



Actions Mesures

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EMC TEST REPORT

Nr 2793-FCC

This test report applies only on equipment described hereafter.

Proposal number: 200307-2237

Date : July 7th, 2003
Location : SMEE **Actions Mesures** Laboratory - 38 VOIRON
Performed by : Jacques LORQUIN
Customer : **TAGSYS S.A. (M. D'ANNUNZIO)**
180, Chemin de Saint Lambert
13821 La PENNE SUR HUVEAUNE
FRANCE

Product : **LHR1**
Type of test : **Radiated and Conducted Emission Test**

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

Result of tests : **Radiated Emission : Comply**
Conducted Emission : Comply

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Written by : Jacques LORQUIN

Approved by : Jacques LORQUIN



FCCID : QHKLIBHANDHLDRD1

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 worst case setup is:

- LHR1 connected to the Pocket PC
- Power supply connected on LHR1.

It has been tested with Pocket PC Compaq iPAQ.

1.2. HARDWARE IDENTIFICATION:

* **Equipment under test (EUT):** LHR1 sn:proto n#2 FCCID: QHKLIBHANDHLDRD1

- Input/output:

- * 1x power supply connector
- * I/O port connector

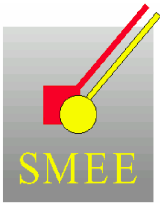
- Size: 250x300x75mm

- Frequencies: Crystal oscillator: 13.56MHz
 Internal clock : 4MHz
 Ceramic resonator: 20MHz
 Bite rate : 19200 Bauds (no frequency above 108MHz)

1.3. Auxiliaries

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

Trade Mark - Model Number (Serial number)	FCC ID	Description	Cable description
Tag 220 (sn: none)	None	Smart label	None
Compaq iPAQ model : 3950 (sn:6Z2BKVL170C3)	Doc of Conf	Pocket PC	All data cables are shielded
Ansmann ACS 410 Traveller (sn: none)	None	Charger	Unshielded cable with ferrite



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1.4. Equipment modifications

No equipment modification (LHR1) has been necessary during testing to achieve compliance to FCC part 15 Subpart C requirements. The unit tested was representative to a production unit.

A Ferrite Wurth ELECTRONIK N°742 7111 (2 pass) has been set on the DC power supply cable see photo below.



1.5. EUT exercise software

The EUT exercise program used during radiated and conducted testing was designed to exercise the LHR1 in a manner similar to a typical use:

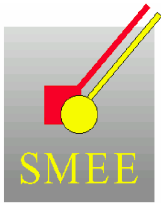
- On Pocket PC: Anticollision.exe V3.04 under Windows Microsoft mobile.

1.6. Special accessories

The serial interfaces cables 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 serial cable (Shielded cable, length: 1.5m);
- ✓ power supply cable of the charger with ferrite (Unshielded, length: 1.8m)



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2. Radiated emission data

2.1. SET-UP

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.

2.1.1. Equipment ON

The **LHR1** and Pocket PC are placed on a non-conducting table of 80cm height, LHR1 set vertical. A smart label is set on the LHR1's antenna.

Equipment configuration and running mode:

- The LHR1 is connected to Pocket PC via serial cable;
- Pocket PC and **LHR1** are ON;
- Charger is powered by 230V50Hz;
- software is running;

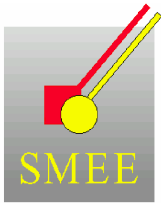
2.1.2. Equipment OFF, Mode batteries Charging

The **LHR1** and Pocket PC are placed on a non-conducting table of 80cm height, LHR1 set vertical. A smart label is set on the LHR1's antenna. The LHR1 is switching off and the batteries charger is connected on LHR1



Equipment configuration and running mode:

- The LHR1 is connected to Pocket PC via serial cable;
- Pocket PC is ON;
- LHR1 is OFF
- Charger is powered by 230V50Hz;



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2.2. TEST EQUIPMENT

Test Equipment up to 1GHz on 10 & 3 meters open site:

Equipment	Company	Model	Serial
Spectrum Analyzer	HP	8568B	2732A04140
Quasi-Peak adapter	HP	85650A	2811A01136
RF Pre-selector	HP	85685A	2833A00773
Biconical Antenna	EMCO	3104C	9401-4636
Log Periodic Antenna	EMCO	3146	2178
Spectrum Analyzer	HP	8593E	3409u00537
Loop antenna	Electro-metrics	EM-6879	690234
Amplifier	HP	8447F H64	3113A06394
OATS			

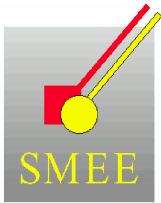
EMCO-1050, 6 meters height antenna mast

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
EMC Analyzer	HP	8591EM	3536A00384
Amplifier	HP	8447F H64	3113A06394
Antenna (30MHz-1GHz)	CHASE	CBL6111A	1628
Loop antenna	Electro-metrics	EM-6879	690234

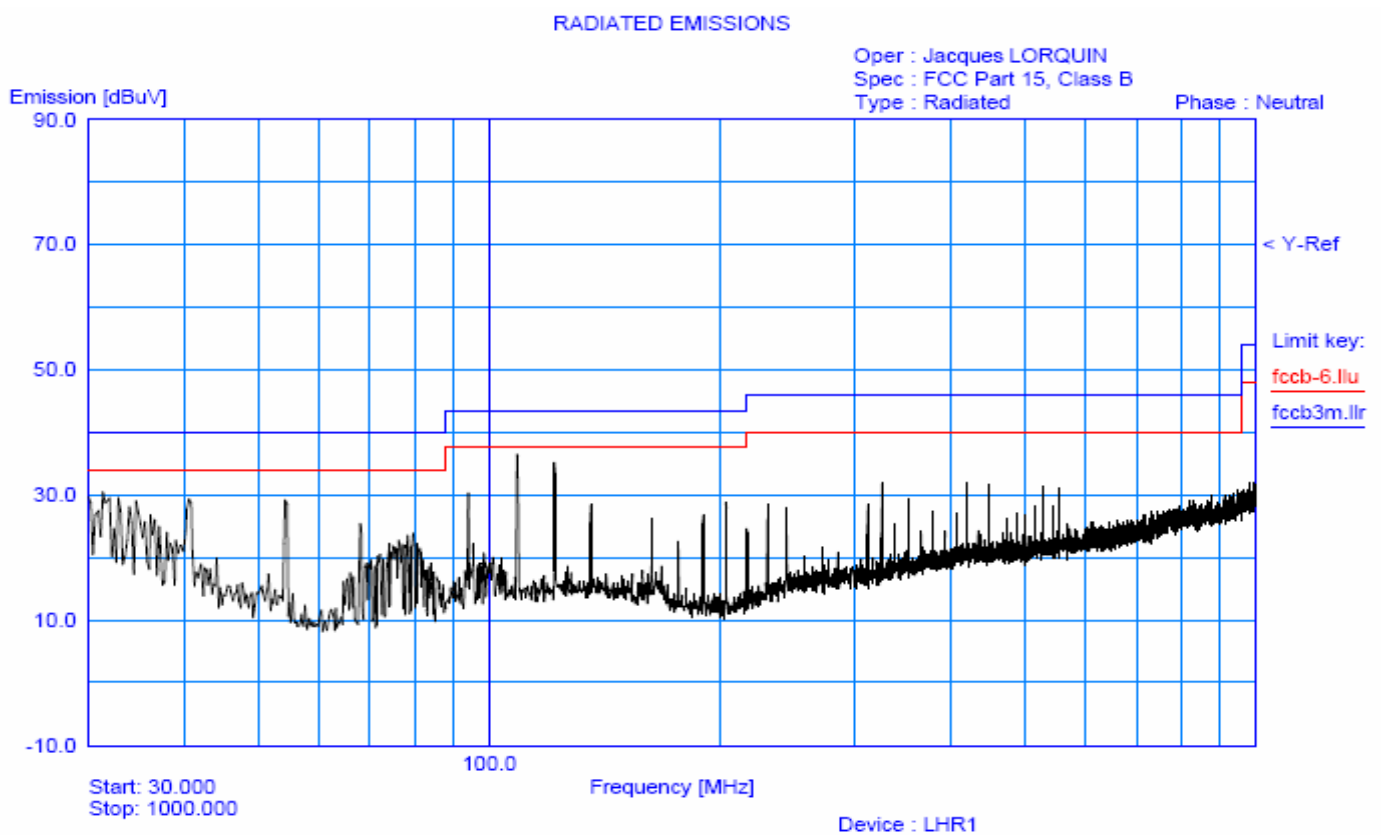


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2.3. TEST SEQUENCE AND RESULTS

2.3.1. Pre-characterization at 3 meters

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, and on 6 faces (3 axes of the EUT are tested) of the EUT. See below for a graph example:



Equipment ON

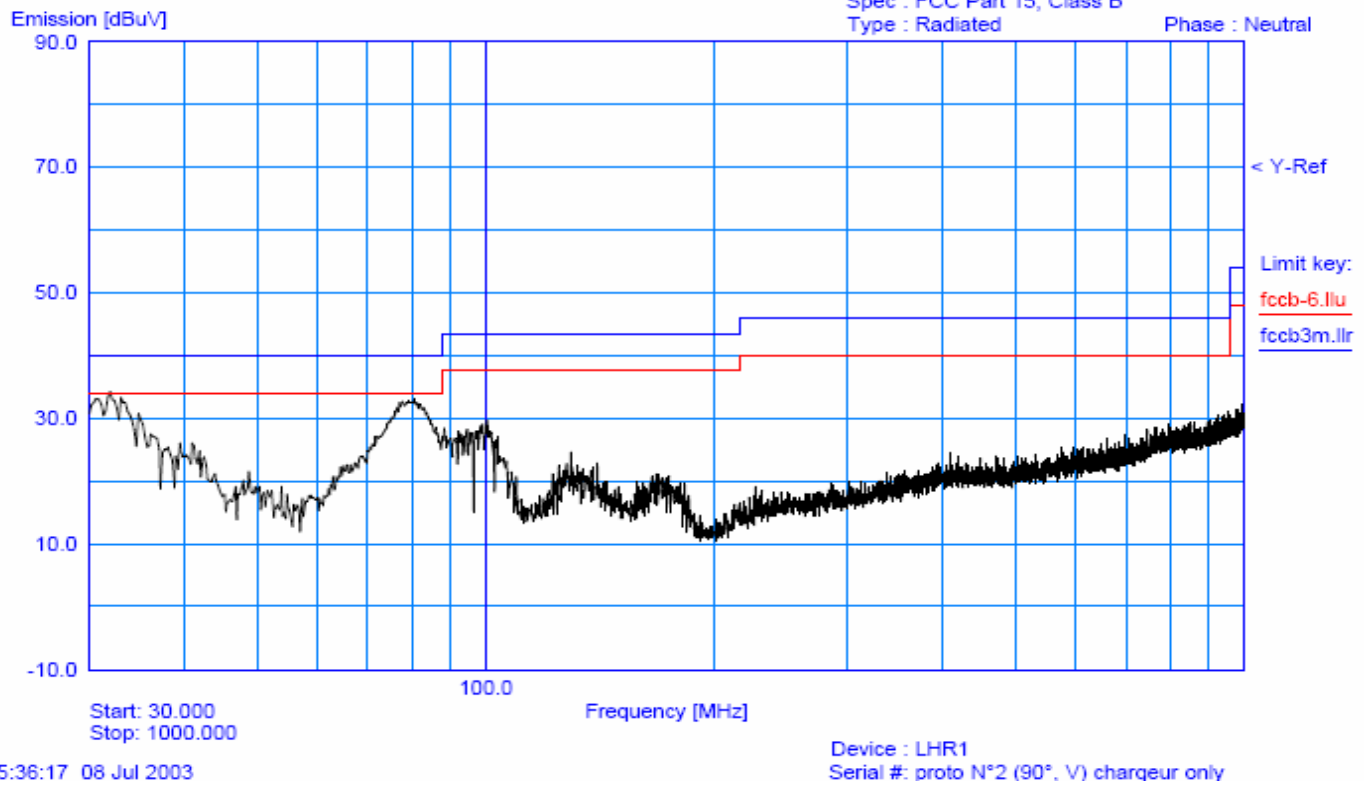


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RADIATED EMISSIONS - TAGSYS

Oper : Jacques LORQUIN
Spec : FCC Part 15, Class B
Type : Radiated

Phase : Neutral

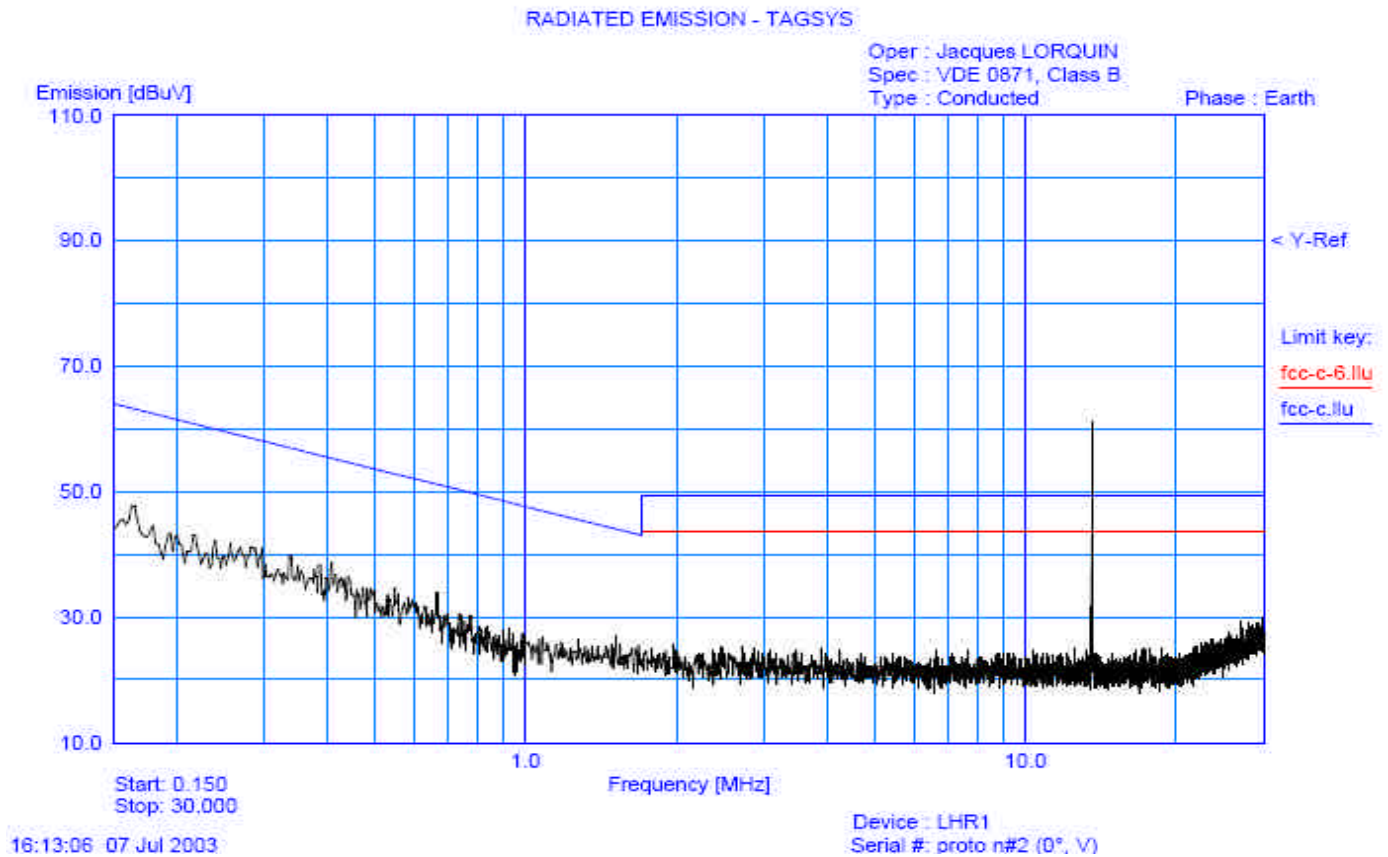


Mode batteries charging



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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) axis and the loop antenna position was rotated during the test for maximized the emission measurement. See below for a graph example:



Result below 30 MHz (mode equipment ON)



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2.3.2.Characterization on 3 meters open site from 30MHz to 1GHz (Mode Radio)

The product has been tested according to ANSI C63.4-(1992), 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 with batteries charged, at a distance of 3 meters from the antenna and compared to the FCC part 15 subpart C §15.209 limits. Measurement bandwidth was 120 kHz 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 and equipment's cables were moved to position that maximized emission (3 axes of the EUT are tested). A summary of the worst case emissions found in all test configurations and modes is shown on clause 2.1.

No	Frequency (MHz)	QPeak Lmt (dBμV/m)	QPeak (dBμV/m)	QPeak-Lmt (dB)	Angle (deg)	Pol	Hgt (cm)	Tot Corr (dB)	Comments
1	40.693	40.0	36.2	-3.8	178	V	101	11.6	
2	54.256	40.0	38.9	-1.1	346	V	102	11.6	
3	67.820	40.0	36.4	-3.6	71	V	101	9.8	
4	108.500	43.5	42.5	-1	110	V	101	15.4	
5	122.057	43.5	30.5	-13	194	V	180	16.0	
6	128.440	43.5	14.1	-29.4	26	V	108	15.1	
7	135.625	46.0	32.7	-13.3	46	V	101	14.8	
8	379.658	46.0	29.1	-16.9	85	V	101	18.8	
8	528.845	46.0	32.7	-13.3	260	V	285	22.3	

2.3.3.Characterization on 10 meters open site from 30MHz to 1GHz (Mode batteries charger)

The product has been tested according to ANSI C63.4-(1992), FCC part 15 subpart B. Radiated Emissions were measured on an open area test site. A description of the facility is on file with the FCC.

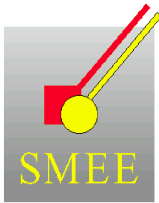
The product has been tested with batteries charged, at a distance of 10 meters from the antenna and compared to the FCC part 15 subpart B §15.109 limits. Measurement bandwidth was 120 kHz from 30 MHz to 1GHz.

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 (3 axes of the EUT are tested). A summary of the worst case emissions found in all test configurations and modes is shown on clause 2.1.

No	Frequency (MHz)	QPeak Lmt (dBμV/m)	QPeak (dBμV/m)	QPeak-Lmt (dB)	Angle (deg)	Pol	Hgt (cm)	Tot Corr (dB)	Comments
1*	31.760	40	32.6	-7.4	1	V	106	12.8	
2*	80.050	40	38.1	-1.9	1	V	159	8.8	

*: The results are extrapolated with §15.31 requirement.

**2.3.4.Characterization on 10 meters open site below 30 MHz (mode: equipment ON)**

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& §15.225 limits. Measurement bandwidth was 9 kHz from 150 kHz to 30 MHz and 100 Hz from 9 kHz to 150 kHz.

The loop antenna position was rotated to locate the orientation that maximized emission reception during testing. Antenna search was performed for both horizontal and vertical polarization. Continuous linear turntable azimuth search was performed with 360 degrees range.

Interconnecting and equipment's cables were moved to position that maximized emission (3 axes of the EUT are tested). A summary of the worst case emissions found in all test configurations and modes is shown on clause 2.1.

Frequency (MHz)	QPeak Lmt (dBµV/m)	QPeak (dBµV/m)	QPeak-Lmt (dB)	Angle EUT (deg)	Pol	Angle Ant. (deg)	Tot Corr (dB)
13.56* ¹	80	67.9	-12.1	82	vertical	90	35.5
27.12	Not traceable signal						

*¹: Fundamental - 15.225 limits. Measure have been done at 10m distance and corrected following requirements of 15.209.e)

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:

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

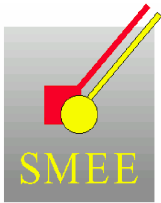
Where
FS = Field Strength
RA = Receiver Amplitude
AF = Antenna Factor
CF = Cable Factor
AG = Amplifier Gain

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

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



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 9 kHz 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.

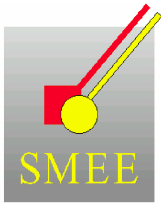
The Peak data are shown on the following plots. Quasi-Peak and Average measurements are detailed in a table with frequencies and levels measured.

Interconnecting and equipment's cables 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 page.

3.1. SET-UP

The LHR1 and Pocket PC are set on a non-conducting table of 80cm height. The cable of the power supply (Charger) has been shorted to 1 meter length. The charger is powered through the LISN.





FCCID : QHKLIBHANDHLDRD1

Equipment configuration and running mode:

Mode batteries charging:

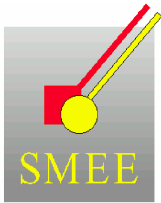
- The LHR1 is connected to Pocket PC via serial cable;
- Pocket PC is ON;
- LHR1 is OFF;
- Charger is powered by 110V60Hz.

Equipment ON:

- The LHR1 is connected to Pocket PC via serial cable;
- Pocket PC is ON;
- LHR1 is ON;
- Charger is powered by 110V60Hz.

3.2. TEST EQUIPMENT

Equipment	Company	Model	Serial
EMC Analyzer	HP	8591EM	3536A00384
test receiver	Rohde&Schwarz	ESH3	872079/117
	Z		
Transient Limiter	HP	11947A	3107A01596
LISN(auxiliary)	EMCO	3810/2SH	9511-11821628
LISN(measure)	Telemeter	TGmbH	NNB 0001300
50Ω / 50μH	Electronis	2/16	
Faraday room	Rayproof		4854

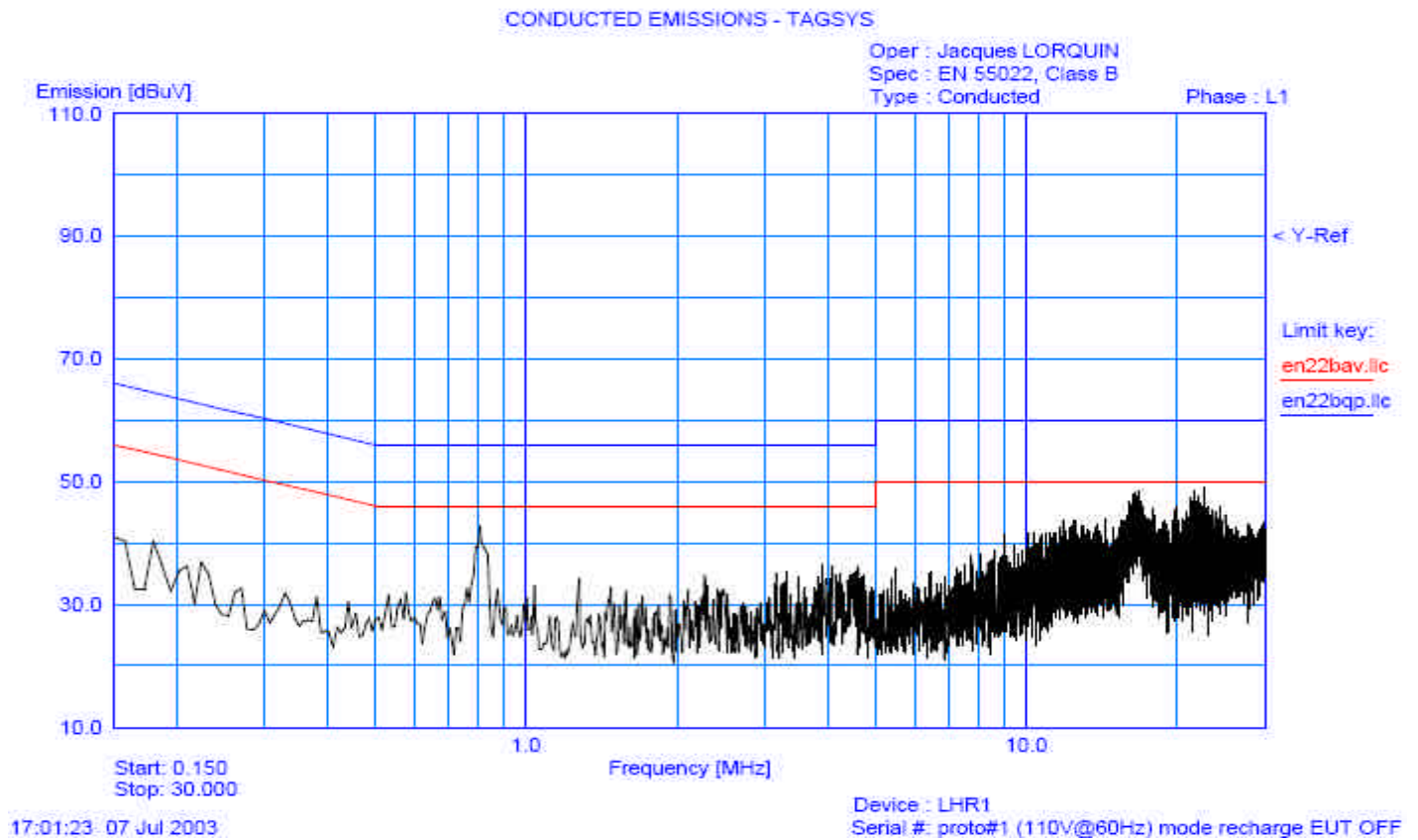


FCCID : QHKLIBHANDHLDRD1

3.3. TEST SEQUENCE AND RESULTS

Measures are performed on line 1 and line 2 of the power supply of the Charger of LHR1,

3.3.1. Line conducted emission data (EUT OFF, batteries charging mode)

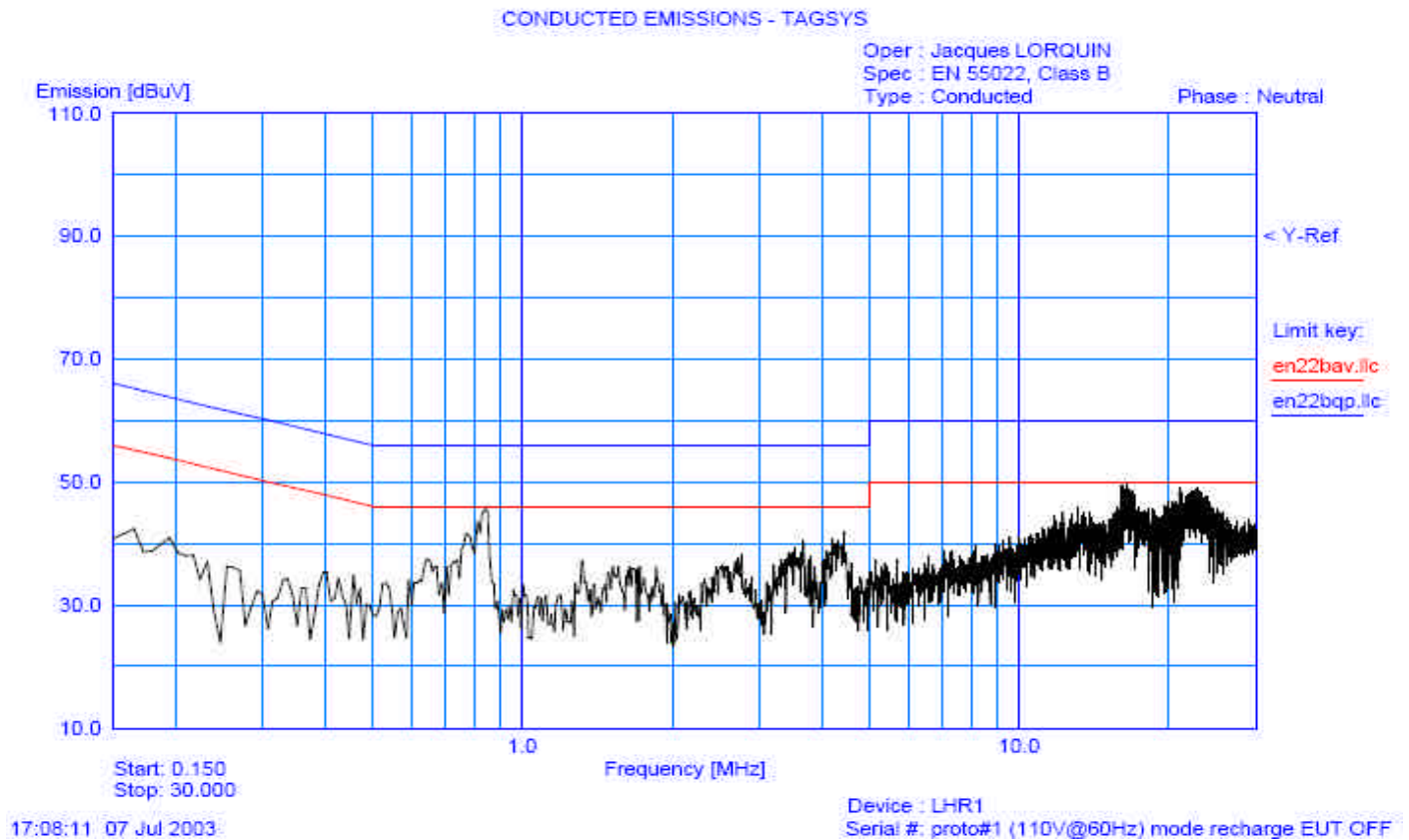


Num.	Freq. [MHz]	Peak [dBuV]	Q-Peak [dBuV]	QP limit [dBuV]	QP delta [dBuV]	Average [dBuV]	AVG Limit [dBuV]	AVG Delta [dBuV]	Comment.
1	0.16	44.94	37.05	64.00	-26.95	22.70	54.00	-31.3	
2	0.18	43.89	34.98	64.00	-29.02	20.90	54.00	-33.1	
3	0.21	41.18	33.46	62.00	-28.54	19.45	52.00	-32.55	
4	0.23	38.31	30.21	62.00	-31.79	17.83	52.00	-34.17	
5	0.81	47.97	38.91	56.00	-17.09	21.64	46.00	-24.36	
6	16.50	48.73	40.69	60.00	-19.31	24.20	50.00	-25.8	
7	16.68	48.32	40.66	60.00	-19.34	23.99	50.00	-26.01	
8	21.57	45.80	36.76	60.00	-23.24	18.41	50.00	-31.59	
9	22.03	48.13	37.79	60.00	-22.21	30.42	50.00	-19.58	

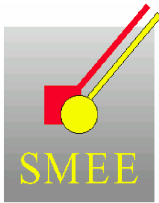


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3.3.2. Neutral conducted emission data (EUT OFF, batteries charging mode)

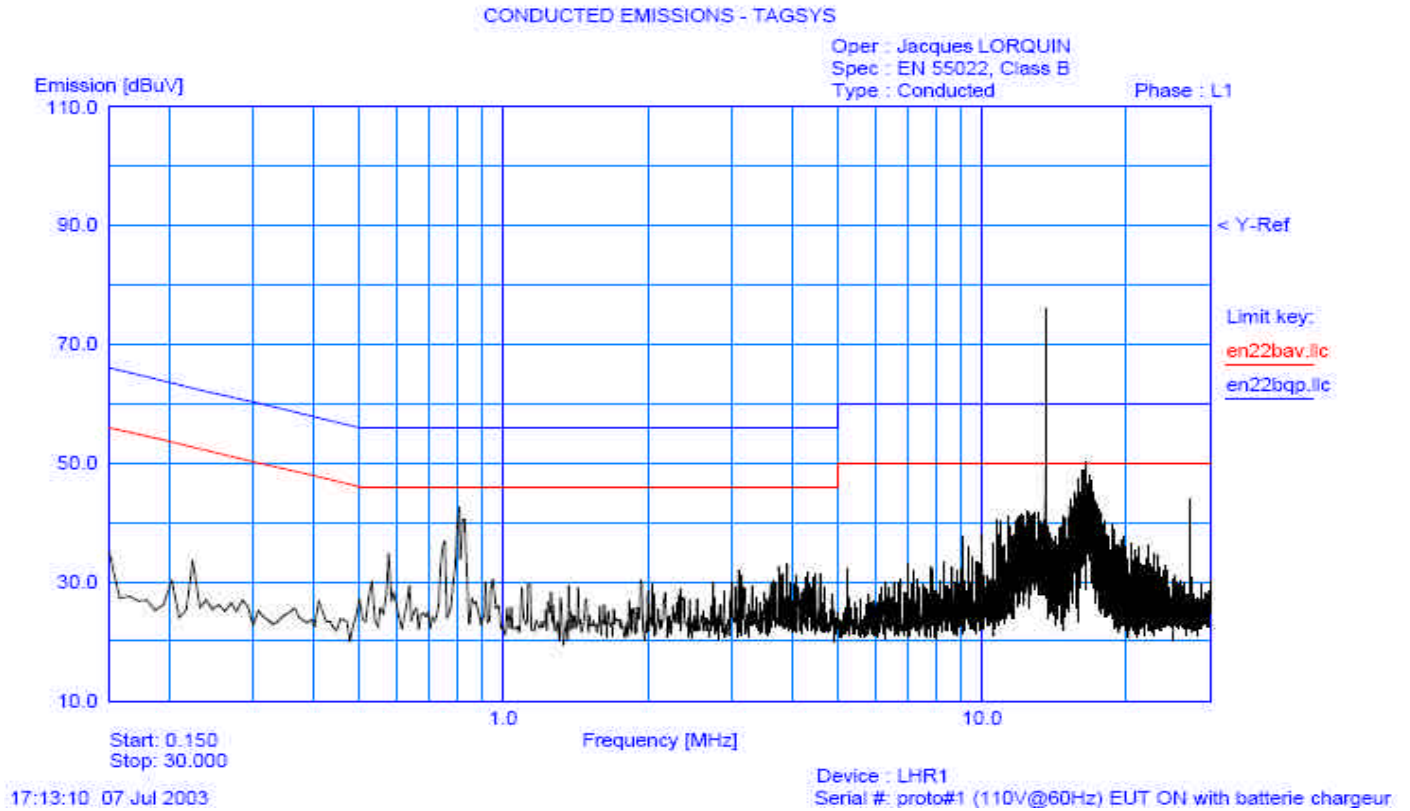


Num.	Freq. [MHz]	Peak [dBμV]	Q-Peak [dBμV]	QP limit [dBμV]	QP delta [dBμV]	Average [dBμV]	AVG Limit [dBμV]	AVG Delta [dBμV]	Comment.
1	0.16	44.52	41.49	64.00	-22.51	26.31	54.00	-27.69	
2	0.19	42.45	39.03	62.00	-22.97	23.77	52.00	-28.23	
3	0.81	50.14	46.00	56.00	-10	28.14	46.00	-17.86	
4	0.84	46.08	41.96	56.00	-14.04	24.46	46.00	-21.54	
5	16.42	51.56	43.40	60.00	-16.6	31.58	50.00	-18.42	
6	16.59	52.21	43.45	60.00	-16.55	31.62	50.00	-18.38	
7	22.57	48.63	43.49	60.00	-16.51	30.48	50.00	-19.52	



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3.3.3. Line conducted emission data (EUT ON)



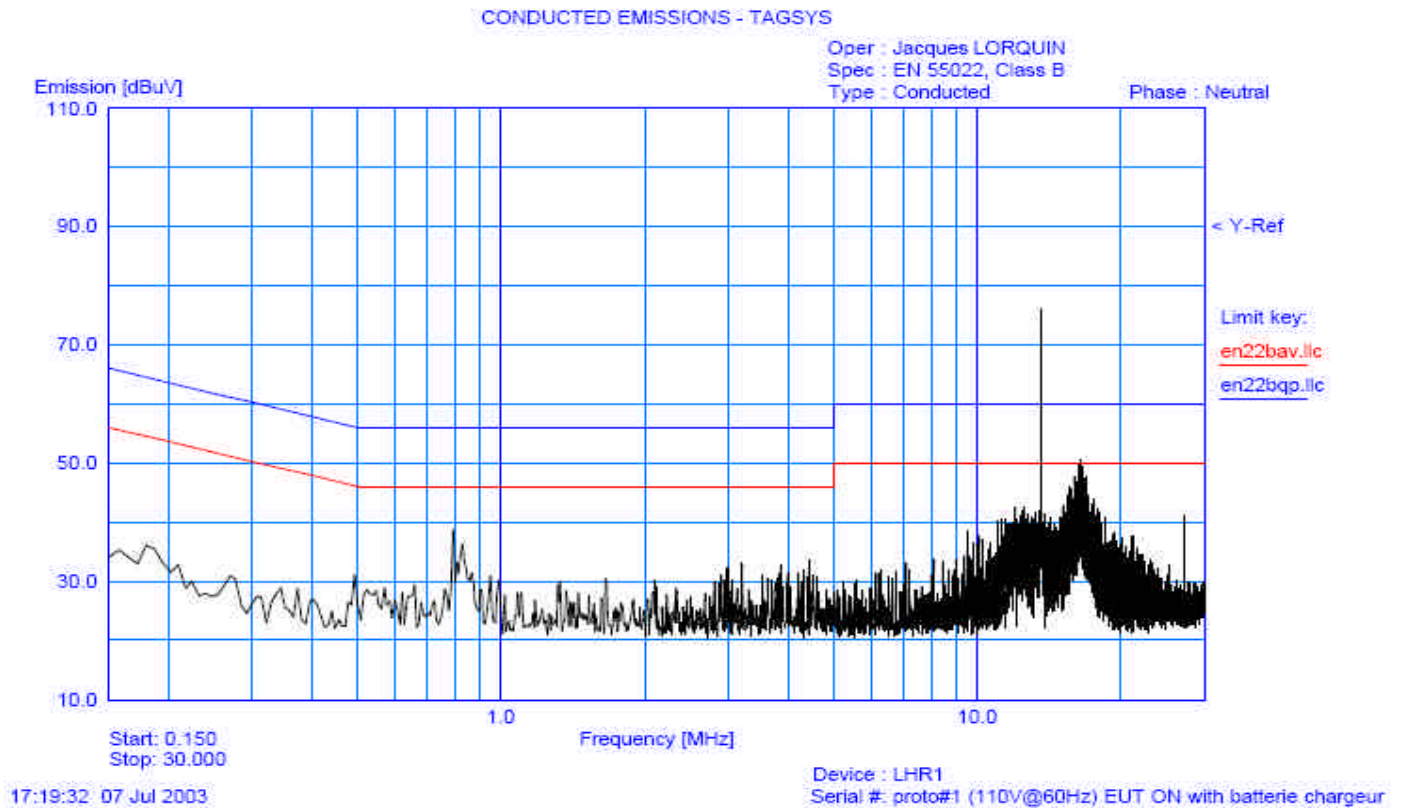
Num.	Freq. [MHz]	Peak [dBμV]	Q-Peak [dBμV]	QP limit [dBμV]	QP delta [dBμV]	Average [dBμV]	AVG Limit [dBμV]	AVG Delta [dBμV]	Comment.
1	0.81	42.71	33.72	56.00	-22.28	18.59	46.00	-27.41	
2	13.56	75.92	-	60.00		-	50.00		See *
3	16.34	50.39	37.93	60.00	-22.07	19.13	50.00	-30.87	
4	16.54	50.46	39.07	60.00	-20.93	19.17	50.00	-30.83	
5	27.11	47.91	45.05	60.00	-14.95	36.21	50.00	-13.79	
6	16.18	46.88	38.60	60.00	-21.4	18.59	50.00	-31.41	

*: Carrier - §15.207(b): Limits shall not apply to carrier current systems operating as intentional radiators on frequencies below 30MHz.



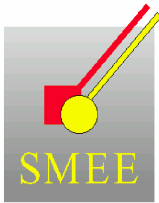
FCCID : QHKLIBHANDHLDRD1

3.3.4. Neutral conducted emission data (EUT ON)



Num.	Freq. [MHz]	Peak [dBμV]	Q-Peak [dBμV]	QP limit [dBμV]	QP delta [dBμV]	Average [dBμV]	AVG Limit [dBμV]	AVG Delta [dBμV]	Comment.
1	0.79	41.03	32.01	56.00	-23.99	18.04	46.00	-27.96	
2	13.56	76.06	-	60.00		-	60.00		See *
3	16.26	48.48	38.00	60.00	-22	19.62	60.00	-40.38	
4	16.32	47.16	38.96	60.00	-21.04	19.68	60.00	-40.32	
5	16.54	50.40	39.75	60.00	-20.25	19.94	60.00	-40.06	
6	27.11	48.02	45.00	60.00	-15	36.44	60.00	-23.56	

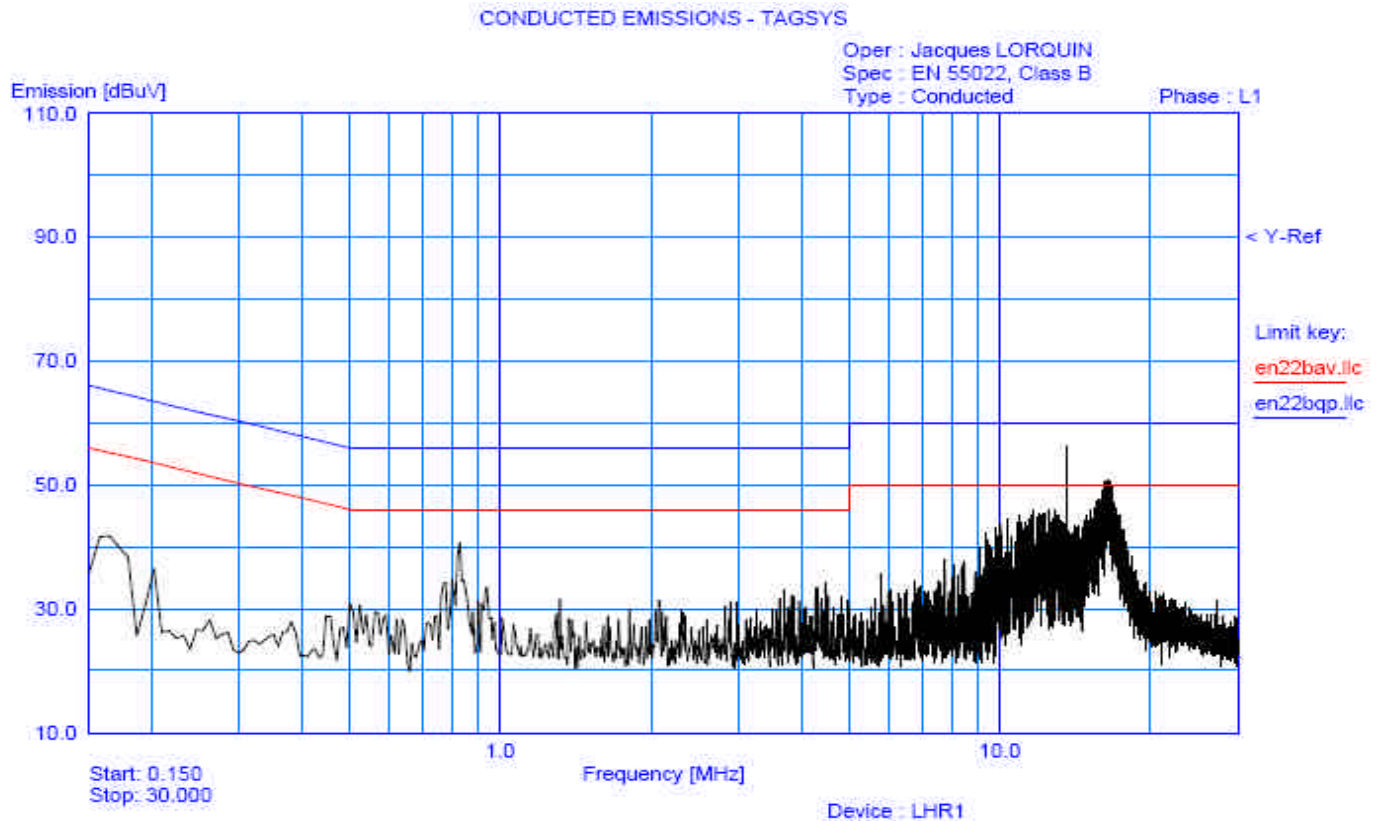
*: Carrier - §15.207(b): Limits shall not apply to carrier current systems operating as intentional radiators on frequencies below 30MHz.



FCCID : QHKLIBHANDHLDRD1

3.3.5.Line conducted emission data (EUT ON)

The antenna is wrapped up in a conductive aluminium foil.



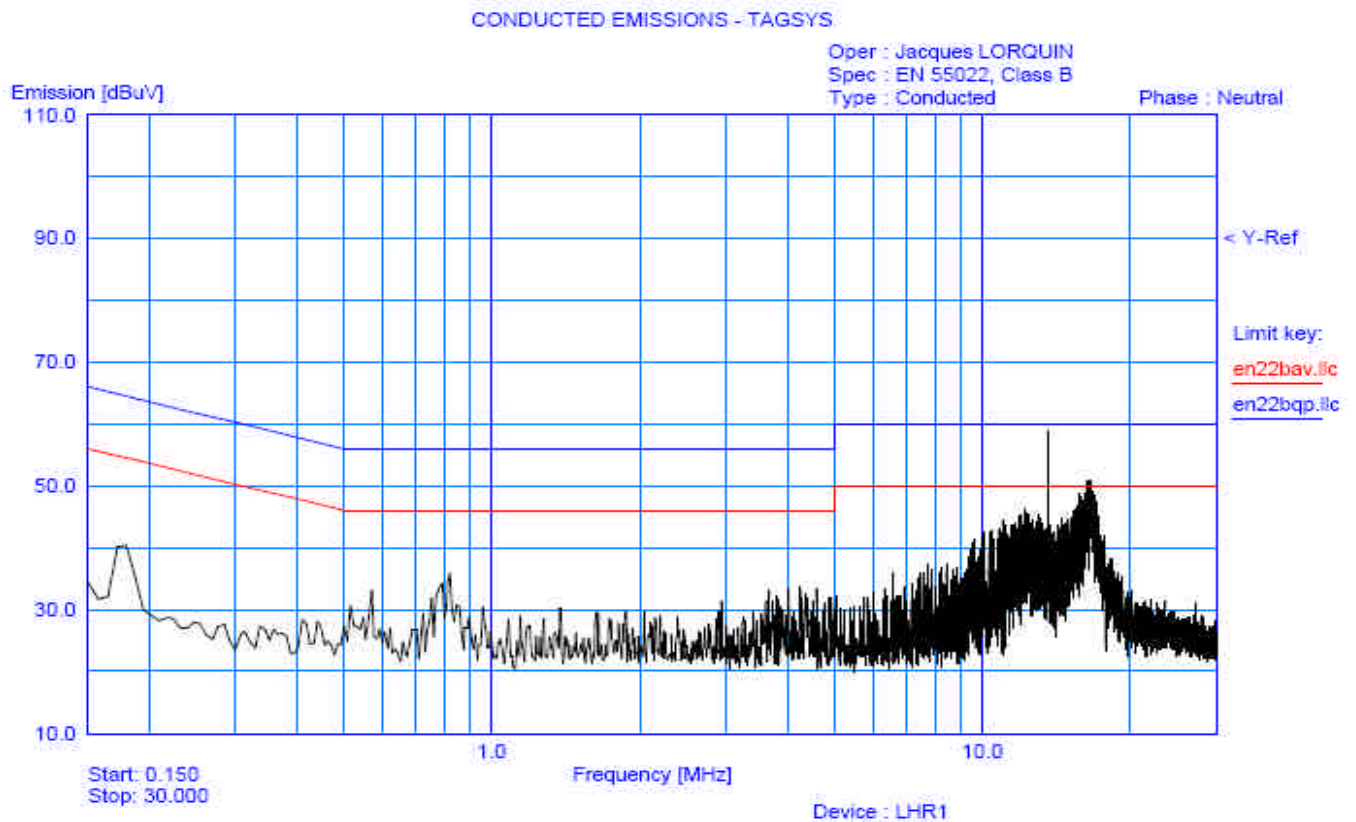
Num.	Freq. [MHz]	Peak [dBμV]	Q-Peak [dBμV]	QP limit [dBμV]	QP delta [dBμV]	Average [dBμV]	AVG Limit [dBμV]	AVG Delta [dBμV]	Comment.
1	0.16	41.34	34.77	64.00	-29.23	17.48	54.00	-36.52	
2	0.83	39.26	32.20	56.00	-23.8	17.94	46.00	-28.06	
3	13.56	59.62	56.9	60.00	-3.1	48.1	50.00	-1.9	
4	16.18	50.93	40.75	60.00	-19.25	22.20	50.00	-27.8	
5	16.29	50.55	41.71	60.00	-18.29	23.14	50.00	-26.86	
6	16.39	50.96	41.80	60.00	-18.2	23.45	50.00	-26.55	



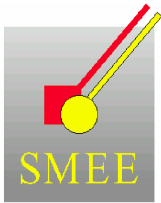
FCCID : QHKLIBHANDHLDRD1

3.3.6. Neutral conducted emission data (EUT ON)

The antenna is wrapped up in a conductive aluminium foil.



Num.	Freq. [MHz]	Peak [dBuV]	Q-Peak [dBuV]	QP limit [dBuV]	QP delta [dBuV]	Average [dBuV]	AVG Limit [dBuV]	AVG Delta [dBuV]	Comment.
1	0.18	41.88	32.99	64.00	-31.01	19.49	54.00	-34.51	
2	0.82	39.37	32.34	56.00	-23.66	18.63	46.00	-27.37	
3	13.57	59.90	57.20	60.00	-2.8	48.2	50.00	-1.8	
4	16.39	50.85	41.63	60.00	-18.37	23.01	50.00	-26.99	
5	16.50	51.31	41.95	60.00	-18.05	23.29	50.00	-26.71	
6	16.60	49.79	40.61	60.00	-19.39	23.04	50.00	-26.96	



FCCID : QHKLIBHANDHLDRD1

4. Field strength of fundamental §15.225(a)

The Equipment has been tested in 3 orthogonal planes, the polarization of the measurements for the larger power level is vertical (The loop antenna position was rotated during the test for maximized the emission measurement and for both vertical and horizontal axis.)

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)	Angle EUT (deg)	Pol	Angle Ant. (deg)	Tot Corr (dB)
13.56	80	67.9	-12.1	82	vertical	90	35.5

The product has been tested with new batteries charged.

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

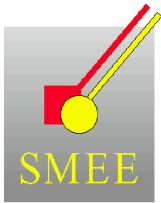
The product has been tested with new batteries charged.

Frequency of carrier: 13.56 MHz

Upper limit: 13.561356 MHz

Lower limit: 13.558644 MHz

Voltage	NEW BATERIES
Frequency (MHz)	13.559835
Result	Pass



FCCID : QHKLIBHANDHLDRD1

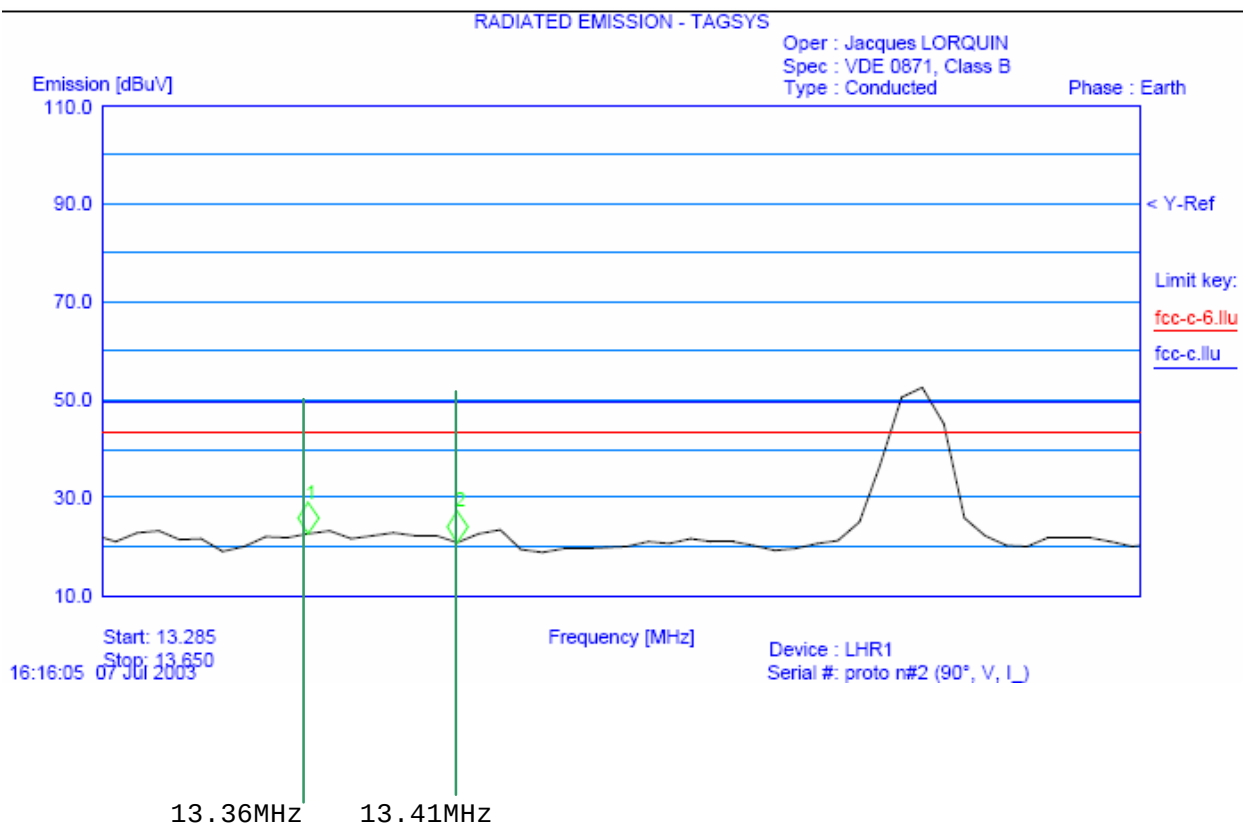
5.2. Temperature

Temperature has been set at -20°C and +50°C with new batteries charged;
 Upper limit: 13.561356 MHz
 Lower limit: 13.558644 MHz

Voltage	-20°C	20°C	+50°C
Frequency (MHz)	13.559995	13.559835	13.559790
Result	Pass	Pass	Pass

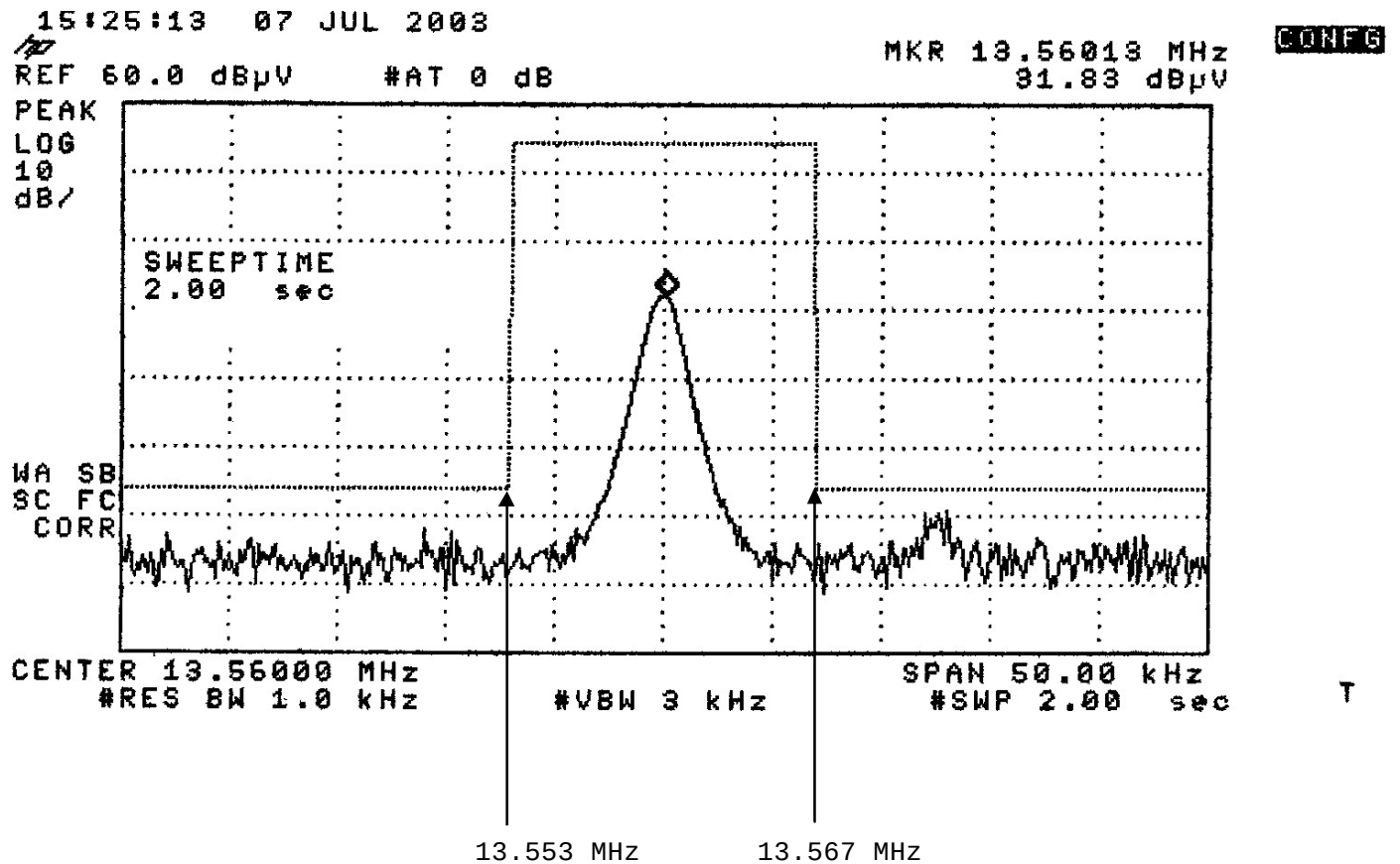
6. Occupied bandwidth

Here is a plot of the occupied bandwidth, which shown that, 13.36MHz - 13.41MHz restricted band is free of spurious emission.



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7.	Band-edge compliance	§15.209
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End of Tests