Accreditation Scope available on www.cofrac.fr

TEST REPORT

N° 109228-617811

FCC REGISTRATION NUMBER: 166175

ISSUED TO	:	**SCHLUMBERGER WATER SERVICES** Delftechpark 20, P.O. Box 553 2600 AN Delft NETHERLANDS
SUBJECT	:	**ELECTROMAGNETIC COMPATIBILITY TESTS ACCORDING TO THE STANDARD 47 CFR PART 15, SUBPART C, 15.247**

Apparatus under test	:	
Product	:	Ground water monitoring transmitter
Trade mark	:	SCHLUMBERGER
Manufacturer	:	SCHLUMBERGER WATER SERVICES
Model	:	Diver-DXT
Serial number	:	- (Prototype)
Applicant	:	**SCHLUMBERGER WATER SERVICES**
FCC ID	:	**V43DIVERDXT2**

* information given by the customer

Test date : March 2011 & November, 2011

Composition of document : 27 pages

Fontenay-Aux-Roses, January 30th 2012

Writen by
Gilles DE BUYSER

LABORATOIRE CENTRAL DES INDUSTRIES ELECTRIQUES
S.A.S au capital de 15.745.984 €
RCS Nanterre B 408 363 174
33 avenue du Général Leclerc
F - 92266 FONTENAY AUX ROSES

The technical manager,
Philippe SISSOKO

TABLE OF CONTENTS

1 – GENERAL

1.1 – Summary of test results

Radiated emissions are made in anechoic chamber, located at Fontenay-Aux-Roses (92260, FRANCE).
FCC REGISTRATION NUMBER: 166175

FCC requirements : 47 CFR Part 15

47 CFR Part 15			
Paragraph No.	**Name of test**	**Remarks**	**Result**
§ 15.203	Antenna requirement	Note 4	Pass
§ 15.205	Restricted bands of operation		Pass
§ 15.207 (a)	Power line conducted limits	Note 5	NA
§15.247 (a) (1)	Frequency hopping system : Channel separation	No hopping	NA
§15.247 (a) (2)	Digital modulation system : 6dB bandwidth		Pass
§15.247 (b)	Maximum peak conducted output power		Pass
§15.247 (c)	Operation with directional antenna gains greater than 6dBi	Note 1	NA
§15.209 (a)	Emission radiated outside the specified frequency band	Note 2	Pass
§15.247 (d)	Band edge emission	DA 00-705	Pass
§15.247 (e)	Digital modulation system : power spectral density		Pass
§15.247 (f)	Hybrid system : time of occupancy	No hopping	NA
§15.247 (h)	Frequency hopping system : individual hopping frequency management	No hopping	NA
§15.247 (i)	Public exposure to RF energy	Note 3	Pass

Note 1: the antenna gain is less than 6 dBi.
Note 2: see FCC part 15.247 (d).
Note 3: this type of equipment uses less than 0.5 W of output power with a high signal transmitting duty factor (section 3 from OET 65c).
Note 4: dedicated antenna (see internal photos).
Note 5: equipment only powered by battery. No charger.

1.2 – References

Measurements were performed in accordance with the following standards:

47 CFR Part 15 of September 2009: Code of federal regulations – Telecommunication – Radiofrequency devices

ANSI C63.4 of December 11, 2003: American national standard for methods of measurement of radio noise emissions from low-voltage electrical and electronic equipment in the range of 9 kHz to 40 GHz.

CISPR 16-4-2 of November, 2003: International electrotechnical commission - Specification for radio disturbance and immunity measuring apparatus and methods – Uncertainties, statistics and limit modeling – Uncertainty in EMC measurements.

Measurement of Digital Transmission Systems Operating under Section 15.247 : March 23, 2005

1.3 – Test methodology

Radio performance tests procedures given in part 15:

Paragraph 33: frequency range of radiated measurements

Paragraph 35: measurement detector functions and bandwidths

Paragraph 203: antenna requirement

Paragraph 205: restricted bands of operation

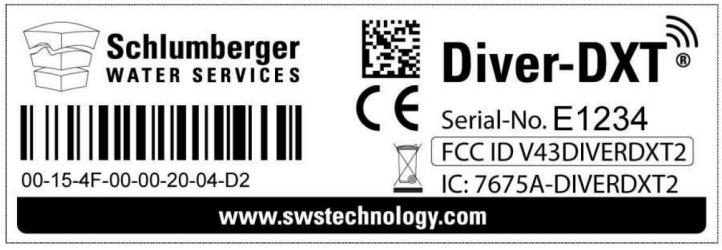
Paragraph 207: conducted limits

Paragraph 209: radiated emission limits; general requirements

Paragraph 247: operation within the bands 2400-2483.5 MHz

1.3 – Equipment under test specification

1.3.1 – General equipment information

Applicant FCC	:	**SCHLUMBERGER WATER SERVICES** Delftechpark 20, P.O. Box 553 2600 AN Delft NETHERLANDS
Manufacturer	:	**SCHLUMBERGER WATER SERVICES** Delftechpark 20, P.O. Box 553 2600 AN Delft NETHERLANDS
Dimensions	:	8.5cm long, 5cm large, 1.5cm high
Frequency band	:	2400 – 2483.5MHz
Number of channel	:	1
Channel spacing	:	-
Modulation	:	Digital modulation IEEE 802.15.4
User frequency adjustment	:	NO
User power adjustment	:	NO
Type of antenna	:	Internal ceramic antenna with 3dBi gain
Is the operation point to point?		NO
Label identification	:	
Power supply	:	batteries 3.6V d.c. (Lithium Thionyl Chloride)
Cables	:	Data cable to the water monitoring sensor

1.3.2 – Description of modifications

No modification

1.3.3 – Description of operation

The equipment was configured in the following operation mode:
- Maximum transmission power.

This equipment uses only one channel of the Zigbee transmitter at 2415MHz.
Conducted measurements are made with a sample equipped with a conducted access to the output of the transmitter instead of the antenna. This sample is set with permanent emission and the usual modulation.
Radiated spurious measurements, are made on the original sample in usual working mode.

1.3.4 – Photograph of the sample

Original sample general view

Conductor access sample on the demonstration board

2 – TEST RESULTS

2.1 – Frequency hopping system: Channel separation

- NOT APPLICABLE -

2.2 – Digital modulation system : 6dB bandwidth and Occupied bandwidth at 99%

2.3.1 – General

The product has been tested with 3.6 V d.c. battery. The results has been compared to the FCC part 15 subpart C §15.247 (a) (2).
Test date: November 2011

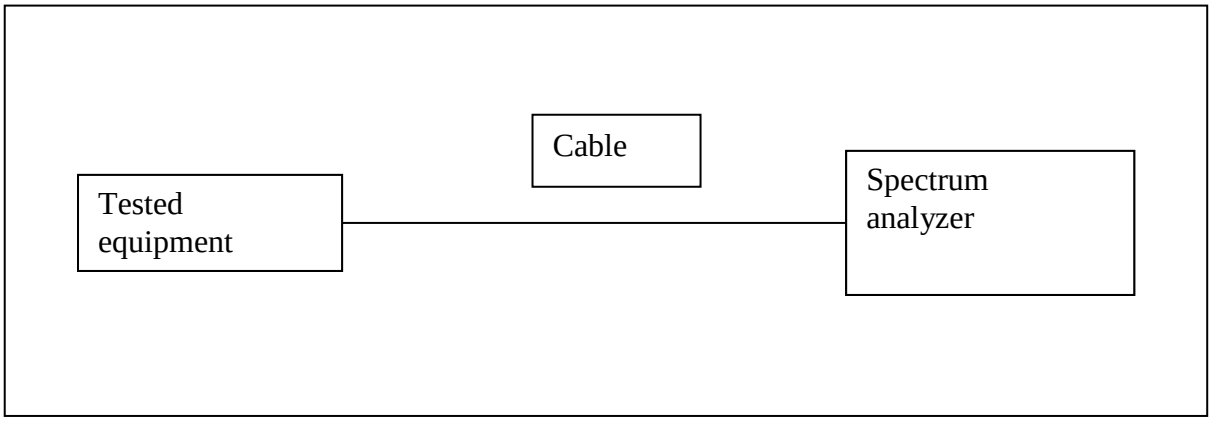
2.3.2 – Test setup

The conductor access sample is used to perform this test. The equipment is directly connected to the spectrum analyzer. The cable loss correction is entered as an offset in the spectrum analyzer.

