

R051-24-09-101190-1/A Ed. 0

RADIO test report

according to standard:
FCC Part 15
Permissive change

Equipment under test:
WAVECARD MODULE WITH 1/4 WAVE
OMNI MMCX AND 1/2 WAVE OMNI RPSMA
ANTENNAS

FCC ID:
S28-WCAMODHEL

Company:
CORONIS SYSTEMS

DISTRIBUTION: Mr RAMI

Company: CORONIS SYSTEMS

Number of pages: 30 including 2 annexes

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PRODUCT: WAVECARD MODULE WITH 1/4 WAVE OMNI MMCX
AND 1/2 WAVE OMNI RPSMA ANTENNAS

Reference / model: module: 915 MHz 25 mW
¼ wave antenna: ANT-916-WRT
½ wave antenna: AXQ/AXH

Serial number: not communicated

MANUFACTURER: not communicated

COMPANY SUBMITTING THE PRODUCT:

Company: CORONIS SYSTEMS

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Responsible: Mr RAMI

DATE(S) OF TEST: 12, 13 and 14 April 2010

TESTING LOCATION: EMITECH ATLANTIQUE laboratory at ANGERS (49) FRANCE
EMITECH ATLANTIQUE open area test site in LA POUEZE (49)
FRANCE
FCC Registration Number: 101696/FRN: 0006 6490 08

TESTED BY: L. BERTHAUD

CONTENTS

TITLE	PAGE
1. INTRODUCTION.....	4
2. PRODUCT DESCRIPTION	4
3. NORMATIVE REFERENCE.....	5
4. TEST METHODOLOGY	5
5. ADD ATTACHMENTS FILES	5
6. TESTS AND CONCLUSIONS	6
6.1 intentional radiator (subpart C)	6
6.2 unintentional radiator (subpart B)	7
7. MAXIMUM PEAK OUTPUT POWER	8
8. INTENTIONAL RADIATOR	10
9. BAND EDGE COMPLIANCE	13
CURVE N°: 1.....	15
CURVE N°: 2.....	16
CURVE N°: 3.....	17
CURVE N°: 4.....	18
CURVE N°: 5.....	20
CURVE N°: 6.....	21
CURVE N°: 7.....	22
CURVE N°: 8.....	23
10. RADIATED EMISSION LIMITS.....	24
ANNEX 1: PHOTOS OF THE EQUIPMENT UNDER TEST	27
ANNEX 2: TEST SET UP AND OPEN AREA TEST SITE	29

1. INTRODUCTION

This document presents the result of RADIO test carried out on the following equipment: WAVECARD MODULE WITH 1/4 WAVE OMNI MMCX AND 1/2 WAVE OMNI RPSMA ANTENNAS in accordance with normative reference.

2. PRODUCT DESCRIPTION

Class: B (residential environment)

Utilization: module used in general telemetry application

Antenna type: ¼ wave omni MMCX / ½ wave omni RP SMA

Operating frequency range: from 907.0272 MHz to 921.3696 MHz

Number of channels: 51

Channel spacing: 210 kHz

Frequency generation: ☒ SAW Resonator ☐ Crystal ☒ Synthesizer

Modulation: Frequency Hopping Spread Spectrum
☒ Amplitude ☐ Digital ☒ Frequency ☐ Phase

Power source: from 3.3 Vd.c to 6 Vd.c

Power level, frequency range and channels characteristics are not user adjustable.

The details pictures of the product and the circuit boards are joined with this file.

3. NORMATIVE REFERENCE

The standards and testing methods related throughout this report are those listed below. They are applied on the whole test report even though the extensions (version, date and amendment) are not repeated.

FCC Part 15 (2009)	Code of Federal Regulations Title 47 – Telecommunication Chapter 1 – Federal Communications Commission Part 15 – Radio frequency devices Subpart C – Intentional Radiators
ANSI C63.4 (2003)	Methods of Measurement of Radio-Noise Emissions from Low-voltage Electrical and Electronics Equipment in the range of 9 kHz to 40 GHz.
Public Notice DA 00-705	Filing and Measurement Guideline for Frequency Hopping Spread Spectrum Systems.

4. 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 107: conducted limits
- Paragraph 109: radiated emission limits
- Paragraph 111: antenna power conducted limits for receivers
- 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 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz

5. ADD ATTACHMENTS FILES

- “Synoptic “***
- “Block diagram “***
- “External photos and Product labeling “***
- “Assembly of components “***
- “Internal photos “***
- “Layout pcb “***
- “Bil of materials “***
- “Schematics “***
- “Product description “***
- “User guide “***

6. TESTS AND CONCLUSIONS

6.1 intentional radiator (subpart C)

