

ISED CABid: ES1909

Test report No:
NIE: 67125RRF.002A1

Test Report

USA FCC Part 15.247, 15.209

CANADA RSS-247, RSS-Gen

(*) Identification of item tested	Wireless datalogger
(*) Trademark	Loadsensing G6
(*) Model and /or type reference	LS-G6-TIL90-X
Other identification of the product	HW version: LS-G6-TIL90-X-1 rev1 SW version: 2.54 FCC ID: 2AHN4-LS-G6-TIL90-X IC: 21260-LSG6TIL90-X
(*) Features	LoRa communication
Applicant	Worldsensing S.L. Calle Viriat 47, planta 10, 08014, Barcelona, Spain
Test method requested, standard	USA FCC Part 15.247 (10-1-19 Edition): Operation within the bands 902 - 928 MHz, 2400 -2483.5 MHz, and 5725 - 5850 MHz. USA FCC Part 15.209 (10-1-19 Edition): Radiated emission limits; general requirements. CANADA RSS-247 Issue 2 (February 2017). CANADA RSS-Gen Issue 5, Amendment 1, March 2019 Guidance for Performing Compliance Measurements on Digital Transmission System, Frequency Hopping Spread Spectrum System, and Hybrid Systems Devices Operating Under Section 15.247 of the FCC Rules. 558074 D01 Meas Guidance v05r02 dated April 2, 2019. ANSI C63.10-2013: American National Standard for Testing Unlicensed Wireless Devices.
Summary	IN COMPLIANCE
Approved by (name / position & signature)	Rafael López Martín EMC Consumer & RF Lab. Manager
Date of issue	2021-10-20
Report template No	FDT08_23 (*) "Data provided by the client"

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Competences and guarantees

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

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

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Uncertainty

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

Data provided by the client

The following data has been provided by the client:

1. Information relating to the description of the sample ("Identification of the item tested", "Trademark", "Model and/or type reference tested").
2. The sample of the model LS-G6-TIL90-X is a Wireless inclinometer to measure angle variation in 3 axis. It sends the data via radio through an external antenna.

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 M/01 is composed of the following elements:

Control N°	Description	Model	Serial N°	Date of reception
67125/033	Wireless datalogger	LS-G6-TIL90-X	32322	2021/01/22

Sample M/01 has undergone the following test(s): The Conducted tests indicated in the Appendix A.

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

Control N°	Description	Model	Serial N°	Date of reception
67125/033	Wireless datalogger	LS-G6-TIL90-X	32322	2021/01/22
67125/034	Antenna	360P	--	2021/01/22

Sample M/02 has undergone the following test(s): The Radiated tests indicated in the Appendix A.

Test sample description

Ports..... :	Port name and description	Cable					
		Specified max length [m]	Attached during test	Shielded	Coupled to patient ⁽³⁾		
	Miniusb port for configuration		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
	RF port attached to external antenna		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Supplementary information to the ports..... :	-						
Rated power supply	Voltage and Frequency		Reference poles				
			L1	L2	L3	N	PE
	<input type="checkbox"/>	AC:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/>	AC:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<input checked="" type="checkbox"/>	DC: DC lithium battery. Saft LSH 14. 3.6V					
	<input type="checkbox"/>	DC:					
Rated Power	1300mA at 3.6V recommended continuous current by manufacturer.						
Clock frequencies	-						
Other parameters..... :	-						
Software version	2.54						
Hardware version..... :	LS-G6-TIL90-X-1 rev1						
Dimensions in cm (W x H x D)..... :	103 x 100 x 61 mm						
Mounting position..... :	<input checked="" type="checkbox"/>	Table top equipment					
	<input checked="" type="checkbox"/>	Wall/Ceiling mounted equipment					

	<input type="checkbox"/>	Floor standing equipment		
	<input type="checkbox"/>	Hand-held equipment		
	<input type="checkbox"/>	Other:		
Modules/parts	Module/parts of test item		Type	Manufacturer
	-			
Accessories (not part of the test item)	Description		Type	Manufacturer
	2 x Saft batteries		Battery	Saft
	-			
Documents as provided by the applicant.....	Description		File name	Issue date
	-			

⁽³⁾ Only for Medical Equipment

Identification of the client

Worldsensing S.L.
Calle Viriat 47, planta 10, 08014, Barcelona, Spain

Testing period and place

Test Location	DEKRA Testing and Certification S.A.U.
Date (start)	2021-01-26
Date (finish)	2021-06-09

Document history

Report number	Date	Description
67125RRF.002	2021-06-21	First release.
67125RRF.002A1	2021-10-20	Second release. This report is modified due to FCC 15.247 (a) (1) (iii) / RSS-247 5.1. (c) testing Specifications. This modification test report cancels and replaces the test report 67125RRF.002.

Environmental conditions

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

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

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

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

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

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

Remarks and comments

The tests have been performed by the technical personnel: Alfonso Gutiérrez, José Manuel Jiménez, Cristina Calle, Pablo Redondo.

Used instrumentation:

Conducted Measurements:

	Last Calibration	Due Calibration
1. Shielded Room ETS LINDGREN S101	N.A.	N.A.
2. Signal and Spectrum Analyzer 10 Hz - 40 GHz ROHDE AND SCHWARZ FSV40	2020/03	2022/03
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. Biconical/Log Antenna 30 MHz - 6 GHz ETS LINDGREN 3142E	2020/04	2023/04
4. Preamplifier G>40dB 10MHz-6GHz, BONN ELEKTRONIK, BLNA 0160-01N	2021/03	2022/03
5. EMI Test Receiver 7 GHz ROHDE AND SCHWARZ ESR7	2020/12	2022/12
6. Digital Multimeter, FLUKE 175	2020/11	2021/11
7. Horn Antenna 1-18 GHz SCHWARZBECK MESS-ELEKTRONIK BBHA 9120 D	2019/11	2022/11
8. RF Preamplifier, 40 dB ,1-18 GHz BONN ELEKTRONIK BLMA 0118-1M	2020/05	2021/05
9. Spectrum Analyzer ROHDE AND SCHWARZ FSW50	2020/07	2022/07

Testing verdicts

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

Summary

1. LoRa 915 MHz

FCC PART 15 PARAGRAPH / RSS-247			
Requirement – Test case		Verdict	Remark
FCC 15.247 (a)(1) / RSS-247 5.1. (b)	20 dB Bandwidth and Carrier frequency separation	P	
FCC 15.247 (a)(1)(iii) / RSS-247 5.1. (c)	Number of hopping channels	P	
FCC 15.247 (f) / RSS-247 5.3. (a)	Time of occupancy (Dwell Time)	P	
FCC 15.247 (b) / RSS-247 5.4. (a)	Maximum peak output power and antenna gain	P	
FCC 15.247 (d) / RSS-247 5.5.	Band-edge compliance of conducted emissions (Transmitter)	P	
FCC 15.247 (f) / RSS-247 5.3. (b)	Power spectral density for hybrid systems	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

TEST CONDITIONS	11
Occupied Bandwidth	13
FCC 15.247 (a) (1) / RSS-247 5.1. (b) 20 dB Bandwidth and Carrier frequency separation	15
FCC 15.247 (f) / RSS-247 5.3. (a) Time of occupancy (Dwell Time)	18
FCC 15.247 (b) / RSS-247 5.4 (a) Maximum output power and antenna gain	20
FCC 15.247 (d) / RSS-247 5.5. Band-edge compliance of conducted emissions (Transmitter)	23
FCC 15.247 (f) / RSS-247 5.3. (b) Power spectral density for hybrid systems	26
FCC 15.247 (d) / RSS-247 5.5. Emission limitations radiated (Transmitter)	29

TEST CONDITIONS

POWER SUPPLY:

V nominal: 3.6 Vdc
Type of Power Supply: Lithium Battery (Saft LSH 14).

ANTENNA:

Type of Antenna: External (Omnidirectional stubby antenna with RPSMA)
Maximum Declared Assembly Gain: -3.2 dBi

TEST FREQUENCIES:

Conducted Tests:

Low Channel: 902.3 MHz
Middle Channel: 914.9 MHz
High Channel: 927.7 MHz

Radiated Tests:

Low Channel: 902.3 MHz
Middle Channel: 914.9 MHz
High Channel: 927.7 MHz

- The equipment can operate as a hybrid system using 8 hopping channels.

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.

RADIATED MEASUREMENTS

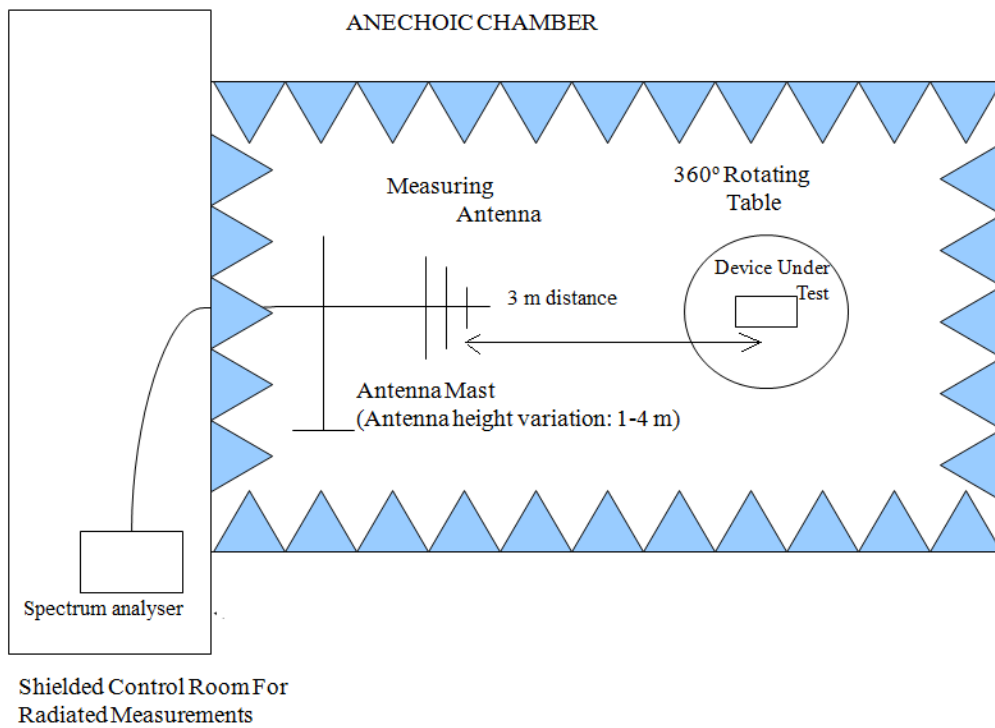
All radiated tests were performed in a semi-anechoic chamber. The measurement antenna (Bilog antenna for the range between 30 MHz to 1000 MHz and 1 GHz-10 GHz Double ridge horn antenna) is situated at a distance of 3 m.

