

RA-24-08103452-1/A Ed. 0

**FCC CERTIFICATION
RADIO Measurement
Technical Report**

**standard to apply:
FCC Part 15.247**

**Equipment under test:
RADIO MODEM "SUPER RTM"**

**FCC ID :
S28-SEVO**

**Company:
CORONIS SYSTEMS**

DISTRIBUTION: Mr BEKKOUCH

Company: CORONIS SYSTEMS

Number of pages: 35 including 5 annexes

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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: RADIO MODEM "SUPER RTM"

Reference / model: Super RTM

Serial number: 0D5008403A53

MANUFACTURER: not communicated

COMPANY SUBMITTING THE PRODUCT:

Company: CORONIS SYSTEMS

Address: espace concorde-Bât. B
120 impasse JB Say
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FRANCE

Responsible: Mr. BEKKOUCH

DATE(S) OF TEST: 08 and 09 September 2008

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: L. BERTHAUD

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1. INTRODUCTION

This document presents the result of RADIO test carried out on the following equipment:
RADIO MODEM "SUPER RTM" in accordance with normative reference.

2. PRODUCT DESCRIPTION

Class: B (residential environment)

Utilization: radio modem for Automatic Metering Reading (water consumption)

Antenna type: incorporated antenna

Operating frequency range: from 904.8384 MHz to 925.4592 MHz

Number of channels: 63

Channel spacing: 170 kHz (minimum)

Frequency generation: ☐ SAW Resonator ☐ Crystal ☒ Synthetiser

Modulation: Frequency Hopping Spread Spectrum (FHSS)
☐ Amplitude ☐ Digital ☒ Frequency ☐ Phase

Power source: lithium battery (1 x 3.6 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 (2007)	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) <i>hopping systems</i>	X				Note 3
	(a) (1) (i) 902 – 928 MHz	X				
	(a) (1) (ii) 5725 – 5850 MHz			X		
	(a) (1) (iii) 2400 – 2483.5 MHz			X		Note 4
	(a) (2) <i>digital modulation techniques</i>			X		
	(b) <i>max output power</i>	X				Note 5
	(c) <i>operation with directional antenna gains > 6 dBi</i>			X		Note 6
	(d) <i>intentional radiator</i>	X				
	(e) <i>peak power spectral density</i>			X		
	(f) <i>hybrid system</i>			X		
	(g)	X				
	(h)	X				
	(i) <i>RF exposure compliance</i>	X				Note 7
DA 00-705	BAND EDGE COMPLIANCE	X				

NAP: Not Applicable

NAs: Not Asked

Note 1: integral 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 (76.5 kHz; see annex 1).

Note 4: the frequency hopping system uses 63 channels (See annex 2).
The timing by channel is 1.032 ms. During 20 s, any channel is used 248 times, then $248 \times 1.032 \text{ ms} = 255.936 \text{ ms}$, thus the average time of occupancy on any channel is less than 400 ms within a period 20 s (see annex 3).

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 RADIO MODEM "SUPER RTM" 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
Power meter 8541B	Gigatronics	3479
Power sensor 80401A	Gigatronics	3182
Log periodic antenna HL223	Rohde & Schwarz	1999
Multimeter 77-2	fluke	812

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 test antenna has been oriented in the two polarizations, we have recorded only the highest level.

The measurement of the electro-magnetic field is realized, with a resolution bandwidth of 100 kHz.

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): 19

Relative humidity (%): 66

We used for power source the internal battery of the equipment and we noted:

Voltage at the beginning test (V): 3.66

Voltage at the end of test (V): 3.57

Voltage drop (%): 2.46

Sample n° 1 Channel 1

		Electro-magnetic field (dBμV/m):	P* (W)	Limit (W)
Normal test conditions	Nominal power source (V): 3.6	121.7	268.929×10^{-3}	1

Polarization of test antenna: horizontal (height: 100 cm)

Position of equipment: laid flat (azimuth: 100 dg)

Sample n° 1 Channel 22

		Electro-magnetic field (dBμV/m):	P* (W)	Limit (W)
Normal test conditions	Nominal power source (V): 3.6	120.3	194.822×10^{-3}	1

Polarization of test antenna: horizontal (height: 100 cm)

Position of equipment: laid flat (azimuth: 109 dg)

Sample n° 1 Channel 43

		Electro-magnetic field (dBμV/m):	P* (W)	Limit (W)
Normal test conditions	Nominal power source (V): 3.6	118.5	128.717×10^{-3}	1

Polarization of test antenna: horizontal (height: 100 cm)

Position of equipment: laid flat (azimuth: 105 dg)

* $P = (E \times d)^2 / (30 \times G_p)$ with $d = 3$ m and $G_p = 1.65$

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 2 to 18 GHz	Microwave DB	1922
High pass filter HP12/3200-5AA	Filtek	
Antenna WR42	IMC	1939
Low-noise amplifier 18 to 26 GHz	ALC	3036
Multimeter 77-2	fluke	812

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): 20

Relative humidity (%): 67

We used for power source the internal battery of the equipment and we noted:

Voltage at the beginning test (V): 3.67

Voltage at the end of test (V): 3.58

Voltage drop (%): 2.45

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

Channel 1

FREQUENCIES (MHz)	Detector	Antenna height (cm)	Azimuth (degree)	resolution bandwidth (kHz)	Polarization H: Horizontal V: Vertical	Field strength (dBμV/m)	Limits (dBμV/m)	Margin (dB)
1809.67	Peak	345	0	100	V	59.97	101.7	41.73
2714.56	Avg	219	246	1000	H	25.51	53.98 *	28.47
2714.56	Peak	219	246	1000	H	47.01	73.98 *	26.97
3619.39	Avg	234	197	1000	H	28.73	53.98 *	25.25
3619.39	Peak	234	197	1000	H	49.63	73.98 *	24.35
4524.24	Avg	105	0	1000	V	28.01	53.98 *	25.97
4524.24	Peak	105	0	1000	V	47.71	73.98 *	26.27
5429.10	Avg	247	0	1000	V	32.68	53.98 *	21.3
5429.10	Peak	247	0	1000	V	53.18	73.98 *	20.8
6333.78	Peak	194	260	100	V	54.47	101.7	47.23
7238.64	Peak	182	0	100	V	59.45	101.7	42.25

Channel 22

FREQUENCIES (MHz)	Detector	Antenna height (cm)	Azimuth (degree)	resolution bandwidth (kHz)	Polarization H: Horizontal V: Vertical	Field strength (dBμV/m)	Limits (dBμV/m)	Margin (dB)
1830.63	Peak	343	0	100	V	57.87	101.7	43.83
2475.95	Avg	223	247	1000	H	24.71	53.98 *	29.27
2475.95	Peak	223	247	1000	H	45.71	73.98 *	28.27
3661.27	Avg	233	197	1000	H	27.33	53.98 *	26.65
3661.27	Peak	233	197	1000	H	48.03	73.98 *	25.95
4576.59	Avg	104	0	1000	V	27.41	53.98 *	26.57
4576.59	Peak	104	0	1000	V	46.11	73.98 *	27.87
5491.90	Peak	245	0	100	V	51.68	101.7	50.02
6407.22	Peak	195	262	100	V	53.47	101.7	48.23
7322.54	Avg	181	0	1000	V	36.95	53.98 *	17.03
7322.54	peak	181	0	1000	V	59.05	73.98 *	14.93

Channel 43

FREQUENCIES (MHz)	detector	Antenna height (cm)	Azimuth (degree)	resolution bandwidth (kHz)	Polarization H: Horizontal V: Vertical	Field strength (dBμV/m)	Limits (dBμV/m)	Margin (dB)
1850.91	Peak	347	0	100	V	57.37	101.7	44.33
2776.36	Avg	224	241	1000	H	23.91	53.98 *	30.07
2776.36	Peak	224	241	1000	H	45.11	73.98 *	28.87
3701.81	Avg	230	198	1000	H	27.03	53.98 *	26.95
3701.81	Peak	230	198	1000	H	47.83	73.98 *	26.15
4627.27	Avg	100	0	1000	V	27.71	53.98 *	26.27
4627.27	Peak	100	0	1000	V	45.21	73.98 *	28.77
5552.72	Peak	247	0	100	V	50.68	101.7	51.02
6478.17	Peak	189	254	100	V	52.67	101.7	49.03
7403.62	Avg	182	0	1000	V	36.05	53.98 *	17.93
7403.62	peak	182	0	1000	V	57.95	73.98 *	16.03

* restricted bands of operation in 15.205, limits corresponding at the 15.209 section.

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 121.7 dBμV/m on channel 1.

So the applicable limit is **101.7 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)).

Any spurious that has more than 20 dB of margin compared to the applicable limit is not necessarily reported.

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
Multimeter 77-2	Fluke	812

Test set up:

The measure is realized in near field. The field strength levels are correlated with the electromagnetic fields measured at 3 m.

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 and n° 2

Upper Band Edge: from 960 MHz to 1240 MHz, CURVE n°3 and n° 4

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)
904.8384	121.7	Peak	608.68	-65	56.7	66.02	9.32
904.8384	91.44	avg	609.92	-46.23	45.21	46.02	0.81
925.4592	118.5	Peak	987.32	-52.54	65.96	73.98	8.02
925.4592	84.22	avg	978.74	-38.96	45.26	53.98	8.72

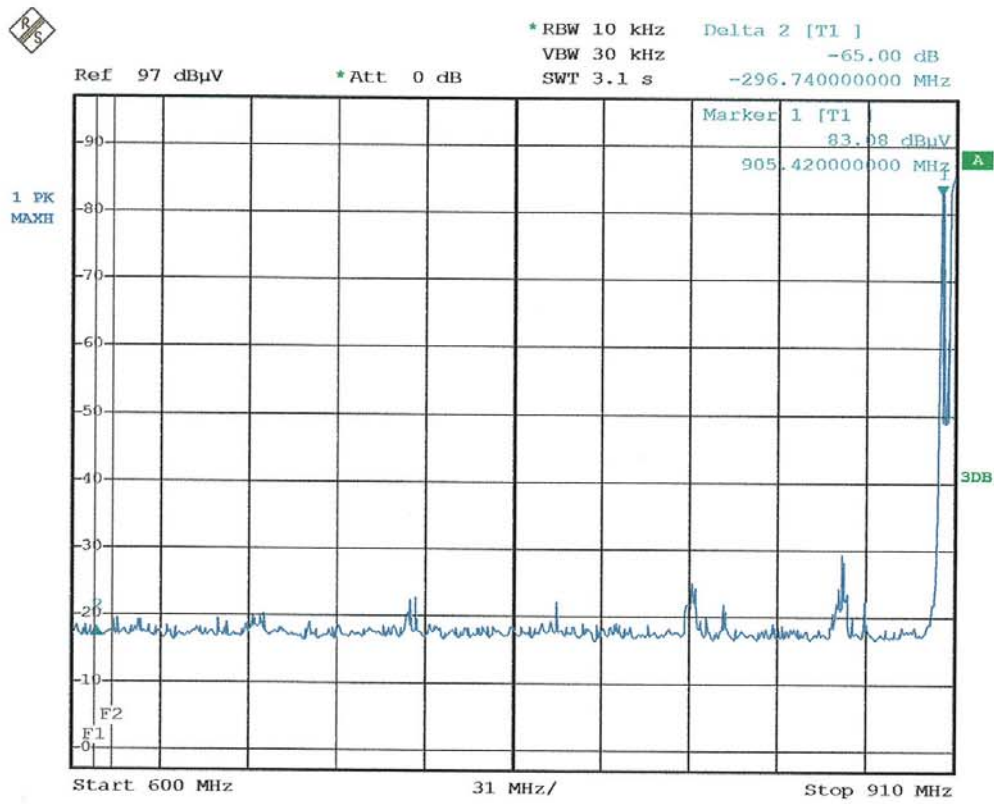
* according to step 2 of Marker-Delta Method DA 00-705.

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

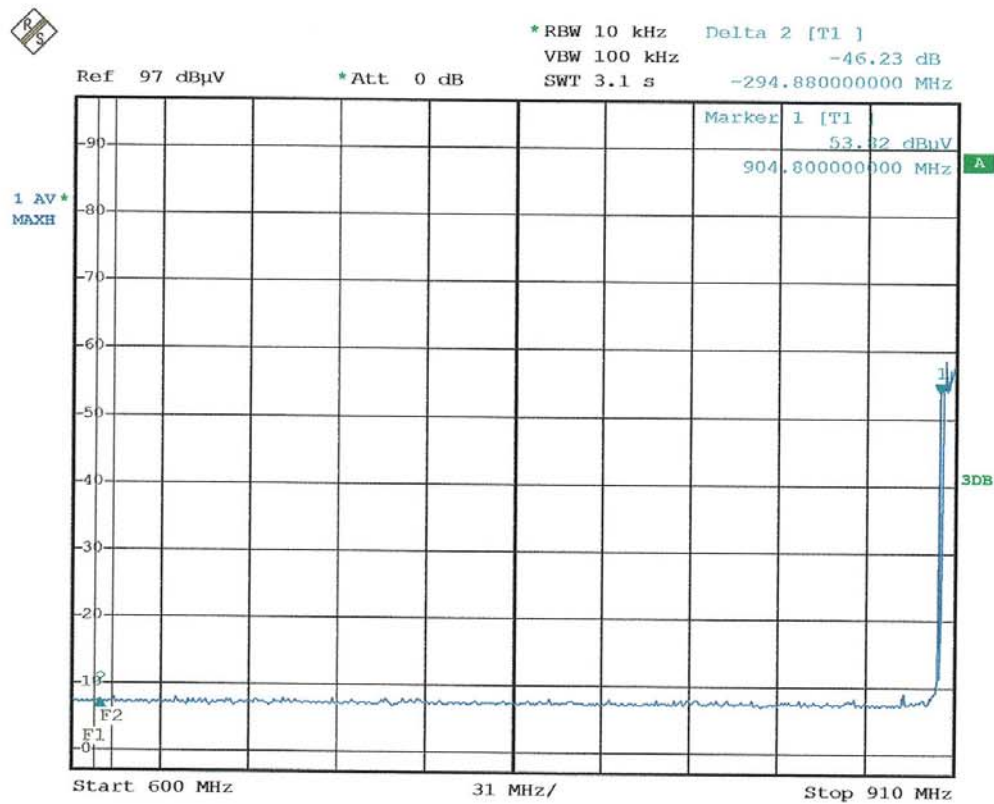
Calculated Emission Level = Field Strength Level – Delta Marker Level

Test conclusion:

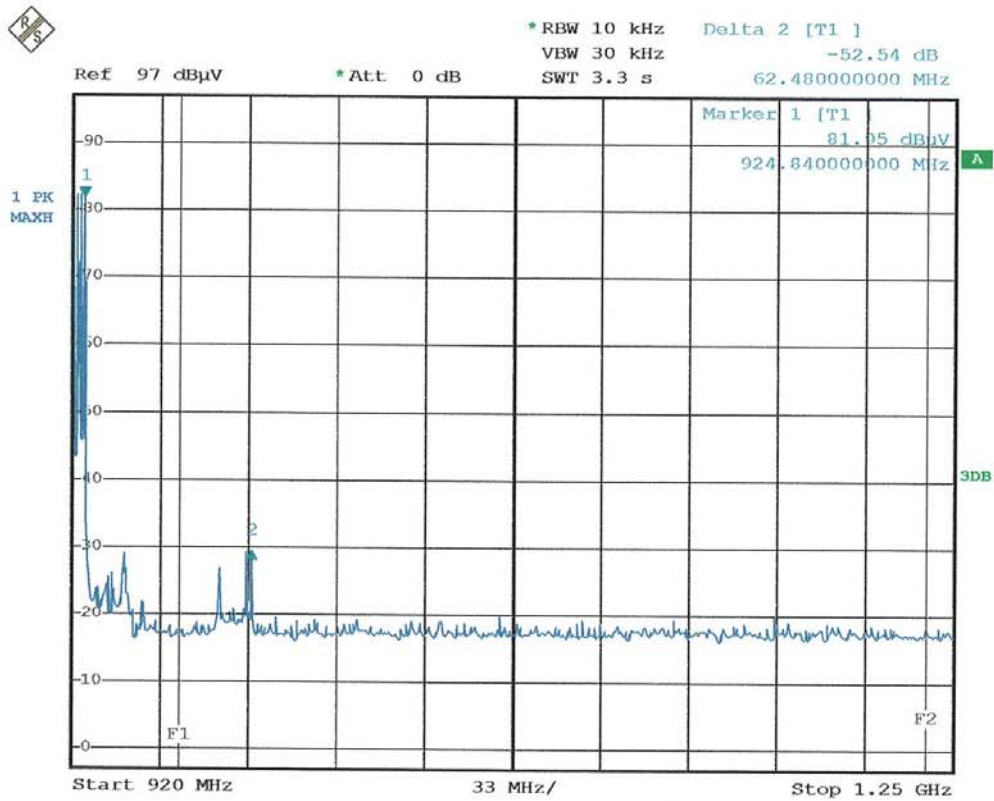
RESPECTED PUBLIC NOTICE



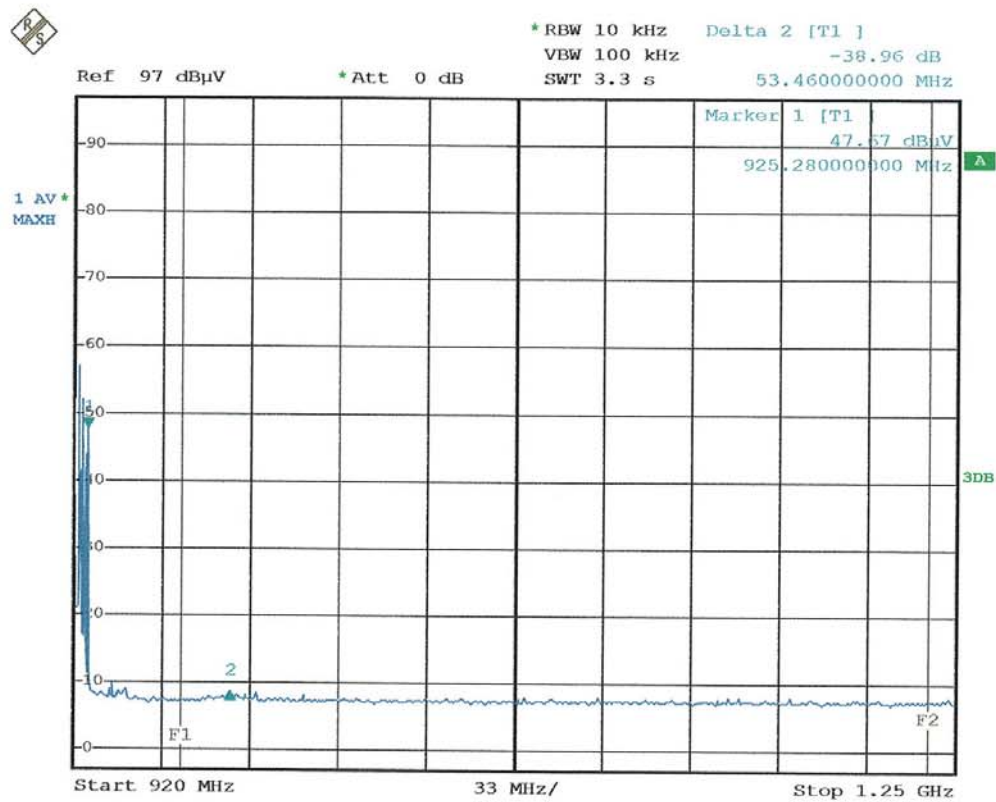
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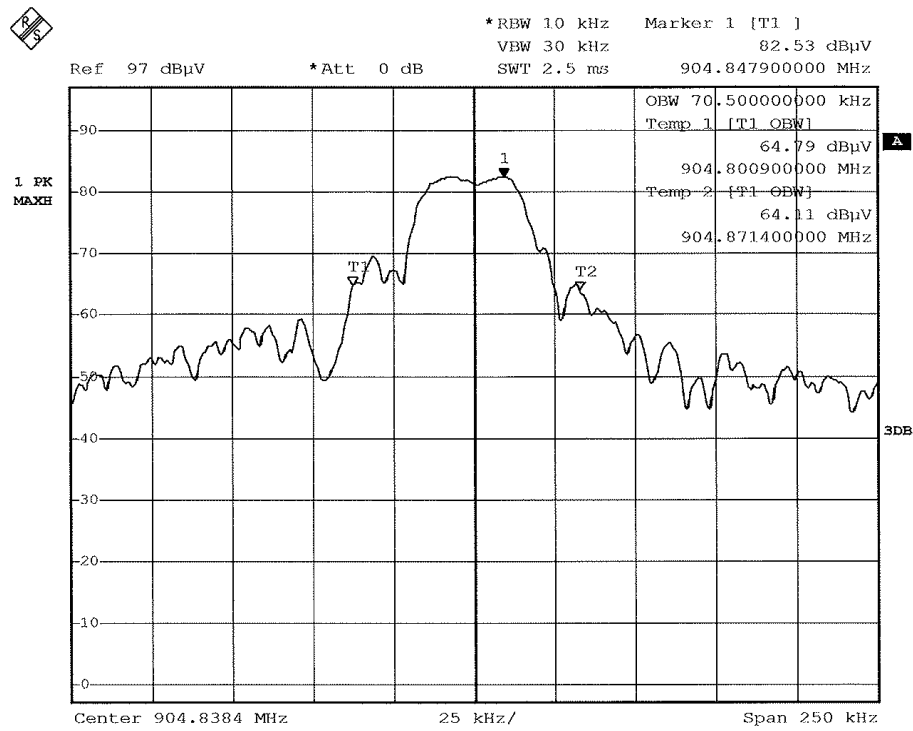
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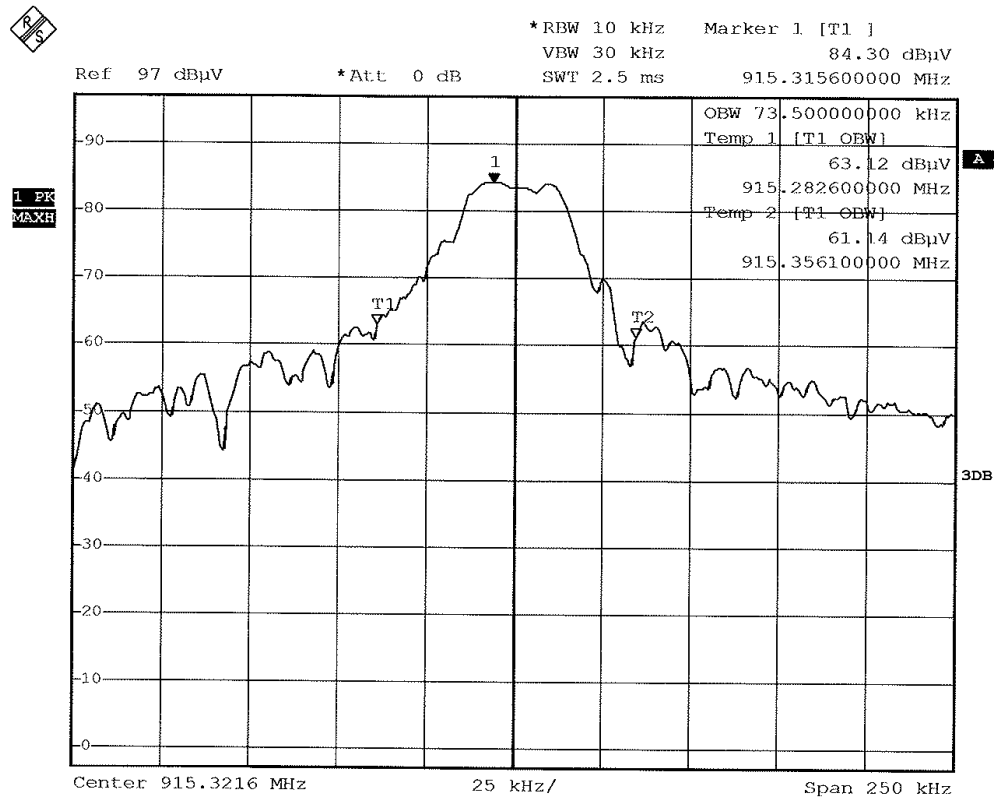
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□□□ End of report, 5 annexes to be forwarded □□□