Test procedure	Description of test	Respected criteria?				Comment
		Yes	No	NAp	NAs	
FCC Part 15.203	ANTENNA REQUIREMENT	X				Note 1
FCC Part 15.205	RESTRICTED BANDS OF OPERATION	X				
FCC Part 15.207	CONDUCTED LIMITS			X		
FCC Part 15.209	RADIATED EMISSION LIMITS; general requirements	X				Note 2
FCC Part 15.247	OPERATION WITHIN THE BAND 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz					
	(a) (1) <i>hopping systems</i>				X	Note 3
	(a) (1) (i) 902 – 928 MHz				X	Note 3
	(a) (1) (ii) 5725 – 5850 MHz			X		
	(a) (1) (iii) 2400 – 2483.5 MHz			X		
	(a) (2) <i>digital modulation techniques</i>			X		
	(b) <i>maximum peak output power</i>	X				
	(c) <i>operation with directional antenna gains > 6 dBi</i>			X		Note 4
	(d) <i>intentional radiator</i>	X				
	(e) <i>peak power spectral density</i>			X		
	(f) <i>hybrid system</i>			X		
	(g) <i>frequency hopping requirements</i>			X		
	(h) <i>frequency hopping intelligence</i>			X		
	(i) <i>RF exposure compliance</i>			X		Note 5
DA 00-705	BAND EDGE COMPLIANCE	X				

NAp: Not Applicable

NAs: Not Asked

Note 1: professionally installed equipment.

Note 2: see FCC part 15.247 (d).

Note 3: permissive change.

Note 4: antenna gains < 6 dBi (declared by the applicant).

Note 5: 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).

6.2 unintentional radiator (subpart B)

Test procedure	Description of test	Respected criteria?				Comment
		Yes	No	NAp	NAs	
FCC Part 15.107	CONDUCTED LIMITS			X		
FCC Part 15.109	RADIATED EMISSION LIMITS	X				
FCC Part 15.111	ANTENNA POWER CONDUCTED LIMITS FOR RECEIVER			X		

NAp: Not Applicable

NAs: Not Asked

Conclusion:

The sample of WAVECARD MODULE WITH 1/4 WAVE OMNI MMCX AND 1/2 WAVE OMNI RPSMA ANTENNAS submitted to the tests complies with the regulations of the standard FCC Part 15 in accordance with the limits or criteria defined in this report.

7. MAXIMUM PEAK OUTPUT POWER

Standard: FCC Part 15

Test procedure: paragraph 15.247

Test equipments:

TYPE	BRAND	EMITECH NUMBER
Spectrum analyzer FSP 40	Rohde & Schwarz	4088
Power source E3610A	Hewlett Packard	4195
Meteo station	Oregon scientific	1539
Power sensor 80401A	Gigatronics	3182
Power meter 8541B	Gigatronics	3479

Test set up:

The measure is realized in conducted mode with a calibrated power meter.

Equipment under test operating condition:

The equipment under test is blocked in continuous transmission mode, modulated by internal data signal, at the highest output power level which the transmitter is intended to operate.

Results:

Ambient temperature (°C): 17.5

Relative humidity (%): 63

Power source: 4.5 Vd.c

Sample n° 1 Channel F1 (907.0272 MHz)

	Level dBm	P (W)	Limit(W)
Normal test conditions	+10.8	12×10^{-3}	1

Power change compared to previous version: -1.6 dB

Channel F2 (913.9392 MHz)

	Level dBm	P (W)	Limit(W)
Normal test conditions	+10.6	11.5×10^{-3}	1

Power change compared to previous version: -1.2 dB

Channel F3 (921.3696 MHz)

	Level dBm	P (W)	Limit(W)
Normal test conditions	+10.2	10.5×10^{-3}	1

Power change compared to previous version: -1.9 dB

Test conclusion:

RESPECTED STANDARD

8. INTENTIONAL RADIATOR

Standard: FCC Part 15

Test procedure: paragraph 15.205
paragraph 15.209
paragraph 15.247

Test equipments:

TYPE	BRAND	EMITECH NUMBER
Test receiver ESH3	Rohde & Schwarz	1058
Test receiver ESVS 10	Rohde & Schwarz	1219
Spectrum analyzer FSP 40	Rohde & Schwarz	4088
Loop antenna	EMCO	1406
Biconical antenna HP 11966C	Hewlett Packard	0728
Log periodic antenna HL 223	Rohde & Schwarz	1999
Open site	Emitech	1274
Antenna RGA-60	Electrometrics	1204
Low-noise amplifier 2 to 18 GHz	Microwave DB	1922
High pass filter HP12/3200-5AA	Filtek	
Power source E3610A	Hewlett Packard	4195
Meteo station AB 888	Oregon scientific	1539

Test set up:

The system is tested in an open area test site (OATS).

The test unit is placed on a rotating table, 0.8 m from a ground plane. Zero degree azimuth corresponds to the front of the equipment under test.

Frequency range: from 9 kHz to harmonic 10 ($F_{\text{carrier}} \leq 10 \text{ GHz}$)

Bandwidth: 120 kHz ($F < 1 \text{ GHz}$) or 100 kHz, following 15.205 or 15.247
1 MHz ($F > 1 \text{ GHz}$) or 100 kHz, following 15.205 or 15.247

Distance of antenna: between 30 m and 3 m according the frequencies and the limits.

Antenna height: 1 to 4 meters

Antenna polarization: vertical and horizontal, only the highest level is recorded.

Equipment under test operating condition:

The equipment under test is blocked in continuous transmission mode, modulated by internal data signal, at the highest output power level which the transmitter is intended to operate.

