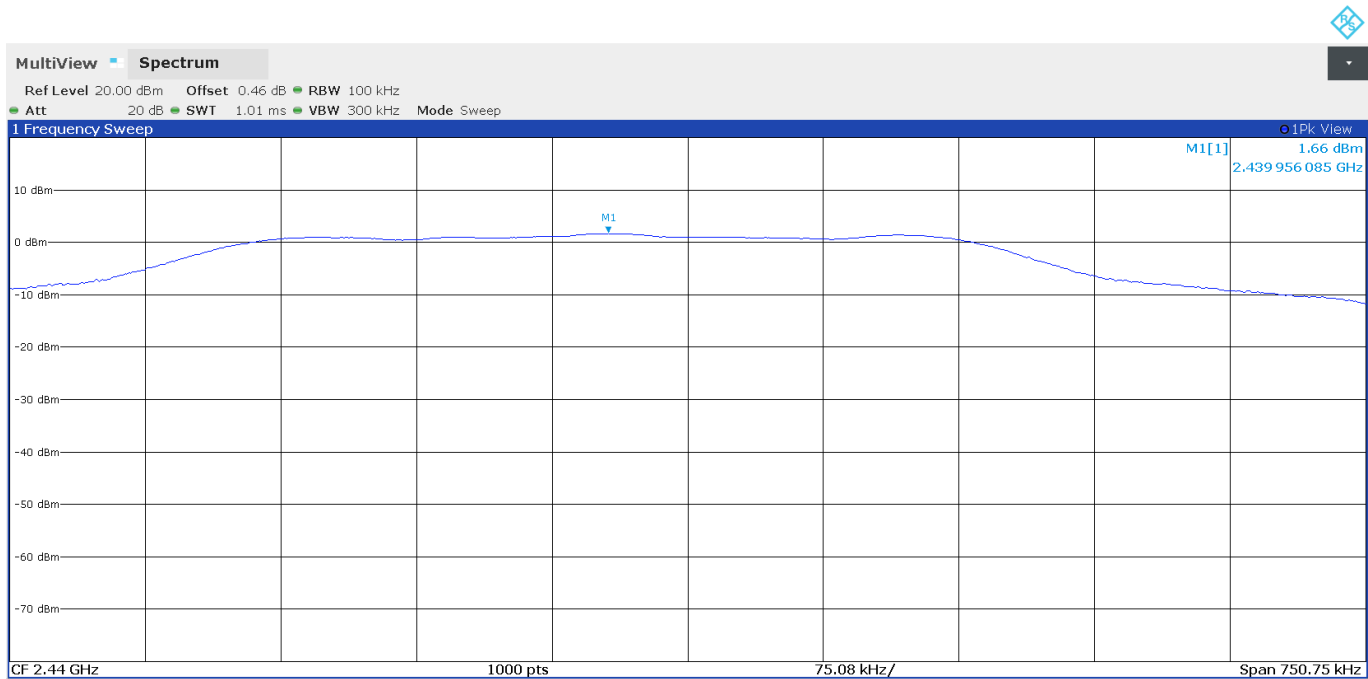
	Low Channel 2402 MHz	Middle Channel 2440 MHz	High Channel 2480 MHz
Power Spectral Density (dBm)	3.50	1.66	1.85
Measurement uncertainty (dB)	<± 0.99		

