



125 Technology Parkway
Norcross, Georgia, US 30092

Test Report


LXE Model: 480628-4096

Direct Sequence
Spread Spectrum
Transmitter

FCC ID: KDZ480628-4096

Applicant: LXE Inc.
125 Technology Parkway
Norcross, GA 30092

Purpose of Testing: To demonstrate compliance with FCC Part 15 Subpart C

Report Prepared By: 
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Issue Date: March 15, 2000

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1.0 GENERAL

1.1 Introduction

The purpose of this report is to demonstrate compliance with Part 15, Subpart C of the FCC's Code of Federal Regulations. Testing was performed from December 21st, 1999 - January 5th, 2000.

1.2 Product Description

1.2.1 General

The Equipment Under Test(EUT) is an OEM Direct Sequence Spread Spectrum PCMCIA radio card manufactured by Lucent Technologies. The radio card is IEEE 802.11b compliant and operates in the band of 2400-2483.5 GHz. The radio is capable of 3 data rates and self adjusts to the most appropriate rate depending on the performance required. The data rates are 11, 5.5 and 2 Mbps, where 11 Mbps gives the maximum throughput for data transfer, and 2 Mbps gives the best coverage where only small data packets are sent.

The radio has 2 ports. The main port is TX/RX and the auxiliary port is RX only. The card can be used either with a single antenna scheme in the main port, or a diverse antenna scheme using both ports.

Upon certification, the radio card will be integrated into individual components of the LXE product line, that together, will make up a wireless LAN for various applications. The individual components are LXE PC based mini-computers equipped with PCMCIA slots to accommodate the various radio cards offered, or they can be used as batch terminals with no radio card at all. For batch operations, the PCMCIA slots are utilized as memory or storage space enhancements. Terminals currently targeted for integration of the 480628-4096 radio card are LXE Models: 1380, 1390, 1600, 2325, 2330, 2335, 2381, 6520, 6521, 6522 and the Mobile Clinical Work Station(MCWS). Each terminal is described in detail in section 1.2.3.

1.2.2 Technical Specifications

Table 1: Specifications

Frequency Band	2400-2483.5 MHz
Number of Channels	11
Modulation Technique	Direct Sequence Spread Spectrum (DBPSK, DQPSK, CCK)
Spreading	11-chip sequence (Barker for 1, 2 Mbps)
Bit Error Rate	Better than 10E-5
Media Access Protocol	CSMA/CA (Collision Avoidance) with ACK
Interface	PC Card Type II Size
Dimensions	85.0 mm X 53.95 mm X 5.0 mm (PC Card)
Output power	15 dBm
Power Consumption PC Card	Doze mode – 15 mA
	Receive mode – 240 mA
	Transit mode – 280 mA
Temperature Range (operational)	0-55 0C 95% max. humidity (non condensing)
Compatibility	Novel Client 3.x & 4.x
	Windows 95/98 and Windows NT@(NDIS Miniport driver)
	Apple
	Windows/CE
Standards	IEEE 802.11b
Regulations	FCC Part 15 Subpart C
	RSS 139 & RSS 102
	ETS 300 328 & 300 826

1.2.3 Integrated Terminals

The 480628-4096 radio will be integrated into the terminals described below. All terminals have been evaluated to, and found to comply with, FCC Part 15, Subpart B, Class A, and in some cases Class B emission requirements.

1380/90

The LXE Models 1380 and 1390 are similar, however the 1390 has an external keyboard with a full screen display, while the 1380 has an integrated keyboard and half screen display. The LXE Models 1380/90 are vehicle mounted ruggedized computer terminals. A typical application for the 1380/90 is mounted on a fork lift type vehicle. The 1380/90 is equipped with a laser bar-code scanner for tracking inventory as it is moved about. The information gathered is then either downloaded via an RS232 link, or transmitted to an LXE Access Point via an RF link. The Access points are connected to a wired LAN via an Ethernet connection.

1600

The LXE Model 1600 is a hand-held pen terminal used in health care environments. The 1600 is equipped with a PCMCIA slot to accommodate a radio card or other peripheral device. When equipped with a radio card, the 1600 is used to transfer patient information entered by medical professionals. The information is transmitted via an RF Link to an LXE Access Point that is wired to the LAN via an Ethernet connection.

2325

The LXE Model 2325 is low cost, vertical hand-held terminal (VHHT) typically used in industrial , warehouse or retail settings. The 2325 is equipped with a PCMCIA slot, bar-code scanner and optional RS232 port. The 2325 is used by the operators to track smaller quantities of inventory, order entry and other applications of this nature. The information gathered is then either downloaded via an RS232 link, or transmitted to an LXE Access Point via an RF link. The Access Points are connected to a wired LAN via an Ethernet connection.

2326

The LXE Model 2326 is the next generation of low cost vertical hand held terminals(VHHT). Intended operation of the 2335 is similar to that of the 2326 and will ultimately replace the 2325, however the 2325 is still in service. The primary difference between the 2325 and 2326 is that the 2326 is more ergonomically designed and incorporates an integrated antenna.

2330

The LXE Model 2330 is high end vertical hand-held terminal(VHHT) that serves the same functions as the 2325, however with greater performance. The 2330 has more options than that of the 2325.

2335

The LXE Model 2335 is the next generation of vertical hand held terminals(VHHT). Intended operation of the 2335 is similar to that of the 2330 and 2325. The 2335 will ultimately replace the 2330, however the 2330 is still in service.

2381

The LXE Model 2381 is a horizontal hand-held terminal(HHHT) and serves the same functions as the other hand-held terminals with a horizontal form factor. Some customers prefer the HHHT vs. the VHHT.

1.2.3 Integrated Terminals(cont.)

6520

The LXE Model 6520 is a standalone table top or mountable Access Point equipped with 2 PCMCIA slots. The 6520 Access Point is used to receive transmitted information from the various terminals described above and makes the information available to a LAN via an Ethernet connection. The 6520 can be used with the LXE radios listed below:

- 1) 480628-3700 - FCC ID: KDZ480628-3700. This radio and all required antennas are already approved by the commission and is currently in service with all Access Points and terminals above except the 2335 and 2381. These terminals are still in development.
- 2) 480628-4096 - FCC ID: KDZ480628-4096. This radio is the subject of this report and will be released in all Access Points and terminals upon certification by the commission.

6521

The LXE Model 6521 is a UL 50, Type 4 rated weatherproof enclosure equipped with a LXE Model 6520 Access Point. The 6521 Access Point is used in environments where weather conditions can be extreme. Typical environments, include ship yards, ports and any outdoor site that requires a weather resistant solution. Like the 6520, the 6521 is used to receive transmitted information from the various terminals described above and makes the information available to a LAN via an Ethernet connection. The 6521 can be used with the LXE radios listed below:

- 1) 480628-3700 - FCC ID: KDZ480628-3700. This radio and all required antennas are already approved by the commission and is currently in service with all Access Points and terminals above except the 2335 and 2381. These terminals are still in development.
- 2) 480628-4096 - FCC ID: KDZ480628-4096. This radio is the subject of this report and will be released in all Access Points and terminals upon certification by the commission.

6522

The LXE Model 6522 is a Ceiling Enclosure, housing a 6520 Access Point. The enclosure is mounted in buildings that are equipped with standard drop ceilings. The 6522 is designed to look like part of the HVAC system and is aesthetically pleasing. The 6522 can be used either in an office or a healthcare environment. Healthcare customers will use either the 1600 or MCWS as terminals and will communicate to the LAN via the 6522 Access Point. In an office environment, the 6522 offers a wireless option to the existing LAN. Radios can be used in the PCMCIA slots of either desktop or laptop computers.

The 6522 can be used with the LXE radios listed below:

- 1) 480628-3700 - FCC ID: KDZ480628-3700. This radio and all required antennas are already approved by the commission and is currently in service with all Access Points and terminals above except the 2335 and 2381. These terminals are still in development.
- 2) 480628-4096 - FCC ID: KDZ480628-4096. This radio is the subject of this report and will be released in all Access Points and terminals upon certification by the commission.

MCWS

The Mobile Clinical Work Station, or MCWS, is a multi-purpose mobile computer station. It is equipped with its own battery power supply, fully functional computer terminal with LCD display and associated peripherals. Primary user of the MCWS are medical professionals who require the portability of computing equipment for inputting and tracking patient information. The MCWS is equipped with a PCMCIA slot to be used by the radio of choice. The information gathered will be transmitted via the RF link to an LXE Access point, usually a 6522 Ceiling Enclosure and will ultimately be made available to the LAN via an Ethernet connection.

1.2.4 Antennas

Table 1 below identifies all of the antennas to be used with the 480628-4096 radio card. In addition, the table identifies which terminal or Access Point uses which antenna and if a diverse scheme is used for that terminal or Access Point.

Table 2: Antennas

ANTENNAS SUBMITTED FOR REGULATORY APPROVAL WITH THE 11Mbps 802.11 RADIO CARD*						
Manufacturer	Manufacturer Part Number	LXE (P/N)	Antenna Used With	Type	Gain (dBi)	Antenna Scheme
Cushcraft & Maxrad	RTN2400SXR	153180-0001	1380/90	Omni	0	Non-Diverse
	MHWS2400RPC					
Lucent Technologies	None	155520-0001	1600	Patch	0	Diverse
Huber & Suner	9090.16.0001	990004-0027	2325	Omni	1.8	Non-Diverse
LXE	155522-0001	155522-0001	2330	Omni	0	Diverse
LXE	155814-0001	155814-0001	2330/2335	Patch	0	
LXE	156426-0001	156426-0001	2381	Patch	0	Diverse
Toko	DAC2450CT1	NONE	2326	Omni	2.15	Non-Diverse
Maxrad		480429-0400	MCWS	Omni	2	Non-Diverse
Cushcraft	S2400XXX**	153179-0001	Access Points 6520, 6521, 6522	Omni	0	Both
		153325-0001		Omni	0	
		480424-0400		Omni	0	
	S2403XXX**	153599-0001		Omni	3	
		153600-0001		Omni	3	
		480424-3404		Omni	3	
	S2406XXX**	480424-1702		Directional	6	
		480424-3402		Patch	6	
		481246-2400		Patch	6	
	PC2415XXX**	460601-3020		Yagi	15	
		460602-3020		Yagi	15	
	LXE	155846-0001		Omni	3	
		155845-0001		Omni	6	
	Mobile Mark	OD9-2400		Omni	9	
Xertex	245BD5W-XXX**	155311-0001		Patch	4&6	
		480424-3411		Patch	4&6	

*Only highest gain of each type of antenna to be tested.

**Manufacturer Model numbers generalized for convenience. Antennas are electrically and functionally equivalent. Different only in connector types and cable lengths. LXE part numbers given to all variations.

2.0 LOCATION OF TEST FACILITY

The LXE test facility is located at the following address:

LXE, Inc.
An Electromagnetic Sciences Company
125 Technology Parkway
Norcross, GA US 30092-2993

2.1 DESCRIPTION OF OPEN AREA TEST SITE

All tests were conducted at the manufacture's test facility at a location specifically prepared for this testing. The radiated emissions test site meets the characteristics of ANSI C63.4:1992, CISPR 16 and EN 55022:1994. This site has been fully described and submitted to the FCC, and accepted in their letter marked 31040/SIT, 1300F2.

The open area test site(OATS) is located in the center of the rooftop of the building. The roof is located at a height of approximately 8 meters above the ground. The 3 meter radiated emissions test site is an open, flat area approximately 6.2m x 9.2m in dimension. All reflecting objects including test personnel lie outside the perimeter of the ellipse. The site has a ground plane which extends 2 meters past the mast and equipment under test(EUT). Material of the ground plane, comprised of individual 1/4" metal screen mesh rolls, were soldered at the seams with gaps smaller than 1/10 of the wavelength at 1000MHz. The ground plane is connected to the earth ground by ground rods. All wiring is done at floor level around the test site periphery.

A nonconductive remotely controlled turntable approximately 0.91m x 1.2m x 0.8m was used to measure radiated emissions from all sides of the EUT. The turntable has a center opening that allows cabling to be routed directly down to the conducting ground plane.

The radiated emissions test setup is shown in figure 1.

