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FCC LISTED, REGISTRATION NUMBER: 720267

IC LISTED REGISTRATION NUMBER IC 4621A-2

Nº 51/LE147

Informe de ensayo nº:
Test report No:

NIE: 52724RRF.001

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.

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	Waspmote Plug & Sense! 802.15.4
Other identification of the product .....:	FCC ID: XKM-WPS-2400-V1 IC: 8472A-WPS2400V1
Final HW version .....:	1.0
Final SW version .....:	1.0
Características .....: Features	Can transmit with the 802.15.4 protocol in the 2.4 GHz ISM band. Contains an XBee-PRO XBP24 802.15.4 radio.
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. - Emission limitations radiated (Transmitter) USA FCC Part 15.209 10-1-15 Edition: Radiated emission limits; general requirements. CANADA RSS-247 Issue 1 (May 2015). CANADA RSS-Gen Issue 4 (November 2014). Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 558074 D01 DTS Meas Guidance v03r03 dated 06/09/2015. ANSI C63.10-2013: American National Standard for Testing Unlicensed Wireless Devices.
Resultado.....: Summary	IN COMPLIANCE

Aprobado por (nombre / cargo y firma) .....: Approved by (name / position & signature)	A. Llamas RF Lab. Manager  Firmado digitalmente por ALEJANDRO LLAMAS RODRIGUEZ Fecha: 2017.03.22 12:21:54 +01'00'
Fecha de realización .....: Date of issue	2017-03-22
Formato de informe No. .....: Report template No	FDT08_18

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Competences and guarantees

AT4 wireless 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.

AT4 wireless 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 conjuction with applications for Certification under Parts 15 or 18 of the Commission's Rules. Registration Number: 720267.

AT4 wireless 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: IC 4621A-2.

In order to assure the traceability to other national and international laboratories, AT4 wireless has a calibration and maintenance program for its measurement equipment.

AT4 wireless 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 AT4 wireless at the time of performance of the test.

AT4 wireless 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 AT4 wireless.
4. This test report cannot be used partially or in full for publicity and/or promotional purposes without previous written permission of AT4 wireless and the Accreditation Bodies.

Uncertainty

Uncertainty (factor k=2) was calculated according to the AT4 wireless 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 Nº	Description	Model	Serial Nº	Date of reception
52724/001	Sensor node with antenna connector	Waspmote Plug & Sense! 802.15.4	---	2017-02-16

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

   All tests 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 2017-03-15 and finished on the same day.

The tests have been performed at AT4 wireless.

Environmental conditions

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 %
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: Test not requested. Only conducted tests in the highest operating channel were requested.

2: Used instrumentation:

		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

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**
Section 15.247 Subclause (a) (2) / RSS-247 5.2. (1)	6 dB Bandwidth		P		
Section 15.247 Subclause (b) / RSS-247 5.4. (4)	Maximum output power and antenna gain		P		
Section 15.247 Subclause (d) / RSS-247 5.5	Emission limitations conducted (Transmitter)		P		
Section 15.247 Subclause (d) / RSS-247 5.5. ..	Band-edge emissions compliance (Transmitter)		P		
Section 15.247 Subclause (e) / RSS-247 5.2. (2)	Power spectral density		P		
Section 15.247 Subclause (d) / RSS-247 5.5. ...	Emission limitations radiated (Transmitter)				NM[1]

1: See section “Remarks and comments”.

Appendix A – Test result

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TEST CONDITIONS

Power supply (V):

$V_{nominal}$ = 3.6 Vdc

Type of power supply = DC voltage from rechargeable battery.

Type of antenna = External attachable antenna.

Declared Gain for antenna (maximum) = 5 dBi

TEST FREQUENCIES:

Highest channel: 2465 MHz

CONDUCTED MEASUREMENTS

The equipment under test was set up in a shielded room and it is connected to the spectrum analyzer using a low loss RF cable. The reading of the spectrum analyzer is corrected with the cable loss.