The Spectrum analyzer settings are:

6dB Bandwidth		99% occupied bandwidth	
RBW = 100kHz	VBW = 300kHz	RBW = 300kHz	VBW = 1MHz
Sweep = 2.5ms	Span = 16MHz	Sweep = 2.5ms	Span = 20MHz

Unit = dBm Detector = peak (with max hold)



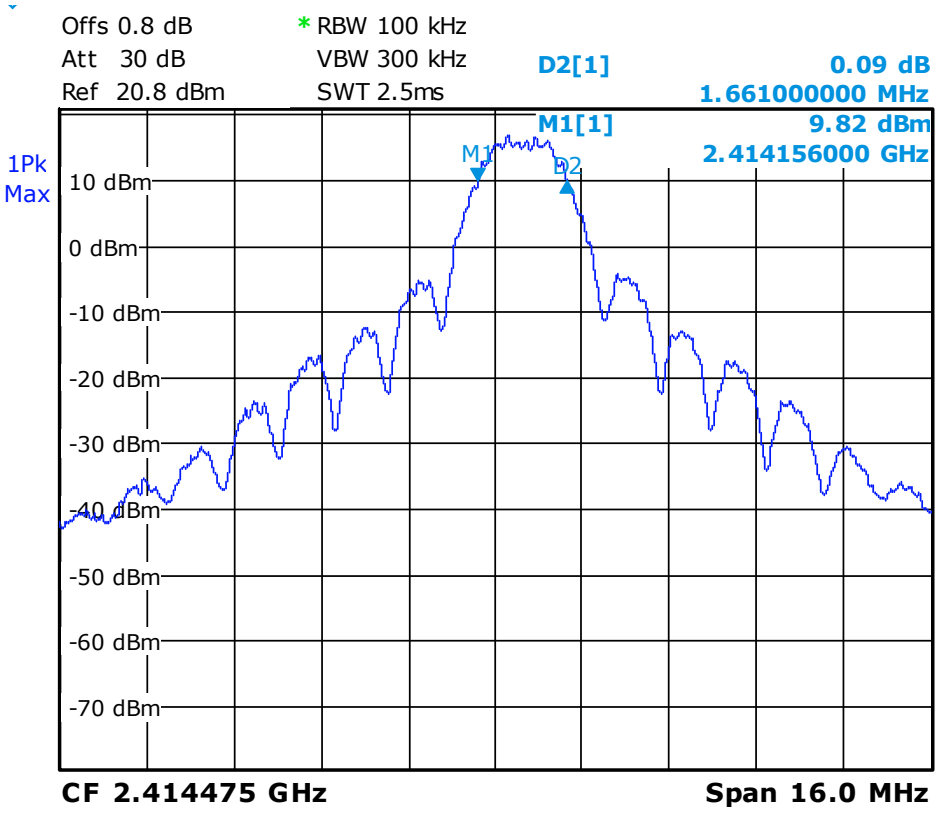
2.3.3 – Equipment list

Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Spectrum analyzer	ROHDE & SCHWARZ	FSL6	A4060032	10/2011	10/2012

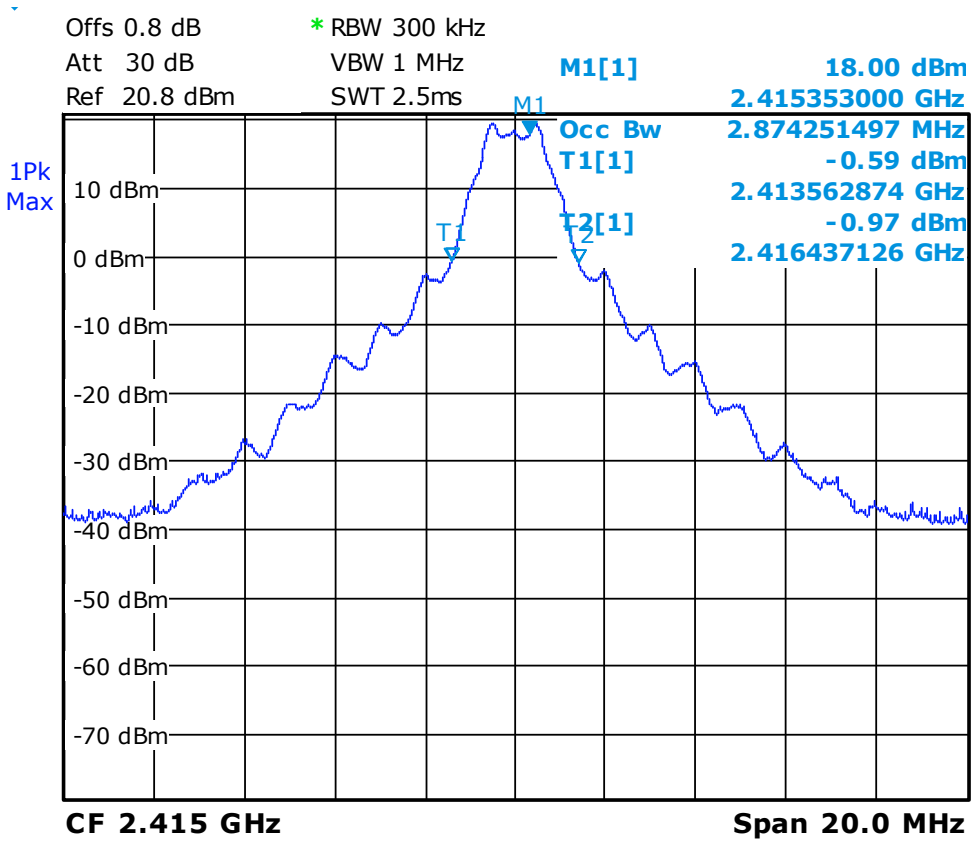
2.3.4 – Test results

The 6dB bandwidth shall be at least 500kHz

Channel	Measured 6dB bandwidth (kHz)	Pass / Fail		Channel	99 % Occupied bandwidth (kHz)
2415 MHz	1661.0	Pass		2415 MHz	2874.2



6dB bandwidth



99% occupied bandwidth

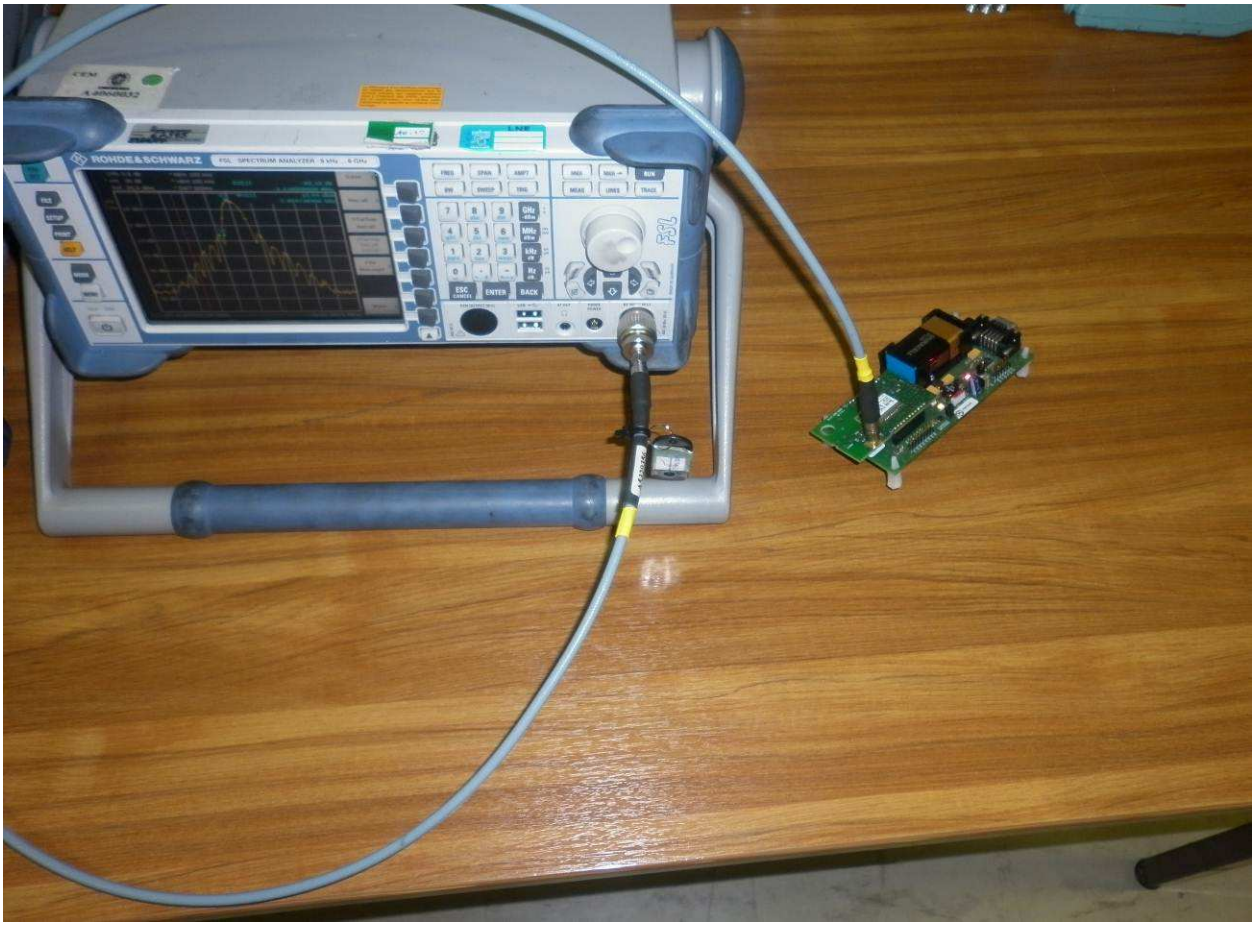
2.4 – Maximum peak conducted output power