2.2 Radiated Emissions Testing Facility Drawing

All dimensions are in meters(m)

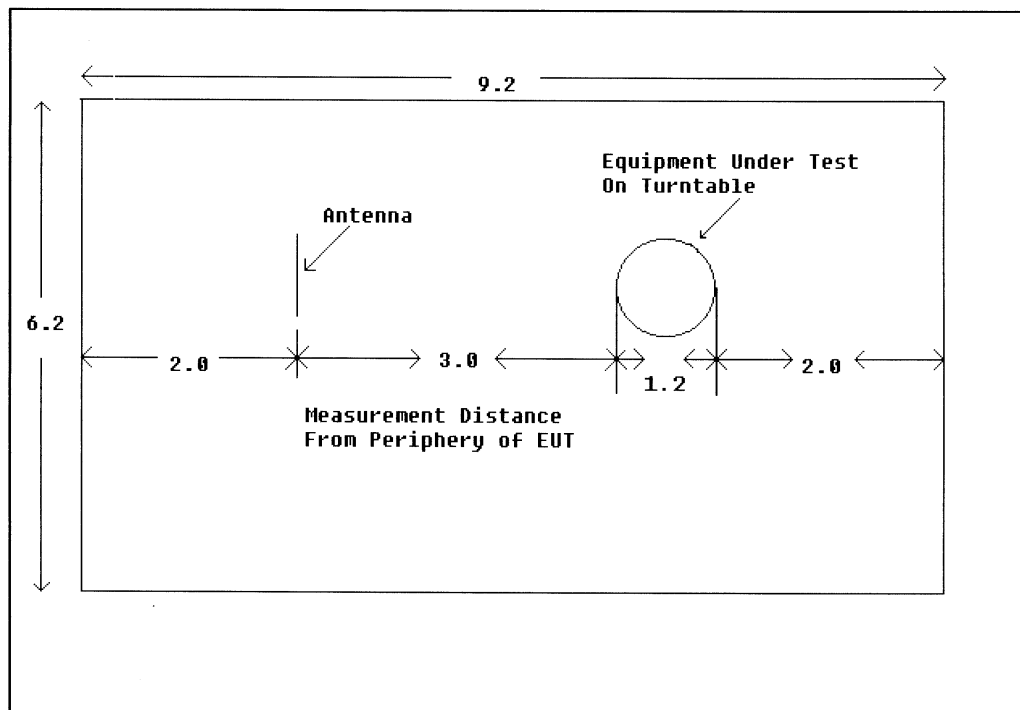


Figure 1: Open Area Test Site(OATS)

3.0 APPLICABLE STANDARD REFERENCES

The following standards were used:

- 1 - ANSI C63.4-1992: Method of Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the 9KHz to 40GHz
- 2 - US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators (October 1997)
- 3 - FCC Bulletin 97-114 Appendix C - Guidance on Measurements for Direct Sequence Spread Spectrum Systems
- 4 - FCC OET Bulletin 65 Appendix C - Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields

4.0 LIST OF TEST EQUIPMENT**Table 3: Test and Support Equipment**

Description	Manufacturer	Model/Part #	Serial #	Calibration Due Date
Spectrum Analyzer	Hewlett Packard	HP 8591A	3131A02254	5/10/00
Spectrum Analyzer	Hewlett Packard	HP 8563E	3304A00657	5/5/00
Preamplifier	LXE	20-1000 MHz	001	4/12/00
Preamplifier	Hewlett Packard	83006A	3116A01317	10/5/00
HI-Pass Filter	MicroWave Circuits	H04G18G2	0001	1/13/01
LISN	EMCO	3810/2NM	9505-1024	5/7/00
Biconical Antenna	EMCO	3104C	9012-4360	5/6/00
Biconical Antenna	Electro-Metric	BIA-25	1165	7/10/00
Log Periodic	EMCO	3146	3011-2946	4/1/00
Horn Antenna	ElectroMetric	RGA-60	6166	8/28/00
Horn Antenna	ElectroMetric	RGA-60	6165	8/28/00
RF Cable			NSN	7/20/00
RF Cable			7015	11/5/00
RF Cable			6986	11/5/00
Power Meter	Hewlett Packard	HP436A		2/10/00
Power Sensor	Hewlett Packard	HP8482H		1/07/01
Antenna Mast	CDI	CDI	N/A	N/A
Turntable	CDI	CDI	N/A	N/A
RF Enclosure	Lindgren Enclosure	14-2/2-0	8147	N/A

5.0 SUPPORT EQUIPMENT

Table 4: Support Equipment

Manufacturer	Equipment Type	Model Number	Serial Number	FCC ID
WinBookxp	LapTop Computer	ANL-4	10AUA01756	JRUANL-4D75

6.0 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

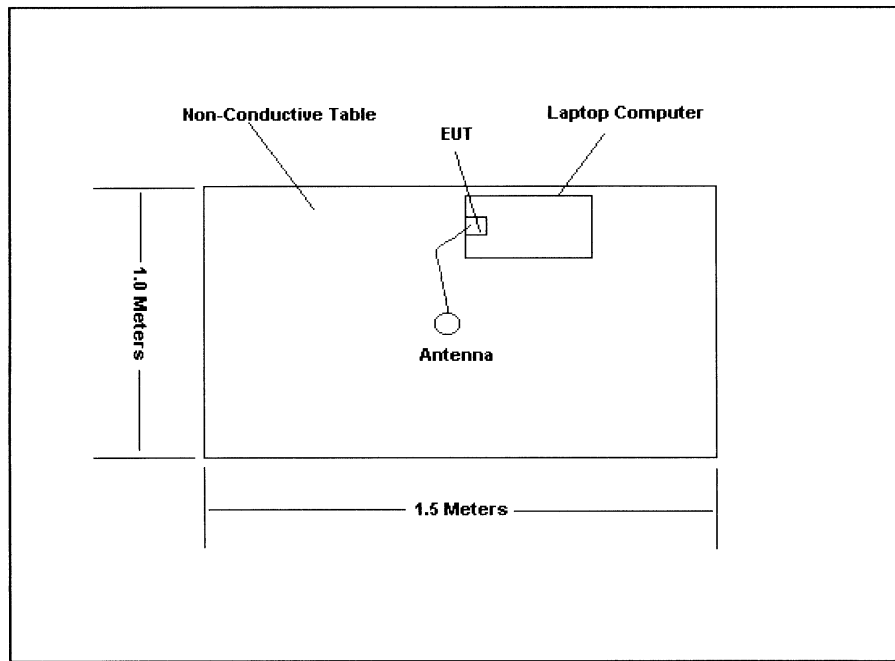


Figure 2: EUT Test Setup

7.0 SUMMARY OF TESTS

Along with the tabular data shown below, plots were taken of all signals deemed important enough to document.

7.1 Antenna Requirement - FCC Section 15.203

All equipment is professionally installed by qualified LXE personnel. However, antennas that are accessible to the user are all equipped with unique and/or proprietary connectors and are not interchangeable with standard antennas without electrical and mechanical modification of the radio card or host unit. Antennas that are not accessible to the end user are equipped with standard N-Type connectors. LXE field service personnel prefer these connectors for ease of installation and repair.

7.2 Power Line Conducted Emissions - FCC Section 15.207

The EUT is powered by a PCMCIA bus of host device supplying 3.3 or 5VDC, and has no connection to the AC Mains. Conducted emissions are not required.

7.3 Radiated Emissions - FCC Section 15.209

Radiated emissions tests were attempted over the frequency range of 30MHz to 25GHz, 10 times the highest fundamental frequency. Measurements of the radiated field strength were made at a distance of 3m from the boundary of the equipment under test(EUT)and the receiving antenna. The antenna height was varied from 1m to 4m so that the maximum radiated emissions level would be detected. Radiated measurements were made with the Spectrum Analyzer's resolution bandwidth set to 120KHz for measurements above 30MHz.

The EUT was caused to go into a "Receive Only" mode of operation for this test. No emissions attributed to the EUT could be detected in the band.

7.4 6dB Bandwidth Requirement - FCC Section 15.247(a)(2)

For the 6dB bandwidth test, the EUT was caused to generate a continuous carrier on the high, middle and low channels. The plots shown below in figures 5, 6 and 7 were taken at a data rate of 2Mbps.

7.5 Peak Output Power Requirement - FCC Section 15.247(b)

The peak output power of the EUT was made at the antenna connector using an HP436A power meter and an HP8482H power sensor. The EUT was caused to generate a constant carrier on high, mid and low channels of the device. On each channel the EUT was then cycled through each of its data rates. Table 4 below shows the results of this test.

Table 5: Peak Output Power

Data Rate (Mbps)	Channel 1 - 2412 MHz (dBm)	Channel 7 - 2442 MHz (dBm)	Channel 11 - 2462 MHz (dBm)
2	15.30	15.00	14.30
5.5	15.40	15.20	14.50
11	15.30	15.01	14.40

8.6 Spurious Emissions - FCC Section 15.247(c)**7.6.1 RF Conducted Spurious Emissions**

The EUT was investigated for conducted spurious emissions from 30MHz to 25GHz, 10 times the highest fundamental frequency. For each measurement, the spectrum analyzer's VBW was set to 100kHz and the RBW was set to 1MHz.

The RF conducted spurious emissions found in the band of 300MHz to 10GHz are reported in Table 5 below. Each emission was compared to the fundamental reference level, also reported in the table below, to determine if they were at least 20dB below the reference level. Plots of the emissions were also taken and follow Table 6:

Table 6: Conducted Spurious Emissions

Channel	Fundamental Frequency (MHz)	Fundamental Reference Level (dBm)	Frequency of Spurious Emissions (MHz)	Level (dBm)	Margin (dB)	Results Pass/Fail
1	2412	3.67	692	-49.17	52.84	Pass
			2,397	-38.83	42.50	Pass
			4,820	-59.83	63.50	Pass
			8,220	-61.67	65.34	Pass
			14,420	-61.33	65.00	Pass
			21,837	-60.67	64.34	Pass
			23,922	-59.33	63.00	Pass
7	2442	4.83	696	-50.00	54.83	Pass
			4,883	-54.83	59.66	Pass
			8,334	-63.17	68.00	Pass
			13,109	-69.67	74.50	Pass
			20,442	-69.33	74.16	Pass
			24,514	-68.17	73.00	Pass
11	2462	4.32	691	-49.17	53.49	Pass
			2,487	-55.68	60.00	Pass
			4,918	-64.17	68.49	Pass
			8,418	-60.33	64.65	Pass
			12,935	-60.33	64.65	Pass
			21,460	-60.00	64.32	Pass
			24,759	-59.50	63.82	Pass



