NEBRASKA CENTER FOR EXCELLENCE IN ELECTRONICS
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ACCREDITED
Certificate Number 1953-01

Test Report

Company: KarlNet, Inc
525 Metro Place North, Ste 100
Dublin, OH 43017
Contact: Kedar Kapoor

Product: KS-CPO-010124B-Xxx series
FCC ID: Q7OKS-CPO010124B

Test Report No: R051903-02.03A

APPROVED BY: Steve Cass
General Manager

Doug Kramer
Test Engineer

DATE: 7 October 2003
Total Pages: 44

Table of Contents

1.0 Summary of test results

1.1 Test Results

Test	Test Specification	Results
CFR 47, FCC Part 15.203	Part 15.203	Complies
CFR 47, FCC Part 15.207	Part 15.207, Class B	Complies
CFR 47, FCC Part 15.209	Part 15.109, Class B	Complies
CFR 47, FCC Part 15.247	Parts 15.209 and 15.247	Complies

1.2 Test Methods

1.2.1 Conducted Emissions

Measurements of conducted emissions to the limits set in CFR 47 Part 15.207 were conducted using the methods shown in ANSI/IEEE C63.4, 2001. Several configurations were examined the results presented represent a worst-case scenario. The EUT was placed on a wooden table approximately 80cm high, positioned 40cm from the vertical ground plane and 80cm or more away from any other conductive surface.

1.2.2 Radiated Emissions

Compliance to CFR 47 Parts 15.109/209 and 15.247 was tested in accordance with the methods of ANSI/IEEE C63.4, 2001. Several configurations were examined the results presented represent a worst-case scenario. The EUT was mounted on a mast approximately 126cm high and centered on a 4m diameter turntable. The table was rotated to maximize emissions. All measurements below 18GHz were taken at a distance of 3m from the EUT. Measurement above 18GHz were made at a distance of 1m.

1.3 Reason for Amendment

This report was modified to include additional information on the frequency range of operation

2.0 Description

2.1 Equipment under test

The KS-CPO-0101-24B-Xxx series of products uses an existing certified radio product (FCC ID: IMRWLPCE24H) and combines it with a KarlNet WPRG+, BB200-1120, rev3 interface board for operation in the band of 2412-2462MHz. The standard panel antenna as tested is 19dBi.

2.1.1 Identification: KS-CPO-0101-24B-Xxx

2.1.2 EUT received date: 19 May 2003

2.1.3 EUT tested dates: 10th, 11th, 16th and 18th June, 30 August 2003

2.1.4 Manufacturer: KarlNet, Inc

2.1.5 Serial number: FCCT1

2.2 Laboratory description

All testing was performed at the NCEE Lincoln facility, which is a FCC registered lab. This site has been fully described in a report submitted to your office, and accepted in a letter dated May 4, 2001. Laboratory environmental conditions varied slightly throughout the tests:

Relative humidity of 46 ± 4%
Temperature of 21 ± 3° Celsius

2.3 Special equipment or setup

The device was modified to enable the transmitter to be active continuously transmitting at the maximum rate. The network port of the EUT was receiving "pings" from the remote PC. A ferrite bead was added to the cable coming from the EUT. Ferrite part number was 0444164281 from Fair-Rite Products.

3.0 Test equipment used

Serial #	*Manufacturer*	*Model*	*Description*	*Last cal.*
1654	EMCO	3142B	Biconilog antenna	03-May-03
6415	EMCO	3115	DRG Horn	17-Sep-02
2576	EMCO	3116	DRG Horn	29-Apr-03
100037	Rohde & Schwarz	ESIB26	EMI Test Receiver	02-Jul-03
100007	Rohde & Schwarz	ESIB7	EMI Test Receiver	26-May-03
082001/003	Rohde & Schwarz	TS-PR18	Preamplifier	N/A
2575	Rohde & Schwarz	ES-K1	Software v1.60	N/A
100023	Rohde & Schwarz	ESH3-Z5	Artificial Mains	20-Sep-02

4.0 Detailed Results

All measurement results are located in the corresponding interval with a probability of approximately 95% (coverage factor k=2). The interval for these measurements is U_x (expanded uncertainty).

Conducted Emissions, 150kHz – 30MHz: U_x = +/- 3.1 dB
Radiated Emissions, 30MHz – 1GHz, 3m distance: U_x = +/- 3.4 dB
Radiated Emissions, 1GHz – 18GHz, 3m distance: U_x = +/- 3.5 dB
Radiated Emissions, above 18GHz, 1m distance: U_x = +/- 3.2 dB

Radiated emissions measurements were made by first using a spectrum analyzer getting a rough signal spectrum, any points were then measured using a CISPR 16 compliant receiver with the following bandwidth setting:

30MHz - 1GHz: 120kHz IF bandwidth, 60kHz steps
Above 1GHz: 1MHz IF bandwidth, 500kHz steps

Conducted measurements were made using a CISPR 16 compliant receiver with the IF bandwidth set to 9kHz taking 5kHz steps through the range 150kHz to 30MHz.
All results shown are corrected to incorporate cables losses, antenna factors, and any amplification.

4.1 FCC Part 15.203 unique connector for antenna

The antenna is attached to a previously approved Part 15 transmitter (FCC ID: IMRWLPCE24H) via a custom pigtail and is lactated physically internal to Q7OKS-CPO010124B. No external connectors exist for the connection of an auxiliary antenna.

4.2 FCC Part 15.207 Conducted Emissions

The EUT was tested in two modes; one was with the transmitter continuously operating and the other, normal mode of operation, when no signal is present to be repeated. The setup can be seen in Figure 3. The normal operation mode provided the highest emissions and those results can be seen in Figure 4. No emissions as measured with a quasi-peak detector were detected within 15dB of the limit. The plot shown Figure 4 is a composite worst-case of the Line and Neutral conductors.

4.3 FCC Part 15.109 Radiated Emissions, Rx only

The EUT was found to not produce any emissions within in excess of the Class ‘B’ limits. The test setup can be seen in Figures 1 and 2. More information on the radiated emissions can be found in Section 4.4. The transmitter was not active for these measurements. Figures 6, 7 and 8 show the worst case. Appendix C shows the measured values denoted by a red ‘+’ in Figures 6, 7 and 8. The blue ‘+’ in figures 7 and 8 show the peak values. No values were found to be in excess of the limits. A table of the values can be seen in Appendix C. All measurements were made at a distance of 3m.

4.4 FCC Parts 15.209 and 15.247 Radiated Emissions, Tx only

The EUT was tested at three frequencies with the transmitter continuously operating, in the lower, middle and upper portions of the band. Measurements were made from 30MHz to 18 GHz at and distance of 3m and from 18GHz to 25GHz at a distance of 1m; no spurious emissions were noted above 18GHz. Figure 5 shows the worst-case emissions in the range 30MHz to 1GHz while the EUT was transmitting. The peak and quasi-peak measurements below 1GHz were found not to exceed the limits. The table following Figure 5 lists the values of the points denoted by a red '+'. Figures 1 and 2 show the configuration of the EUT during testing. The EUT was mounted on a tripod 126cm above a ground plane. The results of the bandedge measurements can be seen in Appendix F. Appendix D contains the results of testing the 3 transmitter frequencies.

