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Rapport d'essai / Test report

N° 115645-R2-E

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Objet / Subject

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

Matériel testé / Apparatus under test

- . Produit / Product : Terminal de paiement / *Payment terminal*
- . Marque / Trade mark : **INGENICO**
- . Constructeur / Manufacturer : **INGENICO**
- . Nom commercial / Marketing name : **ISMP**
- . Type sous test / Model under test : **IMP350-01T1496A & IMP320-01T1492A**
- . N° de série / serial number : **PROTO1 & PROTO1**
- . FCC ID : **XKB-IMP3YYW**

Date des essais / Test date

: Du 19 au 22 Avril 2011 et 16 Février 2012 /
From April 19th to 22nd, 2011 and February 16th, 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 : 35 pages.

MOIRANS, LE 16 FEVRIER 2012 / FEBRUARY 16TH, 2012

Ecrit par / *Written by*,
Anthony MERLIN

Approuvé par / *Approved by*
Yannick SAVOIE



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1. TEST PROGRAM

Standard: - FCC Part 15, Subpart C 15.247
 - ANSI C63.4 (2003)

EMISSION TEST	LIMITS			RESULTS (Comments)
Limits for conducted disturbance at mains ports 150kHz-30MHz	Frequency	Quasi-peak value (dBµV)	Average value (dBµV)	See test reports ^{*2} 115645-R1-E
	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			See test reports ^{*2} 115645-R1-E
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 and See test reports ^{*2} 115645-R1-E
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}: In report 115645-R1-E, tests are performed with Bluetooth module activated in typical use but the equipment is been considered digital device and so tested in compliance with Part15b. Complementary tests of 15.247 are performed in this test report



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

- **Model:**

Commercial Name : ISMP

Reference:

- **IMP320-01T1492A** (No barcode / With Contact less / With Bluetooth)
- **IMP350-01T1496A** (With barcode / With Contact less / With Bluetooth) **Full options**

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

IMP350-01T1496A

Serial number: PROTO1

- **Base with power supply adaptor:**

PHIHONG PSC12A-050, 100-240VAC / 5A / 50-60Hz, output 5VDC / 2A (US plug)

PHIHONG PSC12R-050, 100-240VAC / 5A / 50-60Hz, output 5VDC / 2A (Multi plug)

- **Micro USB power supply adaptor:**

PHIHONG PSAC05R-050, 100-240VAC / 300mA / 50-60Hz, output 5VDC / 1A, No: 05 rev: 01.

Internal max frequencies:

- Clock: 400MHz
- RFID 13.56MHz
- Bluetooth: 2400-2483.5MHz

- **Input/output:**

- 2 x Power supply contacts (Base and Terminal)
- 1 x Mini USB, only used for recharge with power supply PHIHONG PSAC05R-050
- 1 x Dock connector

- **Cables:**

- None

- **Auxiliaries equipment used during test:**

- 1 x IPOD Touch, Apple, Model: A1367, Sn: C3XDV35UDCP7, FCCID: BCG-E2407, IC: 579C-E2407
- 1 x Laptop IBM ThinkPad T60.
- 1 x IMP300-BCSN1476A (Base), FCCID: XKB-IMP3XXCX, sn: Proto1



- **Functions:**

- 1 x Contact less RFID reader at 13.56MHz, disabled during the recharge, tested only in configuration n°2.
- 1 x Bluetooth at 2400-2483.5MHz, always ON.
- 1 x Barcode, not used on base, tested only in configuration n°2.
- 1 x Contact card reader, not used on base, tested only in configuration n°2.

- **Equipment information:**

- External antenna connector: NO
- Radiated fundamental frequency band: 2400-2483.5MHz
- Antenna type: printed antenna (monopole $\lambda/4$)
- Antenna Gain: 0dBi declaration of provider
- Stand By mode: None
- Normal power source: Battery Lithium Ion 3.7VDC
- Modulation Type: GFSK
- Modulation Technology: FHSS
- Transfert rate: 1Mbps
- Packet Type: DH1, DH2, DH3



2.3. EUT CONFIGURATION

Configuration n°1: see test report 115645-R1-E

Terminal on its base for recharge with following parameters (with or without Iphone plugged, worst case results presented):

- Recharge of terminal
- Recharge of Iphone
- Bluetooth, hopping mode
- Contact less OFF
- CAM0 (Contact card) OFF
- Barcode OFF

Configuration n°2: see test report 115645-R1-E

Software TestCem used on terminal, followings functions are tested in loop during all tests (with or without Iphone plugged, worst case results presented):

- CAM0 (Contact card)
- Contact less
- Barcode
- Bluetooth, hopping mode
- Iphone plugged.

Configuration n°3: see test report 115645-R1-E

Terminal plugged to power supply PHIHONG PSAC05R-050 for recharge with following parameters (with or without Iphone plugged, worst case results presented):

- Recharge of terminal
- Bluetooth, hopping mode
- Contact less OFF
- CAM0 (Contact card) OFF
- Barcode OFF



Configuration n°4:

Terminal on its base for recharge with following parameters (with or without Iphone plugged, worst case results presented):

- Carrier frequency 2402MHz – GFSK – DH1 / DH3 / DH5
- Carrier frequency 2441MHz – GFSK – DH1 / DH3 / DH5
- Carrier frequency 2480MHz – GFSK – DH1 / DH3 / DH5
- Frequency Hopping mode – GFSK – DH1 / DH3 / DH5 – Searching to synchronize
- Frequency Hopping mode – GFSK – DH1 / DH3 / DH5 – Data transfer

Configuration n°5:

Terminal alone with following parameters (with or without Iphone plugged, worst case results presented):

- Carrier frequency 2402MHz – GFSK – DH1 / DH3 / DH5
- Carrier frequency 2441MHz – GFSK – DH1 / DH3 / DH5
- Carrier frequency 2480MHz – GFSK – DH1 / DH3 / DH5
- Frequency Hopping mode – GFSK – DH1 / DH3 / DH5 – Searching to synchronize
- Frequency Hopping mode – GFSK – DH1 / DH3 / DH5 – Data transfer

Configuration n°6:

Terminal plugged to power supply PHIHONG PSAC05R-050 for recharge with following parameters (with or without Iphone plugged, worst case results presented):

- Carrier frequency 2402MHz – GFSK – DH1 / DH3 / DH5
- Carrier frequency 2441MHz – GFSK – DH1 / DH3 / DH5
- Carrier frequency 2480MHz – GFSK – DH1 / DH3 / DH5
- Frequency Hopping mode – GFSK – DH1 / DH3 / DH5 – Searching to synchronize
- Frequency Hopping mode – GFSK – DH1 / DH3 / DH5 – Data transfer

2.4. EQUIPMENT MODIFICATIONS

None

2.5. SPECIAL ACCESSORIES

None

3. RADIATED EMISSION DATA

3.1. CLIMATIC CONDITIONS

Date of test	: April 19 th , 2011	and	April 20 th , 2011	February 16 th , 2012
Test performed by	: A.MERLIN			
Atmospheric pressure	: 1011mb		1011mb	1003mb
Relative humidity	: 31%		28%	23%
Ambient temperature	: 22°C		21°C	21°C

3.2. TEST SETUP

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



Configuration n°4



Configuration n°5



Configuration n°6



3.3. TEST SEQUENCE AND RESULTS

3.3.1. 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 and results in test report 115645-R1-E.

3.3.2. 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 graph and results in test report 115645-R1-E.

3.3.3. 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.

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.

See graph and results in test report 115645-R1-E.

3.3.4. 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

See graph and results in test report 115645-R1-E.



Frequency band 1GHz to 25GHz

Configuration n°4:

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

No	Frequency (MHz)	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	4804	54.0	48.8	-5.2	200	H	100	36.4	DH5 / Axis Z
2	7206	54.0	45.9	-8.1	180	H	100	39.7	DH5 / Axis Z
3	4882	54.0	47.1	-6.9	200	H	100	36.7	DH5 / Axis Z
4	7323	54.0	45.8	-8.2	185	H	100	39.8	DH5 / Axis Z
5	4960	54.0	45.7	-8.3	195	H	100	36.9	DH5 / Axis Z
6	7440	54.0	45.2	-8.8	200	H	100	39.9	DH5 / Axis Z

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	4804	74.0	63.8	-10.2	200	H	100	36.4	DH5 / Axis Z
2	7206	74.0	61.6	-12.4	180	H	100	39.7	DH5 / Axis Z
3	4882	74.0	62.3	-11.7	200	H	100	36.7	DH5 / Axis Z
4	7323	74.0	60.4	-13.6	185	H	100	39.8	DH5 / Axis Z
5	4960	74.0	60.2	-13.8	195	H	100	36.9	DH5 / Axis Z
6	7440	74.0	61.1	-12.9	200	H	100	39.9	DH5 / Axis Z

Note: Measures have been done at 3m distance.



