



FCC LISTED, REGISTRATION
NUMBER: 720267

Informe de ensayo nº:
Test report No:

ISED LISTED REGISTRATION
NUMBER 4621A-2

NIE: 48847RRF.002

Partial Test report

USA FCC Part 15.247

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.

Identificación del objeto ensayado.....: Identification of item tested	Wireless sensor node for the Internet of Things
Marca Trade	Libelium
Modelo y/o referencia tipo Model and /or type reference	Waspnote Plug & Sense! LoRaWAN US
Other identification of the product	FCC ID: XKM-WPS-LORA-V1 IC: 8472A-WPSLORAV1
Final HW version	1.0
Final SW version	1.0
Características Features	Can communicate with LoRaWAN networks. USA and Canada version. Contains an RN2903 chipset.
Fabricante Manufacturer	Libelium Comunicaciones Distribuidas S.L. C/ Escatrón 16 (Edificio Libelium), CP: 50014, Zaragoza (SPAIN)
Método de ensayo solicitado, norma.....: Test method requested, standard	USA FCC Part 15.247 10-1-15 Edition: Operation within the bands 902 - 928 MHz, 2400 -2483.5 MHz, and 5725 - 5850 MHz. USA FCC Part 15.209 10-1-15 Edition: Radiated emission limits; general requirements. FCC 15.247 Subclause (a) (1) FCC 15.247 Subclause (a)(1)(i) FCC 15.247 Subclause (b) (2) FCC 15.247 Subclause (d) (conducted) CANADA RSS-247 Issue 1 (May 2015). RSS-247 Clause 5.1 (2) RSS-247 Clause 5.1 (3) RSS-247 Clause 5.4 (1) RSS-247 Clause 5.5 (conducted) CANADA RSS-Gen Issue 4 (November 2014). ANSI C63.10-2013: American National Standard for Testing Unlicensed Wireless Devices.

Resultado:	IN COMPLIANCE		
Summary			
Aprobado por (nombre / cargo y firma)	R. López	RAFAEL LÓPEZ MARTÍN	 Firmado digitalmente por RAFAEL LÓPEZ MARTÍN Fecha: 2017.05.23 14:51:52 +02'00'
Approved by (name / position & signature)	EMC Lab. Manager		
Fecha de realización	2017-05-23		
Date of issue			
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Report template No			

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Competences and guarantees

DEKRA Testing and Certification 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 laboratory with a measurement facility in compliance with the requirements of Section 2.948 of the FCC rules and has been added to the list of facilities whose measurements data will be accepted in conjunction with applications for Certification under Parts 15 or 18 of the Commission's Rules. Registration Number: 720267.

DEKRA Testing and Certification is a laboratory with a measurement site in compliance with the requirements of RSS 212, Issue 1 (Provisional) and has been added to the list of filed sites of the Canadian Certification and Engineering Bureau. Reference File Number: ISED 4621A-2.

In order to assure the traceability to other national and international laboratories, DEKRA Testing and Certification has a calibration and maintenance program for its measurement equipment.

DEKRA Testing and Certification 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 at the time of performance of the test.

DEKRA Testing and Certification is liable to the client for the maintenance of the confidentiality of all information related to the item under test and the results of the test.

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

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General conditions

1. This report is only referred to the item that has undergone the test.
2. This report does not constitute or imply on its own an approval of the product by the Certification Bodies or competent Authorities.
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Uncertainty

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

Usage of samples

Samples undergoing test have been selected by: **the client**

Sample S/01 is composed of the following elements:

Control N°	Description	Model	Serial N°	Date of reception
51748/016	Sensor node with wireless communication	Waspmote Plug & Sense! LoRaWAN US	---	2016-12-27

1. Sample S/01 has undergone the following test(s).

All conducted tests in single channel transmission mode indicated in appendix A.

Sample S/02 is composed of the following elements:

Control N°	Description	Model	Serial N°	Date of reception
51748/034	Sensor node with wireless communication	Wasmote Plug & Sense! LoRaWAN US	---	2017-05-11

2. Sample S/02 has undergone following test(s).

All conducted tests in hopping mode indicated in appendix A.

Test sample description

The test sample consists of a device that receives data from sensors and sends information with its wireless radio. It is battery powered and can be easily programmed.

Identification of the client

Libelium Comunicaciones Distribuidas S.L.

C/ Escatrón 16 (Edificio Libelium), CP: 50014, Zaragoza (SPAIN).

Testing period

The performed test started on 2017-05-17 and finished on 2017-05-18.

The tests have been performed at DEKRA Testing and Certification.

Environmental conditions

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 %
Air pressure	Min. = 860 mbar Max. = 1060 mbar
Shielding effectiveness	> 100 dB
Electric insulation	> 10 kΩ
Reference resistance to earth	< 1 Ω

Remarks and comments

1: The tests have been performed by the technical personnel: Jose Carlos Luque.

2: Used instrumentation:

Conducted Measurements

		Last Cal. date	Cal. due date
1.	Spectrum analyser Agilent PSA E4440A	2015/10	2017/10
2.	DC power supply R&S NGPE 40/40	2014/11	2017/11

3: Test not requested.

Testing verdicts

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

FCC PART 15 PARAGRAPH / RSS-247		VERDICT			
		NA	P	F	NM
FCC 15.247 Subclause (a) (1) / RSS-247 Clause 5.1 (2)	20 dB Bandwidth and Carrier frequency separation		P		
FCC 15.247 Subclause (a)(1)(i) / RSS-247 Clause 5.1 (3)	Number of hopping channels		P		
FCC 15.247 Subclause (a)(1)(i) / RSS-247 Clause 5.1 (3)	Time of occupancy (Dwell Time)		P		
FCC 15.247 Subclause (b) (2) / RSS-247, Clause 5.4 (1)	Maximum peak output power and antenna gain		P		
FCC 15.247 Subclause (d) / RSS-247 Clause 5.5	Emission limitations conducted (Transmitter)		P		
FCC 15.247 Subclause (d) / RSS-247 Clause 5.5	Emission limitations radiated (Transmitter)				NM ³

3: See section "Remarks and comments".

Appendix A – Test results

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TEST CONDITIONS

$V_{\text{nominal}} = 3.6 \text{ Vdc}$

Type of power supply = DC voltage from rechargeable battery.

Type of antenna = External attachable antenna.

Maximum declared antenna gain = 2.0 dBi

Temperature (°C):

$T_n = +15 \text{ to } +35$

$T_{\text{min}} = \text{N/A}$

$T_{\text{max}} = \text{N/A}$

The subscript n indicates normal test conditions.

N/A: Not Applicable.

TEST FREQUENCIES:

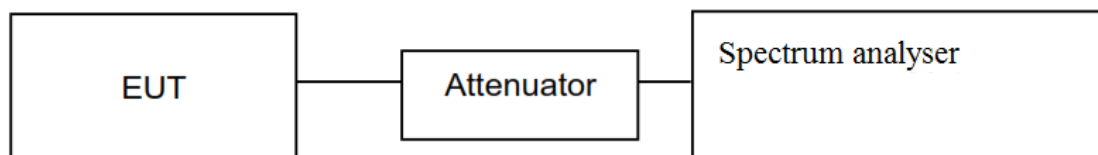
Lowest channel: 902.3 MHz

Middle channel: 908.7 MHz

Highest channel: 914.9 MHz

CONDUCTED MEASUREMENTS

The equipment under test was set up in a shielded room and it is directly connected to the spectrum analyzer using a calibrated attenuator.



