



LCIE

# TEST REPORT

N°: 153622-716327-A (972831)

Version : 02

**Subject** Electromagnetic compatibility and Radio spectrum Matters  
(ERM) tests according to standards:  
FCC CFR 47 Part 15, Subpart C  
RSS-247 Issue 2.0

**Issued to** ACOEM  
200 Chemin des Ormeaux  
69578- LIMONEST  
FRANCE

## Apparatus under test

↻ Product Acquisition System  
↻ Trade mark **ONEPROD**  
↻ Manufacturer **ACOEM**  
↻ Model under test **CAC1008000**  
↻ Serial number **20025 and 20103**  
↻ FCCID **2AC3Z-CAC1008000**  
↻ IC **12336A-CAC1008000**

**Conclusion** See Test Program chapter  
**Test date** June 19, 2018 to June 25, 2018  
**Test location** MOIRANS  
**IC Test site** 6500A-3  
**Composition of document** 37 pages

**Document issued on** October 9, 2018

**Written by :**  
Gaetan DESCHAMPS  
**Tests operator**

**Approved by :**  
Anthony MERLIN  
**Technical manager**



This document shall not be reproduced, except in full, without the written approval of the LCIE. This document contains results related only to the items tested. It does not imply the conformity of the whole production to the items tested. Unless otherwise specified, the decision of conformity takes into account the uncertainty of measurement. This document doesn't anticipate any certification decision.

**LCIE**  
Laboratoire Central des Industries Electriques  
Une société de Bureau Veritas

ZI Centr'alp  
170 rue de Chatagnon  
38430 Moirans FRANCE

Tél : +33 4 76 07 36 36  
contact@lcie.fr  
www.lcie.fr



## PUBLICATION HISTORY

Version	Date	Author	Modification
01	September 10, 2018	Gaetan DESCHAMPS	Creation of the document FCCID and IC missing
02	October 9, 2018	Gaetan DESCHAMPS	FCCID and IC



## SUMMARY

1.	TEST PROGRAM .....	4
2.	SYSTEM TEST CONFIGURATION.....	5
3.	CONDUCTED EMISSION DATA .....	9
4.	RADIATED EMISSION DATA .....	11
5.	BANDWIDTH (15.247) .....	14
6.	MAXIMUM PEAK OUTPUT POWER (15.247) .....	19
7.	POWER SPECTRAL DENSITY (15.247) .....	22
8.	BAND EDGE MEASUREMENT (15.247) .....	27
9.	OCCUPIED BANDWIDTH.....	31
10.	ANNEX 1 (GRAPHS) .....	35
11.	UNCERTAINTIES CHART .....	37



## 1. TEST PROGRAM

**Standard:**

- FCC Part 15, Subpart C 15.247
- ANSI C63.10 (2013)
- RSS-247 Issue 2.0
- RSS-Gen Issue 5
- 558074 D01 DTS Measurement Guidance v04

EMISSION TEST	LIMITS			RESULTS
	Frequency	Quasi-peak value (dB $\mu$ V)	Average value (dB $\mu$ V)	
Limits for conducted disturbance at mains ports 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	
Radiated emissions 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
Radiated emissions 30MHz-25GHz* CFR 47 §15.209 (a) CFR 47 §15.247 (d) RSS-247 §5.5 <b>Highest frequency :</b> <b>(Declaration of provider)</b>	<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
Bandwidth 6dB CFR 47 §15.247 (a) (2) RSS-247 §5.2	At least 500kHz			<input checked="" type="checkbox"/> PASS <input type="checkbox"/> FAIL <input type="checkbox"/> NA <input type="checkbox"/> NP
Power spectral Density CFR 47 §15.247 (e) RSS-247 §5.2	Limit: 8dBm/3kHz			<input checked="" type="checkbox"/> PASS <input type="checkbox"/> FAIL <input type="checkbox"/> NA <input type="checkbox"/> NP
Maximum Peak Output Power CFR 47 §15.247 (b) RSS-247 §5.4	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 CFR 47 §15.209 (a) CFR 47 §15.247 (d) RSS-247 §5.5	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 RSS-Gen §6.7	No limit			<input checked="" type="checkbox"/> PASS <input type="checkbox"/> FAIL <input type="checkbox"/> NA <input type="checkbox"/> NP
Receiver Spurious Emission** RSS-Gen §7.3	<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 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.

\*\*Testing covered the receive mode, and receiver spurious emissions are considered to be the same as transmitter.

## 2. SYSTEM TEST CONFIGURATION

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

**Equipment under test (EUT):**

CAC1008000

Serial Number: 20025 & 20103



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 / Sn	Comments
Supply1	<input checked="" type="checkbox"/> AC <input type="checkbox"/> DC <input type="checkbox"/> Battery	100-240VAC to 5VDC ~50/60Hz 0.1A to 1.0A	VER05US050-BB / P3817	Mark: XP
Internal Battery	<input type="checkbox"/> AC <input type="checkbox"/> DC <input checked="" type="checkbox"/> Battery	3.7Vdc – 2.9hA	Lithium ion battery	/

**Inputs/outputs - Cable:**

Access	Type	Length used (m)	Declared <3m	Shielded	Under test	Comments
Supply 1	Mini USB Port (Secondary of Switching power supply)	1.0	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	

**Auxiliary equipment used during test:**

Type	Reference	Sn	Comments
Test PCB Board	/	/	/
Laptop	Lenovo L470	-	-
Access Point	ASUS	-	-



**Equipment information:**

Type:	<b>WIFI</b>				
Frequency band:	[2400 – 2483.5] MHz				
Sub-band REC7003:	Annex 3 (a)				
Standard:	<input checked="" type="checkbox"/> 802.11b	<input checked="" type="checkbox"/> 802.11g	<input checked="" type="checkbox"/> 802.11n HT20	<input type="checkbox"/> 802.11n HT40	
Spectrum Modulation:	<input checked="" type="checkbox"/> DSSS		<input checked="" type="checkbox"/> OFDM		
Number of Channel:	13				
Spacing channel:	5MHz				
Channel bandwidth:	<input checked="" type="checkbox"/> 20MHz		<input type="checkbox"/> 40MHz		
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	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	
	<input checked="" type="checkbox"/> Single antenna		<input type="checkbox"/> Symmetrical		<input type="checkbox"/> Asymmetrical
	Gain 1: 3dBi	Gain 2: XdBi	Gain 3: XdBi	Gain 4: XdBi	Accumulated Gain: XdBi
Beam forming gain:	<input type="checkbox"/> Yes: XdB			<input checked="" type="checkbox"/> No	
Receiver chains	<input checked="" type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	
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				X $\mu$ s
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"/> X°C	
	Tnom:	20°C			
	Tmax:	<input type="checkbox"/> 35°C	<input type="checkbox"/> 55°C	<input checked="" type="checkbox"/> 60°C	
Type of power source:	<input type="checkbox"/> AC power supply		<input type="checkbox"/> DC power supply		<input checked="" type="checkbox"/> Battery
Operating voltage range:	Vnom:		<input type="checkbox"/> 230V/50Hz		<input checked="" type="checkbox"/> 3.7Vdc
Geo-location capability:	<input type="checkbox"/> Yes (The geographical location determined by the equipment is not accessible to the end user as defined in section 4.3.2.12.2 of ETSI EN 300 328 V2.1.1 standard)			<input checked="" type="checkbox"/> No	
Minimum performance criteria for Receiver blocking test:	<input checked="" type="checkbox"/> PER less than or equal to 10%		<input type="checkbox"/> Alternative performance criteria (4)		



**L C I E**

<b>CHANNEL PLAN</b>	
<b>802.11b / 802.11g / 802.11n HT20</b>	
Channel	Frequency (MHz)
<b>Cmin: 1</b>	<b>2412</b>
2	2417
3	2422
4	2427
5	2432
<b>Cmid: 6</b>	<b>2437</b>
7	2442
8	2447
9	2452
10	2457
<b>Cmax: 11</b>	<b>2462</b>