Verdict: PASS

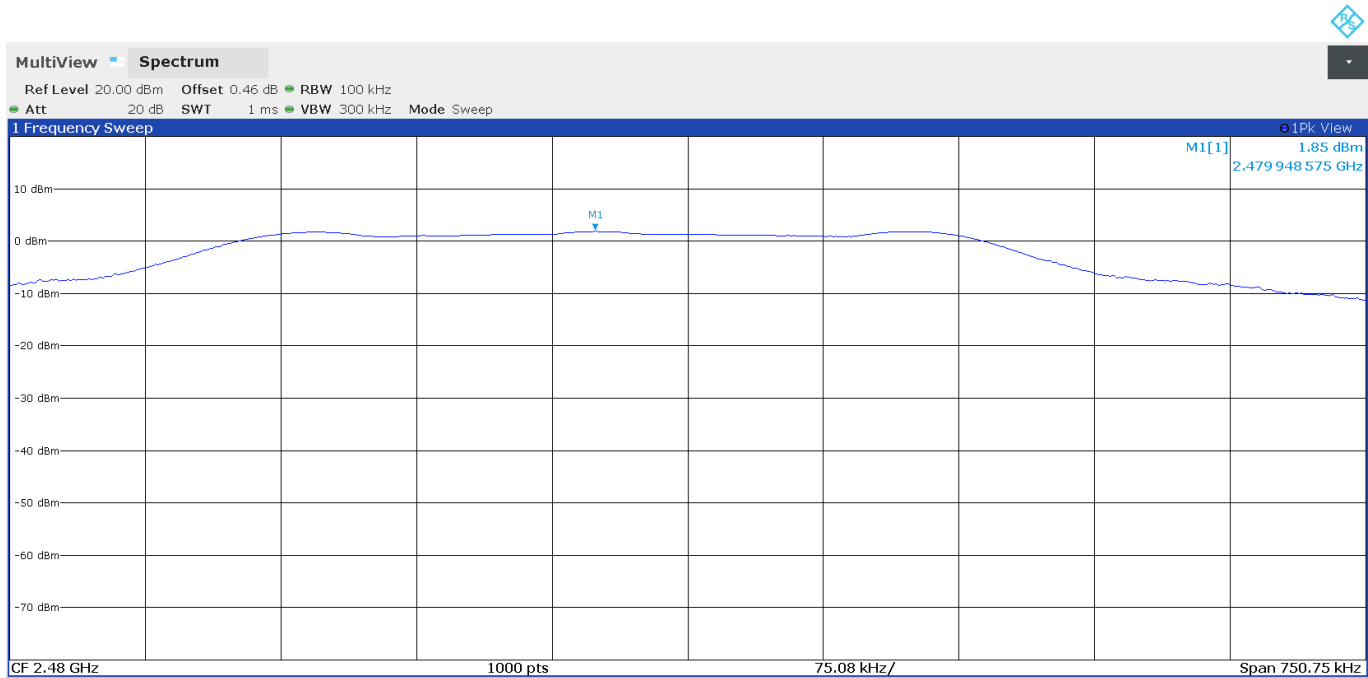
- Low Channel:



- 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-25 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.

- **1M modulation:**

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 detected at less than 20 dB below the limit:

Measurement Uncertainty (dB): ± 4.94

Frequency range 1 - 26 GHz:

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

Spurious frequencies with peak levels above the average limit (54 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)	Detector	Polarization
4.8035	57.88	Peak	H
	47.02	Average	
7.2065	51.37	Peak	V
11.5840	51.69	Peak	V

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

Spurious frequency (GHz)	Emission Level (dB μ V/m)	Detector	Polarization
4.8795	58.03	Peak	H
	50.48	Average	
7.3200	55.71	Peak	V
12.1905	52.42	Peak	H

