RA-24-07104211-1/A Ed. 0

FCC CERTIFICATION
RADIO Measurement
Technical Report

standard to apply:
FCC Part 15.247

Equipment under test:
WAVECARD MODULE WITH HELICAL ANTENNA

FCC ID :
S28-WCAMODHEL

Company:
CORONIS SYSTEMS

DISTRIBUTION: Mr BEKKOUCH **Company: CORONIS SYSTEMS**

Number of pages: 30 including 5 annexes

Ed.	Date	Modified pages	Written by Name	Written by Visa	Technical Verification Quality Approval Name	Technical Verification Quality Approval Visa
0	18-Feb-08	Creation	M. DUMESNIL	M. D.	P. BONNENFANT	

Duplication of this test report is only permitted for an integral photographic facsimile. It includes the number of pages referenced here above.

This document is the result of testing a specimen or a sample of the product submitted. It does not imply an assessment of the conformity of the whole manufactured products of the tested sample.

PRODUCT:	**WAVECARD MODULE WITH HELICAL ANTENNA**
Reference / model:	915MHz 25mW
Serial number:	not communicated
Address radio:	0110560014C
MANUFACTURER:	not communicated

COMPANY SUBMITTING THE PRODUCT:

Company:	CORONIS SYSTEMS
Address:	Le Millénaire 290, rue Alfred Nobel 34000 MONTPELLIER FRANCE
Responsible:	Mr BEKKOUCH
DATE(S) OF TEST:	21 and 24 November 2007
TESTING LOCATION:	EMITECH ATLANTIQUE laboratory at ANGERS (49) FRANCE EMITECH ATLANTIQUE open area test site in LA POUEZE (49) FRANCE Registration Number by FCC: 101696/FRN: 0006 6490 08
TESTED BY:	M. DUMESNIL
TUTOR:	P. BONNENFANT

CONTENTS

TITLE **PAGE**

1. INTRODUCTION

This document presents the result of RADIO test carried out on the following equipment: WAVECARD MODULE WITH HELICAL ANTENNA 915 MHz in accordance with normative reference.

2. PRODUCT DESCRIPTION

Class: A (industrial)

Utilization: Module used in general telemetry application to transfer information from sensors using a radio frequency communication link.

Antenna type: incorporated antenna

Operating frequency range: from 907.0272 MHz to 921.3696 MHz

Number of channels: 51

Channel spacing: 210 kHz

Frequency generation: O SAW Resonator O Crystal ⊙ Synthesizer

Modulation: Frequency Hopping Spread Spectrum (FHSS)
O Amplitude O Digital ⊙ Frequency O 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 (2006)	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 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

Test procedure	Description of test	Criteria respected ?				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) *hopping systems*	X				*Note 3*
	(a) (1) (i) 902 – 928 MHz	X				*Note 4*
	(a) (1) (ii) 5725 – 5850 MHz			X		
	(a) (1) (iii) 2400 – 2483.5 MHz			X		
	(a) (2) *digital modulation techniques*			X		
	(b) *max output power*	X				*Note 5*
	(c) *operation with directional antenna gains > 6 dBi*			X		*Note 6*
	(d) *intentional radiator*	X				
	(e) *peak power spectral density*			X		
	(f) *hybrid system*			X		
	(g)	X				
	(h)	X				
	(i) *RF exposure compliance*	X				*Note 7*
DA 00-705	BAND EDGE COMPLIANCE	X				

NAp: Not Applicable NAs: Not Asked

Note 1: internal antenna (pcb antenna), see photos in annex 4.

Note 2: see FCC part 15.247 (d).

Note 3: the system hops to channel frequencies from a pseudo randomly ordered list of hopping frequencies. Each frequency is used equally on the average by the transmitter, and separated by a minimum of 20 dB bandwidth of the hopping channel (50.6 kHz; see annex 1).

Note 4: the 20 dB bandwidth of the hopping channel is less than 250 kHz and the frequency hopping systems uses 51 channels (see annex 3).
The timing by channel is 1280 µs. During 20 s, any channel is used 232 times, then 232 x 1280 µs = 296.96 ms, thus the average time of occupancy on any channel is less than 400 ms within a 20 s period (see annex 2).

Note 5: conducted measurement is not possible (integral antenna), so we used the radiated method in open field.

Note 6: the antenna gain is less than 6 dBi.

Note 7: 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).

Conclusion:

The sample of WAVECARD MODULE WITH HELICAL ANTENNA 915 MHz 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. PEAK OUTPUT POWER

Standard: FCC Part 15

Test procedure: paragraph 15.247

Test equipment:

TYPE	BRAND	EMITECH NUMBER
Spectrum analyzer FSP 40	Rohde & Schwarz	4088
Open site	EMITECH	1274
Radio frequency generator SME06	Rohde & Schwarz	1669
Power source E3610A	Hewlett Packard	4195
Multimeter 77-2	Fluke	0812
Log periodic antenna HL223	Rohde & Schwarz	1999

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.
The measuring distance between the equipment and the test antenna is 3 m. The test antenna has been oriented in the two polarizations, we have recorded only the highest level.

Then a measurement of the electro-magnetic field is realized, with a resolution bandwidth adjusted at 100 kHz and a video bandwidth adjusted at 300 kHz.

The equipment has been tested in two positions: with its antenna in vertical position and in horizontal position.
Only the highest level has been recorded.

Distance of antenna: 3 meters

Antenna height: 1 to 4 meters

Antenna polarization: vertical and horizontal

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): 15
Relative humidity (%): 74

Power source: 4.65 Vd.c.

Polarization of test antenna: vertical (height: 142 cm)
Position of equipment: to put flat (azimuth: 97 degrees), (highest level radiated)

Sample n° 1 Channel F1 = 907.0272 MHz

		Level recorded (dBµV/m)	**P* (W)**	**Limit (W)**
Normal test conditions	Nominal power source (V): 4.65	97.6	1.73×10^{-3}	1

Sample n° 1 Channel F2 = 913.9392 MHz

		Level recorded (dBµV/m)	**P* (W)**	**Limit (W)**
Normal test conditions	Nominal power source (V): 4.65	97	1.51×10^{-3}	1

Sample n° 1 Channel F3 = 921.3696 MHz

		Level recorded (dBµV/m)	**P* (W)**	**Limit (W)**
Normal test conditions	Nominal power source (V): 4.65	97.3	1.61×10^{-3}	1

* $P = (E \times d)^2 / (30 \times Gp)$ with d = 3 m and Gp = 1

Test conclusion:

RESPECTED STANDARD

8. RADIATED EMISSION OF TRANSMITTER

Standard: FCC Part 15

Test procedure: paragraph 15.205
paragraph 15.209
paragraph 15.247

Test equipment:

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	728
Log periodic antenna HL 223	Rohde & Schwarz	1999
Open site	Emitech	1274
Antenna RGA-60	Electrometrics	1204
Low-noise amplifier 1 to 18 GHz	ALC	2648
High pass filter HPM11630	Microtronics	1673
Power source E3610A	Hewlett Packard	4195
Multimeter 77-2	Fluke	0812

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.
The equipment has been tested in two positions: with its antenna in vertical postion and in horizontal position.
Only the highest level has been recorded.

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

Bandwidth: 120 kHz (F < 1 GHz) or 100 kHz, following 15.205 or 15.247
1 MHz (F > 1 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): 18.5
Relative humidity (%): 71

Power source: 4.65 Vd.c.

The polarity column refers to the antenna polarity at which the maximum emissions level is measured.
Position of equipment: to put flat (highest level radiated).

