



LCIE

TEST REPORT

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Version : 03

Subject Electromagnetic compatibility and Radio spectrum Matters
(ERM) tests according to standards:
FCC CFR 47 Part 15, Subpart C
RSS-247 Issue 1.0

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Apparatus under test

↗ Product ITK SAS
↗ Trade mark **FLOW MASTER**
↗ Manufacturer ITK SAS
↗ Model under test **MAST001**
↗ Serial number **0138A7FA & 0138A6CF**
↗ FCCID **2AIUF-MAST001**

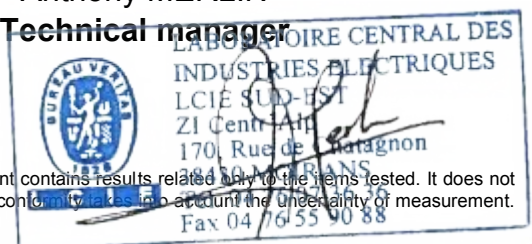
Conclusion See Test Program chapter
Test date June 28, 2016 to July 5, 2016
Test location MOIRANS
IC Test site 6500A-1 & 6500A-3
Composition of document 34 pages

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PUBLICATION HISTORY

Version	Date	Author	Modification
01	September 5, 2016	Gaetan DESCHAMPS	Creation of the document
02	September 8, 2016	Gaetan DESCHAMPS	Modification of product name
03	September 23, 2016	Gaetan DESCHAMPS	Update date calibration and adding a table results in §4.6.2



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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 v03r05

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-247 §5.5	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 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 Highest frequency :32MHz (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-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 §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.

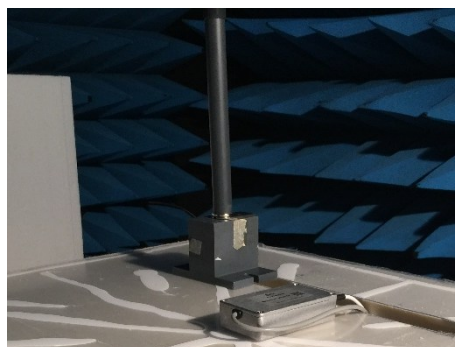
2. SYSTEM TEST CONFIGURATION

2.1. HARDWARE IDENTIFICATION (EUT AND AUXILIARIES):

Equipment under test (EUT):

MAST001

Serial Number: 0138A7FA & 0138A6C



Photography of EUT

Power supply:

During all the tests, EUT is supplied by V_{nom} : 5VDC

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

Name	Type	Rating	Reference	Comments
Supply1	<input type="checkbox"/> AC <input checked="" type="checkbox"/> DC <input type="checkbox"/> Battery	5VDC	-	USB

Inputs/outputs - Cable:

Access	Type	Length used (m)	Declared <3m	Shielded	Under test	Comments
Supply1	USB	0.2	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	-
Access1	SMA	2	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	-

Auxiliary equipment used during test:

Type	Reference	Sn	Comments
Laptop	DELL	-	-



Equipment information:

EUT information			
RF module:	Low Power Long Range LoRa Technology Transceiver Module		
Frequency Band	[903-927]MHz		
Antenna Type:	<input type="checkbox"/> Integral	<input checked="" type="checkbox"/> External	<input type="checkbox"/> Dedicated
Antenna gain:	2.14 dBi ANT-GXS108-CO100B		
Standby mode:	<input checked="" type="checkbox"/> Yes		<input type="checkbox"/> No
Equipment intended use:	<input checked="" type="checkbox"/> Fixed		<input type="checkbox"/> Mobile
Equipment type:	<input type="checkbox"/> Production model		<input checked="" type="checkbox"/> Pre-production model
Type of power source:	<input type="checkbox"/> AC power supply	<input checked="" type="checkbox"/> DC power supply	<input type="checkbox"/> Battery

Channel details:

Channels	CH0	CH1	CH2	CH3	CH4	CH5	CH6	CH7	CH8	CH9	CH10	CH11	CH12	CH13	CH14	CH15
Freq	903	903,8	904,6	905,4	906,2	907	907,8	908,6	909,4	910,2	911	911,8	912,6	913,4	914,2	915
Channels	CH16	CH17	CH18	CH19	CH20	CH21	CH22	CH23	CH24	CH25	CH26	CH27	CH28	CH29	CH30	-
Freq	915,8	916,6	917,4	918,2	919	919,8	920,6	921,4	922,2	923	923,8	924,6	925,4	926,2	927	-

2.2. EUT CONFIGURATION

The EUT is set in the following modes during tests with simulator / software (Cloverflow version C0101):

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

All tests are performed at Cmin, Cmid and Cmax.

The power command is set at 87 ("hexadecimal") by software and not "0E".

Following commands with the specific test software are used to set the product:

1- Time before starting test (60s)

5- Time of a CloverMaster Test (120s)

9 -Time of a FlowSensor Test (63s (max 63s))

=====FCC FlowMeter=====

50 – Timed TX (0A) channel 00, power 86

51 – Timed TX (0A) channel 15, power 86

52 – Timed TX (0A) channel 30, power 86

53 – Timed TX (0A) channel 00, power 86

54 – Timed TX (0A) channel 15, power 86

55 – Timed TX (0A) channel 30, power 86

=====FCC Modem=====

60 – Timed TX (0A) channel 00 (903 Mhz) ,power 87

61 – Timed TX (0A) channel 15 (915 Mhz), power 87

62 – Timed TX (0A) channel 30 (927 Mhz), power 87

63 – Timed TX (0A) channel 00 (903 Mhz), power 87

64 – Timed TX (0A) channel 15 (915 Mhz), power 87

65 – Timed TX (0A) channel 30 (927 Mhz), power 87

=====

q – exit

=====

There are 2 configurations tests (cf §3):

- Configuration 1: The EUT is in TX mode.

- Configuration 2: The EUT is in IDLE mode.

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.

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

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 : July 5, 2016
 Test performed by : Gaëtan DESCHAMPS
 Atmospheric pressure (hPa) : 1000
 Relative humidity (%) : 31
 Ambient temperature (°C) : 22

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	04/16	04/17
Conducted emission comb generator	BARDET	-	A3169049	-	-
LISN	RHODE & SCHWARZ	ENV216	C2320291	11/15	11/16
Receiver 20Hz – 8GHz	ROHDE & SCHWARZ	ESU8	A2642019	08/16	08/17
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.

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 **MAST001**, SN: 0138A7FA, 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 30, 2016
 Test performed by : Gaëtan DESCHAMPS
 Atmospheric pressure (hPa) : 999
 Relative humidity (%) : 32
 Ambient temperature (°C) : 23

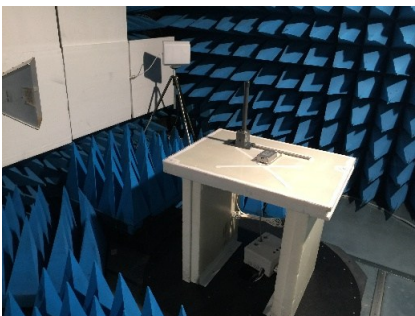
4.2. TEST SETUP

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.

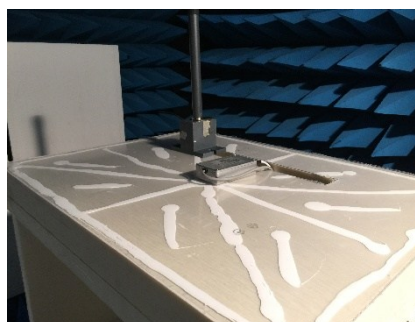
The EUT and auxiliaries are set:

- ☒ 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} .



General Test setup for anechoic chamber and OATS in Axis XY:



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 – 10GHz)

A pre-scan of all the setup has been performed in a 3 meters semi-anechoic chamber for frequency from 30MHz to 10GHz. 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 10GHz.