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 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.

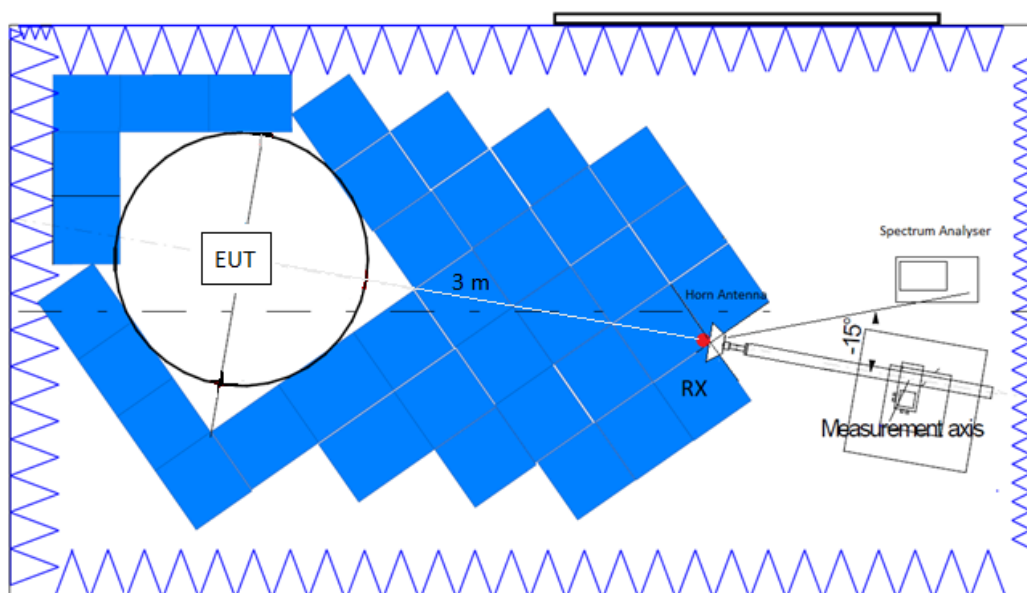
Measurements were made in both horizontal and vertical planes of polarization.

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 10 GHz:



Occupied Bandwidth

SPECIFICATION:

FCC §2.1049. Measurements required: Occupied bandwidth.

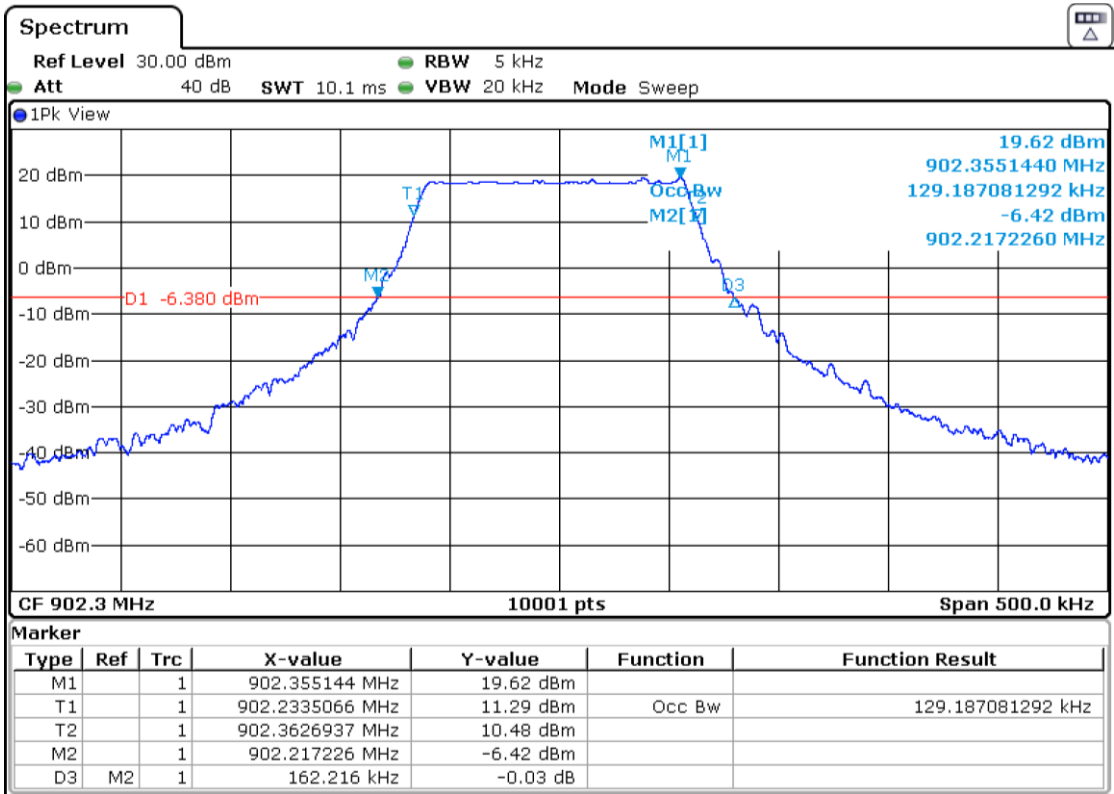
RSS-Gen Clause 6.7.

RESULTS:

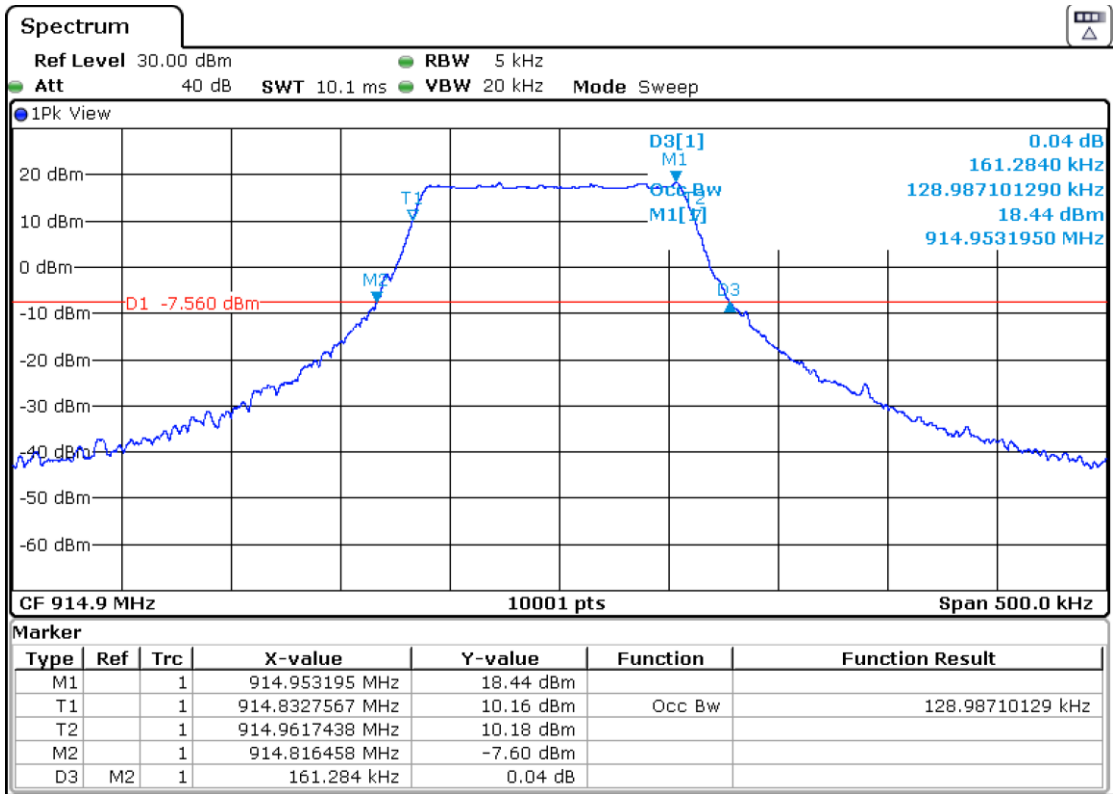
	Low Channel	Middle Channel	High Channel
99% Bandwidth (kHz)	129.1870813	128.9871013	128.4871513
-26 dBc Bandwidth (kHz)	162.216	161.284	163.184
Measurement uncertainty (kHz)	<± 0.52		

Verdict: PASS

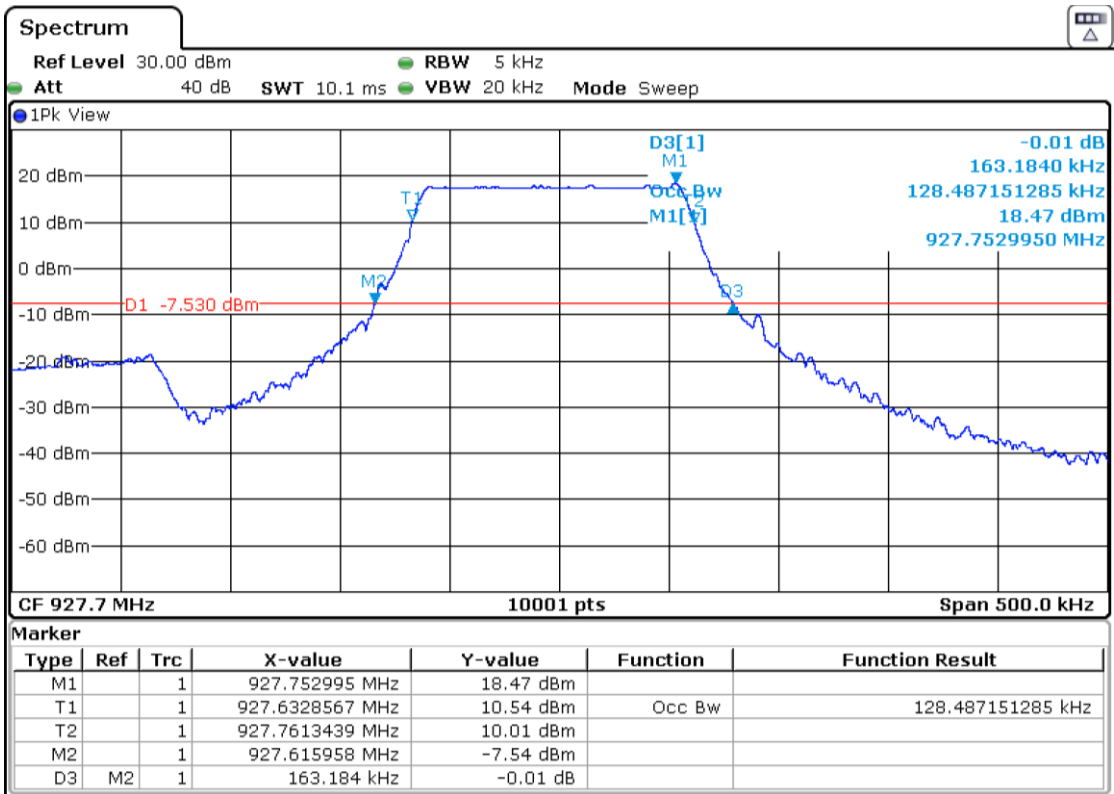
Low Channel:



Middle Channel:



High Channel:



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

SPECIFICATION:

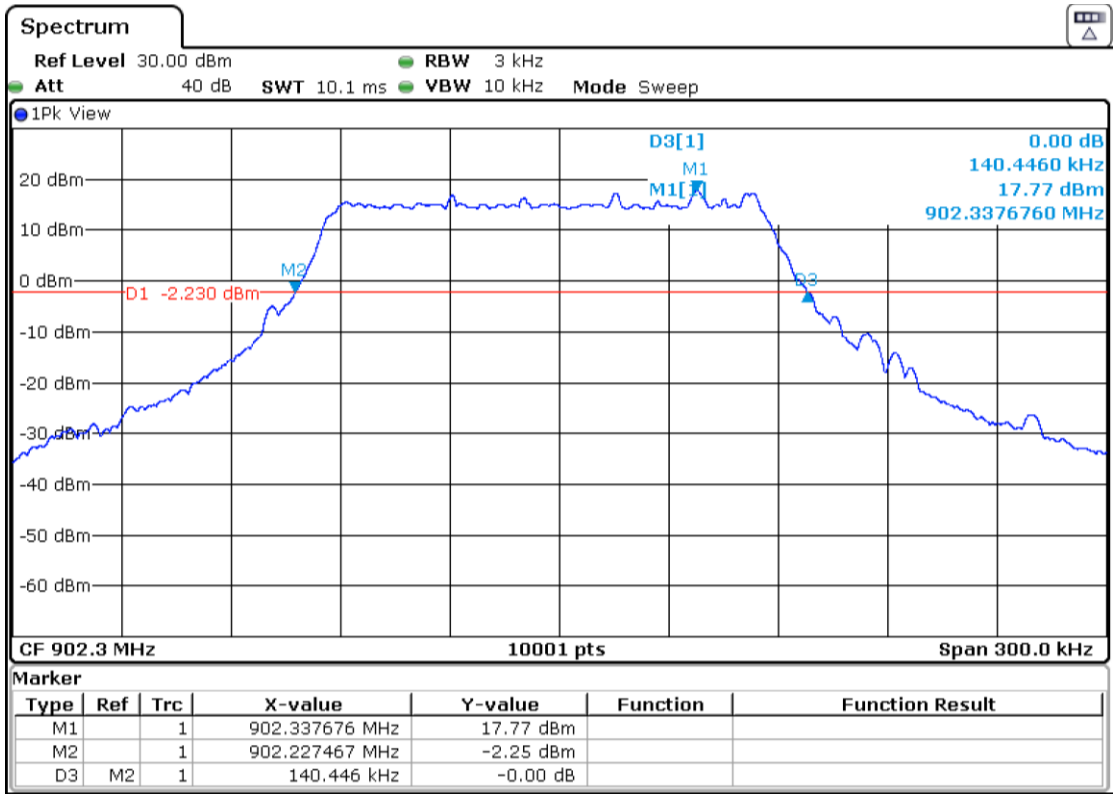
Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

RESULTS:

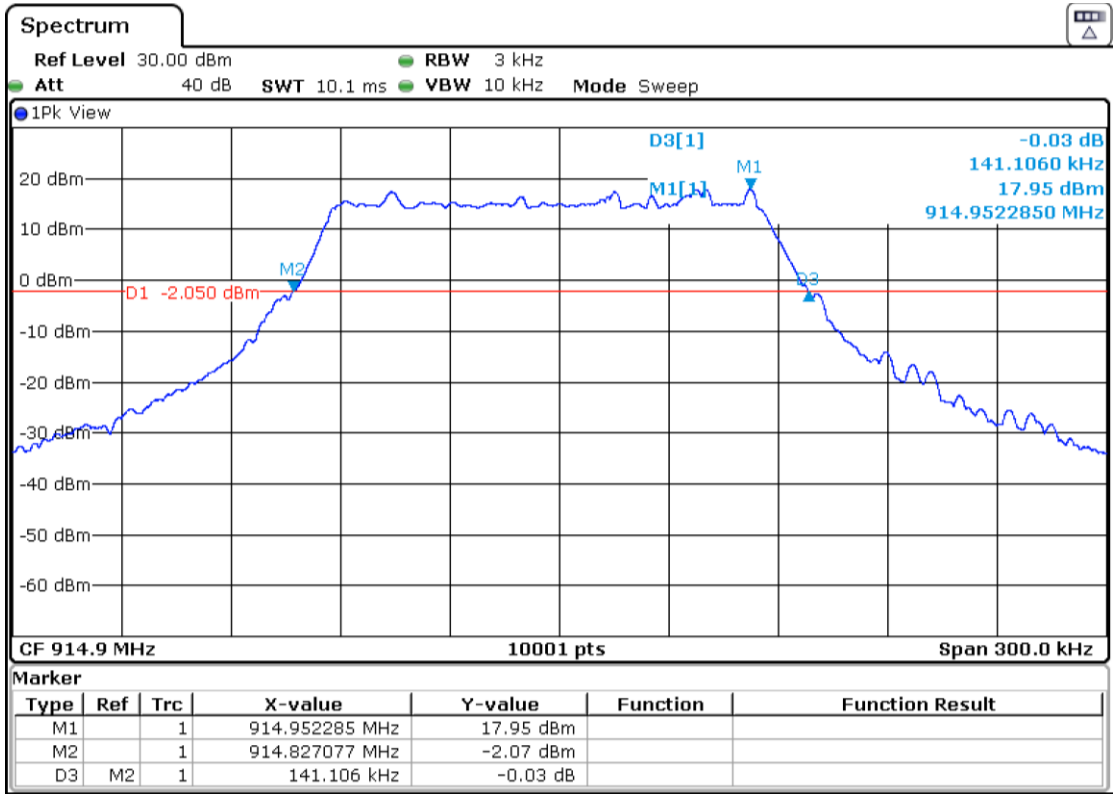
	Low Channel	Middle Channel	High Channel
20 dB Spectrum bandwidth (kHz)	140.446	141.106	144.046
Measurement uncertainty (kHz)	<± 0.52		

Verdict: PASS

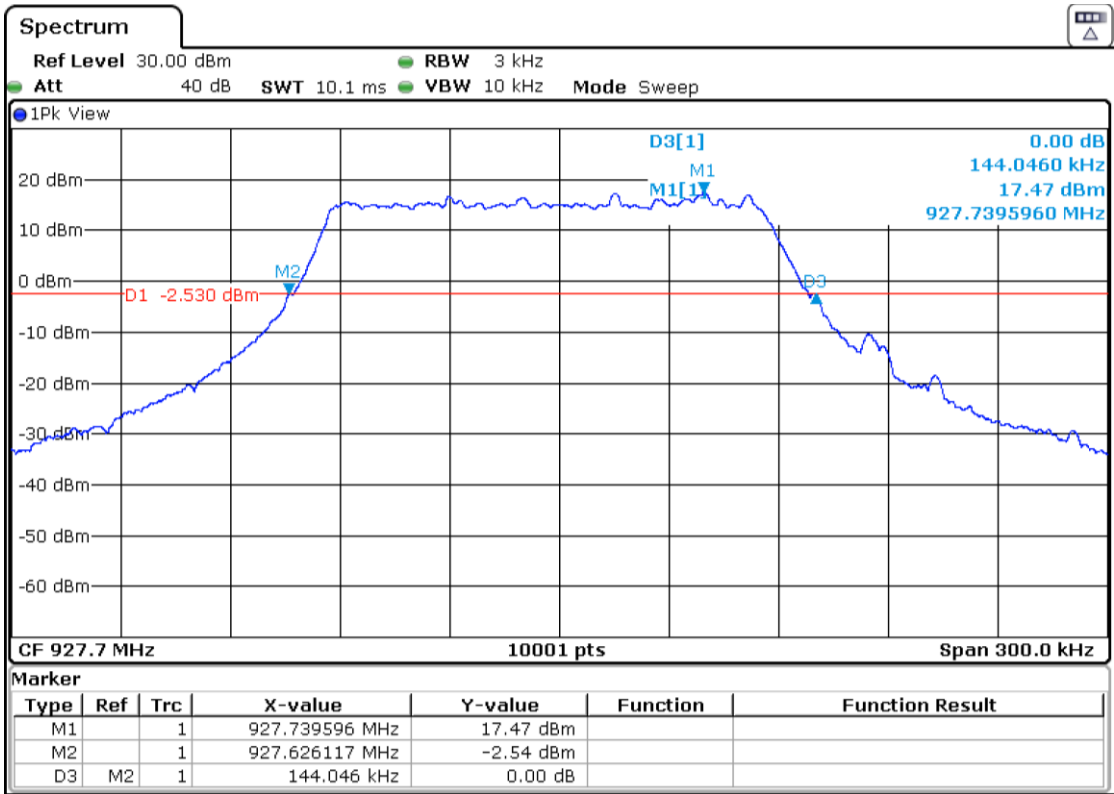
Low Channel:



Middle Channel:

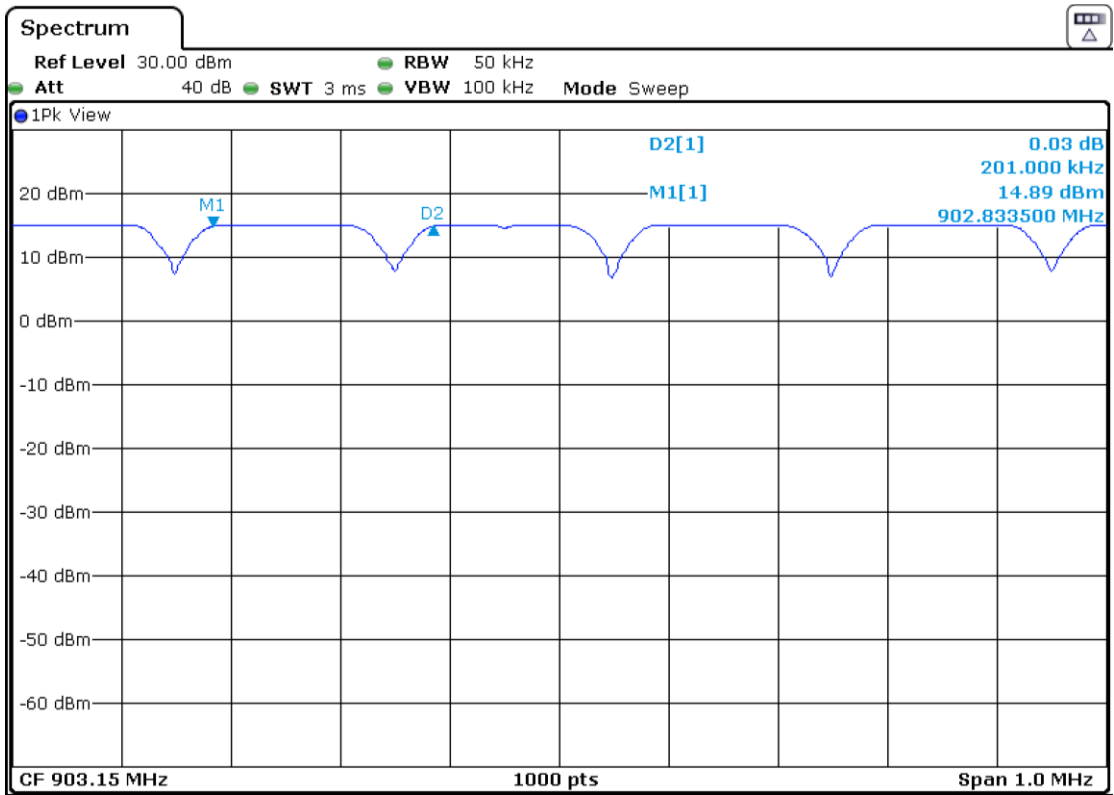


High Channel:



Carrier frequency separation

201 kHz



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

Verdict: PASS

FCC 15.247 (f) / RSS-247 5.3. (a) Time of occupancy (Dwell Time)

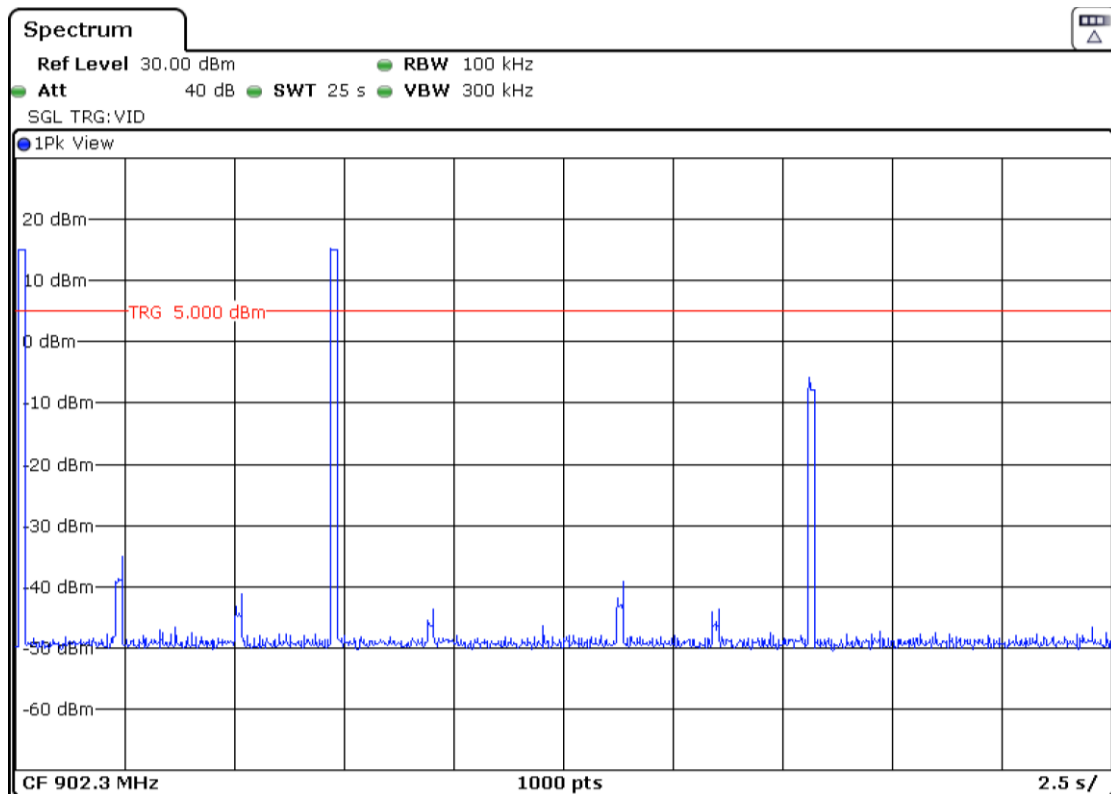
SPECIFICATION:

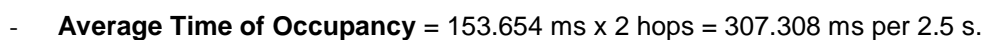
For the purposes of this section, hybrid systems are those that employ a combination of both frequency hopping and digital modulation techniques. The frequency hopping operation of the hybrid system, with the direct sequence or digital modulation operation turned-off, shall have an average time of occupancy on any frequency not to exceed 0.4 seconds within a time period in seconds equal to the number of hopping frequencies employed multiplied by 0.4.

RESULTS:

1. OPERATION AS A FREQUENCY HOPPING SYSTEM USING 8 HOPPING CHANNELS:

- TX time per hop: 153.654 ms (see next plots)
- Number of hops over a period of 2.5 s: 2 (see next plots)





Measurement uncertainty (ms)	$< \pm 1.02$
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2021-10-20

FCC 15.247 (b) / RSS-247 5.4 (a) Maximum 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, but at least 25 hopping channels.

Hybrid systems shall comply with the 1 W limit.

Additionally for RSS-247:

For FHSs operating in the band 902-928 MHz, the e.i.r.p. shall not exceed 4 W if the hopset uses 50 or more hopping channels; the e.i.r.p. shall not exceed 1 W if the hopset uses less than 50 hopping channels.

RESULTS:

The maximum conducted (average) output power was measured using the method AVGSA-1 (trace averaging across on and off times of the EUT transmissions) according to point 11.9.2.2.2 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: -3.2 dBi

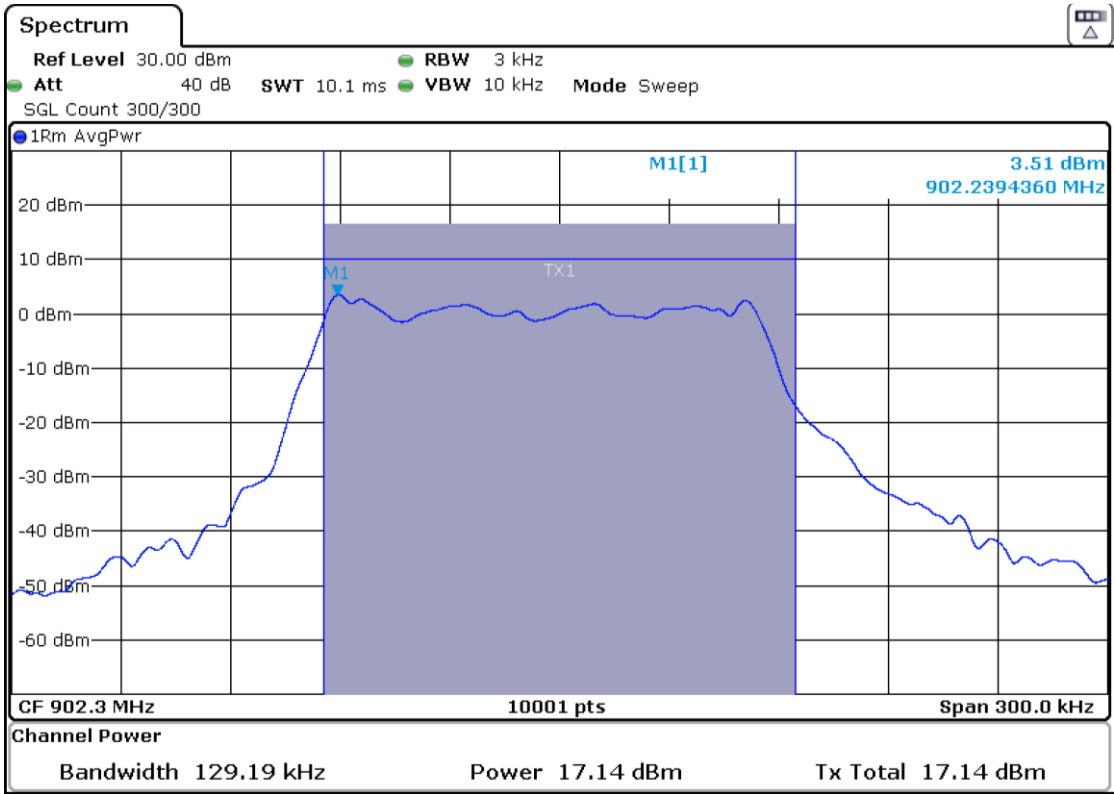
The maximum directional gain of the antenna is less than 6 dBi and therefore the maximum output power is not required to be reduced from the stated values.

	Low Channel	Middle Channel	High Channel
Maximum Average Conducted Power (dBm)	17.14	17.18	17.43
Duty Cycle Correction (dB)	1.60		
Corrected Maximum Average Conducted Power (dBm)	18.74	18.78	19.03
Corrected Maximum EIRP Average Conducted Power (dBm)	15.54	15.58	15.83
Measurement uncertainty (dB)	<±2.57		

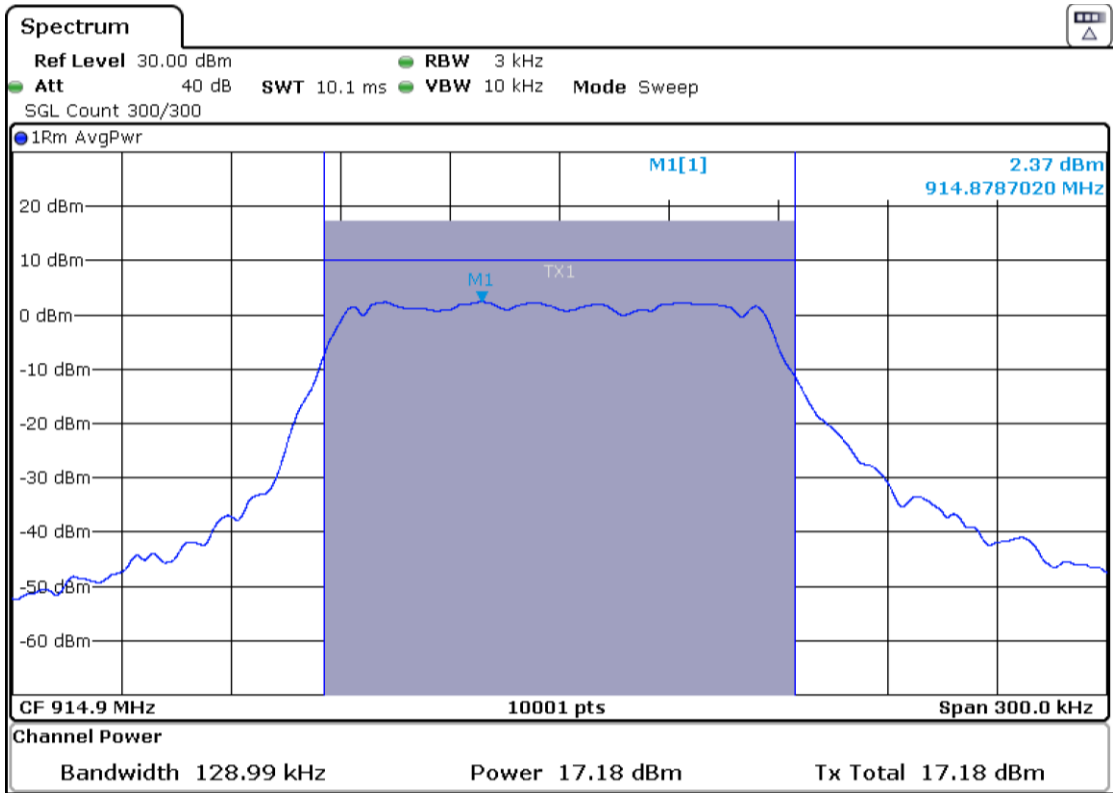
Verdict: PASS

Maximum Average Output Power:

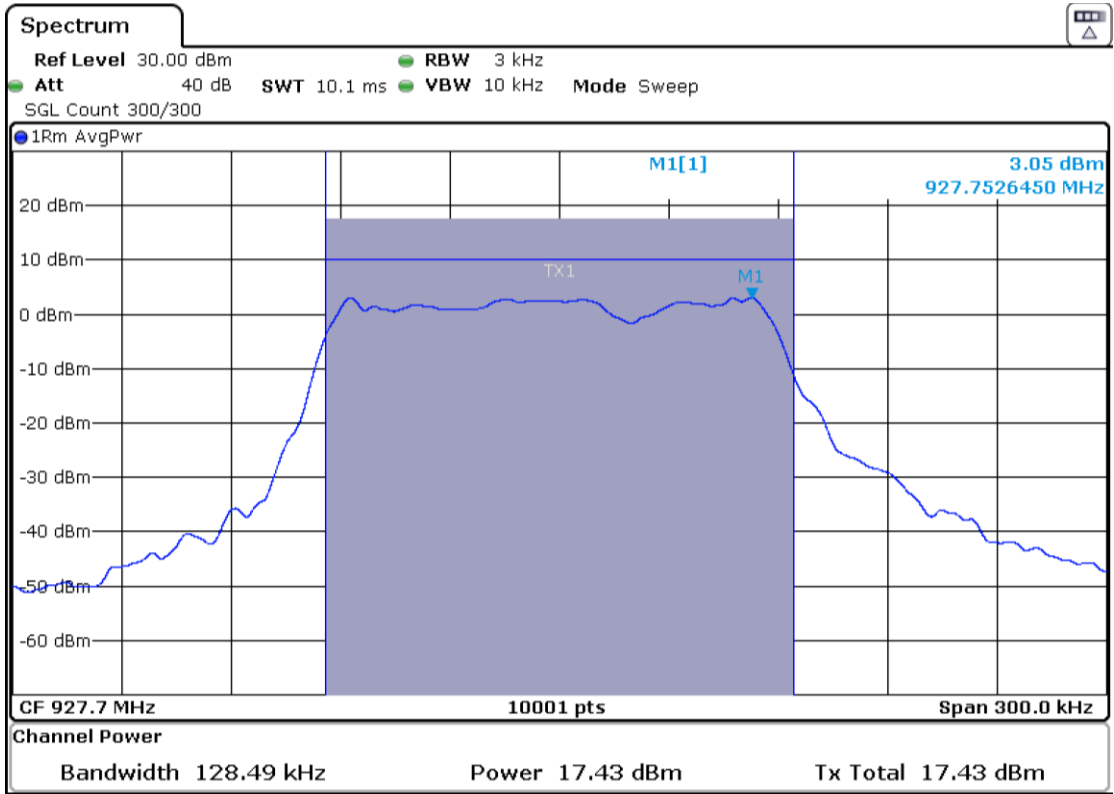
Low Channel:



Middle Channel:



High Channel:



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

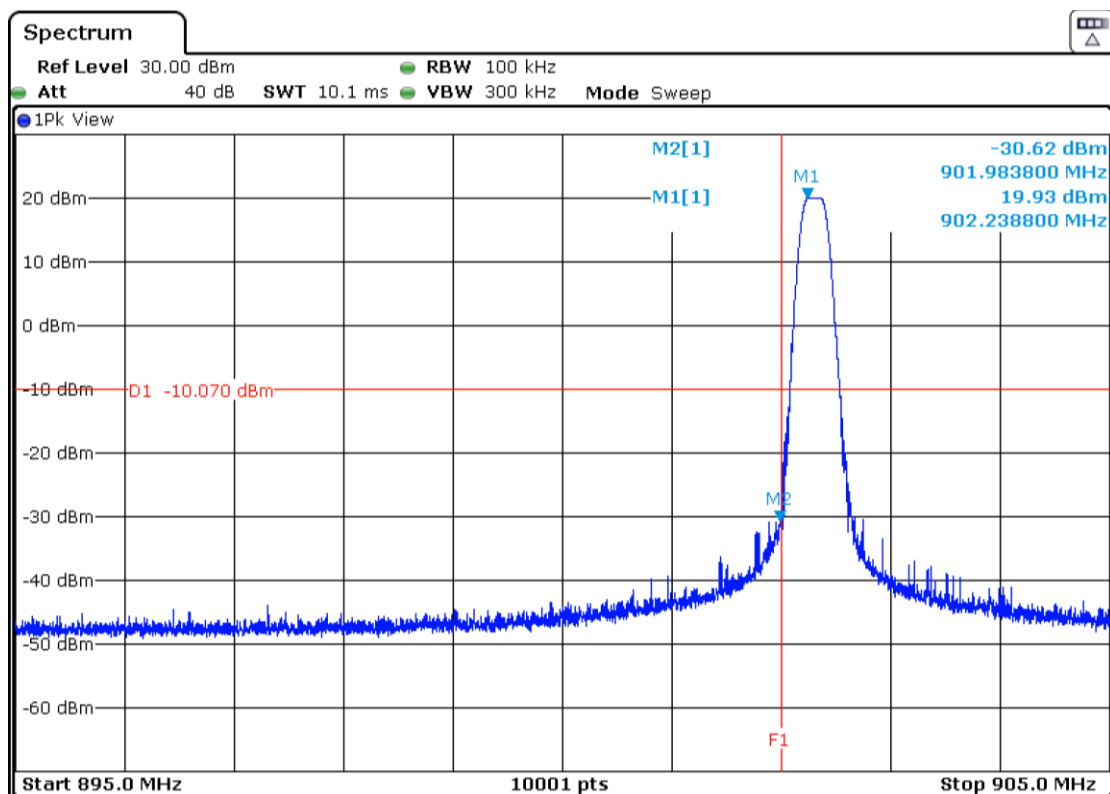
If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

RESULTS:

The attenuation of highest emissions at the band-edge is more than 30 dB respect to the highest level of the desired power.

