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TEST REPORT

N°118072-636270A

FCC REGISTRATION NUMBER: 166175
INDUSTRY CANADA NUMBER: 6230B

ISSUED TO : **INGENICO**
28-32 Boulevard de Grenelle
75015 PARIS - France

SUBJECT : **ELECTROMAGNETIC COMPATIBILITY TESTS ACCORDING TO THE
STANDARD 47 CFR PART 15, SUBPART C, 15.225 and RSS-GEN, RSS-102,
RSS-210**

Apparatus under test

Product : Payment terminal
Trade mark : Ingenico
Manufacturer : Ingenico
Model : ISC480
Reference : ISC480
Serial number : 12339SC00000030

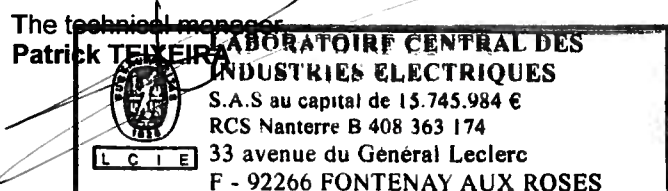
Applicant : **INGENICO**
FCC ID : **XKB-ISC480CL**
IC : **2586D-ISC480CL**

Test date : January 2013

Composition of document : 36 pages

Fontenay-Aux-Roses, March 12th, 2013

Written by
Julien BOUTAUD



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FCC ID: XKB-ISC480CL
IC: 2586D-ISC480CL**1 – GENERAL****1.1 – Summary of test results**

Radiated emissions are made in anechoic chamber, located at Fontenay-Aux-Roses (92260, FRANCE).
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A description of the test facility is on file with the FCC.

47 CFR Part 15 & RSS 210			
Paragraph No.	Name of test	Remarks	Result
§ 15.203	Antenna requirement	Internal antenna	Pass
§ 15.205	Restricted band operation		Pass
§ 15.207 (a) & RSS GEN §7.2.2	Power line conducted limits		Pass
§ 15.209 (a) (b) (c) (d) & table 3 RSS 210	Radiated measurement of spurious emissions		Pass
§15.225 (a) (b) (c) & RSS 210	Field strength within the band 13.110-14.010 MHz		Pass
§15.225 (d) & A2.6 of RSS 210	Field strength outside of the bands 13.110-14.010 MHz		Pass
§15.225 (e) & A.2 of RSS 210	Frequency stability over extreme temperature and voltage conditions		Pass

NA : Not Applicable

Remark:**1.2 – References**

Measurements were performed in accordance with the following standards:

47 CFR Part 15 of October, 2012: Code of federal regulations – Telecommunication –Radiofrequency devices

RSS-Gen of December 2010: General Requirements and Information for the Certification of Radiocommunication Equipment

RSS-102 of Mars 2010: Radio Frequency Exposure Compliance of Radiocommunication Apparatus

RSS-210 of December 2010: Low-power Licence-exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment

ANSI C63.4 of December 11, 2003: American national standard for methods of measurement of radio noise emissions from low-voltage electrical and electronic equipment in the range of 9 kHz to 40 GHz.

CISPR 16-4-2 of November, 2003: International electrotechnical commission - Specification for radio disturbance and immunity measuring apparatus and methods – Uncertainties, statistics and limit modelling – Uncertainty in EMC measurements.



1.3 – test methodology

Radio performance tests procedures given in part 15:

Paragraph 33: frequency range of radiated measurements

Paragraph 35: measurement detector functions and bandwidths

Paragraph 203: antenna requirement

Paragraph 205: restricted bands of operation

Paragraph 207: conducted limits

Paragraph 209: radiated emission limits; general requirements

Paragraph 225: radiated emission limits; general requirements



1.3 - Equipment under test specification

1.3.1 – General equipment information

Applicant	: INGENICO 9 Avenue de la Gare Rovaltain TGV BP 25156 26958 VALENCE FRANCE
Manufacturer	: INGENICO 28-32 Boulevard de Grenelle 75015 PARIS - France
Dimensions	: 229 x 250 x 71 mm
Frequency band	: 13.56 MHz
Number of channel	: 1
Channel spacing	: -
User frequency adjustment	: No
User power adjustment	: No
Type of antenna	: Dedicated loop antenna permanently connected on the PCB
Is the operation point to point?	: No
Power supply	: 120V 60Hz
Internal frequencies	: Ethernet 25 MHz, Thunder3 quartz 12MHz, Video oscillator 24 MHz, Booster3 processor quartz 32.7 kHz + 18.4 MHz, Contactless microcontroller quartz 27.12 MHz, DAC + Ampli (12 MHz)
External links	: Port 1 : Mini USB Port 2 : Power supply DELTA or PHIHONG Note: power supply is an option for this equipment

Description of modifications

The equipment has not been modified during tests.

1.3.3 – Description of operation

The equipment was configured in the following operation mode:

- Maximum transmission power: Permanently emission at 13.56 MHz with the usual modulation.

1.3.4 – Photographs of the sample



General view of the ISC480

Power supply of the ISC480 (optional)



Power supply DELTA (optional) marking plate



Power supply PHIHONG (optional) marking plate



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1.3.5 – Auxiliary equipment

None

2- TEST RESULTS

2.1 Power line conducted emission test

2.1.1 - General

The product has been tested with 120 V / 60 Hz power line voltage and compared to the FCC part 15 subpart C § 15.207 limits.

The 6 dB resolution bandwidth was 9 kHz from 150 kHz to 30 MHz.

2.1.2 – Test setup

The EUT is placed on a table at 0.8 m height. The cable of the power port has been shorted to 1 meter length. The EUT is powered through the LISN.



2.1.3 – Equipment list

Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Spectrum analyser	ROHDE & SHWARZ	ESI40	A2642010	2012/09	2013/09
V ISLN	ROHDE & SHWARZ	ENV216	C2320162	2012/09	2013/10



2.1.4 – Uncertainty

The uncertainty values calculated by the laboratory are lower than limit uncertainty values defined by the CISPR 16-4-2. The conformity of the sample is directly established by the applicable limits values.

Kind of measurement	Wide uncertainty laboratory (k=2) ± x	CISPR uncertainty limit ± y
Measurement of conducted disturbances in voltage on the power port	3.51 dB	3.6 dB

2.1.5 – Test results

ISC480 with power supply DELTA / RFID ON

Conducted measurement on conductor 1

Frequency (MHz)	Peak measurements (dBµV)	Quasi-Peak measurements (dBµV)	Quasi-Peak limits (dBµV)	Average measurement (dBµV)	Average limits (dBµV)
0.54	46	-	56.0	38.9	46.0
25	42	-	60.0	41	50

Conducted measurement on conductor 2

Frequency (MHz)	Peak measurements (dBµV)	Quasi-Peak measurements (dBµV)	Quasi-Peak limits (dBµV)	Average measurement (dBµV)	Average limits (dBµV)
0.53	46	-	56.0	37	46.0
25	42.2	-	60.0	41	50

**ISC480 with power supply PHIHONG / RFID ON**

Conducted measurement on conductor 1

<u>Frequency</u> (MHz)	<u>Peak</u> <u>measurements</u> (dB μ V)	<u>Quasi-Peak</u> <u>measurements</u> (dB μ V)	<u>Quasi-Peak</u> <u>limits</u> (dB μ V)	<u>Average</u> <u>measurement</u> (dB μ V)	<u>Average limits</u> (dB μ V)
0.155	55.5	-	64.5	33	54.5
0.280	43.3	-	62.0	21.7	52.0
0.350	40.2	-	60.5	23.4	50.5
11.4	46	-	60.0	37	50.0
20.8	44.8	-	60.0	29	50.0
25	39.8	-	60.0	38.2	50.0

Conducted measurement on conductor 2

<u>Frequency</u> (MHz)	<u>Peak</u> <u>measurements</u> (dB μ V)	<u>Quasi-Peak</u> <u>measurements</u> (dB μ V)	<u>Quasi-Peak</u> <u>limits</u> (dB μ V)	<u>Average</u> <u>measurement</u> (dB μ V)	<u>Average limits</u> (dB μ V)
0.155	55	-	64.5	31	54.5
0.280	41	-	62.0	24	52.0
0.350	40	-	60.5	25	50.5
11.4	46	-	60.0	35	50.0
20.8	39	-	60.0	22	50.0
25	40.3	-	60.0	39	50.0

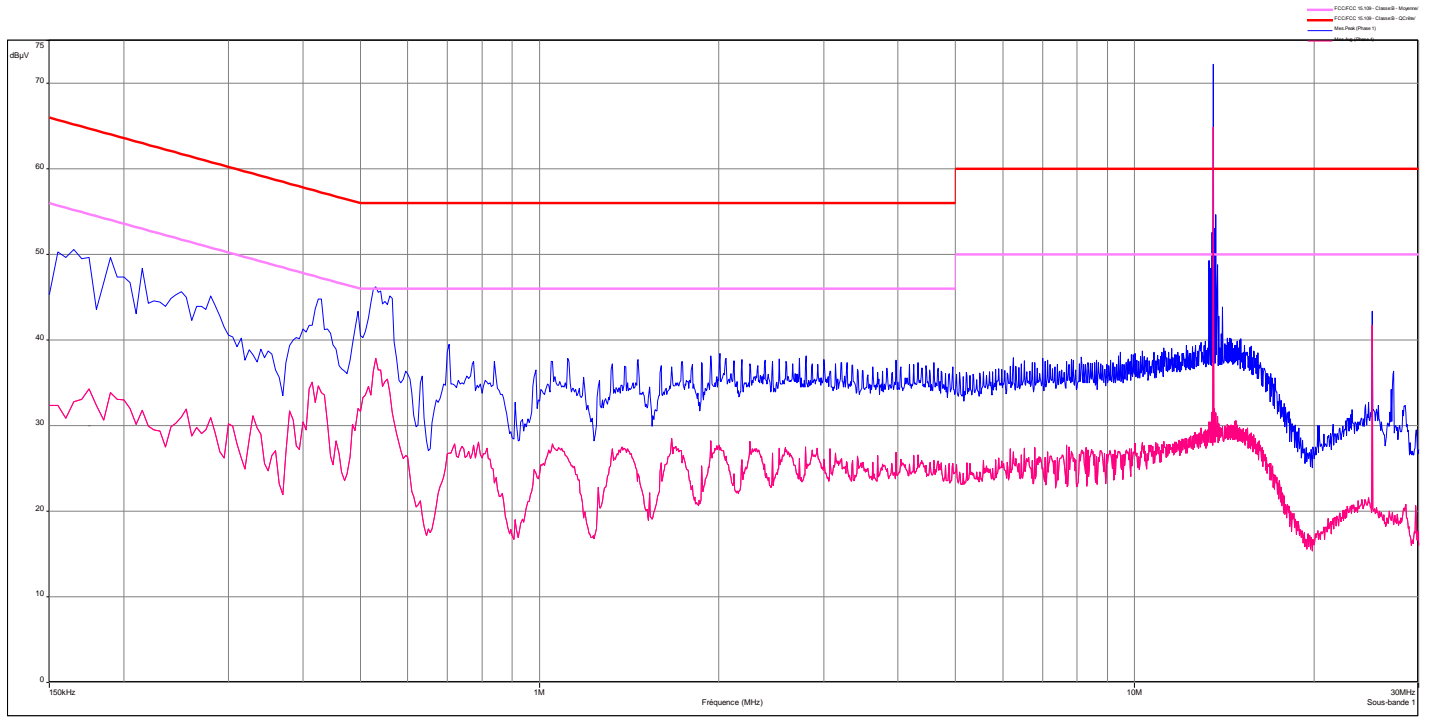
Remark:

The carrier of the transmitter is at 13.56 MHz, measurements with the antenna removed are given in annex to show the compliance at this frequency. The antenna was replaced by a dummy load equal in impedance to the original antenna.

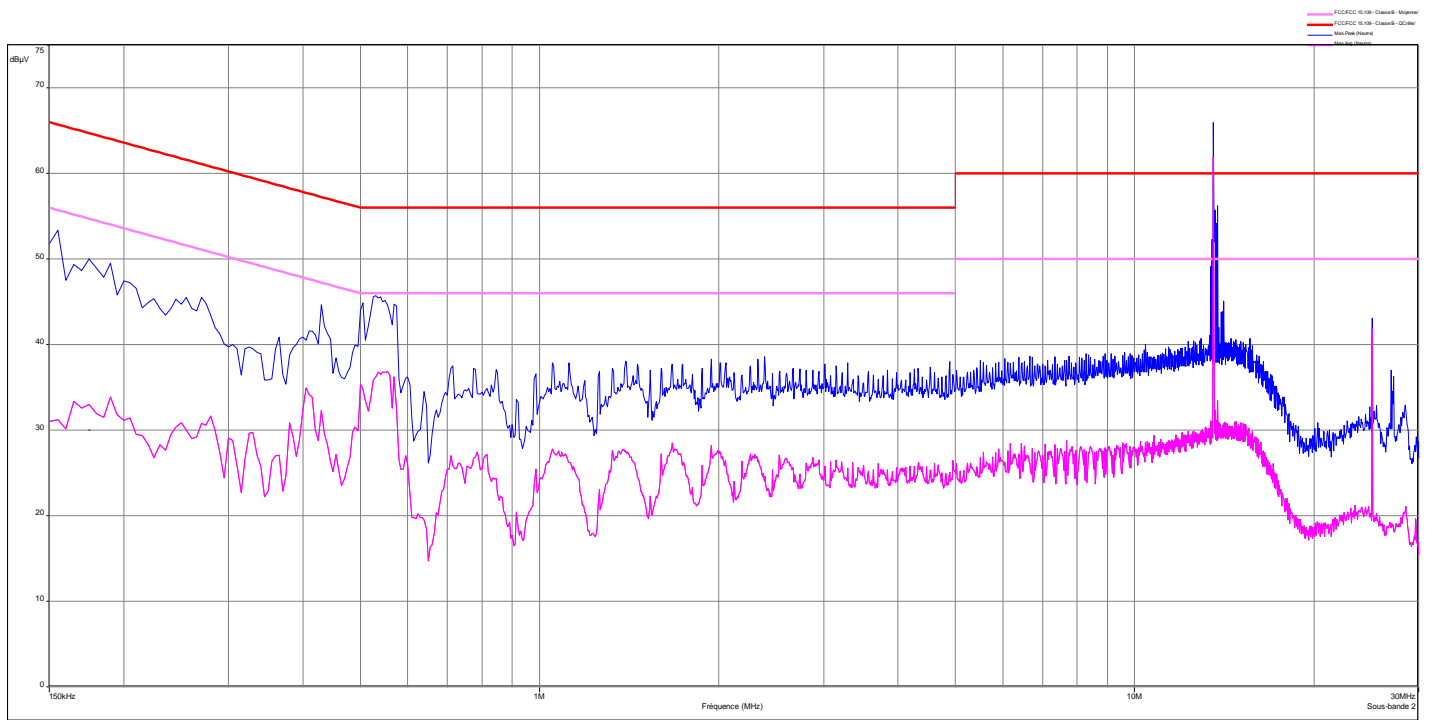


ISC480 with power supply DELTA

Measurement diagram for conductor 1 (DELTA / RFID ON)



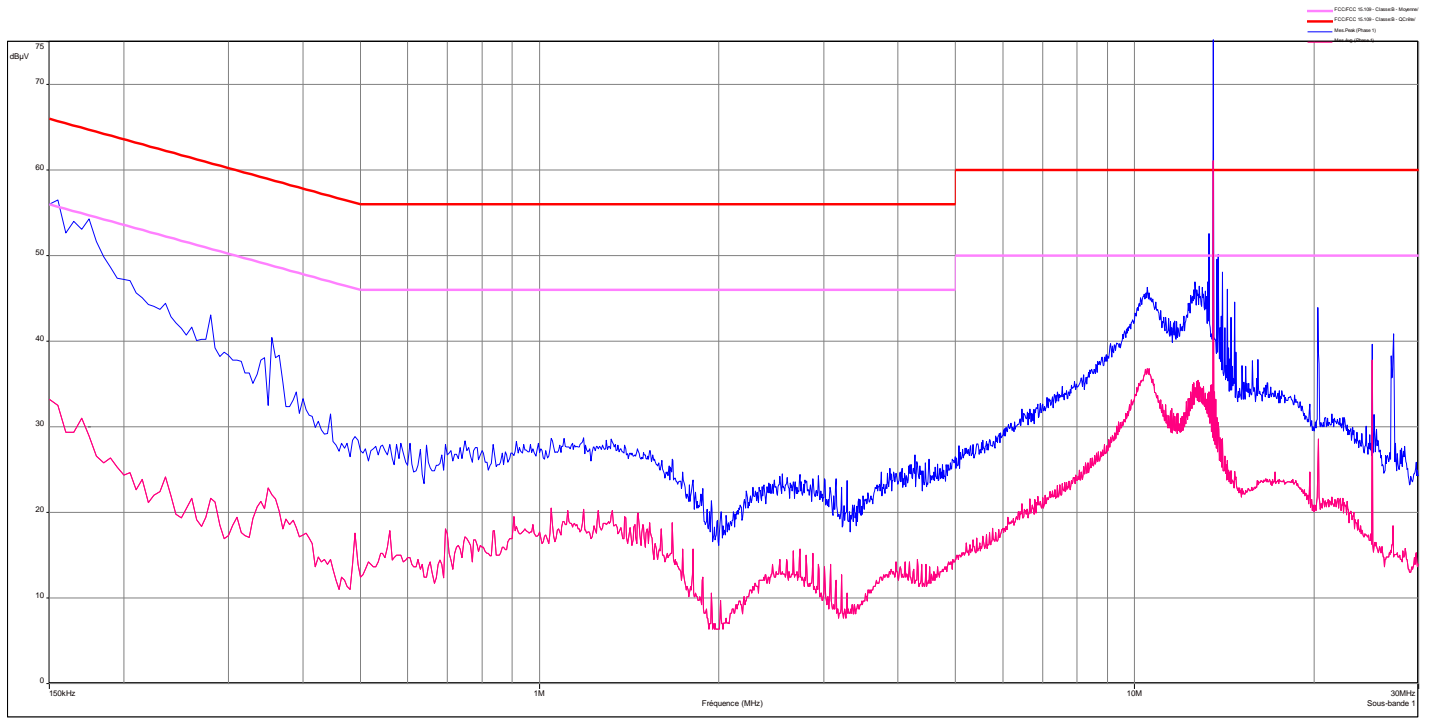
Measurement diagram for conductor 2 (DELTA / RFID ON)