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 10GHz:

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 10GHz.

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
Antenna Bi-log	CHASE	CBL6111A	C2040051	04/14	04/16
Antenna horn	EMCO	3115	C2042027	11/15	11/16
Cable	-	-	A5329191	04/16	04/17
Cable substitution (OATS)	-	-	A5329057	05/16	05/17
Cable substitution (OATS)	-	-	A5329059	05/16	05/17
Cable Measure @3m	-	-	A5329206	04/16	04/17
Cable (OATS)	-	-	A5329623	01/16	01/17
Cable Measure @1m	STORMFLEX	0	A5329680	01/16	01/17
Cable Measure @1m	STORMFLEX	0	A5329682	01/16	01/17
Semi-Anechoic chamber #3	SIEPEL	-	D3044017	03/16	03/19
Radiated emission comb generator	BARDET	-	A3169050	-	-
HF Radiated emission comb generator	LCIE SUD EST	-	A3169088	-	-
High Pass (1-15GHz)	WAINRIGHT	WHKX 1.03/15G-10SS	A7484035	03/15	03/17
OATS	-	-	F2000409	06/15	06/16
Receiver 20-1000MHz	ROHDE & SCHWARZ	ESVS30	A2642006	05/15	05/16
Spectrum analyzer	ROHDE & SCHWARZ	FSV 30	A4060050	08/16	08/17
BAT EMC	NEXIO	v3.9.0.10	L1000115	-	-
Thermo-hygrometer (PM2)	OREGON	BAR916HG-G	B4206011	09/15	09/16
Turntable chamber (Cage#3)	ETS Lingren	Model 2165	F2000371	-	-
Turntable / Mast controller (OATS)	ETS Lindgren	Model 2066	F2000372	-	-
Antenna mast (OATS)	ETS Lindgren	2071-2	F2000392	-	-
Turntable (OATS)	ETS Lindgren	Model 2187	F2000403	-	-
Table	MATURO GmbH	-	F2000437	-	-
Table	LCIE	-	F2000461	-	-
Turntable controller (Cage#3)	ETS Lingren	Model 2090	F2000444	-	-

4.5. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

☒ None ☐ Divergence:

4.6. TEST RESULTS

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

See graphs for 30MHz-1GHz:

Graph identifier	Polarization	Mode	EUT position	Channel	Comments
Emr# 1	H/V	TX	Axis XY	Min	See annex 1
Emr# 2	H/V	TX	Axis XY	Max	See annex 1
Emr# 3	H/V	IDLE	Axis XY	Mid	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.

Worst case:

Configuration 1, TX mode.

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
32,737	11,7	QP	V	10	100	-	18,4	30,1	40,0	-9,9	
36,171	11,0	QP	V	10	100	-	16,4	27,4	40,0	-12,6	
48,122	19,4	QP	V	50	100	-	10,3	29,7	40,0	-10,3	
59,988	22,5	QP	V	330	200	-	7,7	30,2	40,0	-9,8	
84,026	19,0	QP	V	290	170	-	9,5	28,5	40,0	-11,5	
312,600	10,5	QP	V	300	250	-	17,0	27,5	46,0	-18,5	

4.6.3. Characterization on 3meters anechoic chamber from 1GHz to 10GHz

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)
2709.000	18.0	Pk	V	300	150	-	31.7	49.7	74.0	-24.3
2745.000	18.0	Pk	V	250	150	-	31.9	49.9	74.0	-24.1
2781.000	18.0	Pk	V	110	150	-	32.0	50.0	74.0	-24.0
3612.000	19.0	Pk	V	300	150	-	33.8	52.8	74.0	-21.2
3660.000	19.6	Pk	V	15	150	-	34.0	53.6	74.0	-20.4
3708.000	19.8	Pk	V	320	150	-	34.1	53.9	74.0	-20.1
4515.000	20.3	Pk	V	320	150	-	35.3	55.6	74.0	-18.4
4575.000	19.0	Pk	V	360	150	-	35.4	54.4	74.0	-19.6
4635.000	19.5	Pk	V	310	150	-	35.6	55.1	74.0	-18.9
2709.000	4.7	Av	V	300	150	-	31.7	36.4	54.0	-17.6
2745.000	4.4	Av	V	250	150	-	31.9	36.3	54.0	-17.7
2781.000	3.6	Av	V	110	150	-	32.0	35.6	54.0	-18.4
3612.000	5.7	Av	V	300	150	-	33.8	39.5	54.0	-14.5
3660.000	4.8	Av	V	15	150	-	34.0	38.8	54.0	-15.2
3708.000	6.4	Av	V	320	150	-	34.1	40.5	54.0	-13.5
4515.000	4.8	Av	V	320	150	-	35.3	40.1	54.0	-13.9
4575.000	4.4	Av	V	360	150	-	35.4	39.8	54.0	-14.2
4635.000	4.4	Av	V	310	150	-	35.6	40.0	54.0	-14.0

Note: Measures have been done at 3m distance.

4.7. CONCLUSION

Radiated emission data measurement performed on the sample of the product **MAST001**, SN: 0138A7FA & 0138A6CF, 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 : July 1, 2016
Test performed by : Gaëtan DESCHAMPS
Atmospheric pressure (hPa) : 1000
Relative humidity (%) : 33
Ambient temperature (°C) : 22

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.

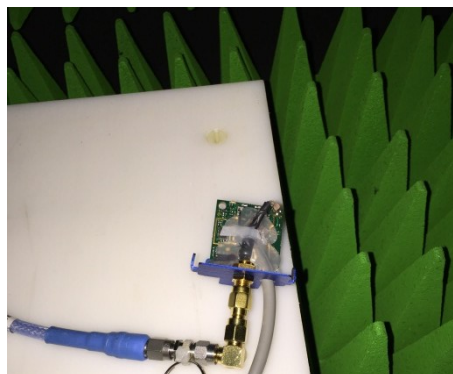
Offset: Attenuator+cable 10.1dB

☐ **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

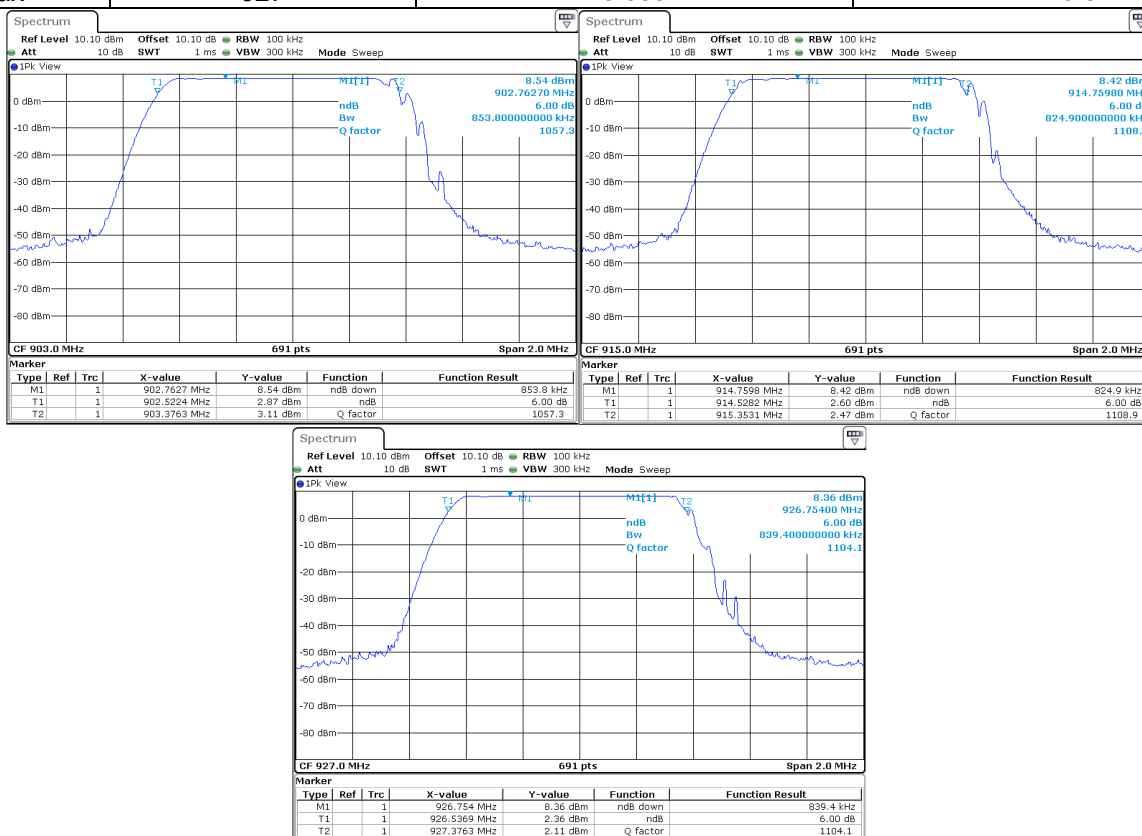
DESCRIPTION	MANUFACTURER	MODEL	N° LCIE	Cal_Date	Cal_Due
Attenuator 10dB	AEROFLEX	-	A7122269	08/16	08/17
Cable Measure @1m	STORMFLEX	0	A5329682	01/16	01/17
Spectrum analyzer	ROHDE & SCHWARZ	FSV 30	A4060050	08/16	08/17
RSCcommander	R&S	v1.6.4	L1000116	-	-
Thermo-hygrometer (PM2)	OREGON	BAR916HG-G	B4206011	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)
Cmin	903	0.853	>0.5
Cmid	915	0.824	>0.5
Cmax	927	0.839	>0.5



