



L C I E

TEST REPORT

N°82688-572664

ISSUED TO

: THALES TRANSPORTATION SYSTEMS
Centre du Bois des bordes
91229 BRETIGNY SUR ORGE
FRANCE

Subject

: Electromagnetic compatibility tests according to the standards FCC CFR 47 Part 15, Subpart C, §15.247 and RSS 210 Annex 8 (Frequency Hopping System).

Apparatus under test

- | | | |
|-----------------|---|------------------------|
| • Product | : | Bluetooth radio module |
| • Trade mark | : | THALES |
| • Manufacturer | : | ADEUNIS |
| • Model | : | ARF32 |
| • serial number | : | prototype |
| • FCC ID | : | V33ARF7044 |
| • IC ID | : | 7678A-ARF7044 |

Test date

: June 10 to 24, 2008 and January 2009

Test location

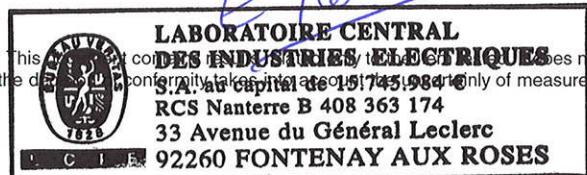
: LCIE (FCC registration number : 888863, IC registration number : 6231A)
Chemin des Hautes Peines
77250 Moret-Sur-Loing - France

Composition of document : 26 pages.

Fontenay-Aux-Roses, March 06th, 2009

The technical manager,
Eric ROUSSEL

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1. Summary of Test Results

TEST	FCC paragraph number	IC paragraph number	Spec.	RESULTS (comments)
Power line conducted emissions	15.207 (a)	RSS-GEN §7.2.2	FCC:Table 15.207 (a) IC: RSS-GEN Table 2	PASS See page 4 to 6
Channel separation	15.247 (a)(1)	A.8.1 b)	Greater than 2/3 of 20dB bandwidth (700kHz)	PASS See page 7 to 9
Time of Occupancy	15.247 (a)(1)(ii)	A.8.1 c)	< 0.4s in 32s	PASS See page 10 to 13
20dB Occupied bandwidth	15.247 (a)(1)	A.8.1 a)	500kHz	PASS See page 14 to 15
Peak Power Output	15.247 (b)	A.8.4 (2)	1 Watt (30dBm)	PASS See page 16 to 19
Spurious emissions (Antenna conducted)	15.247 (c)	A.8.5	- 20dBc	PASS See page 20
Spurious emissions (Radiated)	15.247 (c)	A.8.5	FCC: Table 15.209 (a) IC: RSS-210 §2.6	PASS See page 21 to 24



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2. System test configuration

2.1. Justification

The system was configured for testing in a typical mode (as a customer would normally use it).

2.2. HARDWARE IDENTIFICATION

* Equipment Under Test (EUT):



The equipment under test is a Bluetooth transceiver radio module.

* Configuration:

- Frequency band : from 2400 to 2483.5MHz
- Number of channel : 79
- Channel spacing : 1MHz
- Rated output power : 3dBm (specified by manufacturer, before antenna)
- Kind of antenna : Integrated

2.3. AUXILIARIES

The FCC IDs for all equipment, more description of all cables used in the tested system are:

Trade Mark – Model Number	FCC ID	IC ID	Description	Cable description
THALES *	V33	7678A-	Bluetooth transceiver	
ARF 32	ARF7044	ARF7044		
ARF7069AC	/	/	Demo-board	RS232 port and DC 9V port
Europe électronique équipements 50.040/9/500	/	/	AC-DC converter	1,5m long

*: Equipment under test.

2.4. EQUIPMENT MODIFICATIONS

None.



2.5. EUT EXERCISE SOFTWARE

The EUT exercise program used during radiated and conducted testing was designed to exercise the equipment under test in a manner similar to a typical use. (Frequency hopping is enabled on the 79 channels, with a maximum power with the external software).

If needed, the EUT was transmitting continuous and hopping function is disabled, using the same external software.

3. Powerline Conducted Emission Test

The product has been tested according to ANSI C63.4-(2003), FCC Part 15 subpart C and RSS-210 GEN.

The product has been tested with 110V/60Hz power line voltage and compared to the FCC Part 15 subpart C §15.207 and RSS-210 GEN §7.2.2 limits. Measurement bandwidth was 9kHz from 150 kHz to 30 MHz.

Measurement was initially made with an HP 8566B spectrum analyzer and CISPR compliant accessories in peak mode. If the measured values are higher than 20dB down the quasi peak limit, 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.

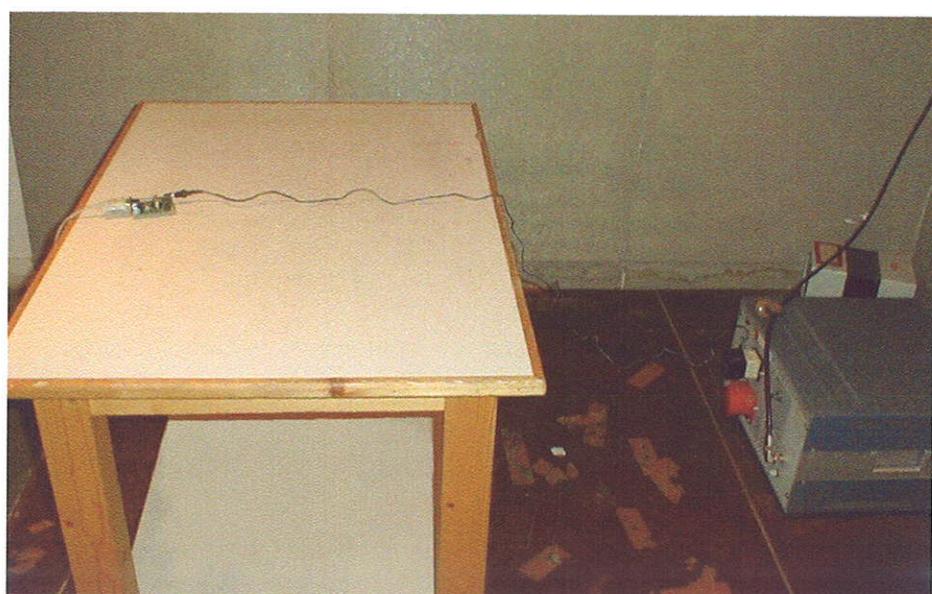
The Peak data are shown on the following plots. Quasi-Peak and Average measurements are detailed in a table with frequencies and levels measured.

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.

3.1. SET-UP

The EUT is placed on a table at 0.8m height. The cable of the power adapter has been shorted to 1meter length. The EUT is powered by the demo-board, powered by the AC/DC adapter, powered through the LISN (measure). The peripheral equipment (PC) is connected to a separate LISN.

- EUT is ON
- The transmitters transmits continually (frequency hopping is enable).



Conducted emission test



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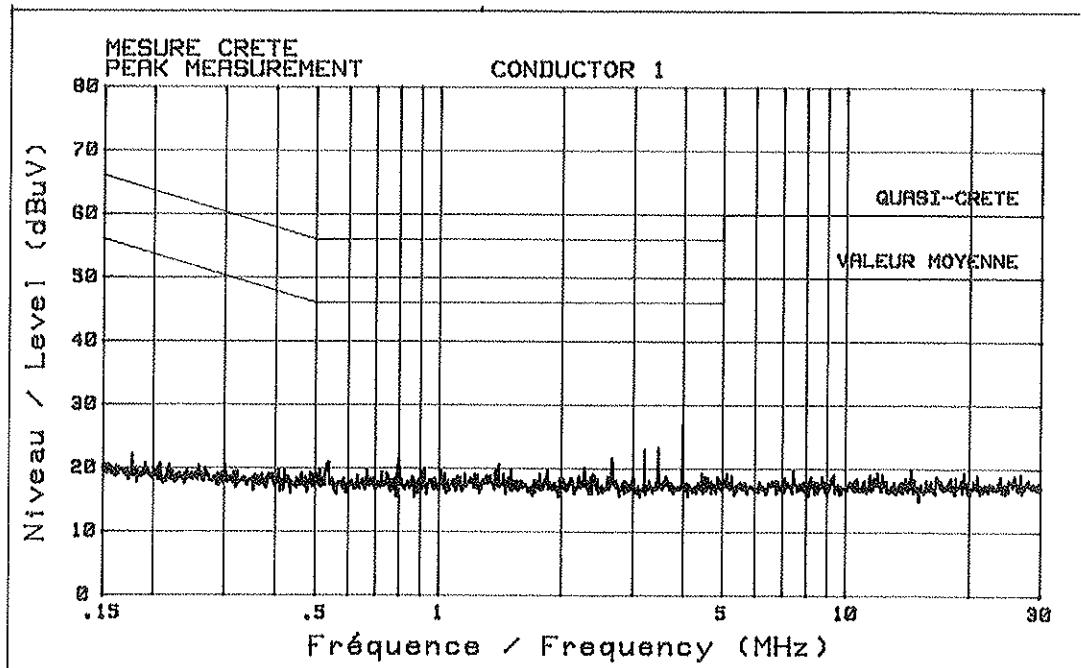
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3.2. TEST SEQUENCE AND RESULTS

Measures are performed on Line 1 and on the Neutral of the power supply.

