

RADIO TEST REPORT

No. 0143245R2

EQUIPMENT UNDER TEST

Equipment: Hugin
Type / model: ET151061 P3
Manufacturer: C Technologies AB
Tested by request of: C Technologies AB

SUMMARY

The equipment complies with the requirements of radiated and conducted emissions according to the following standard:

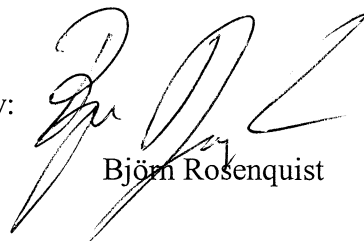
FCC part 15.249, subpart C (2001)

Date of issue: 17 December 2002

Tested by:


Vladimir Bazhanov

Approved by:


Björn Rosenquist

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1. CLIENT INFORMATION

The EUT has been tested by request of

Company: C Technologies AB
Ideon Research Park
Scheelevägen 19 C
SE-223 70 Lund
Sweden

Name of contact: Kåre Lindkvist
kare.lindkvist@cpen.com

2. EQUIPMENT UNDER TEST (EUT)**2.1 Identification of the EUT**

Equipment: Hugin
Type/Model: ET151061 P3
Serial Number: FP1-2
Manufacturer: C Technologies AB
Rating: 3,7 V DC (3,25 – 4,2 V DC) from Li-ion battery
Rating RF output power: 0 dBm (Power class 2)
Antenna gain: 0 dBd (according to the manufacturer)
Operating temperature range: 0 to +40 °C
Frequency range: 2400 – 2483,5 MHz

2.2 Additional information about the EUT

Modulation: Gaussian Frequency Shift Keying (GFSK)

During the tests the EUT supported the following software provided by the manufacturer:

<u>Software</u>	<u>Comment</u>
clirs.exe; rifs.exe	Used to set the EUT in the test mode
cygwin.dll	Program library

The EUT is provides with following hardware Bluetooth component:

<u>Hardware</u>	<u>Comment</u>
Ericsson PBA 313 01/2S	Pre-qualified Bluetooth module

2.3 Peripheral equipment

Defined as equipment needed for correct operation of the EUT, but not included as a part of testing and evaluation of the EUT.

Equipment	Manufacturer / Type	SEMKO No.
RS 232 board	C Technologies	-
Laptop PC	IBM / 2645410	11994
Power supply	OLTRONIX / B200	7084
Power supply	OLTRONIX / B60-1T	7186

The EUT has been tested with the following cable:

Cable	Type	SEMKO No.	Length
Serial	RS 232	-	1,5 m

3. TEST SPECIFICATIONS

3.1 Standards

FCC Subpart C – Intentional Radiators (2001): §15.249

3.2 Additions, deviations and exclusions from standards and accreditation

No deviations or exclusions have been made from standards and accreditation.

3.3 Justification

Preliminary tests was performed on three channels; low, middle and high. The final test was performed on low and middle channels, as no spurious emissions above the noise floor level were found. The worst case test data is reported.

3.4 Mode of operation during the test

Measurement set-up for the out-of-band spurious emission test is described in Section 11.4. During the other tests the EUT was connected to the spectrum analyzer FSIQ 40 (SEMKO No. 9192) by the TS 8960 EUT cable CSY-SMSM-54-004-MS (SEMKO No. 9252). Spectrum analyzer and the EUT settings are specified in the corresponding sections.

3.5 Operating environment

Temperature:	21 °C
Relative Humidity:	21 %

4. TEST SUMMARY

The results in this report apply only to the sample tested:

	Test	Result	Note
15.249	Field strength of fundamental	Pass	
15.249	Band edge compliance	Pass	
15.249	Out of band spurious emission, radiated	Pass	

NA = Not Applicable

NT = Not Tested

5. FIELD STRENGTH OF FUNDAMENTAL

5.1 Test protocol

Date of test: February 27, 2002

The EUT was set to the TX mode and hopping off.

Spectrum analyzer settings:

RBW: 1 MHz

VBW: 1 MHz

Detector: Peak

Channel	Field strength (mV/m)	Limit (mV/m)
2402	29	50
2480	21	50

6. BAND EDGE COMPLIANCE**6.1 Test protocol**

Date of test: February 27, 2002

The EUT was set to TX mode and hopping off.

Channel	Max peak at 2400 MHz	Max peak at 2483.5 MHz	Limit
2402	51 dB μ V/m	–	54 dB μ V/m
2480	–	52 dB μ V/m	54 dB μ V/m

Measurement plots are given in Appendix I.

7. RADIATED SPURIOUS EMISSIONS, TRANSMITTER AND RECEIVER

7.1 Operating environment

Temperature: 21 °C (15 - 35 °C)
Relative Humidity: 21 % (20 - 75 %)

7.2 Measurement uncertainty

300 – 1000 MHz: ± 3,1 dB
1 – 26 GHz: ± 3,3 dB

The measurement uncertainty is given with a confidence of 95% and describes the overall uncertainty of the given measured value during operation of the EUT.

7.3 Test equipment

Equipment	Manufacturer	Type	SEMKO No.
<i>Test site: Semi-anechoic shielded chamber, 10 x 20 x 8,5 m (W x L x H)</i>			
Software:	R&S	ES-K1, V1.60	-
Spectrum analyzer / Measurement receiver:	R&S	ESAI	2973/2974
Antenna amplifier:	SEMKO		7992/7993
Antenna, bilog:	Chase	CBL6111B	12474
<i>Test site: Bluetooth anechoic shielded chamber, 3,68 x 6,98 x 2,35 m (W x L x H)</i>			
Software:	R&S	ES-K1, V1.60	
Signal analyser:	R&S	FSIQ 40	9192
Preamplifier:	HP	8449B	6685
Antenna:			
Double Ridge Guide Horn:	EMCO	3115	4936
Horn antenna:	EMCO	3160-08	30099
Horn antenna:	EMCO	3160-09	30101

R&S = Rohde & Schwarz
HP = Hewlett Packard

7.4 Measurement set-up

7.4.1 Test site: Semi-anechoic shielded chamber (30 – 1000 MHz)

The radiated disturbance electric field intensity was measured in a semi-anechoic chamber at a distance of 3 m and the EUT was placed on a non-metallic table, 0,8 m above the reference ground plane.

An overview sweep with peak detection of the electric field intensity was performed with the measurement receiver in max-hold and with the antenna placed 1,5 m, 2,5 m and 3,5 m above the floor. The polarisation was horizontal and vertical. The measurements were repeated with the EUT rotated in 90-degree steps. The peak overview sweep is found in section 11.5.

For frequencies where high disturbance levels were found a search for max disturbance level was performed. With the EUT and antenna in the worst-case configuration quasi-peak measurements were carried out.

Test set-up photos are shown in Appendix II.

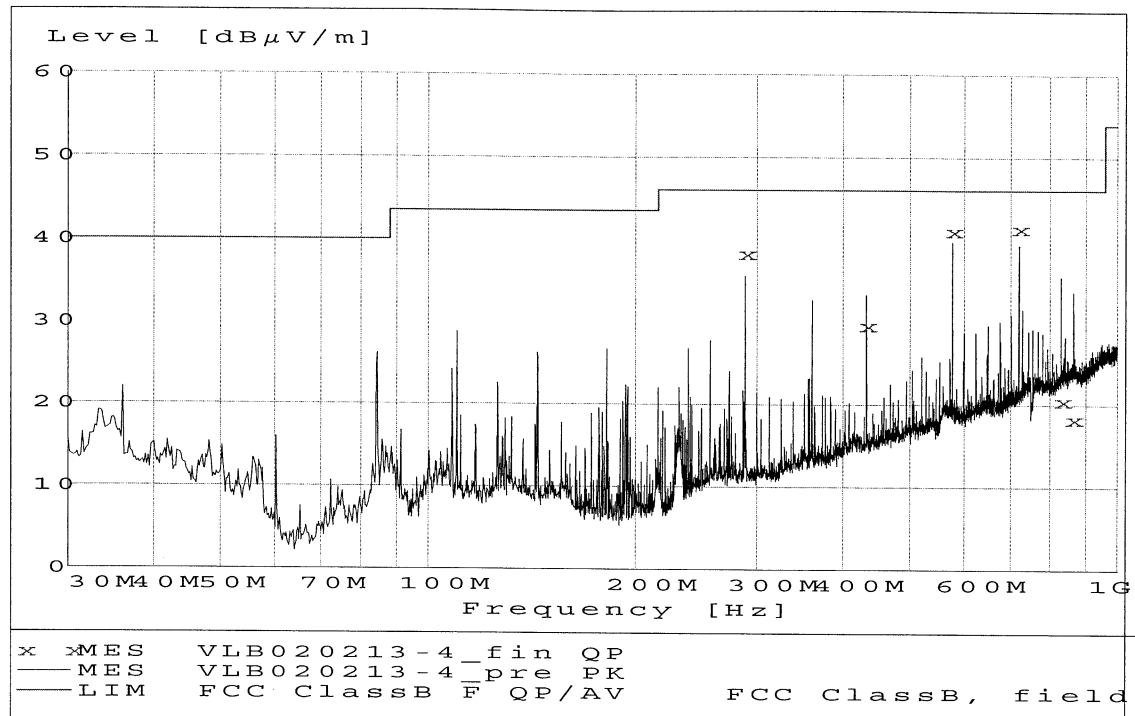
7.4.2 Test site: Bluetooth anechoic shielded chamber (1-26 GHz)

In the Bluetooth anechoic chamber the EUT was placed on a non-metallic table, 1,4 m above the floor. The radiated disturbance electric field intensity was measured at a distance of 3 m. An overview sweep with peak detection of the electric field intensity was performed with the measurement receiver in max-hold and with the antenna placed 1,4 m above the floor. If necessary, the sweep was repeated with average detection. The polarisation was horizontal and vertical. The measurements were repeated with the EUT rotated in 90-degree steps. The specified test mode was enabled.

7.5 Test protocol

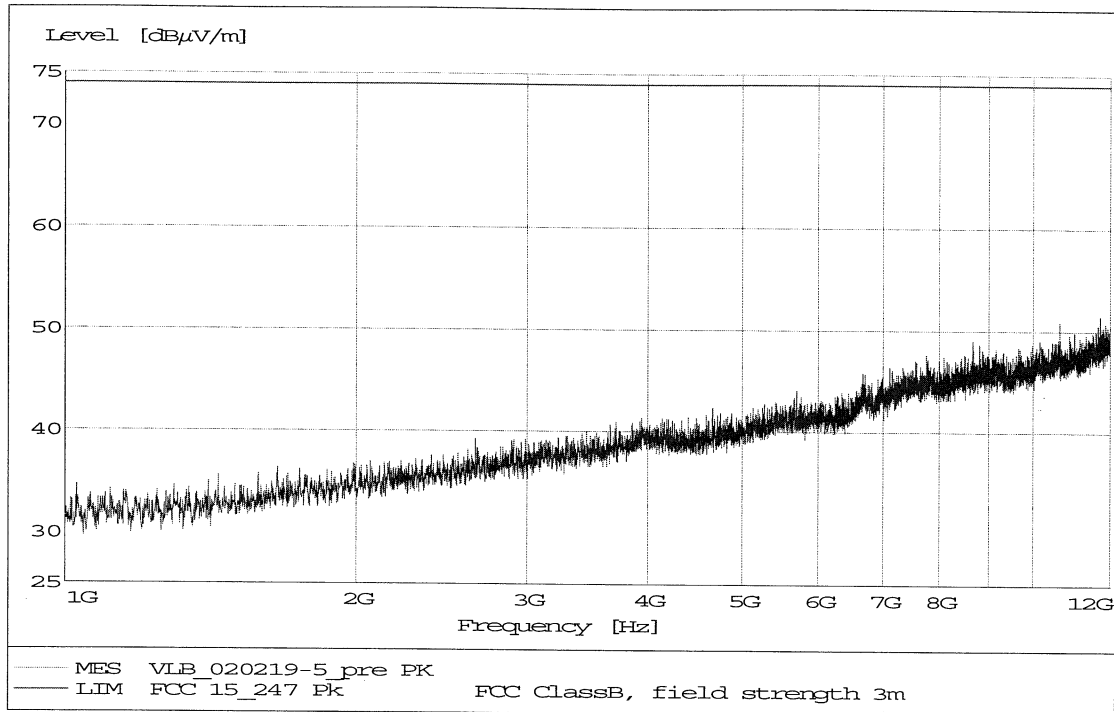
Date of test: February 13, 2002

30 – 1000 MHz, peak detection at a distance of 3 m; RX mode

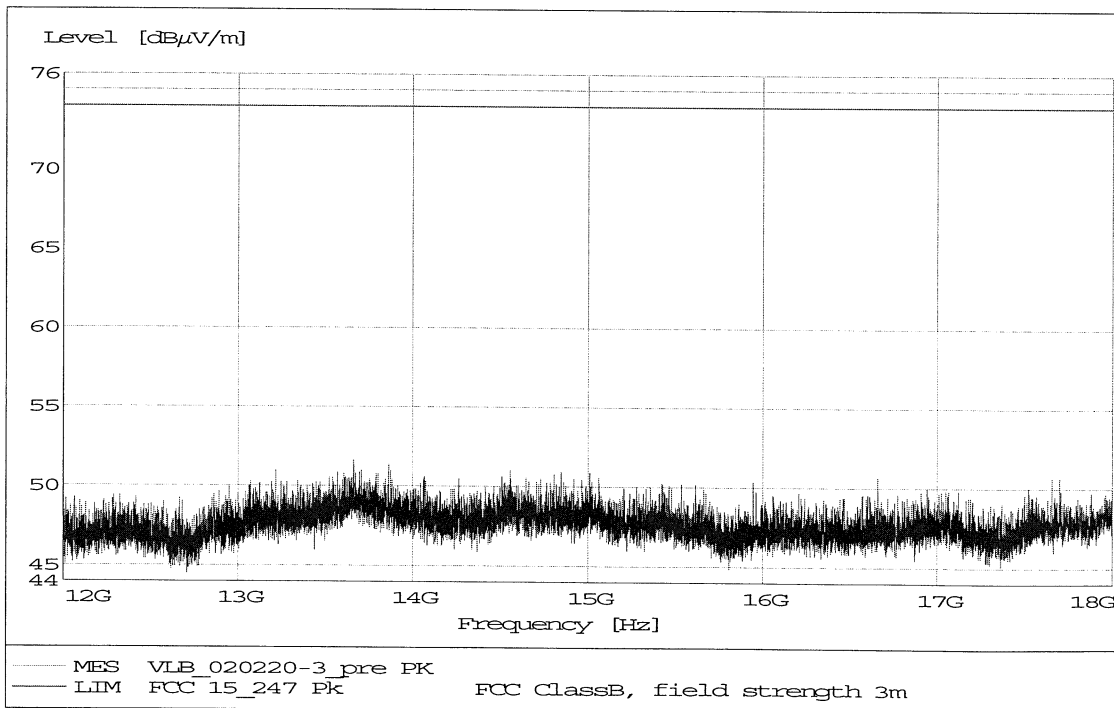


Date of test: February 19, 2002

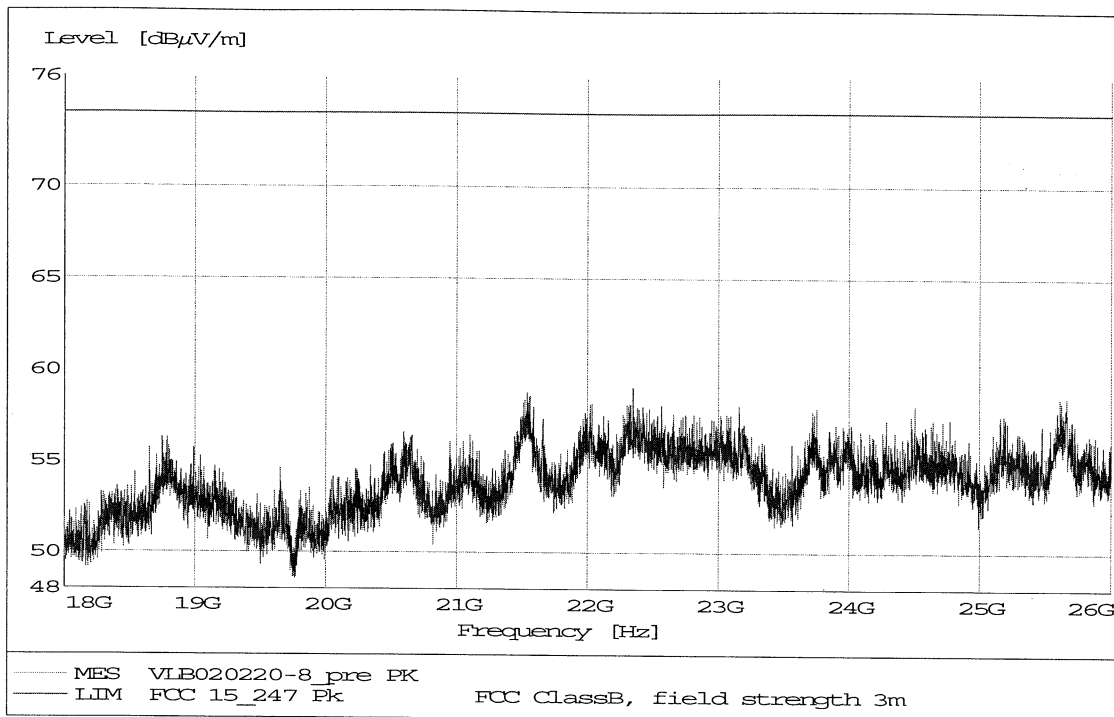
1 – 12 GHz, peak detection at a distance of 3 m; RX mode



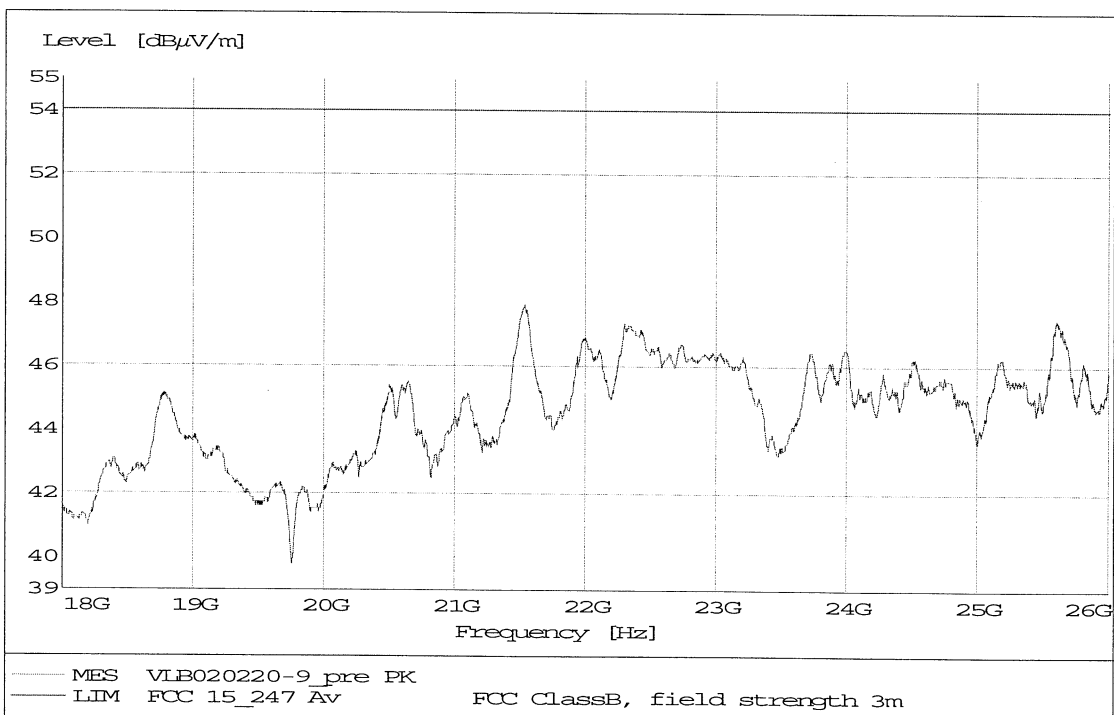
12 – 18 GHz, peak detection at a distance of 3 m; RX mode



18 – 26 GHz, peak detection at a distance of 3 m; RX mode

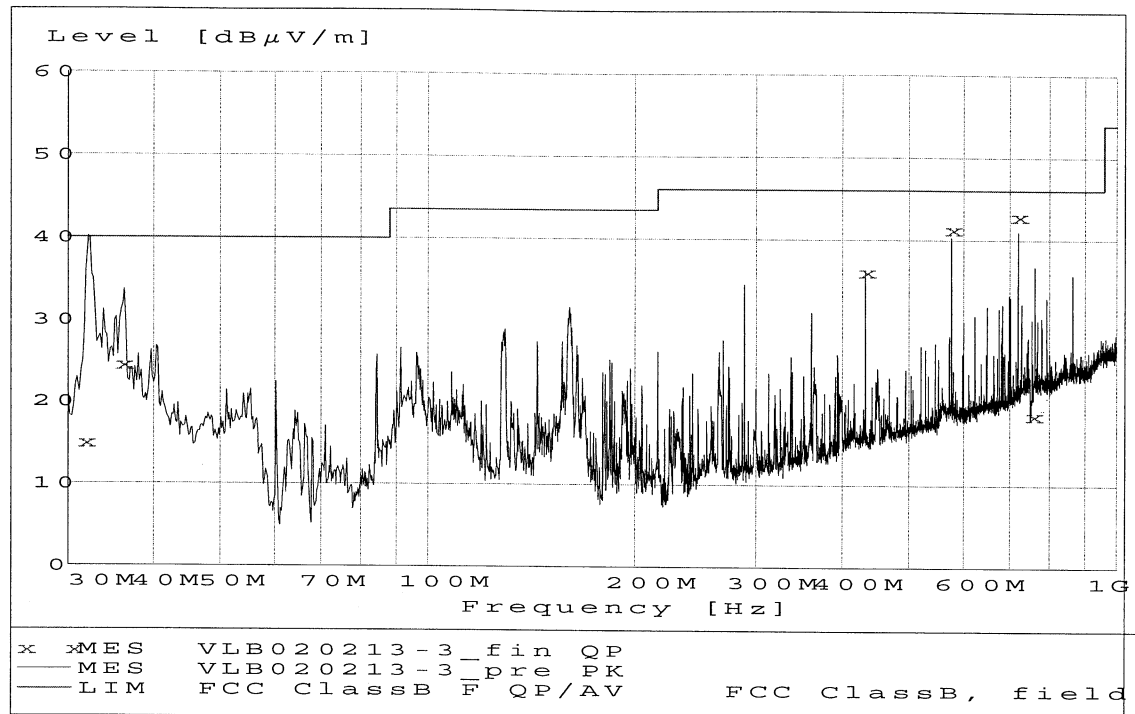


18 – 26 GHz, average detection at a distance of 3 m; RX mode



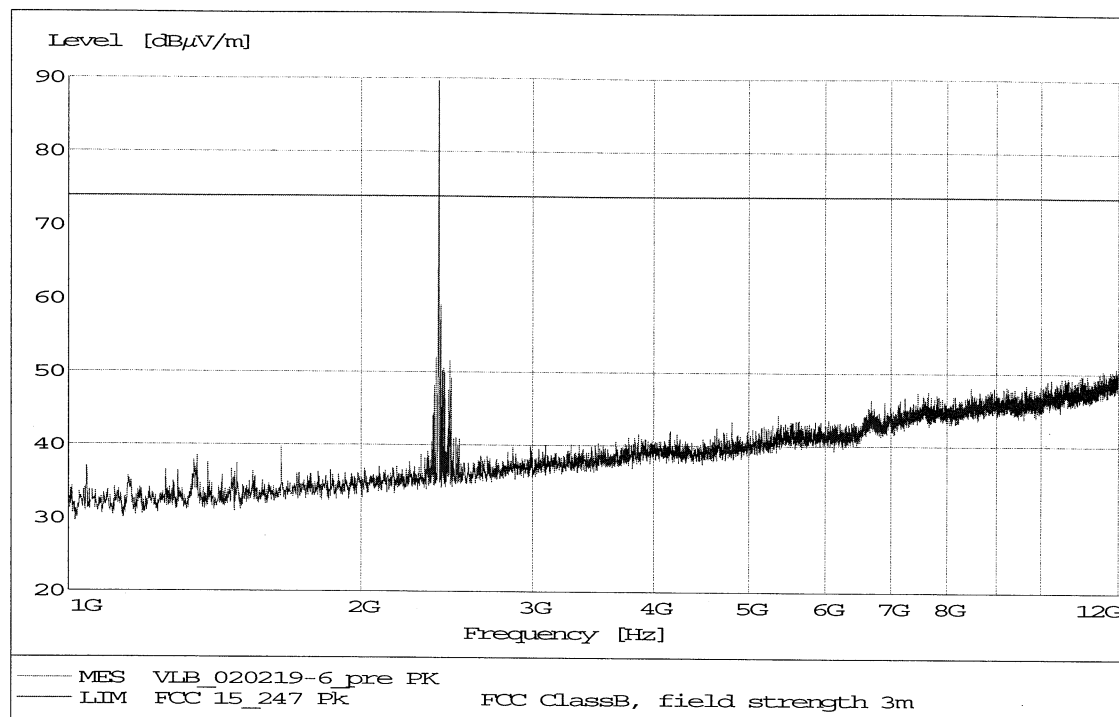
Date of test: February 13, 2002

30 – 1000 MHz, peak detection at a distance of 3 m; TX mode, lower channel



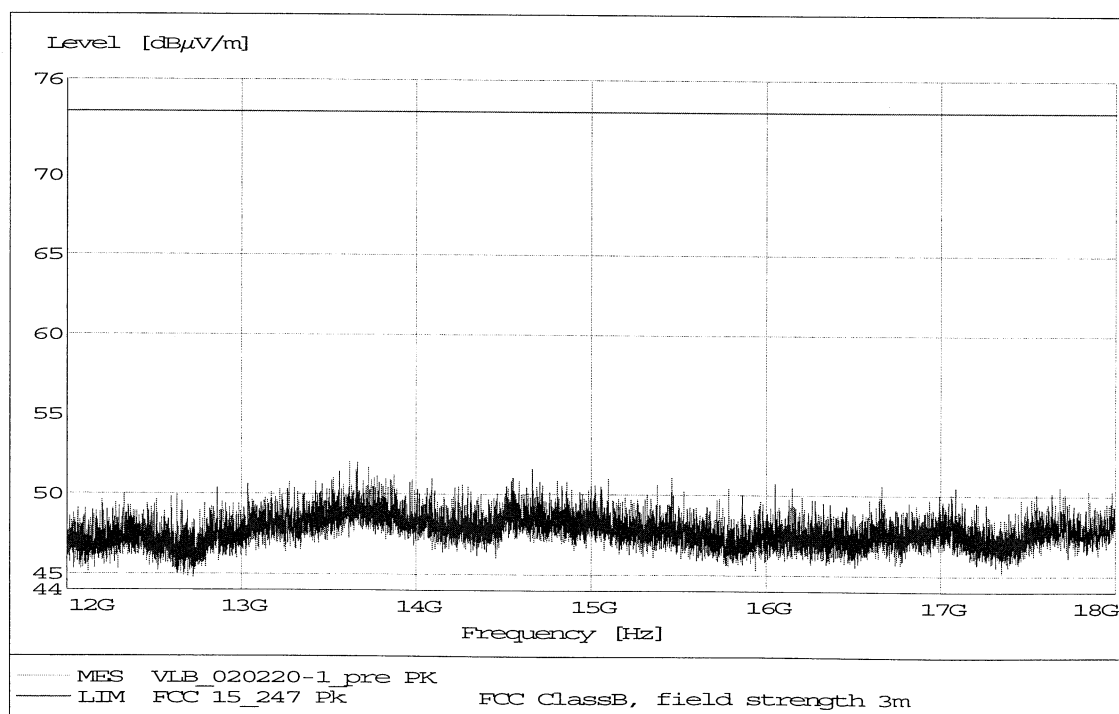
Date of test: February 19, 2002

1 – 12 GHz, peak detection at a distance of 3 m; TX mode, lower channel

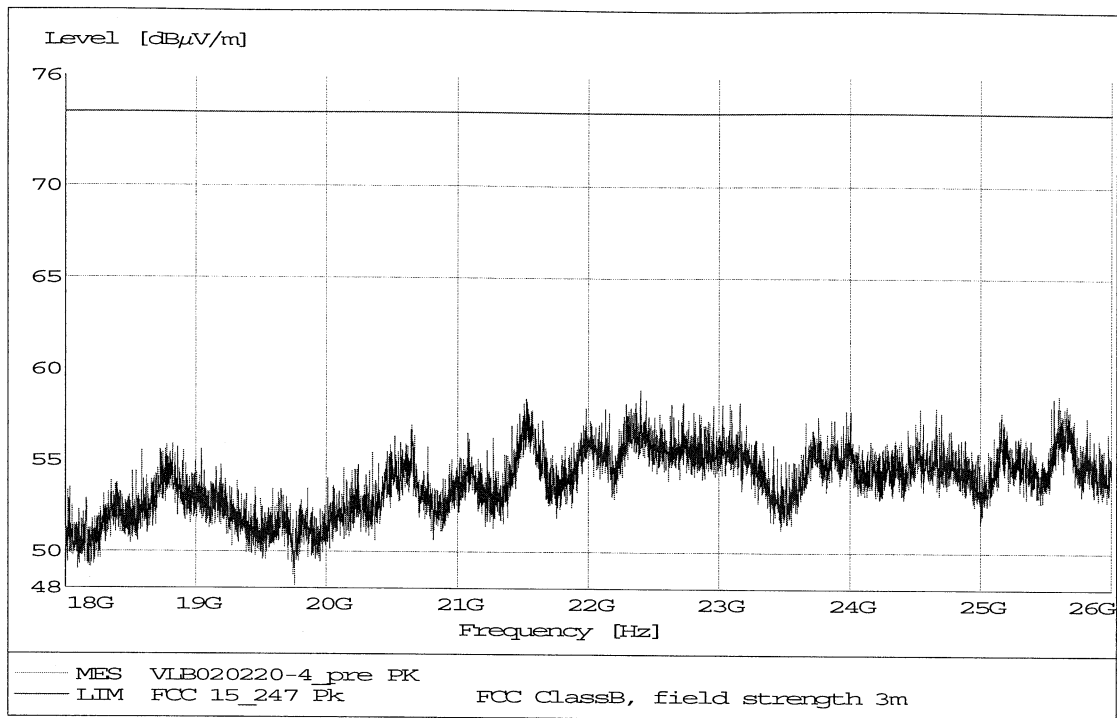


Date of test: February 20, 2002

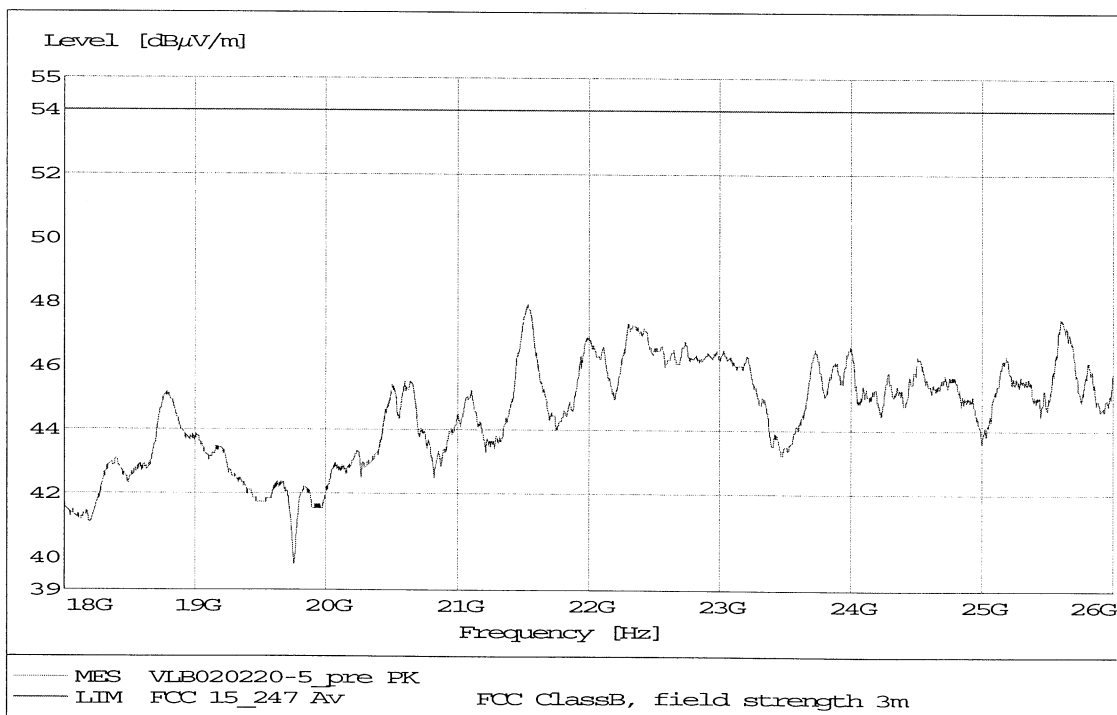
12 – 18 GHz, peak detection at a distance of 3 m; TX mode, lower channel



18 – 26 GHz, peak detection at a distance of 3 m; TX mode, lower channel

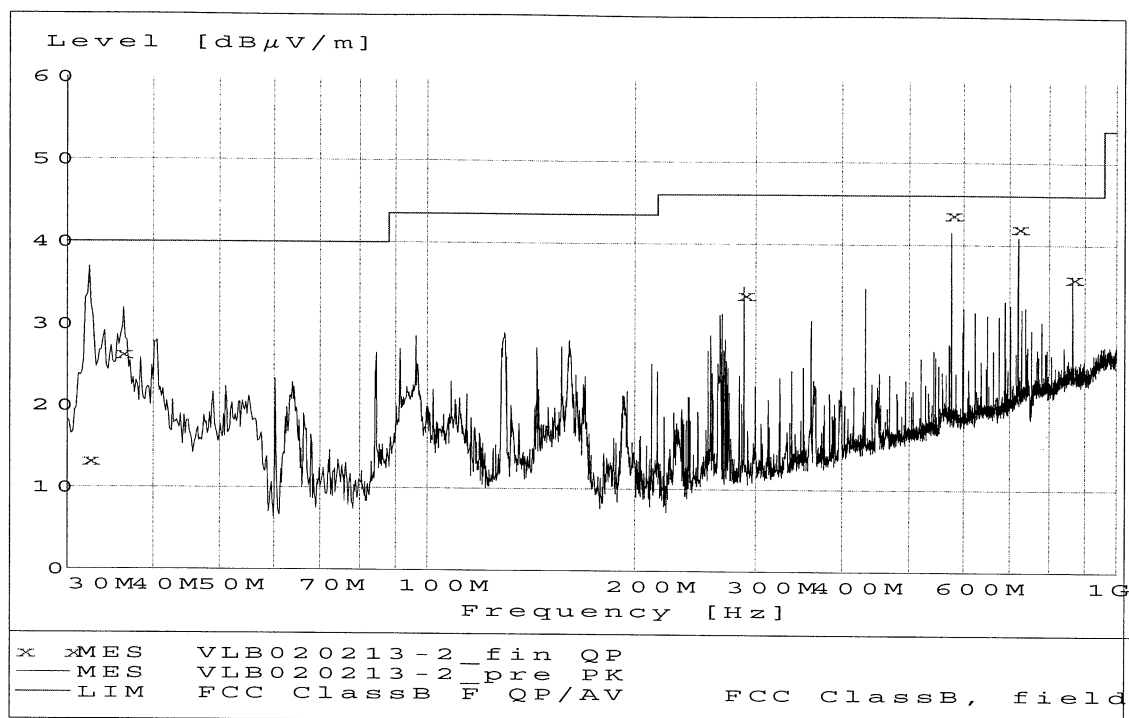


18 – 26 GHz, average detection at a distance of 3 m; TX mode, lower channel



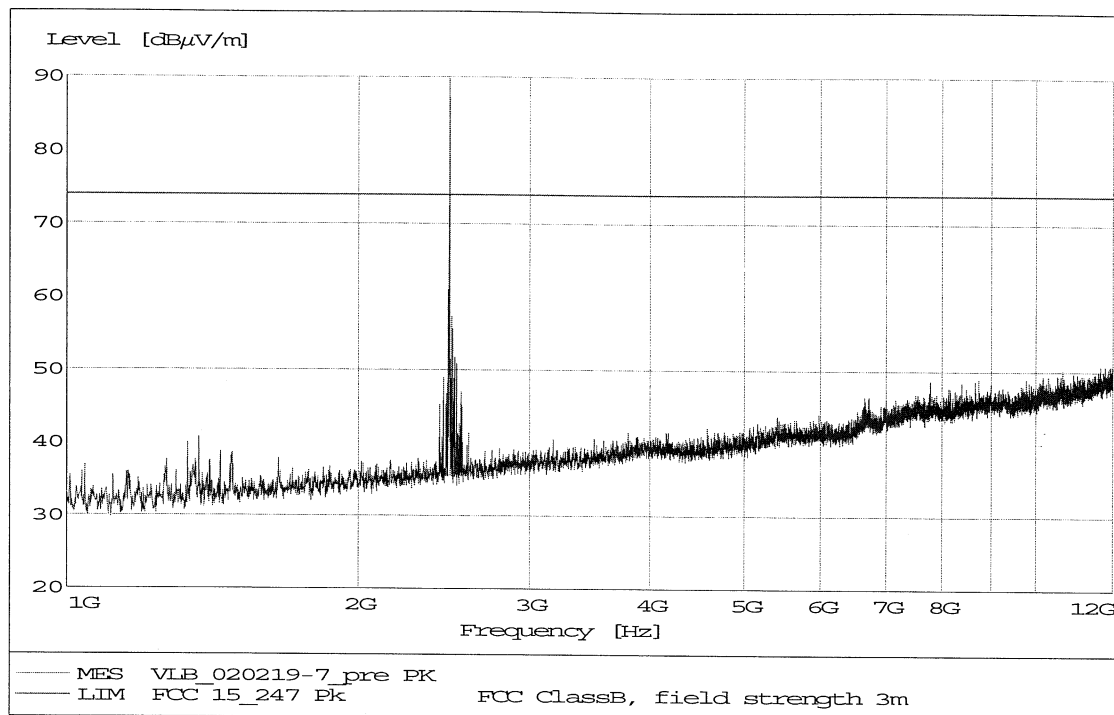
Date of test: February 13, 2002

30 – 1000 MHz, peak detection at a distance of 3 m; TX mode, upper channel



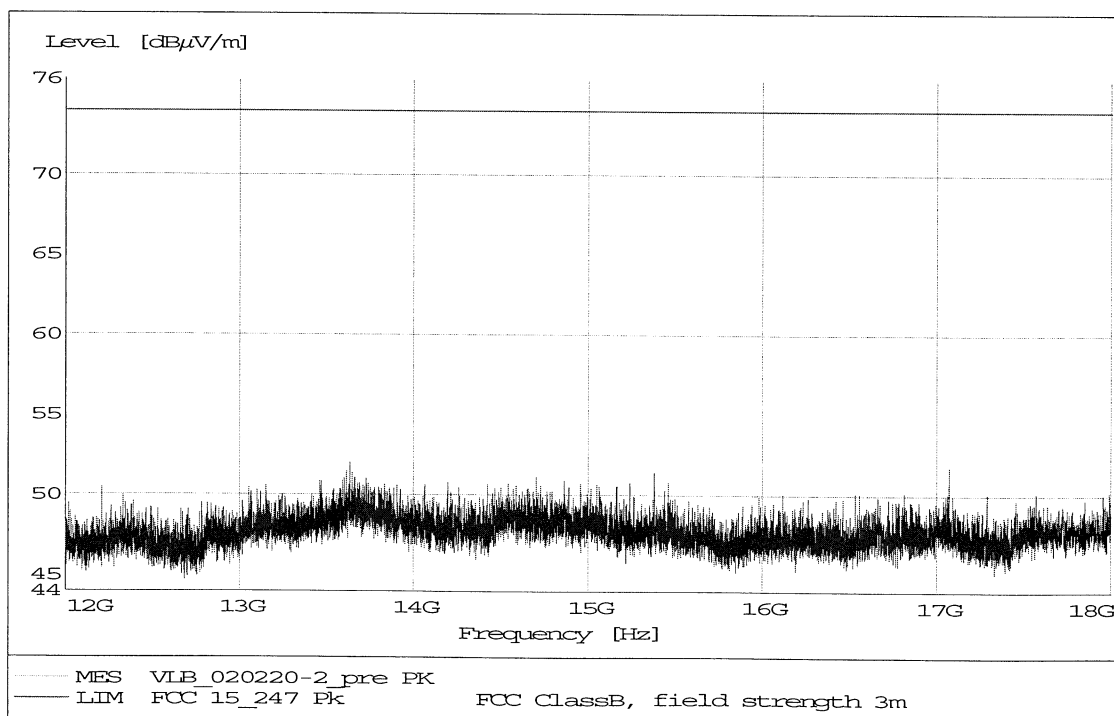
Date of test: February 19, 2002

1 – 12 GHz, peak detection at a distance of 3 m; TX mode, upper channel

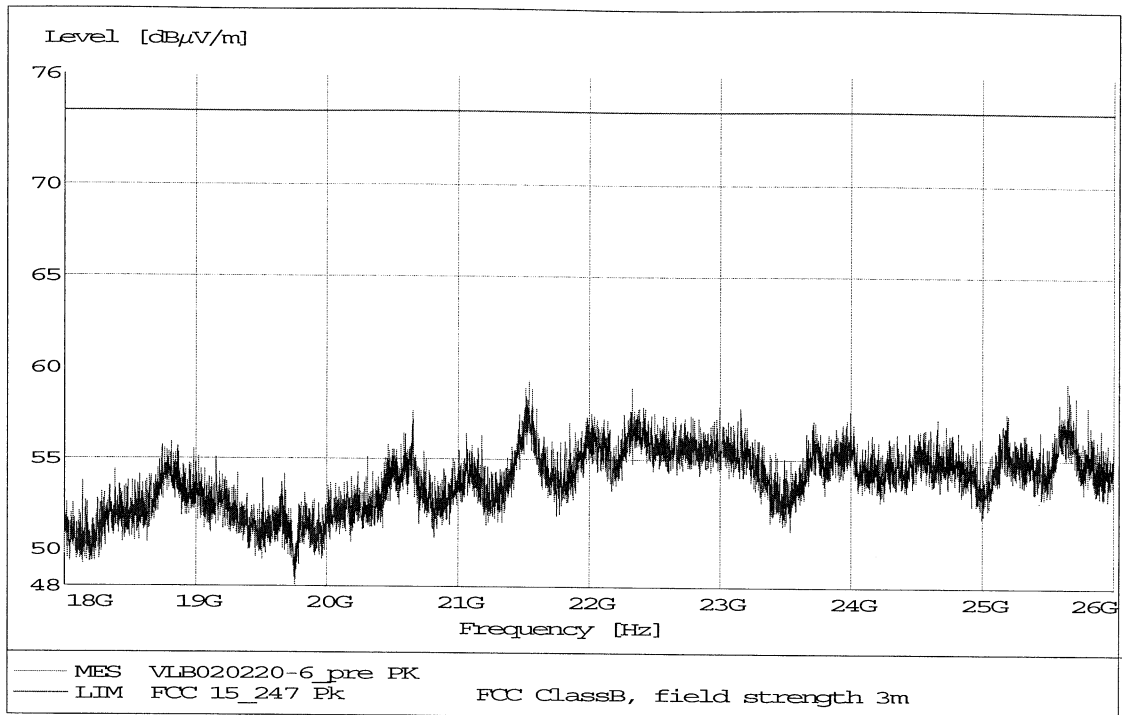


Date of test: February 20, 2002

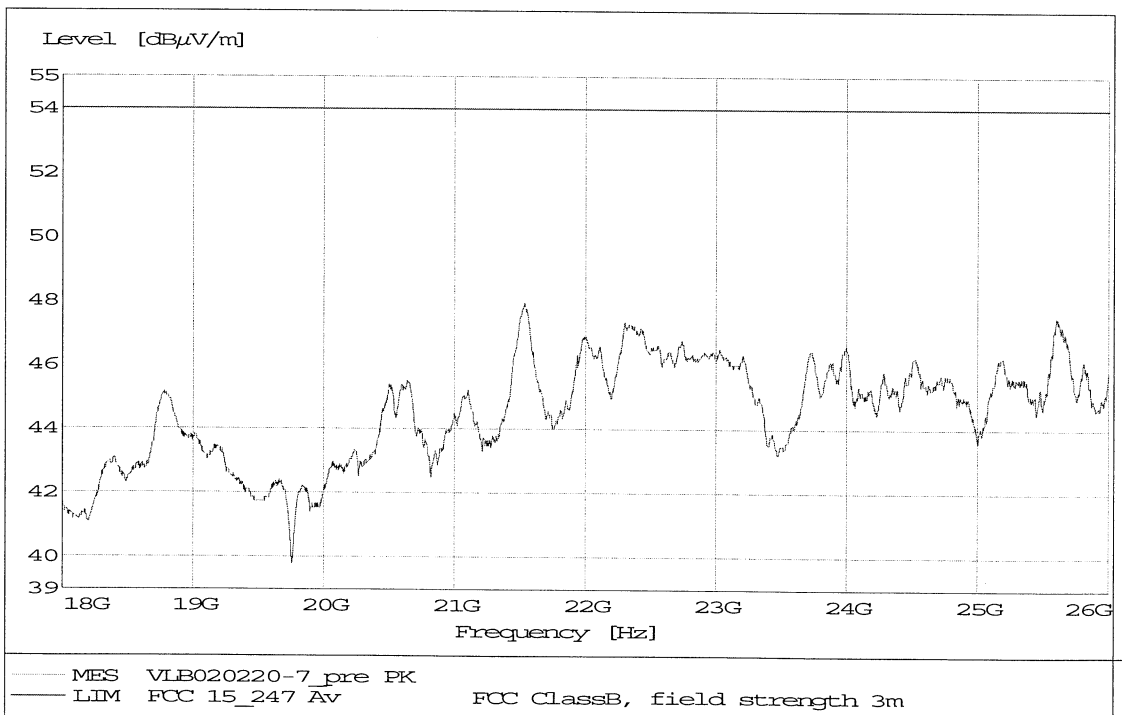
12 – 18 GHz, peak detection at a distance of 3 m; TX mode, upper channel



18 – 26 GHz, peak detection at a distance of 3 m; TX mode, upper channel



18 – 26 GHz, average detection at a distance of 3 m; TX mode, upper channel



7.5.1 Data summary

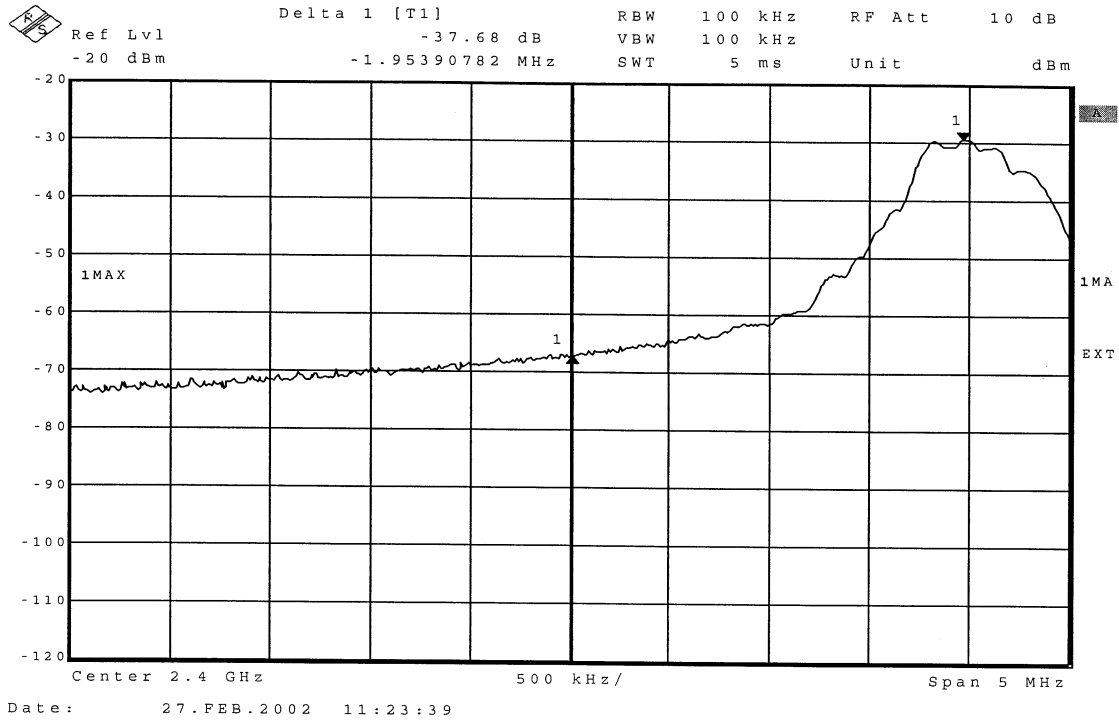
Field strength of spurious emissions, RX test data sequence						
Frequency [MHz]	RBW [kHz]	Measured level		Limit		Note
		Peak [dBμV/m]	QP/AV [dBμV/m]	Peak [dBμV/m]	QP/AV [dBμV/m]	
30 – 88	120	<28	-	-	40	
88 – 216	120	<30	-	-	43,5	
288	120	-	38,3	-	46	
432	120	-	29,6	-	46	
576	120	-	41,1	-	46	
720	120	-	41,4	-	46	
828,4	120	-	20,5	-	46	
859,84	120	-	18,3	-	46	
960 – 1000	120	<28	-	-	54	
1000 – 2400	1000	<38	-	74	54	
2483,5 – 4500	1000	<42	-	74	54	
4500 – 12000	1000	<51	-	74	54	
12000 – 18000	1000	<52	-	74	54	
18000 – 26000	1000	<59	<48	74	54	

Field strength of spurious emissions, TX test data sequence						
Frequency [MHz]	RBW [kHz]	Measured level		Limit		Note
		Peak [dBμV/m]	QP/AV [dBμV/m]	Peak [dBμV/m]	QP/AV [dBμV/m]	
31,76	120	-	15,0	-	40	
32,24	120	-	13,3	-	40	
36	120	-	26,3	-	40	
88 – 216	120	<32	-	-	43,5	
288	120	-	33,8	-	46	
432	120	-	36,1	-	46	
576	120	-	43,7	-	46	
720	120	-	42,9	-	46	
755,12	120	-	18,6	-	46	
864	120	-	36	-	46	
960 – 1000	120	<29	-	-	54	
1000 – 2400	1000	<51	-	74	54	
2483,5 – 4500	1000	<51	-	74	54	
4500 – 12000	1000	<51	-	74	54	
12000 – 18000	1000	<52	-	74	54	
18000 – 26000	1000	<59	<48	74	54	

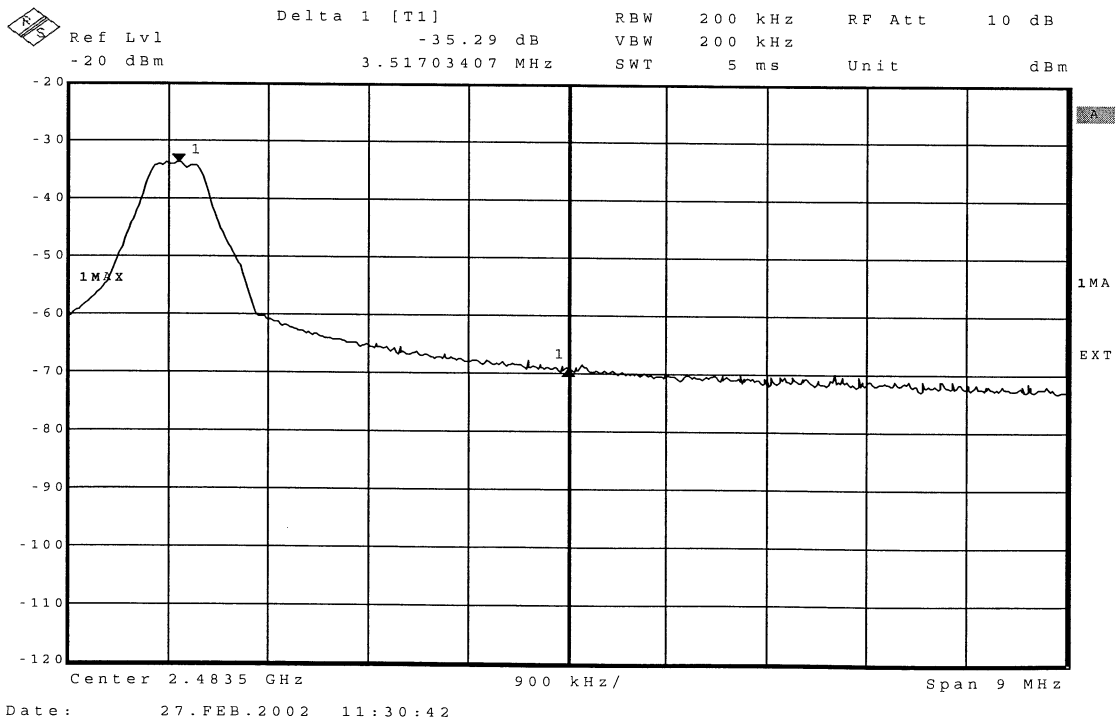
Fulfil requirements: Yes

APPENDIX I – MEASUREMENT PLOTS

Band Edge Compliance at 2400 MHz



Band Edge Compliance at 2483,5 MHz



APPENDIX II – test set-up photos

Test set-up in the semi-anechoic shielded chamber