5.6. CONCLUSION

Bandwidth measurement performed on the sample of the product **MAST001**, SN: 0138A7FA, 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 : July 5, 2016
 Test performed by : Gaëtan DESCHAMPS
 Atmospheric pressure (hPa) : 1002
 Relative humidity (%) : 31
 Ambient temperature (°C) : 21

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 10.1dB

☐ **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.

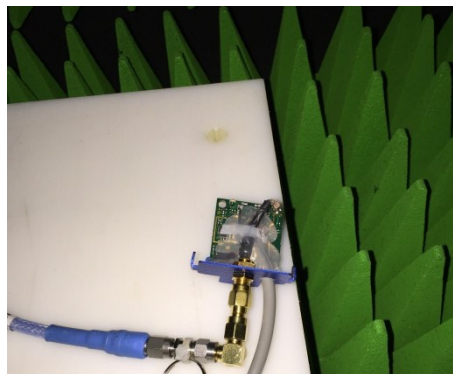
To demonstrate compliance with peak output power requirement of section 15.247 (b), the transmitter's peak output power is calculated using the following equation:

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

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	-	A7122269	08/16	08/17
Cable Measure @1m	STORMFLEX	0	A5329682	01/16	01/17
Spectrum analyzer	ROHDE & SCHWARZ	FSV 30	A4060050	08/16	08/17
RSCCommander	R&S	v1.6.4	L1000116	-	-
Thermo-hygrometer (PM2)	OREGON	BAR916HG-G	B4206011	09/15	09/16

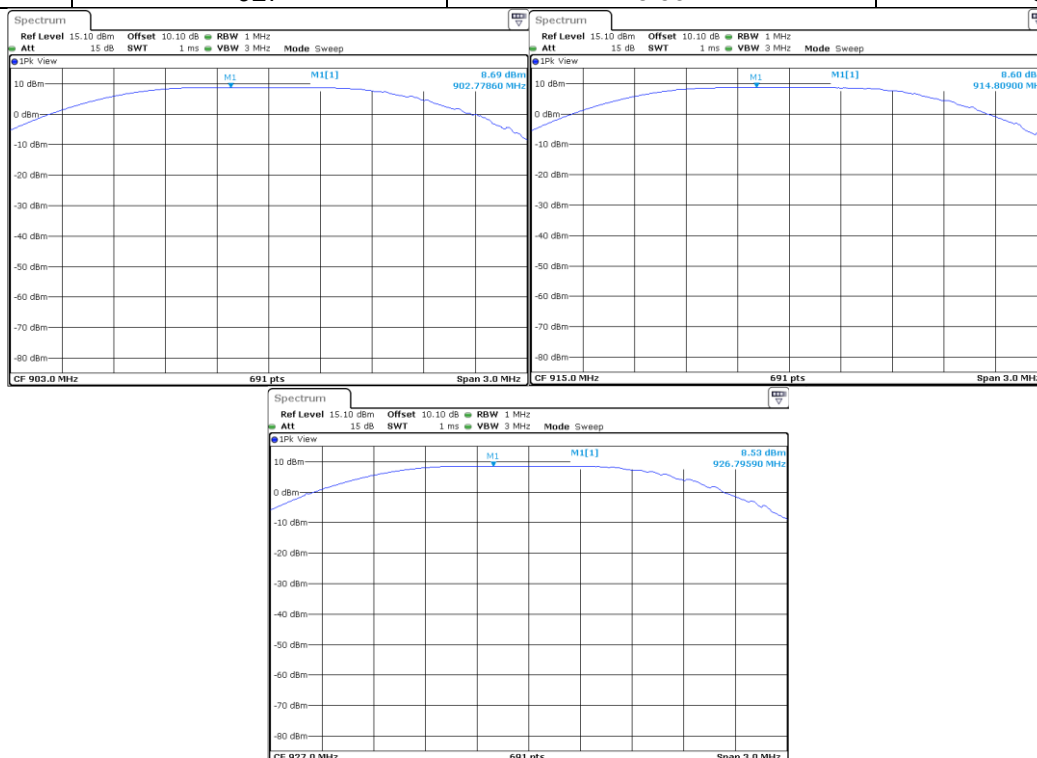
6.4. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

- ☒ None ☐ Divergence:

6.5. TEST SEQUENCE AND RESULTS

Modulation:

Channel	Channel Frequency (MHz)	Peak Output Power (dBm)	Power Limit (dBm)
Cmin	903	8.69	30.0
Cmid	915	8.60	30.0
Cmax	927	8.53	30.0



6.6. CONCLUSION

Maximum Peak Output Power measurement performed on the sample of the product **MAST001**, SN: 0138A7FA, 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

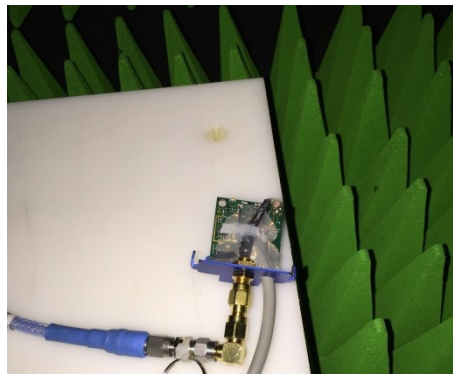
Date of test : July 5, 2016
 Test performed by : Gaëtan DESCHAMPS
 Atmospheric pressure (hPa) : 1002
 Relative humidity (%) : 31
 Ambient temperature (°C) : 21

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 10.1dB



☐ **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	08/16	08/17
Cable Measure @1m	STORMFLEX	0	A5329682	01/16	01/17
Spectrum analyzer	ROHDE & SCHWARZ	FSV 30	A4060050	08/16	08/17
RSCCommander	R&S	v1.6.4	L1000116	-	-
Thermo-hygrometer (PM2)	OREGON	BAR916HG-G	B4206011	09/15	09/16

