TEST REPORT

N°: 141534-685031-A (FILE#855058) **Version : 01**

Subject	**Electromagnetic compatibility tests according to the standards:** **FCC CFR 47 Part 15, Subpart C** **RSS-210 Issue 9**
Issued to	**ASTEEL FLASH DEVELOPPEMENT** Immeuble « Le Silène » 38240 - MEYLAN FRANCE
Apparatus under test	
↳ Product	AVALANCHE BEACON
↳ Trade mark	**ASTEEL FLASH DEVELOPPEMENT**
↳ Manufacturer	**ASTEEL FLASH DEVELOPPEMENT**
↳ Model under test	**AXIO**
↳ Serial number	**XO00061-0121**
↳ FCCID	**O9BARVANANO**
↳ IC	**22008ARVANANO**
Conclusion	See Test Program chapter §1
Test date	March 22, 2016
Test location	MOIRANS
IC Test site	6500A-1 & 6500A-3
Composition of document	23 pages
Document issued on	January 5, 2017

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PUBLICATION HISTORY

Version	Date	Author	Modification
01	January 5, 2017	Jonathan PAUC	Creation of the document

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1. TEST PROGRAM

Standard:
- **FCC Part 15, Subpart C**
- **ANSI C63.10 (2013)**
- **RSS-210 Issue 9**
- **RSS-Gen Issue 4 – Nov 2014**

EMISSION TEST	LIMITS			RESULTS (Comments)
Limits for conducted disturbance at mains ports 150kHz-30MHz *CFR 47 §15.207*	**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 §15.225* *RSS-Gen §4.9*	**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 §15.225* *RSS-Gen §4.9* ***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**
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.

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

2. SYSTEM TEST CONFIGURATION

2.1. HARDWARE IDENTIFICATION (EUT AND AUXILIARIES):

Equipment under test (EUT):

AXIO **Serial Number: XO00061-0121**

Power supply:
During all the tests, EUT is supplied by V_{nom}: 4.5VDC
For measurement with different voltage, it will be presented in test method.

Name	Type	Rating	Reference / Sn	Comments
Supply1	☐ AC ☐ DC ☑ Battery	3 x Batteries type AAA (4.5Vdc)	/	/

Inputs/outputs - Cable:

Access	Type	Length used (m)	Declared <3m	Shielded	Under test	Comments
Supply1	3 x Batteries typ AAA (1.5Vdc each)	/	☐	☐	☑	
Access1	Audio Jack port output (3.5mm)	2	☑	☐	☑	

Auxiliary equipment used during test:

Type	Reference	Sn	Comments
None			

Equipment information:

EQUIPMENT INFORMATION				
RF module:	NC			
Frequency Carrier:	[457 kHz]			
Sub-band REC7003:	ANNEX 2 – Band A [456.9-457.1kHz]			
RF mode:	☑Transmitter	☐Transceiver	☑Receiver	☐Standby
Antenna type:	☐External:		☑Internal:	
Antenna gain:	NC			
Equipment location	☑ Mobile station		☐ Fixed station	
Extreme temperature range:	☑Category I (General) -20°C to +55°C	☐Category II (Portable) -10°C to +55°C	☐Category III (Indoor) +5°C to +35°C	
Extreme test source voltage:	☐±10%:	☑other: From 3.3VDC to 4.5VDC (ask from provider)		
Equipment designed for continuous operation: NO, emitted each 750ms during 100ms (Declaration of provider)				

2.2. EUT CONFIGURATION

A special configuration of the EUT permits:
- Permanent emission of the carrier frequency with modulation
- Permanent RX mode

Inboard Firmware / Software version of EUT: v 1.3

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 (15.209)

