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Test report : 03/417/3
Item tested : BeoCom 1/BeoLine
Type of equipment : Frequency Hopping Transmitter
Client : Bang & Olufsen Telecom A/S

Tested according to : **FCC part 15, subpart C**
Frequency Hopping Transmitters
2400 - 2483.5 MHz

Date of issue : 30 September 2002

Authorised by :


.....
Kjell G. Haga
Managing Director


.....
Frode Sveinsen
Technical Supervisor

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CONTENTS

1	GENERAL INFORMATION.....	3
1.1	Testhouse Info	3
1.2	Client Information.....	3
1.3	Manufacturer.....	3
2	Test Information	4
2.1	Tested Item	4
2.2	Test Environment.....	4
2.3	Test Period.....	4
3	TEST REPORT SUMMARY	5
3.1	General	5
3.2	Test Summary.....	6
3.3	Description of modification for Modification Filing	6
3.4	Family List Rational.....	6
4	TEST RESULTS	7
4.1	Powerline Conducted Emissions	7
4.2	Channel Separation	12
4.3	Pseudorandom Hopping Algorithm.....	16
4.4	Occupancy Time	17
4.5	Occupied Bandwidth	19
4.6	Peak Power Output.....	21
4.7	Spurious Emissions (Radiated)	32
5	LIST OF TEST EQUIPMENT.....	61
6	BLOCK DIAGRAM	62
6.1	System set up	62
6.2	Powerline Conducted Emission	62
6.3	Test Site Radiated Emission.....	63
6.4	Peak Power Output.....	64
7	PICTURES OF TEST SET-UP AND THE TESTED EQUIPMENT.....	65

1 GENERAL INFORMATION

1.1 Testhouse Info

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1.2 Client Information

Name : Bang & Olufsen Telecom A/S
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Telephone : +45 9684 4400
Fax : +45 9684 4401

Contact:

Name : Lars Nielsen
Telephone : +45 9684 4612
E-mail : lne@bang-olufsen.dk

1.3 Manufacturer

Name : Bang & Olufsen Telecom A/S
Address : Kjeldmarksvej 1, DK-2600 STRUER, DENMARK
Telephone : + 45 9684 4400
Fax : + 45 9684 4401
E-mail : lne@bang-olufsen.dk

2 Test Information

2.1 Tested Item

Name :	Bang & Olufsen
FCC ID :	BV5BEOCOM1
Model/version :	Fixed part: BeoLine, Portable part: BeoCom 1
Serial number :	Portable Part: 17390807, Fixed Part: 10
Hardware identity and/or version:	26.06
Software identity and/or version :	None
Frequency Range :	2400 - 2483.5 MHz
Tunable Bands :	1
Number of Channels :	79 ¹
Modulation :	GFSK
Emissions Designator :	1MF1D
User Frequency Adjustment :	None, Software controlled.
Rated Output Power :	250 mW

1) 75 channels in use.

Theory of Operation

The EUT is based on DECT the ETSI standards EN 300 175-1 to EN 300 175-8. The system is improved by implementing extra features to combat interference at 2.4 GHz. The system is implemented with unique IDs and encryption based on DECT, EN 300 175-6 V1.7.0.

2.2 Test Environment

2.2.1 Normal test condition

Temperature:	20 - 23 °C
Relative humidity:	30 - 50 %
Normal test voltage:	115 V AC

The values are the limit registered during the test period.

2.3 Test Period

Item received date:	2003-05-27
Test period :	from 2003-06-16 to 2003-09-29

3 TEST REPORT SUMMARY

3.1 General

Manufacturer: Bang & Olufsen

Model No.: BeoCom 1

Serial No.: None

All measurements are tracable to national standards.

The tests were conducted for the purpose of demonstrating compliance with Part 15, Subpart C, Paragraph 15.247 for Frequency Hopping Spread Spectrum devices. Radiated tests were conducted in accordance with ANSI C63.4-1992. Radiated tests were made in a semi-anechoic chamber at measuring distances of 3 and 10 metres. A description of the test site is on file with the FCC (FCC ID: 994405).

New Submission

Production Unit

Class II Permissive Change

Pre-production Unit

DSS Equipment Code

Family Listing

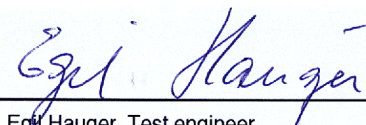
THIS TEST REPORT RELATES ONLY TO THE ITEM (S) TESTED.

Deviations from, additions to, or exclusions from the test specifications are described in "Summary of Test Data".

COMLAB

NEMKO COMLAB REF: 03/417/3

TESTED BY:


Egil Hauger, Test engineer

DATE: 30 September 2003

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3.2 Test Summary

Name of test	Paragraph #	Result
Powerline Conducted Emission	15.207(a)	Complies
Channel Separation	15.247(a)(1)	Complies
Pseudorandom Hopping Algorithm	15.247(a)(1)	Complies
Time of Occupancy	15.247(a)(1)(iii)	Complies
Occupied Bandwidth	15.247(a)(1)	Complies
Peak Power Output	15.247(b)	Complies
Spurious Emissions (Antenna Conducted)	15.247(c)	N/A ¹
Spurious Emissions (Radiated)	15.247(c)	Complies

¹ The tested equipment has integrated antennas only.

3.3 Description of modification for Modification Filing

Not Applicable.

3.4 Family List Rational

Not Applicable.

4 TEST RESULTS

4.1 Powerline Conducted Emissions

Para. No.: 15.207 (a)

Test Performed By: Egil Hauger	Date of Test: 14-15 July 2003
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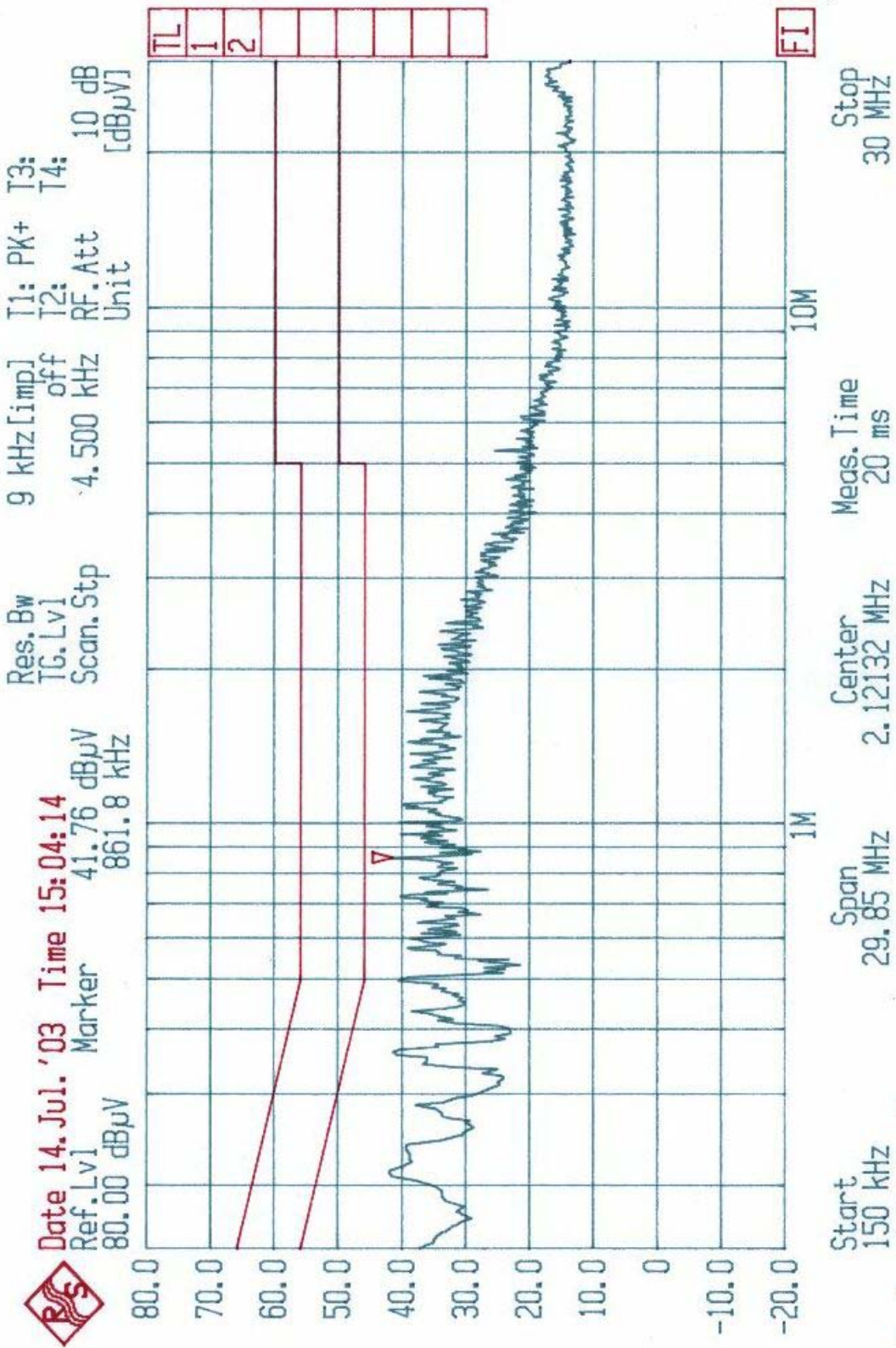
Measurement procedure: CISPR 22 1997 Clause 5.1 Class B ITE.

