Metricom®

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Amendment

Part 15 Certification Application for FCC ID#GNW-24000

Industrie Canada RSS210 Certification Application

EMI Test Report
and
Technical Documentation
on
Metricom, Inc.
Ricochet II Network Radio
Model 24000

Prepared by:
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Tested: April, May, June 1999

Metricom®

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To whom it may concern,

This document is to serve as an amendment to the original certification application filed in January 1999 for Metricom MCDN Network radio GNW-24000.

The reason for re-testing the radios after the original application was submitted is that there was several modifications made to the radios in terms of hardware and software.

The broad changes that prompted re-testing are outlined below.

- Modifications to the 900 MHz and 2.4 GHz RF boards to improve performance in the MCDN network
- Modifications to the digital card to incorporate the Ethernet "Stuffing Option" (See Below)
- Modifications to the software to incorporate "band-splitting". A detailed explanation of "Band-Splitting" is included in this addendum

The following tests were performed to verify that the MCDN Microcell radio is in compliance with 15.247

- Transmit Power
- 20 dB Occupied Bandwidth
- Channel occupancy time
- Radiated emissions in restricted bands
- Class B radiated emissions

The above tests make up an entire suite of tests that is usually conducted on a new product.

There was an additional type of radio tested that was not available for testing during the original testing several months ago. This is a new version of the MCDN radio that has an external Ethernet port. This is referred to as the Ethernet Radio. The Ethernet radio is identical to the MCDN network radio with a few exceptions.

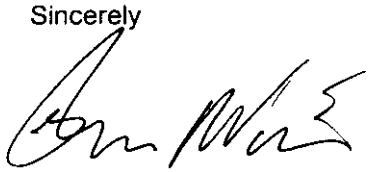
- 2.4 GHz omni or high gain patch antenna rather then the 2.4 GHz patch antennas used on the MCDN Network radio
- The Ethernet radio is DC powered
- There is an external Ethernet port on the radio.

The internal circuit boards in the two units (the Ethernet Radio and the MCDN Network Radio) are the same layout. There are simply additional components installed on the digital card of the Ethernet radio. The Ethernet components are simply a "stuffing option" on the digital card.

Metricom would like to certify both of these versions of the radio under the same GNW number is possible.

If there are any question or concerns with the data in this addendum, please do not hesitate to contact me at the address, phone number or email (preferred) above.

Sincerely



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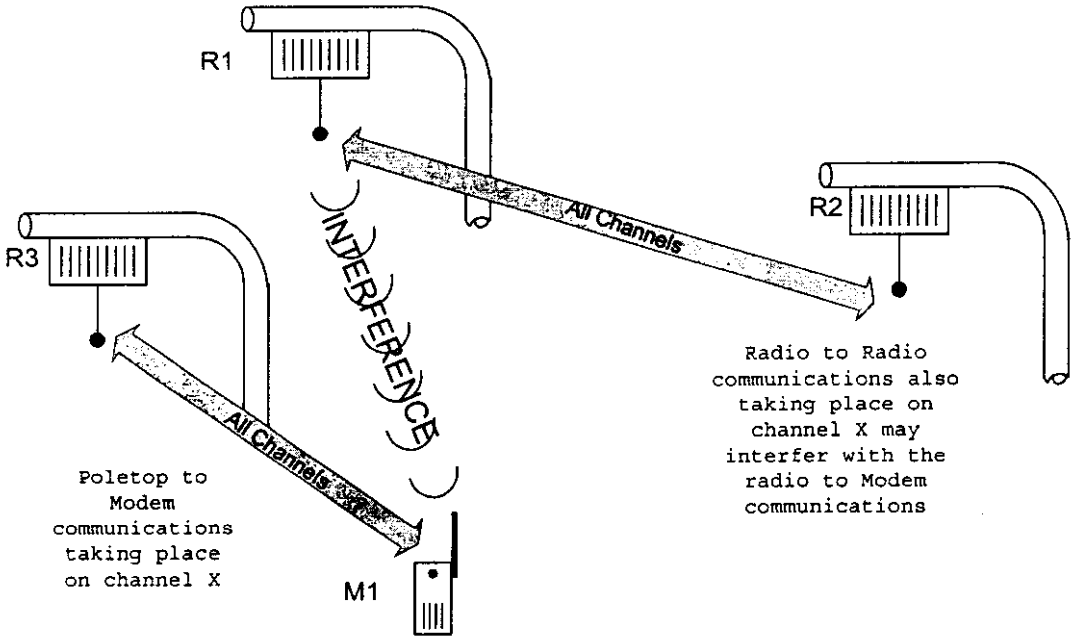
"Band-Splitting" in Metricom's MCDN Network

In the previous MCDN Network that utilized only the Part 15 900 MHz band there were 161 channels that were evenly spaced across the 902 – 928 MHz band. All of these channels were used by the modems (being used by the users of the network) and the MCDN Network radios that would relay the data to a "Wired Access Point" in the MCDN Network.

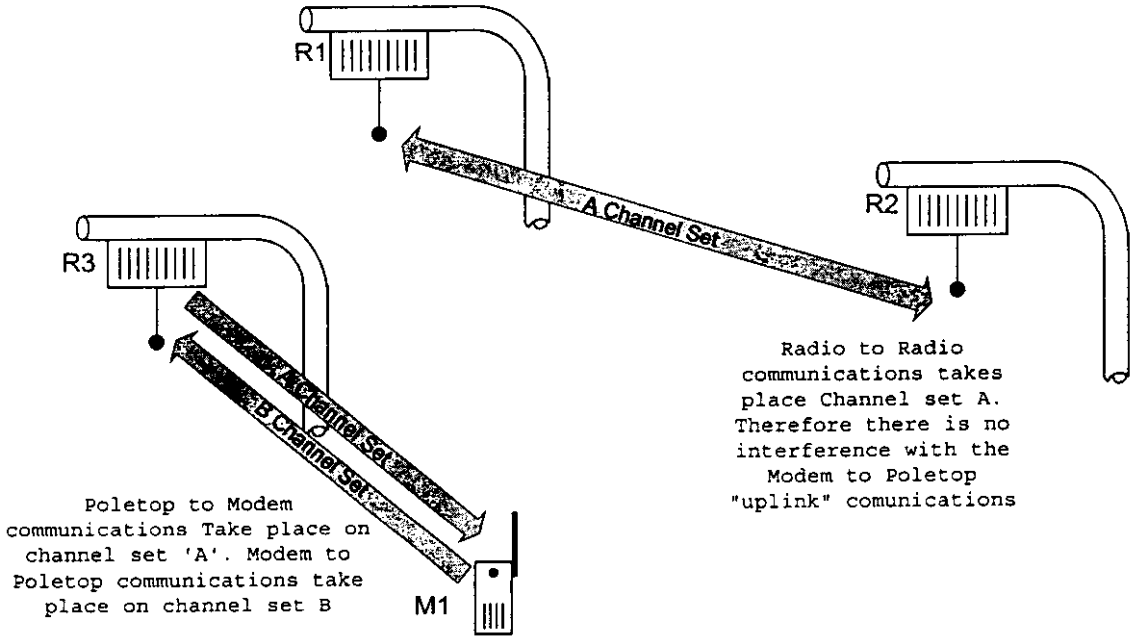
Thus the same channels were used for the traffic from the radio to the modem (Downlink) and the modem to the nearest radio (Uplink) as well as the traffic from radio to radio across the network.

It was found that in many cases, a transmission occurring from radio 'R1' to radio 'R2' on a given channel may interfere with data transmission between radio 'R3' and modem 'M1' on that same channel if all the units were in close proximity to each other. This "Self Interference" would cause the data packet to be re-sent thus creating unnecessary data transmissions and having the effect of slowing the data throughput of the user.



"Band-Splitting" in Metricom's MCDN Network, Continued

Metricom made the decision to assign certain channels to be used in the uplink and others to be used in the downlink. There are a total of 50 channels assigned to the uplink and 56 channels assigned to the downlink. This would reduce the chance of the interference to the uplink from the modem to the radio which is the least robust link in the system. These uplink and downlink channels are referred to as 'A" and 'B' channels in the diagram below.



1.0 Verification of Compliance

Description:	Metricom MCDN Network Radio Metricom Ethernet Radio
Model Number:	24000
Serial Number(s):	Pre-production Models
Applicant:	Metricom Inc.
Type of Test:	FCC part 15.247 Application for Part 15 certification Industrie Canada RSS-210 certification
Date(s) of test:	April – Juine 1999
Tested By	David Waitt (Metricom, Los Gatos) Shawn McGuinness, Electronic Compliance Laboratories. (EC Labs)

The above equipment was tested by Metricom Inc. and EC Labs and found to be in compliance with the requirements set forth in Part 15 of the FCC Rules and Regulations and Industrie Canada RSS210 6.2.2.(O) governing licence-exempt low power radio communication devices.

David Waitt
Engineer
Metricom, Inc.

7-7-99
Date

2.0 General Information

Applicant: Metricom, Inc.
980 University Ave.
Los Gatos, CA. 95030

Contact Person David Waitt
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(Fax) 408-354-1024

Equipment Under Test: Metricom Ricochet II Network Radio

Model Number: 24000

Serial Number(s): LG-84010007 and LG-84010019

Type of Test: FCC part 15 Certification for FCC ID GNW-24000
Industrie Canada RSS-210 Certification application

Reason for **ADDITIONAL** testing:

After the submission of the original certification application, there were several changes made to the radio in both hardware and software. Due to the scope of these changes, the radio was re-tested to ensure that it still complied with 15.247 of the FCC rules.

The note from the original application is included below

Metricom has developed the second generation of its Microcellular Data Network (MCDN). In a broad sense this new network operates in a similar fashion to the current Metricom MCDN, (which is used to provide the Ricochet Wireless data service in the metropolitan areas of San Francisco, San Jose, Seattle and Washington D.C.) The most notable difference between the previous MCDN and the new MCDN is the speed of the network.

Brief description of Metricom's MCDN Network

The MCDN Network is a wide-area wireless data network using frequency-hopping spread-spectrum, packet data technology and Metricom's patented mesh architecture. The new network operates within the Part 15 (902-928 MHz and 2.4–2.4835 GHz) portions of the spectrum.

The Ricochet network consists of shoebox-sized radio transceivers, also called ***microcells***, which are typically mounted to streetlights or utility poles and are self-contained units (no connection other than prime power is required). They are strategically placed every quarter to half mile in a checkerboard pattern over a geographic area. Each microcell employs hundreds of hopping channels in the 900 MHz and 2.4 GHz band. (A detailed discussion of the hopping sequences is contained in Appendix C).

Within a "cluster" of microcells covering every 20 square miles, Metricom installs ***Wired Access Points***, or ***WAPS,*** which convert the RF packets into a format for transmission to the wired IP network backbone. Each WAP and its cluster of microcells can support thousands of subscribers.

The purpose of the MCDN Network Radio is to route data between Ricochet wireless modems and the closest WAP thus enabling users to send and receive email and connect to the internet from anywhere within the geographic area covered by the MCDN.

3.0 Results Summary

The following test were performed to demonstrate compliance with FCC Part 15.247 and RSS-210 6.2.2.(o). Compliance with the following Part 15 / RSS-210 regulations was verified:

Part 15 Paragraph	RSS-210 Paragraph	Test	Results
15.247(b)	6.2.2(o)(a) 3	Maximum Power Output at Antenna Terminal	29.6 dBm Max
15.247(a)(1)	6.2.2(o)(a)	Channel Frequency Separation (900MHz)	318 kHz Max
		(2.4GHz)	320 kHz Max
15.247(a)(1)(I)	6.2.2.(O)(a)-1	Minimum Number of Hopping Channels(900MHz)	50
		(2.4GHz)	256
15.247(a)(1)	6.2.2.(O)(a)-1	Average Channel Occupancy Time (900MHz)	98.32 ms / 10 Sec Avg.
		(2.4GHz)	25.16 ms / 10 Sec Avg
15.247(c)	6.2.2(o)(a) 4	Out of Band Conducted Emissions (900MHz)	-21.33dB @ Band Edge
		(2.4GHz)	-21 dB @ Band Edge
15.205	6.3(c)	Radiated Emissions in Restricted bands(900MHz)	4.1 dB in spec min
		(2.4GHz)	3.1 B in spec min
15.109	6.2.2.(o)(a)4	Class B Unintentional Radiated Emissions	1.7 dB in Spec, min w/QP

4.0 Test Facilities

The following tests:

Part 15	RSS-210	
15.205	6.2.2(o)(a) 5	Radiated Emissions in Restricted bands
15.109	6.2.2.(o)(a)4	Class B Unintentional Radiated Emission
	7.3	Receiver Spurious emissions (Radiated)

were conducted at:

Electronic Compliance Laboratories (**)
1249 Birchwood Drive
Sunnyvale, CA. 94089

The remaining tests described in this report were performed at:

Metricom, Inc.
980 University Ave
Los Gatos, CA. 95030

(**)
A description of the sites located at EC Labs is on file at:

Federal Communications Commission
PO 429
Columbia, MD. 21045

All of the sites at EC Labs are constructed and calibrated to meet ANSI C63.4-1994 requirements.

5.0 Test Equipment & General Test Methods

Equipment:

The following test equipment was used to perform the testing

Description	Manufacturer	S/N	Model No.
EMI Receiver	HP	3325A00137	8456A
Pre-amp	HP	313A06829	8447F
Pre-amp	HP	3008A00527	8449B
LISN	EM	2532	ANS-25/2
Spectrum Analyzer	HP	3137A01183	8563A
Spectrum Analyzer	HP	3137A02798	8563E
Plotter	HP	2644V00365	7470A
Power Meter	HP	US37420106	EPM-442A
Power Sensor	HP	US3718848	ECP-E18A
Biconical Antenna	EM	677	EM-6912
Log-Periodic Antenna	EM	858	EM-6950
Horn Antenna	EM	6231	RGA-60
1.2 - 4GHz FIlter	FSY	001	HM1160-11SS
4 - 10 GHzFilter	FSY	001	HM2950-15SS
10 - 18 GHzFilter	FSY	001	HP8601-7SS

HP = Hewlett Packard EM = Electro Metrics

Methods:

Many of the tests are performed at the low, middle and the high portion of the 902 - 928 MHz band. These tests are typically performed on the following channels / frequencies unless otherwise noted:

900 MHz Channel	Frequency (MHz)	2.4 GHz Channel	Frequency (GHz)
1	902.24	1	2.40064
75	914.08	130	2.44192
161	927.84	259	2.48320

Many of the tests required that the UUT be operated in modes that are not possible in the when the unit is in its normal mode. In these cases, the UUT is put into the "Diagnostic Mode" which allows special commands to sent to the UUT.

The tests below are performed using the basic test setup shown in Fig 1. The only difference between several of the tests is the mode that the UUT is being operated in, normal operating mode or the diagnostic mode.

Part 15	RSS210	Test
15.247(a)(1)	6.2.2(O)(a)	Channel Frequency Separation
15.247(c)	6.2.2(O)(a) 4	Out of Band Conducted Emissions
15.247(a)(1)(I)	6.2.2.(O)(a)-1	Minimum Number of Hopping Channels
15.247(a)(1)	6.2.2.(O)(a)(1)	Maximum time on Channel

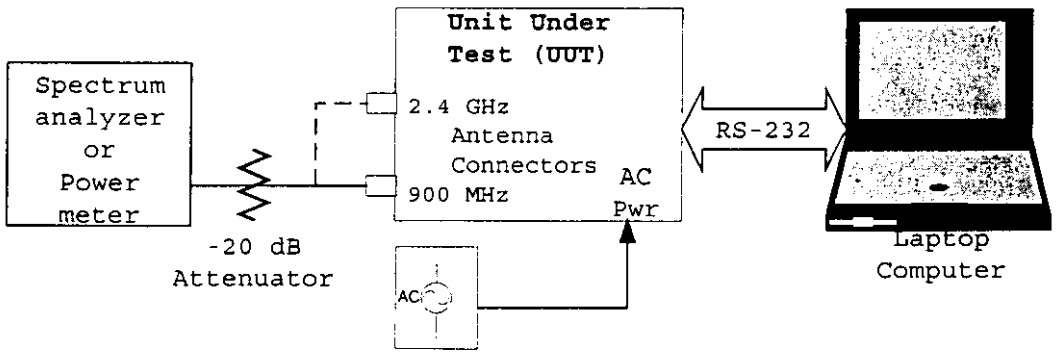


Figure 1. Basic Test Setup

6.0 Test Results

6.1 Maximum Power Output at Antenna Terminals

FCC Specification: **Paragraph: 15.247(b)**

The maximum peak output power shall not exceed 1 watt. If the gain of the antenna that is connected to the system is greater than 6 dBi, then the RF power at the antenna terminal must be reduced such that the Effective Isotropic Radiated Power (EIRP) is +36 dBm or less.

Industrie Canada Specification: **Paragraph RSS210, 6.2.2(o)(a) 3**

The peak output power of the transmitter shall not exceed one watt. Any antenna gain in excess of 6 dBi (6 dB above isotropic gain) shall be added to the measured RF output power before using the power limit.

Procedure:

The UUT was configured to run in diagnostic mode and the hopping function was disabled. The test was configured as shown in the basic test setup using a power meter. The power was then read directly from the power meter .

Result:

The following power levels were measured (corrected for the 20 dB attenuator) on the standard test channels:

NETWORK RADIO

Freq. (MHz)	Level (dBm)	Level (Watts)
902.24	29.2	.831
914.08	29.6	.912
927.84	29.5	.891

Freq. (GHz)	Level (dBm)	Level (Watts)
2.40064	26.2	.416
2.44192	26.2	.416
2.48320	26.7	.467

ETHERNET RADIO

Freq. (MHz)	Level (dBm)	Level (Watts)
902.24	29.47	.885
914.08	29.23	.837
927.84	29.51	.893

Freq. (GHz)	Level (dBm)	Level (Watts)
2.40064	27.8	.605
2.44192	28.3	.676
2.48320	27.8	.602

6.2 Channel Frequency Separation

FCC Specification: **Paragraph 15.247(a)(1)**

Frequency hopping systems 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.

In the case of the Ricochet wireless network, the 20 dB bandwidth specification applies.

Industrie Canada Specification: **Paragraph RSS210, 6.2.2(o)(a) 3**

Frequency hopping systems 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.

Procedure:

The Metricom MCDN radio and the Ethernet radio operate on 56 channels in the 900MHz band. (A "Channel Vs. Freq" table is included in the appendix). The majority of these channels are spaced at 480kHz, however there are some that are spaced at 320 kHz, therefore the 20dB BW of the 900 MHz channels must be 320 kHz or less.

The MCDN radio and the Ethernet radio operate on 256 channels evenly spaced from 2.40032 GHz to 2.48224 GHz. This yields a channel spacing of:

$$\frac{(2482.24 - 2400.32)\ \text{MHz}}{256\ \text{channels}} = \frac{320\ \text{kHz}}{\text{channel}}$$

The test was configured as shown in Figure 1 and performed on channel zero and the highest channel used for that band. Each test channel was tested with each modulation (sometimes called "Gear") that will be used in the system for each band. The UUT was running in the diagnostic mode and set to transmit continuos random data at the highest possible data rate. To reduce possible errors due to an unnecessarily wide resolution bandwidth setting, the spectrum analyzer was set to a resolution bandwidth of 3 kHz. The video bandwidth was also set to 3 kHz.

The analyzer was placed into MAX-HOLD until the trace stabilized. At that point a PEAK SEARCH was performed and the –20 dB points located using the MARKER- DELTA method.

Results:

Given the number of channels being used in each band 320 kHz is the maximum allowed bandwidth. The radios have the capability to use different modulation methods when required, however at the current time, the only modulation used by the Network radio is PI/4 DPSK, however the Ethernet radio will be using two modulations, PI/4DPSK and 16 QAM.

Plots showing the bandwidth for each of the standard test channels are contained in appendix A.

NETWORK RADIO, 900 MHz Band

Chan	Freq MHz	20 dB BW kHz	Modulation
0	902.08	**315**	PI/4 DPSK x 2
75	914.08	**317**	PI/4 DPSK x 2
161	927.84	**313**	PI/4 DPSK x 2

ETHERNET RADIO, 900 MHz Band

Chan	Freq MHz	20 dB BW kHz	Modulation
0	902.08	**318**	PI/4 DPSK x 2
75	914.08	**313**	PI/4 DPSK x 2
161	927.84	**315**	PI/4 DPSK x 2

NETWORK RADIO, 2.4 GHz Band

Chan	Freq MHz	20 dB BW kHz	Modulation
1	2400.32	**313**	PI/4 DPSK x 2
130	2441.892	**317**	PI/4 DPSK x 2
256	2482.22	**320**	PI/4 DPSK x 2

ETHERNET RADIO, 2.4 GHz Band

Chan	Freq MHz	20 dB BW kHz	Modulation
1	2400.32	**310**	PI/4 DPSK x 2
130	2441.892	**317**	PI/4 DPSK x 2
255	2481.93	**315**	PI/4 DPSK x 2
1	2400.32	**312**	16 QAM x 2
130	2441.892	**313**	16 QAM x 2
255	2481.93	**317**	16 QAM x 2

6.2A Minimum Number of Hopping Channels

FCC Specification: **Paragraph: 15.247(a)(1)(i) and (ii)**
For frequency hopping systems operating in the 902-928 MHz band if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies

Frequency hopping systems operating in the 2400-2483.5 MHz and 5725-5850 MHz bands shall use at least 75 hopping frequencies.

Industrie Canada Specification: **Paragraph 6.2.2.(o)(a)(1)**
Frequency hopping systems operating in the 902-928 MHz band shall use at least 50 hopping frequencies.

Procedure:
The UUT was placed in diagnostic mode. The basic test setup shown in Figure 1 was used. The analyzer was set to sweep over a small portion of the 902 - 928 MHz band, (i.e.: 902 - 905 MHz), and wide resolution bandwidth was chosen to allow a fast sweep. The analyzer is set to MAX HOLD.

With the unit in diagnostic mode it is possible to tell the unit to transmit a CW signal on each channel for a short time. With the spectrum analyzer set to MAX HOLD, each of the individual channels can be seen as the unit steps through all of the channels. Because the channels are relatively close together, 902 - 928 MHz band was examined in segments.

The test was then repeated for the 2.4 GHz band

Results:
Since the channels for the MCDN Network radio and the Ethernet radio are the same, only one set of plots is presented in the appendix. The plots for the 900 MHz band show 56 channels. The plots for the 2.4 GHz band show 259 possible channels, however in normal operating mode, for both the MCDN radio and the Ethernet radio, channel 257, 258 and 259 are not used (this is controlled by the software of the radio which has a "Channel Mask") to ensure compliance with the 2.4 GHz upper band-edge emission requirement.

Plots showing the results of the test are contained in appendix A.

6.2B Average Channel Occupancy Time

FCC Specification: **Paragraph 15.247(a)(1)(I) and (ii)**
For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

Frequency hopping systems operating in the 2400-2483.5 MHz and 5725-5850 MHz bands shall use at least 75 hopping frequencies. The maximum 20 dB bandwidth of the hopping channel is 1 MHz. The average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 30 second period.

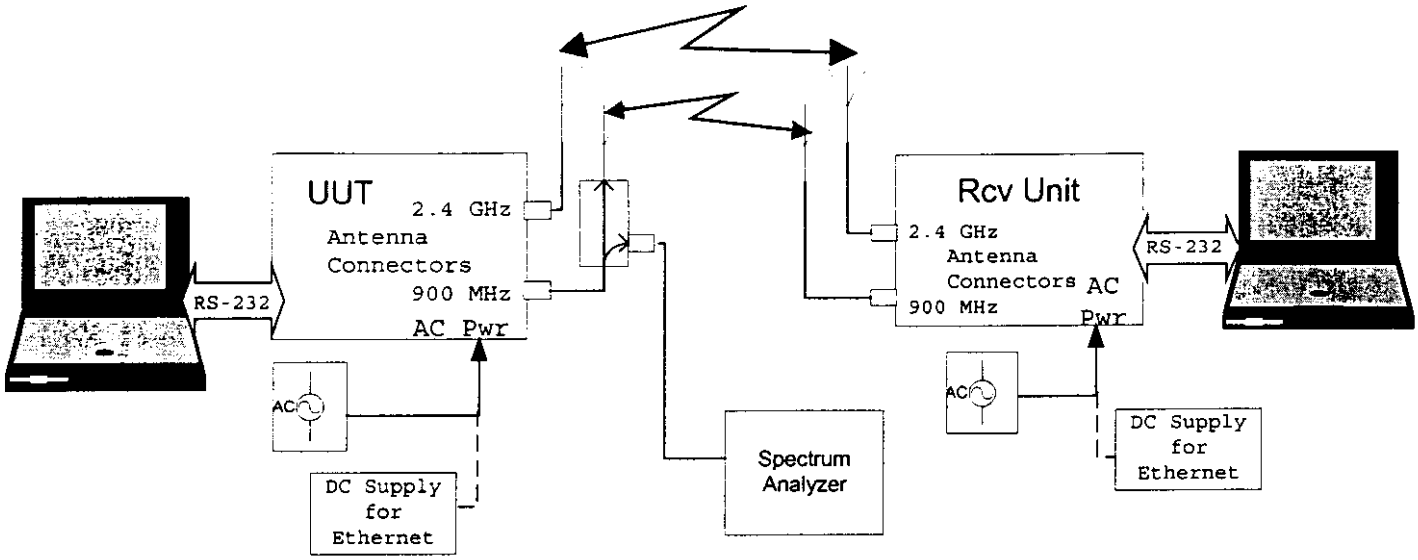
Industrie Canada Specification: **Paragraph 6.2.2.(o)(a)(1)**
The average time occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period.

Procedure:
The test was configured as shown below. (The test setup is shown for 900 MHz, the setup is similar for 2.4 GHz except that the directional coupler is in the 2.4GHz path.) The units were configured to perform a "Z Modem" file transfer of a 10 MB file. The number of times each channel was used during the transfer was obtained from the radio using a special diagnostic command. The average number of hits per channel was calculated with Excel.

The spectrum analyzer was used to measure the duration of transmissions. This is the time required to transmit one packet. With this information and the average number of hits per channel and the total time required for the file transfer to take place, the total time on channel can be calculated.

The file was transferred in the following directions.

Ethernet Radio to MCDN Network Radio	900 MHz
MCDN Network Radio to Ethernet Radio	900 MHz
Ethernet Radio to Modem	900 MHz
MCDN Network Radio to Modem	900 MHz
Ethernet Radio to MCDN Network Radio	2.4 GHz
MCDN Network Radio to Ethernet Radio	2.4 GHz



Time on Channel Test Setup

Results:

The following data was gathered:

Total time required to transfer the file in seconds
Average number of hits per channel
Time of each transmission in seconds

The test results were calculated using the following formula

$$\frac{\left(\text{Avg Transmissions per channel} \bigstar \text{Time per transmission}\right)}{\left(\frac{\text{Total file transfer time}}{\text{Spec Window (Sec)}}\right)} = \frac{\text{Total time on channel}}{\text{Qty of "Spec Windows"}} = \text{Time on Channel per "spec" Sec.}$$

The results are presented in the table below. Plots showing the time of a given transmission are presented in the appendix.

From...	To	Band	Avg Hits / Channel	Total Xsfer Time (s)	Time / Transmission (s)	Avg time/ Channel / "Window" (ms)	Spec
Network Radio	Ethernet Radio	900	182	887.07	0.0400	82.07	.4s / 10 S
Network Radio	Ethernet Radio	2.4	37	877.8	0.0199	25.16	.4s / 30 S
Network Radio	Modem	900	190	880.35	0.0417	90.00	.4s /10 S
Ethernet Radio	Network Radio	900	190	908.76	0.0467	97.64	.4s / 10 S
Ethernet Radio	Network Radio	2.4	35	881.41	0.0194	23.11	.4s / 30 S
Ethernet Radio	Modem	900	193	916.71	0.0467	98.32	.4s / 10 S

6.3 Radiated Emissions in Restricted bands Procedure

FCC Specification: **Paragraph 15.205**

Any emission falling within one of the restricted bands specified in 15.205 shall be below the limits specified in 15.209.

Industrie Canada Specification: **Paragraph RSS210, 6.2.3 (c)**

Except as provided in 6.2.2(o), unwanted emissions falling into restricted bands shall meet Tables 3 and 7 limits.

Procedure:

This test was conducted on a 3 meter open air test site at EC Labs. The unit was placed on a rotatable wooden table 1 meter above the ground plane. A 1 – 18 GHz and 18 - 26.5 GHz Horn antenna were secured to a mast 3 meters away. The unit was tested at each of the standard test channels for each band. The UUT was running in the diagnostic mode and set to transmit CW at maximum power on Channel 0. The test equipment was configured as shown in figure 3. The harmonics of the fundamental that fell in restricted bands (up to the tenth) were measured (See table 1 below). A high pass filter prior to the pre-amplifier was required to prevent the large signal level of the fundamental frequency from overloading the front end of the spectrum analyzer and creating harmonics within the analyzer.

The UUT was rotated 360 degrees and the height of the antenna adjusted from 1 to 4 meters above the ground plane to determine the maximum level of the emission. The level of the harmonic emission is measured in two modes, "Peak" and "Average". The spectrum analyzer reading was entered into a spread sheet where correction factors (antenna factor, cable loss, pre-amplifier gain, HPF loss...) were then applied by EC Lab's Software to obtain a final corrected measurement..

Once all the harmonics that fall in a restricted band (up to the 10th harmonic) have been examined for channel 0, the test is repeated for the remaining two standard test channels for each band.

	Fund	HARMONICS (MHz)								
Channel	Freq(MHz)	2	3	4	5	6	7	8	9	10
0	902.08	**1804.16**	2706.24	3608.32	4510.40	5412.48	**6314.56**	**7216.64**	8118.72	9020.80
75	914.08	**1828.16**	2742.24	3656.32	4570.40	**5484.48**	**6398.56**	7312.64	8226.72	9140.80
161	927.84	**1855.68**	2783.52	3711.36	4639.20	**5567.04**	**6494.88**	7422.72	8350.56	**9278.40**
0	2400.32	4800.64	**7200.96**	**9601.28**	12001.60	**14401.92**	**16802.24**	19202.56	**21602.88**	**24003.20**
130	2441.92	4883.84	7325.76	**9767.68**	12209.60	**14651.52**	**17093.44**	19535.36	**21977.28**	**24419.20**
259	2483.20	4966.40	7449.60	**9932.80**	12416.00	**14899.20**	**17382.40**	19865.60	22348.80	**24832.00**

Table 1: 15.205 Harmonic test table

NOTE: The harmonics that are shaded do not fall within a restricted band, they are therefore subject to the general limits in 15.209.

6.3 Radiated Emissions in Restricted bands Procedure (Continued)

FCC Paragraph 15.205

IC RSS-210 6.2.3 (c)

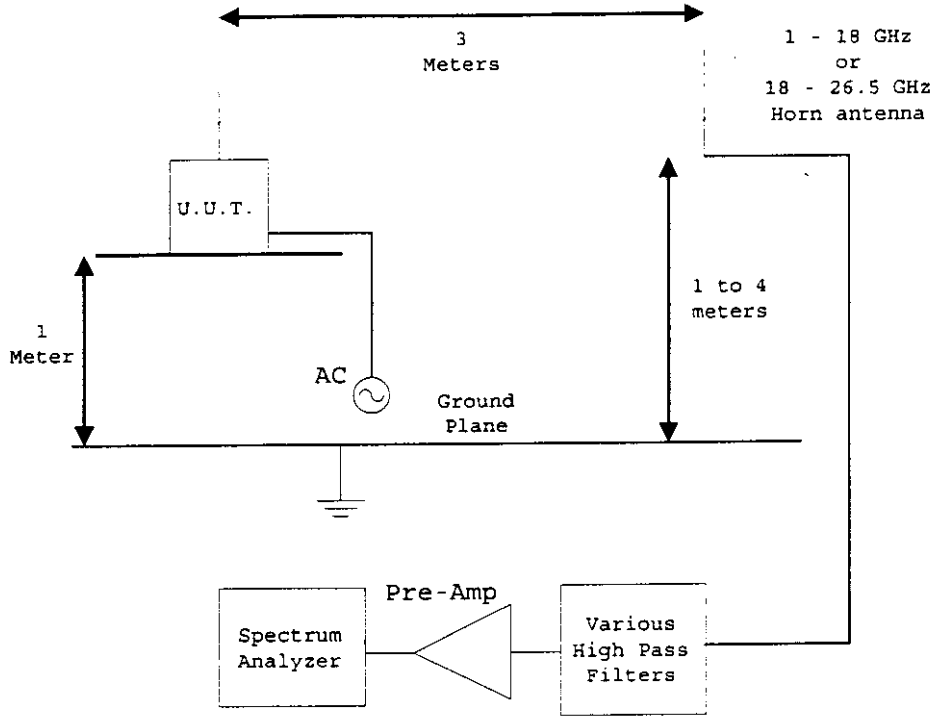


Figure 3: Radiated Emissions in Restricted Bands Test Setup

Results:

There were some harmonic emissions detected during the test. In many cases the resolution bandwidth and the video bandwidth were reduced well below what is required of the specifications in an attempt to find the actual level of the emission. In the case of the "PEAK" measurement the RBW and VBW were always set to 1 MHz. The "AVG" test was conducted with the RBW and VBW set to 10 kHz maximum. There were some cases where an emission was not visible using these 10k/10k bandwidth settings and the bandwidths were set to 1 kHz In an effort to determine if an emission was present. In some cases, even with these lower bandwidths, there was no emission detected.

6.4 Out of Band Emissions

FCC Part 15 specification **Paragraph 15.247(c)**

Industrie Canada Specification: **Paragraph RSS210,6.2.2.(o)(b)4**

OVERVIEW

Two tests were performed to demonstrate 900 MHz band compliance with the 15.247(c) specification. The first test was performed as a conducted test at Metricom using the Basic Test Setup shown in Figure 1. Only the "edges" of the 902 to 928 MHz band are examined since these are expected to be the worst case frequencies for out of band emissions. (The two points where the in-band UUT signal is most likely to "spill" out of the 902 to 928 MHz band) This test is conducted for the 2.4 GHz band in the same manner as the 900MHz band with the exception that it is not conducted for the upper edge of the 2.4 GHz band due to the fact that there is a restricted band that starts at 2.4835GHz. Therefore the level present at 2.4835 GHz must be measured in a radiated setup.

The second test is performed as a conducted test. This test examines a much wider band for out of band emissions (30 MHz to 10 GHz). The test setup for this test is shown in figure 1. The radio is configured to transmit on a single channel in the center of the 902 – 928 MHz band and then repeated for the 2.4 GHz band. The 30MHz to 10GHz is then examined for Out of Band Emissions.

In the case of the MCDN radio the limits set forth in 15.209 and RSS-210 Table 3 are not relevant to the test (for spurs produced from modulation products of the spreading sequence, the information sequence and the carrier frequency, NOT falling in a restricted band) since the transmit power of the radio is about 1 Watt, the -20 dBc rule will be the governing limit.

FCC Specification: **Paragraph 15.247(c)**

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

Industrie Canada Specification: **Paragraph RSS210,6.2.2.(o)(b)4**

In any 100 kHz bandwidth outside the operating frequency bands, between 30 MHz and 5 times the carrier frequency, 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 Table 3, whichever is less stringent.

Test 1 Procedure:

The test setup shown in figure 1 was used for this test. The UUT was running the diagnostic mode and is set to transmit on channel 161 (927.84 MHz). The sweep was set to 928 MHz center with 1 MHz span. The analyzer was set to MAX HOLD and then a peak search was done with the marker and then a delta measurement was made to insure that the signal level was at least -20 dBC at 928.0 MHz. This measurement was made for each of the gears (different modulations) of the Network and Ethernet radios.

The test was then repeated with the sweep set to a center of 902 MHz with a 1 MHz span. The UUT was set to transmit on the lowest channel (902.4 MHz). The measurement was made for each of the modulations that will be used in normal operation.

The test was then repeated for the lower edge of the 2.4GHz band, (The upper bandedge of the 2.4GHz band was not measured in this test due the restricted band that begins at 2483.5GHz.

6.4 Out of Band Emissions (Cont)

Test 1 Results

The upper and lower edges of the 900 MHz band as well as the lower edge of the 2.4 GHz band were examined for the Ethernet radio and the network radio. The results of the upper edge test of the 2.4 GHz band are presented in the Restricted Band Emissions test results. The –dBc level was measured for each of the modulations that the radio will use in normal operation.

MCDN Network Radio			
Edge	Channel	Gear	-dBc @ Bandedge
900 - LOW	2	2FSK	60.33
900 - LOW	2	4FSK	60.67
900 - LOW	2	pi/4 DPSKx2	50.50
900 - HIGH	161	2FSK	38.67
900 - HIGH	161	4FSK	39.00
900 - HIGH	161	pi/4 DPSKx2	27.16
2.4 - LOW	0	pi/4 DPSKx2	21.00
2.4 - LOW	0	16 QAM	21.66

Ethernet Radio			
Edge	Channel	Gear	-dBc @ Bandedge
900 - LOW	2	2FSK	57.34
900 - LOW	2	4FSK	54.84
900 - LOW	2	pi/4 DPSKx2	48.67
900 - HIGH	161	2FSK	40.17
900 - HIGH	161	4FSK	38.67
900 - HIGH	161	pi/4 DPSKx2	21.33
2.4 - LOW	0	pi/4 DPSKx2	33.83
2.4 - LOW	0	16 QAM	43.84

Test 2 Procedure (900 and 2.4 GHz):

The test equipment was configured as shown in figure 1. The test unit was configured to transmit random data on a single channel in the middle of the band being tested. The level of the fundamental was measured to establish a reference to measure the level of the out of band emissions against The 1 GHz to 10GHz band was then examined (in small segments) for out of band emissions. The test was repeated for the 2.4 GHz band. The band of 1 GHz to 25 GHz was examined for Out of band emissions.

Test 2 Results (900 and 2.4 GHz):

Network Radio 900 MHz worst case emission: -92.00 dBm
Network Radio 2.4 GHz worst case emission: -87.50 dBm

Ethernet Radio 900 MHz worst case emission: -71.33 dBm
Ethernet Radio 2.4 GHz worst case emission: -68.33 dBm

6.4 Out of Band Emissions (Upper bandedge of 2.4 GHz band)

Test 1 Procedure for Upper bandedge of the 2.4 GHz band.

The procedure below was provided to EC Labs in Sunnyvale, CA. by the FCC. This is the procedure that was followed to determine compliance with the restricted band emission spec for 2483.5MHz.

STEP 1) Perform an in-band field strength measurement of the fundamental emission using the RBW and detector function required by C63.4 and our Rules for the frequency being measured. For example, for a device operating in the 902-928 MHz band under Section 15.249, use a 120 kHz RBW with a CISPR QP detector (a peak detector with 100 kHz RBW may alternatively be used). For transmitters operating above 1 GHz, use a 1 MHz RBW and a peak detector (as required by Section 15.35). Repeat the measurement with an average detector (i.e., 1 MHz RBW with 10 Hz video bandwidth). Note: For pulsed emissions, other factors must be included. Please contact us for details if the emission under investigation is pulsed. Also, please note that radiated measurements of the fundamental emission of a transmitter operating under 15.247 are not normally required, but they are necessary in connection with this procedure.

STEP 2) Choose a spectrum analyzer span that encompasses both the peak of the fundamental emission and the band-edge emission under investigation. Set the analyzer RBW to 1 % of the total span (but never less than 30 kHz) with a video bandwidth equal to or greater than the RBW. Record the peak levels of the fundamental emission and the relevant bandedge emission (i.e., run several sweeps in peak hold mode). Observe the stored trace and measure the amplitude delta between the peak of the fundamental and the peak of the bandedge emission. This is not a field strength measurement, it is only a relative measurement to determine how much the emission drops at the band-edge relative to the highest fundamental emission level.

STEP 3) Subtract the delta measured in step (2) from the field strengths measured in step (1). The resultant field strengths (CISPR QP, average, or peak, as appropriate) are then used to determine band-edge compliance as required by either 15.249(c) or 15.205.

STEP 4) You can use the above "delta" measurement technique for measuring emissions that are up to two "standard" bandwidths away from the band-edge, where a "standard" bandwidth is the bandwidth specified by C63.4 for the frequency being measured. For example, for bandedge measurements in the restricted band that begins at 2483.5 MHz, C63.4 specifies a measurement bandwidth of at least 1 MHz. Therefore you may use the "delta" technique for measuring emissions up to 2 MHz removed from the band-edge. Radiated emissions that are removed by more than two bandwidths must be measured in the conventional manner.

Test 1 Results for Upper bandedge of the 2.4 GHz band.

The reference measurement of the CW carrier @ 2483.2MHz discussed in step 1 yielded a field strength reading of 110.5 dBuV/m in the peak mode (1 MHz RBW & VBW). This is the highest channel that will be used by the system in normal operation. Correction this level for amplifier gain, antenna factor and attenuation the test setup yields

110.5 dBuv/m + 28.5 dB – 16.691 dB = 122.309 dBuv/m

The delta measurement was made with RBW = VBW = 30 kHz, and yielded 69.5 dB. Subtracting this from the reference measurement:

122.309 dBuV/m – 69.5 dB = 52.809 dBuv/m

Plots showing the reference measurement and the delta measurement are contained in appendix A

6.5 Class B Unintentional Radiated Emissions

FCC Specification: **Paragraph 15.103**

he field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values:

FREQ (MHz)	Field Strength (uV/M)
30->88	100
88->216	150
216->960	200
Above 960	500

Industrie Canada Specification: **Paragraph RSS210, 6.2.2.(o)(a)4**

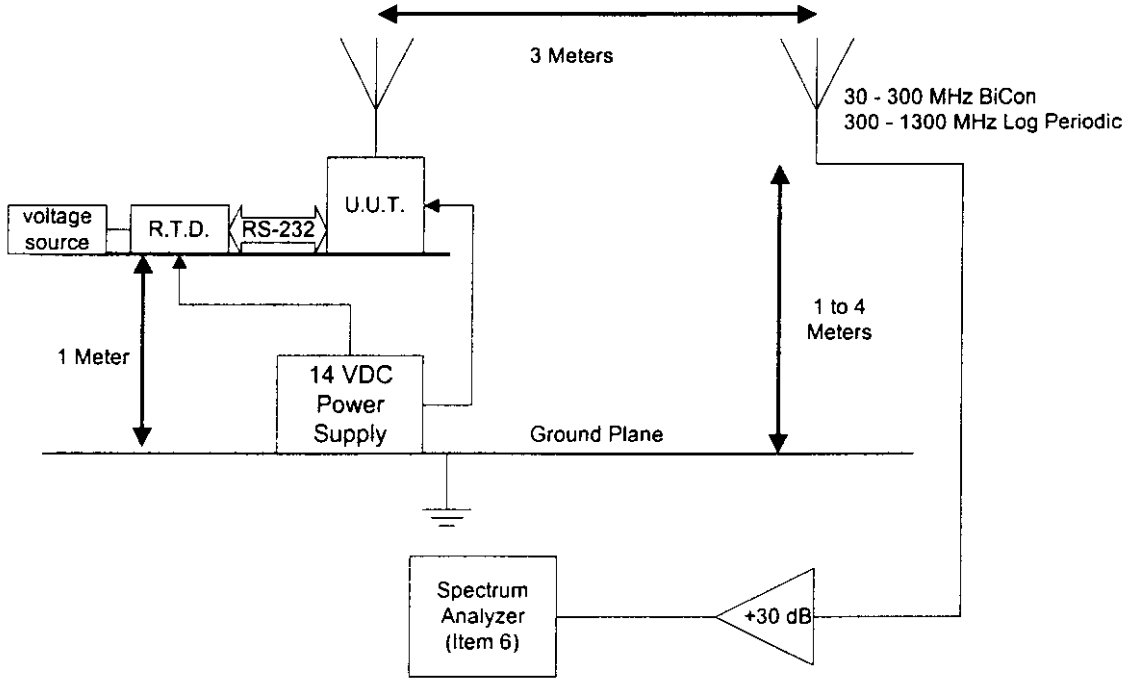
In any 100 kHz bandwidth outside the operating frequency bands, between 30 MHz and 5 times the carrier frequency, the radio frequency power that is produced by the modulation products of the spreading sequence, the information sequence and the carrier frequency shall be either at least 20 dB below that 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 Table 3, whichever is less stringent.

FUNDAMENTAL FREQ (MHz)	FIELD STRENGTH microvolts/metre (watts) #	MEASUREMENT DISTANCE (metres) #
30-88	100 (3 nW), Note 1	3
88-216	150 (6.8 nW), Note 1	3
216-960	200 (12 nW), Note 1	3
Above 960 MHz	500 (75 nW)	3

(RSS-210 Table 3)

Procedure

This was performed on the 3 meter open air test site located at EC Labs with the UUT running normal operating software. The band from 30 MHz to 1 GHz was examined using a BiConical and Log Periodic antenna. The UUT was put on the OATS turntable, and powered up in normal operating mode. The entire 30 MHz to 1 GHz band was examined in small segments for each of the 3 types of test antennas. There was, of course, a lot of background "noise" present (T.V., broadcast radio, ...) so the turn-table was rotated and the spectrum analyzer closely watched for any signals that appear to coincide with the table movement. In some cases the unit under test was powered off to see if the emission disappeared (it was from the unit under test) or if it remains (it is from another source). The test setup is shown below.



6.5 Class B Unintentional Radiated Emissions (Cont)

Results:

The worst case radiated emission between 30 MHz and 1 GHz was at 128MHz and was at a level of 41.0 dBuV @ 3 Meters. This is 2.5dB within the specification using a Quasi Peak Detector. The tables showing the levels of the emissions for all three antennas are contained in Appendix A.