Channel F1 = 907.0272 MHz

FREQUENCIES (MHz)	Detector QP: Quasi-Peak Avg: Average Pk: Peak	Antenna height (cm)	Azimuth (degree)	resolution bandwidth (kHz)	Polarization H: Horizontal V: Vertical	Field strength (dBµV/m)	Limits (dBµV/m)	Margin (dB)
792.752	QP	100	197	120	H	37.7	70.39	32.69
1021.307	Avg	100	196	1000	H	36.46	53.98*	17.52
1021.307	Pk	100	196	1000	H	46.93	73.98*	27.05
1814.048	Pk	108	0	100	V	38.88	70.39	31.31

Channel F2 = 913.9392 MHz

FREQUENCIES (MHz)	Detector QP: Quasi-Peak Avg: Average Pk: Peak	Antenna height (cm)	Azimuth (degree)	resolution bandwidth (kHz)	Polarization H: Horizontal V: Vertical	Field strength (dBµV/m)	Limits (dBµV/m)	Margin (dB)
799.667	QP	100	194	120	H	39.4	70.39	30.99
1028.219	Avg	100	204	1000	H	37.5	53.98*	16.48
1028.219	Pk	100	204	1000	H	46.78	73.98*	27.20
1827.881	Pk	108	0	100	V	39.69	70.39	30.7

Channel F3 = 921.3696 MHz

FREQUENCIES (MHz)	Detector QP: Quasi-Peak Avg: Average Pk: Peak	Antenna height (cm)	Azimuth (degree)	resolution bandwidth (kHz)	Polarization H: Horizontal V: Vertical	Field strength (dBµV/m)	Limits (dBµV/m)	Margin (dB)
807.099	QP	100	196	120	H	39.4	70.39	30.99
1031.963	Avg	100	212	1000	H	30.55	53.98*	23.43
1031.963	Pk	100	212	1000	H	42.48	73.98*	31.50
1842.742	Pk	148	0	100	V	41.02	70.39	29.37

* restricted bands of operation.

Any spurious which has more than 20 dB margin compared to the limit is not necessarily recorded.

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 90.39 dBµV/m on channel F3 = 921.3696 MHz.
So the applicable limit is **70.39 dBµV/m**.
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 equipment used:

TYPE	MANUFACTURER	EMITECH NUMBER
Spectrum analyzer FSP 40	Rohde & Schwarz	4088
Antenna RGA-60	Electrometrics	1204
Alimentation E3610A	MP	4195
Multimeter 77-2	Fluke	0812

Measured condition:

Requirements: Emissions that fall in the restricted bands (part 15.205). These emissions must be less than or equal to 500 µV/m (54 dBµV/m)/ Part 15.35b applies in the restricted bands.

Test procedure: An in band field strength measurement of the fundamental Emission using the RBw and detector function required by C63.4-2003 and FCC Rules.

Test operating condition of the equipment:

The equipment is blocked in frequency hopping mode.

Results:

Lower Band Edge: from 608 MHz to 614 MHz, CURVE n° 1
Upper Band Edge: from 960 MHz to 1240 MHz, CURVE n° 2

Sample n°1:

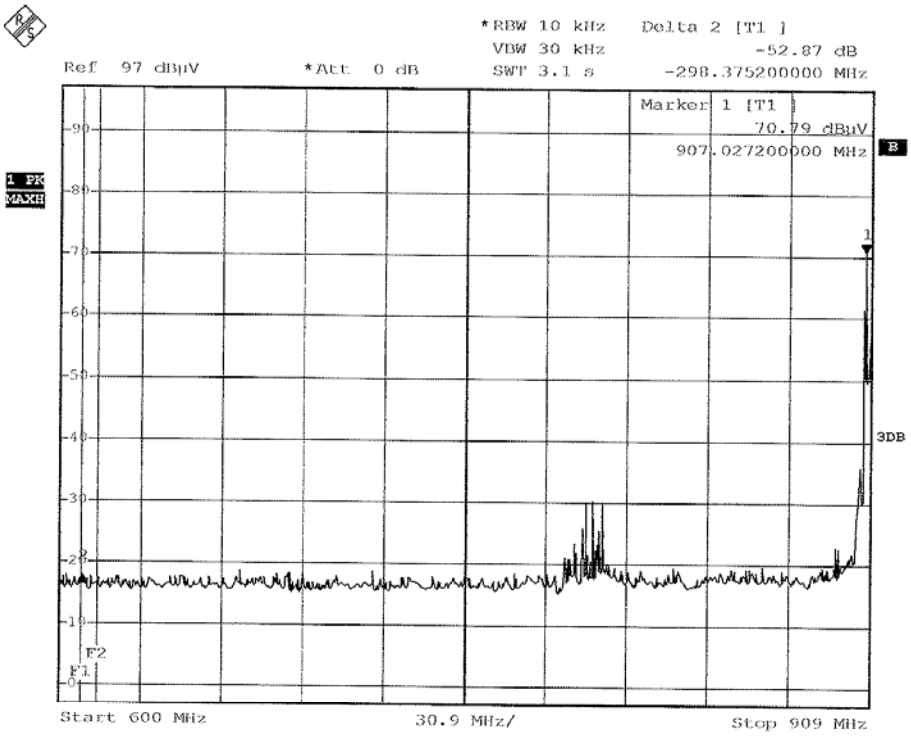
Fundamental frequency (MHz)	Field Strength Level of fundamental (dBµV/m)	Detector (Peak or Average)	Frequency of maximum Band-edges Emission (MHz)	Delta Marker (dB)*	Calculated Max Out of Band Emission Level (dBµV/m)**	Limit (dBµV/m)	Margin (dB)
907.0272	97.6	Peak	608.65	-52.87	44.73(1)	66.02	21.29
921.3696	97.3	Peak	1020.98	-49.21	48.09(1)	73.98	25.89

* 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
(1) the peak level is lower than the average limit.

Test conclusion:

RESPECTED PUBLIC NOTICE

CURVE N°: 1.