Configuration n°5:

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

No	Frequency (MHz)	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	4804	54.0	46.5	-7.5	195	H	100	36.4	DH5 / Axis Z
2	7206	54.0	46.0	-8.0	190	H	100	39.7	DH5 / Axis Z
3	4882	54.0	47.5	-6.5	200	H	100	36.7	DH5 / Axis Z
4	7323	54.0	47.3	-6.7	295	H	100	39.8	DH5 / Axis Z
5	4960	54.0	48.5	-5.5	200	H	100	36.9	DH5 / Axis Z
6	7440	54.0	46.6	-7.4	200	H	100	39.9	DH5 / Axis Z

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	4804	74.0	62.7	-11.3	195	H	100	36.4	DH5 / Axis Z
2	7206	74.0	59.9	-14.1	190	H	100	39.7	DH5 / Axis Z
3	4882	74.0	62.7	-11.3	200	H	100	36.7	DH5 / Axis Z
4	7323	74.0	59.6	-14.4	295	H	100	39.8	DH5 / Axis Z
5	4960	74.0	63.0	-11.0	200	H	100	36.9	DH5 / Axis Z
6	7440	74.0	60.5	-13.5	200	H	100	39.9	DH5 / Axis Z

Note: Measures have been done at 3m distance.



Configuration n°6 :

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

No	Frequency (MHz)	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	4804	54.0	48.6	-5.4	195	H	100	36.4	DH5 / Axis Z
2	7206	54.0	45.4	-8.6	190	H	100	39.7	DH5 / Axis Z
3	4882	54.0	48.0	-6.0	195	H	100	36.7	DH5 / Axis Z
4	7323	54.0	46.1	-7.9	190	H	100	39.8	DH5 / Axis Z
5	4960	54.0	48.1	-5.9	195	H	100	36.9	DH5 / Axis Z
6	7440	54.0	46.8	-7.2	200	H	100	39.9	DH5 / Axis Z

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	4804	74.0	62.0	-12.0	195	H	100	36.4	DH5 / Axis Z
2	7206	74.0	59.4	-14.6	190	H	100	39.7	DH5 / Axis Z
3	4882	74.0	63.3	-10.7	195	H	100	36.7	DH5 / Axis Z
4	7323	74.0	62.2	-11.8	190	H	100	39.8	DH5 / Axis Z
5	4960	74.0	63.5	-10.5	195	H	100	36.9	DH5 / Axis Z
6	7440	74.0	60.5	-13.5	200	H	100	39.9	DH5 / Axis Z

Note: Measures have been done at 3m distance.

RESULTS: PASS

3.4. 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.

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

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

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

**4. MAXIMUM PEAK OUTPUT POWER (15.247)****4.1. TEST CONDITIONS**

Date of test : April 21st, 2011
Test performed by : A.MERLIN
Atmospheric pressure : 1006mb
Relative humidity : 27%
Ambient temperature : 21°C

4.2. EQUIPMENT CONFIGURATION

Modulation: GFSK
Packet Type: DH5 (Worst case)
Hopping sequence: OFF

4.3. 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 \geq 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:

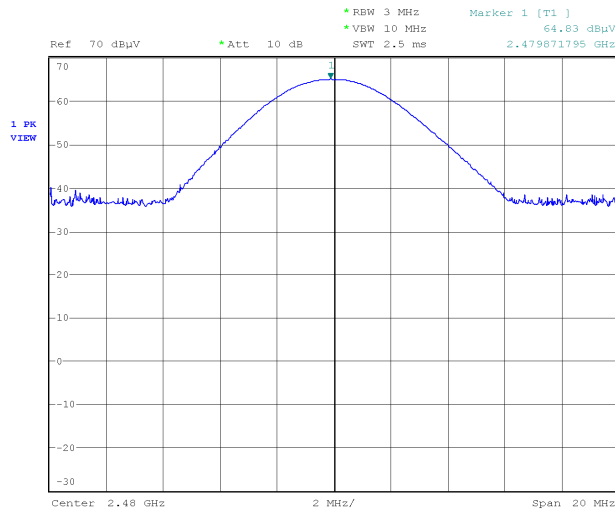
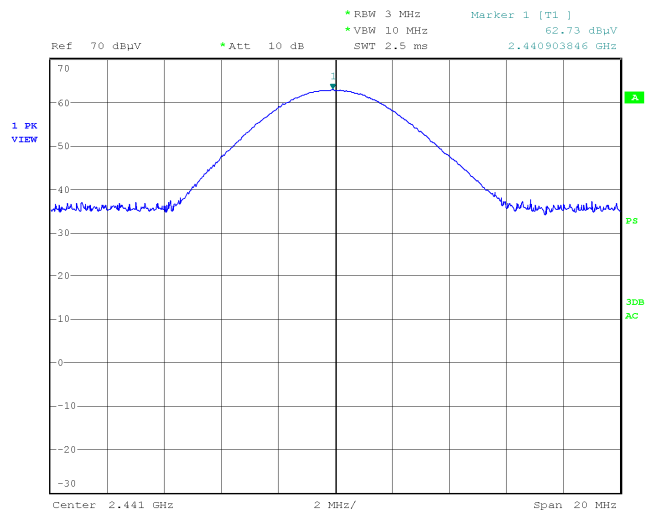
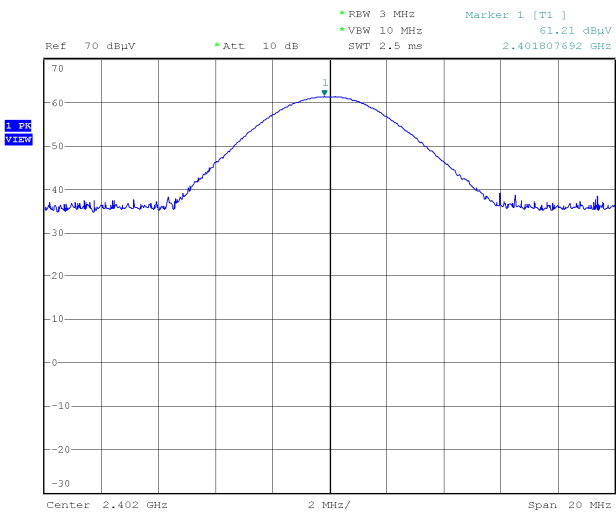
$$P = \frac{(Ed)^2}{30G}$$



Configuration n°4:

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

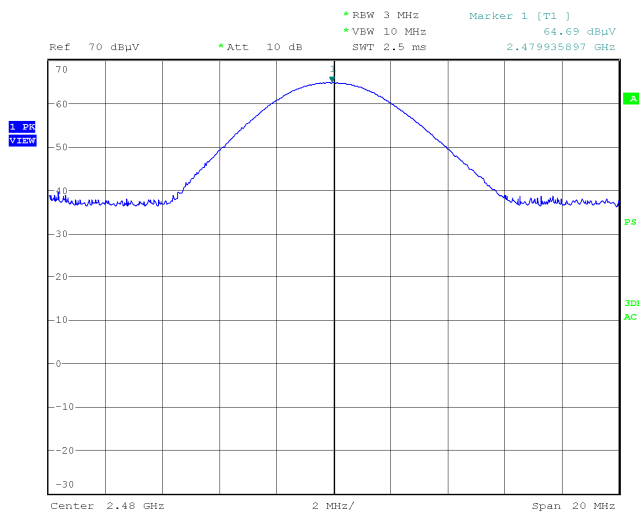
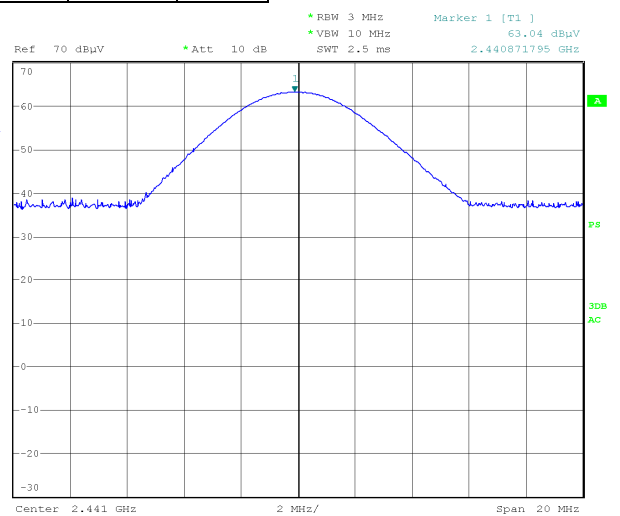
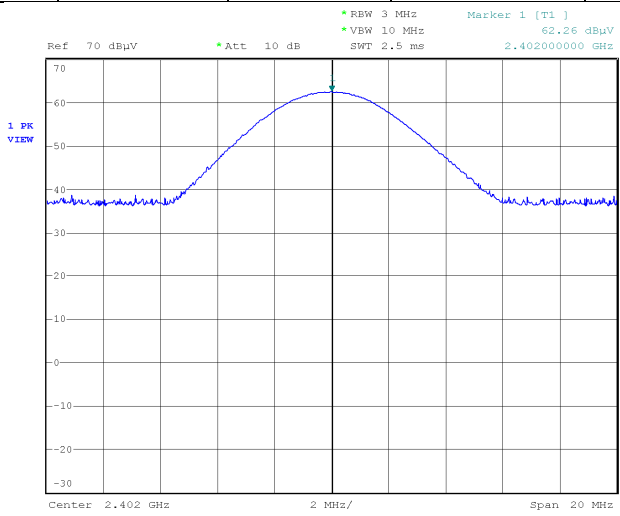
Channel	Channel Frequency (MHz)	Maximum Field (dBµV/m)	Peak Output Power (dBm)	Power Limit (dBm)	FC (dB)	PASS / FAIL
0	2402	92.8	-2.4	21	31.6	P
39	2441	94.3	-0.9	21	31.6	P
78	2480	96.4	1.2	21	31.6	P