Results:

Ambient temperature (°C): 17.5

Relative humidity (%): 63

Power source: 4.5 Vd.c

The polarity column refers to the antenna polarity at which the maximum emissions level is measured.

Sample N°1 ¼ wave omni MMCX antenna

Channel F1 (907.0272 MHz)

FREQUENCIES (MHz)	Detector P: Peak QP: Quasi-Peak Av: Average	Antenna height (cm)	Azimuth (degree)	resolution bandwidth (kHz)	Polarization H: Horizontal V: Vertical	Field strength (dBµV/m)	Limits (dBµV/m)	Margin (dB)
1814	P	110	275	100	V	71.3	84.4	13.1

Channel F2 (913.9392 MHz)

FREQUENCIES (MHz)	Detector P: Peak QP: Quasi-Peak Av: Average	Antenna height (cm)	Azimuth (degree)	resolution bandwidth (kHz)	Polarization H: Horizontal V: Vertical	Field strength (dBµV/m)	Limits (dBµV/m)	Margin (dB)
1827.9	P	110	275	100	V	71.5	84.4	12.9

Channel F3 (921.3696 MHz)

FREQUENCIES (MHz)	Detector P: Peak QP: Quasi-Peak Av: Average	Antenna height (cm)	Azimuth (degree)	resolution bandwidth (kHz)	Polarization H: Horizontal V: Vertical	Field strength (dBµV/m)	Limits (dBµV/m)	Margin (dB)
1842.7	P	110	275	100	V	71.4	84.4	13

Sample N°1 ½ wave omni RP SMA antenna

Channel F1

FREQUENCIES (MHz)	Detector P: Peak QP: Quasi-Peak Av: Average	Antenna height (cm)	Azimuth (degree)	resolution bandwidth (kHz)	Polarization H: Horizontal V: Vertical	Field strength (dBµV/m)	Limits (dBµV/m)	Margin (dB)
1814	P	100	305	100	V	72.4	87.9	15.5

Channel F2

FREQUENCIES (MHz)	Detector P: Peak QP: Quasi-Peak Av: Average	Antenna height (cm)	Azimuth (degree)	resolution bandwidth (kHz)	Polarization H: Horizontal V: Vertical	Field strength (dBµV/m)	Limits (dBµV/m)	Margin (dB)
1827.9	P	100	305	100	V	72.5	87.9	15.4

Channel F3

FREQUENCIES (MHz)	Detector P: Peak QP: Quasi-Peak Av: Average	Antenna height (cm)	Azimuth (degree)	resolution bandwidth (kHz)	Polarization H: Horizontal V: Vertical	Field strength (dBµV/m)	Limits (dBµV/m)	Margin (dB)
1842.7	P	100	305	100	V	72.7	87.9	15.2

Note: any spurious which has more than 20 dB of margin compared to the applicable limit is not necessarily reported.

Applicable limits: In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.

The highest level recorded in a 100 kHz bandwidth is 104.4 dBµV/m on channel F3 (1/4 wave antenna) and 107.9 dBµV/m on channel F3 (1/2 wave antenna).

So the applicable limits are 84.4 dBµV/m (1/4 wave antenna) and 87.9 dBµV/m (1/2 wave antenna).

In addition, radiated emissions which fall in the restricted band, as defined in section 15.205 (a), must also comply with the radiated emission limits specified in section 15.209 (a) (see section 15.205 (c)).

Test conclusion:

RESPECTED STANDARD

9. BAND EDGE COMPLIANCE

Standard: FCC Part 15.247

Test procedure: Public Notice DA 00-705, Delta Marker method

Test equipments:

TYPE	MANUFACTURER	EMITECH NUMBER
Spectrum analyzer FSP 40	Rohde & Schwarz	4088
Antenna RGA-60	Electrometrics	1204
Power source E3610A	Hewlett Packard	4195

Test set up:

Test realized in near field. All field strength measurements are correlated with the radiated maximum peak output power

Test operating condition of the equipment:

The equipment is blocked in frequency hopping mode.

Results:

Lower Band Edge: from 900 MHz to 902 MHz

Upper Band Edge: from 928 MHz to 930 MHz

Sample n°1: ¼ wave omni MMCX antenna

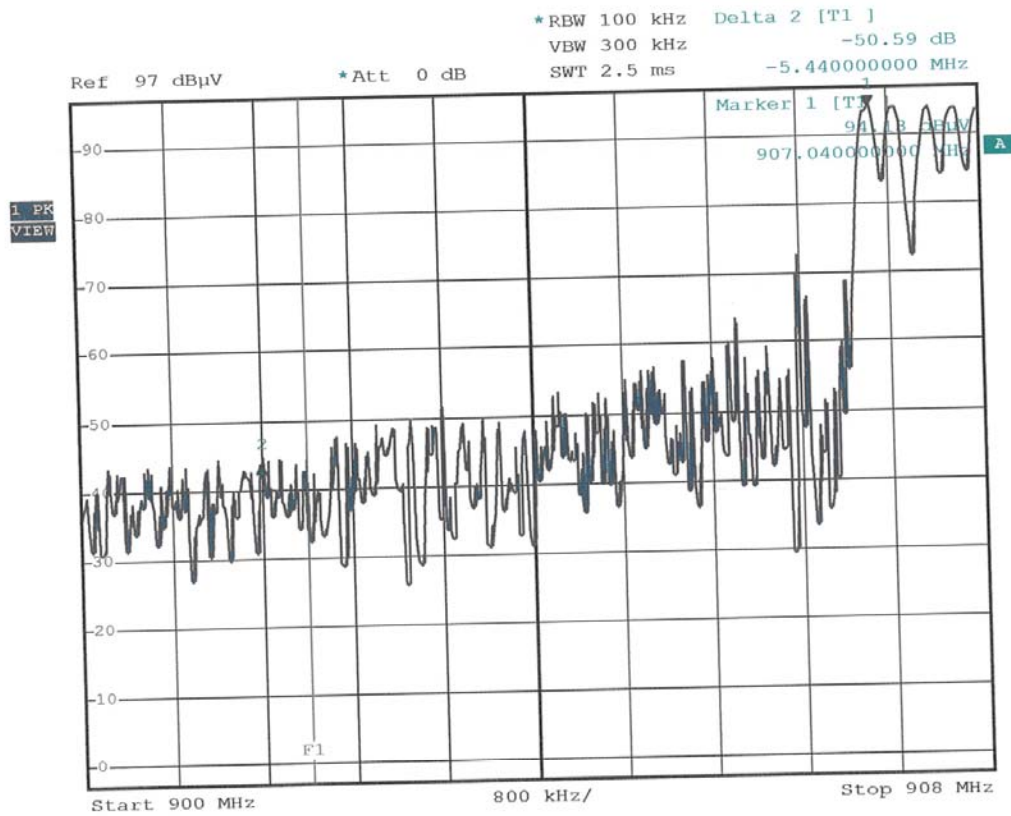
Fundamental frequency (MHz)	Field Strength Level of fundamental (dBµV/m)	Detector (Peak or Average)	Frequency of maximum Band-edges Emission (MHz)	Delta Marker (dB)*	Calculated Max Out of Band Emission Level (dBµV/m)**	Limit (dBµV/m)	Margin (dB)
907.0272	104.4	Peak	901.6	-50.6	53.8	74	20.2
907.0272	90.4	Average	901.28	-64.3	26.1	54	27.9
921.3696	104.3	Peak	928.236	-45.4	58.9	74	15.1
921.3696	90.3	Average	928.038	-61.9	28.4	54	25.6

* according to step 2 of Marker-Delta Method DA 00-705.

** according to step 3 of Marker-Delta Method:

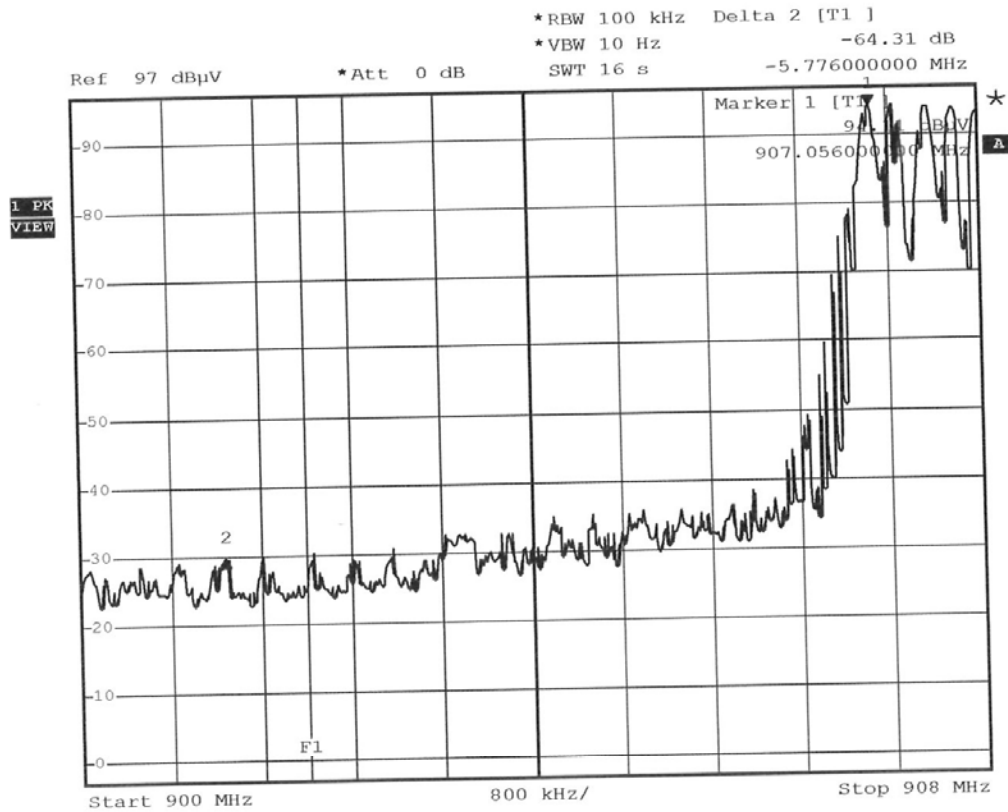
Calculated Emission Level = Field Strength Level – Delta Marker Level

CURVE N°: 1.



