DEKRA Testing and Certification, S.A.U.
Parque Tecnológico de Andalucía,
c/ Severo Ochoa nº 2 · 29590 Campanillas · Málaga · España
C.I.F. A29 507 456

ISED CABid: ES1909
Lab. Company Number: 4621A

Test report No:
69260RRF.002A1

Test Report
USA FCC Part 15.247, 15.209
CANADA RSS-247, RSS-Gen

(*) Identification of item tested	TRX module
(*) Trademark	MIPOT
(*) Model and /or type reference	32001505BUS
Other identification of the product	FCC ID: 2AGJP-MIP IC ID: 28566-MIP
(*) Features	Features; LoRaWAN US915 HW version: 2 SW version: FW01000002
Applicant	MIPOT S.p.A. Via Corona 5, 34071 Cormons (GO), ITALIA
Test method requested, standard	USA FCC Part 15.247 (10-1-21 Edition): Operation within the bands 902 - 928 MHz, 2400 -2483.5 MHz, and 5725 - 5850 MHz. USA FCC Part 15.209 (10-1-21 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)	José Manuel Gómez Galván EMC Consumer & RF Lab. Manager Firmado digitalmente por 53680346W JOSE MANUEL GOMEZ (C:A29507456)
Date of issue	2023-10-03
Report template No	FDT08_24 (*) “Data provided by the client”

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Competences and guarantees

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DEKRA Testing and Certification S.A.U. is an ISED-recognized accredited testing laboratory, CABid: ES1909, Company Number: 4621A, with the appropriate scope of accreditation that covers the performed tests in this 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.

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The results presented in this Test Report apply only to the particular item under test established in this document.

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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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 32001505BUS is a LoRaWAN transceiver (US915 frequency plan).

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

Usage of samples

Samples undergoing test have been selected by: The client.

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

Control Nº	Description	Model	Serial Nº	Date of reception
69260B/012	TRX module	32001505BUS	--	2021/09/21

Sample S/01 has undergone the test(s): All tests indicated in Appendixes A and B.

Test sample description

Ports……:	Port name and description	Cable						
		Specified max length [m]	Attached during test	Shielded	Coupled to patient(3)			
	Power Supply	10	☒	☐	☐			
	UART	10	☒	☐	☐			
	-		☐	☐	☐			
Supplementary information to the ports……:	-							
Rated power supply .....:	Voltage and Frequency		Reference poles					
			L1	L2	L3	N	PE	
	☐	AC:	☐	☐	☐	☐	☐	
	☐	AC:	☐	☐	☐	☐	☐	
	☒	DC: 3 V						
	☐	DC:						
Rated Power .....:	107 mA							
Clock frequencies .....:	48 MHz							
Other parameters.....:	-							
Software version .....:	FW01000002							
Hardware version.....:	rev. 2							
Dimensions in cm (W x H x D)....:	1.13 x 0.25 x 0.89							
Mounting position.....:	☐	Table top equipment						
	☐	Wall/Ceiling mounted equipment						
	☐	Floor standing equipment						
	☐	Hand-held equipment						
	☒	Other: Any position						
Modules/parts .....:	Module/parts of test item		Type	Manufacturer				
	32001505BUS		TRX	MIPOT S.P.A.				
Accessories (not part of the test item) .....:	Description		Type	Manufacturer				
	32001495		BOARD	MIPOT S.P.A.				
	-							
Documents as provided by the applicant.....:	Description		File name	Issue date				
	TEST GUI USER MANUAL							
	TEST ITEM DOCUMENTATION (LAYOUT + BoM)							
	-							

(3) Only for Medical Equipment

Identification of the client

MIPOT S.p.A.

Via Corona 5,

34071 Cormons (GO), ITALIA

Testing period and place

Test Location	DEKRA Testing and Certification S.A.U.
Date (start)	2021-10-21
Date (finish)	2022-01-14

Document history

Report number	Date	Description
69260RRF.002	2023-05-22	First release
69260RRF.002A1	2023-10-03	It is modified due to a change in the FCC ID field and antenna gain. This modification test report cancels and replaces the test report 69260RRF.002

Environmental conditions

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

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

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

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

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

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

Remarks and comments

The tests have been performed by the technical personnel: Jaime Barranquero and Javier Miguel Nadales.

Used instrumentation:

Conducted Measurements:

		Last Calibration	Due Calibration
1.	Shielded Room ETS LINDGREN S101	N/A	N/A
2.	Spectrum Analyzer ROHDE AND SCHWARZ FSW50	2021/07	2023/07
3.	Chamber HERAEUS VMT 04/35	2020/07	2022/07
4.	Signal Generator 10MHZ-18GHZ ROHDE AND SCHWARZ SWM05	2020/08	2022/08
5.	DC Power Supply Keysight Technologies U8002A	N.A.	N.A.
6.	Digital multimeter FLUKE 179	2021/10	2022/10

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.	Ultralog Antenna 30MHz-6GHz, ROHDE AND SCHWARZ HL562E_UPG	2019/10	2022/10
4.	EMI Test Receiver 2 Hz - 44 GHz Rhode and Schwarz ESW44	2021/12	2023/12
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.	Digital Multimeter FLUKE 175	2021/11	2022/11
8.	DC Power supply 30V/3A 90W GW INSTEK GPS-3030D	N.A.	N.A.

Testing verdicts

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

Summary

LoRa 500 kHz

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 peak 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	
Supplementary information and remarks: None.			

LoRa 125 kHz

FCC PART 15 PARAGRAPH / RSS-247			
Requirement – Test case		**Verdict**	**Remark**
15.247 (a) (1) / RSS-247 5.1. (c)	20 dB Bandwidth and Carrier frequency separation	P	
15.247 (a)(1)(i) / RSS-247 5.1 (c)	Number of hopping channels	P	
15.247 (a)(1)(i) / RSS-247 5.1 (c)	Time of occupancy (Dwell Time)	P	
15.247 (b) / RSS-247 5.4. (a)	Maximum peak output power and antenna gain	P	
15.247 (d) / RSS-247 5.5.	Band-edge emissions compliance (Transmitter)	P	
15.247 (d) / RSS-247 5.5.	Emission limitations radiated (Transmitter)	P	
Supplementary information and remarks: None.			

Appendix A: Test results. LoRa 500 kHz

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TEST CONDITIONS

(*): Declared by the Applicant.

POWER SUPPLY (*):

Vnominal:	3 Vdc.
Type of Power Supply:	DC external power supply.

ANTENNA (*):

Type of Antenna:	External.
Maximum Declared Antenna Gain:	+3.3 dBi

TEST FREQUENCIES:

Low Channel:	903.0 MHz
Middle Channel:	907.8 MHz
High Channel:	914.2 MHz

Power setting used ***19 dBm*** with command used for test:

TX_SF12/500kHz

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

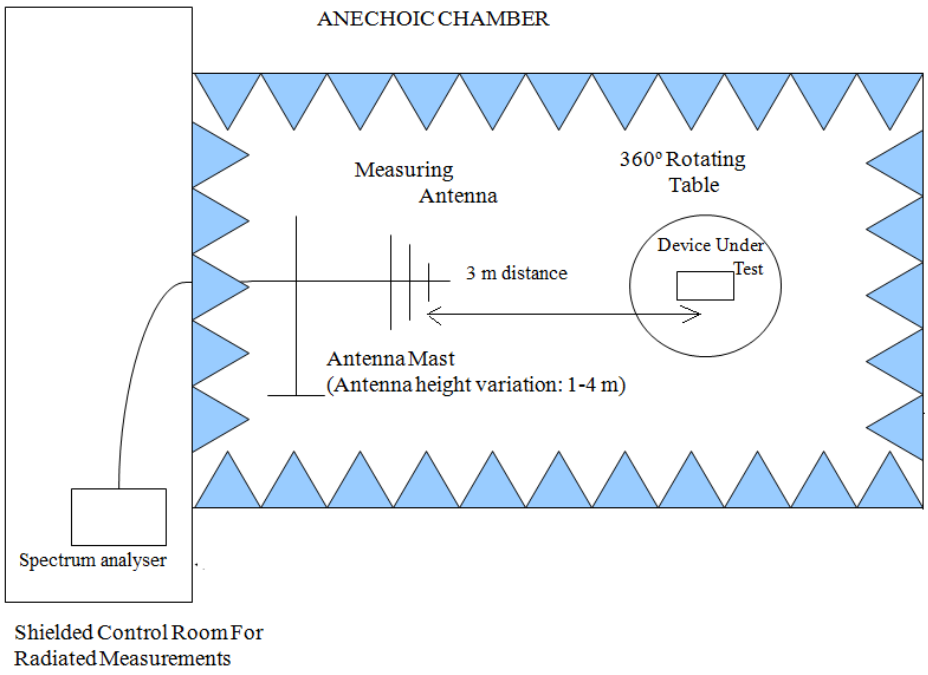
All radiated tests were performed in a semi-anechoic chamber. The measurement antenna (Bilog antenna for the range between 30 MHz to 1000 MHz and 1 GHz-10 GHz Double ridge horn antenna) is situated at a distance of 3 m.

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

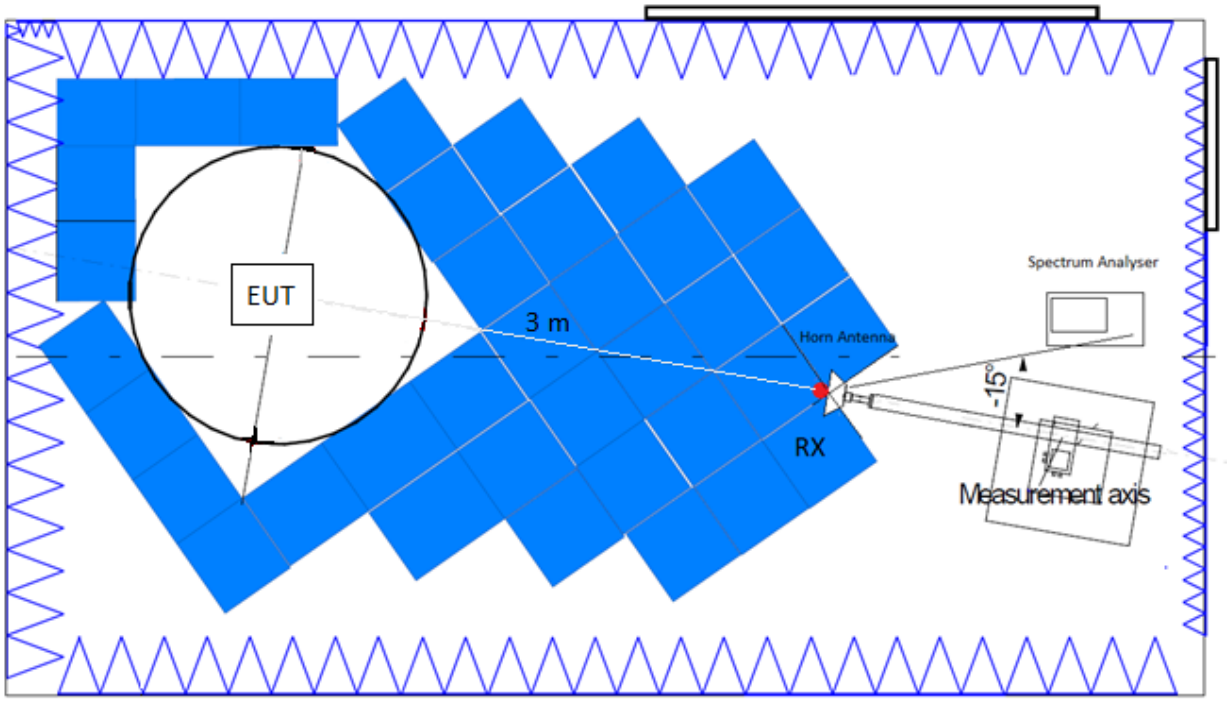
Measurements were made in both horizontal and vertical planes of polarization.

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 10 GHz:

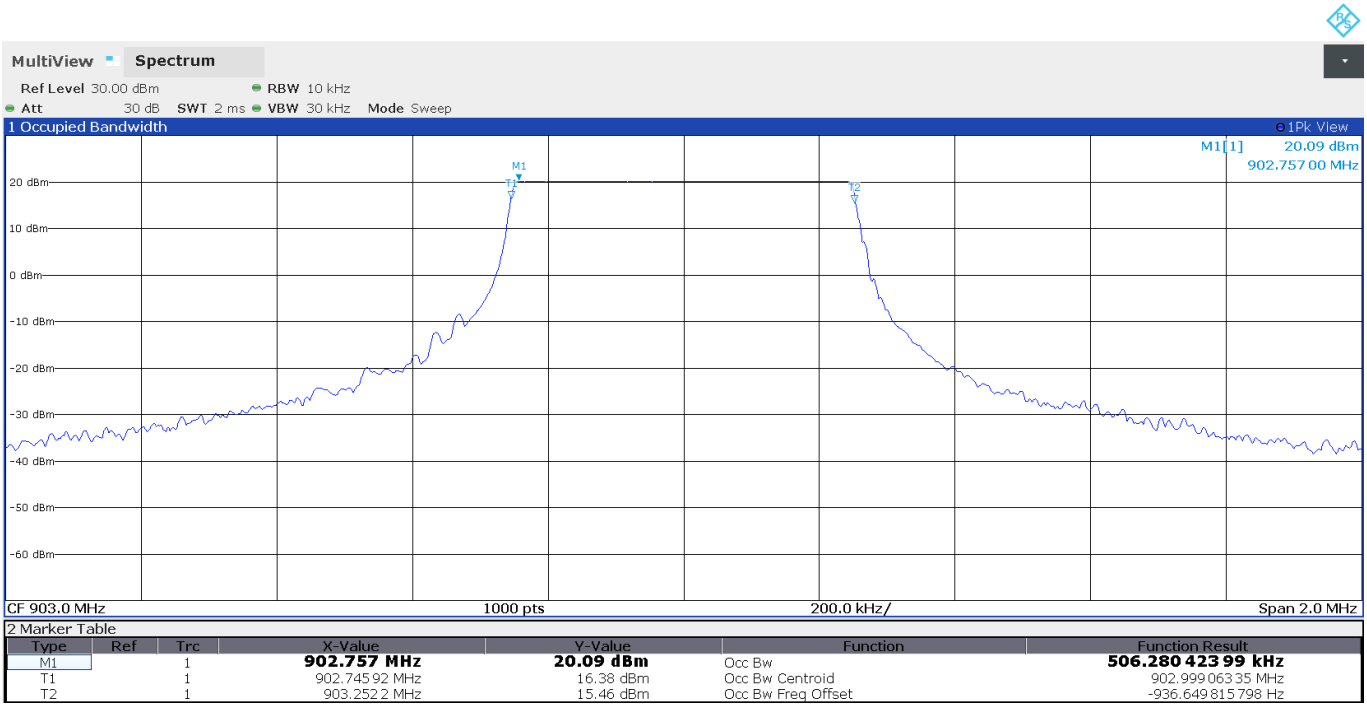


Occupied Bandwidth

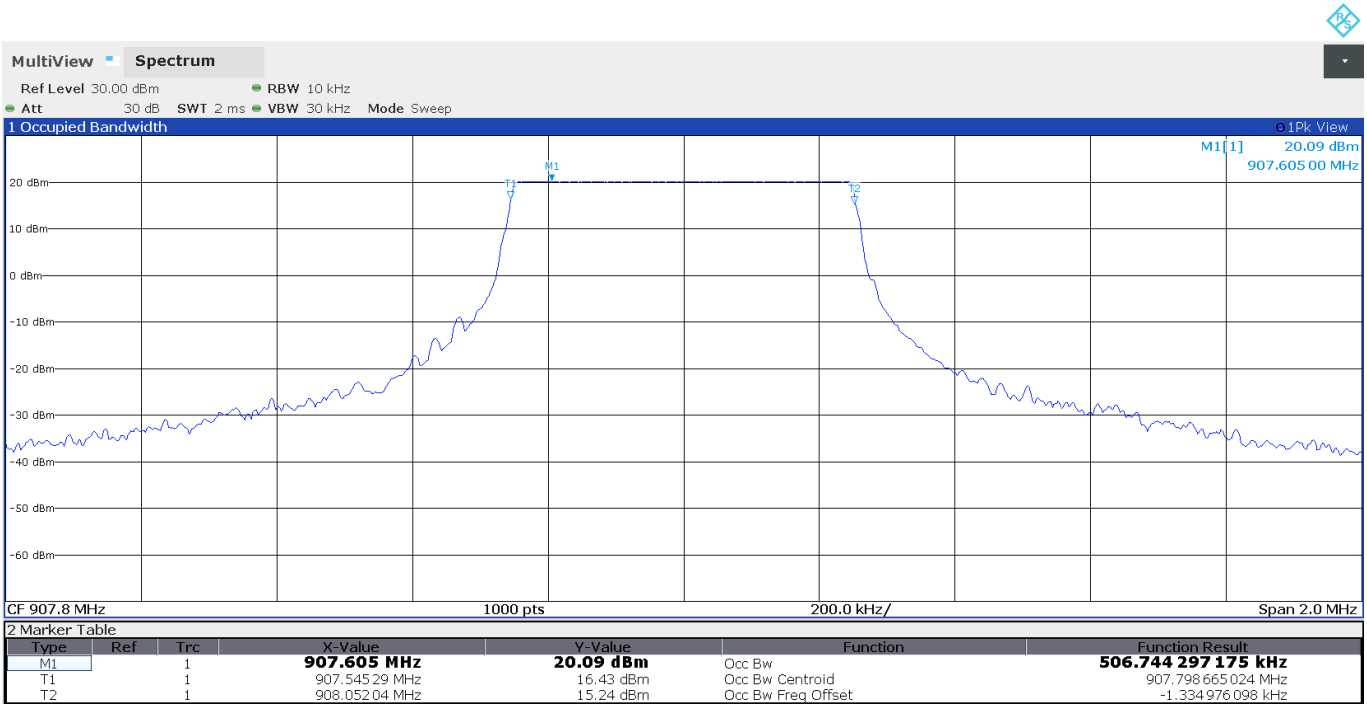
RESULTS:

	Low Channel 903.0 MHz	Middle Channel 907.8 MHz	High Channel 914.2 MHz
99% bandwidth (MHz)	0.56	0.50	0.50
Measurement uncertainty (kHz)	<± 2.31		

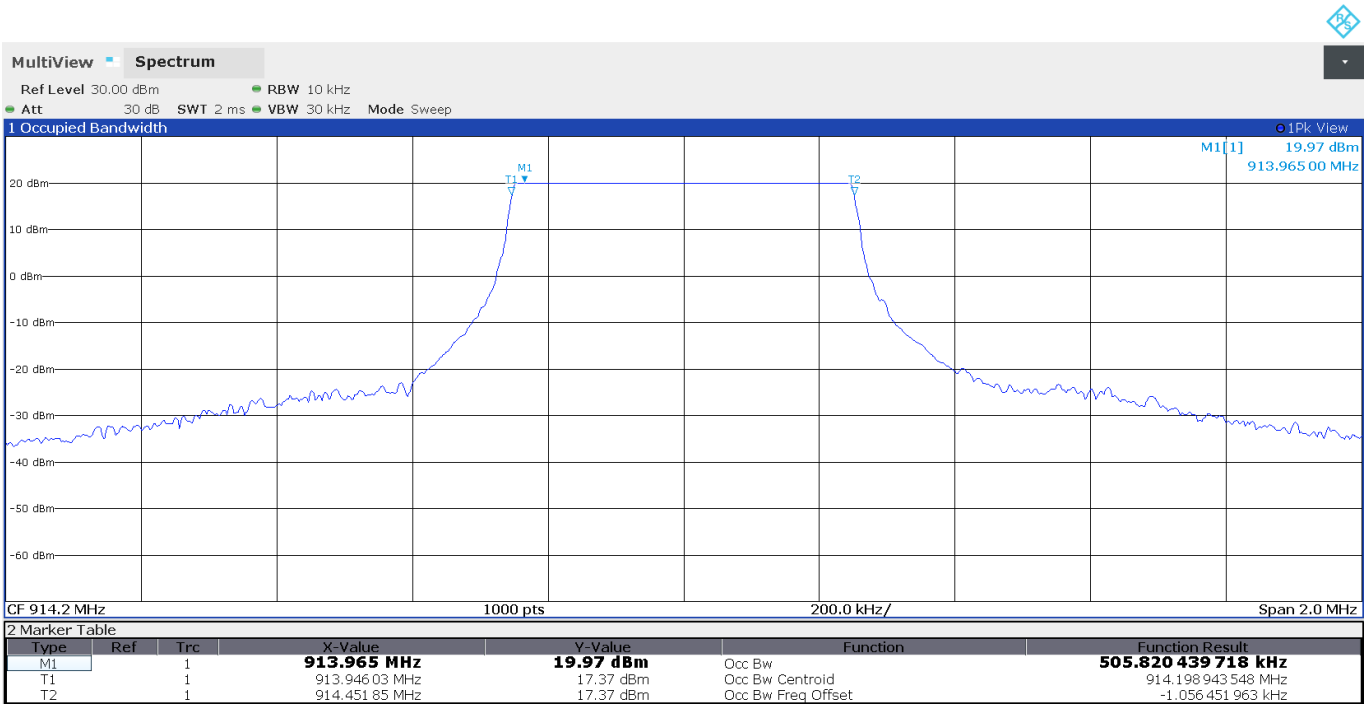
- Low Channel:



- Middle Channel:



- High Channel:



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

SPECIFICATION:

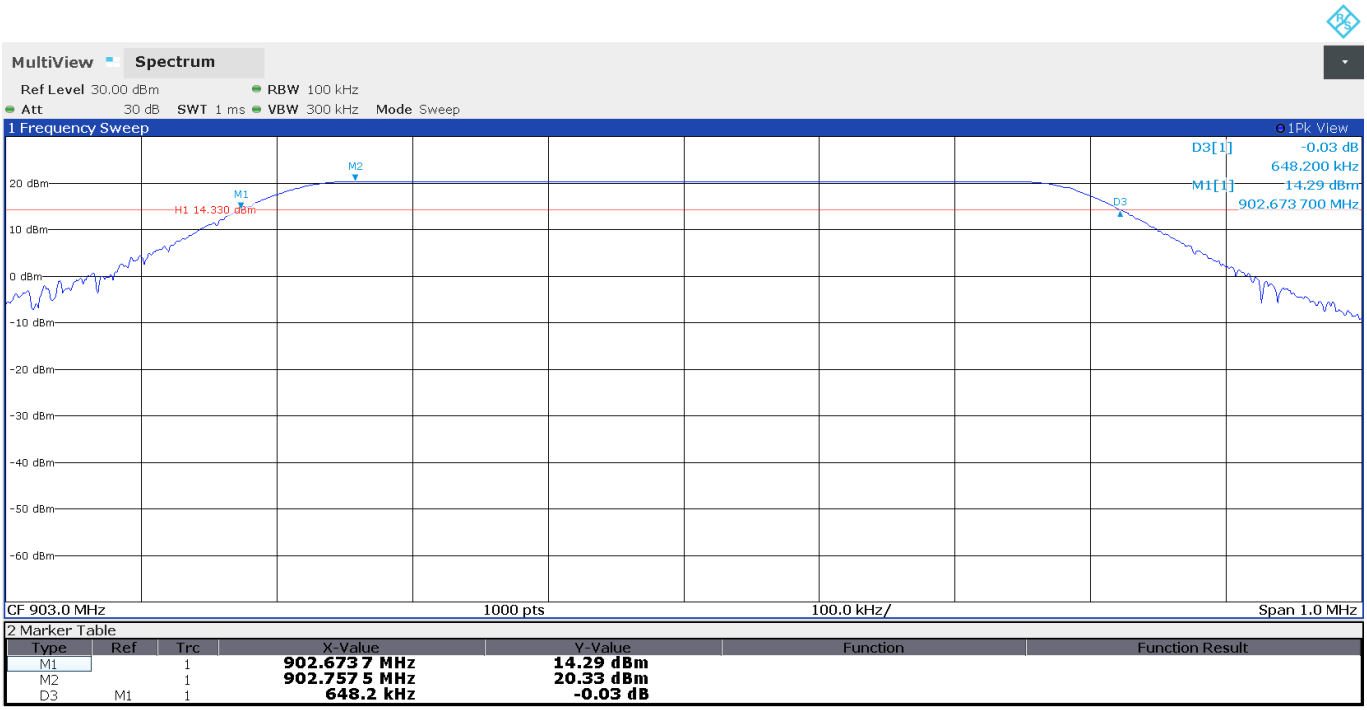
The minimum 6 dB bandwidth shall be at least 500 kHz.

RESULTS:

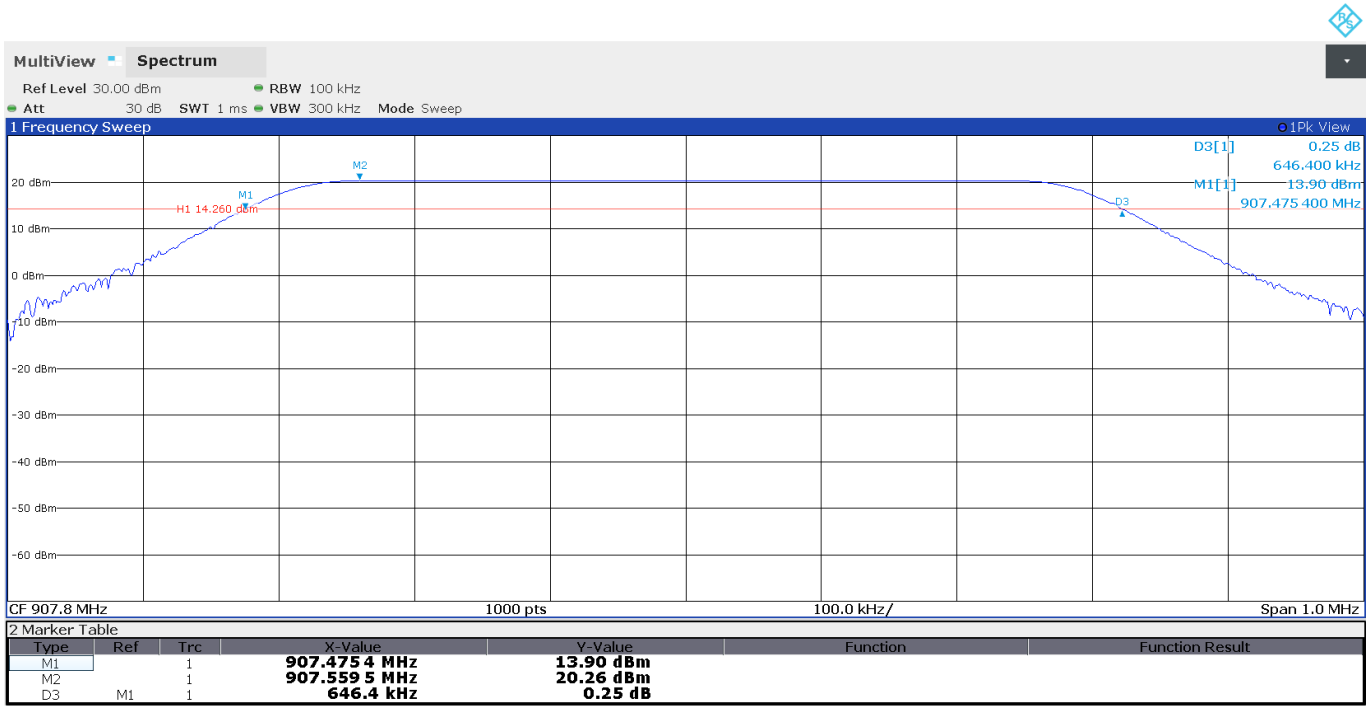
	Low Channel 903.0 MHz	Middle Channel 907.8 MHz	High Channel 914.2 MHz
6 dB Spectrum bandwidth (kHz)	648.2	646.4	644.1
Measurement uncertainty (kHz)	<± 12.13		

Verdict: PASS

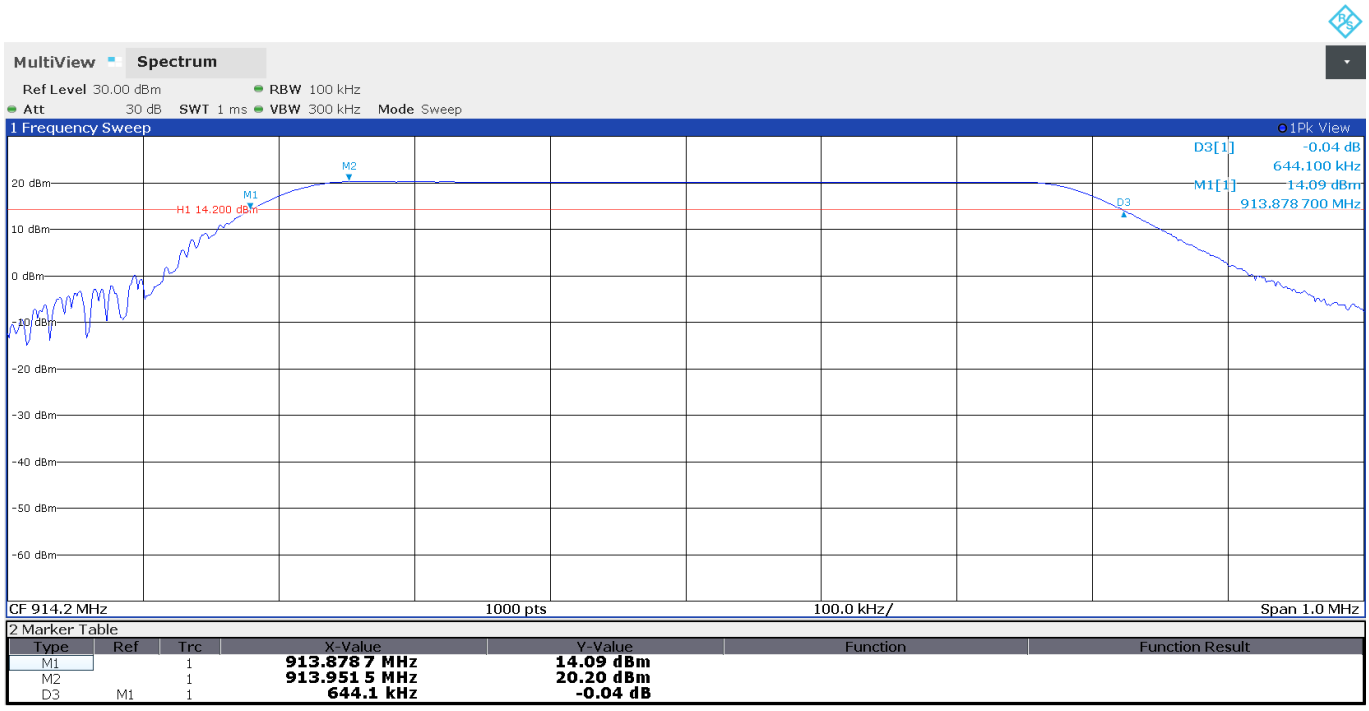
- Low Channel:



- 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 902-928 MHz band: 1 watt (30 dBm).
The e.i.r.p. shall not exceed 4 W (36 dBm) (Canada).

RESULTS:

The maximum conducted output power level in the fundamental emission was measured using the method according to point 11.9.2.2.2 “AVGSA-1” of ANSI C.63.10-2013.

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

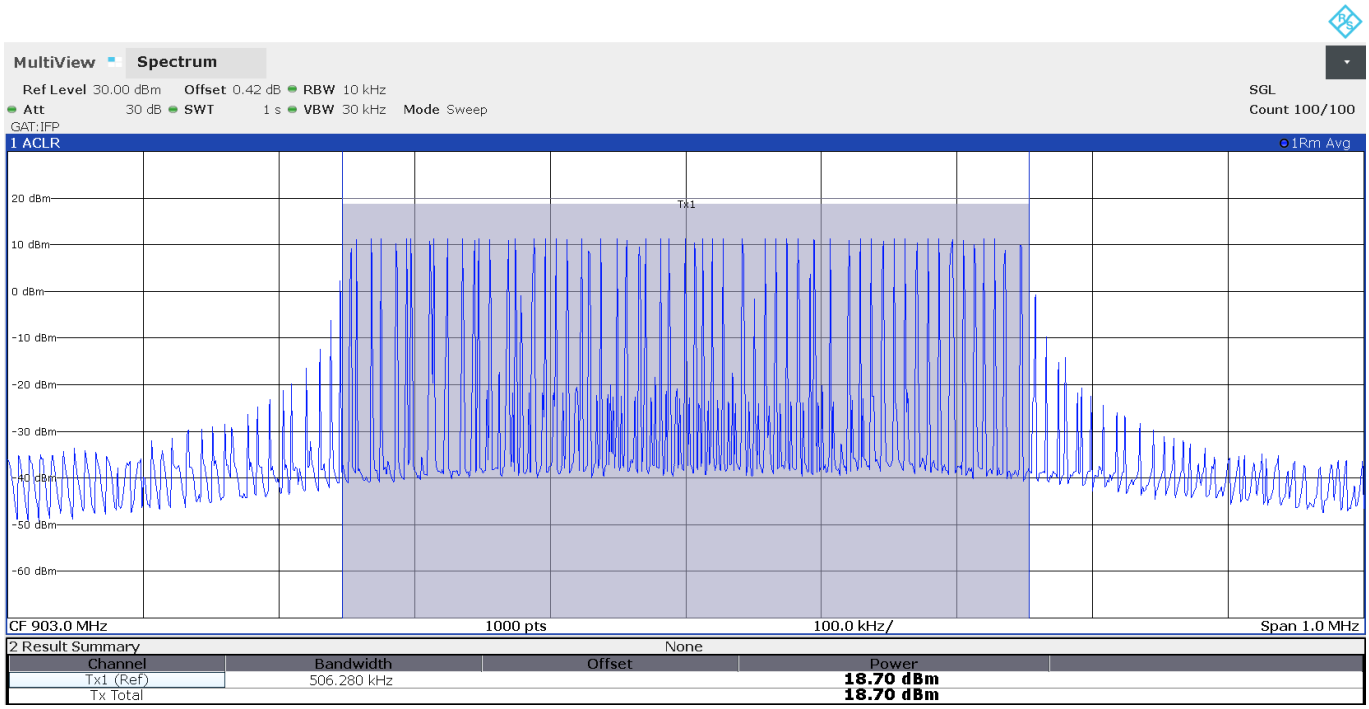
Maximum Declared Antenna Gain: +3.3 dBi

	Low Channel 903.0 MHz	Middle Channel 907.8 MHz	High Channel 914.2 MHz
Maximum Conducted Power (dBm)	18.70	18.65	18.51
Maximum EIRP Power (dBm)	22.00	21.95	21.81
Measurement uncertainty (dB)	<± 2.07		