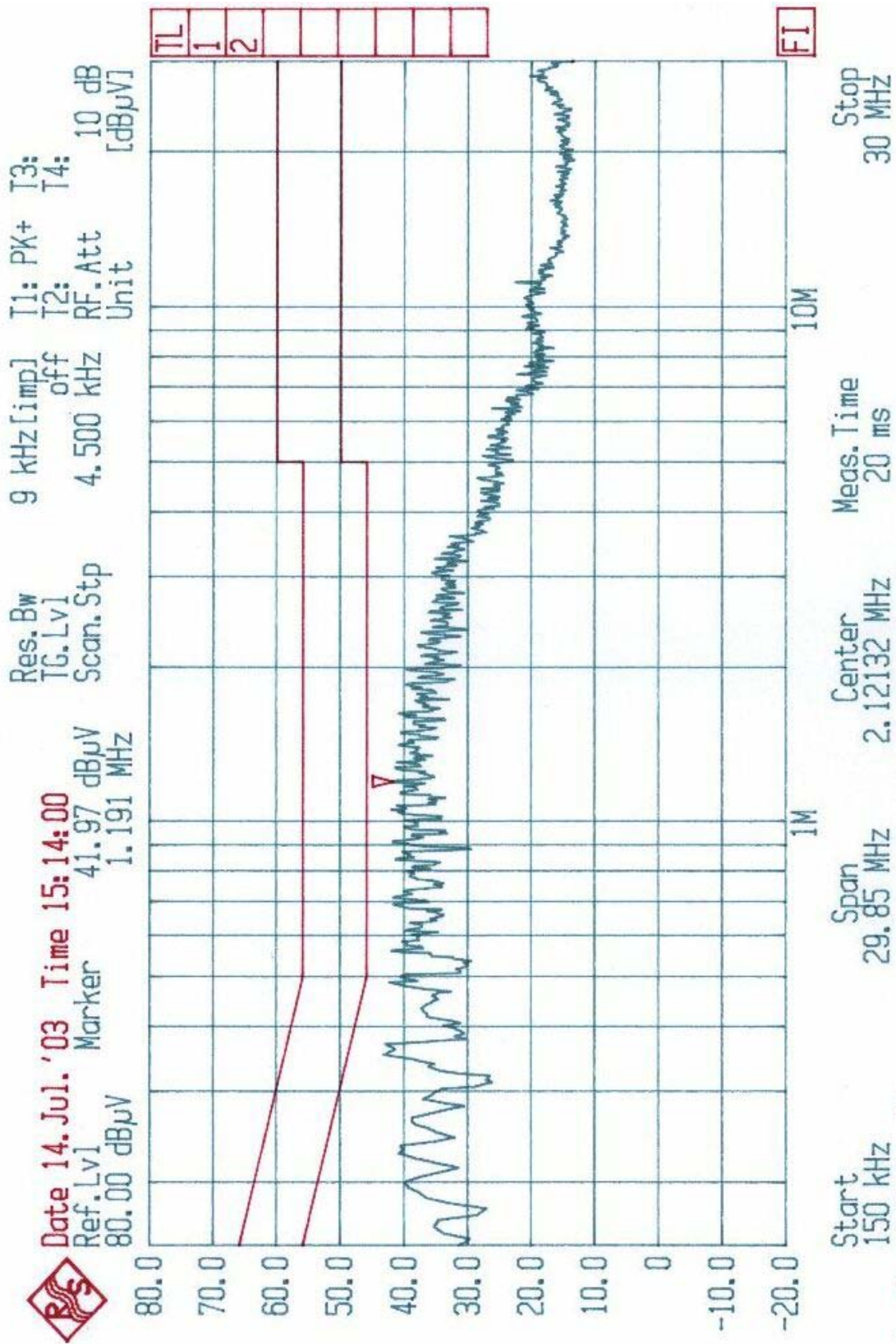
Test Results: **Complies.**

Measurement Data: **See attached graph, (Peak detector).**

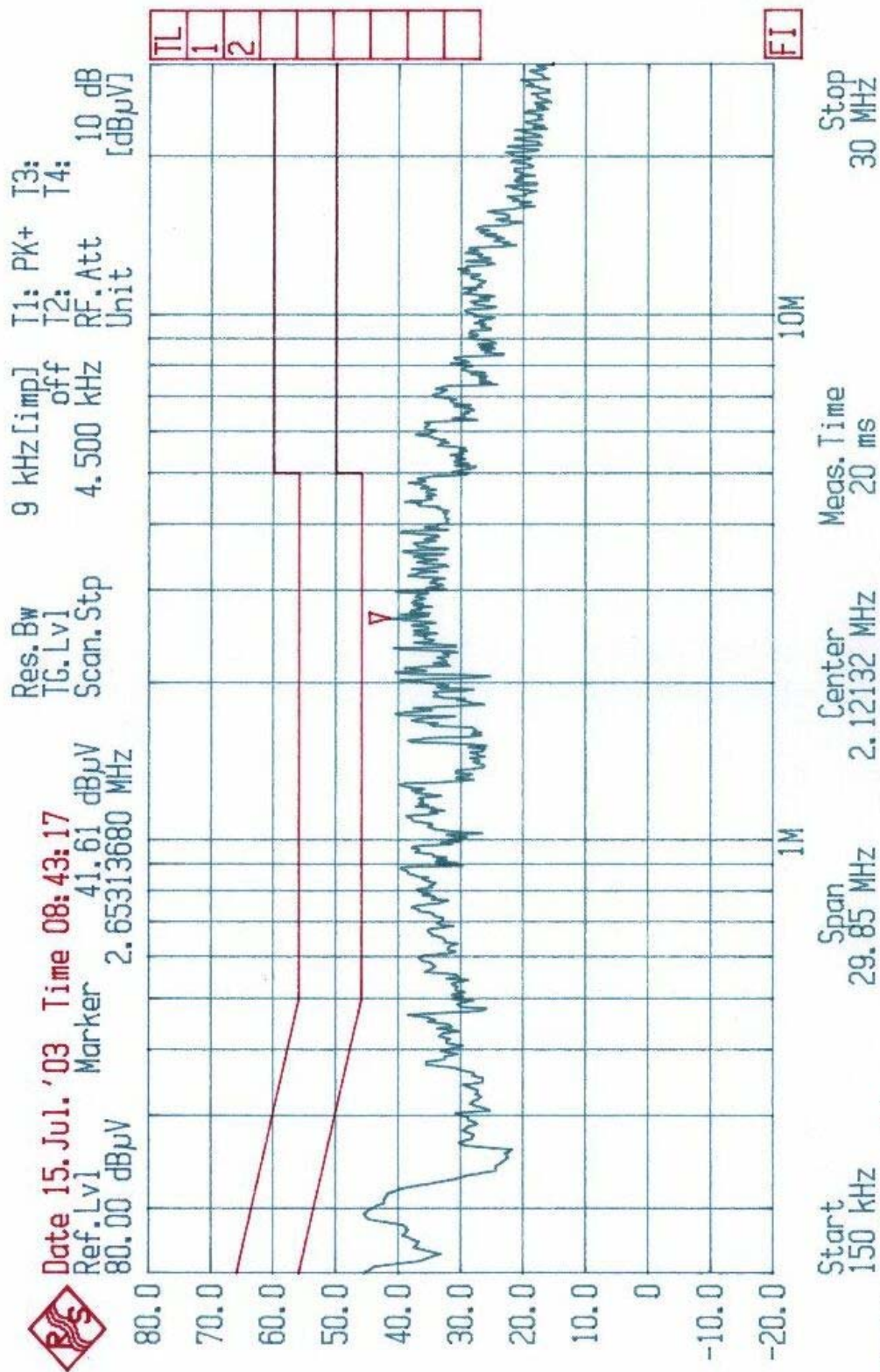
Highest measured value:

Frequency	EUT	Line	Detector	Measured value	Limit	Margin
KHz	Portable/ Fixed	L1/ N	Peak/QP/AV	dB μ V	dB μ V	dB
861,8	Portable	N	Peak	41,7		
			QP	33,2	56	22,8
			AV	22,3	46	23,7
935	Portable	L1	Peak	45,8		
			QP	43,1	56	12,9
			Av	35,3	46	10,7
190,9	Fixed	N	Peak	44,8		
			QP	42,5	63,9	21,4
			Av	35,0	53,9	18,9
2650	Fixed	L1	Peak	41,6		
			QP	31,9	56	24,1
			AV	19,0	46	27

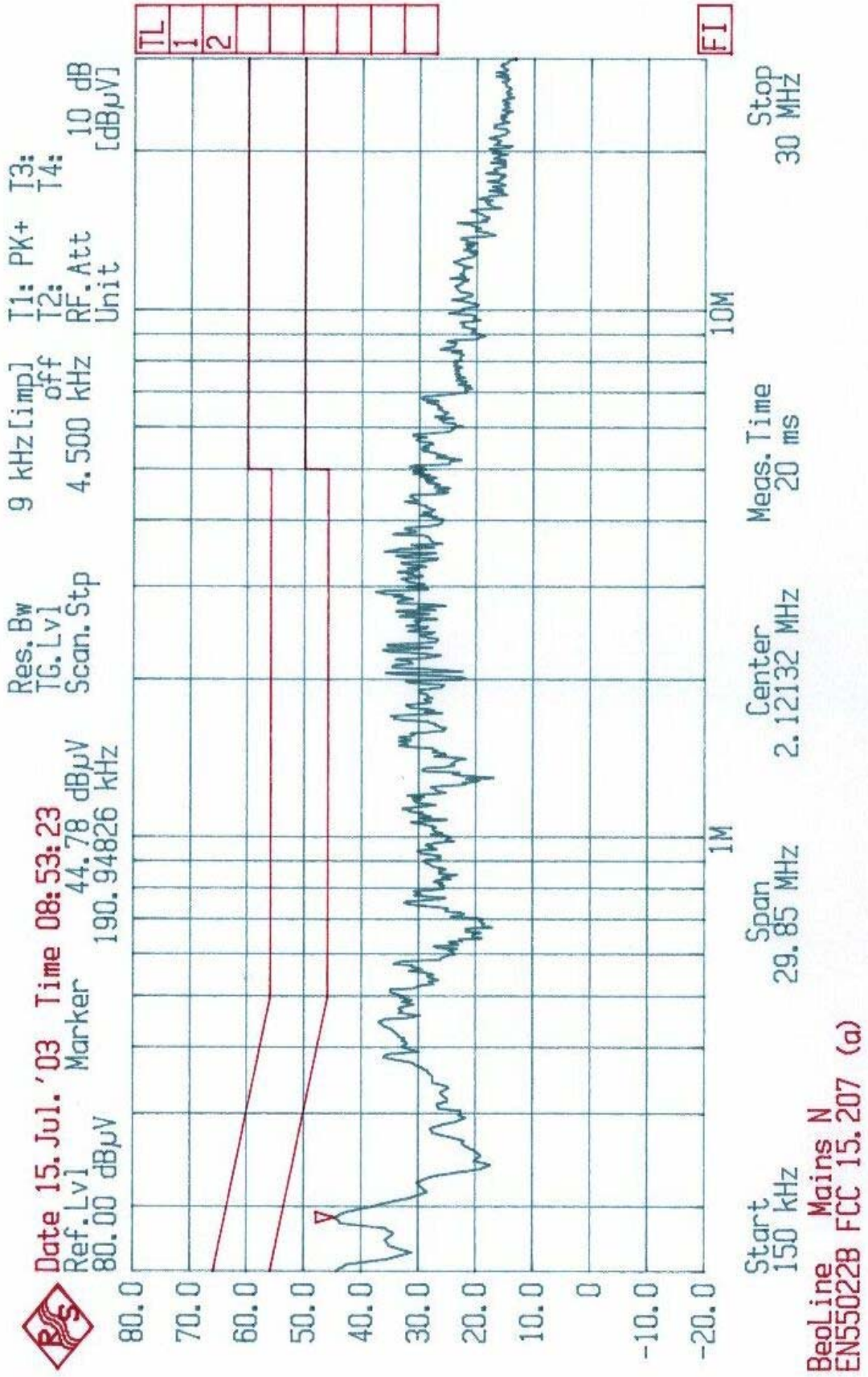




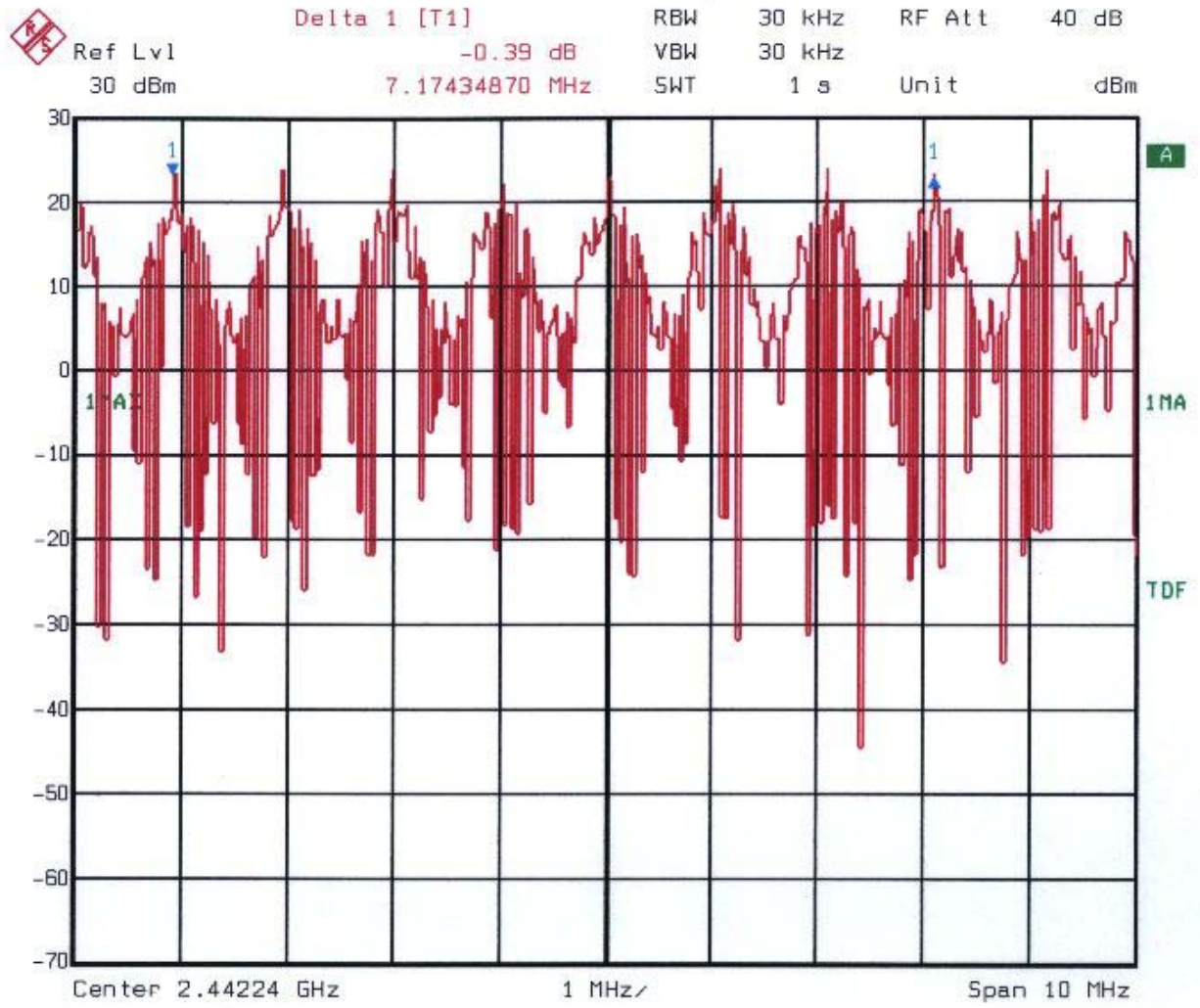
BeoCom 1 Mains L1
EN55022B, FCC 15.207 (a)



BeoLine Mains L1
 EN55022B FCC 15.207 (a)

