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Rapport d'essai / *Test report*

N° 730746-R1-E **JDE :** 126444

DELIVRE A / *ISSUED TO* : **ALPWISE HEADQUARTER**
Le Pulsar
4 Avenue Doyen Louis Weil
38000 GRENOBLE - FRANCE

Objet / *Subject* : Essais de compatibilité électromagnétique conformément aux normes
Electromagnetic compatibility tests according to the standards
FCC CFR 47 Part 15, Subpart B et C
RSS-210 Issue 8

Matériel testé / *Apparatus under test* :

- Produit / *Product* : **Low Energy Bluetooth Module**
- Marque / *Trade mark* : **ALPWISE**
- Constructeur / *Manufacturer* : **ALPWISE HEADQUARTER**
- Type / *Model* : **ALPW-BLEM003**
- N° de série / *serial number* : **None**
- FCC ID : **2ABXUBLEM003**
- IC : **11797A-BLEM003**

Date des essais / *Test date* : Du 11 au 14 Février 2014 / *From February 11th to 14th, 2014*

Lieu d'essai / *Test location* : **LCIE SUD-EST**
ZI Centr'Alp – 170 rue de Chatagnon
38430 MOIRANS - FRANCE

Test réalisé par / *Test performed by* : Anthony MERLIN & Nathalie BUGANZA

Ce document comporte / *Composition of document :* 38 pages.

MOIRANS, LE 25 MARS 2014 / *MARCH 25TH, 2014*

Ecrit par / *Written by,*
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Approuvé par / *Approved by,*
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SUMMARY

1. TEST PROGRAM

Standard:
- **FCC Part 15, Subpart C 15.247**
- **ANSI C63.4 (2003)**
- **RSS-210 Issue 8 – Dec 2010**
- **RSS-Gen Issue 3 – Dec 2010**

EMISSION Test	LIMITS			RESULTS
Limits for conducted disturbance at mains ports 150kHz-30MHz	**Frequency**	**Quasi-peak value (dBµV)**	**Average value (dBµV)**	☒**PASS** ☐**FAIL** ☐**NA** ☐**NP**
	150-500kHz	66 to 56	56 to 46	
	0.5-5MHz	56	46	
	5-30MHz	60	50	
Radiated emissions 9kHz-30MHz *CFR 47 §15.209 (a)* *CFR 47 §15.247 (d)* *RSS-210 §A8.5*	**Measure at 300m** 9kHz-490kHz : 67.6dBµV/m /F(kHz) **Measure at 30m** 490kHz-1.705MHz : 87.6dBµV/m /F(kHz) 1.705MHz-30MHz : 29.5 dBµV/m			☒**PASS** ☐**FAIL** ☐**NA** ☐**NP**
Radiated emissions 30MHz-25GHz* *CFR 47 §15.209 (a)* *CFR 47 §15.247 (d)* *RSS-210 §A8.5* ***Highest frequency : 2480MHz (Declaration of provider)***	**Measure at 3m** 30MHz-88MHz : 40 dBµV/m 88MHz-216MHz : 43.5 dBµV/m 216MHz-960MHz : 46.0 dBµV/m Above 960MHz : 54.0 dBµV/m			☒**PASS** ☐**FAIL** ☐**NA** ☐**NP**
Bandwidth 6dB *CFR 47 §*15.247 (a) (2) *RSS-210 §A8.2*	**At least 500kHz**			☒**PASS** ☐**FAIL** ☐**NA** ☐**NP**
Maximum Peak Output Power *CFR 47 §*15.247 (b) *RSS-210 §A8.4 (4)*	**Limit: 30dBm** Conducted or Radiated measurement			☒**PASS** ☐**FAIL** ☐**NA** ☐**NP**
Band Edge Measurement *CFR 47 §15.209 (a)* *CFR 47 §15.247 (d)* *RSS-210 §A8.5*	**Limit: -20dBc or** **Radiated emissions limits in restricted bands**			☒**PASS** ☐**FAIL** ☐**NA** ☐**NP**
Power spectral Density *CFR 47 §15.247 (e)* *RSS-210 §A8.2*	**Limit: 8dBm/3kHz**			☒**PASS** ☐**FAIL** ☐**NA** ☐**NP**
Occupied bandwidth *RSS-Gen §4.6.1*	**No limit**			☒**PASS** ☐**FAIL** ☐**NA** ☐**NP**
Receiver Spurious Emission** *RSS-Gen §4.10*	**See RSS-Gen §4.10**			☒**PASS** ☐**FAIL** ☐**NA** ☐**NP**

***§15.33:** The highest internal source of a testing device is defined like more the highest frequency generated or used in the testing device or on which the testing device works or agrees.
- If the highest frequency of the internal sources of the testing device is lower than 108 MHz, measurement must be only performed until 1GHz.
- If the highest frequency of the internal sources of the testing device ranges between 108 MHz and 500 MHz, measurement must be only performed until 2GHz.
- If the highest frequency of the internal sources of the testing device ranges between 500 MHz and 1 GHz, measurement must be only performed until 5GHz.

If the highest frequency of the internal sources of the testing device is above 1 GHz, measurement must be only performed until 5 times the highest frequency or 40 GHz, while taking smallest of both.

2. SYSTEM TEST CONFIGURATION

2.1. JUSTIFICATION

ALPW-BLEM003 is a Bluetooth Low Energy module.
To perform tests, manufacturer provided test board to configure module: ALPW-BLEEASYKIT
All I/O of module are out of test board by 10cm length of cable.

2.2. HARDWARE IDENTIFICATION

Equipment under test (EUT):
ALPW-BLEM003

Serial number: **None**
FCC ID: **2ABXUBLEM003**
IC: **11797A-BLEM003**

Power supply:
- Provided by test PCB, 3.0VDC nominal.
During all the tests, EUT is supplied by test board powered by 5VDC USB.

Input/output and cable:
- 1 x MicroUSB, shielded, length: 1.5m
- 43 x I/O, used on test PCB with 10cm length (ALPW-BLEM003)

Auxiliaries used for testing:
- ALPW-BLEEASYKIT for ALPW-BLEM003, BLEMEK-1312022
- Laptop of laboratory for software

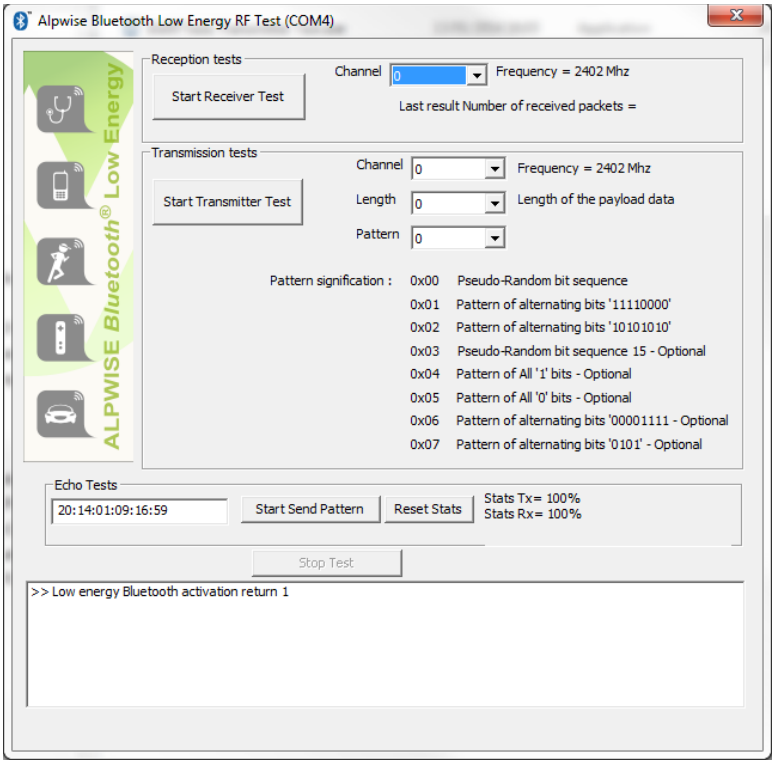
Equipment information: (Declared by provider)

- Frequency band:	[2400.0 – 2483.5] MHz		
- Standard:	☐Wifi	☒Bluetooth	☐Zigbee
- Spectrum Modulation:	☒FHSS		☒DSSS
	Bluetooth low energy is tested like a DSSS.		
- Modulation type:	☒GFSK		
Packet type:	37, length of the payload data		
- Number of channel:	39, 3 for advertisement		
- Channel separation:	☐5MHz	☒2MHz	☐1MHz
- Channel bandwidth:	☐10MHz	☐20MHz	☒1MHz
- Channel tested:	Full test on 2404MHz, 2442MHz and 2480MHz		
- Sub-band REC7003:	Annex 3(a)		
- RF mode:	☒TX/RX	☒RX	
- Antenna type:	Ceramic 0.9dBi		
- Antenna connector:	☐Permanent external	☐Permanent internal	
	☒None	☒Temporary (only for tests)	

Firmware tested:	Application:	DataExchange 1.0 based on ALPW-BLESDE 1.0.0 for Cortex M0
	RF test:	HCIMode-M0 1.0
Revision:	RevA	

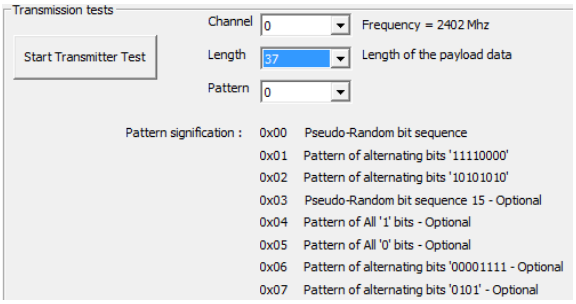
2.3. RUNNING MODE

Software used:



Different configurations are tested in this test report:

- Permanent modulated emission:



- Permanent modulated emission in hopping mode TX – RX in loop

2.4. EQUIPMENT MODIFICATIONS

No equipment modification has been necessary during testing.

2.5. FIELD STRENGTH CALCULATION

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follow:

FS = RA + AF + CF – AG

Where FS = Field Strength
RA = Receiver Amplitude
AF = Antenna Factor
CF = Cable Factor
AG = Amplifier Gain

Assume a receiver reading of 52.5dBµV is obtained. The antenna factor of 7.4 and a cable factor of 1.1 are added. The amplifier gain of 29dB is subtracted, giving a field strength of 32 dBµV/m.
FS = 52.5 + 7.4 + 1.1 – 29 = 32 dBµV/m
The 32 dBµV/m value can be mathematically converted to its corresponding level in µV/m.
Level in µV/m = Common Antilogarithm [(32dBµV/m)/20] = 39.8 µV/m.