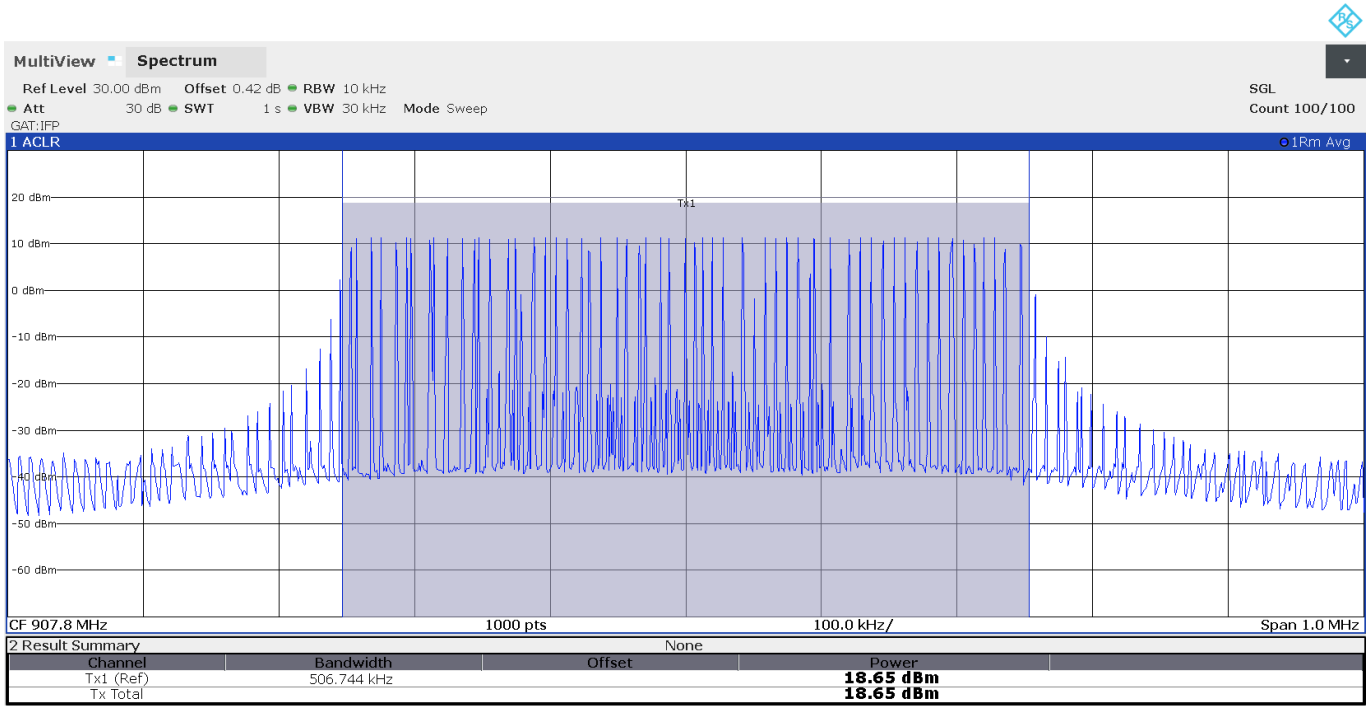
The maximum directional gain of the antenna is less than 6 dBi and therefore the maximum output power is not required to be reduced from the stated values.

Verdict: PASS

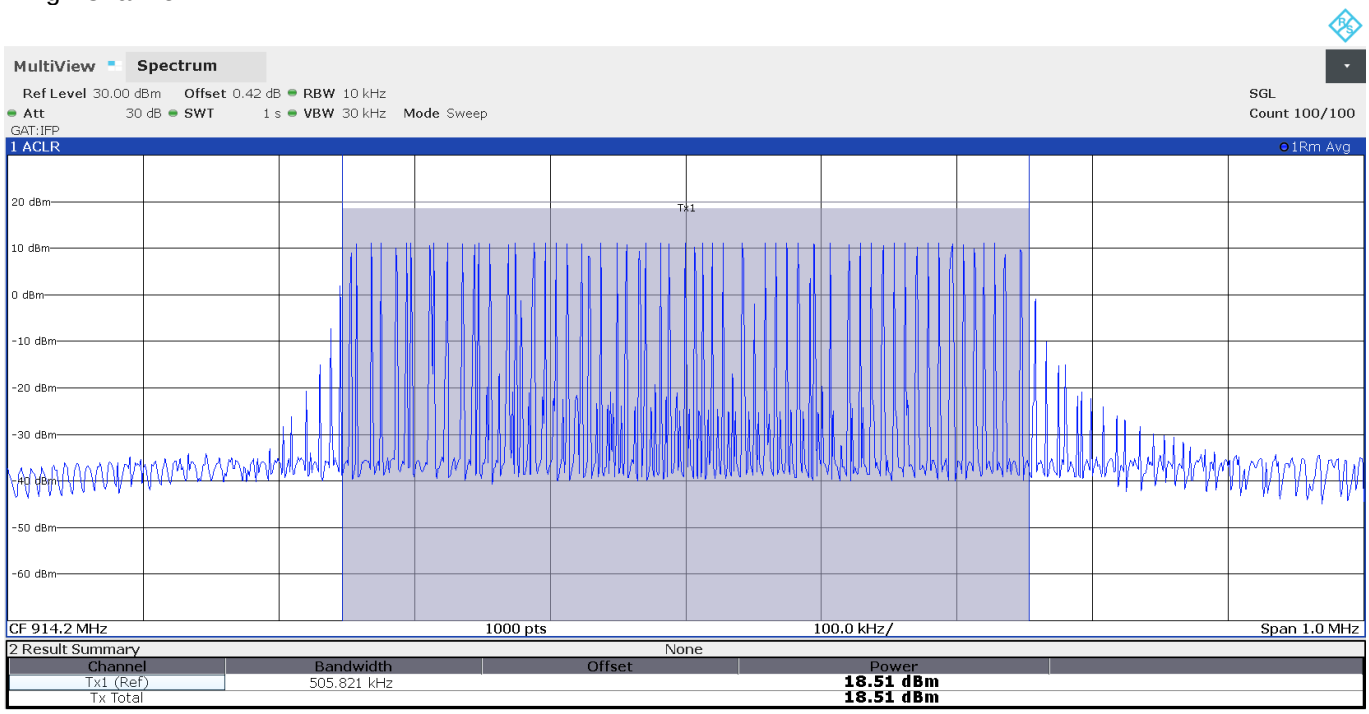
- Low Channel:



- Middle Channel:



- High Channel:



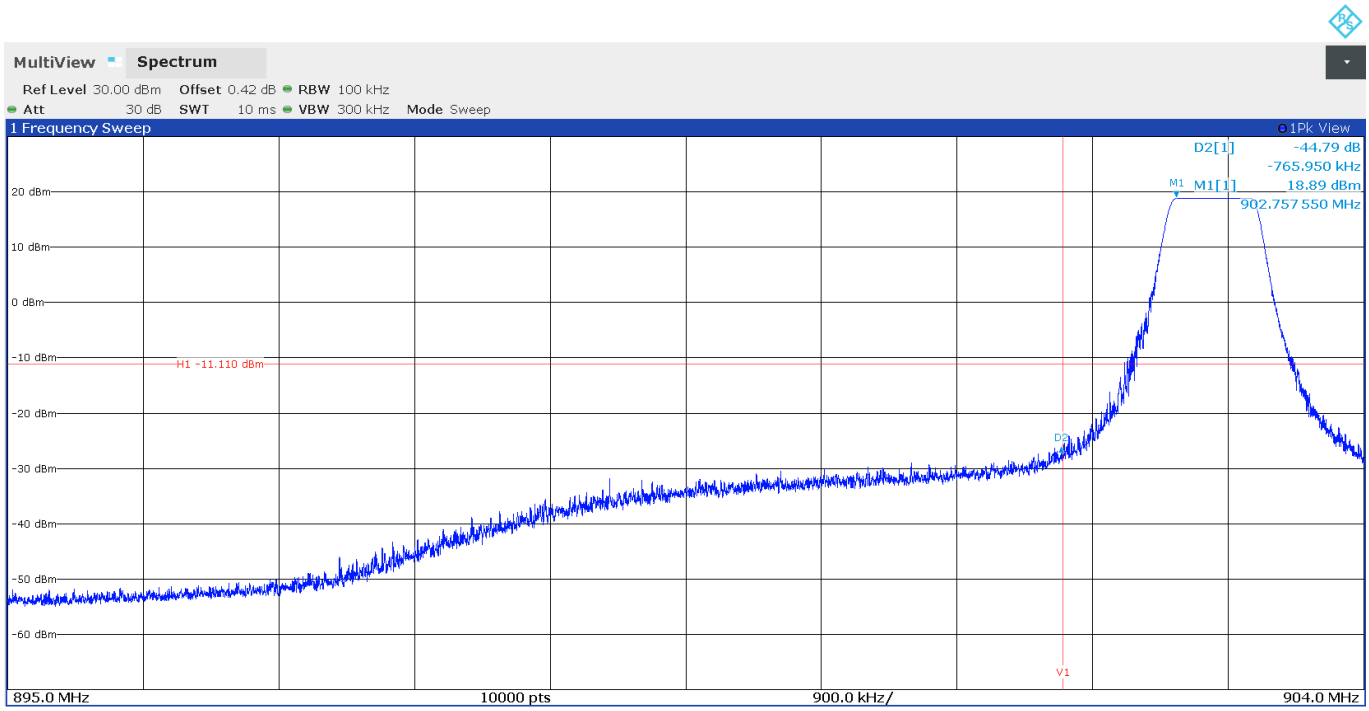
FCC 15.247 (d) / RSS-247 5.5. Band-edge emissions compliance (Transmitter)

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:

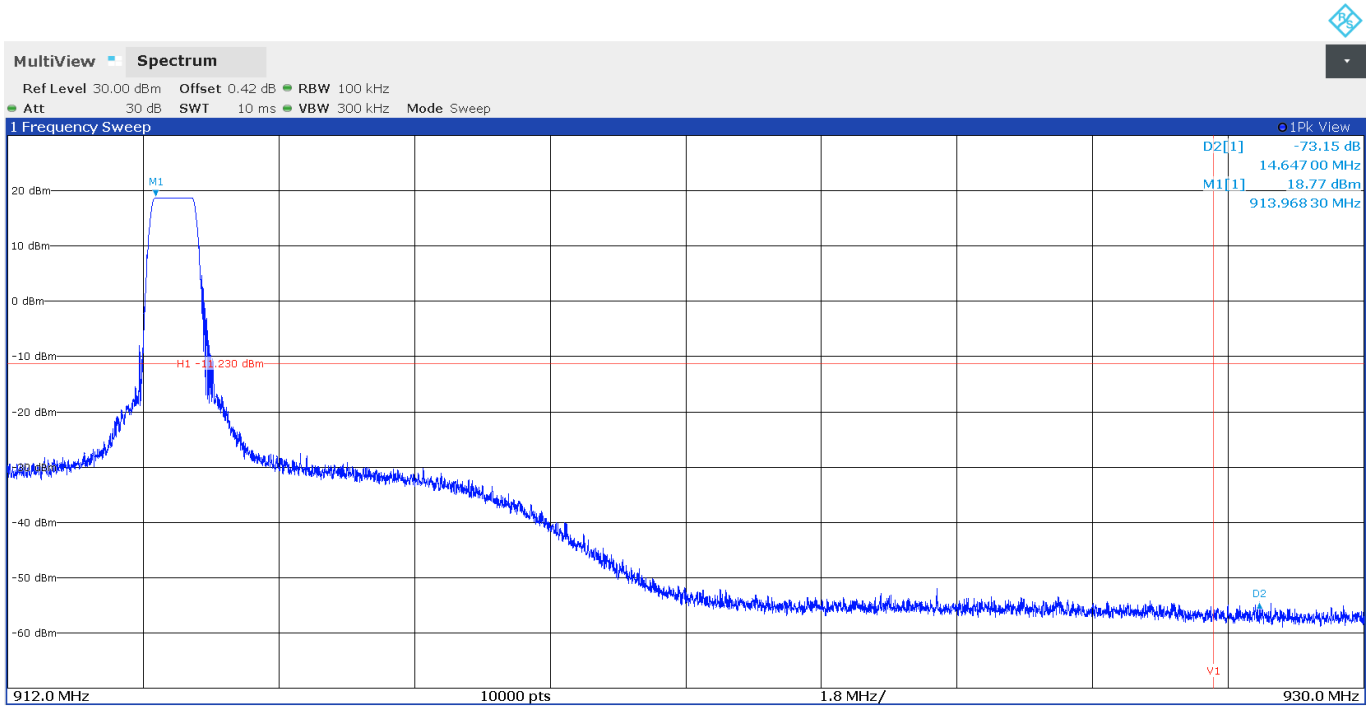
- Low Channel:



Measurement uncertainty (dB) <± 2.99

Verdict: PASS

- High Channel:



Measurement uncertainty (dB) <± 2.99

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.

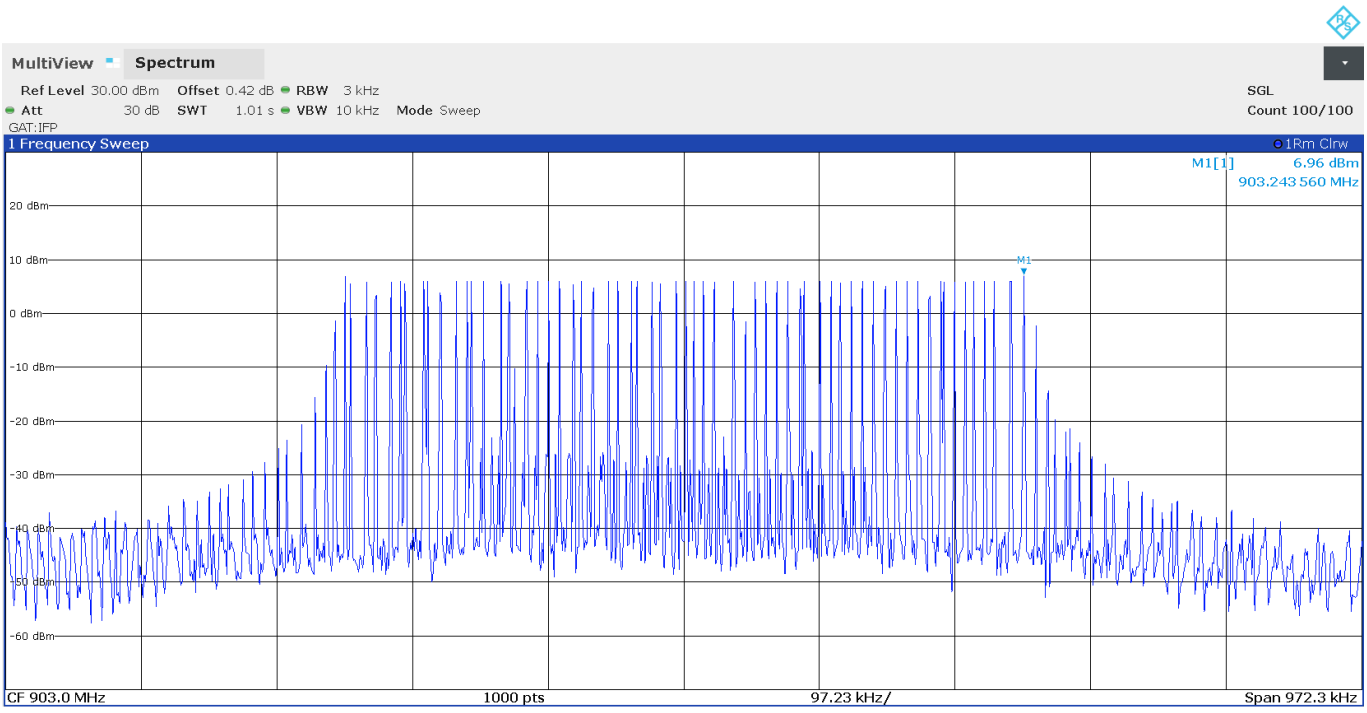
RESULTS:

The maximum power spectral density level in the fundamental emission was measured using the method according to point 11.10.3." Method AVGPSD-1" of ANSI C.63.10-2013.

