

TEST REPORT

N°: 781067-R4-E

JDE : 660267

Subject **Electromagnetic compatibility and Radio spectrum Matters
(ERM) tests according to standards:
FCC CFR 47 Part 15, Subpart B et C
RSS-210 Issue 8**

Issued to **SCHNEIDER ELECTRIC**
5 Avenue Raymond Chanas
38320 EYBENS - FRANCE

Apparatus under test
↳ **Product** **Energy Counter EM4300 (WI-LEM)**
↳ **Trade mark** **SCHNEIDER**
↳ **Manufacturer** **SCHNEIDER**
↳ **Model** **EM4302 / EM4305 / EM4310 / EM4320**
↳ **Model under test** **EM4310**
↳ **Serial number** **140304PRO-1141460017**

Test date From August 1st to 29th, 2014
Test location Moirans
Test performed by Anthony MERLIN / Gaëtan DESCHAMPS
Composition of document 36 pages

Document issued on October 10th, 2014

Written by :
Anthony MERLIN
Tests operator



Approved by :
Yannick SAVOIE
Technical manager



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1. TEST PROGRAM

Standard:

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

EMISSION TEST	LIMITS			RESULTS
Limits for conducted disturbance at mains ports 150kHz-30MHz	Frequency	Quasi-peak value (dBμV)	Average value (dBμV)	<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 CFR 47 §15.209 (a) CFR 47 §15.247 (d) RSS-210 §A8.5	Measure at 300m 9kHz-490kHz : 67.6dBμV/m /F(kHz) Measure at 30m 490kHz-1.705MHz : 87.6dBμV/m /F(kHz) 1.705MHz-30MHz : 29.5 dBμV/m			<input checked="" type="checkbox"/> PASS <input type="checkbox"/> FAIL <input type="checkbox"/> NA <input type="checkbox"/> NP
Radiated emissions 30MHz-25GHz* CFR 47 §15.209 (a) CFR 47 §15.247 (d) RSS-210 §A8.5 Highest frequency : (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 CFR 47 §15.247 (a) (2) RSS-210 §A8.2	At least 500kHz			<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-210 §A8.4 (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-210 §A8.5	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
Power spectral Density CFR 47 §15.247 (e) RSS-210 §A8.2	Limit: 8dBm/3kHz			<input checked="" type="checkbox"/> PASS <input type="checkbox"/> FAIL <input type="checkbox"/> NA <input type="checkbox"/> NP
Occupied bandwidth RSS-Gen §4.6.1	No limit			<input checked="" type="checkbox"/> PASS <input type="checkbox"/> FAIL <input type="checkbox"/> NA <input type="checkbox"/> NP
Receiver Spurious Emission** RSS-Gen §4.10	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. INFORMATIONS:

See description of device file – 12449A-01EM43 and Operational Description - 2ADGA-01-EM43 to see differences between models.

2.2. HARDWARE IDENTIFICATION (EUT AND AUXILIARIES):

Equipment under test (EUT):
EM4310
Serial Number: 140304PRO-1141460017



Photography of EUT

Power supply:
During all the tests, EUT is supplied by V_{nom} : 230VAC
For measurement with different voltage, it will be presented in test method.

Name	Type	Rating	Reference / Sn	Comments
Supply 1	<input checked="" type="checkbox"/> AC <input type="checkbox"/> DC <input type="checkbox"/> Battery	230VAC	-	-
Supply2	<input checked="" type="checkbox"/> AC <input type="checkbox"/> DC <input type="checkbox"/> Battery	3*100Vac / 3*277Vac	-	No tested

**Inputs/outputs - Cable:**

Access	Type	Length used (m)	Declared <3m	Shielded	Under test	Comments
Supply 1	AC	1	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Supply2	AC	-	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	No tested
Access1	Rogowski coil cables	1	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Access2	Rogowski coil cables	1	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Access3	Rogowski coil cables	1	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	

Auxiliary equipment used during test:

Type	Reference	Sn	Comments
Zigbee Dongle USB	-	-	Provided by customer
Laptop	DELL LATITUDE E6430	-	-

Equipment information:

Type:	ZIGBEE			
Frequency band:	[2400 – 2483.5] MHz			
Sub-band REC7003:	Annex 3 (a)			
Spectrum Modulation:	<input checked="" type="checkbox"/> DSSS			
Number of Channel:	16			
Spacing channel:	5MHz			
Channel bandwidth:	2MHz			
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: 0dBi	Gain 2: dBi	Gain 3: dBi	Gain 4: dBi
Beam forming gain:	<input type="checkbox"/> Yes: dB			<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 type="checkbox"/> Yes (Load Based)		<input type="checkbox"/> Off mode	<input checked="" type="checkbox"/> No
	Clear Channel Assessment Time:			None
	q value for Load Based Equipment:			None
Duty cycle*:	<input checked="" type="checkbox"/> Continuous duty		<input type="checkbox"/> Intermittent duty	<input type="checkbox"/> Continuous operation
Equipment type:	<input type="checkbox"/> Production model		<input checked="" type="checkbox"/> Prototype	

*Duty cycle maximum declared by provider is 4%.

Temperature range:	Tmin:	<input type="checkbox"/> -20°C	<input type="checkbox"/> 0°C	<input checked="" type="checkbox"/> -10°C
	Tnom:	20°C		
	Tmax:	<input type="checkbox"/> 35°C	<input checked="" type="checkbox"/> 55°C	<input type="checkbox"/> °C
Test source voltage:	<input checked="" type="checkbox"/> AC: 230 V	<input type="checkbox"/> DC:	<input type="checkbox"/> Battery:	VDC / Alkaline

**CHANNEL PLAN**

Channel	Frequency (MHz)
Cmin: 11	2405
12	2410
13	2415
14	2420
15	2425
16	2430
17	2435
Cmid: 18	2440
19	2445
20	2450
21	2455
22	2460
23	2465
24	2470
25	2475
Cmax: 26	2480

DATA RATE

Data Rate (Mbps)	Modulation Type	Worst Case Modulation
0.25	O-QPSK	<input checked="" type="checkbox"/>

2.3. EUT CONFIGURATION

The EUT is set in the following modes during tests with simulator / software (TestRadio_CEM / v1.4.3):

- Permanent emission with modulation on a fixed channel in the data rate that produced the highest power
- The Power order sent (by Zigbee Dongle USB) for Zigbee Module is set at -9dBm.

The reception mode is activated when the EUT is power on.

2.4. EQUIPMENT MODIFICATIONS

☒ None ☐ Modification:

2.5. FIELD STRENGTH CALCULATION

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

$$FS = RA + AF + CF - AG$$

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

Assume a receiver reading of 52.5dBμV is obtained. The antenna factor of 7.4 and a cable factor of 1.1 are added. The amplifier gain of 29dB is subtracted, giving a field strength of 32 dBμV/m.

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

The 32 dBμV/m value can be mathematically converted to its corresponding level in μV/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 : August 29th, 2014
 Test performed by : M.MOURZAGH
 Atmospheric pressure (hPa) : 996
 Relative humidity (%) : 42
 Ambient temperature (°C) : 23

3.2. TEST SETUP

Mains terminals

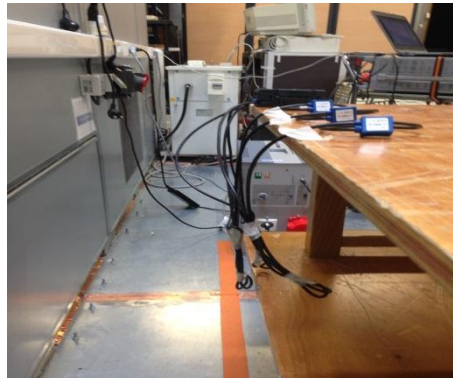
The EUT and auxiliaries are set:

- ☒ 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 C63.4-(2003) and FCC Part 15 subpart B and C. The product has been tested with 120V/60Hz power line voltage and compared to the FCC Part 15 subpart B §15.107 and C §15.207 limits. Measurement bandwidth was 9kHz from 150kHz to 30MHz. This was followed by a Quasi-Peak, i.e. CISPR measurement for any strong signal. If the average limit is met when using a Quasi-Peak detector, the EUT shall be deemed to meet both limits and measurement with the average detector is unnecessary. The LISN (measure) is $50\Omega / 50\mu H$. 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	-	-	A5329578	05/14	05/15
Conducted emission comb generator	BARDET	-	A3169049	-	-
LISN tri-phase ESH2-Z5	RHODE & SCHWARZ	33852.19.53	C2320062	06/14	06/15
Receiver 20Hz – 8GHz	ROHDE & SCHWARZ	ESU8	A2642019	10/13	10/14
Thermo-hygrometer (PM2)	OREGON	BAR916HG-G	B4206011	04/14	04/15
Attenuator 10dB	JFW	-	A7122166	09/13	09/14
Transient limiter	RHODE & SCHWARZ	ESH3-Z2	A7122204	10/13	10/14

3.1. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

☒ None ☐ Divergence:

3.2. TEST RESULTS

Measurements are performed on the phase (L1) and neutral (N) of the power line.

Results: (PEAK detection)

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

3.3. CONCLUSION

Conducted emission data measurement performed on the sample of the product **EM4310**, SN: **140304PRO-1141460017**, in configuration and description presented in this test report, show levels below the FCC CFR 47 Part 15 and RSS-210 Issue 8 limits.