Appendix A

Data and Plots for FCC Part 15 Certification Application for GNW-24000

Industrie Canada RSS-210 Certification Application

Appendix Table of Contents

FCC RADIATED DATA SHEET

DATE: Mar. 17, 1999
EUT: Viper Ethernet Radio
CUSTOMER NAME: Metricom
S/N: 840100ec
WORK ORDER: 9031601
RULE PART: 15.247
FILE: 9031601a.xls

ANTENNA horn
OTHER CAL FACTOR ATTN dB: 0
MODULATION TYPE:
DUTY dB: 0
TESTED E Shawn
HP IL dB: 0
COMMENT Note bold font indicates noise floor measurement
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 =	**902.08**								
1804.16	44.5	Pk	27.4	6.5	35.0	0.0	43.4	74.0	-30.6
1804.16	34.2	Avg	27.4	6.5	35.0	0.0	33.1	54.0	-20.9
2706.24	43.3	Pk	30.6	8.1	35.0	0.0	47.0	74.0	-27.0
2706.24	33.7	Avg	30.6	8.1	35.0	0.0	37.4	54.0	-16.6
3608.32	43.5	Pk	32.5	9.8	35.0	0.0	50.8	74.0	-23.2
3608.32	33.8	Avg	32.5	9.8	35.0	0.0	41.1	54.0	-12.9
4510.40	44.1	Pk	34.2	11.7	35.0	0.0	55.0	74.0	-19.0
4510.40	33.0	Avg	34.2	11.7	35.0	0.0	43.9	54.0	-10.1
5412.48	37.7	Pk	34.8	14.1	35.0	0.0	51.6	74.0	-22.4
5412.48	28.3	Avg	34.8	14.1	35.0	0.0	42.2	54.0	-11.8
6314.56	37.7	Pk	37.3	15.4	35.0	0.0	55.4	74.0	-18.6
6314.56	26.6	Avg	37.3	15.4	35.0	0.0	44.3	54.0	-9.7
7216.64	41.1	Pk	36.8	16.9	35.0	0.0	59.8	74.0	-14.2
7216.64	28.3	Avg	36.8	16.9	35.0	0.0	47.0	54.0	-7.0
8118.72	38.2	Pk	38.4	18.3	35.0	0.0	59.9	74.0	-14.1
8118.72	26.0	Avg	38.4	18.3	35.0	0.0	47.7	54.0	-6.3
9020.80	36.2	Pk	40.4	18.9	35.0	0.0	60.5	74.0	-13.5
9020.80	22.5	Avg	40.4	18.9	35.0	0.0	46.8	54.0	-7.2
Fund =	**914.13**								
1828.26	44.3	Pk	27.4	6.5	35.0	0.0	43.2	74.0	-30.8
1828.26	34.0	Avg	27.4	6.5	35.0	0.0	32.9	54.0	-21.1
2742.39	43.2	Pk	30.6	8.1	35.0	0.0	46.9	74.0	-27.1
2742.39	33.7	Avg	30.6	8.1	35.0	0.0	37.4	54.0	-16.6
3656.52	45.5	Pk	32.5	10.1	35.0	0.0	53.1	74.0	-20.9
3656.52	33.8	Avg	32.5	10.1	35.0	0.0	41.4	54.0	-12.6
4570.65	39.8	Pk	34.2	11.9	35.0	0.0	50.9	74.0	-23.1
4570.65	27.6	Avg	34.2	11.9	35.0	0.0	38.7	54.0	-15.3
5484.78	37.0	Pk	34.8	13.9	35.0	0.0	50.7	74.0	-23.3
5484.78	28.0	Avg	34.8	13.9	35.0	0.0	41.7	54.0	-12.3
6398.91	37.0	Pk	37.3	15.3	35.0	0.0	54.6	74.0	-19.4
6398.91	26.8	Avg	37.3	15.3	35.0	0.0	44.4	54.0	-9.6
7313.04	38.6	Pk	36.8	17.3	35.0	0.0	57.7	74.0	-16.3
7313.04	26.4	Avg	36.8	17.3	35.0	0.0	45.5	54.0	-8.5
8227.17	38.2	Pk	38.4	18.2	35.0	0.0	59.8	74.0	-14.2
8227.17	28.3	Avg	38.4	18.2	35.0	0.0	49.9	54.0	-4.1
9141.30	36.5	Pk	40.4	19.2	35.0	0.0	60.1	74.0	-13.9
9141.30	22.7	Avg	40.4	19.2	35.0	0.0	47.3	54.0	-6.7
Fund =	**927.84**								
1855.68	46.0	Pk	27.4	6.7	35.0	0.0	45.1	74.0	-28.9
1855.68	34.5	Avg	27.4	6.7	35.0	0.0	33.6	54.0	-20.4
2783.52	41.3	Pk	30.6	8.3	35.0	0.0	45.2	74.0	-28.8
2783.52	33.8	Avg	30.6	8.3	35.0	0.0	37.7	54.0	-16.3
3711.36	43.3	Pk	32.5	10.2	35.0	0.0	51.0	74.0	-23.0
3711.36	33.7	Avg	32.5	10.2	35.0	0.0	41.4	54.0	-12.6
4639.20	42.5	Pk	34.2	11.8	35.0	0.0	53.5	74.0	-20.5
4639.20	33.5	Avg	34.2	11.8	35.0	0.0	44.5	54.0	-9.5
5567.04	42.0	Pk	35.6	14.1	35.0	0.0	56.7	74.0	-17.3
5567.04	31.0	Avg	35.6	14.1	35.0	0.0	45.7	54.0	-8.3
6494.88	41.3	Pk	37.3	15.8	35.0	0.0	59.4	74.0	-14.6
6494.88	30.7	Avg	37.3	15.8	35.0	0.0	48.8	54.0	-5.2
7422.72	39.5	Pk	36.8	17.2	35.0	0.0	58.5	74.0	-15.5
7422.72	28.3	Avg	36.8	17.2	35.0	0.0	47.3	54.0	-6.7
8350.56	39.1	Pk	38.4	18.2	35.0	0.0	60.7	74.0	-13.3
8350.56	26.6	Avg	38.4	18.2	35.0	0.0	48.2	54.0	-5.8
9278.40	35.8	Pk	40.4	19.3	35.0	0.0	60.5	74.0	-13.5

FCC RADIATED DATA SHEET

DATE: Mar 17, 1999

EUT: Viper Ethernet Radio
S/N: 840100ec
RULE PART: 15 247

CUSTOMER NAME: Metricom
WORK ORDER: 9031601
FILE: 9031601b xls

ANTENNA horn
OTHER CAL FACTOR ATTN dB: 0
MODULATION TYPE:
DUTY dB: 0
TESTED E Shawn
HP IL dB: 0
COMMENT Note bold font indicates noise floor measurement
DIST dB: 0

FREQ. MHz	READING dB(uV)	Pk, QP, or Av	A.F. dB	Cable loss dB	AMP dB	O.C.F. dB	TOTAL, dB(uV/m)	LIMIT dB(uV/m)	DELTA dB
Fund =	**2400.32**								
4800.64	44.2	Pk	34.2	11.8	35.0	0.0	55.2	74.0	-18.8
4800.64	33.3	Avg	34.2	11.8	35.0	0.0	44.3	54.0	-9.7
7200.96	41.3	Pk	36.8	16.9	35.0	0.0	60.0	74.0	-14.0
7200.96	29.8	Avg	36.8	16.9	35.0	0.0	48.5	54.0	-5.5
9601.28	39.5	Pk	38.0	20.0	35.0	0.0	62.5	74.0	-11.5
9601.28	26.5	Avg	38.0	20.0	35.0	0.0	49.5	54.0	-4.5
12001.60	32.0	Pk	42.6	25.7	35.0	0.0	65.3	74.0	-8.7
12001.60	16.8	Avg	42.6	25.7	35.0	0.0	50.1	54.0	-3.9
14401.92	28.9	Pk	40.9	29.6	35.0	0.0	64.4	74.0	-9.6
14401.92	16.0	Avg	40.9	29.6	35.0	0.0	51.5	54.0	-2.5
16802.24	29.5	Pk	41.2	30.1	35.0	0.0	65.8	74.0	-8.2
16802.24	14.5	Avg	41.2	30.1	35.0	0.0	50.8	54.0	-3.2
19202.56	27.6	Pk	40.2	30.1	35.0	0.0	62.9	74.0	-11.1
19202.56	15.0	Avg	40.2	30.1	35.0	0.0	50.3	54.0	-3.7
21602.88	30.5	Pk	40.3	30.1	35.0	0.0	65.9	74.0	-8.1
21602.88	15.5	Avg	40.3	30.1	35.0	0.0	50.9	54.0	-3.1
24003.20	29.3	Pk	40.4	30.1	35.0	0.0	64.8	74.0	-9.2
24003.20	15.4	Avg	40.4	30.1	35.0	0.0	50.9	54.0	-3.1
Fund =	**2441.85**								
4883.70	44.5	Pk	34.2	12.0	35.0	0.0	55.7	74.0	-18.3
4883.70	33.8	Avg	34.2	12.0	35.0	0.0	45.0	54.0	-9.0
7325.55	42.0	Pk	36.8	17.3	35.0	0.0	61.1	74.0	-12.9
7325.55	30.2	Avg	36.8	17.3	35.0	0.0	49.3	54.0	-4.7
9767.40	38.5	Pk	38.0	20.3	35.0	0.0	61.8	74.0	-12.3
9767.40	26.0	Avg	38.0	20.3	35.0	0.0	49.3	54.0	-4.8
12209.25	32.1	Pk	42.6	26.2	35.0	0.0	65.9	74.0	-8.1
12209.25	16.5	Avg	42.6	26.2	35.0	0.0	50.3	54.0	-3.7
14651.10	28.4	Pk	41.3	30.3	35.0	0.0	65.0	74.0	-9.0
14651.10	15.0	Avg	41.3	30.3	35.0	0.0	51.6	54.0	-2.4
17092.95	29.6	Pk	43.7	30.1	35.0	0.0	68.4	74.0	-5.6
17092.95	13.0	Avg	43.7	30.1	35.0	0.0	51.8	54.0	-2.2
19534.80	28.0	Pk	40.2	30.1	35.0	0.0	63.3	74.0	-10.7
19534.80	14.0	Avg	40.2	30.1	35.0	0.0	49.3	54.0	-4.7
21976.65	28.2	Pk	40.3	30.1	35.0	0.0	63.6	74.0	-10.4
21976.65	14.4	Avg	40.3	30.1	35.0	0.0	49.8	54.0	-4.2
24418.50	28.6	Pk	40.4	30.1	35.0	0.0	64.1	74.0	-9.9
24418.50	15.0	Avg	40.4	30.1	35.0	0.0	50.5	54.0	-3.5
Fund =	**2483.20**								
4966.40	46.5	Pk	34.2	11.8	35.0	0.0	57.5	74.0	-16.5
4966.40	36.6	Avg	34.2	11.8	35.0	0.0	47.6	54.0	-6.4
7449.60	42.2	Pk	36.8	17.2	35.0	0.0	61.2	74.0	-12.8
7449.60	29.0	Avg	36.8	17.2	35.0	0.0	48.0	54.0	-6.0
9932.80	39.0	Pk	38.0	20.4	35.0	0.0	62.4	74.0	-11.6
9932.80	25.4	Avg	38.0	20.4	35.0	0.0	48.8	54.0	-5.2
12416.00	32.0	Pk	42.6	26.8	35.0	0.0	66.4	74.0	-7.6
12416.00	16.0	Avg	42.6	26.8	35.0	0.0	50.4	54.0	-3.6
14899.20	28.0	Pk	41.3	30.9	35.0	0.0	65.2	74.0	-8.8
14899.20	14.0	Avg	41.3	30.9	35.0	0.0	51.2	54.0	-2.8
17382.40	27.2	Pk	43.7	30.1	35.0	0.0	66.0	74.0	-8.0
17382.40	13.2	Avg	43.7	30.1	35.0	0.0	52.0	54.0	-2.0
19865.60	28.4	Pk	40.2	30.1	35.0	0.0	63.7	74.0	-10.3
19865.60	14.1	Avg	40.2	30.1	35.0	0.0	49.4	54.0	-4.6
22348.80	27.8	Pk	40.3	30.1	35.0	0.0	63.2	74.0	-10.8
22348.80	14.6	Avg	40.3	30.1	35.0	0.0	50.0	54.0	-4.0
24832.00	28.1	Pk	40.4	30.1	35.0	0.0	63.6	74.0	-10.4

FCC RADIATED DATA SHEET

DATE: Mar 17 1999

EUT: Viper Network Rad.o
CUSTOMER NAME: Metricom
S/N: 840100e6
WORK ORDER: 9031602
RULE PART: 15 247
FILE: 9031602b xls

ANTENNA horn
OTHER CAL FACTOR ATTN dB: 0
MODULATION TYPE:
DUTY dB: 0
TESTED E Shawn
HP IL dB: 0
COMMENT Note: bold font indicates noise floor measurement
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 =	**2400.32**								
4800.64	53.4	Pk	34.2	11.8	35.0	0.0	64.4	74.0	-9.6
4800.64	50.1	Avg	34.2	11.8	35.0	0.0	61.1	54.0	7.1
7200.96	48.5	Pk	36.8	16.9	35.0	0.0	67.2	74.0	-6.8
7200.96	30.7	Avg	36.8	16.9	35.0	0.0	49.4	54.0	-4.6
9601.28	39.2	Pk	38.0	20.0	35.0	0.0	62.2	74.0	-11.8
9601.28	28.5	Avg	38.0	20.0	35.0	0.0	51.5	54.0	-2.5
12001.60	32.5	Pk	42.6	25.7	35.0	0.0	65.8	74.0	-8.2
12001.60	17.8	Avg	42.6	25.7	35.0	0.0	51.1	54.0	-2.9
14401.92	26.0	Pk	40.9	29.6	35.0	0.0	61.5	74.0	-12.5
14401.92	16.0	Avg	40.9	29.6	35.0	0.0	51.5	54.0	-2.5
16802.24	29.0	Pk	41.2	30.1	35.0	0.0	65.3	74.0	-8.7
16802.24	15.4	Avg	41.2	30.1	35.0	0.0	51.7	54.0	-2.3
19202.56	26.4	Pk	40.2	30.1	35.0	0.0	61.7	74.0	-12.3
19202.56	13.2	Avg	40.2	30.1	35.0	0.0	48.5	54.0	-5.5
21602.88	26.0	Pk	40.3	30.1	35.0	0.0	61.4	74.0	-12.6
21602.88	14.0	Avg	40.3	30.1	35.0	0.0	49.4	54.0	-4.6
24003.20	33.2	Pk	40.4	30.1	35.0	0.0	68.7	74.0	-5.3
24003.20	14.0	Avg	40.4	30.1	35.0	0.0	49.5	54.0	-4.5
Fund =	**2441.86**								
4883.70	57.7	Pk	34.2	12.0	35.0	0.0	68.9	74.0	-5.1
4883.70	55.4	Avg	34.2	12.0	35.0	0.0	66.6	54.0	12.6
7325.55	46.6	Pk	36.8	17.3	35.0	0.0	65.7	74.0	-8.3
7325.55	34.3	Avg	36.8	17.3	35.0	0.0	53.4	54.0	-0.6
9767.40	41.2	Pk	38.0	20.3	35.0	0.0	64.5	74.0	-9.6
9767.40	29.2	Avg	38.0	20.3	35.0	0.0	52.5	54.0	-1.6
12209.25	38.6	Pk	42.6	26.2	35.0	0.0	72.4	74.0	-1.6
12209.25	23.0	Avg	42.6	26.2	35.0	0.0	56.8	54.0	2.8
14651.10	34.0	Pk	41.3	30.3	35.0	0.0	70.6	74.0	-3.4
14651.10	19.2	Avg	41.3	30.3	35.0	0.0	55.8	54.0	1.8
17092.95	32.1	Pk	43.7	30.1	35.0	0.0	70.9	74.0	-3.1
17092.95	23.5	Avg	43.7	30.1	35.0	0.0	62.3	54.0	8.3
19534.80	36.8	Pk	40.2	30.1	35.0	0.0	72.1	74.0	-1.9
19534.80	26.4	Avg	40.2	30.1	35.0	0.0	61.7	54.0	7.7
21976.65	37.6	Pk	40.3	30.1	35.0	0.0	73.0	74.0	-1.0
21976.65	26.4	Avg	40.3	30.1	35.0	0.0	61.8	54.0	7.8
24418.50	34.8	Pk	40.4	30.1	35.0	0.0	70.3	74.0	-3.7
24418.50	22.4	Avg	40.4	30.1	35.0	0.0	57.9	54.0	3.9
Fund =	**2483.20**								
4966.40	67.5	Pk	34.2	11.8	35.0	0.0	78.5	74.0	4.5
4966.40	66.0	Avg	34.2	11.8	35.0	0.0	77.0	54.0	23.0
7449.60	51.6	Pk	36.8	17.2	35.0	0.0	70.6	74.0	-3.4
7449.60	41.3	Avg	36.8	17.2	35.0	0.0	60.3	54.0	6.3
9932.80		Pk	38.0	20.4	35.0	0.0	23.4	74.0	-50.6
9932.80	33.6	Avg	38.0	20.4	35.0	0.0	57.0	54.0	3.0
12416.00	44.2	Pk	42.6	26.8	35.0	0.0	78.6	74.0	4.6
12416.00	33.5	Avg	42.6	26.8	35.0	0.0	67.9	54.0	13.9
14899.20	36.7	Pk	41.3	30.9	35.0	0.0	73.9	74.0	-0.1
14899.20	23.3	Avg	41.3	30.9	35.0	0.0	60.5	54.0	6.5
17382.40	37.3	Pk	43.7	30.1	35.0	0.0	76.1	74.0	2.1
17382.40	25.2	Avg	43.7	30.1	35.0	0.0	64.0	54.0	10.0
19865.60	39.2	Pk	40.2	30.1	35.0	0.0	74.5	74.0	0.5
19865.60	26.1	Avg	40.2	30.1	35.0	0.0	61.4	54.0	7.4
22348.80	37.5	Pk	40.3	30.1	35.0	0.0	72.9	74.0	-1.1
22348.80	26.3	Avg	40.3	30.1	35.0	0.0	61.7	54.0	7.7
24832.00	33.9	Pk	40.4	30.1	35.0	0.0	69.4	74.0	-4.6

FCC RADIATED DATA SHEET

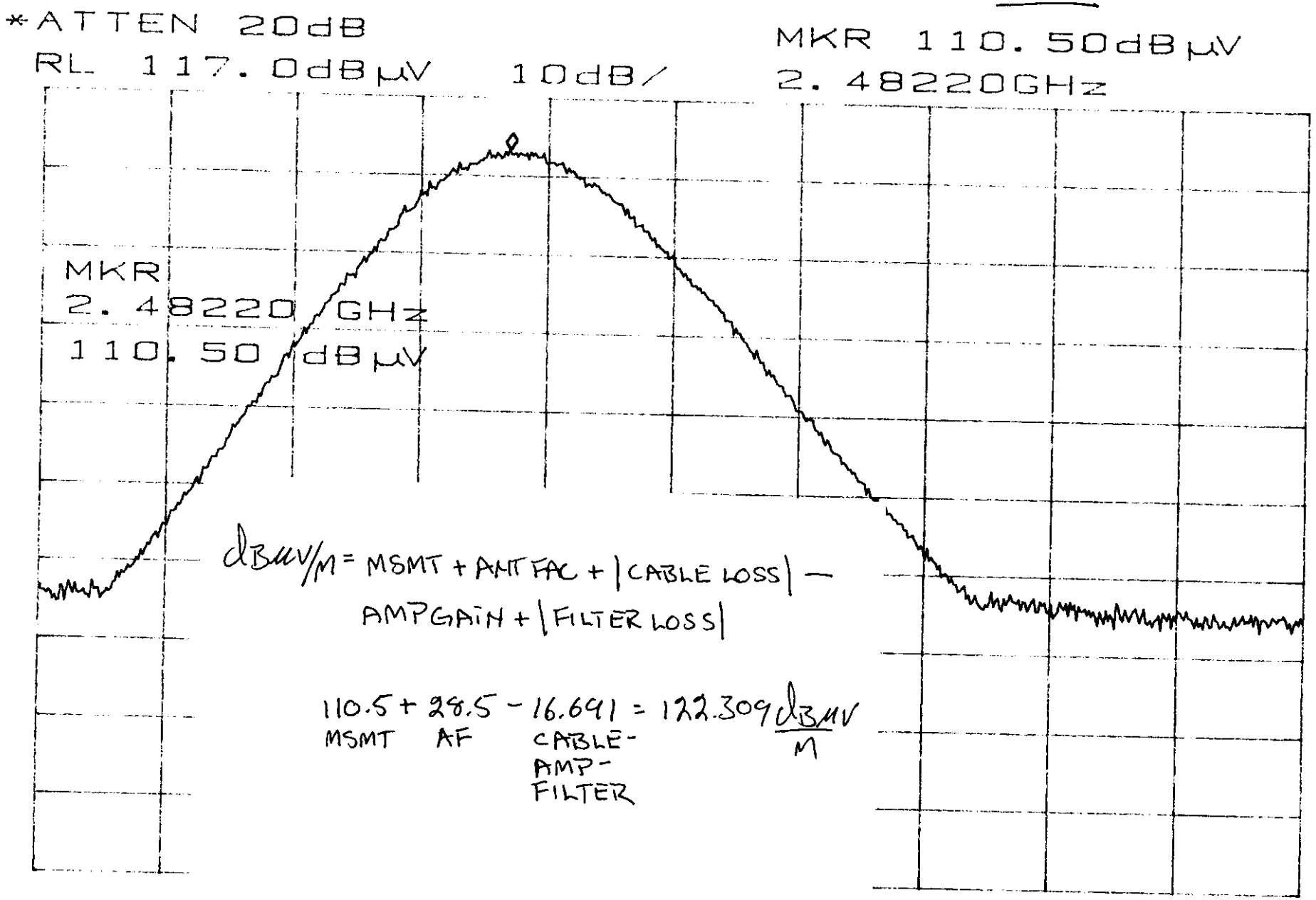
DATE: Mar 17, 1999

EUT: Viper Network Radio
CUSTOMER NAME: Metricom
S/N: 840100e6
WORK ORDER: 9031602
RULE PART: 15 247
FILE: 9031602a xls

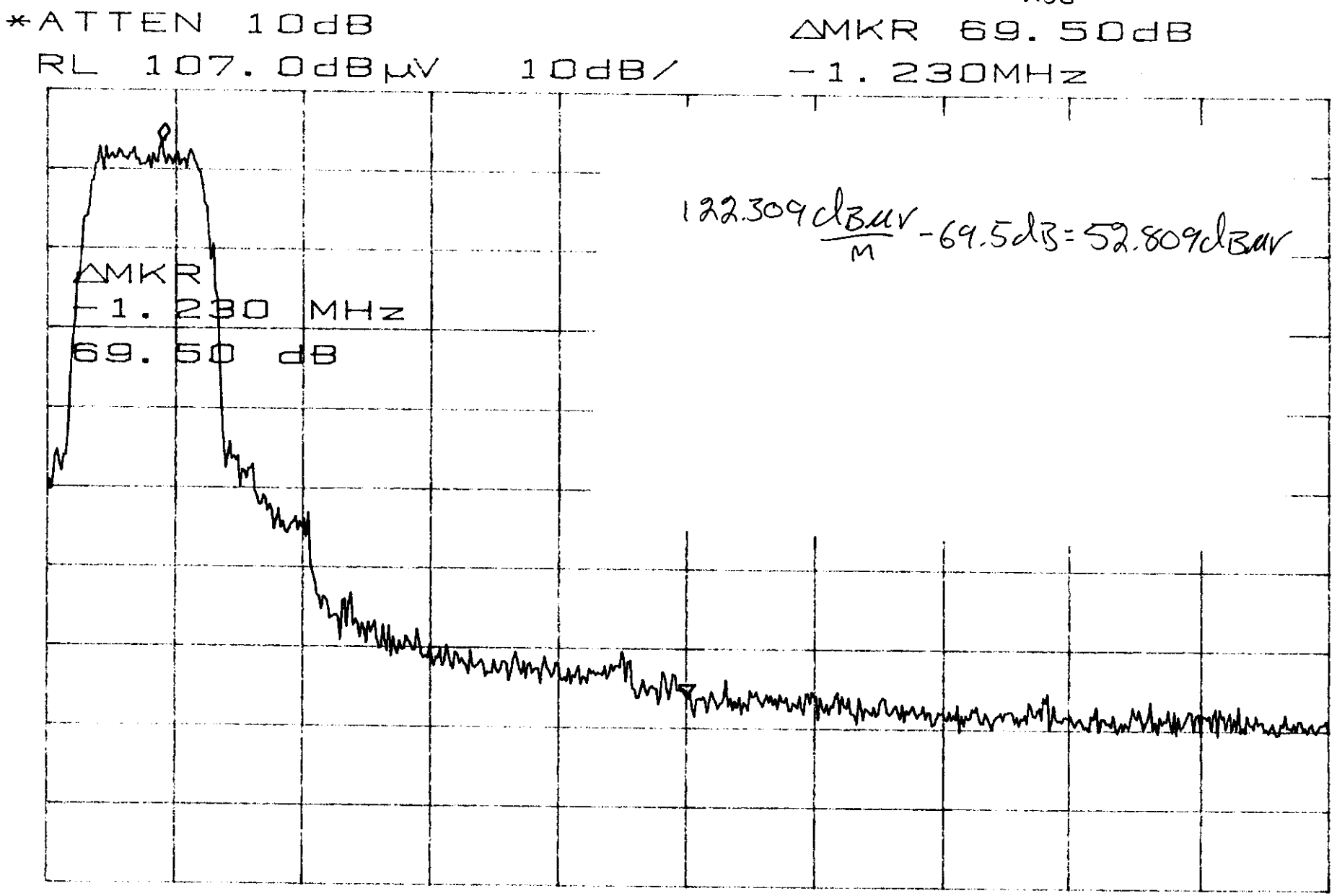
ANTENNA horn
OTHER CAL FACTOR ATTN dB: 0
MODULATION TYPE:
DUTY dB: 0
TESTED E Shawn
HP IL dB: 0
COMMENT Note bold font indicates noise floor measurement
DIST dB: 0

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 =	902.08								
1804.16	44.0	Pk	27.4	6.5	35.0	0.0	42.9	74.0	-31.1
1804.16	34.0	Avg	27.4	6.5	35.0	0.0	32.9	54.0	-21.1
2706.24	43.3	Pk	30.6	8.1	35.0	0.0	47.0	74.0	-27.0
2706.24	33.7	Avg	30.6	8.1	35.0	0.0	37.4	54.0	-16.6
3608.32	43.8	Pk	32.5	9.8	35.0	0.0	51.1	74.0	-22.9
3608.32	33.6	Avg	32.5	9.8	35.0	0.0	40.9	54.0	-13.1
4510.40	42.5	Pk	34.2	11.7	35.0	0.0	53.4	74.0	-20.6
4510.40	33.0	Avg	34.2	11.7	35.0	0.0	43.9	54.0	-10.1
5412.48	36.0	Pk	34.8	14.1	35.0	0.0	49.9	74.0	-24.1
5412.48	23.3	Avg	34.8	14.1	35.0	0.0	37.2	54.0	-16.8
6314.56	35.1	Pk	37.3	15.4	35.0	0.0	52.8	74.0	-21.2
6314.56	23.3	Avg	37.3	15.4	35.0	0.0	41.0	54.0	-13.0
7216.64	37.8	Pk	36.8	16.9	35.0	0.0	56.5	74.0	-17.5
7216.64	26.0	Avg	36.8	16.9	35.0	0.0	44.7	54.0	-9.3
8118.72	37.0	Pk	38.4	18.3	35.0	0.0	58.7	74.0	-15.3
8118.72	25.7	Avg	38.4	18.3	35.0	0.0	47.4	54.0	-6.6
9020.80	34.0	Pk	40.4	18.9	35.0	0.0	58.3	74.0	-15.7
9020.80	23.0	Avg	40.4	18.9	35.0	0.0	47.3	54.0	-6.7
Fund =	914.13								
1828.26	45.2	Pk	27.4	6.5	35.0	0.0	44.1	74.0	-29.9
1828.26	34.2	Avg	27.4	6.5	35.0	0.0	33.1	54.0	-20.9
2742.39	43.5	Pk	30.6	8.1	35.0	0.0	47.2	74.0	-26.8
2742.39	33.8	Avg	30.6	8.1	35.0	0.0	37.5	54.0	-16.5
3656.52	45.8	Pk	32.5	10.1	35.0	0.0	53.4	74.0	-20.6
3656.52	33.0	Avg	32.5	10.1	35.0	0.0	40.6	54.0	-13.4
4570.65	44.5	Pk	34.2	11.9	35.0	0.0	55.6	74.0	-18.4
4570.65	33.6	Avg	34.2	11.9	35.0	0.0	44.7	54.0	-9.3
5484.78	33.0	Pk	34.8	13.9	35.0	0.0	46.7	74.0	-27.3
5484.78	23.5	Avg	34.8	13.9	35.0	0.0	37.2	54.0	-16.8
6398.91	32.1	Pk	37.3	15.3	35.0	0.0	49.7	74.0	-24.3
6398.91	23.5	Avg	37.3	15.3	35.0	0.0	41.1	54.0	-12.9
7313.04	36.8	Pk	36.8	17.3	35.0	0.0	55.9	74.0	-18.1
7313.04	26.4	Avg	36.8	17.3	35.0	0.0	45.5	54.0	-8.5
8227.17	37.6	Pk	38.4	18.2	35.0	0.0	59.2	74.0	-14.8
8227.17	26.4	Avg	38.4	18.2	35.0	0.0	48.0	54.0	-6.0
9141.30	34.8	Pk	40.4	19.2	35.0	0.0	59.4	74.0	-14.6
9141.30	22.4	Avg	40.4	19.2	35.0	0.0	47.0	54.0	-7.0
Fund =	927.84								
1855.68	44.2	Pk	27.4	6.7	35.0	0.0	43.3	74.0	-30.7
1855.68	34.2	Avg	27.4	6.7	35.0	0.0	33.3	54.0	-20.7
2783.52	44.1	Pk	30.6	8.3	35.0	0.0	48.0	74.0	-26.0
2783.52	33.8	Avg	30.6	8.3	35.0	0.0	37.7	54.0	-16.3
3711.36	43.5	Pk	32.5	10.2	35.0	0.0	51.2	74.0	-22.8
3711.36	33.6	Avg	32.5	10.2	35.0	0.0	41.3	54.0	-12.7
4639.20	44.2	Pk	34.2	11.8	35.0	0.0	55.2	74.0	-18.8
4639.20	33.5	Avg	34.2	11.8	35.0	0.0	44.5	54.0	-9.5
5567.04	36.7	Pk	35.6	14.1	35.0	0.0	51.4	74.0	-22.6
5567.04	23.3	Avg	35.6	14.1	35.0	0.0	38.0	54.0	-16.0
6494.88	37.3	Pk	37.3	15.8	35.0	0.0	55.4	74.0	-18.6
6494.88	25.2	Avg	37.3	15.8	35.0	0.0	43.3	54.0	-10.7
7422.72	39.2	Pk	36.8	17.2	35.0	0.0	58.2	74.0	-15.8
7422.72	26.1	Avg	36.8	17.2	35.0	0.0	45.1	54.0	-8.9
8350.56	37.5	Pk	38.4	18.2	35.0	0.0	59.1	74.0	-14.9
8350.56	26.3	Avg	38.4	18.2	35.0	0.0	47.9	54.0	-6.1
9278.40	33.9	Pk	40.4	19.3	35.0	0.0	58.6	74.0	-15.4

"REF" MSMT OF 2.4G HIGH BANDEDGE COMPLIANCE, CH 256



"DELTA" MSMT FOR 2.4GHz HIGH BAND EDGE COMPLIANCE CH 256



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

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

stomer:	METRICOM	Operator:	SHAWN
te:	03-16-1999	Time:	16:18:12
mperature Range:	66 Deg F	Percent Humidity:	48
U.T.:	VIPER NETWORK RADIO		
rial Number:	840100E6		
pport Devices:			
rial Number:			
C ID:			
ercise Program:			
difications:	None		
port File Name:	F:\TESTDATA\9031602.RF		
tenna Type:	BICONICAL		

EST REQ	TEST dBuV	ACTUAL dBuV/m	CLASS B LIMIT	VERSUS B LIMIT	TABLE DEGREES	ANTENNA HEIGHT	POLAR- IZATION	DETECTOR Type
6.000	31.0	22.2	40.0	-17.8	120	1.5	H	PK
2.000	33.9	16.6	40.0	-23.4	90	1.5	H	PK
0.000	52.8	42.0	43.5	-1.5	90	1.5	H	PK
0.000	49.1	38.3	43.5	-5.2	90	1.5	H	QP
TE: BB EMISSIONS FROM 115Mhz TO 175Mhz FOLLOWING READINGS ARE BB PEAKS								
5.690	37.2	25.8	43.5	-17.7	90	1.5	H	PK
0.310	44.5	34.4	43.5	-9.1	90	1.5	H	PK
6.430	53.5	43.9	43.5	0.4	90	2.0	H	PK
5.430	51.4	41.8	43.5	-1.7	90	2.0	H	QP
3.900	41.7	32.7	43.5	-10.8	90	2.0	H	PK
1.100	32.7	23.8	43.5	-19.7	90	1.5	H	PK
TE: RESUME NB SCANS								
3.000	41.8	32.9	43.5	-10.6	45	2.0	H	PK
2.000	47.6	39.2	43.5	-4.3	45	2.0	H	PK
2.000	45.7	37.3	43.5	-6.2	45	2.0	H	QP
5.000	34.3	26.5	43.5	-17.0	90	1.5	H	PK
3.000	28.9	21.3	46.0	-24.7	90	1.5	H	PK
0.000	43.0	35.5	46.0	-10.5	120	1.5	H	PK
2.000	43.7	36.3	46.0	-9.7	90	1.5	H	PK
4.000	47.7	40.8	46.0	-5.2	90	1.5	H	PK
4.000	44.8	37.9	46.0	-8.1	90	1.5	H	QP
1.000	42.7	37.0	46.0	-9.0	75	1.5	H	PK
4.000	49.3	45.2	46.0	-0.8	90	1.5	H	PK

8.000	46.2	42.1	46.0	-3.9	90	1.5	H	QP
4.000	37.9	31.0	46.0	-15.0	90	1.5	V	PK
0.000	42.2	34.7	46.0	-11.3	120	1.5	V	PK
2.000	45.0	36.6	43.5	-6.9	150	1.5	V	PK
0.000	42.3	33.6	43.5	-9.9	90	1.5	V	PK
8.000	48.6	39.7	43.5	-3.8	120	2.0	V	PK

te: 03-16-1999
U.T.: VIPER NETWORK RADIO
rial Number: 840100E6
tenna Type: BICONICAL

EST REQ	TEST dBuV	ACTUAL dBuV/m	CLASS B LIMIT	VERSUS B LIMIT	TABLE DEGREES	ANTENNA HEIGHT	POLAR- IZATION	DETECTOR Type
8.000	46.3	37.4	43.5	-6.1	120	2.0	V	QP
4.000	51.6	42.0	43.5	-1.5	120	1.5	V	PK
4.000	49.7	40.1	43.5	-3.4	120	1.5	V	QP
0.000	52.4	41.6	43.5	-1.9	120	1.5	V	PK
0.000	50.6	39.8	43.5	-3.7	120	1.5	V	QP

CHANGED ANTENNA TO LOG PERIODIC

6.000	29.6	20.6	46.0	-25.4	90	1.5	H	PK
4.000	32.0	24.1	46.0	-21.9	150	2.0	H	PK
2.000	37.3	30.2	46.0	-15.8	45	2.0	H	PK
6.000	32.2	25.6	46.0	-20.4	75	2.0	H	PK
0.000	33.5	27.8	46.0	-18.2	90	2.0	H	PK
8.000	37.7	32.9	46.0	-13.1	90	1.5	H	PK
6.000	41.4	37.4	46.0	-8.6	90	1.5	H	PK
0.000	36.2	32.6	46.0	-13.4	90	1.5	H	PK
4.000	42.4	39.1	46.0	-6.9	90	1.5	H	PK
2.000	44.0	42.1	46.0	-3.9	120	1.5	H	PK
2.000	42.5	40.6	46.0	-5.4	120	1.5	H	QP
6.000	34.0	32.7	46.0	-13.3	90	1.5	H	PK
0.000	35.8	34.6	46.0	-11.4	75	1.0	H	PK
4.000	37.3	36.1	46.0	-9.9	90	1.0	H	PK
4.000	34.3	33.1	46.0	-12.9	120	1.0	V	PK
2.000	38.5	36.6	46.0	-9.4	75	1.0	V	PK
4.000	37.3	34.0	46.0	-12.0	150	1.5	V	PK
0.000	37.0	33.4	46.0	-12.6	150	1.5	V	PK
6.000	45.4	41.4	46.0	-4.6	200	1.5	V	PK
6.000	42.3	38.3	46.0	-7.7	200	1.5	V	QP
8.000	32.0	27.2	46.0	-18.8	200	1.5	V	PK
0.000	36.0	30.3	46.0	-15.7	180	1.5	V	PK
2.000	34.3	27.2	46.0	-18.8	180	1.5	V	PK
4.000	38.7	30.8	46.0	-15.2	150	1.5	V	PK
0.000	33.5	25.0	46.0	-21.0	150	1.5	V	PK
6.000	33.3	24.3	46.0	-21.7	45	1.5	V	PK

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

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

stomer:	METRICOM	Operator:	SHAWN
te:	03-16-1999	Time:	14:01:57
mperature Range:	68 Deg F	Percent Humidity:	50
U.T.:	VIPER BETA ETHERNET RADIO W/ ANTENNA		
rial Number:	840100EC		
pport Devices:			
rial Number:			
C ID:			
ercise Program:			
difications:	None		
port File Name:	F:\TESTDATA\9031601.RF		

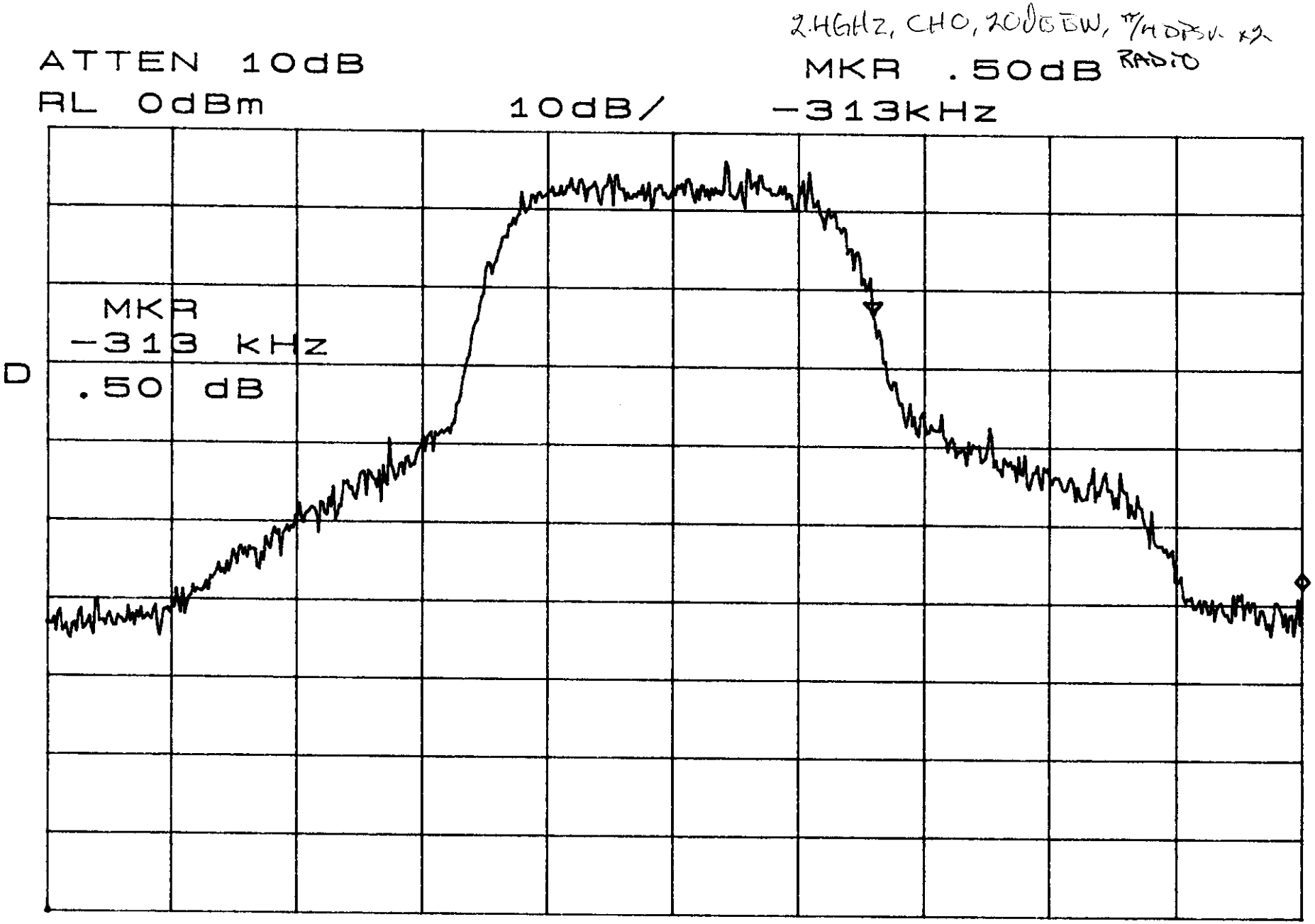
tenna Type: BICONICAL

EST REQ	TEST dBuV	ACTUAL dBuV/m	CLASS B LIMIT	VERSUS B LIMIT	TABLE DEGREES	ANTENNA HEIGHT	POLAR-IZATION	DETECTOR Type
TE: BB EMISSIONS FROM 35MHZ TO 60 MHZ FOLLOWING READINGS ARE BB PEAKS								
7.150	32.0	22.8	40.0	-17.2	180	1.5	H	PK
3.250	41.7	30.3	40.0	-9.7	180	1.5	H	PK
6.050	39.6	24.0	40.0	-16.0	180	2.0	H	PK
TE: RESUME NB SCANS								
4.000	39.0	29.4	43.5	-14.1	90	1.5	H	PK
8.000	35.0	26.1	43.5	-17.4	120	2.0	H	PK
0.000	36.1	27.4	43.5	-16.1	90	1.5	H	PK
6.000	30.3	22.5	43.5	-21.0	120	1.5	H	PK
8.000	29.0	21.4	46.0	-24.6	180	2.0	H	PK
0.000	41.0	33.5	46.0	-12.5	200	1.5	H	PK
2.000	38.5	31.1	46.0	-14.9	180	2.0	H	PK
4.000	34.5	27.6	46.0	-18.4	180	1.5	H	PK
6.000	33.2	27.5	46.0	-18.5	120	1.5	H	PK
8.000	45.4	41.3	46.0	-4.7	220	1.5	H	PK
8.000	42.3	38.2	46.0	-7.8	220	1.5	H	QP
9.990	35.8	33.0	46.0	-13.0	90	1.5	H	PK
9.990	36.5	33.7	46.0	-12.3	45	1.5	H	PK
8.000	38.8	34.7	46.0	-11.3	45	1.5	H	PK
6.000	28.8	23.1	46.0	-22.9	90	1.5	H	PK
4.000	31.0	24.1	46.0	-21.9	90	1.5	H	PK
2.000	33.6	26.2	46.0	-19.8	75	1.5	H	PK
0.000	38.7	31.2	46.0	-14.8	100	1.5	H	PK
6.000	33.8	26.0	43.5	-17.5	150	1.5	H	PK

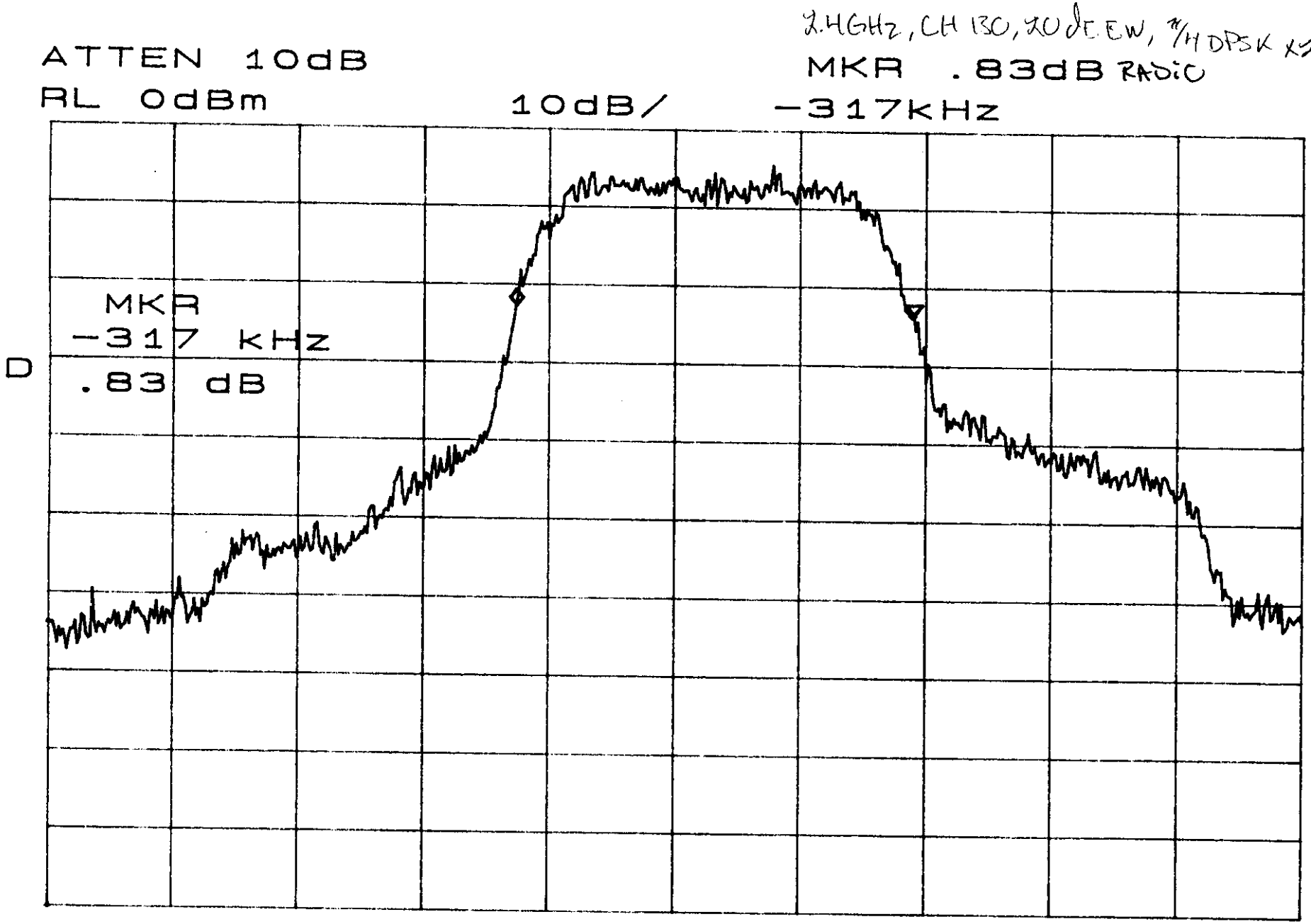
CHANGED ANTENNA TO LOG PERIODIC

6.000	35.6	26.6	46.0	-19.4	120	1.5	H	PK
0.000	32.5	24.0	46.0	-22.0	90	1.5	H	PK
4.000	33.7	25.8	46.0	-20.2	45	1.5	H	PK
2.000	34.7	27.6	46.0	-18.4	120	1.5	H	PK
6.000	32.1	25.5	46.0	-20.5	90	1.5	H	PK
6.000	39.0	32.4	46.0	-13.6	90	1.5	V	PK
2.000	40.0	32.9	46.0	-13.1	120	1.5	V	PK
6.000	35.3	26.3	46.0	-19.7	180	1.5	V	PK