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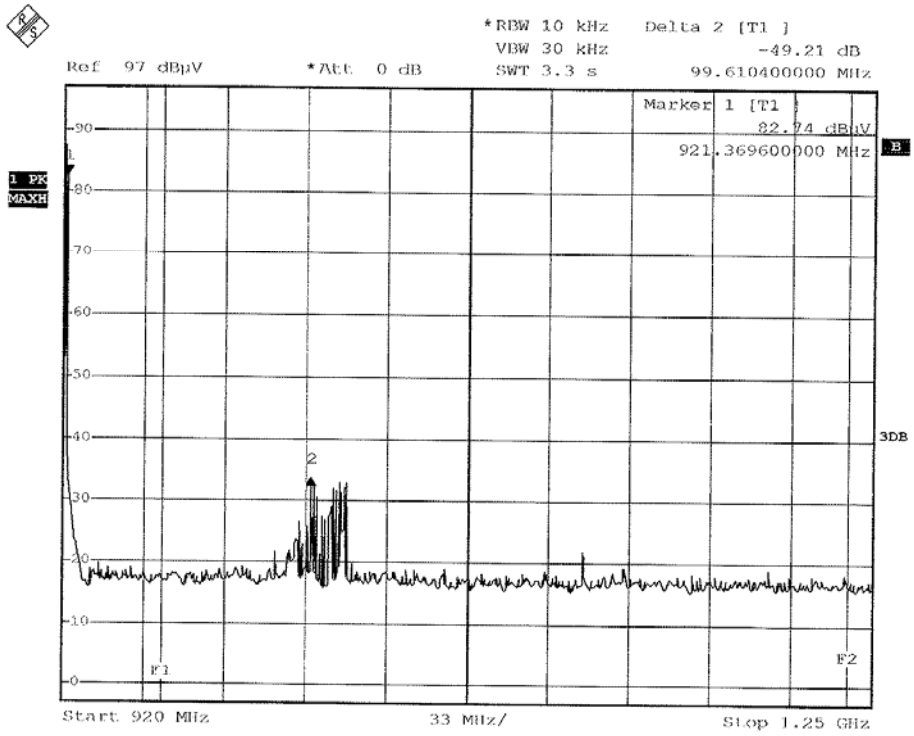
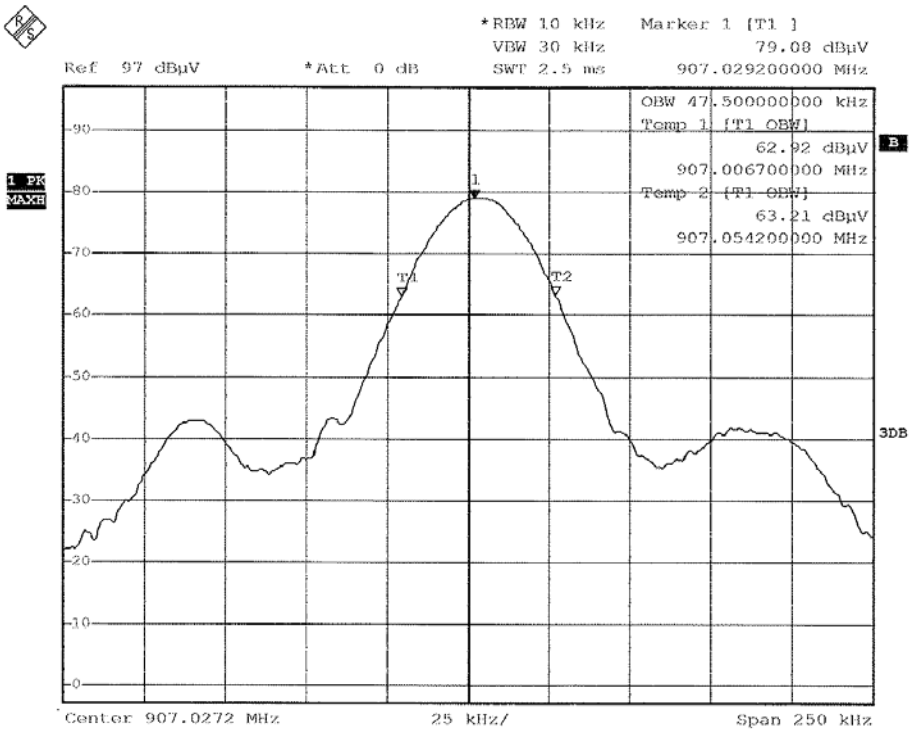
CURVE N°: 2.



Date: 7.MAY.2008 08:51:23

□□□ End of report, 5 annexes to be forwarded □□□

ANNEX 1: OCCUPIED POWER BANDWIDTH AND CHANNEL SEPARATION



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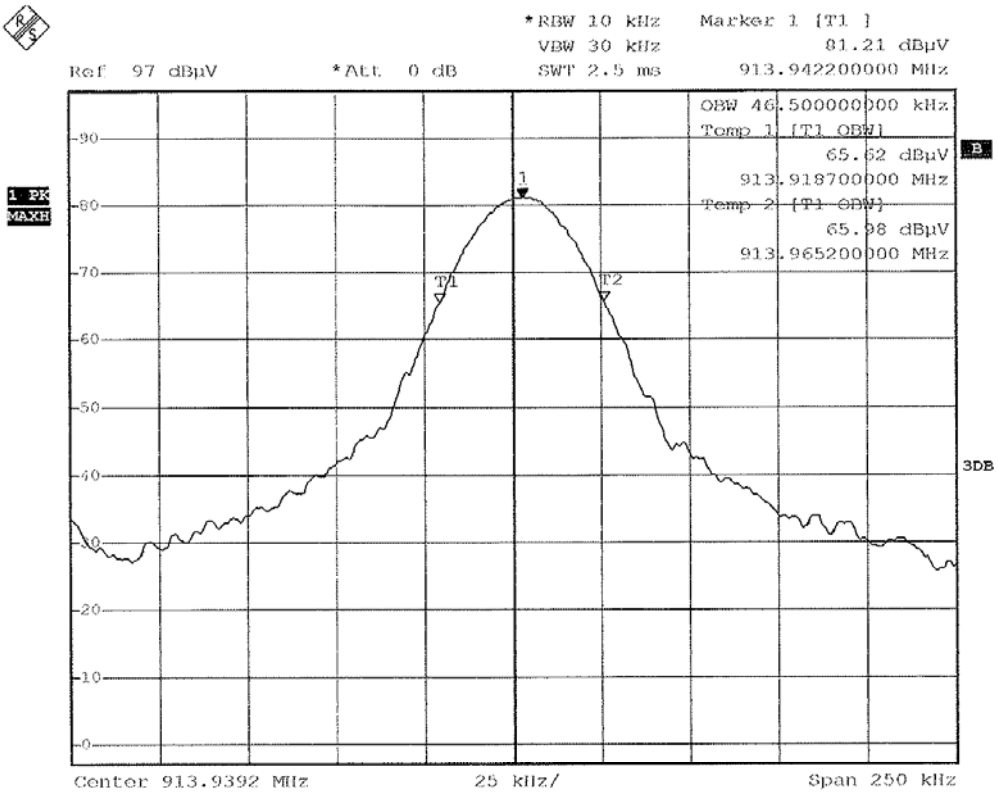

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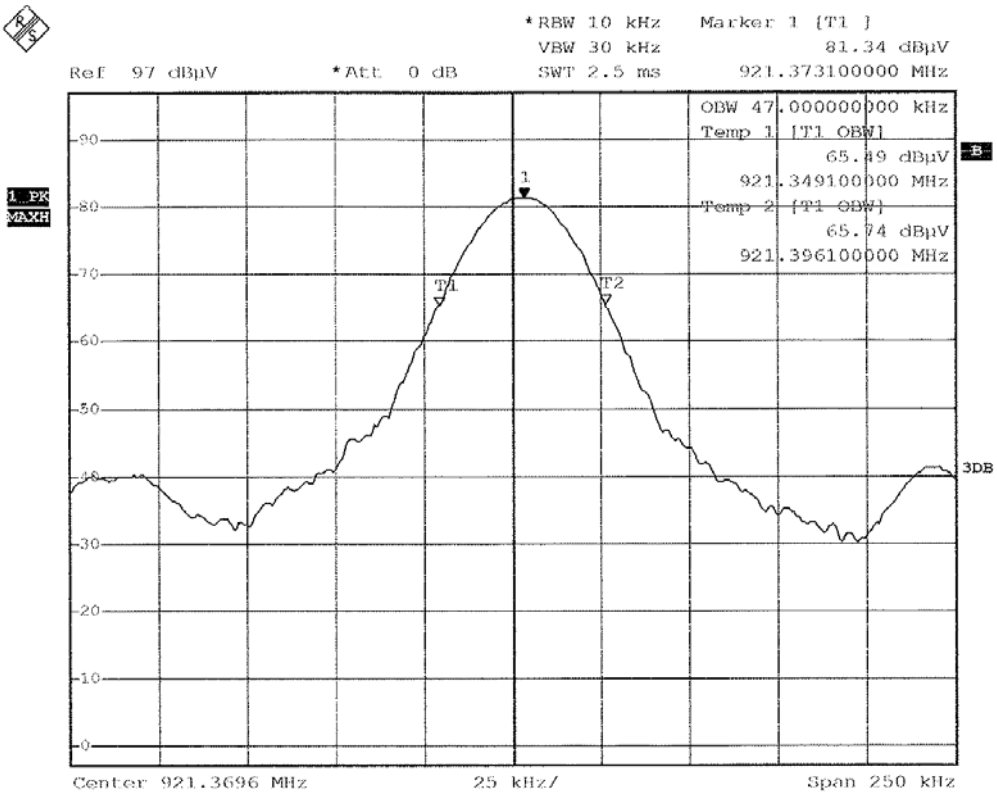

