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Rapport d'essai / *Test report*

N° 570537-R2-E **JDE :** 120707

DELIVRE A / *ISSUED TO* : **BIOMERIEUX**
Chemin de l'orme
69280 MARCY L'ETOILE - FRANCE

Objet / *Subject* : Essais de compatibilité électromagnétique conformément aux normes
FCC CFR 47 Part 15, Subpart B et C
RSS-210 Issue 8
Electromagnetic compatibility tests according to the standards
FCC CFR 47 Part 15, Subpart B and C
RSS-210 Issue 8

Matériel testé / *Apparatus under test* :

- Produit / *Product* : **Air sampler**
- Marque / *Trade mark* : **BIOMERIEUX**
- Constructeur / *Manufacturer* : **LCB**
- Type / *Model* : **Air IDEAL 3P Traceability**
- N° de série / *serial number* : **100008**
- FCC ID : **Y4A-AI3PTRA1**
- IC ID : **9411A-AI3PTRA1**

Date des essais / *Test date* : Du 22 Mai au 4 Juin 2013 / *From May 22nd to June 4th, 2013*

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 :* 42 pages.

MOIRANS, LE 10 DÉCEMBRE 2013 / *DECEMBER 10TH, 2013*

Ecrit par / *Written by*
Anthony MERLIN

Approuvé par / *Approved by*
Jacques LORQUIN

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SUMMARY

1. TEST PROGRAM

Standard:
- **FCC Part 15, Subpart C 15.247**
- **ANSI C63.4 (2003)**
- **RSS-210 Issue 8 – Dec 2010**
- **RSS-Gen Issue 3 – Dec 2010**

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 *CFR 47 §15.209 (a)* *CFR 47 §15.247 (d)* *RSS-210 §A8.5*	**Measure at 300m** 9kHz-490kHz : 67.6dBµV/m /F(kHz) **Measure at 30m** 490kHz-1.705MHz : 87.6dBµV/m /F(kHz) 1.705MHz-30MHz : 29.5 dBµV/m			**PASS**
Radiated emissions 30MHz-25GHz* *CFR 47 §15.209 (a)* *CFR 47 §15.247 (d)* *RSS-210 §A8.5*	**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 *CFR 47 §15.247 (b)* *RSS-210 §A8.4(1)*	**Limit: 30dBm** Conducted or Radiated measurement			**PASS**
Hopping Channel Separation *CFR 47 §15.247 (a) (1)* *RSS-210 §A8.1(b)*	**Minimum between:** Two-third 20dB Bandwidth or 25kHz Whichever is greater			**PASS**
Number of Hopping Frequencies *CFR 47 §15.247 (a) (1) (iii)* *RSS-210 §A8.1(d)*	**At least 15 channels used**			**PASS**
Time of Occupancy (Dwell Time) *CFR 47 §15.247 (a) (1) (iii)* *RSS-210 §A8.1(d)*	**Maximum 0.4 sec within 31.6sec**			**PASS**
Band Edge Measurement *CFR 47 §15.209 (a)* *CFR 47 §15.247 (d)* *RSS-210 §A8.5*	**Limit: -20dBc**			**PASS**
Occupied bandwidth *RSS-Gen §4.6.1*	**No limit**			**PASS**
Receiver Spurious Emission** *RSS-Gen §4.10*	**See RSS-Gen §4.10**			**NA**

***§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. 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):

Air IDEAL 3P Traceability Serial number: 100008

- Internal max frequencies: <108MHz

- **Power supply:**

- AC / DC Adaptor: SINPRO, SPU25A-105, Sn: 07601629 1217. 100-240VAC, 47-63Hz / 0.55A, 12VDC / 2.08A
- Battery: SAFT type 2S2P VL18650 B, Li-ion 7.4VDC

During all the tests, EUT is supplied by this power supply or power supply of laboratory for nominal DC voltage.

- **Input/output:**

- 1 x DC input

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

- None

- **Auxiliaries used for testing:**

- None

- **Equipment information:**

- Frequency band:	[2400.0 - 2483.5] MHz		
- Standard:	☐Wifi	☒Bluetooth	☐Zigbee
- Spectrum Modulation:	☒FHSS		☐DSSS
- Modulation type:	☒GFSK	☒Pi/4 DQPSK	☒8DPSK
Packet type:	1-DH5	2-DH5	3-DH5
Transfert data rate:	1Mbps	2Mbps	3Mbps
- Number of channel:	79		
- Channel separation:	☐5MHz	☐2MHz	☒1MHz
- Channel bandwidth:	☐10MHz	☐20MHz	☒1MHz
- Channel tested:	Full test on 2402MHz / 2441MHz and 2480MHz		
- RF mode:	☒TX/RX	☐RX	☐Standby
- Antenna type:	Patch		
- Antenna connector:	☐Permanent external		☐Permanent internal
	☐None		☒Temporary (only for tests)

2.3. EUT CONFIGURATION

Bluetooth configuration:
A special configuration of the EUT during radiated and conducted tests permits:

- Permanent emission of the carrier frequency without modulation, highest, middle and lowest channel
- Permanent emission of the carrier frequency with modulation, highest, middle and lowest channel
- Choice of modulation type: Worst case, packet type DH5 with all modulations
- FHSS mode ON or OFF

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

Sampling Settings:
Volume 2000liters

Mode of power supply:

- Battery
- Adaptor AC/DC power supply

Worst case of several configurations are measured and presented in this test report.

2.4. EQUIPMENT MODIFICATIONS

None

2.5. SPECIAL ACCESSORIES

None

3. CONDUCTED EMISSION DATA

3.1. TEST CONDITIONS

Date of test : June 4th, 2013
Test performed by : A.MERLIN
Atmospheric pressure : 997hPa
Relative humidity : 34%
Ambient temperature : 23°C

3.2. 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.

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 EQUIPMENT LIST

DESCRIPTION	MANUFACTURER	MODEL	N° LCIE
Cable	-	-	A5329578
Conducted emission comb generator	BARDET	-	A3169049
LISN tri-phase ESH2-Z5	RHODE & SCHWARZ	33852.19.53	C2320062
Receiver 20Hz – 8GHz	ROHDE & SCHWARZ	ESU8	A2642019
Transient limiter	RHODE & SCHWARZ	ESH3-Z2	A7122204

3.5. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

None

3.6. 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

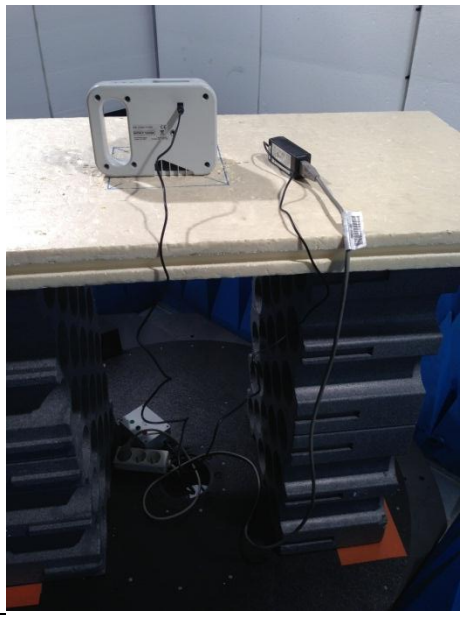
4. RADIATED EMISSION DATA

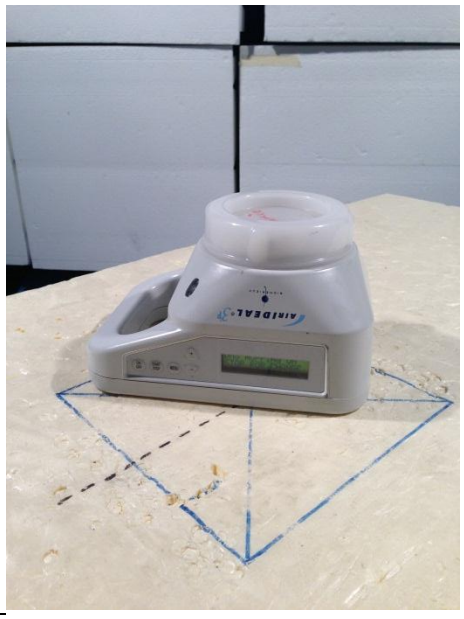
4.1. TEST CONDITIONS

Date of test	: May 24th, 2012	and	June 4th, 2013
Test performed by	: A.MERLIN		A.MERLIN
Atmospheric pressure	: 989hPa		997hPa
Relative humidity	: 30%		34%
Ambient temperature	: 22°C		23°C

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 EQUIPMENT LIST

DESCRIPTION	MANUFACTURER	MODEL	N° LCIE
Amplifier 8-26GHz	ALDETEC	ALS01452	A7102026
Amplifier 1-13GHz	LCIE SUD EST	-	A7102067
Antenna Bi-log	CHASE	CBL6111A	C2040051
Antenna Loop	ELECTRO-METRICS	EM-6879	C2040052
Antenna Bi-log	CHASE	CBL6111A	C2040172
Antenna horn	EMCO	3115	C2042027
Attenuator 10dB	JFW	-	A7122166
Cable N/N	-	-	A5329038
Cable	SUCOFLEX	106G	A5329061
Cable OATS (Mast at 10m)	UTIFLEX	-	A5329188
Cable	UTIFLEX	-	A5329192
Cable OATS (Mast at 10m)	UTIFLEX	-	A5329199
Cable N/N	-	-	A5329206
Cable SMA	-	-	A5329580
Semi-Anechoic chamber #3	SIEPEL	-	D3044017
Radiated emission comb generator	BARDET	-	A3169050
HF Radiated emission comb generator	LCIE SUD EST	-	A3169088
High Pass (4.8-18GHz)	BL Microwave	SH4800-1800	A7484034
OATS	-	-	F2000409
Receiver 20Hz – 8GHz	ROHDE & SCHWARZ	ESU8	A2642019
Receiver 9kHz - 6GHz	ROHDE & SCHWARZ	FSL6	A2642020
Spectrum Analyzer 9KHz – 26.5GHz	HEWLETT PACKARD	8593E	A4060018
Thermo-hygrometer (PM2)	OREGON	BAR916HG-G	B4206011
Turntable chamber (Cage#3)	ETS Lingren	Model 2165	F2000371
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
Turntable controller (Cage#3)	ETS Lingren	Model 2090	F2000444

4.4. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

None

4.5. TEST SEQUENCE AND RESULTS

4.5.1. 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)

4.5.2. 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** (See annex 1)
V polarization **Emr#3** (See annex 1)

4.5.3. Characterization on 10 meters open site from 30MHz to 1GHz

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. 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 tables.

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	33.111	40.0	37.9	**-2.1**	90	V	100	18.9	
2	48.581	40.0	29.1	**-10.9**	245	H	300	10.8	
3	58.611	40.0	28.3	**-11.7**	40	H	320	8.0	
4	59.325	40.0	27.5	**-12.5**	235	V	100	7.9	
5	157.976	43.5	33.6	**-9.9**	320	H	380	13.2	
6	556.082	46.0	32.2	**-13.8**	15	V	255	24.0	
7	851.598	46.0	36.9	**-9.1**	200	V	200	28.0	
8	906.200	46.0	41.2	**-4.8**	65	V	315	28.6	

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

4.5.4. Characterization on 3 meters anechoic chamber from 1GHz to 25GHz

The product has been tested at a distance of **3 meters** from the antenna and compared to the FCC part 15 subpart B §15.109 limits and C §15.209 limits. Measurement bandwidth was 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 following tables.