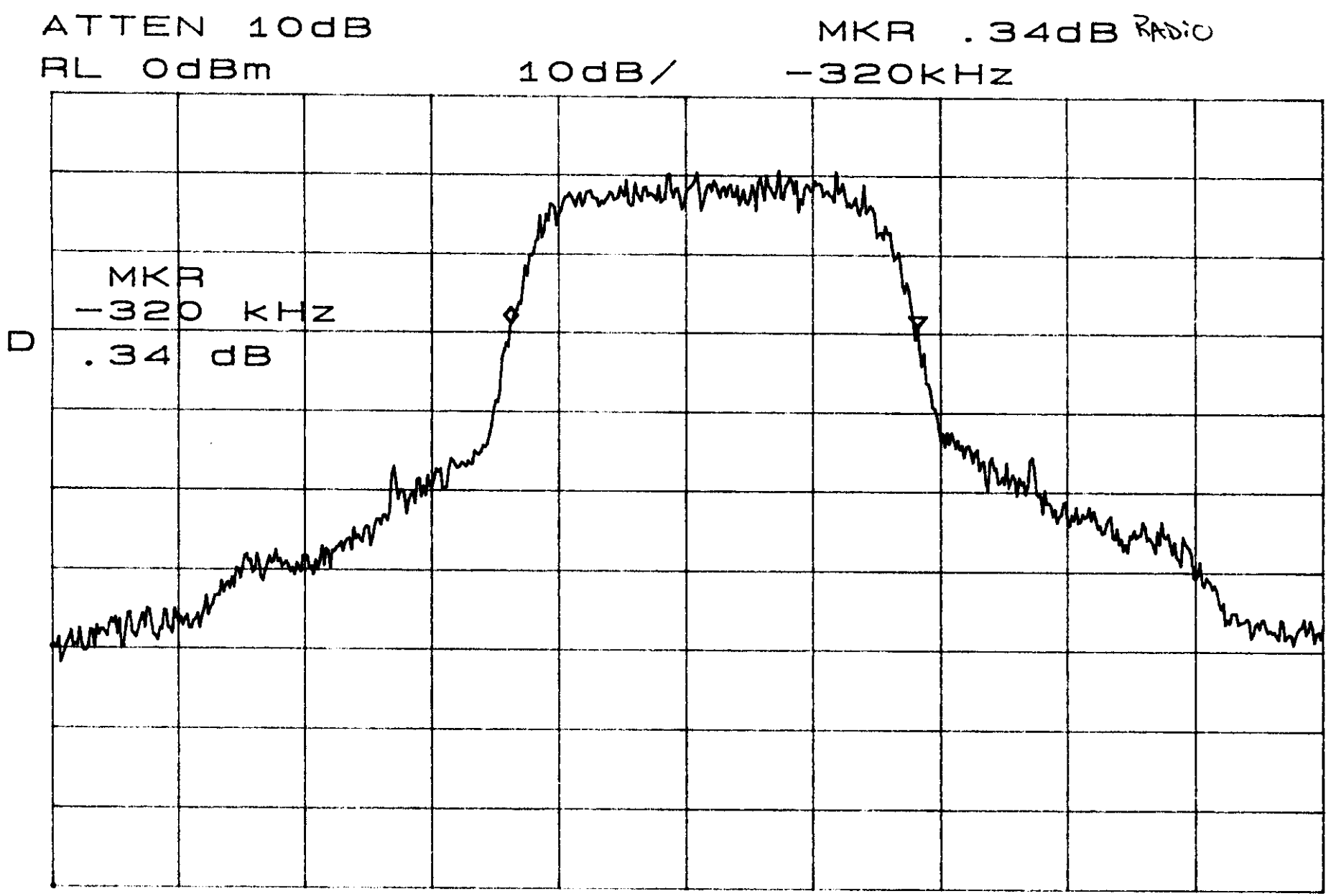
2.4GHz, CH0, 20dB BW, π/4 DQPSK x2



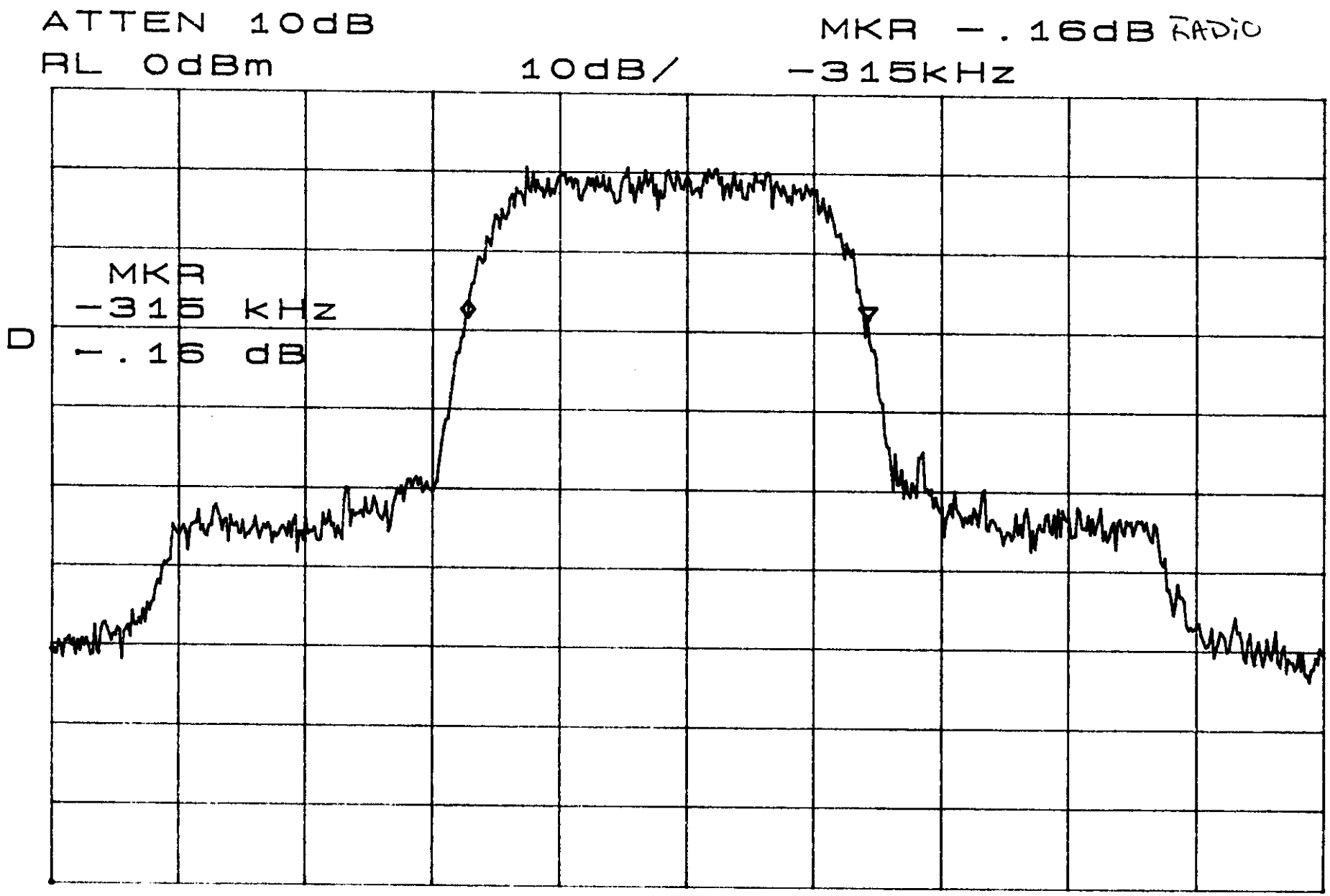
2.4GHz, CH 130, 20dEEW, π/4 DPSK x2



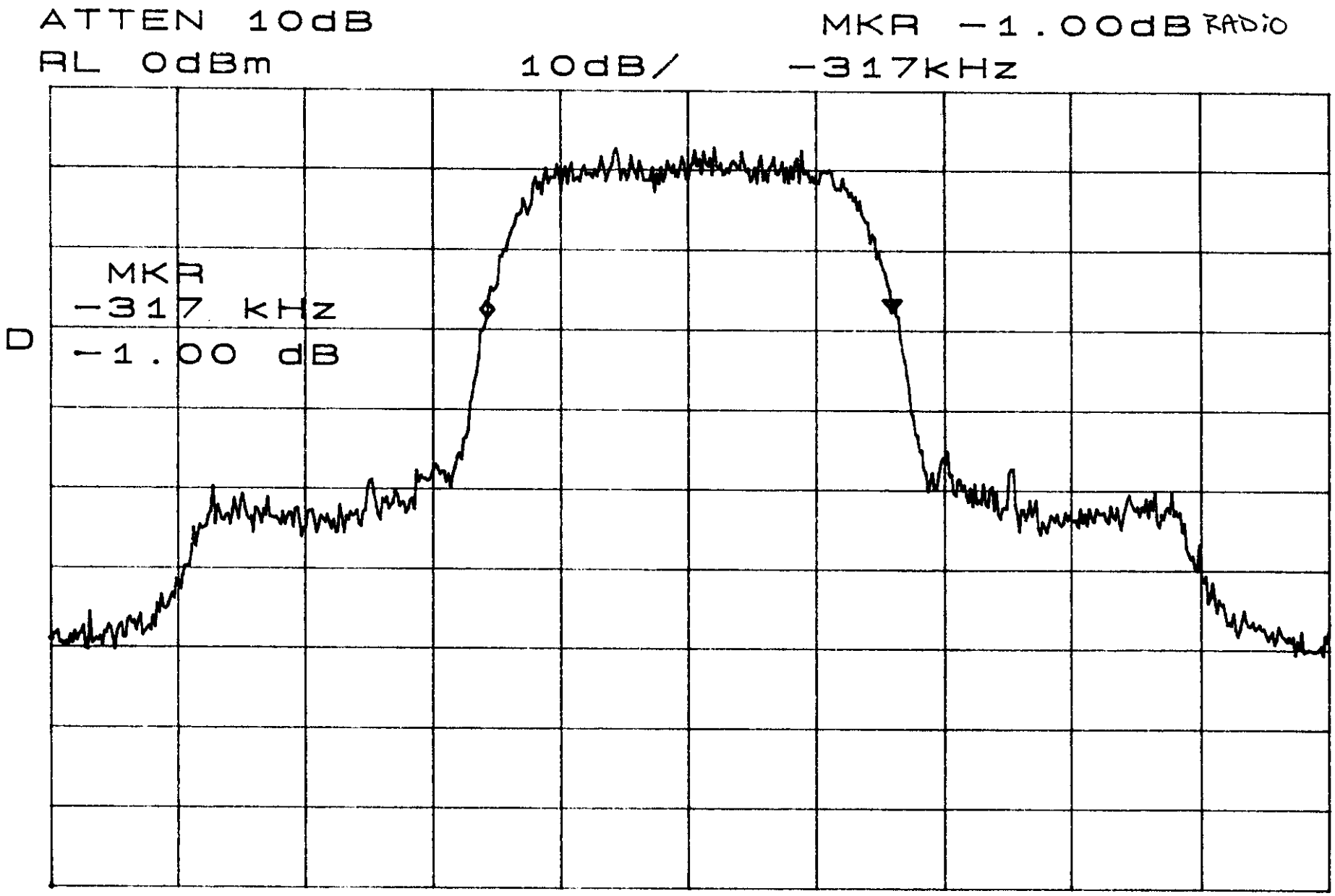
2.4GHz, 20dB BW, CH 256, 1MDSV-XX



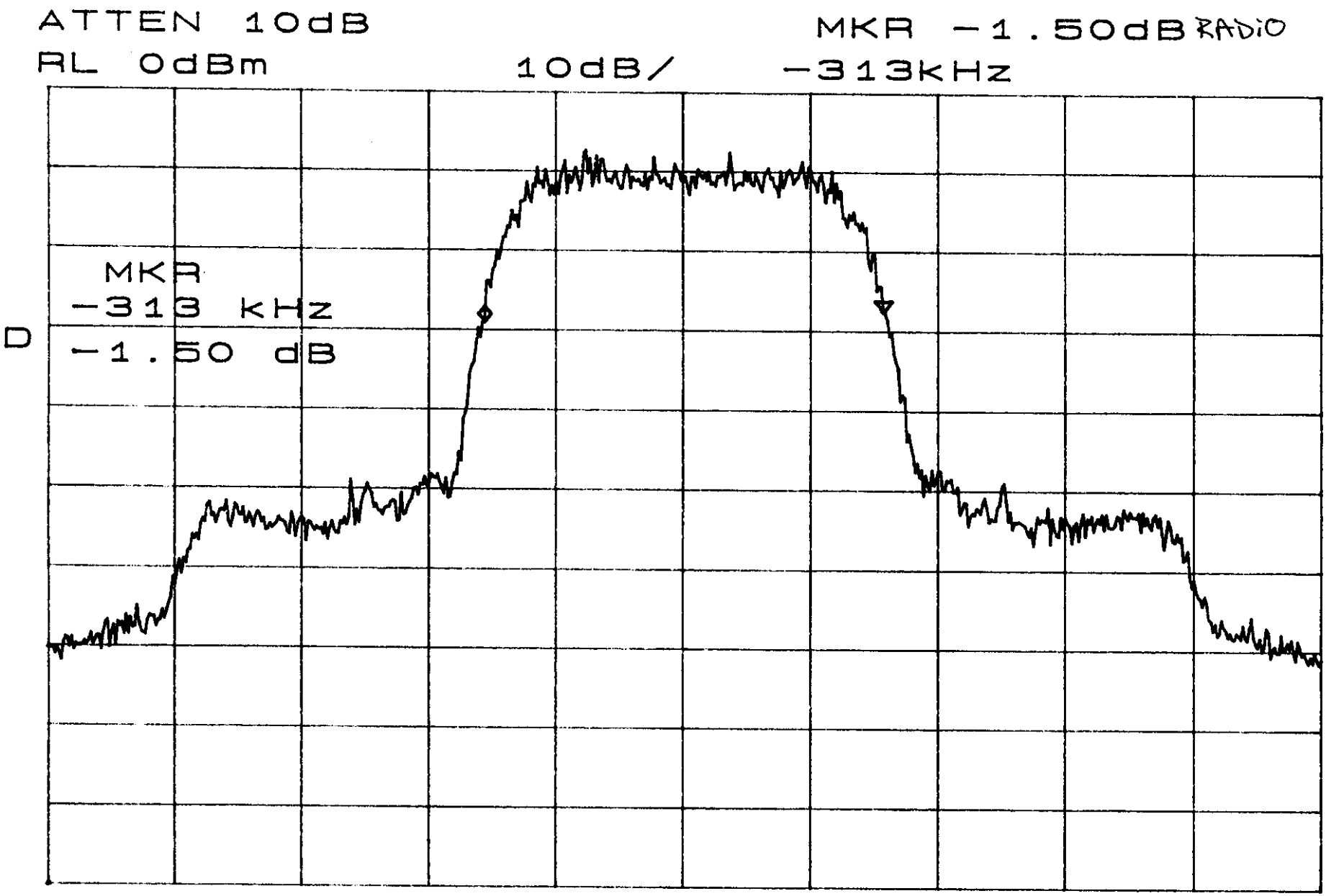
900 MHz, CH0, 20dB BW, π/4 DPSK x2



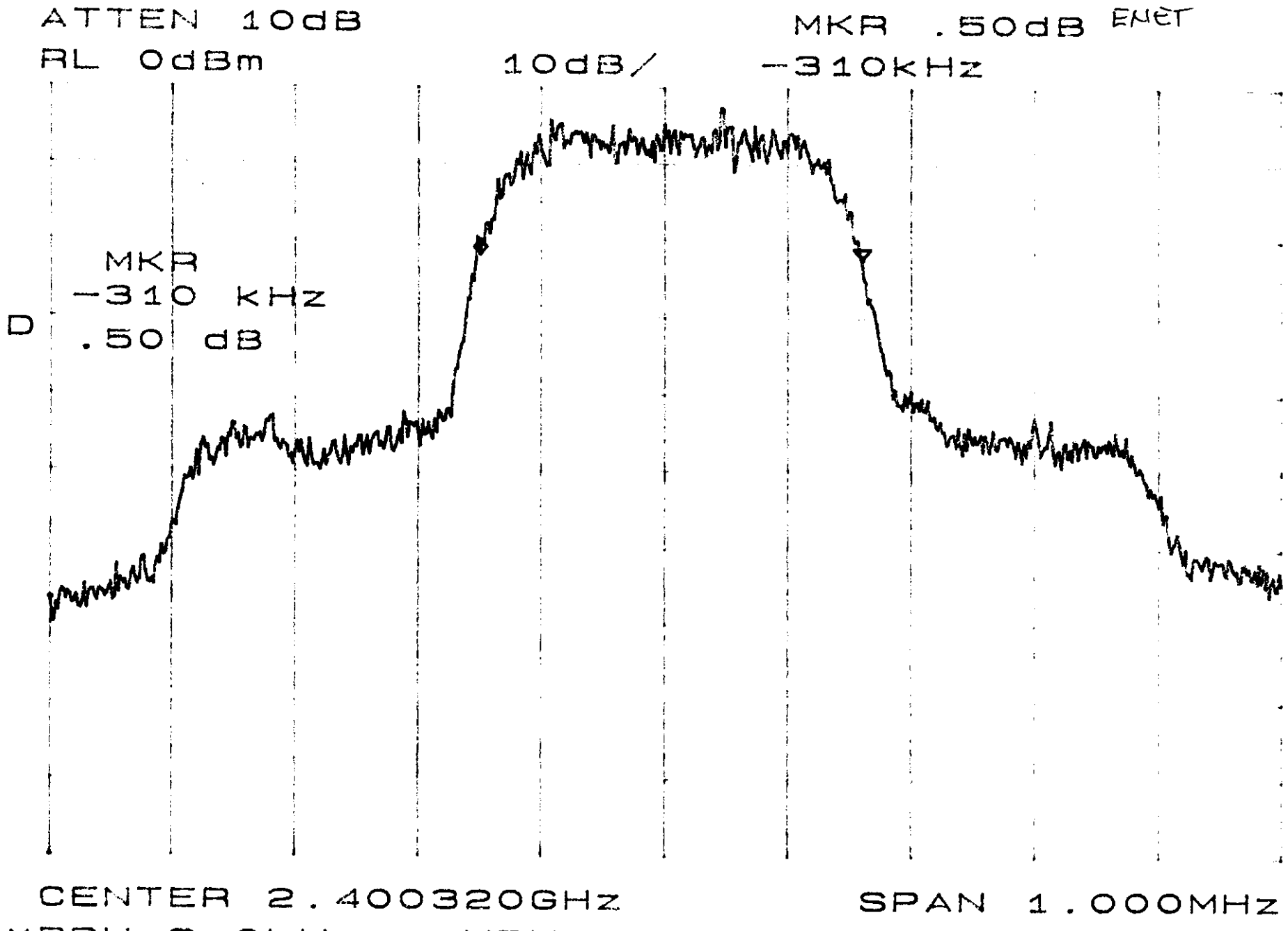
900MHz, CH75, 20dB BW, π/4 DPSK x2



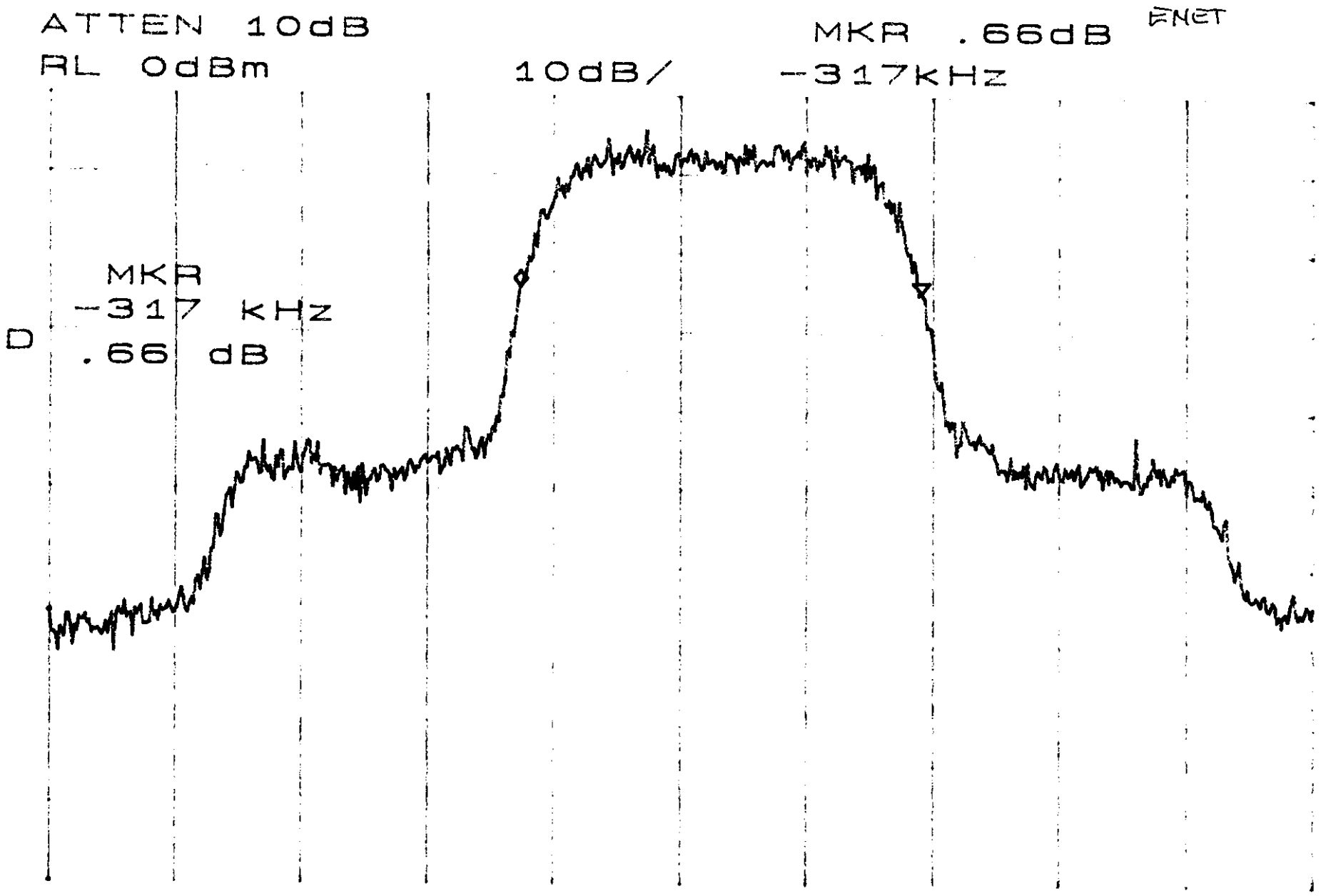
900MHz, CH 161, 20dB BW, π/4 DQPSK x2



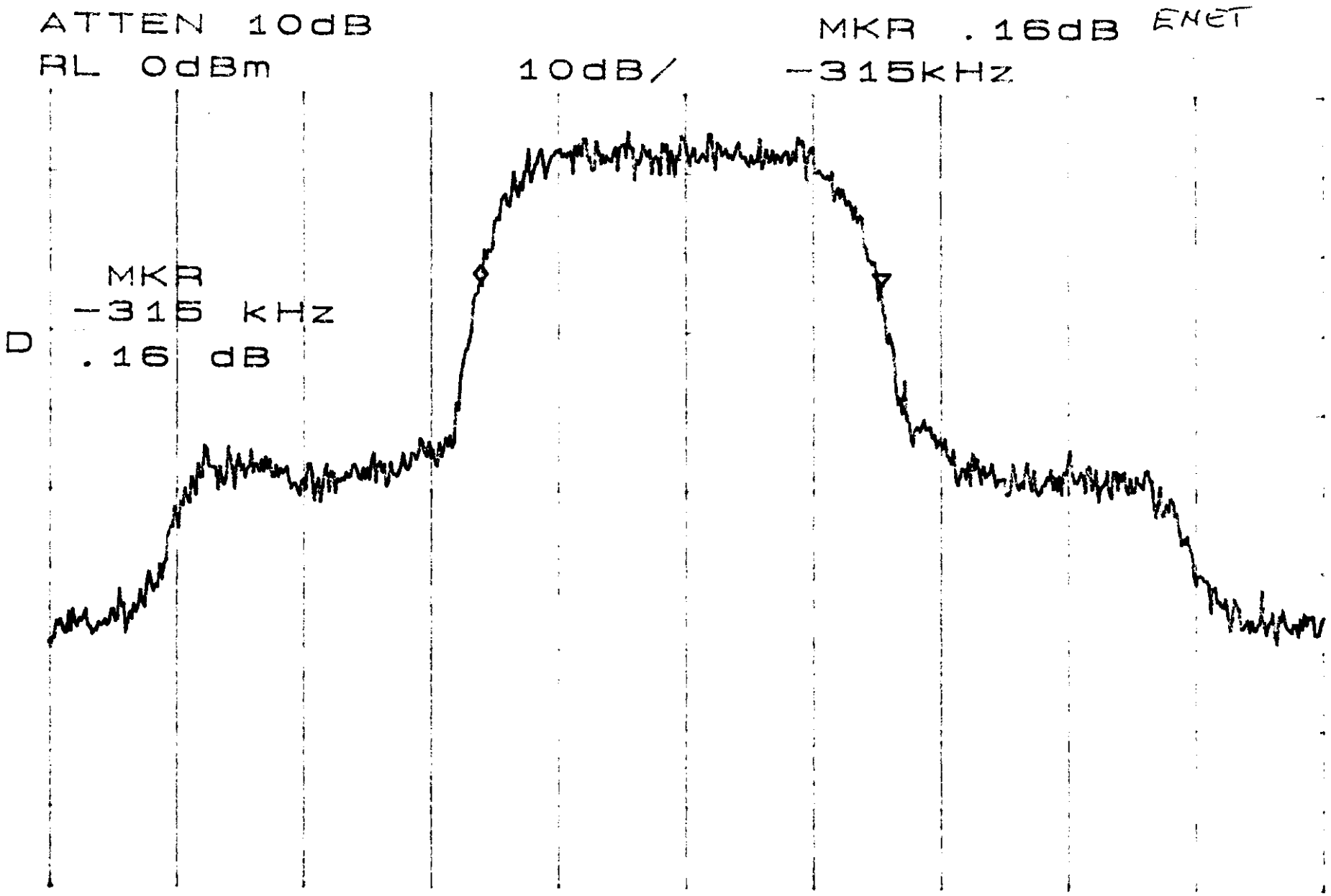
2.4G, CH0, 20dBW, π/4 DQPSK x2



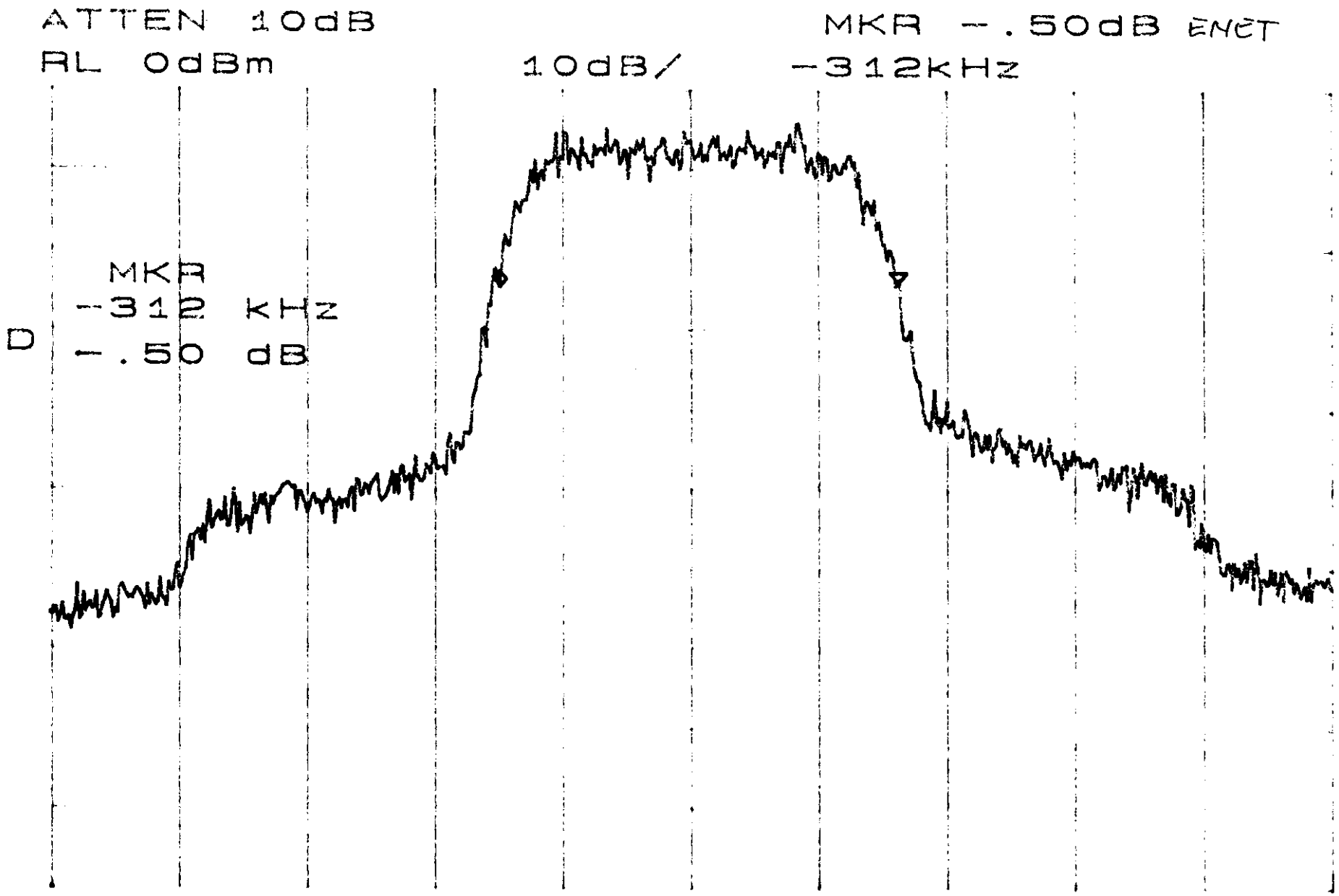
2.4GHz, CH 80, 20dB BW, π/4DQPSK x2



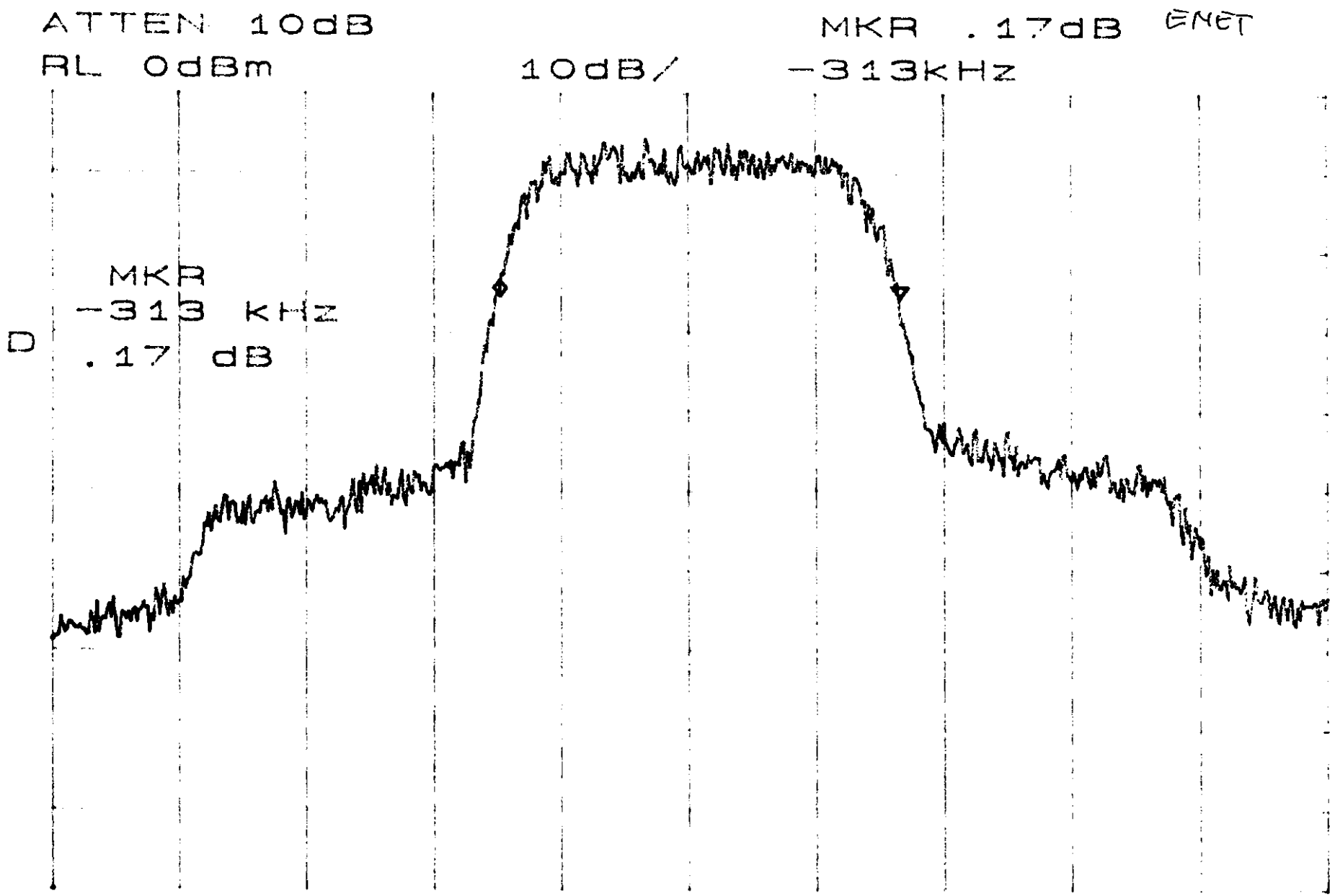
2-HG, CH 255, 20dB BW, π/4 DPSK x2



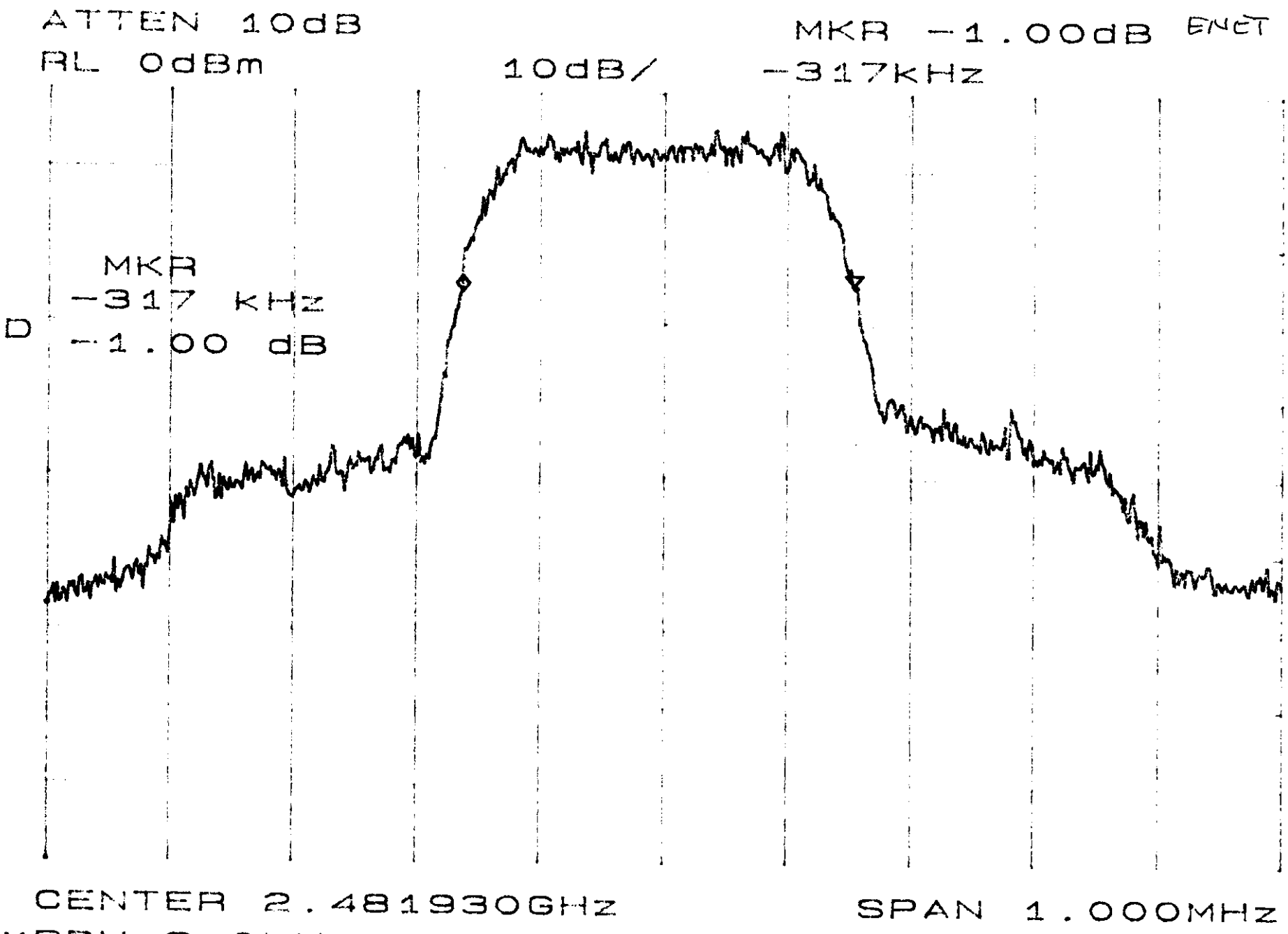
2.4G, CH0, 20dB BW, 16QAMx2



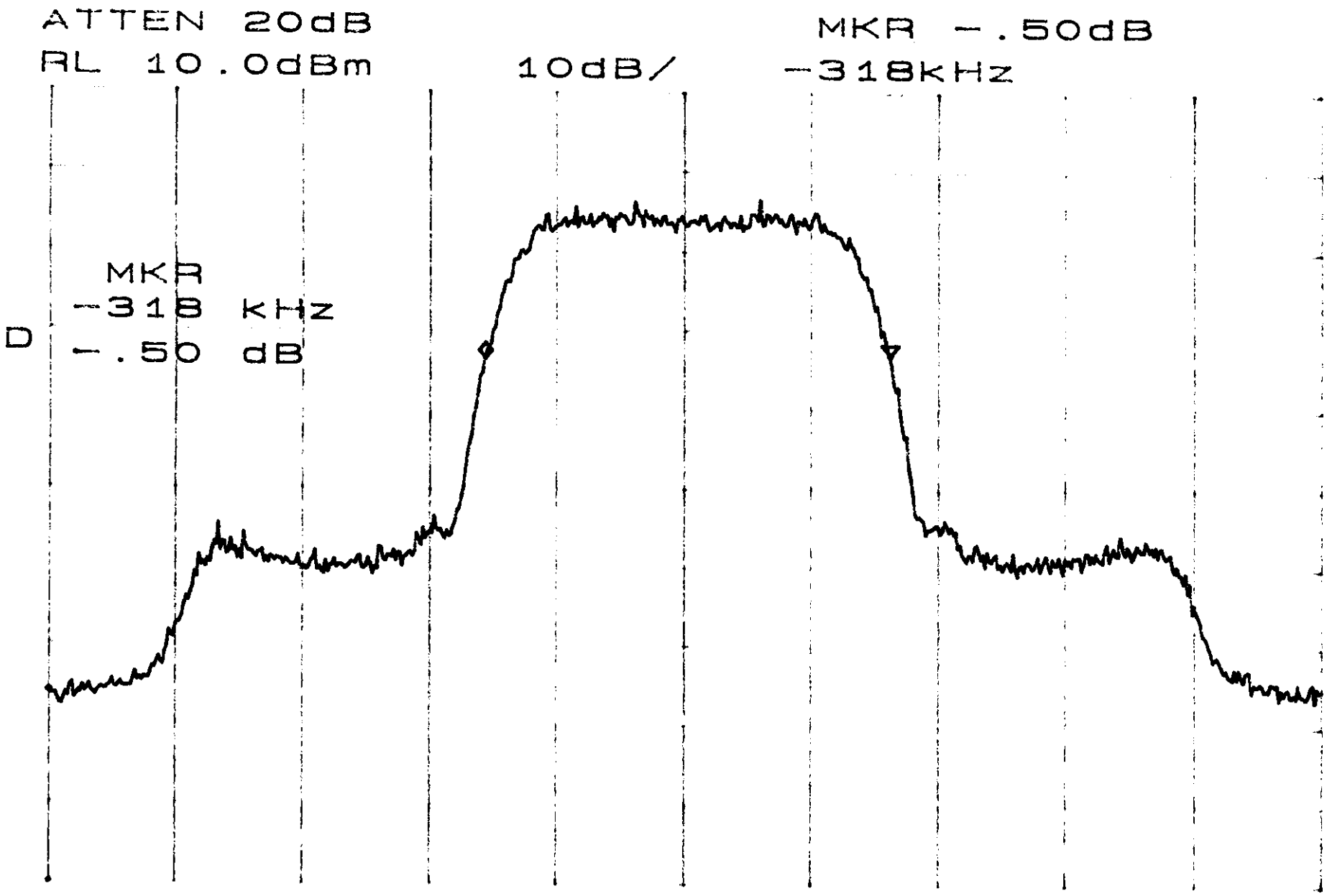
2-HG, CH 130, 20dB BW, 16QAM x2



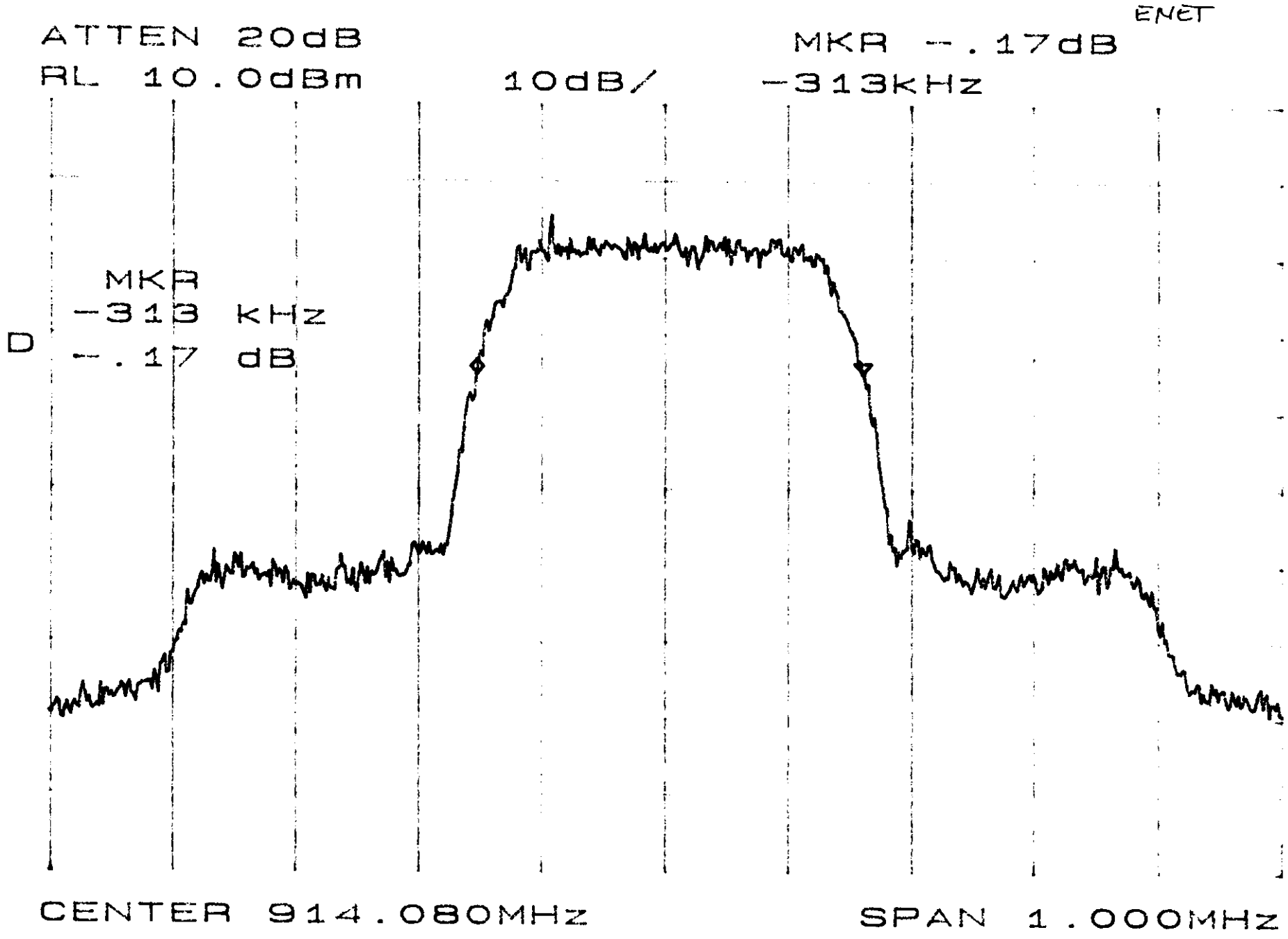
2.4G, CH 255, 20dB BW, 16QAM



900MHZ, CH 0, 20dBBW π/4 DPSK x2
ENET

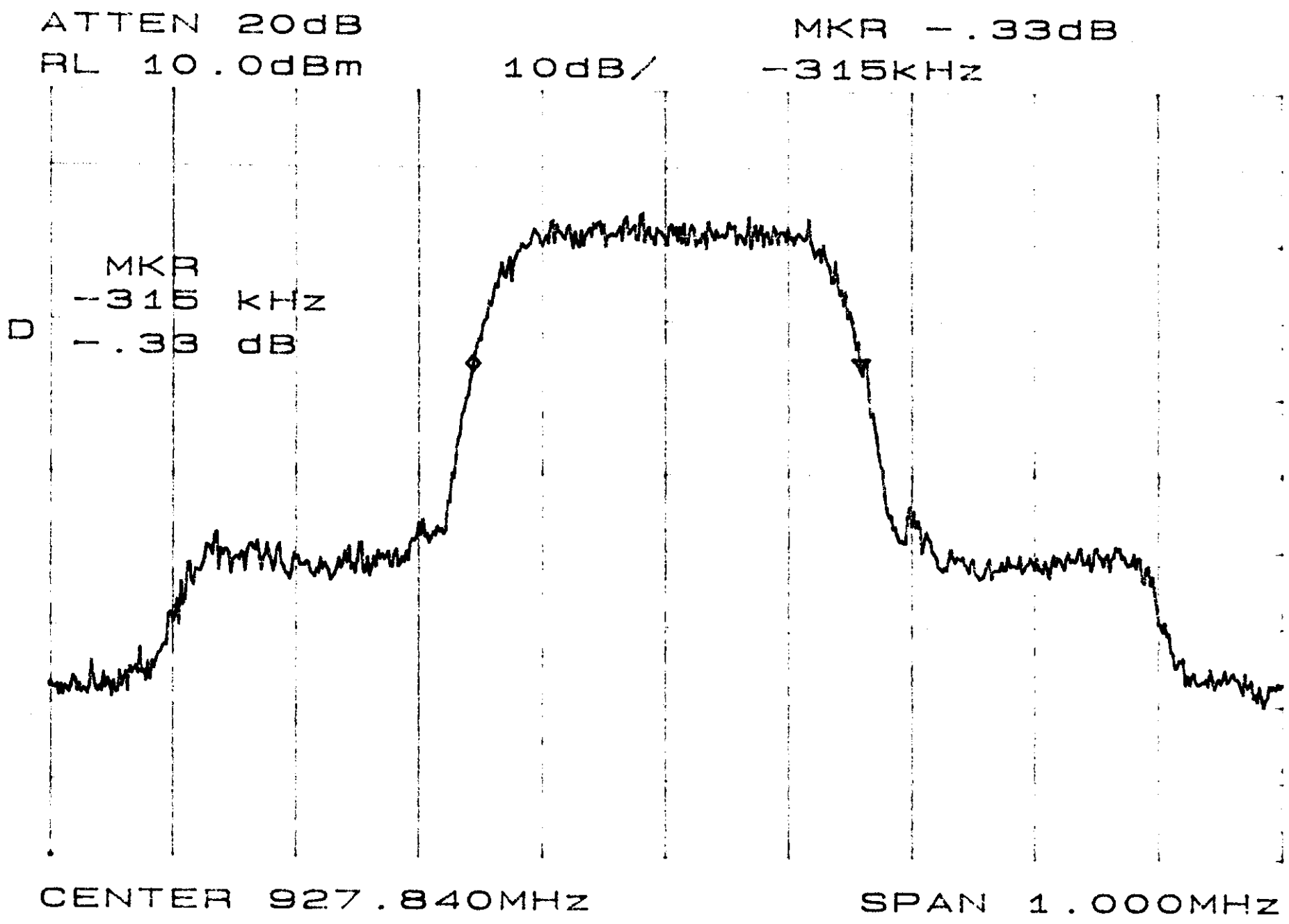


900 MHz, CH 75, 20dB BW, π/4 DPSK x2

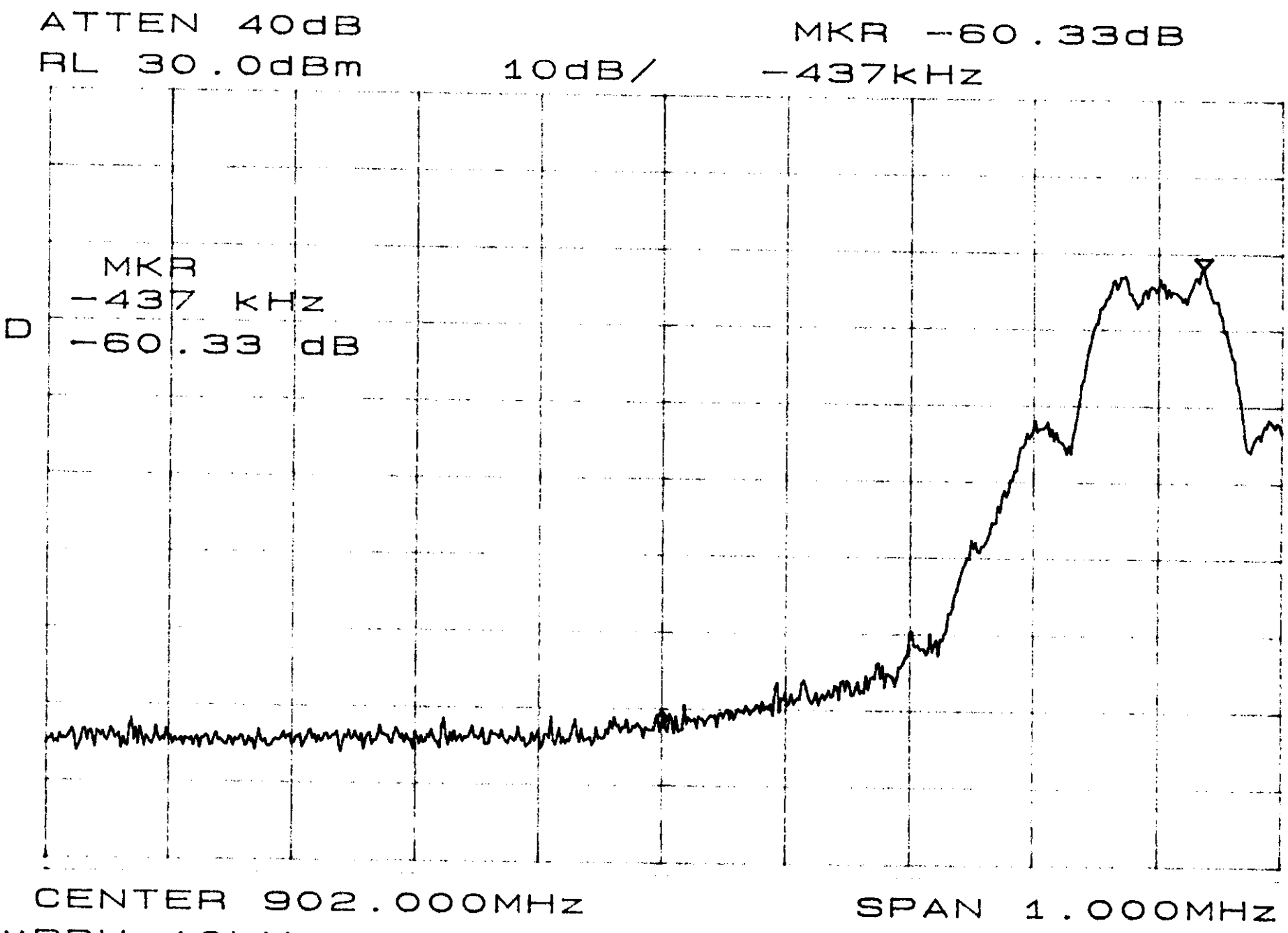


900 MHz, CH 161, 20dB BW, π/4 DQPSK

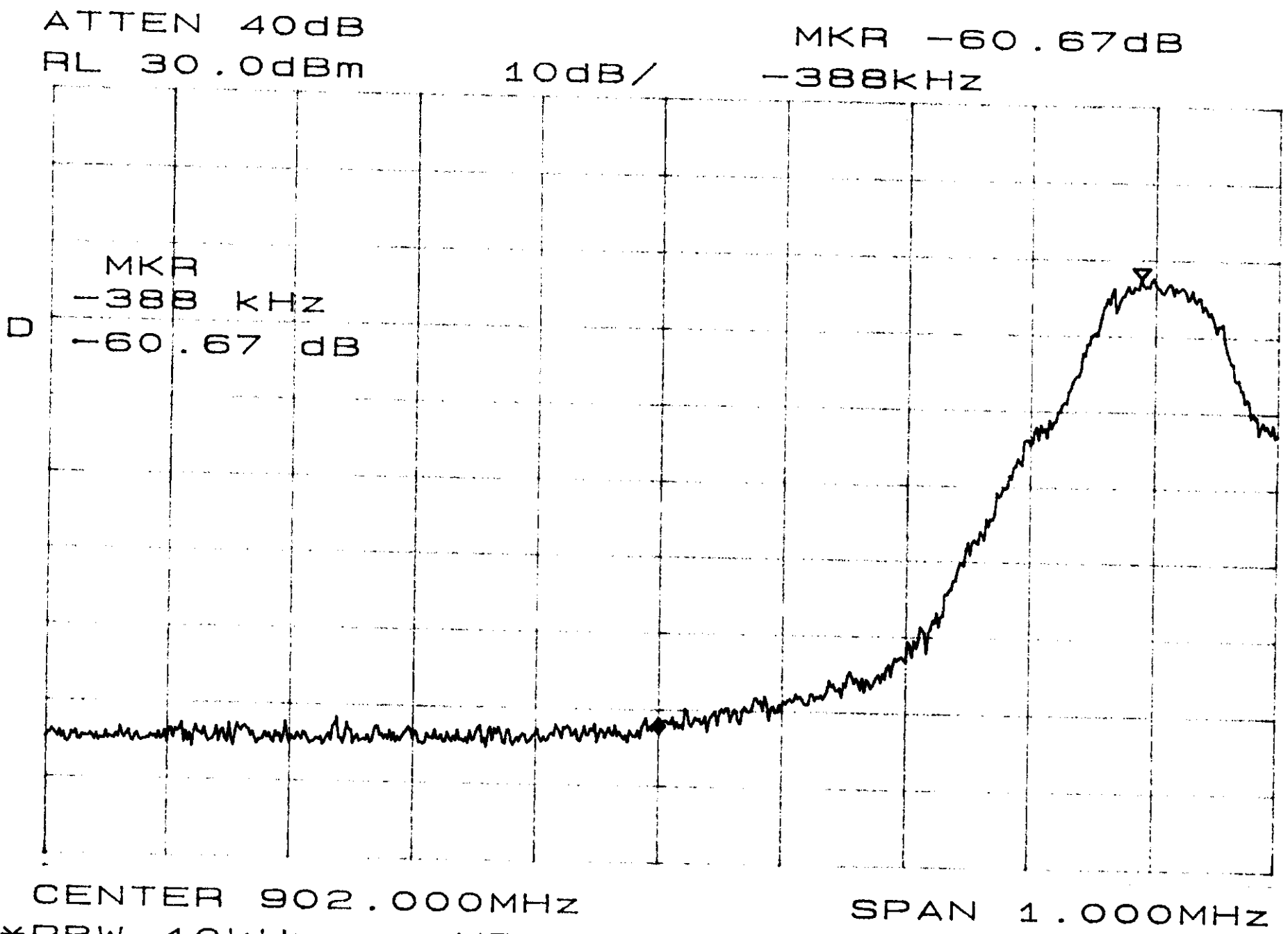
ENET



