TEST REPORT

N°: 140566-682686-A (FILE#869845) **Version : 02**

Subject	**Electromagnetic compatibility tests according to the standards:** **FCC CFR 47 Part 15, Subpart C** **RSS-247 Issue 1.0**
Issued to	**SCHNEIDER ELECTRIC** ZAC Champ St Ange 38760 – Varces-Allières-et-Risset FRANCE
Apparatus under test	
Product	Thermal Monitoring sensor
Trade mark	**SCHNEIDER ELECTRIC**
Manufacturer	**SCHNEIDER ELECTRIC**
Model under test	**TH110**
Serial number	**ID25 - 2920093415** **ID23 - 2920093403**
FCCID	**2AHP8-097742**
IC	**21245-097742**
Conclusion	See Test Program chapter §1 6 – Page 3
Test date	February 15, 2016 to February 16, 2016
Test location	MOIRANS
IC Test site	6500A-1 & 6500A-3
Composition of document	45 pages
Document issued on	July 5, 2016

Written by :
Jonathan PAUC
Tests operator

Approved by :
Anthony MERLIN
Technical manager

LABORATOIRE CENTRAL DES INDUSTRIES ELECTRIQUES
ZI Centr'Alp
170, Rue de Chatagnon
38430 MOIRANS
Tel: 04 76 07 36 36
Fax: 04 76 55 90 88

PUBLICATION HISTORY

Version	Date	Author	Modification
01	March 13, 2016	Jonathan PAUC	Creation of the document
02	July 5, 2016	Jonathan PAUC	Modifications following TCB Remarks

SUMMARY

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 v03r04**

EMISSION TEST	LIMITS			RESULTS
Limits for conducted disturbance at mains ports 150kHz-30MHz	**Frequency**	**Quasi-peak value (dBµV)**	**Average value (dBµV)**	☐ **PASS** ☐ **FAIL** ☑ **NA** ☐ **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			☑ **PASS** ☐ **FAIL** ☐ **NA** ☐ **NP**
Radiated emissions 30MHz-25GHz* *CFR 47 §15.209 (a)* *CFR 47 §15.247 (d)* *RSS-247 §5.5* ***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			☑ **PASS** ☐ **FAIL** ☐ **NA** ☐ **NP**
Bandwidth 6dB *CFR 47 §*15.247 (a) (2) *RSS-247 §5.2.1*	**At least 500kHz**			☑ **PASS** ☐ **FAIL** ☐ **NA** ☐ **NP**
Power spectral Density *CFR 47 §15.247 (e)* *RSS-247 §5.2.2*	**Limit: 8dBm/3kHz**			☑ **PASS** ☐ **FAIL** ☐ **NA** ☐ **NP**
Maximum Peak Output Power *CFR 47 §*15.247 (b) *RSS-247 §5.4.4*	**Limit: 30dBm** Conducted or Radiated measurement			☑ **PASS** ☐ **FAIL** ☐ **NA** ☐ **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**			☑ **PASS** ☐ **FAIL** ☐ **NA** ☐ **NP**
Occupied bandwidth *RSS-Gen §4.6.1*	**No limit**			☑ **PASS** ☐ **FAIL** ☐ **NA** ☐ **NP**
Receiver Spurious Emission** *RSS-Gen §4.10*	**See RSS-Gen §4.10**			☐ **PASS** ☐ **FAIL** ☑ **NA** ☐ **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):

TH110 **Serial Number:** **ID23 - 2920093403**
ID25 - 2920093415

Photography of EUT

Power supply:
During all the tests, EUT is supplied by V_{nom}: 3VDC
For measurement with different voltage, it will be presented in test method.

Power supply :

Name	Type	Rating	Reference	Comments
Supply1	Magnetic field	3vdc	/	/
Supply1_bis	☐ AC ☐ DC ☑ Battery	3Vdc	2 x AA battery	Set only for test

Inputs/outputs - Cable:

Access	Type	Length used (m)	Declared <3m	Shielded	Under test	Comments
Supply1_bis	Power supply from two AA battery “set only for emulate power provide by magnetic field	/	/	/	/	Set only For test

Auxiliary equipment used during test:

Type	Reference	Sn	Comments
Atmel ATMEGA 256RFR2 Xplaned	A091784/03	MAC 0004251918010594	FW: fcc_test_rfr2-1-0-0.hex
Laptop	ProBook 6470b	/	/

Equipment information:

Type:	☑ ZIGBEE		☐ RF4CE	
Frequency band:	[2400 – 2483.5] MHz			
Spectrum Modulation:	☑ DSSS			
Number of Channel:	16			
Spacing channel:	5MHz			
Channel bandwidth:	2MHz			
Antenna Type:	☑ Integral	☐ External	☐ Dedicated	
Antenna connector:	☐ Yes	☑ No	☐ Temporary for test	
Transmit chains:	☑ 1			
	Single antenna			
	Gain 1: 0		Gain 2: XdBi	
Beam forming gain:	No			
Receiver chains	1			
Type of equipment:	☐ Stand-alone	☑ Plug-in	☐ Combined	
Ad-Hoc mode:	☐ Yes		☑ No	
Duty cycle:	☑ Continuous duty	☐ Intermittent duty	☐ 100% duty	
Equipment type:	☐ Production model		☑ Pre-production model	
Operating temperature range:	Tmin:	☐ -20°C	☐ 0°C	☑ -30°C
	Tnom:	20°C		
	Tmax:	☐ 35°C	☐ 55°C	☑ 100°C
Type of power source:	☐ AC power supply	☐ DC power supply	☑ Battery	
Operating voltage range:	Self-powered using stray magnetic fields			

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	☑

2.2. EUT CONFIGURATION

The EUT is set in the following modes during tests with simulator / software (*Firmware* : fcc_test_rfr2-1-0-0.hex):
- Permanent emission with modulation on a fixed channel in the data rate that produced the highest power (PRBS)
- Permanent reception

All tests are performed at Cmin, Cmid and Cmax.

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 52.5dBµV 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 dBµV/m
The 32 dBµV/m value can be mathematically converted to its corresponding level in µV/m.
Level in µV/m = Common Antilogarithm [(32dBµV/m)/20] = 39.8 µV/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

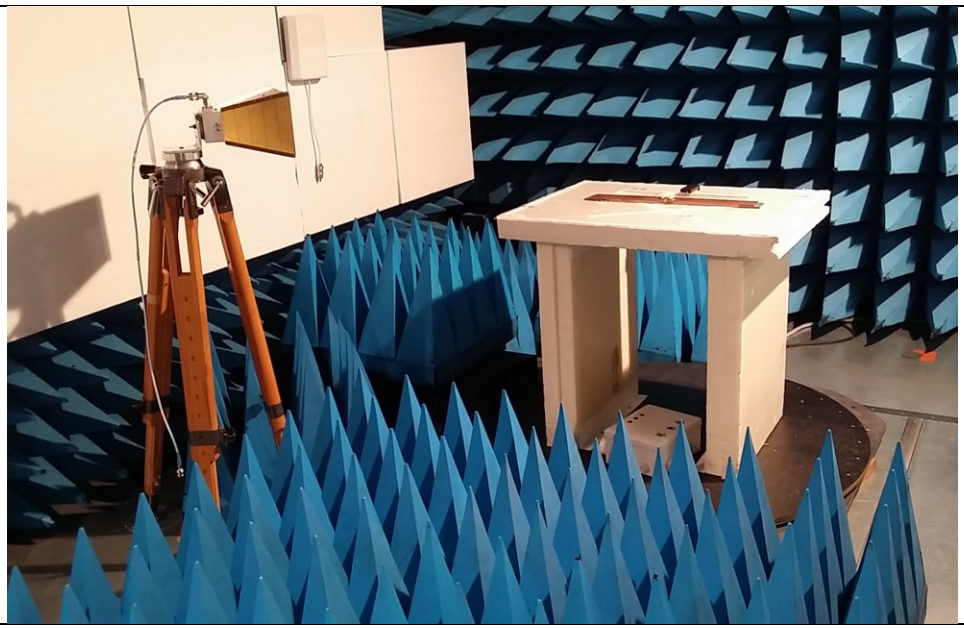
3. RADIATED EMISSION DATA

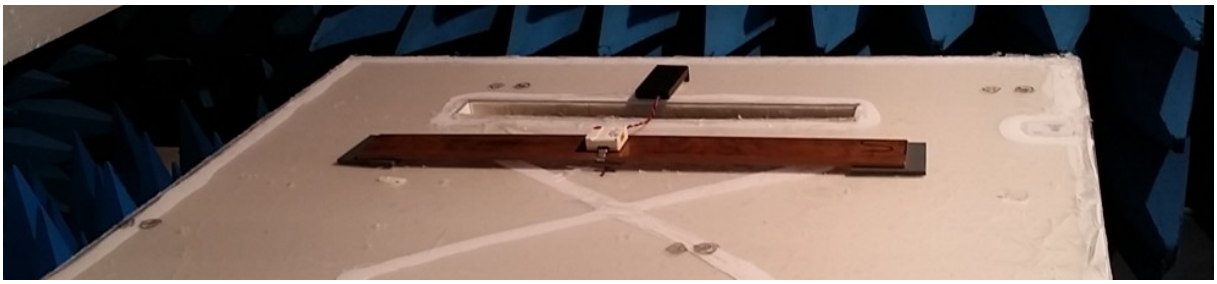
3.1. ENVIRONMENTAL CONDITIONS

Date of test	:	February 16, 2016
Test performed by	:	Jonathan PAUC
Atmospheric pressure (hPa)	:	990
Relative humidity (%)	:	31
Ambient temperature (°C)	:	21

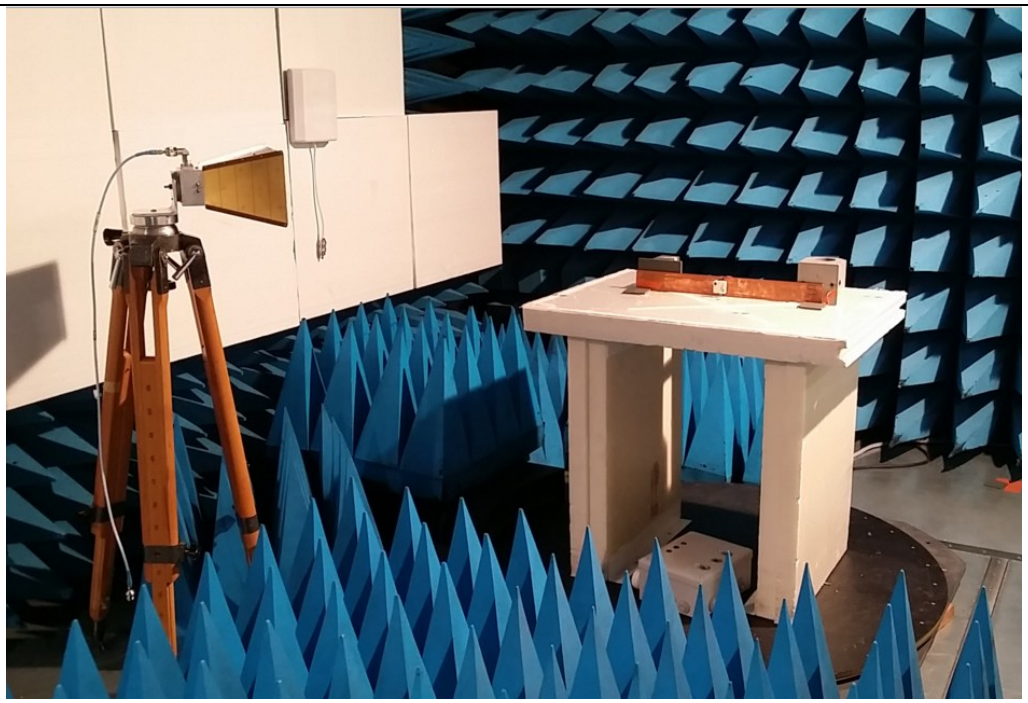
3.2. TEST SETUP

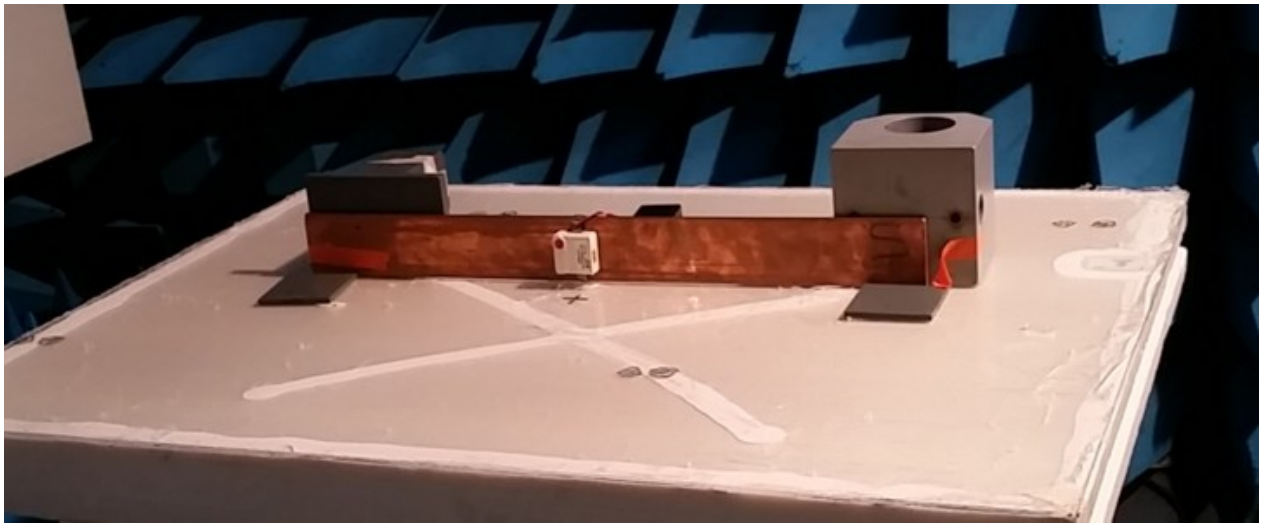
The installation of EUT is identical for pre-characterization measures in a 3 meters semi- anechoic chamber and for measures on the 10 meters Open site.
The EUT and auxiliaries are set:
☑ 80cm above the ground on the non-conducting table (Table-top equipment) - Below 1GHz
☑ 150cm above the ground on 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}.



