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Rapport d'essai / *Test report*

N° 201009-6516CR-A2-R3-E **JDE :** 102753

DELIVRE A / *ISSUED TO* : **OEM INDUSTRY**
Les Viallières – B.P.3
71570 LA CHAPELLE DE GUINCHAY - FRANCE

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* : **AIR SAMPLER**
- Marque / *Trade mark* : **OEM INDUSTRY**
- Constructeur / *Manufacturer* : **OEM INDUSTRY**
- Type / *Model* : **AI3P Traceability**
- N° de série / *serial number* : **100006**
- FCC ID : **Y4A-AI3PTRA**

Date des essais / *Test date* : From November to December 2010

Lieu d'essai / *Test location* : **LCIE SUD-EST**
ZI Centr'Alp – 170 rue de Chatagnon
38430 MOIRANS - France

Test réalisé par / *Test performed by* : Anthony MERLIN

Ce document comporte /*Composition of document* : 45 pages.

MOIRANS, LE 17 JANVIER 2011 / JANUARY 17TH, 2011

Ecrit par / *Written by,*
Anthony MERLIN

Approuvé par / *Approved by,*
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SUMMARY

1. TEST PROGRAM

Standard: **- FCC Part 15, Subpart C 15.247**
- ANSI C63.4 (2009)

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-25GHz*	**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**
Maximum Peak Output Power 15.247 (b)	**Limit: 21dBm** Conducted or Radiated measurement			**PASS**
Hopping Channel Separation 15.247 (a) (1)	**Minimum between:** Two-third 20dB Bandwidth or 25kHz Whichever is greater			**PASS**
Number of Hopping Frequencies 15.247 (a) (1) (iii)	**At least 15 channels used**			**PASS**
Time of Occupancy (Dwell Time) 15.247 (a) (1) (iii)	**Maximum 0.4 sec within 31.6sec**			**PASS**
Band Edge Measurement 15.247 (d)	**Limit: -20dBc**			**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):**

AI3P Traceability Serial number: 100006
FCC ID: **Y4A-AI3PTRA**

Power supply Unit:
AC/DC adaptor MOSCOT type 9886, input 100-240VAC 47-63Hz 0.7A, output 12VDC / 2A, Sn: 05336307 0851.

- **Input/output:**

- 1 x DC power supply port

- **Auxiliaries used for testing:**

- 1 x Laptop TOSHIBA SATELITE S1410-704 (PS141E-04YCM-3V), sn: 13594938G
- 1 x Power supply unit (PA3201U-1ACA SEB100P2-15.0)
- 1 x Bluetooth USB Dongle COM One

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

- None

- **Equipment information:**

- External antenna connector: NO
- Radiated fundamental frequency band: [2400-2483.5]MHz
- Antenna type: Integral
- Antenna Gain: 0dBi (declaration of provider)
- Stand By mode: None
- Normal power source: see power supply unit information
- Modulation Type: GFSK,
- Modulation Technology: FHSS
- Transfert rate: 1/2/3Mbps
- Packet Type: DH1, DH2, DH3

2.3. EUT EXERCISE SOFTWARE

RUID Simulator, version: none.

2.4. EUT CONFIGURATION

Sampling Settings:

Volume	2000liters
Num. Seq	1
Sequence Separation	1
Start delay	2

The Bluetooth communication is permanent during the test; state of EUT is controlled in loop by the software.

Mode:

- Battery
- Adaptor AC/DC power supply

2.5. SPECIAL ACCESSORIES

None

3. CONDUCTED EMISSION DATA

3.1. CLIMATIC CONDITIONS

Date of test : From November to December 2010
Test performed by : A.MERLIN
Atmospheric pressure : 992mb
Relative humidity : 31%
Ambient temperature : 21℃

3.2. SETUP FOR CONDUCTED EMISSIONS MEASUREMENT

The product has been tested according to ANSI C63.4-(2009) 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.

3.3. 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).

Conducted emission test setup

3.4. 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

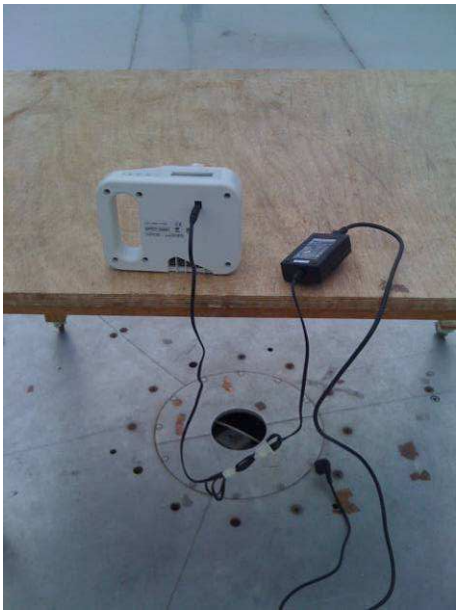
4. RADIATED EMISSION DATA

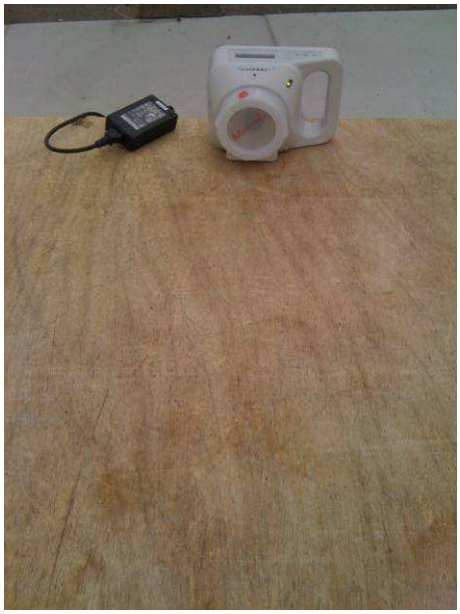
4.1. CLIMATIC CONDITIONS

Date of test : From November to December 2010
Test performed by : A.MERLIN
Atmospheric pressure : 992mb
Relative humidity : 31%
Ambient temperature : 21℃

4.2. 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.





Radiated emission test setup

4.3. TEST SEQUENCE AND RESULTS

4.3.1. 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: **Emr#1** (See annex 1)

4.3.2. Pre-characterization [30MHz-25GHz]

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 25GHz, a search is performed in the semi-anechoic chamber in order to determine frequencies radiated by the EUT (Measuring distance reduced to 1m and 20cm for frequencies from 12GHz to 25GHz).

See graphs for 30MHz-1GHz:

H polarization	**Emr#2**	*Battery Mode Axis XY*	(See annex 1)
V polarization	**Emr#3**	*Battery Mode Axis XY*	(See annex 1)
H polarization	**Emr#4**	*Battery Mode Axis Z*	(See annex 1)
V polarization	**Emr#5**	*Battery Mode Axis Z*	(See annex 1)
H polarization	**Emr#6**	*Adaptor Mode Axis XY*	(See annex 1)
V polarization	**Emr#7**	*Adaptor Mode Axis XY*	(See annex 1)

4.3.3. Characterization on 10 meters open site below 30 MHz

The product has been tested according to ANSI C63.4 (2009), 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 §15.109 limits and C §15.209.
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 in following tables.

Frequency (MHz)	QPeak Limit (dBµV/m) @ 30m	Qpeak (dBµV/m)	Qpeak-Limit (Margin dB)	Turntable Angle (deg)	Ant. Pol./ Angle (deg)	Tot Corr (dB)
No frequency observed						

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

4.3.4. Characterization on 10 meters open site from 30MHz to 25GHz

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 25GHz.
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:

Battery Mode

No	Frequency (MHz)	QPeak Limit (dBµV/m)	Qpeak * (dBµV/m)	Qpeak-Limit (Margin, dB)	Angle (deg)	Pol	Hgt (cm)	Tot Corr (dB)	Comments
1	38.257	40.0	29.8	**-10.2**	90	V	100	12.3	
2	46.576	40.0	31.6	**-8.4**	0	V	130	11.5	
3	163.749	43.5	27.8	**-15.7**	105	H	350	18.4	
4	174.394	43.5	26.9	**-16.6**	95	H	300	18.6	
5	177.525	43.5	31.1	**-12.4**	310	V	100	18.9	
6	211.897	43.5	32.6	**-10.9**	45	H	250	15.9	
7	476.913	46.0	31.2	**-14.8**	80	V	130	21.6	
8	495.198	46.0	35.7	**-10.3**	65	H	200	22.1	
9	504.981	46.0	39.2	**-6.8**	75	V	200	22.2	
10	510.495	46.0	33.3	**-12.7**	100	H	220	22.3	
11	518.123	46.0	34.6	**-11.4**	105	H	200	22.4	
12	524.028	46.0	33.9	**-12.1**	110	H	250	22.5	
13	530.328	46.0	32.6	**-13.4**	135	H	200	22.6	
14	539.749	46.0	38.9	**-7.1**	110	H	150	22.7	
15	602.528	46.0	35.4	**-10.6**	100	H	250	23.5	
16	658.189	46.0	37.3	**-8.7**	95	H	300	24.7	
17	867.519	46.0	34.4	**-11.6**	100	V	100	27.7	
18	882.847	46.0	36.3	**-9.7**	100	V	150	27.9	
19	932.197	46.0	35.6	**-10.4**	95	H	250	28.7	
20	970.729	54.0	35.4	**-18.6**	100	H	200	29.3	

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

Adaptor AC/DC Mode

No	Frequency (MHz)	QPeak Limit (dBµV/m)	Qpeak * (dBµV/m)	Qpeak-Limit (Margin, dB)	Angle (deg)	Pol	Hgt (cm)	Tot Corr (dB)	Comments
1	37.591	40.0	29.0	**-11.0**	35	V	100	12.3	
2	38.687	40.0	27.7	**-12.3**	100	V	150	12.3	
3	106.872	43.5	31.8	**-11.7**	110	V	100	14.5	
4	112.913	43.5	34.0	**-9.5**	95	V	150	15.8	
5	167.824	43.5	28.3	**-15.2**	100	H	300	18.4	
6	173.231	43.5	30.0	**-13.5**	100	V	100	18.5	
7	177.913	43.5	30.6	**-12.9**	245	V	100	18.9	
8	418.962	46.0	33.6	**-12.4**	240	V	150	20.1	
9	441.176	46.0	33.3	**-12.7**	300	V	200	20.7	
10	442.942	46.0	33.9	**-12.1**	310	V	150	20.7	
11	453.871	46.0	32.4	**-13.6**	290	V	100	20.9	
12	479.137	46.0	32.3	**-13.7**	300	V	200	21.7	
13	501.485	46.0	36.3	**-9.7**	305	V	150	22.2	
14	512.906	46.0	38.0	**-8.0**	155	H	200	22.3	
15	523.673	46.0	36.7	**-9.3**	300	V	100	22.4	
16	533.721	46.0	37.6	**-8.4**	305	V	100	22.6	
17	544.154	46.0	36.4	**-9.6**	145	H	200	22.7	
18	546.184	46.0	35.9	**-10.1**	295	V	250	22.7	
19	568.162	46.0	35.1	**-10.9**	165	H	150	23.1	
20	607.482	46.0	39.6	**-6.4**	170	H	350	23.6	

*: 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 to25GHz

Adaptor AC/DC Mode presented (worst case):

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
1	1.028	54.0	32.3	**-21.7**	220	H	110	26.9	
2	1.005	54.0	31.2	**-22.8**	80	V	110	26.8	
3	1.221	54.0	29.9	**-24.1**	195	H	115	27.5	
4	2.064	54.0	42.3	**-11.7**	145	H	110	33.6	
5	3.053	54.0	33.8	**-20.2**	95	H	110	34.9	
6	4.804	54.0	43.9	**-10.1**	190	H	110	36.4	
7	4.882	54.0	44.9	**-9.1**	55	H	115	36.6	
8	4.960	54.0	45.6	**-8.4**	110	H	110	36.9	
9	7.206	54.0	39.8	**-14.2**	80	H	110	39.7	
10	7.323	54.0	37.6	**-16.4**	155	H	110	39.7	
11	7.380	54.0	35.3	**-18.7**	120	H	110	39.8	

No	Frequency (GHz)	Limit Peak (dBµV/m)	Measure Peak (dBµV/m)	Margin (Mes-Lim) (dB)	Angle Table (deg)	Pol Ant.	Ht Ant. (cm)	Correc. factor (dB)	Comments
1	1.028	74.0	55.3	**-18.7**	220	H	110	26.9	
2	1.005	74.0	64.7	**-9.3**	80	V	110	26.8	
3	1.221	74.0	54.4	**-19.6**	195	H	115	27.5	
4	2.064	74.0	63.4	**-10.6**	145	H	110	33.6	
5	3.053	74.0	61.7	**-12.3**	95	H	110	34.9	
6	4.804	74.0	48.95	**-25.1**	190	H	110	36.4	
7	4.882	74.0	49.90	**-24.1**	55	H	115	36.6	
8	4.960	74.0	50.56	**-23.4**	110	H	110	36.9	
9	7.206	74.0	44.77	**-29.2**	80	H	110	39.7	
10	7.323	74.0	42.60	**-31.4**	155	H	110	39.7	
11	7.380	74.0	40.33	**-33.7**	120	H	110	39.8	

Note: Measures have been done at 3m distance.

RESULTS: PASS

4.4. 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.

5. MAXIMUM PEAK OUTPUT POWER (15.247)

5.1. TEST CONDITIONS

Date of test : From November to December 2010
Test performed by : A.MERLIN
Atmospheric pressure : 981mb
Relative humidity : 45%
Ambient temperature : 21°C

5.2. EQUIPMENT CONFIGURATION

Modulation: GFSK
Packet Type: DH1 / DH 3 / DH5
Hopping sequence: NO

5.3. 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 and using 3MHz RBW and 10MHz VBW.
The captured power is measured and recorded; the measurement is repeated until all frequencies required were complete.