3.2.1. Line (L1) conducted emission data



Fréquence (MHz)	Avg (dB μ V)	Lim Avg (dB μ V)	Avg-LimAvg (dB μ V)	QPeak (dB μ V)	LimQPeak (dB μ V)	QPeak- LimQPeak (dB μ V)
--------------------	------------------	-------------------------	----------------------------	--------------------	--------------------------	------------------------------------

No level measured higher than 20dB down the quasi peak limit.

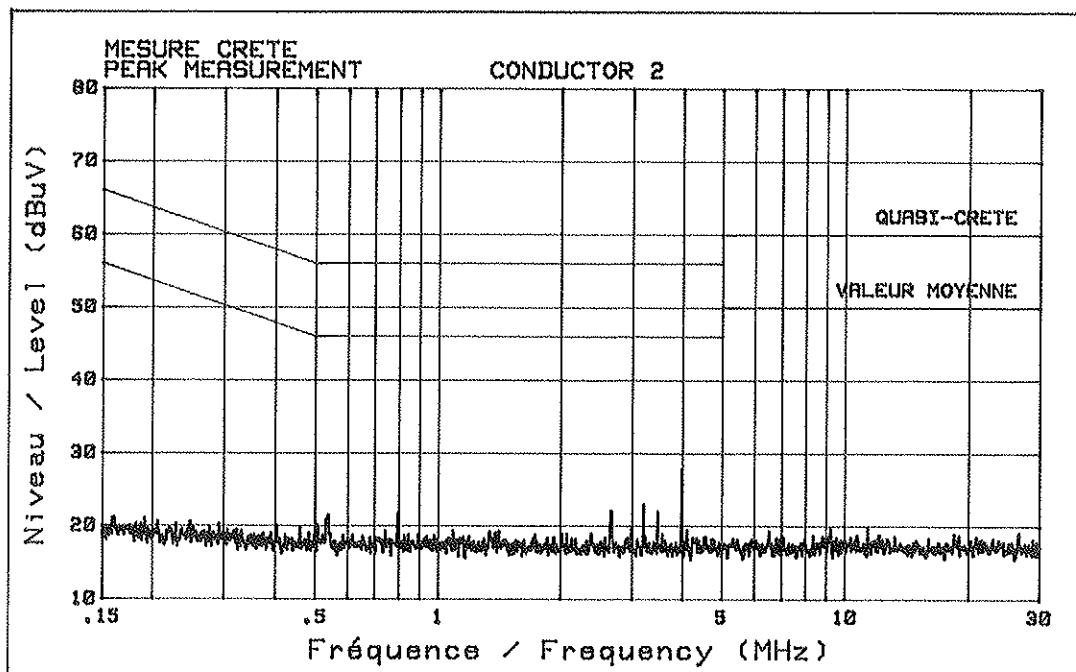


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3.2.2. Neutral (N) conducted emission data



Fréquence (MHz)	Avg (dB μ V)	Lim Avg (dB μ V)	Avg-LimAvg (dB μ V)	QPeak (dB μ V)	LimQPeak (dB μ V)	QPeak- LimQPeak (dB μ V)
--------------------	------------------	-------------------------	----------------------------	--------------------	--------------------------	------------------------------------

No level measured higher than 20dB down the quasi peak limit.



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4. Channel Separation

4.1. SET-UP

The EUT is placed on an anechoic chamber. Levels have been corrected to be in compliant with the open area test site measured values, and is directly connected to the analyzer.

4.2. TEST EQUIPMENT

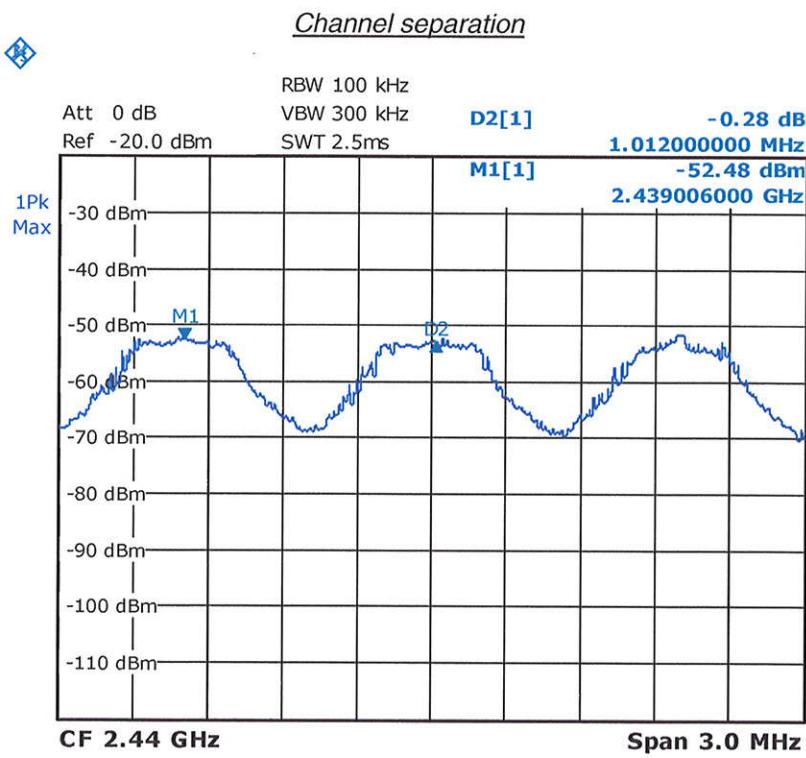
Equipment	Company	Model	Serial
Spectrum Analyzer	ROHDE & SCHWARZ	FSL6	A4060032

4.3. MEASUREMENT DATA

Measured channel separation: **1 MHz**

The minimum limit of channel separation is 2/3 of the 20dB bandwidth of the hopping channel (see 6.3.):
 $2/3 \times 1050 \text{ kHz} = 700 \text{ kHz}$