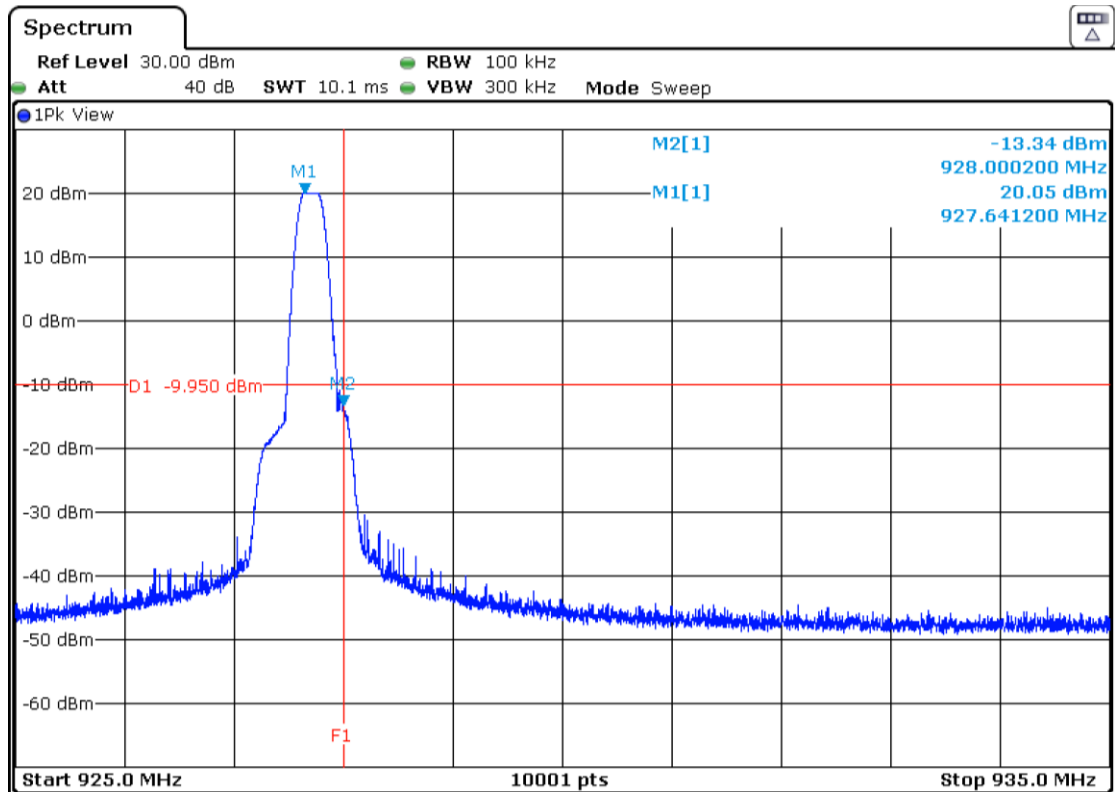
- HOPPING OFF:

- LOW FREQUENCY SECTION:



Verdict: PASS

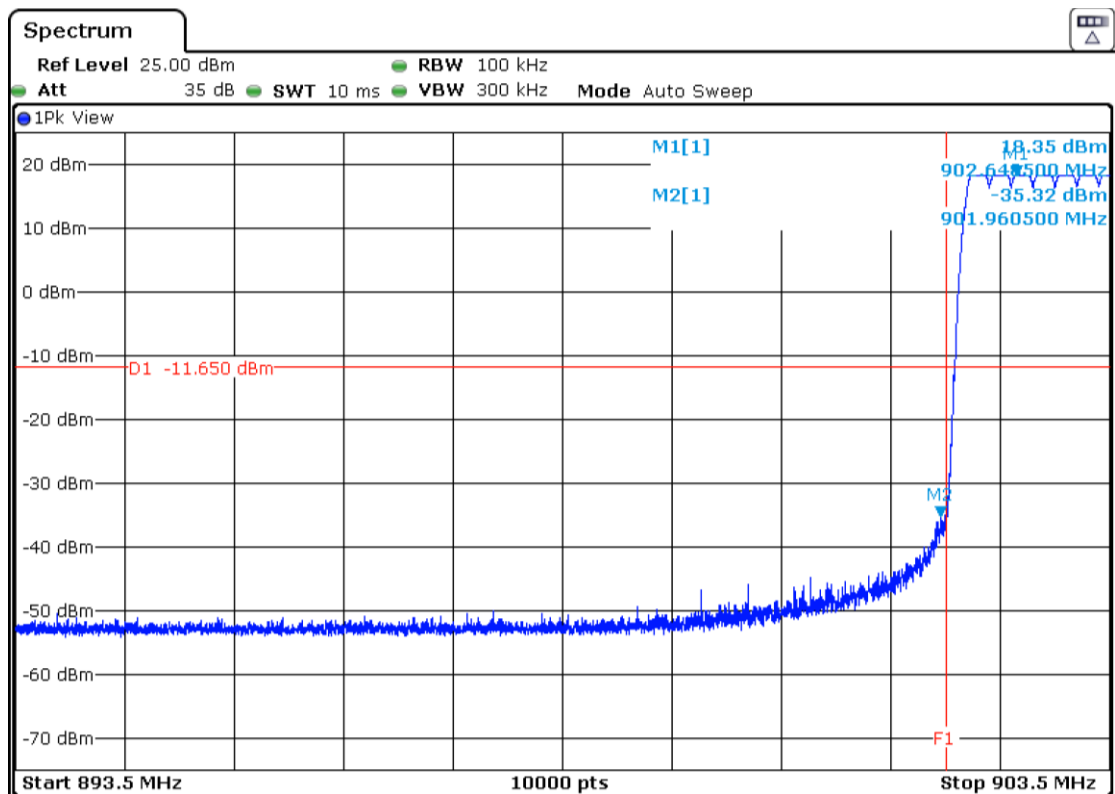
- HIGH FREQUENCY SECTION:



Verdict: PASS

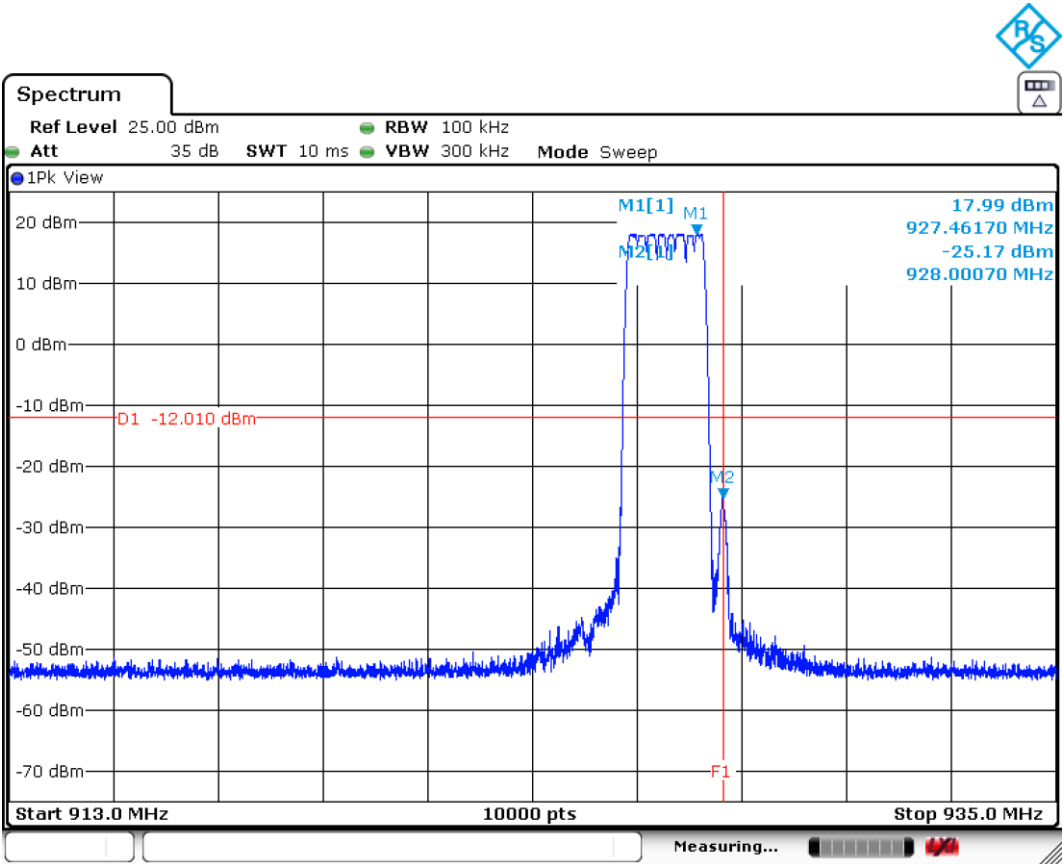
- HOPPING ON:

- LOW FREQUENCY SECTION:



Verdict: PASS

- HIGH FREQUENCY SECTION:



Verdict: PASS

Measurement uncertainty (dB)	<±2.57
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FCC 15.247 (f) / RSS-247 5.3. (b) Power spectral density for hybrid systems

SPECIFICATION:

For the purposes of this section, hybrid systems are those that employ a combination of both frequency hopping and digital modulation techniques.

The power spectral density conducted from the intentional radiator to the antenna due to the digital modulation operation of the hybrid system, with the frequency hopping operation turned off, shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

RESULTS:

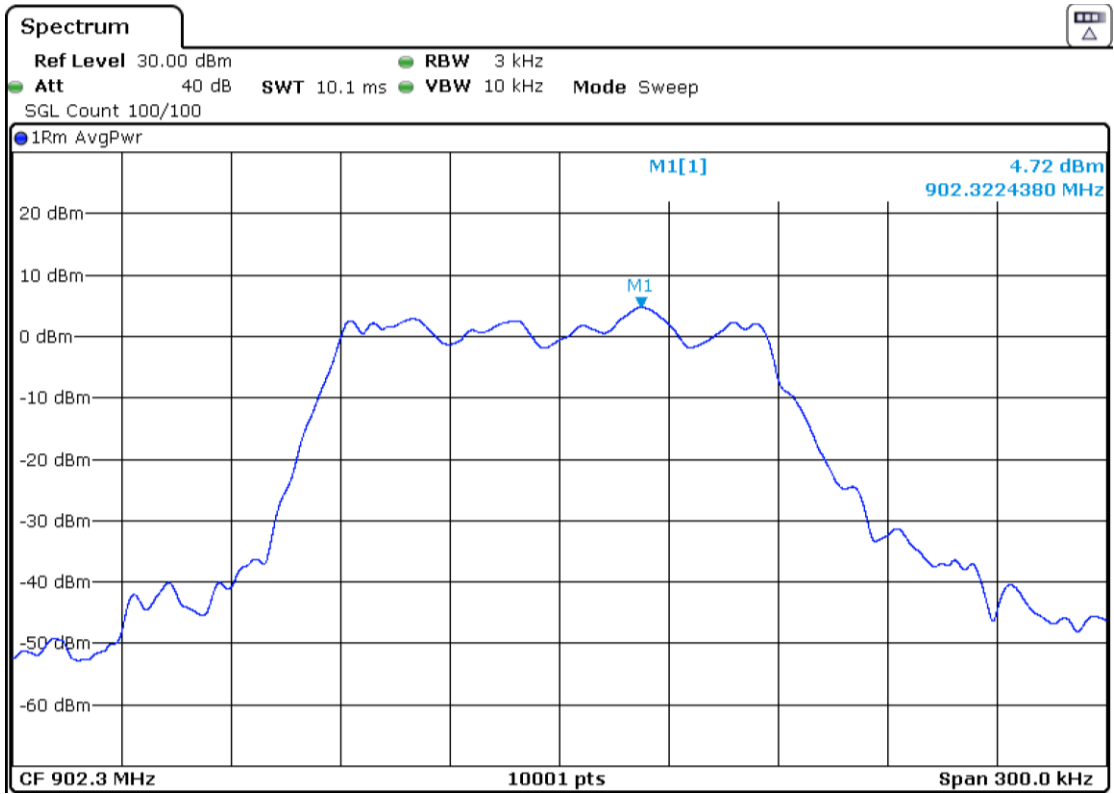
The maximum power spectral density level was measured using the method AVGPS-1 according to point 11.10.3 of ANSI C.63.10-2013.