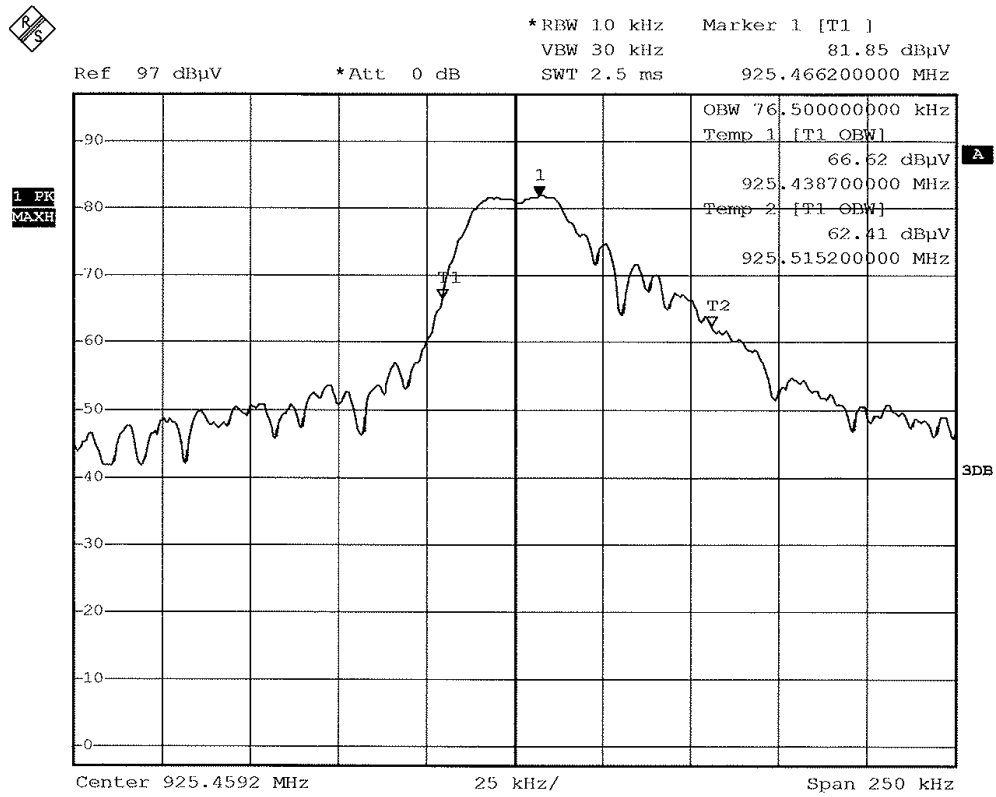
ANNEX 1: OCCUPIED POWER BANDWIDTH AND CHANNEL SEPARATION