Appendix A

Test setup photos

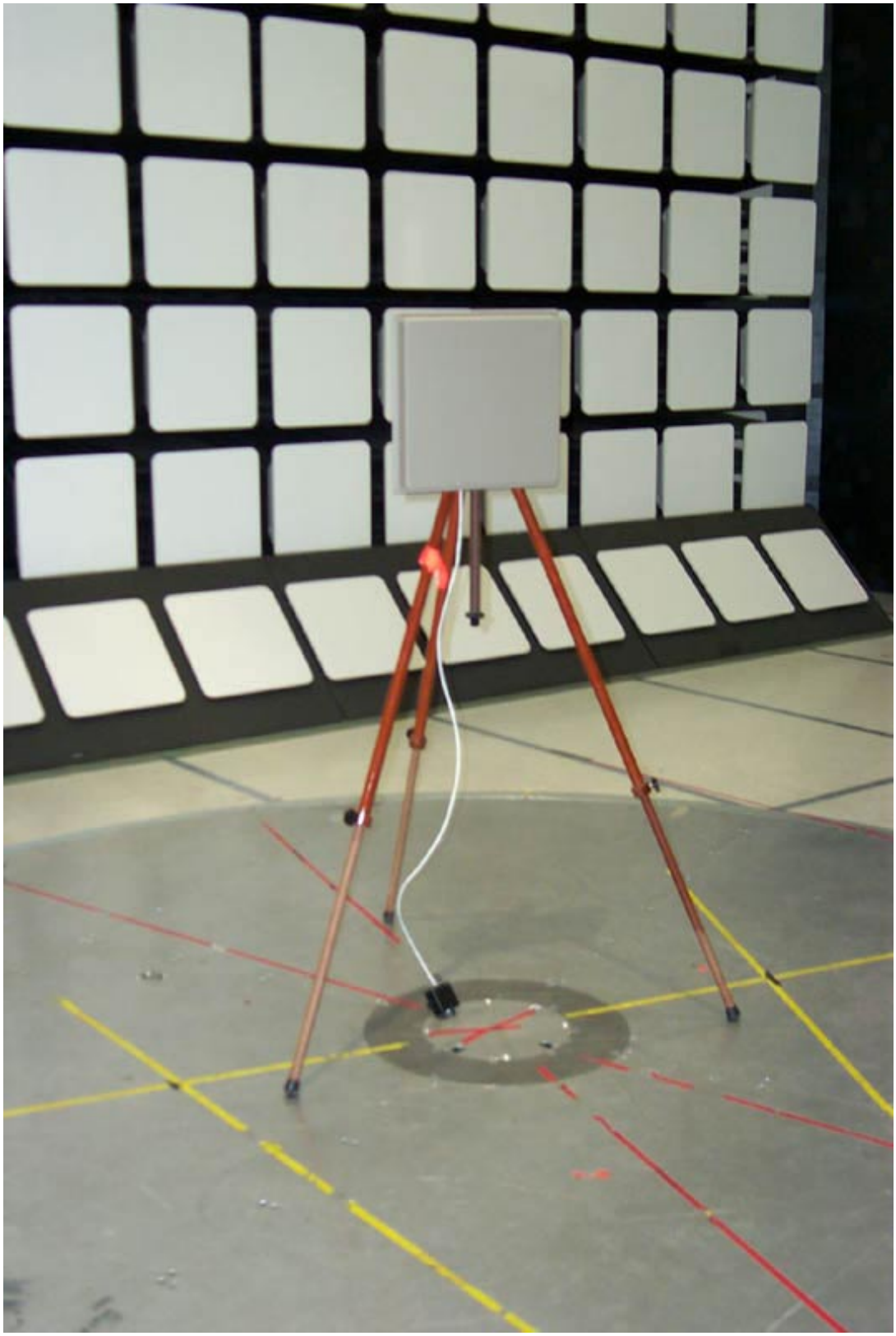

Figure 1 Radiated emissions test setup

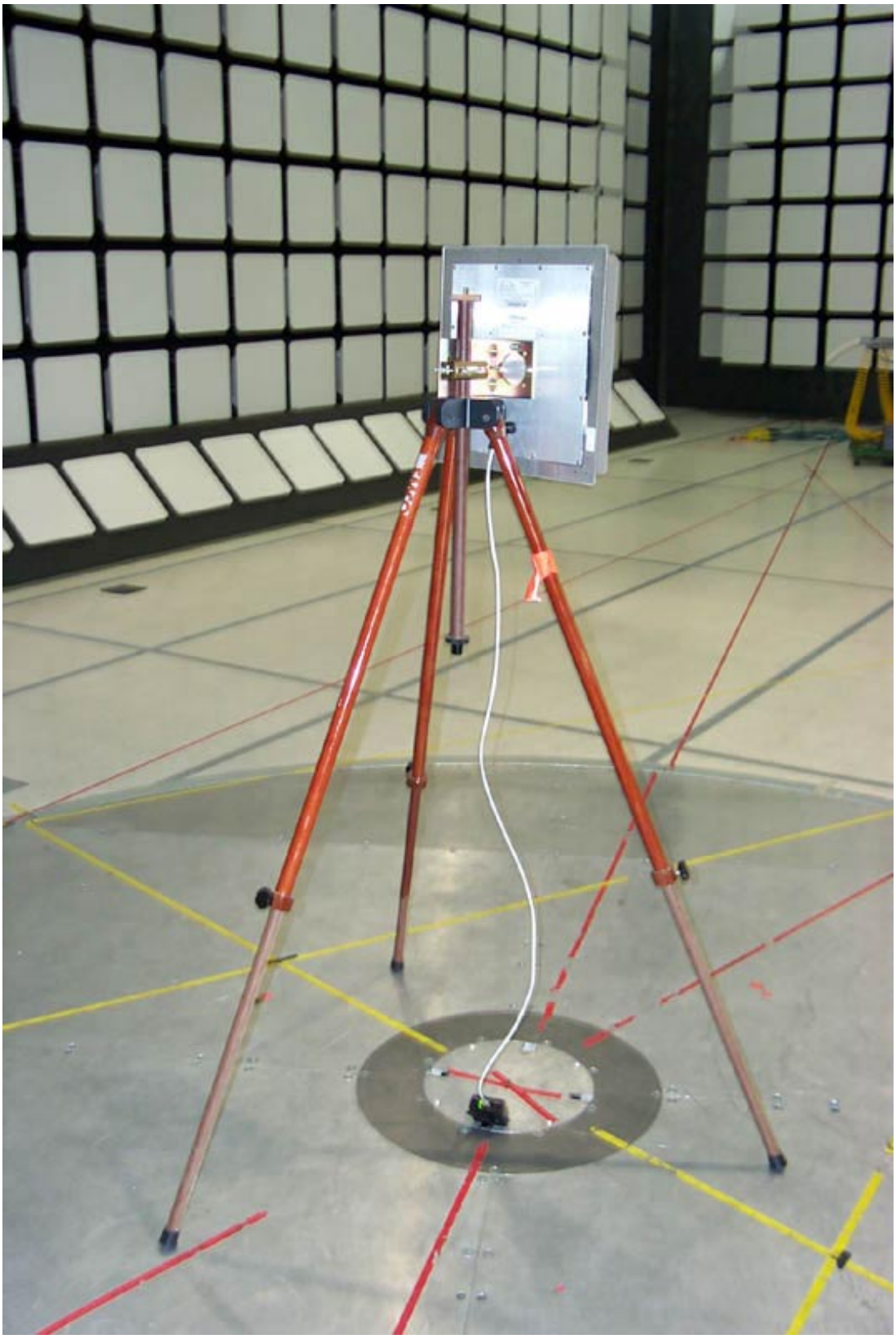

Figure 2 Radiated Emissions test setup

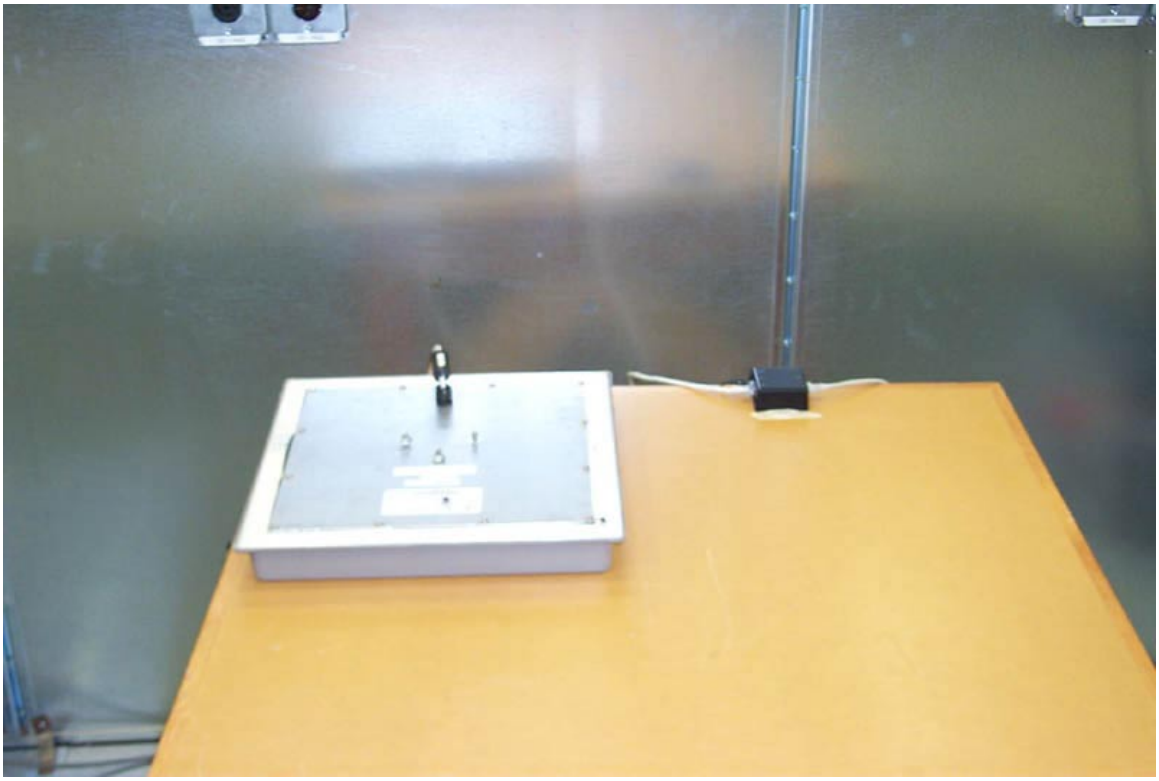

Figure 3 Conducted emissions test setup

Appendix B

Emissions plots

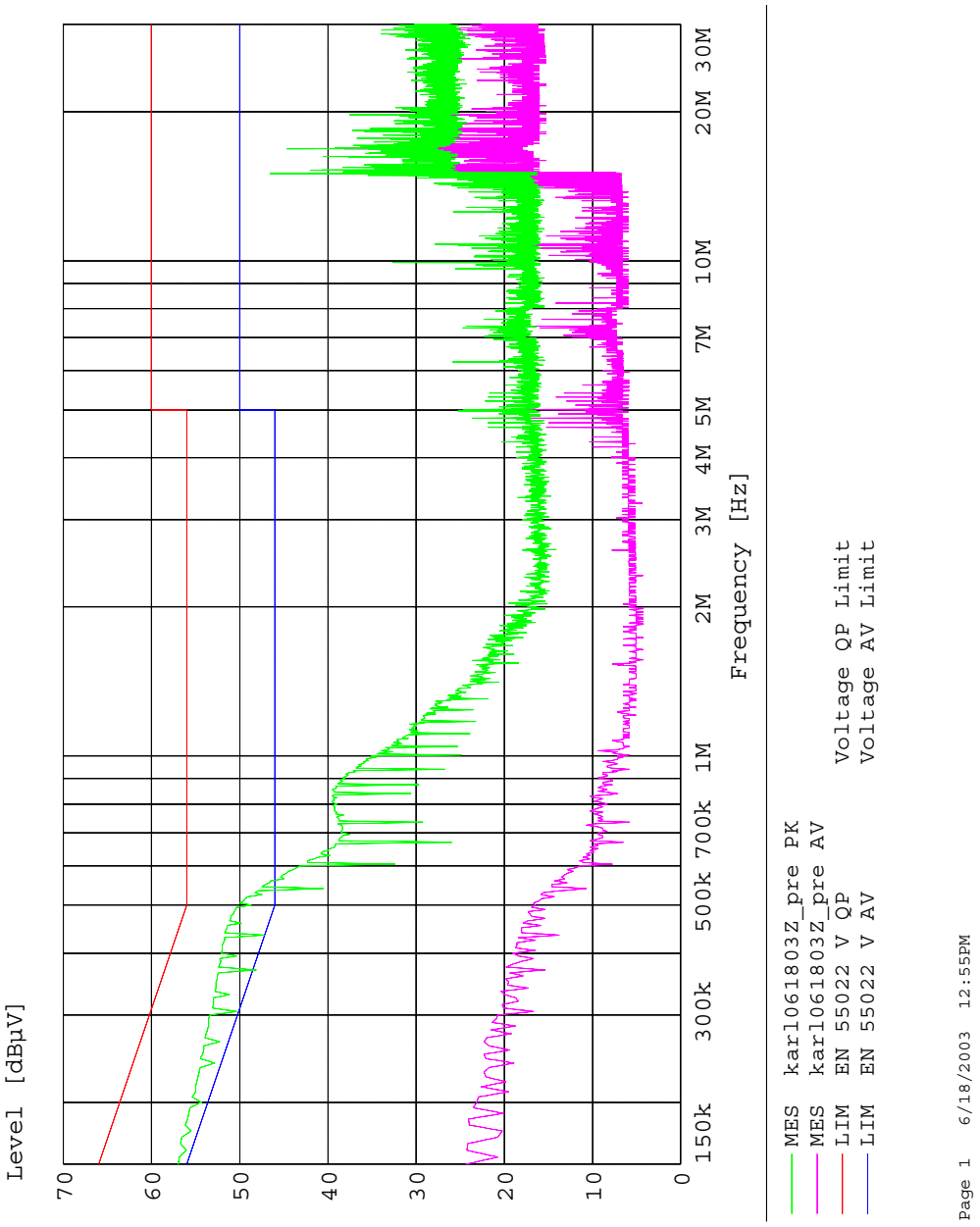

Figure 4 Conducted emissions, worst-case

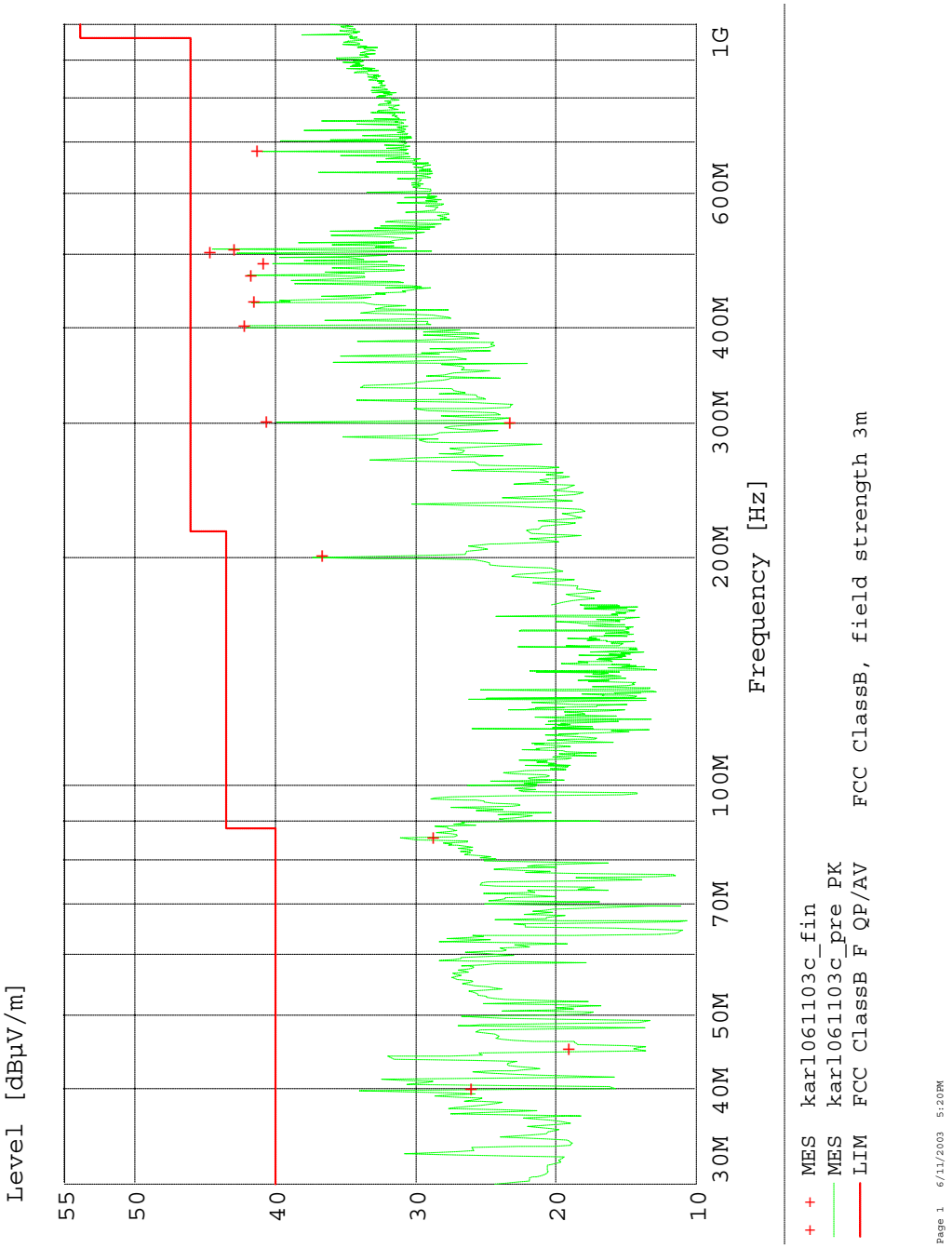

Figure 5 Worst-case emissions below 1GHz with transmitter active

Table of results corresponding to "+" in Figure 5, the worst-case of the 3 transmitter frequencies active, in this case Channel 11 active.

Frequency MHz	Level dBµV/m	Measured dBµV	Transd dB	Cables dB	Limit dBµV/m	Margin dB	Height cm	Angle deg	Pol.
40.02	26.28	12.49	12.7	-1.1	40	13.7	101	198	VERTICAL
45	19.33	7.48	10.7	-1.2	40	20.7	102	129	VERTICAL
85.26	28.98	20.61	6.8	-1.6	40	11	98	212	VERTICAL
200.52	36.93	24.03	10.6	-2.3	43.5	6.6	100	77	HORIZONTAL
300	23.5	7.3	13.4	-2.8	46	22.5	191	235	HORIZONTAL
300.78	40.86	24.58	13.5	-2.8	46	5.1	178	258	HORIZONTAL
401.04	42.45	22.08	17.1	-3.3	46	3.6	118	148	HORIZONTAL
432.36	41.79	21.61	16.8	-3.4	46	4.2	101	352	HORIZONTAL
467.88	42.01	20.46	18.1	-3.5	46	4	99	359	HORIZONTAL
484.02	41.06	19.15	18.3	-3.6	46	4.9	98	358	HORIZONTAL
501.3	44.88	22.66	18.5	-3.7	46	1.1	101	358	HORIZONTAL
505.98	43.18	20.83	18.7	-3.7	46	2.8	98	358	HORIZONTAL
682.02	41.58	15.43	21.8	-4.3	46	4.4	109	319	HORIZONTAL

