

FCC Part 15 EMI TEST REPORT of

E.U.T. : Bluetooth Audio Gateway

MODEL : BAG-2000

FCC ID. : OAJBAG-2000

for

APPLICANT : J Communications Co., Ltd

ADDRESS : No.124-4,Ojeon-Dong, Uiwang-City, Kyungki-Do,
South Korea.

Test Performed by

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Report Number : ET91R-10-026-04

TEST REPORT CERTIFICATION

Applicant : J Communications Co., Ltd.
No.124-4,Ojeon-Dong, Uiwang-City, Kyungid-Do,
South Korea.

Manufacturer : J Communications Co., Ltd.
No.124-4,Ojeon-Dong, Uiwang-City, Kyungid-Do,
South Korea.

Description of EUT :
a) Type of EUT : Bluetooth Audio Gateway
b) Trade Name : Rhapsody AGM
c) Model No. : BAG-2000
d) Power Supply : DC 3.4V-5.0V by battery

Regulation Applied : FCC Rules and Regulations Part 15 Subpart B & C (1999)

I HEREBY CERTIFY THAT: The data shown in this report were made in accordance with the procedures given in ANSI C63.4, and the energy emitted by the device was founded to be within the limits applicable. I assume full responsibility for accuracy and completeness of these data.

Note: 1. The result of the testing report relates only to the item tested.
2. The testing report shall not be reproduced expect in full, without the written approval of ETC.

Issued Date : Dec. 06, 2002

Test Engineer : 
(Ion Lin)

Approve & Authorized Signer :



Will Yauo, Manager
EMC Dept. II of ELECTRONICS
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1 GENERAL INFORMATION

1.1 Product Description

- | | |
|-----------------|---------------------------|
| a) Type of EUT | : Bluetooth Audio Gateway |
| b) Trade Name | : Rhapsody AGM |
| c) Model No. | : BAG-2000 |
| d) Power Supply | : DC 3.4V-5.0V by battery |

1.2 Characteristics of Device

This Bluetooth Audio Gateway designed with a transmitting method of hopping spread spectrum technology. The base unit plugs into a standard analogue telephone jack and provides a digital wireless communication link with the handset using the 2400 to 2483.5 MHz ISM band.

1.3 Test Methodology

For Bluetooth Audio Gateway, both conducted and radiated emissions were performed according to the procedures illustrated in ANSI C63.4 (1992) and for processing gain measurement is according to FCC Public Notice. Other required measurements were illustrated in separate sections of this test report for details.

1.4 Test Facility

The open area test site and conducted measurement facility used to collect the radiated data is located on the roof top of Building at No.34, Lin 5, Ding Fu Tsun, Linkou Hsiang, Taipei Hsien, Taiwan, R.O.C.

This site has been fully described in a report submitted to your office, and accepted in a letter dated Feb. 10, 2000.

2 PROVISIONS APPLICABLE

2.1 Definition

Unintentional radiator:

A device that intentionally generates and radio frequency energy for use within the device, or that sends radio frequency signals by conduction to associated equipment via connecting wiring, but which is not intended to emit RF energy by radiation or induction.

Class A Digital Device:

A digital device which is marketed for use in commercial or business environment; exclusive of a device which is market for use by the general public, or which is intended to be used in the home.

Class B Digital Device :

A digital device which is marketed for use in a residential environment notwithstanding use in a commercial, business or industrial environment. Example of such devices that are marketed for the general public.

Note : A manufacturer may also qualify a device intended to be marketed in a commercial, business, or industrial environment as a Class B digital device, and in fact is encouraged to do so, provided the device complies with the technical specifications for a Class B Digital Device. In the event that a particular type of device has been found to repeatedly cause harmful interference to radio communications, the Commission may classify such a digital device as a Class B Digital Device, Regardless of its intended use.

Intentional radiator:

A device that intentionally generates and emits radio frequency energy by radiation or induction.

2.2 Requirement for Compliance

(1) Conducted Emission Requirement

For unintentional device, according to § 15.107(a) Line Conducted Emission Limits is as following:

| Frequency MHz | Emissions μ V | Emissions dB μ V |
|------------------|----------------------|-------------------------|
| 0.45 - 30.0 | 250 | 48.0 |

For intentional device, according to § 15.207(a) Line Conducted Emission Limits is same as above table.

(2) Radiated Emission Requirement

For unintentional device, according to § 15.109(a), except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values:

| Frequency MHz | Distance Meters | Radiated dB μ V/m | Radiated μ V/m |
|------------------|--------------------|--------------------------|-----------------------|
| 30 - 88 | 3 | 40.0 | 100 |
| 88 - 216 | 3 | 43.5 | 150 |
| 216 - 960 | 3 | 46.0 | 200 |
| above 960 | 3 | 54.0 | 500 |

For intentional device, according to § 15.209(a), the general requirement of field strength of radiated emissions from intentional radiators at a distance of 3 meters shall not exceed the above table.

(3) Antenna Requirement

For intentional device, according to § 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

(4) Hopping Channel Separation

According to 15.247(a)(1), frequency hopping system shall have , hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

(5) Number of Hopping frequencies used

According to 15.247(a)(1)(ii), for frequency hopping system operating in the 2400-2483.5 MHz and 5725-5850 MHz bands shall use at least 75 hopping frequencies.

(6) Hopping Channel Bandwidth

According to 15.247(a)(1)(ii), for frequency hopping system operating in the 2400-2483.5 MHz and 5725-5850 MHz bands, the maximum 20 dB bandwidth of the hopping channel is 1MHz.

(7) Dwell Time of each frequency within a 30-second period

According to 15.247(a)(1)(ii), for frequency hopping system operating in the 2400-2483.5 MHz and 5725-5850 MHz bands, the average time of occupancy on any frequency shall not be greater than 0.4 second within a 30-second period.

(8) Output Power Requirement

For direct sequence system, according to 15.247(b), the maximum peak output power of the transmitter shall not exceed 1 Watt. If transmitting antennas of directional gain greater than 6 dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

(9) 100 kHz Bandwidth of Frequency Band Edges Requirement

According to 15.247(c), if any 100 kHz bandwidth outside these frequency bands, the radio frequency power that is produced by the modulation products of the spreading sequence, the information sequence and the carrier frequency shall be either at least 20 dB below that in any 100 kHz bandwidth within the band that contains the highest level of the desired power or shall not exceed the general levels specified in § 15.209(a), whichever results in the lesser attenuation.

2.3 Restricted Bands of Operation

Only spurious emissions are permitted in any of the frequency bands listed below :

| MHz | MHz | MHz | GHz |
|-------------------|-----------------------|---------------|-------------|
| 0.090 - 0.110 | 16.42-16.423 | 399.9-410 | 4.5-5.25 |
| 0.495 - 0.505 ** | 16.69475 - 16.69525 | 608-614 | 5.35-5.46 |
| 2.1735 - 2.1905 | 16.80425 - 16.80475 | 960-1240 | 7.25-7.75 |
| 4.125-4.128 | 25.5-25.67 | 1300-1427 | 8.025-8.5 |
| 4.17725-4.17775 | 37.5-38.25 | 1435-1626.5 | 9.0-9.2 |
| 4.20725-4.20775 | 73-74.6 | 1645.5-1646.5 | 9.3-9.5 |
| 6.215-6.218 | 74.8-75.2 | 1660-1710 | 10.6-12.7 |
| 6.26775-6.26825 | 108-121.94 | 1718.8-1722.2 | 13.25-13.4 |
| 6.31175-6.31225 | 123-138 | 2200-2300 | 14.47-14.5 |
| 8.291-8.294 | 149.9-150.05 | 2310-2390 | 15.35-16.2 |
| 8.362-8.366 | 156.52475 - 156.52525 | 2483.5-2500 | 17.7-21.4 |
| 8.37625-8.38675 | 156.7-156.9 | 2655-2900 | 22.01-23.12 |
| 8.41425-8.41475 | 162.0125-167.17 | 3260-3267 | 23.6-24.0 |
| 12.29-12.293 | 167.72-173.2 | 3332-3339 | 31.2-31.8 |
| 12.51975-12.52025 | 240-285 | 3345.8-3358 | 36.43-36.5 |
| 12.57675-12.57725 | 322-335.4 | 3360-4400 | Above 38.6 |
| 13.36-13.41 | | | |

** : Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz

2.4 Labeling Requirement

The device shall bear the following statement in a conspicuous location on the device :

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions : (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

2.5 User Information

The users manual or instruction manual for an intentional or unintentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

For a Class B digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual.

The Federal Communications Commission Radio Frequency Interference Statement includes the following paragraph.

This equipment has been tested and found to comply with the limits for a Class B Digital Device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation.

This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction may cause harmful interference to radio communication. However, there is no guarantee that interference will not occur in a particular installation.

If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio / TV technician for help.

3. SYSTEM TEST CONFIGURATION

3.1 Justification

For both radiated and conducted emissions below 1 GHz, the system was configured for testing in a typical fashion as a customer would normally use it. The peripherals other than EUT were connected in normally standing by situation. Measurement was performed under the condition that a computer program was exercised to simulate data communication of EUT, and the transmission rate was set to maximum allowed by EUT. Three highest emissions were verified with varying placement of the transmitting antenna connected to EUT to maximize the emission from EUT.

For conducted emissions, only measured on TX and RX operation, for the digital circuits portion also function normally whenever TX or RX is operated. For radiated emissions, whichever RF channel is operated, the digital circuits' function identically. As the reason, measurement of radiated emissions from digital circuits is only performed with channel 11 by transmitting mode.

3.2 Devices for Tested System

| Device | Manufacture | Model / FCC ID. | Cable Description |
|--------------------------|----------------------------|-------------------------|-------------------|
| Bluetooth Audio Gateway* | J Communications Co., Ltd. | BAG-2000 OAJBAG-2000 | ---- |

Remark “*” means equipment under test.

4 RADIATED EMISSION MEASUREMENT

4.1 Applicable Standard

For unintentional radiator, the radiated emission shall comply with § 15.109(a).

For intentional radiators, according to § 15.247 (a), operation under this provision is limited to frequency hopping and direct sequence spread spectrum, and the out band emission shall be comply with § 15.247 (c)

4.2 Measurement Procedure

1. Setup the configuration per figure 5 and 6 for frequencies measured below and above 1 GHz respectively.
2. For emission frequencies measured below 1 GHz, a pre-scan is performed in a shielded chamber to determine the accurate frequencies of higher emissions will be checked on a open test site. As the same purpose, for emission frequencies measured above 1 GHz, a pre-scan also be performed with a 1 meter measuring distance before final test.
3. For emission frequencies measured below and above 1 GHz, set the spectrum analyzer on a 100 kHz and 1 MHz resolution bandwidth respectively for each frequency measured in step 2.
4. The search antenna is to be raised and lowered over a range from 1 to 4 meters in horizontally polarized orientation. Position the highness when the highest value is indicated on spectrum analyzer, then change the orientation of EUT on test table over a range from 0° to 360° with a speed as slow as possible, and keep the azimuth that highest emission is indicated on the spectrum analyzer. Vary the antenna position again and record the highest value as a final reading. A RF test receiver is also used to confirm emissions measured.

Note : A high pass filter was used to avoid pre-amplifier saturated when measure TX operation mode in frequency band above 1 GHz.

5. Repeat step 4 until all frequencies need to be measured were complete.
6. Repeat step 5 with search antenna in vertical polarized orientations.
7. Check the three frequencies of highest emission with varying the placement of cables associated with EUT to obtain the worse case and record the result.