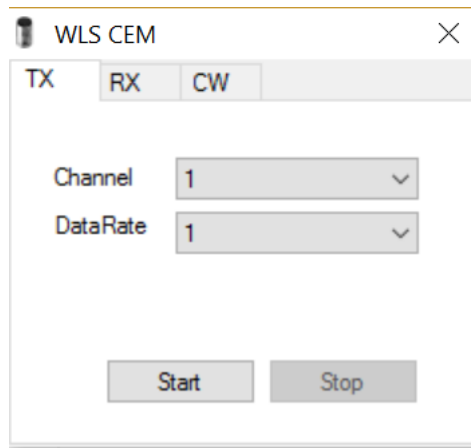


## 2.2. EUT CONFIGURATION

Hardware information		
Firmware (if applicable):	V. :	1.31

The EUT is set in the following modes during tests with the software "WLS CemClient":

- Permanent emission with modulation on a fixed channel in the data rate that produced the highest power, See the following capture:



## 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.

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

## 2.5. CALIBRATION DATE

The calibration intervals are extended at 12+2 months. This extended interval is based on the fact that there is sufficient calibration data to statistically establish a trend or based on experience of use of the test equipment to assure good measurement results for a longer period



### 3. CONDUCTED EMISSION DATA

#### 3.1. ENVIRONMENTAL CONDITIONS

Date of test : June 19, 2018  
Test performed by : Nicolas Billaud  
Atmospheric pressure (hPa) : 1029  
Relative humidity (%) : 30  
Ambient temperature (°C) : 21

#### 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 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	Cal_Date	Cal_Due
Cable + self	-	-	A5329585	07/17	07/18
EMC comb generator	LCIE SUD EST	-	A3169098	-	-
LISN	RHODE & SCHWARZ	ENV216	C2320291	12/17	12/18
Receiver 20Hz – 8GHz	ROHDE & SCHWARZ	ESU8	A2642019	12/17	12/18
Thermo-hygrometer (PM1/2/3)	KIMO	HQ 210	B4206022	08/16	08/18
Transient limiter	RHODE & SCHWARZ	ESH3-Z2	A7122204	02/18	02/19

### 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.

#### Results: (PEAK detection)

Measure on N: graph **Emc#1** (see annex 1)  
Measure on L1: graph **Emc#2** (see annex 1)

### 3.7. CONCLUSION

Conducted emission data measurement performed on the sample of the product **CAC1008000**, SN:**20103**, 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 : June 20, 2018  
 Test performed by : Gaëtan DESCHAMPS  
 Atmospheric pressure (hPa) : 1020  
 Relative humidity (%) : 32  
 Ambient temperature (°C) : 23

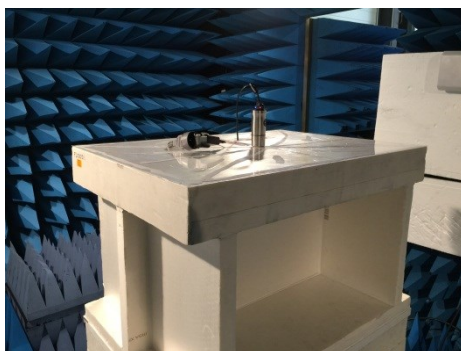
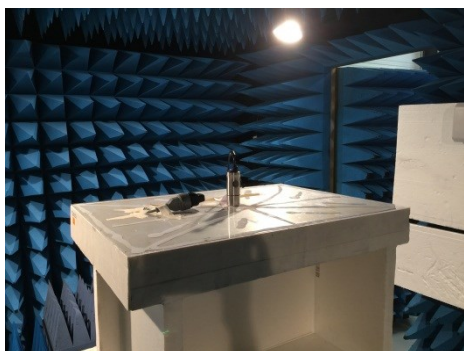
### 4.2. TEST SETUP

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.

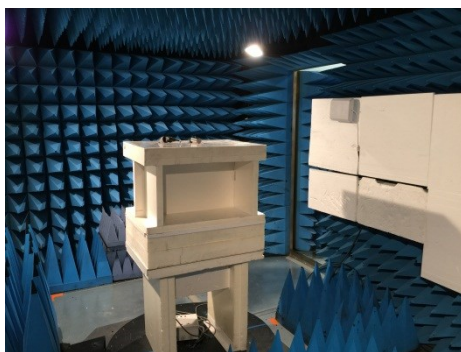
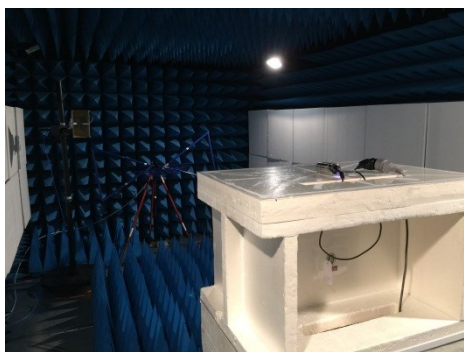
The EUT and auxiliaries are set:

- 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 Axis Z*



*Test setup in anechoic chamber Axis XY*



### 4.3. TEST METHOD

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

Pre-characterisation measurement: (9kHz – 26GHz)

A pre-scan of all the setup has been performed in a 3 meters semi-anechoic chamber for frequency from 30MHz to 26GHz. 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.

The pre-characterization graphs are obtained in PEAK detection and PEAK/AVERAGE from 1GHz to 26GHz.

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 26GHz:

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 from 1GHz to 26GHz.

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 9kHz - 40GHz	LCIE SUD EST	-	A7102082	07/17	07/18
Antenna horn 18GHz	EMCO	3115	C2042029	08/16	08/18
Cable Measure @1m	STORMFLEX	26GHz	A5329680	12/17	12/18
Cable Measure Analyzer-Amplifier SMA	STORMFLEX	26GHz	A5329681	12/17	12/18
Cable Measure @1m	STORMFLEX	26GHz	A5329682	12/17	12/18
Semi-Anechoic chamber #3	SIEPEL	-	D3044017	03/16	03/19
Radiated emission comb generator	BARDET	-	A3169050	-	-
High Pass (4.8-18GHz)	BL Microwave	SH4800-1800	A7484034	05/17	05/19
Spectrum analyzer	ROHDE & SCHWARZ	FSV 30	A4060050	12/17	12/18
Thermo-hygrometer (C3)	OREGON	BAR206	B4204078	10/16	10/18
Thermo-hygrometer (PM1/2/3)	KIMO	HQ 210	B4206022	08/16	08/18
Turntable chamber (Cage#3)	ETS Lingren	Model 2165	F2000371	-	-
Table C3	LCIE	-	F2000461	-	-



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

None                       Divergence:

#### 4.6. TEST RESULTS

##### 4.6.1. 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 observed during the Band edge Measurement, see Test sequence and results in §8.6.**

##### 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 frequency observed during the Band edge Measurement, see Test sequence and results in §8.6.**

##### 4.6.3. Characterization on 3meters anechoic chamber from 1GHz to 26GHz

###### 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.

Test Frequency (MHz)	Meter Reading dB(μV)	Detector (Pk/QP/Av)	Polarity (V/H)	Azimuth (Degrees)	Antenna Height (cm)	Gain/Loss Factor (dB)	Transducer Factor (dB)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Remark
4824.000	50.9	Pk	V	190	150	-	-3.9	47.0	74.0	-27.0	axis XY
4824.000	48.6	Av	V	190	150	-	-3.9	44.7	54.0	-9.3	axis XY
4874.011	54.9	Pk	V	110	150	-	-3.8	51.1	74.0	-22.9	axis XY
4874.011	46.6	Av	V	110	150	-	-3.8	42.8	54.0	-11.2	axis XY
4924.000	54.9	Pk	V	170	150	-	-3.6	51.3	74.0	-22.7	axis XY
4924.000	48.6	Av	V	170	150	-	-3.6	45.0	54.0	-9.0	axis XY

*Note: Measures have been done at 3m distance.*

#### 4.7. CONCLUSION

Radiated emission data measurement performed on the sample of the product **CAC1008000**, SN: **20103**, 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 : June 20, 2018  
Test performed by : Gaëtan DESCHAMPS  
Atmospheric pressure (hPa) : 1020  
Relative humidity (%) : 32  
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 12dB



Remark:

A WLS board is set up on a mother board allowing Ethernet communication and power supply. The WLS board antenna is removed and replaced by a coaxial cable fitted with SMA connector.

