Actions Mesures

ZI des Blanchisseries - 38500 VOIRON - Tél. 04 76 65 76 50 - FAX 04 76 66 18 30

EMC TEST REPORT

Nr 2712-FCC

This test report applies only on equipment described hereafter.

Proposal number: 200301-2130

Date..... :	February 6th ,7th and 10th, 2003
Location..... :	SMEE *Actions Mesures* Laboratory - 38 VOIRON
Performed by..... :	Laurent CHAPUS
Customer **..... :**	**ASK** (Represented by Mr. LOGNON) Les Bouillides – 15, Traverse des Brucs 06560 Valbonne Sophia Antipolis FRANCE

Product..... :	**LDB2**
Type of test..... :	**Radiated and Conducted Emission Test**

Applied standards ..... :	ANSI C63-4 (1992+2000) 47 CFR Part 15 Subpart C

Result of tests..... :	**Transmitter magnetic field**	**: Comply**
	Transmitter modulation bandwidth	**: Comply**
	Transmitter radiated emissions from 9kHz to 30MHz	**: Comply**
	Transmitter radiated emissions from 30MHz to 1GHz	**: Comply**

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Written by ..... : Laurent CHAPUS

Date : May 13th, 2003 Signature

Approved by ..... : Jean-Pierre ORY

1. System test configuration

1.1. Justification

The system was configured for testing in a typical fashion (as a customer would normally use it). The LDB2 was connected to a Personnel Computer. It has been tested with a Personal Computer HP model Vectra Vli8 series.

1.2. HARDWARE IDENTIFICATION:

*** Equipment Under Test (EUT):** **LDB 2** **Sn : Pre serie**

- Configuration :

The LDB2 is configured with the followings boards :
- Coupler board GEN 325
- Antenna board GEN 530
- Power supply board GEN 351
- Contact card interface board GEN 362

- Input/output on LDB2 :

- DC power supply 12V/500mA
- RS232 serial port

- Frequencies :

FREQUENCY	SOURCE	USE
27,120MHz	Oscillator	Main clock frequency for RF treatments, FPGA clock
22,1184MHz	Microcontroller	Microcontroller internal frequency
13,56MHz	FPGA	Carrier frequency and digital filters
9,04MHz	FPGA	SAM main clock source
4,52MHz	SAM electrical interface, FPGA	SAM clock source
3,6864MHz	resonator	Microcontroller
847,500KHz	Contactless card sub-carrier, FPGA	FPGA internal treatments
423,750KHz	FPGA	FPGA internal treatments
211,875KHz	FPGA	FPGA internal treatments
105,937KHz	FPGA, RF data rate	FPGA internal treatments

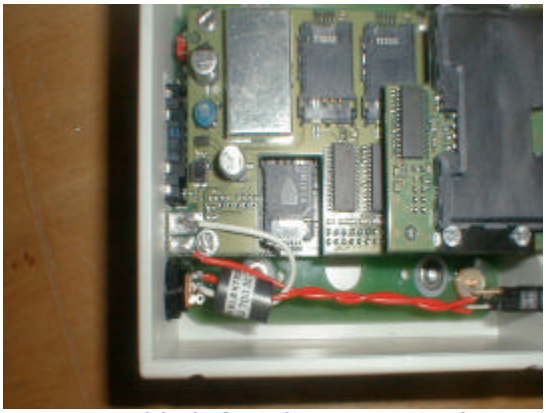
1.3. Auxiliaries

The FCC IDs for all equipment, plus description of all cables used in the tested system are :

Trade Mark – Model Number (Serial number)	FCC ID	Description	Cable description
ASK - LDB2 (sn: Pre-serie)	**QYELDB2-RDDE03082**	**Contactless reader**	**DC power unshielded RS232 serial shielded with ferrite tube**
COMELIT Type AL06E 230Vac/12Vdc-500mA *(used for radiated emission test)*	None	Power supply unit. AC/DC converter with linear transformer.	DC Power cable, unshielded, 1.75m. Direct plug-in adapter
COMELIT Type AL0512/A 120Vac/12Vdc-500mA *(used for conducted emission test)*	None	Power supply unit. AC/DC converter with linear transformer.	DC Power cable, unshielded, 1.75m. Direct plug-in adapter
HEWLETT PACKARD Vectra VLI8 PIII-500 P/N: D7963A (sn: FR72565009)	DOC	Personnel computer	All data cables are shielded. Power cable unshielded.
HEWLETT PACKARD P/N: D2846 (sn JP74001000)	DOC	21" color monitor	Shielded video cable with ferrites at each end. Power cable unshielded.
HEWLETT PACKARD P/N: C4734-60111 (sn: M971168931)	GYUR38SK	Keyboard	Shielded cable
Microsoft X04-72167 sn: 9916996-5	DOC	Mouse	Shielded cable
ASK – C.Ticket ISO 14443-2-3 Mode A and mode B	None	Contactless paper ticket	-

1.4. Equipment modifications

A ferrite is added on the RS232 cable (Ferrite type is Würth Electronik ref. 742 7113)
A ferrite is added inside the equipment on DC power wires. (Ferrite type is Würth Electronik ref. 742 700 30)



Added ferrite on DC wires

1.5. EUT Exercise software

The EUT exercise program used during radiated and conducted testing was designed to exercise the LDB2 in a manner similar to a typical use.
Communications mode A and B (contactless reader) of the standard ISO/IEC 14443-2 are tested.

Software used for each mode is :
Mode A : TESTSCRIPT (running in loop)
Mode B : POLLING V1.4

1.6. Special accessories

The serial interface cable used for compliance testing is shielded as normally supplied. All these cables are normally recommended to be used with the product.

1.7. I/O cables

- 1x DC Power cable : 1.75m (fixed on AC/DC adapter)
- 1x shielded serial RS232 cable, SubD9 connectors : 3m.
- 2x AC power cords (PC and monitor) : 1.5m
- 1x Standard video cable SVGA (with two integrated ferrites) : 1.5m

2. Radiated emission data

2.1. SET-UP

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

Equipment configuration and running mode:

- The LDB2 is connected to the PC with the RS232 serial cable;
- The LDB2 is powered by 230V/50Hz with the AC/DC adapter;
- PC and EUT are ON;
- Software is running;
- A contactless paper ticket (mode A or mode B) is placed 1 cm above the reader.

The installation of EUT is identical for pre-characterization measurement in a 3 meters full anechoic chamber and for measures on a 10 meters Open site.

2.2. TEST EQUIPMENT

Test equipment up to 1GHz on 10 meters open site:

Equipment	Company	Model	Serial	Calibration Due
Spectrum Analyzer	HP	8568B	2732A04140	March 22nd ,2003
Quasi-Peak adapter	HP	85650A	2811A01136	March 22nd ,2003
RF Pre-selector	HP	85685A	2833A00773	March 22nd ,2003
Biconical Antenna	EMCO	3104C	9401-4636	April 4th ,2003
Log Periodic Antenna	EMCO	3146	2178	April 4th ,2003
Spectrum Analyzer	HP	8593E	3409u00537	June 29th ,2003
Loop antenna	Electro-metrics	EM-6879	690234	February 10th ,2004
Amplifier	HP	8447F H64	3113A06394	March 28th ,2003
OATS				April 9th ,2003

EMCO-1050, 6 meters height antenna mast & EMCO-1060, 3 meters diameter Turntable.

A 10 meters Open site located in SMEE *Actions Mesures* - Voiron (FRANCE).

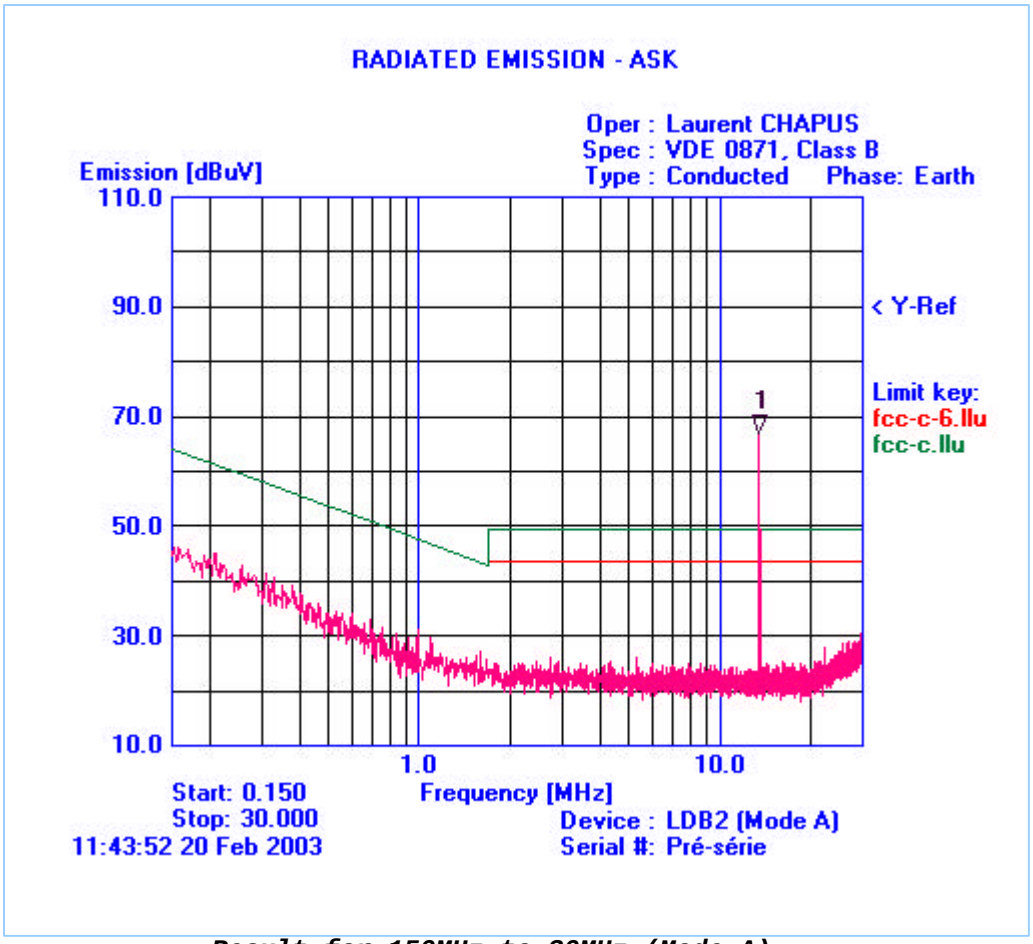
Pre-scan, test equipment up to 1GHz:

Equipment	Company	Model	Serial	Calibration Due
EMC Analyzer	HP	8591EM	3536A00384	March 29th ,2003
Amplifier	HP	8447F H64	3113A06394	March 28th ,2003
Antenna (30MHz-1GHz)	CHASE	CBL6111A	1628	March 29th ,2003
Loop antenna	Electro-metrics	EM-6879	690234	February 10th ,2004

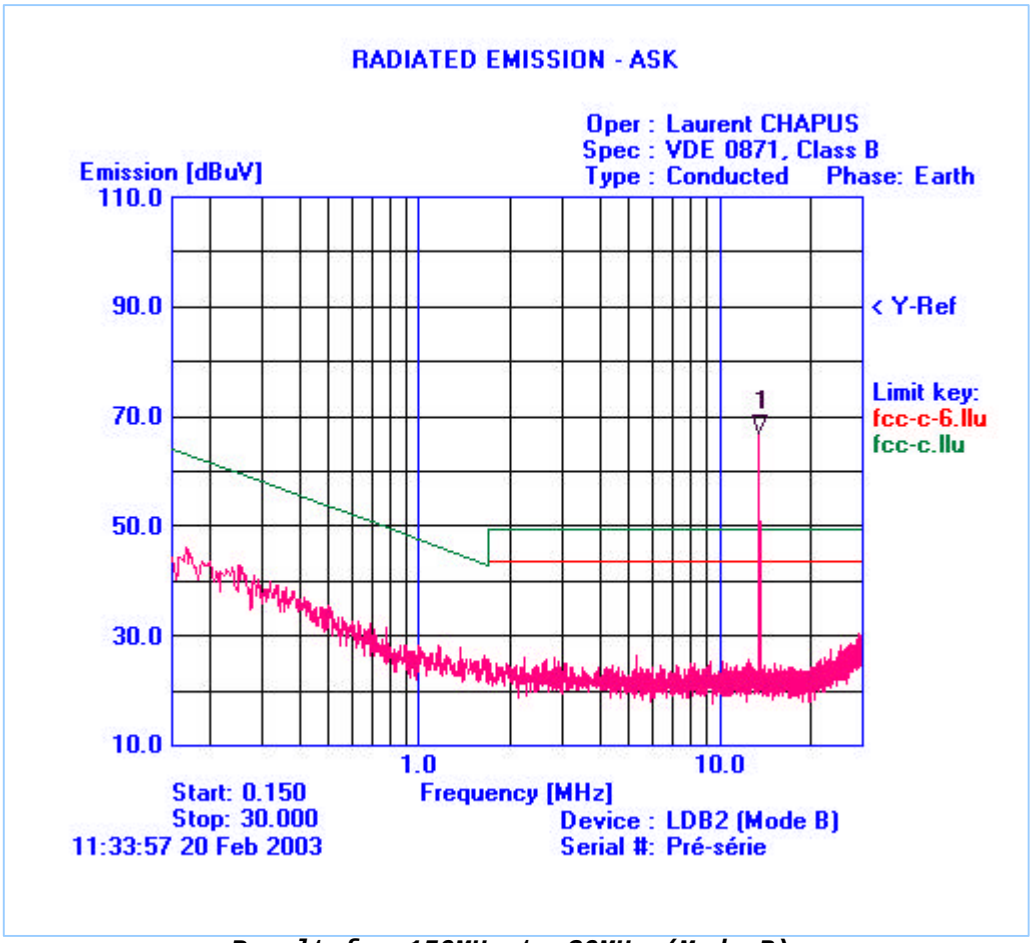
2.3. TEST SEQUENCE AND RESULTS

2.3.1.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.
See below graph examples between 150MHz to 30MHz:
(No frequency observed between 9kHz to 150KHz)



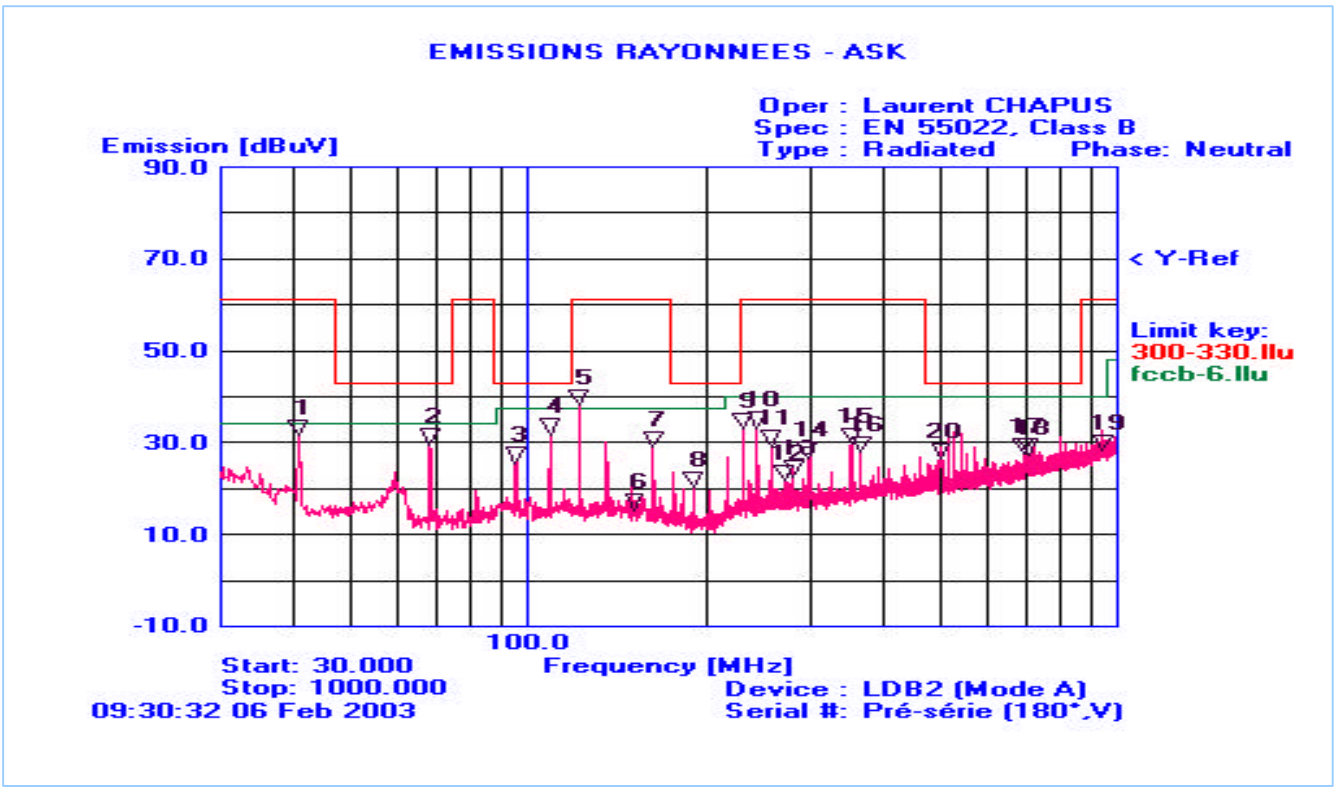
Result for 150MHz to 30MHz (Mode A)
(Marker n°1 is 13.56MHz)



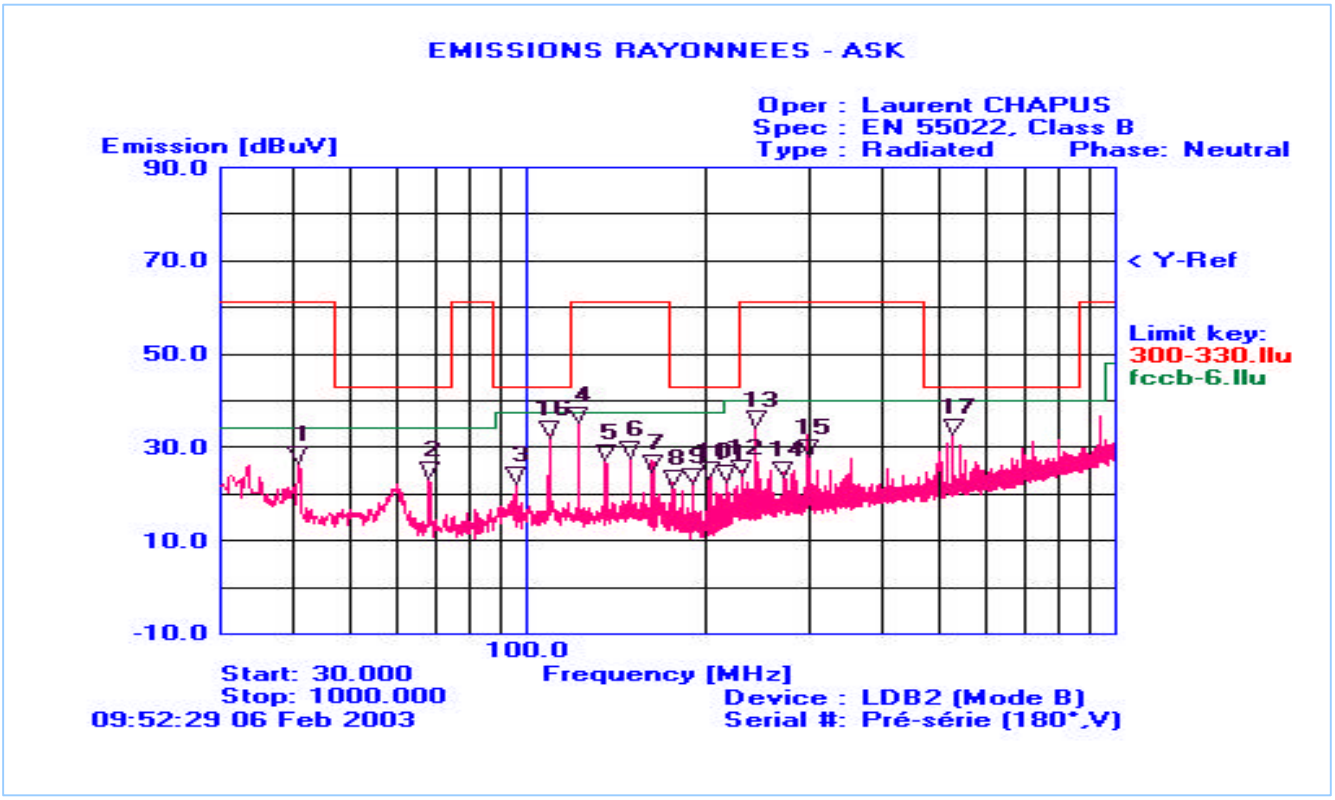
Result for 150MHz to 30MHz (Mode B)
(Marker n°1 is 13.56MHz)

2.3.2.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 and on 4 faces of the EUT.
See below graph examples between 30MHz to 1GHz:



Result for 30MHz to 1GHz (Mode A)



Result for 30MHz to 1GHz (Mode B)

2.3.3.Characterization on 10 meters open site below 30 MHz

The product has been tested according to ANSI C63.4(1992), FCC part 15 subpart C. Radiated Emission were measured on an open area test site.

The product has been tested with 230V / 50Hz power line voltage, 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.

Frequency (MHz)	QPeak Lmt (dBµV/m)	QPeak (dBµV/m)	QPeak-Lmt (dB)	Turntable Angle (deg)	Ant. Pol./ Angle (deg)	Tot Corr (dB)
13.56*[1]	80.0	47.7*[2]	-32.6	234	V / 90	35.4

*[1]: Fundamental – 15.225 limits. Measure have been done at 10m distance and corrected according to requirements of 15.209.e)
*[2] : Highest level observed for mode A and mode B modulation.

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

The product has been tested according to ANSI C63.4(1992), FCC part 15 subpart C. Radiated Emission were measured on an open area test site.

The product has been tested with 230V / 50Hz power line voltage, 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.

Interconnecting cables and equipment's were moved to position that maximized emission. A summary of the worst case emissions found in all test configurations and modes is shown on clause 2.3.2

Result mode A:

No	Frequency (MHz)	QPeak Lmt (dBµV/m)	QPeak (dBµV/m)	QPeak-Lmt (dB)	Angle (deg)	Pol	Hgt (cm)	Tot Corr (dB)	Comments
1	40.706	40.0	34.9	**-5.1**	309	V	226	11.6	*
2	67.799	40.0	36.8	**-3.2**	269	V	104	10.0	*
3	108.497	43.5	36.8	**-6.7**	294	V	251	15.8	*
4	122.028	43.5	43.1	**-0.4**	71	V	101	16.3	*
5	135.605	43.5	39.4	**-4.1**	178	V	106	14.8	*
6	162.735	43.5	39.5	**-4.0**	8	V	103	17.6	*
7	189.852	43.5	37.4	**-6.1**	275	H	342	19.2	*
8	216.971	46.0	39.6	**-6.4**	315	V	120	15.6	*
9	230.529	46.0	35.8	**-10.2**	60	H	272	15.5	*
10	244.093	46.0	42.4	**-3.6**	204	H	328	15.5	*
11	257.660	46.0	38.7	**-7.3**	63	H	209	15.9	*
12	271.225	46.0	36.6	**-9.4**	95	H	229	16.5	*
13	281.523	46.0	44.1	**-1.9**	265	V	102	16.9	*
14	298.328	46.0	37.7	**-8.3**	92	H	270	17.7	*
15	352.563	46.0	39.6	**-6.4**	84	H	246	18.5	*

No	Frequency (MHz)	QPeak Lmt (dBµV/m)	QPeak (dBµV/m)	QPeak-Lmt (dB)	Angle (deg)	Pol	Hgt (cm)	Tot Corr (dB)	Comments
16	500.809	46.0	41.6	**-4.4**	303	V	316	22.1	*
17	705.122	46.0	42.5	**-3.5**	96	V	289	26.1	*
18	999.825	54.0	46.2	**-7.8**	105	V	216	30.2	*

*: The results are extrapolated with §15.31 requirements for measuring distance other than what is specified.

Result mode B:

No	Frequency (MHz)	QPeak Lmt (dBµV/m)	QPeak (dBµV/m)	QPeak-Lmt (dB)	Angle (deg)	Pol	Hgt (cm)	Tot Corr (dB)	Comments
1	40.686	40.0	32.3	**-7.7**	63	V	193	11.6	*
2	108.504	43.5	36.9	**-6.6**	300	V	285	15.8	*
3	122.029	43.5	43.3	**-0.2**	94	V	101	16.3	*
4	135.598	43.5	38.3	**-5.2**	177	V	108	14.8	*
5	149.177	43.5	31.9	**-11.6**	17	V	119	15.2	*
6	162.735	43.5	41.2	**-2.3**	14	V	103	17.6	*
7	189.859	43.5	37.1	**-6.4**	337	V	109	19.2	*
8	216.980	46.0	39.6	**-6.4**	297	V	111	15.6	*
9	244.101	46.0	43.2	**-2.8**	206	H	372	15.5	*
10	271.225	46.0	36.1	**-9.9**	101	H	266	16.5	*
11	281.521	46.0	40.5	**-5.5**	66	H	311	17.0	*
12	298.333	46.0	42.3	**-3.7**	101	H	298	17.7	*
13	300.048	46.0	40.0	**-6.0**	66	H	338	17.8	*
14	528.846	46.0	43.1	**-2.9**	100	H	158	22.5	*
15	691.566	46.0	41.2	**-4.8**	92	V	280	25.9	*
16	800.062	46.0	44.5	**-1.5**	5	V	218	26.6	*
17	999.797	54.0	48.7	**-5.3**	314	V	183	30.2	*

*: The results are extrapolated with §15.31 requirements for measuring distance other than what is specified.

2.4. 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 dBµV/m
The 32 dBµV/m value can be mathematically converted to its corresponding level in µV/m.
Level in µV/m = Common Antilogarithm [(32dBµV/m)/20] = 39.8 µV/m.

3. Conducted emission data

The product has been tested according to ANSI C63.4-(1992) and FCC Part 15 subpart C.

The product has been tested with 110V/60Hz power line voltage and compared to the FCC Part 15 subpart C §15.207 limits. Measurement bandwidth was 9kHz from 150 kHz to 30 MHz.

Measurement was initially made with an HP-8591EM Spectrum Analyzer in peak mode. This was followed by a Quasi-Peak, i.e. CISPR measurement with the Rohde & Schwarz ESH3 receiver for any strong signal. If the average limit is met when using a Quasi-Peak detector, the EUT shall be deemed to meet both limits and measurement with the average detector is unnecessary.

The Peak data are shown on the following plots. Quasi-Peak and Average measurements are detailed in a table with frequencies and levels measured.

Interconnecting cables and equipment's were moved to position that maximized emission. A summary of the worst case emissions found in all test configurations and modes is shown on the following pages.

3.1. SET-UP

The EUT is placed on a non-conducting table of 80cm height. The cable of the power supply has been shorted to 1meter length. The LDB2 is powered trough the LISN with the AC/DC adapter.

Equipment configuration and running mode:

- The LDB2 is connected to the PC with the RS232 serial cable;
- The LDB2 is powered by 230V/50Hz with the AC/DC adapter;
- PC and EUT are ON;
- Software is running;
- A contactless paper ticket (mode A or mode B) is placed 1 cm above the reader.

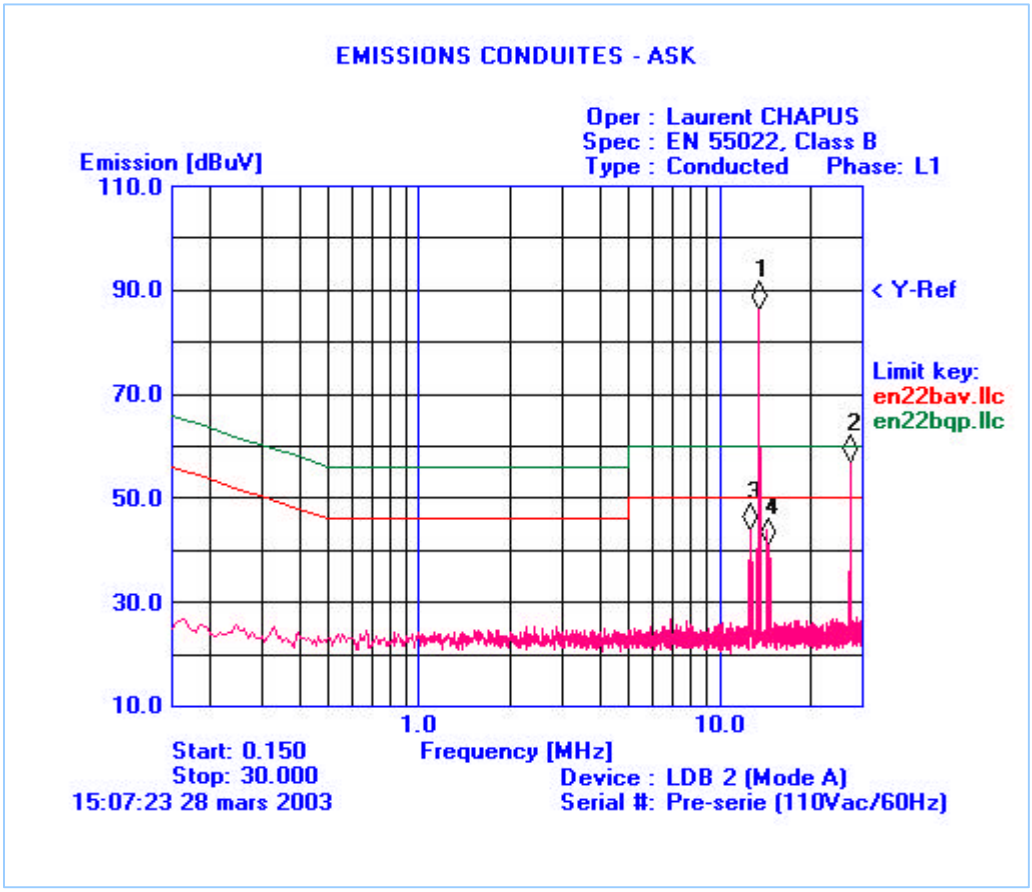
3.2. TEST EQUIPMENT

Equipment	Company	Model	Serial	Calibration Due
EMC Analyzer	HP	8591EM	3536A00384	March 29th ,2003
Test receiver	Rohde&Schwarz	ESH3	872079/117	March 21st ,2003
Transient Limiter	HP	11947A	3107A01596	March 28th ,2003
LISN(auxiliary)	EMCO	3810/2SH	9511-11821628	December 12th ,2003
LISN(measure) 50Ω / 50µH	Telemeter Electronis	TGmbH NNB 2/16	9511-11821628	September 13th ,2003
Faraday room	Rayproof		4854	none

3.3. TEST SEQUENCE AND RESULTS

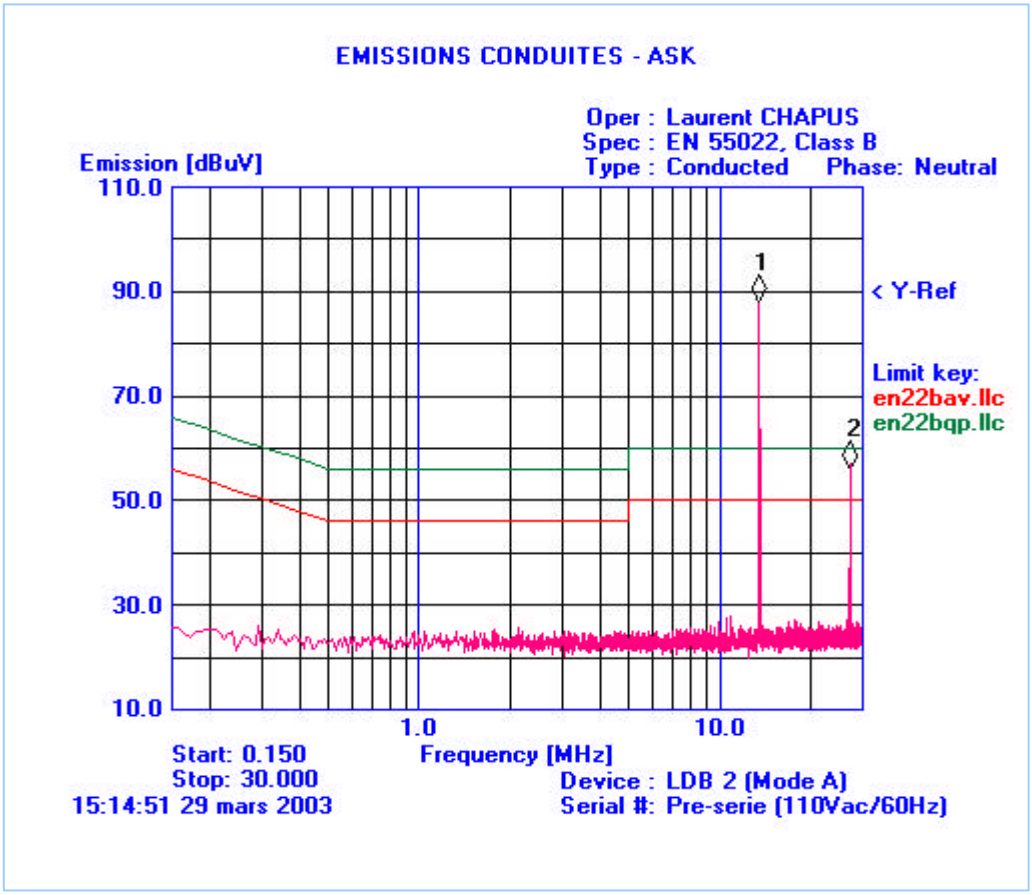
Measures are performed on line 1 and line 2 of the power supply of the LDB2. (Linear transformer with rectifier 110Vac/12Vdc)
Measured are performed with the integrated antenna and also with a dummy load that replaces the antenna (50Ω).

3.3.1.Line conducted emission data on LDB2 – Mode A



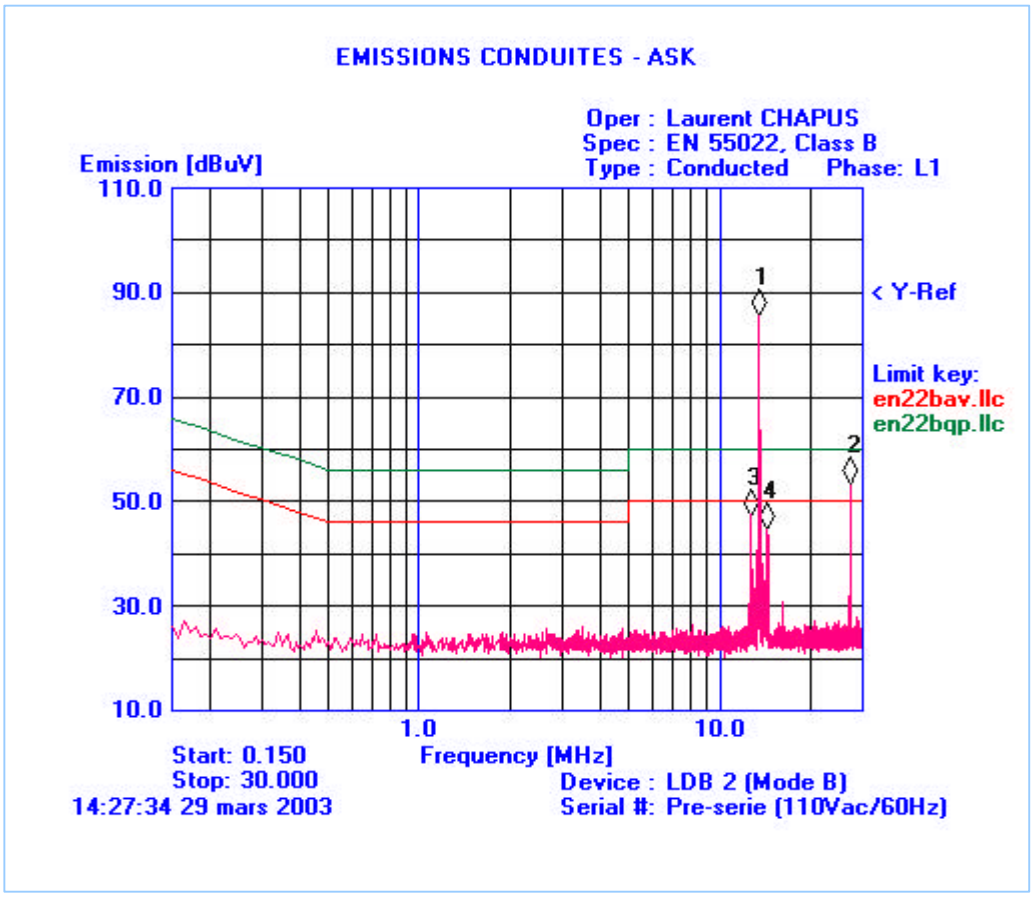
Num.	Freq. [MHz]	Peak [dBµV]	Q-Peak [dBµV]	QP limit [dBµV]	QP delta [dBµV]	Average [dBµV]	AVG Limit [dBµV]	AVG Delta [dBµV]	Comment
1	13.57	86.8	-	-	**-**	-	-	**-**	**Carrier**
2	27.12	-	55.1	60.0	**-4.9**	41.6	50.0	**-8.4**	
3	12.23	-	38.1	60.0	**-21.9**	-	50.0	**-**	
4	14.68	-	40.1	60.0	**-19.9**	-	50.0	**-**	

3.3.2.Neutral conducted emission data on LDB2 – Mode A



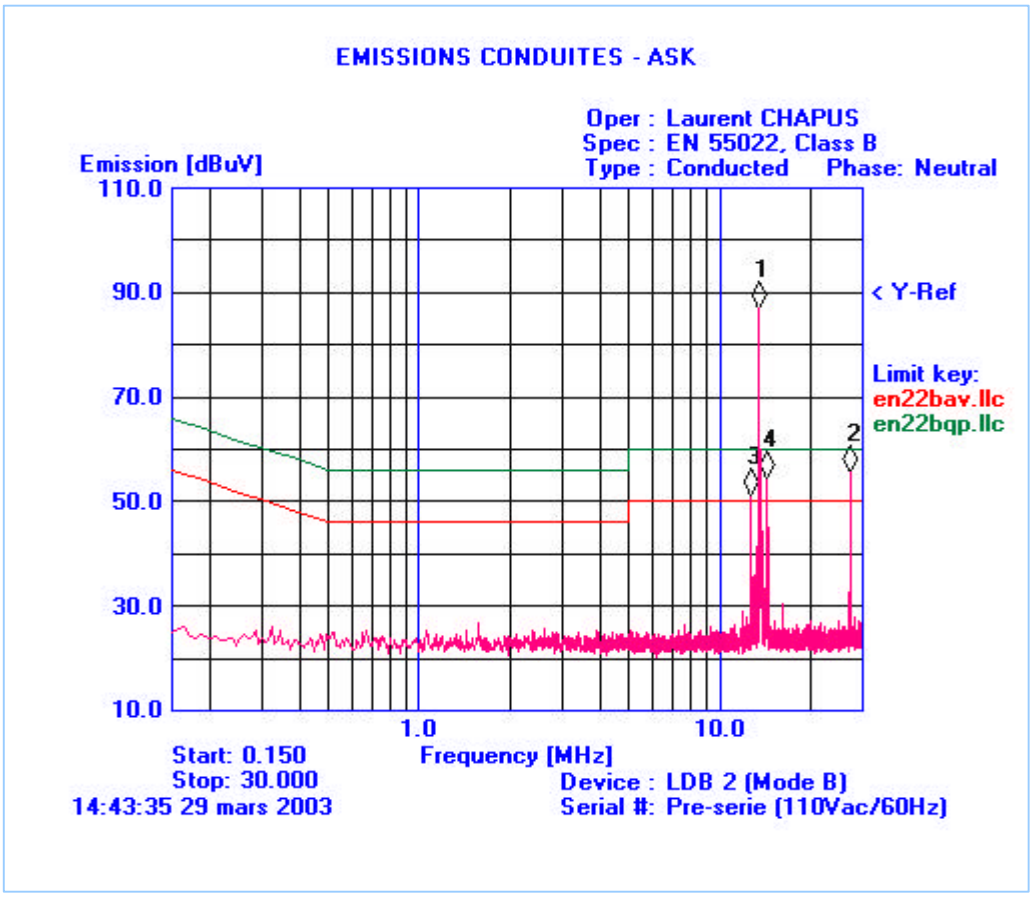
Num.	Freq. [MHz]	Peak [dBµV]	Q-Peak [dBµV]	QP limit [dBµV]	QP delta [dBµV]	Average [dBµV]	AVG Limit [dBµV]	AVG Delta [dBµV]	Comment
1	13.57	88.3	-	-	**-**	-	-	**-**	**Carrier**
2	27.12	-	54.3	60.0	**-5.7**	39.8	50.0	**-10.2**	
3	12.23	-	39.1	60.0	**-20.9**	-	50.0	**-**	
4	14.68	-	41.8	60.0	**-18.2**	-	50.0	**-**	

3.3.3.Line conducted emission data on LDB2 – Mode B



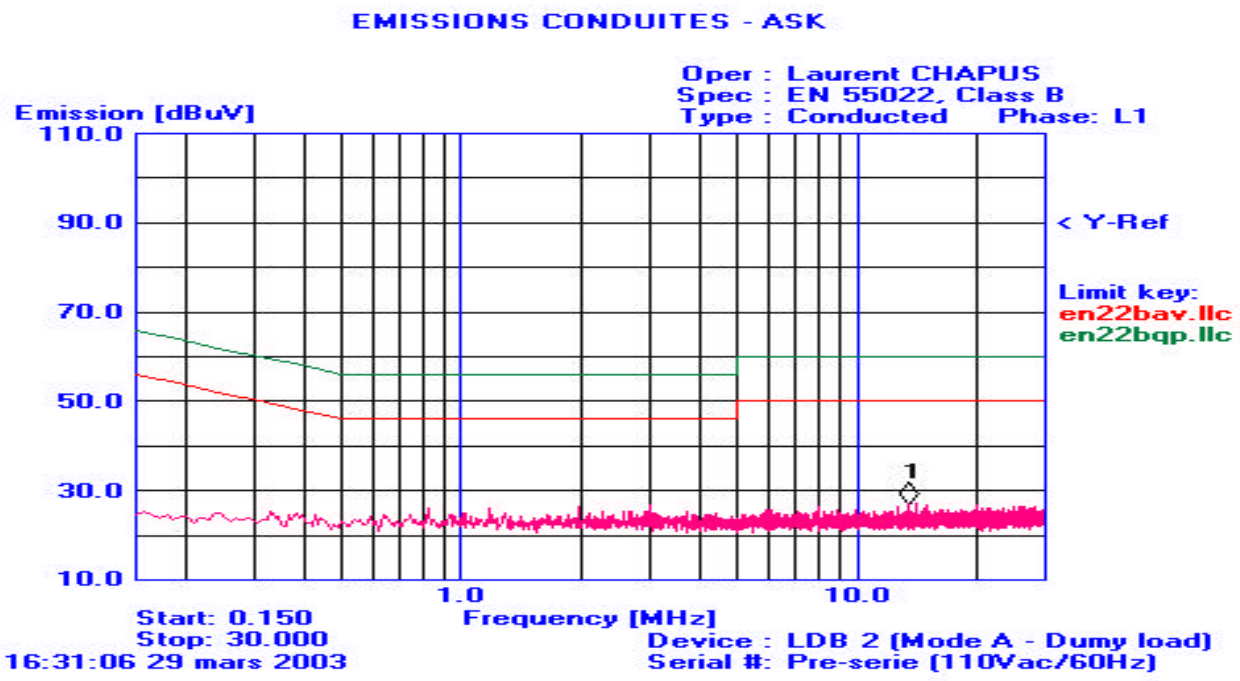
Num.	Freq. [MHz]	Peak [dBµV]	Q-Peak [dBµV]	QP limit [dBµV]	QP delta [dBµV]	Average [dBµV]	AVG Limit [dBµV]	AVG Delta [dBµV]	Comment
1	13.57	86.0	-	-	**-**	-	-	**-**	**Carrier**
2	27.12	-	53.7	60.0	**-6.3**	35.2	50.0	**-14.8**	
3	12.23	-	43.7	60.0	**-16.3**	-	50.0	**-**	
4	14.68	-	44.9	60.0	**-15.1**	-	50.0	**-**	

3.3.4.Neutral conducted emission data on LDB2 – Mode B

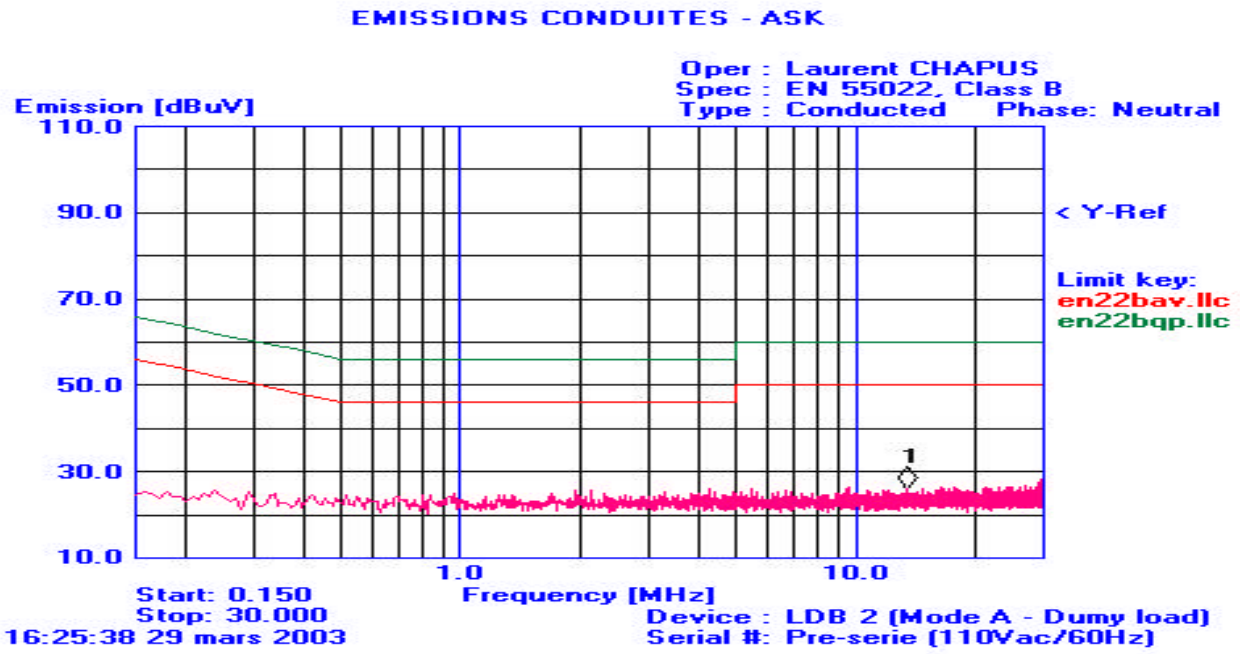


Num.	Freq. [MHz]	Peak [dBµV]	Q-Peak [dBµV]	QP limit [dBµV]	QP delta [dBµV]	Average [dBµV]	AVG Limit [dBµV]	AVG Delta [dBµV]	Comment
1	13.57	87.4	-	-	**-**	-	-	**-**	**Carrier**
2	27.12	-	53.3	60.0	**-6.7**	35.5	50.0	**-14.5**	
3	12.23	-	44.9	60.0	**-15.1**	-	50.0	**-**	
4	14.68	-	46.8	60.0	**-13.2**	-	50.0	**-**	

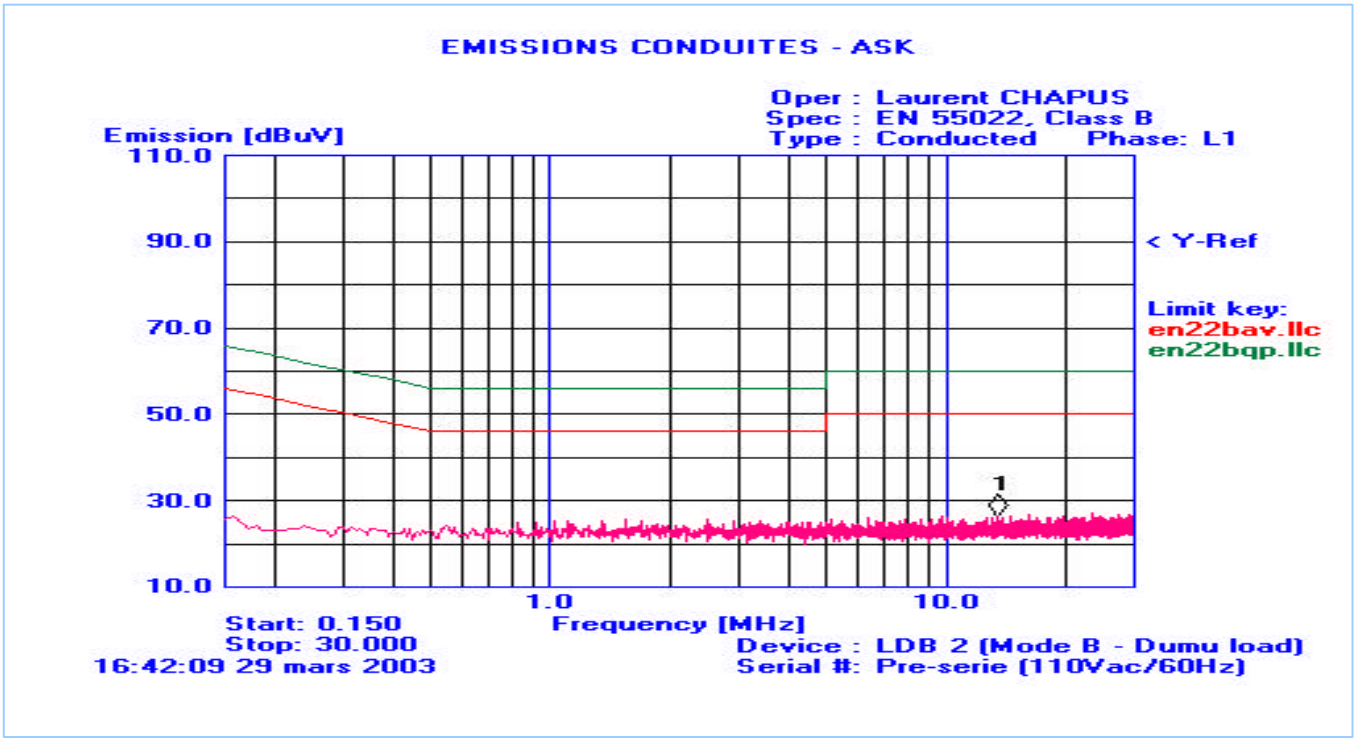
3.3.5.Line conducted emission data on LDB2 – Mode A with dummy load



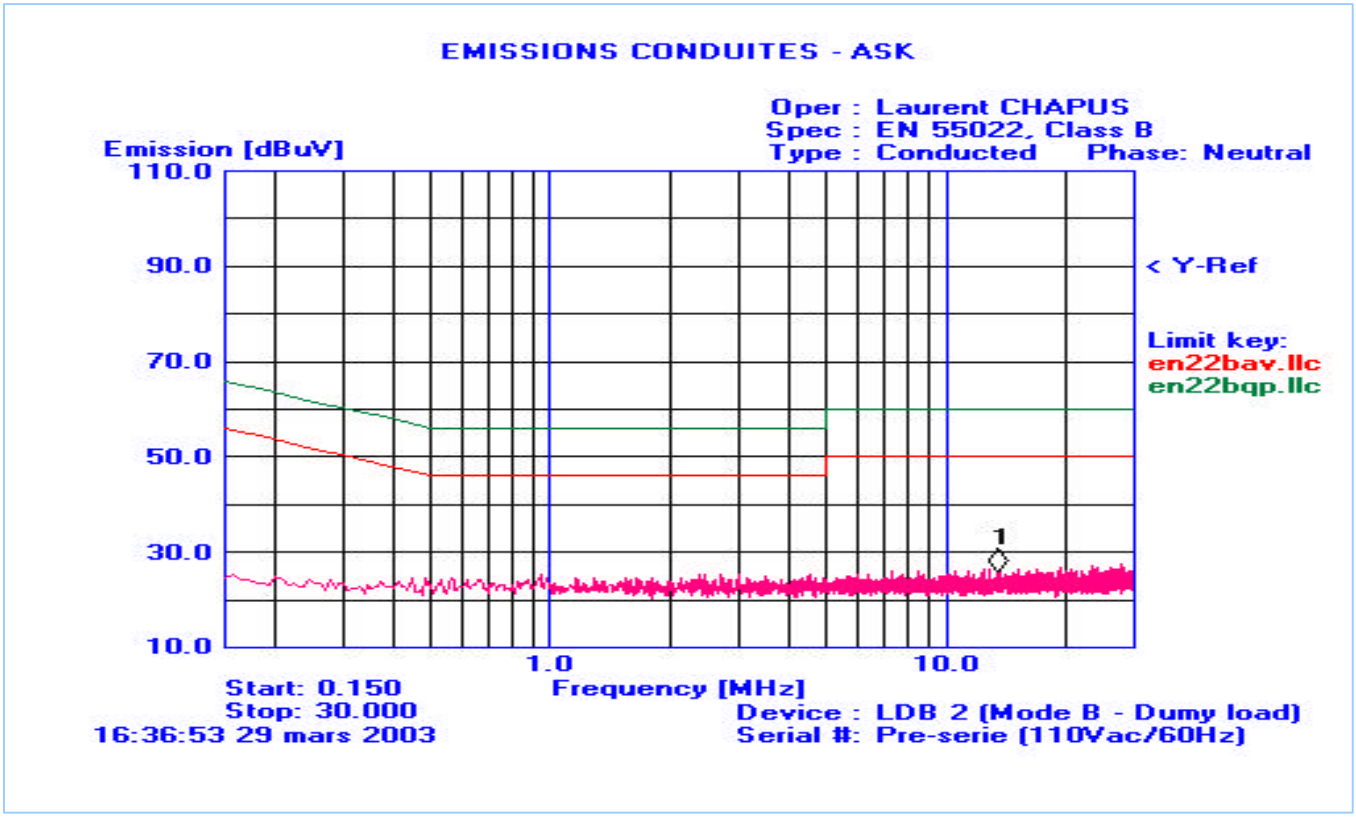
3.3.6.Neutral conducted emission data on LDB2 – Mode A with dummy load



3.3.7.Line conducted emission data on LDB2 – Mode B with dummy load



3.3.8. Neutral conducted emission data on LDB2 – Mode B with dummy load



4. Field strength of fundamental §15.225(a)

The polarization of the measurements for the larger power level is vertical (the test is perform for both vertical and horizontal axis, and the loop antenna position was rotated during the test for maximized the emission measurement.)
Measure have been done at 10m distance and corrected following requirements of 15.209.e)

Frequency (MHz)	QPeak Lmt (dBµV/m)	QPeak (dBµV/m)	QPeak-Lmt (dB)	Turntable Angle (deg)	Ant. Pol./ Angle (deg)	Tot Corr (dB)
13.56*1	80.0	47.7*2	-32.6	234	V / 90	35.4

Maximum deviation under extreme test condition (voltage variation):
Primary 230VAC voltage varied from 85% to 115% (195.5V to 264.5Vac) : Delta < 0.2dBc
Secondary DC voltage varied from 10.2V to 13.8V (12Vdc nominal) : Delta < 0.2dBc
No significant variation of the fundamental amplitude during voltage variation testing per 15.31(e).

Limits Subclause §15.225(a)

Frequency (MHz)	Field strength (µV/m)	Measurement distance (m)
13.56	10 000 80dBµV/m	30

5. Fundamental frequency tolerance (15.225.c)

The frequency tolerance of the carrier signal shall be maintained within +/-0.01% of the operating frequency.

5.1. Voltage fluctuation

Power supply has been set at 85% and 115% of nominal voltage, at 20°C.
Nominal voltage : 12Vdc
Frequency of carrier: 13.56 MHz
Upper limit: 13.561356 MHz
Lower limit: 13.558644 MHz

Voltage	10.2Vdc	12Vdc	13.8Vdc
Frequency (MHz)	13.559845	13.559845	13.559845
Result	Pass	-	Pass

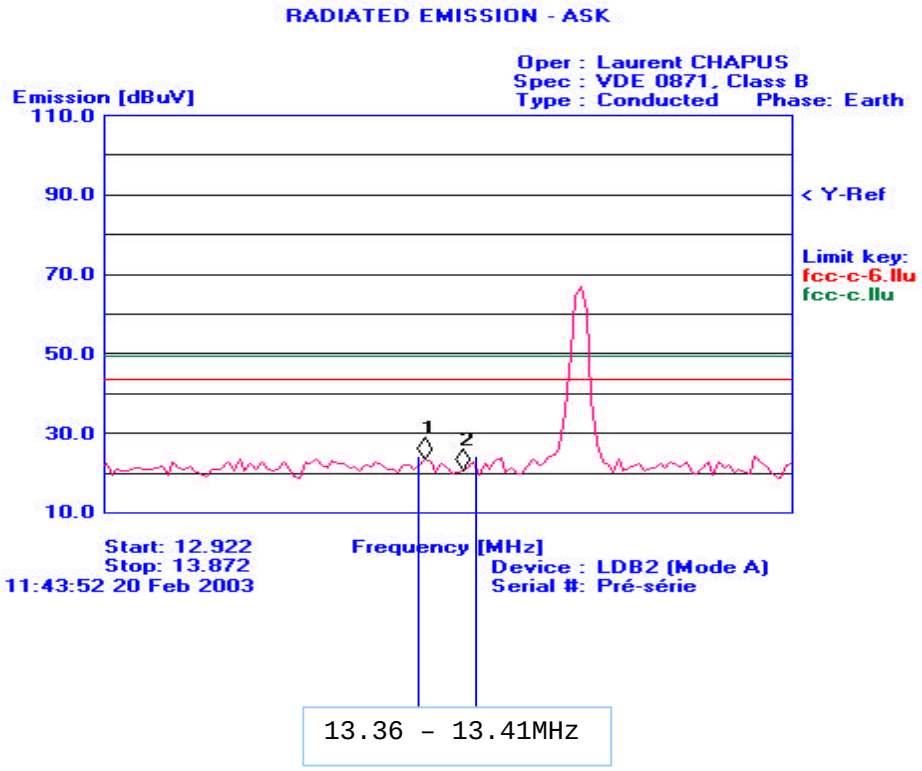
5.2. Temperature fluctuation

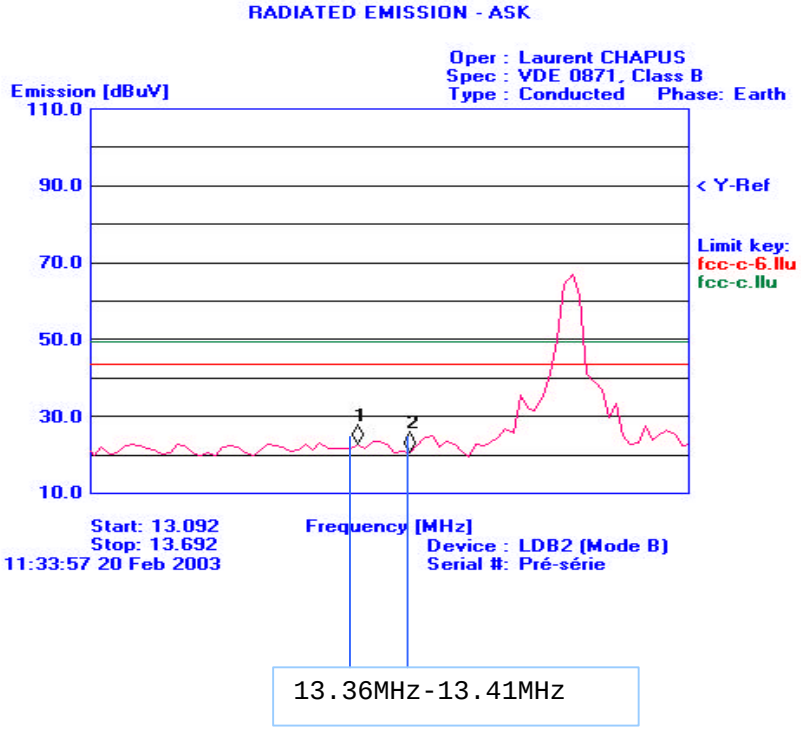
Temperature has been set at –20°C and +50°C at nominal voltage 230V/50Hz (12Vdc secondary voltage with linear transformer)
Frequency of carrier: 13.56 MHz
Upper limit: 13.561356 MHz
Lower limit: 13.558644 MHz

Temperature	**-20°C**	**25°C**	**+50°C**
Frequency (MHz)	13.559793	13.559860	13.560062
Result	Pass	-	Pass

6. Occupied bandwidth §15.205

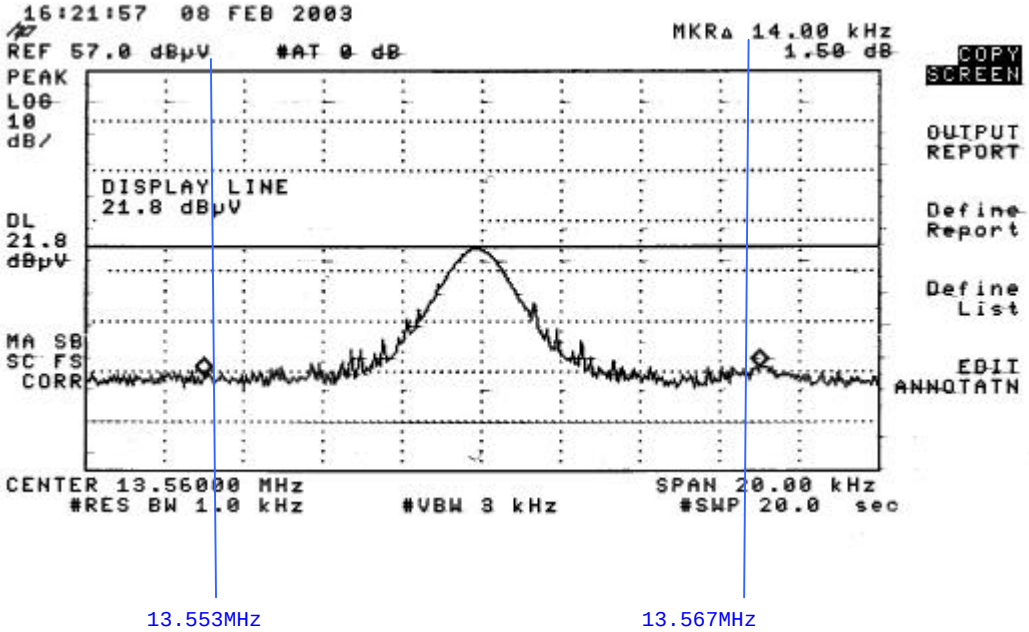
Here is a plot of the occupied bandwidth which shows that the 13.36MHz – 13.41KMz restricted band is free of spurious emission.





7. Band-edge compliance §15.209

ISM band width : 13.553 – 13.567MHz



End of Tests