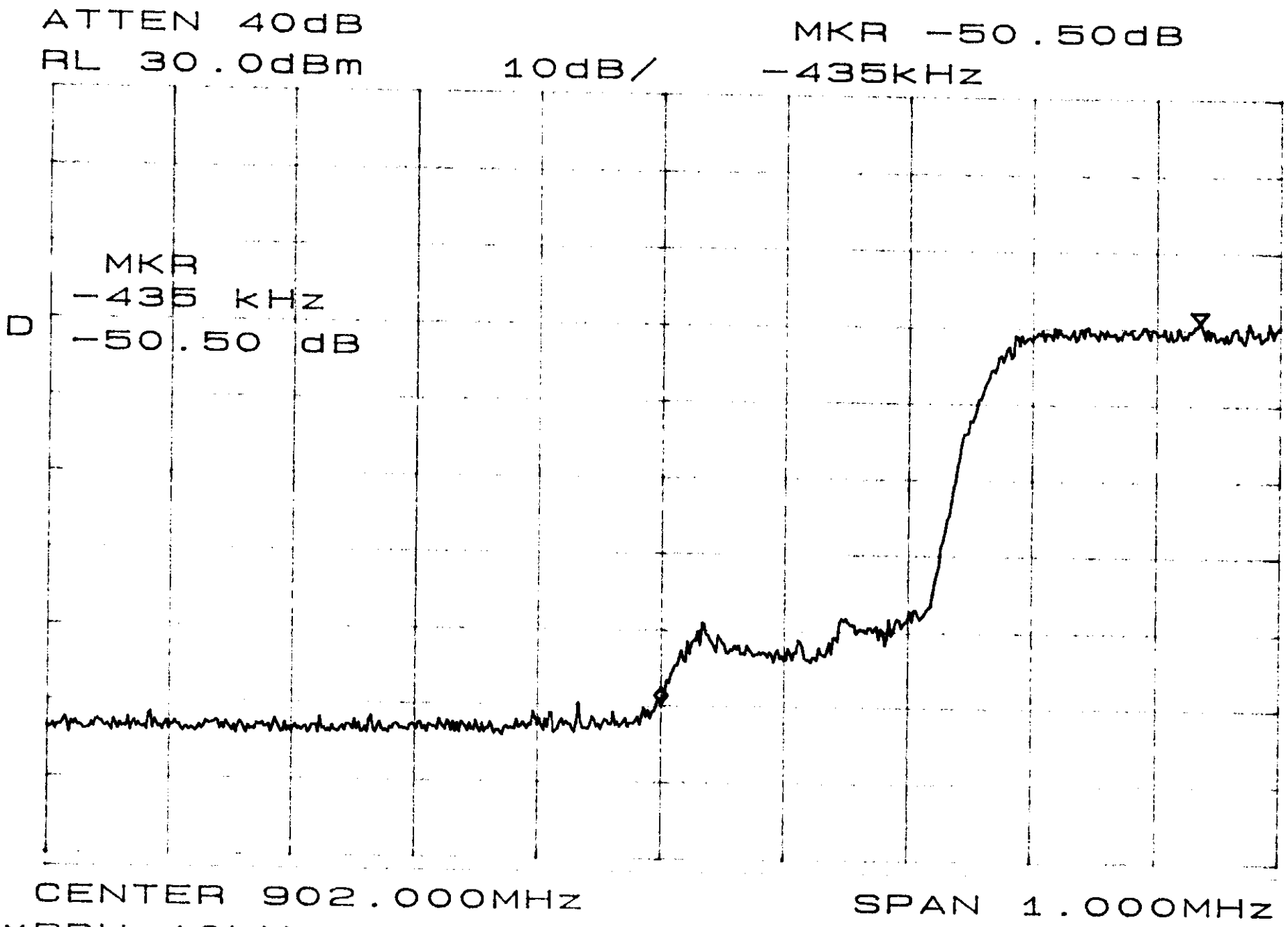
RADIO 900 MHZ BANDEDGE
CH 2, MOD 2FSK



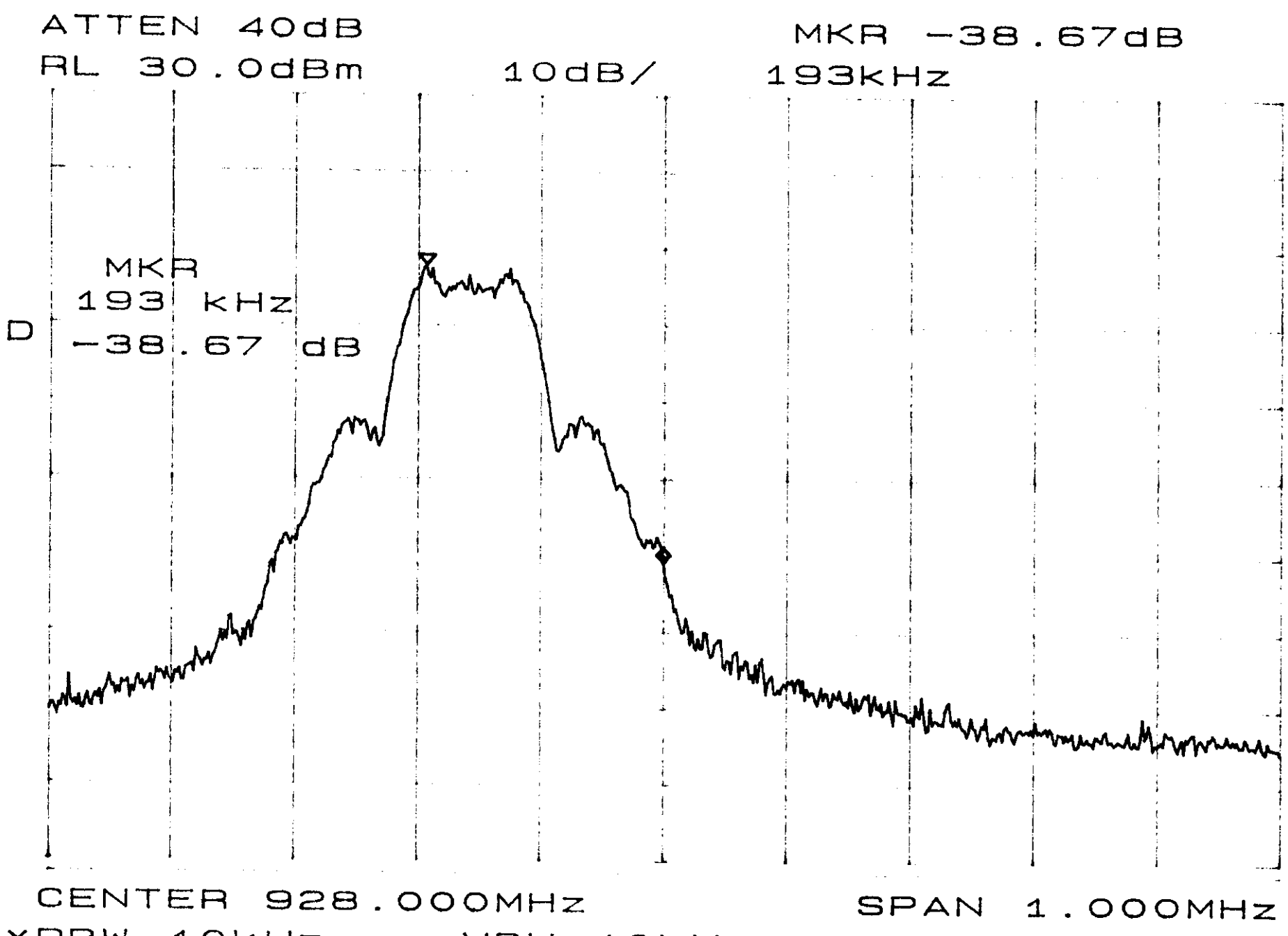
RADIO 900 MHZ BANDEDGE
CH2(0) 4FSK



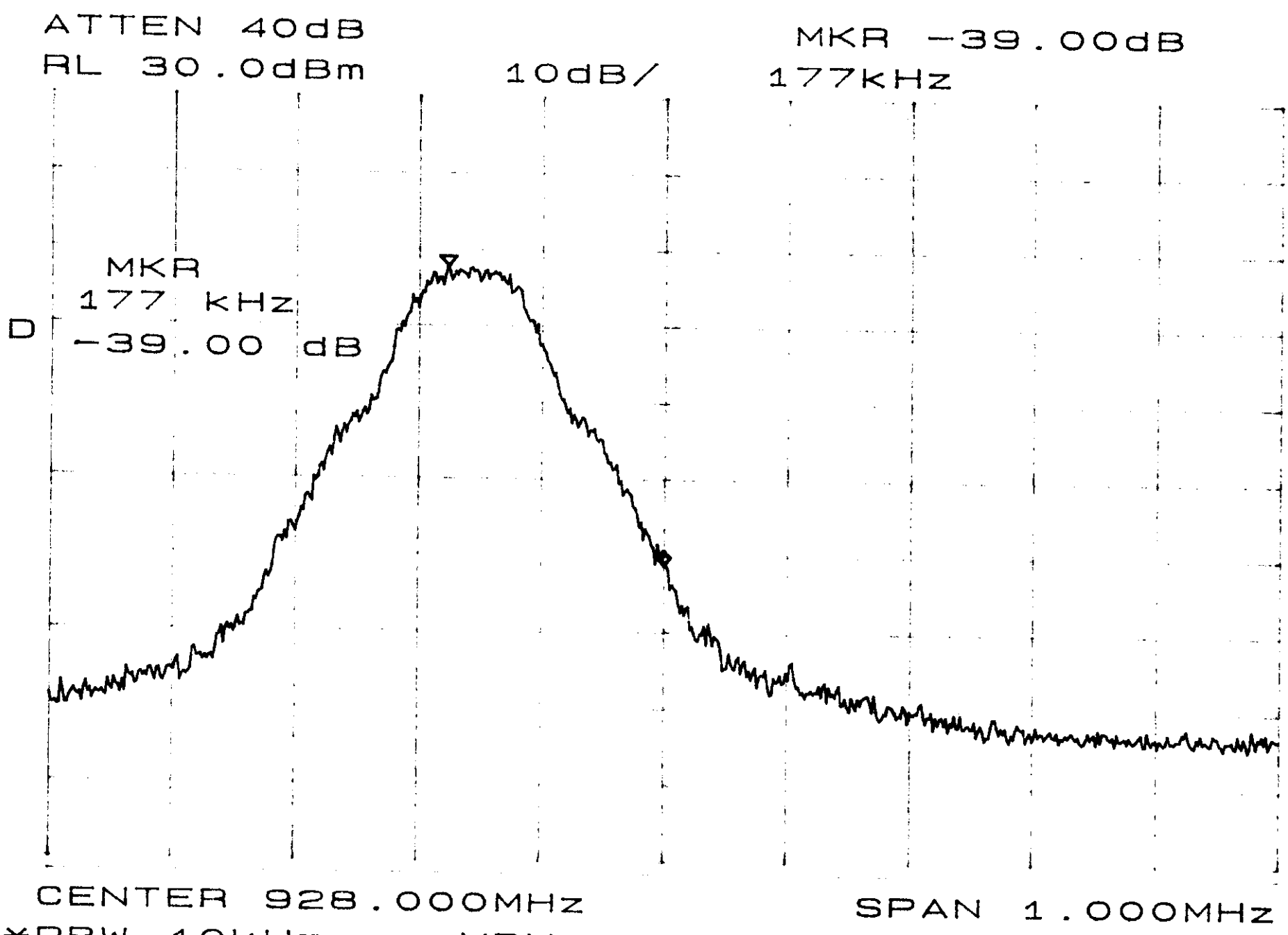
RADIO 900MHZ BANDEDGE
CH2 (0) π/4 DPSK K2



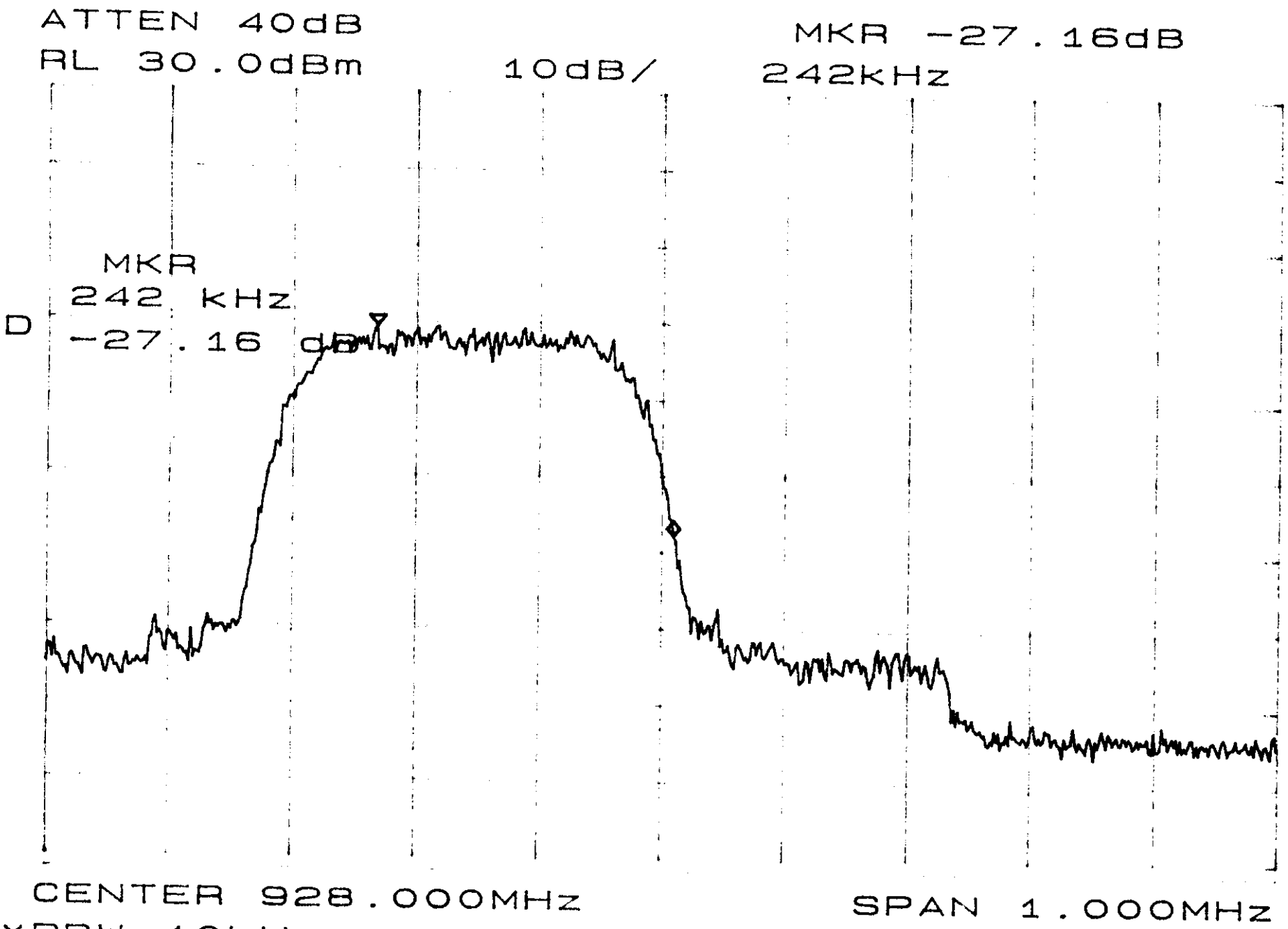
RADIO 900 MHZ BANDEDGE
CH 161 2FSK



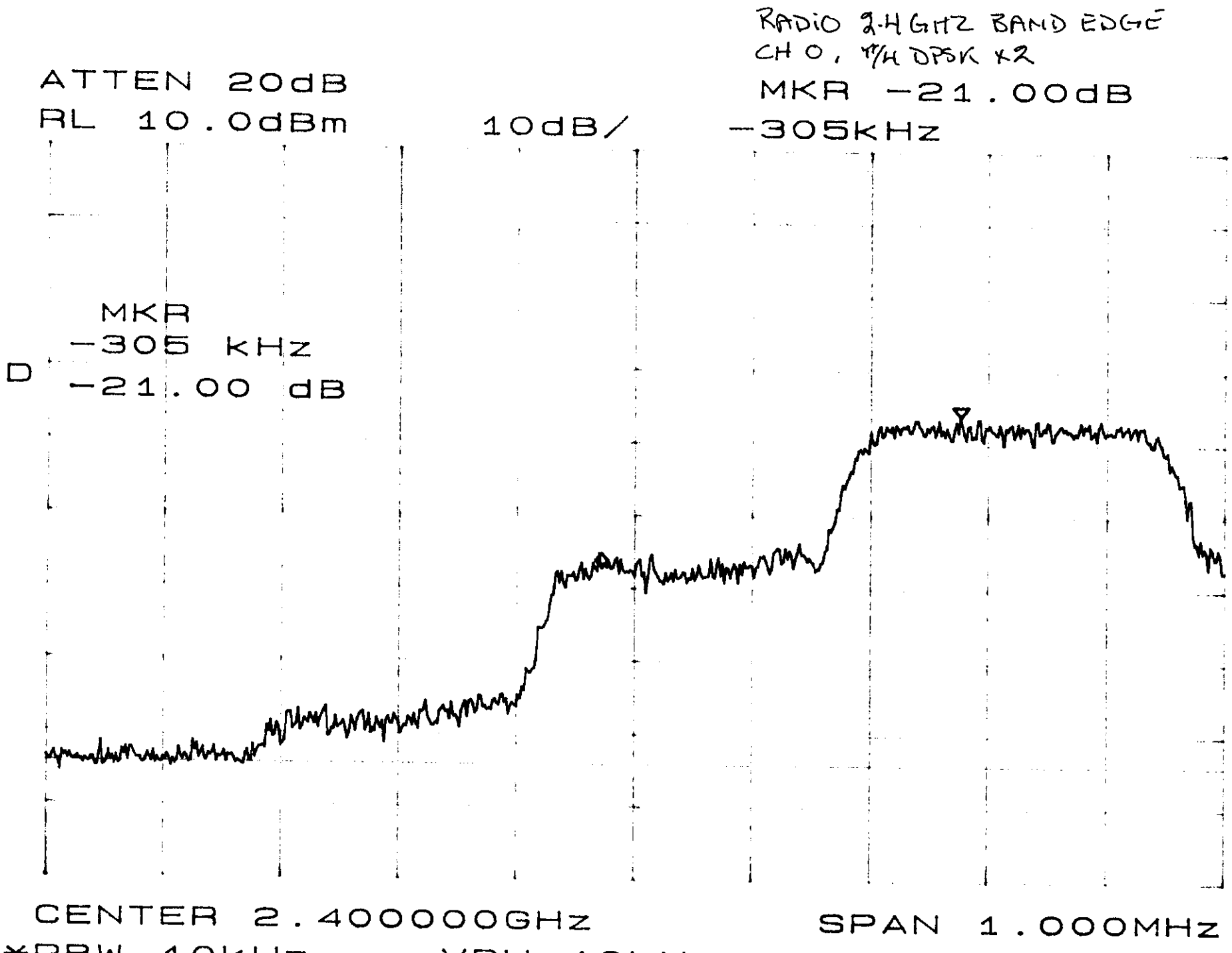
RADIO, 900MHZ BANDEDGE
CH 161 4FSK

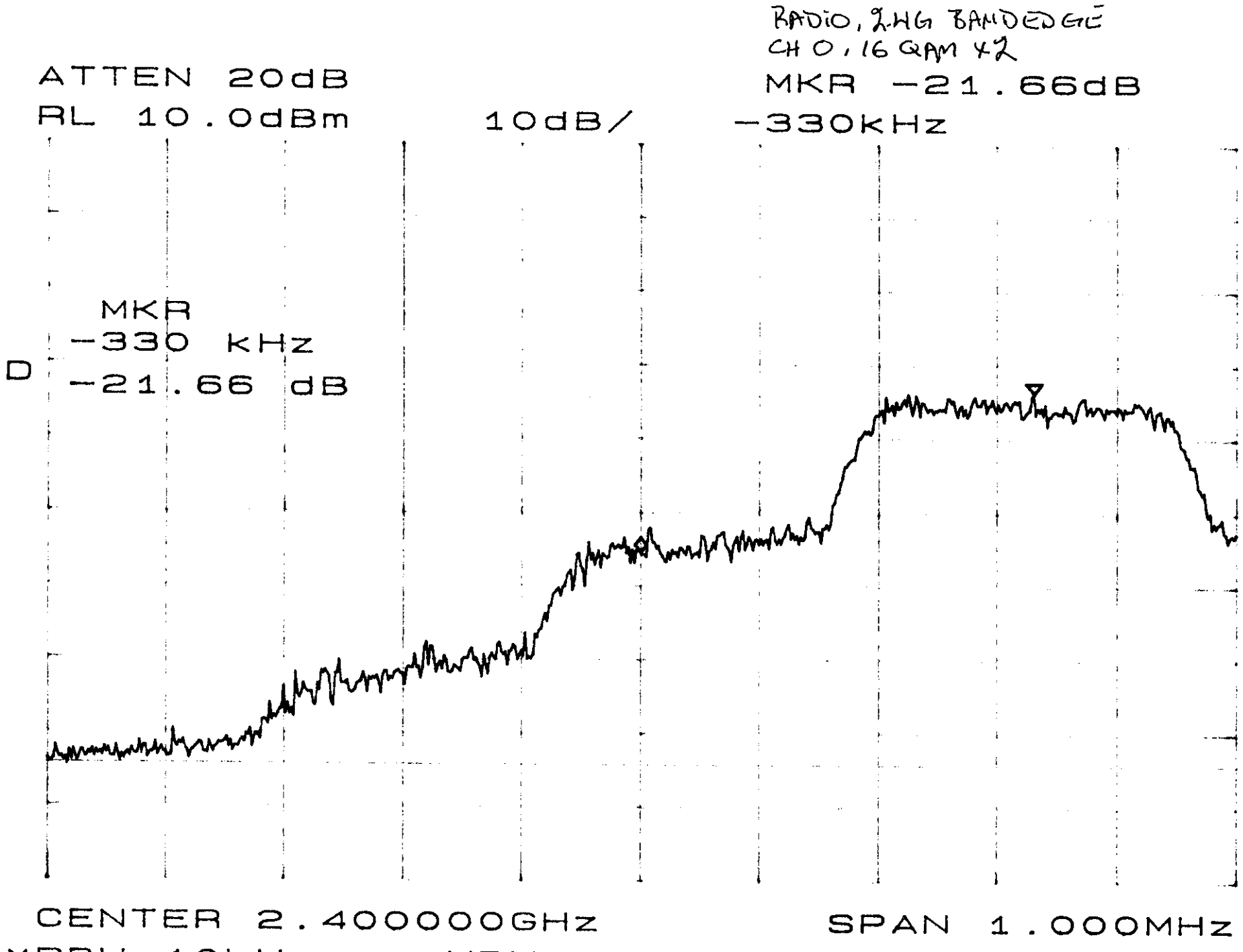


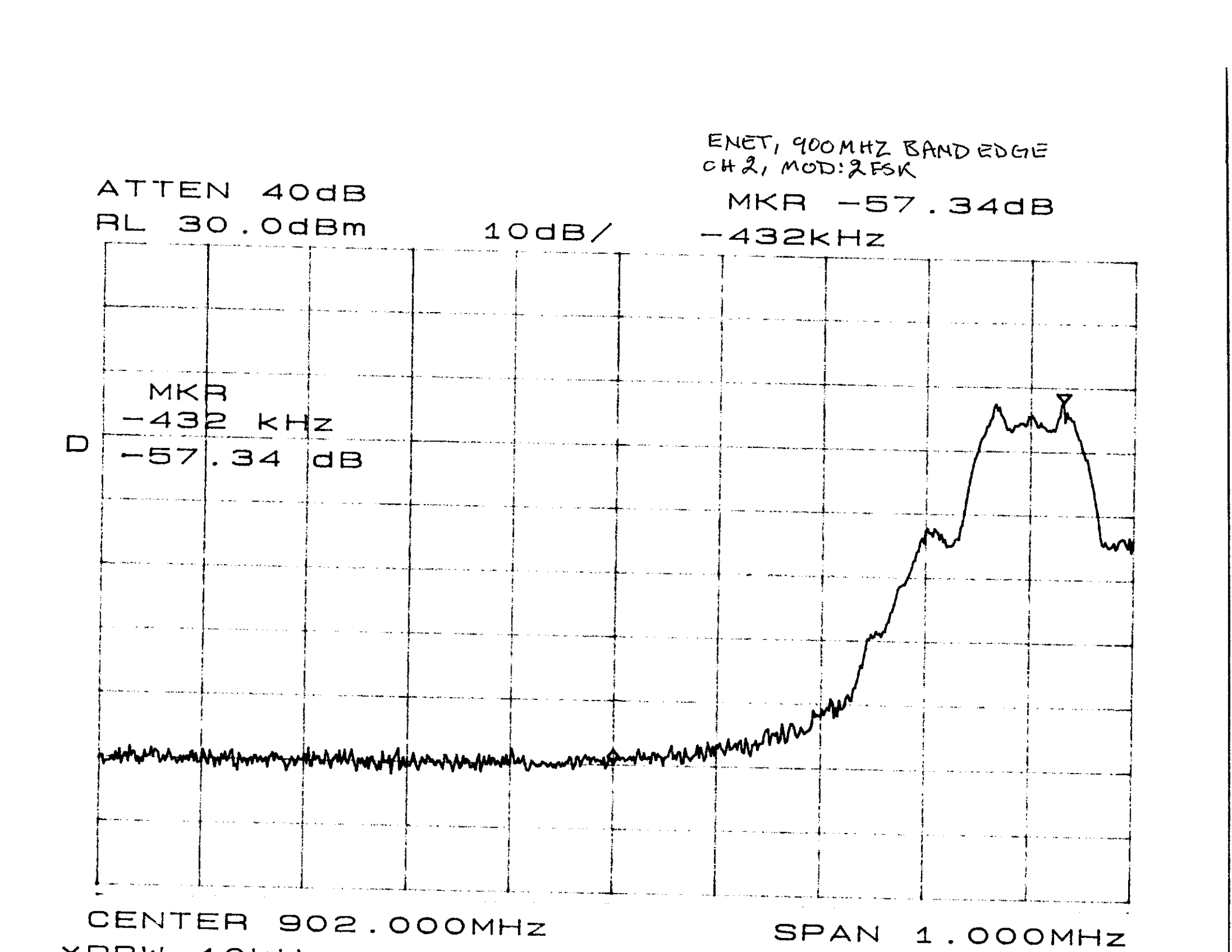
RADIO, 900 MHZ BANDEDGE
CH 161, π/4 DPSK x2



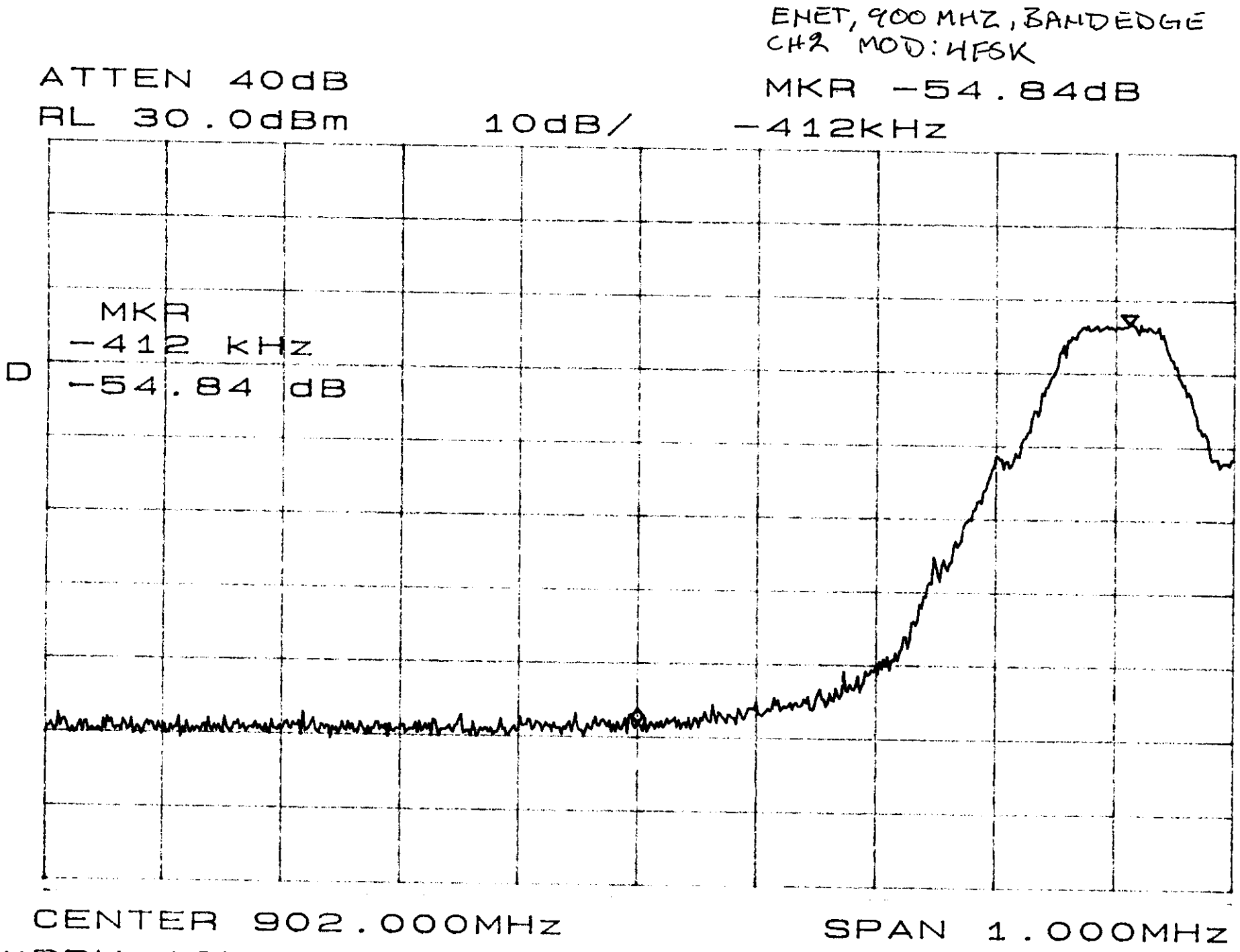
RADIO 2.4 GHZ BAND EDGE
CH 0, π/4 DPSK x2



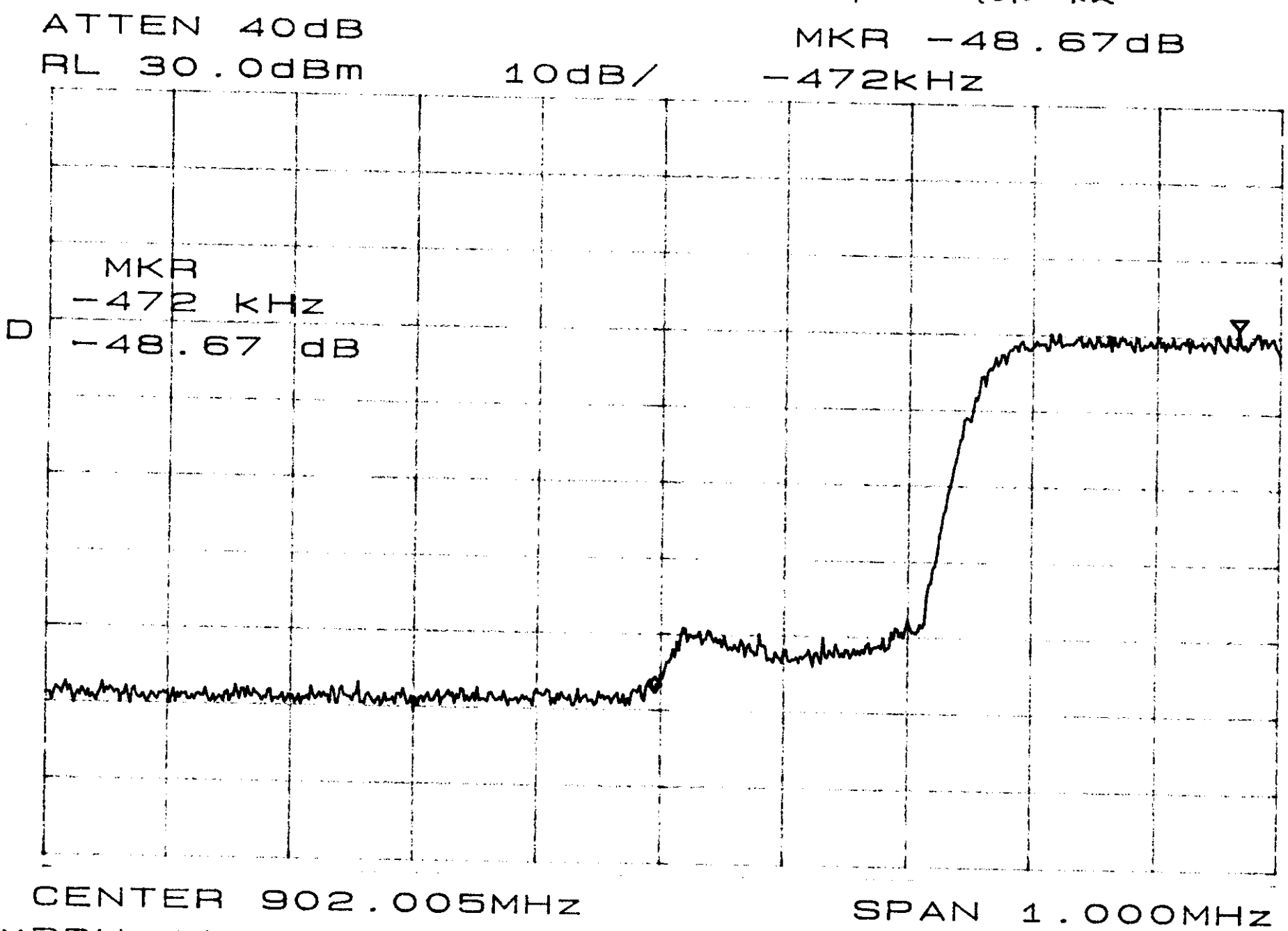

RADIO, 2.4G BANDEDGE
CH 0, 16 QAM x2
ATTEN 20dB
RL 10.0dBm
10dB/
MKR -21.66dB
-330kHz
MKR
-330 kHz
-21.66 dB
CENTER 2.400000GHz
SPAN 1.000MHz


ENET, 900MHZ BAND EDGE
CH 2, MOD: 2FSK
ATTEN 40dB
RL 30.0dBm
10dB/
MKR -57.34dB
-432kHz
MKR
-432 kHz
-57.34 dB
D
CENTER 902.000MHz
SPAN 1.000MHz

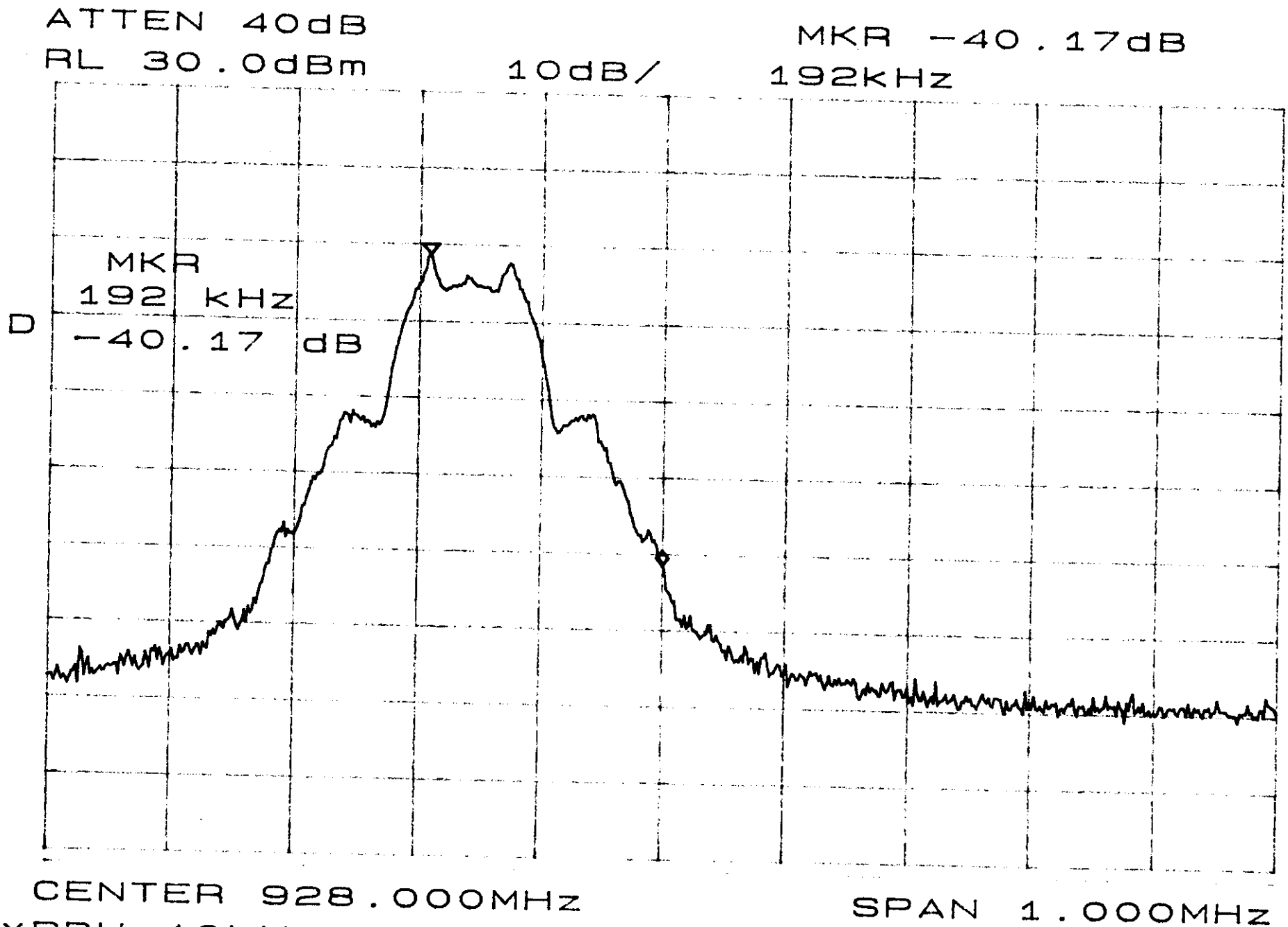
ENET, 900 MHZ, BANDEDGE
CH2 MOD: HFSK



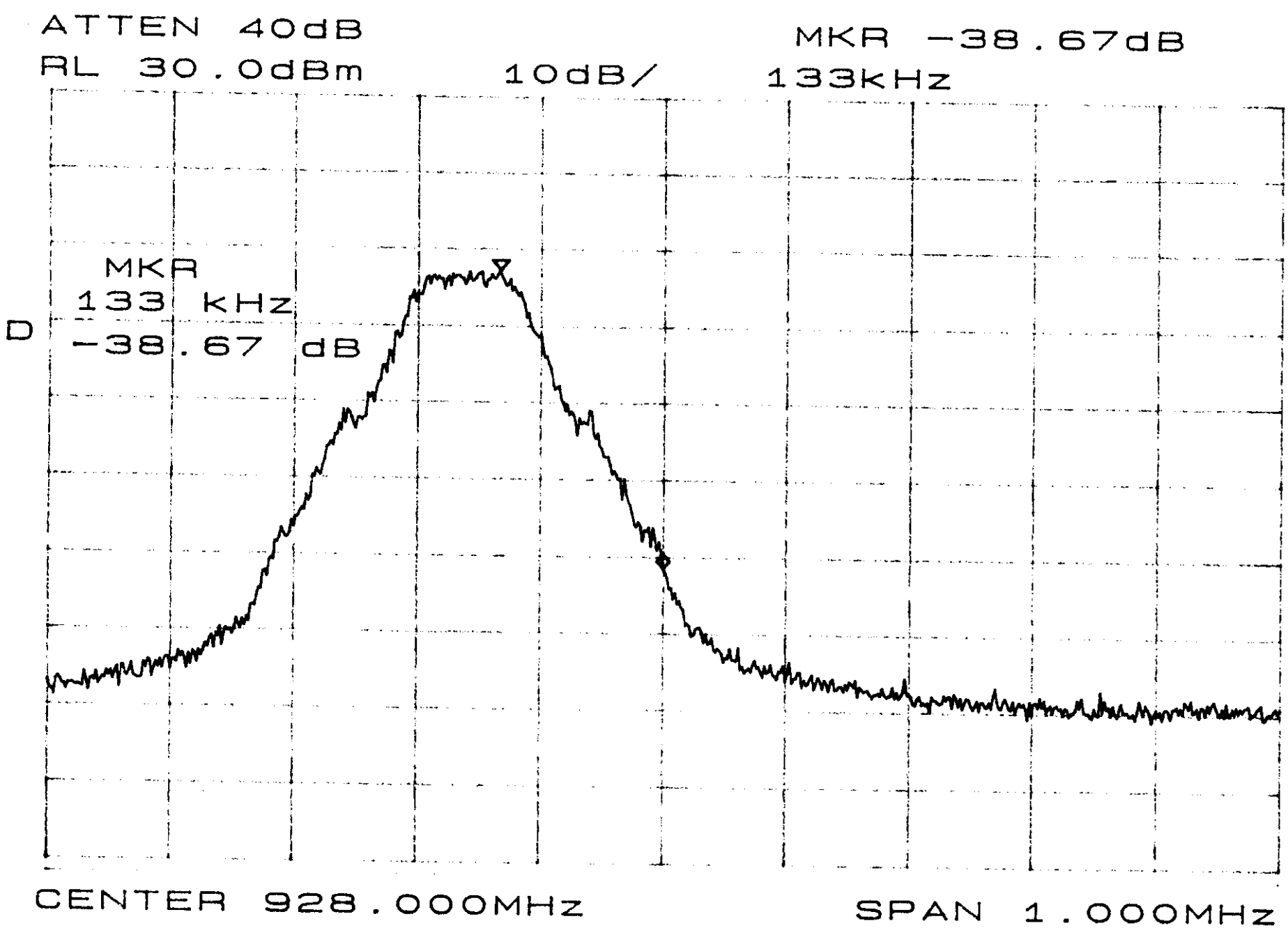
ENET, 900 MHZ BAND EDGE
CH 2, MOD π/4DPSK X2



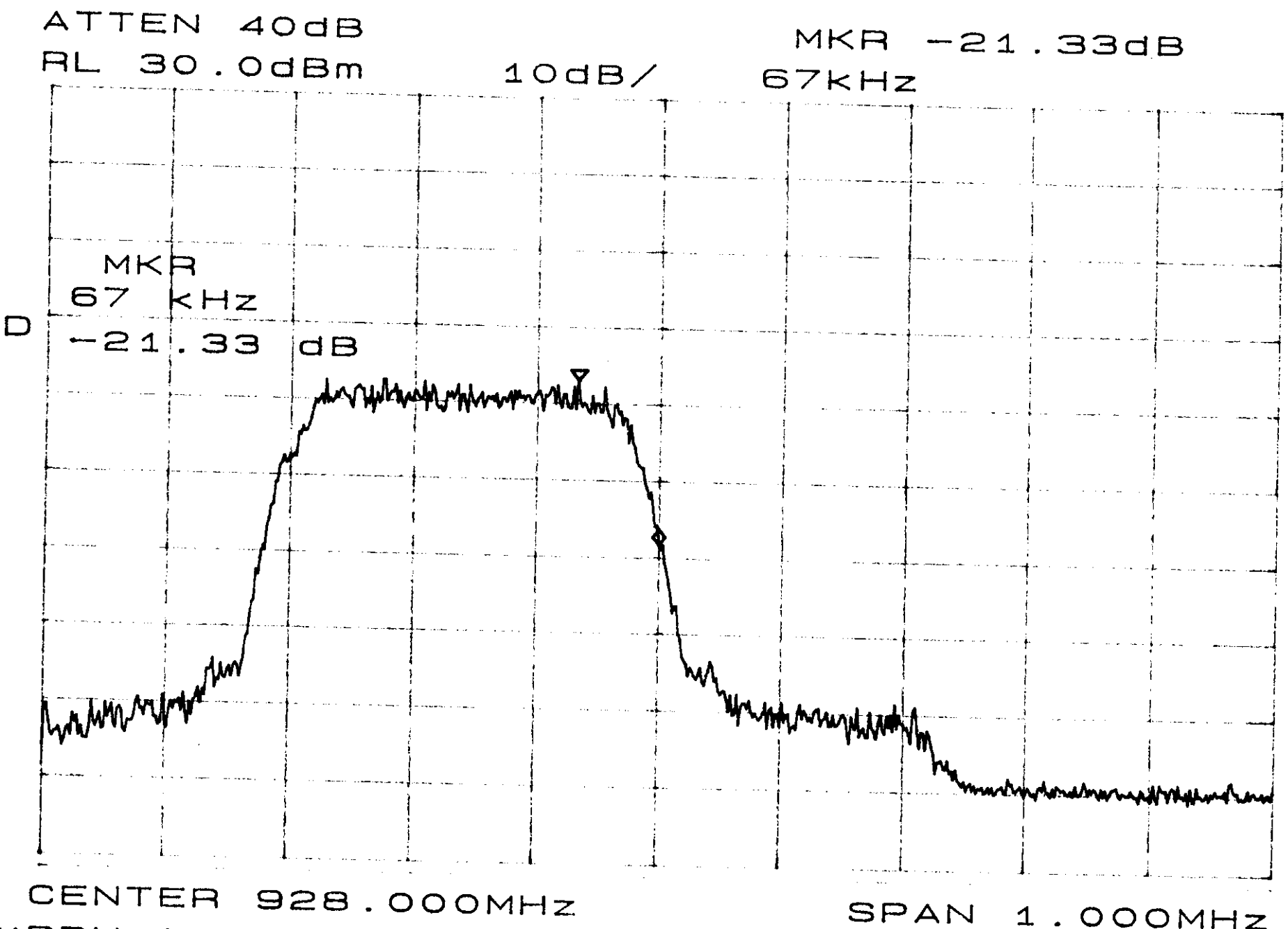
ENET, 900 MHZ BANDEDGE
CH 161, MOD: 2FSK