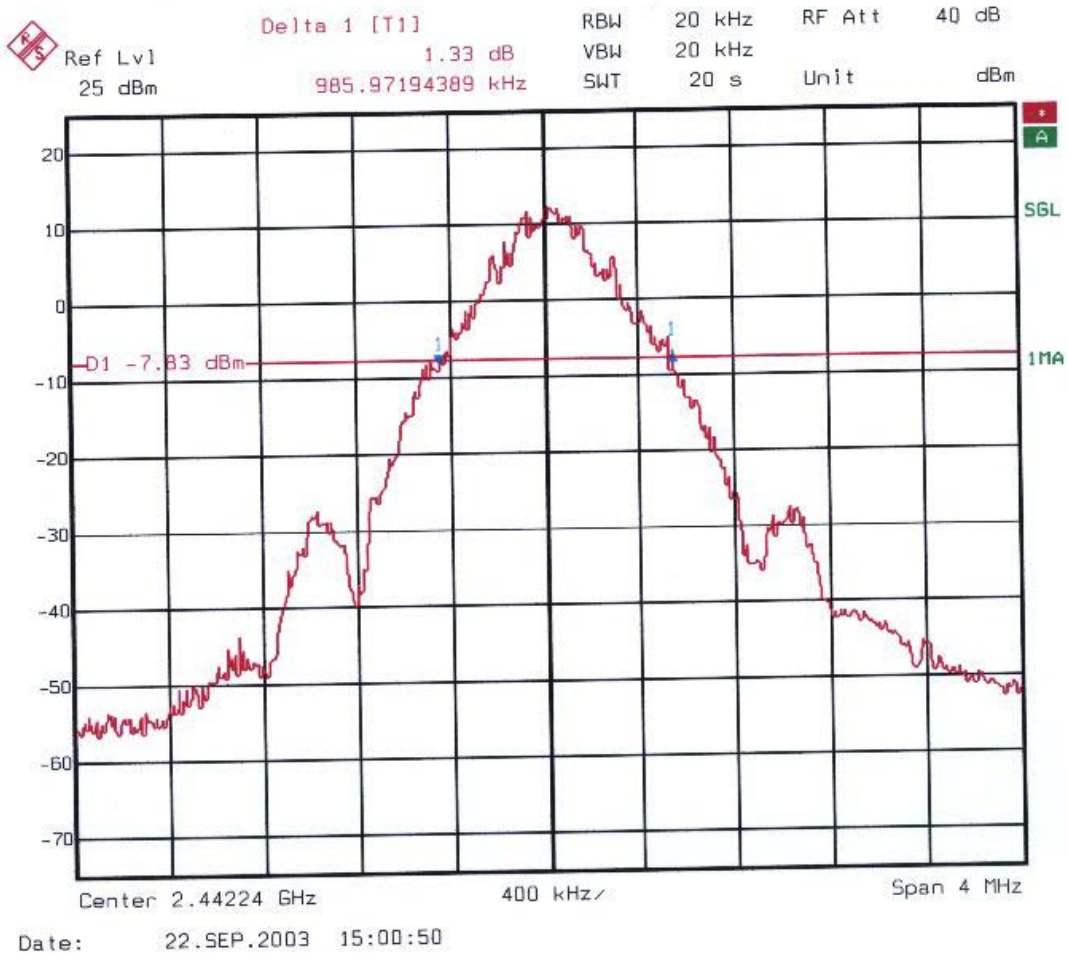


BeoLine Mains N
EN55022B FCC 15.207 (a)

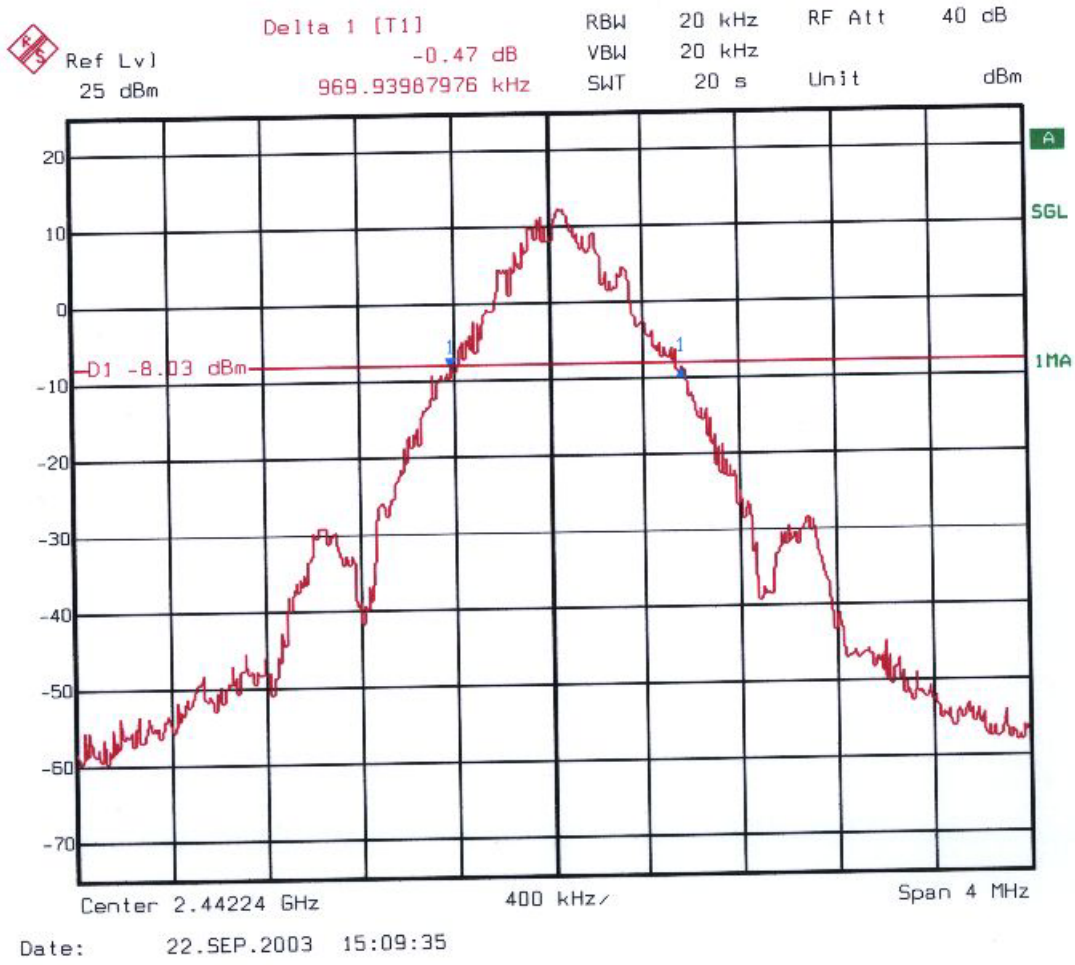


Date: 16.JUN.2003 10:55:34

Channel separation



Occupied Bandwidth, Fixed part



Occupied Bandwidth, Portable part

4.3 Pseudorandom Hopping Algorithm

Para. No.: 15.247 (a)(1)

Test Performed By: Egil Hauger

Date of Test: 29 September 2003

Test Results: **Complies**

Measurement Data:

Requirements:

The channel frequencies shall be selected from a pseudorandom ordered list of hopping frequencies. Each frequency must be used equally by the transmitter.

Base Table Hopping Sequence

The following table, arranged as an 8 × 10 grid, is the base table for the hopping sequence. The sequence is 75 hops long.

