AT4 wireless, S.A.U.
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Nº 51/LE147

Test report No:

NIE: 51748REM.001

Test report

FCC Rules and Regulations CFR 47, Part 15, Subpart B (10-1-15 Edition) & ICES-003 ISSUE 6 (2016)

Identification of item tested .....:	Wireless sensor node for the Internet of Things
Trademark.....:	Libelium
Model and/or type reference.....:	Waspmote Plug & Sense! Sigfox US
Other identification of the product .....:	S/N: Prototype
Final HW version.....:	1.0
Final SW version .....:	1.0
FCC ID.....:	Chipset's FCC ID: 2AGMK-TD1508 Libelium's product FCC ID: XKM-WPS-SFX-V1
IC.....:	Chipset's IC: Telecom Design will NOT certificate this radio for Canada. Libelium's product IC: None. Libelium will NOT certificate this end-device for Canada.
Features.....:	Can communicate with Sigfox networks. USA version. Contains a TD1508 chipset.
Manufacturer.....:	LIBELIUM COMUNICACIONES DISTRIBUIDAS, S.L. C/ Escatrón, 16. (Edificio Libelium), C.P.: 50014. Zaragoza. Spain.
Test method requested, standard .....:	FCC CFR 47, Part 15, Subpart B (10-1-15 Edition) & ICES-003 Issue 6 (2016)
Summary.....:	IN COMPLIANCE
Approved by (name / position & signature).....:	Rafael López EMC Lab Manager Firmado digitalmente por RAFAEL LÓPEZ MARTÍN Fecha: 2017.03.17 13:45:09 +01'00'
Date of issue .....:	2017-03-13
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.

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.
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Uncertainty

Uncertainty (factor k=2) was calculated according to the AT4 wireless internal document PODT000.

Usage of samples

Samples under test have been selected by: the Client.

Sample S/01 is composed of the following elements:

Control Nº	Description	Model	Serial number	Reception date
51748/001	Wireless sensor node for the Internet of Things	Waspmote Plug & Sense! Sigfox US	Prototype	2016-11-17
51748/003	Sensor	---	---	2016-11-17
51748/009	Connector	---	---	2016-11-17
51748/012	Antenna	---	---	2016-11-23

Test sample description

This device 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), C.P.: 50014. Zaragoza. Spain.

Testing period

The performed test started on 2016-12-06 and finished on 2016-12-13.
The tests have been performed at AT4 wireless.

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. = 30 % Max. = 75 %
Air pressure	Min. = 860 mbar Max. = 1060 mbar

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

Temperature	Min. = 15 ºC Max. = 35 ºC
Relative humidity	Min. = 30 % Max. = 75 %
Air pressure	Min. = 860 mbar Max. = 1060 mbar

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. = 30 % Max. = 60 %
Air pressure	Min. = 860 mbar Max. = 1060 mbar

Remarks and comments

The tests have been performed by the technical personnel: Jorge Mora & Ismael Gamarro.

The total uncertainty of the measurement system for the measured radio disturbance characteristics of EUT from 30 MHz to 1000 MHz is I = ± 4,9 dB for quasi-peak measurements, I = ± 4,6 dB for peak measurements (k = 2)

The total uncertainty of the measurement system for the measured radio disturbance characteristics of EUT from 1000 MHz to 26GHz is I = ± 2,6 dB for peaks and average measurements (k = 2)

Testing verdicts (Legend)

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

List of equipment used during the test					
CONTROL NUMBER	**DESCRIPTION**	**MANUFACTURER**	**MODEL**	**LAST CALIBRATION**	**NEXT CALIBRATION**
2942	EMI TEST Receiver	ROHDE & SCHWARZ	ESU40	2016-06-14	2017-10-09
4578	Bilog Antenna	ETS LINDGREN	3142E	2014-03-17	2017-03-17
4658	Preamplifier	SCHWARZBECK	BBV9743	2016-04-28	2017-04-28
4612	Horn Antenna	SCHWARZBECK	BBHA 9120 D	2016-12-19	2019-12-19
3783	Preamplifier	BONN ELEKTRONIK	BLMA 0118-3A	2016-05-03	2017-05-03
4656	Horn Antenna	SCHWARZBECK	BBHA 9170	2014-03-28	2017-03-28
1975	Preamplifier	MITEQ	JS4-12002600-30-5A	2015-10-06	2017-10-06
4570	Thermohigrometer	HW GROUP	HWg-STE	2016-04-28	2017-04-28
4567	Thermohigrometer	HW GROUP	HWg-STE	2016-04-28	2017-04-28