Figure 1 : Frequencies measured below 1 GHz configuration

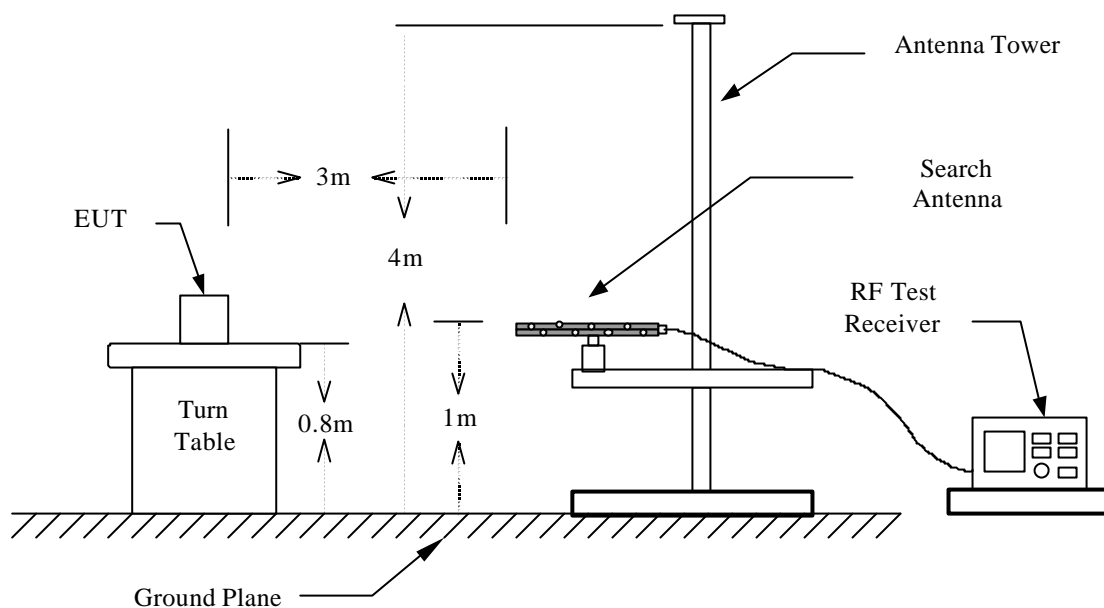
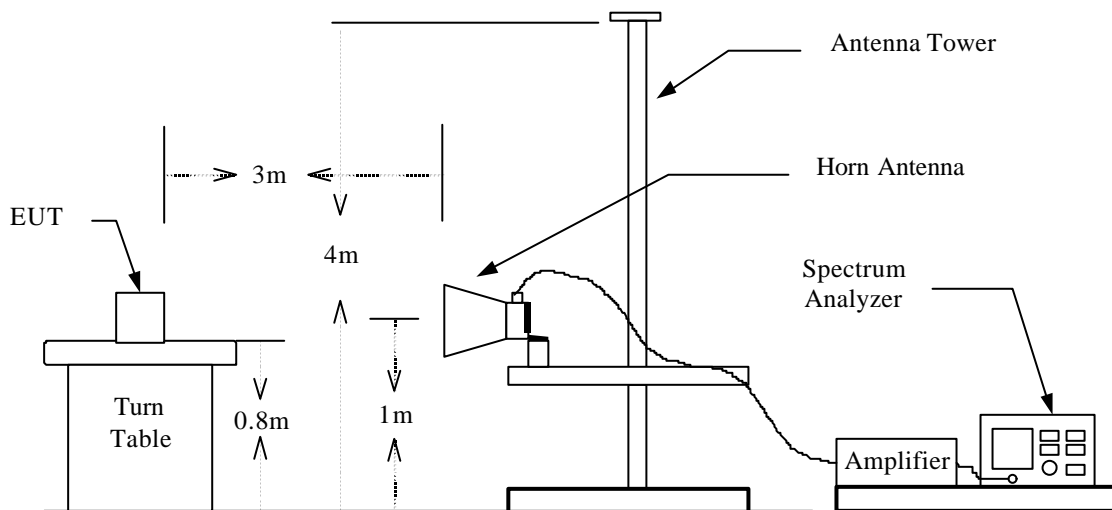


Figure 2 : Frequencies measured above 1 GHz configuration



4.3 Measuring Instrument

The following instrument are used for radiated emissions measurement:

| Equipment | Manufacturer | Model No. | Next Cal. Due |
|----------------------|-----------------|-----------|---------------|
| Spectrum Analyzer | Hewlett-Packard | 8568B | 01/10/2003 |
| Pre-selector | Hewlett-Packard | 85685A | 01/10/2003 |
| Quasi Peak Detector | Hewlett-Packard | 85650A | 01/10/2003 |
| RF Test Receiver | Rohde & Schwarz | ESVS 30 | 08/06/2003 |
| RF Test Receiver | Rohde & Schwarz | ESBI | 05/26/2003 |
| Horn Antenna | EMCO | 3115 | 08/08/2003 |
| Log periodic Antenna | EMCO | 3146 | 11/04/2002 |
| Biconical Antenna | EMCO | 3110B | 11/04/2003 |
| Preamplifier | Hewlett-Packard | 8449B | 05/29/2003 |
| Preamplifier | Hewlett-Packard | 8447D | 04/03/2003 |
| Spectrum Analyzer | Hewlett-Packard | 8564E | 04/14/2003 |

Measuring instrument setup in measured frequency band when specified detector function is used :

| Frequency Band (MHz) | Instrument | Function | Resolution bandwidth | Video Bandwidth |
|----------------------|-------------------|------------|----------------------|-----------------|
| 30 to 1000 | RF Test Receiver | Quasi-Peak | 120 kHz | N/A |
| | Spectrum Analyzer | Peak | 100 kHz | 100 kHz |
| Above 1000 | Spectrum Analyzer | Peak | 1 MHz | 1 MHz |
| | Spectrum Analyzer | Average | 1 MHz | 300 Hz |

4.4 Radiated Emission Data

4.4.1 RF Portion

a) Operation Mode : Receiving / Transmitting

Fundamental Frequency : 2401.930 MHz (Local Frequency : 2400.558 MHz)

Test Date : Oct. 11, 2002

Temperature : 23

Humidity : 62 %

| Frequency (MHz) | Reading (dBuV) | | | | Factor (dB) Corr. | Result @3m (dBuV/m) | | Limit @3m (dBuV/m) | | Margin (dB) | Table Deg. (Deg.) | Ant. High (m) |
|--------------------|----------------|----------|-----------|----------|-------------------------|------------------------|------|-----------------------|------|----------------|-------------------------|---------------------|
| | H Peak | V Ave | H Peak | V Ave | | Peak | Ave | Peak | Ave. | | | |
| *2400.558 | --- | --- | --- | --- | -3.1 | --- | --- | 74.0 | 54.0 | --- | --- | --- |
| *4801.116 | --- | --- | --- | --- | 2.5 | --- | --- | 74.0 | 54.0 | --- | --- | --- |
| *7201.674 | --- | --- | --- | --- | 5.7 | --- | --- | 74.0 | 54.0 | --- | --- | --- |
| *9602.232 | --- | --- | --- | --- | 7.2 | --- | --- | 74.0 | 54.0 | --- | --- | --- |
| *12002.790 | --- | --- | --- | --- | 9.2 | --- | --- | 74.0 | 54.0 | --- | --- | --- |
| 4803.860 | 52.2 | 49.5 | 50.9 | 45.5 | 2.5 | 54.7 | 52.0 | 74.0 | 54.0 | -2.0 | 170 | 1.4 |
| 7205.790 | --- | --- | --- | --- | 5.7 | --- | --- | 74.0 | 54.0 | --- | --- | --- |
| 9607.720 | --- | --- | --- | --- | 7.2 | --- | --- | 74.0 | 54.0 | --- | --- | --- |
| 12009.650 | --- | --- | --- | --- | 9.2 | --- | --- | 74.0 | 54.0 | --- | --- | --- |
| 14411.580 | --- | --- | --- | --- | 11.5 | --- | --- | 74.0 | 54.0 | --- | --- | --- |
| 16813.510 | --- | --- | --- | --- | 11.8 | --- | --- | 74.0 | 54.0 | --- | --- | --- |
| 19215.440 | --- | --- | --- | --- | 8.9 | --- | --- | 74.0 | 54.0 | --- | --- | --- |
| 21617.370 | --- | --- | --- | --- | 9.7 | --- | --- | 74.0 | 54.0 | --- | --- | --- |
| 24019.300 | --- | --- | --- | --- | 10.3 | --- | --- | 74.0 | 54.0 | --- | --- | --- |

Note :

1. Remark “*” means that the emission frequency is produced from local oscillator.
2. Remark “---” means that the emission level is too low to be measured (a pre-amplifier of about 35 dB is used).
3. Margins are derived from Peak or Average whichever is lower. If there is only peak value in Result field, the Margin is also referred to average limits.
4. The expanded uncertainty of the radiated emission tests is 3.53 dB.

b) Operation Mode : Receiving /Transmitting

Fundamental Frequency : 2441.000 MHz (Local Frequency : 2439.500 MHz)

Test Date : Oct. 11, 2002

Temperature : 23

Humidity : 62 %

| Frequency (MHz) | Reading (dBuV) | | | | Factor (dB) Corr. | Result @3m (dBuV/m) | | Limit @3m (dBuV/m) | | Margin (dB) | Table Deg. (Deg.) | Ant. High (m) |
|--------------------|----------------|-----|-----------|-----|-------------------------|------------------------|-----|-----------------------|------|----------------|-------------------------|---------------------|
| | H Peak | Ave | V Peak | Ave | | Peak | Ave | Peak | Ave. | | | |
| *2439.500 | --- | --- | --- | --- | -2.9 | --- | --- | 74.0 | 54.0 | --- | --- | --- |
| *4879.000 | --- | --- | --- | --- | 2.7 | --- | --- | 74.0 | 54.0 | --- | --- | --- |
| *7318.500 | --- | --- | --- | --- | 5.9 | --- | --- | 74.0 | 54.0 | --- | --- | --- |
| *9758.000 | --- | --- | --- | --- | 7.3 | --- | --- | 74.0 | 54.0 | --- | --- | --- |
| *12197.500 | --- | --- | --- | --- | 9.3 | --- | --- | 74.0 | 54.0 | --- | --- | --- |
| 4882.000 | --- | --- | --- | --- | 2.7 | --- | --- | 74.0 | 54.0 | --- | --- | --- |
| 7323.000 | --- | --- | --- | --- | 5.9 | --- | --- | 74.0 | 54.0 | --- | --- | --- |
| 9764.000 | --- | --- | --- | --- | 7.3 | --- | --- | 74.0 | 54.0 | --- | --- | --- |
| 12205.000 | --- | --- | --- | --- | 9.3 | --- | --- | 74.0 | 54.0 | --- | --- | --- |
| 14646.000 | --- | --- | --- | --- | 11.6 | --- | --- | 74.0 | 54.0 | --- | --- | --- |
| 17087.000 | --- | --- | --- | --- | 13.3 | --- | --- | 74.0 | 54.0 | --- | --- | --- |
| 19528.000 | --- | --- | --- | --- | 8.5 | --- | --- | 74.0 | 54.0 | --- | --- | --- |
| 21969.000 | --- | --- | --- | --- | 9.9 | --- | --- | 74.0 | 54.0 | --- | --- | --- |
| 24410.000 | --- | --- | --- | --- | 10.7 | --- | --- | 74.0 | 54.0 | --- | --- | --- |

Note :

1. Remark “*” means that the emission frequency is produced from local oscillator.
2. Remark “---” means that the emission level is too low to be measured (a pre-amplifier of about 35 dB is used).
3. Margins are derived from Peak or Average whichever is lower. If there is only peak value in Result field, the Margin is also referred to average limits.
4. The expanded uncertainty of the radiated emission tests is 3.53 dB.

c)Operation Mode : Receiving /Transmitting

Fundamental Frequency : 2480.000 MHz (Local Frequency : 2478.475 MHz)

