

RADIO TEST REPORT

No. 400882R1

EQUIPMENT UNDER TEST

Equipment: Barcode Reader
Type / model: RF650
Manufacturer: Nordic ID
Tested by request of: Bluegiga Technologies Inc.

SUMMARY

The equipment complies with the requirements of the following standards:

FCC, Part 15, Subpart B (2003) and Subpart C (2003);
RSS-210, Issue 5 (November 2001)

Industry Canada listed test facility No. IC 3481



Date of issue: May 17, 2004

Tested by:

Bazhanov

Vladimir Bazhanov

Approved by:

Björn Rosenquist
Björn Rosenquist



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1. CLIENT INFORMATION

The EUT has been tested by request of

Company: Bluegiga Technologies Inc.
Taivalmäki 11
FI-02200 Espoo
Finland
Name of contact: Mikael Björkas

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

Equipment: Barcode Reader
Type/Model: RF650
Brand name: -
Serial number: -
FCC ID Number: -
Manufacturer: Nordic ID
Rating/Supplying voltage: 2,4 V DC (2,0 to 3,0 V DC)
Rating RF output power: 4 to 20 dBm (Power class 1)
Antenna gain: 0 dBi
External antenna connector: NO
Operating temperature range: 0 to 60 °C
Frequency range: 2400 – 2483,5 MHz
Number of channels: 79
Modulation characteristics: GFSK
Stand by mode supported: Yes



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2.2 Additional hardware information about the EUT

The EUT consists of the following units:

Unit	Type and version
HL board	HL 7#22
BT board	BT 6#0

2.3 Additional software information about the EUT

During the tests the EUT supported the following software:

Software	Version	Comment
Not specified	7.2	Manufacturer's software
CSR Blue Suite	1.18	Test mode and frequency control

2.4 Peripheral equipment

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

Equipment	Manufacturer / Type	Serial number
Interface control card	Bluegiga Technologies Inc.	-
Laptop PC	IBM ThinkPad / 2645450	55223TF

2.5 Modifications during the test

New versions of HL board and BT board have been developed in order to comply with requirements of the standards.



3. TEST SPECIFICATIONS

3.1 Standards

FCC 47 CFR part 15 (2003): Subpart B – Unintentional radiators.
FCC 47 CFR part 15 (2003) and Subpart C – Intentional Radiators; §15.247 Operation within the bands 902-928 MHz, 2400 – 2483.5 MHz and 5725 – 5850 MHz.

Measurements methods according to ANSI C63.4-2001.

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

3.2 Additions, deviations and exclusions from standards

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

3.3 Test set-up

Measurement set-up for the test of out-of-band spurious emissions is described in corresponding section. During other tests the EUT was connected to the spectrum analyser by cable.

3.4 Operating environment

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

Air temperature: 20 – 23 °C
Relative humidity: 17 – 22 %



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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)	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	Out of band spurious emissions, radiated	Pass	
15.247	Out of band spurious emissions, conducted	NA	
15B	Out of band spurious emissions, radiated	Pass	

NA = Not Applicable



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5. PEAK OUTPUT POWER**5.1 Test protocol**

Date of test: April 30, 2004

EUT mode of operation: TX and hopping on one channel.

Spectrum analyser settings:

Span: 10 MHz

RBW: 3 MHz

VBW: 3 MHz

Sweep time: Auto

Detector: Peak

Trace: Max Hold

Channel (MHz)	Peak Output Power (dBm)	Limit value (dBm)
2402	10.1	< 30
2441	7.5	
2480	8.3	

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

Example calculation:

$$\text{Peak output power [dBm]} = \text{Analyser reading [dBm]} + \text{cable loss [dB]} + \text{EUT antenna gain [dBi]}$$


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6. 20 dB BANDWIDTH**6.1 Test protocol**

Date of test: April 30, 2004

EUT mode of operation: TX and hopping on one channel.

Spectrum analyser 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	941	< 1000
2441	872	
2480	869	



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7. CARRIER FREQUENCY SEPARATION

7.1 Test protocol

Date of test: April 30, 2004

EUT mode of operation: TX and hopping on.

Spectrum analyser 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	994	-	> 941
2441	1034	970	> 872
2480	-	962	> 869

Limit = Result from the 20 dB Bandwidth measurements



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8. NUMBER OF HOPPING CHANNELS**8.1 Test protocol**

Date of test: April 30, 2004

EUT mode of operation: TX and hopping on.

Spectrum analyser 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



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9. TIME OF OCCUPANCY (DWELL TIME)

9.1 Test protocol

Date of test: April 30, 2004

EUT mode of operation: TX and hopping on.

Spectrum analyser 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)	2917.8	2925.9	2917.8	-
n	33	33	33	-
Dwell time (s) = $T \cdot 10^{-6} \cdot 3.16 \cdot n$	0.30	0.31	0.30	< 0,4



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10. BAND EDGE COMPLIANCE

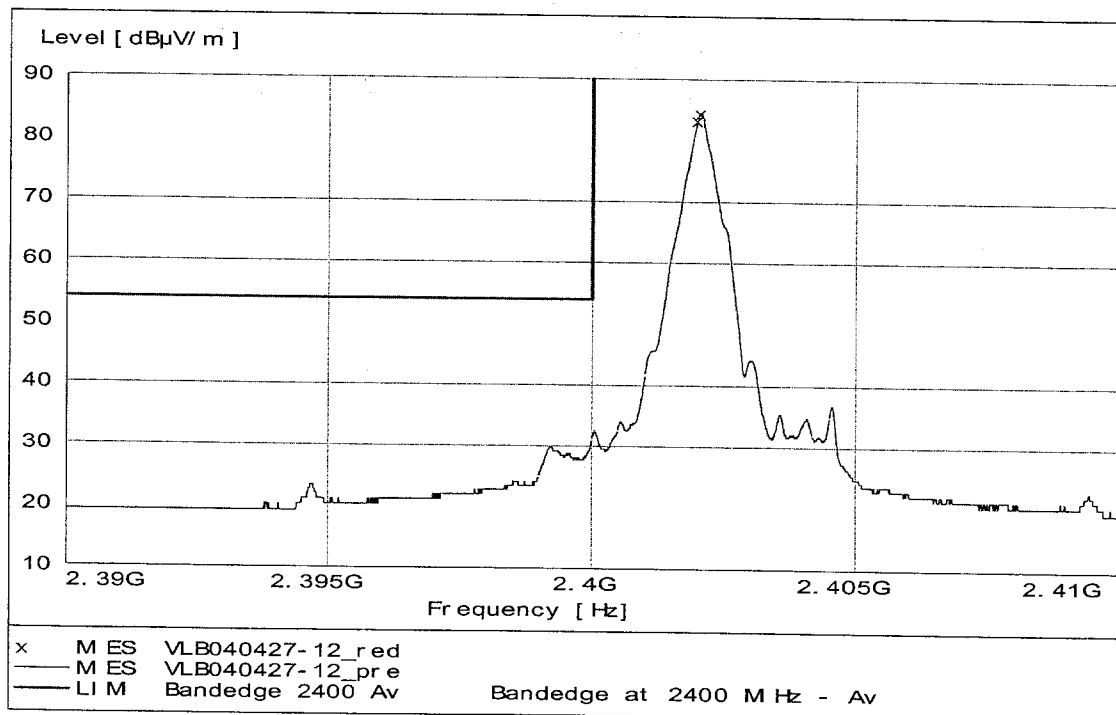
10.1 Test protocol

Date of test: April 27, 2004

EUT mode of operation: TX and hopping off.

Parameter settings	Compliance at 2400 MHz	Compliance at 2483,5 MHz
Start frequency (MHz):	2390	2472
Stop frequency (MHz):	2410	2492
RBW (kHz):	100	100
VBW (kHz):	10	10
Sweep time (ms):	5	5
Detector:	Average	Average
Trace:	Max Hold	Max Hold

Band edge compliance at 2400 MHz



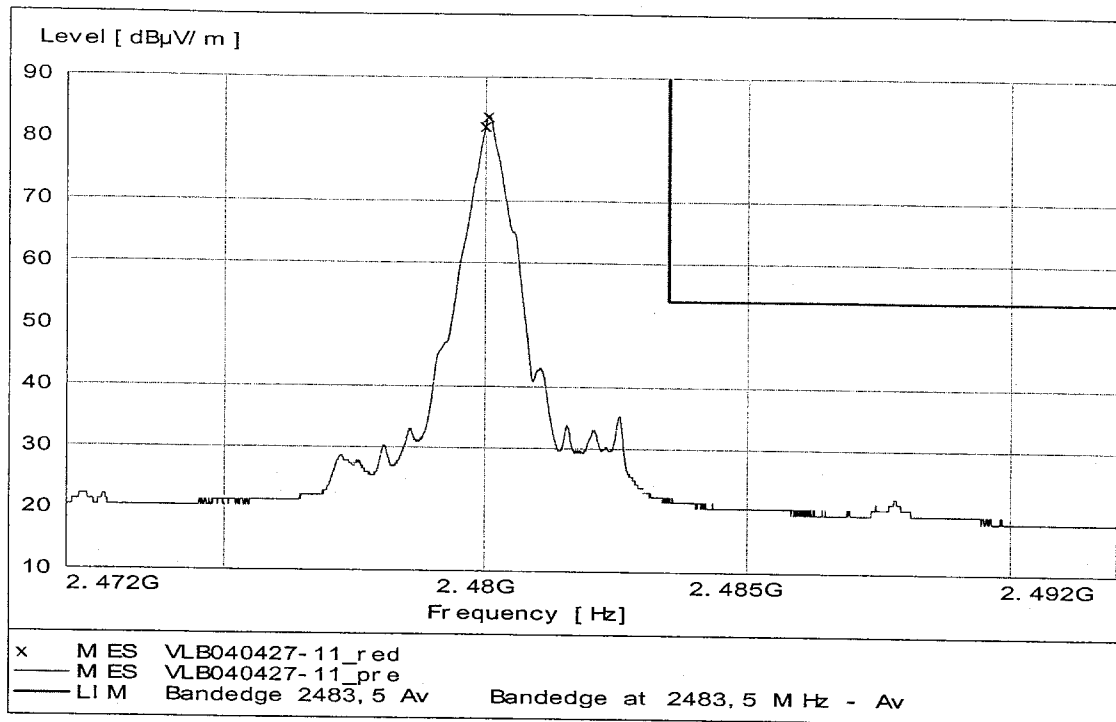
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Band edge compliance at 2483,5 MHz



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11. RADIATED SPURIOUS EMISSIONS

11.1 Operating environment

Temperature: 20 - 23 °C (10 - 40 °C)

Relative Humidity: 17 - 22 % (10 - 90 %)

11.2 Measurement uncertainty

 Radiated disturbance electric field intensity, 30 – 1000 MHz: $\pm 4,6$ dB

 Radiated disturbance electric field intensity, 1000 – 18000 MHz: $\pm 6,0$ 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%.

11.3 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	CBL6111A	8578
<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, V1.70	
Signal analyser:	Rohde & Schwarz	FSIQ 40	40023
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
High-pass filter:	K&L Microwave Inc.	4410-X4500/18000-0	5133
Band rejection filter:	K&L Microwave Inc.	6N45-2450/T100-0/0	12389



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11.4 Measurement set-up

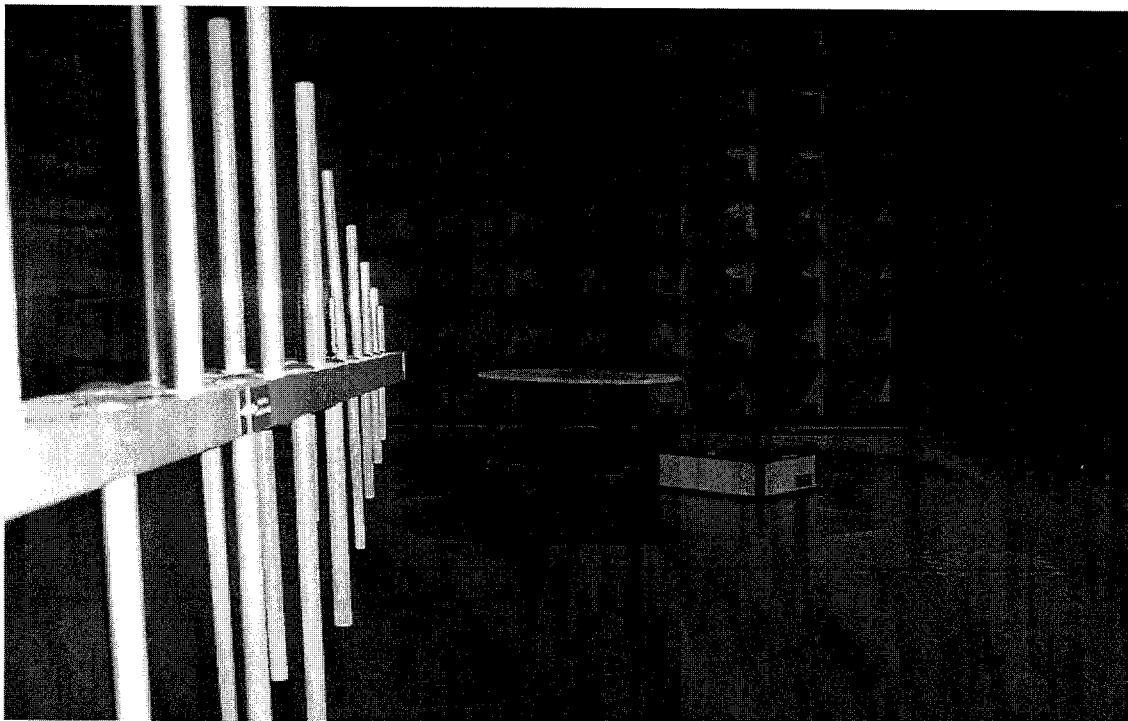
Test site: Semi-anechoic shielded chamber (30 – 1000 MHz)

The radiated disturbance electric field intensity was measured in a semi-anechoic chamber at a distance of 10 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 new measurements with a quasi-peak detector were carried out.

Test set-up photo:



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.

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 new measurements with peak and average detectors were carried out.

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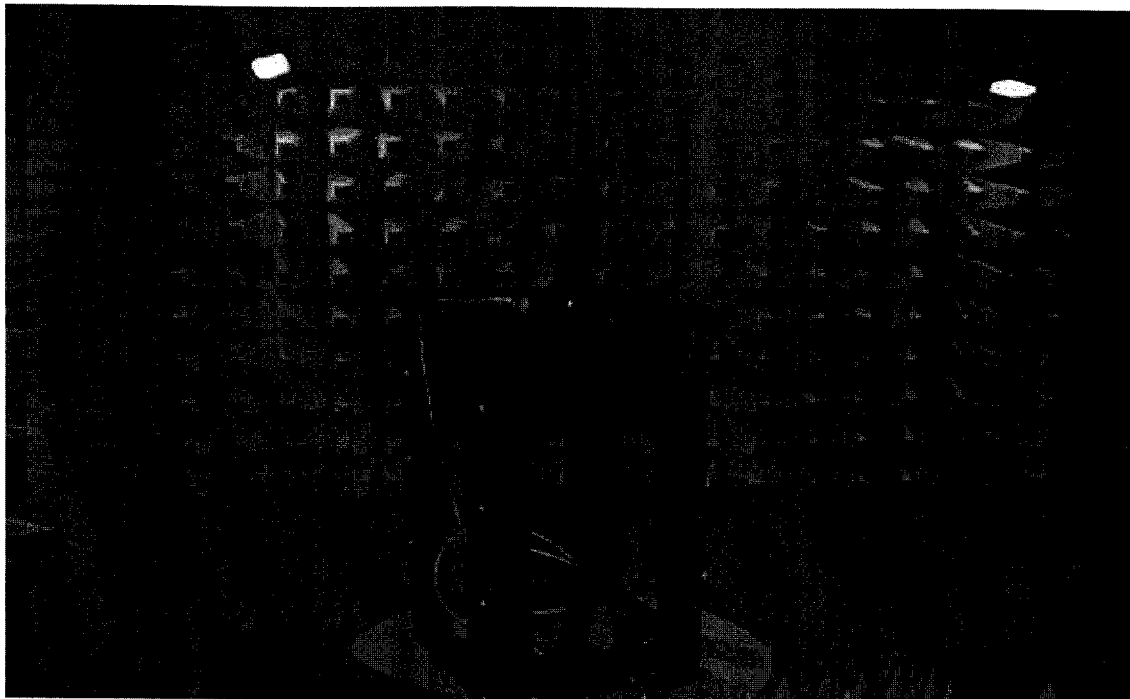
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Test set-up photo:

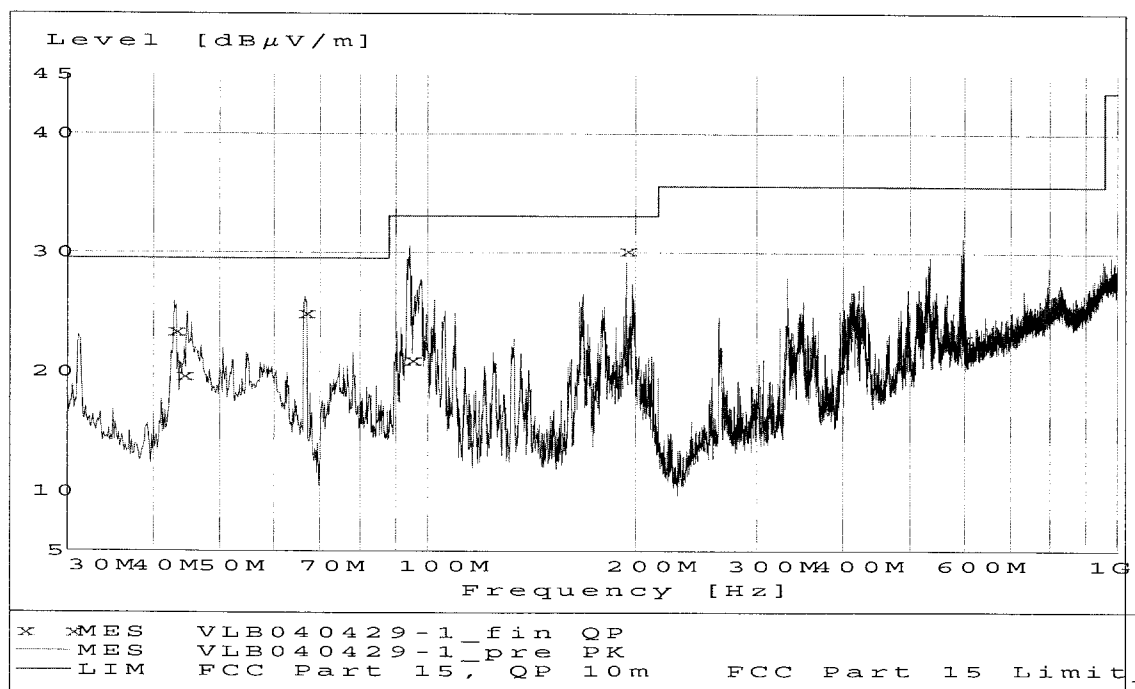


11.5 Test protocol

Semi-anechoic shielded chamber

Date of test: April 29, 2004

30 – 1000 MHz, max peak at a distance of 10 m on the lower TX channel



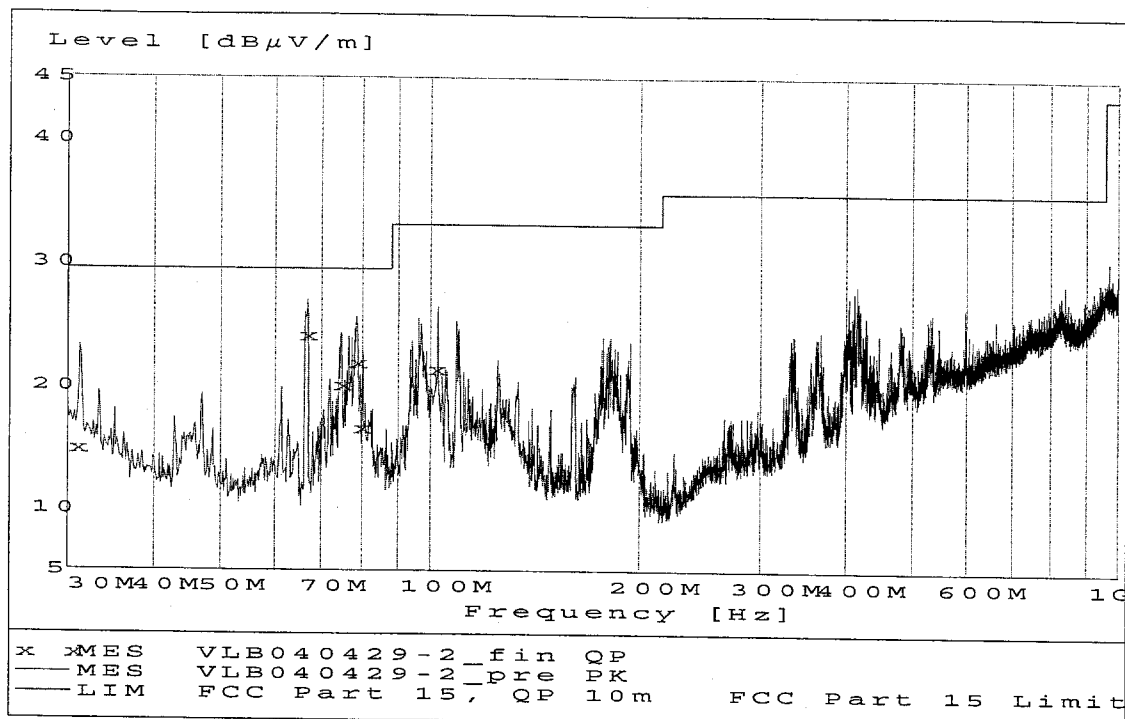
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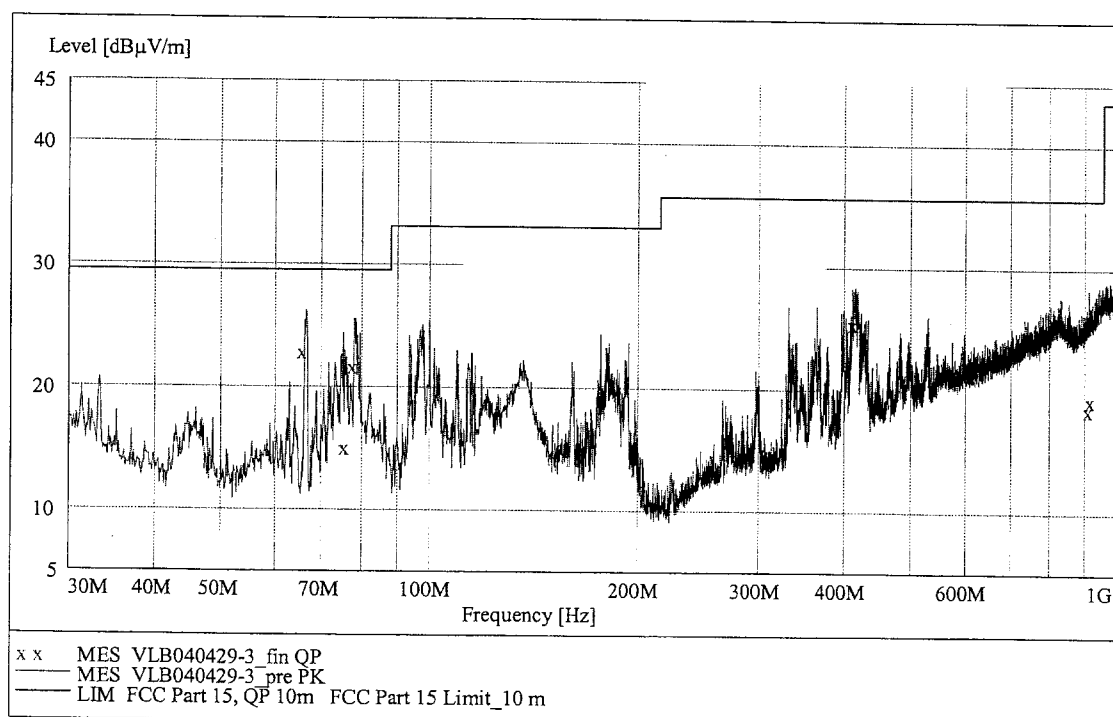
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30 – 1000 MHz, max peak at a distance of 10 m on the middle TX channel



30 – 1000 MHz, max peak at a distance of 10 m on the upper TX channel



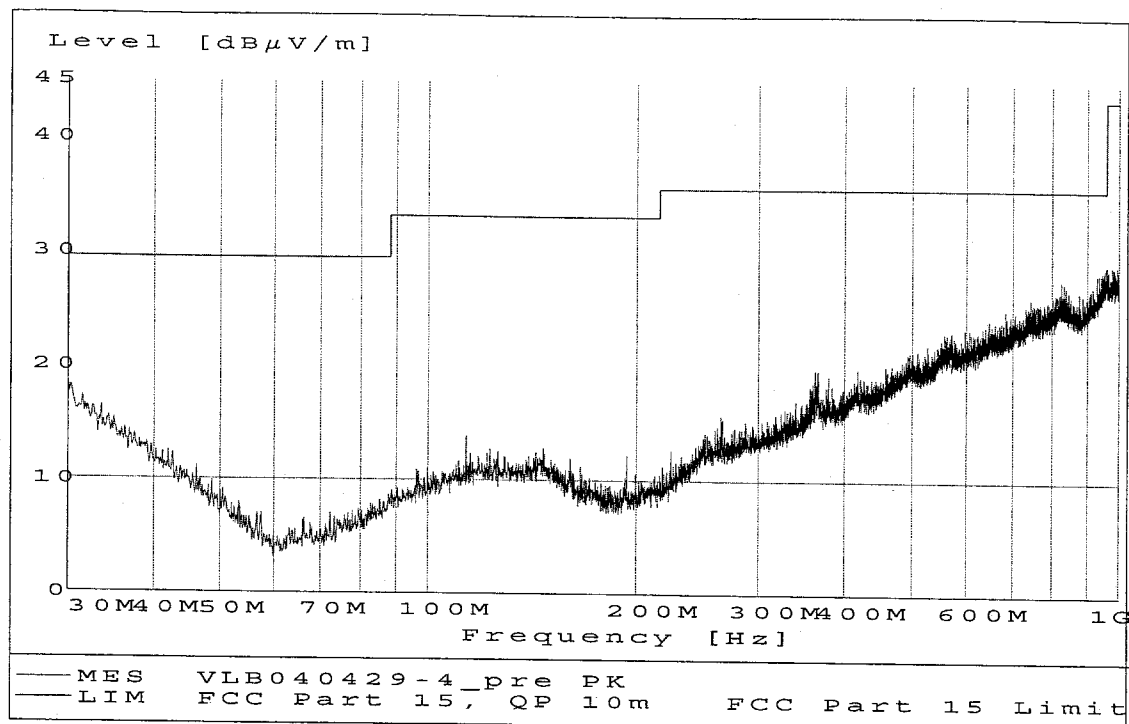
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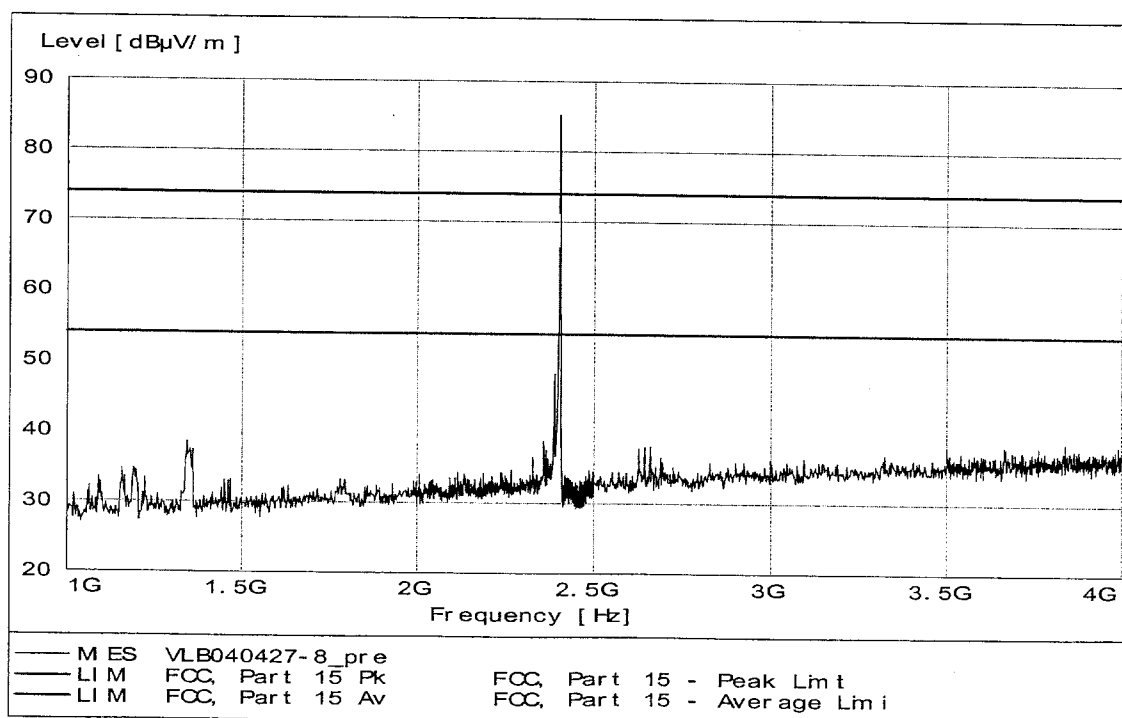
30 – 1000 MHz, max peak at a distance of 10 m in the stand by mode



Bluetooth anechoic shielded chamber

Date of test: April 27, 2004

1000 – 4000 MHz, max peak at a distance of 3 m on the lower TX channel
The carrier is attenuated by band rejection filter K&L 6N45-2450/T100-0/0



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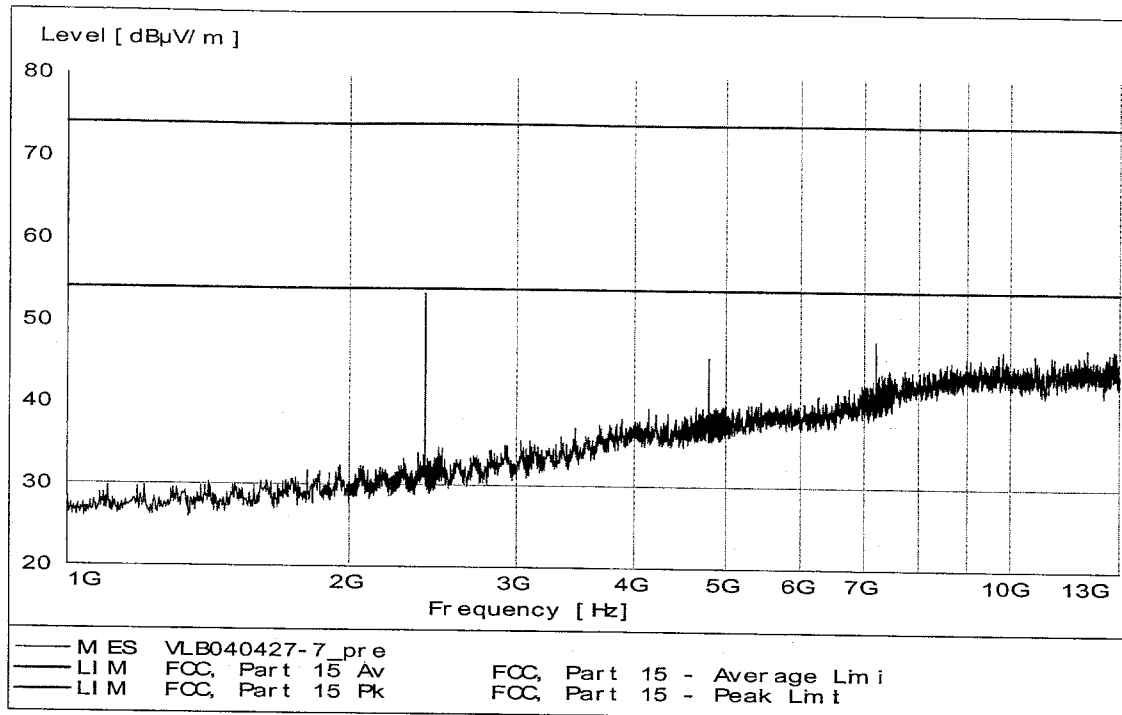
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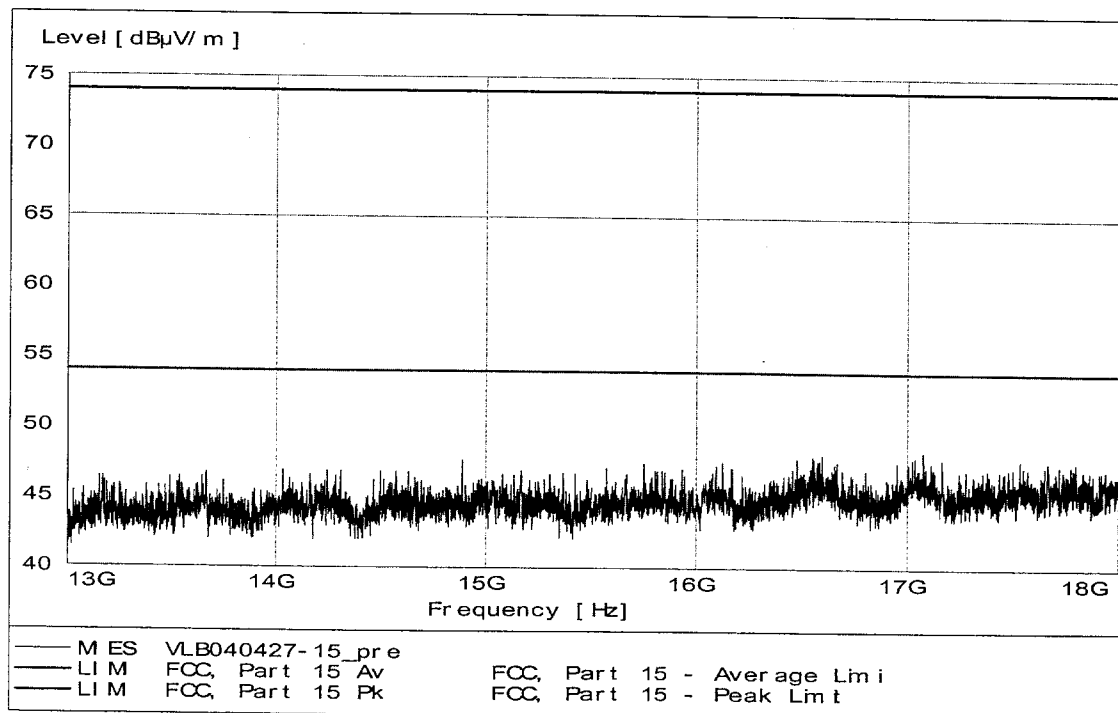
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1000 – 13000 MHz, max peak at a distance of 3 m on the lower TX channel
Emissions below 4000 MHz are attenuated by high-pass filter K&L 4410-X4500/18000-0



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



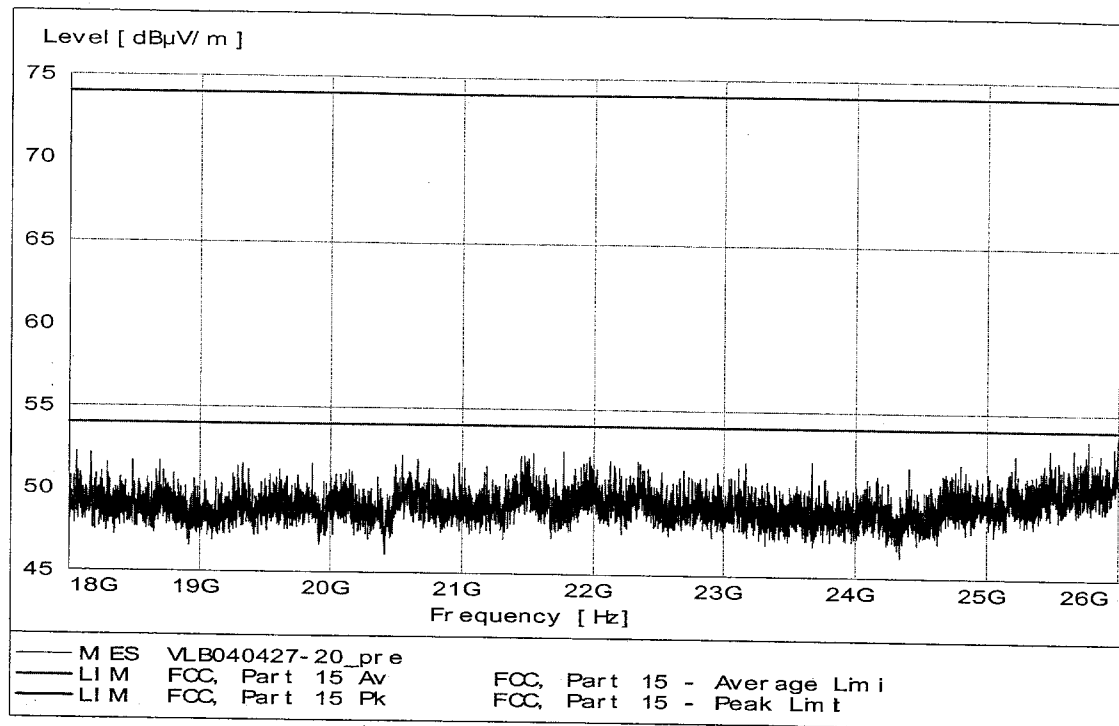
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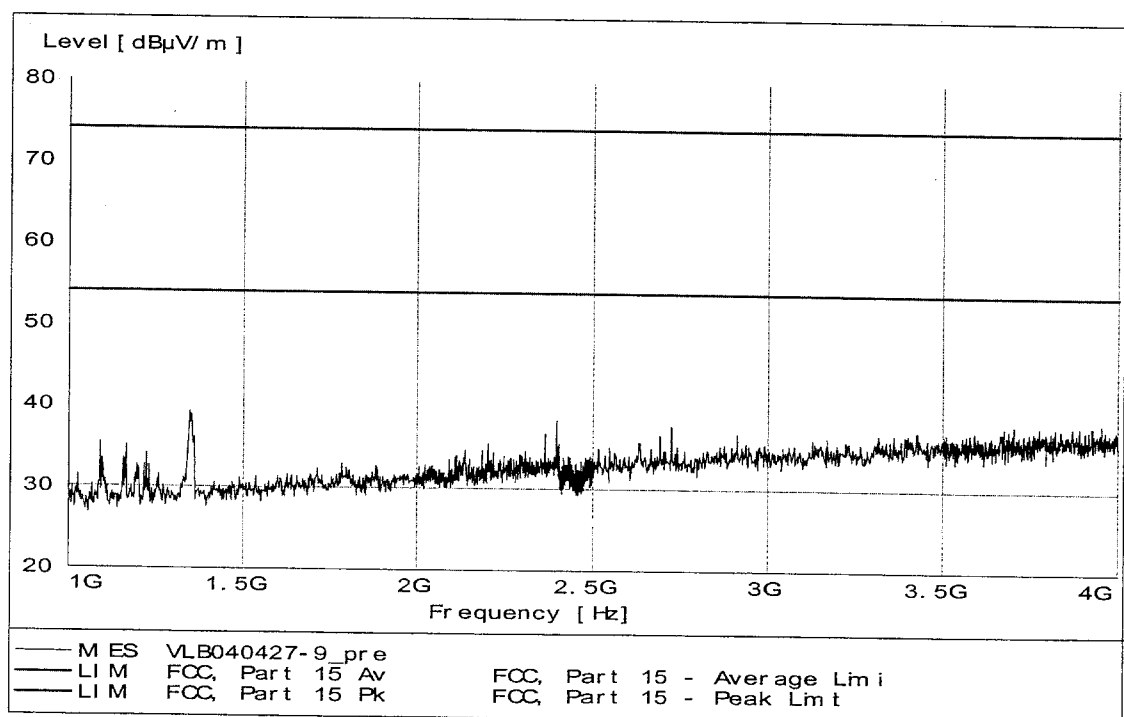
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18000 – 26000 MHz, max peak at a distance of 3 m on the lower TX channel



1000 – 4000 MHz, max peak at a distance of 3 m on the middle TX channel
 The carrier is suppressed by band rejection filter K&L 6N45-2450/T100-0/0



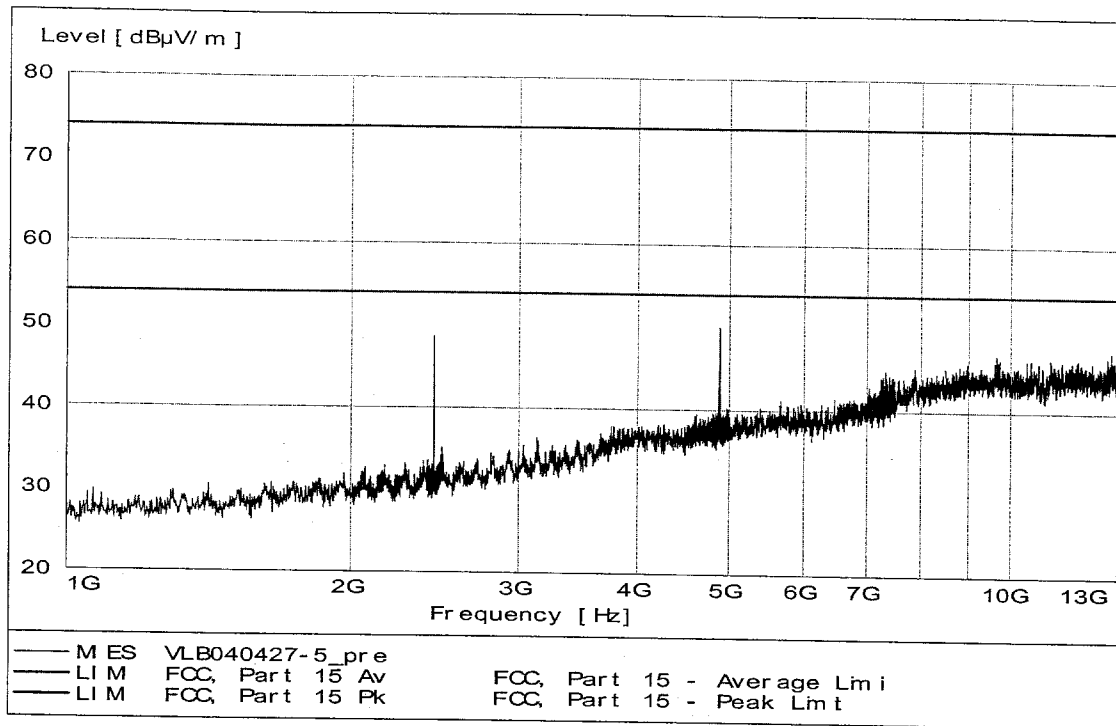
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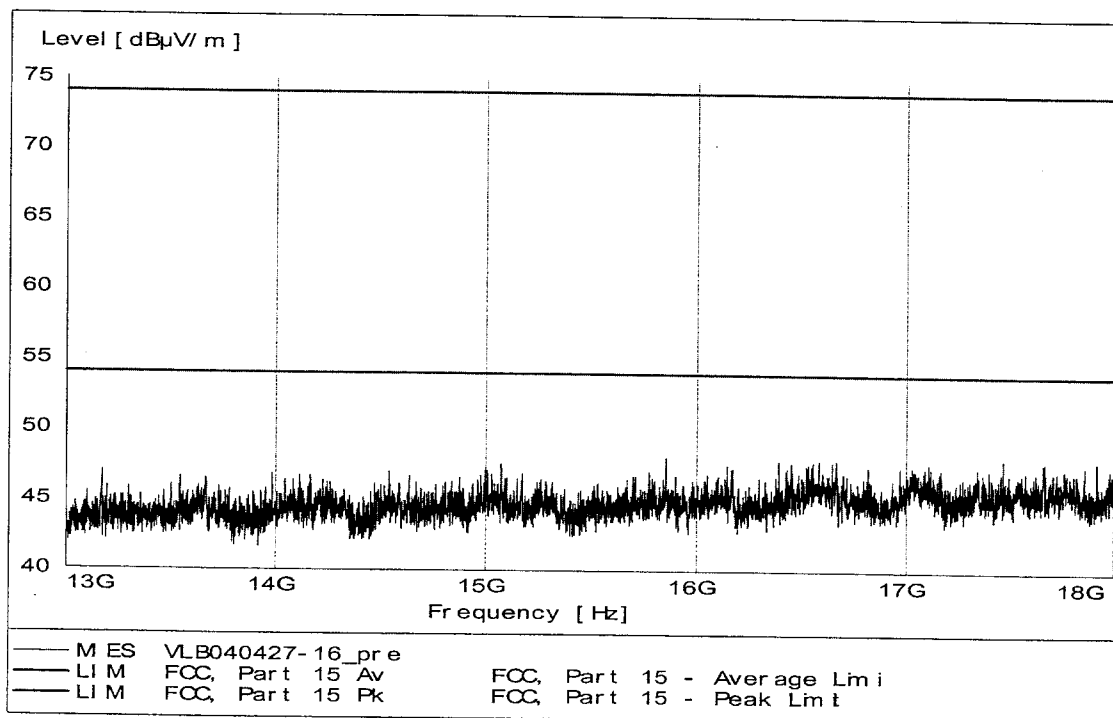
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1000 – 13000 MHz, max peak at a distance of 3 m on the middle TX channel
Emissions below 4000 MHz are attenuated by high-pass filter K&L 4410-X4500/18000-0



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



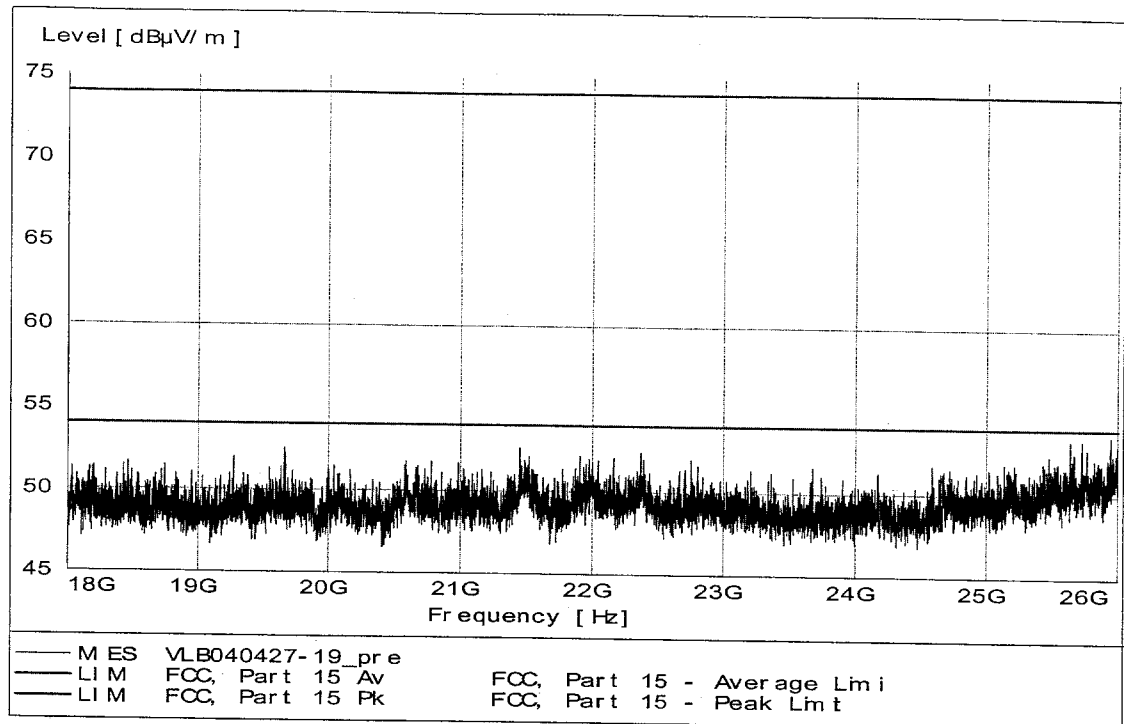
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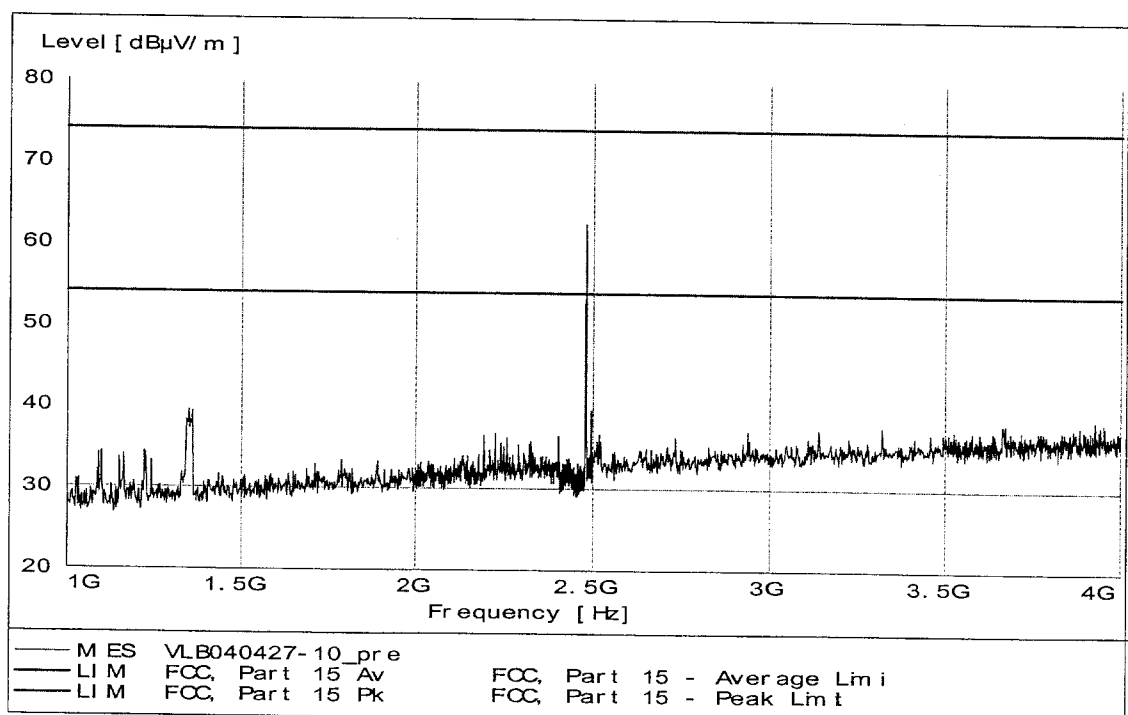
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18000 – 26000 MHz, max peak at a distance of 3 m on the middle TX channel



1000 – 4000 MHz, max peak at a distance of 3 m on the upper TX channel
The carrier is attenuated by band rejection filter K&L 6N45-2450/T100-0/0



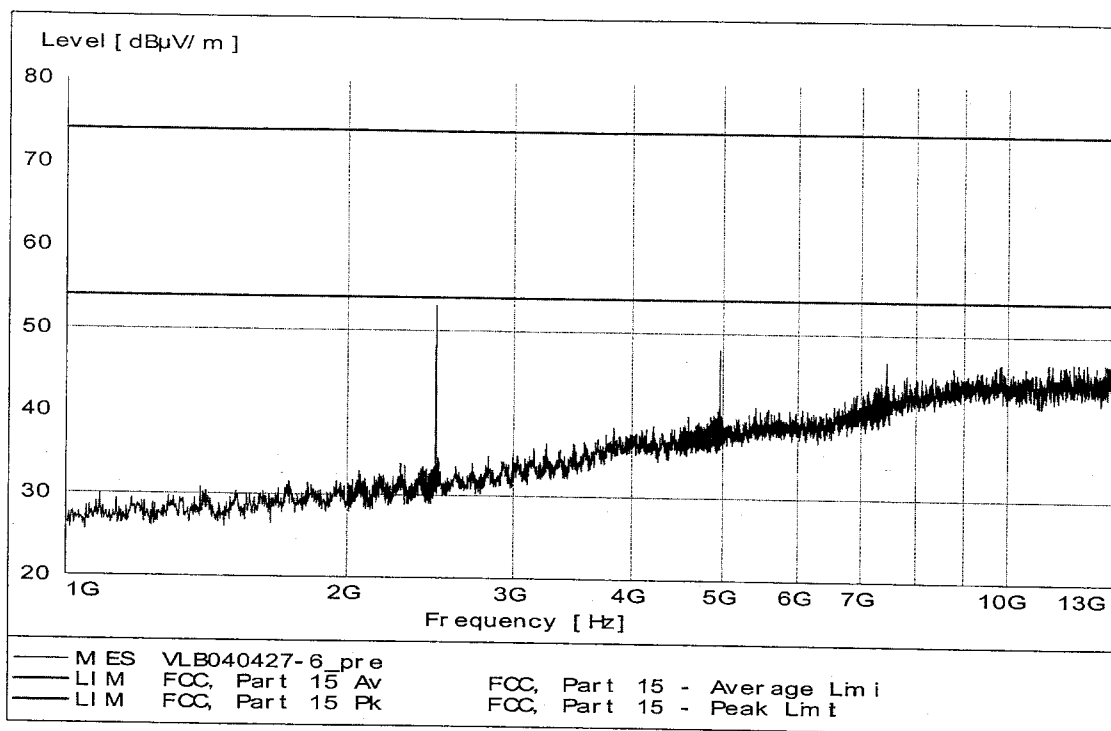
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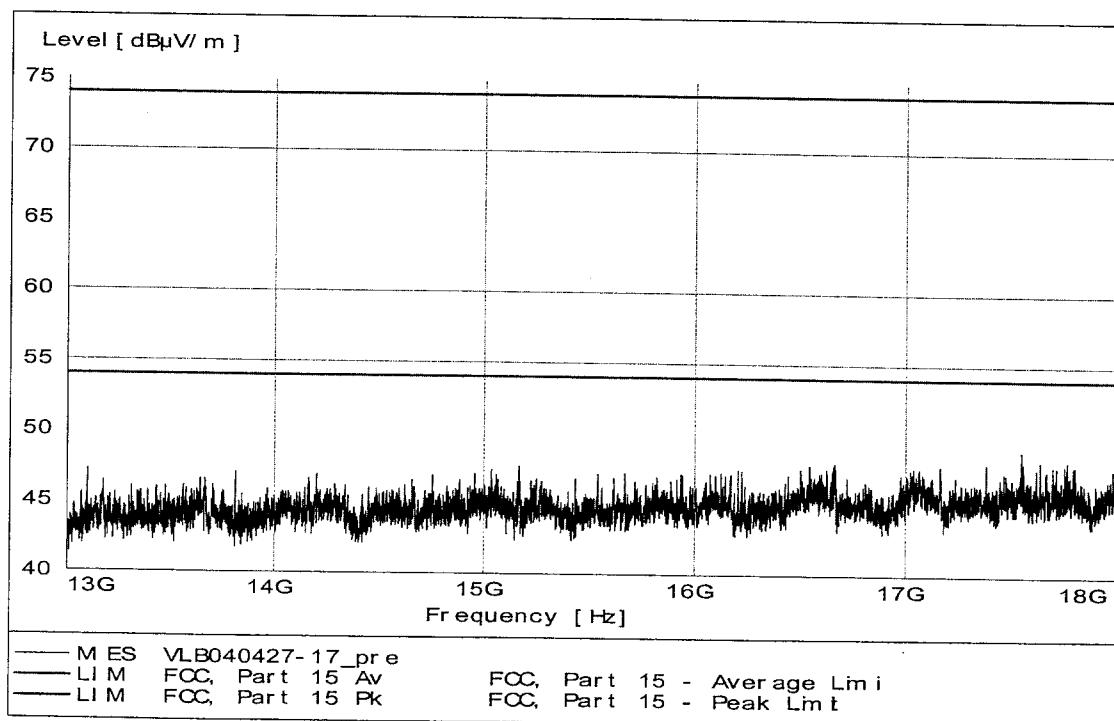
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1000 – 13000 MHz, max peak at a distance of 3 m on the upper TX channel
Emissions below 4000 MHz are attenuated by high-pass filter K&L 4410-X4500/18000-0



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



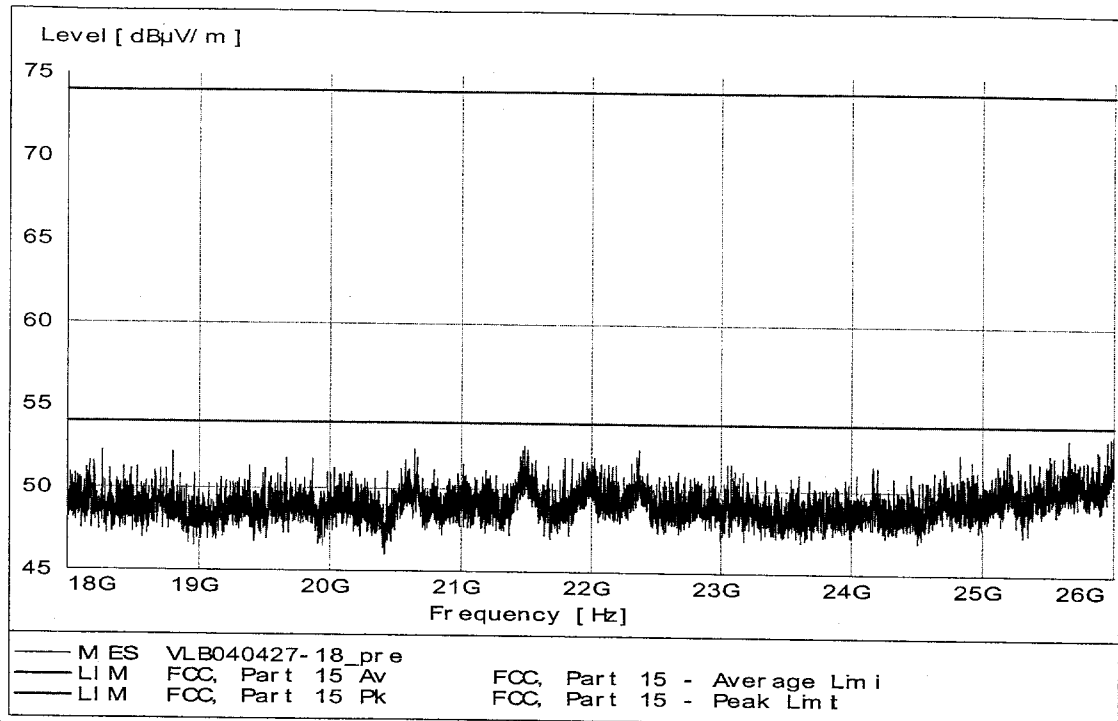
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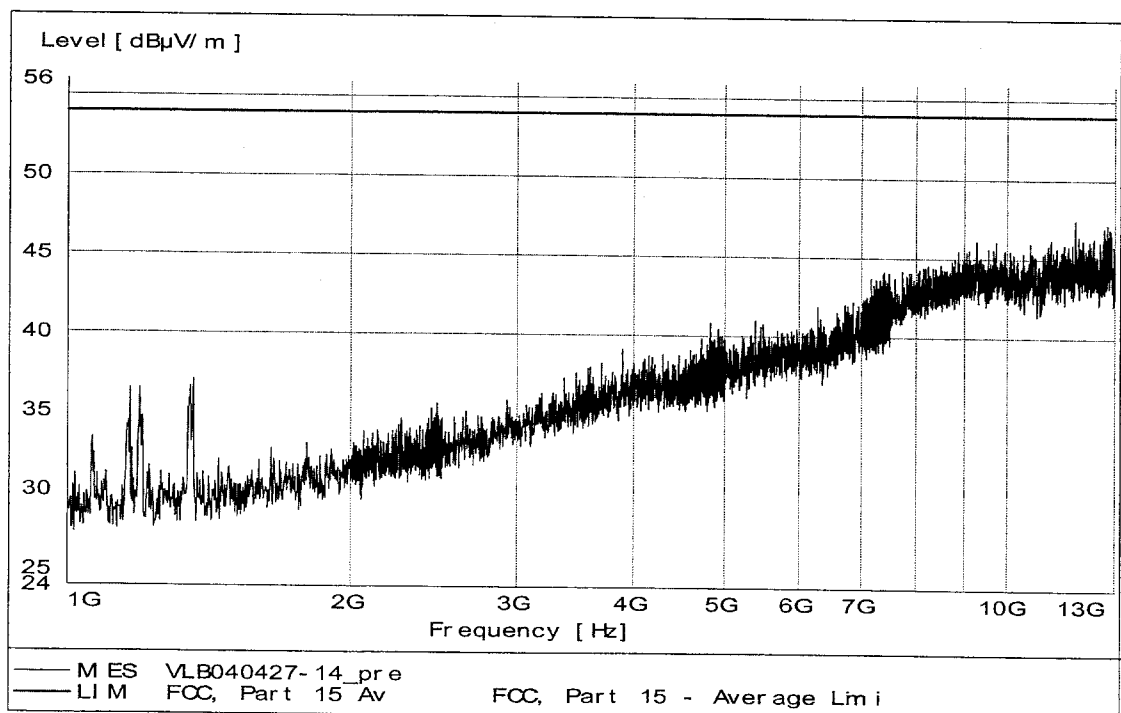
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18000 – 26000 MHz, max peak at a distance of 3 m on the upper TX channel



1000 – 13000 MHz, max peak at a distance of 3 m in the stand by mode



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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)]	
42,96	120	-	23	-	29,5	10 m distance
66,56	120	-	25	-	29,5	"
78,24	120	-	22	-	29,5	"
101,6	120	-	21	-	33	"
194,08	120	-	30	-	33	"
413,52	120	-	26	-	35,6	"
960 – 1000	120	< 30	-	-	43,5	"
4804	1000	54	44	74	54	3 m distance
4882	1000	56	49	74	54	"
4960	1000	55	46	74	54	"
7206	1000	59	46	74	54	"
7323	1000	59	46	74	54	"
7440	1000	60	49	74	54	"
13000 – 18000	1000	< 49	-	74	54	"
18000 – 26000	1000	< 54	-	74	54	"

The limit at 10 m test distance was calculated using an inverse linear distance extrapolation factor 20 dB/decade.

Example calculation:

Measured level [dB(μV/m)] = Analyser reading [dB(μV)] + cable loss [dB] – preamplifier gain [dB]
+ antenna factor [1/m]



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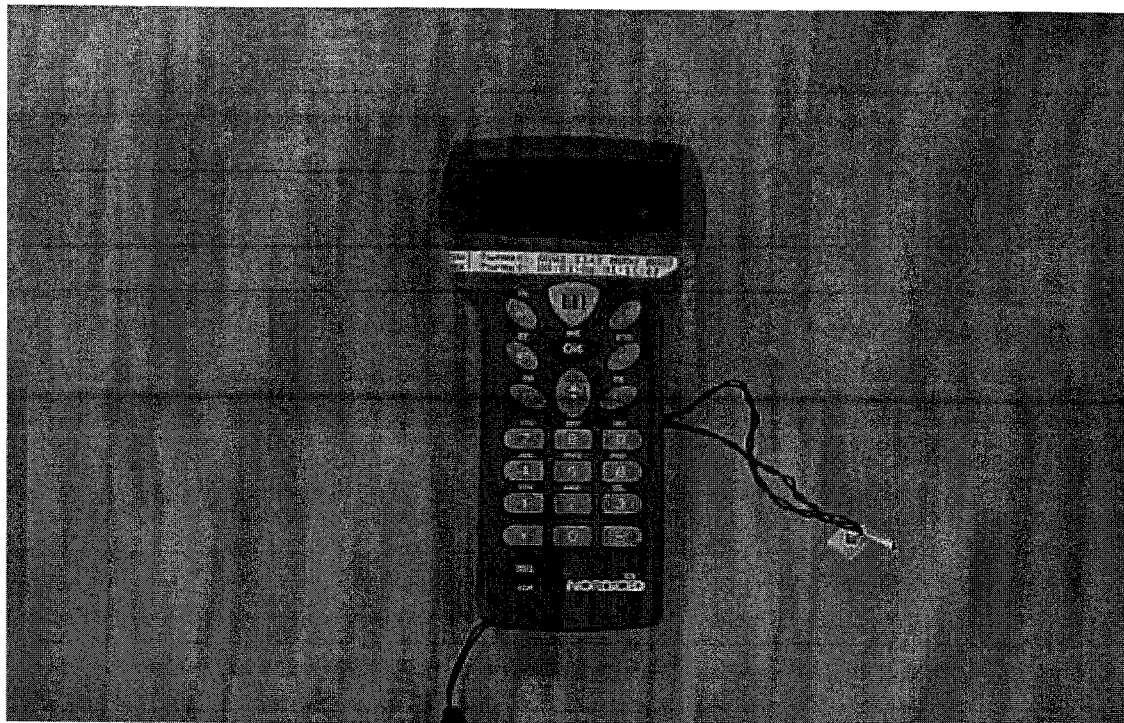
Torshamnsgatan 43, Box 1103, SE-164 22 Kista, Sweden

Telephone +46 8 750 00 00, Fax +46 8 750 60 30, www.sweden.intertek-etlsemko.com

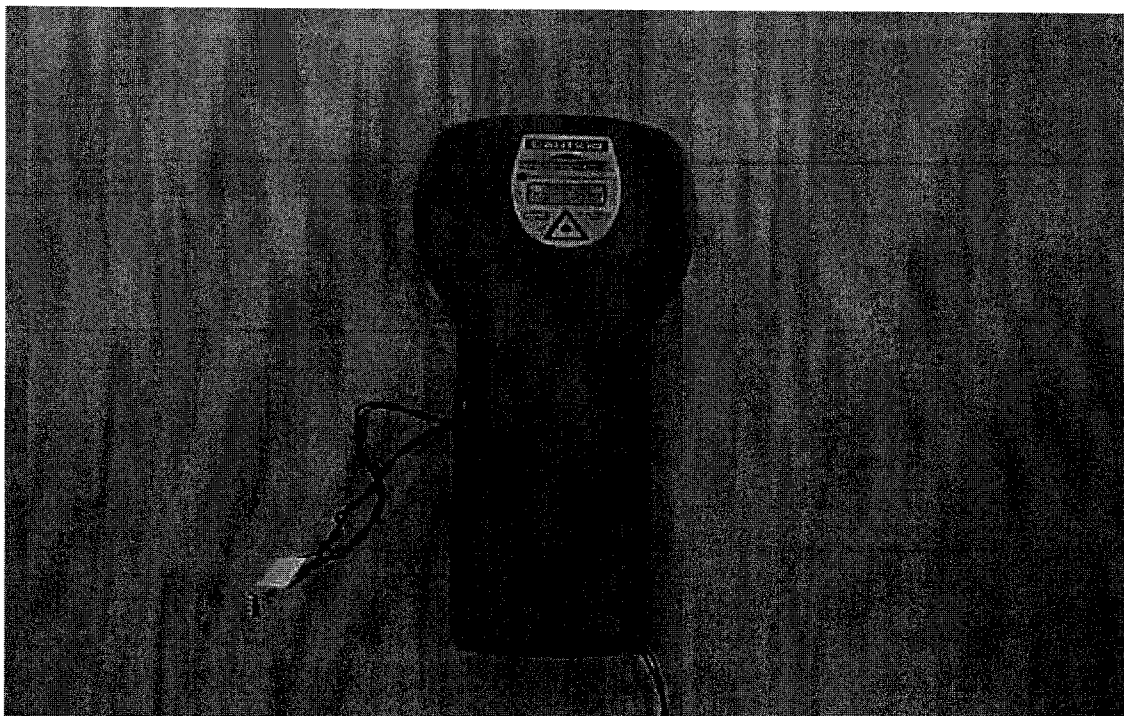
Registered in Sweden: No SE556024059901, Registered office: As address

APPENDIX – PHOTOS OF THE EUT

Unit for radiated measurements – front side



Unit for radiated measurements – back side

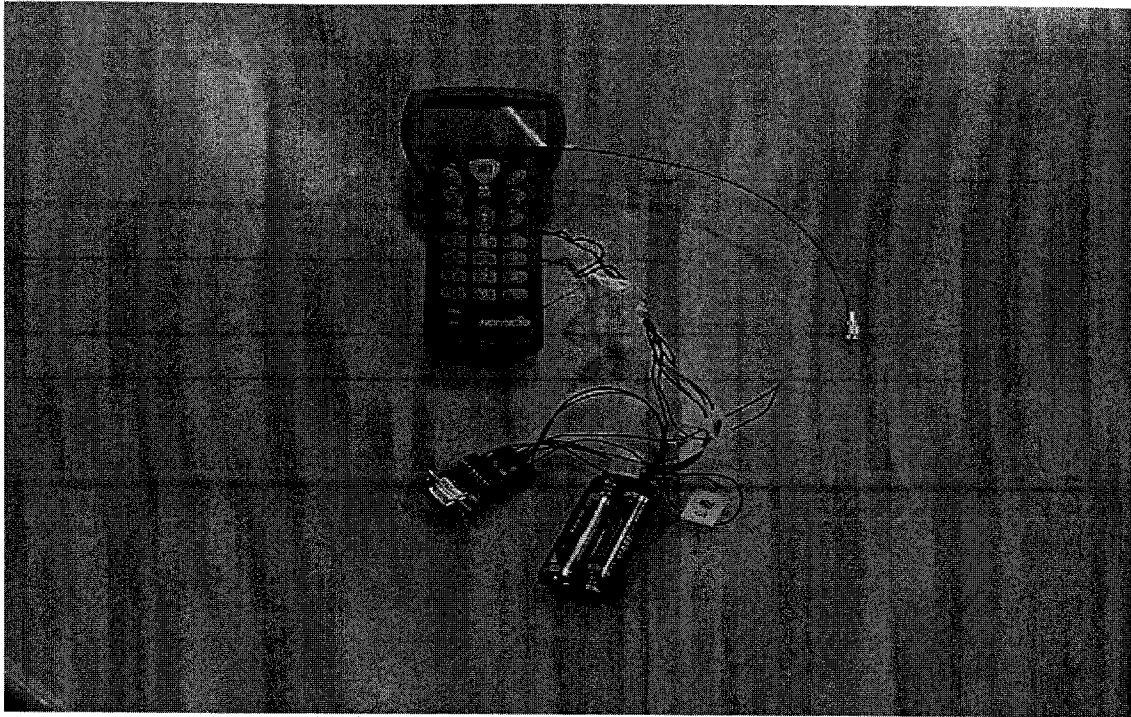
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Unit for conducted measurements with peripherals connected



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