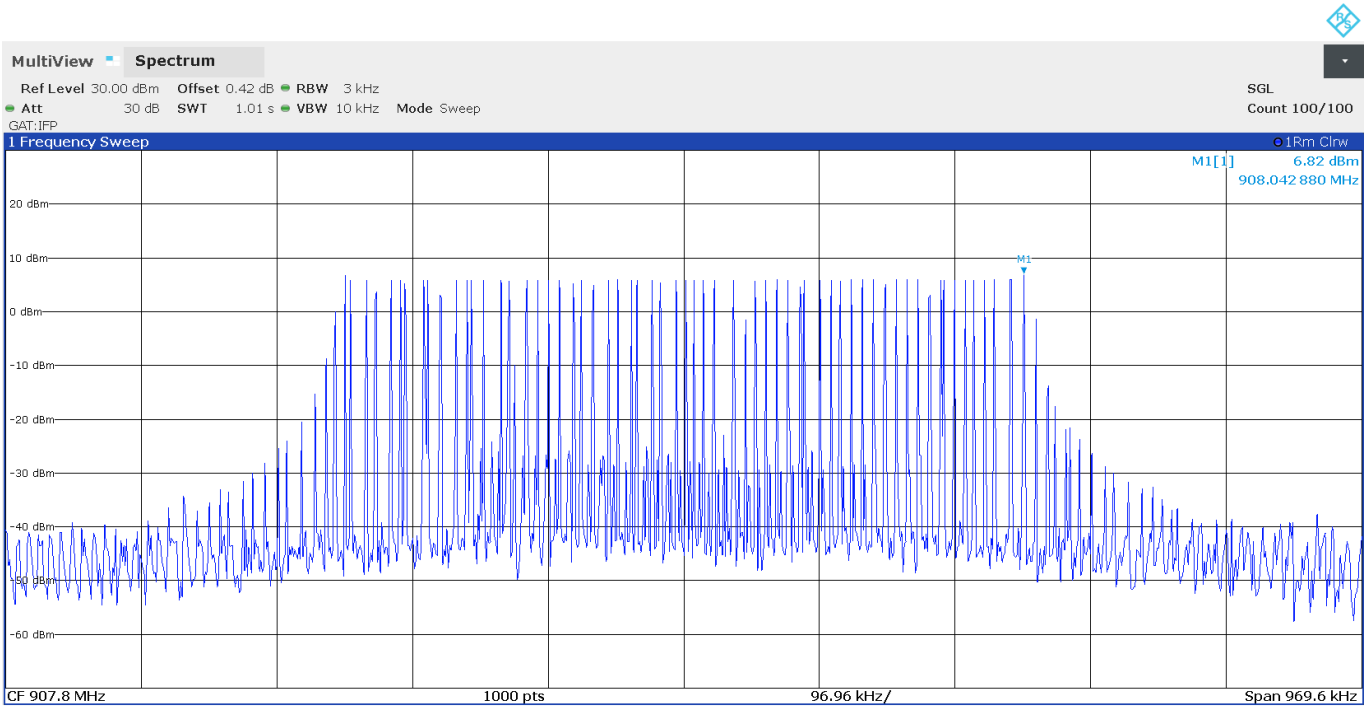
	Low Channel 903.0 MHz	Middle Channel 907.8 MHz	High Channel 914.2 MHz
Power Spectral Density (dBm)	6.96	6.82	6.37
Measurement uncertainty (dB)	<± 2.07		

Verdict: PASS

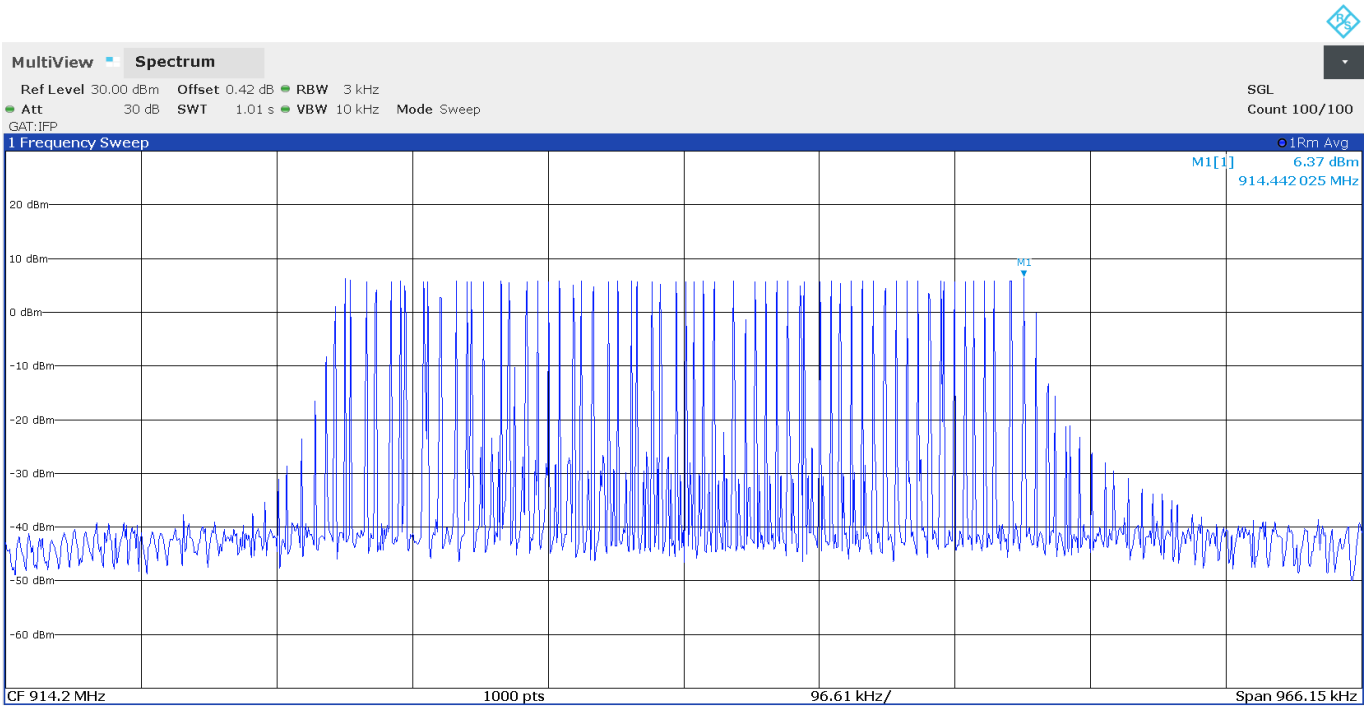
- Low Channel:



- 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 (µV/m)	Field strength (dBµV/m)	Measurement distance (m)
0.009-0.490	2400/F(kHz)	-	300
0.490-1.705	24000/F(kHz)	-	30
1.705 - 30.0	30	-	30
30 - 88	100	40	3
88 - 216	150	43.5	3
216 - 960	200	46	3
960 - 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 360º and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission.

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

All tests were performed in a semi-anechoic chamber at a distance of 3 m for the frequency range 30 MHz-10 GHz.

The field strength is calculated by adding correction factor to the measured level from the spectrum analyzer. This correction factor includes antenna factor, cable loss and pre-amplifiers gain.

Frequency range 30 MHz - 1 GHz:

- LOW CHANNEL. Spurious frequencies closest to the limit:

Spurious Frequency (MHz)	Emission Level (dBµV/m)	Polarization	Detector
839.3680	37.52	V	Quasi peak
847.4190	37.49	V	Quasi peak
871.0385	41.97	V	Quasi peak
935.0585	39.51	V	Quasi peak

- MIDDLE CHANNEL. Spurious frequencies closest to the limit:

Spurious Frequency (MHz)	Emission Level (dBµV/m)	Polarization	Detector
599.9720	27.68	V	Quasi peak
843.7815	41.28	V	Quasi peak
875.7915	44.68	V	Quasi peak
907.8015	42.06	V	Quasi peak
913.3790	39.87	V	Quasi peak
939.8115	43.51	V	Quasi peak

- HIGH CHANNEL. Spurious frequencies closest to the limit:

Spurious Frequency (MHz)	Emission Level (dBµV/m)	Polarization	Detector
563.8395	26.33	V	Quasi peak
850.2320	39.70	V	Quasi peak
882.1935	45.77	V	Quasi peak
914.2520	38.44	V	Quasi peak
919.1505	38.42	V	Quasi peak
946.2135	43.71	V	Quasi peak

Measurement Uncertainty: <± 4.94 dB

Frequency range 1 - 10 GHz:

The results in the next tables show the maximum measured levels in the 1-10 GHz range.

Spurious frequencies with peak levels above the average limit (54 dBµV/m at 3 m) are measured with average detector for checking compliance with the average limit.

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

Spurious frequency (GHz)	Emission Level (dBµV/m)	Polarization	Detector
1.8058	47.79	H	Peak
2.7088	51.61	V	Peak
3.6118	54.29	V	Peak
	50.06		Average
6.3208	50.06	V	Peak
7.2241	50.14	V	Peak
8.1271	54.09	V	Peak
	48.42		Average
9.0301	54.72	V	Peak
	50.72		Average
9.9334	55.22	V	Peak
	47.07		Average

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

Spurious frequency (GHz)	Emission Level (dBµV/m)	Polarization	Detector
1.8154	48.76	H	Peak
2.7232	52.02	V	Peak
3.6310	52.81	V	Peak
4.5388	44.49	V	Peak
6.3547	51.08	V	Peak
8.1703	52.56	V	Peak
9.0781	56.32	V	Peak
	51.90		Average

- HIGH CHANNEL. Spurious frequencies closest to the limit:

Spurious frequency (GHz)	Emission Level (dBµV/m)	Polarization	Detector
1.8283	50.38	H	Peak
2.7424	52.69	V	Peak
3.6568	52.39	V	Peak
6.3997	48.01	V	Peak
7.3138	49.35	V	Peak
8.2279	53.98	V	Peak
9.1423	53.37	V	Peak

Measurement Uncertainty: <± 4.28 dB

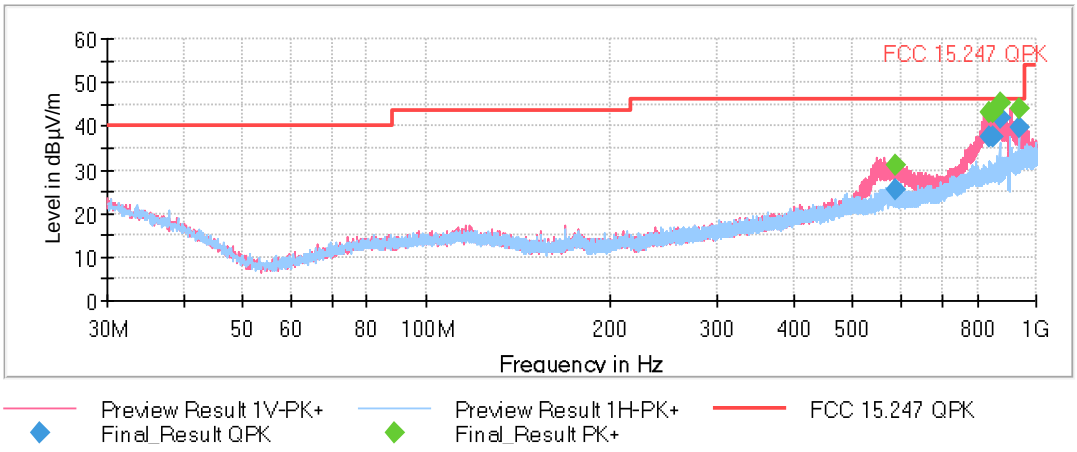
Verdict: PASS

Spectrum analyzer parameters:

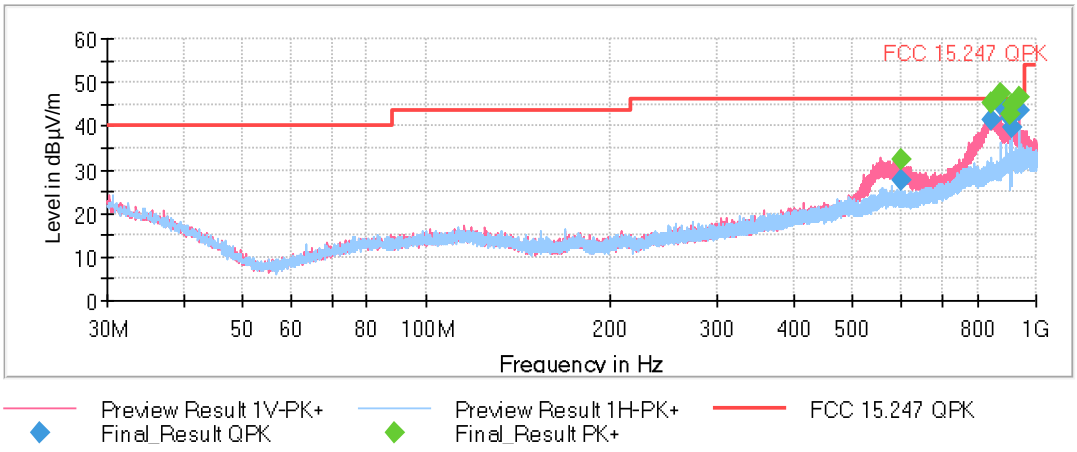
Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
30 MHz - 1 GHz	48,5 kHz	PK+	100 kHz	1 s	30 dB
1 GHz - 10 GHz	300 kHz	PK+ ; AVG	1 MHz	1 s	0 dB

FREQUENCY RANGE 30 MHz - 1 GHz:

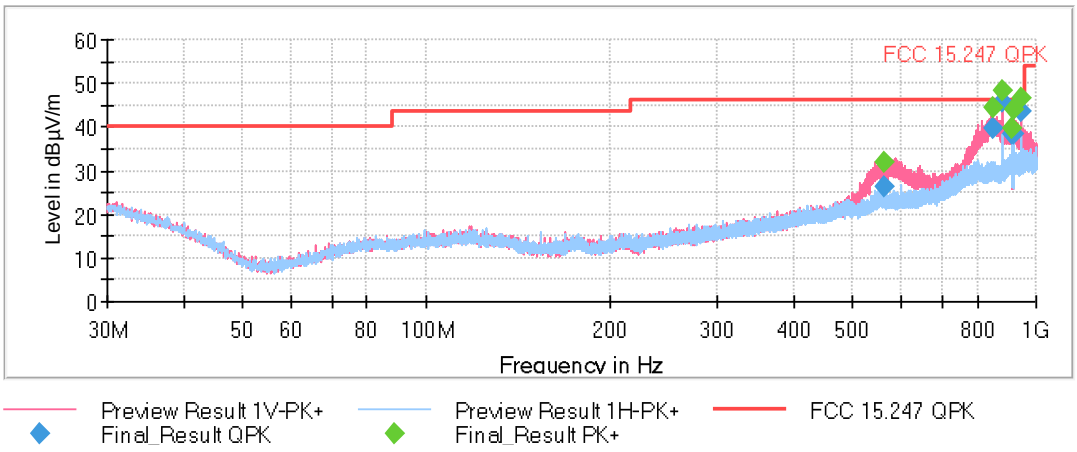
- Low Channel:



- Middle Channel:

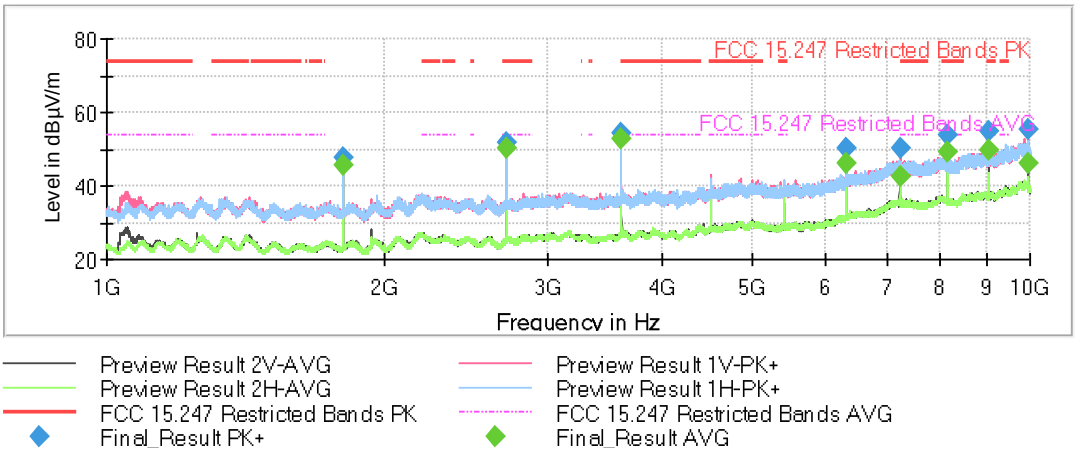


- High Channel:

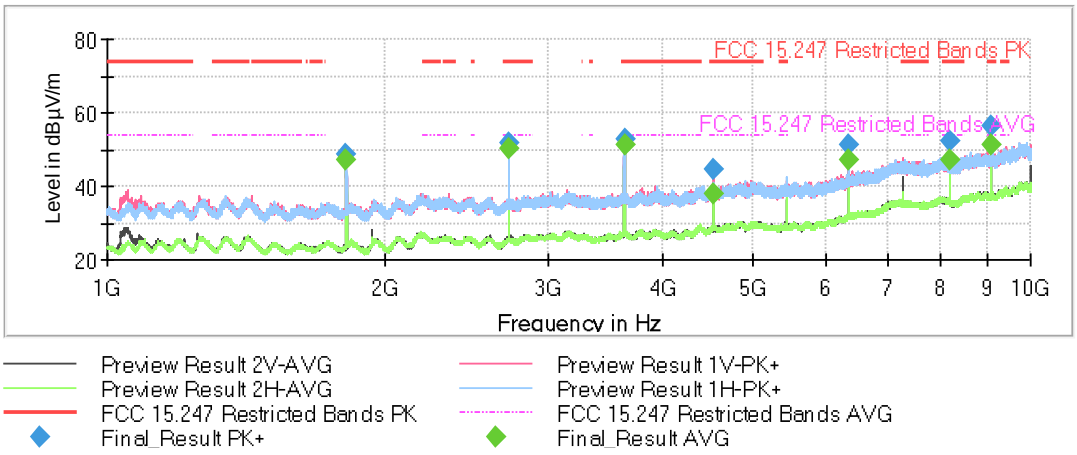


FREQUENCY RANGE 1 - 10 GHz:

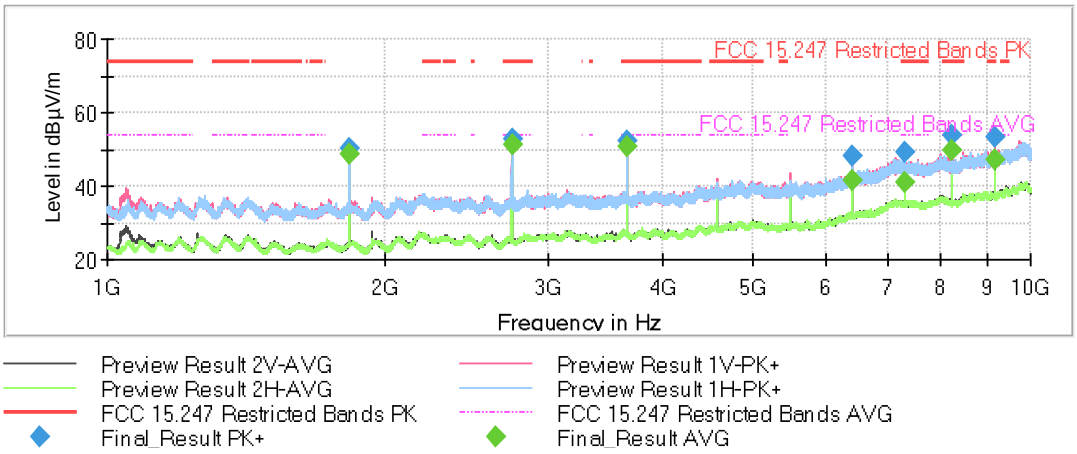
- Low Channel:



- Middle Channel:



- High Channel:



Appendix B: **Test results. LoRa 125 kHz.**

INDEX

TEST CONDITIONS

POWER SUPPLY (*):

Vnominal:	3 Vdc.
Type of Power Supply:	DC external power supply.