**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.



**L C I E**

### 5.3. TEST EQUIPMENT LIST

DESCRIPTION	MANUFACTURER	MODEL	N° LCIE	Cal_Date	Cal_Due
Attenuator 10dB	AEROFLEX	-	A7122269	12/17	12/18
Cable Measure	-	36G	A5329604	12/17	12/18
Spectrum analyzer	ROHDE & SCHWARZ	FSV 30	A4060050	12/17	12/18
Thermo-hygrometer (PM1/2/3)	KIMO	HQ 210	B4206022	08/16	08/18

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

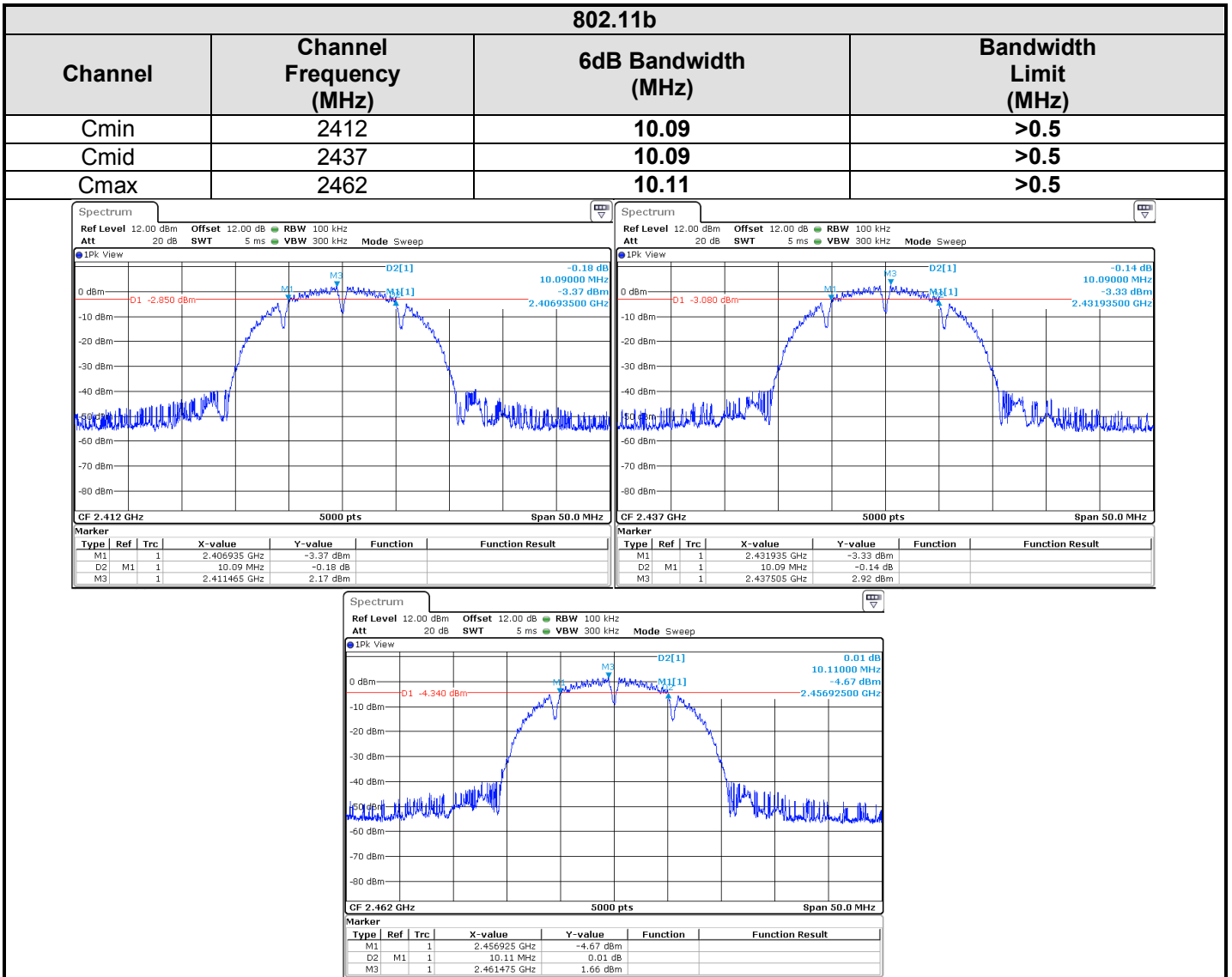
None

Divergence:



L C I E

5.5. TEST SEQUENCE AND RESULTS



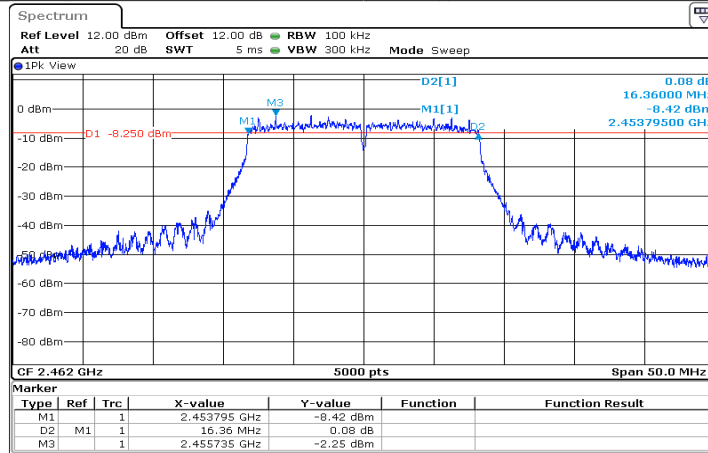
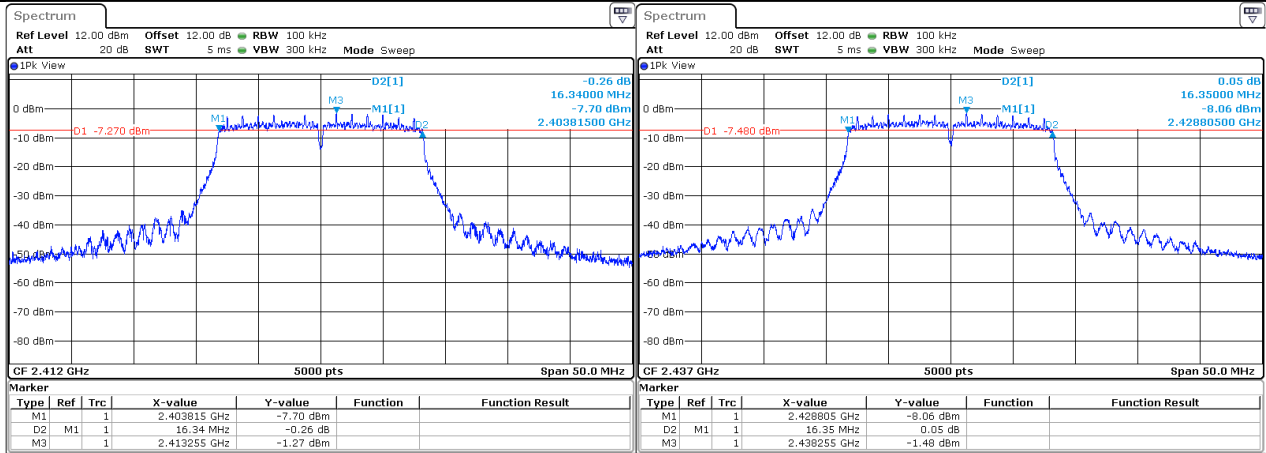