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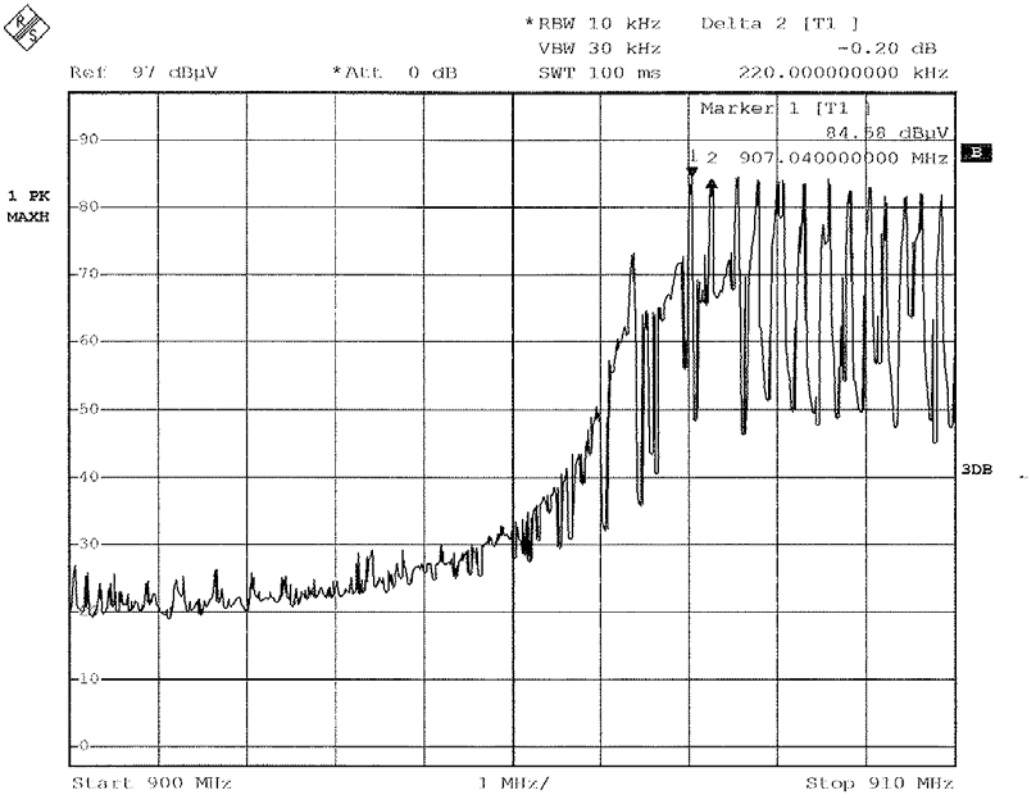

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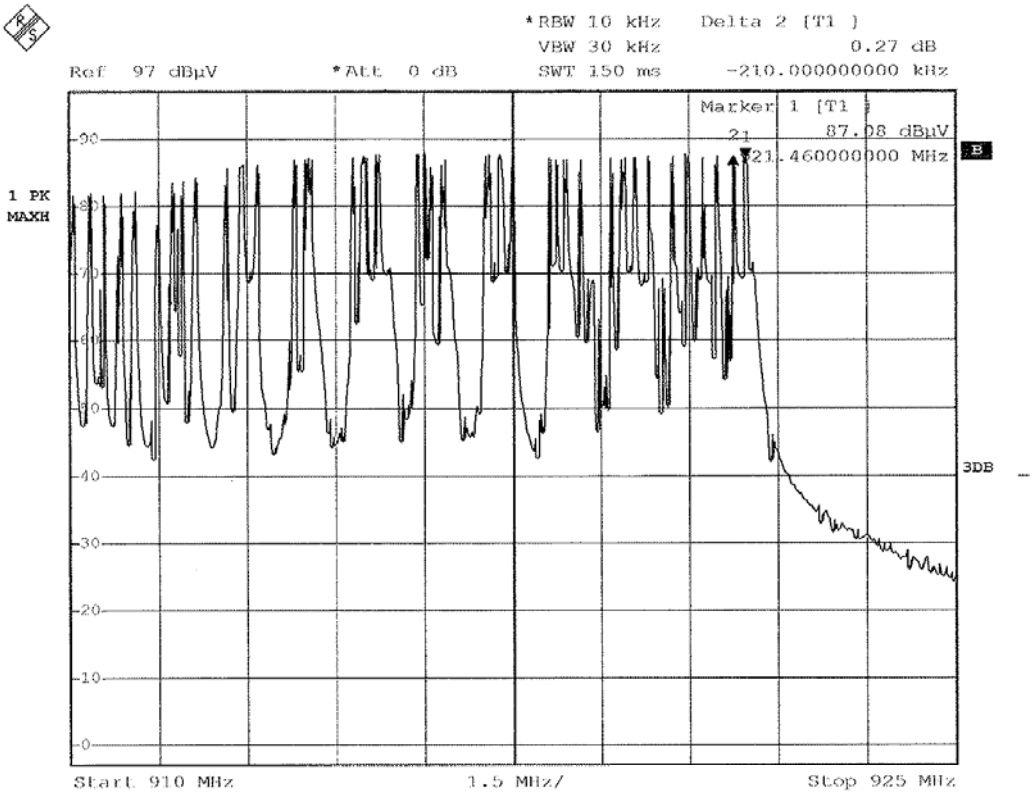

