15.407 Certification
FCC ID: EV9N2X5-7S1-16B

EMI TEST REPORT

On

N2-X Ethernet Extender

Prepared for

Wireless
19 Davis Drive
Belmont, CA 94002-3001
Tel: (650)595-3300
Fax: (650)595-4907

Prepared by

Electronic Compliance Laboratories Inc.

Test Report Number: A903005
Date of Test: February 25, 1999

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1.0 TEST FACILITY

Name: Electronic Compliance Laboratories

Location: 1249 Birchwood Dr.
Sunnyvale, CA 94089

Site Filing: A site description is on file at the Federal Communications Commission
P.O. Box 429
Columbia, MD 21045

NVLAP LAB CODE: 200089

Types of Sites: Open Field Radiated and Indoor Screen Room (Line Conducted). All sites are constructed and calibrated to meet ANSI C63.4-1994 requirements.

2.0 TEST EQUIPMENT

Description	Manufacturer	Model	SN
EMI Receiver	HP	8546A	3325A00137
Spectrum Analyzer	HP	8563A	3137A01183
Spectrum Analyzer	HP	8564E	3741A00986
Preamp	HP	8447F	3113A05849
Preamp	HP	8449B	3008A00527
LISN	EM	ANS-25/2	2532
Biconical Antenna	EM	EM 6912	414
Log Periodic Ant	EM	EM 6950	311
Double Ridge Horn	EM	EM 6961	6231
Filter BP 1.2-45 GHz	FSY	HM 1160-1155	001
Filter BP 4-10 GHz	FSY	HM 2950-1565	001
Filter BP 10-18 GHz	FSY	HP8601-7SS	001
Filter BP 18-26 GHz	FSY	C21G-6.7G-4SS	001

3.0 EUT

N2-X Ethernet Extender - Point to point radio Link
Model Number: - 251-110019-404
Serial Number: - 04-9PP002
FCC ID: - EV9N2X5-7S1-16B

4.0 SUPPORT EQUIPMENT

None

5.0 EQUIPMENT CONFIGURATION

All of the equipment and cables were placed in worst case positions to maximize emissions.

Interconnecting cables were of the type and length specified in the individual equipment requirements.

Grounding was in accordance with the manufacturer requirements and conditions for intended use.

6.0 SUMMARY OF TESTS

The N2 Link 1 x DS1 5.725 - 5.825GHz is a wireless point to point communications system with a low power radio system operating in the 5.725 -5.825 GHz band. Tests were performed using a 28.5 dB gain antenna. Test firmware resident in the EUT was used to do the test.

6.1 15.407(a)(3) Peak Transmit Power

The N2 Link was set to transmit continuously on it's low, middle, and high frequency. The 26 dB bandwidth was measured for each frequency. The peak transmit power limit is the lesser of either 30 dBm or 11 dBm + 10Log(26 dB BW). The peak transmit power limit was reduced by the number of dB that the antenna gain exceeded 23 dBi.

The power was measured by setting RBW to 1MHz and VBW to 30MHz. The analyzer span was set to 1 MHz, the trace set for Max Hold, and the frequency set to the center of the selected EUT frequency. The peak reading of the analyzer was recorded. The analyzer frequency was the shifted by 1 MHz and the procedure was repeated. This was done for 10 MHz on each side of the EUT frequency. Table 1 shows the results for each frequency.

Data Sheets are shown in Appendix A.

Freq. (GHz)	Peak Transmit Power (dBm)	Antenna Gain (dBi)	Limit (dBm) based on 26 dB BW	Limit - Excess Antenna Gain (dBm)	Delta
5.73	3.94	28.5	26.8	4.3	-0.36
5.77	3.79	28.5	26.8	4.3	-0.50
5.80	4.27	28.5	26.8	4.3	-0.03

Table 1. Peak Transmit Power vs. Limit

Peak Spectral Power Density

Peak Power Spectral Density measurements were taken at the same time as the output power. The peak spectral density limit is 17 dBm in any 1 MHz band. This limit is reduced by the number of dB that the antenna gain exceeds 6 dBi, making the limit 5.5 dBm. The N2-X meets the specification. **Data Sheets are shown in Appendix A.**

6.2 15.407(a)(6)

Ratio of the peak excursion of the modulation envelope to the peak transmit power shall not exceed 13 dB.

Freq. (GHz)	Peak Transmit Power (dBm)	Peak Excursion Power (dBm)	Delta	Limit (dB)
5.73	3.94	2.17	1.77	13
5.77	3.79	2.50	1.29	13
5.80	4.27	3.00	1.27	13

6.1.2 **15.407(b)(3) OUT OF BAND EMISSIONS**

The spectrum analyzer plots titled ""‘ OUT OF BAND - LOWER BAND EDGE" shows the output spectrum of the EUT when set to it's lowest transmitting frequency. The spectrum analyzer plots titled ""‘ OUT OF BAND - UPPER BAND EDGE" shows the output spectrum of the EUT when set to it's highest transmitting frequency. The analyzer was placed in MAX HOLD mode, and several sweeps were recorded. The resultant plots show that the EUT emissions were at least 60 dB down from the band edges to 10MHz above and below the band edges.

The spectrum analyzer plots titled ""‘ OUT OF BAND - LOWER BAND EDGE + 10MHz" shows the output spectrum of the EUT when set to it's lowest transmitting frequency. The spectrum analyzer plots titled ""‘ OUT OF BAND - UPPER BAND EDGE + 10 MHz" shows the output spectrum of the EUT when set to it's highest transmitting frequency. The analyzer was placed in MAX HOLD mode, and several sweeps were recorded. The resultant plots show that the EUT emissions were at least 60 dB down for frequencies greater than 10MHz above and below the band edges.

The spreadsheet in Appendix B shows the EIRP of the out of band emissions, up to 20 MHz away from the band edge, is better than -27 dBm / MHz.

The spectrum analyzer plots labeled "OUT OF BAND <30 MHz - 6 GHz", " OUT OF BAND 6 - 13 GHz", "OUT OF BAND 13 - 26.5 GHz", "OUT OF BAND 26.5 - 31GHz", and "OUT OF BAND 31 - 40 GHz", show that emissions measured in >= 100 kHz bandwidth are more than 20 dB below the highest level of the desired power outside of the 5.725 - 5.825 GHz band. **Test Plots are shown in Appendix B.**

6.3 15.205 RESTRICTED BAND RADIATION LIMITS

The EUT was placed on a wooden table resting on a turntable. The wooden table was approximately 1 meter above the groundplane of the 3 meter test site. The search antenna was moved in to 1 meter when necessary to improve the noise floor, and the appropriate range factor was applied. While the EUT was transmitting uninterrupted random data on each of the low / mid / high channels and with the spectrum analyzer on MAX HOLD, the turntable was rotated, and the search antenna raised and lowered in an attempt to maximize the received radiated emission level. **Test results are attached in Appendix C** in tabular form showing that no spurious signals were detected above the 74 dBuV/m peak/54dBuV/m average limits. Peak measurements were made with a RBW and VBW = 1 MHz. Average measurements were made with a RBW = 1 MHz and a VBW = 10 Hz. The N2 harmonics were only measured up to 3rd due to measuring equipment limitations. The Out Of Band plots in Appendix B show that no harmonics are seen above the noise floor.

6.4 15.209 RADIATED EMISSIONS

The attached table shows that the Class B radiated limits from 30 - 1000 MHz are not exceeded by the EUT. The EUT was set in a receive only mode during this test. The EUT was placed near one edge of a wooden table resting on a turntable. The wooden table was approximately 1 meter above the groundplane of the 3 meter test site. The search antennas were located at 3 meters. Measurements were made in accordance with ANSI C63.4-1994. **Test Data is in Appendix E.**

6.5 15.207 AC LINE CONDUCTED EMISSIONS

The RF line conducted levels for emissions in the 0.45 - 30 MHz band must not exceed 250 µV when measured with a LISN. Attached graphs and tabular data show that emissions are below the 250 µV (48 dBµV) maximum allowed level. **Test Data is in Appendix D**.

6.6 15.203 ANTENNA REQUIREMENT

The unit requires professional installation and is therefore exempt from the requirements of 15.203.This product has a standard N type Antenna connector to provide a coupling to the intentional radiator.

Electronic Compliance Laboratories

Chip Matheny Date 06/30/99
Technical Officer

APPENDIX A

Peak Transmit Power and Peak Power Spectral Density Data Sheets

5.725 - 5.825 GHz NII
Output Power / Peak Power Spectral Density

Date:	2/22/99	Freq (GHz) =	5.73568
Work Order	9021001B	26 dB BW =	9.6 MHz
File Name	9021001B1ptp.xls		
Tested By	Shawn McGuiness	**Peak Transmit Power Limit**	
		17dBm+10Log(9.6Mhz)=	26.8 dBm
RBW =	1 MHz		
VBW =	30 kHz	Antenna gain =	28.5 dBi
Span =	1 MHz	Antenna gain - 6dBi =	22.5 dB

Freq (GHZ)	Pout (dBm)	Pout (mW)
5.72568	-53.20	0.000
5.72668	-53.70	0.000
5.72768	-50.70	0.000
5.72868	-52.50	0.000
5.72968	-44.67	0.000
5.73068	-30.50	0.001
5.73168	-22.67	0.005
5.73268	-22.50	0.006
5.73368	-9.33	0.117
5.73468	-3.50	0.447
5.73568	0.00	1.000
5.73668	-2.33	0.585
5.73768	-5.50	0.282
5.73868	-15.80	0.026
5.73968	-23.20	0.005
5.74068	-26.00	0.003
5.74168	-39.00	0.000
5.74268	-52.70	0.000
5.74368	-51.60	0.000
5.74468	-53.70	0.000
5.74568	-55.00	0.000

PTP Limit - 22.5 dB = 4.3 dBm

Ptotal (mW) =	2.48
Ptotal (dBm) =	3.94
Ant. Gain (dBi) =	28.50
EIRP (dBm) =	32.44

5.725 - 5.825 GHz NII
Output Power / Peak Power Spectral Density

Date:	2/22/99	Freq (GHz) =	5.77664
Work Order	9021001B	26 dB BW =	9.7 MHz
File Name	9021001B2ptp.xls		
Tested By	Shawn McGuiness	**Peak Transmit Power Limit**	
		17dBm+10Log(9.7Mhz)=	26.8 dBm
RBW =	1 MHz		
VBW =	30 kHz	Antenna gain =	28.5 dBi
Span =	1 MHz	Antenna gain - 6dBi =	22.5 dB

Freq (GHZ)	Pout (dBm)	Pout (mW)
5.76664	-55.30	0.000
5.76764	-55.00	0.000
5.76864	-52.20	0.000
5.76964	-54.00	0.000
5.77064	-45.00	0.000
5.77164	-31.40	0.001
5.77264	-22.80	0.005
5.77364	-23.20	0.005
5.77464	-9.50	0.112
5.77564	-3.70	0.427
5.77664	0.00	1.000
5.77764	-2.50	0.562
5.77864	-5.80	0.263
5.77964	-18.70	0.013
5.78064	-23.00	0.005
5.78164	-26.50	0.002
5.78264	-38.80	0.000
5.78364	-52.50	0.000
5.78464	-52.50	0.000
5.78564	-53.80	0.000
5.78664	-54.50	0.000

PTP Limit - 22.5 dB = 4.3 dBm

Ptotal (mW) =	2.40
Ptotal (dBm) =	3.79
Ant. Gain (dBi) =	28.50
EIRP (dBm) =	32.29

5.725 - 5.825 GHz NII
Output Power / Peak Power Spectral Density

Date:	2/22/99	Freq (GHz) =	5.81504
Work Order	9021001B	26 dB BW =	9.7 MHz
File Name	9021001B3ptp.xls		
Tested By	Shawn McGuiness	**Peak Transmit Power Limit**	
		17dBm+10Log(9.7Mhz)=	26.8 dBm
RBW =	1 MHz		
VBW =	30 kHz	Antenna gain =	28.5 dBi
Span =	1 MHz	Antenna gain - 6dBi =	22.5 dB

Freq (GHZ)	Pout (dBm)	Pout (mW)
5.80504	-54.30	0.000
5.80604	-54.30	0.000
5.80704	-51.30	0.000
5.80804	-52.50	0.000
5.80904	-45.30	0.000
5.81004	-29.60	0.001
5.81104	-22.50	0.006
5.81204	-21.50	0.007
5.81304	-8.80	0.132
5.81404	-3.70	0.427
5.81504	0.67	1.167
5.81604	-2.20	0.603
5.81704	-5.30	0.295
5.81804	-15.83	0.026
5.81904	-22.50	0.006
5.82004	-25.70	0.003
5.82104	-39.00	0.000
5.82204	-53.50	0.000
5.82304	-51.50	0.000
5.82404	-54.00	0.000
5.82504	-54.30	0.000

PTP Limit - 22.5 dB = 4.3 dBm

Ptotal (mW) =	2.67
Ptotal (dBm) =	4.27
Ant. Gain (dBi) =	28.50
EIRP (dBm) =	32.77

5.725 - 5.825 GHz NII
Out of Band

Date:	9/10/98	**RBW =**	1 MHz
Work Order	8090301B	**VBW =**	30 kHz
File Name	57OOB.xls	**Span =**	1 MHz
Tested By	Chris Byleckie		
		Ant. Gain =	28.5 dBi