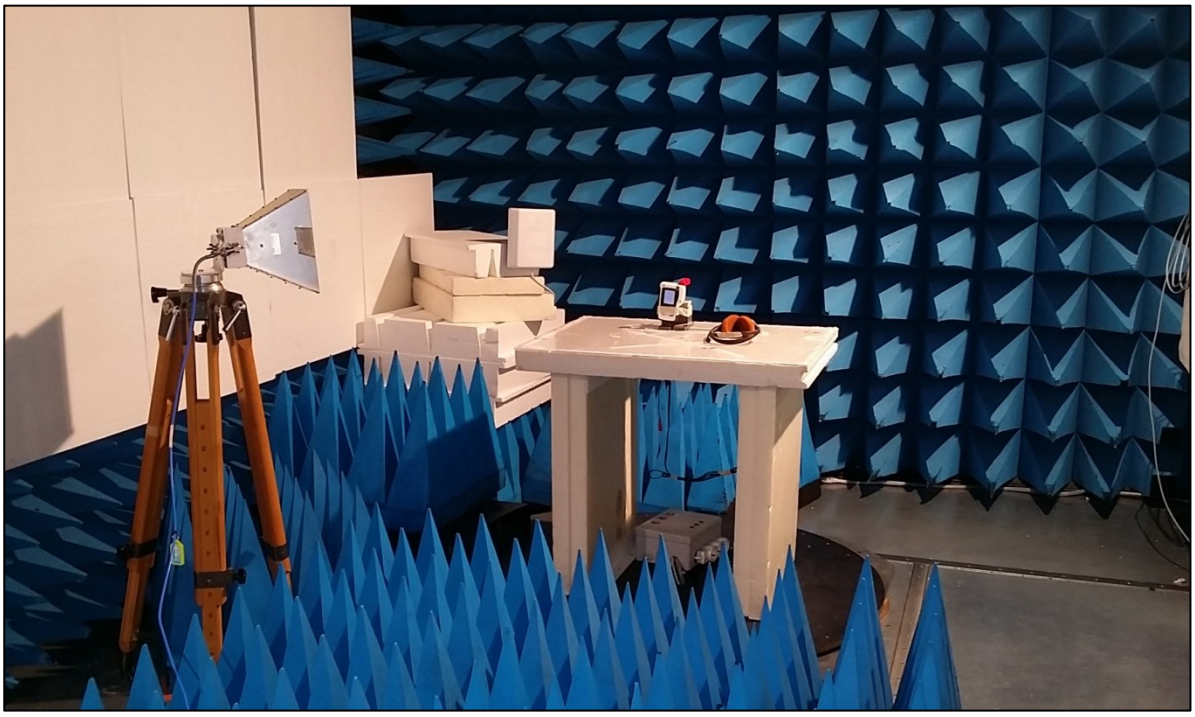
3.1. ENVIRONMENTAL CONDITIONS

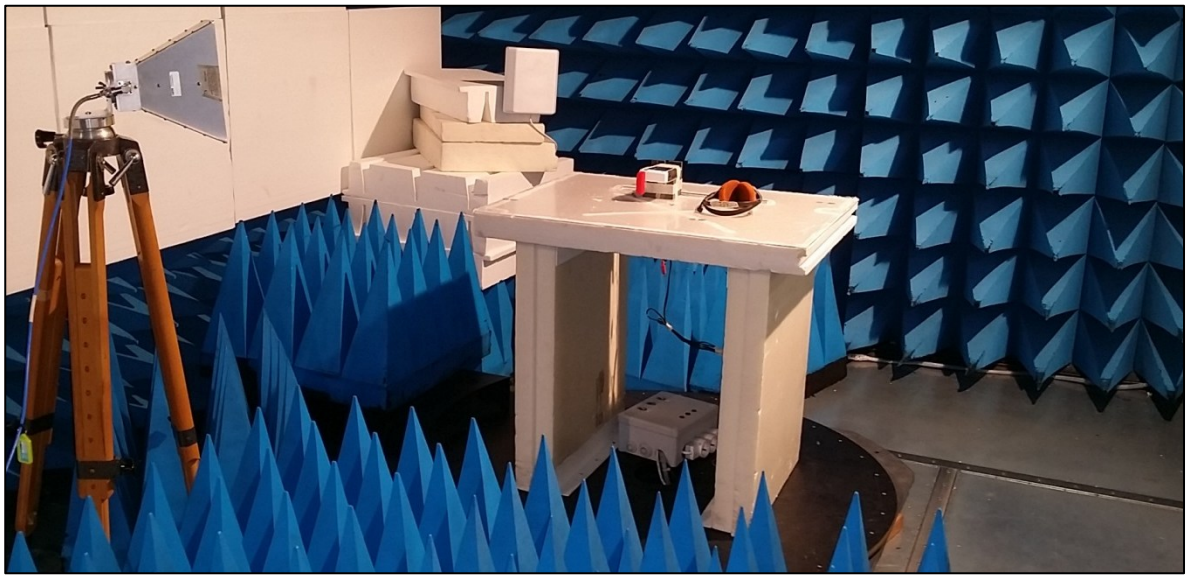
Date of test	:	March 22, 2016
Test performed by	:	Jonathan PAUC
Atmospheric pressure (hPa)	:	990
Relative humidity (%)	:	22
Ambient temperature (°C)	:	22

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 on OATS





Test setup in anechoic chamber

3.3. TEST METHOD

The product has been tested according to ANSI C63.10, FCC Part 15 Subpart C.

Pre-characterisation measurement: (9kHz – 1GHz)
A pre-scan of all the setup has been performed in a 3 meters semi-anechoic chamber for frequency from 30MHz to 1GHz. Test is performed in horizontal (H) and vertical (V) polarization, the loop antenna was rotated during the test for maximized the emission measurement. Continuous linear turntable azimuth search was performed with 360 degrees range. Measurement performed on all axis of EUT used in normal configuration.

Characterization on 10 meters open site from 9kHz to 1GHz:
Radiated Emissions were measured on an open area test site. A description of the facility is on file with the FCC. The product has been tested at a distance of **10 meters** from the antenna and compared to the FCC Part 15 Subpart C limits. Measurement bandwidth was 9kHz below 30MHz and 120kHz from 30 MHz to 1GHz. Test is performed in horizontal (H) and vertical (V) polarization, the loop antenna was rotated during the test for maximized 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.

3.4. TEST EQUIPMENT LIST

DESCRIPTION	MANUFACTURER	MODEL	N° LCIE	Cal_Date	Cal_Due
Antenna Loop	ELECTRO-METRICS	EM-6879	C2040052	11/15	11/17
Cable	SUCOFLEX	106G	A5329061	03/15	03/16
Cable (OATS)	-	-	A5329623	10/15	10/16
OATS	-	-	F2000409	06/15	06/16
Receiver 20Hz – 8GHz	ROHDE & SCHWARZ	ESU8	A2642019	04/15	04/16
Thermo-hygrometer (PM2)	OREGON	BAR916HG-G	B4206011	09/15	09/16
Antenna mast (OATS)	LCIE	-	F2000288	-	-
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	-	-

3.5. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

☑ None ☐ Divergence:

3.6. TEST RESULTS

3.6.1. Pre-characterization at 3 meters [9kHz-30MHz]

See graph for 9kHz-30MHz band:

Graph identifier		Polarization	EUT position	Mode	Comments
Emr#	1	0°	Axis XY	TX	See annex 1
Emr#	2	90°	Axis Z	TX	See annex 1
Emr#	5	0°	Axis XY	RX	See annex 1
Emr#	6	90°	Axis Z	RX	See annex 1

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

See graphs for 30MHz-1GHz:

Graph identifier		Polarization	EUT position	Mode	Comments
Emr#	3	H & V	Axis XY	TX	See annex 1
Emr#	4	H & V	Axis Z	TX	See annex 1
Emr#	7	H & V	Axis XY	RX	See annex 1
Emr#	8	H & V	Axis Z	RX	See annex 1

3.6.3. Characterization on 10 meters open site below 30 MHz

Worst case final data result:
Frequency list has been created with semi-anechoic chamber pre-scan results.
Measurements are performed using a QUASI-PEAK detection.

No	Frequency (MHz)	QPeak Limit (dBµV/m) @ 10m	Qpeak (dBµV/m)	Margin (Mes-Lim) (dB)	Angle Table (deg)	Pol Ant.	Ht Ant. (cm)	Correc. Factor (dB)	Comments
1	0.457	73.5	50.6	**-22.9**	285	90°	100	45.0	/

*: Measure have been done at 10m distance and corrected according to requirements of 15.209.e)
(M@300m = M@10m-59.1dB)

3.6.4. 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.

Test Frequency (MHz)	Meter Reading dB(µV)	Detector (Pk/QP/Av)	Polarity (V/H)	Azimuth (Degrees)	Antenna Height (cm)	Transducer Factor (dB)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)
No frequency observed, margin >20dB in pre-characterization									

3.7. CONCLUSION

The sample of the equipment AXIO, Sn: XO00061-0121, tested in the configuration presented in this test report satisfies to requirements of class B limits of the standard FCC Part 15 Subpart C, for radiated emissions.