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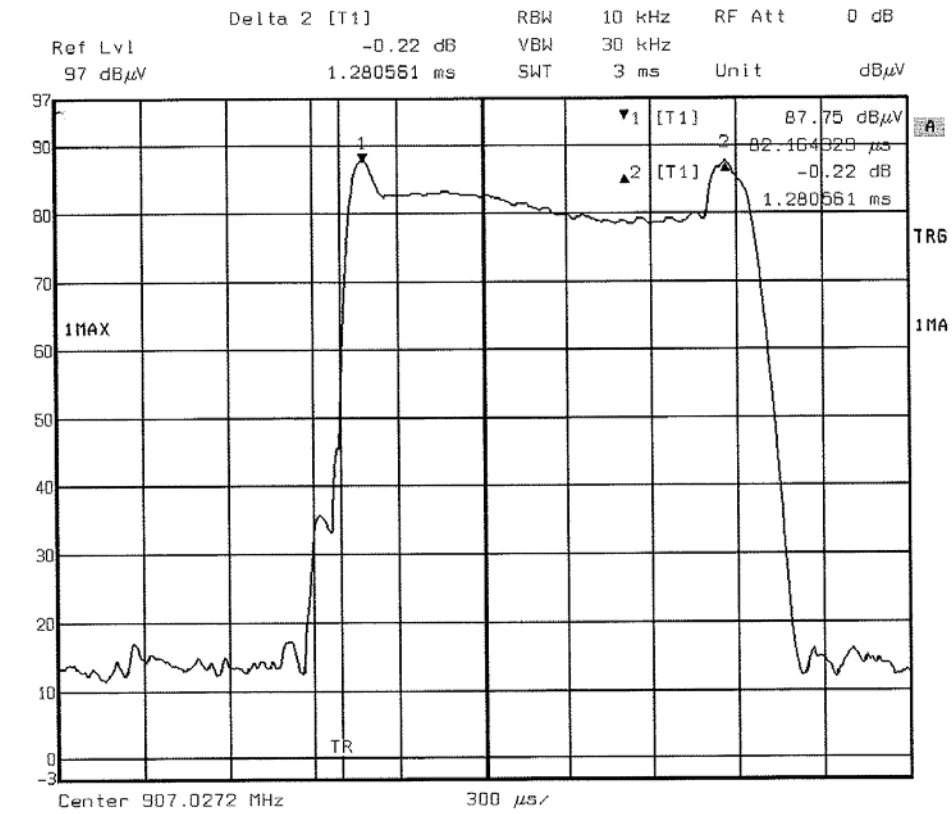
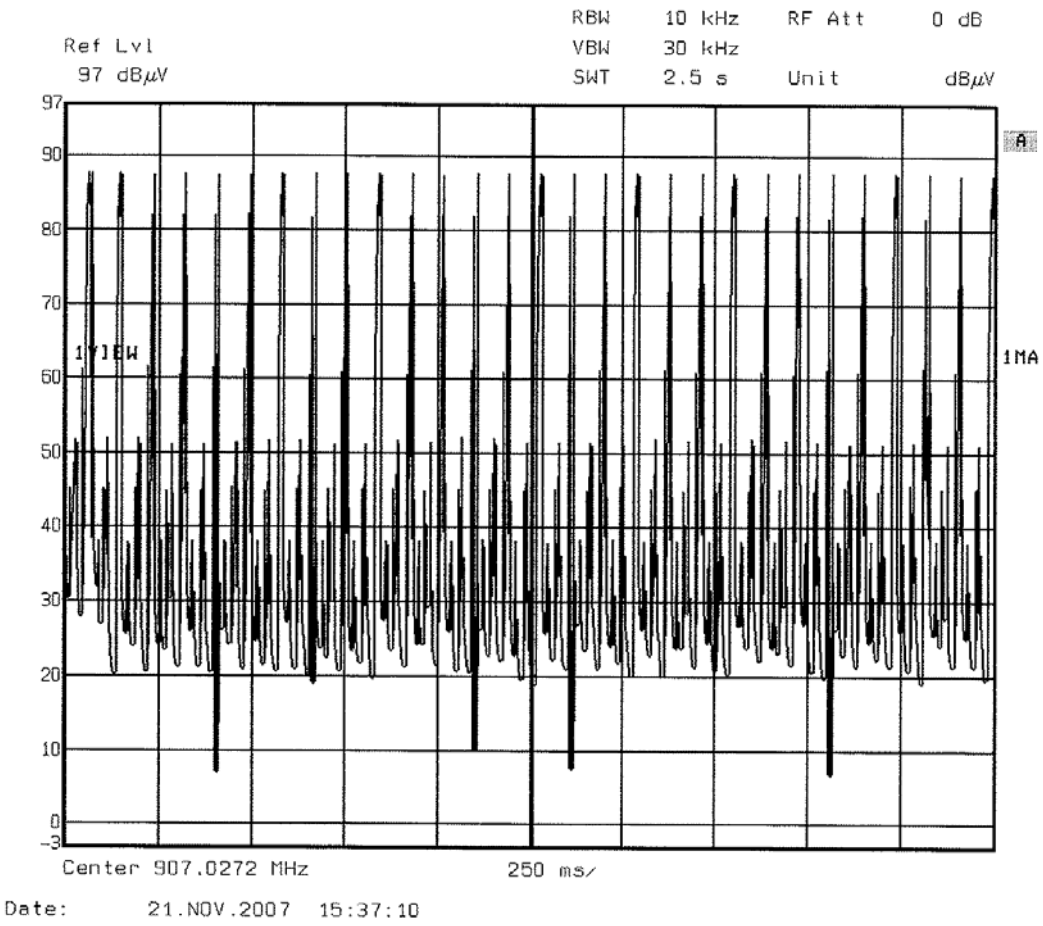
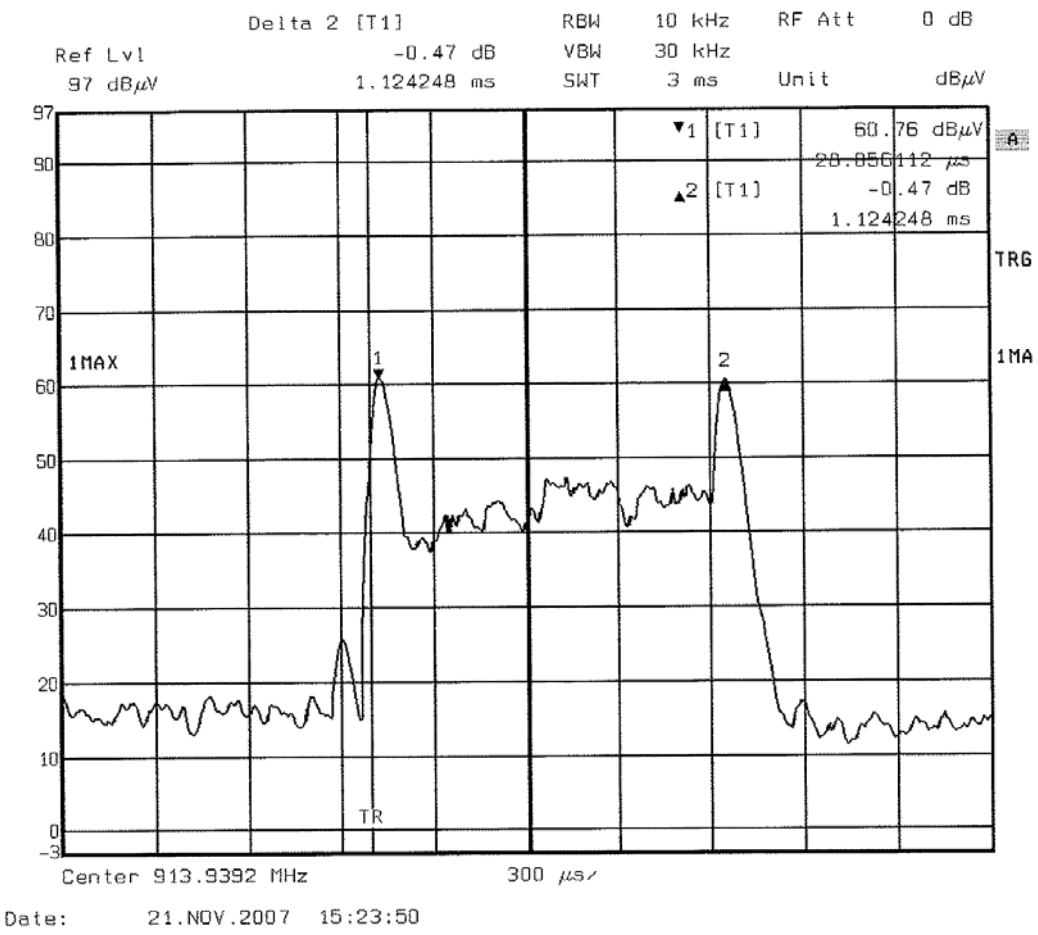
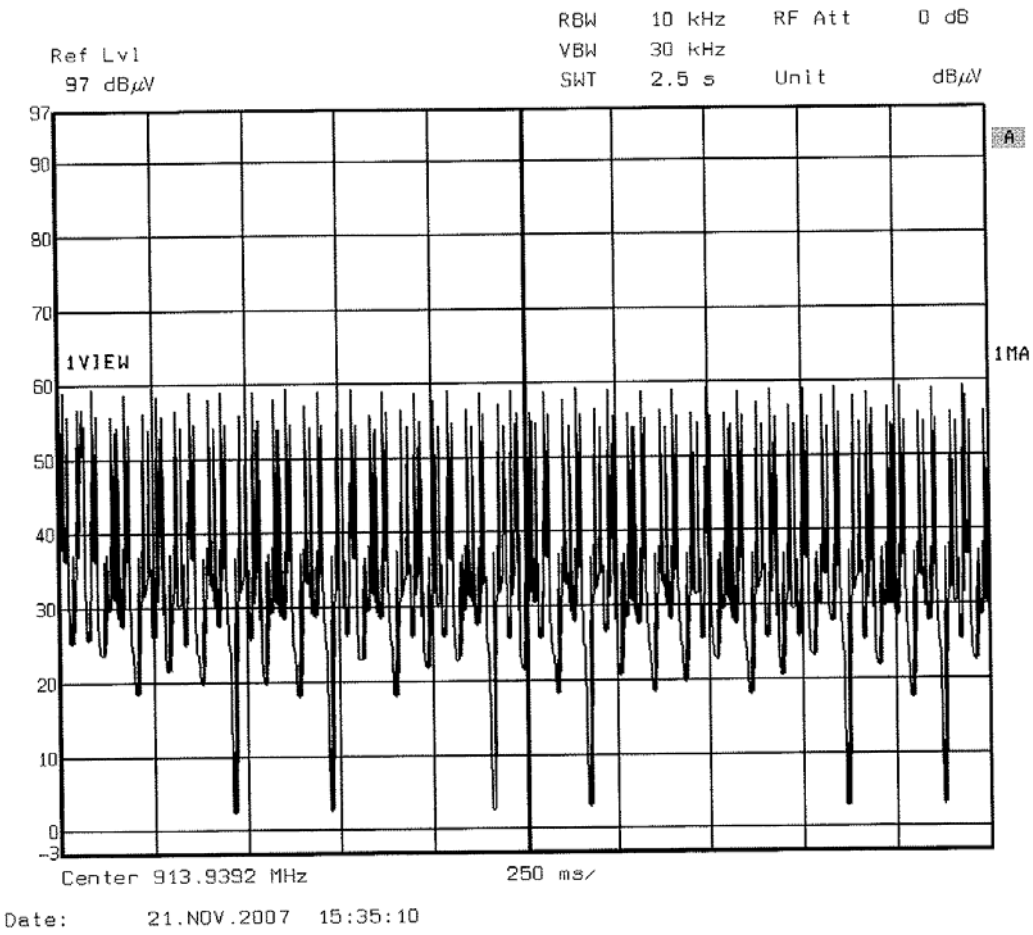
ANNEX 2: AVERAGE TIME OF OCCUPANCY ON ANY FREQUENCY




