



LCIE

TEST REPORT

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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
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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 11th 2015 to March 3rd, 2016

Test location MOIRANS

IC Test site 6500A-1 & 6500A-3

Composition of document 34 pages

Document issued on May 19th, 2016

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SUMMARY

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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 |
|---|---|--------------------------------|-----------------------------|---|
| Limits for conducted disturbance at mains ports 150kHz-30MHz | Frequency | Quasi-peak value (dBµV) | Average value (dBµV) | <input checked="" type="checkbox"/> PASS <input type="checkbox"/> FAIL <input type="checkbox"/> NA <input type="checkbox"/> NP |
| | 150-500kHz | 66 to 56 | 56 to 46 | |
| | 0.5-5MHz | 56 | 46 | |
| | 5-30MHz | 60 | 50 | |
| Radiated emissions 9kHz-30MHz <i>CFR 47 §15.209 (a)</i> <i>CFR 47 §15.247 (d)</i> <i>RSS-247 §5.5</i> | 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 | | | <input type="checkbox"/> PASS <input type="checkbox"/> FAIL <input checked="" type="checkbox"/> NA <input type="checkbox"/> NP |
| Radiated emissions 30MHz-25GHz* <i>CFR 47 §15.209 (a)</i> <i>CFR 47 §15.247 (d)</i> <i>RSS-247 §5.5</i> Highest frequency :16MHz (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 | | | <input checked="" type="checkbox"/> PASS <input type="checkbox"/> FAIL <input type="checkbox"/> NA <input type="checkbox"/> NP |
| Bandwidth 6dB <i>CFR 47 §15.247 (a) (2)</i> <i>RSS-247 §5.2.1</i> | At least 500kHz | | | <input checked="" type="checkbox"/> PASS <input type="checkbox"/> FAIL <input type="checkbox"/> NA <input type="checkbox"/> NP |
| Power spectral Density <i>CFR 47 §15.247 (e)</i> <i>RSS-247 §5.2.2</i> | Limit: 8dBm/3kHz | | | <input checked="" type="checkbox"/> PASS <input type="checkbox"/> FAIL <input type="checkbox"/> NA <input type="checkbox"/> NP |
| Maximum Peak Output Power <i>CFR 47 §15.247 (b)</i> <i>RSS-247 §5.4.4</i> | Limit: 30dBm Conducted or Radiated measurement | | | <input checked="" type="checkbox"/> PASS <input type="checkbox"/> FAIL <input type="checkbox"/> NA <input type="checkbox"/> NP |
| Band Edge Measurement <i>CFR 47 §15.209 (a)</i> <i>CFR 47 §15.247 (d)</i> <i>RSS-247 §5.5</i> | Limit: -20dBc or Radiated emissions limits in restricted bands | | | <input checked="" type="checkbox"/> PASS <input type="checkbox"/> FAIL <input type="checkbox"/> NA <input type="checkbox"/> NP |
| Occupied bandwidth <i>RSS-Gen §4.6.1</i> | No limit | | | <input checked="" type="checkbox"/> PASS <input type="checkbox"/> FAIL <input type="checkbox"/> NA <input type="checkbox"/> NP |
| Receiver Spurious Emission** <i>RSS-Gen §4.10</i> | See RSS-Gen §4.10 | | | <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.

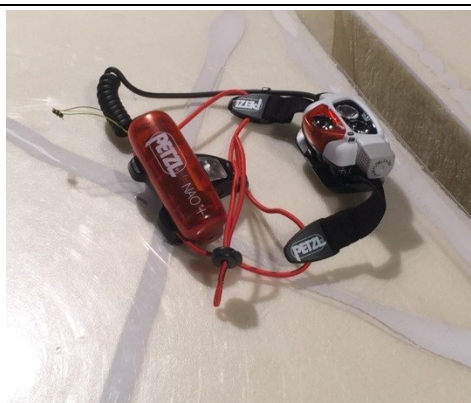
2. SYSTEM TEST CONFIGURATION

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 |



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: | | µs | |
| | 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 | <input type="checkbox"/> °C |
| | Tnom: | 20°C | | |
| | Tmax: | <input type="checkbox"/> 35°C | <input checked="" type="checkbox"/> 55°C | <input type="checkbox"/> °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 | |



CHANNEL PLAN

| Channel | Frequency (MHz) | Channel | Frequency (MHz) |
|-----------------|-----------------|-----------------|-----------------|
| Cmin: 0 | 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 |
| Cmid: 19 | 2440 | Cmax: 39 | 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 μ 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 μ V/m.

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

The 32 dB μ V/m value can be mathematically converted to its corresponding level in μ 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

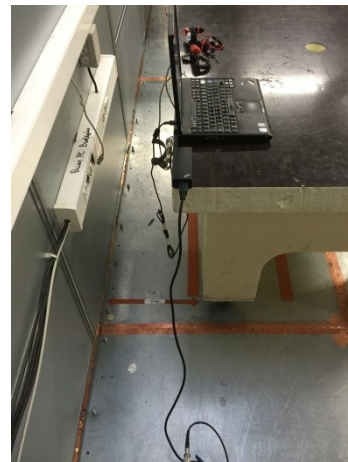
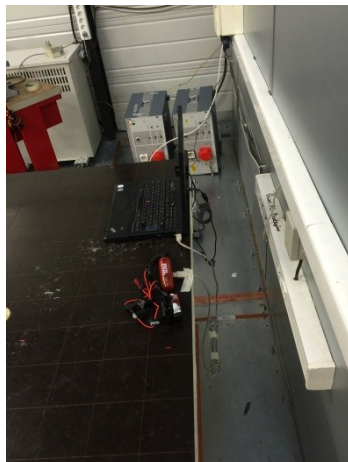
The EUT and auxiliaries are set:

- ☒ 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 $50\Omega / 50\mu H$. 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 |

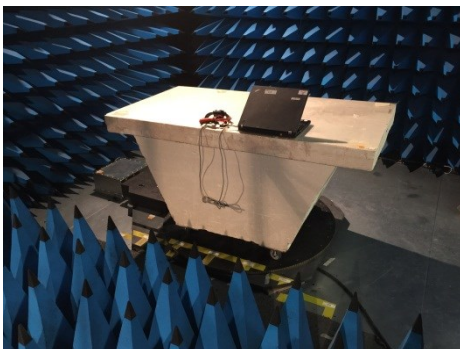
4.2. TEST SETUP

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.

