RA-24-07103070-1/A Ed. 0

FCC CERTIFICATION
RADIO Measurement
Technical Report

standard to apply:
FCC Part 15.247

Equipment under test:
3M WIRELESS SYSTEM / BASE STATION

FCC ID :
VJV-9008251

Company:
TES ELECTRONIC SOLUTION

DISTRIBUTION: Mr LE MERDY **Company: TES ELECTRONIC SOLUTION**

Number of pages: 44 including 5 annexes

Ed.	Date	Modified pages	Written by Name	Visa	Technical Verification Quality Approval Name	Visa
0	19-Oct-07	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:	**3M WIRELESS SYSTEM / BASE STATION**
Reference / model:	9008251
Serial number:	not communicated
MANUFACTURER:	TES ELECTRONIC SOLUTION

COMPANY SUBMITTING THE PRODUCT:

Company:	TES ELECTRONIC SOLUTION
Address:	Centre d'Affaires l'Odyssée ZAC de Cicé-Blossac 35170 BRUZ FRANCE
Responsible:	Mr LE MERDY
DATE(S) OF TEST:	03, 11, 12, 20, 21 and 23 July 2007 3 and 4 October 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 L. BERTHAUD Y. JUDEAUX
TUTOR:	P. BONNENFANT

CONTENTS

TITLE **PAGE**

1. INTRODUCTION

This document presents the result of RADIO test carried out on the following equipment: 3M WIRELESS SYSTEM / BASE STATION in accordance with normative reference.

2. PRODUCT DESCRIPTION

Class: B (residential environment)

Antenna type: dedicated antenna

Operating frequency range: from 2401.92 MHz to 2479.68 MHz

Number of channels: 75

Channel spacing: 900 kHz

Modulation: Frequency Hopping Spread Spectrum (FHSS)

O Amplitude O Digital ⊙ Frequency O Phase

Power source: 115 Va.c. (mains)

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 2400-2483.5 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 2400-2483.5 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: dedicated 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 (see annex 1).
Channel 1 = 504 kHz
Channel 47 = 540 kHz
Channel 91 = 554.4 kHz

Note 4: the frequency hopping system uses 75 channels (see annex 3).
The timing by channel is 844 µs. During 75 channels × 0.4 s (part 15) = 30 s, any channel is used 40 times, then 40 x 844 µs = 33.76 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 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 3M WIRELESS SYSTEM / BASE STATION 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. MEASUREMENT OF THE CONDUCTED DISTURBANCES

Standard: FCC Part 15

Test procedure: Paragraph 15.207

Limits: Class B

Test equipment:

TYPE	BRAND	EMITECH NUMBER
Test receiver ESH3	Rohde & Schwarz	1058
Pulse limiter ESH3-Z2	Rohde & Schwarz	976
Artificial main network L3-25	PMM	834
Spectrum analyzer 8594E	Hewlett Packard	1030
Power source ALT 2000	K. SERRAS	2441
Transient limiter	Hewlett Packard	2565

Software used: BAT-EMC V3.1.7.1

Test set up:

The test unit is placed on a wooden table, 0.8 m over an horizontal reference plane and 0.4 m from a vertical reference plane. It is powered by an artificial main network placed on the ground reference plane (see photos in annex 5).

Equipment under test operating condition:

The equipment is powered with the AC power operating voltage of 115 V / 60 Hz.

Frequency range: 150 kHz - 30 MHz

Detection mode: Peak / Average

Bandwidth: 9 kHz

Results:

Measurement on the mains power supply:

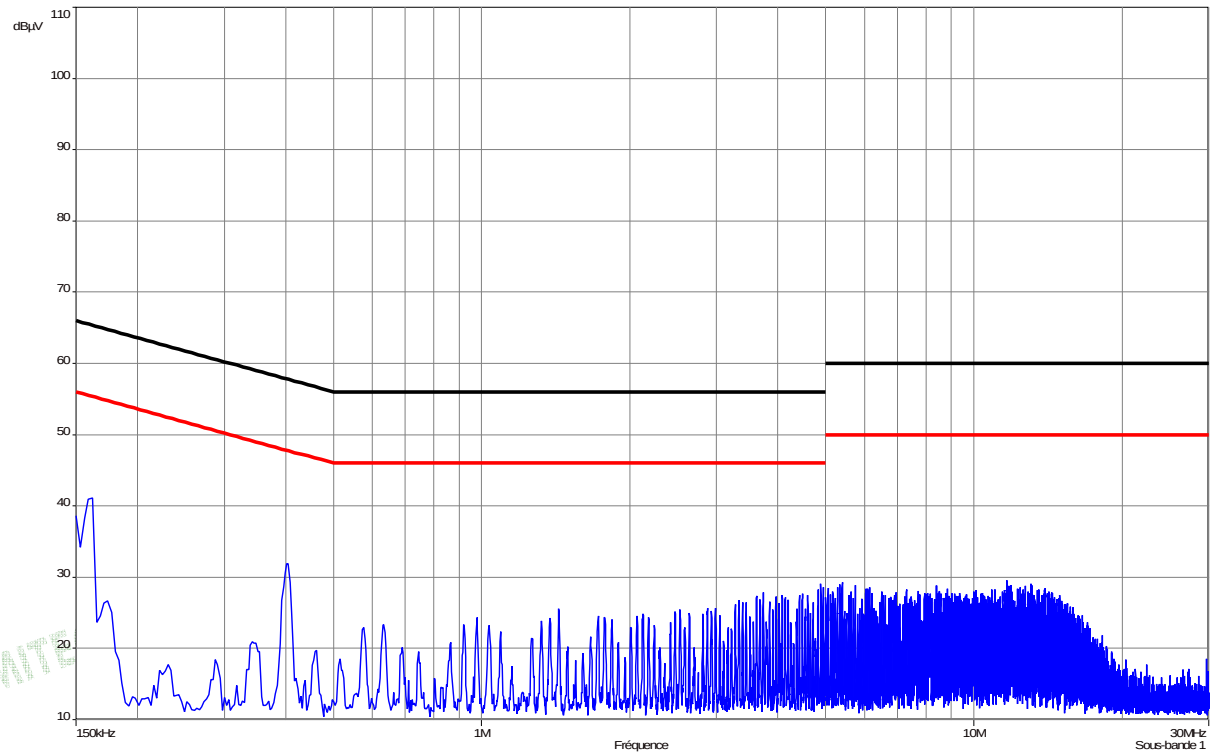
The measurement is made with peak detector.

Curve N° 1: measurement on the Neutral with peak detector
Curve N° 2: measurement on the Line with peak detector

The spectrum line which are less than 6 dB of the limit are analyzed with Quasi-Peak detector and average detector.

CURVE N° 1.

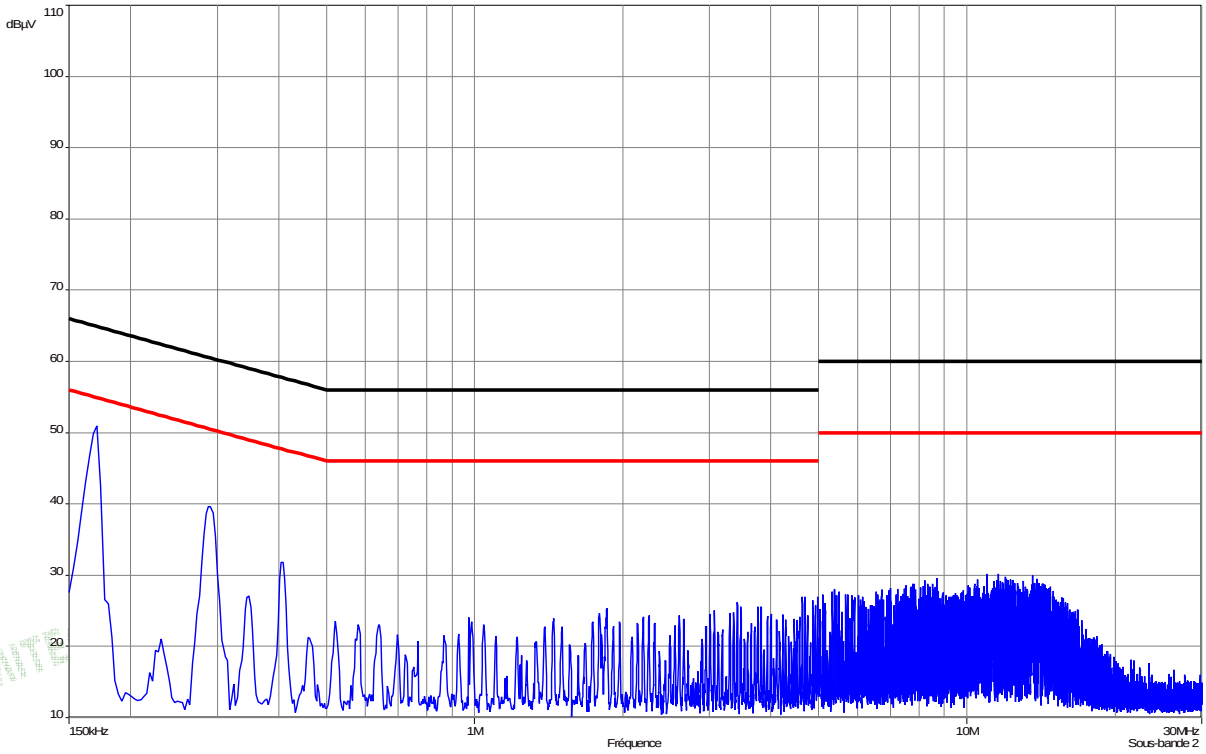
Measurement on the Neutral with peak detector



RBW filter: 10 kHz
VBW filter: 30 kHz
Time sweep: 500 ms/MHz

CURVE N° 2.

Measurement on the Line with peak detector



RBW filter: 10 kHz
VBW filter: 30 kHz
Time sweep: 500 ms/MHz

Test conclusion:

RESPECTED STANDARD

8. 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
Diode detector ODZ0004A	Omniyig	2469
Oscilloscope THS 720	Tektronix	0940
Antenna RGA60	Electrometrics	1938
Antenna RGA60	Electrometrics	1204
Open site	EMITECH	1274
Radio frequency generator SME06	Rohde & Schwarz	1669
High pass filter HPM11630	Micro-tronics	1673
Low-noise amplifier 1 to 18 GHz	ALC	2648
Power meter 8541B	Gigatronics	3479
Power sensor 80401A	Gigatronics	3182
Variac R213	Dereix	1419
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.
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 spectrum analyzer is first replaced by a diode detector which is connected to the vertical channel of an oscilloscope.
The equipment under test is then substituted by a signal generator with a calibrated double ridged guide antenna, and its level adjusted such that the deviation of the Y-trace of the oscilloscope reaches the level obtained with the E.U.T.
The output power level of the signal generator is finally measured with a calibrated RF power meter.

Then a 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): 19.5
Relative humidity (%): 70

Power source: 115 Va.c. through a variac

Sample n° 1 Hopping mode

Polarization of test antenna: horizontal (height: 100 cm)
Position of equipment: wall position (azimuth: 70 degrees)

		Peak Output Power radiated at these frequencies (W): from 2401.92 MHz to 2479.68 MHz	Limits (W)
Normal test conditions	Nominal power source (V): 115	123.026×10^{-3}	1*

* the frequency hopping systems use at least 75 hopping channel.

Sample n° 1 Channel 1 (2401.92 MHz)

		Level dBµV	Cable loss dB	Antenna factor dB	Electro-magnetic field (dBµV/m):	P* (W)
Normal test conditions	Nominal power source (V): 115	82.33	4.98	28.90	116.21	125.35×10^{-3}

Sample n° 1 Channel 47 (2441.66 MHz)

		Level dBµV	Cable loss dB	Antenna factor dB	Electro-magnetic field (dBµV/m):	P* (W)
Normal test conditions	Nominal power source (V): 115	83.21	5.05	29	117.26	159.63×10^{-3}

Sample n° 1 Channel 91 (2479.68 MHz)

		Level dBµV	Cable loss dB	Antenna factor dB	Electro-magnetic field (dBµV/m):	P* (W)
Normal test conditions	Nominal power source (V): 115	82.26	5.12	29.10	116.48	133.39×10^{-3}

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

Test conclusion:

RESPECTED STANDARD

9. 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
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.

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): 19.5
Relative humidity (%): 74

Power source: 115 Va.c. through a variac

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

Channel 1 (2401.92 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)
228.10	QP	215	0	120	V	23.4	97.08	73.68
250	QP	186	160	120	V	31.8	46.02*	14.22
300	QP	175	0	120	V	43.4	97.08	53.68
400	QP	209	0	120	H	31	46.02*	15.02
500	QP	100	186	120	V	45.9	97.08	51.18
560	QP	124	50	120	H	37.7	97.08	59.38
600	QP	125	60	120	H	41.8	97.08	55.28
665	QP	100	69	120	H	35.5	97.08	61.58
675	QP	100	50	120	H	39	97.08	58.08
700	QP	100	144	120	H	43	97.08	54.08
775	QP	152	18	120	H	40.8	97.08	56.28
791.99	QP	126	340	120	V	45	97.08	52.08
4803.85	Pk	170	0	1000	V	59.41	73.98*	14.57
4803.85	Avg	170	0	1000	V	36.11	53.98*	17.87
7205.73	Pk	220	342	100	V	61.58	97.08	35.5
8407.17	Pk	200	46	1000	V	59.72	73.98*	14.26
8407.17	Avg	200	46	1000	V	44.18	53.98*	9.8
9608.23	Pk	240	0	100	V	62.59	97.08	34.49
12009.75	Pk	240	0	1000	V	68.02	73.98*	5.96
12009.75	Avg	240	0	1000	V	48.96	53.98*	5.02

Channel 47 (2441.66 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)
228.10	QP	215	0	120	V	23.4	97.08	73.68
250	QP	186	160	120	V	31.8	46.02*	14.22
300	QP	175	0	120	V	43.4	97.08	53.68
400	QP	209	0	120	H	31	46.02*	15.02
500	QP	100	186	120	V	45.9	97.08	51.18
560	QP	124	50	120	H	37.7	97.08	59.38
600	QP	125	60	120	H	41.8	97.08	55.28
665	QP	100	69	120	H	35.5	97.08	61.58
675	QP	100	50	120	H	39	97.08	58.08
700	QP	100	144	120	H	43	97.08	54.08
775	QP	152	18	120	H	40.8	97.08	56.28
791.99	QP	126	340	120	V	45	97.08	52.08
4883.18	Pk	180	312	1000	V	58.17	73.98*	15.81
4883.18	Avg	180	312	1000	V	36.82	53.98*	17.16
7325.28	Pk	163	339	1000	V	68.28	73.98*	5.7
7325.28	Avg	163	339	1000	V	43.19	53.98*	10.79
8546.08	Pk	200	66	100	H	57.11	97.08	39.97
9767.10	Pk	237	354	100	V	62.98	97.08	34.1
12208.19	Pk	220	20	1000	V	64.46	73.98*	9.52
12208.19	Avg	220	20	1000	V	48.36	53.98*	5.62

Channel 91 (2479.68 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)
228.10	QP	215	0	120	V	23.4	97.08	73.68
250	QP	186	160	120	V	31.8	46.02*	14.22
300	QP	175	0	120	V	43.4	97.08	53.68
400	QP	209	0	120	H	31	46.02*	15.02
500	QP	100	186	120	V	45.9	97.08	51.18
560	QP	124	50	120	H	37.7	97.08	59.38
600	QP	125	60	120	H	41.8	97.08	55.28
665	QP	100	69	120	H	35.5	97.08	61.58
675	QP	100	50	120	H	39	97.08	58.08
700	QP	100	144	120	H	43	97.08	54.08
775	QP	152	18	120	H	40.8	97.08	56.28
791.99	QP	126	340	120	V	45	97.08	52.08
4961.10	Pk	221	0	1000	V	60.89	73.98*	13.09
4961.10	Avg	221	0	1000	V	38.04	53.98*	15.94
7441.73	Pk	162	329	1000	V	66.96	73.98*	7.02
7441.73	Avg	162	329	1000	V	43.5	53.98*	10.48
8682.31	Pk	199	59	100	H	57.25	97.08	39.83
9922.58	Pk	196	9	100	V	62.38	97.08	34.7
12402.77	Pk	200	0	1000	V	66.33	73.98*	7.65
12402.77	Avg	200	0	1000	V	48.63	53.98*	5.35

* 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 117.08 dBµV/m on channel 47.

So the applicable limit is **97.08 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

10. 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
Variac R213	Dereix	1419

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 (53.98 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° 3 and CURVE n° 4
Upper Band Edge: from 2483.5 MHz to 2500 MHz, CURVE n° 5 and CURVE n° 6

Sample n°1:

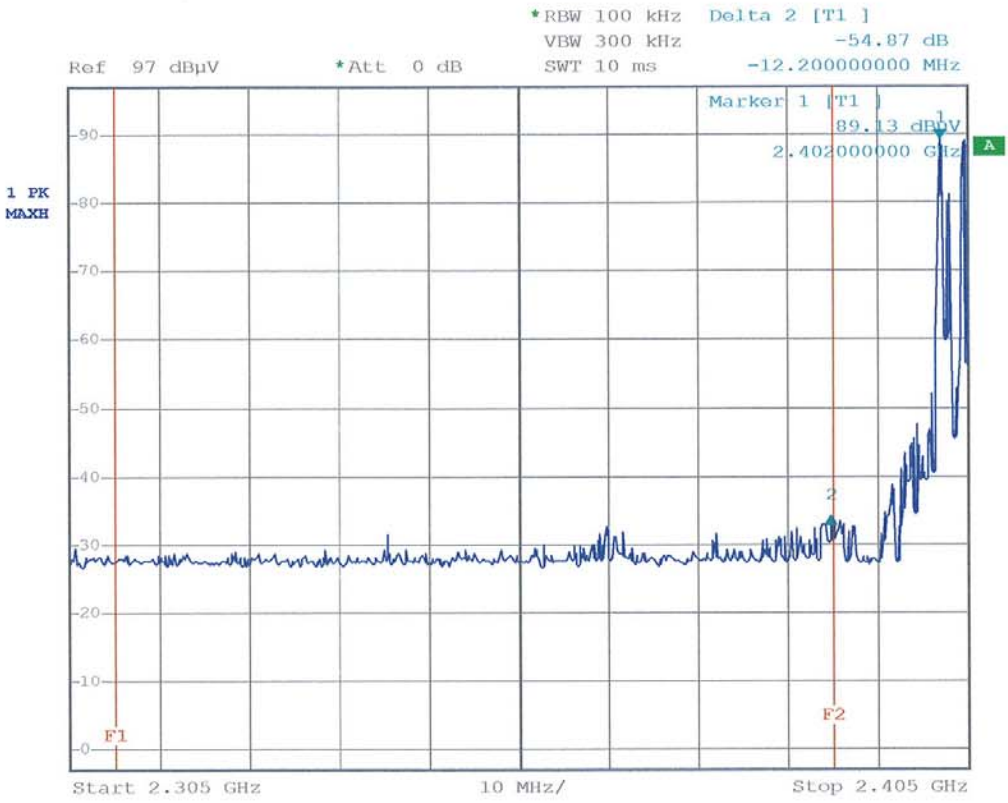
Fundamental frequency (MHz)	Field Strength Level of fundamental (dBµV/m)	Detector (Peak or Average)	Frequency of maximum Band-edges Emission (MHz)	Delta Marker (dB)*	Calculated Max Out of Band Emission Level (dBµV/m)**	Limit (dBµV/m)	Margin (dB)
2401.92	116.24	Peak	2389.8	-54.87	61.37	73.98	12.61
2401.92	96.86	Average	2365.6	-45.12	45.74	53.98	8.24
2479.68	116.47	Peak	2483.7	-48.72	67.75	73.98	6.23
2479.68	90.35	Average	2489.22	-59.05	31.3	53.98	22.68

* 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

CURVE N° 3.



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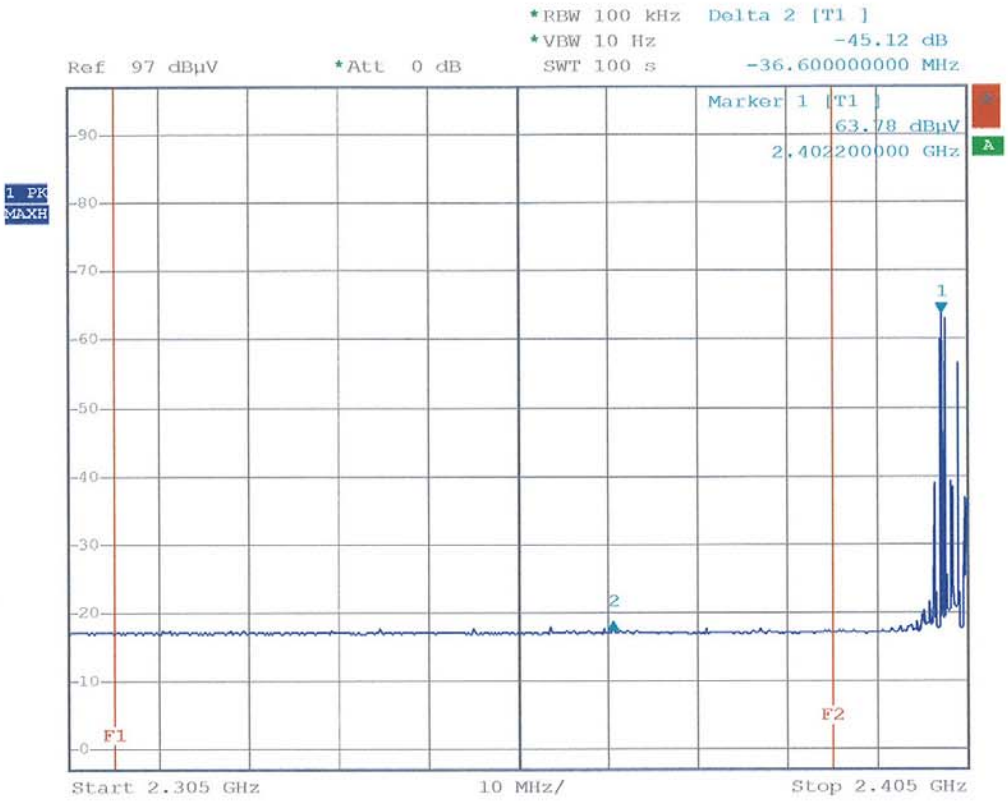

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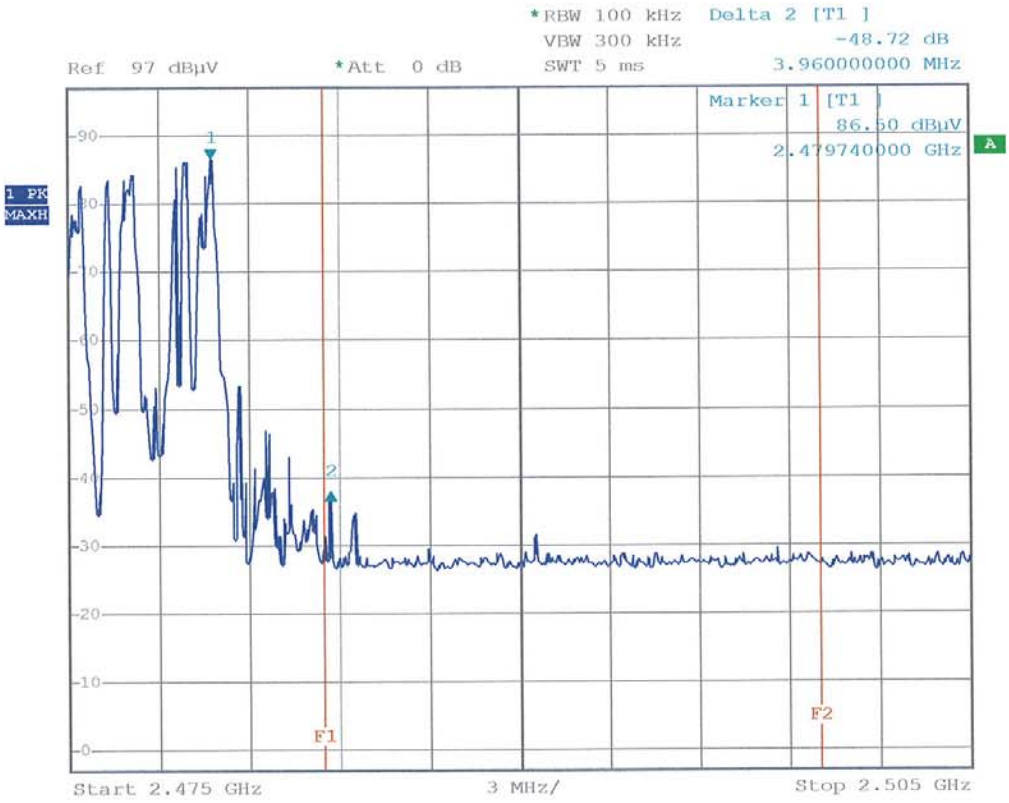

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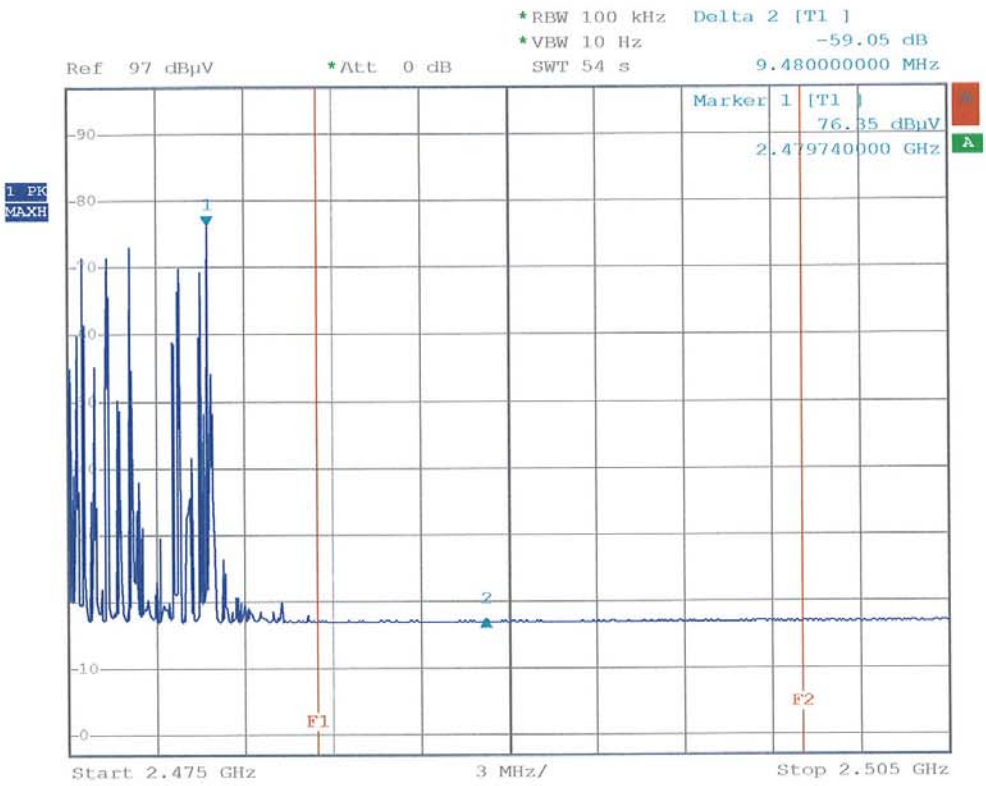

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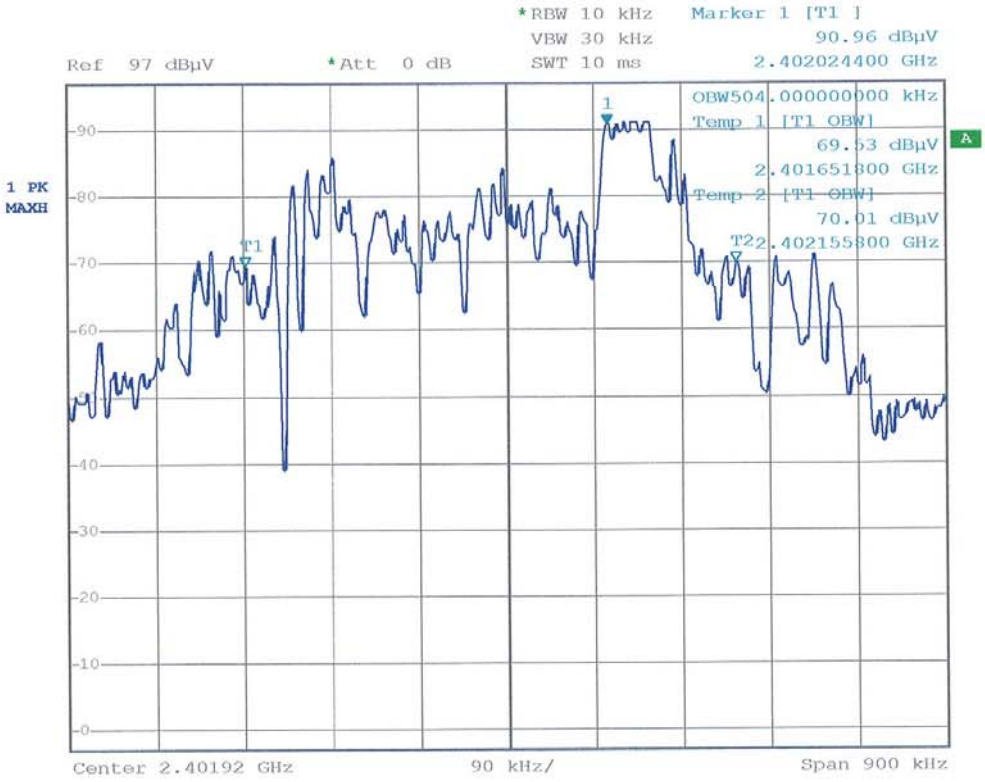
□□□ End of report, 5 annexes to be forwarded □□□

ANNEX 1: OCCUPIED POWER BANDWIDTH AND CHANNEL SEPARATION



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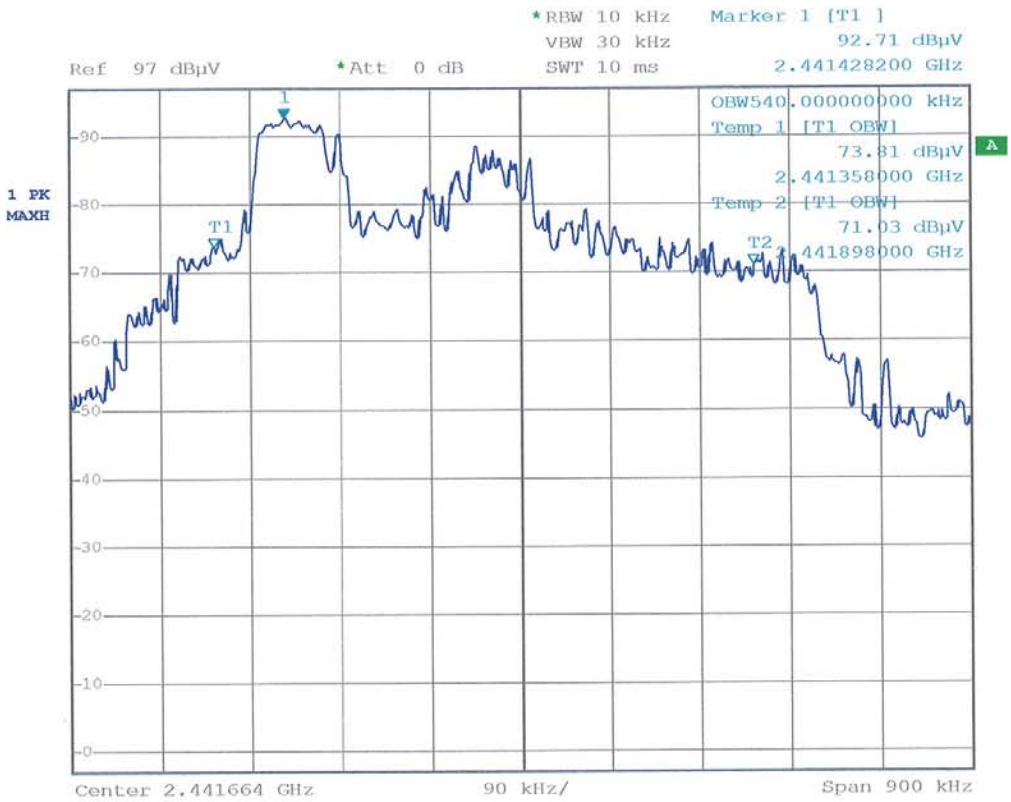

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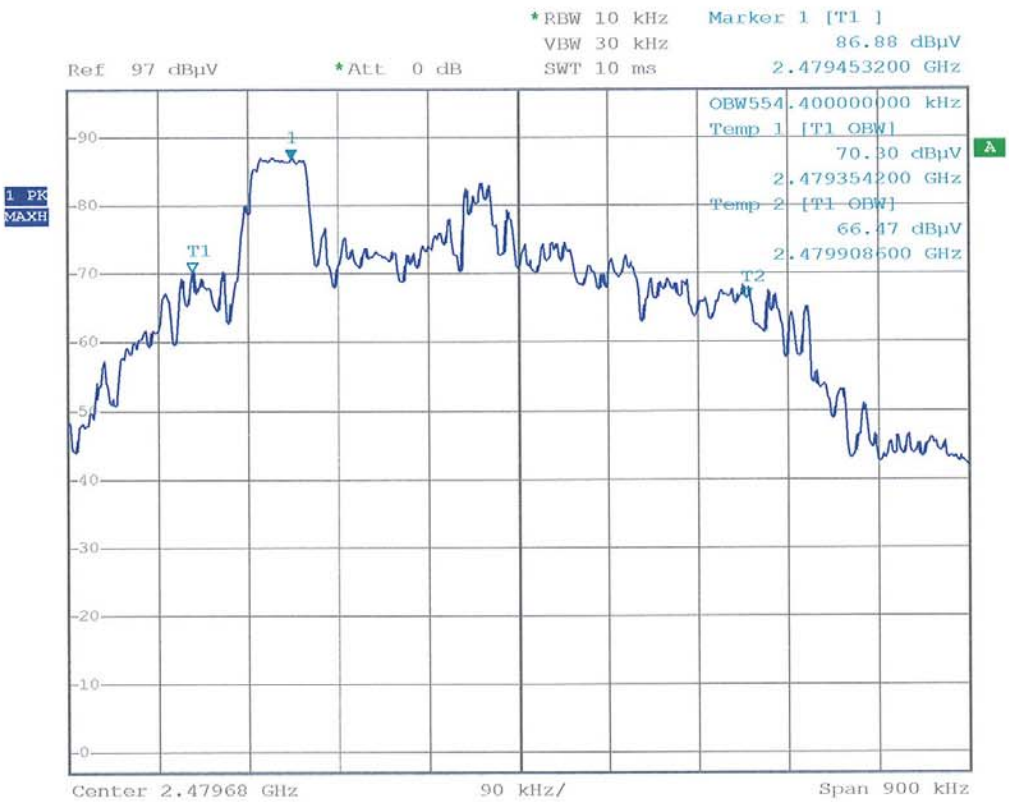

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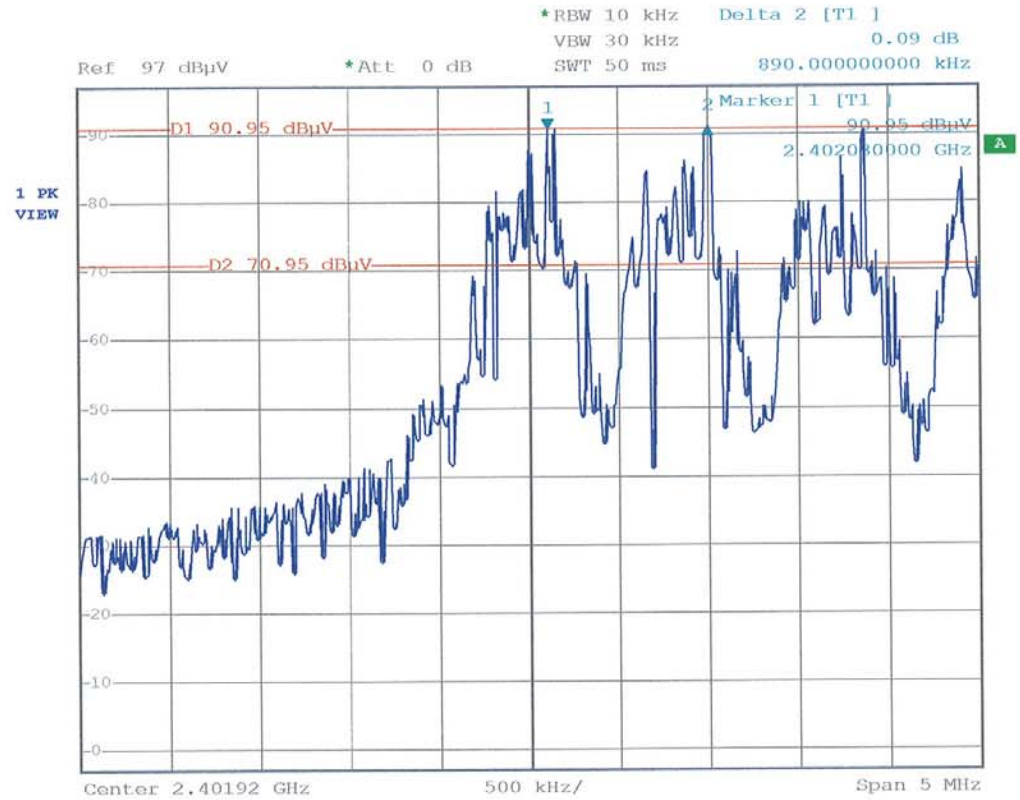

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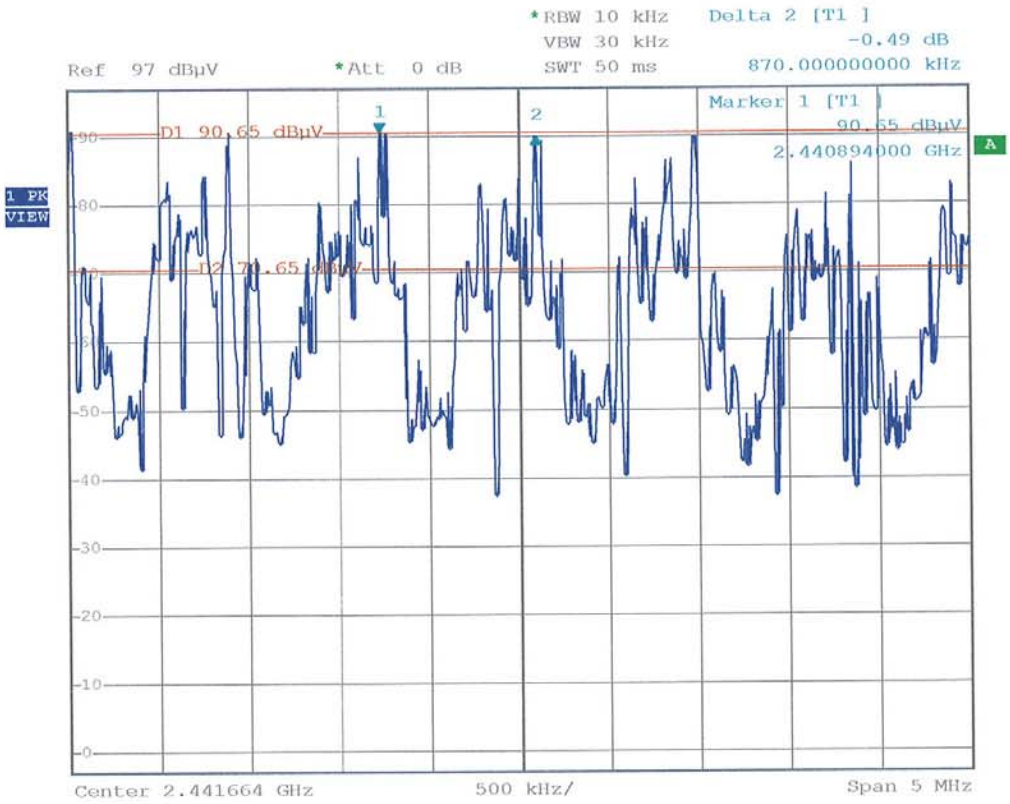

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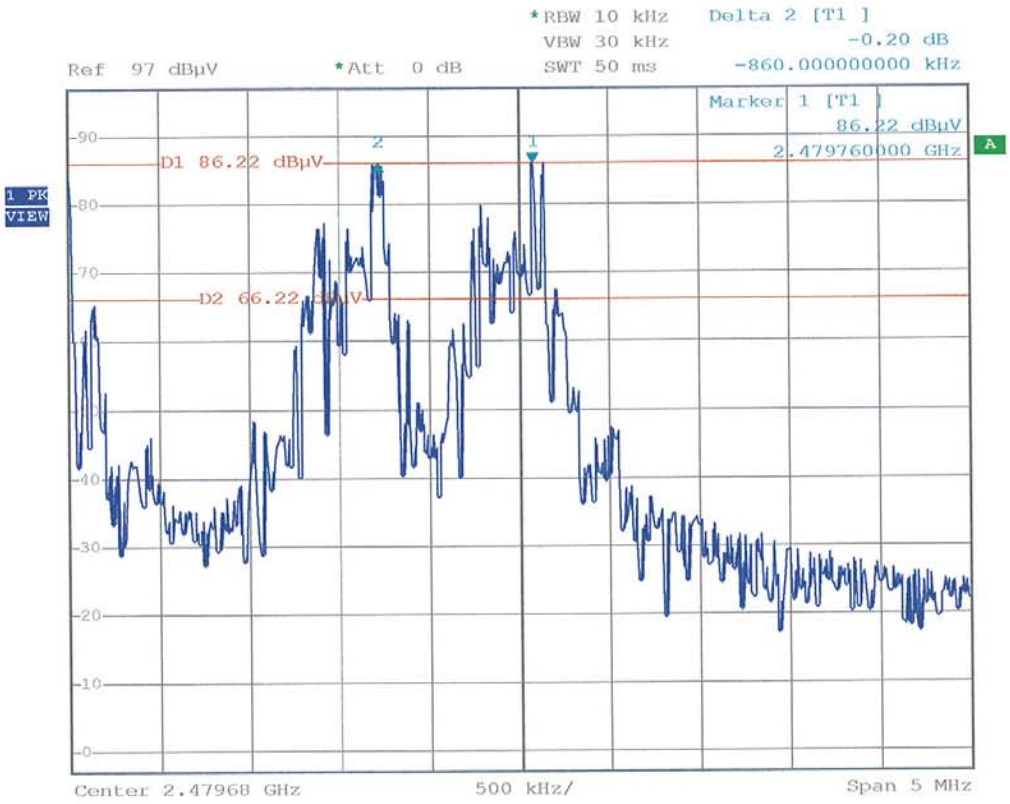

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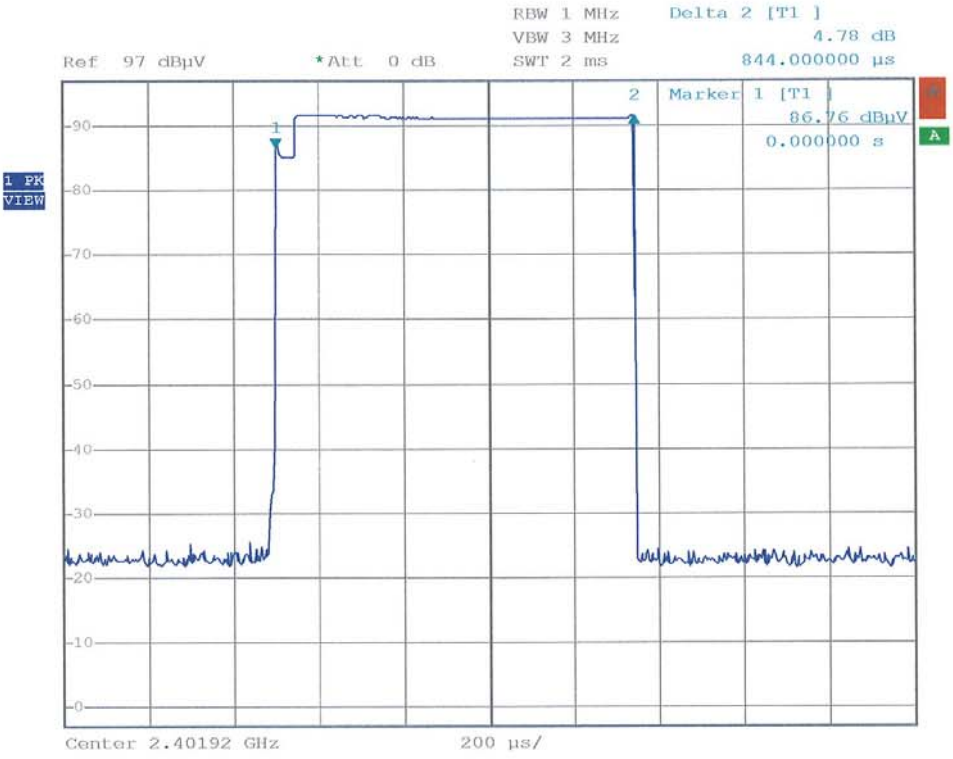
ANNEX 2: AVERAGE TIME OF OCCUPANCY ON ANY FREQUENCY



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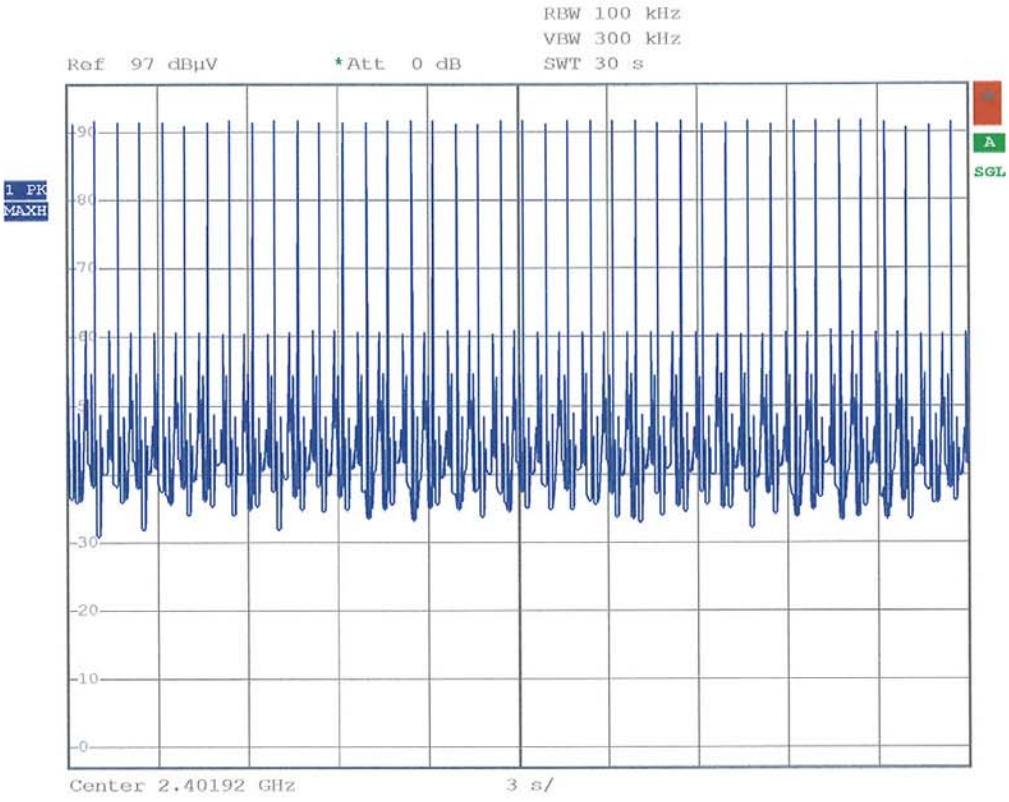

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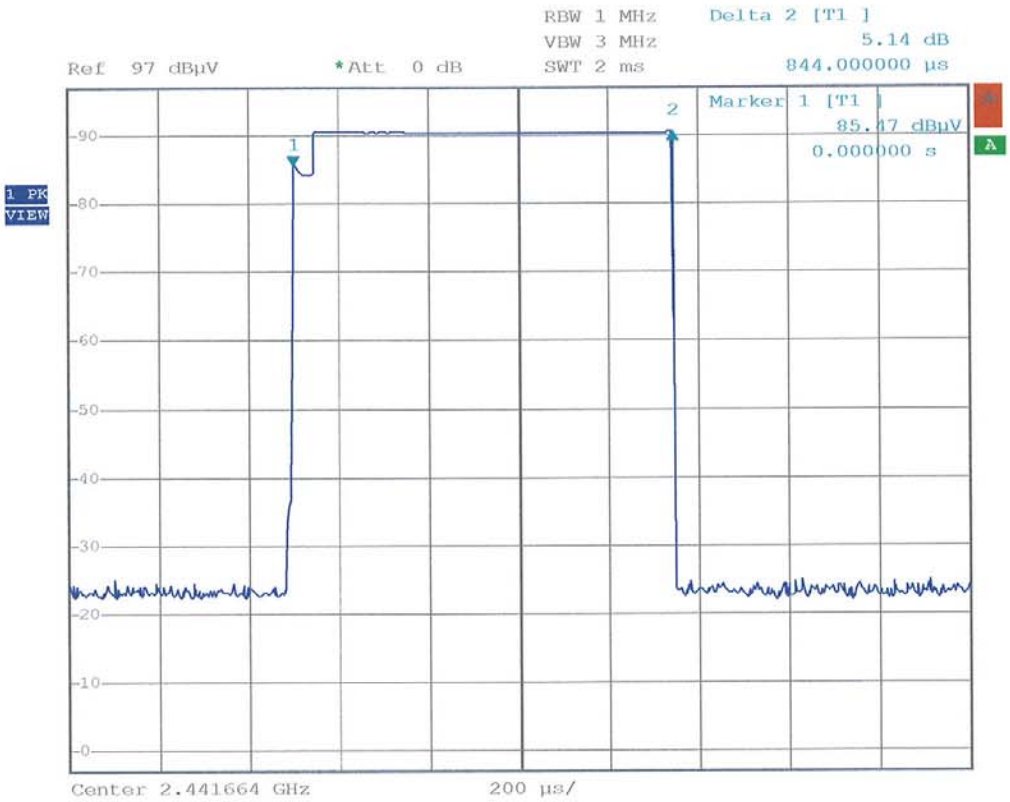

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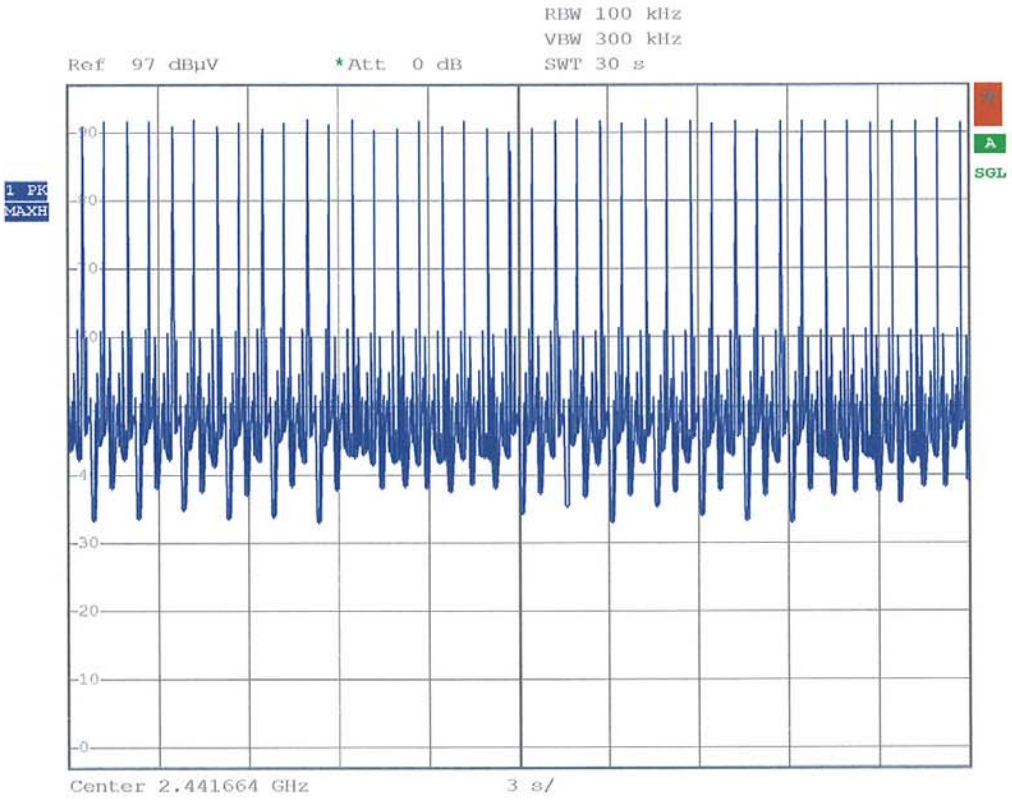

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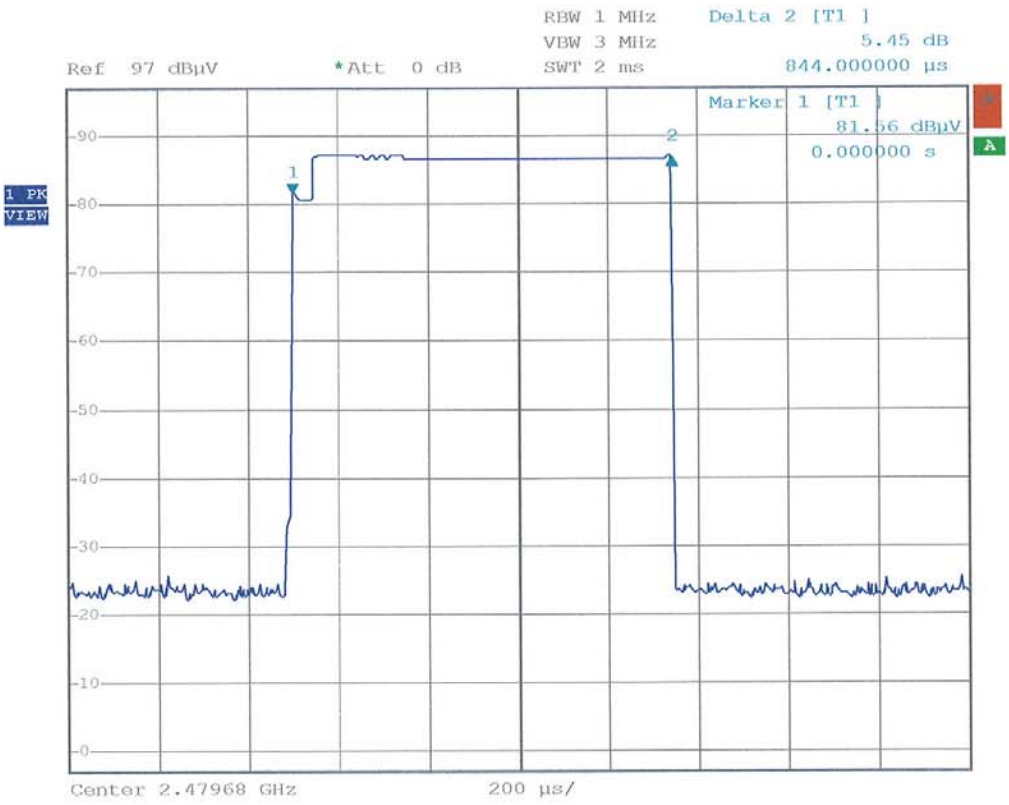

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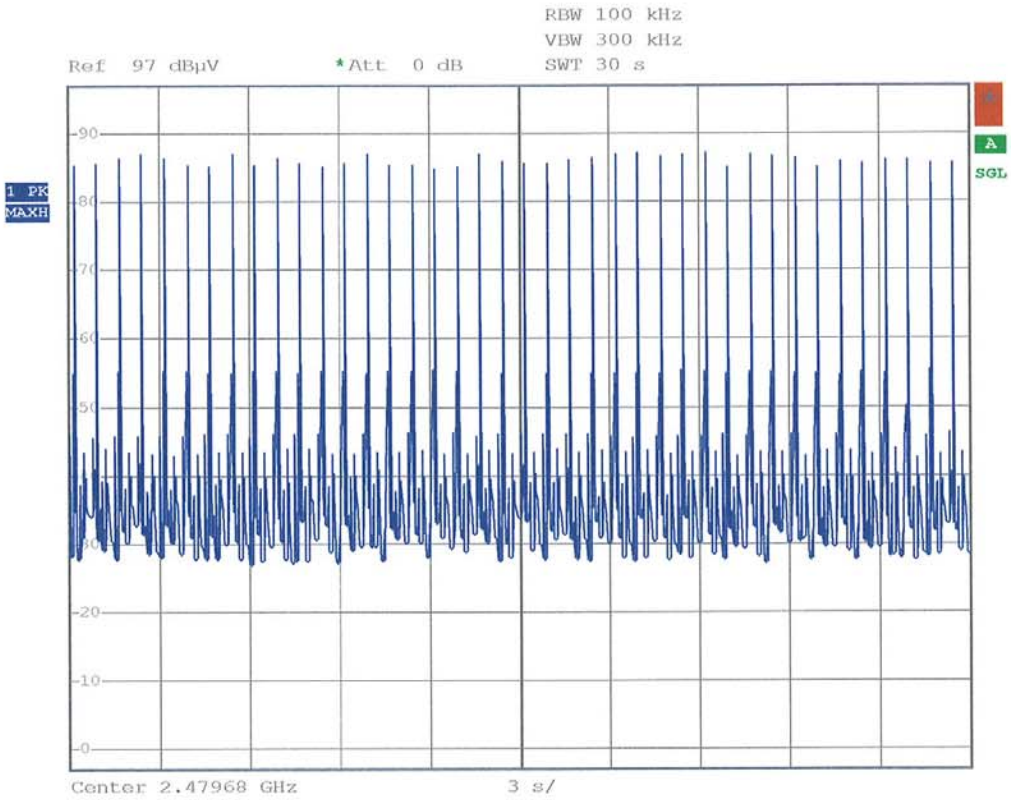
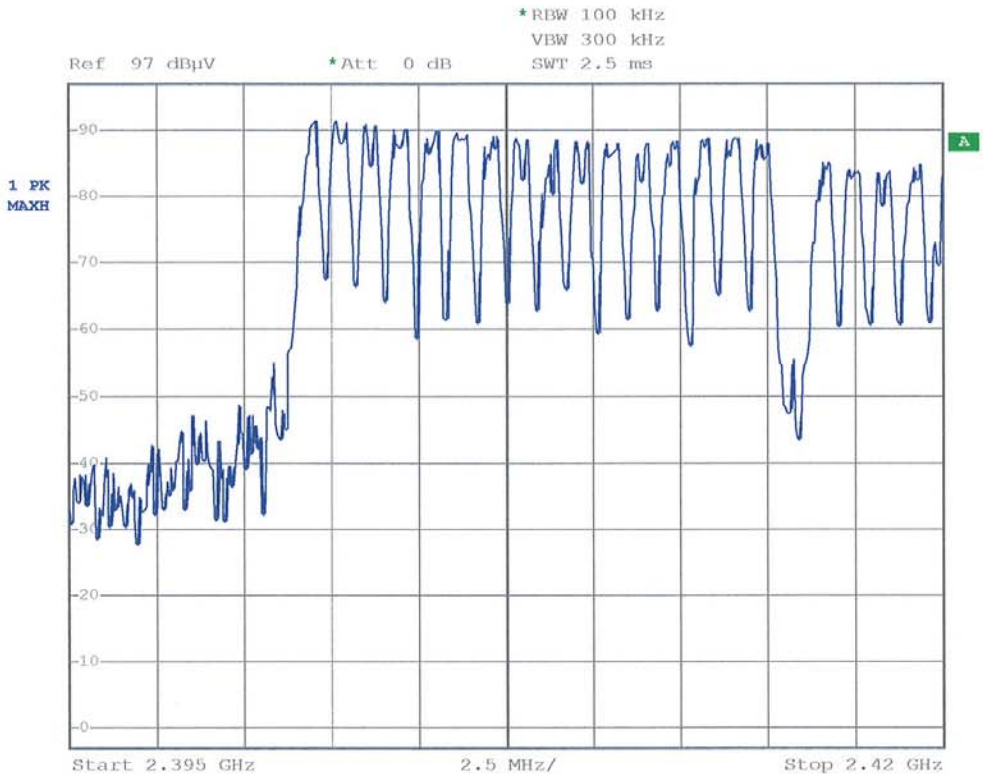


Date: 12.JUL.2007 16:33:57

ANNEX 3: NUMBER OF HOPPING FREQUENCIES



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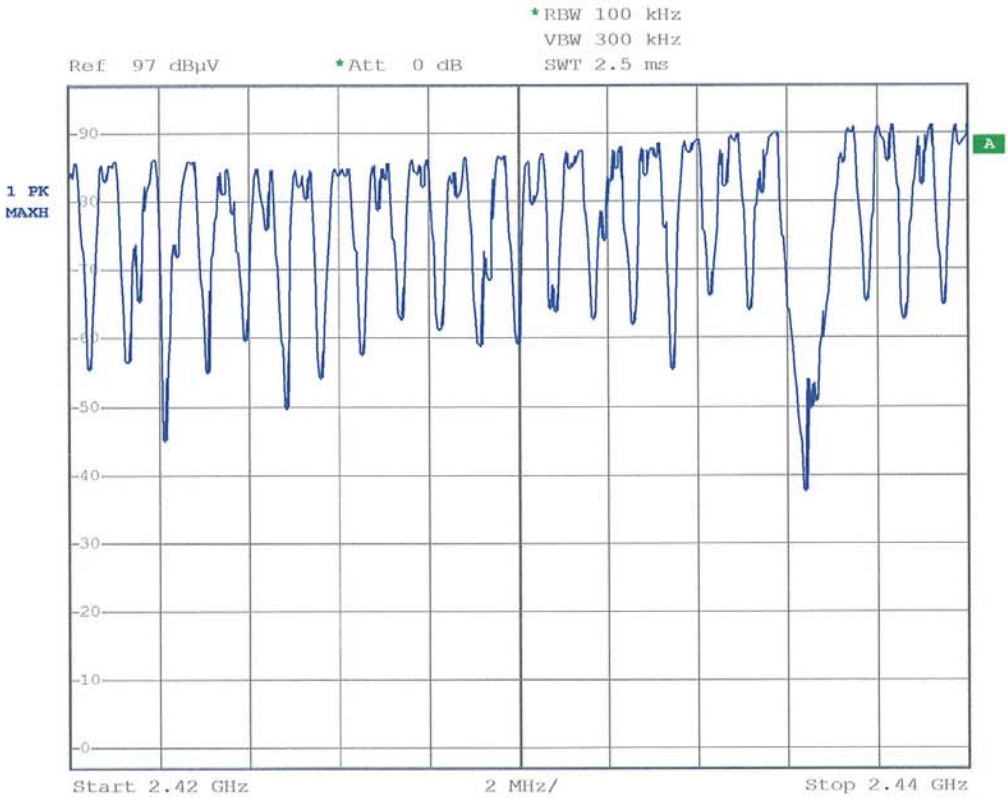

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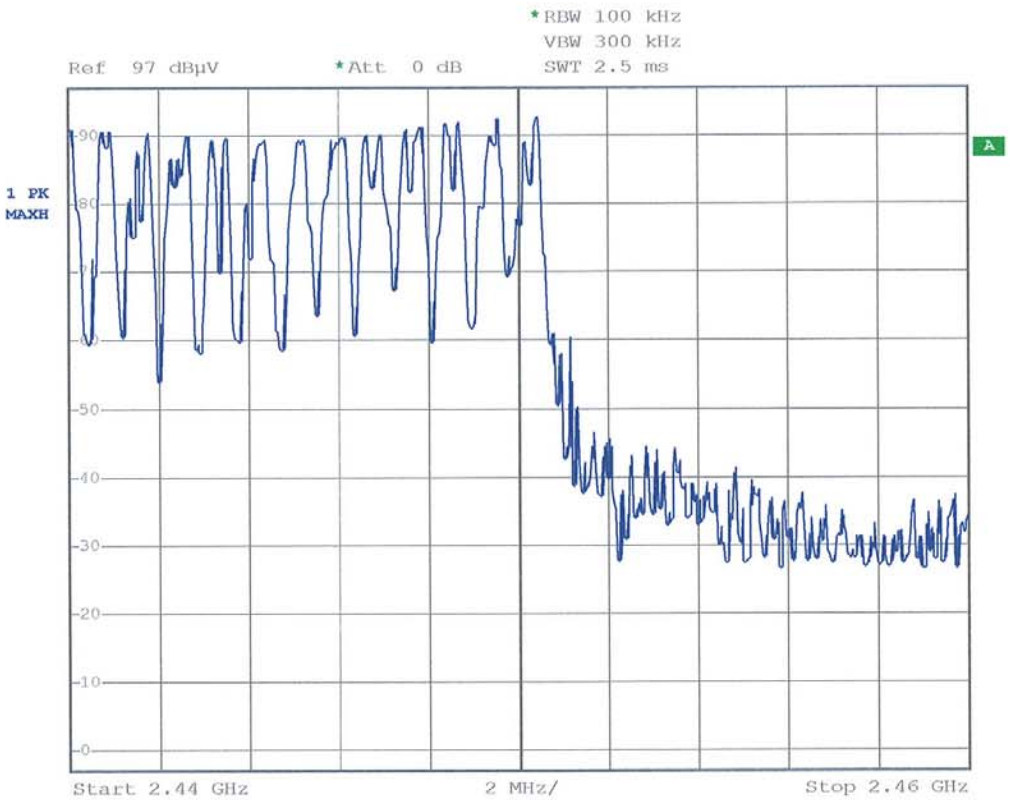

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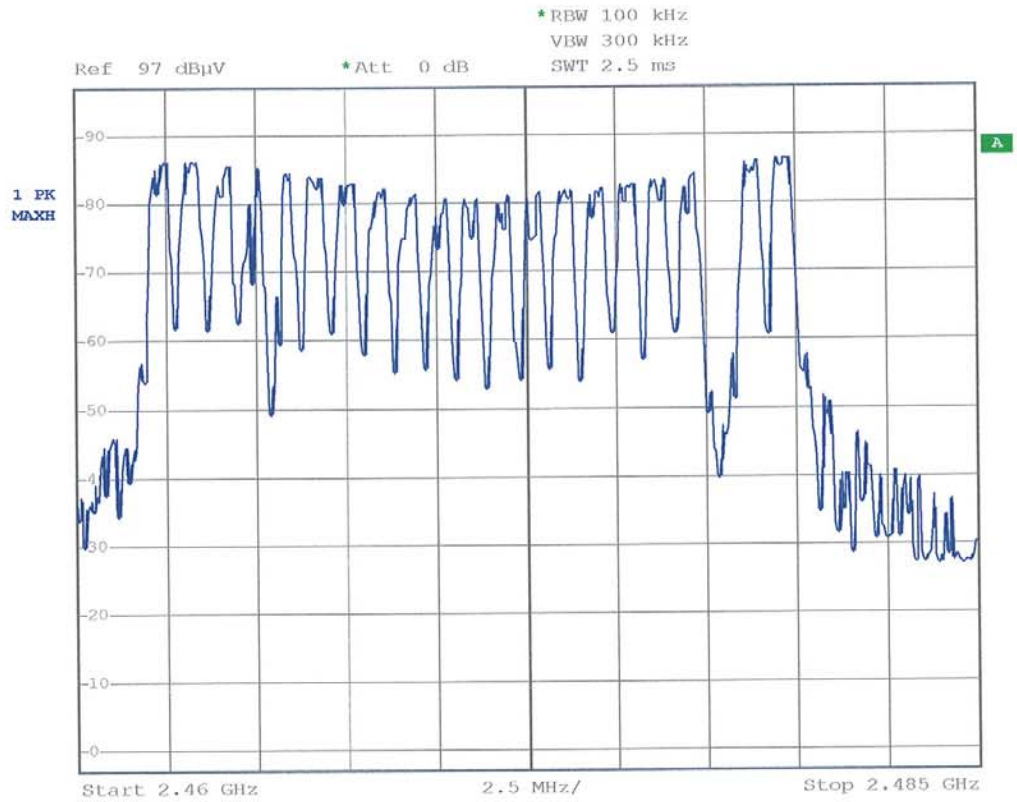

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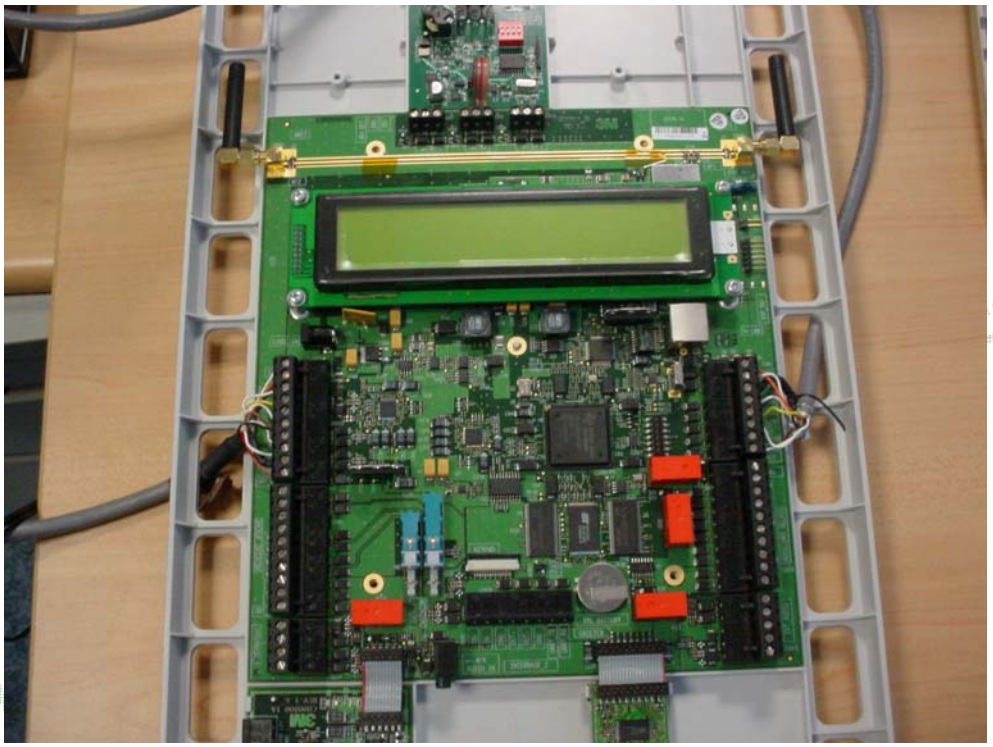
ANNEX 4: PHOTOS OF THE EQUIPMENT UNDER TEST

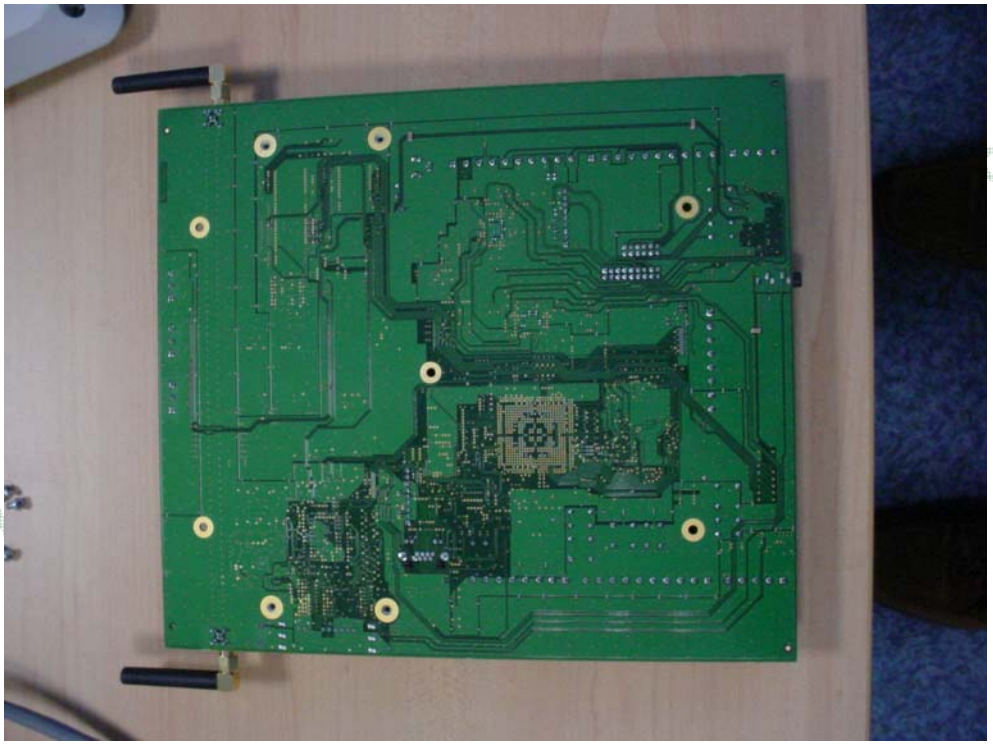
GENERAL VIEW

INTERNAL VIEW

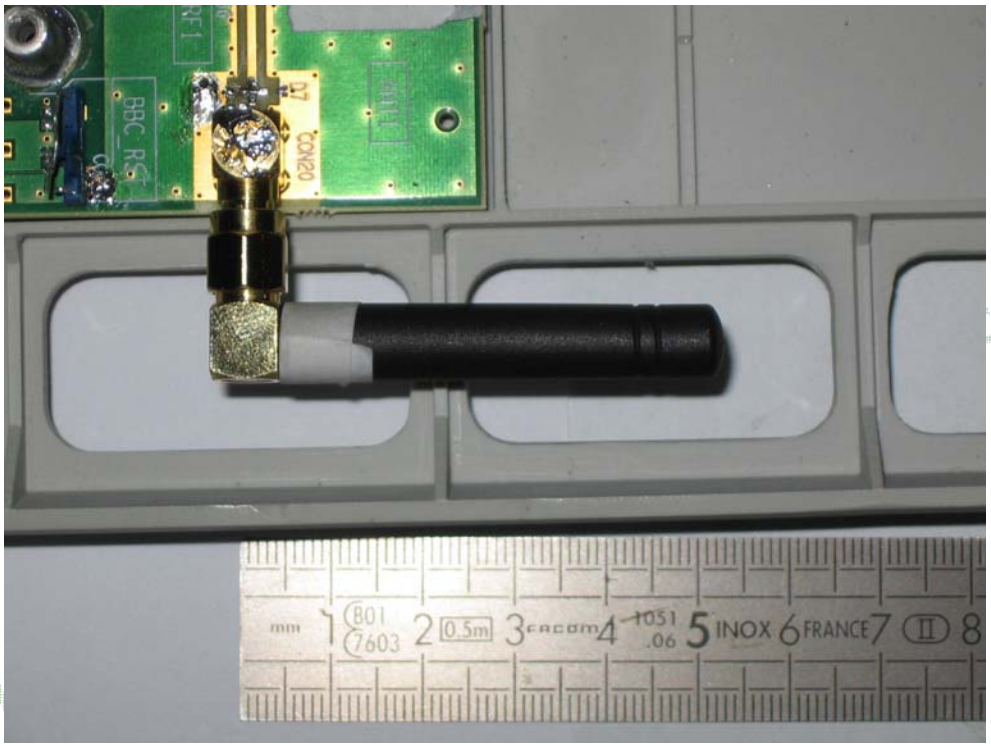
Printed circuit board: face 1



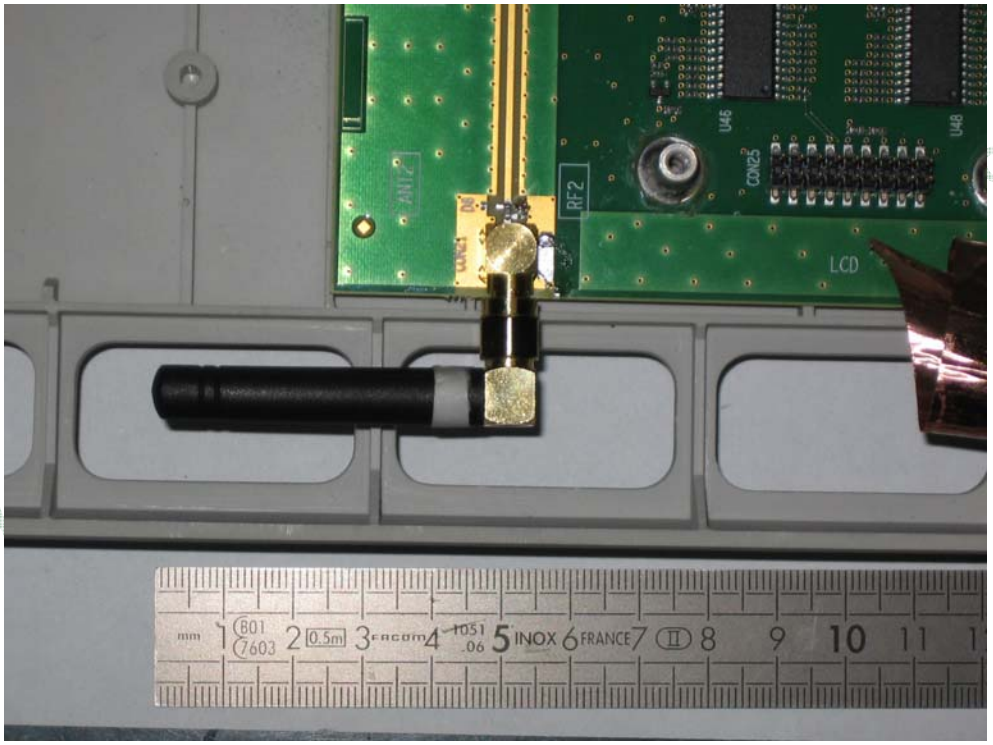
Printed circuit board: face 2



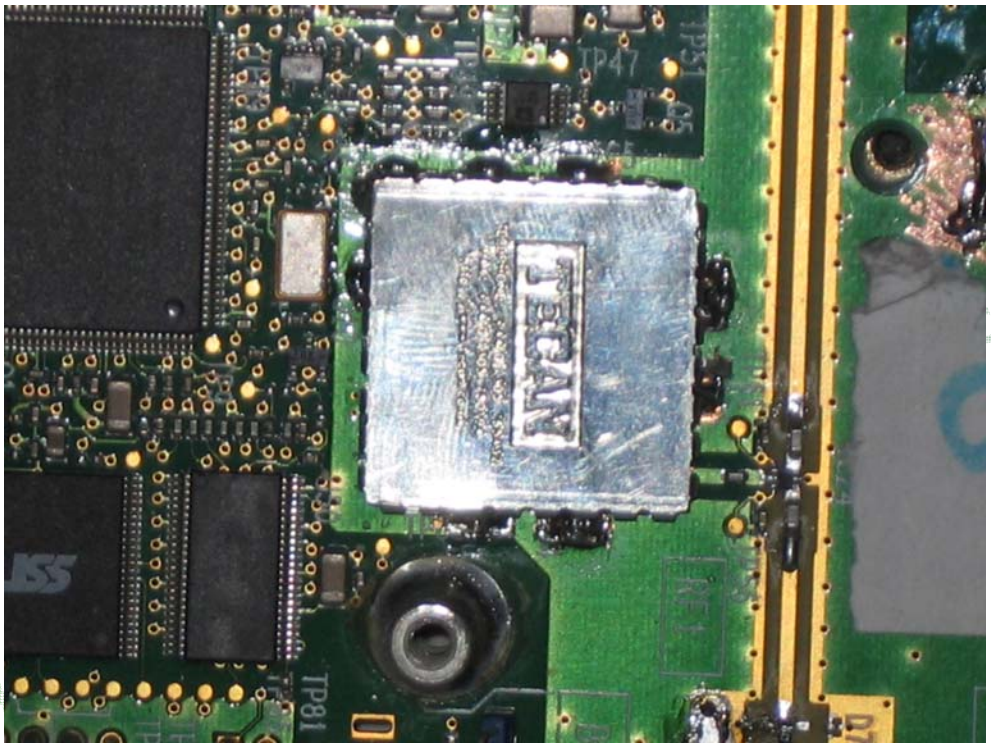
Antenna 1:



Antenna 2:



Radio module:



ANNEX 5: TEST SET UP AND OPEN AREA TEST SITE

CONDUCTED MEASUREMENT SET UP

RADIATED MEASUREMENT SET UP

OPEN AREA TEST SITE