RBW 10 kHz
RF Att 0 dB
Ref Lvl
VBW 30 kHz
97 dBµV
SWT 2.5 s
Unit dBµV
97
90
80
70
1VIEW
60
50
40
30
20
10
0
-3
A
1MA
Center 907.0272 MHz
250 ms/
Date: 21.NOV.2007 15:37:10


Delta 2 [T1]
-0.47 dB
1.124248 ms
RBW 10 kHz
VBW 30 kHz
SWT 3 ms
RF Att 0 dB
Unit dBµV
Ref Lvl
97 dBµV
▼1 [T1] 60.76 dBµV
28.856112 µs
▲2 [T1] -0.47 dB
1.124248 ms
TRG
1MA
1MAX
1
2
TR
97
90
80
70
60
50
40
30
20
10
0
-3
Center 913.9392 MHz
300 µs/
Date: 21.NOV.2007 15:23:50


RBW 10 kHz
RF Att 0 dB
VBW 30 kHz
SWT 2.5 s
Unit dBµV
Ref Lvl
97 dBµV
97
90
80
70
60
50
40
30
20
10
0
-3
A
1VIEW
1MA
Center 913.9392 MHz
250 ms/
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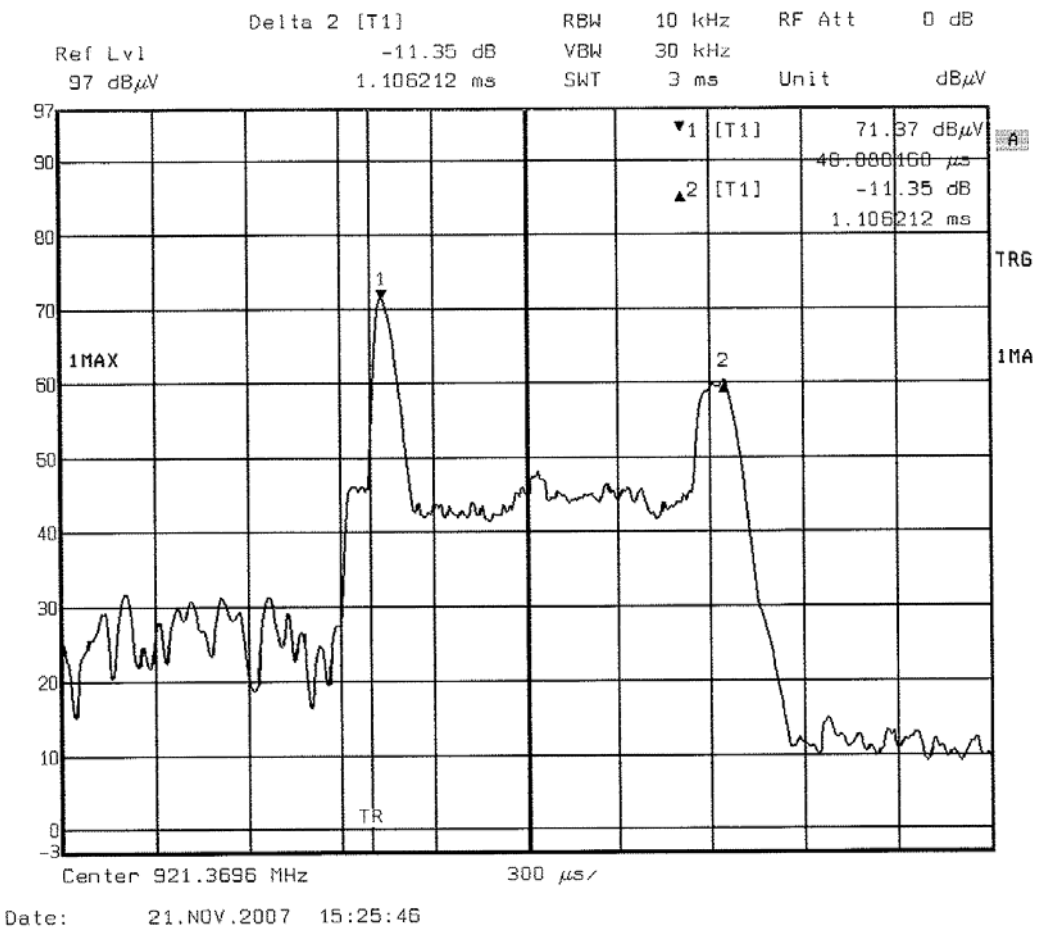
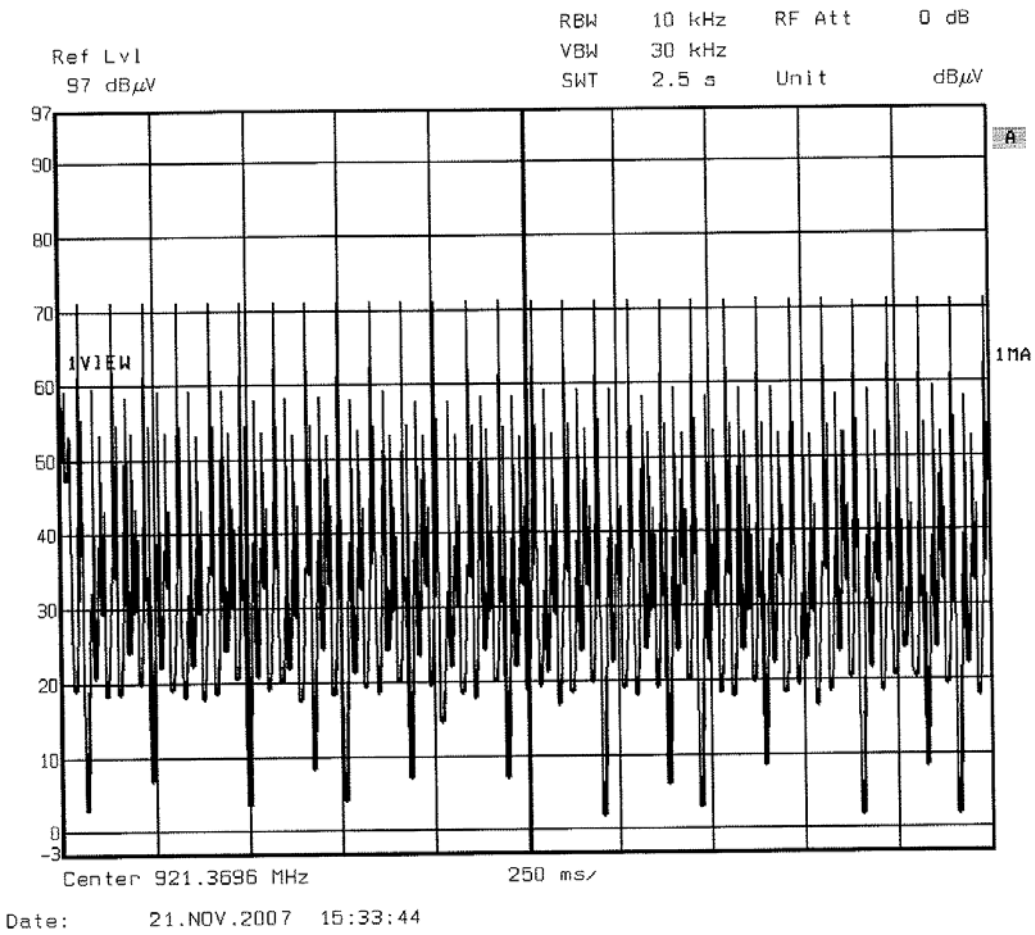
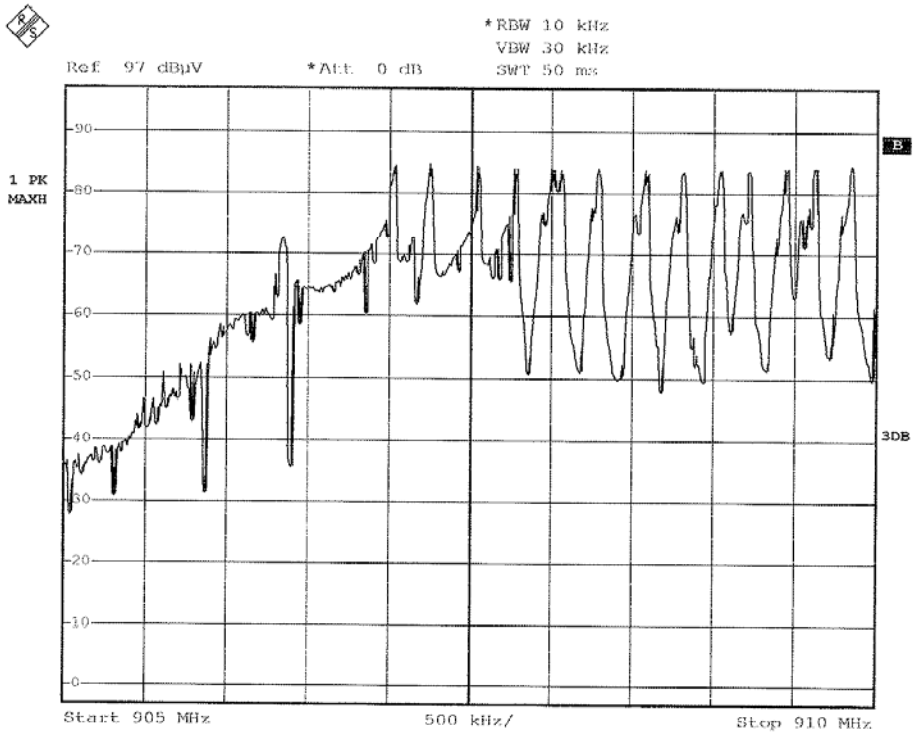