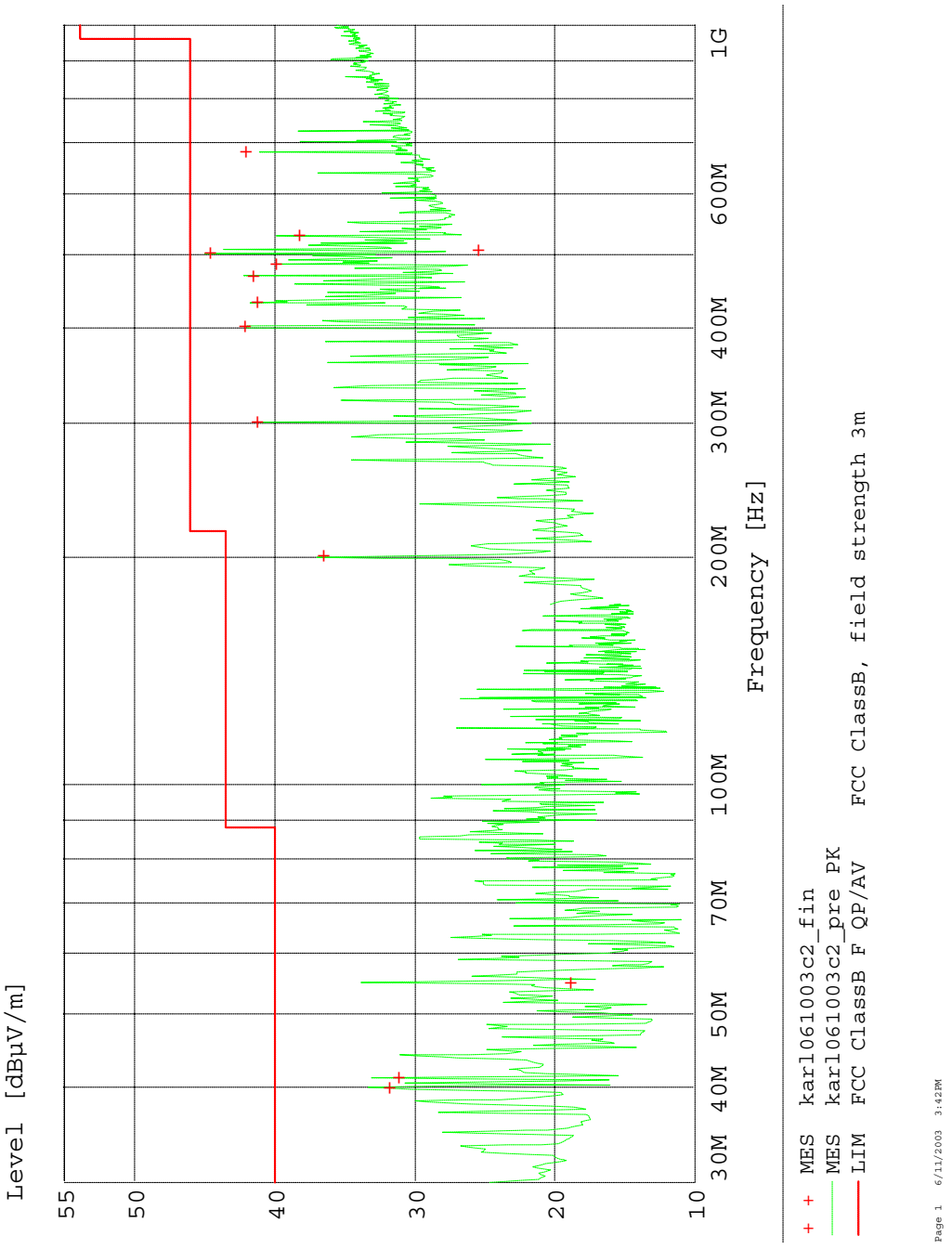

Figure 6 Worst-case emissions below 1GHz with transmitter not active

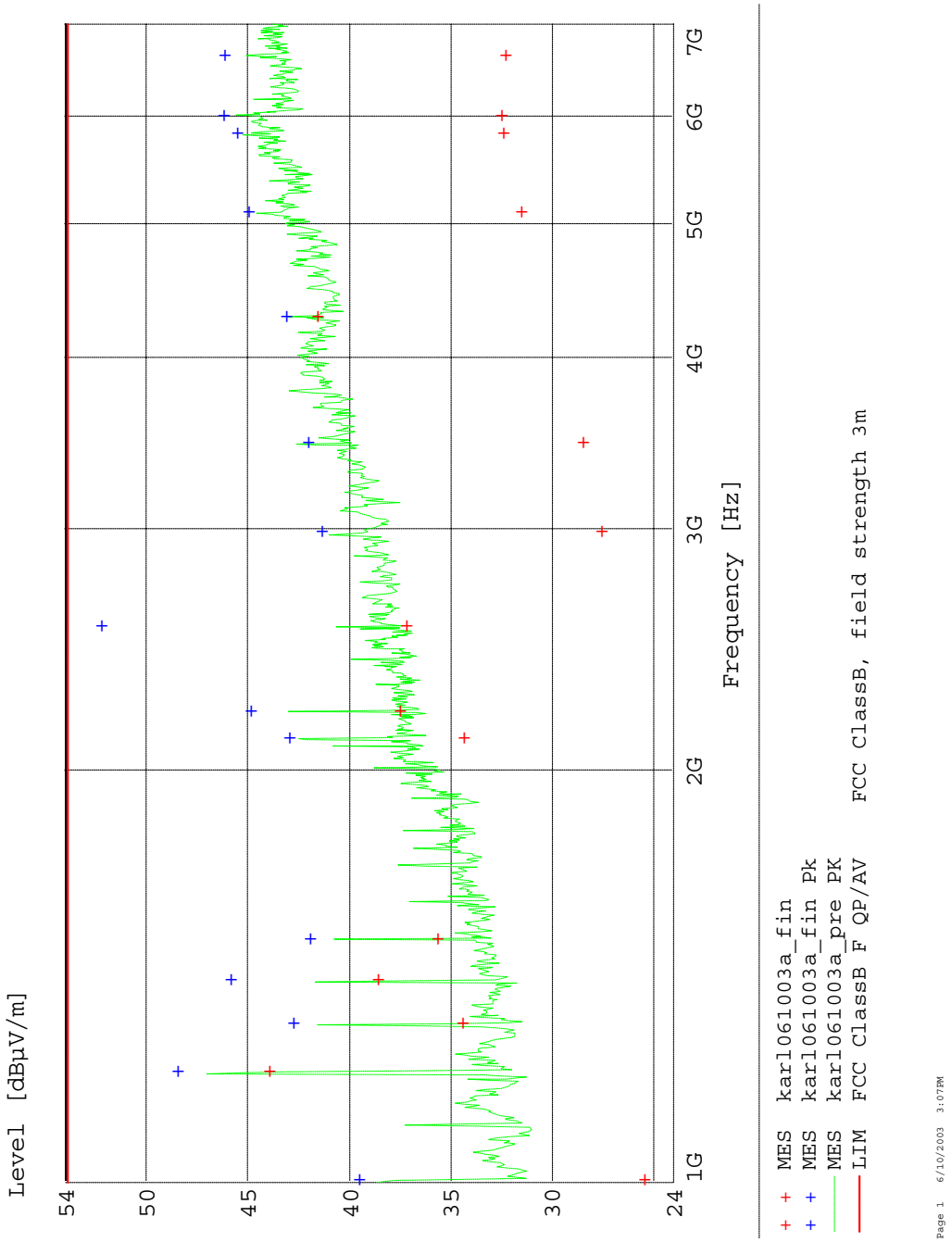

Figure 7 Worst-case emissions above 1GHz with transmitter not active

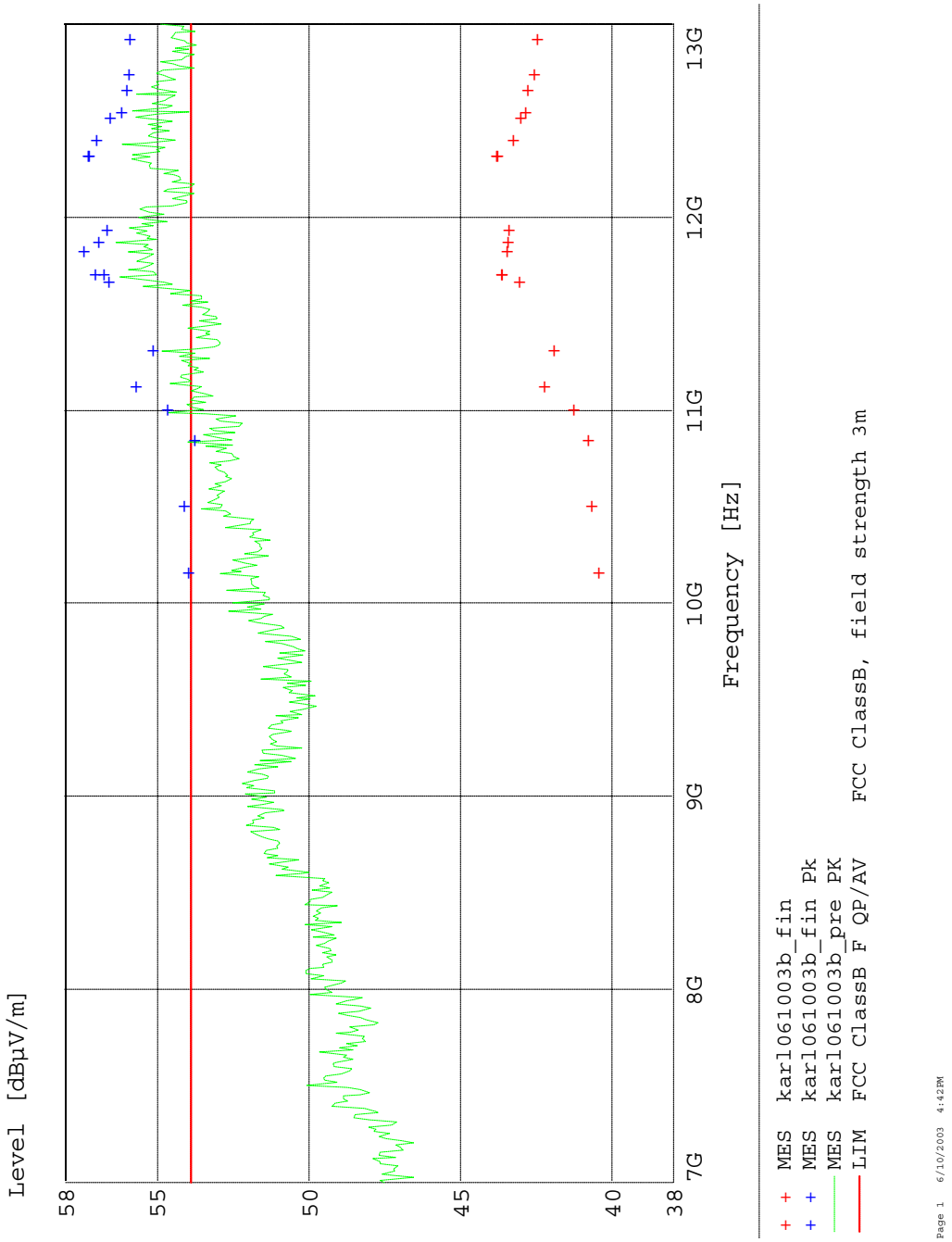

Figure 8 Worst-case emissions above 1GHz with transmitter not active

Appendix C

Emissions results Rx,
3m measurement distance

Path Corrected

Frequency	QP Level	PK Level	Transd	Cables	Limit	Margin	Height	Angle	Pol.
MHz	dBµV/m	dBµV/m	dB	dB	dBµV/m	dB	cm	deg	
40.02	32.04	33.33	12.7	-1.1	40	8	249	233	VERTICAL
41.22	31.39	33.07	12.2	-1.1	40	8.6	99	167	VERTICAL
55.02	19.09	33.86	9.4	-1.3	40	20.9	101	277	VERTICAL
200.52	36.75	36.98	10.6	-2.3	43.5	6.8	99	89	HORIZONTAL
300.78	41.51	40.9	13.5	-2.8	46	4.5	181	105	HORIZONTAL
401.04	42.39	42.04	17.1	-3.3	46	3.6	117	144	HORIZONTAL
432.36	41.45	41.73	16.8	-3.4	46	4.6	100	8	HORIZONTAL
467.88	41.82	42.21	18.1	-3.5	46	4.2	99	357	HORIZONTAL
484.02	40.08	39.83	18.3	-3.6	46	5.9	98	357	HORIZONTAL
501.3	44.81	45	18.5	-3.7	46	1.2	101	353	HORIZONTAL
505.5	25.71	43.59	18.6	-3.7	46	20.3	101	356	HORIZONTAL
528	38.43	39.91	19.3	-3.8	46	7.6	178	35	VERTICAL
682.02	42.28	41.12	21.8	-4.3	46	3.7	109	320	HORIZONTAL