FCC Section 15.247 Subclause (a) (1) / RSS-247 Clause 5.1 (2). 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. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

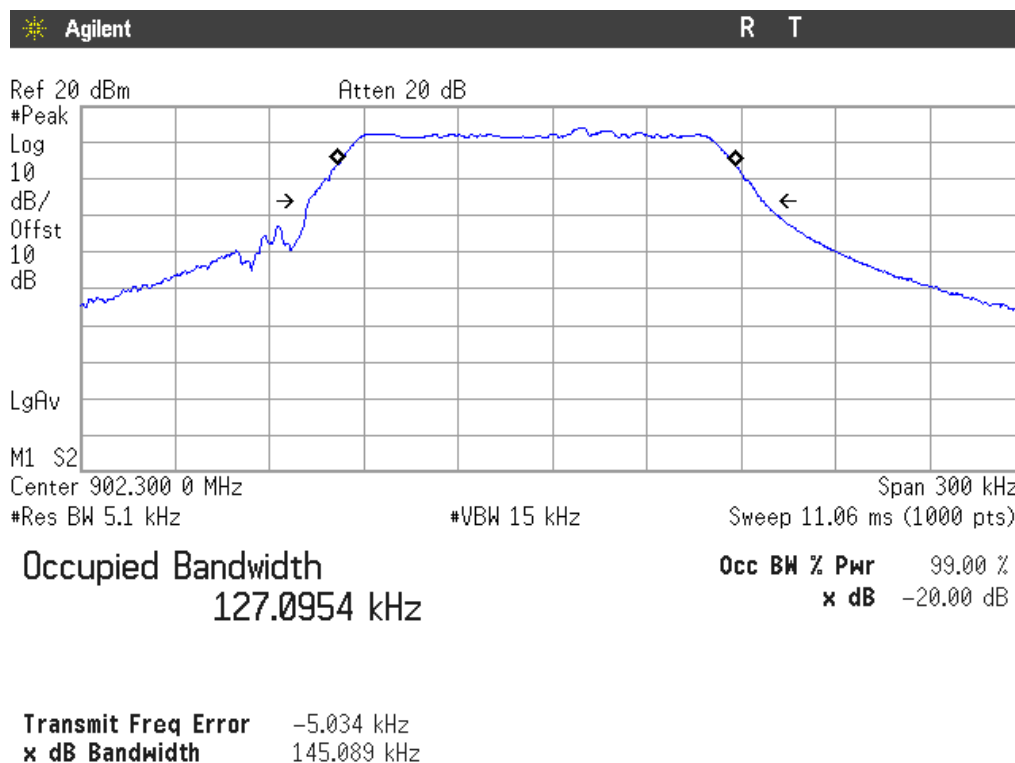
For frequency hopping systems operating in the 902–928 MHz band the maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

RESULTS

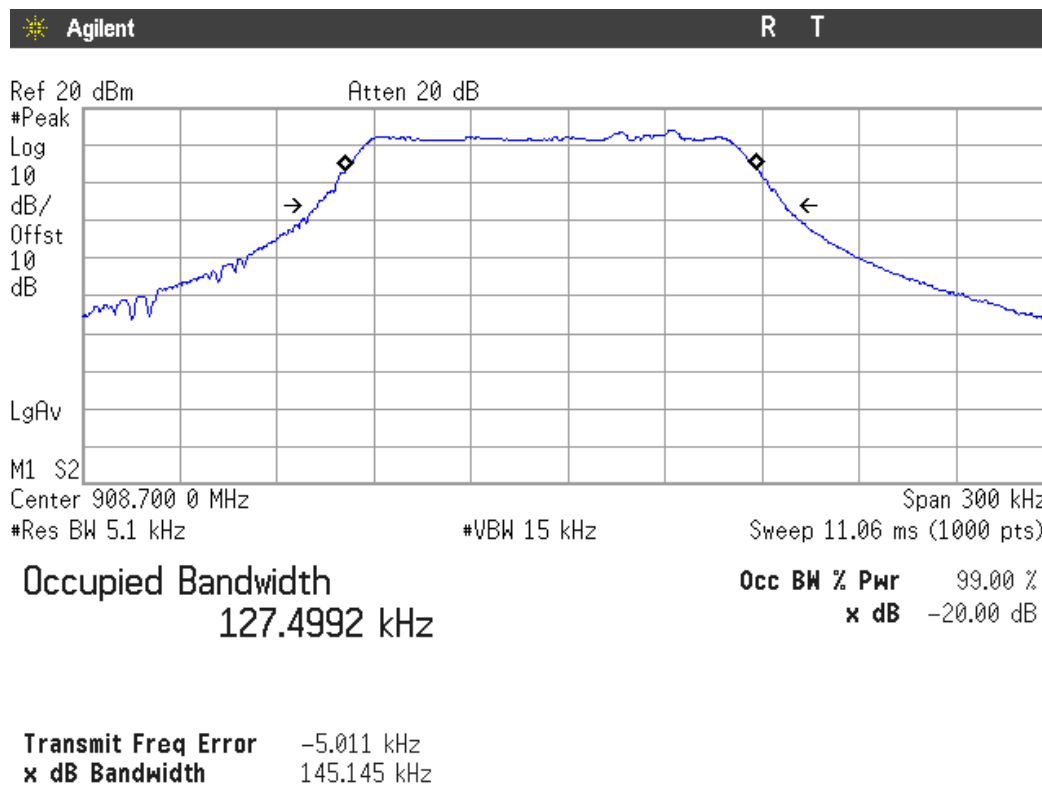
(See next plots)

	Lowest frequency 902.3 MHz	Middle frequency 908.7 MHz	Highest frequency 914.9 MHz
20 dB Spectrum bandwidth (kHz)	145.089	145.145	144.979
Measurement uncertainty (kHz)	< ± 0.67		

