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Rapport d'essai / Test report

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Objet / Subject

: Essais de compatibilité électromagnétique conformément aux normes
FCC CFR 47 Part 15, Subpart B et C.
*Electromagnetic compatibility tests according to the standards
FCC CFR 47 Part 15, Subpart B and C*

Matériel testé / Apparatus under test

- . Produit / Product : **Lecteur sans contact / Contactless reader**
- . Marque / Trade mark : **INGENICO**
- . Constructeur / Manufacturer : **INGENICO**
- . Type / Model : **IUC150-XXTXXXXX**
- . Type sous test / Model under test : **IUC150-00T1653A**
- . N° de série / serial number : **11257IU00000107**
- . FCC ID : **XKB-IUC15XCL**

Date des essais / Test date

: Du 3 au 4 Octobre 2011 / *From October 3rd to 4th, 2011*

Lieu d'essai / Test location

: **LCIE SUD-EST**
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Test réalisé par / Test performed by

: Anthony MERLIN

Ce document comporte / Composition of document : 23 pages.

MOIRANS, LE 6 DECEMBRE 2011 / *DECEMBER 6TH, 2011*

Ecrit par / *Written by*,
Anthony MERLIN

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1. TEST PROGRAM

Standard: - FCC Part 15, Subpart B (Digital Devices)
 - ANSI C63.4 (2003)

EMISSION TEST	LIMITS			RESULTS (Comments)
Limits for conducted disturbance at mains ports 150kHz-30MHz	Frequency	Quasi-peak value (dBµV)	Average value (dBµV)	PASS
	150-500kHz	66 to 56	56 to 46	
	0.5-5MHz	56	46	
	5-30MHz	60	50	
Radiated emissions 30MHz-2GHz*	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

Standard: - FCC Part 15, Subpart C
 - ANSI C63.4 (2003)

EMISSION TEST	LIMITS			RESULTS (Comments)
Limits for conducted disturbance at mains ports 150kHz-30MHz	Frequency	Quasi-peak value (dBµV)	Average value (dBµV)	PASS
	150-500kHz	66 to 56	56 to 46	
	0.5-5MHz	56	46	
	5-30MHz	60	50	
Radiated emissions 9kHz-30MHz	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
Radiated emissions 30MHz-2GHz*	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
Fundamental frequency tolerance	Operation within the band 13.110-14.010 MHz §15.225			PASS
Bandedge compliance	Operation within the band 13.110-14.010 MHz §15.225			PASS

*§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. JUSTIFICATION

The system was configured for testing in a typical fashion (as a customer would normally use it).

2.2. HARDWARE IDENTIFICATION

- **Equipment under test (EUT): (Worst case model)**

IUC150-00T1653A

Serial number: 11257IU00000107
FCC ID: **XKB-IUC15XCL**

- Internal max frequencies: 387MHz

- **Power supply:**

- USB (Laptop power supply)
- Rating: 5VDC
- Frequency: DC

- **Input/output:**

- 1 x USB port
- 2 x SAM
- 1 x Serial port RJ11
- 1 x Earth connection

- **Auxiliaries used for testing:**

- 1 x Laptop TOSHIBA SATELITE S1410-704 (PS141E-04YCM-3V), sn: 13594938G

- **I/O cables used for testing:**

- 1 x USB cable, shielded, length: 1.5m
- 1 x COM cable, unshielded, length: 1.5m



2.3. EUT CONFIGURATION

The EUT exercise program used during radiated and conducted testing was exercised the EUT in a manner similar to a typical use.

IUC supplied by USB, followings parameters are tested in loop:

- 2 x SAM
- COM
- Cless

2.4. EQUIPMENT MODIFICATIONS

None

2.5. SPECIAL ACCESSORIES

None

3. RADIATED EMISSION DATA

3.1. CLIMATIC CONDITIONS

Date of test : October 3rd, 2011
Test performed by : A.MERLIN
Atmospheric pressure : 1003hPa
Relative humidity : 44%
Ambient temperature : 21°C

3.2. TEST SETUP

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



3.3. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

None



3.4. TEST SEQUENCE AND RESULTS

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

A pre-scan of all the setup has been performed in a 3 meters semi anechoic chamber. The distance between EUT and antenna is 3 meters. For Pre-characterization, the loop antenna was rotated during the test for maximized the emission measurement. Measurement performed on 3 axis of EUT. Frequency band investigated is 9kHz to 30MHz.

The pre-characterization graphs are obtained in PEAK detection.

**See graph for 9kHz-30MHz band:
Polarization 90° (Worst case)**

Emr#1 (See annex 1)

3.4.2. Pre-characterization [30MHz-2GHz]

For frequency band 30MHz to 1GHz, a pre-scan of all the setup has been performed in a 3 meters semi anechoic chamber.

The distance between EUT and antenna is 3 meters. Test is performed in horizontal (H) and vertical (V) polarization with a log-periodic antenna. The EUT is being rotated on 360° and on 3 axis during the measurement. The pre-characterization graphs are obtained in PEAK detection.

For frequency band 1GHz to 2GHz, a search is performed in the semi-anechoic chamber in order to determine frequencies radiated by the EUT (Measuring distance reduced to 1m).