Test Date : Oct. 11, 2001

Temperature : 23

Humidity : 62 %

| Frequency (MHz) | Reading (dBuV) | | | | Factor (dB) Corr. | Result @3m (dBuV/m) | | Limit @3m (dBuV/m) | | Margin (dB) | Table Deg. (Deg.) | Ant. High (m) |
|--------------------|----------------|----------|-----------|----------|-------------------------|------------------------|------|-----------------------|------|----------------|-------------------------|---------------------|
| | H Peak | V Ave | H Peak | V Ave | | Peak | Ave | Peak | Ave. | | | |
| *2478.475 | --- | --- | --- | --- | -2.8 | --- | --- | 74.0 | 54.0 | --- | --- | --- |
| *4956.950 | --- | --- | --- | --- | 2.8 | --- | --- | 74.0 | 54.0 | --- | --- | --- |
| *7435.425 | --- | --- | --- | --- | 6.1 | --- | --- | 74.0 | 54.0 | --- | --- | --- |
| *9913.900 | --- | --- | --- | --- | 7.4 | --- | --- | 74.0 | 54.0 | --- | --- | --- |
| *12392.375 | --- | --- | --- | --- | 9.4 | --- | --- | 74.0 | 54.0 | --- | --- | --- |
| 4960.000 | 49.3 | 44.2 | 51.0 | 47.6 | 2.8 | 53.8 | 50.4 | 74.0 | 54.0 | -3.6 | 105 | 180 |
| 7440.000 | --- | --- | --- | --- | 6.1 | --- | --- | 74.0 | 54.0 | --- | --- | --- |
| 9920.000 | --- | --- | --- | --- | 7.4 | --- | --- | 74.0 | 54.0 | --- | --- | --- |
| 12400.000 | --- | --- | --- | --- | 9.4 | --- | --- | 74.0 | 54.0 | --- | --- | --- |
| 14880.000 | --- | --- | --- | --- | 11.5 | --- | --- | 74.0 | 54.0 | --- | --- | --- |
| 17360.000 | --- | --- | --- | --- | 15.2 | --- | --- | 74.0 | 54.0 | --- | --- | --- |
| 19840.000 | --- | --- | --- | --- | 8.6 | --- | --- | 74.0 | 54.0 | --- | --- | --- |
| 22320.000 | --- | --- | --- | --- | 10.2 | --- | --- | 74.0 | 54.0 | --- | --- | --- |
| 24800.000 | --- | --- | --- | --- | 11.0 | --- | --- | 74.0 | 54.0 | --- | --- | --- |

Note :

1. Remark “*” means that the emission frequency is produced from local oscillator.
2. Remark “---” means that the emission level is too low to be measured (a pre-amplifier of about 35 dB is used).
3. Margins are derived from Peak or Average whichever is lower. If there is only peak value in Result field, the Margin is also referred to average limits.
4. The expanded uncertainty of the radiated emission tests is 3.53 dB.

4.4.2 Other Emissions

Operation Mode : Receiving /Transmitting

Test Date : Oct. 11, 2002

Temperature : 23

Humidity : 62 %

| Frequency (MHz) | Ant-Pol H/V | Meter Reading (dBuV) | Corrected Factor (dB) | Result @3m (dBuV/m) | Limit @3m (dBuV/m) | Margin (dB) | Table Degree (Deg.) | Ant. High (m) |
|--------------------|----------------|----------------------------|-----------------------------|---------------------------|--------------------------|----------------|---------------------------|------------------|
| 30.0000 | --- | --- | -9.8 | --- | 40.0 | --- | --- | --- |
| 50.0000 | --- | --- | -14.1 | --- | 40.0 | --- | --- | --- |
| 80.0000 | --- | --- | -15.0 | --- | 40.0 | --- | --- | --- |
| 150.0000 | --- | --- | -10.0 | --- | 43.5 | --- | --- | --- |
| 319.9579 | H | 36.8 | -6.8 | 30.0 | 46.0 | -16.0 | 0 | 2 |
| 500.0000 | --- | --- | -4.4 | --- | 46.0 | --- | --- | --- |
| 800.0000 | --- | --- | 0.7 | --- | 46.0 | --- | --- | --- |

Note :

1. Remark “---” means that the emissions level is too low to be measured.
2. The expanded uncertainty of the radiated emission tests is 3.53 dB.

c) Emission frequencies above 1 GHz

Radiated emission frequencies above 1 GHz to 5 GHz were too low to be measured with a pre-amplifier of 35 dB.

4.5 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor, High Pass Filter Loss (if used) and Cable Loss, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation calculation is as follows:

$$\text{Result} = \text{Reading} + \text{Corrected Factor}$$

where

$$\text{Corrected Factor} = \text{Antenna FACTOR} + \text{Cable Loss} + \text{High Pass Filter Loss} - \text{Amplifier Gain}$$

5 CONDUCTED EMISSION MEASUREMENT

5.1 Description

This EUT is excused from investigation of conducted emission, for it is powered by DC Battery only. According to § 15.207 (d), measurements to demonstrate compliance with the conducted limits are not required for devices which only employ battery power for operation and which do not operate from the AC power lines or contain provisions for operation while connected to the AC power lines.

6 ANTENNA REQUIREMENT

6.1 Standard Applicable

For intentional device, according to § 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. And according to § 15.247 (b), if transmitting antennas of directional gain greater than 6 dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

6.2 Antenna Connected Construction

The antenna terminal of this unit is designed to be mounted permanently on the device. Please see construction Photos Of Exhibit B for details.

7 HOPPING CHANNEL SEPARATION

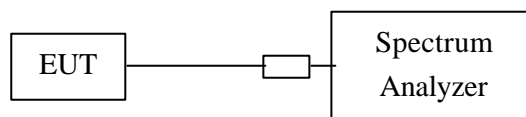
7.1 Standard Applicable

According to 15.247(a)(1), frequency hopping system shall have, hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

7.2 Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT as shown in figure 4 without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range.
3. By using the MaxHold function record the separation of two adjacent channels.
4. Measure the frequency difference of these two adjacent channels by SA MARK function. And then plot the result on SA screen.
5. Repeat above procedures until all frequencies measured were complete.

Figure 4 : Emission bandwidth measurement configuration.



7.3 Measurement Equipment

| Equipment | Manufacturer | Model No. | Next Cal. Due |
|-------------------|-----------------|-----------|---------------|
| Spectrum Analyzer | Hewlett-Packard | 8564E | 04/14/2003 |
| Plotter | Hewlett-Packard | 7440A | N/A |

7.4 Measurement Data

Test Date : Sep. 07, 2001 Temperature : 25 Humidity: 60 %

- 1) 2402MHz : Adjacent Hopping Channel Separation is 997 kHz
- 2) 2441MHz : Adjacent Hopping Channel Separation is 997 kHz
- 3) 2480MHz : Adjacent Hopping Channel Separation is 997 kHz

Note : 1. Please see appendix 1 for Plotted Data

2. The expanded uncertainty of the hopping channel separation tests is 2dB.

8 NUMBER OF HOPPING FREQUENCY USED

8.1 Standard Applicable

According to 15.247(a)(1)(ii), for frequency hopping system operating in the 2400-2483.5 MHz and 5725-5850 MHz bands shall use at least 75 hopping frequencies.

8.2 Measurement Procedure

1. Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.
2. Position the EUT as shown in figure 4 without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range and make sure the instrument is operated in its linear range.
3. Set the SA on MaxHold Mode, and then keep the EUT in hopping mode. Record all the signals from each channel until each one has been recorded.
4. Set the SA on View mode and then plot the result on SA screen.
5. Repeat above procedures until all frequencies measured were complete.

8.3 Measurement Equipment

| Equipment | Manufacturer | Model No. | Next Cal. Due |
|-------------------|-----------------------|-----------|---------------|
| Spectrum Analyzer | Hewlett-Packard | 8564E | 04/14/2003 |
| Attenuator | Weinschel Engineering | 1 | N/A |

8.4 Measurement Data

Test Date : Sep. 07, 2001 Temperature : 25 Humidity: 60 %

There are 79 hopping frequencies in a hopping sequence.

Note : 1. Please see appendix 2 for Plotted Data

2. The expanded uncertainty of number of hopping frequency used tests is 2dB.

9 CHANNEL BANDWIDTH

9.1 Standard Applicable

According to 15.247(a)(1)(ii), for frequency hopping system operating in the 2400-2483.5 MHz and 5725-5850 MHz bands, the maximum 20dB bandwidth of the hopping channel is 1MHz.

9.2 Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT as shown in figure 4 without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
3. Measure the frequency difference of two frequencies that were attenuated 20 dB from the reference level. Record the frequency difference as the emission bandwidth.
4. Repeat above procedures until all frequencies measured were complete.

9.3 Measurement Equipment

| Equipment | Manufacturer | Model No. | Next Cal. Due |
|-------------------|-----------------------|-----------|---------------|
| Spectrum Analyzer | Hewlett-Packard | 8564E | 04/14/2003 |
| Attenuator | Weinschel Engineering | 1 | N/A |

9.4 Measurement Data

Test Date : Sep. 07, 2001 Temperature : 25 Humidity: 60 %

- 1) 2402MHz : Channel Bandwidth is 892 kHz
- 2) 2441MHz : Channel Bandwidth is 892 kHz
- 3) 2480MHz : Channel Bandwidth is 892 kHz

Note : 1. Please see appendix 3 for Plotted Data

2. The expanded uncertainty of channel bandwidth tests is 2dB.

10 DWELL TIME ON EACH CHANNEL

10.1 Standard Applicable

According to 15.247(a)(1)(ii), for frequency hopping system operating in the 2400-2483.5 MHz and 5725-5850 MHz bands, the average time of occupancy on any frequency shall not be greater than 0.4 second within a 30-second period.

10.2 Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT as shown in figure 4 without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range and make sure the instrument is operated in its linear range.
3. Adjust the center frequency of SA on any frequency be measured and set SA to zero span mode. And then, set RBW and VBW of spectrum analyzer to proper value.
4. Measure the time duration of one transmission on the measured frequency. And then plot the result with time difference of this time duration.
5. Repeat above procedures until all frequencies measured were complete.

10.3 Measurement Equipment

| Equipment | Manufacturer | Model No. | Next Cal. Due |
|-------------------|-----------------------|-----------|---------------|
| Spectrum Analyzer | Hewlett-Packard | 8564E | 04/14/2003 |
| Attenuator | Weinschel Engineering | 1 | N/A |

10.4 Measurement Data

Test Date : Sep. 07, 2001 Temperature : 25 Humidity: 60 %

- 1) 2402MHz : the dwell time is $0.667 \times 309 = 206$ ms
- 2) 2441MHz : the dwell time is $0.667 \times 309 = 206$ ms
- 3) 2480MHz : the dwell time is $0.667 \times 309 = 206$ ms

The maximum time of occupancy for a particular channel is 200 msec in any 30 second period, which is less than the 400 msec allowed by the rules; therefore, it meets the requirements of this section.

Note : 1. Please see appendix 4 for Plotted Data

2. The expanded uncertainty of dwell time on each channel tests is 2dB.

11 OUTPUT POWER MEASUREMENT

11.1 Standard Applicable

For direct sequence system, according to 15.247(b), the maximum peak output power of the transmitter shall not exceed 1 Watt. If transmitting antennas of directional gain greater than 6 dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

11.2 Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT as shown in figure 4 without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range and make sure the instrument is operated in its linear range.
3. Set RBW of spectrum analyzer to 1 MHz and VBW to 1 MHz.
4. Measure the highest amplitude appearing on spectral display and record the level to calculate result data.
5. Repeat above procedures until all frequencies measured were complete.

11.3 Measurement Equipment

| Equipment | Manufacturer | Model No. | Next Cal. Due |
|-------------------|-----------------------|-----------|---------------|
| Spectrum Analyzer | Hewlett-Packard | 8564E | 04/14/2003 |
| Attenuator | Weinschel Engineering | 1 | N/A |

11.4 Measurement Data

Test Date : Sep. 07, 2001 Temperature : 25 Humidity: 60 %

- 1) 2402MHz : Output Peak Power is 2.67 dBm = **1.85** mW
- 2) 2441MHz : Output Peak Power is 3.67 dBm = **2.33** mW
- 3) 2480MHz : Output Peak Power is 2.00 dBm = **1.58** mW

Note : 1. Please see appendix 5 for Plotted Data

2. The expanded uncertainty of output power measurement tests is 2dB.

12 100 kHz BANDWIDTH OF BAND EDGES MEASUREMENT

12.1 Standard Applicable

According to 15.247(c), if any 100 kHz bandwidth outside these frequency bands, the radio frequency power that is produced by the modulation products of the spreading sequence, the information sequence and the carrier frequency shall be either at least 20 dB below that in any 100 kHz bandwidth within the band that contains the highest level of the desired power or shall not exceed the general levels specified in § 15.209(a), whichever results in the lesser attenuation.