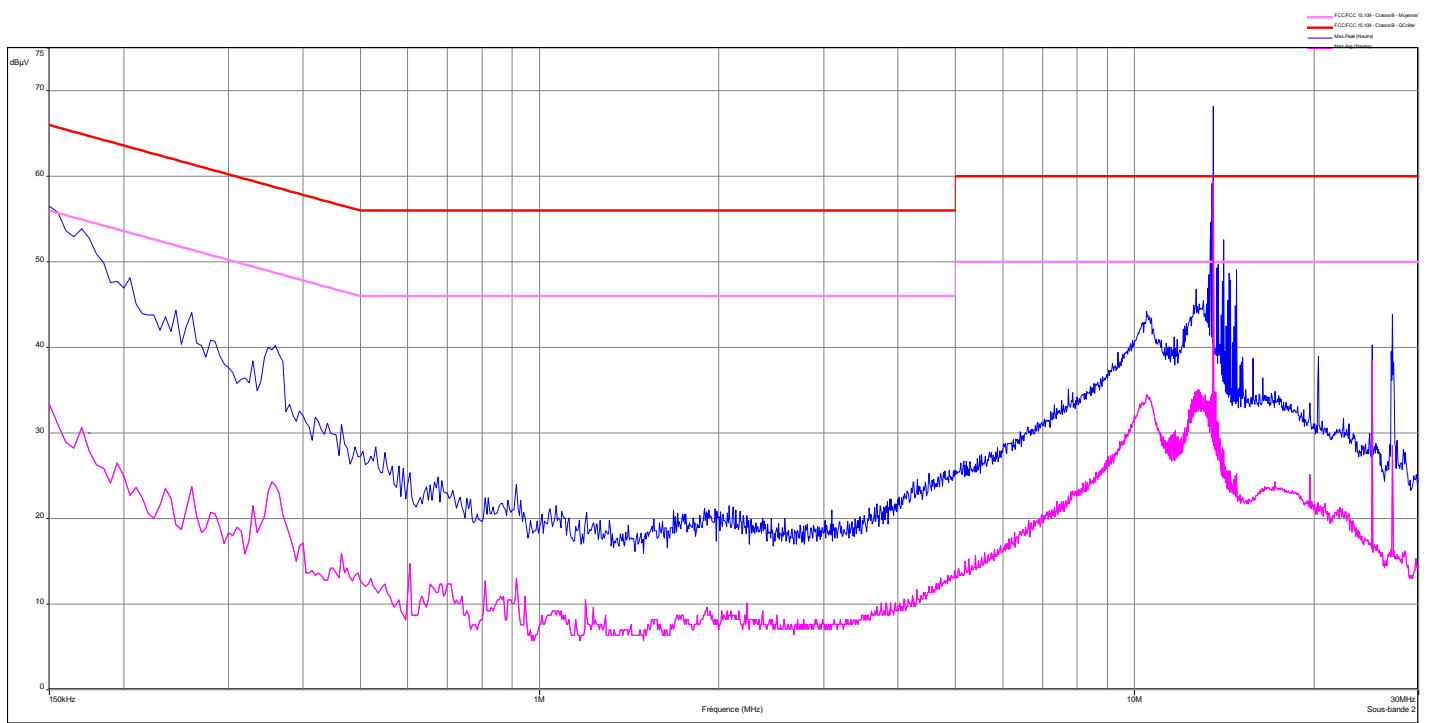


ISC480 with power supply PHIHONG

Measurement diagram for conductor 1 (PHIHONG / RFID ON)



Measurement diagram for conductor 2 (PHIHONG / RFID ON)



2.2 – Field strength within the band 13.110-14.010MHz

2.2.1 – General

The product has been tested with 120 V / 60 Hz power line voltage on charger and compared to the FCC part 15 subpart C §15.225 (a) (b) and (c) limits.

The 6dB resolution bandwidth was :

- 9 KHz from 150 kHz to 30 MHz

2.2.2 – Test setup

The EUT is placed at 3m distance of the loop antenna on a table 80cm height. The level has been maximised by turning the EUT with the rotating table and with the antenna at 0° and 90° around its vertical and horizontal axes. Antenna height was 1m. Pre scans were performed on the EUT put on its three axes to determine the position with maximum radiation.

The measuring value has been extrapolated to a 30m distance measured level according to § 15.31 (f) (2) by the following formula:

$$E_{30m} = E_d \times \left(\frac{d}{30}\right)^2$$

E_{30m} is the field strength at 30m in $\mu V/m$
 E_d is the field strength at the measured distance in $\mu V/m$
 d is the used distance between antenna and EUT in m



2.2.3 – Equipment list

Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Spectrum analyser	ROHDE & SHWARZ	ESI40	A2642010	2012/09	2013/09
Loop antenna	ROHDE & SHWARZ	HFH H2 Z2	C2040007	2012/08	2013/08
Spectrum analyser	ROHDE & SHWARZ	FSL	A4060032	2012/12	2013/12

2.2.4 – Uncertainty

Kind of measurement	Wide uncertainty laboratory (k=2) $\pm x$	CISPR uncertainty limit $\pm y$
E field measurement	4.75 dB	Not defined

2.2.5 – Test results**ISC480 with power supply DELTA**

The measure result at 3 m is 56,763 dB μ V/m for 13.56 MHz

The 30 m measure corrected is M@3m - 40dB

Frequency MHz	Maximum Quasi Peak (30m) dB μ V/m	Quasi Peak Limit (30m) dB μ V/m
13.56	16.763	84.0

ISC480 with power supply PHIHONG

The measure result at 3 m is 56,5 dB μ V/m for 13.56 MHz

The 30 m measure corrected is M@3m - 40dB

Frequency MHz	Maximum Quasi Peak (30m) dB μ V/m	Quasi Peak Limit (30m) dB μ V/m
13.56	16.5	84.0



2.2.6 – Band-edge compliance

Frequency (MHz)	Field strength (μV/m)	Measurement distance (m)
13.553-13.567	15848 (= 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
Outside 13.110-14.010	30 (= 29.5 dBμV/m)	30

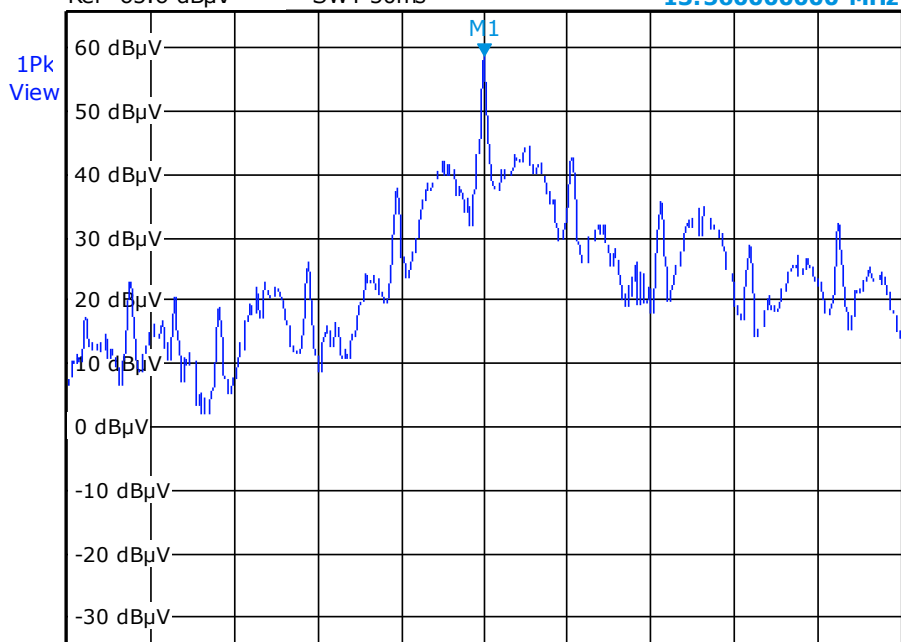
ISC480 with power supply DELTA

Graph from 12.5 to 14.5 MHz with RBW=10kHz and VBW=30kHz (measurement @ 3m)



Offs -60.4 dB * RBW 10 kHz
 * Att 30 dB * VBW 30 kHz
 Ref 65.6 dBμV * SWT 50ms

M1[1] 58.66 dBμV
13.56000000 MHz

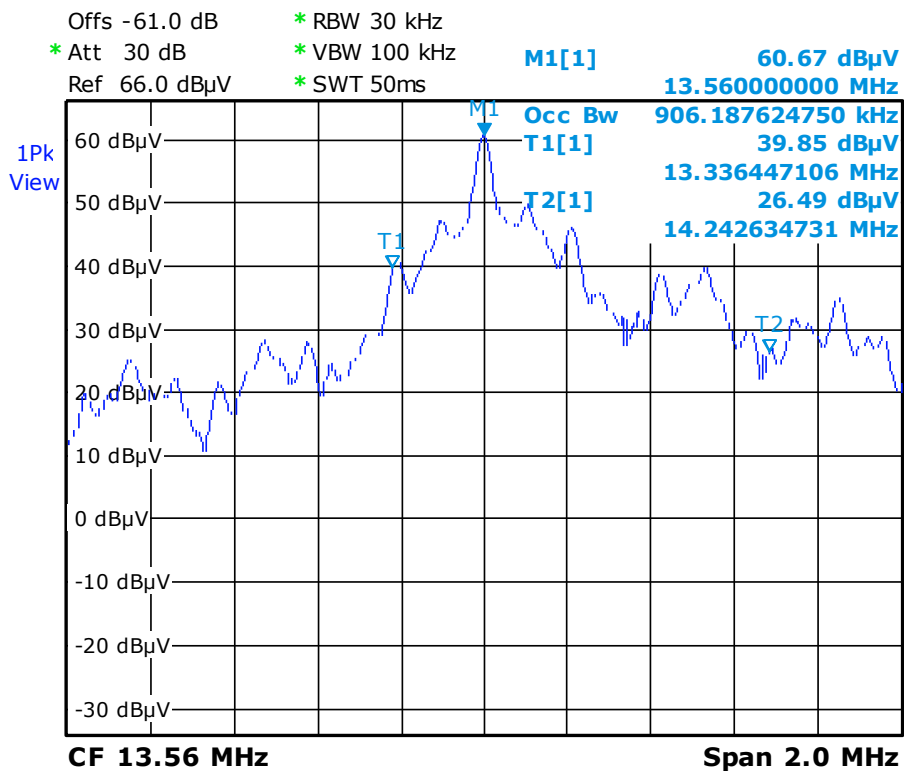


CF 13.56 MHz

Span 2.0 MHz

ISC480 with power supply DELTA

The 99% occupied bandwidth is 906.187 kHz.