L C I E

802.11g

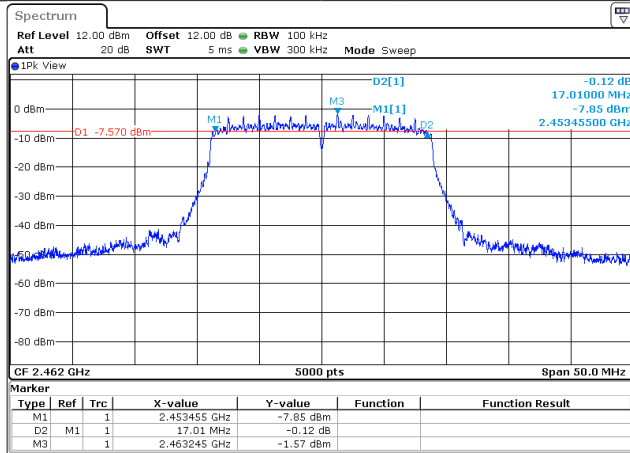
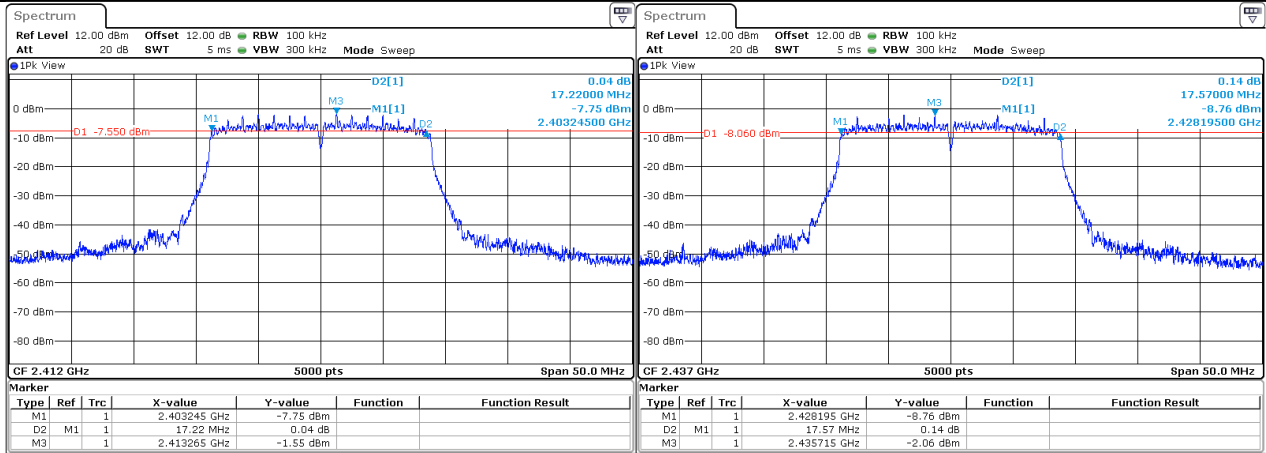
Channel	Channel Frequency (MHz)	6dB Bandwidth (MHz)	Bandwidth Limit (MHz)
Cmin	2412	16.34	>0.5
Cmid	2437	16.35	>0.5
Cmax	2462	16.36	>0.5





L C I E

802.11nHT20			
Channel	Channel Frequency (MHz)	6dB Bandwidth (MHz)	Bandwidth Limit (MHz)
Cmin	2412	17.22	>0.5
Cmid	2437	17.57	>0.5
Cmax	2462	17.01	>0.5



## 5.6. CONCLUSION

Bandwidth measurement performed on the sample of the product **CAC1008000**, SN: 20025, 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 : June 20, 2018  
 Test performed by : Gaëtan DESCHAMPS  
 Atmospheric pressure (hPa) : 1020  
 Relative humidity (%) : 32  
 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 12dB



Remark:

A WLS board is set up on a mother board allowing Ethernet communication and power supply. The WLS board antenna is removed and replaced by a coaxial cable fitted with SMA connector.

**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.

- 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	Cal_Date	Cal_Due
Attenuator 10dB	AEROFLEX	-	A7122269	12/17	12/18
Cable Measure	-	36G	A5329604	12/17	12/18
RF Power sensor	DARE	RPR3006W	A1503031	06/17	06/18
Thermo-hygrometer (PM1/2/3)	KIMO	HQ 210	B4206022	08/16	08/18

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

- None                       Divergence:



L C I E

## 6.5. TEST SEQUENCE AND RESULTS

### Modulation: 802.11b

Channel	Channel Frequency (MHz)	Peak Output Power (dBm)	Power Limit (dBm)
Cmin	2412	15.0	30.0
Cmid	2437	15.4	30.0
Cmax	2462	15.2	30.0

### 802.11g

Channel	Channel Frequency (MHz)	Peak Output Power (dBm)	Power Limit (dBm)
Cmin	2412	12.7	30.0
Cmid	2437	13.0	30.0
Cmax	2462	12.9	30.0

### 802.11nHT20

Channel	Channel Frequency (MHz)	Peak Output Power (dBm)	Power Limit (dBm)
Cmin	2412	12.7	30.0
Cmid	2437	13.0	30.0
Cmax	2462	12.9	30.0

## 6.6. CONCLUSION

Maximum Peak Output Power measurement performed on the sample of the product **CAC1008000**, SN: 20025, 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 : June 21, 2018  
 Test performed by : Gaëtan DESCHAMPS  
 Atmospheric pressure (hPa) : 1020  
 Relative humidity (%) : 32  
 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 12dB



Remark:

A WLS board is set up on a mother board allowing Ethernet communication and power supply. The WLS board antenna is removed and replaced by a coaxial cable fitted with SMA connector.

**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	-	A7122269	12/17	12/18
Cable Measure	-	36G	A5329604	12/17	12/18
Spectrum analyzer	ROHDE & SCHWARZ	FSV 30	A4060050	12/17	12/18
Thermo-hygrometer (PM1/2/3)	KIMO	HQ 210	B4206022	08/16	08/18

**7.4. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION**

- None                       Divergence:

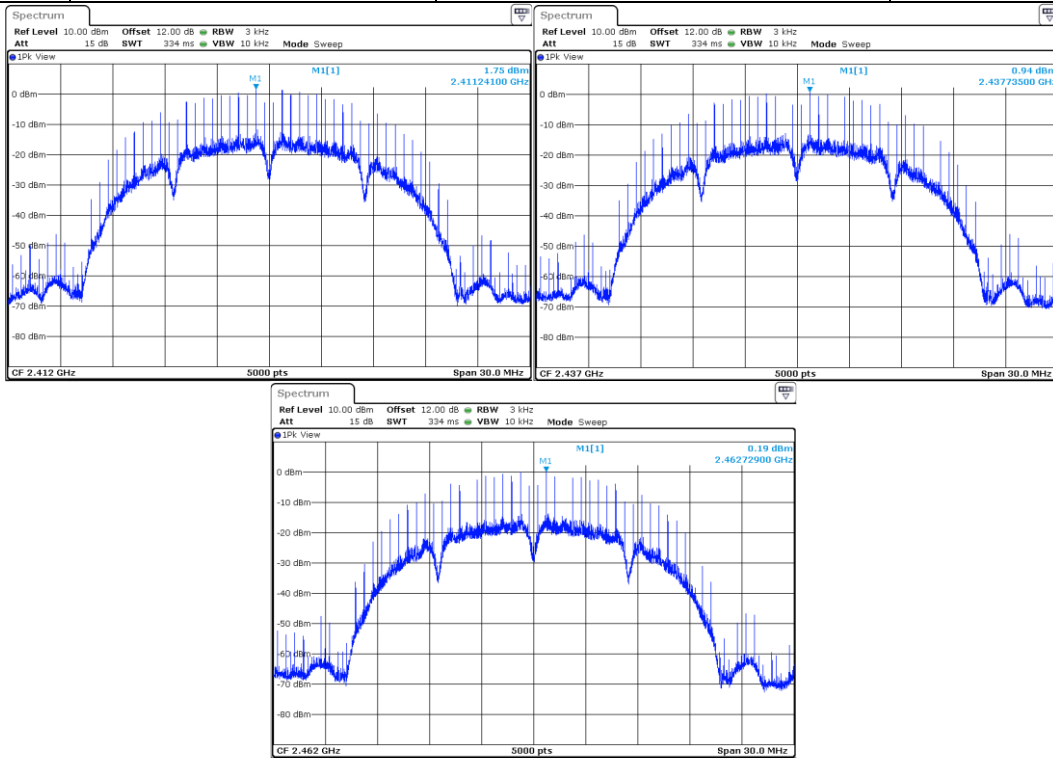


L C I E

**7.5. TEST SEQUENCE AND RESULTS**

**Modulation:  
802.11b:**

Channel	Channel Frequency (MHz)	Power Spectral Density (dBm)	PSD Limit (dBm)
Cmin	2412	<b>1.75</b>	8.0
Cmid	2437	<b>0.94</b>	8.0
Cmax	2462	<b>0.19</b>	8.0