See graphs for 30MHz-1GHz:

H polarization
V polarization

Emr#2 (See annex 1)
Emr#3 (See annex 1)



3.4.3. Characterization on 10 meters open site below 30 MHz

The product has been tested according to ANSI C63.4 (2003), FCC part 15 subpart C. Radiated Emissions were measured on an open area test site. A description of the facility is on file with the FCC.

The product has been tested at a distance of **10 meters** from the antenna and compared to the FCC part 15 subpart C §15.225 limits in the frequency range 13.553MHz 13.567MHz. Measurement bandwidth was 9kHz.

Antenna height was 1m for both horizontal and vertical polarization.

Antenna was rotated around its vertical axis.

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 clauses 3.2.

Frequency (MHz)	QPeak Limit (dBµV/m) @ 30m	Qpeak (dBµV/m)	Qpeak-Limit (Margin dB)	Turntable Angle (deg)	Ant. Pol./ Angle (deg)	Tot Corr (dB)
13.56* ¹	84	60.2	-23.8	90	0	35.3

*¹: Measure have been done at 10m distance and corrected according to requirements of 15.209.e) (M@30m = M@10m-19.1dB)

Limits Sub clause §15.225

Frequency (MHz)	Field strength (µV/m)	Measurement distance (m)
13.553-13.567	15 848 84 dBµV/m	30
13.410-13.553 13.567-13.710	334 50.5 dBµV/m	30
13.110-13.410 13.710-14.010	106 40.5 dBµV/m	30

See chapter 5 of this test report for band edge measurements.



3.4.4. Characterization on 10 meters open site from 30MHz to 2GHz

The product has been tested at a distance of **10 meters** from the antenna and compared to the FCC part 15 subpart B §15.109 limits and C §15.209 limits. Measurement bandwidth was 120kHz from 30 MHz to 1GHz and 1MHz from 1GHz to 2GHz.

Antenna height search was performed from 1m to 4m for both horizontal and vertical polarization. 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 clause 3.2

Worst case final data result:

No	Frequency (MHz)	QPeak Limit (dBµV/m)	Qpeak * (dBµV/m)	Qpeak-Limit (Margin, dB)	Angle (deg)	Pol	Hgt (cm)	Tot Corr (dB)	Comments
1	33.078	40.0	32.6	-7.4	190	V	100	16.3	
2	47.678	40.0	37.6	-2.4	0	V	100	13.3	
3	62.271	40.0	33.1	-6.9	355	V	100	6.7	
4	193.526	43.5	36.1	-7.4	30	V	100	12.1	
5	290.289	46.0	43.6	-2.4	60	V	100	16.1	
6	299.729	46.0	33.6	-12.4	0	V	100	16.2	
7	677.235	46.0	40.6	-5.4	65	H	250	24.3	
8	723.198	46.0	41.2	-4.8	25	V	200	24.9	
9	774.363	46.0	43.7	-2.3	190	V	150	25.8	
10	796.174	46.0	44.1	-1.9	135	V	300	26.1	
11	870.867	46.0	45.2	-0.8	325	V	200	26.9	
12	997.731	54.0	45.6	-8.4	95	V	200	28.5	

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

Frequency band 1GHz to 2GHz

Measurements are performed using a PEAK and Average detection. (RBW = 1MHz)

No	Frequency (GHz)	Limit Average (dBµV/m)	Measure Average (dBµV/m)	Margin (Mes-Lim) (dB)	Angle Table (deg)	Pol Ant.	Ht Ant. (cm)	Correc. factor (dB)	Comments
No Significant Frequency observed									

Note: Measures have been done at 3m distance.

RESULTS: PASS



3.5. FIELD STRENGTH CALCULATION

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

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

Where

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

Assume a receiver reading of 52.5dB 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.

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



4. FUNDAMENTAL FREQUENCY TOLERANCE (15.225E)

4.1. TEST CONDITIONS

Test performed by : A.MERLIN
 Date of test : October 3rd, 2011

The frequency tolerance of the carrier signal shall be maintained within $\pm 0.01\%$ of the operating frequency when the temperature is varied from -20°C to $+50^{\circ}\text{C}$ at the no minal power voltage and the primary power voltage is varied from 85% to 115% of the rated supply voltage at 20°C .

4.2. Temperature and voltage fluctuation

Temperature has been set at $+20^{\circ}\text{C}$, -20°C and $+50^{\circ}\text{C}$.
 The voltage is varied from 4.25VDC to 5.75VDC. (Secondary power / worst case)
 Frequency of carrier: 13.56 MHz
 Upper limit: 13.561356 MHz
 Lower limit: 13.558644 MHz
 The equipment (RF box) is set in a climatic chamber.

Temperature	-20°C	20°C	+50°C
Voltage			
Mains voltage: 5VDC			
Frequency Drift (MHz)	- 0.000016	REF	+ 0.000004
Carrier level (dBc)	+ 0.0	REF	+ 0.0
Mains voltage: 5.75VDC			
Frequency Drift (MHz)	- 0.000016	+ 0.000000	+ 0.000004
Carrier level (dBc)	+ 0.0	+ 0.0	+ 0.0
Mains voltage: 4.25VDC			
Frequency Drift (MHz)	- 0.000016	+ 0.000000	+ 0.000004
Carrier level (dBc)	+ 0.0	+ 0.0	+ 0.0

Frequency drift measured is **16 Hz** when the temperature is varied from -20°C to $+50^{\circ}\text{C}$ and voltage is varied from 4.25VDC to 5.75VDC.