12.2 Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT as shown in figure 4 without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range and make sure the instrument is operated in its linear range.
3. Set both RBW and VBW of spectrum analyzer to 300 kHz with a convenient frequency span including 100kHz bandwidth from band edge.
4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete.

12.3 Measurement Equipment

| Equipment | Manufacturer | Model No. | Next Cal. Due |
|-------------------|-----------------|-----------|---------------|
| Spectrum Analyzer | Hewlett-Packard | 8564E | 04/14/2003 |
| Plotter | Hewlett-Packard | 7440A | N/A |

12.4 Measurement Data

Test Date : Sep. 07, 2001 Temperature : 25 Humidity: 60 %

- a) Lower Band Edge : All emissions in this 100kHz bandwidth are attenuated more than 50dB from the carrier.
- b) Upper Band Edge : All emissions in this 100kHz bandwidth are attenuated more than 50dB from the carrier.

Note : 1. Please see appendix 6 for Plotted Data

2. The expanded uncertainty of the 100 khz bandwidth of band edges tests is 1000Hz.

Appendix 1 : Plotted Data for Separation of Adjacent Channel

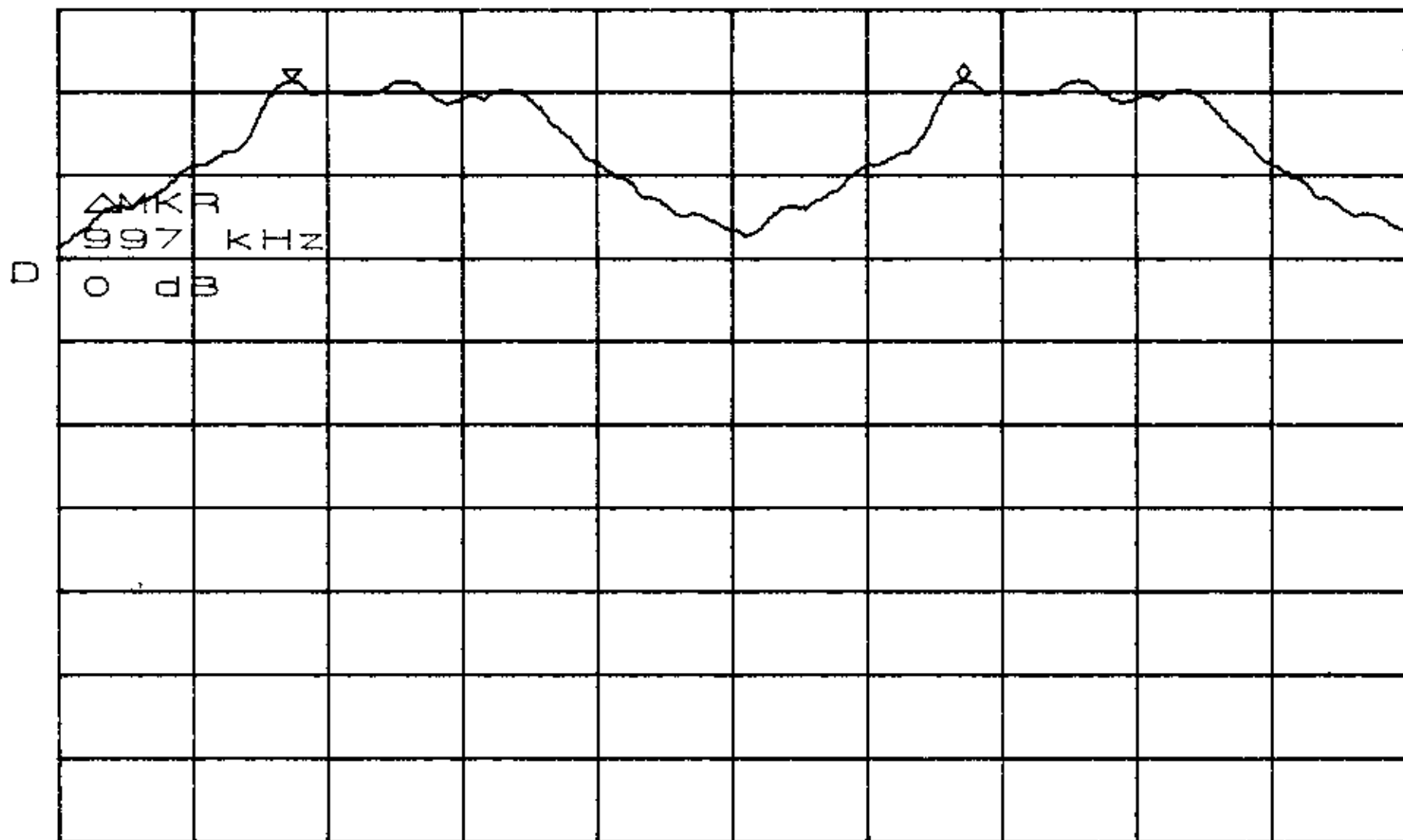
ATTEN 10dB

Δ MKR 0dB

RL 0dBm

10dB/

997kHz



CENTER 2.402500GHz

SPAN 2.000MHz

*RBW 100kHz

*VBW 1.0MHz

*SWP 100ms

ATTEN 10dB

$\Delta MKR - .16dB$

RL 11.0dBm

10dB/

997kHz

D

U

CENTER 2.441500GHz

SPAN 2.000MHz

*RBW 100kHz

*VBW 100kHz

*SWP 100ms

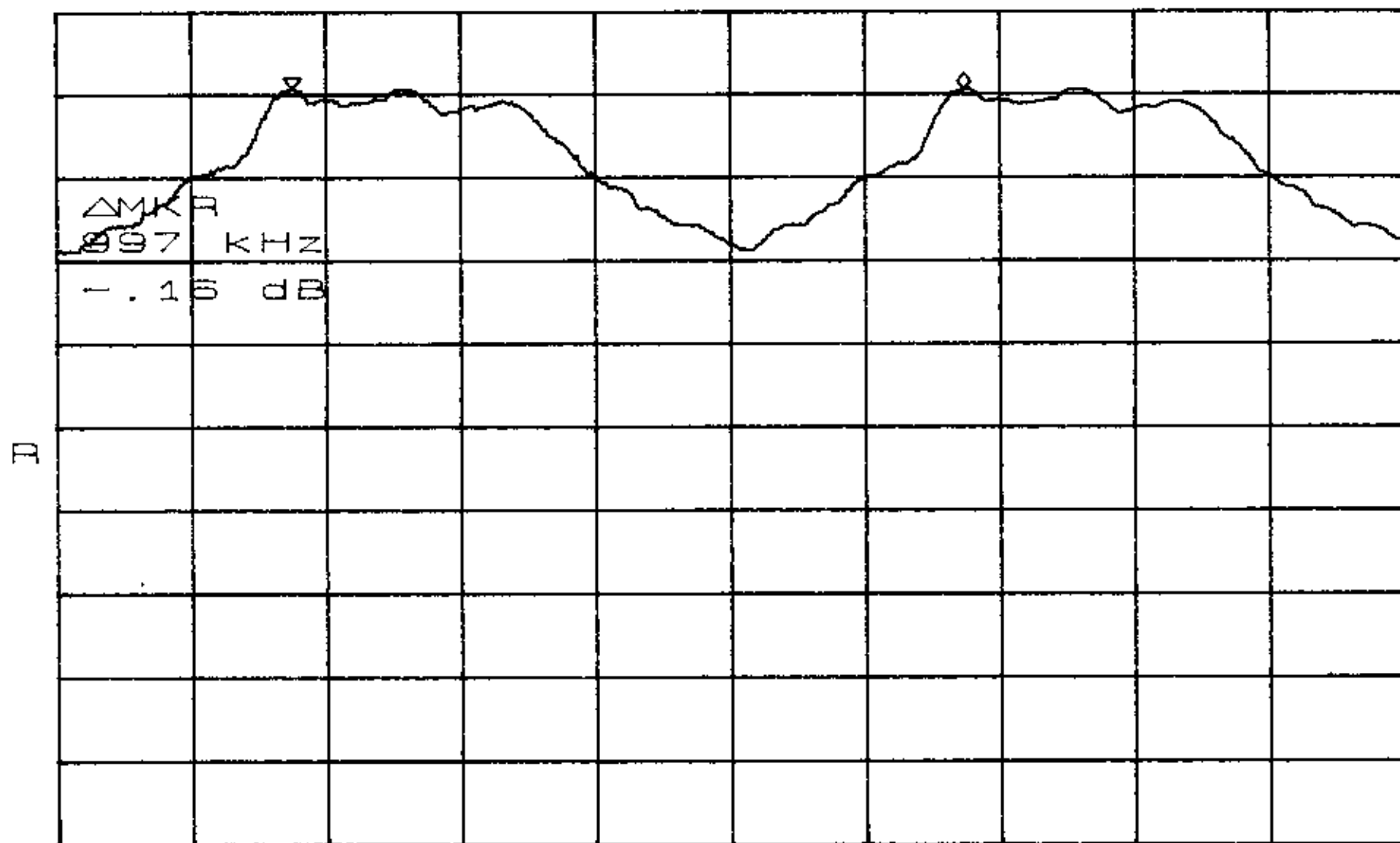
ATTEN 10dB

$\Delta MKR - .16dB$

RL 11.0dBm

10dB/

997KHz



CENTER 2.479500GHz

SPAN 2.000MHz

*RBW 100KHz

*VBW 100KHz

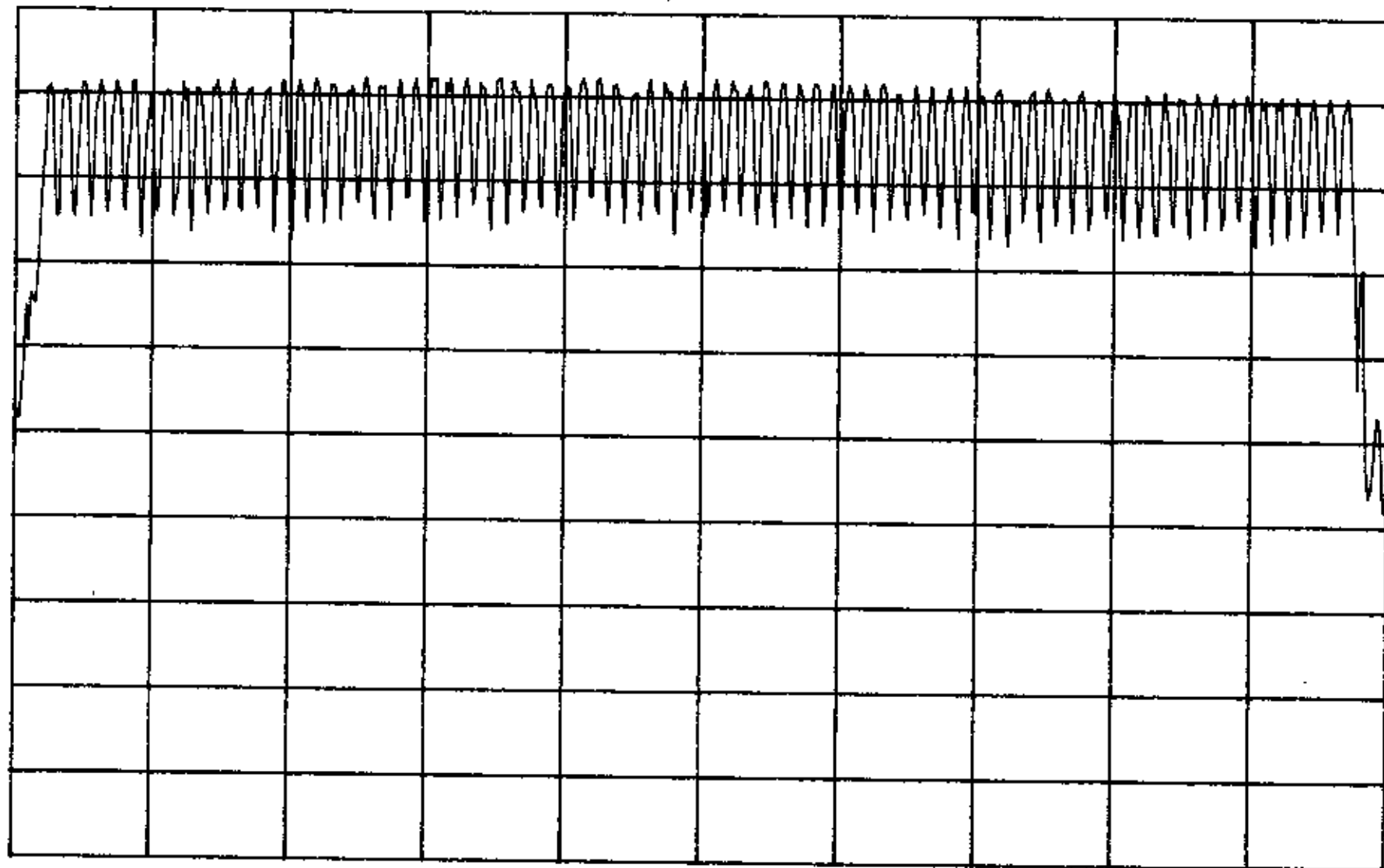
*SWP 100ms

Appendix 2 : Plotted Data for Total Used Hopping Frequencies