Limit from Band Edge = -17 dBm / MHZ

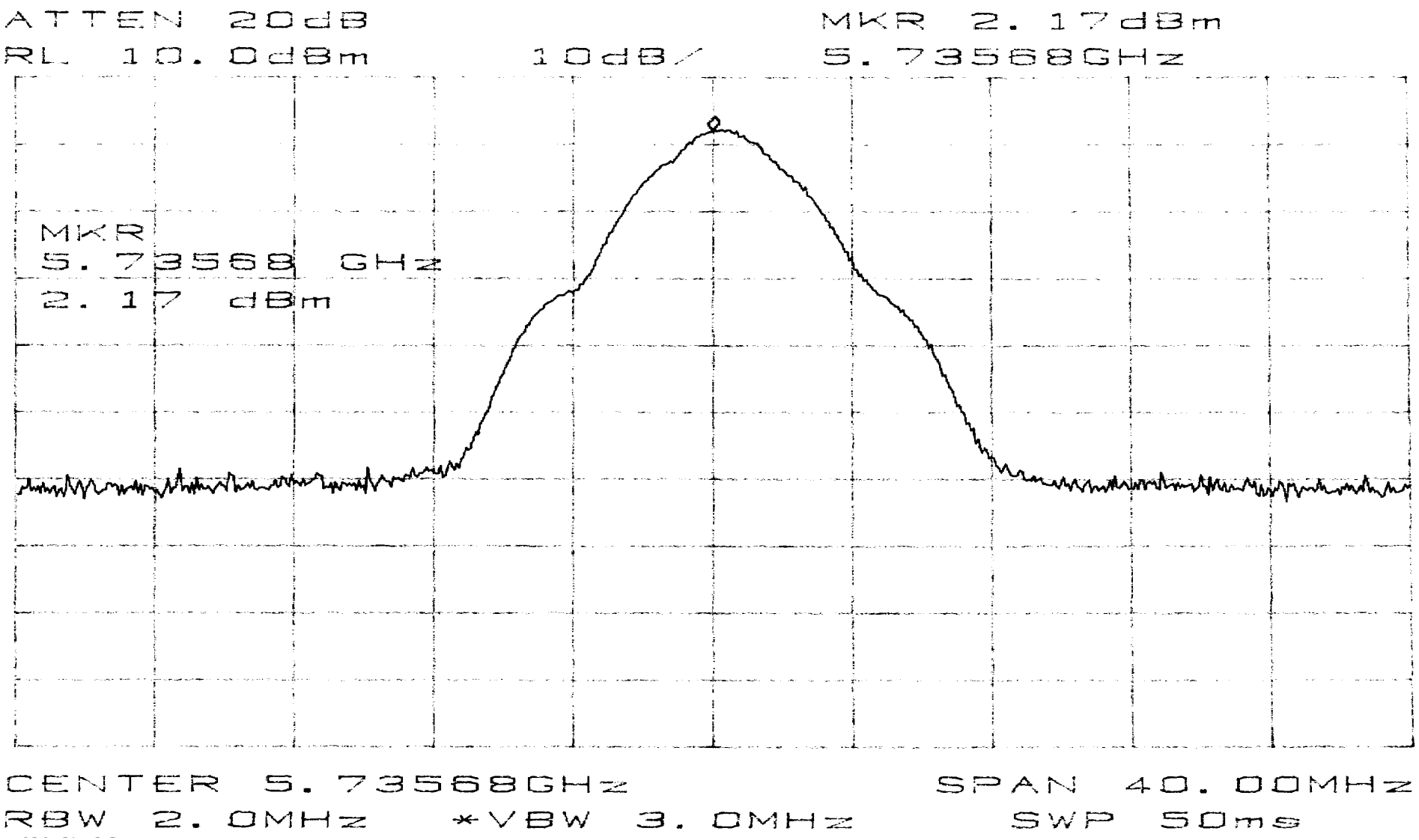
Limit from Band Edge + 10 MHz = -27 dBm / MHz

Freq = 5.73568 GHZ			Freq = 5.80992 GHZ		
Freq (GHz)	**Pout (dBm)**	**Pout (mW)**	**Freq (GHz)**	**Pout (dBm)**	**Pout (mW)**
5.725	-53.50	0.000	5.825	-54.30	0.000
5.724	-53.20	0.000	5.826	-55.30	0.000
5.723	-52.80	0.000	5.827	-55.50	0.000
5.722	-52.70	0.000	5.828	-54.00	0.000
5.721	-54.80	0.000	5.829	-53.80	0.000
5.720	-54.00	0.000	5.830	-55.70	0.000
5.719	-54.80	0.000	5.831	-55.50	0.000
5.718	-55.80	0.000	5.832	-55.80	0.000
5.717	-55.50	0.000	5.833	-55.80	0.000
5.716	-55.00	0.000	5.834	-56.00	0.000
5.715	-53.70	0.000	5.835	-54.00	0.000
5.714	-54.00	0.000	5.836	-55.00	0.000
5.713	-55.00	0.000	5.837	-56.10	0.000
5.712	-54.80	0.000	5.838	-56.30	0.000
5.711	-55.20	0.000	5.839	-55.80	0.000
5.710	-55.50	0.000	5.840	-55.20	0.000
5.709	-56.00	0.000	5.841	-55.70	0.000
5.708	-55.30	0.000	5.842	-54.70	0.000
5.707	-55.20	0.000	5.843	-54.80	0.000
5.706	-55.20	0.000	5.844	-54.80	0.000
5.705	-55.30	0.000	5.845	-56.00	0.000

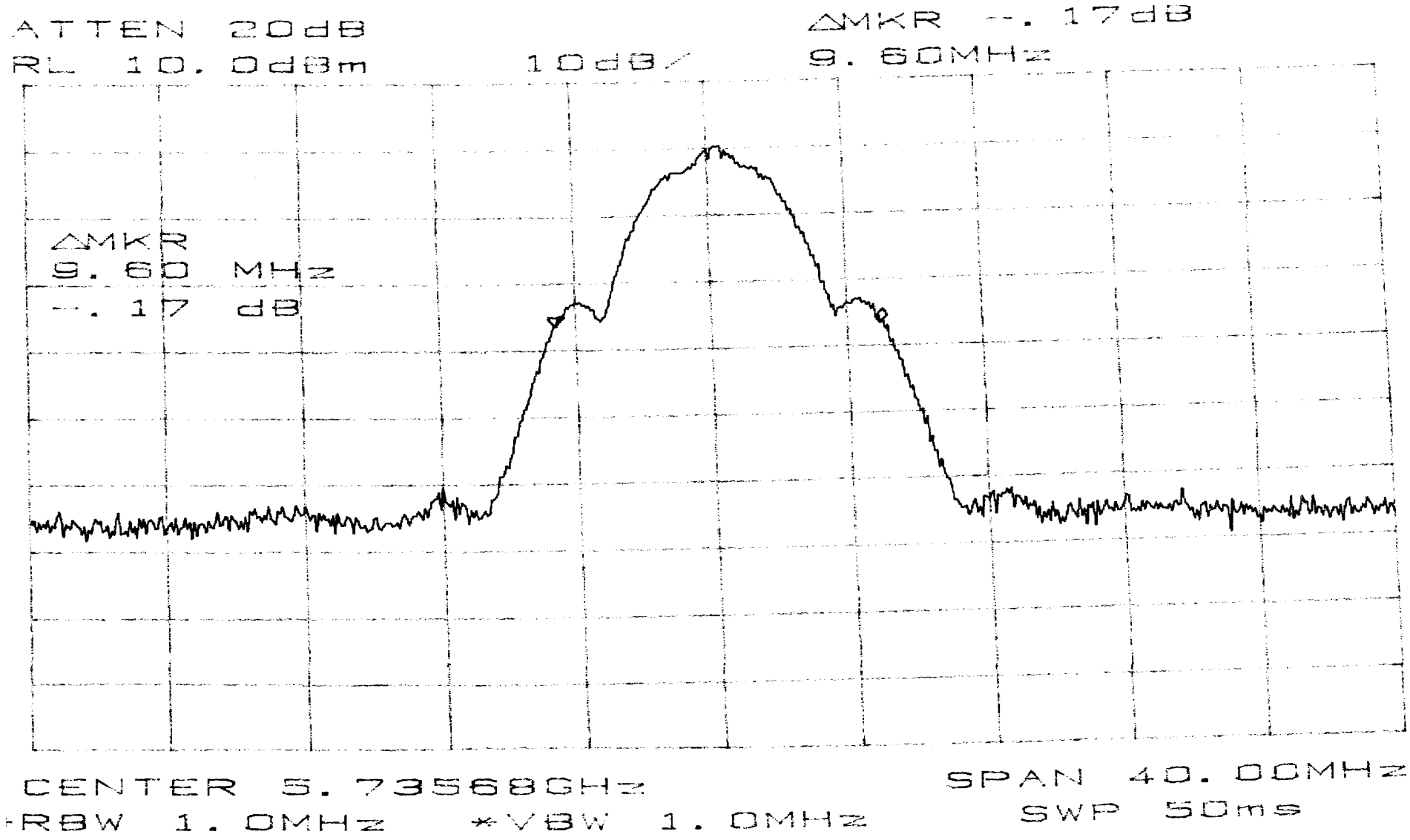
APPENDIX B

Out of Band Plots

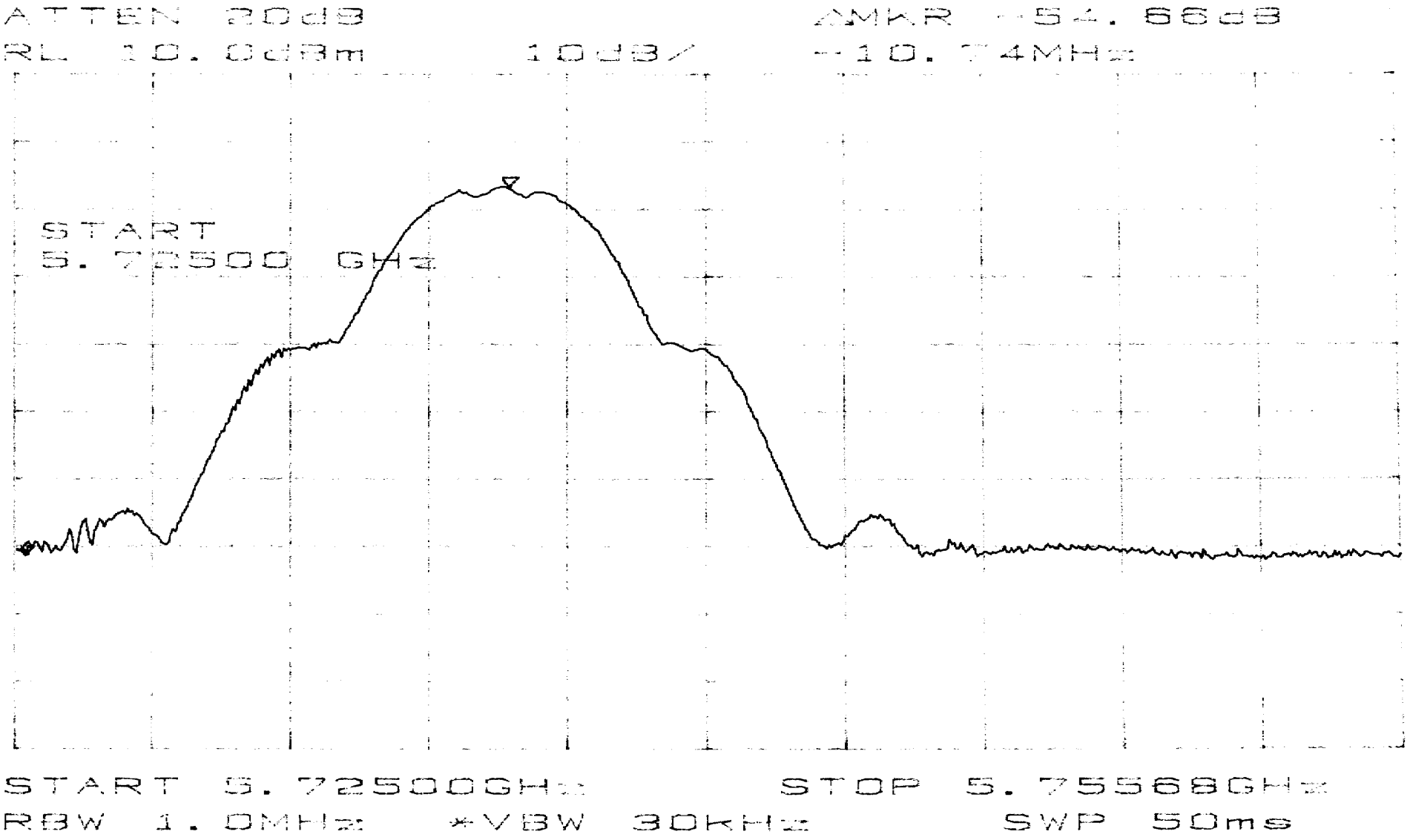
5.7356 Pout


ATTEN 20dB
RL 10.0dBm
10dB/
MKR 2.17dBm
5.735680GHz
MKR
5.73568 GHz
2.17 dBm
CENTER 5.735680GHz
SPAN 40.00MHz
RBW 2.0MHz
*VBW 3.0MHz
SWP 50ms