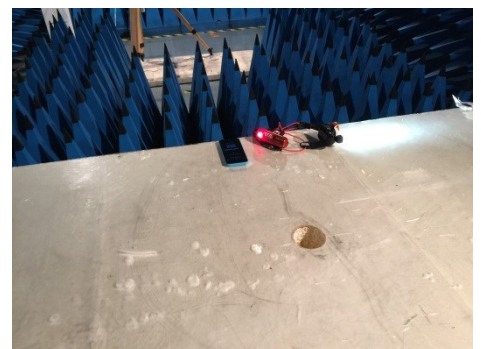
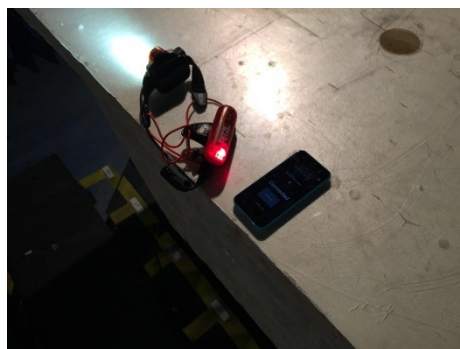
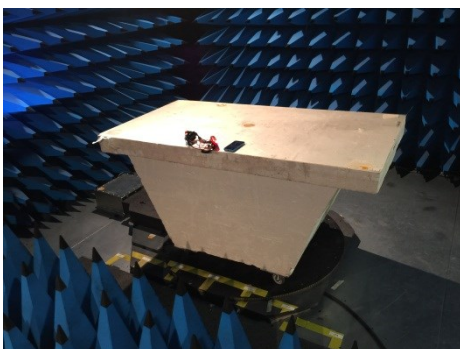
The EUT and auxiliaries are set:

- ☒ 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)

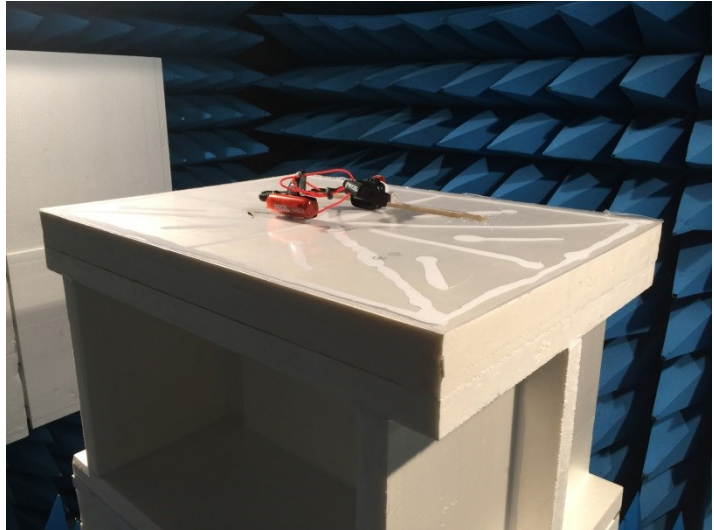
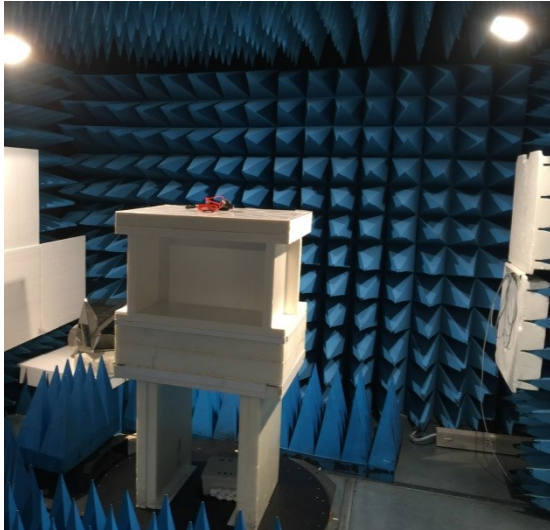
The EUT is powered by V_{nom} .



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.



4.4. TEST EQUIPMENT LIST

| DESCRIPTION | MANUFACTURER | MODEL | N° 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:

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

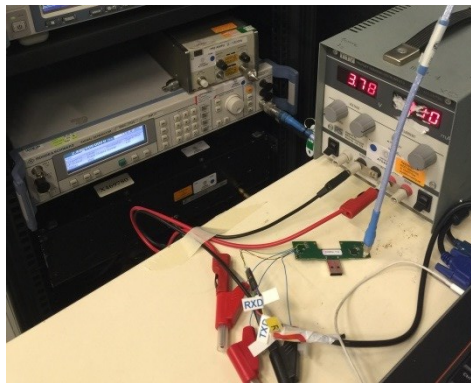
Date of test : November 16th, 2015
Test performed by : G.Deschamps
Atmospheric pressure (hPa) : 994
Relative humidity (%) : 34
Ambient temperature (°C) : 23