Frequency band 1GHz to 25GHz
Measurements are performed using a PEAK and Average detection. (RBW = 1MHz)

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	1.6394	74.0	43.4	-30.6	25	V	110	27.4	
2	2.3509	74.0	38.7	-35.3	115	H	110	30.2	
3	2.3899	74.0	36.9	-37.1	120	H	110	30.4	
4	2.4839	74.0	48.0	-26.0	175	V	110	30.8	
5	2.4846	74.0	48.6	-25.4	190	V	110	30.8	
6	2.4859	74.0	41.4	-32.6	305	H	110	30.8	
7	3.2884	74.0	37.8	-36.2	95	V	110	33.4	
8	4.8040	74.0	46.9	-27.1	30	H	100	36.4	
9	4.8820	74.0	48.4	-25.6	20	H	110	36.5	
10	4.8870	74.0	54.0	-20.0	210	V	110	36.5	
11	4.9600	74.0	54.4	-19.6	20	H	100	36.6	
12	7.2840	74.0	51.8	-22.2	90	H	100	39.8	
13	7.3620	74.0	53.1	-20.9	100	H	100	40.0	

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	1.6520	54.0	28.7	-25.3	25	V	110	27.4	
2	2.3509	54.0	31.1	-22.9	115	H	110	30.2	
3	2.3899	54.0	31.6	-22.4	120	H	110	30.4	
4	2.4839	54.0	32.9	-21.1	175	V	110	30.8	
5	2.4846	54.0	32.7	-21.3	190	V	110	30.8	
6	2.4859	54.0	34.3	-19.7	305	H	110	30.8	
7	3.2884	54.0	28.9	-25.2	95	V	110	33.4	
8	4.8040	54.0	37.4	-16.6	30	H	100	36.4	
9	4.8820	54.0	37.6	-16.4	20	H	110	36.5	
10	4.8870	54.0	38.0	-16.0	210	V	110	36.5	
11	4.9600	54.0	34.6	-19.4	20	H	100	36.6	
12	7.2840	54.0	36.6	-17.4	90	H	100	39.8	
13	7.3620	54.0	37.0	-17.0	100	H	100	40.0	

Note: Measures have been done at 3m distance.

RESULTS: PASS

4.6. 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

Test performed by : A.MERLIN
Date of test : May 23rd, 2013
Ambient temperature : 23°C
Relative humidity : 31%
Atmospheric pressure : 995hPa

5.2. EQUIPMENT CONFIGURATION

Modulation type:	☒GFSK	☒Pi/4 DQPSK	☒8DPSK
Packet type:	1-DH5	2-DH5	3-DH5
Hopping sequence:	OFF	OFF	OFF

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.

5.4. TEST EQUIPMENT LIST

DESCRIPTION	MANUFACTURER	MODEL	N° LCIE
Attenuator 10dB	JFW	-	A7122166
Cable SMA	-	-	A5329580
Receiver 9kHz - 6GHz	ROHDE & SCHWARZ	FSL6	A2642020

5.5. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

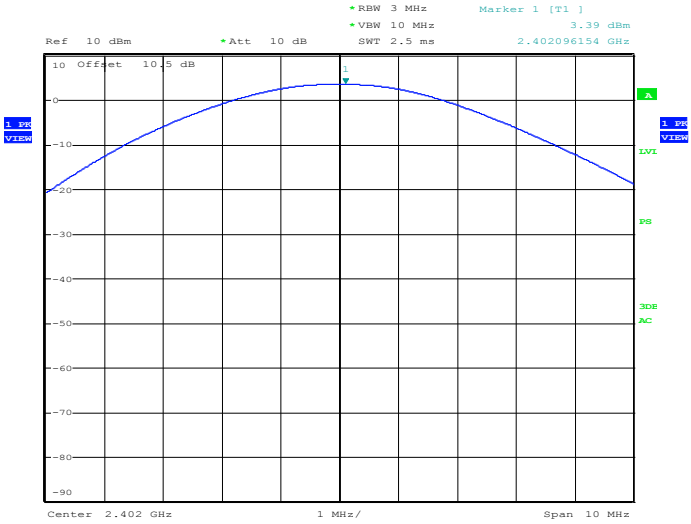
None

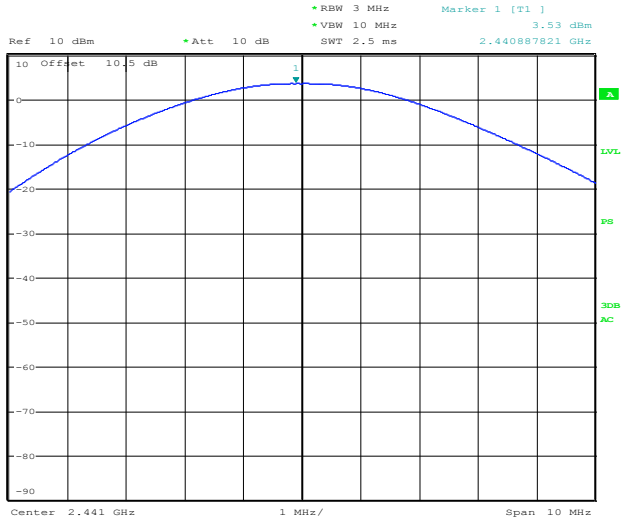
5.6. TEST SEQUENCE AND RESULTS

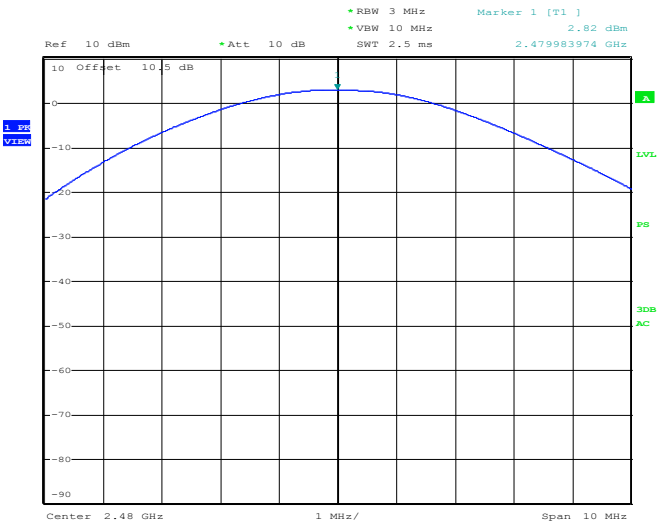
GFSK – 1-DH5 – 1Mbps

Channel	Channel Frequency (MHz)	Peak Conducted Output Power (dBm)	Power Limit (dBm)	PASS / FAIL
0	2402	3.4	30.0	PASS
39	2441	3.6	30.0	PASS
78	2480	2.9	30.0	PASS

Antenna Gain: -0.5dBi



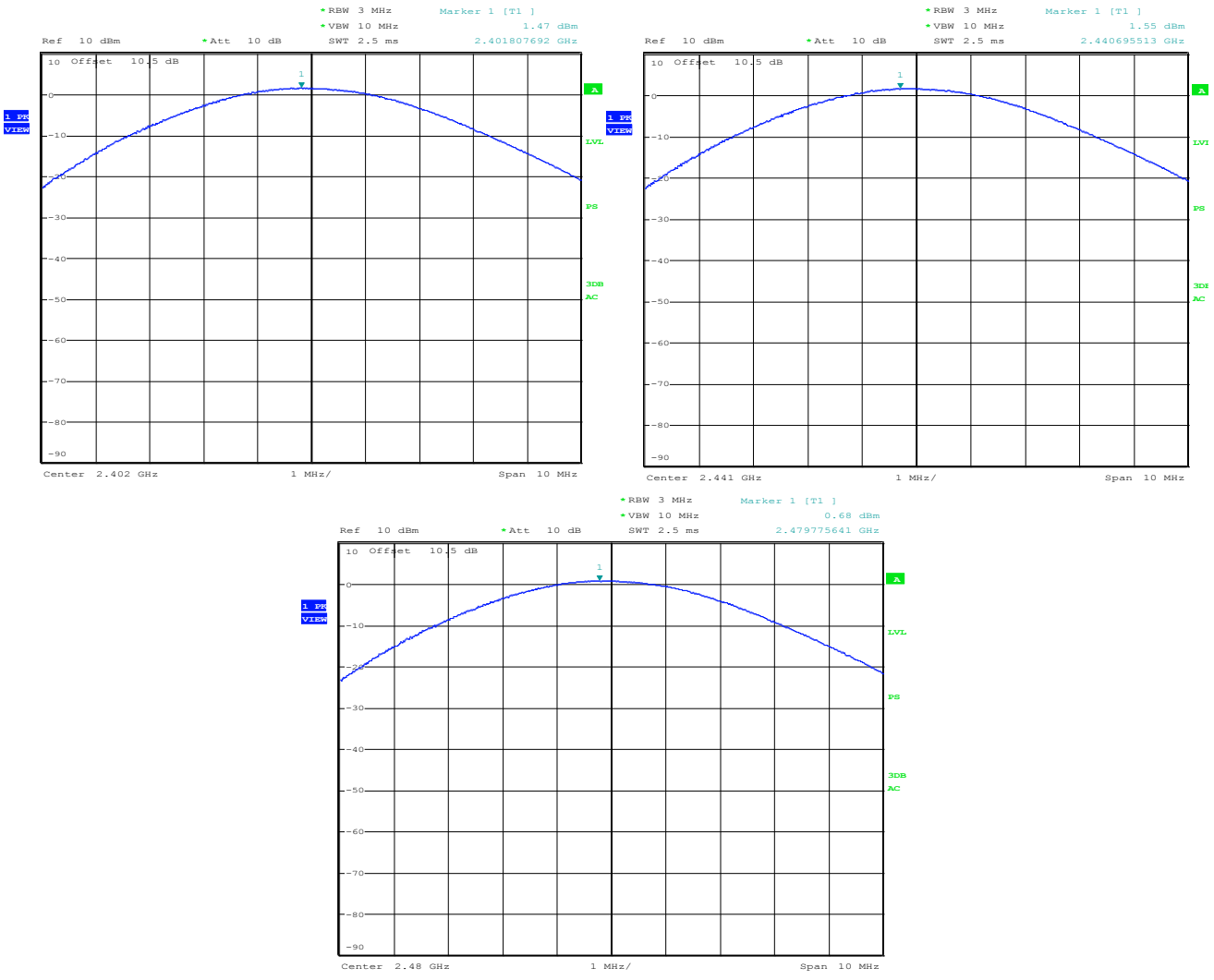




Pi/4 DQPSK – 2-DH5 – 2Mbps

Channel	Channel Frequency (MHz)	Peak Conducted Output Power (dBm)	Power Limit (dBm)	PASS / FAIL
0	2402	1.5	30.0	PASS
39	2441	1.6	30.0	PASS
78	2480	0.7	30.0	PASS