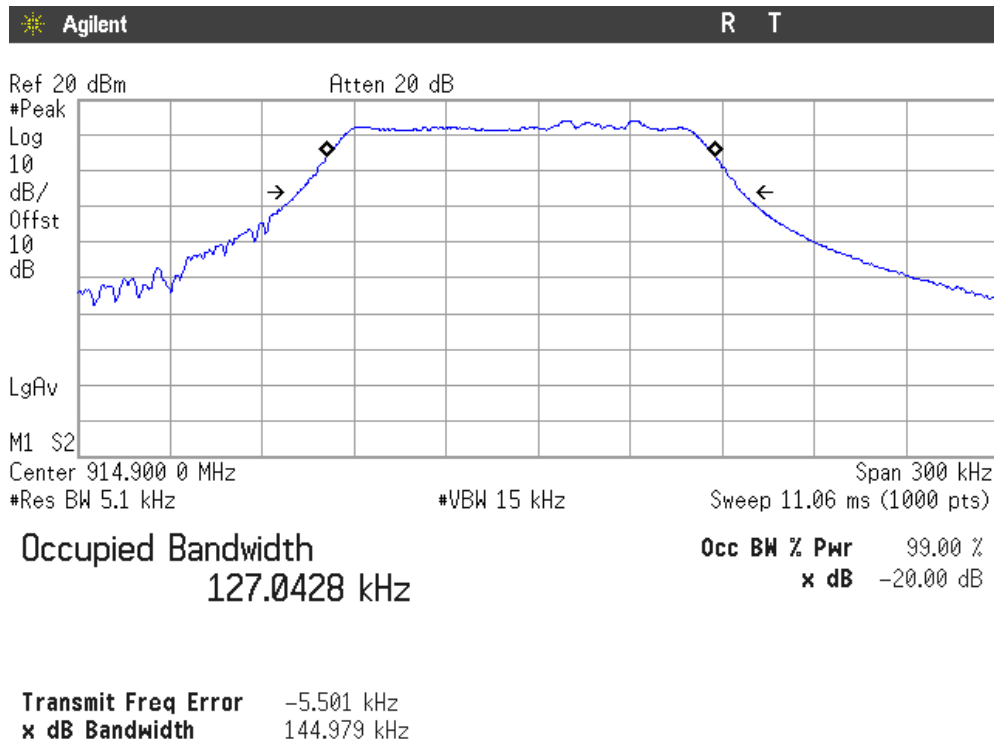
Lowest Channel: 902.3 MHz



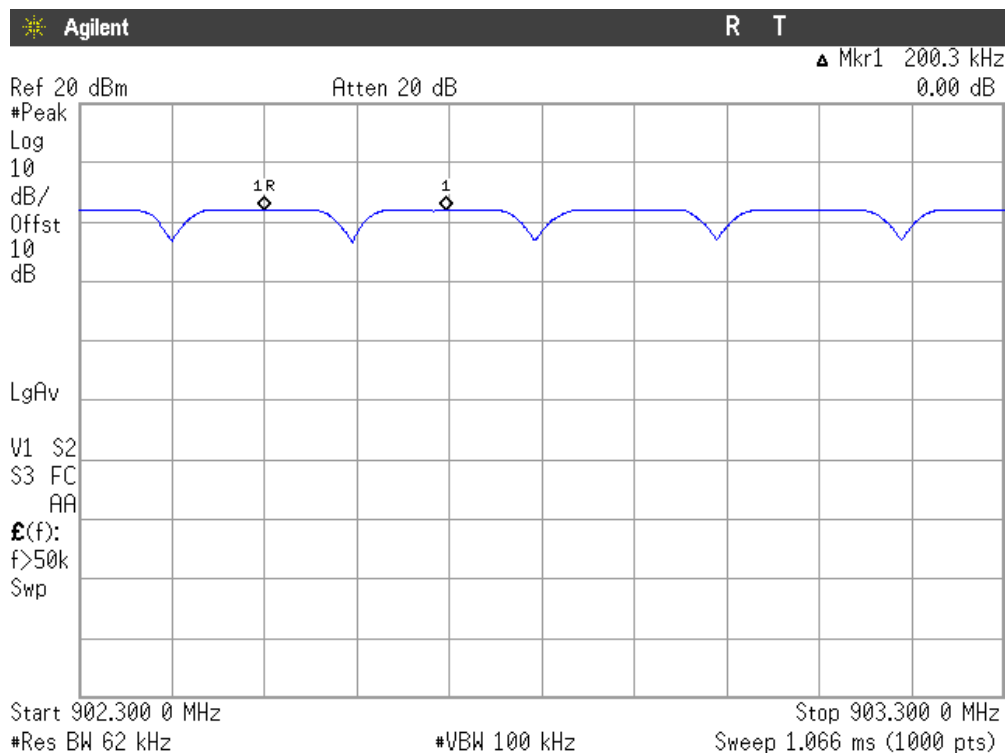
Middle Channel: 908.7 MHz



Highest Channel: 914.9 MHz.



Carrier frequency separation



Measurement uncertainty (kHz)	< ±2.20
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The hopping channel carrier frequencies are separated by a minimum of the 20 dB bandwidth of the hopping channel.

Verdict: PASS

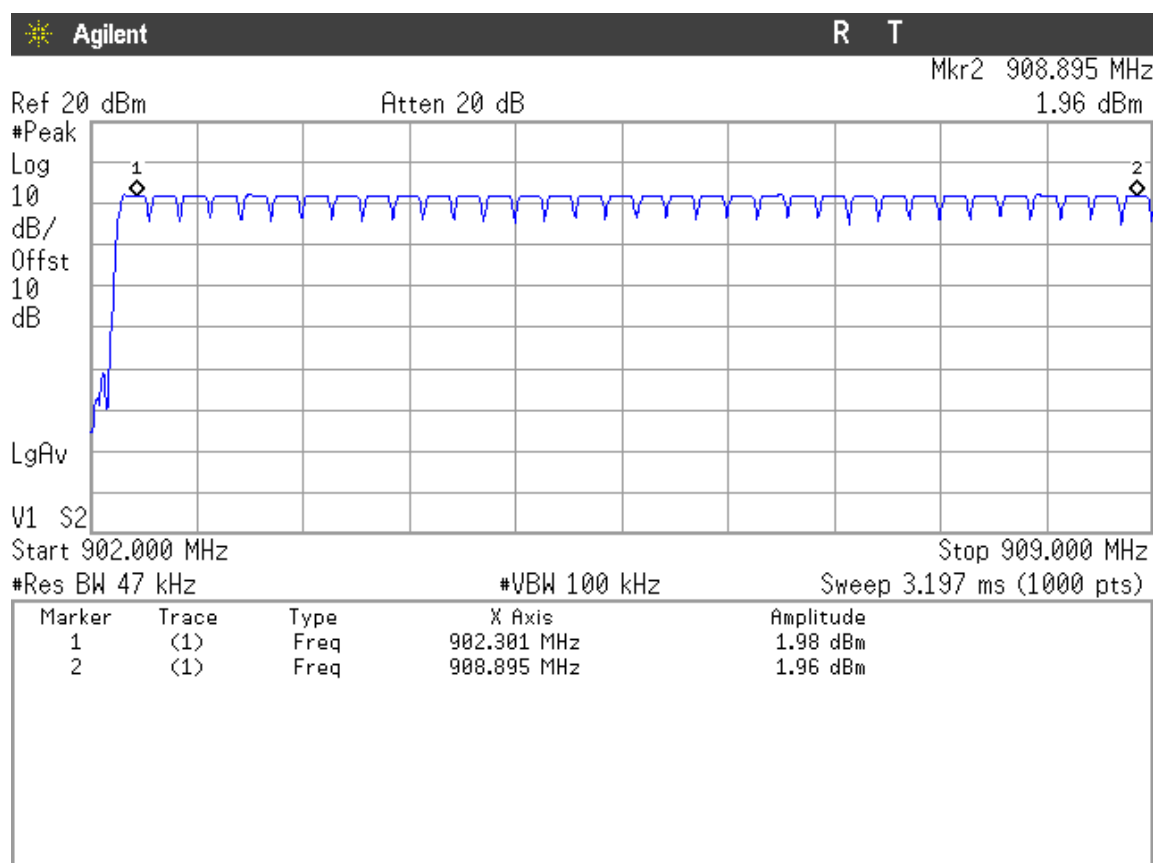
FCC Section 15.247 Subclause (a) (1) (i) / RSS-247 Clause 5.1 (3). Number of hopping channels

SPECIFICATION

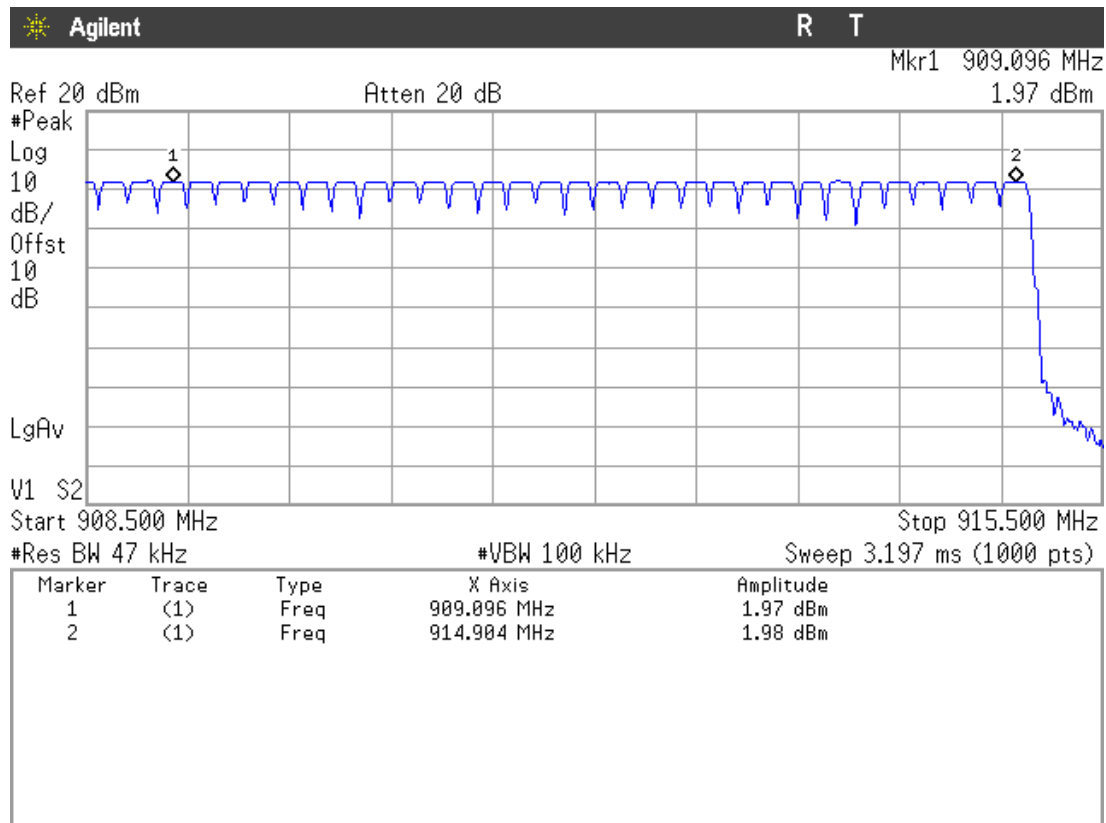
For frequency hopping systems operating in the 902–928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period.

RESULTS

The number of hopping channels is 64 (see next plots).



Number of hopping frequencies: 34



Number of hopping frequencies: 30

Total number of hopping frequencies: 64

Verdict: PASS

FCC Section 15.247 Subclause (a) (1) (i) / RSS-247 Clause 5.1 (3). Time of occupancy (Dwell Time)

SPECIFICATION

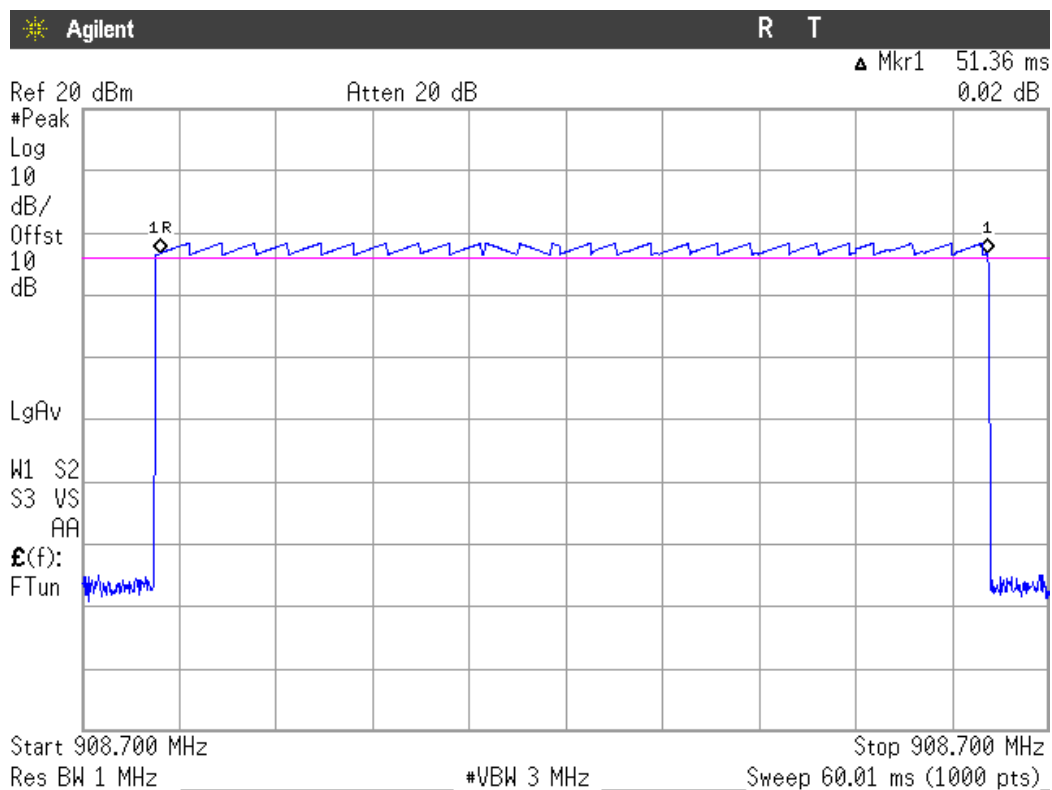
For frequency hopping systems operating in the 902–928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period.