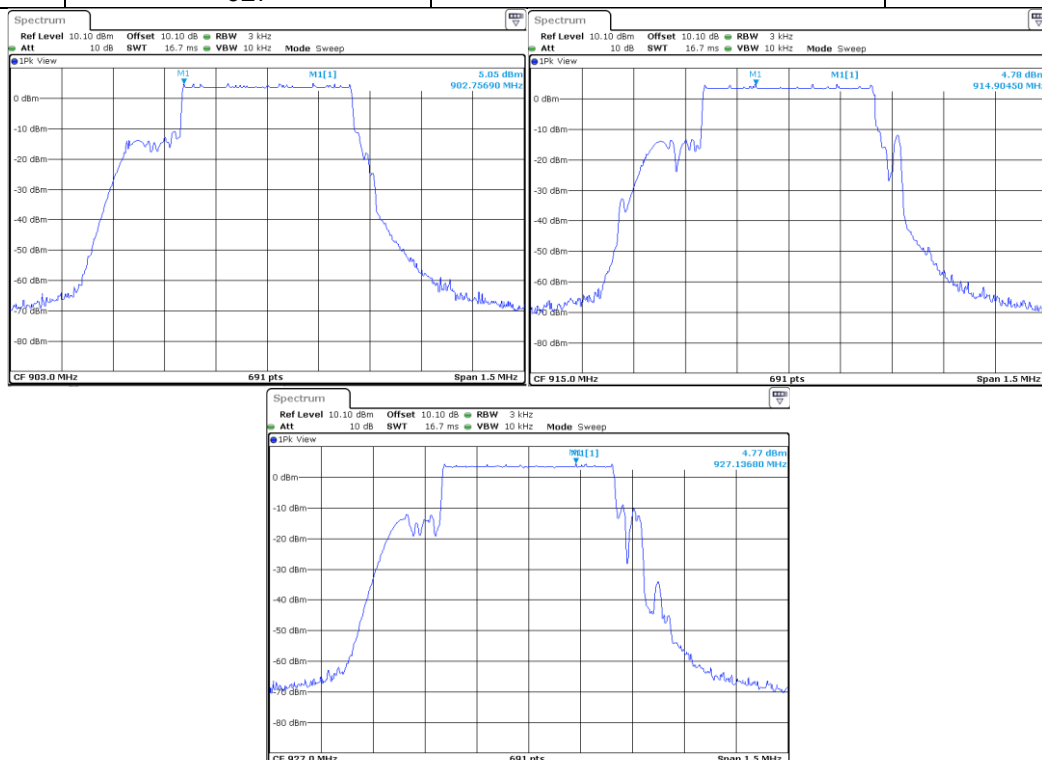
7.4. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

☒ None ☐ Divergence:

7.5. TEST SEQUENCE AND RESULTS

Modulation:

Channel	Channel Frequency (MHz)	Power Spectral Density (dBm)	PSD Limit (dBm)
Cmin	903	5.05	8.0
Cmid	915	4.78	8.0
Cmax	927	4.77	8.0



7.6. CONCLUSION

Power Spectral Density measurement performed on the sample of the product **MAST001**, SN: 0138A7FA, 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)

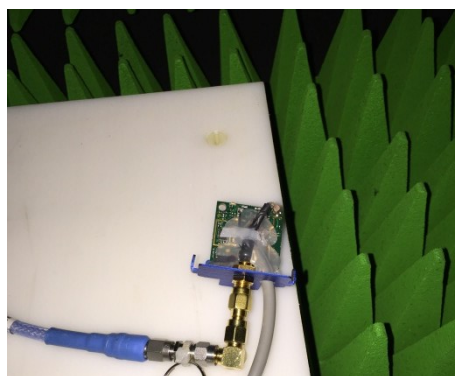
8.1. TEST CONDITIONS

Date of test : July 1, 2016
Test performed by : Gaëtan DESCHAMPS
Atmospheric pressure (hPa) : 1000
Relative humidity (%) : 33
Ambient temperature (°C) : 22

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	-	A7122269	08/16	08/17
Cable Measure @1m	STORMFLEX	0	A5329682	01/16	01/17
Spectrum analyzer	ROHDE & SCHWARZ	FSV 30	A4060050	08/16	08/17
RSCCommander	R&S	v1.6.4	L1000116	-	-
Thermo-hygrometer (PM2)	OREGON	BAR916HG-G	B4206011	09/15	09/16

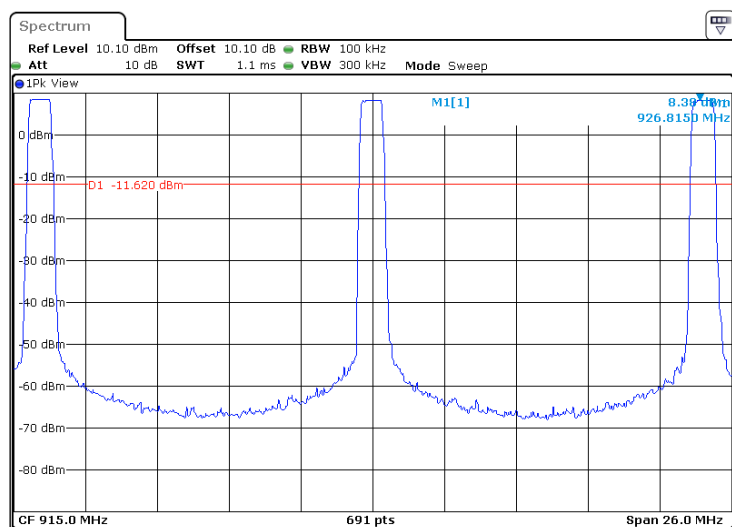
8.5. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

☒ None ☐ Divergence:

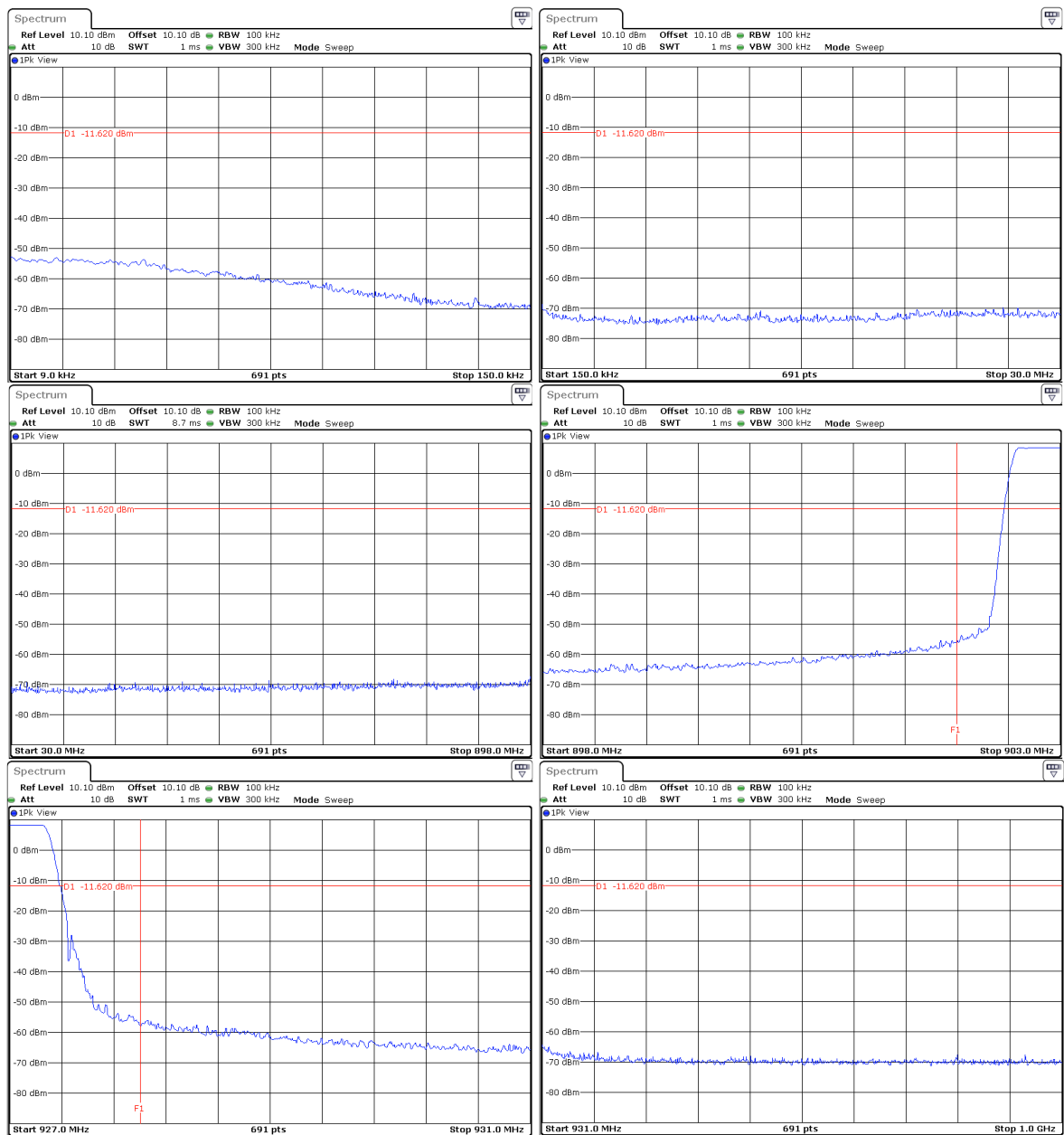
8.6. TEST SEQUENCE AND RESULTS

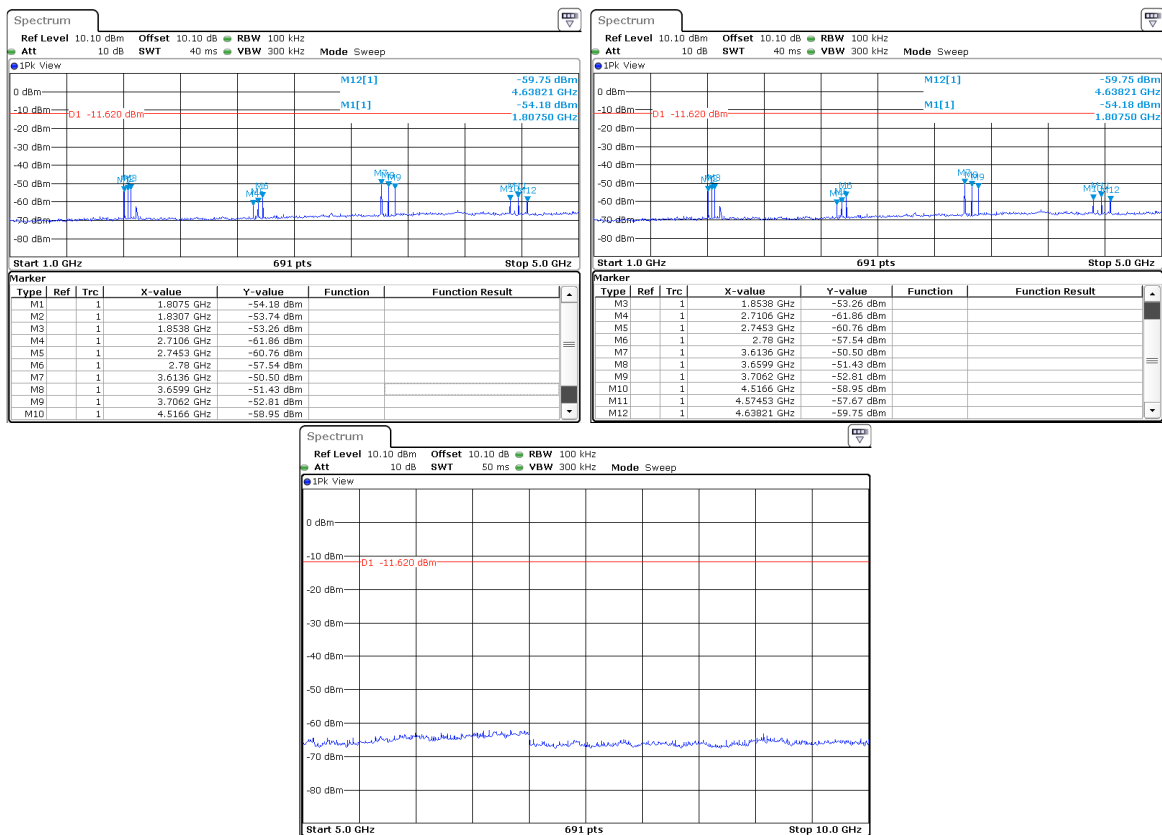
Offset: Attenuator+cable 10.1dB

GRAPH / MODULATION.



Worst case/ Cmax, display line at -11.62dBm.





8.7. CONCLUSION

Band Edge Measurement performed on the sample of the product **MAST001**, SN: 0138A7FA, 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

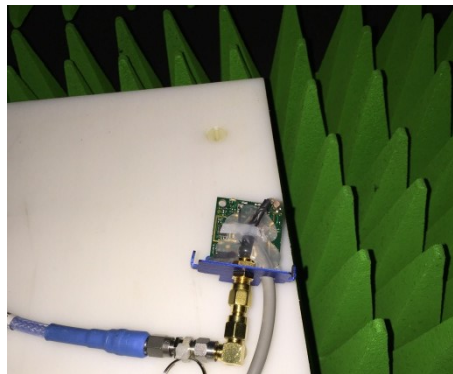
Date of test : July 5, 2016
Test performed by : Gaëtan DESCHAMPS
Atmospheric pressure (hPa) : 1002
Relative humidity (%) : 31
Ambient temperature (°C) : 21