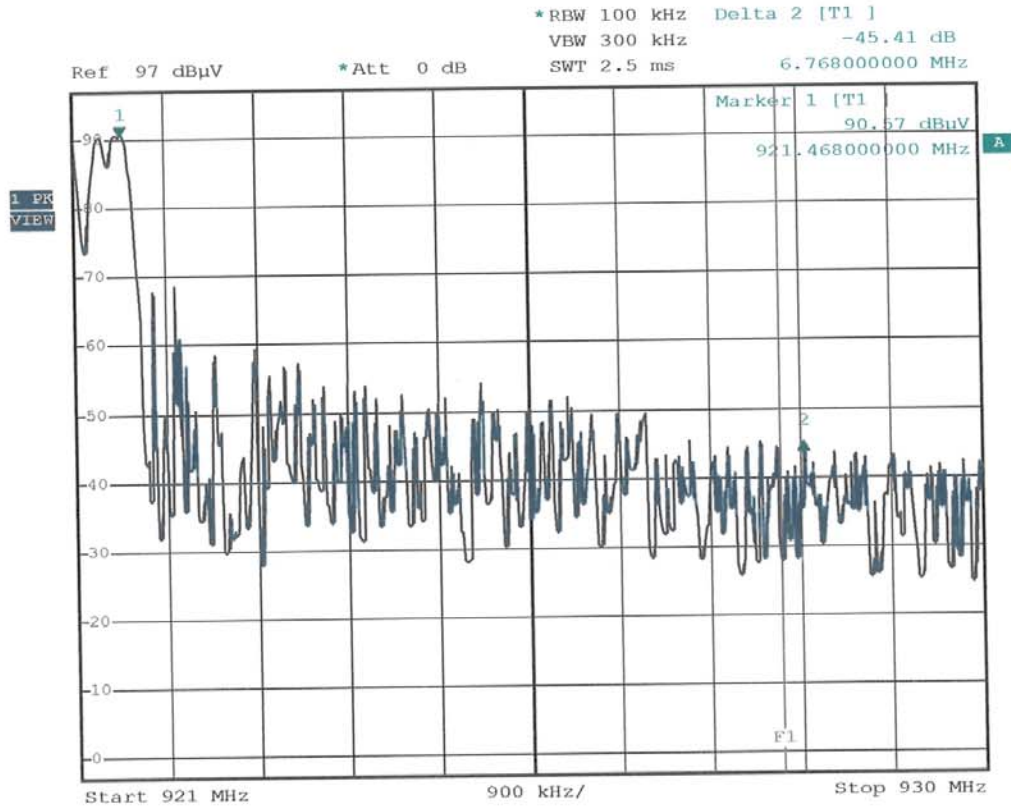
Date: 14.APR.2010 09:11:02

CURVE N°: 2.



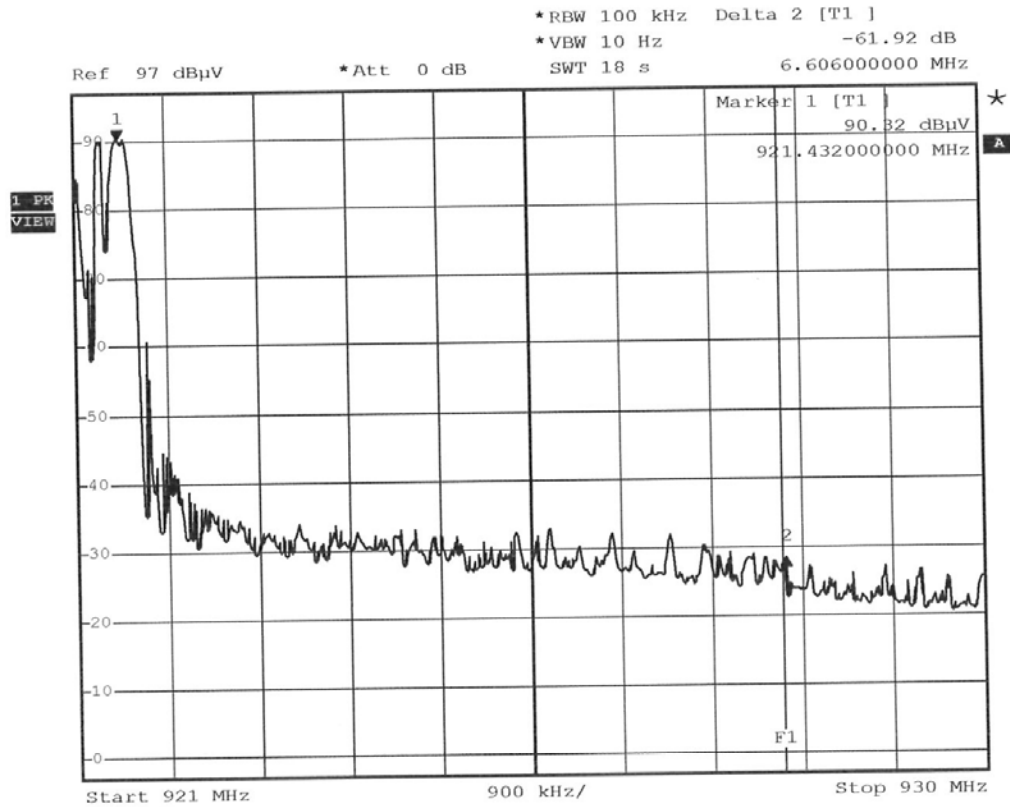
Date: 14.APR.2010 09:32:49

CURVE N°: 3.