4.3. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

None



5. BAND-EDGE COMPLIANCE §15.209

5.1. CLIMATIC CONDITIONS

Date of test : October 4th, 2011
Test performed by : A.MERLIN
Atmospheric pressure : 1005hPa
Relative humidity : 48%
Ambient temperature : 20°C

5.2. EQUIPMENT CONFIGURATION

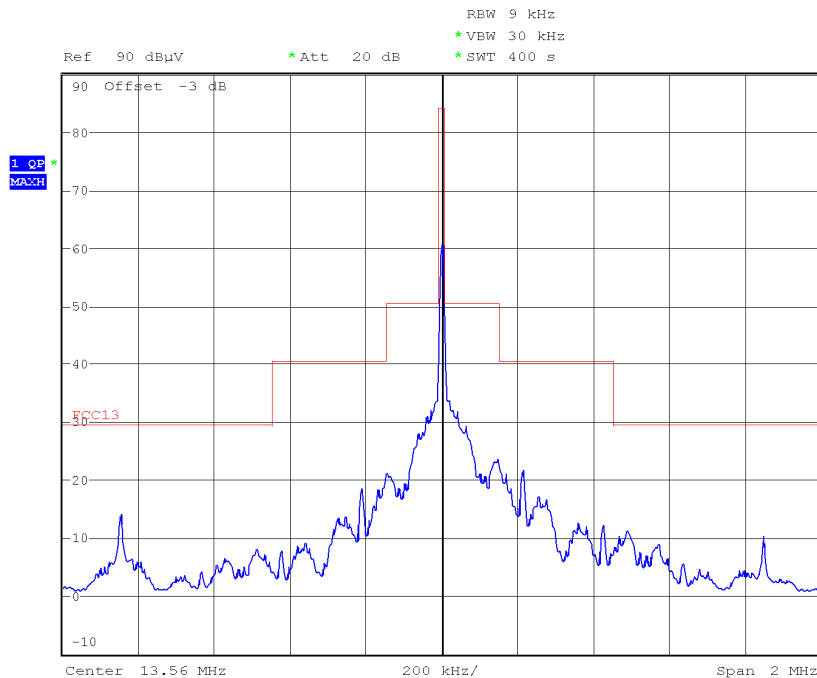
See § 2.3.

5.3. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

None

5.4. Frequency band 13.110-14.010MHz

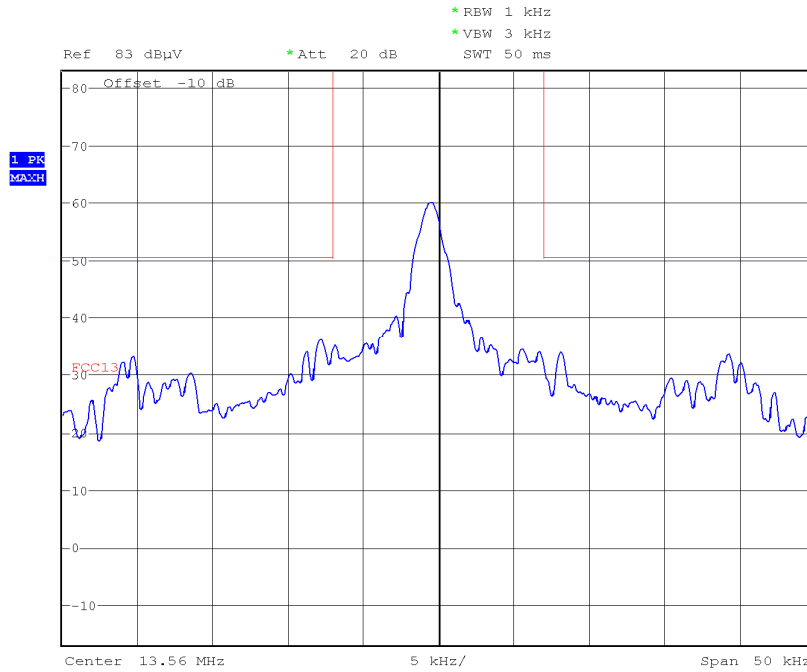
Following plots show radiated emission level in the frequency band 13.110-14.010MHz with a RBW of 9kHz and a quasi-peak detector. The graphs are obtained with a measuring receiver ESU8.





5.5. Frequency band 13.553-13.567MHz

Following plots show radiated emission level in the frequency band 13.55.-13.567MHz with a RBW of 1kHz. The graphs are obtained with a measuring receiver ESU8.



**6. CONDUCTED EMISSION DATA****6.1. CLIMATIC CONDITIONS**

Date of test : October 3rd, 2011
Test performed by : A.MERLIN
Atmospheric pressure : 1003hPa
Relative humidity : 44%
Ambient temperature : 21°C

6.2. SETUP FOR CONDUCTED EMISSIONS MEASUREMENT

The product has been tested according to ANSI C63.4-(2003) and FCC Part 15 subpart B and C.