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 10.1dB



☐ **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

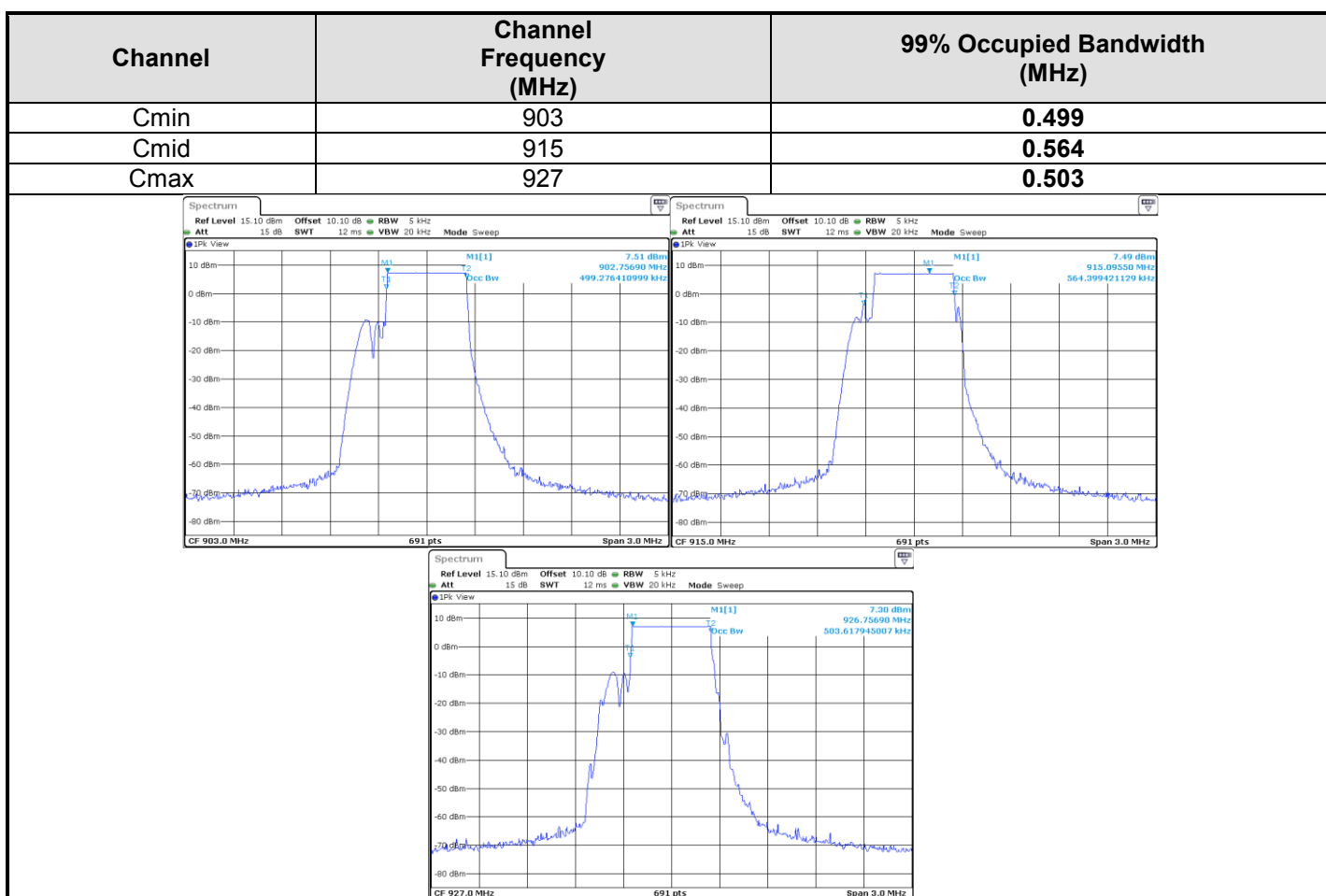
9.3. TEST EQUIPMENT LIST

DESCRIPTION	MANUFACTURER	MODEL	N° LCIE	Cal_Date	Cal_Due
Attenuator 10dB	AEROFLEX	-	A7122269	08/16	08/17
Cable Measure @1m	STORMFLEX	0	A5329682	01/16	01/17
Spectrum analyzer	ROHDE & SCHWARZ	FSV 30	A4060050	08/16	08/17
RSCCommander	R&S	v1.6.4	L1000116	-	-
Thermo-hygrometer (PM2)	OREGON	BAR916HG-G	B4206011	09/15	09/16

9.4. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

☒ None ☐ Divergence:

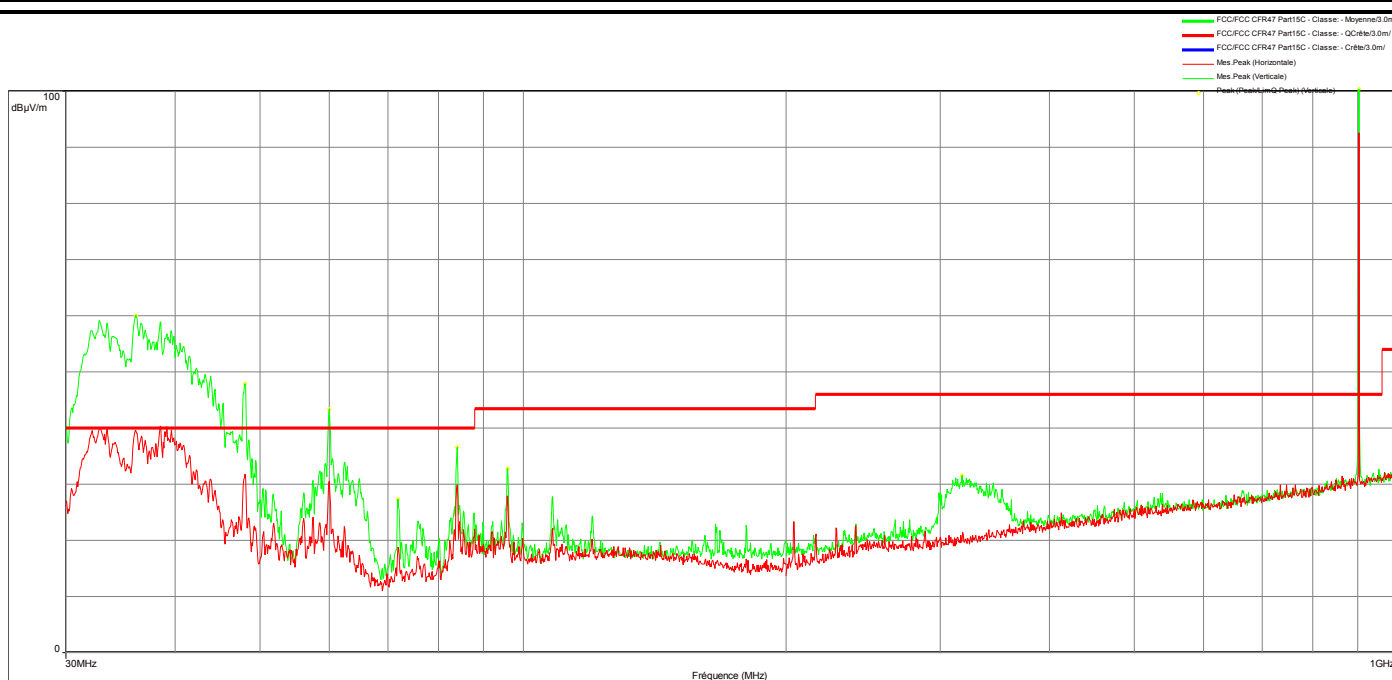
9.5. TEST SEQUENCE AND RESULTS



10. ANNEX 1 (GRAPHS)

RADIATED EMISSIONS

Graph name:	Emr#1	Test configuration:	
Limit:	FCC CFR47 Part15C	(H+V) - Configuration 1 - Axis XY - Cmin <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)	Polarization
36.086	60.0	40.0	20.0	Vertical
48.088	47.8	40.0	7.8	Vertical
60.022	43.4	40.0	3.4	Vertical
71.905	27.4	40.0	-12.6	Vertical
84.060	36.5	40.0	-3.5	Vertical
95.960	32.8	43.5	-10.7	Vertical
317.760	31.5	46.0	-14.5	Vertical
902.760	104.9	46.0	58.9	Vertical