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 |

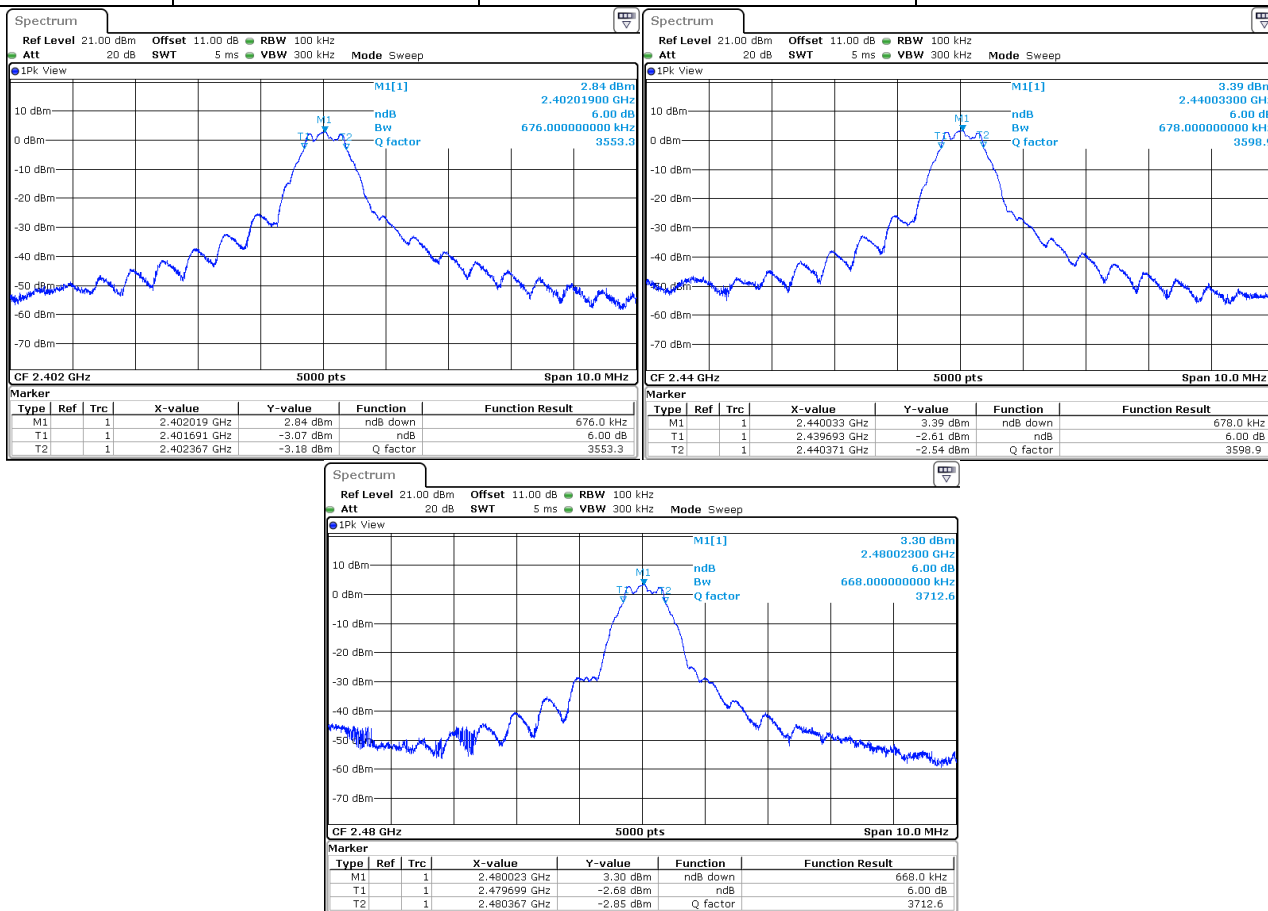
5.4. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

☒ None

☐ Divergence:

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 |



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)

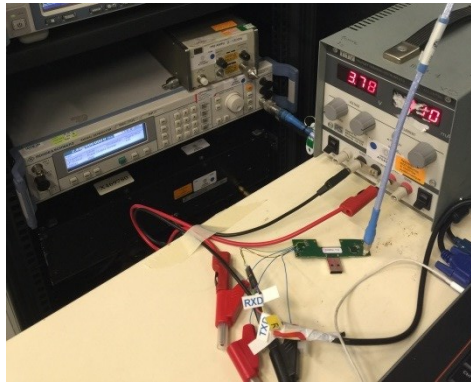
6.1. TEST CONDITIONS

Date of test : November 16th, 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 \geq 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 | 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 |

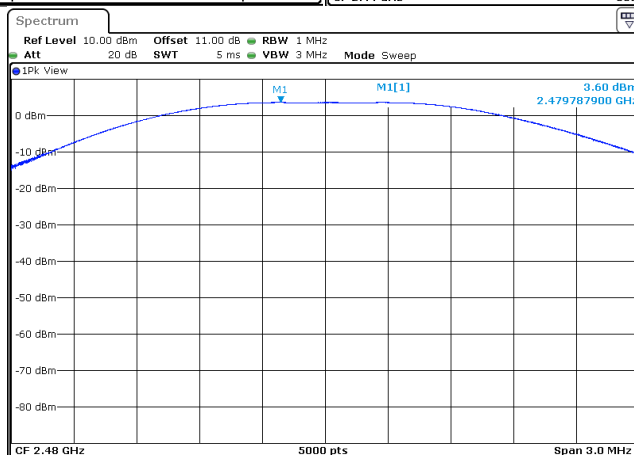
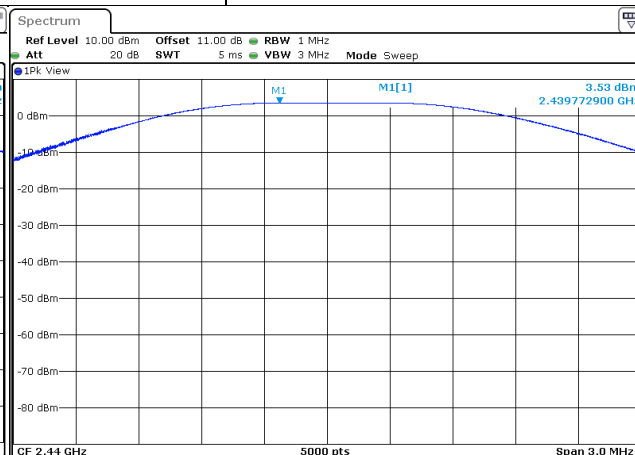
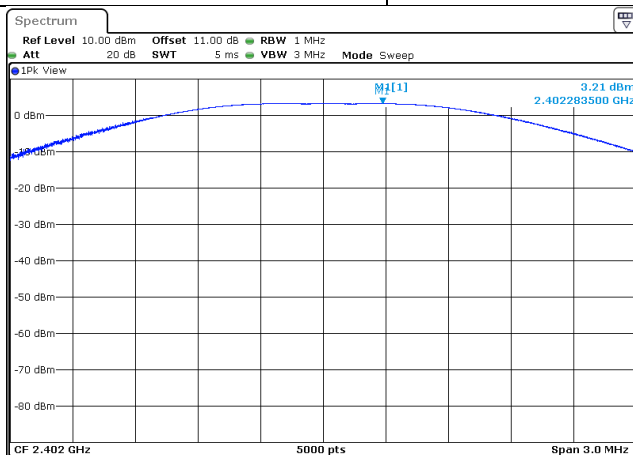
6.4. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

- ☒ None ☐ Divergence:

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)

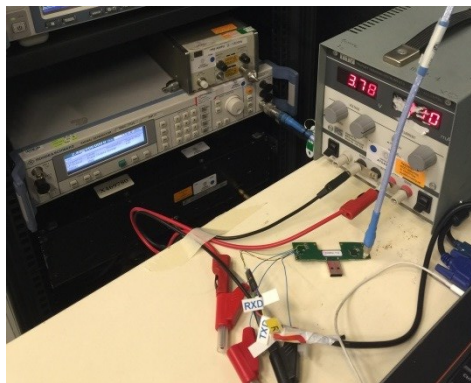
7.1. TEST CONDITIONS

Date of test : November 16th, 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 | 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 |