4. FUNDAMENTAL FREQUENCY TOLERANCE (RSS)

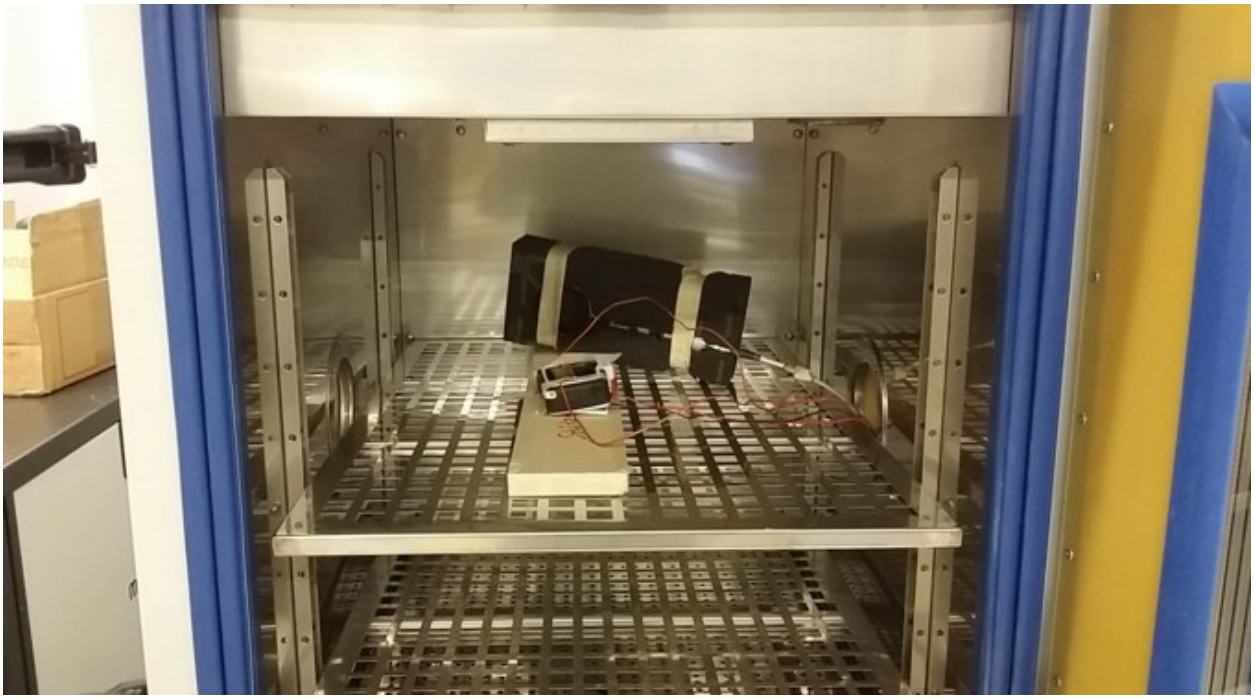
4.1. ENVIRONMENTAL CONDITIONS

Date of test	:	April 28, 2016
Test performed by	:	Jonathan PAUC
Atmospheric pressure (hPa)	:	1001
Relative humidity (%)	:	41
Ambient temperature (°C)	:	21

4.2. TEST SETUP

Frequency of carrier: 457kHz

The equipment (RF box) is set in a climatic chamber. Measure is performed on one channel of RF module.



Test setup

4.3. TEST METHOD

The frequency tolerance of the carrier signal shall be maintained within ±0.01% of the operating frequency when the temperature is varied from -30°C to +50°C at the nominal power voltage and the primary power voltage is varied from battery's operating end-point voltage (3.3Vdc) to nominal voltage (4.5Vdc) at 20°C.

4.4. TEST EQUIPMENT LIST

DESCRIPTION	MANUFACTURER	MODEL	N° LCIE	Cal date	Ca due
Climatic chamber	BIA CLIMATIC	CL 6-25	D1022117	08/15	08/16
Cable SMA	-	-	A5329373	10/15	10/16
Loop					
Spectrum analyzer	ROHDE & SCHWARZ	FSV 30	A4060051	11/15	11/16
Thermometer	FLUKE	52 II	B4043150		

4.5. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

☑ None ☐ Divergence:

4.6. TEST RESULTS

Temperature Voltage	-30°C	20°C	+50°C
4.5Vdc	0.9 Hz -0,7 dB	**REF** REF	4.4 Hz -0,9 dB
3.3Vdc	0.9 Hz -0,7 dB	0 -0,2	4.4 Hz +0,4 dB

Frequency drift measured is **4.4Hz** when the temperature is varied from -30°C to +50°C and voltage is varied.

4.1. CONCLUSION

The sample of the equipment AXIO, Sn: XO00061-0121, tested in the configuration presented in this test report satisfies to requirements of the standard FCC Part 15 Subpart C, for fundamental frequency tolerance.

5. OCCUPIED BANDWIDTH

5.1. ENVIRONMENTAL CONDITIONS

Date of test	:	May 17, 2016
Test performed by	:	Jonathan PAUC
Atmospheric pressure (hPa)	:	990
Relative humidity (%)	:	45
Ambient temperature (°C)	:	21

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.

☑ ***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 in the range of 1% to 5% of the anticipated emission bandwidth
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. OBW 99% function of spectrum analyzer used

5.3. TEST EQUIPMENT LIST

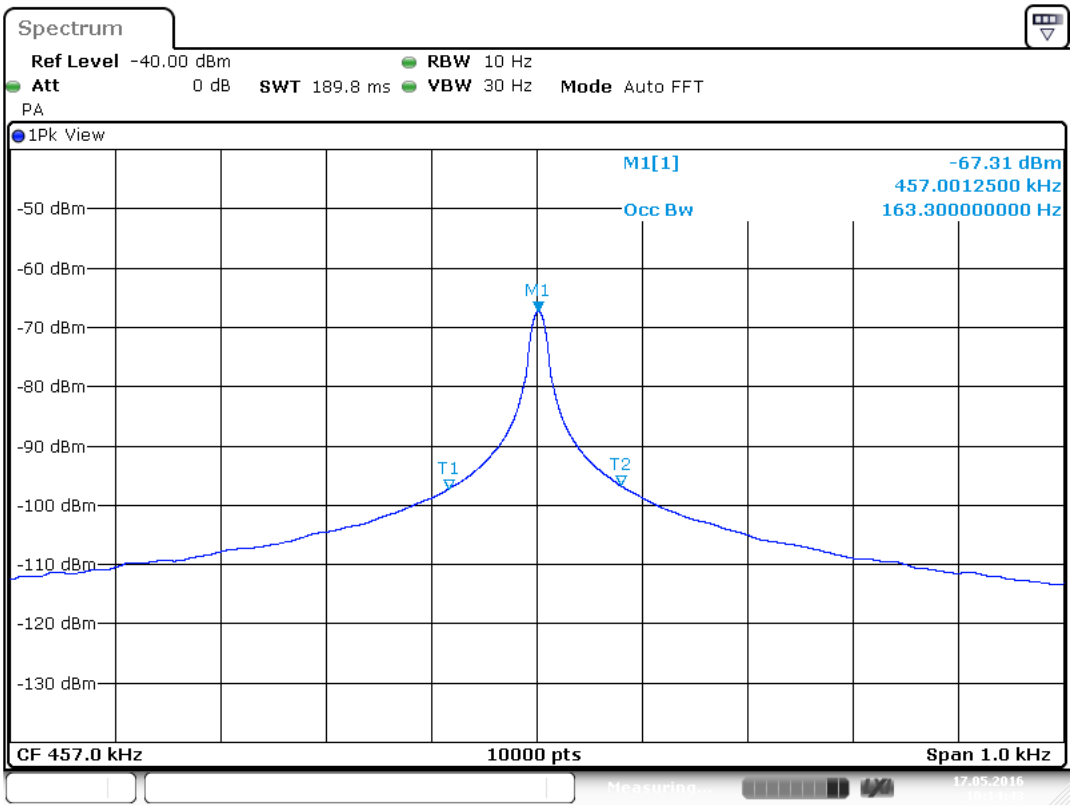
DESCRIPTION	MANUFACTURER	MODEL	N° LCIE	Cal Date	Due Date
Spectrum analyzer	ROHDE & SCHWARZ	FSV 30	A4060051	11/15	11/16
Power supply	TTi	PL320	A7040059	-	-
Cable Measure	-	-	A5329373	10/15	10/16
Thermo-hygrometer (PM2)	OREGON	BAR916HG-G	B4206011	08/15	08/16
Loop antenna	LCIE	-	-	-	-