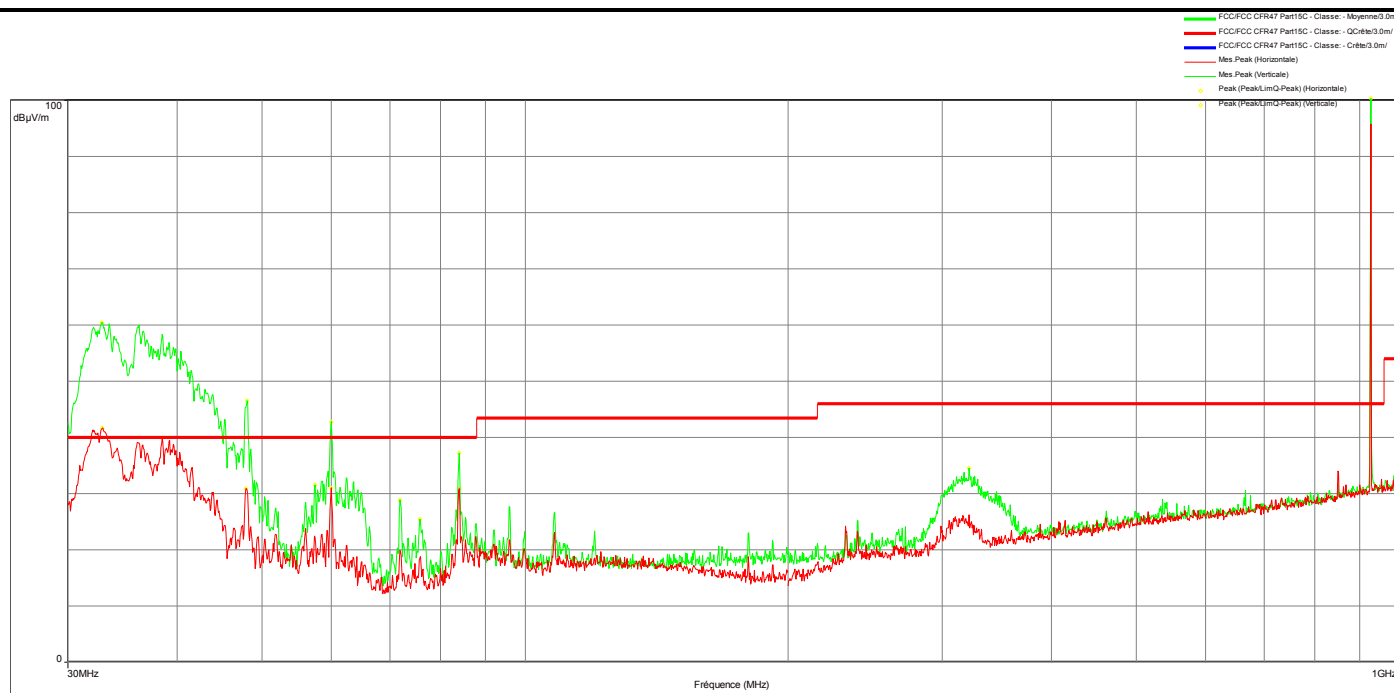
See table in Tests results in §4.6.2 («Radiated emission data»)



L C I E

RADIATED EMISSIONS

Graph name:	Emr#2	Test configuration:	
Limit:	FCC CFR47 Part15C	(H+V) - Configuration 1 - Axis XY - Cmax <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)	Polarization
32.839	41.7	40.0	1.7	Horizontal
47.952	30.9	40.0	-9.1	Horizontal
60.022	31.0	40.0	-9.0	Horizontal
84.060	30.9	40.0	-9.1	Horizontal
32.788	60.4	40.0	20.4	Vertical
48.088	46.6	40.0	6.6	Vertical
57.489	31.6	40.0	-8.4	Vertical
60.005	42.8	40.0	2.8	Vertical
71.922	28.9	40.0	-11.1	Vertical
75.815	25.4	40.0	-14.6	Vertical
84.026	37.2	40.0	-2.8	Vertical
321.840	34.5	46.0	-11.5	Vertical
926.800	103.8	46.0	57.8	Vertical

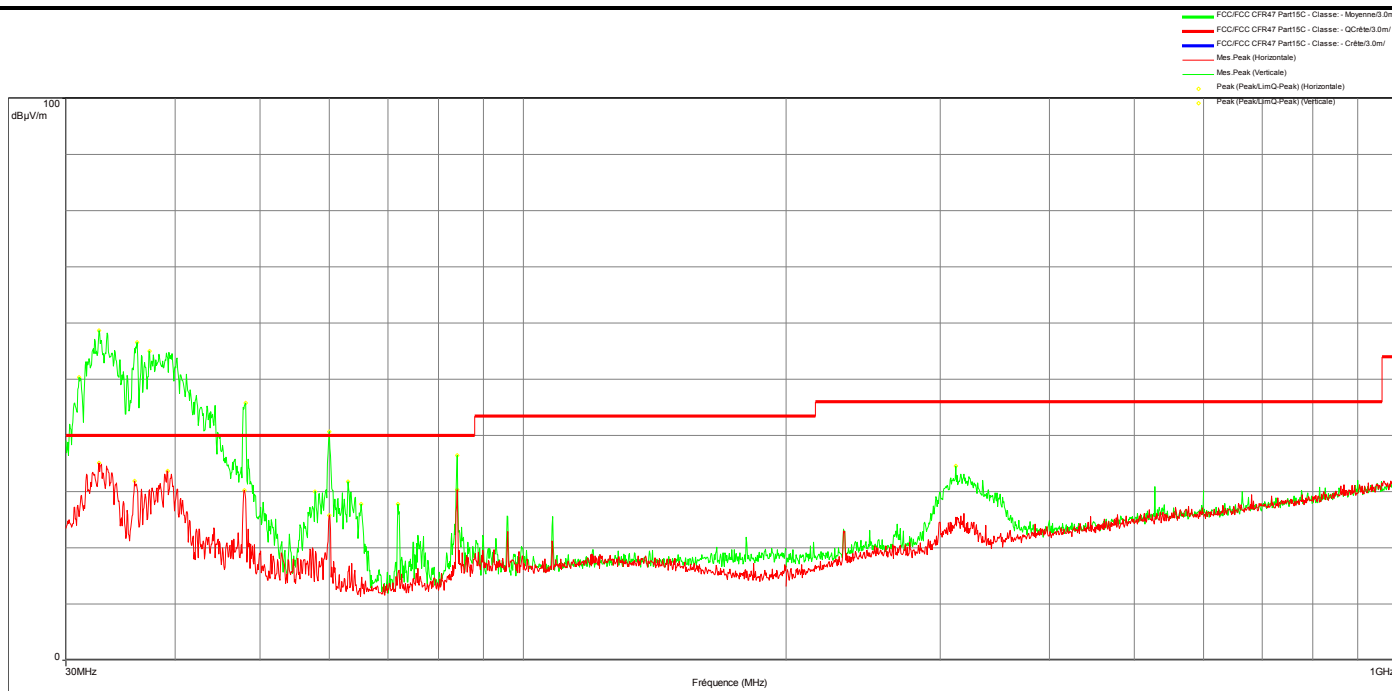
See table in Tests results in §4.6.2 («Radiated emission data»)



L C I E

RADIATED EMISSIONS

Graph name:	Emr#3	Test configuration:	
Limit:	FCC CFR47 Part15C	(H+V) - Configuration 2 - Axis XY - IDLE <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)	Polarization
32.737	35.1	40.0	-4.9	Horizontal
35.933	31.8	40.0	-8.2	Horizontal
39.197	33.7	40.0	-6.3	Horizontal
47.969	30.2	40.0	-9.8	Horizontal
60.039	25.8	40.0	-14.2	Horizontal
84.026	30.3	40.0	-9.7	Horizontal
31.054	50.4	40.0	10.4	Vertical
32.737	58.7	40.0	18.7	Vertical
36.171	56.6	40.0	16.6	Vertical
37.361	55.0	40.0	15.0	Vertical
48.122	45.8	40.0	5.8	Vertical
57.829	30.1	40.0	-9.9	Vertical
59.988	40.7	40.0	0.7	Vertical
63.048	31.8	40.0	-8.2	Vertical
65.241	27.7	40.0	-12.3	Vertical
71.922	27.7	40.0	-12.3	Vertical
84.026	36.4	40.0	-3.6	Vertical
312.600	34.6	46.0	-11.4	Vertical