3. CONDUCTED EMISSION DATA

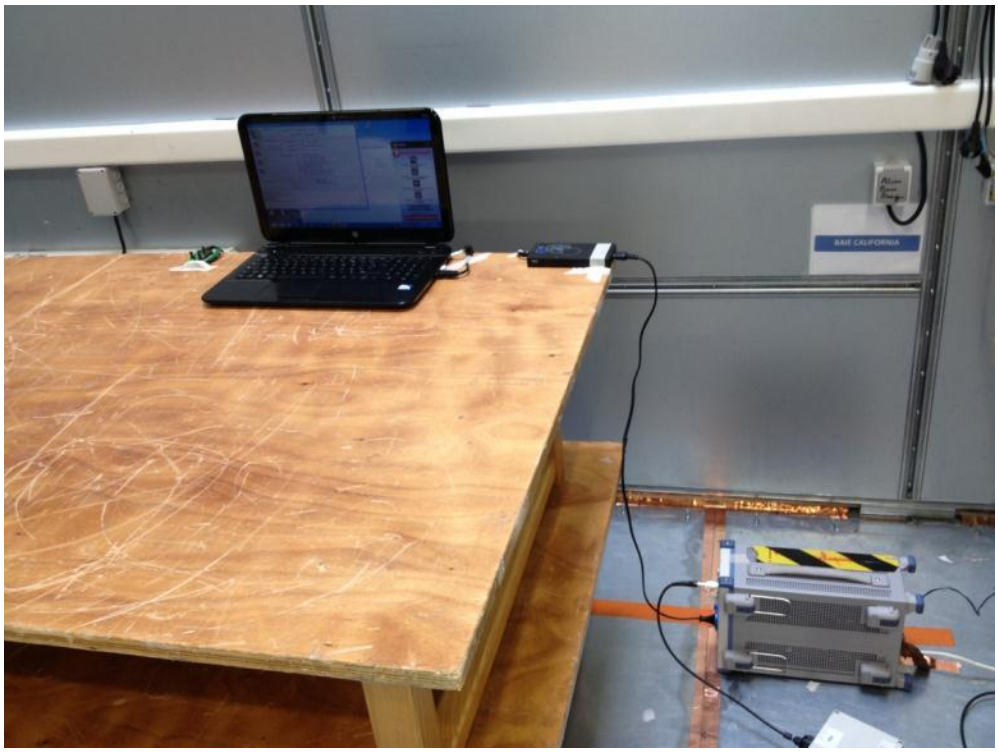
3.1. ENVIRONMENTAL CONDITIONS

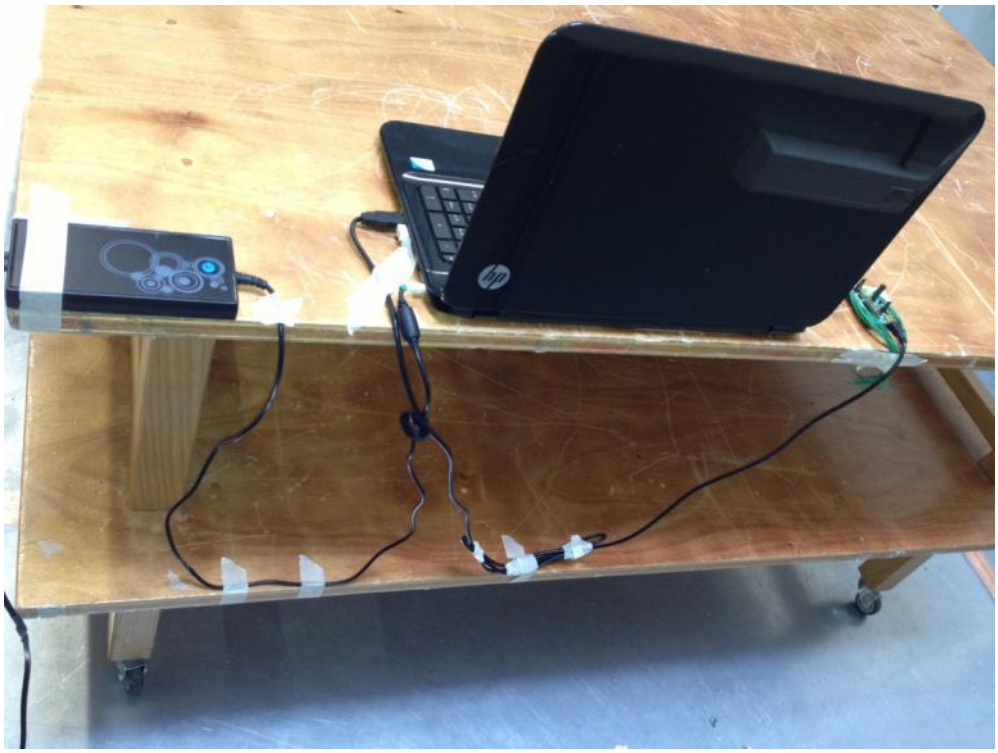
Date of test : February 20th, 2014
Test performed by : Nathalie BUGANZA
Atmospheric pressure : 994hPa
Relative humidity : 30%
Ambient temperature : 22°C

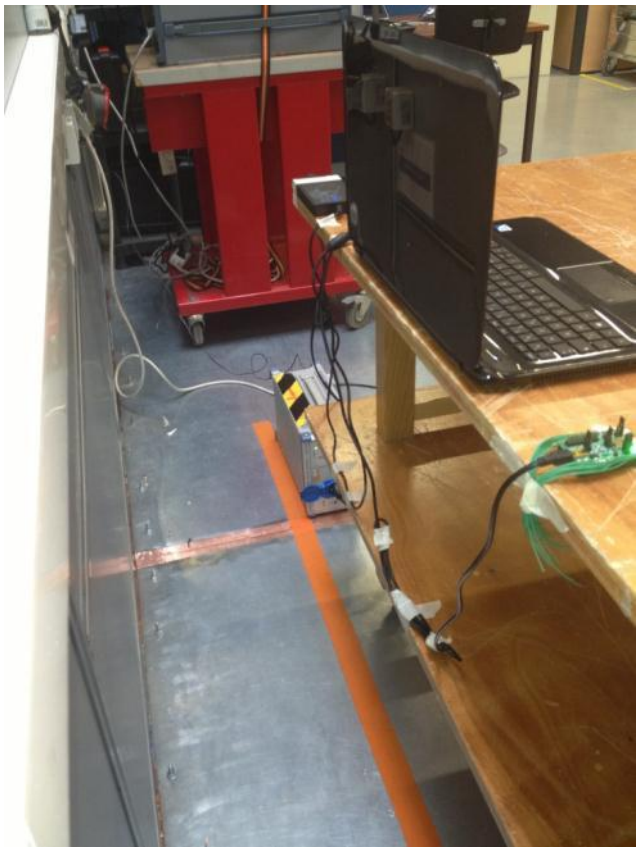
3.2. TEST SETUP

Mains terminals
The EUT and auxiliaries are set:
☒ 80cm above the ground on the non-conducting table (Table-top equipment)
☐ 10cm above the ground on isolating support (Floor standing equipment)
The distance between the EUT and the LISN is 80cm. The EUT is 40cm away for the vertical ground plane.

The EUT is powered by V_{nom}.
The EUT is powered through a LISN (measure). Auxiliaries are powered by another LISN.







Test setup

3.3. TEST METHOD

The product has been tested according to ANSI C63.4-(2003) and FCC Part 15 subpart B and C. The product has been tested with 120V/60Hz power line voltage and compared to the FCC Part 15 subpart B §15.107 and C §15.207 limits. Measurement bandwidth was 9kHz from 150kHz to 30MHz. This was followed by a Quasi-Peak, i.e. CISPR measurement for any strong signal. If the average limit is met when using a Quasi-Peak detector, the EUT shall be deemed to meet both limits and measurement with the average detector is unnecessary. The LISN (measure) is 50Ω / 50µH. The Peak data are shown on plots in annex 1. Quasi-Peak and Average measurements are detailed in a table with frequencies and levels measured. Interconnecting cables and equipment's were moved to position that maximized emission. A summary of the worst case emissions found in all test configurations and modes is shown on the following page.
Measurements are performed on the phase (L1) and neutral (N) of power line voltage. Graphs are obtained in PEAK detection. Measures are also performed in Quasi-Peak and Average for any strong signal.

3.4. TEST EQUIPMENT LIST

DESCRIPTION	MANUFACTURER	MODEL	N° LCIE
Cable	-	-	A5329585
Conducted emission comb generator	BARDET	-	A3169049
LISN	RHODE & SCHWARZ	ENV216	C2320123
Receiver 20Hz-26.5GHz	ROHDE & SCHWARZ	ESMI	A2642009
Receiver display	ROHDE & SCHWARZ	ESMI	A2642007
Thermo-hygrometer (PM2)	OREGON	BAR916HG-G	B4206011
Transient limiter	RHODE & SCHWARZ	ESH3-Z2	A7122204

3.5. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

☒None ☐Divergence:

3.6. TEST RESULTS

Measurements are performed on the phase (L1) and neutral (N) of the power line of the laptop.
Results: (PEAK detection)
Measure on L1: graph **Emc#1** (see annex 1)
Measure on N: graph **Emc#2** (see annex 1)

3.7. CONCLUSION

RESULTS: ☒**PASS** ☐**FAIL**

4. RADIATED EMISSION DATA

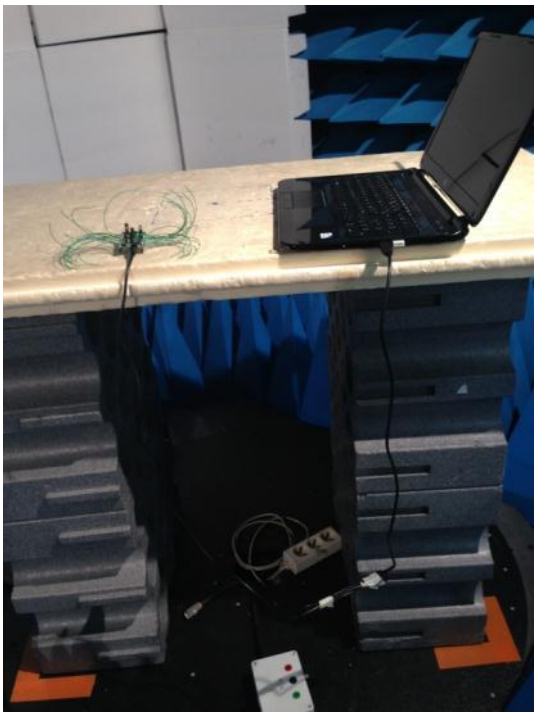
4.1. ENVIRONMENTAL CONDITIONS

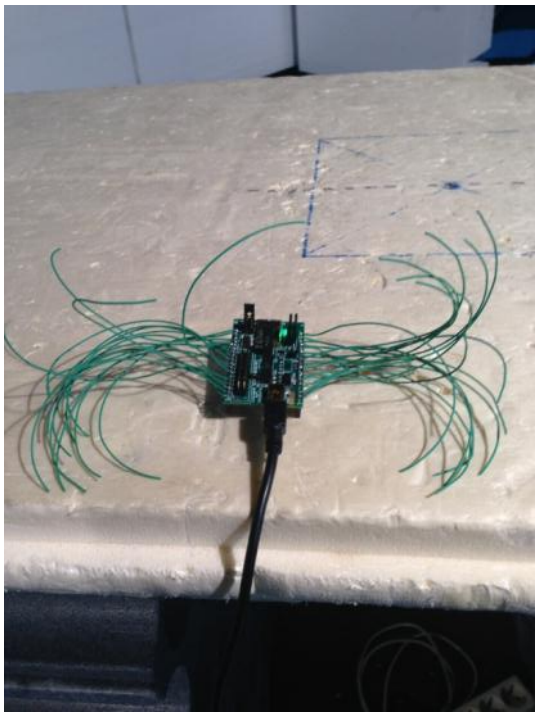
Date of test : February 17th, 2014
Test performed by : A.MERLIN
Atmospheric pressure : 987hPa
Relative humidity : 39%
Ambient temperature : 22°C

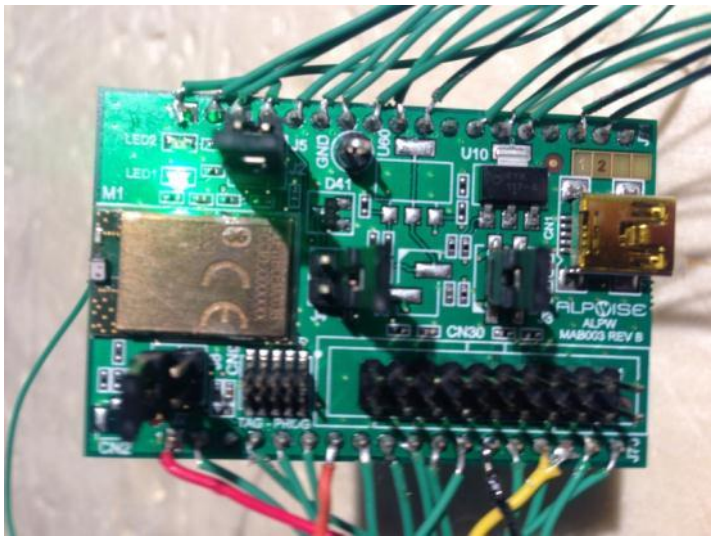
4.2. TEST SETUP

The installation of EUT is identical for pre-characterization measures in a 3 meters semi- anechoic chamber and for measures on the 10 meters Open site.
The EUT and auxiliaries are set:
☒ 80cm above the ground on the non-conducting table (Table-top equipment)
☐ 10cm above the ground on isolating support (Floor standing equipment)
The EUT is powered by V_{nom}.