5.4. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

☑ None ☐ Divergence:

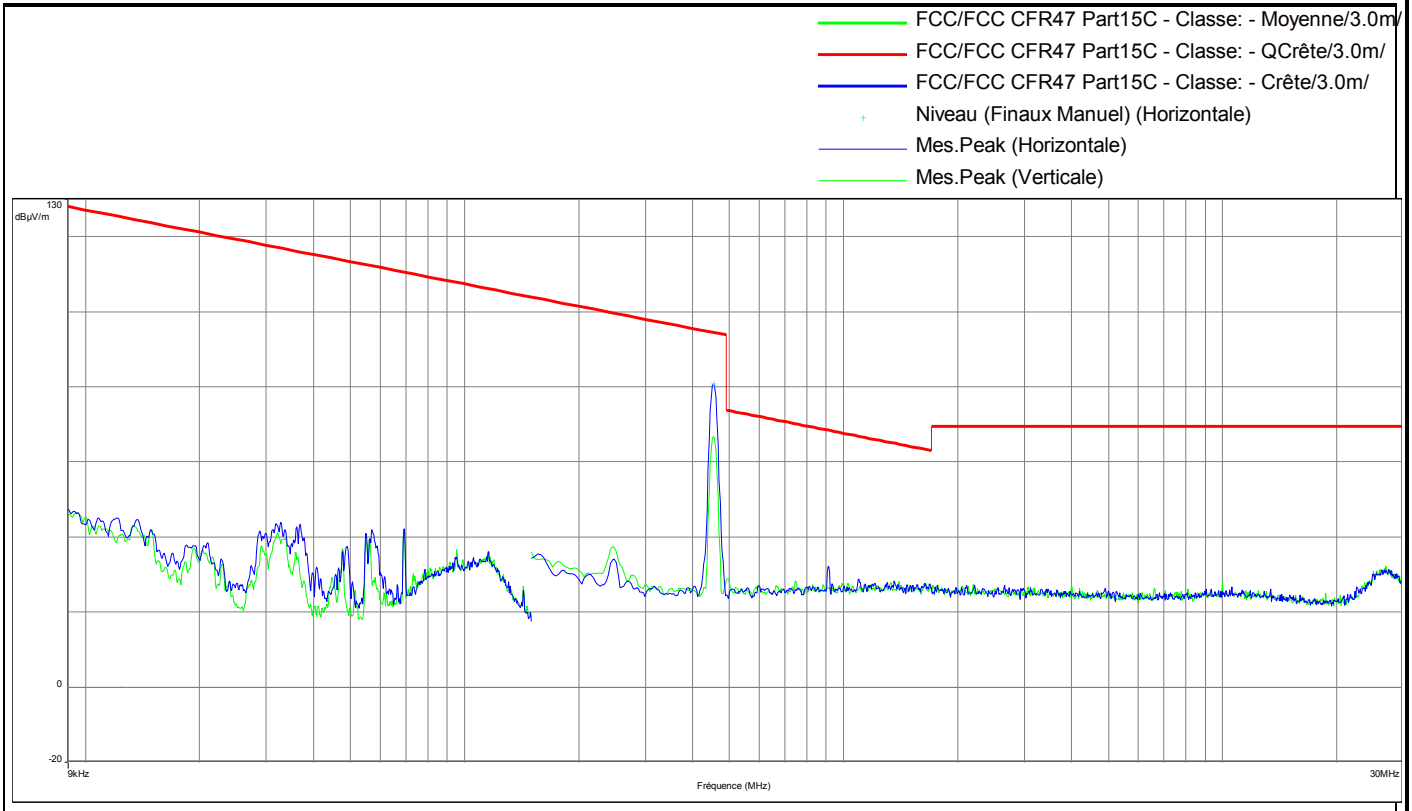
5.5. TEST SEQUENCE AND RESULTS

Channel	Channel Frequency (kHz)	99% Occupied Bandwidth (Hz)
Nom	457	163.3



6. ANNEX 1 (GRAPHS)

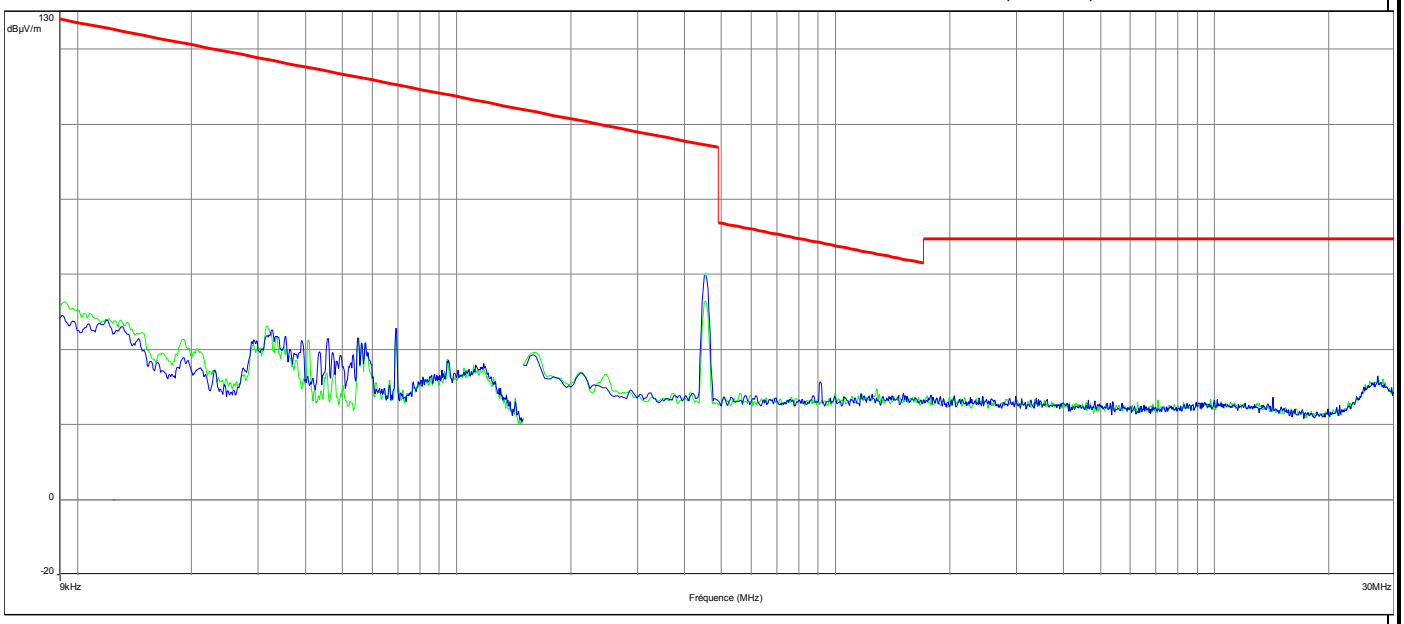
RADIATED EMISSIONS			
Graph name:	Emr#1	**Test configuration:**	
Limit:	FCC CFR47 Part15C	(H+V) - TX mode - Axis XY	
Class:			
Frequency range: [9kHz - 30MHz]			
