15.247 Certification
FCC ID: NVCRMI0003

EMI TEST REPORT
LOW POWER GAS RMI REV.E

Prepared for

Whisper Communication Inc.
3200 Coronado Drive
Santa Clara, CA 95054
Tel: (408) 490-3800
Fax: (408) 490-3801

Prepared by

Electronic Compliance Laboratories Inc.
1249 Birchwood Dr.
Sunnyvale, CA 94089
Tel: (408) 747-1490
Fax: (408) 747-1495

Test Report Number: A809003

Date of Test: August 31, 1998

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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

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.
Test facility is recognized by the National Voluntary Laboratory Accreditation Program for satisfactory compliance with criteria established in Title 15, Part 285 Code of Federal Regulations.

NVLAP Code: 20089 effective through: March 31, 1999

2.0 TEST EQUIPMENT

Description	Manufacturer	Model	SN
EMI Receiver	HP	8546A	3325A00137
Power Meter	HP	437B	3125U13399
Power Sensor	HP	8481	3318A16275
Spectrum Analyzer	HP	8563E	3137A01183
Preamp	HP	8447F	3113A05849
Preamp	HP	8449B	3008A00527
LISN	EM	ANS-25/2	2532
Biconical Antenna	EM	EM 6912	677
Log Periodic Ant	EM	EM 6950	858
Double Ridge Horn	EM	EM 6961	6231
Filter BP 1.2-4 GHz	FSY	HM1160-11SS	001
Filter BP 4-10 GHz	FSY	HM2950-15SS	001
Filter BP10-18 GHz	FSY	HP8601-7SS	001

3.0 EUT

Product: LOW POWER GAS RMI REV.E
Model Number: 100G-XX00-XX
Serial Number: 0001B69F9

Description:

The Whisper Communication Inc. LOW POWER GAS RMI REV.E is a spread spectrum frequency hopping radio transceiver operating in the 902 - 928 MHz band that resides in a gas meter "trace" housing. The RMI unit transmits gas consumption information to a remote cell.

4.0 SUPPORT EQUIPMENT

Equipment Type: N/A
Model Number: N/A
Serial Number: N/A
Manufacturer: N/A

:

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 manufacturers requirements and conditions for intended use.

EUT PORT	CONNECTED TO	CABLE TYPE

6.0 SUMMARY OF TESTS

The LOW POWER GAS RMI REV.E is a frequency hopping spread spectrum (FHSS) radio system operating in the 902-928 MHz band. Tests were performed with one standard antenna. Test firmware resident in the EUT and was used to do the test.

6.1 15.247(a)(1) FREQUENCY HOPPING SYSTEMS

The LOW POWER GAS RMI REV.E uses 50 channels, each 120 kHz wide. The system hops using pseudorandom sequences. On average, each channel is used equally.

6.1.1 15.247(a)(1)(i) CHANNEL UTILIZATION

Three spectrum analyzer plots labeled "**CHANNEL UTILIZATION 903 - 912**", "**CHANNEL UTILIZATION 912 - 920**", and "**CHANNEL UTILIZATION 920 - 928**" . The total number of channels shown is 67, which exceeds the minimum requirement of 50. The channels used have nominal center frequencies of 902 through 918 MHz.

Three spectrum analyzer MAX HOLD plots labeled " **BANDWIDTH**" show the 20 dB bandwidth of the hopping channel to be < 500 kHz (110/ 113 / 113 kHz) at the low/midband/high frequencies of 904.32 / 914.94 / 925.38 MHz. **Plots are in Appendix A.**

Zero span spectrum analyzer plots labeled "**CHANNEL DWELL TIME**" shows Worst case transmission time in a given slot: 270ms msec elapsed time, <100 % Low Power Gas RMI Rev. E

Maximum allowed: 400 msec.
The test plots are in Appendix A.

6.1.2 **15.247(b) MAXIMUM PEAK OUTPUT POWER**

The maximum power of the hopping channel to be +10.17 dBm or .010 W. The EUT was made to transmit uninterrupted random data on each of the low/mid/high channels.

The output was fed directly via cable soldered to the antenna connection point on the circuit board, spectrum analyzer set on MAX HOLD with no additional attenuation. See Appendix A for Plots.

Pout = +10.17 dBm / 10.4 mW
Limit: +30 dBm / 1 W maximum power

-3.0 dBi Internal Antenna
EIRP = +10.17 (peak power) -3 dBi (peak gain, dBi) = +7.17 dBm / .005 W EIRP

6.1.3 **15.247(c) OUT OF BAND EMISSIONS**

The spectrum analyzer plots, in Appendix A, titled "**OUT OF BAND -Lower Band Edge**" , "**OUT OF BAND - Upper Band Edge**" and shows the output spectrum of the EUT while hopping one of the pseudorandom sequences and continuously transmitting packetized data. The analyzer was placed in MAX HOLD mode, and individual sweeps were recorded continually for 10 minutes with the same spectrum analyzer connection as was used for peak output power. The resultant plot shows that the EUT emissions remain inside the 902-928 MHz band .

The spectrum analyzer plots labeled "**OUT OF BAND Emissions 0 Hz - 1 GHz** ", "**OUT OF BAND Emissions 1 - 2.75 GHz** ", "**OUT OF BAND Emissions 2.75 - 26.5 GHz** " show that emissions are more than 20 dB below the highest level of the desired power outside of the 902 - 928 MHz band.

6.2 **15.203 ANTENNA REQUIREMENT**

This product has an antenna which is permanently connected to the circuit board and is not removable by the user. The antenna has a gain of -3 dBi.

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 tabular form showing that no spurious signals were detected above the 74 dBuV/m peak/54dBuV/m average limits. Peak measurements were taken with an RBW and VBW = 1MHz. Average readings were taken with an RBW = 1MHz and a VBW = 10 Hz. **Test data is in Appendix B.**

6.4 15.209 RADIATED EMISSIONS

The data sheets in Appendix C show that the Class B radiated limits from 30 - 1000 MHz are not exceeded by the EUT. The EUT was operating normally with a combination of transmission and reception and hopping using a pseudorandom sequence 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 . The search antennas were located at 3 meters. Measurements were made in accordance with ANSI C63.4-1994.