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

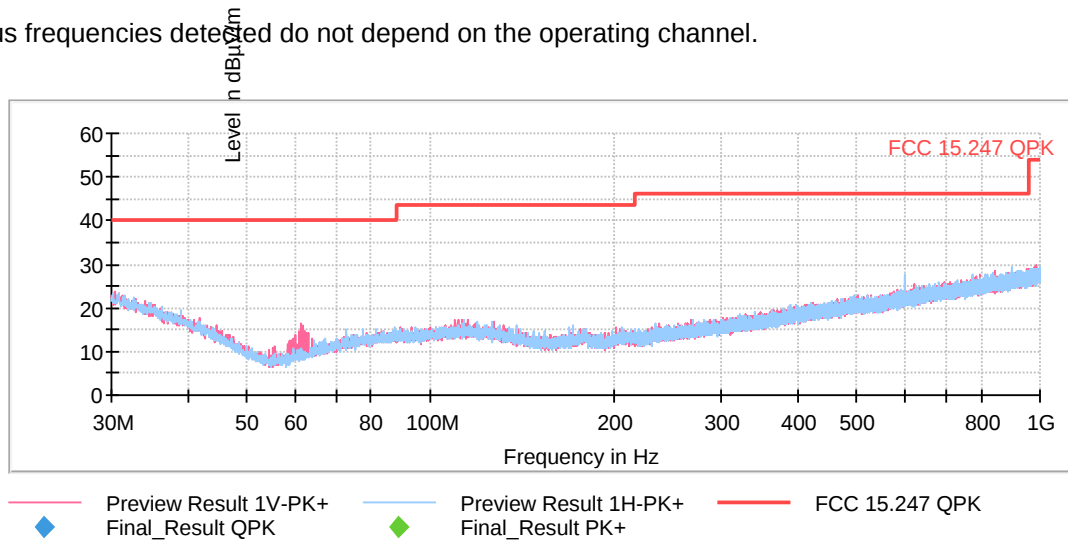
Spurious frequency (GHz)	Emission Level (dB μ V/m)	Detector	Polarization
4.9600	60.18	Peak	H
	53.73	Average	
7.4405	54.66	Peak	V
	46.55	Average	

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

Verdict: PASS

FREQUENCY RANGE 30 MHz - 1 GHz:

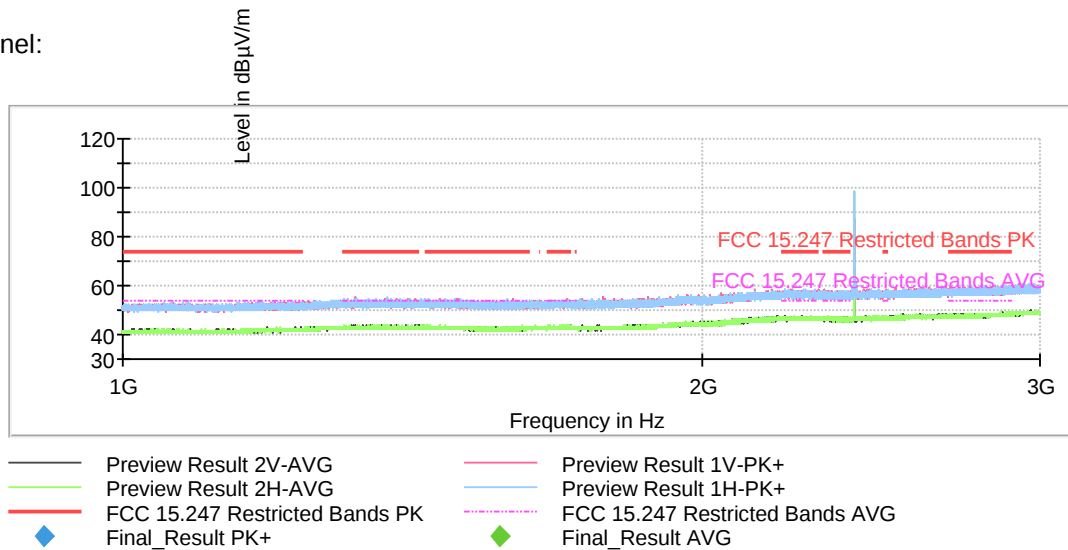
The spurious frequencies detected do not depend on the operating channel.