Measured number of channel: **79**



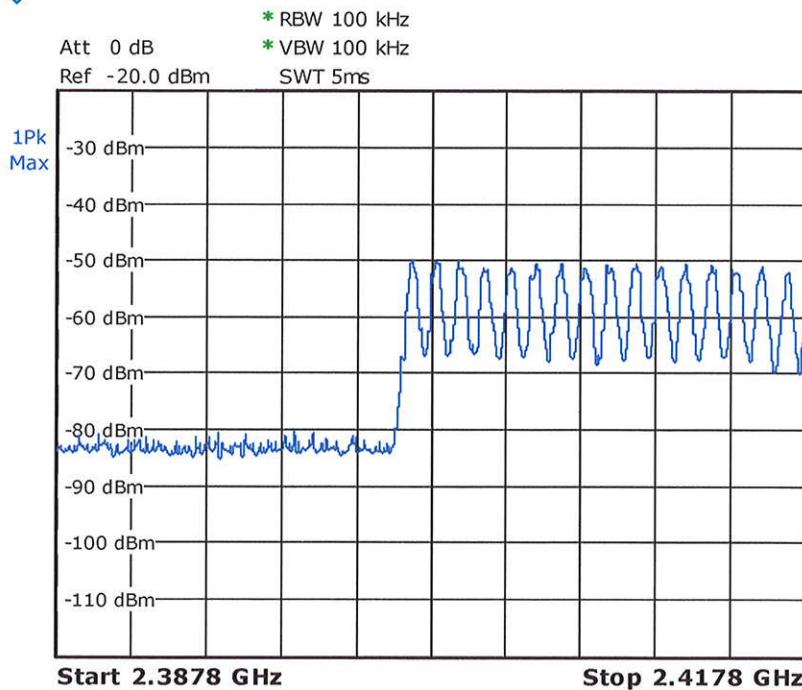
Date: 24.JUN.2008 10:35:18



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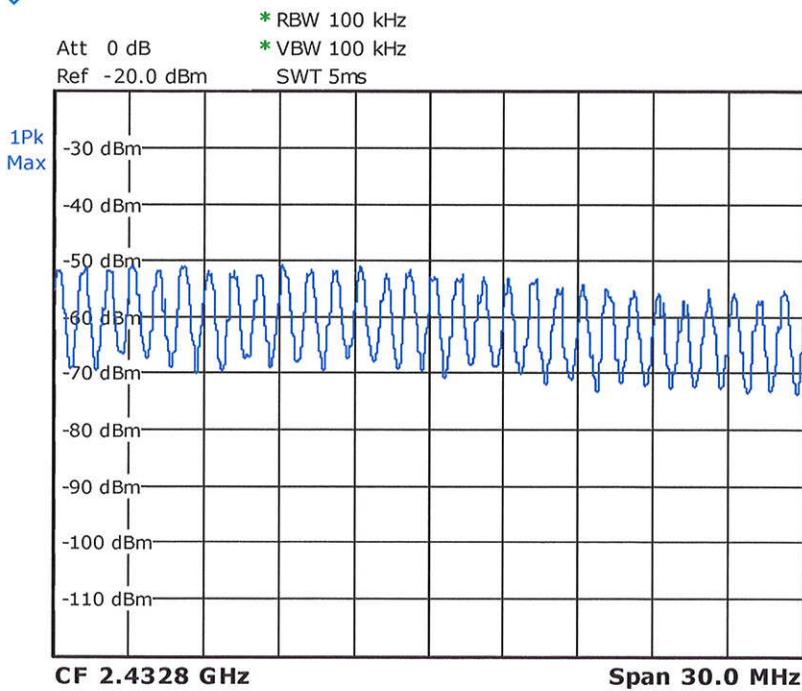
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Date: 24.JUN.2008 10:40:55

Number of channel (LOW band): 16 channels



Date: 24.JUN.2008 10:45:16

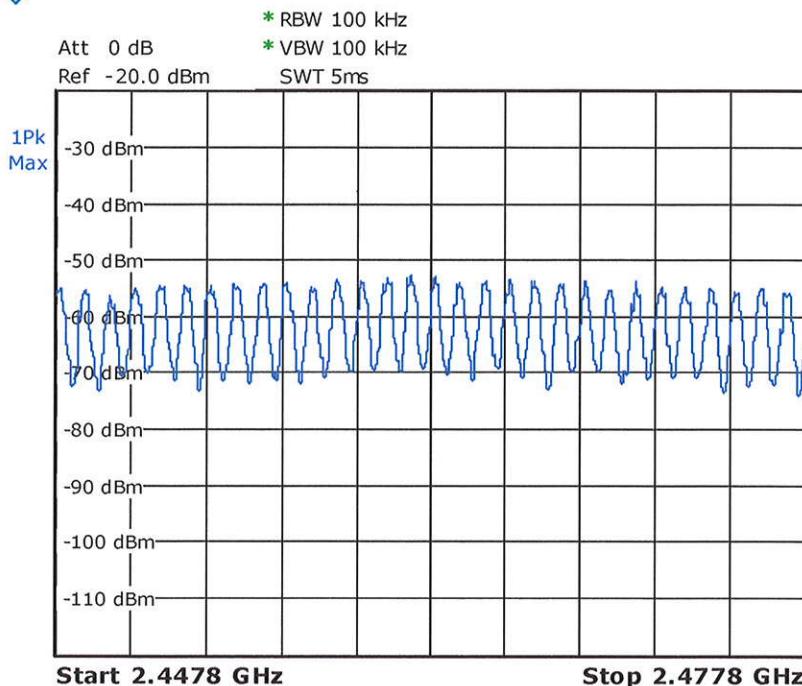
Number of channel (second band): 30 channels



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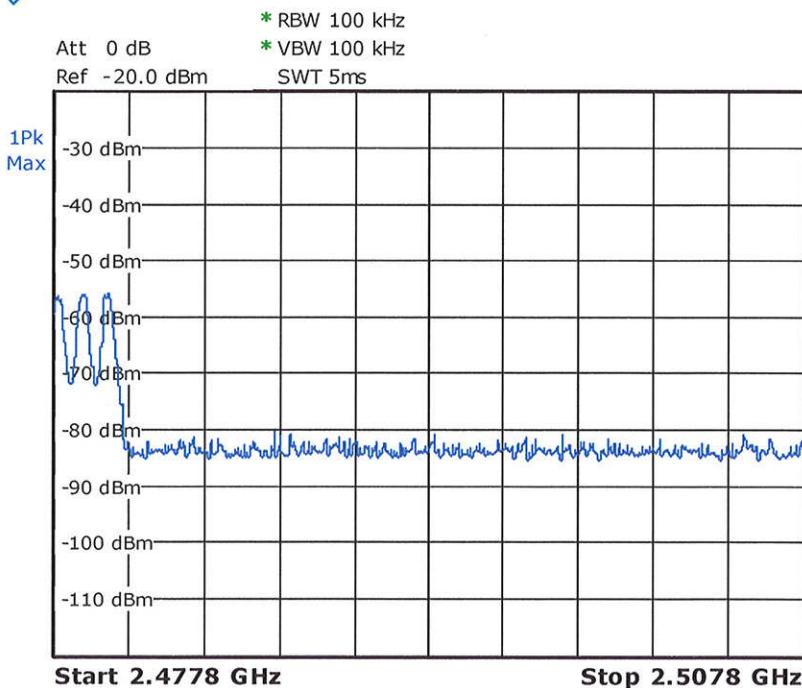
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Date: 24.JUN.2008 10:49:36

Number of channel (third band): 30 channels



Date: 24.JUN.2008 10:51:52

Number of channel (high band): 3 channels



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5. Time of Occupancy

5.1. SET-UP

The EUT is placed on a table and is directly connected to the analyzer. The analyzer IF output is connected to an oscilloscope

5.2. TEST EQUIPMENT

Equipment	Company	Model	Serial
Spectrum Analyzer	Rohde & Schwarz	FSL6	A4060032

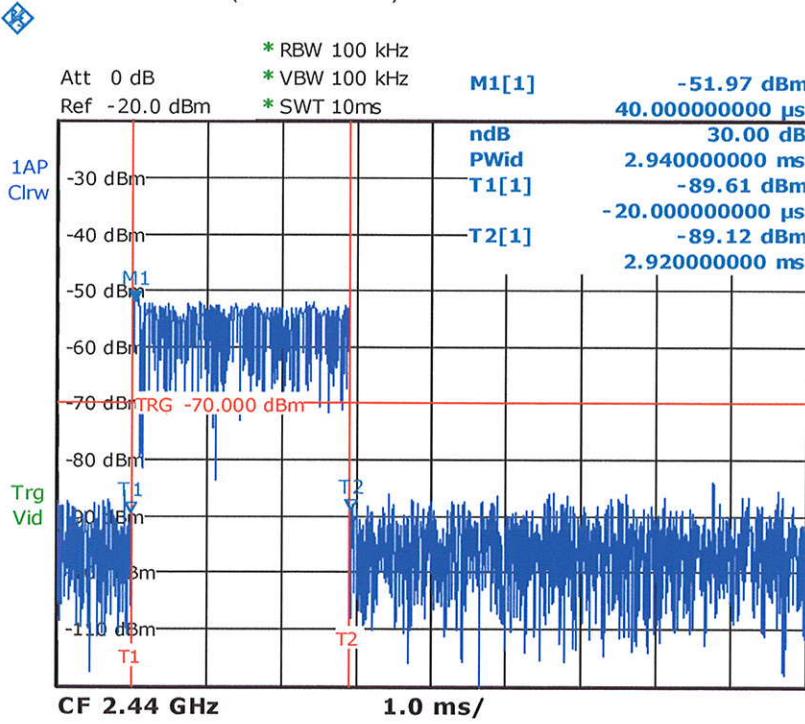
5.3. MEASUREMENT DATA

A) DH5 mode

Limit of time of occupancy: $0,4\text{s} \times 79 \text{ channels} \rightarrow 31,6\text{s}$

Measured time of occupancy: 2.94ms on a channel appearing 97 times in a period of 32s

Time of occupancy = $0.00294 \times 97 = 0.285 \text{ s}$ ($0.285\text{s} < 0.4\text{s}$)