The product has been tested with 120V/60Hz power line voltage and compared to the FCC Part 15 subpart B §15.107 and C §15.207 limits. Measurement bandwidth was 9kHz from 150 kHz to 30 MHz.

Measurement is made with a Rohde & Schwarz ESU8 receiver in peak mode. 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.

6.3. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

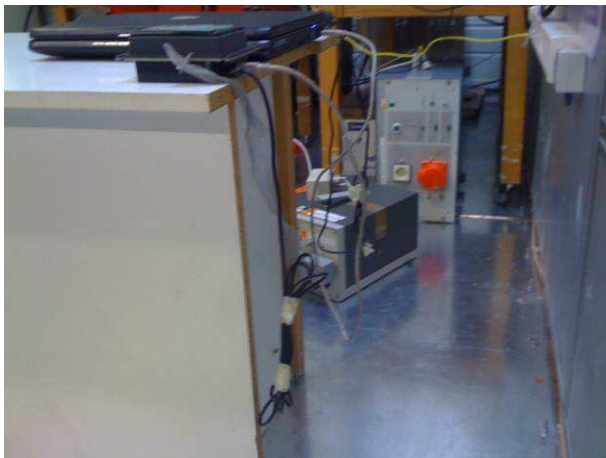
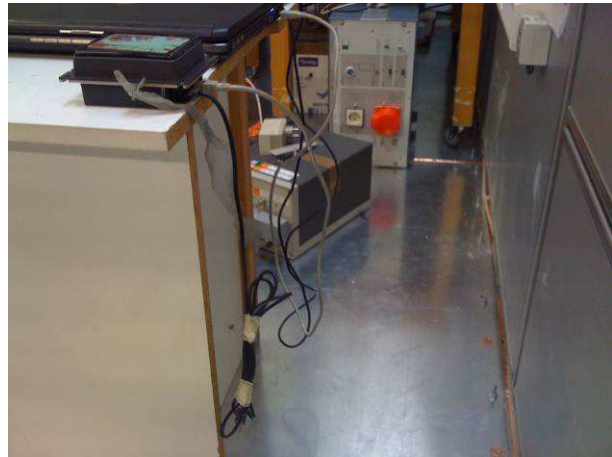
None

6.4. TEST SETUP

The EUT is placed on the ground reference plane, at 80cm from the LISN. The distance between the EUT and the vertical ground plane is 40cm.

Auxiliaries are powered by another LISN.

The cable has been shorted to 1meter length. The EUT is powered trough the LISN (measure).



6.5. TEST SEQUENCE AND RESULTS

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.

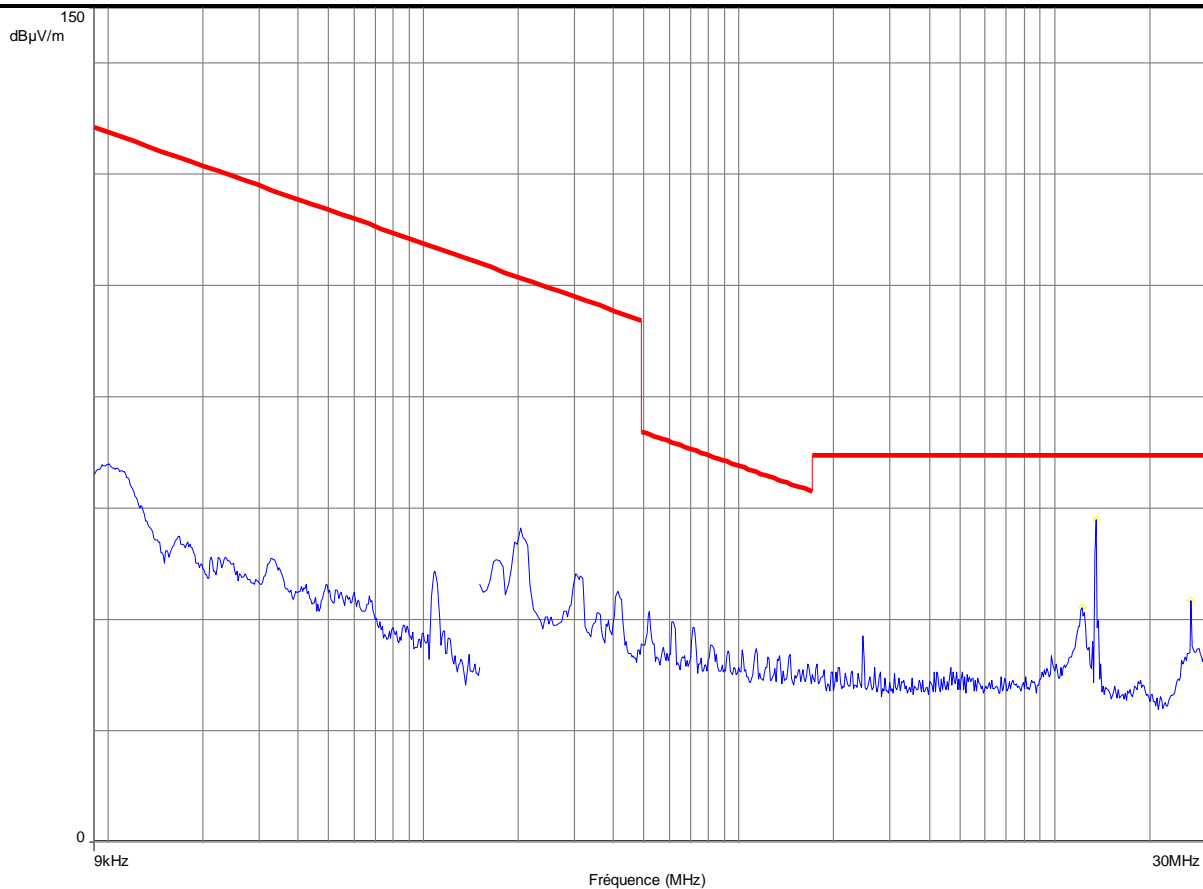
Measure on L1: graph Emc#1 (see annex 1)
Measure on N: graph Emc#2 (see annex 1)