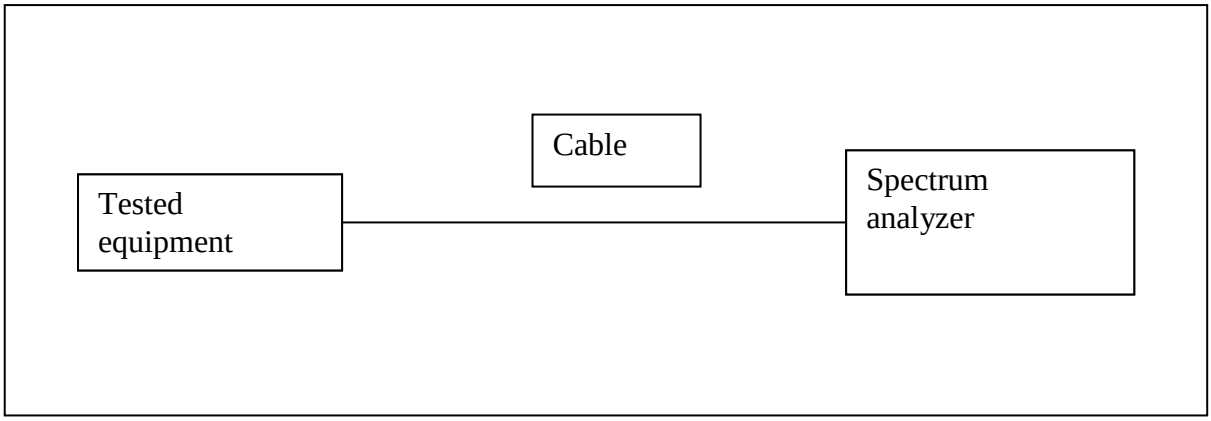
2.4.1 – General

The product has been tested with 3.6 V d.c. battery. The results has been compared to the FCC part 15 subpart C §15.247 (b).
Test date: November 2011

2.4.2 – Test setup

The conductor access sample is used to perform this test. The equipment is directly connected to the spectrum analyzer. The cable loss correction is entered as an offset in the spectrum analyzer.





2.4.3 – Test configuration

Test is carried out in average method with test method is in accordance with Power output option 1, RBW greater than 6 dB bandwidth from “Measurement of Digital Transmission Systems Operating under Section 15.247: March 23, 2005”

- Span = 20 MHz (> EBW)
- RBW = 3 MHz, VBW = 10 MHz

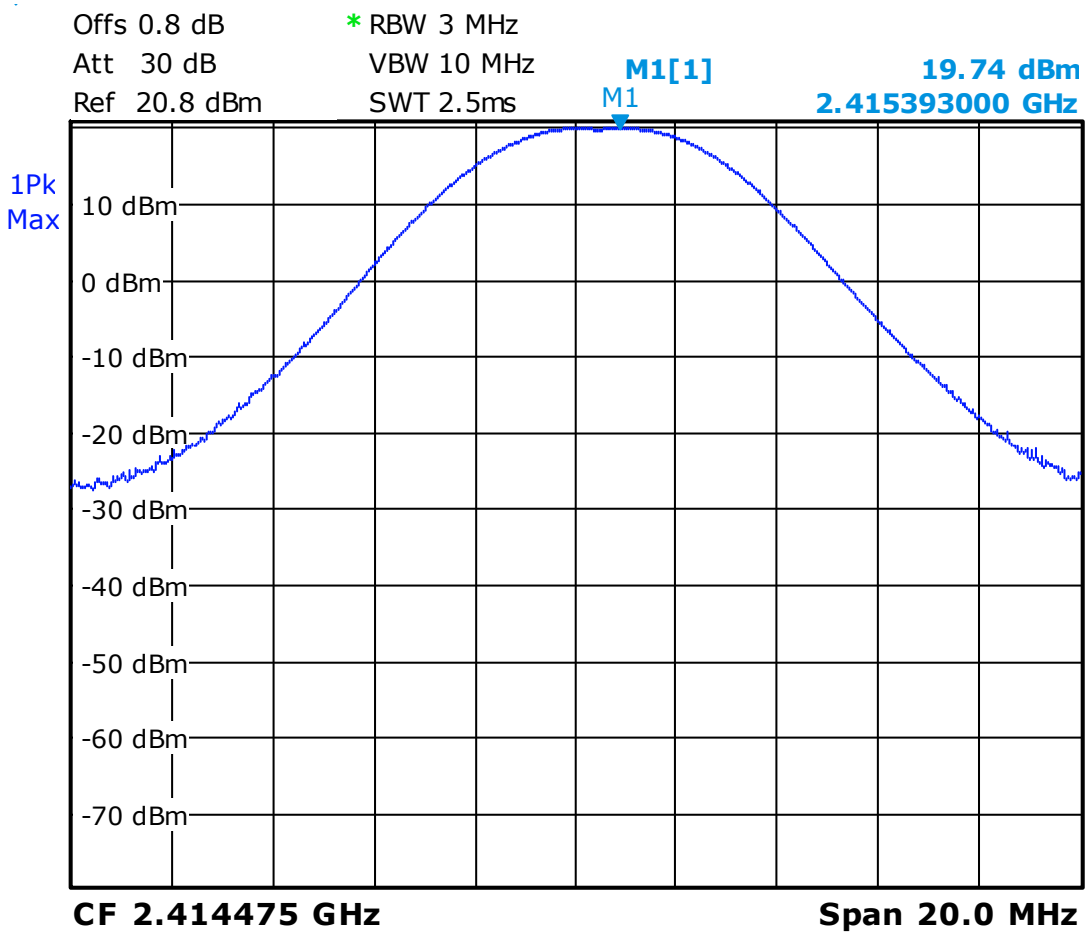
2.4.4 – Equipment list

Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Spectrum analyzer	ROHDE & SCHWARZ	FSL6	A4060032	10/2011	10/2012

2.4.5 –Test results

Channel	Output power (dBm)	Limit (dBm)
2415 MHz	19.8	30

19.8 dBm = 0.095 W (limit 1 W)



Output power on the transmitter channel

2.5 – Operation with directional antenna gains greater than 6dBi

- NOT APPLICABLE -

2.6 – Emission radiated outside the specified frequency band

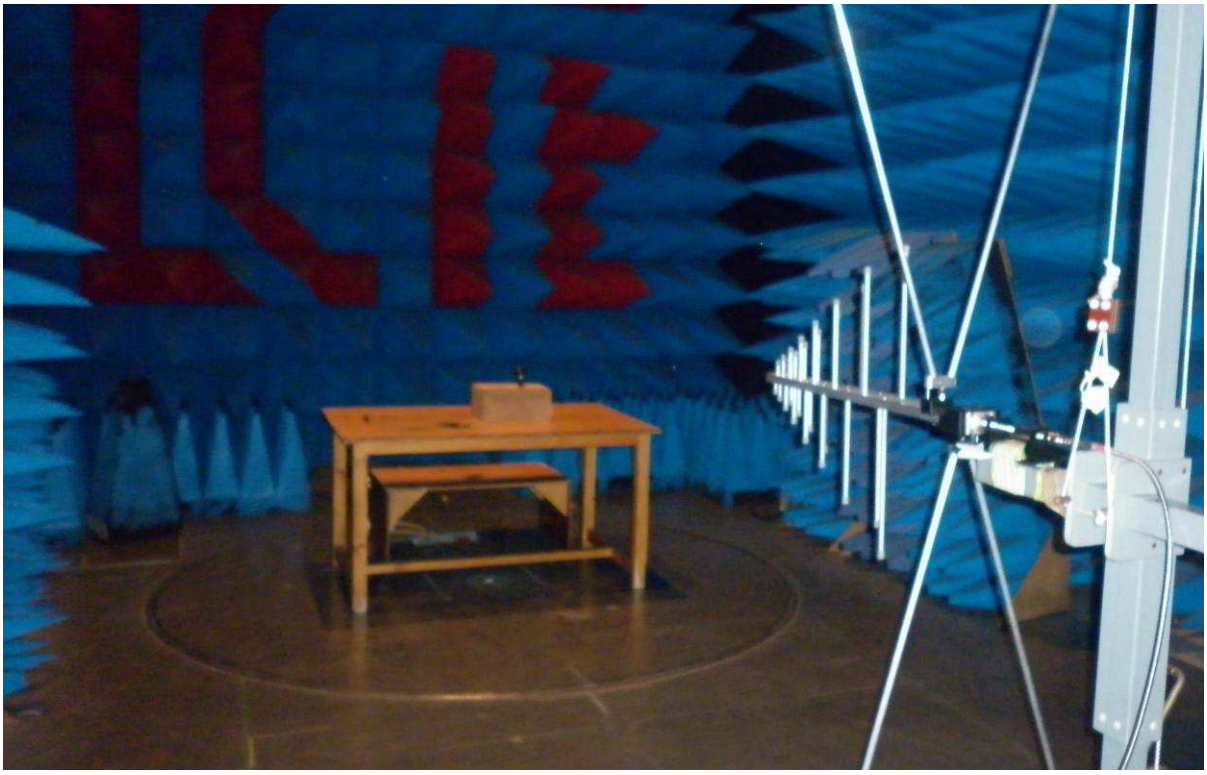
2.6.1 – General

The product has been tested with 3.6 V d.c. battery and compared to the FCC part 15 subpart C §15.209 limits.
Test date: March 2011

The 6dB resolution bandwidth was 120 kHz from 30MHz to 1GHz, and 1MHz above 1GHz to 18GHz.