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Norcross, Georgia, US 30092

Appendix A

Conducted Spurious Emissions Plots

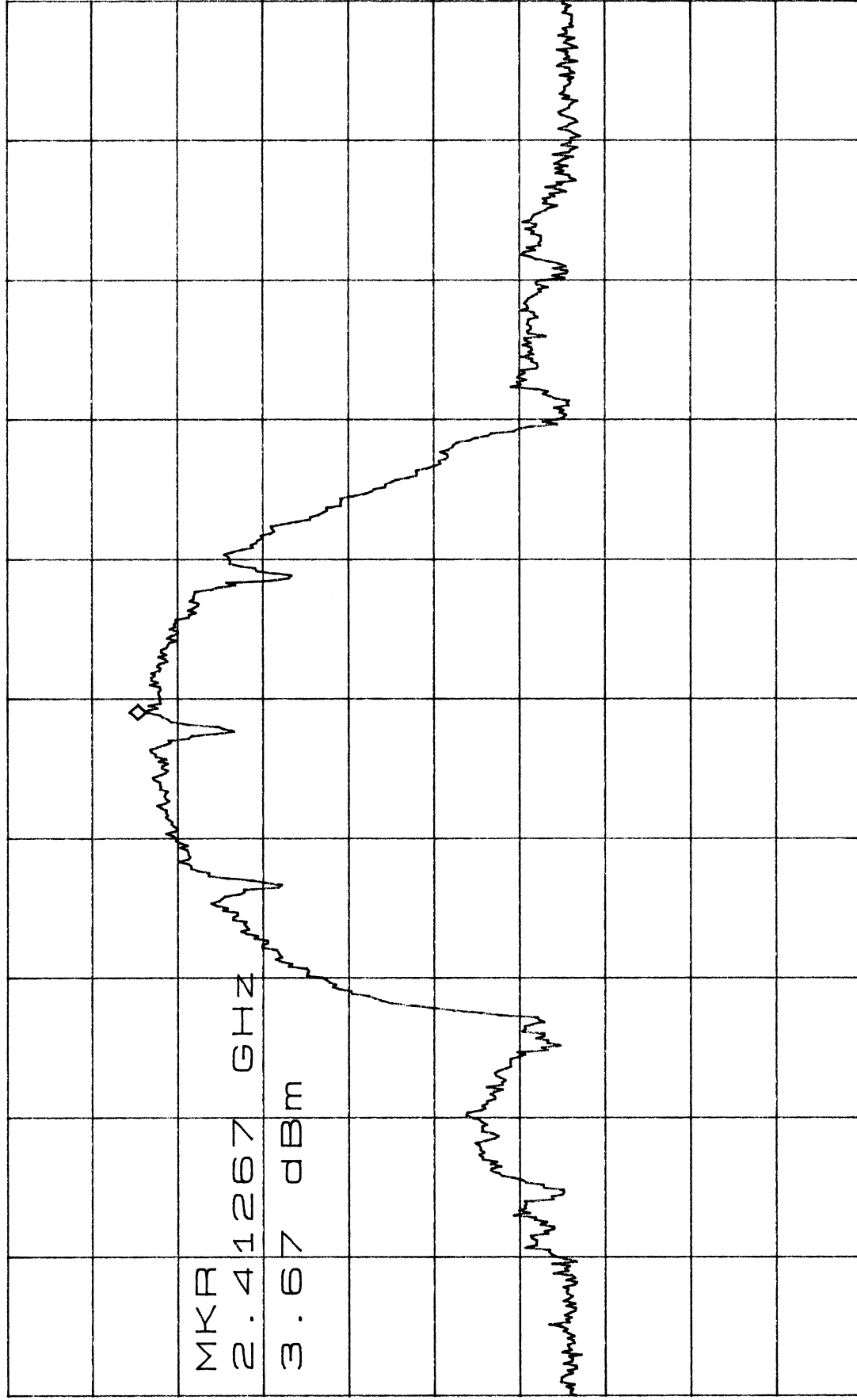
LXE Model: 480628-4096

FCC ID: KDZ480628-4096

Issue Date: January 19, 2000

*ATTEN 40dB
RL 20.0dBm

MKR 3.67dBm
2.41267GHz

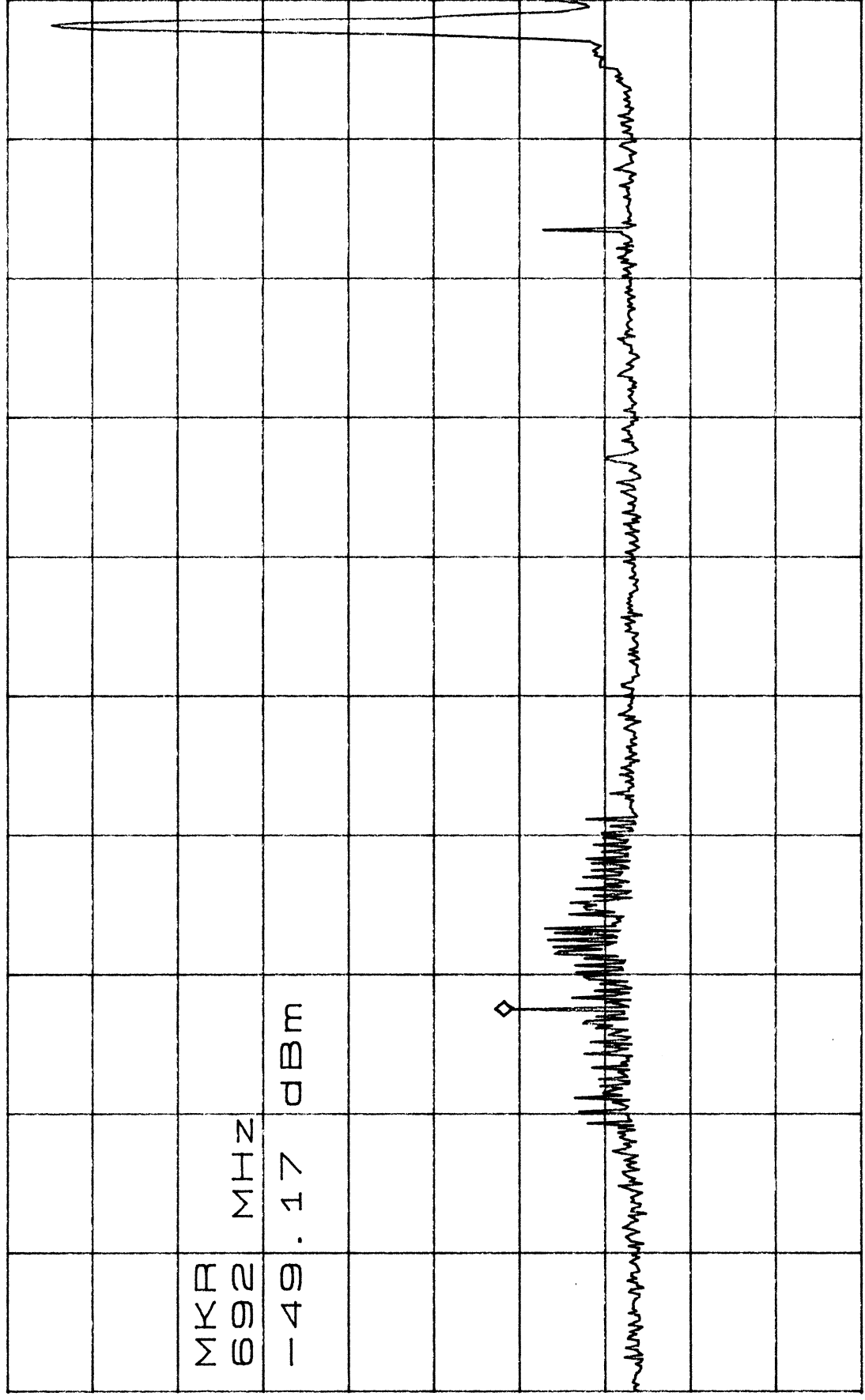


START 2.38817GHz STOP 2.43817GHz
*RBW 100kHz *VBW 1.0MHz SWP 50ms

*ATTEN 20dB
RL 10.0dBm

MKR -49.17dBm
692MHz

10dB/



D

START 30MHz

STOP 2.437GHz

*RBW 100kHz

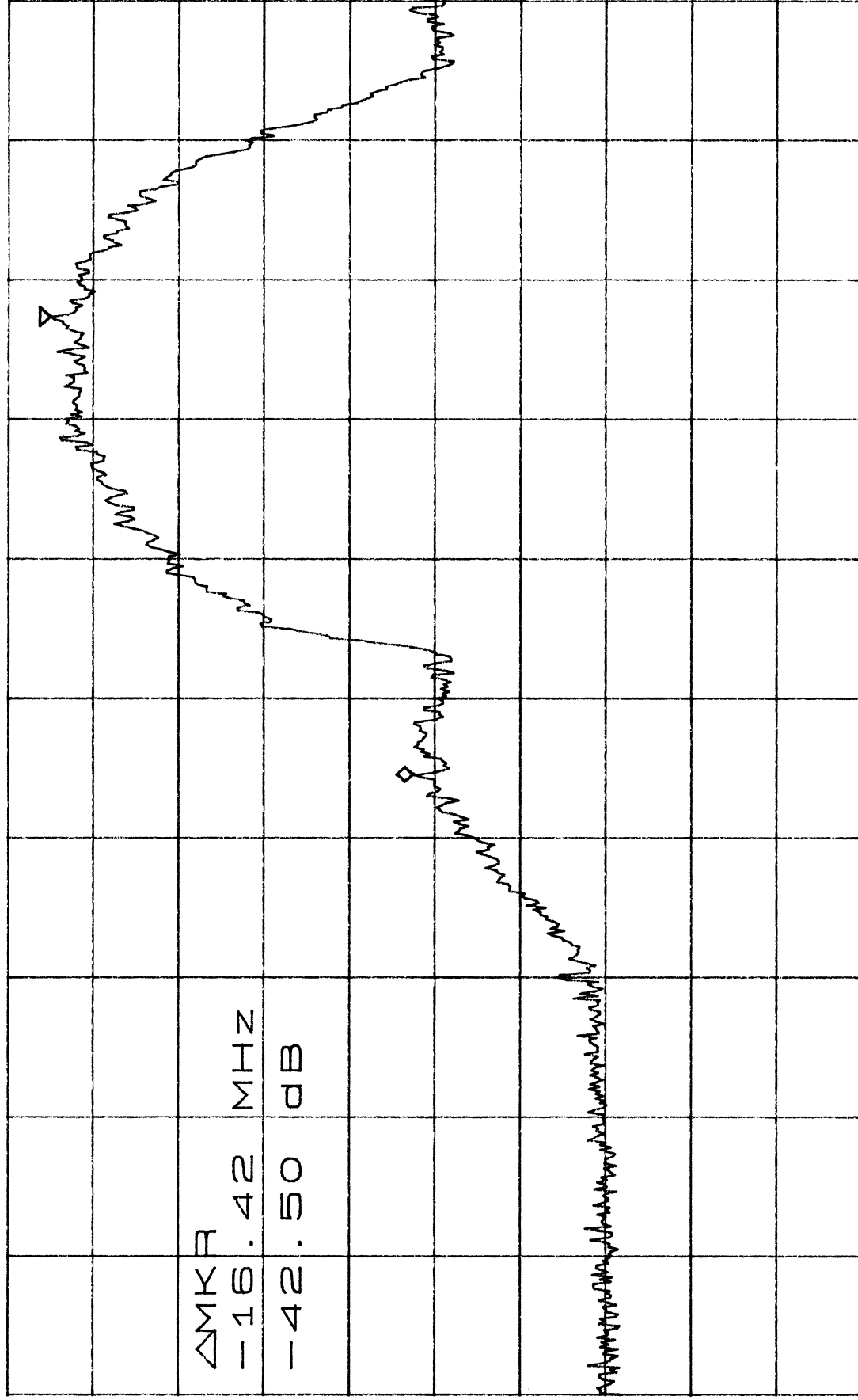