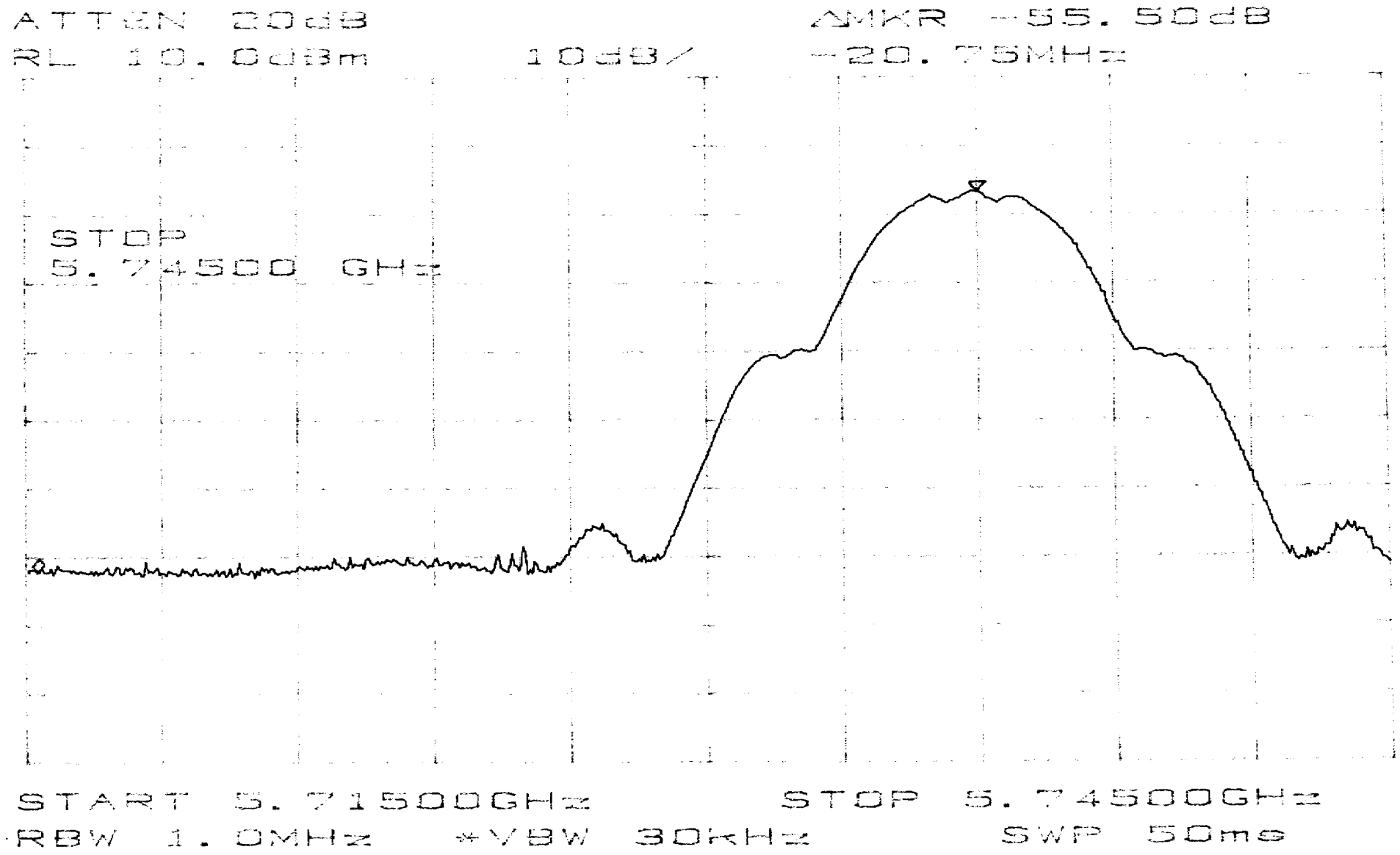
5.7356 26 dB Bandwidth



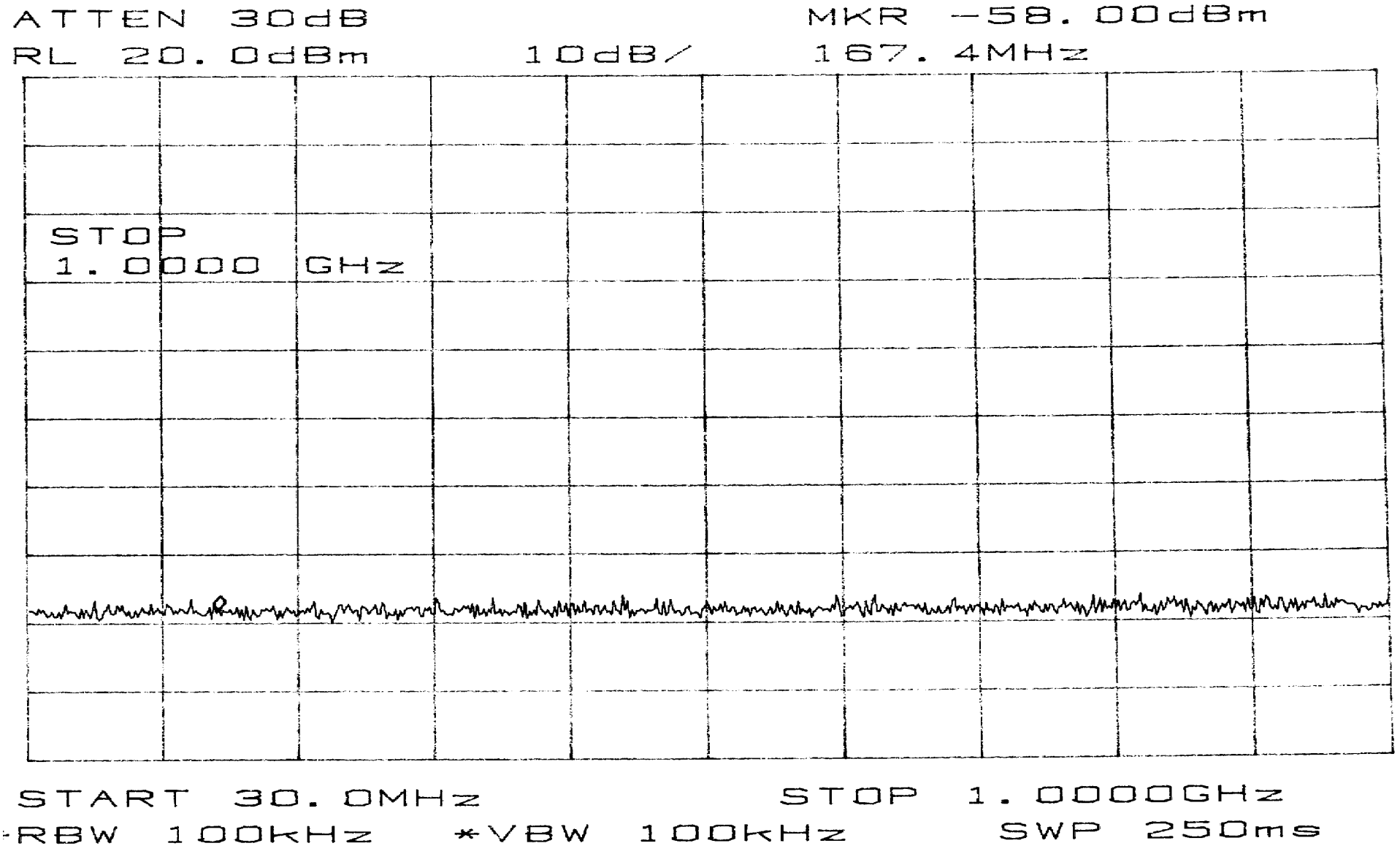
5.7356 Out of Band – Band Edge



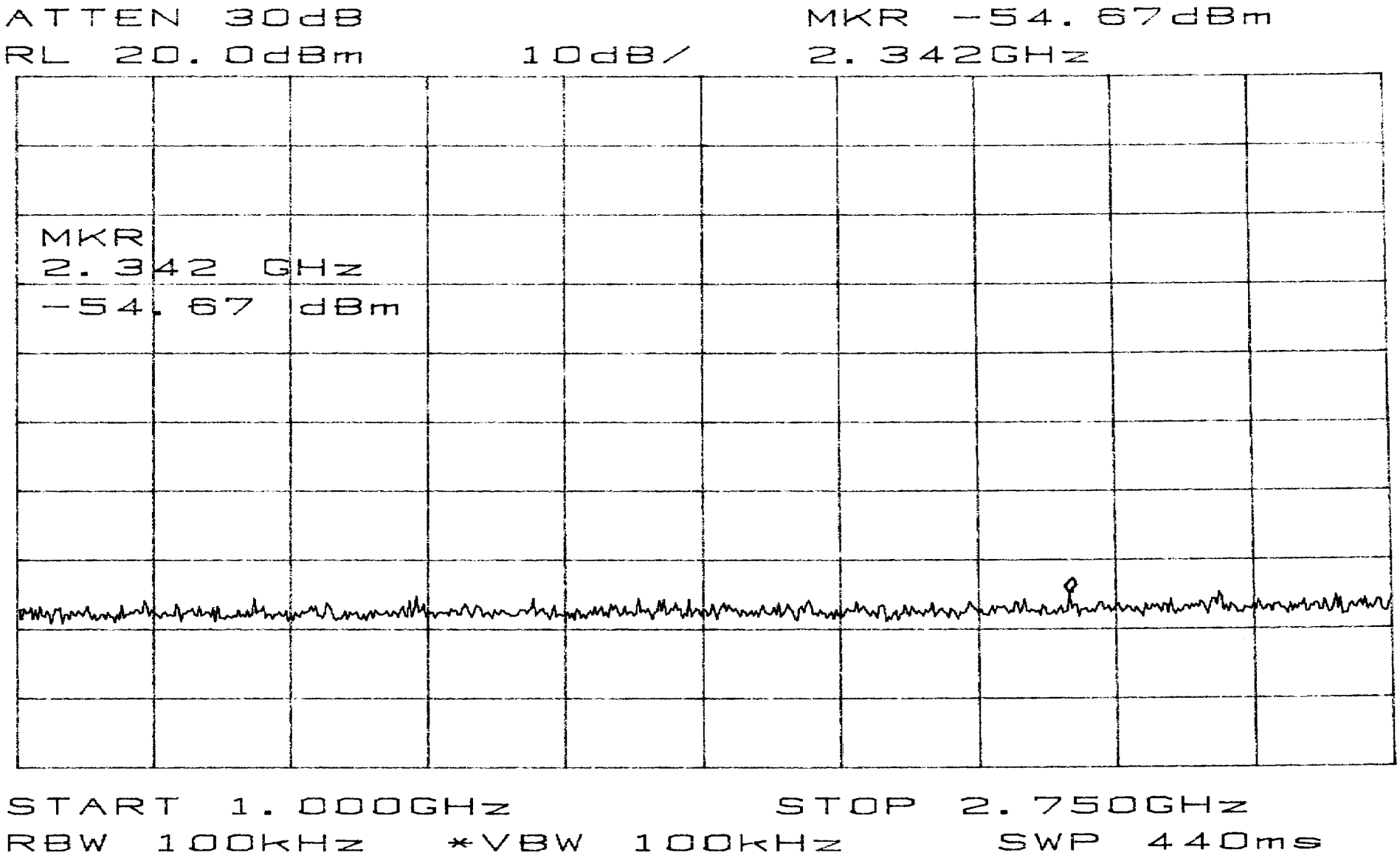
5.7356 Out of Band – Band Edge + 10 MHz



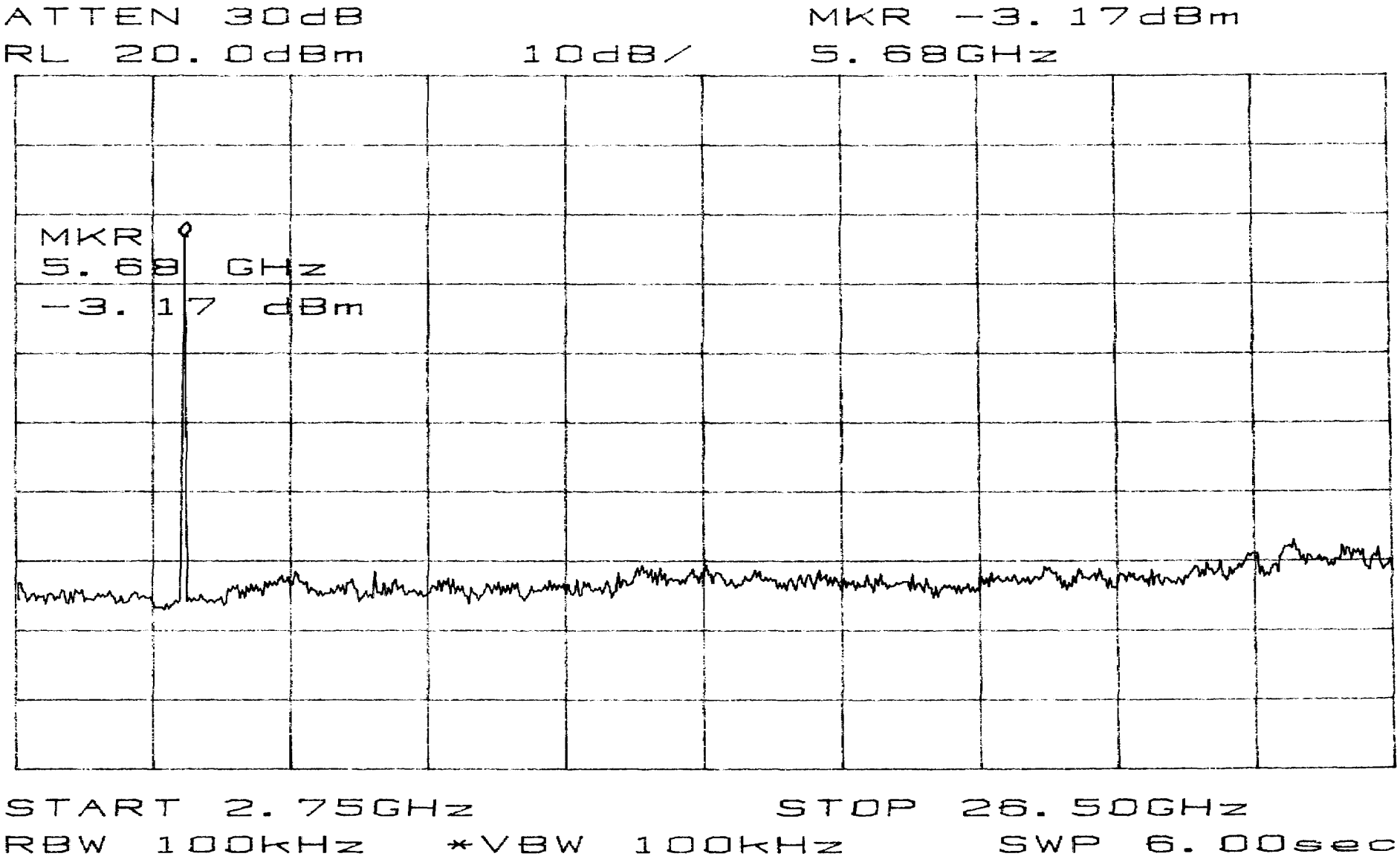
5.7356 Out of Band – 30 MHz to 1 GHz



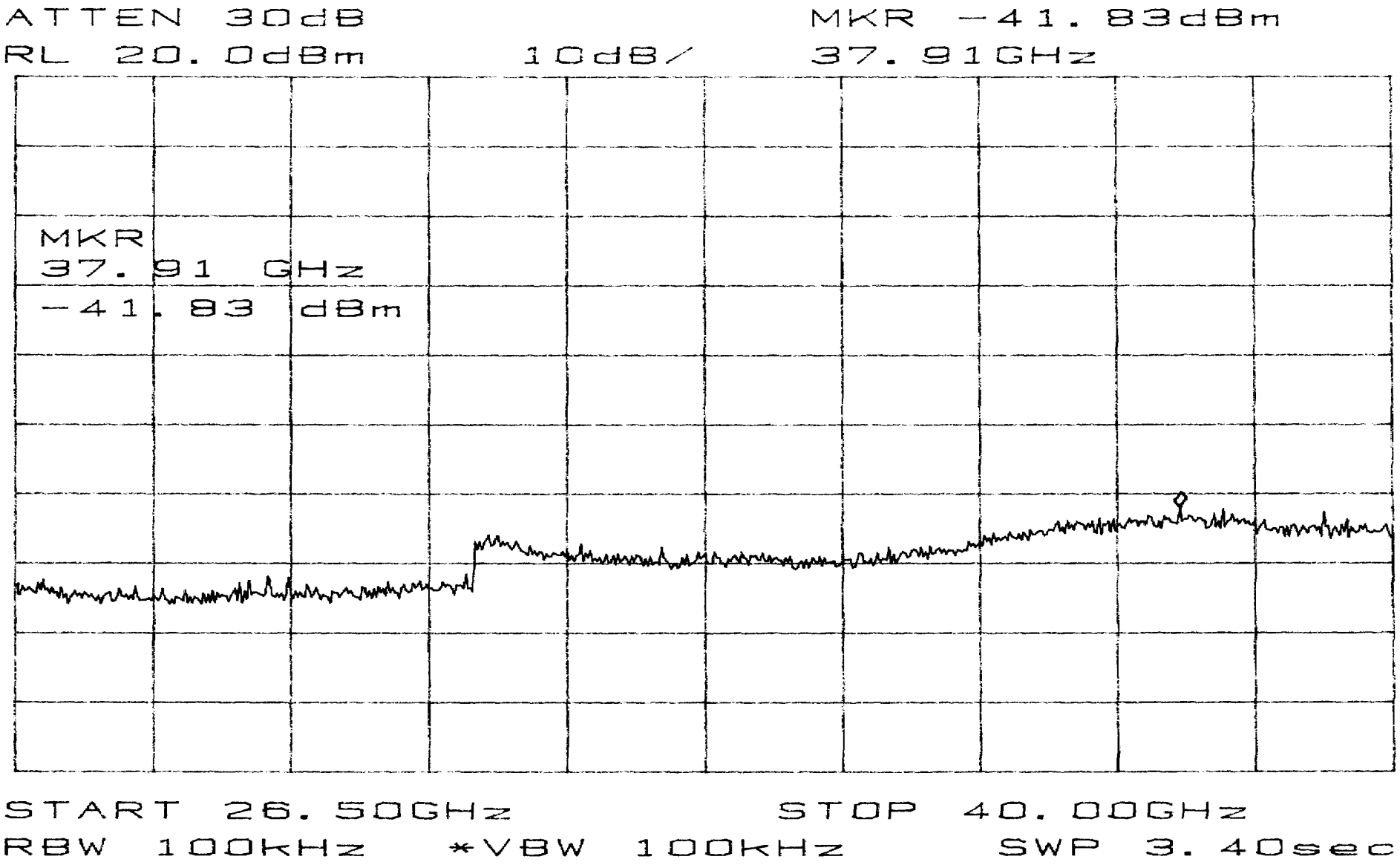
5.7356 Out of Band – 1 to 2.75 GHz