Antenna polarization:	Horizontal	**RBW :**	100kHz
Azimuth:	0° - 360°	**VBW :**	300kHz



Spurious emissions

Frequency (MHz)	Peak Level (dBµV/m)	Polarisation
0.454	80.8	Horizontale

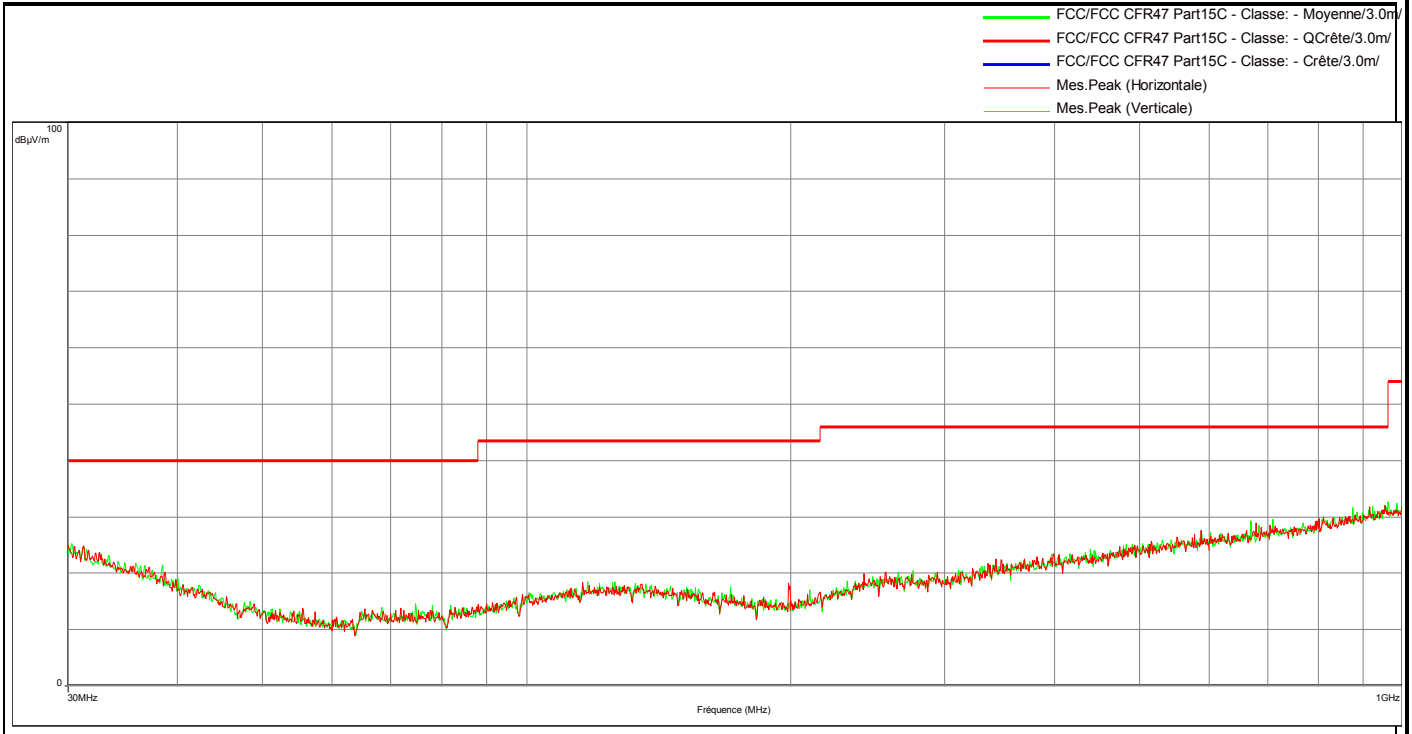
RADIATED EMISSIONS			
Graph name:	Emr#2	**Test configuration:**	
Limit:	FCC CFR47 Part15C	(H+V) - TX mode - Axis Z	
Class:			
Frequency range: [9kHz - 30MHz]			
Antenna polarization:	Horizontal	**RBW :**	100kHz
Azimuth:	0° - 360°	**VBW :**	300kHz