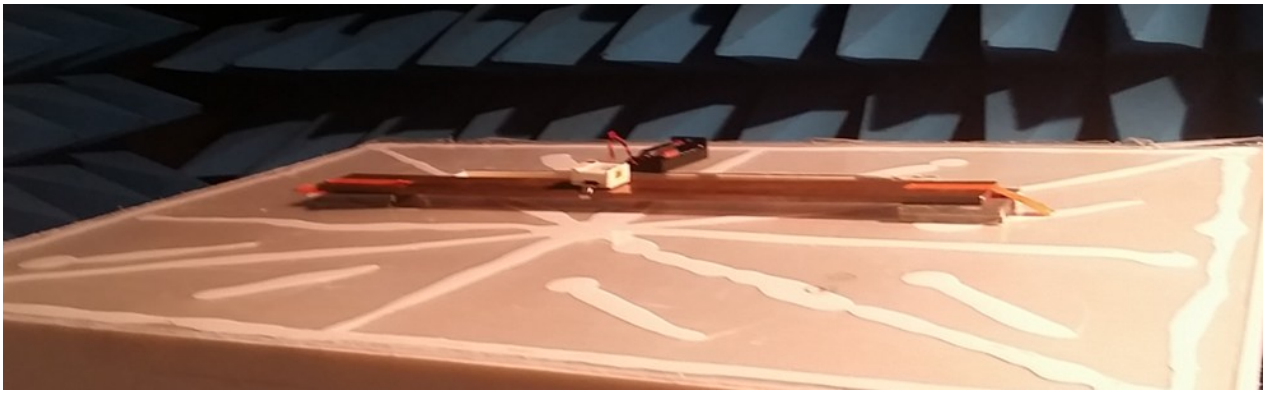


Test setup in anechoic chamber < 1GHz (Axis XY)

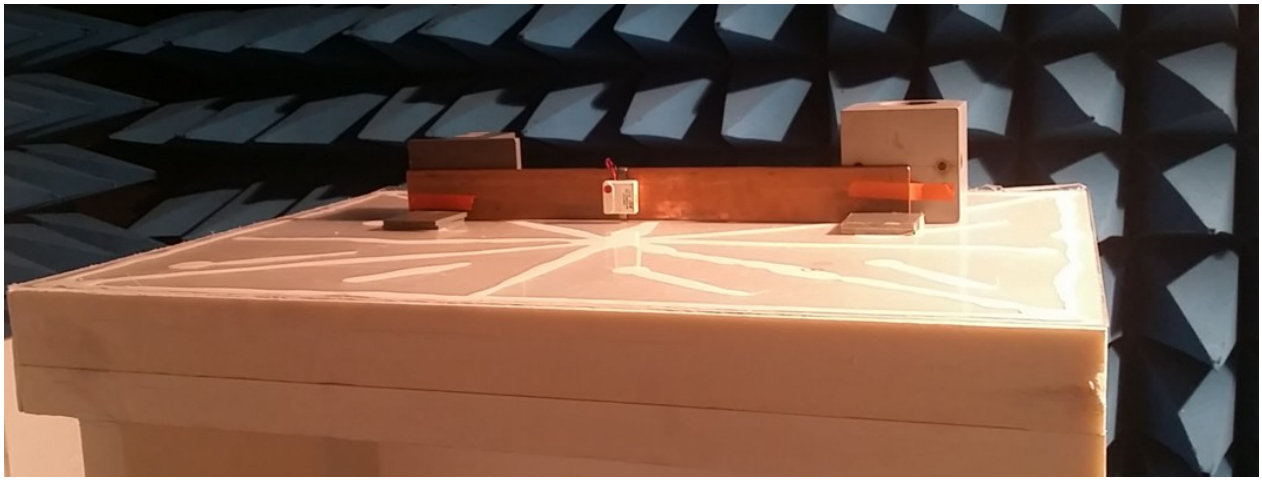




Test setup in anechoic chamber < 1GHz (Axis Z)



Test setup in anechoic chamber > 1GHz (Axis XY)



Test setup in anechoic chamber > 1GHz (Axis Z)

3.3. TEST METHOD

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

Pre-characterisation measurement: (30Hz – 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 12.75GHz.

Characterization on 10 meters open site from 30MHz 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 12.75GHz:
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 12.75GHz.
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.

NOTE:
1. Average value =Peak value + 20 Log (duty cycle) = Peak value – 37.2dB.

Duty cycle = 0.0014/(0.1+0.0014)

3.4. TEST EQUIPMENT LIST

DESCRIPTION	MANUFACTURER	MODEL	N° LCIE	Cal_Date	Cal_Due
Amplifier 1-13GHz	LCIE SUD EST	-	A7102067	10/15	10/16
Antenna horn	RAVEN ENGINEERING	96001	C2042046	04/14	04/16
Antenna horn	EMCO	3115	C2042027	11/15	11/16
Cable Measure @3m 18GHz	-	-	A5329038	08/15	08/16
Cable Measure @3m	-	-	A5329206	04/15	04/16
Semi-Anechoic chamber #3	SIEPEL	-	D3044017	04/13	04/16
Spectrum analyzer	ROHDE & SCHWARZ	FSV 30	A4060051	11/15	11/16
BAT EMC	NEXIO	v3.9.0.10	L1000115	-	-
Thermo-hygrometer (C3)	OREGON	BAR206	B4204078	04/15	04/16
Turntable chamber (Cage#3)	ETS Lingren	Model 2165	F2000371	-	-
Turntable controller (Cage#3)	ETS Lingren	Model 2090	F2000444	-	-

3.5. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

☑ None ☐ Divergence:

3.6. TEST RESULTS

3.6.1. 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 Z	Min	See annex 1
Emr# 3	H & V	TX	Axis XY	Mid	See annex 1
Emr# 4	H & V	TX	Axis Z	Mid	See annex 1
Emr# 5	H & V	TX	Axis XY	Max	See annex 1
Emr# 6	H & V	TX	Axis Z	Max	See annex 1
Emr# 7	H & V	Functionnal	Axis XY	Channel 26	See annex 1
Emr# 8	H & V	Functionnal	Axis Z	Channel 26	See annex 1

3.6.2. Pre-characterization at 3 meters [1GHz-12.75GHz]

See graphs for 1GHz-12.75GHz:

Graph identifier	Polarization	Mode	EUT position	Channel	Comments
Emr# 9	H & V	TX	Axis XY	Min	See annex 1
Emr# 10	H & V	TX	Axis Z	Min	See annex 1
Emr# 11	H & V	TX	Axis XY	Mid	See annex 1
Emr# 12	H & V	TX	Axis Z	Mid	See annex 1
Emr# 13	H & V	TX	Axis XY	Max	See annex 1
Emr# 14	H & V	TX	Axis Z	Max	See annex 1
Emr# 15	H & V	Functionnal	Axis XY	Channel 26	See annex 1
Emr# 16	H & V	Functionnal	Axis Z	Channel 26	See annex 1

3.6.3. 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 significant 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)

3.6.4. Characterization on 3meters anechoic chamber from 1GHz to 12.75GHz

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	2483.976	74.0	72.0	**-2.0**	54.0	34.8	**-19.2**	72	H	150	31.2	Cmax – Z Axis
2	2485.025	74.0	67.2	**-6.8**	54.0	30.0	**-24.0**	72	H	150	31.2	Cmax – Z Axis
3	2485.980	74.0	64.4	**-9.6**	54.0	27.2	**-26.8**	72	H	150	31.2	Cmax – Z Axis
4	2486.928	74.0	61.3	**-12.7**	54.0	24.1	**-29.9**	72	H	150	31.2	Cmax – Z Axis
5	2488.122	74.0	59.3	**-14.7**	54.0	22.1	**-31.9**	72	H	150	31.2	Cmax – Z Axis
6	2488.952	74.0	57.2	**-16.8**	54.0	20.0	**-34.0**	72	H	150	31.2	Cmax – Z Axis
7	2490.131	74.0	56.0	**-18.0**	54.0	18.8	**-35.2**	72	H	150	31.2	Cmax – Z Axis
8	2491.072	74.0	53.9	**-20.1**	54.0	16.7	**-37.3**	72	H	150	31.2	Cmax – Z Axis
9	2492.016	74.0	53.5	**-20.5**	54.0	16.3	**-37.7**	72	H	150	31.2	Cmax – Z Axis
10	2493.062	74.0	50.8	**-23.2**	54.0	13.6	**-40.4**	72	H	150	31.2	Cmax – Z Axis
11	2493.987	74.0	49.5	**-24.5**	54.0	12.3	**-41.7**	72	H	150	31.2	Cmax – Z Axis
12	2494.995	74.0	51.2	**-22.8**	54.0	14.0	**-40.0**	72	H	150	31.2	Cmax – Z Axis
13	2496.081	74.0	55.0	**-19.0**	54.0	17.8	**-36.2**	72	H	150	31.2	Cmax – Z Axis
14	2497.097	74.0	49.6	**-24.4**	54.0	12.4	**-41.6**	72	H	150	31.2	Cmax – Z Axis
15	2498.067	74.0	49.4	**-24.6**	54.0	12.2	**-41.8**	72	H	150	31.2	Cmax – Z Axis
16	2499.119	74.0	49.3	**-24.7**	54.0	12.1	**-41.9**	72	H	150	31.2	Cmax – Z Axis
18	4809.190	74.0	55.5	**-18.5**	54.0	18.3	**-35.7**	115	H	150	36.4	Cmin – Z Axis
19	4879.060	74.0	57.5	**-16.5**	54.0	20.3	**-33.7**	115	H	150	36.5	Cmid - Z Axis
20	4959.130	74.0	58.1	**-15.9**	54.0	20.9	**-33.1**	115	H	150	36.7	Cmax – Z Axis

Note: Measures have been done at 3m distance.

3.7. CONCLUSION

Radiated emission data measurement performed on the sample of the product TH110, SN: ID23 - 2920093403 , in configuration and description presented in this test report, show levels below the FCC CFR 47 Part 15 and RSS-247 limits.

4. BANDWIDTH (15.247)

4.1. TEST CONDITIONS

Date of test : February 15, 2016
Test performed by : Jonathan PAUC
Atmospheric pressure (hPa) : 987
Relative humidity (%) : 30
Ambient temperature (°C) : 21.6

4.2. 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 11.9dB

☐ ***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) ≥ 3 x 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.

4.3. TEST EQUIPMENT LIST

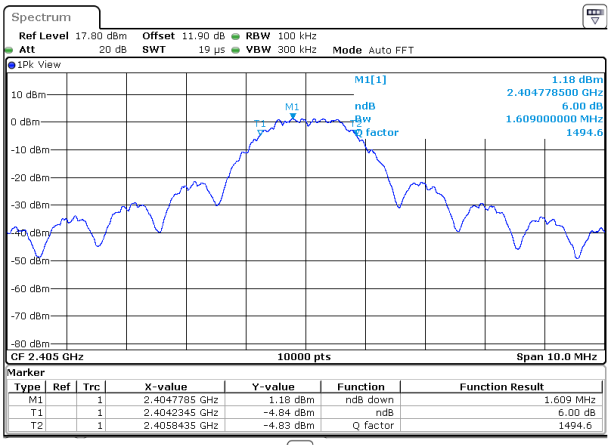
DESCRIPTION	MANUFACTURER	MODEL	N° LCIE	Cal_Date	Cal_Due
Attenuator 10dB	AEROFLEX	-	A7122206	03/15	03/16
Cable SMA	-	18G	A5329373	10/15	10/16
Spectrum analyzer	ROHDE & SCHWARZ	FSV 30	A4060051	11/15	11/16
RSCommander	R&S	v1.6.4	L1000116	-	-

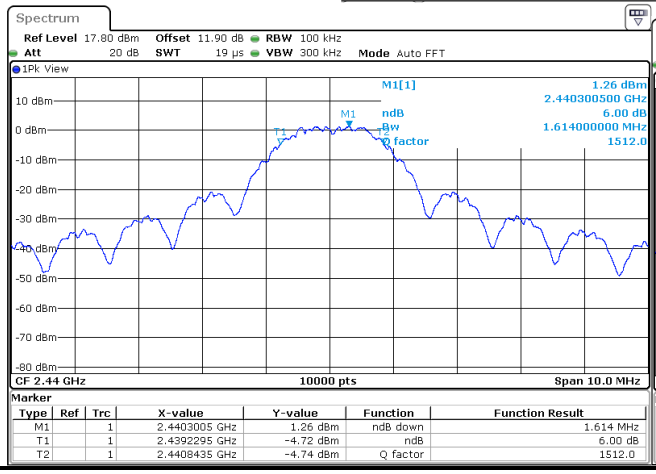
4.4. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

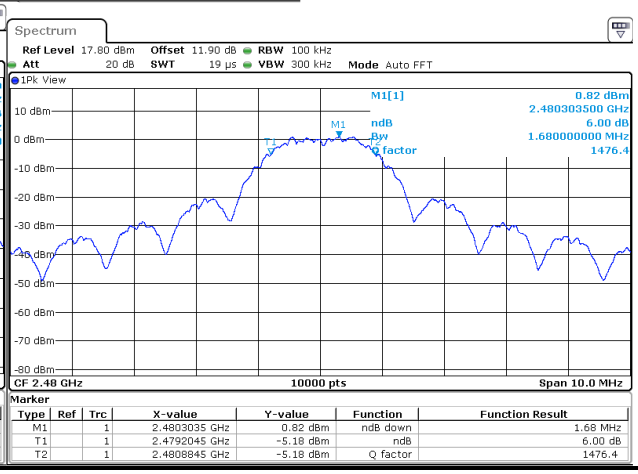
☑ None ☐ Divergence:

4.5. TEST SEQUENCE AND RESULTS

Channel	Channel Frequency (MHz)	6dB Bandwidth (MHz)	Bandwidth Limit (MHz)
11	2405	**1.609**	**>0.5**
18	2440	**1.614**	**>0.5**
26	2480	**1.680**	**>0.5**







4.6. CONCLUSION

Bandwidth measurement performed on the sample of the product TH110, SN:ID25 - 2920093415, in configuration and description presented in this test report, show levels below the FCC CFR 47 Part 15 and RSS-247 limits.

5. MAXIMUM PEAK OUTPUT POWER (15.247)

5.1. TEST CONDITIONS

Date of test	:	February 15, 2016
Test performed by	:	Jonathan PAUC
Atmospheric pressure (hPa)	:	987
Relative humidity (%)	:	30
Ambient temperature (°C)	:	21.6

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.
Offset: Attenuator+cable 11.9dB

☐ ***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

5.3. TEST EQUIPMENT LIST

DESCRIPTION	MANUFACTURER	MODEL	N° LCIE	Cal_Date	Cal_Due
Attenuator 10dB	AEROFLEX	-	A7122206	03/15	03/16
Cable SMA	-	18G	A5329373	10/15	10/16
Spectrum analyzer	ROHDE & SCHWARZ	FSV 30	A4060051	11/15	11/16
RSCommander	R&S	v1.6.4	L1000116	-	-

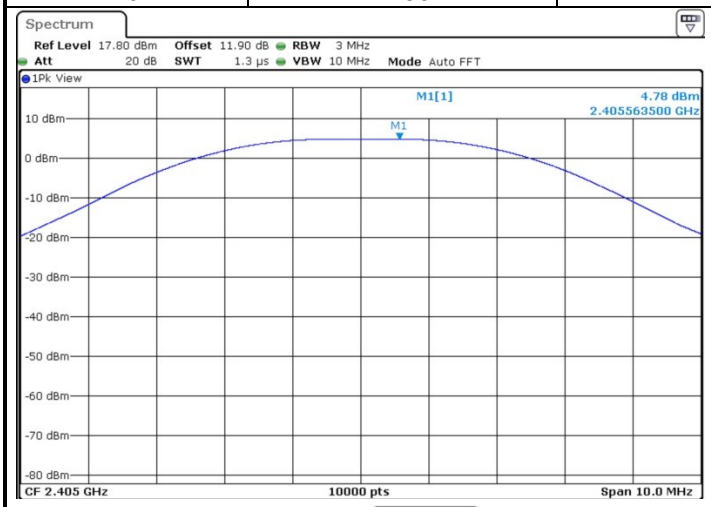
5.4. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

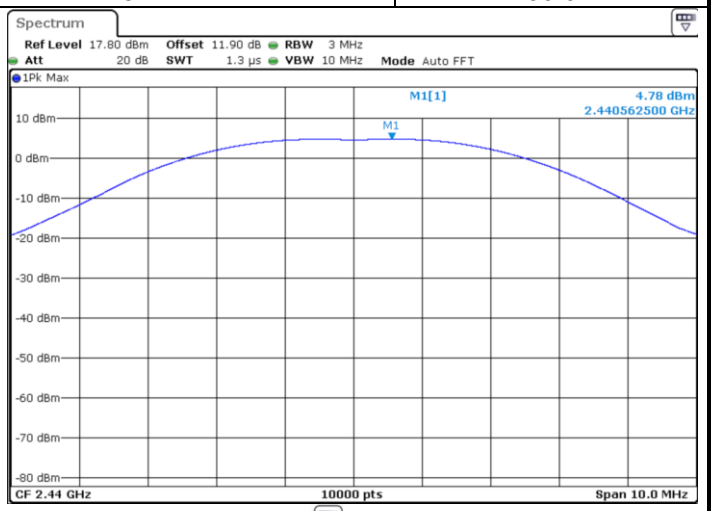
☑ None ☐ Divergence:

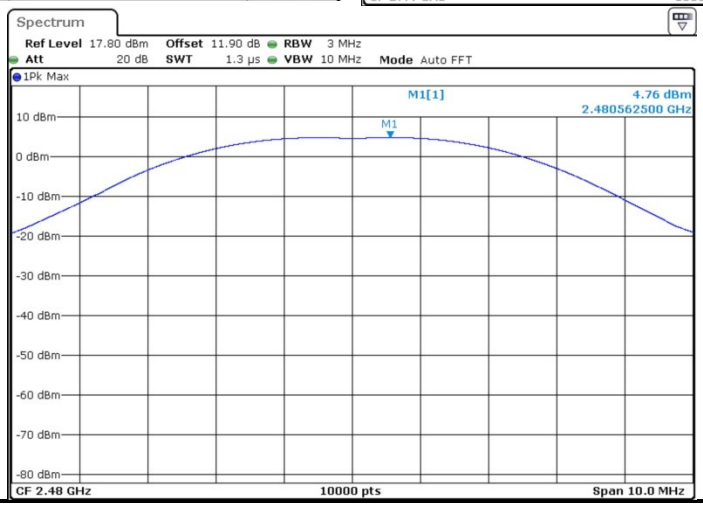
5.5. TEST SEQUENCE AND RESULTS

Modulation:

Channel	Channel Frequency (MHz)	Peak Output Power (dBm)	Power Limit (dBm)
11	2405	**4.8**	30.0
18	2440	**4.8**	30.0
26	2480	**4.8**	30.0







5.6. CONCLUSION

Maximum Peak Output Power measurement performed on the sample of the product TH110, SN: ID25 - 2920093415, in configuration and description presented in this test report, show levels below the FCC CFR 47 Part 15 and RSS-247 limits.