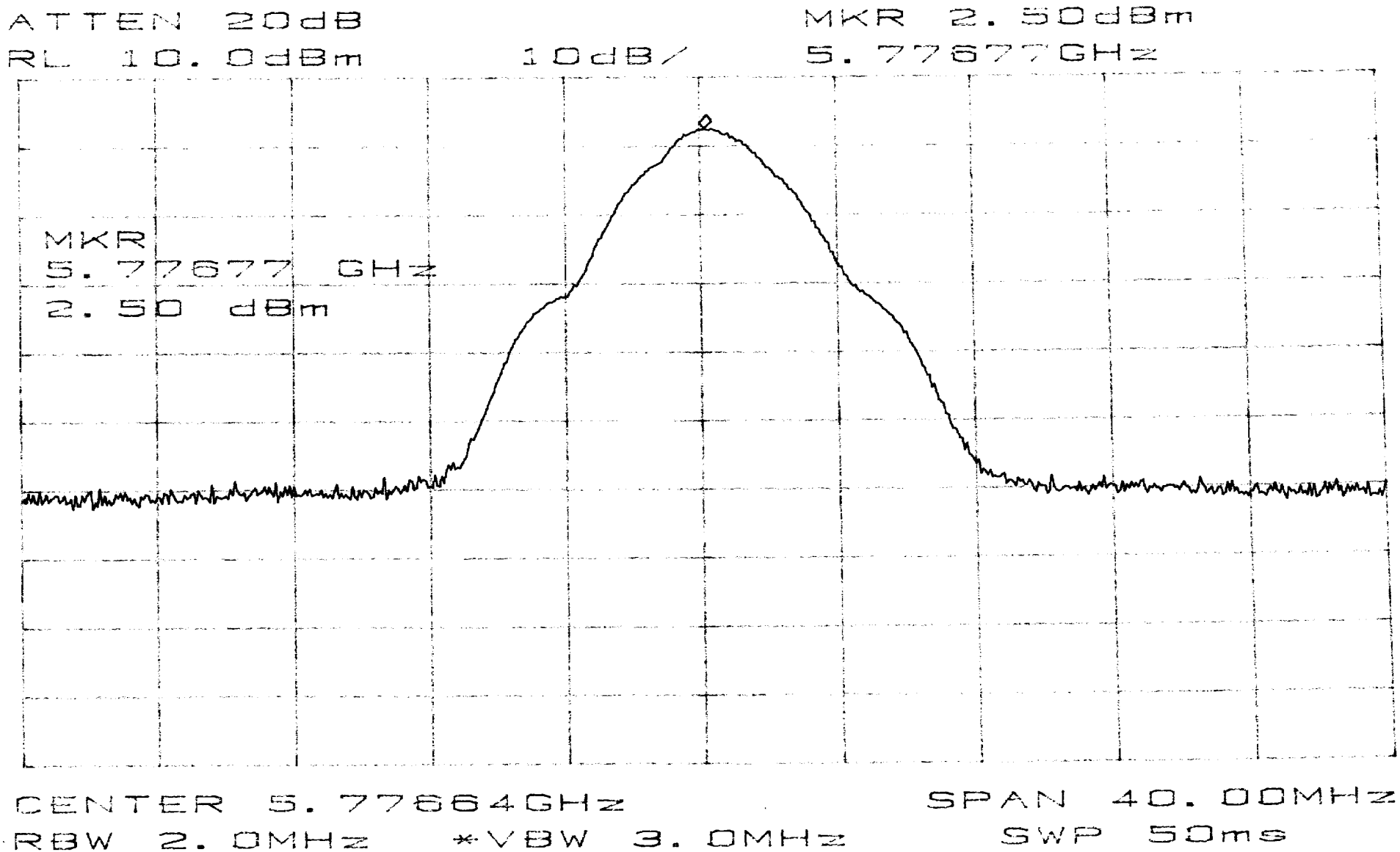
5.7356 Out of Band – 2.75 to 26.5 GHz



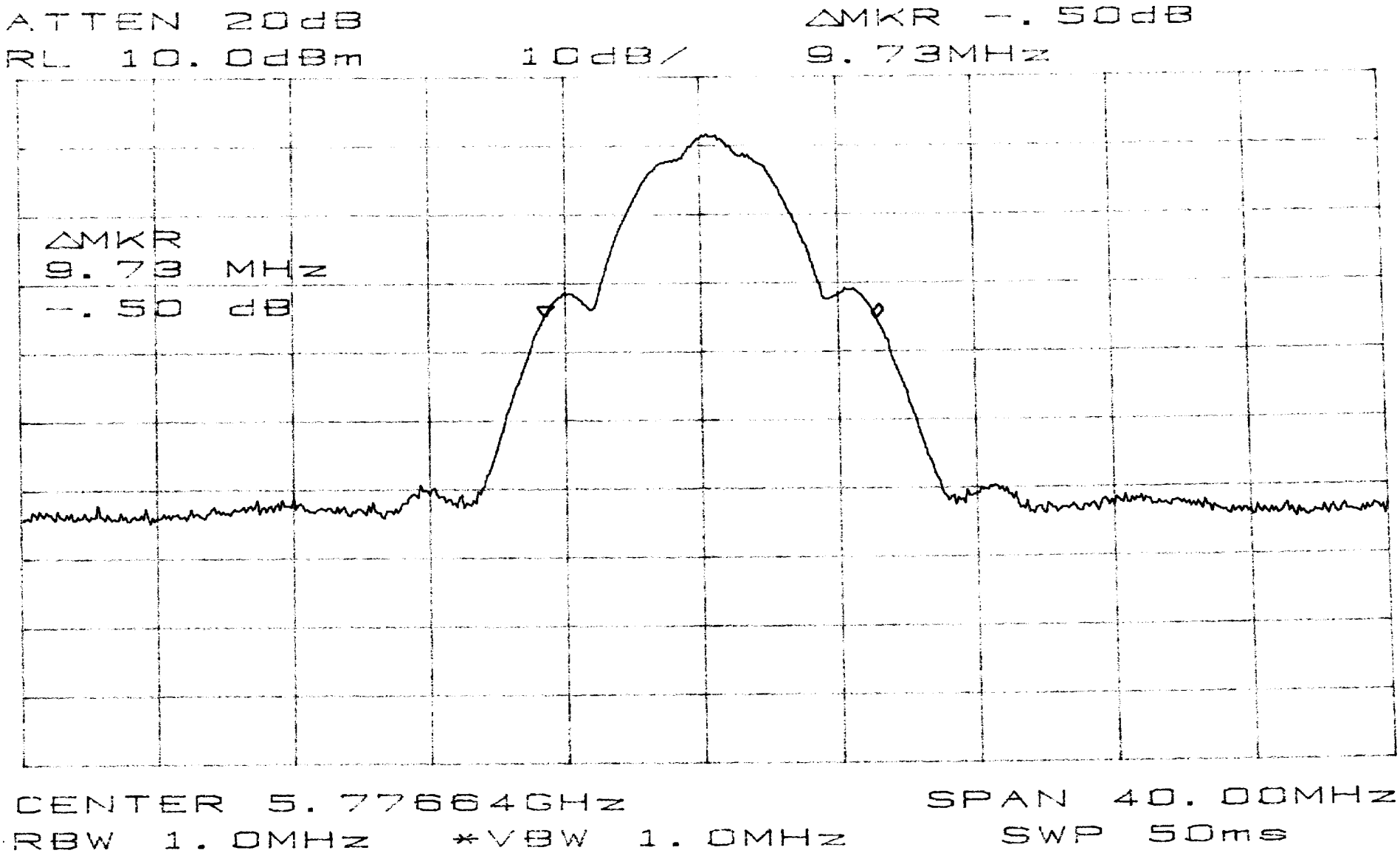
5.7356 Out of Band – 26.5 to 40 GHz



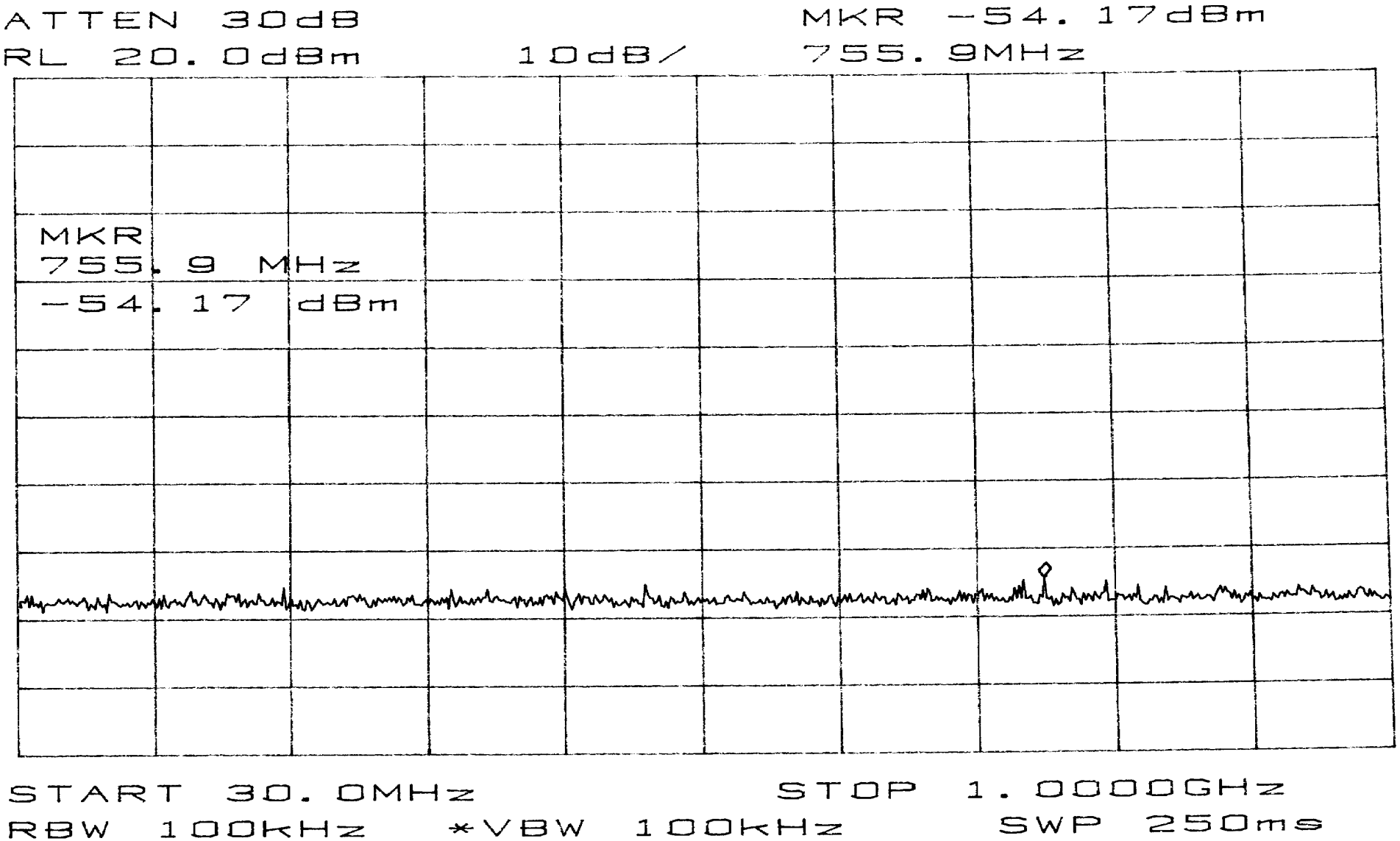
5.7776 Pout


ATTEN 20dB
RL 10.0dBm
10dB/
MKR 2.50dBm
5.776770GHz
MKR
5.77677 GHz
2.50 dBm
CENTER 5.776640GHz
SPAN 40.00MHz
RBW 2.0MHz
*VBW 3.0MHz
SWP 50ms

