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# Rapport d'essai / Test report

N° 221171-A1-R1-E

JDE : 113232

## DELIVRE A / ISSUED TO

: **INGENICO**  
9 Avenue de la Gare  
Rovaltain TGV - Quartier de la gare  
26958 VALENCE - 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 : **Lecteur sans contact / Contactless reader**
- . Marque / Trade mark : **INGENICO**
- . Constructeur / Manufacturer : **INGENICO**
- . Type / Model : **IUC180-00T1999 / IUC180-00T1651**
- . Type sous test / Model under test : **IUC180-00T1651**
- . N° de série / serial number : **11283IU00000246**
- . FCC ID : **XKB-IUC18X-RF**
- . IC : **2586D-IUC18XRF**

## Date des essais / Test date

: Du 2 au 12 Avril 2012 / From April 2<sup>nd</sup> to 12<sup>th</sup>, 2012

## 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 19 JUILLET 2012 / JULY 19TH, 2012

Ecrit par / Written by,  
Anthony MERLIN

Approuvé par / Approved by,  
Jacques LORQUIN



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**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) and §15.225 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) and §15.225 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: 21dBm 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) and 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			Not Applicable
Fundamental field strength limit CFR 47 §15.225 and RSS-210 §A2.6	Operation within the band 13.110-14.010 MHz			PASS
Fundamental frequency tolerance CFR 47 §15.225 and RSS-210 §A2.6	Operation within the band 13.110-14.010 MHz			PASS
Band edge compliance CFR 47 §15.225 and RSS-210 §A2.6	Operation within the band 13.110-14.010 MHz			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.

\*\*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).

The equipment IUC180 can be used with several internal option cards:

- COM2 + MDB + Bluetooth Configuration n°1 – IUC180-00T1999
- COM2 + MDB + Bluetooth + GPRS modular approval Configuration n°2 – IUC180-00T1651

The Equipment Under Test will be the configuration n°2 to represent others configurations. (Worst case)

IUC180 has to be integrated in unattended devices. The test configuration is given by the manufacturer

### 2.2. HARDWARE IDENTIFICATION

- **Equipment under test (EUT):**

**IUC180-00T1651**

Serial number: 11283IU00000246  
FCC ID: **XKB-IUC18X-RF**

- Internal max frequencies <500MHz (Declaration of provider)

- **Power supply:**

- DC voltage, 12-30VDC, tested at 12VDC (worst case)

During all the tests, EUT is supplied by an AC/DC adaptor, not supplied with EUT so not tested, PHIHONG PSM36W-120TW, 100-240VAC / 1.5A / 50-60Hz, output 12VDC / 3A.

- **Input/output:**

- 1 x Power supply connector, 2 wires
- 5 x USB
- 1 x LAN
- 2 x COM
- 1 x Earth
- 1 x Jack "Clock"
- 1 x MDB master
- 1 x MDB slave, same connector that power supply
- 2 x SMA connector, GPRS and Bluetooth
- 2 x SAM
- 1 x SIM
- 1 x MicroSD

- **Modular Approval contained:**

- 1 x GPRS module, SAGEMCOM, HILO V2 INGENICO, FCC ID: VW3HILOV2

- **Auxiliaries used for testing:**

- 1 x Laptop TOSHIBA SATELLITE, PS141E-04YC, Sn: 13594938G
- 2 x SAM
- 1 x SIM
- 1 x Contactless card



• **I/O cables used for testing:**

- 1 x AC power cord, 2 wires, unshielded: 2m
- 1 x DC power supply cable (fixed on mains power unit), unshielded: 1.75m
- 1 x Ethernet cable Type: STP Cat 5e, shielded: 1m
- 5 x USB cables, shielded: 1m
- 2 x RS232 Com cables, RJ11, unshielded, 1.5m (COM 0 & COM 2)
- 1 x MDB-slave '6 pins' <-> MDB-master '8 pins' cable, unshielded, 4 wires, length: 1m
- 1 x Jack cable, unshielded, length: 0.2cm

• **Equipment information – 13.56MHz:**

- Type:  Bluetooth  Other: 13.56MHz RFID
- Frequency band: [13.56] MHz
- Number of channel: 1
- RF mode:  TX/RX  RX  Standby
- Antenna type: Internal
- Antenna connector:  Permanent external  Permanent internal  Temporary (only for tests)  
 None
- Normal power source: 12VDC (host)
- Extreme temperature range: -30°C to +55°C
- Extreme test source voltage:  12VDC ±10%  other:

• **Equipment information:**

- Type:  Bluetooth  Other:
- Frequency band: [2400.0 – 2483.5] MHz
- Number of channel: 79
- Channel tested: Full test on 2402MHz / 2441MHz / 2480MHz
- Modulation Technology:  FHSS  DSSS
- Modulation type:  GFSK  Pi/4 DQPSK  8DPSK
- Packet type: DH1 DH3 DH5
- Transfert data rate: 1Mbps 2Mbps 3Mbps
- RF mode:  TX/RX  RX  Standby
- Antenna type: SMA connector + Whip antenna (not supplied)
- Antenna connector:  Permanent external  Permanent internal  Temporary (only for tests)  
 None
- Normal power source: 12VDC (host)
- Extreme temperature range: -30°C to +55°C
- Extreme test source voltage:  12VDC ±10%  other:

### 2.3. EUT CONFIGURATION

#### **For all tests:**

A generic program test is loaded on EUT, in order to perform in loop following functions:

- Reading / writing SAM card (SAM1 & SAM2)
- Reading / writing  $\mu$ SD card (MMC)
- RX/TX on Serial port (COM0 & COM2)
- RX/TX between MDB master and slave
- Reading Contactless card

With laptop:

- Continuous Ethernet communication is performed from EUT to Laptop (Ping)

#### **For special Bluetooth tests:**

With a special mode of EUT a communication is performed with CMU, a permanent link with followings parameters is tested (worst case):

- Lowest, middle, highest channel
- Max power
- EDR / DH5
- Hopping mode: ON or OFF following test

### 2.4. EQUIPMENT MODIFICATIONS

A ferrite (integrated secondary power supply PHIHONG PSM36W-120TW) is set on two wires which provided 12Vdc (MDB slave connector side).

A ferrite type WE 74271222(Two turns) is set on others MDB slave wires



### 2.5. SPECIAL ACCESSORIES

None



### 3. CONDUCTED EMISSION DATA

#### 3.1. CLIMATIC CONDITIONS

Date of test : April 6<sup>th</sup>, 2012  
Test performed by : A.MERLIN  
Atmospheric pressure : 983hPa  
Relative humidity : 43%  
Ambient temperature : 21°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.

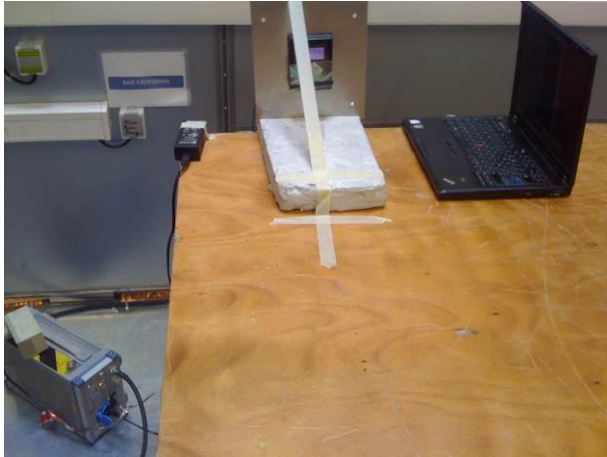
Auxiliaries are powered by another LISN.

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





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Conducted emission test setup



**3.4. TEST EQUIPMENT LIST**

DESCRIPTION	MANUFACTURER	MODEL	N° LCIE
Cable	-	-	A5329562
Conducted emission comb generator	BARDET	-	A3169049
LISN	RHODE & SCHWARZ	ENV216	C2320123
Receiver 20Hz – 8GHz	ROHDE & SCHWARZ	ESU8	A2642019
Thermo-hygrometer	LACROSS Techn.	WS-2357	B4206014
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**

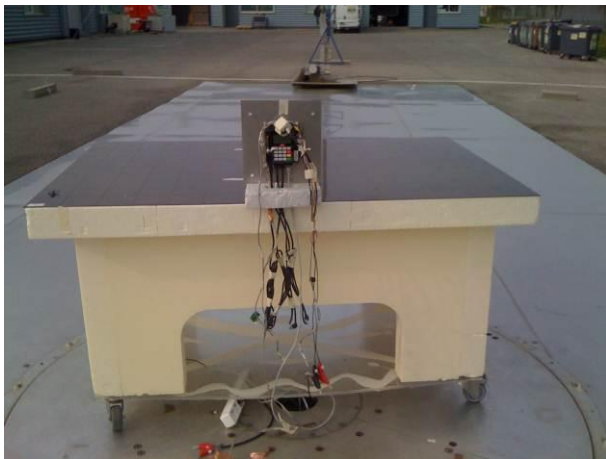
## 4. RADIATED EMISSION DATA

### 4.1. CLIMATIC CONDITIONS

Date of test : April 2<sup>nd</sup>, 2012  
Test performed by : A.MERLIN  
Atmospheric pressure : 993hPa  
Relative humidity : 36%  
Ambient temperature : 21°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.





L C I E



Radiated emission test setup



**4.3. TEST EQUIPMENT LIST**

DESCRIPTION	MANUFACTURER	MODEL	N° LCIE
Antenna Bi-log	CHASE	CBL6111A	C2040051
Antenna Loop	ELECTRO-METRICS	EM-6879	C2040052
Antenna Bi-log	CHASE	CBL6111A	C2040172
Antenna horn	EMCO	3115	C2042027
Cable N/N	-	-	A5329038
Cable	SUCOFLEX	106G	A5329061
Cable	-	-	A5329183
Cable OATS (Mast at 10m)	UTIFLEX	-	A5329188
Cable	UTIFLEX	-	A5329189
Cable	-	-	A5329191
Cable OATS (Mast at 10m)	UTIFLEX	-	A5329199
Semi-Anechoic chamber #1	SIEPEL	-	D3044016
Semi-Anechoic chamber #3	SIEPEL	-	D3044017
Radiated emission comb generator	BARDET	-	A3169050
OATS	-	-	F2000409
Receiver 20Hz – 8GHz	ROHDE & SCHWARZ	ESU8	A2642019
Receiver 9kHz - 6GHz	ROHDE & SCHWARZ	FSL6	A2642020
Thermo-hygrometer	OREGON	BAR206	B4204078
Antenna mast (OATS)	LCIE	-	F2000288
Turntable chamber (Cage#3)	ETS Lingren	Model 2165	F2000371
Turntable / Mast controller (OATS)	ETS Lindgren	Model 2066	F2000372
Turntable controller (Cage#2-3)	ETS Lingren	Model 2066	F2000393
Turntable (OATS)	ETS Lindgren	Model 2187	F2000403
Turntable chamber (Cage#2)	ETS Lingren	Model 2165	F2000404
Turntable chamber (Cage#1)	MATURO Gmbh	TT 2.0 SI	F2000406
Antenna mast (Cage#1)	MATURO Gmbh	AM 4.0	F2000407
Turntable controller (Cage#1)	MATURO Gmbh	Control Unit	F2000408
Table	LCIE	-	F2000438

**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-26GHz]

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 26GHz, 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 26GHz).