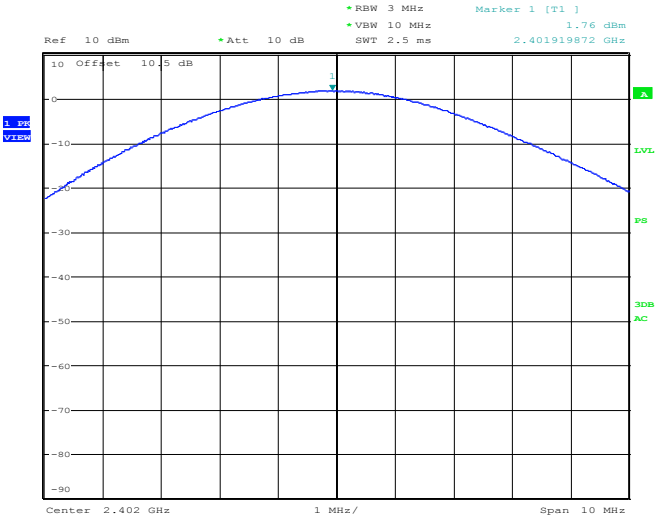
Antenna Gain: -0.5dBi

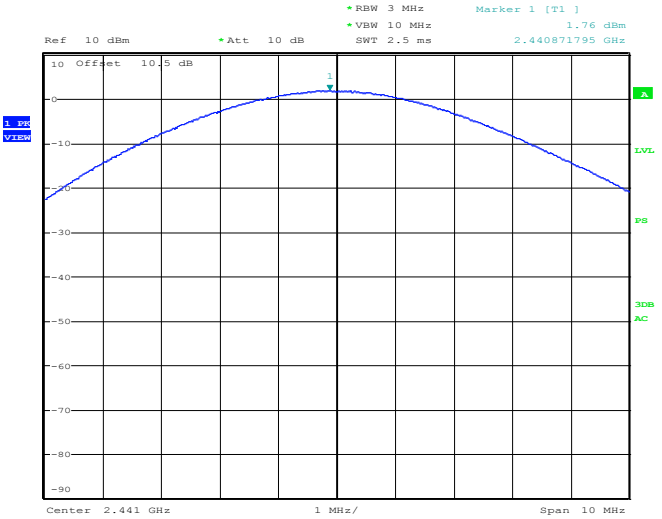


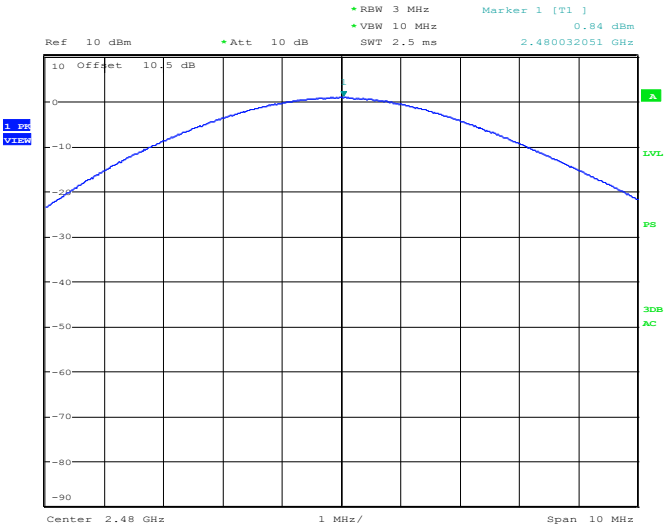
8DPSK – 3-DH5 – 3Mbps

Channel	Channel Frequency (MHz)	Peak Conducted Output Power (dBm)	Power Limit (dBm)	PASS / FAIL
0	2402	1.8	30.0	PASS
39	2441	1.8	30.0	PASS
78	2480	0.9	30.0	PASS

Antenna Gain: -0.5dBi







6. HOPPING CHANNEL SEPARATION (15.247)

6.1. TEST CONDITIONS

Date of test : May 22nd, 2013
Test performed by : A.MERLIN
Atmospheric pressure : 983hPa
Relative humidity : 40%
Ambient temperature : 22°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 type:	☒GFSK	☒Pi/4 DQPSK	☒8DPSK
Packet type:	1-DH5	2-DH5	3-DH5
Hopping sequence:	ON	ON	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. TEST EQUIPMENT LIST

DESCRIPTION	MANUFACTURER	MODEL	N° LCIE
Attenuator 10dB	JFW	-	A7122166
Cable SMA	-	-	A5329580
Receiver 9kHz - 6GHz	ROHDE & SCHWARZ	FSL6	A2642020

6.1. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

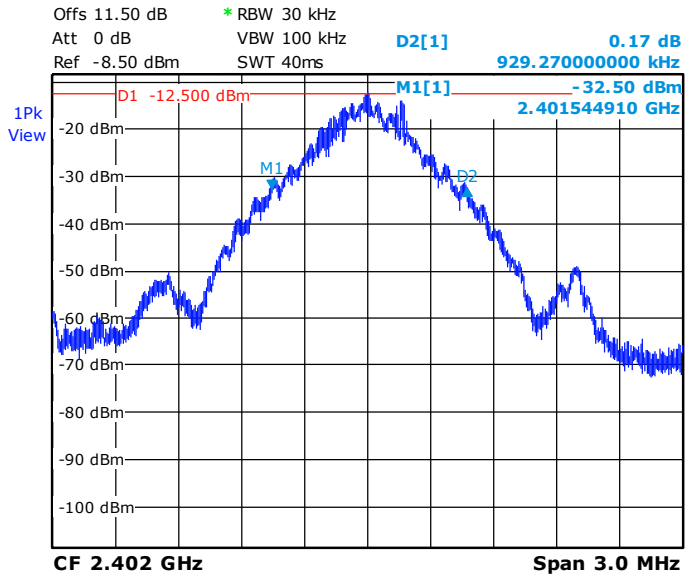
None

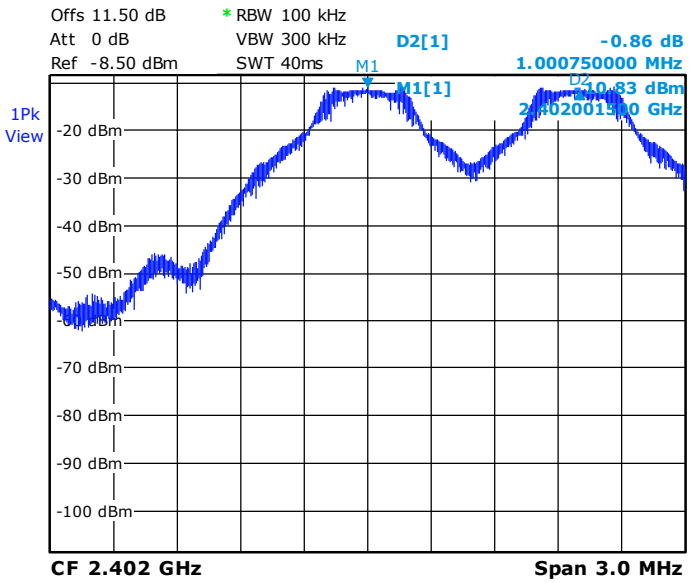
6.2. TEST SEQUENCE AND RESULTS

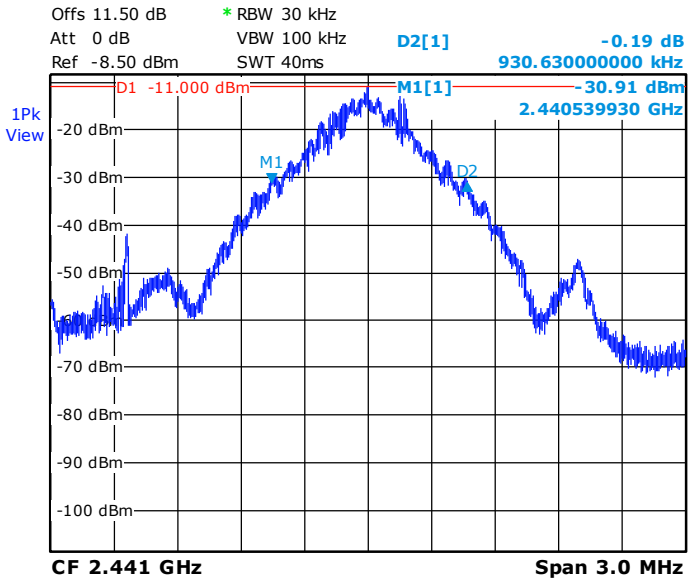
GFSK – 1-DH5 – 1Mbps

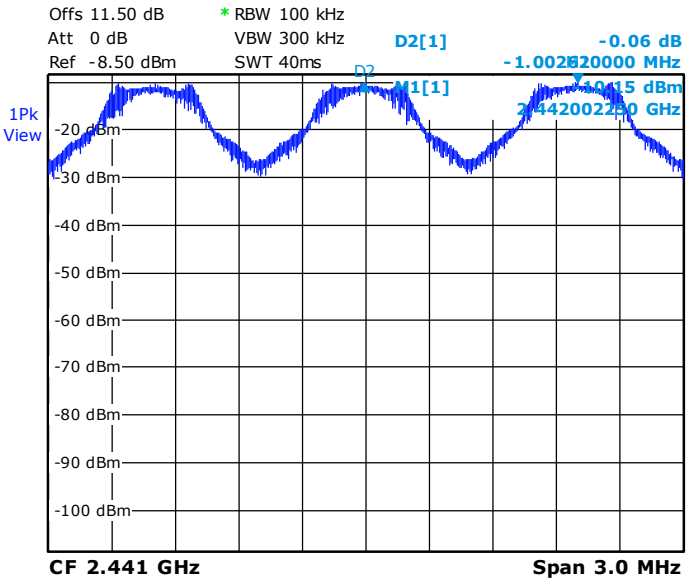
Channel	Channel Frequency (MHz)	Adjacent Channel Separation (MHz)	20dB Bandwidth (MHz)	Minimum Limit (MHz)	PASS / FAIL
0	**2402**	**1.000**	**0.929**	**0.620**	**PASS**
39	**2441**	**1.002**	**0.930**	**0.620**	**PASS**
78	**2480**	**1.008**	**0.937**	**0.624**	**PASS**