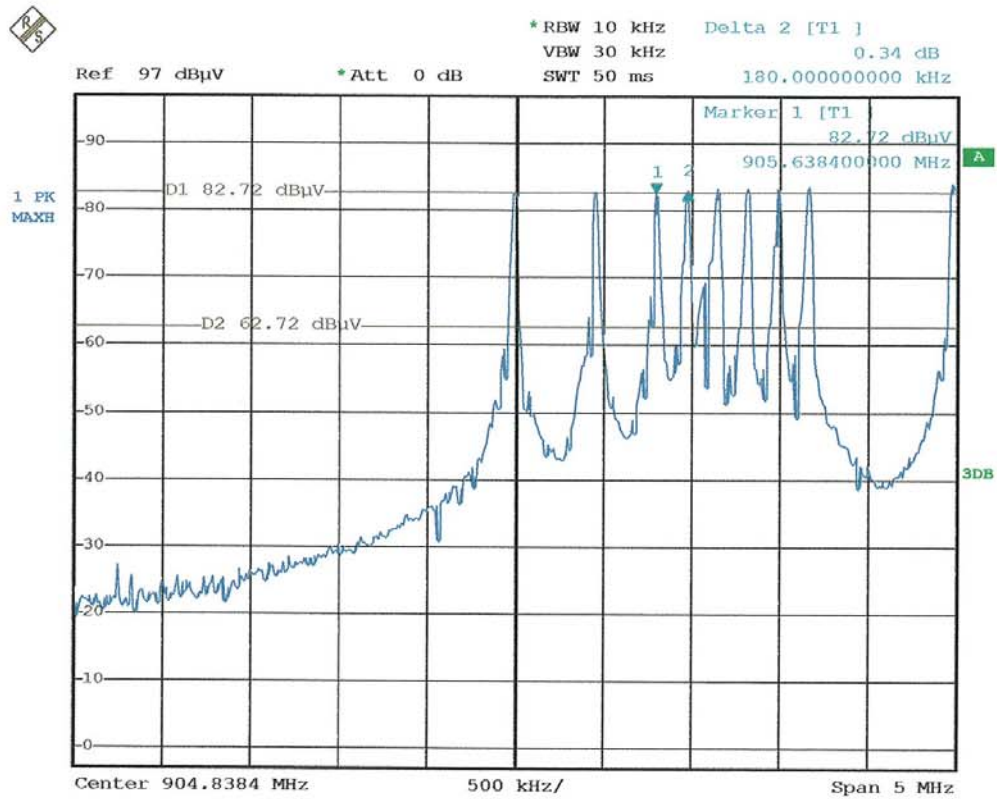
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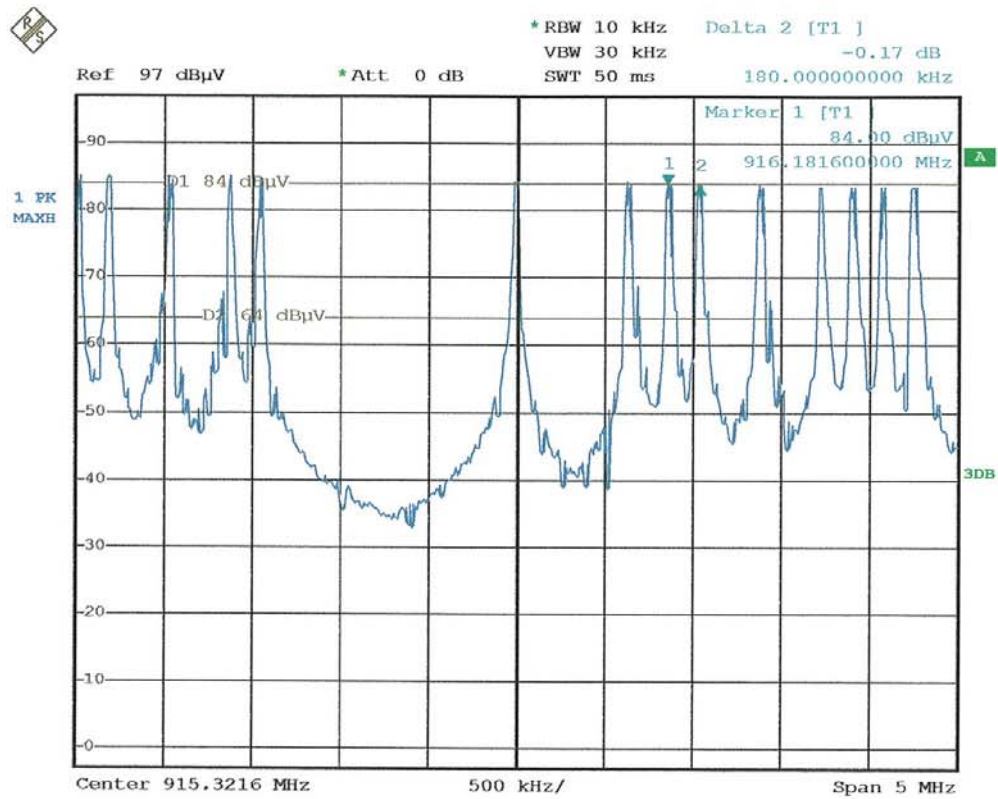
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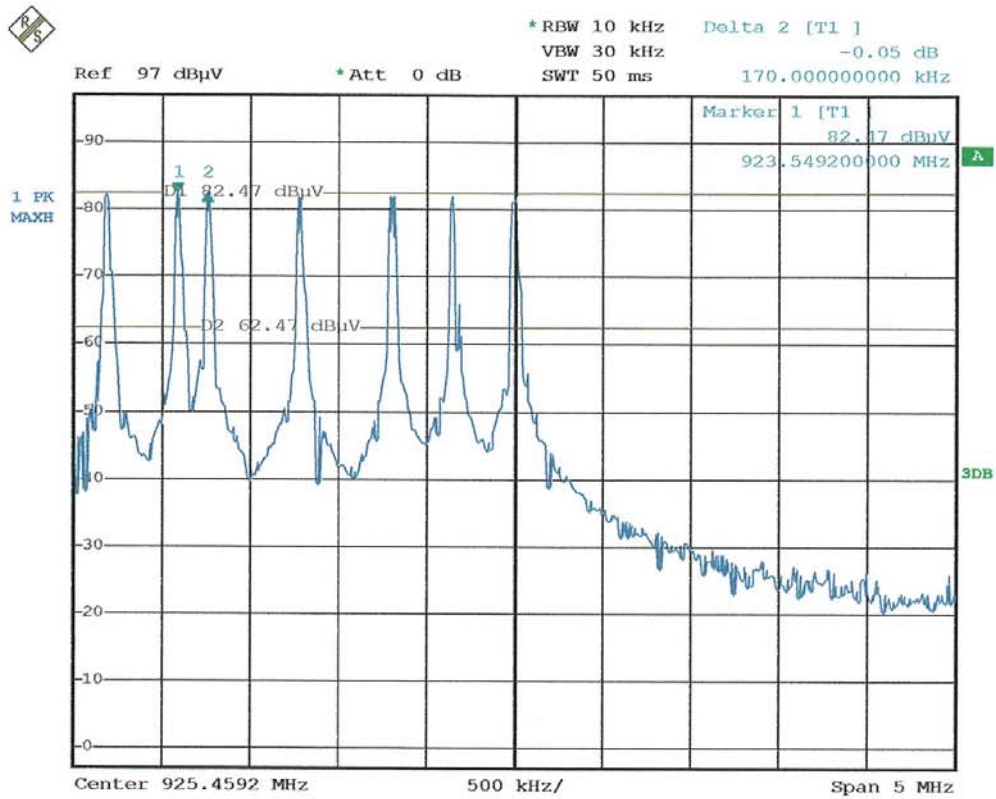
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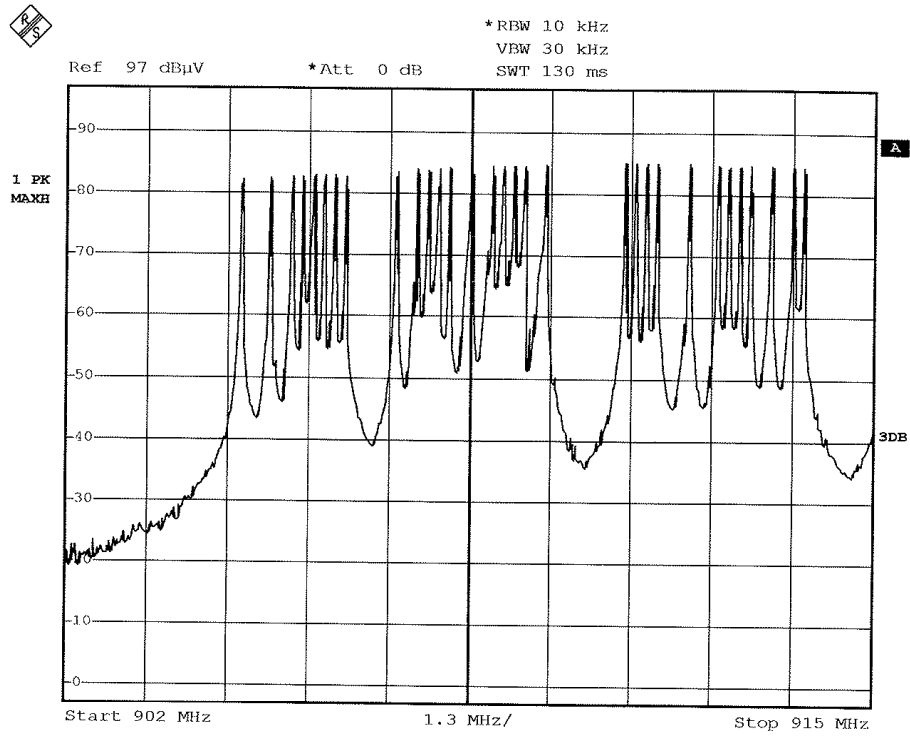