Configuration n°5:

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

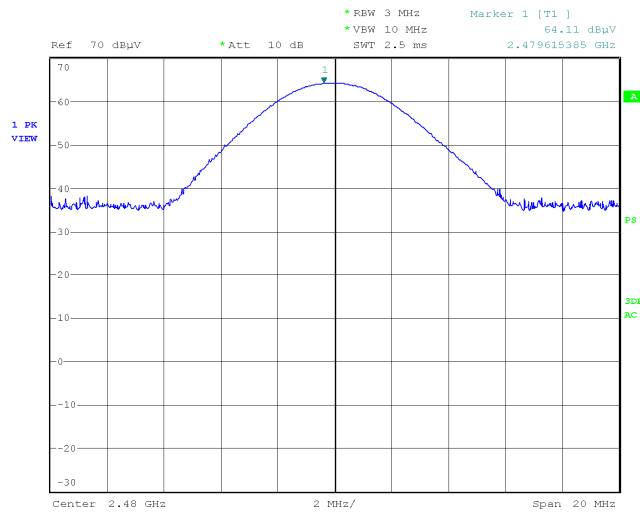
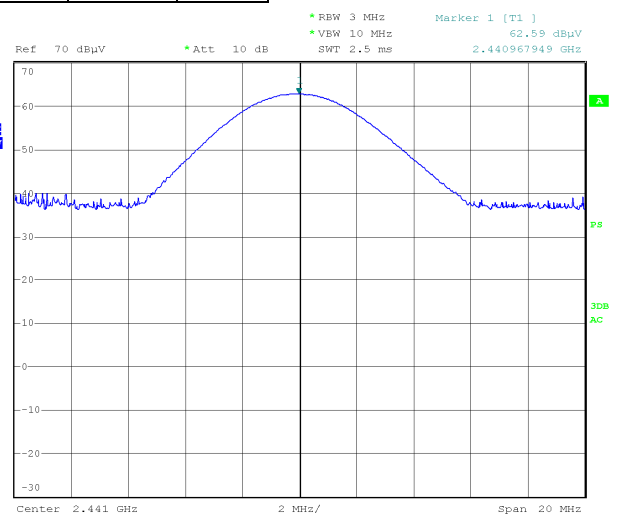
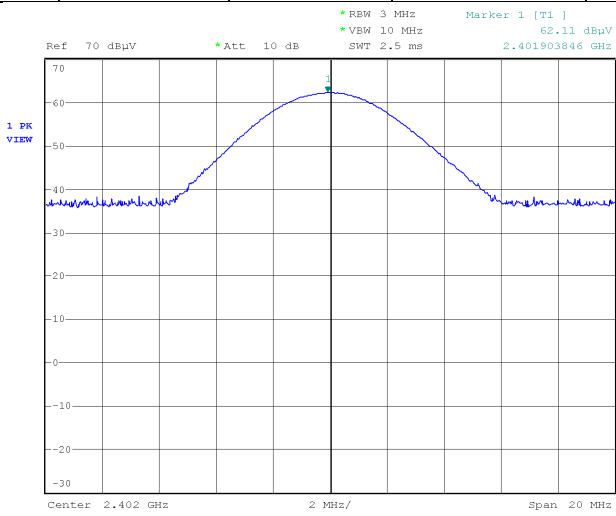
Channel	Channel Frequency (MHz)	Maximum Field (dBµV/m)	Peak Output Power (dBm)	Power Limit (dBm)	FC (dB)	PASS / FAIL
0	2402	93.9	-1.3	21	31.6	P
39	2441	94.7	-0.5	21	31.6	P
78	2480	96.3	1.1	21	31.6	P



Configuration n°6:

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	93.7	-1.5	21	31.6	P
39	2441	94.2	-1.0	21	31.6	P
78	2480	95.7	0.5	21	31.6	P





5. HOPPING CHANNEL SEPARATION (15.247)

5.1. TEST CONDITIONS

Date of test : April 22nd, 2011
Test performed by : A.MERLIN
Atmospheric pressure : 1005mb
Relative humidity : 28%
Ambient temperature : 21°C

5.2. 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 shall be a minimum limit for the hopping channel separation.

5.3. EQUIPMENT CONFIGURATION

Modulation: GFSK
Packet Type: DH5 / DH3 / DH1 – Different configurations, same results.
Hopping sequence: ON

5.4. SETUP – 20DB BANDWIDTH

The EUT is placed in an anechoic chamber; 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.

5.5. SETUP – ADJACENT CHANNEL SEPARATION

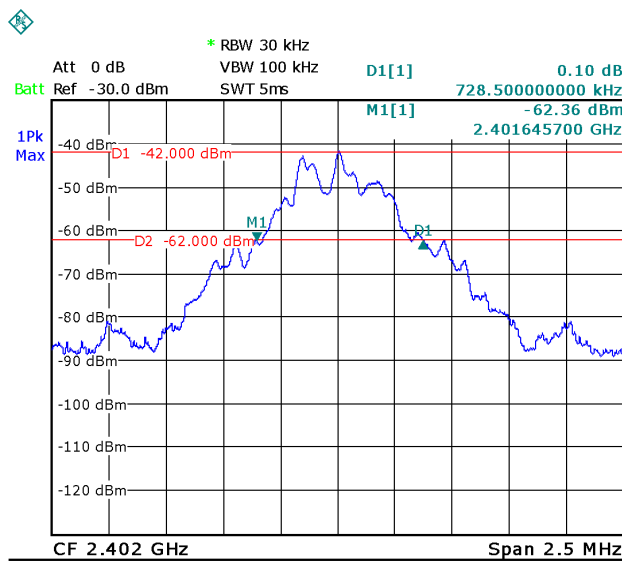
The EUT is placed in an anechoic chamber; the EUT is turn ON and using the MaxHold function, the separation of two adjacent channels is recorded. A delta marker is used to measure the frequency difference.