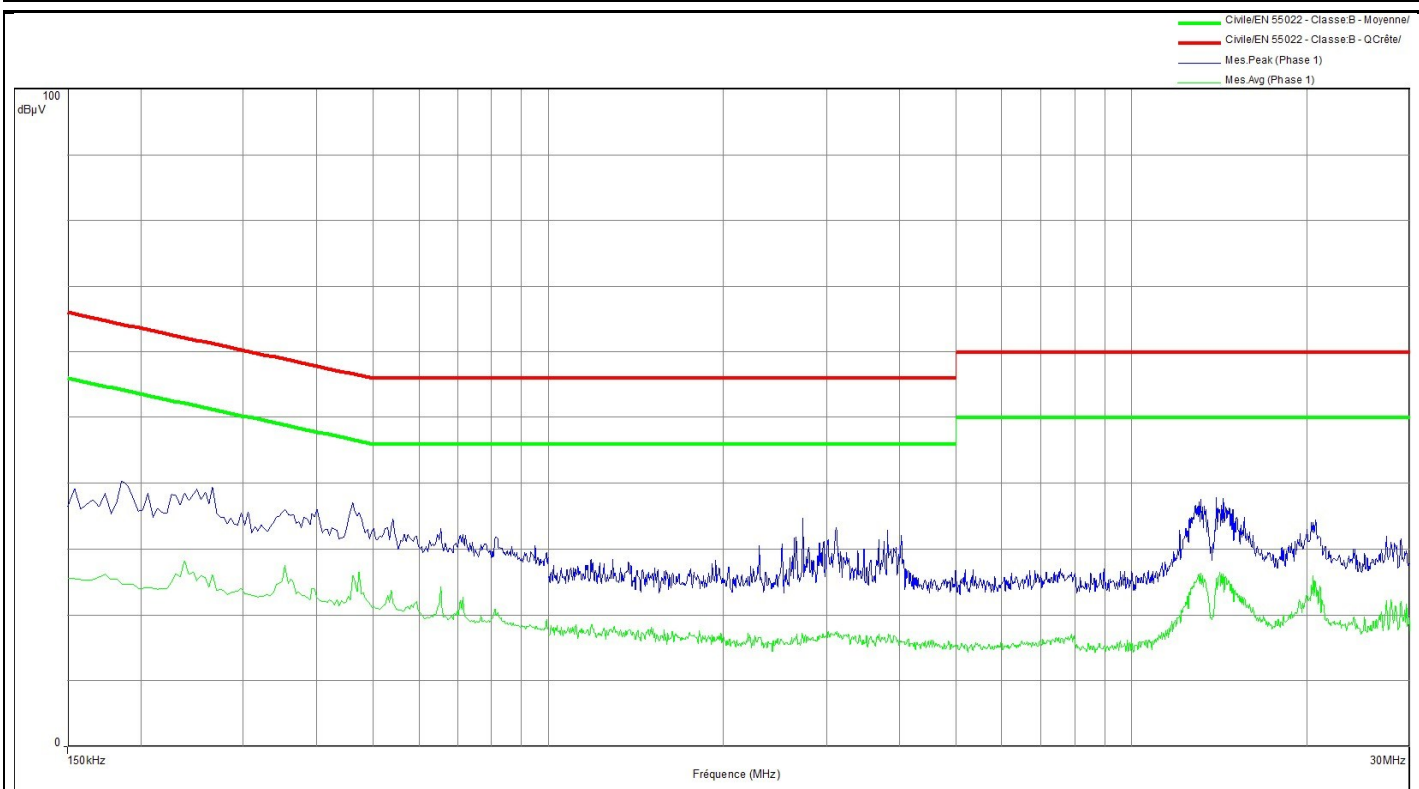
See table in Tests results in §4.6.2 («Radiated emission data»)



L C I E

CONDUCTED EMISSIONS

Graph name:	Emc#1	Test configuration:	
Limit:	EN 55022	Emc1	
Class:	B		
Frequency range: [150kHz - 30MHz]			
Voltage / Frequency:	110VAC / 60Hz	RBW :	10kHz
Line:	Phase	VBW :	30kHz



Spurious emissions

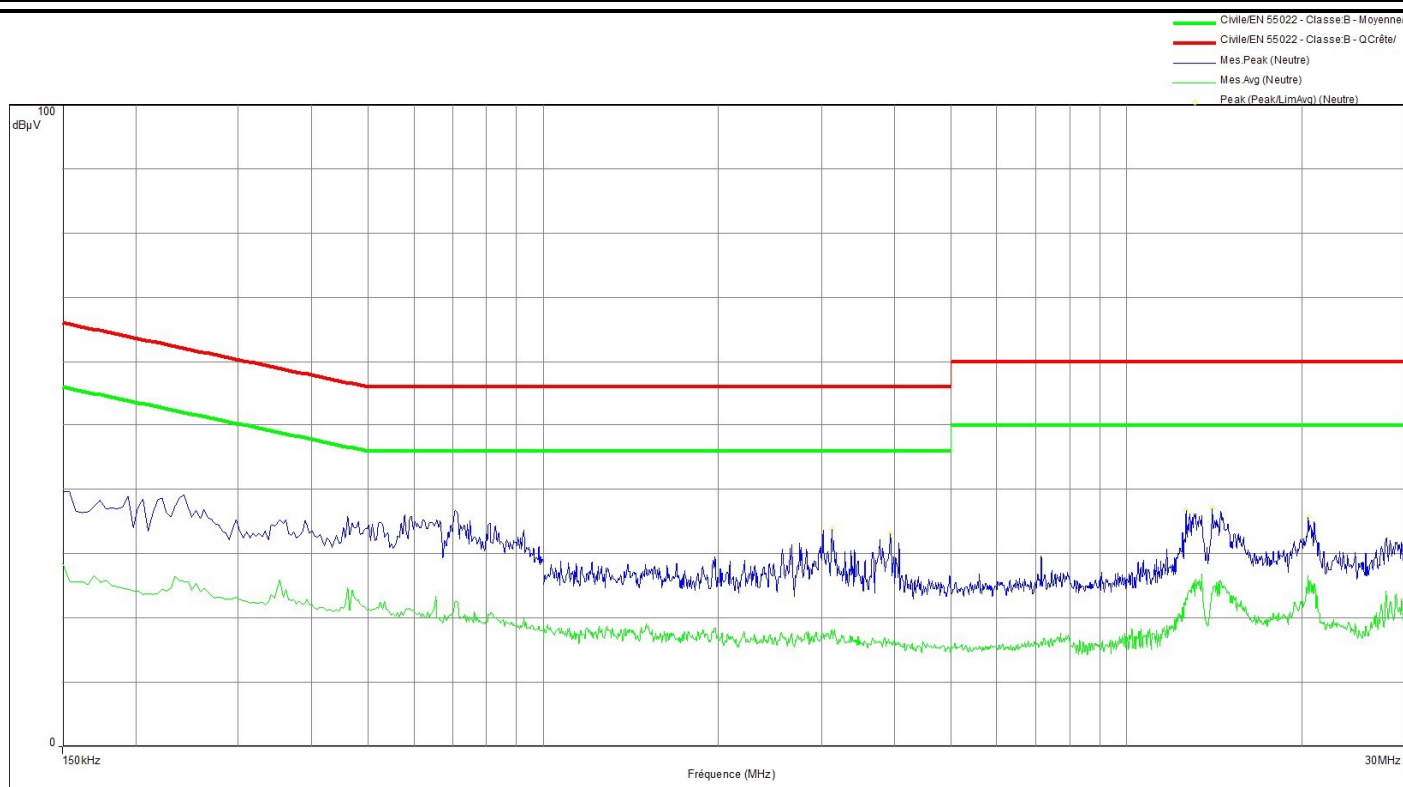
Frequency (MHz)	Peak (dBμV/m)	LimQP (dBμV/m)	Peak-LimQP (dB)
0.186	40.47	54.21	-13.74
2.728	34.78	46	-11.22
3.82	32.85	46	-13.15
13.132	37.7	50	-12.3
13.992	37.87	50	-12.13



L C I E

CONDUCTED EMISSIONS

Graph name:	Emc#2	Test configuration:	
Limit:	EN 55022	Emc2	
Class:	B		
Frequency range: [150kHz - 30MHz]			
Voltage / Frequency:	110VAC / 60Hz	RBW :	10kHz
Line:	Neutral	VBW :	30kHz



Spurious emissions

Frequency (MHz)	Peak (dBμV/m)	LimQP (dBμV/m)	Peak-LimQP (dB)
3.12	33.81	46	-12.19
3.932	33.18	46	-12.82
12.64	36.87	50	-13.13
14.004	37.14	50	-12.86
20.476	35.72	50	-14.28

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.