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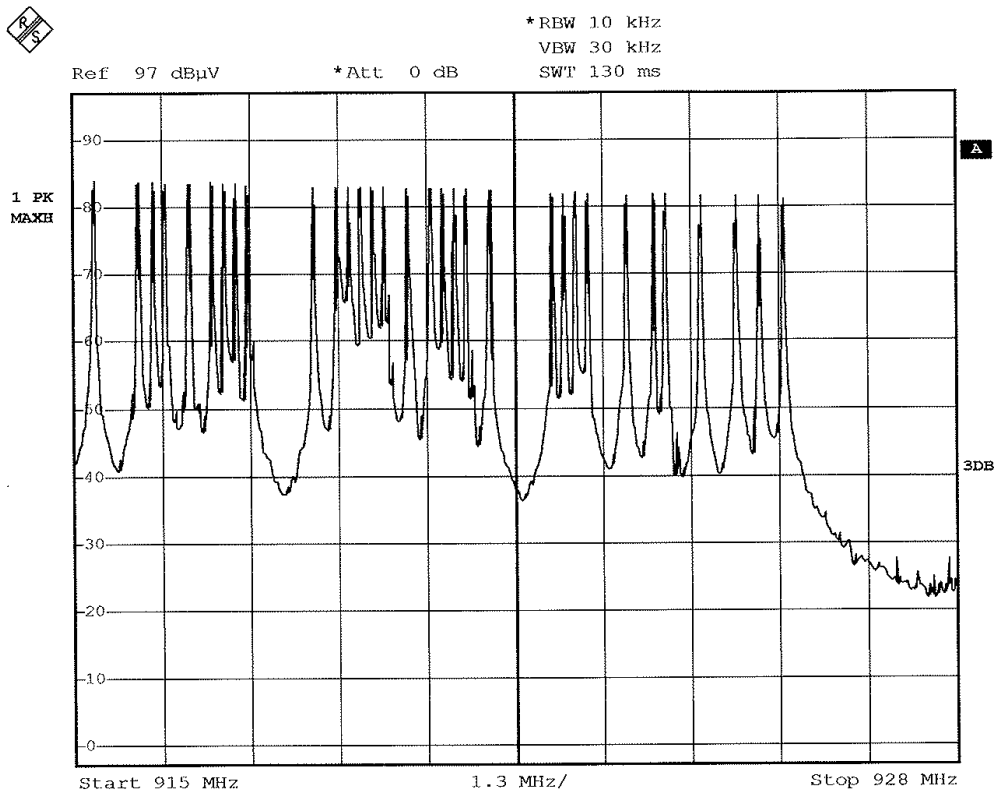


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ANNEX 2: NUMBER OF HOPPING FREQUENCIES