**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 below 30 MHz**

The product has been tested according to ANSI C63.4 (2003), FCC part 15 subpart C. Radiated Emissions were measured on an open area test site. A description of the facility is on file with the FCC. The product has been tested at a distance of **10 meters** from the antenna and compared to the FCC part 15 subpart C §15.109 limits and C §15.209 and FCC part 15 subpart C §15.225 limits in the frequency range 13.553MHz 13.567MHz. 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)
13.56* <sup>1</sup>	84.0	38.9	-45.1	270	0	35.3

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

**Limits Sub clause §15.225**

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

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





**4.5.4. Characterization on 10 meters open site from 30MHz to 26GHz**

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 26GHz.

Antenna height search was performed from 1m to 4m for both horizontal and vertical polarization. Continuous linear turntable azimuth search was performed with 360 degrees range. Measurement performed on 3 axis of EUT.

A summary of the worst case emissions found in all test configurations and modes is shown on clause 3.2

**Worst case final data result:**

No	Frequency (MHz)	QPeak Limit (dBµV/m)	Qpeak * (dBµV/m)	Qpeak-Limit (Margin, dB)	Angle (deg)	Pol	Hgt (cm)	Tot Corr (dB)	Comments
1	40.678	40.0	38.2	-1.8	270	V	100	13.2	
2	54.237	40.0	31.0	-9.0	270	V	100	7.9	
3	67.796	40.0	35.8	-4.2	270	V	100	7.6	
4	81.230	40.0	29.1	-10.9	0	V	100	9.5	
5	193.560	43.5	39.4	-4.1	0	V	100	12.6	
6	199.997	43.5	38.6	-4.9	170	V	100	12.4	
7	224.997	46.0	39.7	-6.3	0	V	300	14.1	
8	324.995	46.0	38.8	-7.2	205	V	300	17.6	
9	499.995	46.0	41.3	-4.7	0	V	250	21.7	
10	532.520	46.0	33.2	-12.8	80	V	400	22.4	
11	624.888	46.0	38.0	-8.0	355	H	300	24.2	
12	874.993	46.0	42.6	-3.4	250	V	250	27.8	

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



**Frequency band 1GHz to 26GHz**

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	4.804	54.0	53.4	-0.6	95	V	110	37.8	
2	4.882	54.0	53.2	-0.8	90	V	100	37.8	
3	4.960	54.0	53.0	-1.0	95	V	110	37.8	
4	7.206	54.0	44.3	-9.7	95	V	110	39.9	
5	7.323	54.0	44.0	-10.0	90	V	100	39.9	
6	7.440	54.0	43.4	-10.6	95	V	110	39.9	

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	4.804	74.0	67.2	-6.8	95	V	110	37.8	
2	4.882	74.0	66.1	-7.9	90	V	100	37.8	
3	4.960	74.0	65.2	-8.8	95	V	110	37.8	
4	7.206	74.0	56.3	-17.7	95	V	110	39.9	
5	7.323	74.0	55.9	-18.1	90	V	100	39.9	
6	7.440	74.0	55.5	-18.5	95	V	110	39.9	

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.

$$FS = 52.5 + 7.4 + 1.1 - 29 = 32 \text{ dB}\mu\text{V/m}$$

The 32 dBµV/m value can be mathematically converted to its corresponding level in µV/m.

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

**5. BAND-EDGE COMPLIANCE §15.209****5.1. CLIMATIC CONDITIONS**

Date of test : April 3<sup>rd</sup>, 2012  
Test performed by : A.MERLIN  
Atmospheric pressure : 1000hPa  
Relative humidity : 41%  
Ambient temperature : 21°C

**5.1. TEST EQUIPMENT LIST**

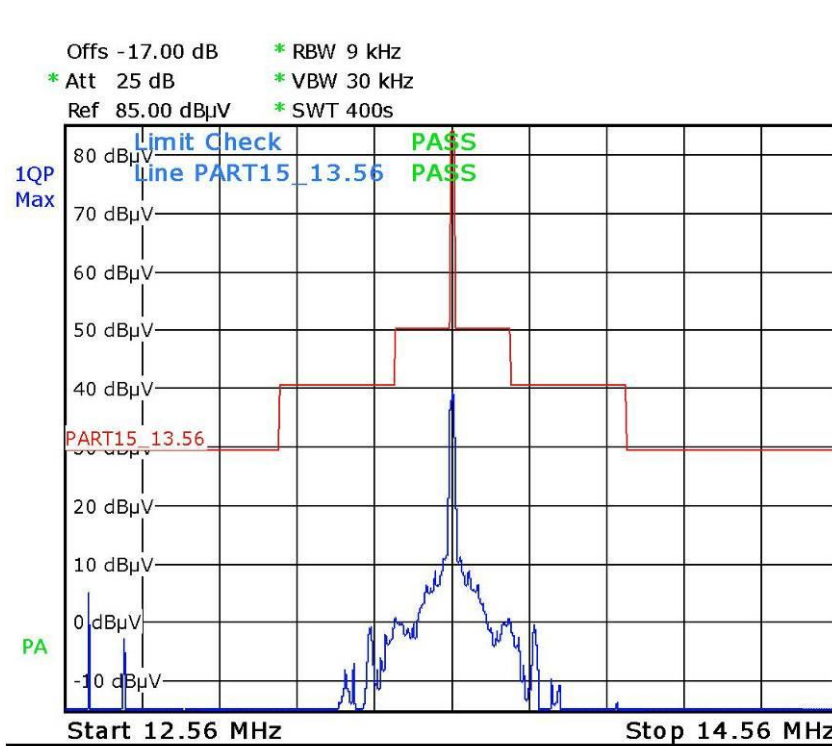
DESCRIPTION	MANUFACTURER	MODEL	N° LCIE
Antenna Loop	ELECTRO-METRICS	EM-6879	C2040052
Cable	-	-	A5329190
Receiver 9kHz - 6GHz	ROHDE & SCHWARZ	FSL6	A2642020

**5.2. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION**

None

**5.3. Frequency band 13.110-14.010MHz**

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





**6. MAXIMUM PEAK OUTPUT POWER (15.247)**

**6.1. TEST CONDITIONS**

Date of test : April 5<sup>th</sup>, 2012  
Test performed by : A.MERLIN  
Atmospheric pressure : 984hPa  
Relative humidity : 42%  
Ambient temperature : 22°C

**6.2. EQUIPMENT CONFIGURATION**

**Worst case presented:**

Modulation: 8DPSK  
Packet Type: DH5  
Hopping sequence: NO

**6.3. 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.

**6.4. TEST EQUIPMENT LIST**

DESCRIPTION	MANUFACTURER	MODEL	N° LCIE
Cable SMA/SMA	-	-	A5329373
Digital Radiocommunication Tester	ROHDE & SCHWARZ	CMU200	A2440004
Receiver 20Hz – 8GHz	ROHDE & SCHWARZ	ESU8	A2642019

**6.5. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION**

None

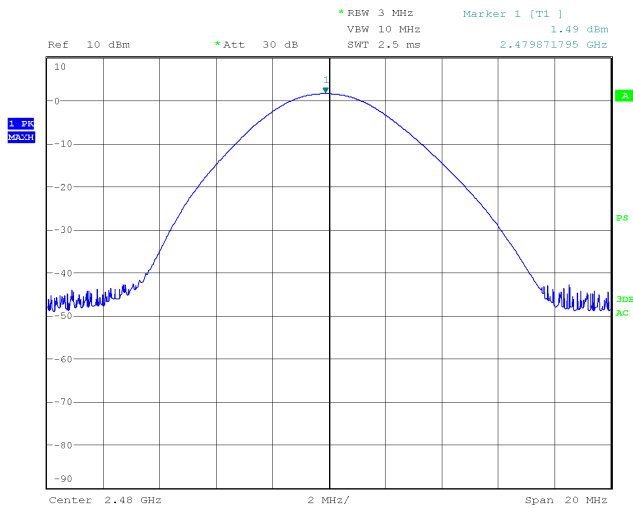
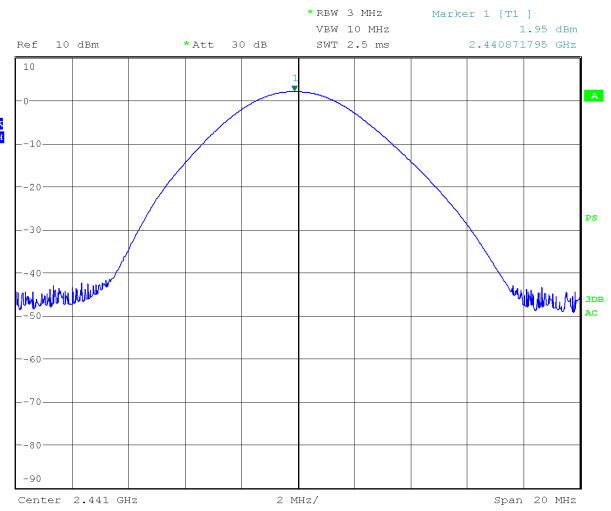
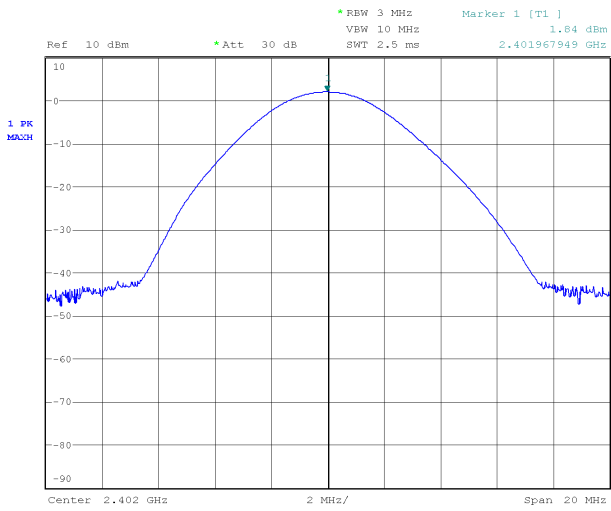


L C I E

Channel	Channel Frequency (MHz)	Peak Output Power (dBm)	Power Limit (dBm)	PASS / FAIL
0	2402	3.7	21	P
39	2441	3.8	21	P
78	2480	3.3	21	P

Attenuation of cable = 1.8dB

Graph:







## 7. HOPPING CHANNEL SEPARATION (15.247)

### 7.1. TEST CONDITIONS

Date of test : April 5<sup>th</sup>, 2012  
Test performed by : A.MERLIN  
Atmospheric pressure : 984hPa  
Relative humidity : 42%  
Ambient temperature : 22°C

### 7.2. 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.

### 7.3. EQUIPMENT CONFIGURATION

Modulation type:  GFSK  Pi/4 DQPSK  8DPSK  
Packet type: DH1 DH3 DH5  
Transfert data rate: 1Mbps 2Mbps 3Mbps  
Channel frequency: 2402MHz / 2441MHz / 2480MHz  
Hopping sequence: ON

### 7.4. 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.

### 7.5. 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.

### 7.6. TEST EQUIPMENT LIST

DESCRIPTION	MANUFACTURER	MODEL	N° LCIE
Cable SMA/SMA	-	-	A5329373
Digital Radiocommunication Tester	ROHDE & SCHWARZ	CMU200	A2440004
Receiver 20Hz – 8GHz	ROHDE & SCHWARZ	ESU8	A2642019