RESULT: PASS



7. ANNEX 1 (GRAPHS)

RADIATED EMISSIONS		
Graph name :	Emr#1	Test configuration:
Limit :	FCC Part15C	
PARAMETERS		
Antenna polarization:	90° (Worst case)	Legend:
Azimuth :	0° - 360°	█ Peak Measure
RBW :	200Hz	█ QPeak Limit@3m
VBW :	1kHz	
Frequency :	9kHz- 150kHz	
PARAMETERS		
Antenna polarization:	90° (Worst case)	Legend:
Azimuth :	0° - 360°	█ Peak Measure
RBW :	10kHz	█ QPeak Limit@3m
VBW :	30kHz	
Frequency :	150kHz- 30MHz	

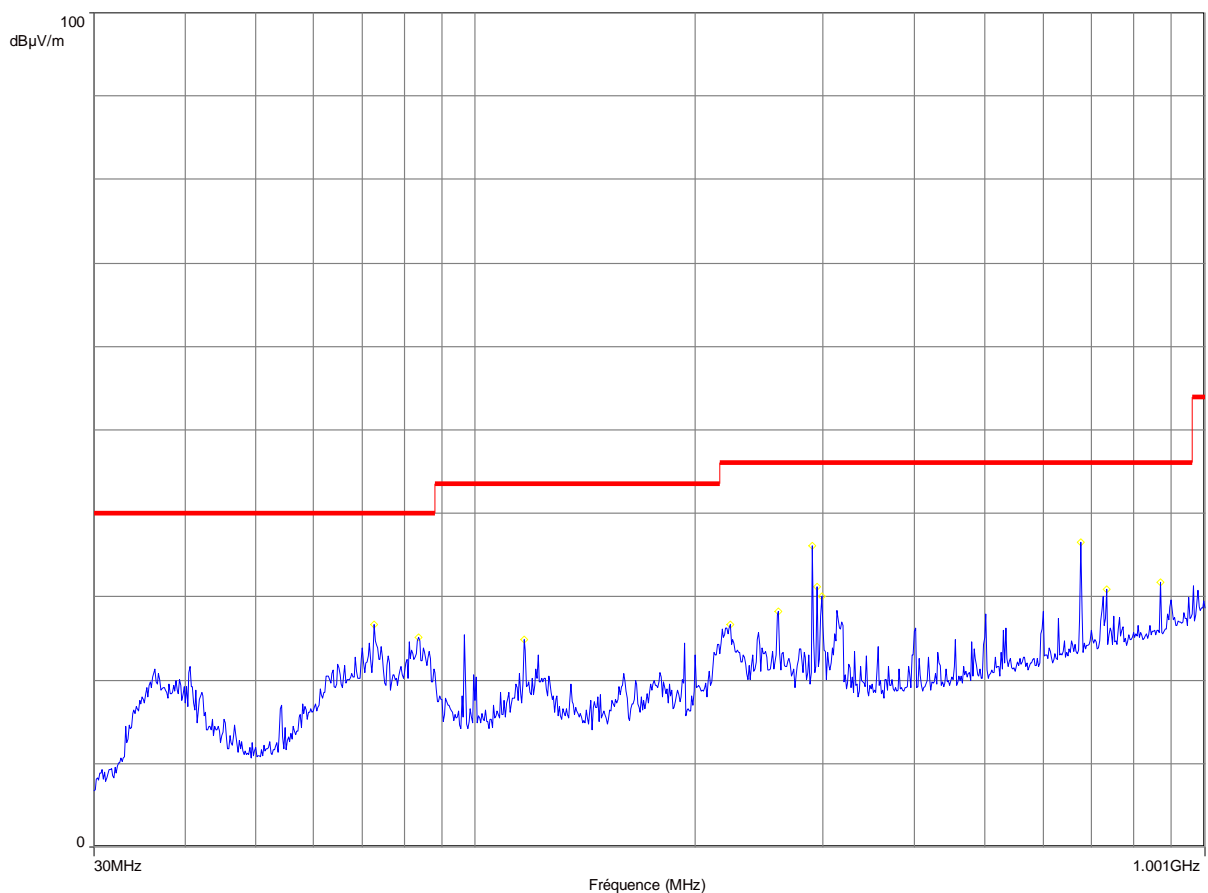


Frequency (MHz)	Peak (dBµV/m)
12.190	42.21
13.534*	58.03
27.110	43.41

*Carrier frequency



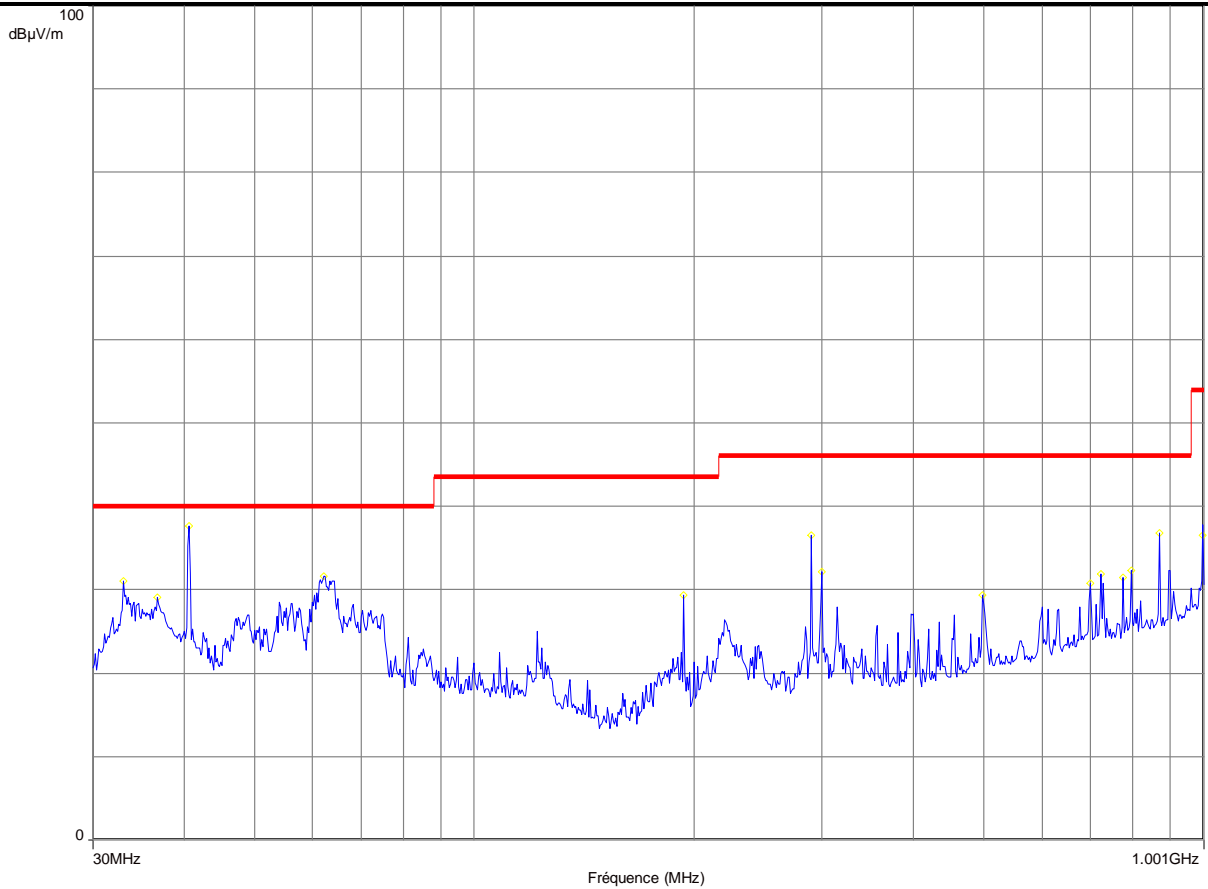
RADIATED EMISSIONS		
Graph name :	Emr#2	Test configuration:
Limit :	FCC Part15C	
PARAMETERS		
Antenna polarization:	Horizontale	Legend:
Azimuth :	0° - 360°	Peak Measure
RBW :	100kHz	
VBW :	300kHz	QPeak Limit@3m
Frequency :	30MHz- 1.001GHz	



Frequency (MHz)	Peak (dBµV/m)
72.680	26.72
83.760	25.14
116.840	24.86
223.920	26.70
259.880	28.19
290.200	36.07
293.760	31.25
298.560	30.01
677.320	36.46
732.480	30.96
871.080	31.75



RADIATED EMISSIONS		
Graph name :	Emr#3	Test configuration:
Limit :	FCC Part15C	
PARAMETERS		
Antenna polarization:	Verticale	Legend:
Azimuth :	0°- 360°	█ Peak Measure
RBW :	100kHz	█ QPeak Limit@3m
VBW :	300kHz	
Frequency :	30MHz- 1.001GHz	