	0	1	2	3	4	5	6	7	8	9
0	0	27	38	14	26	49	13	33	73	55
10	16	1	11	54	8	64	2	48	28	61
20	4	40	65	6	23	67	57	42	12	29
30	62	36	47	5	71	43	32	56	21	59
40	39	15	53	18	45	37	74	63	46	3
50	51	31	72	58	9	70	35	69	25	34
60	50	60	68	22	52	24	41	7	17	30
70	19	10	20	66	44					

4.4 Occupancy Time

Para. No.: 15.247 (a)(1)(iii)

Test Performed By: Egil Hauger	Date of Test: 29 September 2003
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Test Results: Complies

Measurement Data: Number of RF channel: 75
RF burst pr channel: 444,9 μ s
Time between each RF burst on same RF channel: 751,5 ms

Portable part: Time of occupancy: $(444,9 \mu\text{s}/751,5 \text{ ms}) * 0,4 * 75 \text{ sec} = 0,0177 \text{ s}$

Fixed part with one line OFF-HOOK: $(444,9 \mu\text{s}/751,5 \text{ ms}) * 0,4 * 75 \text{ sec} = 0,0177 \text{ s}$

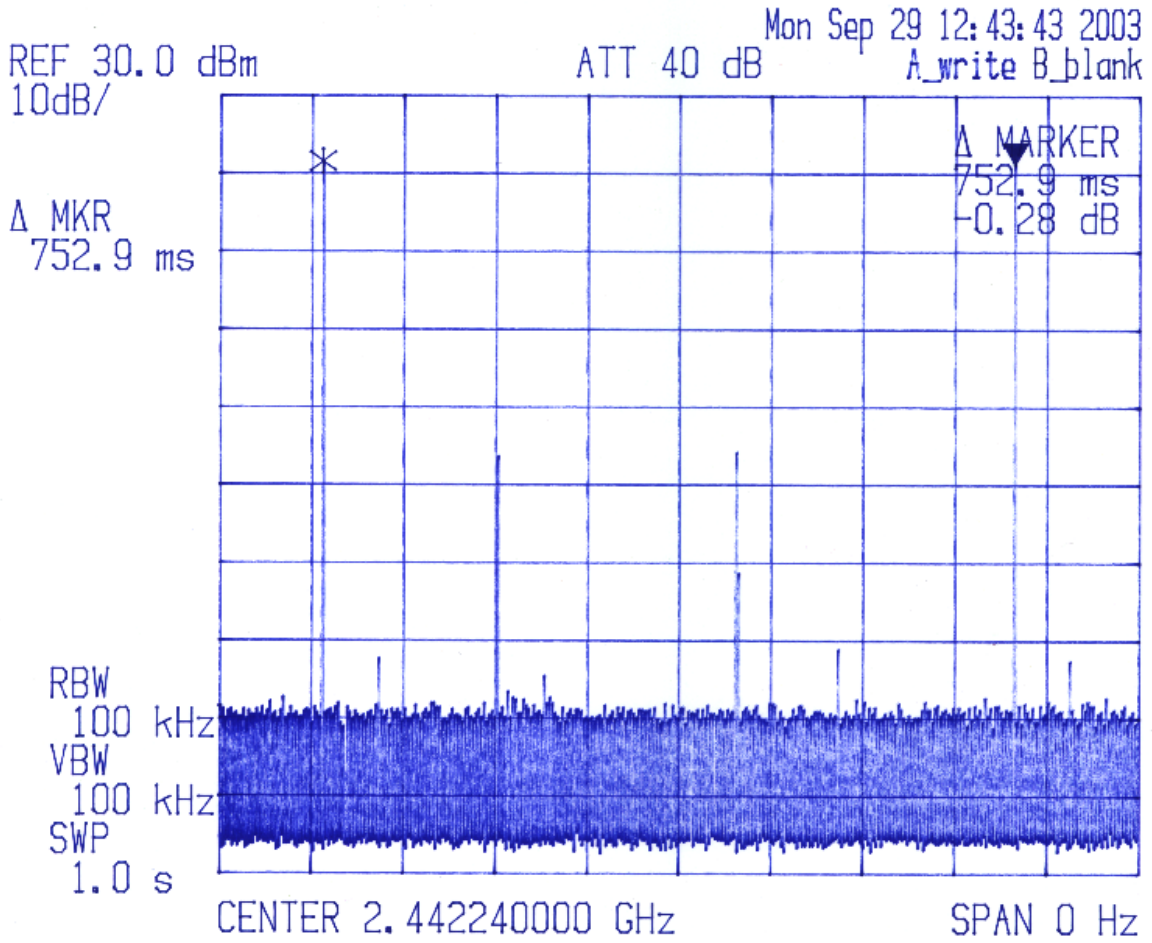
Fixed part with four line OFF-HOOK: $(4 * 444,9 \mu\text{s}/751,5 \text{ ms}) * 0,4 * 75 \text{ sec} = 0,071 \text{ s}$

The maximum number of lines fixed part can handle is four.

See attached graph.

Requirements:

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.



4.5 Occupied Bandwidth

Para. No.: 15.247 (a)(1)(iii)

Test Performed By: Egil Hauger	Date of Test: 29. September 2003
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Test Results: Complies

Measurement Data: 75 RF channels in use

See attached graph.

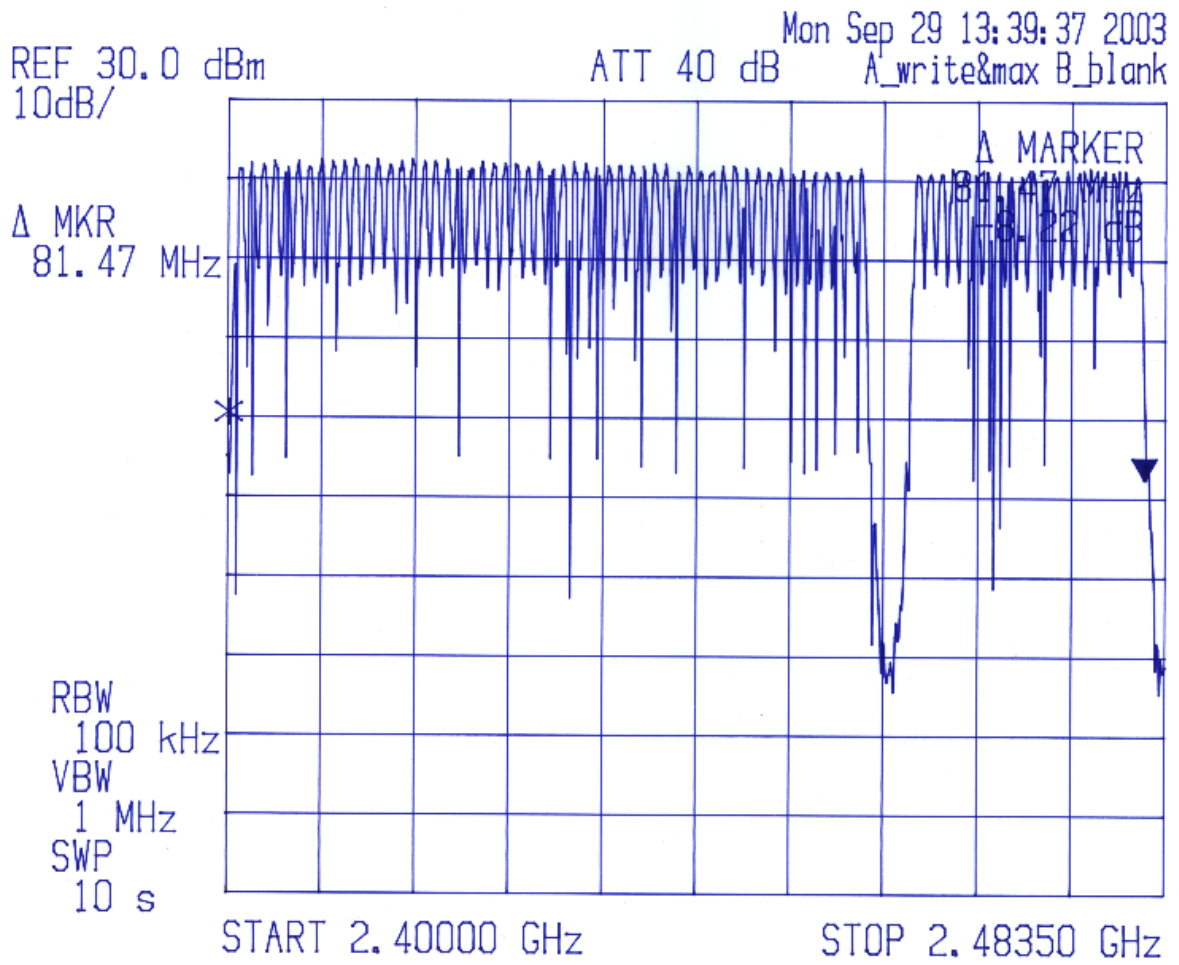
Requirements:

Frequency hopping systems in the 2400 - 2483.5 MHz band shall use at least 15 non-overlapping channels. No requirements for bandwidth for this frequency band.

Channel Centre Frequencies

The following table, arranged as a 10 × 8 grid, lists the 79 channel centre frequencies. The values are in MHz. Only 75 of the 79 are used at a time.