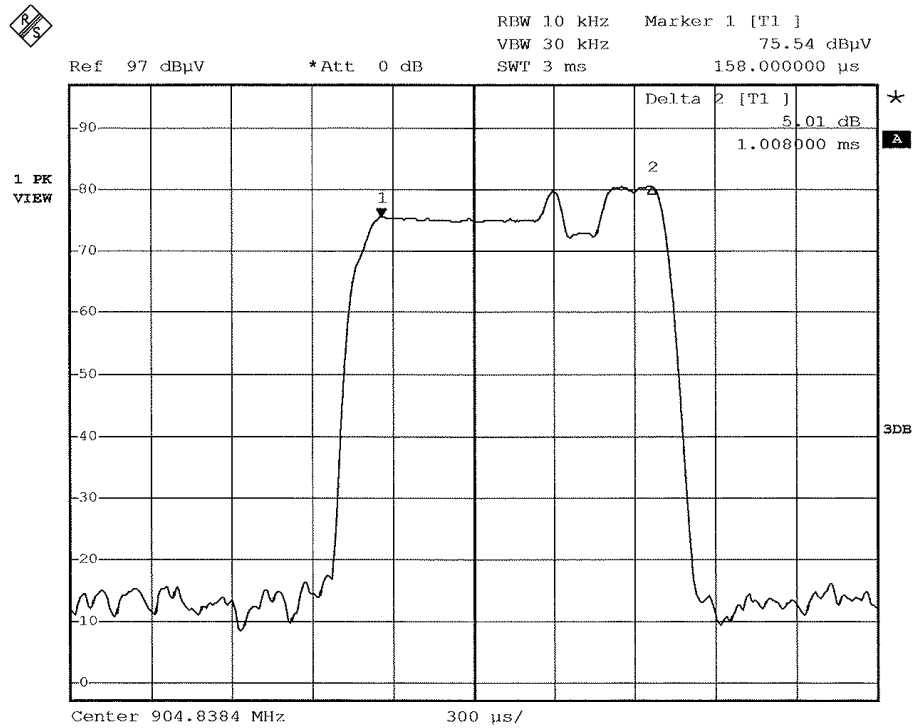


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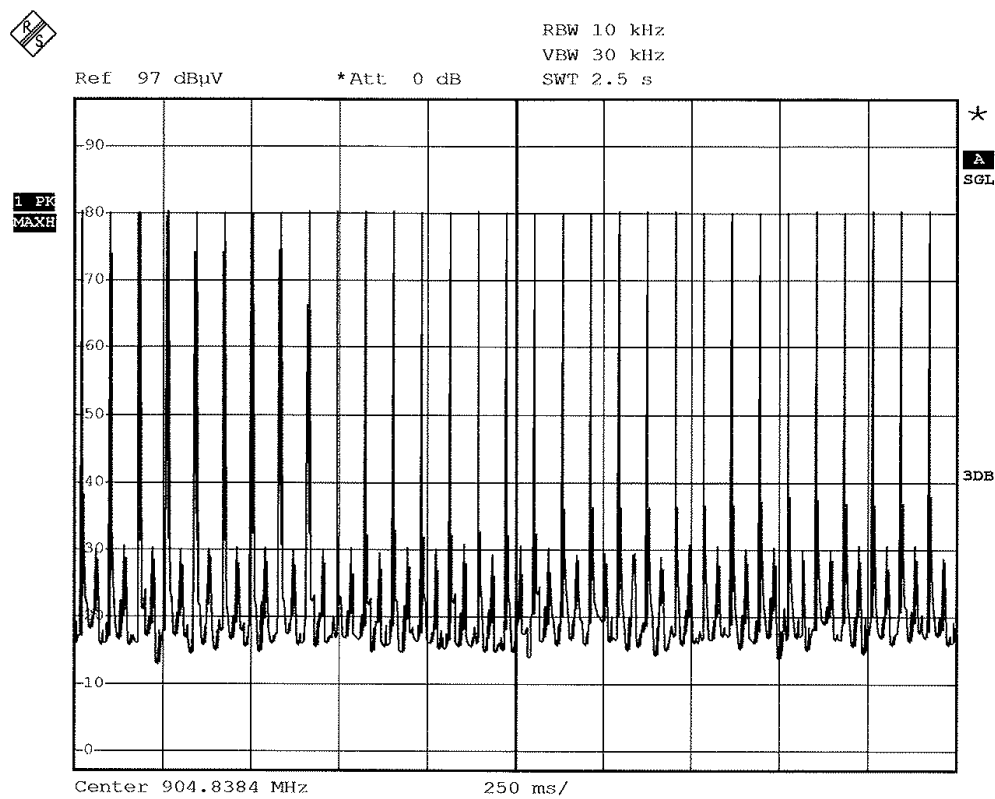


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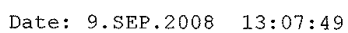
ANNEX 3: AVERAGE TIME OF OCCUPANCY ON ANY FREQUENCY

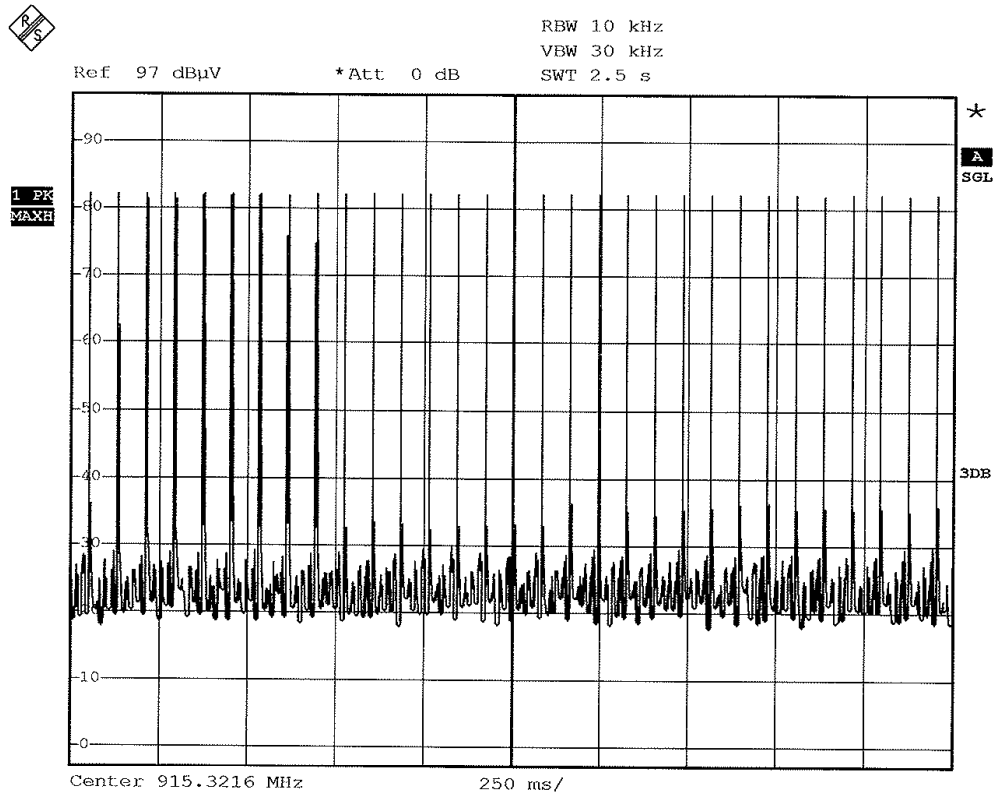


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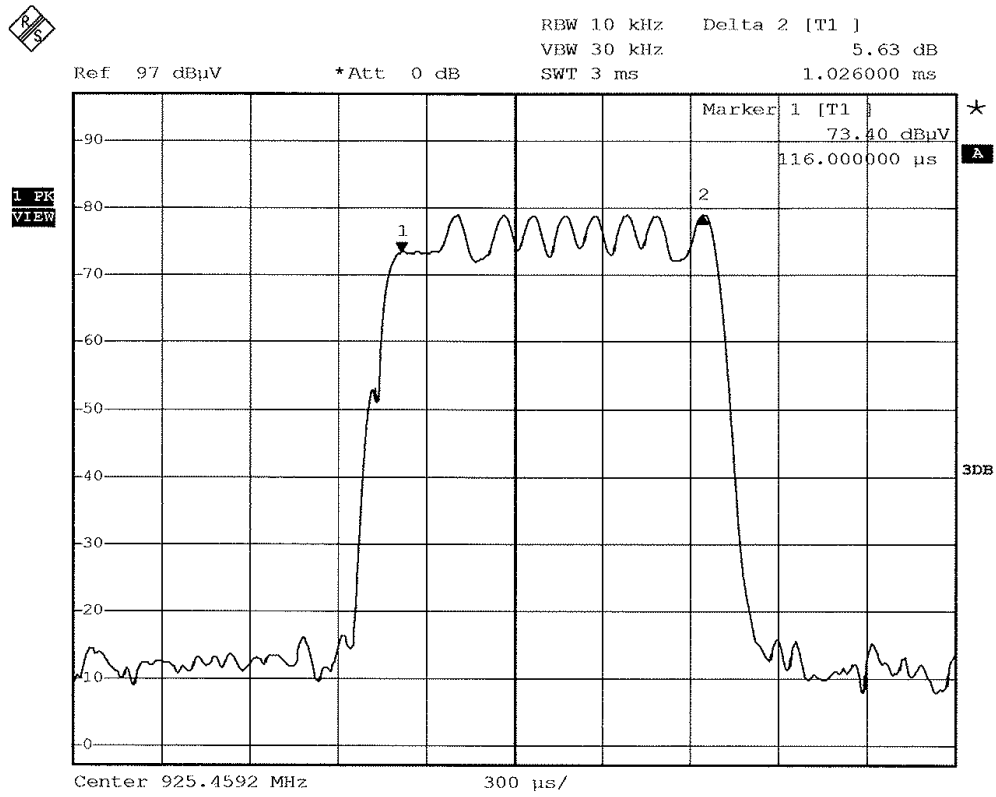