Date: 14.APR.2010 09:25:12

CURVE N°: 4.



Date: 14.APR.2010 09:31:12

Sample n°1: ½ wave omni RP SMA antenna

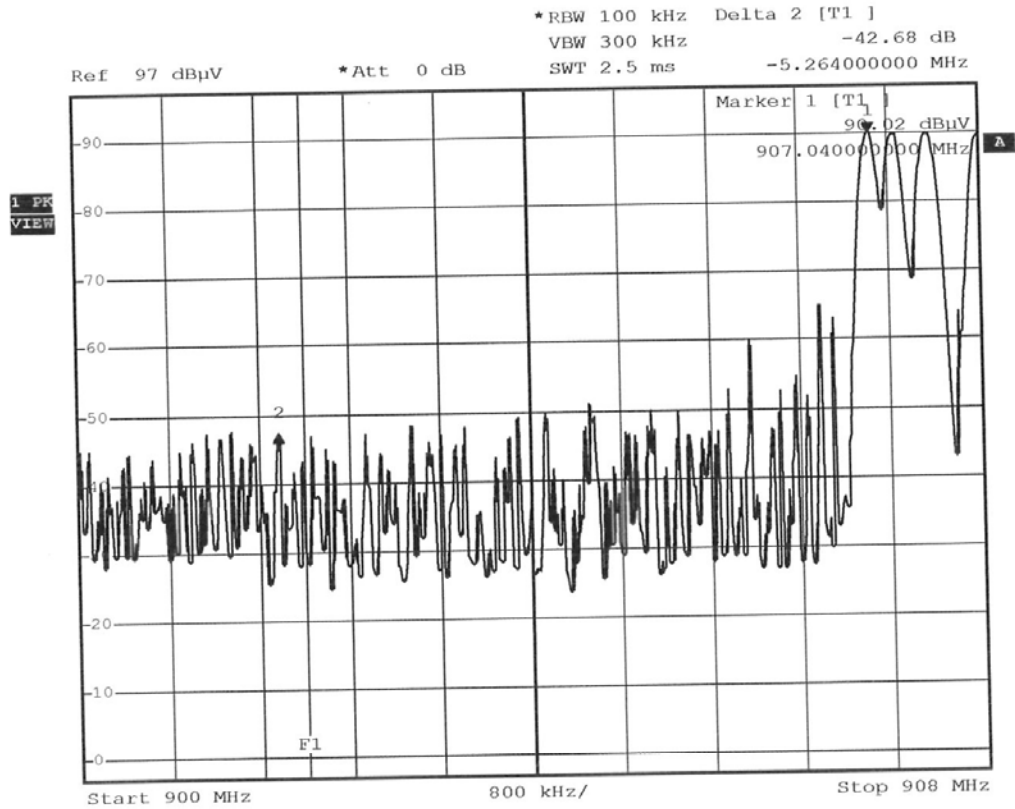
Fundamental frequency (MHz)	Field Strength Level of fundamental (dBµV/m)	Detector (Peak or Average)	Frequency of maximum Band-edges Emission (MHz)	Delta Marker (dB)*	Calculated Max Out of Band Emission Level (dBµV/m)**	Limit (dBµV/m)	Margin (dB)
907.0272	107.6	Peak	901.776	-42.7	64.9	74	9.1
907.0272	93.6	Average	900.512	-58.7	34.9	54	19.1
921.3696	107.9	Peak	928.164	-48.6	59.3	74	14.7
921.3696	93	Average	928.02	-65.9	28	54	26

* according to step 2 of Marker-Delta Method DA 00-705.