2.6.2 – Test setup

The EUT is placed on a table at 0.8 m height. Measurements have been made with antenna at 3m distance on the open area test site. The values have been maximised by rotating the equipment, move the antenna height and antenna polarization.



2.6.3 – Equipment list

Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
EMI RECEIVER	RHODE & SCHWARZ	ESI40	A2642010	09/2010	09/2011
Semi anechoic chamber 11,8x8,1x9,5m	SIEPEL	C01	D3044008	-	-
Horn antenna	EMCO	3115	C2042018	05/2010	05/2011
Bilog antenna	SCHWARZBECK	VULB9160	C2040150	06/2010	06/2011
Preamplifier	BONN ELEKTRONIK	BLNA 3018-8F30S	A7080053	03/2010	03/2011

2.6.4 – Uncertainty

The uncertainty values calculated by the laboratory are lower than limit uncertainty values defined by the CISPR 16-4-2. The conformity of the sample is directly established by the applicable limits values.

Kind of measurement	**Wide uncertainty laboratory (k=2) ±x(dB)**	**CISPR uncertainty limit ±y(dB)**
Measurement of radiated electric field from 30 to 200MHz in horizontal position on the Fontenay-aux-Roses site	4.78	5.2
Measurement of radiated electric field from 30 to 200MHz in vertical position on the Fontenay-aux-Roses site	4.96	5.2
Measurement of radiated electric field from 200 to 1000MHz on the Fontenay-aux-Roses site	5.15	5.2
Measurement of radiated electric field from 1 to 18GHz on the Fontenay-aux-Roses site	5.16	Under consideration

2.6.5 – Test results

3 m radiated measurements from 30 to 1000 MHz

Frequency (MHz)	**Quasi-peak measurements @ 3m (dBµV/m)**	**Limits Quasi peak @ 3m (dBµV/m)**
87.7	19.996	40
92.15	25.023	43.5
93.4	24.537	43.5
95.6	22.645	43.5
97.45	21.743	43.5
393.44	30.373	46

See diagrams 1 to 4

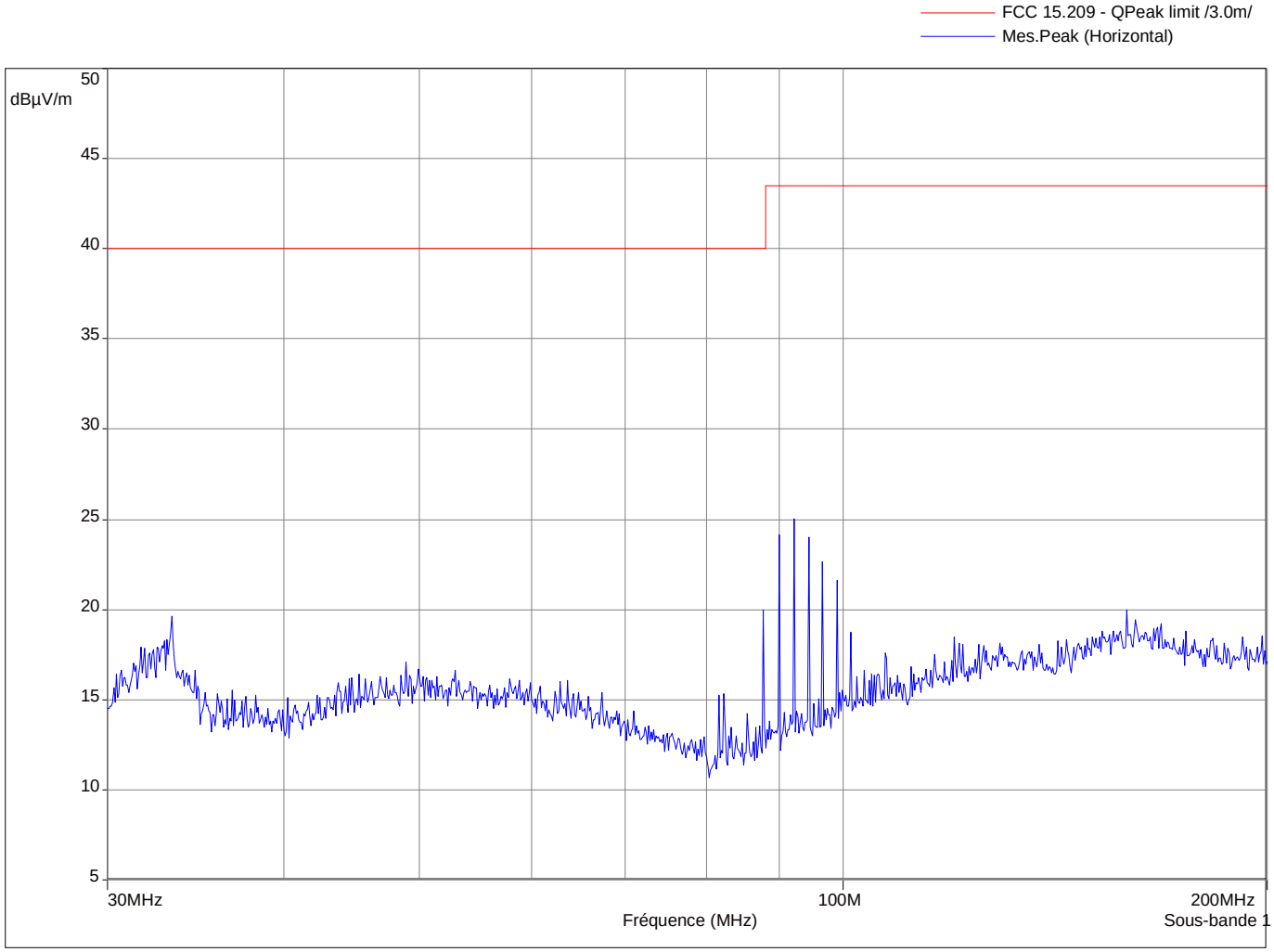
3 m radiated measurements from 1000 to 24835 MHz

Frequency (MHz)	Average measurements @ 3m (dBµV/m)	Limits average @ 3m (dBµV/m)
2399.9	46.9	54
2483.6	36.8	54
4830.7	52.6	54

Frequency (MHz)	Peak measurements @ 3m (dBµV/m)	Limits Paek @ 3m (dBµV/m)
2399.9	59.4	74
2483.6	50.4	74
4830.7	56.1	74