	0	1	2	3	4	5	6	7	8
0	2401,28000	2402,30400	2403,32800	2404,35200	2405,37600	2406,40000	2407,42400	2408,44800	2409,47200
1	2411,52000	2412,54400	2413,56800	2414,59200	2415,61600	2416,64000	2417,66400	2418,68800	2419,71200
2	2421,76000	2422,78400	2423,80800	2424,83200	2425,85600	2426,88000	2427,90400	2428,92800	2429,95200
3	2432,00000	2433,02400	2434,04800	2435,07200	2436,09600	2437,12000	2438,14400	2439,16800	2440,19200
4	2442,24000	2443,26400	2444,28800	2445,31200	2446,33600	2447,36000	2448,38400	2449,40800	2450,43200
5	2452,48000	2453,50400	2454,52800	2455,55200	2456,57600	2457,60000	2458,62400	2459,64800	2460,67200
6	2462,72000	2463,74400	2464,76800	2465,79200	2466,81600	2467,84000	2468,86400	2469,88800	2470,91200
7	2472,96000	2473,98400	2475,00800	2476,03200	2477,05600	2478,08000	2479,10400	2480,12800	2481,15200



4.6 Peak Power Output

Para. No.: 15.247 (b)

Test Performed By: Egil Hauger	Date of Test: 29 September 2003
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Test Results: Complies

Measurement Data:

Maximum Conducted Peak Output Power, Watts

RF channel	1	41	79
Fixed part antenna 1	0,257	0,324	0,263
Fixed part antenna 2	0,200	0,277	0,204
Portable part	0,234	0,185	0,187

Power supply variation within 85 to 115 % of nominal value has no influence on Peak Output Power from fixed part.

See attached graph.

Detachable antenna? Yes No
 If detachable, is the antenna connector non-standard? Yes No

Requirements:

The maximum peak output power for frequency hopping systems shall not exceed the following limits:

For systems employing at least 75 hopping channels: 1 watt

For all other frequency hopping systems in the 2400 - 2483.5 MHz band: 0.125 watts

If transmitting antennas of directional gain greater than 6 dBi are used, the peak output power from the intentional radiator shall be reduced below the stated value above by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Maximum Field Strength of Fundamental, Peak, mV/m.

Measuring distance: 3 m.

RF channel	1	41	79
Fixed part antenna 1	1195	1470	1586
Fixed part antenna 2	1140	1344	1145
Portable part	1144	1149	1154

Calculated maximum EIRP using free field formula:

Fixed part channel 79 antenna 1

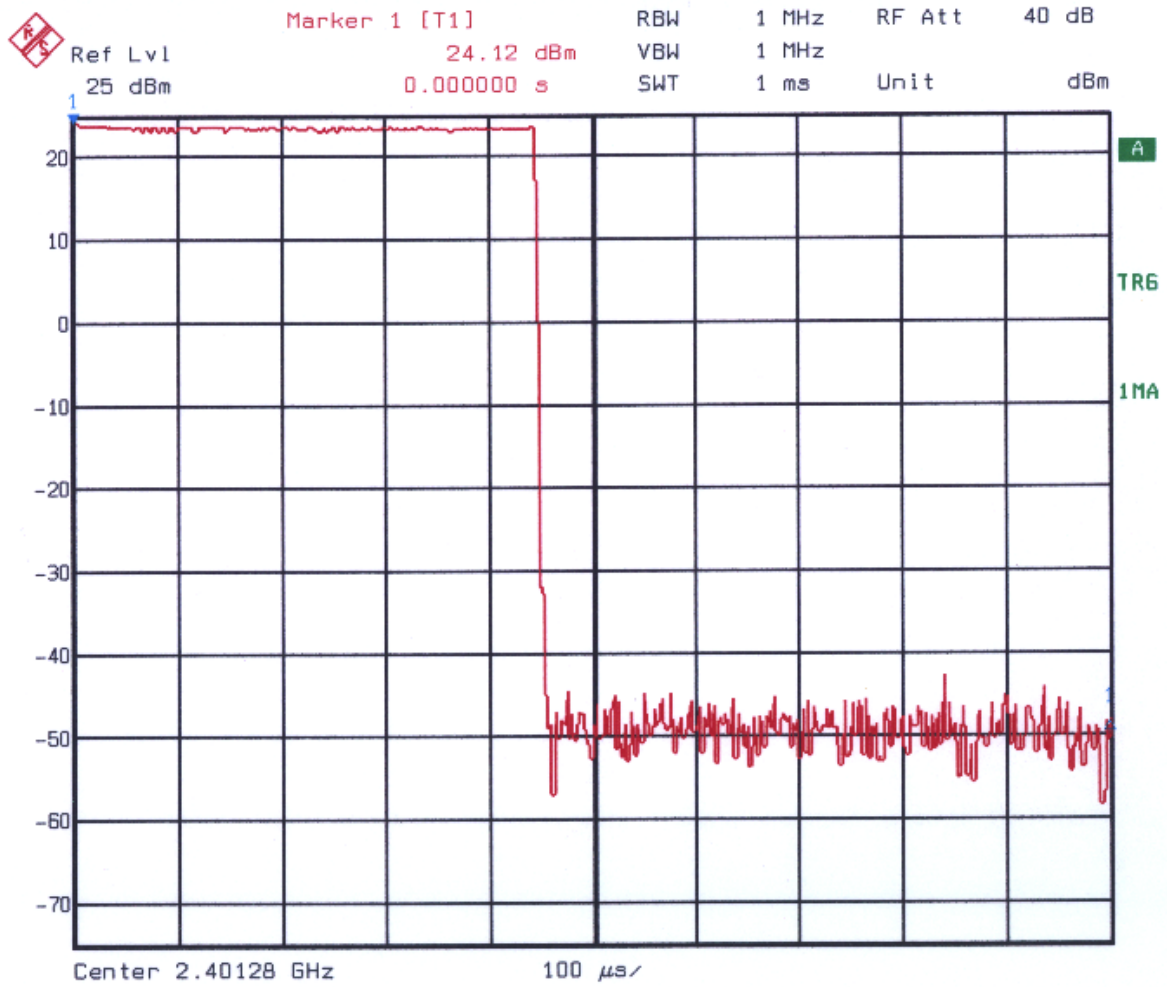
$$P \text{ (EIRP) watts} = (3 \cdot 1,586)^2 / 30 = 0,754 \text{ watts.}$$

Portable part channel 79:

$$P \text{ (EIRP) watts} = (3 \cdot 1,154)^2 / 30 = 0,399 \text{ watts.}$$

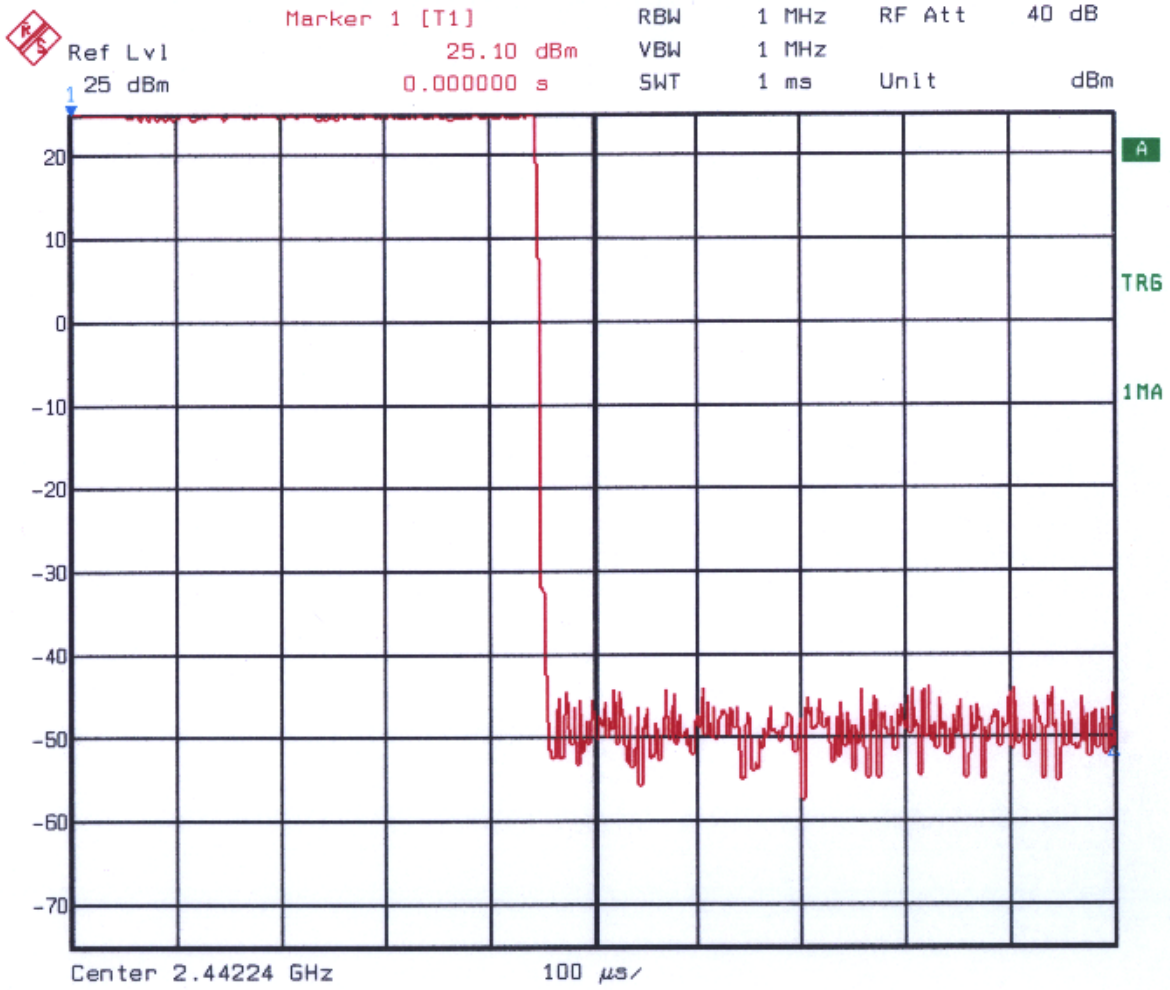
Antenna gain Fixed part: $10 \cdot \log(0,754/0,263) = 4,6 \text{ dBi}$