*VBW 1.0MHz

SWP 610ms

*ATTEN 20dB
RL 10.0dBm

ΔMKR -42.50dB
-16.42MHz

10dB/



D

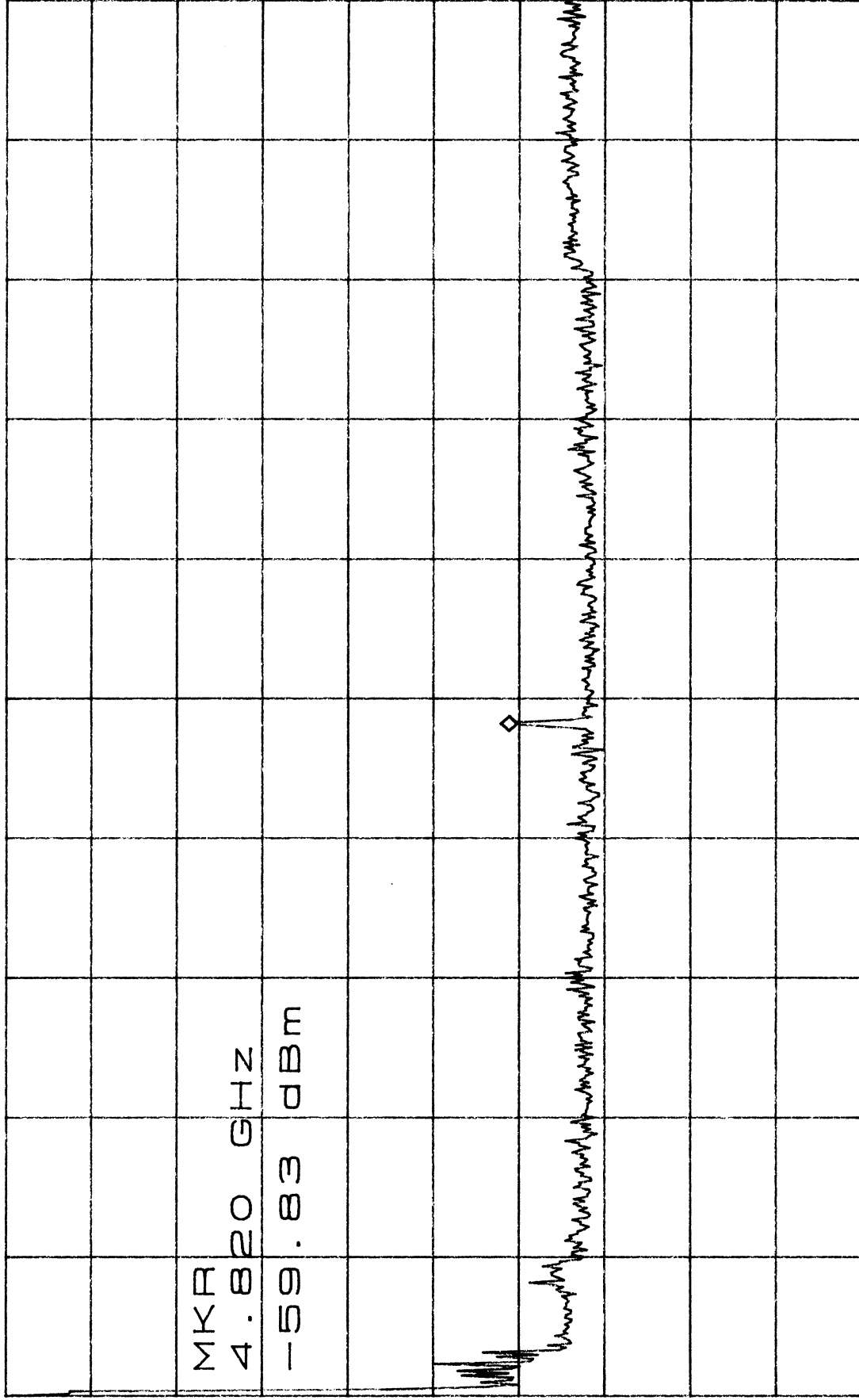
*ATTEN 20dB

MKR -59.83dBm

RL 0dBm

10dB/

4.820GHz



D

START 2.412GHz

STOP 7.412GHz

*RBW 100kHz

*VBW 1.0MHz

SWP 1.3sec

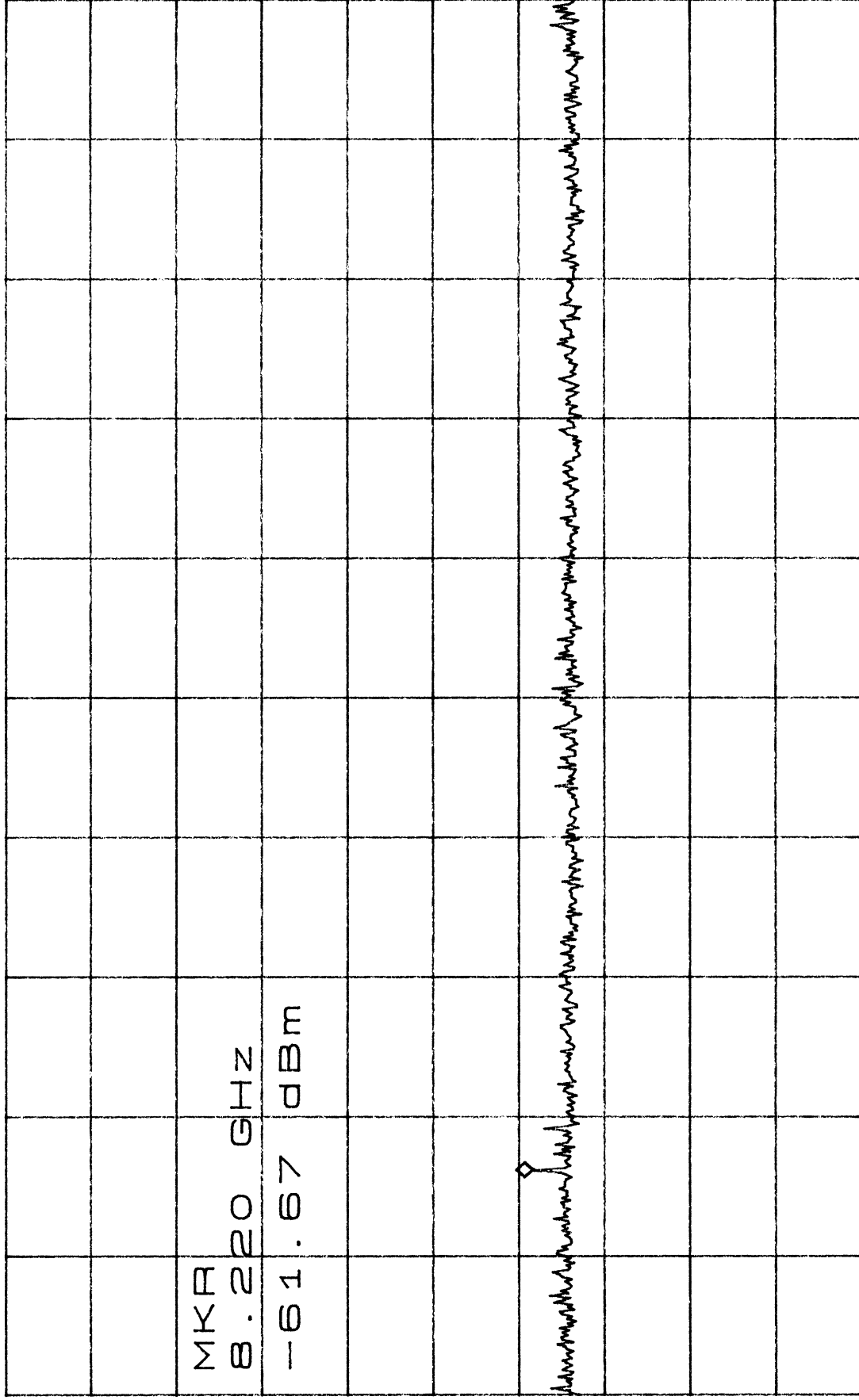
*ATTEN 20dB

MKR -61.67dBm

RL 0dBm

10dB/

8.220GHz



START 7.412GHz

STOP 12.412GHz

*RBW 100kHz

*VBW 1.0MHz

SWP 1.3sec

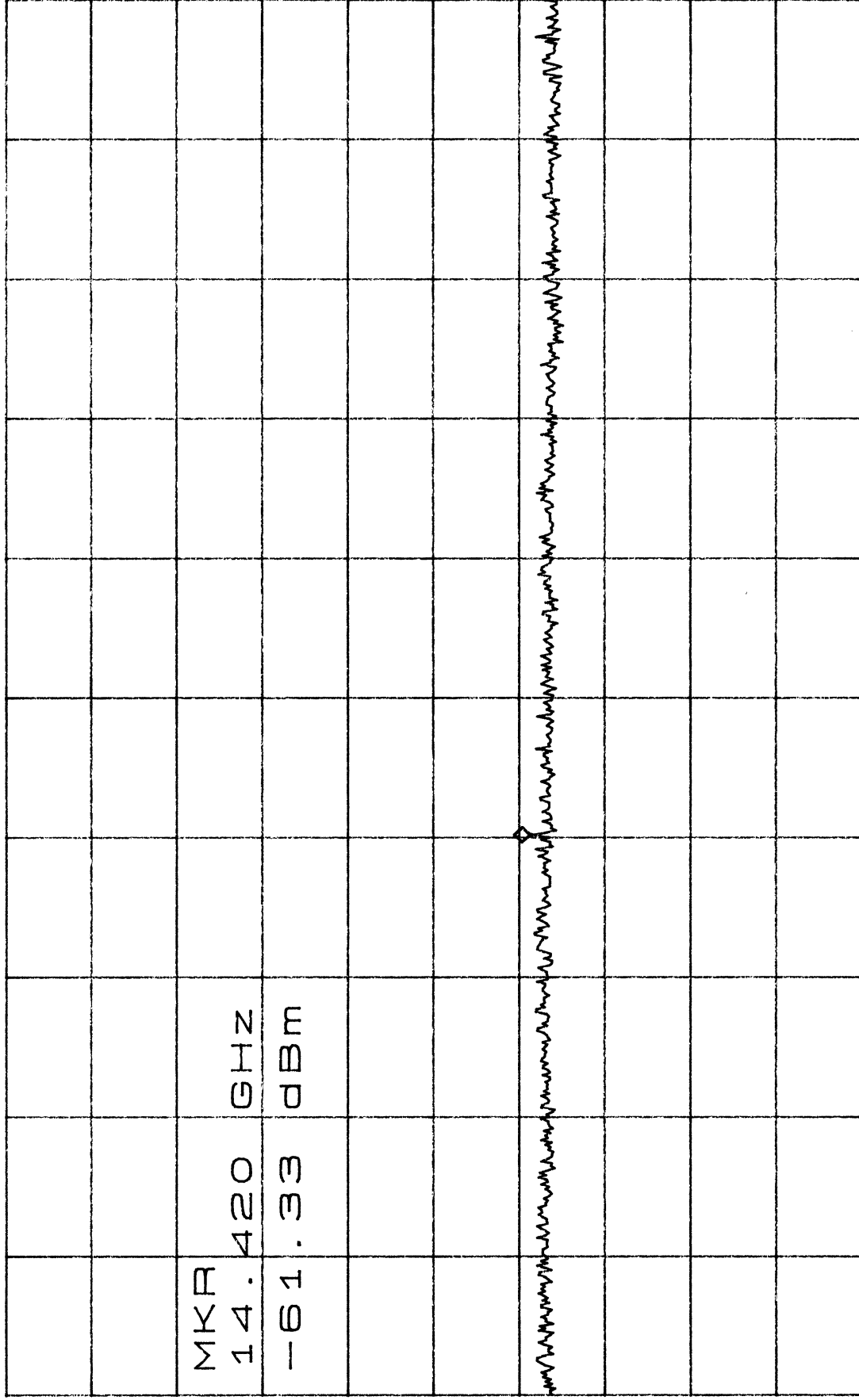
*ATTEN 20dB

MKR -61.33dBm

RL 0dBm

10dB/

14.420GHz



D

START 12.412GHz

STOP 17.412GHz