Electronic Compliance Laboratories

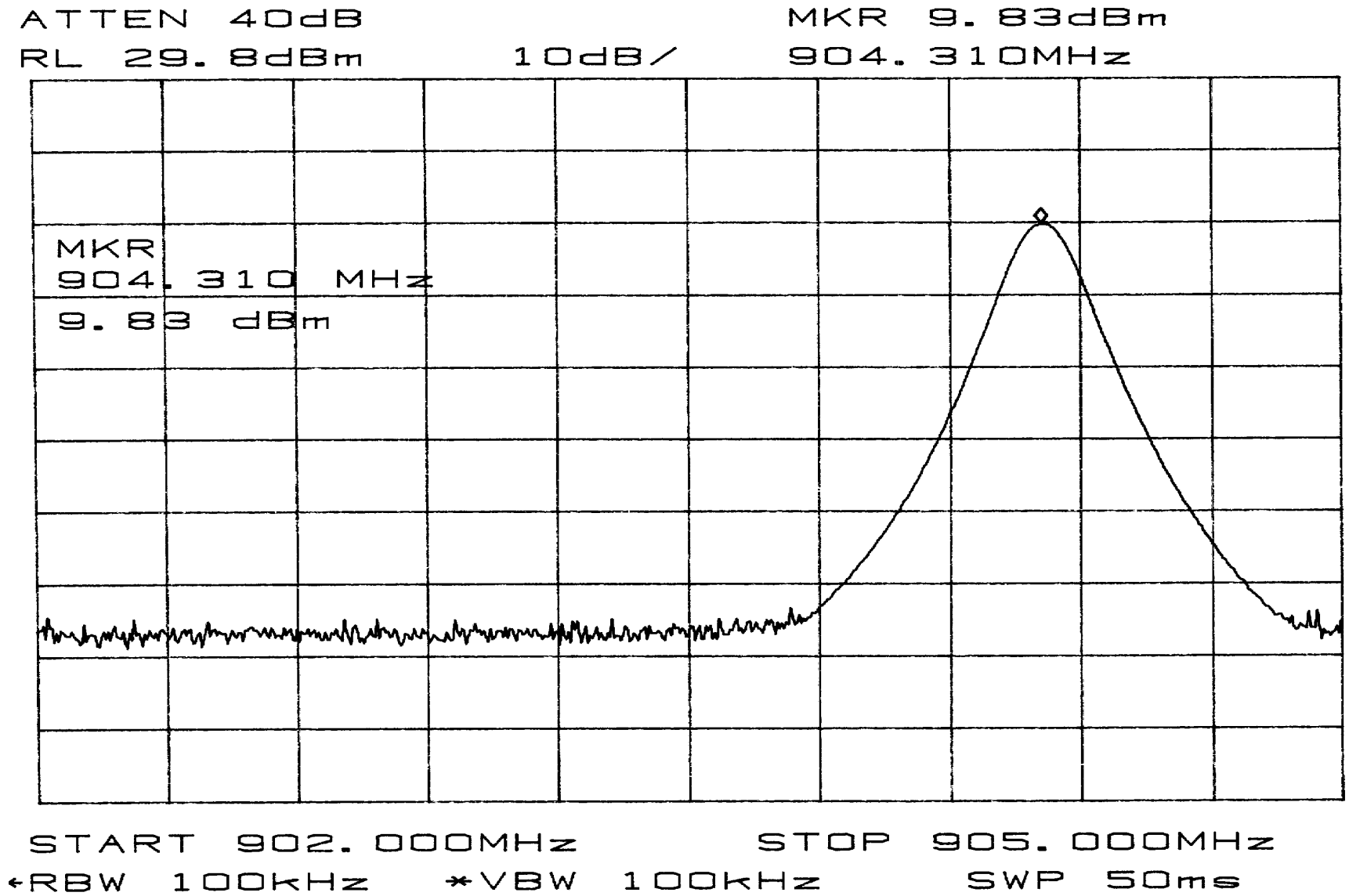
_____ _____

Chris Byleckie Date
Technical Director

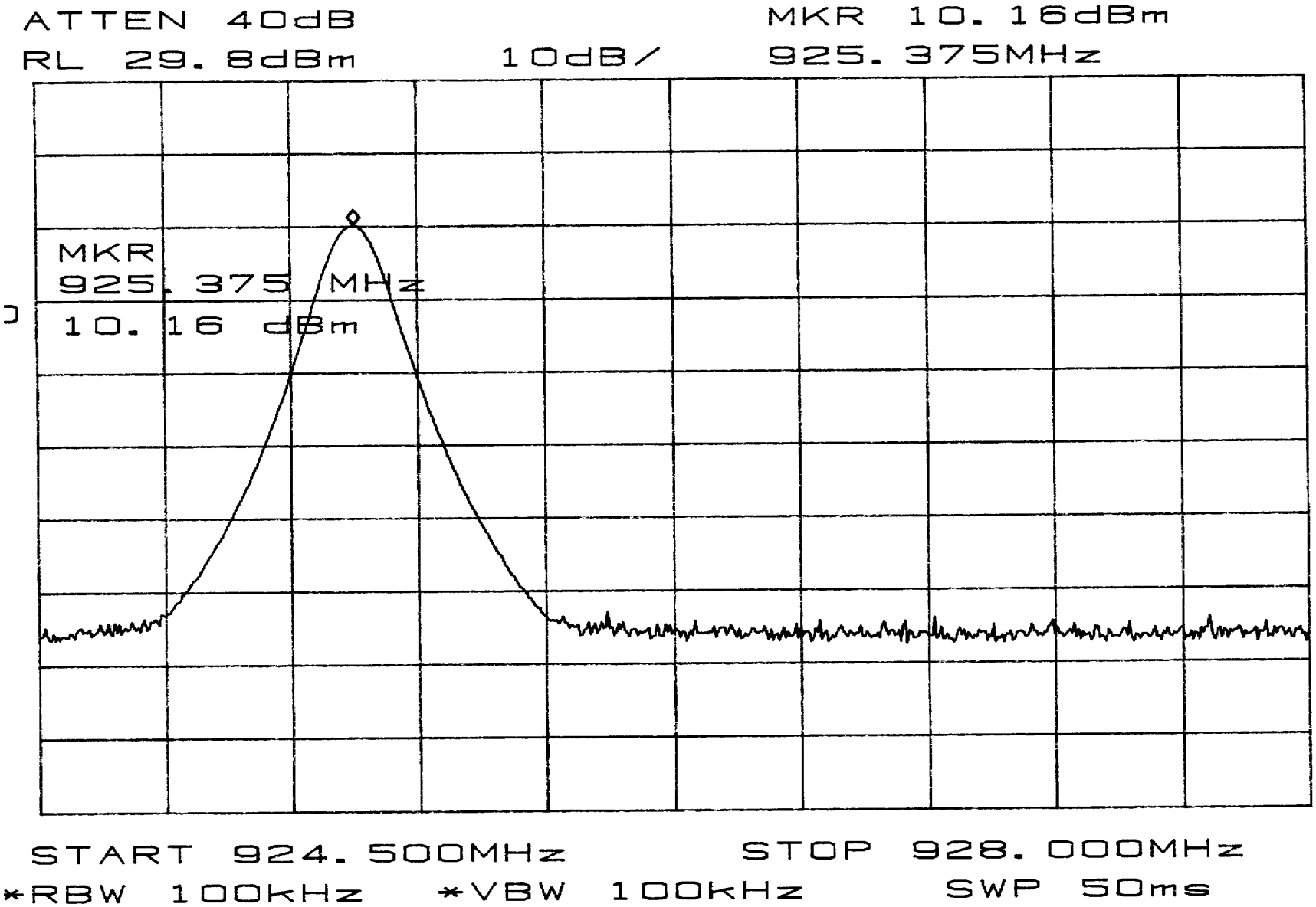
APPENDIX A

SPREAD SPECTRUM PLOTS

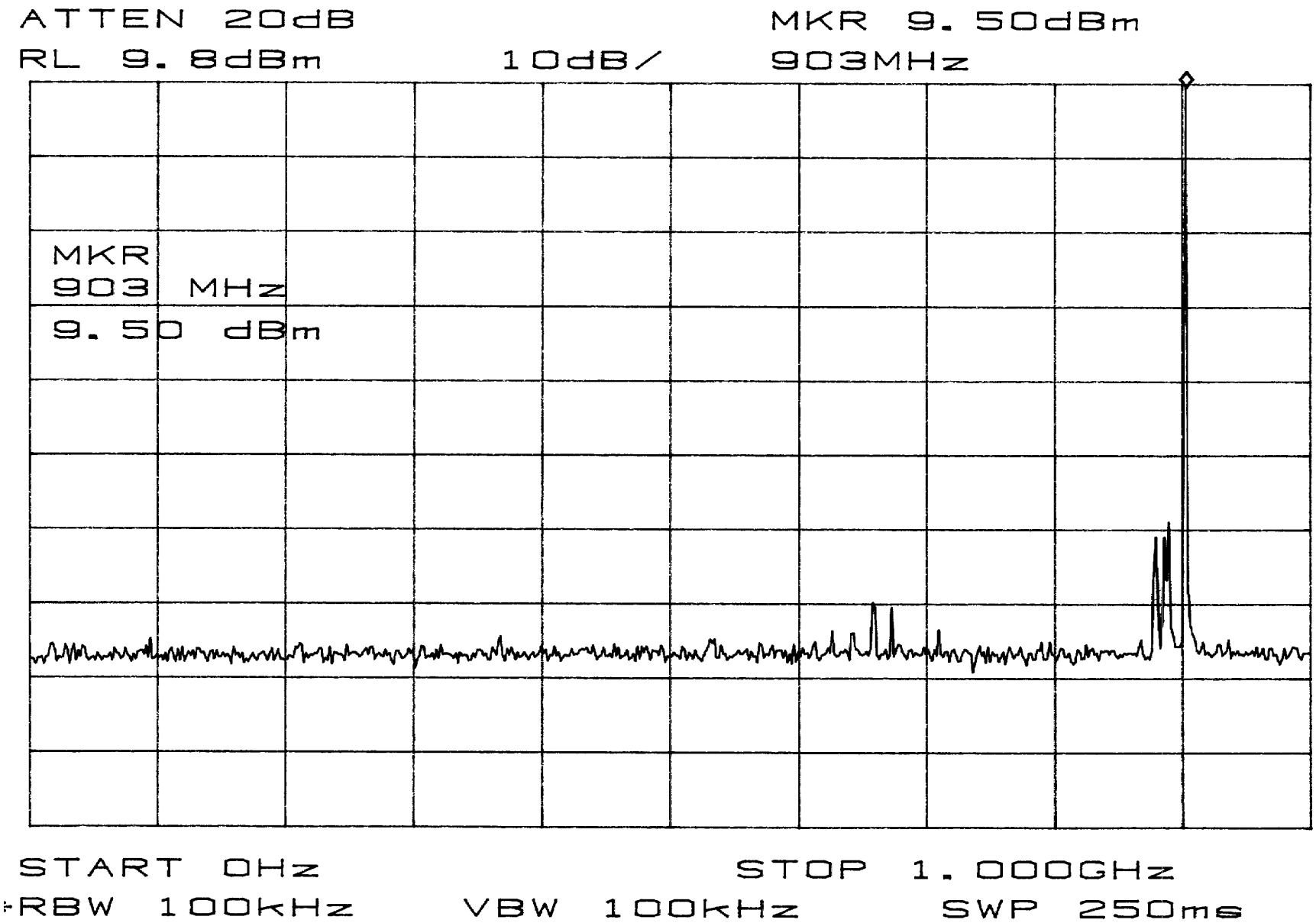
Out of Band - Lower Band Edge



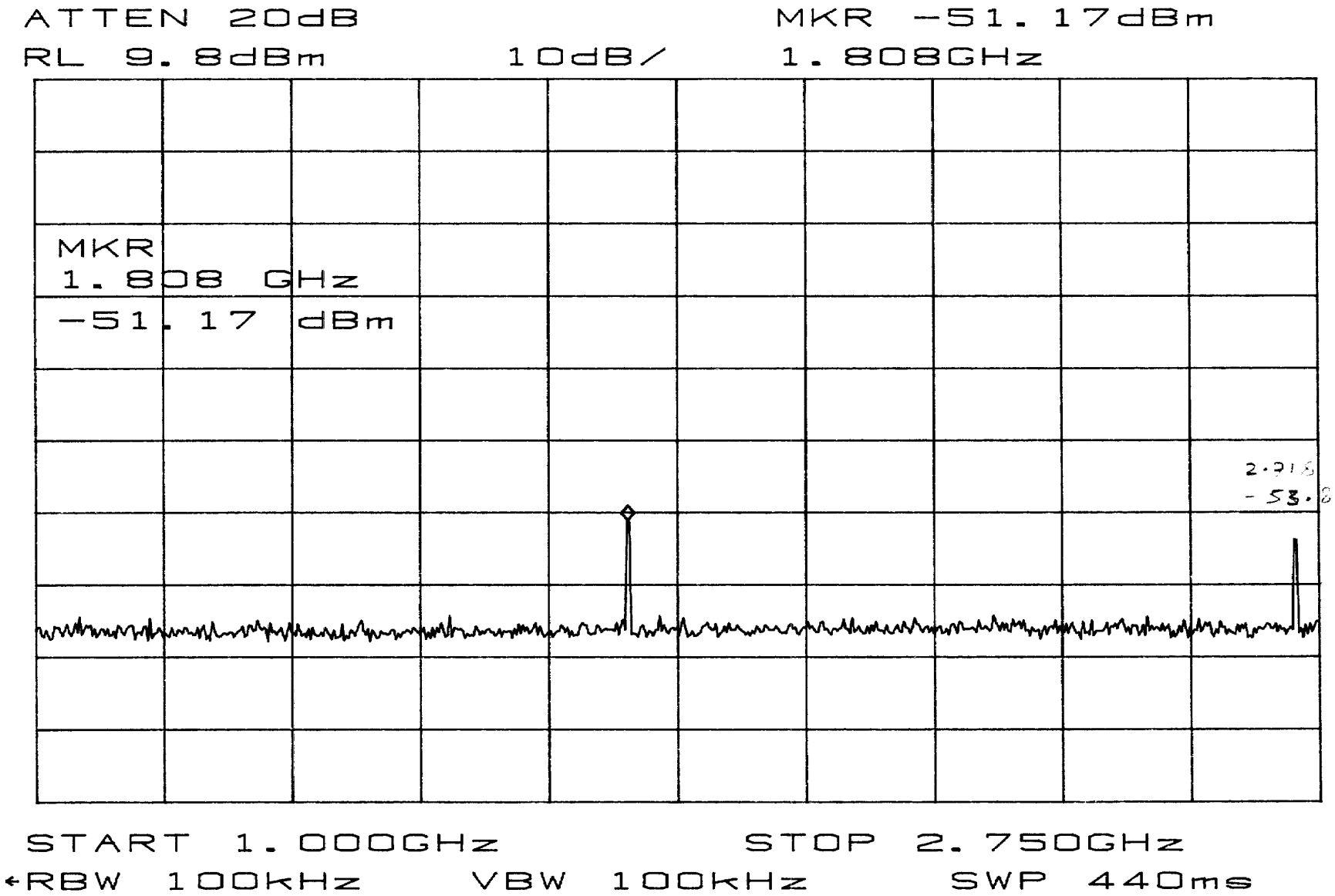
Out of Band - Upper Band Edge