Spurious emissions

Frequency (MHz)	Peak Level (dBµV/m)	Polarisation
0.454	59.9	Horizontale

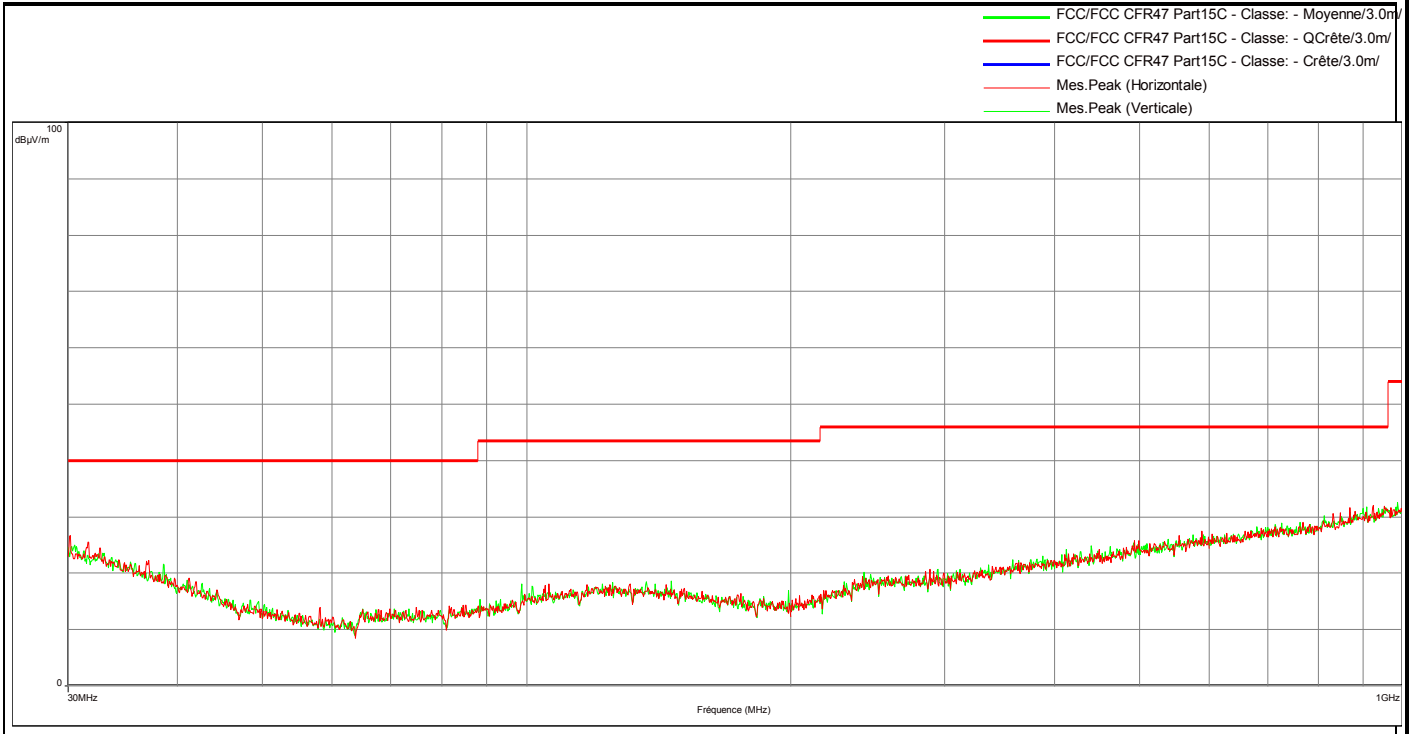
RADIATED EMISSIONS			
Graph name:	Emr#3	**Test configuration:**	
Limit:	FCC CFR47 Part15C	(H+V) - TX mode - Axis XY	
Class:			
Frequency range: [30MHz - 1GHz]			
Antenna polarization:	Horizontal & Vertical	**RBW :**	100kHz
Azimuth:	0° - 360°	**VBW :**	300kHz



Spurious emissions

No significative frequency observed

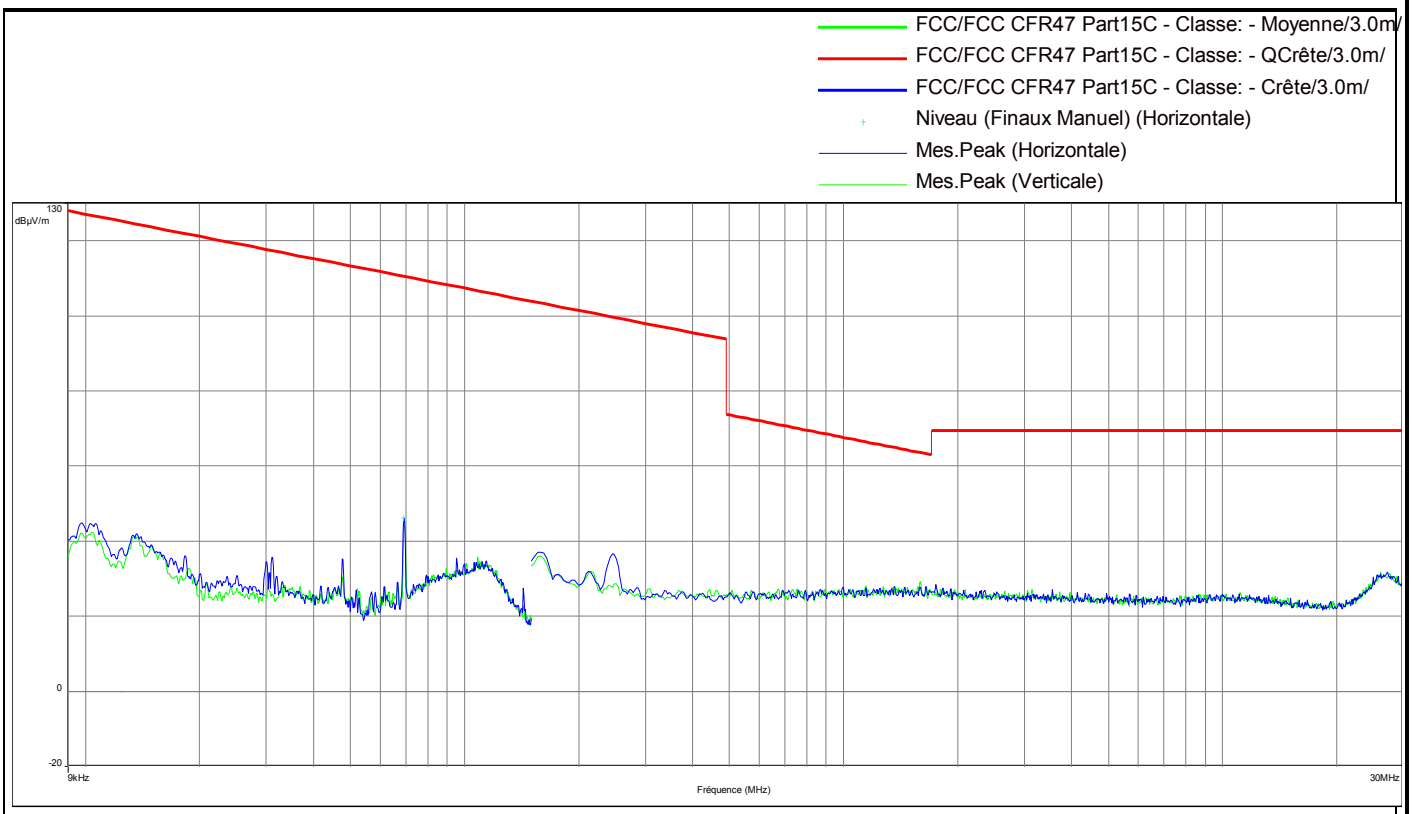
RADIATED EMISSIONS			
Graph name:	Emr#4	**Test configuration:**	
Limit:	FCC CFR47 Part15C	(H+V) - TX mode - Axis Z	
Class:			
Frequency range: [30MHz - 1GHz]			
Antenna polarization:	Horizontal & Vertical	**RBW :**	100kHz
Azimuth:	0° - 360°	**VBW :**	300kHz