4. RADIATED EMISSION DATA

4.1. ENVIRONMENTAL CONDITIONS

Date of test	:August 27 th , 2014	September 2 nd , 2014
Test performed by	:A.Merlin / G.Deschamps	M.Mourzagh
Atmospheric pressure (hPa)	:995	997
Relative humidity (%)	:40	40
Ambient temperature (°C)	:23	24

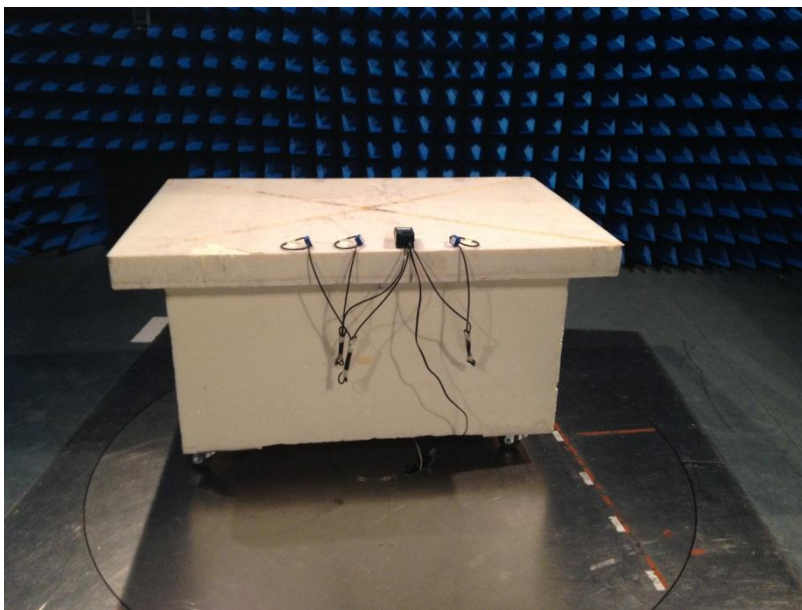
4.2. TEST SETUP

The installation of EUT is identical for pre-characterization measures in a 3 meters semi- anechoic chamber and for measures on the 10 meters Open site.

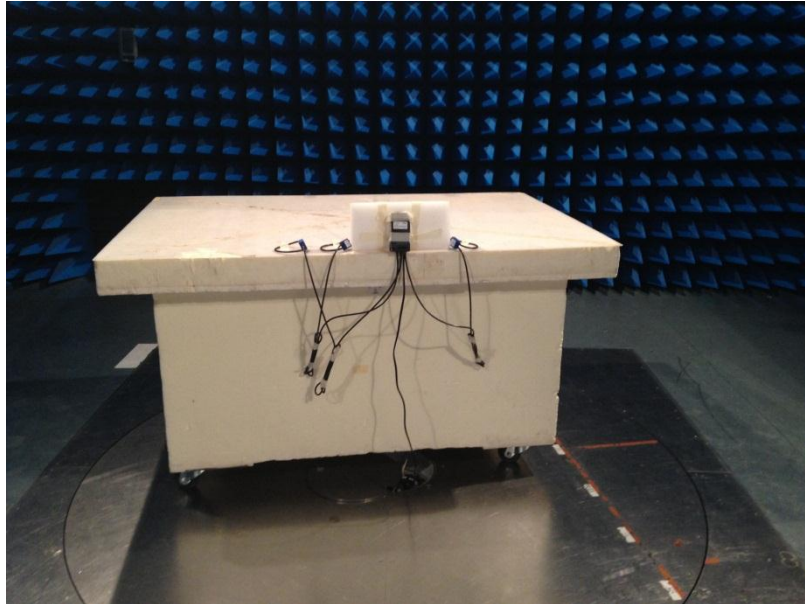
The EUT and auxiliaries are set:

- ☒ 80cm above the ground on the non-conducting table (Table-top equipment)
- ☐ 10cm above the ground on isolating support (Floor standing equipment)

The EUT is powered by V_{nom} .



Test setup in anechoic chamber Axis XY



Test setup in anechoic chamber Axis Z

4.3. TEST METHOD

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.

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

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

The product has been tested according to ANSI C63.4 (2003), FCC part 15 subpart C. Radiated Emissions were measured on an open area test site. A description of the facility is on file with the FCC. The product has been tested at a distance of **10 meters** from the antenna and compared to the FCC part 15 subpart C §15.225 limits in the frequency range 13.553MHz 13.567MHz. Measurement bandwidth was 9kHz below 30MHz and 120kHz from 30 MHz to 1GHz. Test is performed in horizontal (H) and vertical (V) polarization, the loop antenna was rotated during the test 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 B §15.109 limits and C §15.209 limits. Measurement bandwidth was 1MHz from 1GHz to 25GHz.

Test is performed in horizontal (H) and vertical (V) polarization. Continuous linear turntable azimuth search was performed with 360 degrees range. Measurement performed on all axis of EUT used in normal configuration. A summary of the worst case emissions found in all test configurations and modes is shown. The height antenna is

- ☐ On mast, varied from 1m to 4m
- ☒ Fixed and centered on the EUT

Frequency list has been created with anechoic chamber pre-scan results.



4.4. TEST EQUIPMENT LIST

DESCRIPTION	MANUFACTURER	MODEL	N° LCIE	Cal_Date	Cal_Due
Antenna Bi-log	CHASE	CBL6111A	C2040172	04/13	04/15
Amplifier 1-13GHz	LCIE SUD EST	-	A7102067	09/13	09/14
Antenna horn	EMCO	3115	C2042027	04/13	04/14
Antenna horn	EMCO	3115	C2042029	04/13	04/14
Cable - Measure	-	-	A5329038	04/13	04/14
Cable Measure	-	-	A5329206	01/14	01/15
Cable Measure	-	-	A5329604	04/13	04/14
Semi-Anechoic chamber #3	SIEPEL	-	D3044017	-	-
Radiated emission comb generator	BARDET	-	A3169050	-	-
HF Radiated emission comb generator	LCIE SUD EST	-	A3169088	-	-
Frequency generator 2GHz – 18GHz	HEWLETT PACKARD	8672A	A5442022	08/13	08/14
Receiver 20Hz – 8GHz	ROHDE & SCHWARZ	ESU8	A2642019	10/13	10/14
Spectrum analyzer	ROHDE & SCHWARZ	FSV 30	A4060050	-	-
Thermo-hygrometer (C3)	OREGON	BAR206	B4204078	01/14	01/15
Thermo-hygrometer (PM2)	OREGON	BAR916HG-G	B4206011	04/14	04/15
Turntable chamber (Cage#3)	ETS Lingren	Model 2165	F2000371	-	-
Table	LCIE	-	F2000461	-	-
Turntable controller (Cage#3)	ETS Lingren	Model 2090	F2000444	-	-
Amplifier 0.1MHz – 1300 MHz	HEWLETT PACKARD	8447F	A7486006	10/13	10/14
Antenna Bi-Log	AH System	SAS-521-7	C2040180	01/14	01/15
Cable	-	-	A5329065	01/14	01/15
Cable	MICRO-COAX	-	A5329657	04/14	04/15
Cable	MICRO-COAX	-	A5329658	04/14	04/15
Semi-Anechoic chamber #1	SIEPEL	-	D3044016	04/14	04/15
Radiated emission comb generator	BARDET	-	A3169050	-	-
Spectrum Analyzer 9kHz - 6GHz	ROHDE & SCHWARZ	FSL6	A2642020	07/14	07/15
Thermo-hygrometer (C1)	OREGON	WMR 80	B4206013	01/14	01/15
Turntable chamber (Cage#1)	MATURO Gmbh	TT 2.0 SI	F2000406	-	-
Antenna mast (Cage#1)	MATURO Gmbh	AM 4.0	F2000407	-	-
Turntable controller (Cage#1)	MATURO Gmbh	Control Unit	F2000408	-	-
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	Mode	EUT position	Channel	Comments
Emr# 1	H	TX	Axis XY	Min	See annex 1
Emr# 2	V	TX	Axis XY	Min	See annex 1
Emr# 3	H	TX	Axis XY	Max	See annex 1
Emr# 4	V	TX	Axis XY	Max	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	Frequency (MHz)	Limit Quasi-Peak (dBμV/m)	Measure Quasi-Peak (dBμV/m)	Margin (Mes-Lim) (dB)	Angle Table (deg)	Pol Ant.	Ht Ant. (cm)	Correc. Factor (dB)	Comments
No suspect frequency observed									

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



4.6.3. 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	2213.340	74.0	49.1	-24.9	54.0	35.9	-18.1		H	1	31.0	Axe XY
2	2245.230	74.0	51.4	-22.6	54.0	38.3	-15.7	150	H	1	31.1	Axe XY
3	2276.850	74.0	54.0	-20.0	54.0	46.0	-8.0	160	H	1	31.1	Axe XY
4	2309.300	74.0	54.2	-19.8	54.0	45.2	-8.8	30	H	1	31.2	Axe XY
5*	2340.920	74.0	65.6	-8.4	54.0	37	-17	30	H	1	31.2	Axe XY
6	2373.090	74.0	56.5	-17.5	54.0	46.3	-7.7	30	H	1	31.2	Axe XY
7	12195.000	74.0	43.6	-30.4	54.0	28.4	-25.6	0	H	1	5.6	Axe XY
8	2213.340	74.0	48.5	-25.5	54.0	33.5	-20.5	360	V	1	31.0	Axe XY
9	2245.230	74.0	48.8	-25.2	54.0	34.2	-19.8	340	V	1	31.1	Axe XY
10	2276.850	74.0	50.6	-23.4	54.0	38.5	-15.5	340	V	1	31.1	Axe XY
11	2309.300	74.0	50.8	-23.2	54.0	38.3	-15.7	310	V	1	31.2	Axe XY
12*	2340.920	74.0	59.0	-15.0	54.0	31	-23	310	V	1	31.2	Axe XY
13	2373.090	74.0	52.4	-21.6	54.0	39.8	-14.2	310	V	1	31.2	Axe XY
14	12195.000	74.0	43.6	-30.4	54.0	28.4	-25.6	0	V	1	5.6	Axe XY

***Average results calculated with duty cycle method:**

*Average = Peak measure – 20*log(duty cycle).*

Note: Measures have been done at 3m distance.