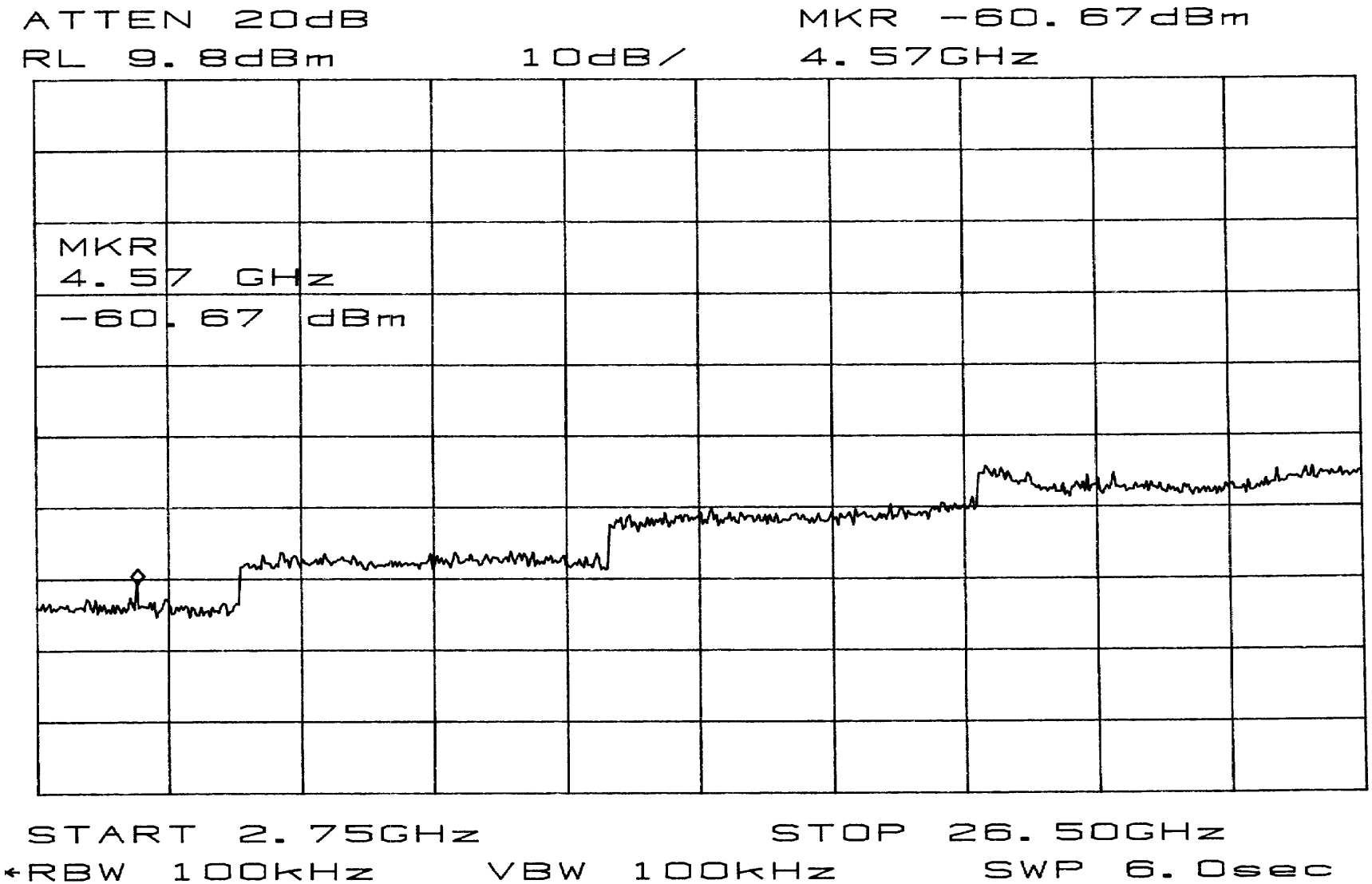
Out of Band Emissions 0 Hz – 1GHz



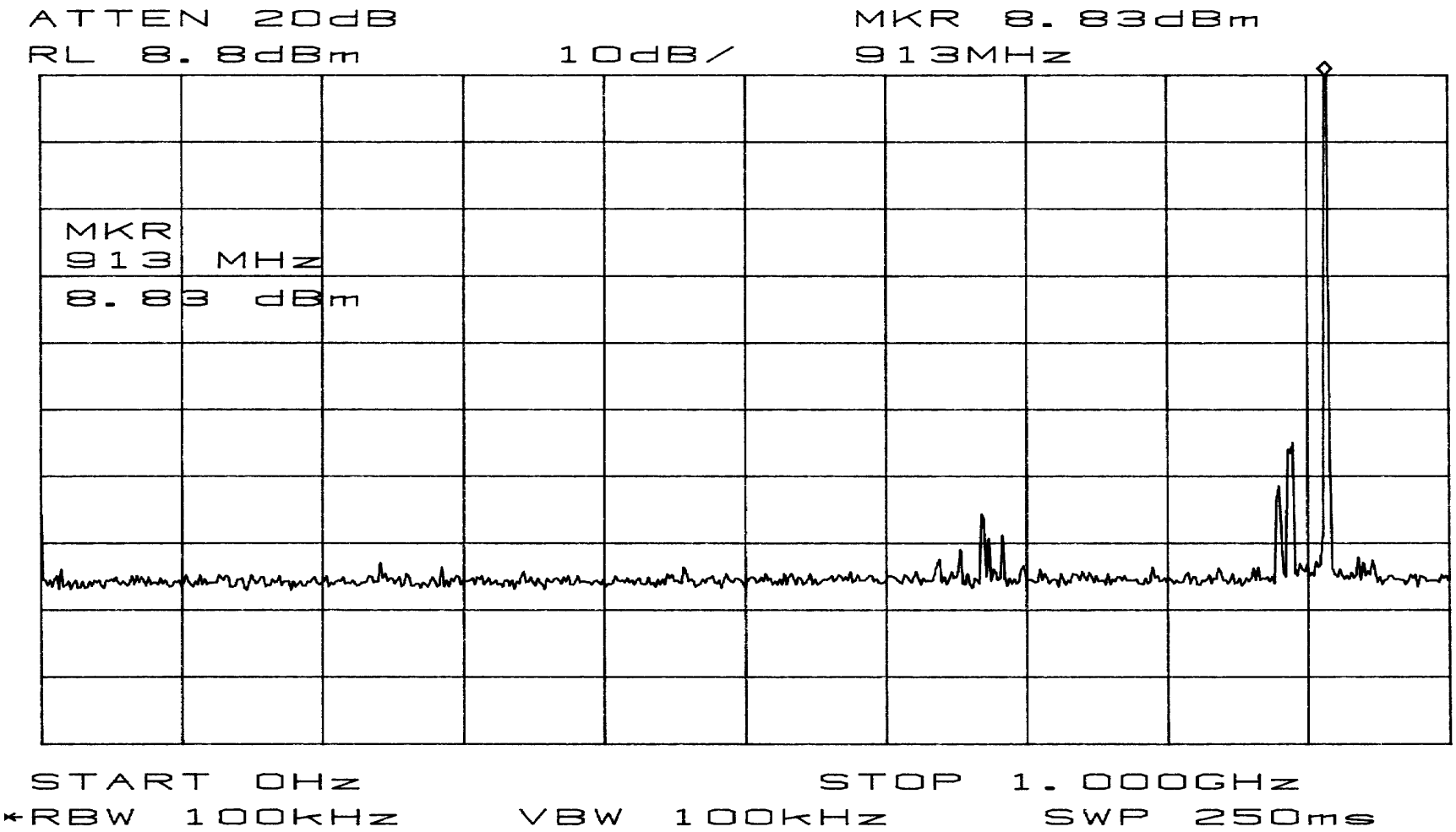
Out of Band Emissions 1- 2.75 GHz



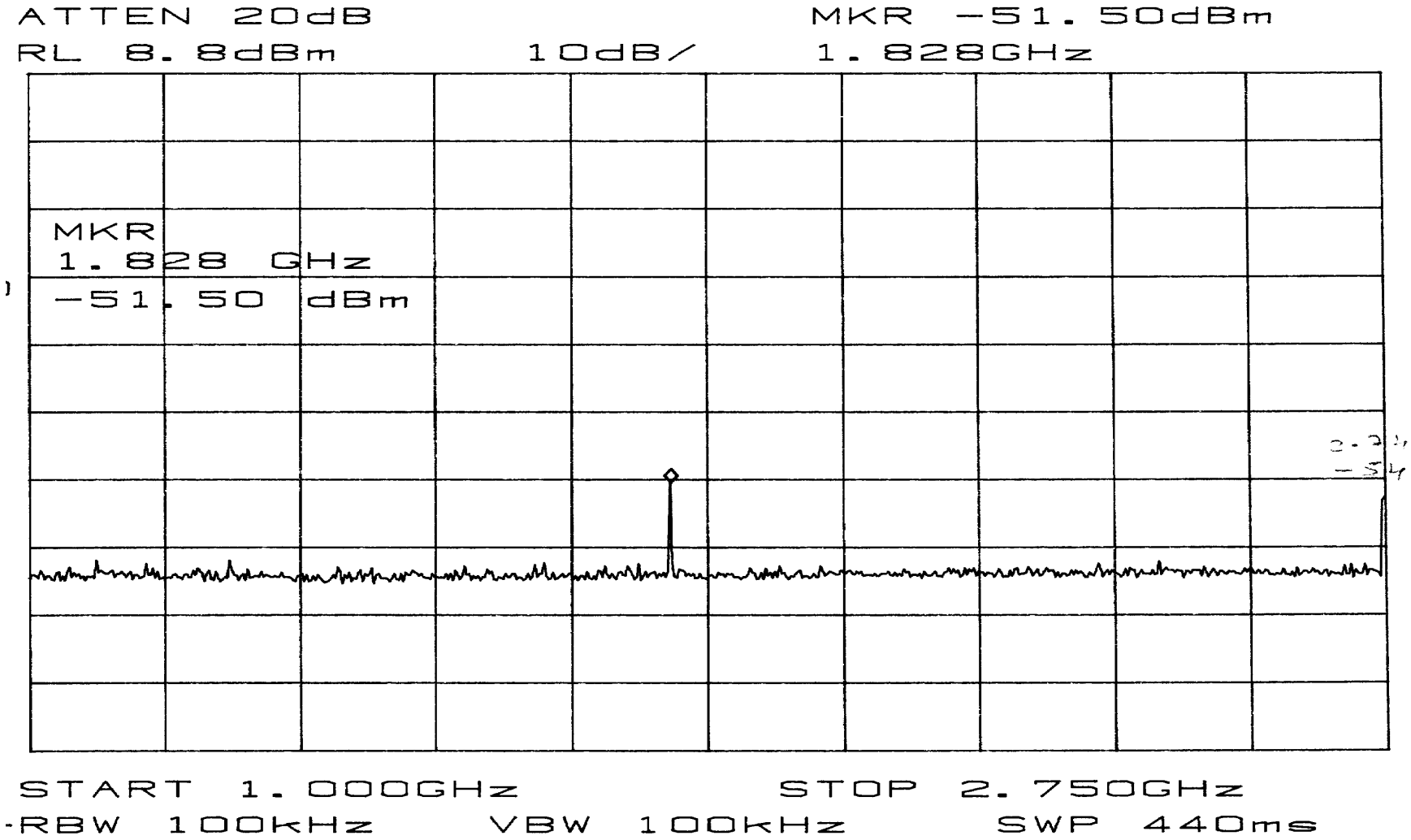
Out of Band Emissions 2.75 – 26.5 GHz



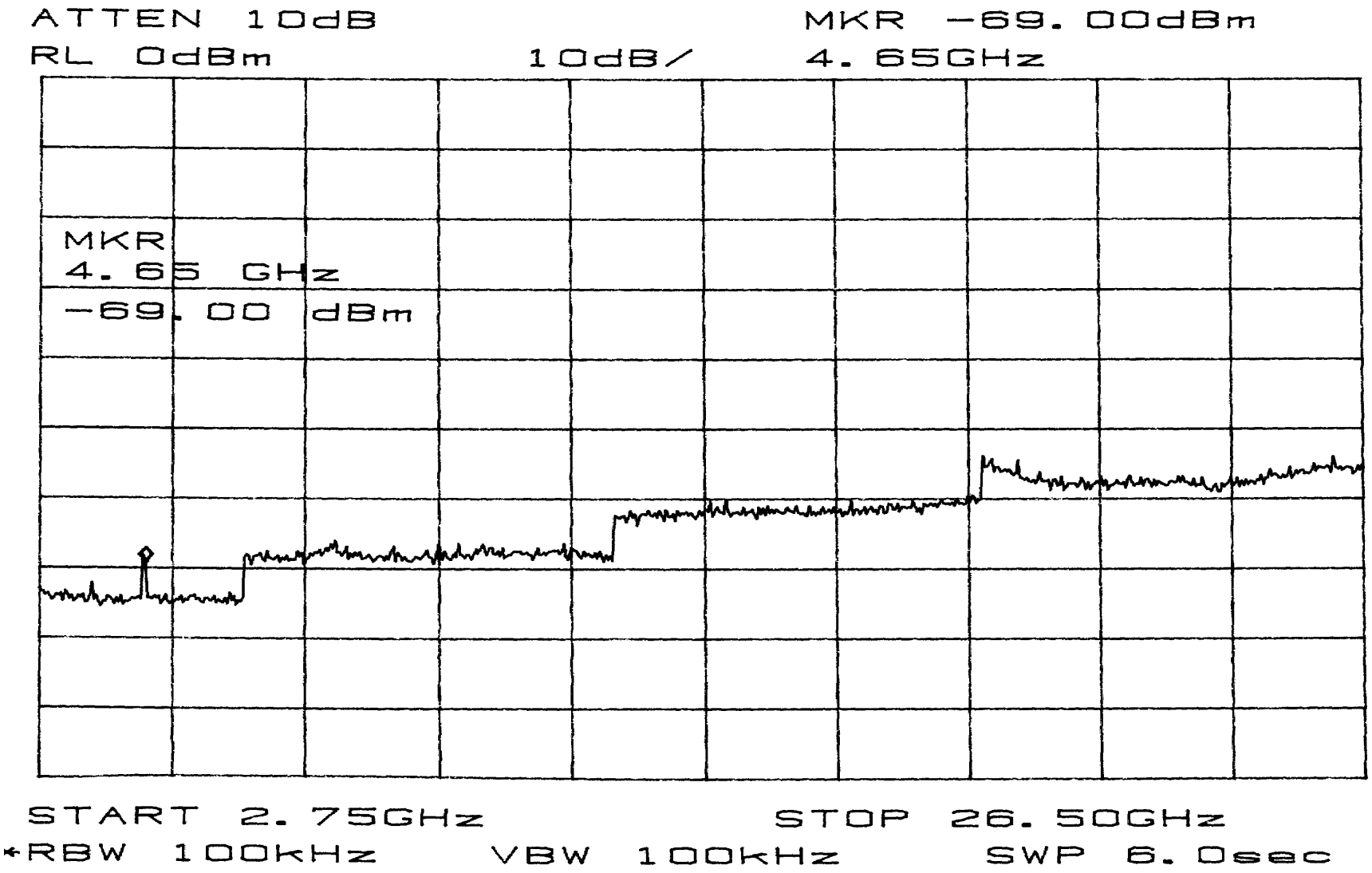
Out of Band Emissions 0 Hz – 1GHz



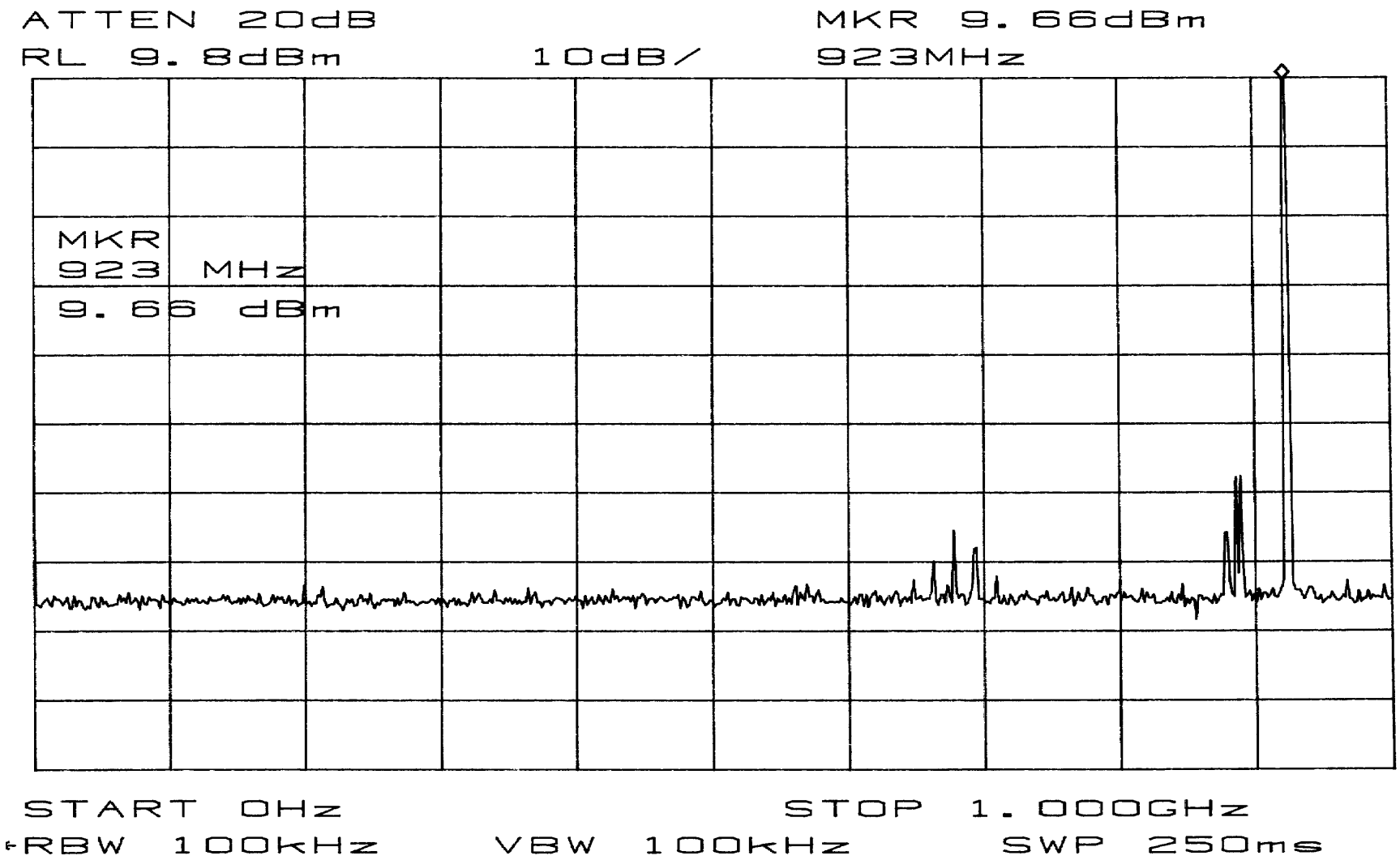
Out of Band Emissions 1- 2.75 GHz