ANTENNA (*):

Type of Antenna:	External.
Maximum Declared Antenna Gain:	+3.3 dBi

TEST FREQUENCIES:

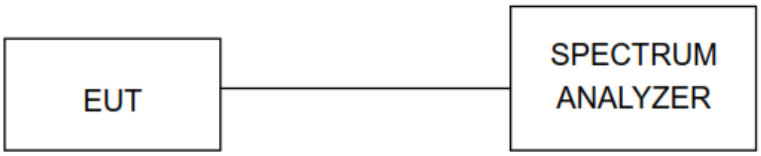
Low Channel:	902.3 MHz
Middle Channel:	908.5 MHz
High Channel:	914.9 MHz

The equipment can operate as FHSS system using 64 hopping channels.

Power setting used ***17 dBm*** with command used for test:

TX_SF10/125kHz

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:

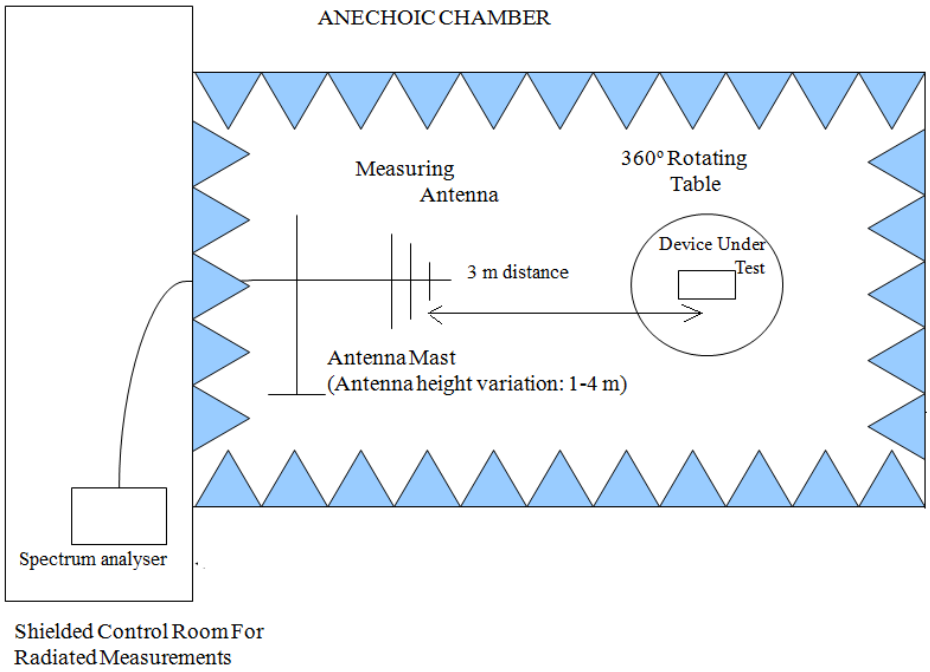
All radiated tests were performed in a semi-anechoic chamber. The measurement antenna (Bilog antenna for the range between 30 MHz to 1000 MHz and 1 GHz-10 GHz Double ridge horn antenna) is situated at a distance of 3 m.

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

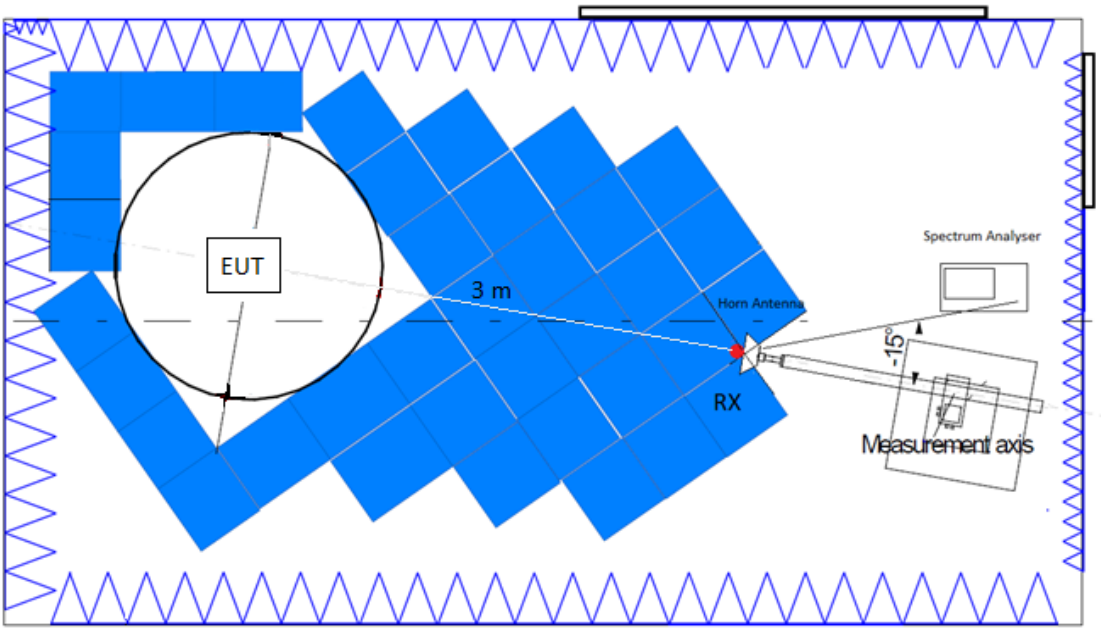
Measurements were made in both horizontal and vertical planes of polarization.

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 10 GHz:



FCC 15.247 (a) (1) / RSS-247 5.1. (c) 20 dB Bandwidth and Carrier frequency separation

SPECIFICATION:

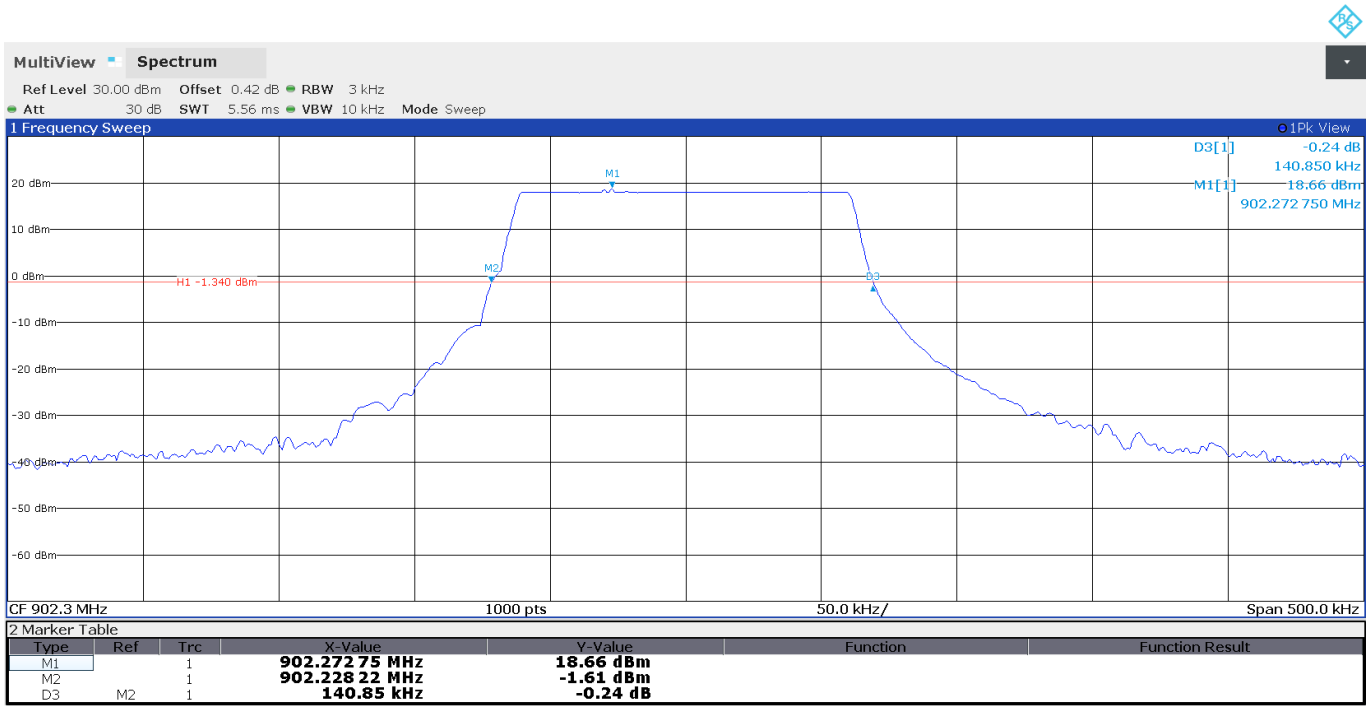
Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

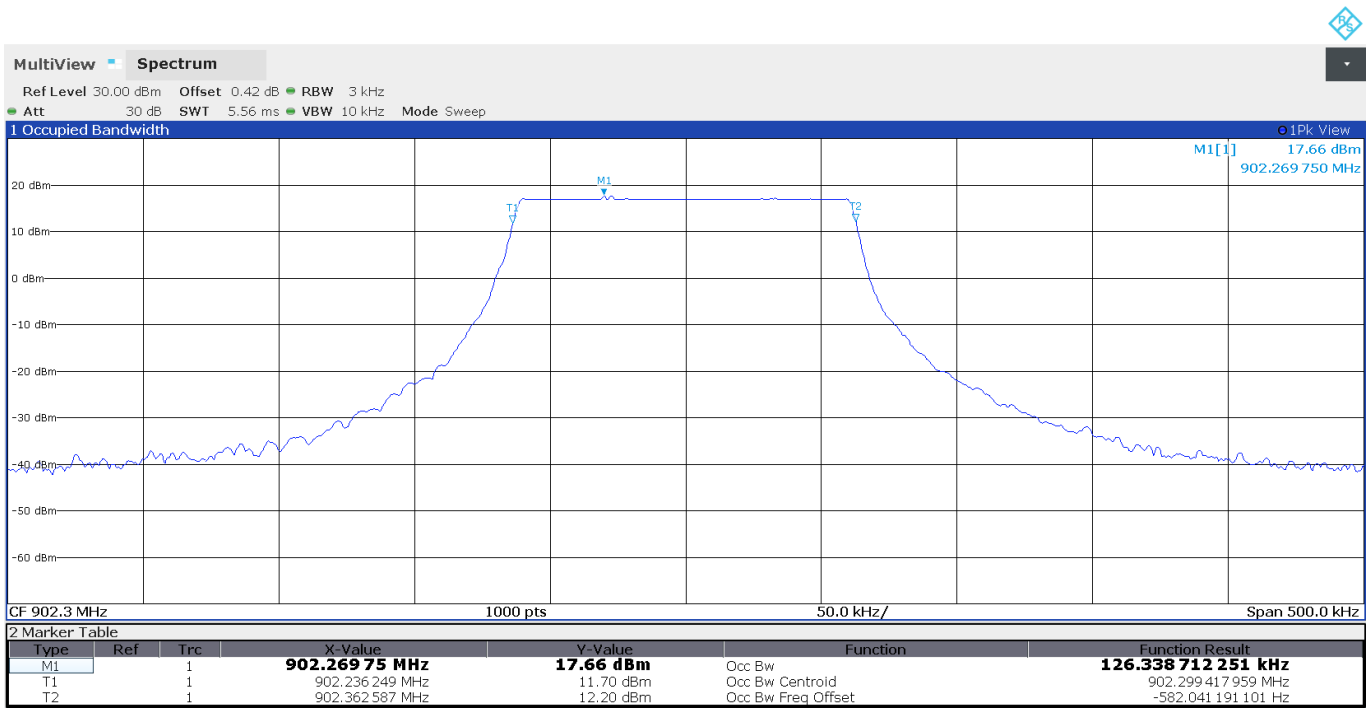
RESULTS:

	Low Channel 902.3 MHz	Middle Channel 908.5 MHz	High Channel 914.9 MHz
20 dB Spectrum Bandwidth (kHz)	140.85	140.19	139.91
99% Bandwidth (kHz)	126.33	126.51	126.57
Measurement uncertainty (kHz)	<±0.73		

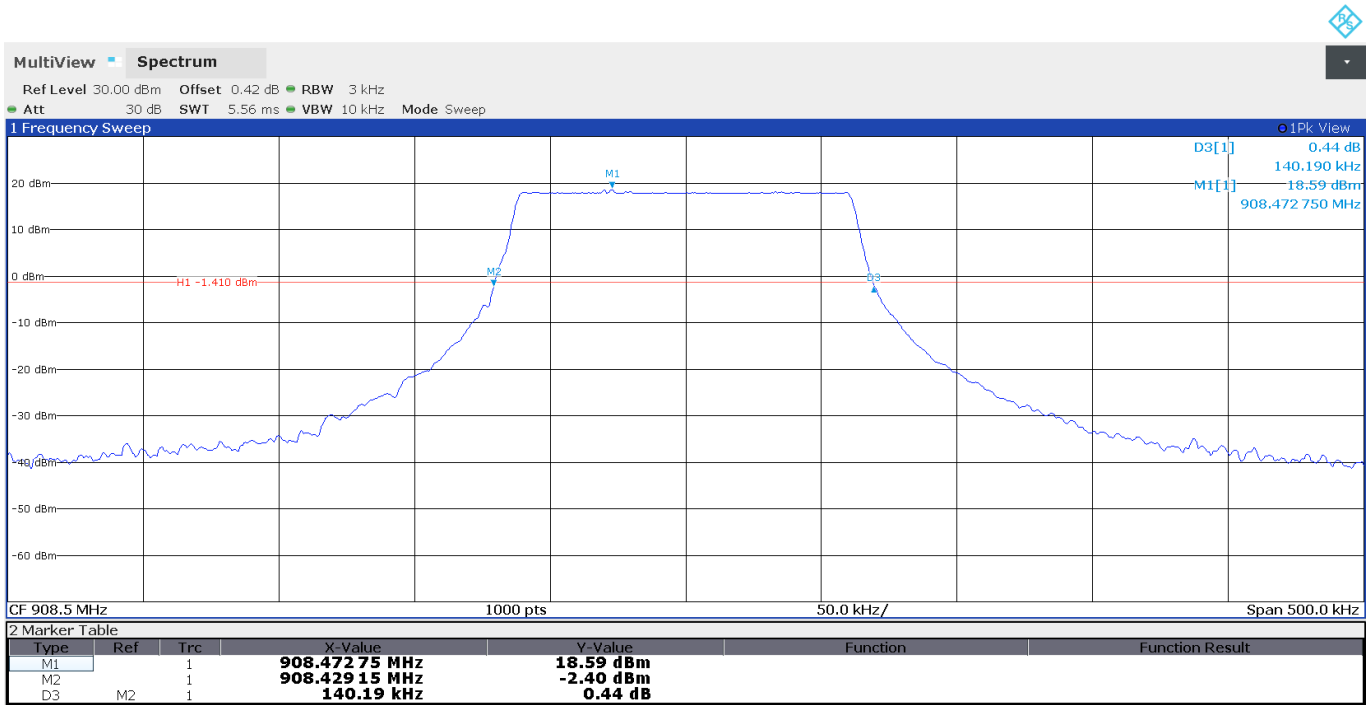
Verdict: PASS

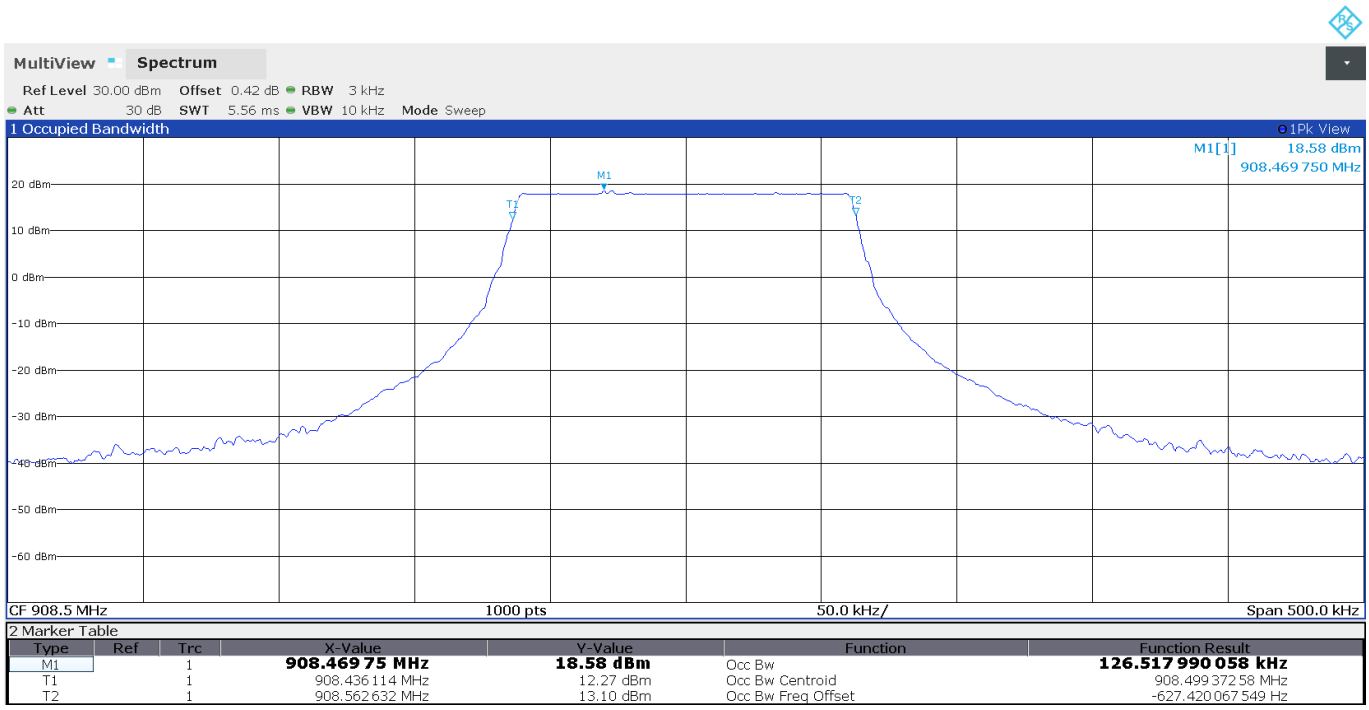
- Low Channel:


MultiView
Spectrum
Ref Level 30.00 dBm Offset 0.42 dB RBW 3 kHz
Att 30 dB SWT 5.56 ms VBW 10 kHz Mode Sweep
1 Frequency Sweep
1Pk View
D3[1] -0.24 dB
140.850 kHz
M1[1] 18.66 dBm
902.272 750 MHz
M1
M2
D3
H1 -1.340 dBm
20 dBm
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
CF 902.3 MHz
1000 pts
50.0 kHz/
Span 500.0 kHz
2 Marker Table
Type Ref Trc X-Value Y-Value Function Function Result
M1 1 902.272 75 MHz 18.66 dBm
M2 1 902.228 22 MHz -1.61 dBm
D3 M2 1 140.85 kHz -0.24 dB

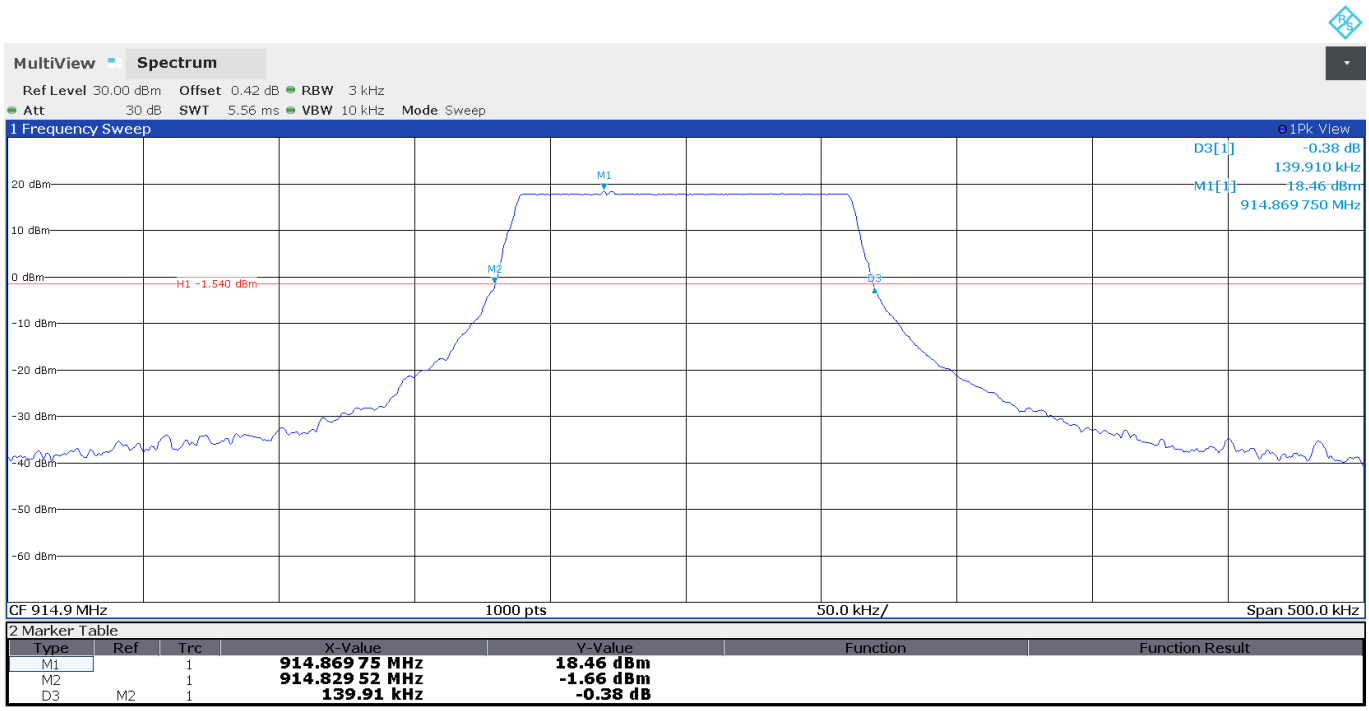

MultiView
Spectrum
Ref Level 30.00 dBm Offset 0.42 dB RBW 3 kHz
Att 30 dB SWT 5.56 ms VBW 10 kHz Mode Sweep
1 Occupied Bandwidth
1Pk View
M1[1] 17.66 dBm
902.269 750 MHz
M1
T1
T2
20 dBm
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
CF 902.3 MHz
1000 pts
50.0 kHz/
Span 500.0 kHz
2 Marker Table
Type Ref Trc X-Value Y-Value Function Function Result
M1 1 902.269 75 MHz 17.66 dBm Occ Bw 126.338 712 251 kHz
T1 1 902.236 249 MHz 11.70 dBm Occ Bw Centroid 902.299 417 959 MHz
T2 1 902.362 587 MHz 12.20 dBm Occ Bw Freq Offset -582.041 191 101 Hz

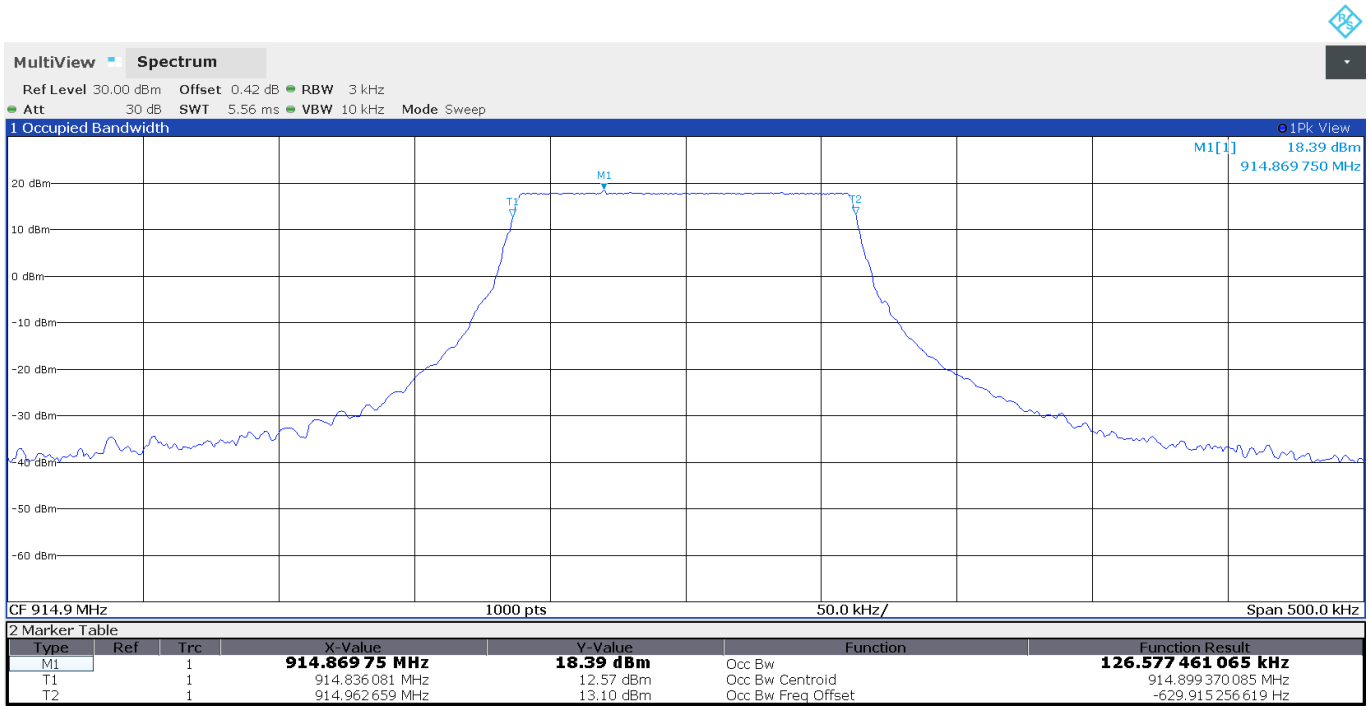
- Middle Channel:





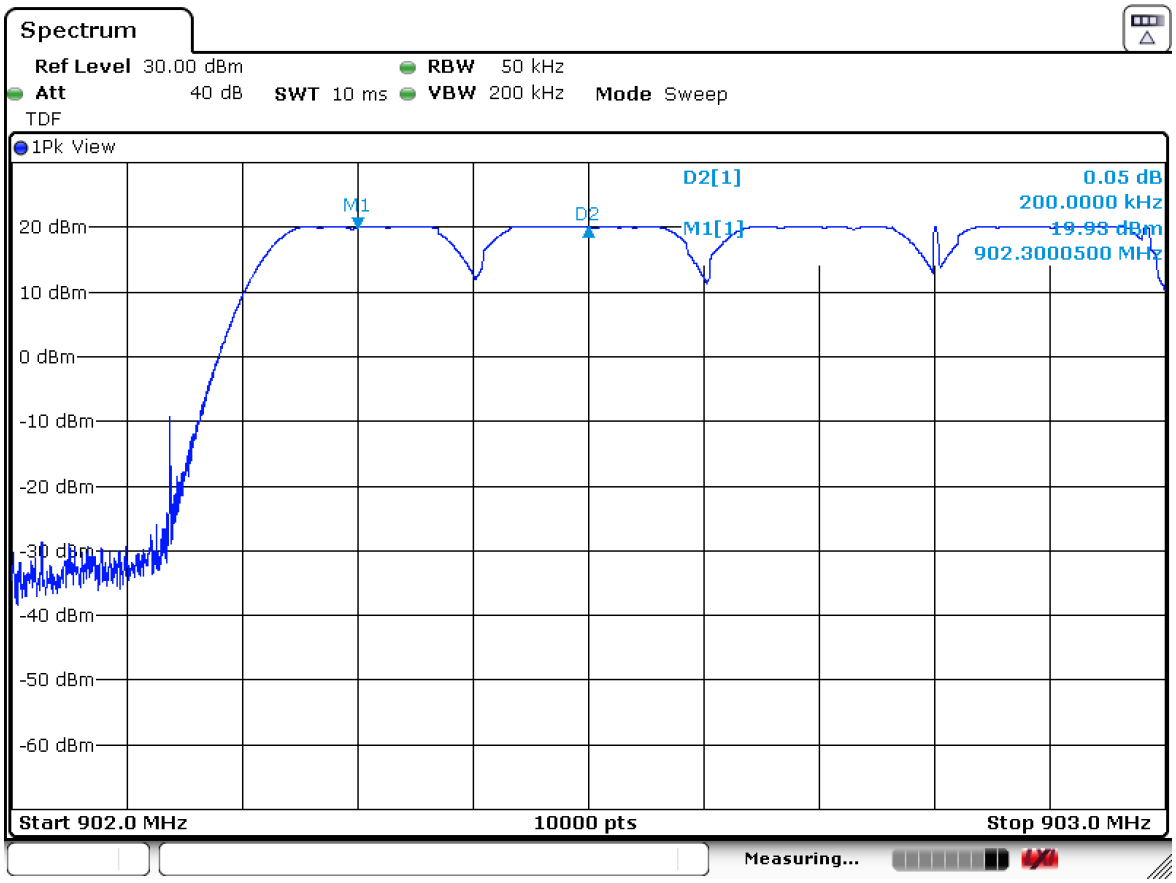
- High Channel:





Carrier frequency separation

Carrier frequency separation: 200.00 kHz



The hopping channel carrier frequencies are separated by a minimum two-thirds of the 20 dB bandwidth of the hopping channel.

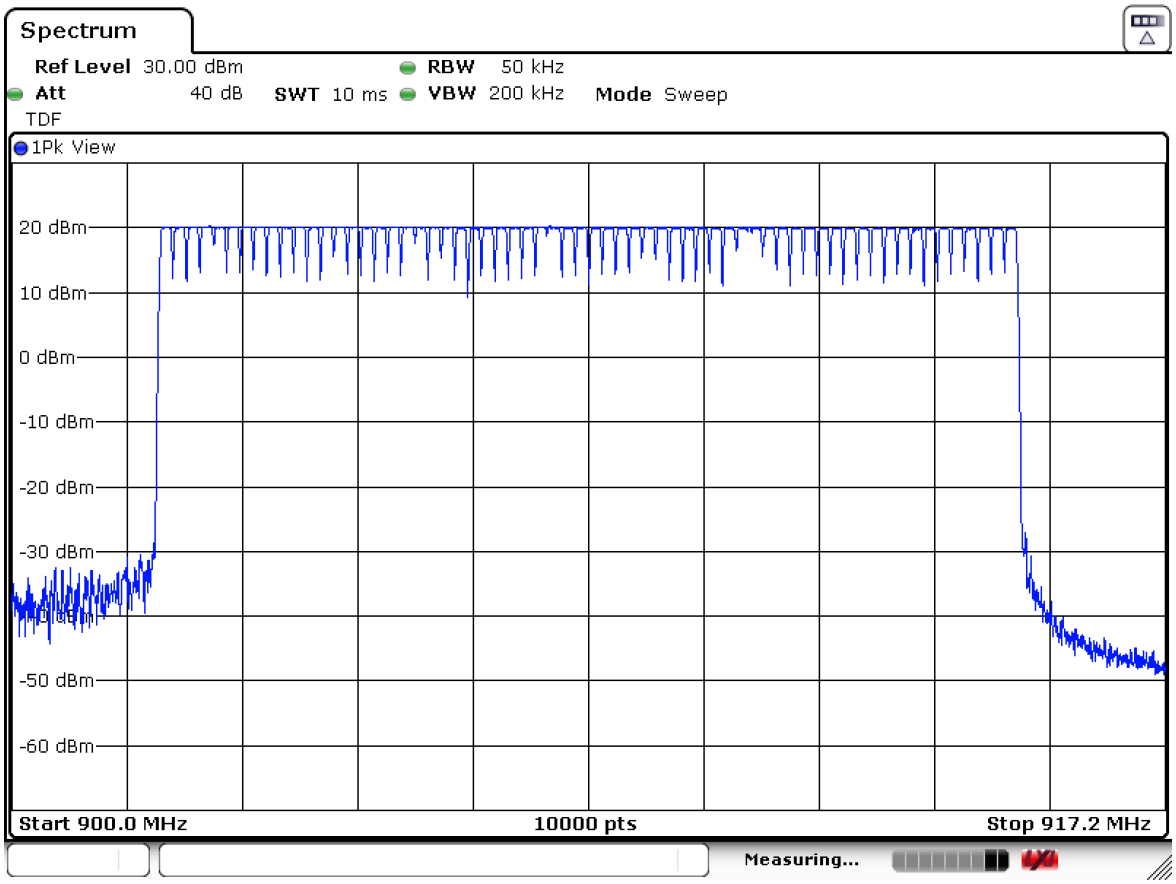
Verdict: PASS

FCC 15.247 (a)(1)(i) / RSS-247 5.1 (c) Number of hopping channels

SPECIFICATION:

For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies.