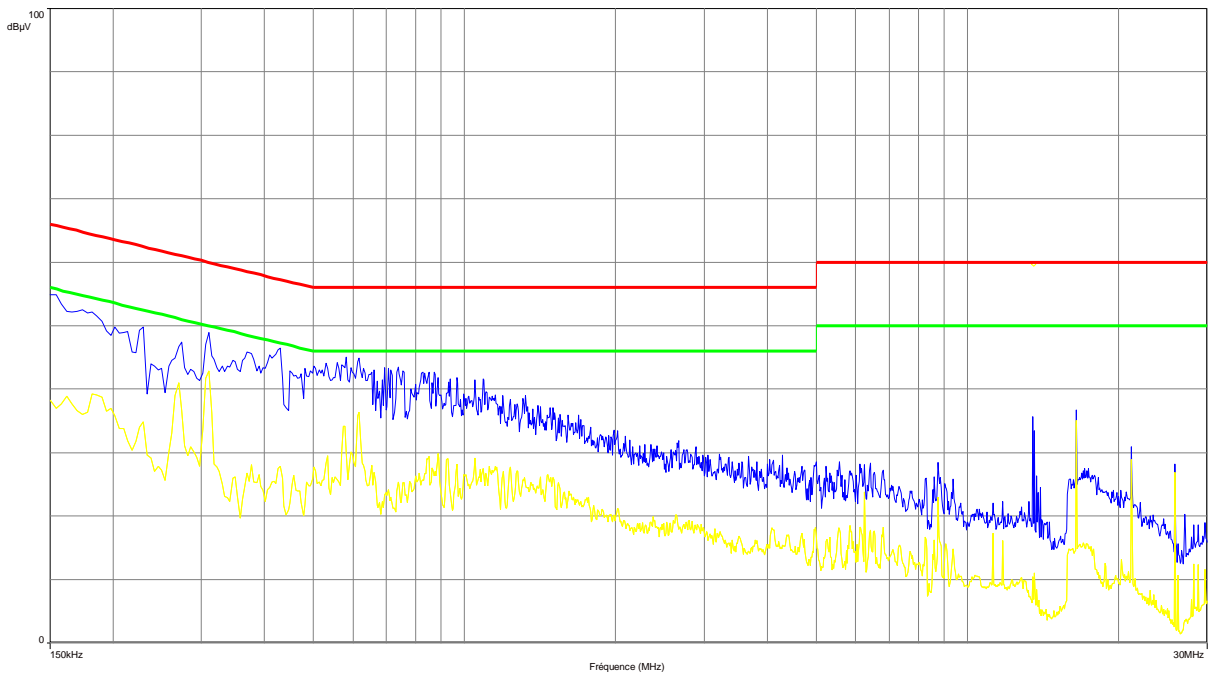


Frequency (MHz)	Peak (dBµV/m)
33.080	31.11
36.800	29.07
40.600	37.59
62.240	31.55
193.560	29.40
290.160	36.57
299.800	32.10
497.680	29.38
699.880	30.69
723.200	31.93
774.280	31.43
796.040	32.31
870.800	36.75
997.720	36.56



RADIATED EMISSIONS		
Graph name :	Emc#1	Test configuration:
Limit :	EN 55011 / EN55022	
Class :	B	

PARAMETERS			
Voltage / Frequency :	110VAC / 60Hz	Legend:	
Line :	Phase1	 Peak Measure	 Average Measure
RBW :	9kHz	 QPeak Limit	 Average Limit
VBW :	30kHz		
Frequency :	150kHz- 30MHz		



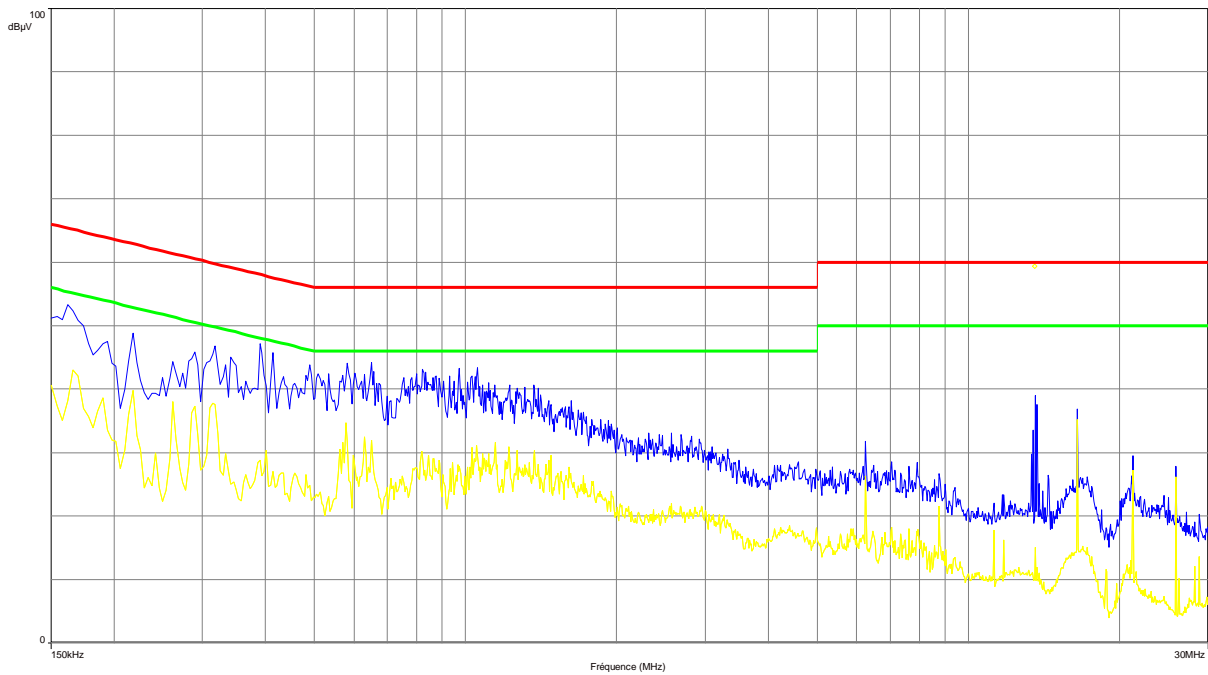
Frequency (MHz)	Avg (dBµV)	Lim Avg (dBµV)	Avg-LimAvg (dBµV)	QPeak (dBµV)	LimQPeak (dBµV)	QPeak-LimQPeak (dBµV)
13.562*	39.56	50.00	-10.44	53.42	60.00	-6.58