Frequency	AV Level	PK Level	Transd	Cables	Limit	Margin	Height	Angle	Pol.
MHz	dBµV/m	dBµV/m	dB	dB	dBµV/m	dB	cm	deg	
1003	25.53	39.58	24.9	26.2	53.9	28.4	139	293	HORIZONTAL
1203	44	48.56	25.7	25.7	53.9	9.9	109	1	VERTICAL
1303.5	34.52	42.86	26	25.7	53.9	19.4	99	331	VERTICAL
1403.5	38.65	45.95	26.3	25.5	53.9	15.3	125	37	VERTICAL
1504	35.72	42.02	26.6	25	53.9	18.2	106	305	HORIZONTAL
2105.5	34.45	43.04	29.2	22.8	53.9	19.5	101	27	HORIZONTAL
2205.5	37.56	44.98	29.5	22.8	53.9	16.3	100	343	HORIZONTAL
2546.5	37.29	52.36	30.5	22.3	53.9	16.6	149	6	VERTICAL
2977	27.61	41.43	31.6	21.7	53.9	26.3	100	182	VERTICAL
3462.5	28.54	42.12	32.7	20.7	53.9	25.4	399	202	VERTICAL
4280.5	41.68	43.22	34.1	19.7	53.9	12.2	249	345	HORIZONTAL
5104	31.61	45.07	35.5	18.3	53.9	22.3	99	239	VERTICAL
5820.5	32.5	45.64	36.7	17.6	53.9	21.4	350	94	VERTICAL
5994.5	32.62	46.31	36.9	17.4	53.9	21.3	350	58	VERTICAL
6642	32.36	46.28	36.6	17.3	53.9	21.5	399	162	VERTICAL
10151	40.53	54.06	39.1	14.2	53.9	13.4	399	254	VERTICAL
10499	40.78	54.2	39.4	14.5	53.9	13.1	201	118	VERTICAL
10840	40.87	53.83	39.9	14.3	53.9	13	204	83	VERTICAL
10992.5	41.36	54.72	40.1	14.5	53.9	12.5	99	207	VERTICAL
11116.5	42.32	55.77	40.2	14	53.9	11.6	350	287	HORIZONTAL
11305	42.01	55.2	40.3	14.1	53.9	11.9	101	263	VERTICAL
11659.5	43.15	56.66	40.9	14	53.9	10.7	399	330	VERTICAL
11701.5	43.75	57.07	41.1	13.7	53.9	10.1	106	127	VERTICAL
11702	43.72	56.82	41.1	13.7	53.9	10.2	109	359	VERTICAL
11817	43.55	57.47	41.4	14.1	53.9	10.4	150	76	VERTICAL
11870.5	43.52	56.98	41.6	14.3	53.9	10.4	272	301	HORIZONTAL
11922	43.51	56.7	41.8	14.3	53.9	10.4	350	256	VERTICAL
12308.5	43.9	57.33	41.4	14	53.9	10	346	9	HORIZONTAL
12311	43.89	57.31	41.4	14	53.9	10	217	97	VERTICAL
12392.5	43.34	57.05	41.3	14.4	53.9	10.6	350	250	VERTICAL
12511	43.11	56.61	41.1	13.9	53.9	10.8	211	309	VERTICAL
12539.5	42.93	56.24	41.1	14	53.9	11	399	123	HORIZONTAL
12647.5	42.88	56.08	41.1	14	53.9	11	249	184	HORIZONTAL
12732.5	42.66	55.99	41.1	14	53.9	11.2	349	177	VERTICAL
12919	42.56	55.96	41.2	14.2	53.9	11.3	349	199	HORIZONTAL