*RBW 100kHz

*VBW 1.0MHz

SWP 1.3sec

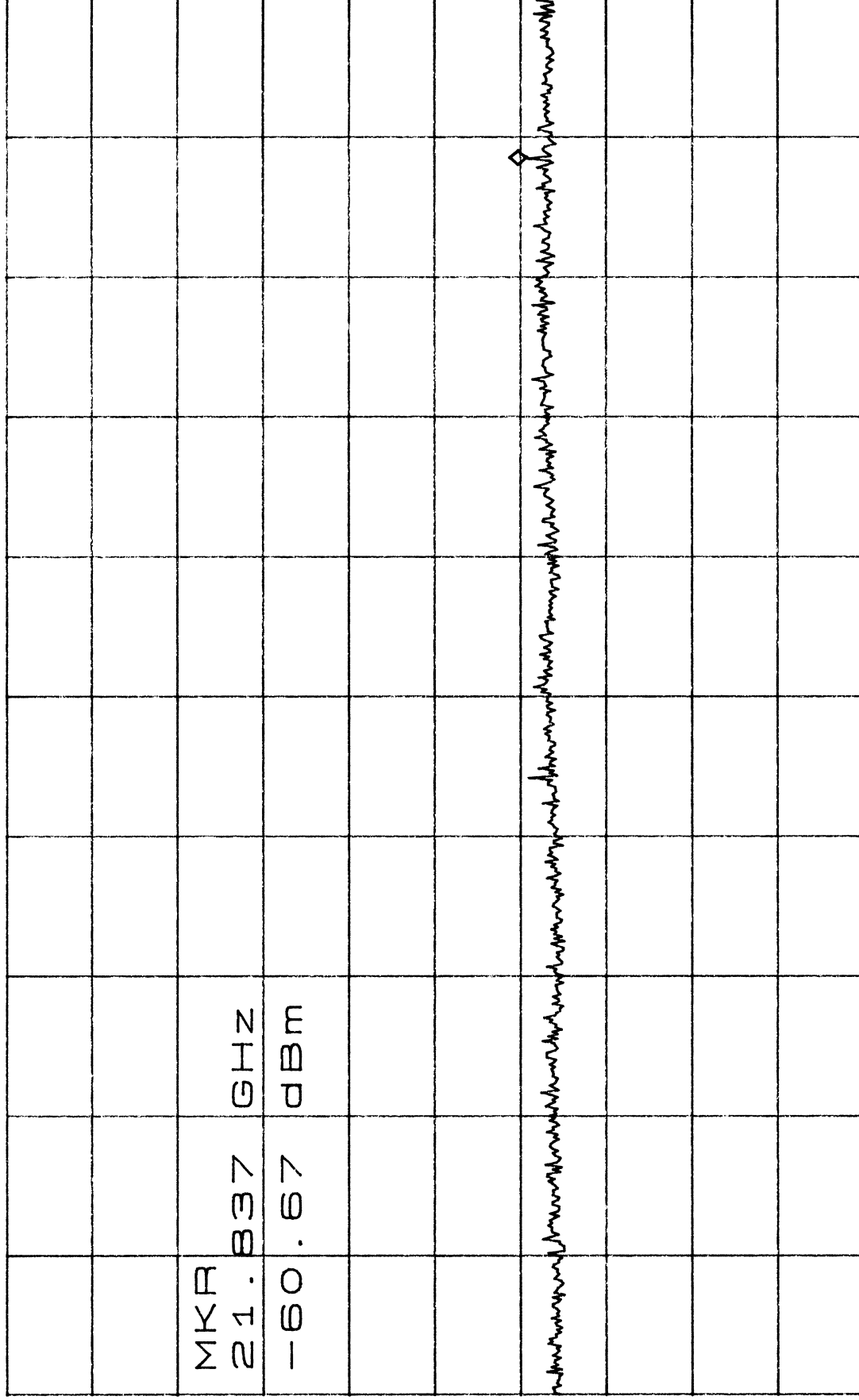
*ATTEN 20dB

MKR -60.67dBm

RL 0dBm

10dB/

21.837GHz



D

START 17.412GHz

STOP 22.412GHz

*RBW 100kHz

*VBW 1.0MHz

SWP 1.3sec

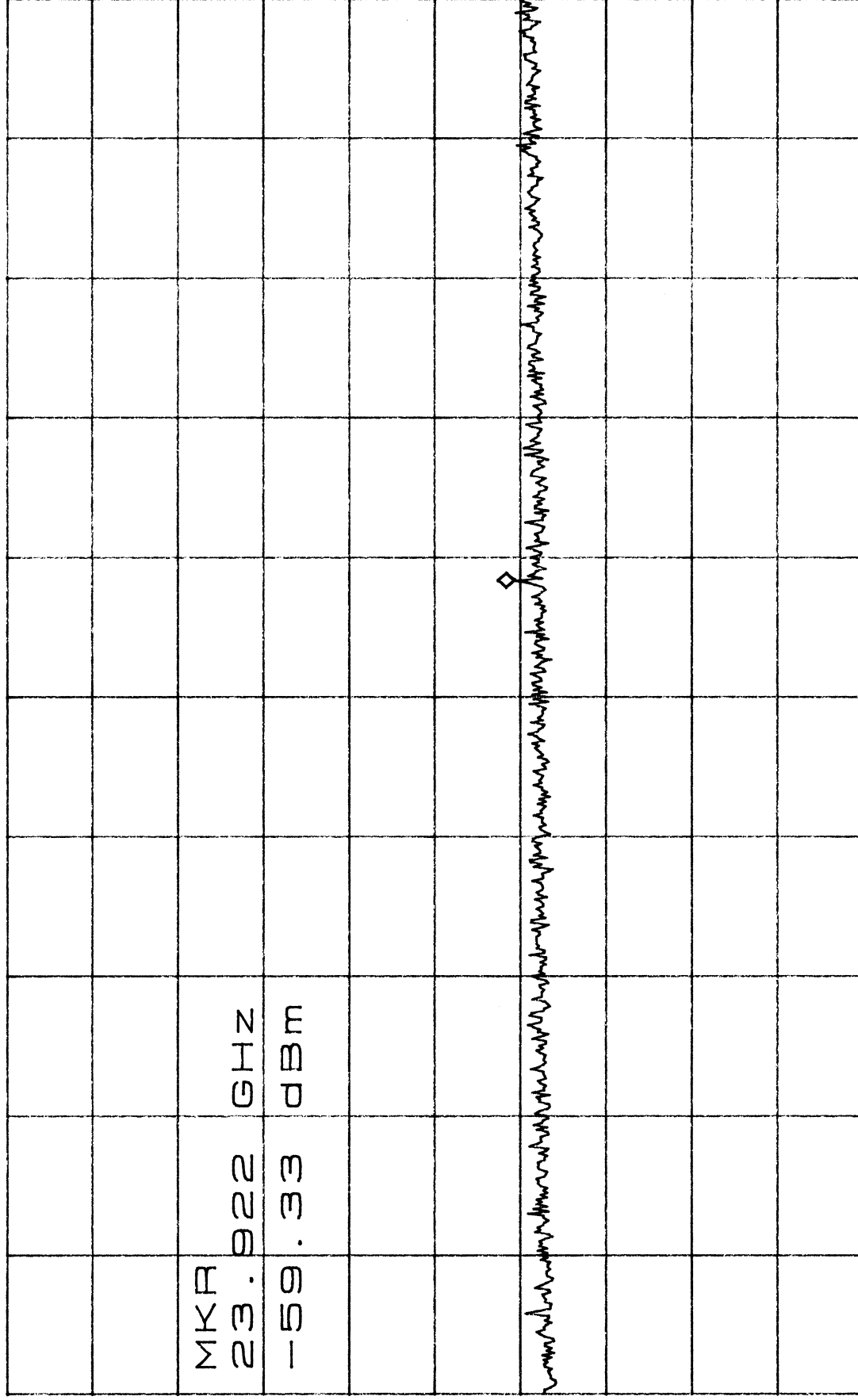
*ATTEN 20dB

MKR -59.33dBm

RL 0dBm

10dB/

23.922GHz



START 22.412GHz STOP 25.000GHz

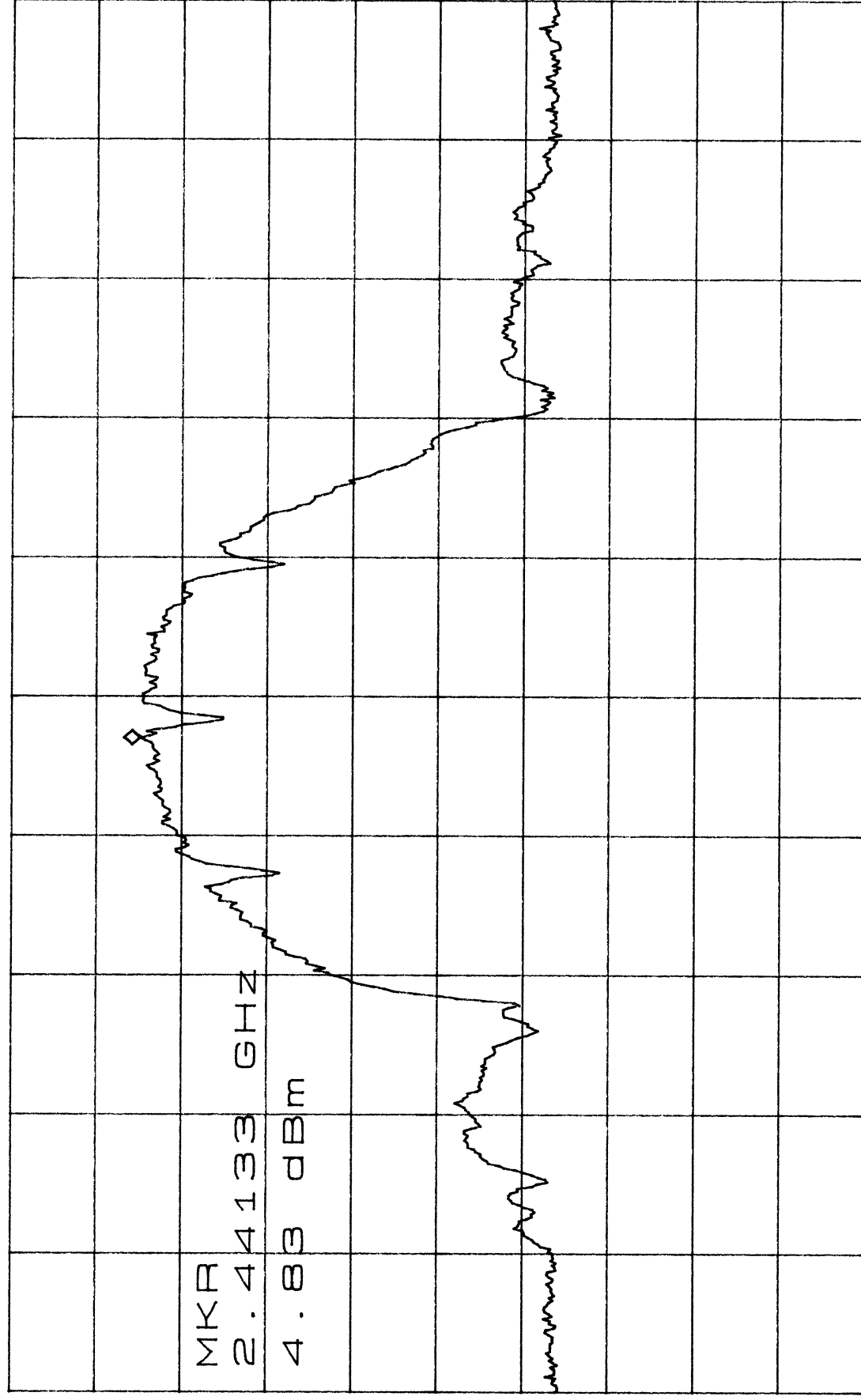
*RBW 100kHz

*VBW 1.0MHz

SWP 650ms

*ATTEN 40dB
RL 20.0dBm

MKR 4.83dBm
2.44133GHz



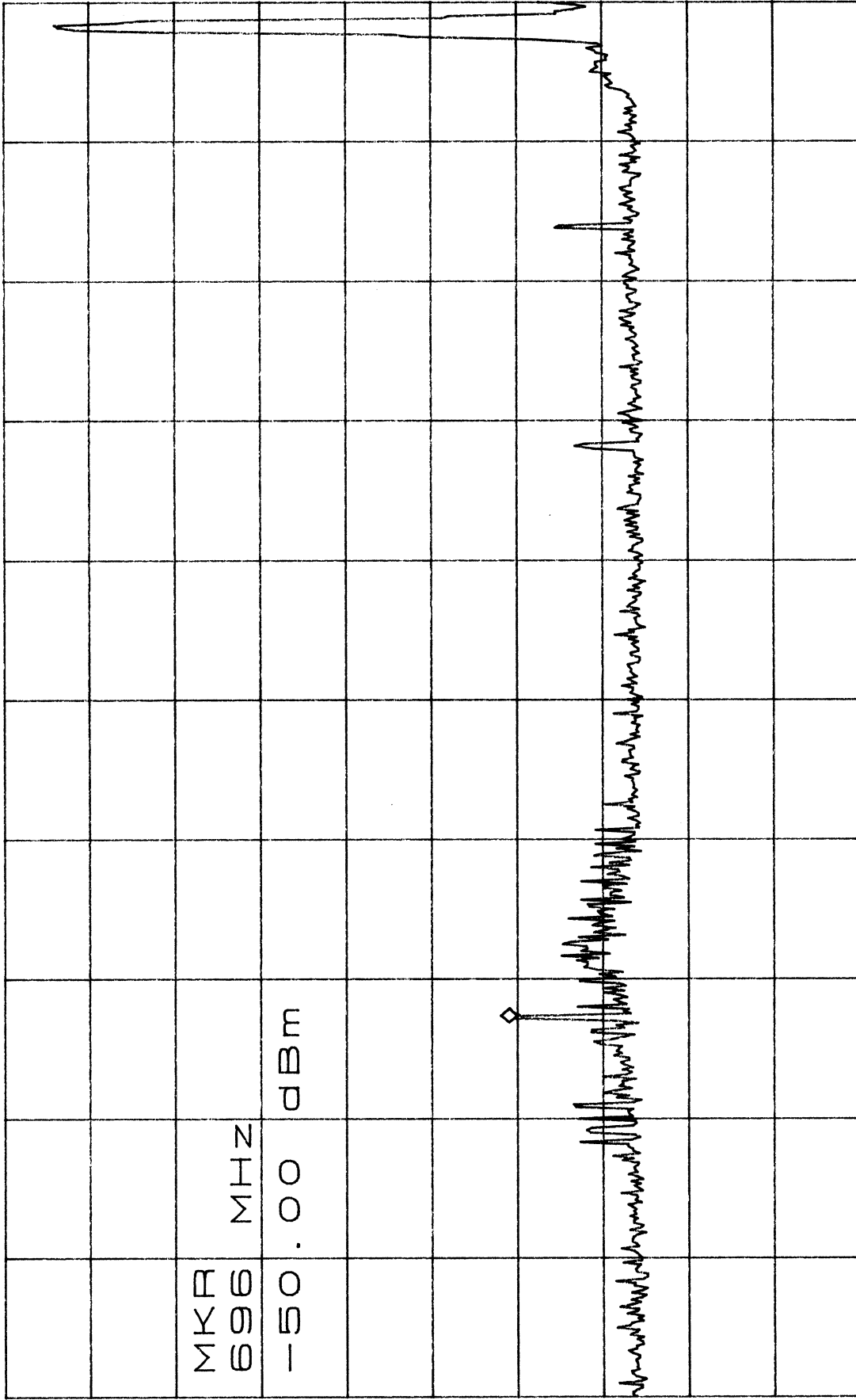
START 2.41783GHz
*RBW 100kHz *VBW 1.0MHz