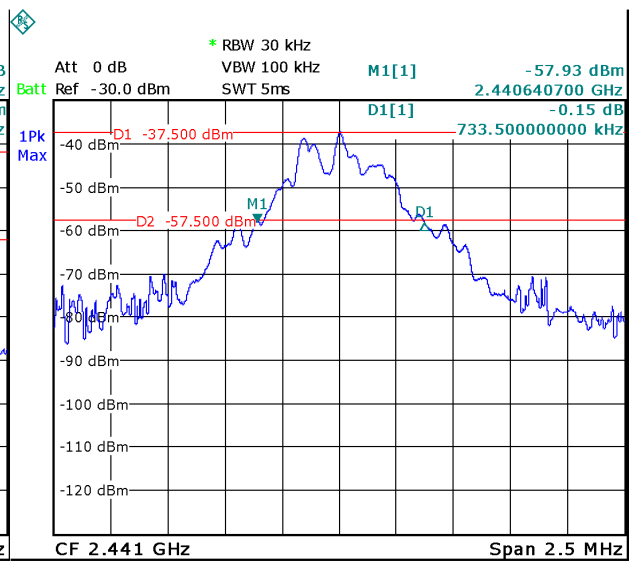
5.6. RESULTS – 20DB BANDWIDTH

Modulation: GFSK – DH1

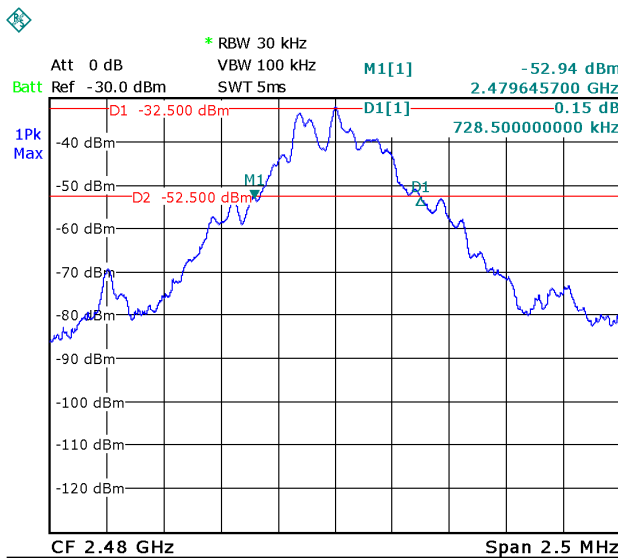
Channel	Channel Frequency (MHz)	20dB Bandwidth (MHz)
0	2402	0.729
39	2441	0.734
78	2480	0.729



Date: 22.APR.2011 12:07:05



Date: 22.APR.2011 12:12:43

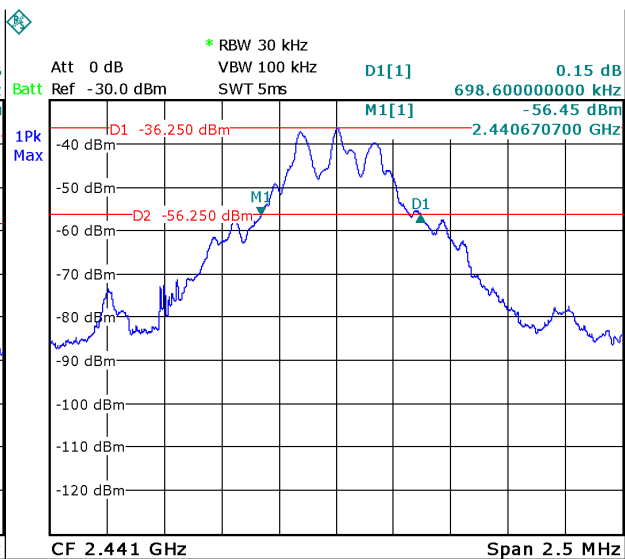
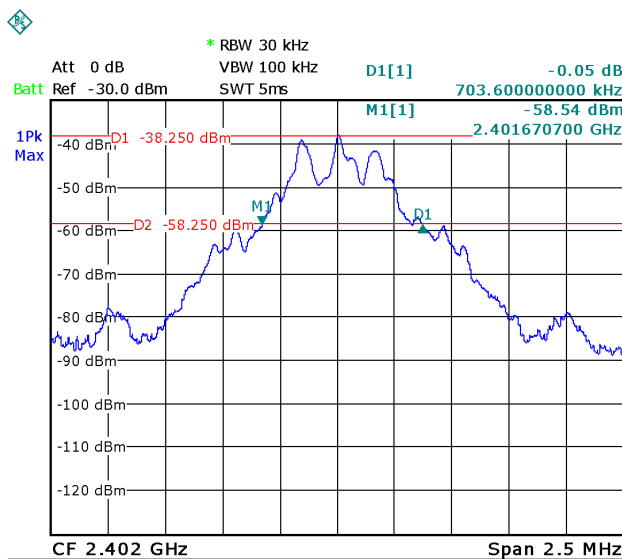


Date: 22.APR.2011 12:14:40



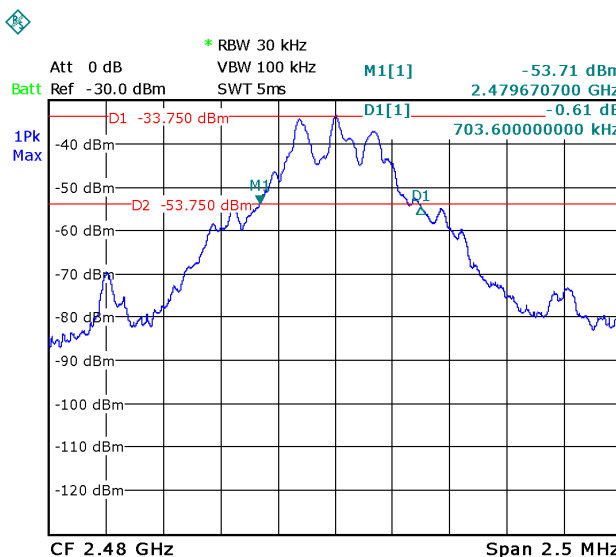
Modulation: GFSK – DH3

Channel	Channel Frequency (MHz)	20dB Bandwidth (MHz)
0	2402	0.703
39	2441	0.699
78	2480	0.704



Date: 22.APR.2011 13:18:35

Date: 22.APR.2011 13:20:29

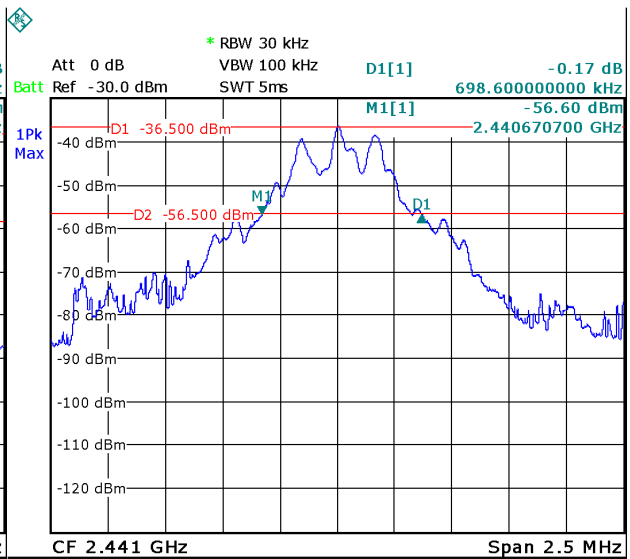
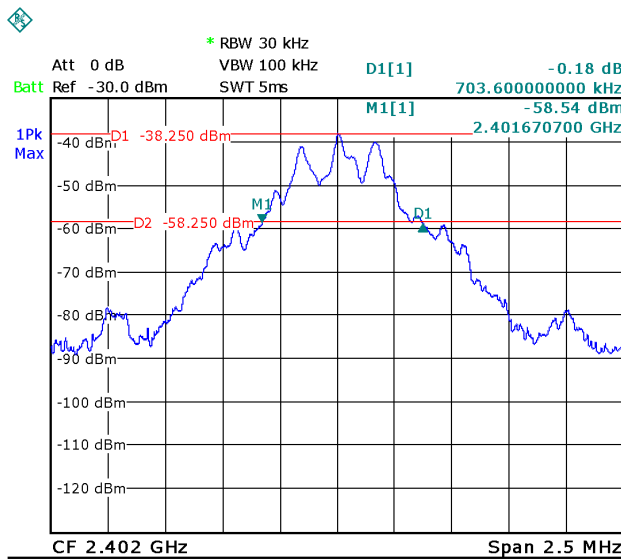


Date: 22.APR.2011 13:21:30



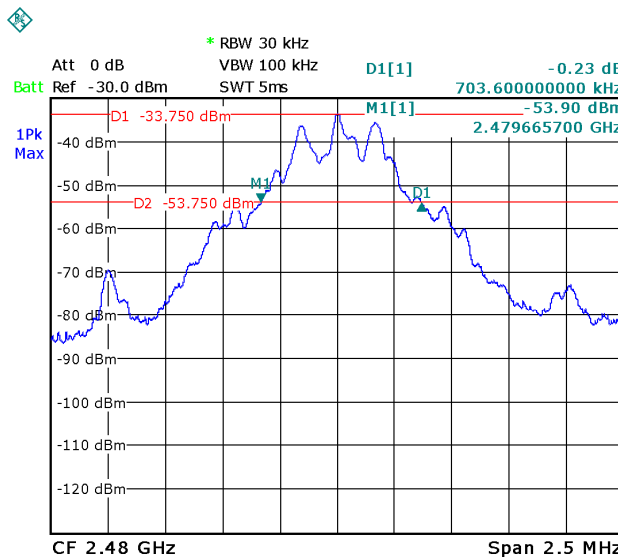
Modulation: GFSK – DH5

Channel	Channel Frequency (MHz)	20dB Bandwidth (MHz)
0	2402	0.704
39	2441	0.699
78	2480	0.704