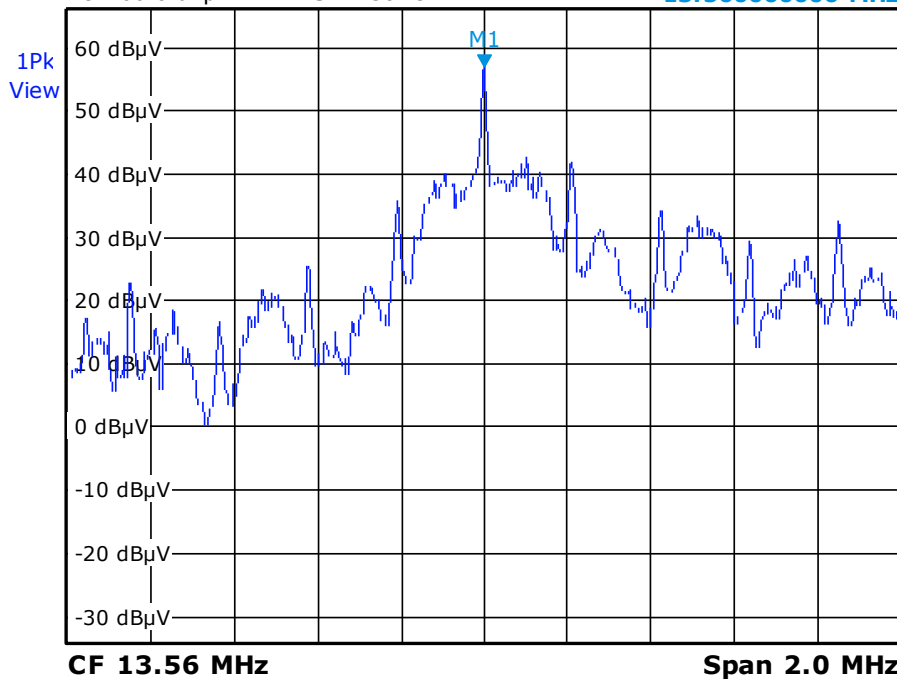
ISC480 with power supply PHIHONG

Graph from 12.5 to 14.5 MHz with RBW=10kHz and VBW=30kHz (measurement @ 3m)



Offs -61.0 dB * RBW 10 kHz
* Att 30 dB * VBW 30 kHz
Ref 66.0 dBμV * SWT 50ms

M1[1] 57.04 dBμV
13.56000000 MHz



2.3 – Field strength outside the 13.110-14010MHz band

2.3.1 – General

The product has been tested with 120 V / 60 Hz power line voltage on charger and compared to the FCC part 15 subpart C § 15.209 limits.

The 6dB resolution bandwidth was:

- 200 Hz from 9 kHz to 150 kHz.
- 9 kHz from 150 kHz to 30 MHz.
- 120 kHz from 30 MHz to 1000 MHz.
- 1 MHz from 1 GHz to 18 GHz.

-Frequency range: 9 kHz to 30 MHz

Measuring Distance: **3 m**

Antenna:

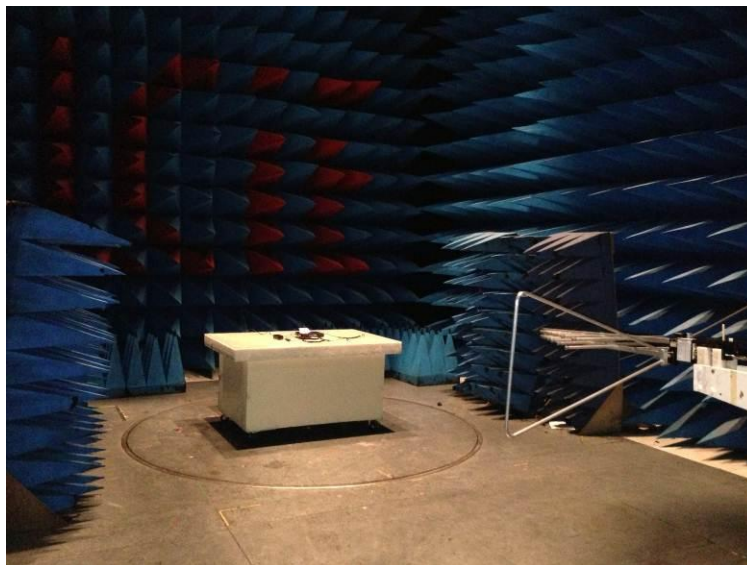
- Loop antenna (9 KHz to 30 MHz)

-Frequency range: 30 MHz to 18000 MHz

Measuring Distance: **3 m**

Antenna:

- BiLog (30 MHz to 1000 MHz)
- horn (1000 MHz to 18000 MHz)



The EUT is placed at 3m distance of the loop antenna (0.009 to 30MHz) on a table 80cm height. The level has been maximised by turning the EUT with the rotating table and with the antenna at 0° and 90° around its vertical and horizontal axes. Antenna height was 1m. Pre scans were performed on the EUT put on its three axes to determine the position with maximum radiation.

The EUT is placed at 3m distance of the BiLog (30 to 1000MHz) or horn (above 1GHz) antenna on a table 80cm height. The level has been maximised by turning the EUT with the rotating table and with the antenna in horizontal and vertical polarity. Antenna height search was performed from 1 to 4m.



2.3.2 – Equipment list

Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Spectrum analyser	ROHDE & SCHWARZ	ESI40	A2642010	2012/09	2013/09
BiLog antenna	SCHWARZBECK	VULB 9160	C2040150	2011/12	2012/12
Horn antenna	EMCO	3115	C2042018	2012/04	2013/04
Loop antenna	ROHDE & SCHWARZ	HFH H2 Z2	C2040007	2012/08	2013/08

2.3.3 – Uncertainty

The uncertainty values calculated by the laboratory are lower than limit uncertainty values defined by the CISPR 16-4-2. The conformity of the sample is directly established by the applicable limits values.

Kind of measurement	Wide uncertainty laboratory (k=2) ± x	CISPR uncertainty limit ± y
E field measurement within the band 150kHz-30MHz	4.75 dB	Not defined
Measurement of radiated electric field from 30 to 200MHz in horizontal position on the Fontenay-aux-Roses site (with EATON 96002 antenna)	4.80 dB	5.2 dB
Measurement of radiated electric field from 30 to 200MHz in vertical position on the Fontenay-aux-Roses site (with EATON 96002 antenna)	5.03 dB	5.2 dB
Measurement of radiated electric field from 200 to 1000MHz on the Fontenay-aux-Roses site	5.07 dB	5.2 dB

2.3.4 – Test results on transmitter

3 m radiated measurement graph from 30 to 1000 MHz

Frequency (MHz)	Peak measurements @ 3m (dBµV/m)	Limits @ 3m (dBµV/m)
40.7	31.3	40.0
100	29.4	43.0
271.2	37.3	46.0
298.3	36.9	46.0
325.5	36.3	46.0
400	35.8	46.0
666.7	40.3	46.0

Note: these values are the maximum level for both measurements on ISC480 with power supply DELTA

3 m radiated measurement graph from 1 to 6 GHz

Frequency (MHz)	Peak measurements (dBµV/m)	Peak limits (dBµV/m)	Average measurement (dBµV/m)	Average limits (dBµV/m)
1466	37.8	74	27.6	54

Note: these values are the maximum level for both measurements on ISC480 with power supply DELTA



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3 m radiated measurement graph from 30 to 1000 MHz

<u>Frequency (MHz)</u>	<u>Peak measurements @ 3m (dBμV/m)</u>	<u>Limits @ 3m (dBμV/m)</u>
91	27	43.0
233	38.5	46.0
298	41.5	46.0
332	36.8	46.0
400.0	37.3	46.0
616	39	46.0
705	38.4	46.0

Note: these values are the maximum level for both measurements on ISC480 with power supply PHIHONG

3 m radiated measurement graph from 1 to 6 GHz

<u>Frequency (MHz)</u>	<u>Peak measurements (dBμV/m)</u>	<u>Peak limits (dBμV/m)</u>	<u>Average measurement (dBμV/m)</u>	<u>Average limits (dBμV/m)</u>
1467	38.5	74	28.1	54

Note: these values are the maximum level for both measurements on ISC480 with power supply PHIHONG

2.3.5 – Test results on receiver

The RFID receiver works at the same time as the transmitter. Spurious emissions for transmitter already represents the receive mode.