STOP 2.46783GHz
SWP 50ms

*ATTEN 20dB
RL 10.00dBm

MKR -50.00dBm
696MHz

10dB/



START 30MHz

STOP 2.466GHz

*RBW 100kHz

*VBW 1.0MHz

SWP 610ms

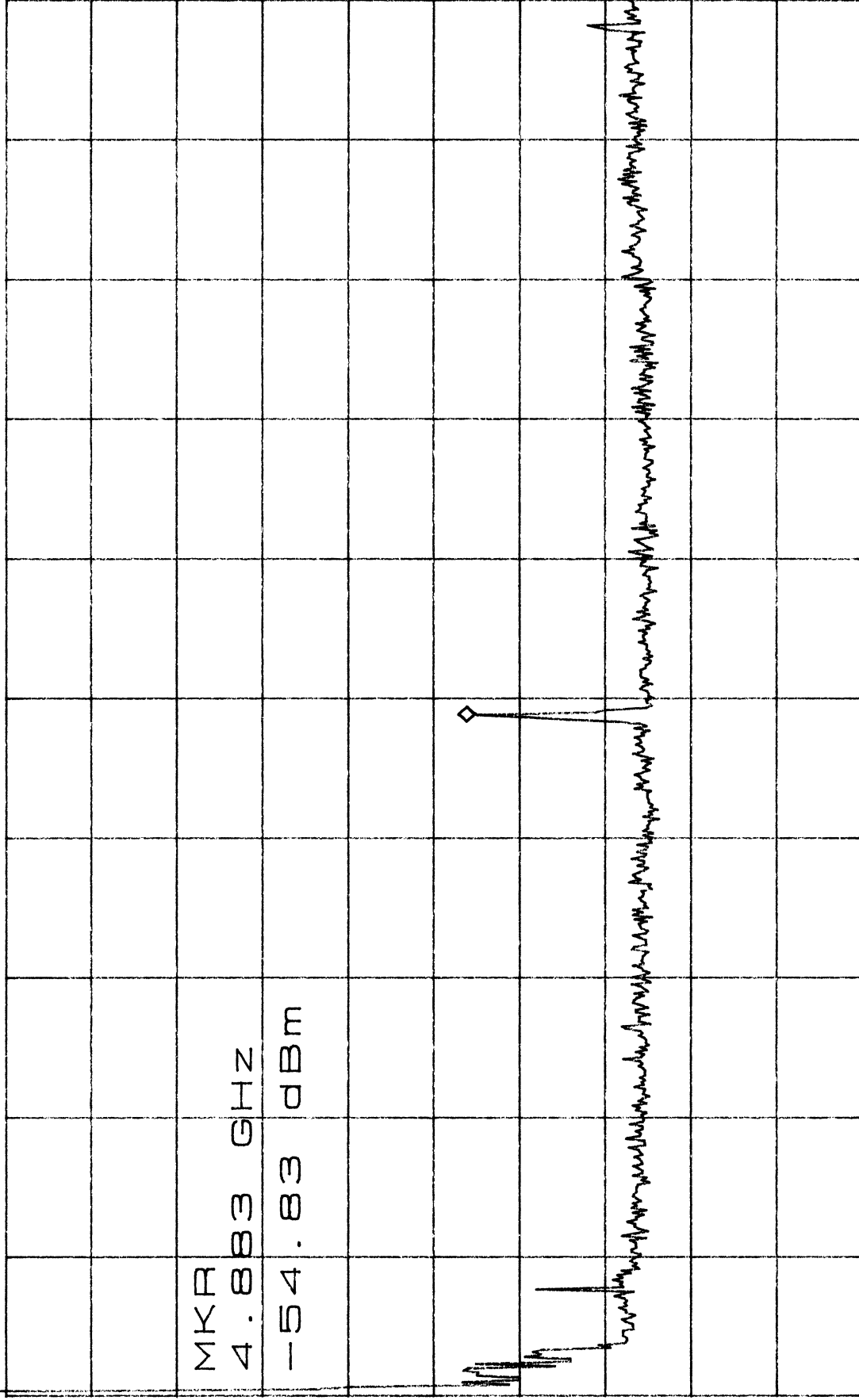
*ATTEN 10dB

MKR -54.83dBm

RL 0dBm

10dB/

4.883GHz



START 2.442GHz

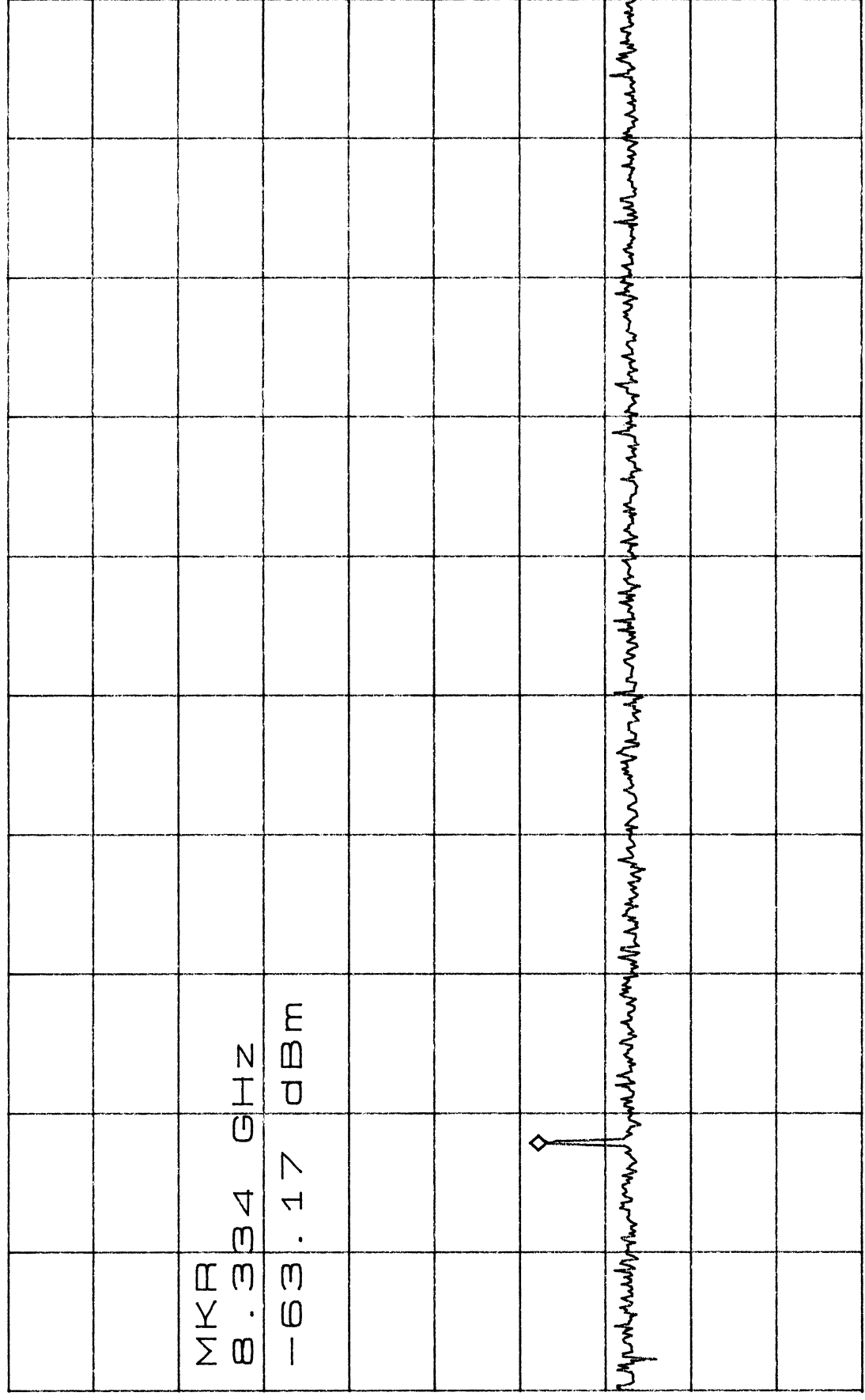
STOP 7.440GHz

*RBW 100kHz

*VBW 1.0MHz

SWP 1.3sec

*ATTEN 10dB MKR -63.17dBm
RL 0dBm 8.334GHz 10dB/



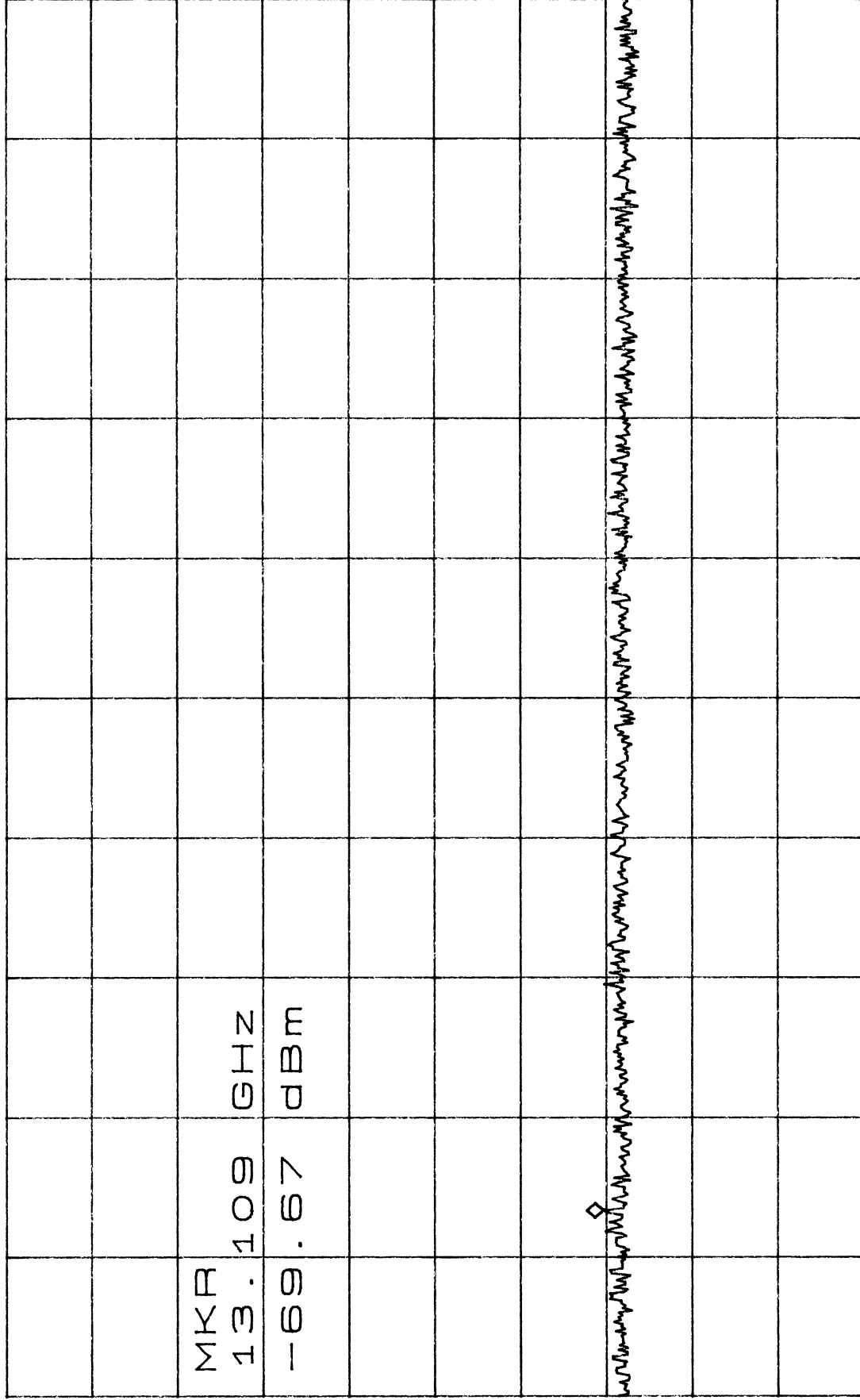
*ATTEN 10dB

MKR -69.67dBm

RL 0dBm

10dB/

13.109GHz



START 12.442GHz

STOP 17.442GHz

*RBW 100kHz

*VBW

1.0MHz

SWP 1.3sec

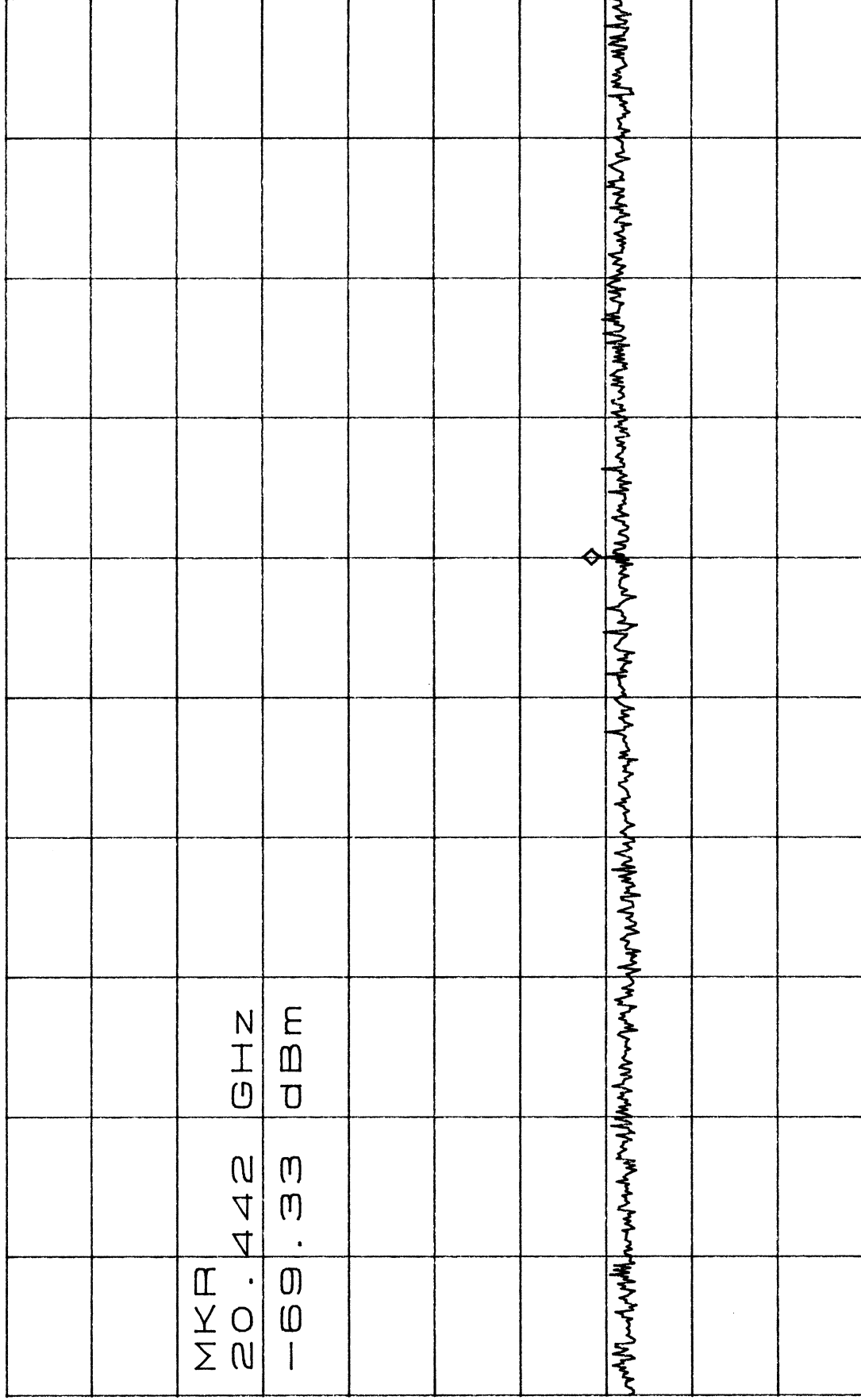
*ATTEN 10dB

MKR -69.33dBm

RL 0dBm

10dB/

20.442GHz



START 17.442GHz