Radiated measurement:
The product has been tested at a distance of 3 meters from the antenna and using 3MHz RBW and 10MHz VBW.
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 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:

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

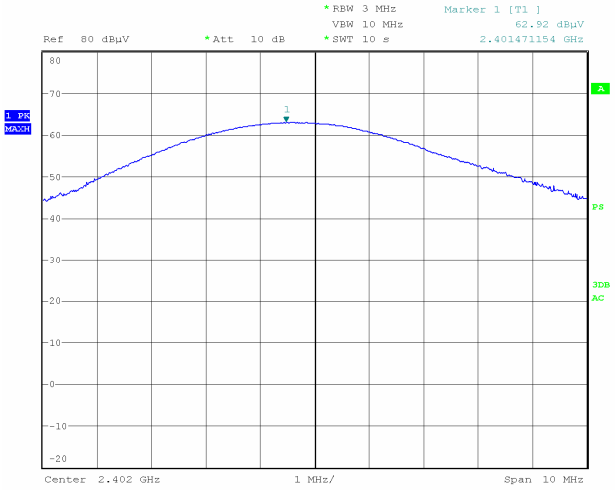
Where:
- E is the measured maximum fundamental field strength in V/m, utilizing a RBW ≥ the 20 dB bandwidth of the emission, VBW > RBW, peak detector function. Follow the procedures in C63.4-1992 with respect to maximizing the emission.
- G is the numeric gain of the transmitting antenna with reference 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:

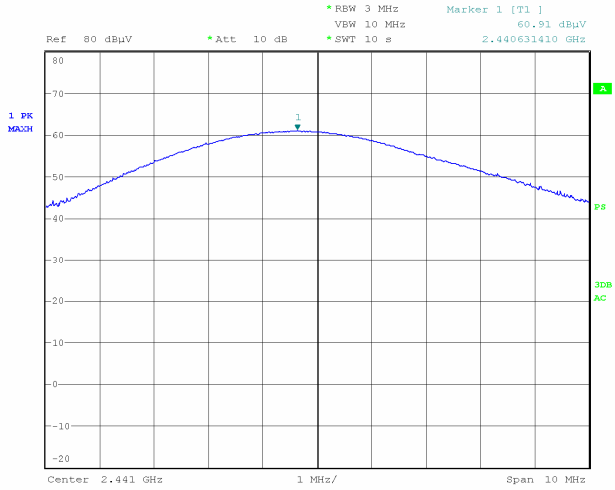
$$P = \frac{(E\,d)^2}{30G}$$

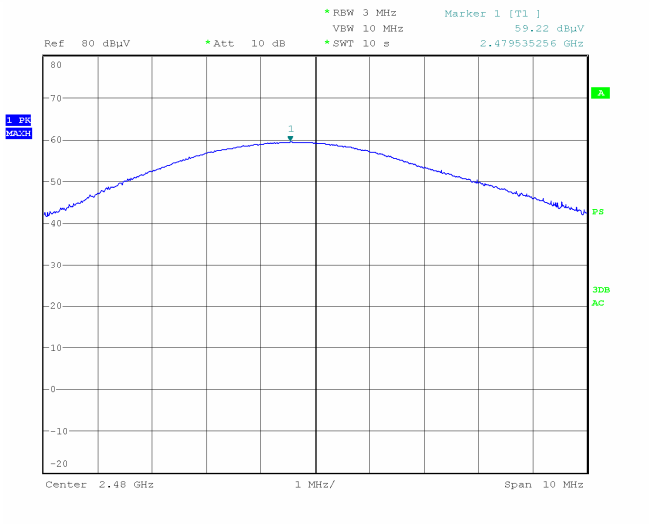
Modulation: GFSK – DH1 *Radiated measurement (conducted not possible)*

Channel	Channel Frequency (MHz)	Maximum Field (dBµV/m)	Peak Output Power (dBm)	Power Limit (dBm)	FC (dB)	PASS / FAIL
0	**2402**	95.40	0.17	**21**	**32.5**	**PASS**
39	**2441**	93.40	-1.80	**21**	**32.5**	**PASS**
78	**2480**	91.70	-3.50	**21**	**32.5**	**PASS**

Graphs:



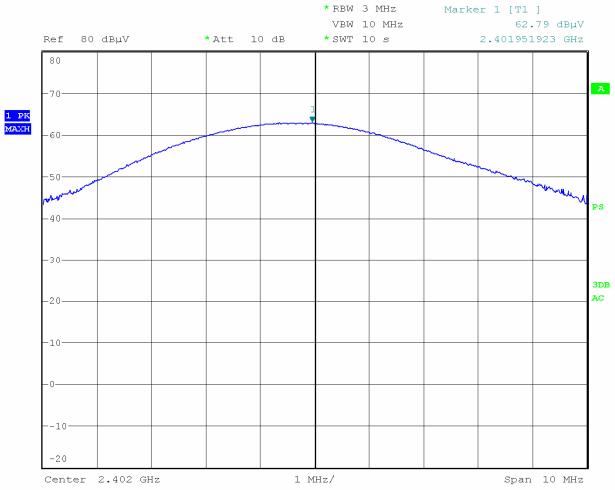


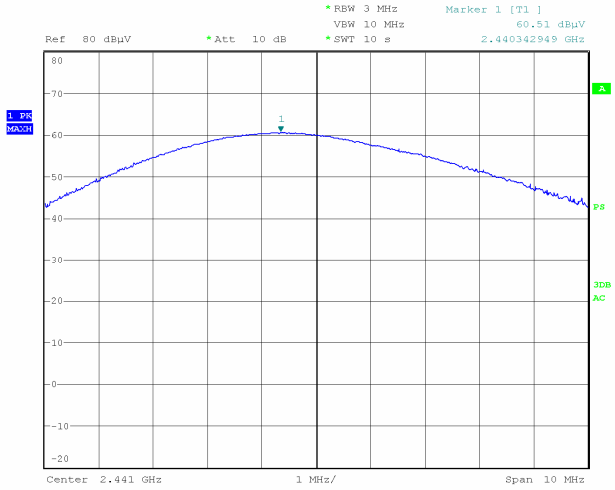


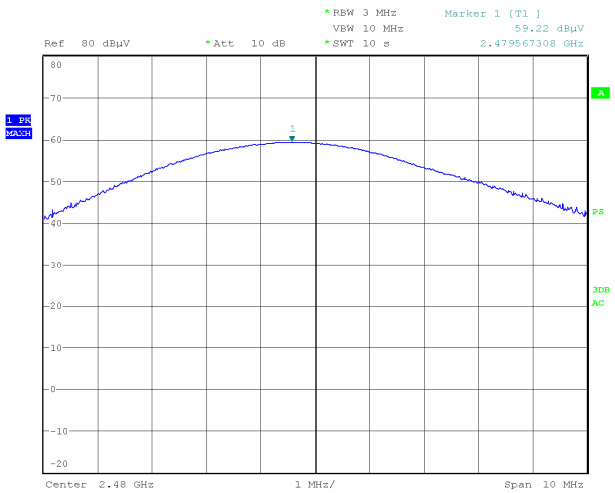
Modulation: GFSK – DH3 *Radiated measurement (conducted not possible)*

Channel	Channel Frequency (MHz)	Maximum Field (dBµV/m)	Peak Output Power (dBm)	Power Limit (dBm)	FC (dB)	PASS / FAIL
0	**2402**	95.30	0.07	**21**	**32.5**	**PASS**
39	**2441**	93.00	-2.20	**21**	**32.5**	**PASS**
78	**2480**	91.70	-3.50	**21**	**32.5**	**PASS**

Graphs:



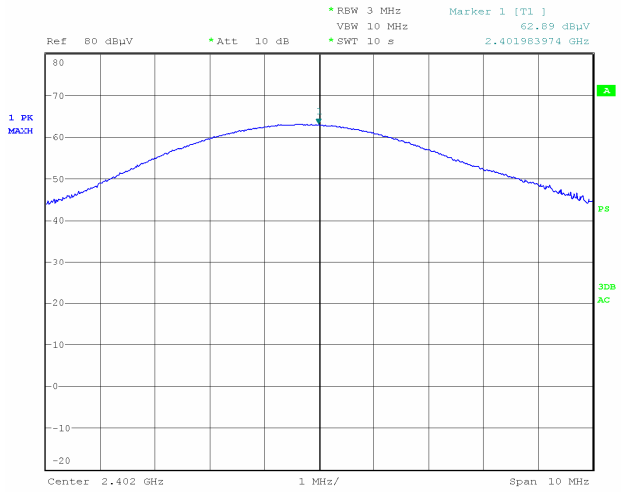


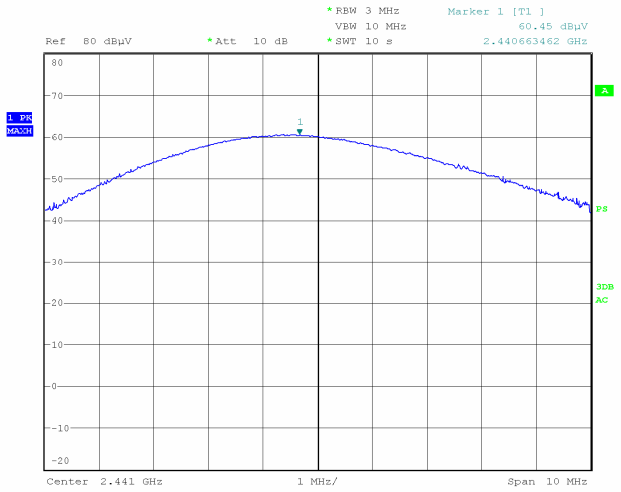


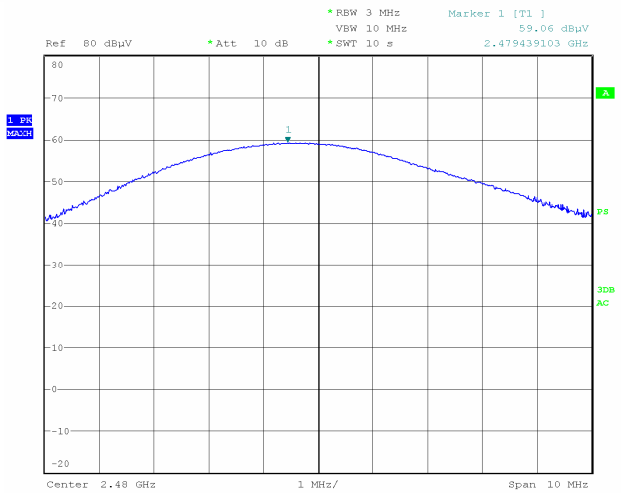
Modulation: GFSK – DH5 *Radiated measurement (conducted not possible)*

Channel	Channel Frequency (MHz)	Maximum Field (dBµV/m)	Peak Output Power (dBm)	Power Limit (dBm)	FC (dB)	PASS / FAIL
0	**2402**	95.40	0.17	**21**	**32.5**	**PASS**
39	**2441**	93.00	-2.20	**21**	**32.5**	**PASS**
78	**2480**	91.60	-3.60	**21**	**32.5**	**PASS**

Graphs:







6. HOPPING CHANNEL SEPARATION (15.247)

6.1. TEST CONDITIONS

Date of test : From November to December 2010
Test performed by : A.MERLIN
Atmospheric pressure : 990mb
Relative humidity : 44%
Ambient temperature : 20°C

6.2. LIMIT

For frequency hopping system operating in the 2400-2483.5MHz, if the 20dB bandwidth of hopping channel is greater than 25kHz, two-thirds 20dB Bandwidth of hopping channel shell be a minimum limit for the hopping channel separation.

6.3. EQUIPMENT CONFIGURATION

Modulation: GFSK
Packet Type: DH1 / DH3 / DH5
Hopping sequence: ON

6.4. SETUP – 20DB BANDWIDTH

The EUT is placed in an anechoic chamber; levels have been corrected to be in compliant with the Peak Output Power measured. The EUT is turn ON and using the MaxHold function, the frequency separation of two frequencies that were attenuated 20dB from the Peak Output Power level. A delta marker is used to measure the frequency difference as the emission bandwidth.

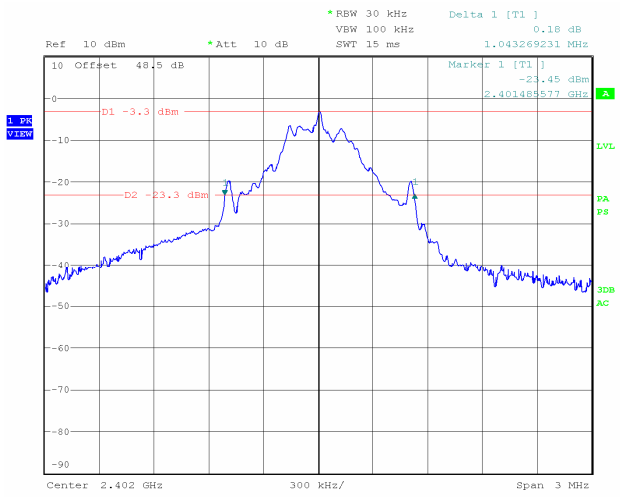
6.5. SETUP – ADJACENT CHANNEL SEPARATION

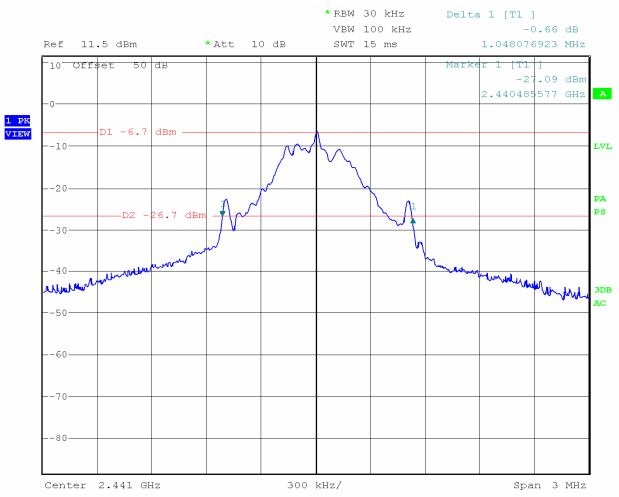
The EUT is placed in an anechoic chamber; levels have been corrected to be in compliant with the Peak Output Power measured. The EUT is turn ON and using the MaxHold function, the separation of two adjacent channels is recorded. A delta marker is used to measure the frequency difference.

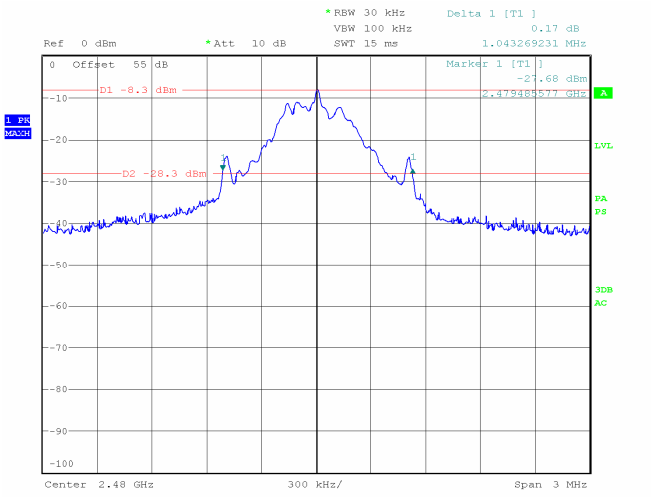
6.6. RESULTS – 20DB BANDWIDTH

Modulation: GFSK – DH1

Channel	Channel Frequency (MHz)	20dB Bandwidth (MHz)
0	2402	1.043
39	2441	1.048
78	2480	1.043

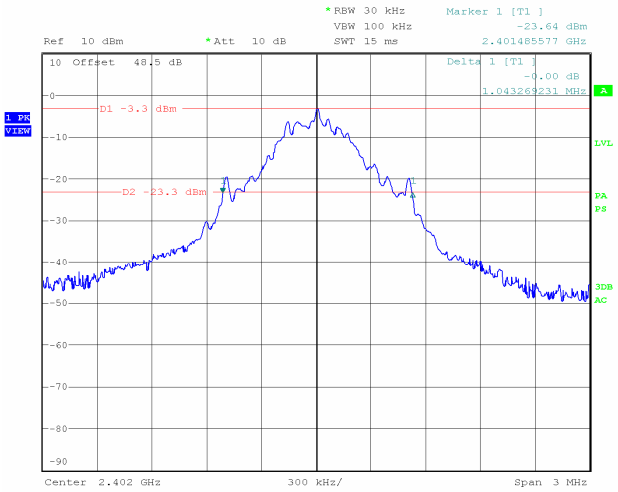


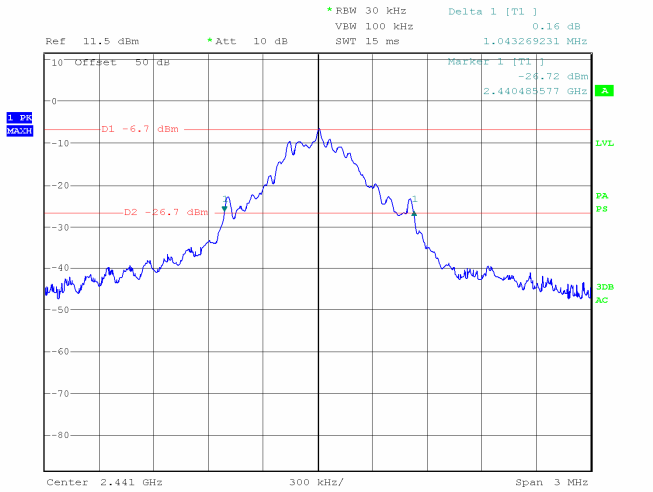


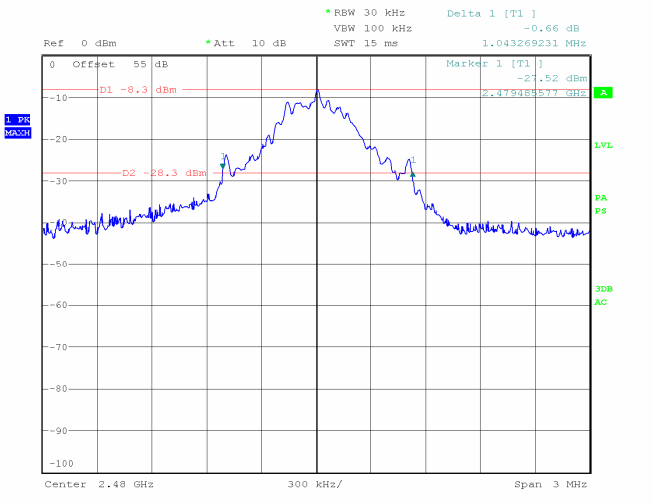


Modulation: GFSK – DH3

Channel	Channel Frequency (MHz)	20dB Bandwidth (MHz)
0	2402	1.043
39	2441	1.043
78	2480	1.043

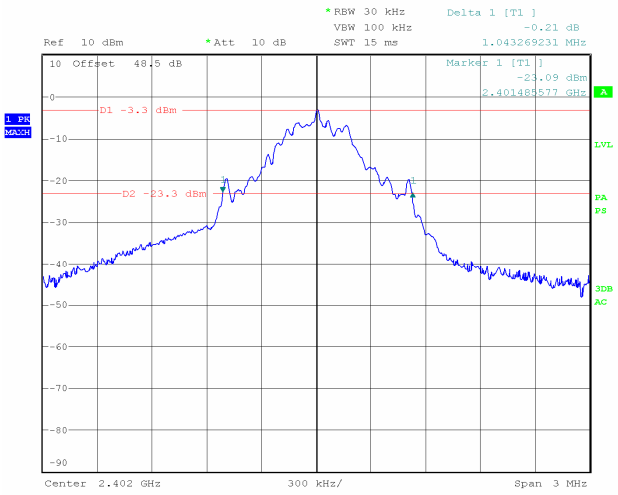


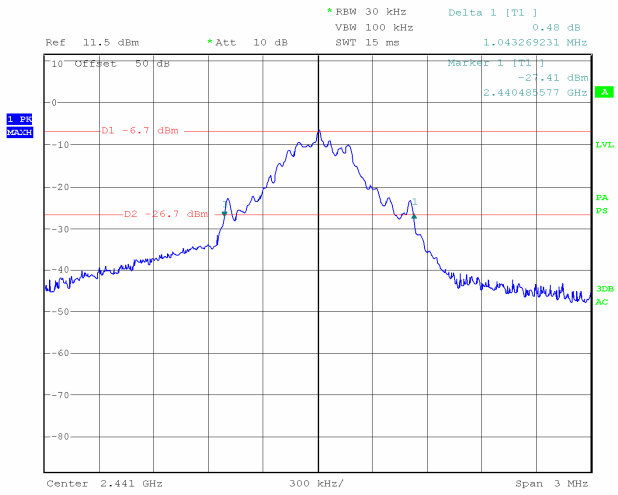


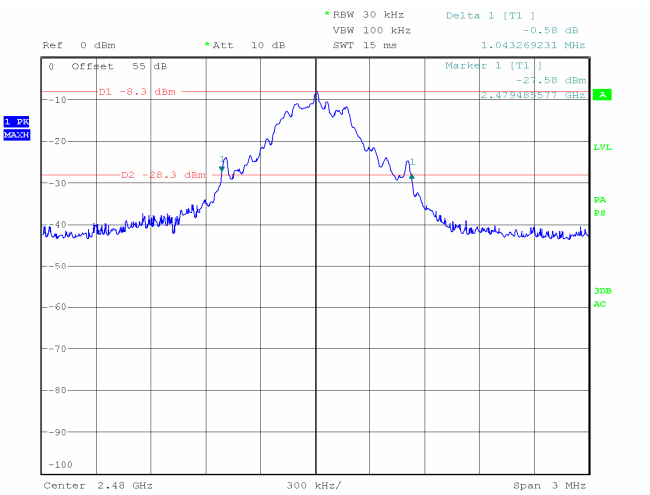


Modulation: GFSK – DH5

Channel	Channel Frequency (MHz)	20dB Bandwidth (MHz)
0	2402	1.043
39	2441	1.043
78	2480	1.043





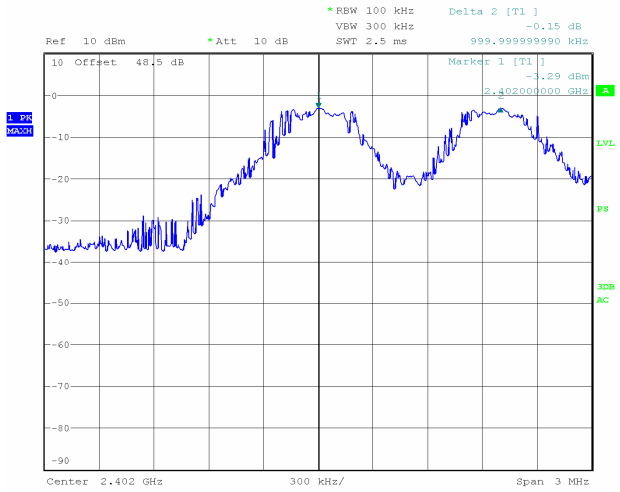


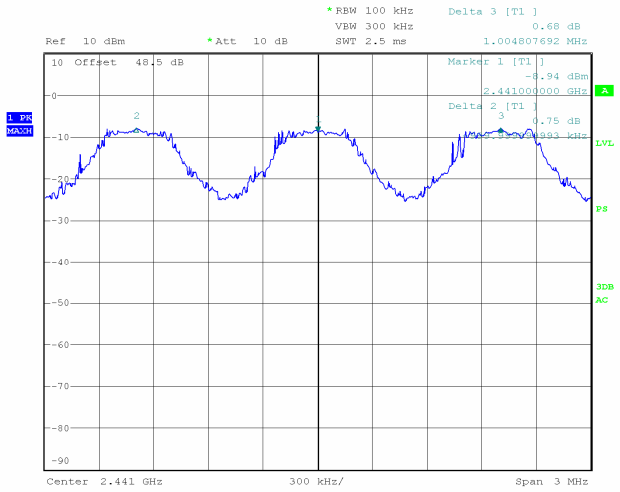
6.7. SETUP – ADJACENT CHANNEL SEPARATION

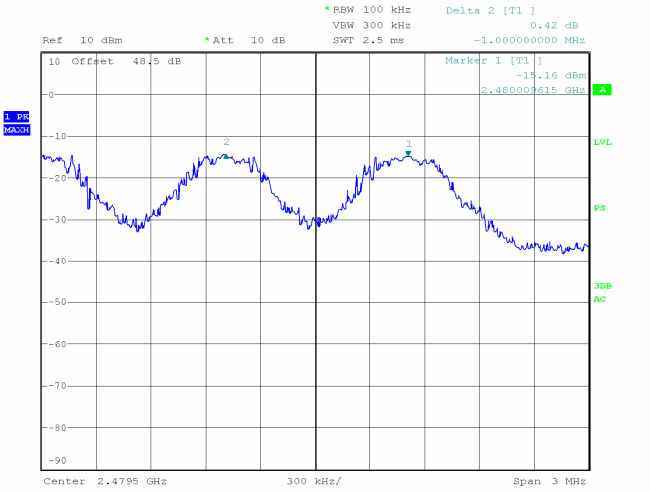
Modulation: GFSK – DH1

Channel	Channel Frequency (MHz)	Adjacent Channel Separation (MHz)	20dB Bandwidth (MHz)	Minimum Limit (MHz)	PASS / FAIL
0	2402	0.999	1.043	0.695	PASS
39	2441	1.004	1.048	0.698	PASS
78	2480	1.000	1.043	0.695	PASS

Limit used: Two-third 20dB Bandwidth



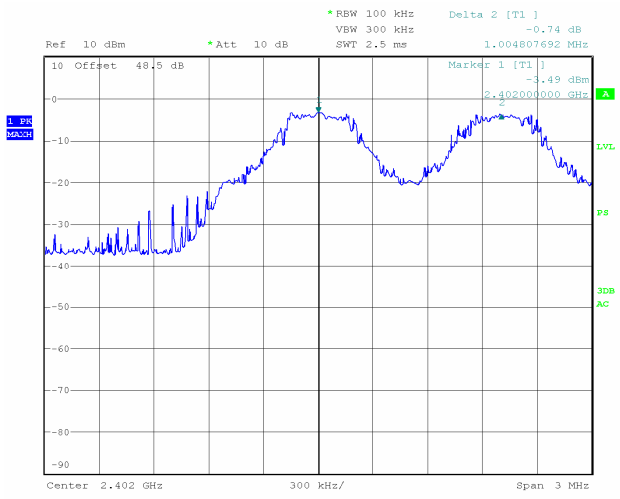


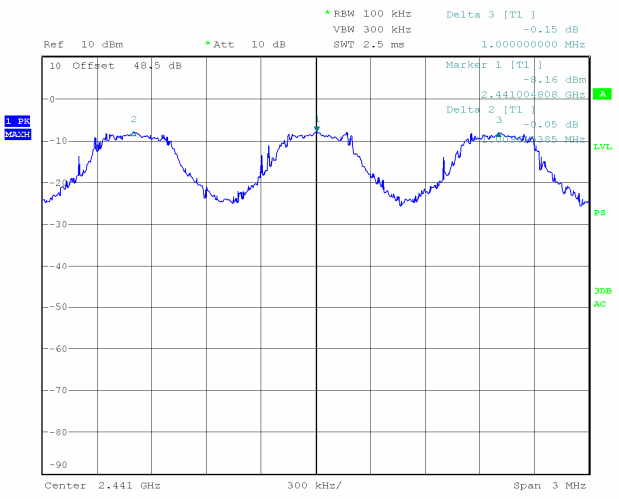


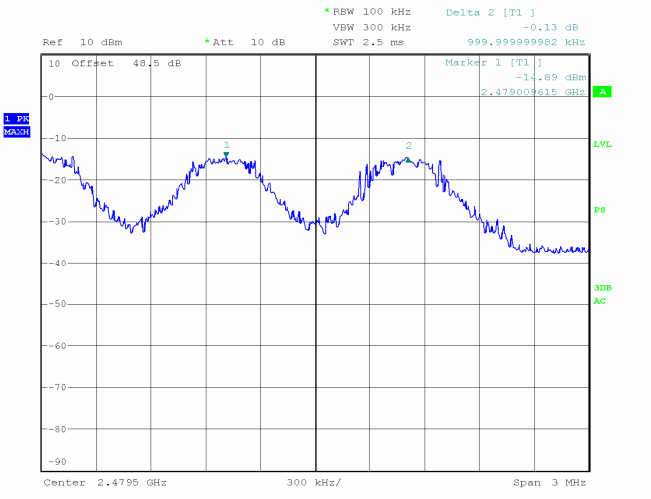
Modulation: GFSK – DH3

Channel	Channel Frequency (MHz)	Adjacent Channel Separation (MHz)	20dB Bandwidth (MHz)	Minimum Limit (MHz)	PASS / FAIL
0	2402	1.004	1.043	0.695	PASS
39	2441	1.000	1.043	0.695	PASS
78	2480	0.999	1.043	0.695	PASS