Appendix A – Test result

APPENDIX A CONTENT

DESCRIPTION OF THE OPERATION MODES

The operation modes described in this paragraph constitute a functionality of the sample under test for itself. Every operation mode takes a failure criteria for the immunity test that they were applying to it and a monitoring to guarantee performance of the same ones.

The operation modes used by the samples to which the present report refers, are shown in the following table:

OPERATION MODE	DESCRIPTION
OM#01	EUT ON. Radio in IDLE mode. Sensor connected. Power supply: 6Vdc.
OM#02	EUT ON. Equipment in IDLE mode connected by USB cable to an auxiliary PC. Charging battery: 6Vdc. PC Power supply: 115Vac.
OM#03	EUT ON. Equipment in transmission mode connected by USB cable to an auxiliary PC. Charging battery: 6Vdc. PC Power supply: 115Vac.

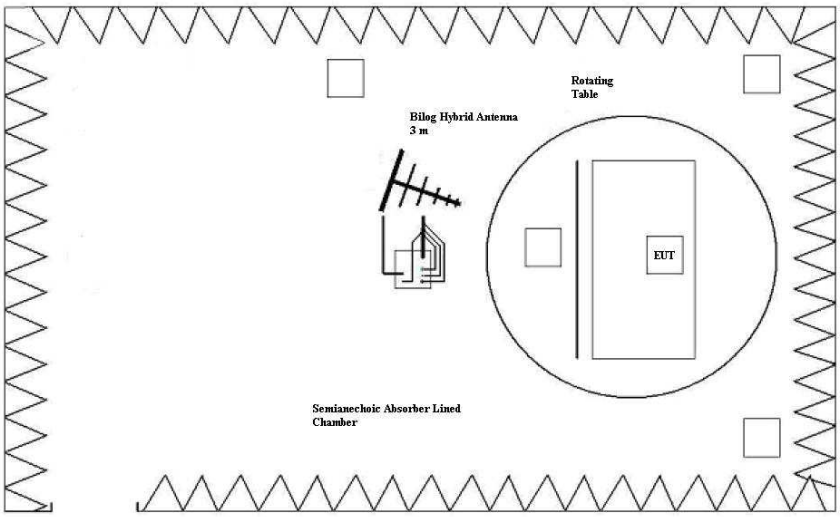
RADIATED EMISSION. ELECTROMAGNETIC FIELD MEASURE

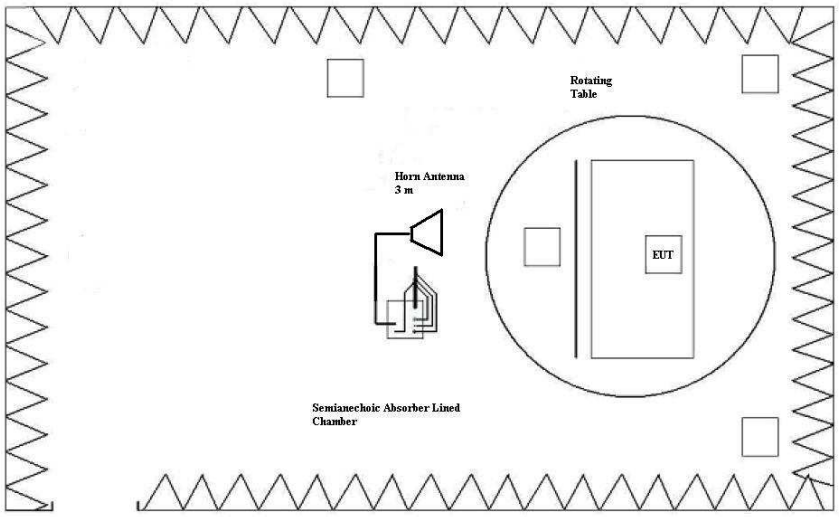
LIMITS:	Product standard:	FCC CFR 47, Part 15, Subpart B (10-1-15 Edition), Secs. 15.109 & ICES-003 Issue 6 (2016)
	Test standard:	FCC CFR 47, Part 15, Subpart B (10-1-15 Edition), Secs. 15.109 & ICES-003 Issue 6 (2016)