### 7.7. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

None



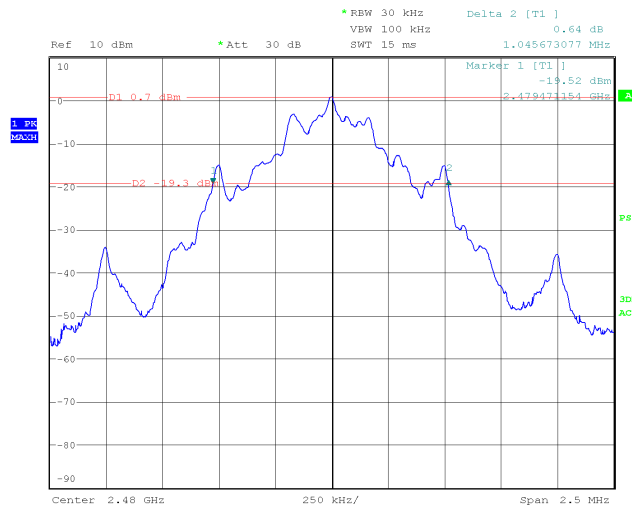
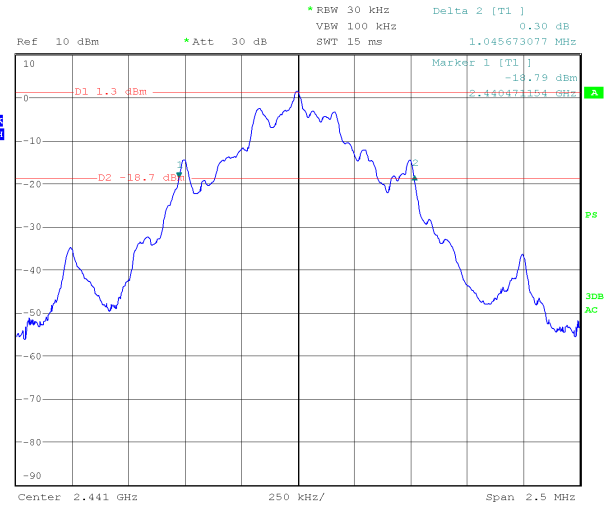
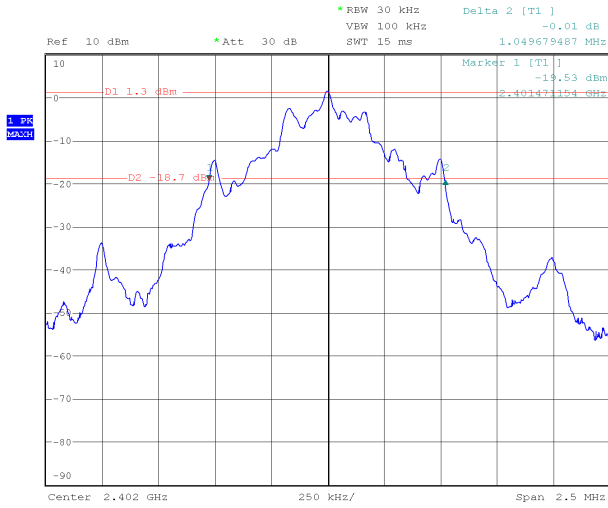
L C I E

**7.8. RESULTS – 20dB BANDWIDTH**

**DH1 Measurements:**

Channel Frequency (MHz)	20dB Bandwidth (MHz)
2402	1.050
2441	1.046
2480	1.046

**Graph:**



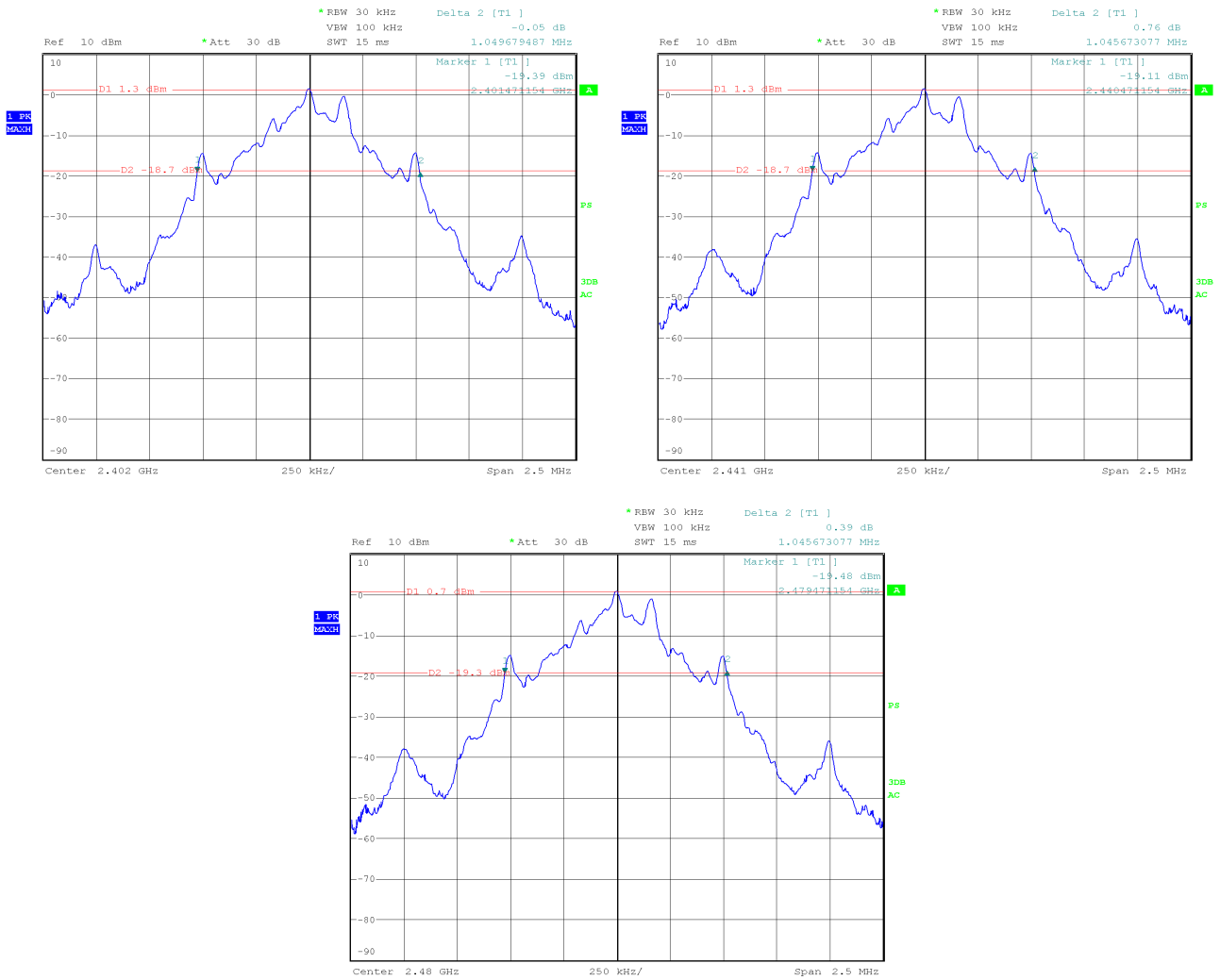


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DH3 Measurements:

Channel Frequency (MHz)	20dB Bandwidth (MHz)
2402	1.050
2441	1.046
2480	1.046

Graph:



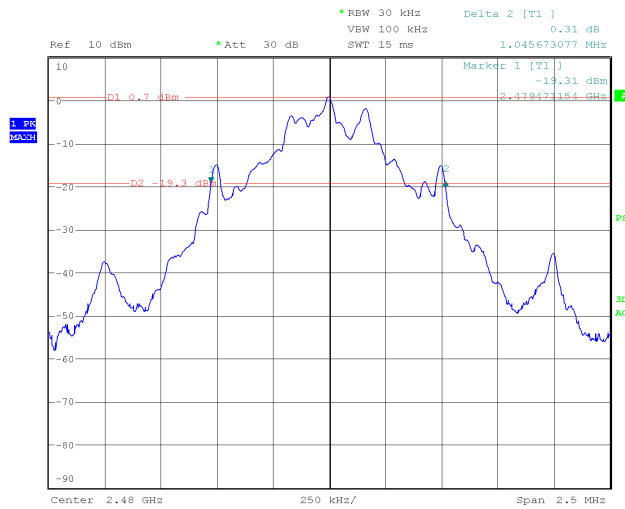
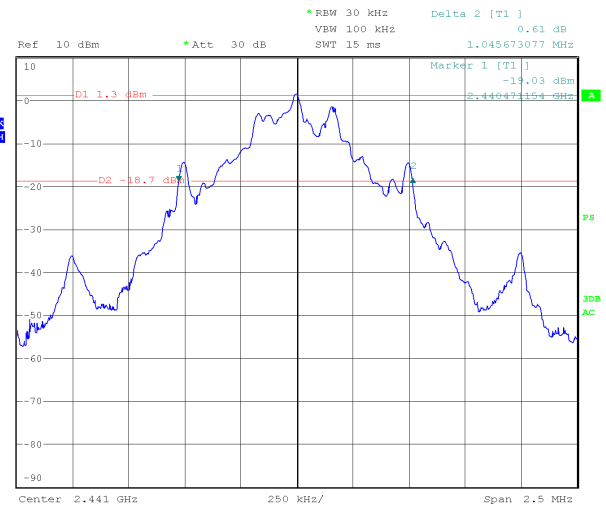
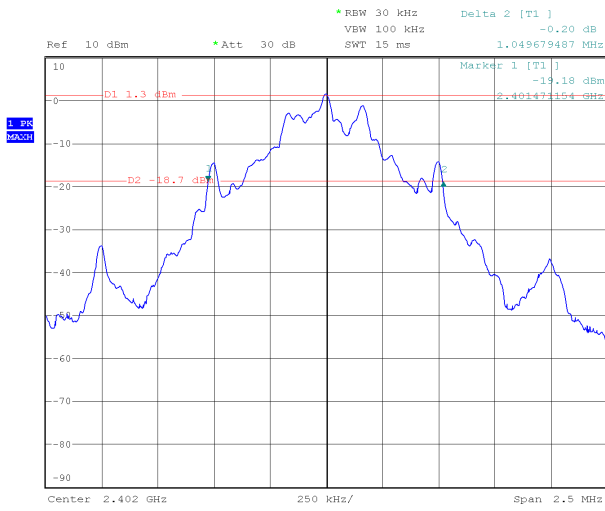