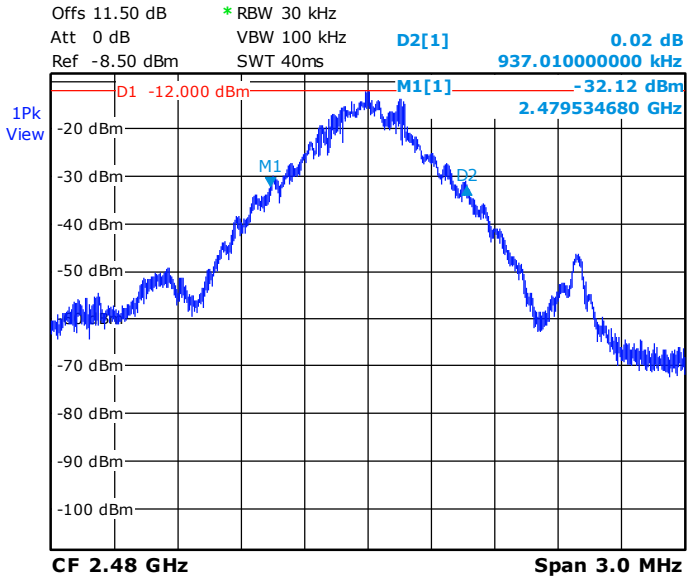
Limit used: Two-third 20dB Bandwidth

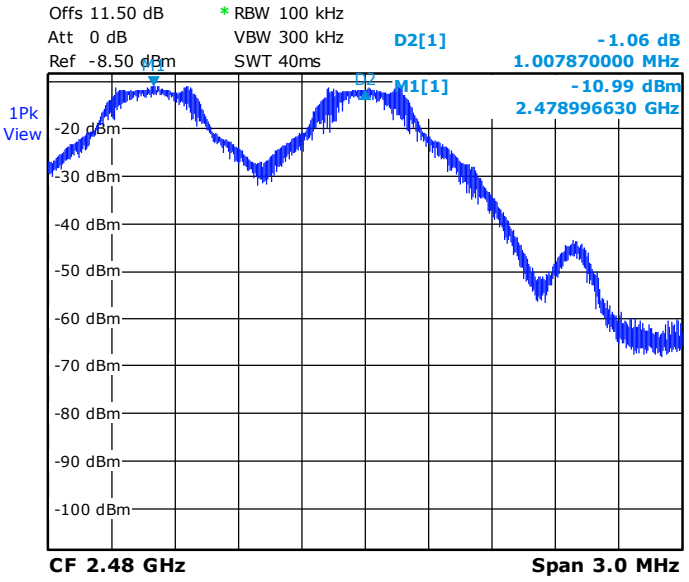





Offs 11.50 dB
Att 0 dB
Ref -8.50 dBm
* RBW 30 kHz
VBW 100 kHz
SWT 40ms
D2[1]
-0.19 dB
930.630000000 kHz
D1 -11.000 dBm
M1[1]
-30.91 dBm
2.440539930 GHz
1Pk
View
M1
D2
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-70 dBm
-80 dBm
-90 dBm
-100 dBm
CF 2.441 GHz
Span 3.0 MHz


Offs 11.50 dB
Att 0 dB
Ref -8.50 dBm
* RBW 100 kHz
VBW 300 kHz
SWT 40ms
D2[1]
-0.06 dB
M1[1]
1Pk
View
D2
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
-90 dBm
-100 dBm
CF 2.441 GHz
Span 3.0 MHz

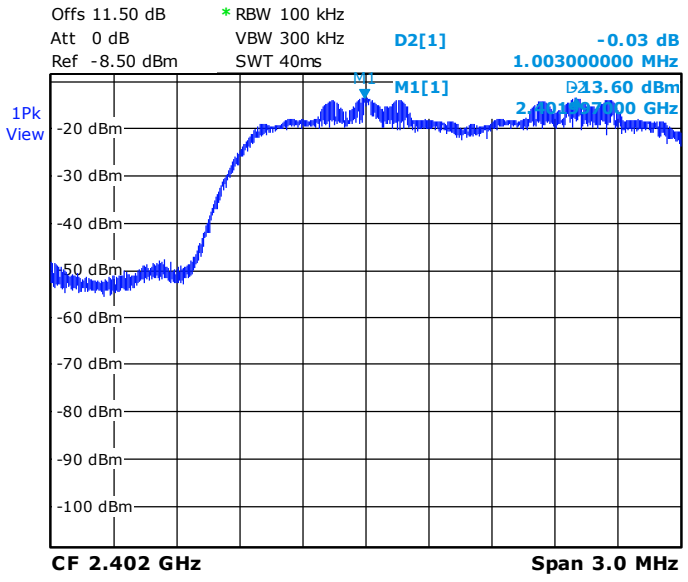

Offs 11.50 dB
Att 0 dB
Ref -8.50 dBm
* RBW 30 kHz
VBW 100 kHz
SWT 40ms
D2[1]
0.02 dB
937.010000000 kHz
D1 -12.000 dBm
M1[1]
-32.12 dBm
2.479534680 GHz
1Pk
View
M1
D2
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-70 dBm
-80 dBm
-90 dBm
-100 dBm
CF 2.48 GHz
Span 3.0 MHz

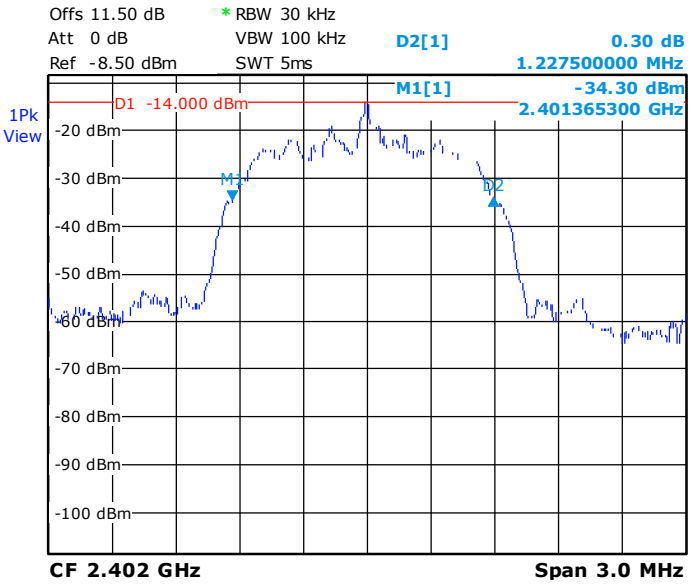

Offs 11.50 dB
Att 0 dB
Ref -8.50 dBm
* RBW 100 kHz
VBW 300 kHz
SWT 40ms
D2[1]
-1.06 dB
1.007870000 kHz
M1[1]
-10.99 dBm
2.478996630 GHz
1Pk
View
D2
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
-90 dBm
-100 dBm
CF 2.48 GHz
Span 3.0 MHz

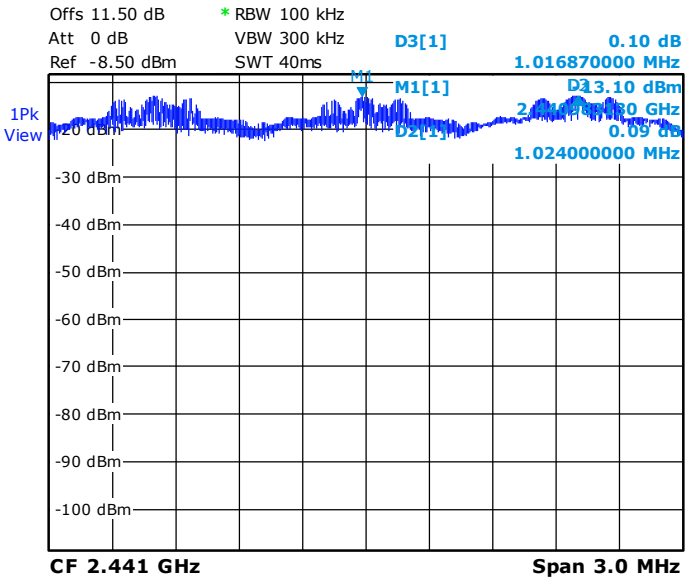
Pi/4 DQPSK – 2-DH5 – 2Mbps

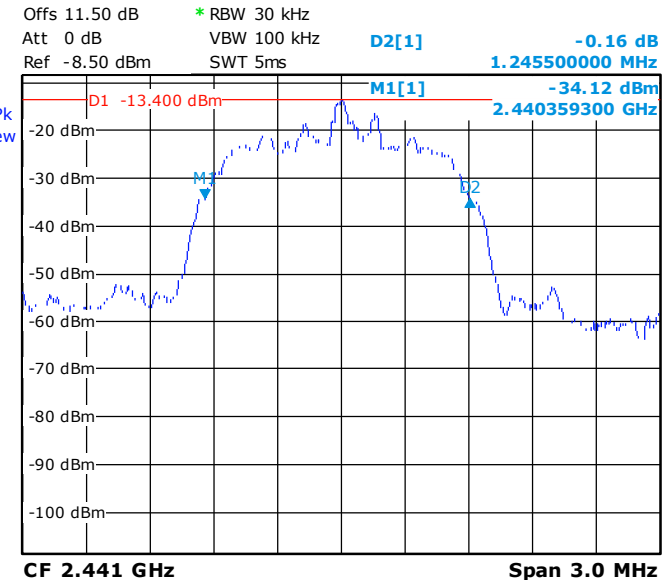
Channel	Channel Frequency (MHz)	Adjacent Channel Separation (MHz)	20dB Bandwidth (MHz)	Minimum Limit (MHz)	PASS / FAIL
0	2402	1.003	1.227	0.818	PASS
39	2441	1.016	1.245	0.830	PASS
78	2480	1.000	1.246	0.831	PASS

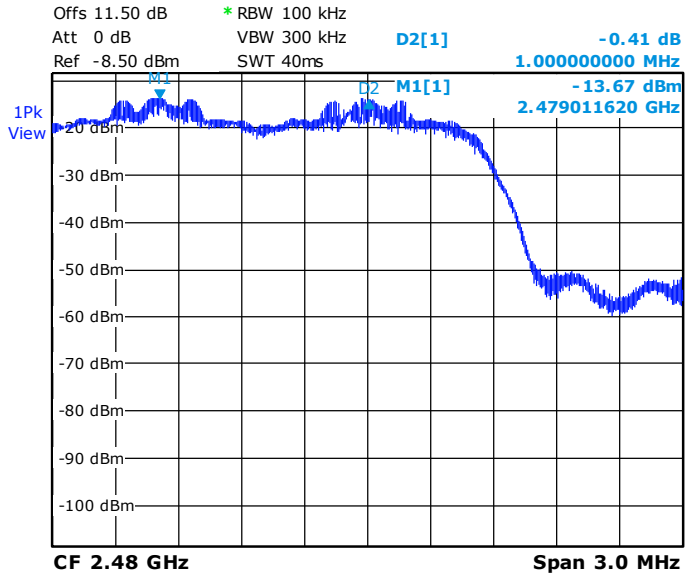
Limit used: Two-third 20dB Bandwidth

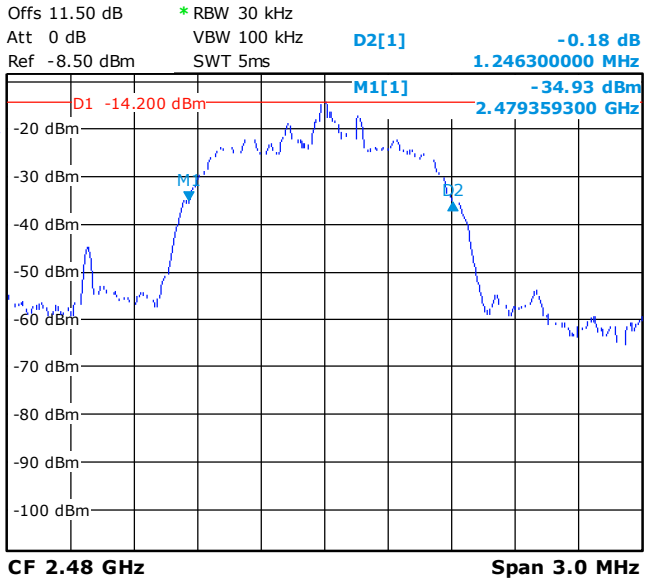





Offs 11.50 dB
Att 0 dB
Ref -8.50 dBm
* RBW 100 kHz
VBW 300 kHz
SWT 40ms
D3[1]
0.10 dB
1.016870000 MHz
M1[1]
D2[1]
0.09 dB
1.024000000 MHz
1Pk View
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
-90 dBm
-100 dBm
CF 2.441 GHz
Span 3.0 MHz