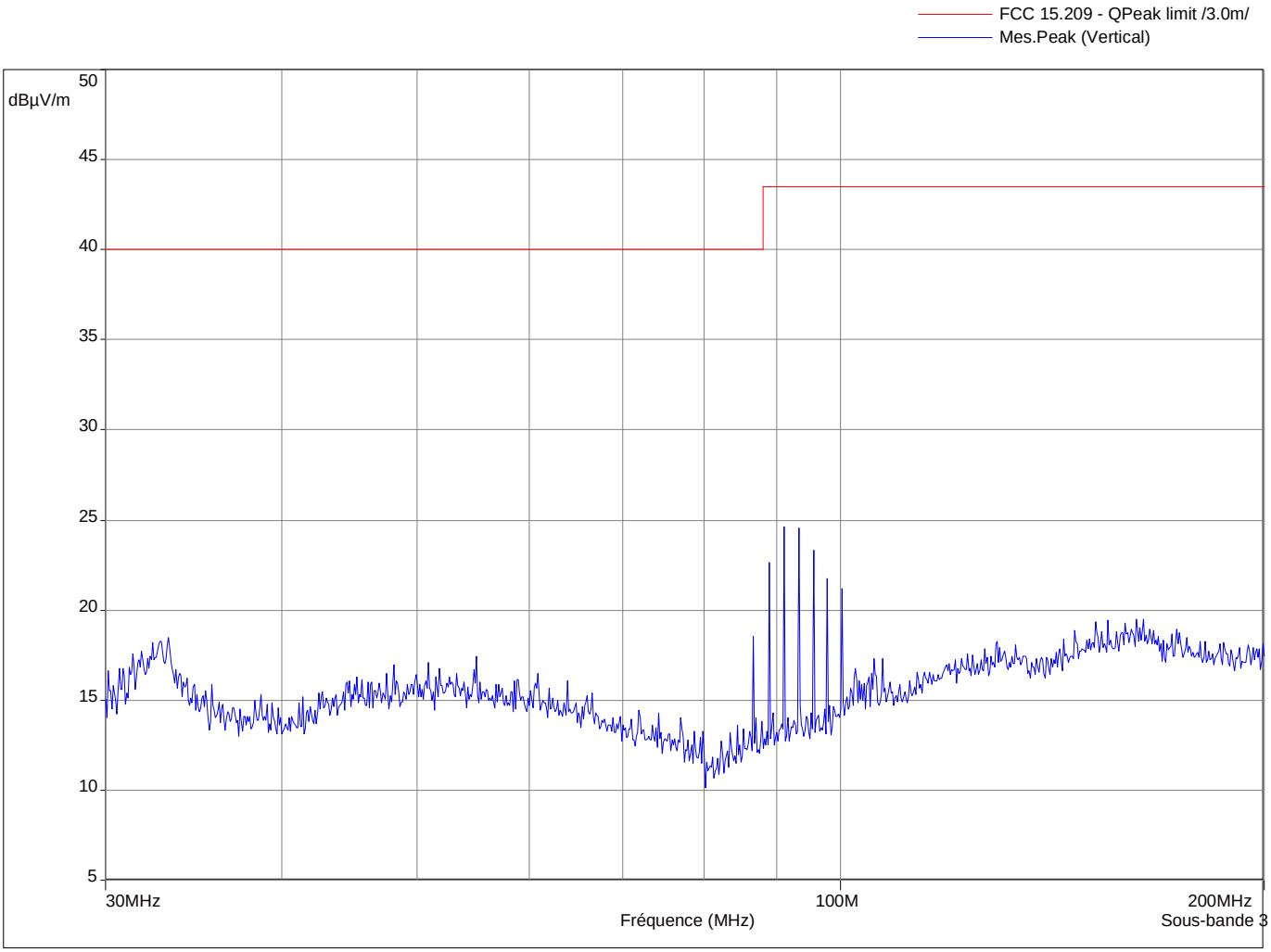
See diagrams 5 and 6.
No other spurious emission observed above 6GHz.

Diagram N°1



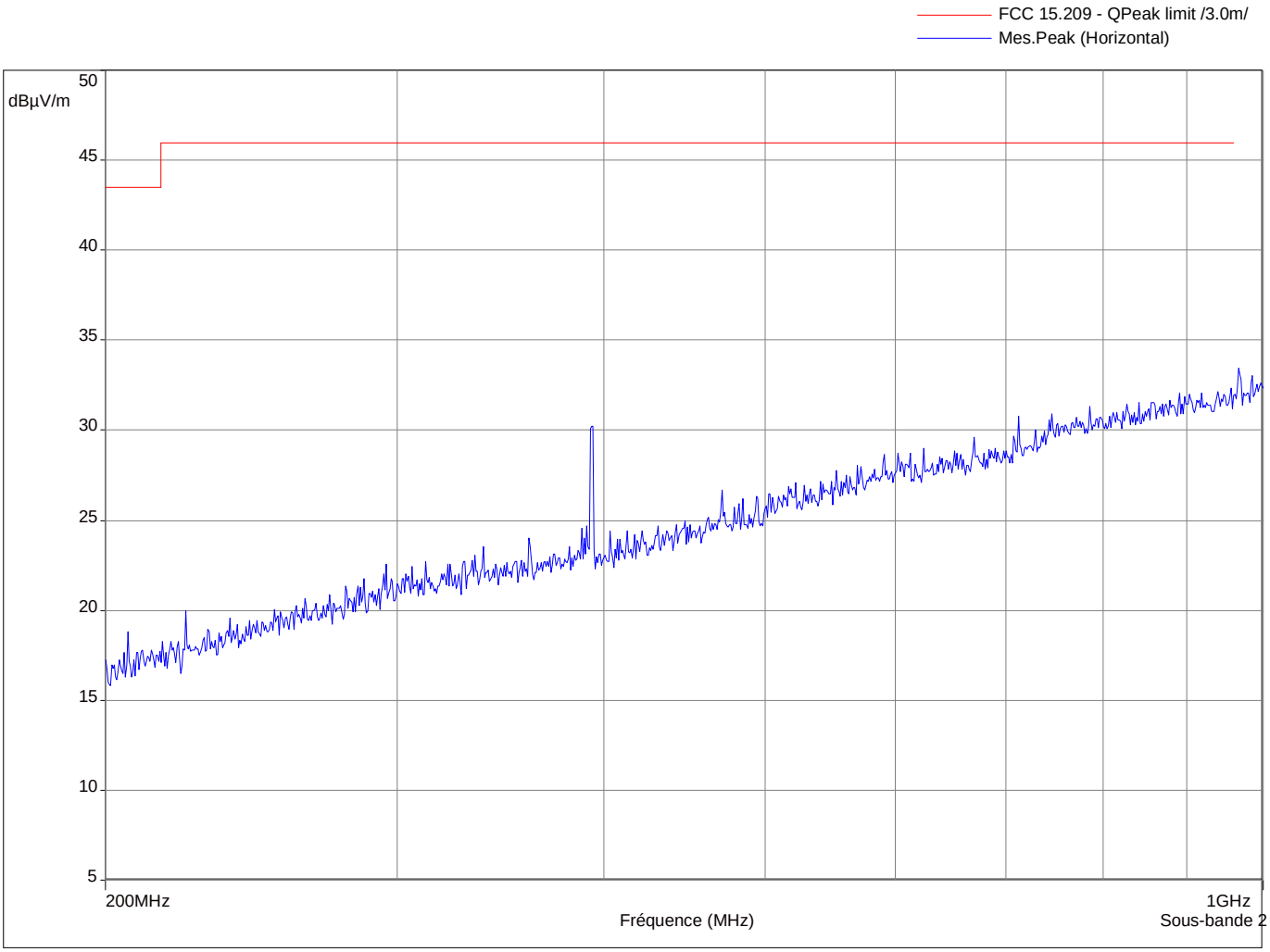
Radiated emission – Horizontal polarization

Diagram N°2



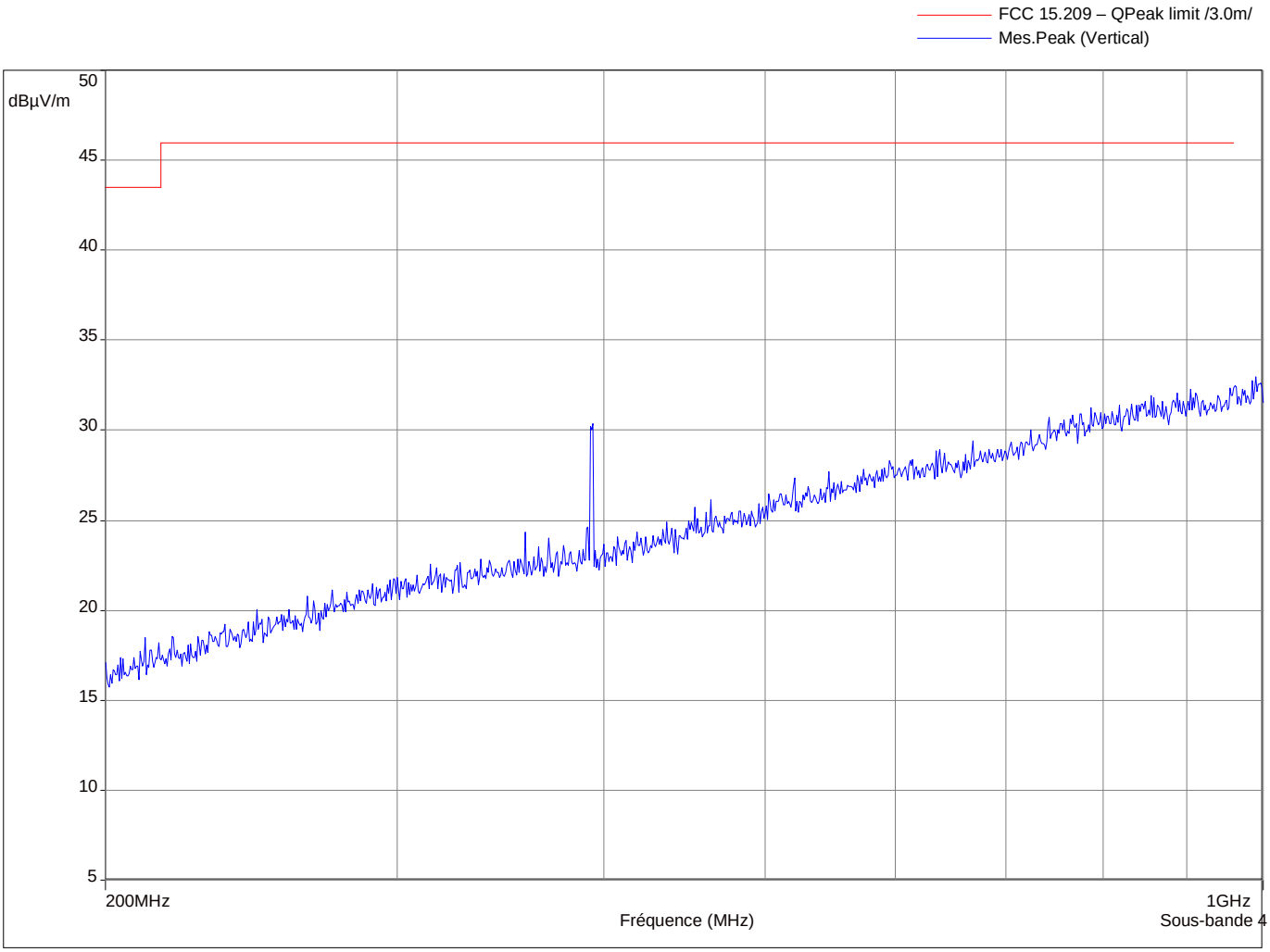
Radiated emission – Vertical polarization

