

RADIO TEST REPORT

No. 403218R1

EQUIPMENT UNDER TEST

Equipment: Bluetooth module
Type / model: MA9C
Manufacturer: FLIR Systems AB
Tested by request of: FLIR Systems AB

SUMMARY

The equipment complies with the requirements of the following standards:

FCC, Part 15, Subpart B (2002) and Subpart C (2002);
RSS-210, Issue 5 (November 2001)

Industry Canada listed test facility No. IC 3481



Date of issue: May 12, 2004

Tested by:

Vladimir Bazhanov

Approved by:

Björn Rosenquist



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Intertek Semko AB

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1. CLIENT INFORMATION

The EUT has been tested by request of

Company: FLIR Systems AB
Rinkebyvägen 19
P.O. Box 3
SE-182 11 Danderyd
Sweden
Name of contact: Lucas Ekeröth

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

Equipment: Bluetooth module
Type/Model: MA9C
Brand name: MA9C
Serial number: 1036
FCC ID Number: -
Manufacturer: FLIR Systems AB
Rating/Supplying voltage: 3,3 V DC (3,13 – 3,47 V DC)
Rating RF output power: 1 mW (Power class 2)
Antenna gain: 0 dBi
External antenna connector: YES
Operating temperature range: -15 to +70 °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 unit:

Unit	Type and version	Serial number
Bluetooth module	MA9C, Product number: 1195256-04	1036

2.3 Additional software information about the EUT

During the tests the EUT supported the following software:

Software	Version	Comment
1.1.1	edit 1	

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
Power supply	B60-1T OLTRONIX	-

2.5 Modifications during the test

No modifications have been made during the tests.



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3. TEST SPECIFICATIONS

3.1 Standards

FCC 47 CFR part 15 (2002): Subpart B – Unintentional radiators
FCC 47 CFR part 15 (2002) 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: 16 - 34 %



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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	
15B	Out of band spurious emissions, radiated	Pass	



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

Date of test: March 30, 2004

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

Spectrum analyser settings:

Span: 10 MHz

RBW: 3 MHz

VBW: 3 MHz

Sweep time: 5 ms

Detector: Peak

Trace: Max Hold

Channel (MHz)	Peak Output Power (dBm)	Limit value (dBm)
2402	0.5	< 30
2441	0.2	
2480	0.2	

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: May 7, 2004

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

Spectrum analyser settings:

Span: 1,5 MHz
RBW: 10 kHz
VBW: 30 kHz
Sweep time: 38 ms
Detector: Peak
Trace: Max Hold

Channel (MHz)	20 dB Bandwidth (kHz)	Limit value (kHz)
2402	917	
2441	884	< 1000
2480	926	



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7. CARRIER FREQUENCY SEPARATION

7.1 Test protocol

Date of test: May 7, 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	1002	-	> 917
2441	1010	1002	> 884
2480	-	994	> 926

Limit = Result from the 20 dB Bandwidth measurements



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

Date of test: May 7, 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: May 7, 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)	1418.8	1418.8	1418.8	-
n	35	37	35	-
Dwell time (s) = $T \cdot 10^{-6} \cdot 3.16 \cdot n$	0.16	0.17	0.16	< 0,4



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10. BAND EDGE COMPLIANCE

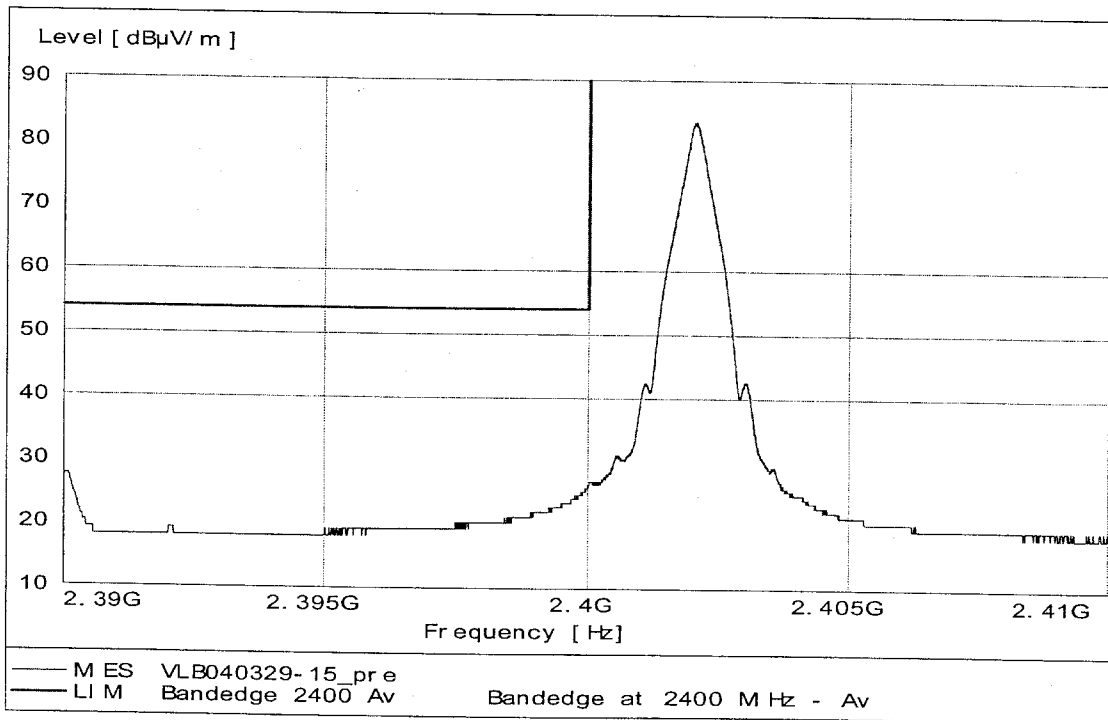
10.1 Test protocol

Date of test: March 29, 2004

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

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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11. RADIATED SPURIOUS EMISSIONS

11.1 Operating environment

Temperature: 20 - 23 °C (10 - 40 °C)
 Relative Humidity: 16 - 31 % (10 - 90 %)

11.2 Measurement uncertainty

Radiated disturbance electric field intensity, 30 – 1000 MHz: ± 4,6 dB
 Radiated disturbance electric field intensity, 1000 – 18000 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%.

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

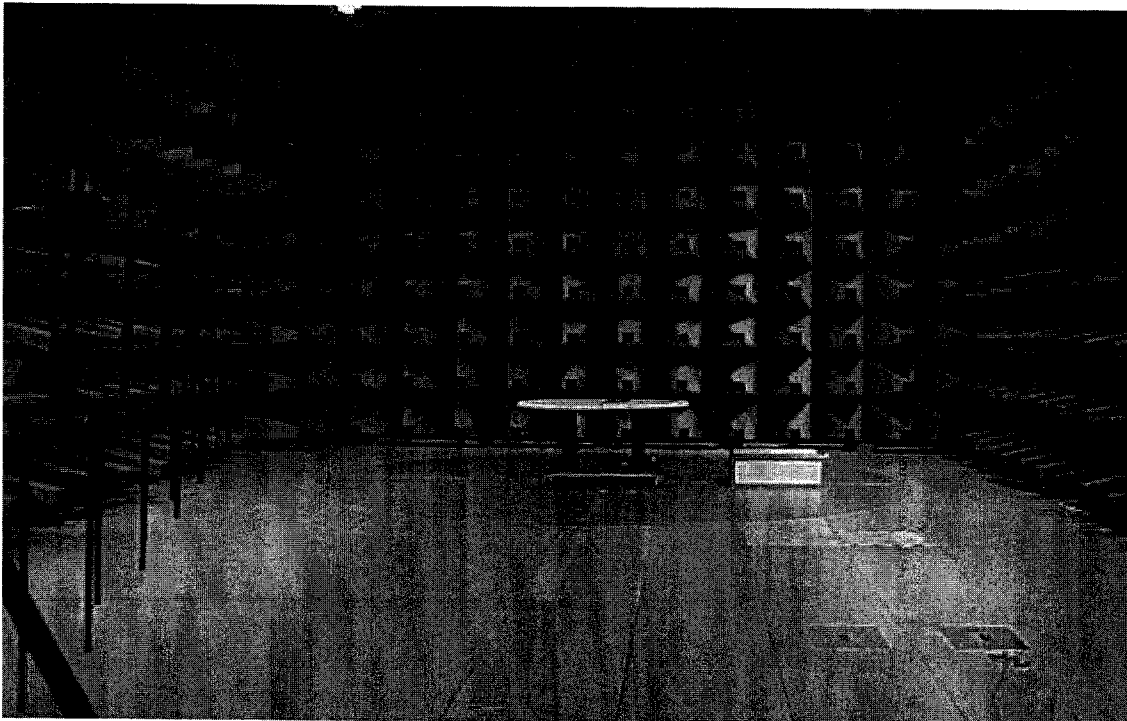
Test site: Semi-anechoic shielded chamber (30 – 1000 MHz)

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 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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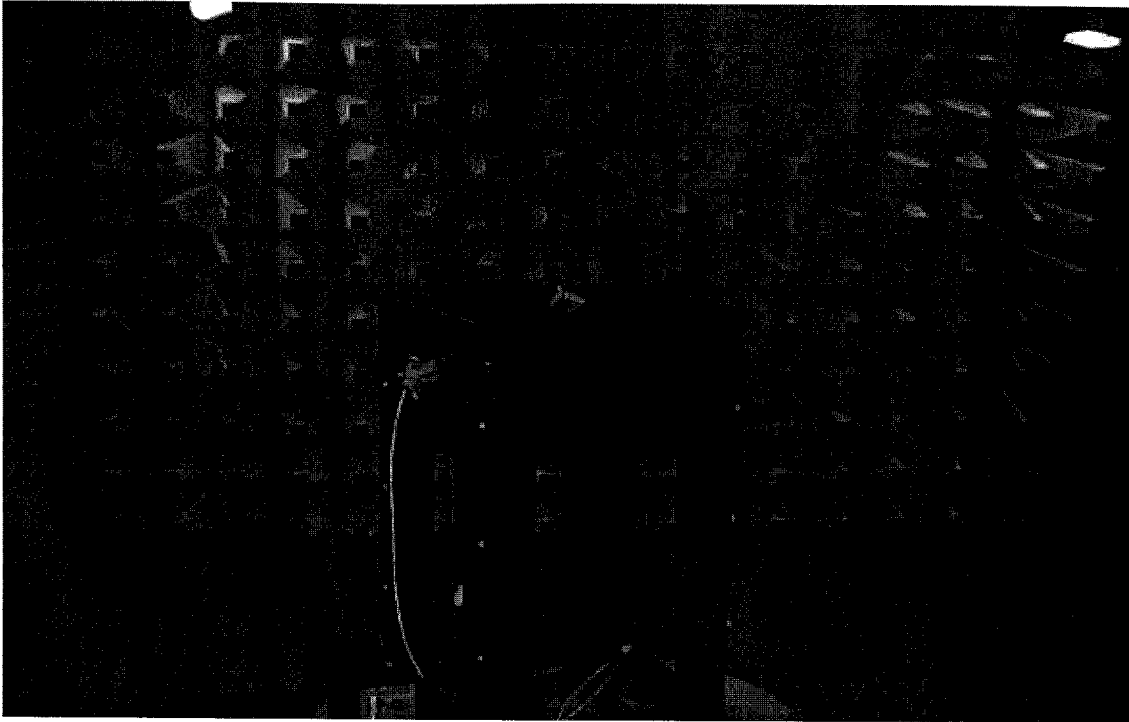
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Test set-up photo:

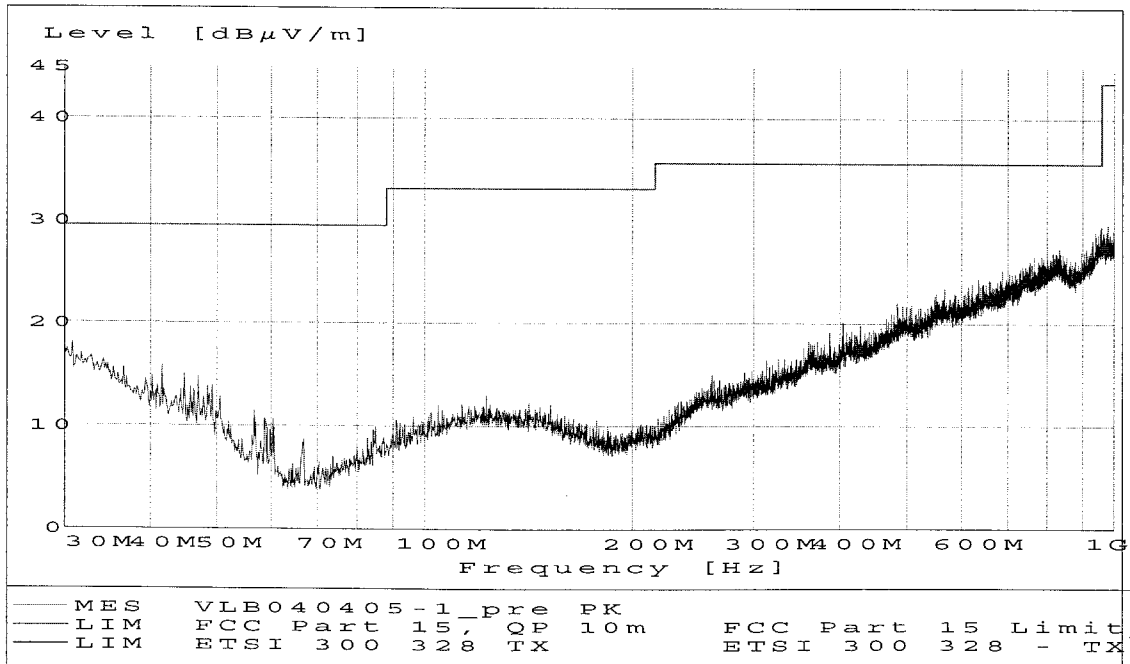


11.5 Test protocol

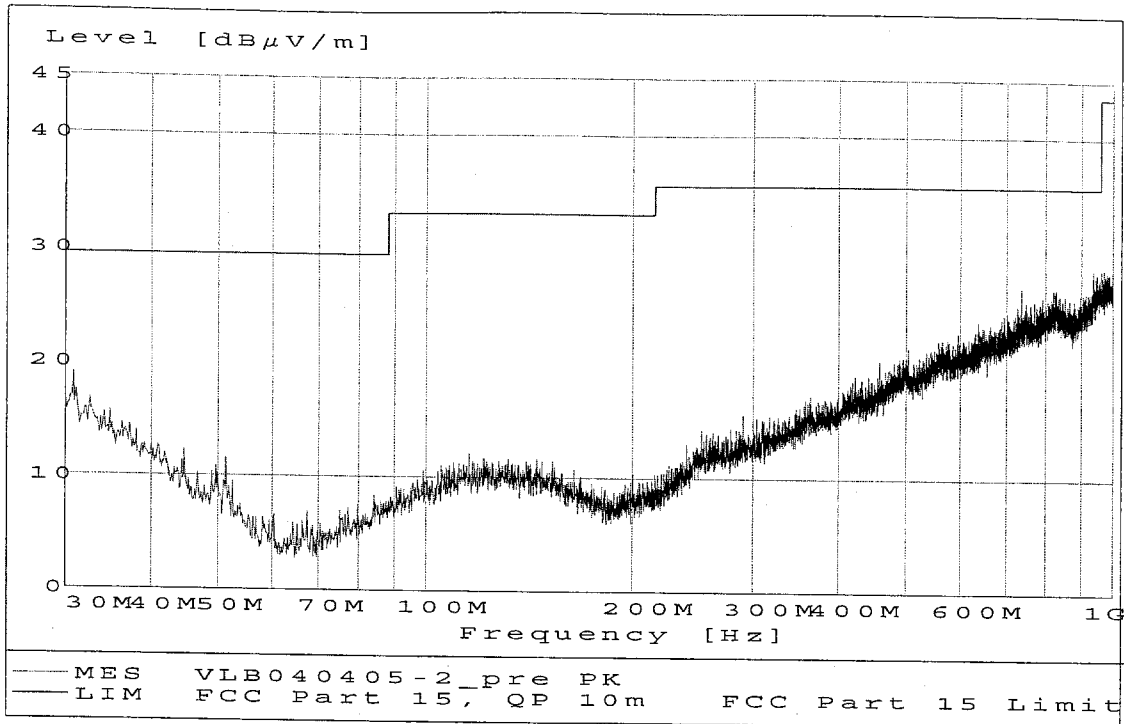
Semi-anechoic shielded chamber

Date of test: April 5, 2004

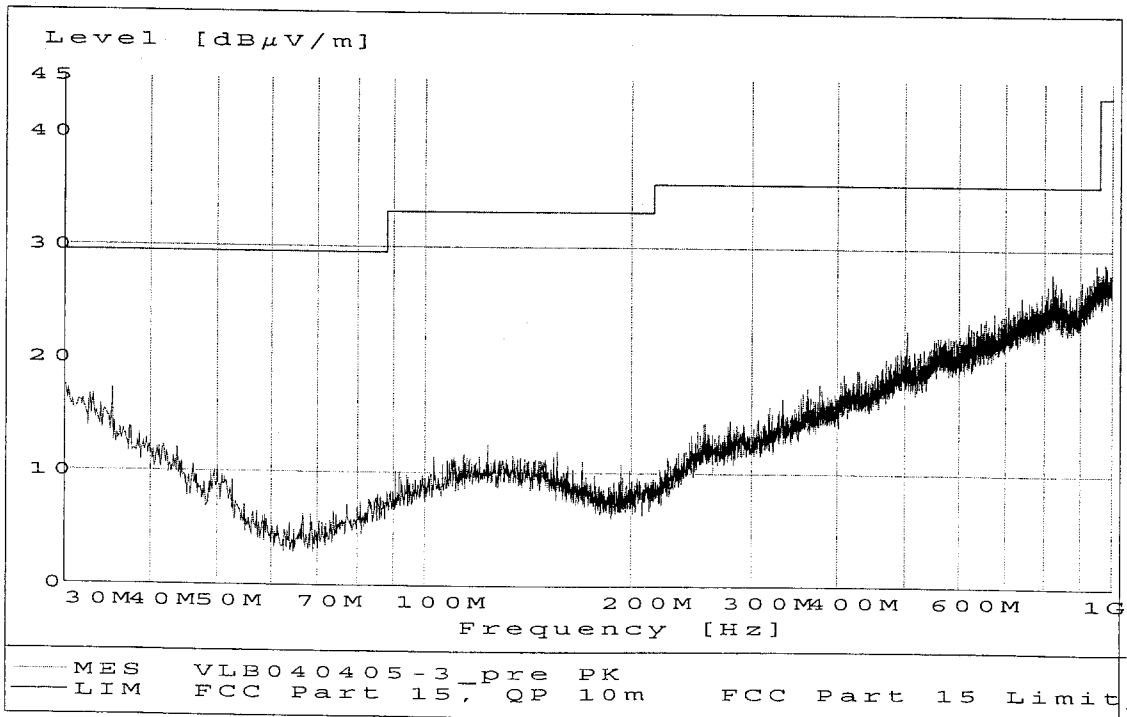
30 – 1000 MHz, max peak at a distance of 10 m on the lower TX channel



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



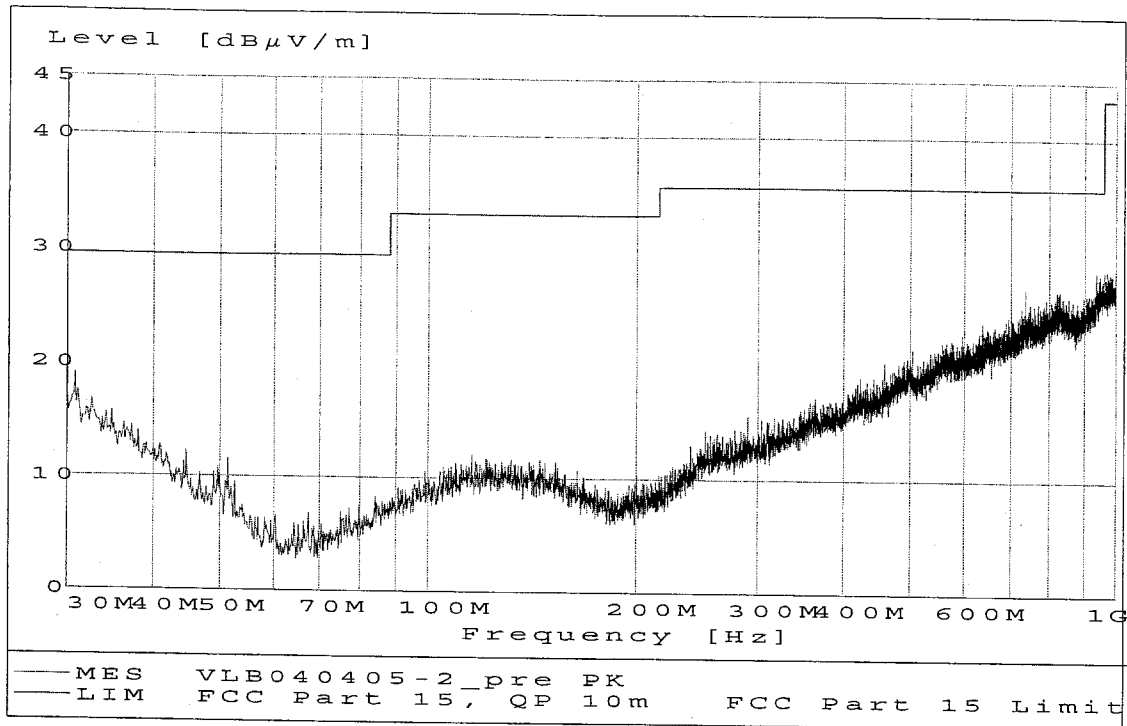
30 – 1000 MHz, max peak at a distance of 10 m on the upper TX channel



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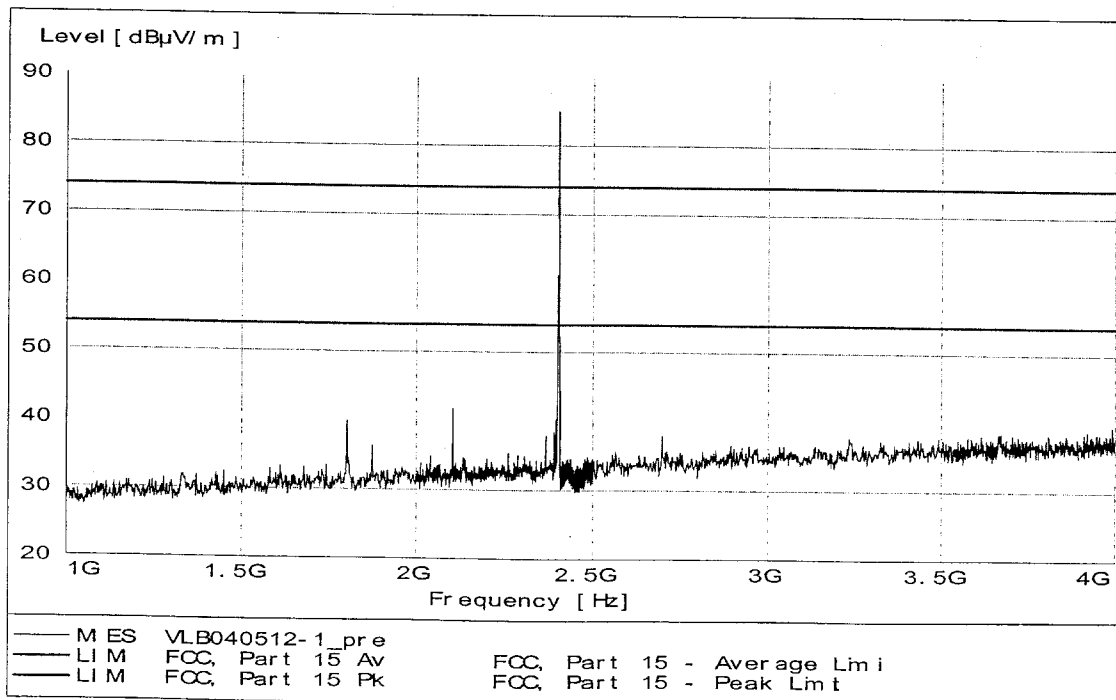
30 – 1000 MHz, max peak at a distance of 10 m in the stand by mode



Bluetooth anechoic shielded chamber

Date of test: March 29, April 2, and May 12, 2004

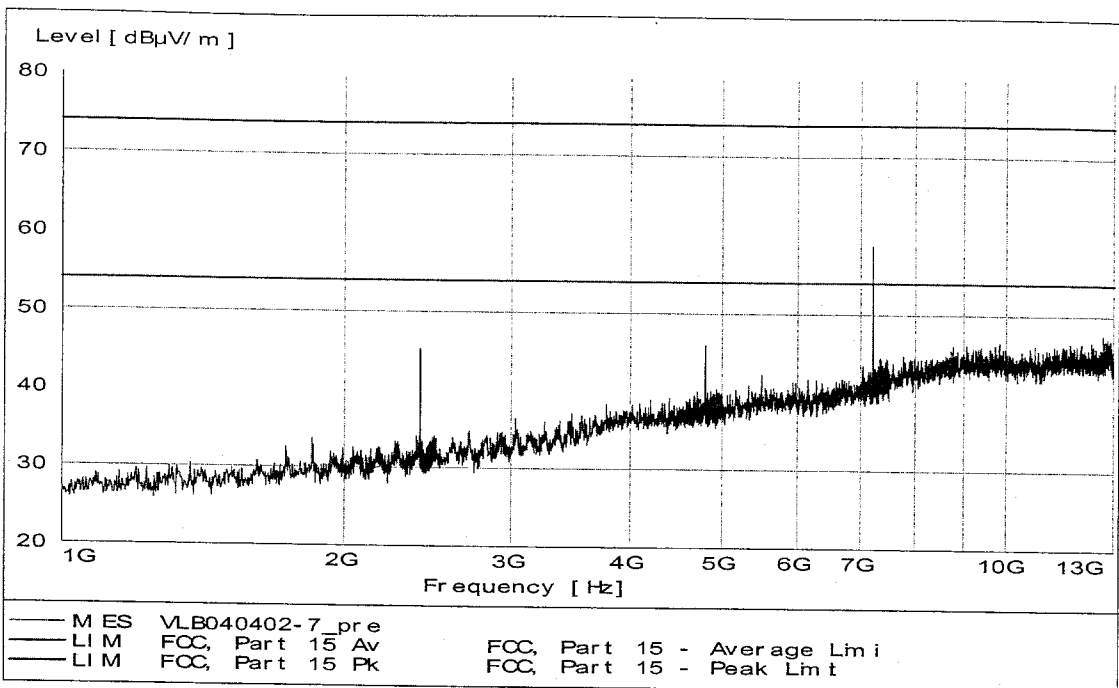
1000 – 4000 MHz, max peak at a distance of 3 m on the lower TX channel
 The carrier is attenuated by band rejection filter K&L 6N45-2450/T100-0/0



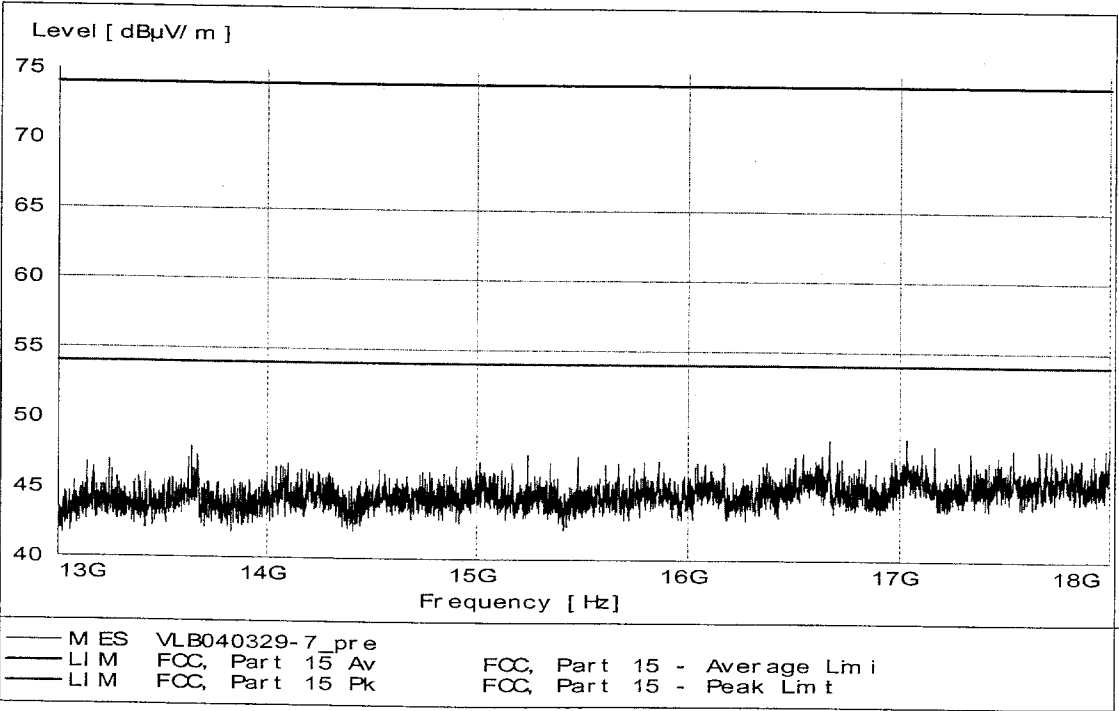
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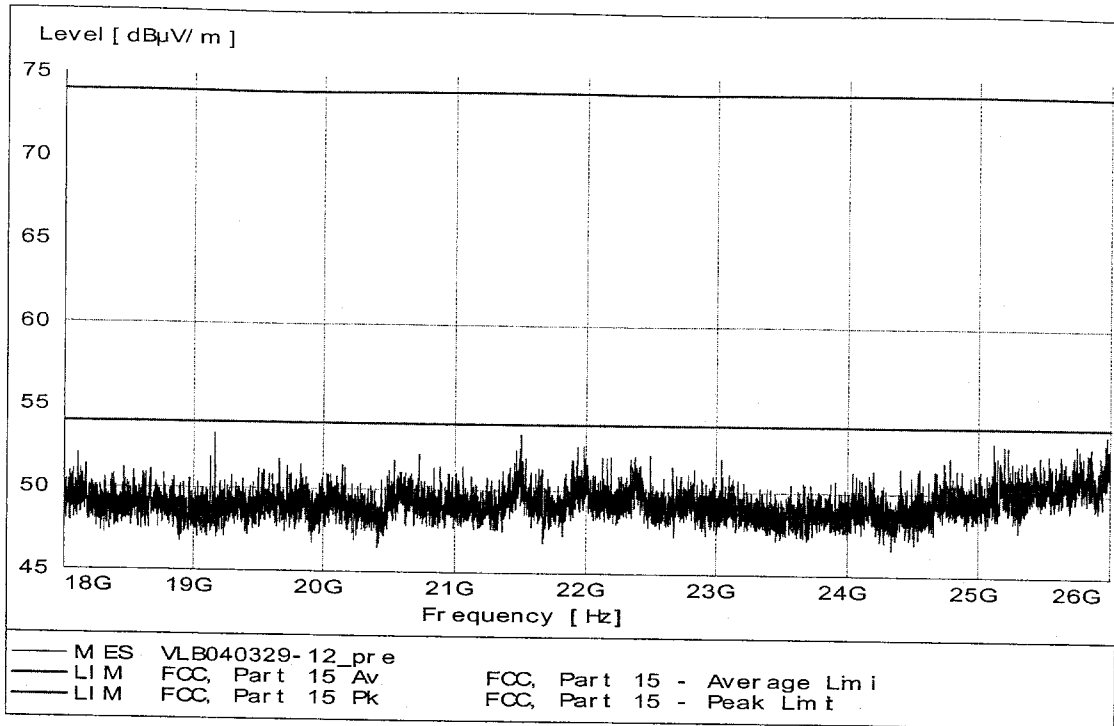
1000 – 13000 MHz, max peak at a distance of 3 m on the lower TX channel
 Emissions below 4000 MHz are attenuated by high-pass filter K&L 4410-X4500/18000-0



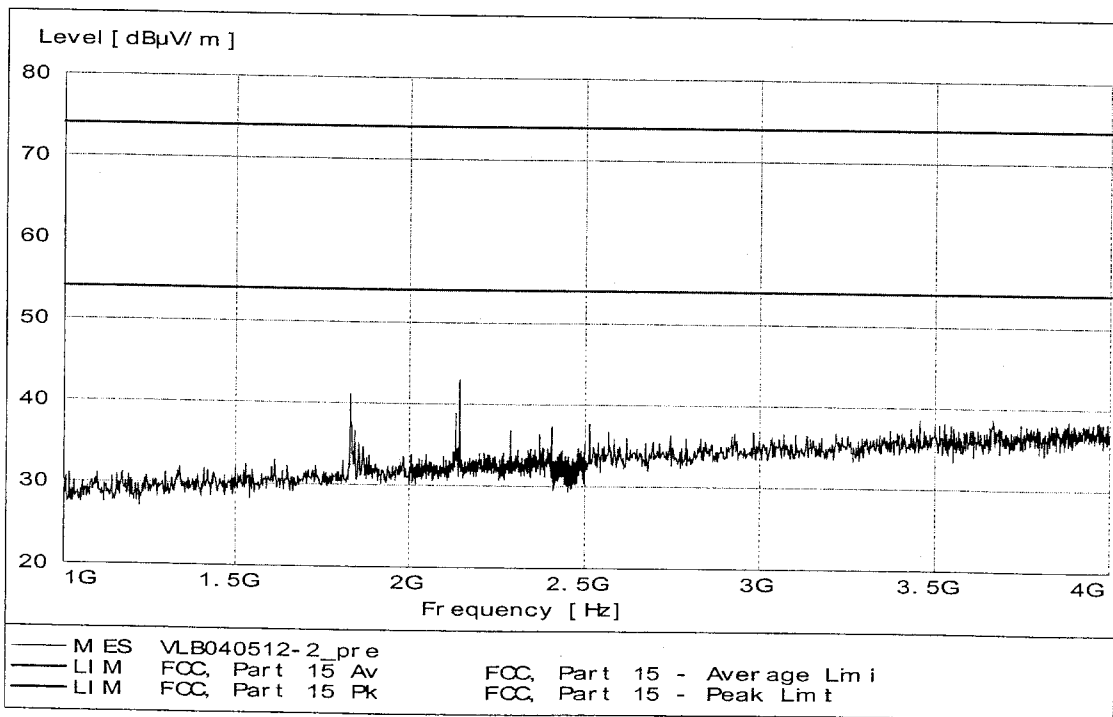
13000 – 18000 MHz, max peak at a distance of 3 m on the lower TX channel



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



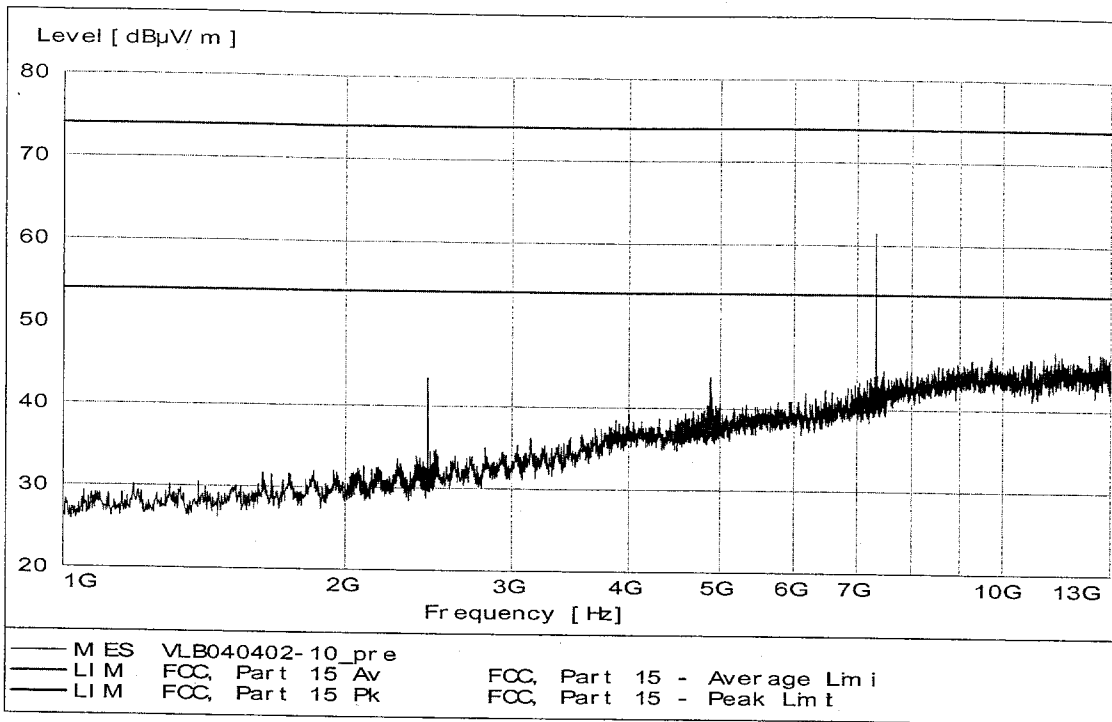
1000 – 4000 MHz, max peak at a distance of 3 m on the middle TX channel
The carrier is suppressed by band rejection filter K&L 6N45-2450/T100-0/0



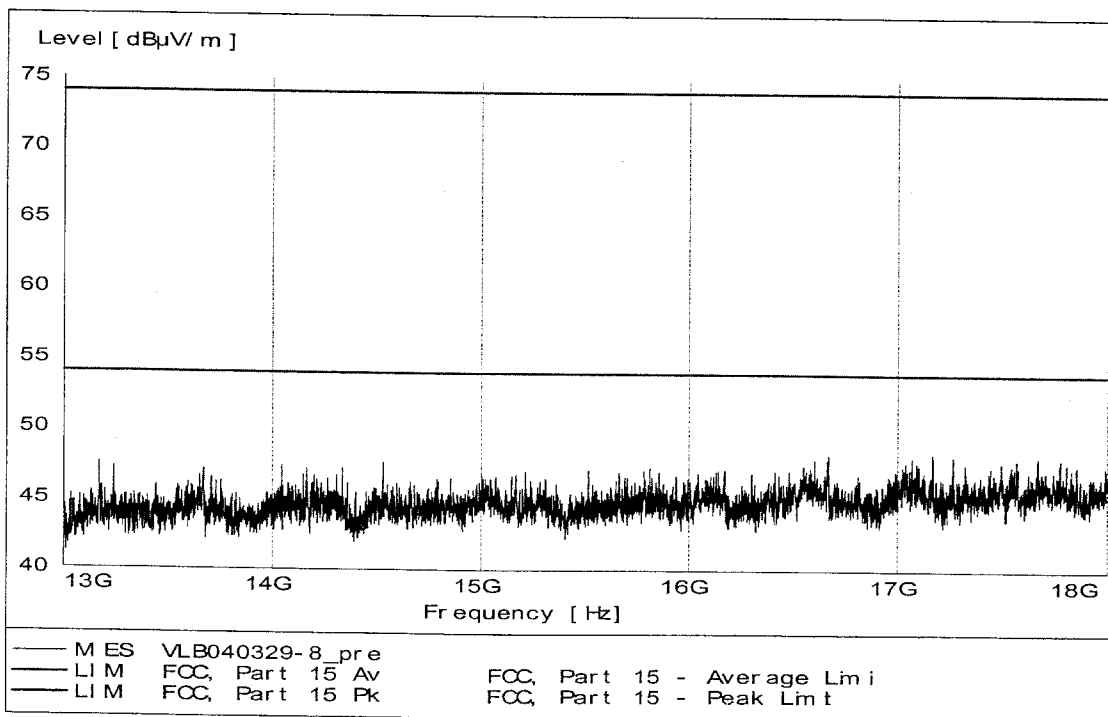
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1000 – 13000 MHz, max peak at a distance of 3 m on the middle TX channel
 Emissions below 4000 MHz are attenuated by high-pass filter K&L 4410-X4500/18000-0



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



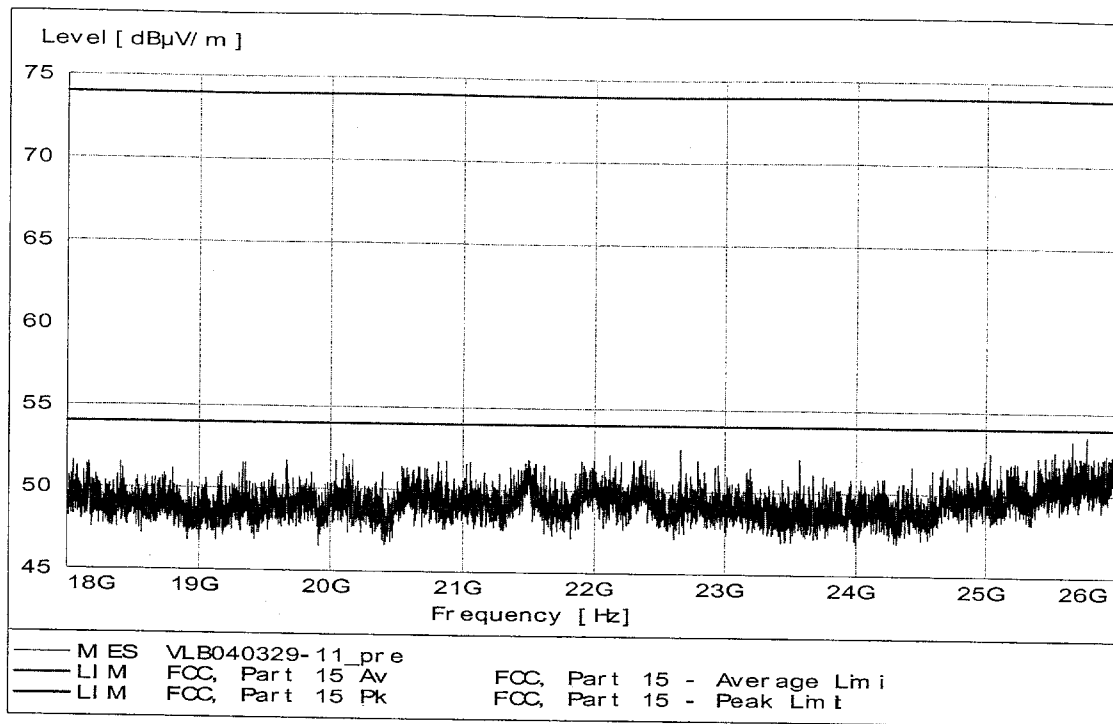
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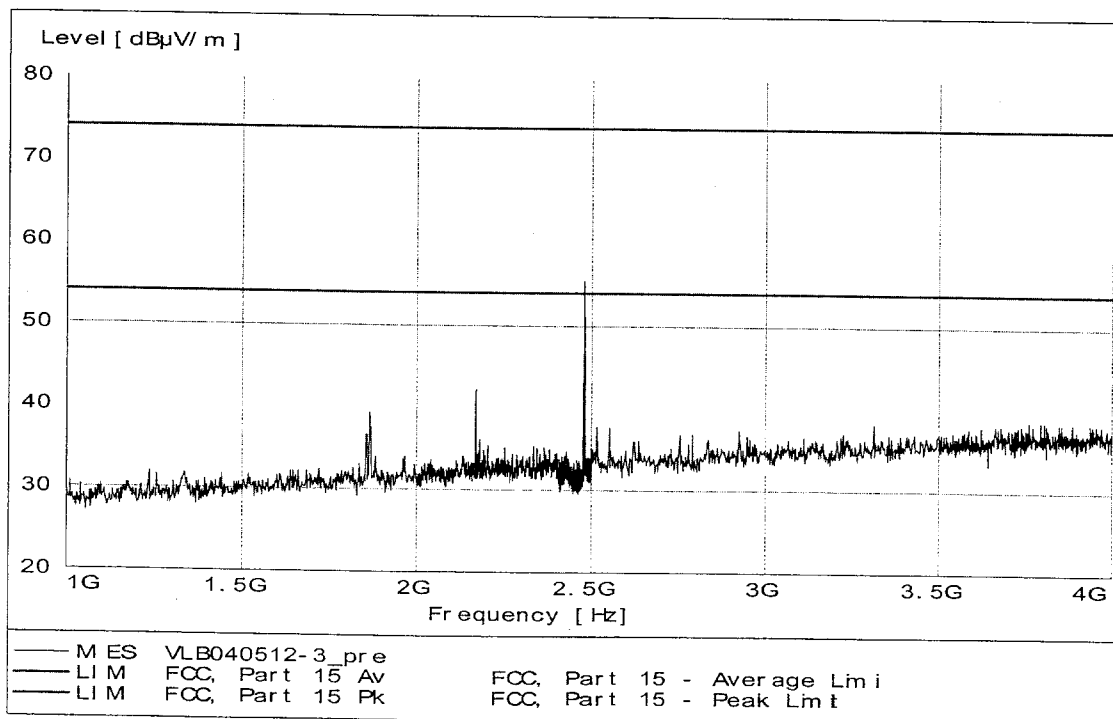
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18000 – 26000 MHz, max peak at a distance of 3 m on the middle TX channel



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



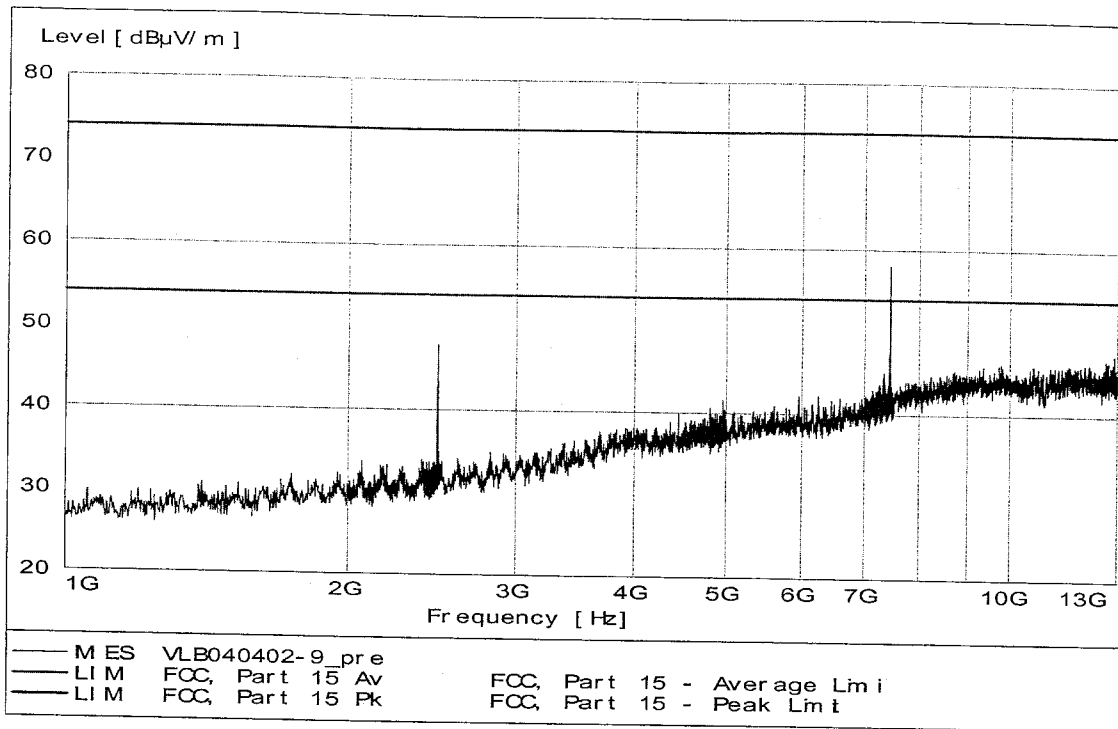
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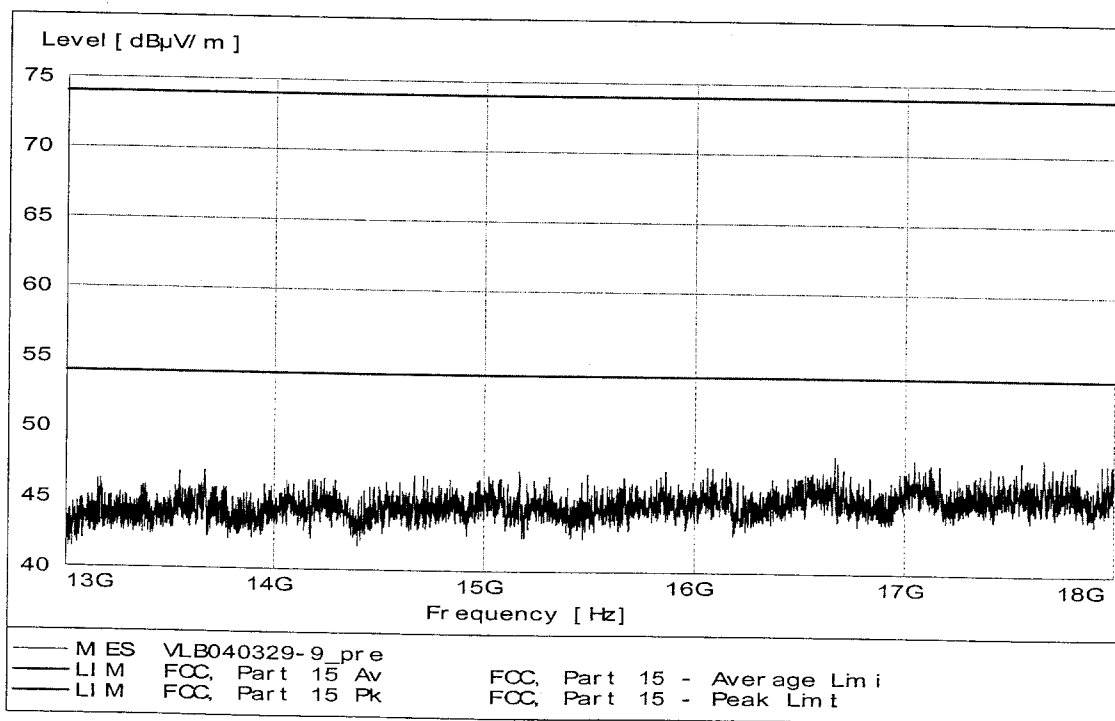
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1000 – 13000 MHz, max peak at a distance of 3 m on the upper TX channel
 Emissions below 4000 MHz are attenuated by high-pass filter K&L 4410-X4500/18000-0



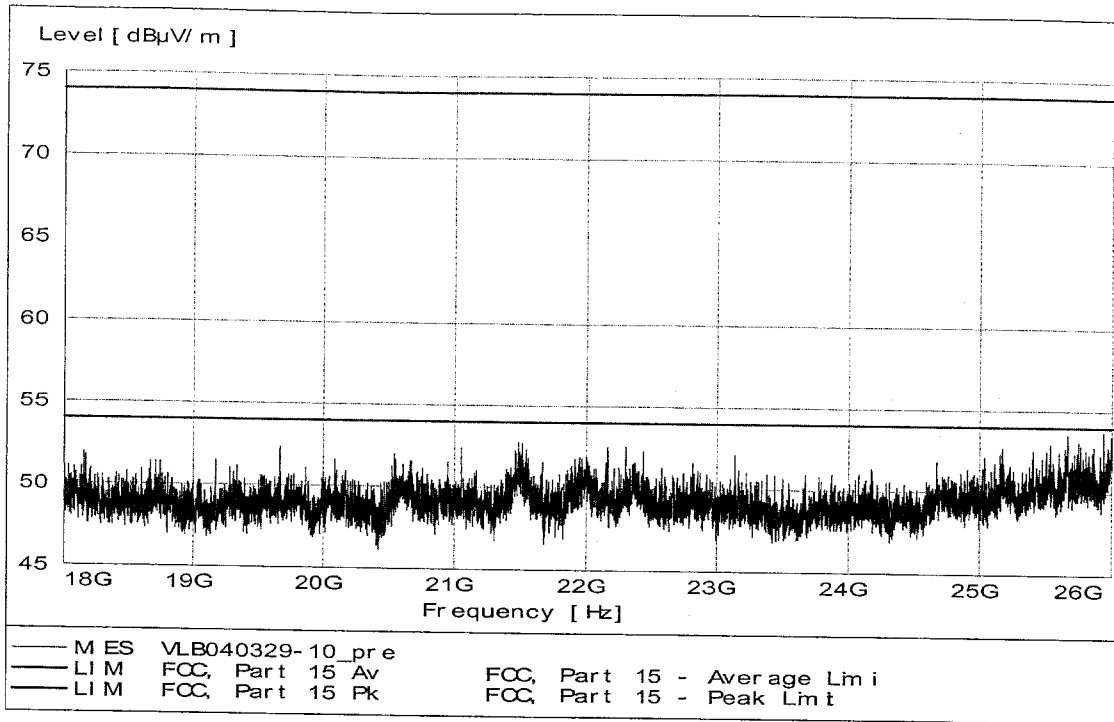
13000 – 18000 MHz, max peak at a distance of 3 m on the upper TX channel



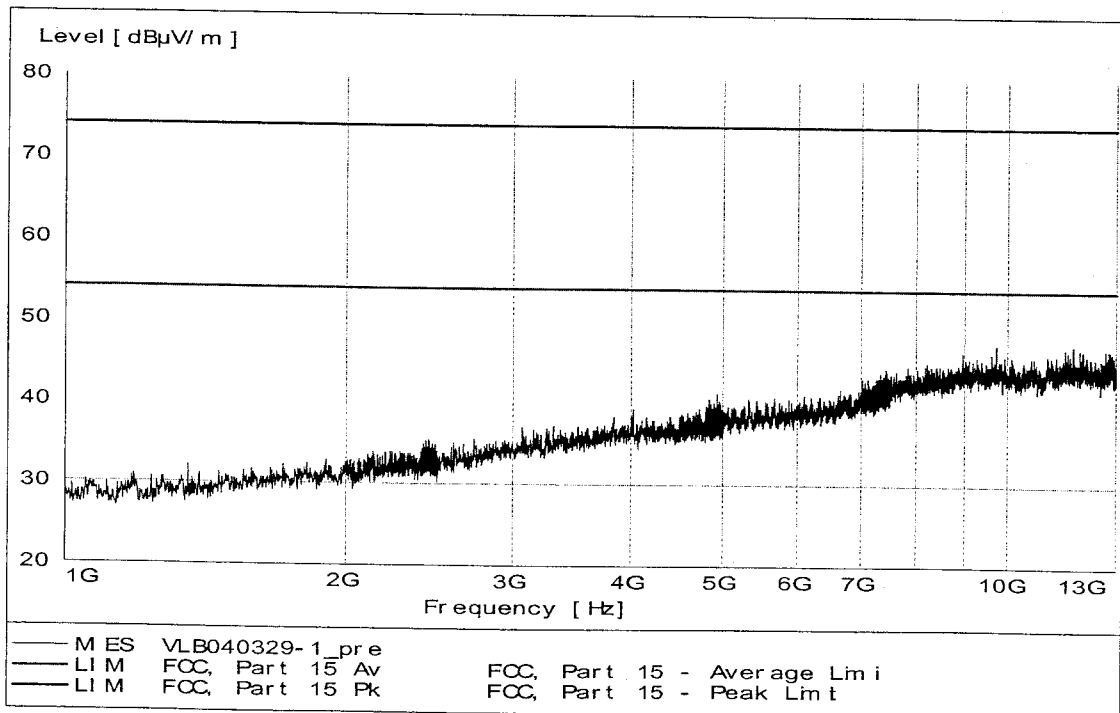
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18000 – 26000 MHz, max peak at a distance of 3 m on the upper TX channel



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)]	
30 – 88	120	< 20	-	-	29,5	10 m distance
88 – 216	120	< 13	-	-	33	"
216 – 960	120	< 30	-	-	35,6	"
960 – 1000	120	< 30	-	-	43,5	"
1803,61	1000	47	-	74	54	3 m distance
1829,66	1000	48	-	74	54	"
1865,73	1000	46	-	74	54	"
2101,80	1000	49	-	74	54	"
2141,08	1000	50	-	74	54	"
2168,34	1000	49	-	74	54	"
4804	1000	54	41	74	54	"
4882	1000	53	41	74	54	"
4960	1000	53	40	74	54	"
7206	1000	62	46	74	54	"
7323	1000	65	47	74	54	"
7440	1000	65	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:

$$\text{Measured level [dB(μV/m)]} = \text{Analyser reading [dB(μV)]} + \text{cable loss [dB]} - \text{preamplifier gain [dB]} + \text{antenna factor [1/m]}$$



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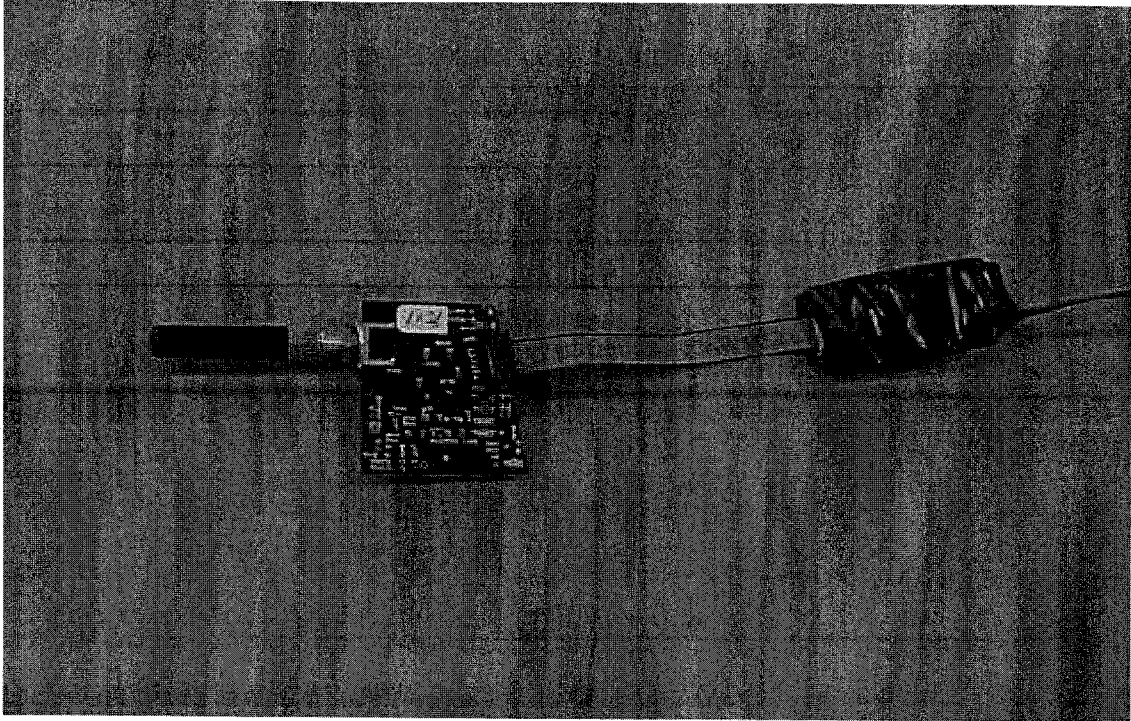
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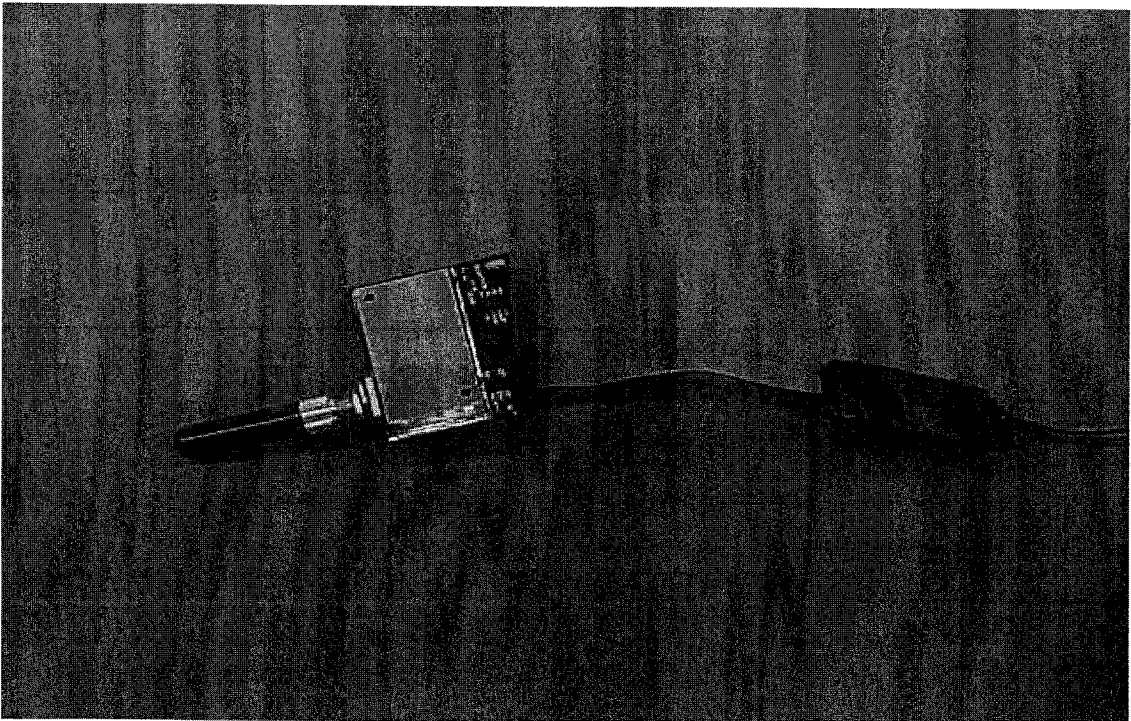
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APPENDIX – PHOTOS OF THE EUT

Unit for radiated measurements (upper side)



Unit for radiated measurements (back side)



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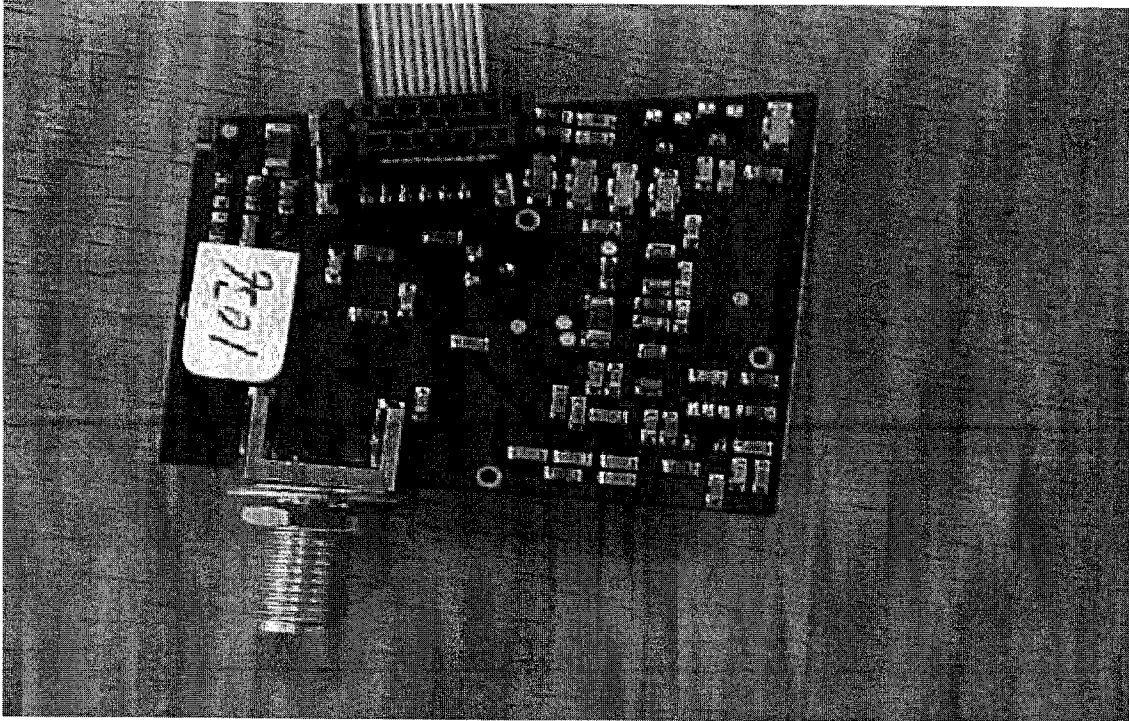
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Identification photo

Unit for conducted measurements



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