4.7. CONCLUSION

Radiated emission data measurement performed on the sample of the product **EM4310**, SN: **140304PRO-1141460017**, in configuration and description presented in this test report, show levels above the FCC CFR 47 Part 15 and RSS-210 Issue 8 limits.



5. BANDWIDTH (15.247)

5.1. TEST CONDITIONS

Date of test : August 27st, 2014
 Test performed by : A.Merlin / G.Deschamps
 Atmospheric pressure (hPa) : 995
 Relative humidity (%) : 57
 Ambient temperature (°C) : 24

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



Test setup:

☐ **Radiated measurement:**

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

Measurement Procedure:

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

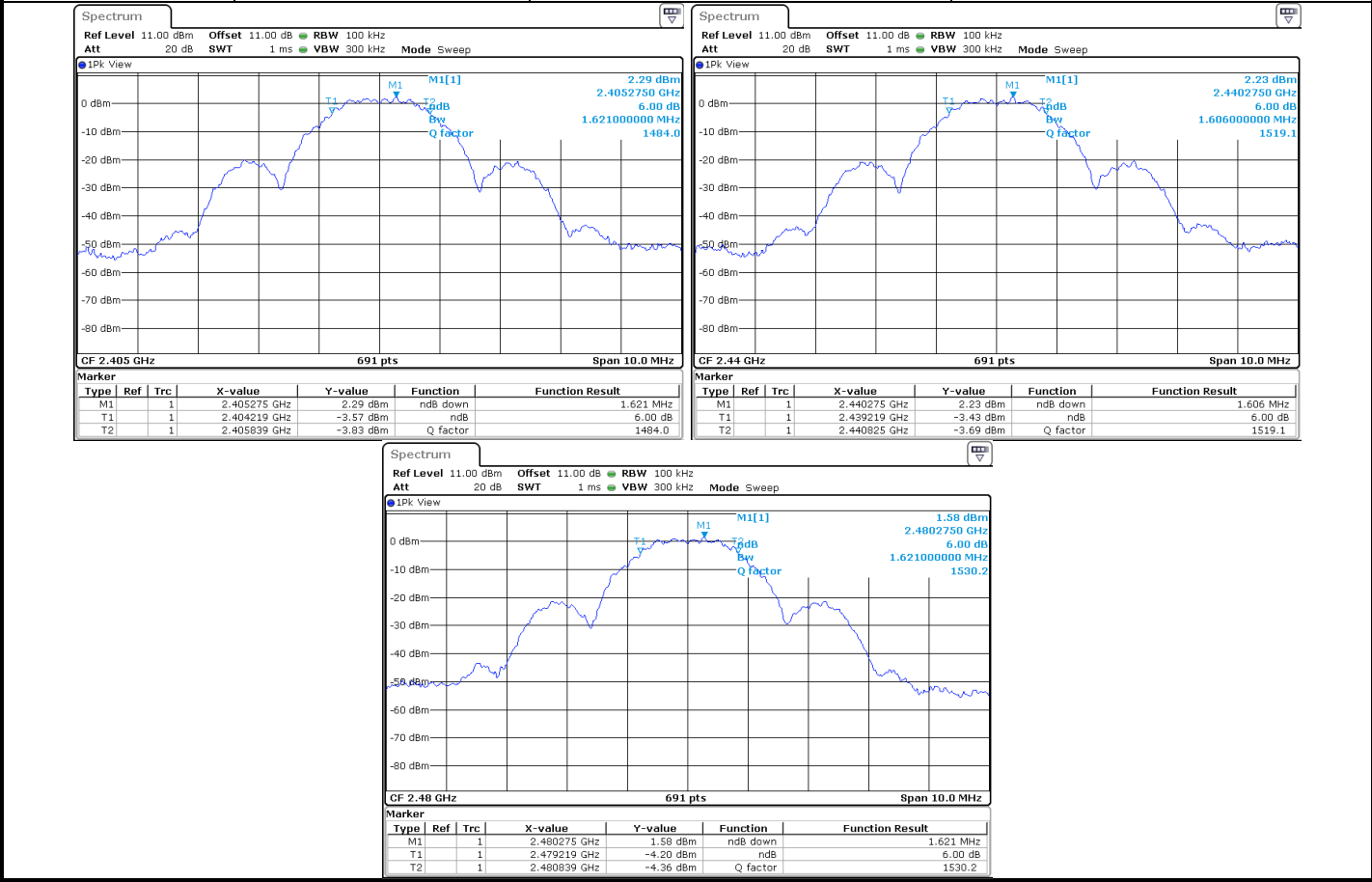
DESCRIPTION	MANUFACTURER	MODEL	N° LCIE
Attenuator 10dB	JFW	-	A7122166
Cable Measure	-	-	A5329604
Receiver 20Hz – 8GHz	ROHDE & SCHWARZ	ESU8	A2642019
Power supply DC	AFX	0	A7044292
Thermo-hygrometer (C3)	OREGON	BAR206	B4204078
Thermo-hygrometer (PM2)	OREGON	BAR916HG-G	B4206011

5.4. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION☒ None☐ Divergence:



5.5. TEST SEQUENCE AND RESULTS

Channel	Channel Frequency (MHz)	6dB Bandwidth (kHz)	Bandwidth Limit (kHz)
Cmin	2405	1621	>500
Cmid	2440	1606	>500
Cmax	2480	1621	>500



5.6. CONCLUSION

Bandwidth measurement performed on the sample of the product **EM4310**, SN: **140304PRO-1141460017**, in configuration and description presented in this test report, show levels below the FCC CFR 47 Part 15 and RSS-210 Issue 8 limits.



6. MAXIMUM PEAK OUTPUT POWER (15.247)

6.1. TEST CONDITIONS

Date of test : August 26st, 2014
 Test performed by : A.Merlin / G.Deschamps
 Atmospheric pressure (hPa) : 985
 Relative humidity (%) : 43
 Ambient temperature (°C) : 24

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



Test setup:

☐ **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**

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	JFW	-	A7122166	09/13	09/14
Cable Measure	-	-	A5329604	04/13	04/14
Receiver 20Hz – 8GHz	ROHDE & SCHWARZ	ESU8	A2642019	10/13	10/14
Thermo-hygrometer (PM2)	OREGON	BAR916HG-G	B4206011	04/14	04/15
Turntable chamber (Cage#3)	ETS Lingren	Model 2165	F2000371	-	-
Power supply DC	AFX	0	A7044292	-	-

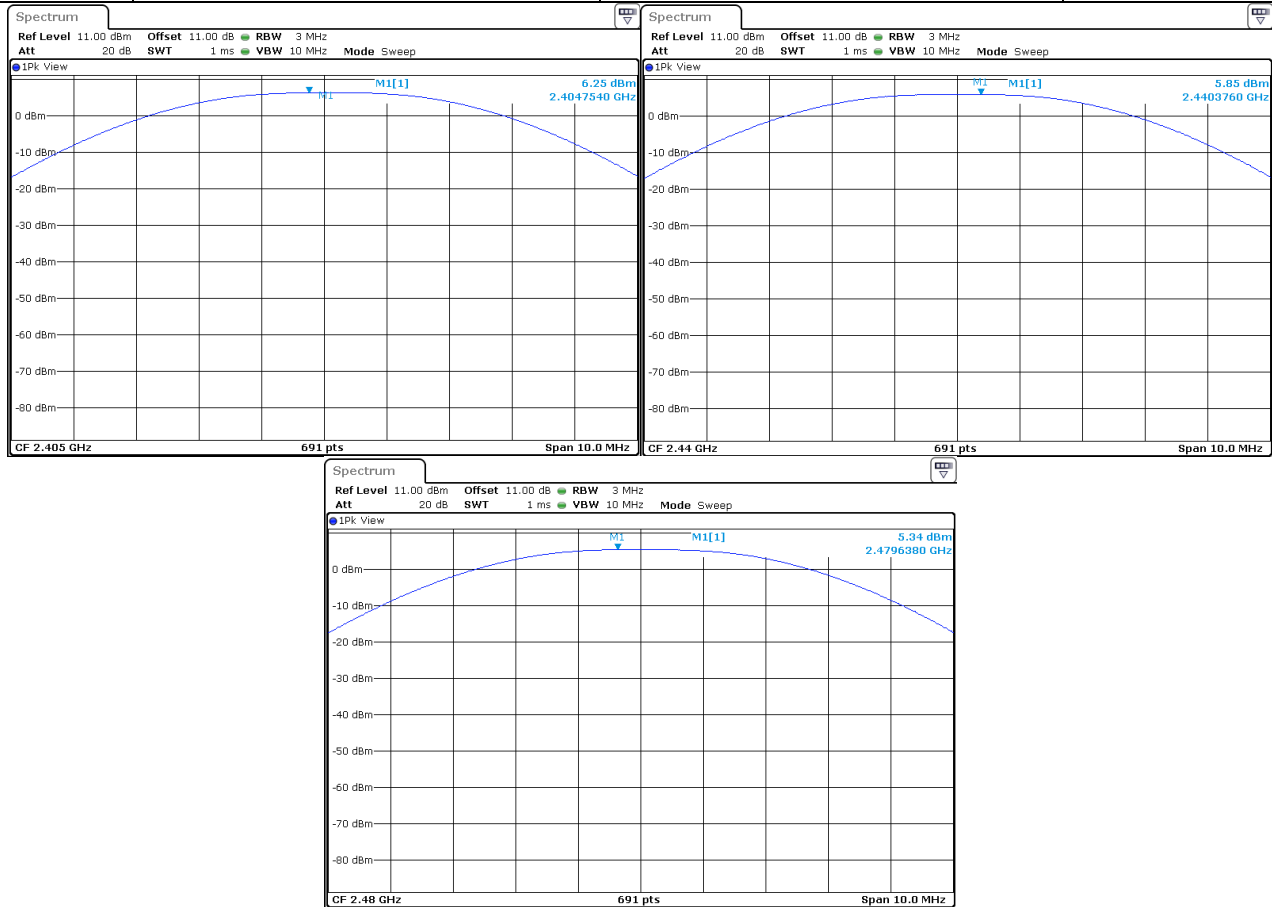
6.4. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

☒ None

☐ Divergence:

6.5. TEST SEQUENCE AND RESULTS

Channel	Channel Frequency (MHz)	Peak Output Power (dBm)	Power Limit (dBm)
Cmin	2405	6.3	30.0
Cmid	2440	5.9	30.0
Cmax	2480	5.4	30.0



6.6. CONCLUSION

Maximum Peak Output Power measurement performed on the sample of the product **EM4310**, SN: **140304PRO-1141460017**, in configuration and description presented in this test report, show levels below the FCC CFR 47 Part 15 and RSS-210 Issue 8 limits.

7. POWER SPECTRAL DENSITY (15.247)

7.1. TEST CONDITIONS

Date of test : August 26st, 2014
 Test performed by : A.Merlin / G.Deschamps
 Atmospheric pressure (hPa) : 985
 Relative humidity (%) : 43
 Ambient temperature (°C) : 24

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



Test setup:

☐ **Radiated measurement:**

The EUT is placed in an anechoic chamber; the center frequency of the spectrum analyzer is set to the fundamental frequency.

The product has been tested at a distance of 3 meters from the antenna. Continuous linear turntable azimuth search was performed with 360 degrees range. Measurement performed on 3 axis of EUT. A summary of the worst case emissions found in all test configurations and modes is shown on following table. The captured power is measured and recorded; the measurement is repeated until all frequencies required were complete.

To demonstrate compliance with peak output power requirement of section 15.247 (b), the transmitter's peak output power is calculated using the following equation:

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

Where:

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

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

**Measurement Procedure PKPSD:**

- a) Set analyzer center frequency to DTS channel center frequency.
- b) Set the span to 1.5 times the DTS bandwidth.
- c) Set the RBW to: $3 \text{ kHz} \leq \text{RBW}$.
- d) Set the VBW $\geq 3 * \text{RBW}$.
- 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

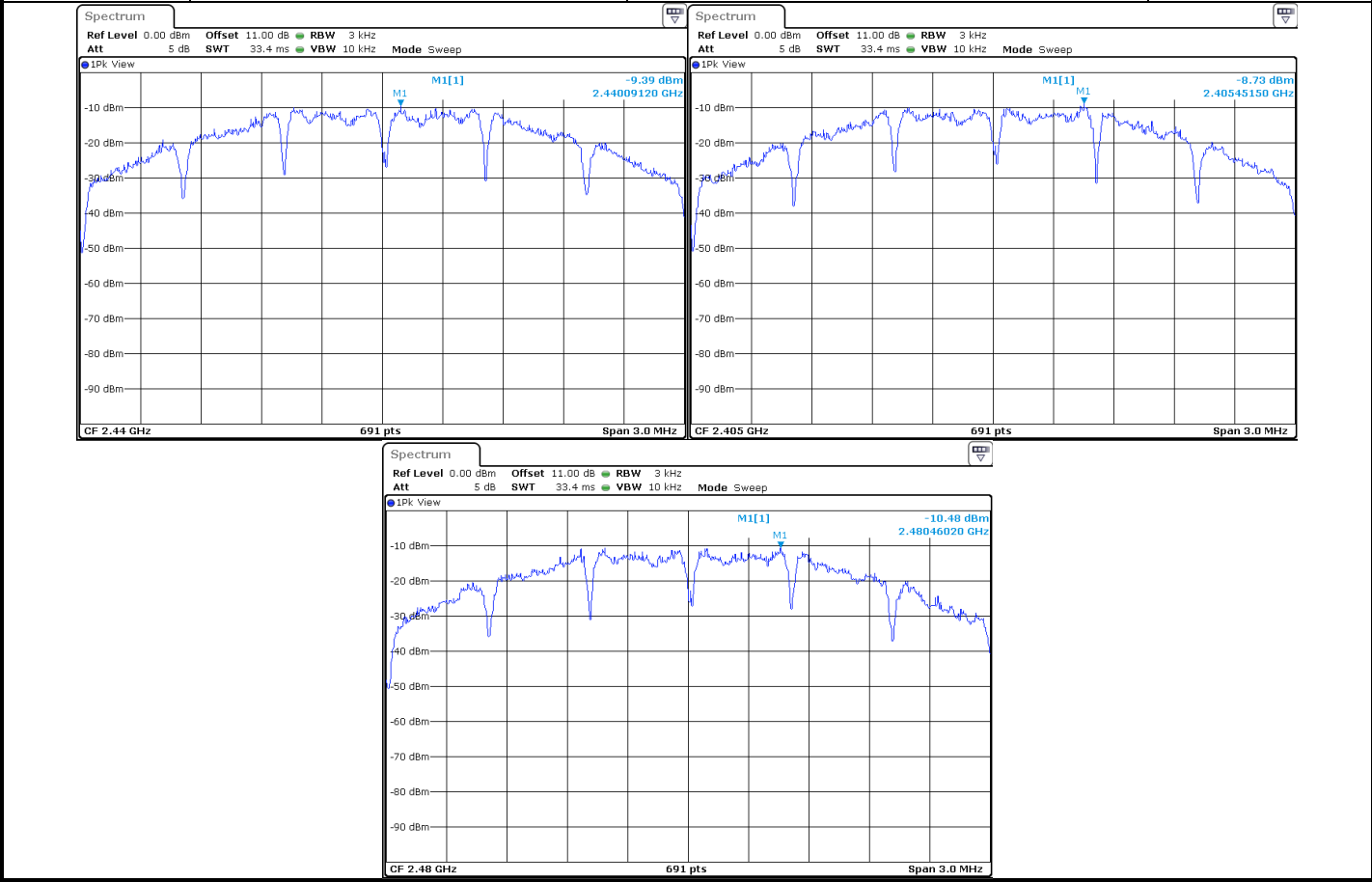
DESCRIPTION	MANUFACTURER	MODEL	N° LCIE	Cal_Date	Cal_Due
Attenuator 10dB	JFW	-	A7122166	10/14	10/15
Cable Measure	-	-	A5329604	04/13	04/14
Receiver 20Hz – 8GHz	ROHDE & SCHWARZ	ESU8	A2642019	10/13	10/14
Power supply DC	AFX	0	A7044292	-	-
Thermo-hygrometer (C3)	OREGON	BAR206	B4204078	01/14	01/15
Thermo-hygrometer (PM2)	OREGON	BAR916HG-G	B4206011	04/14	04/15

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



7.5. TEST SEQUENCE AND RESULTS

Channel	Channel Frequency (MHz)	Power Spectral Density (dBm)	PSD Limit (dBm)
Cmin	2405	-8.7	8.0
Cmid	2440	-9.3	8.0
Cmax	2480	-10.4	8.0



7.6. CONCLUSION

Power Spectral Density measurement performed on the sample of the product **EM4310**, SN: **140304PRO-1141460017**, in configuration and description presented in this test report, show levels below the FCC CFR 47 Part 15 and RSS-210 Issue 8 limits.



8. BAND EDGE MEASUREMENT (15.247)

8.1. TEST CONDITIONS

Date of test : August 26st, 2014
Test performed by : A.Merlin / G.Deschamps
Atmospheric pressure (hPa) : 984
Relative humidity (%) : 43
Ambient temperature (°C) : 24

8.2. LIMIT

RF antenna conducted test:

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

Radiated emission test:

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

8.3. SETUP

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

RBW: 100kHz

VBW: 300kHz



Test setup:

8.4. TEST EQUIPMENT LIST

DESCRIPTION	MANUFACTURER	MODEL	N° LCIE	Cal_Date	Cal_Due
Attenuator 10dB	JFW	-	A7122166	10/14	10/15
Cable Measure	-	-	A5329604	04/13	04/14
Receiver 20Hz – 8GHz	ROHDE & SCHWARZ	ESU8	A2642019	10/13	10/14
Spectrum Analyzer 9KHz – 26.5GHz	HEWLETT PACKARD	8593E	A4060018	12/13	12/14
Power supply DC	AFX	0	A7044292	-	-
Thermo-hygrometer (C3)	OREGON	BAR206	B4204078	01/14	01/15
Thermo-hygrometer (PM2)	OREGON	BAR916HG-G	B4206011	04/14	04/15

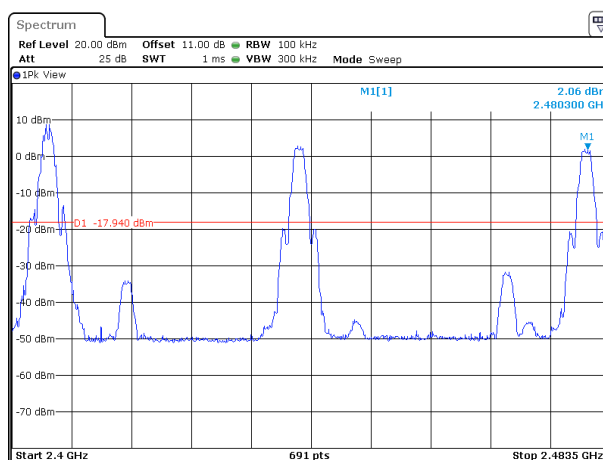
8.5. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

☒ None

☐ Divergence:

8.6. TEST SEQUENCE AND RESULTS

Offset: Attenuator + cable = 11dB

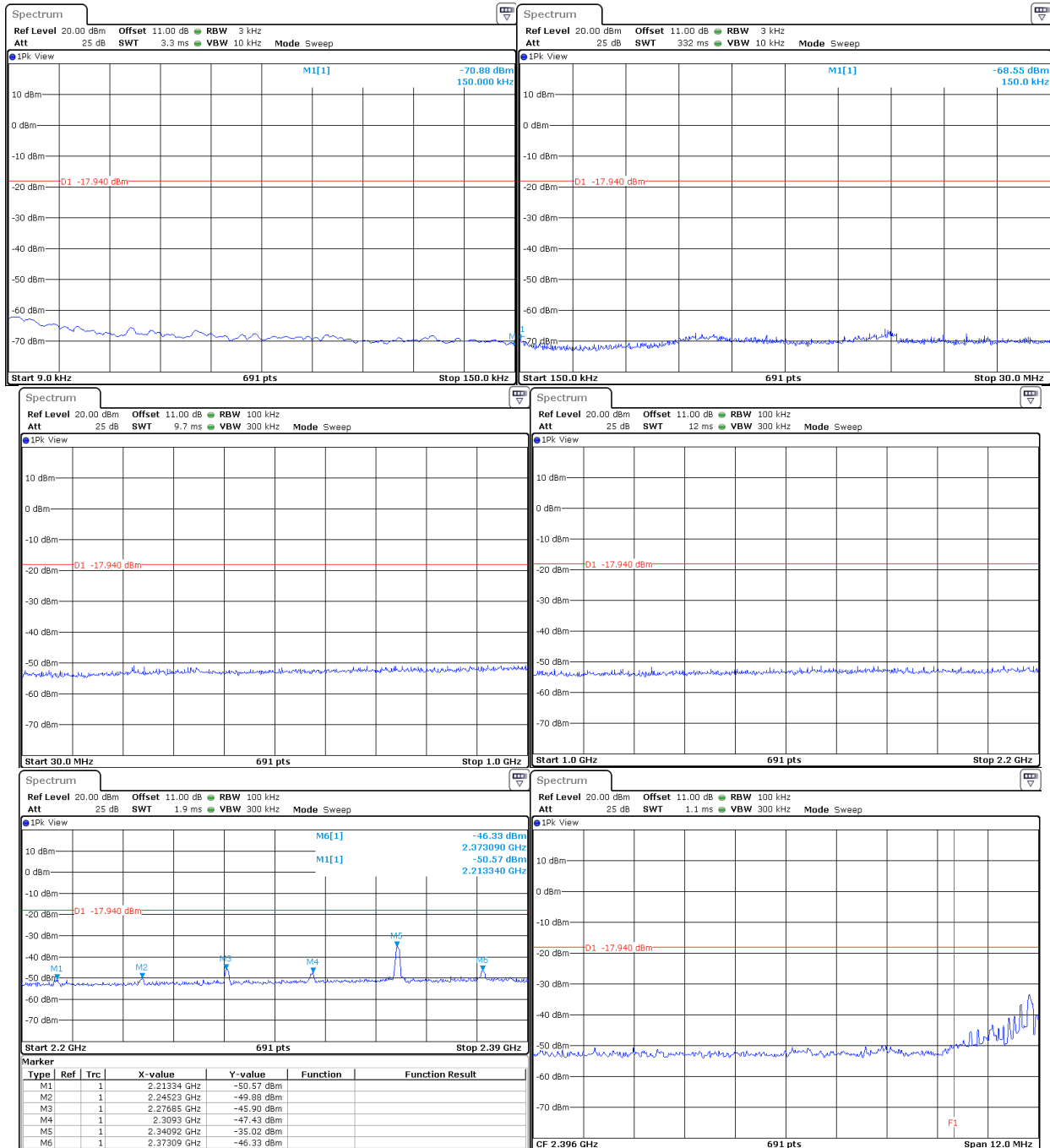


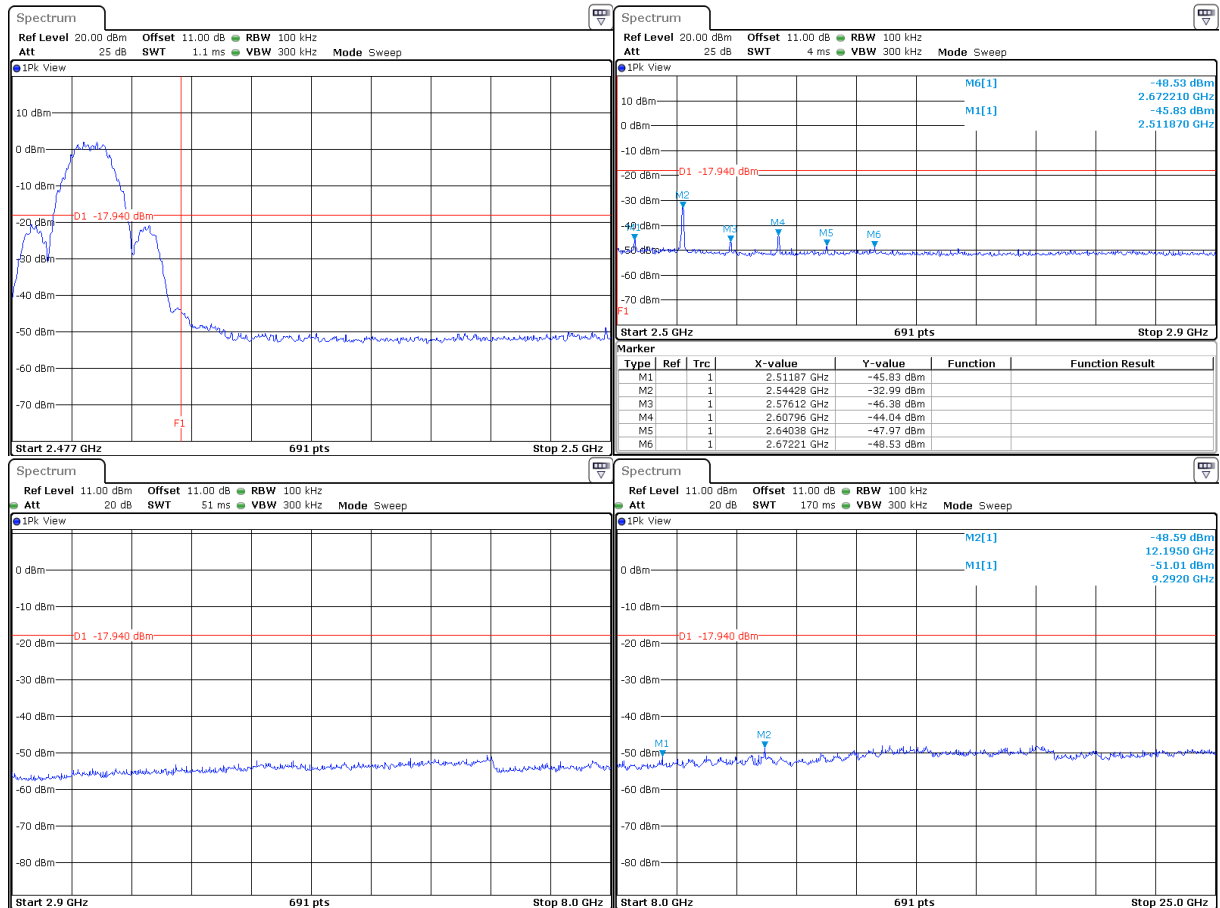
-20dbc limit used:

Worst case: Channel max, limit at -17.94dBm



Graphs 9kHz to 25GHz:





8.7. CONCLUSION

Band Edge Measurement performed on the sample of the product **EM4310**, SN: **140304PRO-1141460017**, in configuration and description presented in this test report, show levels below the FCC CFR 47 Part 15 and RSS-210 Issue 8 limits.

9. OCCUPIED BANDWIDTH

9.1. TEST CONDITIONS

Date of test : August 1st, 2014
Test performed by : A.Merlin / G.Deschamps
Atmospheric pressure (hPa) : 995
Relative humidity (%) : 57
Ambient temperature (°C) : 24

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



Test setup:

☐ **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:

1. RBW used should not be lower than 1% of the selected span
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. OBW 99% function of spectrum analyzer used

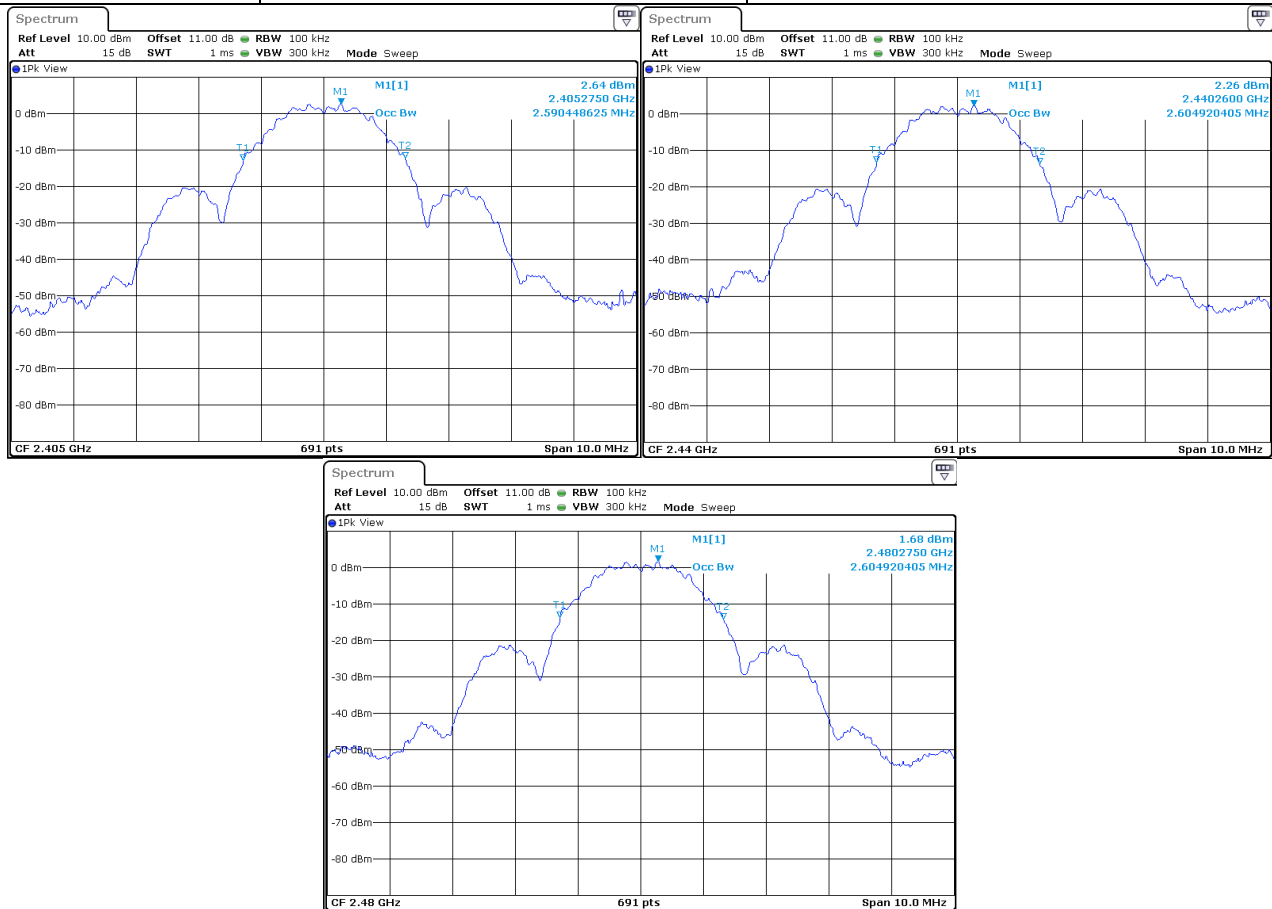
**9.3. TEST EQUIPMENT LIST**

DESCRIPTION	MANUFACTURER	MODEL	N° LCIE	Cal_Date	Cal_Due
Attenuator 10dB	JFW	-	A7122166	10/14	10/15
Cable Measure	-	-	A5329604	04/13	04/14
Receiver 20Hz – 8GHz	ROHDE & SCHWARZ	ESU8	A2642019	10/13	10/14
Power supply DC	AFX	0	A7044292	-	-
Thermo-hygrometer (C3)	OREGON	BAR206	B4204078	01/14	01/15
Thermo-hygrometer (PM2)	OREGON	BAR916HG-G	B4206011	04/14	04/15

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)
Cmin	2405	2590.5
Cmid	2440	2605.0
Cmax	2480	2605.0

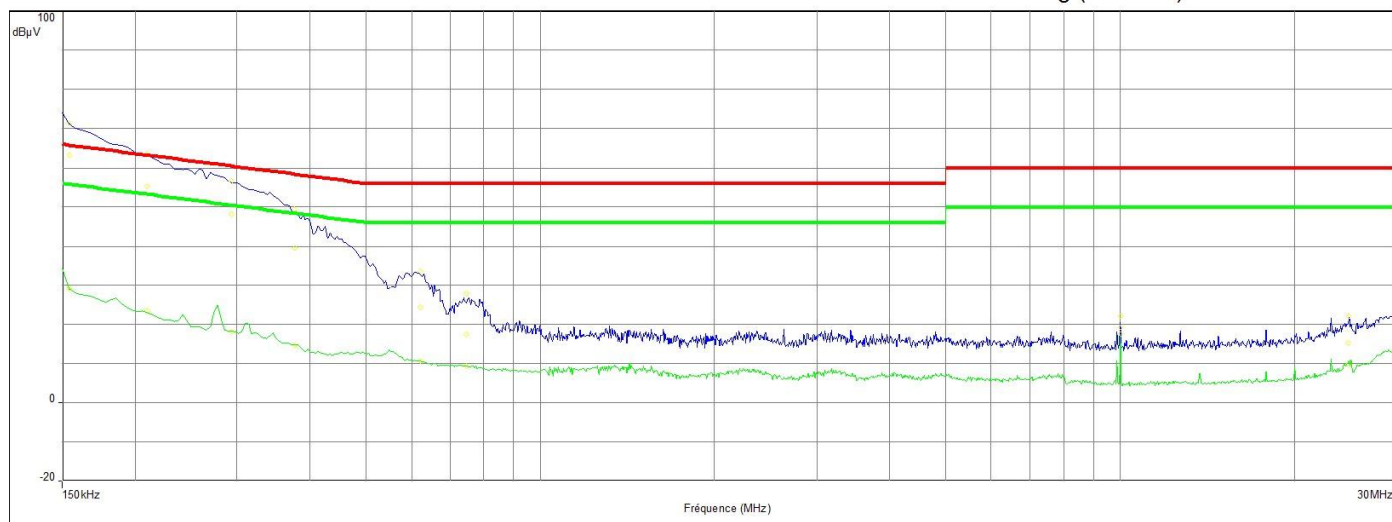


10. ANNEX 1 (GRAPHS)

CONDUCTED EMISSIONS

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

- Civile/EN 55022 - Classe:B - Moyenne/
- Civile/EN 55022 - Classe:B - QCrête/
- Mes.Peak (SR 550xx) (Phase 1)
- Mes.QPeak (SR 550xx) (Phase 1)
- Mes.Avg (SR 550xx) (Phase 1)
- Mes.Peak (Phase 1)
- Mes.Avg (Phase 1)



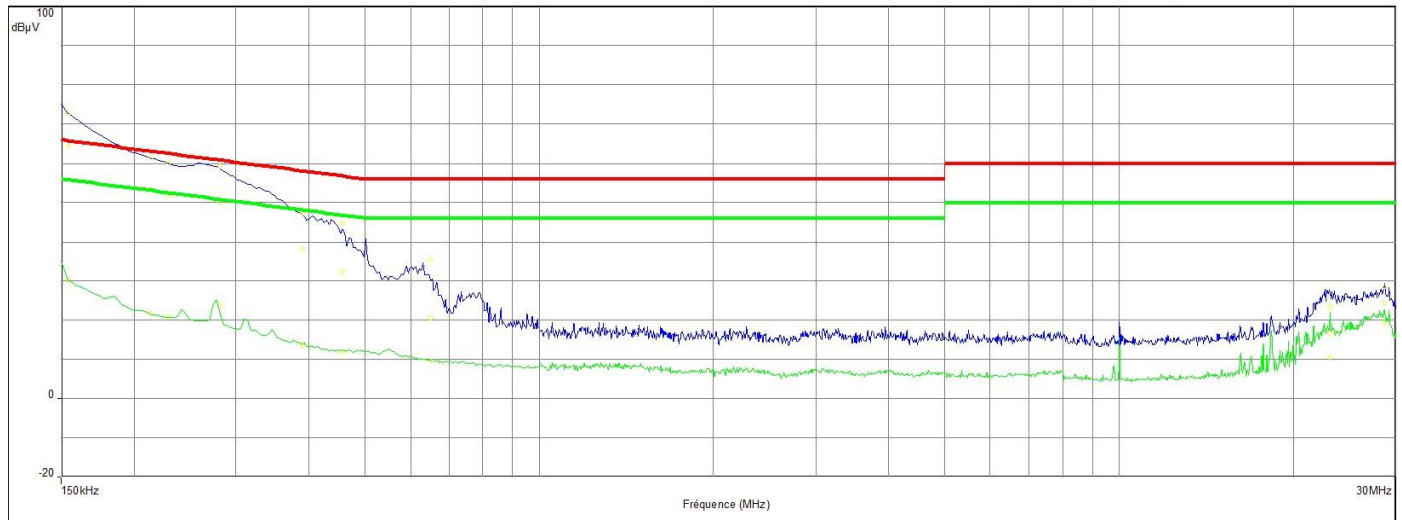
Spurious emissions

Frequency (MHz)	Mes.QPeak (dBμV)	LimQP (dBμV)	Mes.QPeak-LimQP (dB)	Mes.Avg (dBμV)	LimAvg (dBμV)	Mes.Avg-LimAvg (dB)
0.150	64.45	66	-1.55	30.70	56	-25.30
0.154	63.12	65.78	-2.66	29.07	55.78	-26.72
0.208	55.23	63.21	-7.97	23.39	53.21	-29.81
0.292	47.94	60.41	-12.48	18.08	50.41	-32.34
0.376	39.43	58.32	-18.9	14.63	48.32	-33.69
0.621	24.16	56	-31.84	10.64	46	-35.36
0.744	17.39	56	-38.61	9.38	46	-36.62
10	19.22	60	-40.78	17.38	50	-32.62
24.772	15.31	60	-44.69	9.66	50	-40.34

CONDUCTED EMISSIONS

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

- Civile/EN 55022 - Classe:B - Moyenne/
- Civile/EN 55022 - Classe:B - QCrête/
- Mes.Peak (SR 550xx) (Phase 1)
- Mes.QPeak (SR 550xx) (Phase 1)
- Mes.Avg (SR 550xx) (Phase 1)
- Mes.Peak (Phase 1)
- Mes.Avg (Phase 1)



Spurious emissions

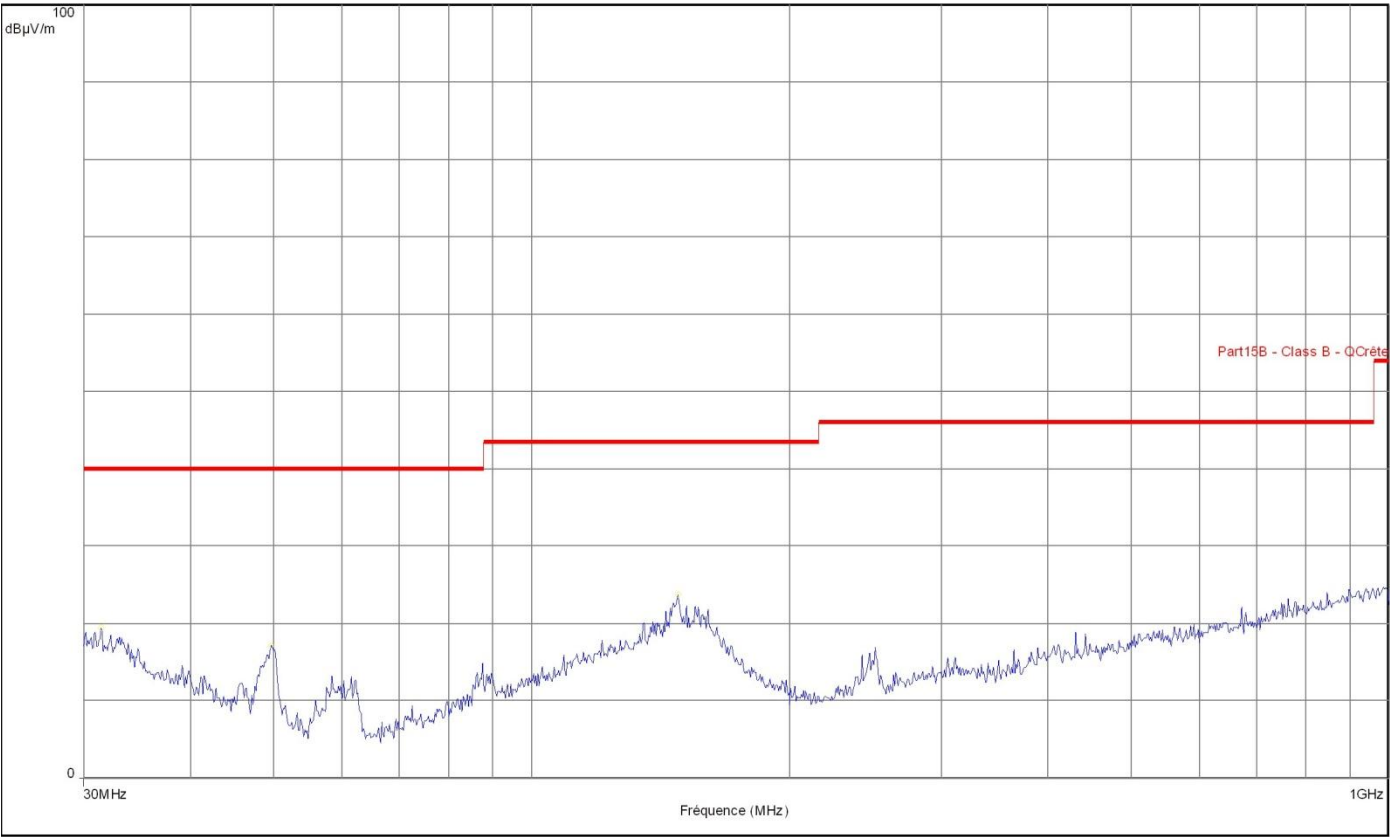
Frequency (MHz)	Mes.QPeak (dBμV)	LimQP (dBμV)	Mes.QPeak-LimQP (dB)	Mes.Avg (dBμV)	LimAvg (dBμV)	Mes.Avg-LimAvg (dB)
0.150	63.67	66	-2.33	31.10	56	-24.90
0.154	64.38	65.78	-1.4	30.16	55.78	-25.62
0.212	53.22	63.05	-9.83	21.72	53.05	-31.33
0.228	51.86	62.45	-10.59	20.7	52.45	-31.75
0.28	49.94	60.76	-10.82	23.74	50.76	-27.01
0.388	38.07	58.06	-19.99	13.55	48.06	-34.51
0.457	32.29	56.73	-24.44	11.81	46.73	-34.92
0.65	20.55	56	-35.45	9.51	46	-36.49
23.077	16.63	60	-43.37	10.29	50	-39.71
28.683	24.27	60	-35.73	19.41	50	-30.59



RADIATED EMISSIONS

Graph name:	Emr#1	Test configuration:	
Limit:	FCC CFR47 Part15B	P(H) - Axis XY	
Class:	B		
Frequency range: [30MHz - 1GHz]			
Antenna polarization:	Vertical	RBW :	100kHz
Azimuth:	0° - 360°	VBW :	300kHz

- FCC/FCC CFR47 Part15B - Classe:B - Moyenne/3.0m/
- FCC/FCC CFR47 Part15B - Classe:B - QCrête/3.0m/
- FCC/FCC CFR47 Part15B - Classe:B - Crête/3.0m/
- Niveau (Suspect Manuel) (Horizontale)
- Mes.Peak (Horizontale)



Spurious emissions

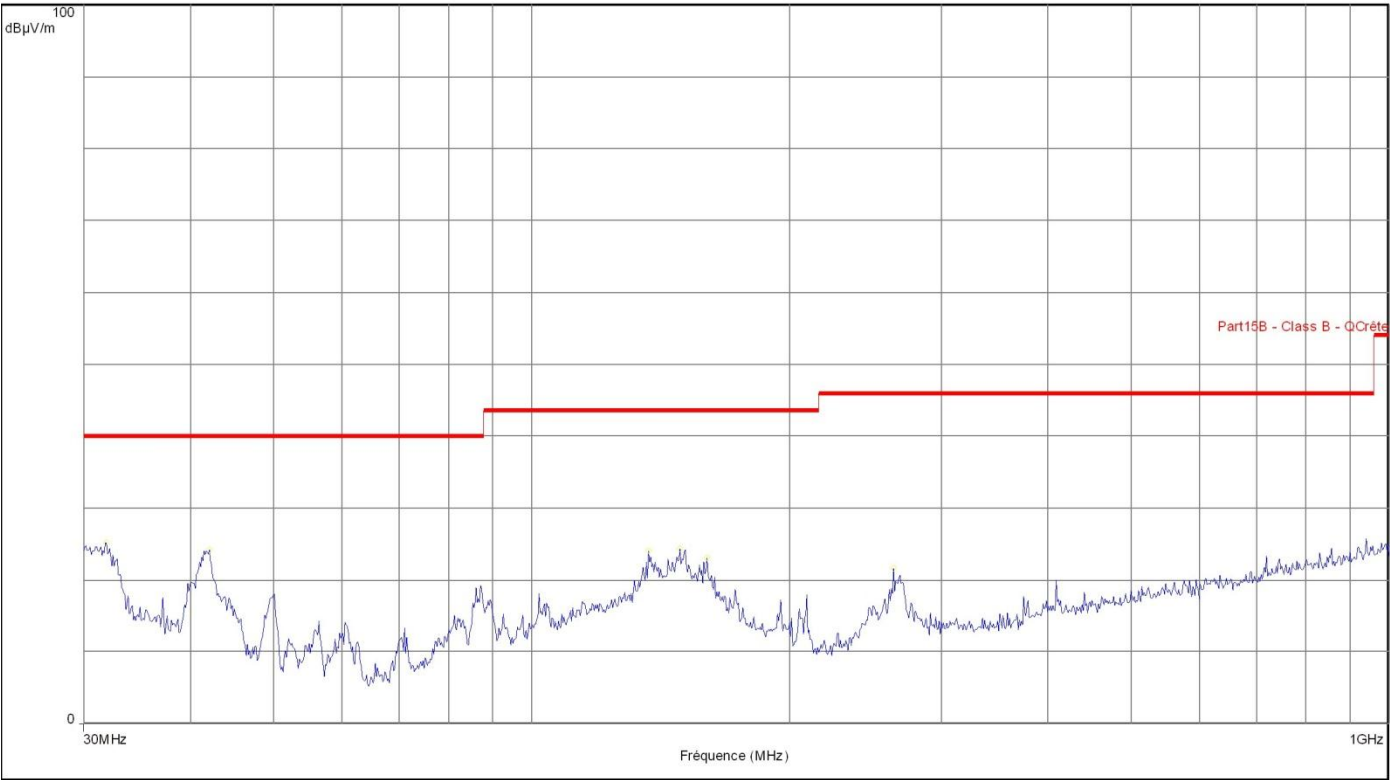
Frequency (MHz)	Peak (dBµV/m)
31.445	19.49
49.72	17.15
147.827	23.78



RADIATED EMISSIONS

Graph name:	Emr#2	Test configuration:	
Limit:	FCC CFR47 Part15B	P(V) - Axis XY	
Class:	B		
Frequency range: [30MHz - 1GHz]			
Antenna polarization:	Vertical	RBW :	100kHz
Azimuth:	0° - 360°	VBW :	300kHz

- FCC/FCC CFR47 Part15B - Classe:B - Moyenne/3.0m/
- FCC/FCC CFR47 Part15B - Classe:B - QCrête/3.0m/
- FCC/FCC CFR47 Part15B - Classe:B - Crête/3.0m/
- Niveau (Suspect Manuel) (Verticale)
- Mes.Peak (Verticale)
- Peak (Peak/LimQ-Peak) (Verticale)



Spurious emissions

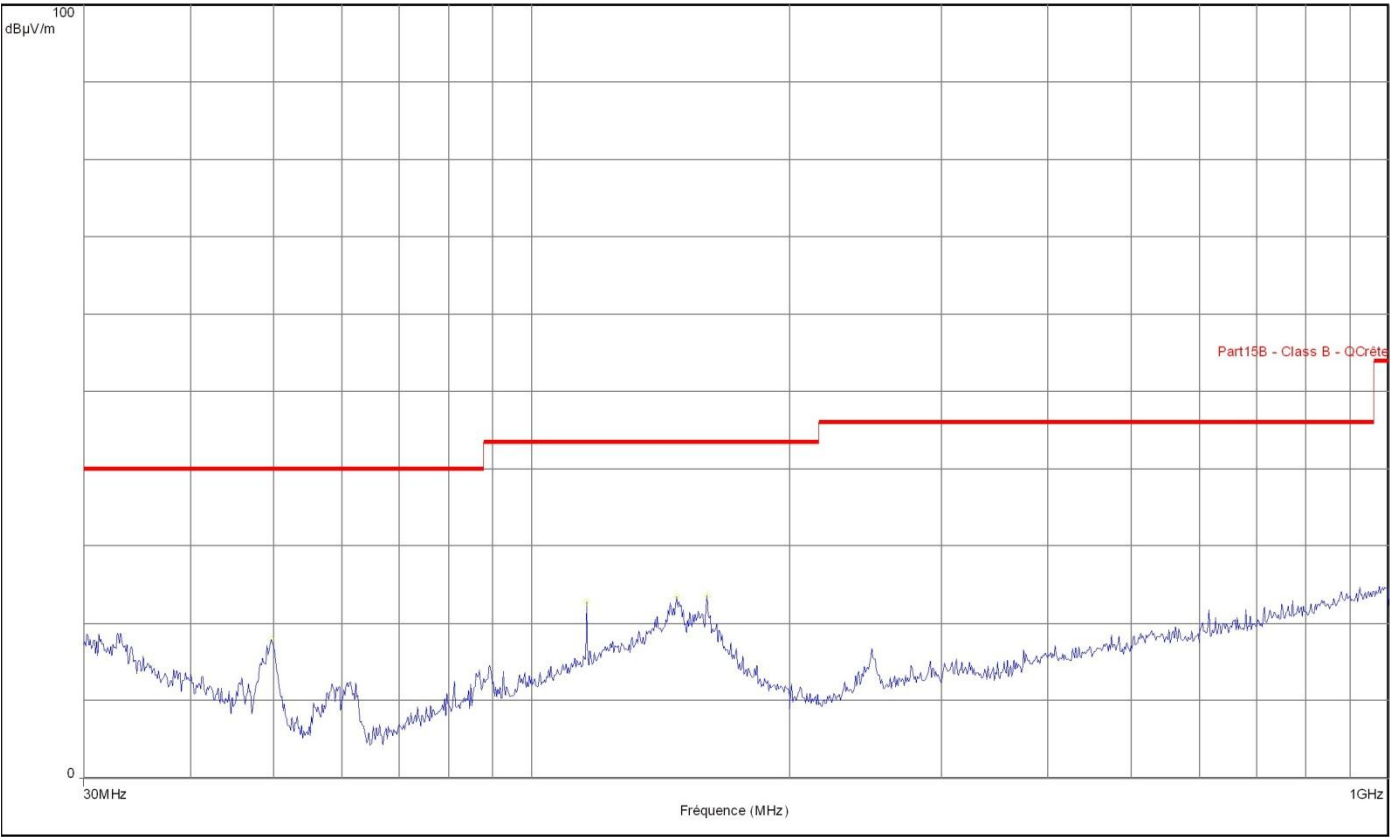
Frequency (MHz)	Peak (dBµV/m)
31.853	25.18
42.053	24.15
136.845	24
148.66	24.31
160.135	22.99
264.16	21.61



RADIATED EMISSIONS

Graph name:	Emr#3	Test configuration:	
Limit:	FCC CFR47 Part15B	P(H) - Axis Z	
Class:	B		
Frequency range: [30MHz - 1GHz]			
Antenna polarization:	Vertical	RBW :	100kHz
Azimuth:	0° - 360°	VBW :	300kHz

- FCC/FCC CFR47 Part15B - Classe:B - Moyenne/3.0m/
- FCC/FCC CFR47 Part15B - Classe:B - QCrête/3.0m/
- FCC/FCC CFR47 Part15B - Classe:B - Crête/3.0m/
- Niveau (Suspect Manuel) (Horizontale)
- Mes.Peak (Horizontale)



Spurious emissions

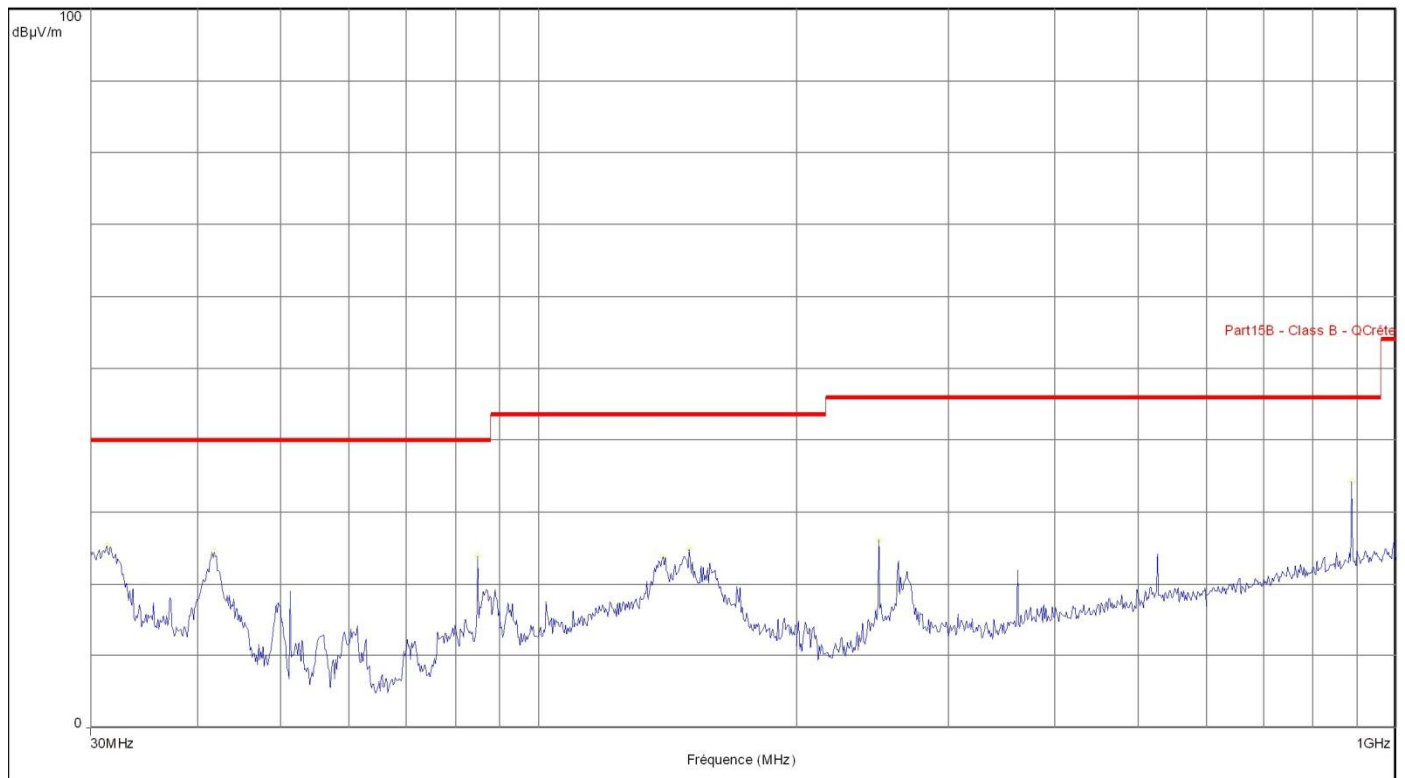
Frequency (MHz)	Peak (dBµV/m)
49.72	17.98
115.935	22.79
147.708	23.49
159.999	23.61



RADIATED EMISSIONS

Graph name:	Emr#4	Test configuration:	
Limit:	FCC CFR47 Part15B	P(V) - Axis Z	
Class:	B		
Frequency range: [30MHz - 1GHz]			
Antenna polarization:	Vertical	RBW :	100kHz
Azimuth:	0° - 360°	VBW :	300kHz

- FCC/FCC CFR47 Part15B - Classe:B - Moyenne/3.0m/
- FCC/FCC CFR47 Part15B - Classe:B - QCrête/3.0m/
- FCC/FCC CFR47 Part15B - Classe:B - Crête/3.0m/
- Niveau (Suspect Manuel) (Verticale)
- Mes.Peak (Verticale)
- Peak (Peak/LimQ-Peak) (Verticale)



Spurious emissions

Frequency (MHz)	Peak (dBμV/m)
31.36	25.39
41.832	24.44
84.842	23.95
139.803	23.79
149.612	24.87
249.48	26
887.76	34.17

**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.