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**DH5 Measurements:**

Channel Frequency (MHz)	20dB Bandwidth (MHz)
2402	1.049
2441	1.046
2480	1.046

**Graph:**





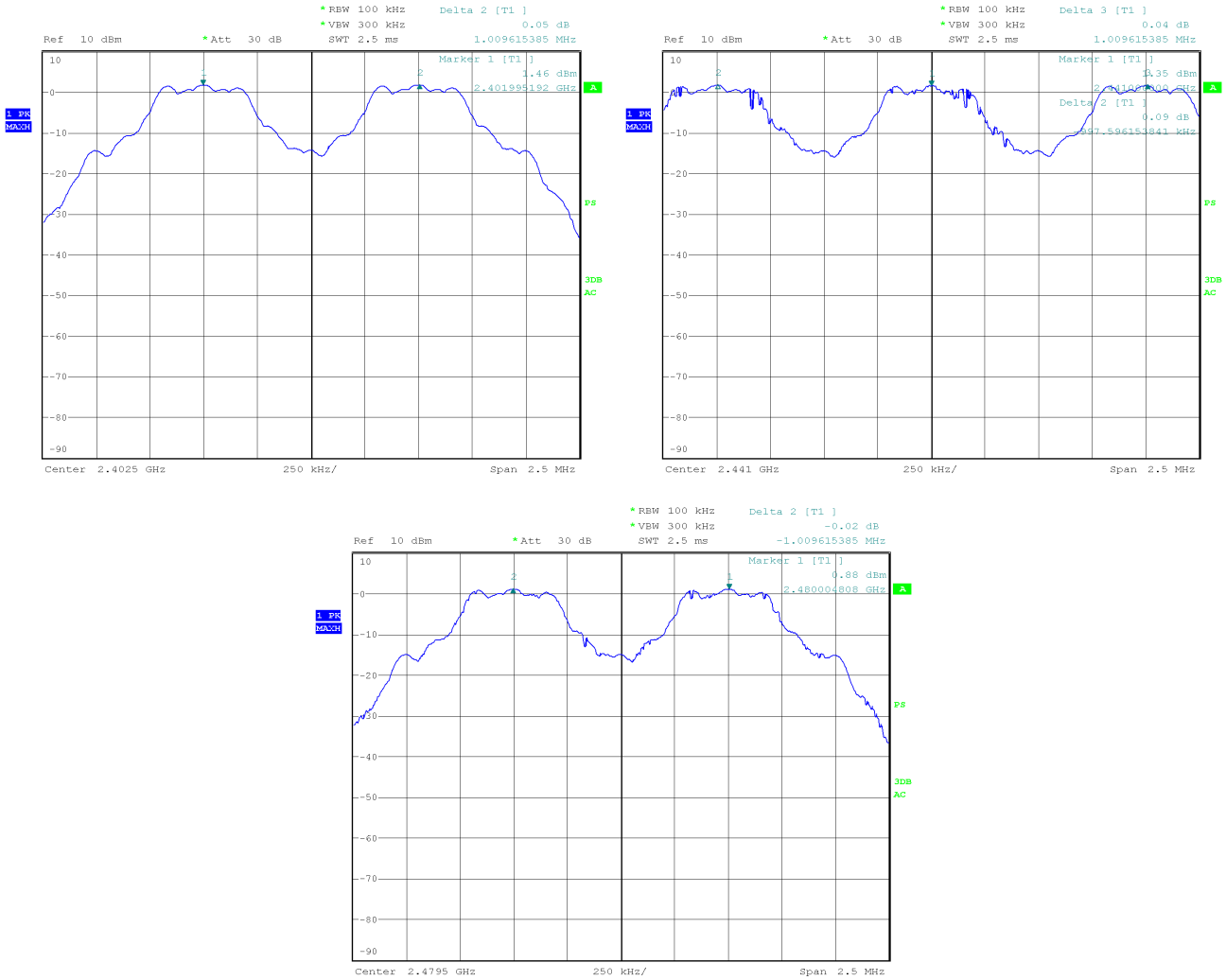
L C I E

**7.9. SETUP – ADJACENT CHANNEL SEPARATION**

**DH1 Measurements:**

Channel Frequency (MHz)	Adjacent Channel Separation (MHz)	Minimum Limit (MHz)	PASS / FAIL
2402	1.010	0.698	P
2441	0.998	0.698	P
2480	1.010	0.698	P

**Graph:**



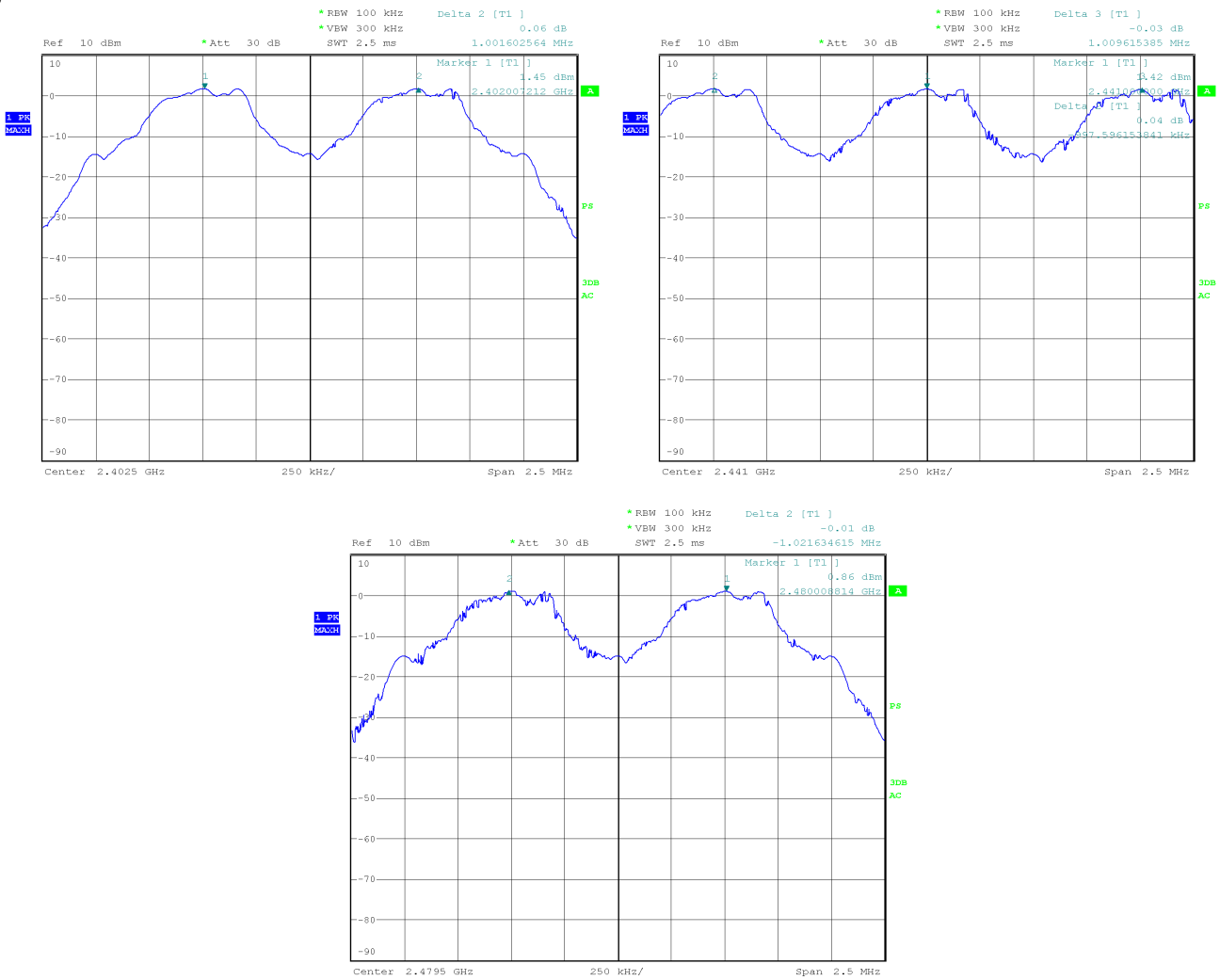


L C I E

**DH3 Measurements:**

Channel Frequency (MHz)	Adjacent Channel Separation (MHz)	Minimum Limit (MHz)	PASS / FAIL
2402	1.002	0.698	P
2441	1.010	0.698	P
2480	1.022	0.698	P

**Graph:**





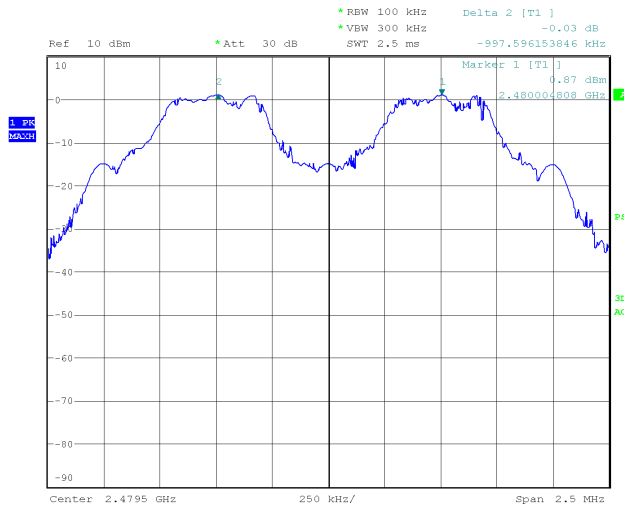
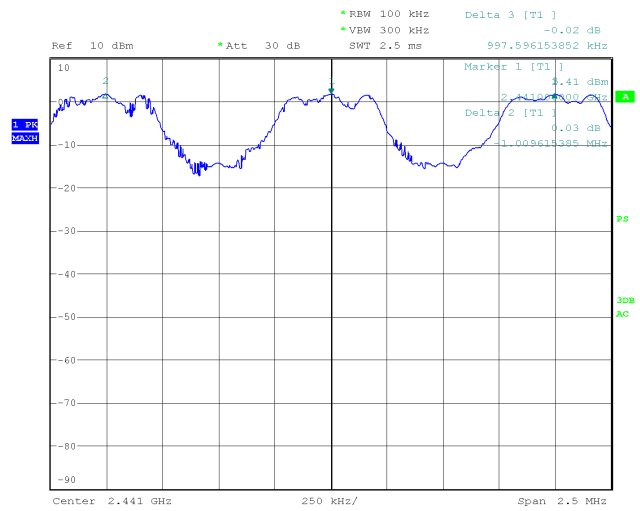
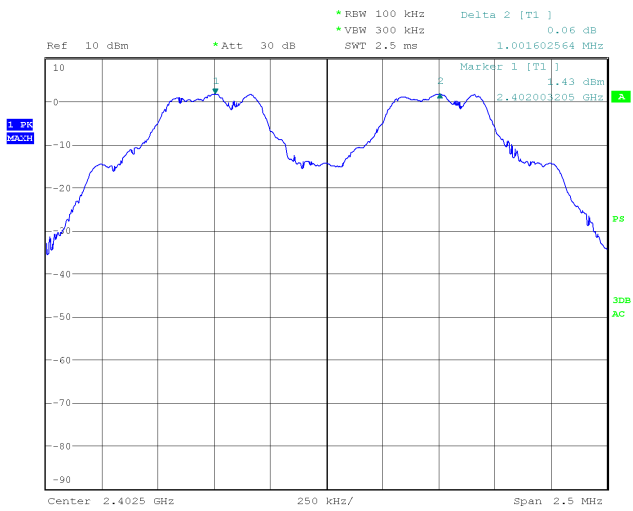


L C I E

**DH5 Measurements:**

Channel Frequency (MHz)	Adjacent Channel Separation (MHz)	Minimum Limit (MHz)	PASS / FAIL
2402	1.002	0.698	P
2441	0.998	0.698	P
2480	0.998	0.698	P

**Graph:**





**8. NUMBER OF HOPPING FREQUENCIES (15.247)**

**8.1. TEST CONDITIONS**

Date of test : April 5<sup>th</sup>, 2012  
Test performed by : A.MERLIN  
Atmospheric pressure : 984hPa  
Relative humidity : 42%  
Ambient temperature : 22°C

**8.2. LIMIT**

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

**8.3. EQUIPMENT CONFIGURATION**

**Same results following parameters of modulation**

Modulation: 8DPSK  
Packet Type: DH5  
Hopping sequence: YES

**8.4. 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

**8.5. TEST EQUIPMENT LIST**

DESCRIPTION	MANUFACTURER	MODEL	N° LCIE
Cable SMA/SMA	-	-	A5329373
Digital Radiocommunication Tester	ROHDE & SCHWARZ	CMU200	A2440004
Receiver 20Hz – 8GHz	ROHDE & SCHWARZ	ESU8	A2642019