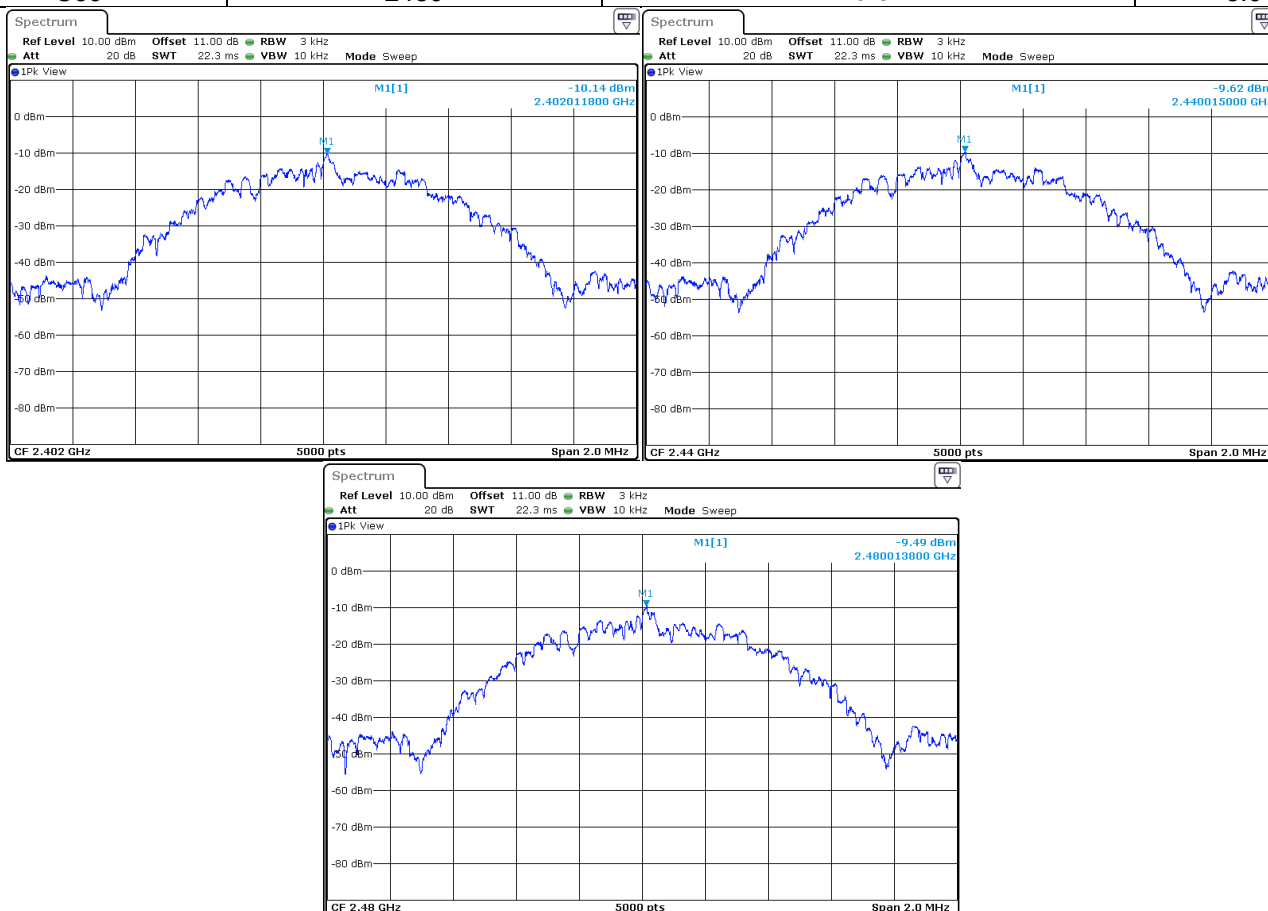
7.4. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

☒ None ☐ Divergence:

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 12th, 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.

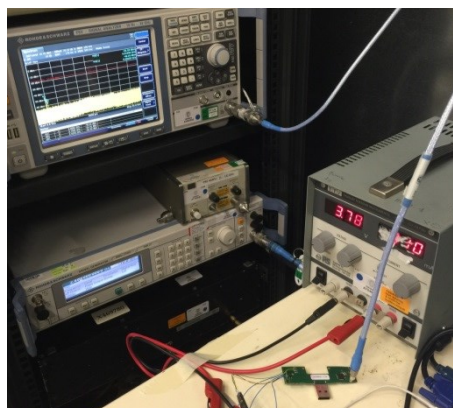
Radiated emission test: § 12 (DTS Measurement Guidance)

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 |

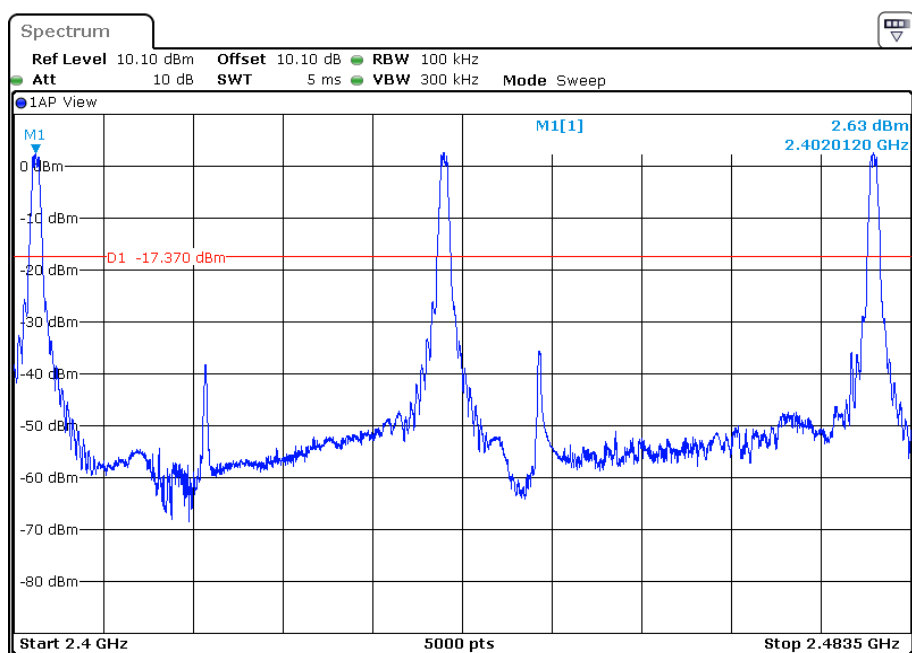
8.5. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

☒ None ☐ Divergence:

8.6. TEST SEQUENCE AND RESULTS

Offset: Attenuator+cable 10.1dB

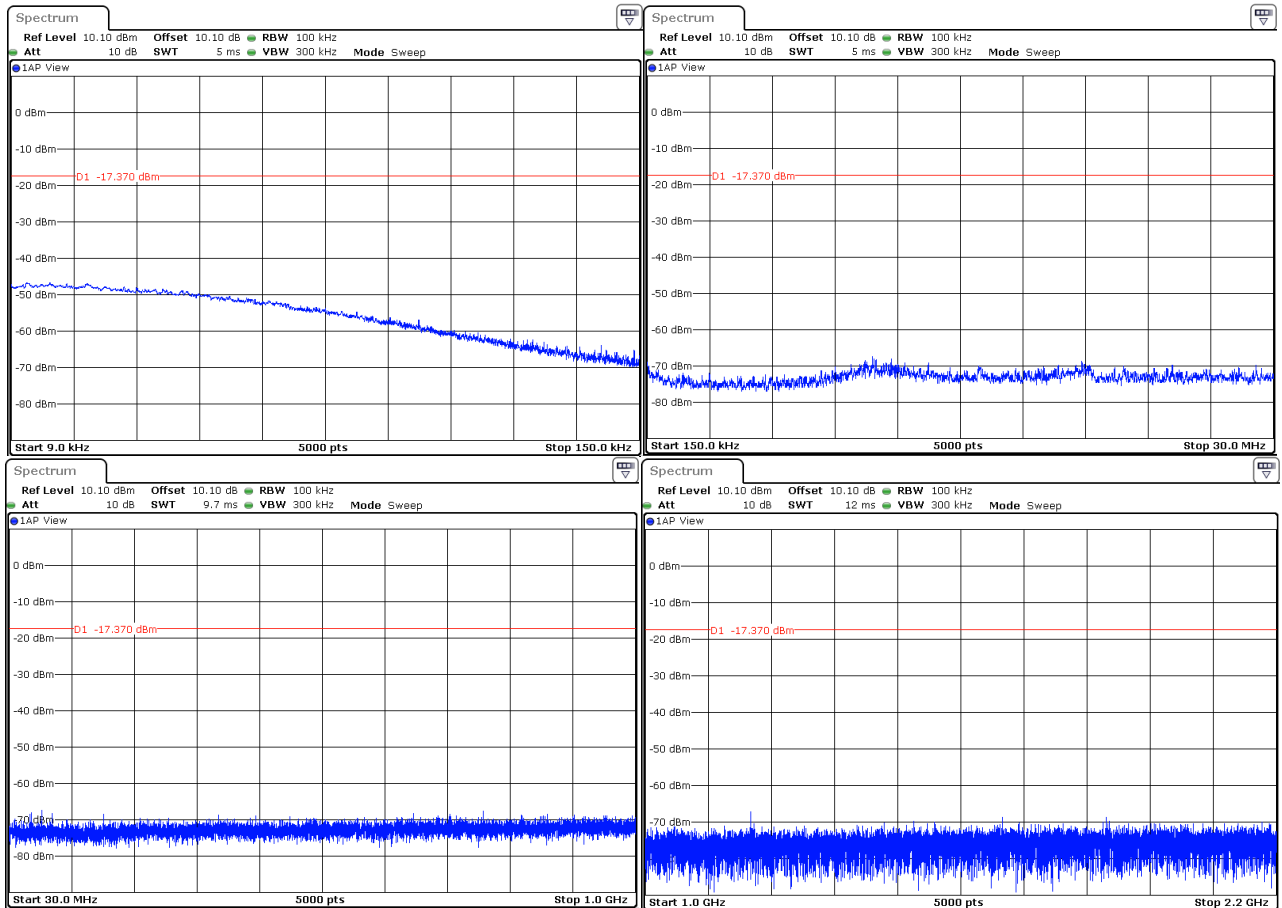
GRAPH / MODULATION.