*Carrier frequency



CONDUCTED EMISSIONS		
Graph name :	Emc#2	Test configuration:
Limit :	EN 55011 / EN55022	
Class :	B	

PARAMETERS			
Voltage / Frequency :	110VAC / 60Hz	Legend:	
Line :	Neutral	Peak Measure	Average Measure
RBW :	9kHz	QPeak Limit	Average Limit
VBW :	30kHz		
Frequency :	150kHz- 30MHz		



Frequency (MHz)	Avg (dBµV)	Lim Avg (dBµV)	Avg-LimAvg (dBµV)	QPeak (dBµV)	LimQPeak (dBµV)	QPeak-LimQPeak (dBµV)
13.562*	38.49	50.00	-11.51	53.11	60.00	-6.89

*Carrier frequency



8. TEST EQUIPMENT LIST

USED	N° LCIE	TYPE	COMPANY	REF
RADIATED EMISSION DATA				
x	A7486006	Amplifier 0.1MHz – 1300 MHz	HEWLETT PACKARD	8447F
x	C2040052	Antenna Loop	ELECTRO-METRICS	EM-6879
x	C2040146	Antenna Bi-Log XWing	TESEQ	CBL6144
x	A5329045	Cable	-	-
x	A5329056	Cable	-	-
x	A5329057	Cable	-	-
x	D3044015	Semi-Anechoic chamber #2	SIEPEL	-
x	A3169050	Radiated emission comb generator	BARDET	-
x	A4060017	Spectrum analyzer	HEWLETT PACKARD	HP8568B
x	A4060019	Spectrum analyzer display	HEWLETT PACKARD	HP85662A
x	F2000393	Turntable controller (Cage#2-3)	ETS Lingren	Model 2066
x	F2000404	Turntable chamber (Cage#2)	ETS Lingren	Model 2165
x	F2000438	Table	LCIE	-
x	C2040051	Antenna Bi-log	CHASE	CBL6111A
x	A5329061	Cable	SUCOFLEX	106G
x	A5329188	Cable OATS (Mast at 10m)	UTIFLEX	-
x	A5329199	Cable OATS (Mast at 10m)	UTIFLEX	-
x	F2000409	OATS	-	-
x	A3169050	Radiated emission comb generator	BARDET	-
x	A2642019	Receiver 20Hz – 8GHz	ROHDE & SCHWARZ	ESU8
x	F2000372	Turntable / Mast controller (OATS)	ETS Lindgren	Model 2066
x	F2000392	Antenna mast (OATS)	ETS Lindgren	2071-2
x	F2000438	Table	LCIE	-
FUNDAMENTAL FREQUENCY TOLERANCE				
x	A2642019	Receiver 20Hz – 8GHz	ROHDE & SCHWARZ	ESU8
x	C2040052	Antenna Loop	ELECTRO-METRICS	EM-6879
x	A5329061	Cable	SUCOFLEX	106G
X	B2082009	Frequency Counter	HEWLETT PACKARD	HP 5350B
X	A7044055	Power supply DC	TDK	-
BANDEDGE COMPLIANCE				
x	A2642019	Receiver 20Hz – 8GHz	ROHDE & SCHWARZ	ESU8
x	C2040052	Antenna Loop	ELECTRO-METRICS	EM-6879
x	A5329038	Cable	/	/
CONDUCTED EMISSION DATA				
x	A5329560	Cable	-	-
x	A3169049	Conducted emission comb generator	BARDET	-
x	C2320068	LISN	EMCO	3825/2
x	A7152030	Load 50Ω	-	-
x	A2642019	Receiver 20Hz – 8GHz	ROHDE & SCHWARZ	ESU8
x	A4049061	Transient limiter	HEWLETT PACKARD	11947A
x	A5329560	Cable	-	-
x	A3169049	Conducted emission comb generator	BARDET	-



9. 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.