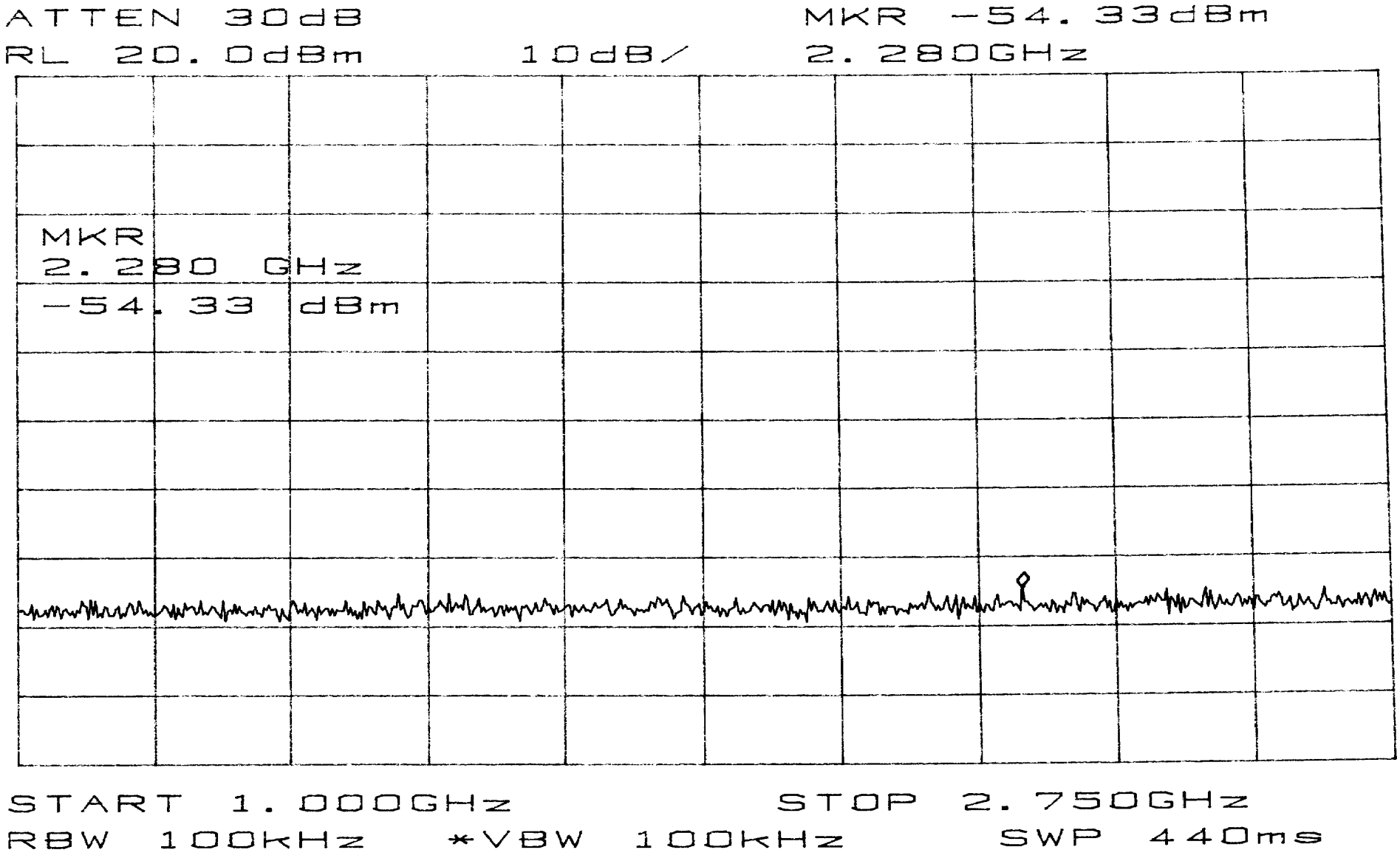
5.7766 26 dB Bandwidth



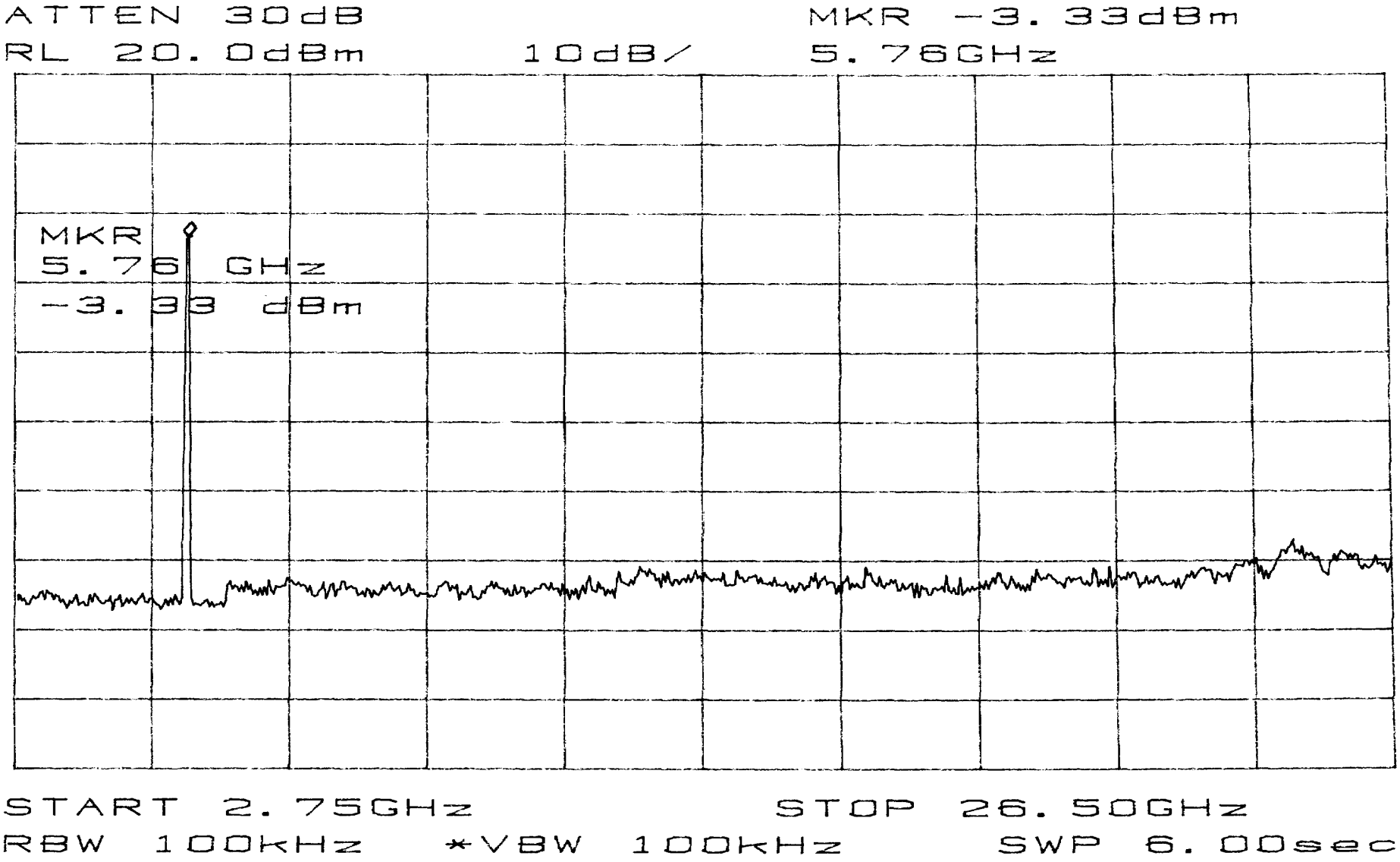
5.7766 Out of Band – 30 MHz to 1 GHz



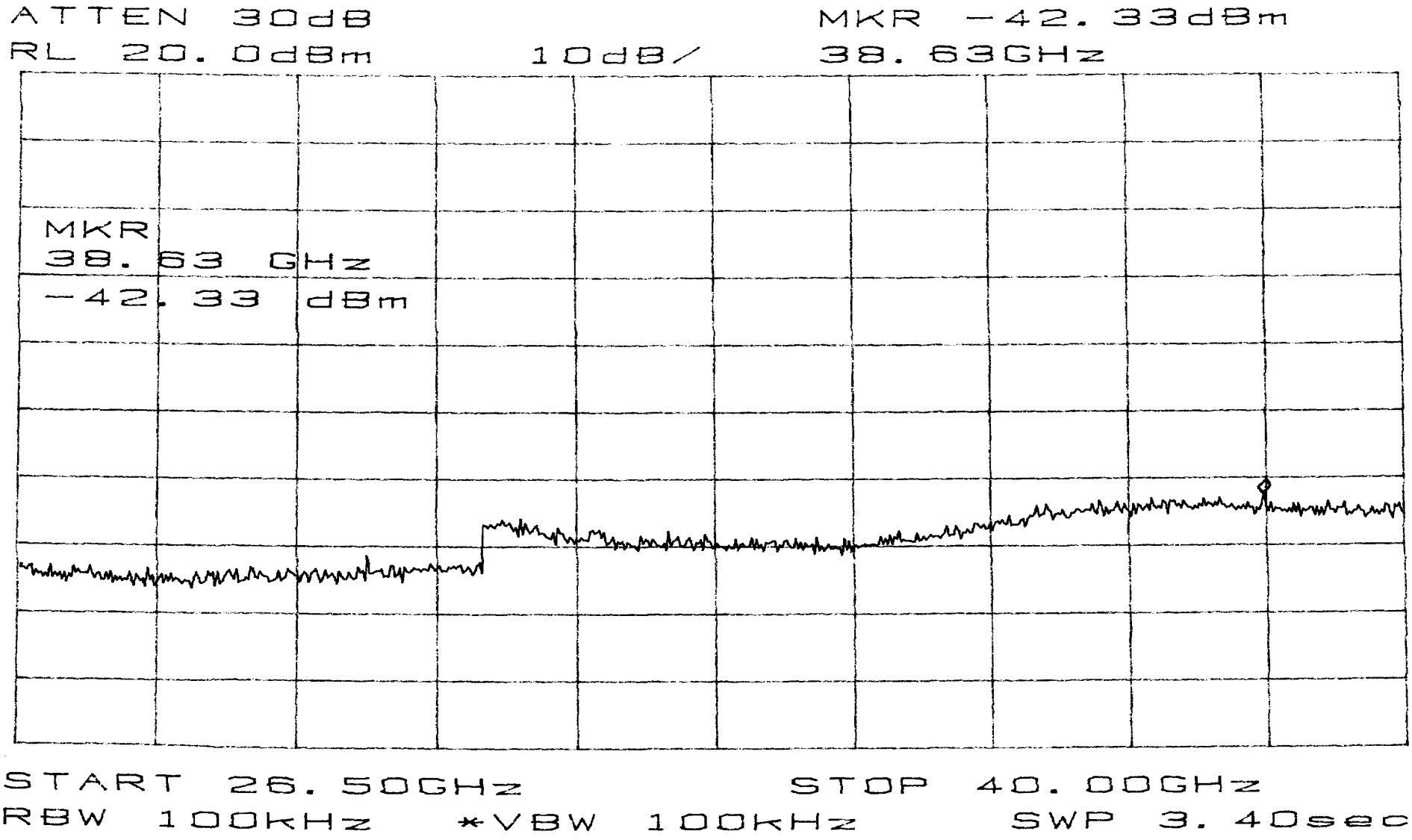
5.7766 Out of Band – 1 to 2.75 GHz



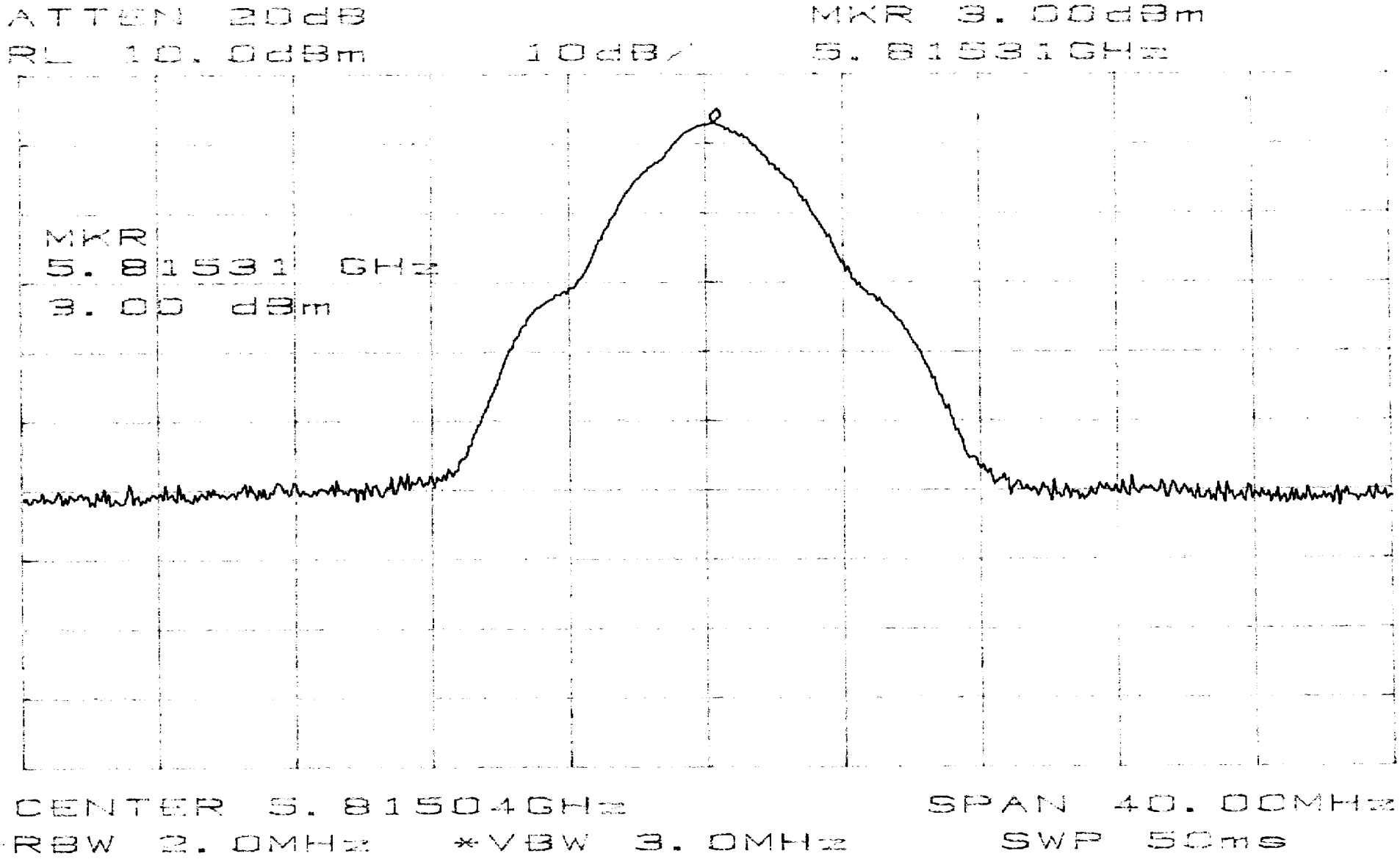
5.7766 Out of Band – 2.75 to 26.5 GHz