Limit used: Two-third 20dB Bandwidth



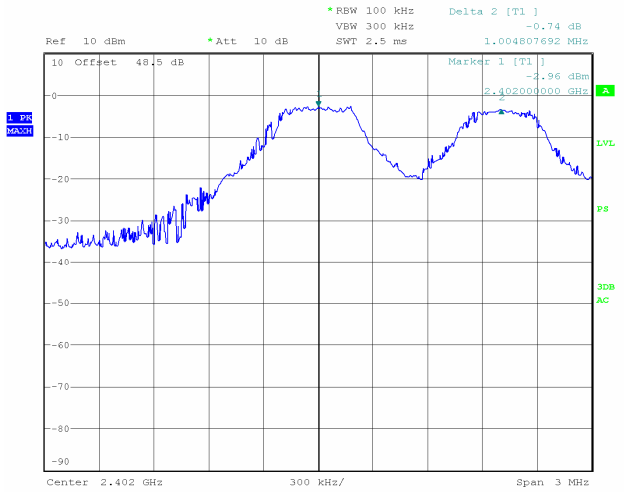


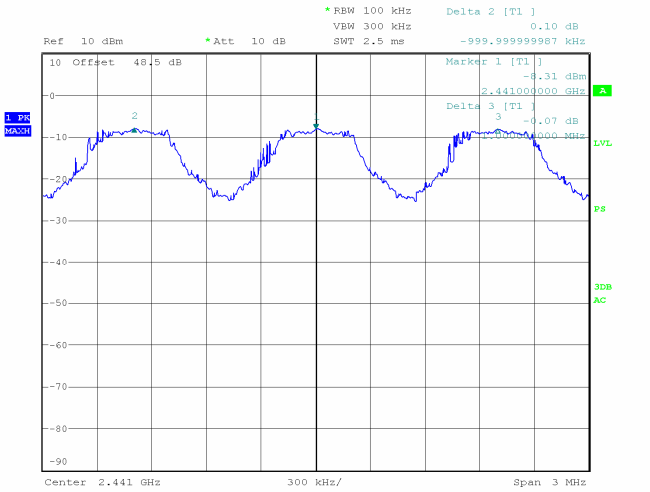


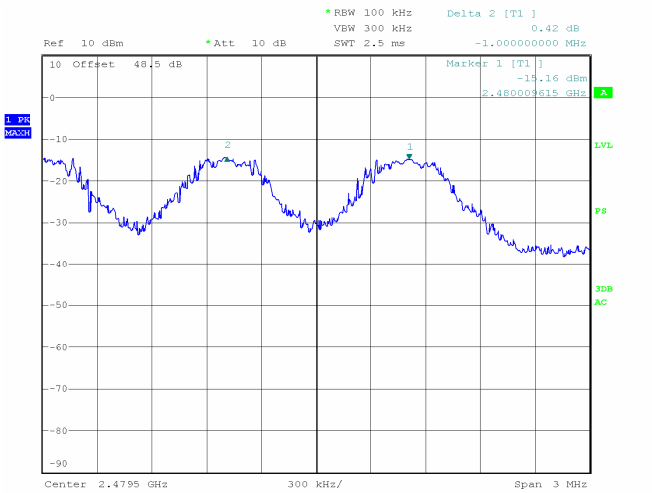
Modulation: GFSK – DH5

Channel	Channel Frequency (MHz)	Adjacent Channel Separation (MHz)	20dB Bandwidth (MHz)	Minimum Limit (MHz)	PASS / FAIL
0	2402	1.004	1.043	0.695	PASS
39	2441	1.000	1.043	0.695	PASS
78	2480	1.000	1.043	0.695	PASS

Limit used: Two-third 20dB Bandwidth







7. NUMBER OF HOPPING FREQUENCIES (15.247)

7.1. TEST CONDITIONS

Date of test : From November to December 2010
Test performed by : A.MERLIN
Atmospheric pressure : 990mb
Relative humidity : 44%
Ambient temperature : 20°C

7.2. LIMIT

For frequency hopping system operating in the 2400-2483.5MHz, at least 15 channels frequencies must be used and should be equally spaced.

7.3. EQUIPMENT CONFIGURATION

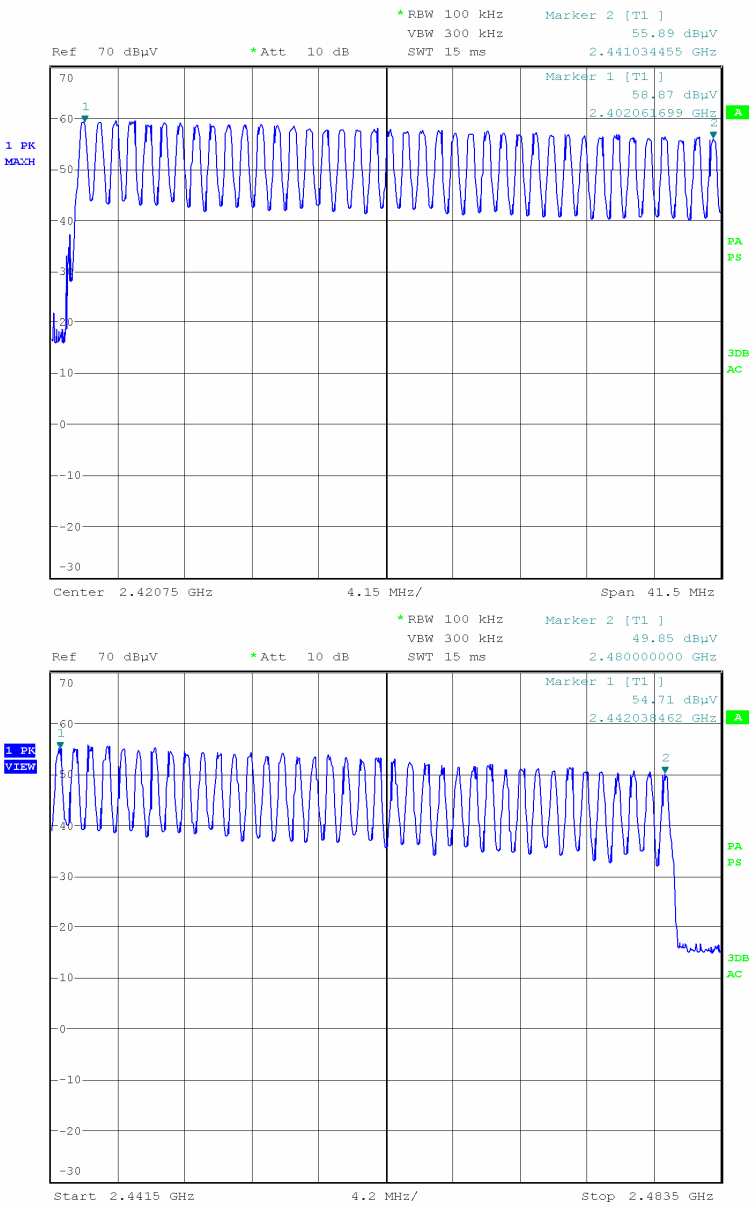
Modulation: GFSK
Packet Type: DH5 / DH3 / DH1, same results
Hopping sequence: ON

7.4. SETUP

The EUT is placed in an anechoic chamber. The EUT is turn ON and using the MaxHold function and a delta marker the number of frequencies used for this FHSS system is recorded, see following graphs.
RBW: 100kHz
VBW: 300kHz

7.5. RESULTS

GFSK – DH5:



Number of frequency used in the hopping sequence: 79 channels

8. TIME OF OCCUPANCY (DWELL TIME) (15.247)

8.1. TEST CONDITIONS

Date of test : From November to December 2010
Test performed by : A.MERLIN
Atmospheric pressure : 990mb
Relative humidity : 44%
Ambient temperature : 20°C

8.2. LIMIT

The average time of occupancy on any channel shall not be greater than 0.4 seconds within period of 0.4 seconds multiplied by the number of hopping channels employed.

8.3. EQUIPMENT CONFIGURATION

Modulation: GFSK
Channel frequency: 2402MHz
Hopping sequence: ON

8.4. SETUP

The EUT is placed in an anechoic chamber. The EUT is turn ON; the Dwell Time is measured and calculated using the zero SPAN mode on a channel frequency and a SWEEP with an adapter value to measure the number of transmission within a period and the time of transmission
RBW: 1MHz
VBW: 3MHz

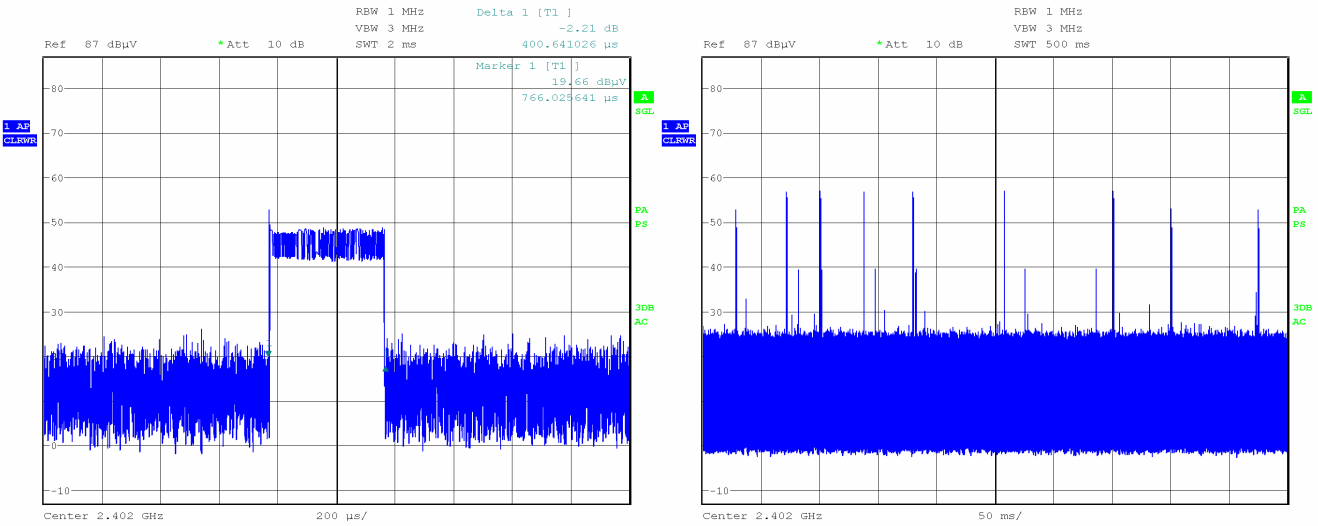
8.5. RESULTS

Modulation: GFSK

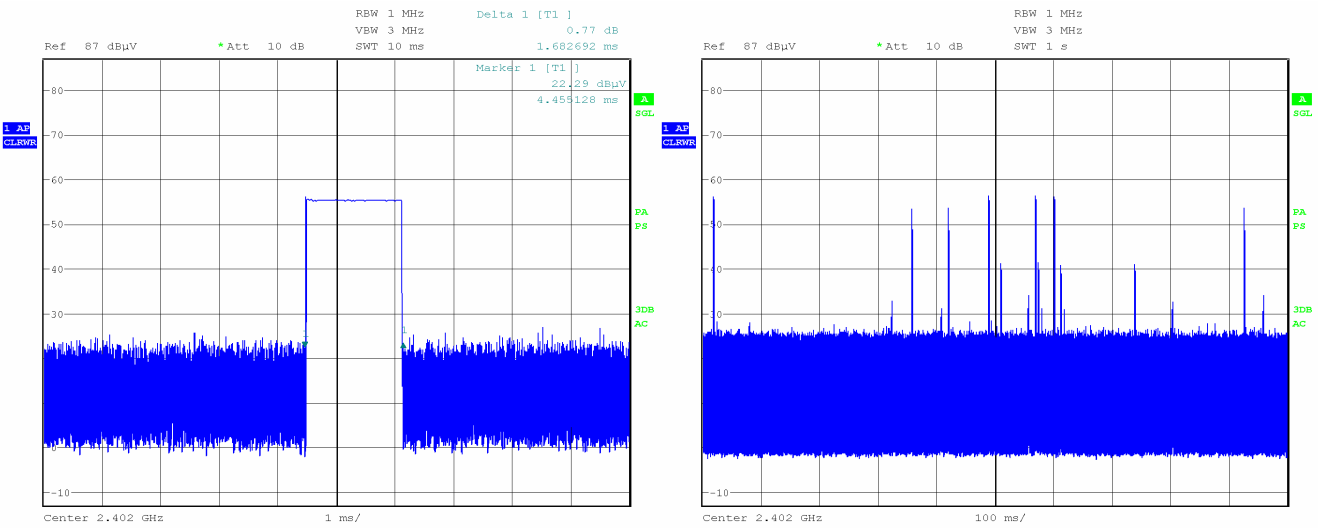
Packet Mode	Number of transmission in the period	Length of transmission time (ms)	Result (ms)	Limit (ms)	PASS / FAIL
DH1	9 (times/ 0.5sec) * 63.2	0.401	228	400	PASS
DH3	7 (times/ 1.0sec) * 31.6	1.683	372	400	PASS
DH5	4 (times/ 1.0sec) * 31.6	2.933	371	400	PASS

Note: Period of 31.6 seconds (79 channels x 0.4)

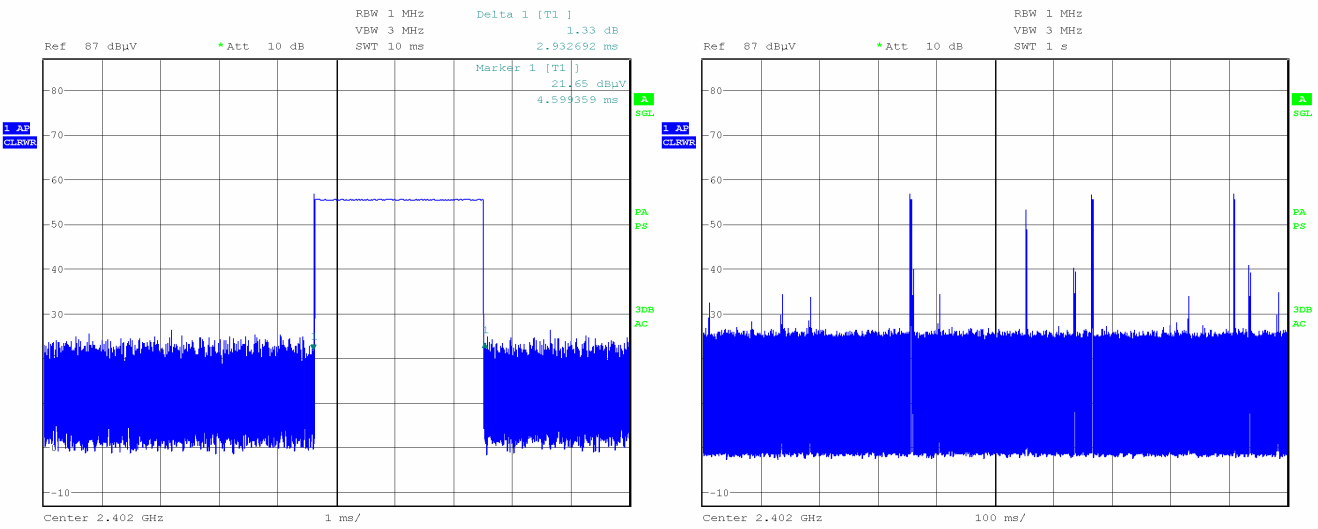
DH1 :