STOP 22.442GHz

*RBW 100kHz

*VBW

1.0MHz

SWP 1.3sec

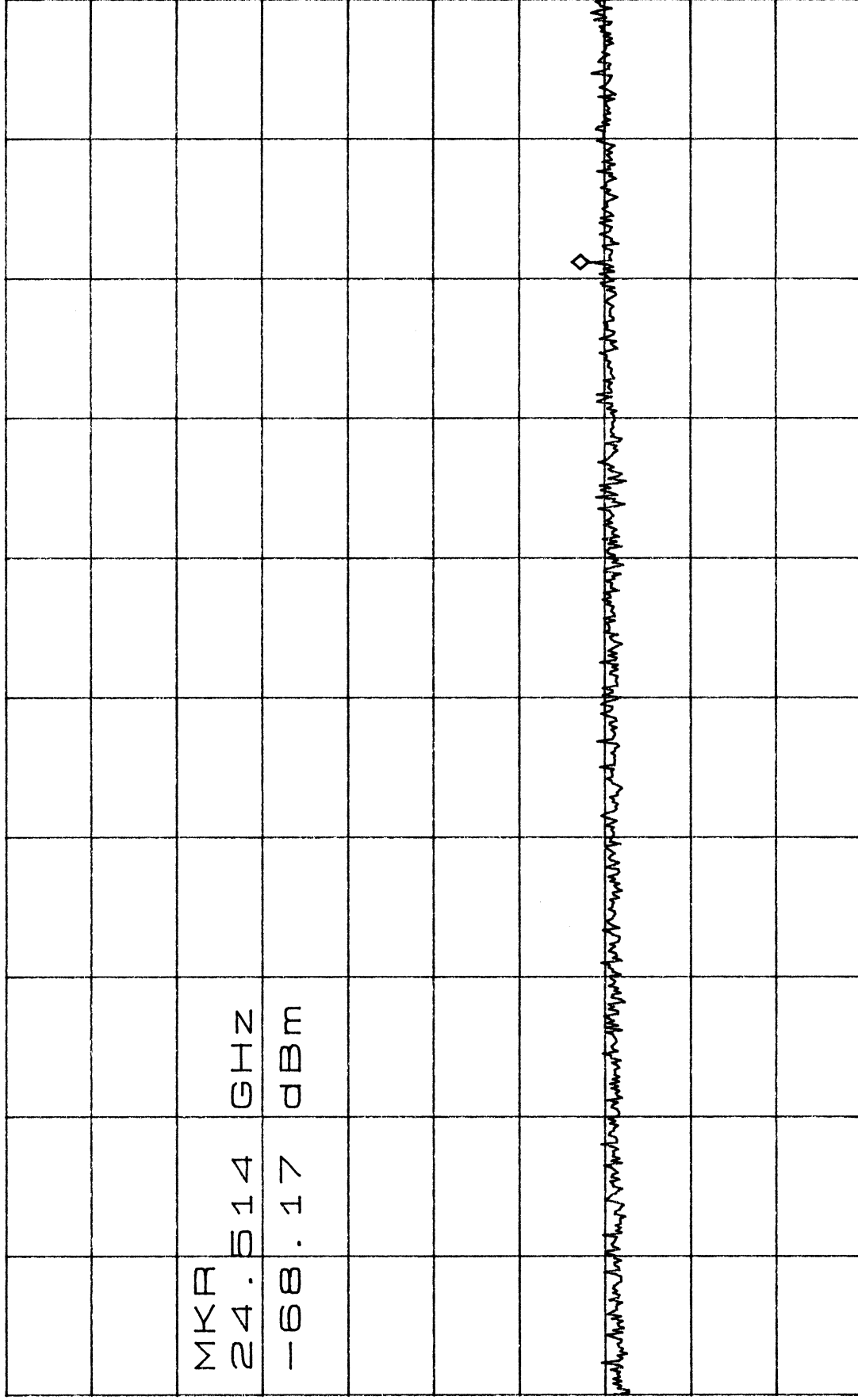
*ATTEN 10dB

MKR -68.17dBm

RL 0dBm

10dB/

24.514GHz



START 22.420GHz

STOP 25.000GHz

*RBW 100kHz

*VBW

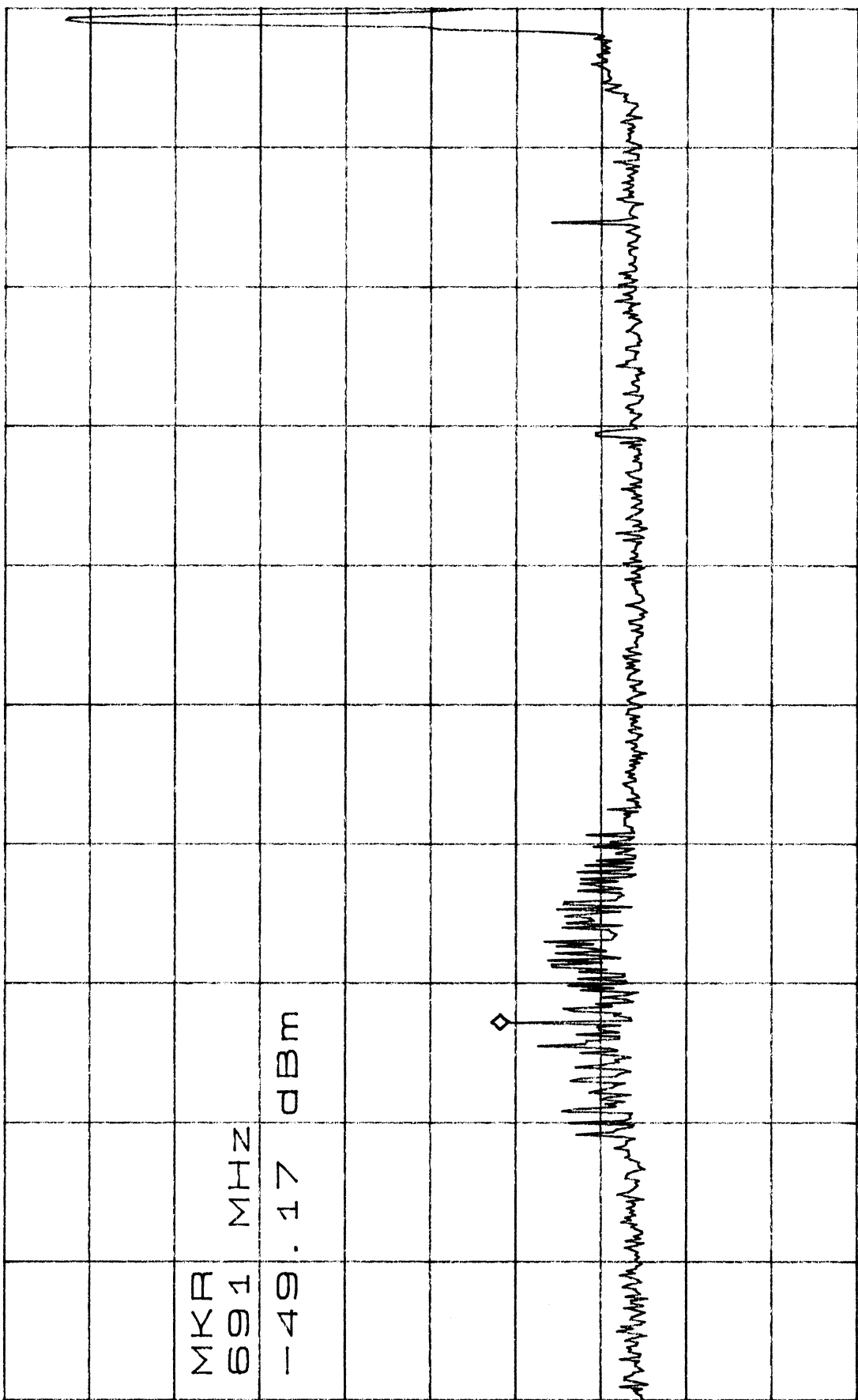
1.0MHz

SWP 650ms

*ATTEN 20dB
RL 10.0dBm

MKR -49.17dBm
691MHz

10dB/

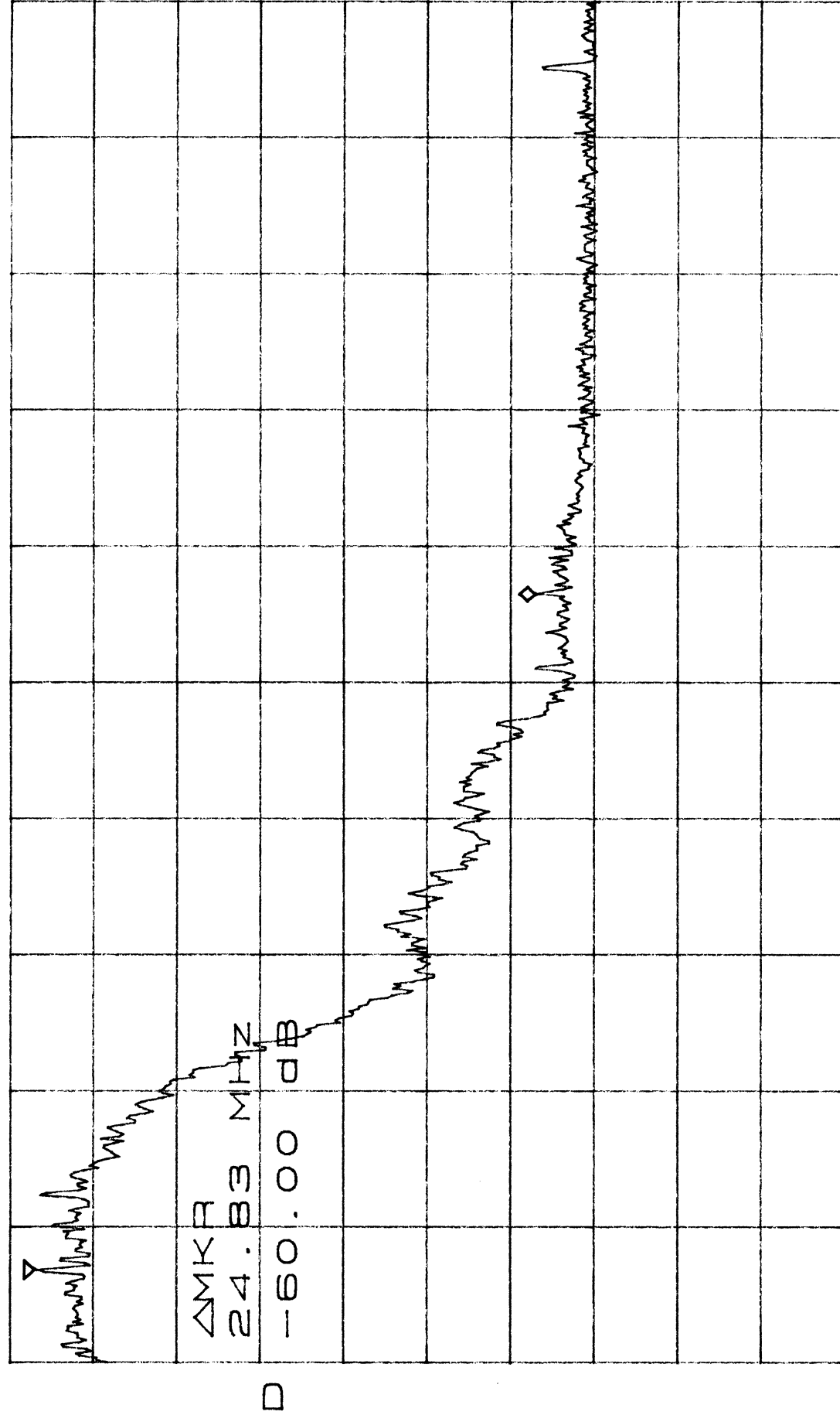


START 30MHz
*PRBW 100kHz

STOP 2.462GHz
*VBW 1.0MHz SWP 610ms

*ATTEN 20dB
RL 10.0dBm

ΔMKR -60.00dB
24.83MHz



CENTER 2.48350GHZ

SPAN 50.00MHz

*RBW 100KHz

*VBW 1.0MHz

SWP 50ms

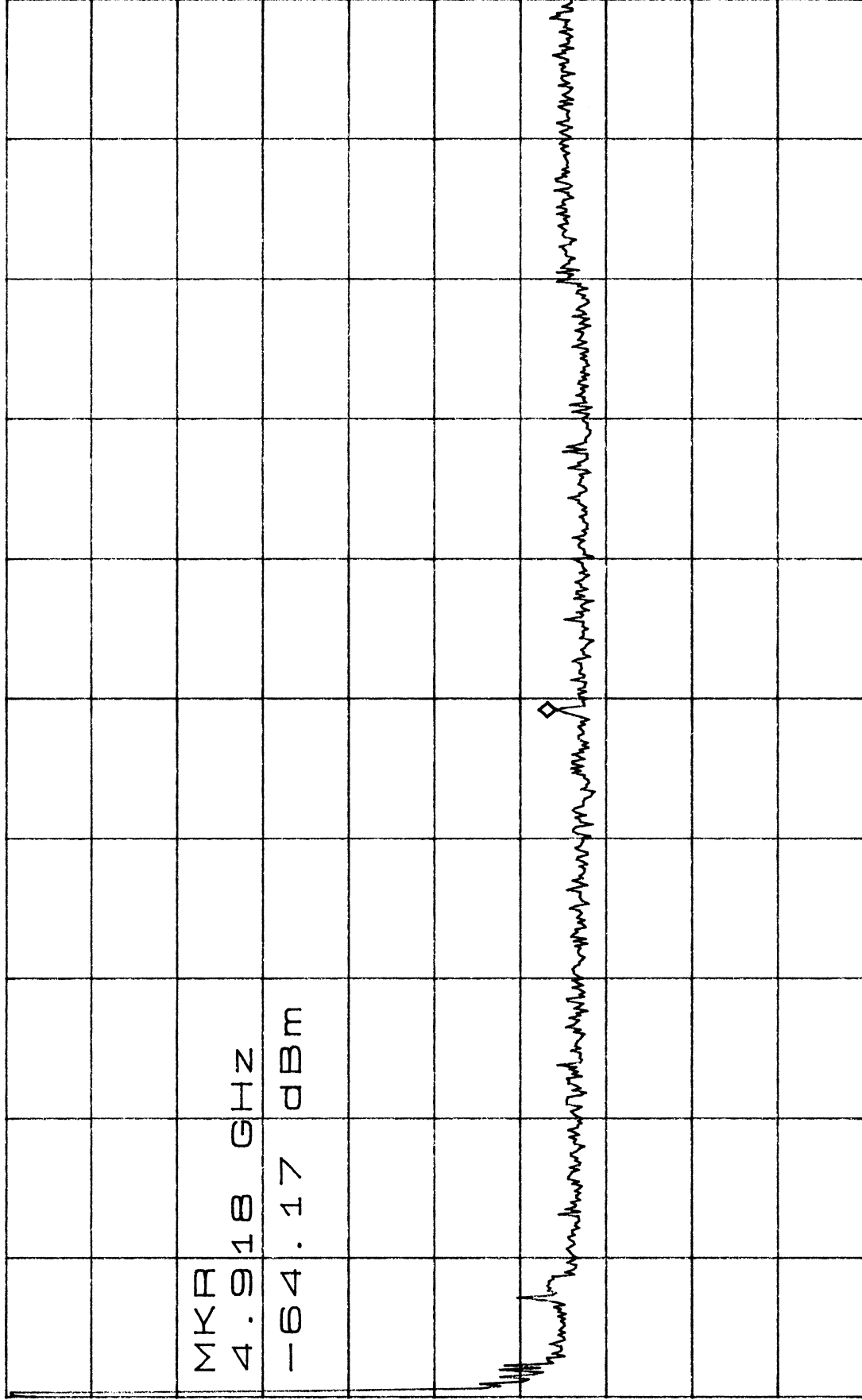
*ATTEN 20dB

MKR -64.17dBm

RL 0dBm

10dB/

4.918GHz



START 2.460GHz

STOP 7.460GHz

*RBW 100kHz

*VBW 1.0MHz