Offs 11.50 dB
Att 0 dB
Ref -8.50 dBm
* RBW 30 kHz
VBW 100 kHz
SWT 5ms
D2[1]
-0.16 dB
1.245500000 MHz
M1[1]
-34.12 dBm
2.440359300 GHz
D1 -13.400 dBm
1Pk View
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
-90 dBm
-100 dBm
CF 2.441 GHz
Span 3.0 MHz

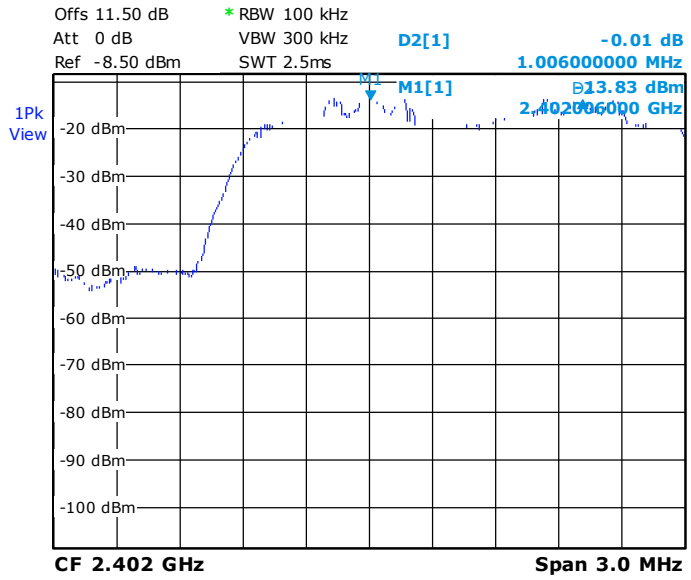

Offs 11.50 dB
Att 0 dB
Ref -8.50 dBm
* RBW 100 kHz
VBW 300 kHz
SWT 40ms
D2[1]
-0.41 dB
1.000000000 MHz
M1[1]
-13.67 dBm
2.479011620 GHz
1Pk View
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
-90 dBm
-100 dBm
CF 2.48 GHz
Span 3.0 MHz

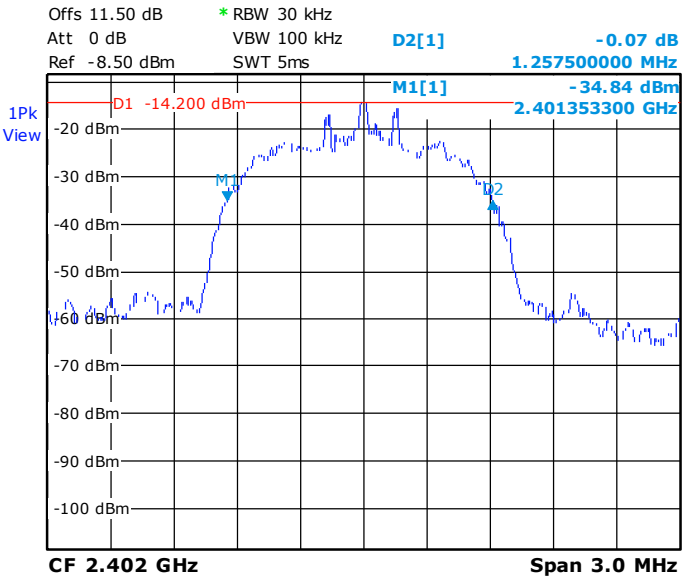

Offs 11.50 dB
Att 0 dB
Ref -8.50 dBm
* RBW 30 kHz
VBW 100 kHz
SWT 5ms
D2[1]
-0.18 dB
1.246300000 MHz
M1[1]
-34.93 dBm
2.479359300 GHz
D1 -14.200 dBm
1Pk View
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
-90 dBm
-100 dBm
CF 2.48 GHz
Span 3.0 MHz

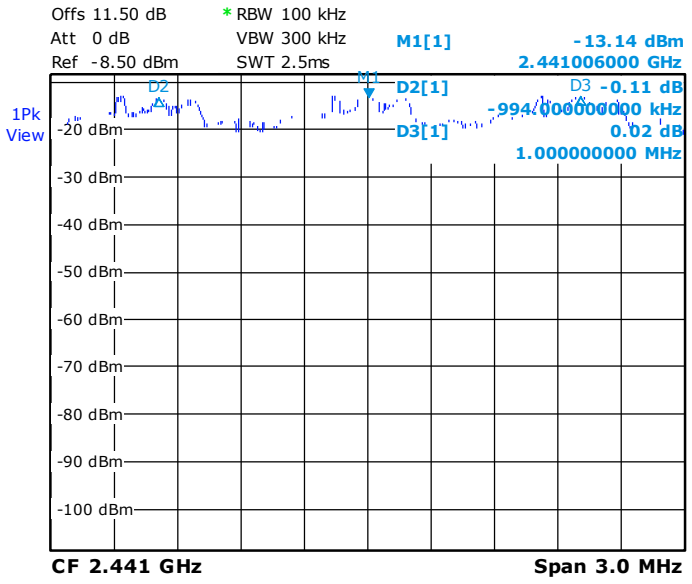
8DPSK – 3-DH5 – 3Mbps

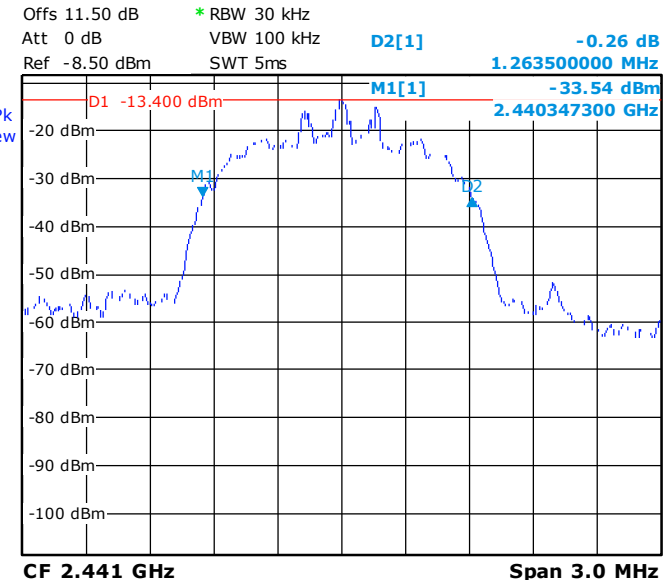
Channel	Channel Frequency (MHz)	Adjacent Channel Separation (MHz)	20dB Bandwidth (MHz)	Minimum Limit (MHz)	PASS / FAIL
0	**2402**	**1.006**	**1.258**	**0.839**	**PASS**
39	**2441**	**0.994**	**1.264**	**0.842**	**PASS**
78	**2480**	**1.006**	**1.281**	**0.854**	**PASS**

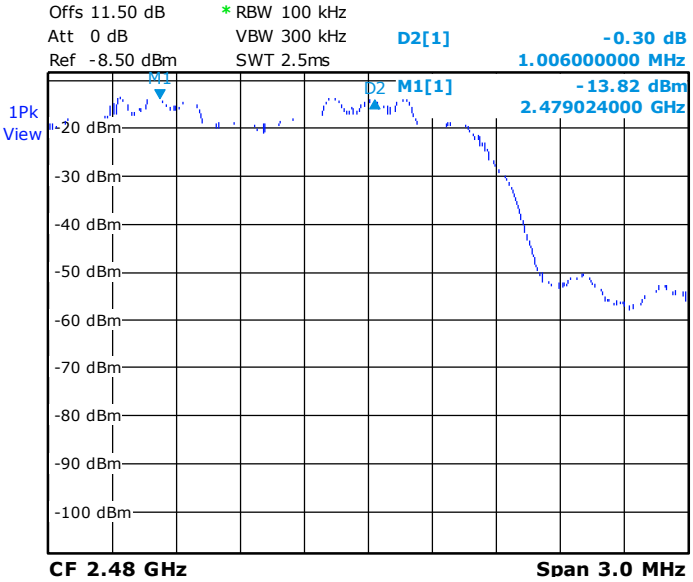
Limit used: Two-third 20dB Bandwidth

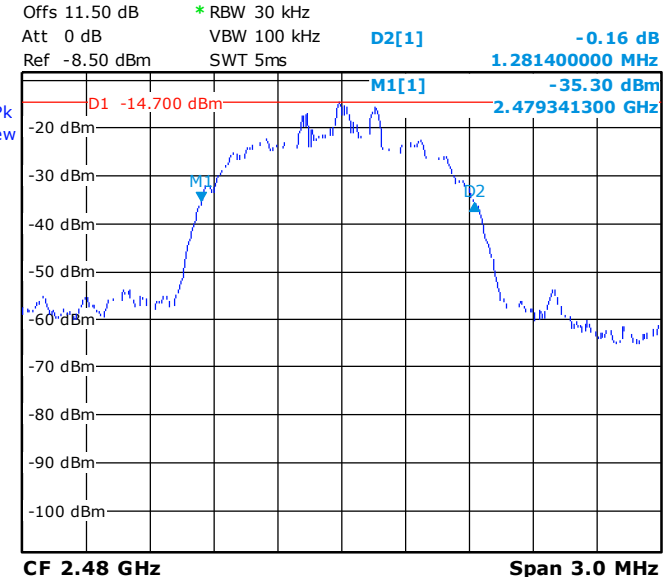





Offs 11.50 dB
Att 0 dB
Ref -8.50 dBm
* RBW 100 kHz
VBW 300 kHz
SWT 2.5ms
M1[1] -13.14 dBm
2.441006000 GHz
D2[1] -0.11 dB
-994.000000000 kHz
D3[1] 0.02 dB
1.000000000 MHz
1Pk View
CF 2.441 GHz
Span 3.0 MHz


Offs 11.50 dB
Att 0 dB
Ref -8.50 dBm
* RBW 30 kHz
VBW 100 kHz
SWT 5ms
D2[1] -0.26 dB
1.263500000 MHz
D1 -13.400 dBm
M1[1] -33.54 dBm
2.440347300 GHz
1Pk View
CF 2.441 GHz
Span 3.0 MHz


Offs 11.50 dB
Att 0 dB
Ref -8.50 dBm
* RBW 100 kHz
VBW 300 kHz
SWT 2.5ms
D2[1] -0.30 dB
1.006000000 MHz
M1[1] -13.82 dBm
2.479024000 GHz
1Pk View
CF 2.48 GHz
Span 3.0 MHz


Offs 11.50 dB
Att 0 dB
Ref -8.50 dBm
* RBW 30 kHz
VBW 100 kHz
SWT 5ms
D2[1] -0.16 dB
1.281400000 MHz
D1 -14.700 dBm
M1[1] -35.30 dBm
2.479341300 GHz
1Pk View
CF 2.48 GHz
Span 3.0 MHz

7. NUMBER OF HOPPING FREQUENCIES (15.247)

7.1. TEST CONDITIONS

Date of test : May 22nd, 2013
Test performed by : A.MERLIN
Atmospheric pressure : 983hPa
Relative humidity : 40%
Ambient temperature : 22°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 type:	☒GFSK	☒Pi/4 DQPSK	☒8DPSK
Packet type:	1-DH5	2-DH5	3-DH5
Hopping sequence:	ON	ON	ON

Same results following modulation and packet, 3-DH5 case presented.