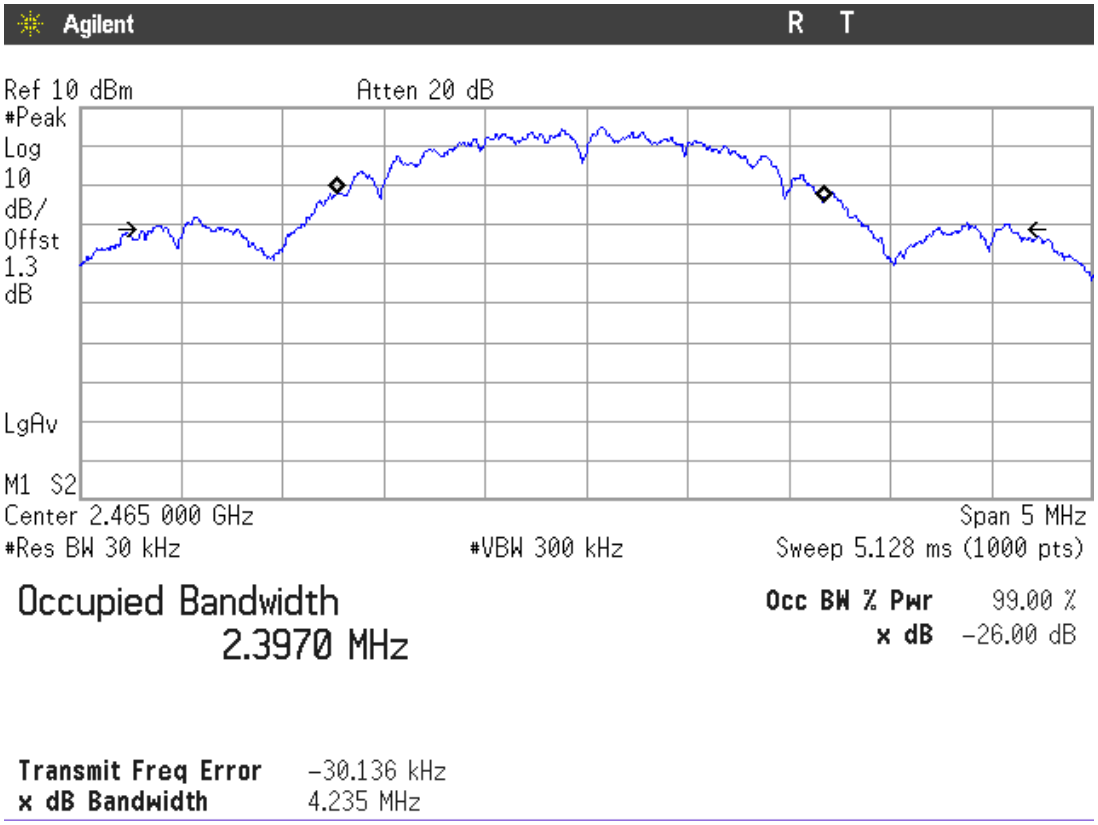
Occupied Bandwidth

RESULTS

(see next plot).

	Highest frequency 2465 MHz
99% bandwidth (MHz)	2.397
-26 dBc bandwidth (MHz)	4.235
Measurement uncertainty (kHz)	<± 5.0

Highest channel



Section 15.247 Subclause (a) (2) / RSS-247 5.2. (1). 6 dB Bandwidth

SPECIFICATION

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

RESULTS

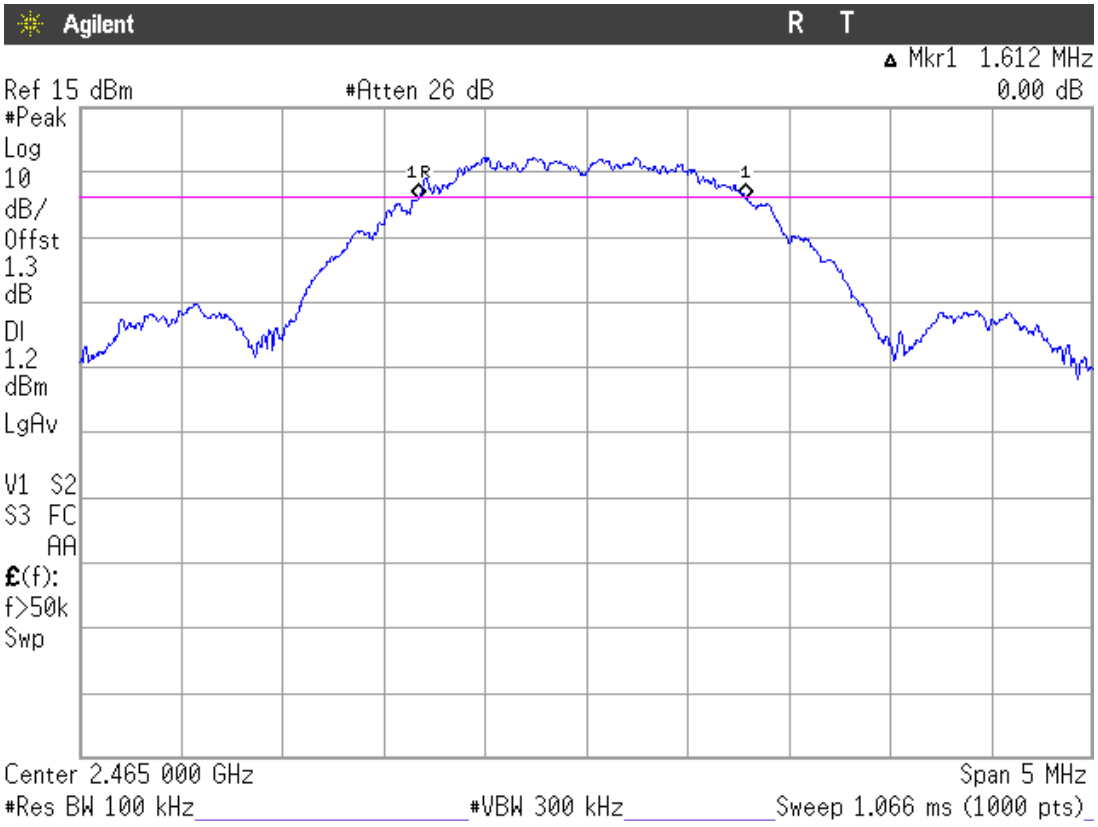
6 dB Bandwidth (see next plot).