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

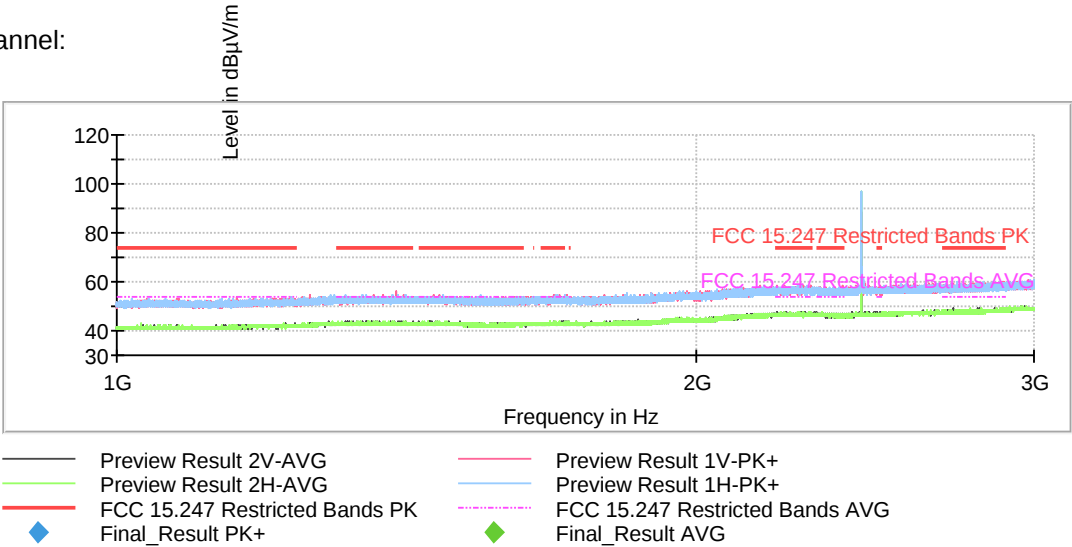
FREQUENCY RANGE 1 - 3 GHz:

- Low Channel:



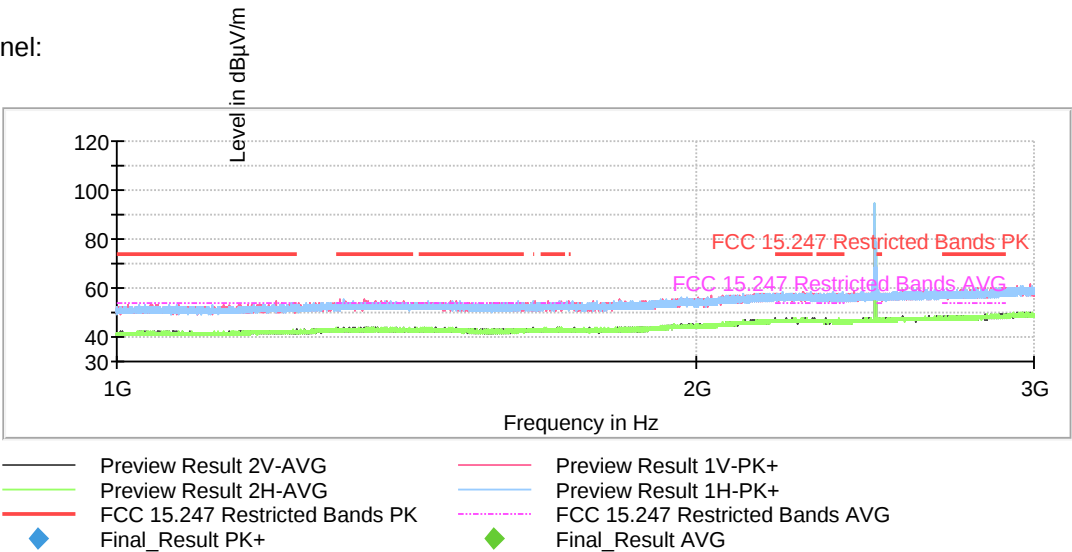
The peak above the limit is the carrier frequency.

- Middle Channel:



The peak above the limit is the carrier frequency.

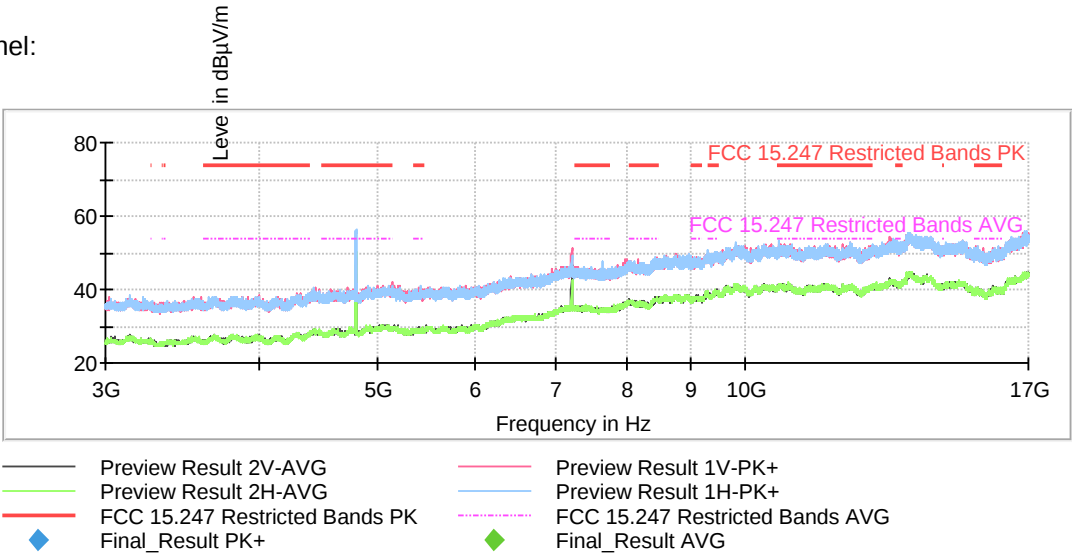
- High Channel:



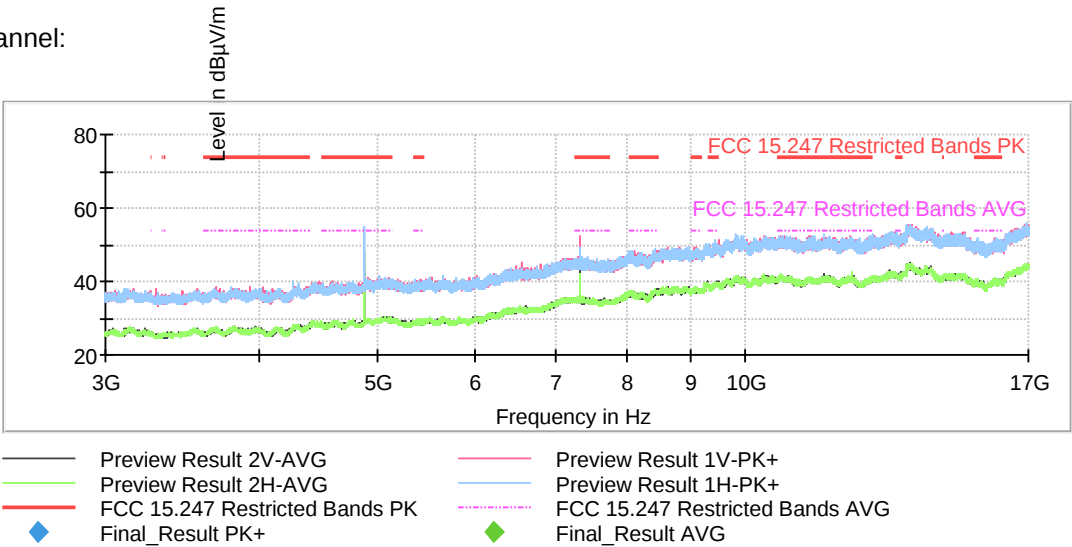
The peak above the limit is the carrier frequency.