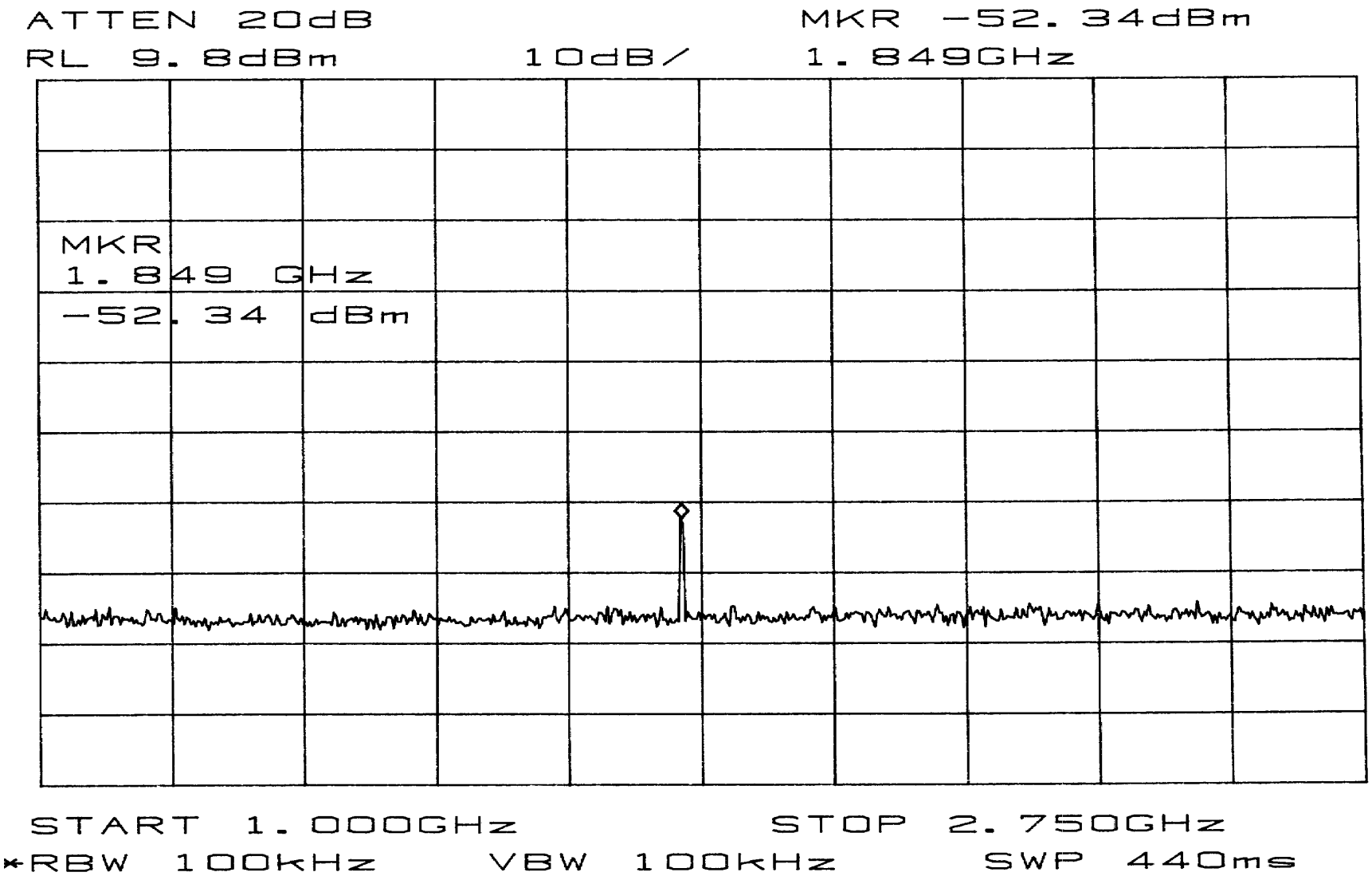
Out of Band Emissions 2.75 – 26.5 GHz



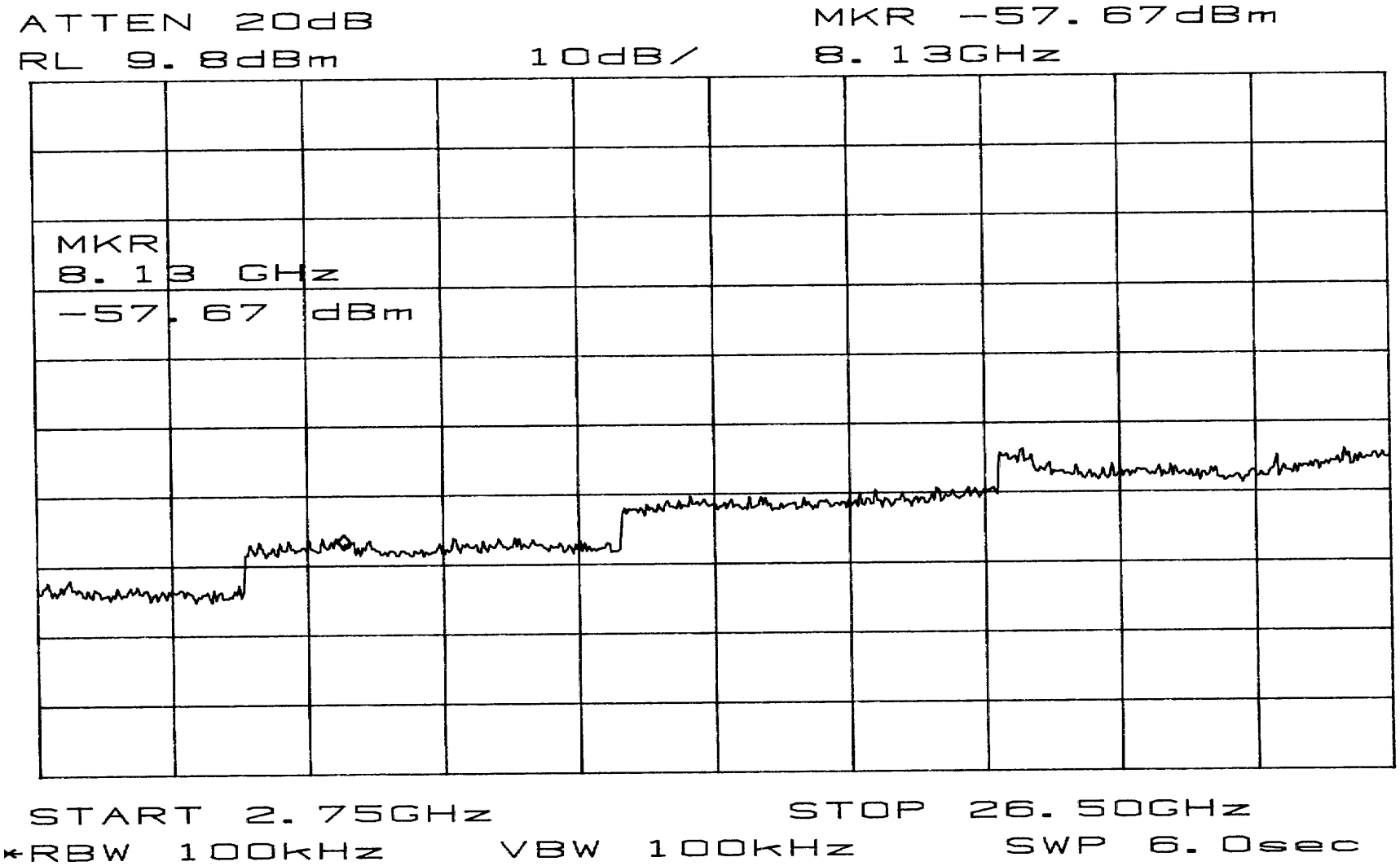
Out of Band Emissions 0 Hz – 1GHz



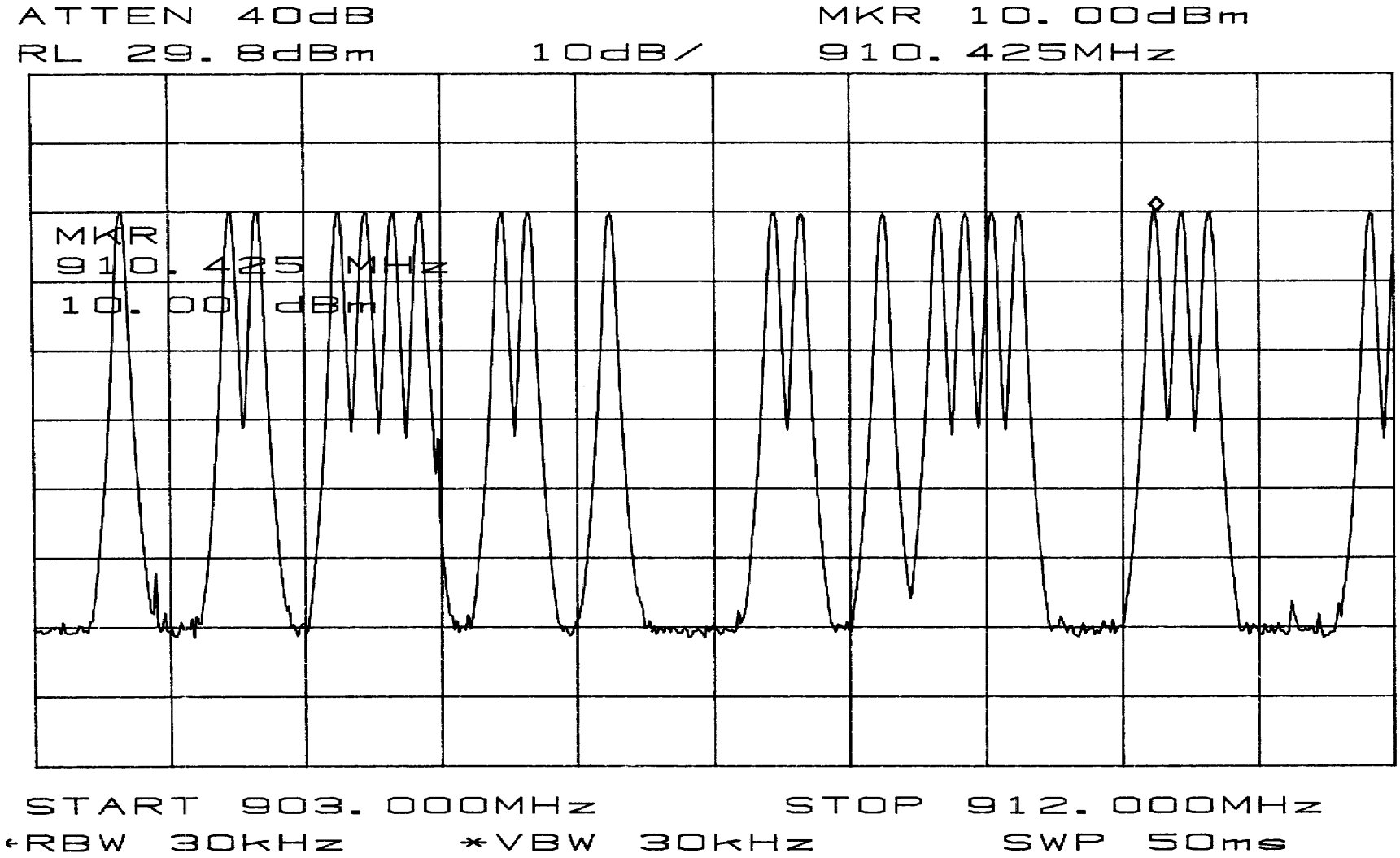
Out of Band Emissions 1- 2.75 GHz



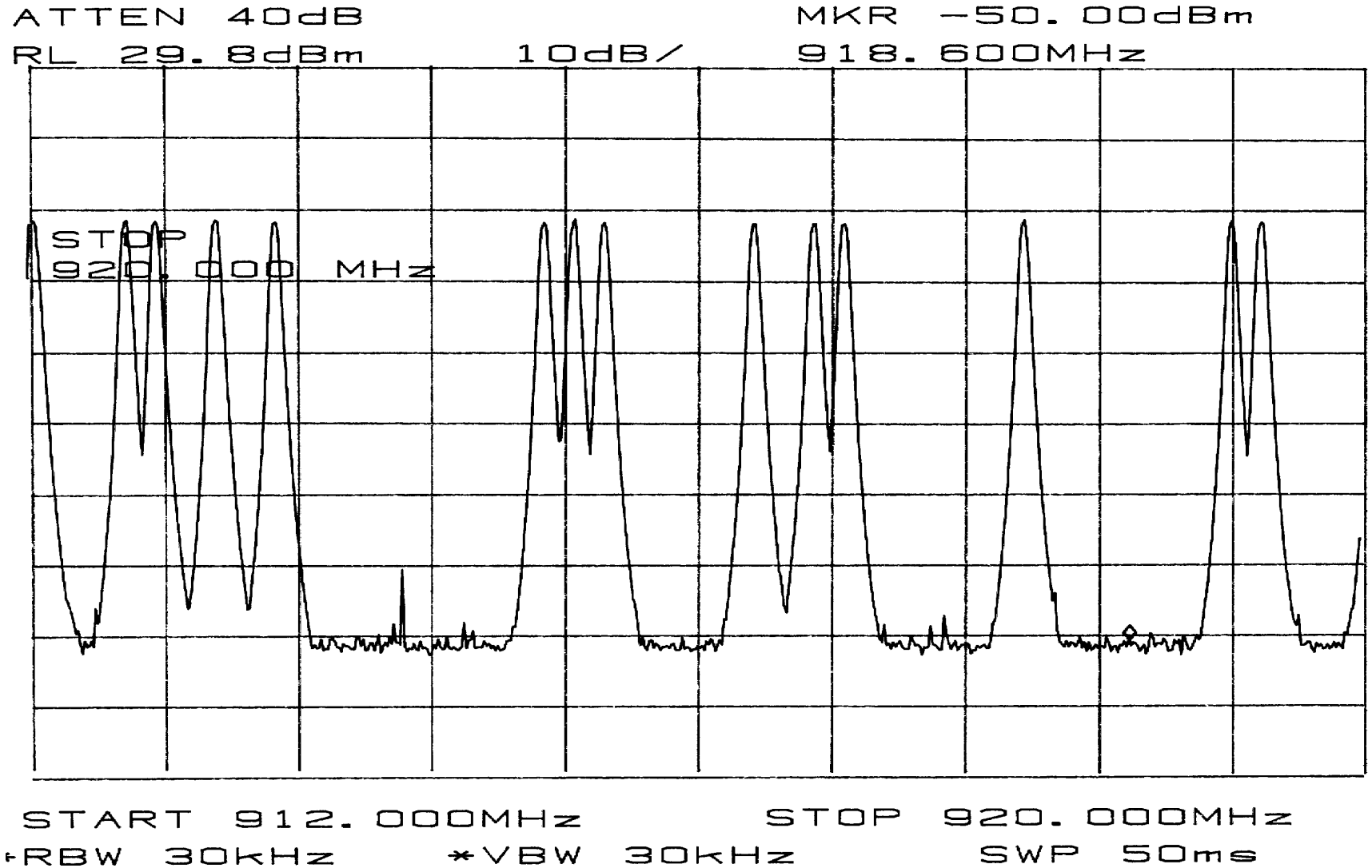
Out of Band Emissions 2.75 – 26.5 GHz



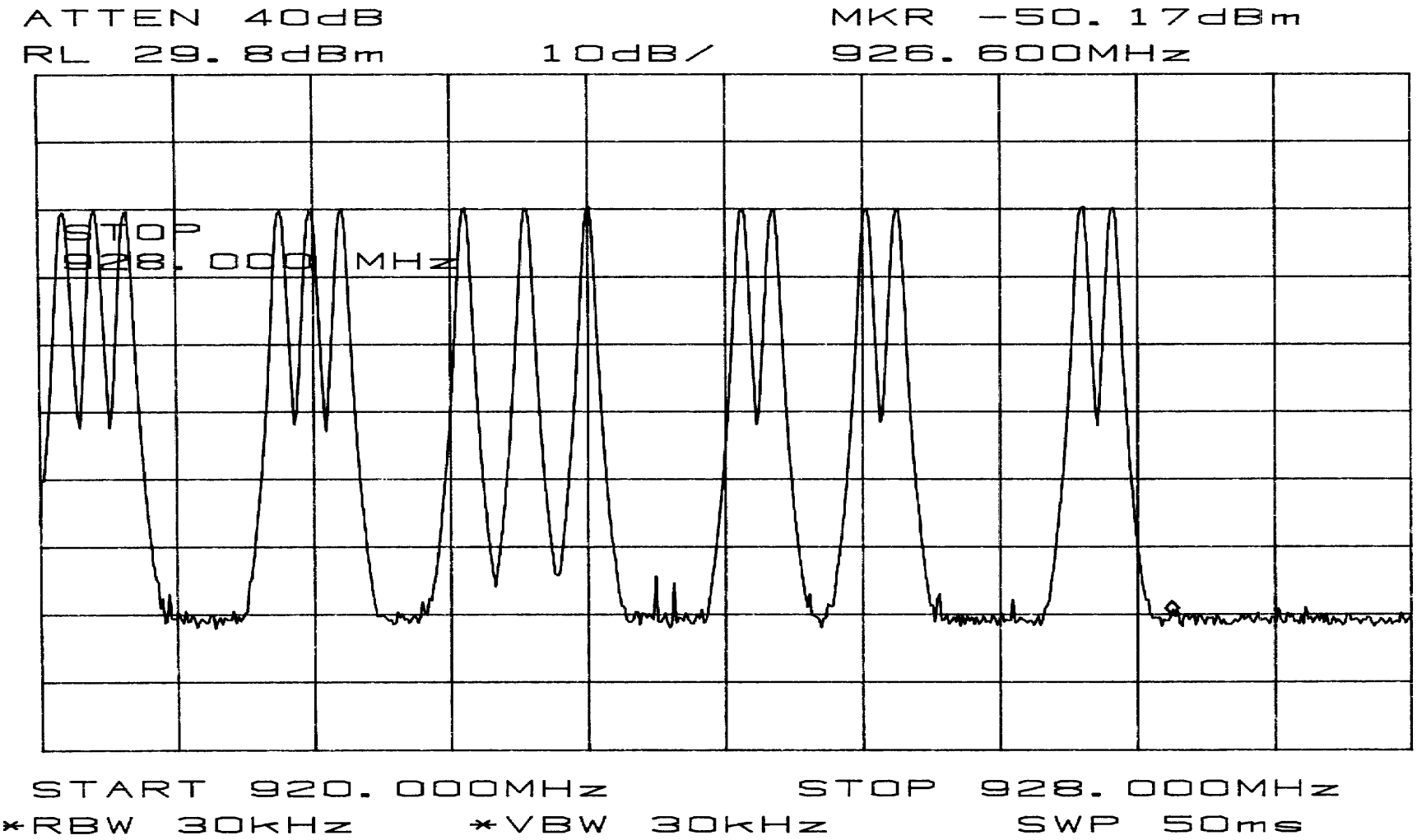