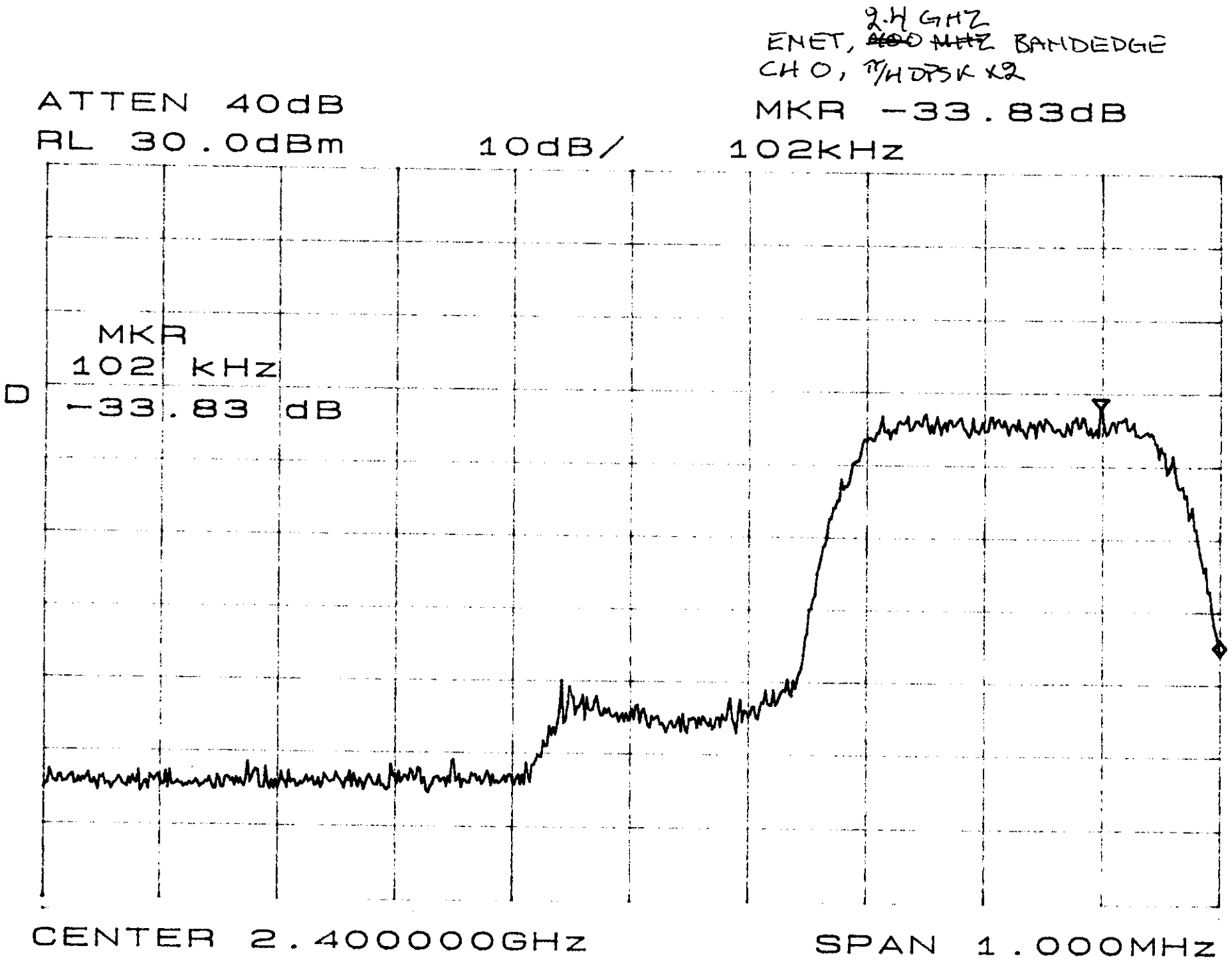


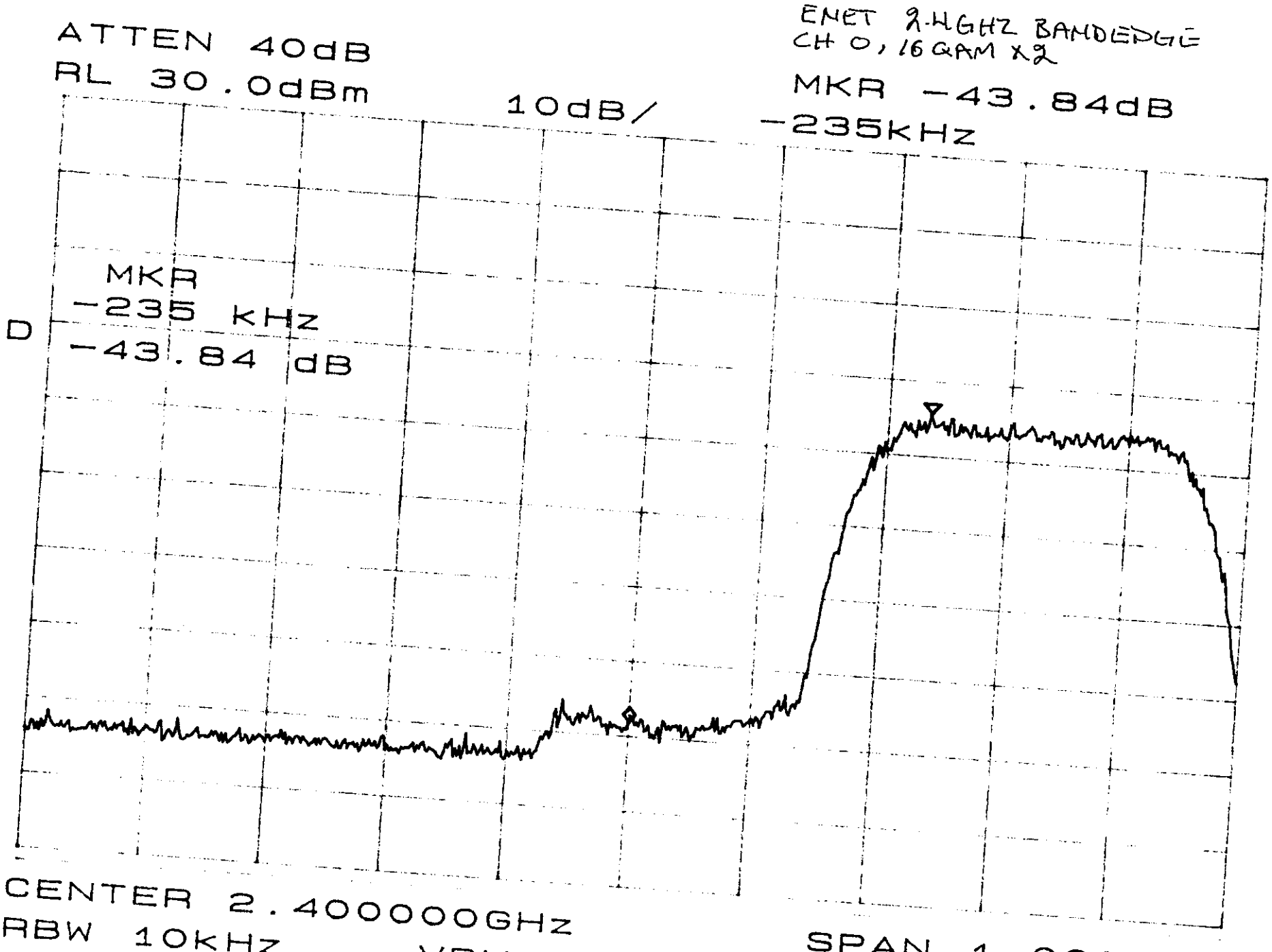
ENET, 900 MHZ BANDEDGE
CH 161, MOD 4FSK



ENET, 900 MHZ BANDEDGE
CH 161, π/4 DPSK x2

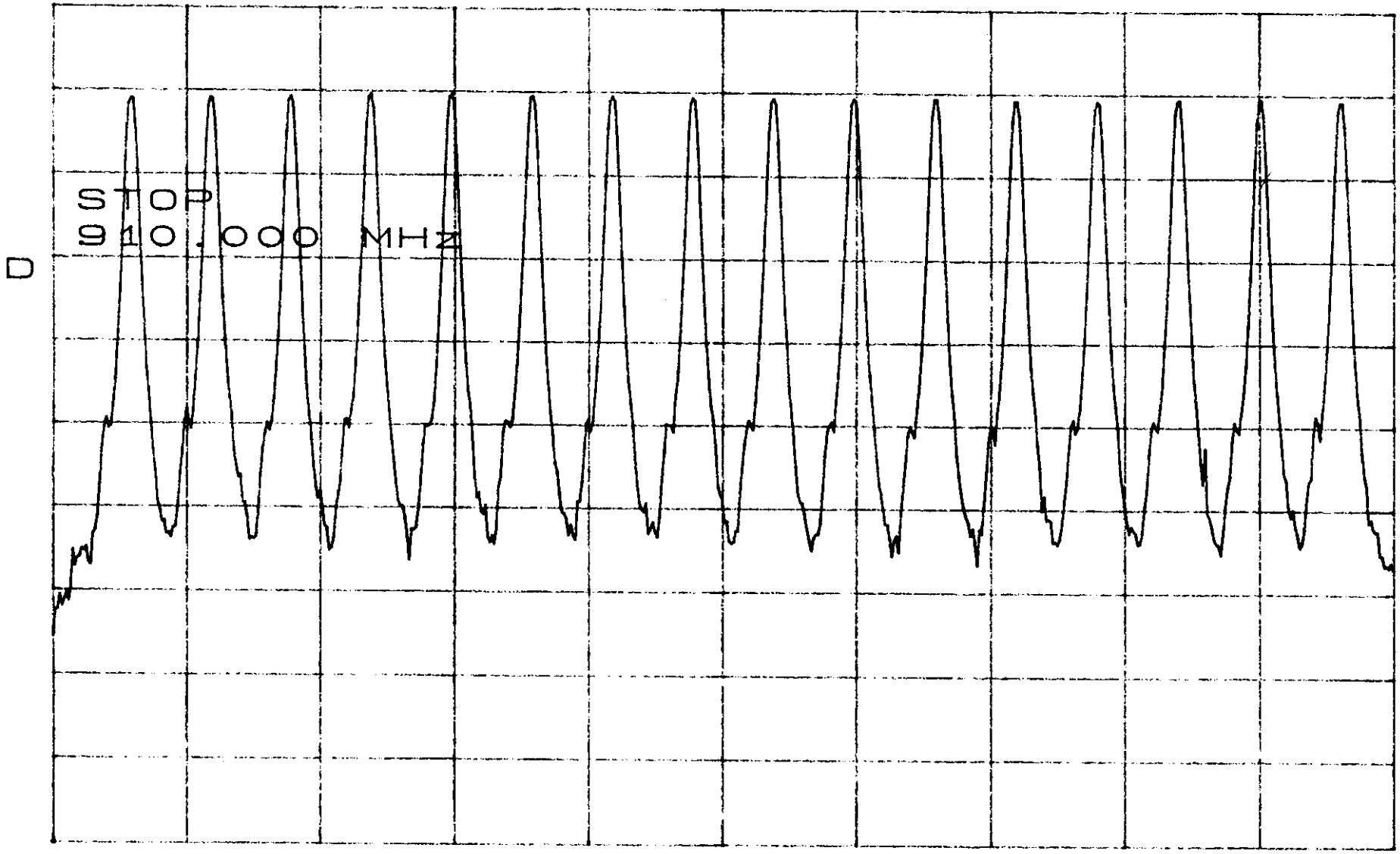



2.4 GHZ
ENET, ~~400 MHZ~~ BANDEDGE
CH 0, π/4 DQPSK X2
ATTEN 40dB
RL 30.0dBm
10dB/
MKR -33.83dB
102kHz
MKR
102 kHz
-33.83 dB
D
CENTER 2.400000GHz
SPAN 1.000MHz


ENET 2.4GHZ BANDEDGE
CH 0, 16 QAM x2
ATTEN 40dB
RL 30.0dBm
10dB/
MKR -43.84dB
-235kHz
MKR
-235 kHz
-43.84 dB
D
CENTER 2.400000GHz
*RBW 10KHz
SPAN

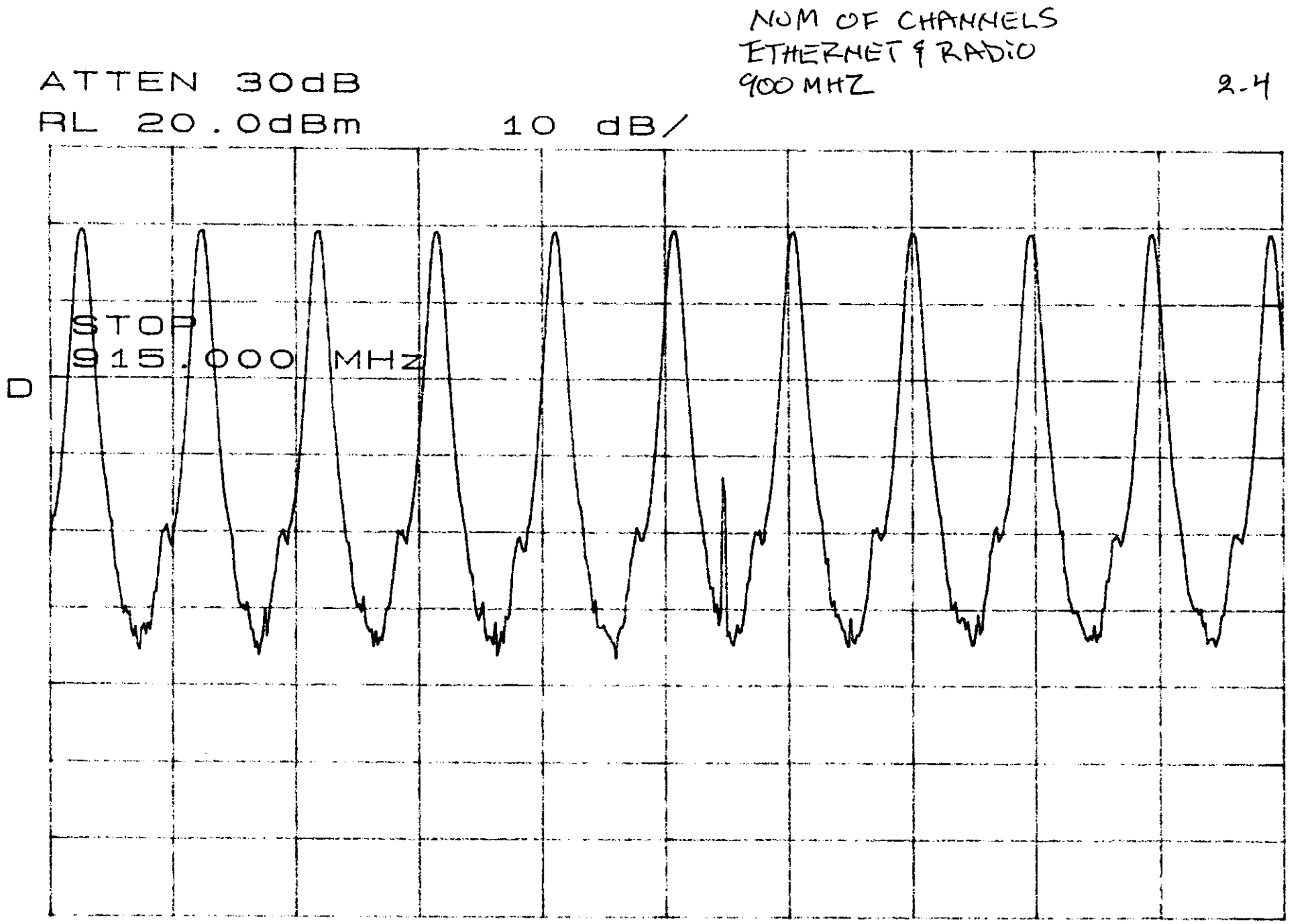
NUM OF CHANNELS
ETHERNET RADIO
900 MHZ

1-4



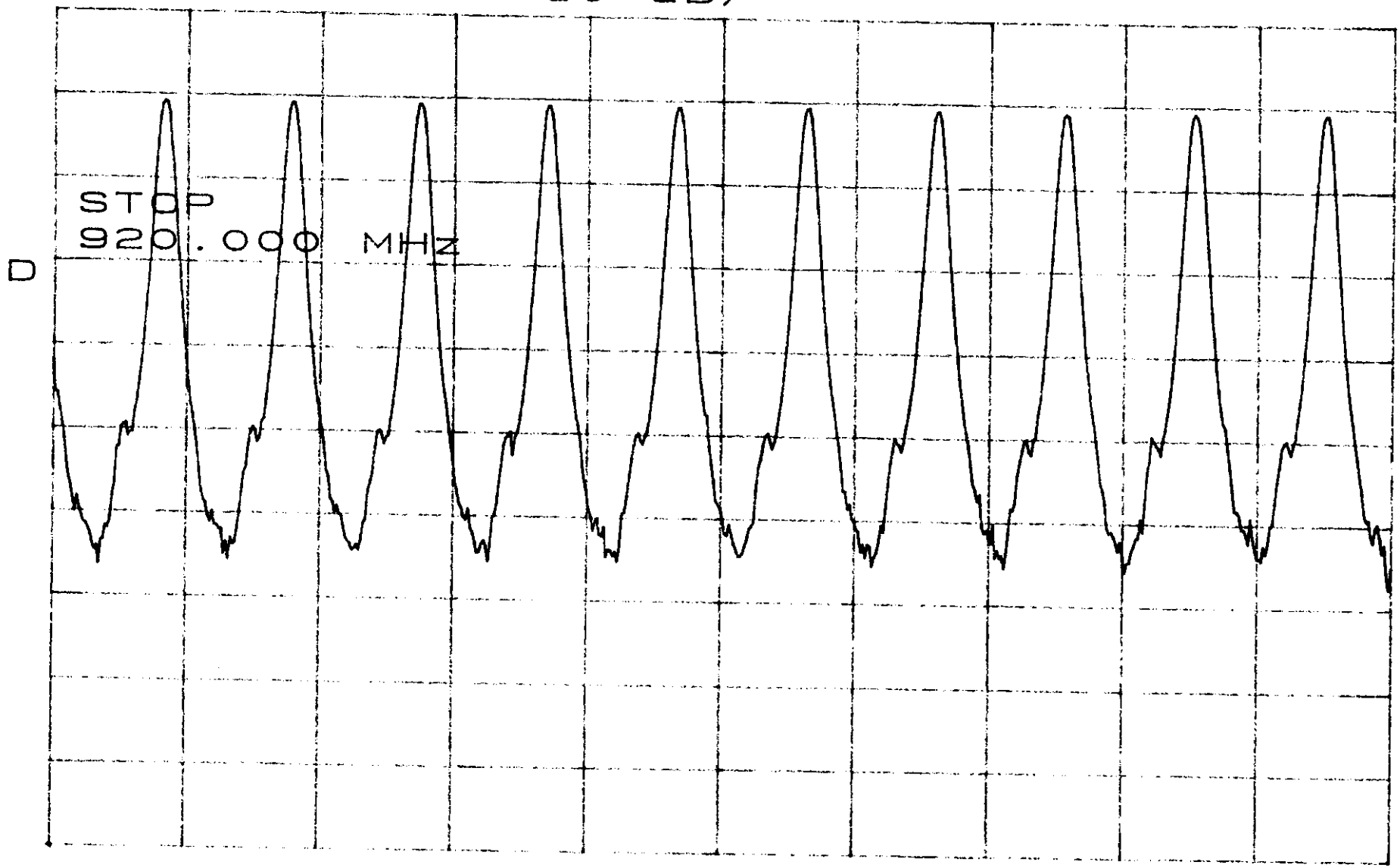
NUM OF CHANNELS
ETHERNET & RADIO
900 MHZ

2.4



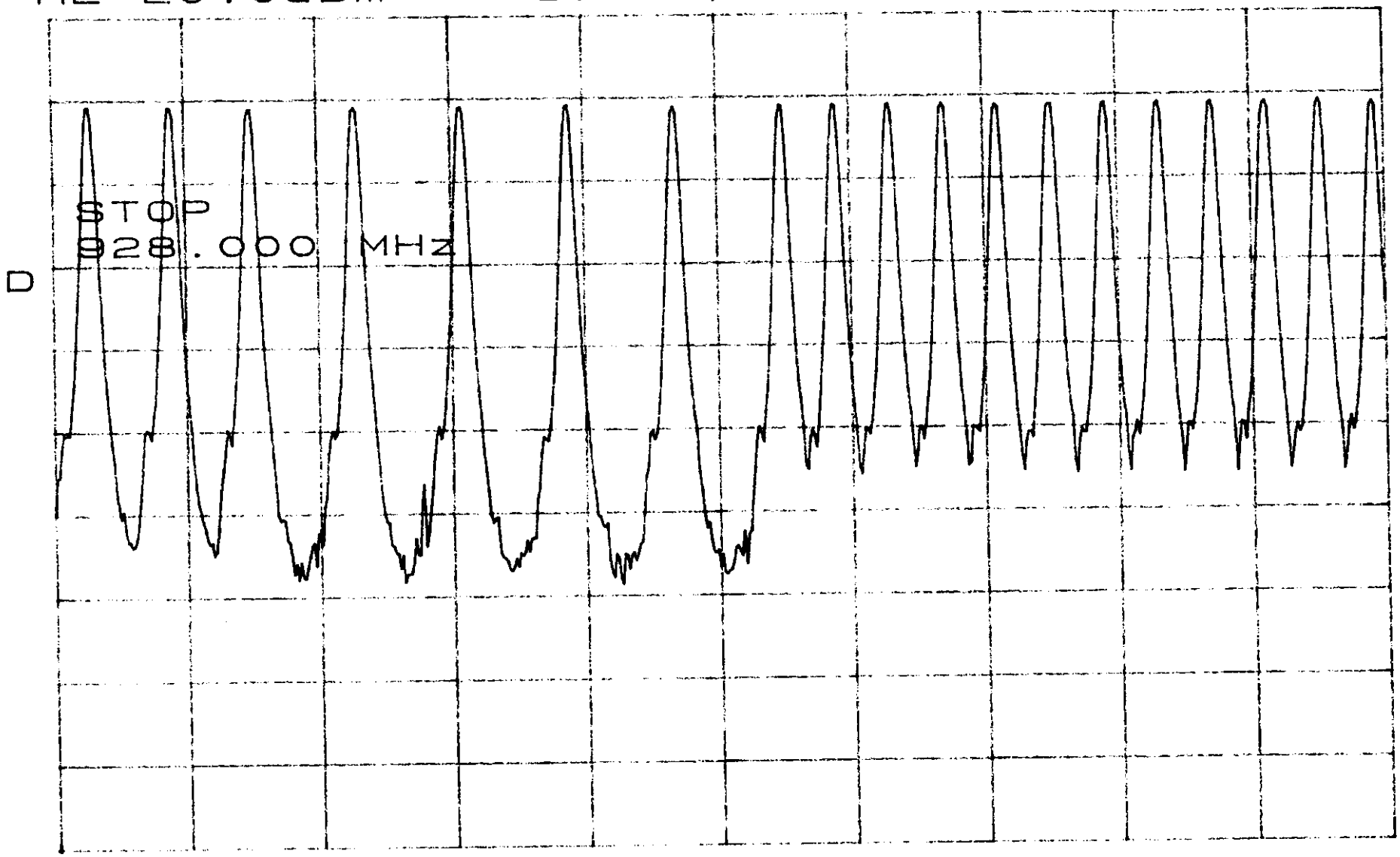
NUM OF CHANNELS
ETHERNET & RADIO
900MHZ

3-4



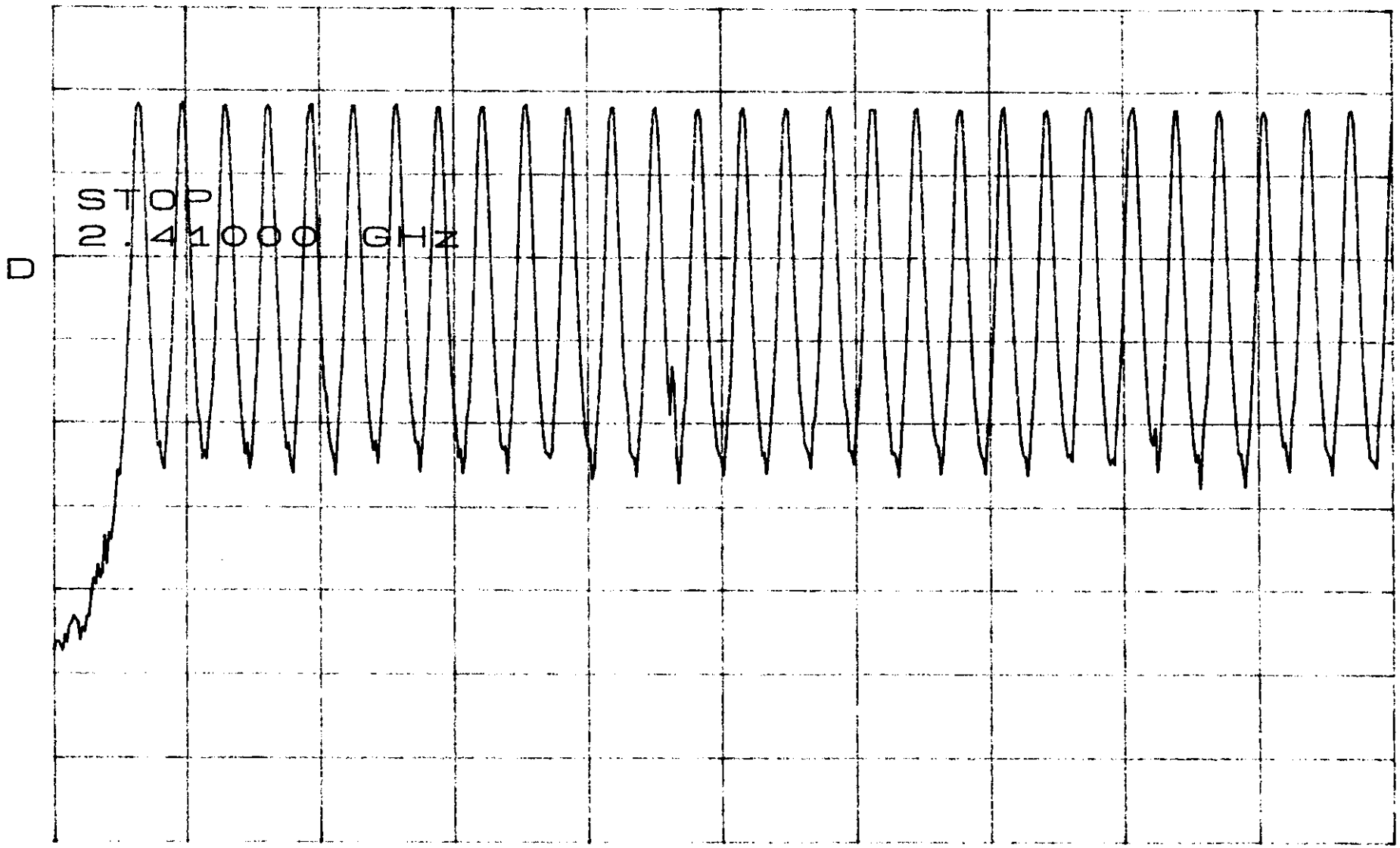
NUM OF CHANNELS
ETHERNET & RADIO
900 MHZ