ATTEN 10dB

RL 0dBm

10dB/



START 2.40000GHz

STOP 2.48350GHz

*RBW 100KHz

*VBW 1.0MHz

SWP 50.0ms

Appendix 3 : Plotted Data for Channel Bandwidth

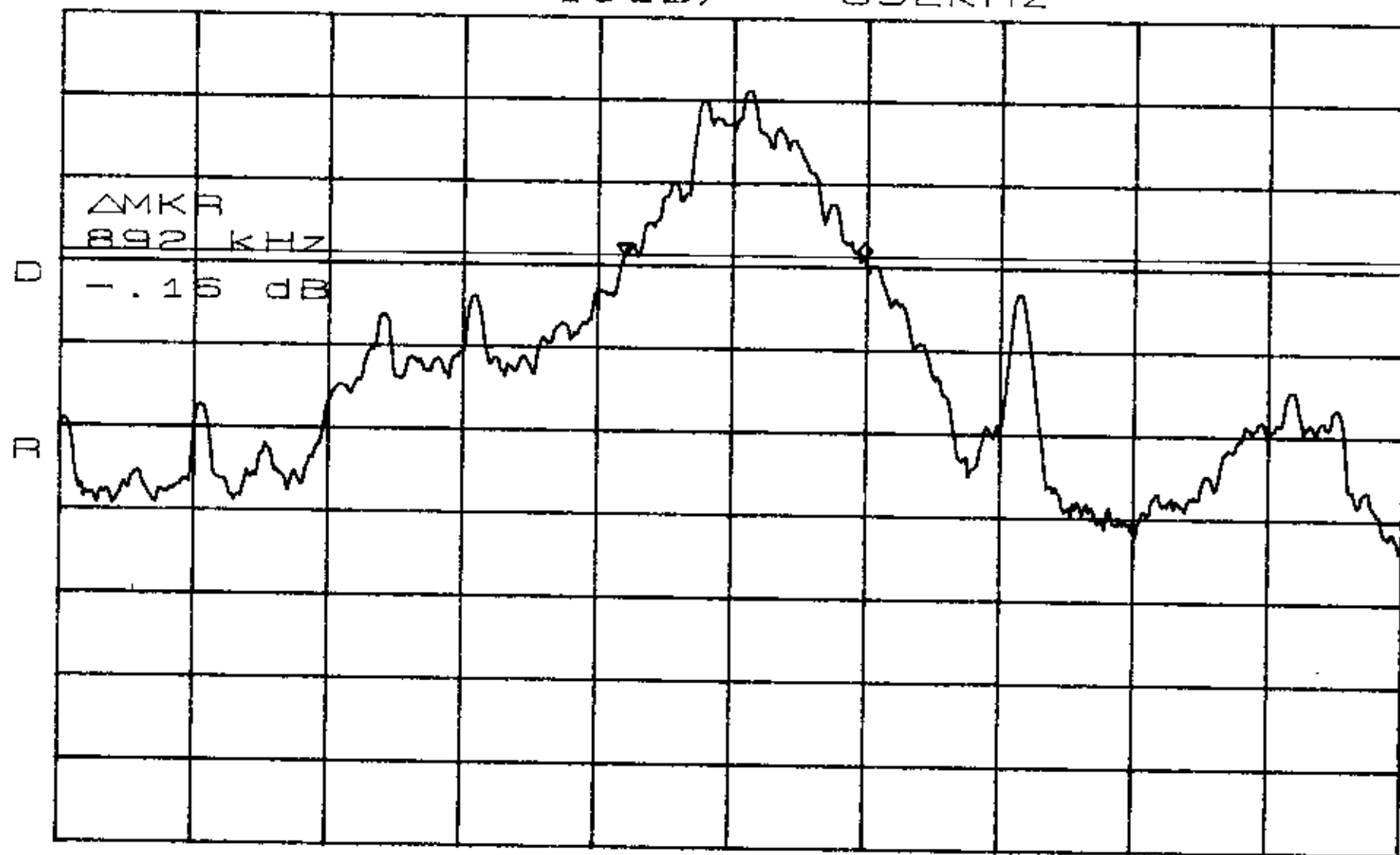
ATTEN 10dB

RL 11.0dBm

10dB/

$\Delta MKR - .16dB$

892KHz



CENTER 2.402000GHz

SPAN 5.000MHz

*RBW 30KHz

*VBW 100KHz

*SWP 100ms

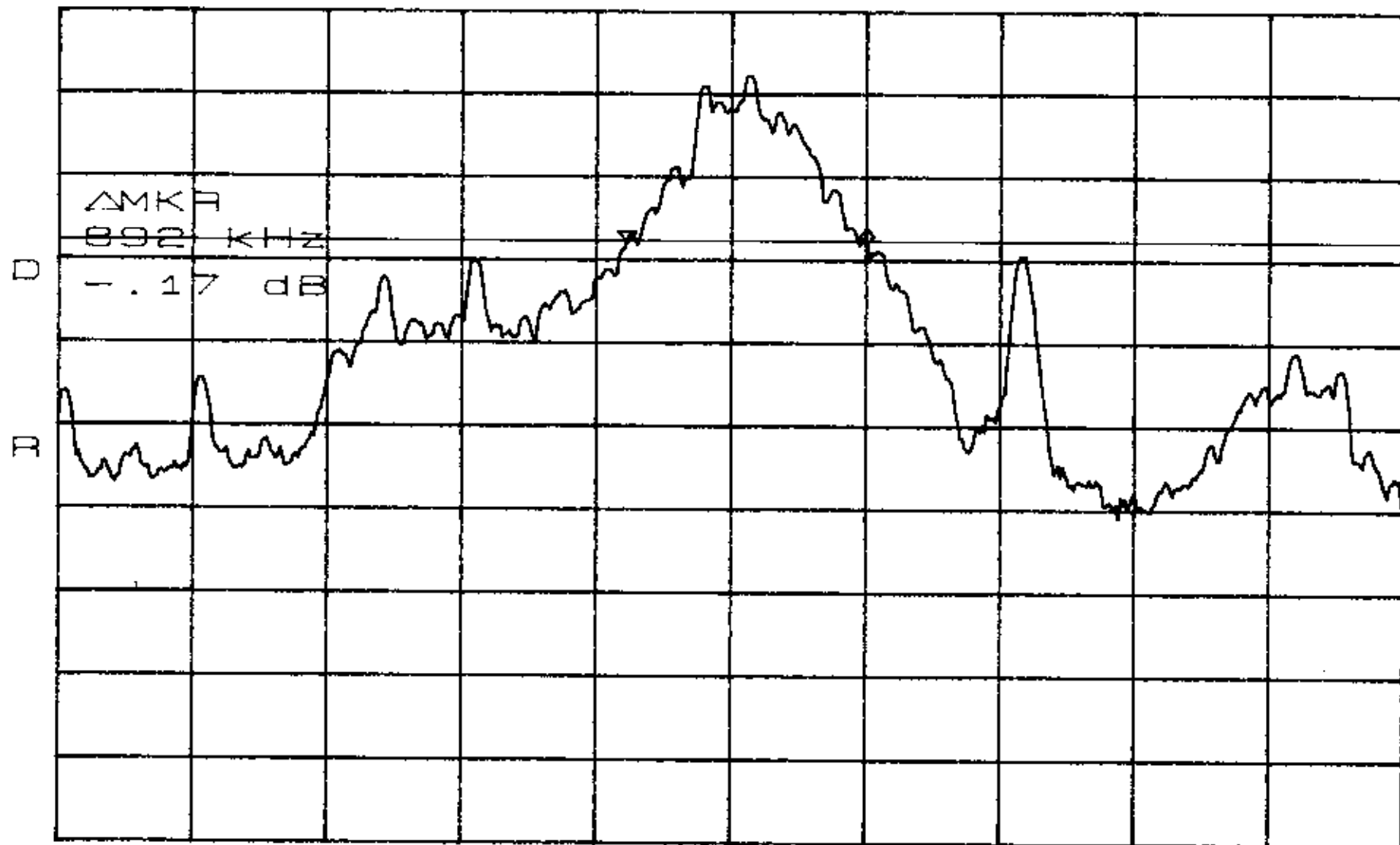
ATTEN 10dB

$\Delta MKR - .17dB$

RL 11.0dBm

10dB/

892KHz



CENTER 2.441000GHz

SPAN 5.000MHz

*RBW 30KHz

*VBW 100KHz

*SWP 100ms

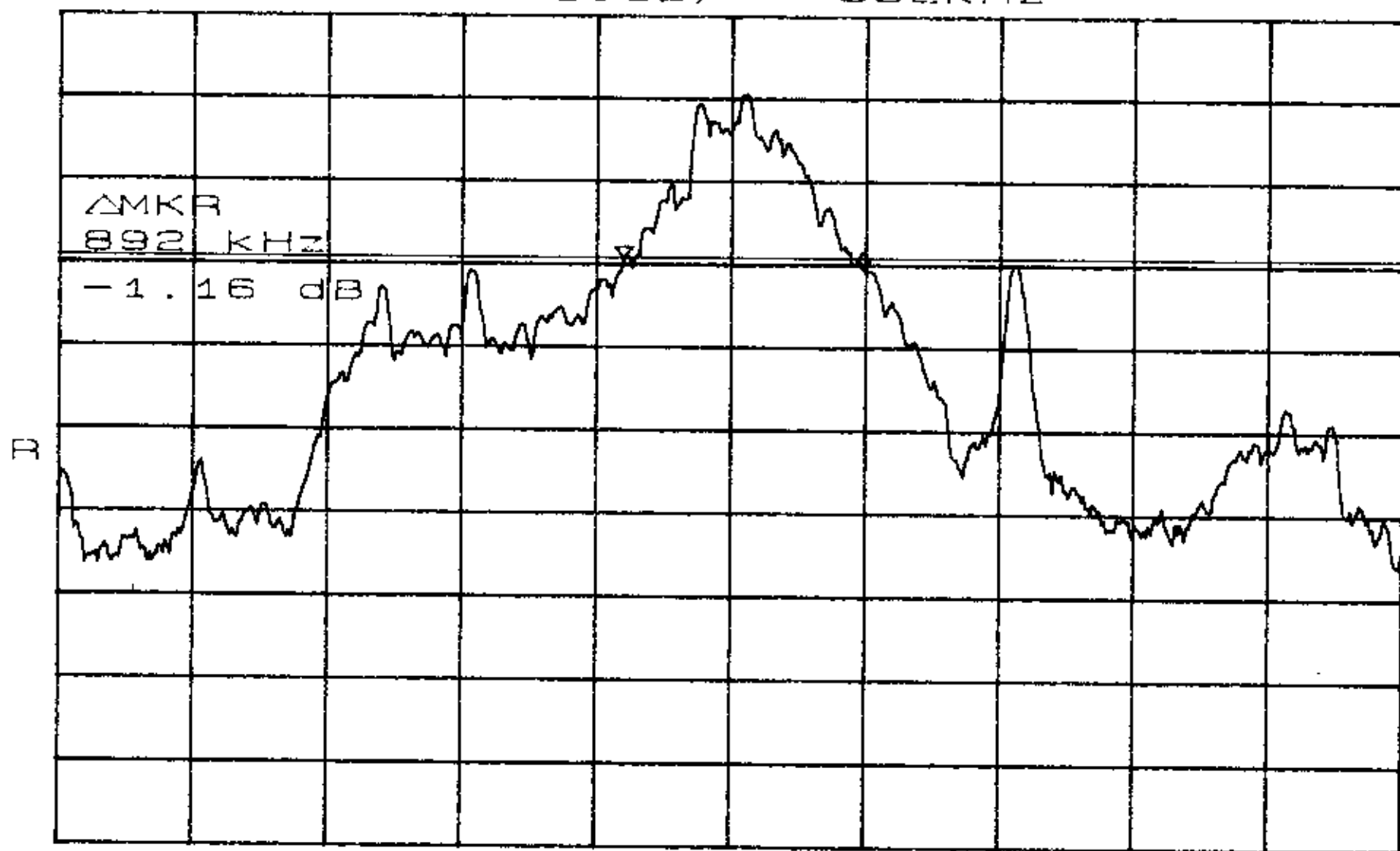
ATTEN 10dB

$\Delta MKR -1.16dB$

RL 11.0dBm

10dB/

892kHz



CENTER 2.4800000GHz

SPAN 5.000MHz

*RBW 30kHz

*VBW 100kHz

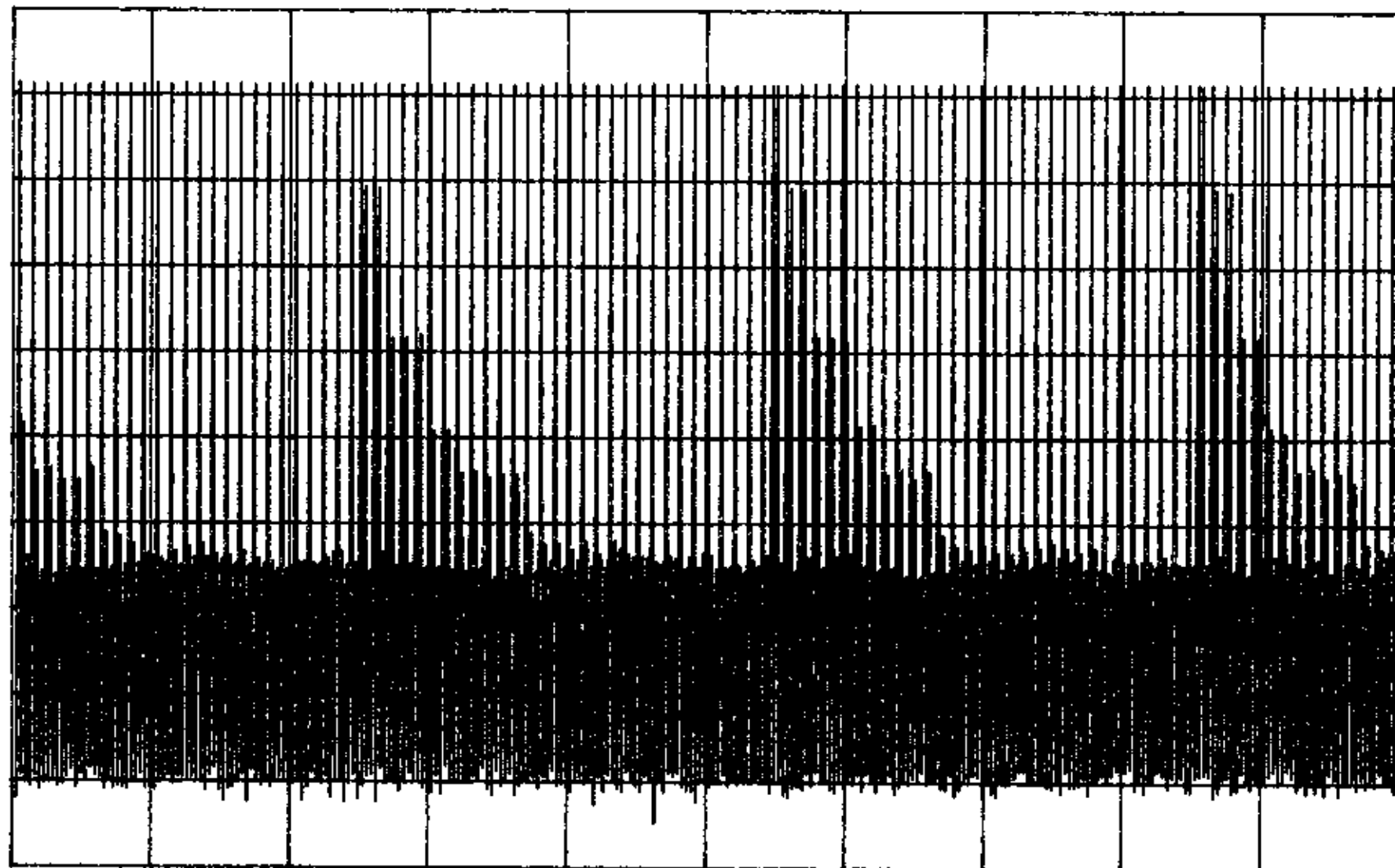
*SWP 100ms

Appendix 4 : Plotted Data for Channel Dwell Time

ATTEN 10dB

RL 0dBm

10dB/



CENTER 2.402000000GHz

SPAN 0Hz

*RBW 1.0MHz