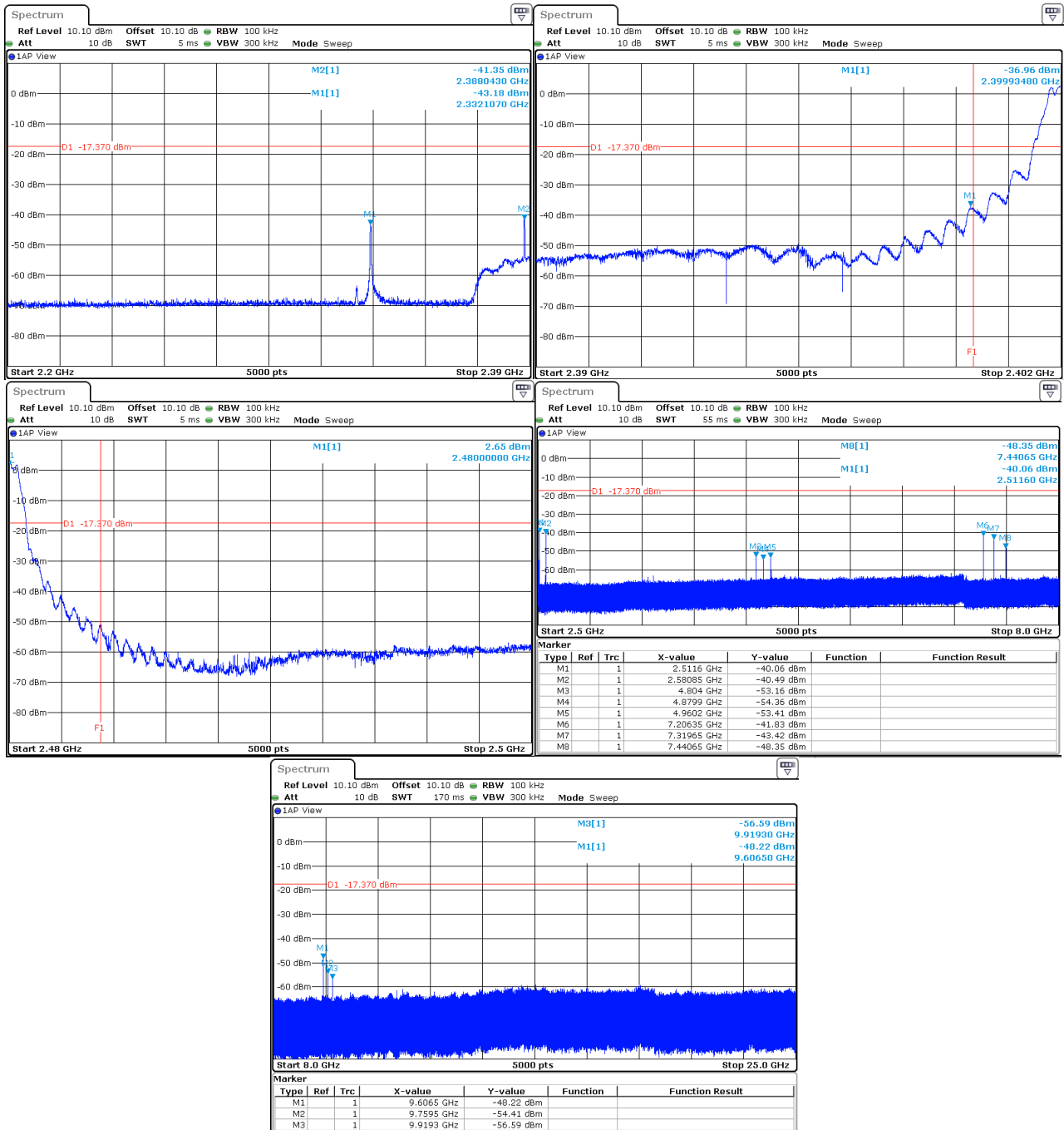


Worst case in Cmin and display line at -17.37dBm



L C I E





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 16th, 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 |

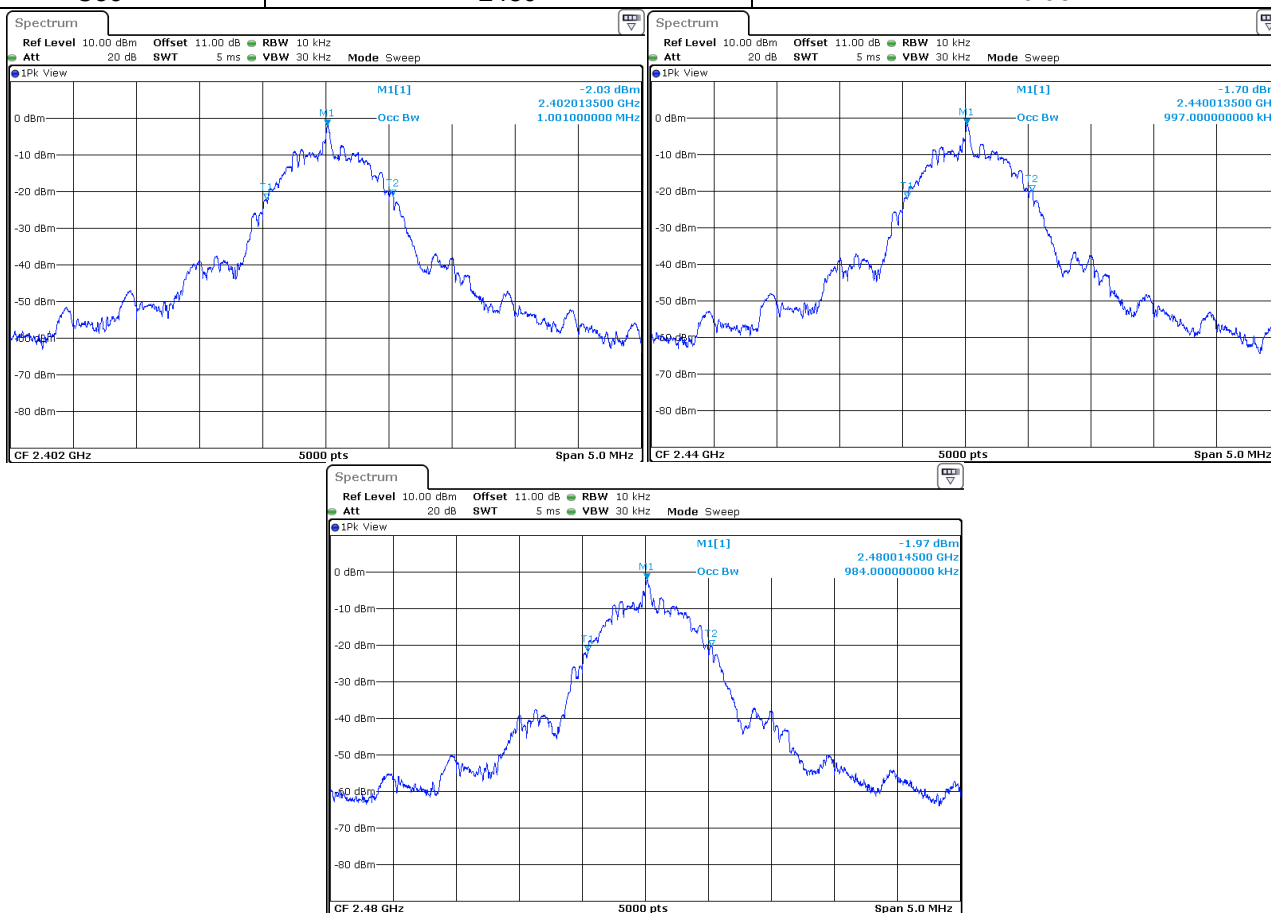
9.4. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

☒ None

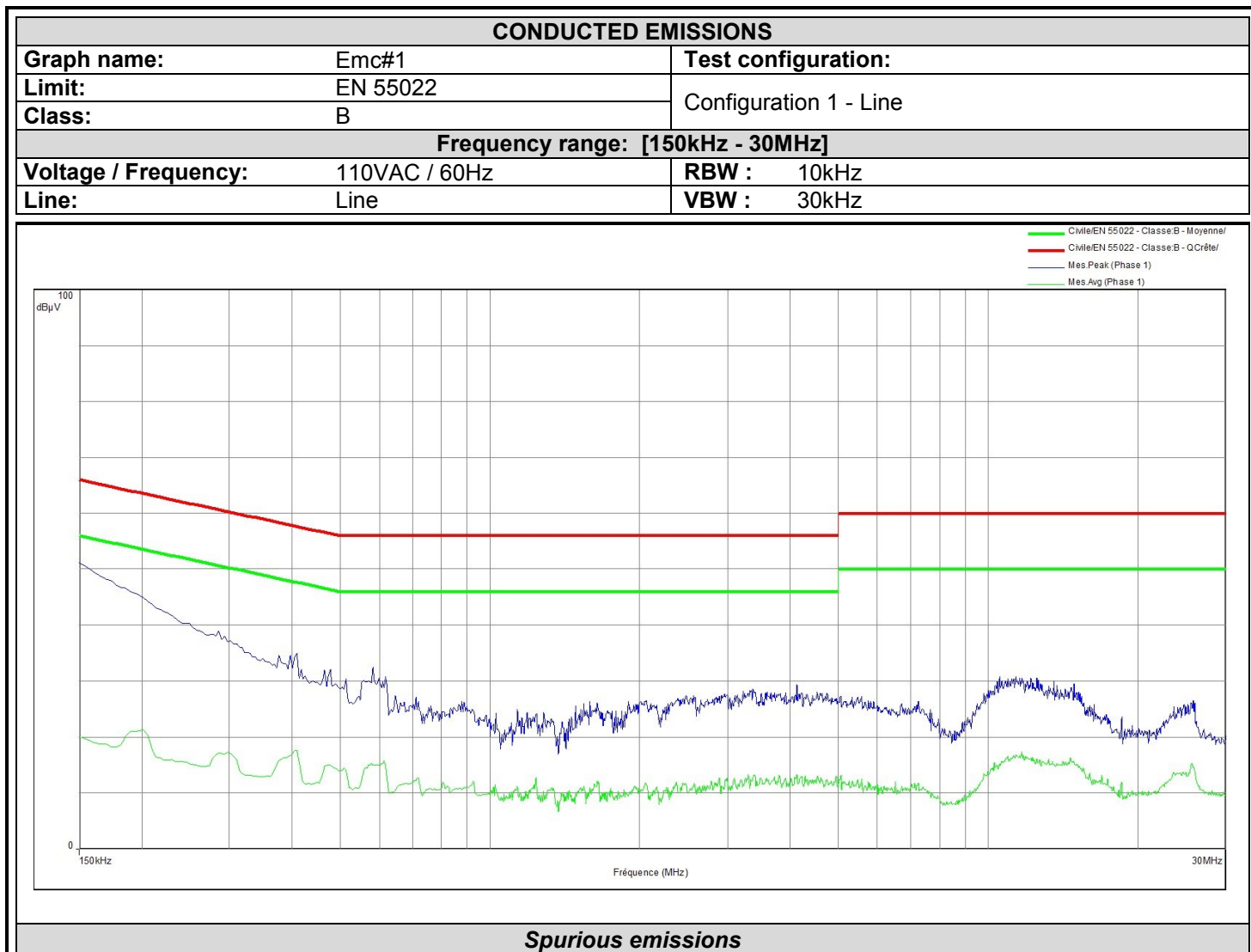
☐ Divergence:

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 |



10. ANNEX 1 (GRAPHS)



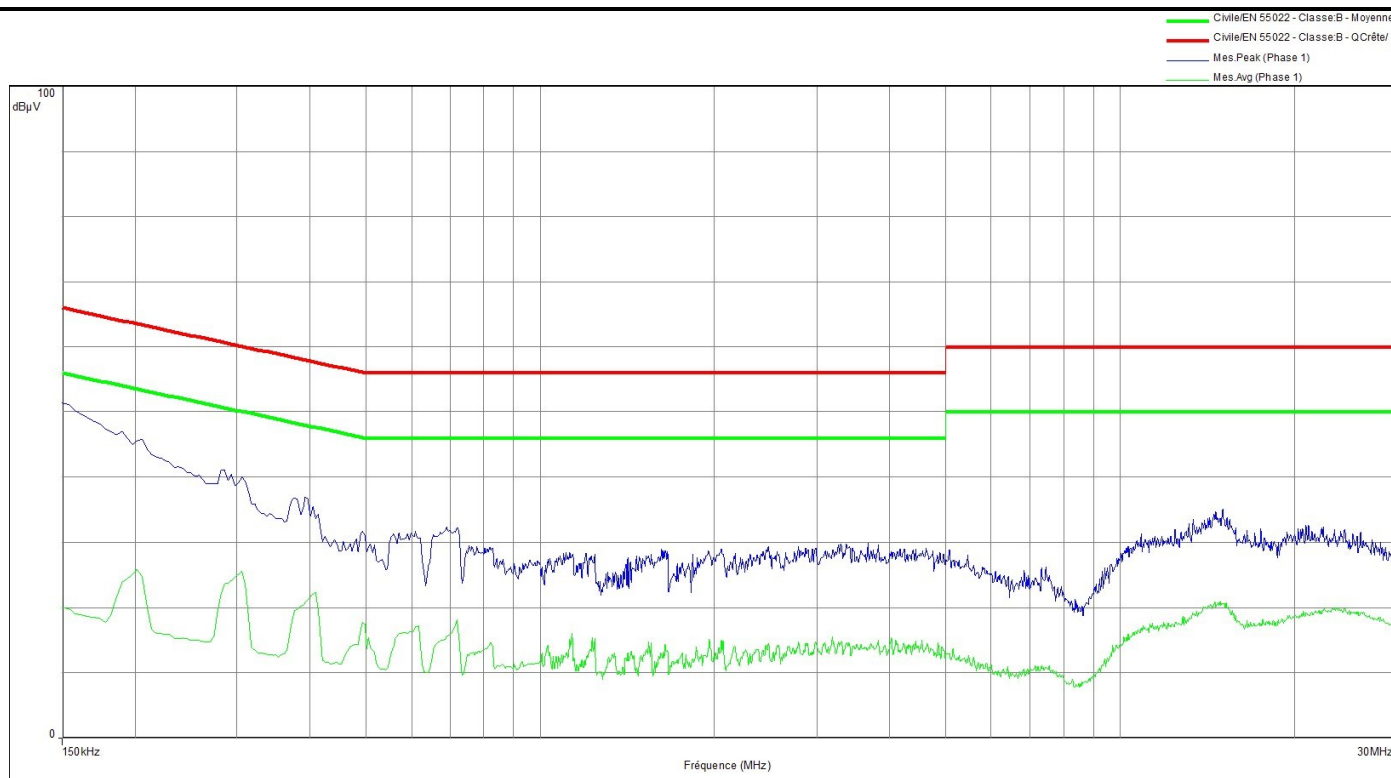
| Frequency (MHz) | Peak (dBμV) | LimM (dBμV) | Peak-LimM (dB) |
|-----------------|-------------|-------------|----------------|
| 0.15 | 51.1 | 56 | -4.9 |



