

RADIO TEST REPORT

No. 500209R1-2

EQUIPMENT UNDER TEST

Equipment: S1500 TagMaster Reader
Type / model: S1513/00
Manufacturer: TagMaster AB
Tested by request of: TagMaster AB

SUMMARY

The equipment complies with the requirements of the following standards:

FCC, Part 15, Subpart B (2004) and Subpart C (2004);
RSS-210, Issue 6 (September 2005); RSS-Gen, Issue 1 (September 2005).

Industry Canada listed test facility No. IC 3481



Date of issue: October 11, 2005

Tested by:

Bazhanov

Vladimir Bazhanov

Approved by:

ho | ohansson

Lars-Olov Johansson

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1. CLIENT INFORMATION

The EUT has been tested by request of

Company: TagMaster AB
ELECTRUM 410
SE-164 40 Kista
Sweden
Name of contact: Mr. Mikael Willgert

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

Equipment: S1500 TagMaster Reader
Type/Model: S1513/00
Brand name: TagMaster
Serial number: 50 343667
Manufacturer: TagMaster AB
Rating/Supplying voltage: 12 V / 24 V DC
Rating RF output power: 10 mW and 500 mW e.i.r.p.
Antenna gain: 7 dBi
External antenna connector: No
Operating temperature range: -20 to +60 °C
Frequency range: 2400 - 2483,5 MHz and 2446 – 2454 MHz
Number of channels: 401
Channel separation: 200 kHz
Modulation characteristics: FHSS
Stand by mode supported: No



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2.2 Additional software information about the EUT

During the tests the EUT supported the following software:

Software	Version	Comment
Read Range	0.9.7	Frequency and output power control

2.3 Peripheral equipment

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

Equipment	Manufacturer / Type	Serial number
AC/DC adapter	FW7207/24	-
Laptop PC	Toshiba PP348E-4PU86-SE	Z0108561G

2.4 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 (2004) Subpart B – Unintentional radiators
FCC 47 CFR part 15 (2004) 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 C63.4-2003

RSS-210, Issue 6 (September 2005): Low Power Licence-Exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment.

RSS-Gen, Issue 1 (September 2005): General Requirements and Information for the Certification of Radiocommunication Equipment.

3.2 Additions, deviations and exclusions from standards

If not additionally specified the tests have been performed just for 500 mW output power level.

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

3.3 Test set-up

Measurement set-ups for the test of conducted disturbance voltage in the frequency range 0,15-30 MHz and out-of-band spurious emissions test are described in corresponding sections. 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: 21 – 23 °C
Relative humidity: 23 – 46 %



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4. TEST SUMMARY

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

FCC reference	Industry Canada reference	Test	Result	Note
15.247(b)	A2.9(1)	Peak output power	Pass	1)
15.247(a)	A8.1(1)	20 dB Bandwidth	Pass	1)
15.247(a)	A8.1(2)	Carrier frequency separation	Pass	1)
15.247(a)	A8.1(4)	Number of hopping frequencies (channels)	Pass	1)
15.247(a)	A8.1(4)	Time of occupancy (dwell time)	Pass	1)
15.247	A8.1	Band edge compliance	Pass	1)
15.247(d)	2.7, A2.9(1), A8.5	Out of band spurious emissions, radiated	Pass	1)
15.247(d)	2.7, A8.5	Out of band spurious emissions, conducted	NA	1)
15B	6 (a)(Table1)	Out of band spurious emissions, radiated	NA	2)
15B	7.2.2 (Table 2)	Conducted emission at AC port	Pass	2)

NA = Not Applicable

Notes:

- 1). Industry Canada reference: RSS-210, Issue 6 (September 2005)
- 2). Industry Canada reference: RSS-Gen, Issue 1 (September 2005)



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5. PEAK OUTPUT POWER

5.1. Test set-up

See Section 11.3.

5.2. Test protocol

Date of test: June 6, 2005

Output power level, mW	Measured value, dBm e.i.r.p.			Limit, dBm e.i.r.p.
	2402 MHz	2442 MHz	2482 MHz	
10	7,9	7,4	7,9	30
500	23,7	24,2	24,2	



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6. 20 dB BANDWIDTH

6.1 Test protocol

Date of test: June 24, 2005

EUT mode of operation: TX, 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	129	< 1000
2442	132	
2482	135	



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7. CARRIER FREQUENCY SEPARATION

7.1 Test protocol

Date of test: June 24, 2005

EUT mode of operation: TX and hopping on.

Spectrum analyser settings:

Span: 600 kHz

RBW: 30 kHz

VBW: 30 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	200.8	-	> 129
2442	200.8	199.6	> 132
2482	-	199.6	> 135

Limit = Result from the 20 dB Bandwidth measurements



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8. NUMBER OF HOPPING CHANNELS

8.1 Test protocol

Date of test: June 24, 2005

EUT mode of operation: TX and hopping on.

Spectrum analyser settings:

Start frequency: 2400 MHz

Stop frequency: 2484 MHz

RBW: 30 kHz

VBW: 30 kHz

Sweep time: Auto

Detector: Peak

Trace: Max Hold

Number of hopping channels	Limit value
400	> 75



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9. TIME OF OCCUPANCY (DWELL TIME)

9.1 Test protocol

Date of test: June 24, 2005

EUT mode of operation: TX and hopping on.

Spectrum analyzer settings:

Determination of transmitting time T

Span: 0 Hz
 RBW: 200 kHz
 VBW: 200 kHz
 Sweep time: 500 ms
 Continuous sweep
 Detector: Peak
 Trace: Clear/Write
 Trigger: Video

Determination of the number of times n the channel is active during the sweep time of 160 s

RBW: 30 kHz
 VBW: 30 kHz
 Sweep time: 160 s
 Single sweep

Test parameters	Channel (MHz)			Limit value (s)
	2402	2442	2482	
T (μs)	182364.7	186372.7	183366.7	-
n	1	1	1	-
Dwell time (s) = $T \cdot 10^{-6} \cdot n$	0.182	0.186	0.183	< 0,4



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10. BAND EDGE COMPLIANCE

10.1. Test set-up

See Section 11.3.

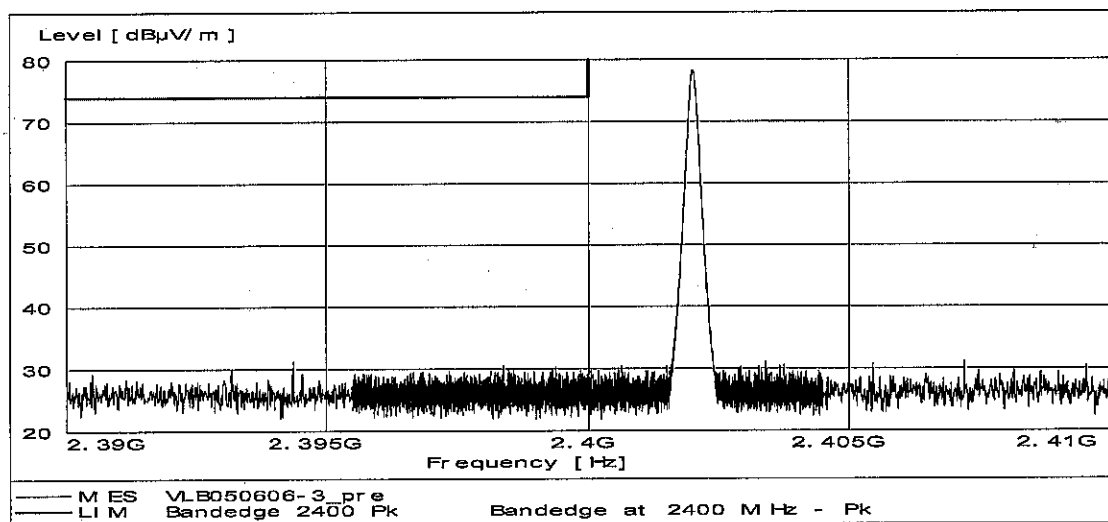
10.2 Test protocol

Date of test: June 6, 2005

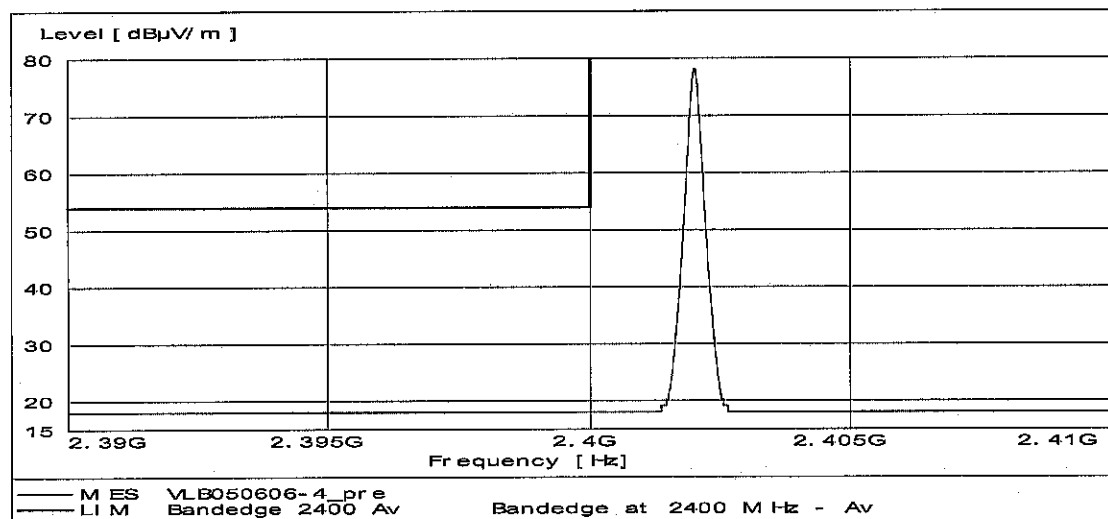
Extra attenuation: 40 dB

Band edge compliance at 2400 MHz

Sweep with peak detector



Sweep with average detector



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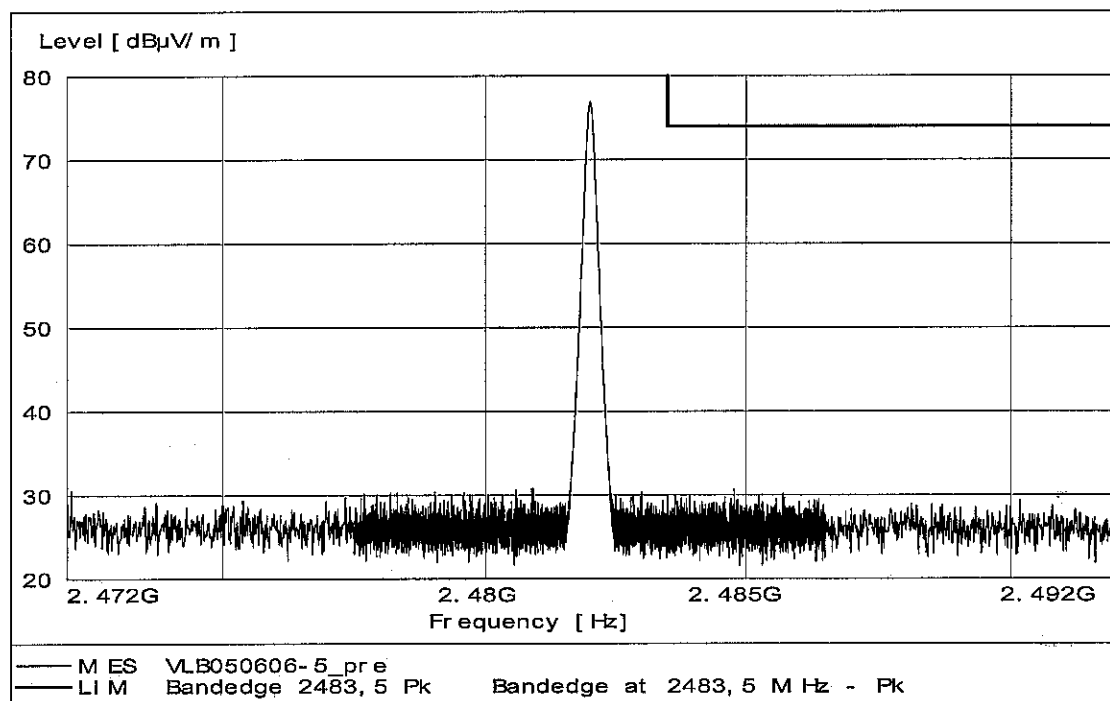
Torshamnsgatan 43, Box 1103, SE-164 22 Kista, Sweden

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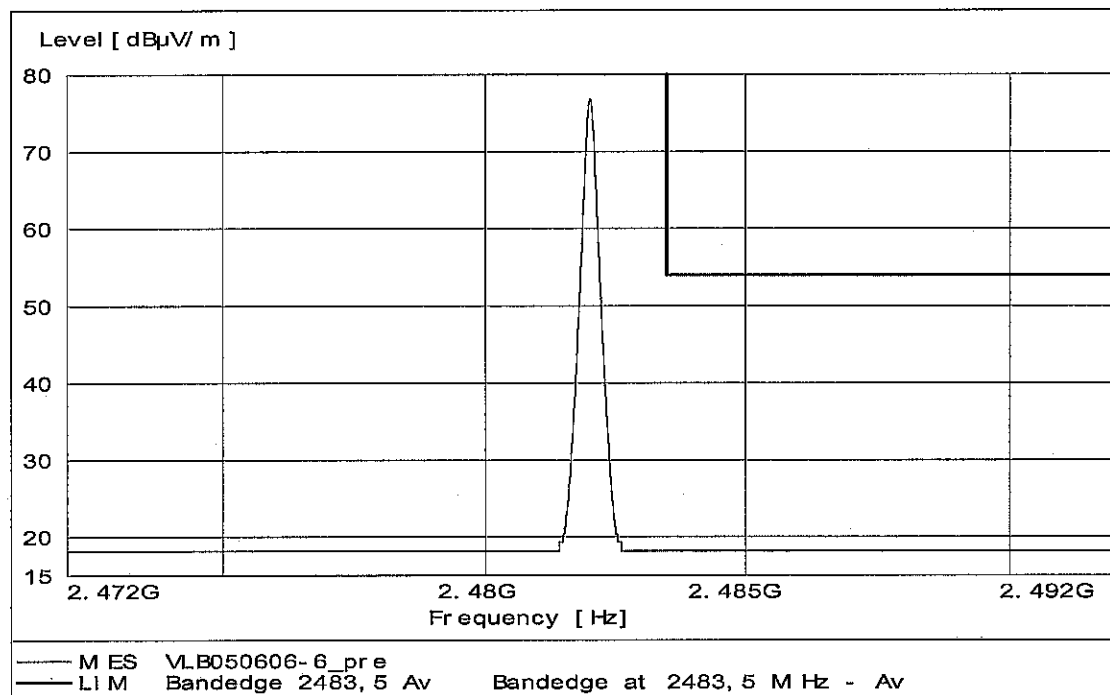
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Band edge compliance at 2483,5 MHz

Sweep with peak detector



Sweep with average detector



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11. RADIATED SPURIOUS EMISSIONS

11.1 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%.

11.2 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	4410-X4500/18000-0	5133
Band rejection filter	K & L	6N45-2450/T 100-0/0	12389
Transformer	Tufvassons	AFM-1500	30317



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11.3 Measurement set-up

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

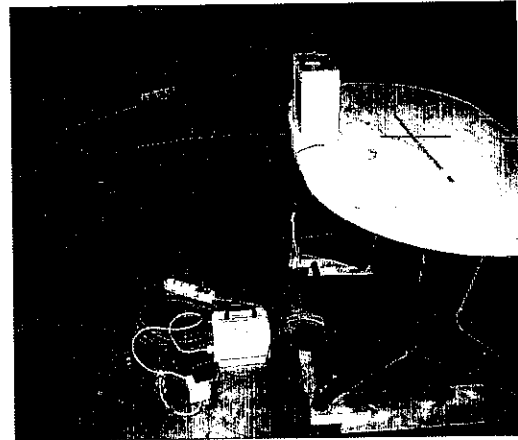
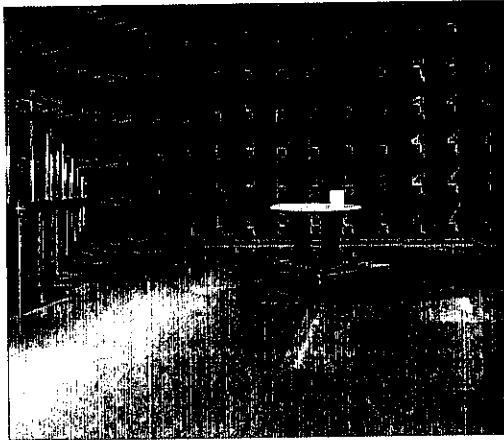
The radiated disturbance electric field intensity was measured in a semi-anechoic chamber at a distance of 10 m and the EUT was placed on a non-metallic table, 0,8 m above the reference ground plane. The specified test mode was enabled. Test set-up photos are given below.

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 quasi-peak detector were carried out.

The EUT was supplied with 120 V AC (60 Hz) during the test.

Test set-up photos:



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.

The EUT was supplied by 120 V AC (60 Hz) during the test.



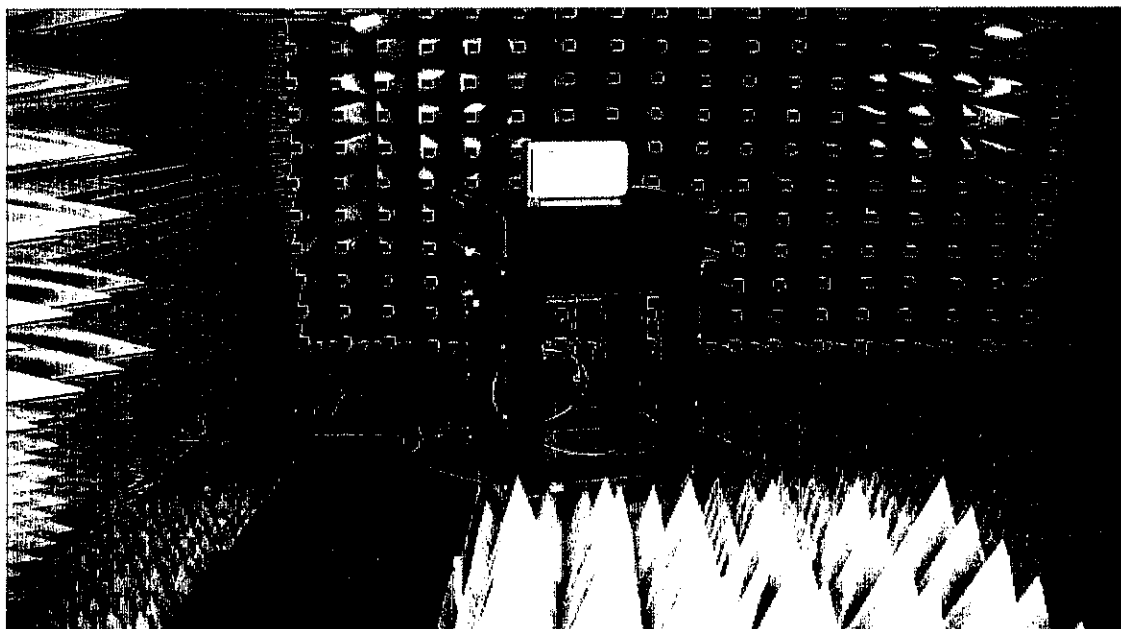
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Test set-up photo:

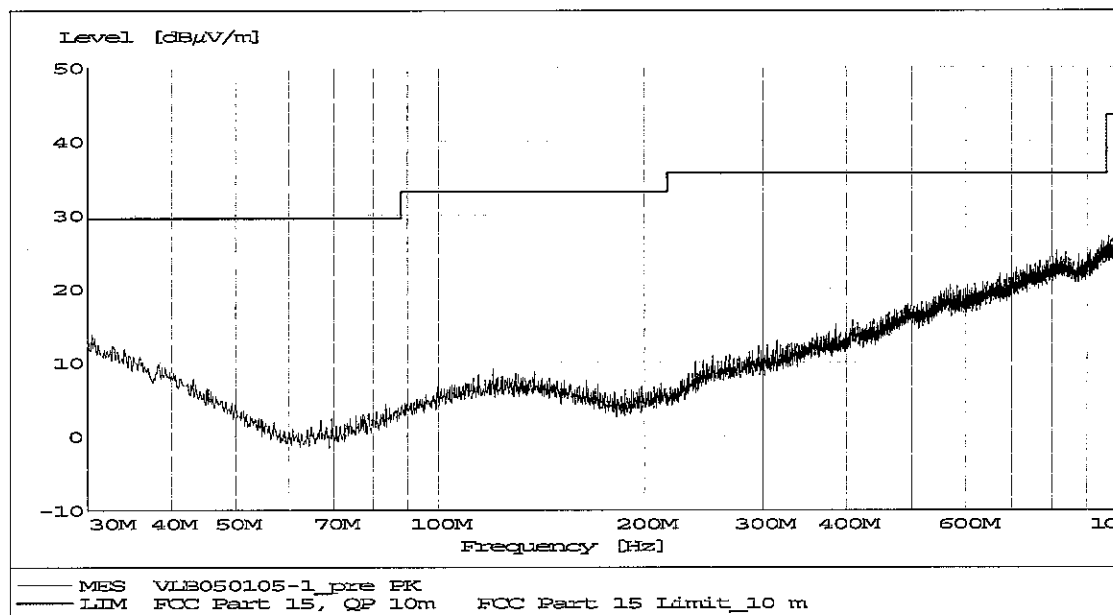


11.4 Test protocol

Semi-anechoic shielded chamber

Date of test: January 5, 2005

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



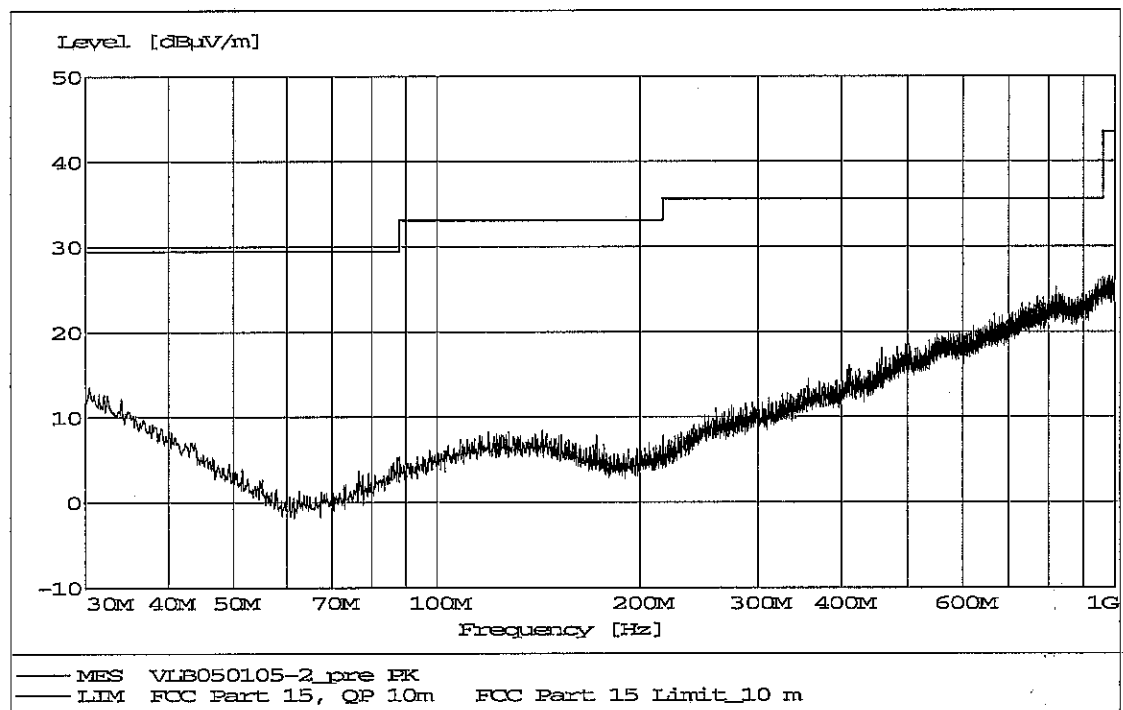
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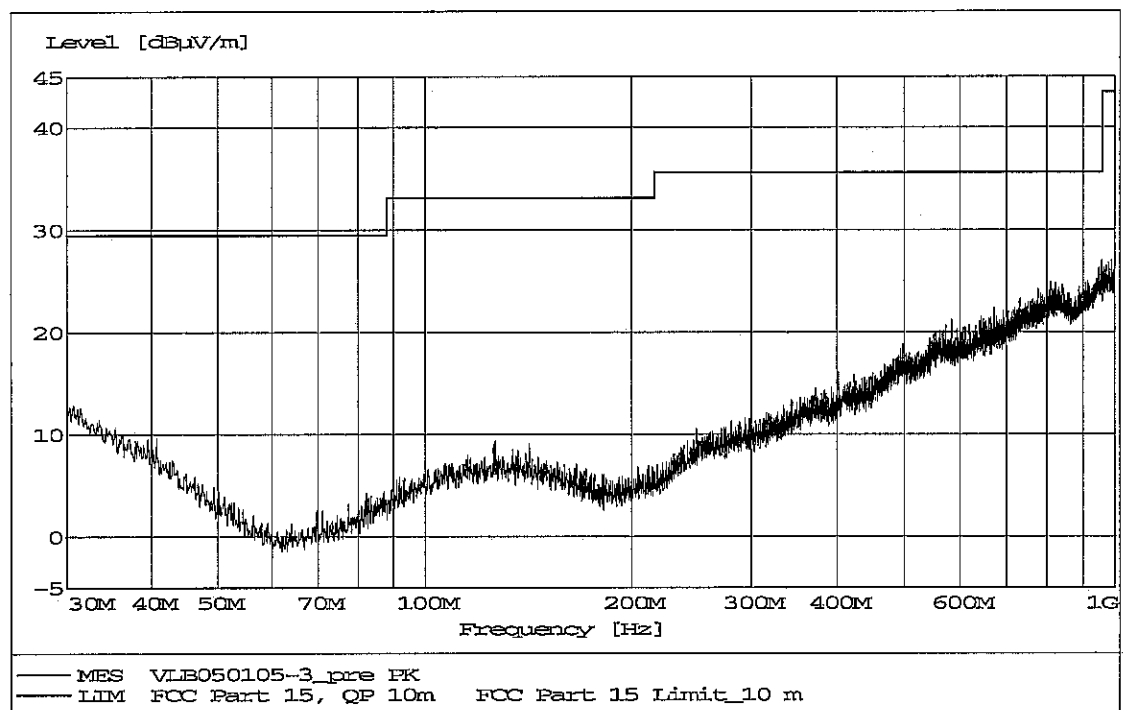
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30 – 1000 MHz, max peak at a distance of 10 m on the middle TX channel



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



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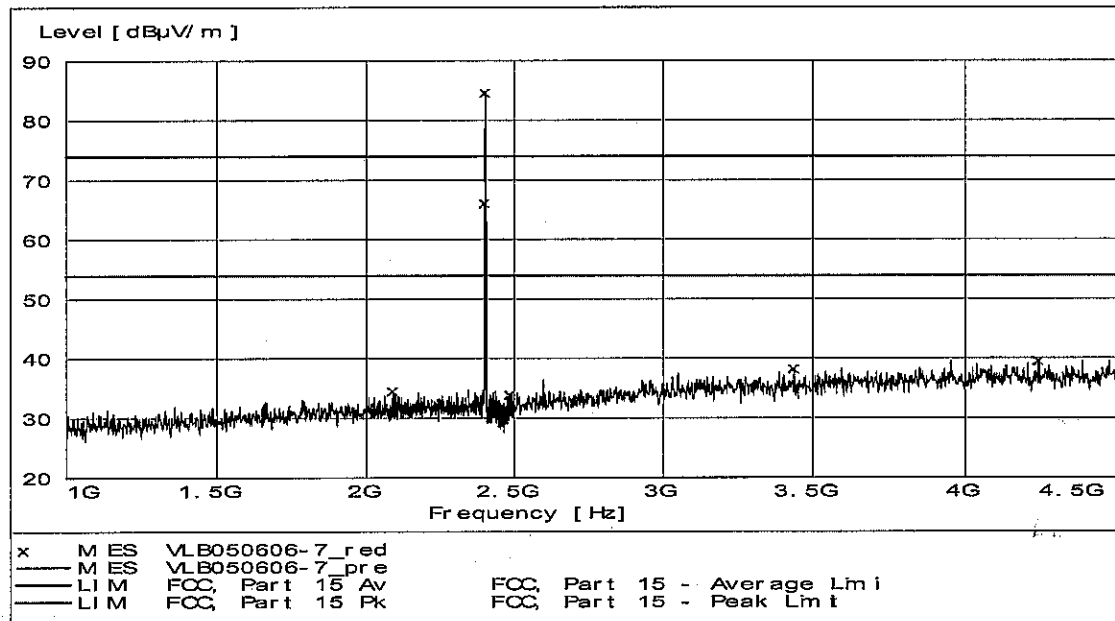
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Bluetooth anechoic shielded chamber

Date of test: June 6-7, 2005

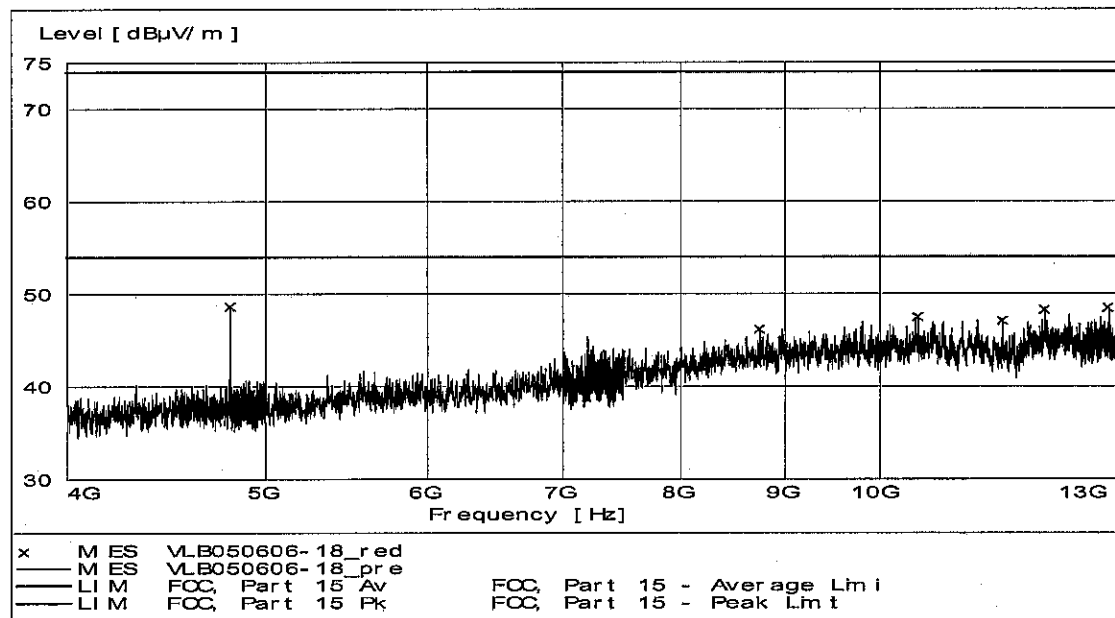
1000 – 4500 MHz, max peak at a distance of 3 m on the lower TX channel.

Carrier is attenuated by 20 dB and by band rejection filter K&L 6N45-2450/T 100-0/0



4000 – 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



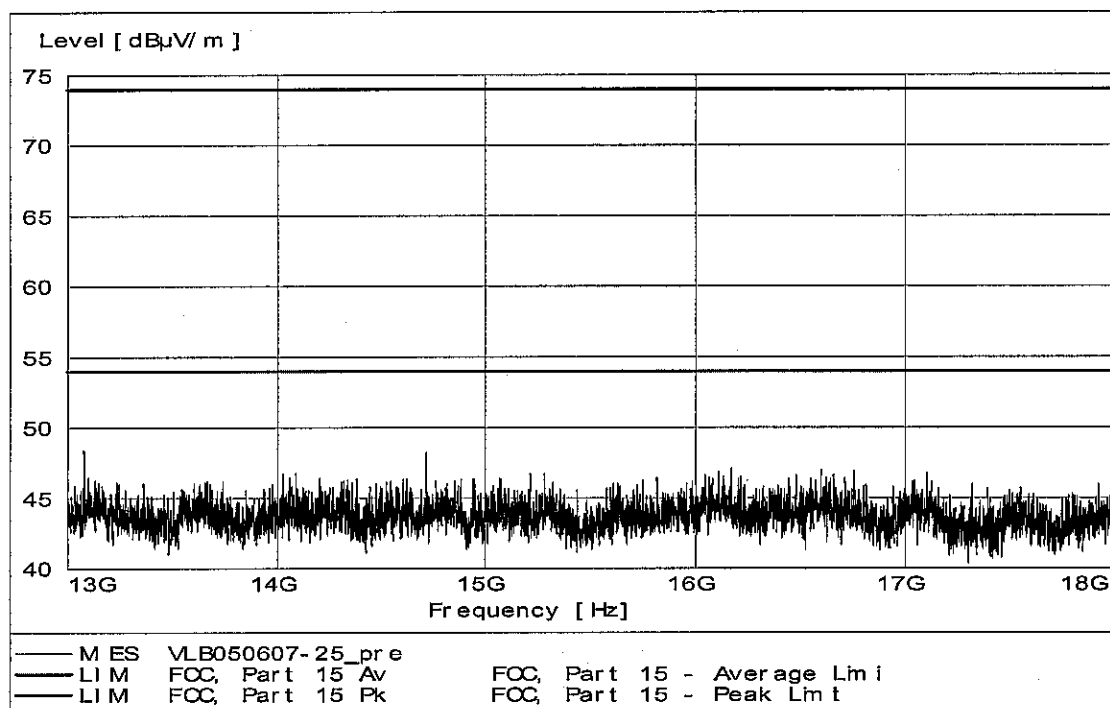
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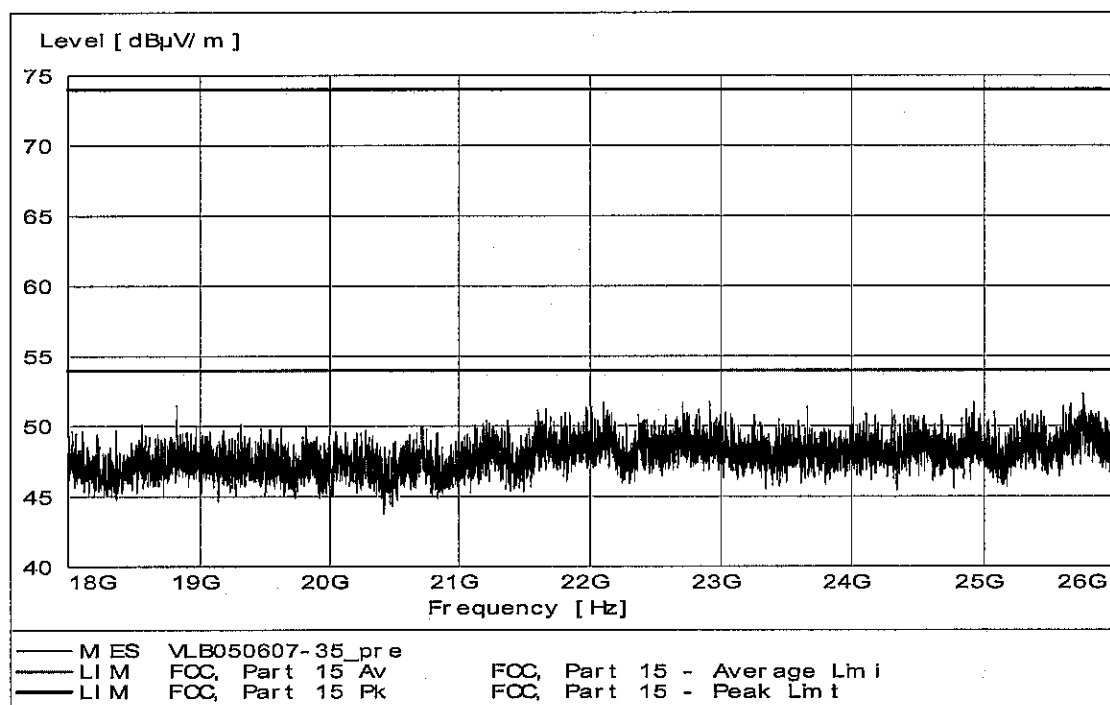
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13 – 18 GHz, max peak at a distance of 3 m on the lower TX channel



18 – 26 GHz, max peak at a distance of 3 m on the lower TX channel



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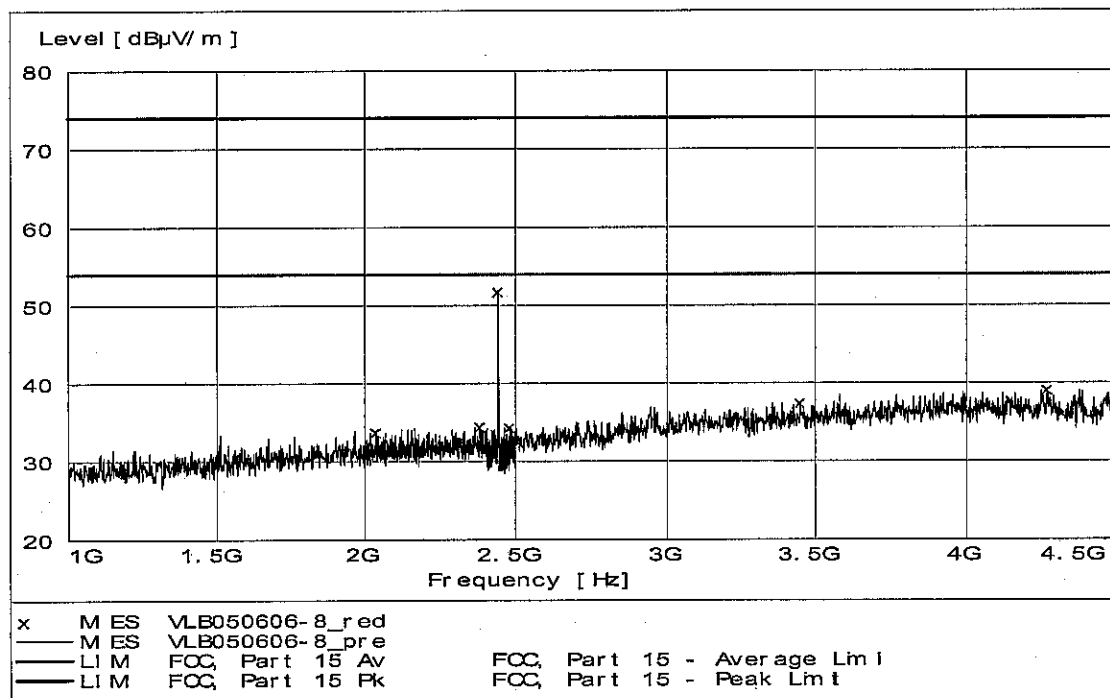
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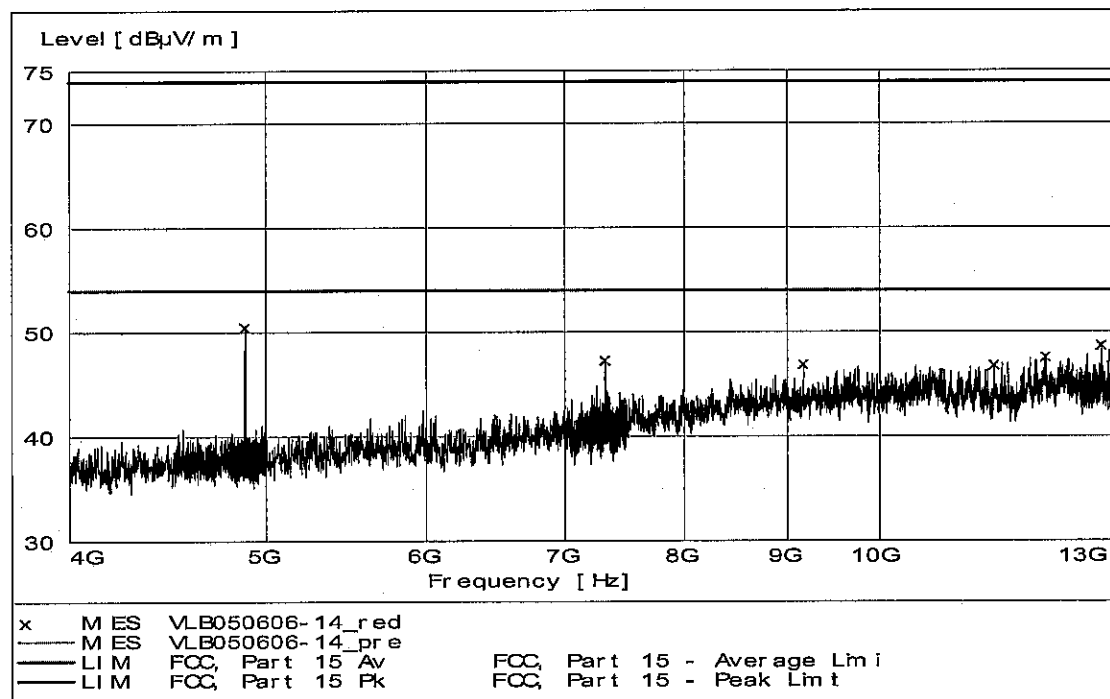
1000 – 4500 MHz, max peak at a distance of 3 m on the middle TX channel.

Carrier is attenuated by 20 dB and by band rejection filter K&L 6N45-2450/T 100-0/0



4000 – 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



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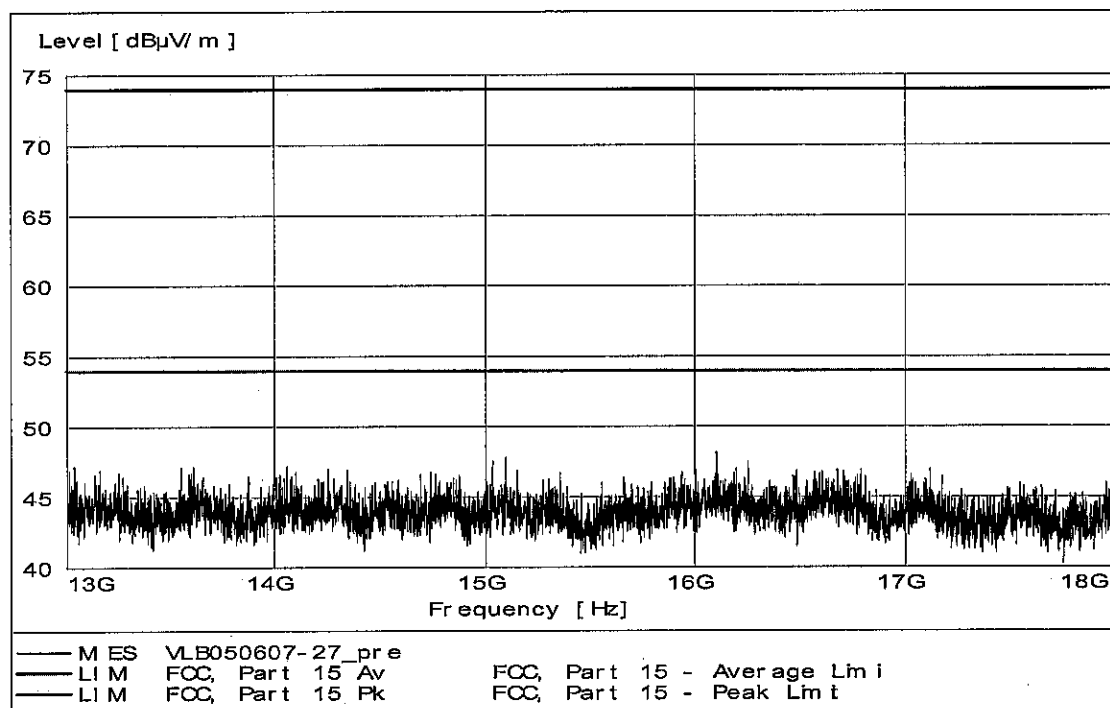
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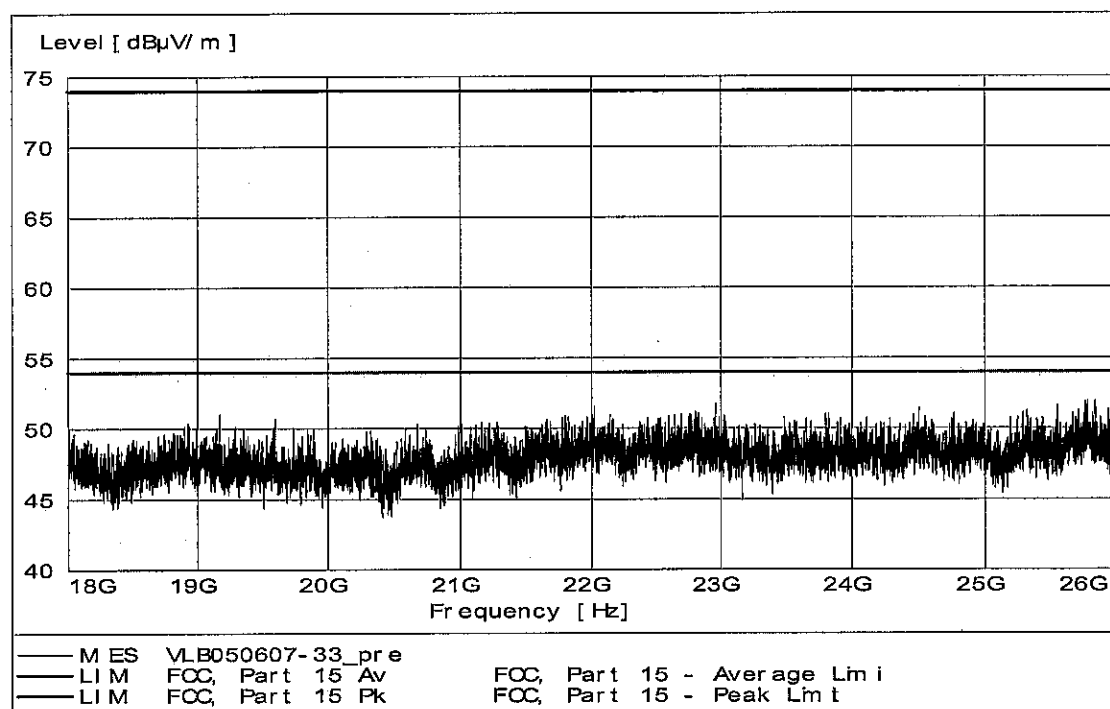
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13 – 18 GHz, max peak at a distance of 3 m on the middle TX channel



18 – 26 GHz, max peak at a distance of 3 m on the middle TX channel



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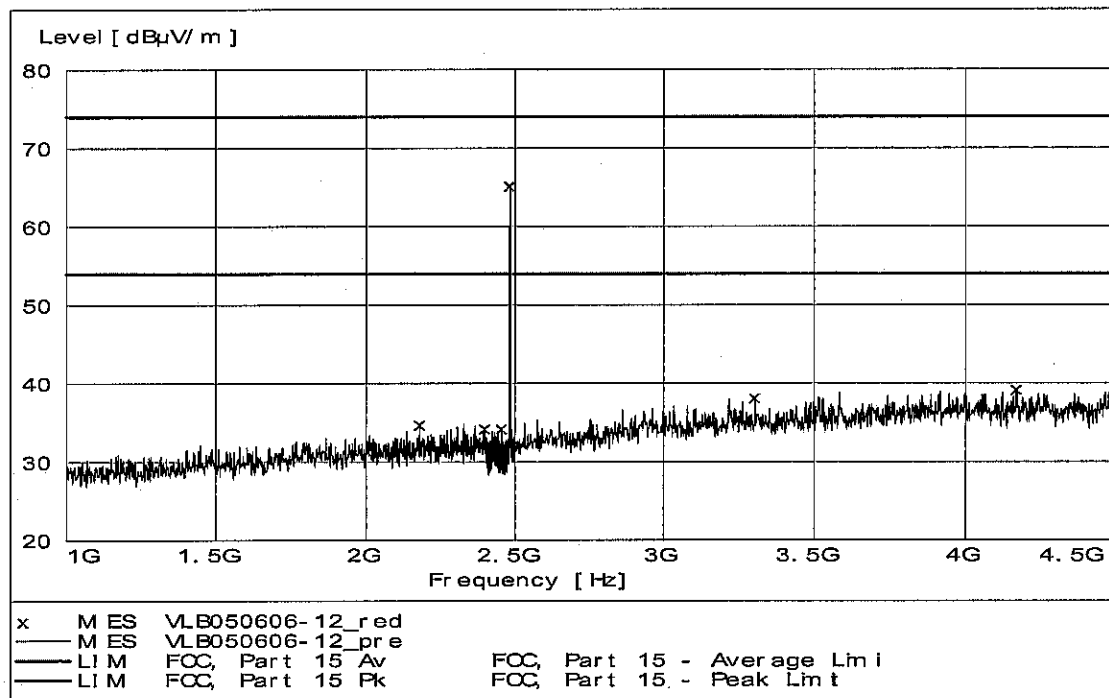
Torshamnsgatan 43, Box 1103, SE-164 22 Kista, Sweden

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

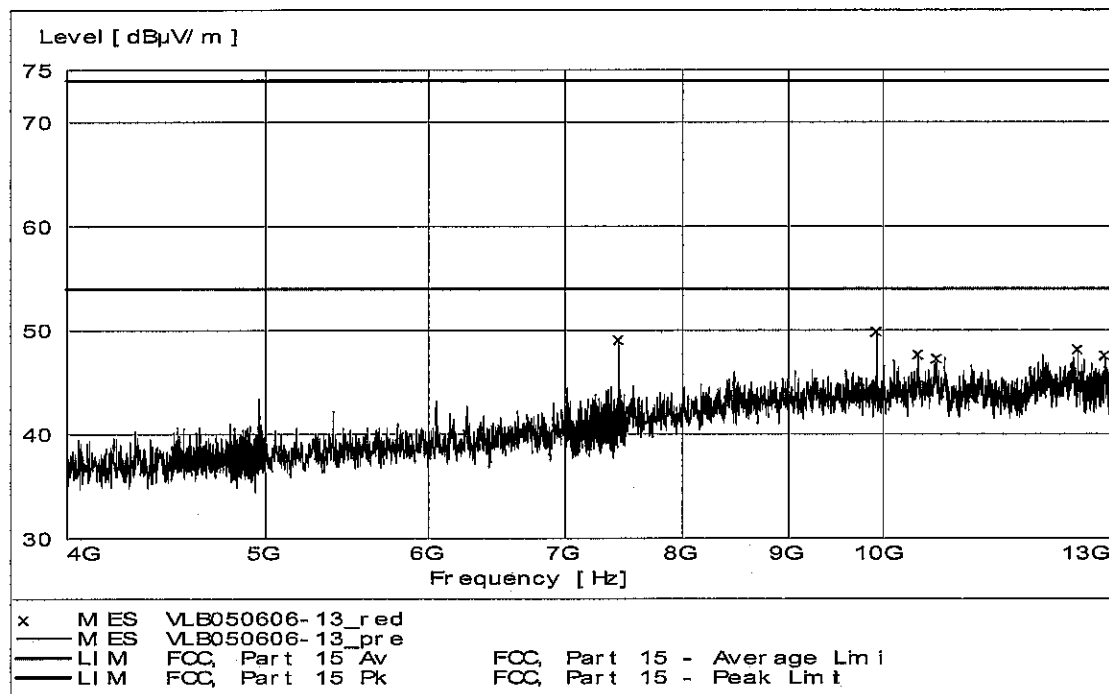
1000 – 4500 MHz, max peak at a distance of 3 m on the upper TX channel.

Carrier is attenuated by 20 dB and by band rejection filter K&L 6N45-2450/T 100-0/0



4000 – 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



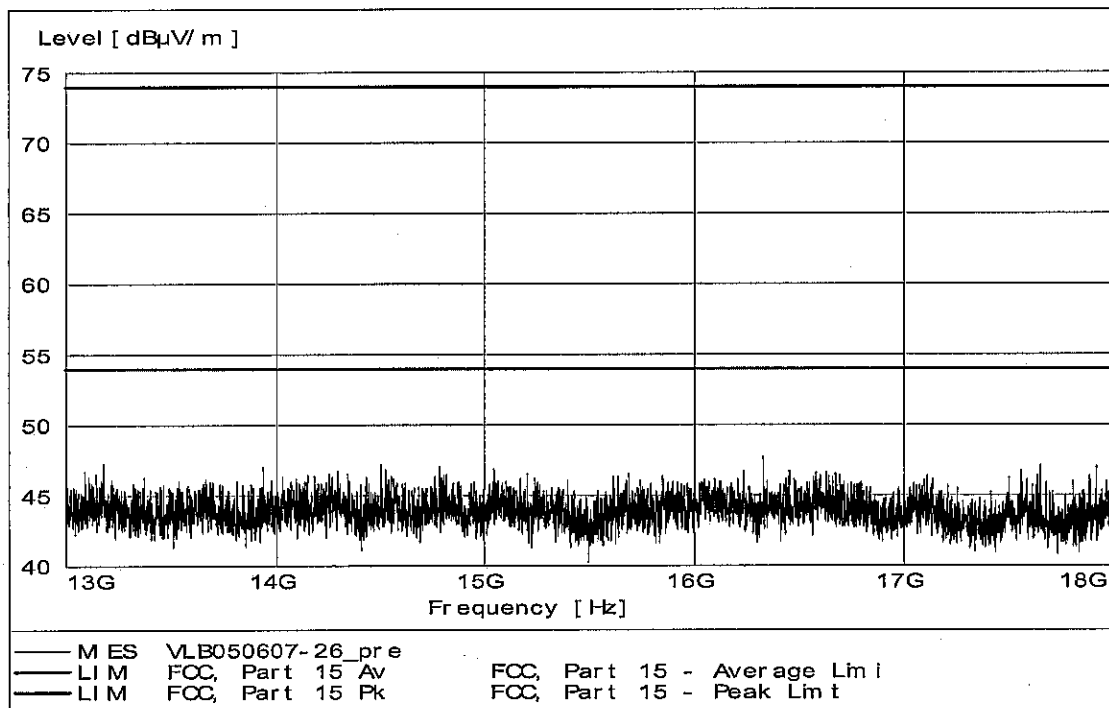
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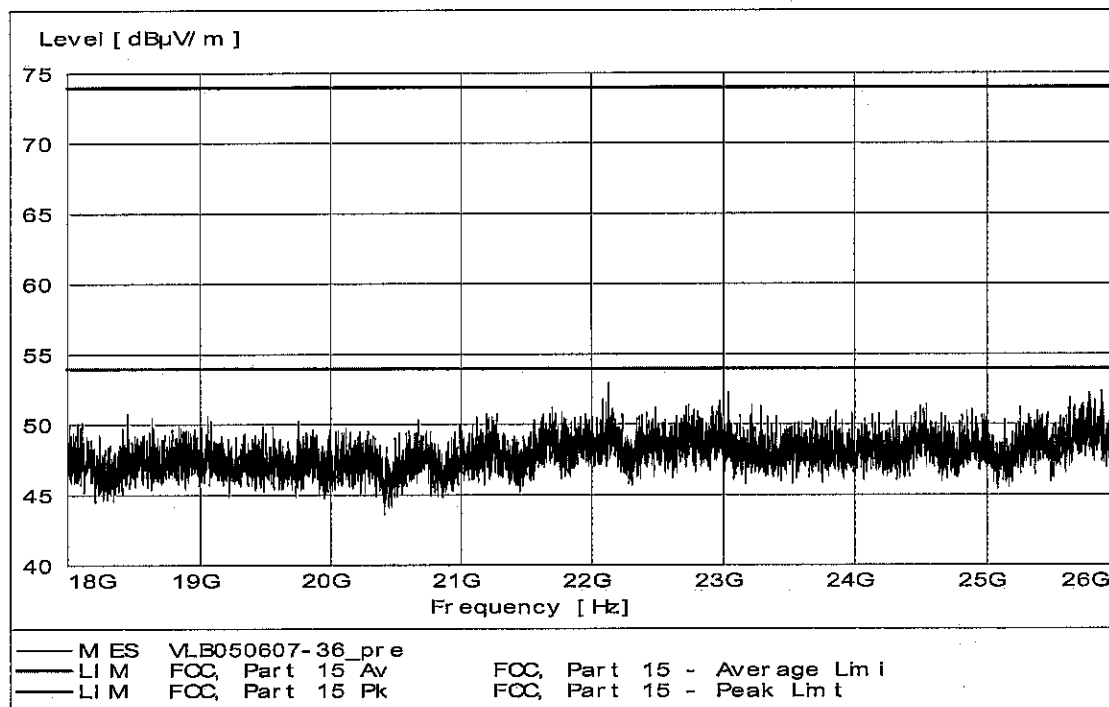
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13 – 18 GHz, max peak at a distance of 3 m on the upper TX channel



18 – 26 GHz, max peak at a distance of 3 m on the upper TX channel



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Data summary

Field strength of spurious emissions						
Frequency	RBW	Measured level		Limit		Note
[MHz]	[kHz]	Peak [dB(μV/m)]	QP/AV [dB(μV/m)]	Peak [dB(μV/m)]	QP/AV [dB(μV/m)]	
30 – 88	120	< 15	-	-	29,5	10 m distance
88 – 216	120	< 10	-	-	33	Noise floor
216 – 960	120	< 27	-	-	35,6	Noise floor
960 – 1000	120	< 28	-	-	43,5	Noise floor
4804	1000	53	50	74	54	3 m distance
4884	1000	53	50	74	54	"
4964	1000	50	-	74	54	"
7206	1000	53	46	74	54	"
7326	1000	54	47	74	54	"
7446	1000	55	49	74	54	"
9608	1000	61	-	100 *	-	"
9768	1000	61	-	100 *	-	"
9928	1000	62	-	100 *	-	"
12010	1000	57	50	74	54	"
12210	1000	56	46	74	54	"
12410	1000	56	46	74	54	"
13000 – 18000	1000	< 48	-	74	54	Noise floor
18000 – 26000	1000	< 52	-	74	54	Noise floor

* Peak in-band emission measured using 100 kHz RBW is equal to 120 dB(μ V/m).

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

Example calculation:

Measured level [dB μ V/m] = Analyser reading [dB μ V] + cable loss [dB] – preamplifier gain [dB] + antenna factor [1/m]



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12. CONDUCTED DISTURBANCE VOLTAGE IN THE FREQUENCY RANGE 0,15 - 30 MHZ

12.1 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%.

12.2 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	30317

12.3 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 the ground plane. Amplitude measurements were performed with a quasi-peak detector. The EUT was supplied by 120 VAC (60 Hz) during the test.



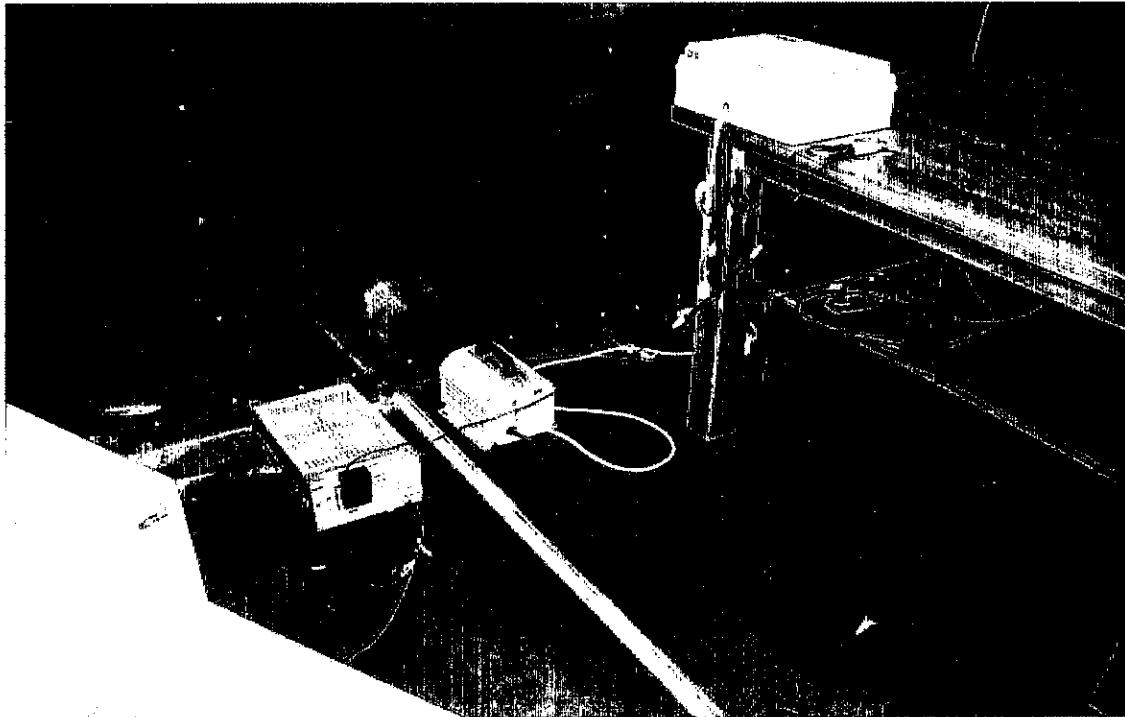
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Test set-up photo:



12.4 Test protocol

Date of test: June 6, 2005

Frequency /MHz	Quasi-Peak	
	Disturbance Level /dB(μV)	Permitted limit /dB(μV)
0,1800	56	65
0,3600	34	59
2,1300	31	56
2,1900	32	56
2,8425	34	56



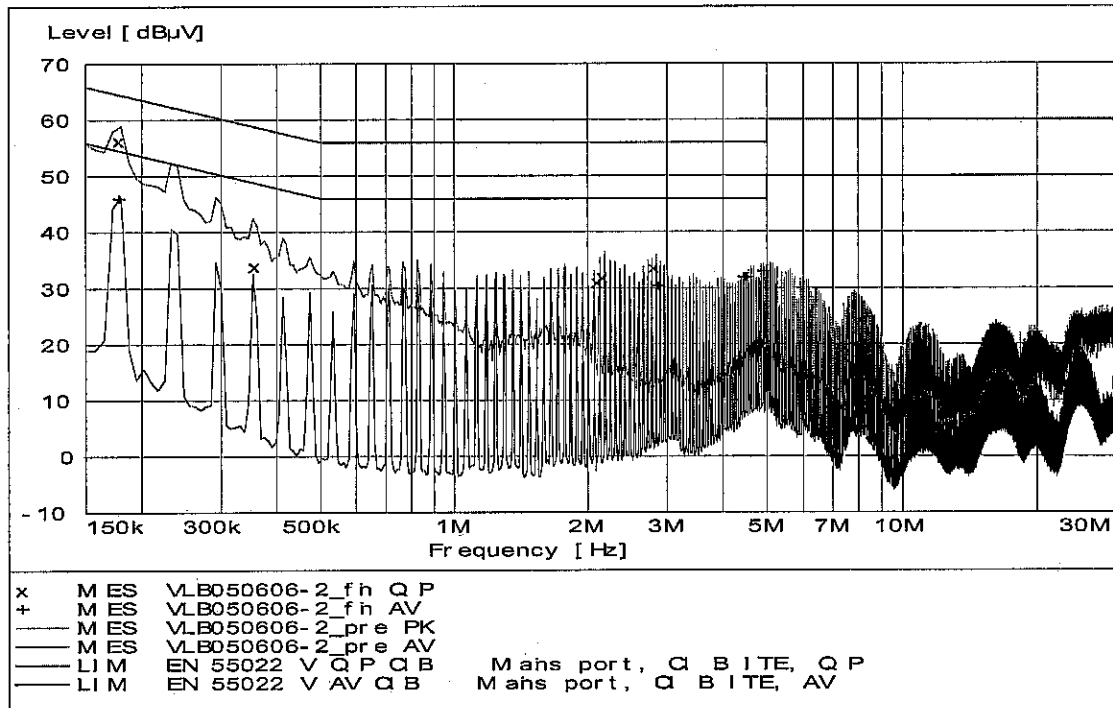
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Overview sweeps performed with peak and average detectors



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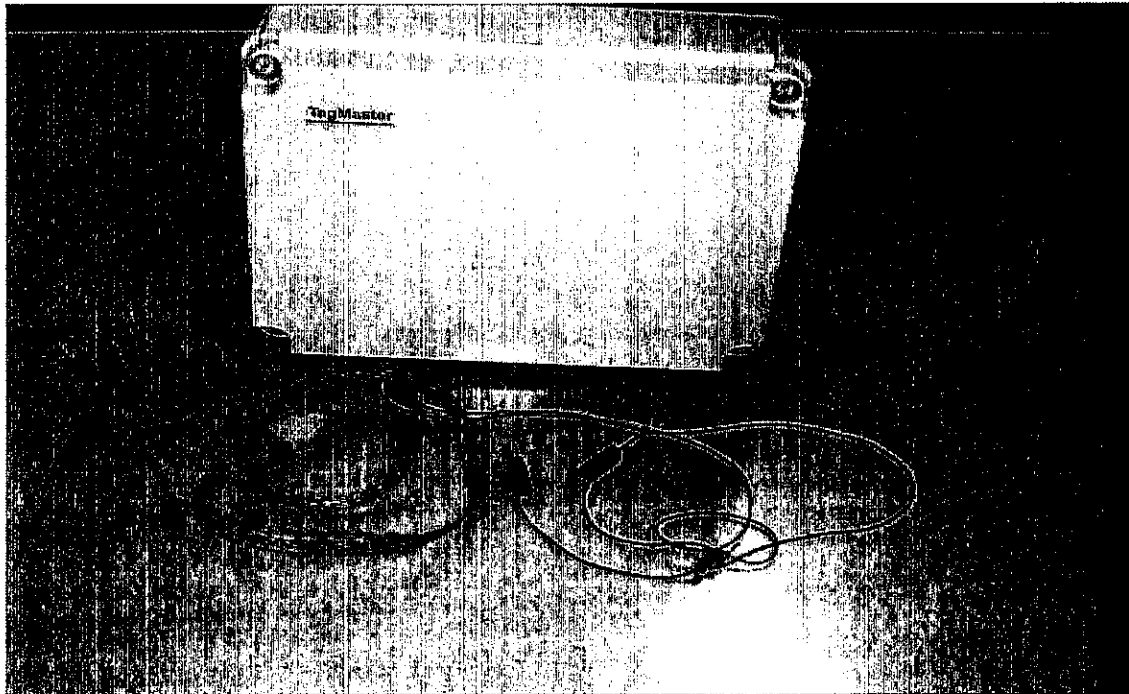
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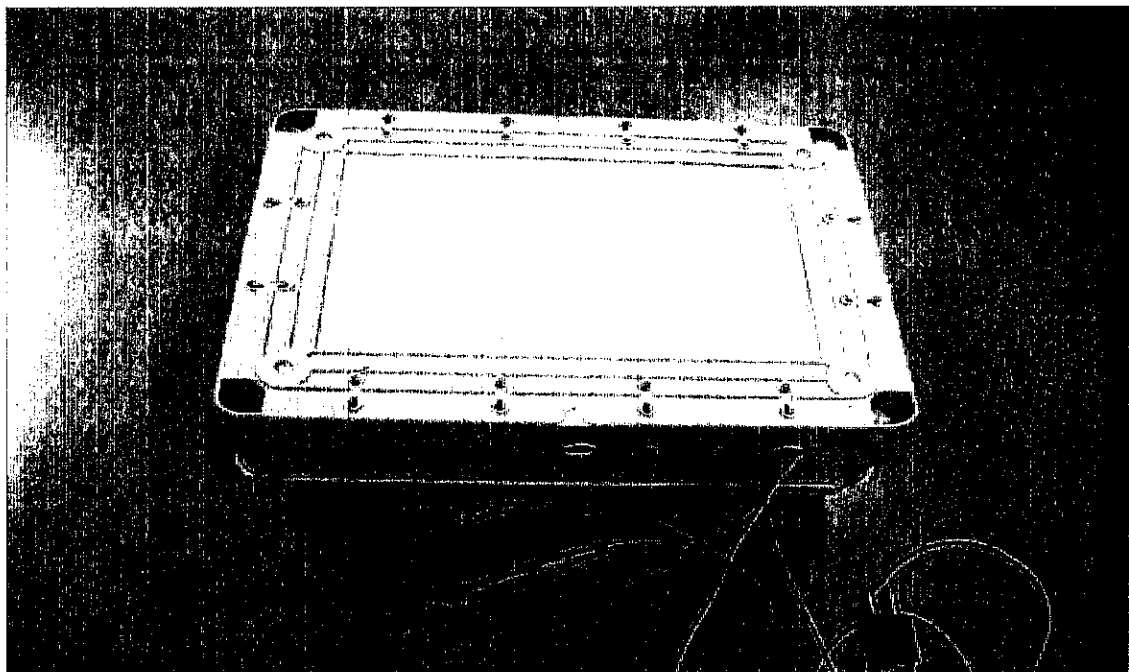
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APPENDIX I – PHOTOS OF THE EUT

General view



Back side



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