DH3 :



DH5 :


RBW 1 MHz
VBW 3 MHz
SWT 10 ms
Delta 1 [T1]
1.33 dB
2.932692 ms
Marker 1 [T1]
21.65 dBµV
4.599359 ms
Ref 87 dBµV
*Att 10 dB
1 AP
CLRWR
A
SGL
PA
PS
3DB
AC
Center 2.402 GHz
1 ms/
RBW 1 MHz
VBW 3 MHz
SWT 1 s
Ref 87 dBµV
*Att 10 dB
Center 2.402 GHz
100 ms/

9. BAND EDGE MEASUREMENT (15.247)

9.1. TEST CONDITIONS

Date of test : From November to December 2010
Test performed by : A.MERLIN
Atmospheric pressure : 990mb
Relative humidity : 44%
Ambient temperature : 20°C

9.2. LIMIT

In Bandedge, the limit of spurious emissions are below -20dB of the highest emission level of operating band (in 100kHz RBW).
In the restrict band (2310-2390MHz) and (2483.5-2500MHz) including bandedge, the limit of spurious emissions are 15.209. (RBW:1MHz / VBW:1MHz)

9.3. EQUIPMENT CONFIGURATION

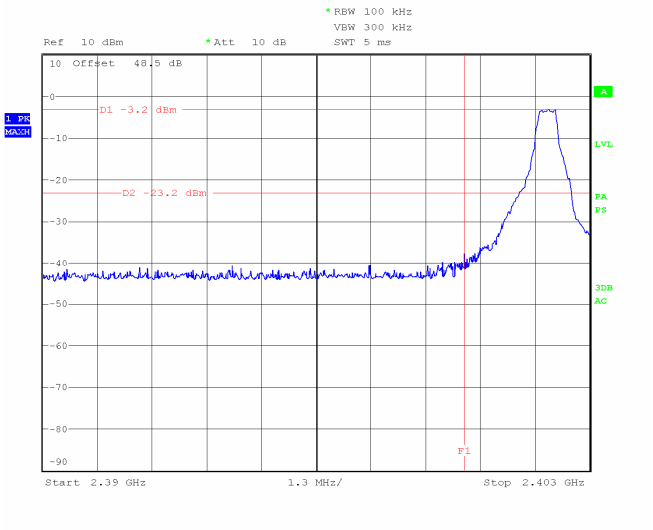
Modulation: GFSK
Hopping sequence: ON

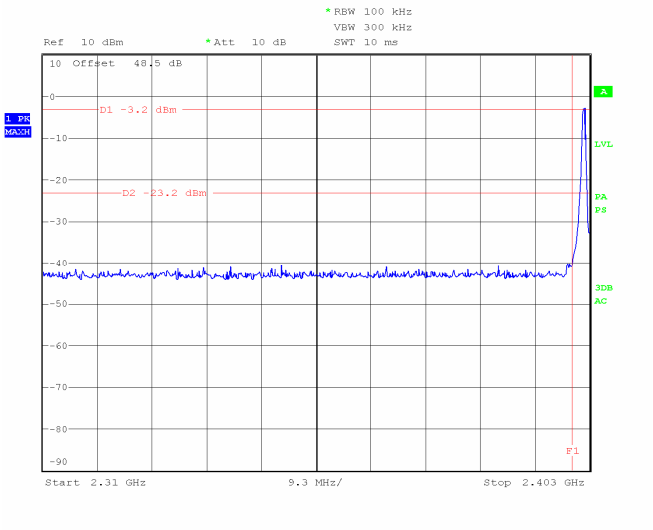
9.4. SETUP

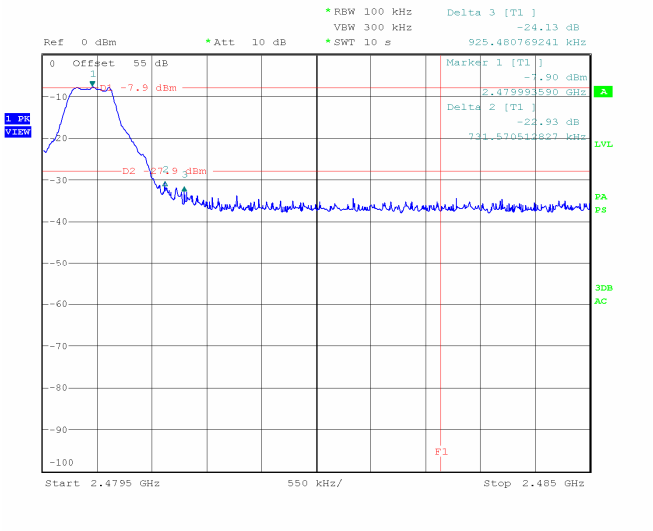
The EUT is placed in an anechoic chamber; levels have been corrected to be in compliant with Peak Output Power measurement. The EUT is turn ON; the graphs of the restrict frequency band are recorded with a display line indicating the highest level and other the 20dB offset below to show compliance with 15.247 (d) and 15.205. The emissions in restricted bands are compared to 15.209 limits.
RBW: 100kHz
VBW: 300kHz

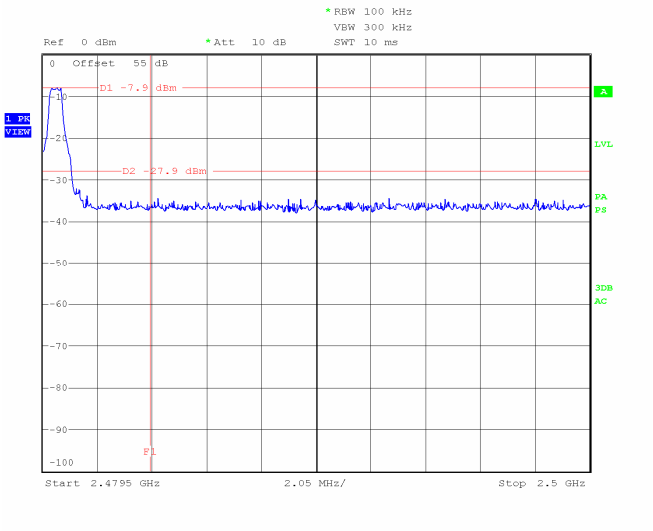
9.5. RESULTS

GFSK – DH1 :

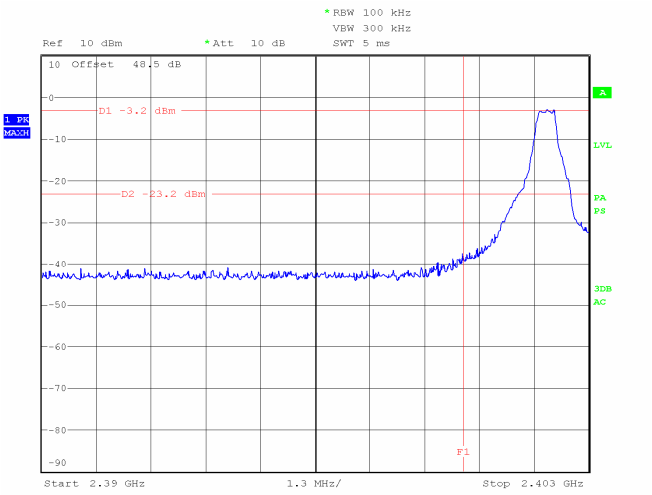


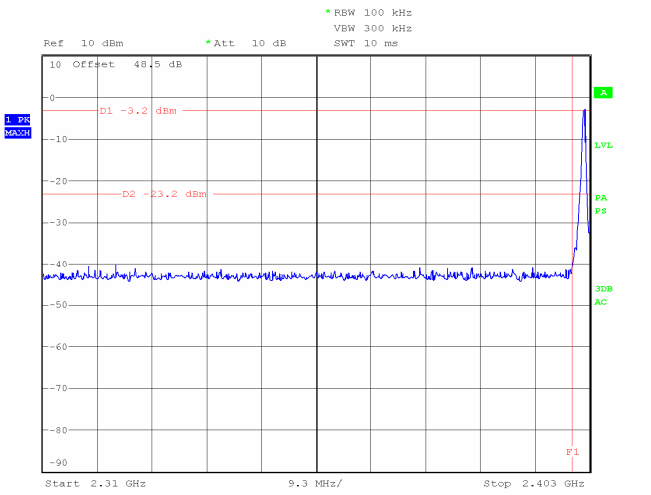


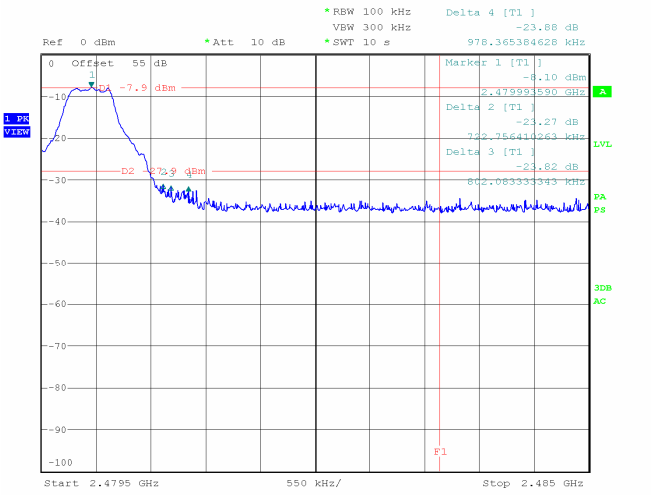


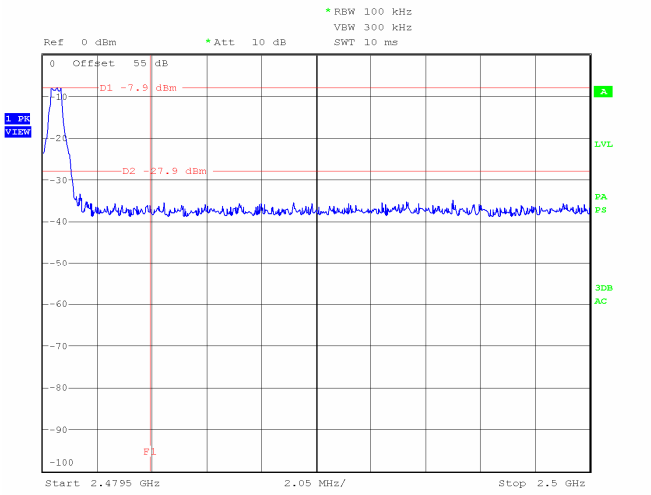


GFSK – DH3 :

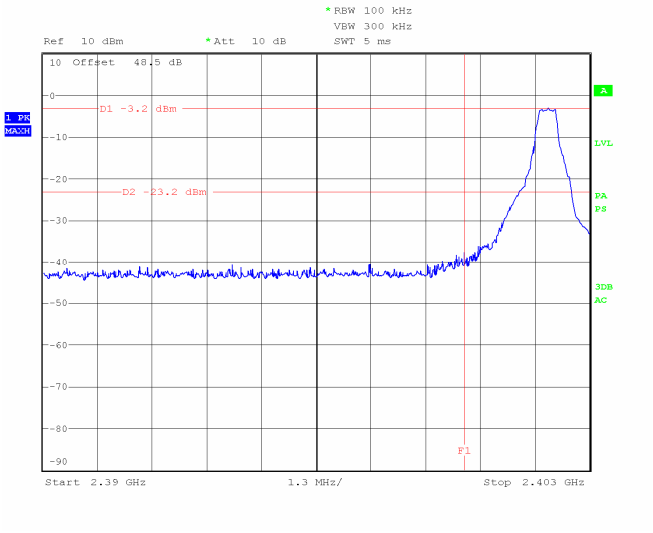

RBW 100 kHz
VBW 300 kHz
Ref 10 dBm
Att 10 dB
SWT 5 ms
Offset 48.5 dB
D1 -3.2 dBm
D2 -23.2 dBm
Start 2.39 GHz
1.3 MHz/
Stop 2.403 GHz

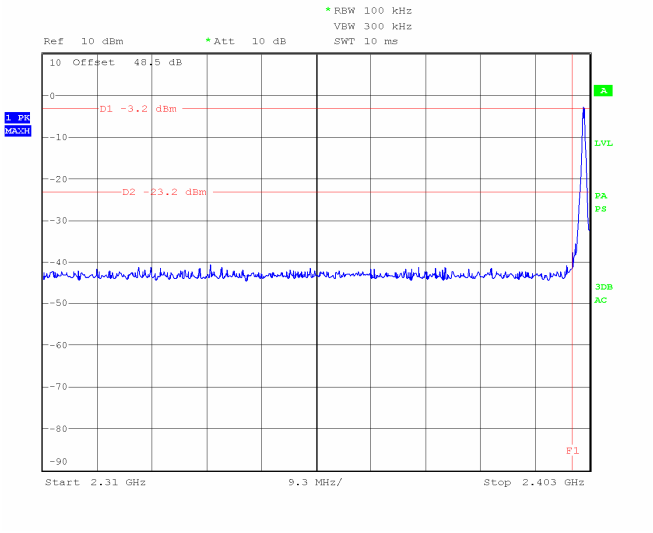

RBW 100 kHz
VBW 300 kHz
Ref 10 dBm
Att 10 dB
SWT 10 ms
Offset 48.5 dB
D1 -3.2 dBm
D2 -23.2 dBm
Start 2.31 GHz
9.3 MHz/
Stop 2.403 GHz