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

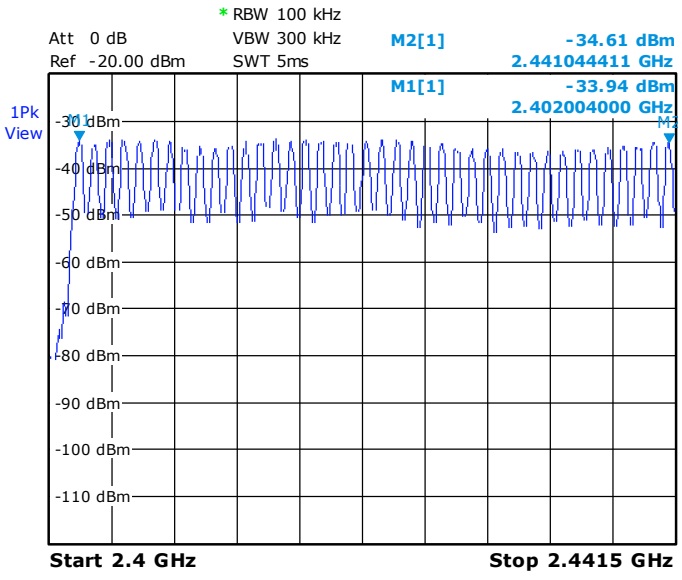
7.5. TEST EQUIPMENT LIST

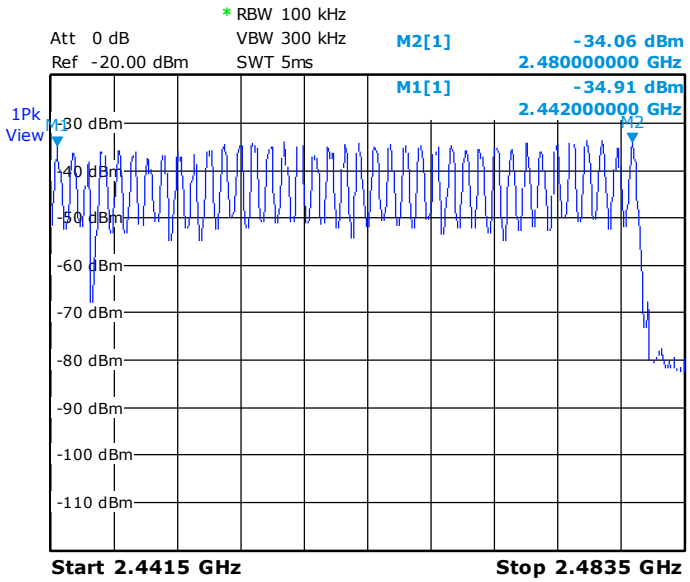
DESCRIPTION	MANUFACTURER	MODEL	N° LCIE
Attenuator 10dB	JFW	-	A7122166
Cable SMA	-	-	A5329580
Receiver 9kHz - 6GHz	ROHDE & SCHWARZ	FSL6	A2642020

7.6. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

None

7.7. TEST SEQUENCE AND RESULTS





Number of frequency used in the hopping sequence: 79 channels.

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

8.1. TEST CONDITIONS

Test performed by : A.MERLIN
Date of test : May 22nd, 2013
Ambient temperature : 23°C
Relative humidity : 40
Atmospheric pressure : 993hPa

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: 3-DH5, worst case, longest packet
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: 100kHz
VBW: 300kHz

8.5. TEST EQUIPMENT LIST

DESCRIPTION	MANUFACTURER	MODEL	N° LCIE
Attenuator 10dB	JFW	-	A7122166
Cable SMA	-	-	A5329580
Receiver 9kHz - 6GHz	ROHDE & SCHWARZ	FSL6	A2642020

8.6. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

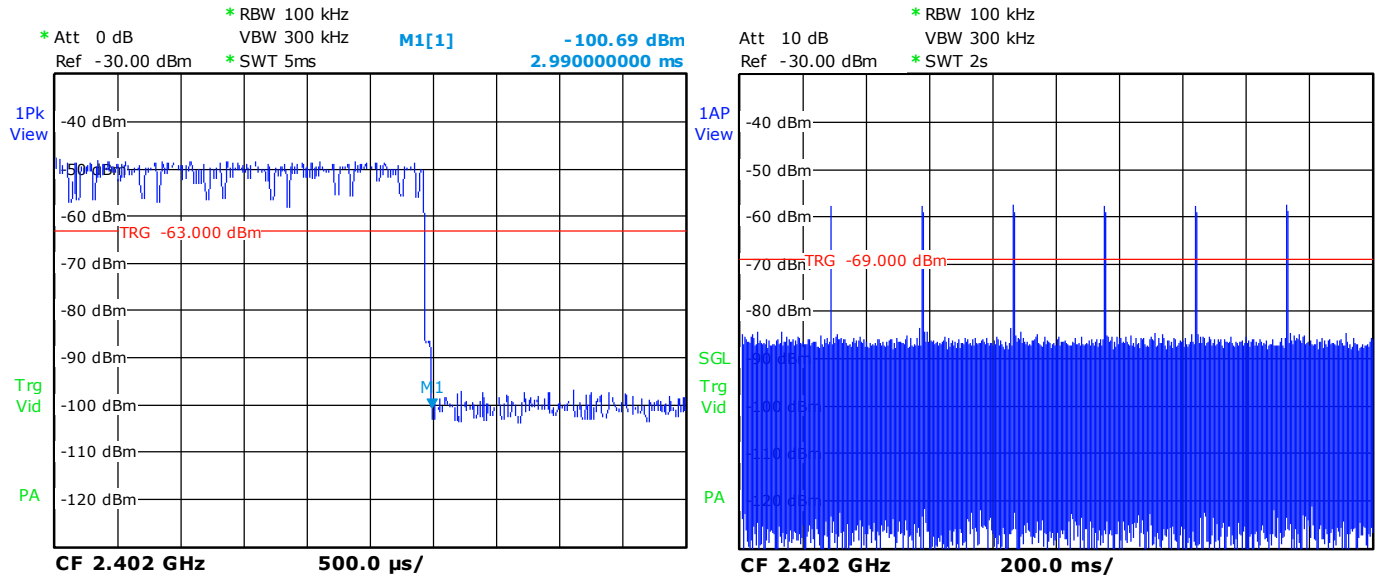
None

8.7. TEST SEQUENCE AND RESULTS

Packet Mode	Number of transmission in the period	Length of transmission time (ms)	Result (ms)	Limit (ms)	PASS / FAIL
3-DH5	7 (times/ 2 sec)	2.99	**331**	400	**PASS**

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

8DPSK / 3-DH5 (Worst case)



9. BAND EDGE MEASUREMENT (15.247)

9.1. TEST CONDITIONS

Date of test : May 24th, 2013
Test performed by : A.MERLIN
Atmospheric pressure : 991hPA
Relative humidity : 31%
Ambient temperature : 22°C°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: 1-DH5 (Worst case)
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. TEST EQUIPMENT LIST

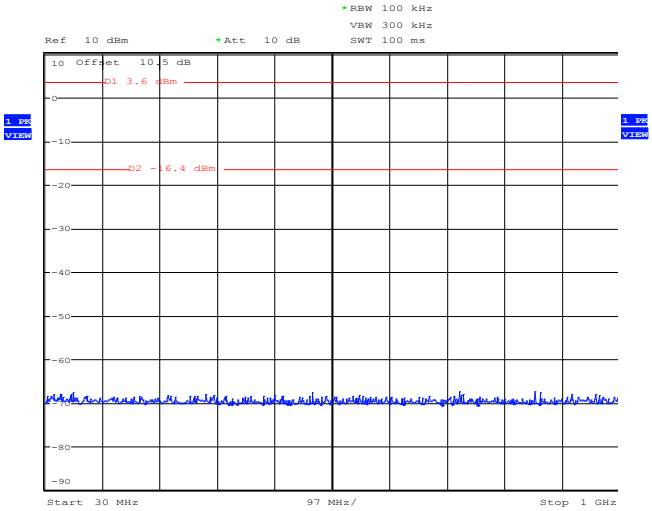
DESCRIPTION	MANUFACTURER	MODEL	N° LCIE
Amplifier 8-26GHz	ALDETEC	ALS01452	A7102026
Amplifier 1-13GHz	LCIE SUD EST	-	A7102067
Attenuator 10dB	JFW	-	A7122166
Cable SMA	-	-	A5329580
Semi-Anechoic chamber #3	SIEPEL	-	D3044017
High Pass (4.8-18GHz)	BL Microwave	SH4800-1800	A7484034
Receiver 9kHz - 6GHz	ROHDE & SCHWARZ	FSL6	A2642020
Spectrum Analyzer 9KHz – 26.5GHz	HEWLETT PACKARD	8593E	A4060018

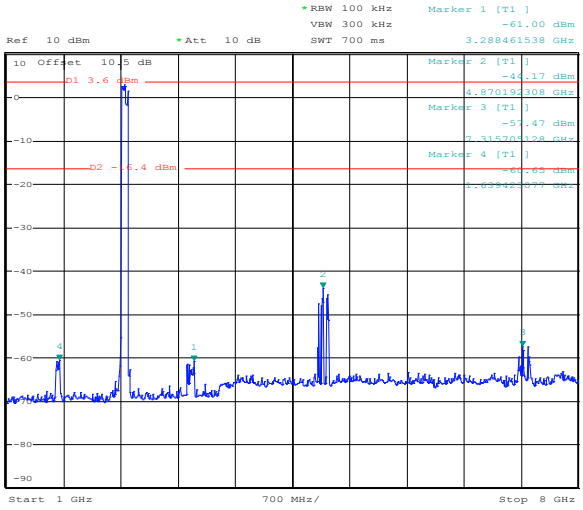
9.6. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