6. POWER SPECTRAL DENSITY (15.247)

6.1. TEST CONDITIONS

Date of test : February 15, 2016
Test performed by : Jonathan PAUC
Atmospheric pressure (hPa) : 987
Relative humidity (%) : 30
Ambient temperature (°C) : 21.6

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 11.9dB

☐ ***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 ≥ 3 x 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.

6.3. TEST EQUIPMENT LIST

DESCRIPTION	MANUFACTURER	MODEL	N° LCIE	Cal_Date	Cal_Due
Attenuator 10dB	AEROFLEX	-	A7122206	03/15	03/16
Cable SMA	-	18G	A5329373	10/15	10/16
Spectrum analyzer	ROHDE & SCHWARZ	FSV 30	A4060051	11/15	11/16
RSCommander	R&S	v1.6.4	L1000116	-	-

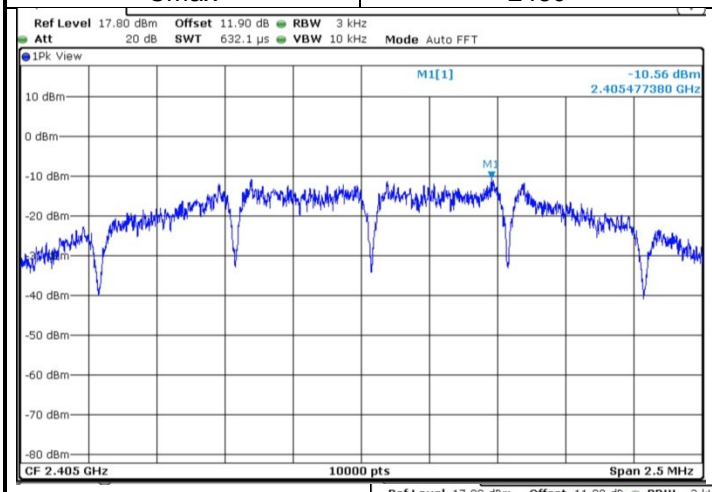
6.4. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

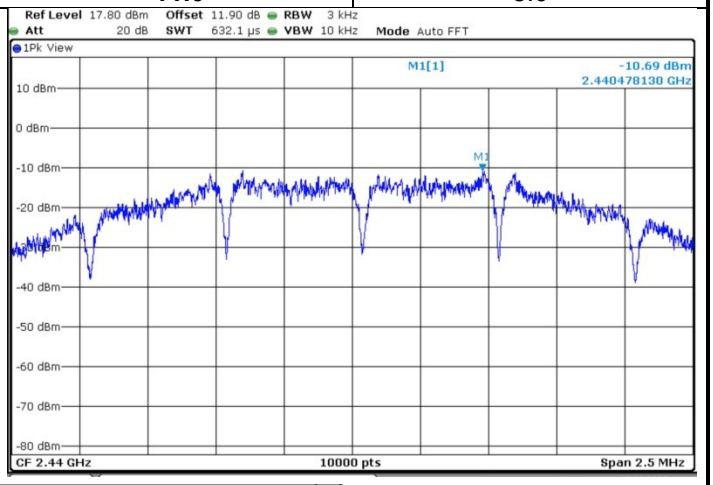
☑ None ☐ Divergence:

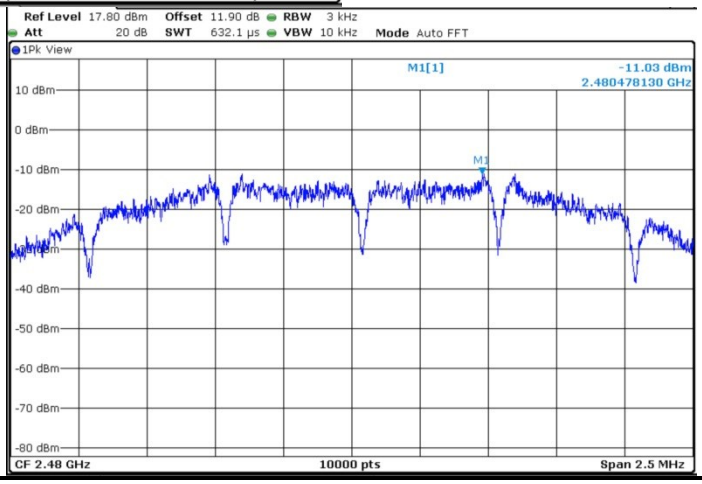
6.5. TEST SEQUENCE AND RESULTS

Modulation:

Channel	Channel Frequency (MHz)	Power Spectral Density (dBm)	PSD Limit (dBm)
Cmin	2405	**-10.6**	8.0
Cmid	2440	**-10.7**	8.0
Cmax	2480	**-11.0**	8.0







6.6. CONCLUSION

Power Spectral Density measurement performed on the sample of the product TH110, SN:ID25 - 2920093415, in configuration and description presented in this test report, show levels below the FCC CFR 47 Part 15 and RSS-247 limits.

7. BAND EDGE MEASUREMENT (15.247)

7.1. TEST CONDITIONS

Date of test : February 15, 2016
Test performed by : Jonathan PAUC
Atmospheric pressure (hPa) : 987
Relative humidity (%) : 30
Ambient temperature (°C) : 21.6

7.2. 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.

7.3. 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

7.4. TEST EQUIPMENT LIST

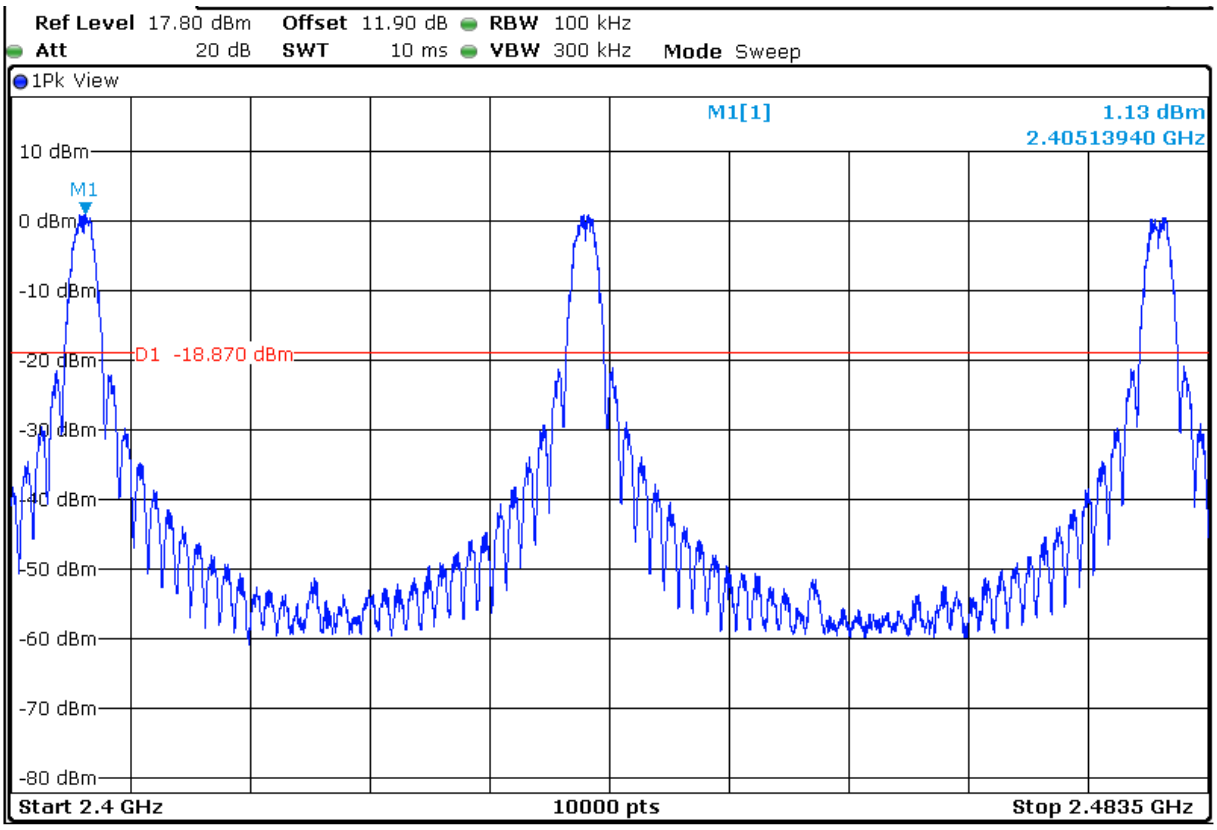
DESCRIPTION	MANUFACTURER	MODEL	N° LCIE	Cal_Date	Cal_Due
Attenuator 10dB	AEROFLEX	-	A7122206	03/15	03/16
Cable SMA	-	18G	A5329373	10/15	10/16
Spectrum analyzer	ROHDE & SCHWARZ	FSV 30	A4060051	11/15	11/16
RSCommander	R&S	v1.6.4	L1000116	-	-

7.5. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

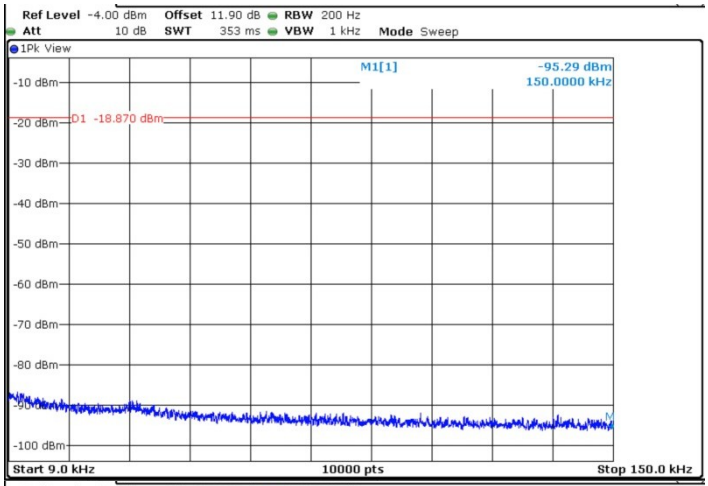
☑ None ☐ Divergence:

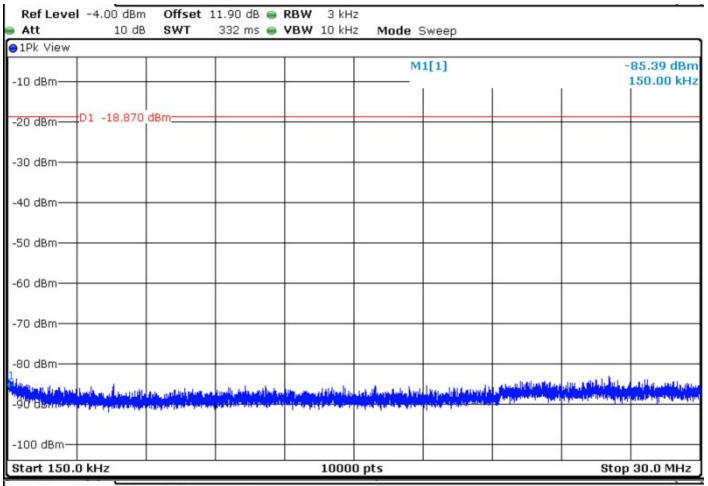
7.6. TEST SEQUENCE AND RESULTS

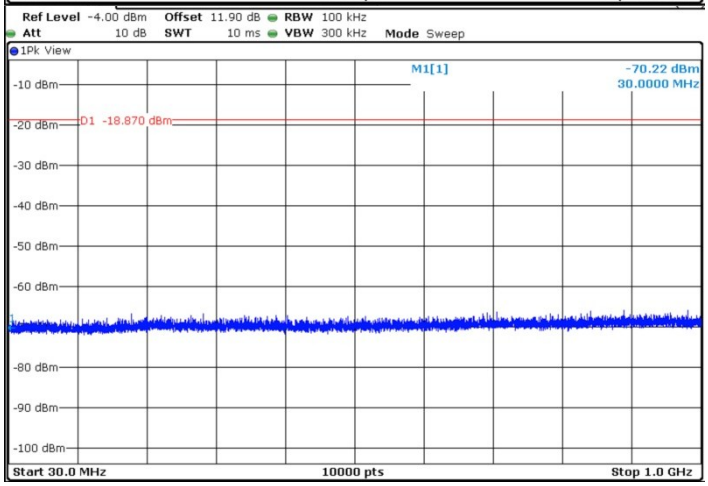
Offset: Attenuator+cable 11.9dB
GRAPH / MODULATION.