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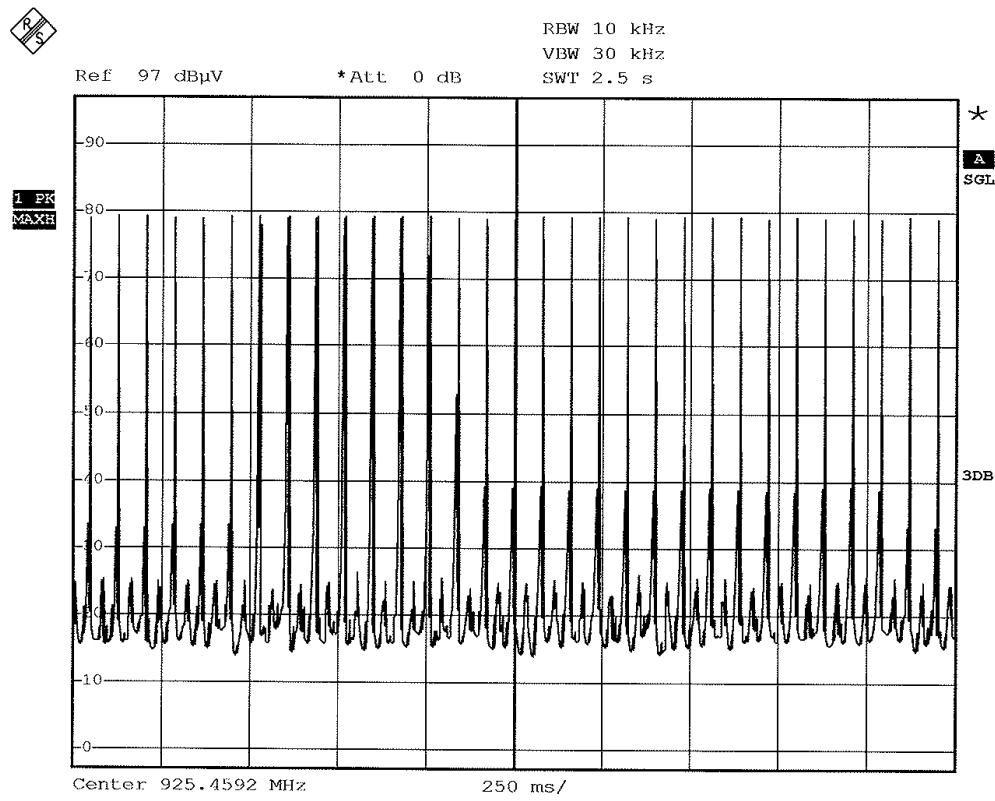




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Date: 9.SEP.2008 13:09:31



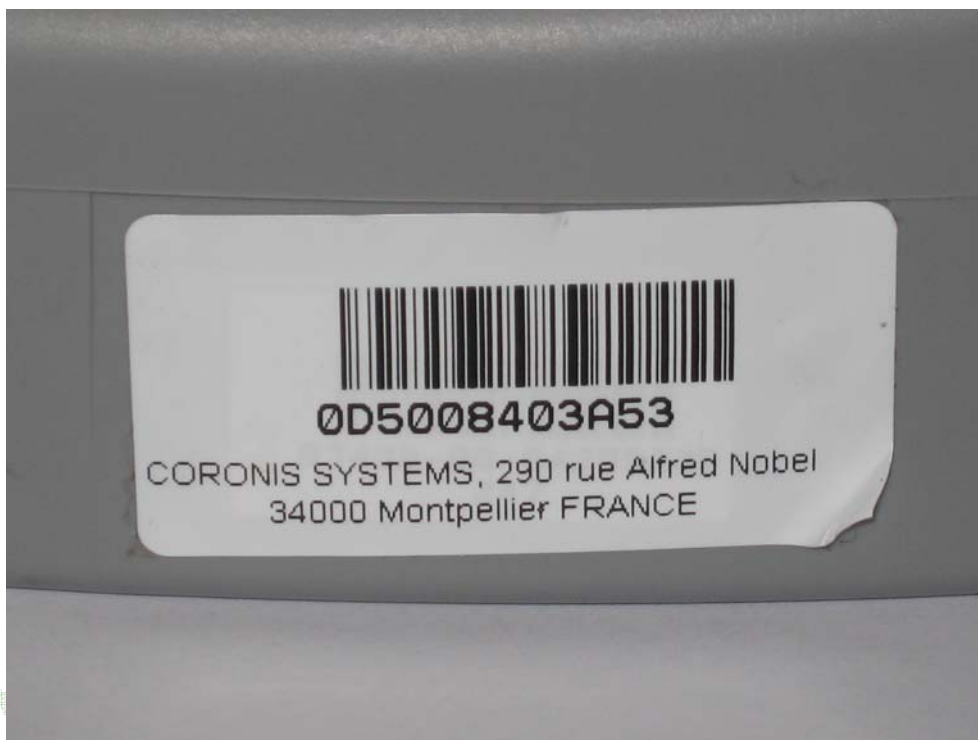
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ANNEX 4: PHOTOS OF THE EQUIPMENT UNDER TEST

GENERAL VIEW



SERIAL NUMBER



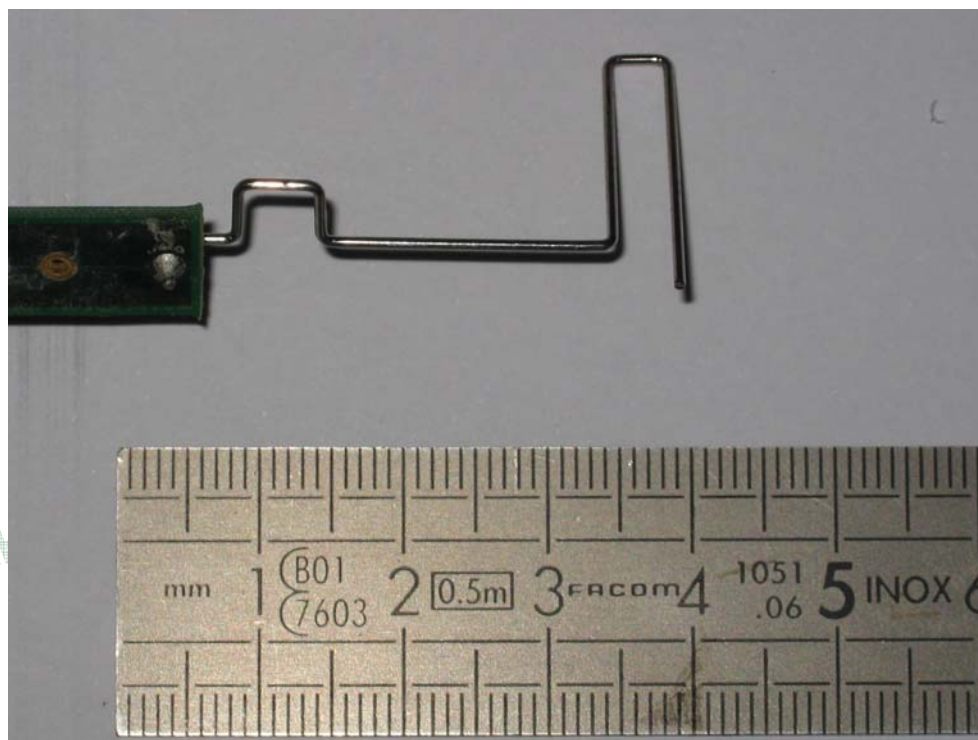
Printed circuit board: face 1



Printed circuit board: face 2



Antenna



ANNEX 5: TEST SET UP AND OPEN AREA TEST SITE

RADIATED MEASUREMENT



OPEN AREA TEST SITE