Date: 22.APR.2011 13:23:26

Date: 22.APR.2011 13:24:26



Date: 22.APR.2011 13:27:22

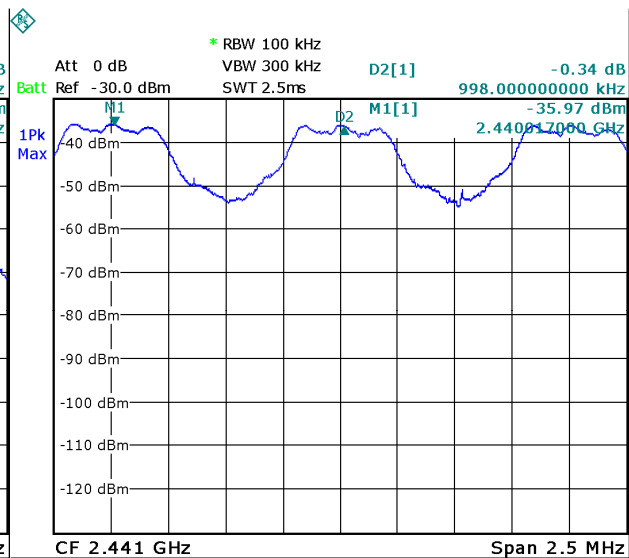
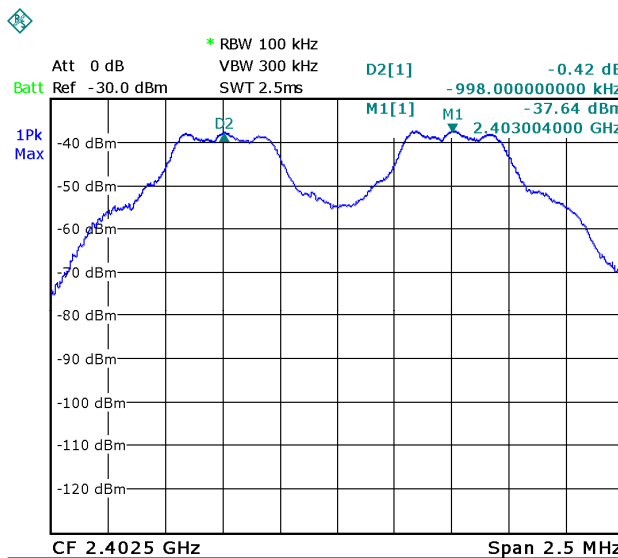


5.7. SETUP – ADJACENT CHANNEL SEPARATION

Modulation: GFSK – DH1

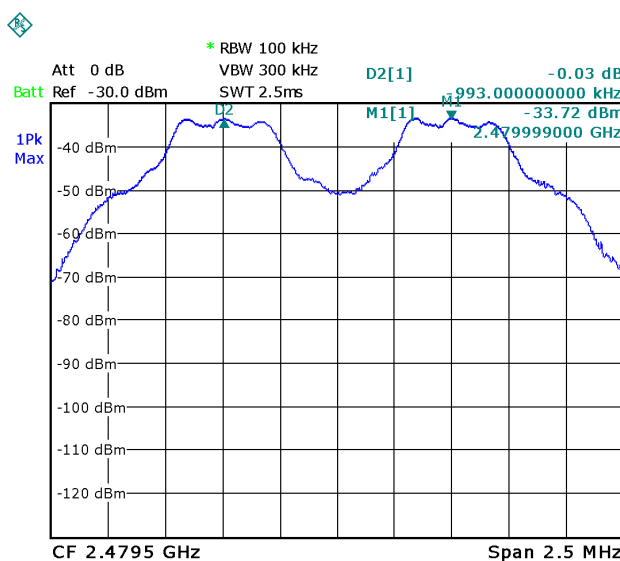
Channel	Channel Frequency (MHz)	Adjacent Channel Separation (MHz)	20dB Bandwidth (MHz)	Minimum Limit (MHz)	PASS / FAIL
0	2402	998	0.729	0.491	P
39	2441	998	0.734	0.489	P
78	2480	993	0.729	0.494	P

Limit used: Two-third 20dB Bandwidth



Date: 22.APR.2011 13:31:05

Date: 22.APR.2011 13:38:17



Date: 22.APR.2011 13:37:21

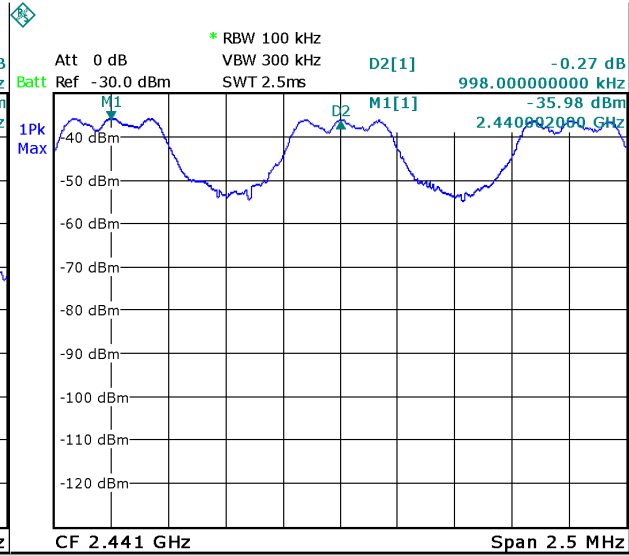
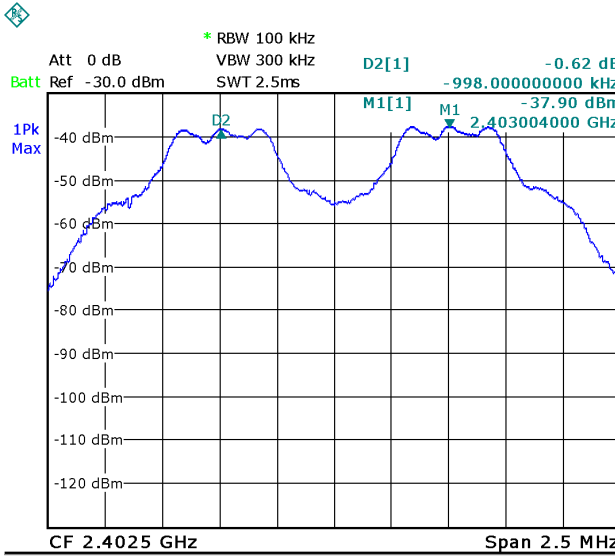


L C I E

Modulation: GFSK – DH3

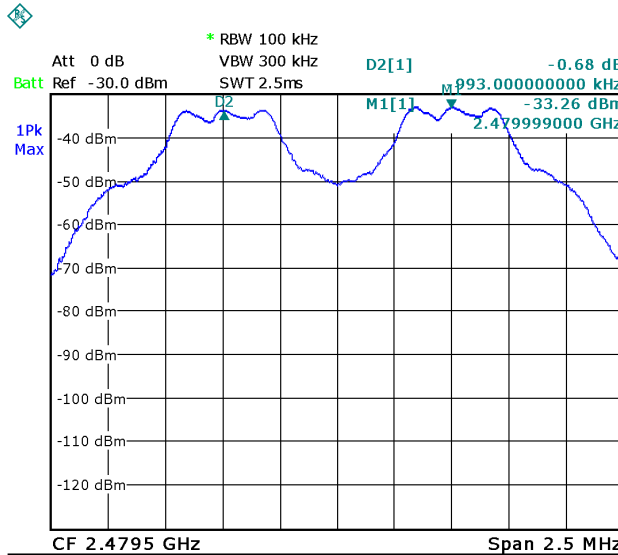
Channel	Channel Frequency (MHz)	Adjacent Channel Separation (MHz)	20dB Bandwidth (MHz)	Minimum Limit (MHz)	PASS / FAIL
0	2402	998	0.703	0.478	P
39	2441	998	0.699	0.475	P
78	2480	993	0.704	0.475	P