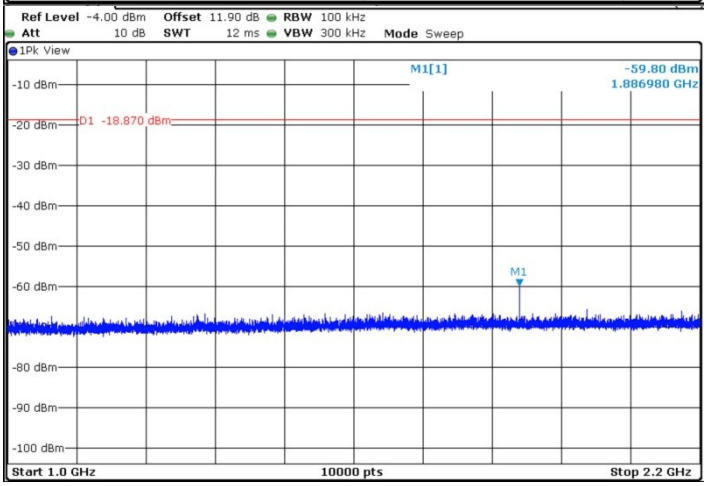


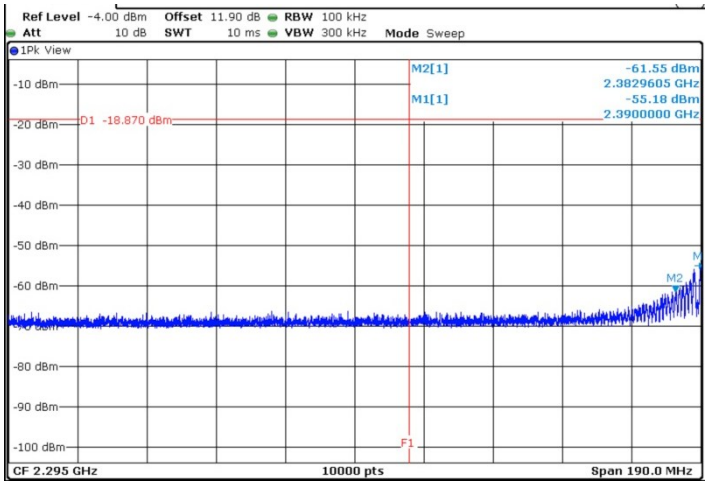
-20dBc limit used: **Worst case : Channel Min, limit at : -18.87dBm**

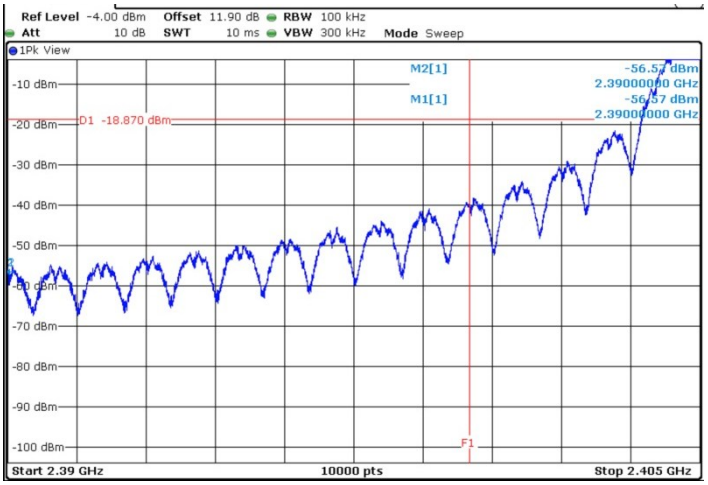

Ref Level -4.00 dBm Offset 11.90 dB RBW 200 Hz
Att 10 dB SWT 353 ms VBW 1 kHz Mode Sweep
1Pk View
M1[1] -95.29 dBm
150.0000 kHz
D1 -18.870 dBm
Start 9.0 kHz 10000 pts Stop 150.0 kHz

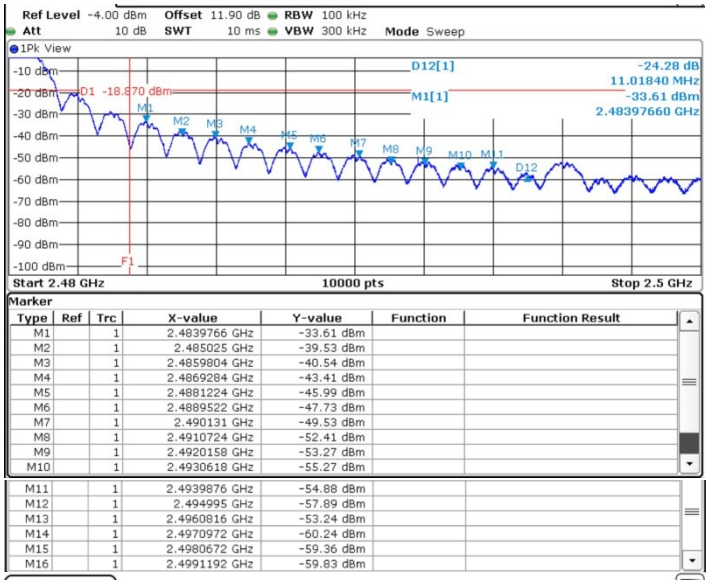

Ref Level -4.00 dBm Offset 11.90 dB RBW 3 kHz
Att 10 dB SWT 332 ms VBW 10 kHz Mode Sweep
1Pk View
M1[1] -85.39 dBm
150.00 kHz
D1 -18.870 dBm
Start 150.0 kHz 10000 pts Stop 30.0 MHz


Ref Level -4.00 dBm Offset 11.90 dB RBW 100 kHz
Att 10 dB SWT 10 ms VBW 300 kHz Mode Sweep
1Pk View
M1[1] -70.22 dBm
30.0000 MHz
D1 -18.870 dBm
Start 30.0 MHz 10000 pts Stop 1.0 GHz


Ref Level -4.00 dBm Offset 11.90 dB RBW 100 kHz
Att 10 dB SWT 12 ms VBW 300 kHz Mode Sweep
1Pk View
M1[1] -59.80 dBm
1.886980 GHz
D1 -18.870 dBm
M1
Start 1.0 GHz 10000 pts Stop 2.2 GHz

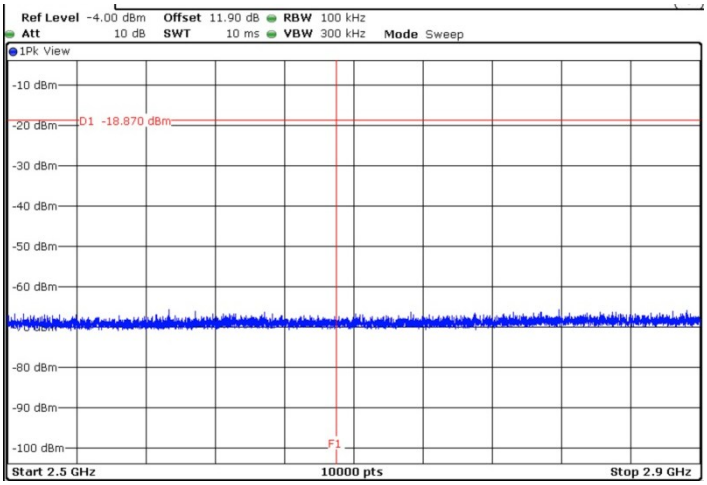

Ref Level -4.00 dBm Offset 11.90 dB RBW 100 kHz
Att 10 dB SWT 10 ms VBW 300 kHz Mode Sweep
1Pk View
M2[1] -61.55 dBm
2.3829605 GHz
M1[1] -55.18 dBm
2.3900000 GHz
D1 -18.870 dBm
CF 2.295 GHz 10000 pts Span 190.0 MHz

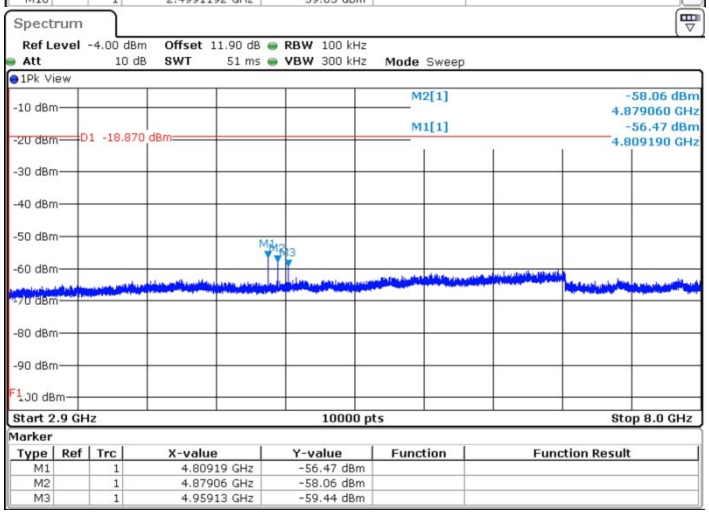

Ref Level -4.00 dBm Offset 11.90 dB RBW 100 kHz
Att 10 dB SWT 10 ms VBW 300 kHz Mode Sweep
1Pk View
M2[1] -56.57 dBm
2.39000000 GHz
M1[1] -56.57 dBm
2.39000000 GHz
D1 -18.870 dBm
Start 2.39 GHz 10000 pts Stop 2.405 GHz



Marker

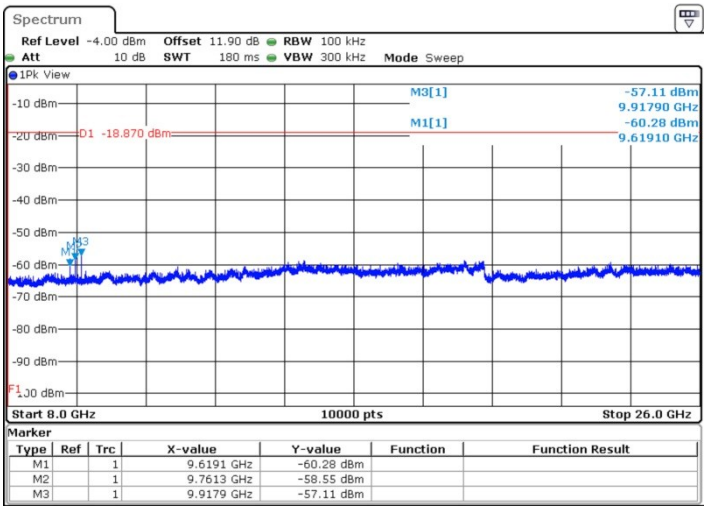
Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4839766 GHz	-33.61 dBm		
M2		1	2.485025 GHz	-39.53 dBm		
M3		1	2.4859804 GHz	-40.54 dBm		
M4		1	2.4869284 GHz	-43.41 dBm		
M5		1	2.4881224 GHz	-45.99 dBm		
M6		1	2.4889522 GHz	-47.73 dBm		
M7		1	2.490131 GHz	-49.53 dBm		
M8		1	2.4910724 GHz	-52.41 dBm		
M9		1	2.4920158 GHz	-53.27 dBm		
M10		1	2.4930618 GHz	-55.27 dBm		
M11		1	2.4939876 GHz	-54.88 dBm		
M12		1	2.494995 GHz	-57.89 dBm		
M13		1	2.4960816 GHz	-53.24 dBm		
M14		1	2.4970972 GHz	-60.24 dBm		
M15		1	2.4980672 GHz	-59.36 dBm		
M16		1	2.4991192 GHz	-59.83 dBm		





Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	4.80919 GHz	-56.47 dBm		
M2		1	4.87906 GHz	-58.06 dBm		
M3		1	4.95913 GHz	-59.44 dBm		



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	9.6191 GHz	-60.28 dBm		
M2		1	9.7613 GHz	-58.55 dBm		
M3		1	9.9179 GHz	-57.11 dBm		

7.7. CONCLUSION

Band Edge Measurement performed on the sample of the product TH110, SN:ID25 - 2920093415, in configuration and description presented in this test report, show levels below the FCC CFR 47 Part 15 and RSS-247 limits.

8. OCCUPIED BANDWIDTH

8.1. TEST CONDITIONS

Date of test : February 15, 2016
Test performed by : Jonathan PAUC
Atmospheric pressure (hPa) : 987
Relative humidity (%) : 30
Ambient temperature (°C) : 21.6

8.2. 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 = 11.9dB

☐ ***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:

a) RBW shall be in the range of 1% to 5% of the anticipated occupied bandwidth
b) Set the video bandwidth (VBW) ≥ 3 x RBW
c) SPAN = Capture all products of the modulation process
d) Detector = Peak.
e) Trace mode = max hold.
f) Sweep = auto couple.
g) Allow the trace to stabilize.
h) OBW 99% function of spectrum analyzer used

8.3. TEST EQUIPMENT LIST

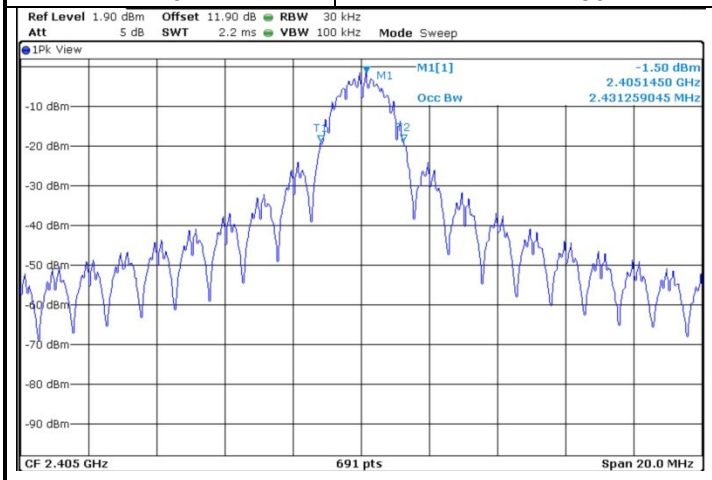
DESCRIPTION	MANUFACTURER	MODEL	N° LCIE	Cal_Date	Cal_Due
Attenuator 10dB	AEROFLEX	-	A7122206	03/15	03/16
Cable SMA	-	18G	A5329373	10/15	10/16
Spectrum analyzer	ROHDE & SCHWARZ	FSV 30	A4060051	11/15	11/16
RSCommander	R&S	v1.6.4	L1000116	-	-

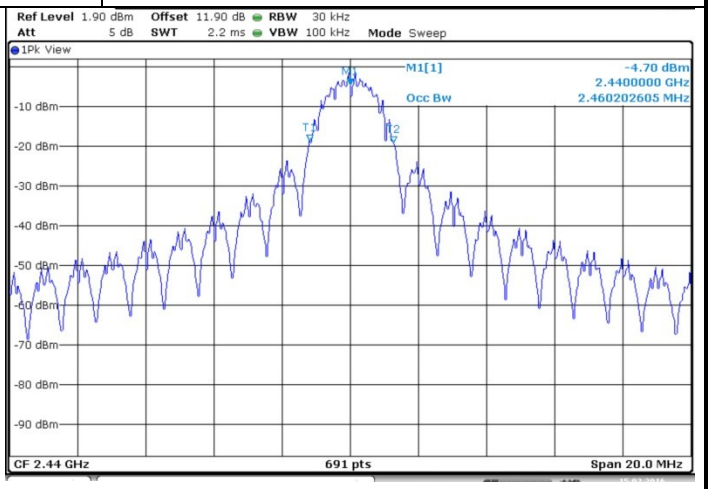
8.4. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

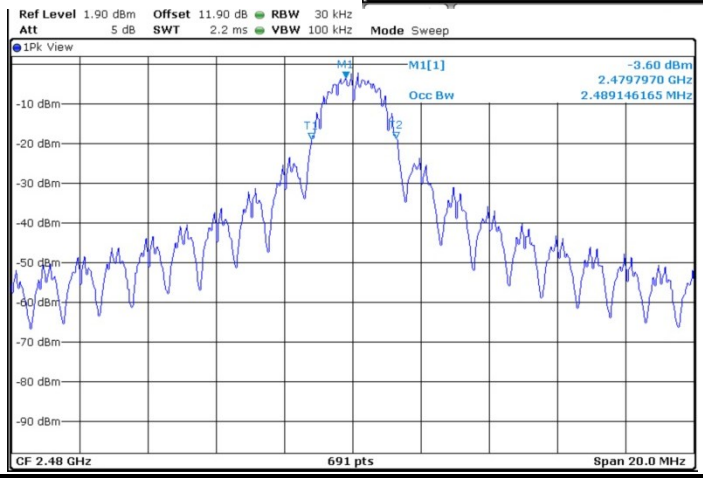
☑ None ☐ Divergence:

8.5. TEST SEQUENCE AND RESULTS

Channel	Channel Frequency (MHz)	99% Occupied Bandwidth (MHz)
11	2405	**2.431**
18	2440	**2.460**
26	2480	**2.489**

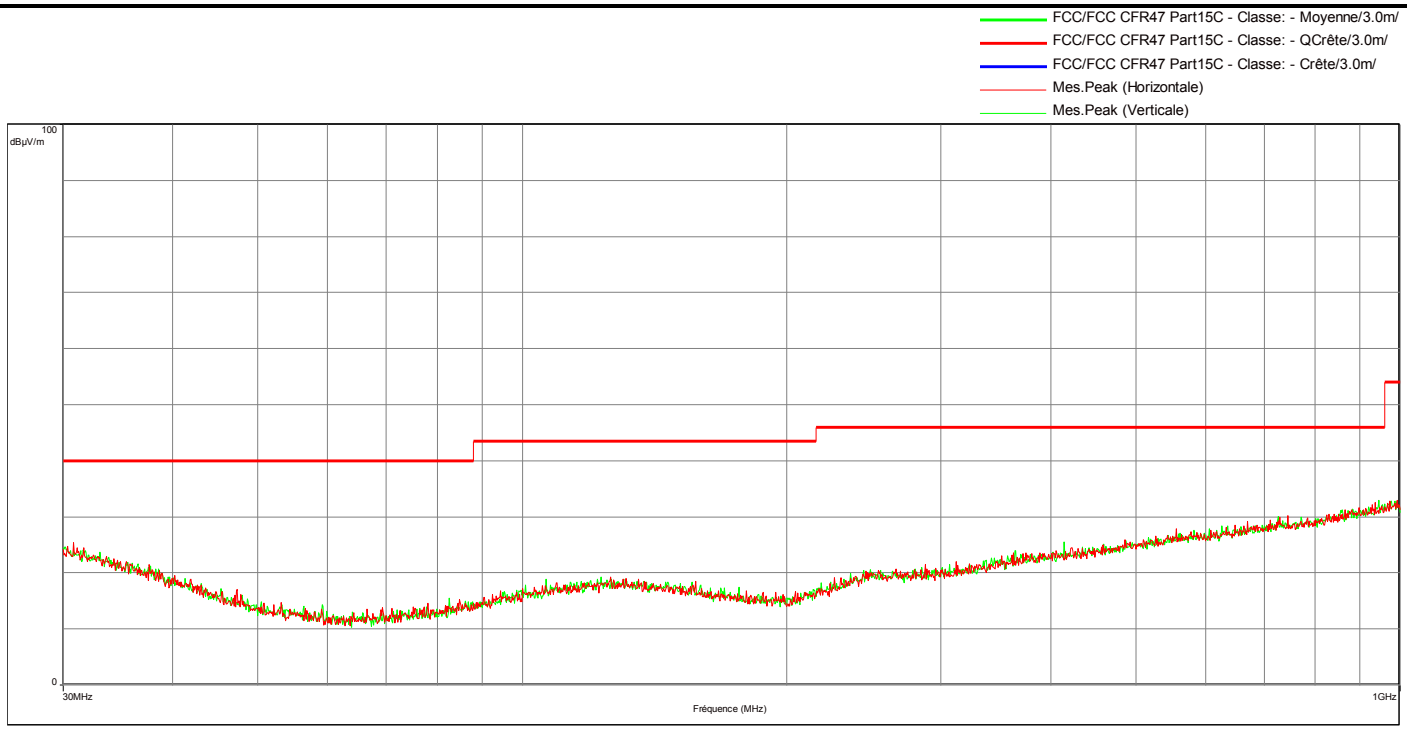






9. ANNEX 1 (GRAPHS)

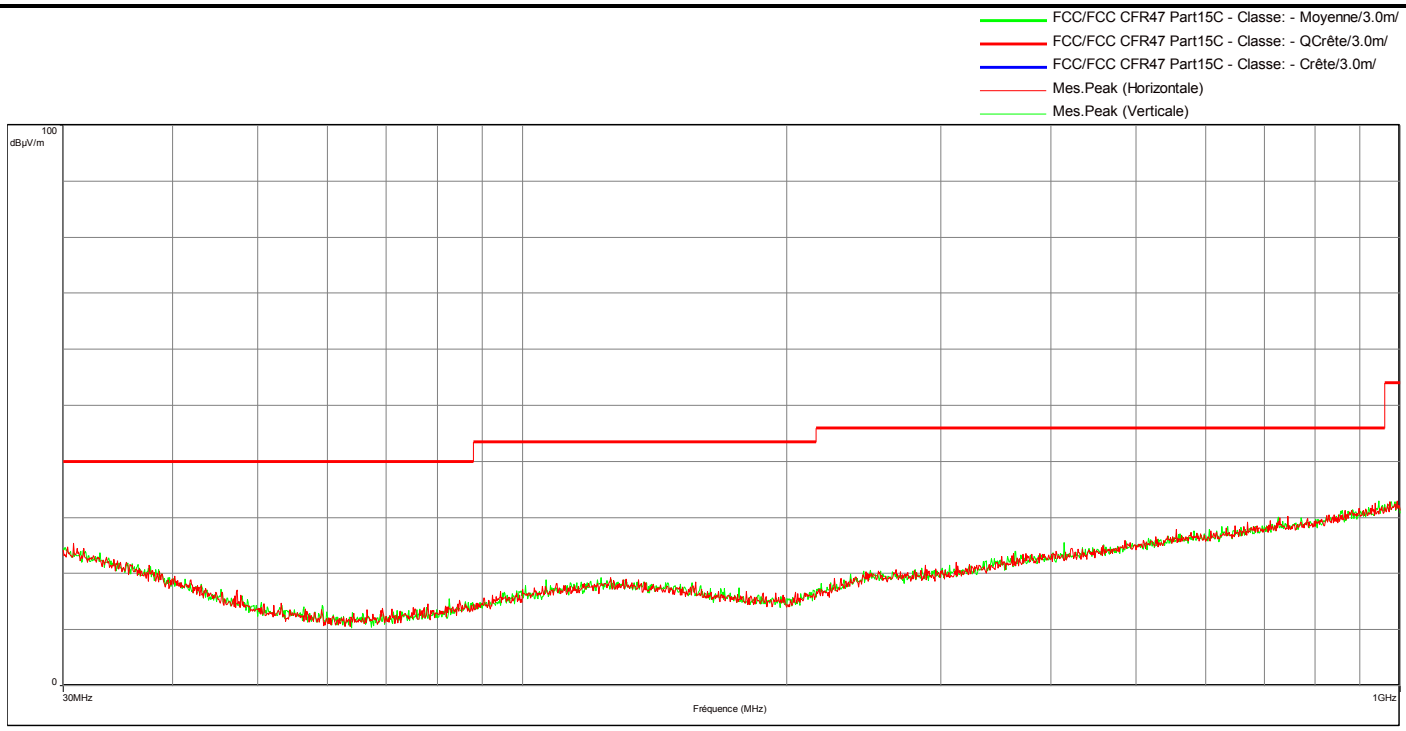
RADIATED EMISSIONS			
Graph name:	Emr#1	**Test configuration:**	
Limit:	FCC CFR47 Part15C	(H+V) - CMin - TX mode - Axis XY	
Class:			
Frequency range: [30MHz - 1GHz]			
Antenna polarization:	Horizontal & Vertical	**RBW :**	100kHz
Azimuth:	0° - 360°	**VBW :**	300kHz



Spurious emissions

No significative frequency observed

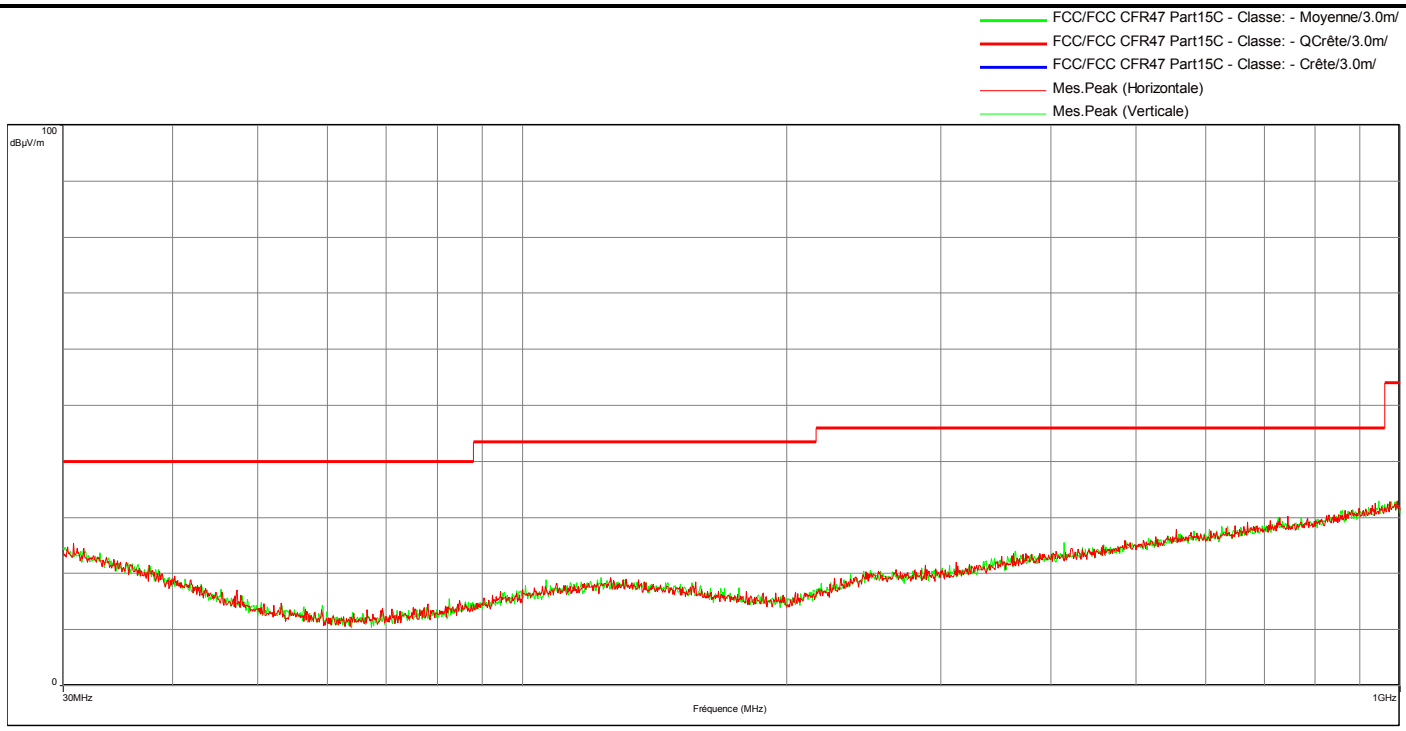
RADIATED EMISSIONS			
Graph name:	Emr#2	**Test configuration:**	
Limit:	FCC CFR47 Part15C	(H+V) - CMin - TX mode - Axis Z	
Class:			
Frequency range: [30MHz - 1GHz]			
Antenna polarization:	Horizontal & Vertical	**RBW :**	100kHz
Azimuth:	0° - 360°	**VBW :**	300kHz



Spurious emissions

No significative frequency observed

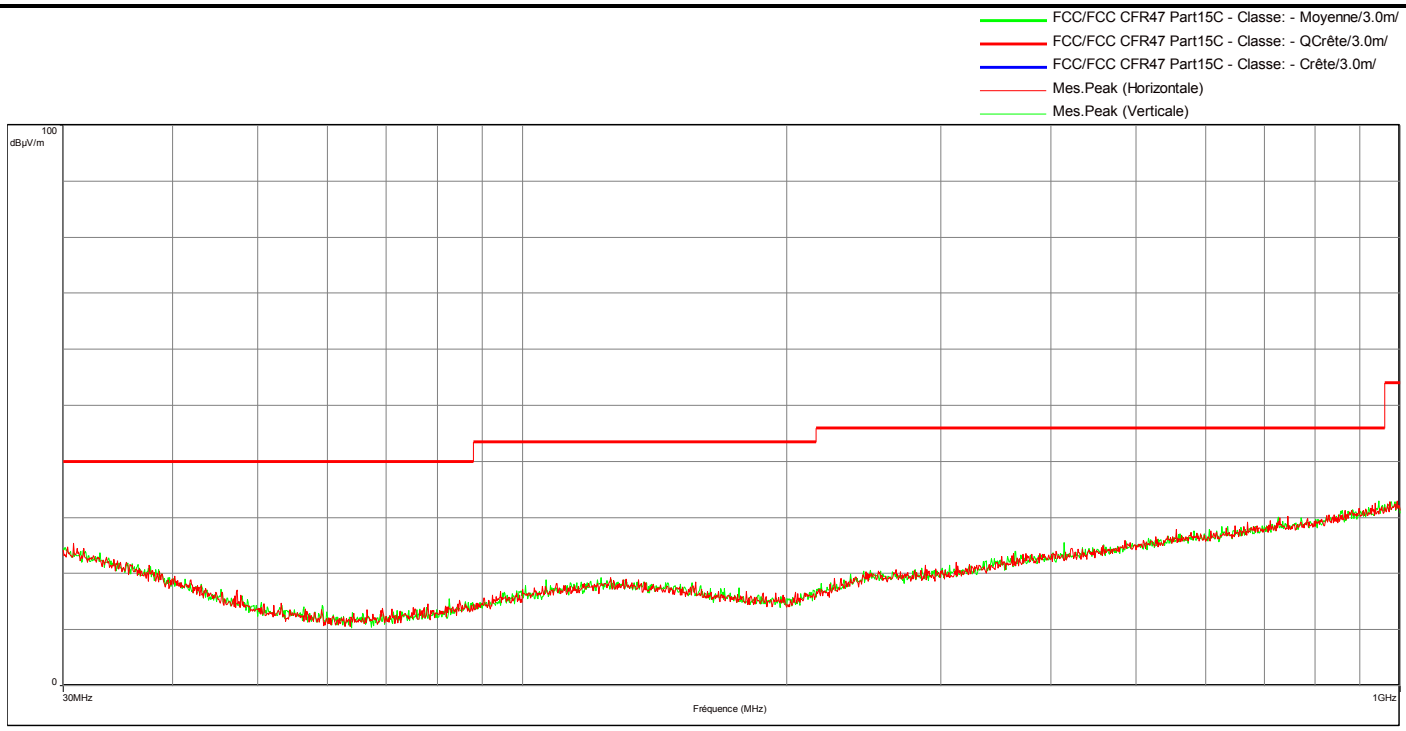
RADIATED EMISSIONS			
Graph name:	Emr#3	**Test configuration:**	
Limit:	FCC CFR47 Part15C	(H+V) - CMid - TX mode - Axis XY	
Class:			
Frequency range: [30MHz - 1GHz]			
Antenna polarization:	Horizontal & Vertical	**RBW :**	100kHz
Azimuth:	0° - 360°	**VBW :**	300kHz