Appendix D

Emissions results Tx,
3m measurement distance

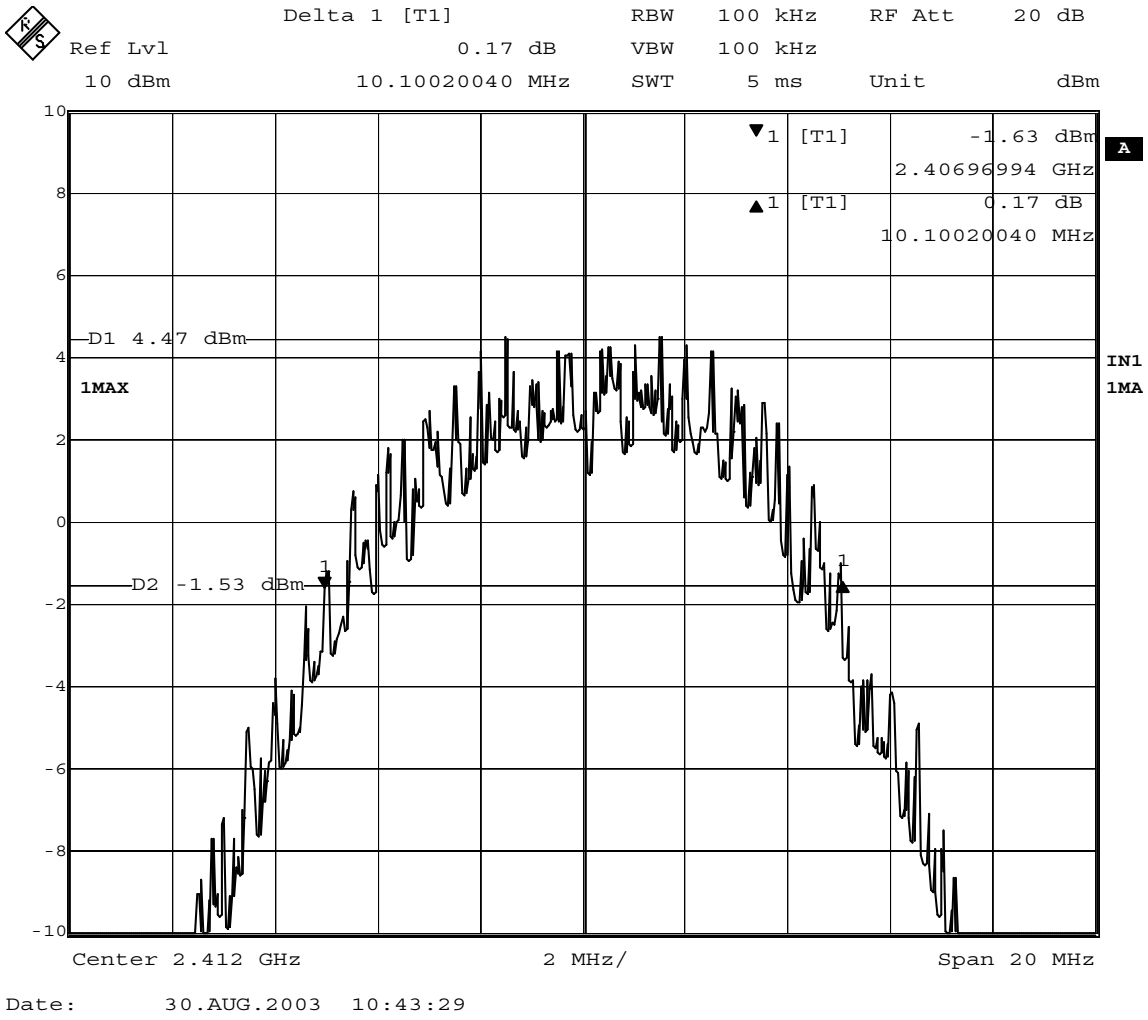

Figure 9 Channel 1 6dB bandwidth, 10.1MHz

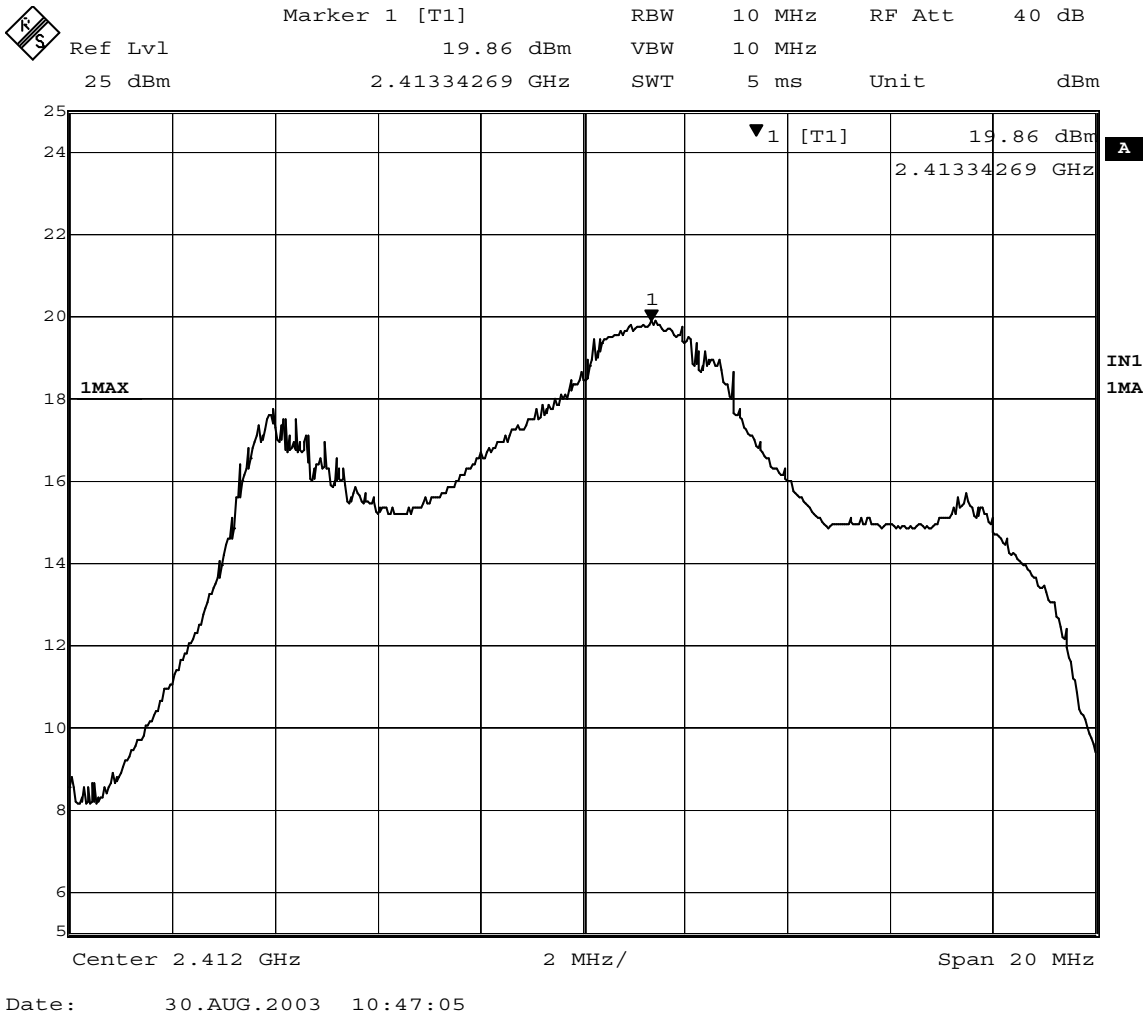

Figure 10 Channel 1 max power

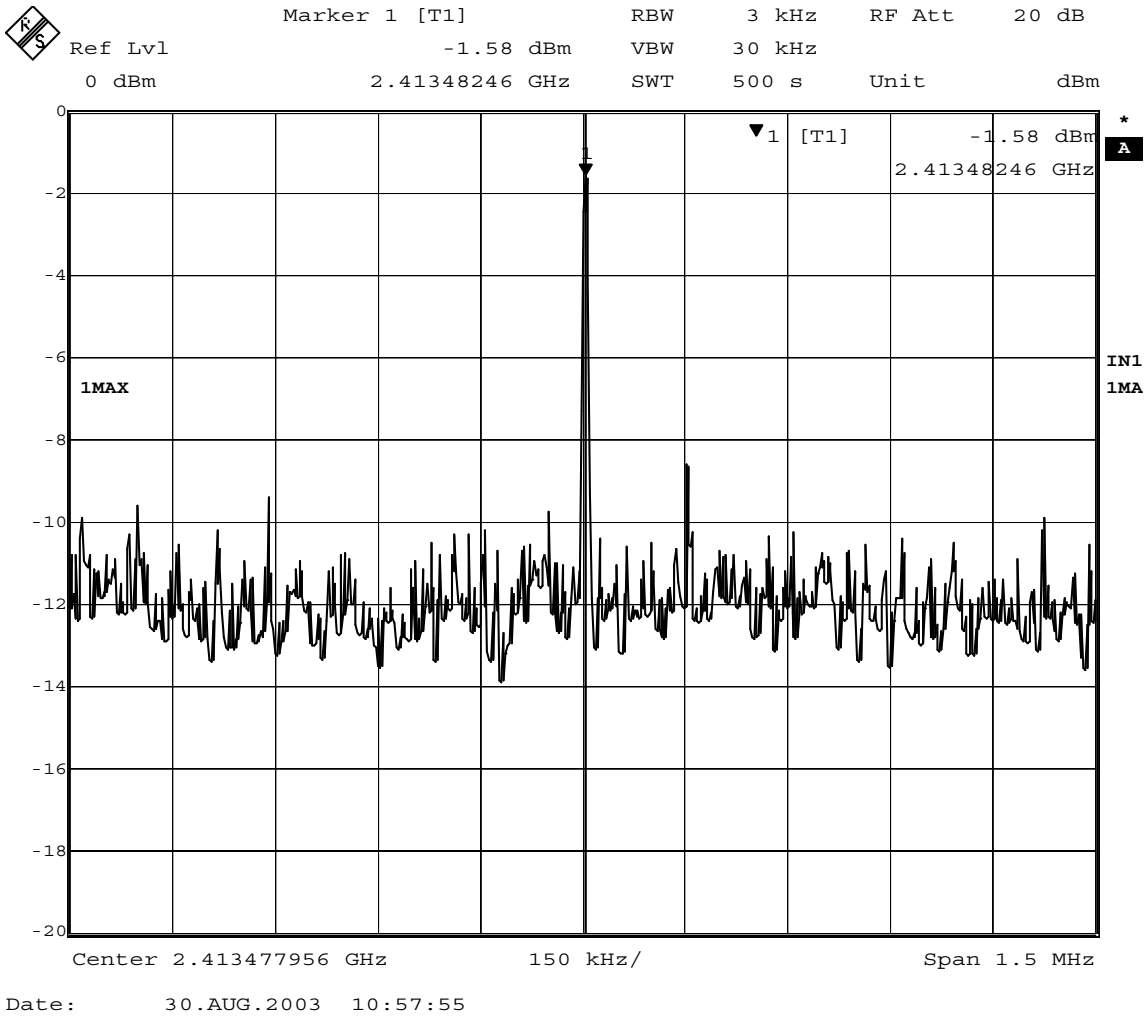

Figure 11 Channel 1, PSD

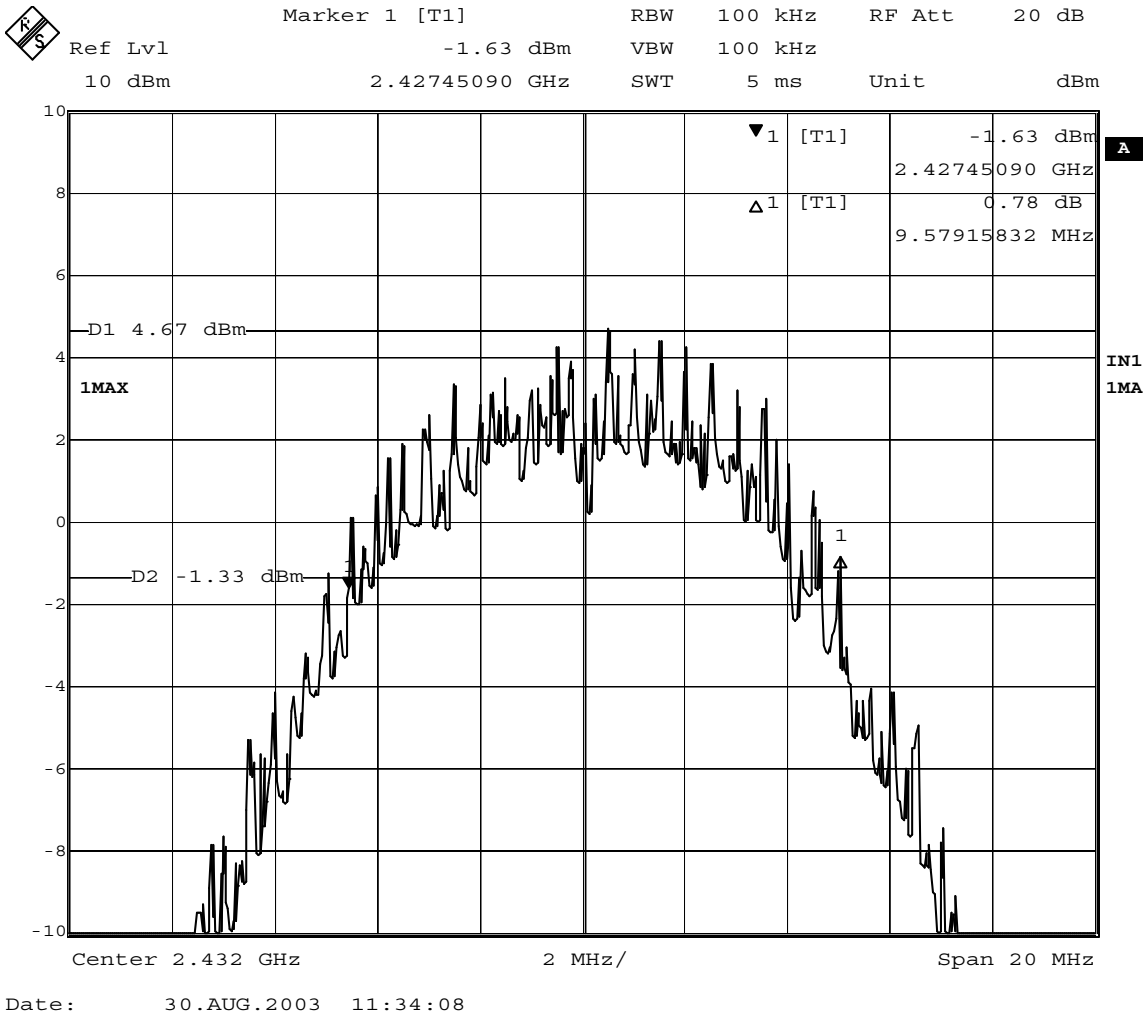

Figure 12 Channel 5, 6dB bandwidth, 9.57MHz

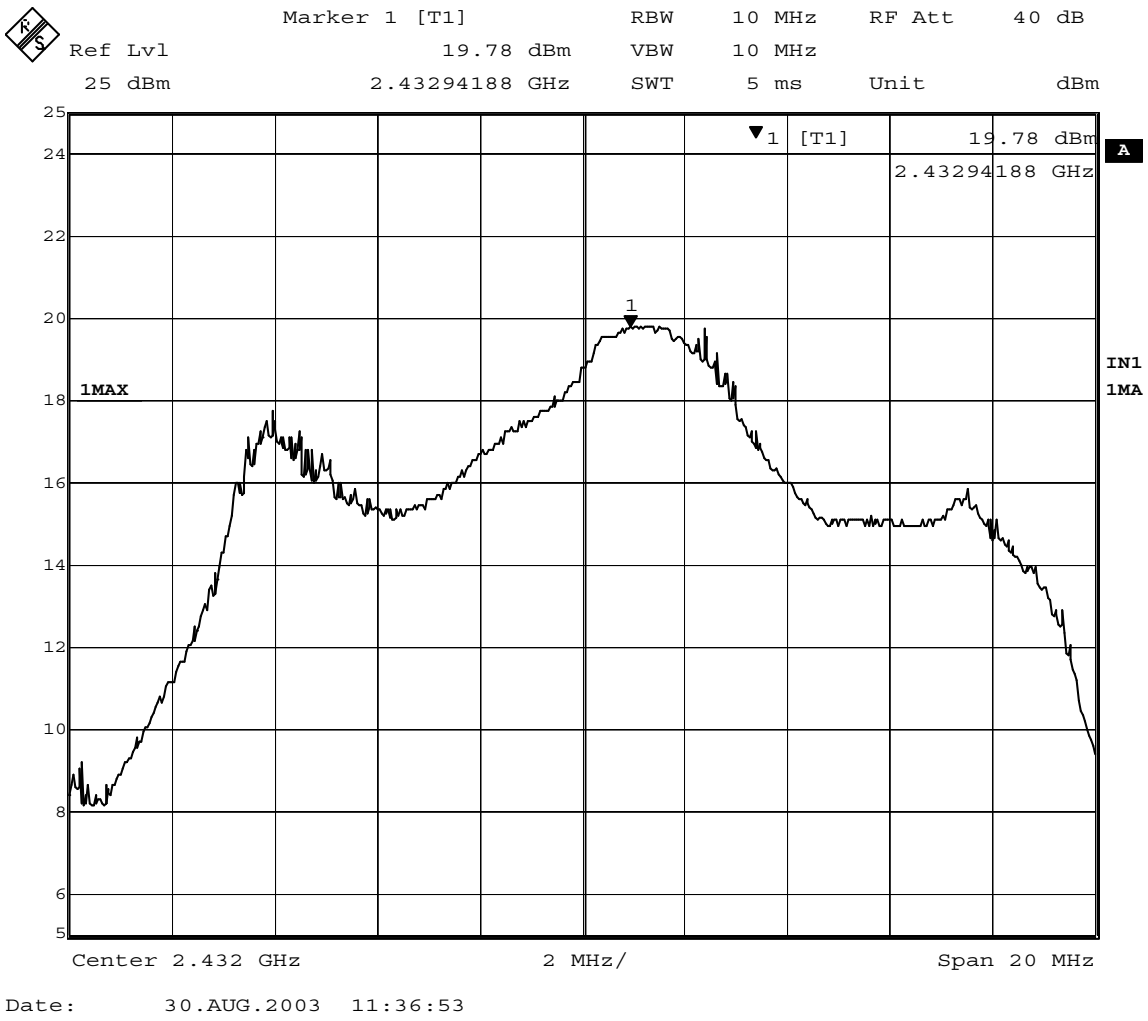

Figure 13 Channel 5 max power

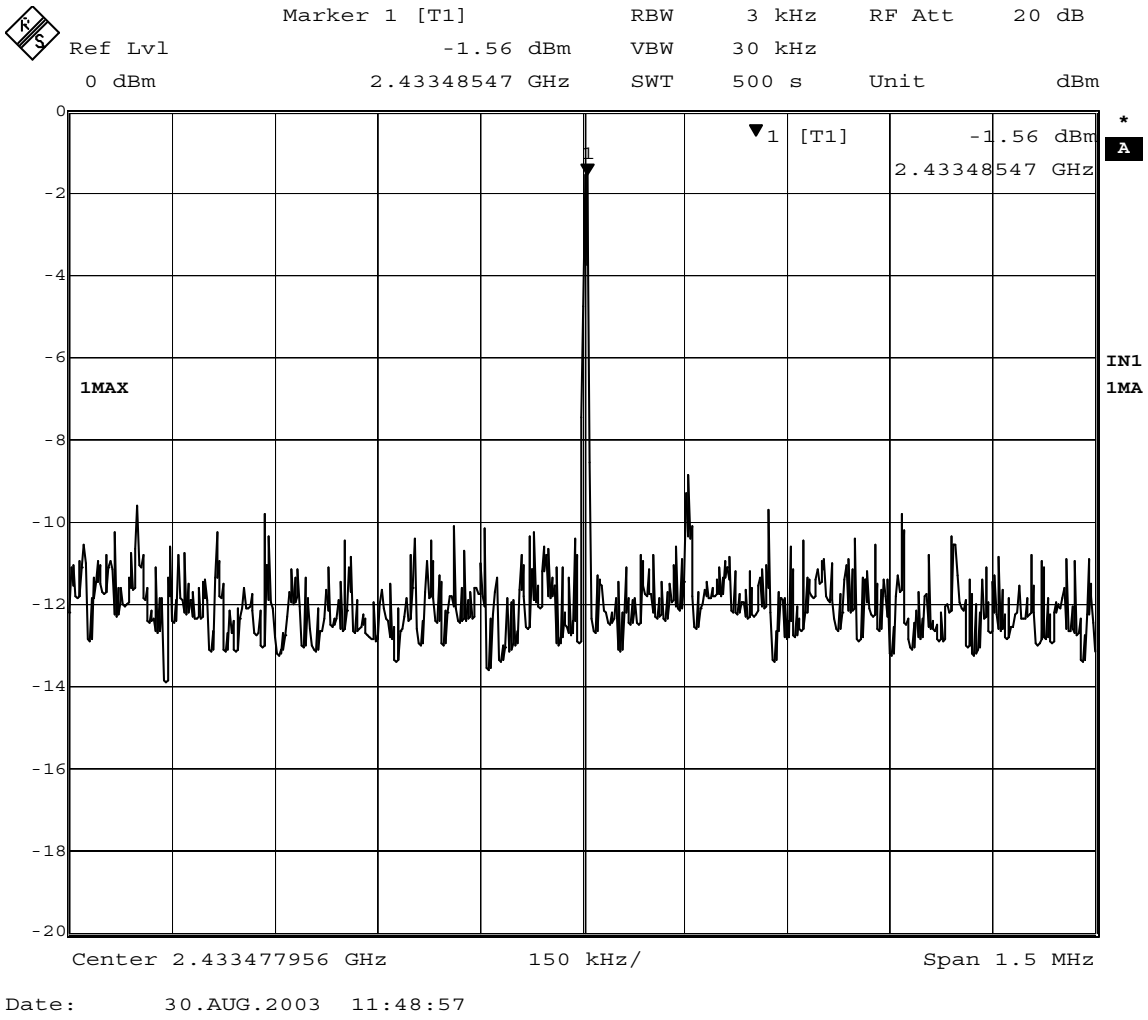

Figure 14 Channel 5, PSD

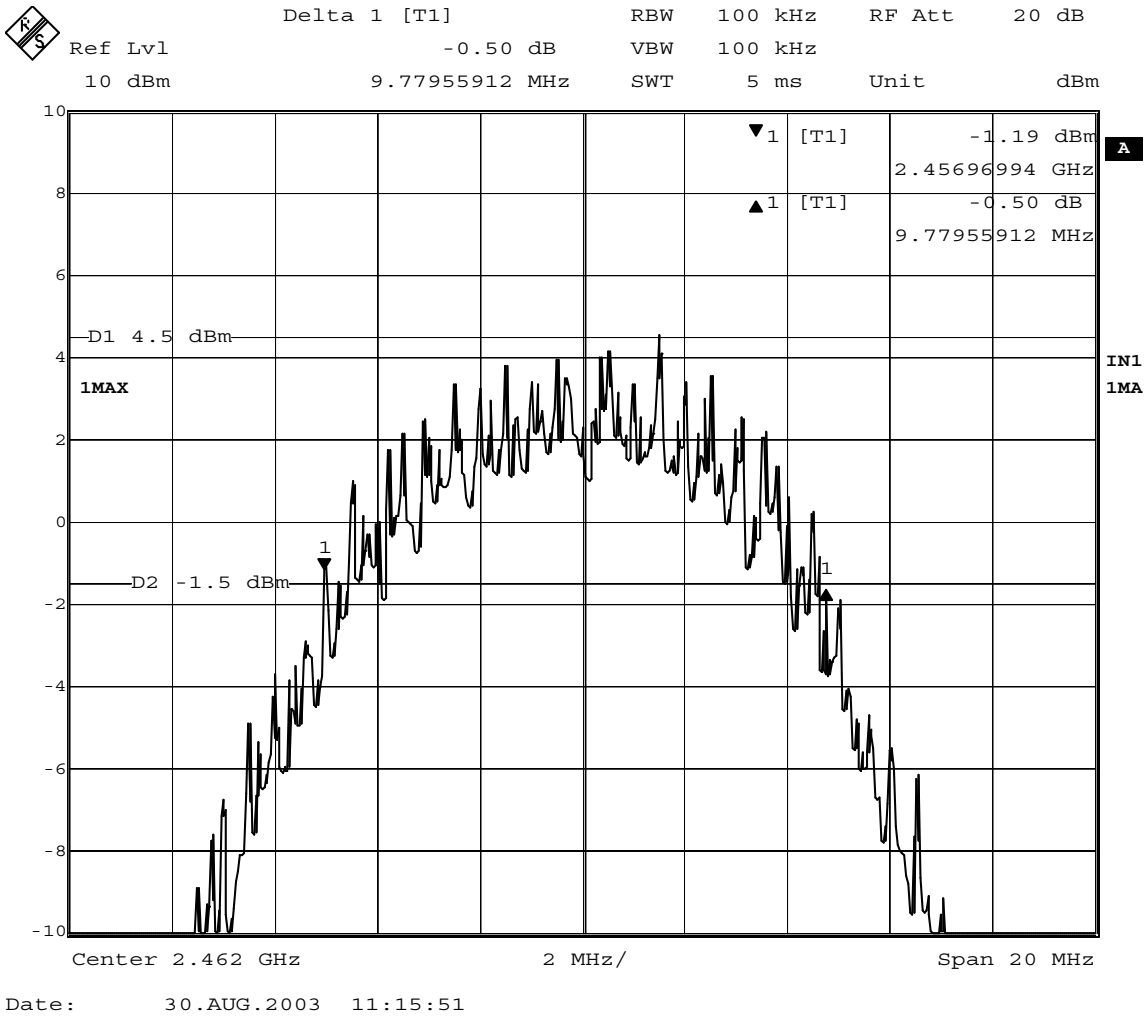

Figure 15 Channel 11, 6dB bandwidth, 9.77MHz

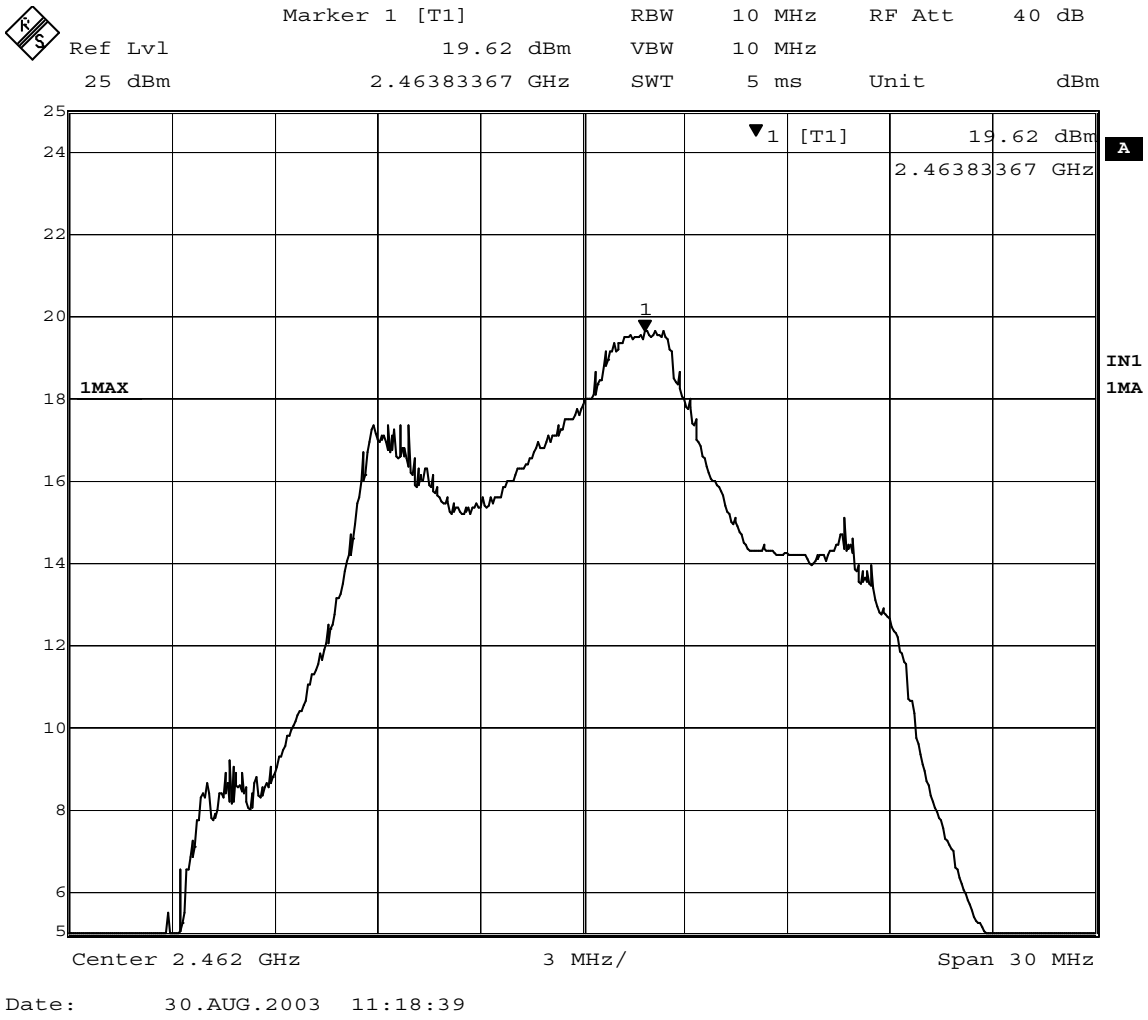

Figure 16 Channel 11, max power

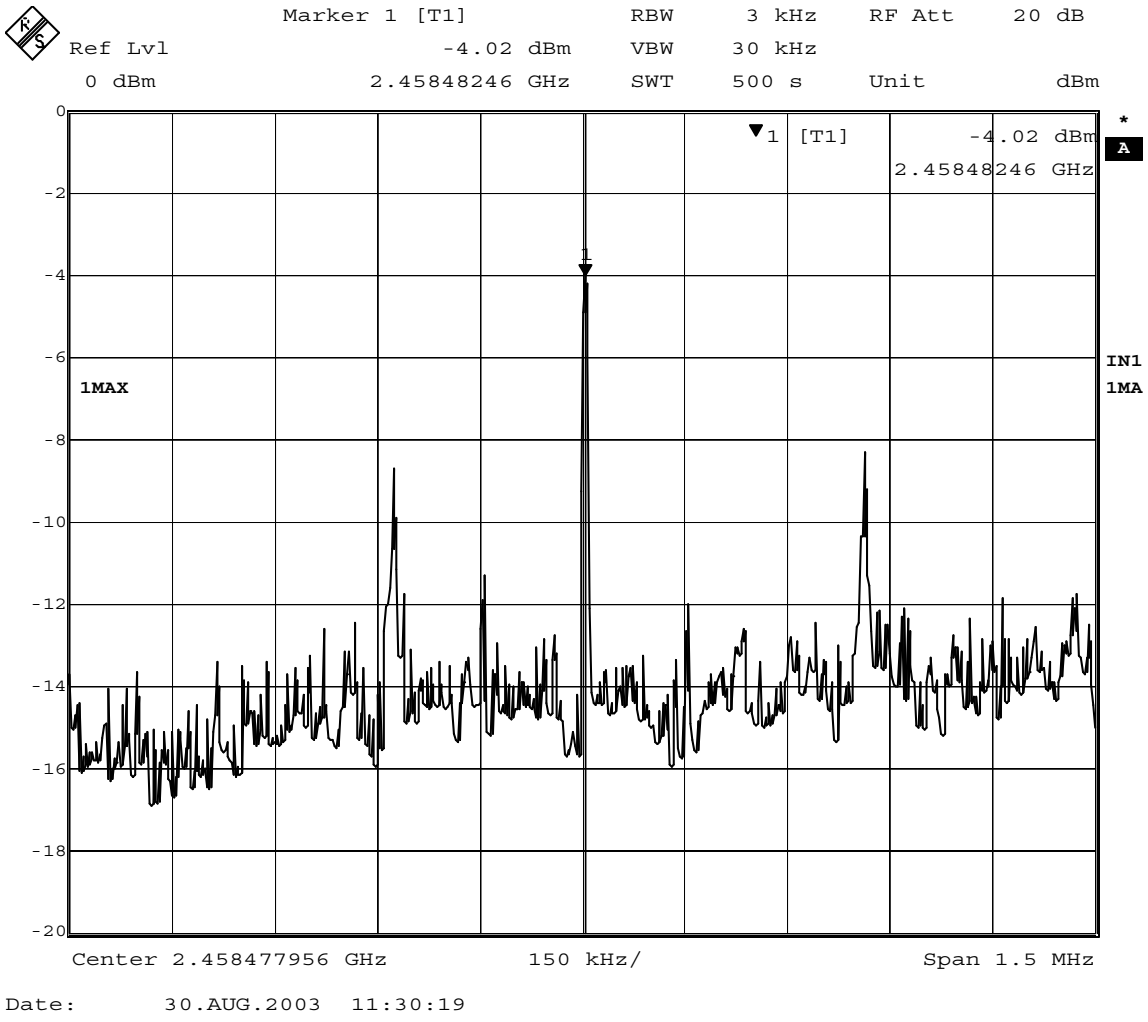

Figure 17 Channel 11, PSD

Appendix E

Sample calculation

Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF – (-CF + AG) + AV

where FS = Field Strength

RA = Receiver Amplitude

AF = Antenna Factor

CF = Cable Attenuation Factor

AG = Amplifier Gain

AV = Averaging Factor (if applicable)

Assume a receiver reading of 55 dBµV is obtained. The Antenna Factor of 12 and a Cable Factor of 1.1 is added. The Amplifier Gain of 20 dB is subtracted, giving a field strength of 48.1 dBµV/m.

FS = 55 + 12 – (-1.1 + 20) + 0 = 48.1 dBµV/m

The 48.1 dBµV/m value can be mathematically converted to its corresponding level in µV/m.

Level in µV/m = Common Antilogarithm [(48.1 dBµV/m)/20]= 254.1 µV/m

Appendix F