4-4



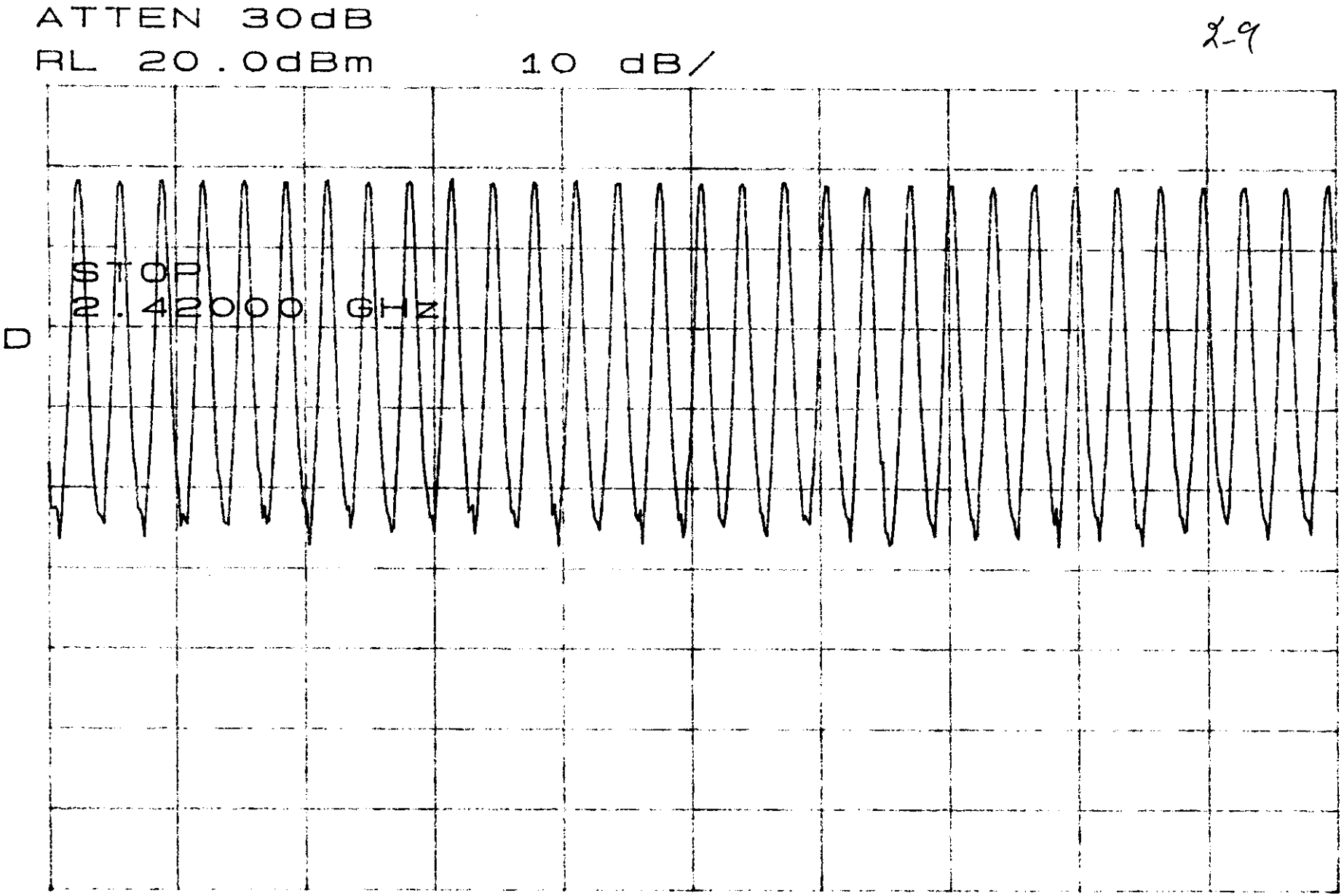
NUM OF CHAN
ETHERNET
2.4G

1-9



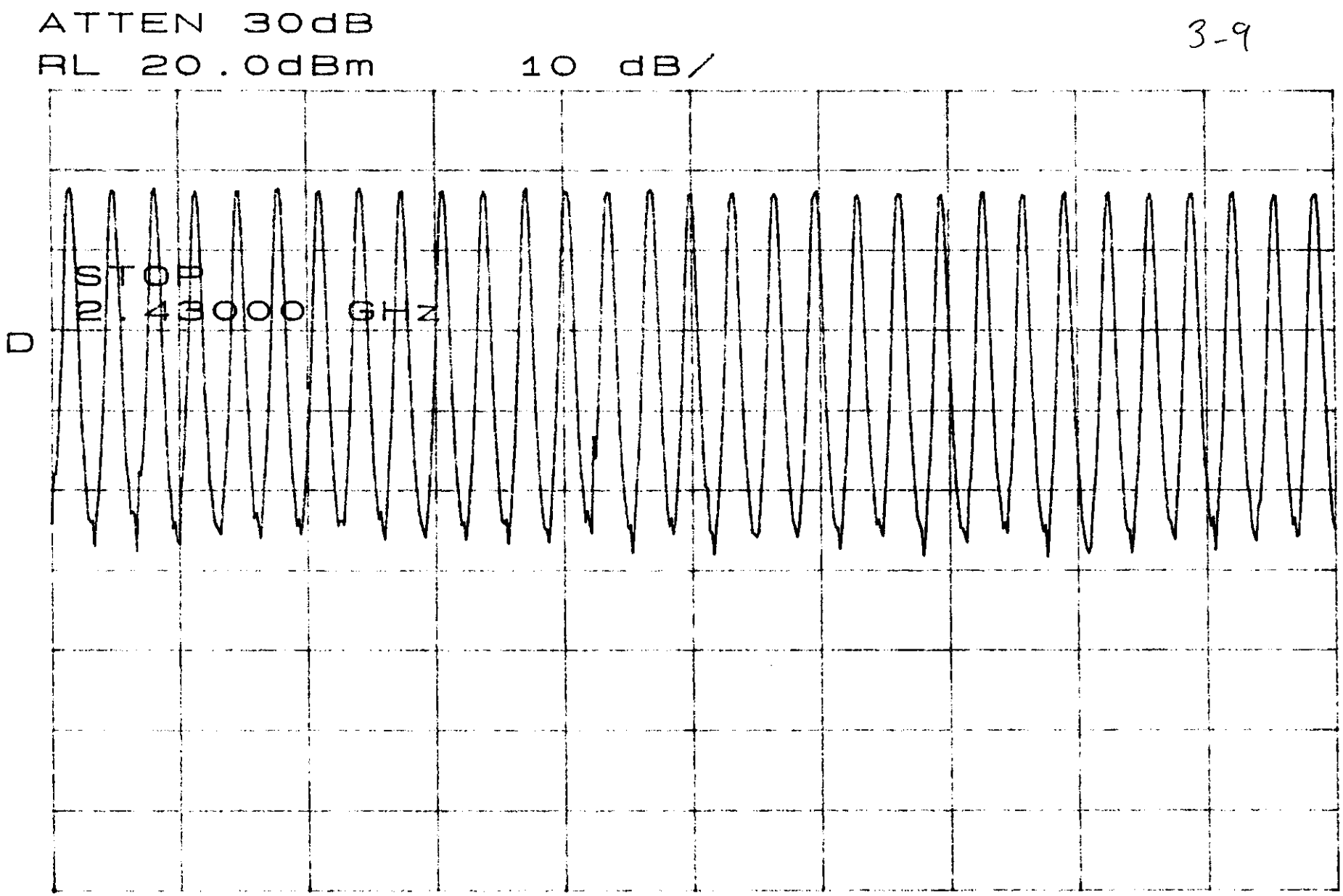
NUM OF CHAN
ETHERNET

2-9



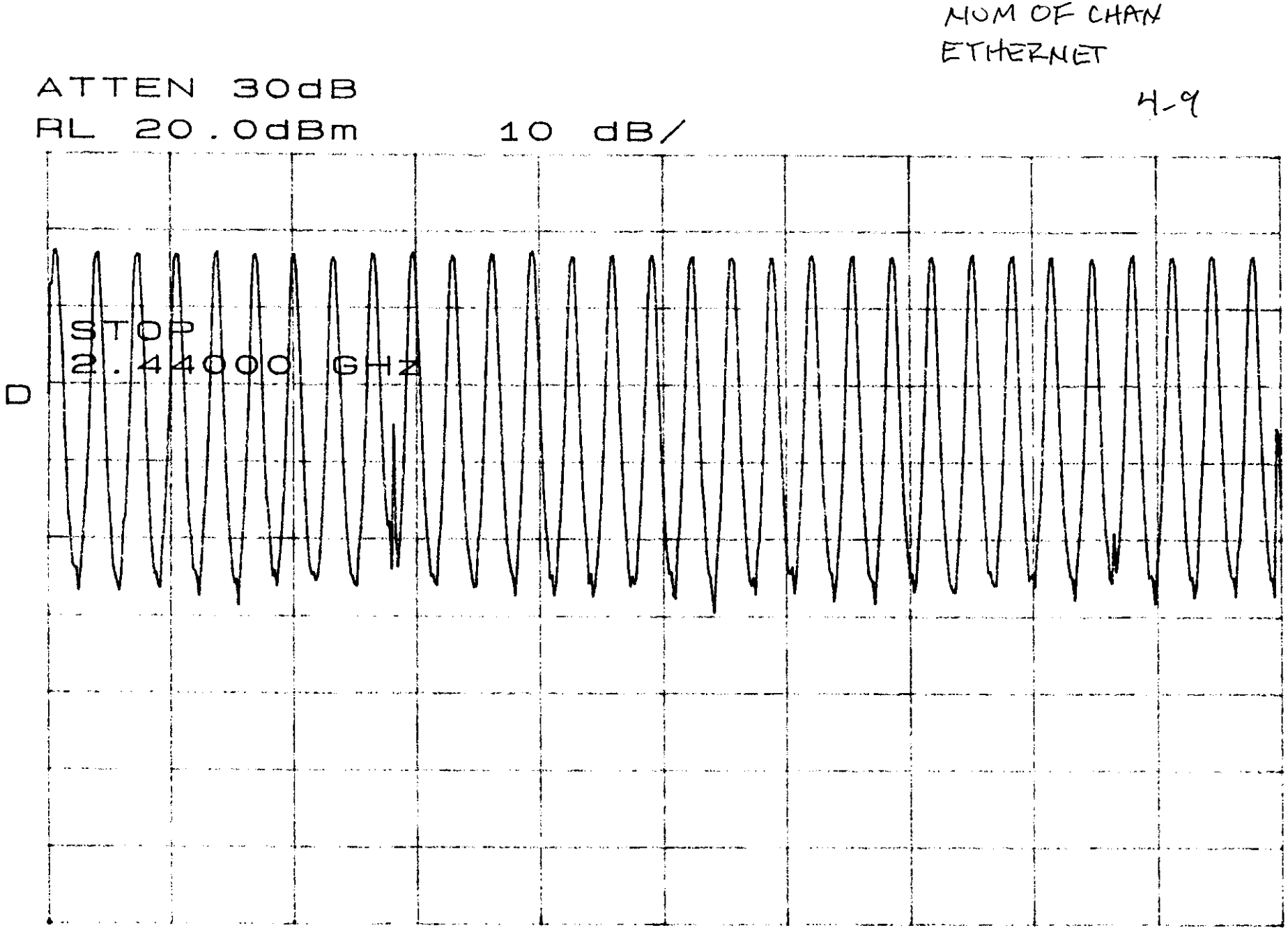
NUM OF CHAN
ETHERNET

3-9



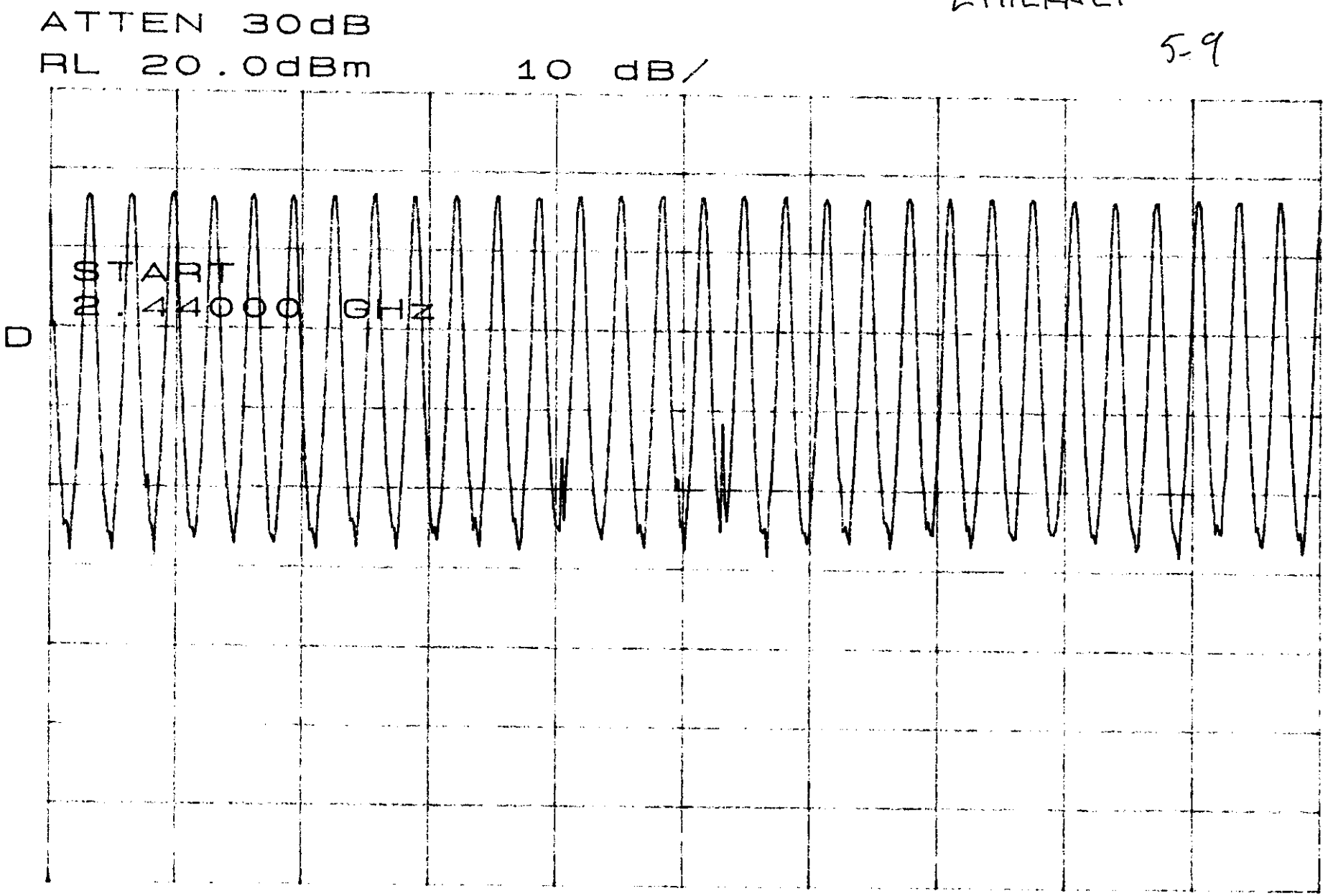
NUM OF CHAN
ETHERNET

4-9



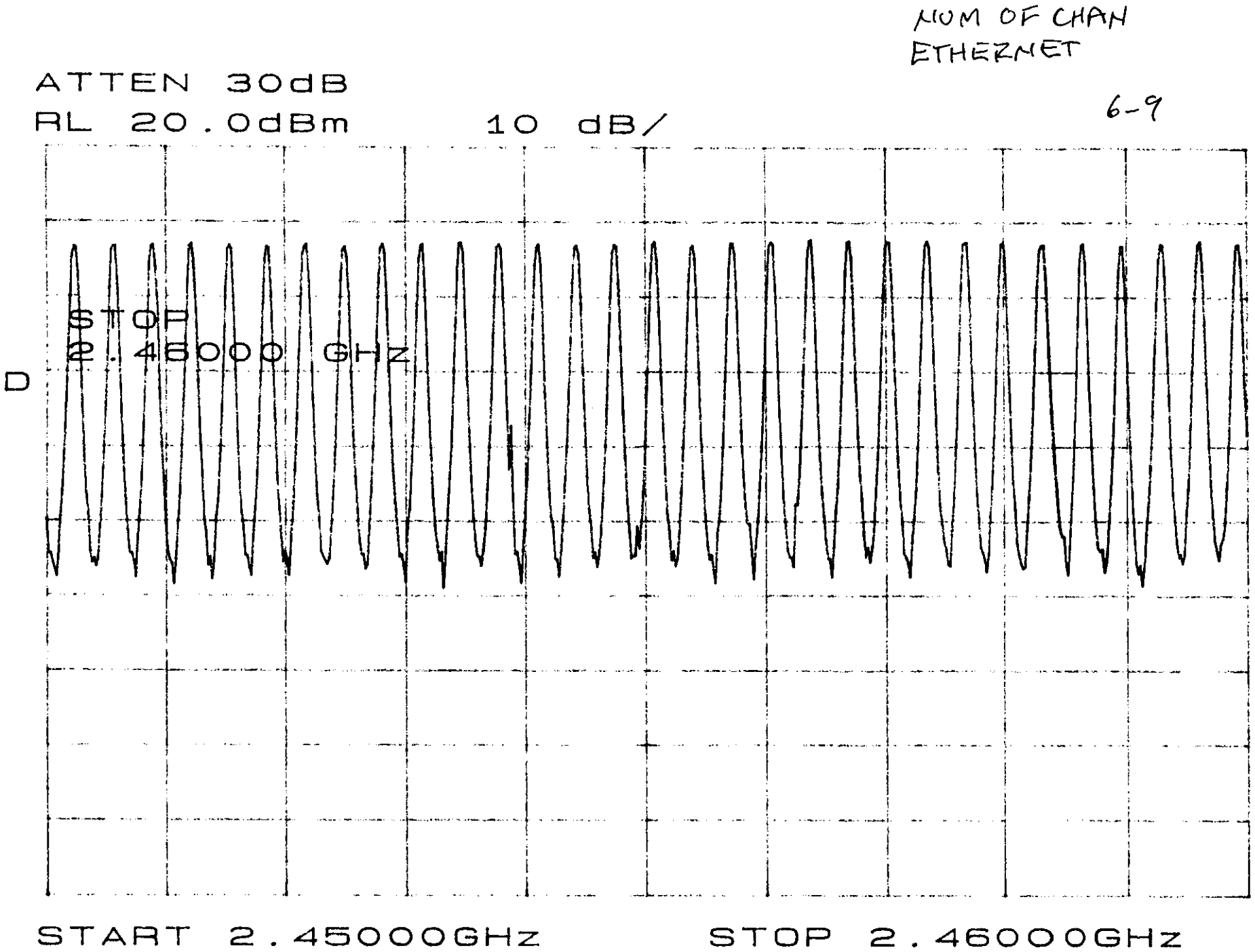
NUM OF CHAN
ETHERNET

5-9



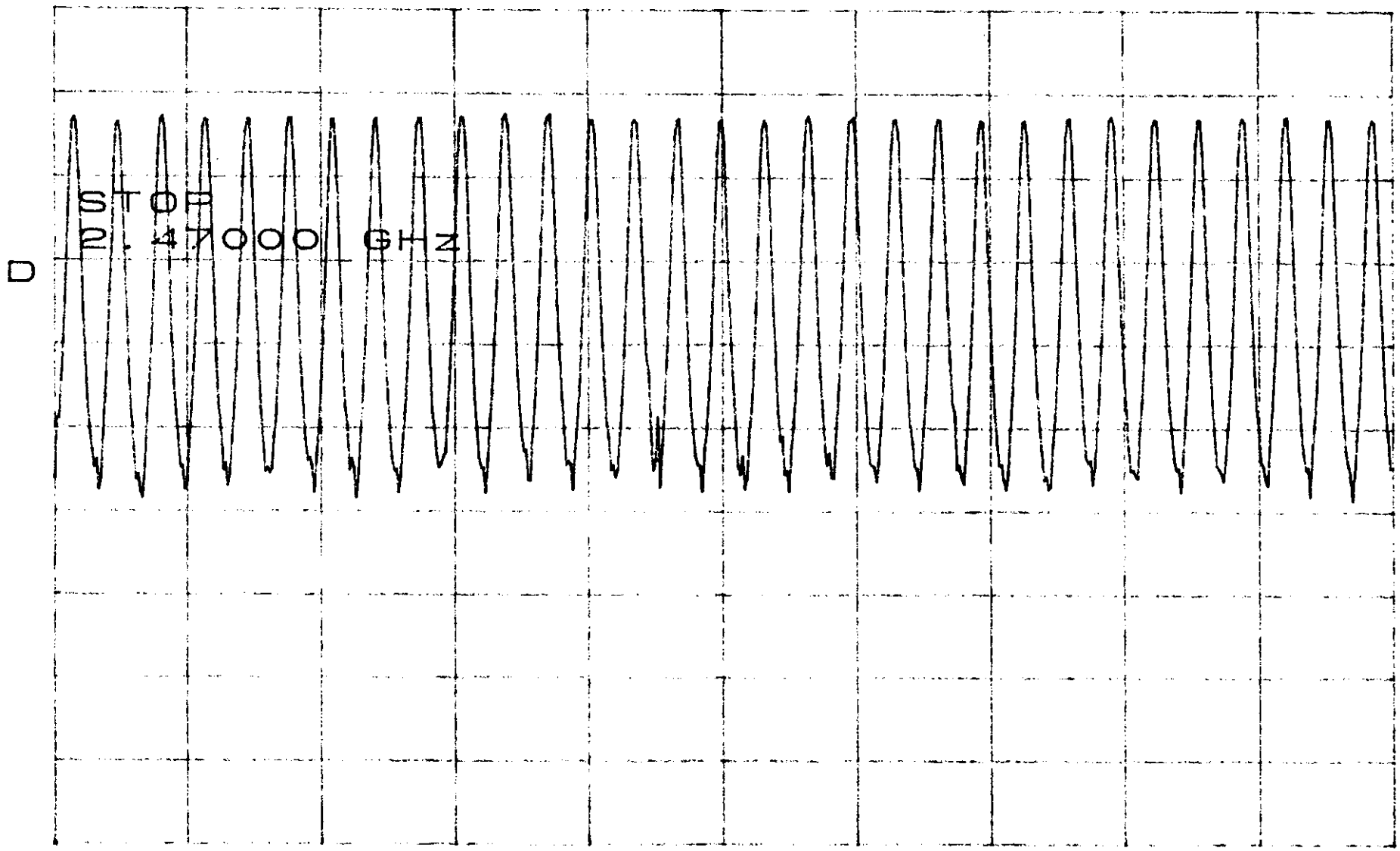
NUM OF CHAN
ETHERNET

6-9



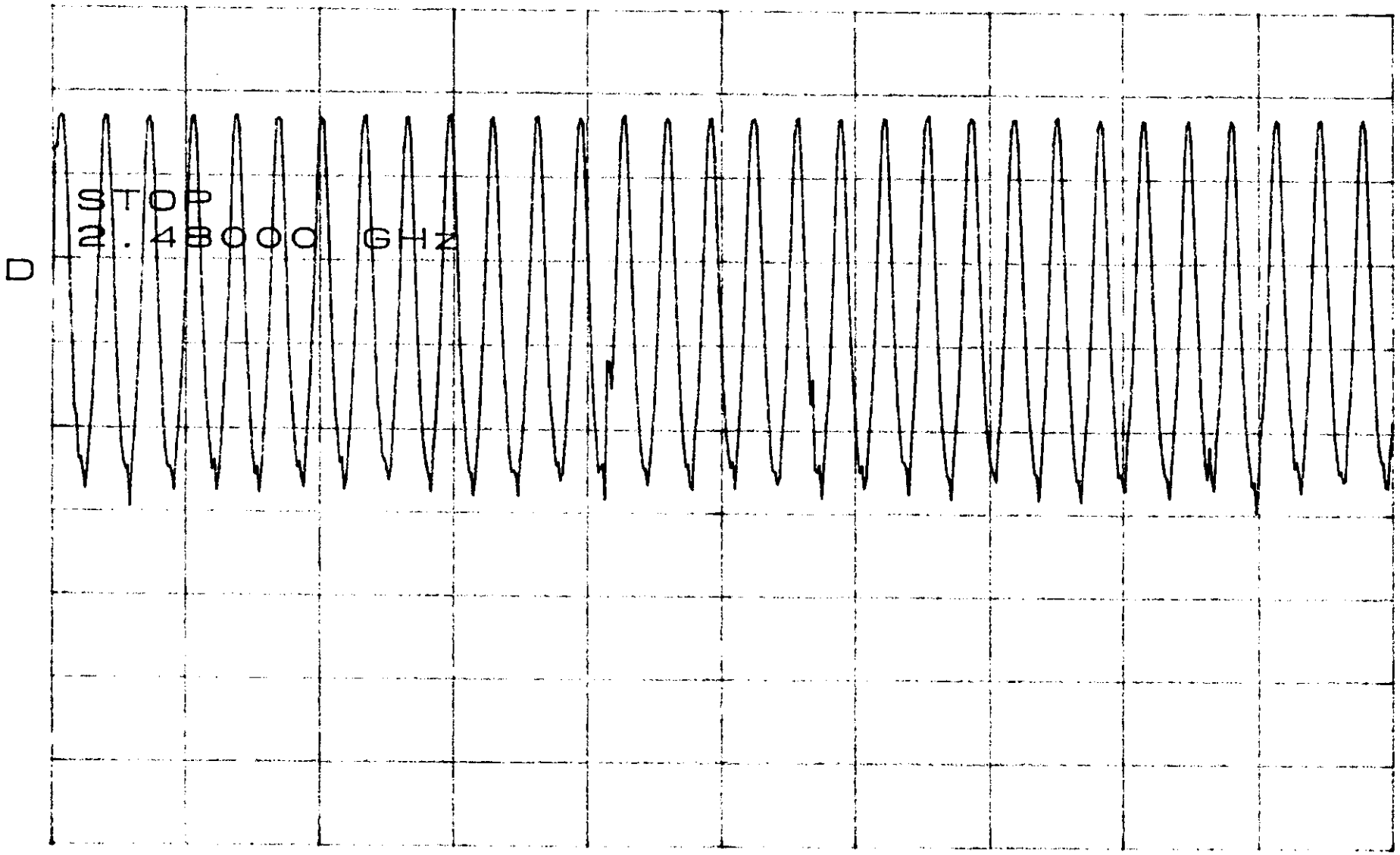
NUM OF CHAN
ETHERNET

7-9

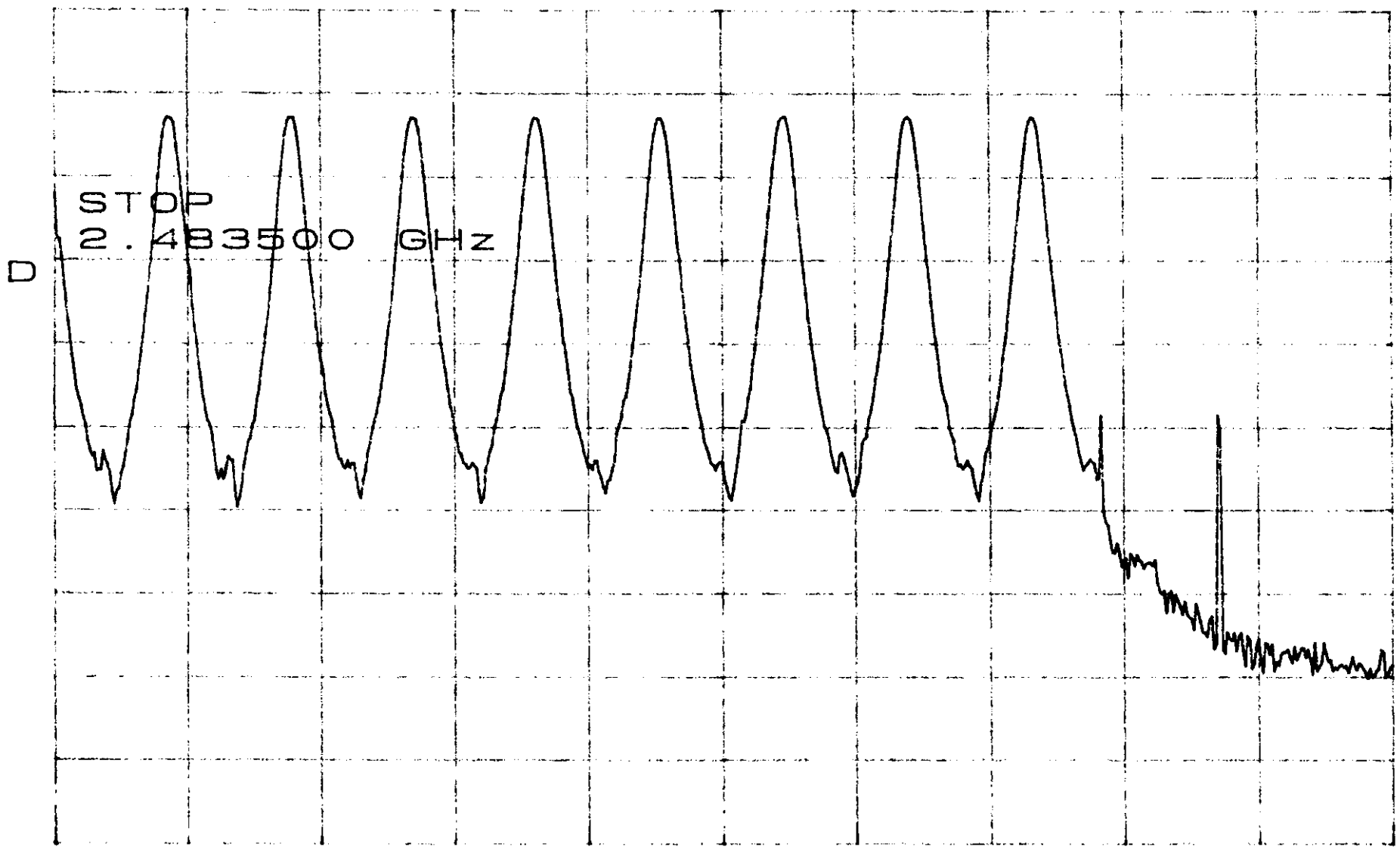


NUM OF CHAN
ETHERNET

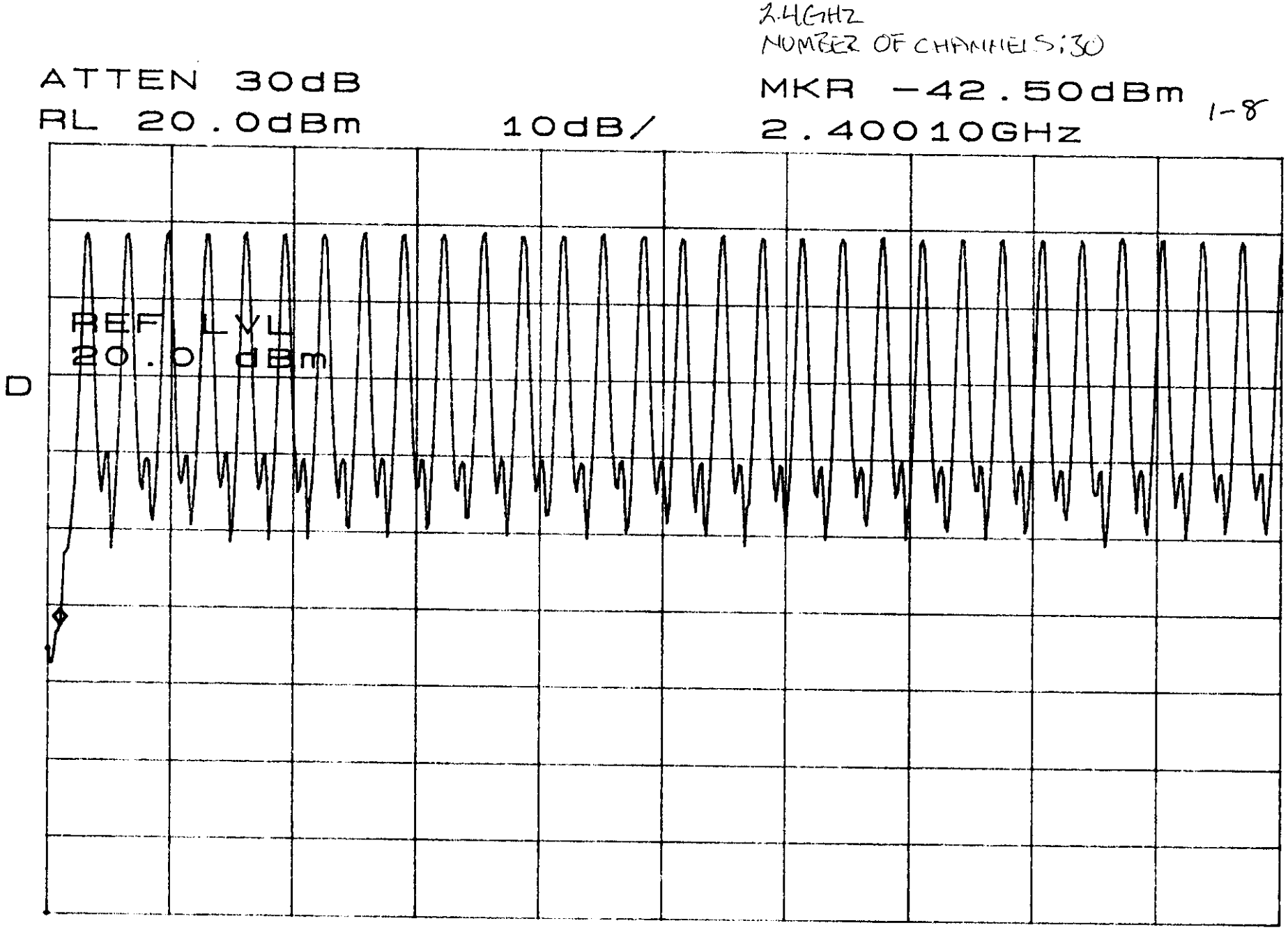
8-9



NUM OF CHAN
ETHERNET
9-9

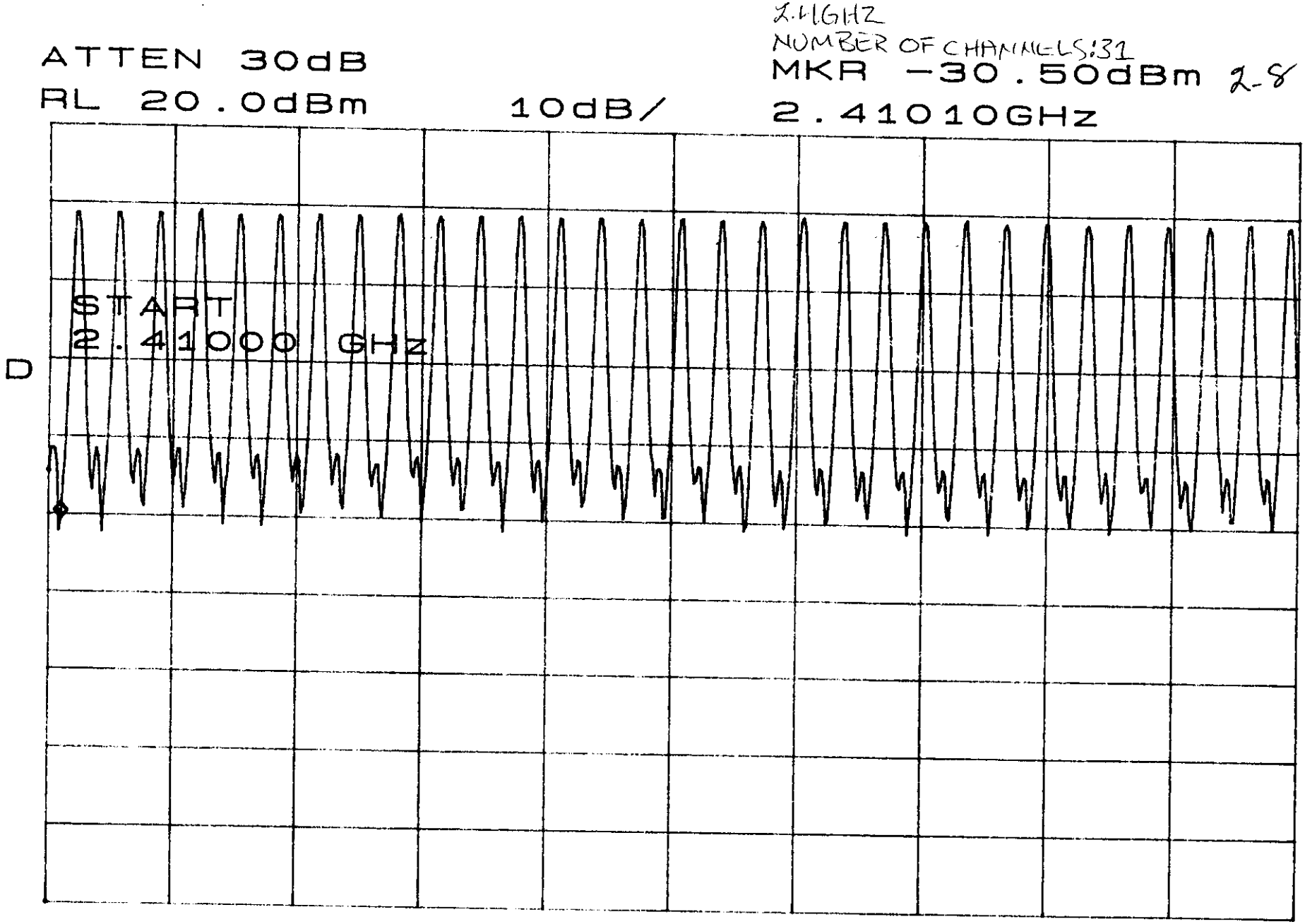


2.4GHz
NUMBER OF CHANNELS: 30



1-8

2.41GHZ
NUMBER OF CHANNELS:31

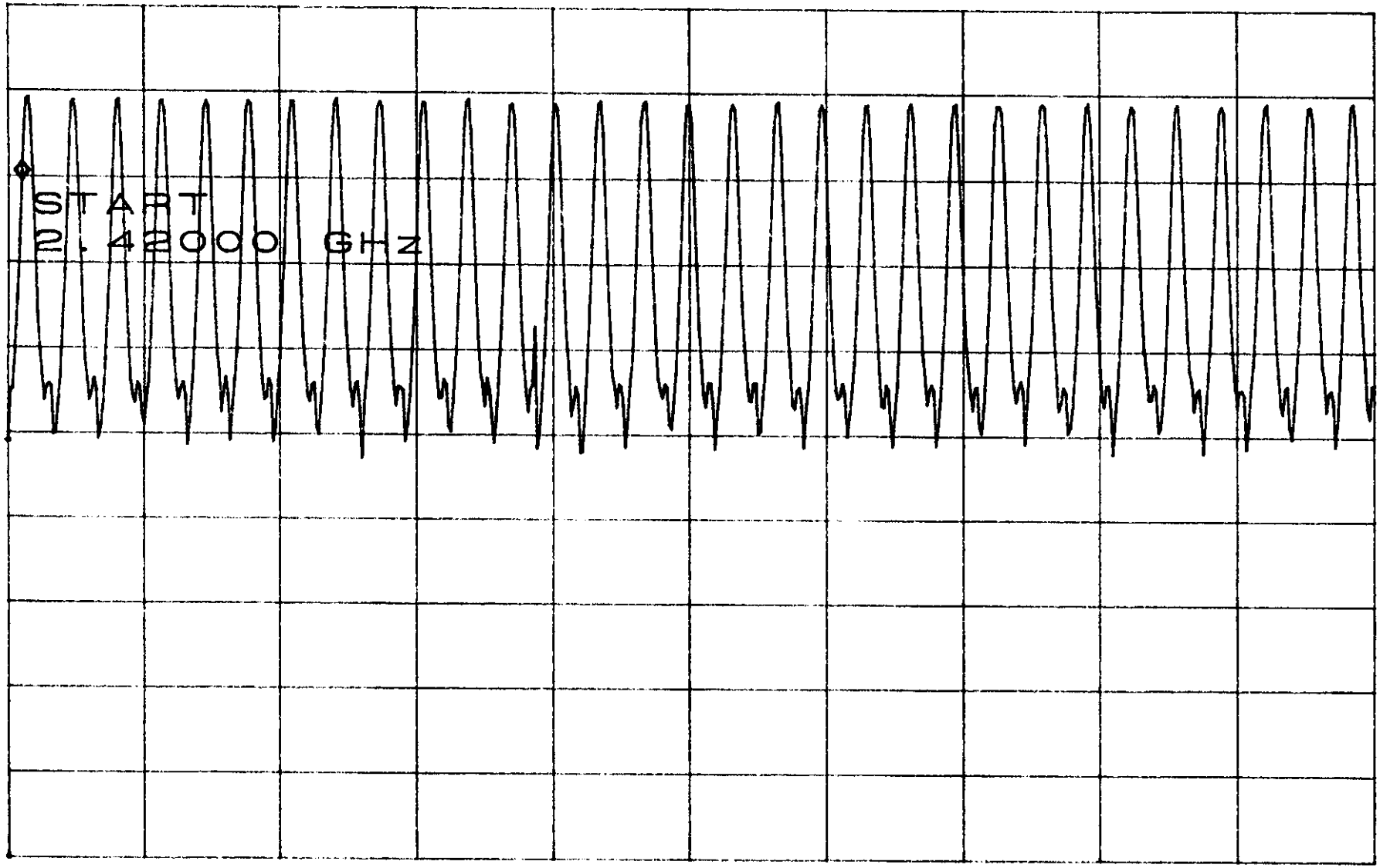


2-8

2.4GHZ
NUMBER OF CHANNELS: 31

ATTEN 30dB
RL 20.0dBm 10dB/
MKR -.33dBm
2.42010GHz

3-8

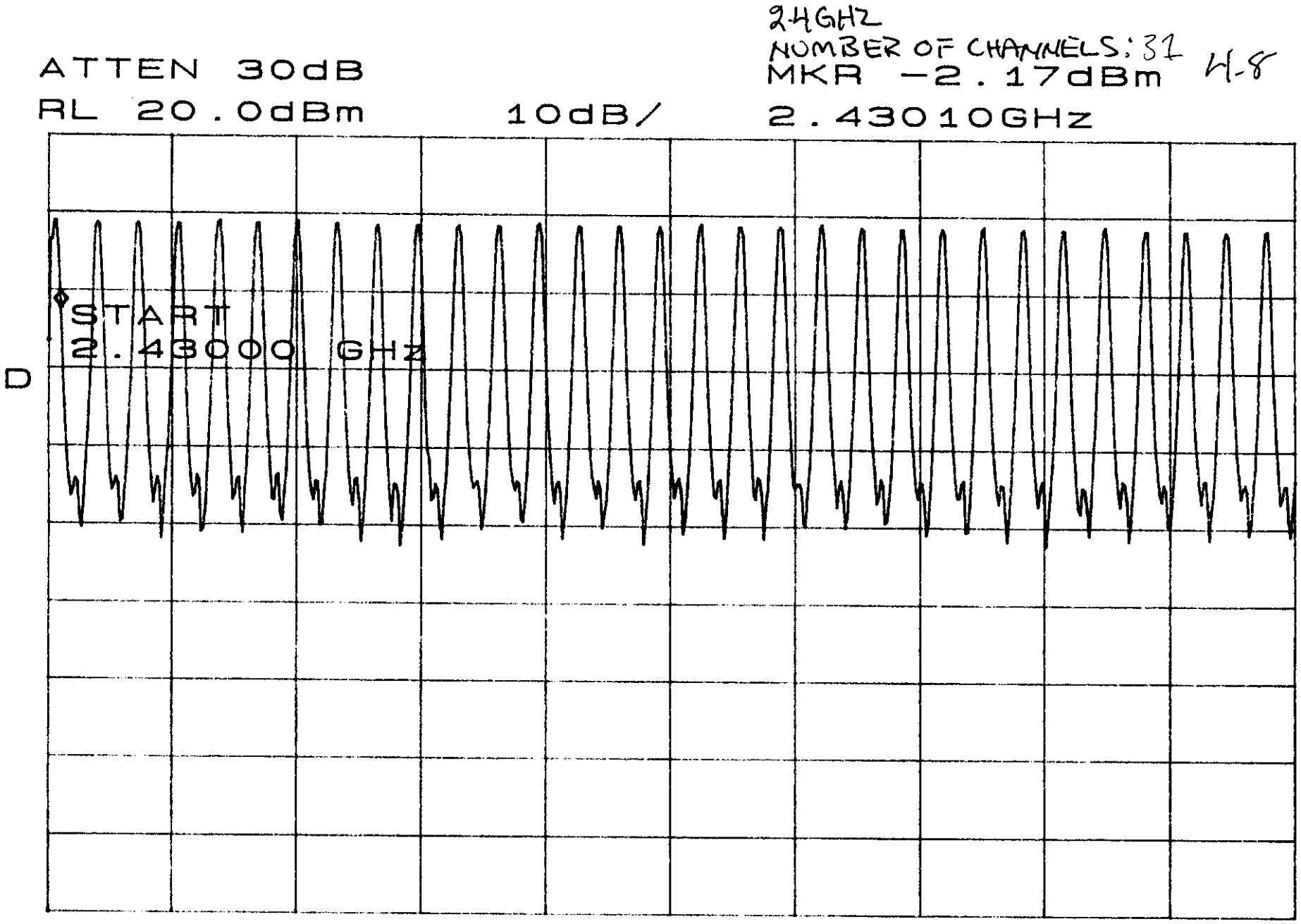


D

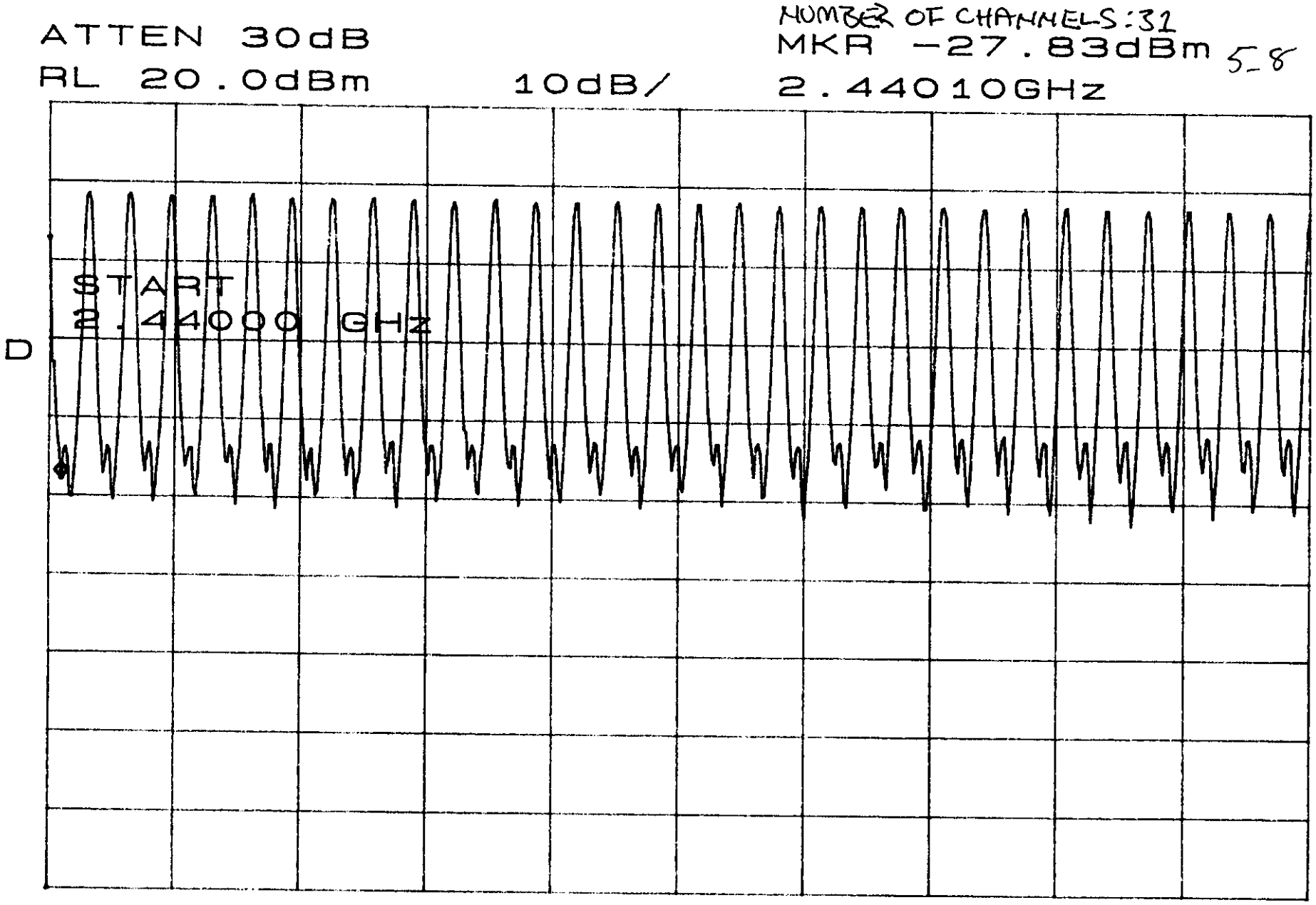
START 2.42000GHz STOP 2.43000GHz

*RBW 30kHz VBW 30kHz SWP 50.0ms

2.4GHz
NUMBER OF CHANNELS: 37
H-8



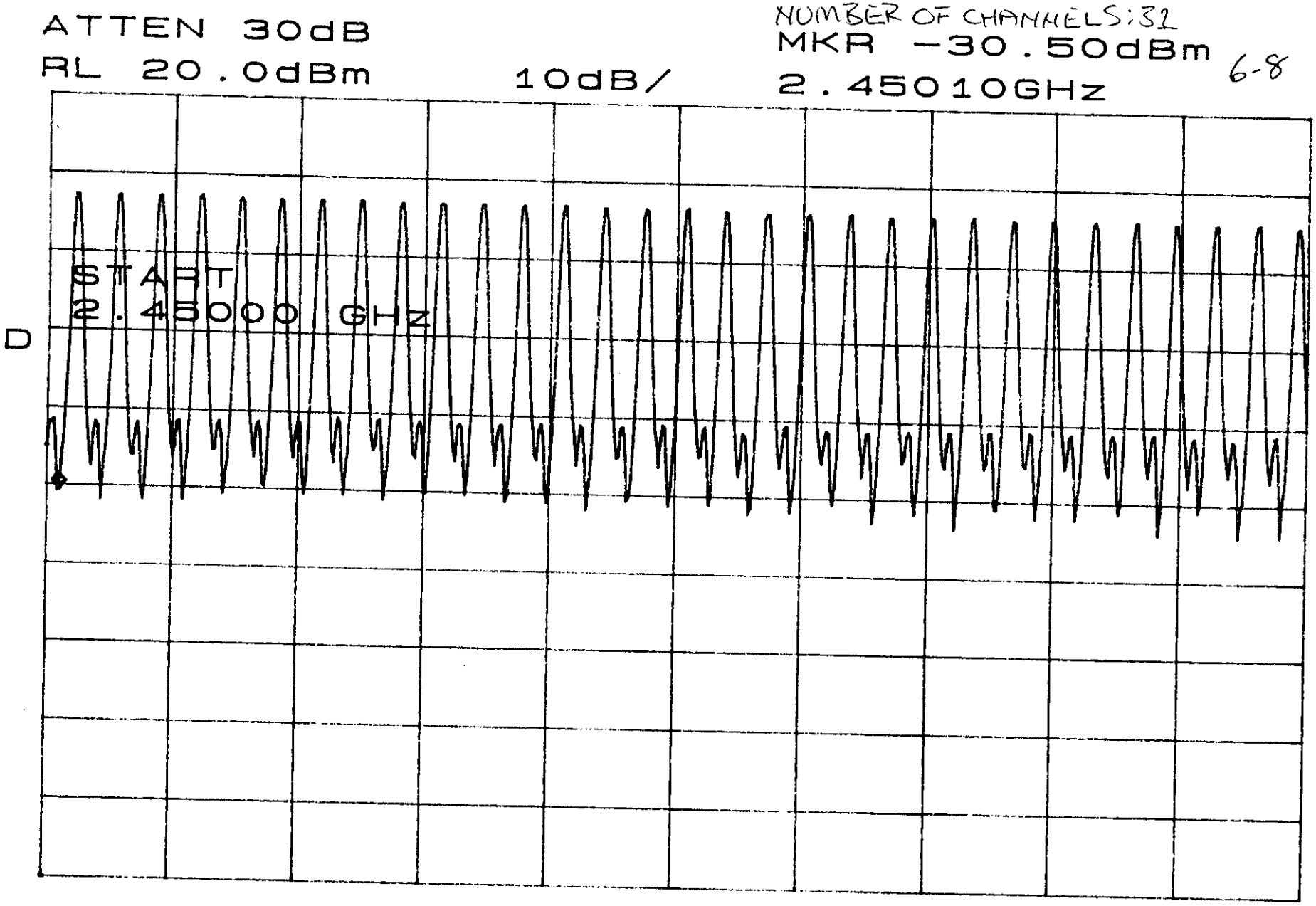
2.4GHZ
NUMBER OF CHANNELS: 31



5_8

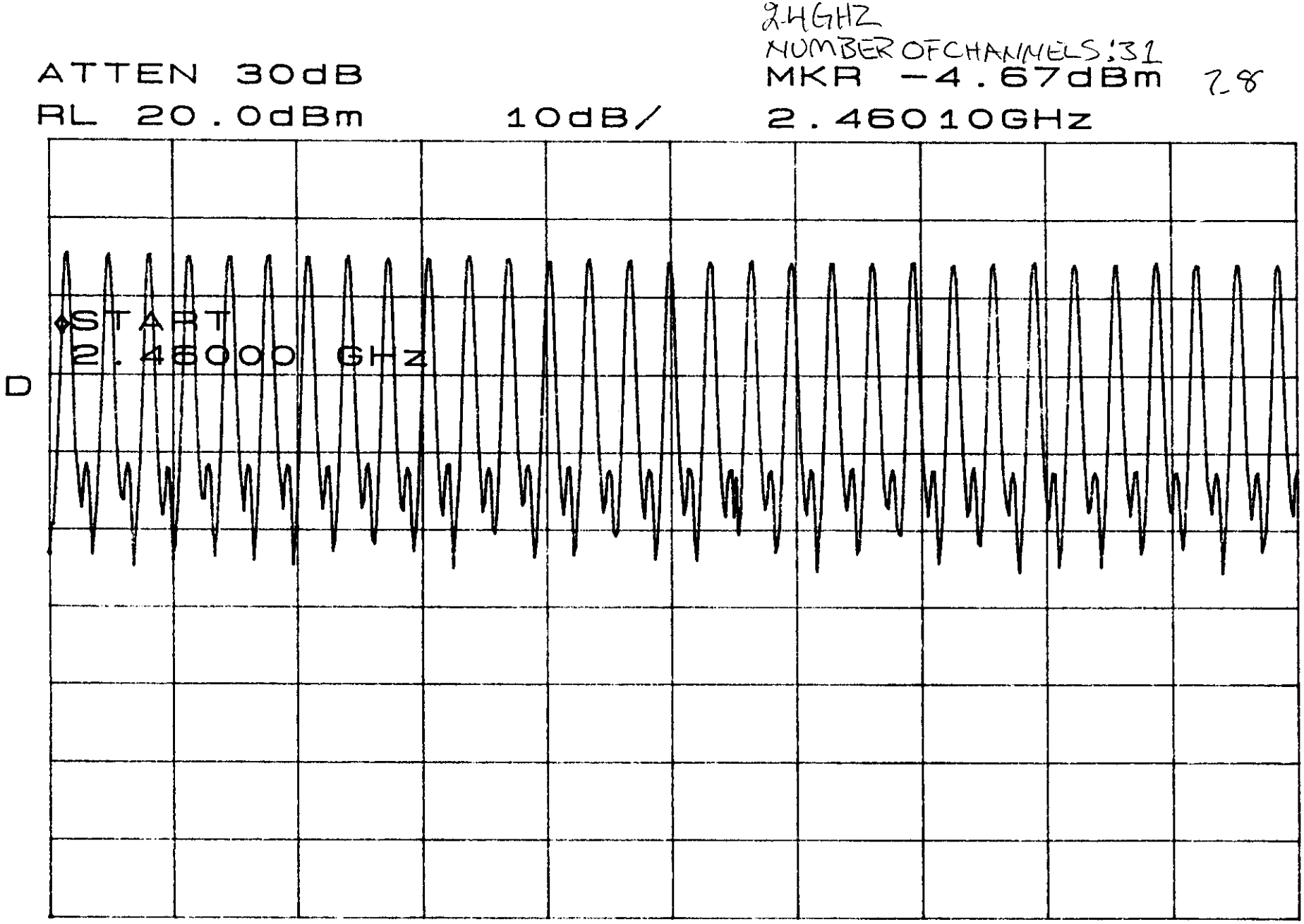
START 2.44000GHz STOP 2.45000GHz

2.4GHz
NUMBER OF CHANNELS: 32

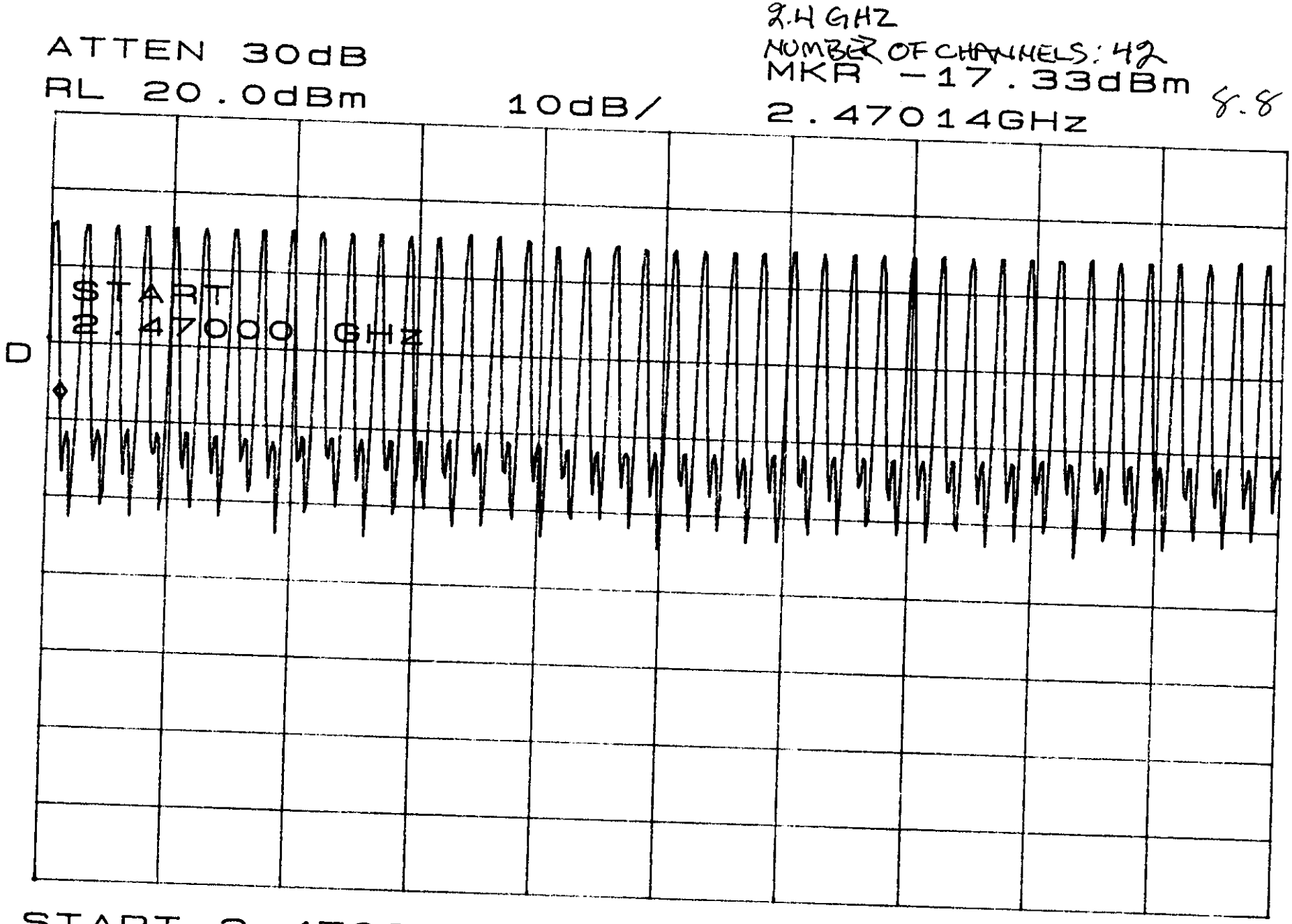


6-8

2.4GHZ
NUMBER OF CHANNELS: 31

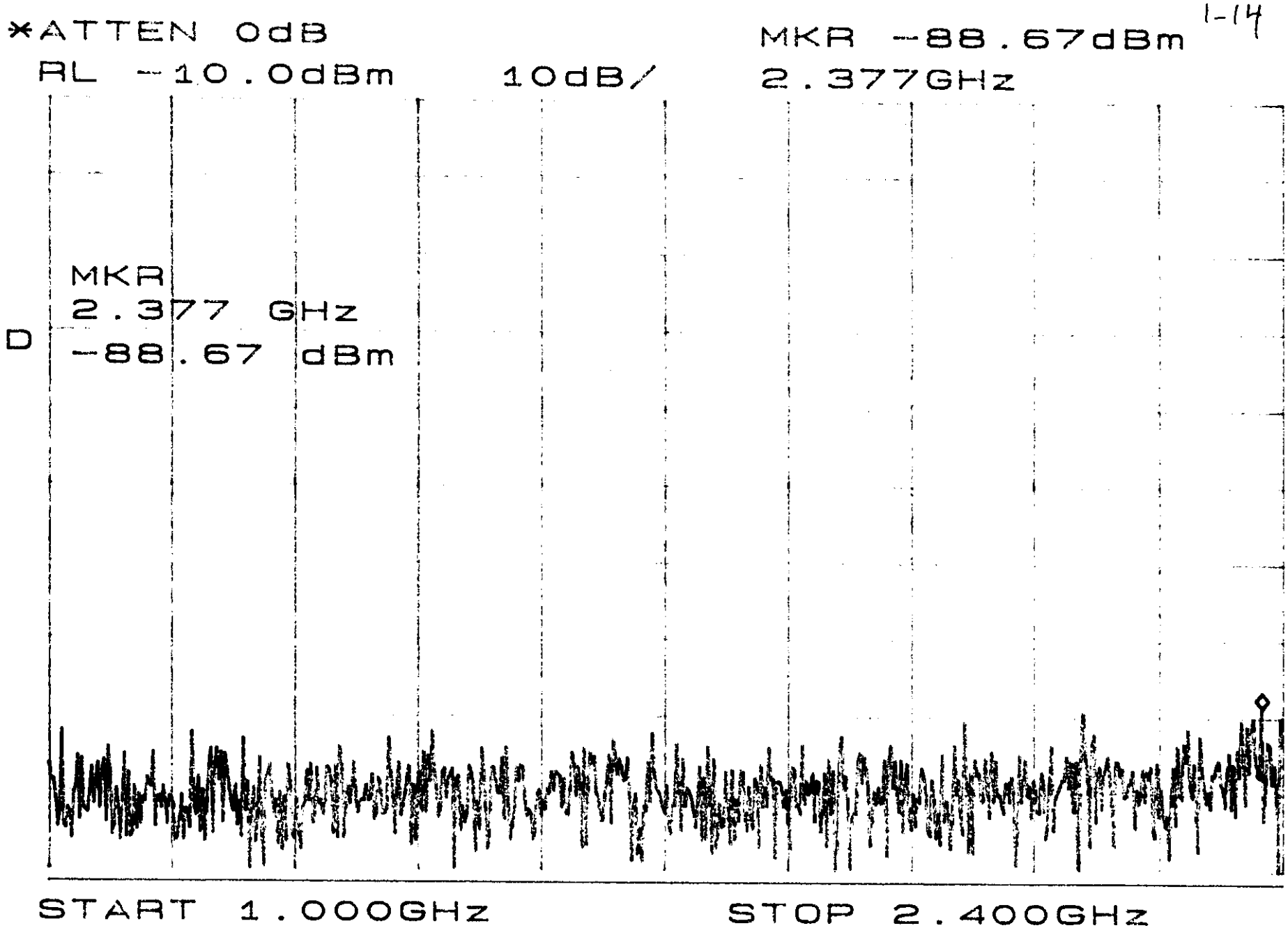


2.4 GHZ
NUMBER OF CHANNELS: 42