Spurious emissions

No significative frequency observed

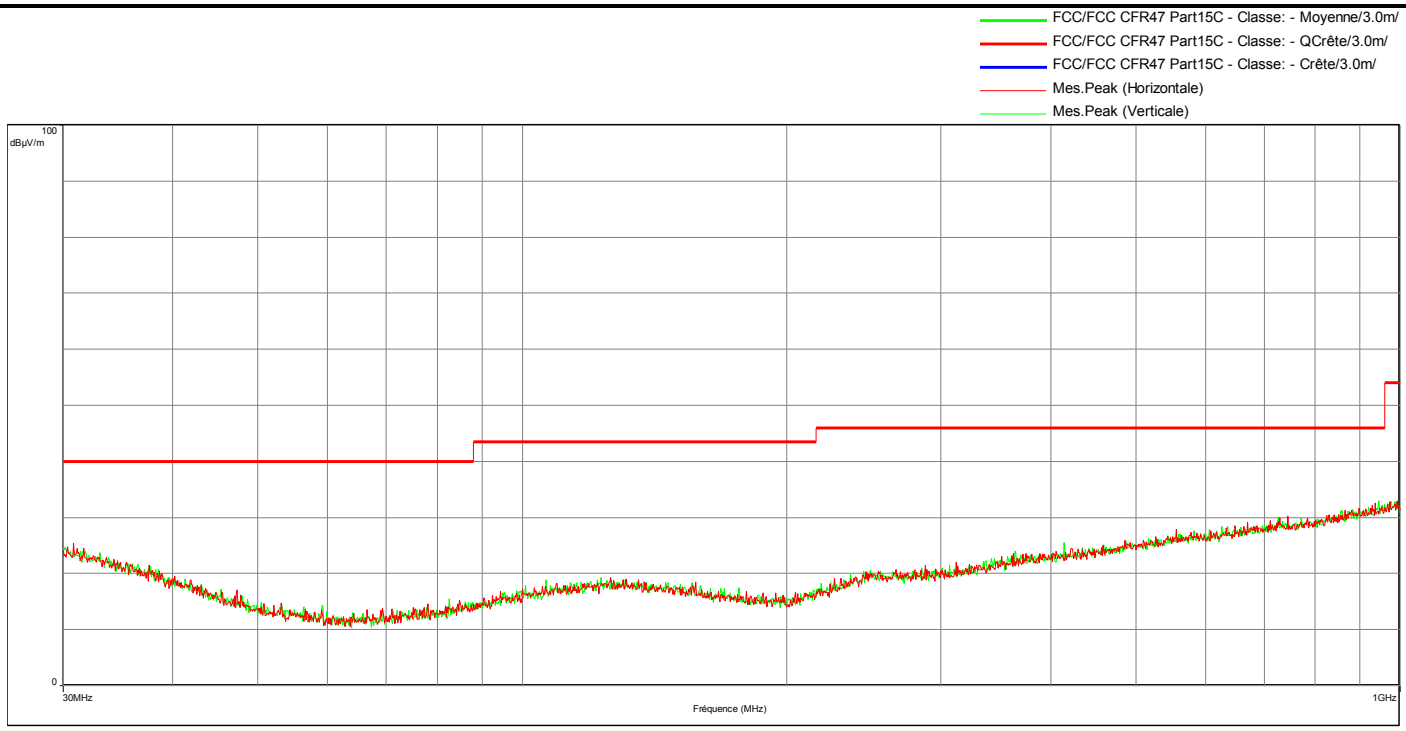
RADIATED EMISSIONS			
Graph name:	Emr#4	**Test configuration:**	
Limit:	FCC CFR47 Part15C	(H+V) - CMid - TX mode - Axis Z	
Class:			
Frequency range: [30MHz - 1GHz]			
Antenna polarization:	Horizontal & Vertical	**RBW :**	100kHz
Azimuth:	0° - 360°	**VBW :**	300kHz



Spurious emissions

No significative frequency observed

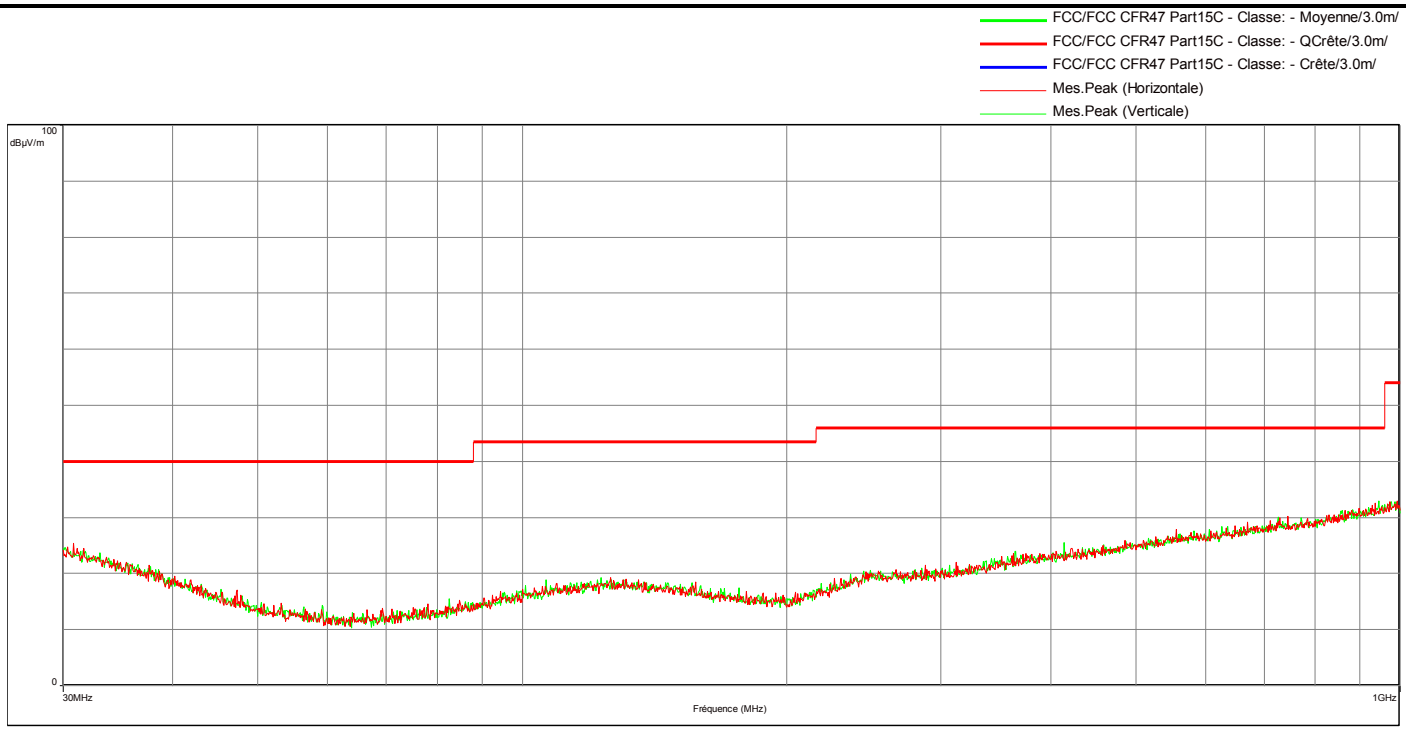
RADIATED EMISSIONS			
Graph name:	Emr#5	**Test configuration:**	
Limit:	FCC CFR47 Part15C	(H+V) - CMax - TX mode - Axis XY	
Class:			
Frequency range: [30MHz - 1GHz]			
Antenna polarization:	Horizontal & Vertical	**RBW :**	100kHz
Azimuth:	0° - 360°	**VBW :**	300kHz



Spurious emissions

No significative frequency observed

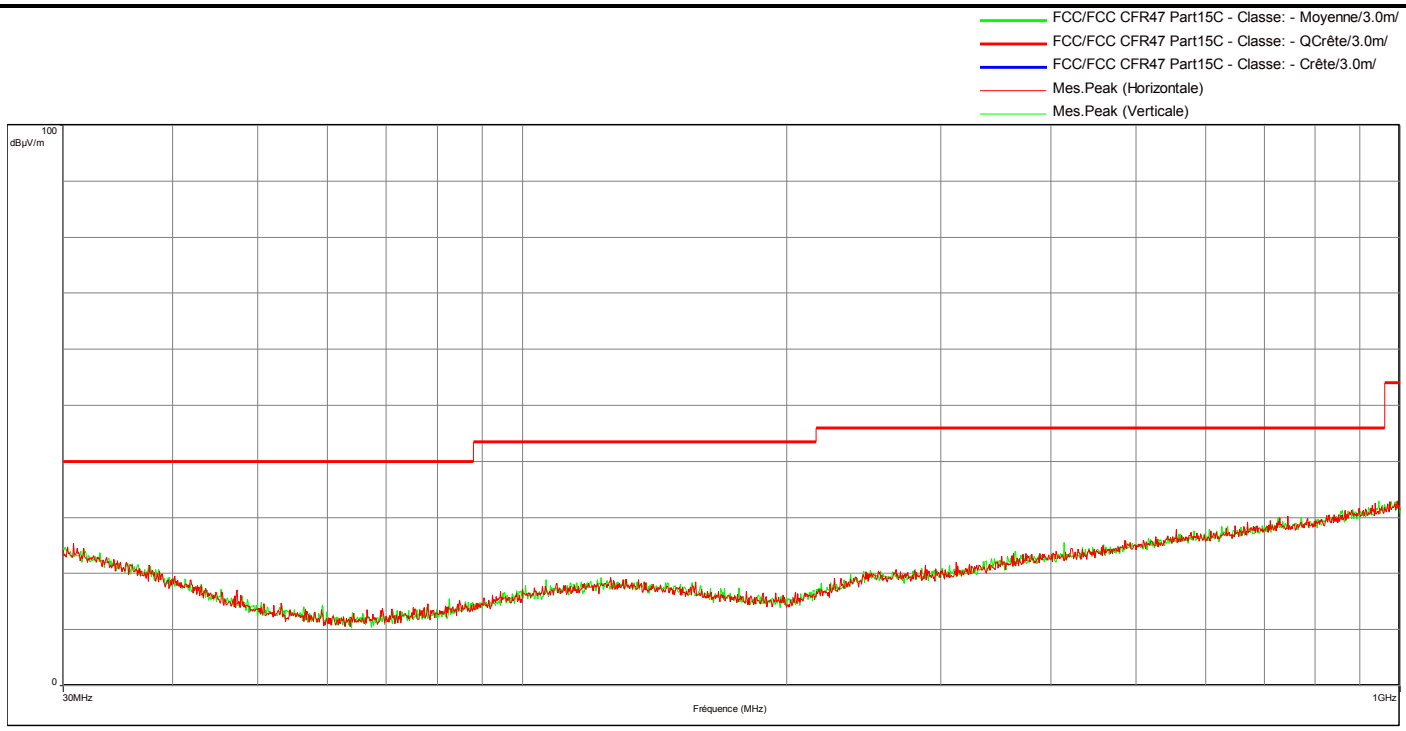
RADIATED EMISSIONS			
Graph name:	Emr#6	**Test configuration:**	
Limit:	FCC CFR47 Part15C	(H+V) - CMax - TX mode - Axis Z	
Class:			
Frequency range: [30MHz - 1GHz]			
Antenna polarization:	Horizontal & Vertical	**RBW :**	100kHz
Azimuth:	0° - 360°	**VBW :**	300kHz



Spurious emissions

No significative frequency observed

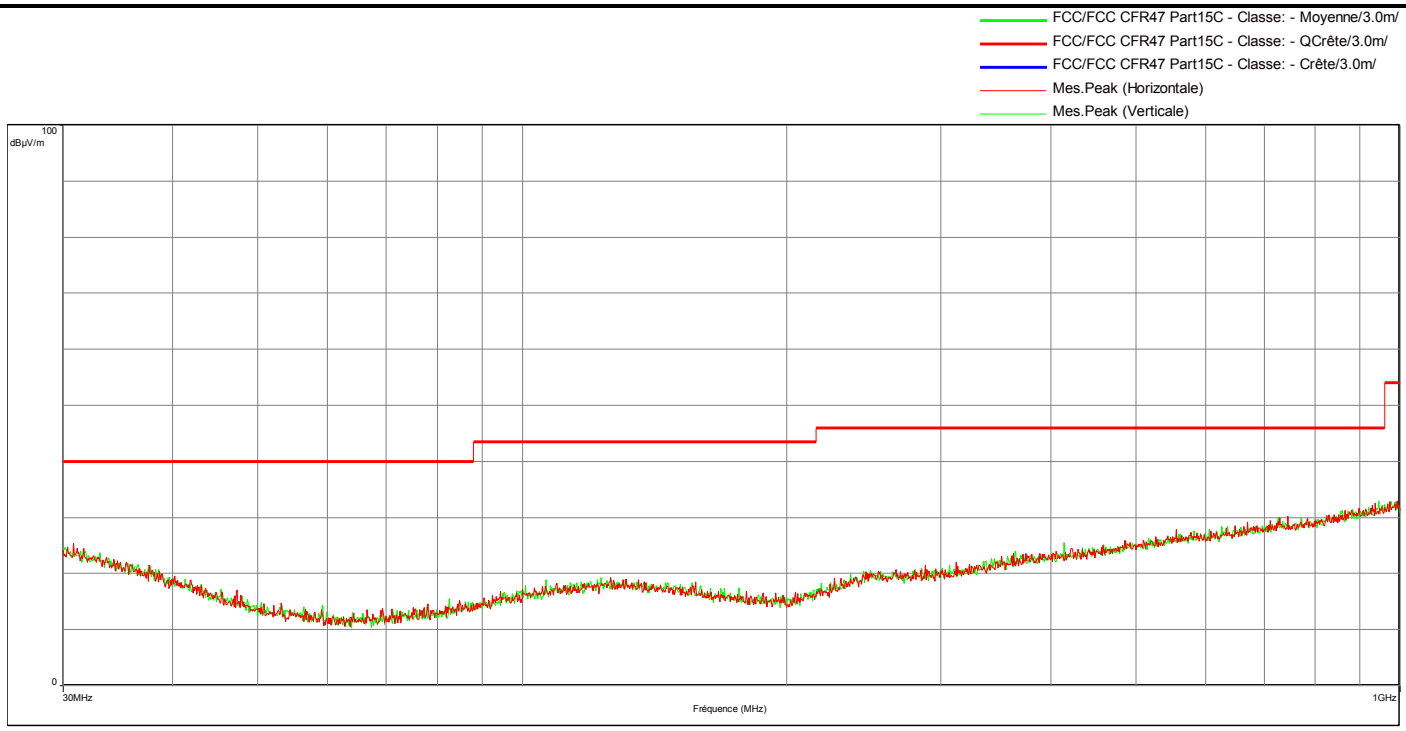
RADIATED EMISSIONS			
Graph name:	Emr#7	**Test configuration:**	
Limit:	FCC CFR47 Part15C	(H+V) - CMax - Functionnal mode - Axis XY	
Class:			
Frequency range: [30MHz - 1GHz]			
Antenna polarization:	Horizontal & Vertical	**RBW :**	100kHz
Azimuth:	0° - 360°	**VBW :**	300kHz



