RA-24-08101217-2/A Ed. 0

FCC CERTIFICATION
RADIO Measurement
Technical Report

standard to apply:
FCC Part 15.247

Equipment under test:
MECCANO SPYKEE CELL WIRELESS ROBOT

FCC ID :
R9P870865

Company:
MECCANO

FOR THE ATTENTION OF: Mr TREMEL **Company: Wany Robotics**

TRANSMIT TO: Mr THEODORE **Company: MECCANO**

Number of pages: 35 including 5 annexes

Ed.	Date	Modified pages	Written by Name	Visa	Technical Verification Quality Approval Name	Visa
0	9-Sep-08	Creation	L. BERTHAUD	LB	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:	**MECCANO SPYKEE CELL WIRELESS ROBOT**
Reference / model:	Meccano Spykee Cell
Serial number:	not communicated
MANUFACTURER:	Rootland (China)

COMPANY SUBMITTING THE PRODUCT:

Company:	MECCANO
Address:	avenue de Saint Exupery 62100 CALAIS FRANCE
Responsible:	Mr. THEODORE
DATE(S) OF TEST:	25, 26 and 27 June 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

CONTENTS

TITLE **PAGE**

1. INTRODUCTION

This document presents the result of RADIO test carried out on the following equipment:
MECCANO SPYKEE CELL WIRELESS ROBOT in accordance with normative reference.

2. PRODUCT DESCRIPTION

ITU Emission code: 1M00F7D

Class: B (residential environment)

Utilization: wireless robot

Antenna type: incorporated antenna

Operating frequency range: from 2402 to 2480 MHz

Number of channels: 79

Channel spacing: 1 MHz

Frequency generation: O SAW Resonator O Crystal ⊙ Synthetiser

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

Power source: 9 Vd.c. (6 x 1.5 V LR6-AA batteries)

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) *hopping systems*	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) *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 (811.63 kHz; see annex 1).

Note 4: the frequency hopping system uses 79 channels (see in annex 2).
The timing by channel is 418.84 µs. During 79 channels × 0.4 s (part 15) = 31.6 s, any channel is used 328 times, then 328 x 418.84 µs = 137.38 ms, thus the average time of occupancy on any channel is less than 400 ms within a period of 0.4 s multiplied by the number of hopping channels employed, in normal operating mode (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 MECCANO SPYKEE CELL WIRELESS ROBOT 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
Antenna RGA60	Electrometrics	1204
Open site	EMITECH	1274
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.
We use for this measure outdoor test site and substitution method. 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.

The measurement of the electro-magnetic field is realized with a resolution bandwidth and video bandwidth adjusted at 1 MHz.

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): 24
Relative humidity (%): 47

We used for power source the internal batteries of the equipment and we noted:
Voltage at the beginning of test (V): 9.3
Voltage at the end of test (V): 9.05
Voltage drop during the test (%): 2.7

Sample n° 1 Channel 1

		Level dBµV	Cable loss dB	Antenna factor dB	Electro-magnetic field (dBµV/m):	P* (W)
Normal test conditions	Nominal power source (V): 9	45.8	4.64	28.9	79.34	1.56×10^{-5}

Polarization of test antenna: horizontal (height: 185 cm)
Position of equipment: upright (azimuth: 174 degrees)

Sample n° 1 Channel 40

		Level dBµV	Cable loss dB	Antenna factor dB	Electro-magnetic field (dBµV/m):	P* (W)
Normal test conditions	Nominal power source (V): 9	43.6	4.7	29.1	77.4	0.99×10^{-5}

Polarization of test antenna: horizontal (height: 163 cm)
Position of equipment: upright (azimuth: 158 degrees)

Sample n° 1 Channel 79

		Level dBµV	Cable loss dB	Antenna factor dB	Electro-magnetic field (dBµV/m):	P* (W)
Normal test conditions	Nominal power source (V): 9	44.6	4.75	29.2	78.55	1.3×10^{-5}

Polarization of test antenna: horizontal (height: 189 cm)
Position of equipment: upright (azimuth: 182 degrees)

* $P = (E \times d)^2 / (30 \times Gp)$ with d = 3 m and Gp = 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
Variac R213	Dereix	1419
Low-noise amplifier 18 to 26 GHz	ALC	3036

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 ($F_{carrier} \leq 10$ 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): 20.5
Relative humidity (%): 59

We used for power source the internal batteries of the equipment and we noted:
Voltage at the beginning of test (V): 9.3
Voltage at the end of test (V): 9.02
Voltage drop during the test (%):3

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)
206.47	QP	100	0	120	V	46.7	58.35	11.65
265.48	QP	179	0	120	V	45	46.02*	1.02
471.95	QP	100	0	120	V	37.1	58.35	21.25
530.96	QP	100	182	120	V	30.1	58.35	28.25

Channel 40

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)
206.47	QP	100	0	120	V	46.7	58.35	11.65
265.48	QP	179	0	120	V	45	46.02*	1.02
471.95	QP	100	0	120	V	37.1	58.35	21.25
530.96	QP	100	182	120	V	30.1	58.35	28.25

Channel 79

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)
206.47	QP	100	0	120	V	46.7	58.35	11.65
265.48	QP	179	0	120	V	45	46.02*	1.02
471.95	QP	100	0	120	V	37.1	58.35	21.25
530.96	QP	100	182	120	V	30.1	58.35	28.25

* restricted bands of operation in 15.205, this limit 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 78.35 dBµV/m on channel 79.

So the applicable limit is 58.35 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 necessary 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

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 2310 MHz to 2390 MHz, CURVE n° 1
Upper Band Edge: from 2483.5 MHz to 2500 MHz, CURVE n° 2

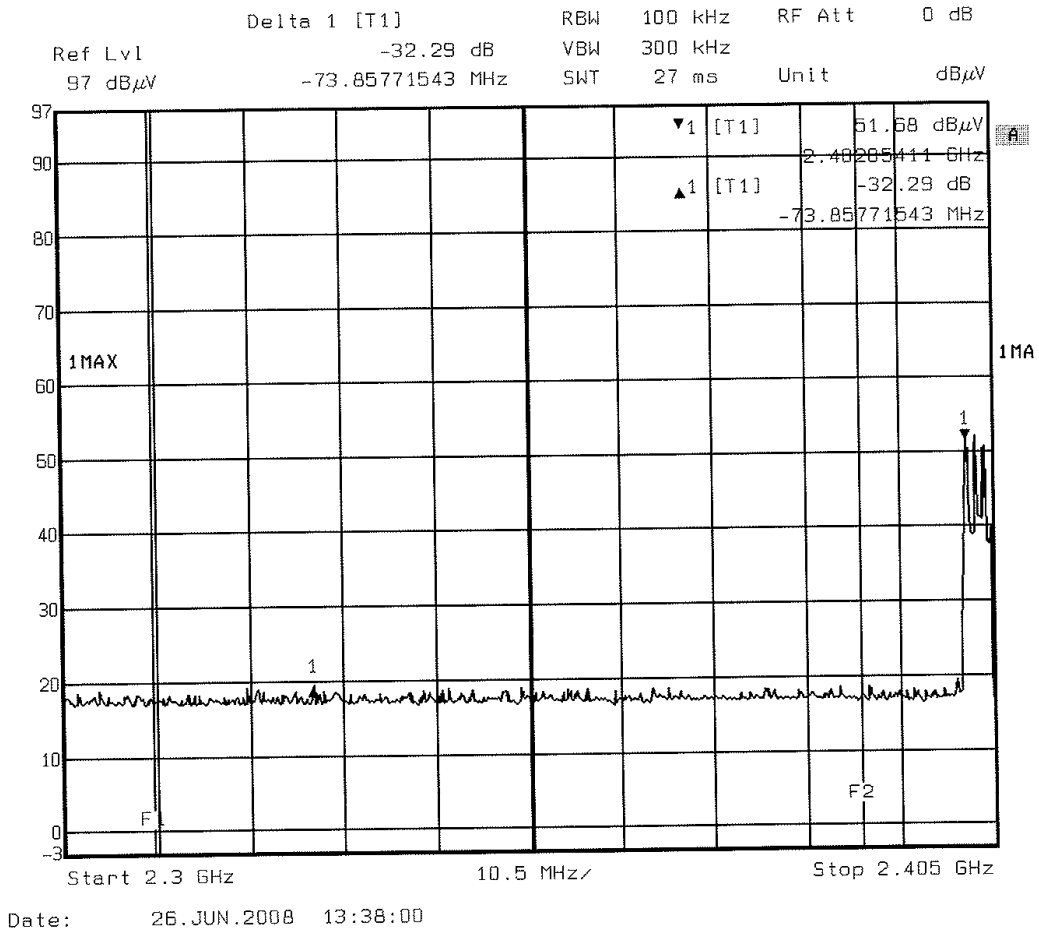
Sample n°1:

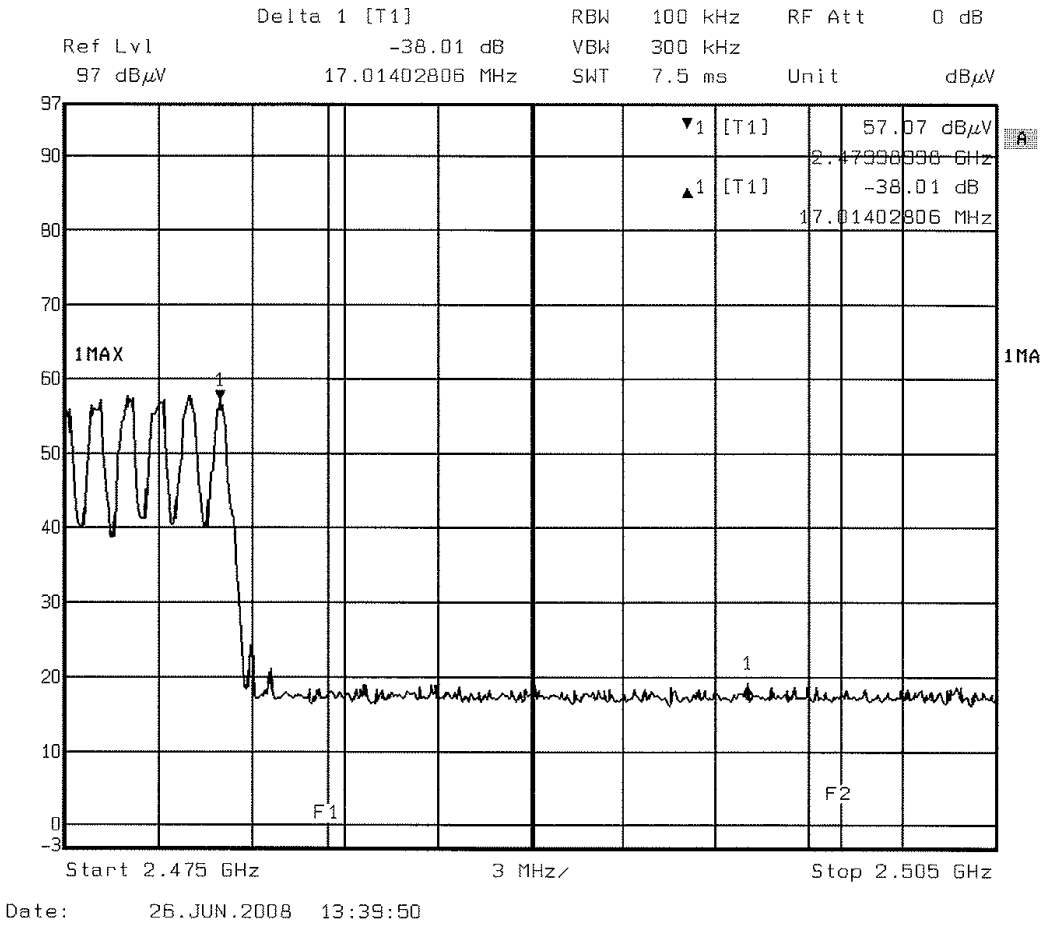
Fundamental frequency (MHz)	Field Strength Level of fundamental (dBµV/m)	Detector (Peak or Average)	Frequency of maximum Band-edges Emission (MHz)	Delta Marker (dB)*	Calculated Max Out of Band Emission Level (dBµV/m)**	Limit (dBµV/m)	Margin (dB)
2402	79.34	Peak	2328.196	-32.29	47.05 (1)	73.98	26.93
2480	78.55	Peak	2497.004	-38.01	40.54 (1)	73.98	33.44

* 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 (53.98 dBµV/m).

Test conclusion:

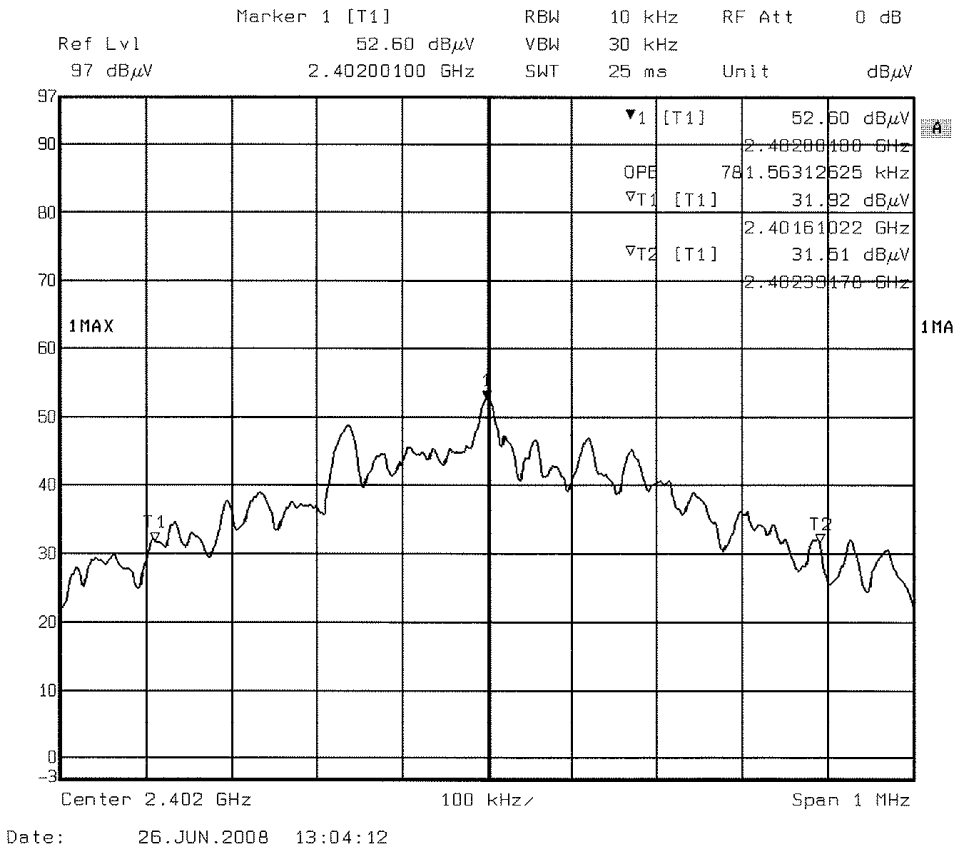
RESPECTED PUBLIC NOTICE

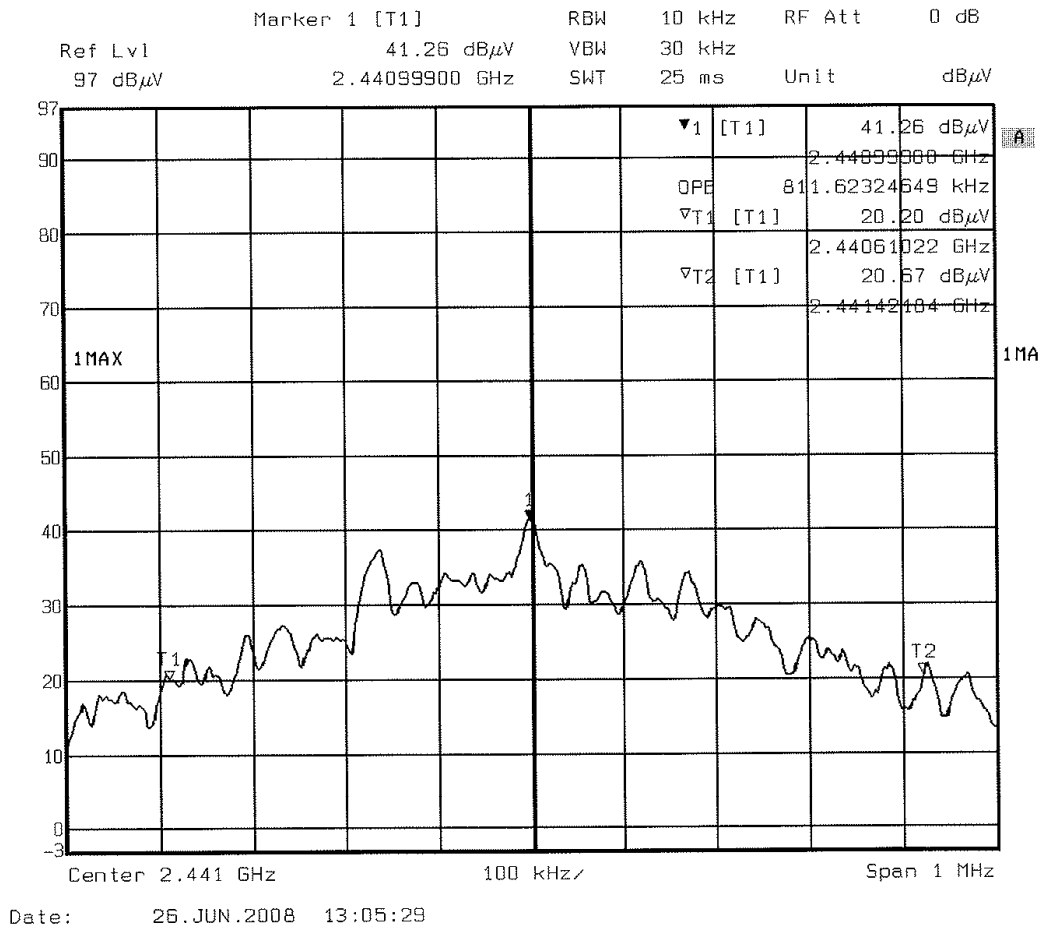

Delta 1 [T1]
-32.29 dB
-73.85771543 MHz
RBW 100 kHz
VBW 300 kHz
SWT 27 ms
RF Att 0 dB
Unit dBµV
Ref Lvl
97 dBµV
▼1 [T1] 51.68 dBµV
2.48285411 GHz
▲1 [T1] -32.29 dB
-73.85771543 MHz
1MAX
1MA
97
90
80
70
60
50
40
30
20
10
0
-3
F1
F2
Start 2.3 GHz
10.5 MHz/
Stop 2.405 GHz
Date: 26.JUN.2008 13:38:00