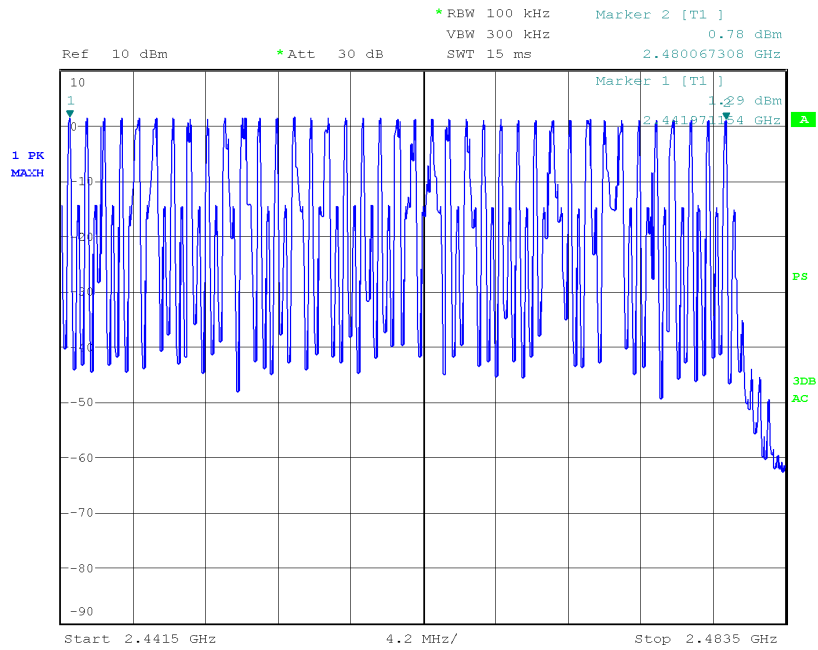
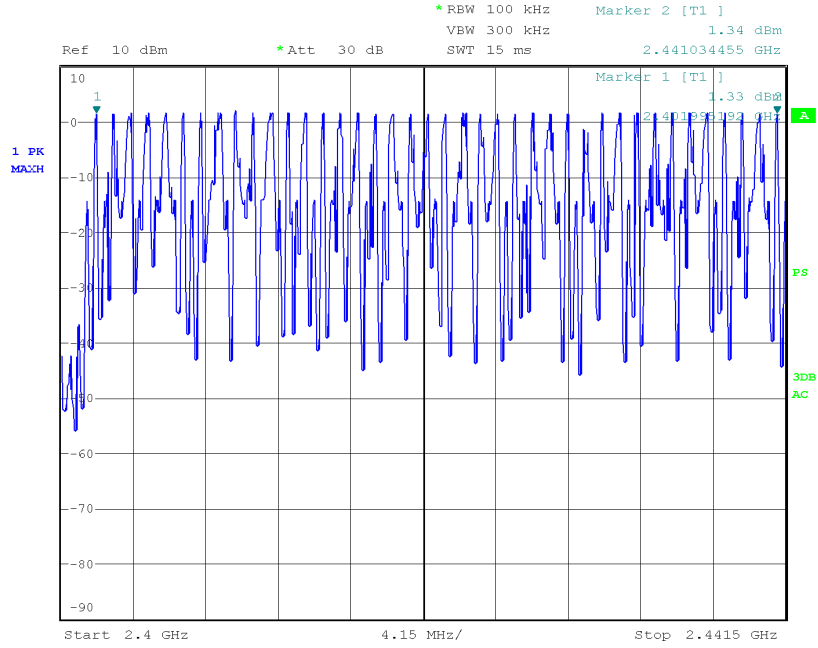
**8.6. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION**

None



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8.7. RESULTS



Number of frequency used in the hopping sequence: 79 Channels

**9. TIME OF OCCUPANCY (DWELL TIME) (15.247)****9.1. TEST CONDITIONS**

Date of test : April 5<sup>th</sup>, 2012  
Test performed by : A.MERLIN  
Atmospheric pressure : 984hPa  
Relative humidity : 42%  
Ambient temperature : 22°C

**9.2. 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.

**9.3. EQUIPMENT CONFIGURATION**

Modulation type:  GFSK  Pi/4 DQPSK  8DPSK  
Packet type: DH1 DH3 DH5  
Transfert data rate: 1Mbps 2Mbps 3Mbps  
Channel frequency: 2402MHz  
Hopping sequence: ON

**9.4. 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

**9.5. TEST EQUIPMENT LIST**

DESCRIPTION	MANUFACTURER	MODEL	N° LCIE
Cable SMA/SMA	-	-	A5329373
Digital Radiocommunication Tester	ROHDE & SCHWARZ	CMU200	A2440004
Receiver 20Hz – 8GHz	ROHDE & SCHWARZ	ESU8	A2642019

**9.6. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION**

None



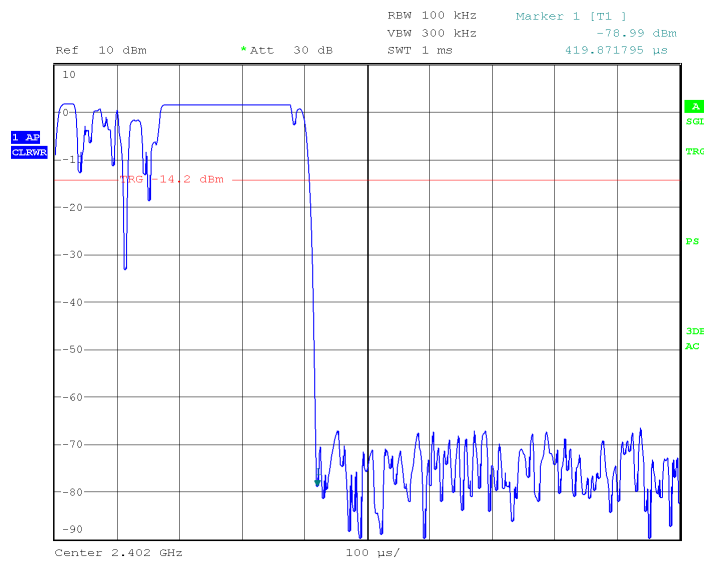
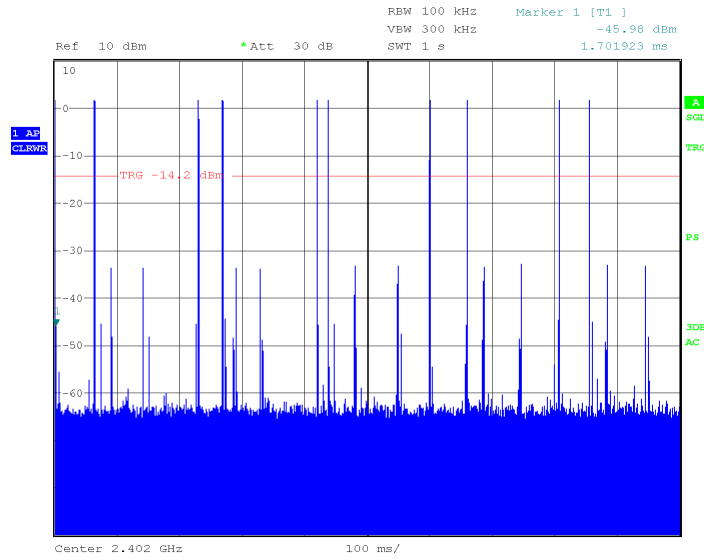
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9.7. RESULTS

DH1 Measurements:

Number of transmission in the period	Length of transmission time (ms)	Result (ms)	Limit (ms)	PASS / FAIL
10 (times/ 1sec) * 31.6 =	0.419	132	400	PASS

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



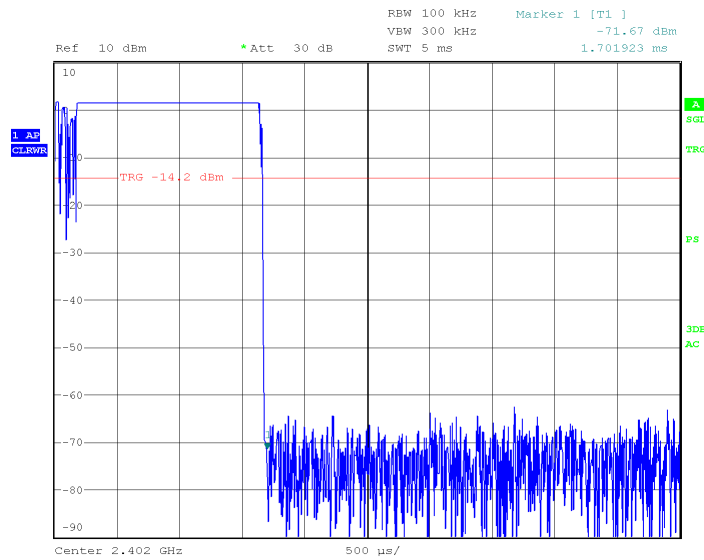
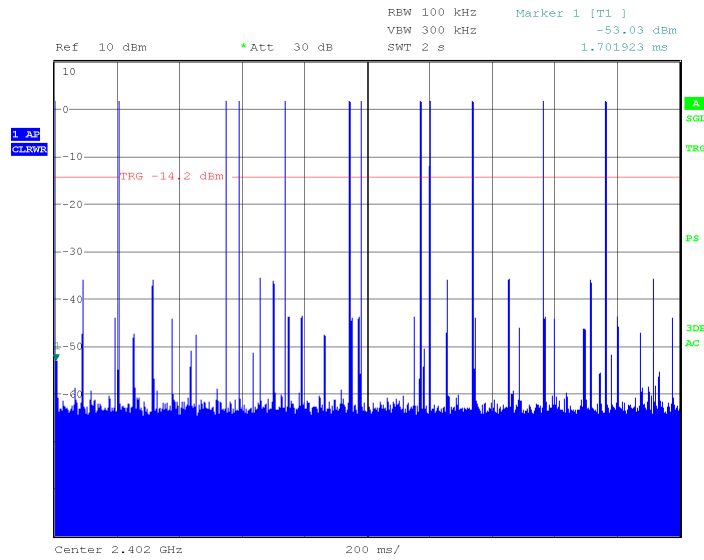


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**DH3 Measurements:**

Number of transmission in the period	Length of transmission time (ms)	Result (ms)	Limit (ms)	PASS / FAIL
12 (times / 2sec) * 15.8	1.702	323	400	PASS

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





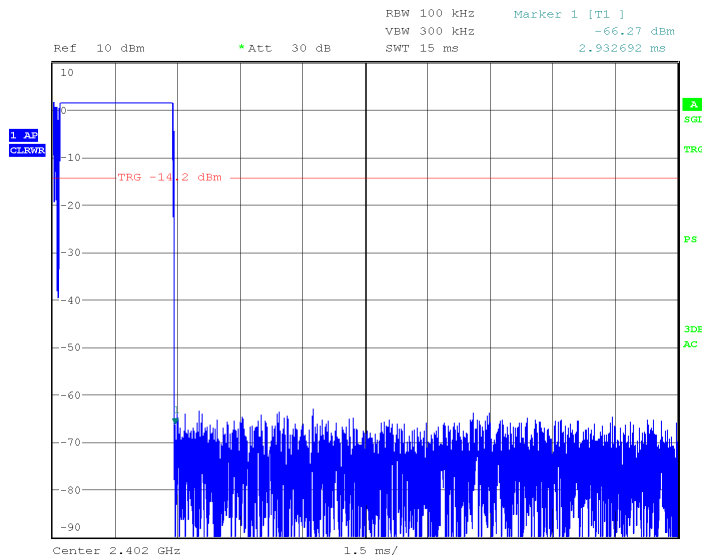
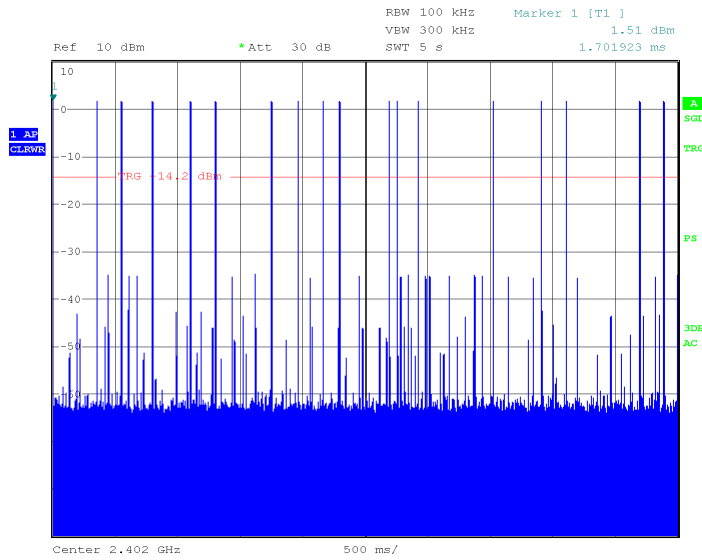