Limit used: Two-third 20dB Bandwidth



Date: 22.APR.2011 13:55:54

Date: 22.APR.2011 13:56:42



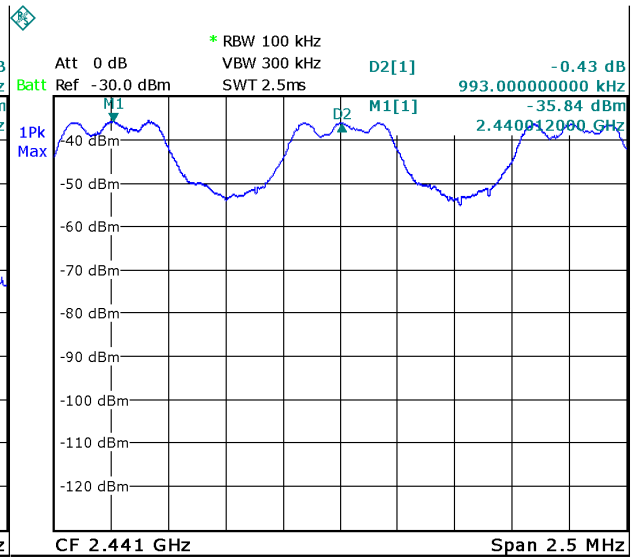
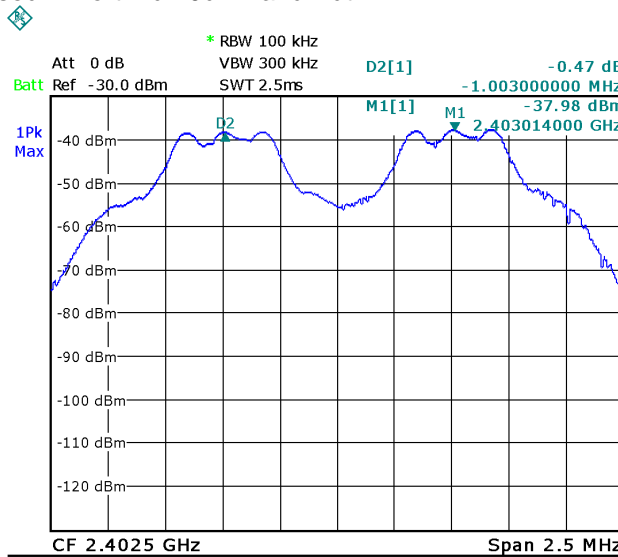
Date: 22.APR.2011 13:57:37



Modulation: GFSK – DH5

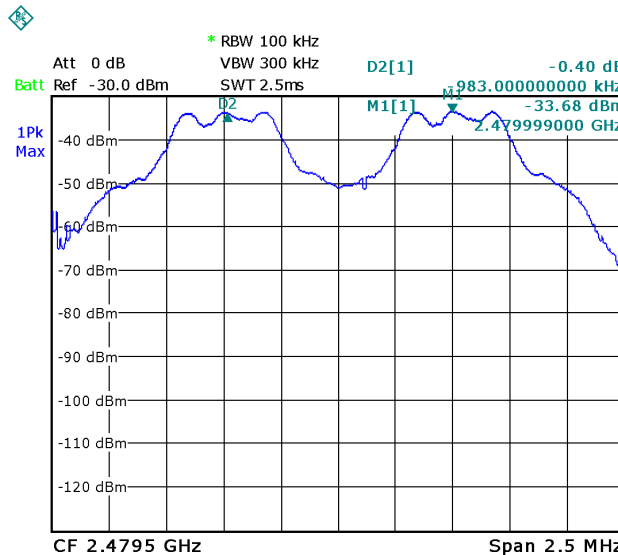
Channel	Channel Frequency (MHz)	Adjacent Channel Separation (MHz)	20dB Bandwidth (MHz)	Minimum Limit (MHz)	PASS / FAIL
0	2402	1.003	0.704	0.475	P
39	2441	993	0.699	0.475	P
78	2480	998	0.704	0.478	P

Limit used: Two-third 20dB Bandwidth



Date: 22.APR.2011 14:05:42

Date: 22.APR.2011 14:06:35



Date: 22.APR.2011 14:07:18



6. NUMBER OF HOPPING FREQUENCIES (15.247)

6.1. TEST CONDITIONS

Date of test : April 22nd, 2011
Test performed by : A.MERLIN
Atmospheric pressure : 1005mb
Relative humidity : 28%
Ambient temperature : 22°C

6.2. LIMIT

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

6.3. EQUIPMENT CONFIGURATION

Modulation: GFSK
Packet Type: DH5 / DH3 / DH1 same results – Different configurations, same results.
Hopping sequence: ON

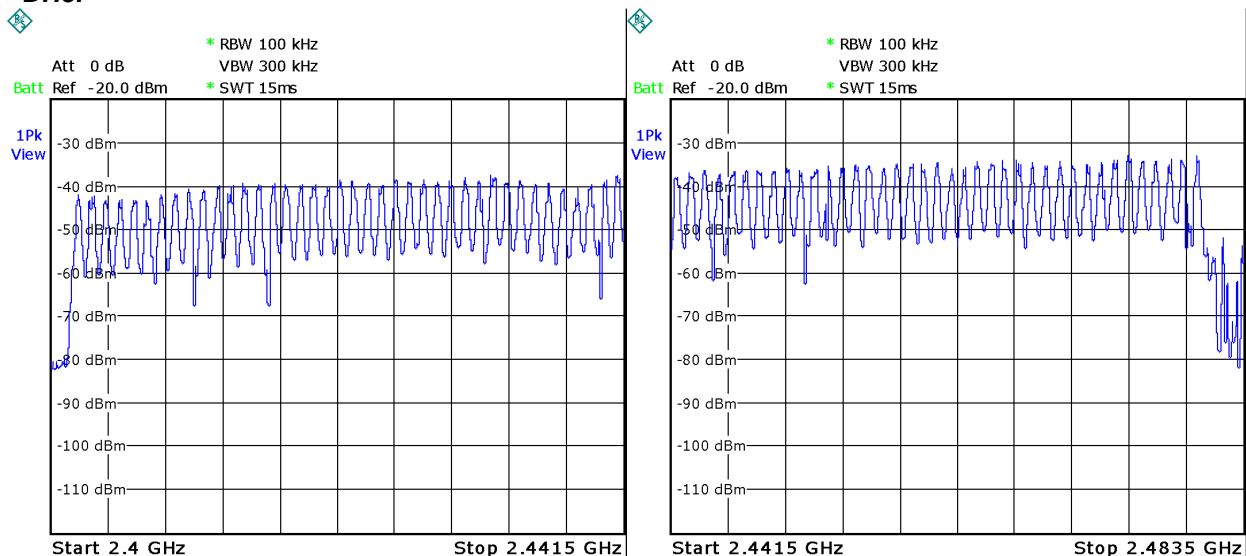
6.4. SETUP

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

6.5. RESULTS

GFSK – DH5:



Date: 22.APR.2011 11:49:15

Date: 22.APR.2011 11:54:41

Number of frequency used in the hopping sequence: 79 channels

**7. TIME OF OCCUPANCY (DWELL TIME) (15.247)****7.1. TEST CONDITIONS**

Date of test : April 22nd, 2011
Test performed by : A.MERLIN
Atmospheric pressure : 1005mb
Relative humidity : 28%
Ambient temperature : 22°C

7.2. 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.

7.3. EQUIPMENT CONFIGURATION

Modulation: GFSK
Channel frequency: 2402MHz
Hopping sequence: ON
Different configurations, same results.

7.4. 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



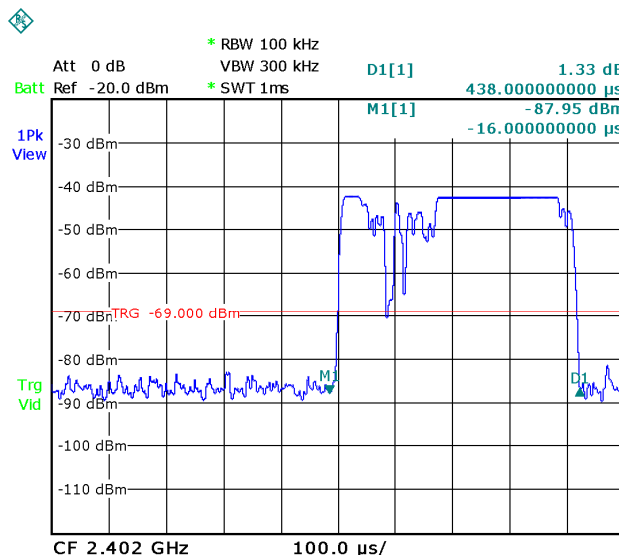
7.5. RESULTS

Modulation:

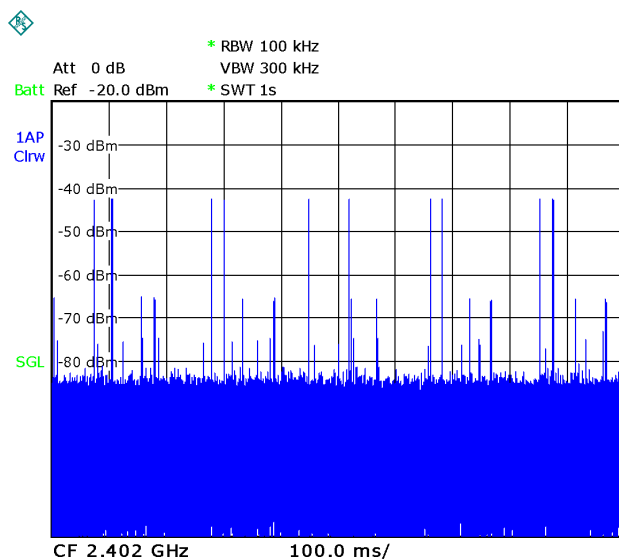
Packet Mode	Number of transmission in the period	Length of transmission time (ms)	Result (ms)	Limit (ms)	PASS / FAIL
DH1	10 (times/ 1 sec) * 31.6 = 348	0.438	139	400	P
DH3	25 (times/ 5 sec) * 6.32 = 158	1.696	268	400	P
DH5	15 (times/ 5 sec) * 6.32 = 95	2.966	282	400	P

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

Graphs: DH1 / GFSK

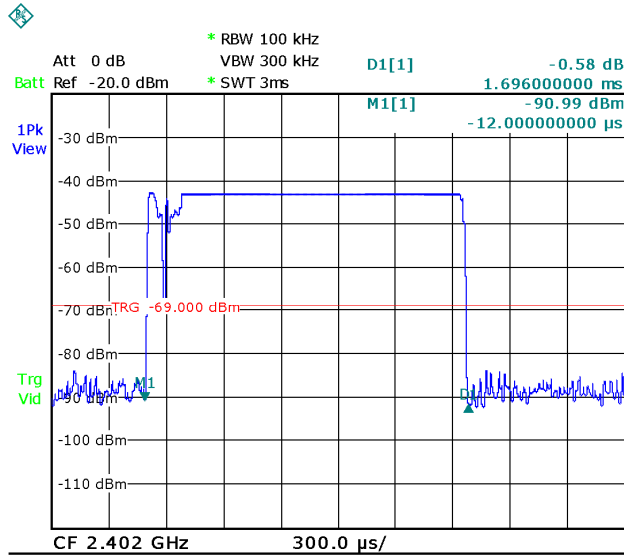


Date: 22.APR.2011 15:37:18

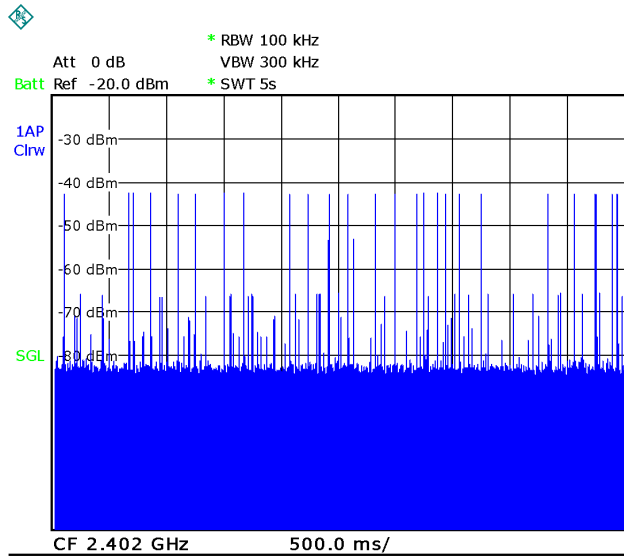


Date: 22.APR.2011 15:38:28

Graphs: DH3 / GFSK

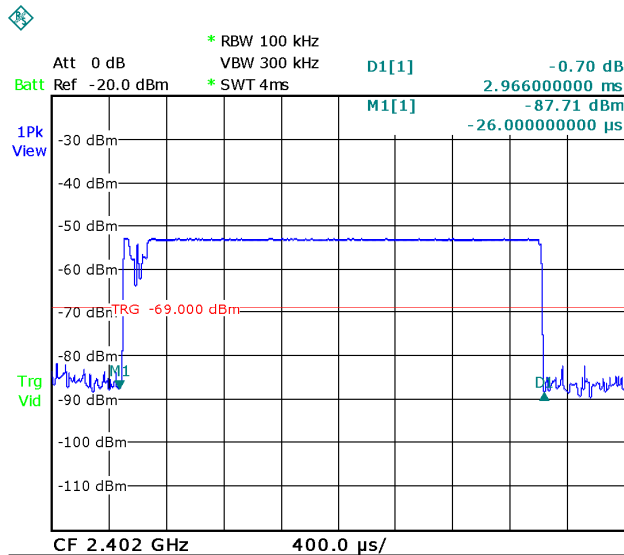


Date: 22.APR.2011 15:33:10

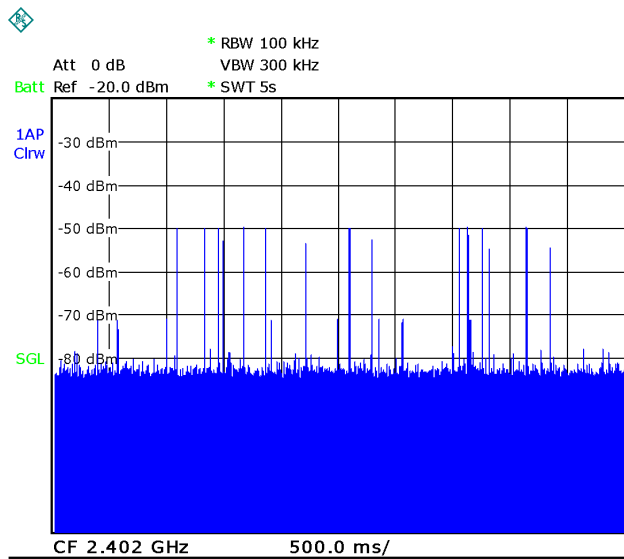


Date: 22.APR.2011 15:34:46

Graphs: DH5 / GFSK



Date: 22.APR.2011 15:11:25



Date: 22.APR.2011 15:25:42

**8. BAND EDGE MEASUREMENT (15.247)****8.1. TEST CONDITIONS**

Date of test : April 22nd, 2011
Test performed by : A.MERLIN
Atmospheric pressure : 1005mb
Relative humidity : 28%
Ambient temperature : 22°C

8.2. 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)

8.3. EQUIPMENT CONFIGURATION

Modulation: GFSK
Packet: DH5 (Worst case) – Configuration n°2 (Worst case)
Hopping sequence: ON

8.4. SETUP

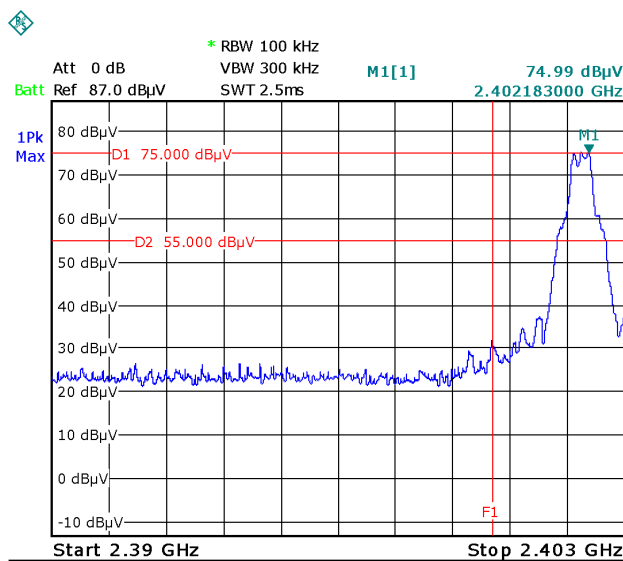
The EUT is placed in an anechoic chamber; the EUT is turn ON; the graphs of the restrict frequency band are recorded with a display line indicating the highest level and other the 20dB offset below to show compliance with 15.247 (d) and 15.205. The emissions in restricted bands are compared to 15.209 limits.