RESULTS

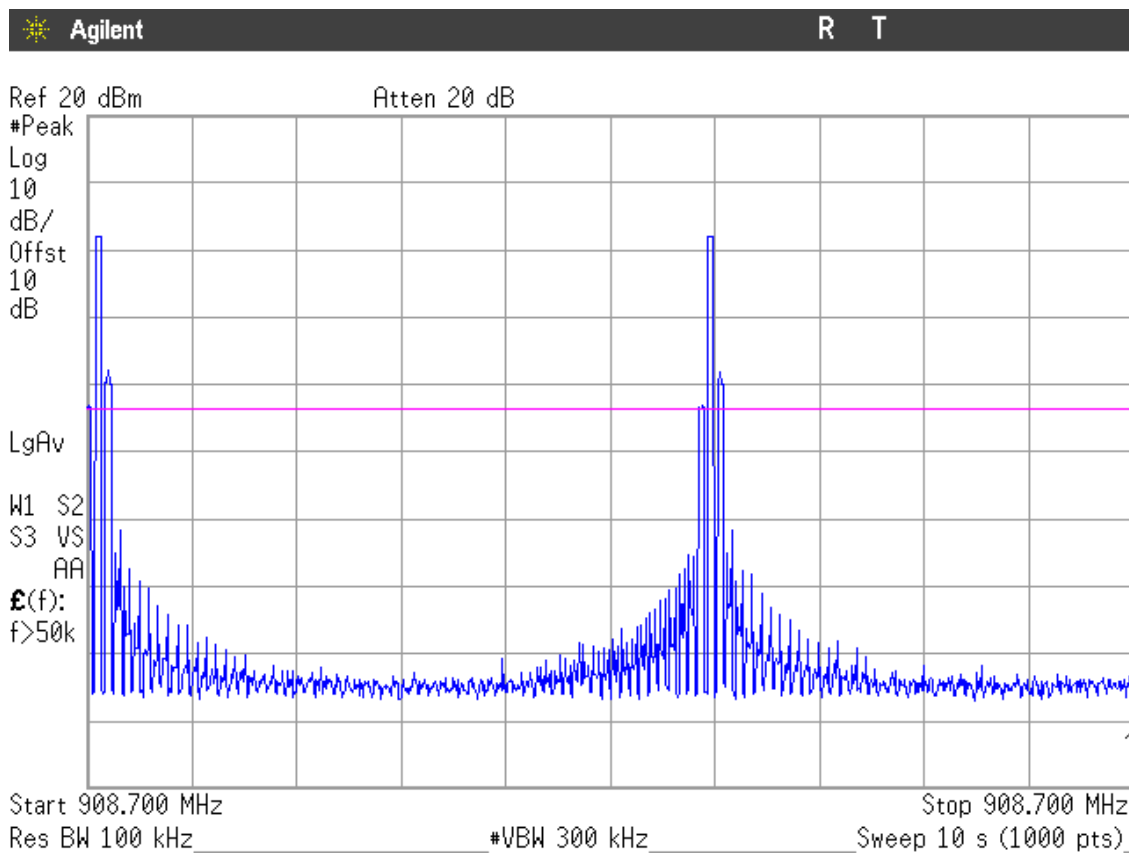
The equipment has one operation mode.

The 20 dB bandwidth of the hopping channel is less than 250 kHz.

1. Tx-time per hop = 51.36 ms (see next plot).



2. Number of hops over a period of 10 seconds = 2 (see next plot).



Number of hops in the period specified in the requirements = (2 hops) x (20 s / 10 s) = 4 hops.

Averaging time of occupancy = 4 hops per 20 seconds x 51.36 ms = 205.44 ms per 20 seconds.

Measurement uncertainty (%)	<±0.01
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Verdict: PASS

FCC Section 15.247 Subclause (b) (2) / RSS-247 Clause 5.4 (1). 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, but at least 25 hopping channels.

The e.i.r.p. shall not exceed 4 W (36 dBm) if the hopset uses 50 or more hopping channels (Canada).

RESULTS

MAXIMUM OUTPUT POWER. See next plots.

Declared maximum antenna gain: 2.0 dBi.

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

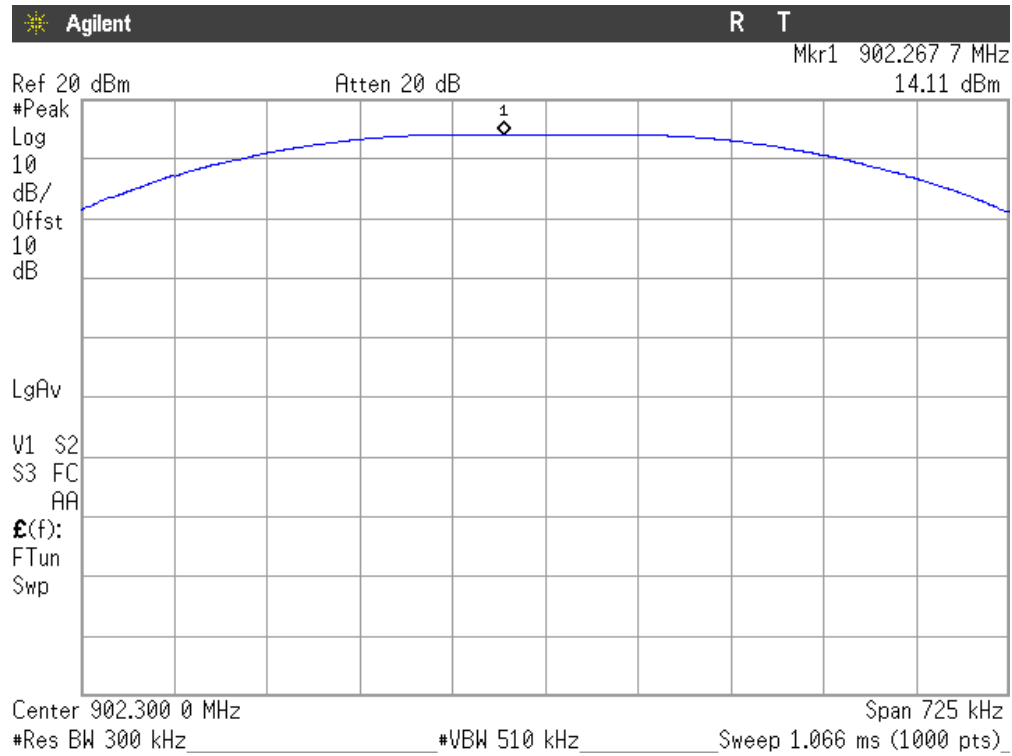
	Lowest frequency 902.3 MHz	Middle frequency 908.7 MHz	Highest frequency 914.9 MHz
Maximum peak power (dBm)	14.11	14.09	14.07
Maximum EIRP power (dBm)	16.11	16.09	16.07
Measurement uncertainty (dB)	<±0.78		

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.

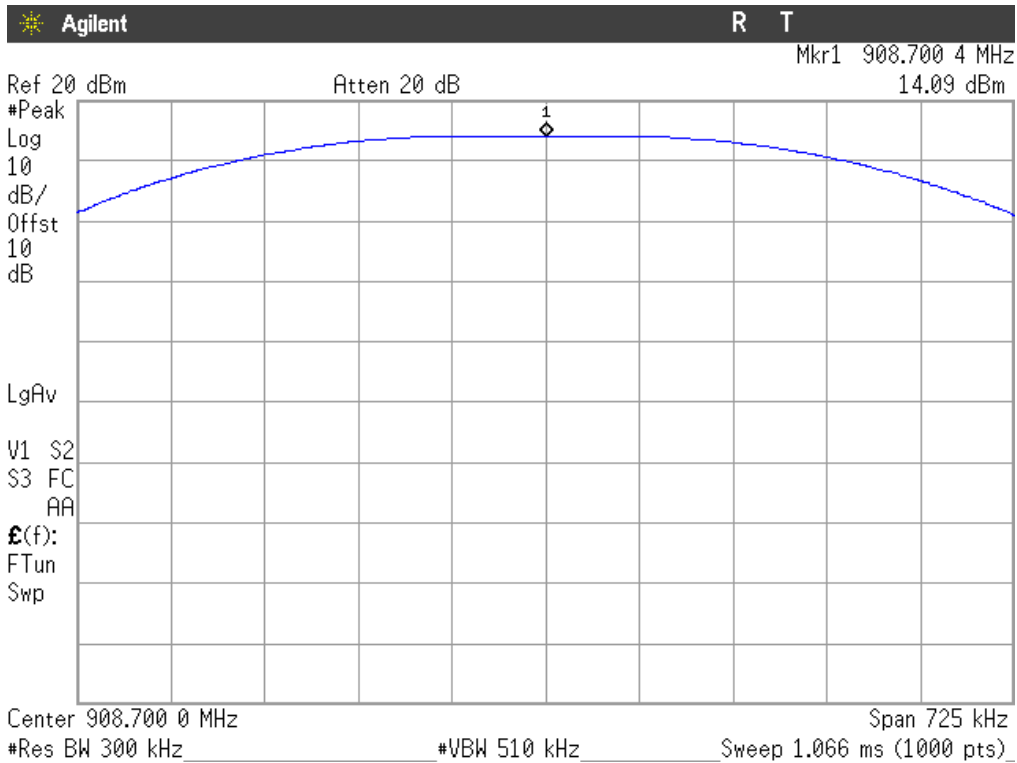
Verdict: PASS

PEAK OUTPUT POWER (CONDUCTED).