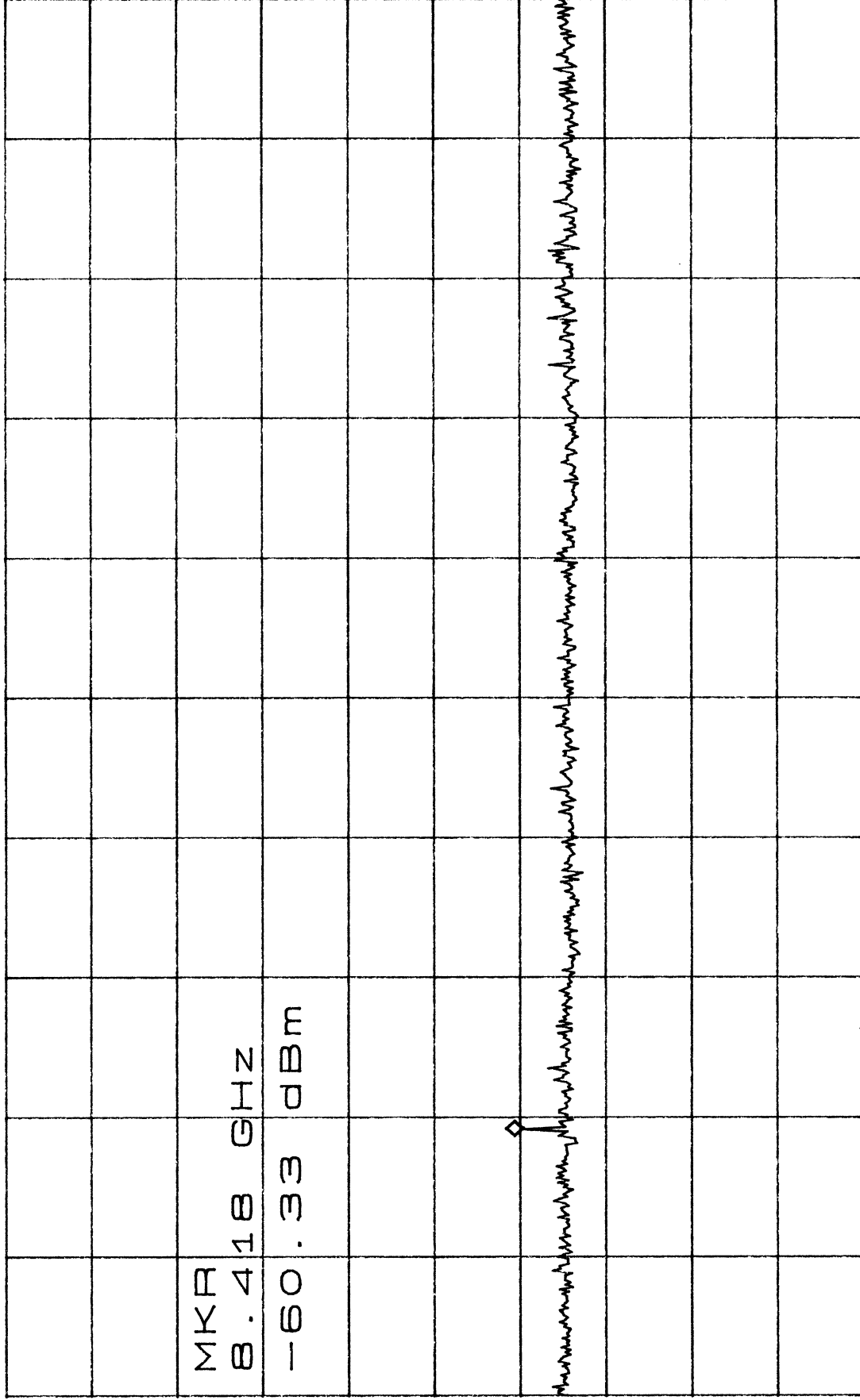
SWP 1.3sec

*ATTEN 20dB

MKR -60.33dBm

RL 0dBm

10dB/ 8.418GHz



D

START 7.460GHz

STOP 12.460GHz

*RBW 100kHz

*VBW 1.0MHz

SWP 1.3sec

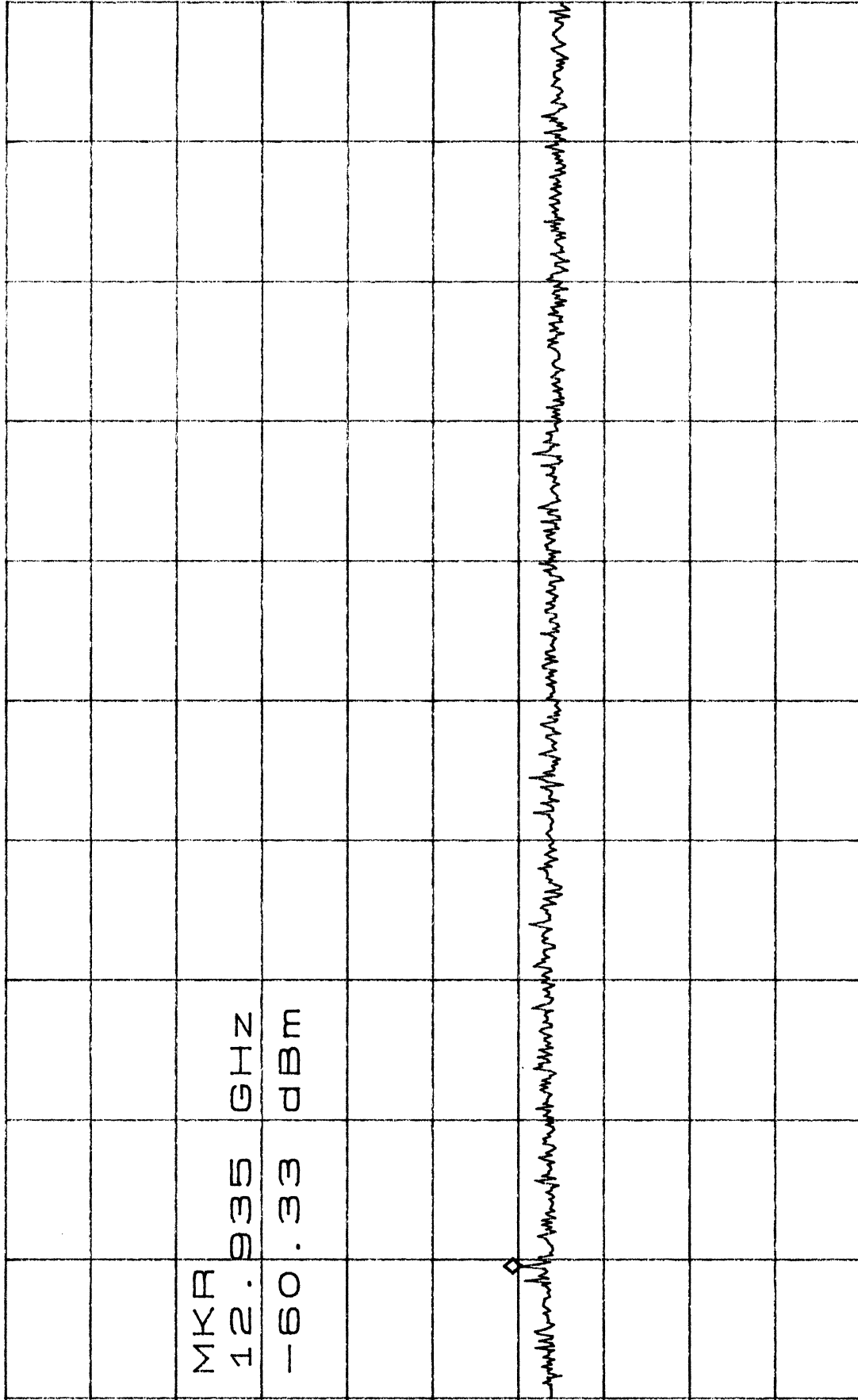
*ATTEN 20dB

MKR -60.33dBm

RL 0dBm

10dB/

12.935GHz



START 12.460GHz

STOP 17.460GHz

*RBW 100kHz

*VBW

1.0MHz

SWP 1.3sec

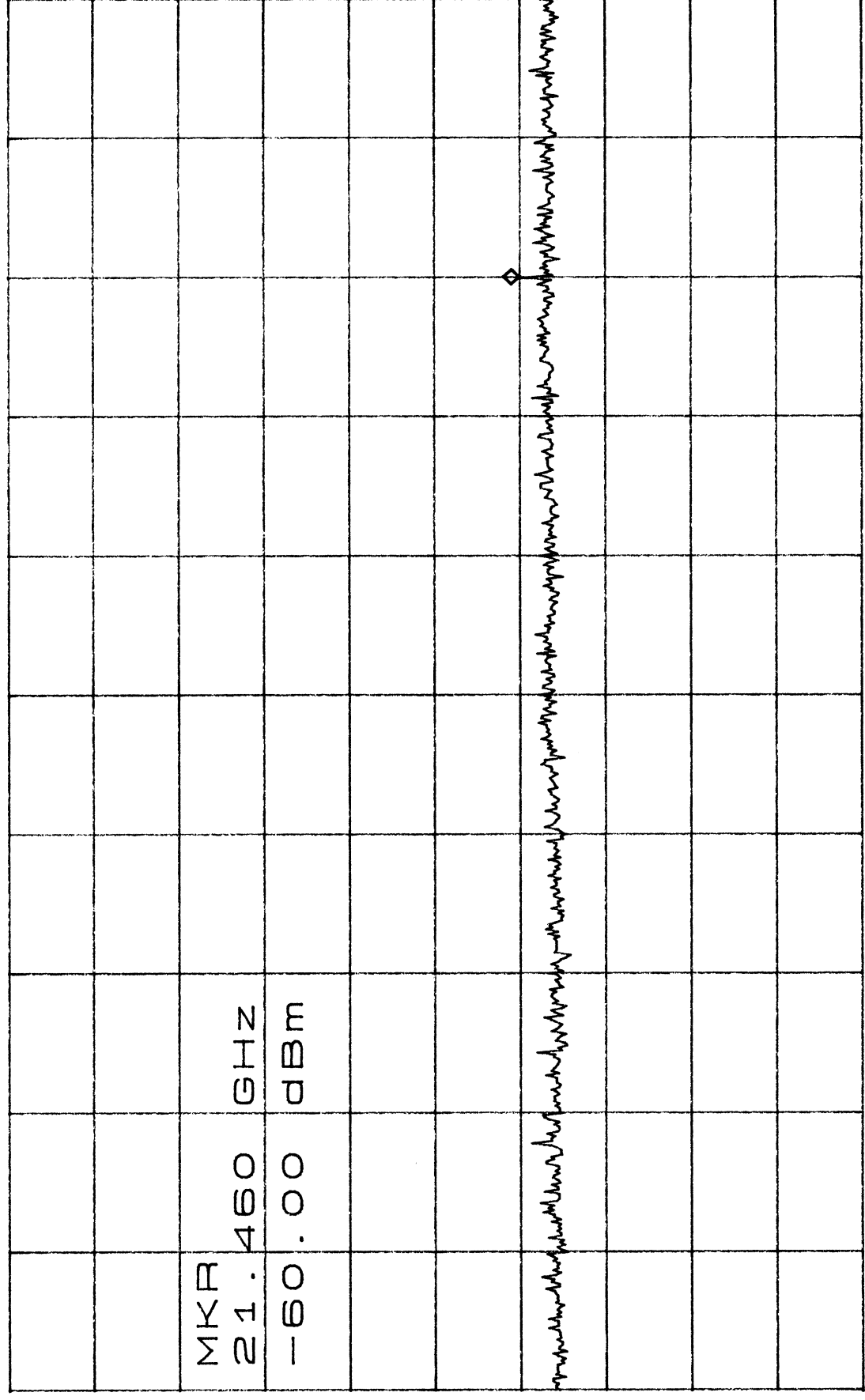
*ATTEN 20dB

MKR -60.00dBm

RL 0dBm

10dB/

21.460GHz



D

START 17.460GHz

STOP 22.460GHz

*RBW 100kHz

*VBW 1.0MHz

SWP 1.3sec

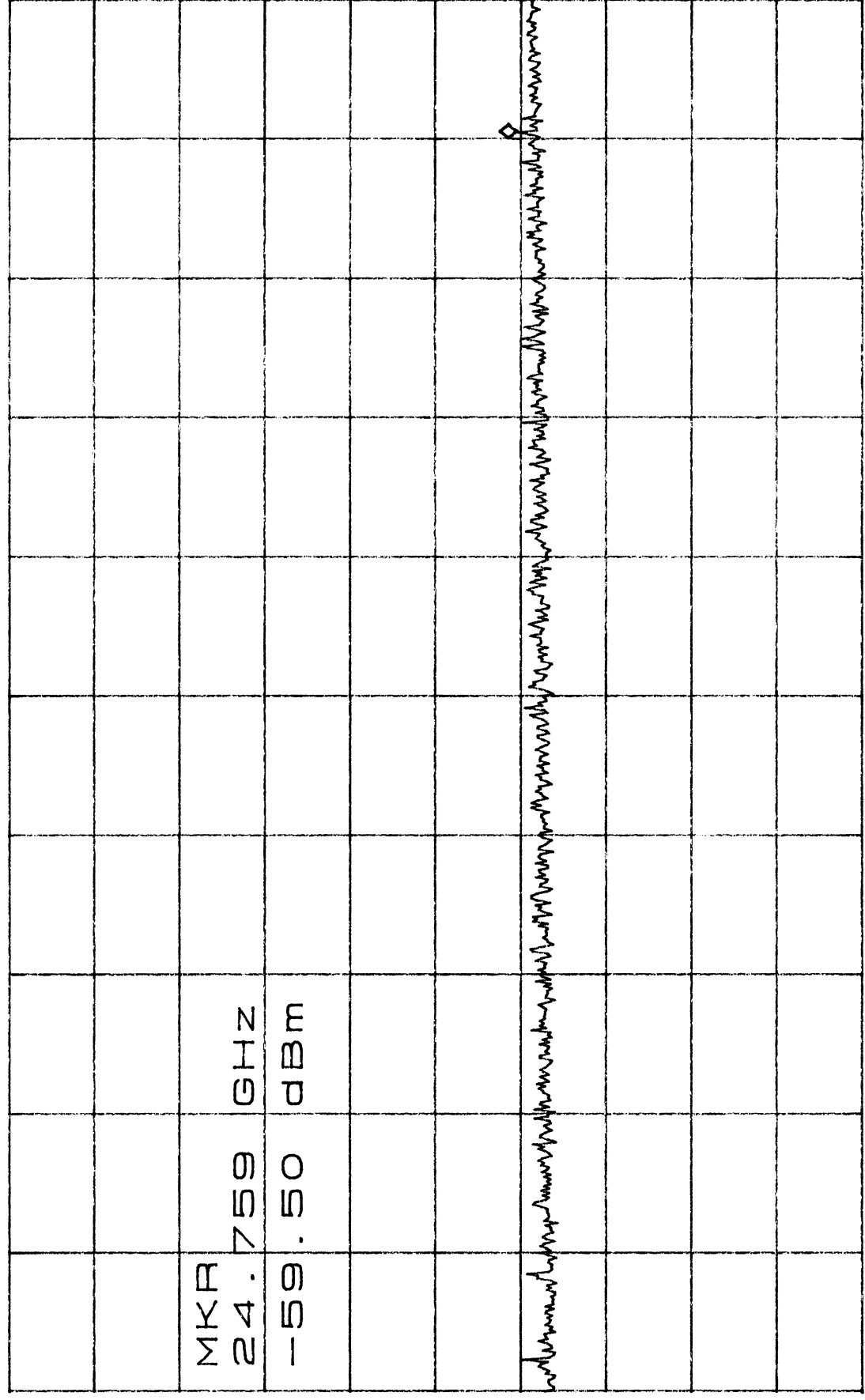
*ATTEN 20dB

MKR -59.50dBm

RL 0dBm

10dB/

24.759GHZ



START 22.460GHZ

STOP 25.000GHZ

*RBW 100KHZ

*VBW 1.0MHZ

SWP 640ms