Bandedge information

The following pages contain information about the signal of interest in relation to the restricted bands of 2.31GHz to 2.39GHz and 2.4853GHz to 2.5GHz.

	Radiated		Radiated					
Channel	Peak (dBuV/m)	Fig.	Average (dBuV/m)	Fig.				
1	121.8		115.24					
11	122.90		116.06					
	Conducted Peak							
Channel	100kHz RBW (dBm)	Fig.	RestBand (dBm)	Fig.	Freq (Ghz)	1MHz RBW(dBm)		
1	4.45		-53.36		2.3866	11.07		
11	4.2		-54.79		2.4880	11		
	Conducted Average							
Channel	100kHz RBW (dBm)	Fig.	RestBand (dBm)	Fig.	Freq (Ghz)	1MHz RBW (dBm)		
1	-38.44		-74.99		2.3863	-33		
11	-35.72		-73.13		2.4877	-29.42		
	Delta dB							
Channel	Peak (dB)		Average (dB)					
1	57.81		36.55					
11	58.99		37.41				Restricted Bands	
							Freq (Ghz)	
	Mhz from BandEdge						Miniumum	Maximum
Channel	Peak (Mhz)		Average (Mhz)			Lower	2.3100	2.3900
1	3.40		3.70			Upper	2.4835	2.5000
11	4.50		4.20					
	BW Delta dB (1MHz vs 100kHz)							
Channel	Peak (dB)		Average (dB)				Limits (dBuV/m)	
1	0.00		0.00			Average	54	
11	0.00		0.00			Peak	74	
	Restricted Band Calculated Values (dBuV/m)							
Channel	Peak		Average					
1	63.99		78.69					
11	63.91		78.65					

The average calculated bandedge value appears in excess of the limit. Due to the method of transmission and measurement in figures 20, 21, 23 and 25 the signal to noise ratio of the average measurement is low enough to cause the calculations to appear in excess of the limit.

