

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:

Vladimir Bazhanov

Approved by:

Lars-Olov Johansson

This report may not be reproduced other than in full, except with the prior written approval by SEMKO.



Intertek Semko AB

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

CONTENTS

	Page
1. Client information	3
2. Equipment under test (EUT).....	3
2.1 Identification of the EUT according to the manufacturer/client declaration	3
2.2 Additional software information about the EUT	4
2.3 Peripheral equipment.....	4
2.4 Modifications during the test.....	4
3. Test specifications.....	5
3.1 Standards	5
3.2 Additions, deviations and exclusions from standards.....	5
3.3 Test set-up	5
3.4 Operating environment.....	5
4. Test summary	6
5. Peak output power	7
5.1. Test set-up	7
5.2. Test protocol	7
6. 20 dB Bandwidth	8
6.1 Test protocol	8
7. Carrier frequency separation.....	9
7.1 Test protocol	9
8. Number of hopping channels.....	10
8.1 Test protocol	10
9. Time of occupancy (Dwell time).....	11
9.1 Test protocol	11
10. Band edge compliance.....	12
10.1. Test set-up	12
10.2 Test protocol	12
11. Radiated spurious emissions	14
11.1 Measurement uncertainty	14
11.2 Test equipment.....	14
11.3 Measurement set-up.....	15
11.4 Test protocol	16
12. Conducted disturbance voltage in the frequency range 0,15 - 30 MHz.....	25
12.1 Measurement uncertainty	25
12.2 Test equipment.....	25
12.3 Measurement set-up.....	25
12.4 Test protocol	26
Appendix I – Photos of the EUT	28



Intertek Semko AB

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

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



Intertek Semko AB

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

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.



Intertek Semko AB

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

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 %



Intertek Semko AB

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

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)



Intertek Semko AB

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

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	



Intertek Semko AB

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

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	
2442	132	< 1000
2482	135	

**Intertek Semko AB**

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

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



Intertek Semko AB

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

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



Intertek Semko AB

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

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



Intertek Semko AB

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

10. BAND EDGE COMPLIANCE

10.1. Test set-up

See Section 11.3.

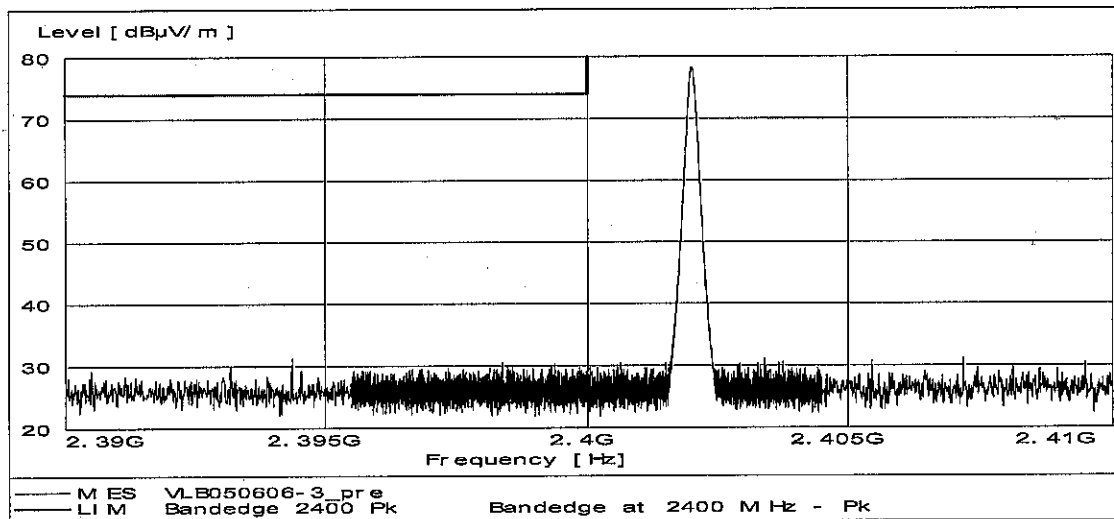
10.2 Test protocol

Date of test: June 6, 2005

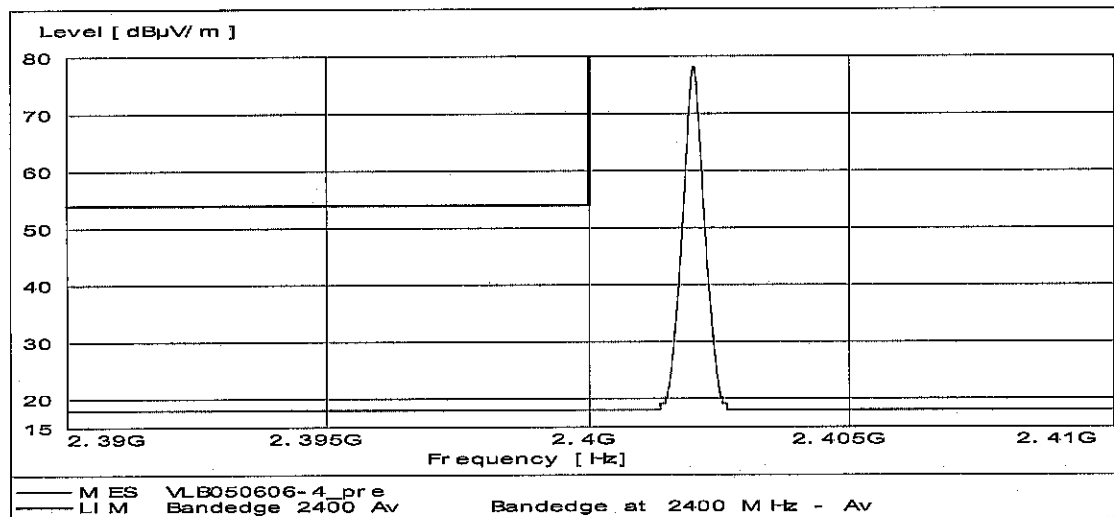
Extra attenuation: 40 dB

Band edge compliance at 2400 MHz

Sweep with peak detector



Sweep with average detector



Intertek Semko AB

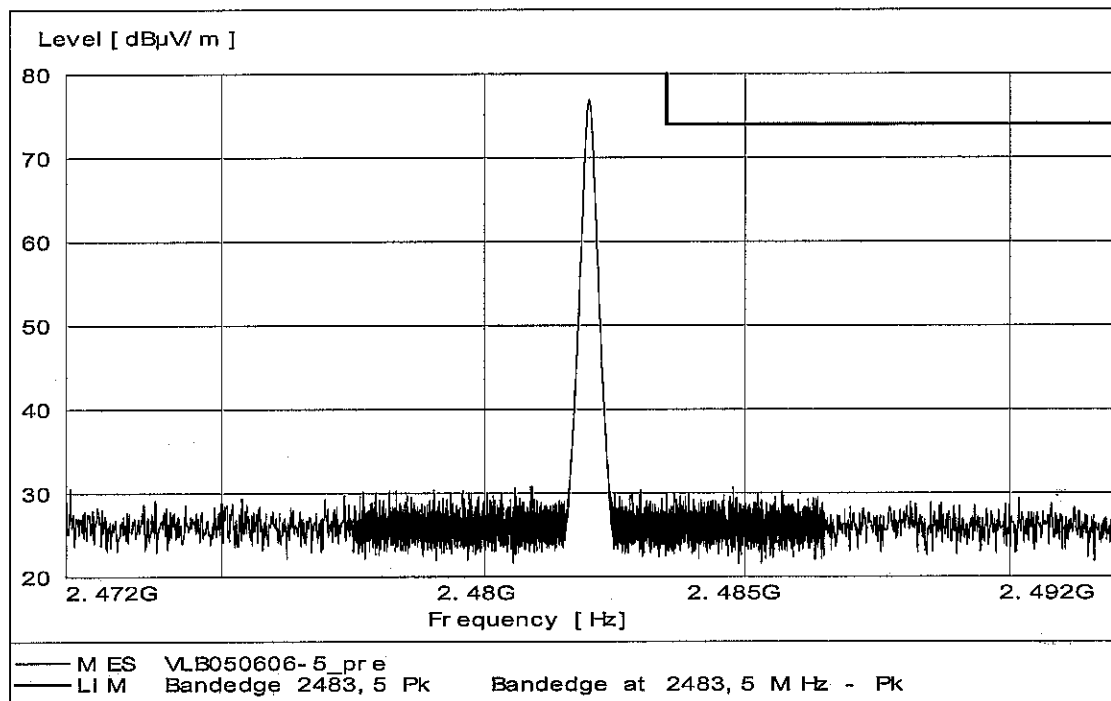
Torshamnsgatan 43, Box 1103, SE-164 22 Kista, Sweden

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

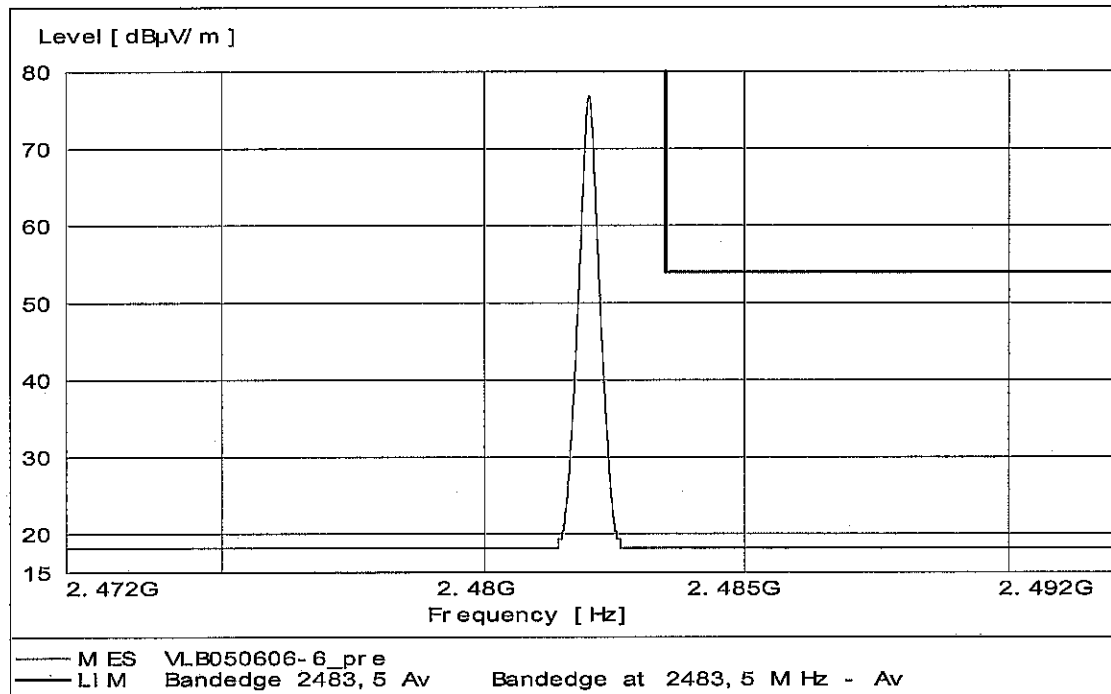
Registered in Sweden: No SE556024059901, Registered office: As address

Band edge compliance at 2483,5 MHz

Sweep with peak detector



Sweep with average detector



Intertek Semko AB

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

11. RADIATED SPURIOUS EMISSIONS

11.1 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%.

11.2 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



Intertek Semko AB

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

5142_04.01_Notebook_P_1724024

11.3 Measurement set-up

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

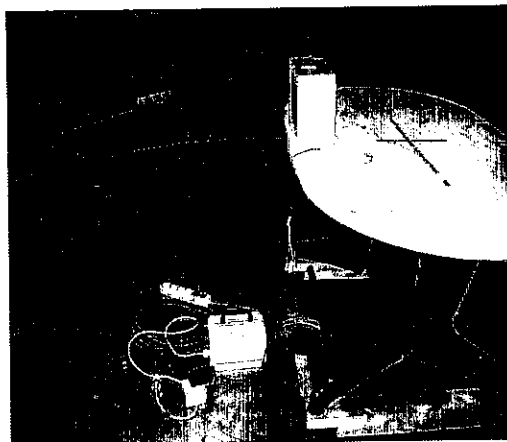
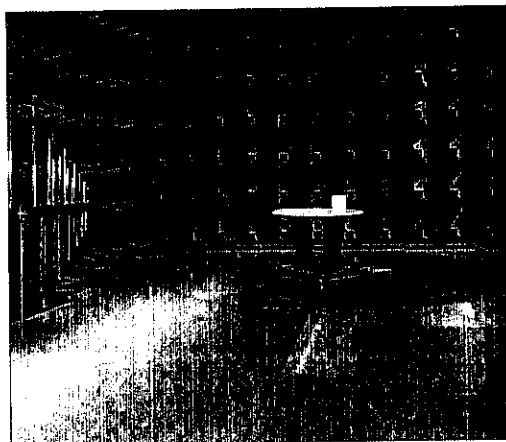
The radiated disturbance electric field intensity was measured in a semi-anechoic chamber at a distance of 10 m and the EUT was placed on a non-metallic table, 0,8 m above the reference ground plane. The specified test mode was enabled. Test set-up photos are given below.

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.



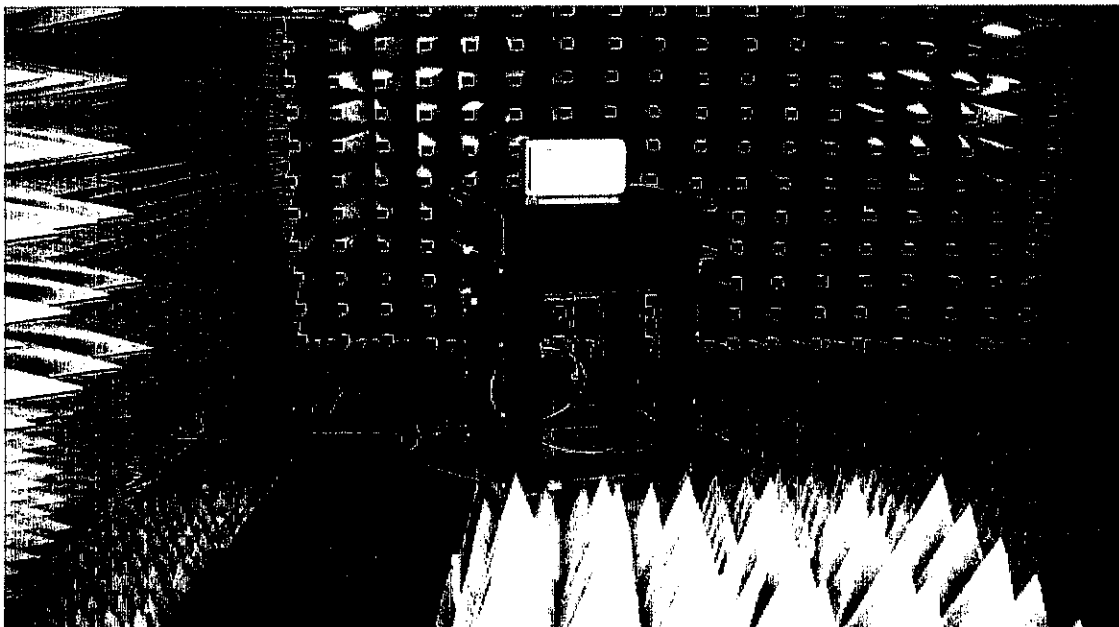
Intertek Semko AB

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

Test set-up photo:

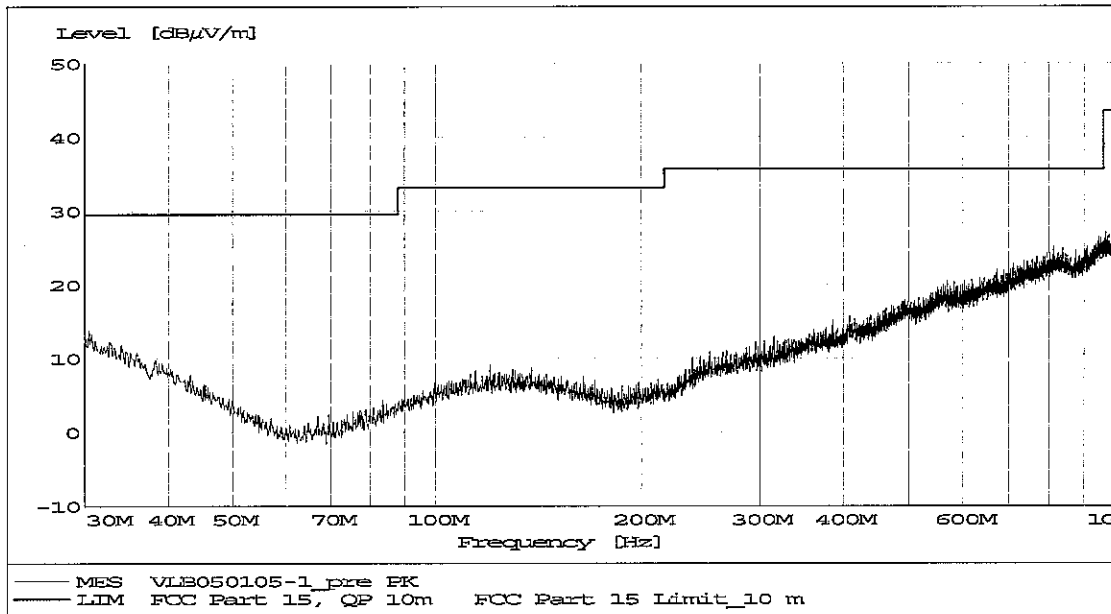


11.4 Test protocol

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



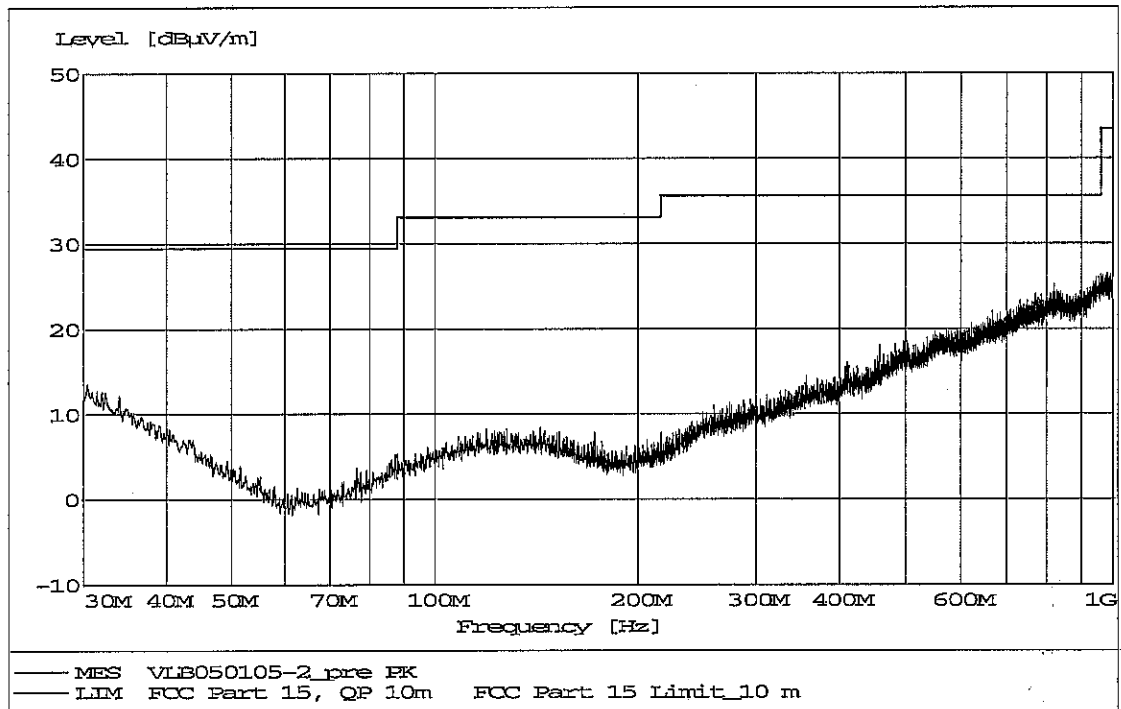
Intertek Semko AB

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

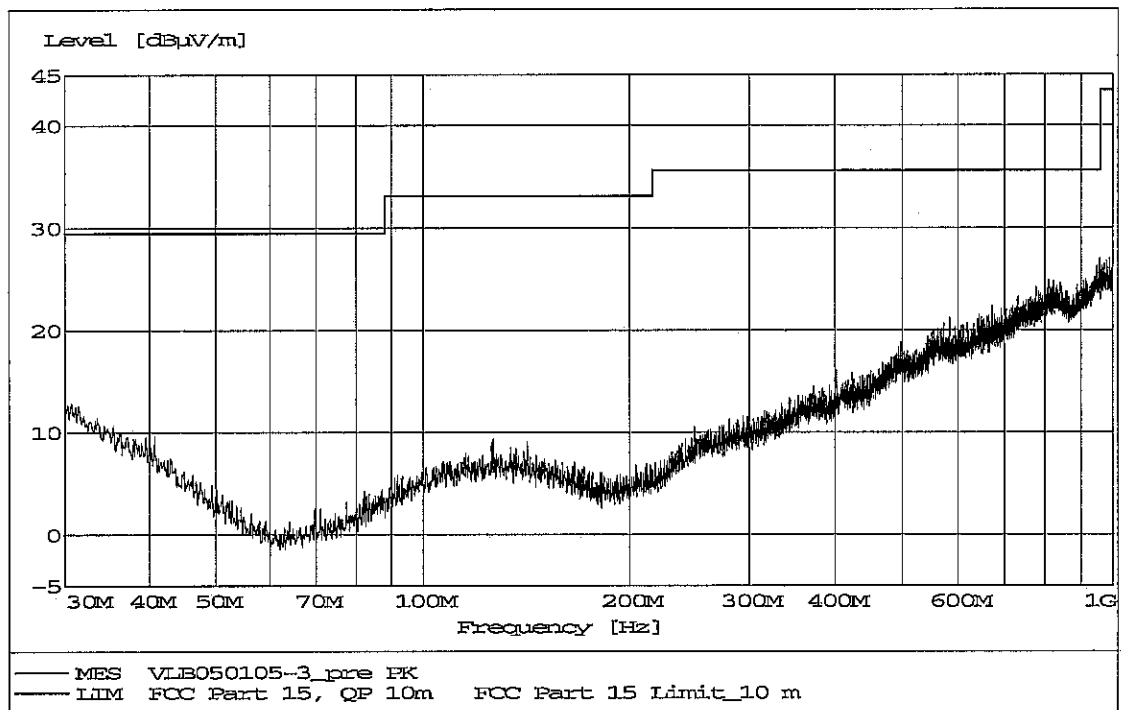
Telephone +46 8 750 00 00, Fax +46 8 750 60 30, www.sweden.intertek-etlsemko.com

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

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



Intertek Semko AB

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

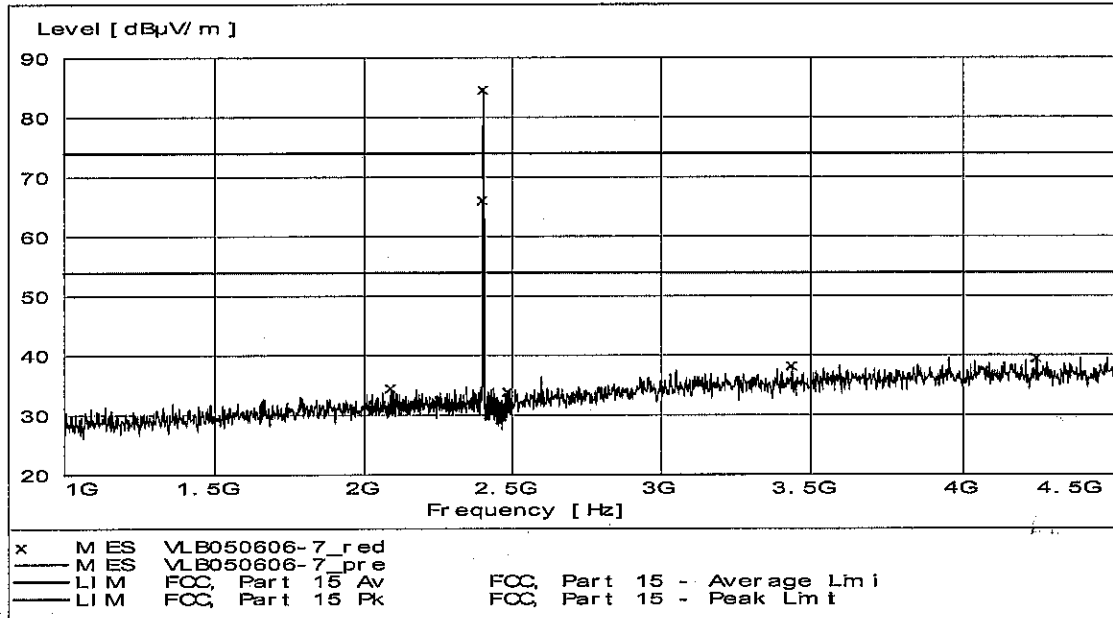
Registered in Sweden: No SE556024059901, Registered office: As address

Bluetooth anechoic shielded chamber

Date of test: June 6-7, 2005

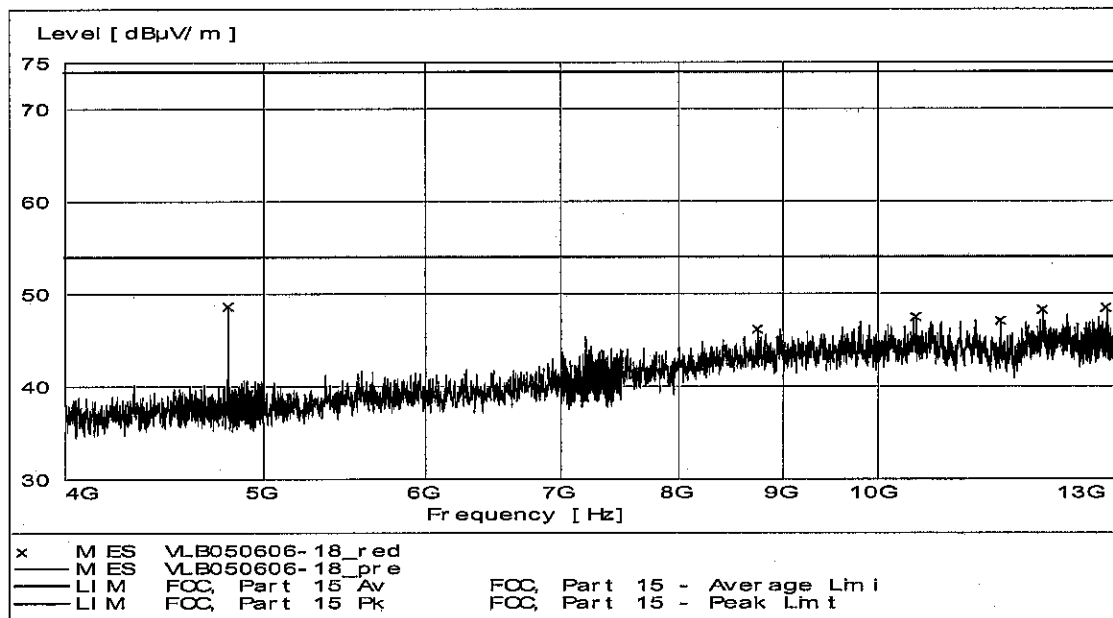
1000 – 4500 MHz, max peak at a distance of 3 m on the lower TX channel.

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



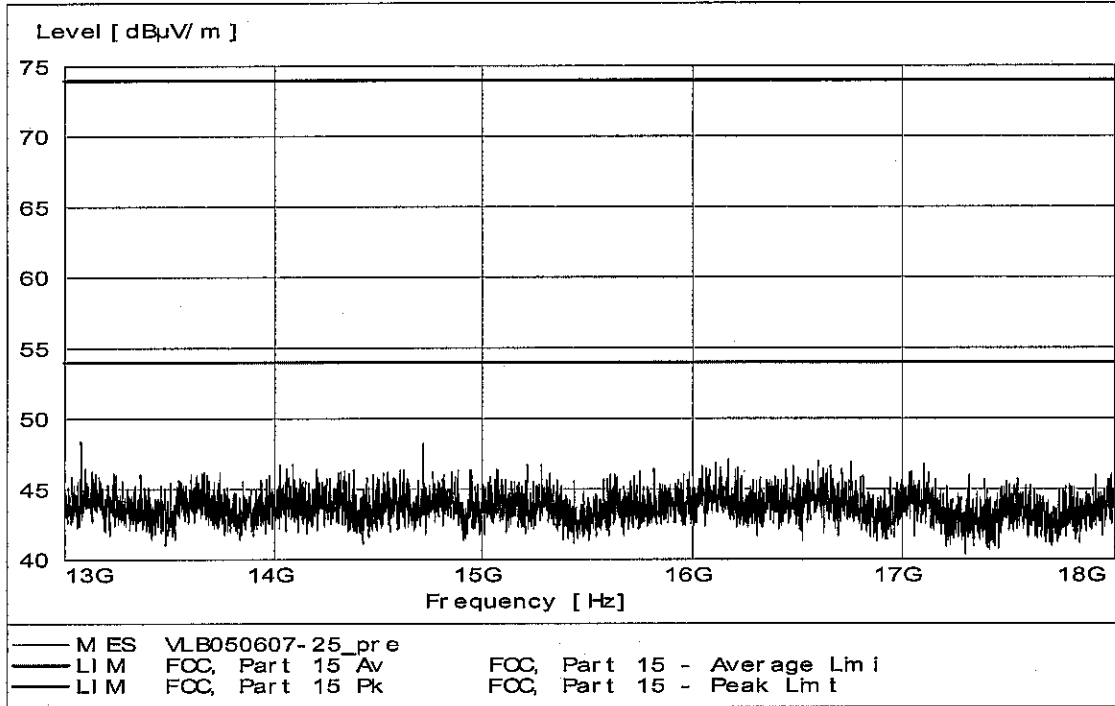
Intertek Semko AB

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

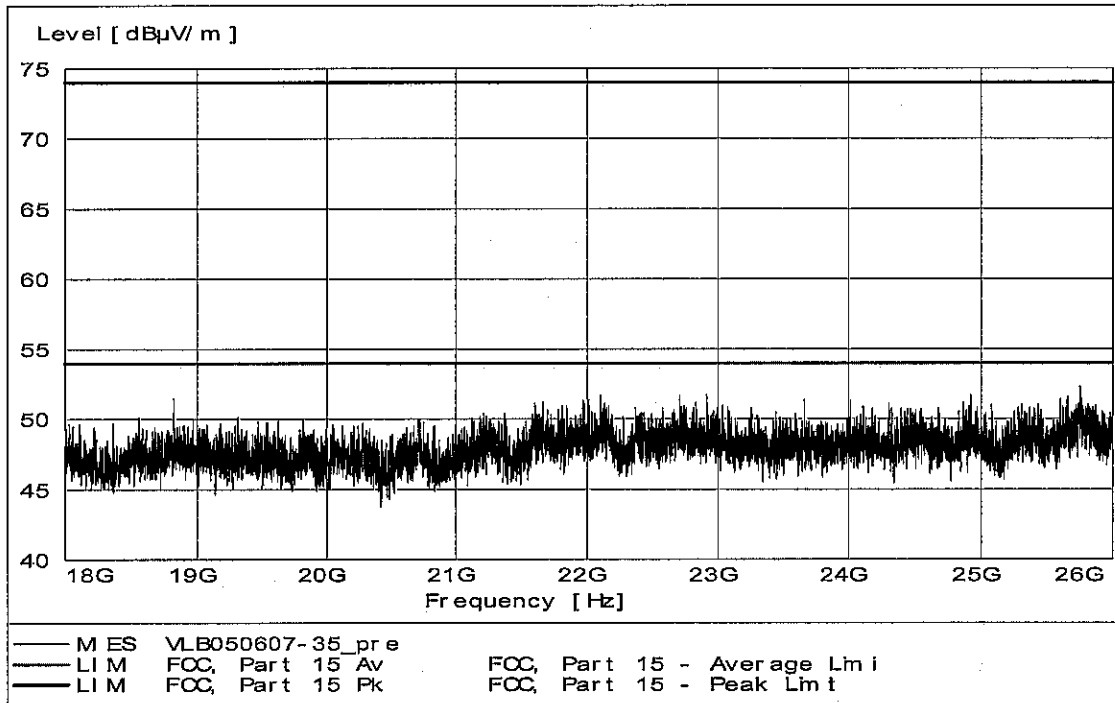
Telephone +46 8 750 00 00, Fax +46 8 750 60 30, www.sweden.intertek-ettsemko.com

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

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



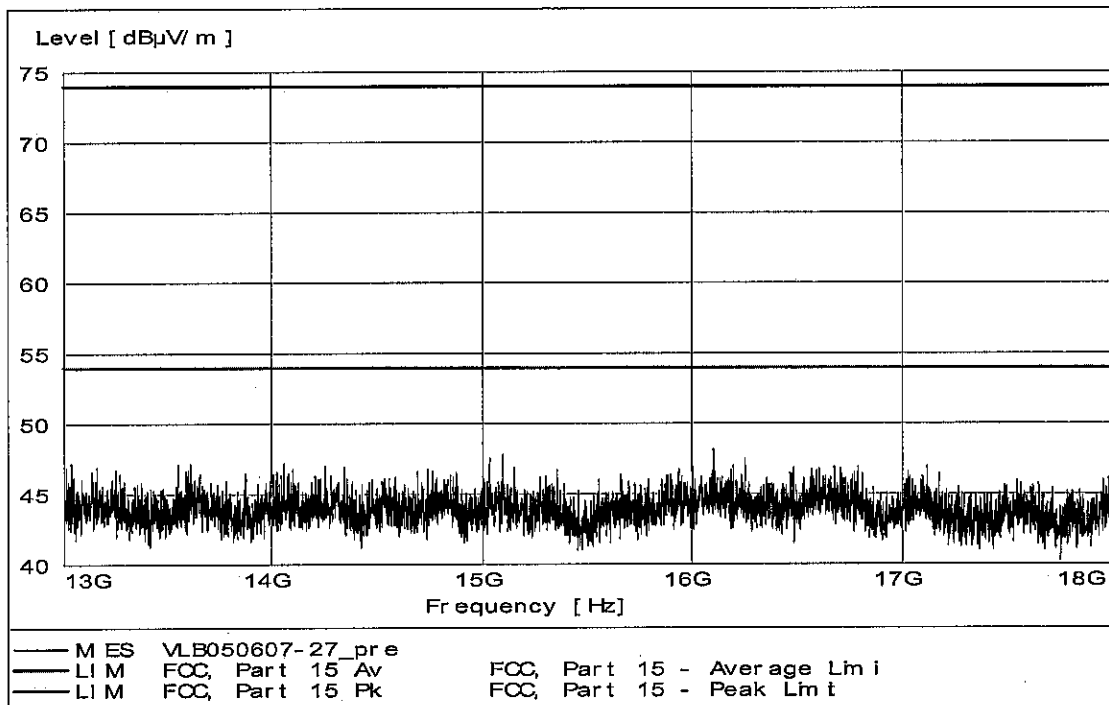
Intertek Semko AB

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

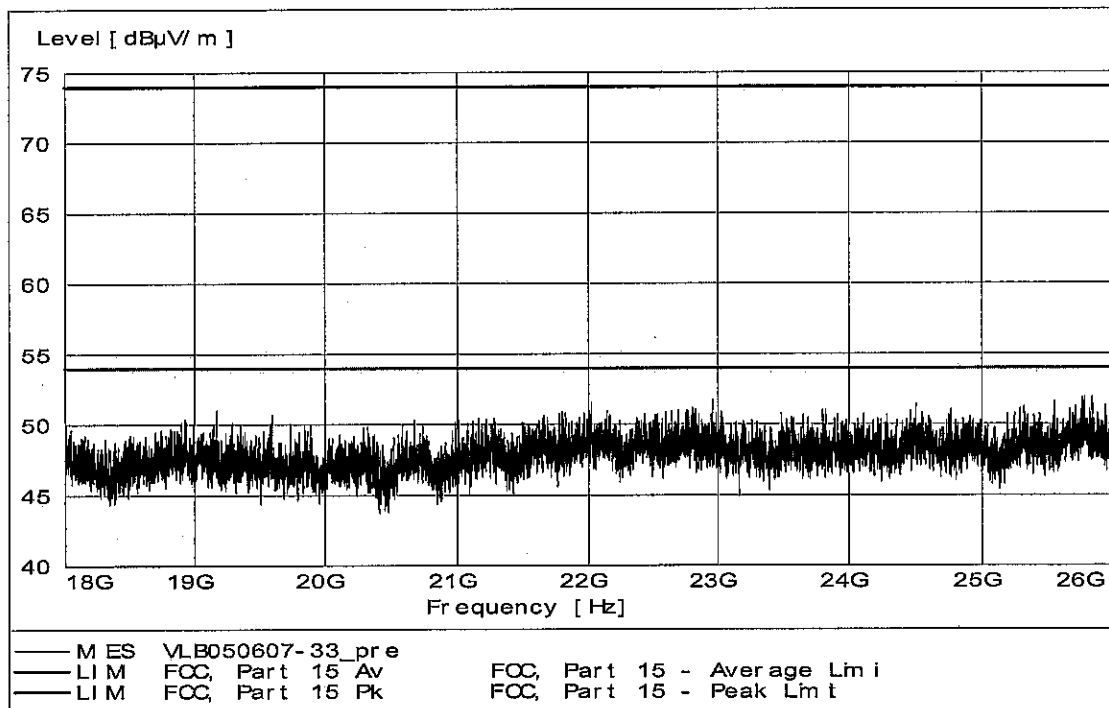
Telephone +46 8 750 00 00, Fax +46 8 750 60 30, www.sweden.intertek-eflsemko.com

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

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



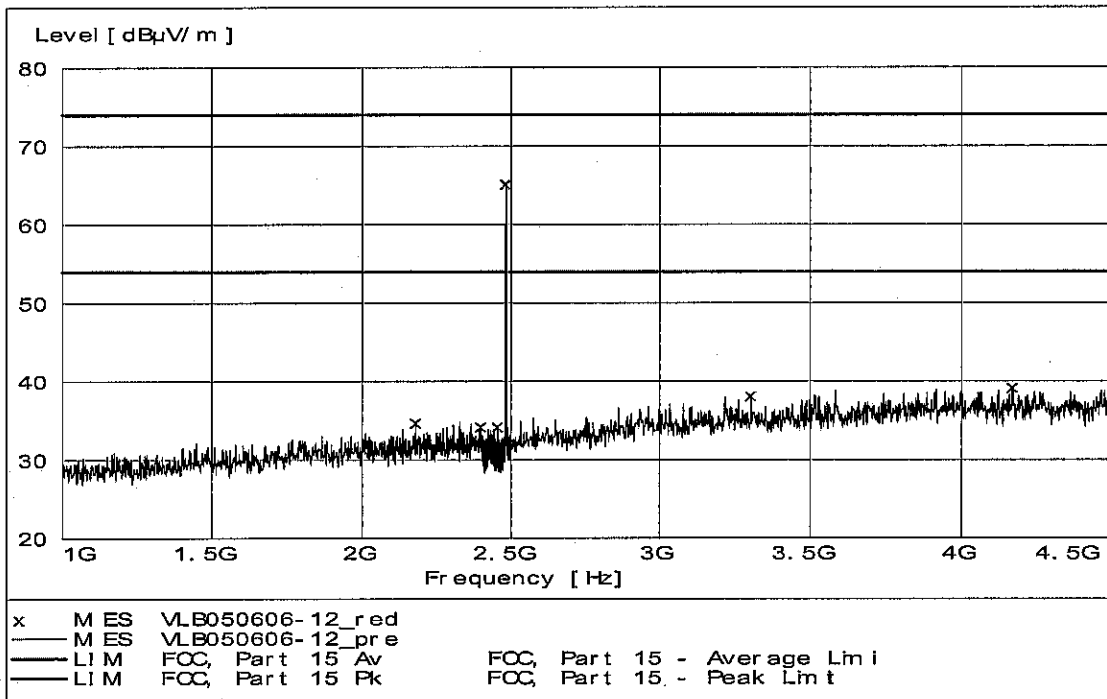
Intertek Semko AB

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

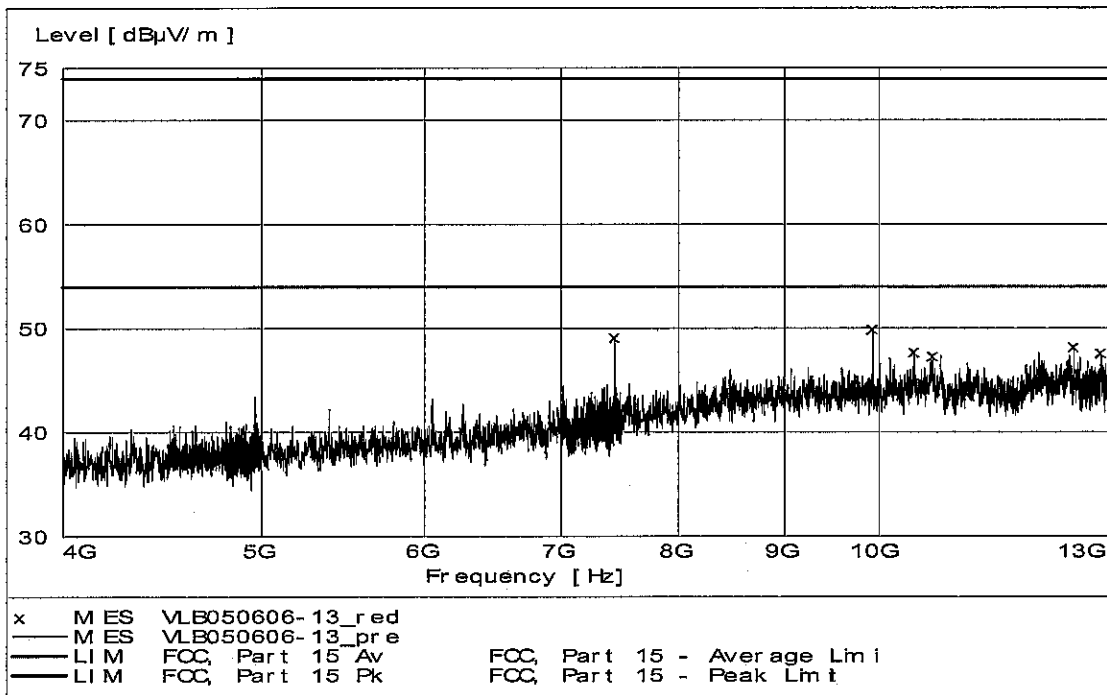
Telephone +46 8 750 00 00, Fax +46 8 750 60 30, www.sweden.intertek-etlsemko.com

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



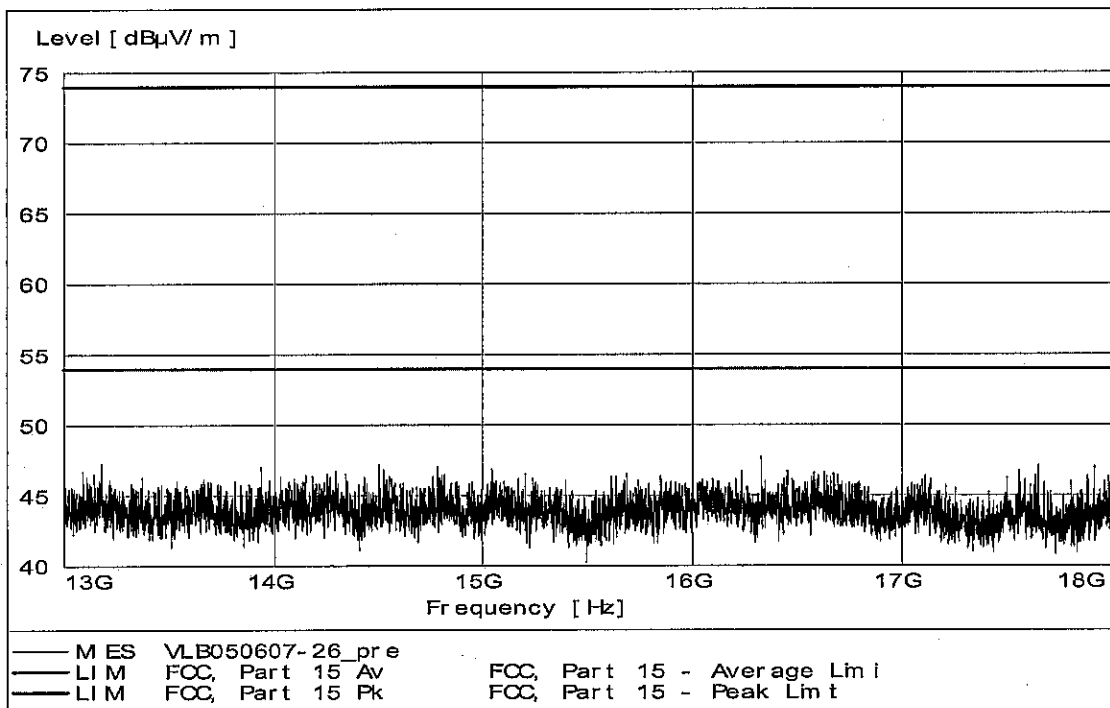
Intertek Semko AB

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

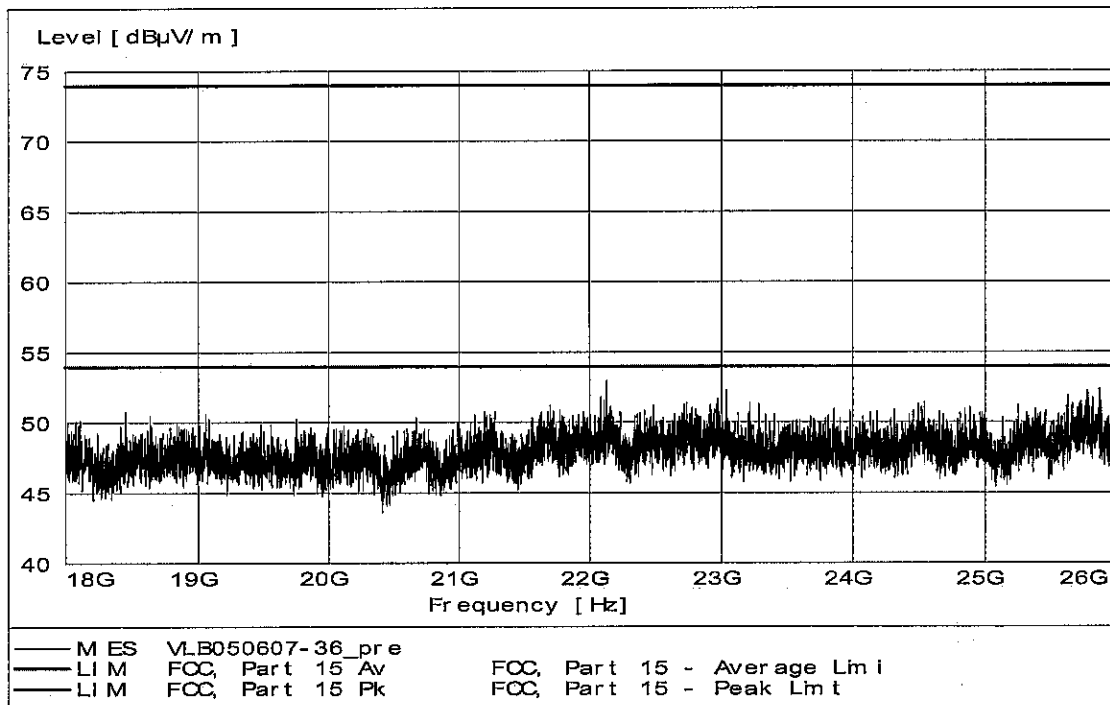
Telephone +46 8 750 00 00, Fax +46 8 750 60 30, www.sweden.intertek-etlsemko.com

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

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



Intertek Semko AB

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

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	< 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(μV/m).

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

Example calculation:

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



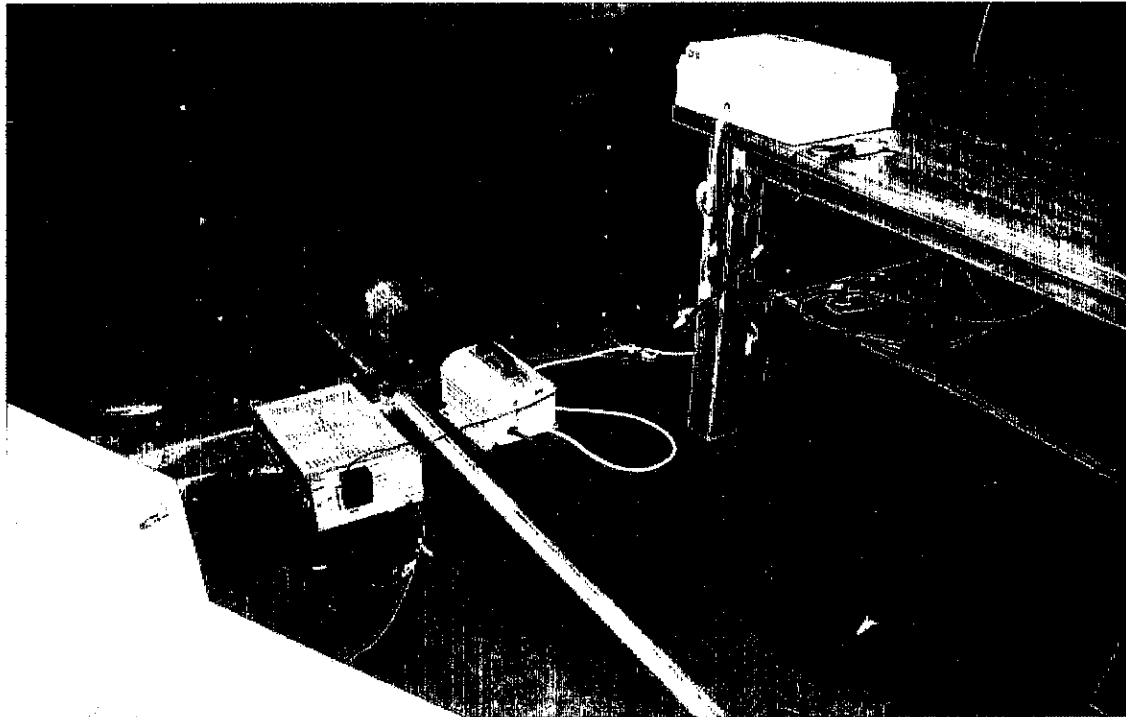
Intertek Semko AB

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 SE558024059901, Registered office: As address

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



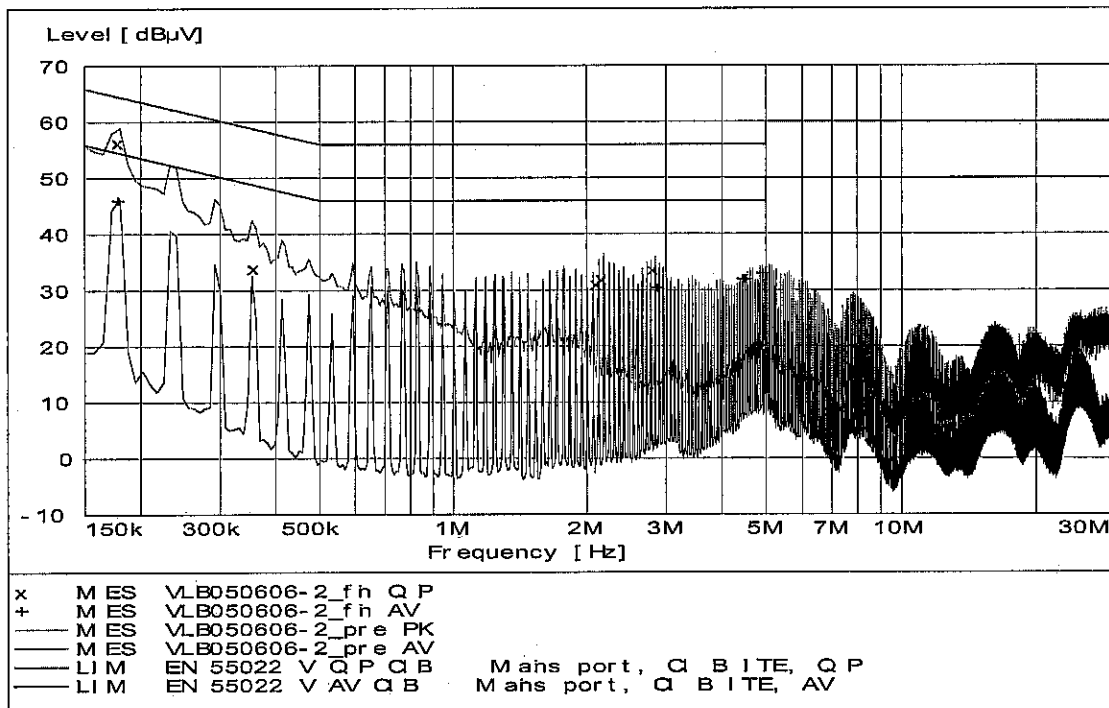
Intertek Semko AB

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

Overview sweeps performed with peak and average detectors



Intertek Semko AB

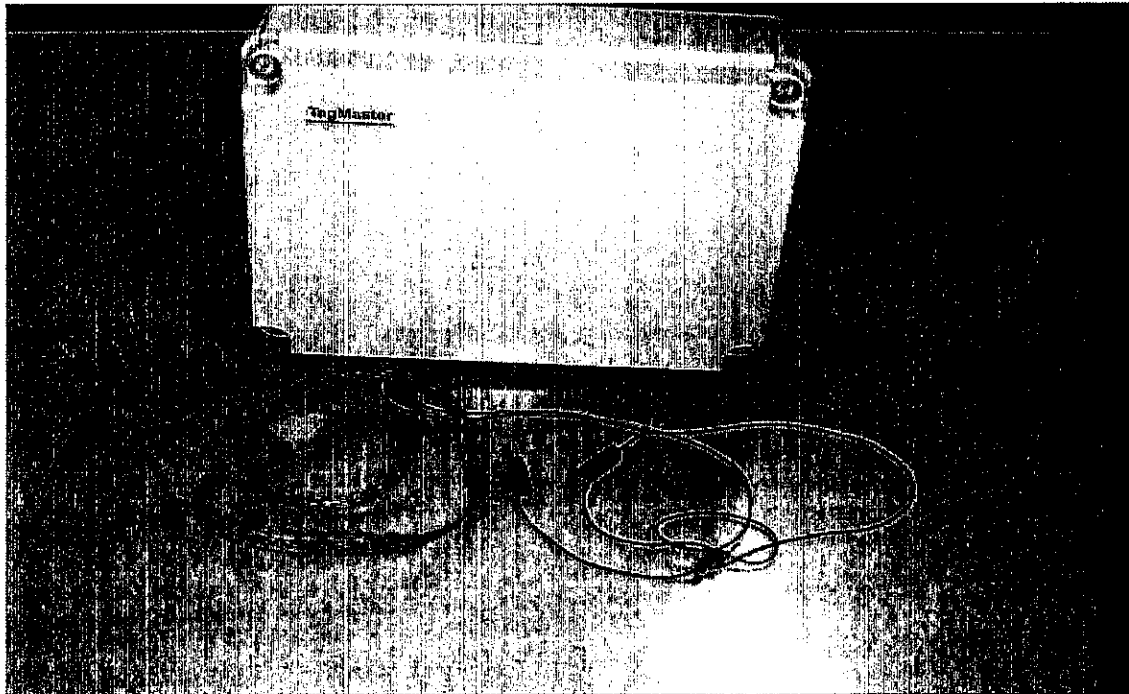
Torshamnsgatan 43, Box 1103, SE-164 22 Kista, Sweden

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

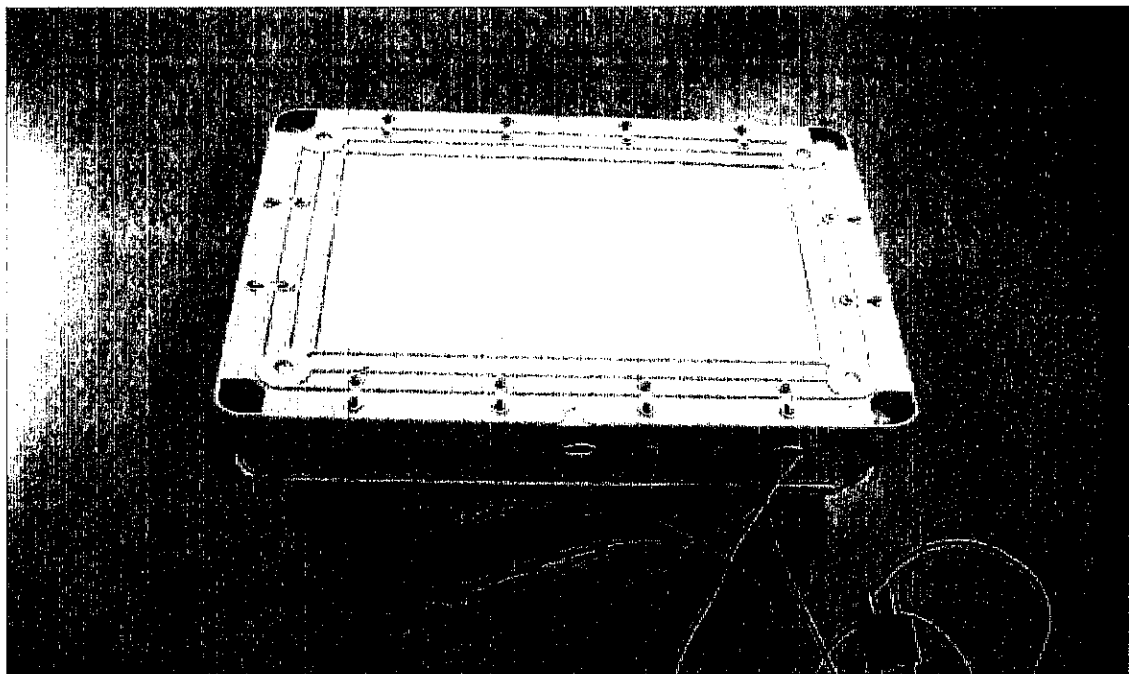
Registered in Sweden: No SE556024059901, Registered office: As address

APPENDIX I – PHOTOS OF THE EUT

General view



Back side



Intertek Semko AB

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