RBW: 100kHz
VBW: 300kHz

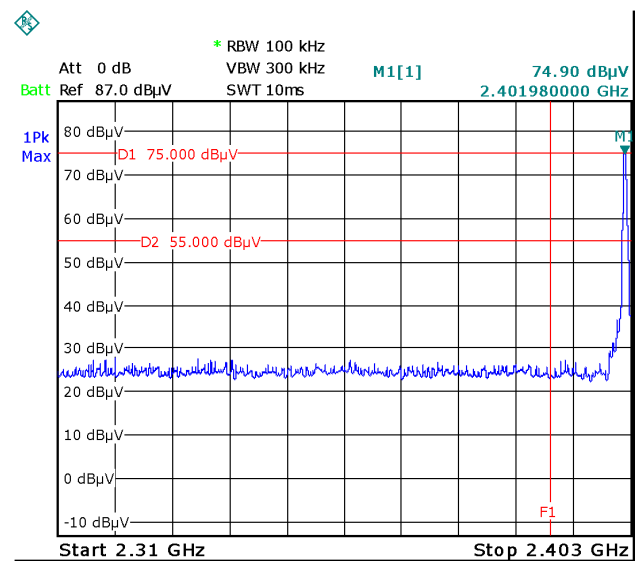
8.5. RESULTS

Restricted Band (2310-2390) MHz

Frequency (MHz)	Maximum field strength in restrict band (dBµV/m)	Limit (dBµV/m)	Detector
No frequency observed		74	PK
		54	AV



Date: 22.APR.2011 15:51:52

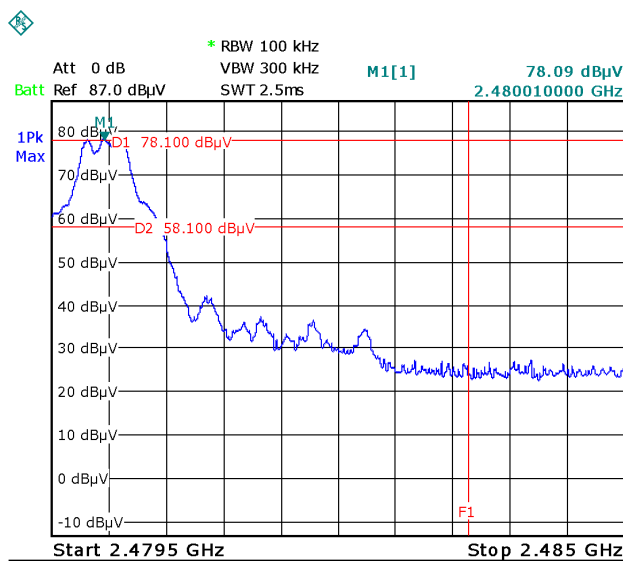


Date: 22.APR.2011 15:59:41

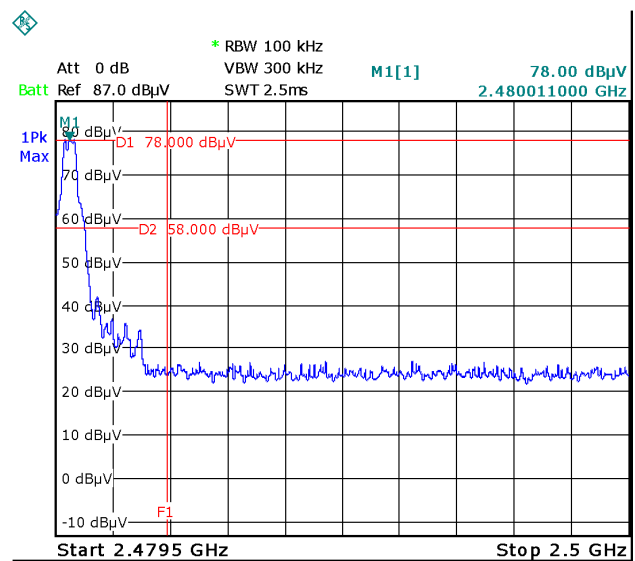


Restricted Band (2483.5-2500) MHz

Frequency (MHz)	Maximum field strength in restrict band (dBµV/m)	Limi (dBµV/m)	Detector
No frequency observed		74	PK
		54	AV



Date: 22.APR.2011 16:00:43



Date: 22.APR.2011 16:01:35



9. TEST EQUIPMENT LIST

USED	N° LCIE	TYPE	COMPANY	REF	CAL DATE	CAL DUE
RADIATED EMISSION DATA						
X	A7102024	Amplifier 8 GHz	HEROTEK	A1080304A	01/11	01/12
X	A7102026	Amplifier 8-26GHz	ALDETEC	ALS01452	12/10	12/11
X	C2040051	Antenna Bi-log	CHASE	CBL6111A	08/10	08/12
X	C2040052	Antenna Loop	ELECTRO-METRICS	EM-6879	12/10	12/11
X	C2042027	Antenna horn	EMCO	3115	10/10	10/11
X	C2042028	Antenna horn 26GHz	SCHWARZBECK	BBHA 9170	-	-
X	A5329038	Cable N/N	-	-	04/11	04/12
X	A5329041	Cable SMA/SMA	-	-	-	-
X	A5329061	Cable	SUCOFLEX	106G	01/11	01/12
X	A5329183	Cable	-	-	03/11	03/12
X	A5329188	Cable OATS (Mast at 10m)	UTIFLEX	-	05/10	05/11
X	A5329189	Cable	UTIFLEX	-	02/11	02/12
X	A5329199	Cable OATS (Mast at 10m)	UTIFLEX	-	05/10	05/11
X	A5329207	Cable	UTIFLEX	-	02/11	02/12
X	D3044016	Semi-Anechoic chamber #1	SIEPEL	-	01/11	01/12
X	D3044017	Semi-Anechoic chamber #3	SIEPEL	-	-	-
X	A3169050	Radiated emission comb generator	BARDET	-	-	-
X	F2000409	OATS	-	-	08/10	08/11
X	A2642019	Receiver 20Hz – 8GHz	ROHDE & SCHWARZ	ESU8	10/10	10/11
X	A4060018	Spectrum Analyzer 9KHz – 26.5GHz	HEWLETT PACKARD	8593E	03/11	03/12
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	F2000406	Turntable chamber (Cage#1)	MATURO Gmbh	TT 2.0 SI	-	-
X	F2000407	Antenna mast (Cage#1)	MATURO Gmbh	AM 4.0	-	-
X	F2000408	Turntable controller (Cage#1)	MATURO Gmbh	Control Unit	-	-
MAXIMUM PEAK OUTPUT POWER						
X	C2042027	Antenna horn	EMCO	3115	10/10	10/11
X	A5329038	Cable N/N	-	-	04/11	04/12
X	A5329189	Cable	UTIFLEX	-	02/11	02/12
X	D3044016	Semi-Anechoic chamber #1	SIEPEL	-	01/11	01/12
X	A2642019	Receiver 20Hz – 8GHz	ROHDE & SCHWARZ	ESU8	10/10	10/11
X	F2000406	Turntable chamber (Cage#1)	MATURO Gmbh	TT 2.0 SI	-	-
X	F2000407	Antenna mast (Cage#1)	MATURO Gmbh	AM 4.0	-	-
X	F2000408	Turntable controller (Cage#1)	MATURO Gmbh	Control Unit	-	-
HOPPING CHANNEL SEPARATION						
x	C2042027	Antenna horn	EMCO	3115	10/10	10/11
X	A5329038	Cable N/N	-	-	04/11	04/12
x	A2642019	Receiver 20Hz – 8GHz	ROHDE & SCHWARZ	ESU8	10/10	10/11
NUMBER OF HOPPING CHANNEL						
x	C2042027	Antenna horn	EMCO	3115	10/10	10/11
X	A5329038	Cable N/N	-	-	04/11	04/12
x	A2642019	Receiver 20Hz – 8GHz	ROHDE & SCHWARZ	ESU8	10/10	10/11
TIME OF OCCUPANCY						
x	C2042027	Antenna horn	EMCO	3115	10/10	10/11
X	A5329038	Cable N/N	-	-	04/11	04/12
x	A2642019	Receiver 20Hz – 8GHz	ROHDE & SCHWARZ	ESU8	10/10	10/11
x	A2440004	Digital Radiocommunication Tester	ROHDE & SCHWARZ	CMU200	-	-
BAND EDGE MEASUREMENT						
x	C2042027	Antenna horn	EMCO	3115	10/10	10/11
X	A5329038	Cable N/N	-	-	04/11	04/12
x	A2642019	Receiver 20Hz – 8GHz	ROHDE & SCHWARZ	ESU8	10/10	10/11



10. 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