Spurious emissions

No significative frequency observed

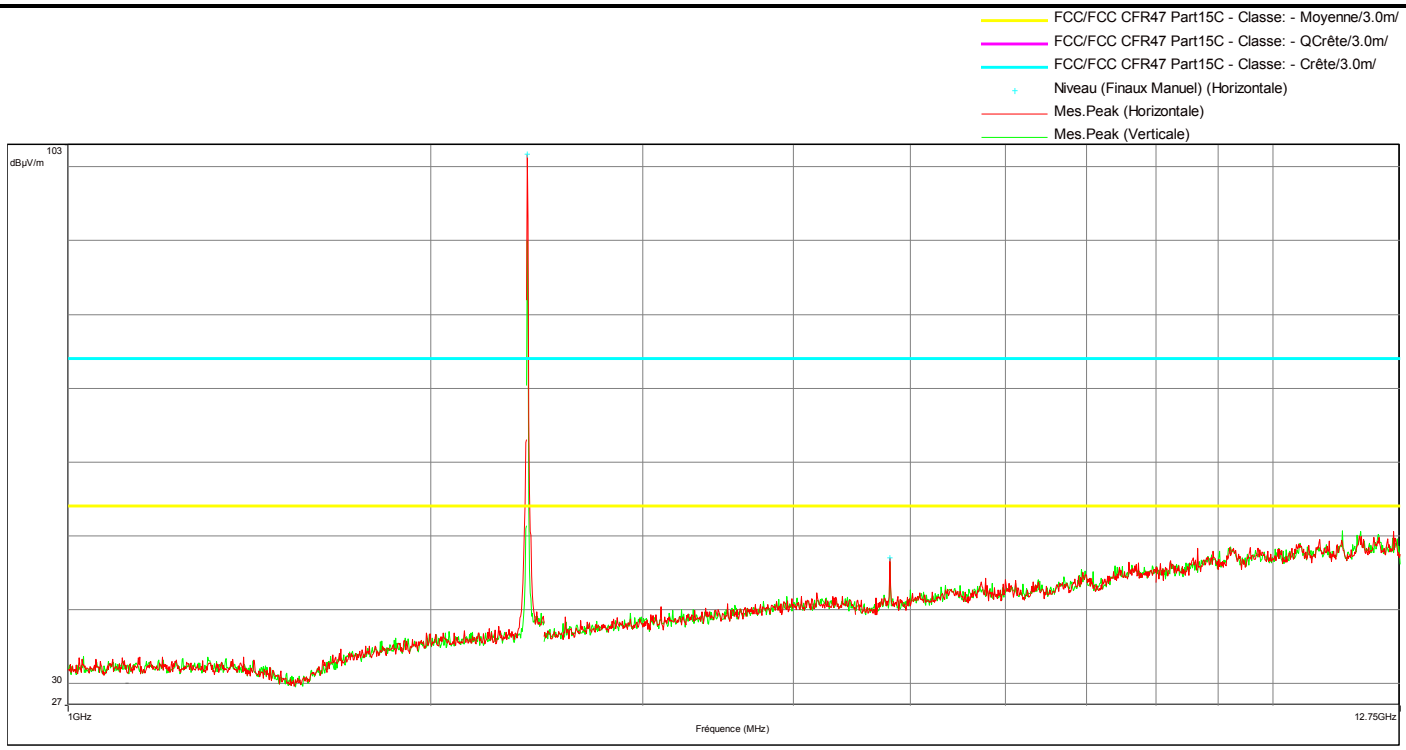
RADIATED EMISSIONS			
Graph name:	Emr#8	**Test configuration:**	
Limit:	FCC CFR47 Part15C	(H+V) - CMax - Functionnal mode - Axis Z	
Class:			
Frequency range: [30MHz - 1GHz]			
Antenna polarization:	Horizontal & Vertical	**RBW :**	100kHz
Azimuth:	0° - 360°	**VBW :**	300kHz



Spurious emissions

No significative frequency observed

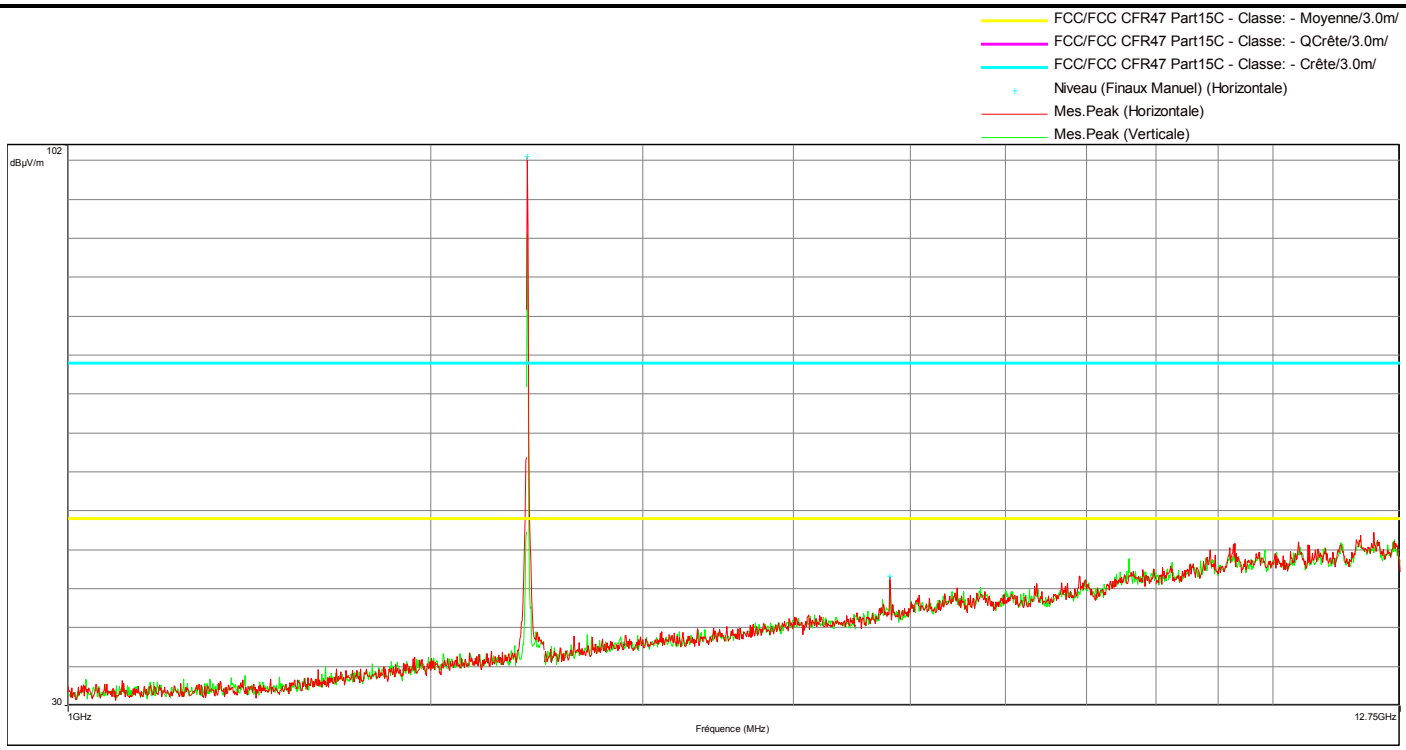
RADIATED EMISSIONS			
Graph name:	Emr#9	**Test configuration:**	
Limit:	FCC CFR47 Part15C	(H+V) - CMin - TX mode - Axis XY	
Class:			
Frequency range: [1GHz - 12.75GHz]			
Antenna polarization:	Horizontal & Vertical	**RBW :**	1MHz
Azimuth:	0° - 360°	**VBW :**	3MHz



Spurious emissions

Frequency (MHz)	Peak Level (dBµV/m)	Polarisation
2404.517	101.7	Horizontale
4809.400	47.0	Horizontale

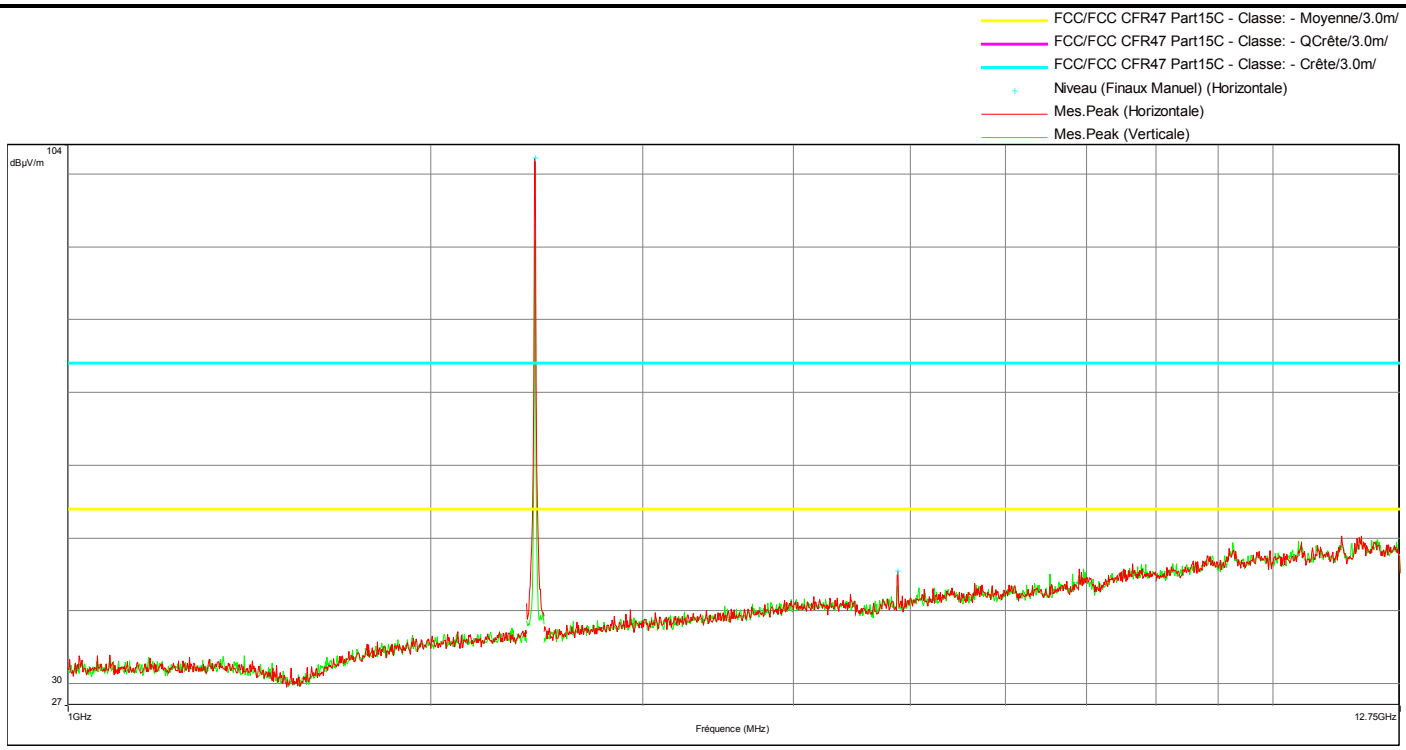
RADIATED EMISSIONS			
Graph name:	Emr#10	**Test configuration:**	
Limit:	FCC CFR47 Part15C	(H+V) - CMin - TX mode - Axis Z	
Class:			
Frequency range: [1GHz - 12.75GHz]			
Antenna polarization:	Horizontal & Vertical	**RBW :**	1MHz
Azimuth:	0° - 360°	**VBW :**	3MHz



Spurious emissions

Frequency (MHz)	Peak Level (dBµV/m)	Polarisation
2405.519	100.5	Horizontale
4810.800	46.6	Horizontale

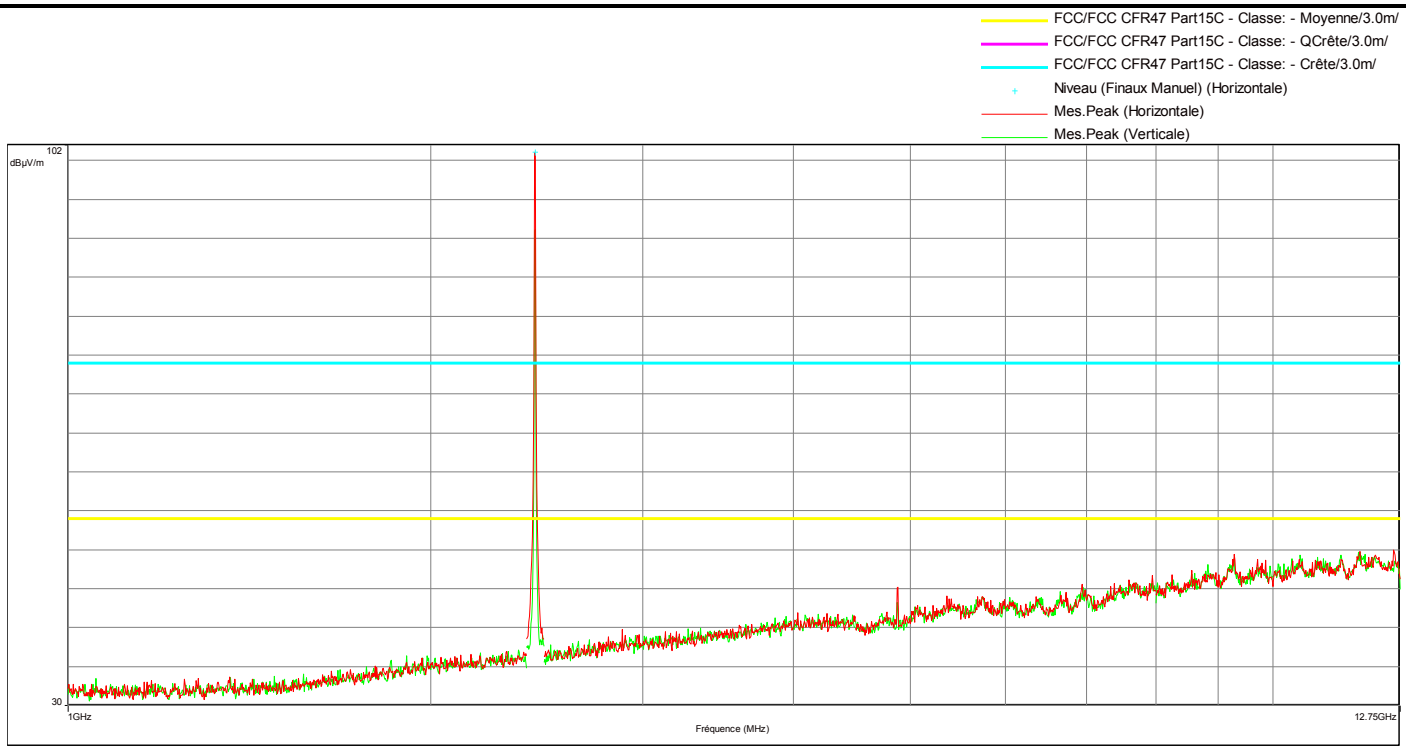
RADIATED EMISSIONS			
Graph name:	Emr#11	**Test configuration:**	
Limit:	FCC CFR47 Part15C	(H+V) - CMid - TX mode - Axis XY	
Class:			
Frequency range: [1GHz - 12.75GHz]			
Antenna polarization:	Horizontal & Vertical	**RBW :**	1MHz
Azimuth:	0° - 360°	**VBW :**	3MHz



Spurious emissions

Frequency (MHz)	Peak Level (dBµV/m)	Polarisation
2440.514	102.2	Horizontale
4881.150	45.5	Horizontale