Limits of interference Class B

The applied limit for radiated emissions, 3 m distance, according with the requirements of FCC Rules and Regulations 47 CFR Part 15, Subpart B (10-01-15 Edition), Secs. 15.109 & ICES-003 Issue 6 (2016) in the frequency range 30 MHz to 26 GHz for class B equipments.

Frequency range (MHz)	QP Limit for 3 m	
	(µV/m)	(dBµV/m)
30 to 88	100	40
88 to 216	150	43.5
216 to 960	200	46
Above 960	500	54





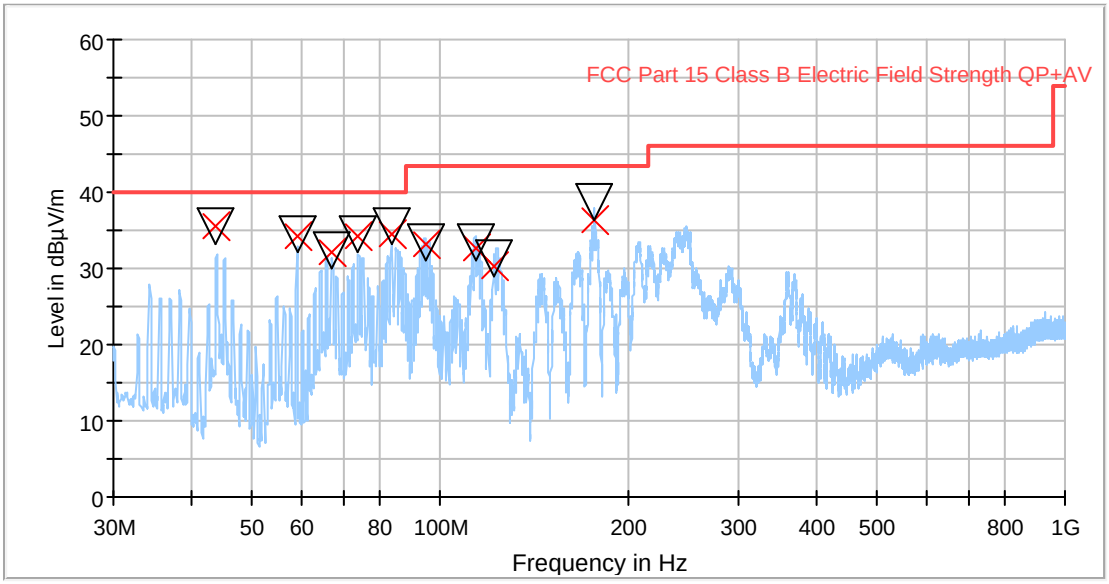
TESTED SAMPLE:	OM#01
TESTED OPERATION MODES:	OM#01
TEST RESULTS:	CRmmnnRRPP: CR, Radiation Condition; mm: Sample number; nn: Operation mode; RR: Range; PP: Polarization.

CRmmnnRRPP	Description	Result
CR0101LR	Range: 30 MHz - 1000 MHz.	P
CR0101HR1_PH	Range: 1 GHz - 18 GHz. Horizontal Polarization.	P
CR0101HR1_PV	Range: 1 GHz - 18 GHz. Vertical Polarization.	P

Radiated Emission. CR0101LR

Project:	51748REM.001
Company:	LIBELIUM
Sample:	S/01
Operation mode:	OM#01
Description:	EUT ON. Radio in IDLE mode. Sensor conected Power supply: 6Vdc