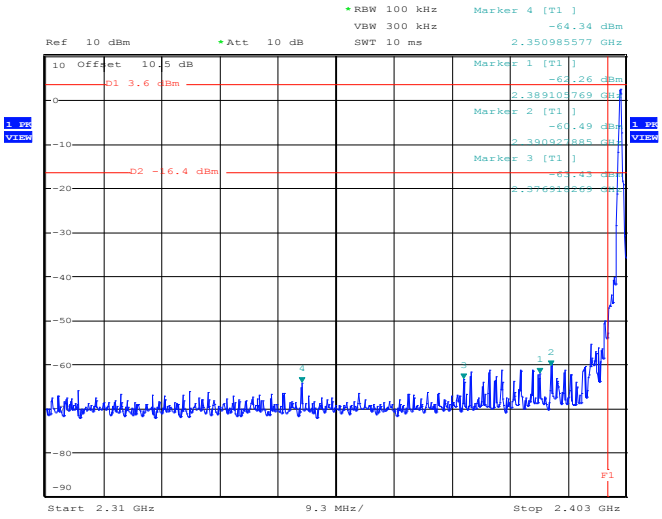
None

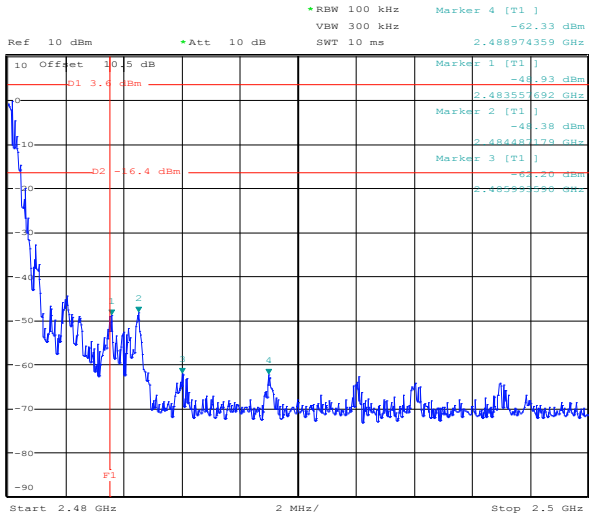
9.7. TEST SEQUENCE AND RESULTS

For spurious in restricted frequency band, see Radiated emission data paragraph.









Measurement from 8GHz to 26GHz: No frequency observed

10. OCCUPIED BANDWIDTH

10.1. CLIMATIC CONDITIONS

Date of test : May 22nd, 2013
Test performed by : A.MERLIN
Atmospheric pressure : 983hPa
Relative humidity : 40%
Ambient temperature : 22°C

10.1. TEST EQUIPMENT LIST

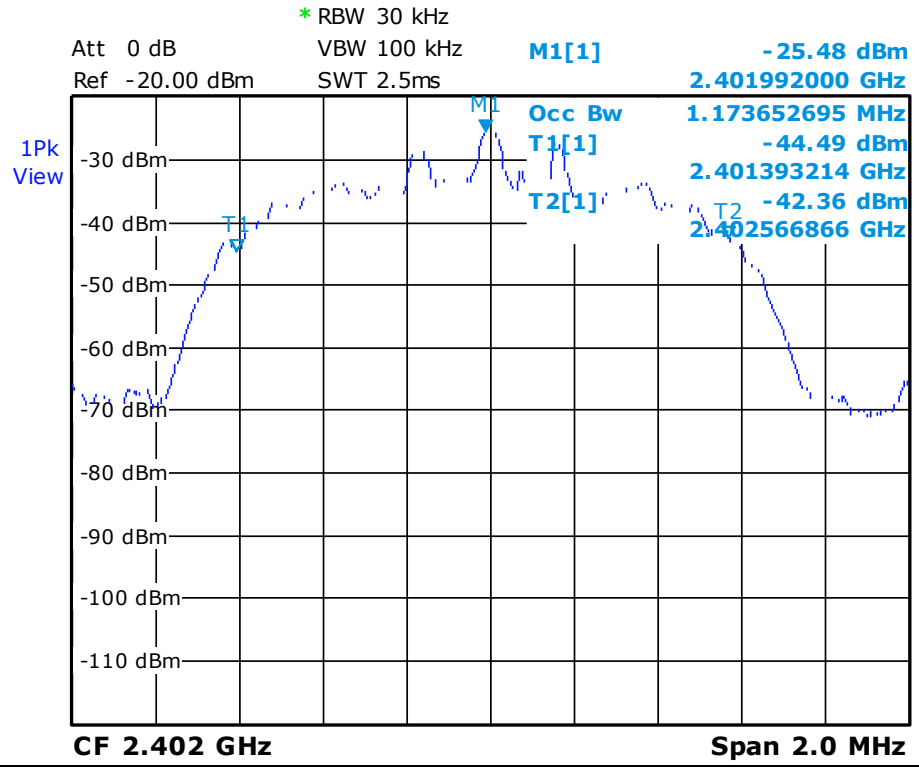
DESCRIPTION	MANUFACTURER	MODEL	N° LCIE
Attenuator 10dB	JFW	-	A7122166
Cable SMA	-	-	A5329580
Receiver 9kHz - 6GHz	ROHDE & SCHWARZ	FSL6	A2642020

10.1. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

None

10.2. TEST RESULTS

8DPSK / 3-DH5 (Worst case)



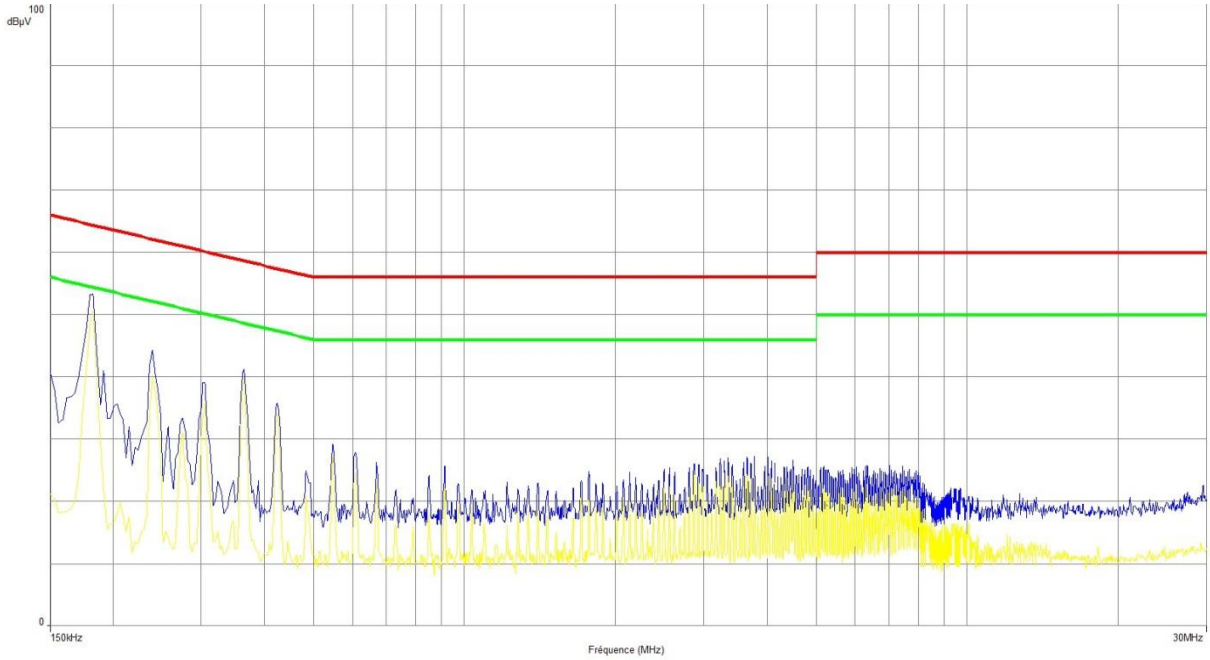
Measured occupied bandwidth is **1.174MHz**, same results following channel.

Measurement settings:
RBW = 30kHz / Video BW = 100kHz / SPAN = 2MHz
The occupied bandwidth is measured with OBW 99% function of spectrum analyzer.

11. ANNEX 1 (GRAPHS)

CONDUCTED EMISSIONS		
Graph name :	Emc#1	**Test configuration:**
Limit :	EN 55022	
Class :	B	

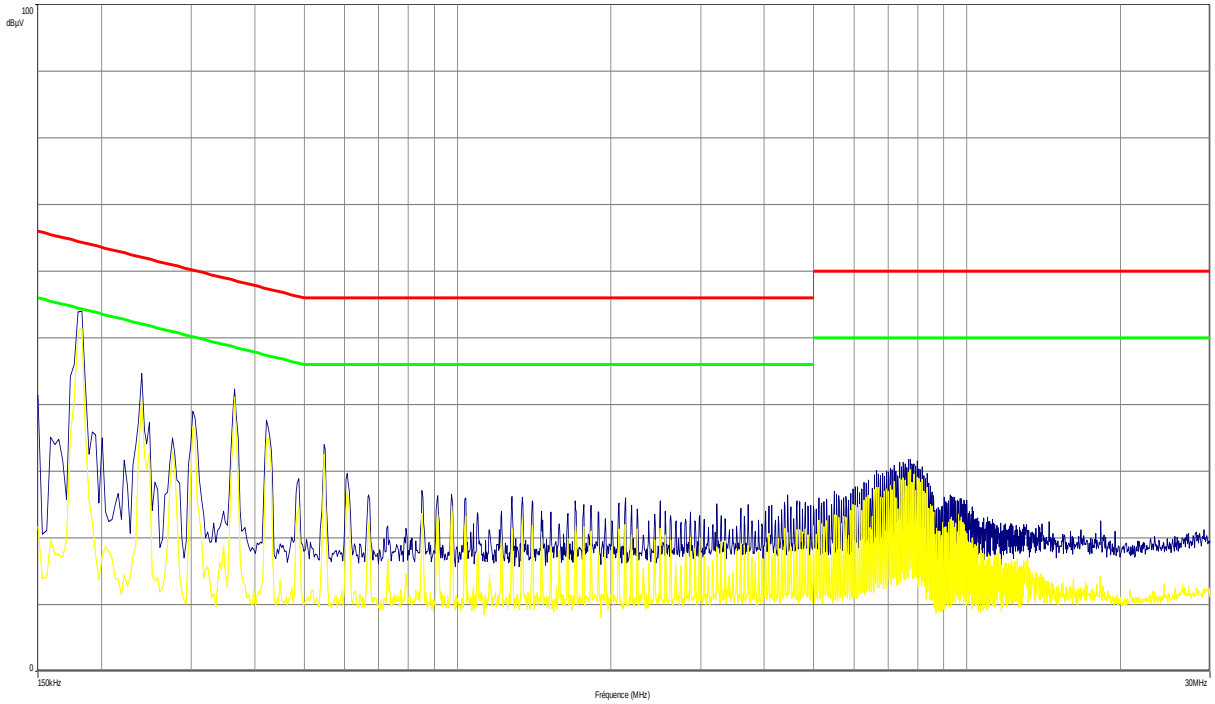
PARAMETERS					
Voltage / Frequency :	110VAC / 60Hz	**Legend:**			
Line :	Phase		**Peak Measure**		**Average Measure**
RBW :	9kHz				
VBW :	30kHz		**QPeak Limit**		**Average Limit**
Frequency :	150kHz- 30MHz				