	Low Channel	Middle Channel	High Channel
Average Power Spectral Density (dBm)	4.72	4.66	4.87
Duty Cycle Correction (dB)	1.60		
Corrected Average Power Spectral Density (dBm)	6.321	6.261	6.471
Measurement uncertainty (dB)	<±2.57		

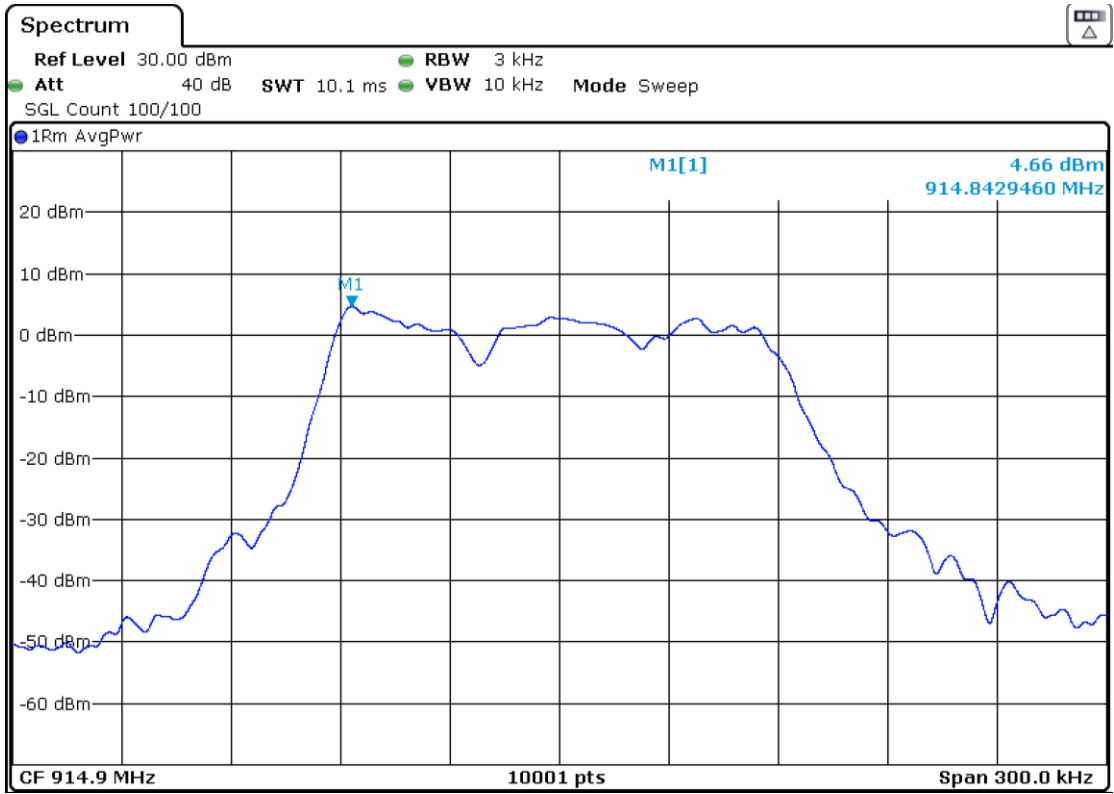
Verdict: PASS

Power Spectral Density:

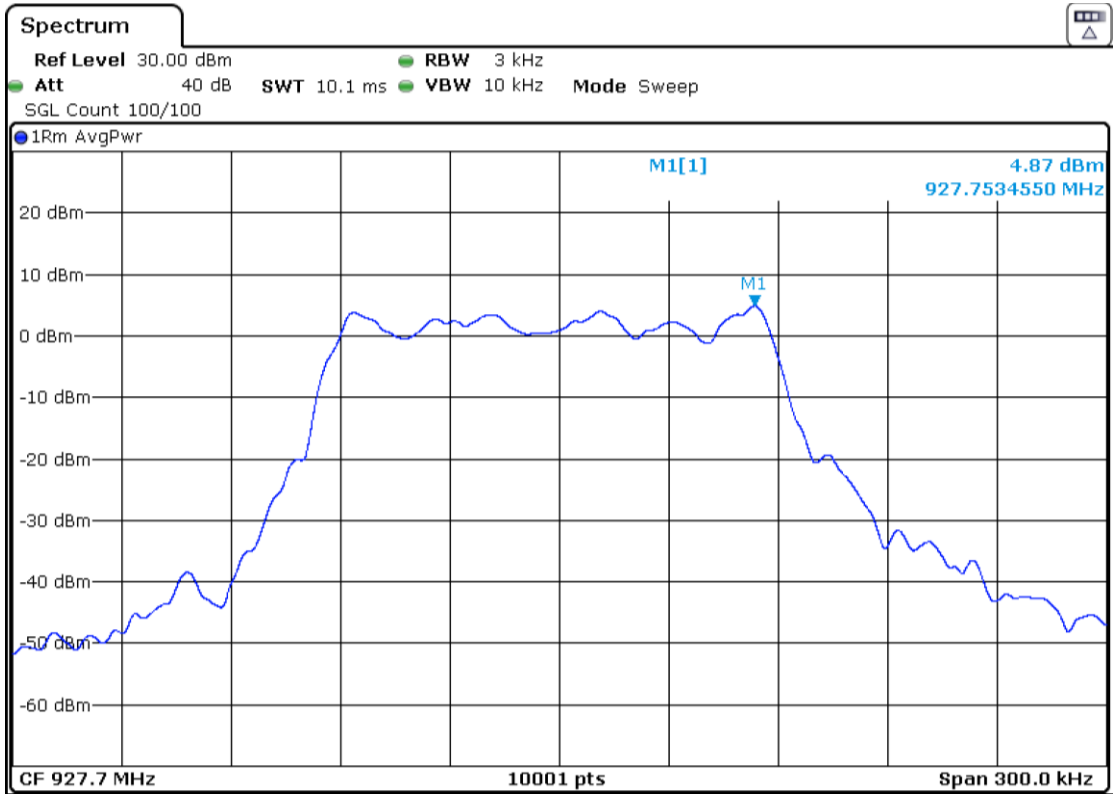
Low Channel:



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 §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 - 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-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.

RADIATED:

Frequency range 30 MHz - 1 GHz:

The spurious frequencies do not depend on the operating channel.

Spurious frequencies closest to the limit:

Spurious Frequency (MHz)	Emission Level (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
800.0345	26.28	H	Quasi-Peak	<± 4.99

Frequency range 1 - 10 GHz:

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

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	Measurement Uncertainty (dB)
1.804533333	38.25	H	Peak	<± 4.98
2.706666667	41.88	V	Peak	<± 4.98
3.6095	46.05	V	Peak	<± 4.98
6.316	53.83	H	Peak	<± 4.98
8.12075	52.08	V	Peak	<± 4.98
9.023	52.25	V	Peak	<± 4.98

- MIDDLE CHANNEL. Spurious frequencies closest to the limit:

Spurious Frequency (GHz)	Emission Level (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
1.8298	40.94	V	Peak	<± 4.98
2.7448	42.29	V	Peak	<± 4.98
5.4895	47.60	V	Peak	<± 4.98
6.4045	54.73	H	Peak	<± 4.98
	51.69		Average	<± 4.98
7.3195	48.41	H	Peak	<± 4.98
8.234	51.84	V	Peak	<± 4.98
9.14875	51.32	V	Peak	<± 4.98

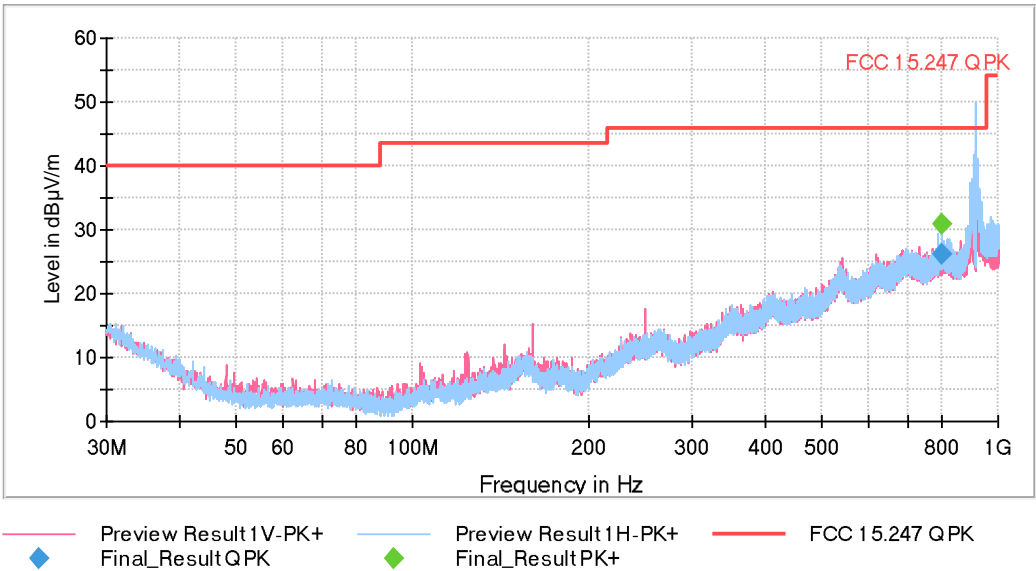
- HIGH CHANNEL. Spurious frequencies closest to the limit:

Spurious Frequency (GHz)	Emission Level (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
1.855533333	37.62	H	Peak	<± 4.98
2.783533333	40.64	V	Peak	<± 4.98
5.5665	47.3	V	Peak	<± 4.98
6.4937	48.91	V	Peak	<± 4.98
7.4217	46.61	V	Peak	<± 4.98
8.349	50.43	V	Peak	<± 4.98
9.2785	50.29	V	Peak	<± 4.98

Verdict: PASS

FREQUENCY RANGE 30 MHz - 1 GHz:

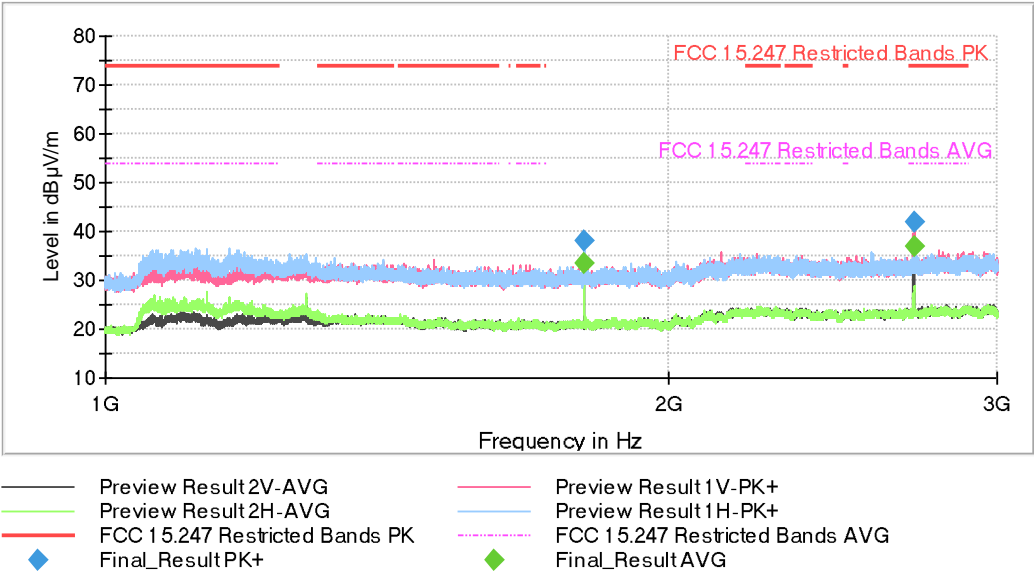
This plot is valid for all channels.



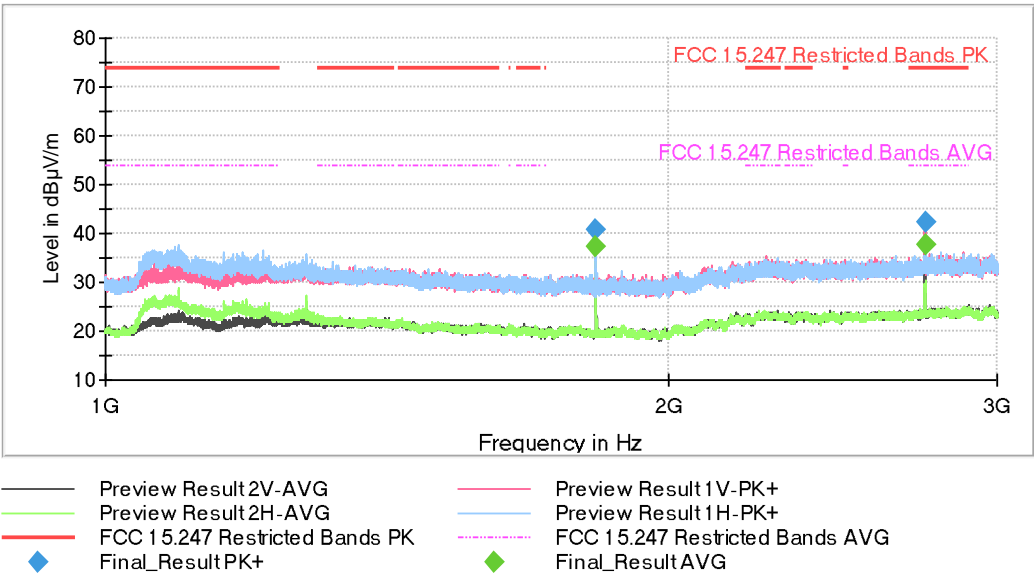
The peak above the limit is the carrier frequency.

FREQUENCY RANGE 1 - 3 GHz:

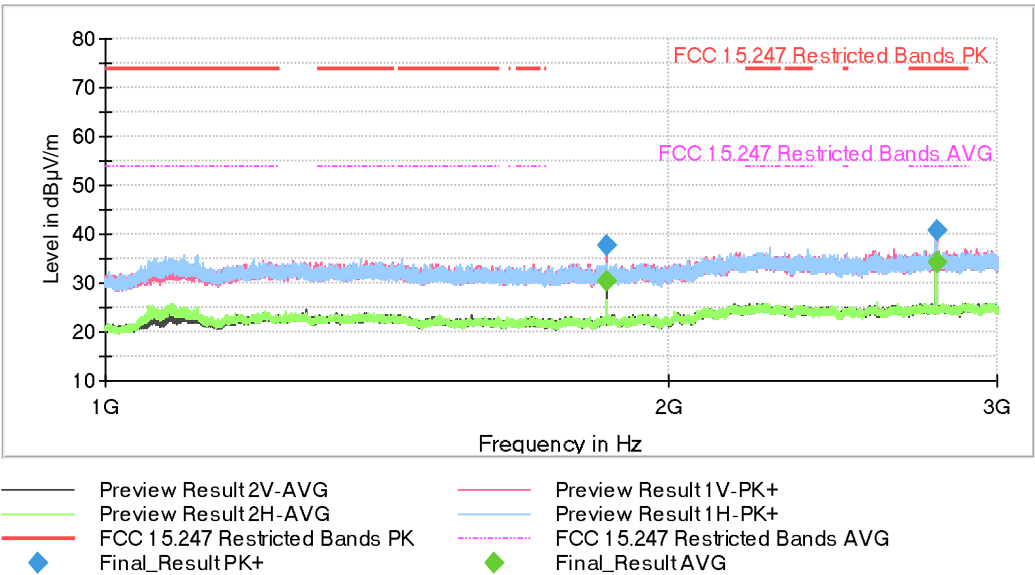
- Low Channel:



- Middle Channel:

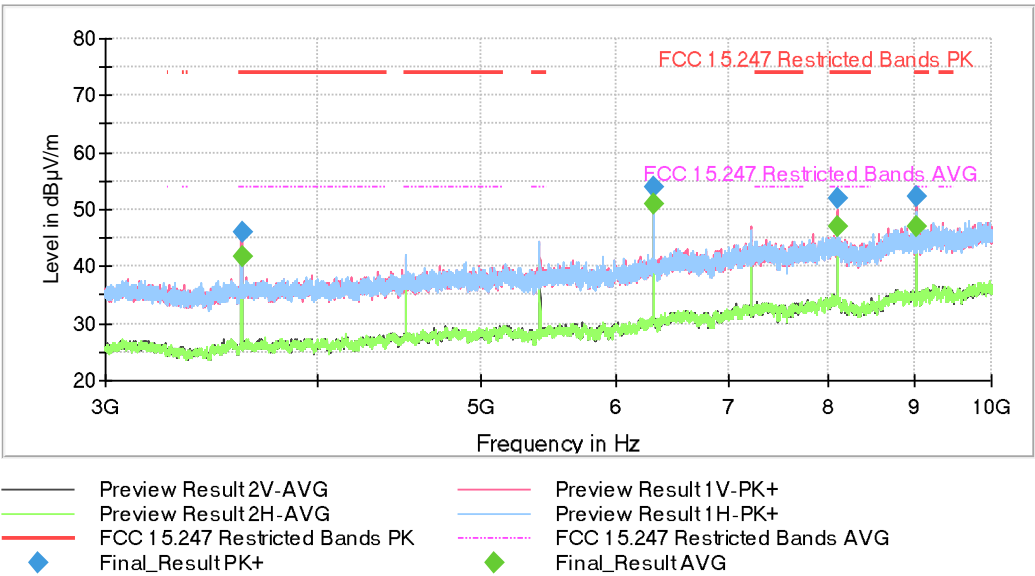


- High Channel:

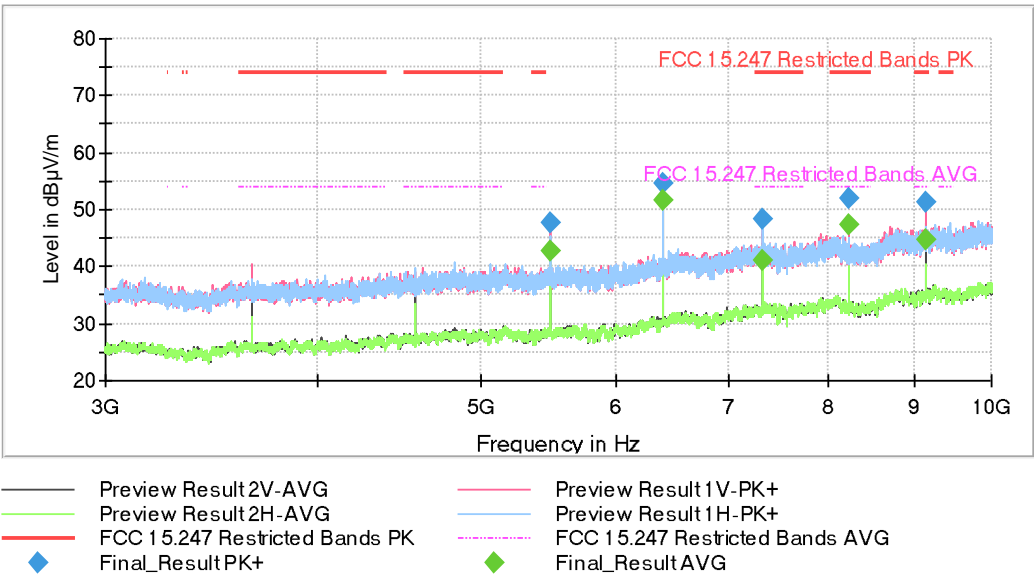


FREQUENCY RANGE 3 - 10 GHz:

- Low Channel:



- Middle Channel:



- High Channel:

