

Test report No:

NIE: 66096RRF.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	Optical heart rate sensor
(*) Trademark	Polar
(*) Model and /or type reference	Polar Verity Sense / 4J
Other identification of the product	HW version: 00784292 SW version: 0.1.1 FCC ID: INW4J IC: 6248A-4J
(*) Features	Bluetooth LE & ANT+ (ANT+ simultaneously with BLE only) optical heart rate
Applicant	Polar Electro Oy Professorintie 5, 90440 Kempele, Finland
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 EMC Consumer & RF Lab. Manager  RAFAEL LÓPEZ MARTÍN 2020.12.28 08:25:24 +01'00'
Date of issue	2020-12-28
Report template No	FDT08_23 (*) "Data provided by the client"

Index

Competences and guarantees3

General conditions3

Uncertainty3

Data provided by the client.....3

Usage of samples4

Test sample description4

Identification of the client.....5

Testing period and place5

Document history5

Environmental conditions6

Remarks and comments7

Testing verdicts.....8

Summary8

Appendix A: Test results. Bluetooth Low Energy 5.0 (2M, 1M).....9

Appendix B: Test results. ANT+55

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 Polar Verity Sense / 4J is an optical heart rate sensor with Bluetooth Low Energy and USB 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°	Reception
66096B/017	Optical Heart Rate Sensor	Polar Verity Sense / 4J	887AE827	2020/10/30
66096B/011	Arm Band	--	--	2020/10/30

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

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

Control N°	Description	Model	Serial N°	Reception
66096B/013	Optical Heart Rate Sensor	Polar Verity Sense / 4J	887AD925	2020/10/30
66096B/007	Arm Band	--	--	2020/10/30

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

Test sample description

Ports..... :	Port name and description	Cable			
		Specified max length [m]	Attached during test	Shielded	Coupled to patient ⁽³⁾
	USB port	0.02	☒	☐	☐
	-		☐	☐	☐
Supplementary information to the ports.....:					
Rated power supply	Voltage and Frequency				
	☒	DC: 3.9 V			
Rated Power	0.25 W				
Clock frequencies	32 MHz, 32,768 kHz				
Other parameters.....:	-				
Software version	0.1.1				
Hardware version.....:	00784292				
Dimensions in cm (W x H x D)....:	Ø 27 mm, thickness 10 mm, weight 5 g				
Mounting position.....:	☐	Table top equipment			
	☐	Wall/Ceiling mounted equipment			
	☐	Floor standing equipment			
	☐	Hand-held equipment			
	☒	Other: Upper arm with Arm Band and holder.			
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 applicable to medical equipments.

Identification of the client

Polar Electro Oy

Professorintie 5, 90440 Kempele, Finland

Testing period and place

Test Location	DEKRA Testing and Certification S.A.U.
Date (start)	2020-11-04
Date (finish)	2020-11-30

Document history

Report number	Date	Description
66096RRF.002	2020-12-28	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: José Manuel Jiménez, Javier Miguel Nadales and Alfonso Gutiérrez.

Used instrumentation:

Conducted Measurements:

	Last Calibration	Due Calibration
1. Signal and Spectrum Analyzer 10 Hz - 40 GHz ROHDE AND SCHWARZ FSV40	2019/09	2021/09
2. Shielded Room ETS LINDGREN S101	N.A.	N.A.
3. DC Power Supply, 30V/5A KEYSIGHT TECHNOLOGIES U8002A	N.A.	N.A.
4. Digital Multimeter, FLUKE 175	2020/11	2021/11

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. Hybrid Bilog Antenna 30MHz-6GHz SUNOL SCIENCES CORPORATION JB6	2018/10	2021/10
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	2019/10	2021/10
6. Digital Multimeter, FLUKE 175	2020/11	2021/11
7. Horn Antenna 1-18 GHz SCHWARZBECK MESS-ELEKTRONIK BBHA 9120 D	2018/01	2021/01
8. Horn Antenna 18 - 40 GHz SCHWARZBECK MESS-ELEKTRONIK BBHA 9170	2020/05	2023/05
9. RF Preamplifier G>30dB, 1-18GHz BONN ELEKTRONIK BLMA 0118-3A	2020/10	2021/10
10. Low Noise Amplifier G>30dB, 18 - 40 GHz BONN ELEKTRONIK BLMA 1840-1M	2019/02	2021/02
11. Signal and Spectrum Analyzer 10 Hz - 40 GHz ROHDE AND SCHWARZ FSV40	2019/10	2021/10
12. Digital Multimeter, FLUKE 175	2020/11	2021/11

Testing verdicts

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

Summary

1. Bluetooth Low Energy 5.0 (2M, 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.			

2. ANT+.

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 (2M, 1M)

TEST CONDITIONS.....	11
Occupied Bandwidth	14
FCC 15.247 (a)(2) / RSS-247 5.2. (a) 6 dB Bandwidth	18
FCC 15.247 (b) / RSS-247 5.4. (d) Maximum Output Power and Antenna Gain	22
FCC 15.247 (d) / RSS-247 5.5. Band-Edge Emissions Compliance (Transmitter)	28
FCC 15.247 (e) / RSS-247 5.2. (b) Power Spectral Density.....	31
FCC 15.247 (d) / RSS-247 5.5. Emission Limitations Radiated (Transmitter)	35

TEST CONDITIONS

POWER SUPPLY (V):

Vnominal:	3.9 Vdc
Type of Power Supply:	Battery.
Type of Antenna:	Integral.
Maximum Declared Antenna Gain:	-1 dBi

TEST FREQUENCIES:

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

- WORST CASE: Pre-scan performed with the Swimming Holder and the Arm Band, being the worst case the one with the Arm Band.

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.



The DC supply voltage is applied using an external calibrated power supply with a multimeter.

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 (antenna and 18 GHz-40 GHz horn antenna).

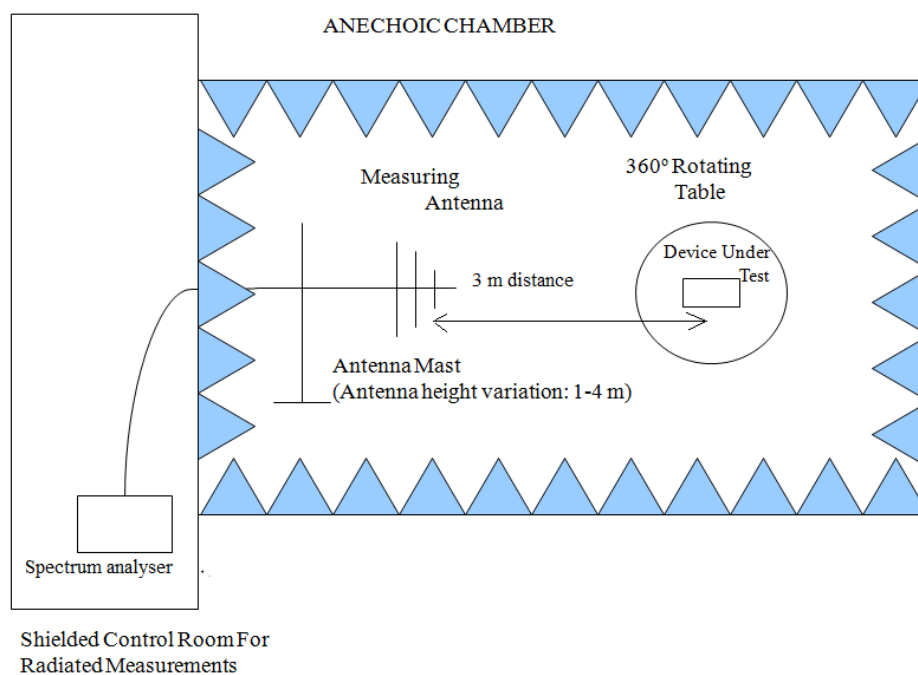
For radiated emissions in the range 17 GHz-26 GHz that is performed at a distance closer than the specified distance, an inverse proportionality factor of 20 dB per decade is used to normalize the measured data for determining compliance.

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.

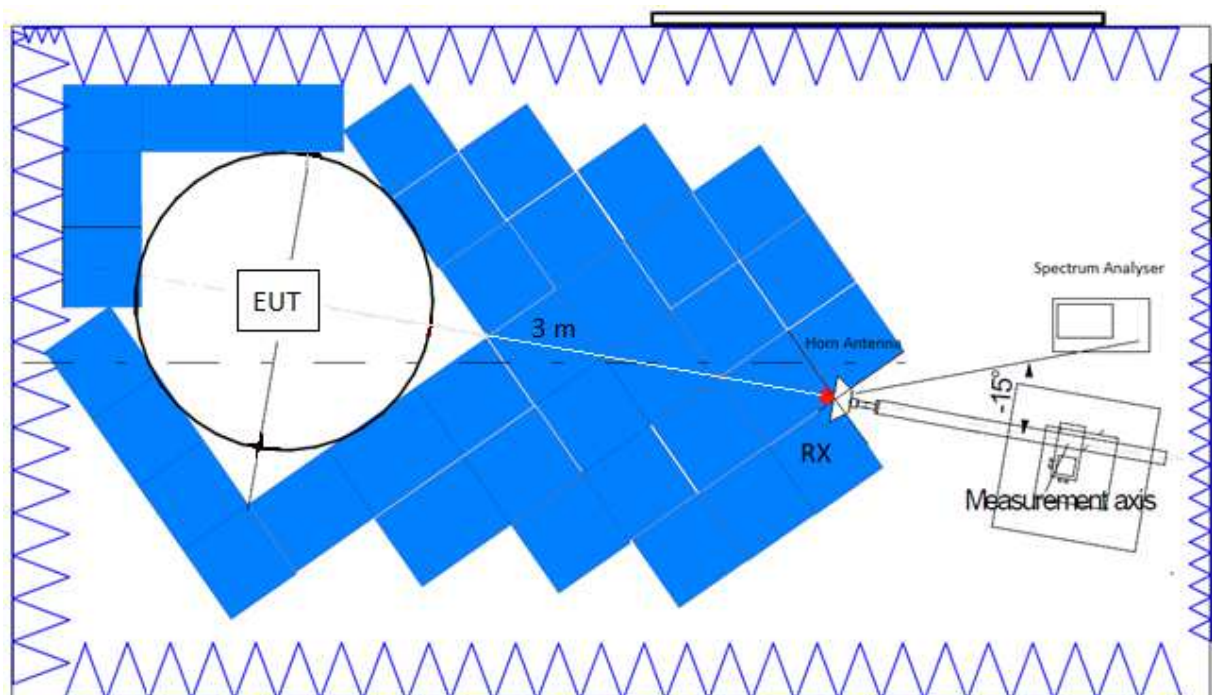
Measurements were made in both horizontal and vertical planes of polarization.

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.

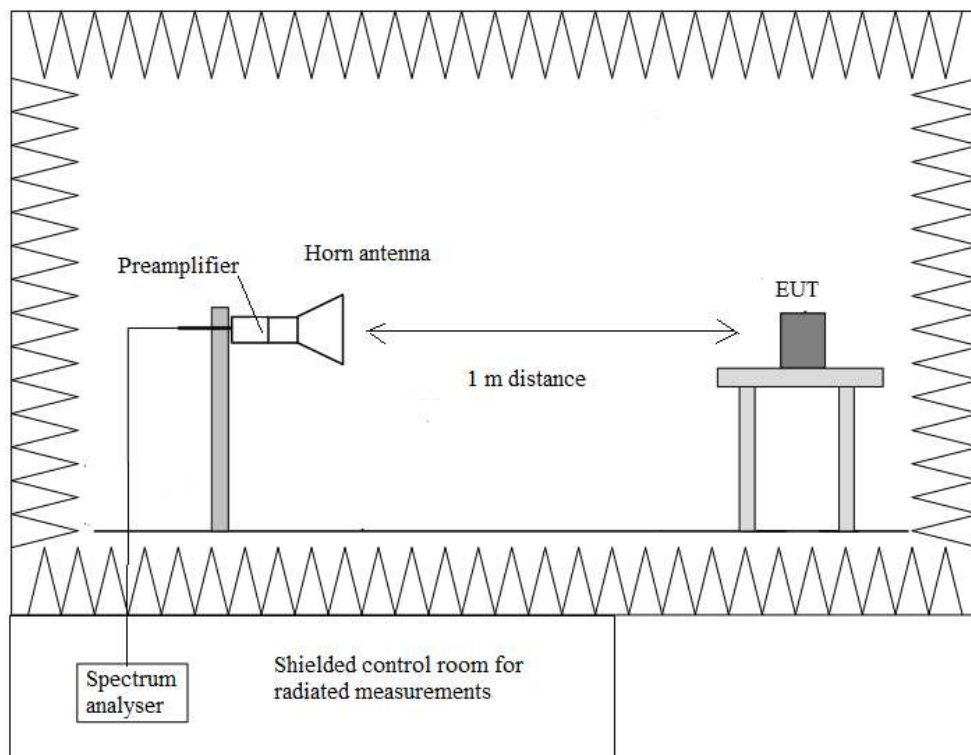
Radiated measurements setup from 30 MHz to 1 GHz:



Radiated measurements setup from 1 GHz to 17 GHz:



Radiated measurements setup $f > 17$ GHz:



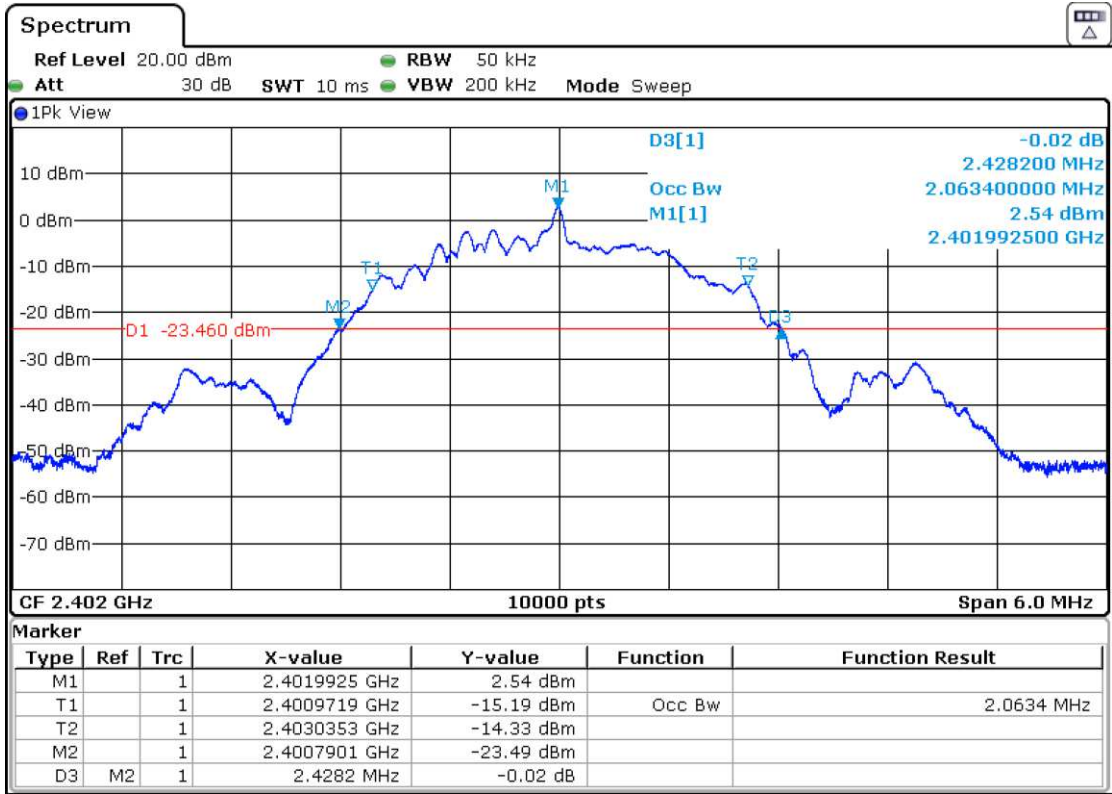
Occupied Bandwidth

RESULTS:

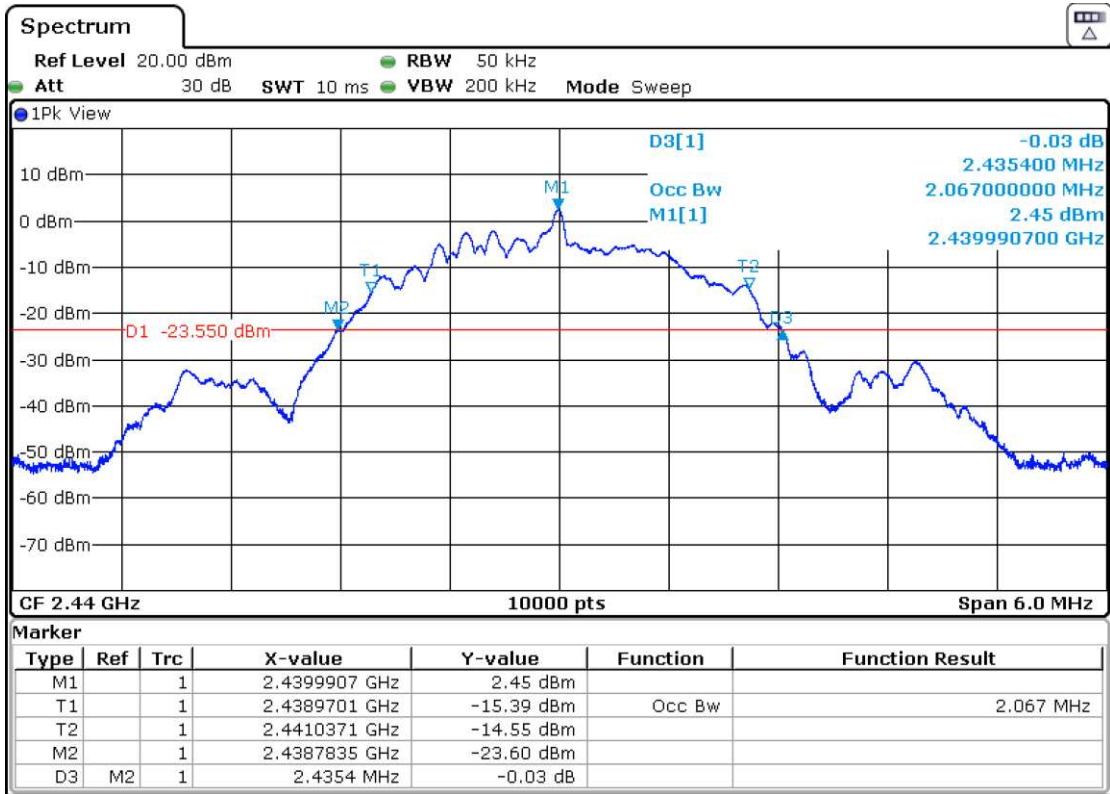
• 2M modulation:

	Low Channel 2402 MHz	Middle Channel 2440 MHz	High Channel 2480 MHz
99% bandwidth (MHz)	2.0634	2.067	2.0682
Measurement uncertainty (kHz)	<± 6.20		

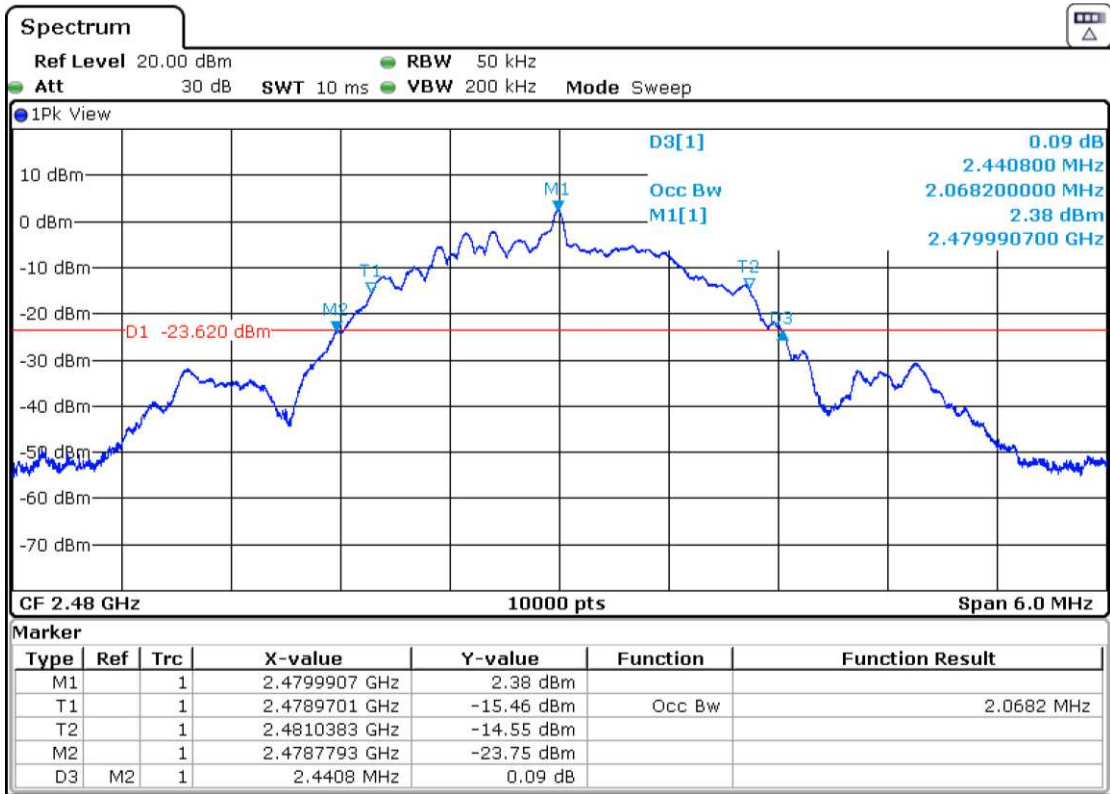
- Low Channel:



- Middle Channel:



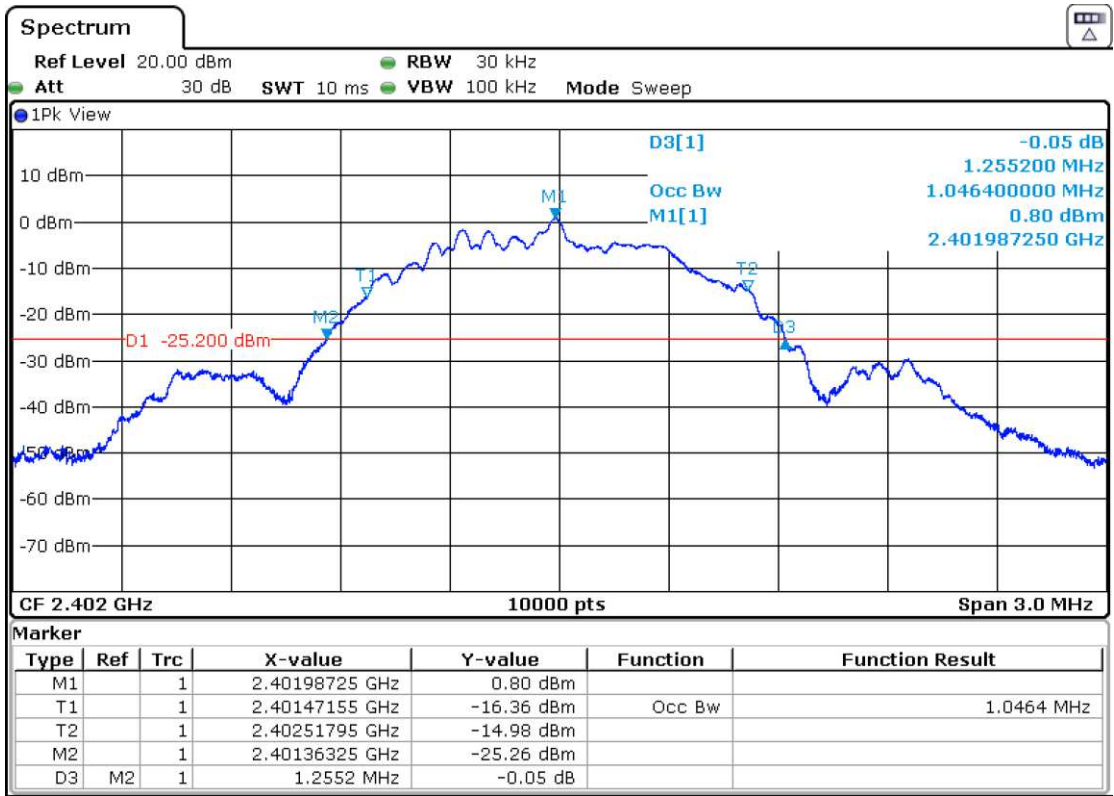
- High Channel:



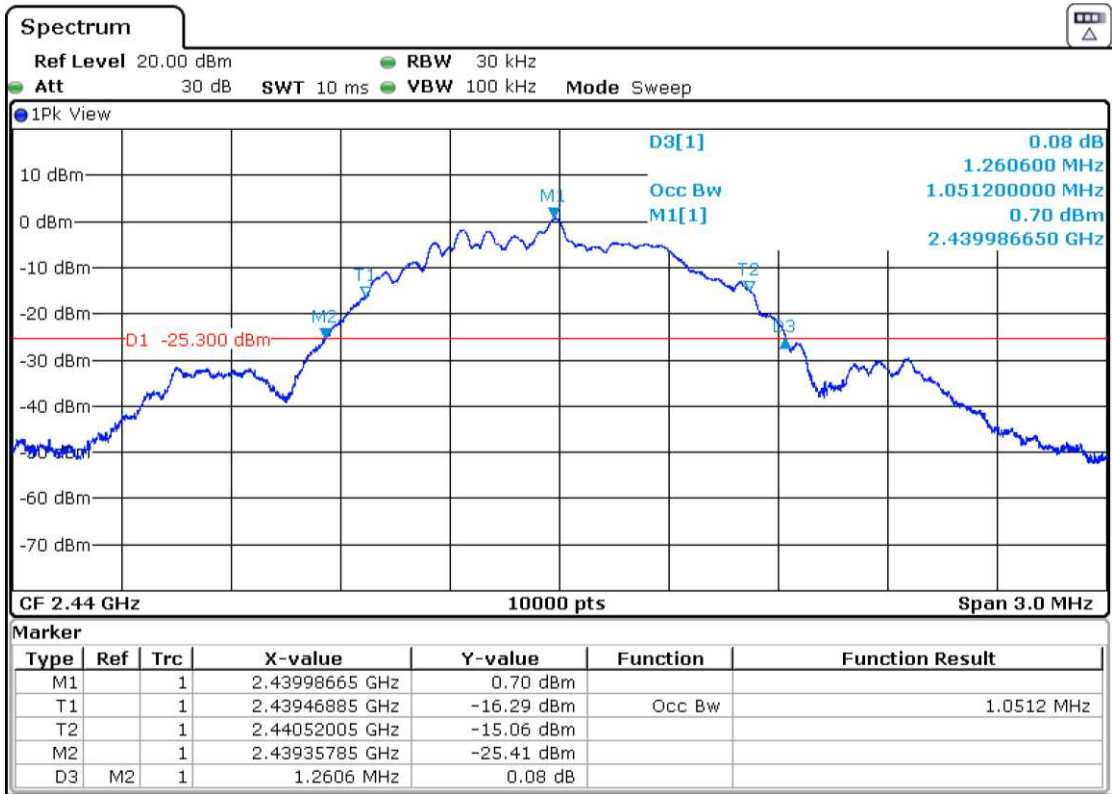
1M modulation:

	Low Channel 2402 MHz	Middle Channel 2440 MHz	High Channel 2480 MHz
99% bandwidth (MHz)	1.0464	1.0512	1.0536
Measurement uncertainty (kHz)	<± 3.77		

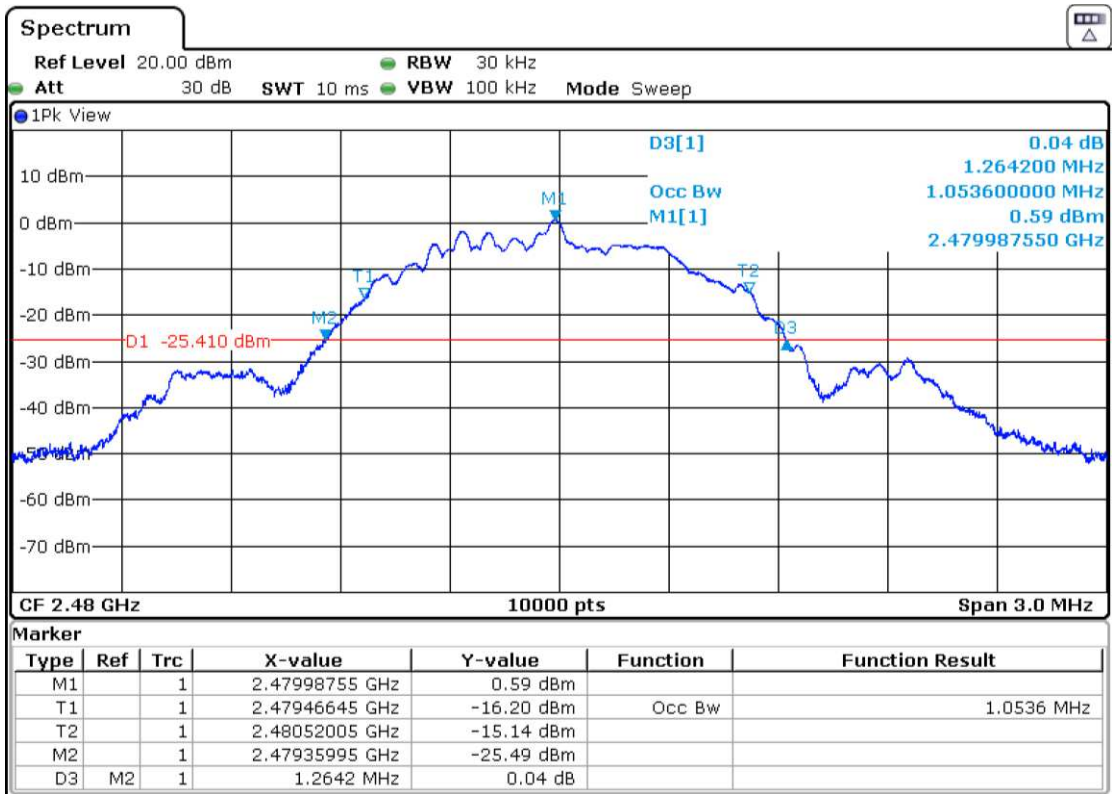
- Low Channel:



- 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.

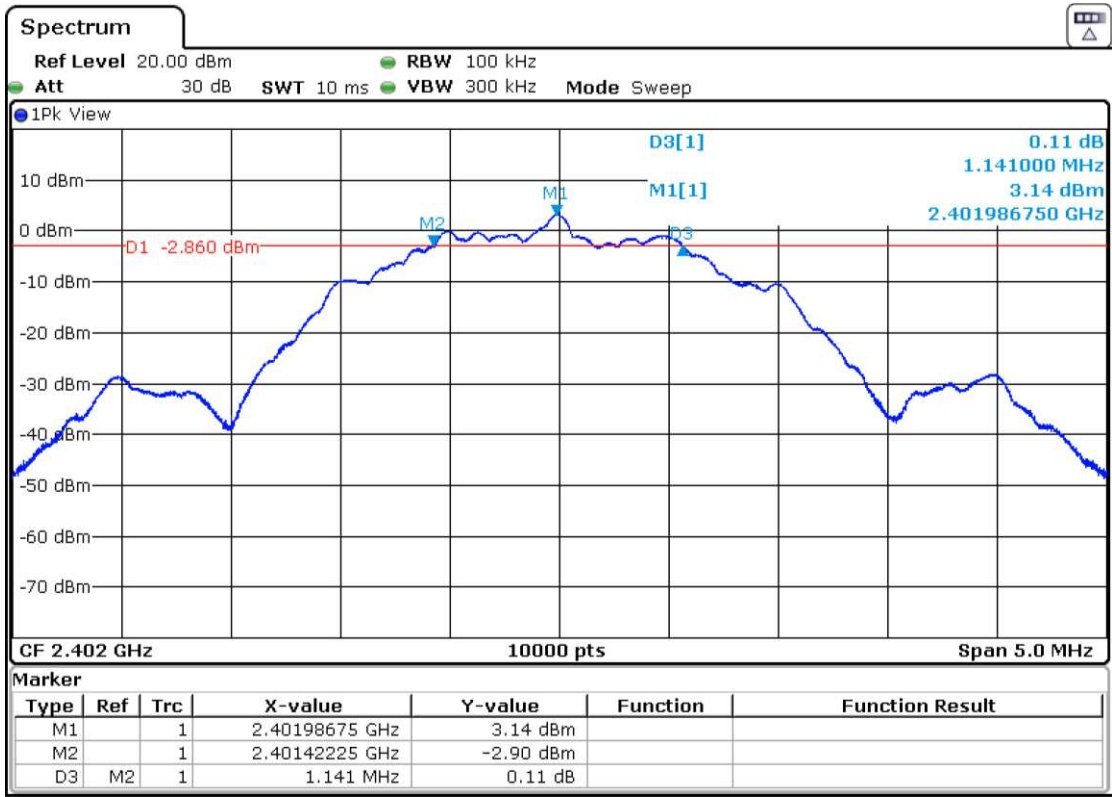
RESULTS:

• 2M modulation:

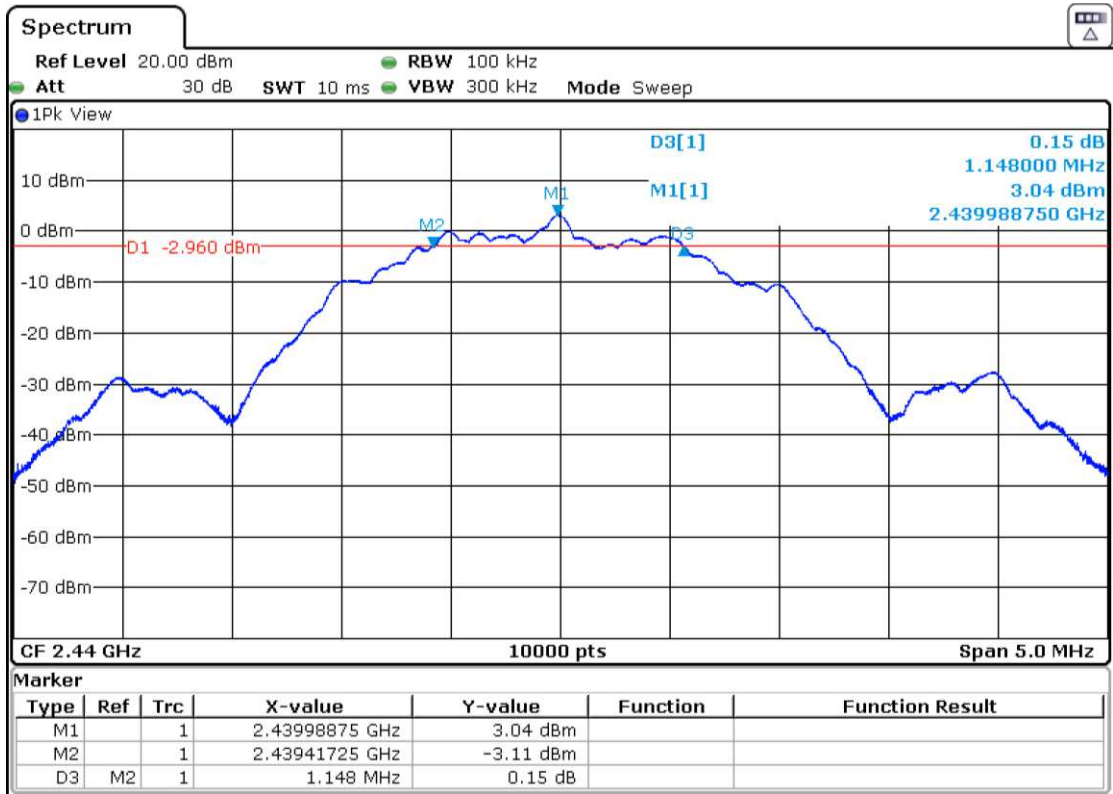
	Low Channel 2402 MHz	Middle Channel 2440 MHz	High Channel 2480 MHz
6 dB Spectrum bandwidth (MHz)	1.141	1.148	1.1485
Measurement uncertainty (kHz)	<±11.88		

Verdict: PASS

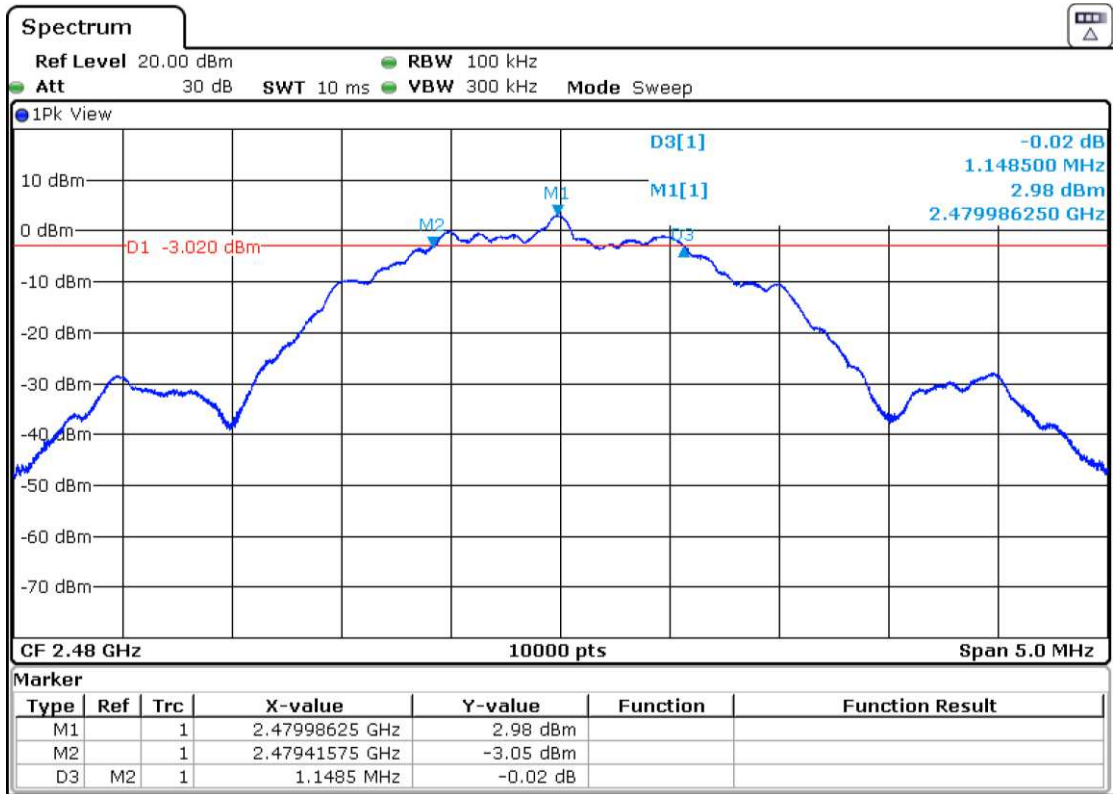
- Low Channel:



- Middle Channel:



- High Channel:

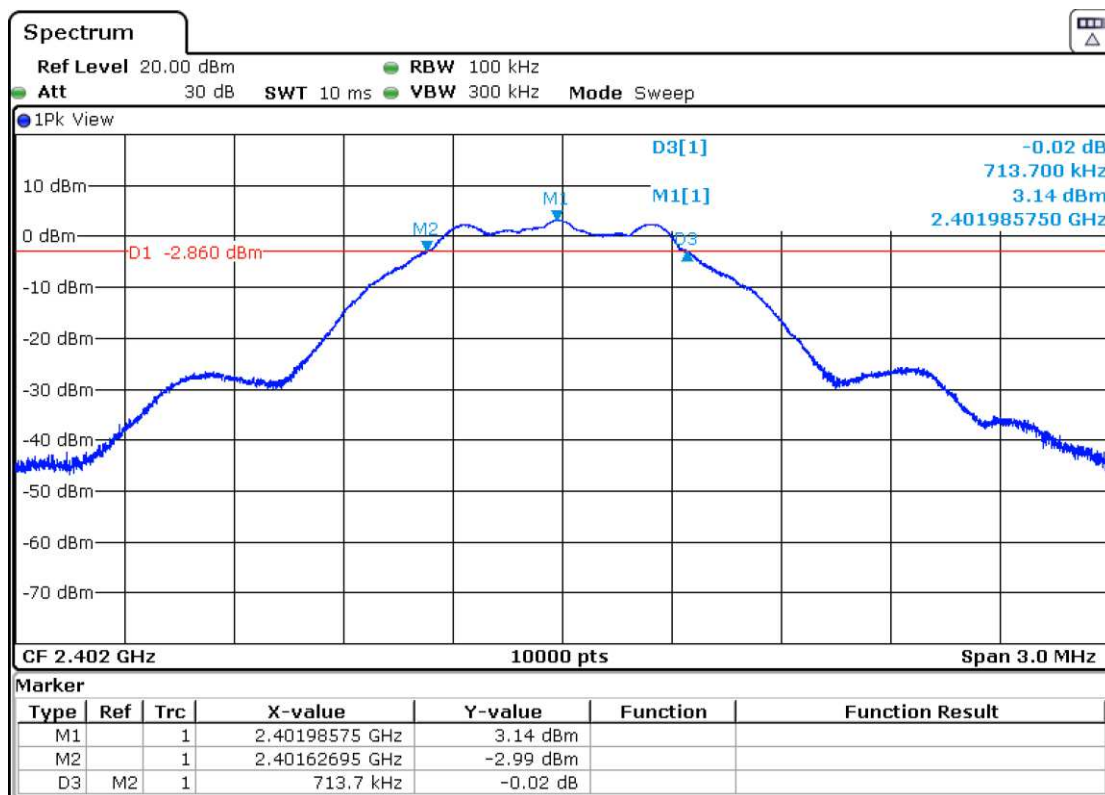


• **1M modulation:**

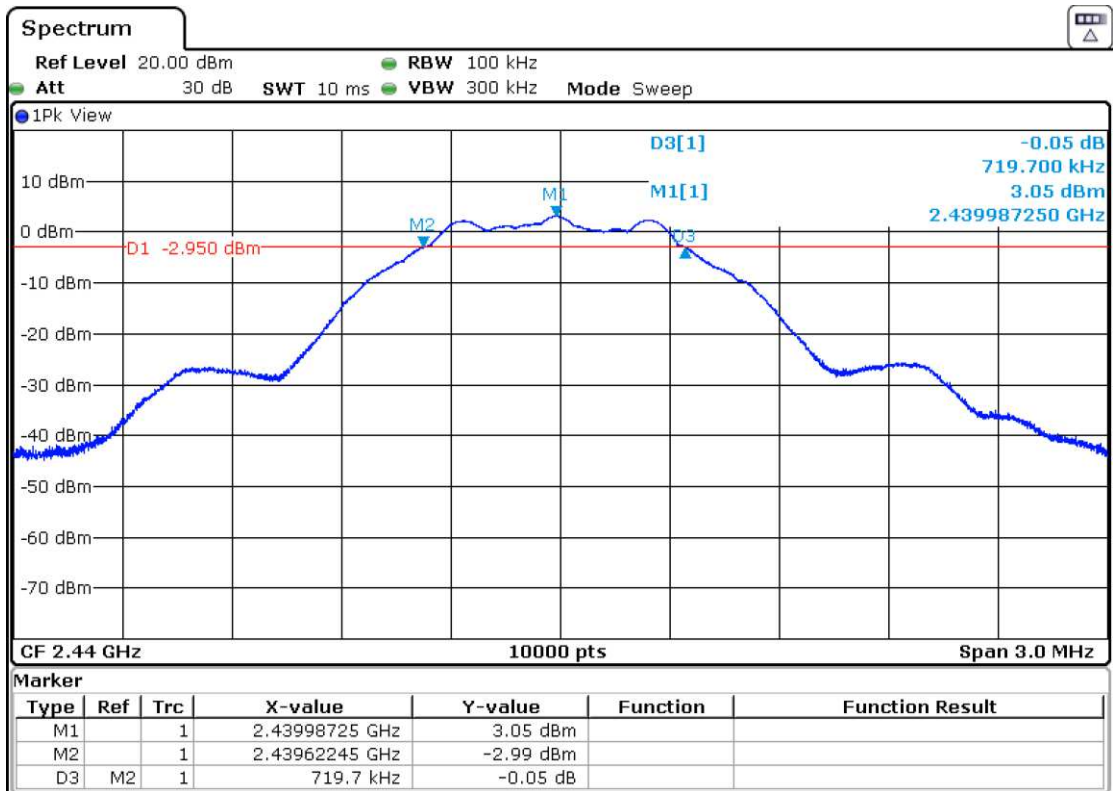
	Low Channel 2402 MHz	Middle Channel 2440 MHz	High Channel 2480 MHz
6 dB Spectrum bandwidth (MHz)	0.7137	0.7197	0.7188
Measurement uncertainty (kHz)	<±11.88		

Verdict: PASS

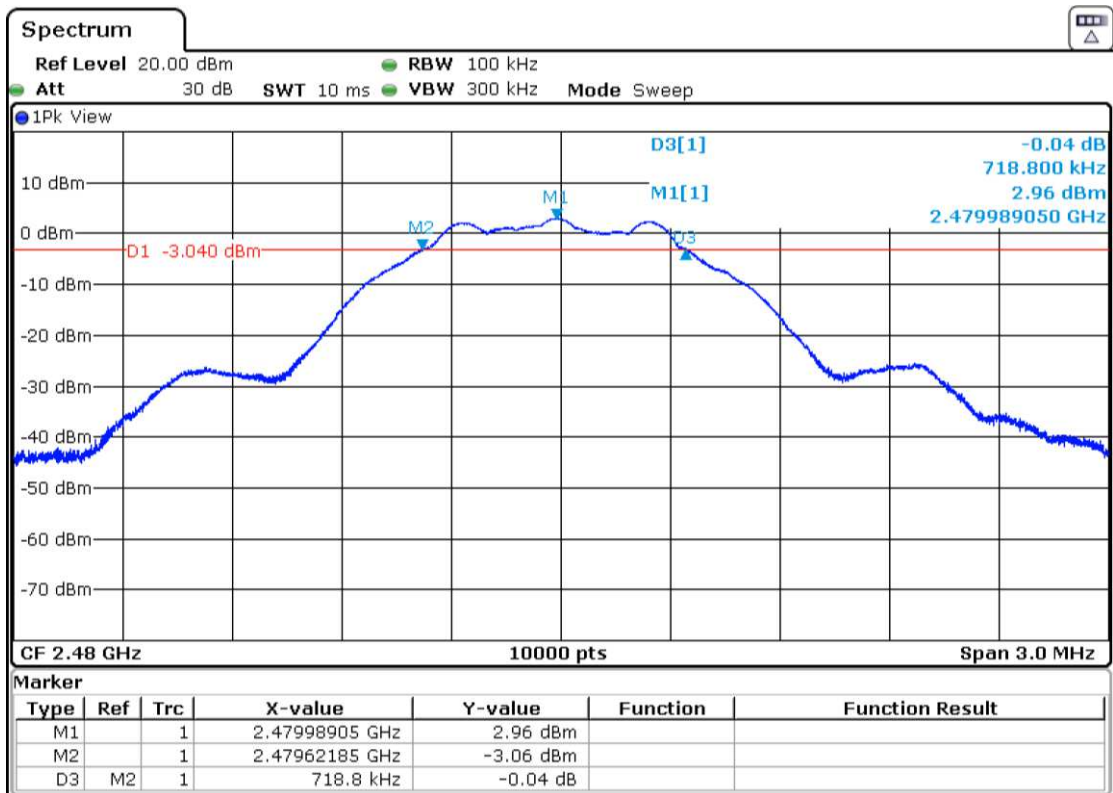
- Low Channel:



- 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: -1 dBi

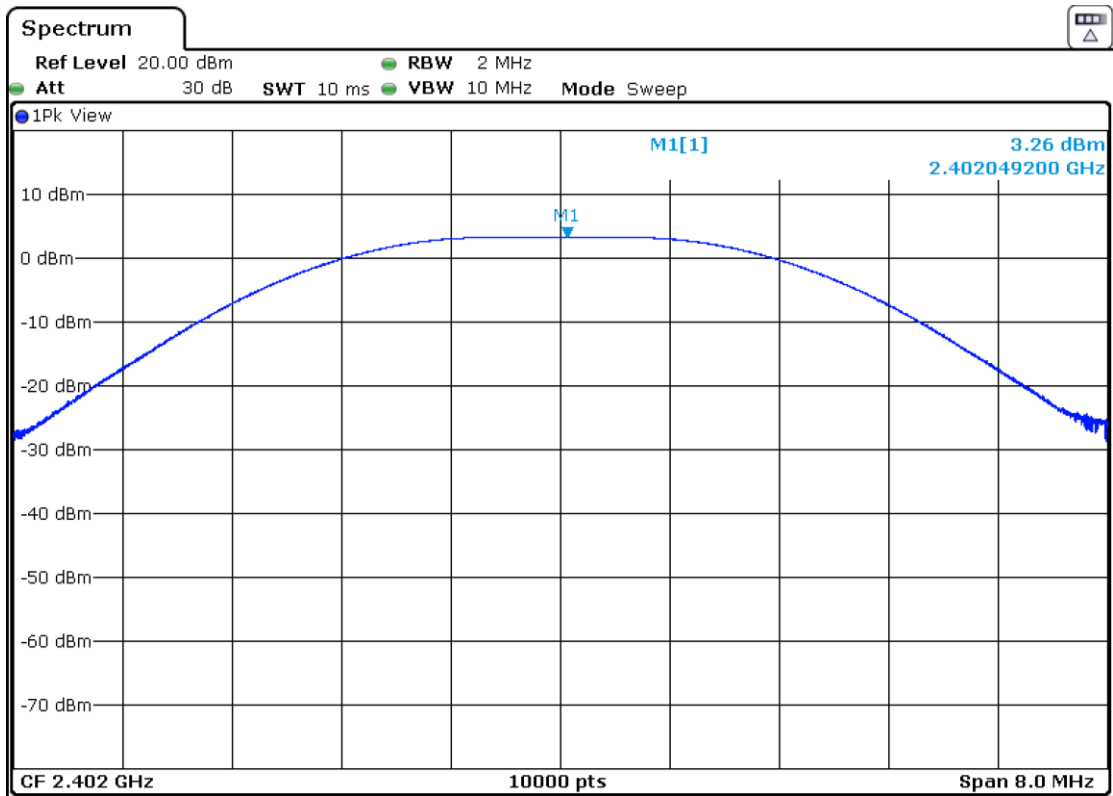
• 2M modulation:

	Low Channel 2402 MHz	Middle Channel 2440 MHz	High Channel 2480 MHz
Maximum Conducted Power (dBm)	3.26	3.16	3.10
Maximum EIRP Power (dBm)	2.26	2.16	2.10
Measurement uncertainty (dB)	< $\pm$ 2.57		

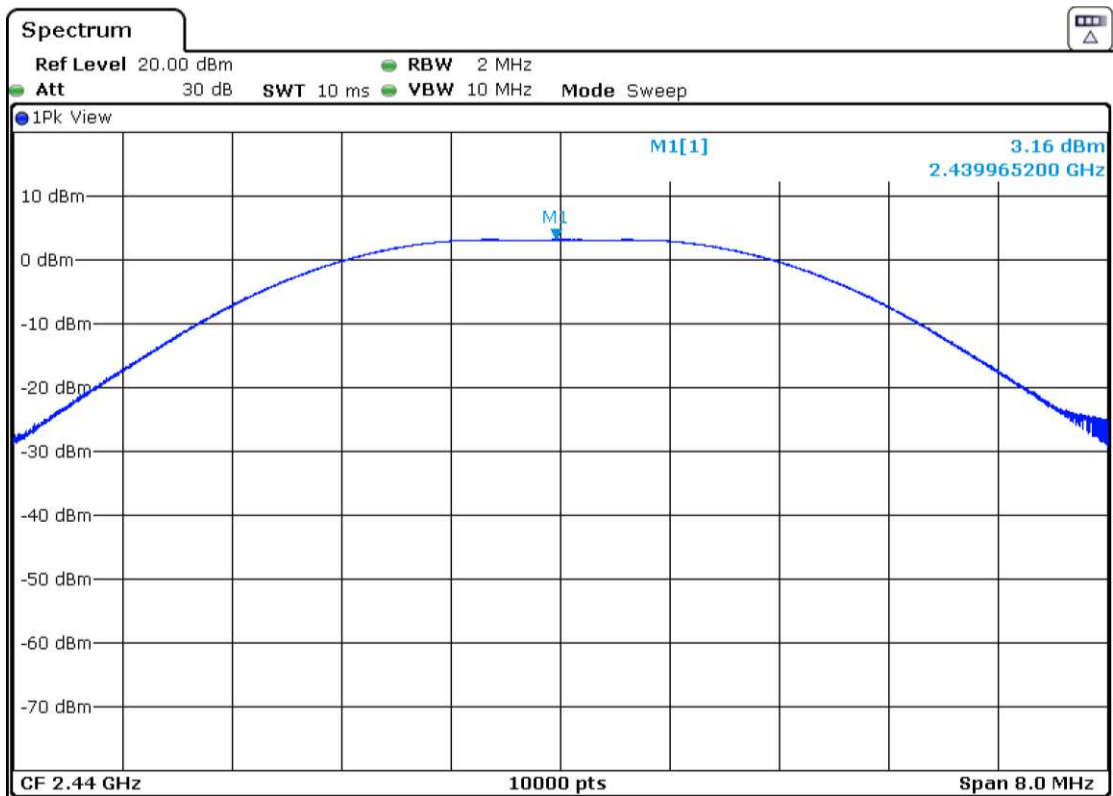
The maximum directional gain of the antenna is less than 6 dBi and therefore the maximum output power is not required to be reduced from the stated values.

Verdict: PASS

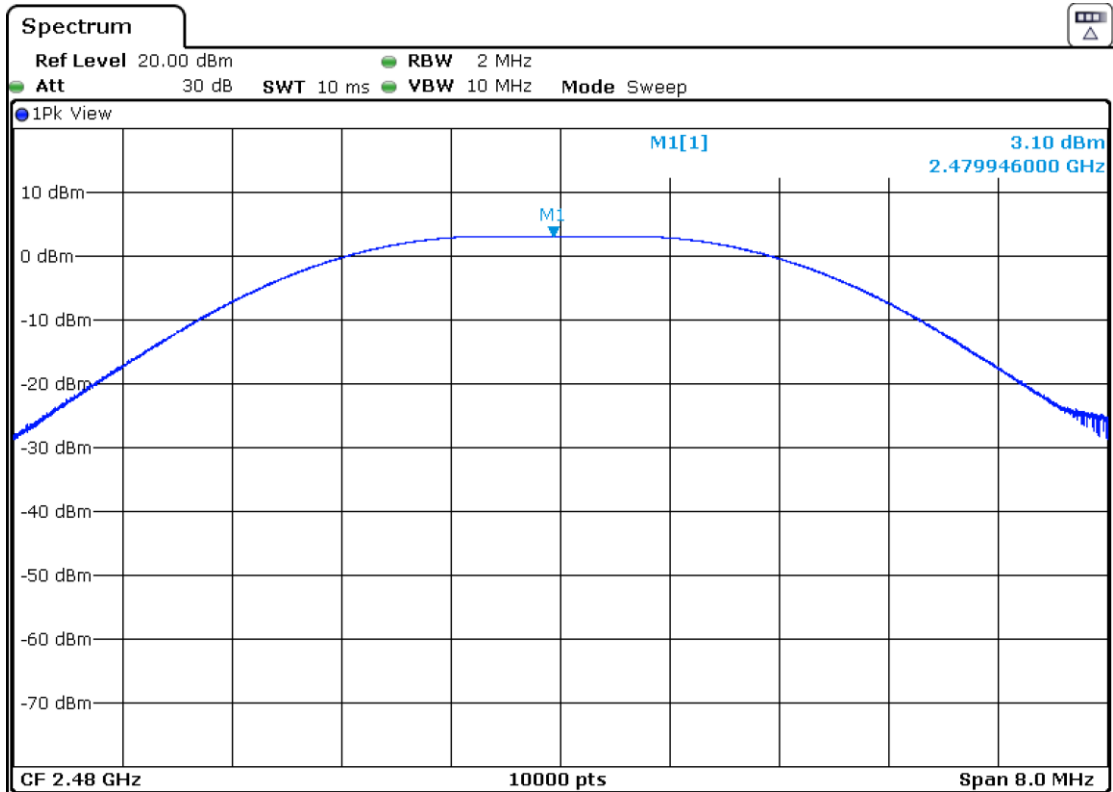
- Low Channel:



- Middle Channel:



- High Channel:



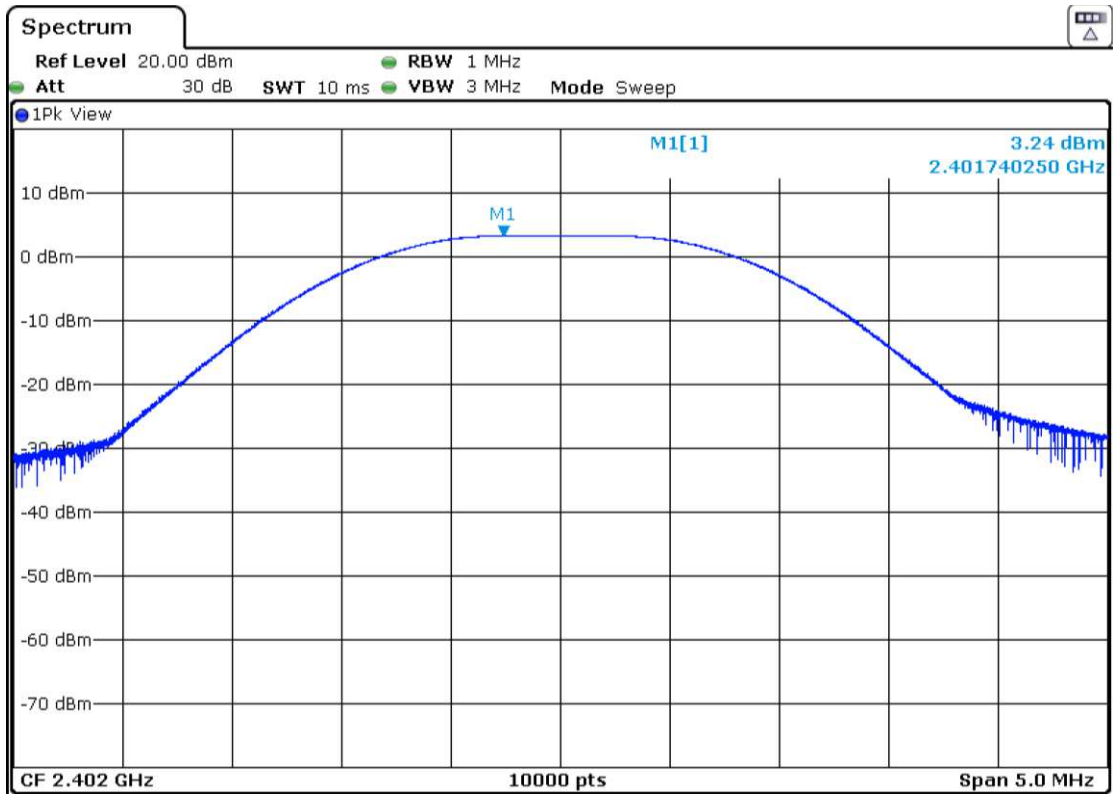
- **1M modulation:**

	Low Channel 2402 MHz	Middle Channel 2440 MHz	High Channel 2480 MHz
Maximum Conducted Power (dBm)	3.24	3.16	3.08
Maximum EIRP Power (dBm)	2.24	2.16	2.08
Measurement uncertainty (dB)	<±2.57		

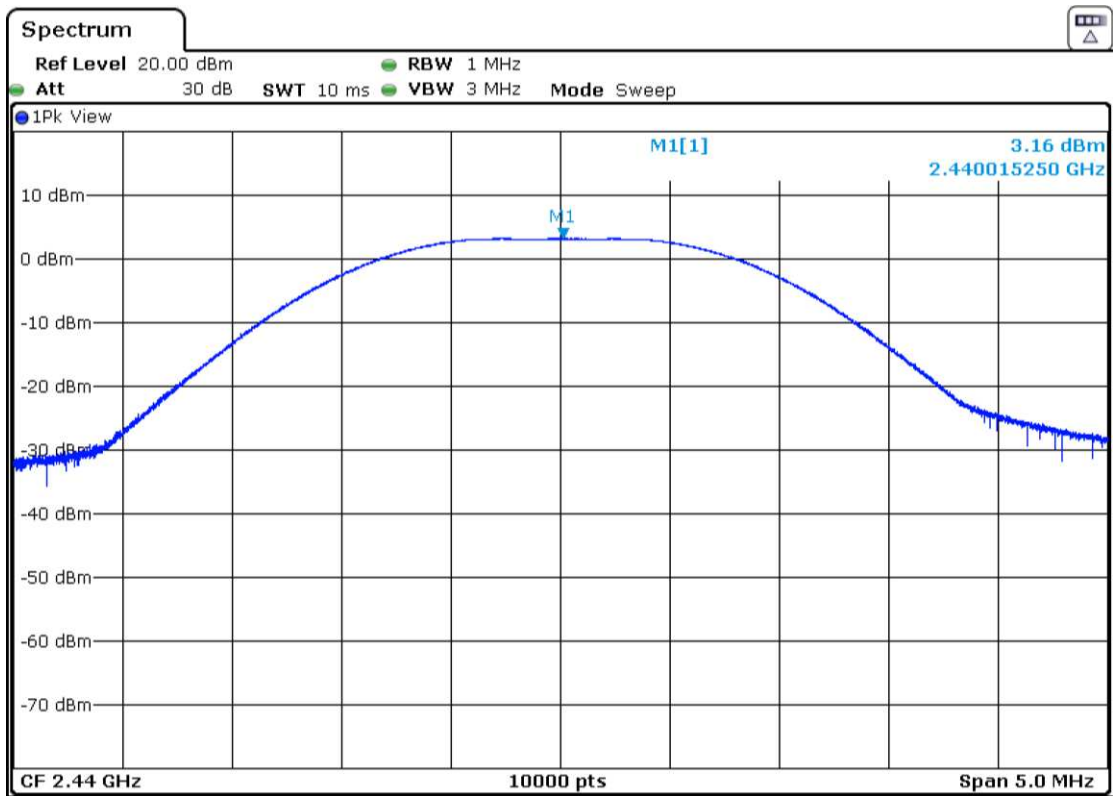
The maximum directional gain of the antenna is less than 6 dBi and therefore the maximum output power is not required to be reduced from the stated values.

Verdict: PASS

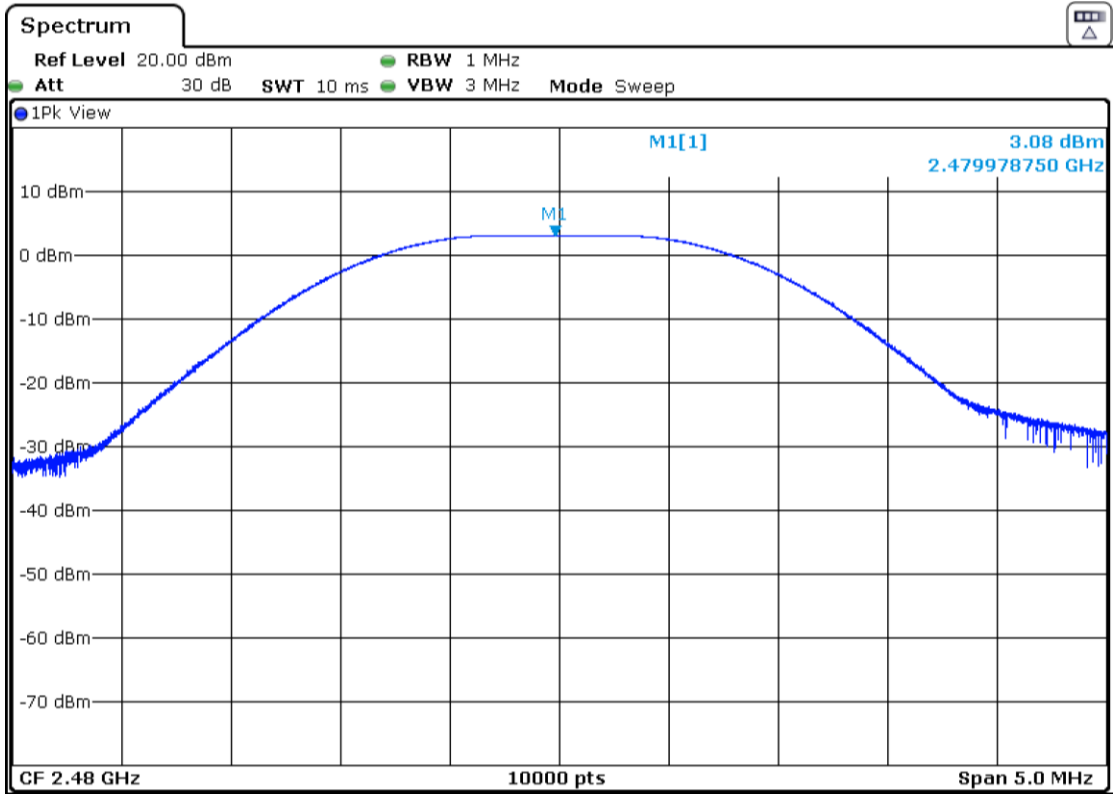
- Low Channel:



- Middle Channel:



- High Channel:



FCC 15.247 (d) / RSS-247 5.5. Band-Edge Emissions Compliance (Transmitter)

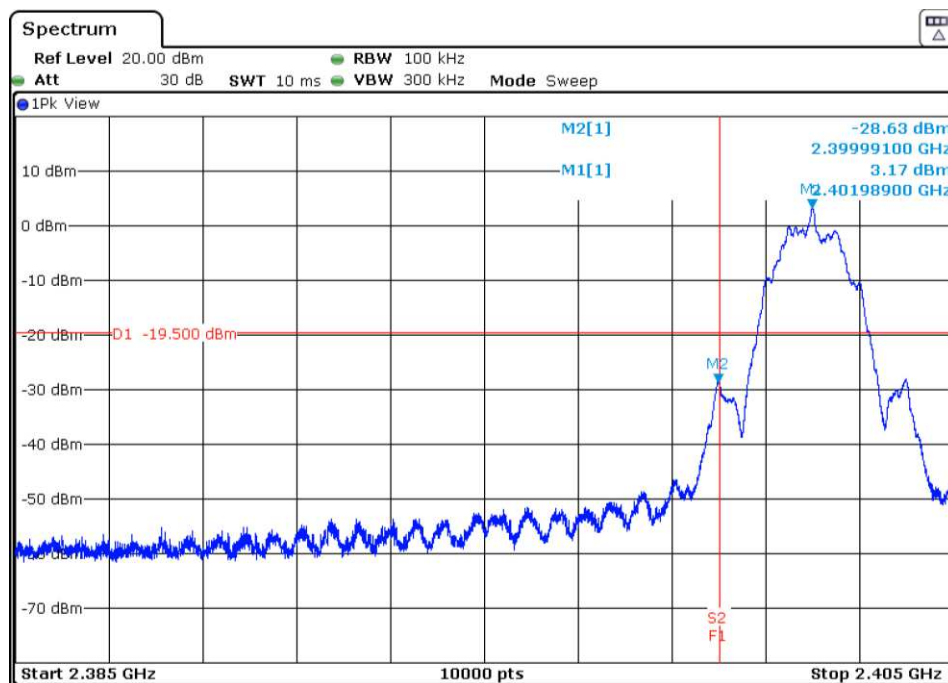
SPECIFICATION:

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:

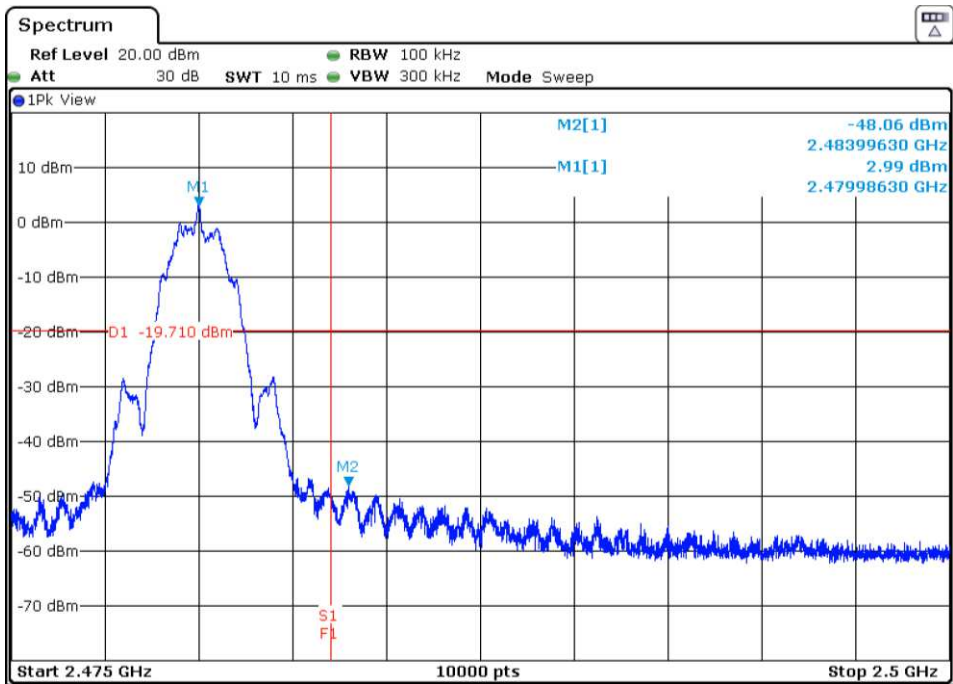
- **2M modulation:**

- Low Channel:



Verdict: PASS

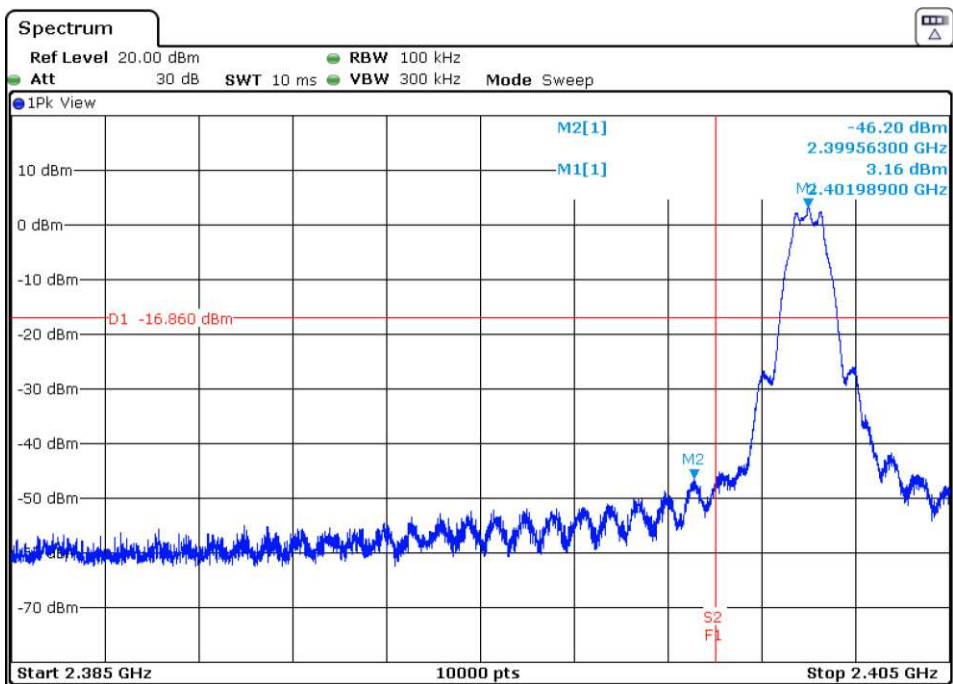
- High Channel:



Verdict: PASS

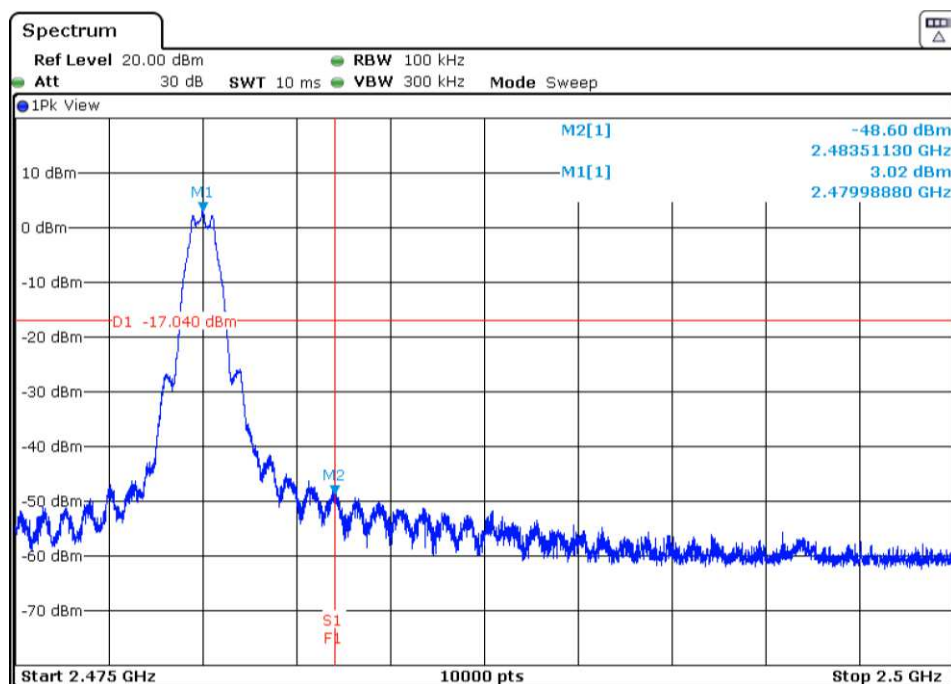
• 1M modulation:

- Low Channel:



Verdict: PASS

- High Channel:



Verdict: PASS

Measurement uncertainty (dB)	<±2.57
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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:

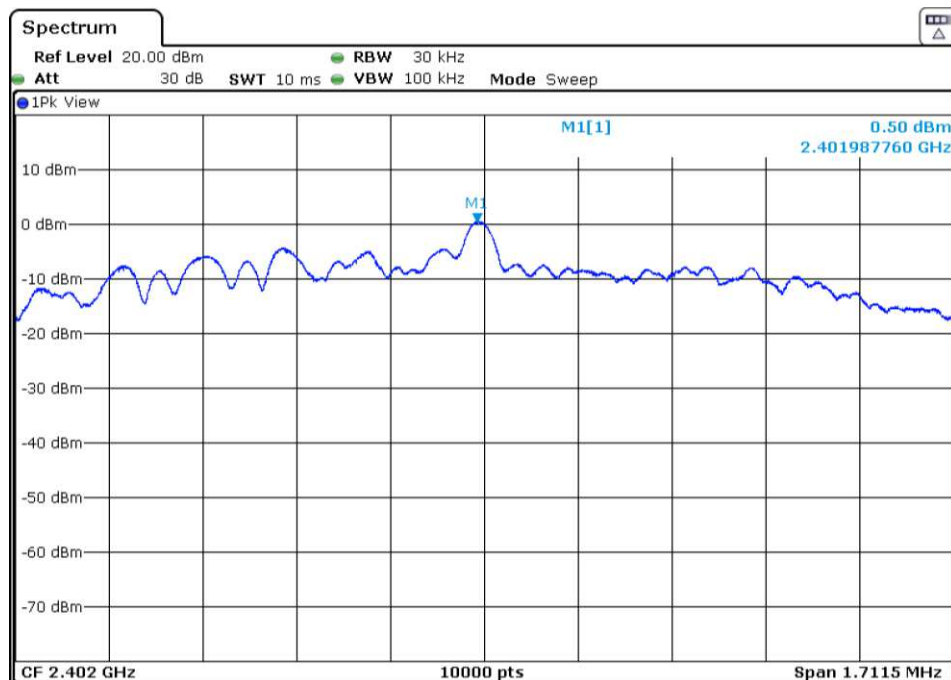
The maximum power spectral density level in the fundamental emission was measured using the method according to point 11.10.2." Method PKPSD (peak PSD)" of ANSI C.63.10-2013.

• 2M modulation:

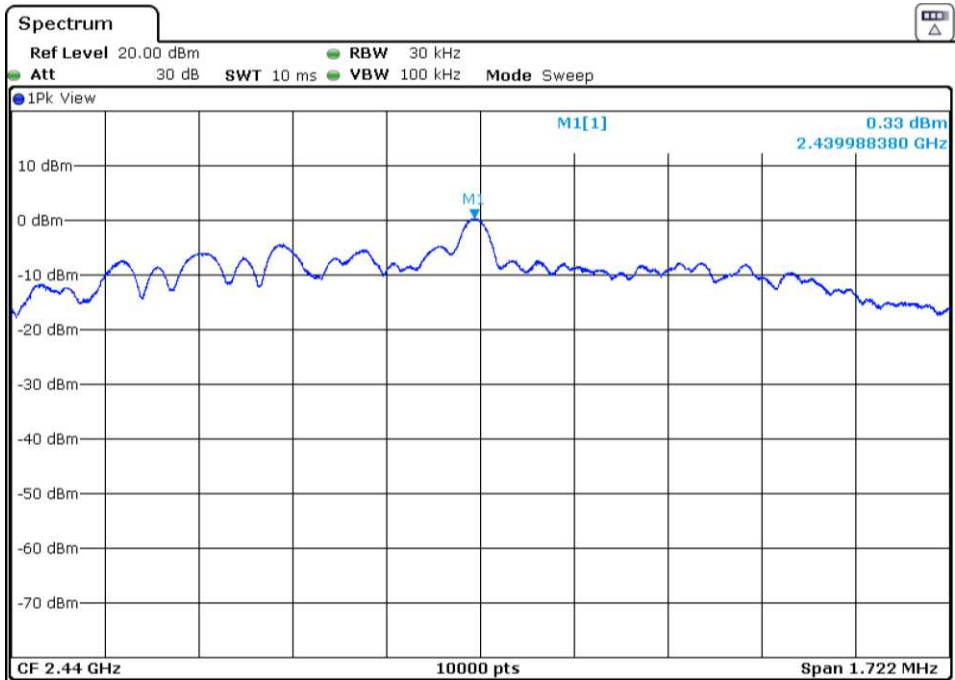
	Low Channel 2402 MHz	Middle Channel 2440 MHz	High Channel 2480 MHz
Power Spectral Density (dBm)	0.5	0.33	0.29
Measurement uncertainty (dB)	<±2.57		

Verdict: PASS

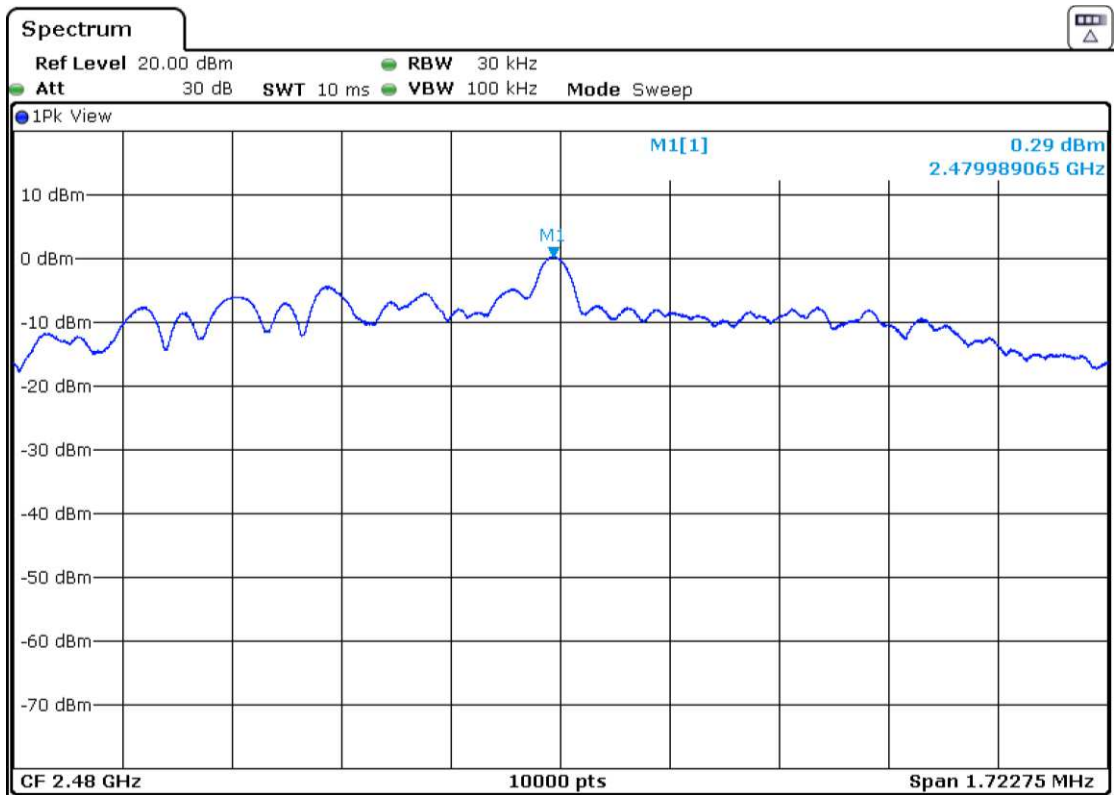
- Low Channel:



- Middle Channel:



- High Channel:

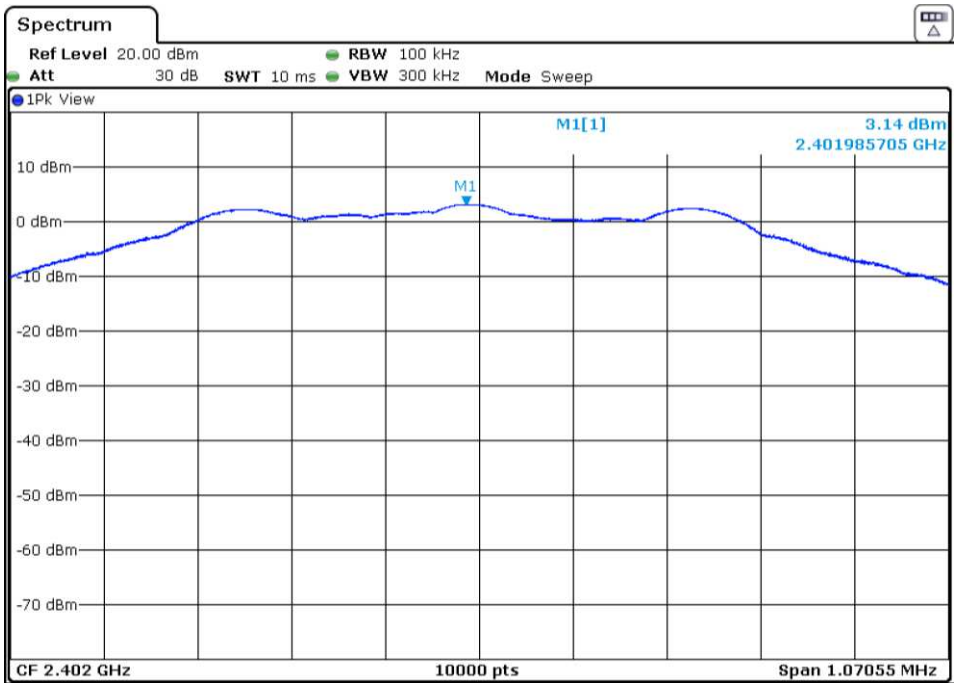


• 1M modulation:

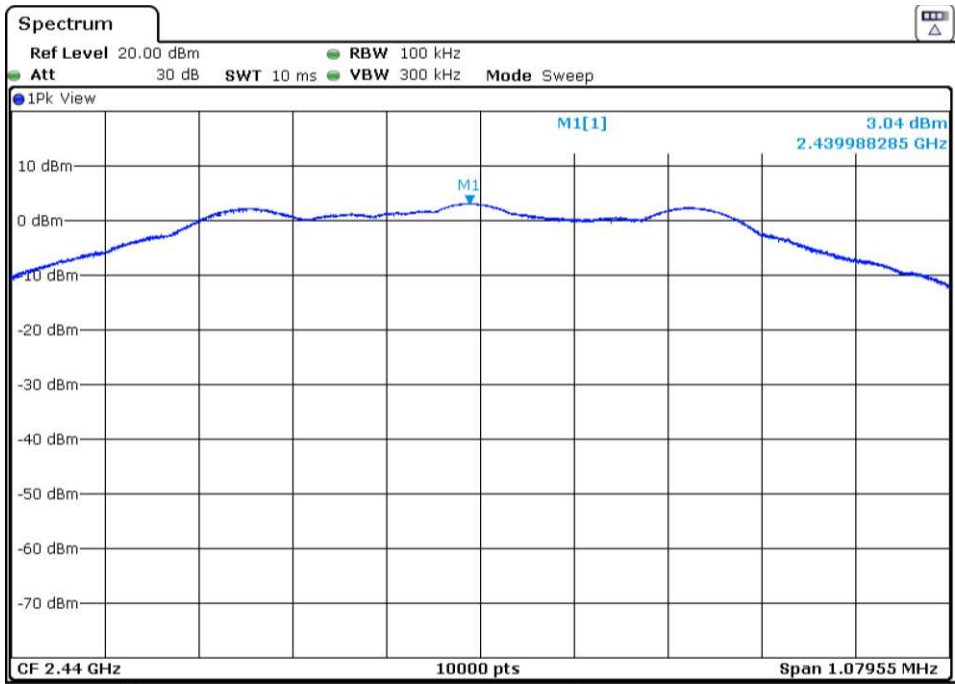
	Low Channel 2402 MHz	Middle Channel 2440 MHz	High Channel 2480 MHz
Power Spectral Density (dBm)	3.14	3.04	2.96
Measurement uncertainty (dB)	<±2.57		

Verdict: PASS

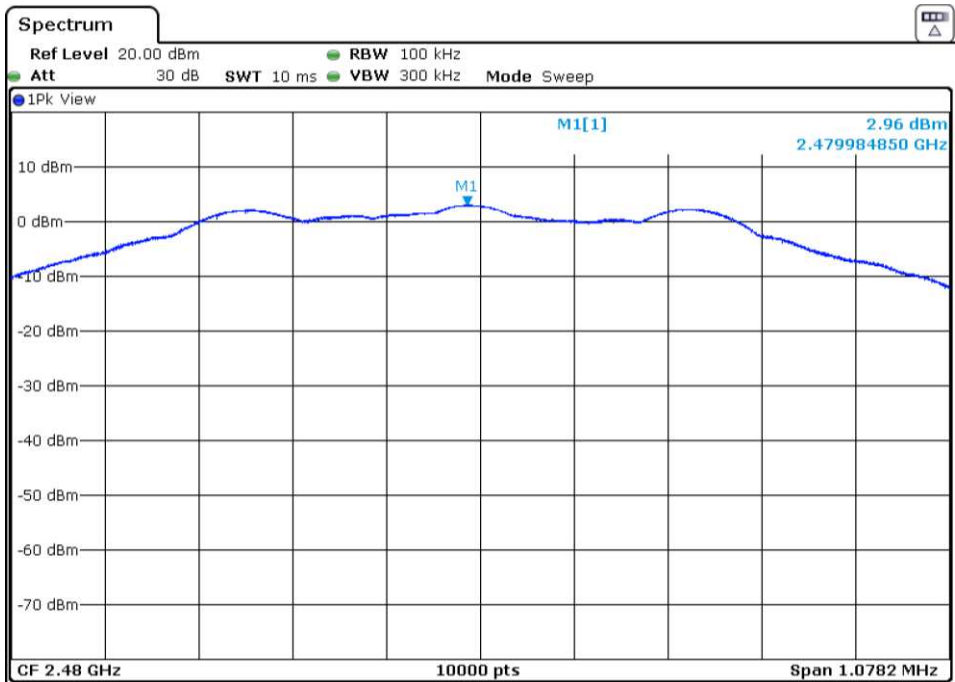
- Low Channel:



- 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 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 frequencies detected do not depend neither on the operating channel nor the modulation mode.

Spurious frequencies detected at less than 20 dB below the limit:

Spurious frequency (MHz)	Emission Level ($\text{dB}\mu\text{V/m}$)	Polarization	Detector	Measurement Uncertainty (dB)
30.533500	21.78	H	Quasi-Peak	$\leq \pm 5.08$
687.514500	30.65	H	Quasi-Peak	$\leq \pm 5.08$
812.499000	28.03	H	Quasi-Peak	$\leq \pm 5.08$

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.

- 2M modulation:**

- LOW CHANNEL. Spurious frequencies detected closest to the limit:

Spurious frequency (GHz)	Emission Level (dB μ V/m)	Duty cycle Correction (dB)	Corrected Emission Level (dB μ V/m)	Polarization	Detector	Measurement Uncertainty (dB)
4.804	45.28	-	45.28	V	Peak	$<\pm 5.13$
	38.19	4.86	43.05		Average	$<\pm 5.13$
7.207	48.48	-	48.48	V	Peak	$<\pm 5.13$
	38.84	4.86	43.70		Average	$<\pm 5.13$

- MIDDLE CHANNEL. Spurious frequencies detected closest to the limit:

Spurious frequency (GHz)	Emission Level (dB μ V/m)	Duty cycle Correction (dB)	Corrected Emission Level (dB μ V/m)	Polarization	Detector	Measurement Uncertainty (dB)
4.879	45.08	-	45.08	V	Peak	$<\pm 5.13$
	39.37	4.86	44.23		Average	$<\pm 5.13$
7.3185	48.11	-	48.11	V	Peak	$<\pm 5.13$
	38.8	4.86	43.66		Average	$<\pm 5.13$

- HIGH CHANNEL. Spurious frequencies detected closest to the limit:

Spurious frequency (GHz)	Emission Level (dB μ V/m)	Duty cycle Correction (dB)	Corrected Emission Level (dB μ V/m)	Polarization	Detector	Measurement Uncertainty (dB)
4.959	45.52	-	45.52	V	Peak	$<\pm 5.13$
	38.47	4.86	43.33		Average	$<\pm 5.13$

Measurement Uncertainty (dB): $<\pm 5.13$ for $1 \leq f \leq 17$ GHz
 $<\pm 4.82$ for $17 < f \leq 26$ GHz

Verdict: PASS

- **1M modulation:**

- LOW CHANNEL. Spurious frequencies detected closest to the limit:

Spurious frequency (GHz)	Emission Level (dBμV/m)	Duty cycle Correction (dB)	Corrected Emission Level (dBμV/m)	Polarization	Detector	Measurement Uncertainty (dB)
4.8035	45.47	-	45.47	V	Peak	<± 5.13
	40.61	2.04	42.65		Average	<± 5.13
7.205	48.93	-	48.93	V	Peak	<± 5.13
	40.33	2.04	42.37		Average	<± 5.13

- MIDDLE CHANNEL. Spurious frequencies detected closest to the limit:

Spurious frequency (GHz)	Emission Level (dBμV/m)	Duty cycle Correction (dB)	Corrected Emission Level (dBμV/m)	Polarization	Detector	Measurement Uncertainty (dB)
4.8795	46.21	-	46.21	V	Peak	<± 5.13
	42.63	2.04	44.67		Average	<± 5.13
7.319	47.98	-	47.98	H	Peak	<± 5.13
	40.53	2.04	42.57		Average	<± 5.13

- HIGH CHANNEL. Spurious frequencies detected closest to the limit:

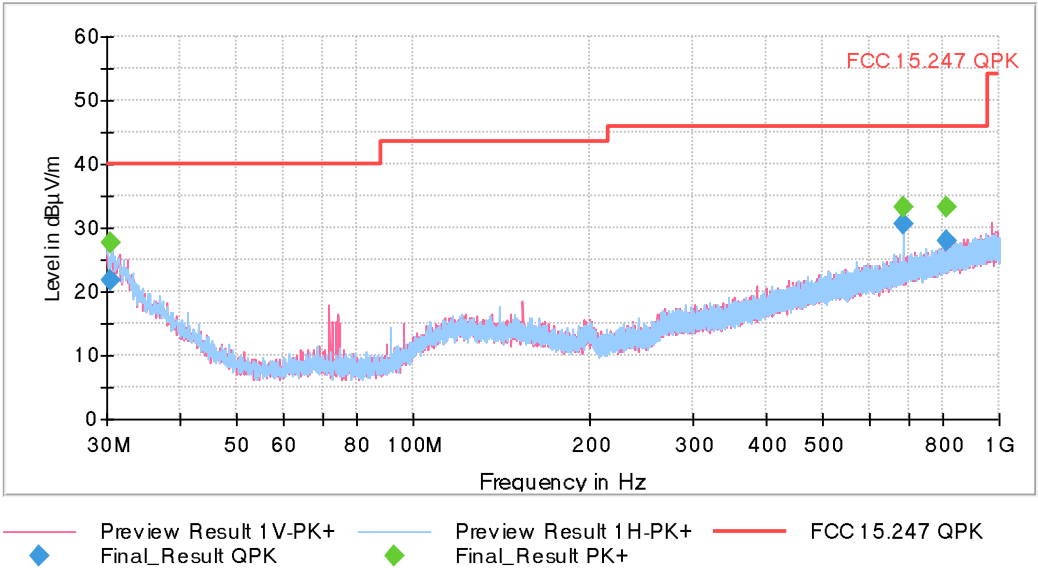
Spurious frequency (GHz)	Emission Level (dBμV/m)	Duty cycle Correction (dB)	Corrected Emission Level (dBμV/m)	Polarization	Detector	Measurement Uncertainty (dB)
4.96	45.58	-	45.58	V	Peak	<± 5.13
	41.01	2.04	43.05		Average	<± 5.13
17.7115	34.79	-	34.79	H	Peak	<± 4.82
	33.08	2.04	35.12		Average	<± 4.82

Measurement Uncertainty (dB): <± 5.13 for $1 \leq f \leq 17$ GHz
<± 4.82 for $17 < f \leq 26$ GHz

Verdict: PASS

FREQUENCY RANGE 30 MHz - 1 GHz:

The spurious frequencies detected do not depend neither on the operating channel nor the modulation mode.

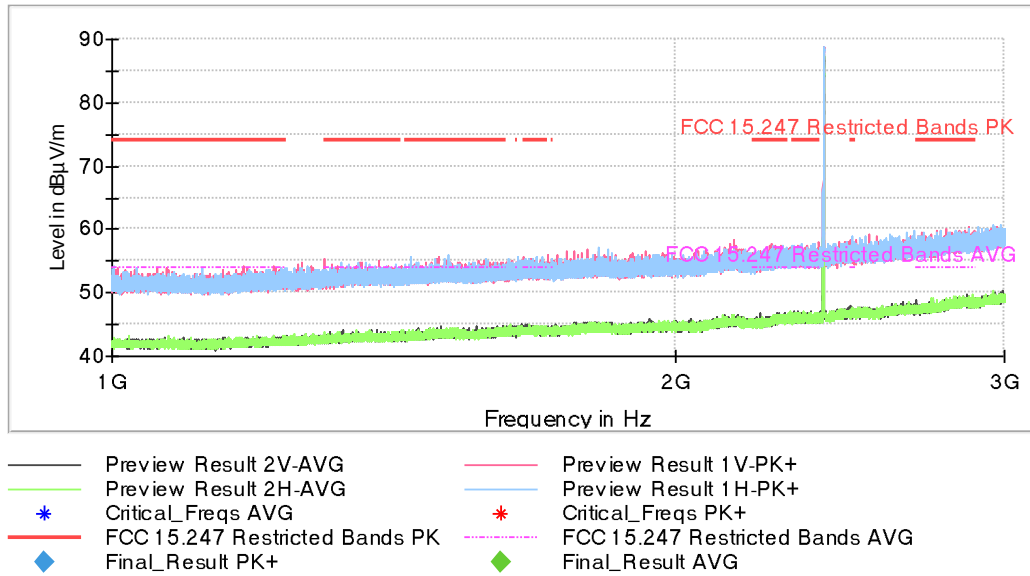


This plot is valid for the Low, Middle and High Channels.

- **2M modulation:**

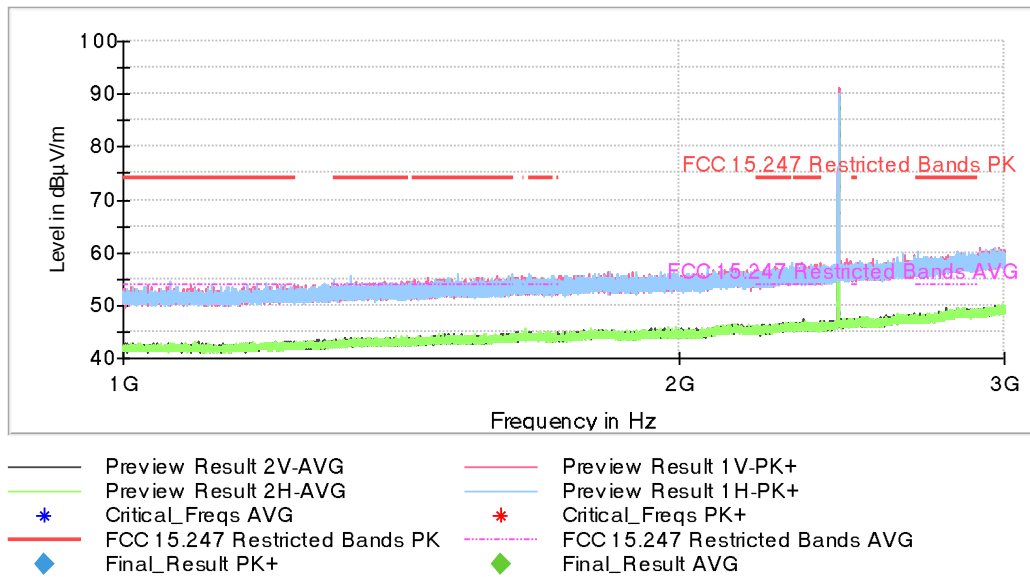
FREQUENCY RANGE 1 - 3 GHz:

- Low Channel:



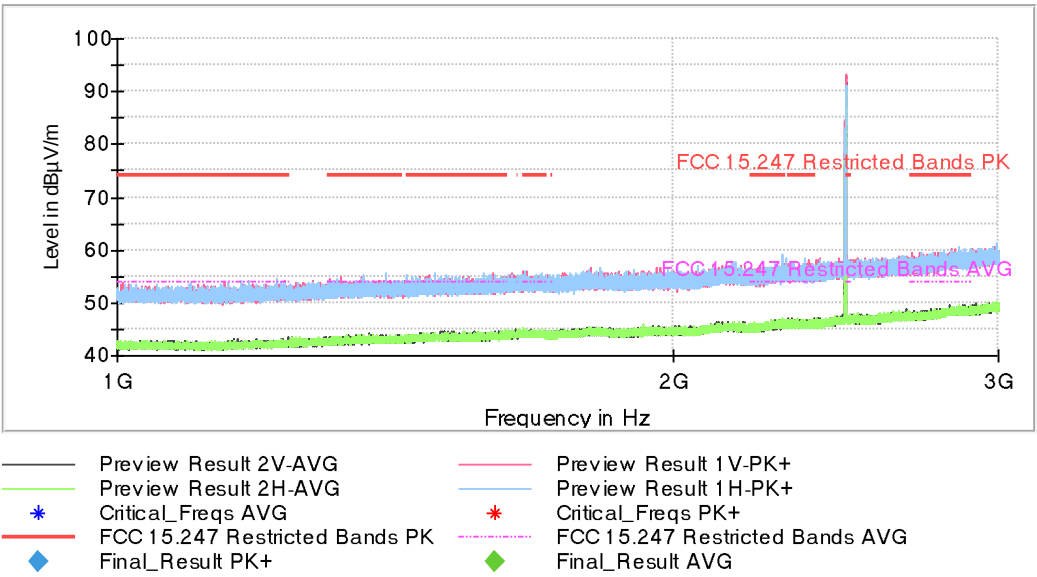
The peak above the limit is the carrier frequency.

- Middle Channel:



The peak above the limit is the carrier frequency.

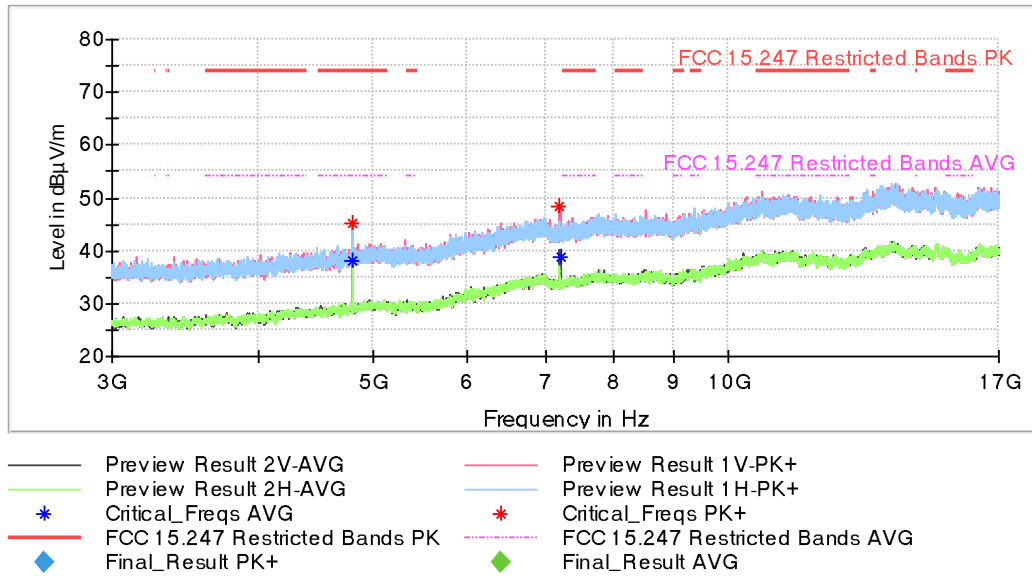
- High Channel:



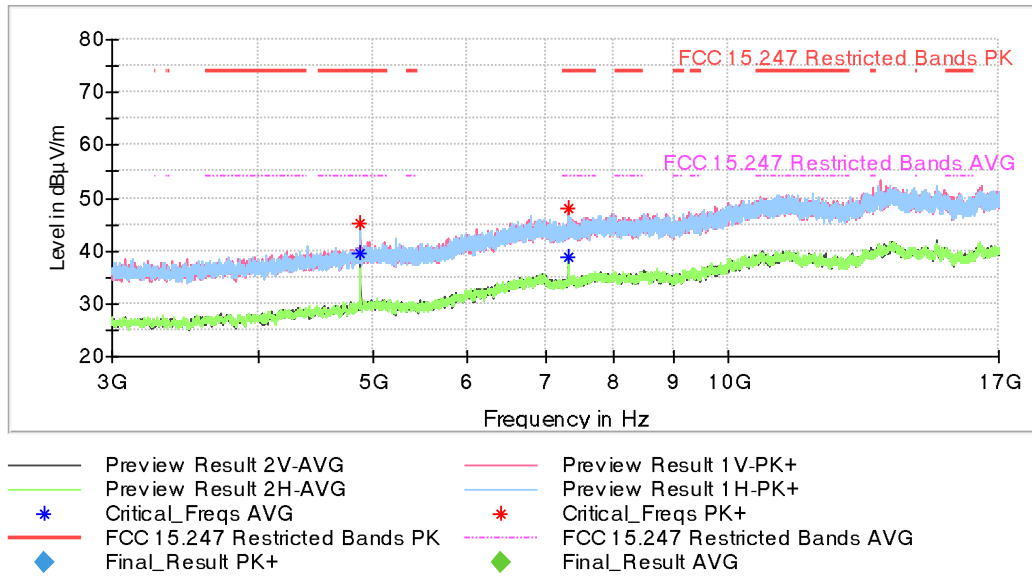
The peak above the limit is the carrier frequency.

FREQUENCY RANGE 3 - 17 GHz:

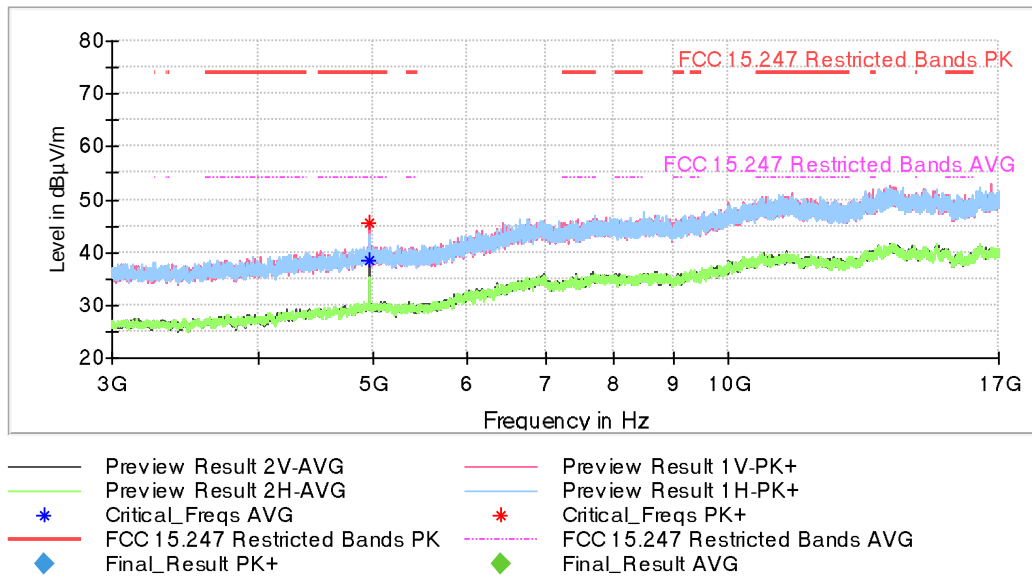
- Low Channel:



- Middle Channel:

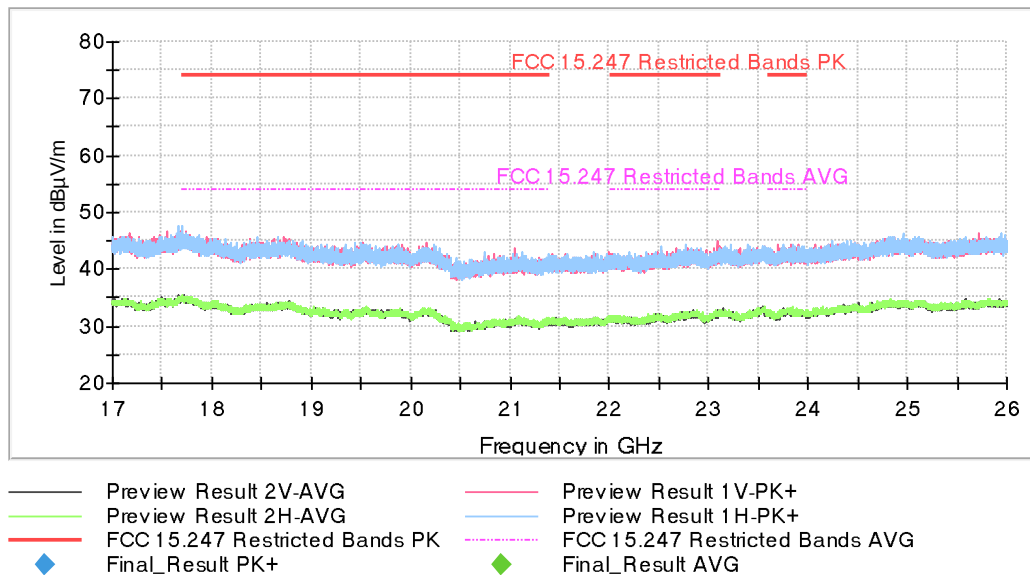


- High Channel:



FREQUENCY RANGE 17 - 26 GHz:

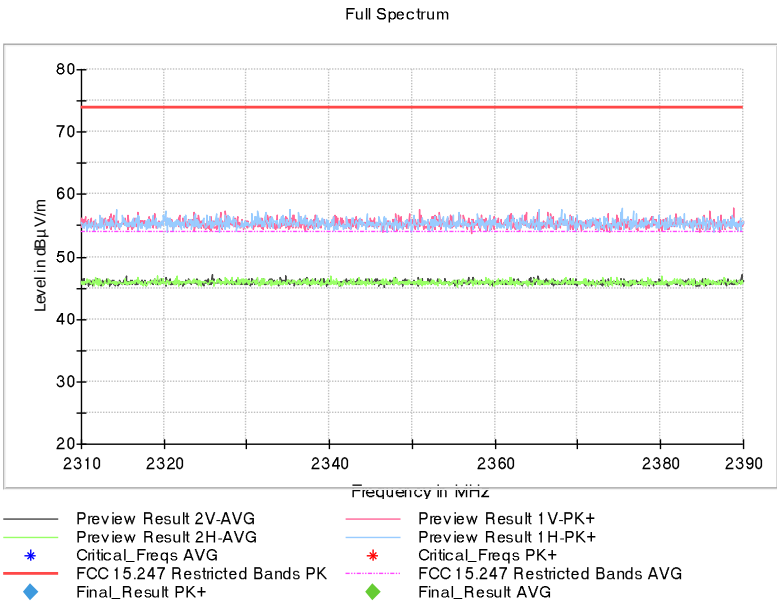
The spurious frequencies detected do not depend on the operating channel.



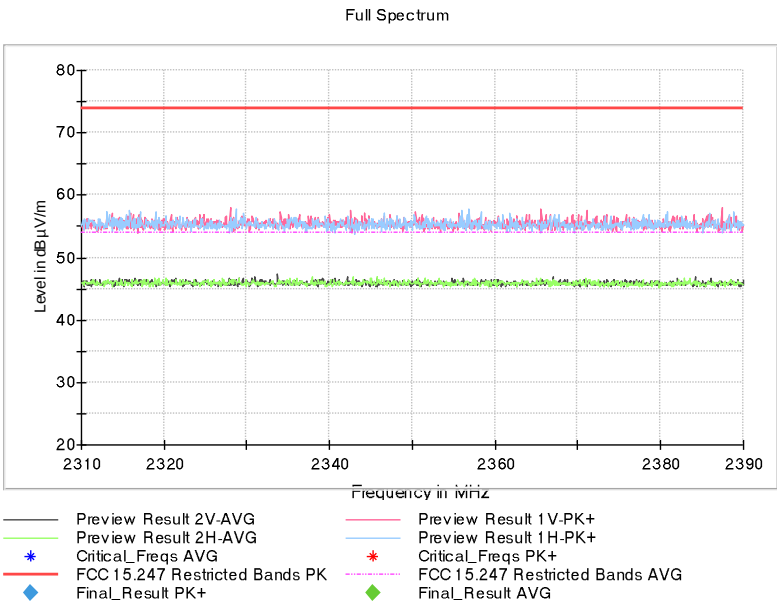
This plot is valid for the Low, Middle and High Channels.

FREQUENCY RANGE 2.31-2.39 GHz:

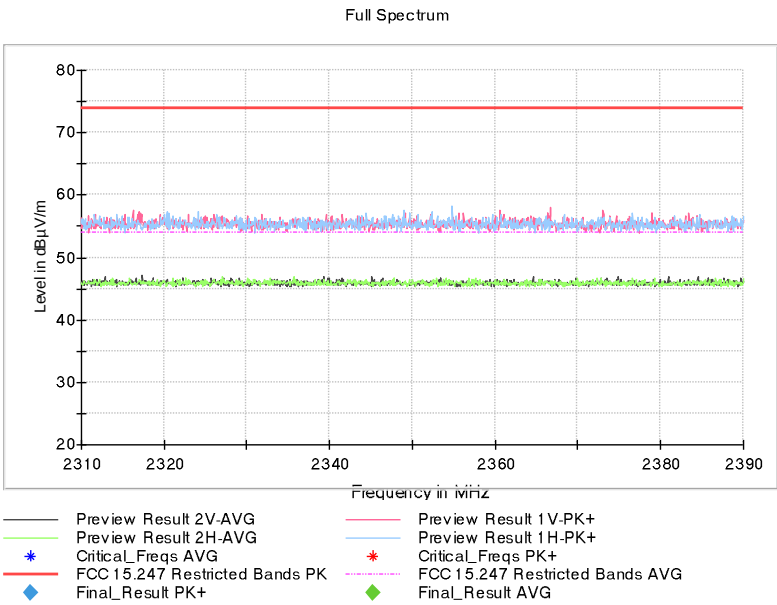
- Low Channel:



- Middle Channel:

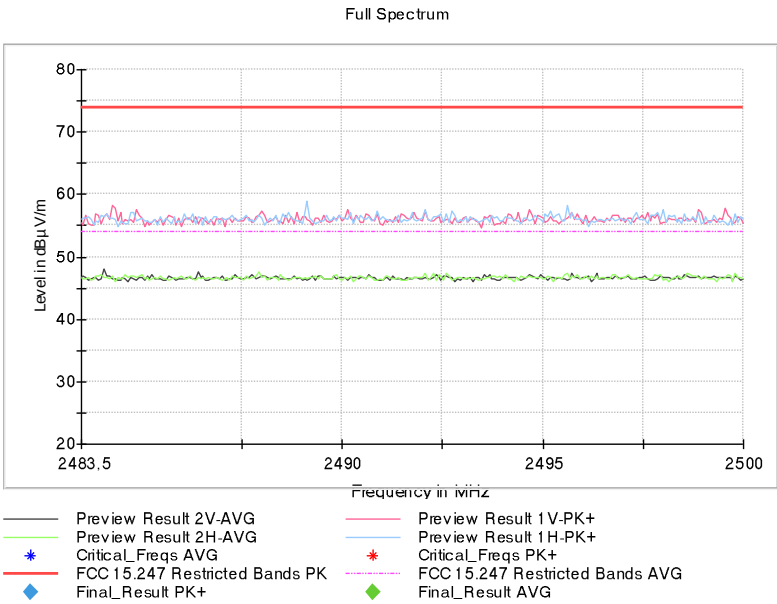


- High Channel:

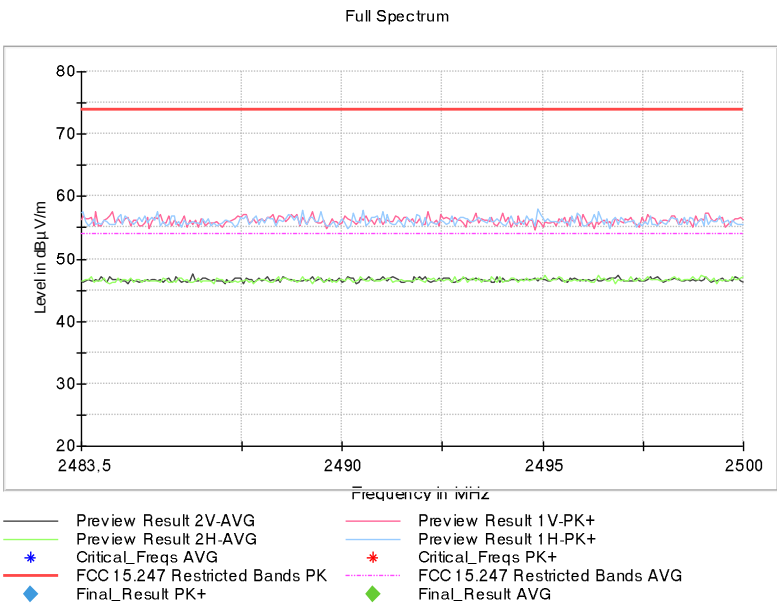


FREQUENCY RANGE 2.4835-2.5 GHz:

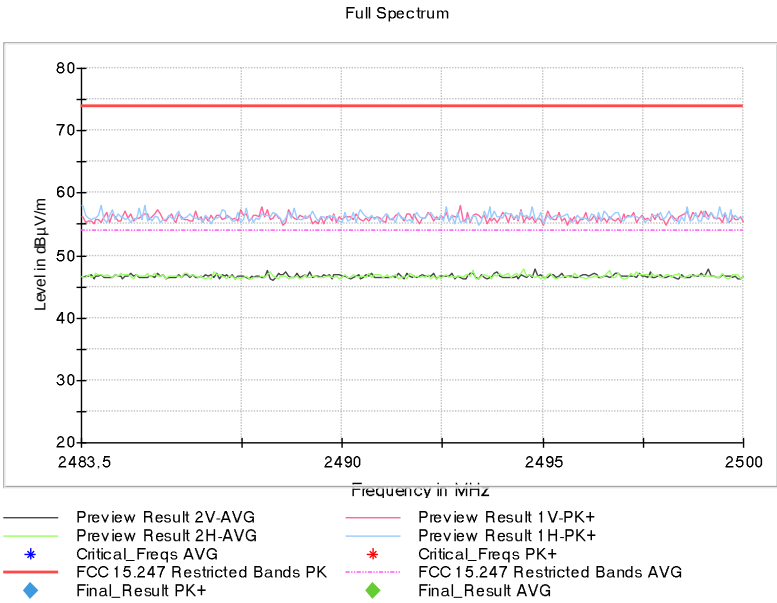
- Low Channel:



- Middle Channel:



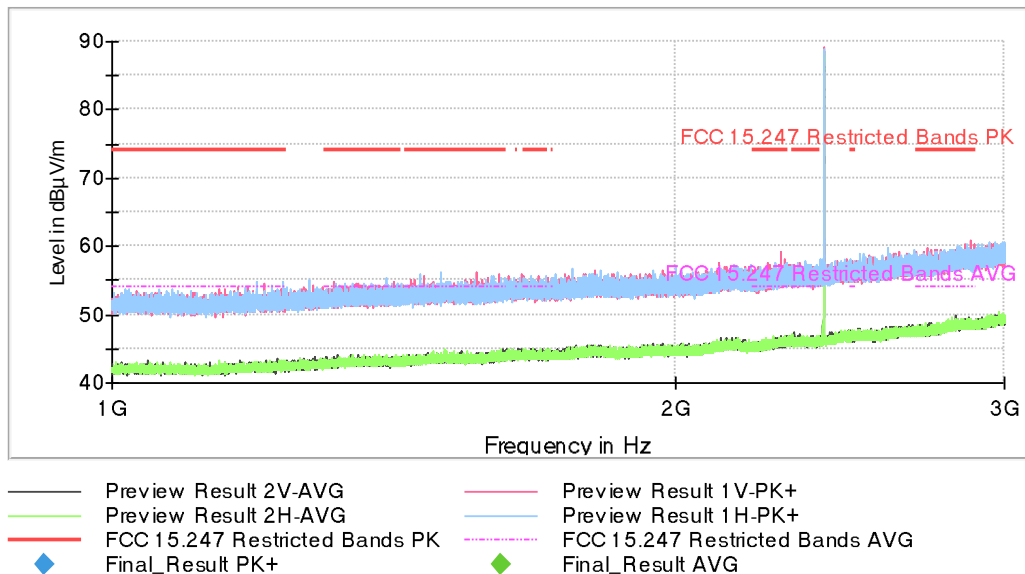
- High Channel:



- **1M modulation:**

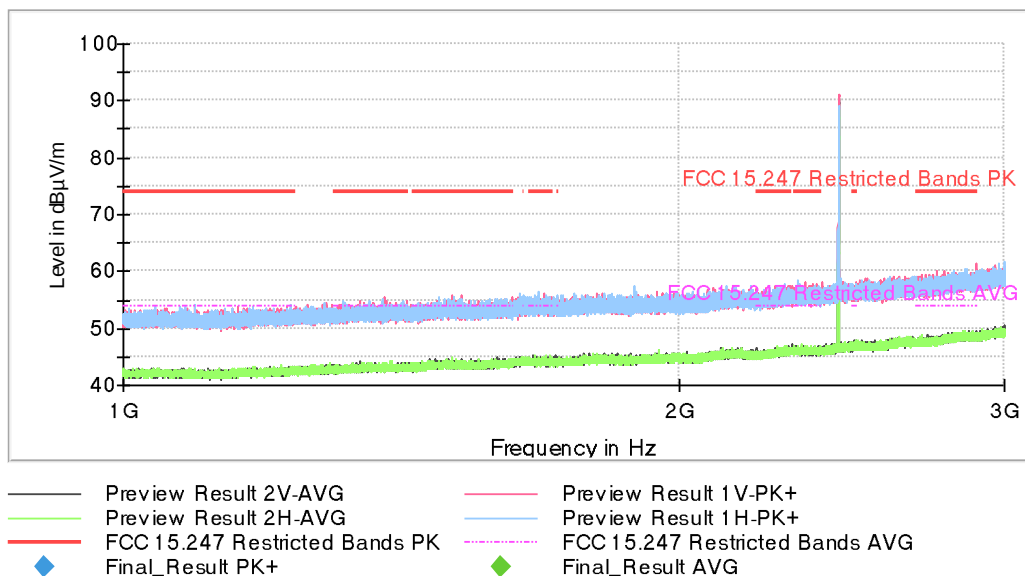
FREQUENCY RANGE 1 - 3 GHz:

- Low Channel:



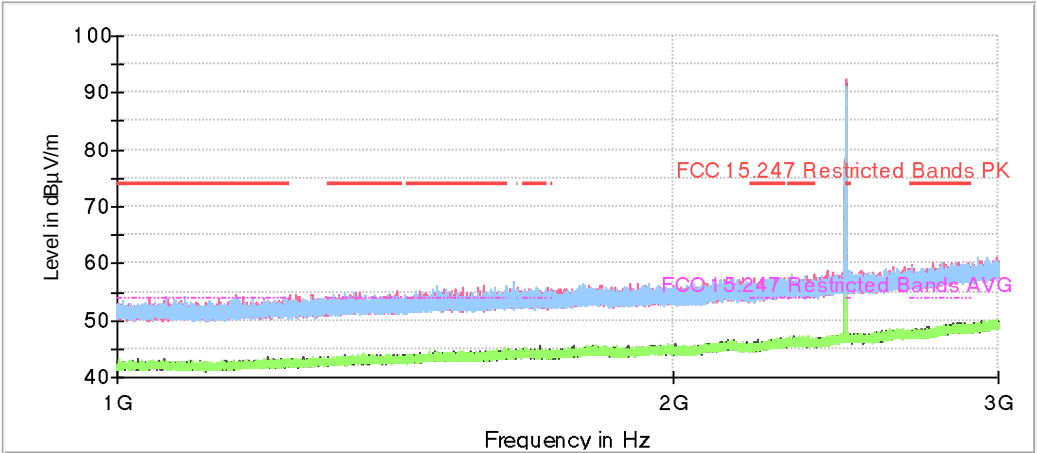
The peak above the limit is the carrier frequency.

- Middle Channel:



The peak above the limit is the carrier frequency.

- High Channel:

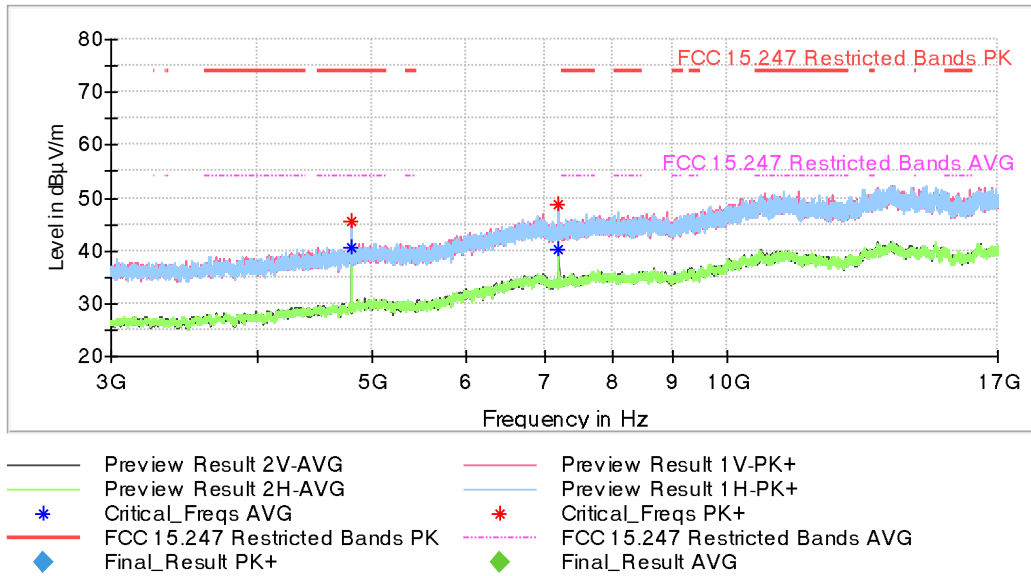


- | | |
|----------------------------------|-----------------------------------|
| — Preview Result 2V-AVG | — Preview Result 1V-PK+ |
| — Preview Result 2H-AVG | — Preview Result 1H-PK+ |
| — FCC 15.247 Restricted Bands PK | — FCC 15.247 Restricted Bands AVG |
| ◆ Final_Result PK+ | ◆ Final_Result AVG |

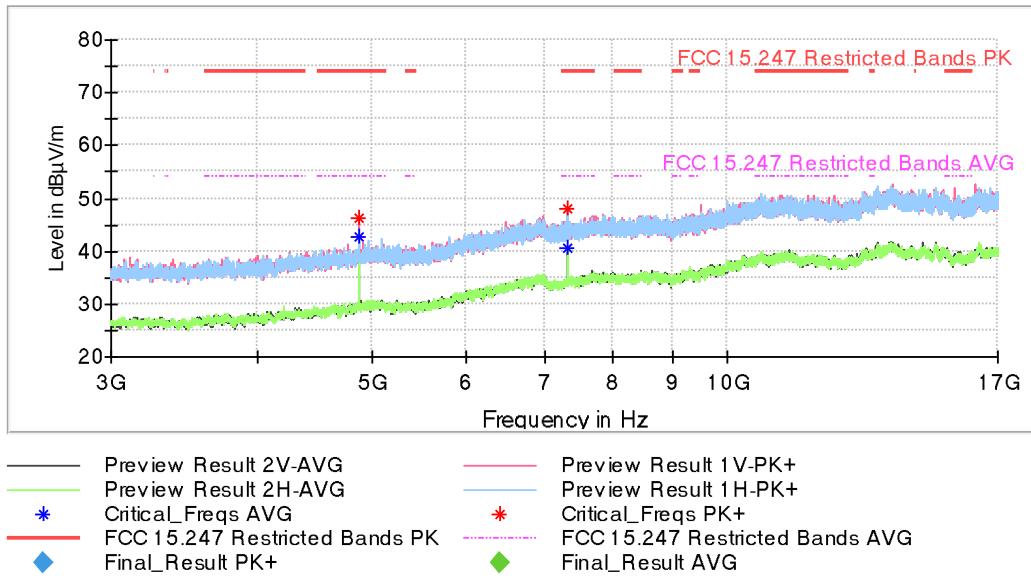
The peak above the limit is the carrier frequency.

FREQUENCY RANGE 3 - 17 GHz:

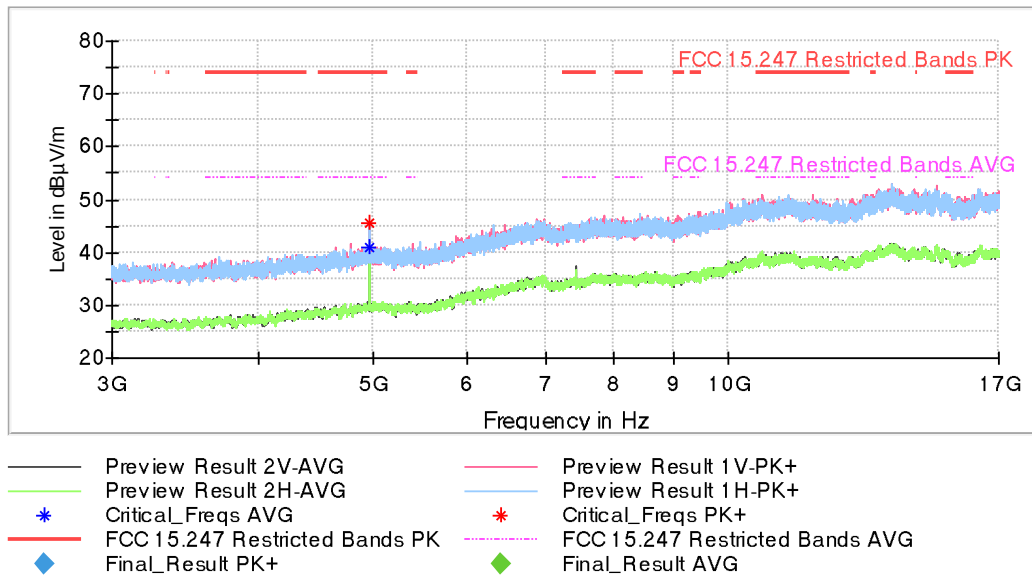
- Low Channel:



- Middle Channel:

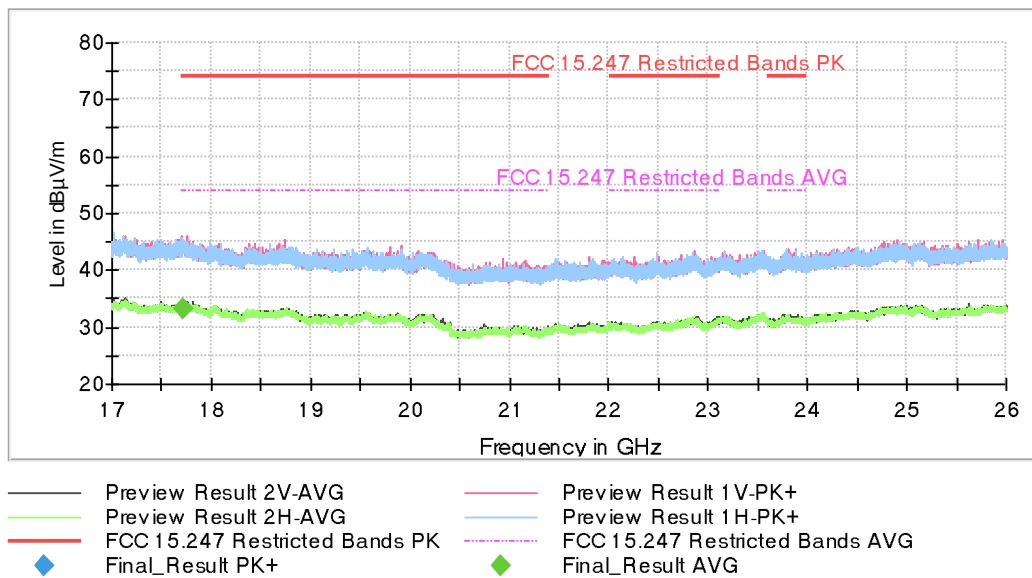


- High Channel:



FREQUENCY RANGE 17 - 26 GHz:

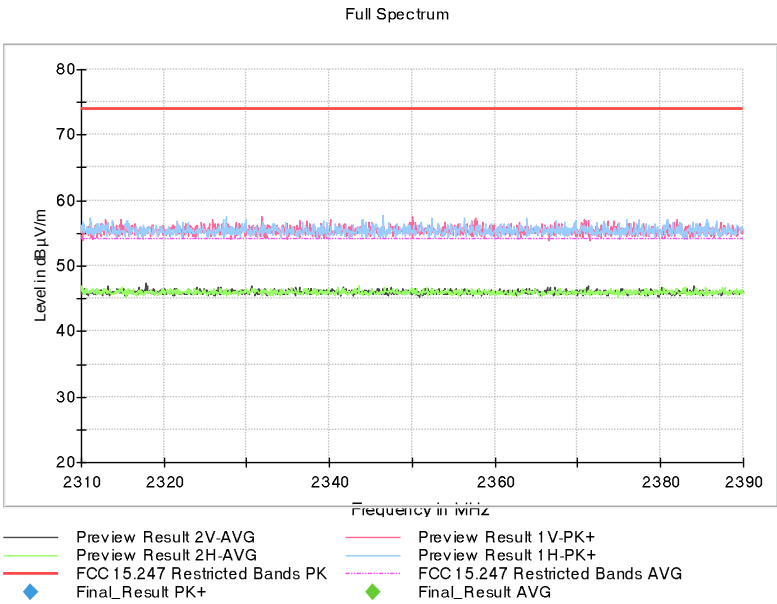
The spurious frequencies detected do not depend on the operating channel.



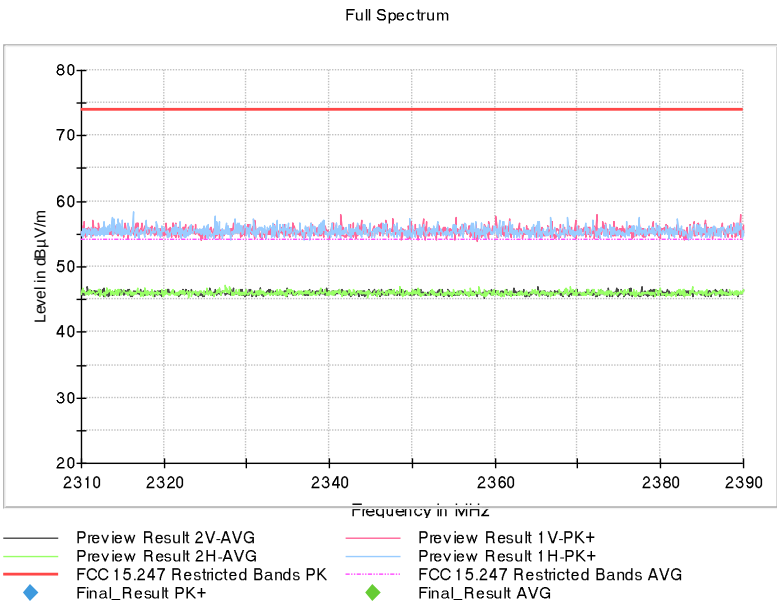
This plot is valid for the Low, Middle and High Channels.

FREQUENCY RANGE 2.31-2.39 GHz:

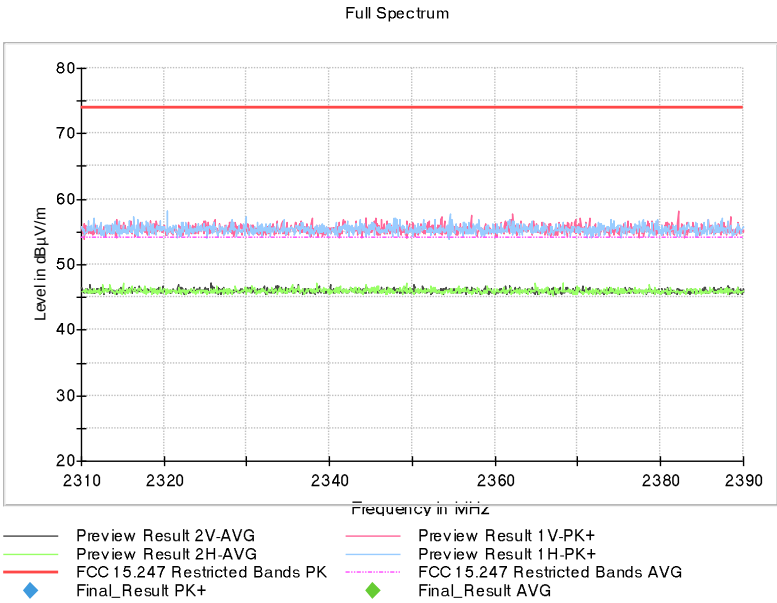
- Low Channel:



- Middle Channel:

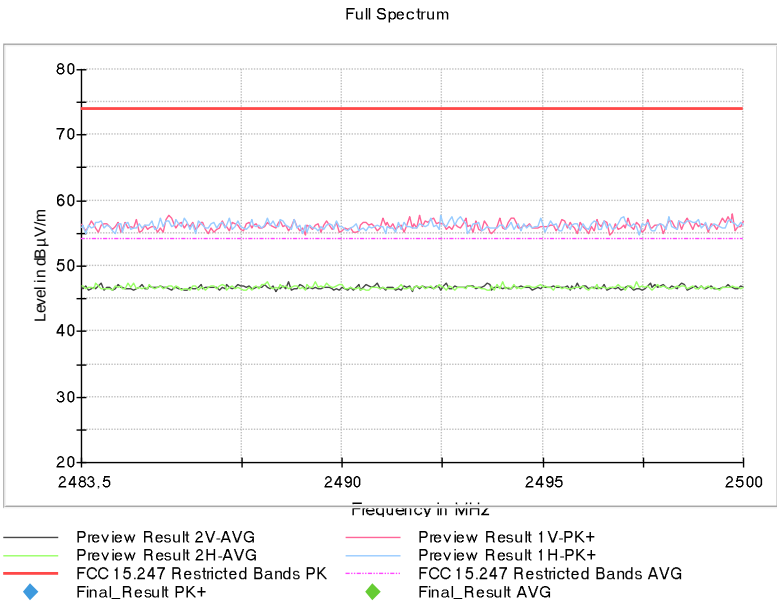


- High Channel:

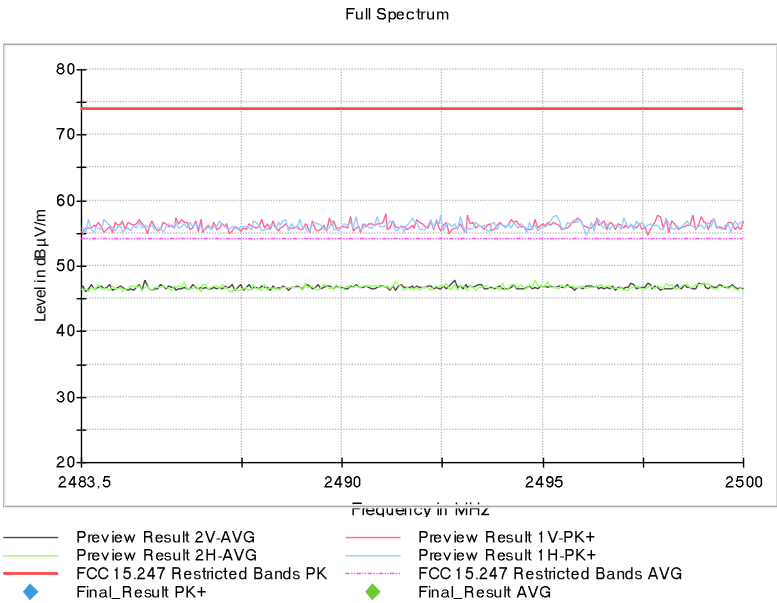


FREQUENCY RANGE 2.4835-2.5 GHz:

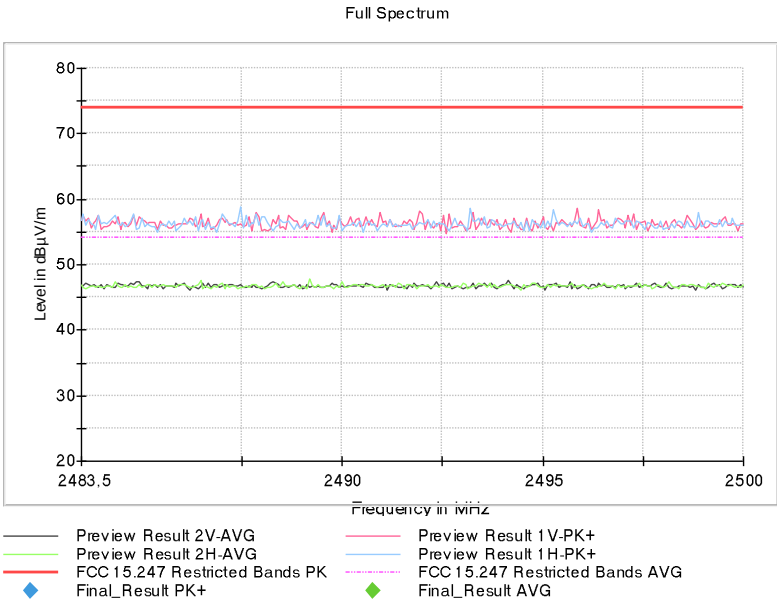
- Low Channel:



- Middle Channel:



- High Channel:



Appendix B: Test results. ANT+

INDEX

TEST CONDITIONS.....57

Occupied Bandwidth60

FCC 15.247 (a) (2) / RSS-247 5.2 (a) 6 dB Bandwidth61

FCC 15.247 (b) / RSS-247 5.4 (d) Maximum Output Power and Antenna Gain62

FCC 15.247 (d) / RSS-247 5.5. Band-Edge Emissions Compliance (Transmitter)64

FCC 15.247 (e) / RSS-247 5.2. (b) Power Spectral Density.....66

FCC 15.247 (d) / RSS-247 5.5. Emission Limitations Radiated (Transmitter)67

TEST CONDITIONS

POWER SUPPLY (V):

V nominal:	3.9 Vdc
Type of Power Supply:	Battery.
Type of Antenna:	Integral.
Maximum Declared Antenna Gain:	-1 dBi

TEST FREQUENCIES:

Single Channel:	2457 MHz
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- WORST CASE: Pre-scan performed with the Swimming Holder and the Arm Band, being the worst case the one with the Arm Band.

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.



The DC supply voltage is applied using an external calibrated power supply with a multimeter.

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 (antenna and 18 GHz-40 GHz horn antenna).

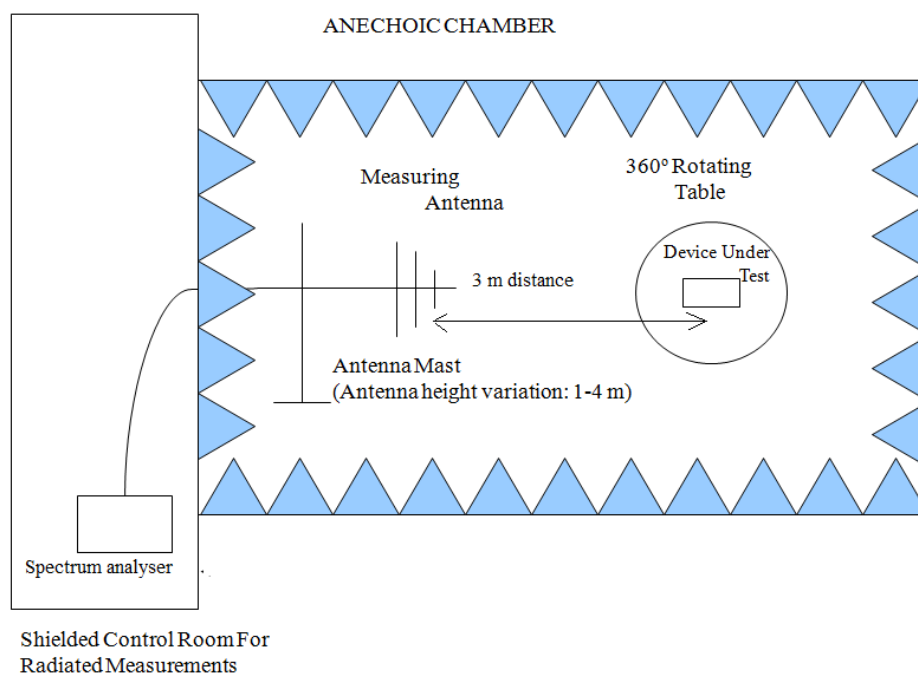
For radiated emissions in the range 17 GHz-26 GHz that is performed at a distance closer than the specified distance, an inverse proportionality factor of 20 dB per decade is used to normalize the measured data for determining compliance.

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.

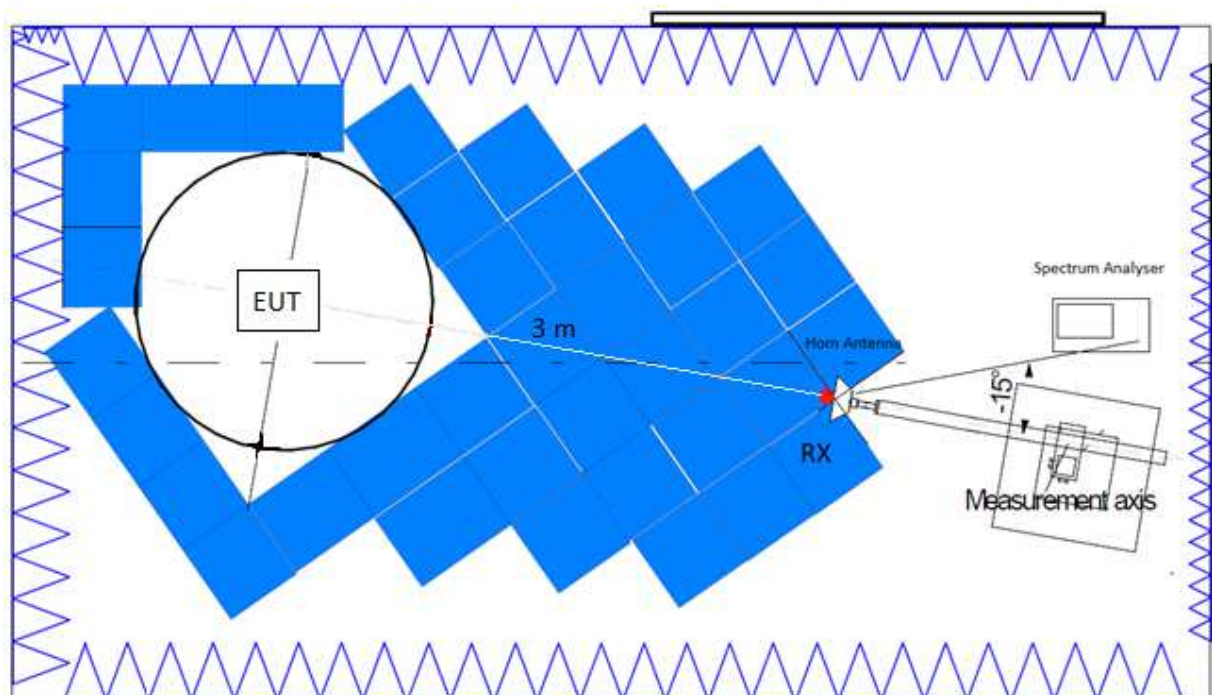
Measurements were made in both horizontal and vertical planes of polarization.

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.

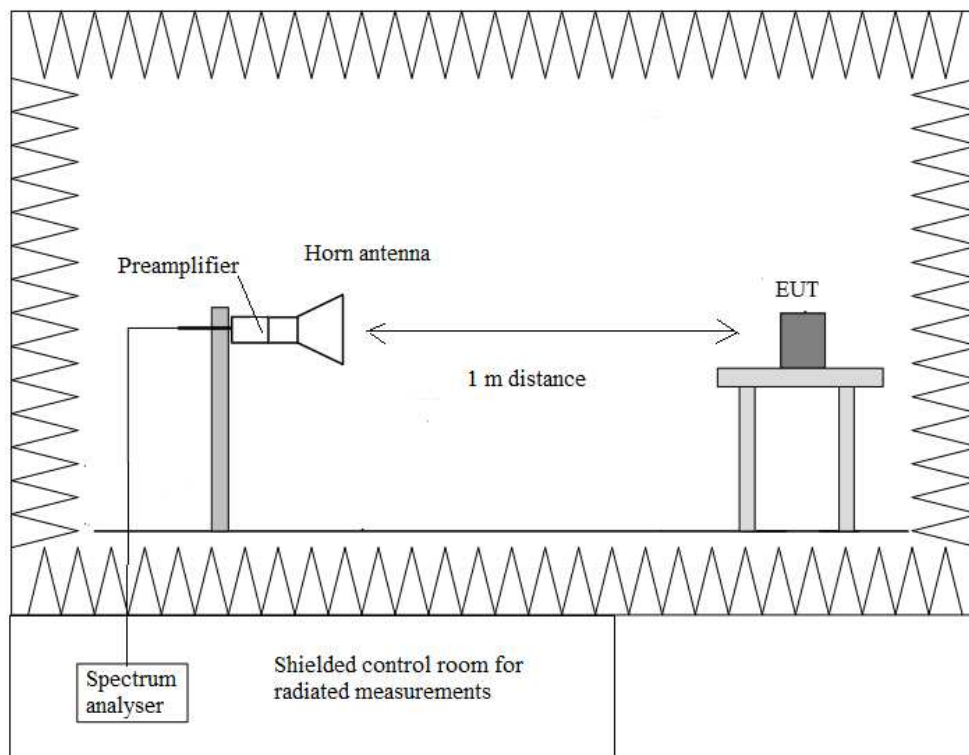
Radiated measurements setup from 30 MHz to 1 GHz:



Radiated measurements setup from 1 GHz to 17 GHz:



Radiated measurements setup $f > 17$ GHz:

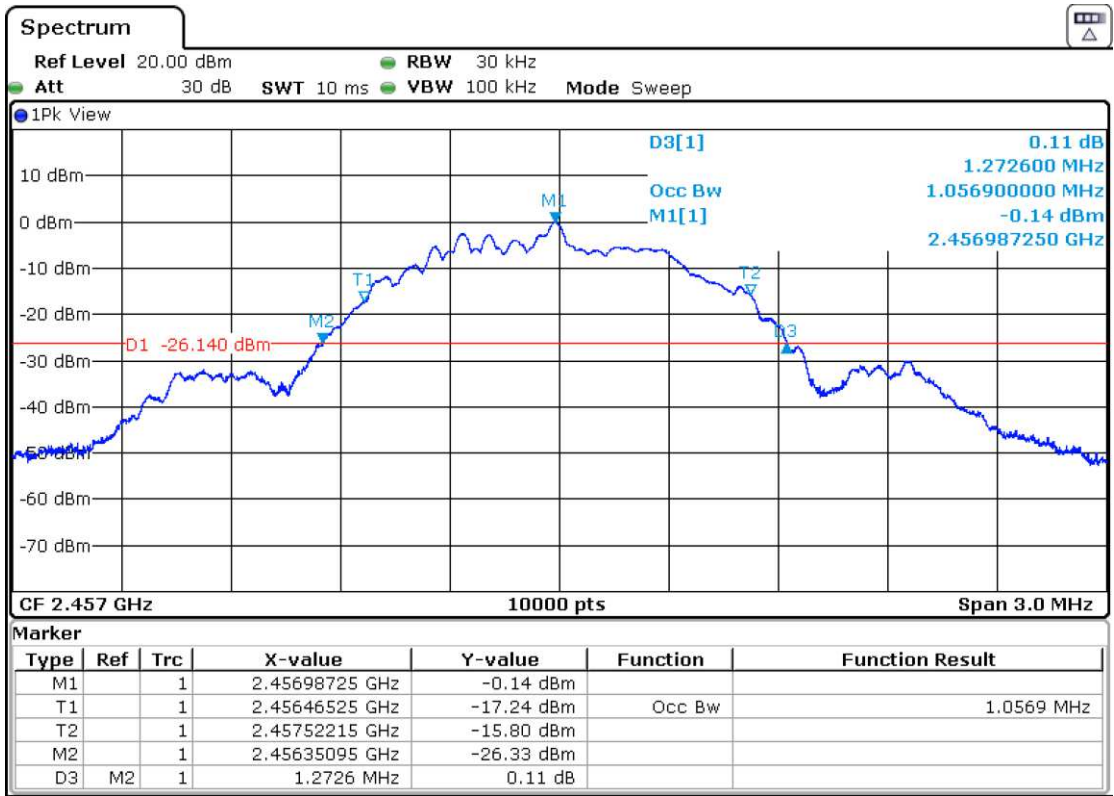


Occupied Bandwidth

RESULTS:

	Single Channel 2457 MHz
99% bandwidth (MHz)	1.0569
Measurement uncertainty (kHz)	<± 3.77

- Single Channel:



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

SPECIFICATION:

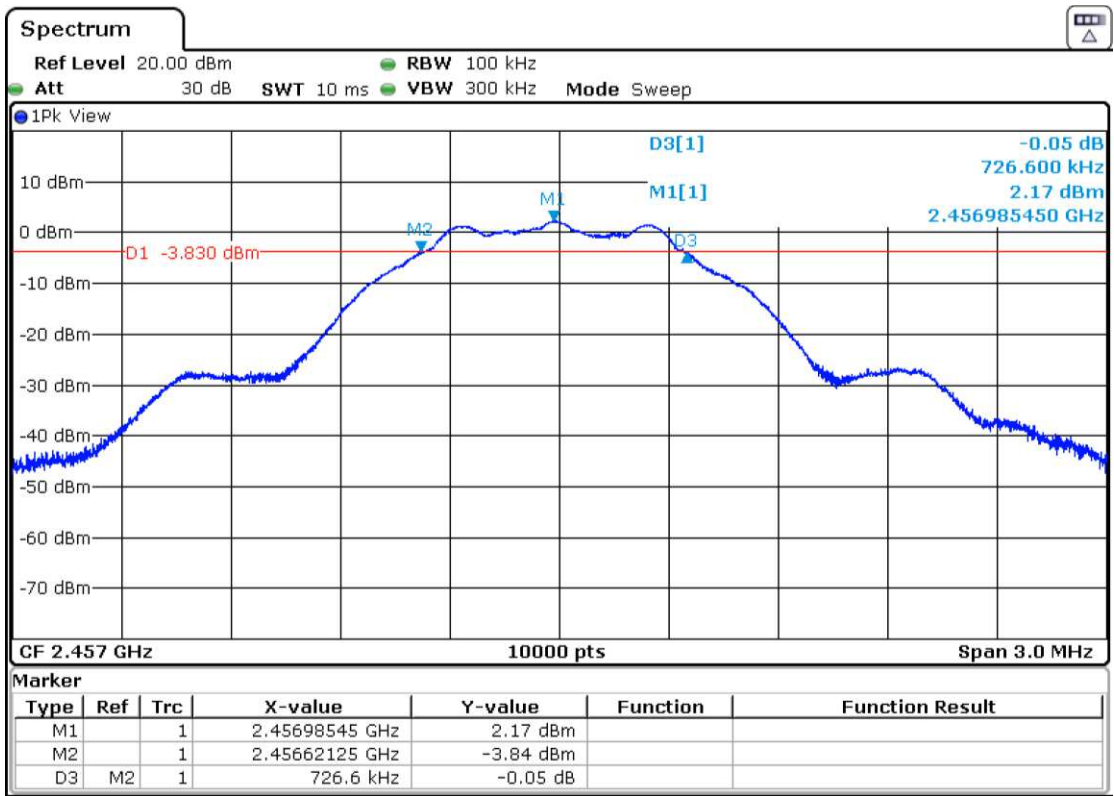
The minimum 6 dB bandwidth shall be at least 500 kHz.

RESULTS:

	Single Channel 2457 MHz
6 dB Spectrum bandwidth (MHz)	0.7266
Measurement uncertainty (kHz)	<±11.76

Verdict: PASS

- Single 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.

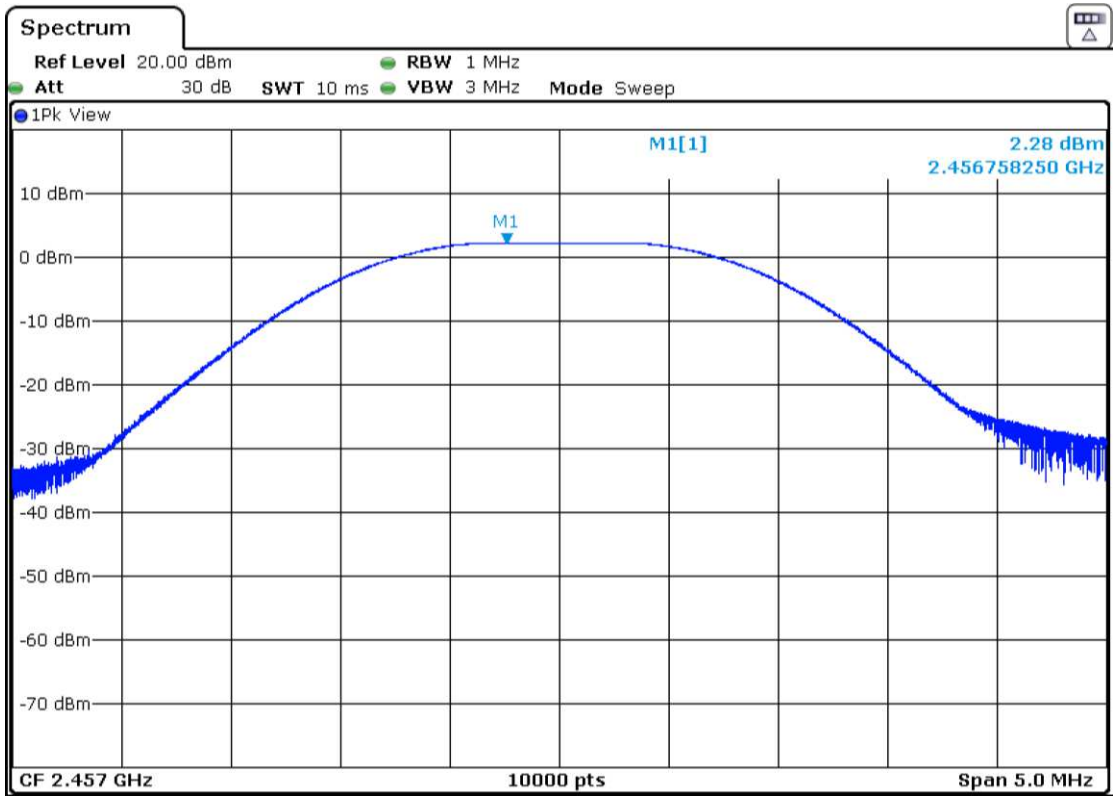
Maximum Declared Antenna Gain: -1 dBi

	Single Channel 2457 MHz
Maximum Conducted Power (dBm)	2.28
Maximum EIRP Power (dBm)	1.28
Measurement uncertainty (dB)	$<\pm 2.57$

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

- Single Channel:



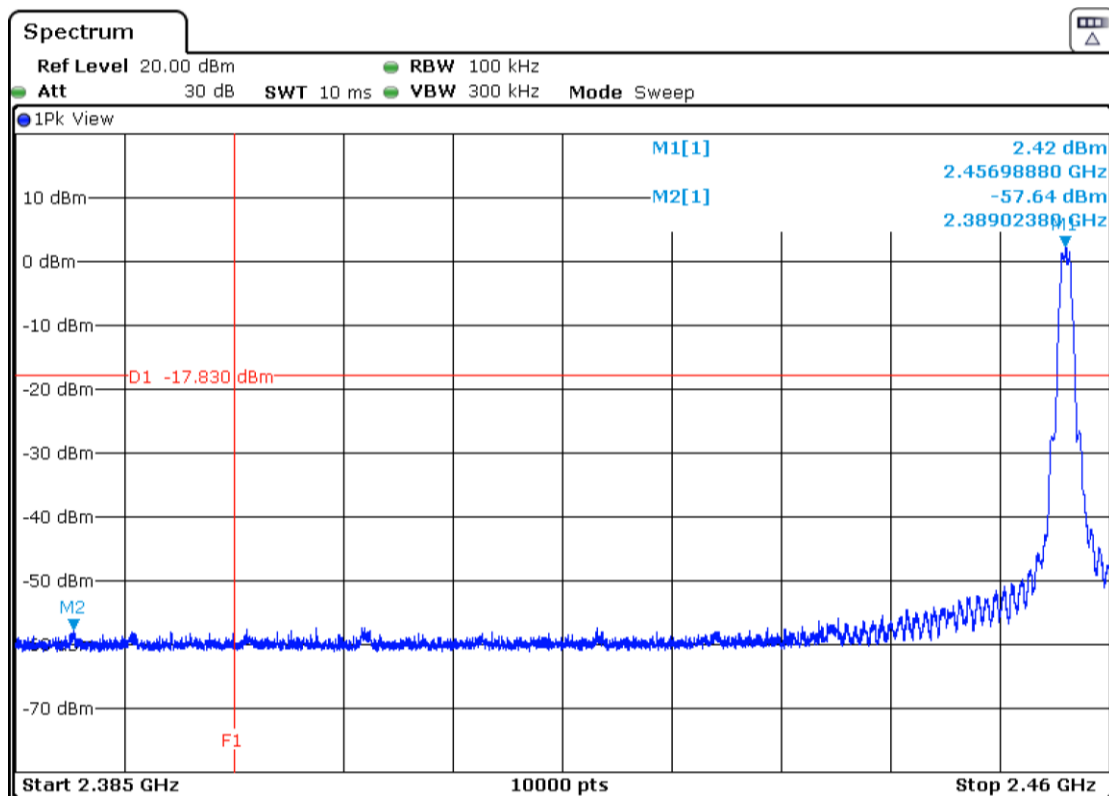
FCC 15.247 (d) / RSS-247 5.5. Band-Edge Emissions Compliance (Transmitter)

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.

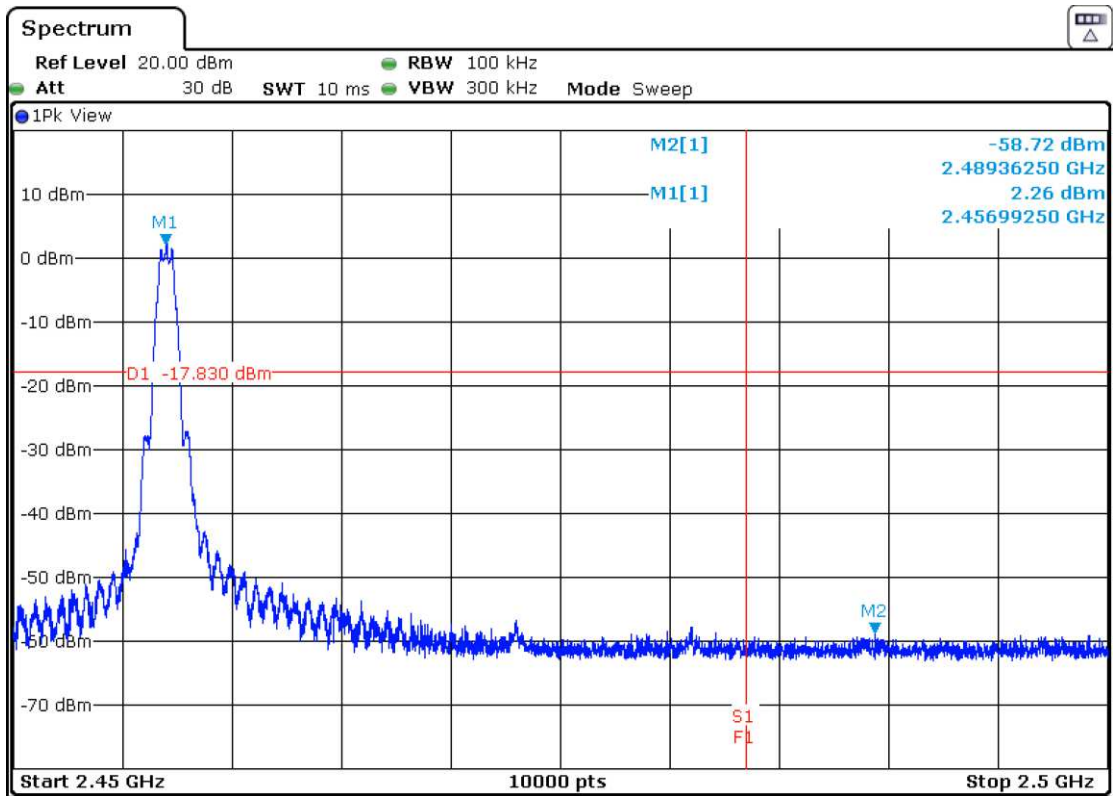
RESULTS:

- Band-Edge Low:



Verdict: PASS

- Band-Edge High:



Measurement uncertainty (dB)	<±2.57
------------------------------	--------

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.

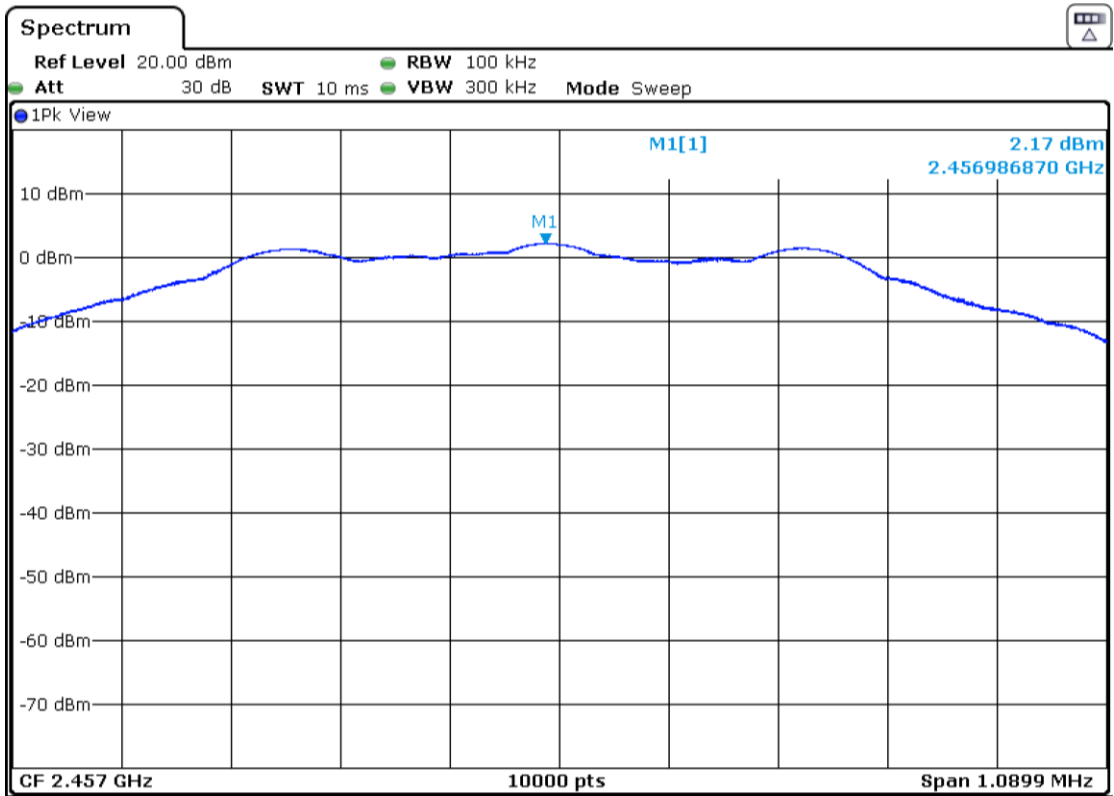
RESULTS:

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.

	Single Channel 2457 MHz
Power Spectral Density (dBm)	2.17
Measurement uncertainty (dB)	<±2.57

Verdict: PASS

- Single 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:

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.

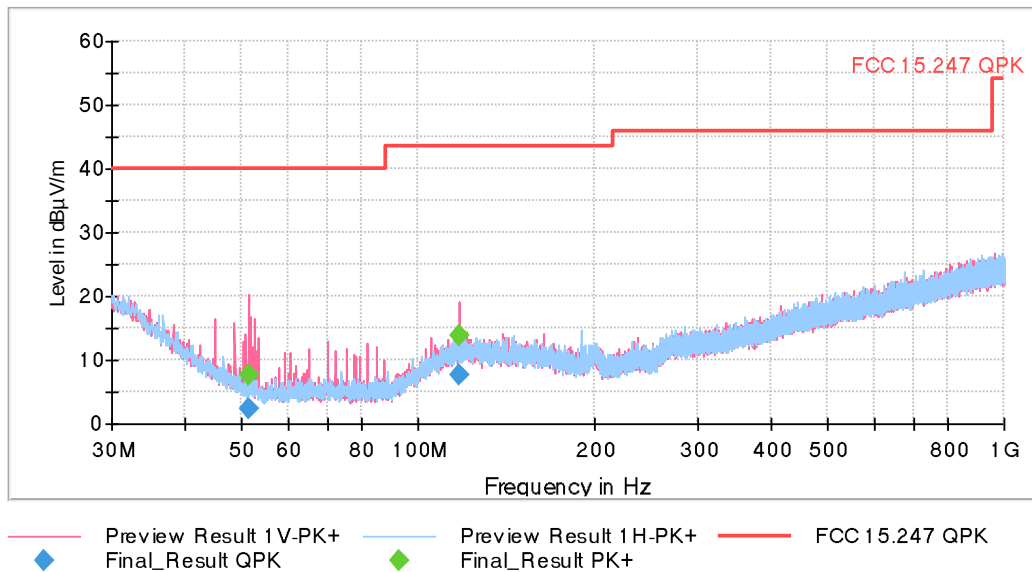
Spurious signals with peak levels above the average limit (54 dB μ V/m at 3 m) are measured with average detector for checking compliance with the average limit.

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

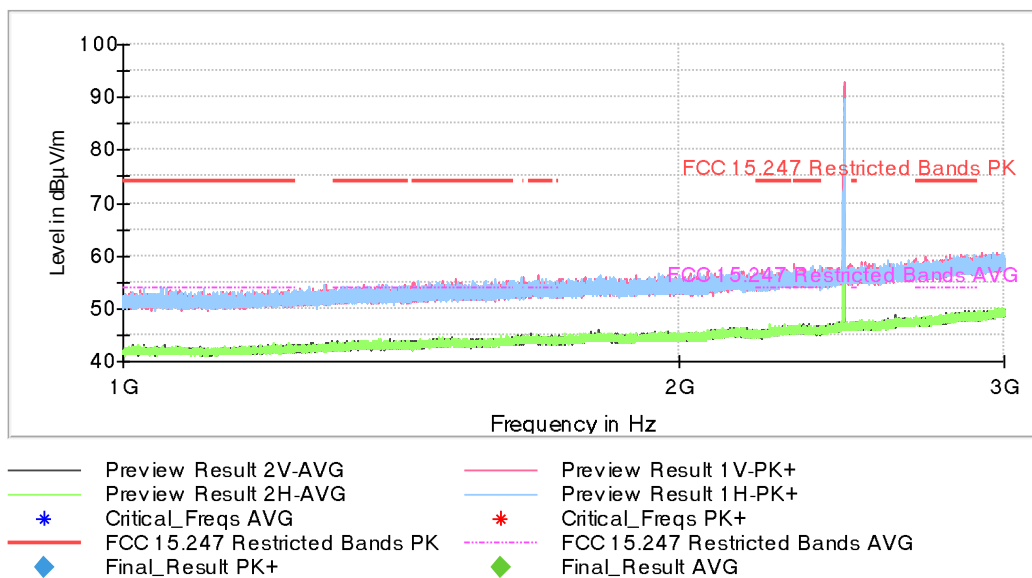
Measurement Uncertainty (dB): $<\pm 5.13$ for $1 \leq f \leq 17$ GHz
 $<\pm 4.82$ for $17 < f \leq 26$ GHz

Verdict: PASS

FREQUENCY RANGE 30 MHz - 1 GHz:

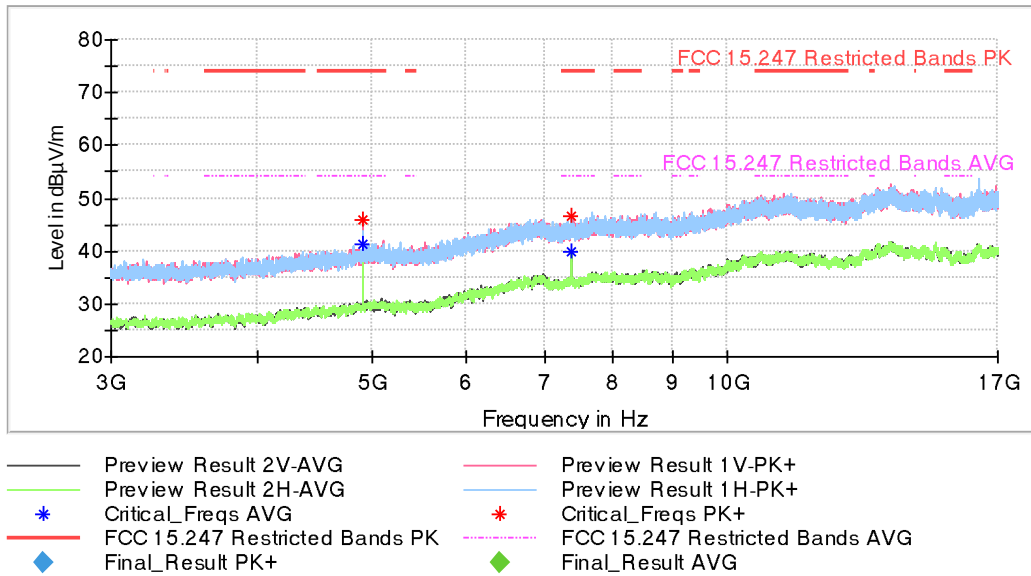


FREQUENCY RANGE 1 - 3 GHz:

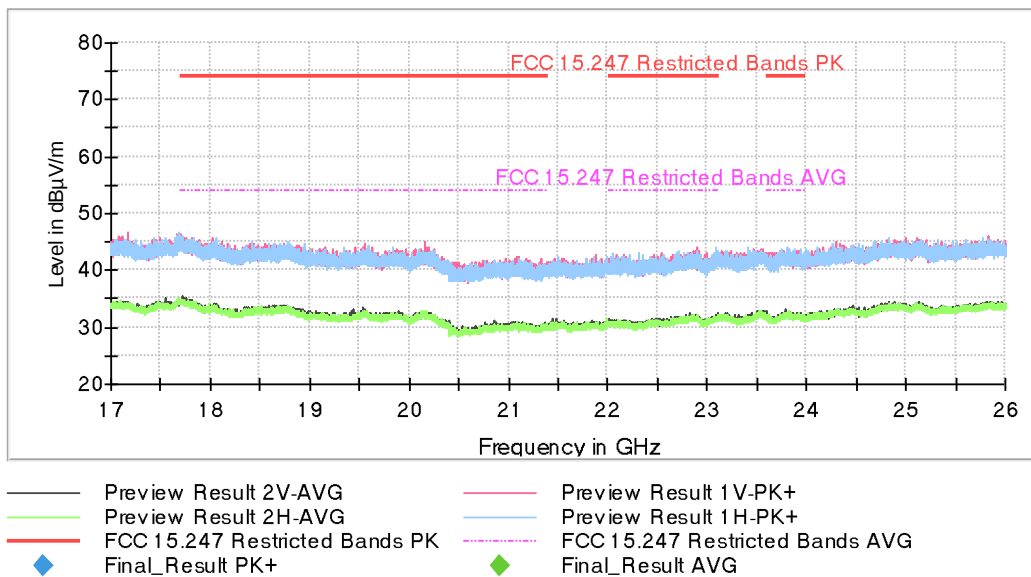


The peak above the limit is the carrier frequency.

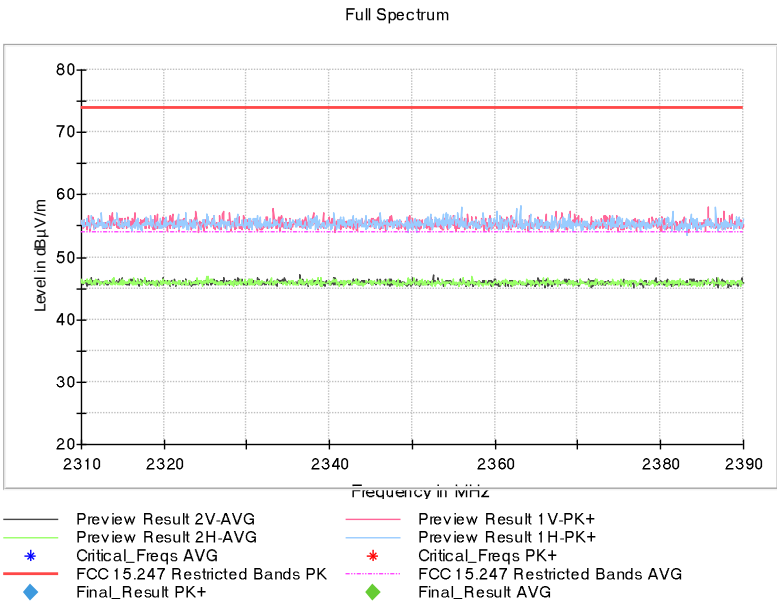
FREQUENCY RANGE 3 - 17 GHz:



FREQUENCY RANGE 17 - 26 GHz:



FREQUENCY RANGE 2.31-2.39 GHz (Restricted Band):



FREQUENCY RANGE 2.4835-2.5 GHz (Restricted Band):