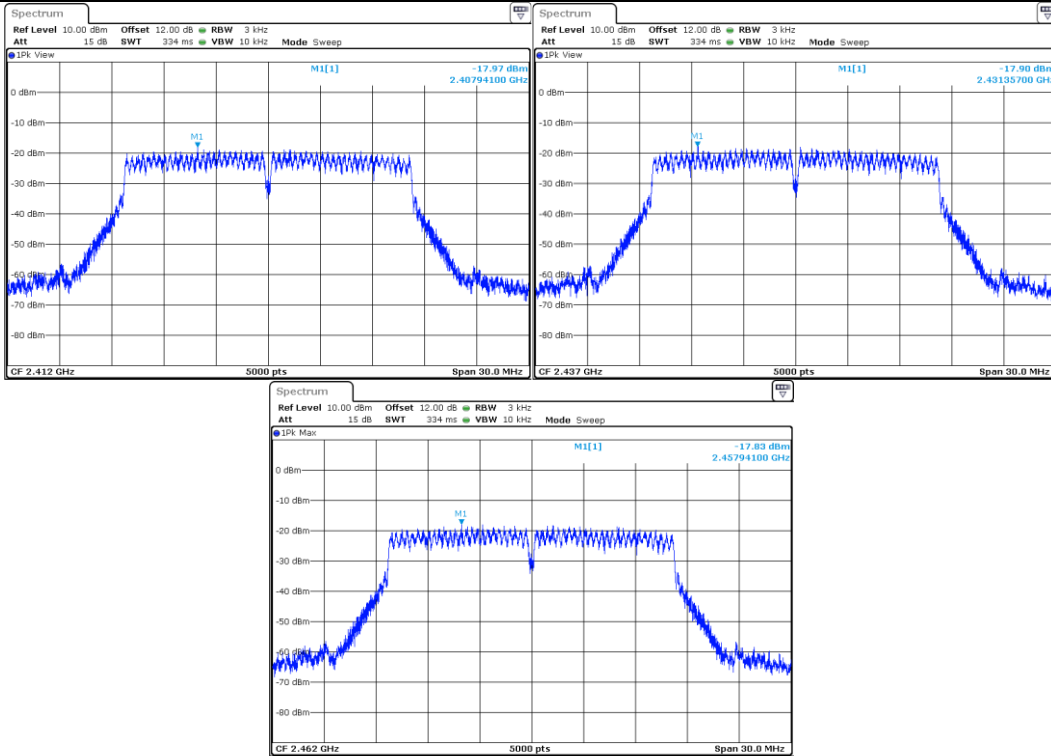




L C I E

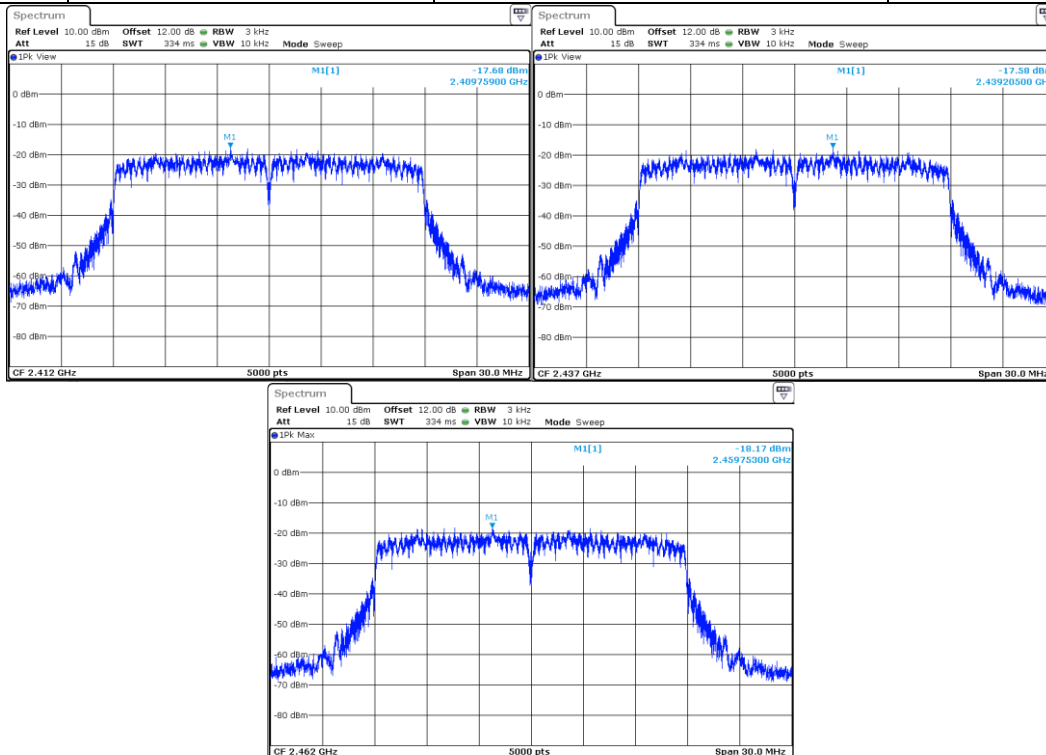
802.11g:

Channel	Channel Frequency (MHz)	Power Spectral Density (dBm)	PSD Limit (dBm)
Cmin	2412	-17.97	8.0
Cmid	2437	-17.90	8.0
Cmax	2462	-17.83	8.0



802.11nHT20:

Channel	Channel Frequency (MHz)	Power Spectral Density (dBm)	PSD Limit (dBm)
Cmin	2412	-17.68	8.0
Cmid	2437	-17.58	8.0
Cmax	2462	-18.17	8.0



7.6. CONCLUSION

Power Spectral Density measurement performed on the sample of the product **CAC1008000**, SN: 20025, 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 : June 20, 2018  
Test performed by : Gaëtan DESCHAMPS  
Atmospheric pressure (hPa) : 1020  
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 30 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 -30dBc limit, lowest power output level is considered, worst case.



#### Remark:

A WLS board is set up on a mother board allowing Ethernet communication and power supply. The WLS board antenna is removed and replaced by a coaxial cable fitted with SMA connector.

#### **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 maximum conducted 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 30dB 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



**LCIE**

#### 8.4. TEST EQUIPMENT LIST

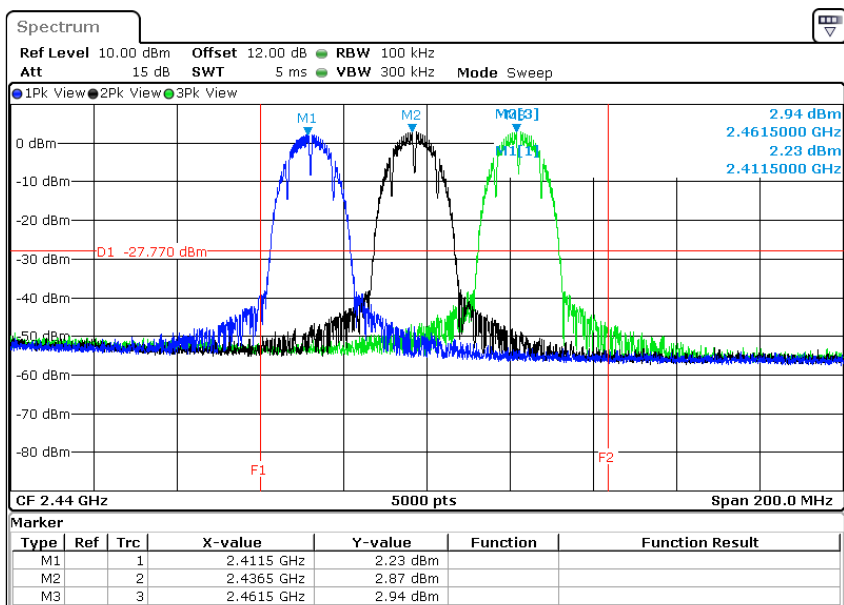
DESCRIPTION	MANUFACTURER	MODEL	N° LCIE	Cal_Date	Cal_Due
Attenuator 10dB	AEROFLEX	-	A7122269	12/17	12/18
Cable Measure	-	36G	A5329604	12/17	12/18
Spectrum analyzer	ROHDE & SCHWARZ	FSV 30	A4060050	12/17	12/18
Thermo-hygrometer (PM1/2/3)	KIMO	HQ 210	B4206022	08/16	08/18