Spurious emissions

No significative frequency observed

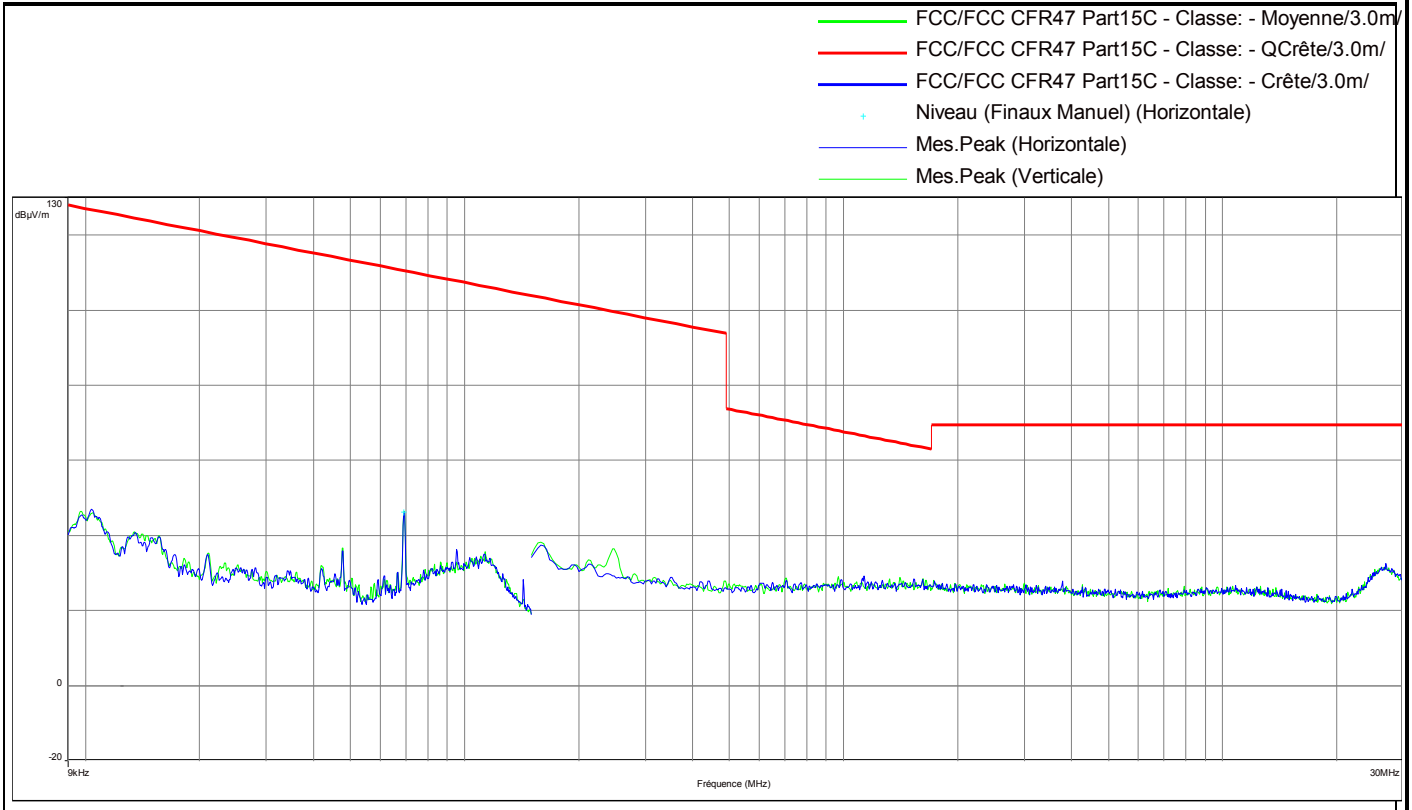
RADIATED EMISSIONS			
Graph name:	Emr#5	**Test configuration:**	
Limit:	FCC CFR47 Part15C	(H+V) - RX mode - Axis XY	
Class:			
Frequency range: [9kHz - 30MHz]			
Antenna polarization:	Horizontal	**RBW :**	100kHz
Azimuth:	0° - 360°	**VBW :**	300kHz