Delta 2 [T1]
RBW 10 kHz
RF Att 0 dB
Ref Lvl
-11.35 dB
VBW 30 kHz
97 dBµV
1.106212 ms
SWT 3 ms
Unit dBµV
1 [T1] 71.37 dBµV
48.000160 µs
2 [T1] -11.35 dB
1.106212 ms
TRG
1MA
1MAX
TR
Center 921.3696 MHz
300 µs/
Date: 21.NOV.2007 15:25:46


RBW 10 kHz
RF Att 0 dB
VBW 30 kHz
SWT 2.5 s
Unit dBµV
Ref Lvl
97 dBµV
97
90
80
70
60
50
40
30
20
10
0
-3
A
VIEW
1MA
Center 921.3696 MHz
250 ms/
Date: 21.NOV.2007 15:33:44

ANNEX 3: NUMBER OF HOPPING FREQUENCIES



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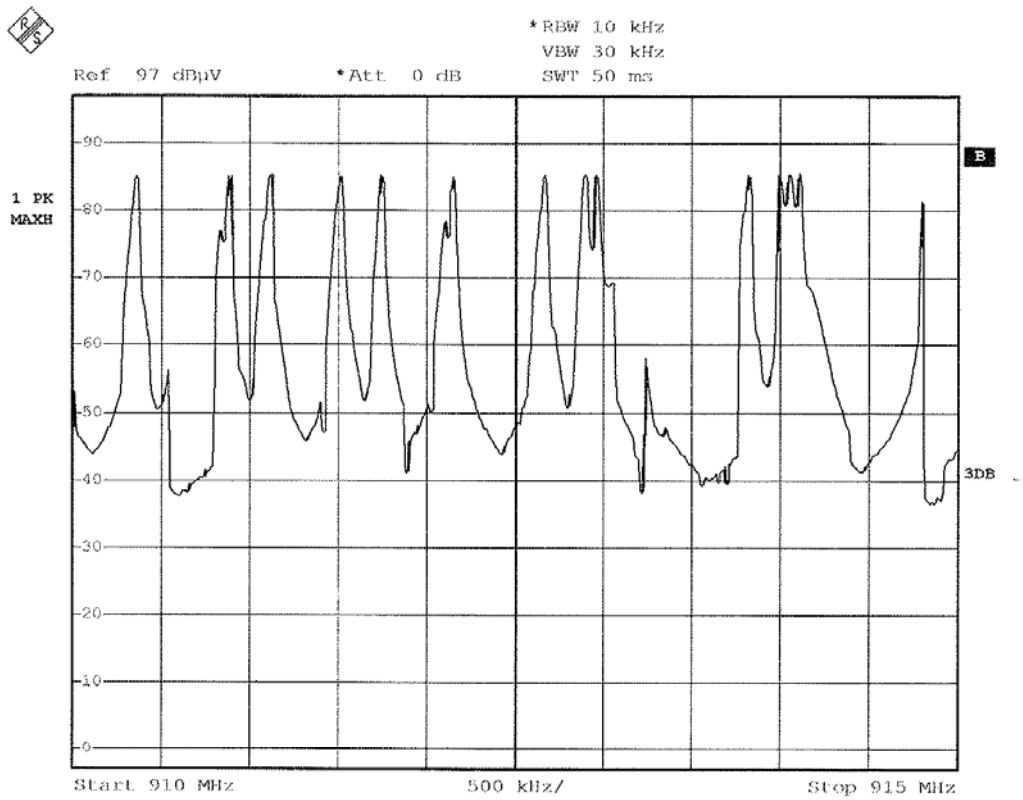