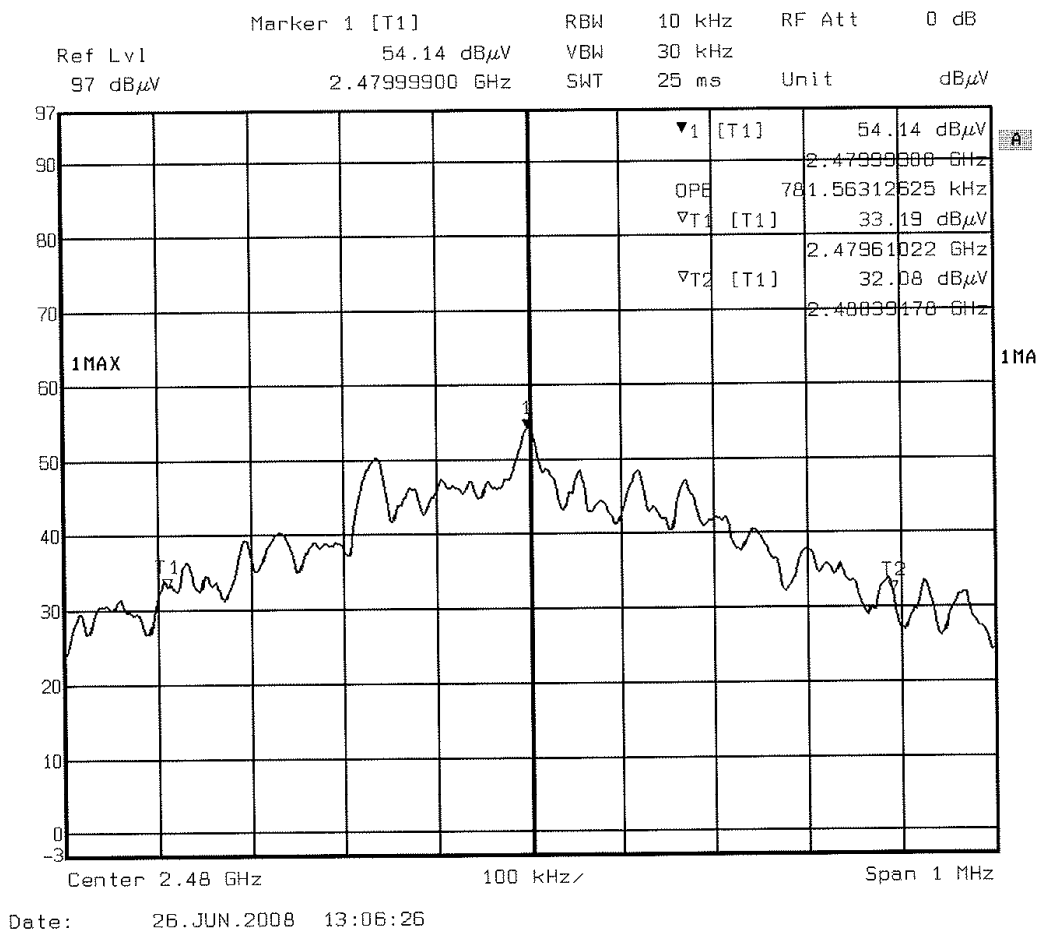


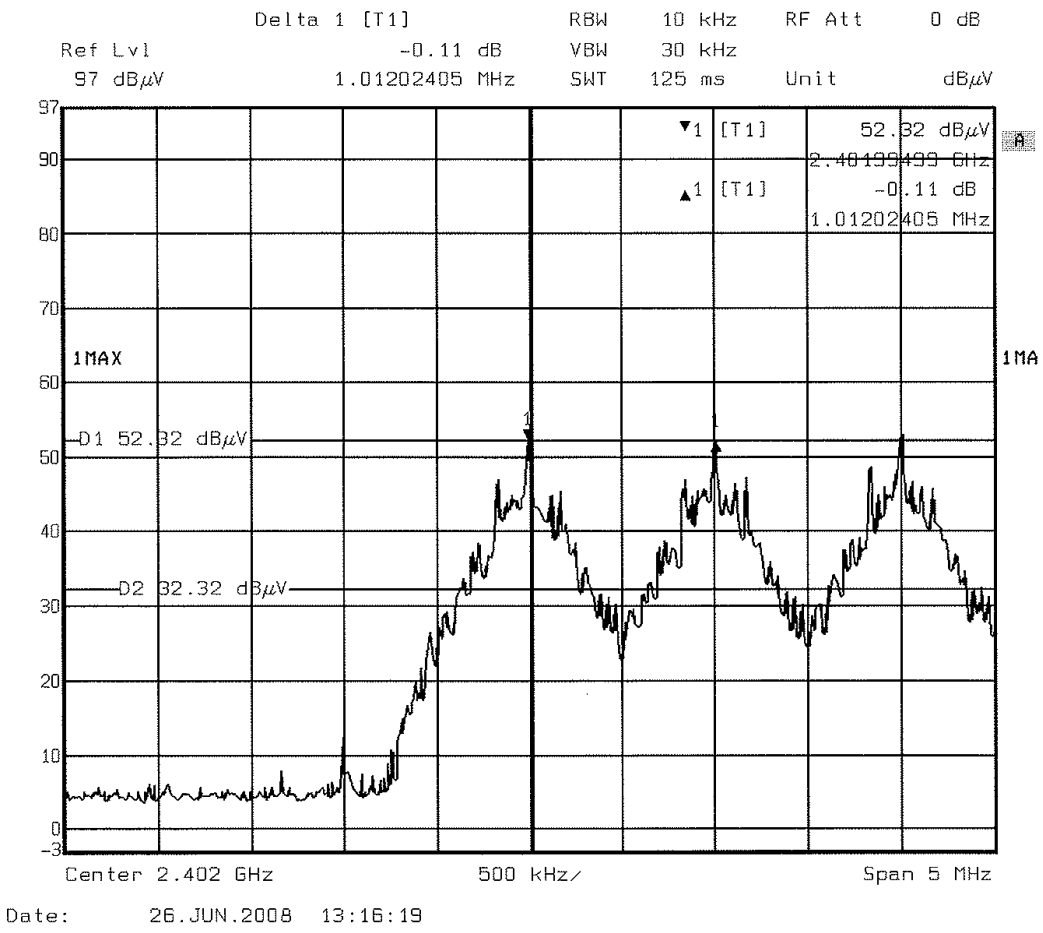
□□□ End of report, 5 annexes to be forwarded □□□

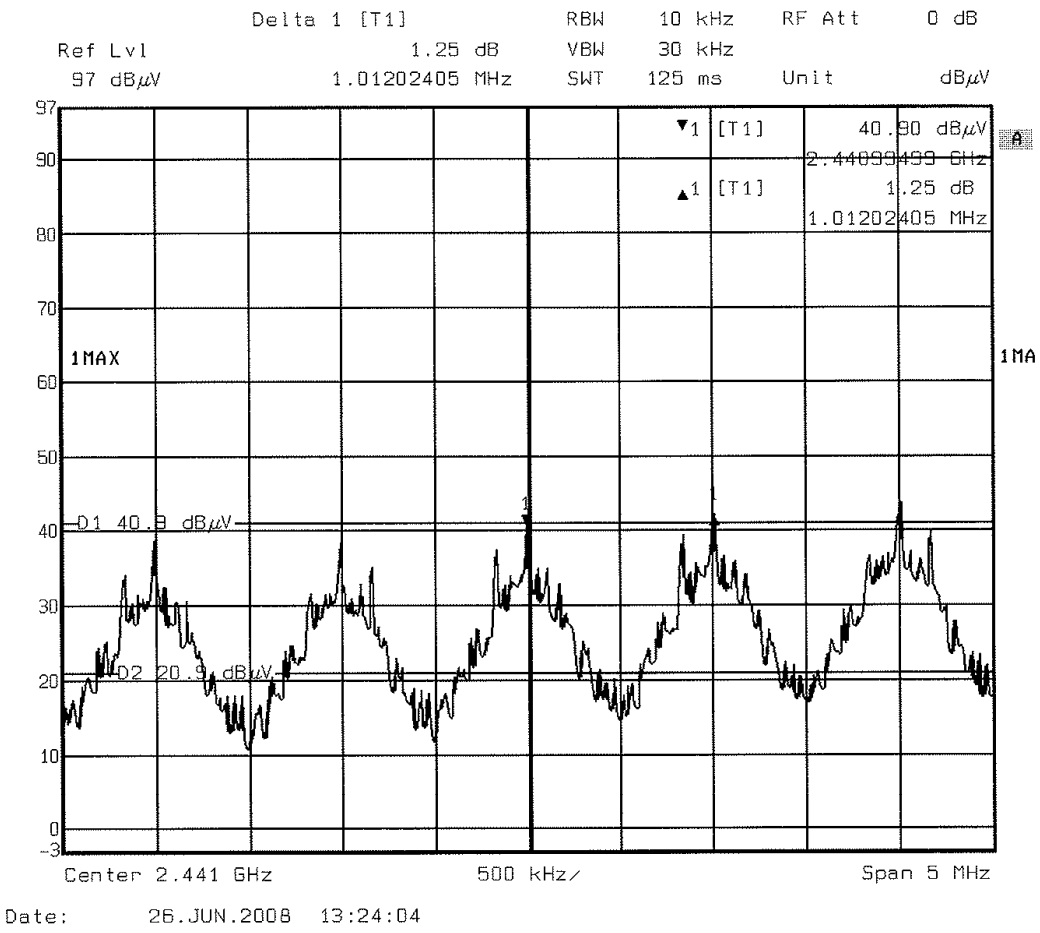
ANNEX 1: OCCUPIED POWER BANDWIDTH AND CHANNEL SEPARATION