** according to step 3 of Marker-Delta Method:

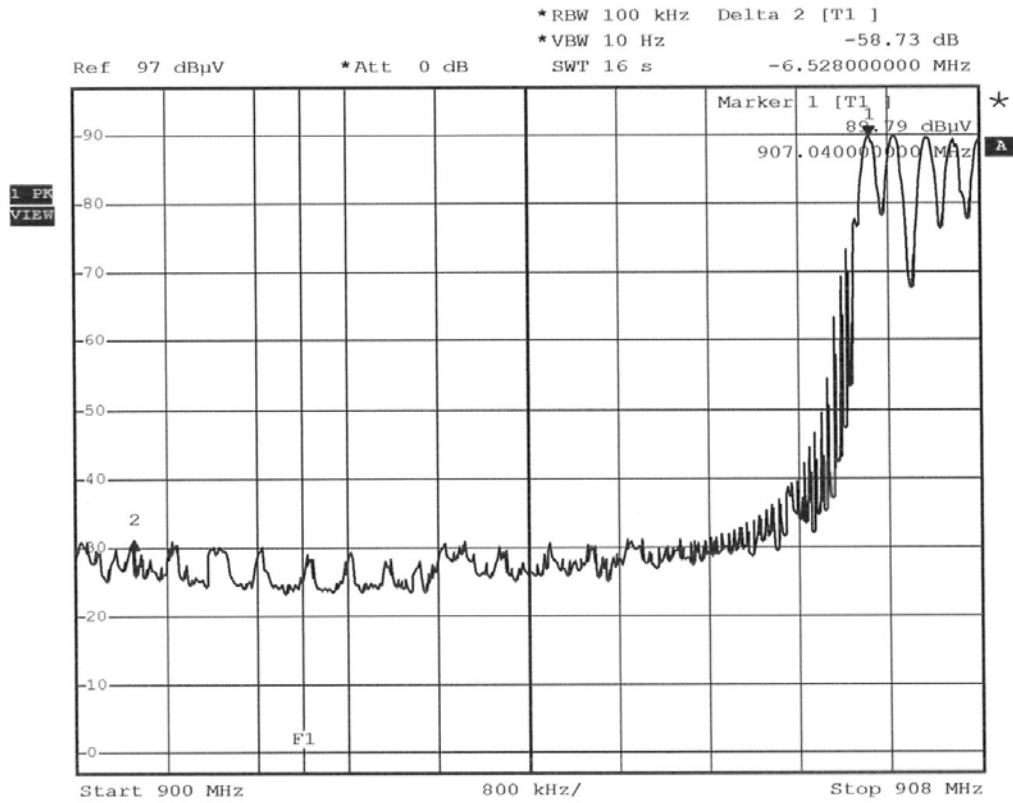
Calculated Emission Level = Field Strength Level – Delta Marker Level

CURVE N°: 5.



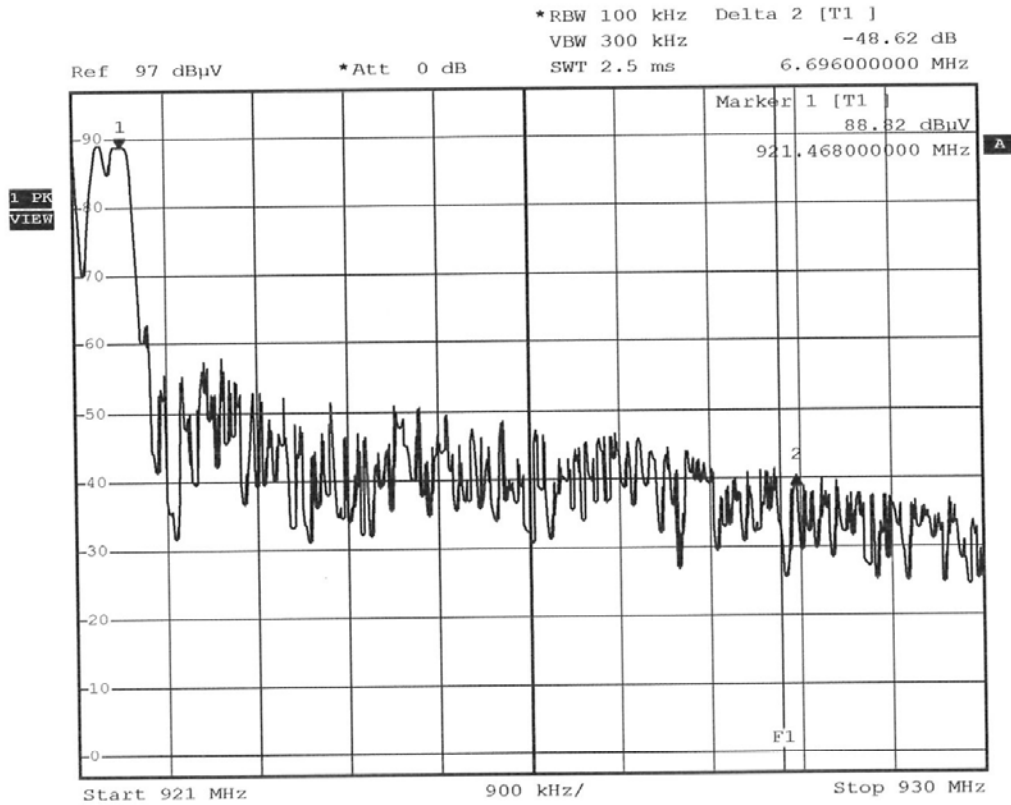
Date: 14.APR.2010 09:36:31

CURVE N°: 6.