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

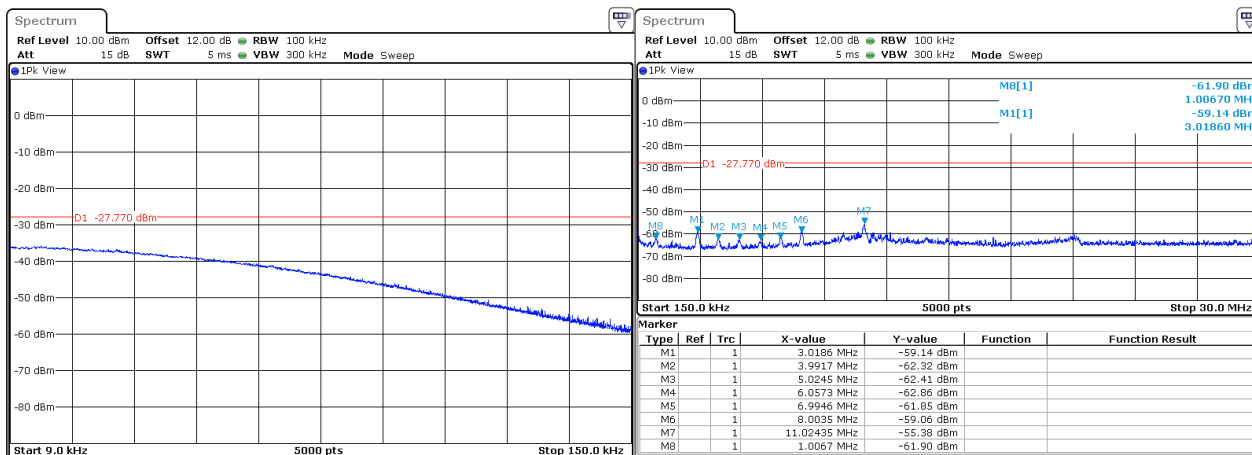
None       Divergence:

## 8.6. TEST SEQUENCE AND RESULTS

Offset: Attenuator+cable 12dB  
**GRAPH / MODULATION.**  
**802.11b:**

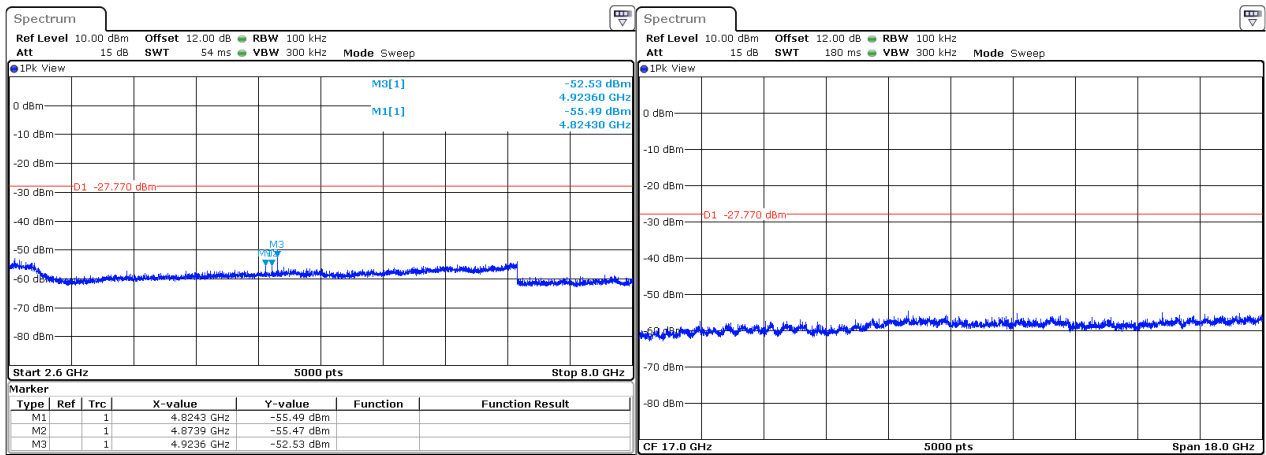
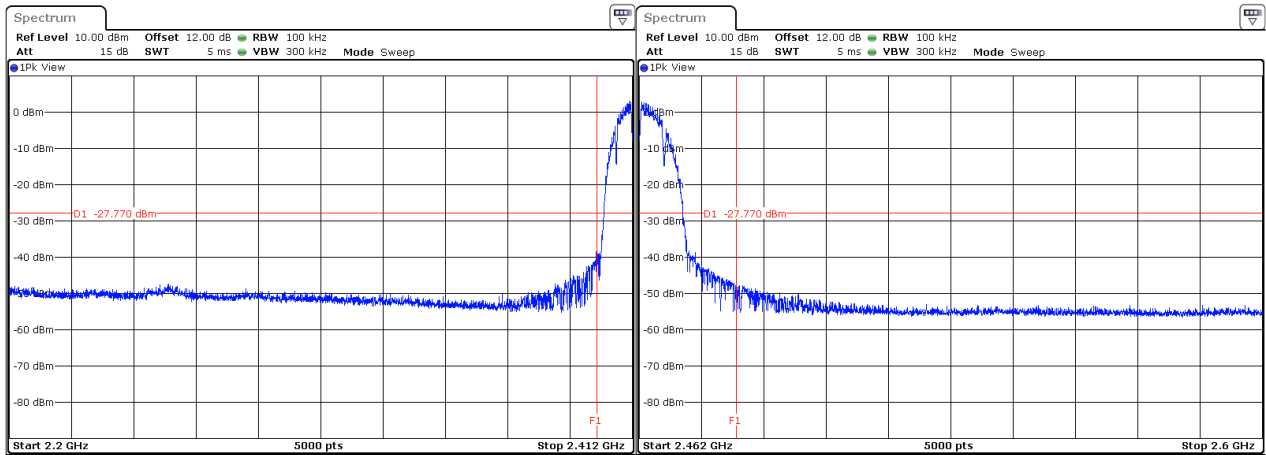
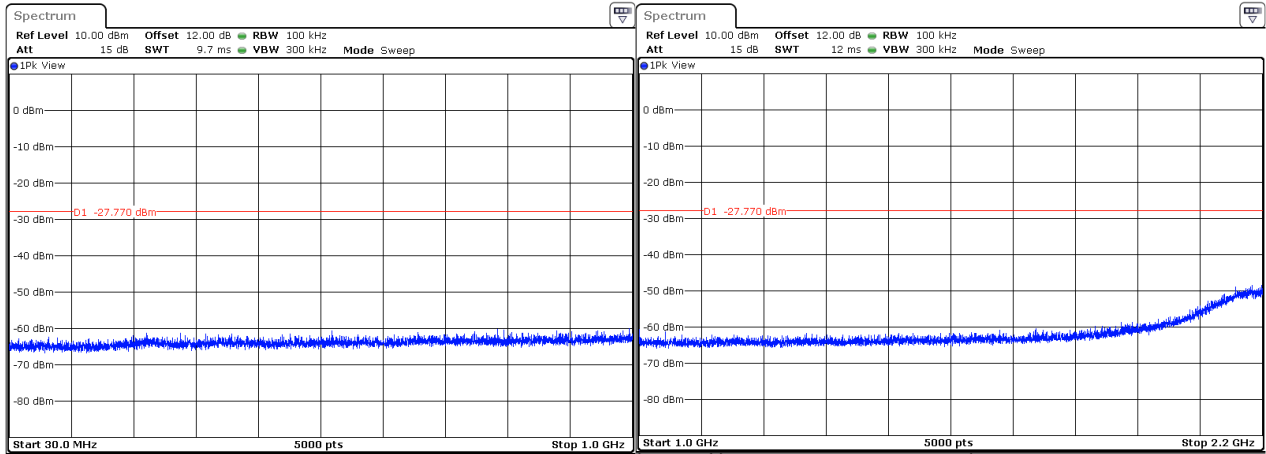


Worst case Cmin with display line at -27.77dBm (-30dBc).





L C I E



## 8.7. CONCLUSION

Band Edge Measurement performed on the sample of the product **CAC1008000**, SN: 20025, 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 : June 21, 2018  
Test performed by : Gaëtan DESCHAMPS  
Atmospheric pressure (hPa) : 1020  
Relative humidity (%) : 32  
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 12dB



Remark:

A WLS board is set up on a mother board allowing Ethernet communication and power supply. The WLS board antenna is removed and replaced by a coaxial cable fitted with SMA connector.