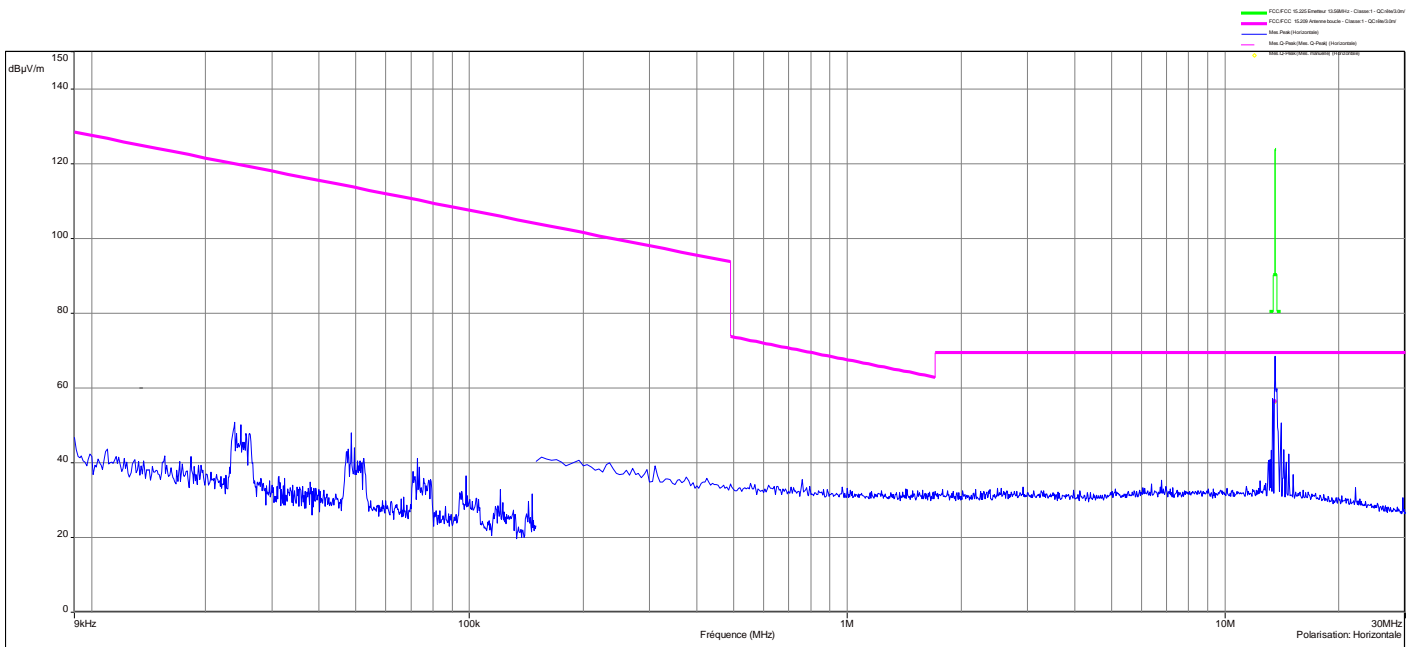
2.3.6 – Measurements diagrams

3 m radiated measurement from 9 kHz to 30 MHz

ISC480 with power supply PHIHONG

Perpendicular antenna from 9 KHz to 30 MHz

Loop antenna measurements

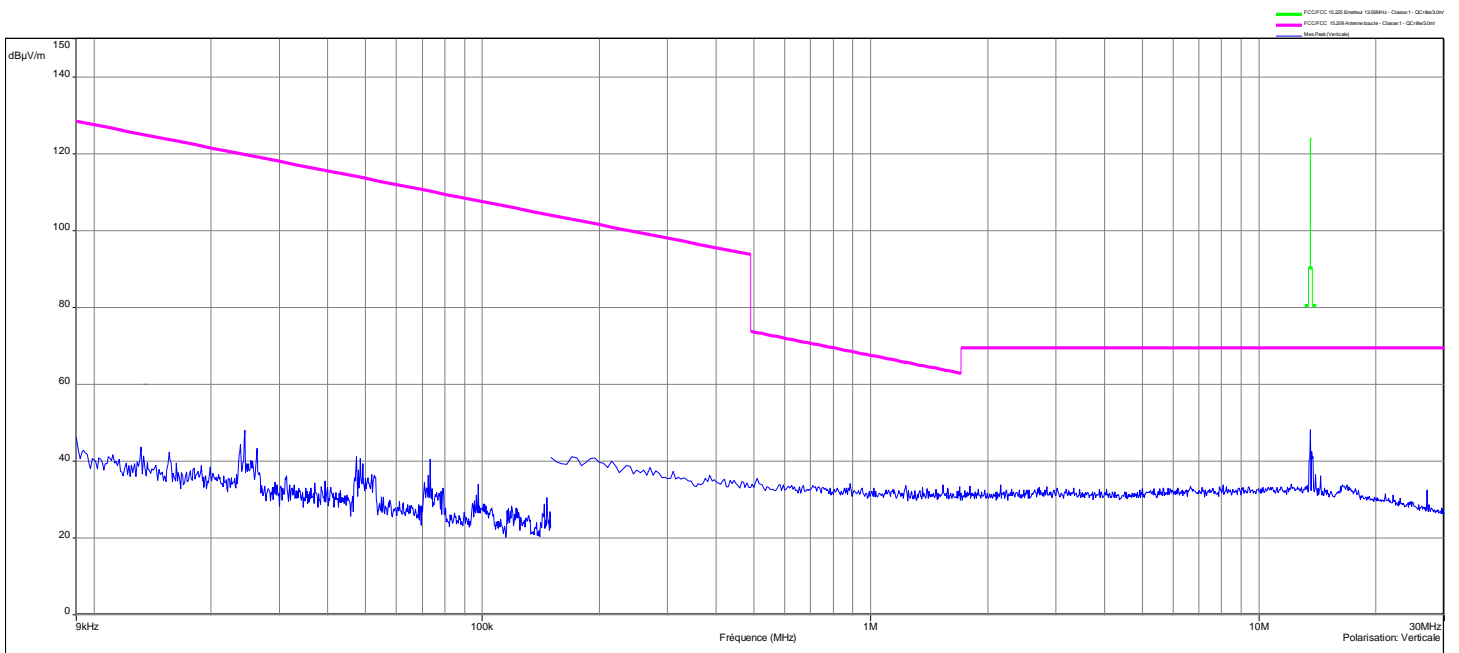




ISC480 with power supply PHIHONG

Parallel antenna from 9 KHz to 30 MHz

Loop antenna measurements

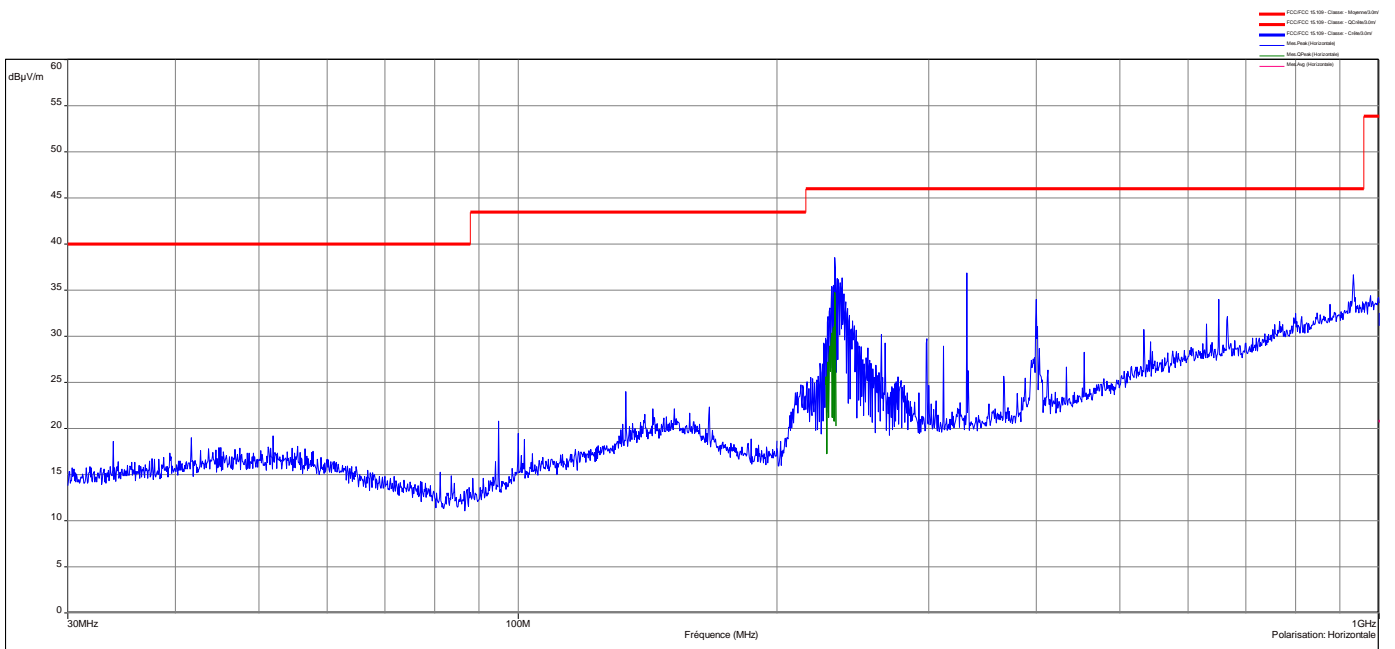




3 m radiated measurement graph from 30 to 1000 MHz

ISC480 with power supply PHIHONG

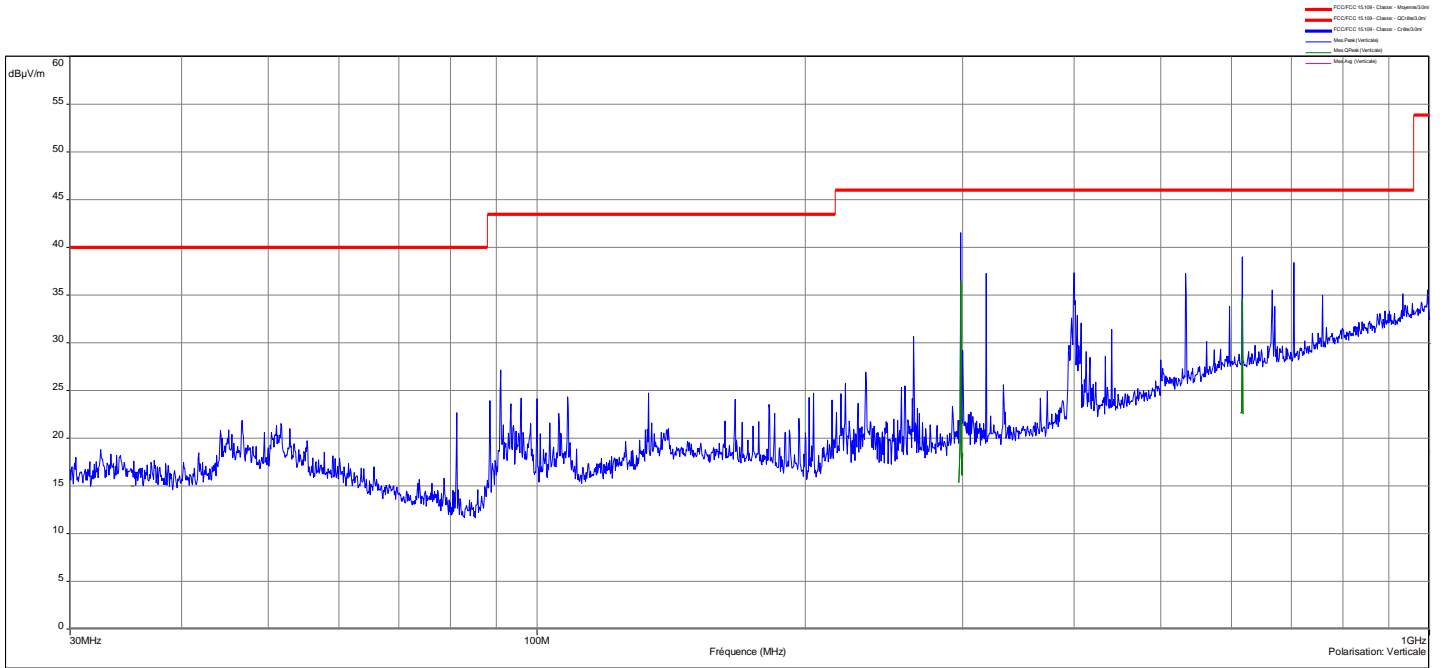
Horizontal antenna from 30 to 1000 MHz





ISC480 with power supply PHIHONG

Vertical antenna from 30 to 1000 MHz



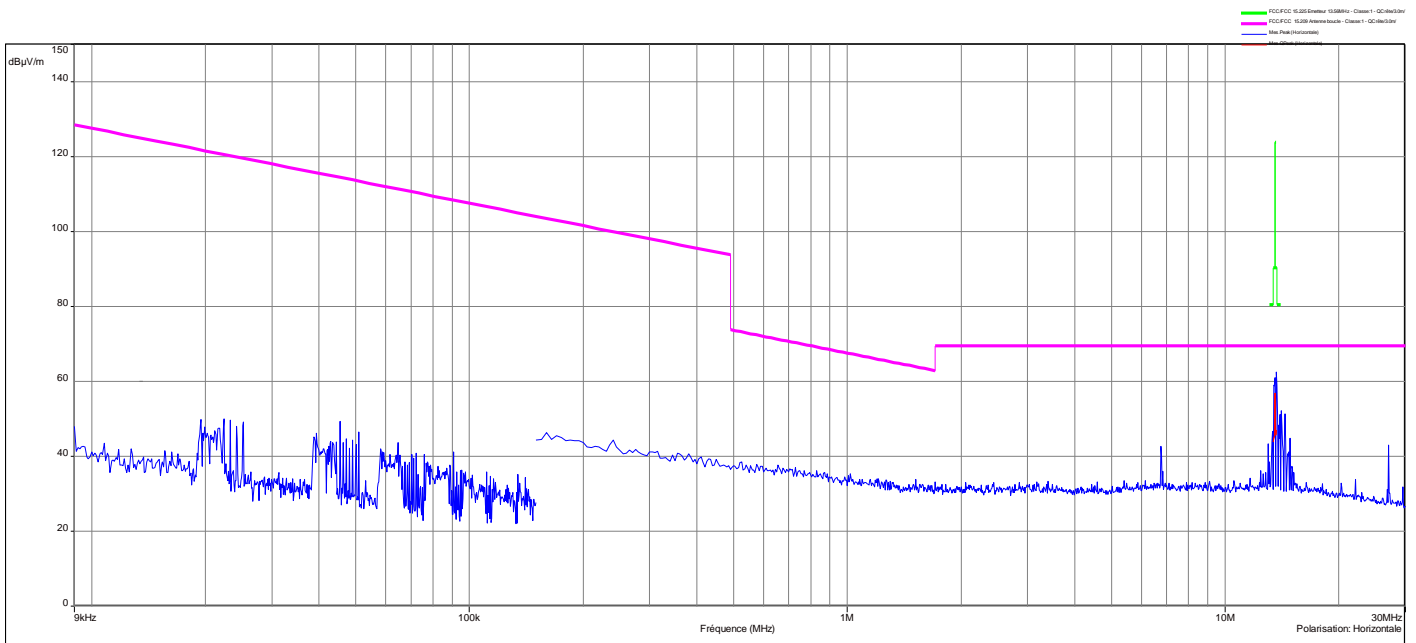
2.3.7 – Measurements diagrams

3 m radiated measurement from 9 kHz to 30 MHz

ISC480 with power supply DELTA

Perpendicular antenna from 9 KHz to 30 MHz

Loop antenna measurements

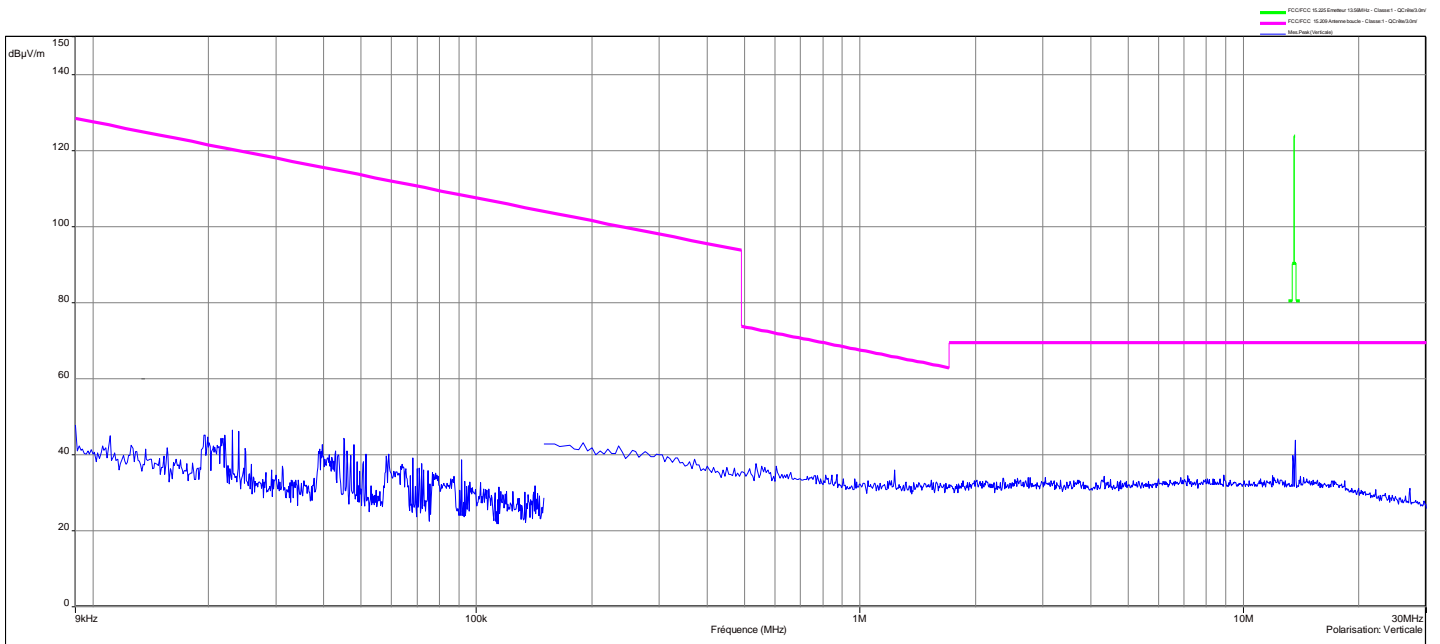




ISC480 with power supply DELTA

Parallel antenna from 9 KHz to 30 MHz

Loop antenna measurements