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**DH5 Measurements:**

Number of transmission in the period	Length of transmission time (ms)	Result (ms)	Limit (ms)	PASS / FAIL
18 (times / 5sec) * 6.32	2.933	333	400	PASS

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



**10. BAND EDGE MEASUREMENT (15.247)****10.1. TEST CONDITIONS**

Date of test : April 5<sup>th</sup>, 2012  
Test performed by : A.MERLIN  
Atmospheric pressure : 984hPa  
Relative humidity : 42%  
Ambient temperature : 22°C

**10.2. 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)

**10.3. EQUIPMENT CONFIGURATION**

Modulation:  
Channel frequency:  
Hopping sequence: ON

**10.4. 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

**10.5. TEST EQUIPMENT LIST**

DESCRIPTION	MANUFACTURER	MODEL	N° LCIE
Cable SMA/SMA	-	-	A5329373
Digital Radiocommunication Tester	ROHDE & SCHWARZ	CMU200	A2440004
Receiver 20Hz – 8GHz	ROHDE & SCHWARZ	ESU8	A2642019

**10.6. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION**

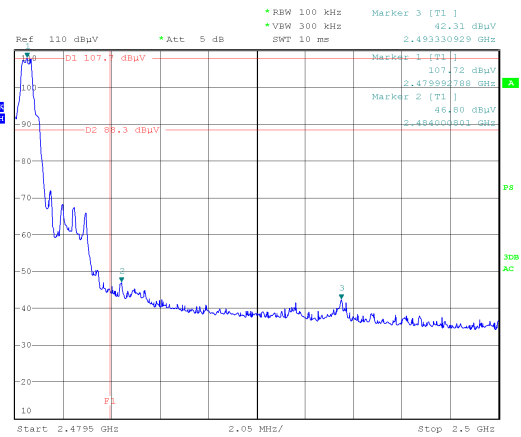
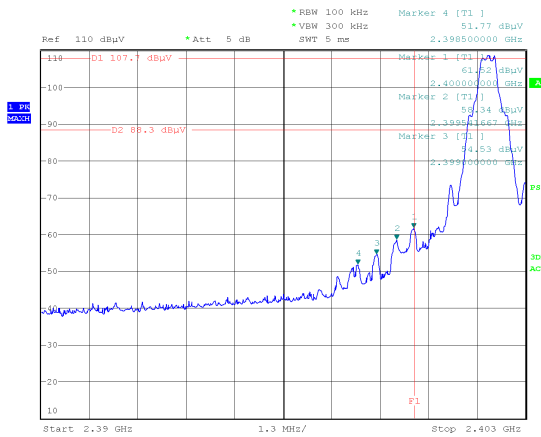
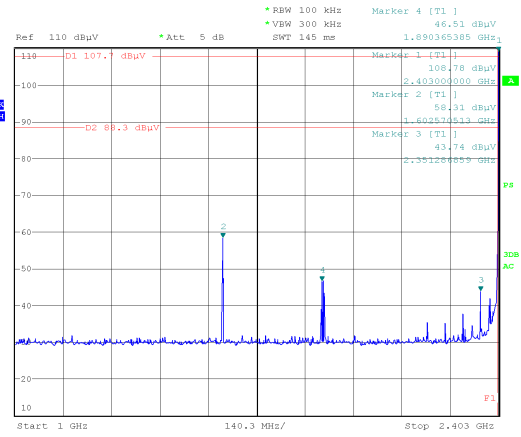
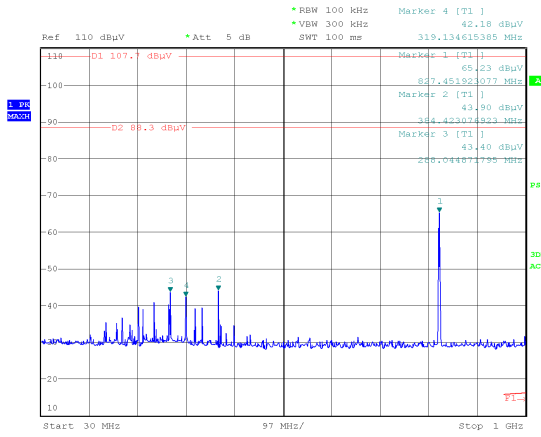
None



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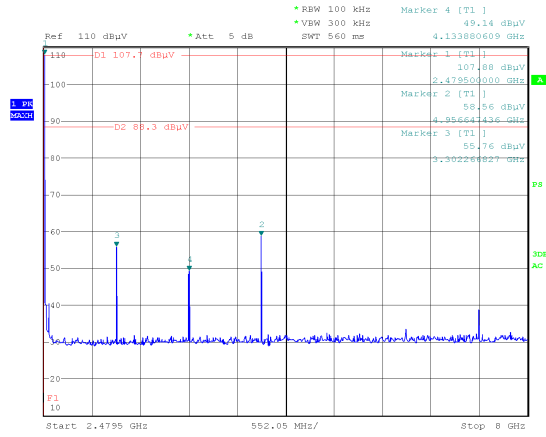
10.7. RESULTS

No	Frequency (GHz)	Limit Average (dBµV/m)	Measure Average (dBµV/m)	Margin (Mes-Lim) (dB)	Limit Peak (dBµV/m)	Measure Peak (dBµV/m)	Margin (Mes-Lim) (dB)
1	1.602	54.0	35.8	-18.2	74.0	47.8	-26.2
2	2.351	54.0	34.1	-19.9	74.0	39.9	-34.1
3	2.484	54.0	41.3	-12.7	74.0	43.5	-30.5
4	2.493	54.0	34.5	-19.5	74.0	39.6	-34.4
5	4.133	54.0	35.6	-18.4	74.0	46.9	-27.1
6	4.956	54.0	40.2	-13.8	74.0	49.6	-24.4





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**Measurement from 8GHz to 26GHz:** No frequency observed

*Note: For frequencies from 8GHz to 26GHz, it isn't possible to export screenshots.*



## 11. FUNDAMENTAL FREQUENCY TOLERANCE

### 11.1. TEST CONDITIONS

Date of test : April 12<sup>th</sup>, 2012  
 Test performed by : A.MERLIN

The frequency tolerance of the carrier signal shall be maintained within  $\pm 0.01\%$  of the operating frequency when the temperature is varied from  $-30^{\circ}\text{C}$  to  $+50^{\circ}\text{C}$  at the nominal power voltage and the primary power voltage is varied from 85% to 115% of the rated supply voltage at  $20^{\circ}\text{C}$ .

### 11.2. TEMPERATURE AND VOLTAGE FLUCTUATION

Temperature has been set at  $+20^{\circ}\text{C}$ ,  $-20^{\circ}\text{C}$ ,  $-30^{\circ}\text{C}$  and  $+50^{\circ}\text{C}$ .

Voltage is varied from 10.2VDC to 13.8VDC

Frequency of carrier: 13.56 MHz

Upper limit: 13.561356 MHz

Lower limit: 13.558644 MHz

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

Voltage	Temperature	-30°C	-20°C	20°C	+55°C
<b>Mains voltage: 12.0VDC</b>					
Frequency Drift (MHz)		- 0.000007	- 0.000005	REF	+ 0.000015
Carrier level (dBc)		- 1.1	- 1.0	REF	- 0.6
<b>Mains voltage: 10.2VDC</b>					
Frequency Drift (MHz)		- 0.000007	- 0.000005	+ 0.000000	+ 0.000015
Carrier level (dBc)		- 1.1	- 1.0	+ 0.0	- 0.6
<b>Mains voltage: 13.8VDC</b>					
Frequency Drift (MHz)		- 0.000007	- 0.000005	+ 0.000000	+ 0.000015
Carrier level (dBc)		- 1.1	- 1.0	+ 0.0	- 0.6

Frequency drift measured is **15 Hz** when the temperature is varied from  $-30^{\circ}\text{C}$  to  $+50^{\circ}\text{C}$  and voltage is varied from  $12.0\text{VDC} \pm 15\%$ .

**11.3. TEST EQUIPMENT LIST**

DESCRIPTION	MANUFACTURER	MODEL	N° LCIE
Passive loop antenna	EMCO	7405-901	A2240015
Cable N/N	-	-	A5329038
Climatic chamber	BIA CLIMATIC	CL 6-25	D1022117
Multimeter	FLUKE	189	A1240171
Power supply DC 100V	HEWLETT PACKARD	6634B	A704282
Receiver 9kHz - 6GHz	ROHDE & SCHWARZ	FSL6	A2642020

**11.4. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION**

DC voltage is varied (worst case) because AC/DC adaptor won't sell with equipment.

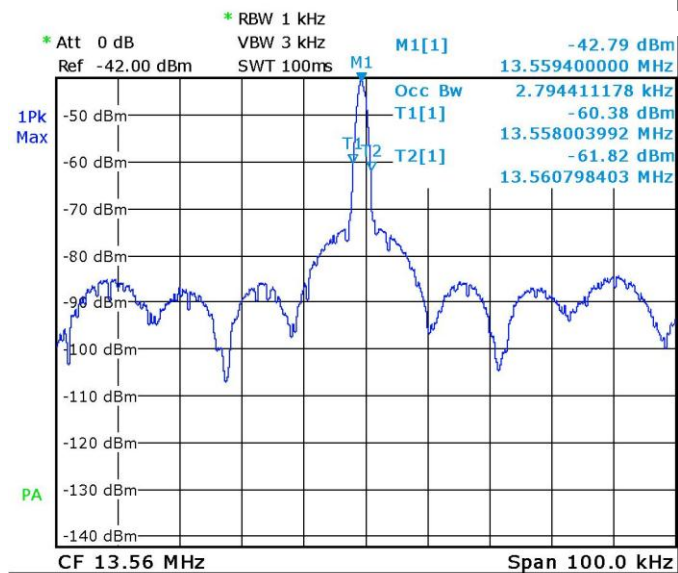
**12. OCCUPIED BANDWIDTH**

**12.1. CLIMATIC CONDITIONS**

Date of test : April 5<sup>th</sup>, 2012  
 Test performed by : A.MERLIN  
 Atmospheric pressure : 984hPa  
 Relative humidity : 42%  
 Ambient temperature : 22°C