**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	-	A7122269	12/17	12/18
Cable Measure	-	36G	A5329604	12/17	12/18
Spectrum analyzer	ROHDE & SCHWARZ	FSV 30	A4060050	12/17	12/18
Thermo-hygrometer (PM1/2/3)	KIMO	HQ 210	B4206022	08/16	08/18

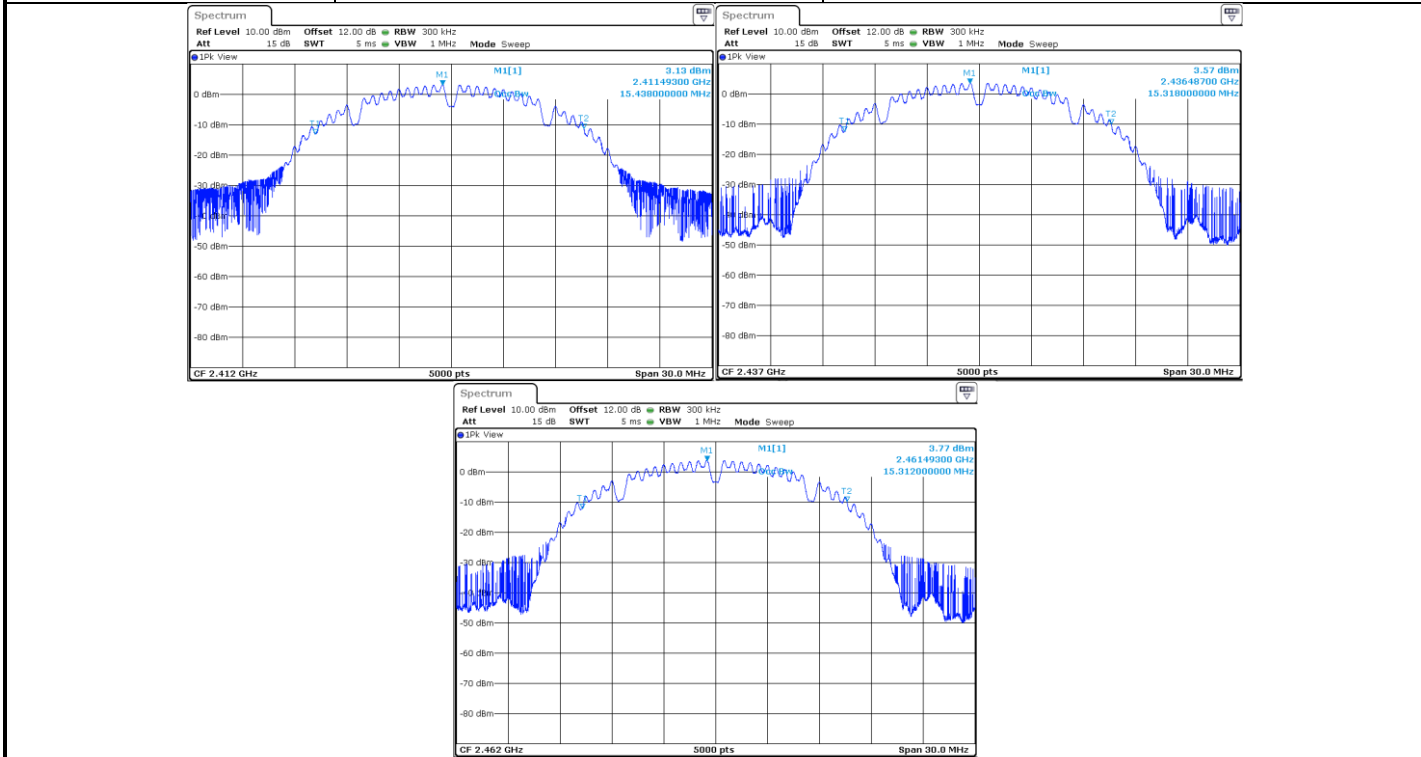
### 9.4. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

None       Divergence:

### 9.5. TEST SEQUENCE AND RESULTS

**Modulation:**  
**802.11b:**

Channel	Channel Frequency (MHz)	99% Occupied Bandwidth (MHz)
Cmin	2412	15.438
Cmid	2437	15.318
Cmax	2462	15.312



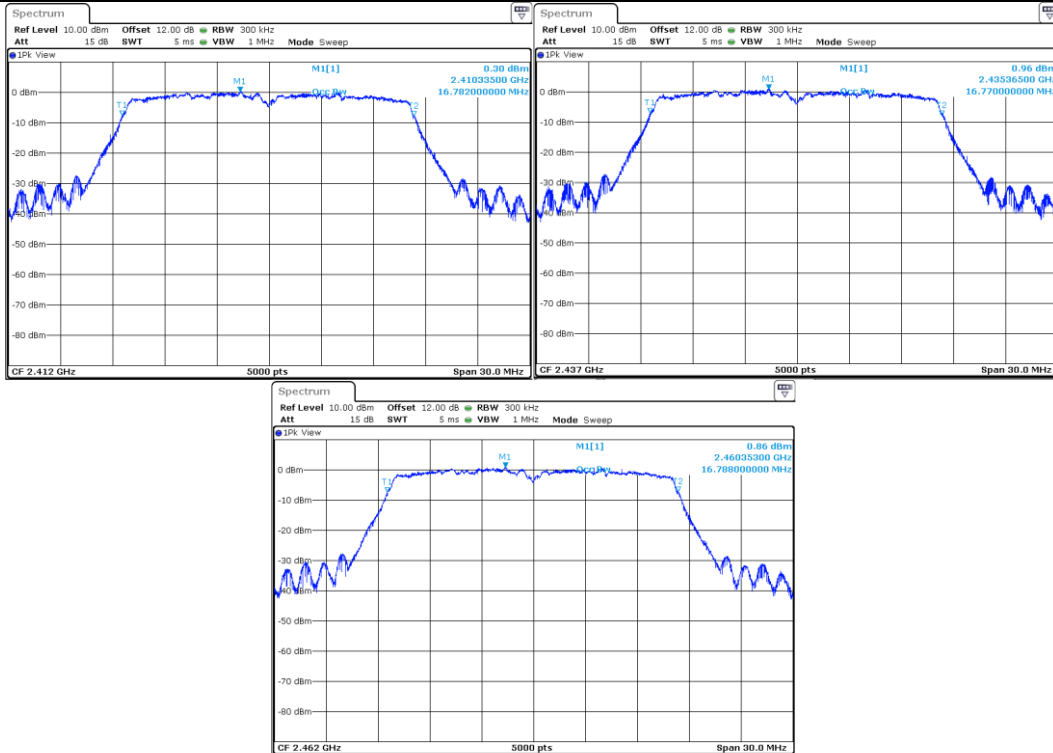




L C I E

802.11g:

Channel	Channel Frequency (MHz)	99% Occupied Bandwidth (MHz)
Cmin	2412	16.782
Cmid	2437	16.770
Cmax	2462	16.788

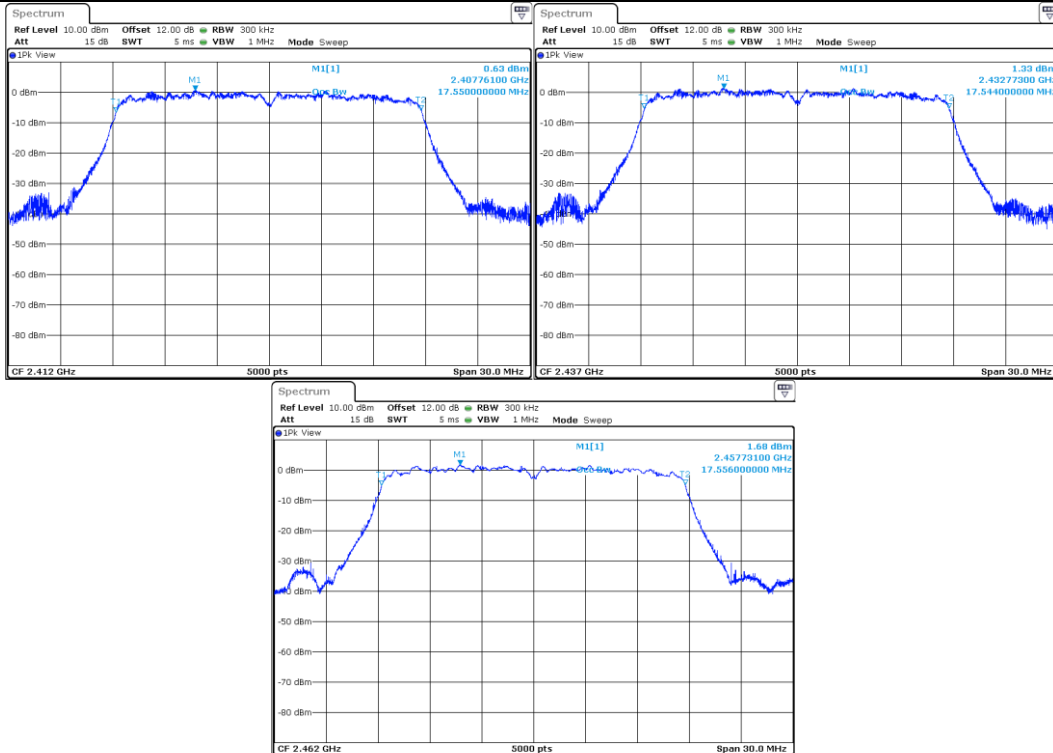




L C I E

**802.11nHT20:**

Channel	Channel Frequency (MHz)	99% Occupied Bandwidth (MHz)
Cmin	2412	17.550
Cmid	2437	17.544
Cmax	2462	17.556