Diagram N°3



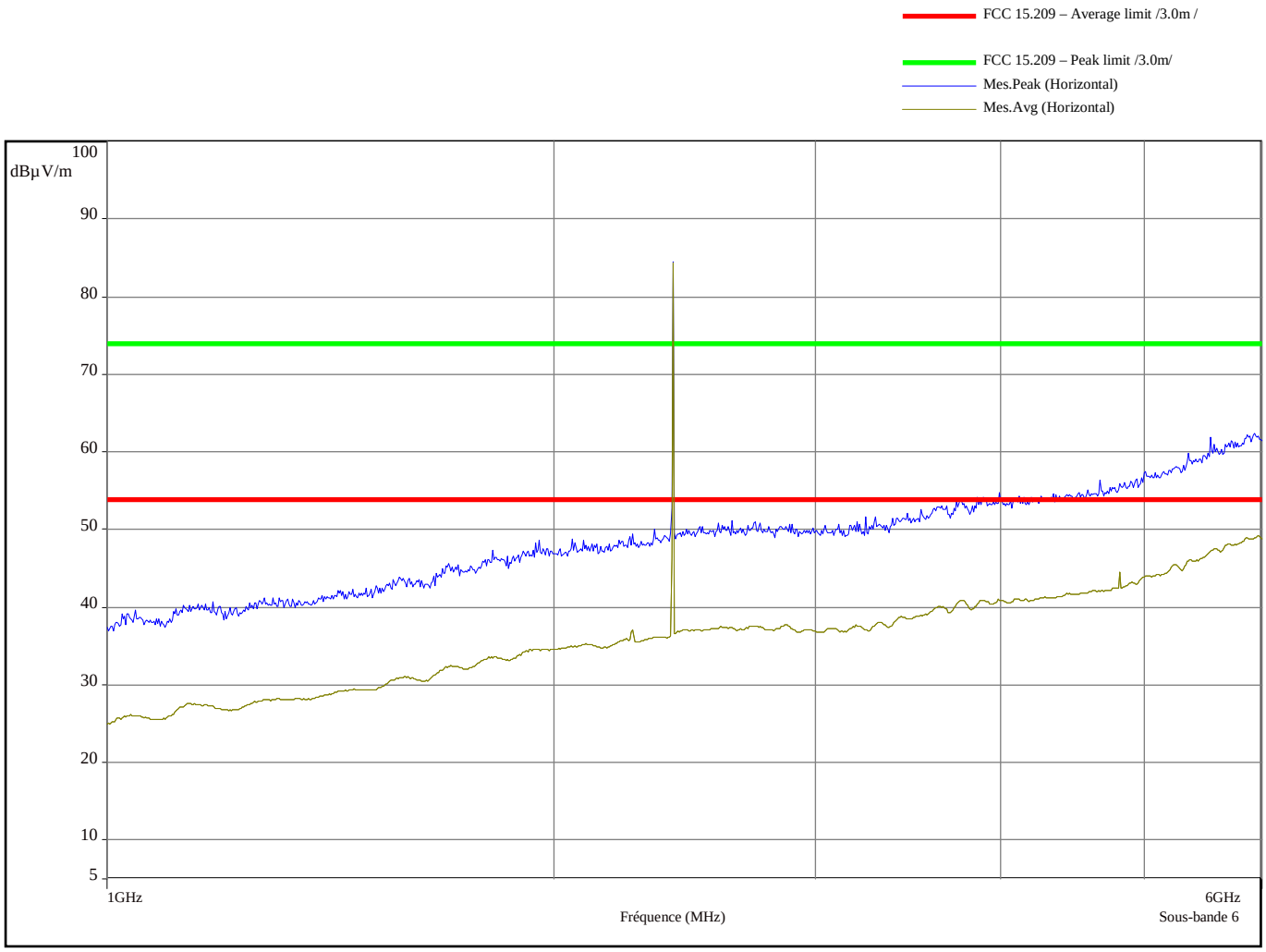
Radiated emission – Horizontal polarization

Diagram N°4



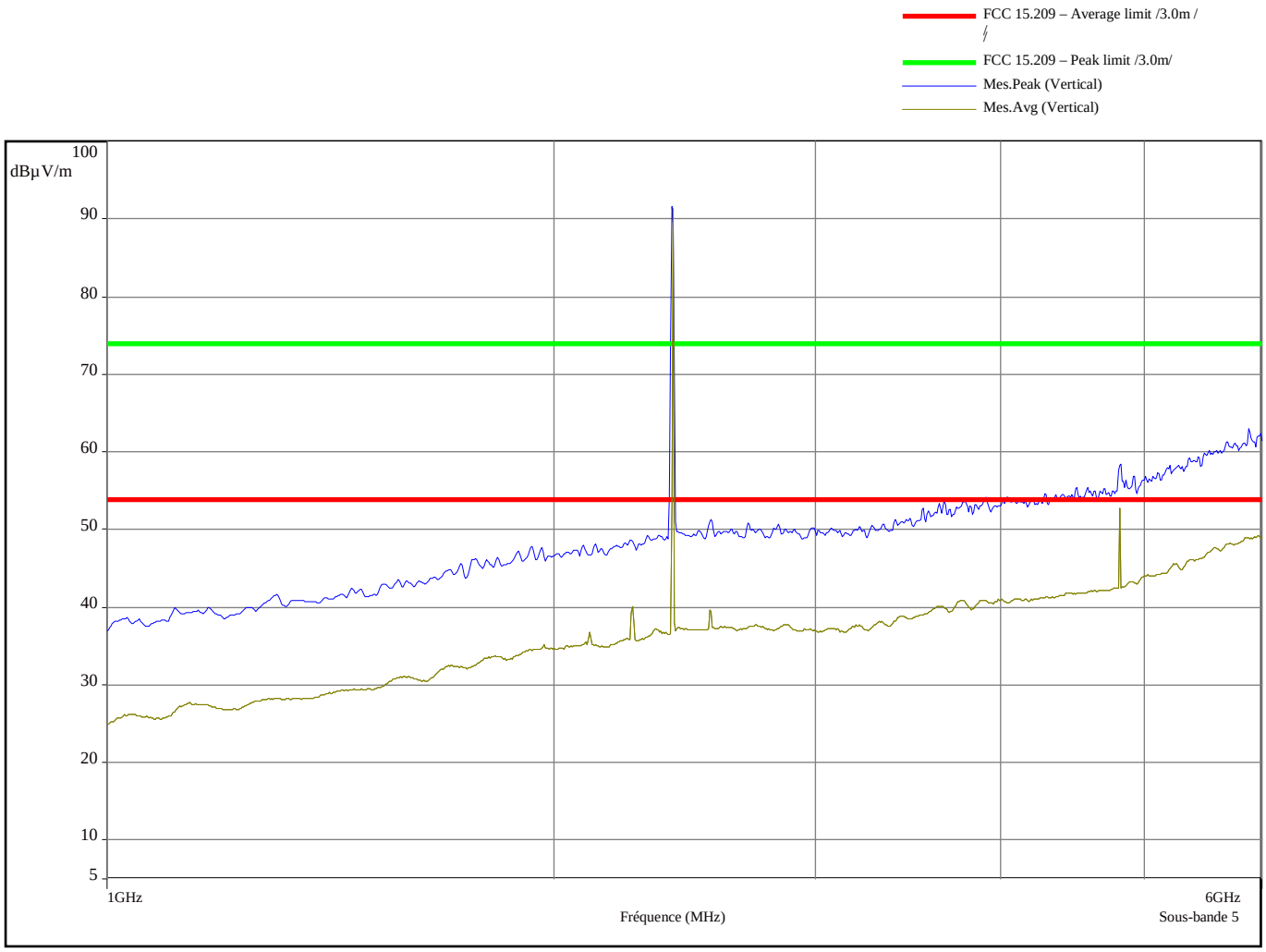
Radiated emission – Vertical polarization