Channel Utilization 903 – 912 MHz



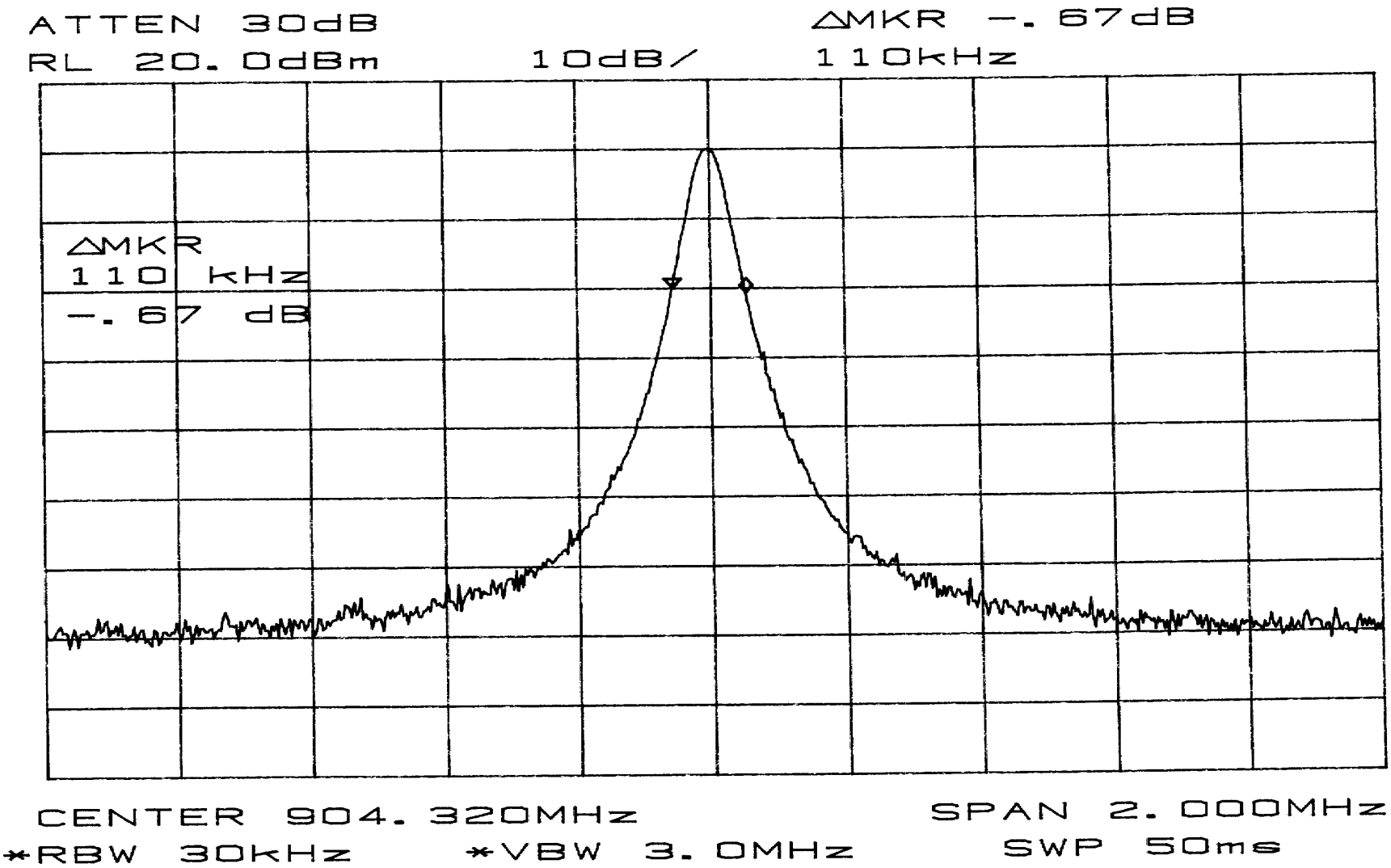
Channel Utilization 912- 920 MHz



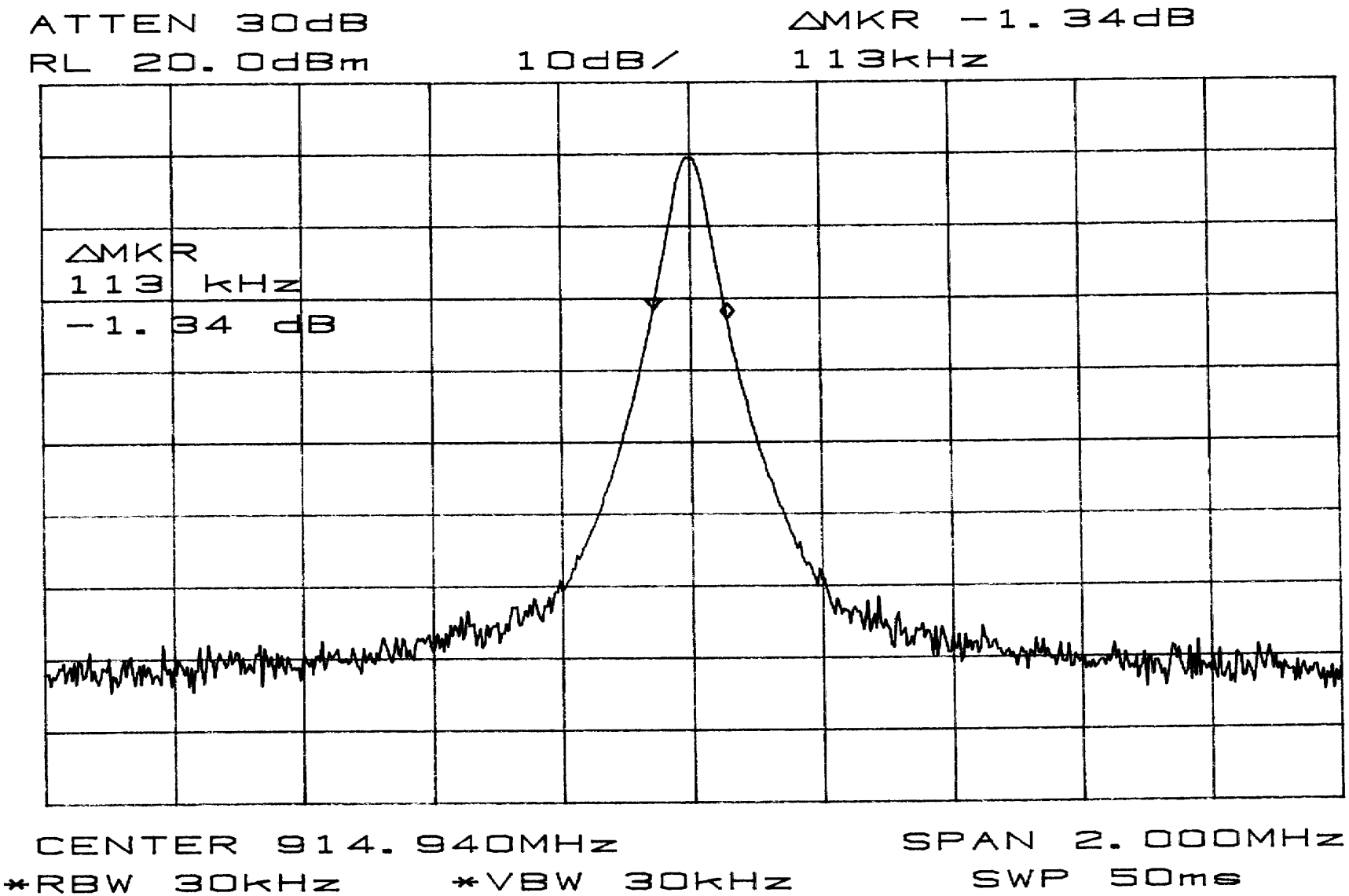
Channel Utilization 920 - 928 MHz



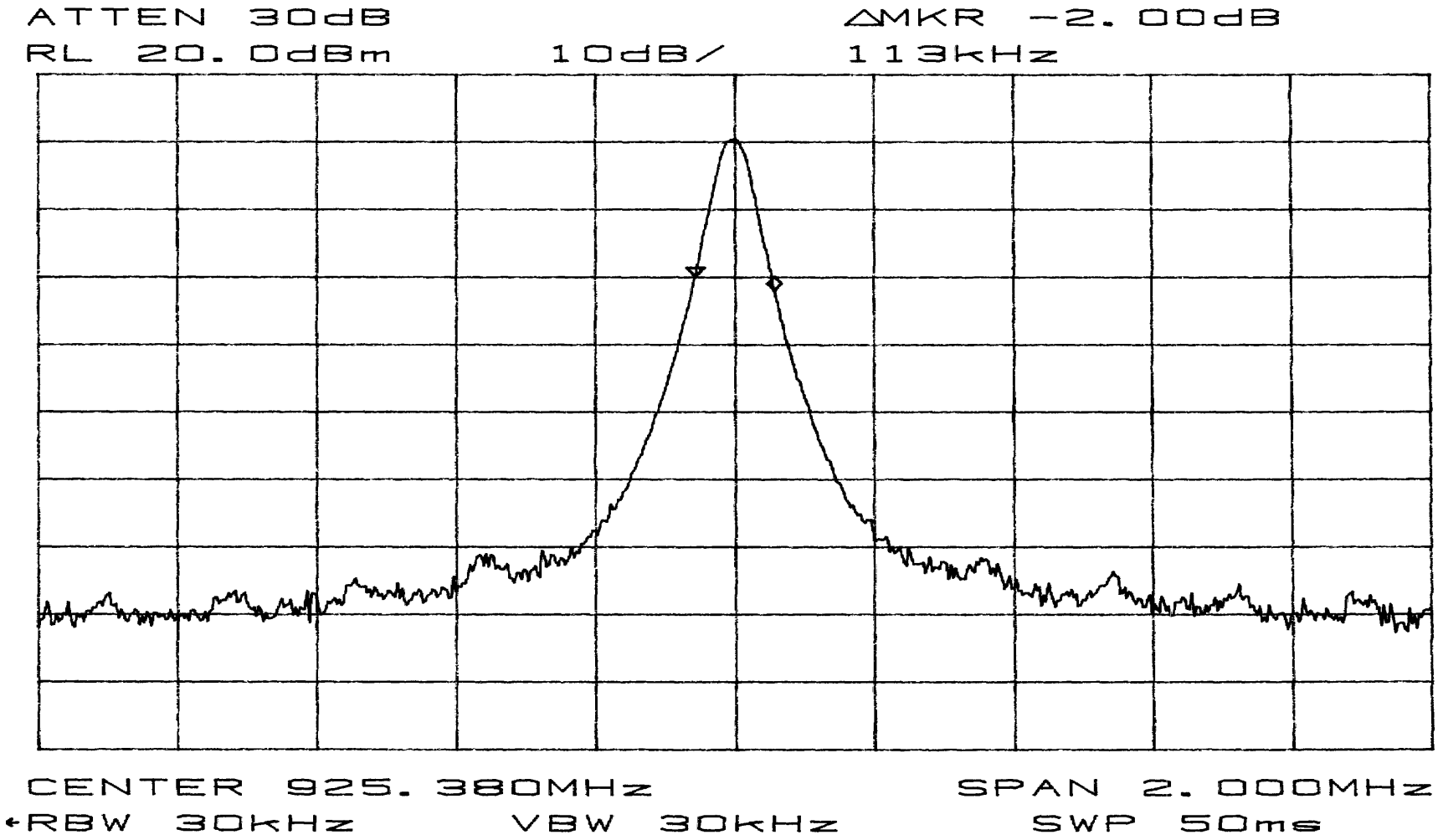
Bandwidth


ATTEN 30dB
RL 20.0dBm
10dB/
ΔMKR -.67dB
110kHz
ΔMKR
110 kHz
-.67 dB
CENTER 904.320MHz
SPAN 2.000MHz
*RBW 30kHz