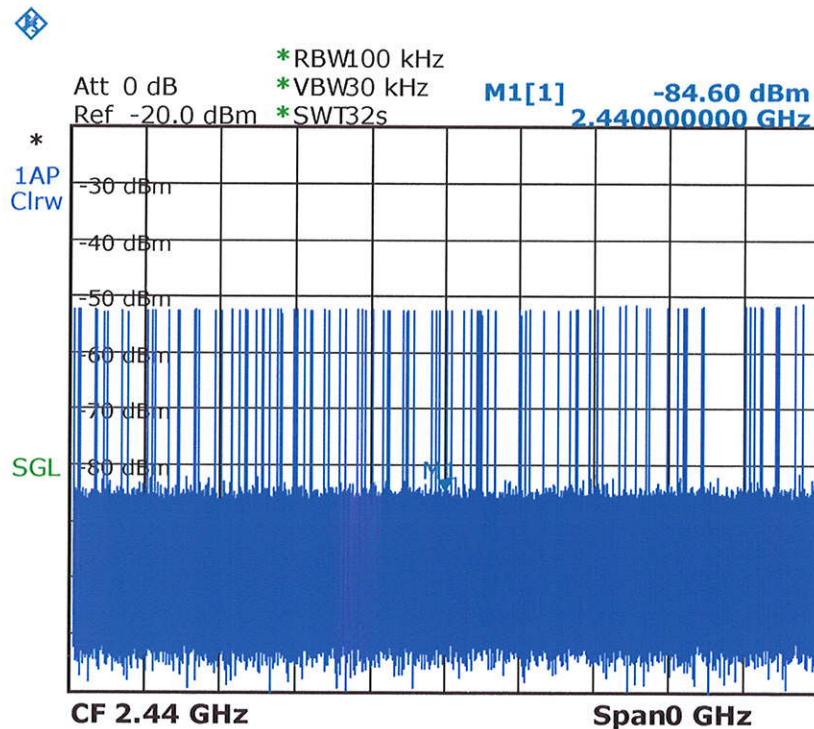
Data packet time measurement in DH5 mode



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Date: 24.JUN.2008 11:09:15

Number of data transmission on the channel (DH5 mode)



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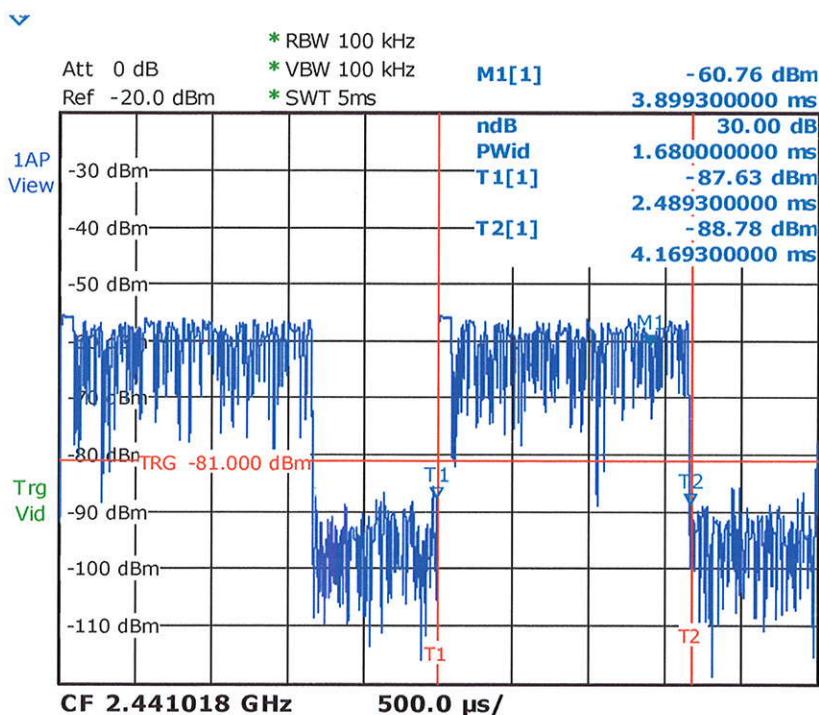
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B) DH3 mode

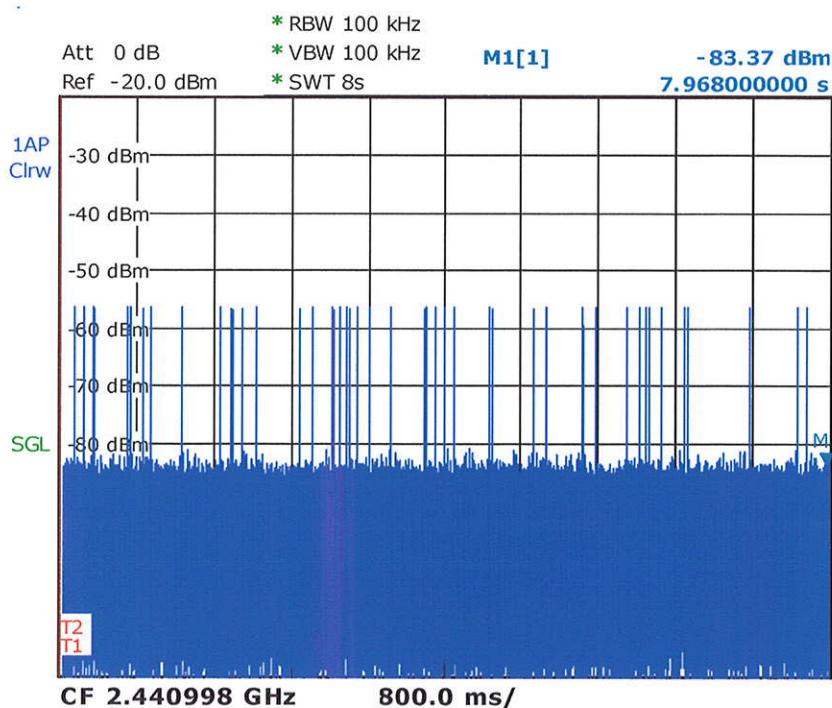
Limit of time of occupancy: $0.4s \times 79$ channels $\rightarrow 31.6s$

Measured time of occupancy: 1.68ms on a channel appearing 184 times in a period of 32s

Time of occupancy = $0.00168 \times 184 = 0.309$ s (0.309s < 0.4s)



Data packet time measurement in DH3 mode



Number of data transmission on the channel (DH3 mode)



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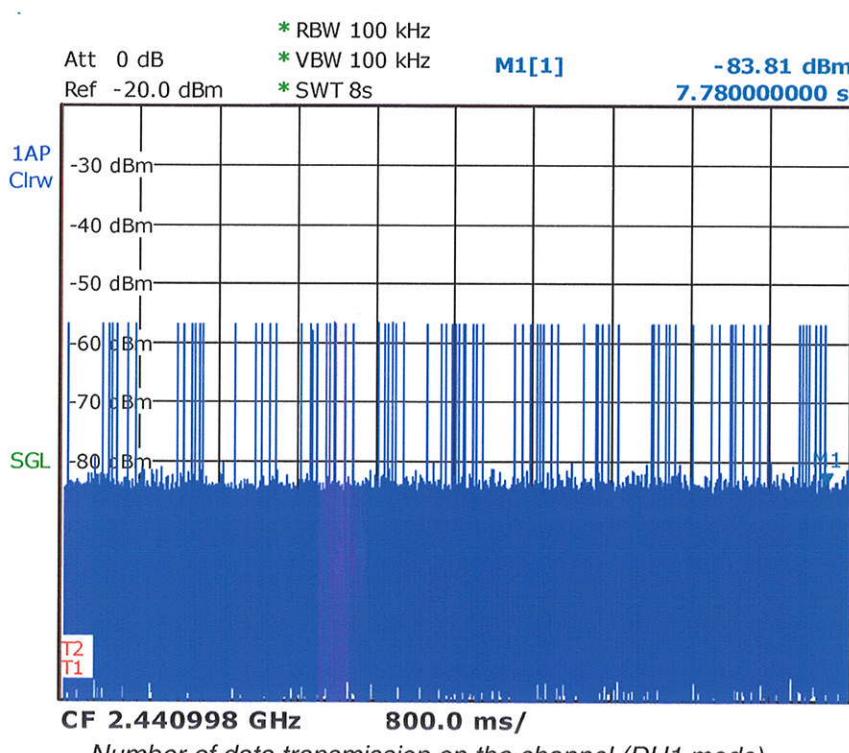
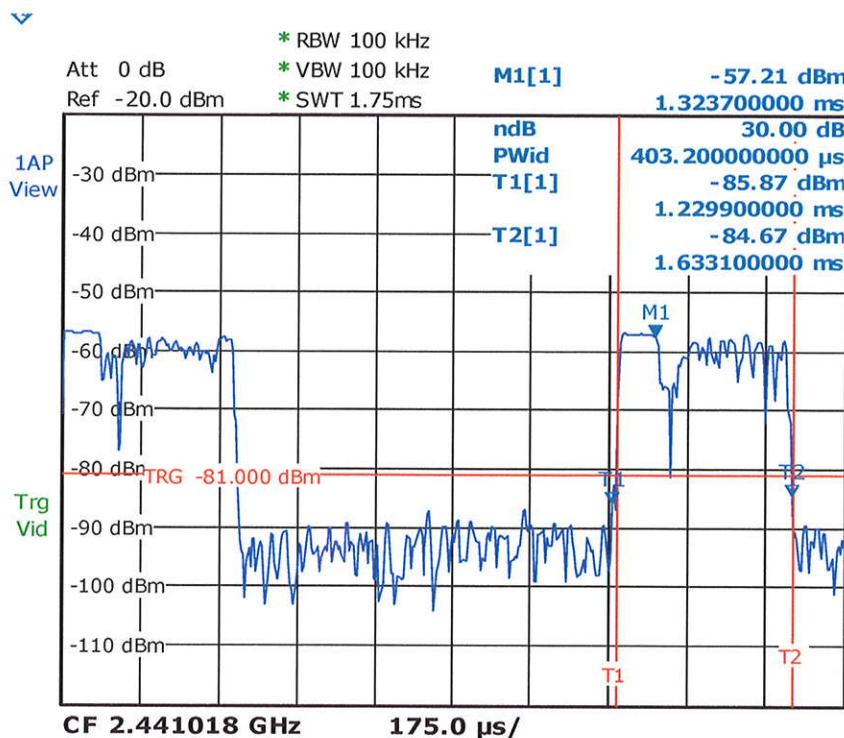
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C) DH1 mode