	Highest frequency 2465 MHz
6 dB Spectrum bandwidth (MHz)	1.612
Measurement uncertainty (kHz)	<±11.0

Verdict: PASS

6 dB BANDWIDTH.

Highest Channel



Section 15.247 Subclause (d) / RSS-247 5.5. Emission limitations conducted (Transmitter)

SPECIFICATION

In any 100 kHz bandwidth outside the frequency band in which the 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. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required shall be 30 dB instead of 20 dB.

RESULTS:

Reference Level Measurement

	Highest frequency 2465 MHz
Reference Level Measurement (dBm)	7.20
Measurement uncertainty (dB)	<±0.78

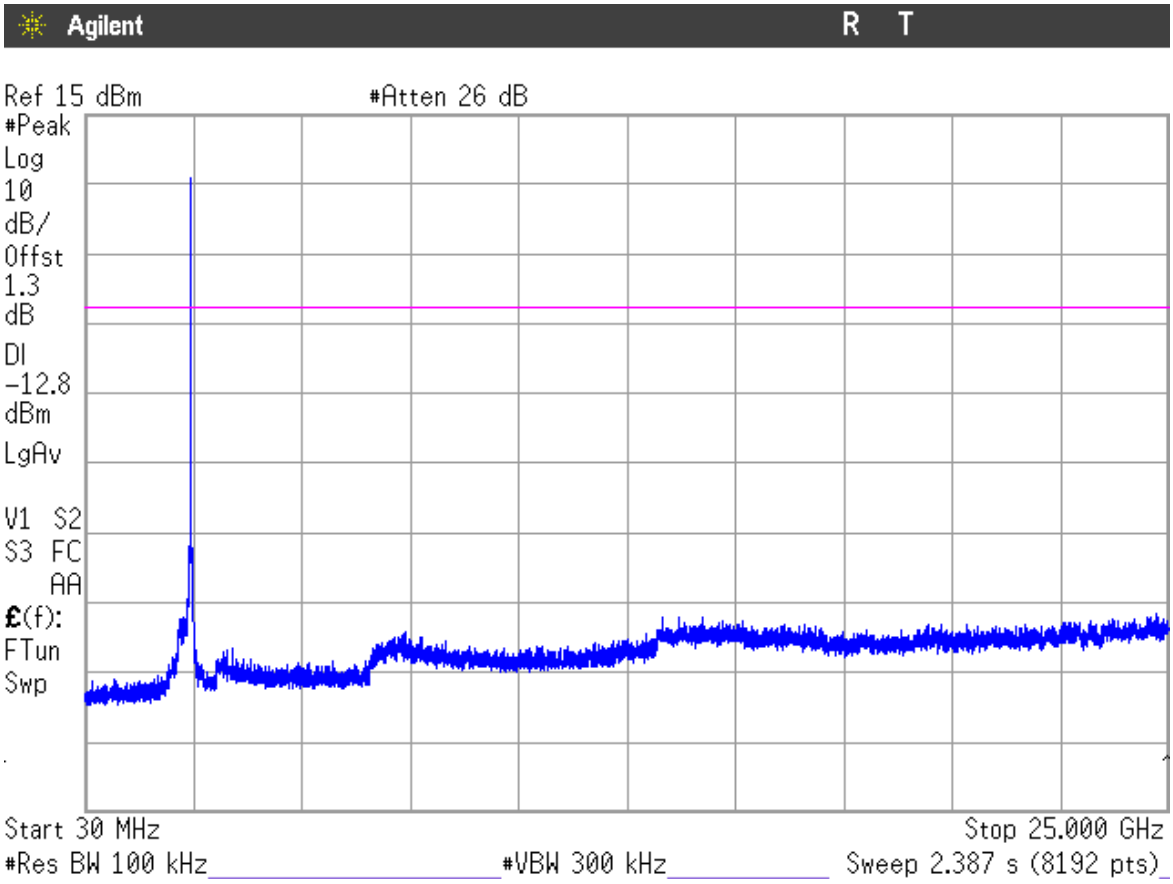
Highest frequency 2465 MHz:

All peaks are more than 20 dB below the limit.