*VBW 3.0MHz
SWP 50ms

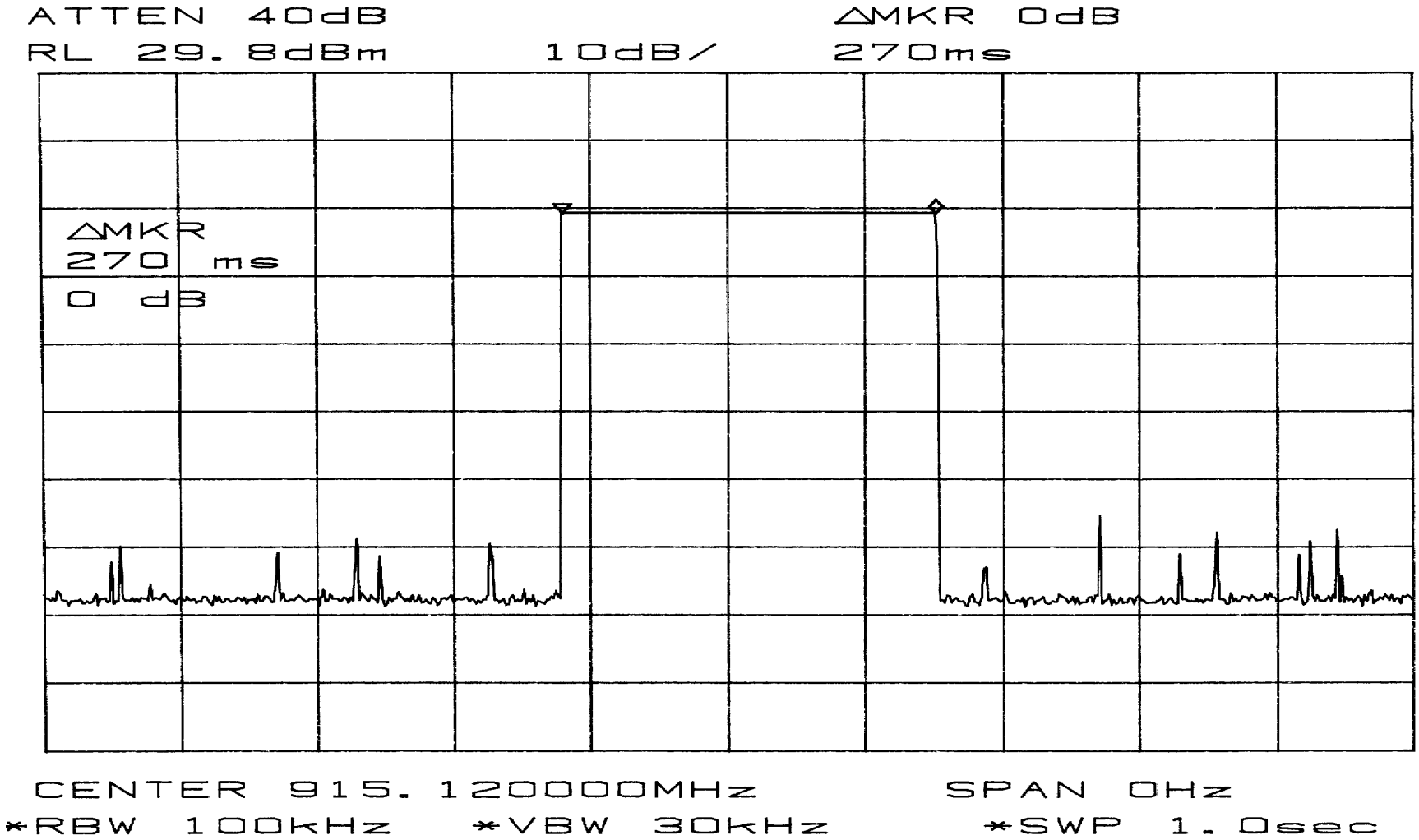
Bandwidth


ATTEN 30dB
RL 20.0dBm
10dB/
ΔMKR -1.34dB
113kHz
ΔMKR
113 kHz
-1.34 dB
CENTER 914.940MHz
SPAN 2.000MHz
*RBW 30kHz
*VBW 30kHz
SWP 50ms

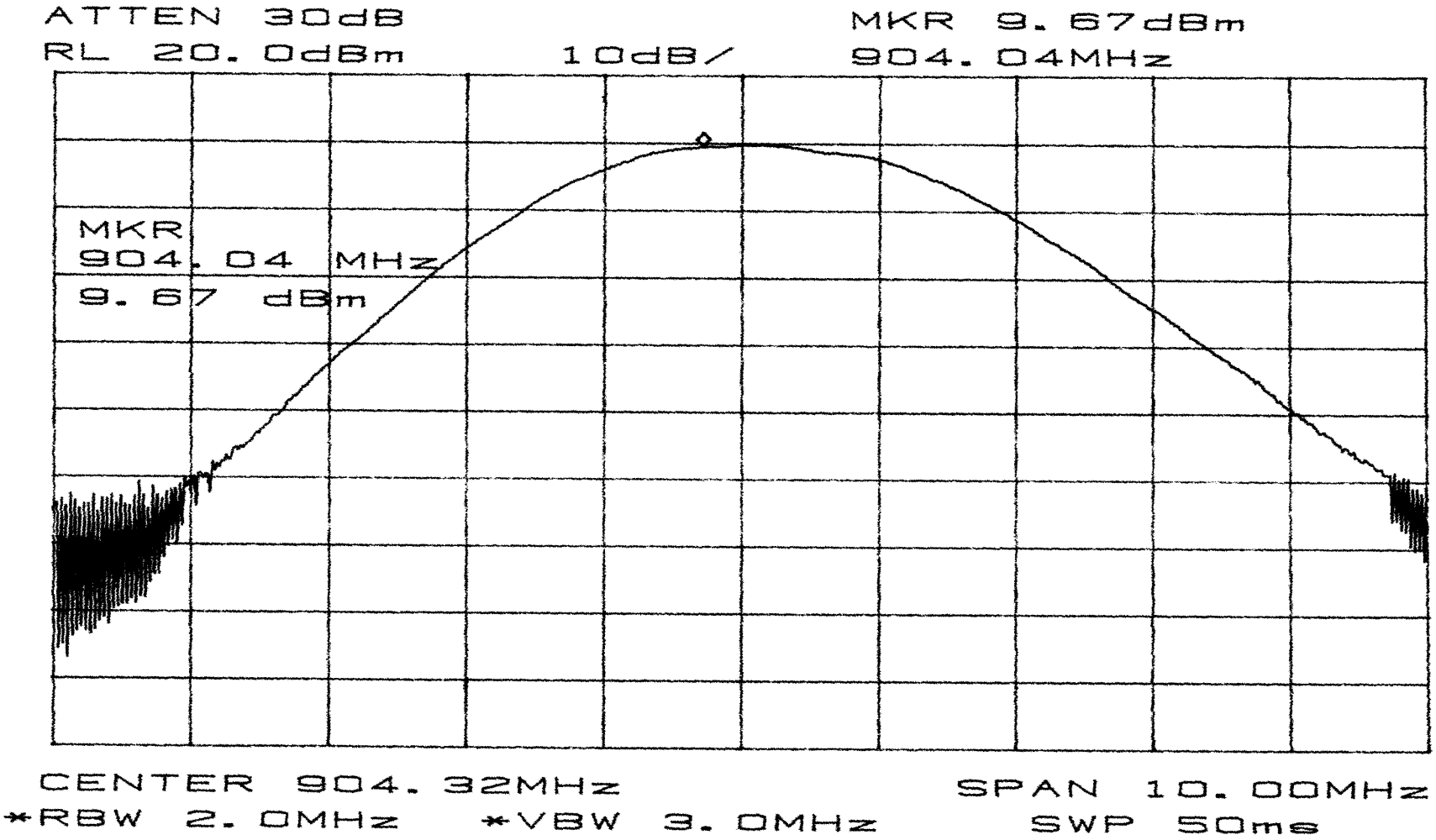
Bandwidth


ATTEN 30dB
ΔMKR −2.00dB
RL 20.0dBm
10dB/
113kHz
CENTER 925.380MHz
SPAN 2.000MHz
RBW 30kHz
VBW 30kHz
SWP 50ms