*VBW 1.0MHz

*SWP 10.0sec

ATTEN 10dB

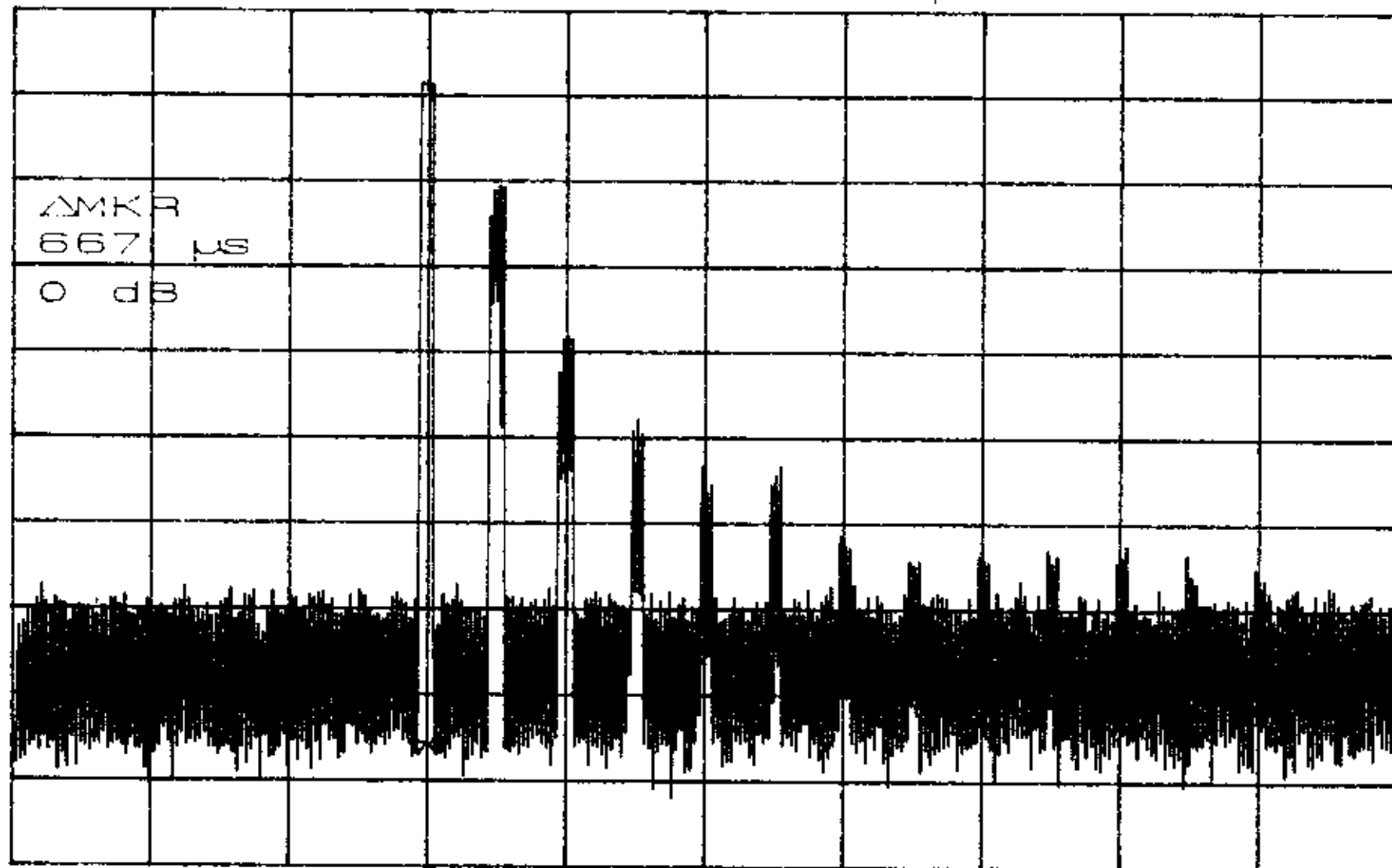
ΔMKR 0dB

RL 0dBm

10dB/

667 μs

S



CENTER 2.402000000GHz

SPAN 0Hz

*RBW 1.0MHz

*VBW 1.0MHz

*SWP 50.0ms

ATTEN 10dB

FL 0dB

10dB/



CENTER 2.4410000000GHZ

SPAN CHZ

*RESW 1.0MHZ

*VBW 1.0MHZ

*SWP 10.0sec

ATTEN 10dB

$\Delta MKR -1.50dB$

RL 0dBm

10dB/

667 μs

S

ΔMKR

667 μs

-1.50 dB

CENTER 2.4410000000GHZ

SPAN 0HZ

*RBW 1.0MHZ

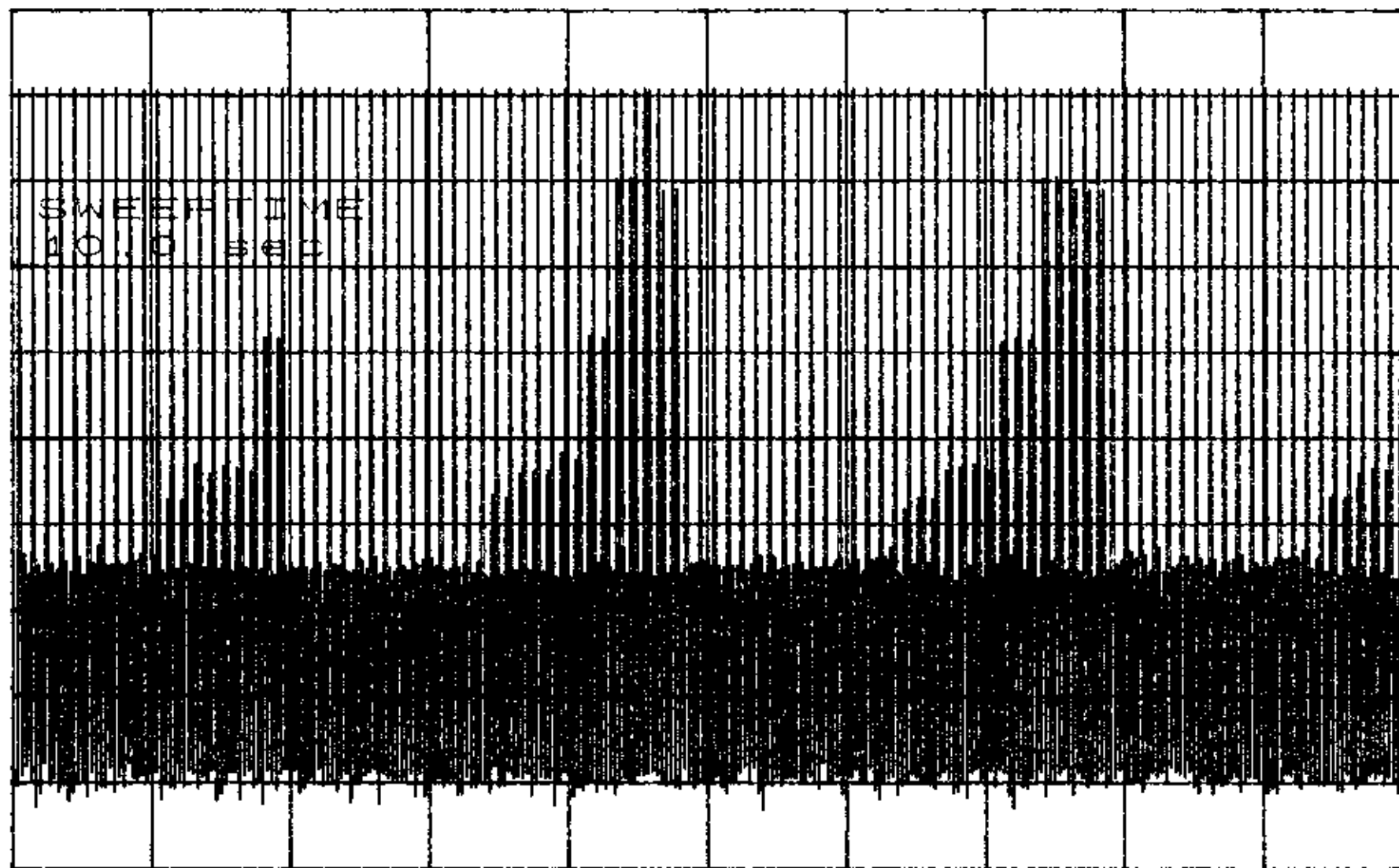
*VBW 1.0MHZ

*SWP 50.0ms

ATTEN 10dB

RL 0dBm

10dB/



CENTER 2.4790000000GHZ

SPAN 0Hz

*RBW 1.0MHZ

*VBW 1.0MHZ

*SWP 10.0sec

ATTEN 10dB

$\Delta MKR -1.83dB$

RL 0dBm

10dB/

667 μs

S

ΔMKR

667 μs

-1.83 dB

CENTER 2.479000000GHZ

SPAN 0Hz

*RBW 1.0MHz

*VBW 1.0MHz

*SWP 50.0ms

Appendix 5 : Plotted Data for Output Peak Power

ATTEN 10dB

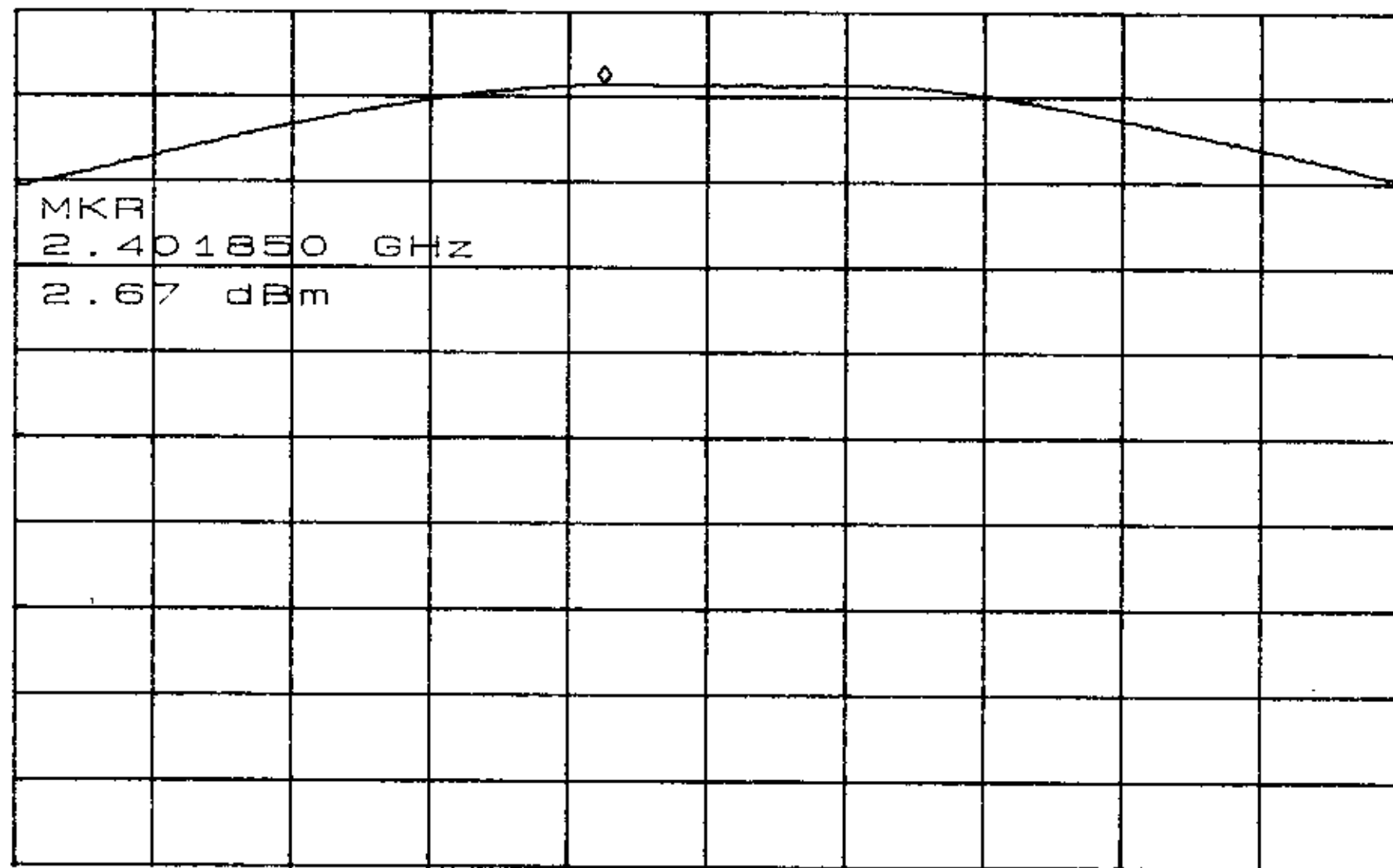
RL 11.0dBm