Spurious emissions

Frequency (MHz)	Peak Level (dBµV/m)	Polarisation
0.069	46.2	Horizontale

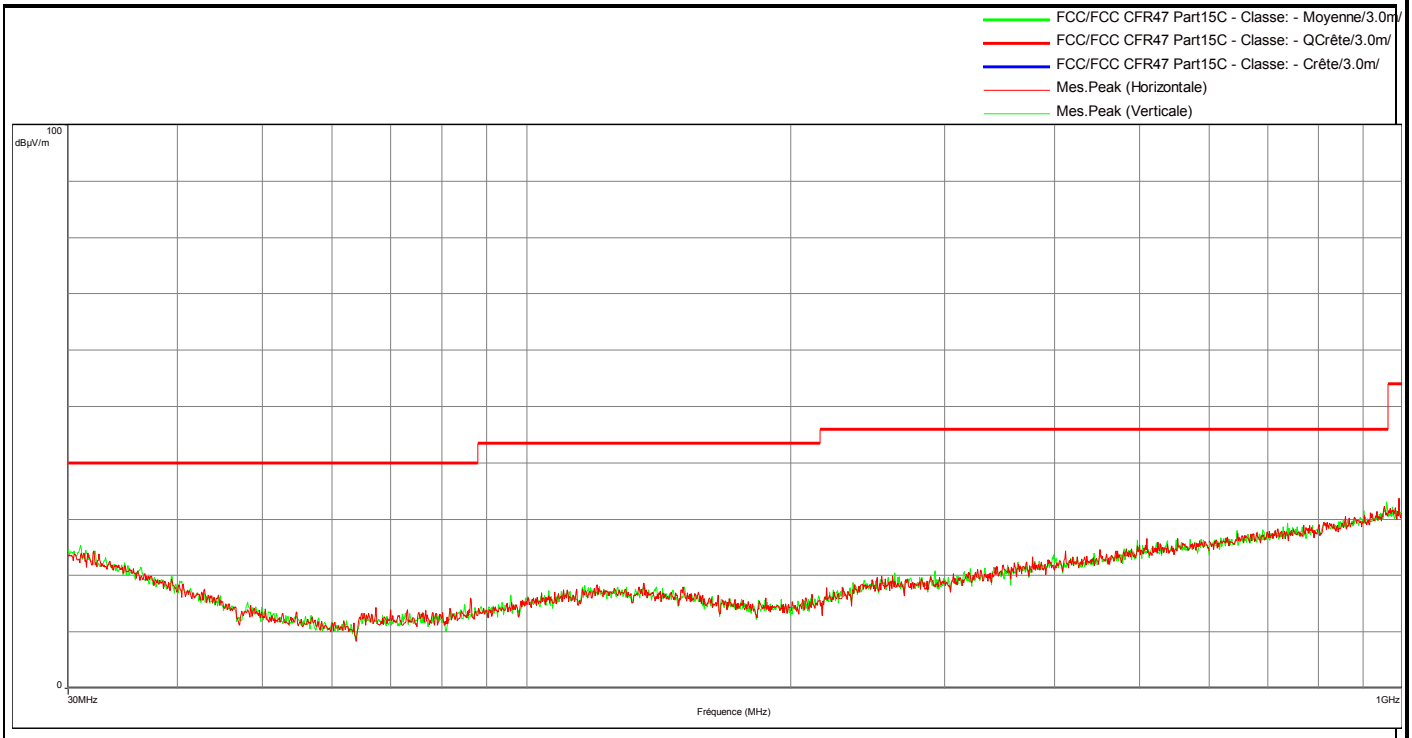
RADIATED EMISSIONS			
Graph name:	Emr#6	**Test configuration:**	
Limit:	FCC CFR47 Part15C	(H+V) - RX mode - Axis Z	
Class:			
Frequency range: [9kHz - 30MHz]			
Antenna polarization:	Horizontal	**RBW :**	100kHz
Azimuth:	0° - 360°	**VBW :**	300kHz



Spurious emissions

Frequency (MHz)	Peak Level (dBµV/m)	Polarisation
0.069	46.2	Horizontale

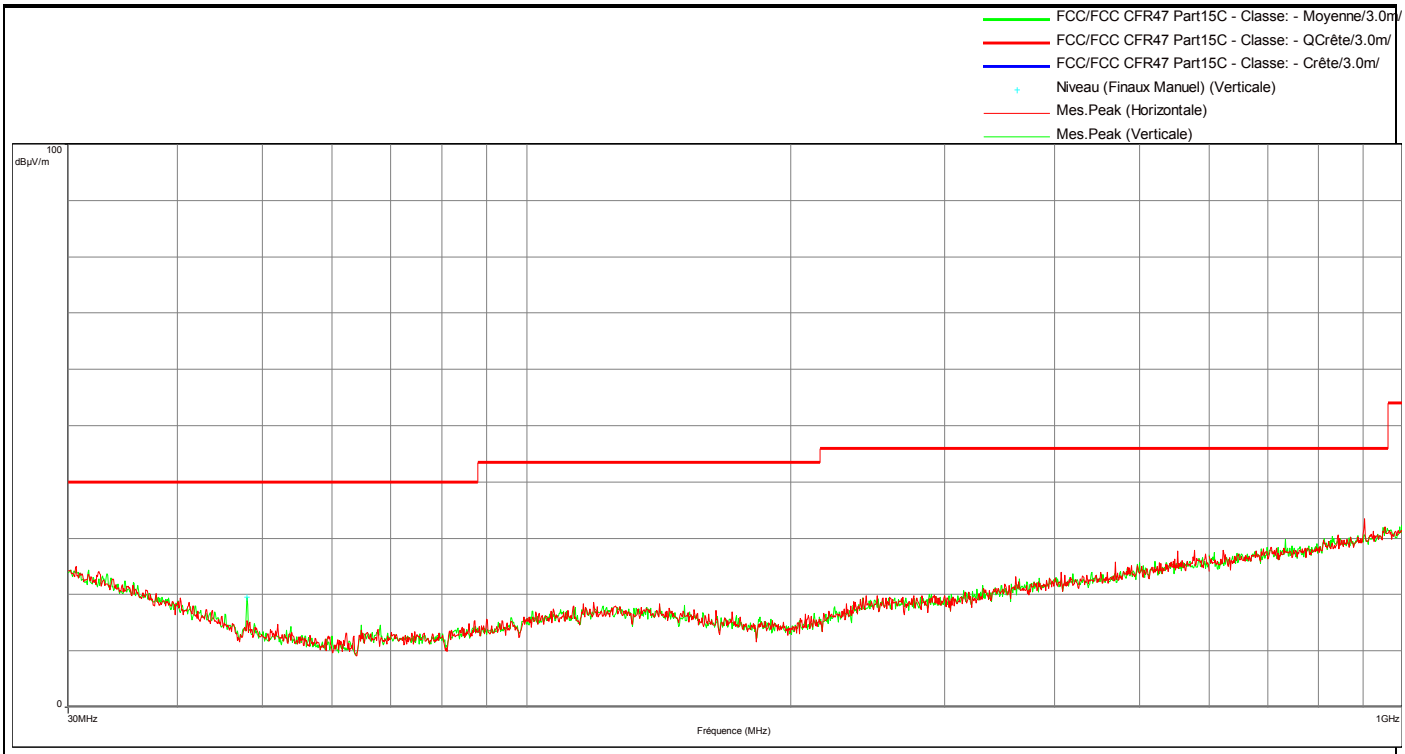
RADIATED EMISSIONS			
Graph name:	Emr#7	**Test configuration:**	
Limit:	FCC CFR47 Part15C	(H+V) - RX mode - Axis XY	
Class:			
Frequency range: [30MHz - 1GHz]			
Antenna polarization:	Horizontal & Vertical	**RBW :**	100kHz
Azimuth:	0° - 360°	**VBW :**	300kHz



Spurious emissions

No significative frequency observed

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



Spurious emissions

Frequency (MHz)	Peak Level (dBµV/m)	Polarisation
48.003	19.5	Verticale

7. 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.*