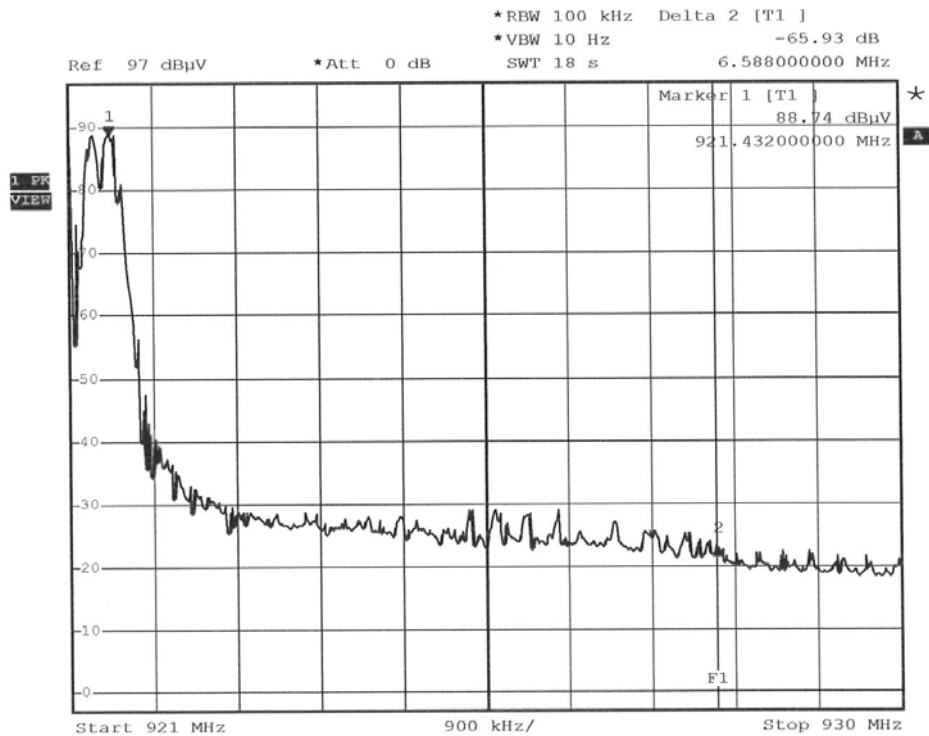
Date: 14.APR.2010 09:37:46

CURVE Nº: 7.



Date: 14.APR.2010 09:39:48

CURVE N°: 8.



Date: 14.APR.2010 09:40:57

Test conclusion:

RESPECTED PUBLIC NOTICE

10. RADIATED EMISSION LIMITS

Standard: FCC Part 15

Test procedure: paragraph 109

Limit class: Class B

Standard deviation: For $F > 1\text{GHz}$, the measurement is carried out at 3 m, instead of 10 m

Test equipments:

TYPE	BRAND	EMITECH NUMBER
Test receiver	Rohde & Schwarz ESVS 10	1219
Biconical antenna	Hewlett Packard 11966 C	0728
Log periodic antenna	Rohde & Schwarz HL 223	1999
Double ridged guide antenna	Electrometrics EM 6961	1204
Spectrum analyzer	Rohde & Schwarz FSP40	4088
Open area test site	EMITECH	1274
Preamplifier 1 to 18 GHz	DBS Microwave DB97-1852	2648
High pass filter	Micro-tronics HPM11630	1673
Power source	Hewlett Packard E3610A	1495

Test set up:

The system is tested in an open area test site (OATS).

The test unit is placed on a rotating table, 0.8 m from a ground plane. Zero degree azimuths correspond to the front of the equipment under test.

Frequency range: The highest frequency generated in the device is $f = 921.3696\text{ MHz}$
According the Sec.15.33 of the FCC Part 15 standard, the frequency range measured is indicated in the following table:

For unintentional radiator, including a digital device (Sec.15.33, §(b)(1) of the FCC Part 15 standard) :

Highest frequency generated or used in the device or on which the device operates or tunes (MHz)	Upper frequency of measurement range (MHz)
Below 1.705	30
1.705 – 108	1000
108 – 500	2000
500 – 1000	5000
Above 1000	5 th harmonic of the highest frequency or 40 GHz, whichever is lower

Detection mode: Quasi-peak ($F < 1 \text{ GHz}$)
Average ($F > 1 \text{ GHz}$)

Bandwidth: 120 kHz ($F < 1 \text{ GHz}$)
1 MHz ($F > 1 \text{ GHz}$)

Distance of antenna: 3 meters

Antenna height: 1 to 4 meters

Antenna polarization: vertical and horizontal (only the highest level is recorded)

Equipment under test operating condition:

The equipment is blocked in continuous reception/standby mode.

Results:

Ambient temperature (°C):	17.5
Relative humidity (%):	63

Power source: 4.5 Vd.c

Not any spurious has been detected.

Note: any spurious which has more than 20 dB of margin compared to the applicable limit is not necessarily reported.

Test conclusion:

RESPECTED STANDARD

□□□ End of report, 2 annexes to be forwarded □□□

ANNEX 1: PHOTOS OF THE EQUIPMENT UNDER TEST

GENERAL VIEW FACE 1



GENERAL VIEW FACE 2



¼ WAVE OMNI MMCX ANTENNA



½ WAVE OMNI RP SMA ANTENNA



ANNEX 2: TEST SET UP AND OPEN AREA TEST SITE

RADIATED MEASUREMENTS



OPEN AREA TEST SITE