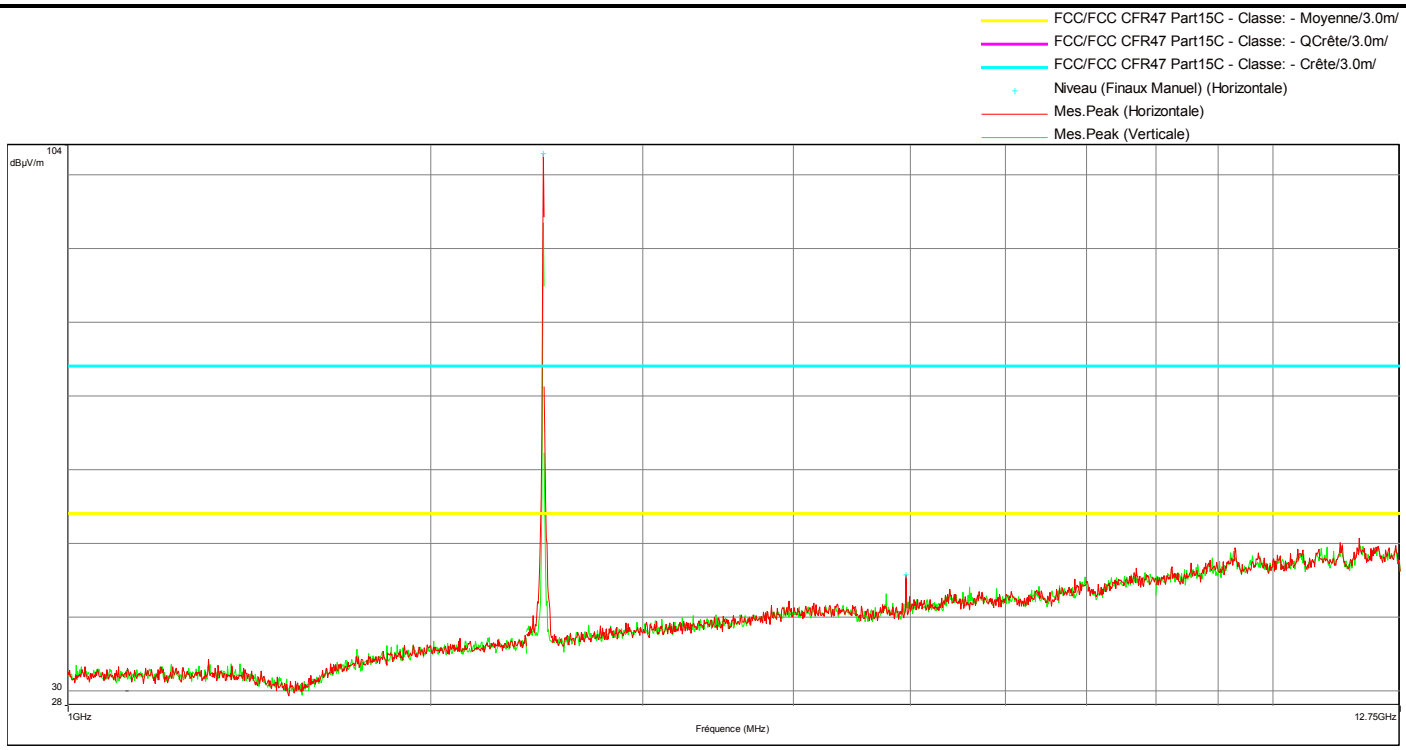
RADIATED EMISSIONS			
Graph name:	Emr#12	**Test configuration:**	
Limit:	FCC CFR47 Part15C	(H+V) - CMid - TX mode - Axis Z	
Class:			
Frequency range: [1GHz - 12.75GHz]			
Antenna polarization:	Horizontal & Vertical	**RBW :**	1MHz
Azimuth:	0° - 360°	**VBW :**	3MHz



Spurious emissions

Frequency (MHz)	Peak Level (dBµV/m)	Polarisation
2440.498	101.1	Horizontale

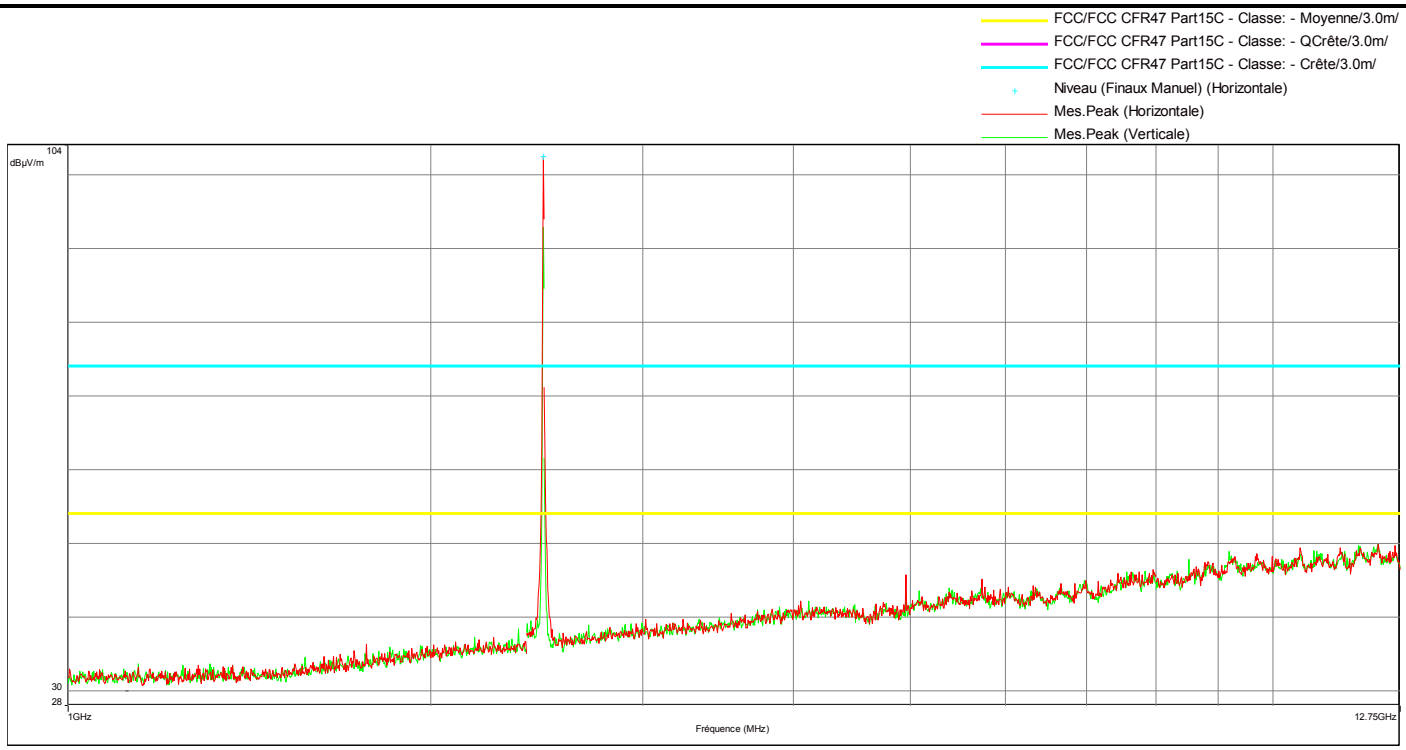
RADIATED EMISSIONS			
Graph name:	Emr#13	**Test configuration:**	
Limit:	FCC CFR47 Part15C	(H+V) - CMax - TX mode - Axis XY	
Class:			
Frequency range: [1GHz - 12.75GHz]			
Antenna polarization:	Horizontal & Vertical	**RBW :**	1MHz
Azimuth:	0° - 360°	**VBW :**	3MHz



Spurious emissions

Frequency (MHz)	Peak Level (dBµV/m)	Polarisation
2479.517	102.8	Horizontale
4959.200	45.7	Horizontale

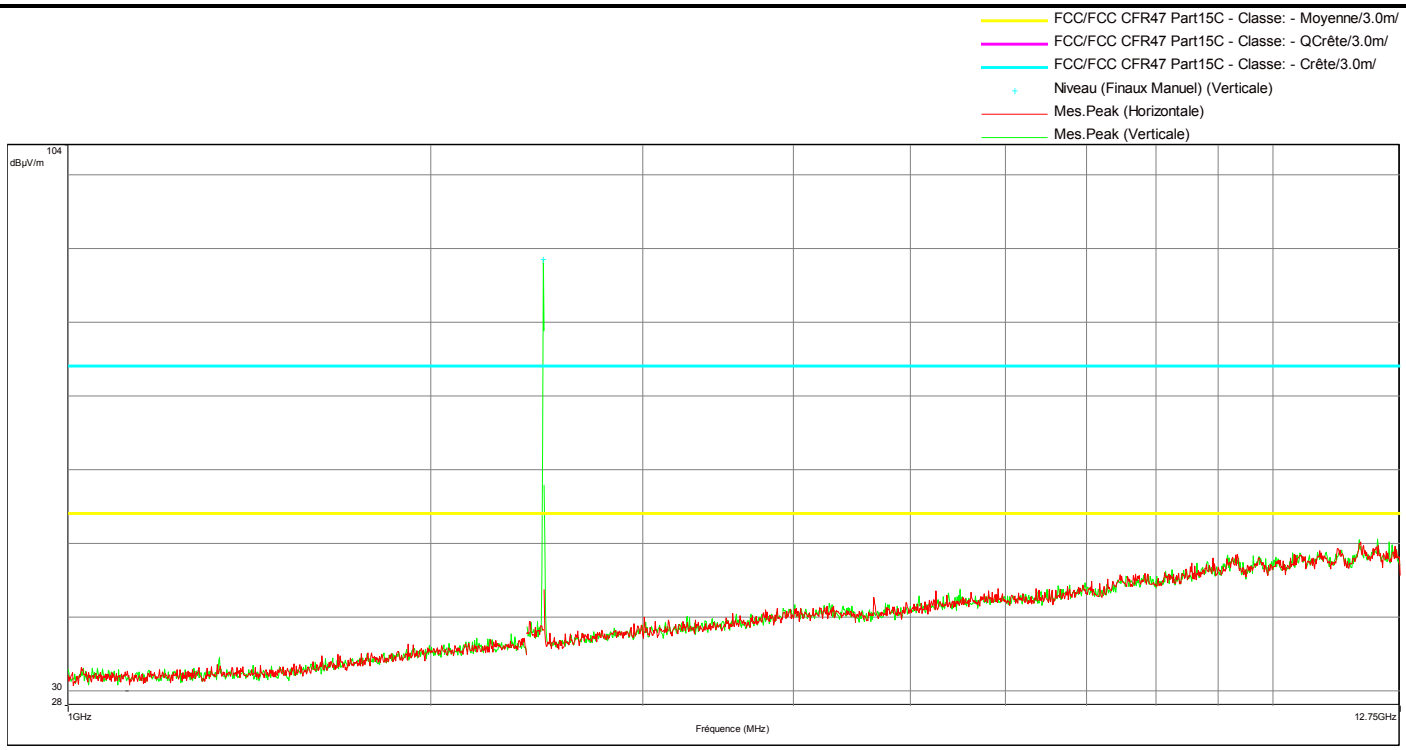
RADIATED EMISSIONS			
Graph name:	Emr#14	**Test configuration:**	
Limit:	FCC CFR47 Part15C	(H+V) - CMax - TX mode - Axis Z	
Class:			
Frequency range: [1GHz - 12.75GHz]			
Antenna polarization:	Horizontal & Vertical	**RBW :**	1MHz
Azimuth:	0° - 360°	**VBW :**	3MHz



Spurious emissions

Frequency (MHz)	Peak Level (dBµV/m)	Polarisation
2479.534	102.4	Horizontale

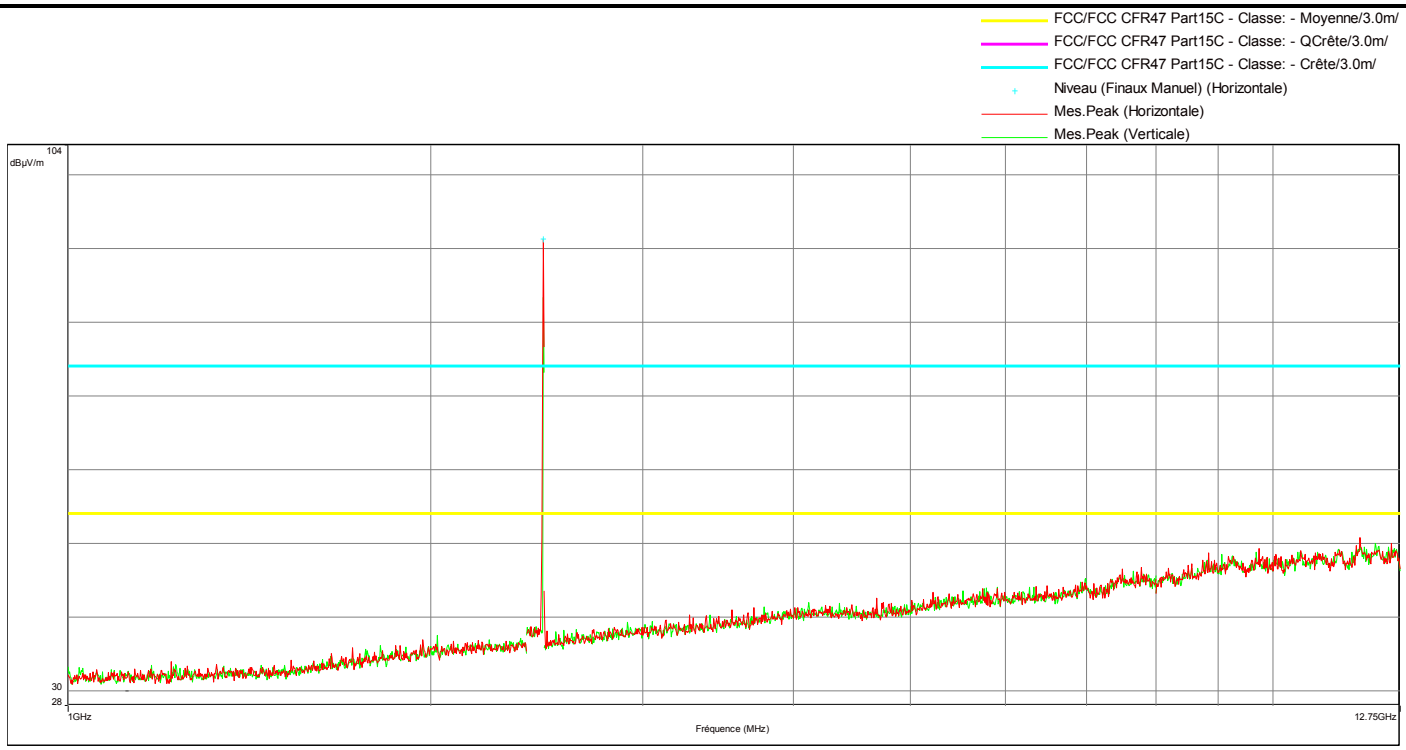
RADIATED EMISSIONS			
Graph name:	Emr#15	**Test configuration:**	
Limit:	FCC CFR47 Part15C	(H+V) - CMax - Functionnal mode - Axis XY	
Class:			
Frequency range: [1GHz - 12.75GHz]			
Antenna polarization:	Horizontal & Vertical	**RBW :**	1MHz
Azimuth:	0° - 360°	**VBW :**	3MHz



Spurious emissions

Frequency (MHz)	Peak Level (dBµV/m)	Polarisation
2480.369	88.5	Verticale

RADIATED EMISSIONS			
Graph name:	Emr#16	**Test configuration:**	
Limit:	FCC CFR47 Part15C	(H+V) - CMax - Functionnal mode - Axis Z	
Class:			
Frequency range: [1GHz - 12.75GHz]			
Antenna polarization:	Horizontal & Vertical	**RBW :**	1MHz
Azimuth:	0° - 360°	**VBW :**	3MHz



Spurious emissions

Frequency (MHz)	Peak Level (dBµV/m)	Polarisation
2479.851	91.2	Horizontale

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