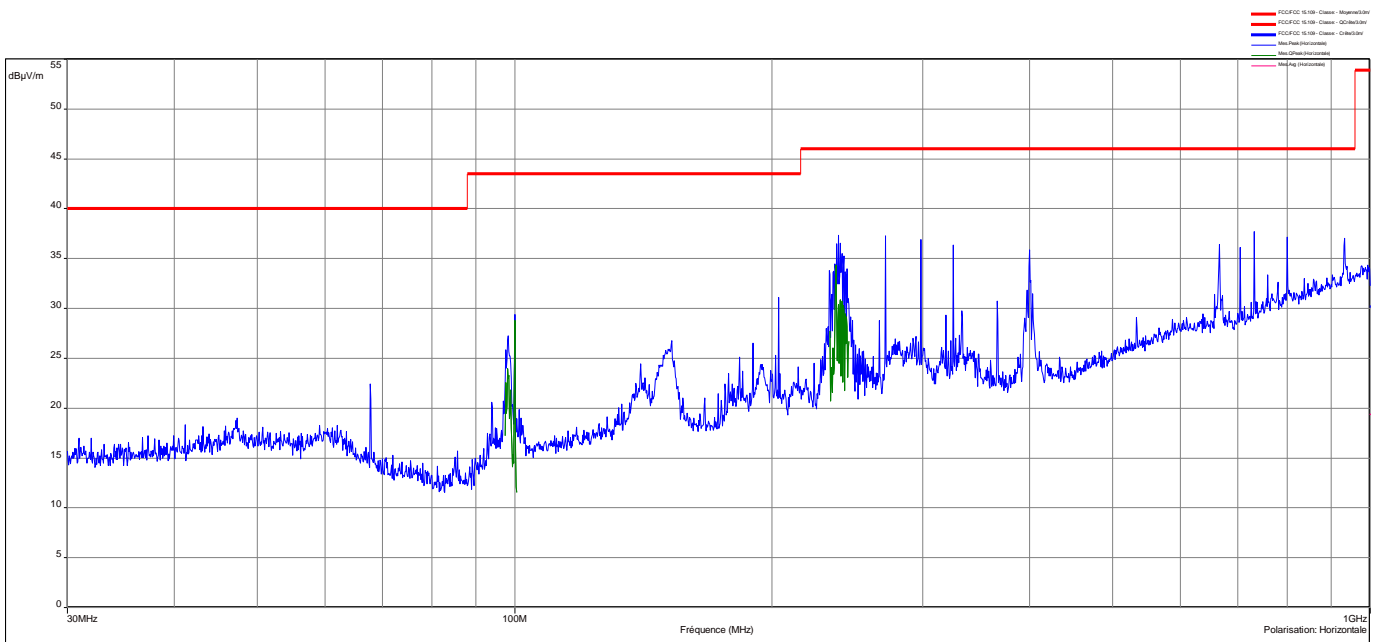




3 m radiated measurement graph from 30 to 1000 MHz

ISC480 with power supply DELTA

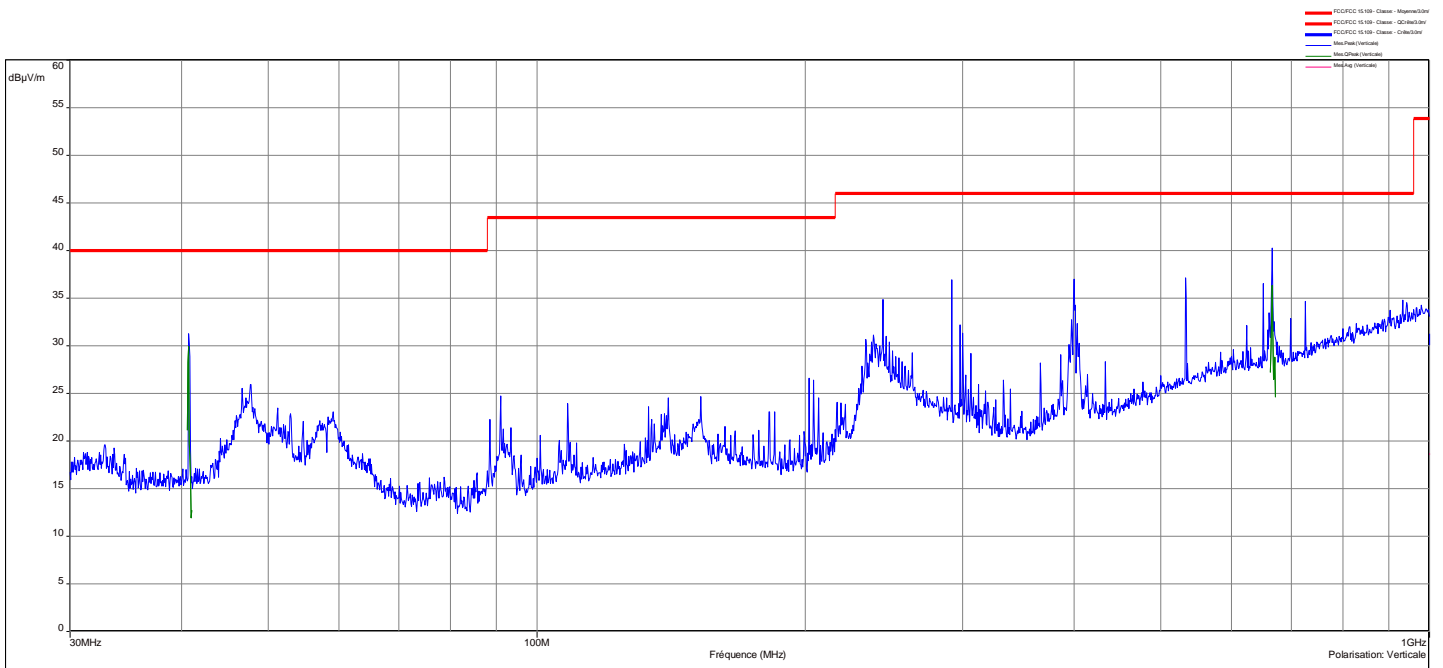
Horizontal antenna from 30 to 1000 MHz





ISC480 with power supply DELTA

Vertical antenna from 30 to 1000 MHz



2.4 – Frequency stability over extreme voltage and temperature condition

2.4.1 – General

The product has been powered with AC power supply and it was tested inside a climatic chamber and compared to the FCC part 15 subpart C § 15.225 (e) limits.

2.4.2 – Test setup





2.4.3 – Equipment list

Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Spectrum analyser	ROHDE & SCHWARZ	FSL	A4060032	2012/12	2013/12
Climatic chamber	CLIMATS	-	D1025029	2012/02	2013/02
AC power supply	ADAPTIVE POWER SYSTEMS	FC210	A7360017	Inspected before test	-

2.4.4 – Uncertainty

The uncertainty values calculated by the laboratory are lower than limit uncertainty values defined by the CISPR 16-4-2. The conformity of the sample is directly established by the applicable limits values.