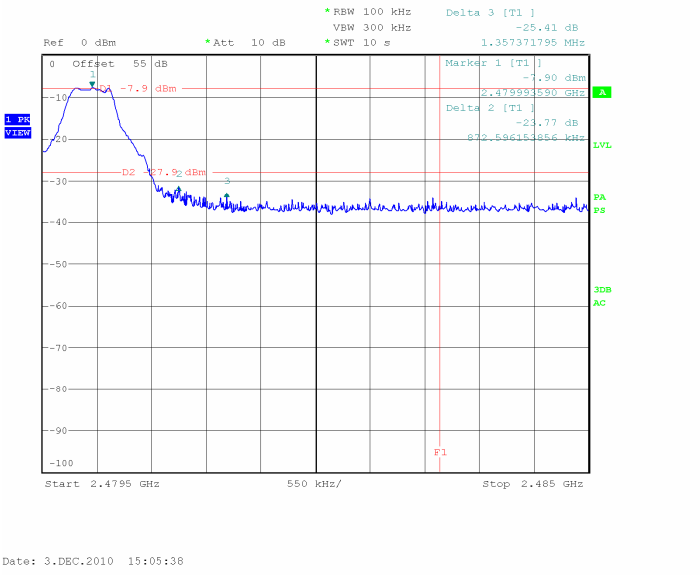

RBW 100 kHz
VBW 300 kHz
SWT 10 s
Ref 0 dBm
Att 10 dB
Offset 55 dB
D1 -7.9 dBm
D2 -27.9 dBm
Delta 4 [T1]
-23.88 dB
978.365384628 kHz
Marker 1 [T1]
-8.10 dBm
2.479993590 GHz
Delta 2 [T1]
-23.27 dB
722.756410263 kHz
Delta 3 [T1]
-23.82 dB
802.083333343 kHz
Start 2.4795 GHz
550 kHz/
Stop 2.485 GHz

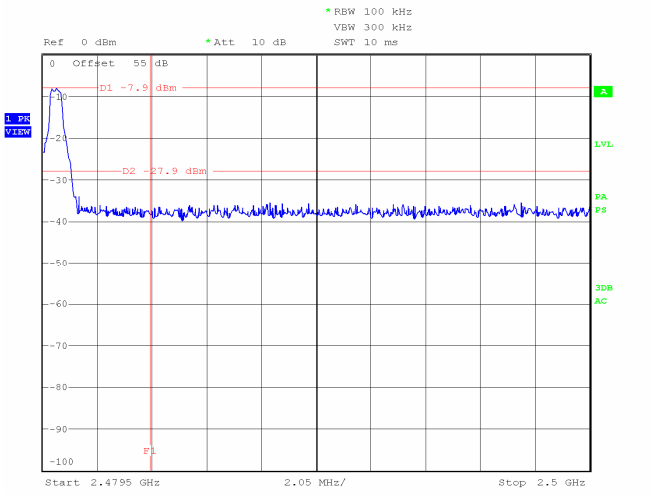

RBW 100 kHz
VBW 300 kHz
SWT 10 ms
Ref 0 dBm
Att 10 dB
Offset 55 dB
D1 -7.9 dBm
D2 -27.9 dBm
Start 2.4795 GHz
2.05 MHz/
Stop 2.5 GHz

GFSK – DH5:





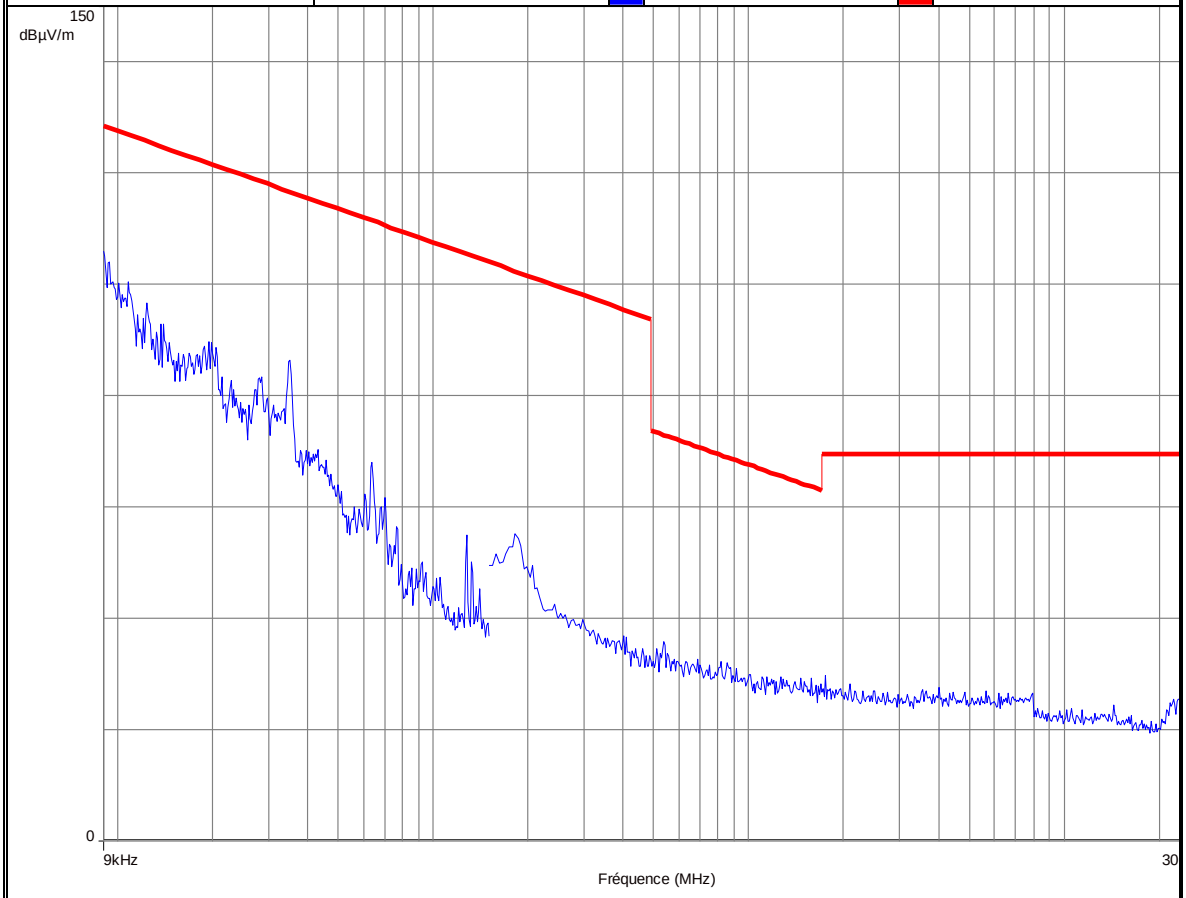




Date: 3.DEC.2010 15:05:38

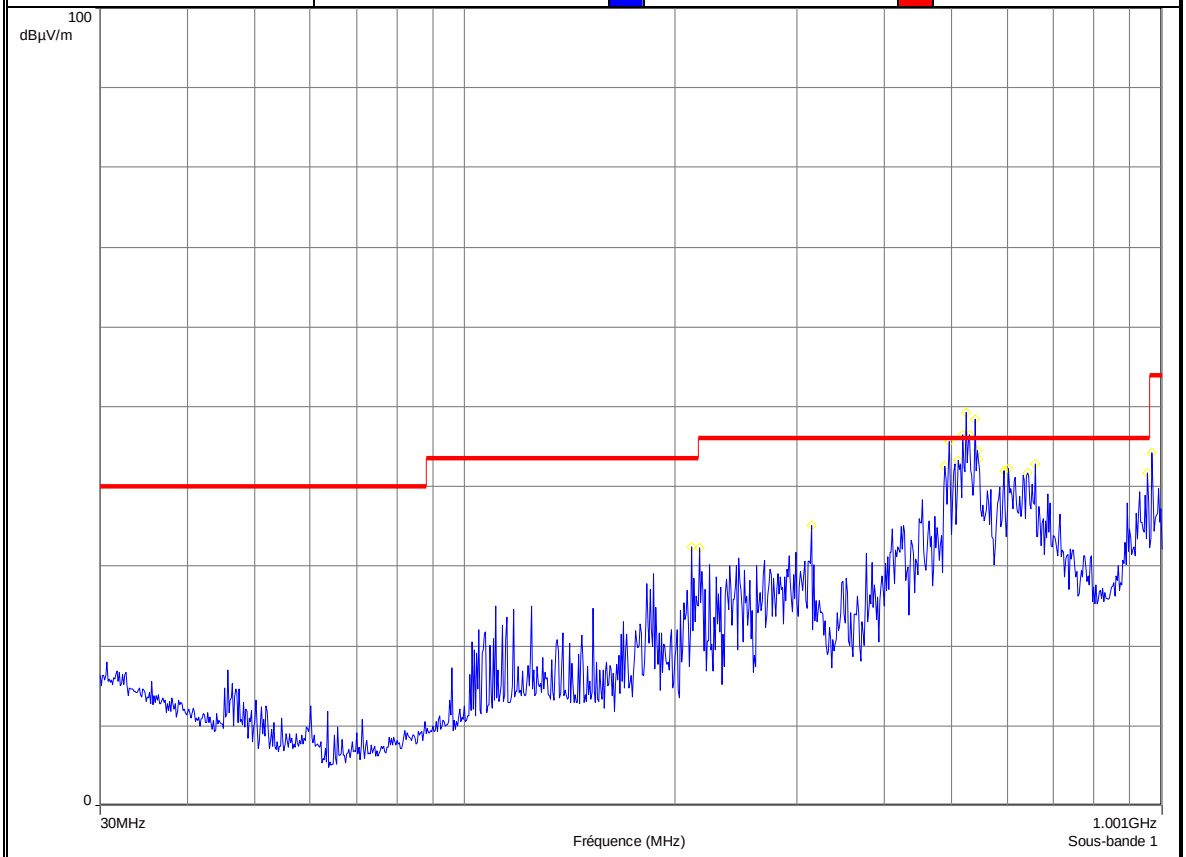
10. ANNEX 1 (GRAPHS)

RADIATED EMISSION		Test configuration:
Graph name:	**Emr#1**	**With power supply**
Azimuth:	**0°- 360°**	**Axis XY Worst case**
RBW:	**200Hz / 9kHz**	**Peak Measure** / **QPeak Limit@3m**



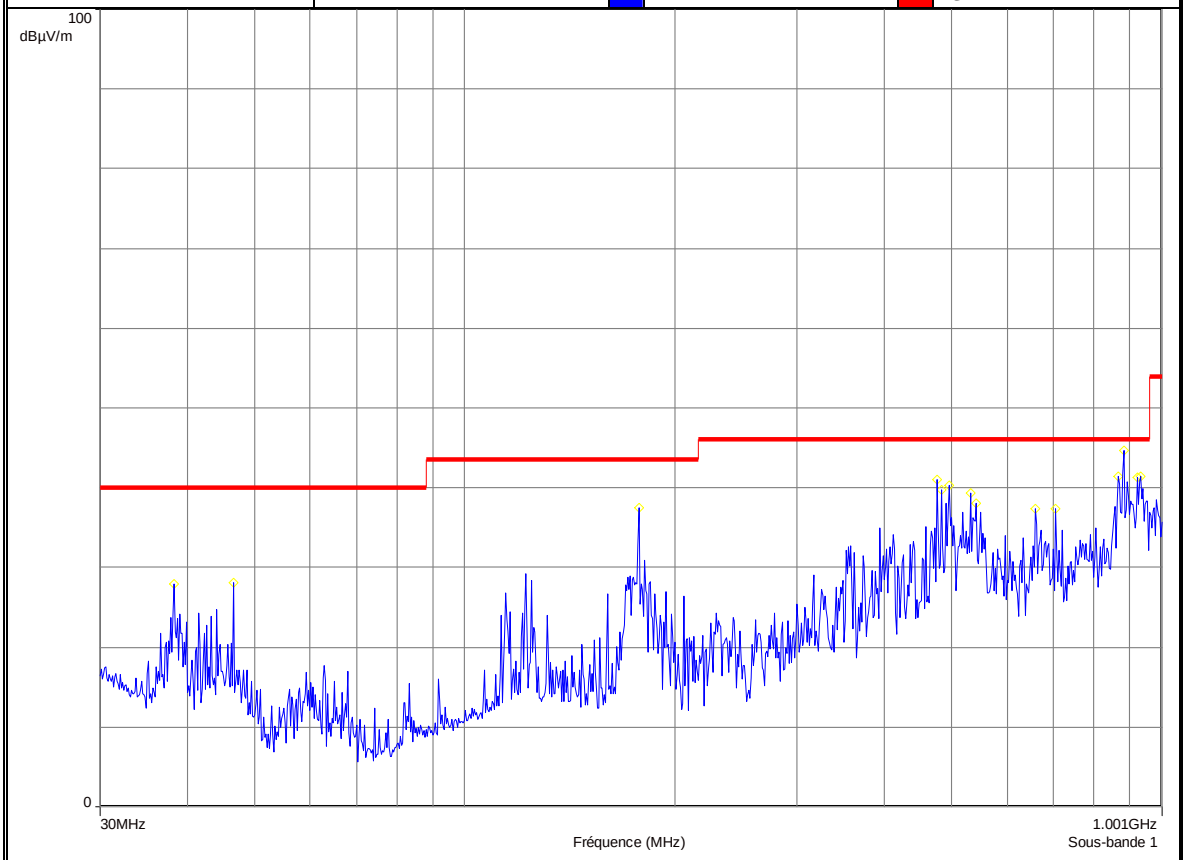
Frequency (MHz)	Peak (dBµV/m)
No frequency observed	

RADIATED EMISSION		Test configuration:
Graph name:	**Emr#2**	**Battery Mode**
Antenna position:	**Horizontal**	**Axis XY**
Azimuth:	**0° - 360°**	
RBW/VBW:	**120kHz / 300kHz**	**Peak Measure** / **QPeak Limit@3m**