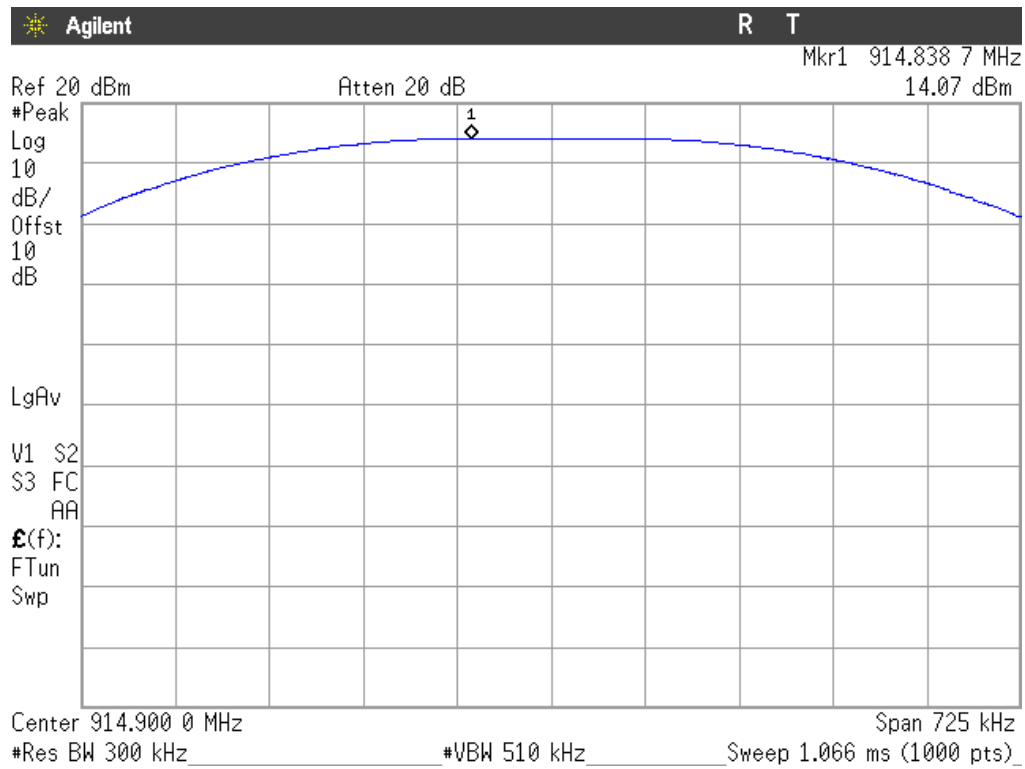
Lowest Channel



Middle Channel



Highest Channel



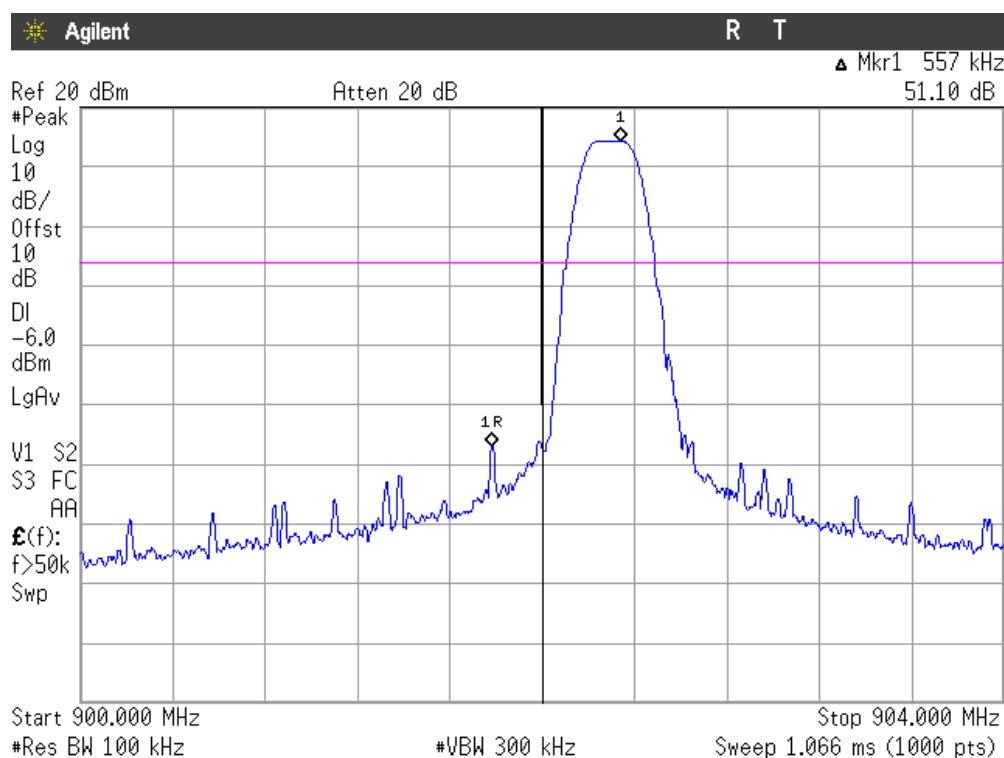
FCC Section 15.247 Subclause (d) / RSS-247 Clause 5.5. Band-edge compliance of conducted emissions (Transmitter)

SPECIFICATION

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated 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 root-mean-square averaging over a time interval, the attenuation required shall be 30 dB instead of 20 dB.