10dB/

MKR 2.67dBm

2.401850GHz

μ



CENTER 2.402000GHz

SPAN 2.000MHz

*RBW 1.0MHz

*VBW 1.0MHz

*SWP 100ms

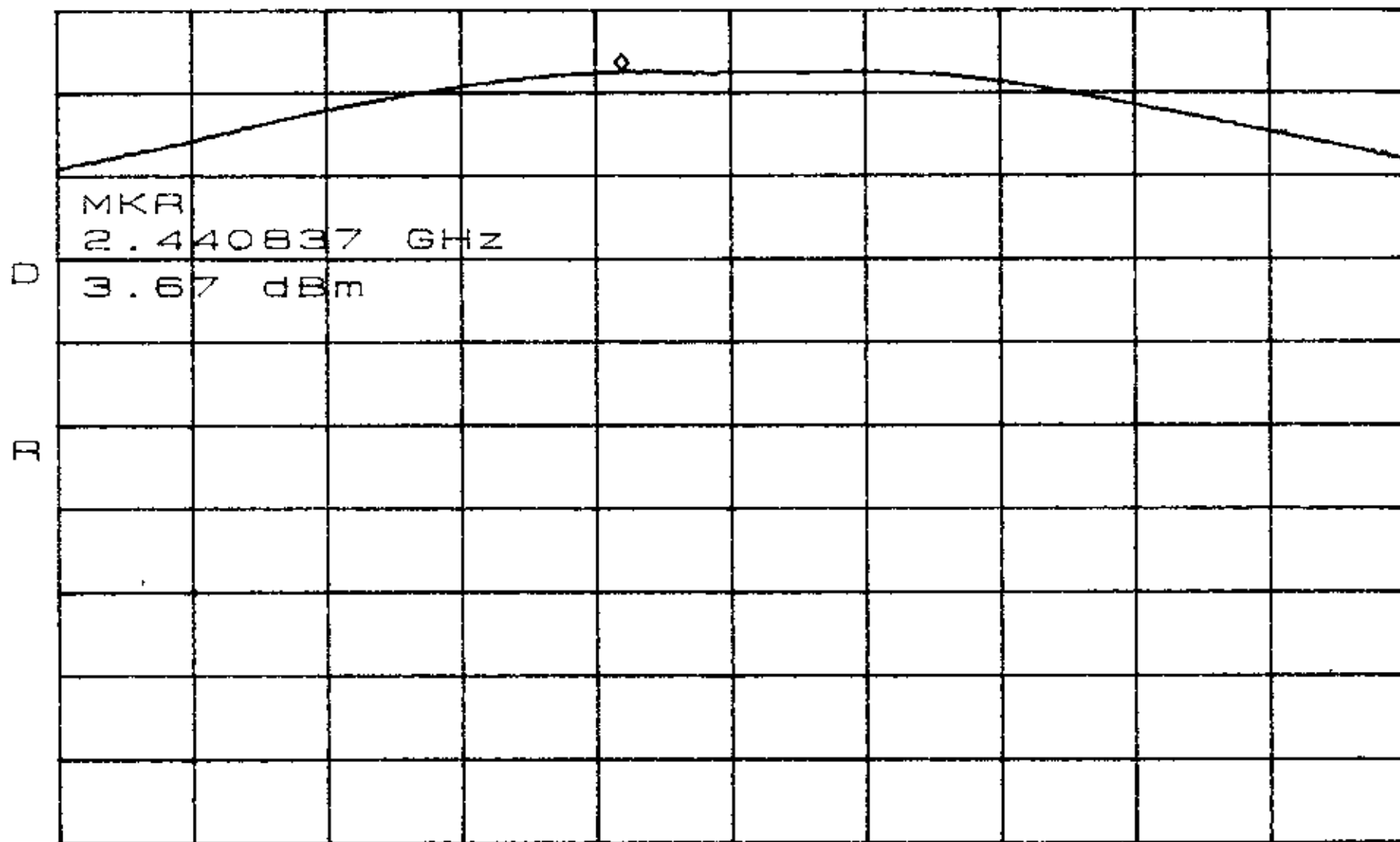
ATTEN 10dB

MKR 3.67dBm

RL 11.0dBm

10dB/

2.440837GHz



CENTER 2.441000GHz

SPAN 2.000MHz

*RBW 1.0MHz

*VBW 1.0MHz

*SWP 100ms

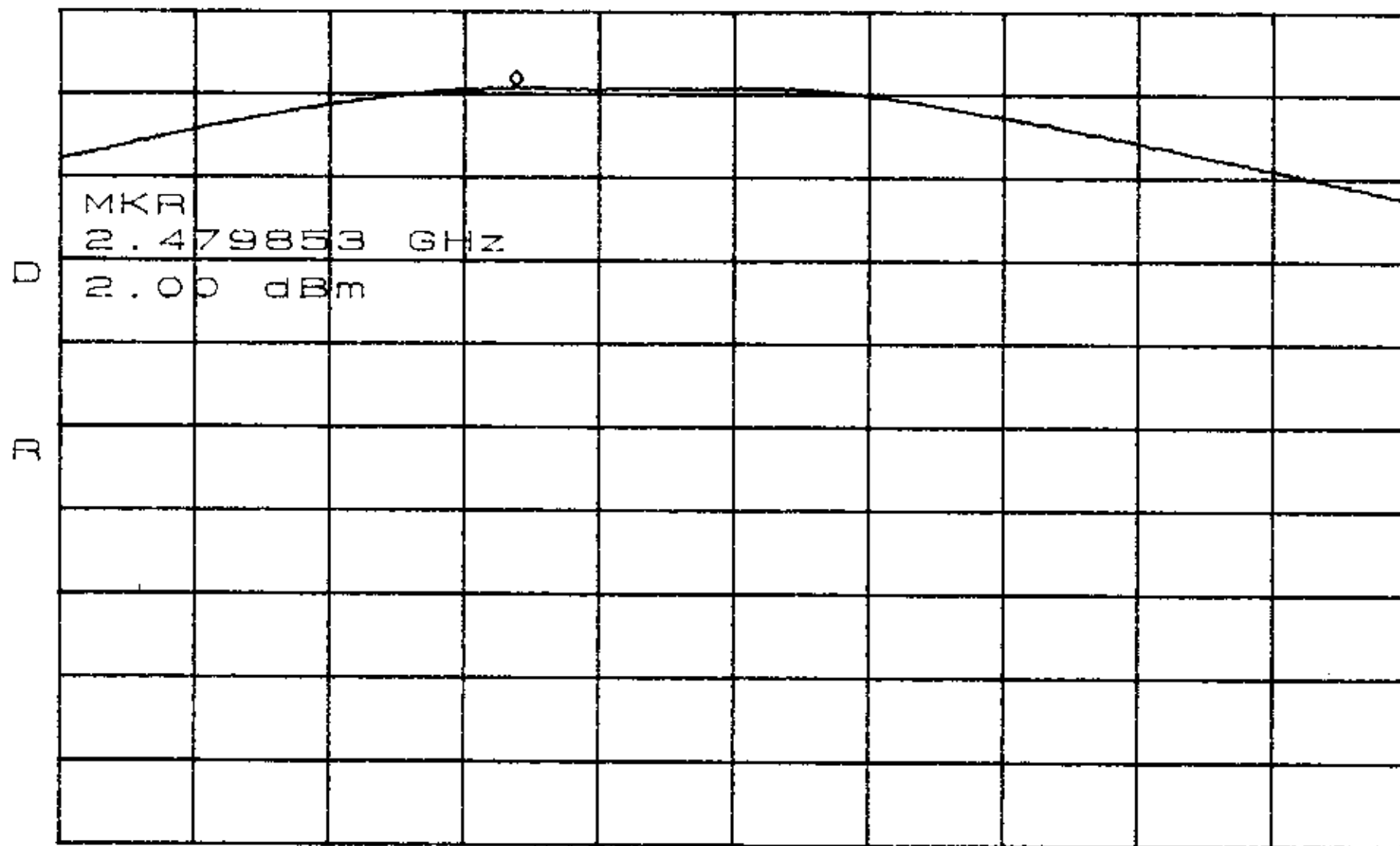
ATTEN 10dB

MKR 2.00dBm

RL 11.0dBm

10dB/

2.479853GHz



CENTER 2.480177GHz

SPAN 2.000MHz

*RBW 1.0MHz

*VBW 1.0MHz

*SWP 100ms

Appendix 6 : Plotted Data for 100 kHz Bandwidth from Band Edge

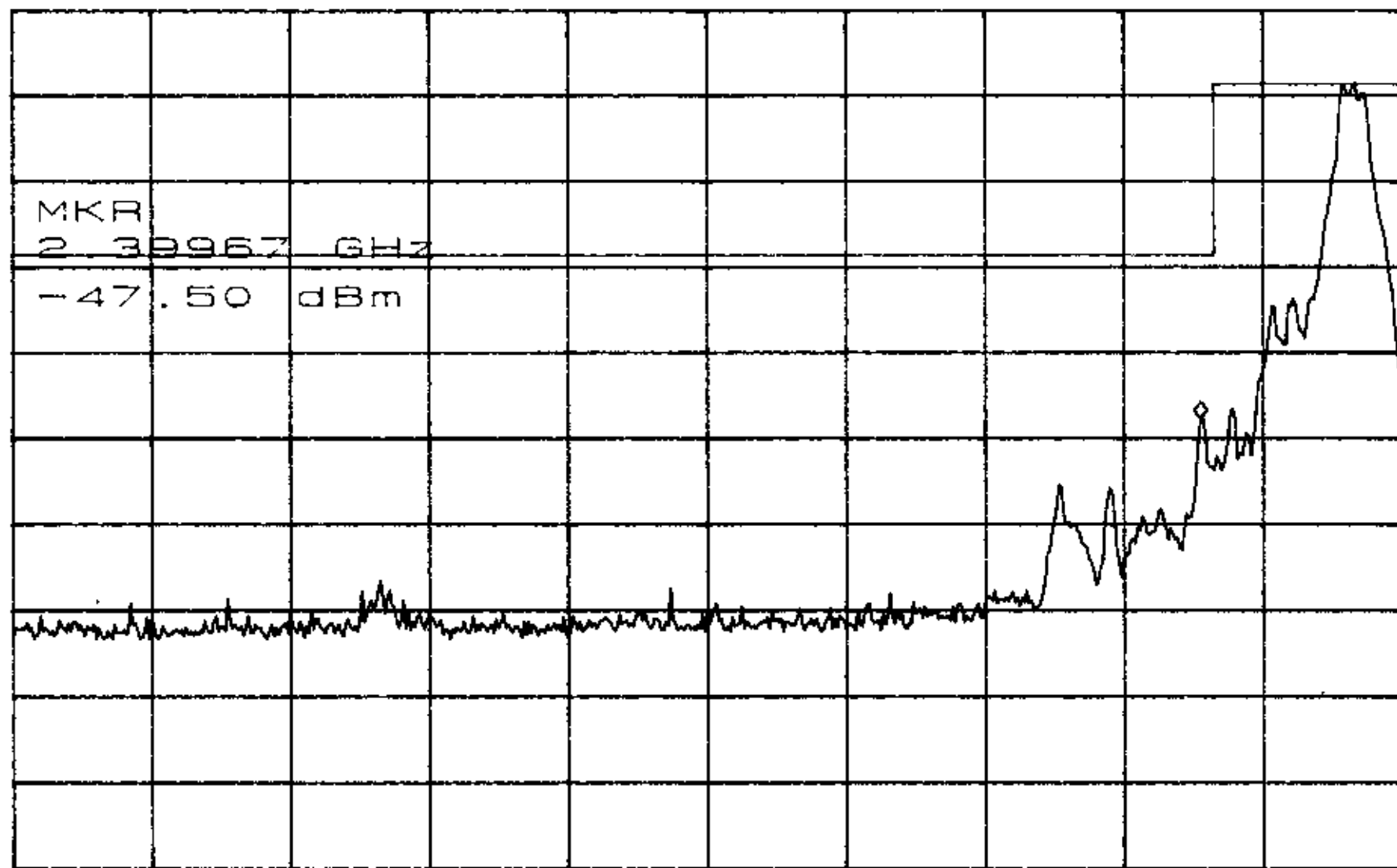
ATTEN 10dB

MKR -47.50dBm

RL 0dBm

10dB/

2.39967GHz



START 2.38000GHz

STOP 2.40300GHz

*RBW 100kHz

*VBW 1.0MHz

*SWP 100ms

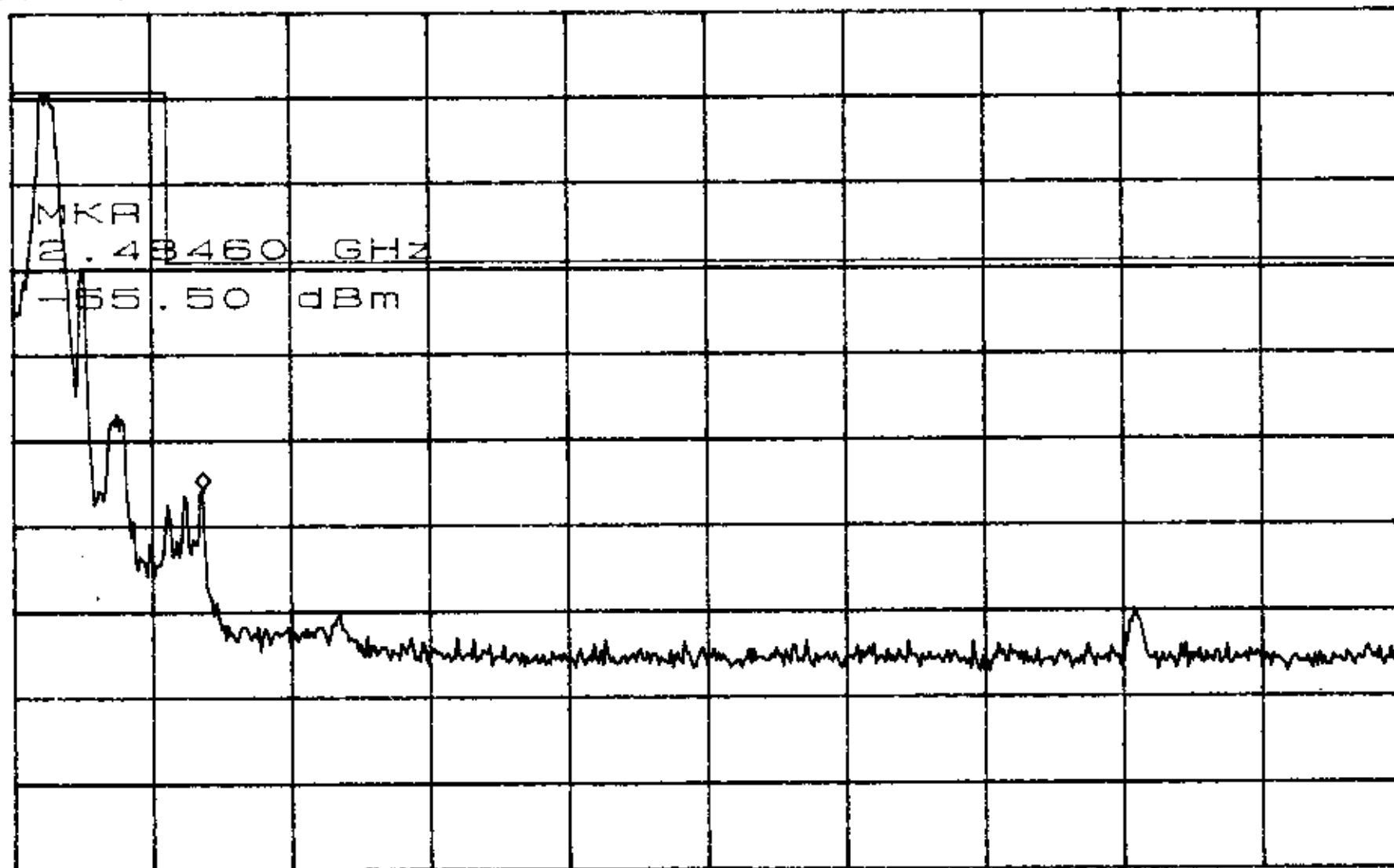
ATTEN 10dB

MKR -55.50dBm

RL 0dBm

10dB/

2.48460GHz



START 2.47900GHz

STOP 2.52000GHz

*RBW 100KHz

*VBW 100KHz

*SWP 100ms