Kind of measurement	Wide uncertainty laboratory (k=2) ± x
Frequency stability	±10 ⁻⁷ of frequency

2.4.5 – Test results

ISC480 with power supply DELTA

Temperature	Voltage	Frequency (MHz)	Limits
20 °C	120V	13.55991	Reference
20 °C	138V	13.55991	Fmin = 13.546350 - Fmax = 13.573469
20 °C	102V	13.55991	
- 20 °C	120V	13.55991	
- 20 °C	138V	13.55991	
- 20 °C	102V	13.55991	
- 30 °C	120V	13.55991	
- 30 °C	138V	13.55991	
- 30 °C	102V	13.55991	
+ 50 °C	120V	13.55991	
+ 50 °C	138V	13.55991	
+ 50 °C	102V	13.55991	

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ISC480 with power supply PHIHONG

Temperature	Voltage	Frequency (MHz)	Limits
20 °C	120V	13.55985	Reference
20 °C	138V	13.55985	Fmin = 13.573409 - Fmax = 13.546290
20 °C	102V	13.55985	
- 20 °C	120V	13.55985	
- 20 °C	138V	13.55985	
- 20 °C	102V	13.55985	
- 30 °C	120V	13.55985	
- 30 °C	138V	13.55985	
- 30 °C	102V	13.55985	
+ 50 °C	120V	13.55985	
+ 50 °C	138V	13.55985	
+ 50 °C	102V	13.55985	