Test setup on OATS







Test setup in anechoic chamber

4.3. TEST METHOD

Pre-characterisation measurement: (9kHz – 25GHz)
A pre-scan of all the setup has been performed in a 3 meters semi-anechoic chamber for frequency from 30MHz to 25GHz. Test is performed in horizontal (H) and vertical (V) polarization, the loop antenna was rotated during the test for maximized the emission measurement. Continuous linear turntable azimuth search was performed with 360 degrees range. Measurement performed on all axis of EUT used in normal configuration.
The pre-characterization graphs are obtained in PEAK detection and PEAK/AVERAGE from 1GHz to 25GHz.

Characterization on 10 meters open site from 9kHz to 1GHz:
The product has been tested according to ANSI C63.4 (2003), FCC part 15 subpart C. Radiated Emissions were measured on an open area test site. A description of the facility is on file with the FCC. The product has been tested at a distance of **10 meters** from the antenna and compared to the FCC part 15 subpart C §15.225 limits in the frequency range 13.553MHz 13.567MHz. Measurement bandwidth was 9kHz below 30MHz and 120kHz from 30 MHz to 1GHz. Test is performed in horizontal (H) and vertical (V) polarization, the loop antenna was rotated during the test for maximized the emission measurement. The height antenna is varied from 1m to 4m. Continuous linear turntable azimuth search was performed with 360 degrees range. Measurement performed on all axis of EUT used in normal configuration. A summary of the worst case emissions found in all test configurations and modes is shown.
Frequency list has been created with anechoic chamber pre-scan results.

Characterization on 3 meters full anechoic chamber from 1GHz to 25GHz:
The product has been tested at a distance of **3 meters** from the antenna and compared to the FCC part 15 subpart B §15.109 limits and C §15.209 limits. Measurement bandwidth was 1MHz from 1GHz to 25GHz.
Test is performed in horizontal (H) and vertical (V) polarization. Continuous linear turntable azimuth search was performed with 360 degrees range. Measurement performed on all axis of EUT used in normal configuration. A summary of the worst case emissions found in all test configurations and modes is shown.The height antenna is
☐ On mast, varied from 1m to 4m
☒ Fixed and centered on the EUT
Frequency list has been created with anechoic chamber pre-scan results.

4.4. TEST EQUIPMENT LIST

DESCRIPTION	MANUFACTURER	MODEL	N° LCIE
Amplifier 1-13GHz	LCIE SUD EST	-	A7102067
Antenna Bi-log	CHASE	CBL6111A	C2040051
Antenna Bi-log	CHASE	CBL6111A	C2040172
Antenna horn	EMCO	3115	C2042029
Cable N/N	-	-	A5329038
Cable	SUCOFLEX	106G	A5329061
Cable	UTIFLEX	-	A5329192
Cable N/N	-	-	A5329206
Cable	-	-	A5329352
Cable	-	-	A5329603
Cable (OATS)	-	-	A5329623
Semi-Anechoic chamber #3	SIEPEL	-	D3044017
Radiated emission comb generator	BARDET	-	A3169050
HF Radiated emission comb generator	LCIE SUD EST	-	A3169088
High Pass (4.8-18GHz)	BL Microwave	SH4800-1800	A7484034
OATS	-	-	F2000409
Receiver 20Hz – 8GHz	ROHDE & SCHWARZ	ESU8	A2642019
Receiver 20-1000MHz	ROHDE & SCHWARZ	ESVS30	A2642006
Spectrum Analyzer 9KHz – 26.5GHz	HEWLETT PACKARD	8593E	A4060018
Thermo-hygrometer (C3)	OREGON	BAR206	B4204078
Thermo-hygrometer (PM2)	OREGON	BAR916HG-G	B4206011
Turntable chamber (Cage#3)	ETS Lingren	Model 2165	F2000371
Turntable / Mast controller (OATS)	ETS Lindgren	Model 2066	F2000372
Antenna mast (OATS)	ETS Lindgren	2071-2	F2000392
Turntable (OATS)	ETS Lindgren	Model 2187	F2000403
Table	MATURO Gmbh	-	F2000437
Turntable controller (Cage#3)	ETS Lingren	Model 2090	F2000444

4.5. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

☒None ☐Divergence:

4.6. TEST RESULTS

4.6.1. Pre-characterization at 3 meters [9kHz-30MHz]

No significative frequency observed

4.6.2. Pre-characterization at 3 meters [30MHz-1GHz]

See graphs for 30MHz-1GHz:

Graph:	Emr#1	Horizontal polarization	–	EUT axis XY	See annex 1
Graph:	Emr#2	Vertical polarization	–	EUT axis XY	See annex 1
Graph:	Emr#3	Horizontal polarization	–	EUT axis Z	See annex 1
Graph:	Emr#4	Vertical polarization	–	EUT axis Z	See annex 1

4.6.3. Pre-characterization at 3 meters [1GHz-25GHz]

See table results for 1GHz-25GHz.

4.6.4. Characterization on 10 meters open site below 30 MHz

Worst case final data result:

Frequency list has been created with semi-anechoic chamber pre-scan results.
Measurements are performed using a QUASI-PEAK detection.

No	Frequency (MHz)	QPeak Limit (dBµV/m) @ 30m	Qpeak (dBµV/m) @ 30m	Margin (Mes-Lim) (dB)	Angle Table (deg)	Pol Ant.	Ht Ant. (cm)	Correc. Factor (dB)	Comments
No frequency									

Note: Measure have been done at 10m distance and corrected according to requirements of 15.209.e) (M@30m = M@10m-19.1dB)

Limits Sub clause §15.225

Frequency (MHz)	Field strength (µV/m)	Measurement distance (m)
13.553-13.567	15 848 84 dBµV/m	30
13.410-13.553 13.567-13.710	334 50.5 dBµV/m	30
13.110-13.410 13.710-14.010	106 40.5 dBµV/m	30

See following chapter of this test report for band edge measurements.

4.6.5. Characterization on 10 meters open site from 30MHz to 1GHz

Worst case final data result:
Frequency list has been created with semi-anechoic chamber pre-scan results.
Measurements are performed using a QUASI-PEAK detection.

No	Frequency (MHz)	Limit Quasi-Peak (dBµV/m)	Measure Quasi-Peak (dBµV/m)	Margin (Mes-Lim) (dB)	Angle Table (deg)	Pol Ant.	Ht Ant. (cm)	Correc. Factor (dB)	Comments
1	37.072	40.0	33.3	**-6.7**	10	V	100	16.5	
2	50.147	40.0	30.2	**-9.8**	75	H	210	10.1	
3	76.183	40.0	31.1	**-8.9**	225	V	100	8.8	
4	151.993	43.5	27.0	**-16.5**	220	H	400	13.6	
5	189.500	43.5	33.1	**-10.4**	135	V	100	11.4	
6	228.048	46.0	26.3	**-19.7**	125	H	255	12.5	
7	341.357	46.0	29.4	**-16.6**	135	H	330	17.2	
8	386.687	46.0	30.5	**-15.5**	220	V	210	18.5	

Note: Measure have been done at 10m distance and corrected according to requirements of 15.209.e) (M@3m = M@10m+10.5dB)

4.6.6. Characterization on 3meters anechoic chamber from 1GHz to 25GHz

Worst case final data result:

The frequency list is created from the results obtained during the pre-characterization in anechoic chamber. Measurements are performed using a PEAK and AVERAGE detection.

No	Frequency (MHz)	Limit Peak (dBµV/m)	Measure Peak (dBµV/m)	Margin (Mes-Lim) (dB)	Angle Table (deg)	Pol Ant.	Ht Ant. (cm)	Correc. Factor (dB)	Comments
1	2349.700	74.0	56.4	**-17.6**	70	V	100	30.2	
2	2375.000	74.0	51.4	**-22.6**	75	V	100	30.3	
3	2483.500	74.0	71.1	**-2.9**	180	V	100	30.8	
4	2500.000	74.0	47.7	**-26.3**	195	V	100	30.9	
5	4804.000	74.0	55.6	**-18.4**	275	V	100	36.4	
6	4884.000	74.0	55.9	**-18.1**	270	V	100	36.5	
7	4960.000	74.0	54.0	**-20.0**	275	V	100	36.6	

No	Frequency (MHz)	Limit Average (dBµV/m)	Measure Average (dBµV/m)	Margin (Mes-Lim) (dB)	Angle Table (deg)	Pol Ant.	Ht Ant. (cm)	Correc. Factor (dB)	Comments
1	2349.700	54.0	33.7	**-20.3**	70	V	100	30.2	
2	2375.000	54.0	34.0	**-20.0**	75	V	100	30.3	
3	2483.500	54.0	43.5	**-10.5**	180	V	100	30.8	
4	2500.000	54.0	34.2	**-19.8**	195	V	100	30.9	
5	4804.000	54.0	44.0	**-10.0**	275	V	100	36.4	
6	4884.000	54.0	43.6	**-10.4**	270	V	100	36.5	
7	4960.000	54.0	40.3	**-13.7**	275	V	100	36.6	

Note: Measures have been done at 3m distance.

4.7. CONCLUSION

RESULTS: ☒**PASS** ☐**FAIL**

5. BANDWIDTH (15.247)

5.1. TEST CONDITIONS

Date of test : February 11th, 2014
Test performed by : A.MERLIN
Atmospheric pressure : 989hPa
Relative humidity : 43%
Ambient temperature : 22°C

5.2. LIMIT

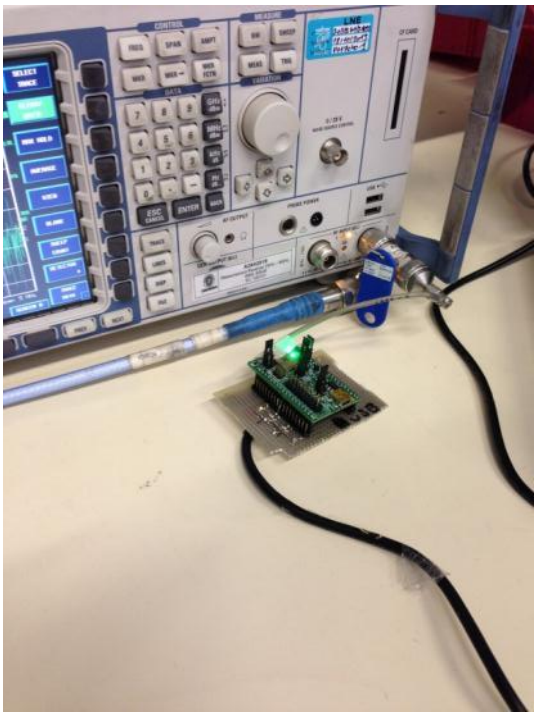
The 6 dB bandwidth must be greater than 500 kHz.

5.3. SETUP

☒ ***Conducted measurement:***
The EUT is turned ON and connected to measurement instrument; the center frequency of the spectrum analyzer is set to the fundamental frequency. The captured power is measured and recorded; the measurement is repeated until all frequencies required were complete.

☐ ***Radiated measurement:***
The EUT is placed in an anechoic chamber; the center frequency of the spectrum analyzer is set to the fundamental frequency. The captured power is measured and recorded; the measurement is repeated until all frequencies required were complete, a delta marker is used to measure the frequency difference as the emission bandwidth.

Measurement Procedure:
1. Set resolution bandwidth (RBW) = 100kHz.
2. Set the video bandwidth (VBW) ≥ 3 x RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission. Compare the resultant bandwidth with the RBW setting of the analyzer.



5.4. TEST EQUIPMENT LIST

DESCRIPTION	MANUFACTURER	MODEL	N° LCIE
Attenuator 10dB	JFW	-	A7122166
Receiver 20Hz – 8GHz	ROHDE & SCHWARZ	ESU8	A2642019
Thermo-hygrometer (PM2)	OREGON	BAR916HG-G	B4206011

5.5. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

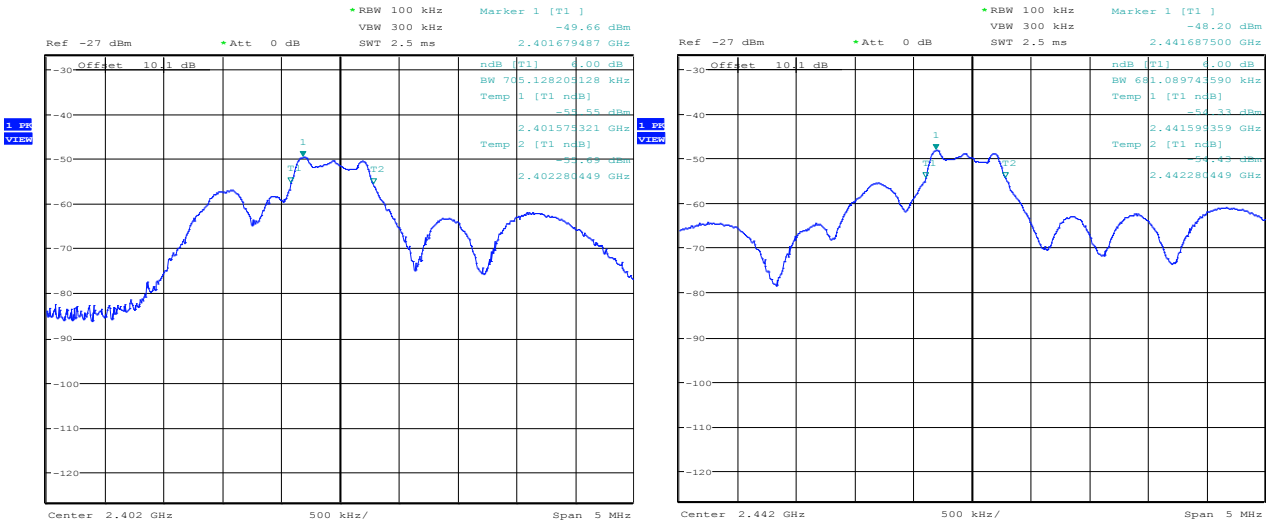
☒None ☐Divergence:

5.6. TEST SEQUENCE AND RESULTS

Channel	Channel Frequency (MHz)	6dB Bandwidth (kHz)	PASS / FAIL
0	2402	**705**	PASS
20	2442	**681**	PASS
39	2480	**681**	PASS

Offset: Attenuator+cable 10.1dB

Graph:



5.7. CONCLUSION

RESULTS: ☒**PASS** ☐**FAIL**

6. MAXIMUM PEAK OUTPUT POWER (15.247)

6.1. TEST CONDITIONS

Date of test : February 11th, 2014
Test performed by : A.MERLIN
Atmospheric pressure : 989hPa
Relative humidity : 43%
Ambient temperature : 22°C

6.2. SETUP

☒ ***Conducted measurement:***
The EUT is turned ON and connected to measurement instrument; the center frequency of the spectrum analyzer is set to the fundamental frequency.

☐ ***Radiated measurement:***
The EUT is placed in an anechoic chamber; the center frequency of the spectrum analyzer is set to the fundamental frequency.
The product has been tested at a distance of 3 meters from the antenna. Continuous linear turntable azimuth search was performed with 360 degrees range. Measurement performed on 3 axis of EUT. A summary of the worst case emissions found in all test configurations and modes is shown on following table. The captured power is measured and recorded; the measurement is repeated until all frequencies required were complete.
To demonstrate compliance with peak output power requirement of section 15.247 (b), the transmitter's peak output power is calculated using the following equation:

$$E = \frac{\sqrt{30PG}}{d}$$

Where:
- E is the measured maximum fundamental field strength in V/m.
- G is the numeric gain of the transmitting antenna with reference to an isotropic radiator.
- d is the distance in meters from which the field strength was measured.
- P is the power in watts for which you are solving:

$$P = \frac{(Ed)^2}{30G}$$

Maximum peak conducted output power

One of the following procedures may be used to determine the maximum peak conducted output power of a DTS EUT.

- ☒ ***RBW ≥ DTS bandwidth***

This procedure shall be used when the measurement instrument has available a resolution bandwidth that is greater than the DTS bandwidth.

a) Set the RBW ≥ DTS bandwidth.
b) Set VBW ≥ 3 x RBW.
c) Set span ≥ 3 x RBW
d) Sweep time = auto couple.
e) Detector = peak.
f) Trace mode = max hold.
g) Allow trace to fully stabilize.
h) Use peak marker function to determine the peak amplitude level.

- ☐ ***Integrated band power method***

This procedure may be used when the maximum available RBW of the measurement instrument is less than the DTS bandwidth.

a) Set the RBW = 1 MHz.
b) Set the VBW ≥ 3 x RBW
c) Set the span ≥ 1.5 x DTS bandwidth.
d) Detector = peak.
e) Sweep time = auto couple.
f) Trace mode = max hold.
g) Allow trace to fully stabilize.
h) Use the instrument's band/channel power measurement function with the band limits set equal to the DTS bandwidth edges

6.3. TEST EQUIPMENT LIST

DESCRIPTION	MANUFACTURER	MODEL	N° LCIE
Attenuator 10dB	JFW	-	A7122166
Receiver 20Hz – 8GHz	ROHDE & SCHWARZ	ESU8	A2642019
Thermo-hygrometer (PM2)	OREGON	BAR916HG-G	B4206011

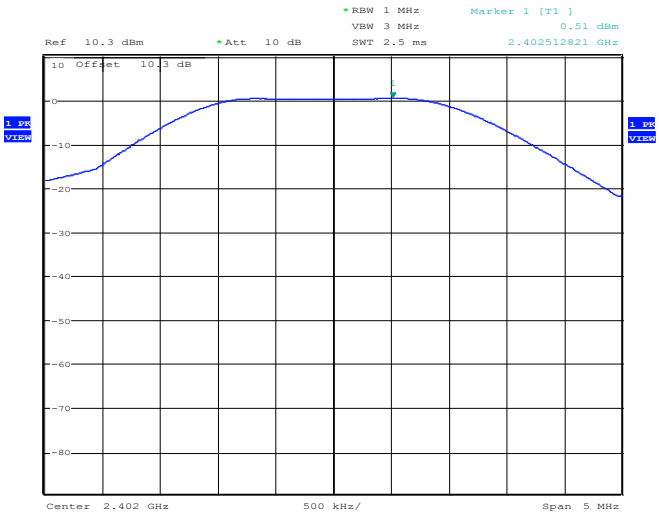
6.4. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

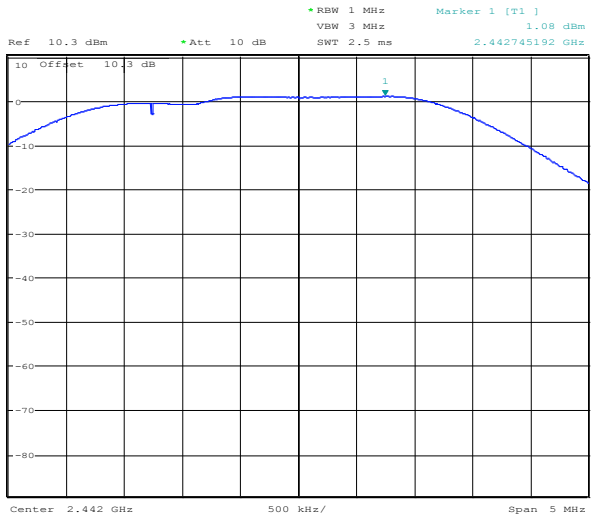
☒None ☐Divergence:

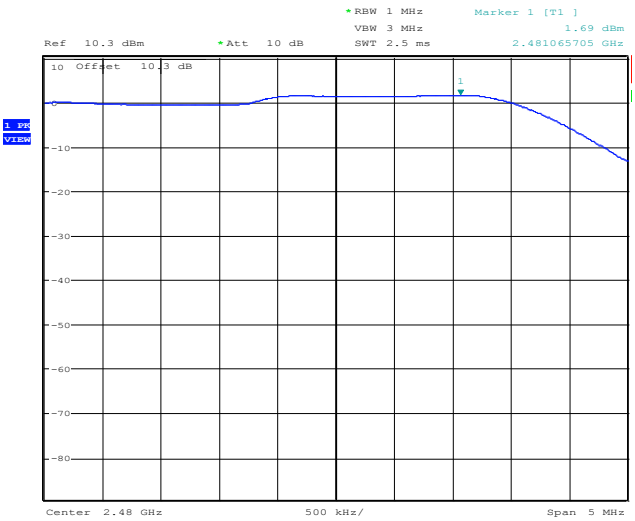
6.5. TEST SEQUENCE AND RESULTS

Channel	Channel Frequency (MHz)	Peak Output Power (dBm)	Power Limit (dBm)	PASS / FAIL
0	2402	**0.6**	30.0	PASS
20	2442	**1.1**	30.0	PASS
39	2480	**1.7**	30.0	PASS

Offset: Attenuator+cable 10.3dB







6.6. CONCLUSION

RESULTS: ☒**PASS** ☐**FAIL**

7. POWER SPECTRAL DENSITY (15.247)

7.1. TEST CONDITIONS

Date of test : February 12th, 2014
Test performed by : A.MERLIN
Atmospheric pressure : 984hPa
Relative humidity : 39%
Ambient temperature : 22°C

7.2. SETUP

☒ ***Conducted measurement:***
The EUT is turned ON and connected to measurement instrument; the center frequency of the spectrum analyzer is set to the fundamental frequency.

☐ ***Radiated measurement:***
The EUT is placed in an anechoic chamber; the center frequency of the spectrum analyzer is set to the fundamental frequency.
The product has been tested at a distance of 3 meters from the antenna. Continuous linear turntable azimuth search was performed with 360 degrees range. Measurement performed on 3 axis of EUT. A summary of the worst case emissions found in all test configurations and modes is shown on following table. The captured power is measured and recorded; the measurement is repeated until all frequencies required were complete.
To demonstrate compliance with peak output power requirement of section 15.247 (b), the transmitter's peak output power is calculated using the following equation:

$$E = \frac{\sqrt{30PG}}{d}$$

Where:
- E is the measured maximum fundamental field strength in V/m.
- G is the numeric gain of the transmitting antenna with reference to an isotropic radiator.
- d is the distance in meters from which the field strength was measured.
- P is the power in watts for which you are solving:

$$P = \frac{(Ed)^2}{30G}$$

Measurement Procedure PKPSD:
a) Set analyzer center frequency to DTS channel center frequency.
b) Set the span to 1.5 times the DTS bandwidth.
c) Set the RBW to: 3 kHz ≤ RBW ≤ 100 kHz.
d) Set the VBW ≥ 3 □ RBW.
e) Detector = peak.
f) Sweep time = auto couple.
g) Trace mode = max hold.
h) Allow trace to fully stabilize.
i) Use the peak marker function to determine the maximum amplitude level within the RBW.
j) If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

7.3. TEST EQUIPMENT LIST

DESCRIPTION	MANUFACTURER	MODEL	N° LCIE
Attenuator 10dB	JFW	-	A7122166
Receiver 20Hz – 8GHz	ROHDE & SCHWARZ	ESU8	A2642019
Thermo-hygrometer (PM2)	OREGON	BAR916HG-G	B4206011

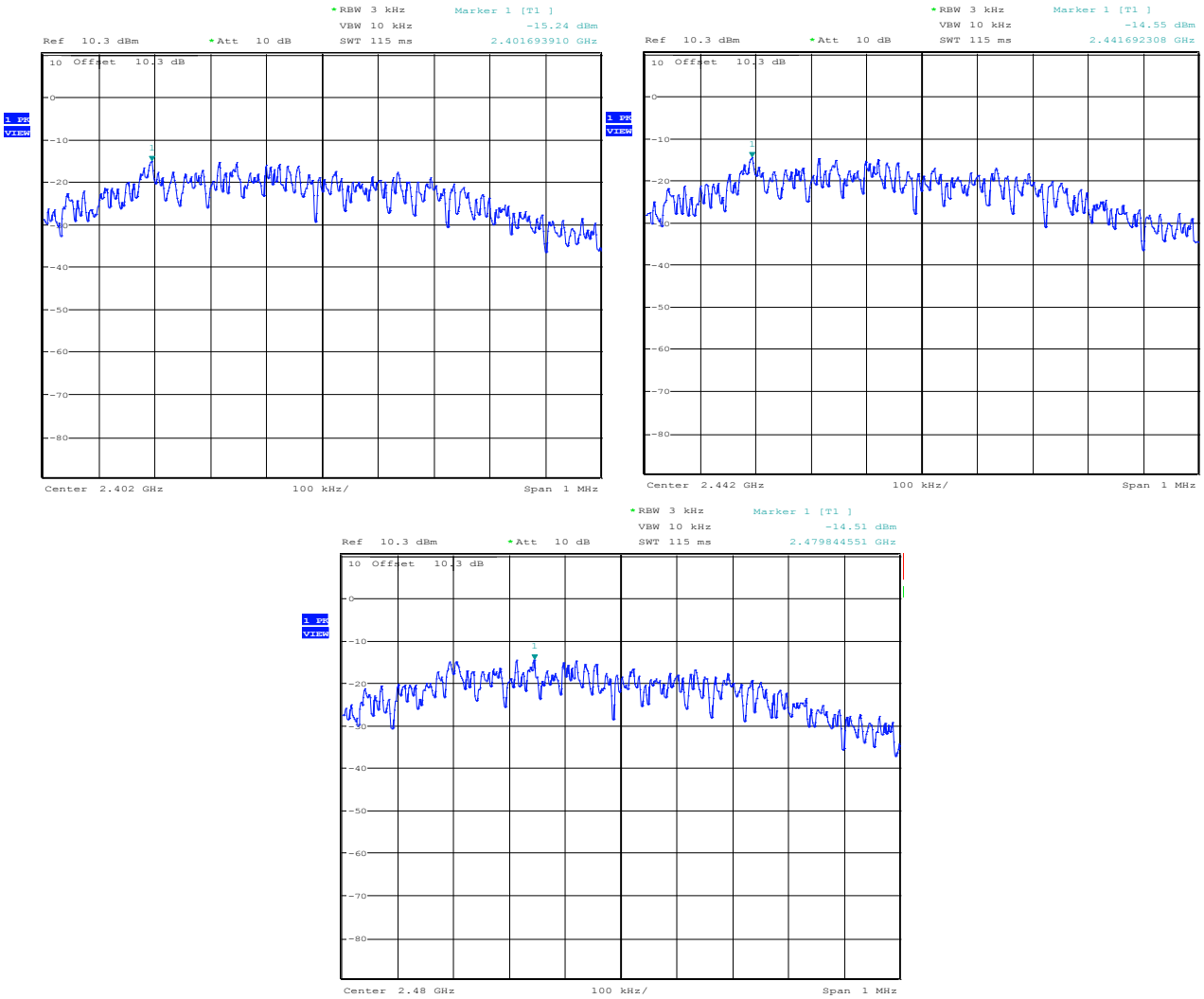
7.4. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

☒None ☐Divergence:

7.5. TEST SEQUENCE AND RESULTS

Channel	Channel Frequency (MHz)	Power Spectral Density (dBm)	PSD Limit (dBm)	PASS / FAIL
0	2402	**-15.2**	8.0	PASS
20	2442	**-14.5**	8.0	PASS
39	2480	**-14.5**	8.0	PASS

Offset: Attenuator+cable 10.3dB



7.6. CONCLUSION

RESULTS: ☒**PASS** ☐**FAIL**

8. BAND EDGE MEASUREMENT (15.247)

8.1. TEST CONDITIONS

Date of test : February 12th, 2014
Test performed by : A.MERLIN
Atmospheric pressure : 984hPa
Relative humidity : 39%
Ambient temperature : 22°C

8.2. LIMIT

RF antenna conducted test:
Set RBW = 100 kHz, Video bandwidth (VBW) > RBW, scan up through 10th harmonic. All harmonics/spurs must be at least 20 dB down from the highest emission level within the authorized band as measured with a 100 kHz RBW. Note: If the device complies with the use of power option 2 the attenuation under this paragraph shall be 30 dB instead of 20 dB. *For -20dBc limit, lowest power output level is considered, worst case.*

Radiated emission test:
Applies to harmonics/spurs that fall in the restricted bands listed in Section 15.205. The maximum permitted average field strength is listed in Section 15.209. For measurements above 1 GHz, set RBW = 1MHz, VBW = 10 Hz, Sweep: Auto. If the emission is pulsed, modify the unit for continuous operation; use the settings shown above, then correct the reading by subtracting the peak-average correction factor, derived from the appropriate duty cycle calculation. See results in Radiated emissions section before.

8.3. SETUP

The EUT is placed in an anechoic chamber; levels have been corrected to be in compliant with Peak Output Power measurement. The EUT is turn ON; the graphs of the restrict frequency band are recorded with a display line indicating the highest level and other the 20dB offset below to show compliance with 15.247 (d) and 15.205. The emissions in restricted bands are compared to 15.209 limits.
RBW: 100kHz
VBW: 300kHz

8.4. TEST EQUIPMENT LIST

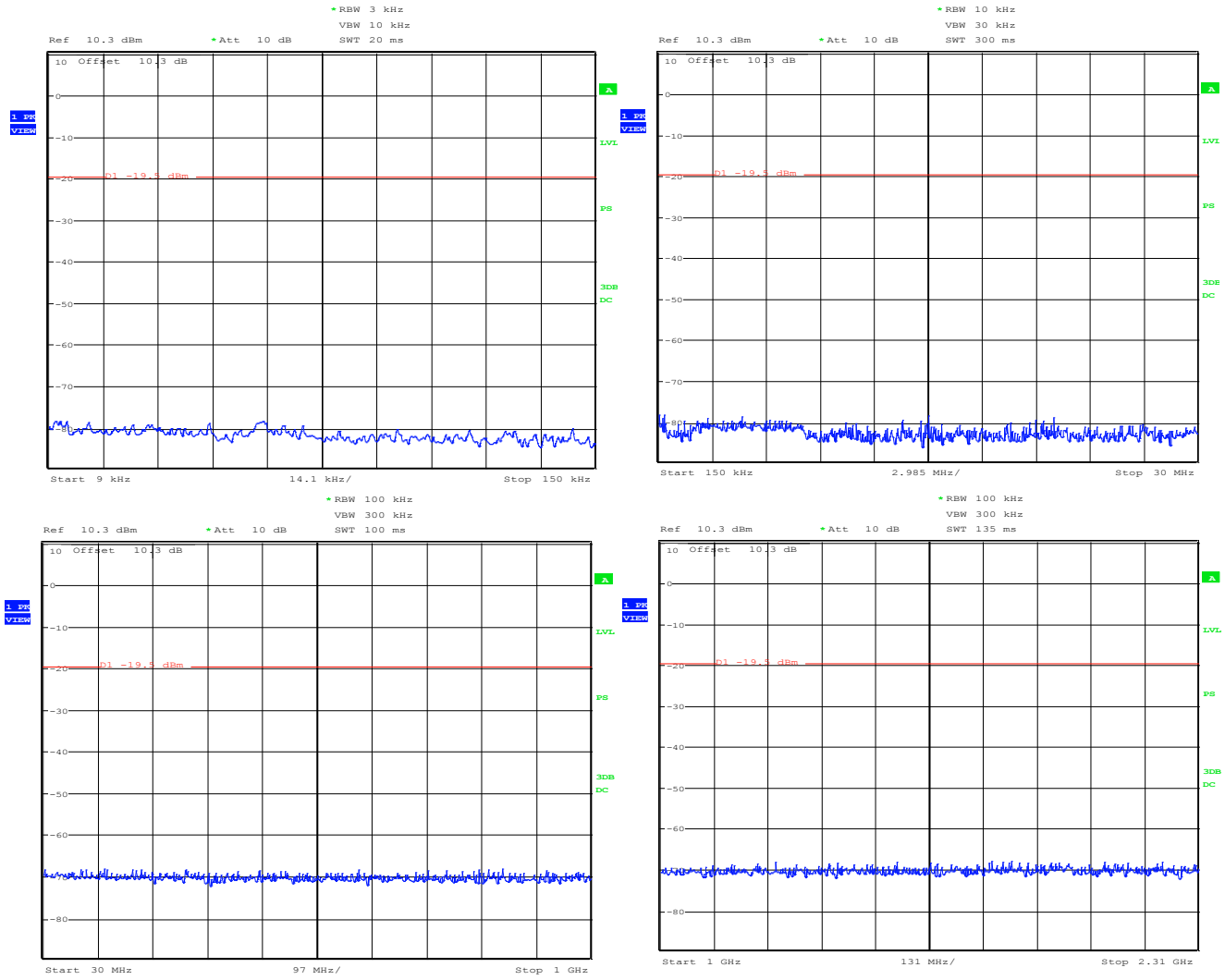
DESCRIPTION	MANUFACTURER	MODEL	N° LCIE
Attenuator 10dB	JFW	-	A7122166
Cable	-	-	A5329603
Receiver 20Hz – 8GHz	ROHDE & SCHWARZ	ESU8	A2642019
Receiver 20Hz-26.5GHz	ROHDE & SCHWARZ	ESIB26	A2642021

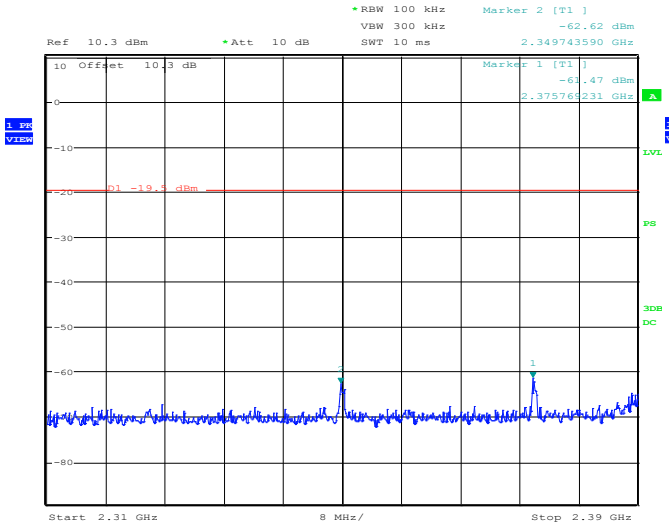
8.5. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

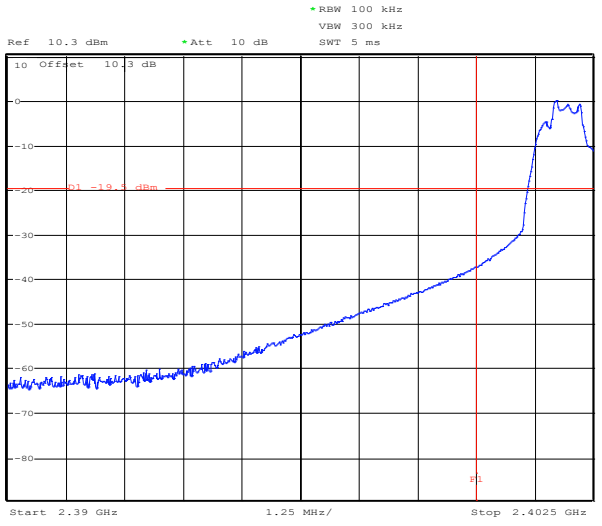
☒None ☐Divergence:

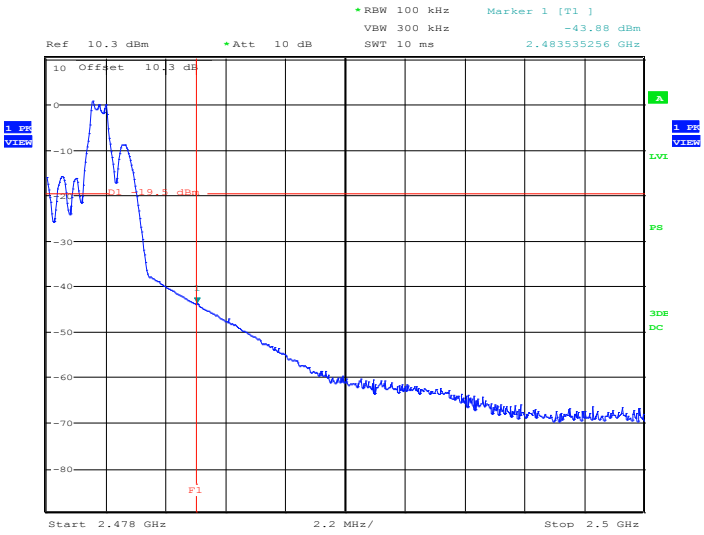
8.6. TEST SEQUENCE AND RESULTS

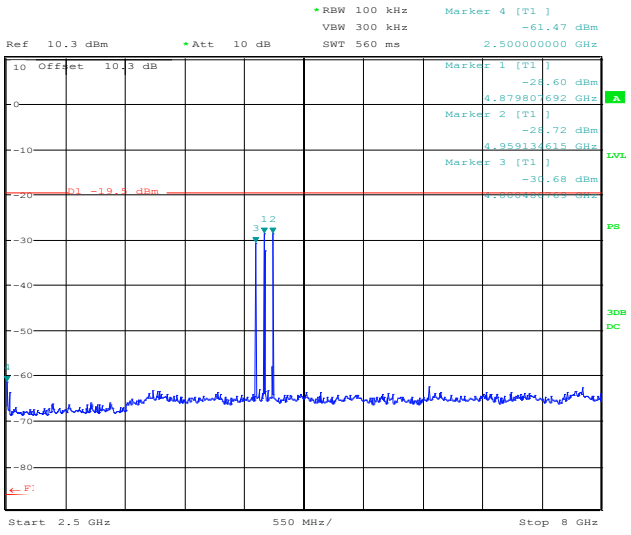
Offset: Attenuator+cable 10.3dB




RBW 100 kHz
VBW 300 kHz
SWT 10 ms
Marker 2 [T1]
-62.62 dBm
2.349743590 GHz
Ref 10.3 dBm
Att 10 dB
10 Offset 10.3 dB
Marker 1 [T1]
-61.47 dBm
2.375765231 GHz
D1 -19.7 dBm
Start 2.31 GHz
8 MHz/
Stop 2.39 GHz


RBW 100 kHz
VBW 300 kHz
SWT 5 ms
Ref 10.3 dBm
Att 10 dB
10 Offset 10.3 dB
D1 -19.7 dBm
F1
Start 2.39 GHz
1.25 MHz/
Stop 2.4025 GHz


RBW 100 kHz
VBW 300 kHz
SWT 10 ms
Marker 1 [T1]
-43.88 dBm
2.483535256 GHz
Ref 10.3 dBm
Att 10 dB
10 Offset 10.3 dB
D1 -19.7 dBm
F1
Start 2.478 GHz
2.2 MHz/
Stop 2.5 GHz


RBW 100 kHz
VBW 300 kHz
SWT 560 ms
Marker 4 [T1]
-61.47 dBm
2.500000000 GHz
Ref 10.3 dBm
Att 10 dB
10 Offset 10.3 dB
Marker 1 [T1]
-28.60 dBm
4.879807692 GHz
Marker 2 [T1]
-28.72 dBm
4.959134615 GHz
Marker 3 [T1]
-30.68 dBm
D1 -19.7 dBm
Start 2.5 GHz
550 MHz/
Stop 8 GHz

8.7. CONCLUSION

RESULTS: ☒**PASS** ☐**FAIL**

9. OCCUPIED BANDWIDTH

9.1. TEST CONDITIONS

Date of test : February 12th, 2014
Test performed by : A.MERLIN
Atmospheric pressure : 984hPa
Relative humidity : 39%
Ambient temperature : 22°C

9.2. SETUP

☒ ***Conducted measurement:***
The EUT is turned ON and connected to measurement instrument; the center frequency of the spectrum analyzer is set to the fundamental frequency. The captured power is measured and recorded; the measurement is repeated until all frequencies required were complete.

☐ ***Radiated measurement:***
The EUT is turned ON and connected to measurement instrument; the center frequency of the spectrum analyzer is set to the fundamental frequency. The captured power is measured and recorded; the measurement is repeated until all frequencies required were complete.

Measurement settings:
RBW used should not be lower than 1% of the selected span
RBW = 30kHz / Video BW = 100kHz / SPAN = 5.0MHz / MaxHold / PEAK
The occupied bandwidth is measured with OBW function of spectrum analyzer.

9.3. TEST EQUIPMENT LIST

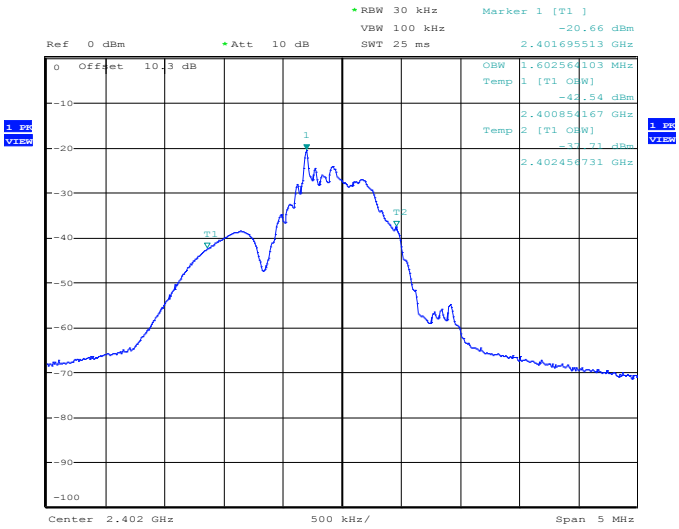
DESCRIPTION	MANUFACTURER	MODEL	N° LCIE
Attenuator 10dB	JFW	-	A7122166
Receiver 20Hz – 8GHz	ROHDE & SCHWARZ	ESU8	A2642019
Thermo-hygrometer (PM2)	OREGON	BAR916HG-G	B4206011

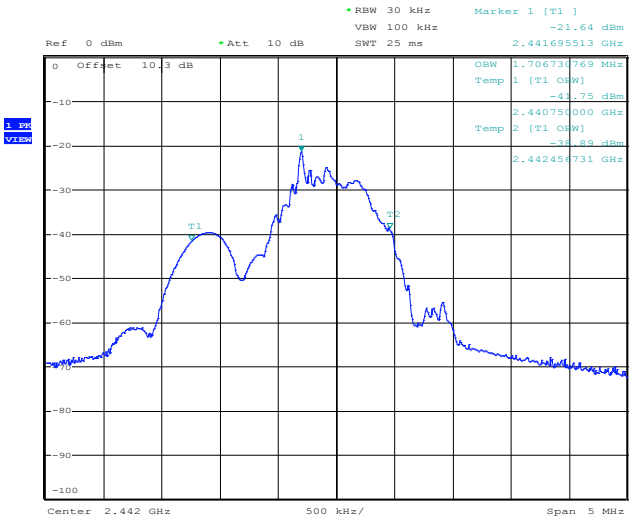
9.4. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

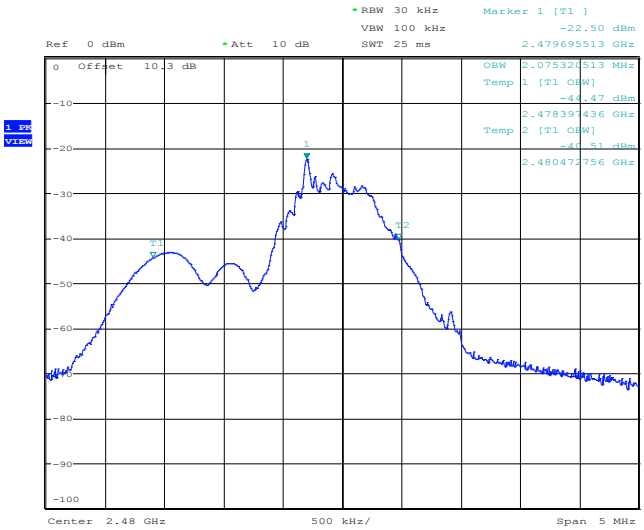
☒None ☐Divergence:

9.5. TEST SEQUENCE AND RESULTS

Channel	Channel Frequency (MHz)	99% Occupied Bandwidth (%)
0	2402	**1.602**
20	2442	**1.706**
39	2480	**2.075**

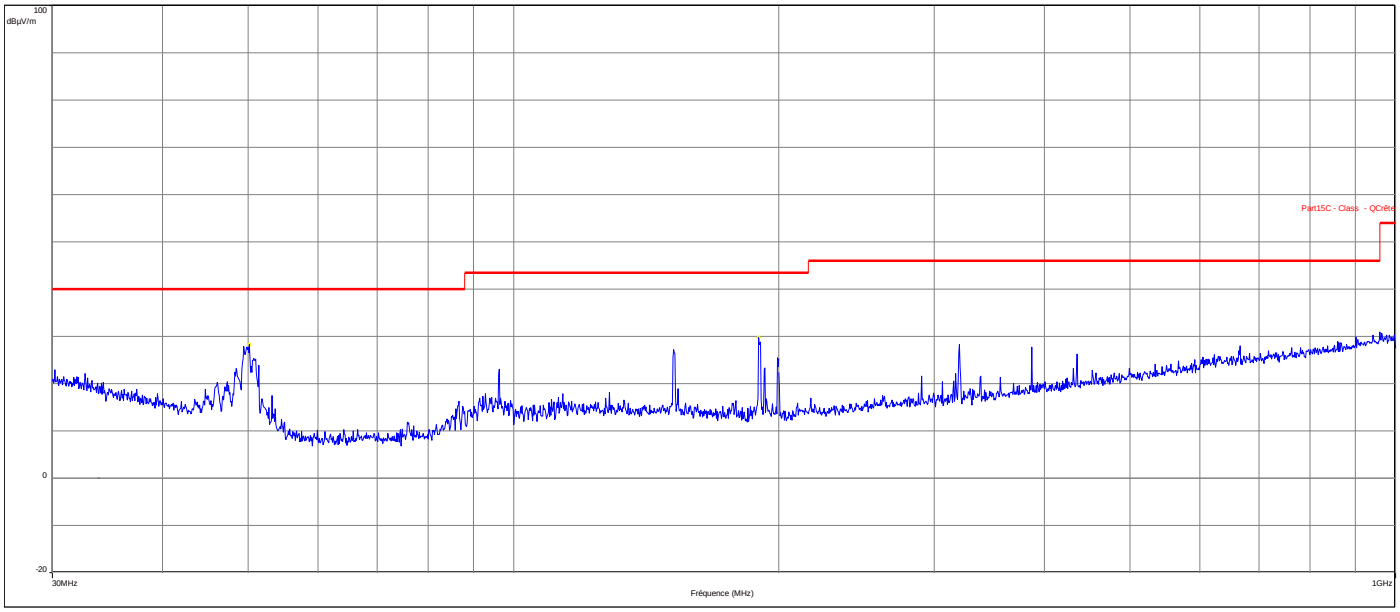






10. ANNEX 1 (GRAPHS)

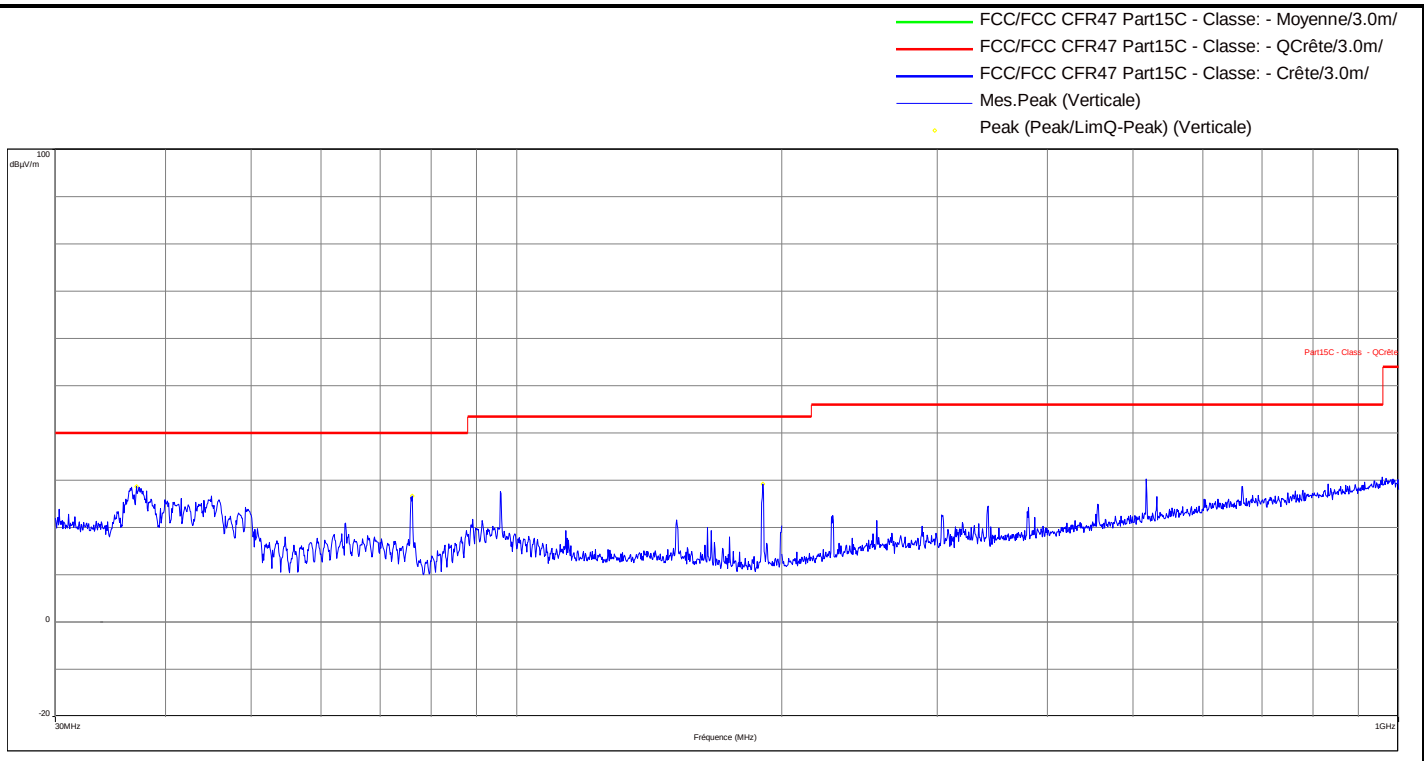
RADIATED EMISSIONS			
Graph name:	Emr#1	**Test configuration:**	
Limit:	FCC CFR47 Part15C	(H) ALPW-BLEM003 + ALPW-BLEEASYKIT - Axis XY	
Class:			
Frequency range: [30MHz - 1GHz]			
Antenna polarization:	Horizontal	**RBW :**	100kHz
Azimuth:	0° - 360°	**VBW :**	300kHz



Spurious emissions

Frequency (MHz)	Peak (dBµV/m)
50.145	28.33
189.715	29.73

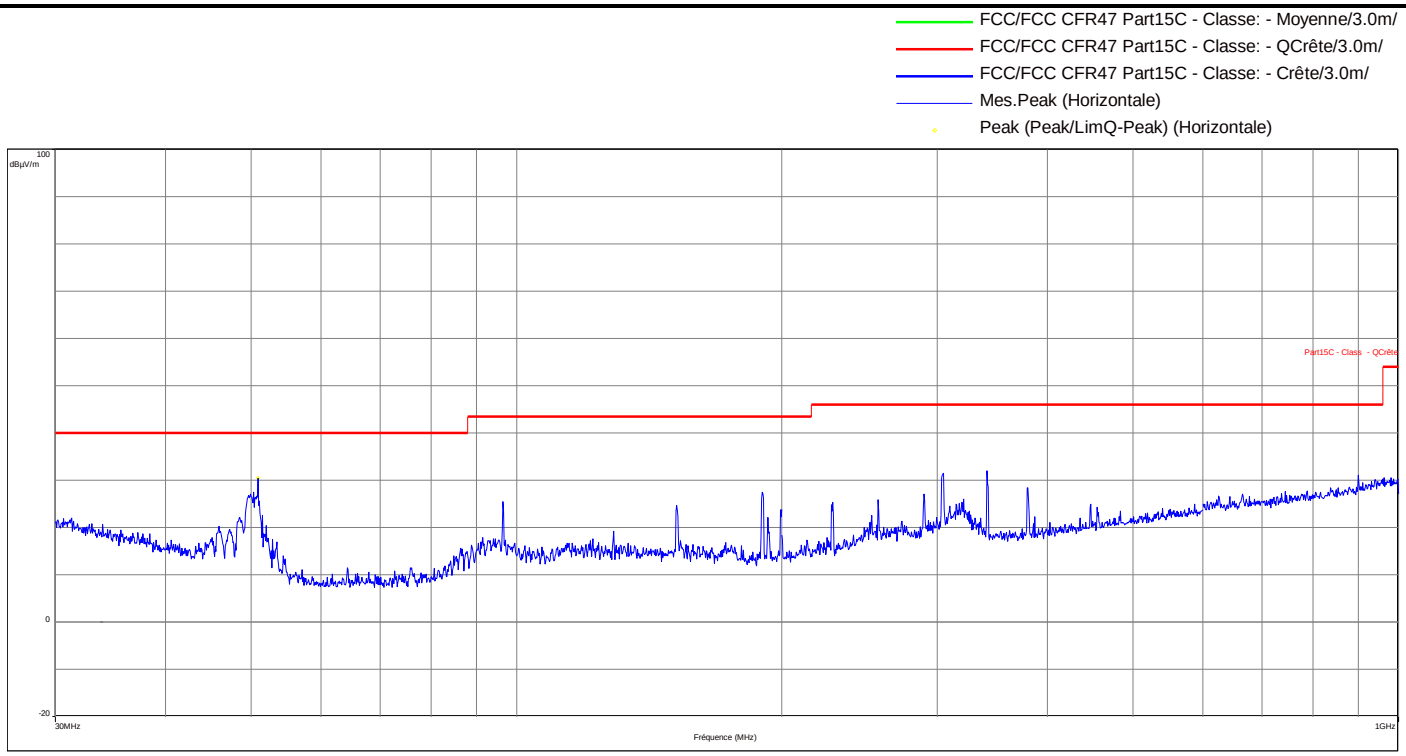
RADIATED EMISSIONS			
Graph name:	Emr#2	**Test configuration:**	
Limit:	FCC CFR47 Part15C	(V) ALPW-BLEM003 + ALPW-BLEEASYKIT - Axis XY	
Class:			
Frequency range: [30MHz - 1GHz]			
Antenna polarization:	Vertical	**RBW :**	100kHz
Azimuth:	0° - 360°	**VBW :**	300kHz



Spurious emissions

Frequency (MHz)	Peak (dBµV/m)
37.072	28.64
76.104	26.66
190.378	29.18

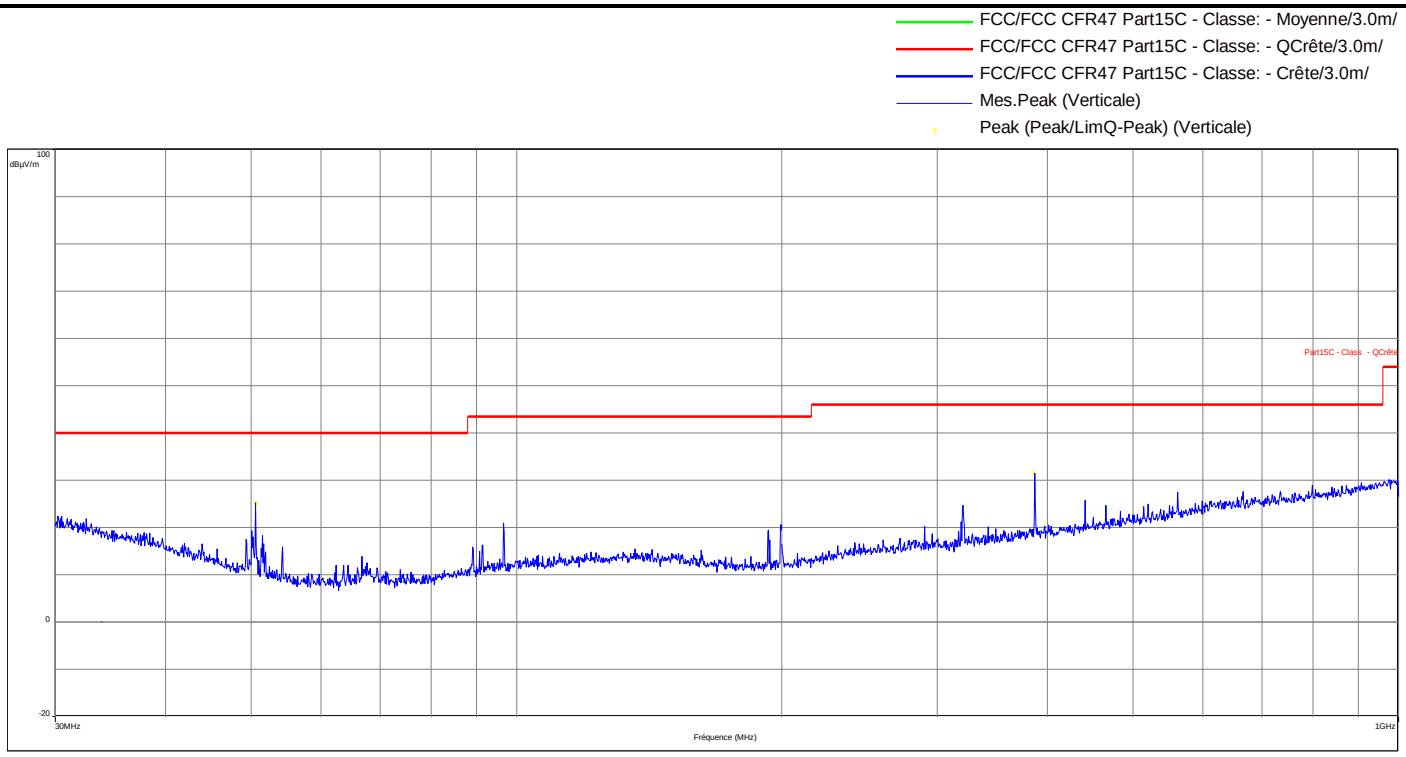
RADIATED EMISSIONS			
Graph name:	Emr#3	**Test configuration:**	
Limit:	FCC CFR47 Part15C	(H) ALPW-BLEM003 + ALPW-BLEEASYKIT - Axis Z	
Class:			
Frequency range: [30MHz - 1GHz]			
Antenna polarization:	Horizontal	**RBW :**	100kHz
Azimuth:	0° - 360°	**VBW :**	300kHz