L C I E

CONDUCTED EMISSIONS

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



Spurious emissions

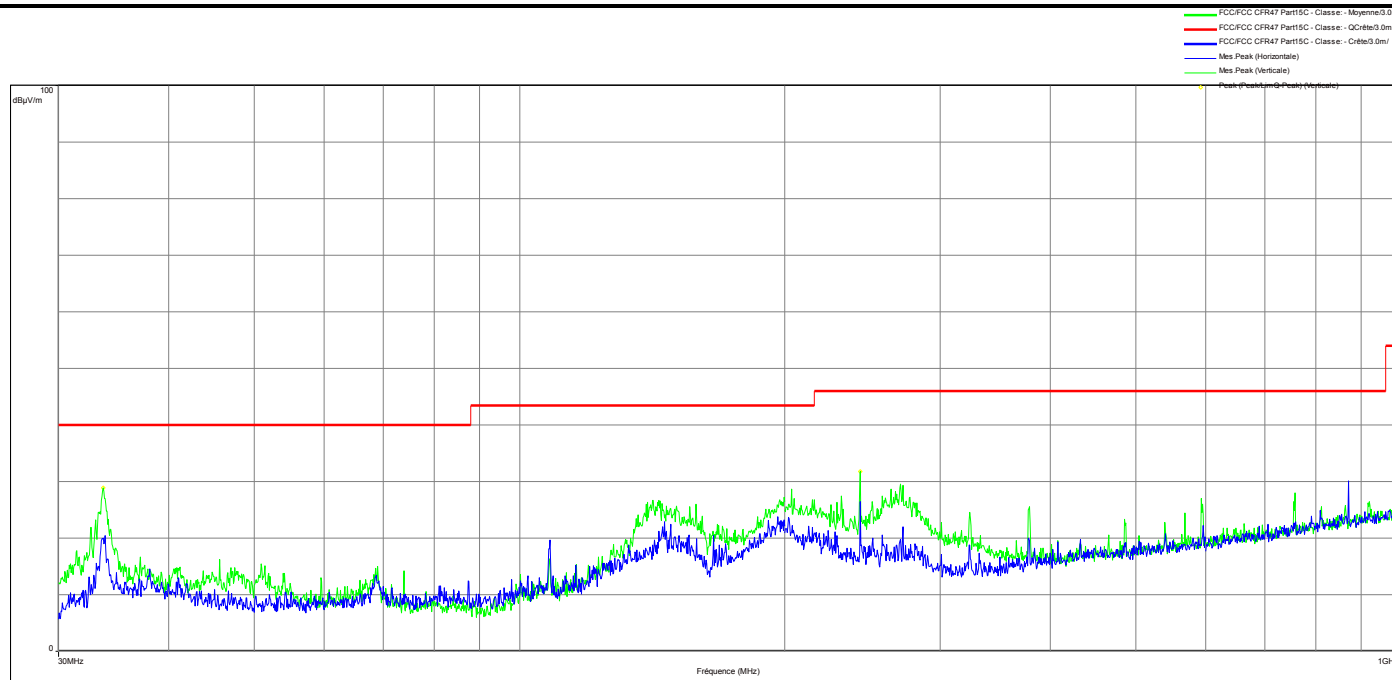
| Frequency (MHz) | Peak (dBμV) | LimM (dBμV) | Peak-LimM (dB) |
|-----------------|-------------|-------------|----------------|
| 0.15 | 51.4 | 56 | -4.6 |
| 15.004 | 35.16 | 50 | -14.84 |



L C I E

RADIATED EMISSIONS

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



Spurious emissions

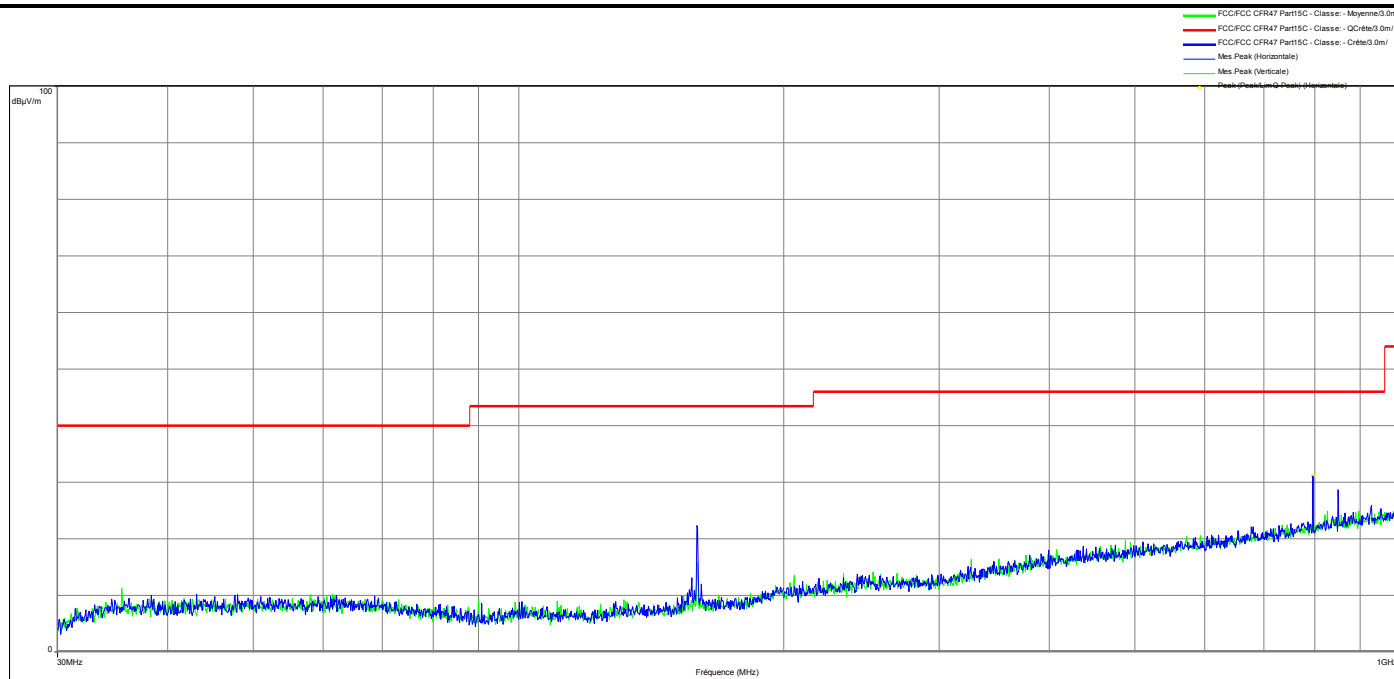
| Frequency (MHz) | Peak (dBµV/m) | LimQP (dBµV/m) | Peak-LimQP (dB) | Polarisation |
|-----------------|---------------|----------------|-----------------|--------------|
| 33.740 | 28.9 | 40.0 | -11.1 | Vertical |
| 243.400 | 31.8 | 46.0 | -14.2 | Vertical |



L C I E

RADIATED EMISSIONS

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



Spurious emissions

| Frequency (MHz) | Peak (dBμV/m) | LimQP (dBμV/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.