Limit of time of occupancy: $0.4s \times 79$ channels $\rightarrow 31.6s$

Measured time of occupancy: 0.4ms on a channel appearing 328 times in a period of 32s

Time of occupancy = $0.0004 \times 328 = 0.131$ s (0.131s < 0.4s)





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6. Occupied Bandwidth

6.1. SET-UP

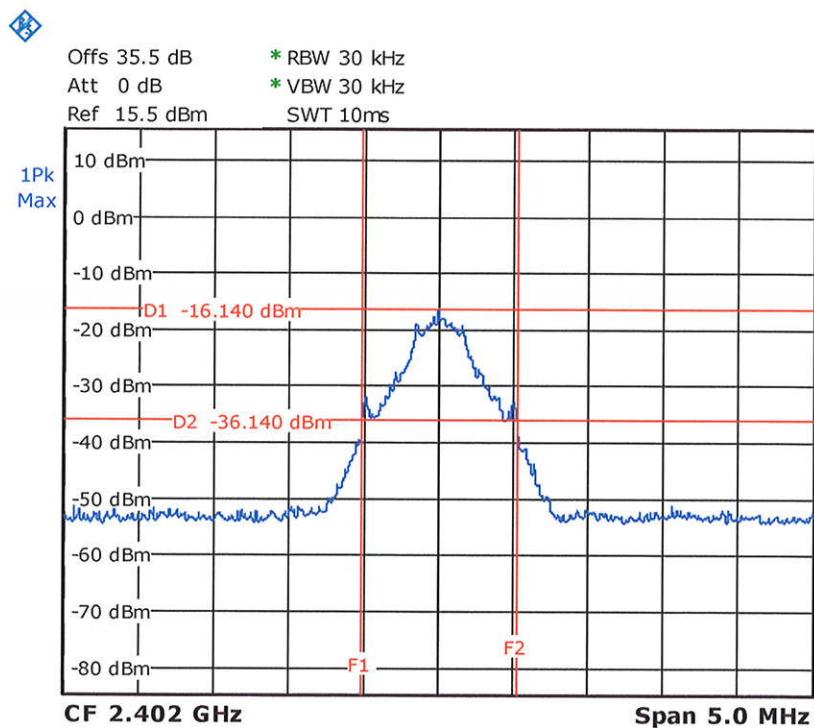
The EUT is placed on a table and is directly connected to the analyzer.

6.2. TEST EQUIPMENT

Equipment	Company	Model	Serial
Spectrum Analyzer	Rohde & Schwarz	FSL6	A4060032

6.3. MEASUREMENT DATA

Measured 20dB bandwidth: 1.05MHz



Date: 24.JUN.2008 11:54:29

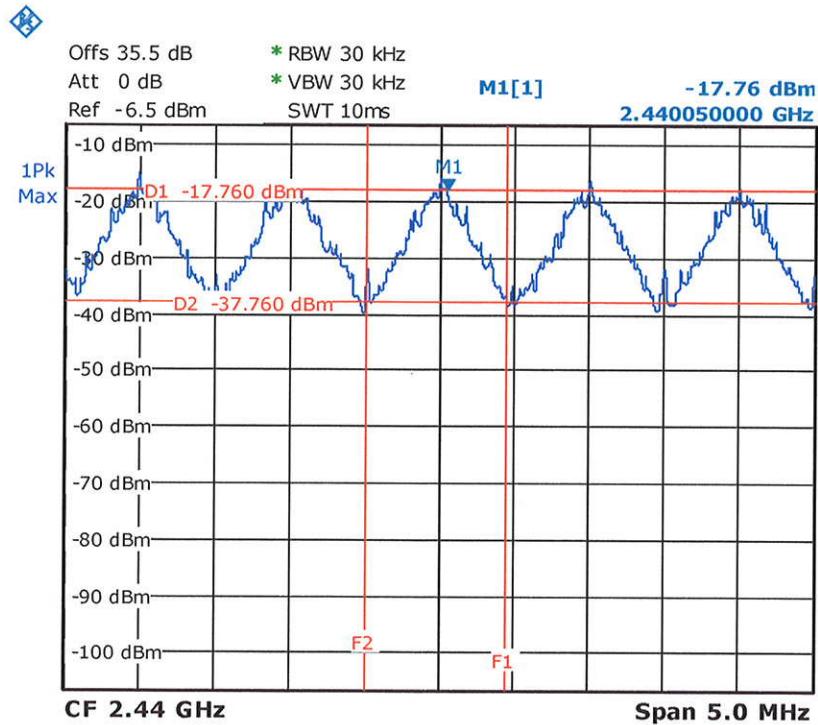
Occupied bandwidth : LOW channel



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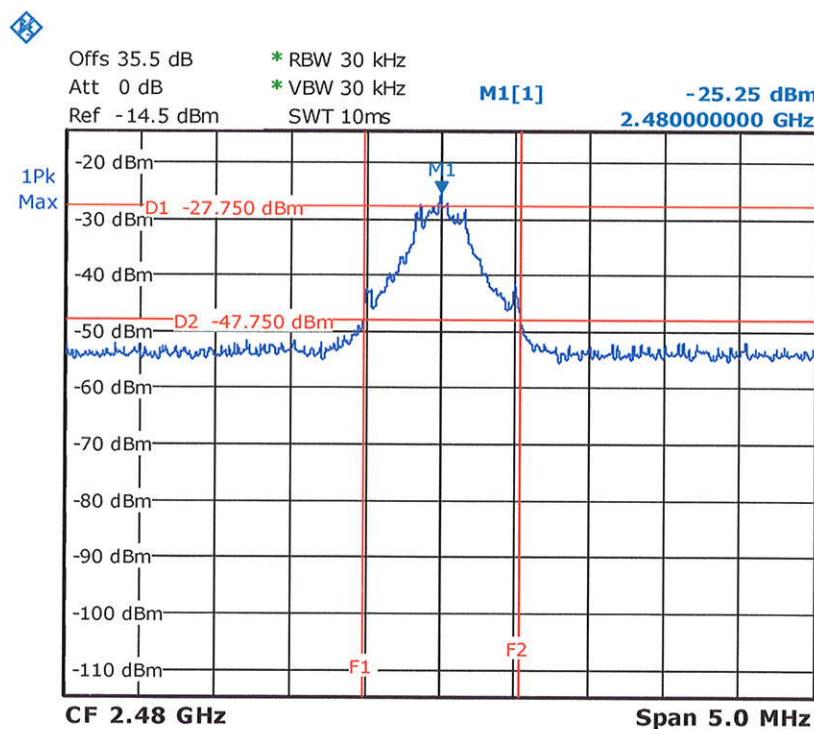
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Date: 24.JUN.2008 11:59:27

Occupied bandwidth : MID channel



Date: 24.JUN.2008 11:56:43

Occupied bandwidth : HIGH channel



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7. Peak Power Output (Conducted)

7.1. SET-UP

The EUT is placed on a table and is directly connected to the analyzer.