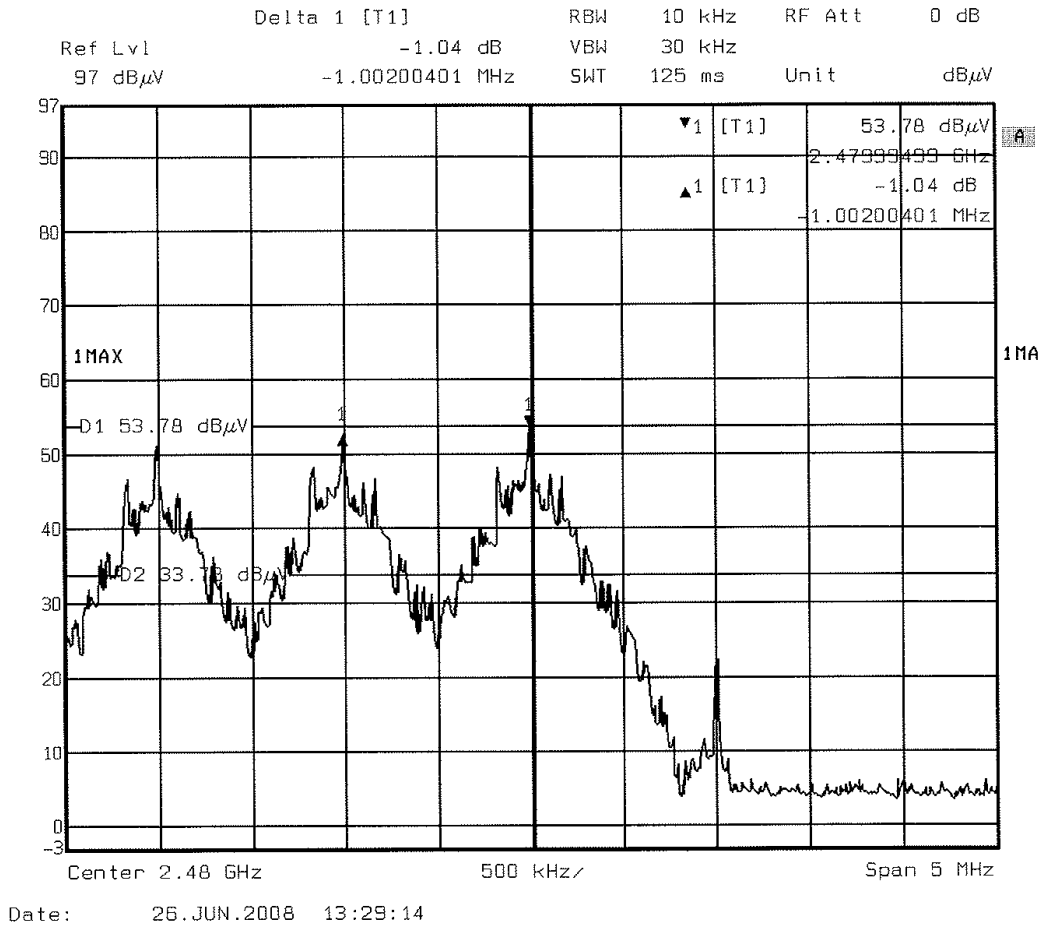



Marker 1 [T1]
RBW 10 kHz
RF Att 0 dB
Ref Lvl
41.26 dBµV
VBW 30 kHz
97 dBµV
2.44099900 GHz
SWT 25 ms
Unit dBµV
1 [T1] 41.26 dBµV
2.44099900 GHz
OPB 811.62324649 kHz
T1 [T1] 20.20 dBµV
2.44061022 GHz
T2 [T1] 20.67 dBµV
2.44142184 GHz
1MAX
1MA
97
90
80
70
60
50
40
30
20
10
0
-3
T1
T2
Center 2.441 GHz
100 kHz/
Span 1 MHz
Date: 26.JUN.2008 13:05:29

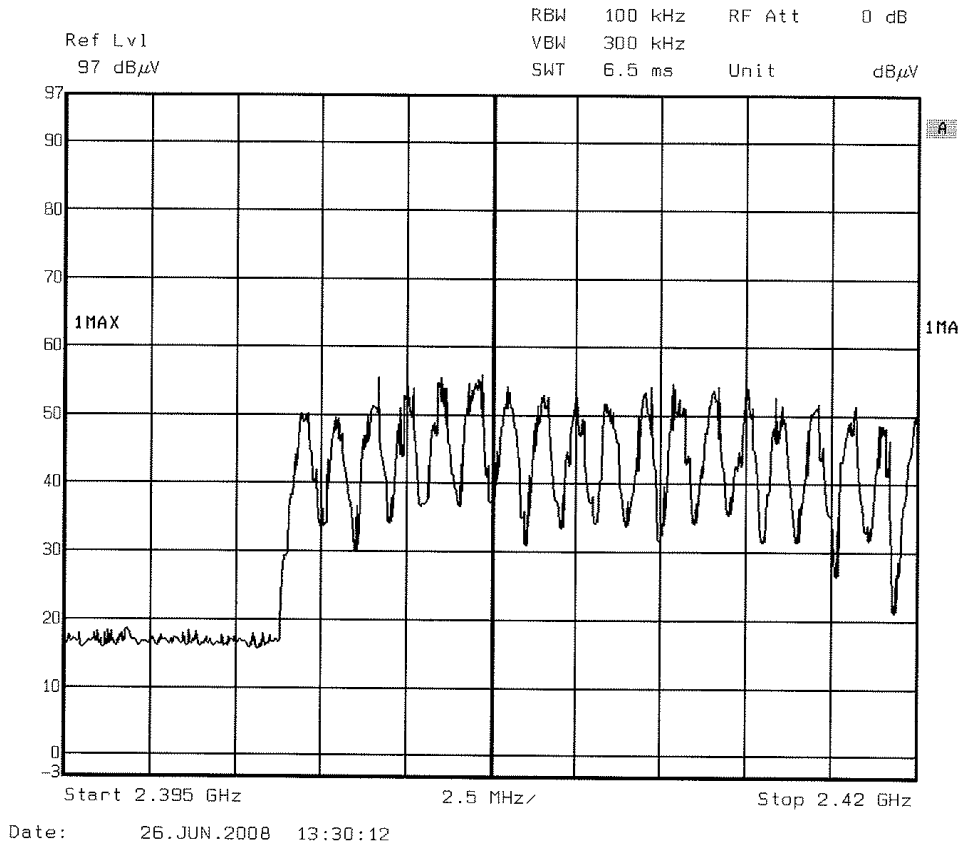

Marker 1 [T1]
RBW 10 kHz
RF Att 0 dB
Ref Lvl
54.14 dBµV
VBW 30 kHz
97 dBµV
2.47999900 GHz
SWT 25 ms
Unit dBµV
▼1 [T1] 54.14 dBµV
2.47999900 GHz
OPB 781.56312625 kHz
▽T1 [T1] 33.19 dBµV
2.47961022 GHz
▽T2 [T1] 32.08 dBµV
2.48039178 GHz
1MAX
1MA
97
90
80
70
60
50
40
30
20
10
0
-3
T1
T2
Center 2.48 GHz
100 kHz/
Span 1 MHz
Date: 26.JUN.2008 13:06:26