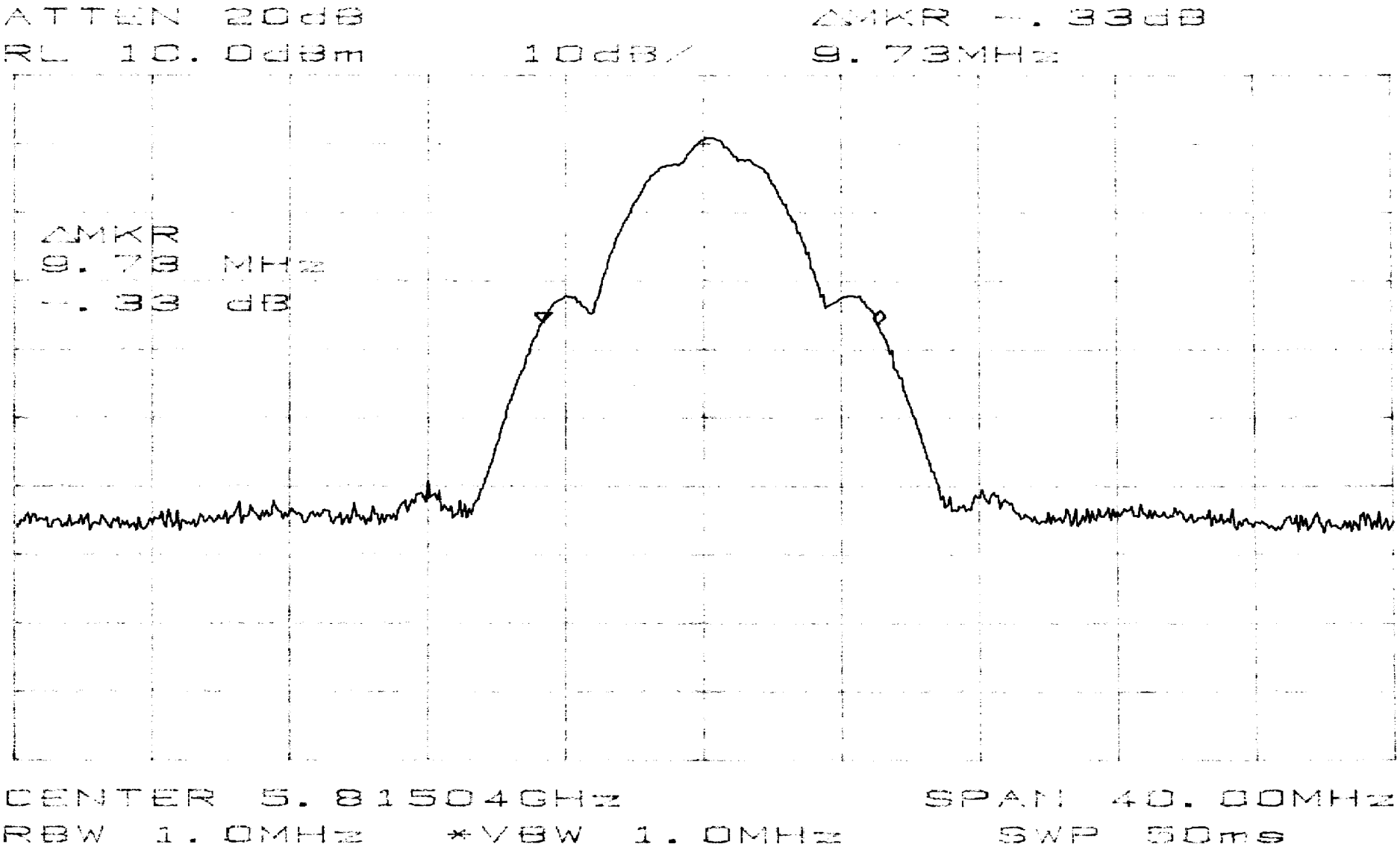
5.7766 Out of Band – 26.5 to 40 GHz



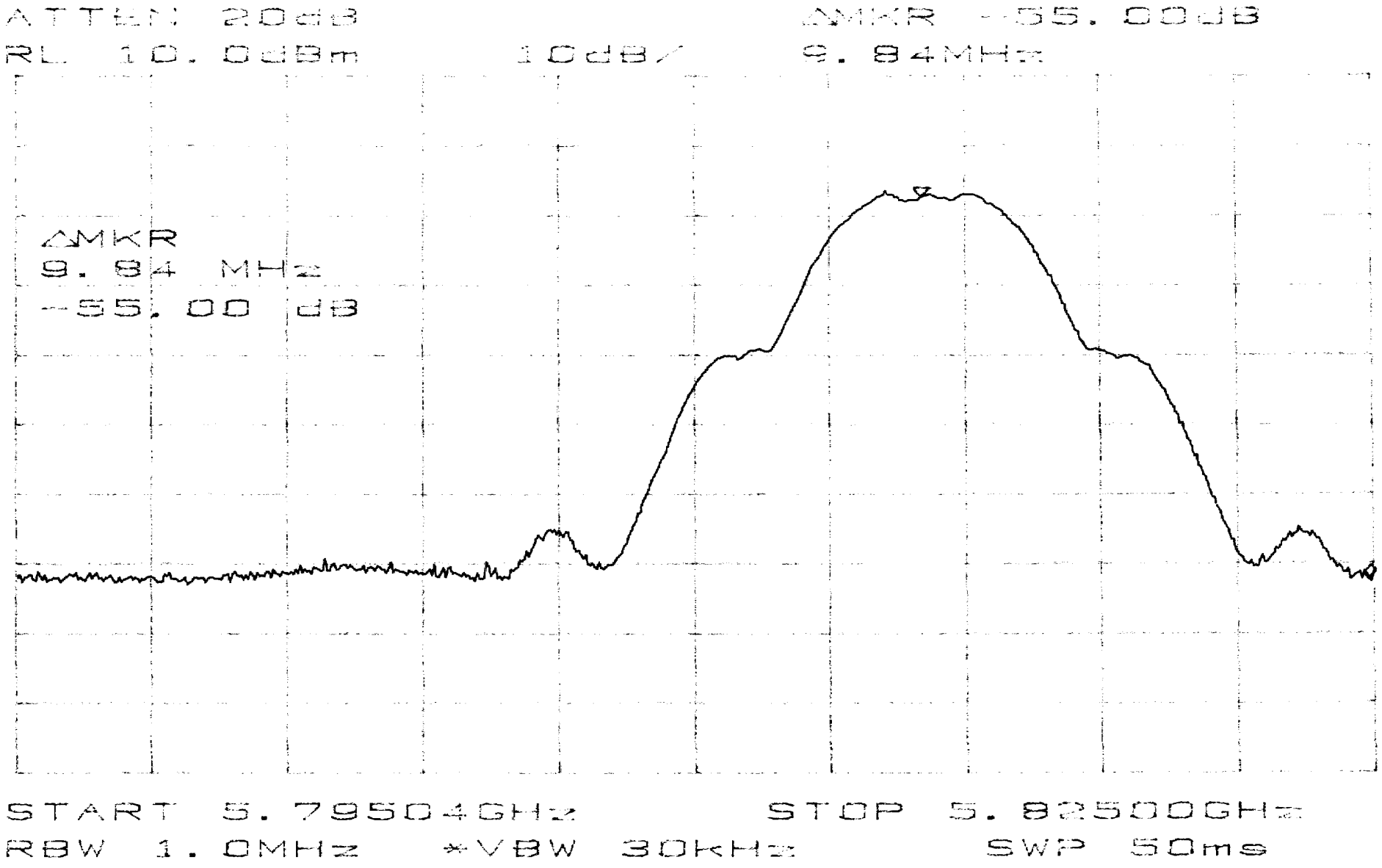
5.8150 Pout


ATTEN 20dB
RL 10.0dBm
10dB/
MKR 3.00dBm
5.81531GHz
MKR
5.81531 GHz
3.00 dBm
CENTER 5.81504GHz
SPAN 40.00MHz
RBW 2.0MHz
*VBW 3.0MHz
SWP 50ms