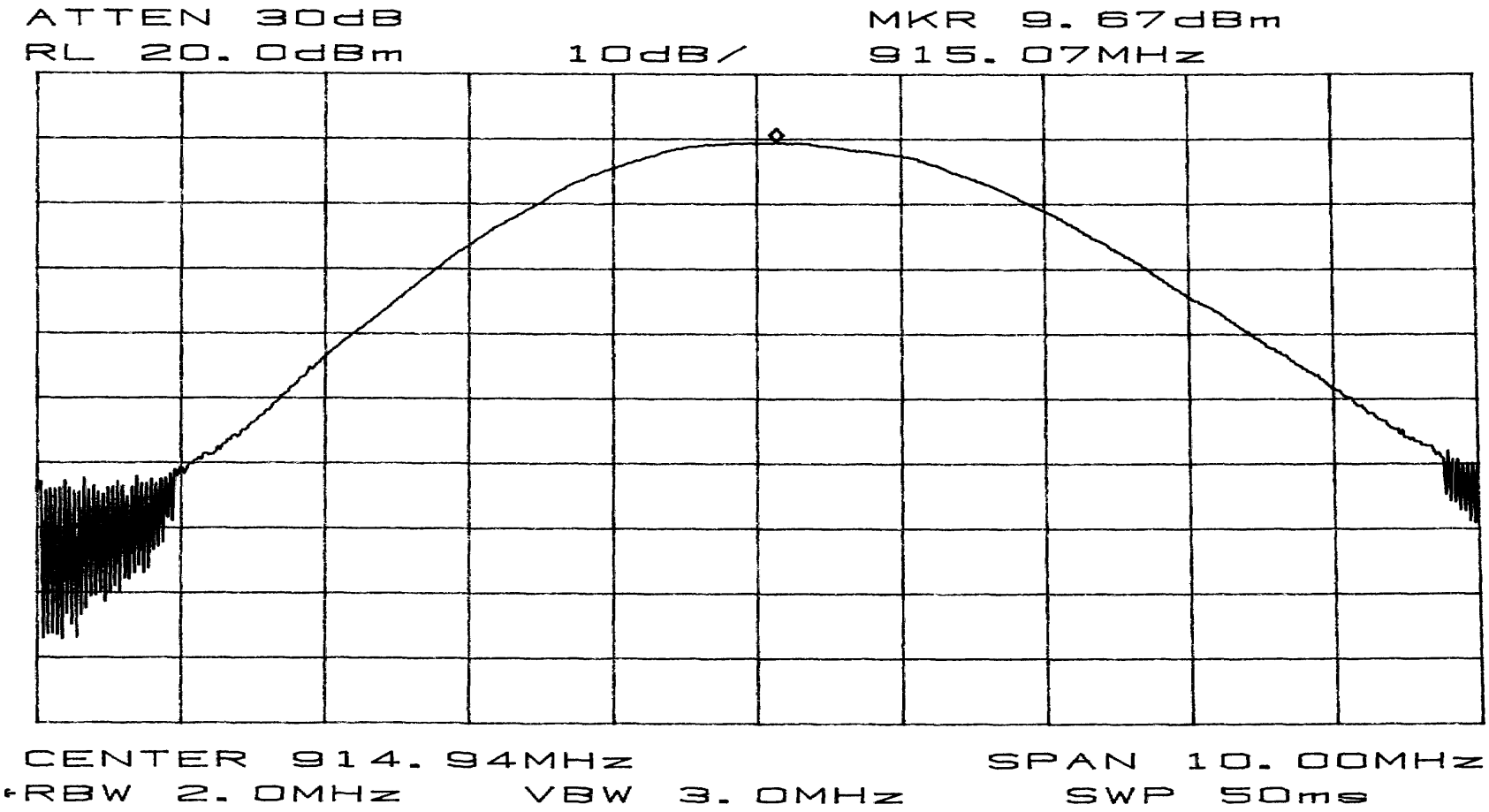
Channel Dwell Time



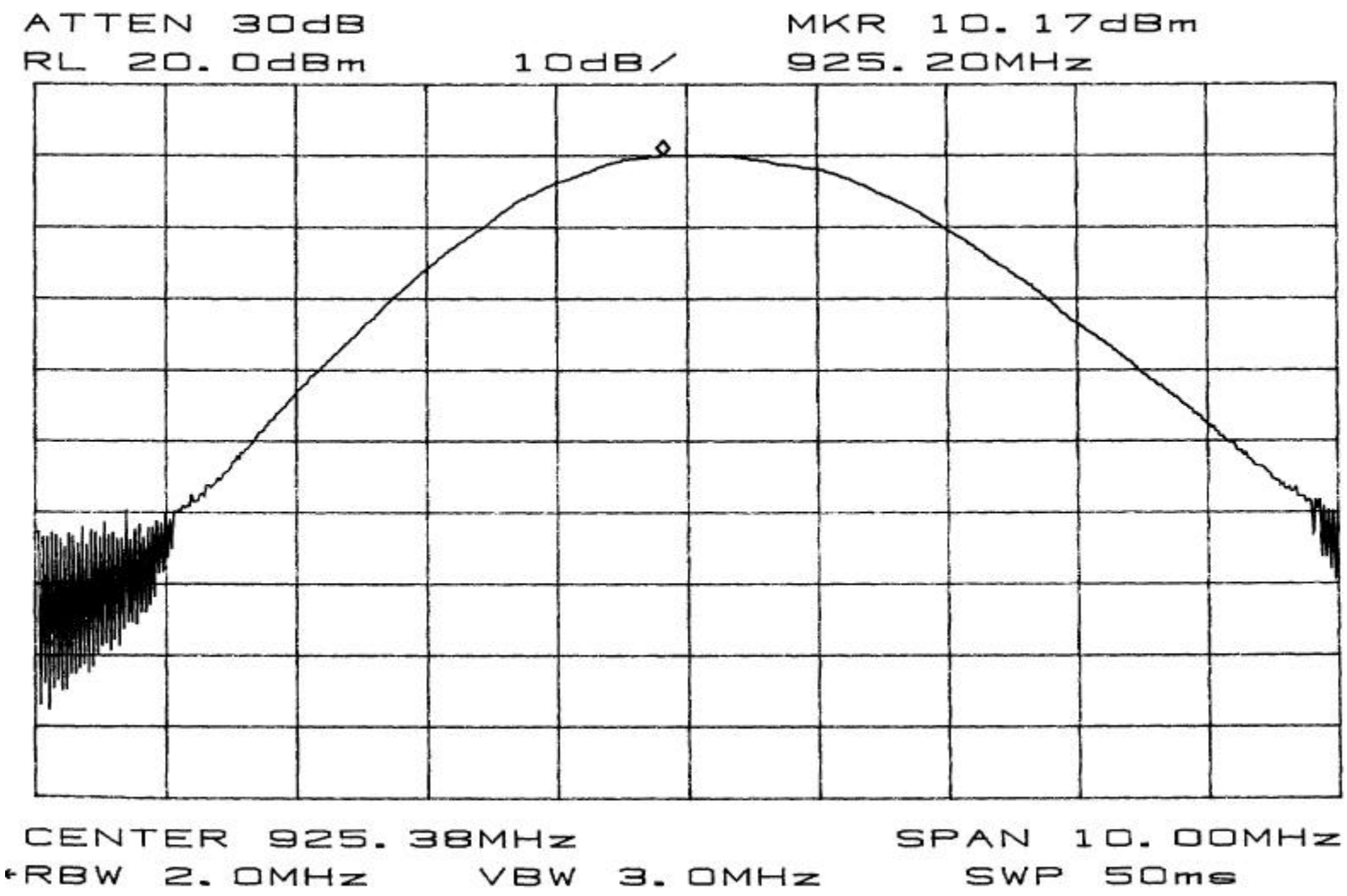
Output Power



Output Power



Output Power



APPENDIX B

RESTRICTED BAND DATA

EUT:	Low Power Gas RMI	**CUSTOMER NAME:**	Whisper Comm
RULE PART:	FCC PART 15.205	**WORK ORDER:**	8082701
		FILE:	8082701
ANTENNA:	HORN 0	**ATTN dB**	0
POLARIZATION:	VERTICAL	**DUTY dB**	0
MODULATION TYPE:		**HP IL dB**	0
TESTED BY:	SURESH	**DIST dB:**	0
COMMENT:	Sr No 0001B69F9		

FREQ. MHz	READING dB(uV)	NF	Pk or Av	A.F. dB	Cbl dB	FLTR dB	AMP dB	TOTAL, dB(uV/m)	LIMIT dB(uV/m)	DELTA dB
904.32 MHz										
2712.96	42.50		Pk	28.6	-5.3	-0.4	35.6	41.2	74.0	-32.8
2712.96	32.17		Avg	28.6	-5.3	-0.4	35.6	30.8	54.0	-23.2
3617.28	40.00		Pk	32.4	-6.2	-0.4	35.1	43.9	74.0	-30.1
3617.28	30.83		Avg	32.4	-6.2	-0.4	35.1	34.7	54.0	-19.3
4521.60	39.83	*	Pk	32.8	-7.0	-0.4	35.1	44.9	74.0	-29.1
4521.60	29.33	*	Avg	32.8	-7.0	-0.4	35.1	34.4	54.0	-19.6
5425.92	43.83		Pk	33.6	-8.1	-0.4	35.0	50.9	74.0	-23.1
5425.92	34.33		Avg	33.6	-8.1	-0.4	35.0	41.4	54.0	-12.6
8138.88	41.33	*	Pk	37.0	-11.4	-0.4	35.5	54.6	74.0	-19.4
8138.88	30.50	*	Avg	37.0	-11.4	-0.4	35.5	43.8	54.0	-10.2
9043.20	41.17	*	Pk	37.8	-12.1	-0.4	35.5	55.9	74.0	-18.1
9043.20	29.83	*	Avg	37.8	-12.1	-0.4	35.5	44.6	54.0	-9.4
914.94 MHz										
2744.82	41.50		Pk	28.6	-5.3	-0.4	35.5	40.3	74.0	-33.7
2744.82	31.33		Avg	28.6	-5.3	-0.4	35.5	30.1	54.0	-23.9
3659.76	40.50	*	Pk	32.4	-6.2	-0.4	35.1	44.4	74.0	-29.6
3659.76	29.17	*	Avg	32.4	-6.2	-0.4	35.1	33.0	54.0	-21.0
4574.70	40.67	*	Pk	32.8	-7.0	-0.4	35.2	45.7	74.0	-28.3
4574.70	30.00		Avg	32.8	-7.0	-0.4	35.2	35.0	54.0	-19.0
7319.52	41.67	*	Pk	36.0	-10.6	-0.4	35.4	53.3	74.0	-20.7
7319.52	31.50		Avg	36.0	-10.6	-0.4	35.4	43.1	54.0	-10.9
8234.46	40.33	*	Pk	37.0	-11.4	-0.4	35.5	53.6	74.0	-20.4
8234.46	30.17		Avg	37.0	-11.4	-0.4	35.5	43.4	54.0	-10.6
9149.40	40.50	*	Pk	37.8	-12.1	-0.4	35.5	55.3	74.0	-18.7
9149.40	29.67		Avg	37.8	-12.1	-0.4	35.5	44.4	54.0	-9.6
925.38 MHz										
2776.14	43.00		Pk	28.6	-5.3	-0.4	35.5	41.8	74.0	-32.2
2776.14	31.33		Avg	28.6	-5.3	-0.4	35.5	30.1	54.0	-23.9
3701.52	41.50		Pk	32.4	-6.2	-0.4	35.1	45.4	74.0	-28.6
3701.52	29.83		Avg	32.4	-6.2	-0.4	35.1	33.7	54.0	-20.3
4626.90	40.33		Pk	32.8	-7.0	-0.4	35.2	45.4	74.0	-28.6
4626.90	29.83		Avg	32.8	-7.0	-0.4	35.2	34.9	54.0	-19.1
7403.04	40.83	*	Pk	36.0	-10.6	-0.4	35.4	52.4	74.0	-21.6
7403.04	30.67	*	Avg	36.0	-10.6	-0.4	35.4	42.3	54.0	-11.7
8328.42	41.00	*	Pk	37.0	-11.4	-0.4	35.5	54.3	74.0	-19.7
8328.42	30.17	*	Avg	37.0	-11.4	-0.4	35.5	43.4	54.0	-10.6

APPENDIX C

RADIATED EMISSIONS

Electronic Compliance Laboratories, Inc.
1249 Birchwood Ave.
Sunnyvale, CA
Radiated Emissions
Frequency range: 30MHz-1000MHz
3 Meter Open Site
Site Calibrated: June 1997

Government Agency and Limit: FCC Class B

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

Customer:	WHISPER COMMUNICATION	Operator:	SURESH
Date:	08-31-1998	Time:	12:04:18
Temperature Range:	70 Deg F	Percent Humidity:	60
E.U.T.:	LOW POWER GAS RMI		
Serial Number:	0001B69F9		
Support Devices:			
Serial Number:			
FCC ID:			
Exercise Program:	NONE		
Modifications:	NONE		
Report File Name:	F:\TESTDATA\8082701.RF		