7.2. TEST EQUIPMENT

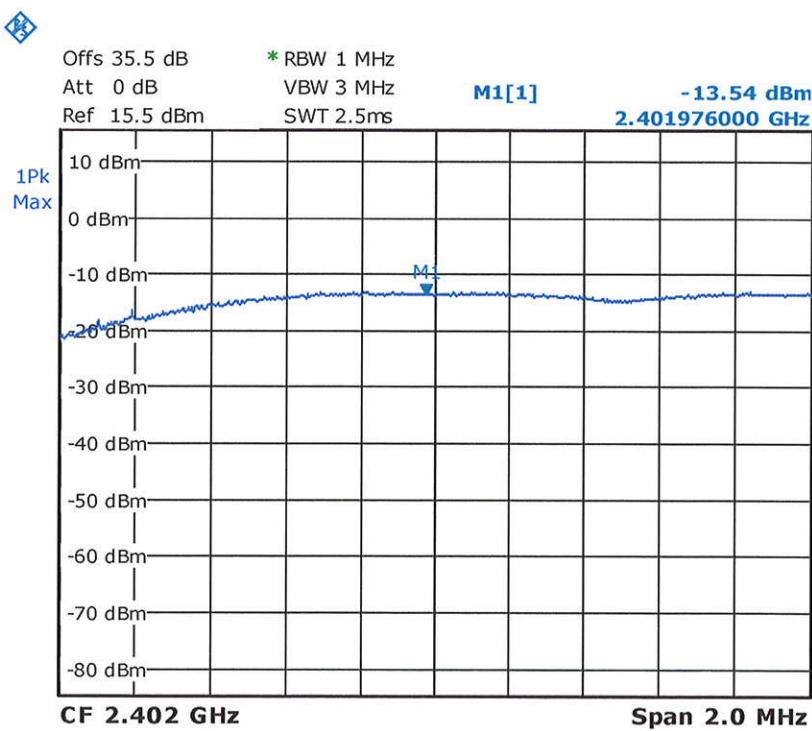
Equipment	Company	Model	Serial
Spectrum Analyzer	Rohde & Schwarz	FSL6	A4060032

7.3. MEASUREMENT DATA

7.3.1. Peak Output power (Frequency hopping enable)

Output power is set at maximum (Software controlled)

Maximum measured value: -13.54dBm



Date: 24.JUN.2008 11:20:33

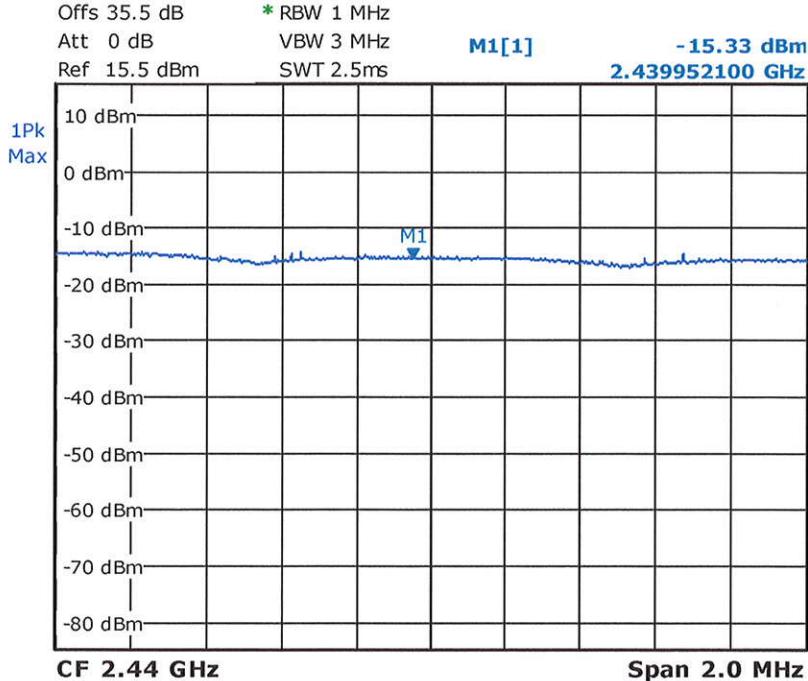
Peak output power : low channel



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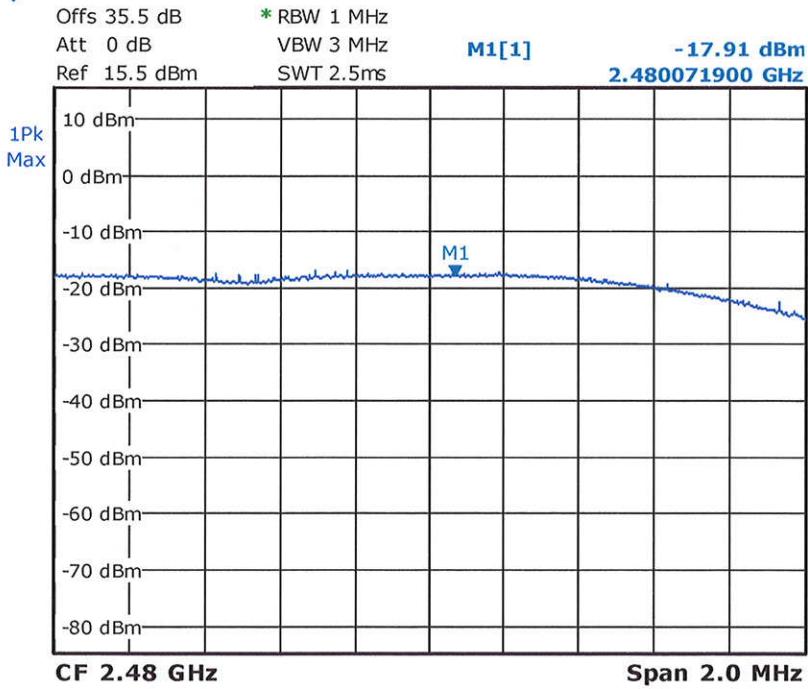
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Date: 24.JUN.2008 11:21:30

Peak output power : mid channel



Date: 24.JUN.2008 11:23:15

Peak output power : HIGH channel



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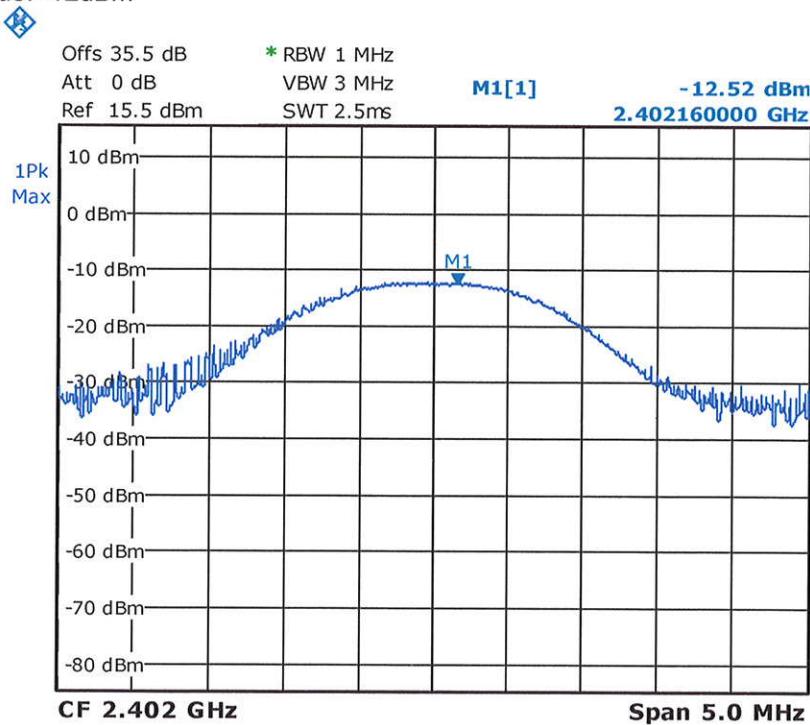
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7.3.2. Peak Output power – (Frequency hopping disable)

Output power is set at maximum (Software controlled)

Maximum measured value: -12dBm



Date: 24.JUN.2008 11:27:49

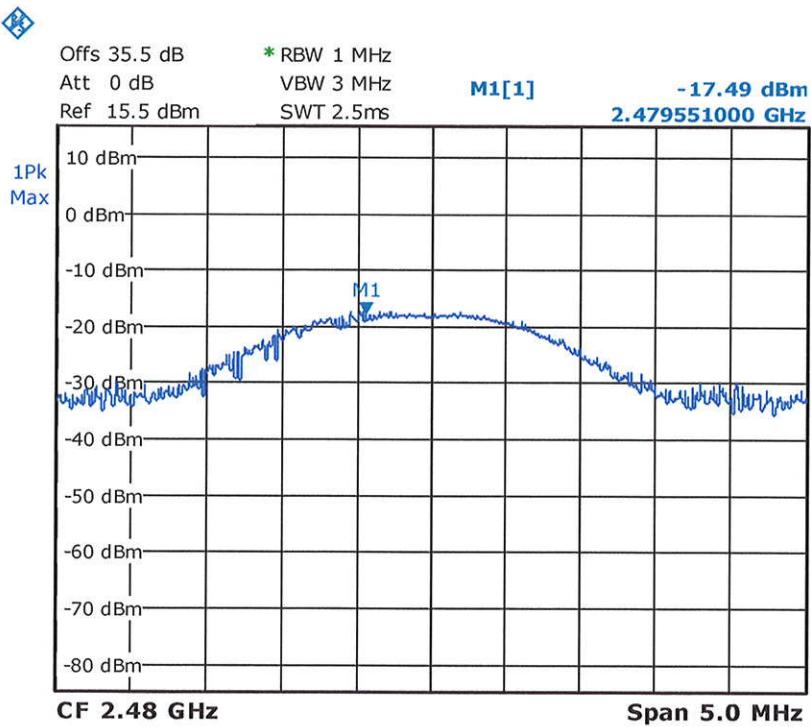
Peak output power : LOW channel



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Date: 24.JUN.2008 11:26:40

Peak output power : HIGH channel



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8. Spurious Emissions (Conducted)

8.1. SET-UP

The EUT is placed on a table at 0.8m height.