Frequency (MHz)	Avg (dBµV)	Lim Avg (dBµV)	MesAvg - LimAvg (dBµV)	QPeak (dBµV)	Lim QPeak (dBµV)	MesQP - LimQP (dBµV)
0.182835	41.95	54.36	-12.4	52.3	64.36	-12.06
0.242535	35.63	52.01	-16.38	44.4	62.01	-17.61
0.30522	29.84	50.1	-20.26	37.85	60.1	-22.25
0.36492	35.45	48.62	-13.17	39.99	58.62	-18.62
0.427605	32.68	47.3	-14.62	36.03	57.3	-21.27

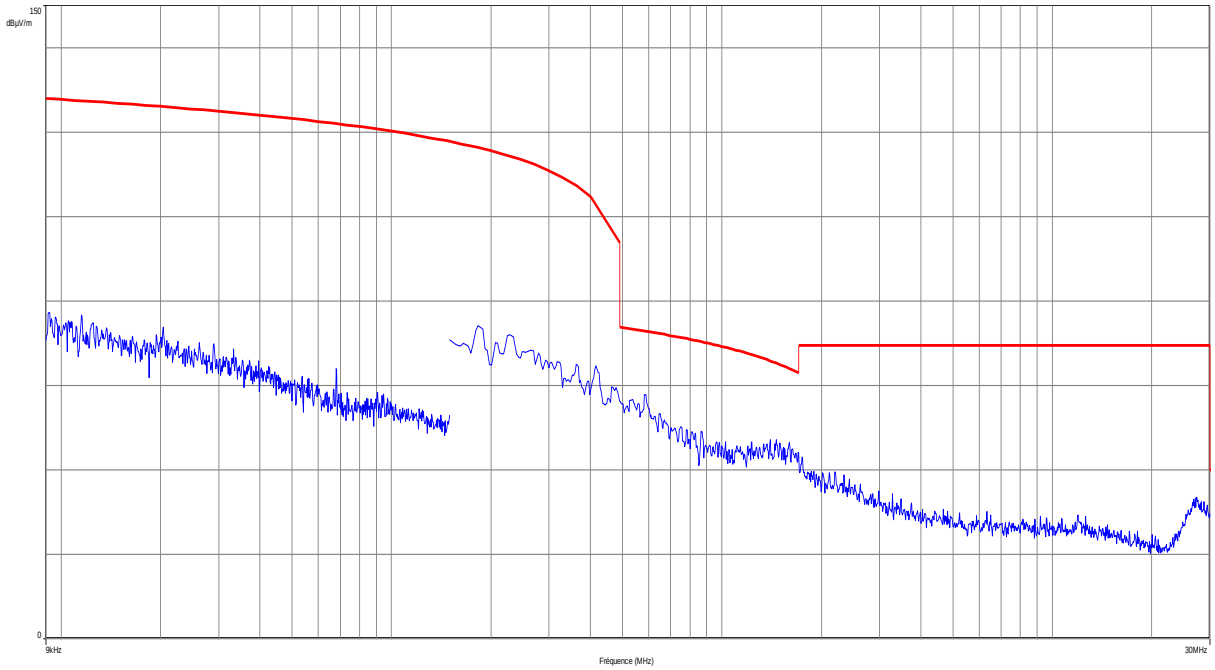
CONDUCTED EMISSIONS		
Graph name :	Emc#2	**Test configuration:**
Limit :	EN 55022	
Class :	B	

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

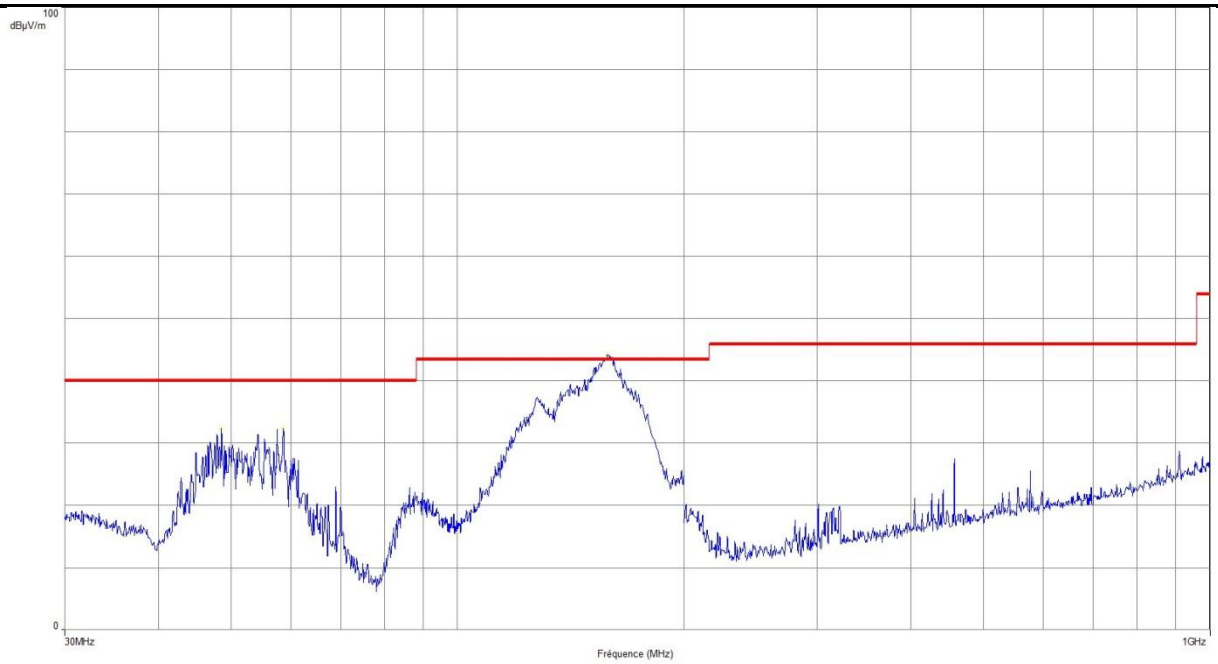


Frequency (MHz)	Avg (dBµV)	Lim Avg (dBµV)	MesAvg - LimAvg (dBµV)	QPeak (dBµV)	Lim QPeak (dBµV)	MesQP - LimQP (dBµV)
0.182835	42.53	54.36	-11.83	52.8	64.36	-11.56
0.242535	35.94	52.01	-16.06	44.65	62.01	-17.36
0.36492	37.34	48.62	-11.28	41.17	58.62	-17.44
0.427605	35.73	47.3	-11.57	39.26	57.3	-18.04

RADIATED EMISSIONS			
Graph name :	Emr#1	**Test configuration:**	
Limit :	FCC Part15C		
Class :	-		
PARAMETERS			
Antenna polarization:	0°	**Legend:**	
Azimuth :	0° - 360°		**Peak Measure**
RBW :	100kHz		
VBW :	300kHz		**QPeak Limit@3m**
Frequency :	9kHz - 30MHz		

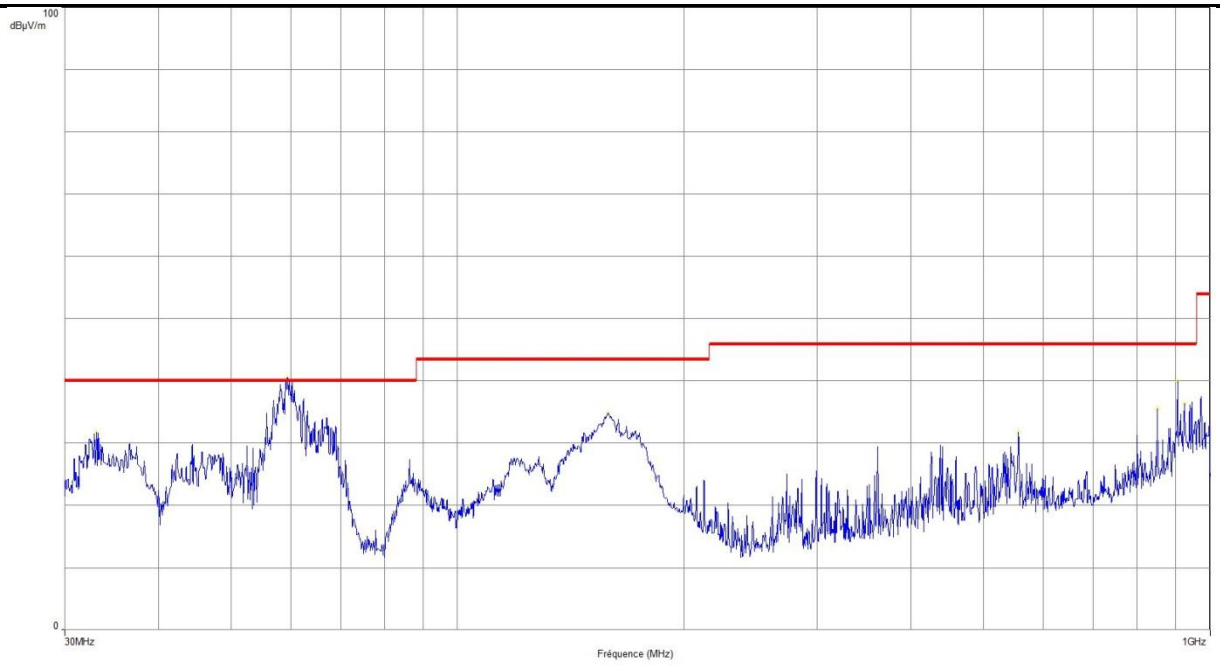


RADIATED EMISSIONS			
Graph name :	Emr#2	**Test configuration:**	
Limit :	FCC Part15C		
Class :	-		
PARAMETERS			
Antenna polarization:	Horizontal	**Legend:**	
Azimuth :	0° - 360°		**Peak Measure**
RBW :	100kHz		
VBW :	300kHz		**QPeak Limit@3m**
Frequency :	30MHz - 1GHz		



Frequency (MHz)	Peak Level (dBµV/m)	Peak-LimQP (dB)	Angle (°)
48.581	32.39	-7.61	30
58.611	32.31	-7.69	217
157.976	44.24	0.74	324

RADIATED EMISSIONS			
Graph name :	Emr#3	**Test configuration:**	
Limit :	FCC Part15C		
Class :	-		
PARAMETERS			
Antenna polarization:	Vertical	**Legend:**	
Azimuth :	0° - 360°		**Peak Measure**
RBW :	100kHz		
VBW :	300kHz		**QPeak Limit@3m**
Frequency :	30MHz - 1GHz		



Frequency (MHz)	Peak Level (dBµV/m)	Peak-LimQP (dB)	Angle (°)
33.111	31.73	-8.27	116
59.325	40.48	0.48	259
158.435	34.8	-8.7	81
556.08	31.73	-14.27	152
851.6	35.49	-10.51	243
906.2	39.91	-6.09	350
925.16	36.32	-9.68	314

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

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.*