**12.2. TEST RESULTS**

**13.56MHz Measurement:**



Measured occupied bandwidth is **2.8 kHz**

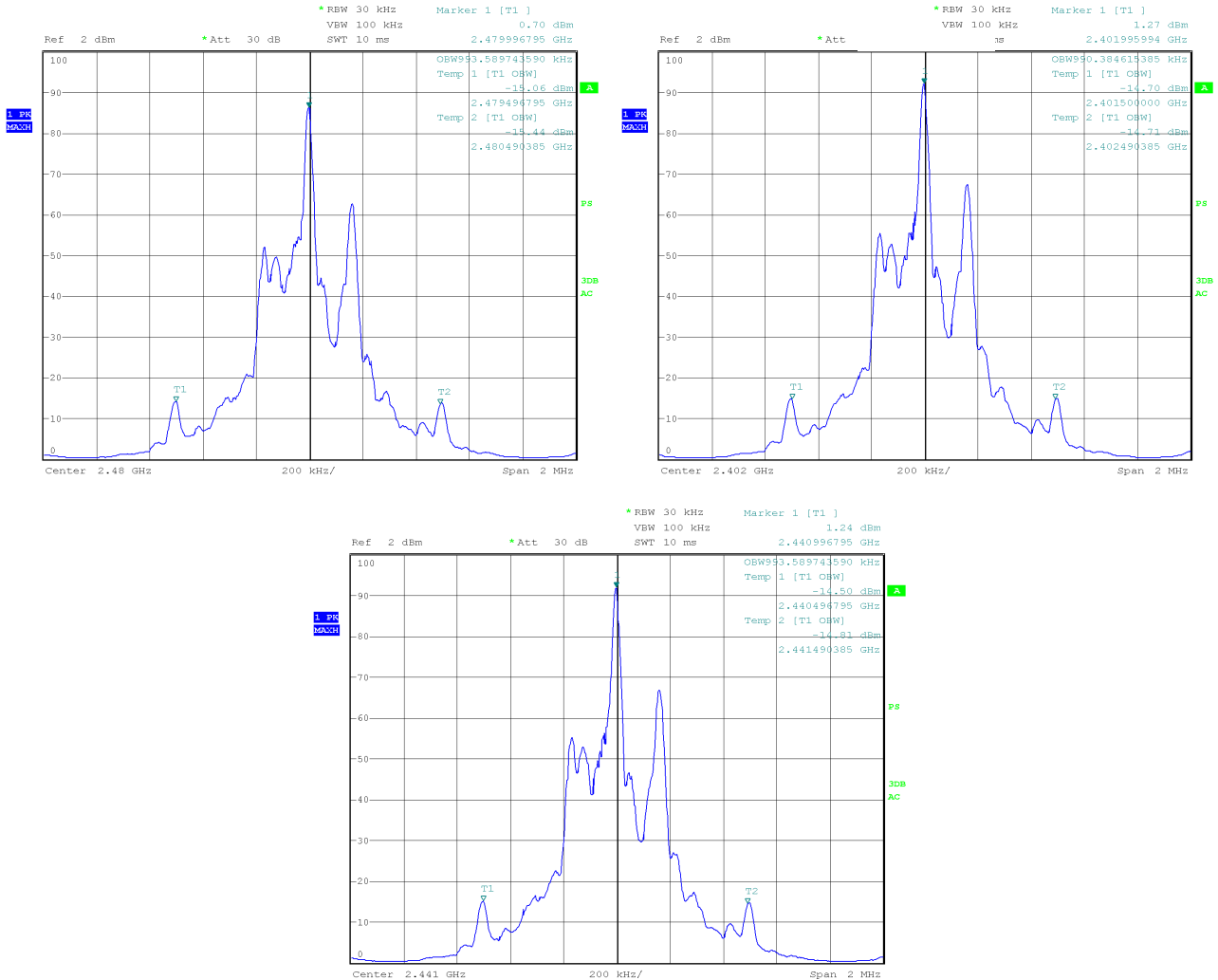
Measurement settings:

RBW = 1kHz / Video BW = 3kHz / SPAN = 100kHz



LCIE

**Bluetooth Measurement:**



Measured occupied bandwidth is **994 kHz** (Worst case)

Measurement settings:  
 RBW = 30kHz / Video BW = 100kHz / SPAN = 2MHz  
 Linear unit

**12.3. TEST EQUIPMENT LIST**

DESCRIPTION	MANUFACTURER	MODEL	N° LCIE
Cable SMA/SMA	-	-	A5329373
Digital Radiocommunication Tester	ROHDE & SCHWARZ	CMU200	A2440004
Receiver 20Hz – 8GHz	ROHDE & SCHWARZ	ESU8	A2642019

**12.4. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION**

None





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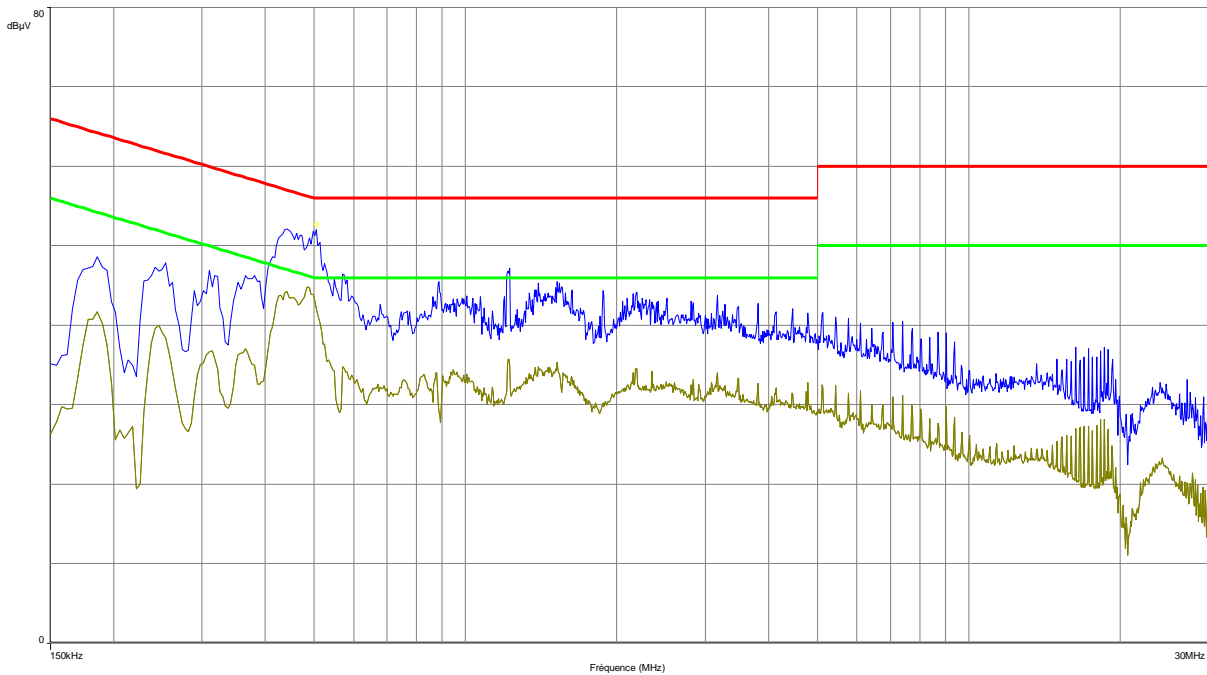
**13. ANNEX 1 (GRAPHS)**

**RADIATED EMISSIONS**

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

**PARAMETERS**

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



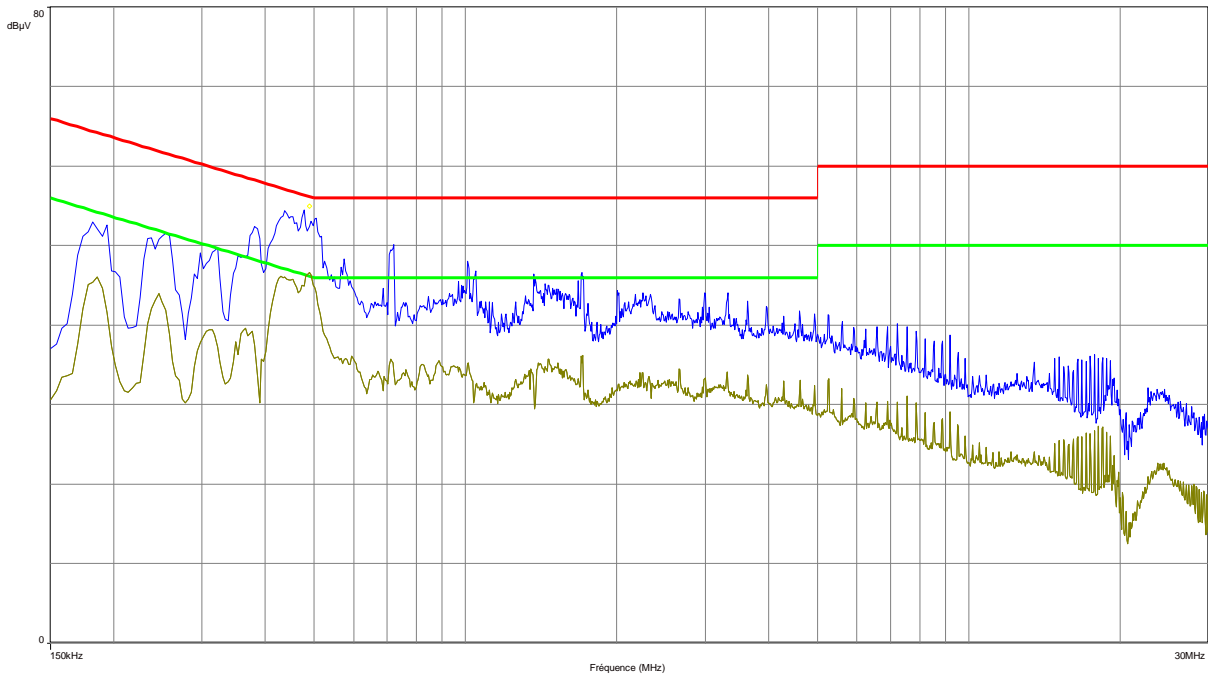
Frequency (MHz)	Avg (dBµV)	Lim Avg (dBµV)	Avg-LimAvg (dBµV)	QPeak (dBµV)	LimQPeak (dBµV)	QPeak-LimQPeak (dBµV)
0.506	41.92	46.00	<b>-4.08</b>	49.18	56.00	<b>-6.82</b>



**L C I E**

RADIATED 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	QPeak Limit	Average Limit
VBW :	30kHz		
Frequency :	150kHz- 30MHz		

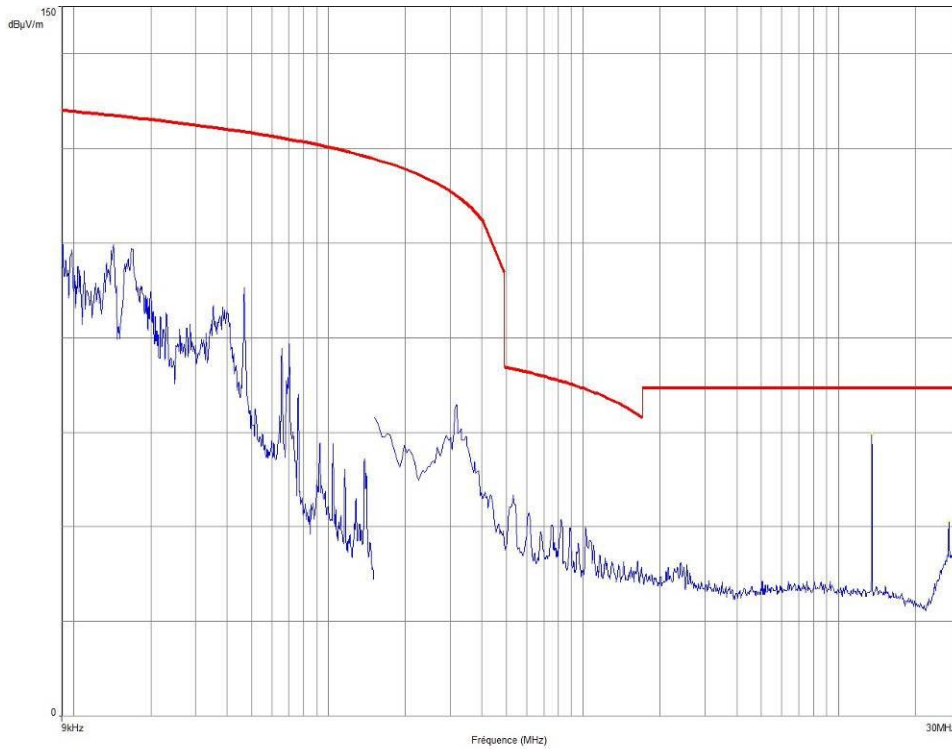


Frequency (MHz)	Avg (dBµV)	Lim Avg (dBµV)	Avg-LimAvg (dBµV)	QPeak (dBµV)	LimQPeak (dBµV)	QPeak-LimQPeak (dBµV)
0.490	46.01	46.17	<b>-0.16</b>	51.22	56.17	<b>-4.95</b>