Diagram N°5



Radiated emission – Horizontal polarization

Diagram N°6



Radiated emission – Vertical polarization

2.7 – Digital modulation system: power spectral density

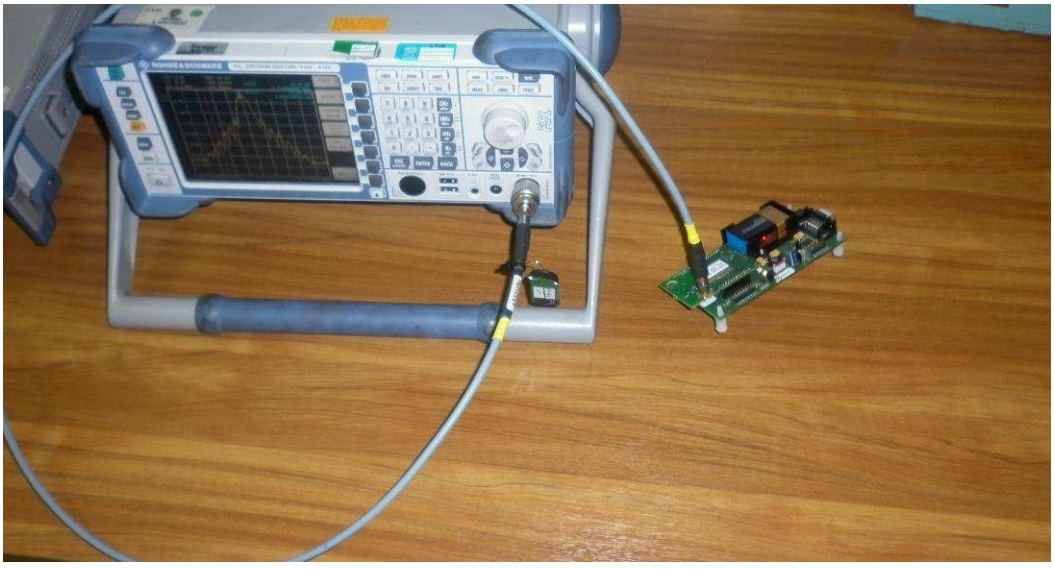
2.7.1 – General

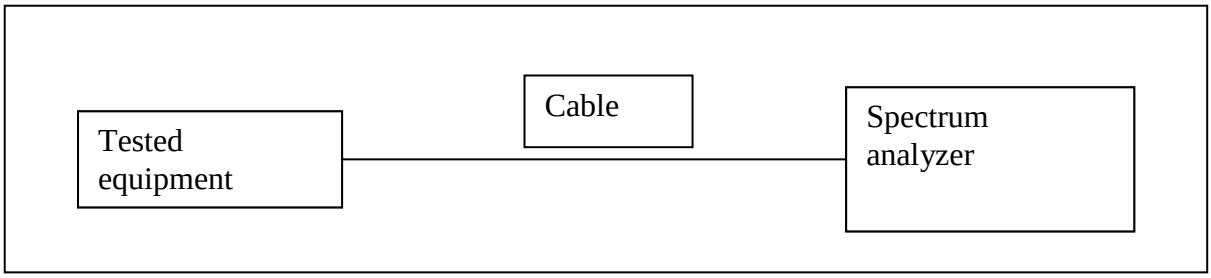
The product has been tested with 3.6 V d.c. battery. The results has been compared to the FCC part 15 subpart C §15.247 (e)
Test date: November 2011

2.7.2 – Test setup

The conductor access sample is used to perform this test. The equipment is directly connected to the spectrum analyzer. The cable loss correction is entered as an offset in the spectrum analyzer.
Use of PSD option 1, from "Measurement of Digital Transmission Systems Operating under Section 15.247: March 23, 2005"

The Spectrum analyzer is set as follows:
RBW = 3kHz VBW = 10kHz
Sweep = 170s Span = 500kHz
Unit = dBµV/m Detector = peak (with max hold).





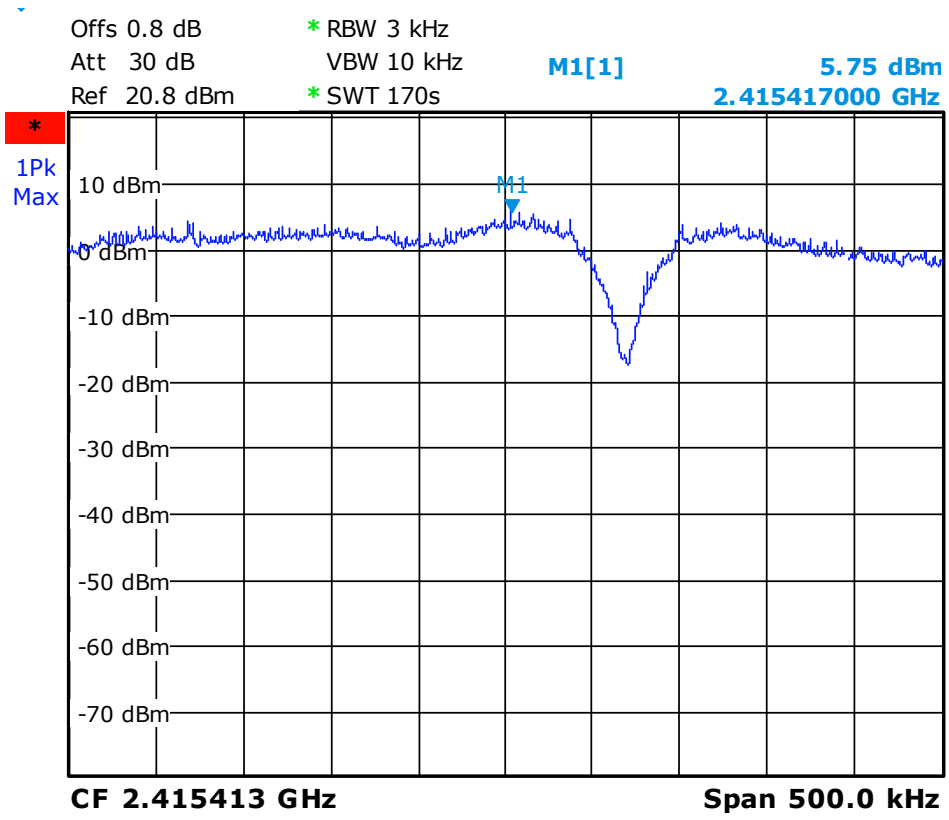
2.7.3 – Equipment list

Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Spectrum analyzer	ROHDE & SCHWARZ	FSL6	A4060032	10/2011	10/2012

2.7.4 – Test results

The calculated power level must be no greater than +8 dBm.

Channel	Measured power density (dBm)	Power density limit (dBm)	Result Pass / Fail
2415 MHz	5.8	8	Pass



Power density on transmitter channel

2.8 – Hybrid system: time of occupancy

- NOT APPLICABLE -

2.9 – Frequency hopping system : individual hopping frequency management

- NOT APPLICABLE -

2.10 – Public exposure to RF energy

- NOT APPLICABLE -

2.11 – Bandedge emission measurement

2.11.1 – General

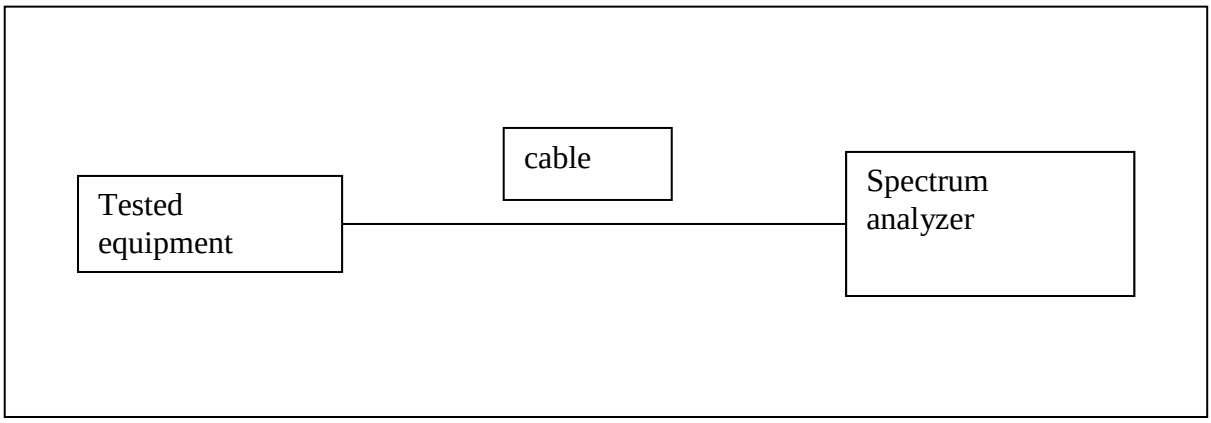
The product has been tested with 3.6 V d.c. battery. The results has been compared to the FCC part 15 subpart C §15.247 (d).
Test date: November 2011

2.11.2 – Test setup

The conductor access sample is used to perform this test. The equipment is directly connected to the spectrum analyzer. The cable loss correction is entered as an offset in the spectrum analyzer.

The Spectrum analyzer setting is:

RBW = 100kHz	VBW = 300kHz
Sweep = 2.5ms	Span = at least 20MHz
Unit = dBm	Detector = peak (with max hold)



2.11.3 – Equipment list

Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Spectrum analyzer	ROHDE & SCHWARZ	FSL6	A4060032	10/2011	10/2012

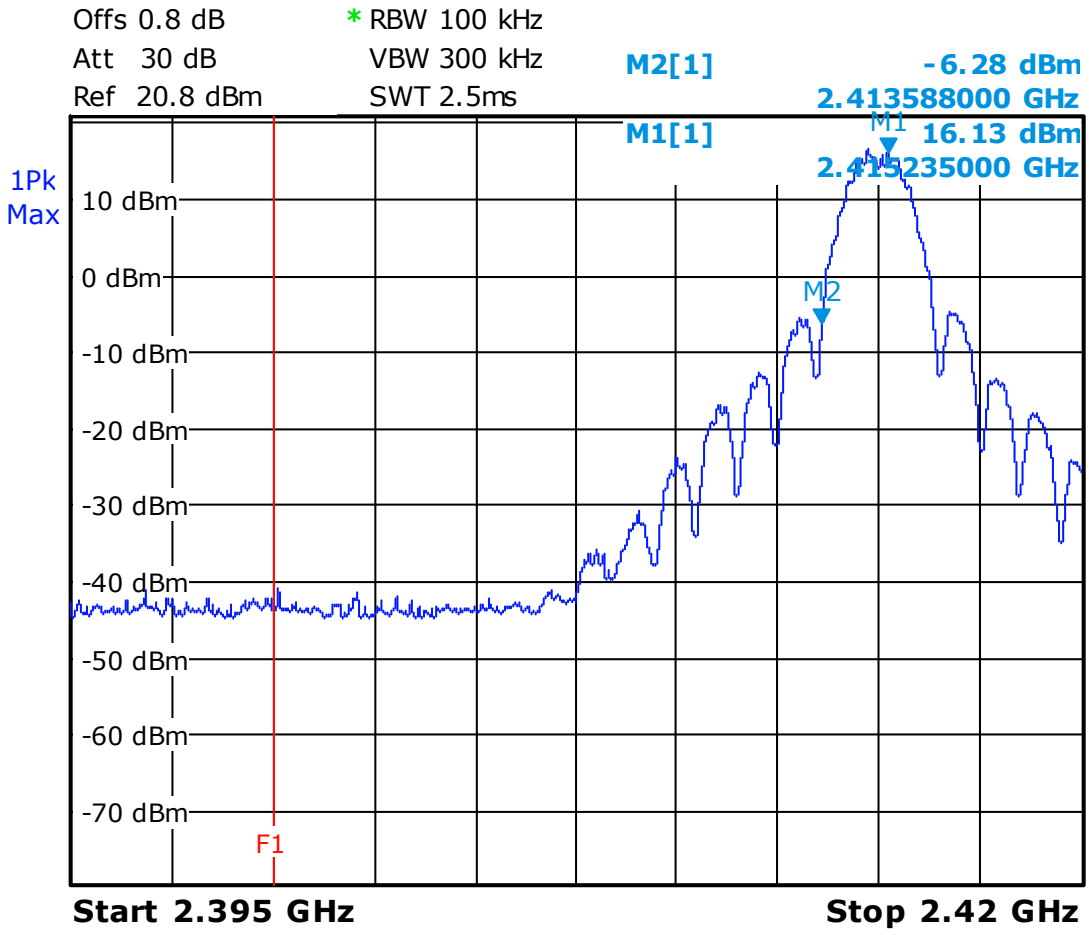
2.11.4 – Test results

In any 100 kHz bandwidth outside the frequency band in witch the equipment internal radiator is operating, the radio power produced by the internal radiator shall be at least 20 dB below the highest level (100 kHz bandwidth) of emission within the operating frequency band.

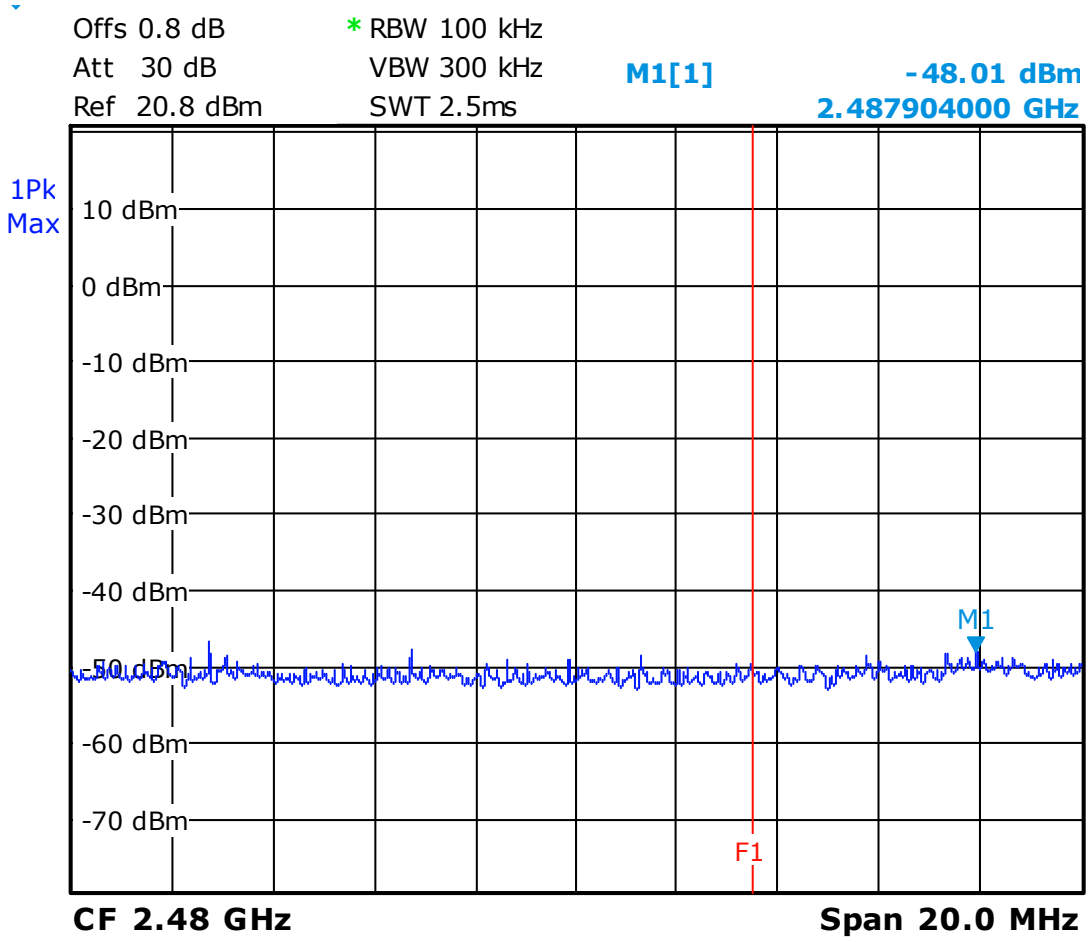
Fl is the lowest frequency with 20 dB below the highest level.
Fh is the highest frequency with 20 dB below the highest level.

Fl shall be > 2400MHz
Fh shall be < 2483.5MHz

Channel	Frequency at level max -20dB (MHz)	Frequency limit (MHz)	Pass / Fail
2415 MHz	Fl= 2413.5	2400.0	Pass
2415 MHz	Fh= 2418.7	2483.5	Pass



Lowest frequency band edge



Highest frequency band edge

End of test report