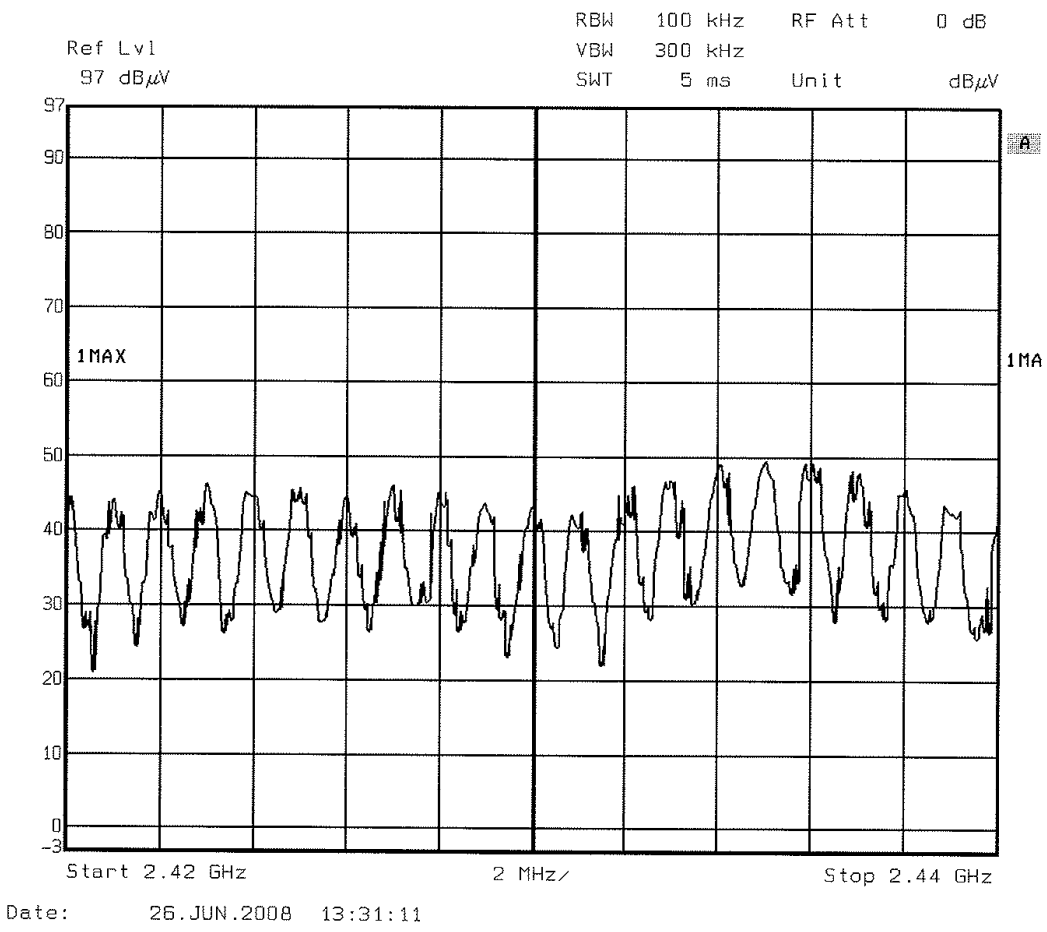

Delta 1 [T1]
RBW 10 kHz
RF Att 0 dB
Ref Lvl
-0.11 dB
VBW 30 kHz
97 dBµV
1.01202405 MHz
SWT 125 ms
Unit dBµV
1 [T1]
52.32 dBµV
2.40139499 GHz
1 [T1]
-0.11 dB
1.01202405 MHz
1MAX
1MA
D1 52.32 dBµV
D2 32.32 dBµV
97
90
80
70
60
50
40
30
20
10
0
-3
Center 2.402 GHz
500 kHz/
Span 5 MHz
Date: 26.JUN.2008 13:16:19

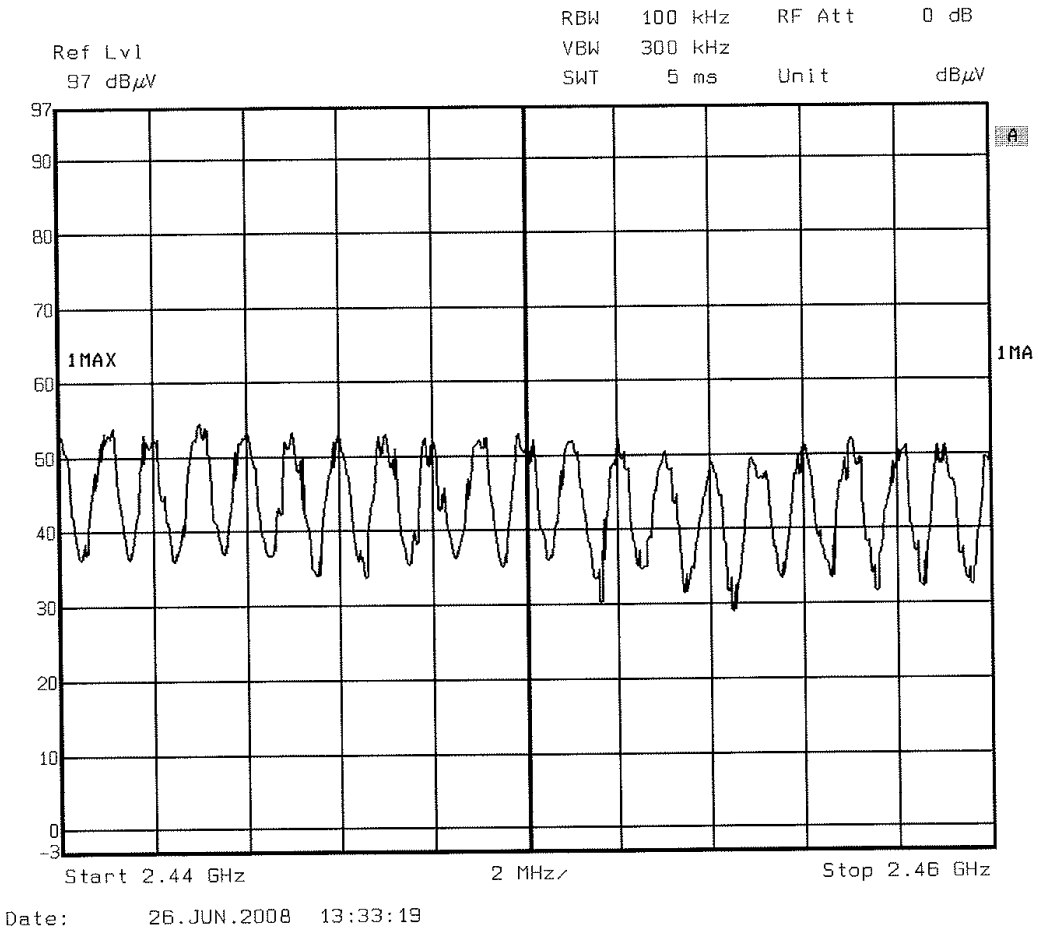

Delta 1 [T1]
RBW 10 kHz
RF Att 0 dB
Ref Lvl
1.25 dB
VBW 30 kHz
97 dBµV
1.01202405 MHz
SWT 125 ms
Unit dBµV
▼1 [T1]
40.90 dBµV
2.44099499 GHz
▲1 [T1]
1.25 dB
1.01202405 MHz
1MAX
1MA
D1 40.9 dBµV
D2 20.9 dBµV
Center 2.441 GHz
500 kHz/
Span 5 MHz
Date: 26.JUN.2008 13:24:04

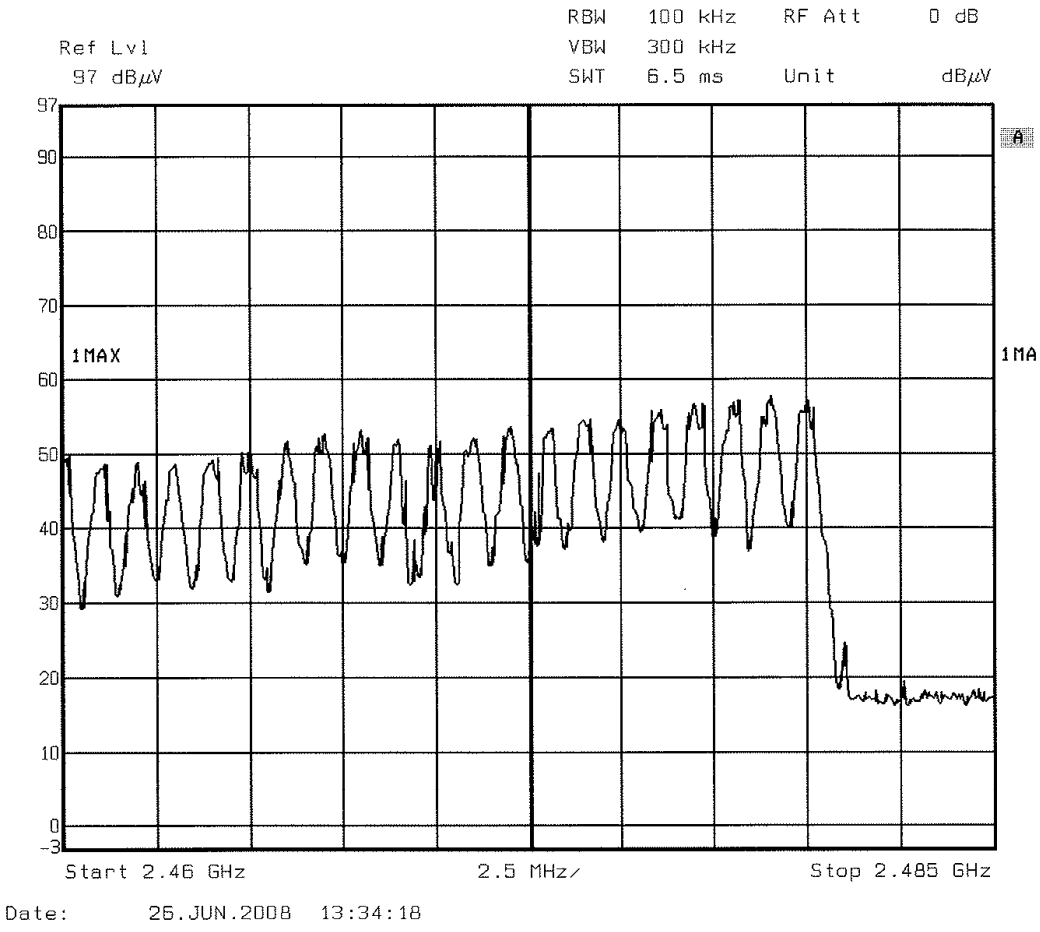

Delta 1 [T1]
RBW 10 kHz
RF Att 0 dB
Ref Lvl
-1.04 dB
VBW 30 kHz
97 dBµV
-1.00200401 MHz
SWT 125 ms
Unit dBµV
1 [T1] 53.78 dBµV
2.47999499 GHz
1 [T1] -1.04 dB
-1.00200401 MHz
1MAX
1MA
D1 53.78 dBµV
D2 33.78 dBµV
97
90
80
70
60
50
40
30
20
10
0
-3
Center 2.48 GHz
500 kHz/
Span 5 MHz
Date: 26.JUN.2008 13:29:14