FREQUENCY RANGE 3 - 17 GHz:

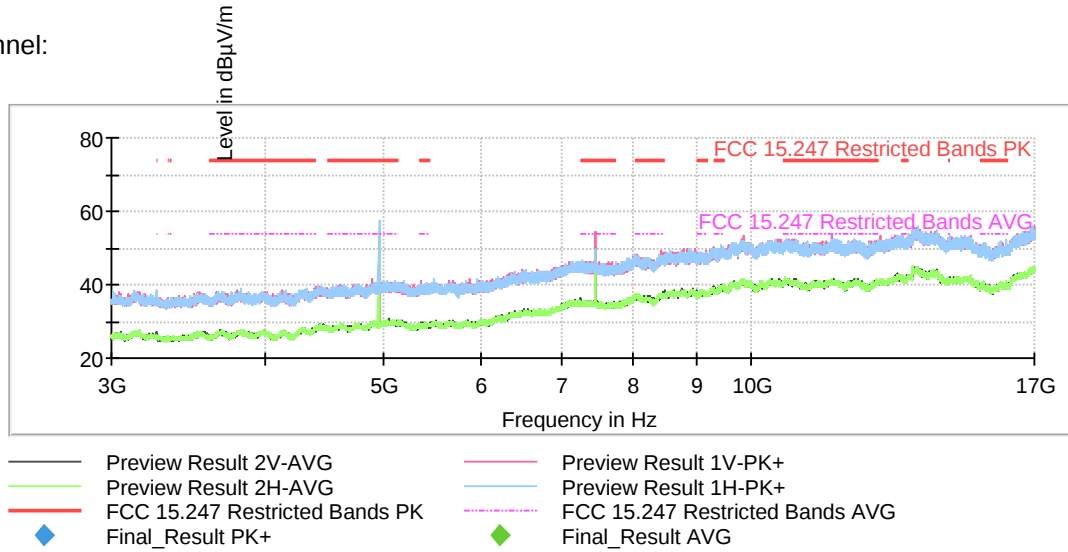
- Low Channel:



- Middle Channel:

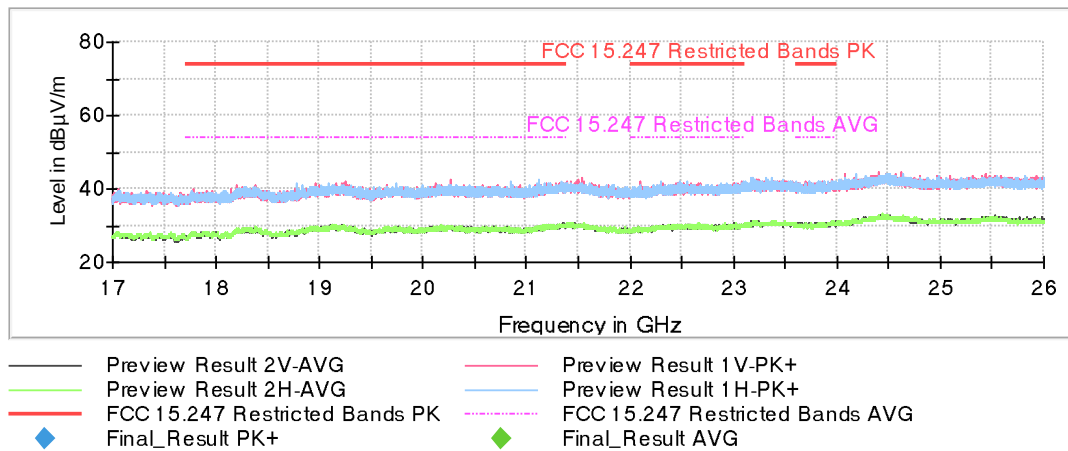


- High Channel:



FREQUENCY RANGE 17 - 26 GHz:

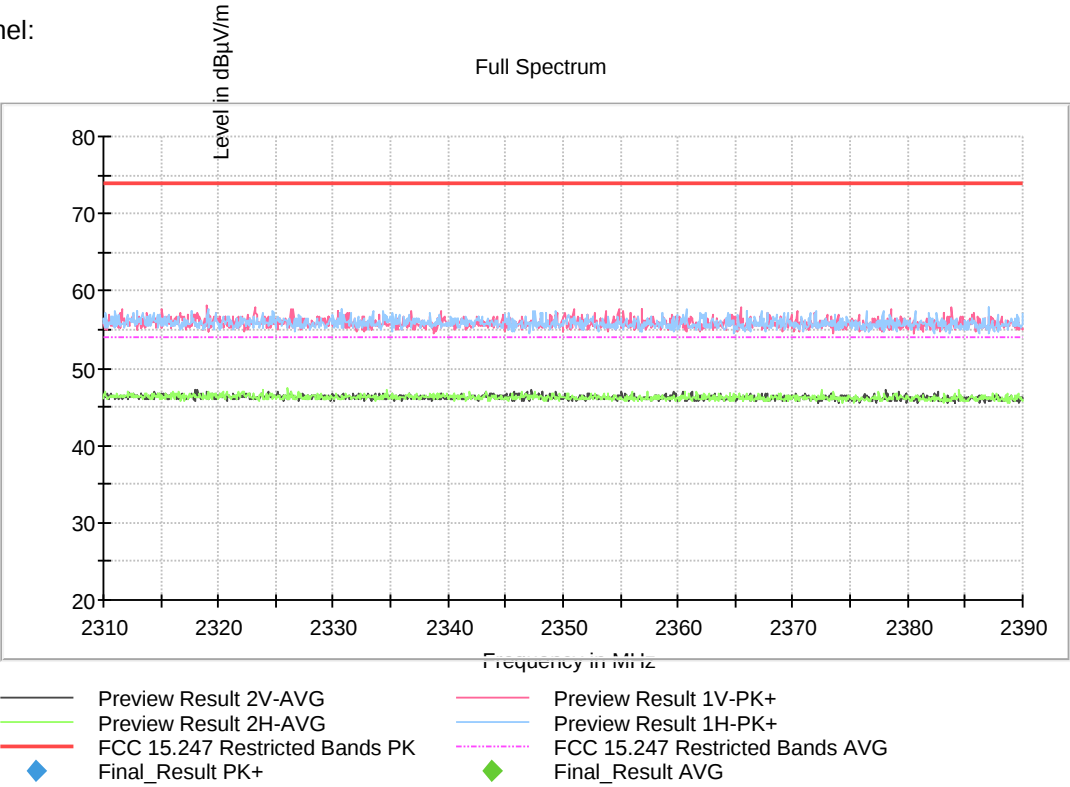
The spurious frequencies detected do not depend on the operating channel.



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

FREQUENCY RANGE 2.31-2.39 GHz:

- Low Channel:



- Middle Channel:

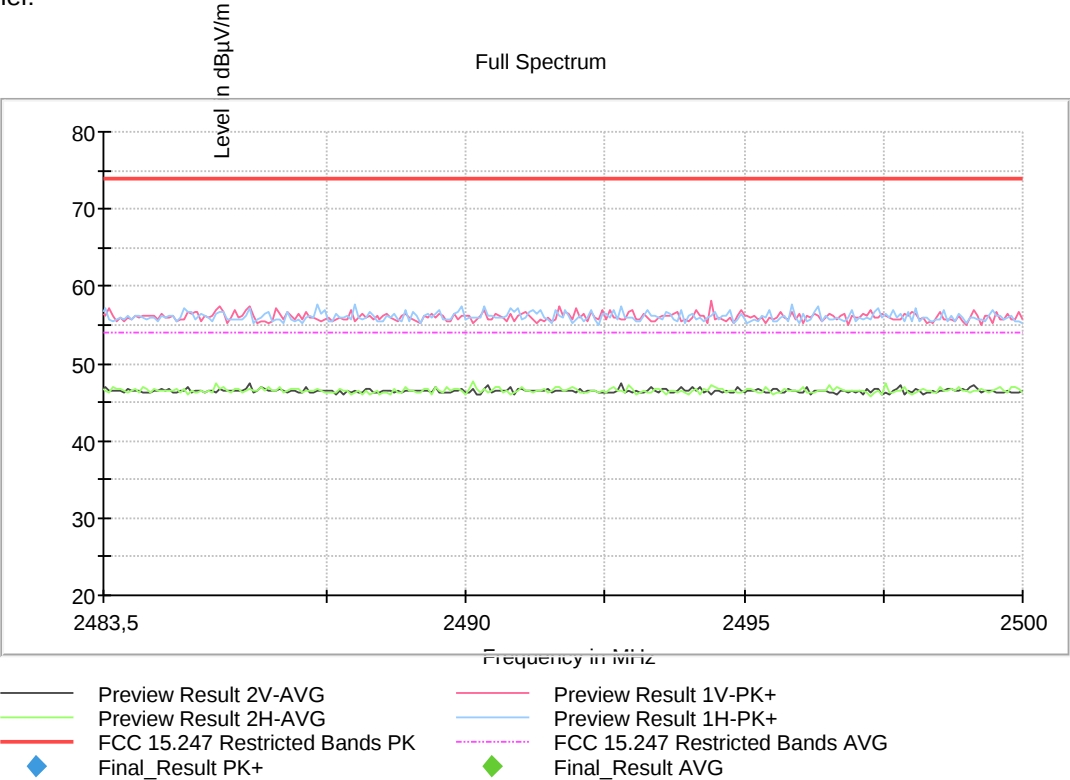


- High Channel:

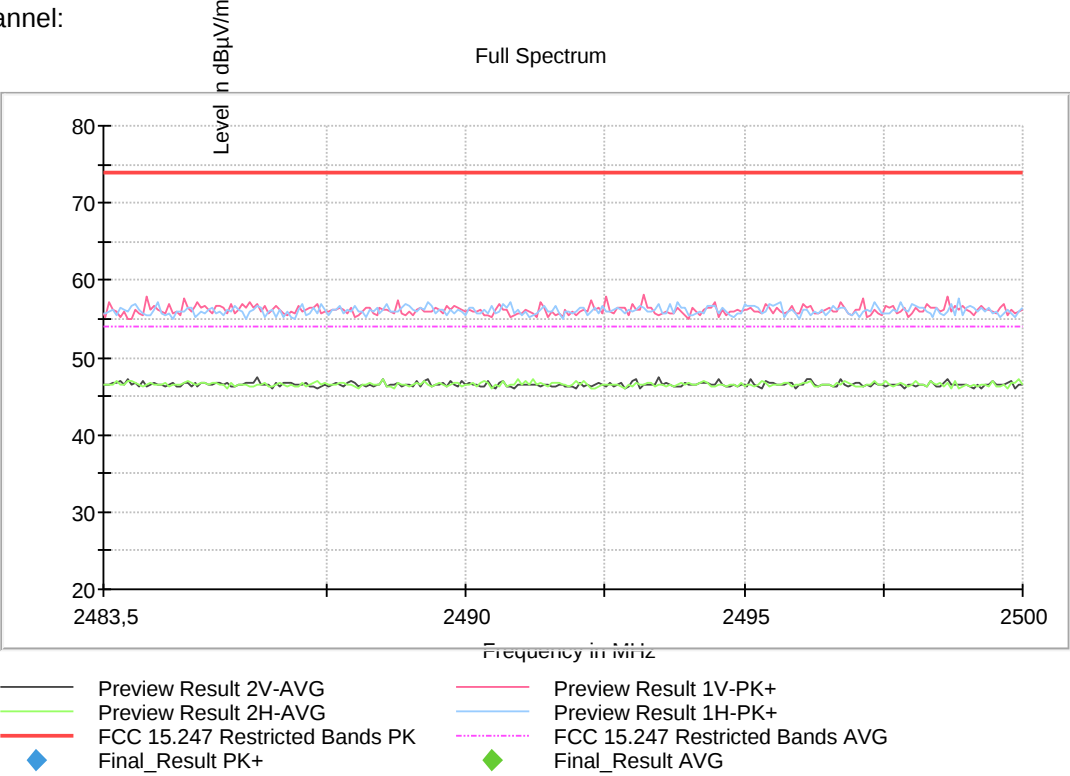


FREQUENCY RANGE 2.4835-2.5 GHz:

- Low Channel:



- Middle Channel:



- High Channel:

