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# TEST REPORT

N°: 141034-683751-A (FILE#871966)

Version : 02

**Subject** Electromagnetic compatibility tests according to the standards:  
FCC CFR 47 Part 15, Subpart C  
RSS-247 Issue 1.0

**Issued to** PETZL  
Site de Crolles, Cedex 105A  
38920 - CROLLES  
France

**Apparatus under test**

↳ Product	HEADLAMP
↳ Trade mark	PETZL
↳ Manufacturer	PETZL PRODUCTION
↳ Model under test	NAO+
↳ Serial number	E36053 UFL A04 & E36053 A02
↳ FCCID	2AFG9-E36
↳ IC	20473-E36

**Conclusion** See page 4

**Test date** November 11<sup>th</sup> 2015 to March 3<sup>rd</sup>, 2016  
**Test location** MOIRANS  
**IC Test site** 6500A-1 & 6500A-3  
**Composition of document** 34 pages

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**Written by :**  
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**Tests operator**



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## PUBLICATION HISTORY

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01	March 3rd, 2016	Gaetan DESCHAMPS	Creation of the document
02	May 19th, 2016	Gaetan DESCHAMPS	Correction of Cmid



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## 1. TEST PROGRAM

Standard:

- FCC Part 15, Subpart C 15.247
- ANSI C63.10 (2013)
- RSS-247 Issue 1.0 – May 2015
- RSS-Gen Issue 4 – Nov 2014
- 558074 D01 DTS Measurement Guidance v03r03

EMISSION TEST	LIMITS			RESULTS
	Frequency	Quasi-peak value (dB $\mu$ V)	Average value (dB $\mu$ V)	
<b>Limits for conducted disturbance at mains ports</b> 150kHz-30MHz	150-500kHz	66 to 56	56 to 46	<input checked="" type="checkbox"/> PASS <input type="checkbox"/> FAIL <input type="checkbox"/> NA <input type="checkbox"/> NP
	0.5-5MHz	56	46	
	5-30MHz	60	50	
<b>Radiated emissions</b> 9kHz-30MHz CFR 47 §15.209 (a) CFR 47 §15.247 (d) RSS-247 §5.5	<b>Measure at 300m</b> 9kHz-490kHz : 67.6dB $\mu$ V/m /F(kHz) <b>Measure at 30m</b> 490kHz-1.705MHz : 87.6dB $\mu$ V/m /F(kHz) 1.705MHz-30MHz : 29.5 dB $\mu$ V/m			<input type="checkbox"/> PASS <input type="checkbox"/> FAIL <input checked="" type="checkbox"/> NA <input type="checkbox"/> NP
<b>Radiated emissions</b> 30MHz-25GHz* CFR 47 §15.209 (a) CFR 47 §15.247 (d) RSS-247 §5.5 <b>Highest frequency :16MHz</b> <i>(Declaration of provider)</i>	<b>Measure at 3m</b> 30MHz-88MHz : 40 dB $\mu$ V/m 88MHz-216MHz : 43.5 dB $\mu$ V/m 216MHz-960MHz : 46.0 dB $\mu$ V/m Above 960MHz : 54.0 dB $\mu$ V/m			<input checked="" type="checkbox"/> PASS <input type="checkbox"/> FAIL <input type="checkbox"/> NA <input type="checkbox"/> NP
<b>Bandwidth 6dB</b> CFR 47 §15.247 (a) (2) RSS-247 §5.2.1	<b>At least 500kHz</b>			<input checked="" type="checkbox"/> PASS <input type="checkbox"/> FAIL <input type="checkbox"/> NA <input type="checkbox"/> NP
<b>Power spectral Density</b> CFR 47 §15.247 (e) RSS-247 §5.2.2	<b>Limit: 8dBm/3kHz</b>			<input checked="" type="checkbox"/> PASS <input type="checkbox"/> FAIL <input type="checkbox"/> NA <input type="checkbox"/> NP
<b>Maximum Peak Output Power</b> CFR 47 §15.247 (b) RSS-247 §5.4.4	<b>Limit: 30dBm</b> Conducted or Radiated measurement			<input checked="" type="checkbox"/> PASS <input type="checkbox"/> FAIL <input type="checkbox"/> NA <input type="checkbox"/> NP
<b>Band Edge Measurement</b> CFR 47 §15.209 (a) CFR 47 §15.247 (d) RSS-247 §5.5	<b>Limit: -20dBc or</b> <b>Radiated emissions limits in restricted bands</b>			<input checked="" type="checkbox"/> PASS <input type="checkbox"/> FAIL <input type="checkbox"/> NA <input type="checkbox"/> NP
<b>Occupied bandwidth</b> RSS-Gen §4.6.1	<b>No limit</b>			<input checked="" type="checkbox"/> PASS <input type="checkbox"/> FAIL <input type="checkbox"/> NA <input type="checkbox"/> NP
<b>Receiver Spurious Emission**</b> RSS-Gen §4.10	<b>See RSS-Gen §4.10</b>			<input type="checkbox"/> PASS <input type="checkbox"/> FAIL <input checked="" type="checkbox"/> NA <input type="checkbox"/> 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.



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## 2. SYSTEM TEST CONFIGURATION

### 2.1. HARDWARE IDENTIFICATION (EUT AND AUXILIARIES):

#### Equipment under test (EUT):

NAO+

Serial Number: E36053 UFL A04



Photography of EUT

#### Power supply:

During all the tests, EUT is supplied by  $V_{nom}$ : 3.7VDC

For measurement with different voltage, it will be presented in test method.

Name	Type	Rating	Reference	Comments
Supply1	<input type="checkbox"/> AC <input type="checkbox"/> DC <input checked="" type="checkbox"/> Battery	3.7V, 2600mAh and 9,62Wh	E36053 A08	Li-ion



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**Inputs/outputs - Cable:**

Access	Type	Length used (m)	Declared <3m	Shielded	Under test	Comments
Supply1	Internal Battery	-	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	-
Access1	USB	0.2	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Only used to recharge.

**Auxiliary equipment used during test:**

Type	Reference	Sn	Comments
		None	

**Equipment information:**

Bluetooth LE Type:	<input type="checkbox"/> v4.0		<input checked="" type="checkbox"/> v4.1
Frequency band:	[2400 – 2483.5] MHz		
Spectrum Modulation:	<input checked="" type="checkbox"/> DSSS (Tested like it)		
Number of Channel:	40		
Spacing channel:	2MHz		
Channel bandwidth:	1MHz		
Antenna Type:	<input checked="" type="checkbox"/> Integral	<input type="checkbox"/> External	<input type="checkbox"/> Dedicated
Antenna connector:	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input checked="" type="checkbox"/> Temporary for test
Transmit chains:	<input checked="" type="checkbox"/> 1		
	Single antenna		
	Gain 1: 1.55dBi		Gain 2: dBi
Beam forming gain:	No		
Receiver chains	1		
Type of equipment:	<input checked="" type="checkbox"/> Stand-alone	<input type="checkbox"/> Plug-in	<input type="checkbox"/> Combined
Ad-Hoc mode:	<input type="checkbox"/> Yes		<input checked="" type="checkbox"/> No
Adaptivity mode:	<input checked="" type="checkbox"/> Yes (Load Based)	<input type="checkbox"/> Off mode	<input type="checkbox"/> No
	Clear Channel Assessment Time: $\mu$ s		
	q value for Load Based Equipment:		
Duty cycle:	<input checked="" type="checkbox"/> Continuous duty	<input type="checkbox"/> Intermittent duty	<input type="checkbox"/> 100% duty
Equipment type:	<input checked="" type="checkbox"/> Production model		<input type="checkbox"/> Pre-production model
Operating temperature range:	Tmin:	<input checked="" type="checkbox"/> -20°C	<input type="checkbox"/> 0°C
	Tnom:	20°C	
	Tmax:	<input type="checkbox"/> 35°C	<input checked="" type="checkbox"/> 55°C
Type of power source:	<input type="checkbox"/> AC power supply	<input type="checkbox"/> DC power supply	<input checked="" type="checkbox"/> Battery (Li-ion)
Operating voltage range:	Vmin:	<input type="checkbox"/> 207V/50Hz	<input checked="" type="checkbox"/> 3.2Vdc
	Vnom:	<input type="checkbox"/> 230V/50Hz	<input checked="" type="checkbox"/> 3.7Vdc
	Vmax:	<input type="checkbox"/> 253V/50Hz	<input checked="" type="checkbox"/> 4.2Vdc



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#### CHANNEL PLAN

Channel	Frequency (MHz)	Channel	Frequency (MHz)
<b>Cmin: 0</b>	2402	20	2442
1	2404	21	2444
2	2406	22	2446
3	2408	23	2448
4	2410	24	2450
5	2412	25	2452
6	2414	26	2454
7	2416	27	2456
8	2418	28	2458
9	2420	29	2460
10	2422	30	2462
11	2424	31	2464
12	2426	32	2466
13	2428	33	2468
14	2430	34	2470
15	2432	35	2472
16	2434	36	2474
17	2436	37	2476
18	2438	38	2478
<b>Cmid: 19</b>	2440	<b>Cmax: 39</b>	2480

#### DATA RATE

Data Rate (Mbps)	Modulation Type	Worst Case Modulation
1	GFSK	<input checked="" type="checkbox"/>



## 2.2. EUT CONFIGURATION

The EUT is set in the following modes during tests with software (SDK 8.0 / DTM):

- Permanent emission with modulation on a fixed channel in the data rate that produced the highest power
- Permanent reception

For the conducted and radiated emission data, the test configurations are:

- Configuration 1: The EUT is powered by USB, the LED and Bluetooth function is off. The USB recharges the internal battery (the charge indicator is on).
- Configuration 2: The EUT is powered by battery, the LED and Bluetooth are on.

For the others test the EUT is set in different radio emission mode with the following sequences:

- TX 2402: 0x80 0x28
- TX 2440: 0x93 0x28
- TX 2480: 0xA7 0x28
- RX 2402: 0x40 0x28
- RX 2440: 0x53 0x28
- RX 2480: 0x67 0x28
- Reset: 0x00 0x00
- Test End: 0xC0 0x00

Firmware / Software Lamp version: V1.1

## 2.3. EQUIPMENT MODIFICATIONS

None  Modification:

## 2.4. 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 52.5dB $\mu$ V 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 dB $\mu$ V/m.

$$FS = 52.5 + 7.4 + 1.1 - 29 = 32 \text{ dB}\mu\text{V/m}$$

The 32 dB $\mu$ V/m value can be mathematically converted to its corresponding level in  $\mu$ V/m.

$$\text{Level in } \mu\text{V/m} = \text{Common Antilogarithm } [(32 \text{ dB}\mu\text{V/m})/20] = 39.8 \mu\text{V/m.}$$



### 3. CONDUCTED EMISSION DATA

#### 3.1. ENVIRONMENTAL CONDITIONS

Date of test	March 1, 2016	:
Test performed by	Gaëtan DESCHAMPS	:
Atmospheric pressure (hPa)	999	:
Relative humidity (%)	32	:
Ambient temperature (°C)	23	:

#### 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 C63.10 and FCC Part 15 subpart C. The product has been tested with 120V/60Hz power line voltage and compared to the FCC Part 15 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  $50\Omega / 50\mu\text{H}$ . 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	Cal_Date	Cal_Due
Cable + self	-	-	A5329578	07/15	07/16
Conducted emission comb generator	BARDET	-	A3169049	-	-
LISN	RHODE & SCHWARZ	ENV216	C2320291	11/15	11/16
Receiver 20Hz – 8GHz	ROHDE & SCHWARZ	ESU8	A2642019	04/15	04/16
BAT EMC	NEXIO	v3.9.0.10	L1000115	-	-
Thermo-hygrometer (PM2)	OREGON	BAR916HG-G	B4206011	09/15	09/16
Transient limiter	RHODE & SCHWARZ	ESH3-Z2	A7122204	01/16	01/17

### 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.

#### Only the configuration 1:

##### Results: (PEAK detection)

Measure on L1:

graph Emc#1

(see annex 1)

Measure on N:

graph Emc#2

(see annex 1)

### 3.7. CONCLUSION

Conducted emission data measurement performed on the sample of the product NAO+, SN: E36053 UFL A04, in configuration and description presented in this test report, show levels below the FCC CFR 47 Part 15 and RSS-247 limits.

## 4. RADIATED EMISSION DATA

### 4.1. ENVIRONMENTAL CONDITIONS

Date of test February 29, 2016  
 Test performed by Gaëtan DESCHAMPS  
 Atmospheric pressure (hPa) 999  
 Relative humidity (%) 32  
 Ambient temperature (°C) 23

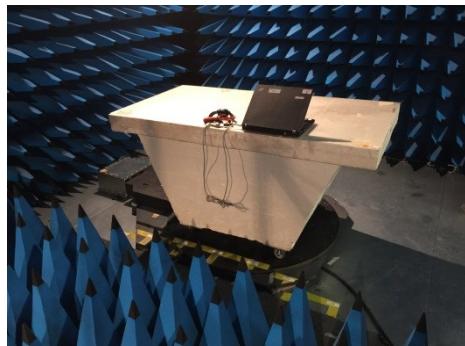
### 4.2. TEST SETUP

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.

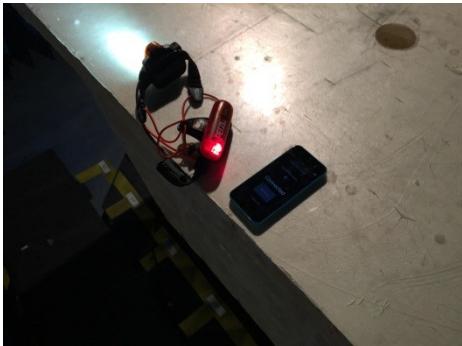
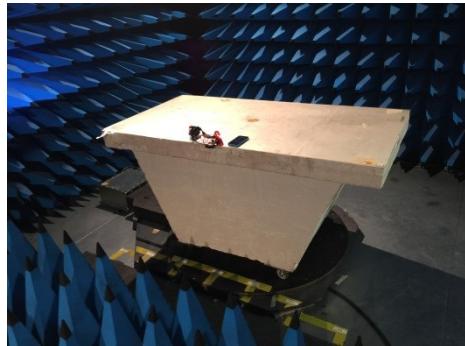
The EUT and auxiliaries are set:

- 80cm above the ground on the non-conducting table (Table-top equipment) - Below 1GHz
- 150cm above the ground on the non-conducting table (Table-top equipment) - Above 1GHz
- 10cm above the ground on isolating support (Floor standing equipment)

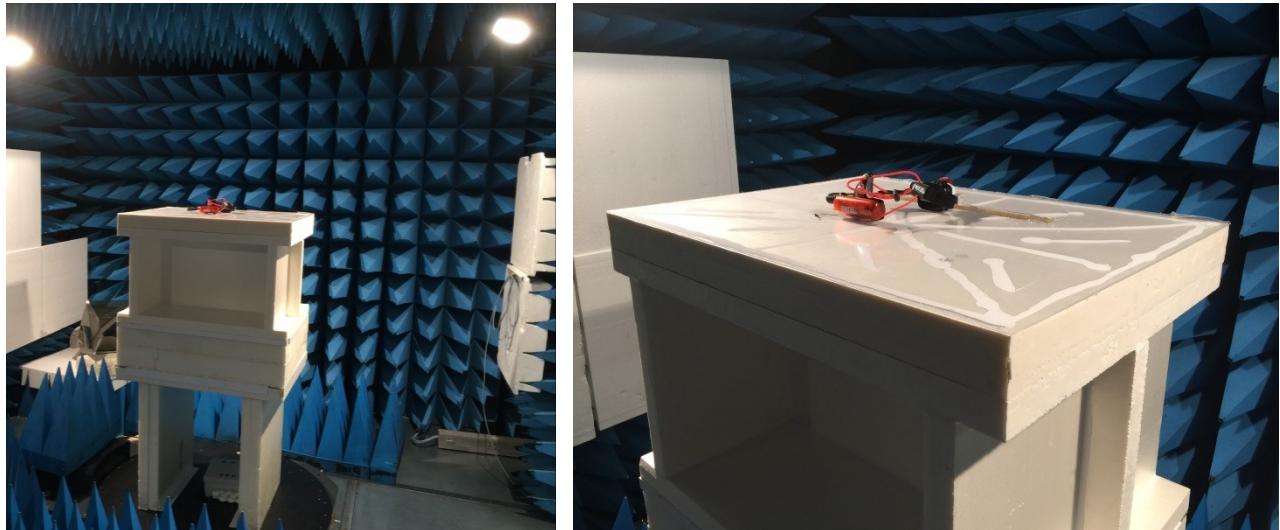
The EUT is powered by  $V_{nom}$ .



Test setup in anechoic chamber for configuration1



Test setup in anechoic chamber for configuration2



#### 4.3. TEST METHOD

The product has been tested according to ANSI C63.10, FCC part 15 subpart C.

Pre-characterisation measurement: (9kHz – 1GHz)

A pre-scan of all the setup has been performed in a 3 meters semi-anechoic chamber for frequency from 30MHz to 1GHz. Test is performed in horizontal (H) and vertical (V) polarization, the loop antenna was rotated during the test to maximize 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.

Characterization on 10 meters open site from 9kHz to 1GHz:

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 limits. 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 to maximize 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 C limits. Measurement bandwidth was 1MHz above 1GHz.

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 (EUT smaller than the beamwidth of the measurement antenna, ANSI C63.10 §6.6.5)  
Frequency list has been created with anechoic chamber pre-scan results.



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#### 4.4. TEST EQUIPMENT LIST

DESCRIPTION	MANUFACTURER	MODEL	Nº LCIE	Cal_Date	Cal_Due
Amplifier 0.1MHz – 1300 MHz	HEWLETT PACKARD	8447D	A7085009	01/16	01/17
Antenna Bi-Log XWing	TESEQ	CBL6144	C2040146	11/14	11/16
Emission Cable	MICRO-COAX	6GHz	A5329654	04/15	04/16
Emission Cable	MICRO-COAX	6GHz	A5329655	04/15	04/16
Emission Cable	MICRO-COAX	6GHz	A5329656	04/15	04/16
Semi-Anechoic chamber #2	SIEPEL	-	D3044015	03/15	03/16
Radiated emission comb generator	BARDET	-	A3169050	-	-
Spectrum Analyzer 9kHz - 6GHz	ROHDE & SCHWARZ	FSL6	A2642020	01/16	01/17
BAT EMC	NEXIO	v3.9.0.10	L1000115	-	-
Thermo-hygrometer (PM2)	OREGON	BAR916HG-G	B4206011	09/15	09/16
Turntable controller (Cage#2)	ETS Lingren	Model 2066	F2000393	-	-
Turntable chamber (Cage#2)	ETS Lingren	Model 2165	F2000404	-	-
Table	MATURO GmbH	-	F2000437	-	-

#### 4.5. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

None

Divergence:



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## 4.6. TEST RESULTS

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

See graphs for 30MHz-1GHz:

Graph identifier	Polarization	EUT position	Comments	
Emr# 1	H/V	Axis XY	Configuration 1	See Annex1
Emr# 2	H/V	Axis XY	Configuration 2	See Annex 1

### 4.6.2. 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 significant suspect frequency observed.

### 4.6.3. 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 (dB $\mu$ V/m)	Measure Peak (dB $\mu$ V/m)	Margin Peak (dB)	Limit Average (dB $\mu$ V/m)	Measure Average (dB $\mu$ V/m)	Margin Average (dB)	Angle Table (°)	Pol. Ant.	Ht. Ant. (cm)	FC (dB)	Remark
1	2332.100	74.0	37.9	<b>-36.1</b>	54.0	25.1	<b>-28.9</b>	0	H	150	-2.6	
2	2388.040	74.0	38.1	<b>-35.9</b>	54.0	25.2	<b>-28.8</b>	0	H	150	-2.5	
3	4804.000	74.0	50.8	<b>-23.2</b>	54.0	38.6	<b>-15.4</b>	130	H	150	3.6	
4	4880.000	74.0	52.6	<b>-21.4</b>	54.0	41.7	<b>-12.3</b>	150	H	150	3.8	
5	4960.000	74.0	56.2	<b>-17.8</b>	54.0	45.3	<b>-8.7</b>	130	H	150	4.0	
6	7320.000	74.0	55.8	<b>-18.2</b>	54.0	43.0	<b>-11.0</b>	355	H	150	7.5	
7	7440.000	74.0	53.1	<b>-20.9</b>	54.0	39.7	<b>-14.3</b>	0	H	150	7.7	

Note: Measures have been done at 3m distance.

## 4.7. CONCLUSION

Radiated emission data measurement performed on the sample of the product NAO+, SN: E36053 UFL A04, in configuration and description presented in this test report, show levels below the FCC CFR 47 Part 15 and RSS-247 limits.



## 5. BANDWIDTH (15.247)

### 5.1. TEST CONDITIONS

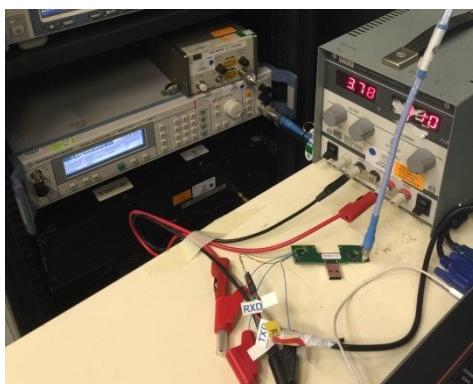
Date of test :November 16<sup>th</sup>, 2015  
Test performed by :G.Deschamps  
Atmospheric pressure (hPa) :994  
Relative humidity (%) :34  
Ambient temperature (°C) :23

### 5.2. 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.

Offset: Attenuator+cable 11dB



#### **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: §8.1 Option 1 (DTS Measurement Guidance)**

1. Set resolution bandwidth (RBW) = 100kHz.
2. Set the video bandwidth (VBW)  $\geq 3 \times$  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.



### 5.3. TEST EQUIPMENT LIST

DESCRIPTION	MANUFACTURER	MODEL	N° LCIE	Cal_Date	Cal_Due
Attenuator 10dB	AEROFLEX	-	A7122267	02/15	02/16
Cable Measure	-	40G	A5329604	12/14	12/15
Spectrum analyzer	ROHDE & SCHWARZ	FSV 30	A4060050	01/15	01/16
Thermo-hygrometer (PM2)	OREGON	BAR916HG-G	B4206011	09/15	09/16

### 5.4. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

None

Divergence:



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## 5.5. TEST SEQUENCE AND RESULTS

Channel	Channel Frequency (MHz)	6dB Bandwidth (MHz)	Bandwidth Limit (MHz)
C0	2402	0.676	>0.5
C20	2440	0.678	>0.5
C39	2480	0.668	>0.5

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1	1	1	2.402019 GHz	2.84 dBm	ndB down	676.0 kHz
T1	1	1	2.401691 GHz	-3.07 dBm	ndB	6.00 dB
T2	1	1	2.402367 GHz	-3.18 dBm	Q factor	3553.3

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1	1	1	2.440033 GHz	3.39 dBm	ndB down	678.0 kHz
T1	1	1	2.439593 GHz	-2.61 dBm	ndB	6.00 dB
T2	1	1	2.440371 GHz	-2.54 dBm	Q factor	3598.9

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1	1	1	2.480023 GHz	3.30 dBm	ndB down	668.0 kHz
T1	1	1	2.479599 GHz	-2.68 dBm	ndB	6.00 dB
T2	1	1	2.480367 GHz	-2.85 dBm	Q factor	3712.6

## 5.6. CONCLUSION

Bandwidth measurement performed on the sample of the product NAO+, SN: E36053 UFL A04, in configuration and description presented in this test report, show levels below the FCC CFR 47 Part 15 and RSS-247 limits.



## 6. MAXIMUM PEAK OUTPUT POWER (15.247)

### 6.1. TEST CONDITIONS

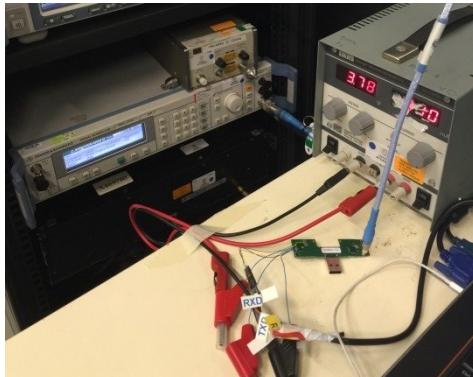
Date of test :November 16<sup>th</sup>, 2015  
Test performed by :G.Deschamps  
Atmospheric pressure (hPa) :994  
Relative humidity (%) :34  
Ambient temperature (°C) :23

### 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.

Offset: Attenuator+cable 11dB



#### **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      §9.1.1 (DTS Measurement Guidance)**

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

- Set the RBW  $\geq$  DTS bandwidth.
- Set VBW  $\geq 3 \times$  RBW.
- Set span  $\geq 3 \times$  RBW
- Sweep time = auto couple.
- Detector = peak.
- Trace mode = max hold.
- Allow trace to fully stabilize.
- 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.

- Set the RBW = 1 MHz.
- Set the VBW  $\geq 3 \times$  RBW
- Set the span  $\geq 1.5 \times$  DTS bandwidth.
- Detector = peak.
- Sweep time = auto couple.
- Trace mode = max hold.
- Allow trace to fully stabilize.
- 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	Nº LCIE	Cal_Date	Cal_Due
Attenuator 10dB	AEROFLEX	-	A7122267	02/15	02/16
Cable Measure	-	40G	A5329604	12/14	12/15
Spectrum analyzer	ROHDE & SCHWARZ	FSV 30	A4060050	01/15	01/16
Thermo-hygrometer (PM2)	OREGON	BAR916HG-G	B4206011	09/15	09/16

### **6.4. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION**

None

Divergence:



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## 6.5. TEST SEQUENCE AND RESULTS

### Modulation:

Channel	Peak Output Power (dBm)	Power Limit (dBm)
C0	3.21	30.0
C20	3.53	30.0
C39	3.60	30.0

## 6.6. CONCLUSION

Maximum Peak Output Power measurement performed on the sample of the product NAO+, SN: E36053 UFL A04, in configuration and description presented in this test report, show levels below the FCC CFR 47 Part 15 and RSS-247 limits.



## 7. POWER SPECTRAL DENSITY (15.247)

### 7.1. TEST CONDITIONS

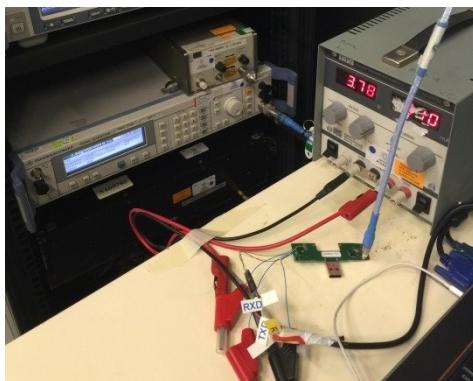
Date of test :November 16<sup>th</sup>, 2015  
Test performed by :G.Deschamps  
Atmospheric pressure (hPa) :994  
Relative humidity (%) :34  
Ambient temperature (°C) :23

### 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.

Offset: Attenuator+cable 11dB



#### **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: §10.2 (DTS Measurement Guidance)**

- 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.
- d) Set the VBW  $\geq 3 \times$  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	Nº LCIE	Cal_Date	Cal_Due
Attenuator 10dB	AEROFLEX	-	A7122267	02/15	02/16
Cable Measure	-	40G	A5329604	12/14	12/15
Spectrum analyzer	ROHDE & SCHWARZ	FSV 30	A4060050	01/15	01/16
Thermo-hygrometer (PM2)	OREGON	BAR916HG-G	B4206011	09/15	09/16

**7.4. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION** None Divergence:



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## 7.5. TEST SEQUENCE AND RESULTS

### Modulation:

Channel	Channel Frequency (MHz)	Power Spectral Density (dBm)	PSD Limit (dBm)
C0	2402	-10.1	8.0
C20	2440	-9.6	8.0
C39	2480	-9.5	8.0

## 7.6. CONCLUSION

Power Spectral Density measurement performed on the sample of the product NAO+, SN: E36053 UFL A04, in configuration and description presented in this test report, show levels below the FCC CFR 47 Part 15 and RSS-247 limits.



## 8. BAND EDGE MEASUREMENT (15.247)

### 8.1. TEST CONDITIONS

Date of test :November 12<sup>th</sup>,2015  
Test performed by :G.Deschamps  
Atmospheric pressure (hPa) :999  
Relative humidity (%) :32  
Ambient temperature (°C) :23

### 8.2. LIMIT

#### **RF antenna conducted test: § 11 (DTS Measurement Guidance)**

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: § 12 (DTS Measurement Guidance)**

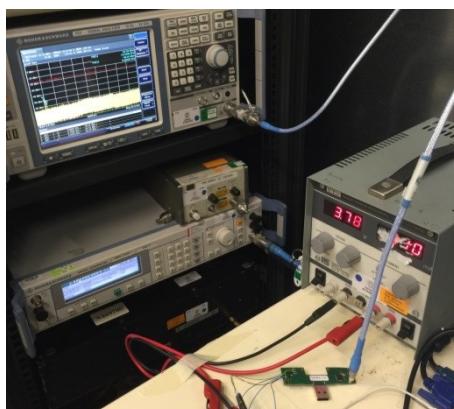
Applies to harmonics/spurs that fall in the restricted bands listed in Section 15.205. The maximum permitted average field strength is listed in Section 15.209. For measurements above 1 GHz, set RBW = 1MHz, VBW = 10 Hz, Sweep: Auto. If the emission is pulsed, modify the unit for continuous operation; 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	Cal_Date	Cal_Due
Attenuator 10dB	AEROFLEX	-	A7122267	02/15	02/16
Cable	-	-	A5329705	11/14	11/15
Spectrum analyzer	ROHDE & SCHWARZ	FSV 30	A4060050	01/15	01/16
Thermo-hygrometer (PM2)	OREGON	BAR916HG-G	B4206011	09/15	09/16

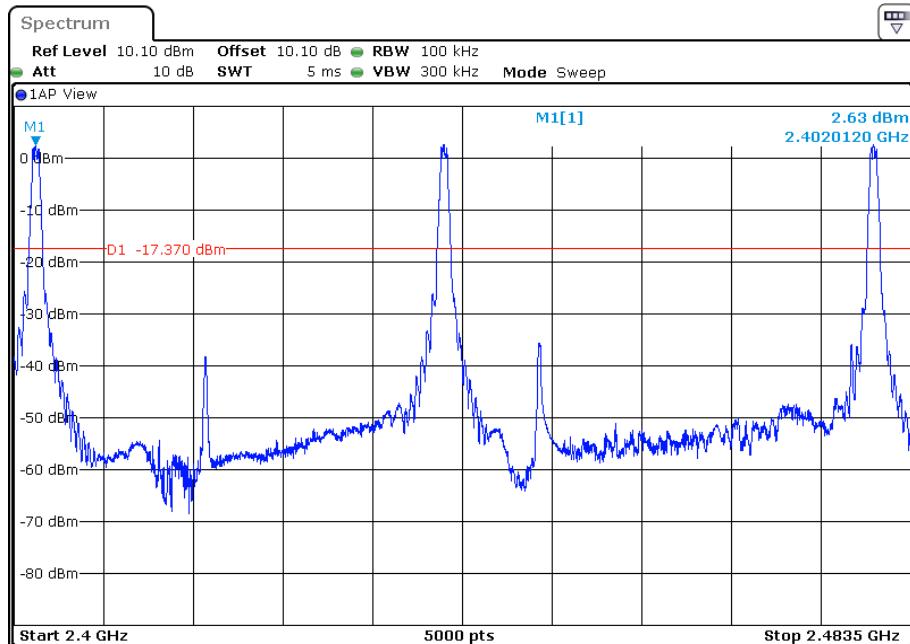
#### 8.5. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

None       Divergence:

#### 8.6. TEST SEQUENCE AND RESULTS

Offset: Attenuator+cable 10.1dB

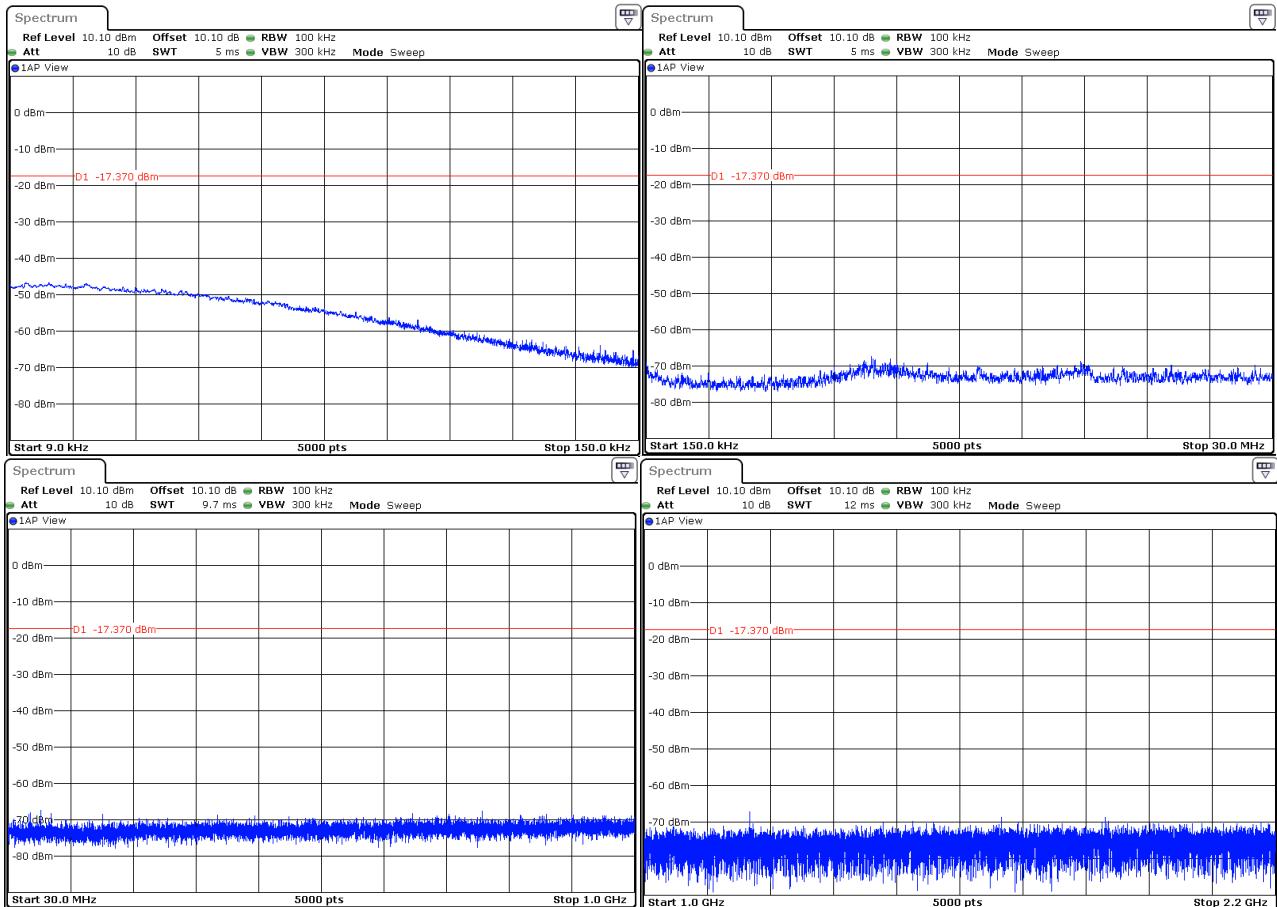
GRAPH / MODULATION.



Worst case in Cmin and display line at -17.37dBm

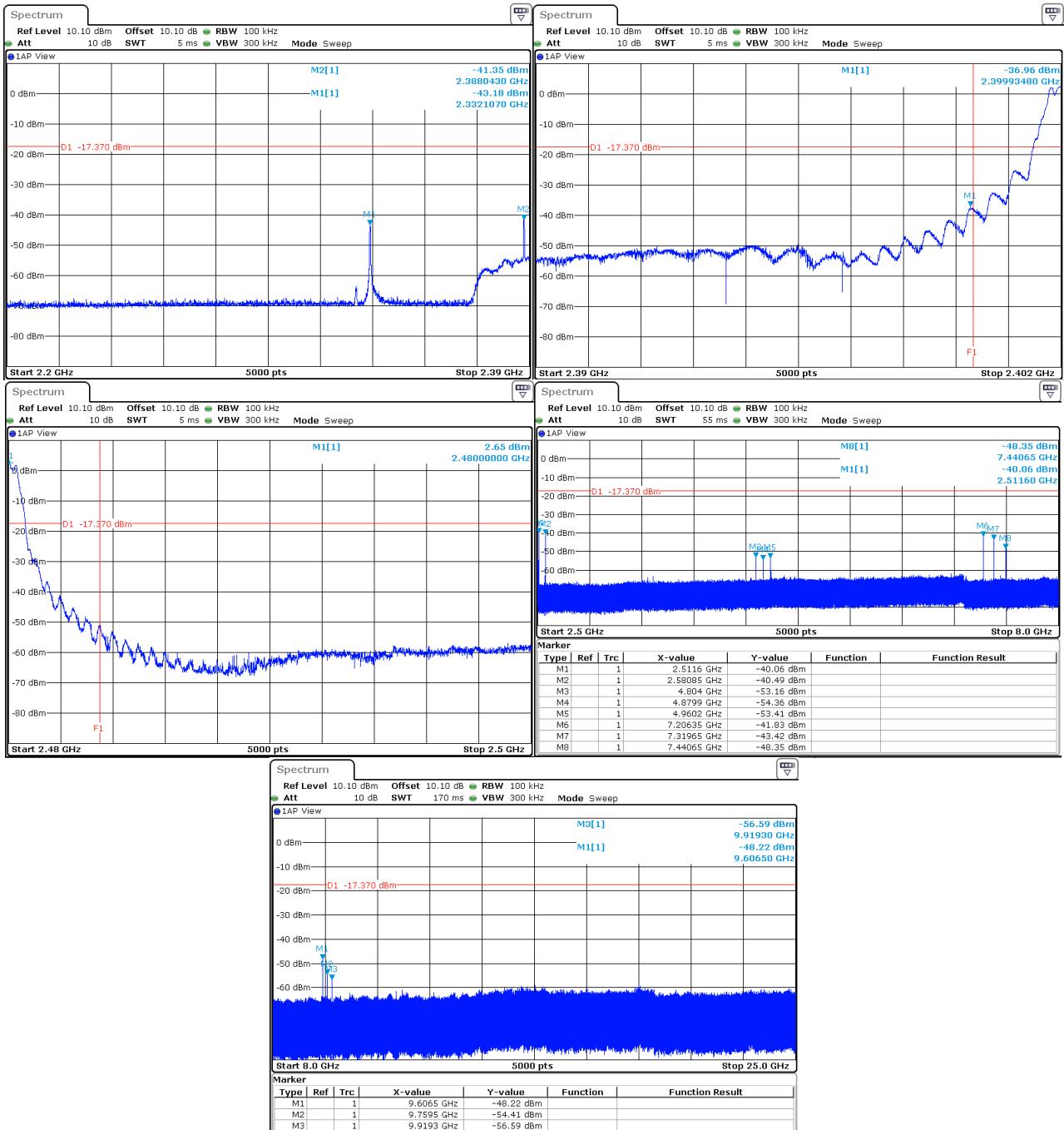


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## 8.7. CONCLUSION

Band Edge Measurement performed on the sample of the product NAO+, SN: E36053 UFL A04, in configuration and description presented in this test report, show levels below the FCC CFR 47 Part 15 and RSS-247 limits.



## 9. OCCUPIED BANDWIDTH

### 9.1. TEST CONDITIONS

Date of test : November 16<sup>th</sup>, 2015  
Test performed by : G.Deschamps  
Atmospheric pressure (hPa) : 994  
Relative humidity (%) : 34  
Ambient temperature (°C) : 23

### 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.

Offset: Attenuator+cable 11dB

#### **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 Procedure:**

- RBW shall be in the range of 1% to 5% of the anticipated occupied bandwidth
- Set the video bandwidth (VBW)  $\geq 3 \times$  RBW
- SPAN = Capture all products of the modulation process
- Detector = Peak.
- Trace mode = max hold.
- Sweep = auto couple.
- Allow the trace to stabilize.
- OBW 99% function of spectrum analyzer used

### 9.3. TEST EQUIPMENT LIST

DESCRIPTION	MANUFACTURER	MODEL	N° LCIE	Cal_Date	Cal_Due
Attenuator 10dB	AEROFLEX	-	A7122267	02/15	02/16
Cable	-	-	A5329705	11/14	11/15
Spectrum analyzer	ROHDE & SCHWARZ	FSV 30	A4060050	01/15	01/16
Thermo-hygrometer (PM2)	OREGON	BAR916HG-G	B4206011	09/15	09/16

### 9.4. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

None       Divergence:



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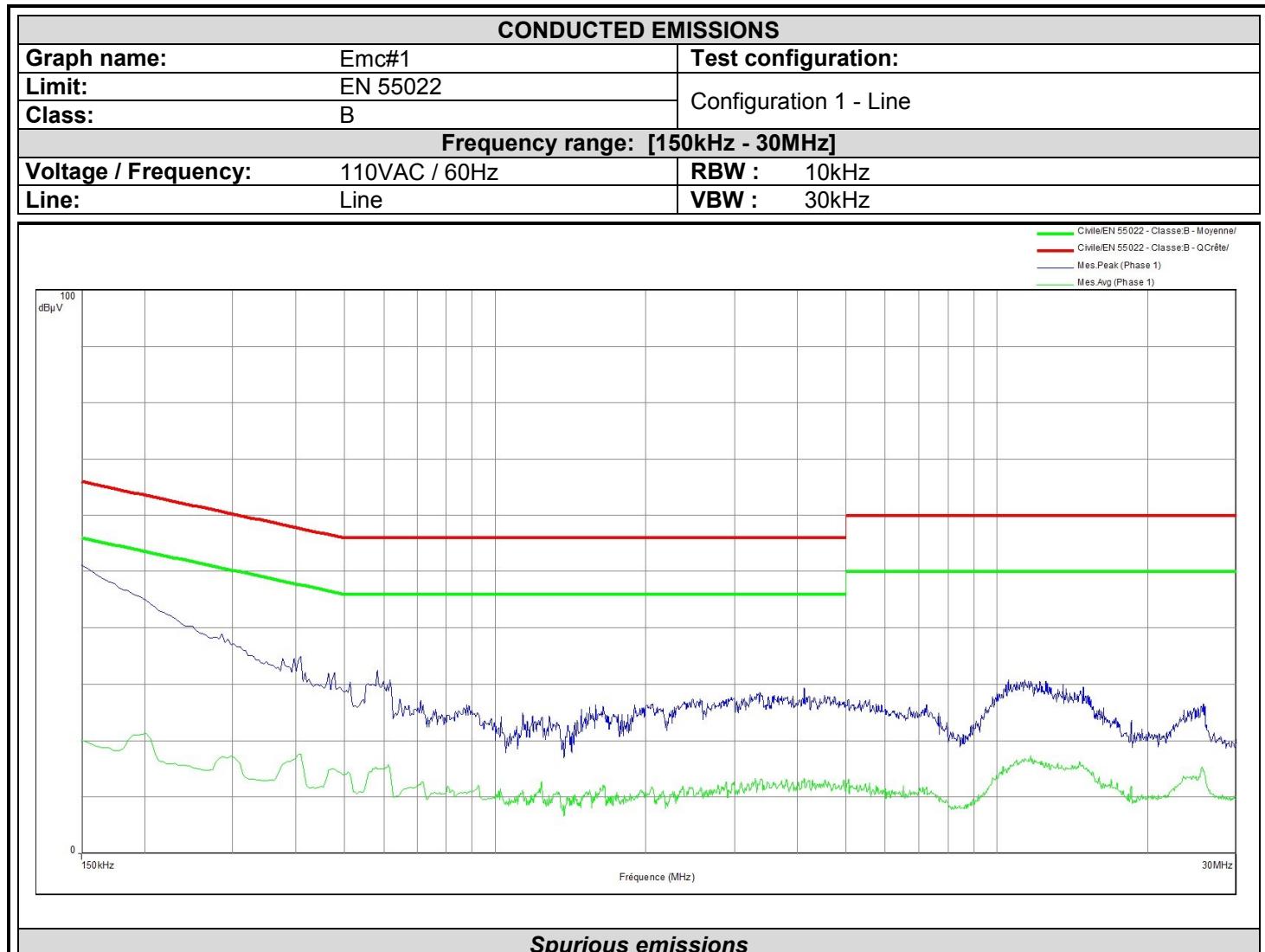
## 9.5. TEST SEQUENCE AND RESULTS

Channel	Channel Frequency (MHz)	99% Occupied Bandwidth (MHz)
C0	2402	1.001
C20	2440	0.997
C39	2480	0.984



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## 10. ANNEX 1 (GRAPHS)

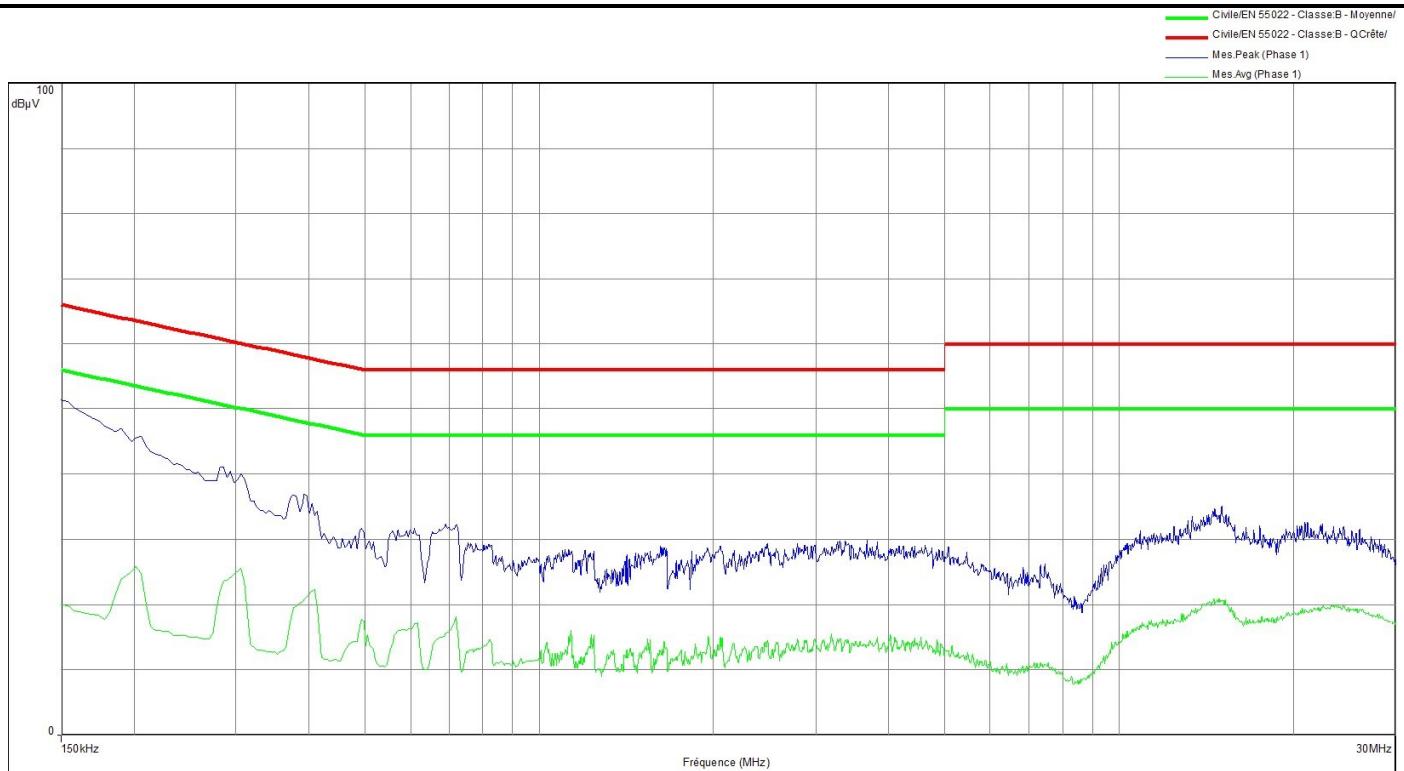




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### CONDUCTED EMISSIONS

Graph name:	Emc#2	Test configuration:
Limit:	EN 55022	Configuration 1 - Neutral
Class:	B	
<b>Frequency range: [150kHz - 30MHz]</b>		
Voltage / Frequency:	110VAC / 60Hz	RBW : 10kHz
Line:	Neutral	VBW : 30kHz