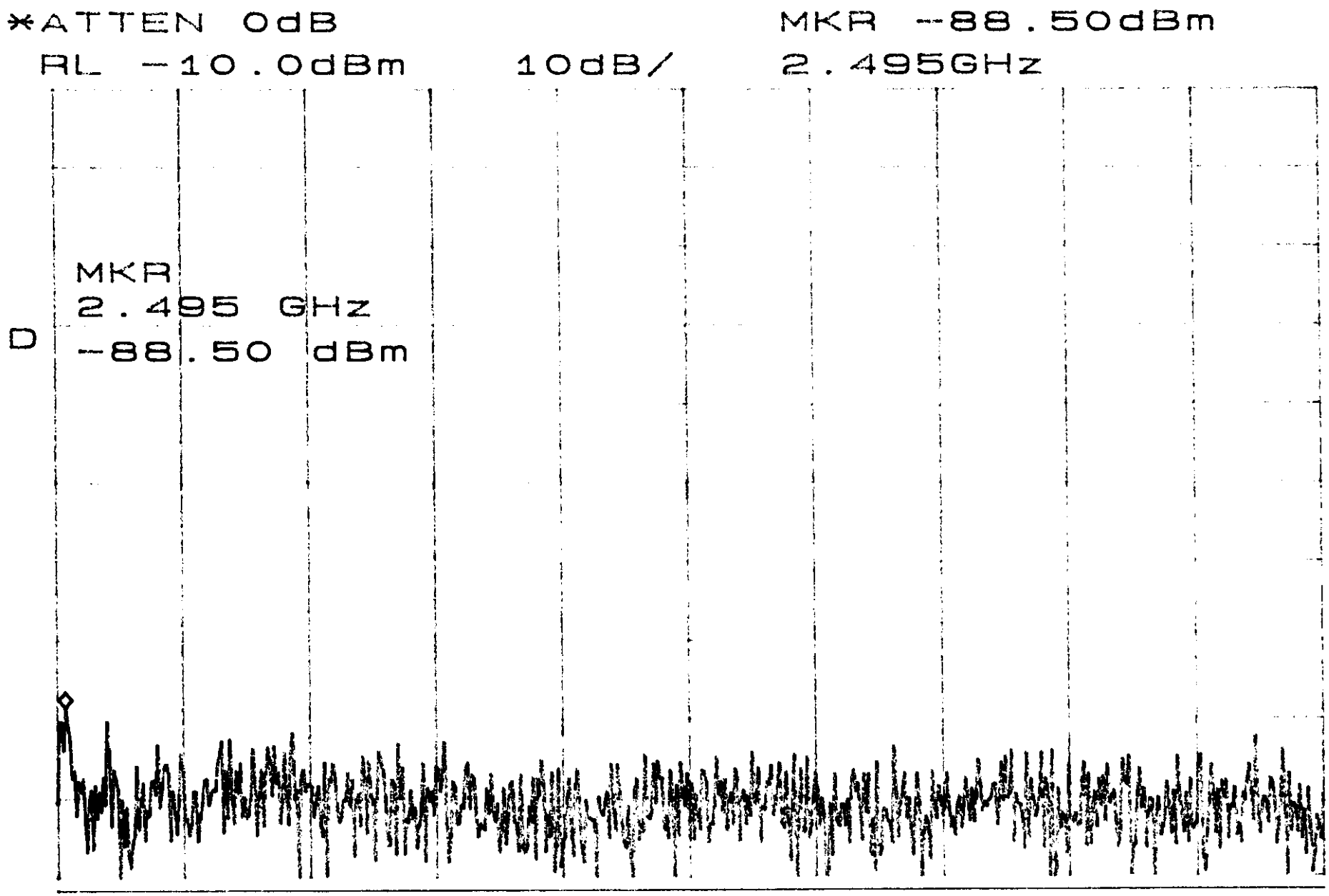
RADIO, 003

1-14



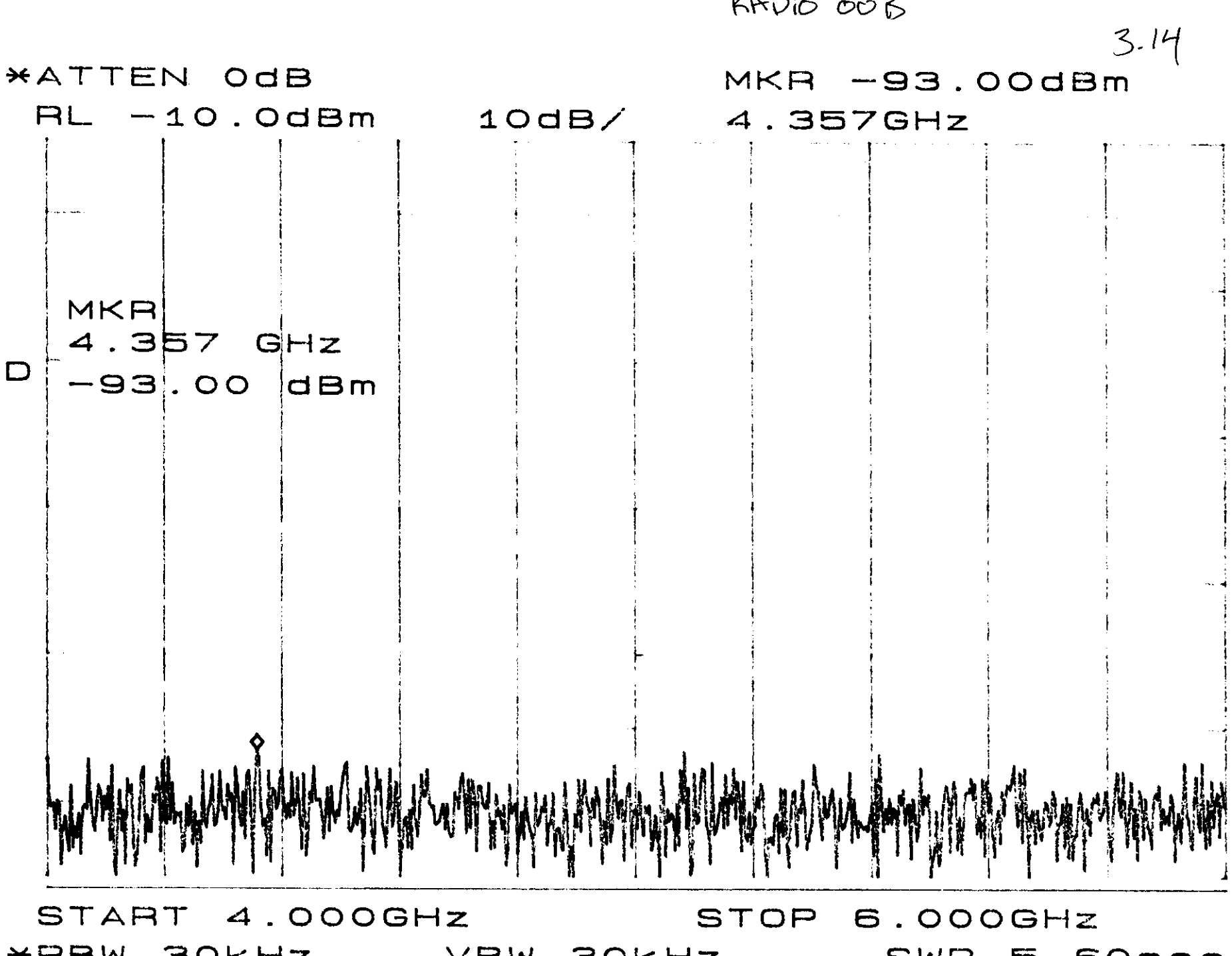
RADIO, OOB

2-14



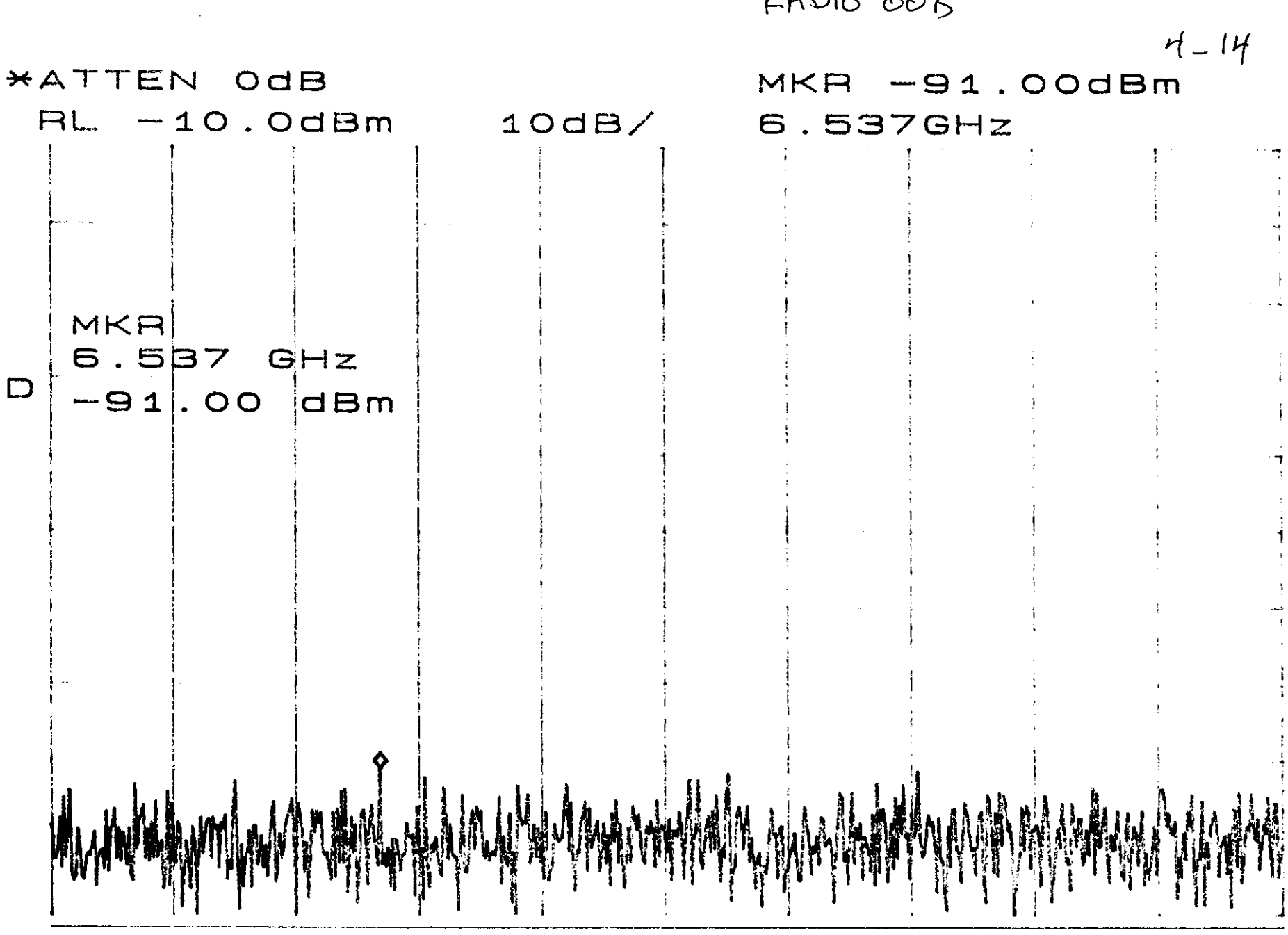
RADIO 00B

3.14



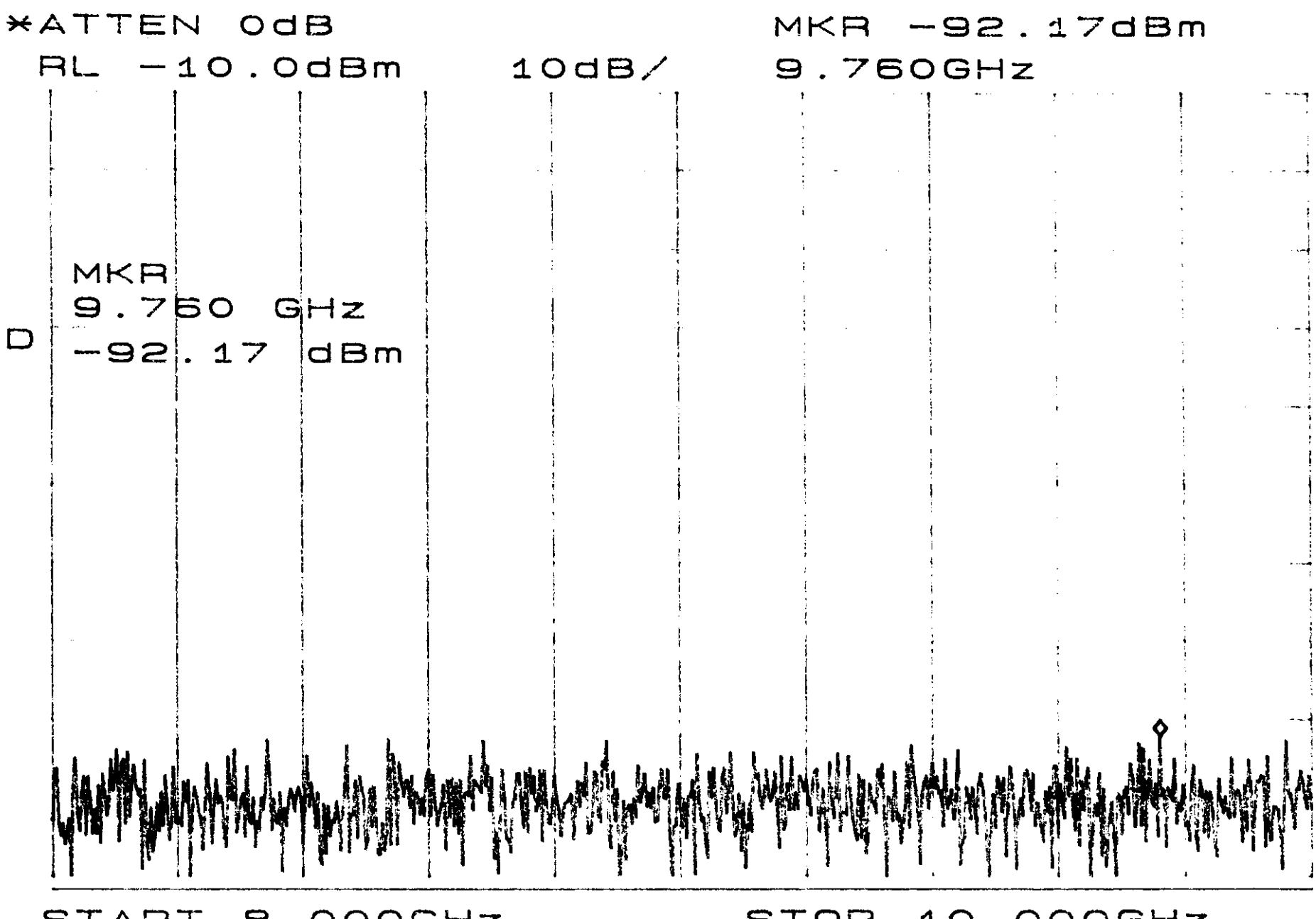
RADIO 003

4-14



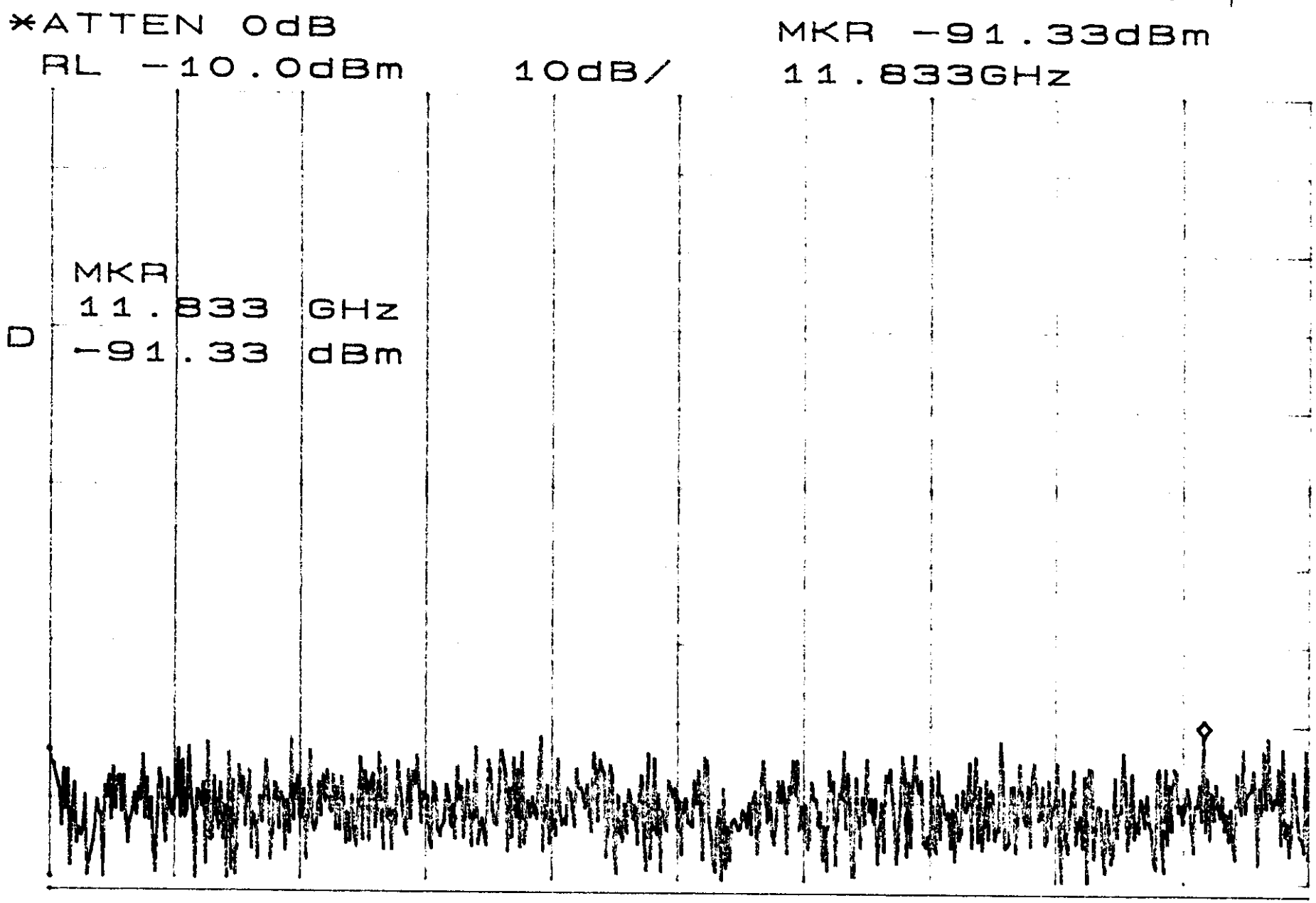
RADIO 007

5-14



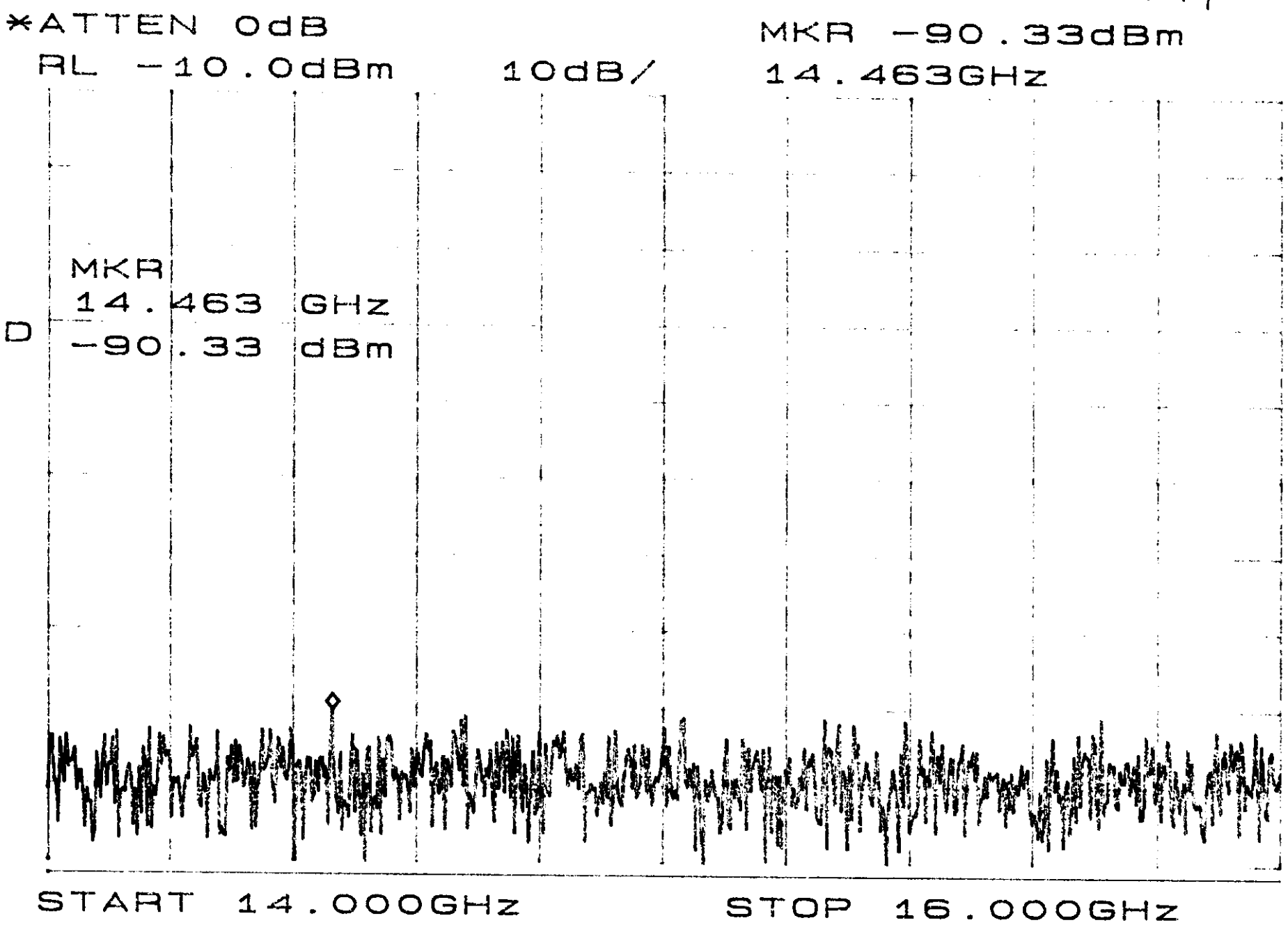
RADIO COB

6-14



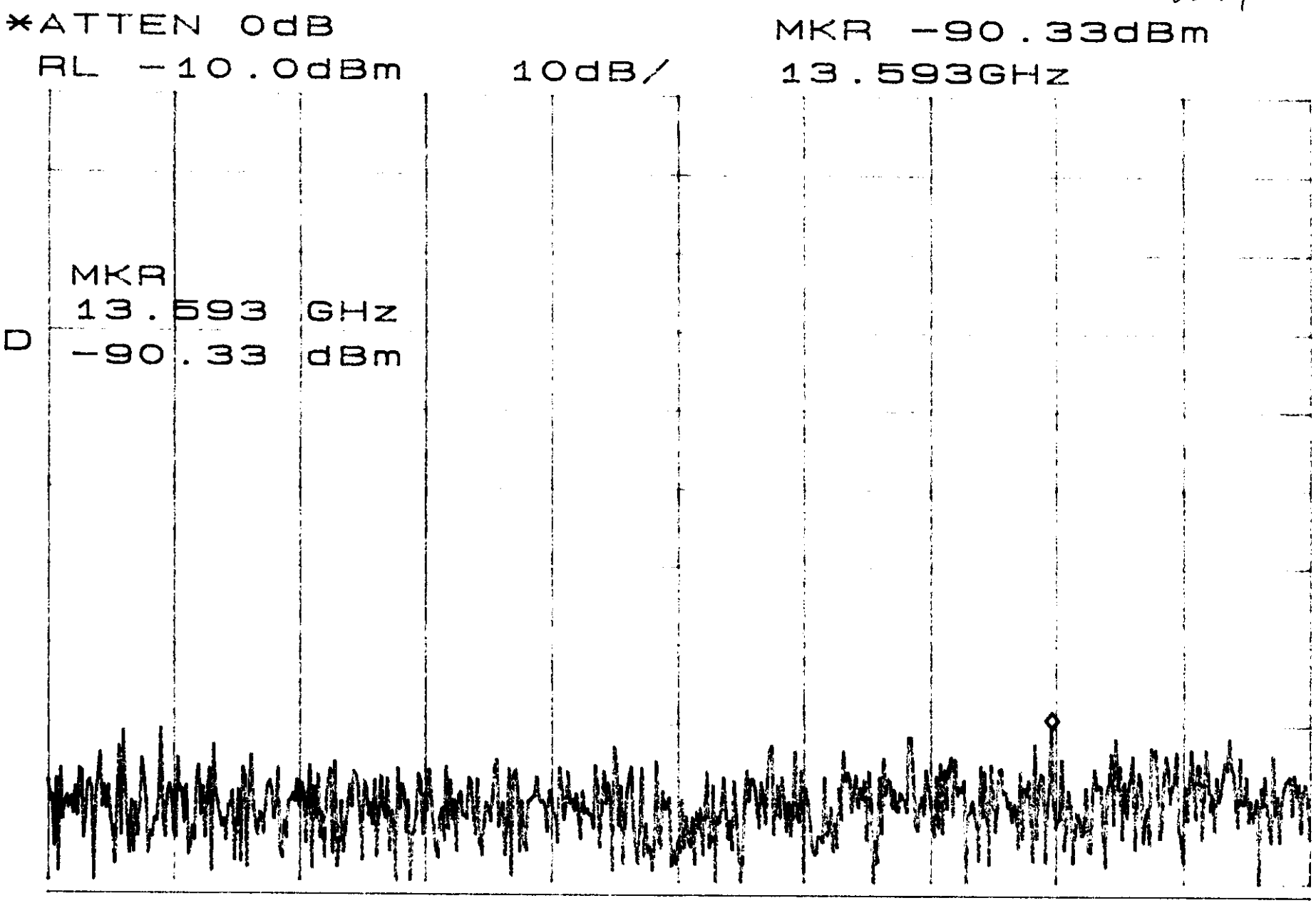
RADIO COB

7-14



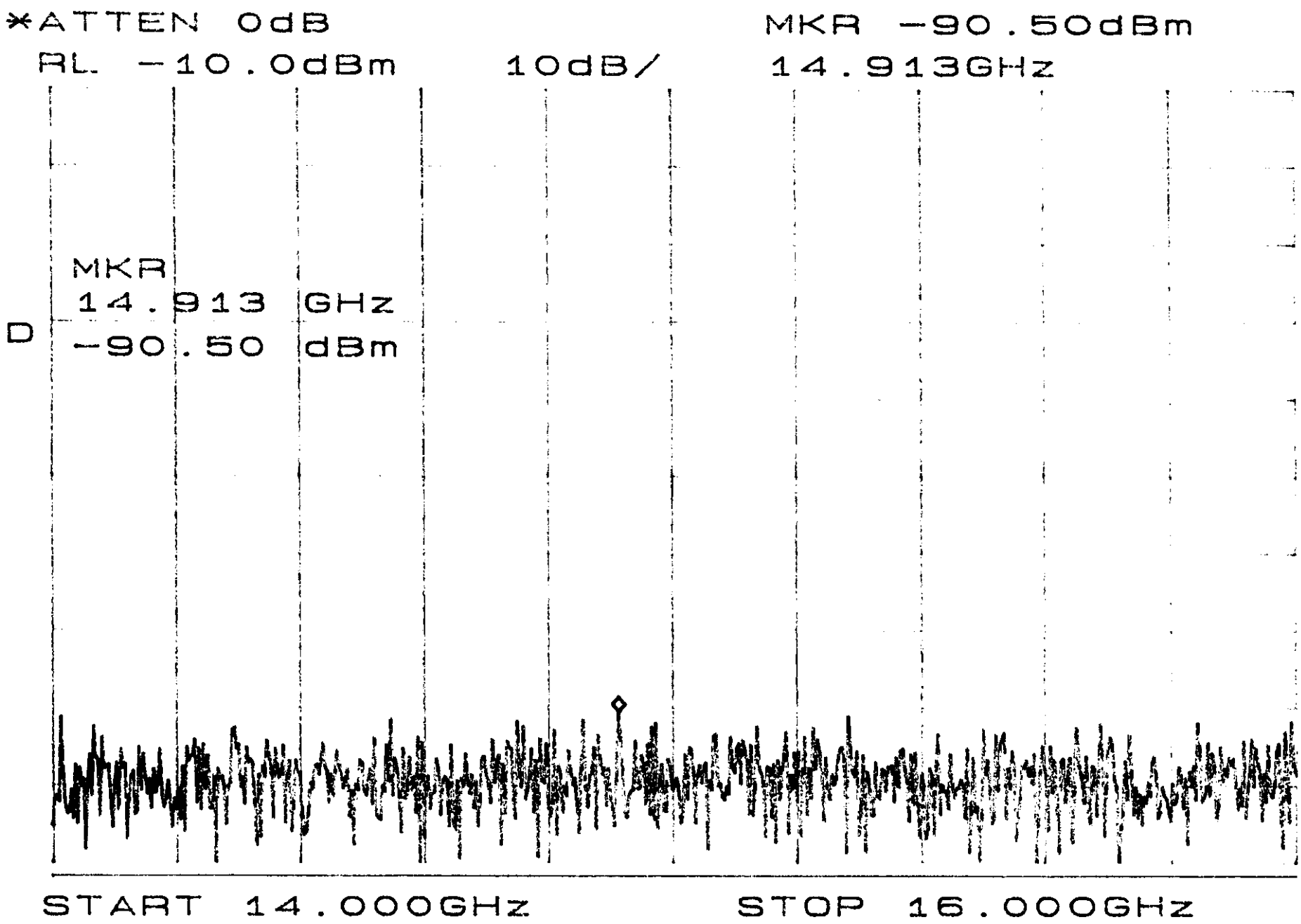
RADIO 007

8-14



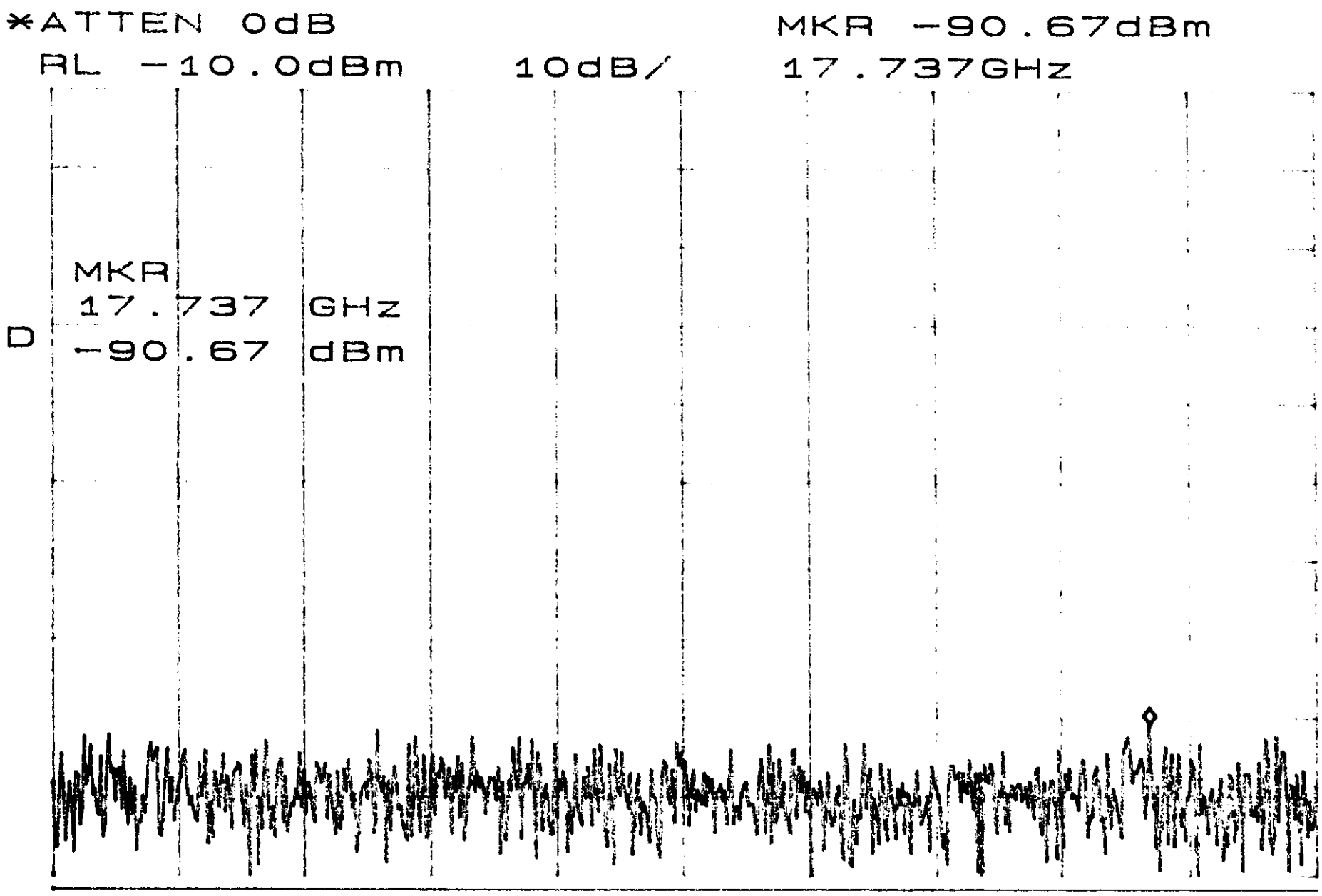
RADIO 003

9-14



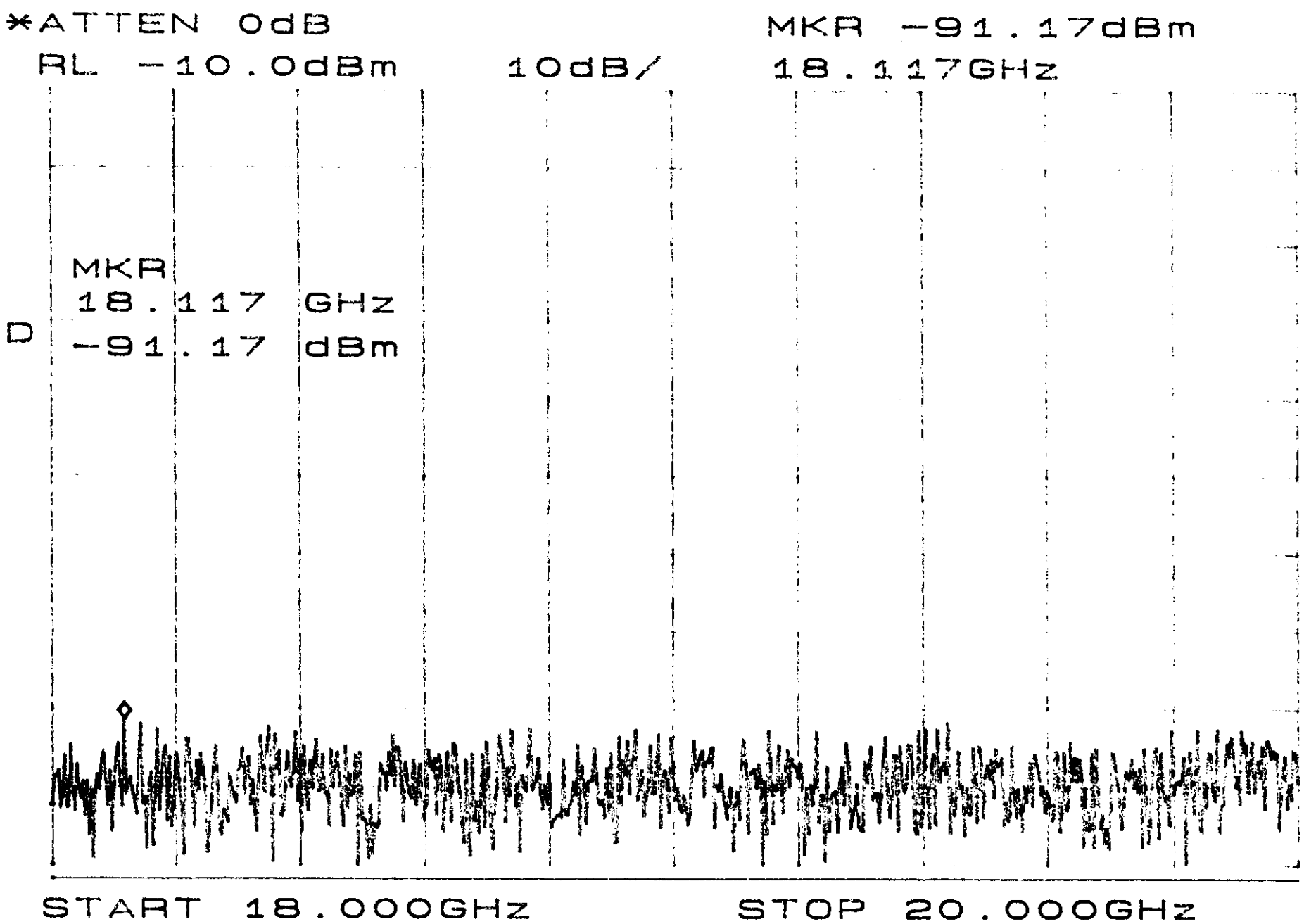
RADIO 003

10-14



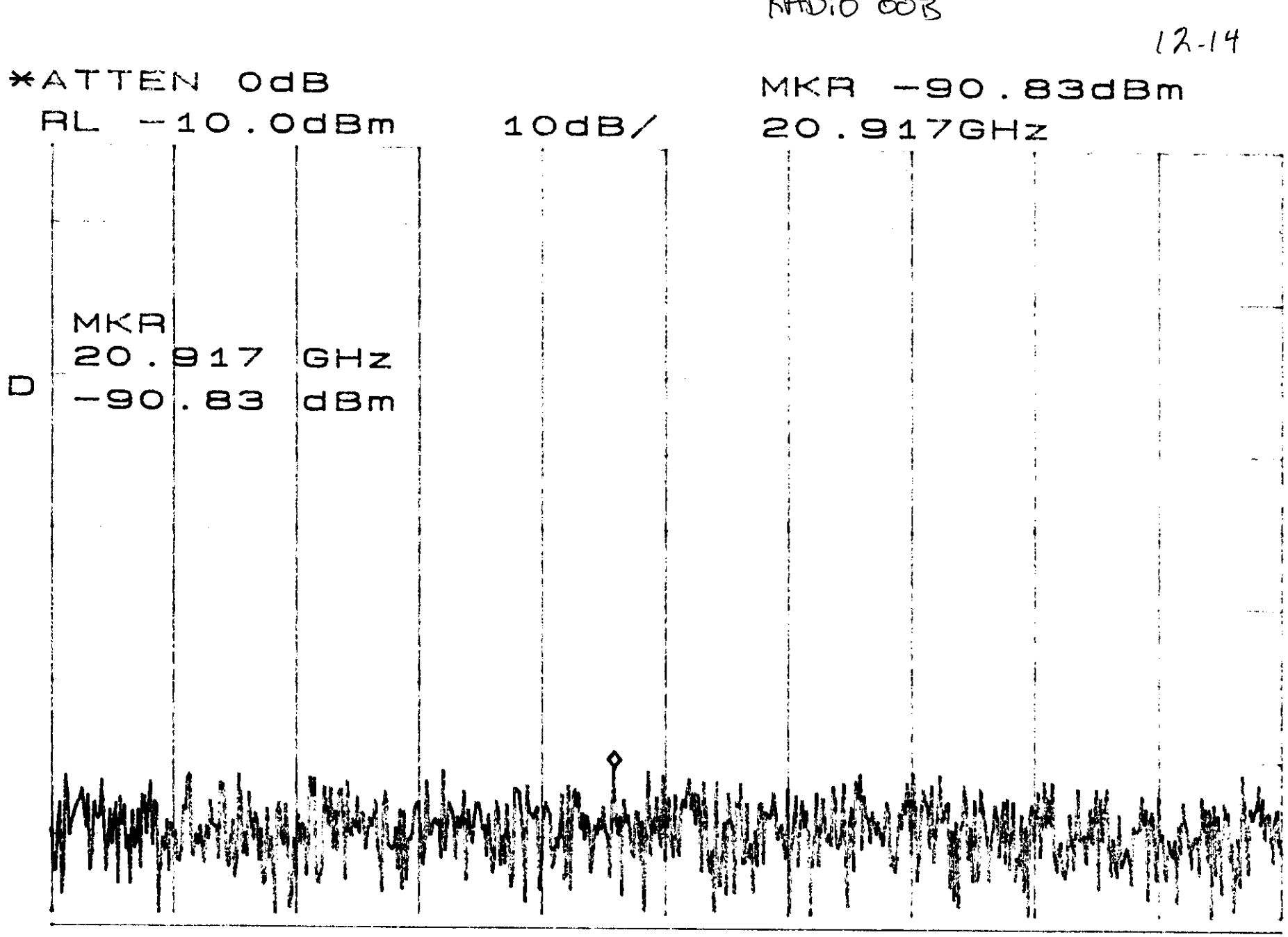
RADIO 003

11.14



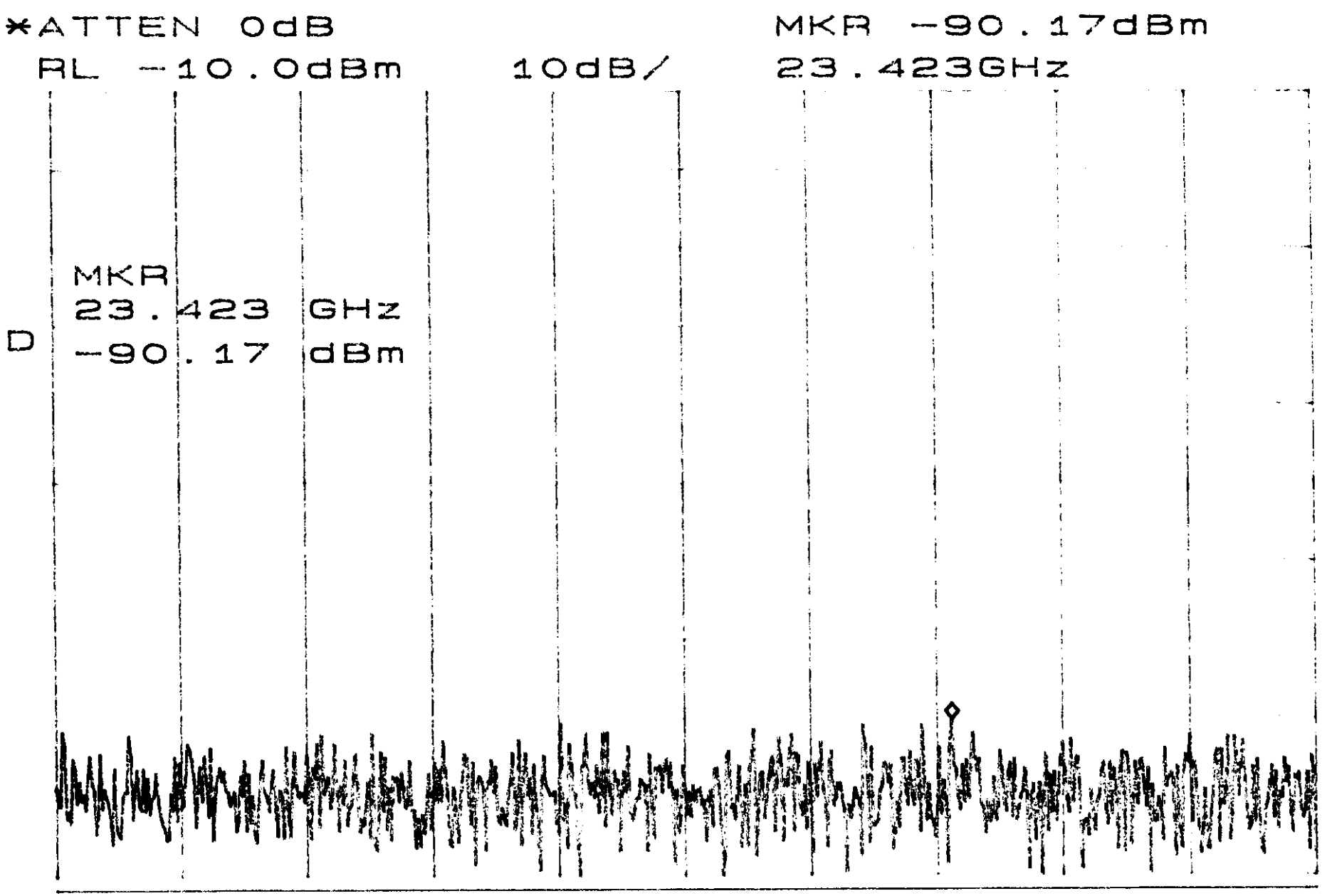
RADIO OOB

12-14



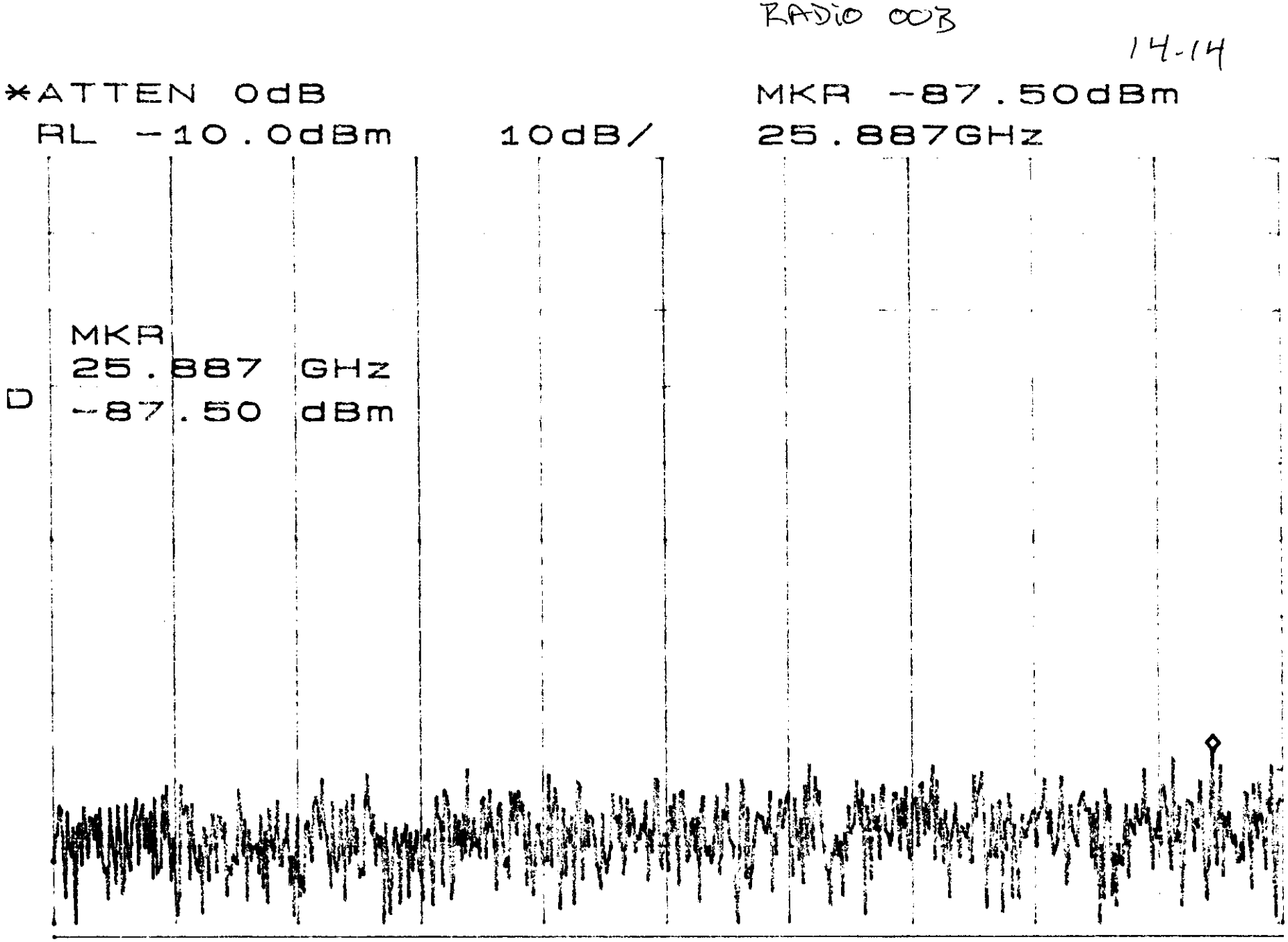
RADIO 00B

13-14



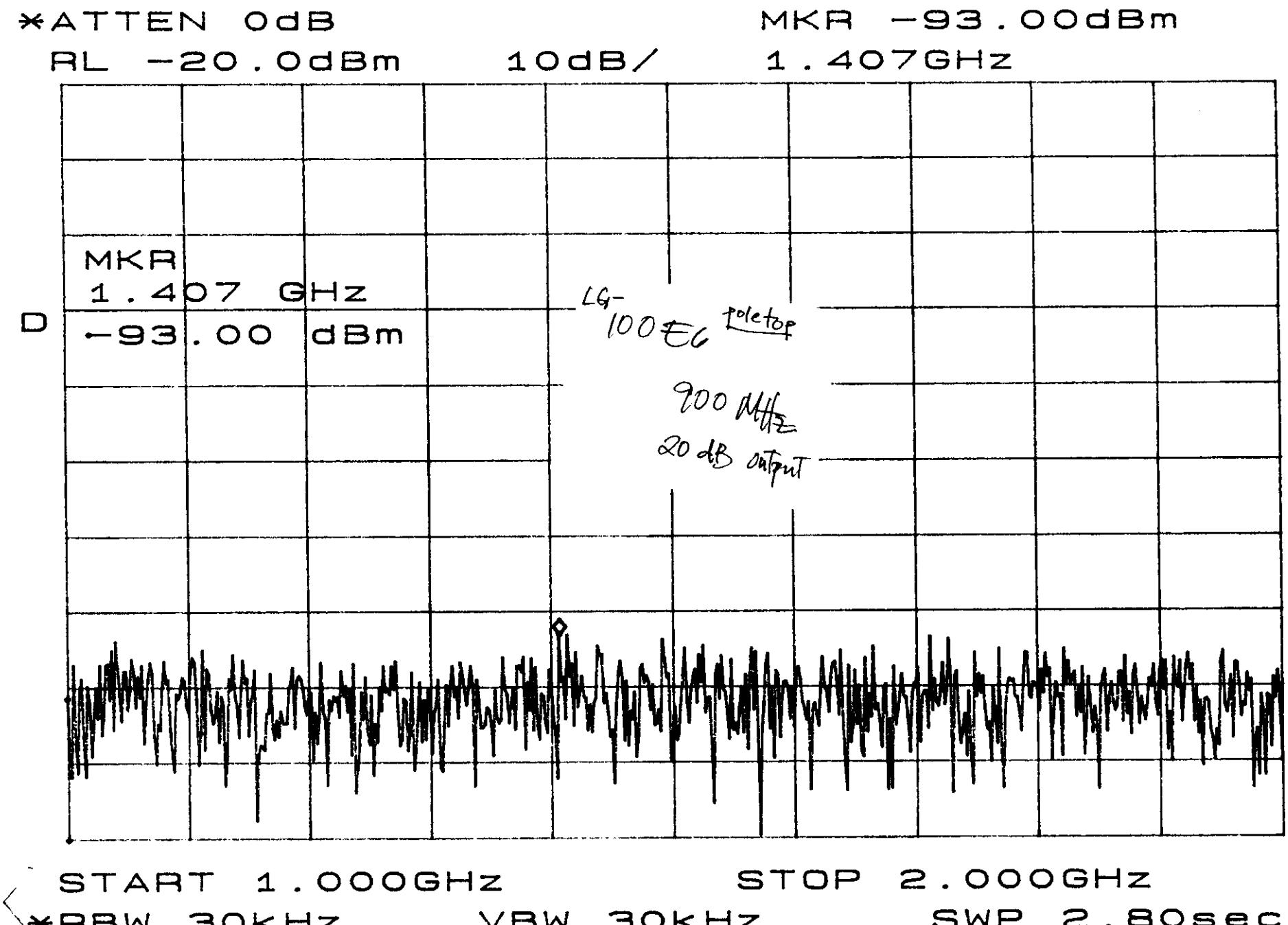
RADIO 003

14-14



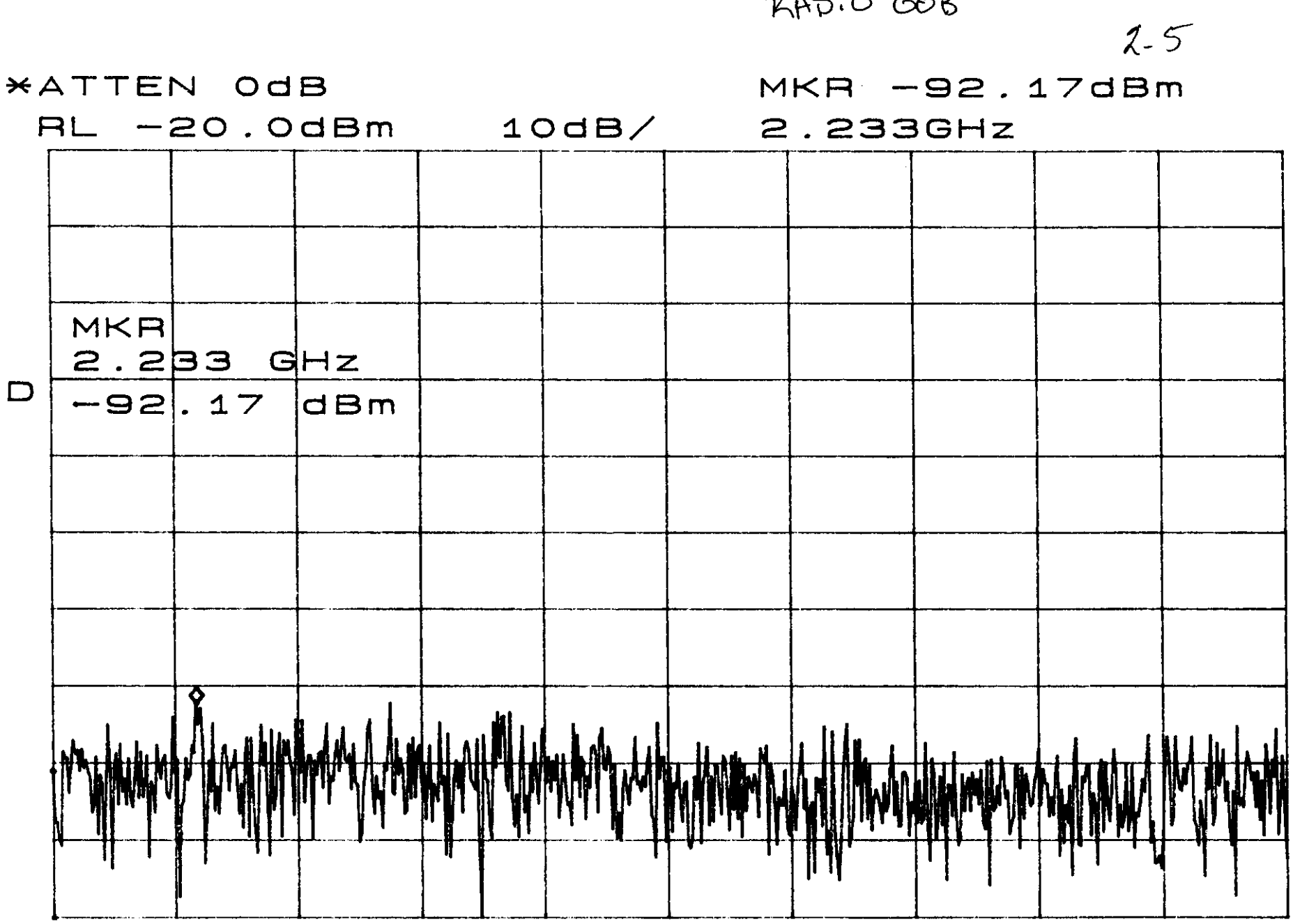
RADIO OOB

1-5


*ATTEN 0dB
MKR -93.00dBm
RL -20.0dBm
10dB/
1.407GHz
MKR
1.407 GHz
-93.00 dBm
D
LG-
100EC
Toletop
900 MHz
20 dB output
START 1.000GHz
STOP 2.000GHz
*RBW 30kHz
VBW 30kHz
SWP 2.80sec

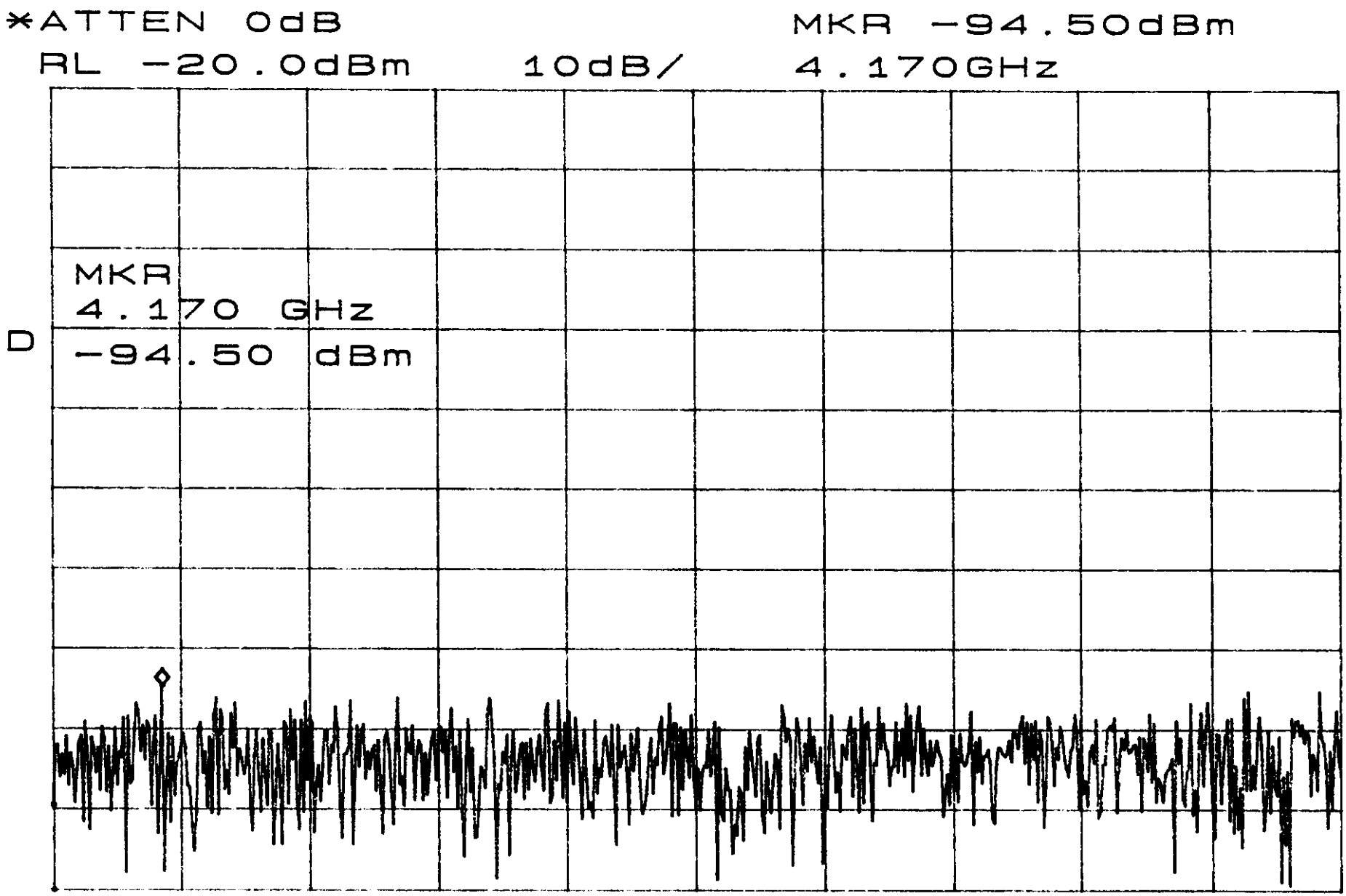
RADIO COB

2-5


*ATTEN 0dB
RL -20.0dBm
10dB/
MKR -92.17dBm
2.233GHz
MKR
2.233 GHz
-92.17 dBm
D
START 2.000GHz
STOP 4.000GHz

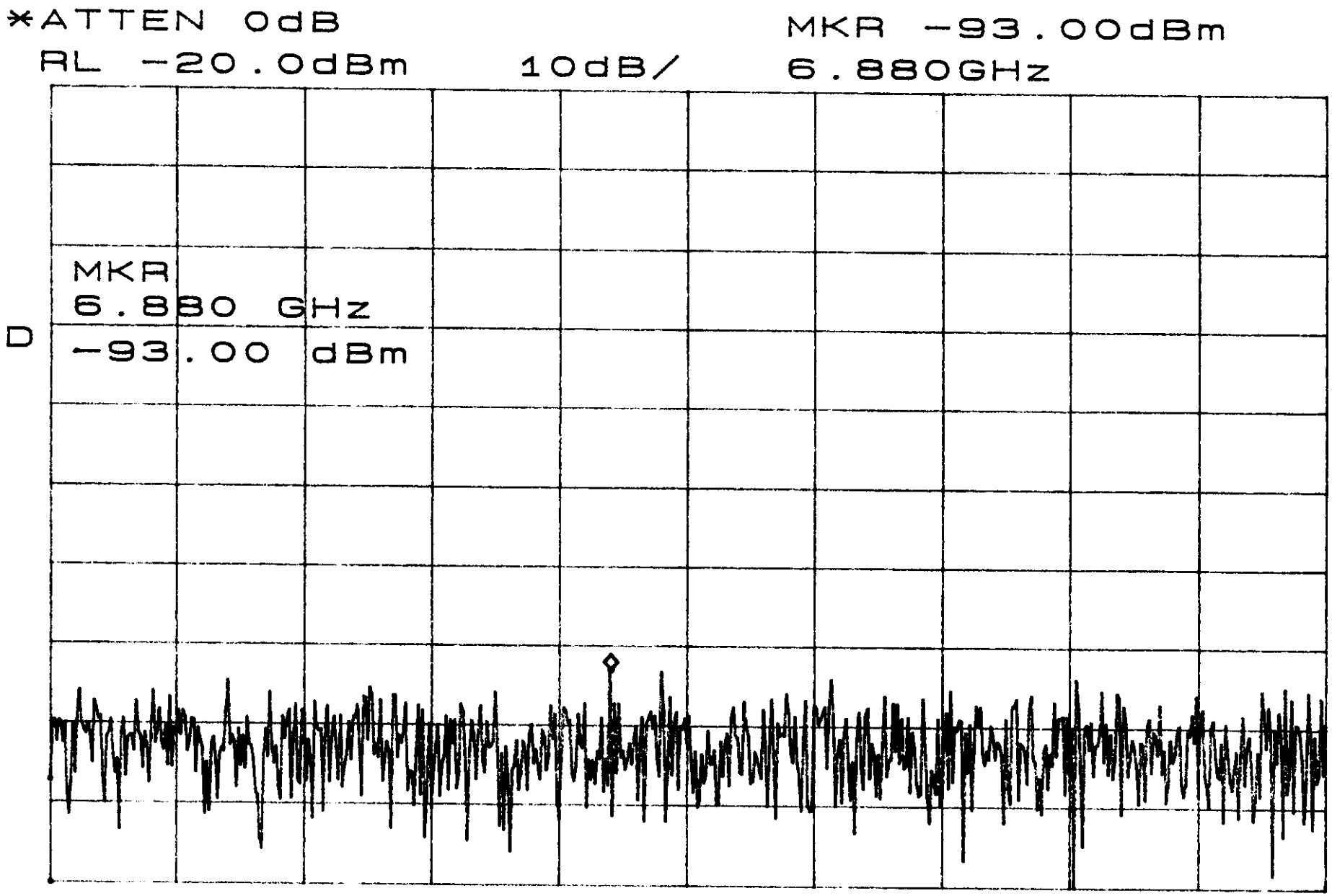
RADIO OOB

3.5


*ATTEN 0dB
RL -20.0dBm
10dB/
MKR -94.50dBm
4.170GHz
MKR
4.170 GHz
-94.50 dBm
D
START 4.000GHz
STOP 6.000GHz
*RBW 30kHz
VBW 30kHz
SWP 5.60sec