8.2. TEST EQUIPMENT

Equipment	Company	Model	Serial

8.3. MEASUREMENT DATA

Tests have been done in radiated mode only. (The equipment has an integral antenna only)



9. Spurious Emissions (Radiated)

9.1. SET-UP

The installation of EUT is identical for pre-characterization measurement in a shielded chamber and for measures on a 10 meters open area test site.

The EUT is placed on a non-conducting table of 80cm height.

Equipment configuration and running mode:

- EUT is ON with GFSK modulation activated;
- EUT was transmitting continuous and hopping function was disabled for spurious emissions measurement.
- EUT was transmitting continuous and hopping function was enabled for band edge measurement.

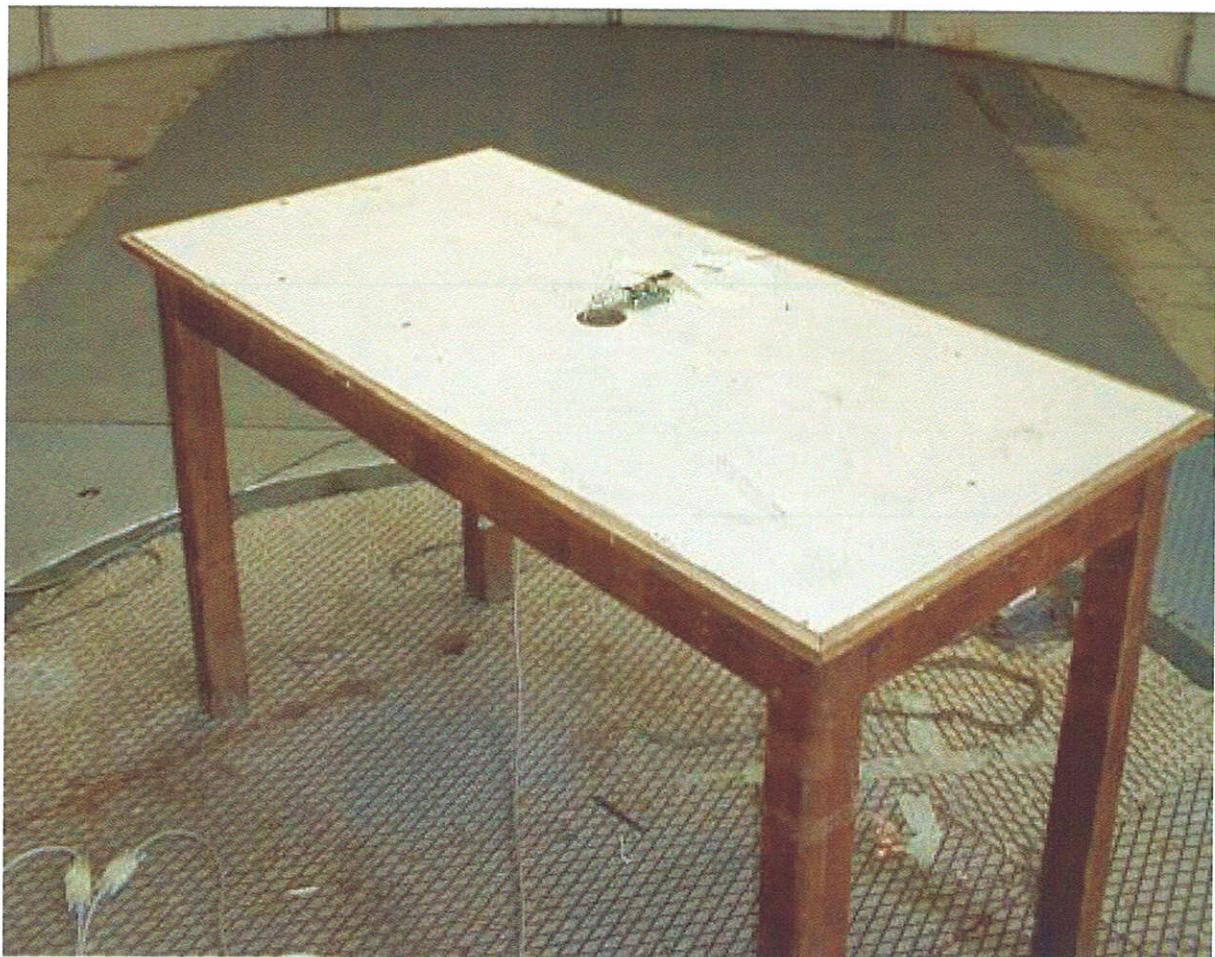
The product has been tested according to ANSI C63.4(2003), FCC part 15 subpart C and RSS-210. Radiated Emission was measured on an open area test site. A description of the facility is on file with the FCC.

The product has been tested at a distance of **10 meters** from the antenna. The RBW and VBW are 100kHz for peak measurement.

For average measurement, the RBW is 100kHz and VBW is 10Hz.

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.

Equipment was tested in its tree orthogonal planes and moved to position that maximized emission.