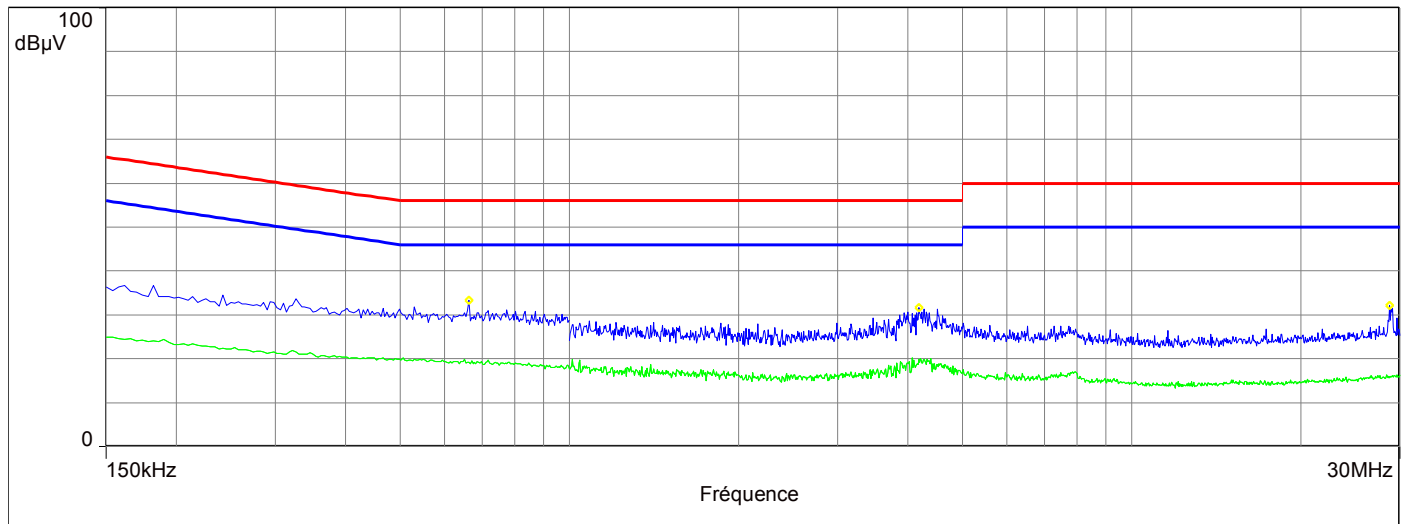
L C I E

**10. ANNEX 1 (GRAPHS)**

**CONDUCTED EMISSIONS**

<b>Graph name:</b>	Emc#1	<b>Test configuration:</b>	
<b>Limit:</b>	FCC CFR47 Part15C	FCC N 120V/60Hz	
<b>Class:</b>	B		
<b>Frequency range: [150kHz - 30MHz]</b>			
<b>Voltage / Frequency:</b>	120V/60Hz	<b>RBW :</b>	10kHz
<b>Line:</b>	Neutral	<b>VBW :</b>	30kHz

- FCC/FCC CFR47 Part15C - Classe:B - Moyenne/
- FCC/FCC CFR47 Part15C - Classe:B - QCrête/
- ◊ Niveau (Suspect Manuel) (Phase 1)
- Mes.Peak (Phase 1)
- Mes.Avg (Phase 1)



**Spurious emissions**

Frequency (MHz)	Peak Level (dBµV)	Line
0.662	33.3	Phase 1
4.184	31.6	Phase 1
28.800	32.2	Phase 1

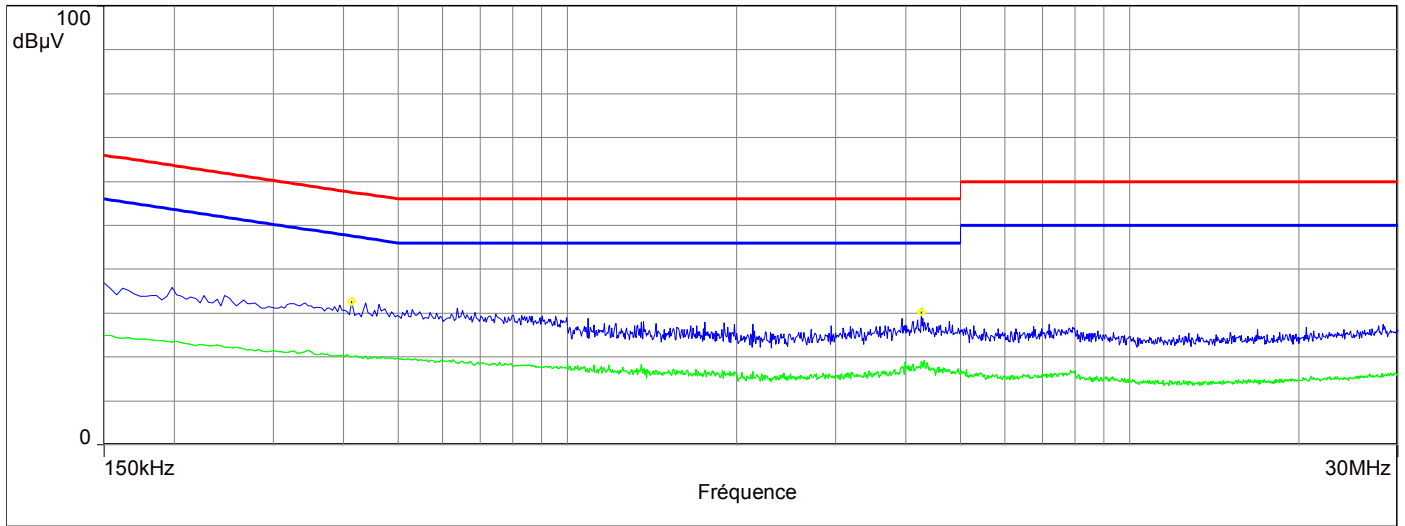


L C I E

**CONDUCTED EMISSIONS**

<b>Graph name:</b>	Emc#2	<b>Test configuration:</b>
<b>Limit:</b>	FCC CFR47 Part15C	FCC L 120V/60Hz
<b>Class:</b>	B	
<b>Frequency range: [150kHz - 30MHz]</b>		
<b>Voltage / Frequency:</b>	120V/60Hz	<b>RBW :</b> 10kHz
<b>Line:</b>	Phase	<b>VBW :</b> 30kHz

- FCC/FCC CFR47 Part15C - Classe:B - Moyenne/
- FCC/FCC CFR47 Part15C - Classe:B - QCrête/
- ◊ Niveau (Suspect Manuel) (Phase 1)
- Mes.Peak (Phase 1)
- Mes.Avg (Phase 1)



**Spurious emissions**

Frequency (MHz)	Peak Level (dBµV)	Line
0.414	32.6	Phase 1
4.264	30.2	Phase 1



## 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>	3.51 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>	3.26 dB	A l'étude / Under consid.
Mesure des perturbations discontinues conduites en tension <i>Measurement of discontinuous conducted disturbances in voltage</i>	3.45 dB	3.6 dB
Mesure des perturbations conduites en courant <i>Measurement of conducted disturbances in current</i>	3.09 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>	5.20 dB	6.3 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.