Antenna gain Portable part: $10 \cdot \log(0,399/0,187) = 3,3 \text{ dBi}$



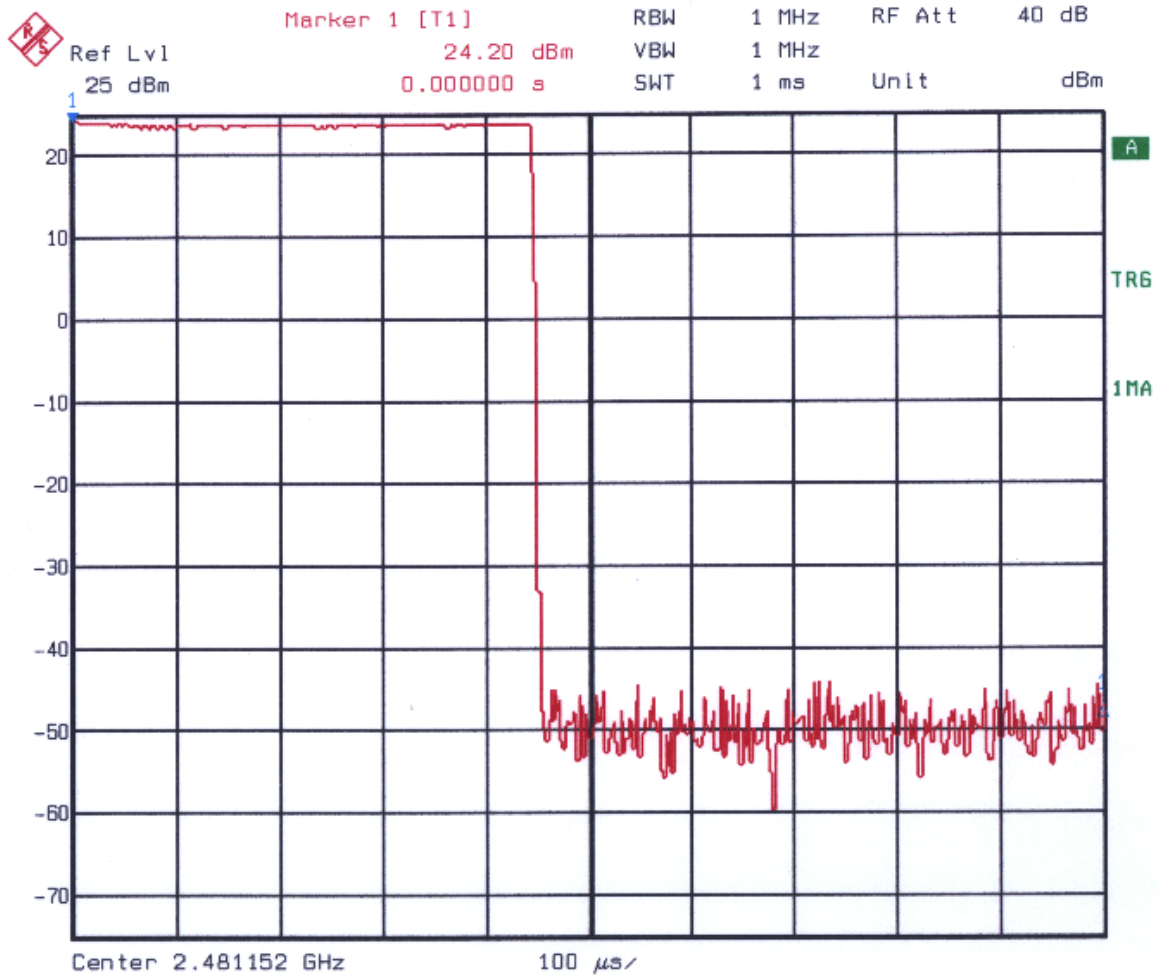
Date: 29.SEP.2003 16:51:58

Fixed part ch. 1 ant.1



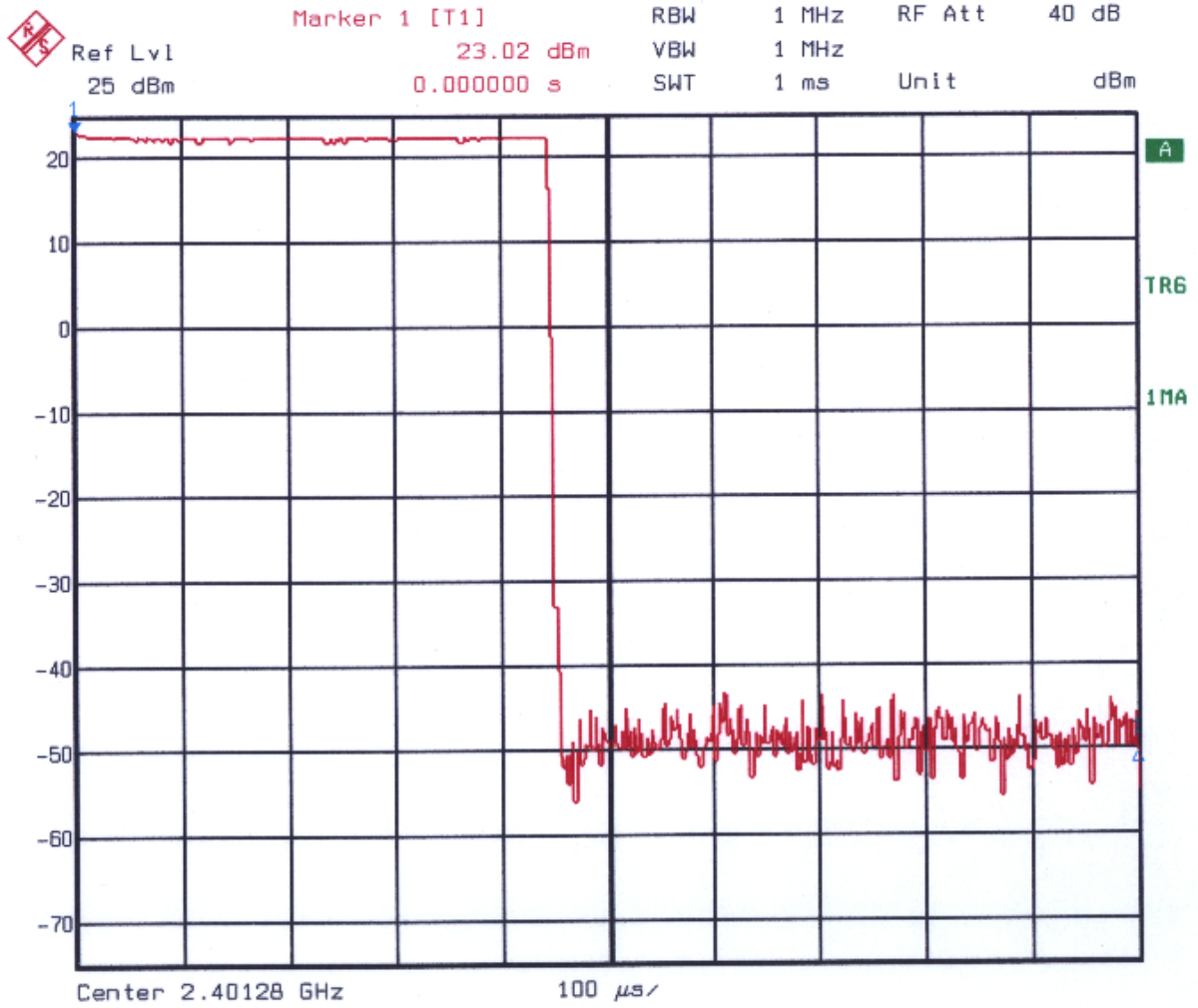
Date: 29.SEP.2003 16:53:44

Fixed part ch. 41 ant. 1



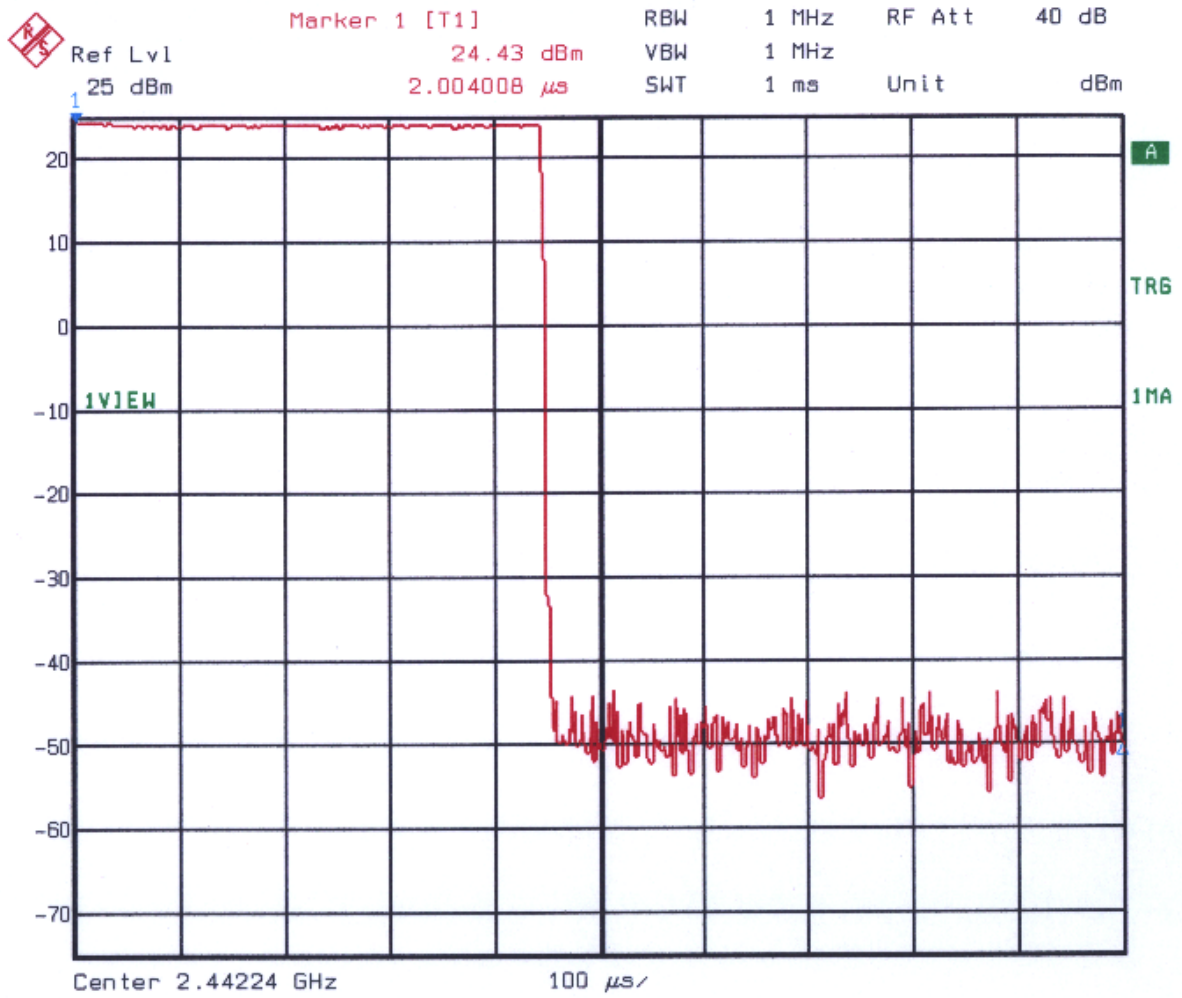
Date: 29.SEP.2003 16:54:48

Fixed part ch. 79 ant. 1

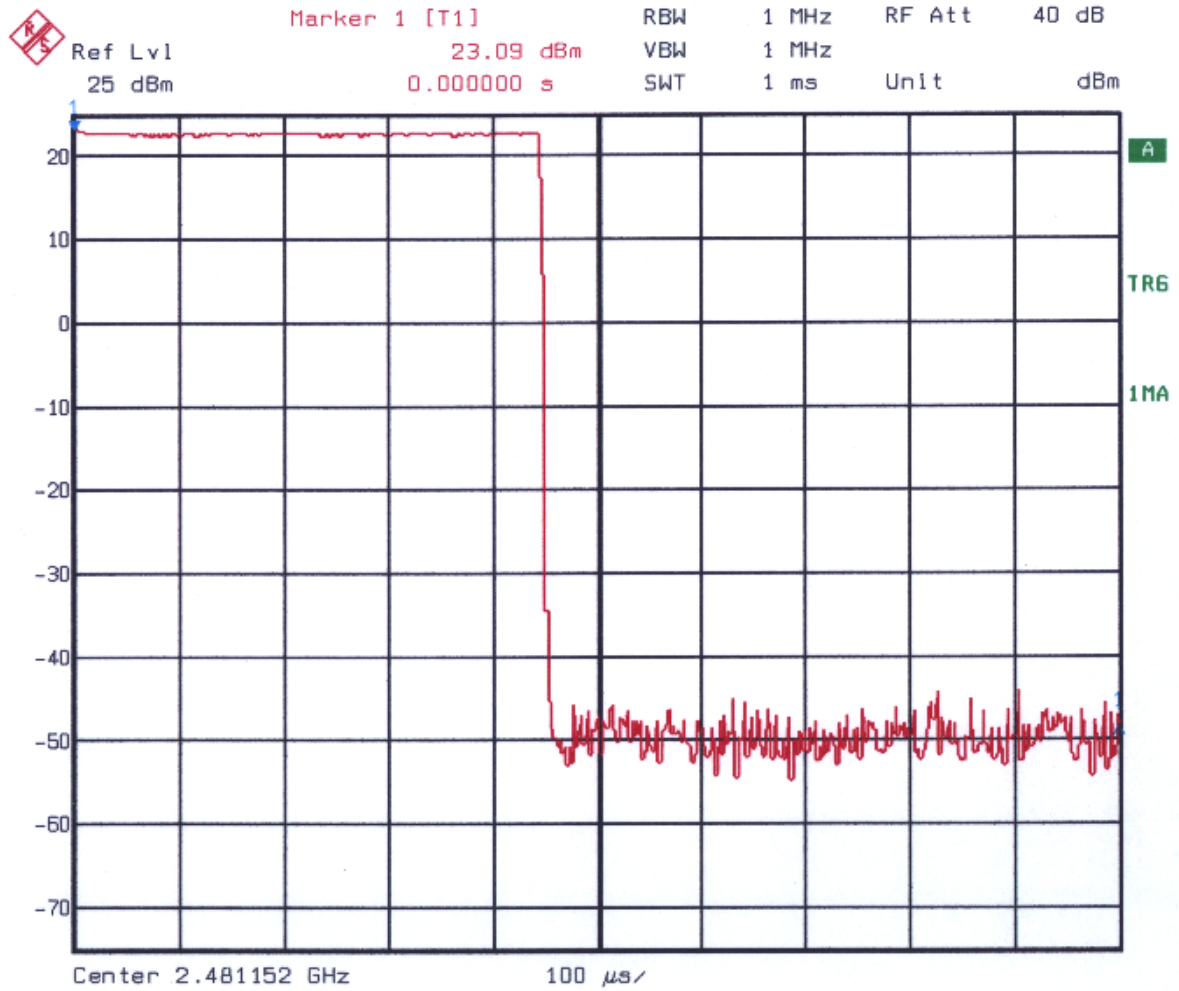


Date: 29.SEP.2003 16:49:30

Fixed part ant. 2 ch. 1



Fixed part ant. 2 ch. 41



Date: 29.SEP.2003 16:46:50

Fixed part ant. 2 ch. 79