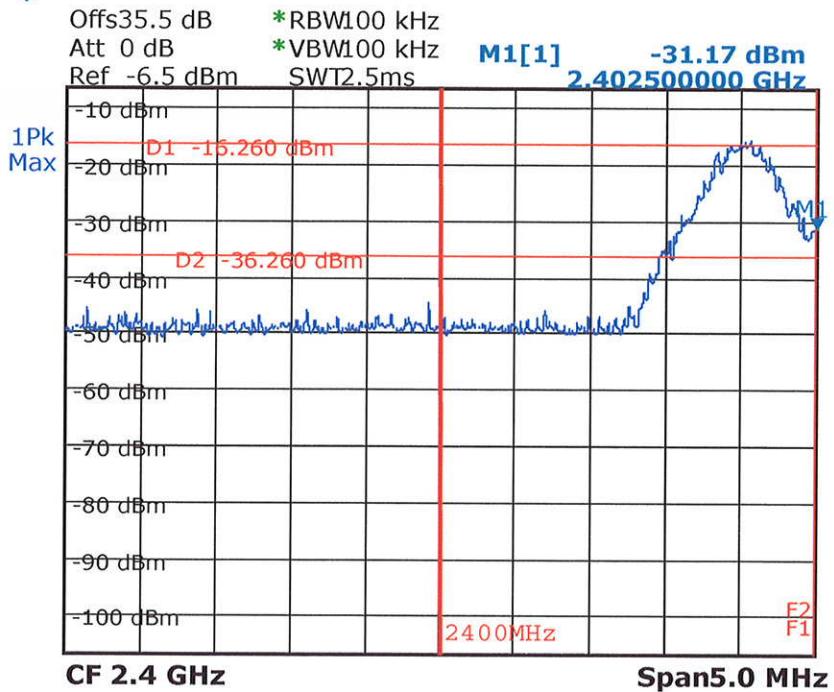


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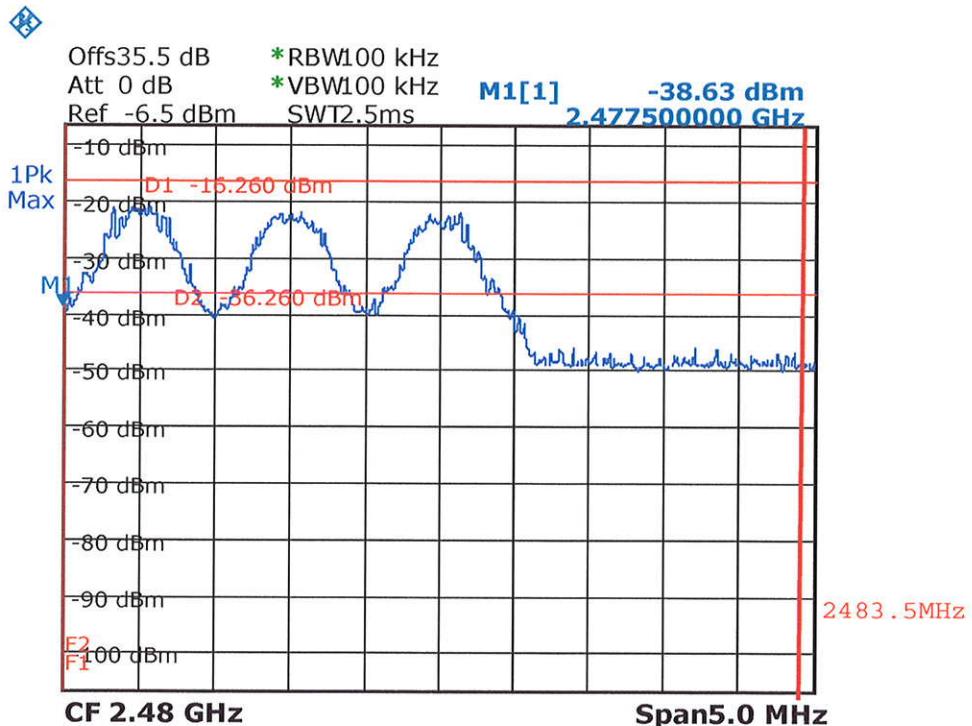
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9.2. Measurement data: Band Edge plots



Date: 24.JUN.2008 12:01:46

Low Band Edge (Level at 2.4GHz: -42dBm)



Date: 24.JUN.2008 12:02:37

High Band Edge (Level at 2483.5GHz: -48dBm)

As 2.485 GHz falls in a restricted band of 15.205 table, this frequency should also comply with radiated emission limit of 15.209:

Peak measurement with RBW=1MHz and VBW=1MHz at 10m = 41.6 dB μ V/m
 $m@3m = m@10 \cdot 20 \log(3/10)$

Frequency MHz	field strength at 3m dB μ V/m (Peak)	Limit at 3m dB μ V/m (average)
2483.5	52.0	54.0



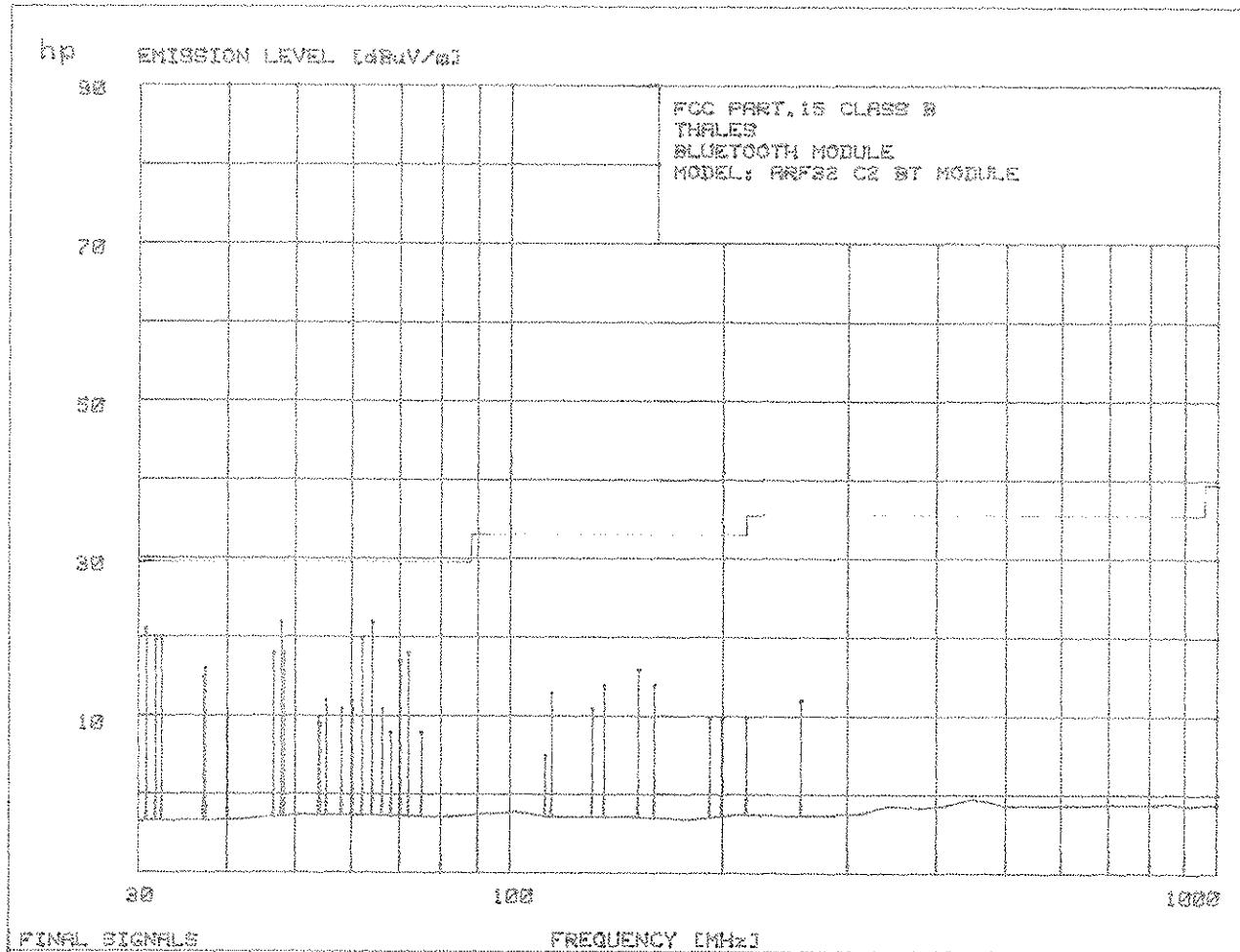
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9.3. Measurement data: spurious emissions

EUT Configuration: frequency hopping disable



No	Frequency (MHz)	Corrected reading (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Peak / Quasi Peak	Comments
1	31	21	29.5	-8.5	QP	
2	31.9	20	29.5	-9.5	QP	
3	32.8	20	29.5	-9.5	QP	
4	47.9	21.9	29.5	-7.6	QP	
5	62.1	20	29.5	-9.5	QP	
6	64.5	21.9	29.5	-7.6	QP	

No frequency higher than 1GHz (except fundamental of used signal)



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10. Test Equipment List

Test	Appareil / Apparatus	Marque / Trademark	Type / Type	Immatriculation / Registration number
<i>Essais en espace libre / Open area test site</i>				
X	Analyseur de spectre/ Spectrum analyseur	HEWLETT PACKARD	8566B	A4060004
X	Présélecteur / Preselector	HEWLETT PACKARD	85685A	-
X	Adaptateur quasi-crête / Quasi-Peak adaptator	HEWLETT PACKARD	85650A	B2163019
X	Préamplificateur / Preamplifier	HEWLETT PACKARD	8449B	A4069002
X	Générateur / Signal Generator	ROHDE & SCHWARZ	SMY02	A5442013
X	Générateur / Signal Generator	ROHDE & SCHWARZ	SMP02	B2163019
X	Antenne bilog / Bilog antenna	CHASE	CBL 6112A	C2040040
X	Antenne cornet / Horn antenna	EMCO	.3115	C2042016
X	Antenne cornet / Horn antenna	ETS	.3115	C2042023
X	Antenne cornet / Horn antenna	AH SYSTEMS	SAS572	C2042025
X	Antenne cornet / Horn antenna	LINDGREN	3117	C2042031



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11. 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 (triphasé) <i>Measurement of conducted disturbances in voltage on the power port (three phases)</i>	3.6 dB	3.6 dB
Mesure des perturbations conduites en tension sur le réseau d'énergie (monophasé) <i>Measurement of conducted disturbances in voltage on the power port (single line)</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 <i>Measurement of radiated electric field on the open area test site</i>	5.07 dB	5.2 dB
Mesure du champ électrique rayonné IN SITU de 30 à 1000 MHz <i>IN SITU measurement of radiated electric field from 30 to 1000MHz</i>	A l'étude / Under consideration	5.2 dB

Les valeurs d'incertitudes calculées du laboratoire étant inférieures aux valeurs d'incertitudes limites établies par le CISPR, 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 CISPR. The conformity of the sample is directly established by the applicable limits values.