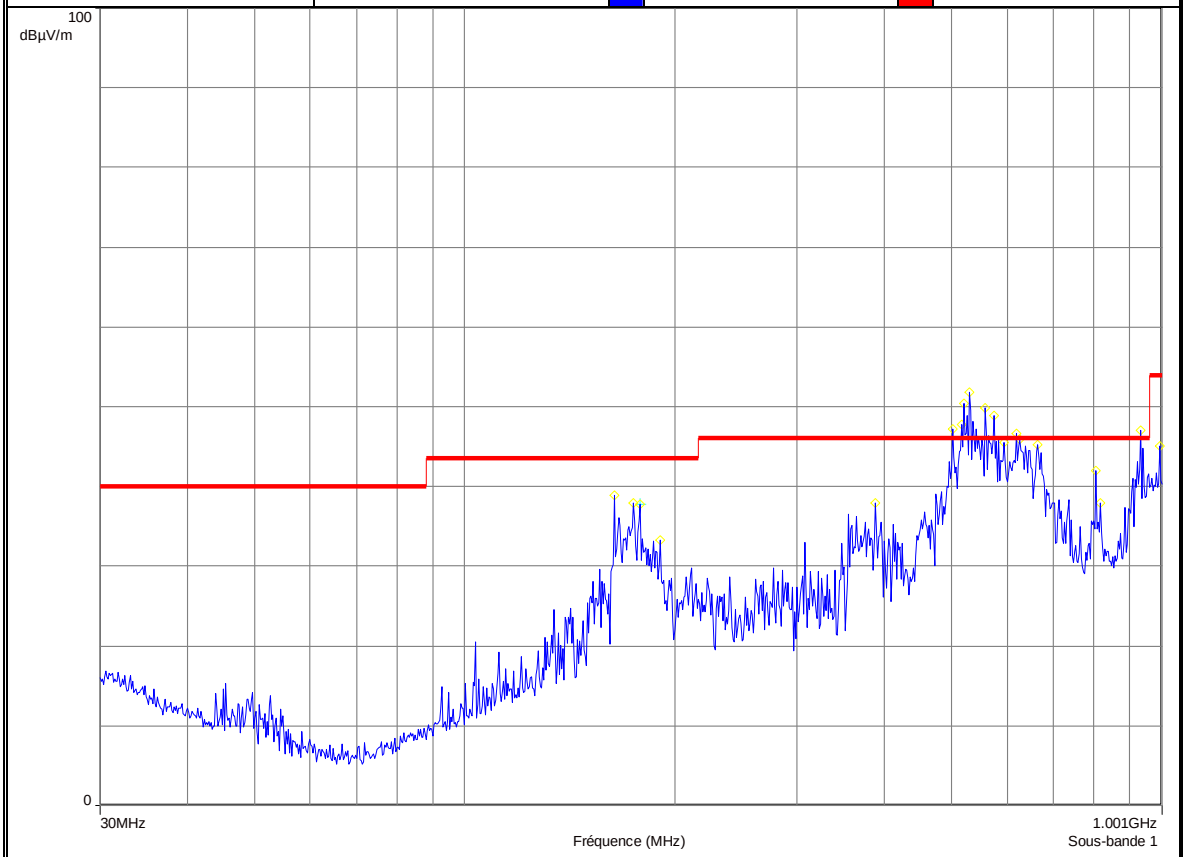
Frequency (MHz)	Peak (dBµV/m)
211.900	32.4
217.300	32.3
314.050	35.1
487.700	42.5
495.200	45.6
510.450	43.2
518.900	46.5
524.050	49.3
530.400	46.5
539.800	48.5
542.850	44.5
545.650	43.4
594.850	42.0
602.600	42.2
641.450	41.8
658.700	42.9
955.550	41.8
970.000	44.2

RADIATED EMISSION		Test configuration:
Graph name:	**Emr#3**	**Battery Mode**
Antenna position:	**Vertical**	**Axis XY**
Azimuth:	**0°- 360°**	
RBW/VBW:	**120kHz / 300kHz**	**Peak Measure** / **QPeak Limit@3m**



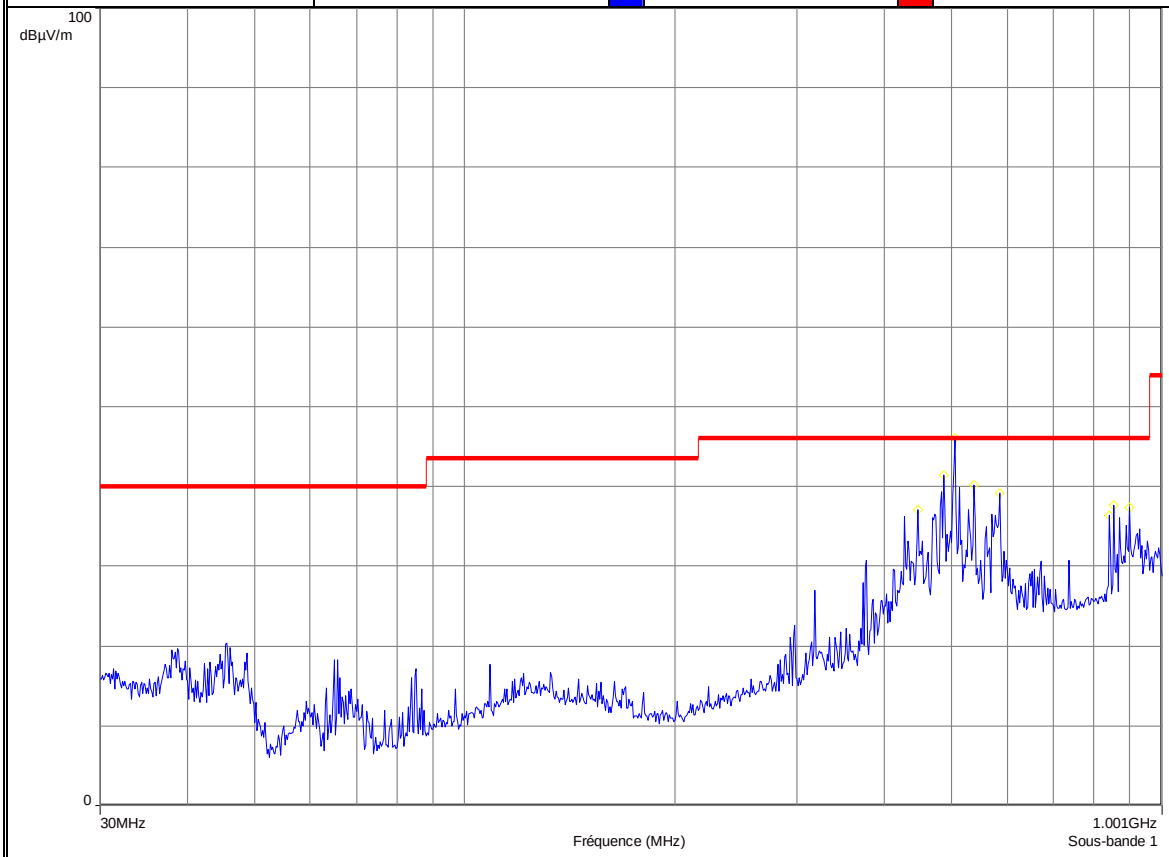
Frequency (MHz)	Peak (dBµV/m)
38.300	27.9
46.600	28.1
177.550	37.4
476.650	41.0
483.050	39.7
496.400	40.4
531.150	39.4
542.250	38.0
658.450	37.3
705.350	37.3
867.350	41.5
882.850	44.6
924.200	41.3
932.200	41.4

RADIATED EMISSION		Test configuration:
Graph name:	**Emr#4**	**Battery Mode**
Antenna position:	**Horizontal**	**Axis Z**
Azimuth:	**0°- 360°**	
RBW/VBW:	**120kHz / 300kHz**	**Peak Measure** / **QPeak Limit@3m**



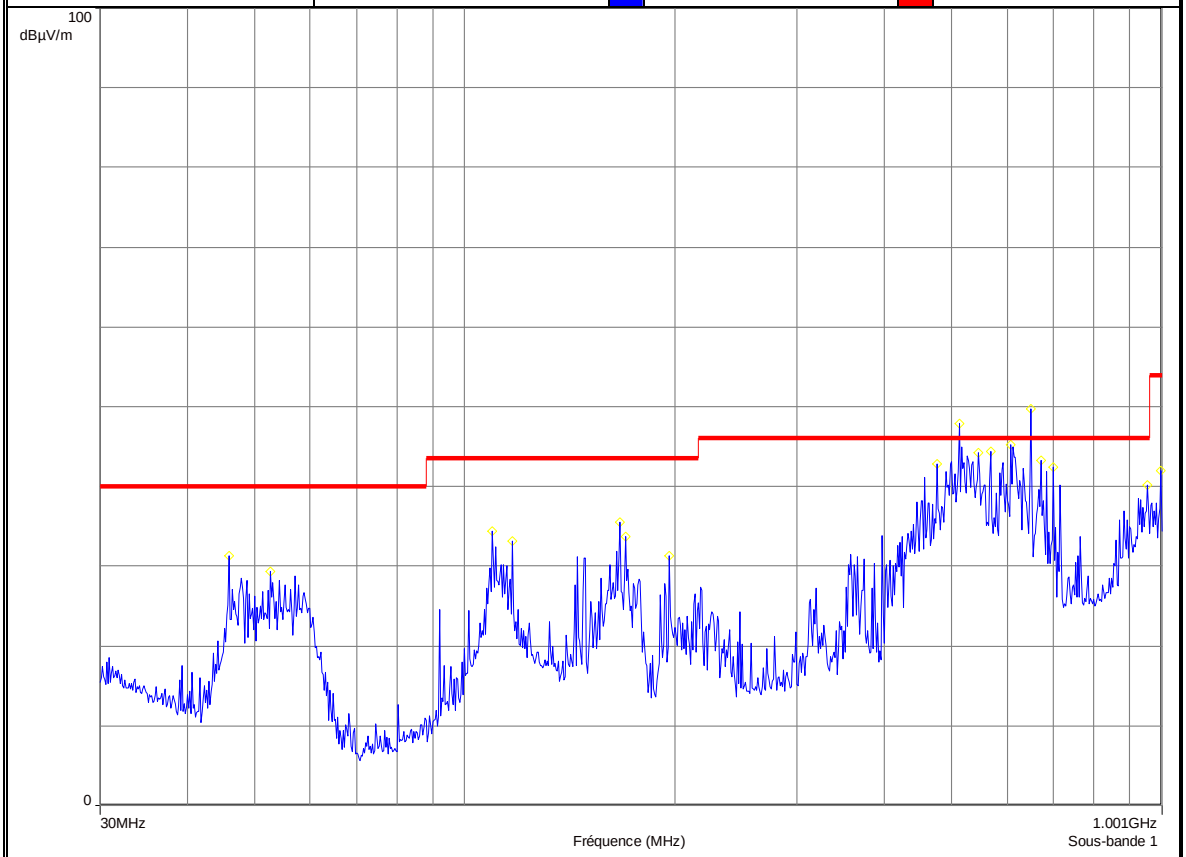
Frequency (MHz)	Peak (dBµV/m)
163.750	39.0
174.850	38.0
178.300	37.8
190.750	33.3
388.850	37.9
500.400	47.2
515.950	47.8
520.100	50.5
528.950	51.9
558.000	49.9
574.000	48.9
594.850	45.5
618.650	46.7
626.650	46.0
664.000	45.2
803.400	42.0
816.100	38.0
932.000	47.1
995.150	45.1

RADIATED EMISSION		Test configuration:
Graph name:	**Emr#5**	**Battery Mode**
Antenna position:	**Vertical**	**Axis Z**
Azimuth:	**0° - 360°**	
RBW/VBW:	**120kHz / 300kHz**	**Peak Measure** / **QPeak Limit@3m**



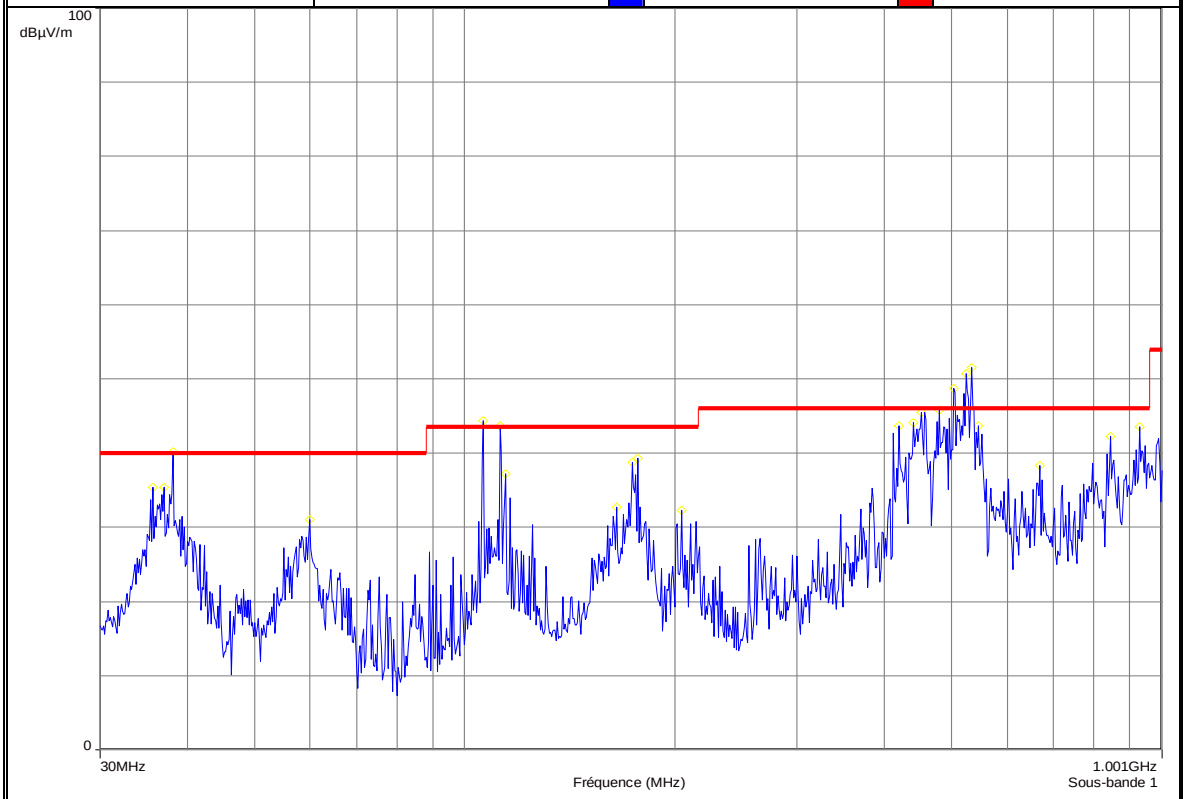
Frequency (MHz)	Peak (dBµV/m)
446.400	37.0
486.800	41.4
504.500	46.1
537.000	40.2
584.900	39.2
841.500	36.4
853.000	37.6
897.750	37.4