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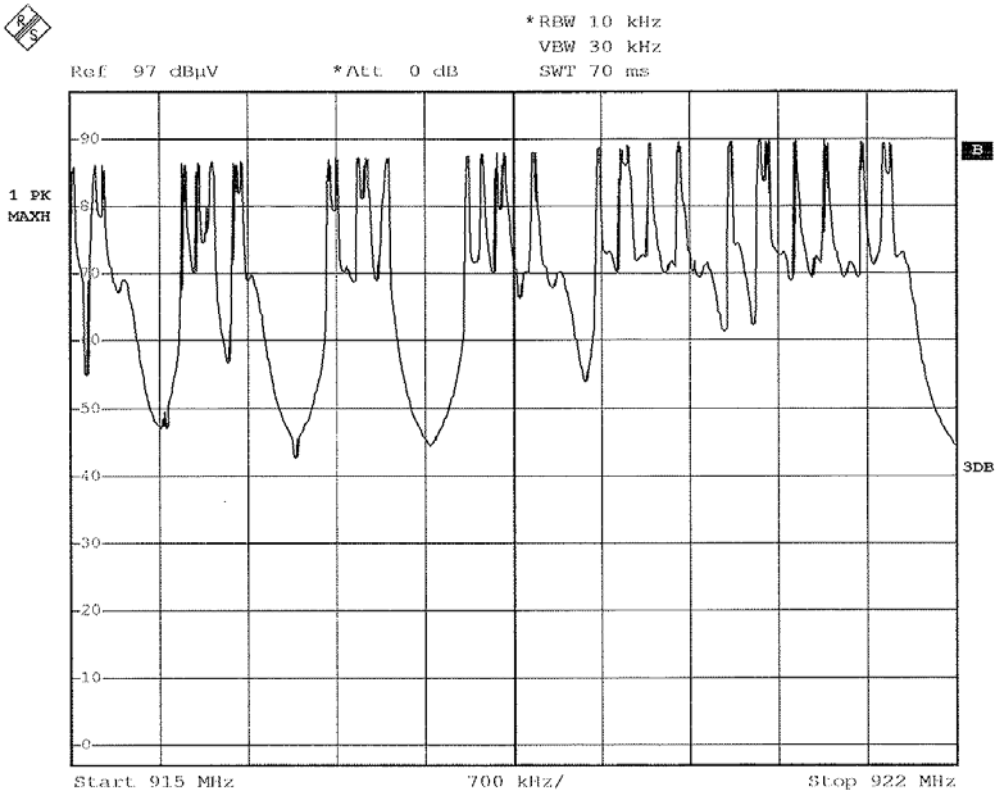

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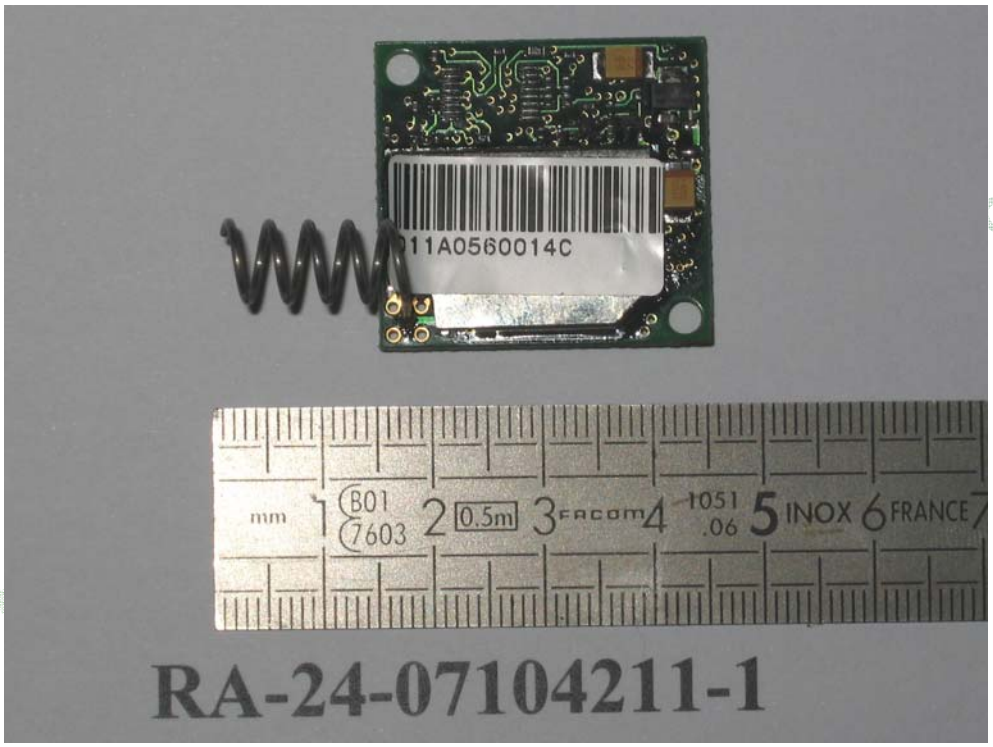
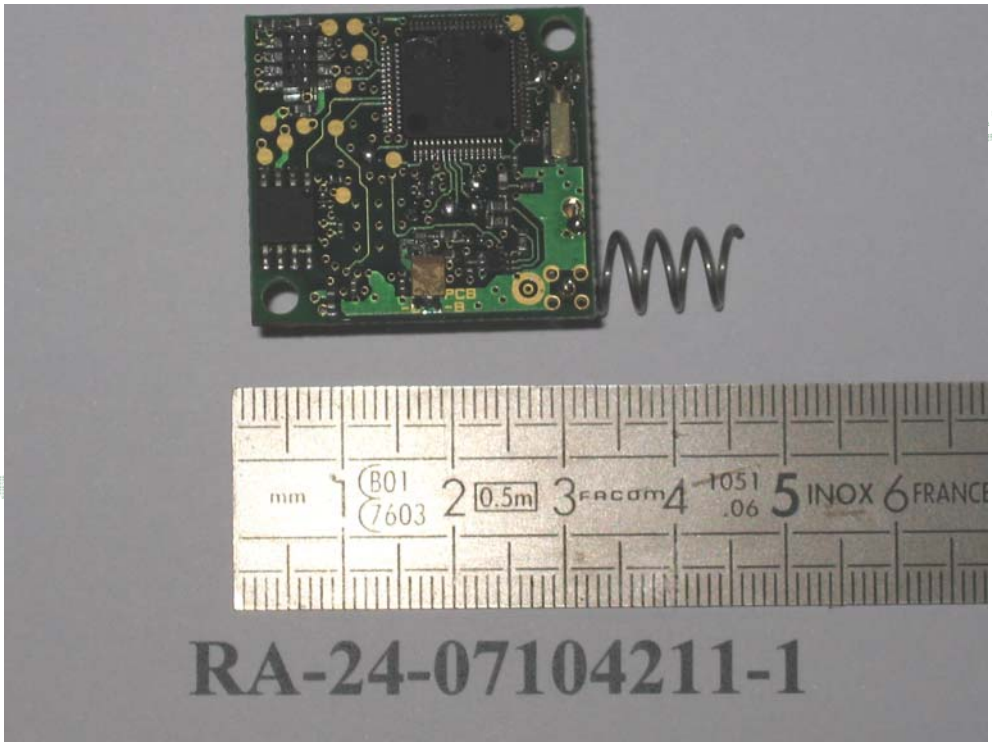
ANNEX 4: PHOTOS OF THE EQUIPMENT UNDER TEST

GENERAL VIEW





ANNEX 5: TEST SET UP AND OPEN AREA TEST SITE

TEST SET UP

EQUIPMENT UNDER TEST TO PUT FLAT

EQUIPMENT UNDER TEST VERTICAL

OPEN AREA TEST SITE