ANNEX 2: NUMBER OF HOPPING FREQUENCIES

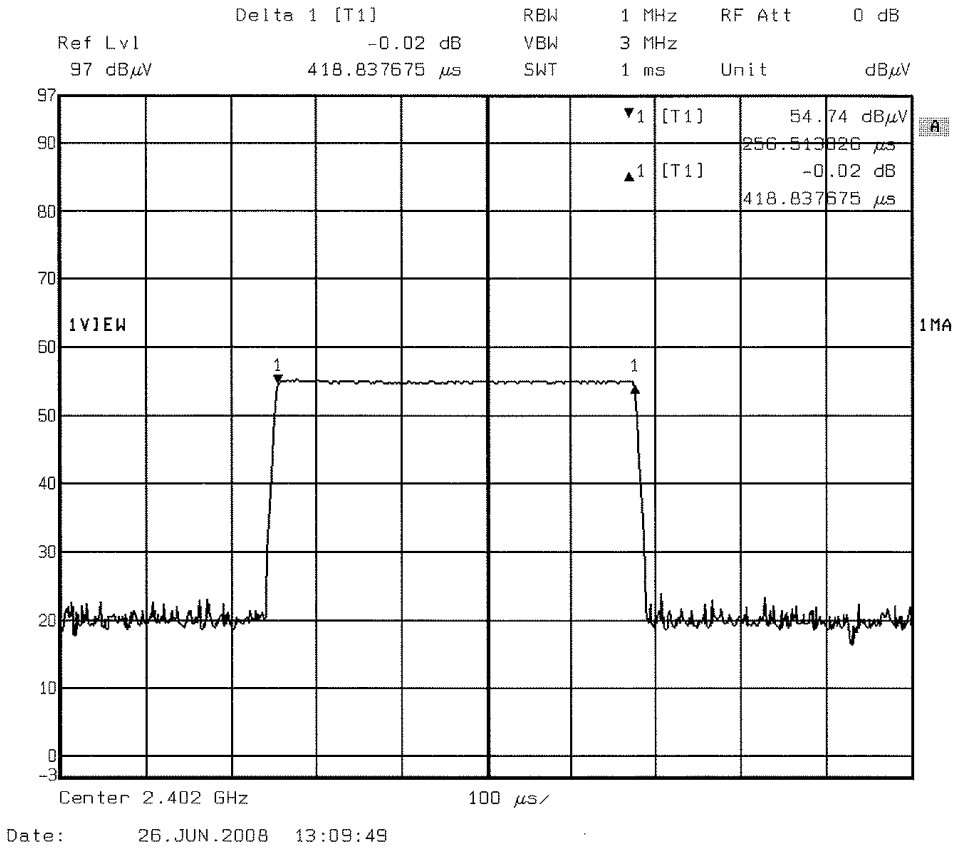


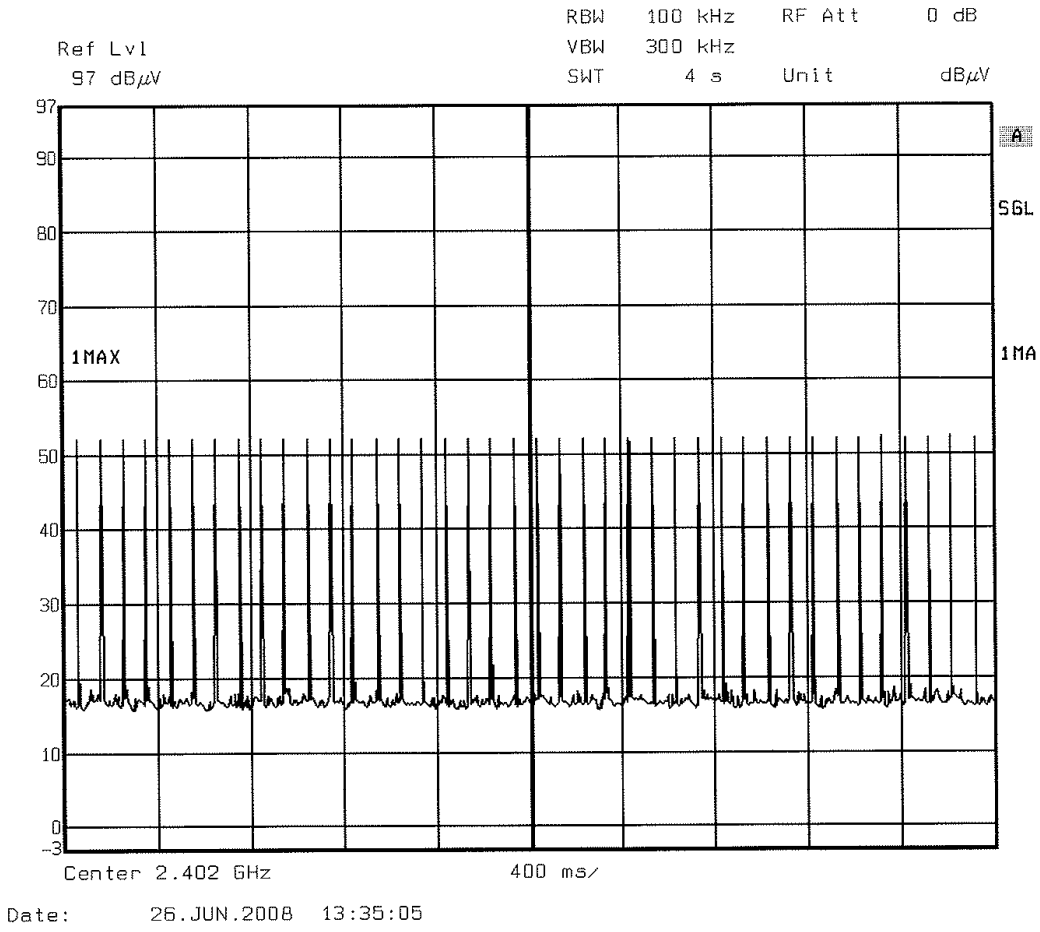

RBW 100 kHz
RF Att 0 dB
VBW 300 kHz
Ref Lvl
97 dBµV
SWT 5 ms
Unit dBµV
97
90
80
70
1MAX
60
50
40
30
20
10
0
-3
1MA
Start 2.42 GHz
2 MHz/
Stop 2.44 GHz
Date: 26.JUN.2008 13:31:11

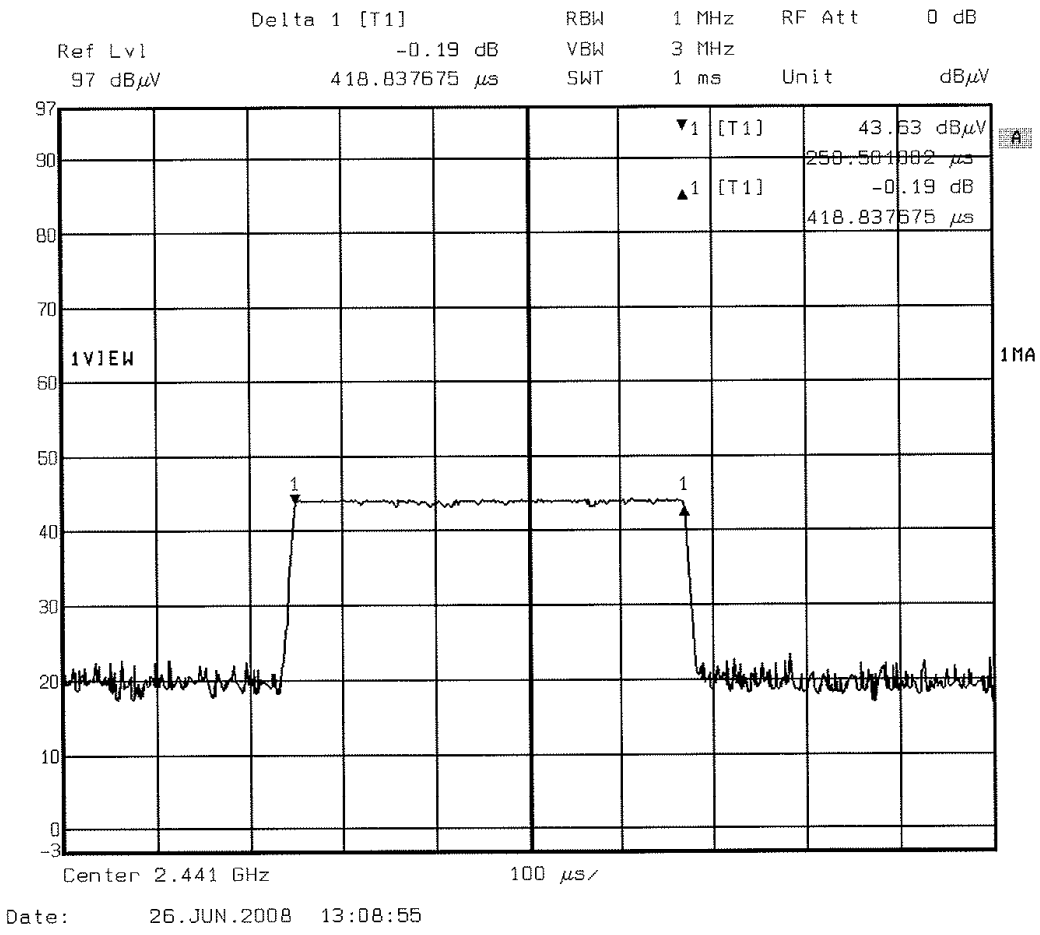

RBW 100 kHz
RF Att 0 dB
VBW 300 kHz
SWT 5 ms
Unit dBµV
Ref Lvl
97 dBµV
97
90
80
70
60
50
40
30
20
10
0
-3
1MAX
1MA
A
Start 2.44 GHz
2 MHz/
Stop 2.46 GHz
Date: 26.JUN.2008 13:33:19

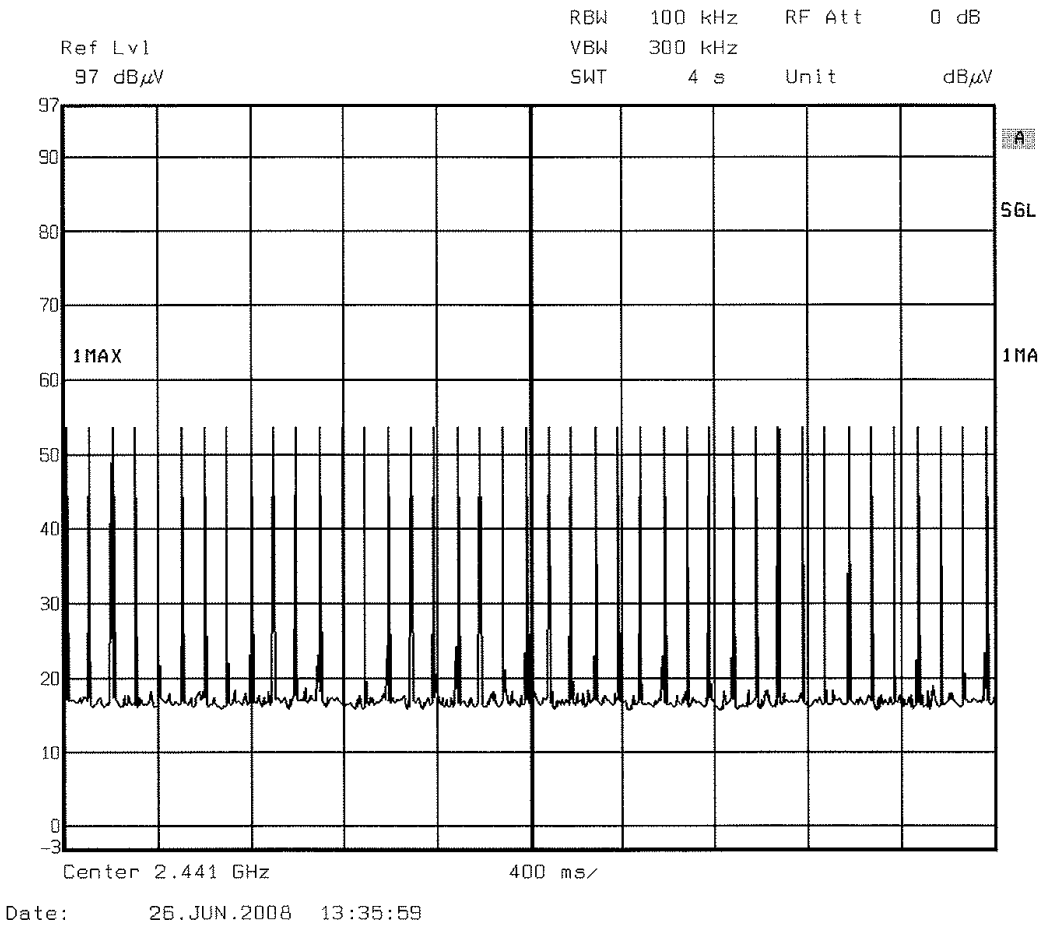

RBW 100 kHz
RF Att 0 dB
Ref Lvl
VBW 300 kHz
97 dBµV
SWT 6.5 ms
Unit dBµV
97
90
80
70
1MAX
1MA
60
50
40
30
20
10
0
-3
Start 2.46 GHz
2.5 MHz/
Stop 2.485 GHz
Date: 26.JUN.2008 13:34:18

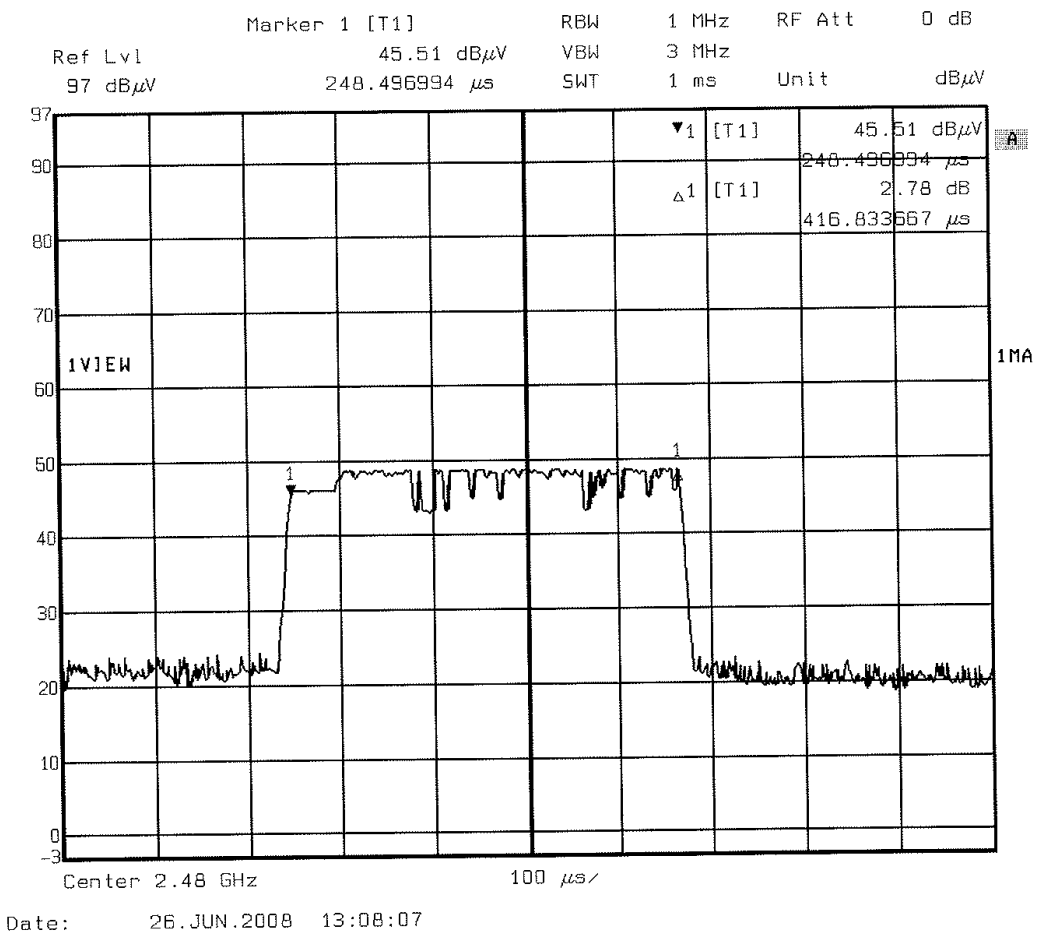
ANNEX 3: AVERAGE TIME OF OCCUPANCY ON ANY FREQUENCY

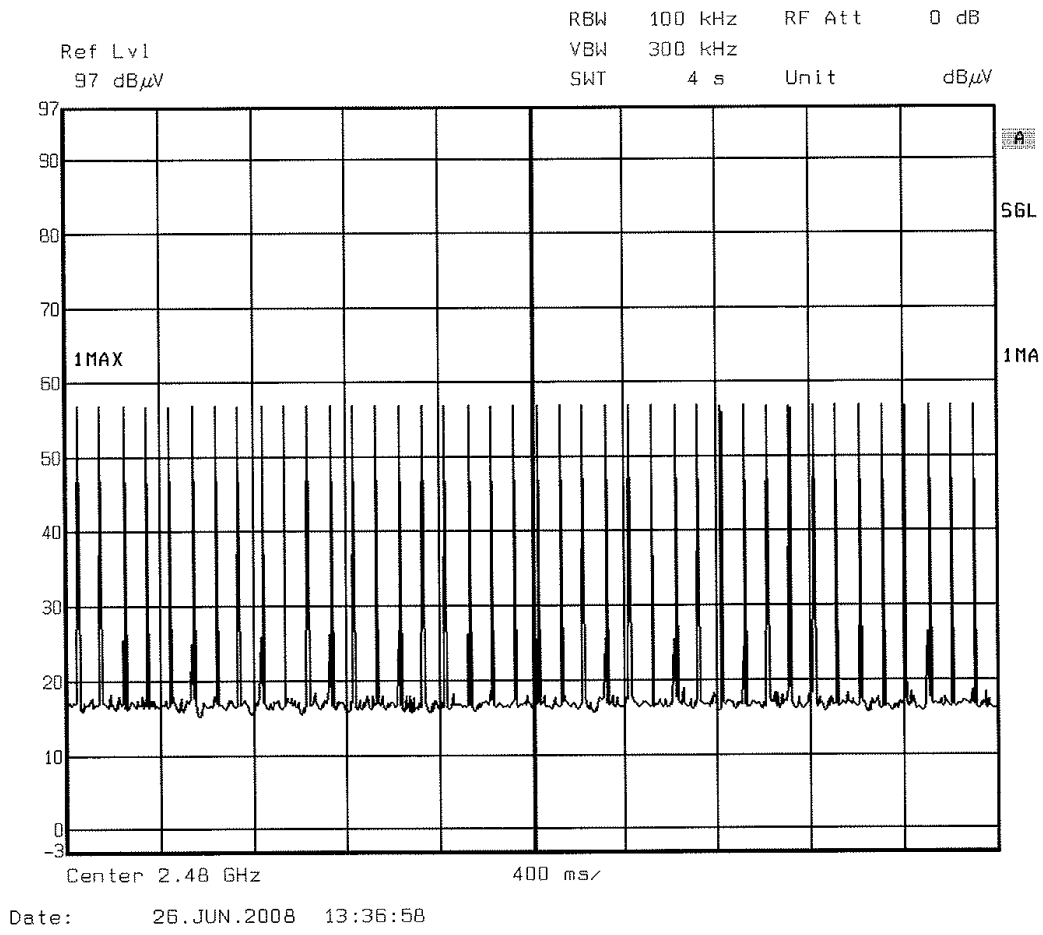



RBW 100 kHz
RF Att 0 dB
VBW 300 kHz
Ref Lvl
97 dBµV
SWT 4 s
Unit dBµV
97
90
80
70
60
50
40
30
20
10
0
-3
1MAX
A
SGL
1MA
Center 2.402 GHz
400 ms/
Date: 26.JUN.2008 13:35:05


Delta 1 [T1]
RBW 1 MHz
RF Att 0 dB
Ref Lvl
-0.19 dB
VBW 3 MHz
97 dBµV
418.837675 µs
SWT 1 ms
Unit dBµV
1 [T1] 43.63 dBµV
250.501002 µs
1 [T1] -0.19 dB
418.837675 µs
1VIEW
1MA
97
90
80
70
60
50
40
30
20
10
0
-3
Center 2.441 GHz
100 µs/
Date: 26.JUN.2008 13:08:55


RBW 100 kHz
RF Att 0 dB
Ref Lvl
VBW 300 kHz
97 dBµV
SWT 4 s
Unit dBµV
97
90
80
70
60
50
40
30
20
10
0
-3
1MAX
A
SGL
1MA
Center 2.441 GHz
400 ms/
Date: 26.JUN.2008 13:35:59

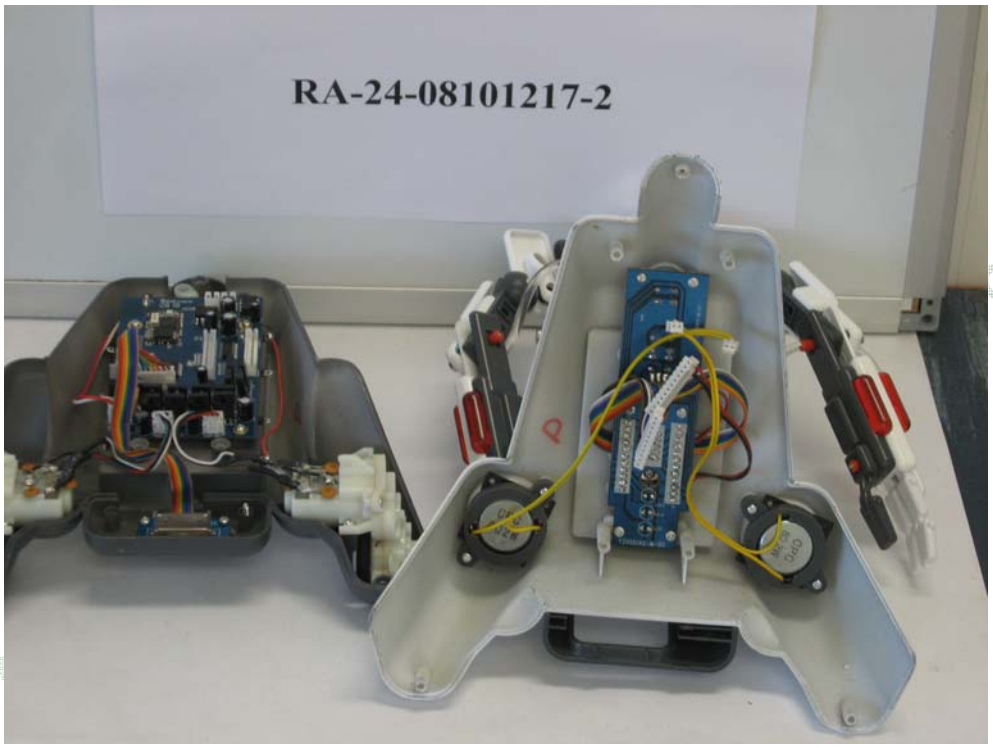

Marker 1 [T1]
RBW 1 MHz
RF Att 0 dB
Ref Lvl
45.51 dBµV
VBW 3 MHz
97 dBµV
248.496994 µs
SWT 1 ms
Unit dBµV
▼1 [T1] 45.51 dBµV
248.496994 µs
Δ1 [T1] 2.78 dB
416.833667 µs
A
1VIEW
1MA
97
90
80
70
60
50
40
30
20
10
0
-3
Center 2.48 GHz
100 µs/
Date: 26.JUN.2008 13:08:07


RBW 100 kHz
RF Att 0 dB
VBW 300 kHz
Ref Lvl
97 dBµV
SWT 4 s
Unit dBµV
97
90
80
70
60
50
40
30
20
10
0
-3
1MAX
S6L
1MA
Center 2.48 GHz
400 ms/
Date: 26.JUN.2008 13:36:58

ANNEX 4: PHOTOS OF THE EQUIPMENT UNDER TEST

GENERAL VIEW

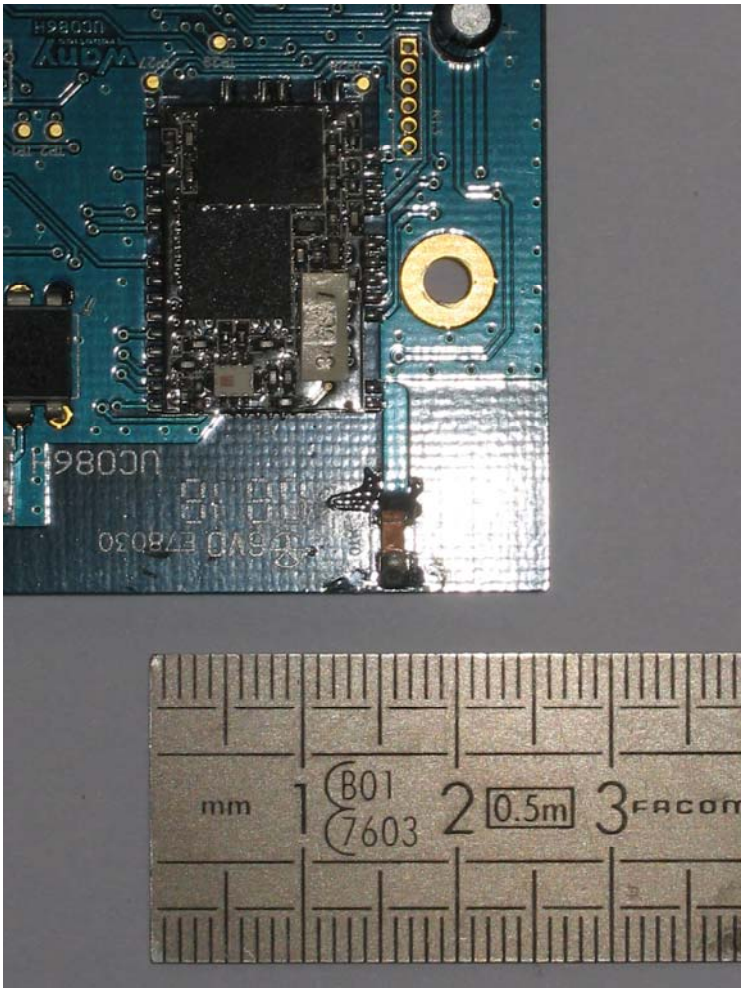
INTERNAL VIEW



Printed circuit board: face 1

Printed circuit board: face 2

Antenna



ANNEX 5: TEST SET UP AND OPEN AREA TEST SITE

Test set up

Open area test site