



L C I E

Rapport d'essai / Test report

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FRANCE

Objet / Subject : Essais de compatibilité électromagnétique conformément aux normes FCC CFR 47 Part 15, Subpart C.
Electromagnetic compatibility tests according to the standards FCC CFR 47 Part 15, Subpart C.

Matériel testé / Apparatus under test :

- Produit / Product : Lecteur de tag RFID / RFID tag reader
- Marque / Trade mark : TAGSYS
- Constructeur / Manufacturer : TAGSYS
- Type / Model : WIFI INVENTORY READER
- N° de série / serial number * : Proto n°1 *
- FCC ID : QHKWIFILIBINVREAD

* : information donnée par le client / information given by the customer

Date des essais / Test date : 4 et 5 janvier 2007 / January 4th and 5th, 2007

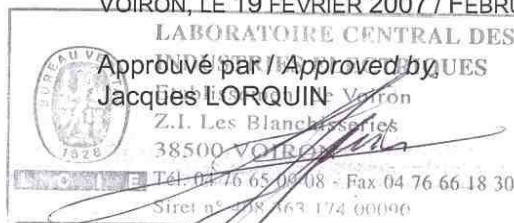
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VOIRON, LE 19 FÉVRIER 2007 / FEBRUARY 19TH, 2007



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1. TEST PROGRAM**Standard : FCC CFR 47, PART 15, Subpart C**

ANSI C63-4 (2003).

Requirements for intentional radiator. Chapter 15.225 (Operation within the band 13.110-14.010MHz)

2. SYSTEM TEST CONFIGURATION**2.1. Justification**

The system was configured for testing in a typical fashion (as a customer would normally use it).
The WIFI INVENTORY READER is tested with the 13.56MHz antenna L-W1.

2.2. HARDWARE IDENTIFICATION

- Equipment under test (EUT):**

WIFI INVENTORY READER

Serial number: Proto n°1

The WIFI INVENTORY READER is powered with its internal power battery.

Note: the WIFI INVENTORY READER contains the transmitter Module FCC ID: MCQ-50M880

- Input/output on the LP101 reader:**

- 1x RF antenna output (BNC Reverse connector)

- Auxiliaries used for testing:**

Trade Mark – Model Number (Serial number)	Description	Cable description
TOSHIBA SATELITE S1410-704 (PS141E-04YCM-3V) sn: 13594938G with its power supply unit (PA3201U-1ACA SEB100P2-15.0)	Laptop Personal Computer	Power cable unshielded USB cable: shielded Ethernet cable: unshielded
NETGEAR WGT624 v3 108Mbps Wireless Router With power adapter Mascot 9725	Wireless Router	Power cable unshielded Ethernet cable: unshielded

- I/O cables used for testing:**

- 1x Antenna RF cable, coaxial 50Ω: 3m (with two ferrites on reader's side)

2.3. Equipment modifications

No equipment modification has been necessary during testing.

2.4. EUT Exercise software

The EUT exercise program used during radiated testing was exercised the WIFI INVENTORY READER in a manner similar to a typical use.

The TAGSYS PX Explorer program permits the continuous reading of a tag number. The reader is communicating with the PC by the WIFI air link.

PC Software used: TAGSYS PX Explorer.

2.5. Special accessories

The RF antenna cable is coaxial 50Ω with two ferrites on the reader's side.

3. RADIATED EMISSION DATA

3.1. TEST SETUP

The installation of EUT is identical for pre-characterization measurement in a 3 meters full anechoic chamber and for measures on a 3 meters Open site.

Power supply: fully charged battery.

The EUT is placed on a non-conducting table of 80cm height.



Radiated emission test setup

Equipment configuration and running mode:

A RFID tag is placed in the vicinity of the antenna. The reader is communicating with the PC.

3.2. TEST SEQUENCE AND RESULTS

3.2.1. Pre-characterization at 3 meters [9kHz-30MHz]

A pre-scan of all the setup has been performed in a 3 meters full anechoic chamber.

The distance between EUT and antenna is 3 meters. Pre-characterization is performed in vertical (V) polarization and the loop antenna position was rotated during the test for maximized the emission measurement.

Frequency band investigated is 9kHz to 30MHz.

The pre-characterization graphs are obtained in PEAK detection.

See graphs for 150kHz-30MHz band:

graph#1

(See annex 1)

(Note: no frequency observed in the band 9kHz to 150KHz)

3.2.2. Pre-characterization at 3 meters [30MHz-1GHz]

A pre-scan of all the setup has been performed in a 3 meters full anechoic chamber.

The distance between EUT and antenna is 3 meters. Test is performed in horizontal (H) and vertical (V) polarization with a log-periodic antenna Chase CBL6111A. The EUT is being rotated on 360° during the measurement. The pre-characterization graphs are obtained in PEAK detection.

See graphs for 30MHz-1GHz:

H polarization
V polarization

graph#2
graph#3

(See annex 1)
(See annex 1)

3.2.3. Characterization on 10 meters open site below 30 MHz

The product has been tested according to ANSI C63.4 (2003), FCC part 15 subpart C. Radiated Emissions were measured on an open area test site. A description of the facility is on file with the FCC.

The product has been tested at a distance of **10 meters** from the antenna and compared to the FCC part 15 subpart C §15.225 limits in the frequency range 13.553MHz 13.567MHz. Measurement bandwidth was 9kHz.

Antenna height was 1m for both horizontal and vertical polarization.

Antenna was rotated around its vertical axis.

Continuous linear turntable azimuth search was performed with 360 degrees range.

3 axis measurements were performed for both reader and antenna positions.

A summary of the worst case emissions found in all test configurations and modes is shown on clauses 3.2.1.

Frequency (MHz)	QPeak Limit (dBµV/m) @ 30m	QPeak (dBµV/m)	QPeak-Lmt (Margin dB)	Turntable Angle (deg)	Ant. Pol./ Angle (deg)	Tot Corr (dB)
13.560046 ^{*1}	84.0	58.8	-25.2	270°	V / 90°	37.9
27.121000 ^{*2}	29.5	23.8	-5.7	270°	V / 90°	39.7

^{*1}: Fundamental – 15.225 limits. Measure have been done at 10m distance and corrected according to requirements of 15.209.e) ($M@30m = M@10m - 19.1dB$)

^{*2}: Measure have been done at 10m distance and corrected according to requirements of 15.209.e)

Limits Subclause §15.225

Frequency (MHz)	Field strength (µV/m)	Measurement distance (m)
13.553-13.567	15 848 84 dBµV/m	30
13.410-13.553 13.567-13.710	334 50.5 dBµV/m	30
13.110-13.410 13.710-14.010	106 40.5 dBµV/m	30

3.2.4. Characterization on 10 meters open site from 30MHz to 1GHz

The product has been tested according to ANSI C63.4 (2003), FCC part 15 subpart C. Radiated Emissions were measured on an open area test site. A description of the facility is on file with the FCC.

The product has been tested at a distance of **10 meters** from the antenna and compared to the FCC part 15 subpart C §15.209 limits. Measurement bandwidth was 120kHz from 30 MHz to 1GHz.

Antenna height search was performed from 1m to 4m for both horizontal and vertical polarization. Continuous linear turntable azimuth search was performed with 360 degrees range.

3 axis measurements were performed for both reader and antenna positions.

A summary of the worst case emissions found in all test configurations and modes is shown on clause 3.2.2.

No	Frequency (MHz)	QPeak Limit (dBμV/m)	Qpeak * (dBμV/m)	Qpeak-Limit (Margin, dB)	Angle (deg)	Pol	Hgt (cm)	Tot Corr (dB)	Comments
1	40.175	40.0	32.0	-8.0	145	V	130	11.0	
2	122.053	43.5	38.2	-5.3	210	V	130	15.6	
3	135.610	43.5	37.9	-5.6	220	V	130	14.4	
4	149.167	43.5	34.1	-9.4	245	V	100	14.4	
5	162.713	43.5	33.9	-9.6	235	V	100	16.9	
6	176.281	43.5	38.4	-5.1	235	V	120	17.5	
7	189.841	43.5	42.0	-1.5	230	V	120	18.4	
8	203.407	43.5	33.3	-10.2	10	V	100	15.3	
9	257.657	46.0	39.5	-6.5	200	V	110	15.2	

*: Measure have been done at 10m distance and corrected according to requirements of 15.209.e) (M@3m = M@10m+10.5dB)

RESULTS: PASS

3.3. Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follow :

$$FS = RA + AF + CF - AG$$

Where
 FS = Field Strength
 RA = Receiver Amplitude
 AF = Antenna Factor
 CF = Cable Factor
 AG = Amplifier Gain

Assume a receiver reading of 52.5dBμV is obtained. The antenna factor of 7.4 and a cable factor of 1.1 is added. The amplifier gain of 29dB is subtracted, giving a field strength of 32 dBμV/m.

$$FS = 52.5 + 7.4 + 1.1 - 29 = 32 \text{ dB}\mu\text{V/m}$$

The 32 dBμV/m value can be mathematically converted to its corresponding level in μV/m.

$$\text{Level in } \mu\text{V/m} = \text{Common Antilogarithm } [(32\text{dB}\mu\text{V/m})/20] = 39.8 \mu\text{V/m}.$$

4. FUNDAMENTAL FREQUENCY TOLERANCE (15.225E)

The frequency tolerance of the carrier signal shall be maintained within +/-0.01% of the operating frequency when the temperature is varied from -20°C to +50°C. The test is performed with a new fully charged battery.

4.1. Temperature and voltage fluctuation

Temperature has been set at +25°C, -20°C and +50°C.

Frequency of carrier: 13.56 MHz

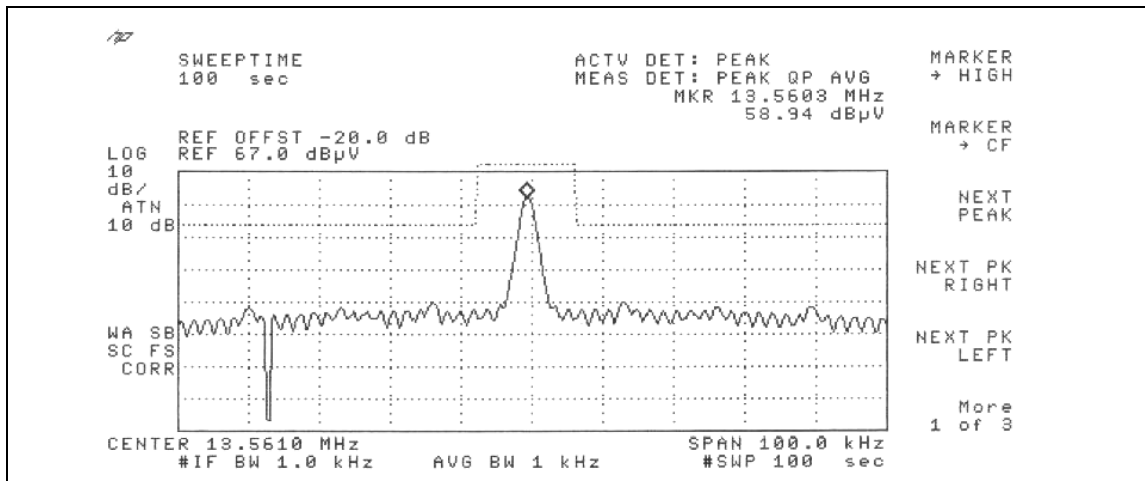
Upper limit: 13.561356 MHz

Lower limit: 13.558644 MHz

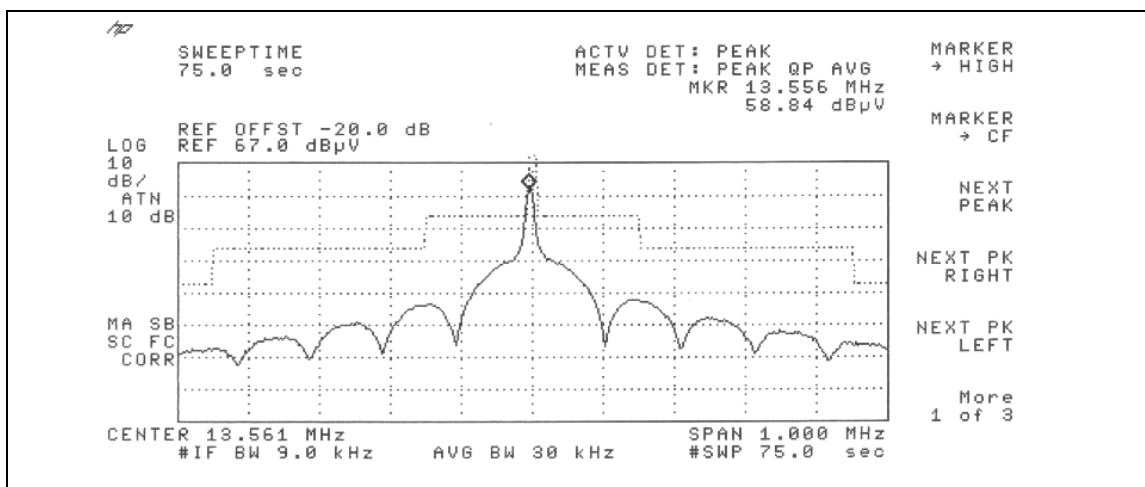
Temperature	-20°C	25°C	+50°C
Frequency (MHz)	13.560360 MHz	13.559893 MHz	13.559830 MHz
Carrier level	-0.4dBc	REF	-1.3dBc

Frequency drift measured is **530Hz** when the temperature is varied from -20°C to +55°C .

5. BAND-EDGE COMPLIANCE §15.209



RBW = 1kHz, VBW = 1kHz

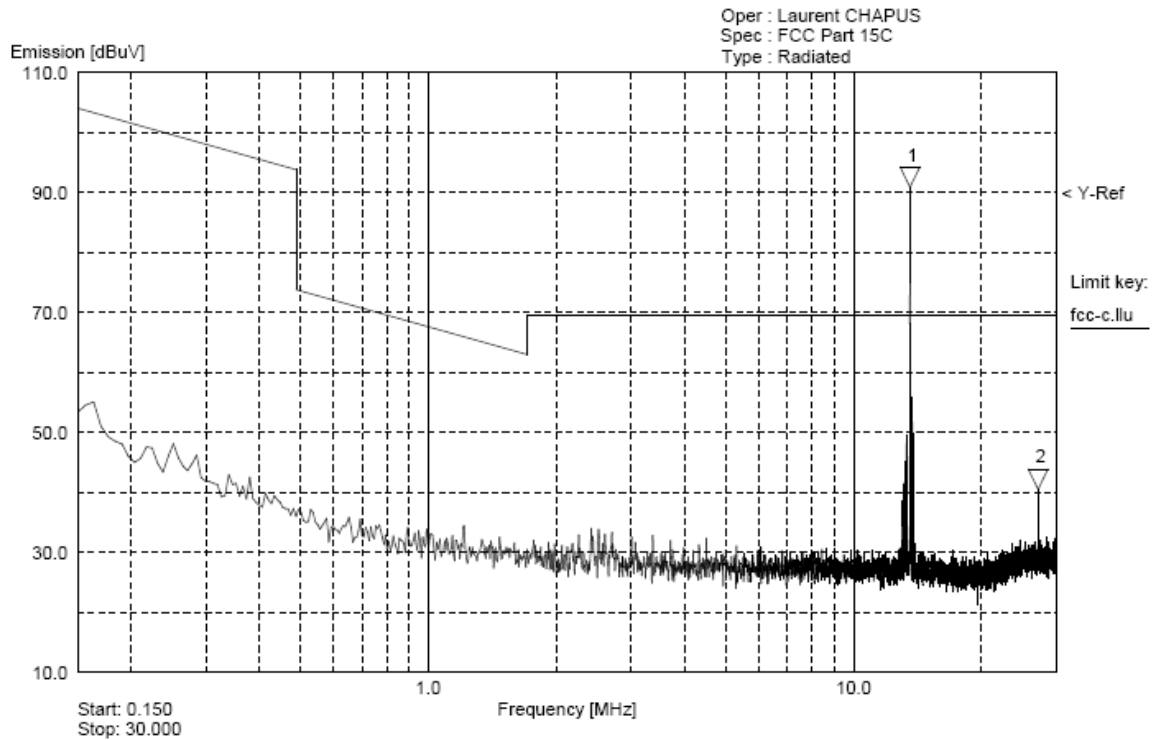


RBW= 9.0kHz, VBW=30KHz

6. ANNEX 1 (GRAPHS)

RADIATED EMISSIONS (Pre-characterization)		Test configuration:
Graph name:	graph#1	
Antenna polarization	Perpendicular	
Frequency band	150kHz-30MHz	
Azimuth:	90°	
RBW / VBW :	9kHz / 30kHz	

RADIATED EMISSION - TAGSYS



11:48:11 03 Jan 2007

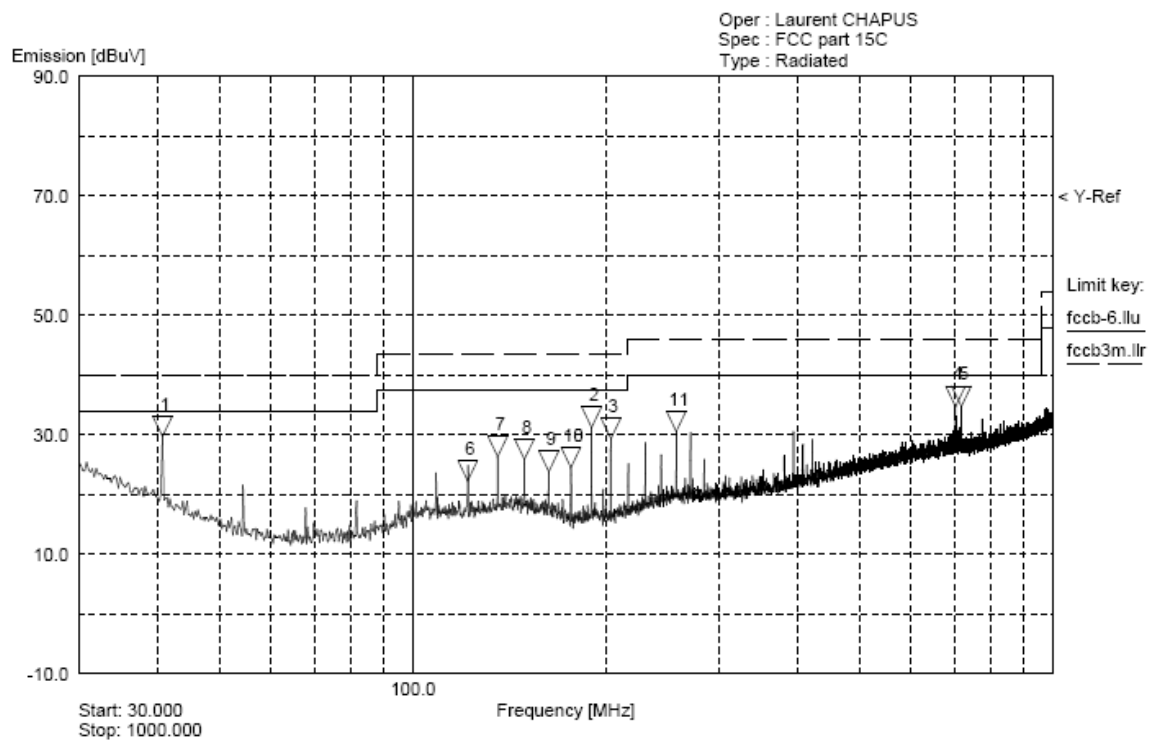
Device : LIB INV WIFI READER
Serial #: 90° (Ant H) Parr

Marker ▽	Frequency [MHz]	Peak [dBuV]	Q-Peak [dBuV]	Average [dBuV]	Limit [dBuV]
1	13.57	90.88 *	-	-	69.50
2	27.13	40.50	-	-	69.50

Marker 1 is carrier frequency

RADIATED EMISSIONS		Test configuration:
Graph name:	graph#2	
Antenna polarisation	Horizontal	
Frequency band	30MHz – 1GHz	
Azimuth:	From 0° to 360° (Max-hold measurement)	
RBW / VBW :	120kHz / 300kHz	

RADIATED EMISSIONS - TAGSYS



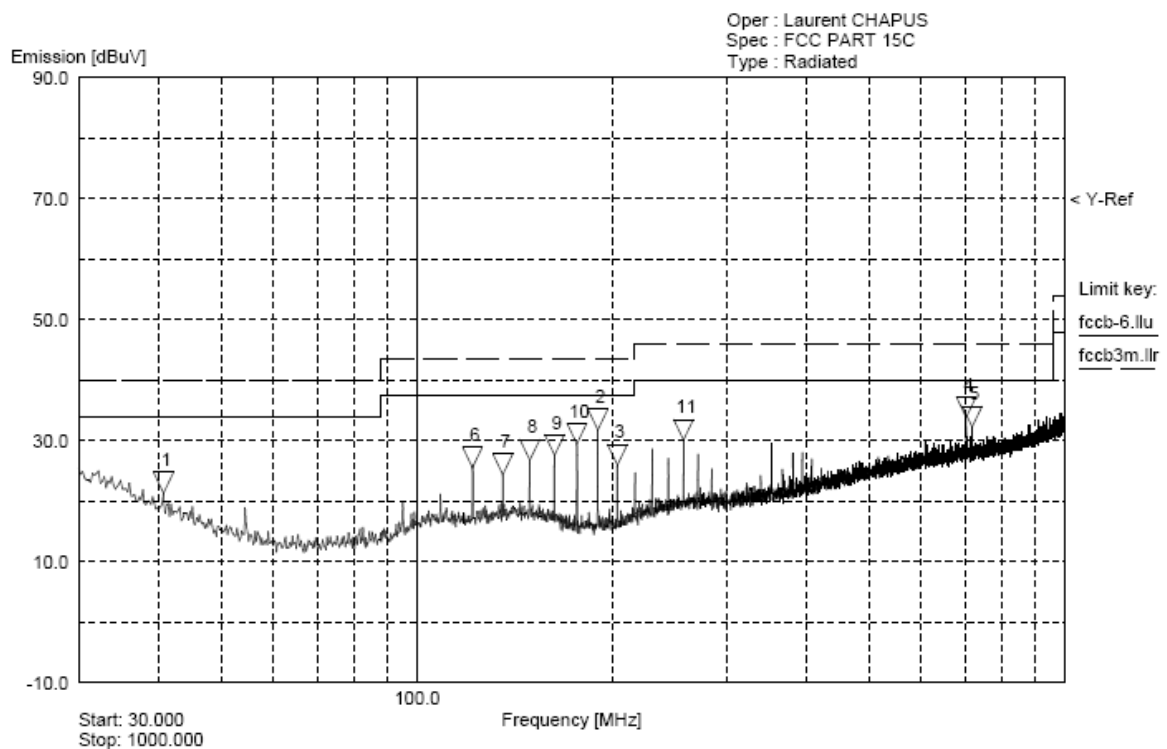
11:34:44 03 Jan 2007

Device : LIB INV WIFI READER
Serial #: Pol H Pré-série (2 ferrites on RF cable) Ant H

Marker ▽	Frequency [MHz]	Peak [dBuV]	Q-Peak [dBuV]	Average [dBuV]	Limit [dBuV]
1	40.58	29.72	-	-	34.00
2	190.1	31.22	-	-	37.50
3	203.7	29.36	-	-	37.50
4	704.1	34.74	-	-	40.00
5	718.9	34.75	-	-	40.00
6	121.7	22.30	-	-	37.50
7	135.6	26.34	-	-	37.50
8	149.3	25.91	-	-	37.50
9	162.9	23.82	-	-	37.50
10	176.4	24.49	-	-	37.50
11	257.7	30.56	-	-	40.00

RADIATED EMISSIONS		Test configuration:
Graph name:	graph#3	
Antenna polarisation	Vertical	
Frequency band	30MHz – 1GHz	
Azimuth:	From 0° to 360° (Max-hold measurement)	
RBW / VBW :	120kHz / 300kHz	

RADIATED EMISSIONS - TAGSYS



11:22:33 03 Jan 2007

Device : LIB INV WIFI READER
Serial #: Pol V Pré-série (2 ferrites on RF cable) Ant H

Marker ▽	Frequency [MHz]	Peak [dBuV]	Q-Peak [dBuV]	Average [dBuV]	Limit [dBuV]
1	40.58	21.34	-	-	34.00
2	190.1	31.75	-	-	37.50
3	203.7	25.99	-	-	37.50
4	704.1	33.84	-	-	40.00
5	718.9	32.27	-	-	40.00
6	121.7	25.53	-	-	37.50
7	135.6	24.41	-	-	37.50
8	149.3	26.81	-	-	37.50
9	162.9	27.59	-	-	37.50
10	176.4	29.46	-	-	37.50
11	257.7	30.10	-	-	40.00

7. TEST EQUIPMENT LIST

	N°LCIE	TYPE	COMPANY	REF	SN
RADIATED EMISSION MEASUREMENT					
	C2040057VO	Antenna monopole	AH SYSTEM	SAS-551	181
	A7102026VO	Amplifier 8-26GHz	ALDETEC	ALS01452	1
X	C4040009VO	Air Compressor	ATLAS COPCO	LX111	0615-038
X	A3169050VO	Radiated emission comb generator	BARDET		PR17B
X	C2040051VO	Antenna Bi-log	CHASE	CBL6111A	1628
	C2040052VO	Antenna Loop	ELECTRO-METRICS	EM-6879	690234
	C2042027VO	Antenna horn	EMCO	3115	6382
X	C2040050VO	Antenna biconic	EMCO	3104C	9401-4636
X	C2040056VO	Antenna log-periodic	EMCO	3146	2178
X	F2000286VO	Turntable controller	EMCO	1060-10	1217
X	F2000287VO	Antenna mast controller	EMCO	1050	8811-1295
X	F2000288VO	Antenna mast	EMCO	1050	
X	F2000289VO	Turntable	EMCO	1060	
X	F2000371VO	Turntable chamber	ETS Lingren	Model 2065	F2000371VO
X	F2000372VO	Turntable controller chamber	ETS Lingren	Model 2066	F2000372VO
X	D3044009VO	Anechoic chamber	EUROSHIELD	RDF-F-60-060	1213
	A7102024VO	Amplifier 8 GHz	HEROTEK	A1080304A	222033
X	A4060016VO	Spectrum analyzer 9kHz –1.8GHz	HEWLETT PACKARD	8591E	3536A00384
X	A7102019VO	Amplifier 9 KHz – 1300 MHz	HEWLETT PACKARD	8447F Opt 64	3113A06394
X	A4060018VO	Spectrum Analyzer 9KHz – 26.5GHz	HEWLETT PACKARD	8593E	3409u00537
X	A4049060VO	Adapter quasi-peak	HEWLETT PACKARD	HP85650A	2811A01134
X	A4060028VO	Spectrum analyzer display	HEWLETT PACKARD	HP85662A	2816A16603
X	A4060029VO	Spectrum analyzer	HEWLETT PACKARD	HP8568B	2732A04155
X	A4060030VO	Pre-selector RF	HEWLETT PACKARD	HP85685A	2837A00784
	A5329032VO	Absorption clamp	LUTHI	MDS21	2826
	A5329044VO	Absorption clamp	RHODE ET SCHWARZ	85024A	194.0100.50
	A2640011VO	Measurement receiver 9kHz–30MHz	ROHDE ET SCHWARZ	ESH3	972079/117
	C2042028VO	Antenna horn 26GHz	SCHWARZBECK	BBHA 9170	BBHA9170232
X	A5329045VO	Cable IMR&EMR (Anechoic chamber)	SMEE	KX13	
X	A5329048VO	Cable EMR OATS	SUCOFLEX	106G	553
	A5329038VO	Cable coaxial 3.5 m (Blue)	SUHNER	SUCOFLEX 106	26732/6
X	A5329056VO	Cable Radiat EMI (Pre-amp/Analyzer)			
X	A5329057VO	Cable Radiat. EMI (Pre-amp/cage)			
X	A5329059VO	Cable OATS (Mast at 10m)			
	A5329058VO	Cable OATS (Mast at 3m)			
MISCALLENOUS (CONTROL EQUIPMENT)					
	A6440068VO	Data Logger	AGILENT	34970A	US37043935
	A6440068VO	Data Logger Board	AGILENT	34901A	MY41037442
	D1022117VO	Climatic chamber	BIA CLIMATIC	CL 6-25	200 105 6
	A7043037VO	Power supply DC 30V 10A	ELC	AL924	95/00600
	A1240170VO	Multimeter	Fluke	87	75250745
	A1240171VO	Multimeter	FLUKE	189	89770115
	A4024018VO	Oscilloscope 500 MHz	Hewlett Packard	54542C	US36040602
	A4024019VO	Oscilloscope	Hewlett Packard	54720A	7426600
X	B4204052VO	Thermo-hygrometer	HUGER		
	A7043036VO	Power supply DC 300W / 150V-6A	SODILEC	7SDLIN/GB AUTO 300	493711
	A4083040VO	Oscilloscope 100 MHz 500Ms/s	Tektronix	TDS30-25	H712103

8. UNCERTAINTIES CHART

Type de mesure / Kind of measurement	Incertitude élargie laboratoire / Wide uncertainty laboratory (k=2) ± x	Incertitude limite du CISPR / CISPR uncertainty limit ± y
Mesure des perturbations conduites en tension sur le réseau d'énergie <i>Measurement of conducted disturbances in voltage on the power port</i>	3.57 dB	3.6 dB
Mesure des perturbations conduites en tension sur le réseau de télécommunication <i>Measurement of conducted disturbances in voltage on the telecommunication port.</i>	3.28 dB	A l'étude / Under consid.
Mesure des perturbations discontinues conduites en tension <i>Measurement of discontinuous conducted disturbances in voltage</i>	3.47 dB	3.6 dB
Mesure des perturbations conduites en courant <i>Measurement of conducted disturbances in current</i>	2.90 dB	A l'étude / Under consid.
Mesure du champ électrique rayonné sur le site en espace libre de Voiron <i>Measurement of radiated electric field on the Voiron open area test site</i>	5.07 dB	5.2 dB