Antenna Type: BICONICAL

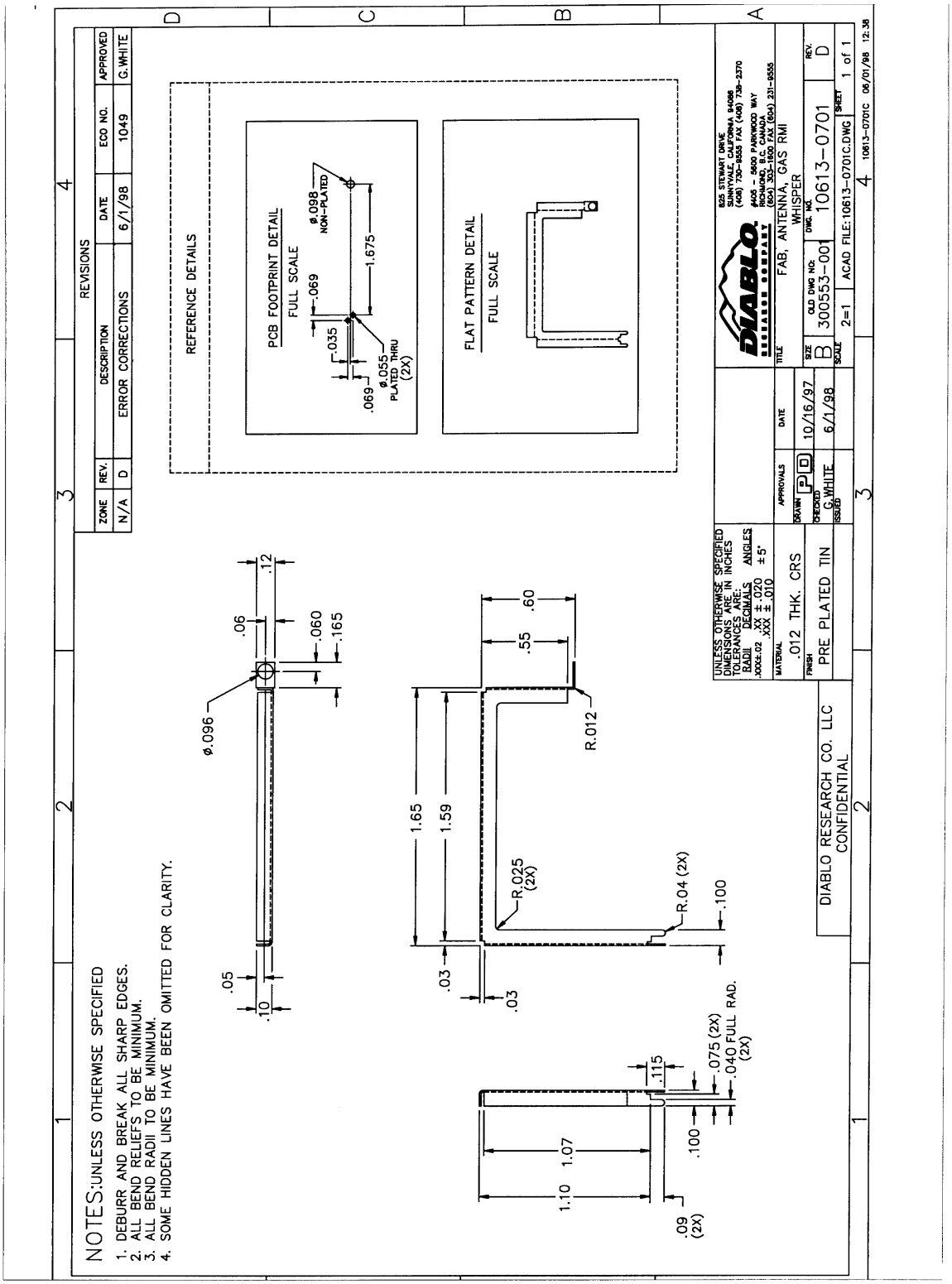
TEST FREQ	TEST dBuV	ACTUAL dBuV/m	CLASS B LIMIT	VERSUS B LIMIT	TABLE DEGREES	ANTENNA HEIGHT	POLAR-IZATION	DETECTOR Type
260.000	30.2	23.1	46.0	-22.9	90	2.0	H	PK
64.884	49.1	32.1	40.0	-7.9	90	1.5	V	PK
292.400	45.9	42.3	46.0	-3.7	270	1.5	V	PK
292.400	41.3	37.7	46.0	-8.3	270	1.5	V	QP

CHANGED ANTENNA TO LOG PERIODIC

NO EMISSIONS FOUND ABOVE NOISE FLOOR

APPENDIX D

ANTENNA DRAWINGS

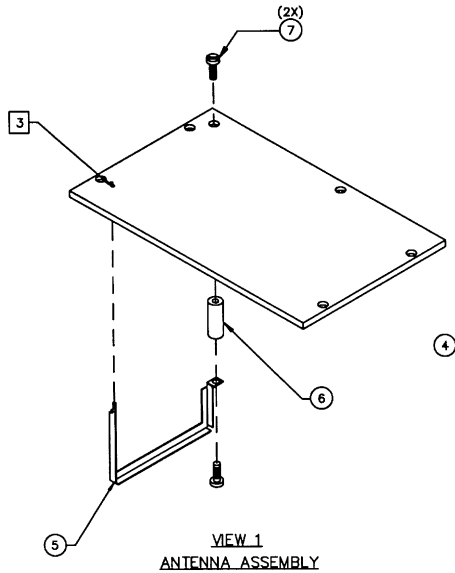

NOTES: UNLESS OTHERWISE SPECIFIED
1. DEBURR AND BREAK ALL SHARP EDGES.
2. ALL BEND RELIEFS TO BE MINIMUM.
3. ALL BEND RADII TO BE MINIMUM.
4. SOME HIDDEN LINES HAVE BEEN OMITTED FOR CLARITY.
REVISIONS
ZONE | REV. | DESCRIPTION | DATE | ECO NO. | APPROVED
N/A | D | ERROR CORRECTIONS | 6/1/98 | 1049 | G.WHITE
REFERENCE DETAILS
PCB FOOTPRINT DETAIL
FULL SCALE
FLAT PATTERN DETAIL
FULL SCALE
DIABLO RESEARCH COMPANY
FAB, ANTENNA, GAS RMI
WHISPER
10613-0701
DIABLO RESEARCH CO. LLC
CONFIDENTIAL
.012 THK. CRS
PRE PLATED TIN
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
RADII DECIMALS ANGLES
.XXX±.02 .XX ±.020 ±5°
.XXX ±.010
APPROVALS DATE
DRAWN P D 10/16/97
CHECKED 6/1/98
ISSUED G.WHITE
SIZE B
OLD DWG NO. 300553-001
DWG. NO. 10613-0701
REV. D
SCALE 2=1
SHEET 1 of 1
ACAD FILE: 10613-0701C.DWG
10613-0701C 06/01/98 12:38

NOTES: UNLESS OTHERWISE SPECIFIED

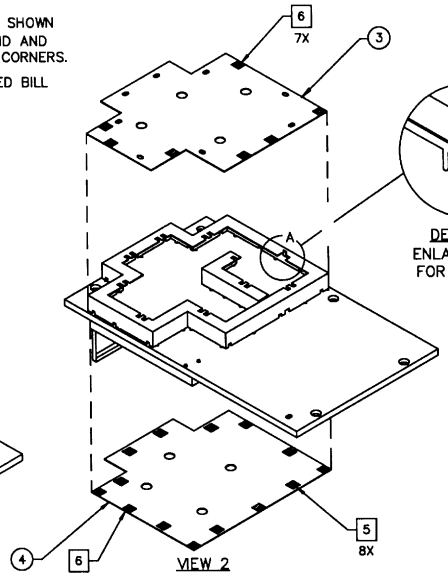
1. INSTALL BARCODE LABEL (ITEM 4) ON THE PCA, ORIENTED AS SHOWN.
2. ALL ELECTRONIC COMPONENTS HAVE BEEN OMITTED FOR CLARITY.
3. SOLDER ANTENNA AT CONTACT POINTS SHOWN.
4. BEND ALL TABS, 16X, AS SHOWN IN DETAIL A, UP VERTICALLY BEFORE ATTACHING SHIELD LIDS. AFTER ATTACHING LIDS, BEND ALL TABS BACK DOWN HORIZONTALLY.
5. SOLDER THE TABS TO THE LID AS SHOWN BY SHADED AREAS FOR BOTH THE TOP AND BOTTOM LIDS. (16X TOTAL)
6. SOLDER THE LID TO THE SHIELD FENCE AT ALL POINT AS SHOWN BY THE SHADED BOX (14X TOTAL) MAKE SURE THE LID AND SHIELD ARE COMPLETELY ATTACHED, ESPECIALLY AT THE CORNERS.
7. PAGE 2 OF THIS DOCUMENT IS A SEPARATE IMPACT BASED BILL OF MATERIALS.

REVISIONS

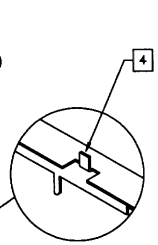
ZONE	REV.	DESCRIPTION	DATE	ECO NO.	APPROVED
N/A	A	PRODUCTION RELEASE	11/26/97	1027	G.WHITE
C/4	B	ADDED INTERNAL FENCE TO SHIELD	03/19/98	PENDING	G.WHITE
D/6	C	REMOVED BATTERY	04/20/98	1041	G.WHITE



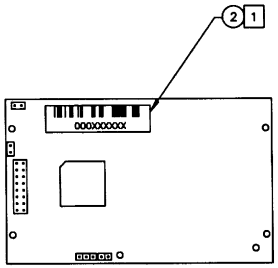
VIEW 1
ANTENNA ASSEMBLY



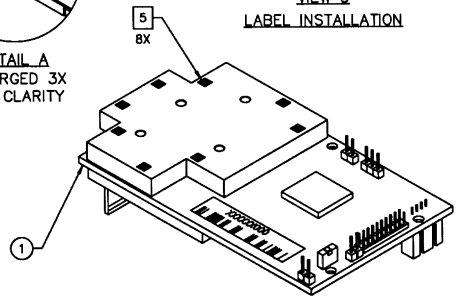
VIEW 2
SHIELD ASSEMBLY



DETAIL A
ENLARGED 3X
FOR CLARITY



VIEW 3
LABEL INSTALLATION



VIEW 4
COMPLETED ASSEMBLY

SEE SEPARATE BILL OF MATERIALS

DIABLO RESEARCH CO. LLC
CONFIDENTIAL

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
RADII .XX ± ANGLES ±
.XXX ±
DO NOT SCALE DRAWING

MATERIAL
FINISH

APPROVALS	DATE
DRAWN PD	10/24/97
CHECKED G.WHITE	4/10/98
ENGINEER	

DIABLO RESEARCH COMPANY LLC
685 STEWART DRIVE
SUNNYVALE, CALIFORNIA 94086
(408) 720-8888 FAX (408) 720-3370
9405 SEED PARKWOOD WAY
RICHMOND, B.C. CANADA
(604) 303-3600 FAX (604) 321-8888

ASSEMBLY, PCA 2ND OPS, LOW POWER GAS RMI V2, WHISPER

SIZE C | DWG. NO. 10566-0900 | REV. C

SCALE: N/A | ACAD FILE:10566-0900C.DWG | SHEET 1 OF 2

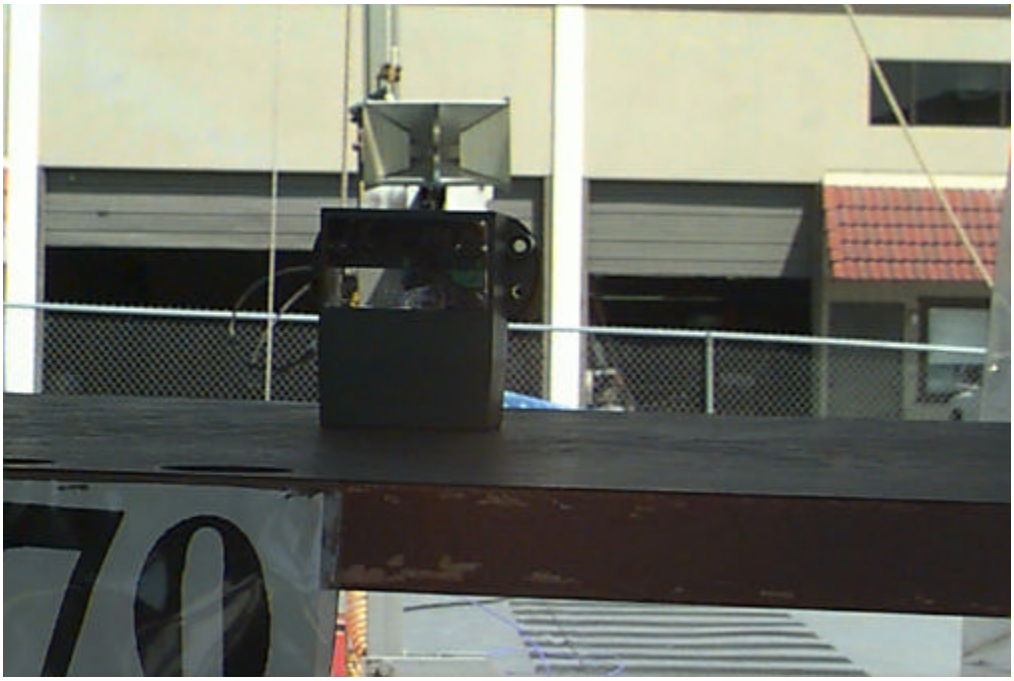
10566-0900C 04/24/98 08:52

APPENDIX E

SET-UP PHOTOS

FCC Part 15.209 Class B
Radiated Emissions

FCC Part 15.205
Restricted Band



FCC Part 15.247