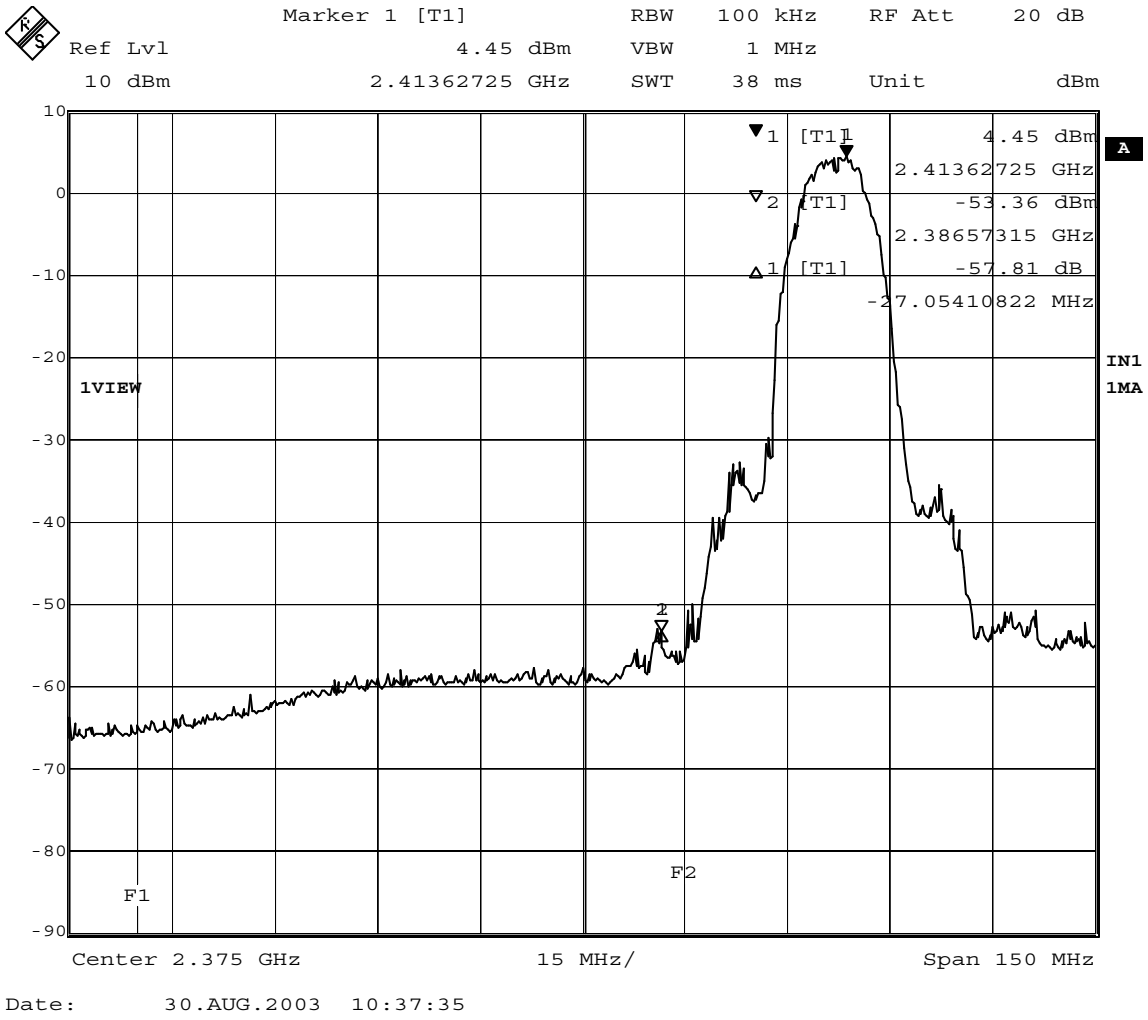

Figure 18 Channel 1 Peak delta dB, restricted band conducted measurement

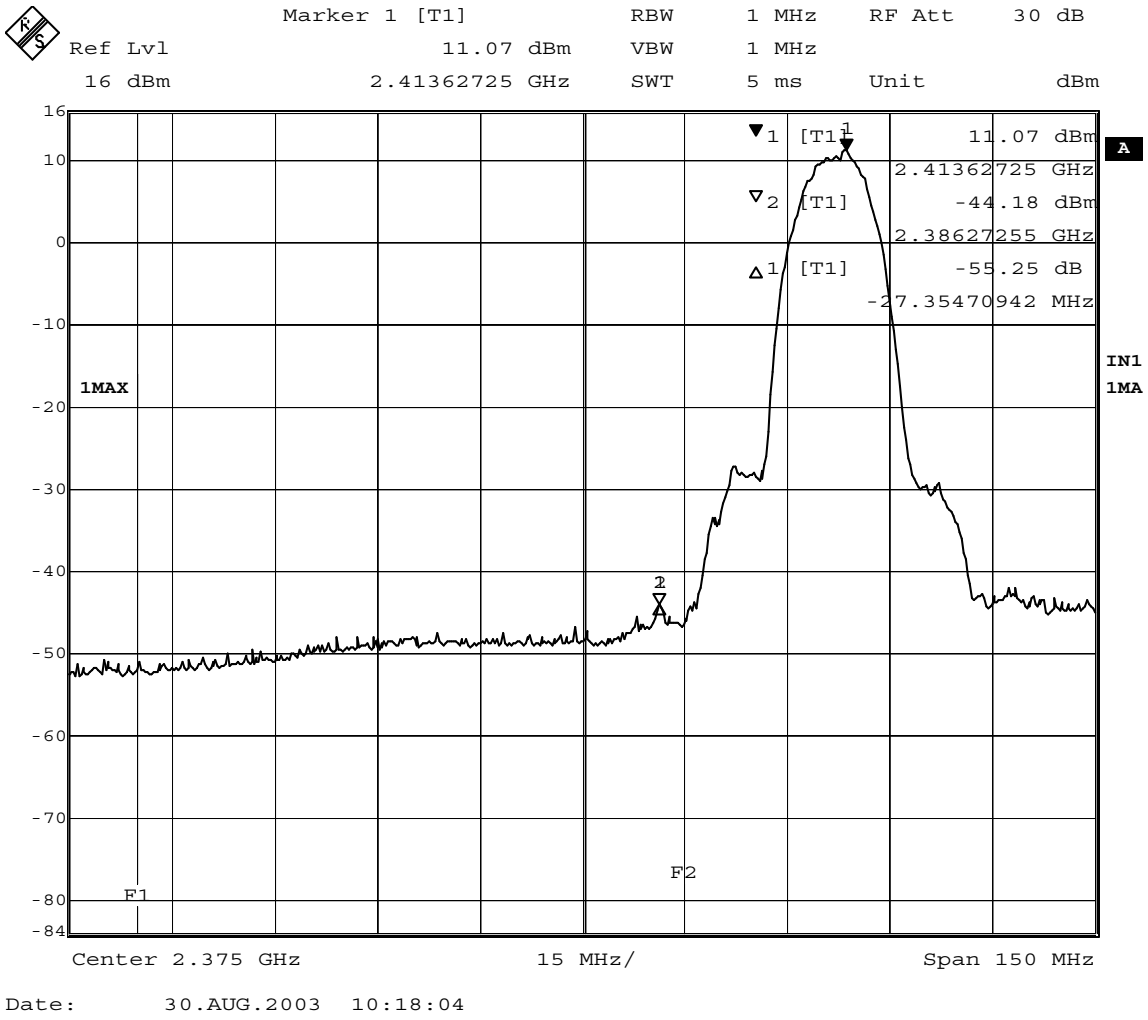

Figure 19 Channel 1 Peak reference, restricted band conducted measurement

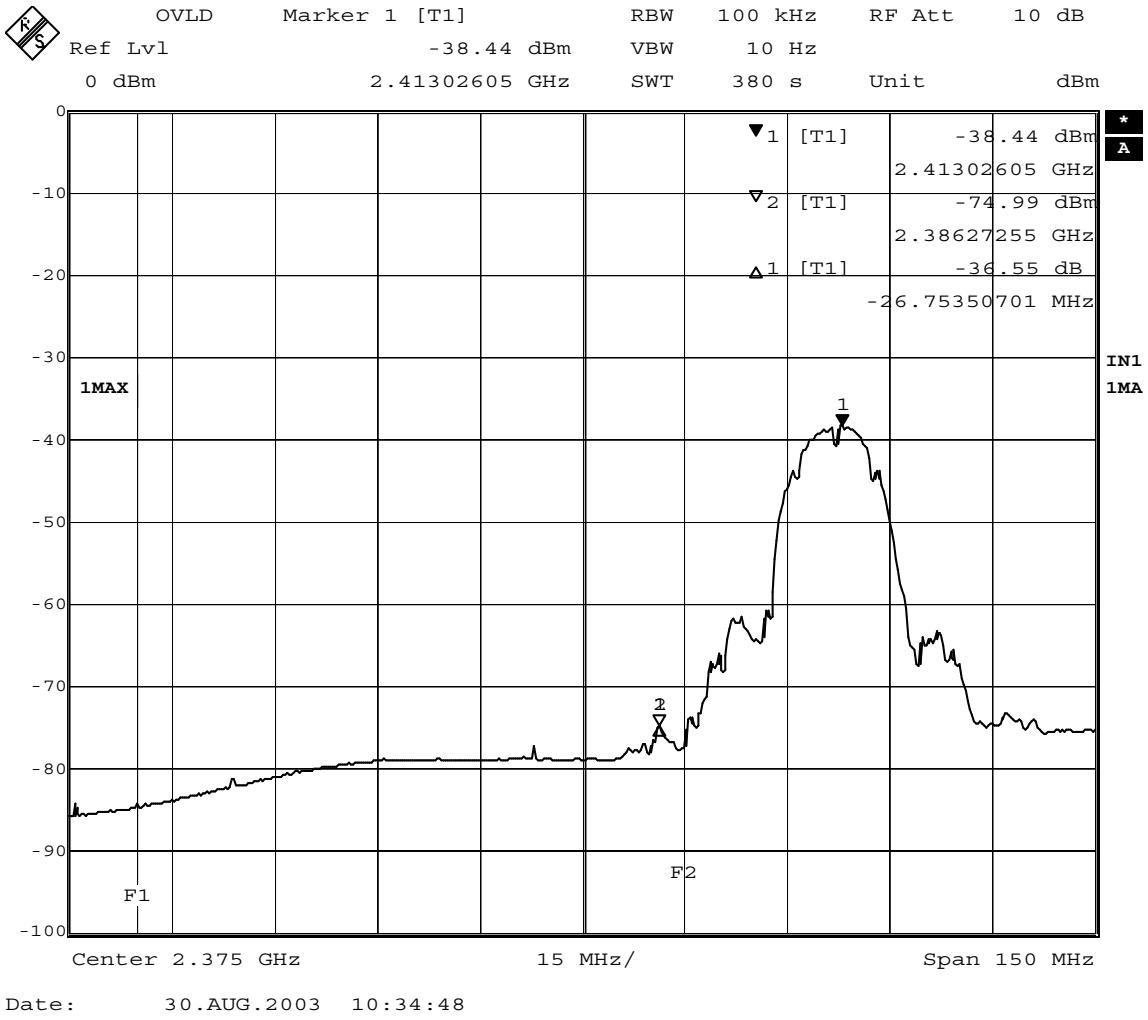

Figure 20 Channel 1 Average delta dB, restricted band conducted measurement

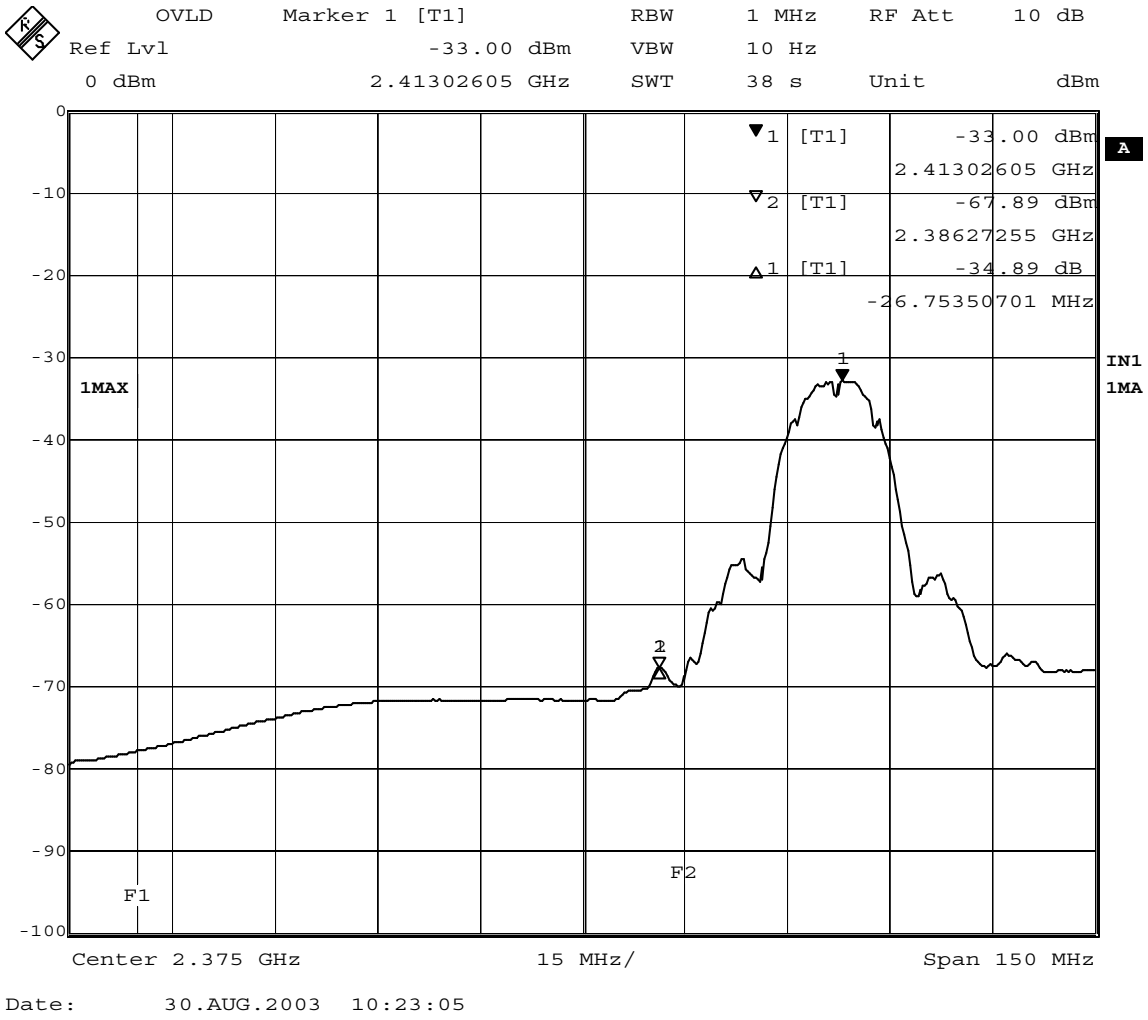

Figure 21 Channel 1, Average, BW delta dB

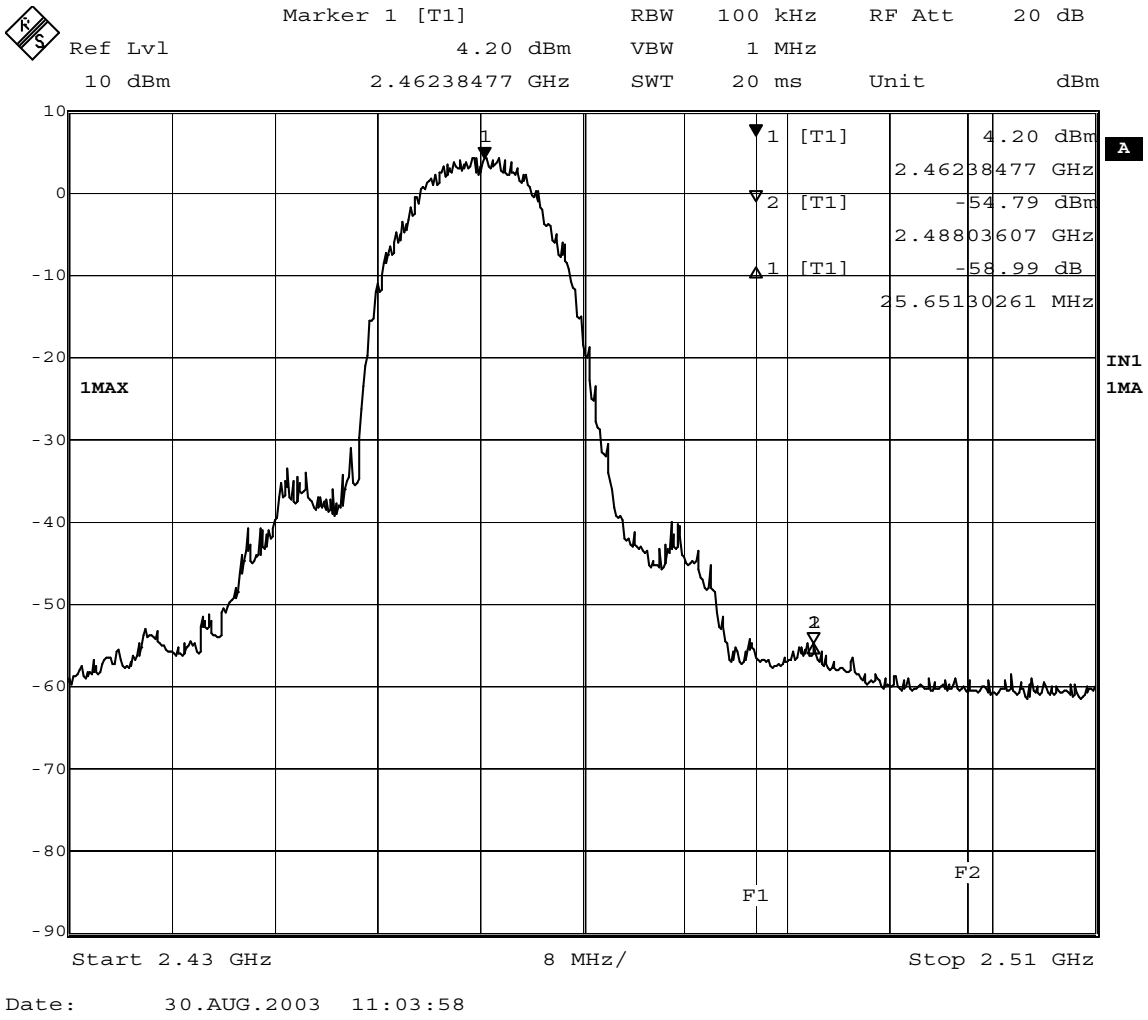

Figure 22 Channel 11, Peak delta dB

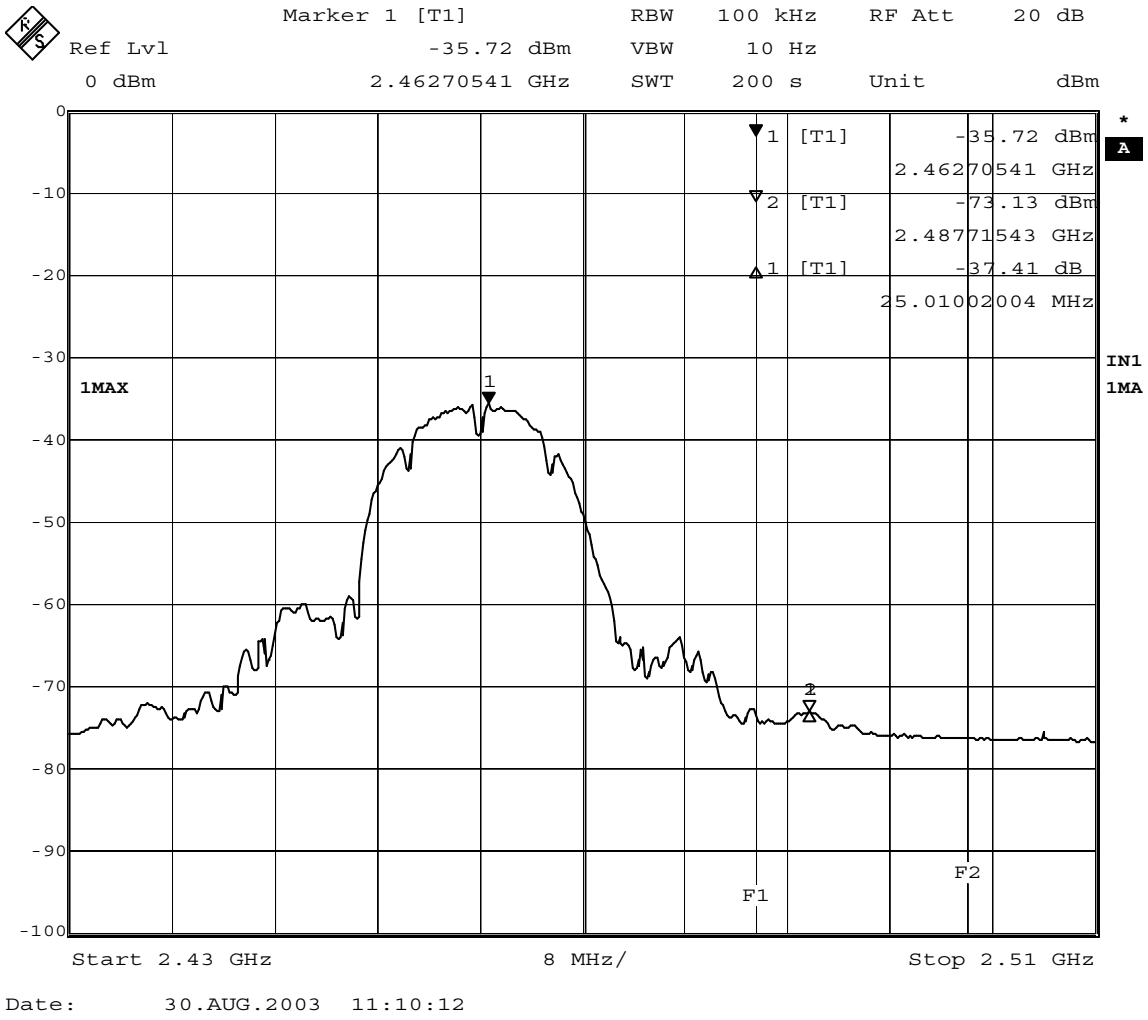

Figure 23 Channel 11, Average conducted delta dB

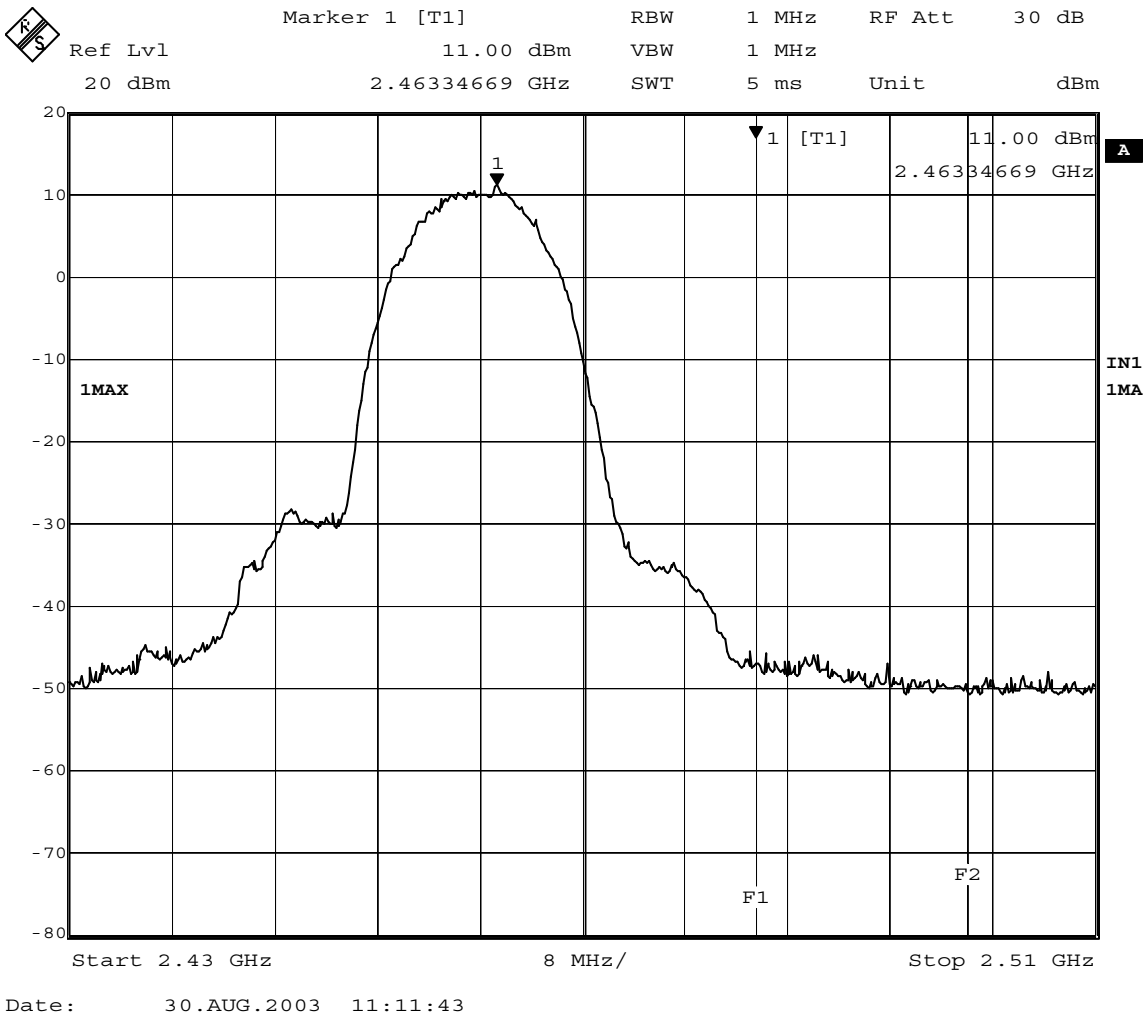

Figure 24 Channel 11, peak conducted, BW delta dB

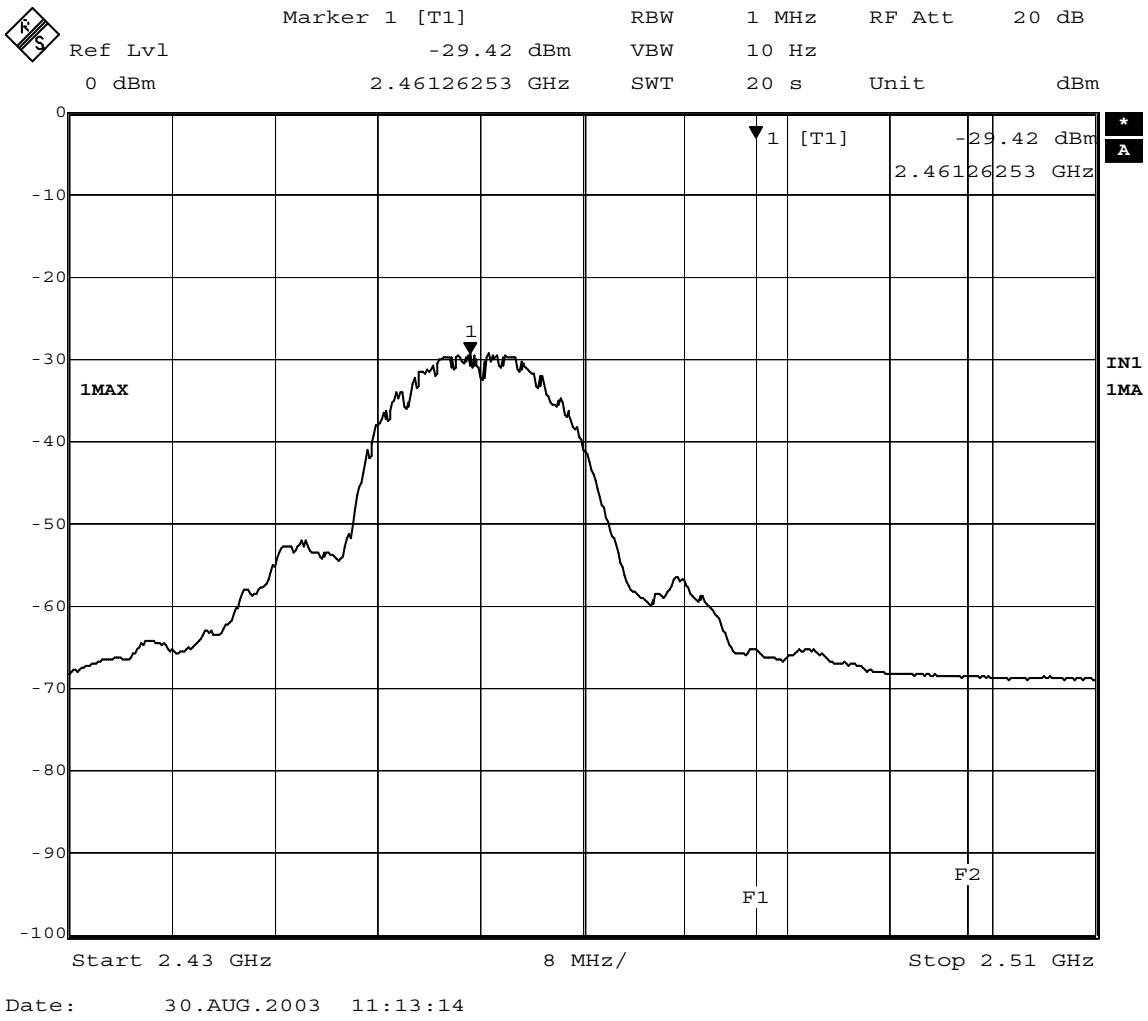

Figure 25 Channel 11, Average conducted, BW delta dB