Full Spectrum



Peak Preview
FCC Part 15 Class B Electric Field Strength QP+AV
QuasiPeak
MaxPeak

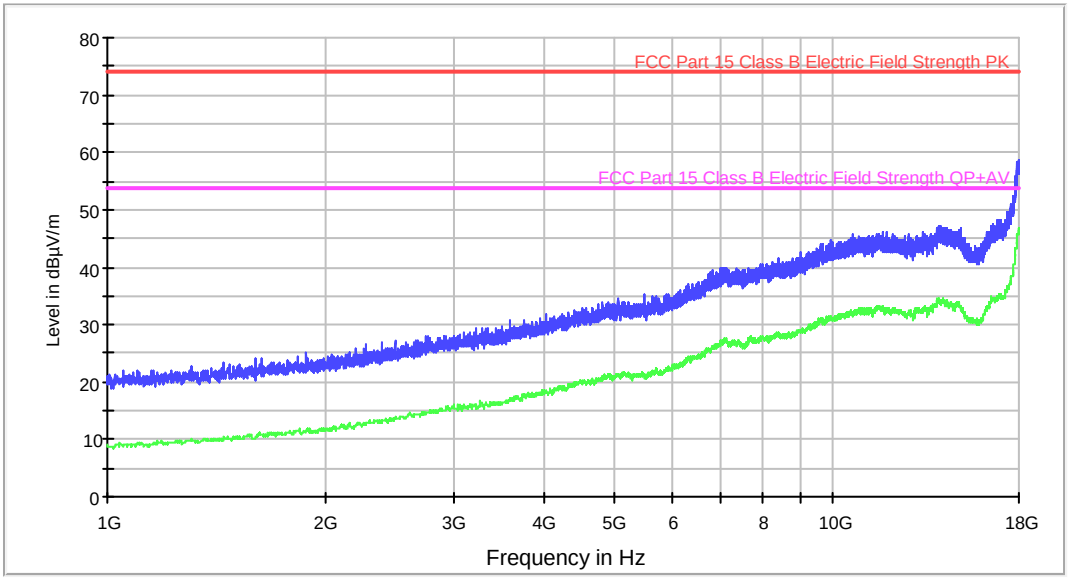
Maximizations

Frequency (MHz)	QuasiPeak (dBµV/m)	MaxPeak (dBµV/m)	Height (cm)	Pol	Azimuth (deg)
43.867532	35.42	35.59	98.0	V	34.0
58.974026	34.15	34.54	122.0	V	4.0
67.203896	32.21	32.33	154.0	V	17.0
74.040260	34.24	34.54	166.0	V	0.0
83.859740	34.41	35.47	181.0	V	348.0
94.702597	33.09	33.51	132.0	V	0.0
113.909091	32.63	33.43	104.0	V	204.0
122.066234	30.17	31.21	110.0	V	218.0
176.945455	36.20	38.62	190.0	V	10.0

Radiated Emission. CR0101HR1_PH

Project:	51748REM.001
Company:	LIBELIUM
Sample:	S/01
Operation mode:	OM#01
Description:	EUT ON. Radio in IDLE mode. Sensor active. Power supply 6 Vdc. Horizontal polarization.

ER EMI FCC 15 Class B (1-18GHz)



Peak Scan
FCC Part 15 Class B Electric Field Strength PK
Average Scan
FCC Part 15 Class B Electric Field Strength QP+AV