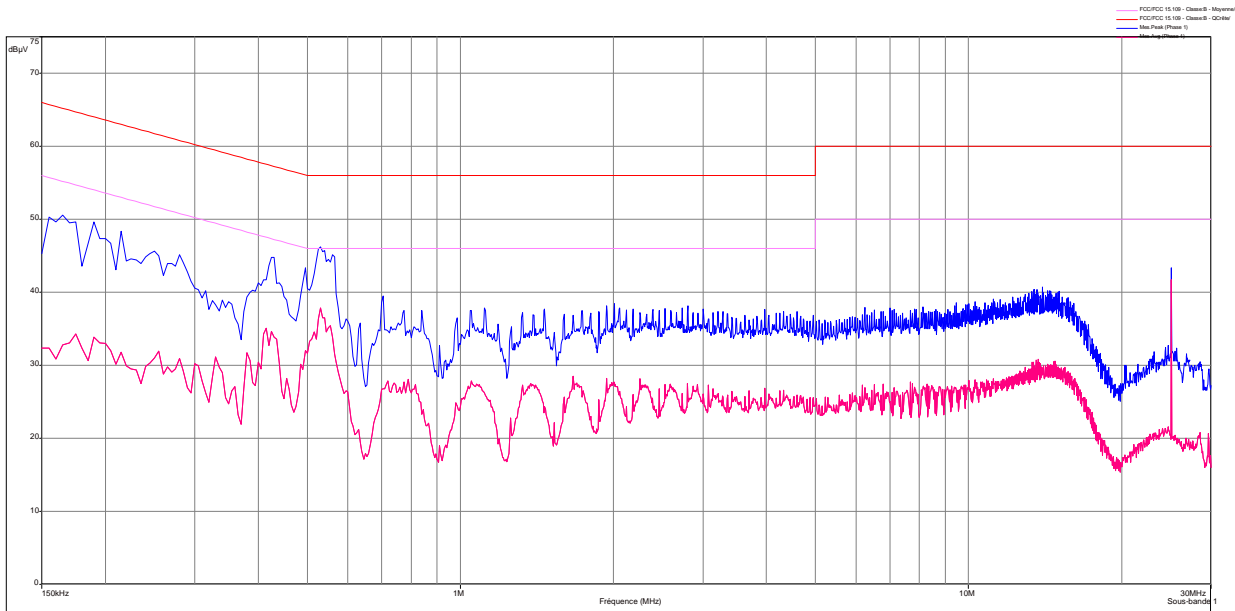
ANNEX

INGENICO

ISC480

DELTA power supply, mode RFID activated with antenna removed.
The antenna was replaced by a dummy load equal in impedance to the original antenna.

120V 60Hz



Conductor 1

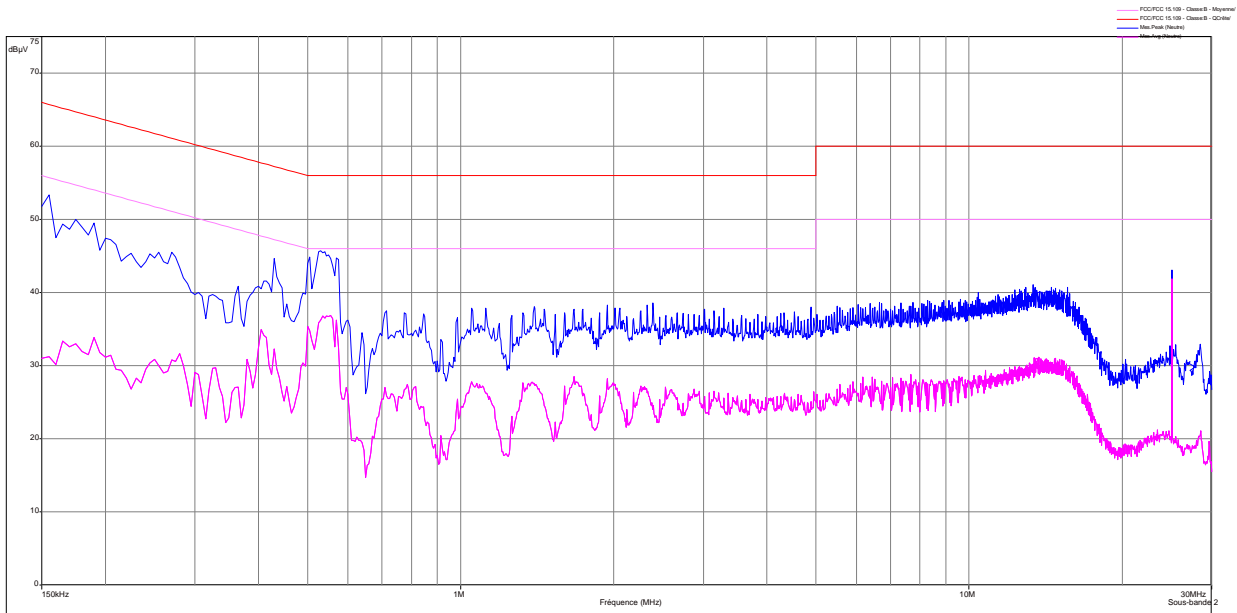


INGENICO

ISC480

DELTA power supply, mode RFID activated with antenna removed.
The antenna was replaced by a dummy load equal in impedance to the original antenna.

120V 60Hz



Conductor 2

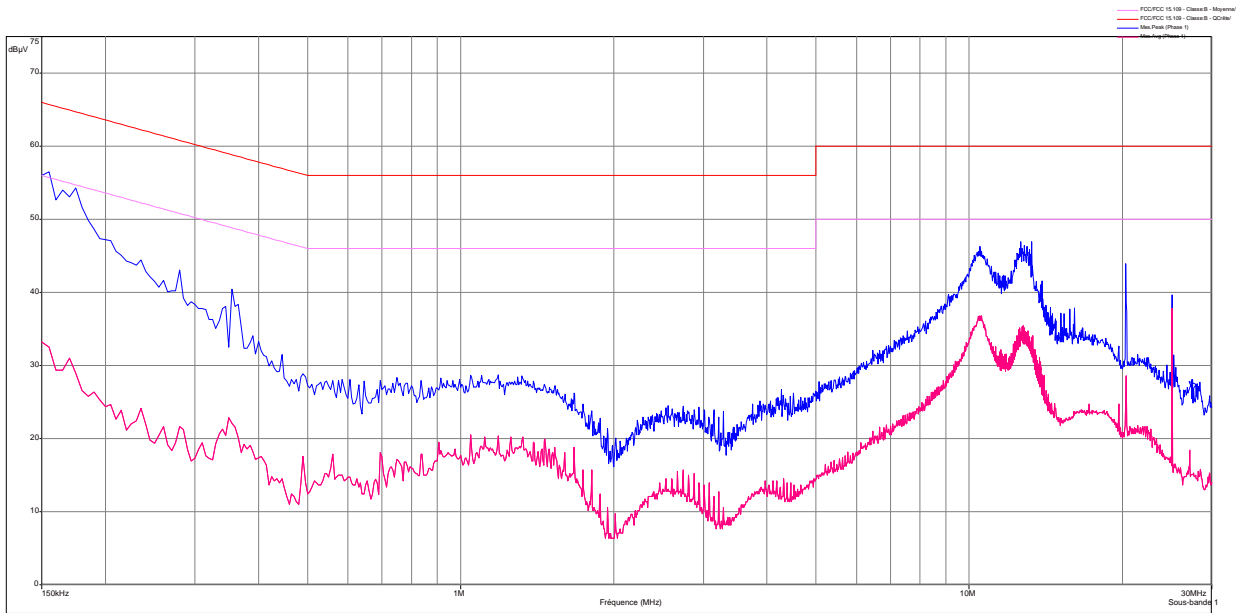


INGENICO

ISC480

PHIHONG power supply, mode RFID activated with antenna removed.
The antenna was replaced by a dummy load equal in impedance to the original antenna.

120V 60Hz



Conductor 1



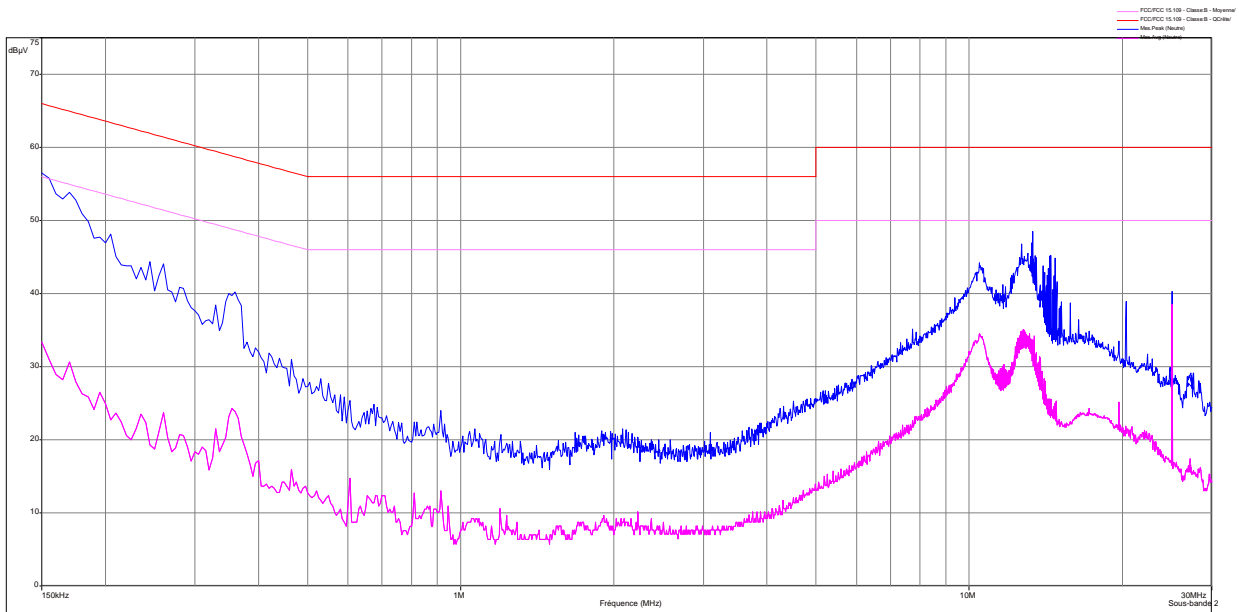
INGENICO

ISC480

PHIHONG power supply, mode RFID activated with antenna removed.

The antenna was replaced by a dummy load equal in impedance to the original antenna.

120V 60Hz



Conductor 2

End of test report