Measurement uncertainty (dB): < 2.03

Verdict: PASS

Highest frequency



Note: The peak shown in the plot above the limit is the carrier frequency.

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

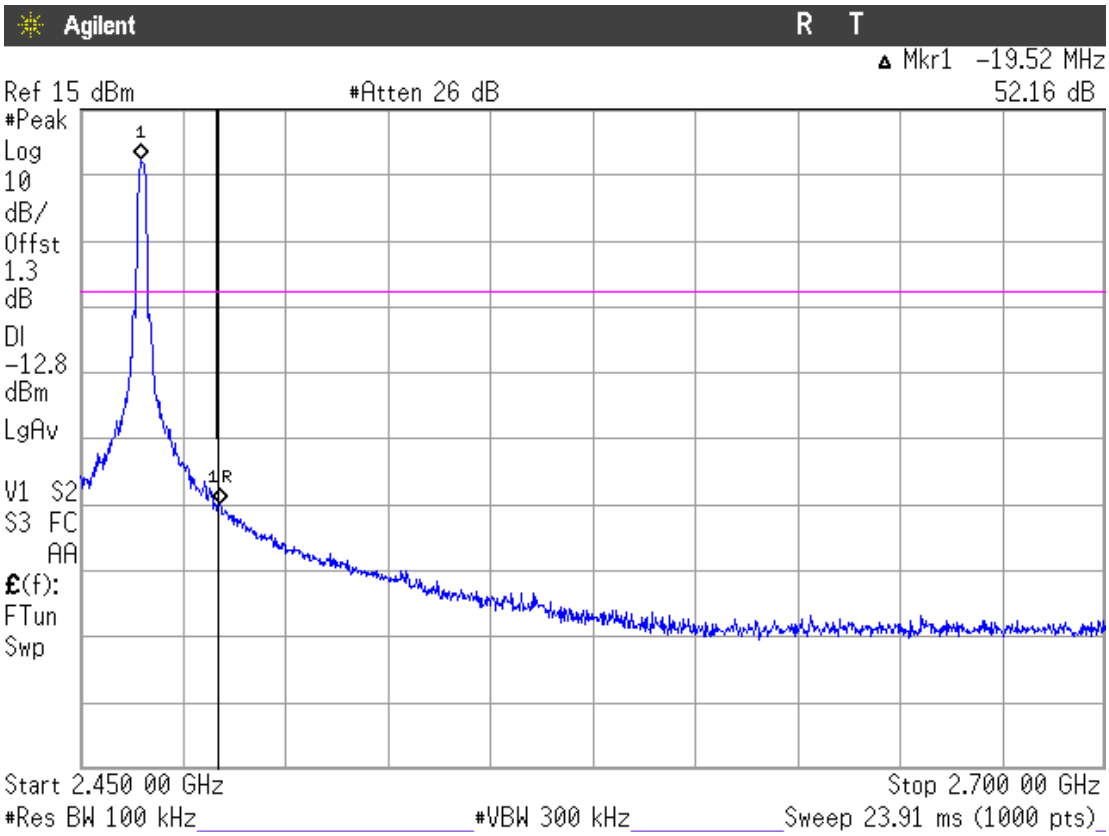
SPECIFICATION

In any 100 kHz bandwidth outside the frequency band in which the 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. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required shall be 30 dB instead of 20 dB.

RESULTS:

1. HIGH FREQUENCY SECTION. CONDUCTED.

See next plot.



Measurement uncertainty (dB)	< ±2.03

Verdict: PASS

Section 15.247 Subclause (e) / RSS-247 5.2. (2) 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 PKPSD (Peak PSD) according to point 10.2. of Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 558074 D01 DTS Meas Guidance v03r05 dated 04/08/2016.

Power spectral density (see next plot).

	Highest frequency 2480 MHz
Power spectral density (dBm)	6.99
Measurement uncertainty (dB)	<±0.78

Verdict: PASS

POWER SPECTRAL DENSITY

Highest Channel