

RADIO TEST REPORT

No. 305608R1

EQUIPMENT UNDER TEST

Equipment: Sound Level Equipment
Type / model: 1012
Manufacturer: GN Otometrics A/S
Tested by request of: GN Otometrics A/S

SUMMARY

The equipment complies with the requirements of the following standards:

FCC, Part 15, Subpart B (2001) and Subpart C (2001);
RSS-210, Issue 5 (November 2001)

Date of issue: May 23, 2003

Tested by:


Vladimir Bazhanov

Approved by:


Björn Rosenquist

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1. CLIENT INFORMATION

The EUT has been tested by request of

Company: GN Otometrics A/S
Dybendalsvaenget 2
DK-2630 Taastrup
Denmark
Name of contact: Per Pape Thomsen

2. EQUIPMENT UNDER TEST (EUT)**2.1 Identification of the EUT according to the manufacturer/client declaration**

Equipment: Sound Level Equipment
Type/Model: 1012
Brand name: Otoflex
Serial number: -
FCC ID Number: QCN-1012
Manufacturer: GN Otometrics A/S
Rating/Supplying voltage: 5,0 V DC (4,0 ... 6,4 V DC)
Rating RF output power: Power class 2
Antenna gain: 1,2 dBi
External antenna connector: No
Operating temperature range: 0 to 35 °C
Frequency range: 2400 – 2483,5 MHz
Number of channels: 79
Modulation characteristics: GFSK
Stand by mode supported: Yes

2.2 Additional hardware information about the EUT

The EUT consists of the following unit:

Unit	Type and version	Serial number
Otoflex 100	1012	-

2.3 Additional software information about the EUT

During the tests the EUT supported the following software:

Software	Version	Comment
KERNEL	0.50 BQB	Not final version

2.4 Modifications during the test

No modifications have been made during the tests.

3. TEST SPECIFICATIONS

3.1 Standards

FCC (2001): Subpart B – Unintentional radiators and Subpart C – Intentional Radiators; §15.247 for frequency hopping systems operating in the 2400 – 2483.5 MHz and 5725 – 5850 MHz; §15.205 for restricted bands; §15.107, §15.207 for conducted limits; §15.109, §15.209 and §15.249 for radiated limits.

RSS-210, Issue 5 (November 2001): Low Power Licence-Exempt Radiocommunication Devices.

3.2 Additions, deviations and exclusions from standards and accreditation

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

3.3 Test set-up

The EUT was tested supplied from internal batteries. Measurement set-ups for the test of conducted disturbance voltage in the frequency range 0,45-30 MHz and out-of-band spurious emissions test are described in Sections 12.4 and 13.4 respectively. During other tests the EUT was connected to the spectrum analyzer FSIQ 40 (SEMCO No. 9192) by the cable Suhner Sucoflex 104 (SEMCO No. 5186). Spectrum analyzer and the EUT settings are specified in the corresponding sections. The frequencies and hopping mode of the EUT were controlled by the KERNEL 0.50 BQB software (see Section 2.3).

3.4 Operating environment

If not additionally specified, the tests were performed under the following environmental conditions:

Air temperature:	21 - 23 °C
Relative humidity:	29 - 31 %

4. TEST SUMMARY

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

FCC reference	Test	Result	Note
15.247(b)	Peak output power	Pass	
15.247(a)	TX Output Spectrum – 20 dB Bandwidth	Pass	
15.247(a)	Carrier frequency separation	Pass	
15.247(a)	Number of hopping frequencies (channels)	Pass	
15.247(a)	Time of occupancy (dwell time)	Pass	
15.247(c)	Band edge compliance	Pass	
15.247 (d)	Peak power spectral density	Pass	
15.107 (a)	Conducted disturbance voltage in the frequency range 0,45 - 30 MHz	Pass	
15.109 (a)	Out of band spurious emissions, radiated	Pass	
15.249(c)	Out of band spurious emissions, radiated	Pass	

5. PEAK OUTPUT POWER

5.1 Test protocol

Date of test: May 14, 2003

EUT mode of operation: TX and hopping off.

Spectrum analyzer settings:

Span: 10 MHz

RBW: 3 MHz

VBW: 3 MHz

Sweep time: 1 s

Detector: Peak

Trace: Max Hold

Channel (MHz)	Peak Output Power (dBm)	Limit value (dBm)
2402	-1,0	< 30
2441	-1,6	
2480	-1,8	

Measurement results are corrected for attenuation in the set-up configuration and antenna gain declared by the manufacturer.

6. TX OUTPUT SPECTRUM – 20 dB BANDWIDTH**6.1 Test protocol**

Date of test: May 14, 2003

EUT mode of operation: TX and hopping off.

Spectrum analyzer settings:

Span: 1,5 MHz

RBW: 30 kHz

VBW: 30 kHz

Sweep time: 5 ms

Detector: Peak

Trace: Max Hold

Channel (MHz)	20 dB Bandwidth (kHz)	Limit value (kHz)
2402	799	< 1000
2441	805	
2480	847	

7. CARRIER FREQUENCY SEPARATION

7.1 Test protocol

Date of test: May 14, 2003

EUT mode of operation: TX and hopping on.

Spectrum analyzer settings:

Span: 4 MHz

RBW: 100 kHz

VBW: 100 kHz

Sweep time: Auto

Detector: Peak

Trace: Max Hold

Channel (MHz)	Carrier frequency separation from the next channel		Limit value (kHz)
	To the right (kHz)	To the left (kHz)	
2402	993	-	799
2441	1010	986	805
2480	-	1002	847

8. NUMBER OF HOPPING CHANNELS

8.1 Test protocol

Date of test: May 14, 2003

EUT mode of operation: TX and hopping on.

Spectrum analyzer settings:

Start frequency: 2400 MHz

Stop frequency: 2484 MHz

RBW: 100 kHz

VBW: 100 kHz

Sweep time: Auto

Detector: Peak

Trace: Max Hold

Number of hopping channels	Limit value
79	> 75

9. TIME OF OCCUPANCY (DWELL TIME)

9.1 Test protocol

Date of test: May 14, 2003

EUT mode of operation: TX and hopping on.

Spectrum analyzer settings:

Determination of transmitting time T

Span: 0 Hz
 RBW: 1 MHz
 VBW: 1 MHz
 Sweep time: 4 ms
 Single sweep
 Detector: Peak
 Trace: Clear/Write
 Trigger: Video

Determination of the number of times n the channel is active during the sweep time of 10 s

RBW: 100 kHz
 VBW: 100 kHz
 Sweep time: 10 s

Test parameters	Channel (MHz)			Limit value (s)
	2402	2441	2480	
T (μs)	2980	2980	2980	-
n	34	37	37	-
Dwell time (s) = $T \cdot 10^{-6} \cdot 3 \cdot n$	0,30	0,33	0,33	< 0,4

10. BAND EDGE COMPLIANCE

10.1 Measurement set-up

For measurement set-up see Section 13.4.2.

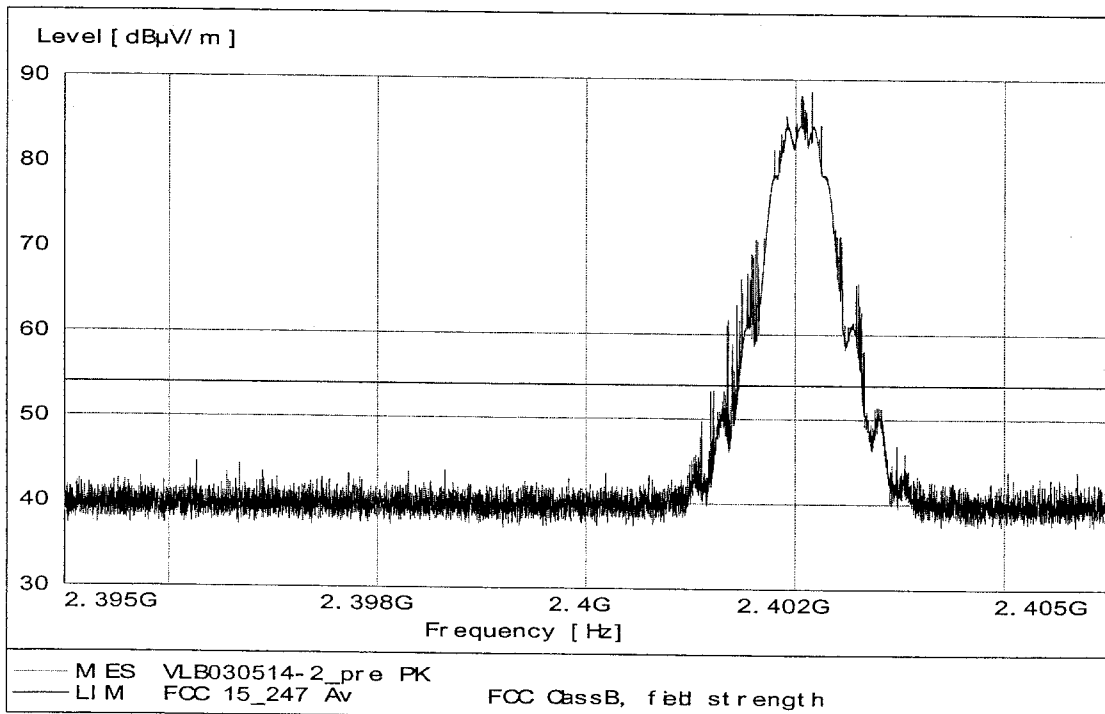
10.2 Test protocol

Date of test: May 14, 2003

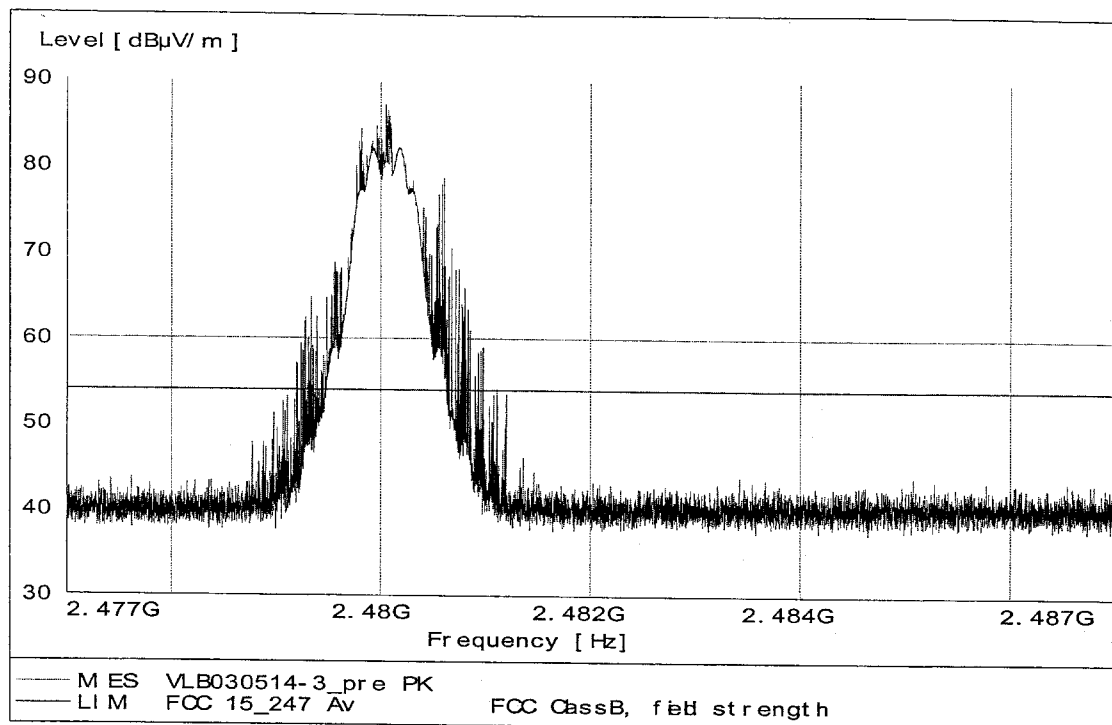
EUT mode of operation: TX and hopping off.

Parameter settings	Compliance at 2400 MHz	Compliance at 2483,5 MHz
Start frequency (MHz):	2395	2477
Stop frequency (MHz):	2405	2487
RBW (kHz):	100	100
VBW (kHz):	100	100
Sweep time (ms):	5	5
Detector:	Peak	Peak
Trace:	Max Hold	Max Hold

Band edge compliance at 2400 MHz



Band edge compliance at 2483,5 MHz



11. PEAK POWER SPECTRAL DENSITY**11.1 Test protocol**

Date of test: May 14, 2003

EUT mode of operation: TX, hopping on and maximum data rate.

Spectrum analyzer settings:

Span: 1 MHz
RBW: 3 kHz
VBW: 10 kHz
Sweep time: Auto
Detector: Peak
Trace: Max Hold

Channel (MHz)	Peak Power Spectral Density (dBm)	Limit value (dBm)
2402	-8,3	< 8
2441	-8,7	
2480	-8,7	

Measurement results are corrected for attenuation in the set-up configuration.

12. CONDUCTED DISTURBANCE VOLTAGE IN THE FREQUENCY RANGE 0,45 - 30 MHZ**12.1 Operating environment**

Temperature: 21 °C (15 - 35 °C)
Relative Humidity: 26 % (20 - 75 %)

12.2 Measurement uncertainty

Conducted disturbance voltage, quasi-peak detection: $\pm 2,0$ dB

The measurement uncertainty describes the overall uncertainty of the given measured value during operation of the EUT.

Measurement uncertainty is calculated in accordance with EA-4/02-1997.
The measurement uncertainty is given with a confidence of 95%.

12.3 Test equipment

Test site:	FCC		
Equipment	Manufacturer	Type	SEMKO No.
Software:	Rohde & Schwarz	ES-K1 V1.60	
Measurement receiver:	Rohde & Schwarz	ESHS 30	4946
Artificial mains network:	Rohde & Schwarz	ESH3-Z5	2727
Transformer:	TUFVASSONS	AFM-1500	375

12.4 Measurement set-up

The mains terminal disturbance voltage was measured with the EUT located 0,8 m above the ground plane and 0,4 m from the vertical ground plane. The EUT was connected to an artificial mains network (AMN). The AMN was placed on a metallic, grounded floor. Amplitude measurements were performed with a quasi-peak detector. The test set-up photo is given below.

Test set-up photo:



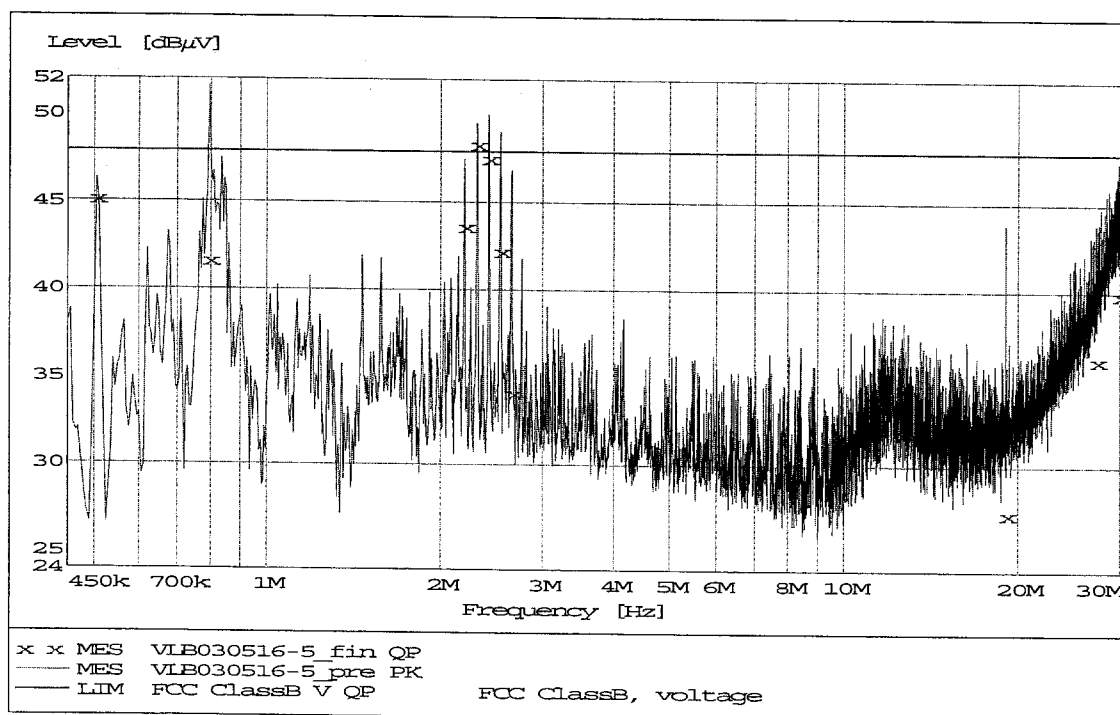
12.5 Test protocol

Date of test: May 16, 2003

Frequency /MHz	Quasi-Peak	
	Disturbance Level /dB(μ V)	Permitted limit /dB(μ V)
0,505	45	48
0,795	42	48
2,200	44	48
2,310	48	48
2,425	48	48
2,540	42	48
2,655	34	48
19,075	27	48
27,340	36	48
29,885	40	48

Highlighted results comply with the limit within the measurement uncertainty margins (see Section 12.2).

An overview sweep performed with a peak detector is shown below.



13. RADIATED SPURIOUS EMISSIONS

13.1 Operating environment

Temperature: 21 – 23 °C (15 – 35 °C)
Relative Humidity: 29 – 31 % (20 – 75 %)

13.2 Measurement uncertainty

Radiated disturbance electric field intensity, 30 – 1000 MHz: ± 4,6 dB
Radiated disturbance electric field intensity, 1000 – 26000 MHz: ± 6,0 dB

The measurement uncertainty describes the overall uncertainty of the given measured value during operation of the EUT.

Measurement uncertainty is calculated in accordance with EA-4/02-1997.
The measurement uncertainty is given with a confidence of 95%.

13.3 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>			30300
Software:	Rohde & Schwarz	ES-K1, V1.60	
Measurement receiver:	Rohde & Schwarz	ESAI	2973/2974
Antenna amplifier:	SEMKO		7992/7993
Antenna, bilog:	Chase	CBL6111B	971
<i>Test site: Bluetooth anechoic shielded chamber, 3,7 x 7,0 x 2,4 m (W x L x H)</i>			12285
Software:	Rohde & Schwarz	ES-K1, V1.60	
Signal analyser:	Rohde & Schwarz	FSIQ 40	9192
Preamplifier:	MITEQ	AFS6/AFS44	12335
Antennas:			
Double Ridge Guide Horn:	EMCO	3115	4936
Horn antenna:	EMCO	3160-08	30099
Horn antenna:	EMCO	3160-09	30101

13.4 Measurement set-up

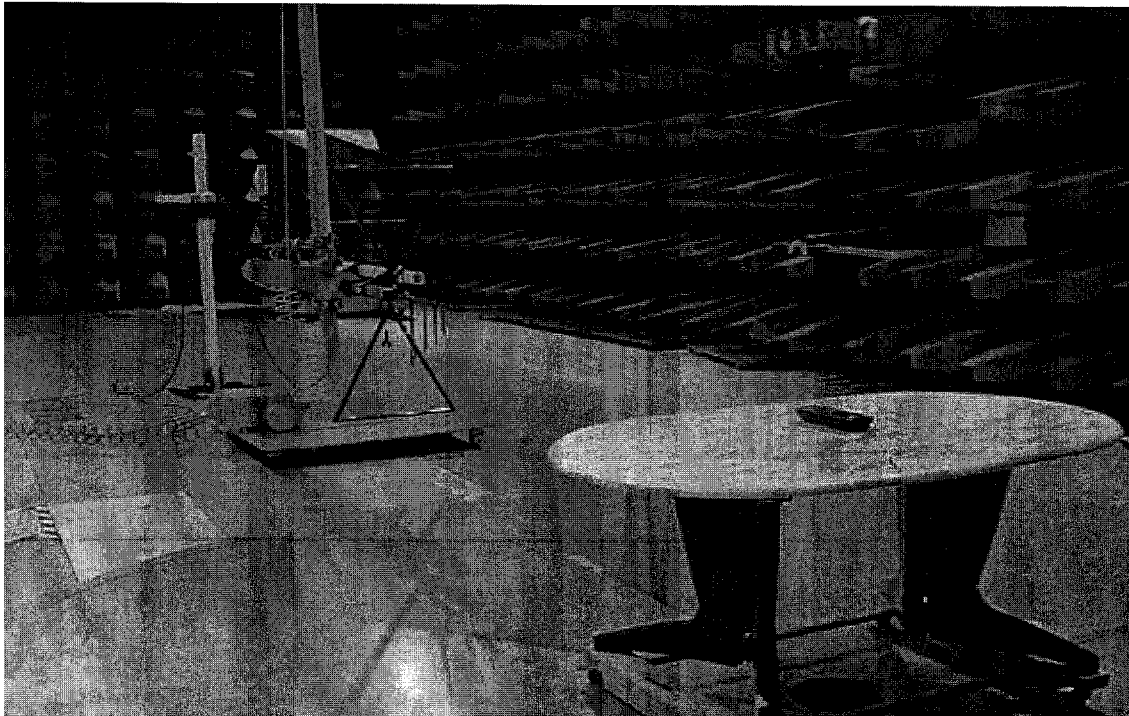
13.4.1 Test site: Semi-anechoic shielded chamber (30 – 1000 MHz)

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. The specified test mode was enabled. Test set-up photo is given below.

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.

At the 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.

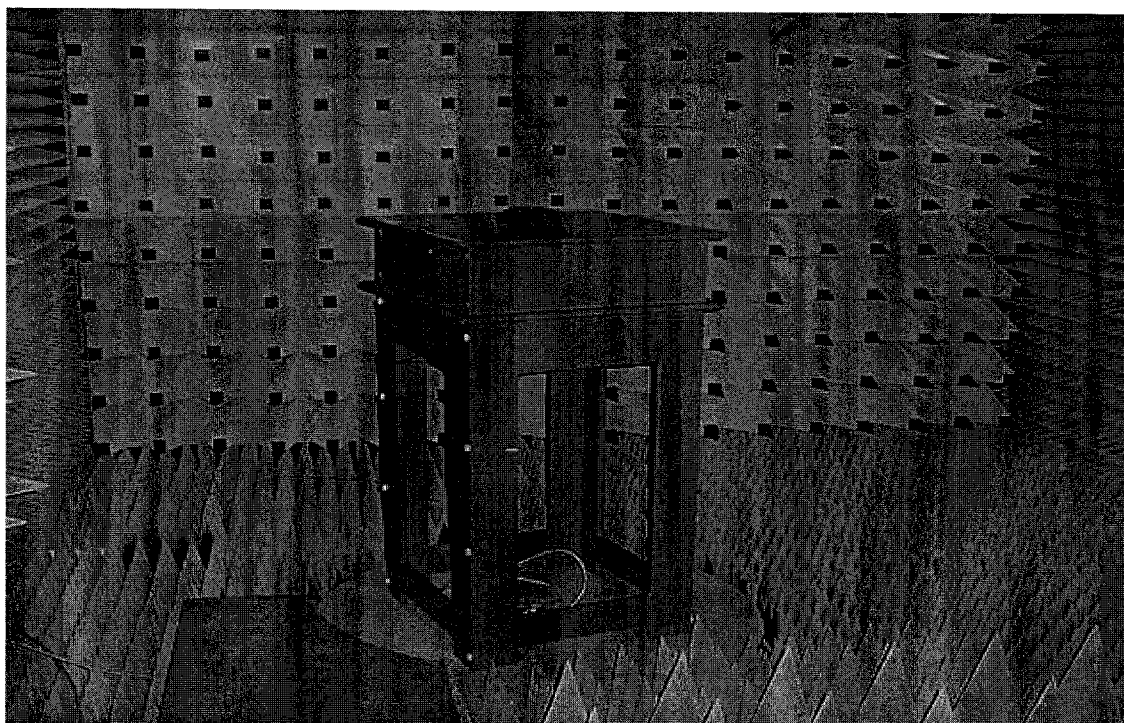
Test set-up photo:



13.4.2 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. The specified test mode was enabled.

An overview sweep with peak detection of the electric field intensity was performed with the spectrum analyser in max-hold and with the antenna placed 1,4 m above the floor. The polarisation was horizontal and vertical. The measurements were repeated with the EUT rotated in 90-degree steps. If necessary, the sweep was repeated with average detection. Test set-up photo is shown below.

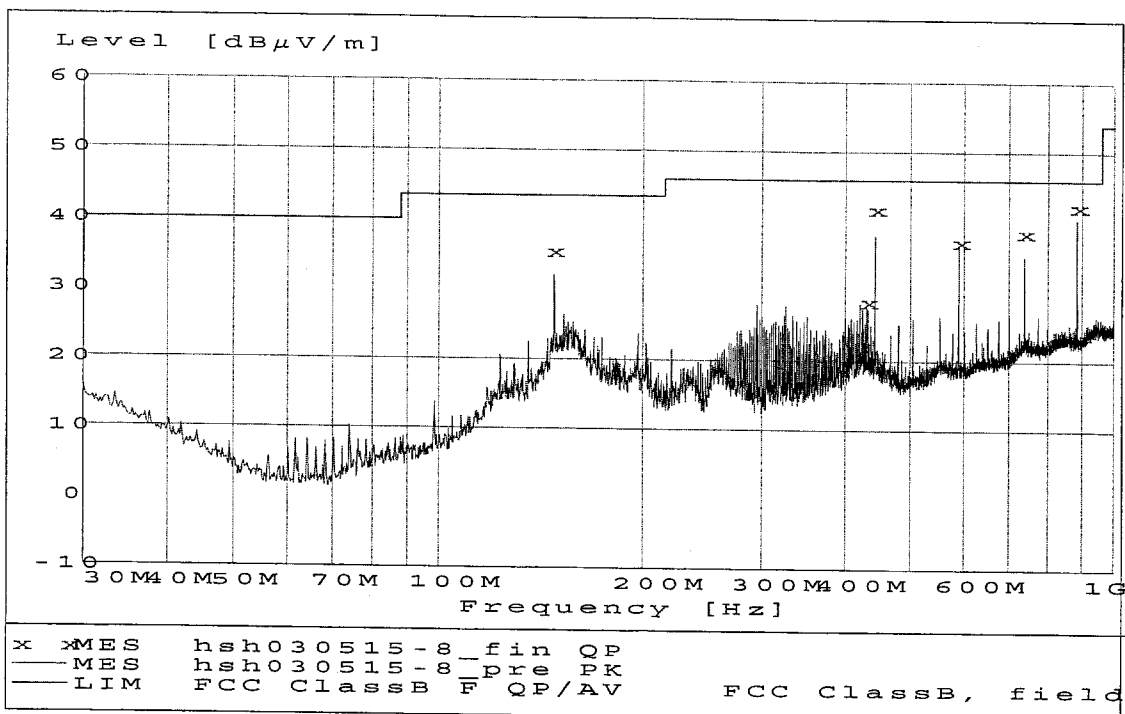


13.5 Test protocol

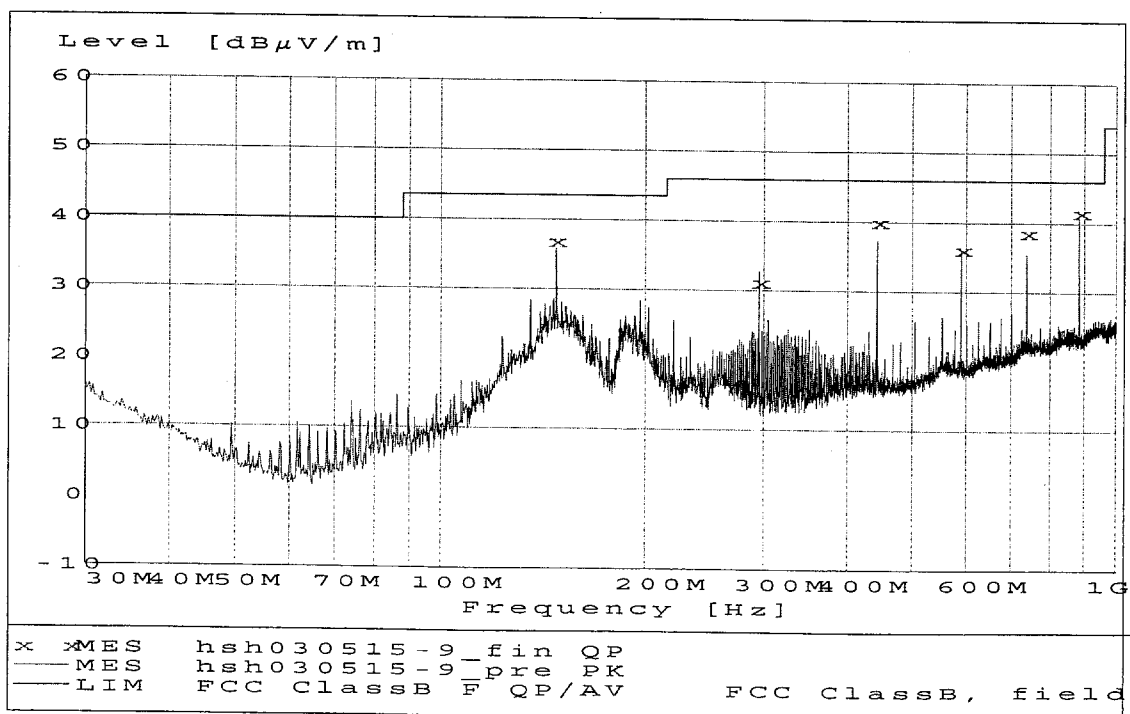
13.5.1 Semi-anechoic shielded chamber

Date of test: May 15, 2003

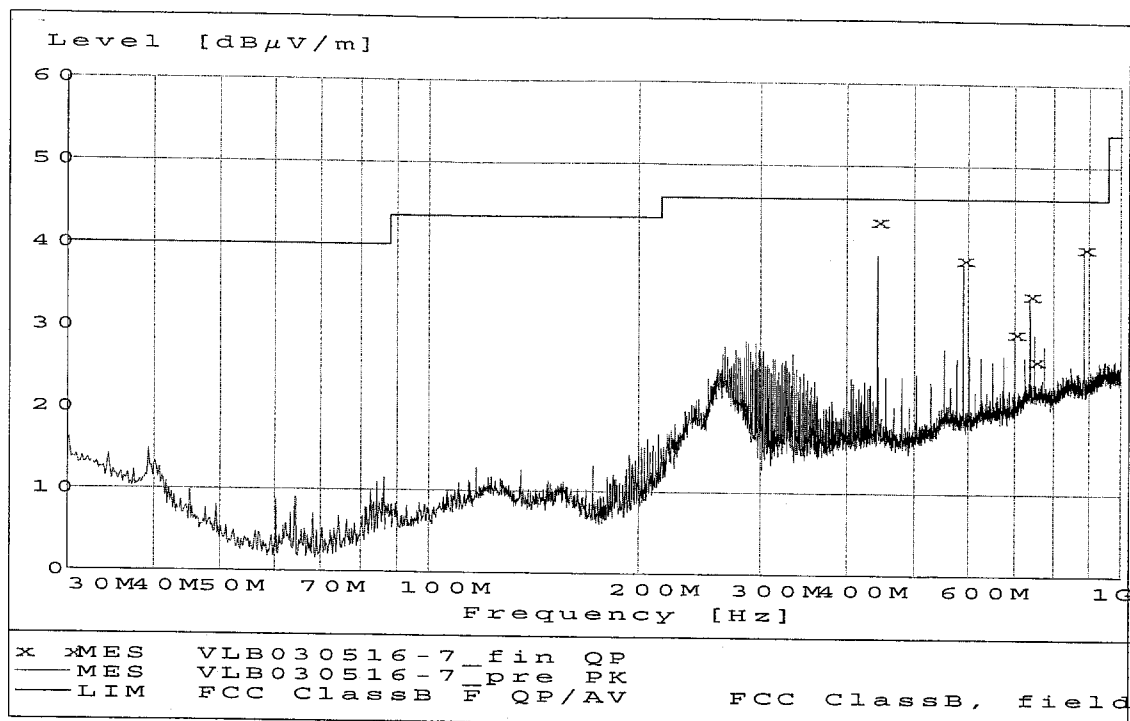
30 – 1000 MHz, max peak at a distance of 3 m on the lower TX channel



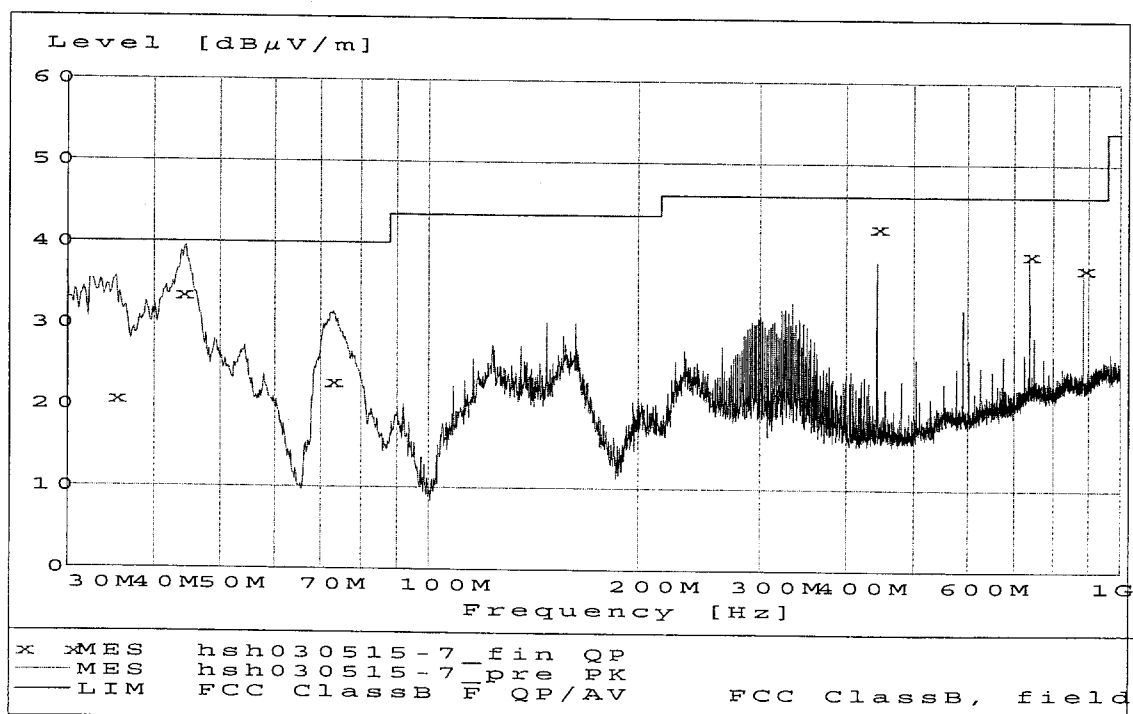
30 – 1000 MHz, max peak at a distance of 3 m on the middle TX channel



30 – 1000 MHz, max peak at a distance of 3 m on the upper TX channel



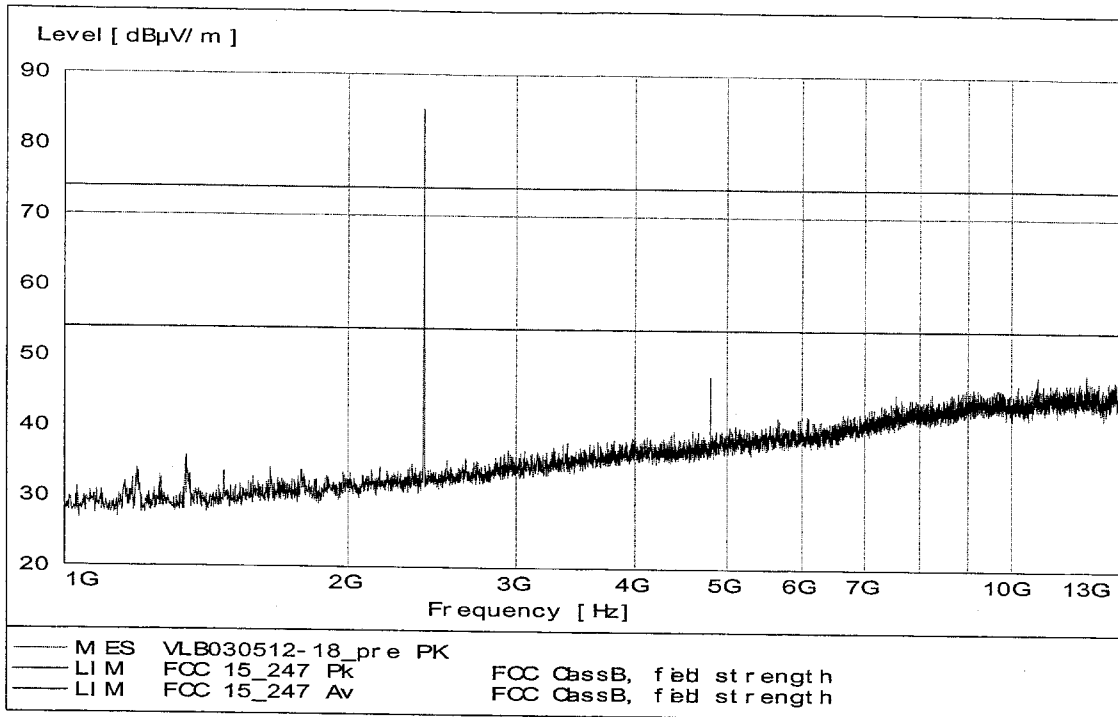
30 – 1000 MHz, max peak at a distance of 3 m in the stand-by mode



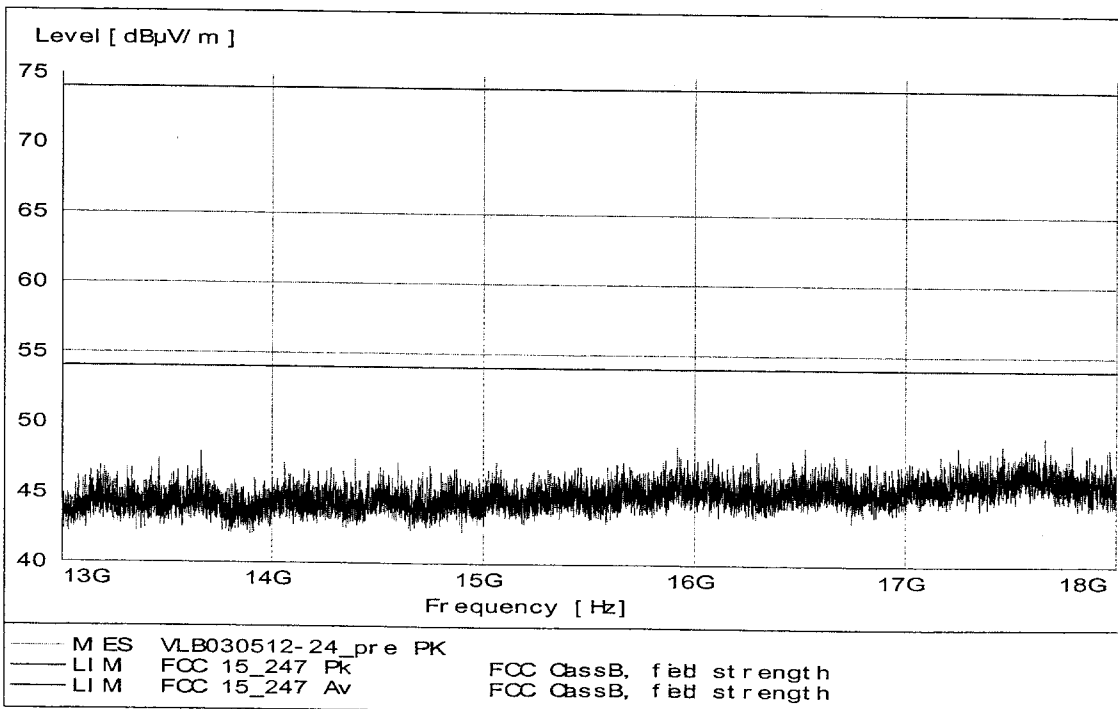
13.5.2 Bluetooth anechoic shielded chamber

Date of test: May 12, 2003

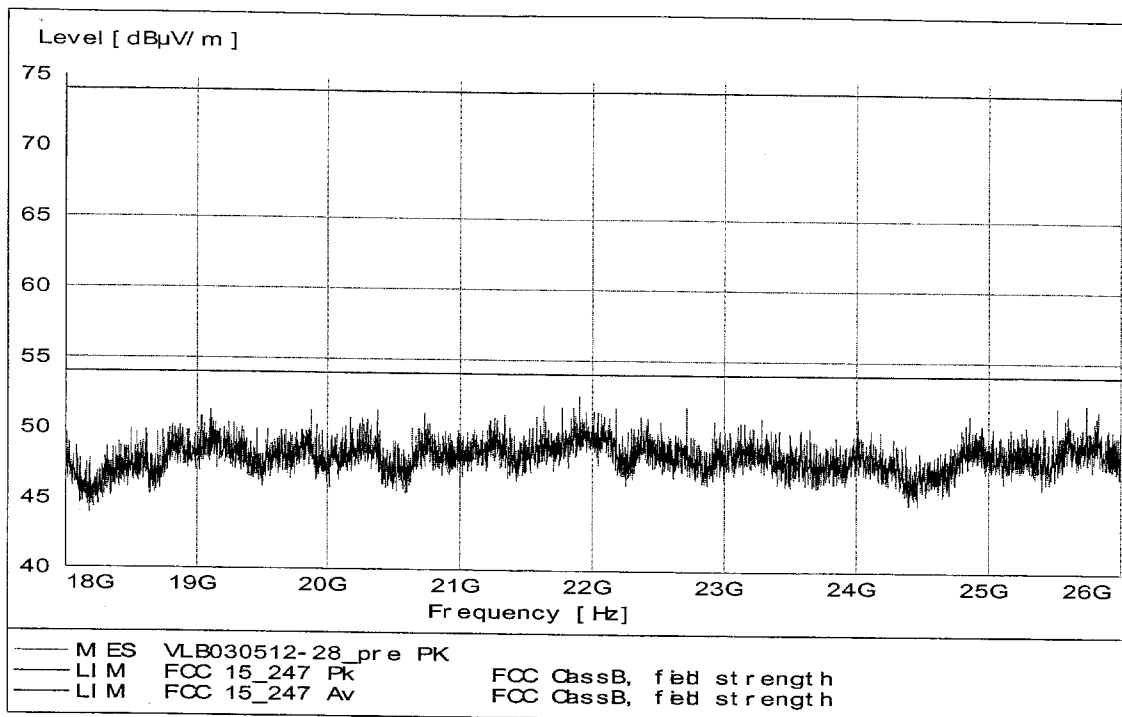
1000 – 13000 MHz, max peak at a distance of 3 m on the lower TX channel



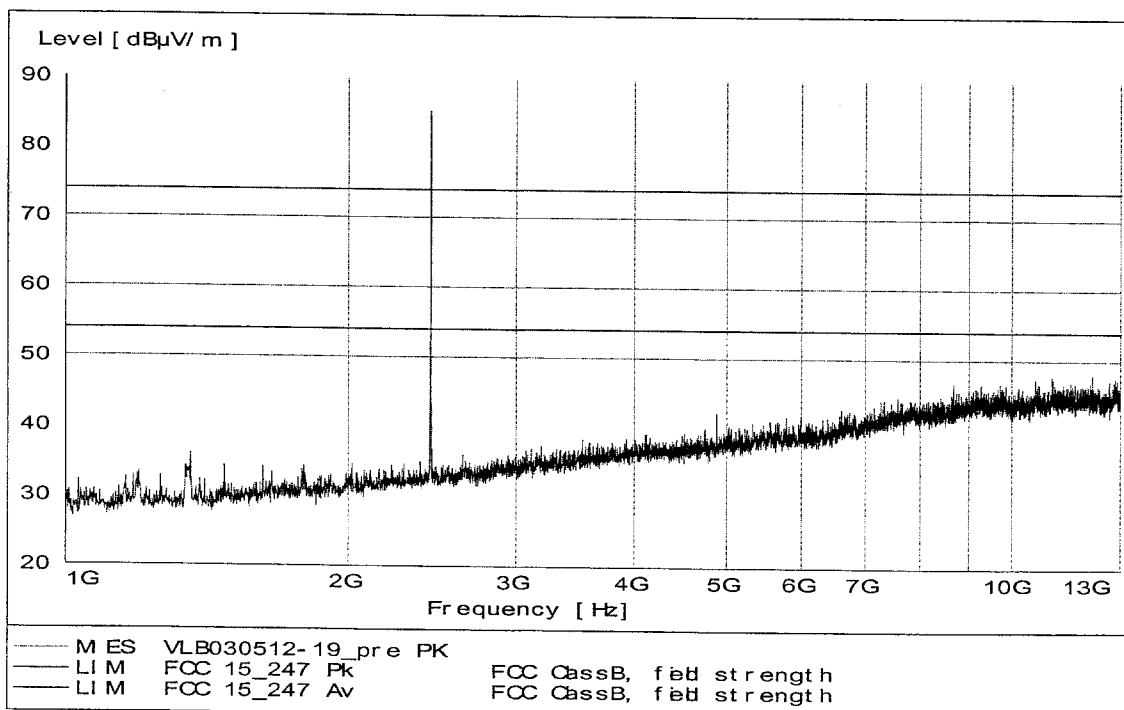
13000 – 18000 MHz, max peak at a distance of 3 m on the lower TX channel



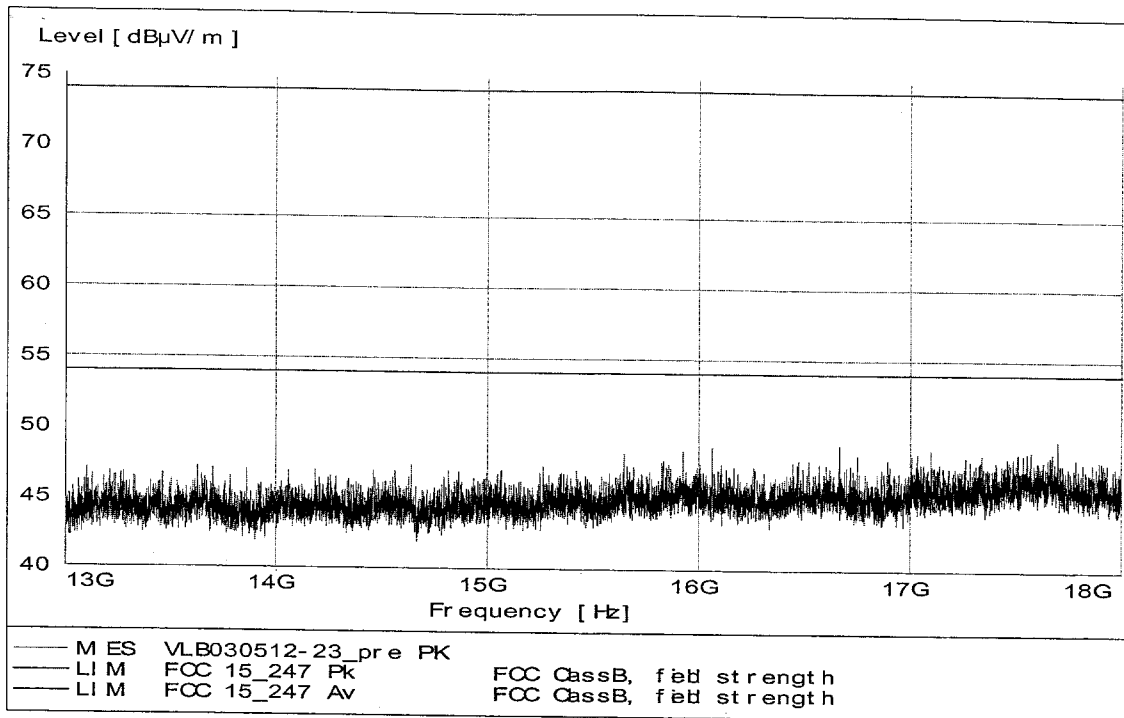
18000 – 26000 MHz, max peak at a distance of 3 m on the lower TX channel



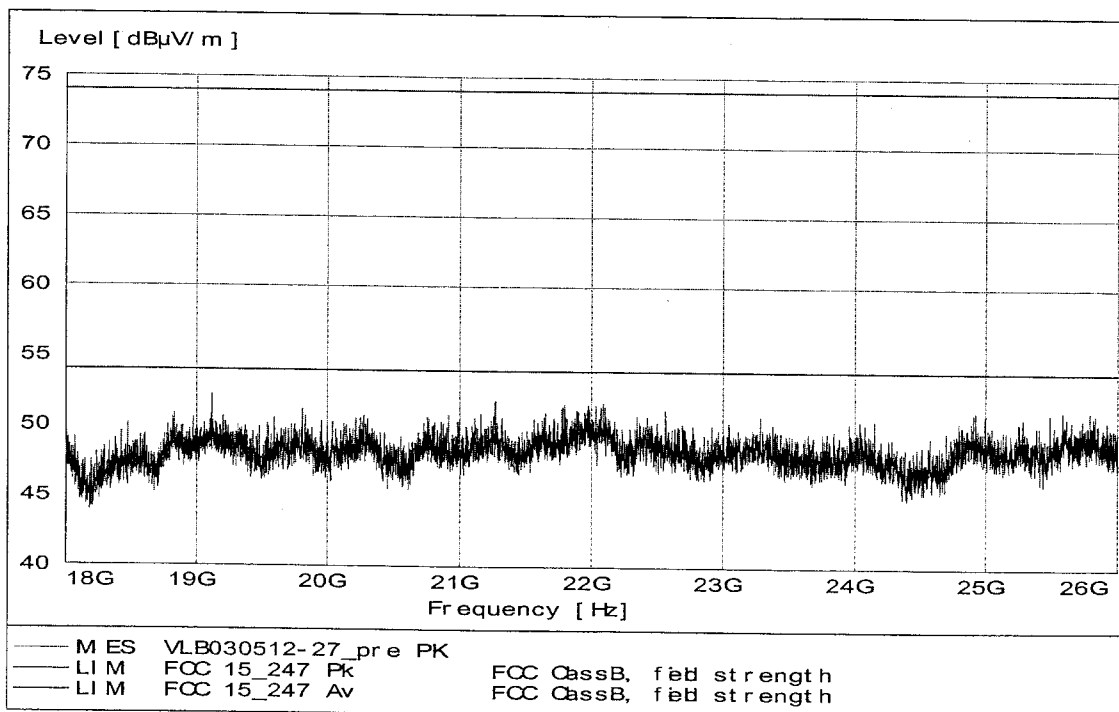
1000 – 13000 MHz, max peak at a distance of 3 m on the middle TX channel



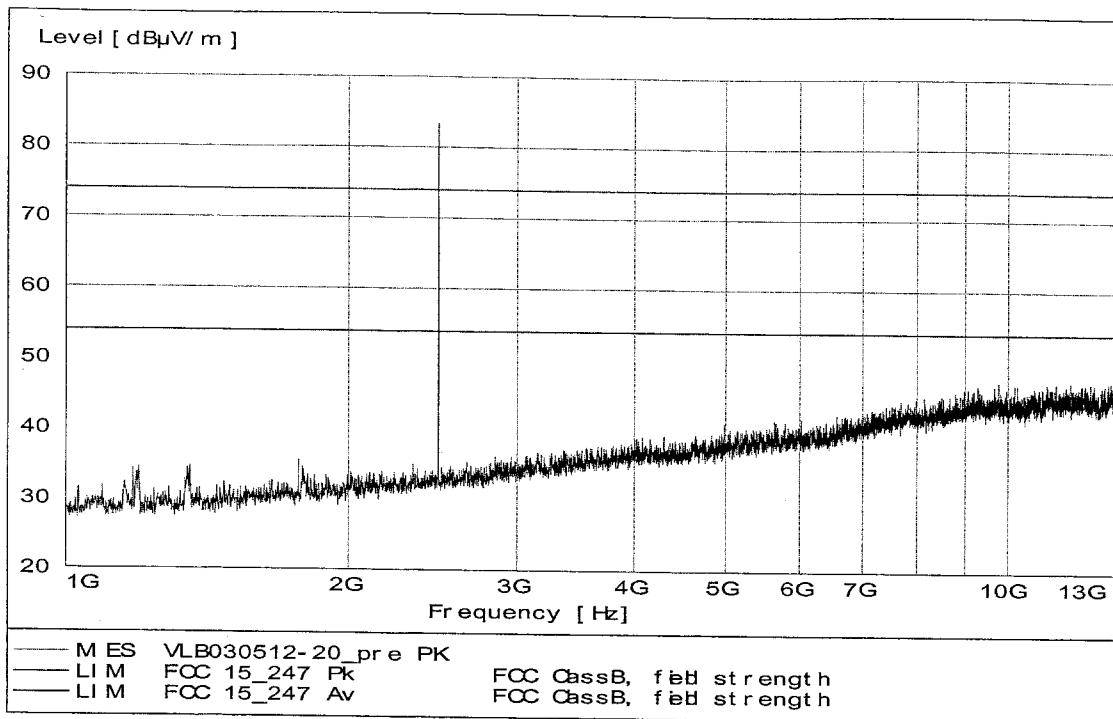
13000 – 18000 MHz, max peak at a distance of 3 m on the middle TX channel



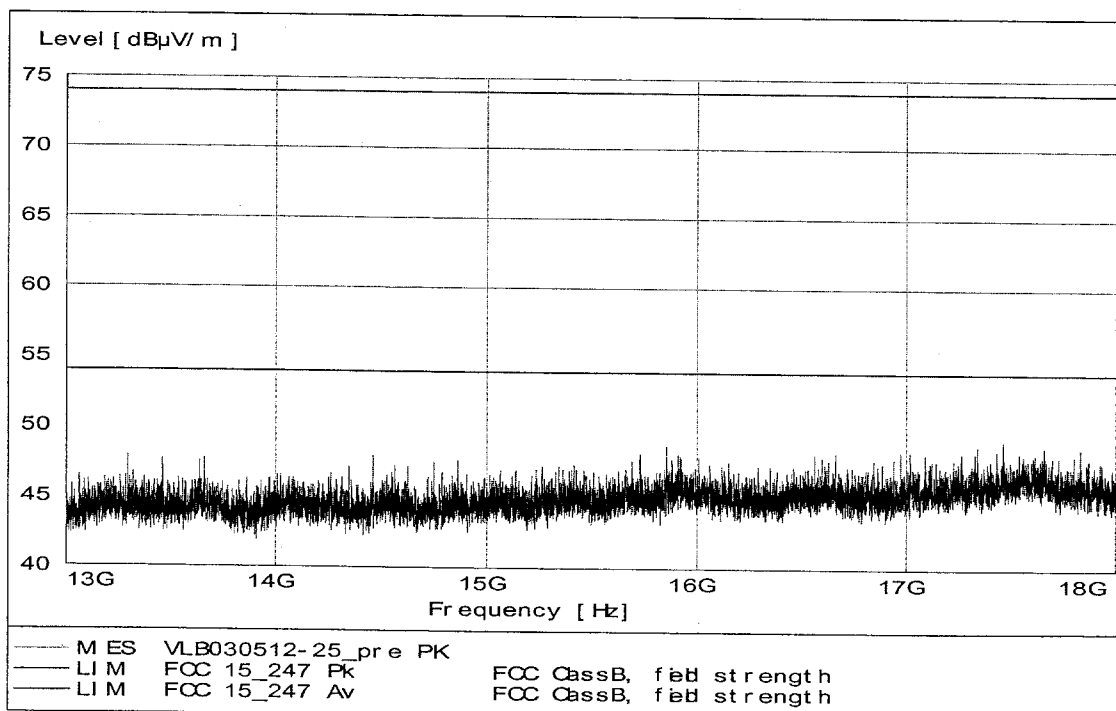
18000 – 26000 MHz, max peak at a distance of 3 m on the middle TX channel



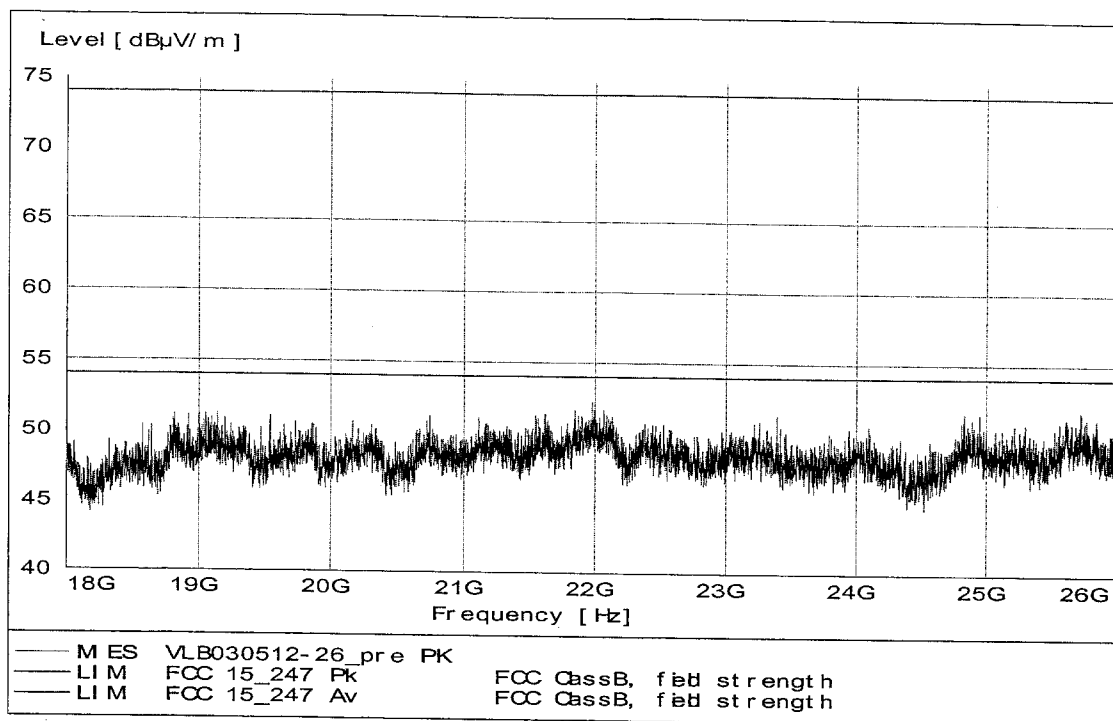
1000 – 13000 MHz, max peak at a distance of 3 m on the upper TX channel



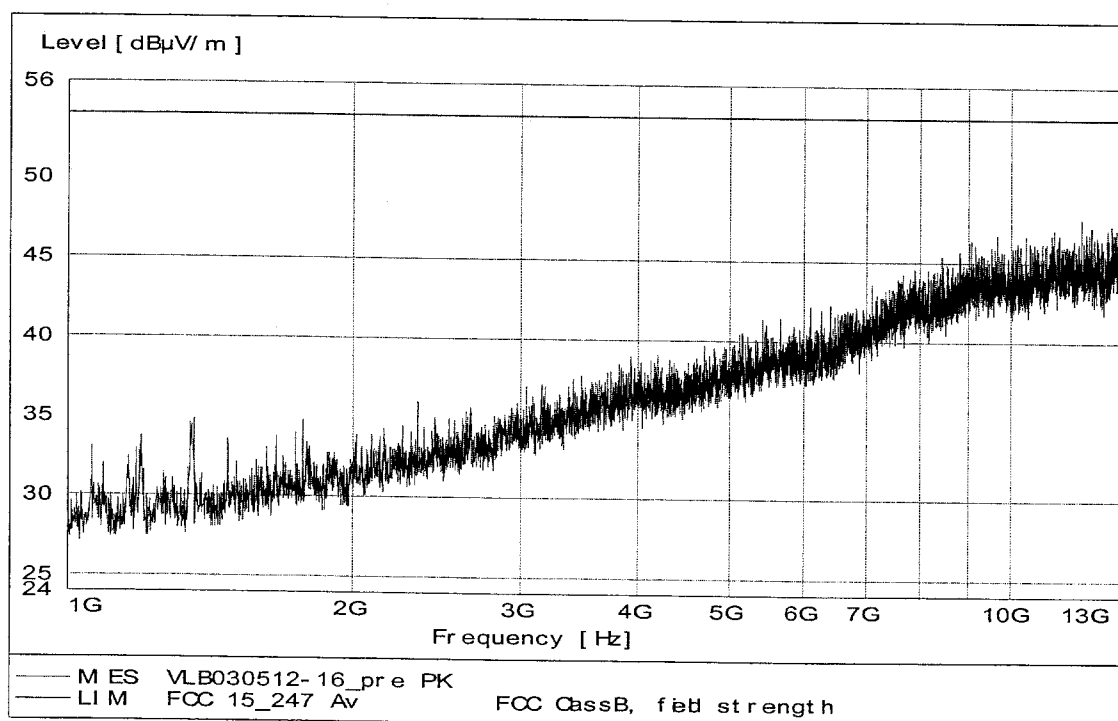
13000 – 18000 MHz, max peak at a distance of 3 m on the upper TX channel



18000 – 26000 MHz, max peak at a distance of 3 m on the upper TX channel



1 – 13 GHz, peak detection at a distance of 3 m in the stand by mode

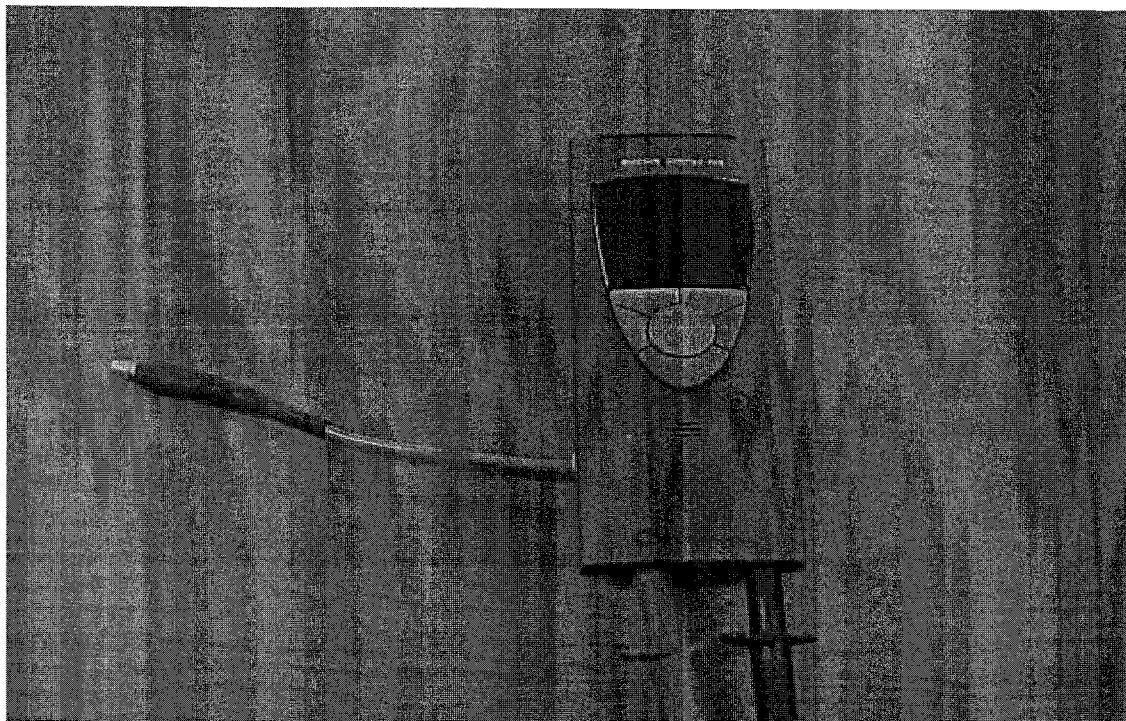


13.5.3 Data summary

Field strength of spurious emissions						
Frequency [MHz]	RBW [kHz]	Measured level		Limit		Note
		Peak [dB(μV/m)]	QP/AV [dB(μV/m)]	Peak [dB(μV/m)]	QP/AV [dB(μV/m)]	
35	120	-	21	-	40	
44	120	-	34	-	40	
73	120	-	23	-	40	
147	120	-	37	-	43,5	
294	120	-	31	-	46	
430	120	-	29	-	46	
442	120	-	43	-	46	
590	120	-	39	-	46	
700	120	-	30	-	46	
737	120	-	39	-	46	
749	120	-	26	-	46	
885	120	-	42	-	46	
960 – 1000	120	<27	-	-	54	
1000 – 13000	1000	<48	-	74	54	
13000 – 18000	1000	<49	-	74	54	
18000 – 26000	1000	<53	-	74	54	

APPENDIX – PHOTOS OF THE EUT

Unit for conducted measurements



Unit for radiated measurements



Identification photo