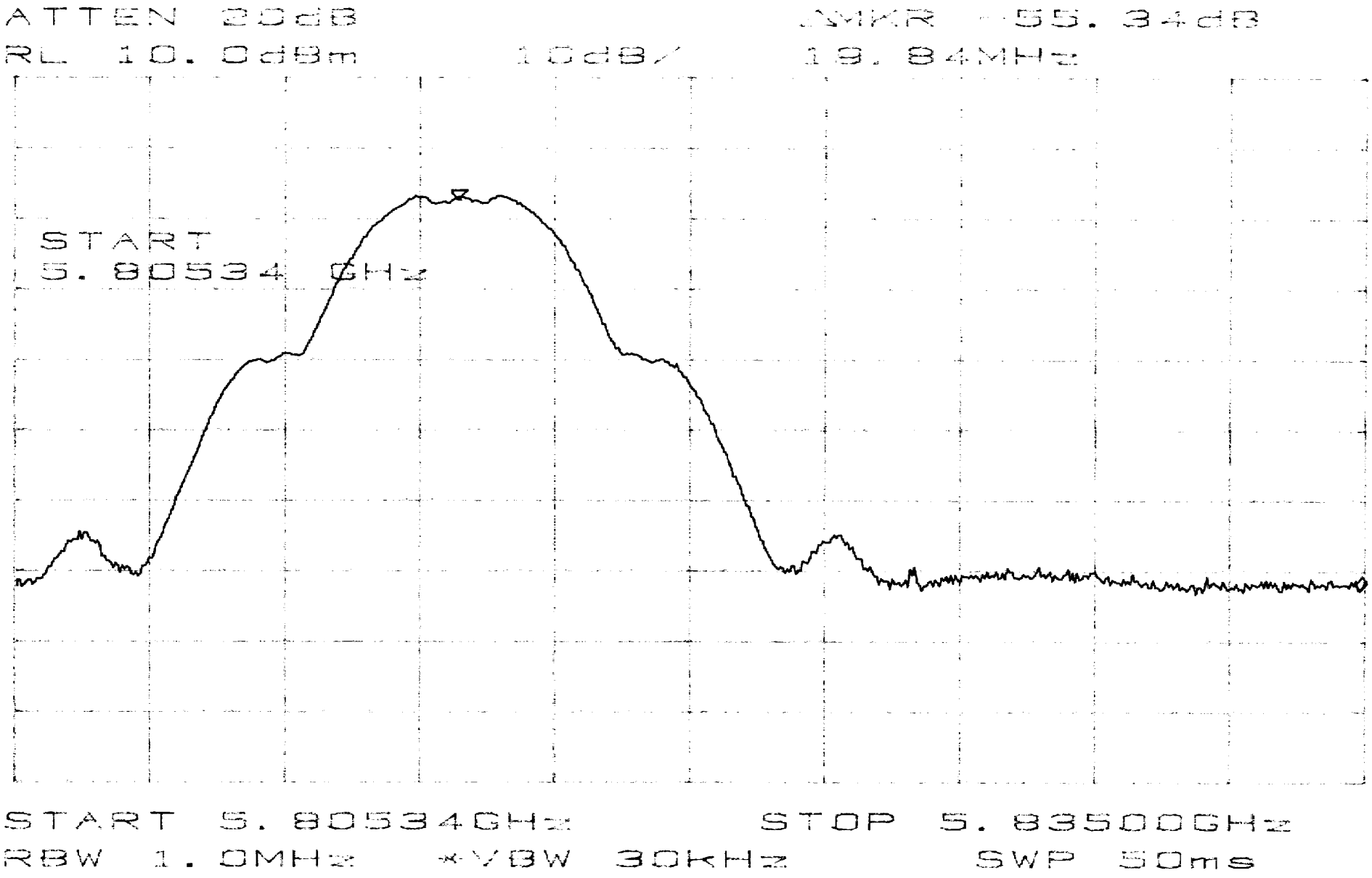
5.8150 26 dB Bandwidth



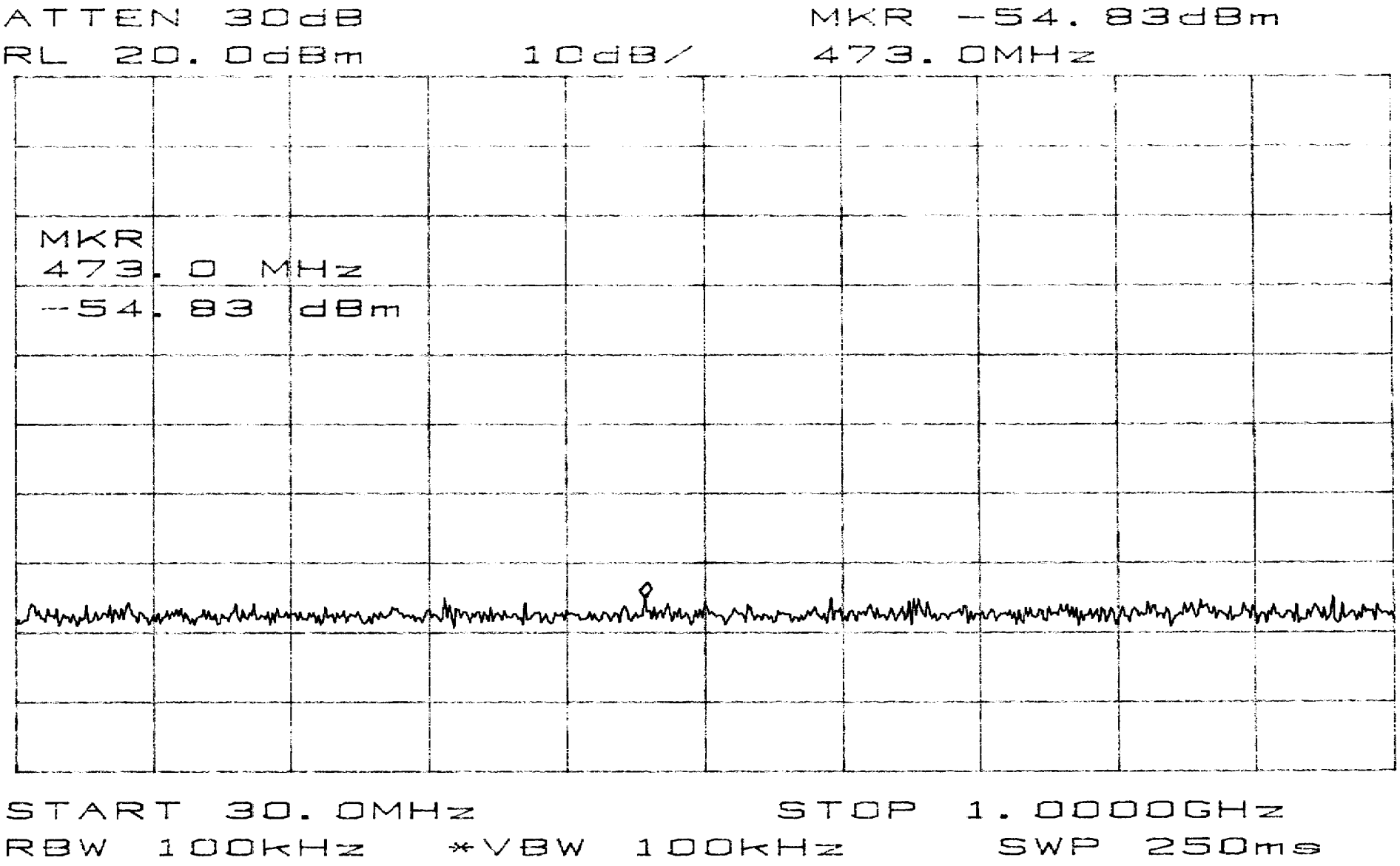
5.8150 Out of Band – Band Edge



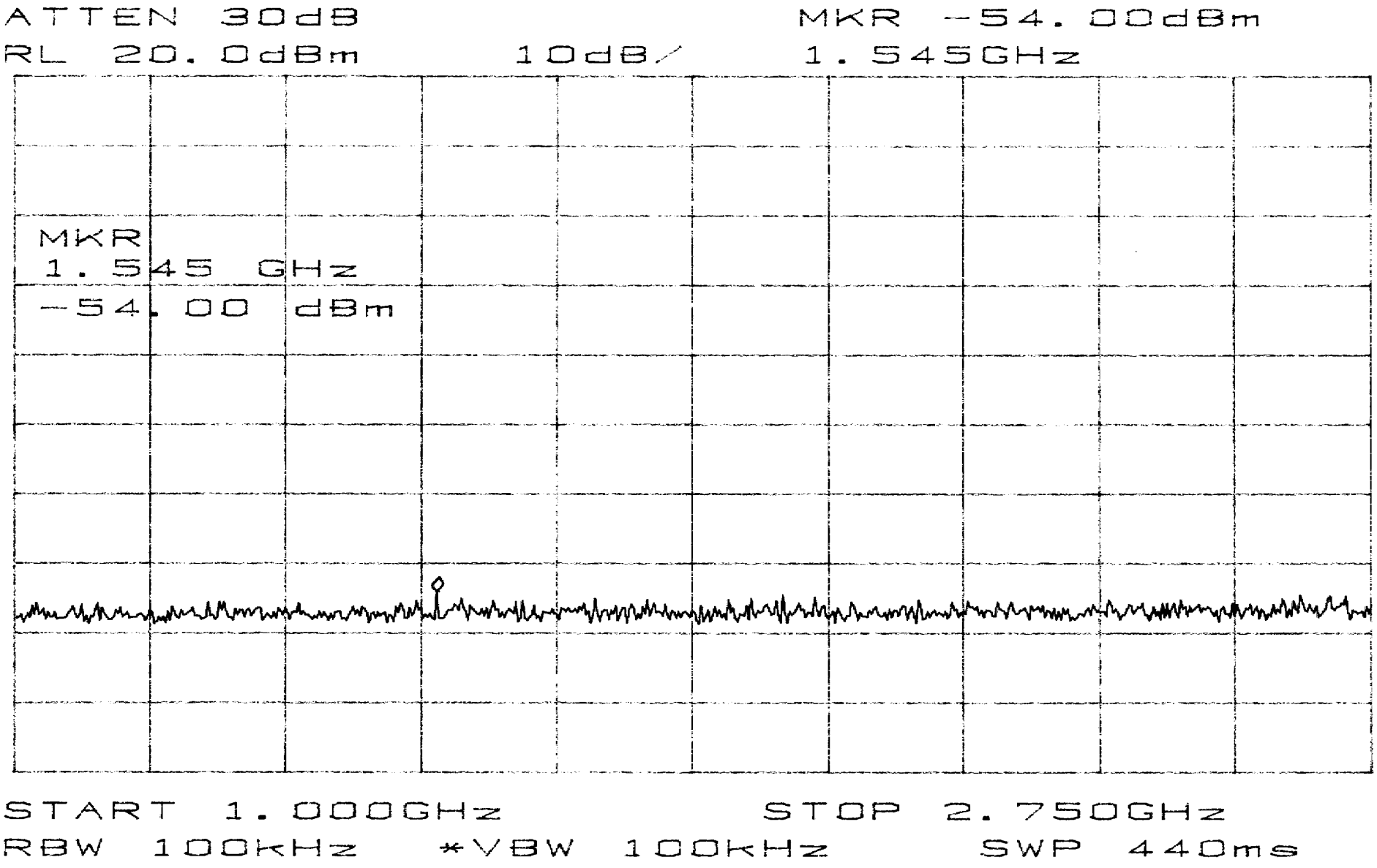
5.8150 Out of Band – Band Edge + 10 MHz



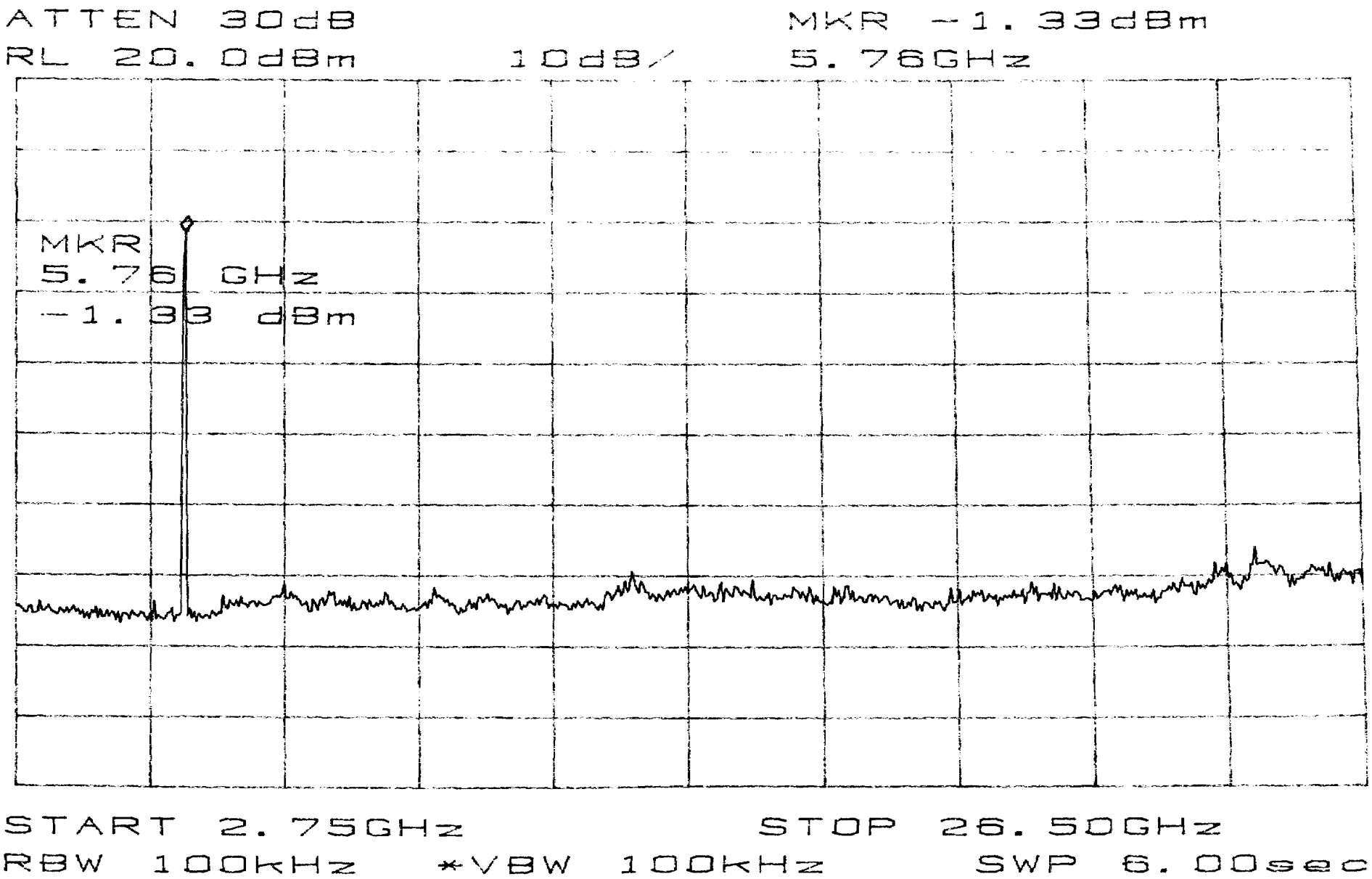
5.8150 Out of Band – 30 MHz to 1 GHz



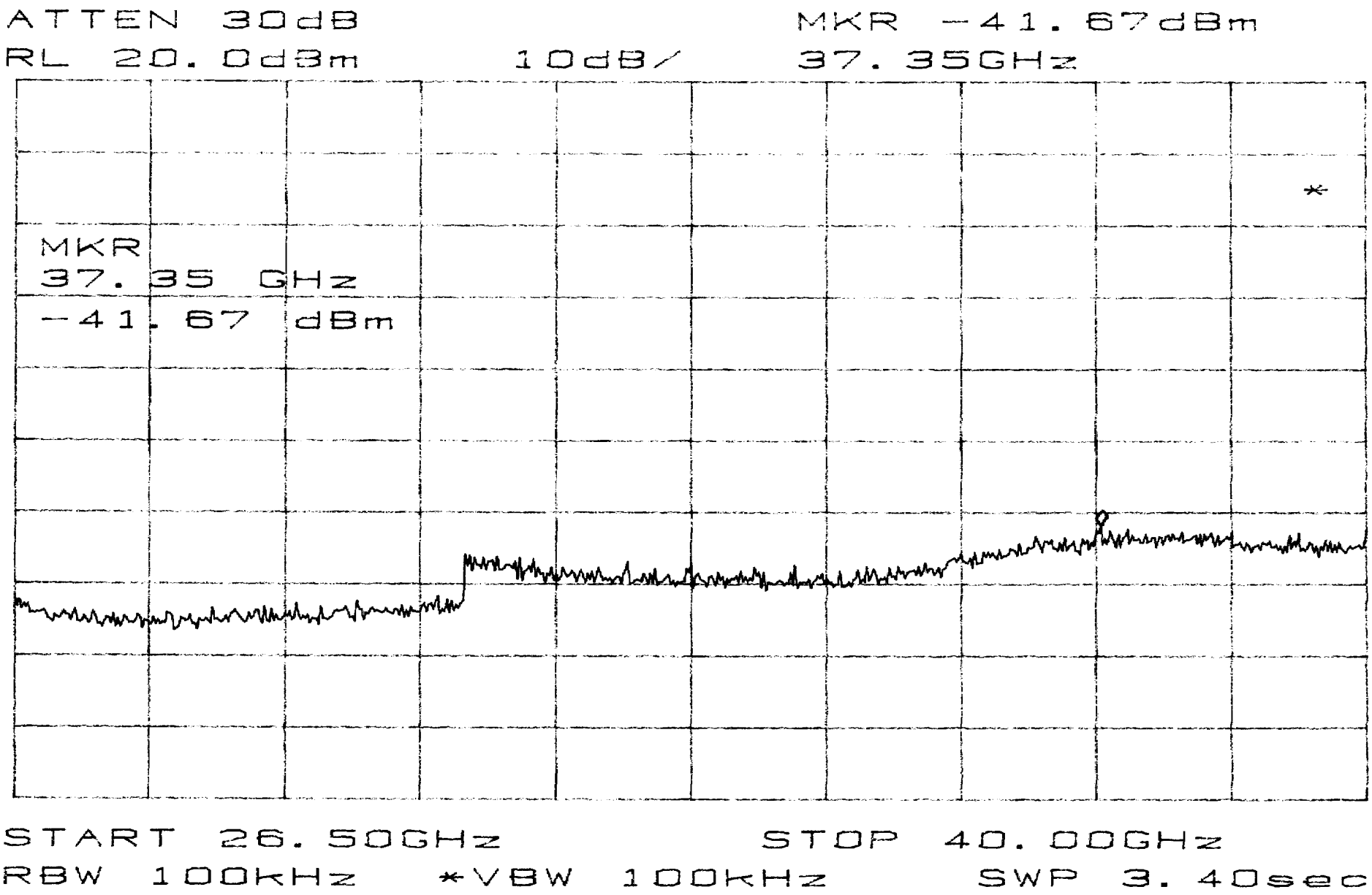
5.8150 Out of Band – 1 to 2.75 GHz



5.8150 Out of Band – 2.75 to 26.5 GHz



5.8150 Out of Band – 26.5 to 40 GHz



APPENDIX C

Restricted Band Data

FCC RADIATED DATA SHEET

				DATE:	MAR. 9, 1999
EUT:	5.75Ghz TRANSCEIVER			**CUSTOMER NAME:**	WIRELESS
S/N:	PROTO			**WORK ORDER:**	9021001
RULE PART:	15.247			**FILE:**	9021001B.XLS
ANTENNA:	HORN	**OTHER CAL FACTORS:**		**ATTN dB:**	0
MODULATION TYPE:				**DUTY dB:**	0
TESTED BY:	SHAWN			**HP IL dB:**	0
COMMENTS:				**DIST dB:**	0

FREQ.	READING	Pk, QP,	A.F.	Cable loss	AMP	O.C.F.	TOTAL,	LIMIT	DELTA
MHz	dB(uV)	or Av	dB	dB	dB	dB	dB(uV/m)	dB(uV/m)	dB
Fund =	**5735.7**								
11471.36	**38.0**	Pk	40.4	23.8	35.0	0.0	67.2	74.0	-6.8
11471.36	**22.5**	Avg	40.4	23.8	35.0	0.0	51.7	54.0	-2.3
17207.04	**32.1**	Pk	43.7	30.1	35.0	0.0	70.9	74.0	-3.1
17207.04	**14.2**	Avg	43.7	30.1	35.0	0.0	53.0	54.0	-1.0
22942.72	**31.4**	Pk	40.3	30.1	35.0	0.0	66.8	74.0	-7.2
22942.72	**15.6**	Avg	40.3	30.1	35.0	0.0	51.0	54.0	-3.0
Fund =	**5776.6**								
11553.28	**37.6**	Pk	40.9	24.1	35.0	0.0	67.6	74.0	-6.4
11553.28	**22.8**	Avg	40.9	24.1	35.0	0.0	52.8	54.0	-1.2
17329.92	**31.8**	Pk	43.7	30.1	35.0	0.0	70.6	74.0	-3.4
17329.92	**14.5**	Avg	43.7	30.1	35.0	0.0	53.3	54.0	-0.7
23106.56	**31.6**	Pk	40.3	30.1	35.0	0.0	67.0	74.0	-7.0
23106.56	**15.8**	Avg	40.3	30.1	35.0	0.0	51.2	54.0	-2.8
Fund =	**5815.0**								