L C I E

RADIATED EMISSIONS		
Graph name :	Emr#1	Test configuration:
Limit :	FCC Part15C	Worst case
Class :	Class B	
PARAMETERS		
Antenna polarization:	0°	Legend:
Azimuth :	0° - 360°	Peak Measure
RBW :	100Hz	
VBW :	300Hz	QPeak Limit@3m
Frequency :	9kHz- 150kHz	
PARAMETERS		
Antenna polarization:	0°	Legend:
Azimuth :	0° - 360°	Peak Measure
RBW :	10kHz	
VBW :	30kHz	QPeak Limit@3m
Frequency :	150kHz- 30MHz	



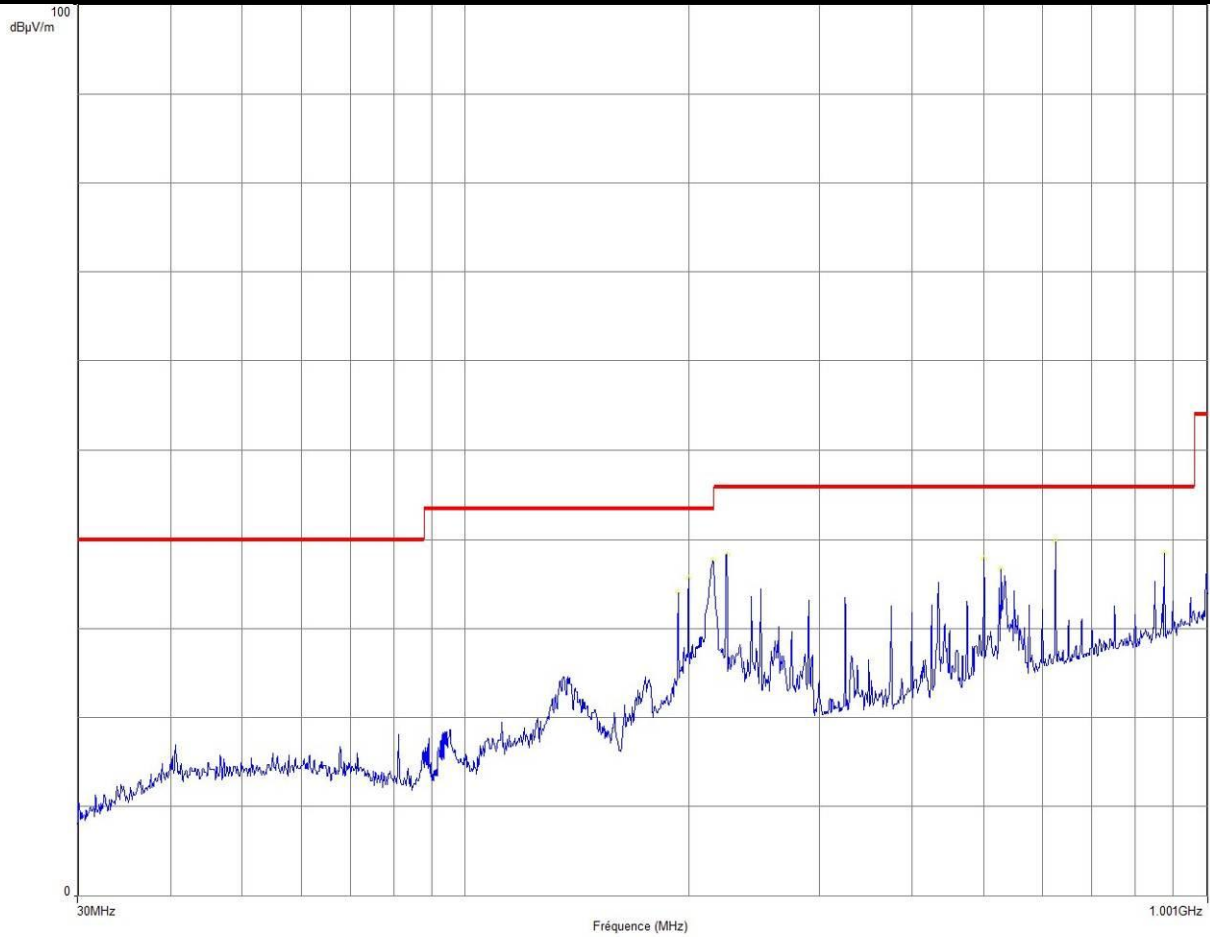
Frequency (MHz)	Peak (dBµV/m)
13.558*	59.51
27.122	41.04

\*Carrier Frequency



L C I E

RADIATED EMISSIONS		
Graph name :	Emr#2	Test configuration:
Limit :	FCC Part15C	
Class :	Class B	
PARAMETERS		
Antenna polarization:	Horizontale	Legend:
Azimuth :	0° - 360°	<span style="background-color: blue; color: white;">█</span> Peak Measure
RBW :	100kHz	<span style="background-color: red; color: white;">█</span> QPeak Limit@3m
VBW :	300kHz	
Frequency :	30MHz- 1.001GHz	

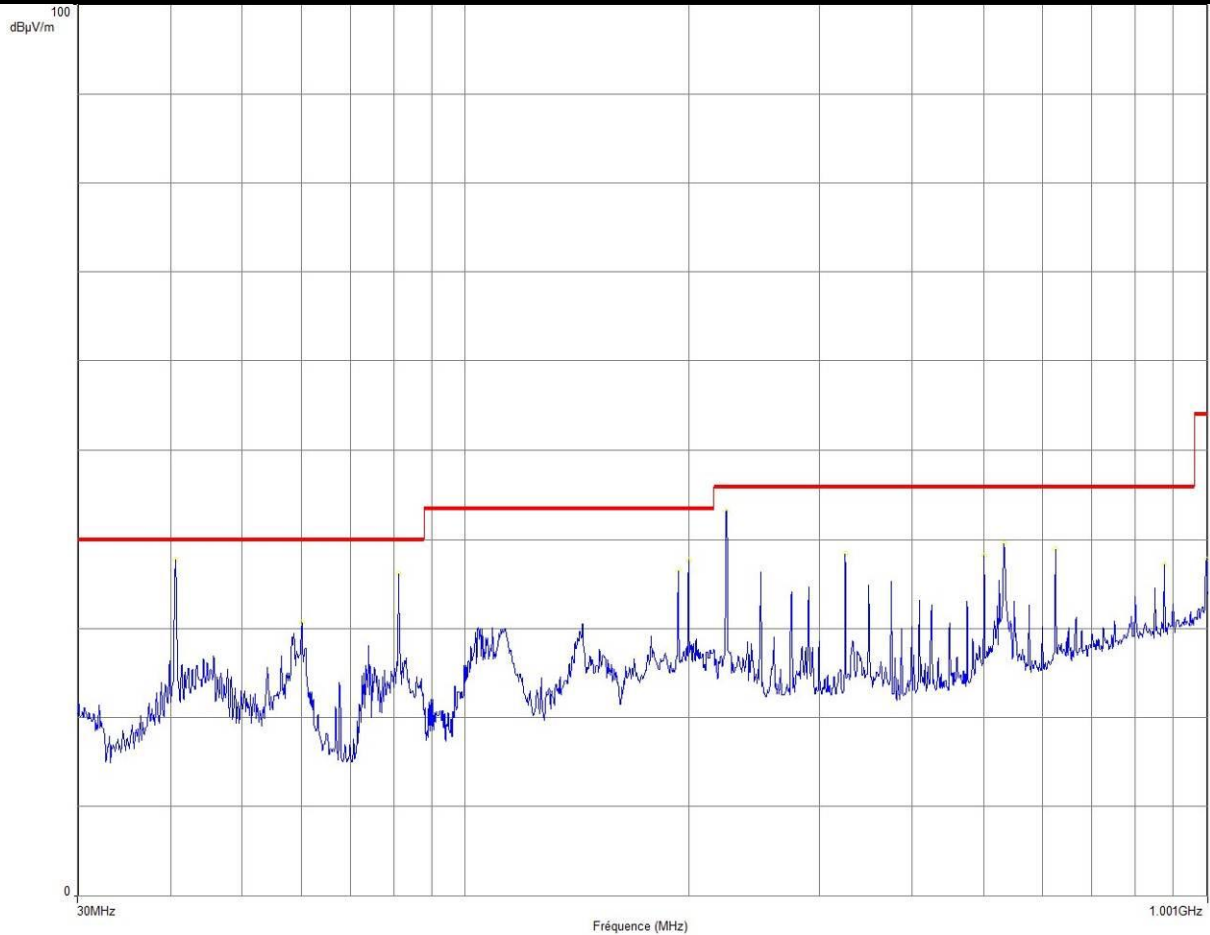


Frequency (MHz)	Peak (dBµV/m)
193.60	34.07
199.88	35.63
215.48	37.67
224.92	38.35
499.88	37.83
527.68	36.67
624.88	39.75
875.00	38.41



L C I E

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



Frequency (MHz)	Peak (dBuV/m)
40.60	37.70
60.12	30.69
81.24	36.19
193.56	36.47
199.96	37.64
224.88	43.15
324.88	38.42
499.88	38.23
532.52	39.55
624.88	38.95
875.00	37.21
998.64	37.82



**14. UNCERTAINTIES CHART**

Type de mesure / Kind of measurement	Incertitude élargie laboratoire / Wide uncertainty laboratory (k=2) ± x	Incertitude limite du CISPR / CISPR uncertainty limit ± y
Mesure des perturbations conduites en tension sur le réseau d'énergie <i>Measurement of conducted disturbances in voltage on the power port</i>	3.57 dB	3.6 dB
Mesure des perturbations conduites en tension sur le réseau de télécommunication <i>Measurement of conducted disturbances in voltage on the telecommunication port.</i>	3.28 dB	A l'étude / Under consid.
Mesure des perturbations discontinues conduites en tension <i>Measurement of discontinuous conducted disturbances in voltage</i>	3.47 dB	3.6 dB
Mesure des perturbations conduites en courant <i>Measurement of conducted disturbances in current</i>	2.90 dB	A l'étude / Under consid.
Mesure du champ électrique rayonné sur le site en espace libre de Moirans <i>Measurement of radiated electric field on the Moirans open area test site</i>	5.07 dB	5.2 dB

Les valeurs d'incertitudes calculées du laboratoire étant inférieures aux valeurs d'incertitudes limites établies par la norme, la conformité de l'échantillon est établie directement par les niveaux limites applicables. / The uncertainty values calculated by the laboratory are lower than limit uncertainty values defined by the standard. The conformity of the sample is directly established by the applicable limits values.