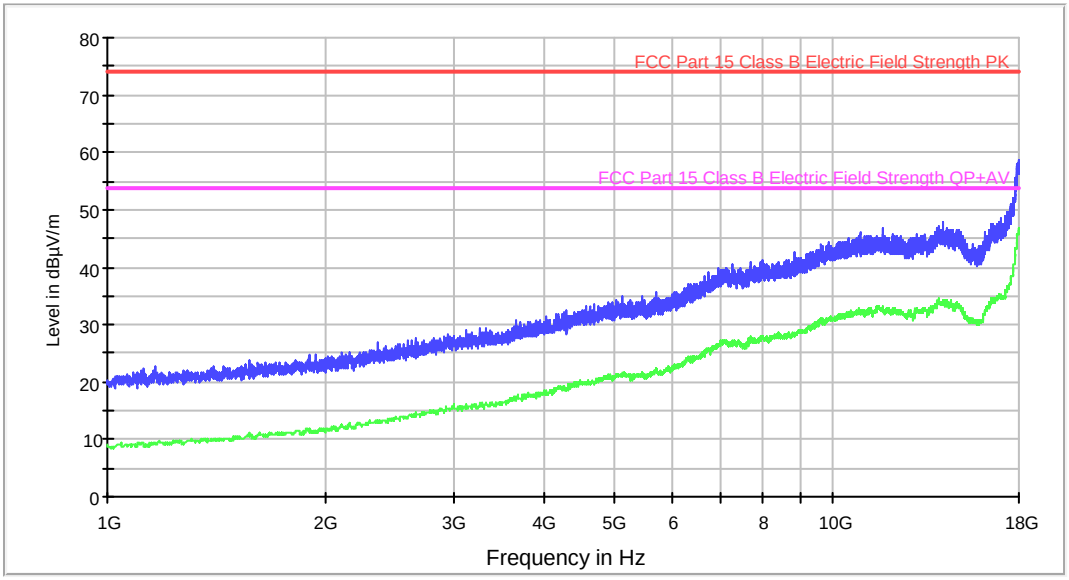
Subrange Maxima

Frequency (MHz)	MaxPeak-ClearWrite (dBµV/m)	Average-ClearWrite (dBµV/m)
1303.000000	22.9	10.0
1597.000000	24.0	10.1
2275.000000	26.4	12.8
3161.000000	28.7	15.8
4241.000000	31.7	19.2
5476.000000	35.3	21.2
7004.000000	39.8	27.2
9893.000000	44.6	31.2
13249.000000	46.0	32.4
17993.000000	58.6	46.6

Radiated Emission. CR0101HR1_PV

Project:	51748REM.001
Company:	LIBELIUM
Sample:	S/01
Operation mode:	OM#01
Description:	EUT ON. Radio in IDLE mode. Sensor active. Power supply 6 Vdc. Vertical polarization.

ER EMI FCC 15 Class B (1-18GHz)



MaxPeak-ClearWrite-PK+
FCC Part 15 Class B Electric Field Strength PK
Average-ClearWrite-AVG
FCC Part 15 Class B Electric Field Strength QP+AV

Subrange Maxima

Frequency (MHz)	MaxPeak-ClearWrite (dBµV/m)	Average-ClearWrite (dBµV/m)
1165.000000	22.6	9.2
1566.000000	23.8	11.0
2360.000000	26.8	13.1
3111.000000	28.9	15.7
4184.000000	31.8	19.1
5458.000000	34.9	21.2
7263.000000	40.5	27.0
9857.000000	44.4	31.0
11688.000000	46.8	32.9
17979.000000	58.7	46.3

CONTINUOUS CONDUCTED EMISSION

LIMITS:	Product standard :	FCC CFR 47, Part 15, Subpart B (10-1-15 Edition), Secs. 15.107 and Subpart C (10-1-15 Edition) Secs. 15.207 & ICES-003 Issue 6 (2016)
	Test standard :	FCC CFR 47, Part 15, Subpart B (10-1-15 Edition), Secs. 15.107, 15 and Subpart C (10-1-15 Edition) Secs. 15.207 & ICES-003 Issue 6 (2016)

CLASS B

The applied limit for continuous conducted emissions in power leads, according with the requirements of FCC Rules and Regulations 47 CFR Part 15, Subpart B (10-01-15 Edition), Secs. 15.107 and Subpart C (10-1-15 Edition) Secs. 15.207 & ICES-003 Issue 6 (2016), in the frequency range 0,15 to 30 MHz, for Class B equipment was:

Frequency range (MHz)	**Limit (dBµV)**	
	Quasi-peak	**Average**
0,15 to 0,5	66-56	56-46
0,5 to 5	56	46
5 to 30	60	50