11630	**38.2**	Pk	40.9	24.7	35.0	0.0	68.8	74.0	-5.2
11630	**22.8**	Avg	40.9	24.7	35.0	0.0	53.4	54.0	-0.6
17445	**32.0**	Pk	43.7	30.1	35.0	0.0	70.8	74.0	-3.2
17445	**15.0**	Avg	43.7	30.1	35.0	0.0	53.8	54.0	-0.2
23260	**31.8**	Pk	40.3	30.1	35.0	0.0	67.2	74.0	-6.8
23260	**15.2**	Avg	40.3	30.1	35.0	0.0	50.6	54.0	-3.4

APPENDIX D
15.209 Radiated Emissions

Electronic Compliance Laboratories, Inc.
1249 Birchwood Ave.
Sunnyvale, CA

Radiated Emissions
Frequency range: 30MHz-1000MHz

10 Meter Open Site
Site Calibrated: June 1997

Government Agency and Limit: FCC Class A

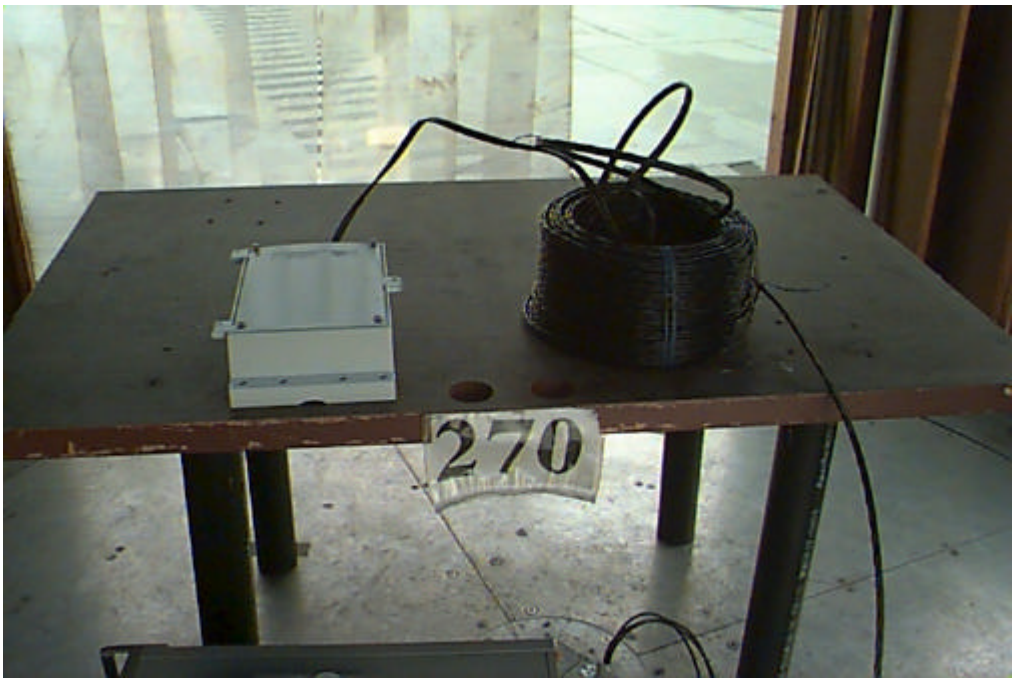
QP = Quasi-Peak Note: Ignore peak readings when Quasi-Peak reading exists
PK = Peak

Customer:	WIRELESS	Operator:	SHAWN
Date:	02-12-1999	Time:	08:59:16
Temperature Range:	48 Deg F	Percent Humidity:	62
E.U.T.:	5.725 Ghz TRANSCEIVER		
Serial Number:	PROTO		
Modifications:	None		
Report File Name:	F:\TESTDATA\9021001b.RF		

Antenna Type: BICONICAL

TEST FREQ	TEST dBuV	ACTUAL dBuV/m	CLASS A LIMIT	VERSUS A LIMIT	TABLE DEGREES	ANTENNA HEIGHT	POLAR-IZATION	DETECTOR Type
112.000	43.7	32.3	43.5	-11.2	45	1.5	V	PK
114.500	44.7	33.6	43.5	-9.9	75	2.0	V	PK
124.200	48.5	38.2	43.5	-5.3	90	2.0	V	PK
124.200	46.0	35.7	43.5	-7.8	90	2.0	V	QP
240.000	32.0	24.2	46.4	-22.2	90	2.0	V	PK
280.000	33.6	27.8	46.4	-18.6	0	1.5	V	PK
280.000	28.7	22.9	46.4	-23.5	45	2.0	H	PK
240.000	29.0	21.2	46.4	-25.2	75	2.0	H	PK
120.000	36.6	26.1	43.5	-17.4	45	2.0	H	PK
		CHANGED ANTENNA TO LOG PERIODIC						
360.000	32.0	23.3	46.4	-23.1	120	2.0	V	PK
448.000	32.5	25.9	46.4	-20.5	90	1.5	V	PK
360.000	28.9	20.2	46.4	-26.2	0	2.0	H	PK

APPENDIX E
Set-up Photographs



FCC 15.209 Class A
Radiated Emissions

FCC 15.205 Restricted Band

FCC 15.407 Conducted RF