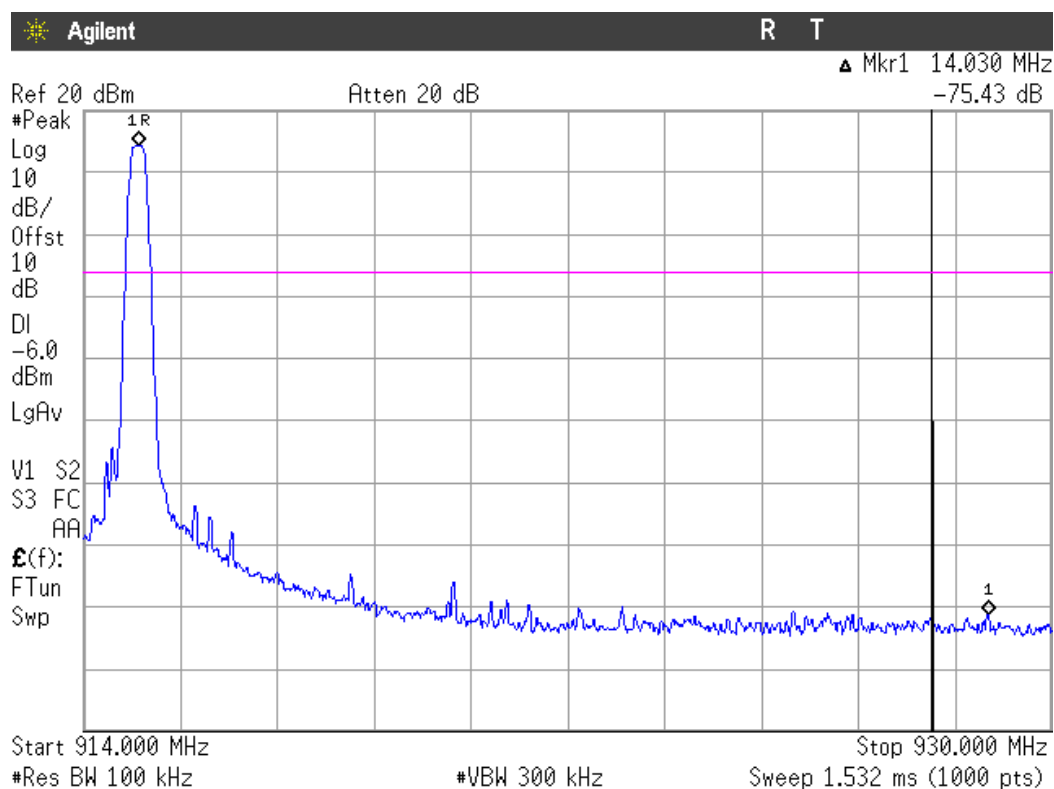
RESULTS:

1. LOW FREQUENCY SECTION (HOPPING OFF). See next plot.



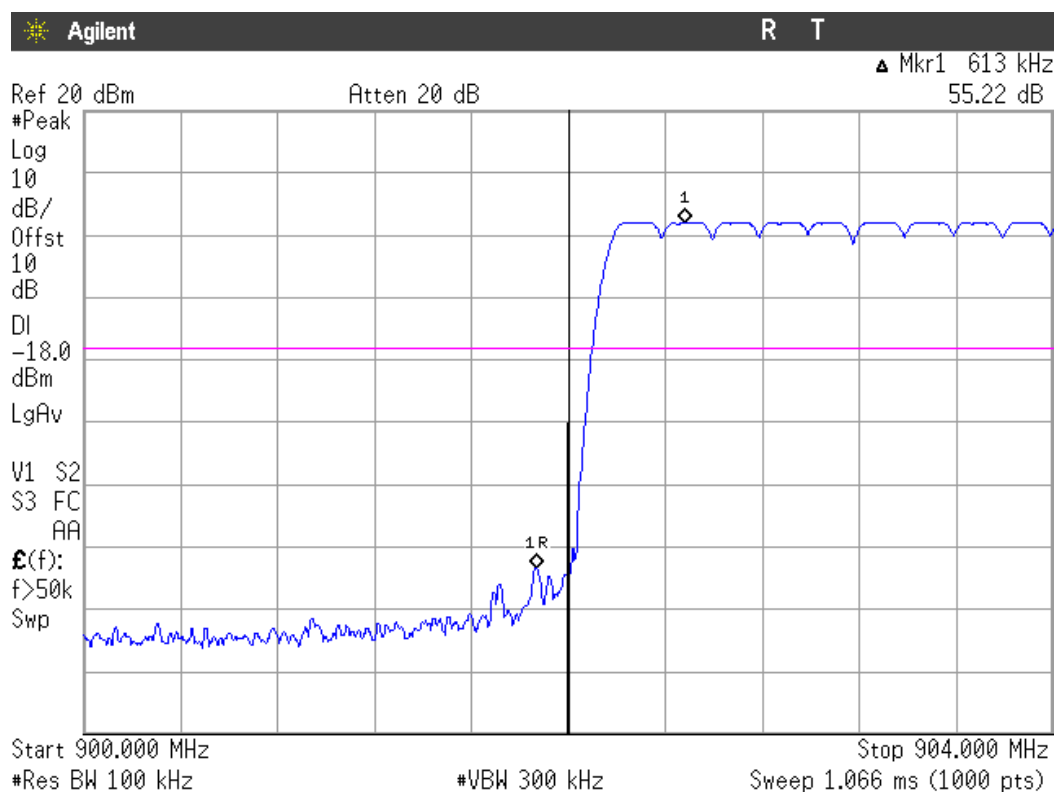
Verdict: PASS

2. HIGH FREQUENCY SECTION (HOPPING OFF). See next plot.



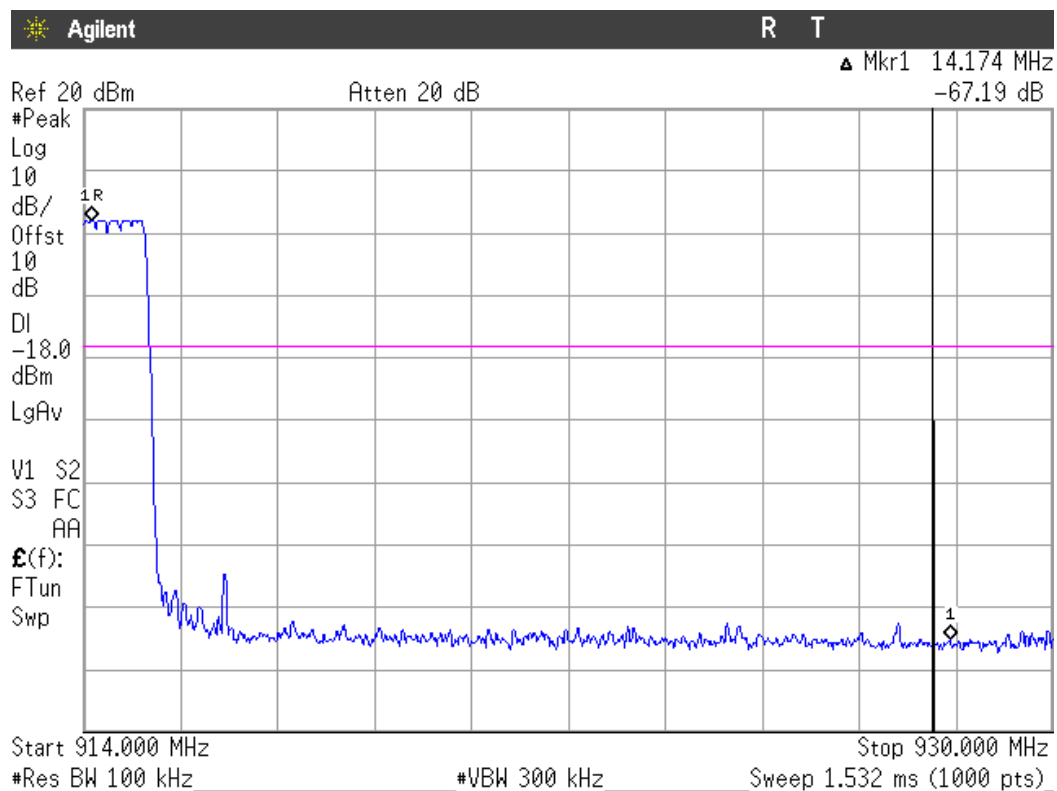
Verdict: PASS

3. LOW FREQUENCY SECTION (HOPPING ON). See next plot.



Verdict: PASS

4. HIGH FREQUENCY SECTION (HOPPING ON). See next plot.



Verdict: PASS

Measurement uncertainty (dB)	<±2.03
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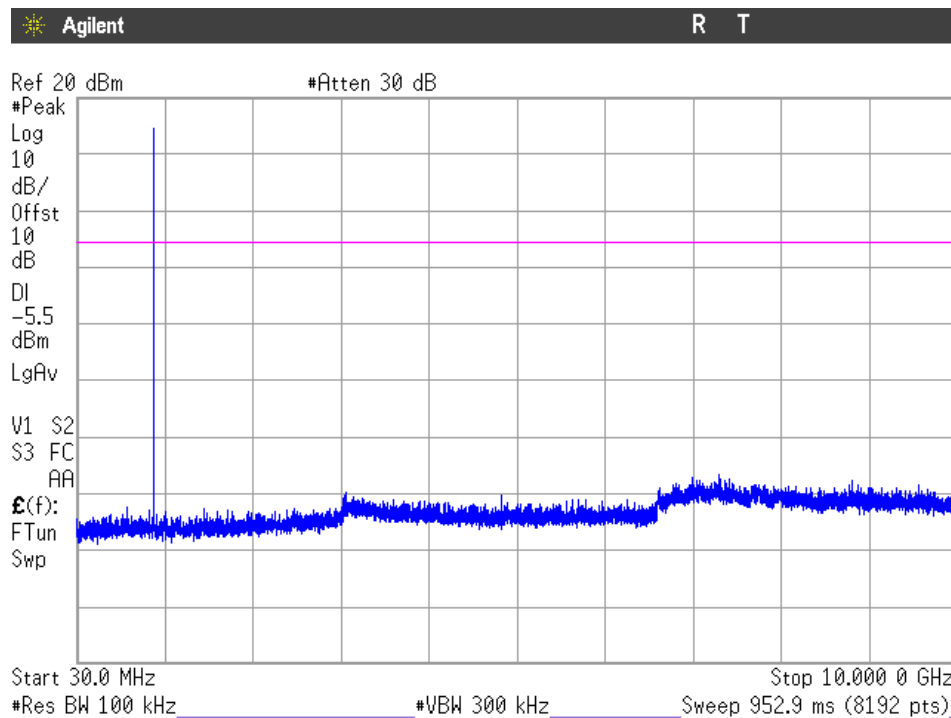
FCC Section 15.247 Subclause (d) / RSS-247 Clause 5.5. Emission limitations conducted (Transmitter)

SPECIFICATION

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated 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 root-mean-square averaging over a time interval, the attenuation required shall be 30 dB instead of 20 dB.

RESULTS:

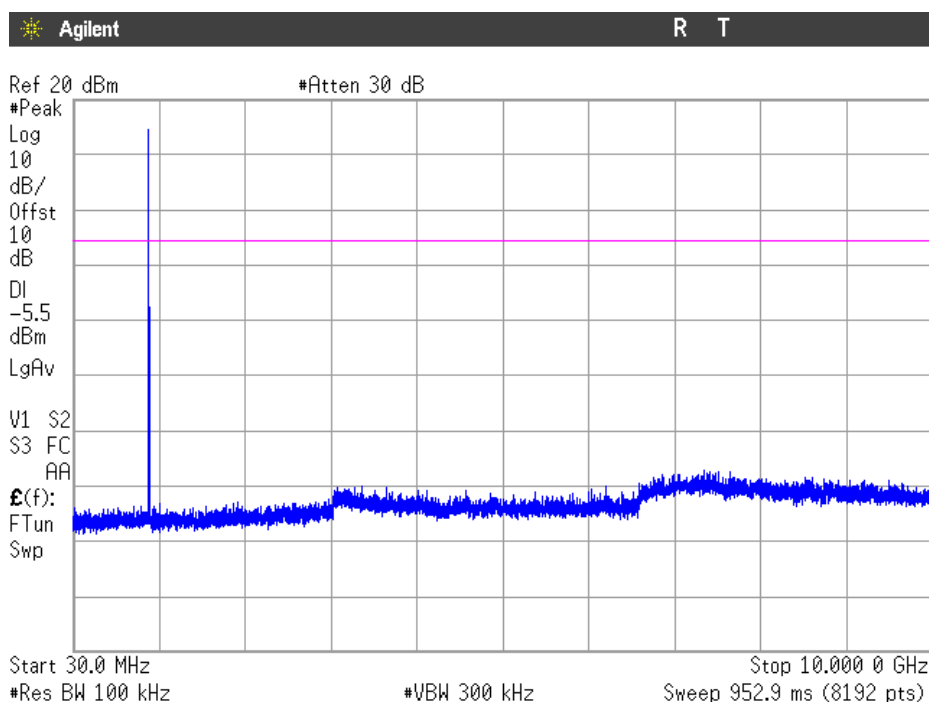
1. LOWEST CHANNEL 30 MHz-10 GHz (see next plot).



Note: The peak above the limit is the carrier frequency.

Verdict: PASS

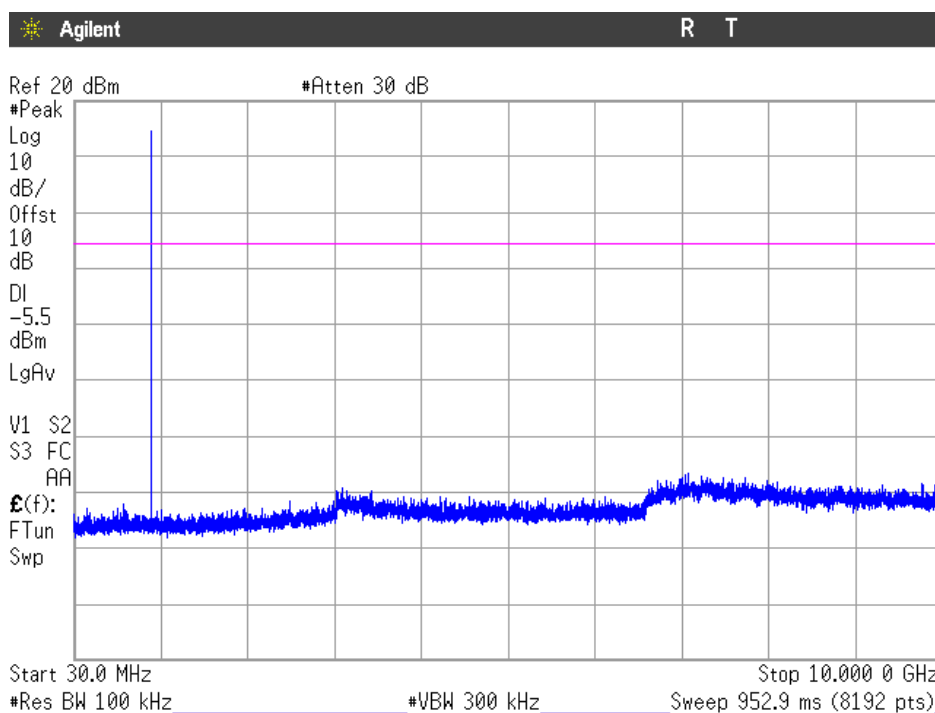
2. MIDDLE CHANNEL 30 MHz-10 GHz (see next plot).



Note: The peak above the limit is the carrier frequency.

Verdict: PASS

3. HIGH CHANNEL 30 MHz-10 GHz (see next plot).



Note: The peak above the limit is the carrier frequency.

Measurement uncertainty (dB)	<±2.03
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Verdict: PASS