### Spurious emissions

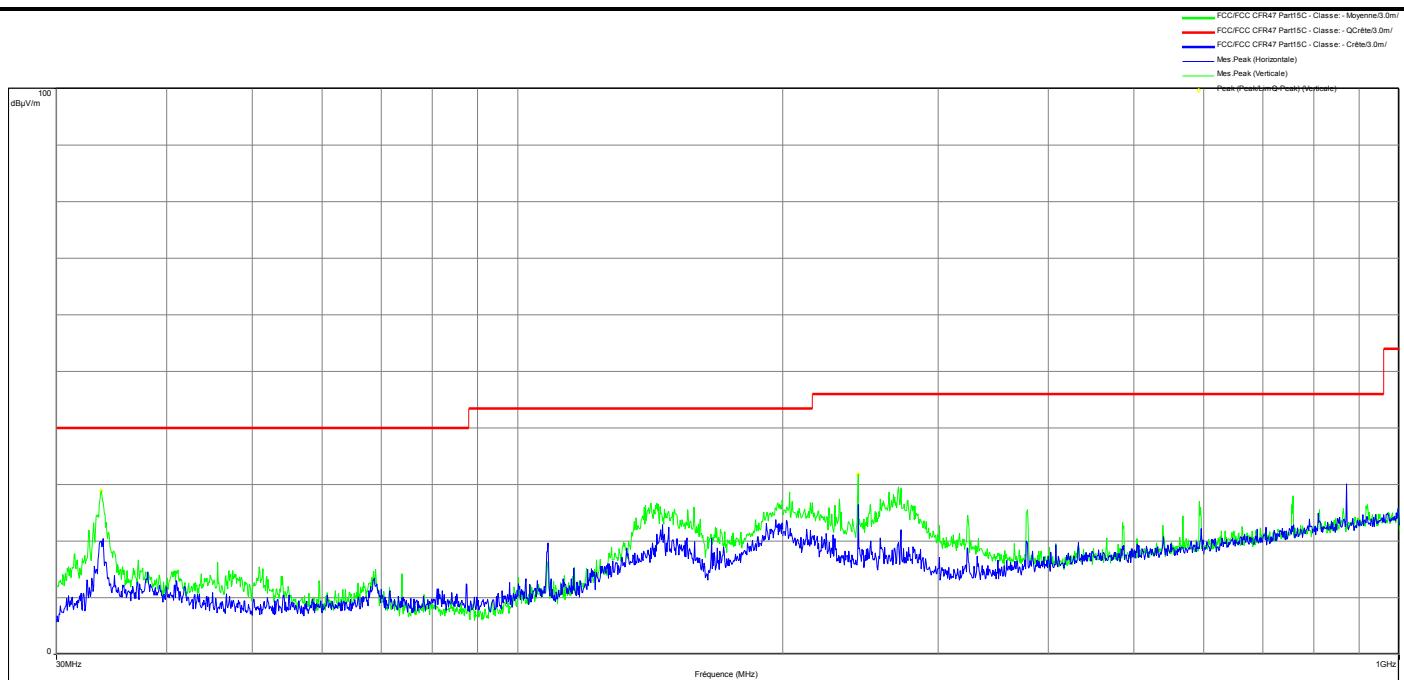
Frequency (MHz)	Peak (dB $\mu$ V)	LimM (dB $\mu$ V)	Peak-LimM (dB)
0.15	51.4	56	-4.6
15.004	35.16	50	-14.84



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### RADIATED EMISSIONS

Graph name:	Emr#1	Test configuration:
Limit:	FCC CFR47 Part15C	(H+V) - Configuration 1 <1GHz
Class:		
<b>Frequency range: [30MHz - 1GHz]</b>		
Antenna polarization:	Horizontal & Vertical	
Azimuth:	0° - 360°	
<small>FCC/CFCC CFR47 Part15C - Classe : Moyenne 3.0m/ FCC/CFCC CFR47 Part15C - Classe : Crête 3.0m/ FCC/CFCC CFR47 Part15C - Classe : Crête 3.0m/ Mes Peak (Horizontale) Mes Peak (Verticale) Peak (Peak H) &amp; Peak (Peak V)</small>		



### Spurious emissions

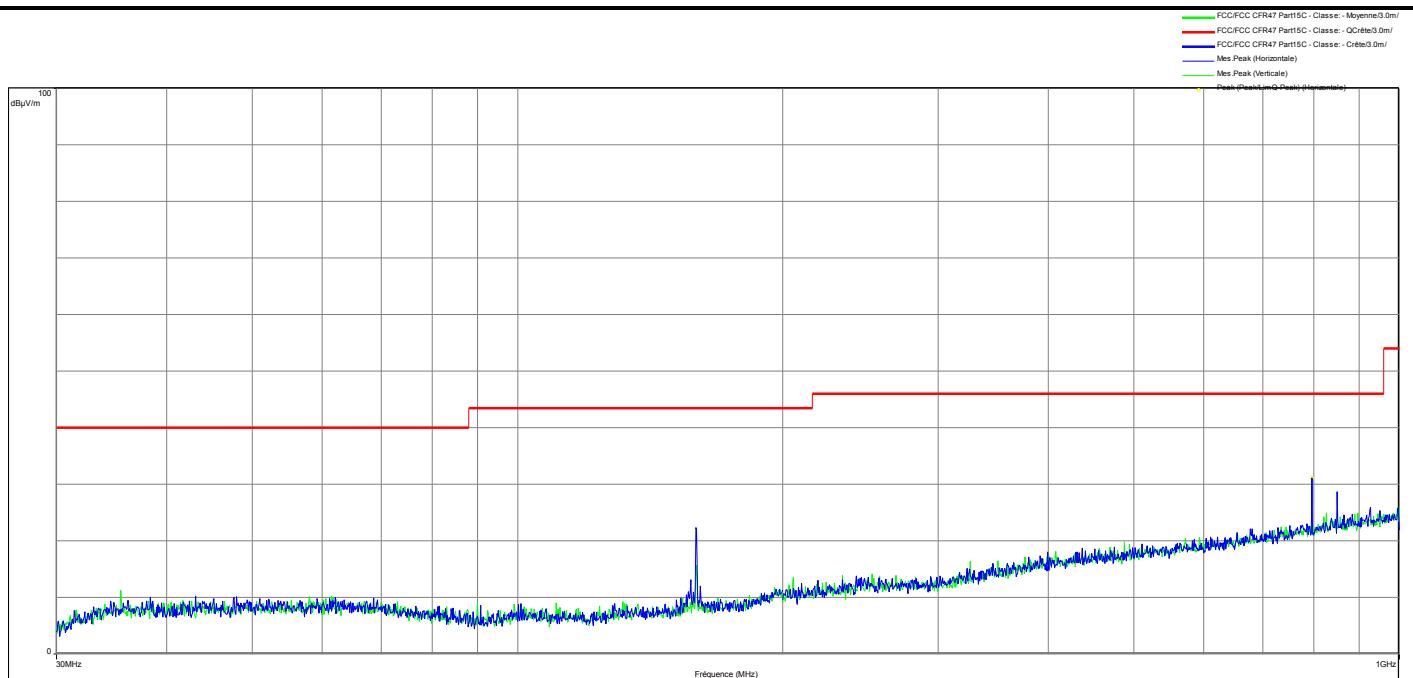
Frequency (MHz)	Peak (dBµV/m)	LimQP (dBµV/m)	Peak-LimQP (dB)	Polarisation
33.740	28.9	40.0	-11.1	Vertical
243.400	31.8	46.0	-14.2	Vertical



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### RADIATED EMISSIONS

Graph name:	Emr#2	Test configuration:
Limit:	FCC CFR47 Part15C	(H+V) - Configuration 2 <1GHz
Class:		
<b>Frequency range: [30MHz - 1GHz]</b>		
Antenna polarization:	Horizontal & Vertical	RBW : 100kHz
Azimuth:	0° - 360°	VBW : 300kHz



### Spurious emissions

Frequency (MHz)	Peak (dB $\mu$ V/m)	LimQP (dB $\mu$ V/m)	Peak-LimQP (dB)	Polarisation
796.400	31.1	46.0	-14.9	Horizontal



## 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 <i>Measurement of conducted disturbances in voltage on the power port</i>	3.57 dB	3.6 dB
Mesure des perturbations conduites en tension sur le réseau de télécommunication <i>Measurement of conducted disturbances in voltage on the telecommunication port.</i>	3.28 dB	A l'étude / Under consid.
Mesure des perturbations discontinues conduites en tension <i>Measurement of discontinuous conducted disturbances in voltage</i>	3.47 dB	3.6 dB
Mesure des perturbations conduites en courant <i>Measurement of conducted disturbances in current</i>	2.90 dB	A l'étude / Under consid.
Mesure du champ électrique rayonné sur le site en espace libre de Moirans <i>Measurement of radiated electric field on the Moirans open area test site</i>	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.