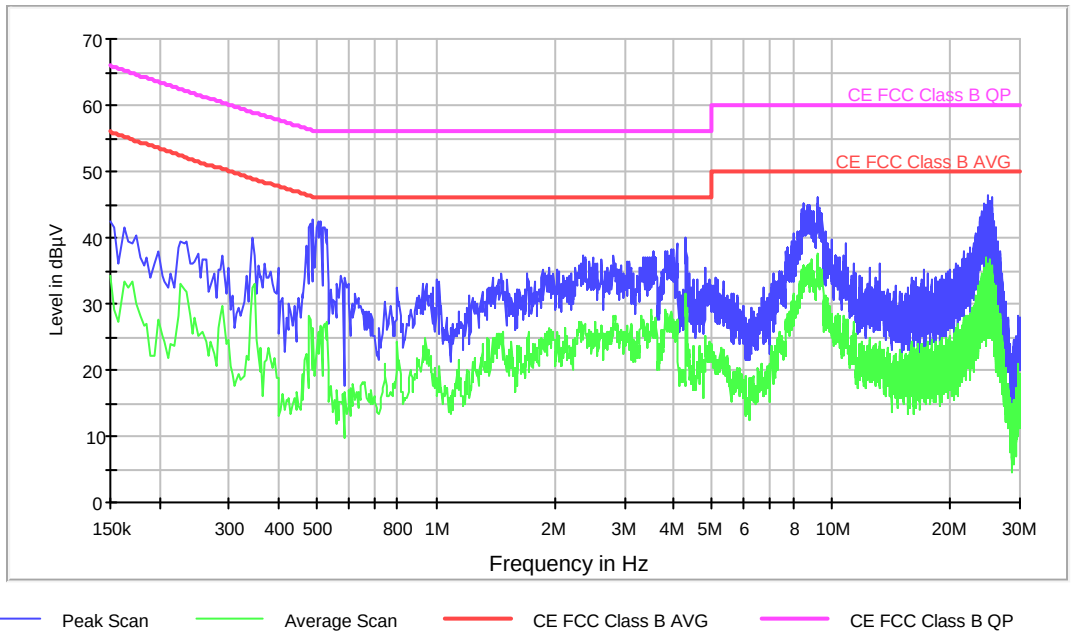
TESTED SAMPLES:	S/01
TESTED OPERATION MODES:	OM#02 & OM#03
TEST RESULTS:	CCmmnnhh: CC, Conducted Condition; mm: Sample number; nn: Operation mode; hh: wire

CCmmnnhh	**Description**	**Result**
CC01020N	Neutral wire noise.	P
CC0102L1	Phase wire noise.	P
CC01030N	Neutral wire noise.	P
CC0103L1	Phase wire noise.	P

Conducted Emission. CC01020N

Project:	51748REM.001
Company:	LIBELIUM
Sample:	S/01
Operation mode:	OM#02
Description:	EUT ON. Equipment in idle mode connected by USB cable to an auxiliary PC. Charging battery: 6Vdc. PC power supply: 115Vac. Neutral wire noise.

EC FCC Class B



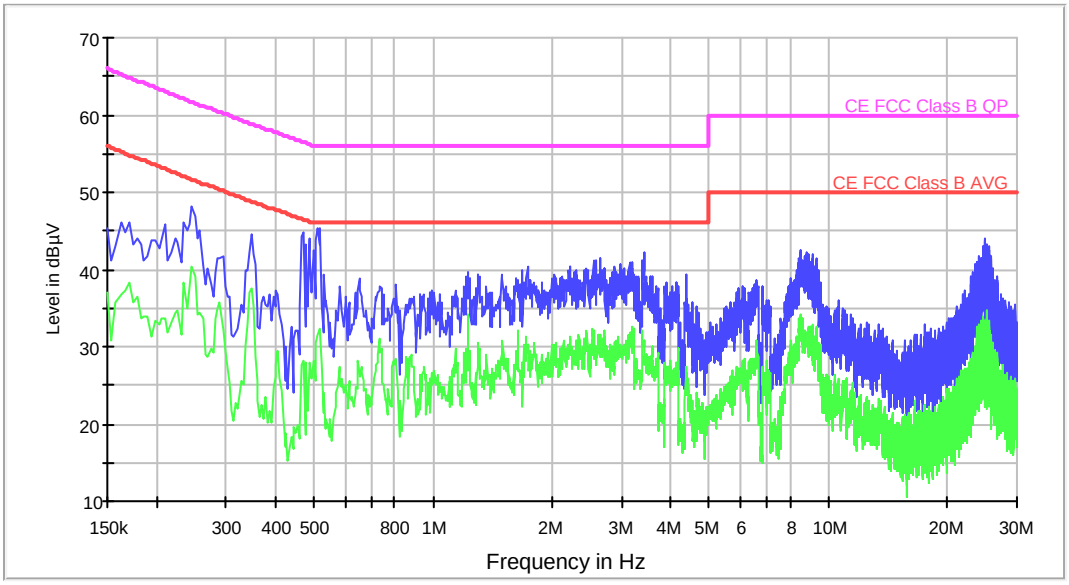
Subrange Maxima

Frequency (MHz)	MaxPeak-ClearWrite (dBµV)	Average-ClearWrite (dBµV)
0.150000	42.3	34.3
0.342000	39.9	32.4
0.490000	42.8	26.4
1.006000	33.7	18.4
1.930000	35.6	24.1
3.554000	38.0	27.1
4.270000	40.0	31.4
9.206000	46.0	35.2
10.858000	39.0	26.3
24.770000	46.3	35.8

Conducted Emission. CC0102L1

Project:	51748REM.001
Company:	LIBELIUM
Sample:	S/01
Operation mode:	OM#02
Description:	EUT ON. Equipment in idle mode connected by USB cable to an auxiliary PC. Charging battery: 6Vdc. PC power supply: 115Vac. Phase wire noise.

EC FCC Class B



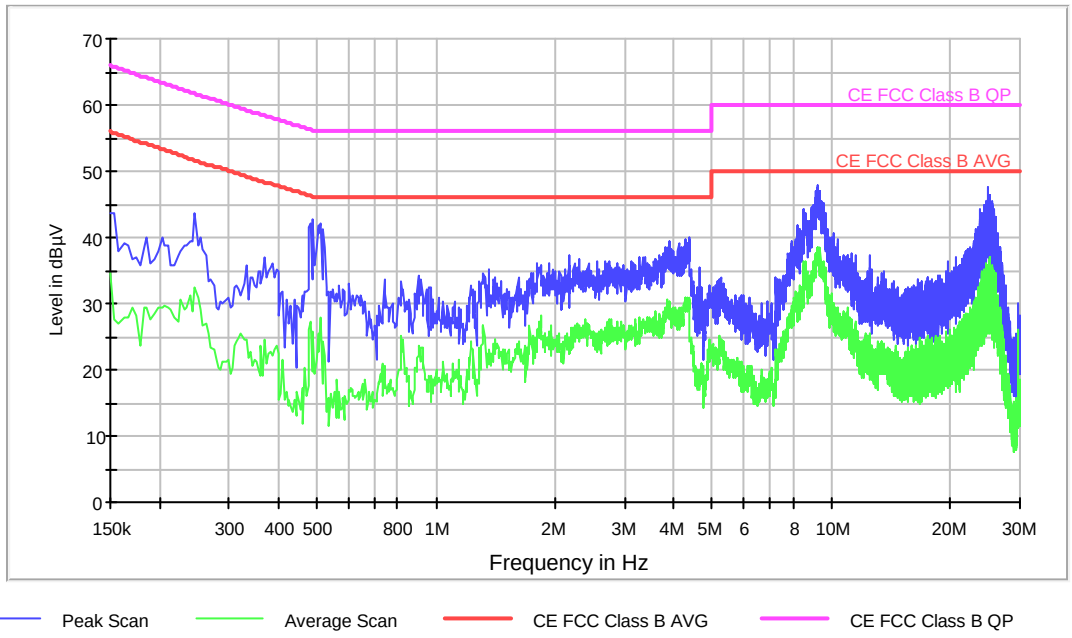
Subrange Maxima

Frequency (MHz)	MaxPeak-ClearWrite (dBµV)	Average-ClearWrite (dBµV)
0.246000	48.2	40.4
0.258000	45.2	34.4
0.510000	45.4	31.6
1.226000	39.5	34.3
1.730000	40.4	29.1
3.410000	42.2	30.9
4.358000	39.4	26.5
8.534000	42.6	33.0
10.574000	36.0	24.6
24.746000	43.9	31.4

Conducted Emission. CC01030N

Project:	51748REM.001
Company:	LIBELIUM
Sample:	S/01
Operation mode:	OM#03
Description:	EUT ON. Equipment in tx mode connected by USB cable to an auxiliary PC. Charging battery: 6Vdc. PC power supply: 115Vac. Neutral wire noise.

EC FCC Class B



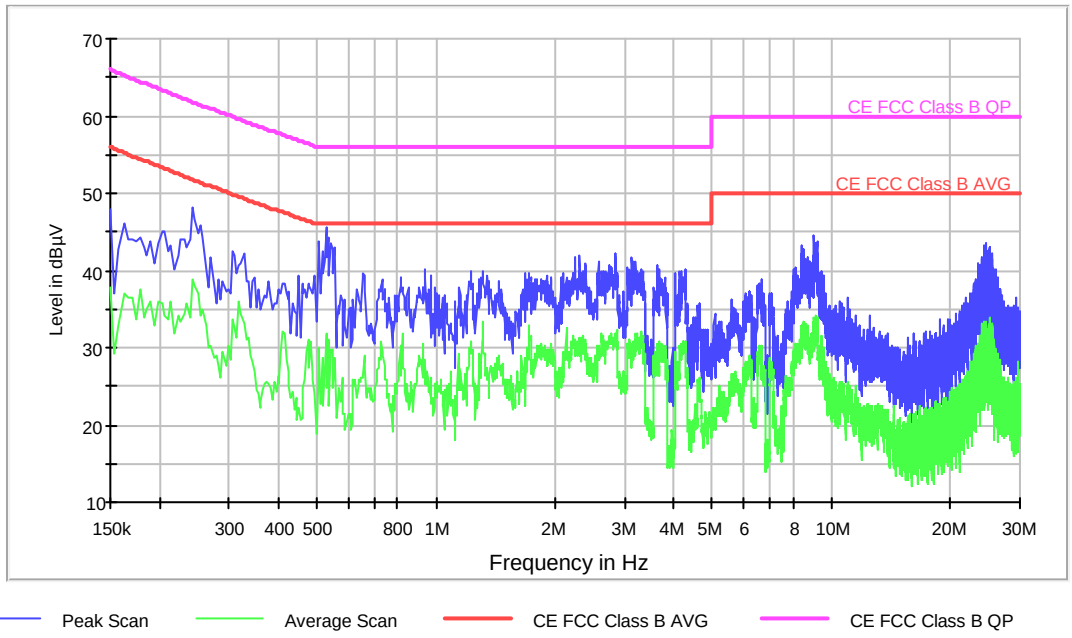
Subrange Maxima

Frequency (MHz)	MaxPeak-ClearWrite (dBµV)	Average-ClearWrite (dBµV)
0.154000	43.8	27.5
0.258000	38.1	26.6
0.490000	42.8	25.7
0.902000	34.3	22.0
1.802000	36.0	25.0
2.170000	37.3	25.0
4.374000	39.9	29.7
9.278000	47.7	38.1
11.250000	37.7	27.5
25.002000	47.5	33.1

Conducted Emission. CC0103L1

Project:	51748REM.001
Company:	LIBELIUM
Sample:	S/01
Operation mode:	OM#03
Description:	EUT ON. Equipment in tx mode connected by USB cable to an auxiliary PC. Charging battery: 6Vdc. PC power supply: 115Vac. Phase wire noise.

EC FCC Class B



Subrange Maxima

Frequency (MHz)	MaxPeak-ClearWrite (dBµV)	Average-ClearWrite (dBµV)
0.242000	48.3	38.7
0.258000	44.2	34.8
0.526000	45.7	31.9
0.938000	40.2	25.4
1.318000	39.8	33.4
2.834000	42.3	31.3
3.642000	40.7	30.6
9.070000	44.5	33.9
11.014000	36.6	25.2
24.606000	43.5	31.5