RESULTS:



Total number of hopping channels: 64

Verdict: PASS

FCC 15.247 (a)(1)(i) / RSS-247 5.1 (c) Time of occupancy (Dwell Time)

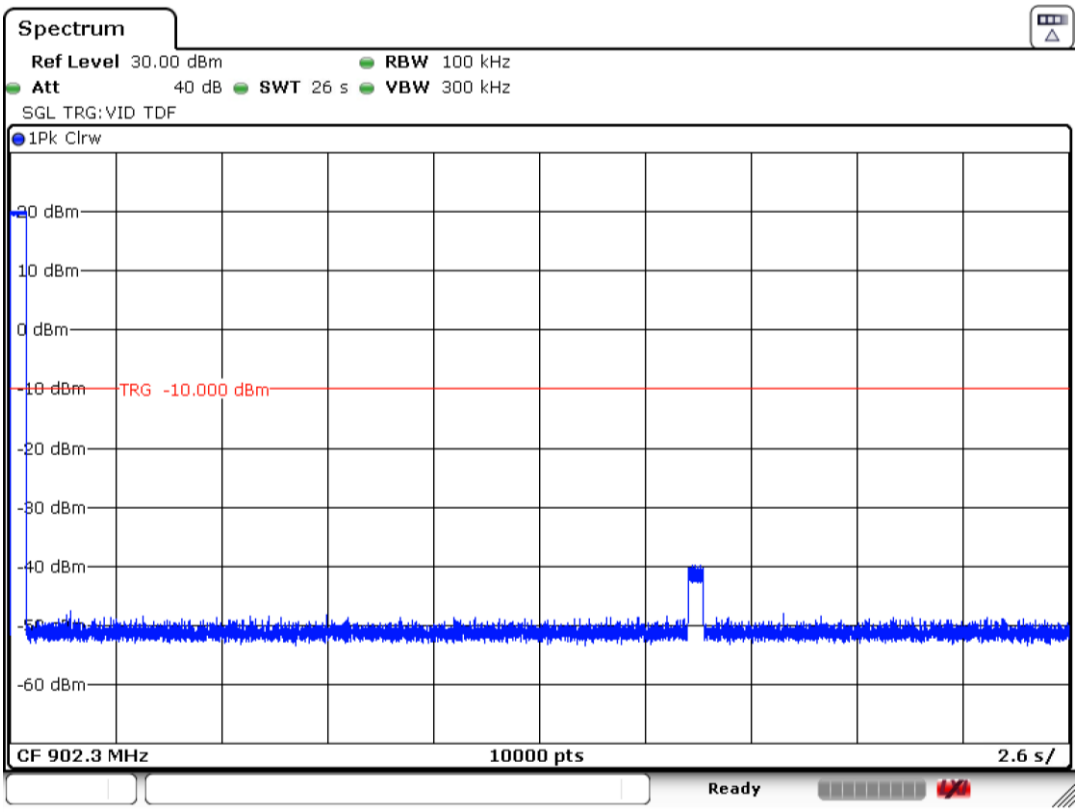
SPECIFICATION:

The average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period.

RESULTS:

- Time of Occupancy:

Nº of hops over the period	1
Average Time of Occupancy	397.4819 ms



Measurement uncertainty (ms)	<±11.57

Verdict: PASS

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

SPECIFICATION:

For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels.
The e.i.r.p. shall not exceed 4 W if the hopset uses 50 or more hopping channels.

RESULTS:

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

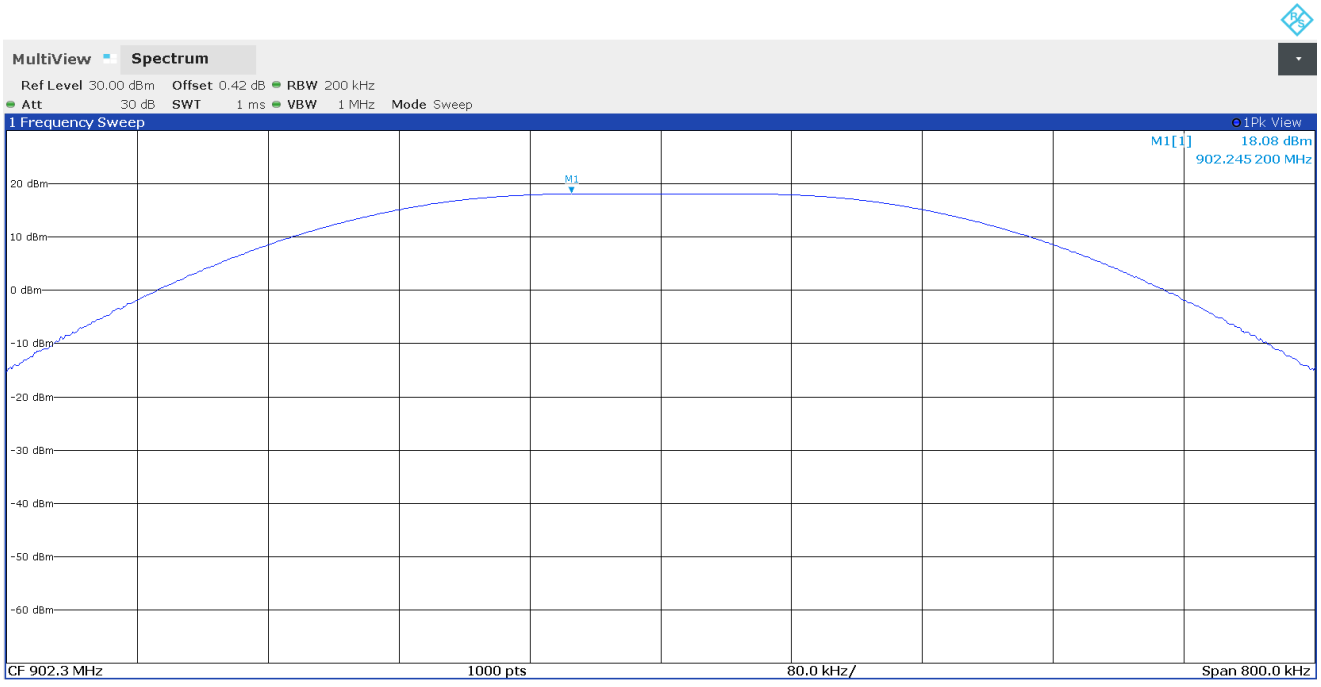
Maximum Declared Antenna Gain: +3.3 dBi

	Low Channel 902.3 MHz	Middle Channel 908.5 MHz	High Channel 914.9 MHz
Maximum Peak Conducted Power (dBm)	18.08	18.91	16.87
Maximum EIRP Power (dBm)	21.38	22.21	20.17
Measurement uncertainty (dB)	<± 2.07		

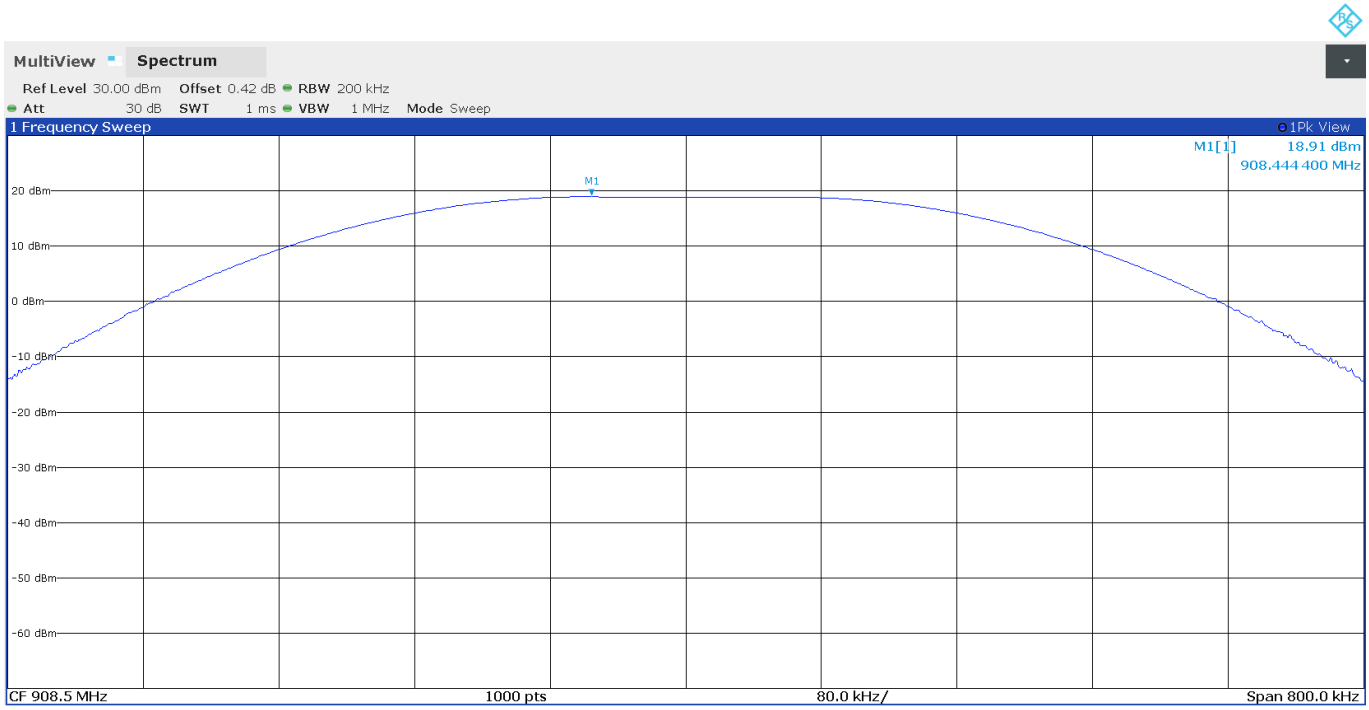
The maximum directional gain of the antenna is less than 6 dBi and therefore the maximum output power is not required to be reduced from the stated values.

Verdict: PASS

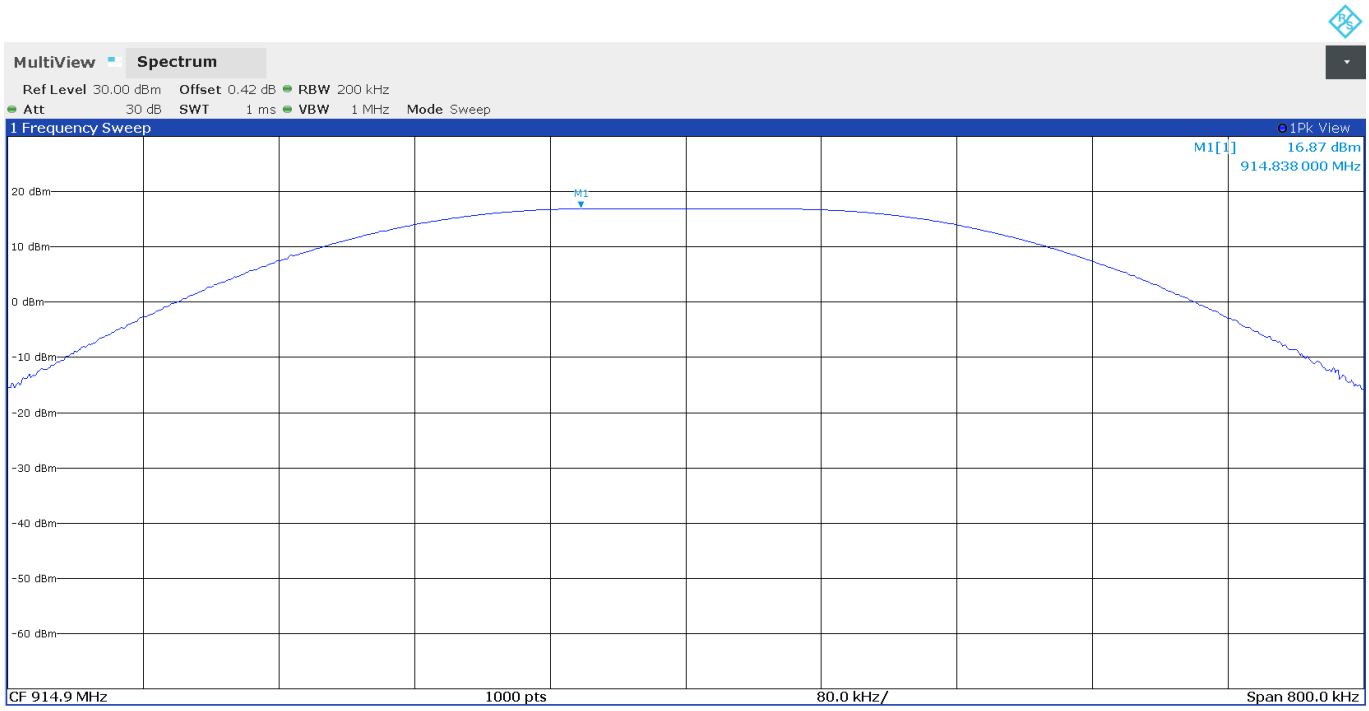
- Low Channel:



- Middle Channel:



- High Channel:



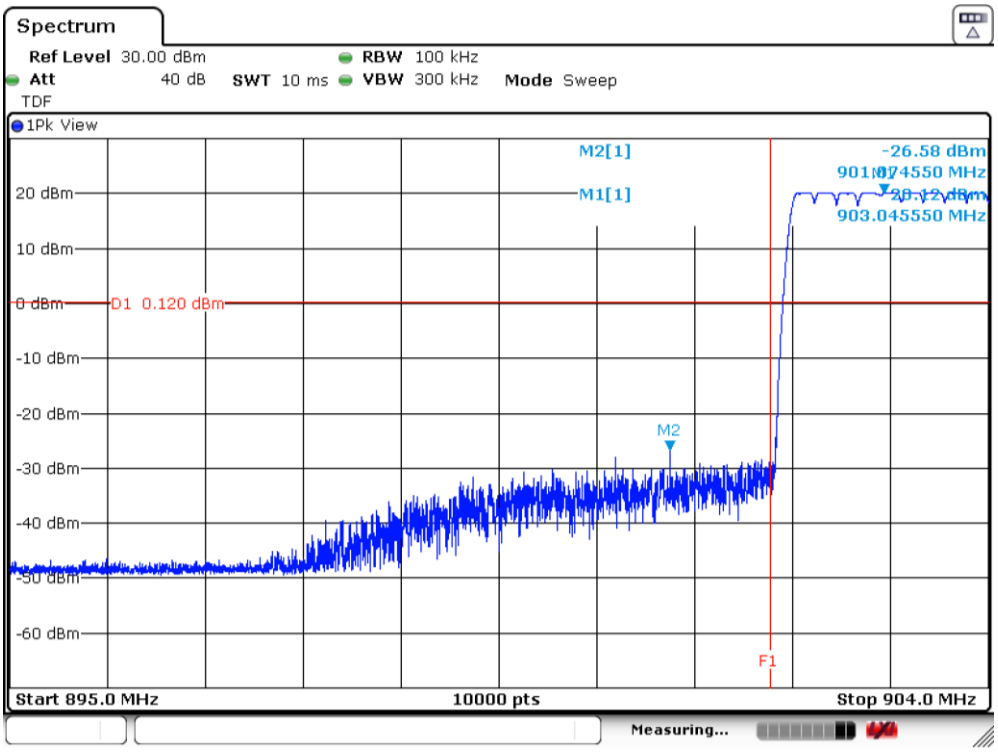
FCC 15.247 (d) / RSS-247 5.5. Band-edge emissions compliance (Transmitter)

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.

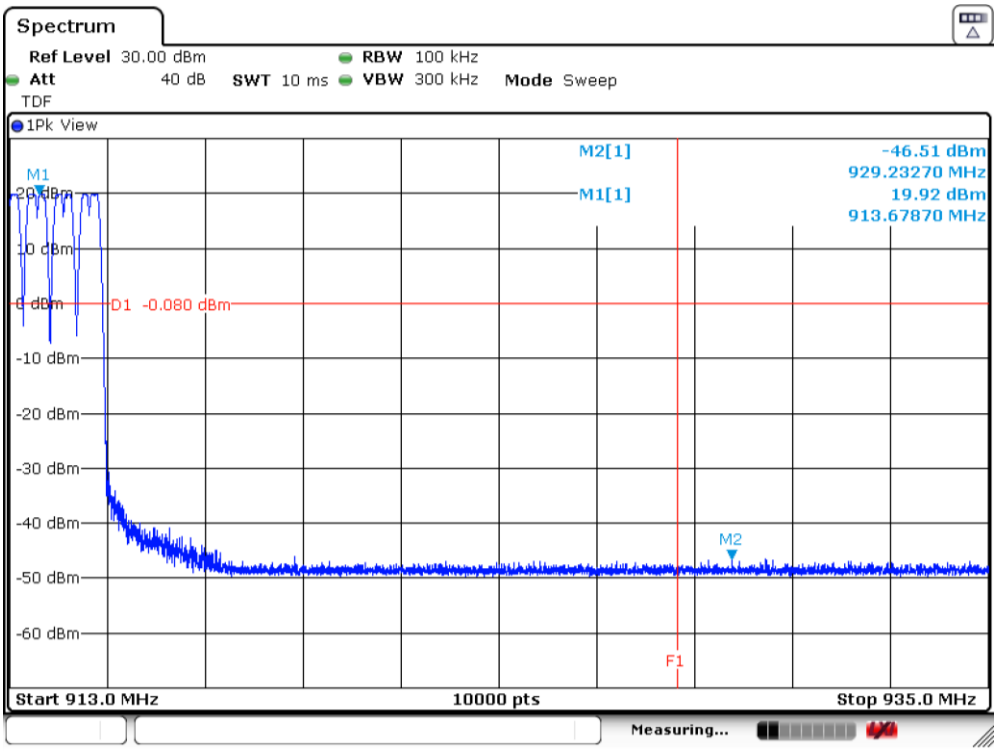
RESULTS:

- HOPPING ON:
  - Low Frequency Section 902 MHz:



Verdict: PASS

- High Frequency Section 928 MHz:

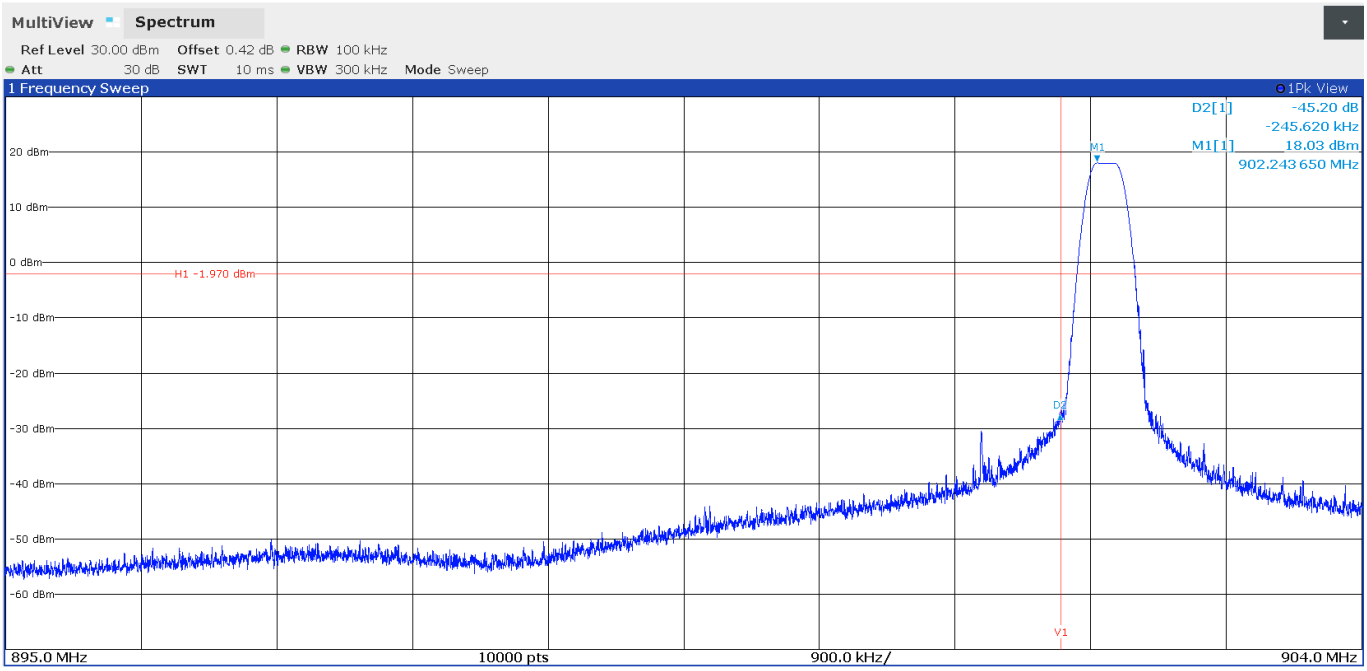


Measurement uncertainty (dB)	<±2.57

Verdict: PASS

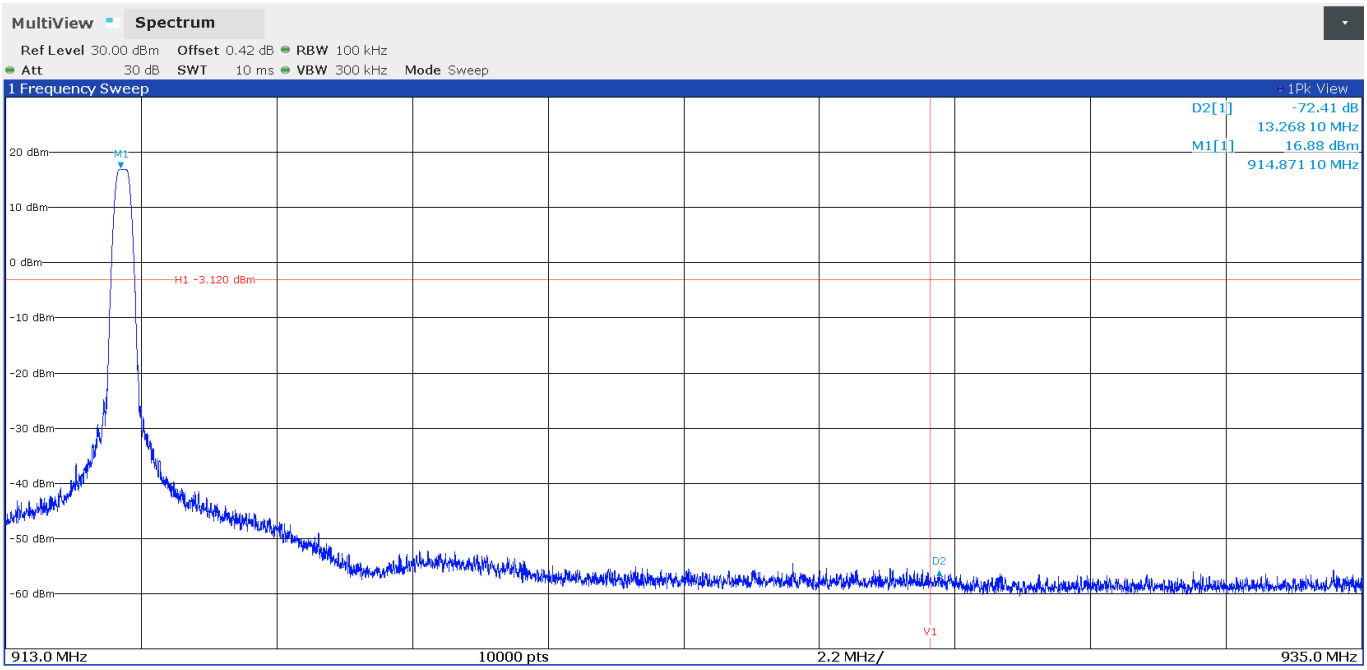
- HOPPING OFF:

  - Low Frequency Section 902 MHz:



Verdict: PASS

  - High Frequency Section 908 MHz:



Measurement uncertainty (dB)	<±2.99

Verdict: PASS

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

SPECIFICATION:

Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)/RSS-Gen):

Frequency Range (MHz)	Field strength (µV/m)	Field strength (dBµV/m)	Measurement distance (m)
0.009-0.490	2400/F(kHz)	-	300
0.490-1.705	24000/F(kHz)	-	30
1.705 - 30.0	30	-	30
30 - 88	100	40	3
88 - 216	150	43.5	3
216 - 960	200	46	3
960 - 25000	500	54	3

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 360º and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission.

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

All tests were performed in a semi-anechoic chamber at a distance of 3 m for the frequency range 30 MHz-10 GHz.

The field strength is calculated by adding correction factor to the measured level from the spectrum analyzer. This correction factor includes antenna factor, cable loss and pre-amplifiers gain.

Frequency range 30 MHz - 1 GHz:

- LOW CHANNEL. Spurious frequencies closest to the limit:

Spurious Frequency (MHz)	Emission Level (dBµV/m)	Polarization	Detector
870.3110	42.59	V	Quasi peak
907.6560	39.29	V	Quasi peak
934.3310	41.34	V	Quasi peak

- MIDDLE CHANNEL. Spurious frequencies closest to the limit:

Spurious Frequency (MHz)	Emission Level (dBµV/m)	Polarization	Detector
844.4605	40.28	V	Quasi peak
876.5190	45.08	V	Quasi peak
913.0880	39.56	V	Quasi peak
940.4905	43.62	V	Quasi peak

- HIGH CHANNEL. Spurious frequencies closest to the limit:

Spurious Frequency (MHz)	Emission Level (dBµV/m)	Polarization	Detector
808.1340	34.85	V	Quasi peak
882.9210	45.38	V	Quasi peak
920.2175	40.66	V	Quasi peak
946.9410	42.15	V	Quasi peak

Measurement Uncertainty: <± 4.94 dB

Frequency range 1 - 10 GHz:

The results in the next tables show the maximum measured levels in the 1-10 GHz range.

Spurious frequencies with peak levels above the average limit (54 dBµV/m at 3 m) are measured with average detector for checking compliance with the average limit.

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

Spurious frequency (GHz)	Emission Level (dBµV/m)	Polarization	Detector
1.8043 (*)	64.68	V	Peak
	60.73		Average
2.7067	52.42	V	Peak
3.6091	49.02	V	Peak
4.5115	43.28	V	Peak
8.1208	50.43	V	Peak
9.0235	53.76	V	Peak

(*): This spurious frequency is outside the restricted bands as defined in §15.205(a). The measured maximum carrier level at 3 m was 116.09 dBµV/m (Peak) so the spurious level is more than 20 dB below the carrier level

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

Spurious frequency (GHz)	Emission Level (dBµV/m)	Polarization	Detector
1.8169	47.52	H	Peak
2.7253	52.35	V	Peak
3.6340	53.63	V	Peak
4.5427	45.99	V	Peak
6.3595	49.54	V	Peak
7.2679	50.79	V	Peak
8.1676	53.24	V	Peak
9.0850	55.33	V	Peak
	51.47		Average
9.9937	54.74	V	Peak
	46.87		Average

- HIGH CHANNEL. Spurious frequencies closest to the limit:

Spurious frequency (GHz)	Emission Level (dBµV/m)	Polarization	Detector
1.8298 (*)	62.55	V	Peak
	62.19		Average
2.7448	54.38	H	Peak
	39.64		Average
3.6595	44.85	H	Peak
4.5739	42.64	H	Peak
7.3192	47.75	V	Peak
8.2342	48.01	V	Peak
9.1489	52.06	V	Peak

(*): This spurious frequency is outside the restricted bands as defined in §15.205(a). The measured maximum carrier level at 3 m was 116.54 dBµV/m (Peak) so the spurious level is more than 20 dB below the carrier level.

Measurement Uncertainty: <± 4.28 dB

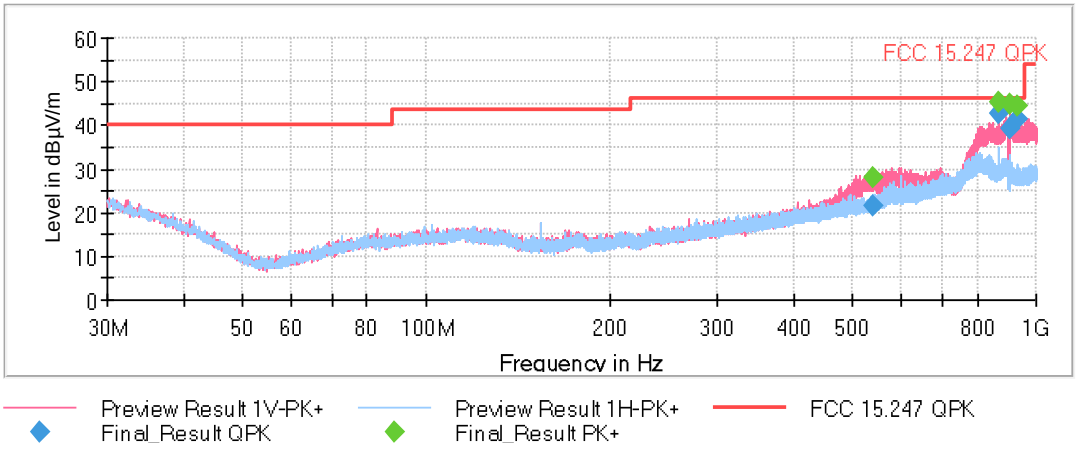
Verdict: PASS

Spectrum analyzer parameters:

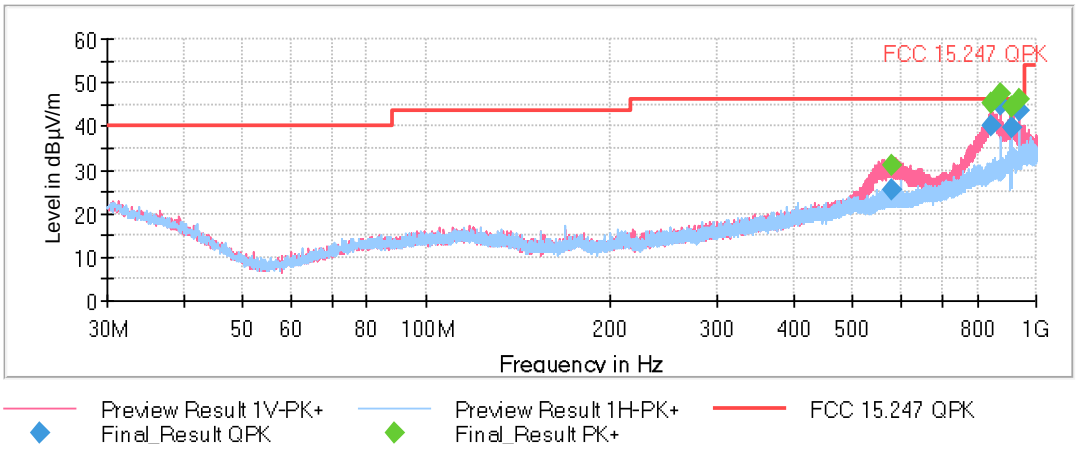
Subrange	**Step Size**	**Detectors**	**Bandwidth**	**Sweep Time**	**Preamp**
30 MHz - 1 GHz	48,5 kHz	PK+	100 kHz	1 s	30 dB
1 GHz - 10 GHz	300 kHz	PK+ ; AVG	1 MHz	1 s	0 dB

FREQUENCY RANGE 30 MHz - 1 GHz:

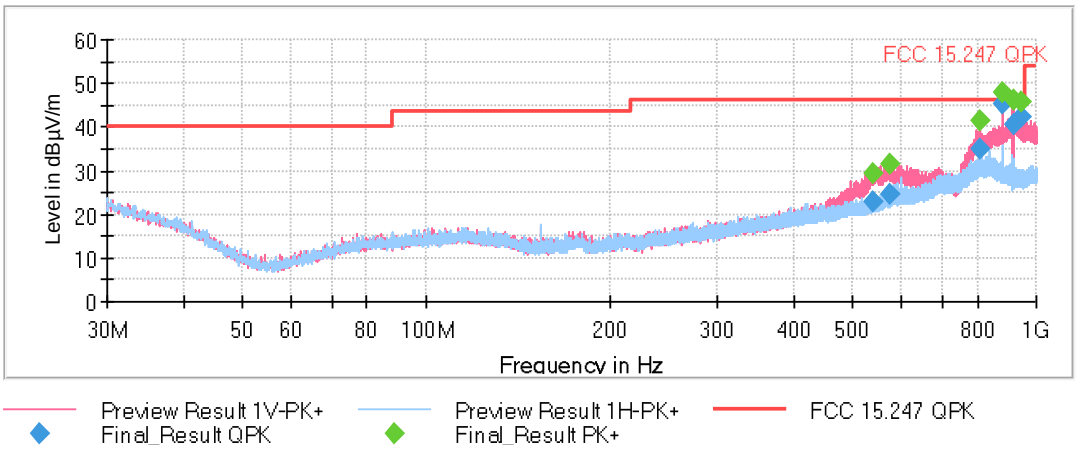
- Low Channel:



- Middle Channel:

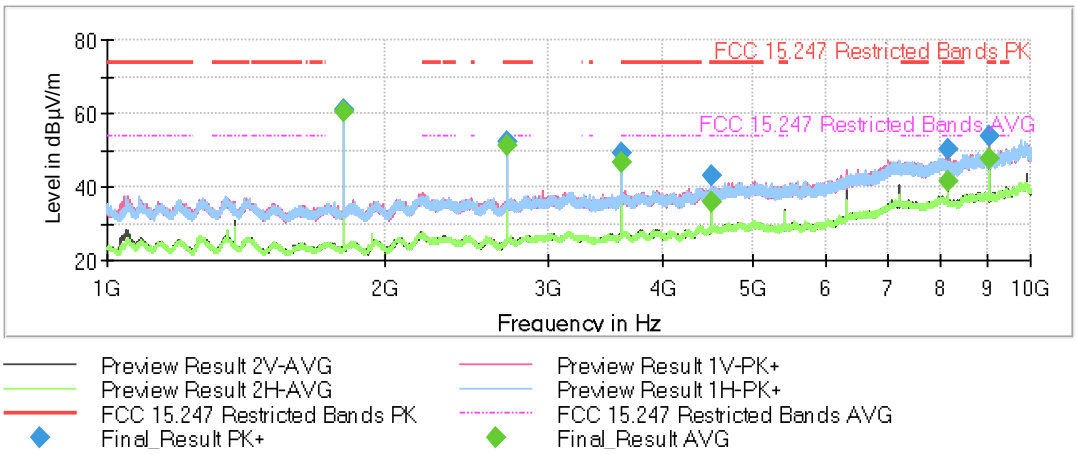


- High Channel:

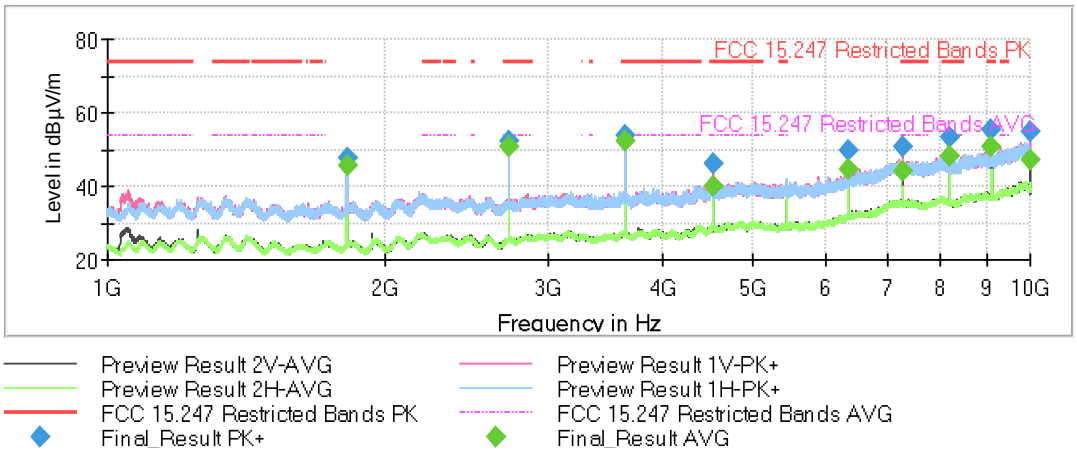


FREQUENCY RANGE 1 - 10 GHz:

- Low Channel:



- Middle Channel:



- High Channel: