

RADIO TEST REPORT

No. 409110-2

EQUIPMENT UNDER TEST

Equipment:	TWIS system
Type / model:	ME6820-M1 AP6803-M2
Manufacturer:	SAAB Communications AB
Tested by request of:	SAAB Communications AB

SUMMARY

The equipment complies with the requirements of the following standard:
FCC, Part 15, Subpart B (2002) and Subpart C (2002);

Date of issue: August 30, 2004

Tested by:

David Weinman App.

Linda Heikurainen

Approved by:


Björn Rosenquist

Björn Rosenquist



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1. CLIENT INFORMATION

The EUT has been tested by request of

Company: SAAB Communications AB
Vattenkraftsvägen 8
SE-135 70 Stockholm
SWEDEN

Name of contact: Anders Salomonsson

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

Equipment: TWIS system

Type/Model: Hand Portable Transceiver/ME6820-M1*
Access Point Transceiver/AP6803-M2

Serial number: ME6820-M1: SN: 116*
AP6803-M2: SN: 133

Manufacturer: SAAB Communications AB

Rating/Supplying voltage: ME6820-M1: 4,5 V Ni-MH/alkaline cells
AP6803-M2: 9 – 33 V DC

Rating RF output power: 100 mW e.i.r.p.

Antenna gain: 0 dBi

External antenna connector: AP6803-M2: Yes
ME6820-M1: No

Operating temperature range: -40 to +55°C

Frequency range: 2400 – 2483,5 MHz

Number of channels: 25

Modulation characteristics: $\pi/4$ DQPSK

Stand by mode supported: Yes

* Serial number 236 was used for the output power test, time of occupancy, number of hopping frequencies, carrier frequency separation and the band edge compliance test.

2.2 Modifications during the test

The output power level was lowered in order to comply with the requirements. This change was done in the Procom plus software, the output level was changed from +20 and "fine adjustment 0" to +20 and "fine adjustment -15" (where as "fine adjustment" is divided into 15 steps/dB, one step is $\approx 0,067$ dB.).

A change of frequencies in the band edges where made in order to comply with ETSI EN 300 328 requirements, band edge compliance where made at frequencies 2404 MHz and 2479 MHz.

No other modifications where made. Intertek Semko AB

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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

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 PT was supplied by its internal battery during the tests. A head set, type Peltor MT7H10F-T5142 was connected. The AP was supplied by an external 12 V DC power supply.

The operation mode was set by Procom plus software.

3.4 Operating environment

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

Air temperature: 21 - 24 °C
Relative humidity: 15 - 36 %



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4. TEST SUMMARY

Test result AP6803-M2

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

Test result ME6820-M1

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	
15B	Out of band spurious emissions, radiated	Pass	
15.247	Out of band spurious emissions, radiated	Pass	
15.247	Out of band spurious emissions, conducted	N/A	1.

N/A= Not Applicable

Note 1: Not applicable the EUT has no removable antenna.



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5. PEAK OUTPUT POWER

5.1 Test protocol

Date of test: 2004-08-23

EUT mode of operation: TX and hopping off.

A Power meter was used with a Peak power sensor.

ME6820-M1

Channel (MHz)	Peak Output Power (dBm)	Limit value (dBm)
2400	20,9	< 21
2441	20,7	
2482	20,5	

This measurement applies also for AP6803-M2.

The output power level was lowered in order to comply with the requirements, see section 2.2.

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

Example calculation:

Peak output power [dBm] = Analyser reading [dBm] + cable loss [dB] + EUT antenna gain [dBi]



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

Date of test: December 15, 2003

EUT mode of operation: TX and hopping off.

Spectrum analyzer settings:

Span: 1 MHz

RBW: 10 kHz

VBW: 10 kHz

Sweep time: 30 ms

Detector: Peak

Trace: Max Hold

AP6803-M2

Channel (MHz)	20 dB Bandwidth (kHz)
2400,6	263
2440,2	275
2479,8	275

ME6820-M1

Channel (MHz)	20 dB Bandwidth (kHz)
2403,3	273
2442,9	278
2482,5	270



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7. CARRIER FREQUENCY SEPARATION

7.1 Test protocol

Date of test: August 30, 2004

EUT mode of operation: TX and hopping on.

Spectrum analyzer settings:

Span: 5 - 10 MHz*

RBW: 100/30 kHz*

VBW: 30 kHz

Sweep time: 30 ms

Detector: Peak

Trace: Max Hold

Note *: for exact value see the graphs in appendix II.

ME6820-M1

Channel (MHz)	Carrier frequency separation from the next channel		Limit value (kHz)
	To the right (kHz)	To the left (kHz)	
2409	3025	--	> 278
2441	2970	3030	> 278
2472	--	2975	> 278

This measurement applies also for AP6803-M2.

Limit = Result from the 20 dB Bandwidth measurements



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

Date of test: August 30, 2004

EUT mode of operation: TX and hopping on.

Spectrum analyzer settings:

Start frequency: 2390 MHz

Stop frequency: 2500 MHz

RBW: 1000 kHz

VBW: 300 kHz

Sweep time: Auto

Detector: Peak

Trace: Max Hold

ME6820-M1

Number of hopping channels	Limit
25	> 15

This measurement applies also for AP6803-M2.



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9. TIME OF OCCUPANCY (DWELL TIME)

9.1 Test protocol

Date of test: August 30, 2004

EUT mode of operation: TX and hopping on.

Spectrum analyzer settings:

Determination of transmitting time T

Span: 0 Hz

RBW: 10 kHz

VBW: 10 kHz

Sweep time: 30 ms

Single sweep

Detector: Peak

Trace: Clear/Write

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

RBW: 10 kHz

VBW: 10 kHz

Sweep time: 10 s

ME6820-M1

Test parameters	Channel (MHz) 2420	Limit value (s)
T (ms)	3.0	-
n	19	-
Dwell time (s) = $T \cdot 10^{-3} \times n$	0,057	< 0,4

This measurement applies also for AP6803-M2.



10. BAND EDGE COMPLIANCE

10.1 Measurement set-up

For measurement set-up see section 11.4 Measurement set-up.

10.2 Test protocol, average measurement

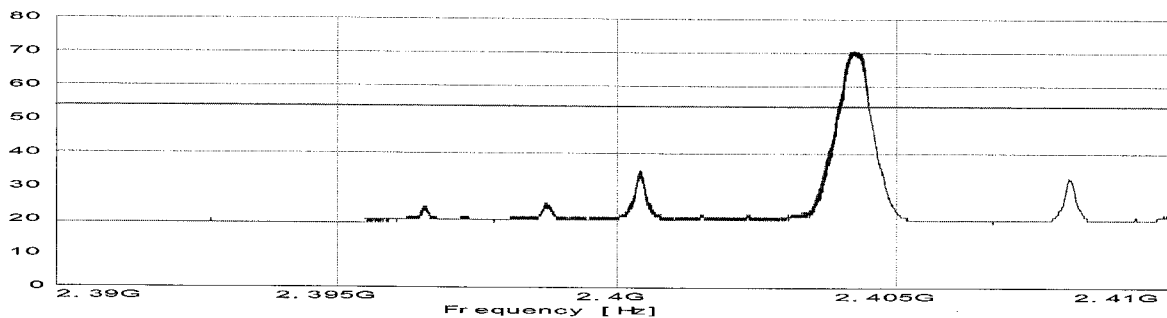
Date of test: August 23, 2004

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):	100	100
Sweep time (ms):	5	5
Detector:	Average	Average

10.2.1. Band edge compliance at 2400 MHz

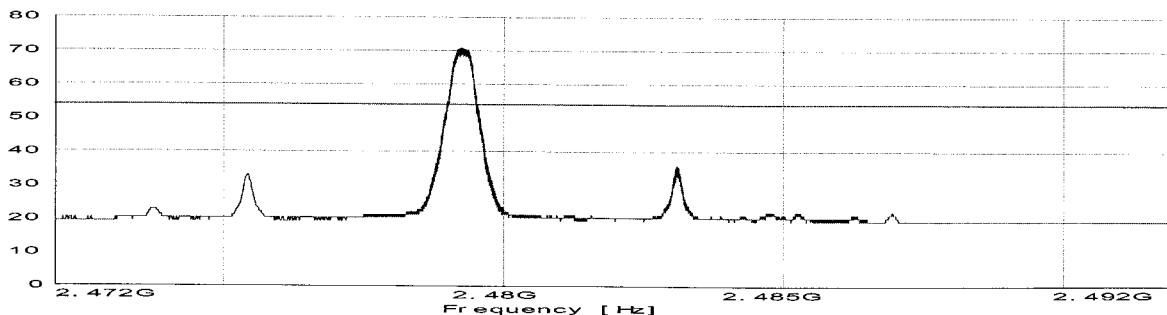
ME6820-M1



This measurement applies also for AP6803-M2.

10.2.2. Band edge compliance at 2483.5 MHz

ME6820-M1



This measurement applies also for AP6803-M2.



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11. OUT OF BAND SPURIOUS EMISSIONS, RADIATED

11.1 Operating environment

Temperature: 21 - 24 °C (10 - 40 °C)
 Relative Humidity: 15 - 24 % (10 - 90 %)

11.2 Measurement uncertainty

Radiated disturbance electric field intensity, 30 – 1000 MHz: $\pm 4,6$ dB
 Radiated disturbance electric field intensity, 1000 – 26000 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	CBL6111B	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, V1.60	
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
Filter	K&L	4H10-X4500/18000-0/0	5133
Filter	K&L	6N45-2450/T100-0/0	12389



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11.4 Measurement set-up

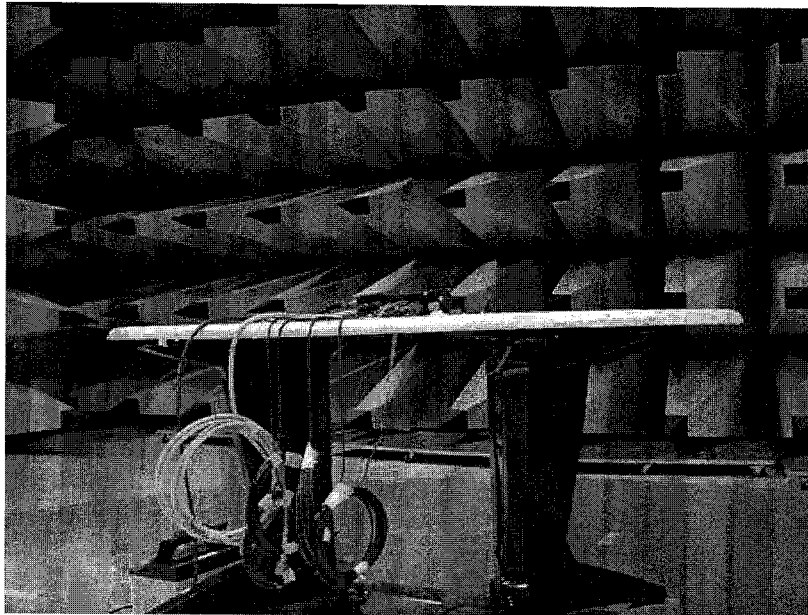
11.4.1 Test site: Semi-anechoic shielded chamber (30 – 1000 MHz)

The radiated disturbance electric field intensity was measured in a semi-anechoic chamber at a distance of 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.

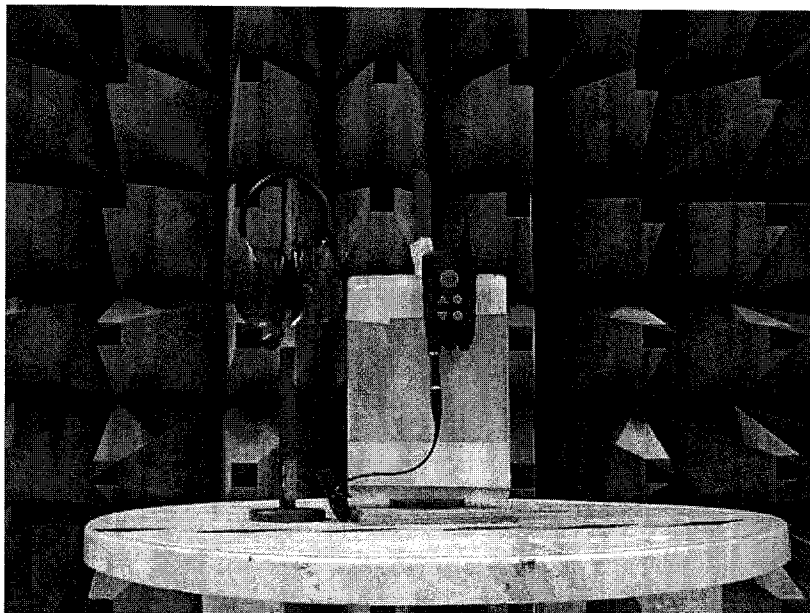
An overview sweep with peak detection of the electric field intensity was performed with the measurement receiver in max-hold and with the antenna placed 1,5 m, 2,5 m and 3,5 m above the floor. The polarisation was horizontal and vertical. The measurements were repeated with the EUT rotated in 90-degree 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 quasi-peak measurements were carried out.

AP6803-M2



ME6820-M1



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11.4.2 Test site: Bluetooth anechoic shielded chamber (1 – 26 GHz)

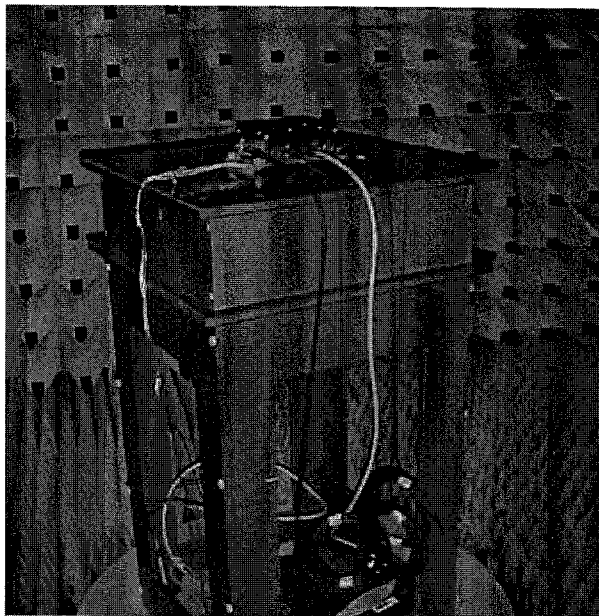
In the Bluetooth anechoic chamber the EUT was placed on a non-metallic table, 1.4 m above the floor. The radiated disturbance electric field intensity was measured at a distance of 3 m. The specified test mode was enabled.

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.

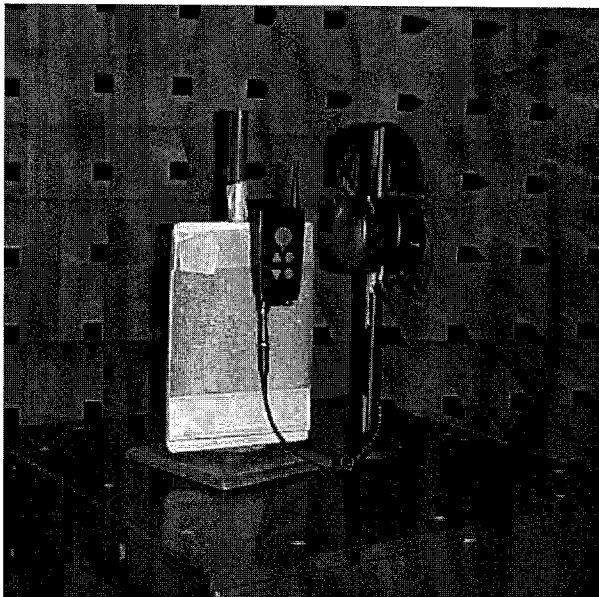
The antenna output port was connected to a 2.4 GHz band rejection filter in the frequency range from 1 to 4 GHz in order to avoid saturation to the input stage of the spectrum analyzer.

A 2.5 GHz high pass filter was used in the frequency range from 4 to 13 GHz.

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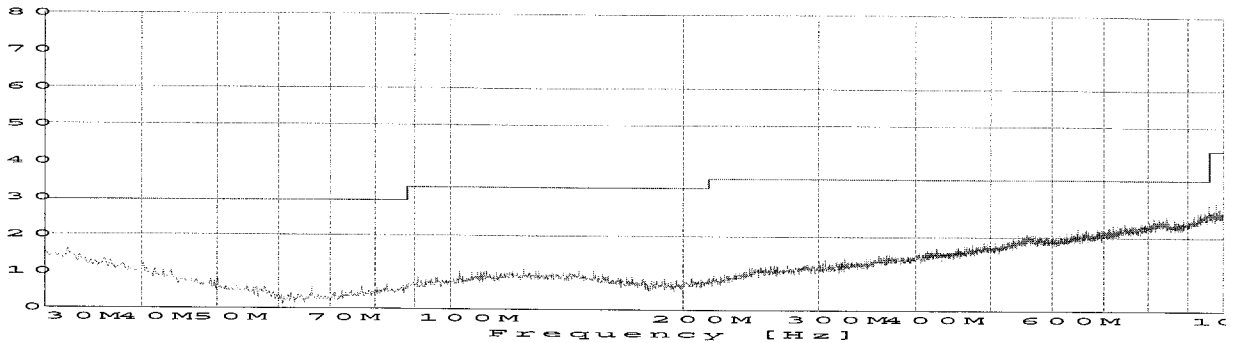
11.5 Diagrams

11.5.1 Semi-anechoic shielded chamber

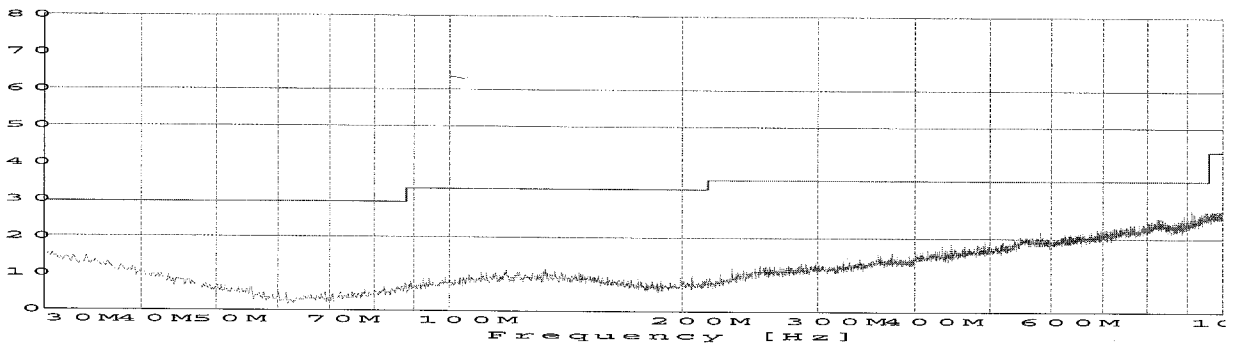
Date of test: December 5, 2003

AP6803-M2

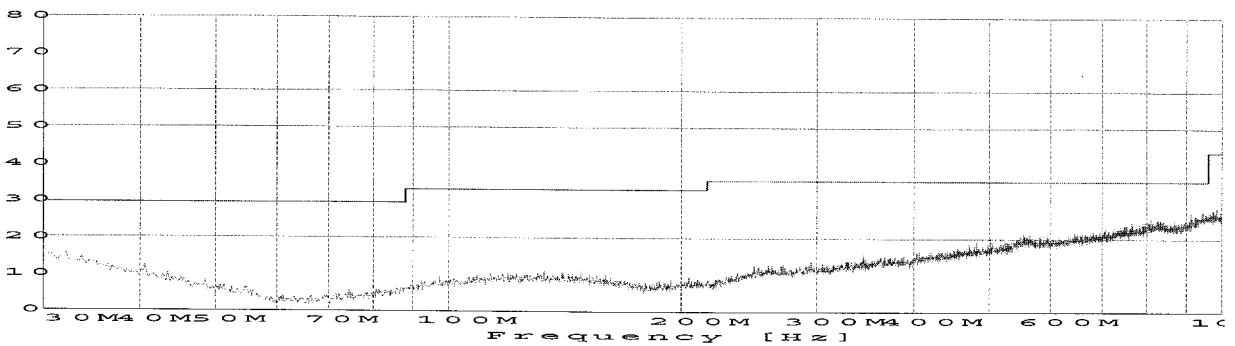
30 – 1000 MHz, max peak at a distance of 10 m on the lower TX channel



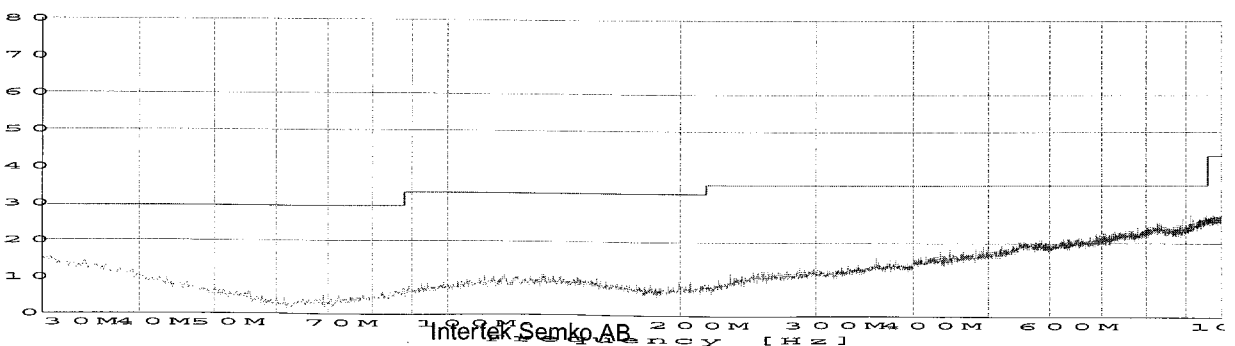
30 – 1000 MHz, max peak at a distance of 10 m on the middle TX channel



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



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



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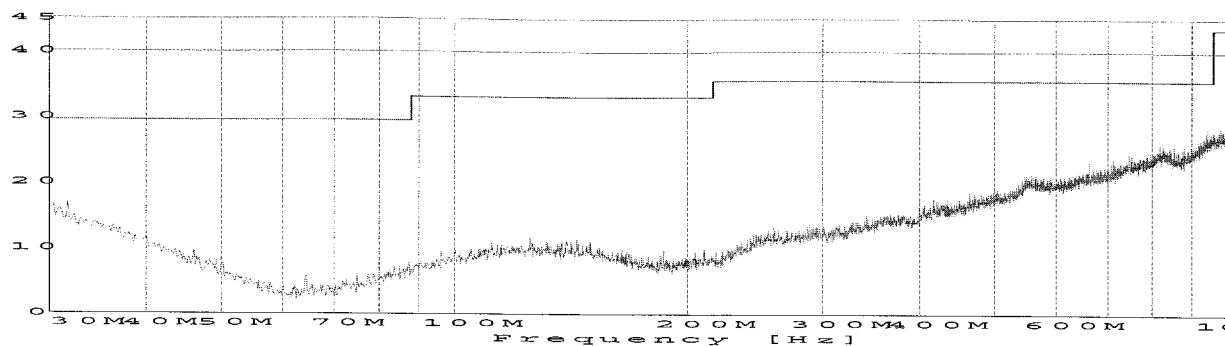
Torshamnsgatan 43, Box 1103, SE-164 22 Kista, Sweden

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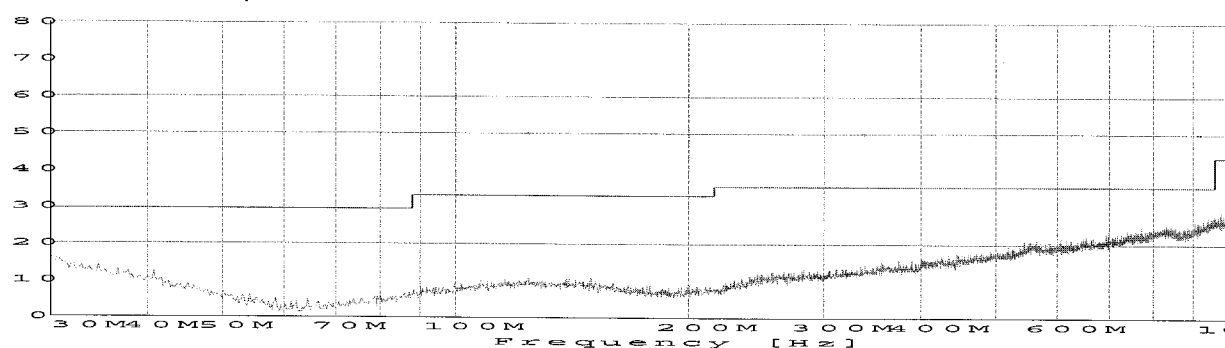
Registered in Sweden: No SE556024059901, Registered office: As address

ME6820-M1

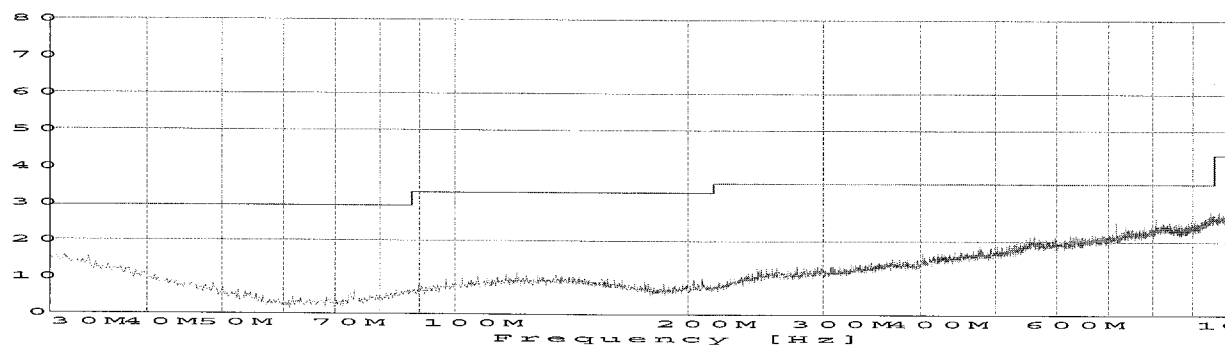
30 – 1000 MHz, max peak at a distance of 10 m on the lower TX channel



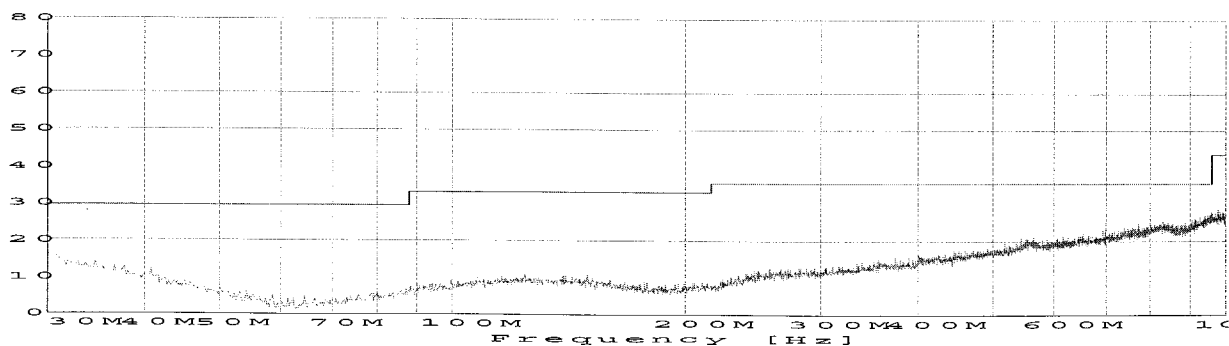
30 – 1000 MHz, max peak at a distance of 10 m on the middle TX channel



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



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



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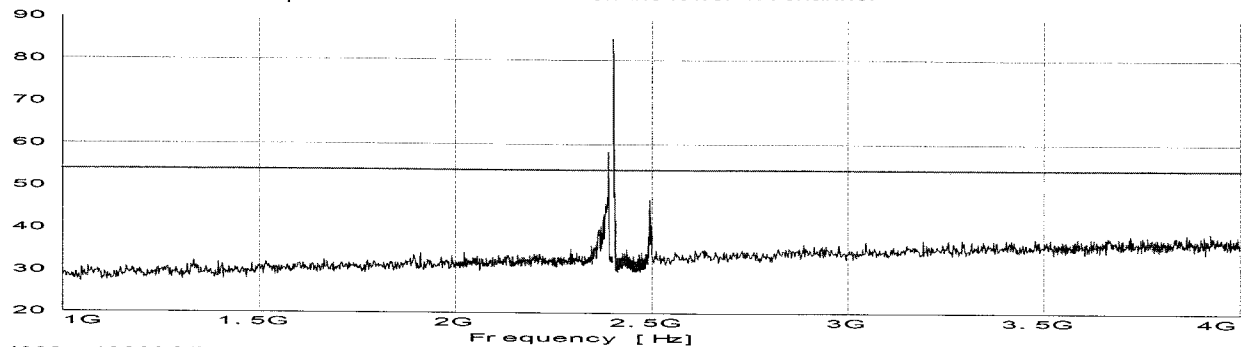
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11.5.2 Bluetooth anechoic shielded chamber

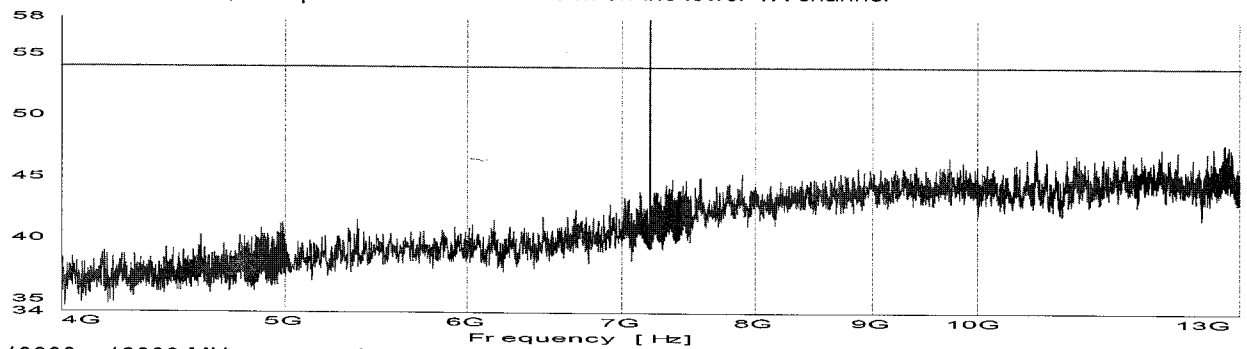
Date of test: December 3 – 16, 2003

AP6803-M2

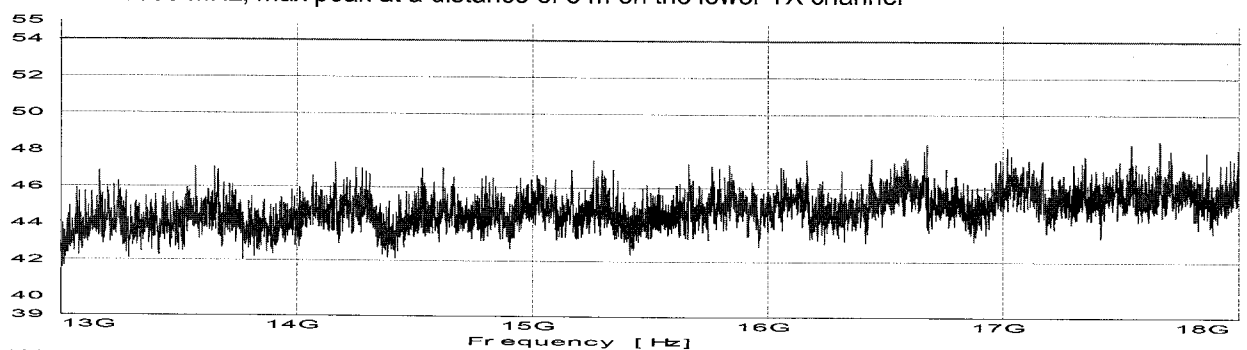
1000 – 4000 MHz, max peak at a distance of 3 m on the lower TX channel



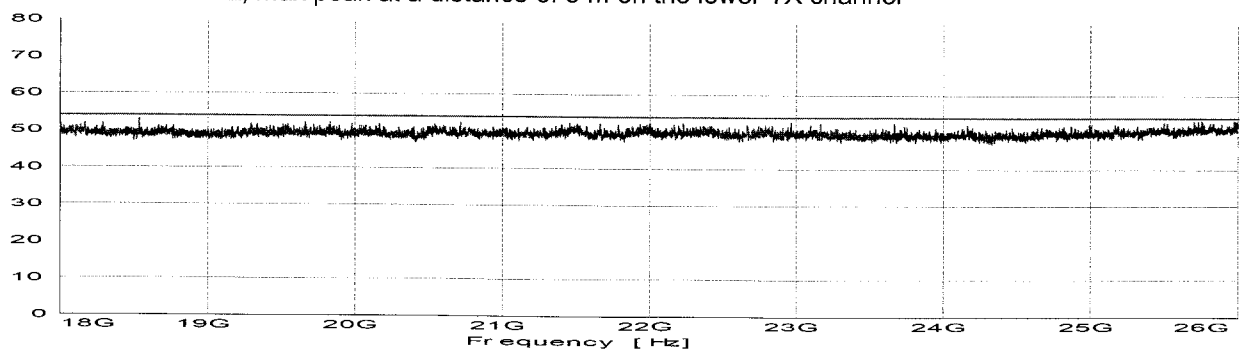
4000 – 13000 MHz, max peak at a distance of 3 m on the lower TX channel



Frequency [Hz]
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



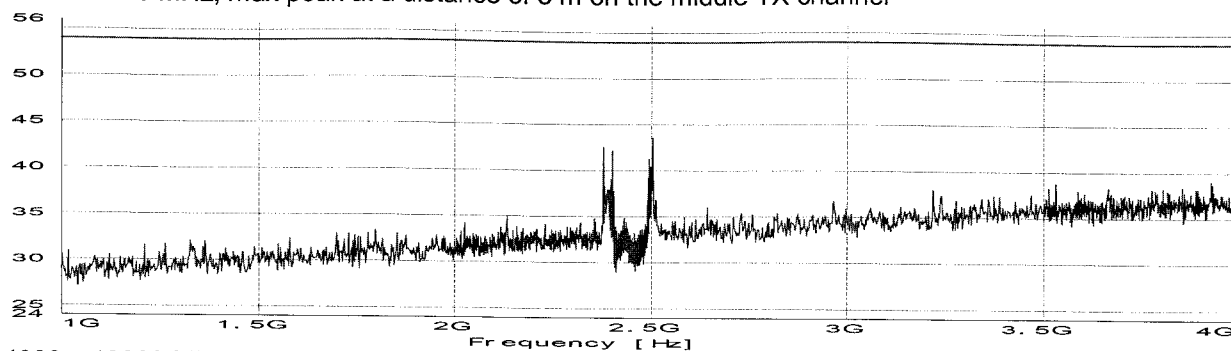
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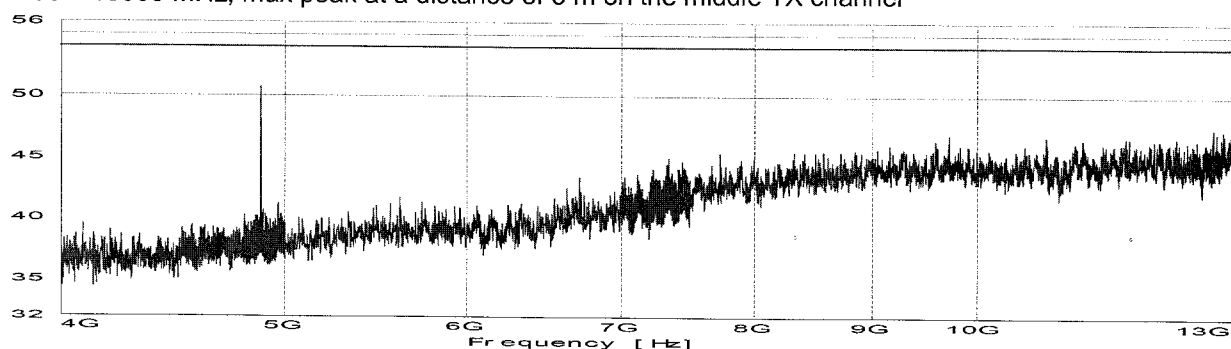
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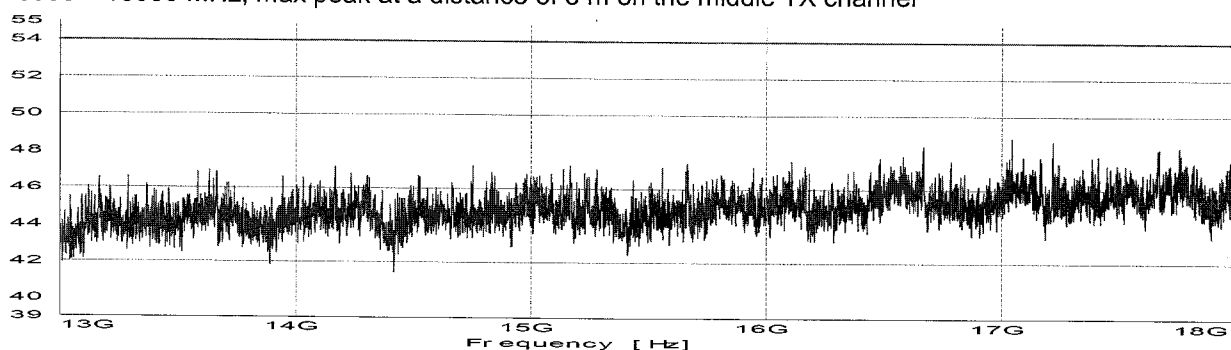
1000 – 4000 MHz, max peak at a distance of 3 m on the middle TX channel



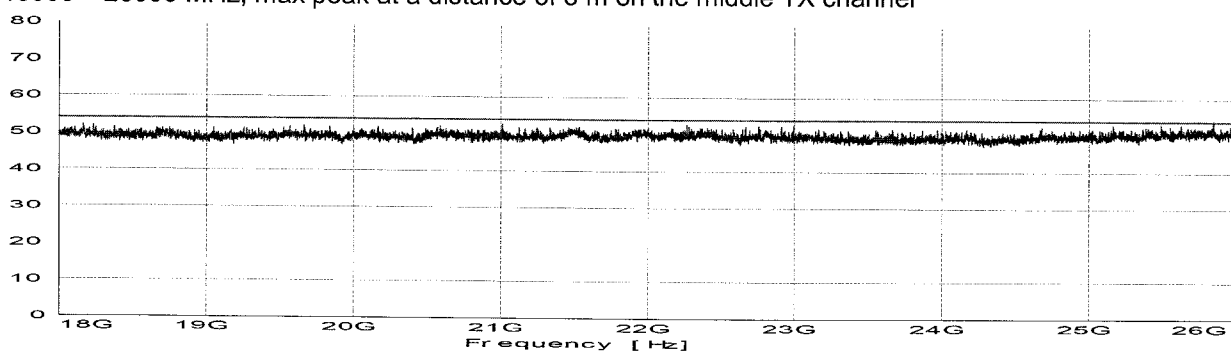
4000 – 13000 MHz, max peak at a distance of 3 m on the middle TX channel



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



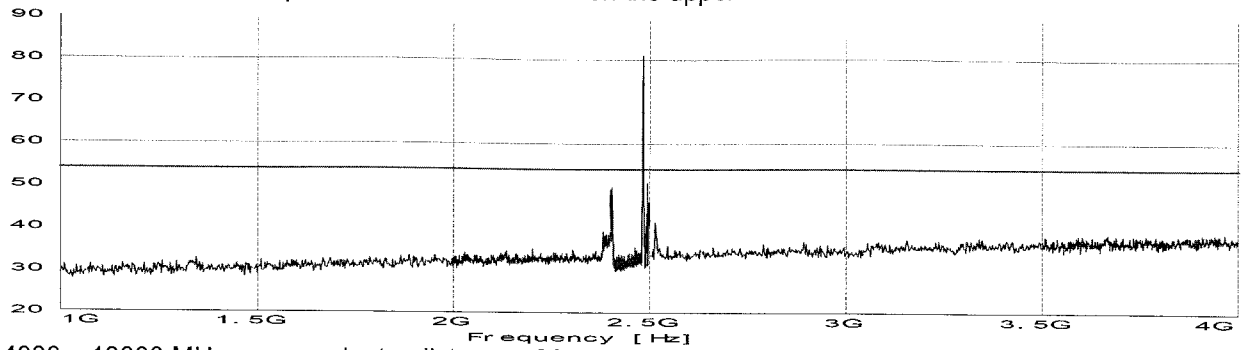
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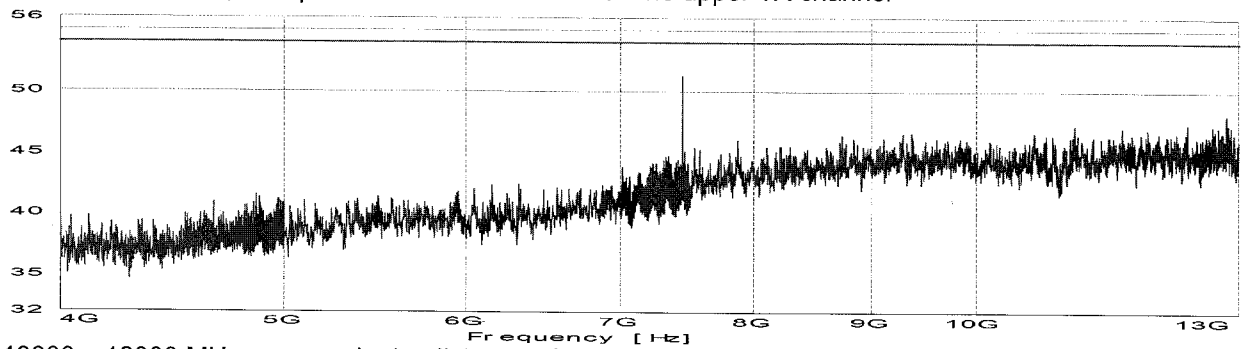
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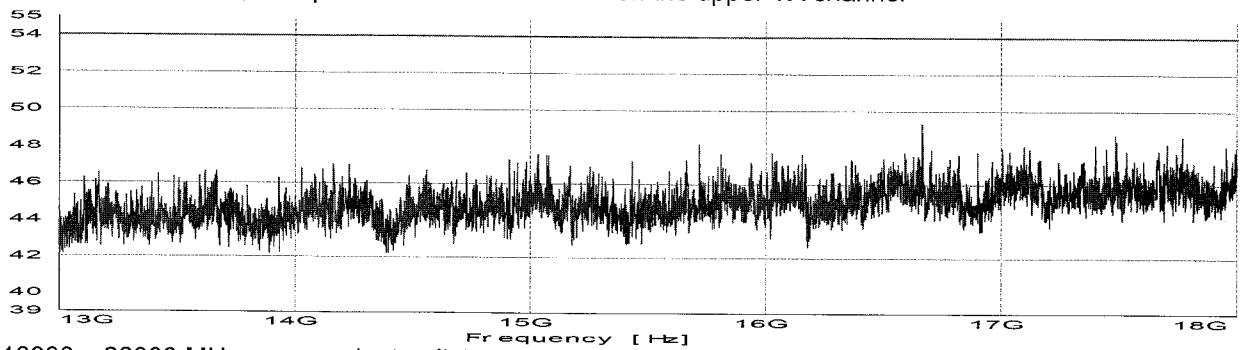
1000 – 4000 MHz, max peak at a distance of 3 m on the upper TX channel



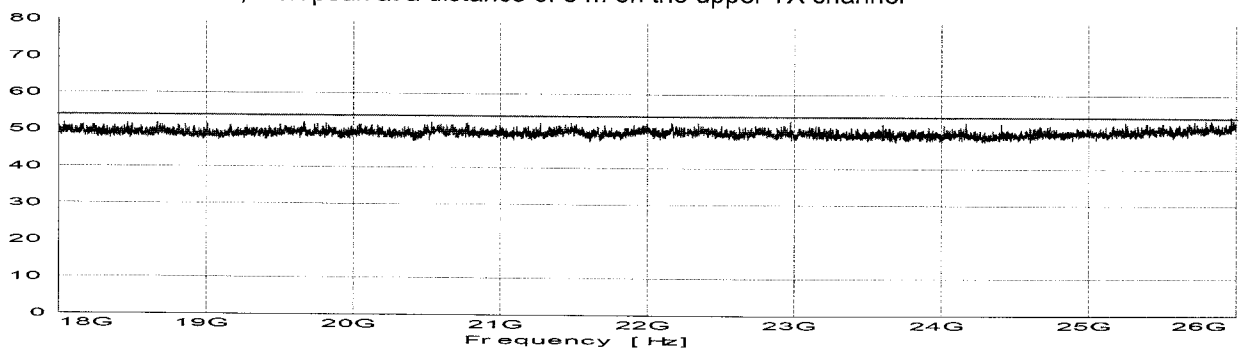
4000 – 13000 MHz, max peak at a distance of 3 m on the upper TX channel



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



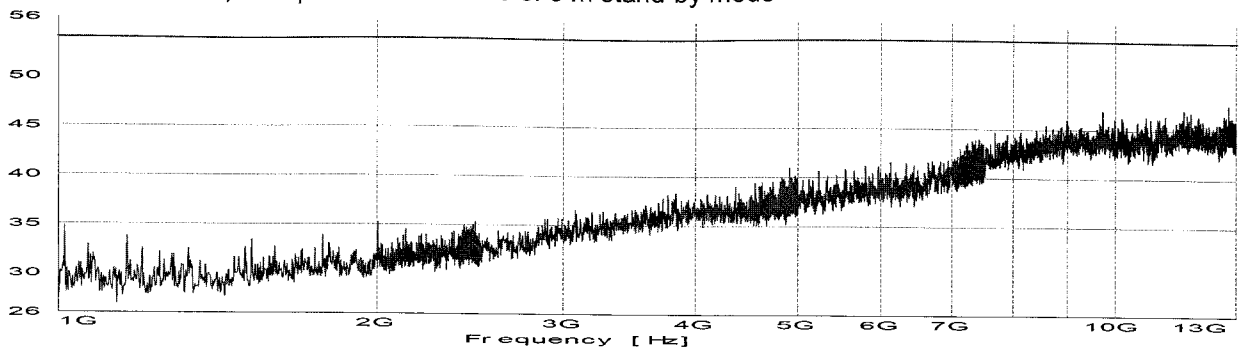
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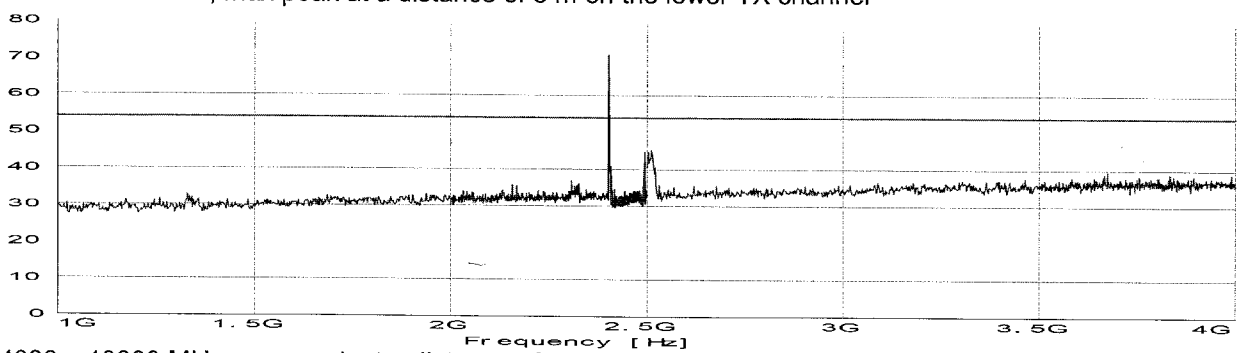
Registered in Sweden: No SE556024059901, Registered office: As address

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

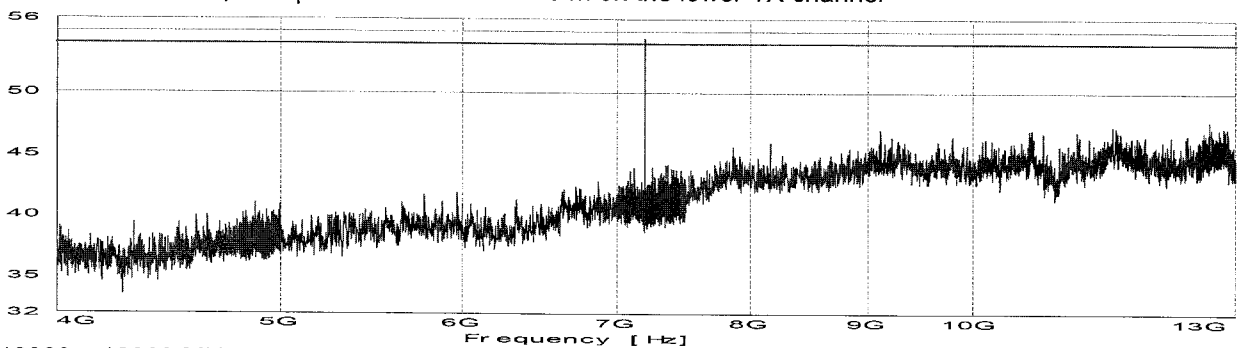


ME6820-M1

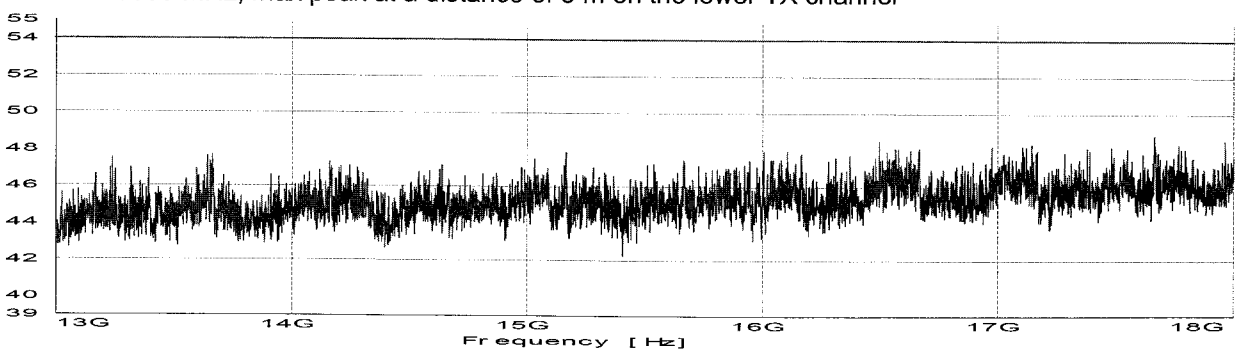
1000 – 4000 MHz, max peak at a distance of 3 m on the lower TX channel



4000 – 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



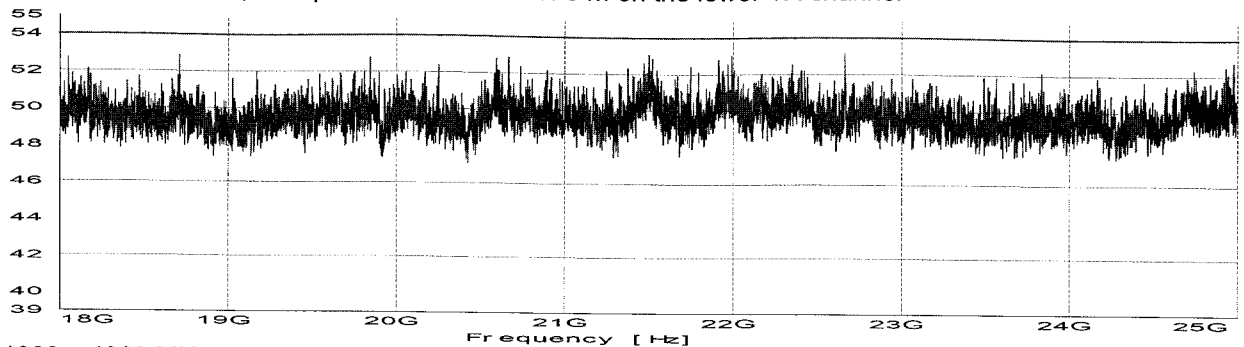
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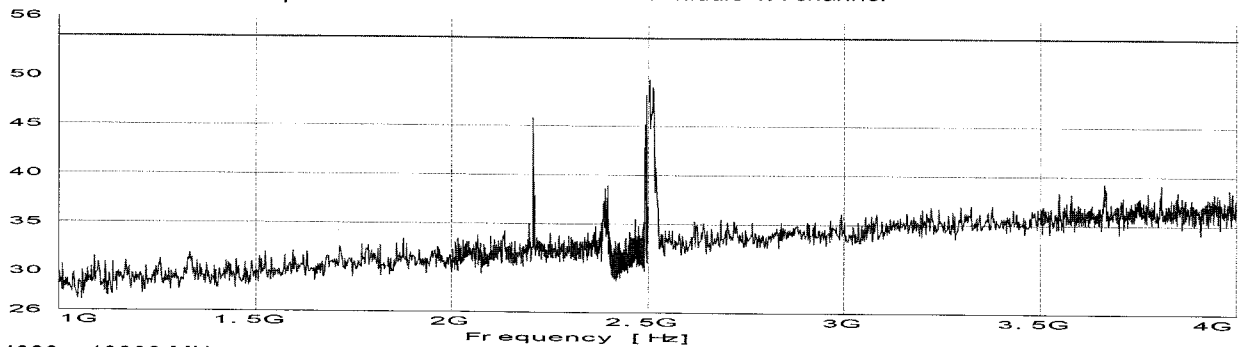
Telephone +46 8 750 00 00, Fax +46 8 750 60 30, www.sweden.intertek-etlsemko.com

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

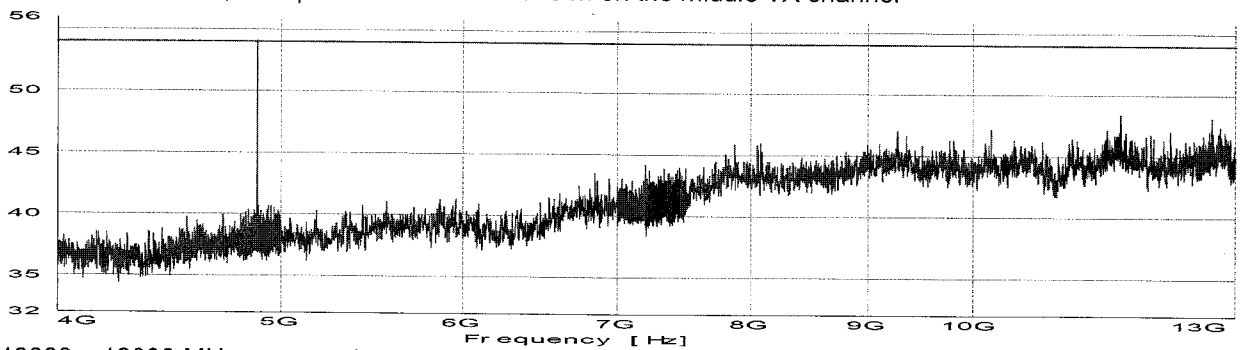
18000 – 25000 MHz, max peak at a distance of 3 m on the lower TX channel



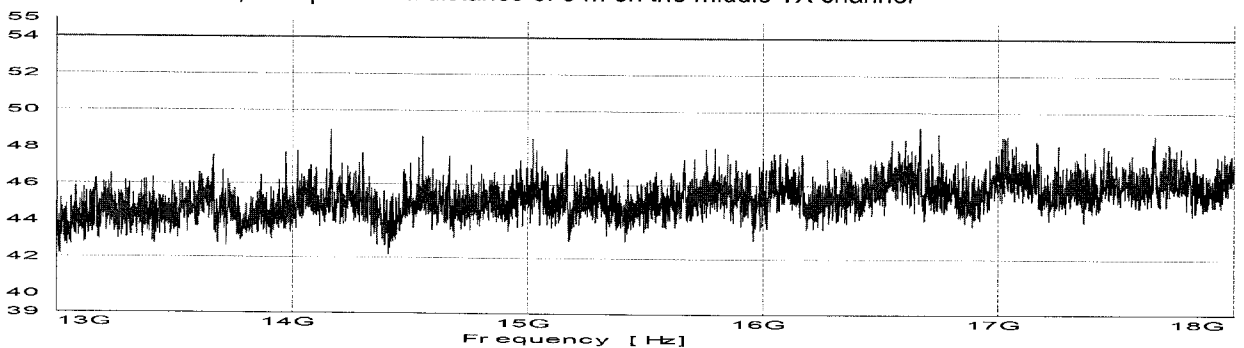
1000 – 4000 MHz, max peak at a distance of 3 m on the middle TX channel



4000 – 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



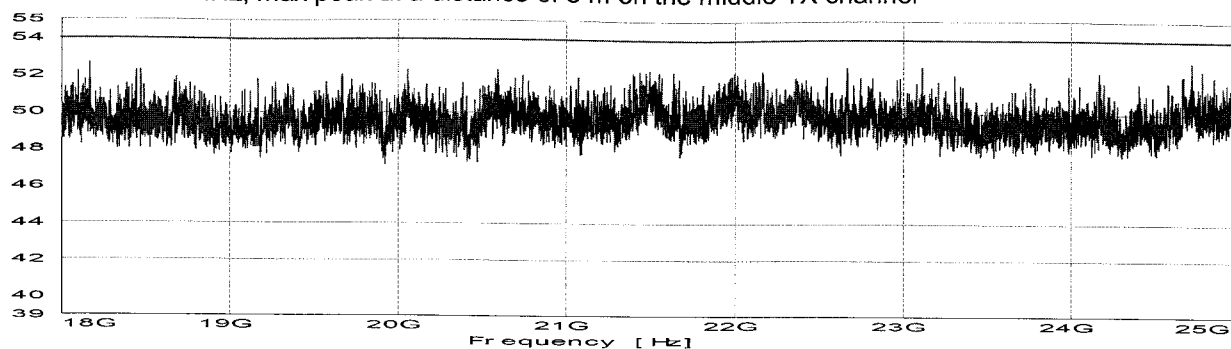
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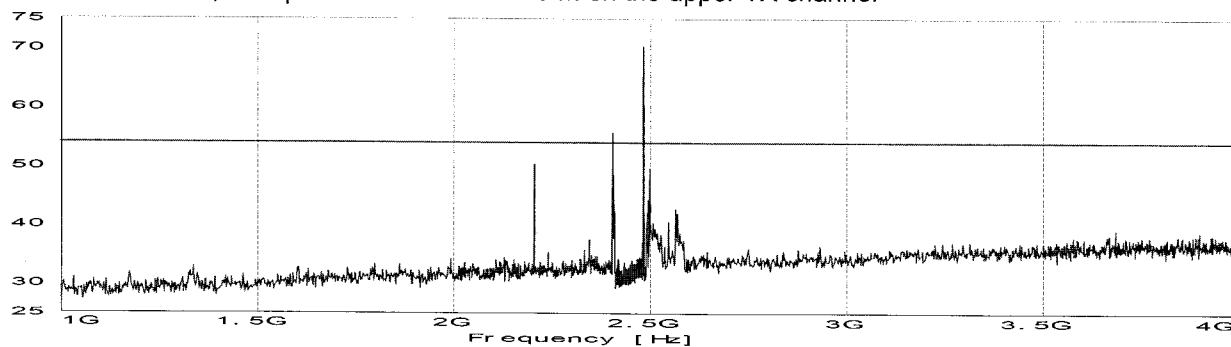
Telephone +46 8 750 00 00, Fax +46 8 750 60 30, www.sweden.intertek-etlsemko.com

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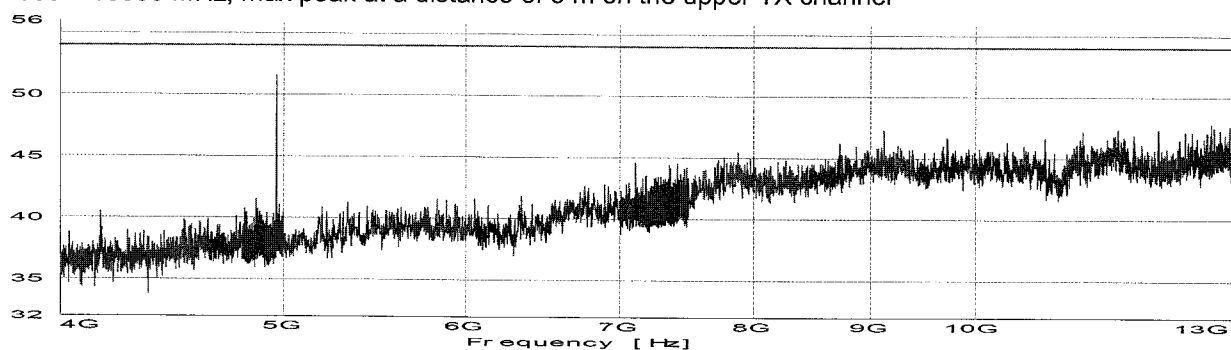
18000 – 25000 MHz, max peak at a distance of 3 m on the middle TX channel



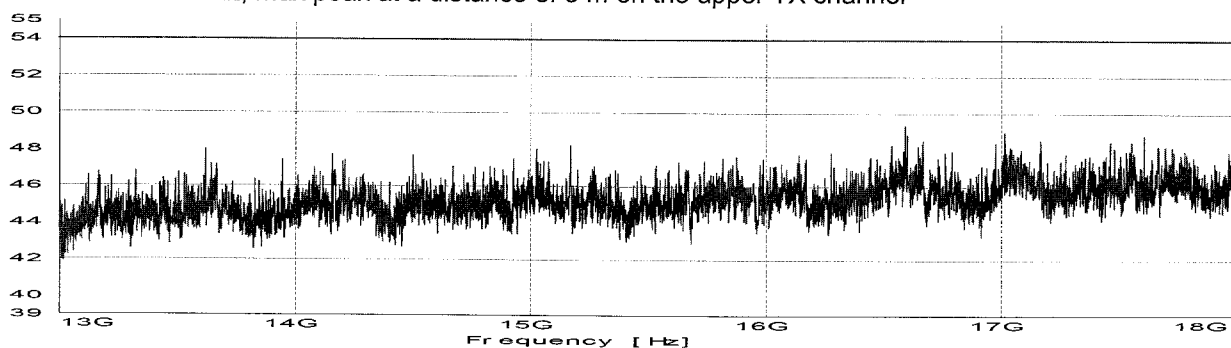
1000 – 4000 MHz, max peak at a distance of 3 m on the upper TX channel



4000 – 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



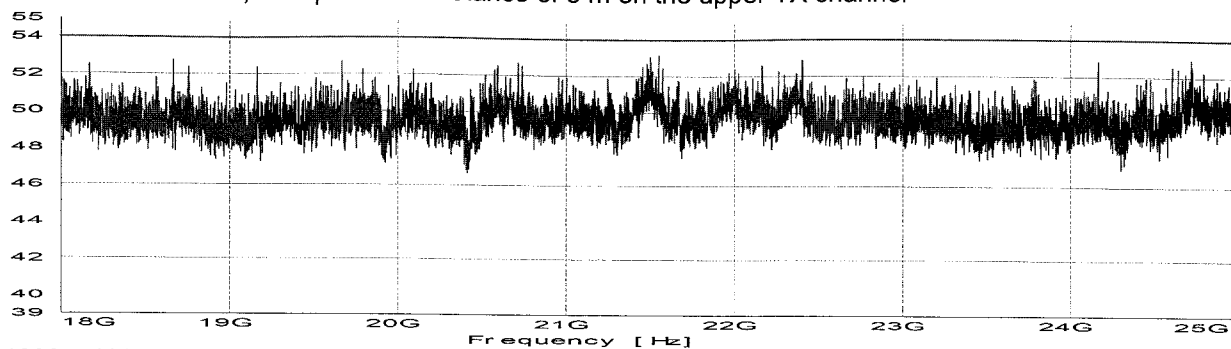
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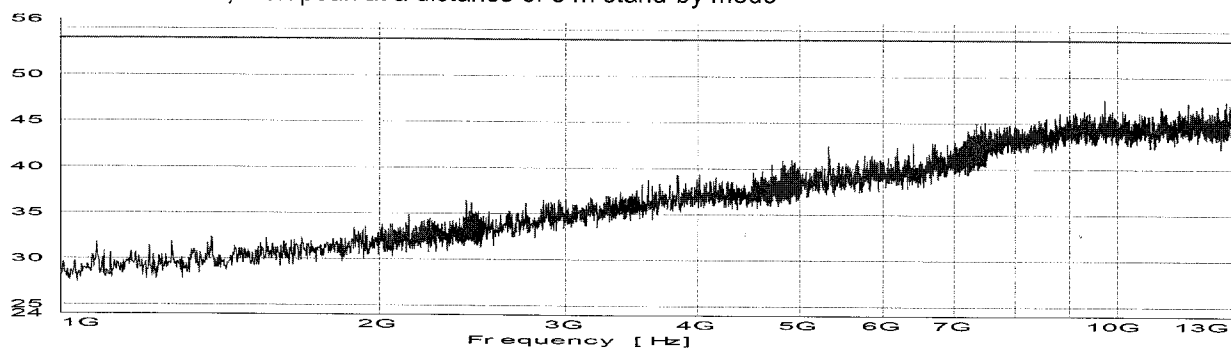
Telephone +46 8 750 00 00, Fax +46 8 750 60 30, www.sweden.intertek-etlsemko.com

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

18000 – 25000 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 stand-by mode



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11.5.3 Test protocol

AP6803-M2

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	--	*	--	30.0	* Noise floor
88 - 216	120	--	*	--	33.5	
216 - 960	120	--	*	--	36.0	
960 - 1000	120	--	*	--	44.0	
2390	1000	58	46	74	54	LF
2494	1000	47		74	54	LF
2404	1000	50		74	54	HF
4882	1000	64	49	74	54	MF
7201	1000	66	52	74	54	LF
7449	1000	61	48	74	54	HF
13000 - 18000	1000	--	*	--	54	*Noise floor
18000 - 25000	1000	--	*	--	54	*Noise floor

ME6820-M1

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	--	*	--	30.0	* Noise floor
88 - 216	120	--	*	--	33.5	
216 - 960	120	--	*	--	36.0	
960 - 1000	120	--	*	--	44.0	
2204	1000	50		74	54	HF
4882	1000	58	44	74	54	MF
4966	1000	51		74	54	
7201	1000	61	49	74	54	
13000 – 18000	1000	--	*	--	54	*Noise floor
18000 - 25000	1000	--	*	--	54	*Noise floor

LF= low frequency/channel
MF= middle frequency/channel
HF= high frequency/channel



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12. OUT OF BAND SPURIOUS EMISSIONS, CONDUCTED

12.1 Test equipment

Equipment	Manufacturer	Type	SEMKO No.
Spectrum analyzer:	HP	8593E	6661
Attenuator 10 dB	Narda	776B-10	8337
Attenuator 10 dB	R&S	RBU 50	8776

HP = Hewlett & Packard

R&S= Rhode & Schwarz

12.2 Measurement set-up

The EUT was connected to a spectrum analyzer through a 20 dB power attenuator.

12.3 Test protocol

Strength of conducted spurious emissions						
Frequency [MHz]	RBW [kHz]	Measured level		Limit		Note
		Peak [dB(μV)]	QP/AV [dB(μV)]	Peak [dBμV]	QP/AV [dBμV]	
30 - 1000	100	< 63	-	-	106	Noise floor
1000 - 6000	100	< 78	-	-	106	Noise floor
6000 - 25000	100	< 90	-	-	106	Noise floor

Limit: In any 100 kHz bandwidth outside the operating frequency band (2400 – 2483,5 MHz), the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.



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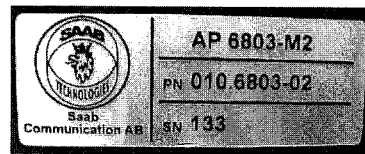
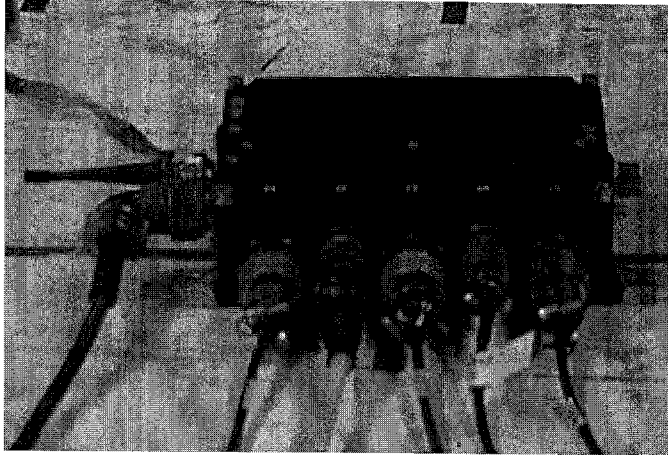
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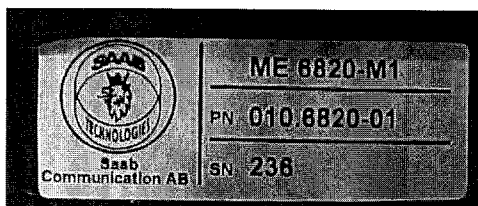
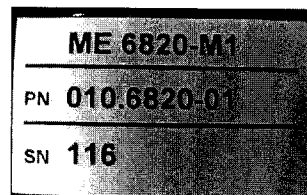
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APPENDIX I – PHOTOS OF THE EUT

AP6803-M2



ME6820-M1



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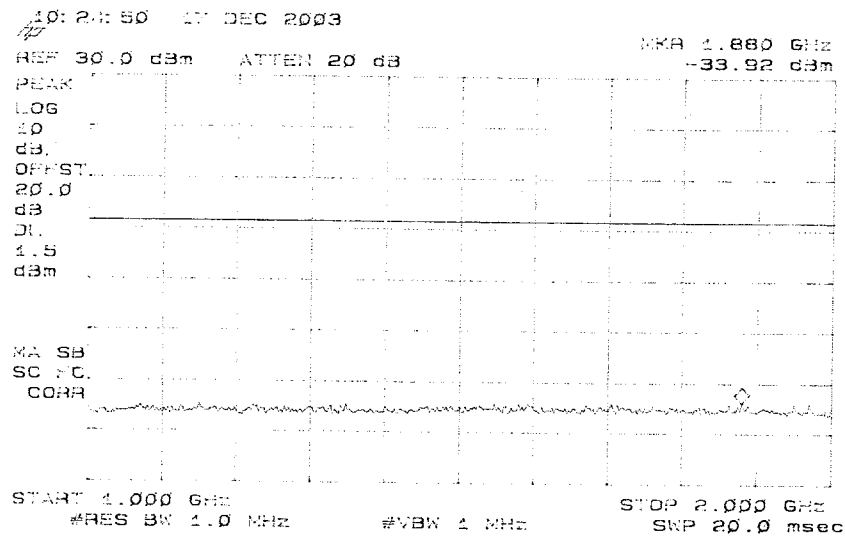
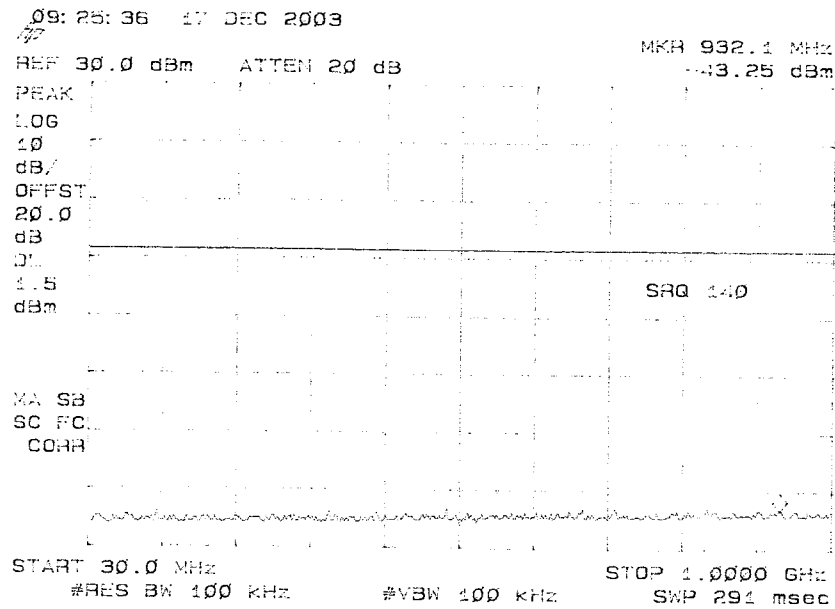
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APPENDIX II – GRAPHS

AP 6803-M2 lowest frequency

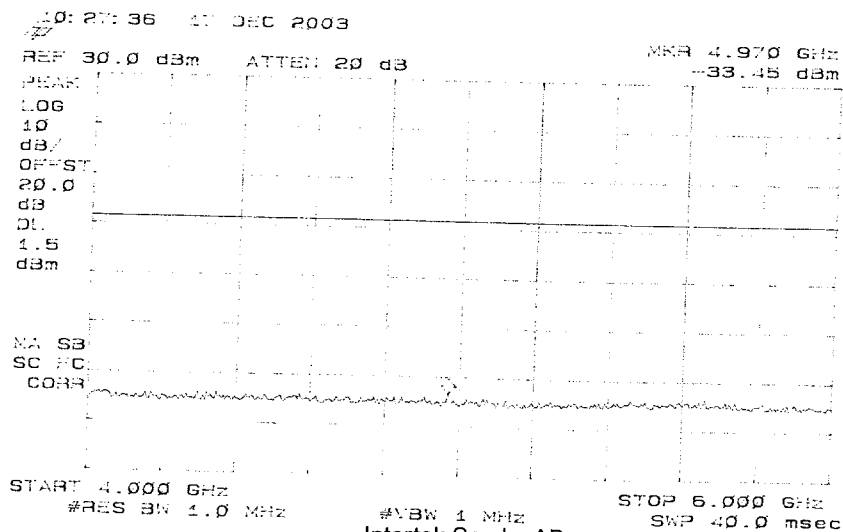
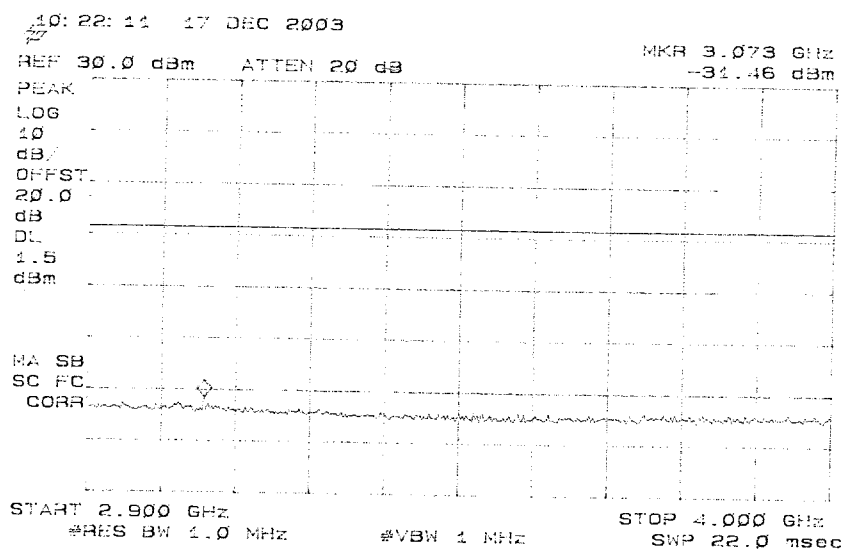
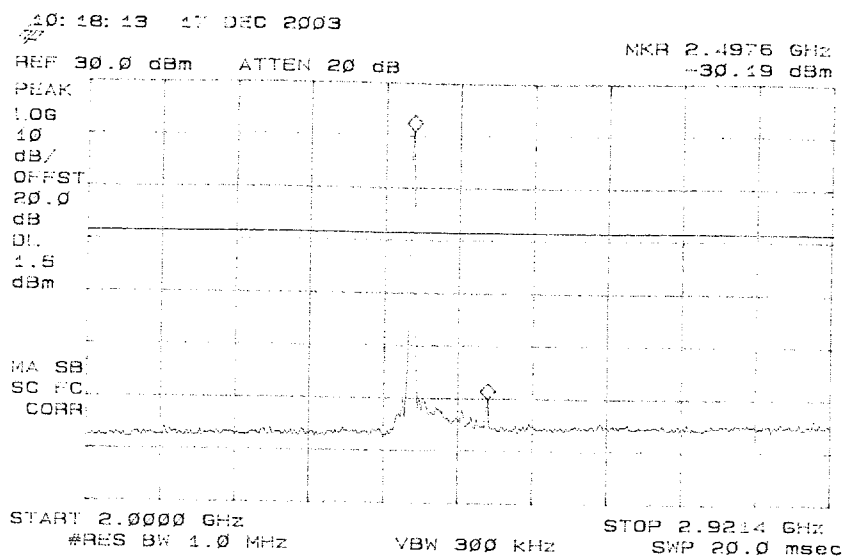


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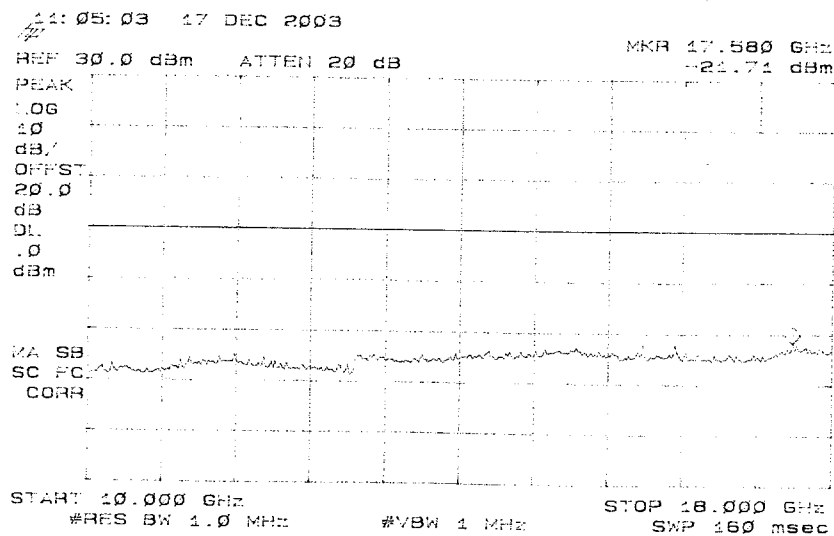
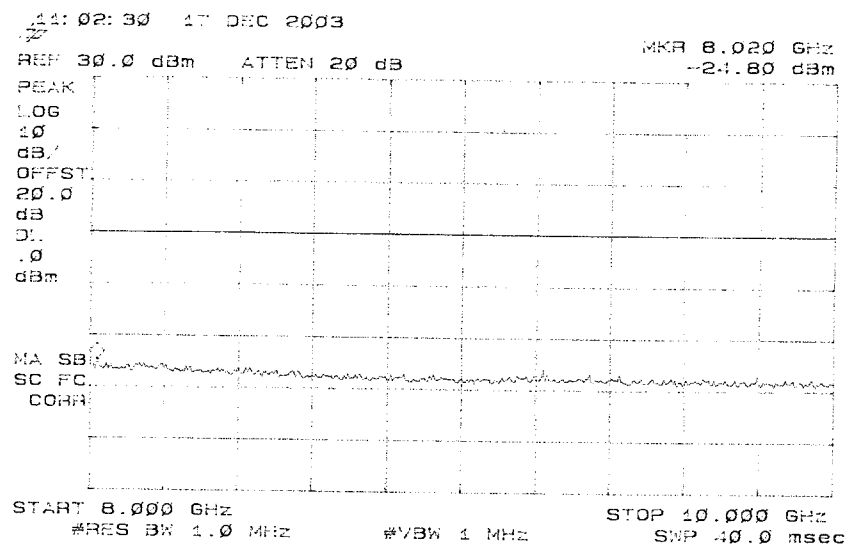
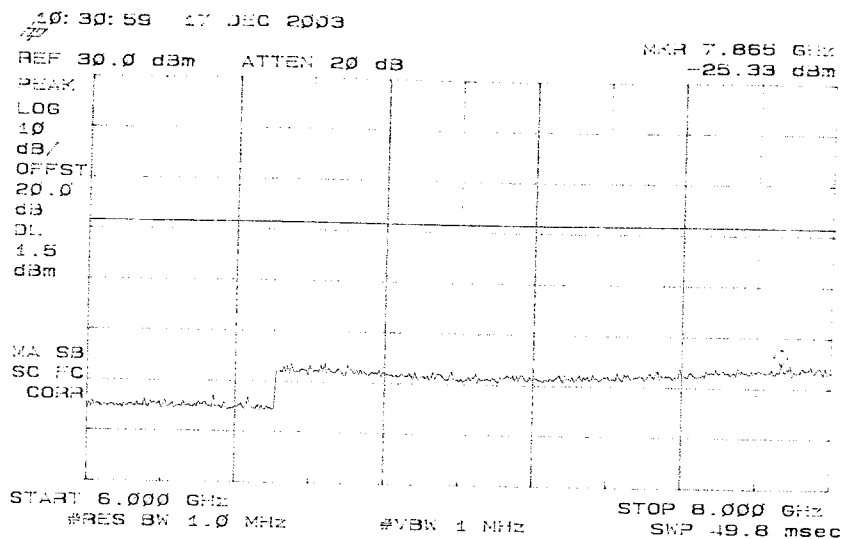
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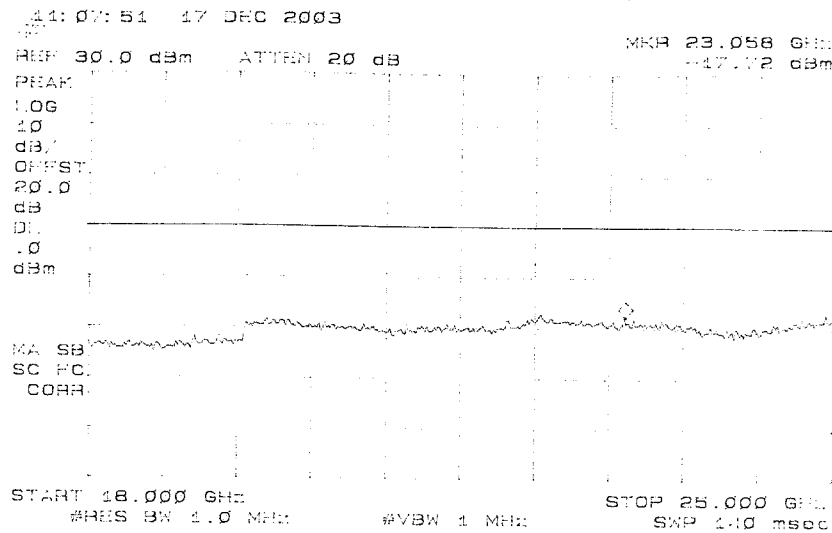


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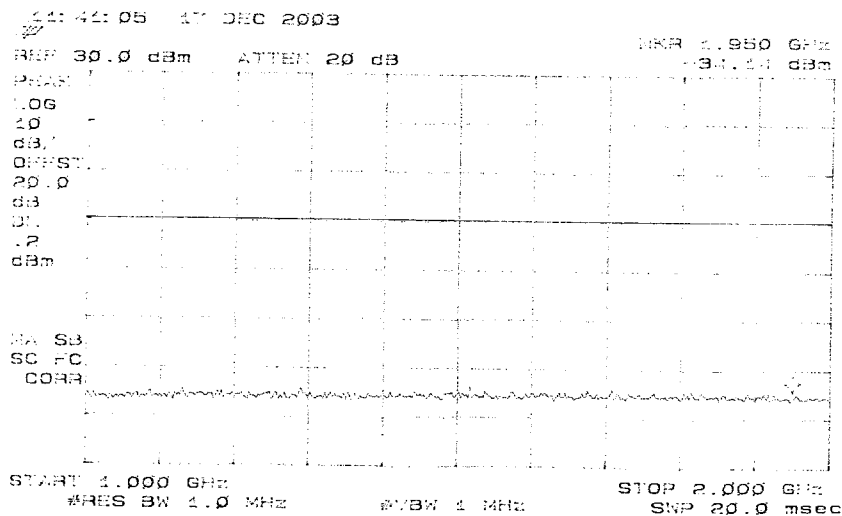
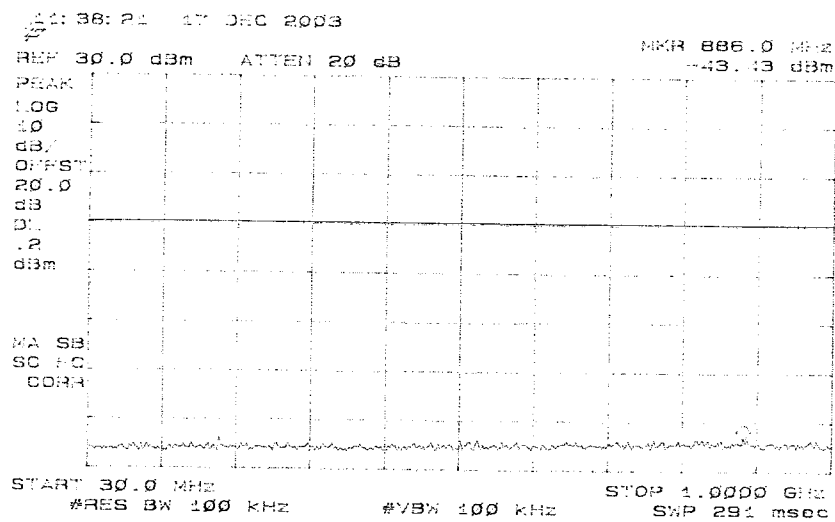
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AP 6803-M2 middle frequency

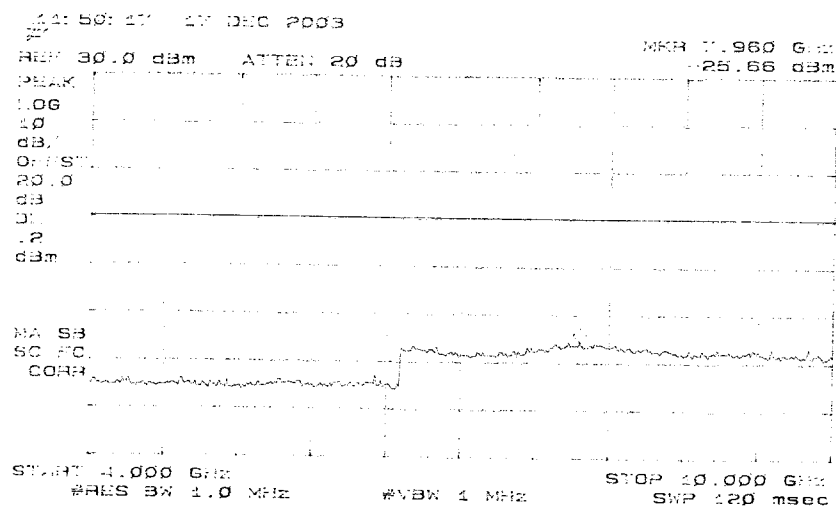
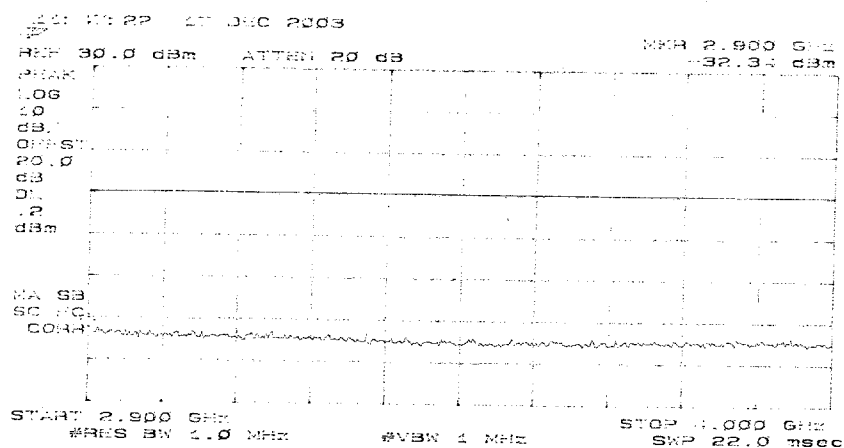
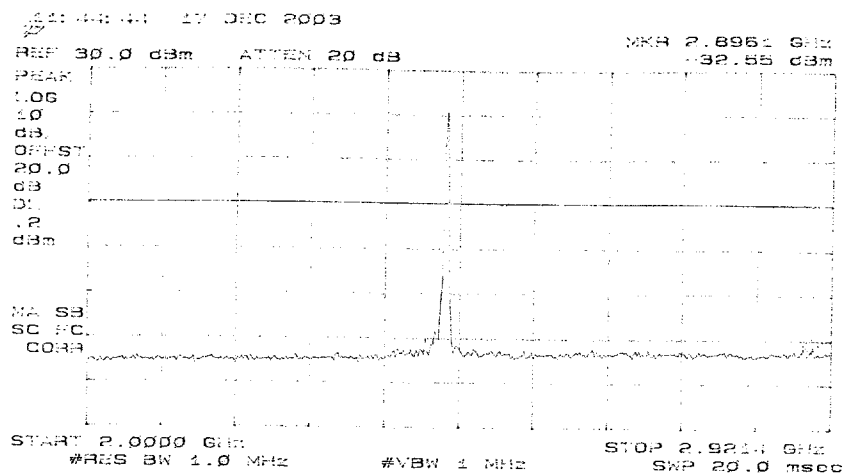


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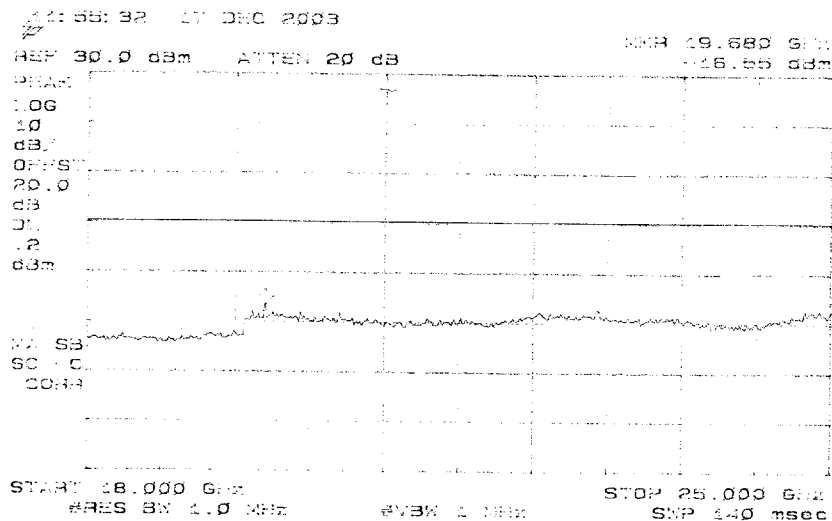
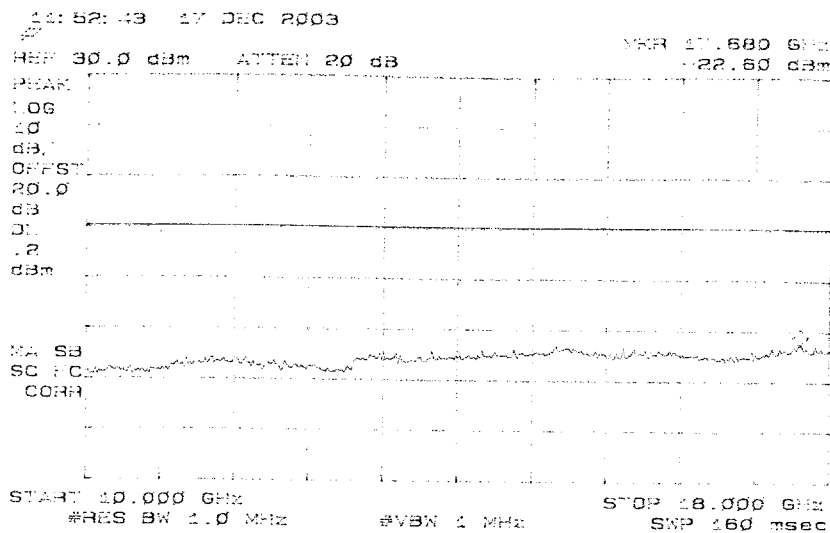


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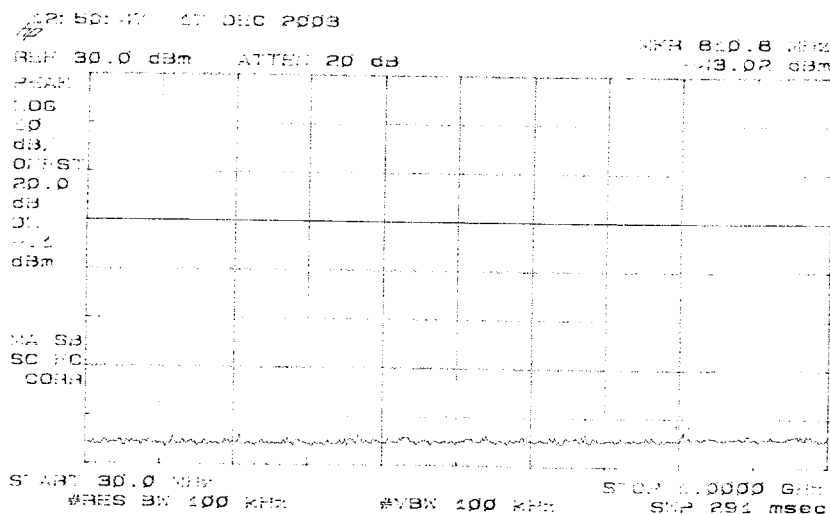
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AP 6803-M2 highest frequency

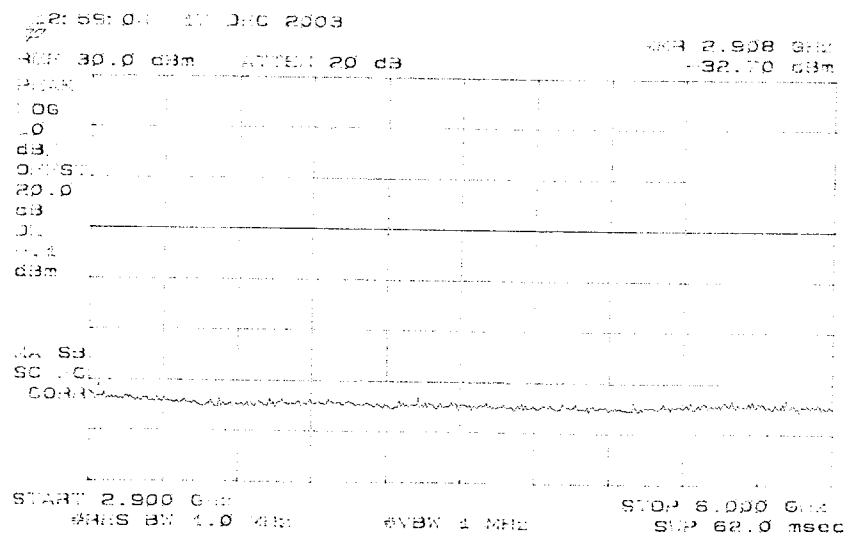
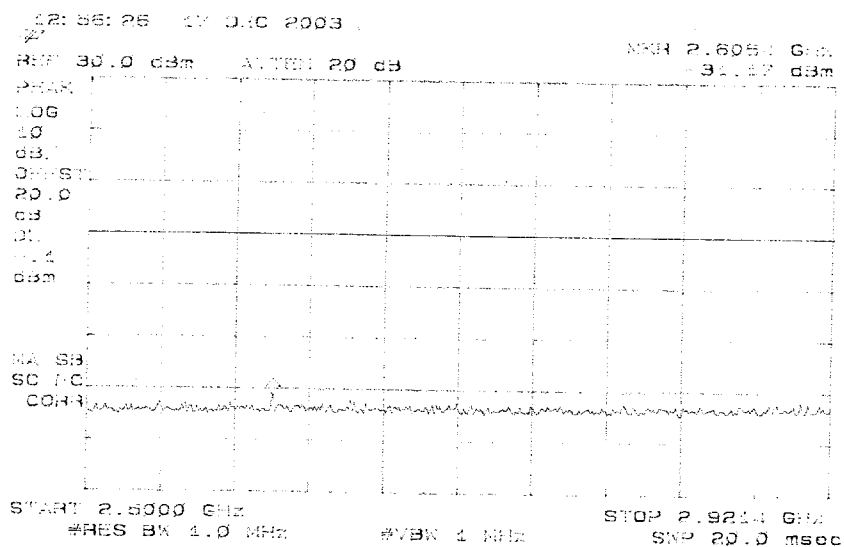
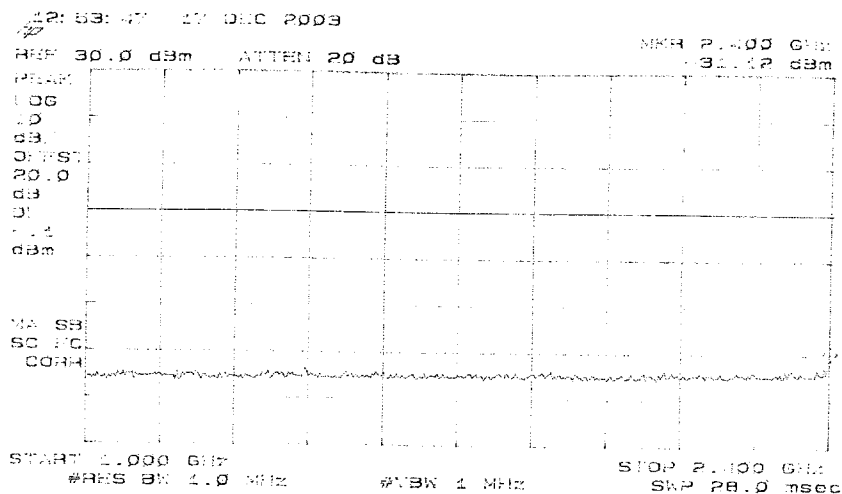


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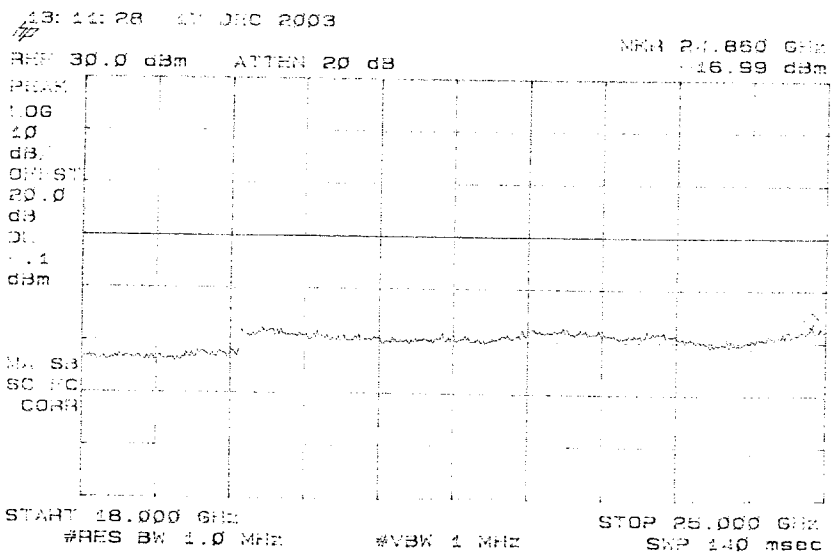
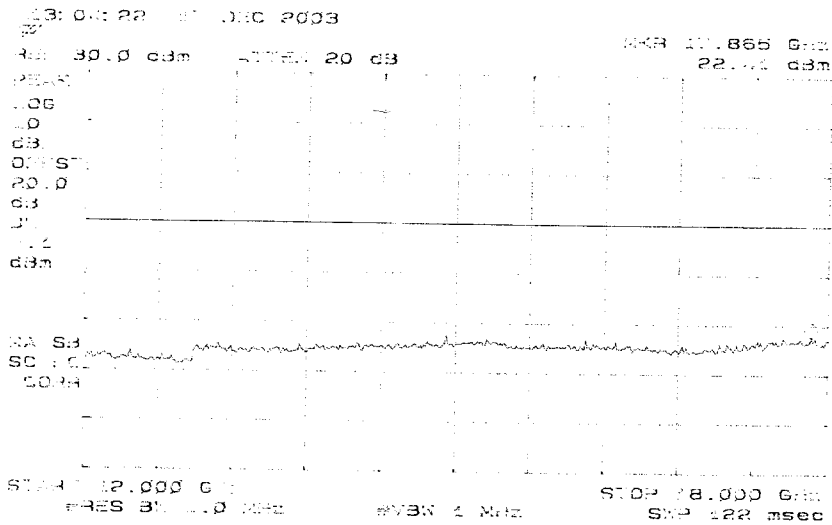
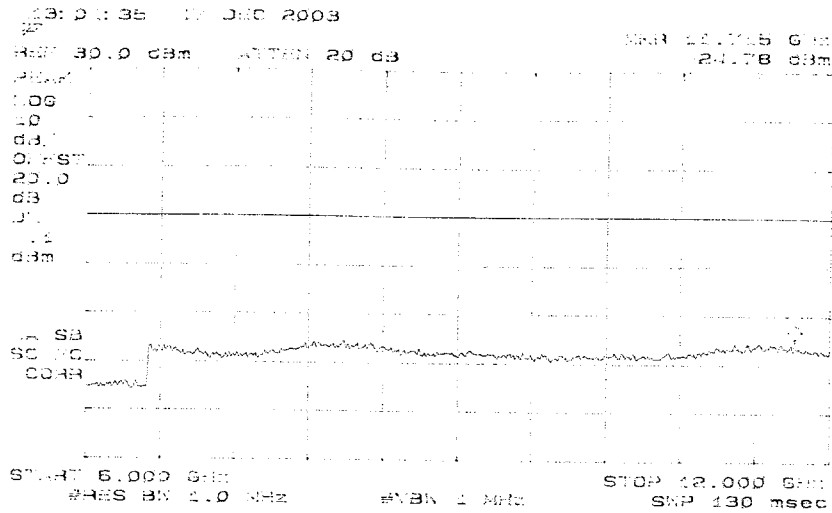


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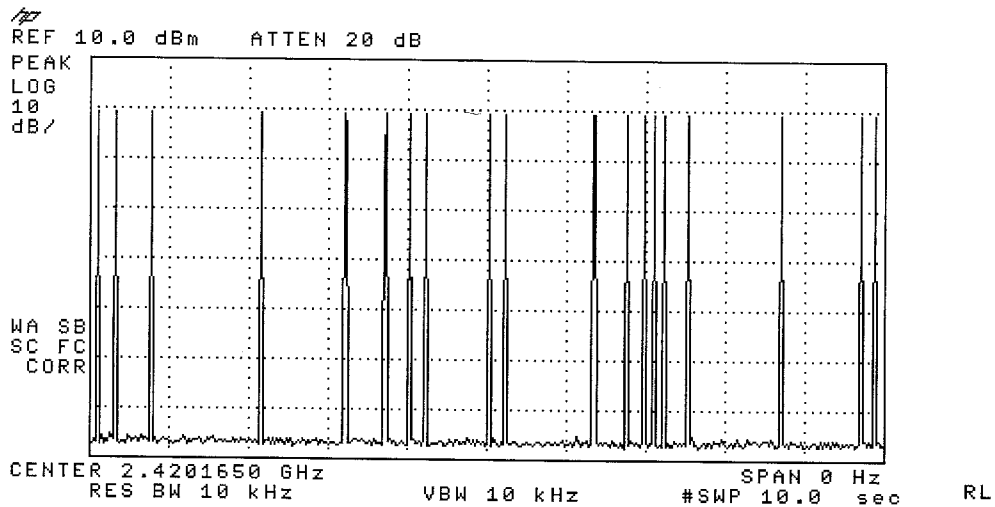
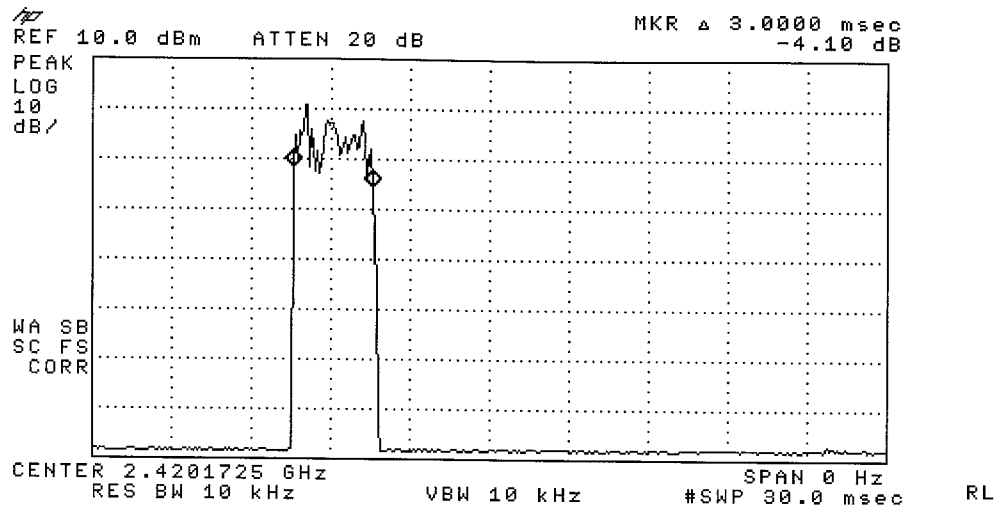
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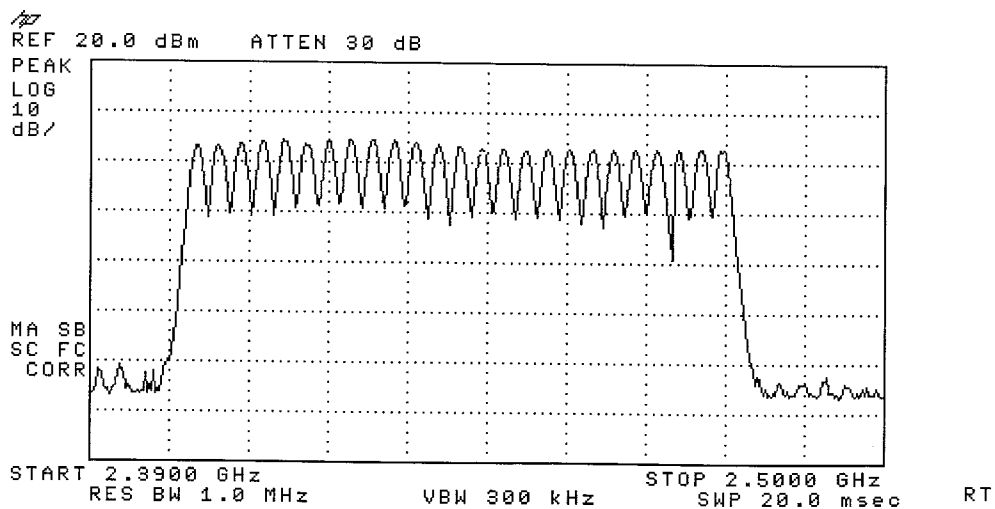
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ME 6820-M1 Time of occupancy (Dwell time)



ME 6820-M1 Number of hopping frequencies



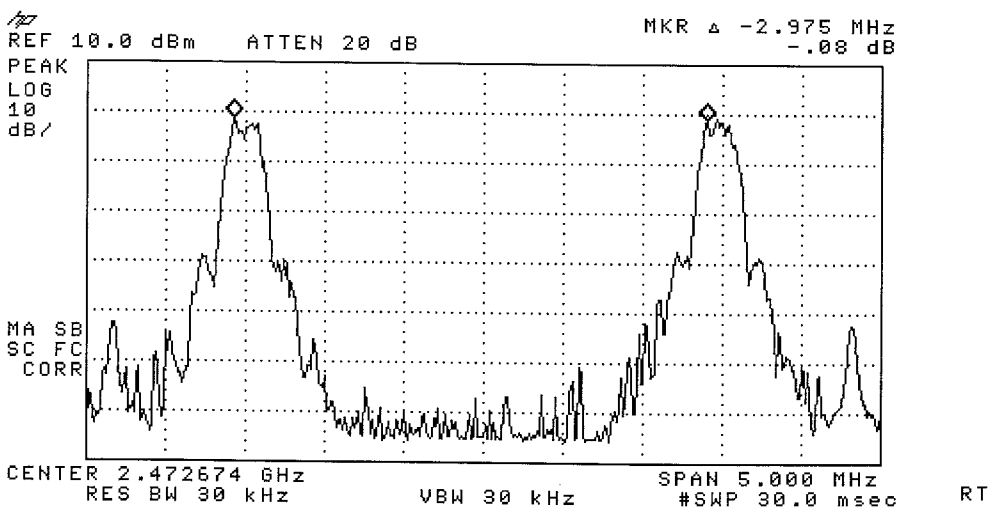
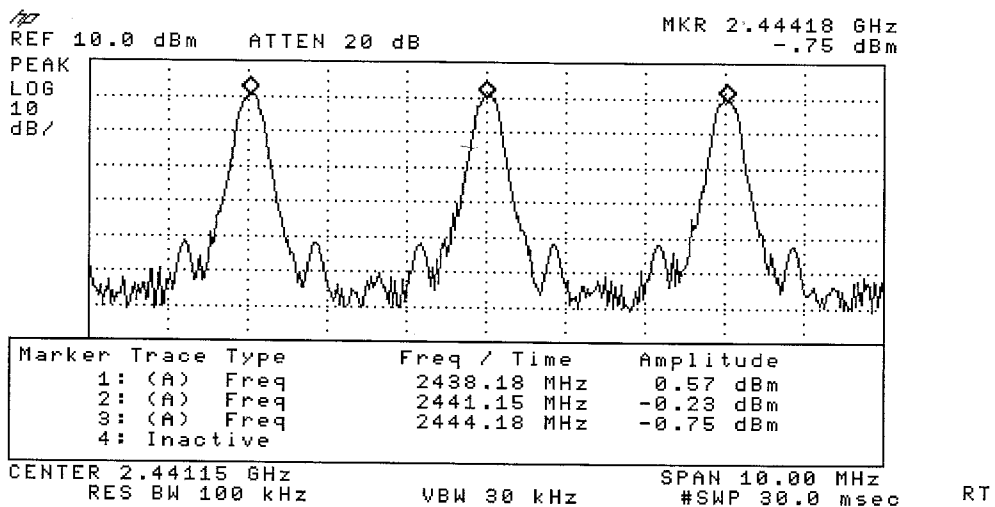
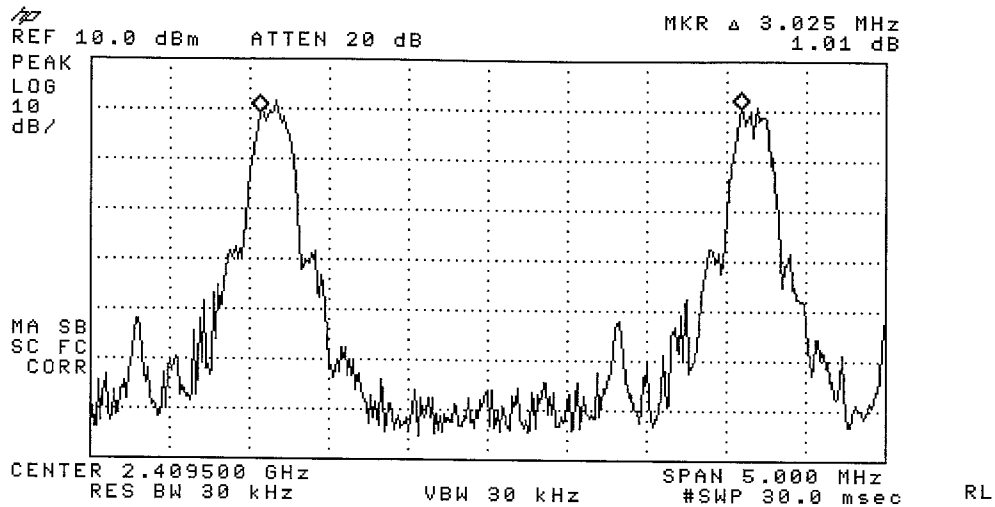
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ME6820-M1 Carrier frequency separation



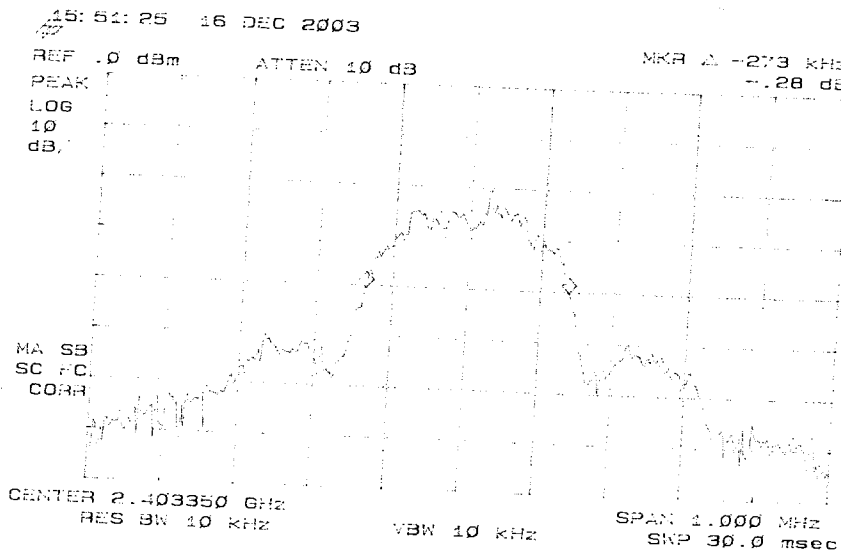
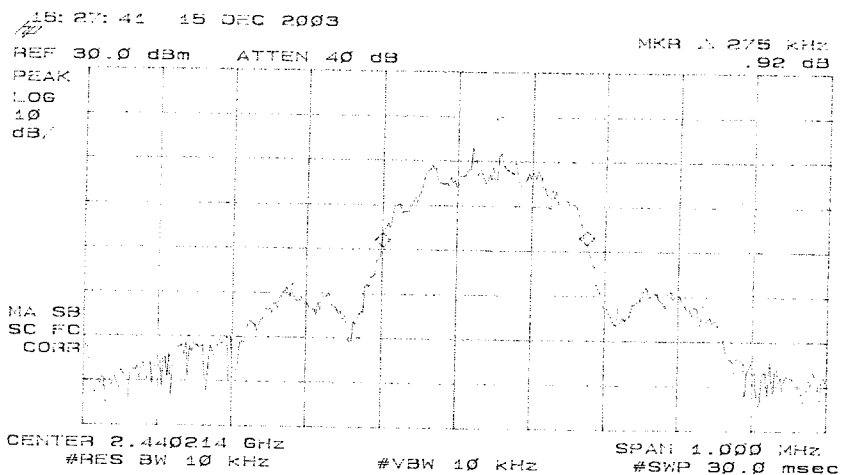
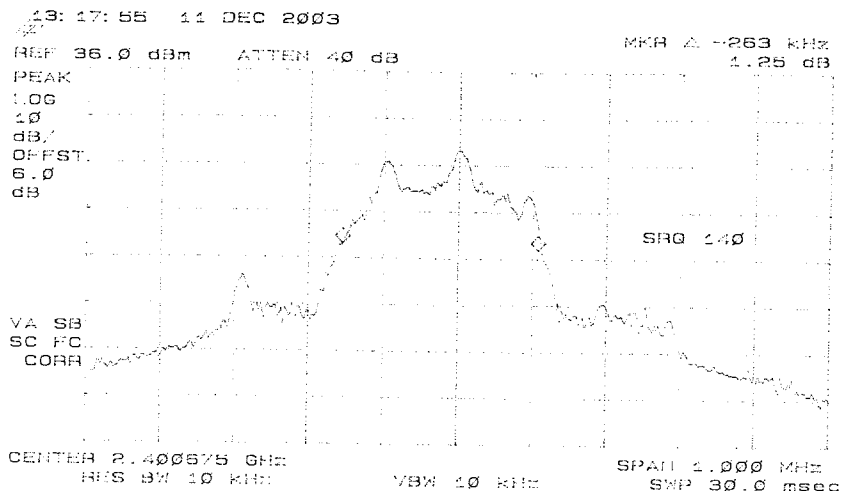
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AP 6803-M2 20 dB Bandwidth



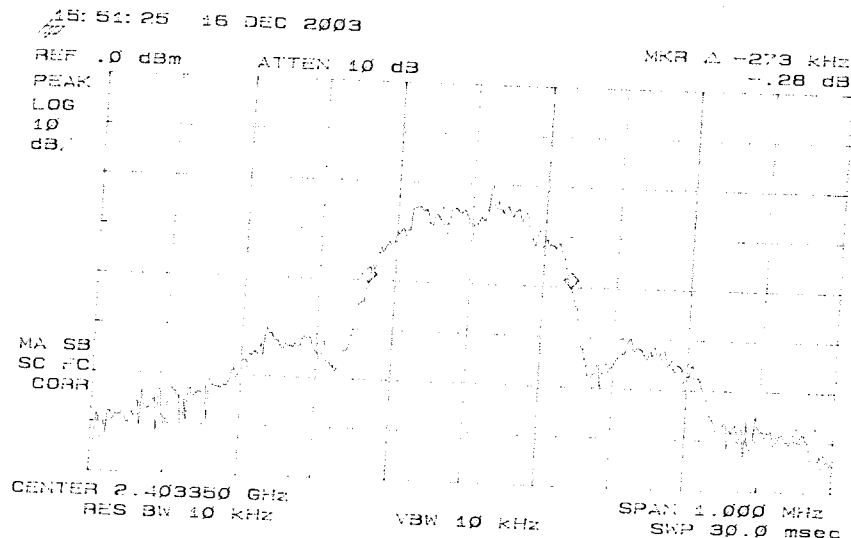
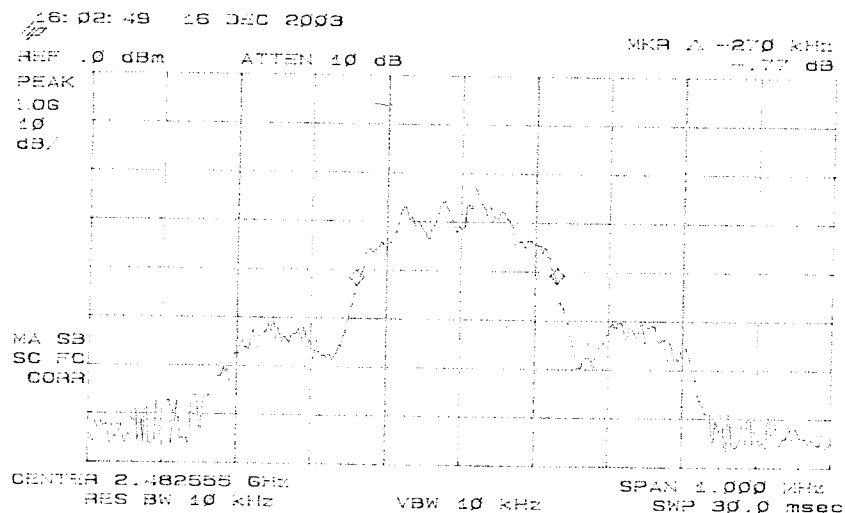
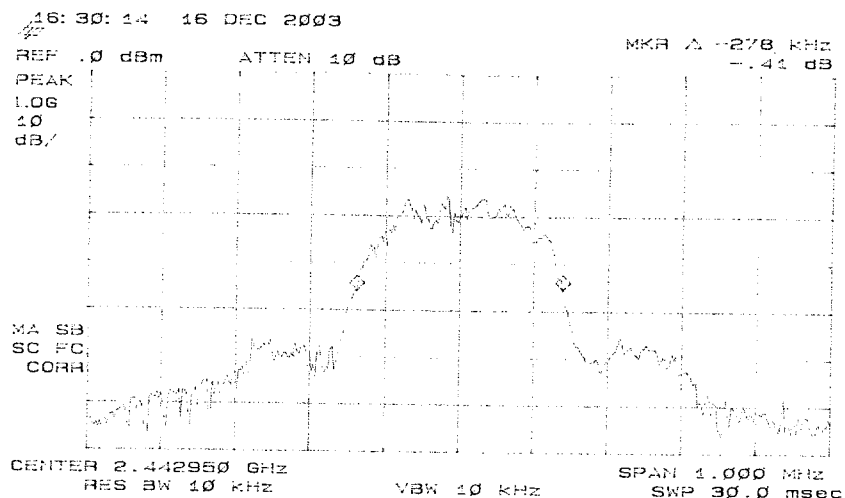
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