RADIATED EMISSION		Test configuration:	
Graph name:	**Emr#6**	**With power supply**	
Antenna position:	**Horizontal**	**Axis XY**	
Azimuth:	**0°- 360°**		
RBW/VBW:	**120kHz / 300kHz**	**Peak Measure**	**QPeak Limit@3m**



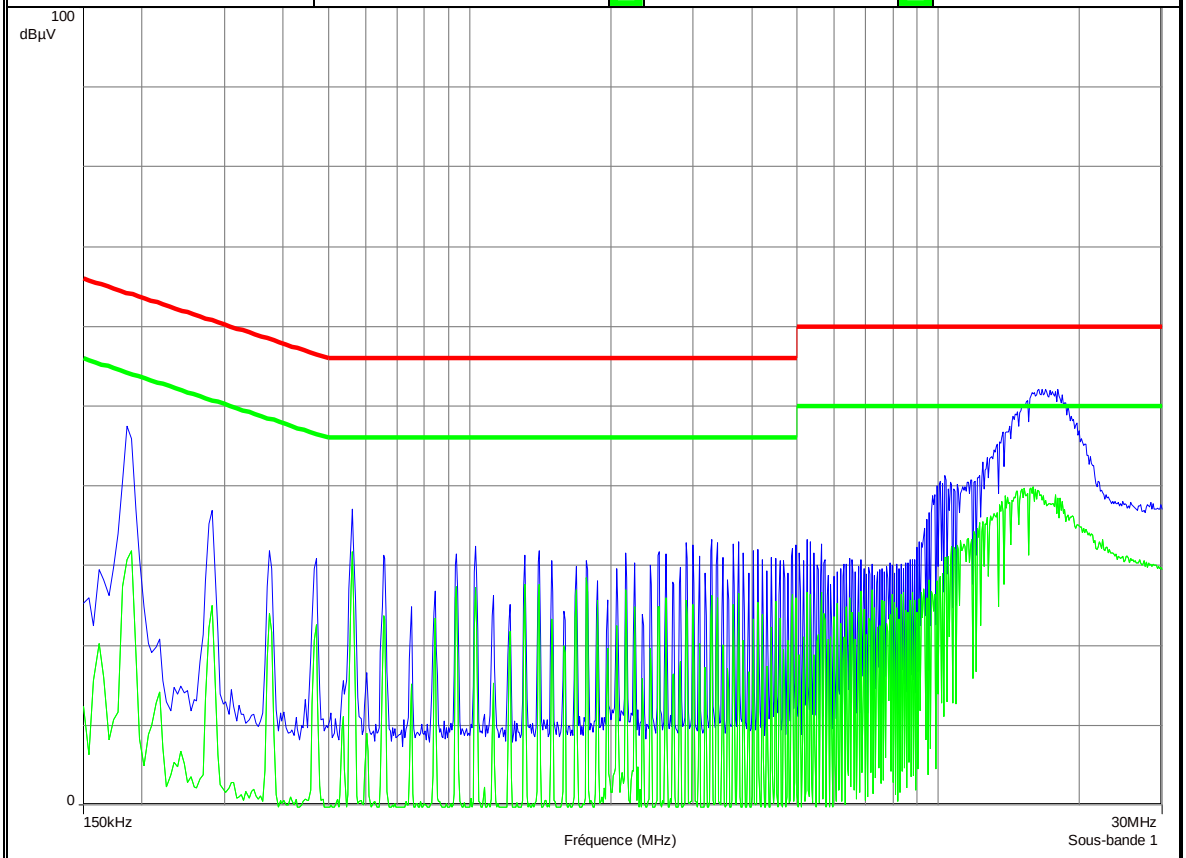
Frequency (MHz)	Peak (dBµV/m)
45.950	31.3
52.600	29.4
109.400	34.4
116.950	33.1
166.700	35.5
170.300	33.7
196.700	31.4
476.700	42.9
512.300	48.0
544.950	44.2
567.600	44.4
607.800	45.2
649.700	49.7
671.550	43.2
699.750	42.5
955.300	40.1
996.950	42.0

RADIATED EMISSION		Test configuration:
Graph name:	**Emr#7**	**With power supply**
Antenna position:	**Vertical**	**Axis XY**
Azimuth:	**0°- 360°**	
RBW/VBW:	**120kHz / 300kHz**	**Peak Measure** / **QPeak Limit@3m**



Frequency (MHz)	Peak (dBµV/m)
35.700	35.3
37.050	35.4
38.200	40.2
59.900	31.0
106.500	44.5
112.400	43.8
114.650	37.2
164.950	32.7
173.700	38.8
177.000	39.3
204.400	32.3
419.850	43.7
441.100	44.2
452.350	45.5
479.950	45.8
502.700	48.7
523.000	50.8
533.800	51.6
546.600	43.7
669.100	38.3
844.050	42.2
930.350	43.5

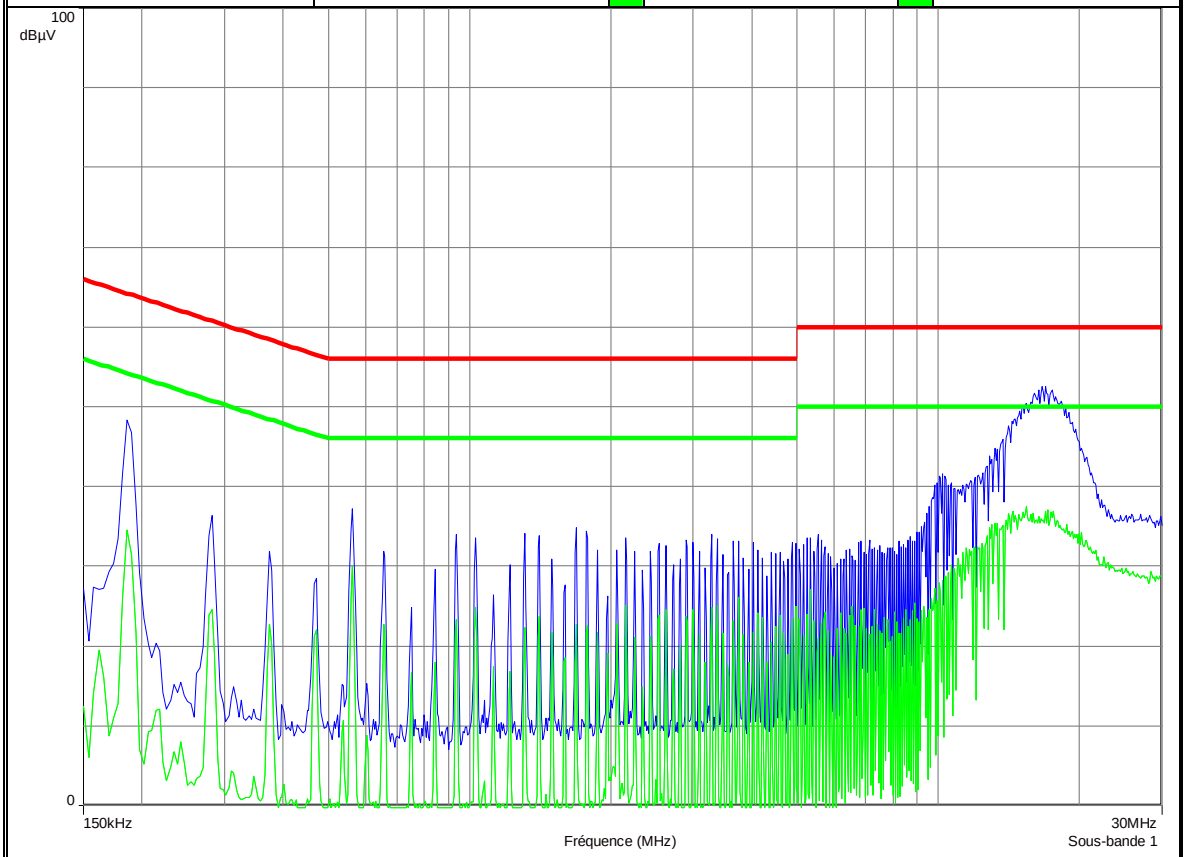
CONDUCTED EMISSIONS		Test configuration:			
Graph name:	**Emc#1**				
Voltage / Frequency	**120VAC / 60 Hz**				
Line/Port	**Phase 1**		**Peak Measure**		**QPeak Limit**
RBW / VBW :	**9kHz / 30kHz**		**Average Measure**		**Average Limit**



Frequency (MHz)	Avg (dBµV)	Lim Avg (dBµV)	Avg-LimAvg (dBµV)	QPeak (dBµV)	LimQPeak (dBµV)	QPeak-LimQPeak (dBµV)

No significative frequency observed

CONDUCTED EMISSIONS		Test configuration:			
Graph name:	**Emc#2**				
Voltage / Frequency	**120VAC / 60 Hz**				
Line/Port	**Neutral**	**Peak Measure**		**QPeak Limit**	
RBW / VBW :	**9kHz / 30kHz**	**Average Measure**		**Average Limit**	



Frequency (MHz)	Avg (dBµV)	Lim Avg (dBµV)	Avg-LimAvg (dBµV)	QPeak (dBµV)	LimQPeak (dBµV)	QPeak-LimQPeak (dBµV)

No significative frequency observed

11. TEST EQUIPMENT LIST

USED	N°LCIE	TYPE	COMPANY	REF	CAL DATE	CAL DUE
CONDUCTED EMISSION DATA						
x	A5329198	Cable	-	-	01/10	01/11
x	D3044010	Faraday Cage	RAY PROOF	-	01/10	01/11
x	A3169049	Conducted emission comb generator	BARDET	-	-	-
x	C2320123	LISN	RHODE & SCHWARZ	ENV216	05/10	05/11
x	A2642019	Receiver 20Hz – 8GHz	ROHDE & SCHWARZ	ESU8	07/10	07/11
x	A4049061	Transient limiter	HEWLETT PACKARD	11947A	12/09	12/10
RADIATED EMISSION DATA						
x	A7102024	Amplifier 1 - 8 GHz	HEROTEK	A1080304A	10/09	10/10
x	A7102026	Amplifier 8 - 26GHz	ALDETEC	ALS01452	-	-
x	C2040050	Antenna biconic	EMCO	3104C	01/10	01/11
x	C2040052	Antenna Loop	ELECTRO-METRICS	EM-6879	12/09	12/10
x	C2040056	Antenna log-periodic	EMCO	3146	01/10	01/11
x	C2040146	Antenna Bi-Log XWing	TESEQ	CBL6144	03/10	03/12
x	C2042028	Antenna horn 26GHz	SCHWARZBECK	BBHA 9170	-	-
x	C2042029	Antenna horn	EMCO	3115	09/09	09/10
x	A5329038	Cable N/N	-	-	02/10	02/11
x	A5329061	Cable N/N	SUCOFLEX	106G	12/09	12/10
x	A5329185	Cable N/N OATS (Mast at 3m)	UTIFLEX	-	05/10	05/11
x	A5329188	Cable N/N OATS (Mast at 10m)	UTIFLEX	-	05/10	05/11
x	A5329199	Cable N/N OATS (Mast at 10m)	UTIFLEX	-	05/10	05/11
x	A5329206	Cable N/N	-	-	02/10	02/11
x	D3044015	Semi-Anechoic chamber #2	SIEPEL	-	08/09	08/10
x	D3044017	Semi-Anechoic chamber #3	SIEPEL	-	-	-
x	A3169050	Radiated emission comb generator	BARDET	-	-	-
x	A7484035	High Pass (1-15GHz)	WAINRIGHT	WHKX 1.03/15G-10SS	01/09	01/11
x	F2000409	OATS	-	-	08/10	08/11
x	A2642019	Receiver 20Hz – 8GHz	ROHDE & SCHWARZ	ESU8	10/10	10/11
x	B4204052	Thermo-hygrometer	HUGER	-	04/10	04/12
x	F2000371	Turntable chamber (Cage#3)	ETS Lingren	Model 2165	-	-
x	F2000372	Turntable / Mast controller (OATS)	ETS Lindgren	Model 2066	-	-
x	F2000392	Antenna mast (OATS)	ETS Lindgren	2071-2	-	-
x	F2000393	Turntable controller (Cage#2-3)	ETS Lingren	Model 2066	-	-
x	F2000403	Turntable (OATS)	ETS Lindgren	Model 2187	-	-
x	F2000404	Turntable chamber (Cage#2)	ETS Lingren	Model 2165	-	-
MAXIMUM PEAK OUTPUT POWER						
x	C2042029	Antenna horn	EMCO	3115	09/09	09/10
x	A5329206	Cable N/N	-	-	02/10	02/11
x	F2000409	OATS	-	-	08/10	08/11
x	A2642019	Receiver 20Hz – 8GHz	ROHDE & SCHWARZ	ESU8	10/10	10/11
x	B4204052	Thermo-hygrometer	HUGER	-	04/10	04/12
x	F2000372	Turntable / Mast controller (OATS)	ETS Lindgren	Model 2066	-	-
x	F2000392	Antenna mast (OATS)	ETS Lindgren	2071-2	-	-
x	F2000403	Turntable (OATS)	ETS Lindgren	Model 2187	-	-
HOPPING CHANNEL SEPARATION						
x	C2042029	Antenna horn	EMCO	3115	09/09	09/10
x	A5329206	Cable N/N	-	-	02/10	02/11
x	A2642019	Receiver 20Hz – 8GHz	ROHDE & SCHWARZ	ESU8	10/10	10/11
NUMBER OF HOPPING CHANNEL						
x	C2042029	Antenna horn	EMCO	3115	09/09	09/10
x	A5329206	Cable N/N	-	-	02/10	02/11
x	A2642019	Receiver 20Hz – 8GHz	ROHDE & SCHWARZ	ESU8	10/10	10/11
TIME OF OCCUPANCY						
x	C2042029	Antenna horn	EMCO	3115	09/09	09/10
x	A5329206	Cable N/N	-	-	02/10	02/11
x	A2642019	Receiver 20Hz – 8GHz	ROHDE & SCHWARZ	ESU8	10/10	10/11
BAND EDGE MEASUREMENT						
x	C2042029	Antenna horn	EMCO	3115	09/09	09/10
x	A5329206	Cable N/N	-	-	02/10	02/11
x	A2642019	Receiver 20Hz – 8GHz	ROHDE & SCHWARZ	ESU8	10/10	10/11

12. 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