Spurious emissions

Frequency (MHz)	Peak (dBµV/m)
50.961	30.41

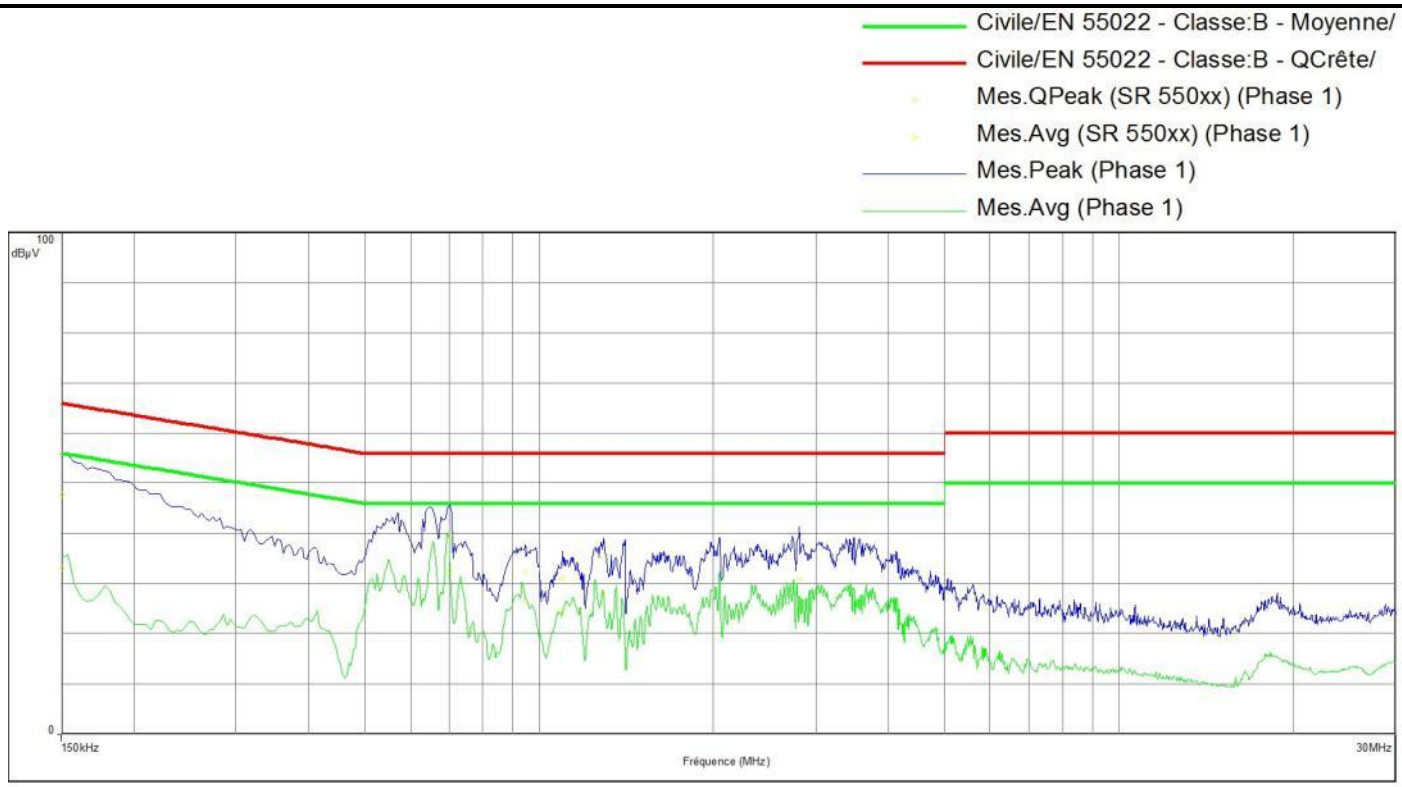
RADIATED EMISSIONS			
Graph name:	Emr#4	**Test configuration:**	
Limit:	FCC CFR47 Part15C	(V) ALPW-BLEM003 + ALPW-BLEEASYKIT - Axis Z	
Class:			
Frequency range: [30MHz - 1GHz]			
Antenna polarization:	Vertical	**RBW :**	100kHz
Azimuth:	0° - 360°	**VBW :**	300kHz



Spurious emissions

Frequency (MHz)	Peak (dBµV/m)
50.553	25.27
386.72	31.48

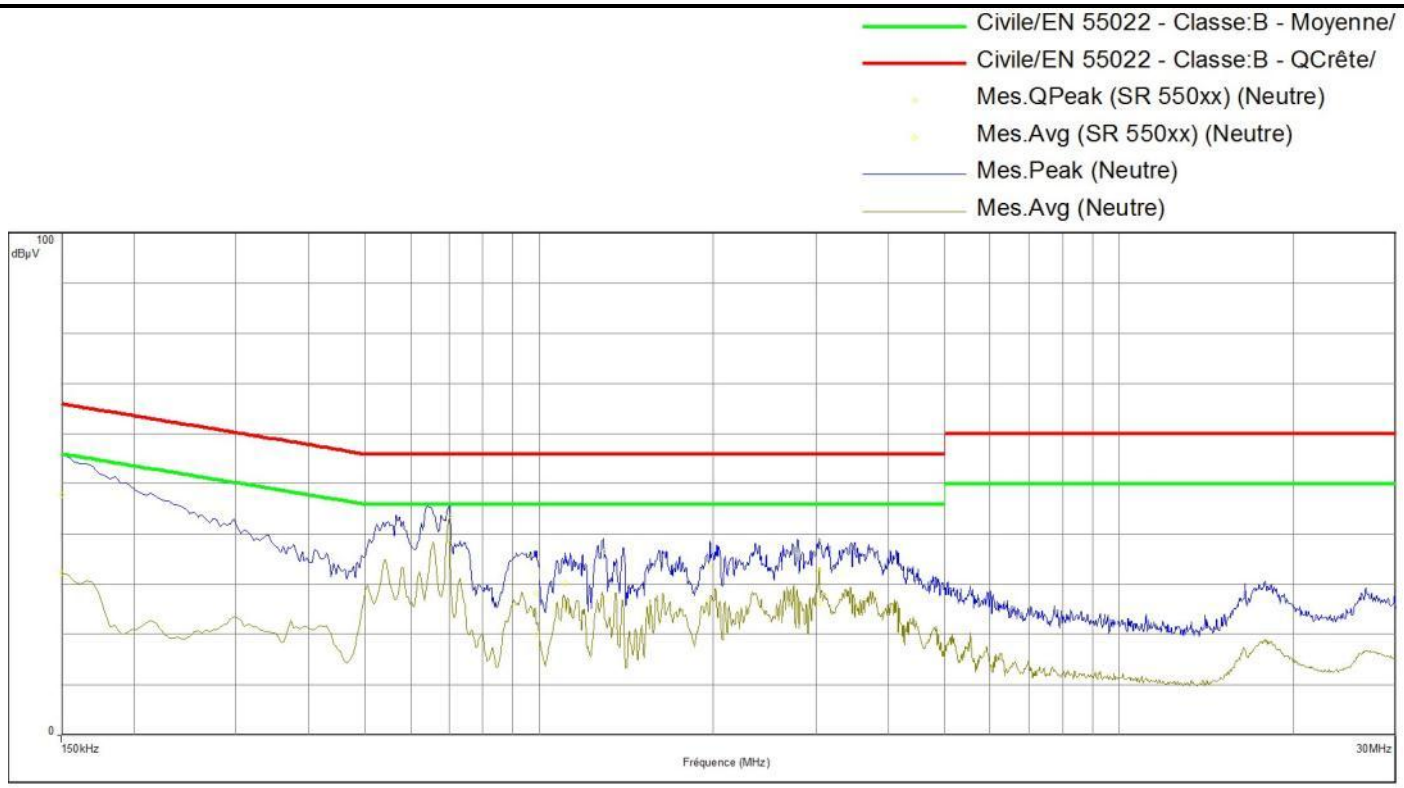
CONDUCTED EMISSIONS			
Graph name:	Emc#1	**Test configuration:**	
Limit:	EN 55022	110V - ALPW-BLEM003 + ALPW-BLEEASYKIT (L)	
Class:	B		
Frequency range: [150kHz - 30MHz]			
Voltage / Frequency:	110VAC / 60Hz	**RBW :**	10kHz
Line:	Phase	**VBW :**	30kHz



Spurious emissions

Frequency (MHz)	Mes.QPeak (dBµV)	LimQP (dBµV)	Mes.QPeak-LimQP (dB)	Mes.Avg (dBµV)	LimAvg (dBµV)	Mes.Avg-LimAvg (dB)
0.15	47.74	66	-18.26	33.06	56	-22.94
0.702	39.56	56	-16.44	32.63	46	-13.37
0.946	32.31	56	-23.69	26.5	46	-19.5
1.096	31.04	56	-24.96	24.49	46	-21.51
1.288	35.11	56	-20.89	27.82	46	-18.18
2.812	30.94	56	-25.06	25.13	46	-20.87

CONDUCTED EMISSIONS			
Graph name:	Emc#2	**Test configuration:**	
Limit:	EN 55022	110V - ALPW-BLEM003 + ALPW-BLEEASYKIT (N)	
Class:	B		
Frequency range: [150kHz - 30MHz]			
Voltage / Frequency:	110VAC / 60Hz	**RBW :**	10kHz
Line:	neutre	**VBW :**	30kHz



Spurious emissions

Frequency (MHz)	Mes.QPeak (dBµV)	LimQP (dBµV)	Mes.QPeak-LimQP (dB)	Mes.Avg (dBµV)	LimAvg (dBµV)	Mes.Avg-LimAvg (dB)
0.15	47.82	66	-18.18	32.3	56	-23.7
0.698	43.57	56	-12.43	38.49	46	-7.51
0.99	28.07	56	-27.93	20.05	46	-25.95
1.108	30.23	56	-25.77	25.73	46	-20.27
1.288	36.51	56	-19.49	26.68	46	-19.32
1.972	33.67	56	-22.33	26.74	46	-19.26
2.792	36.04	56	-19.96	26.09	46	-19.91
3.044	32.75	56	-23.25	26.2	46	-19.8

11. UNCERTAINTIES CHART

Type de mesure / *Kind of measurement*	**Incertitude élargie laboratoire / *Wide uncertainty laboratory* (k=2) ± x**	**Incertitude limite du CISPR / *CISPR uncertainty limit* ± y**
Mesure des perturbations conduites en tension sur le réseau d'énergie *Measurement of conducted disturbances in voltage on the power port*	3.57 dB	3.6 dB
Mesure des perturbations conduites en tension sur le réseau de télécommunication *Measurement of conducted disturbances in voltage on the telecommunication port.*	3.28 dB	A l'étude / Under consid.
Mesure des perturbations discontinues conduites en tension *Measurement of discontinuous conducted disturbances in voltage*	3.47 dB	3.6 dB
Mesure des perturbations conduites en courant *Measurement of conducted disturbances in current*	2.90 dB	A l'étude / Under consid.
Mesure du champ électrique rayonné sur le site en espace libre de Moirans *Measurement of radiated electric field on the Moirans open area test site*	5.07 dB	5.2 dB

Les valeurs d'incertitudes calculées du laboratoire étant inférieures aux valeurs d'incertitudes limites établies par la norme, la conformité de l'échantillon est établie directement par les niveaux limites applicables. / *The uncertainty values calculated by the laboratory are lower than limit uncertainty values defined by the standard. The conformity of the sample is directly established by the applicable limits values.*