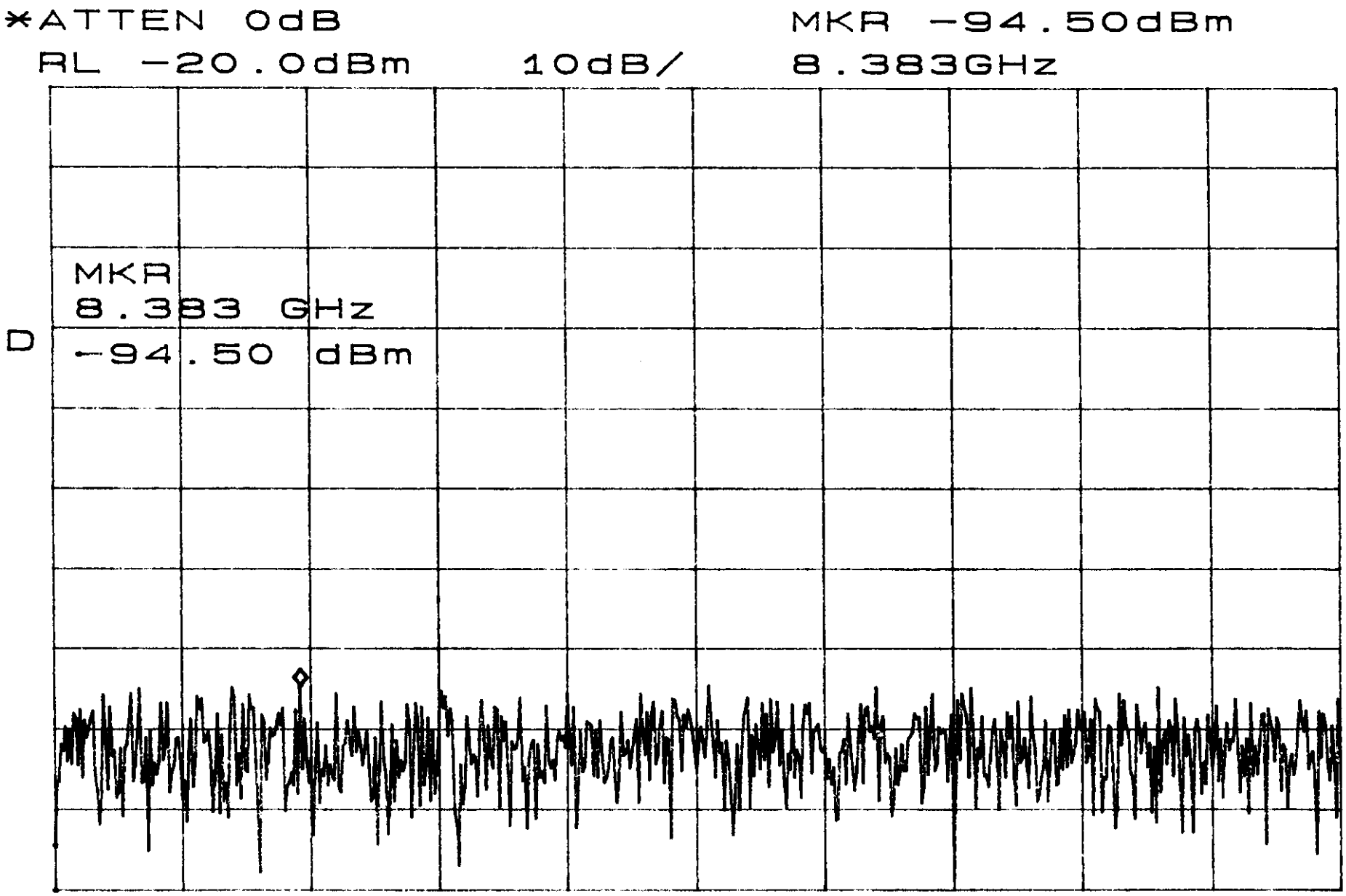
RADIO 00B

4-5


*ATTEN 0dB
RL -20.0dBm
10dB/
MKR -93.00dBm
6.880GHz
MKR
6.880 GHz
-93.00 dBm
D
START 6.000GHz
STOP 8.000GHz
*RBW 30kHz
VBW 30kHz
SWP 5.60sec

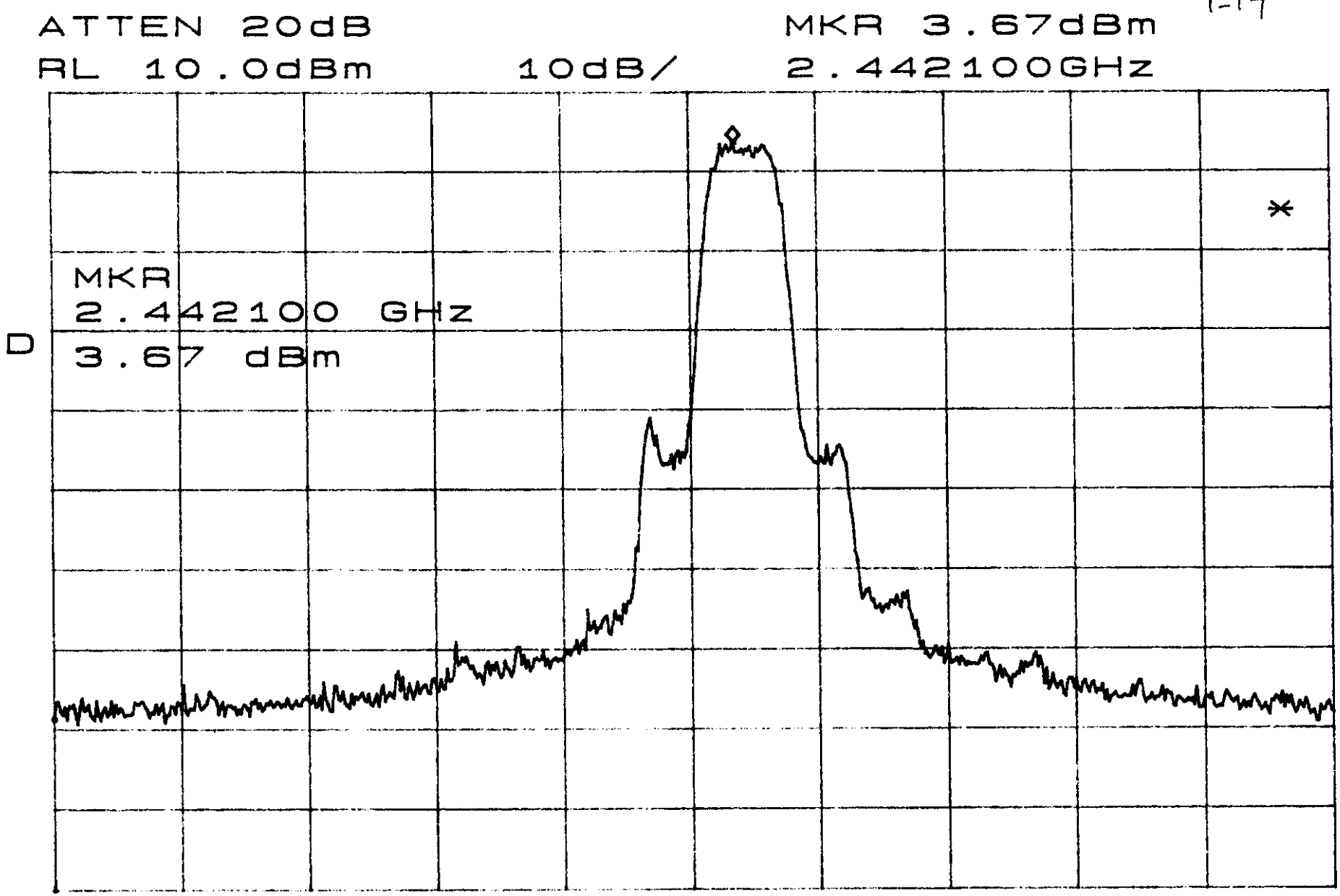
RADIO 003

5.5


*ATTEN 0dB
MKR -94.50dBm
RL -20.0dBm
10dB/
8.383GHz
MKR
8.383 GHz
-94.50 dBm
D
START 8.000GHz
STOP 10.000GHz
*RBW 30kHz
VBW 30kHz
SWP 5.60sec

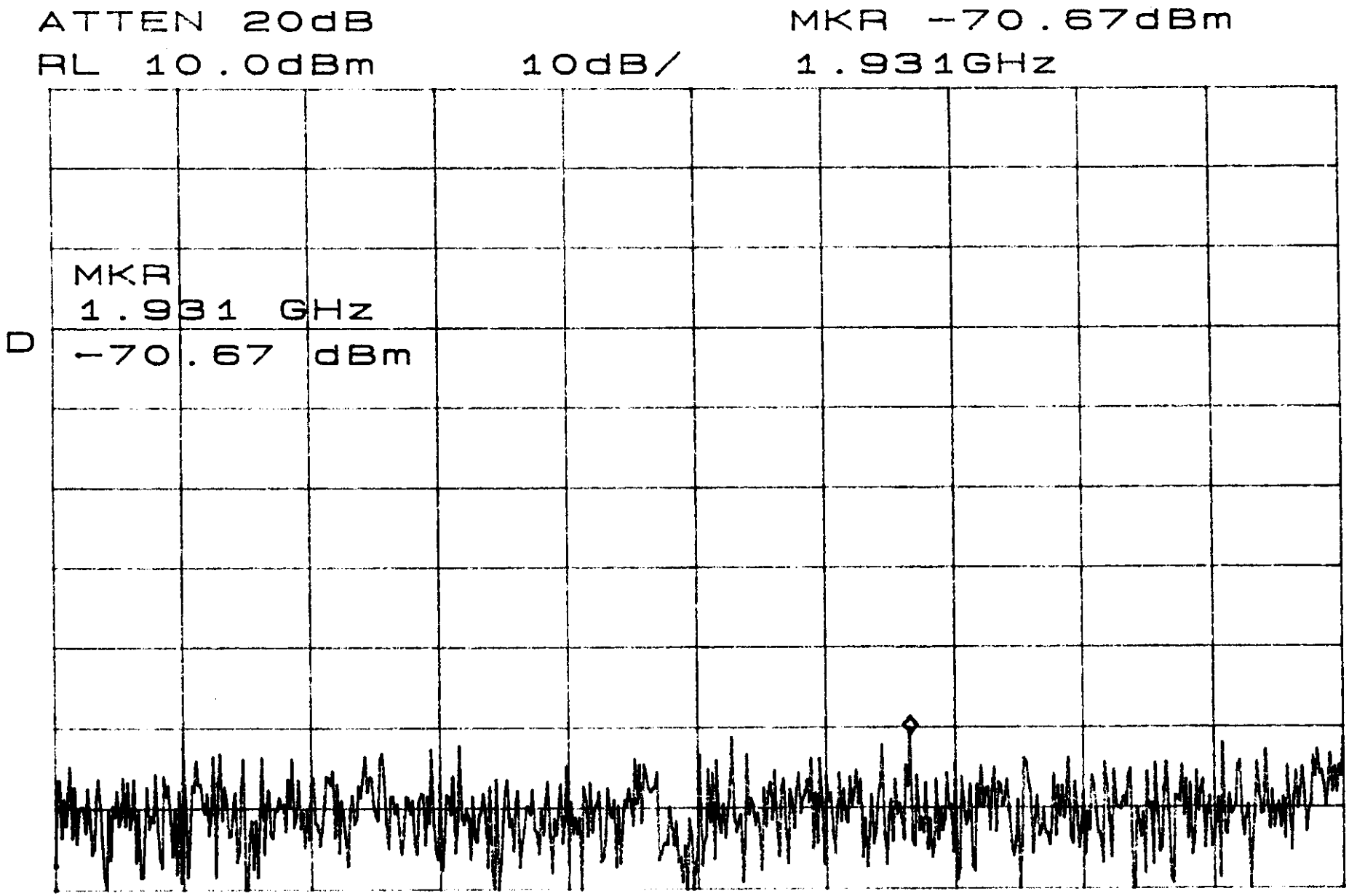
ENCT 603

1-14


ATTEN 20dB
RL 10.0dBm
10dB/
MKR 3.67dBm
2.442100GHz
MKR
2.442100 GHz
3.67 dBm
D
CENTER 2.441925GHz
SPAN 5.000MHz

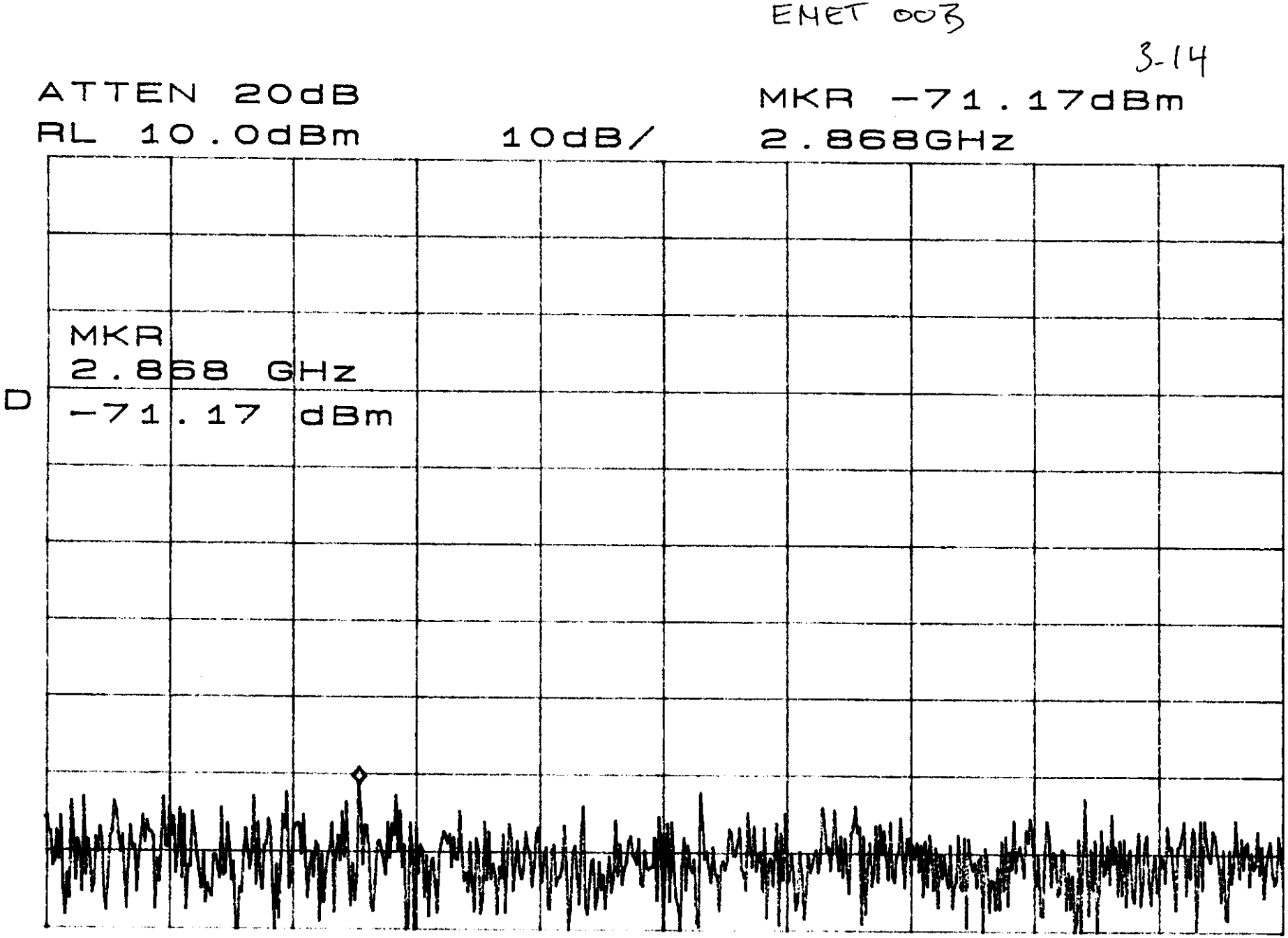
EHET 00B

2.14


ATTEN 20dB
MKR -70.67dBm
RL 10.0dBm
10dB/
1.931GHz
MKR
1.931 GHz
-70.67 dBm
D
START 1.000GHz
STOP 2.400GHz
RBW 30kHz
VBW 30kHz
SWP 3.90sec

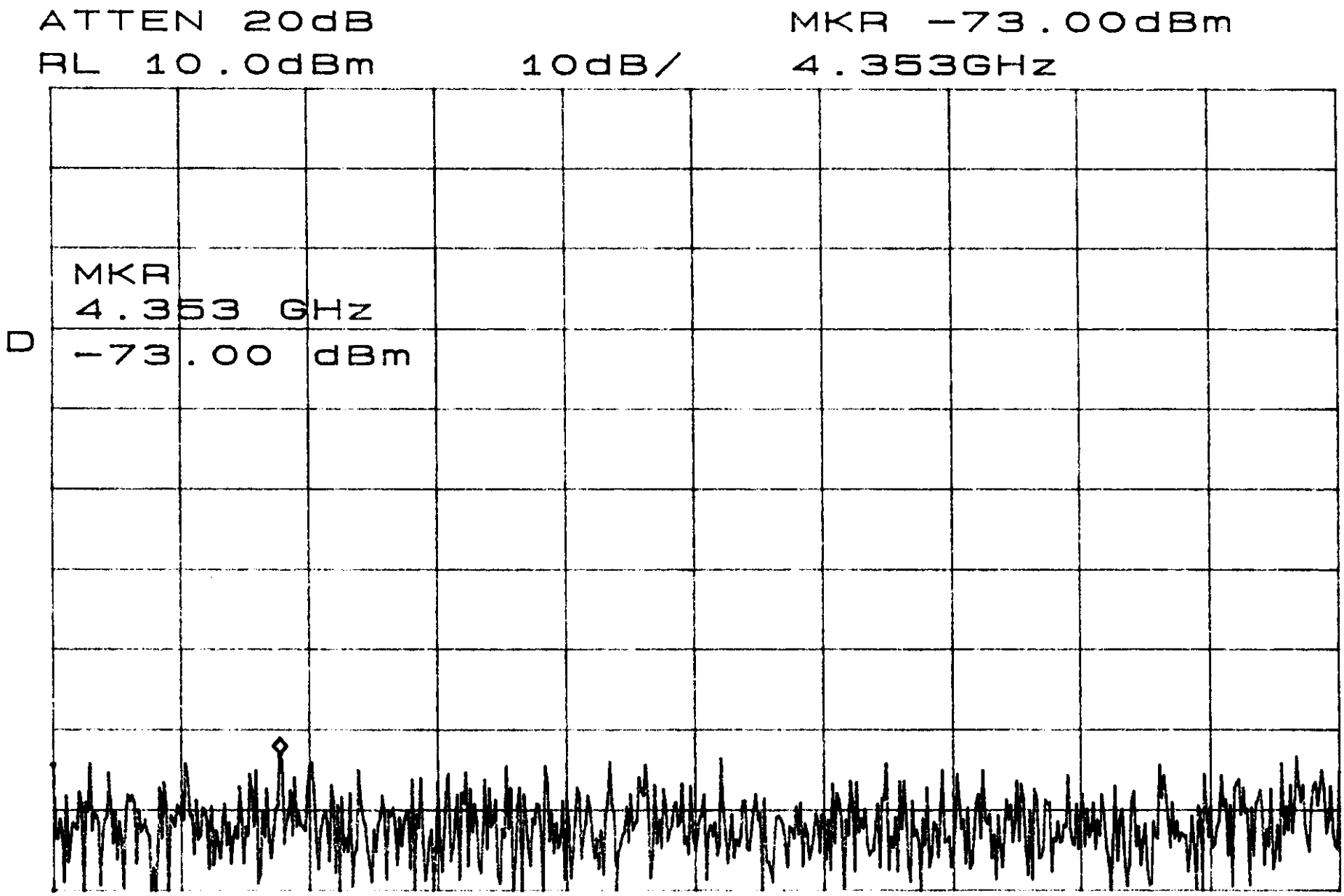
EMET 003

3-14


ATTEN 20dB
RL 10.0dBm
10dB/
MKR -71.17dBm
2.868GHz
MKR
2.868 GHz
-71.17 dBm
D
START 2.484GHz
STOP 4.000GHz

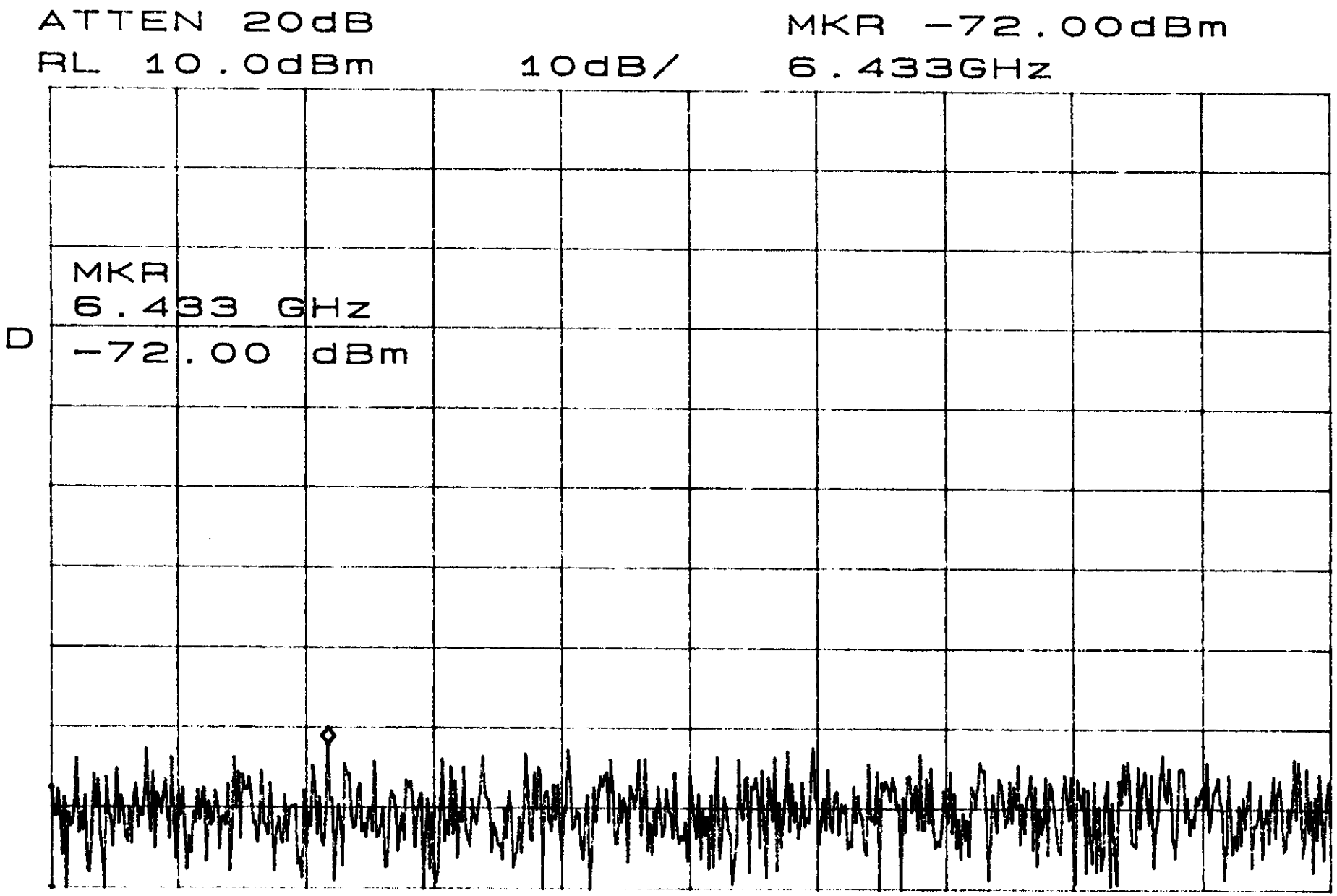
ENET 003

4-14


ATTEN 20dB
RL 10.0dBm
10dB/
MKR -73.00dBm
4.353GHz
MKR
4.353 GHz
-73.00 dBm
D
START 4.000GHz
STOP 6.000GHz

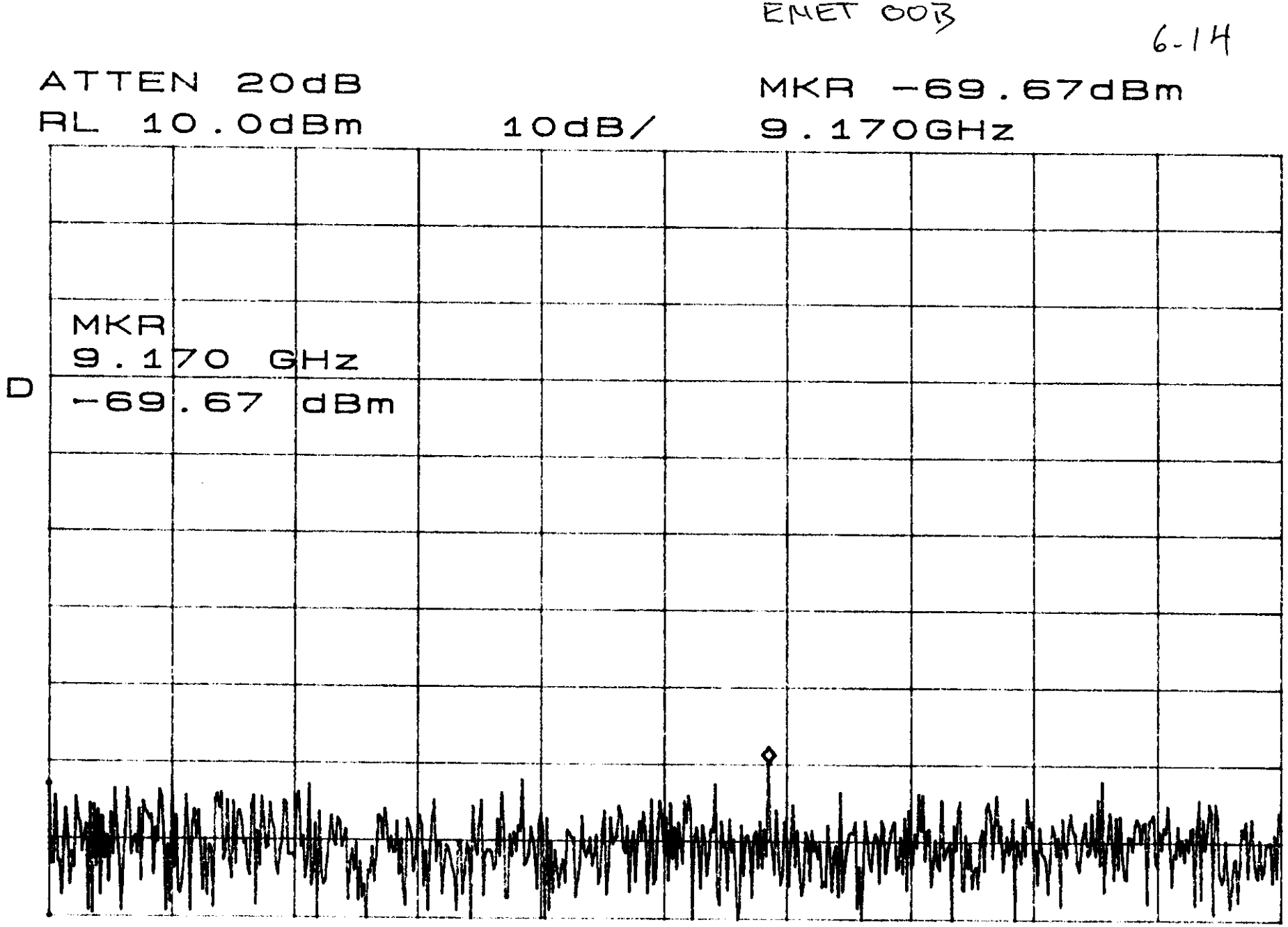
ENET 6073

5.14



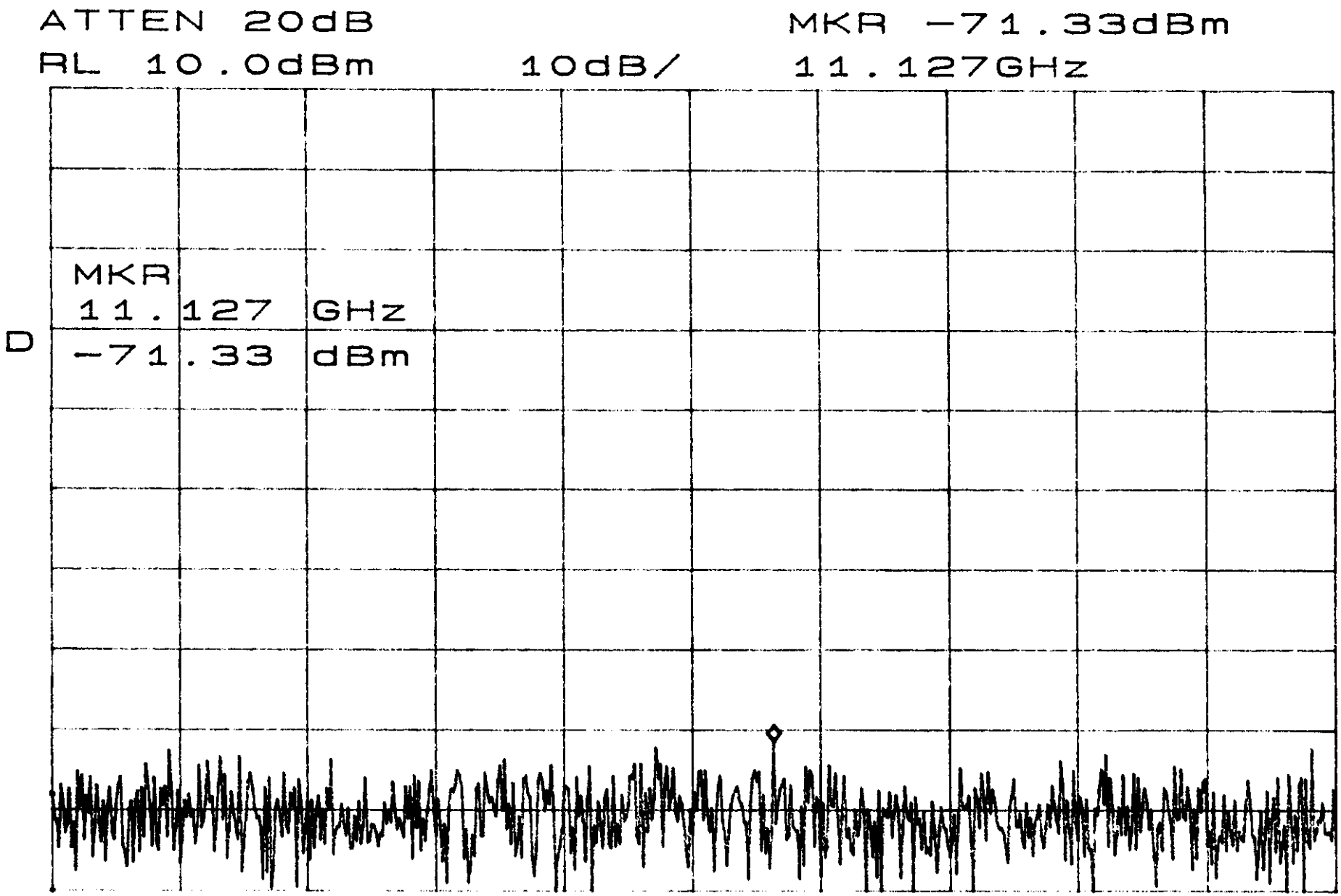
EMET 003

6-14


ATTEN 20dB
RL 10.0dBm
10dB/
MKR -69.67dBm
9.170GHz
MKR
9.170 GHz
-69.67 dBm
D
START 8.000GHz
STOP 10.000GHz
*RBW 30kHz
VBW 30kHz
SWP 5.50sec

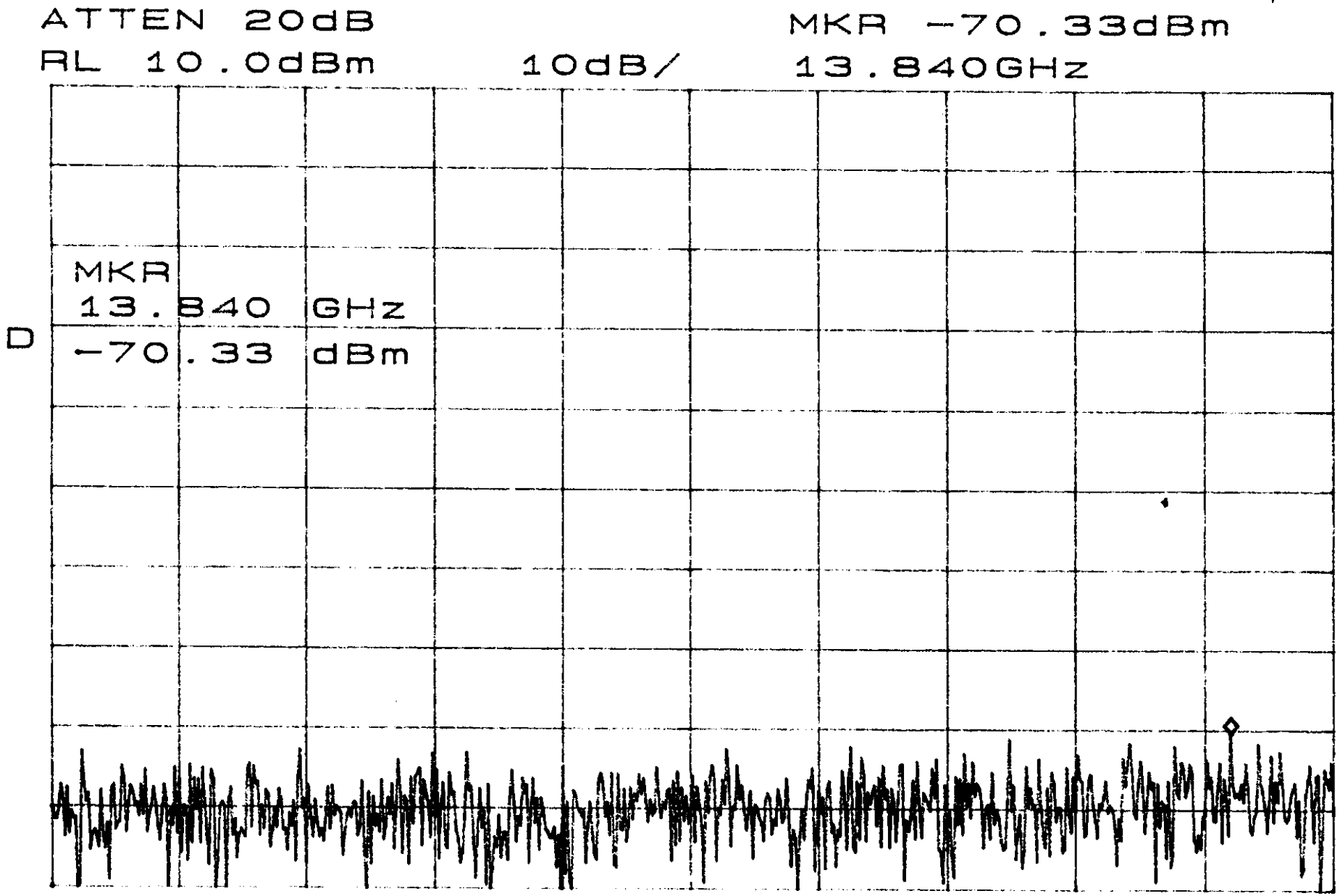
ENET 00B

7-14


ATTEN 20dB
MKR −71.33dBm
RL 10.0dBm
10dB/
11.127GHz
MKR
11.127 GHz
−71.33 dBm
D
START 10.000GHz
STOP 12.000GHz

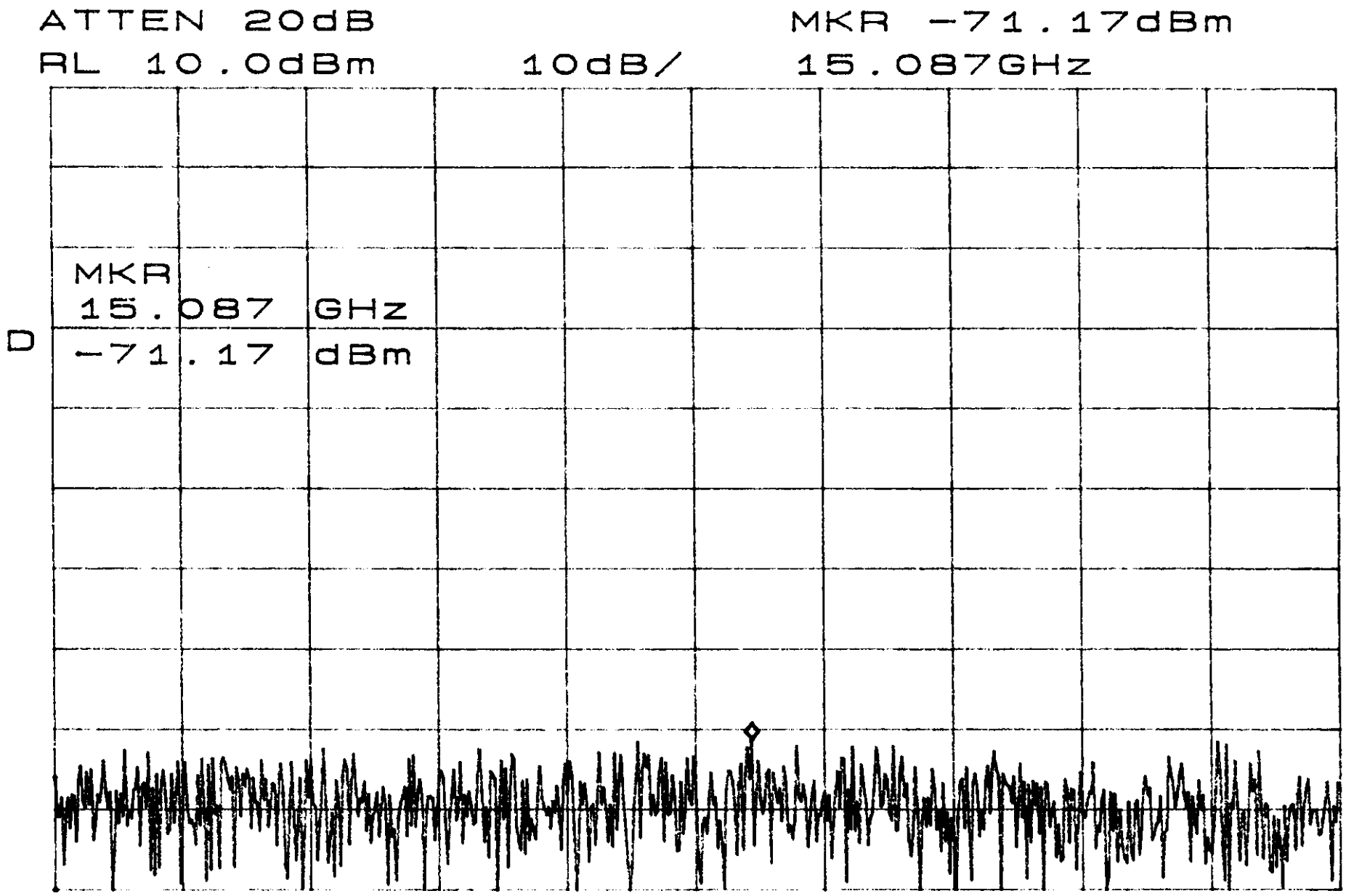
EMET 003

8-14


ATTEN 20dB
MKR -70.33dBm
RL 10.0dBm
10dB/
13.840GHz
MKR
13.840 GHz
-70.33 dBm
D
START 12.000GHz
STOP 14.000GHz
*RBW 30kHz
VBW 30kHz
SWP 5.60sec

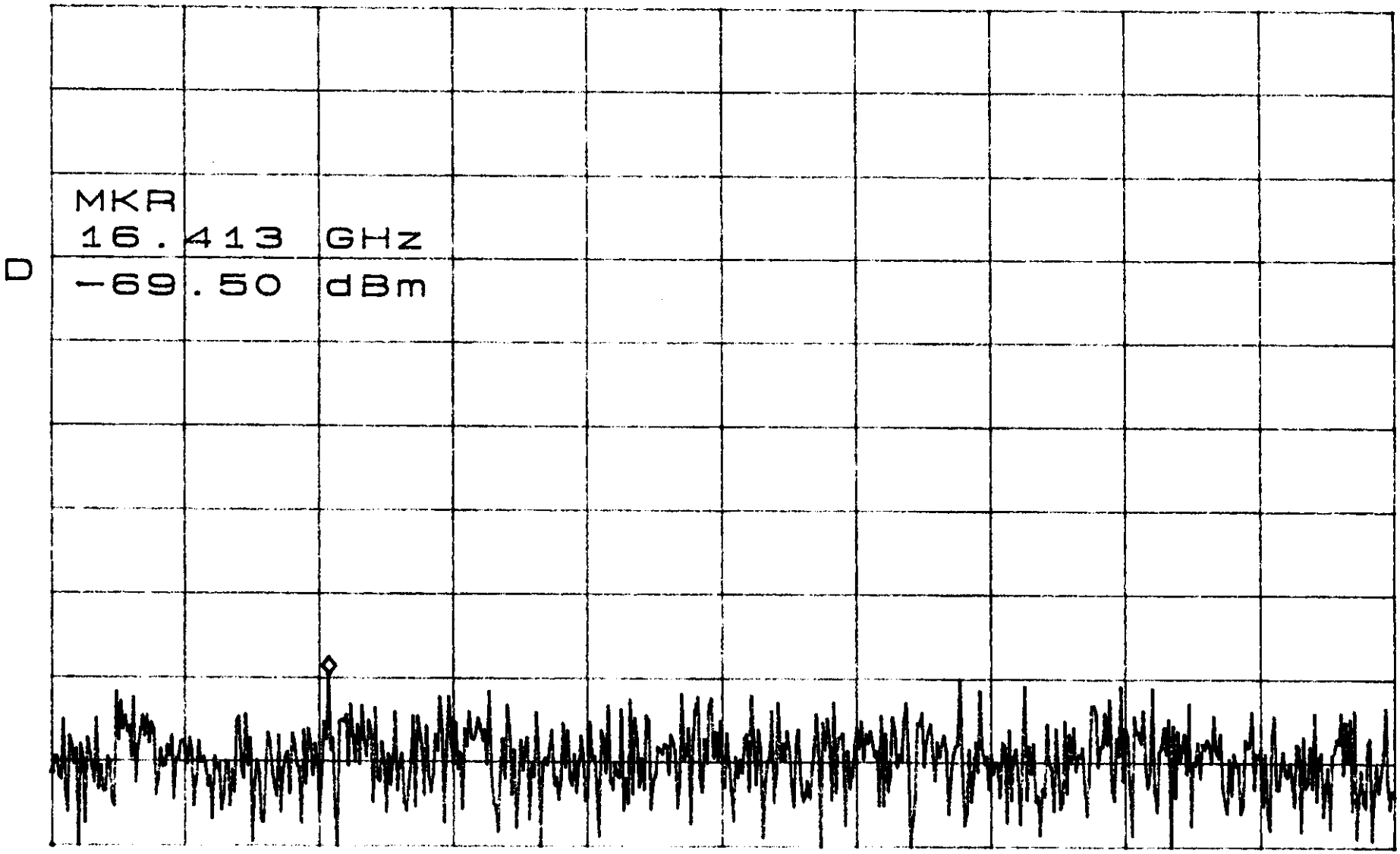
EMET 003

9.14


ATTEN 20dB
MKR -71.17dBm
RL 10.0dBm
10dB/
15.087GHz
MKR
15.087 GHz
-71.17 dBm
D
START 14.000GHz
STOP 16.000GHz
*RBW 30kHz
VBW 30kHz
SWP 5.60sec

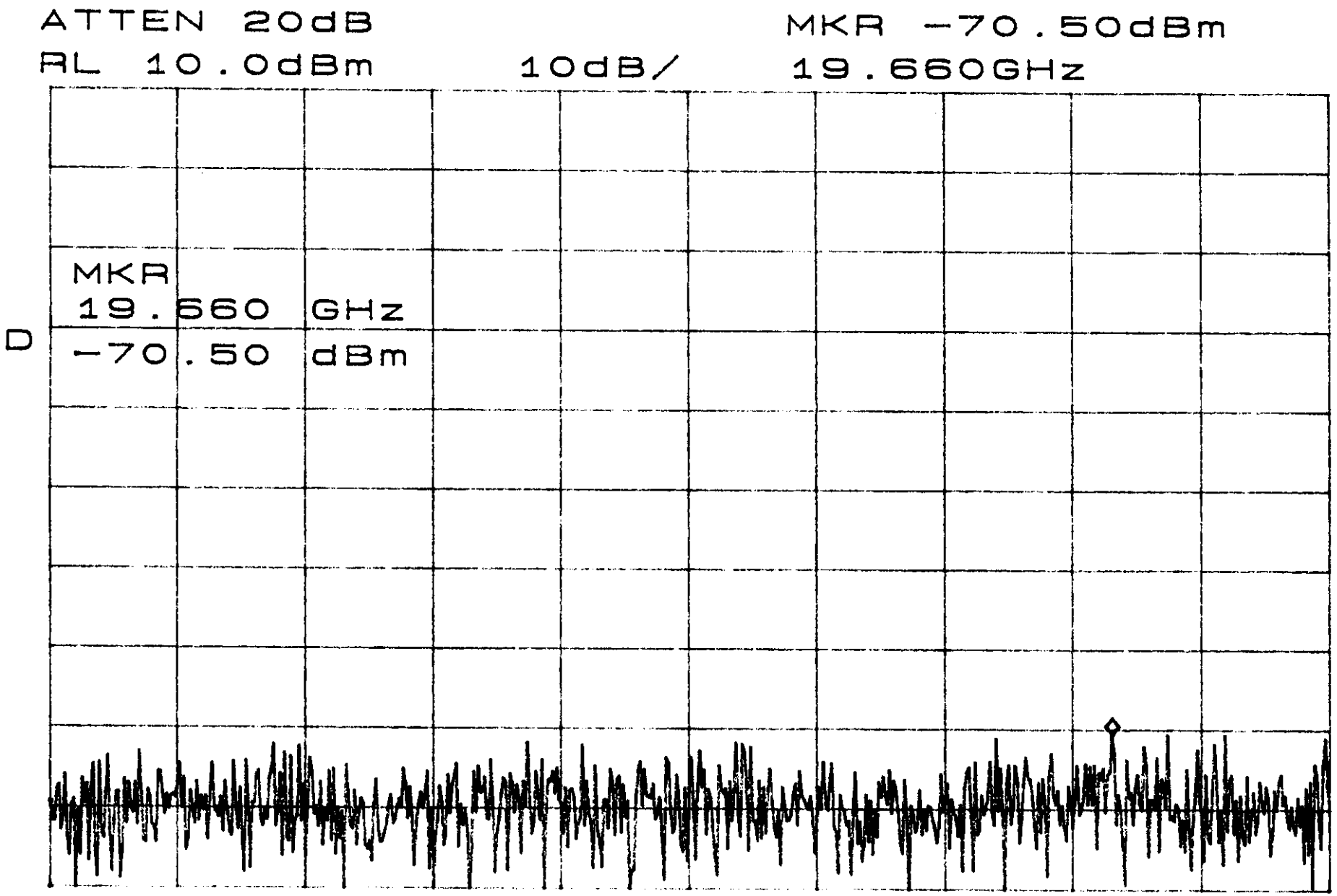
ENET 0073

10-14



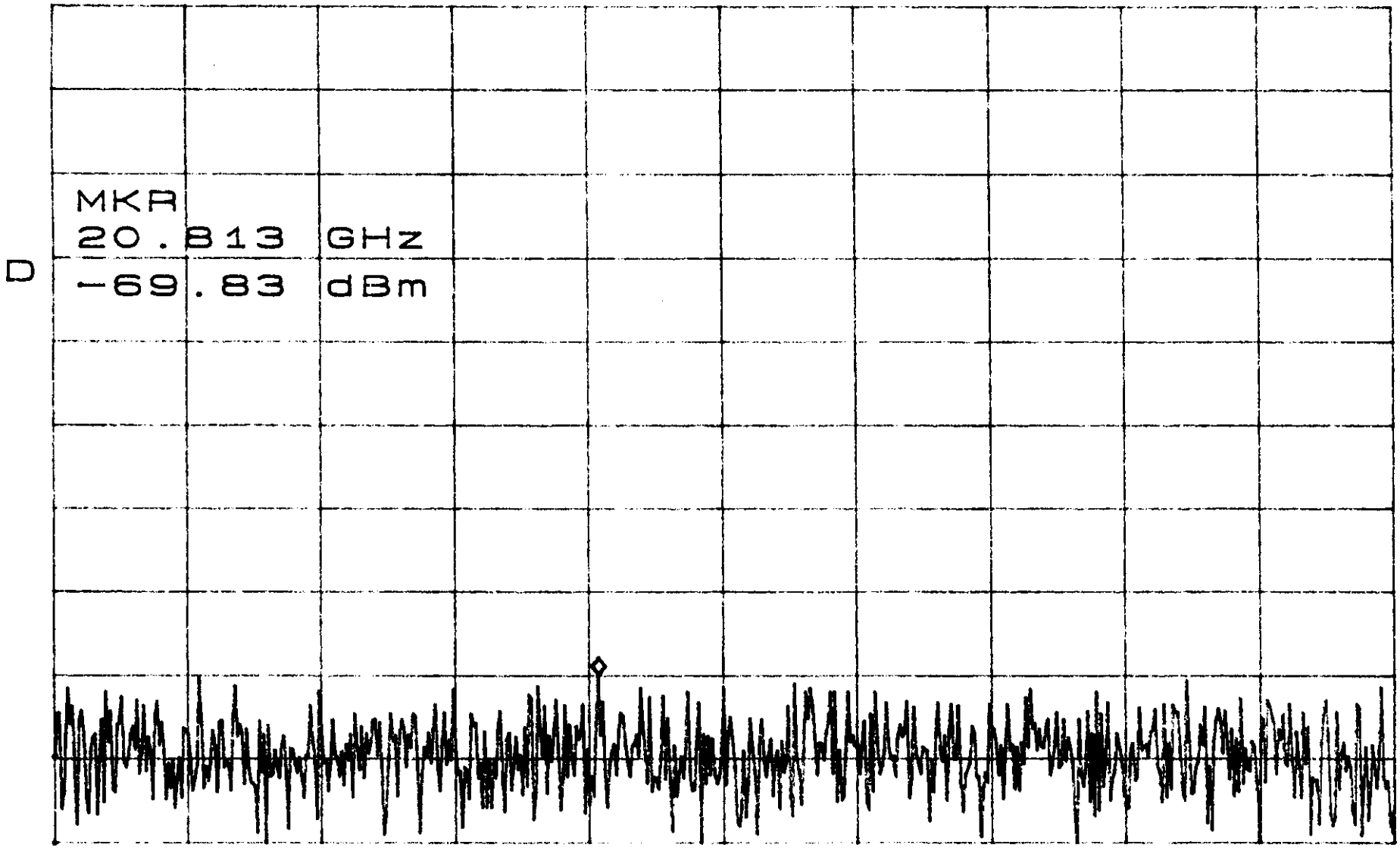
EHET COB

11.14



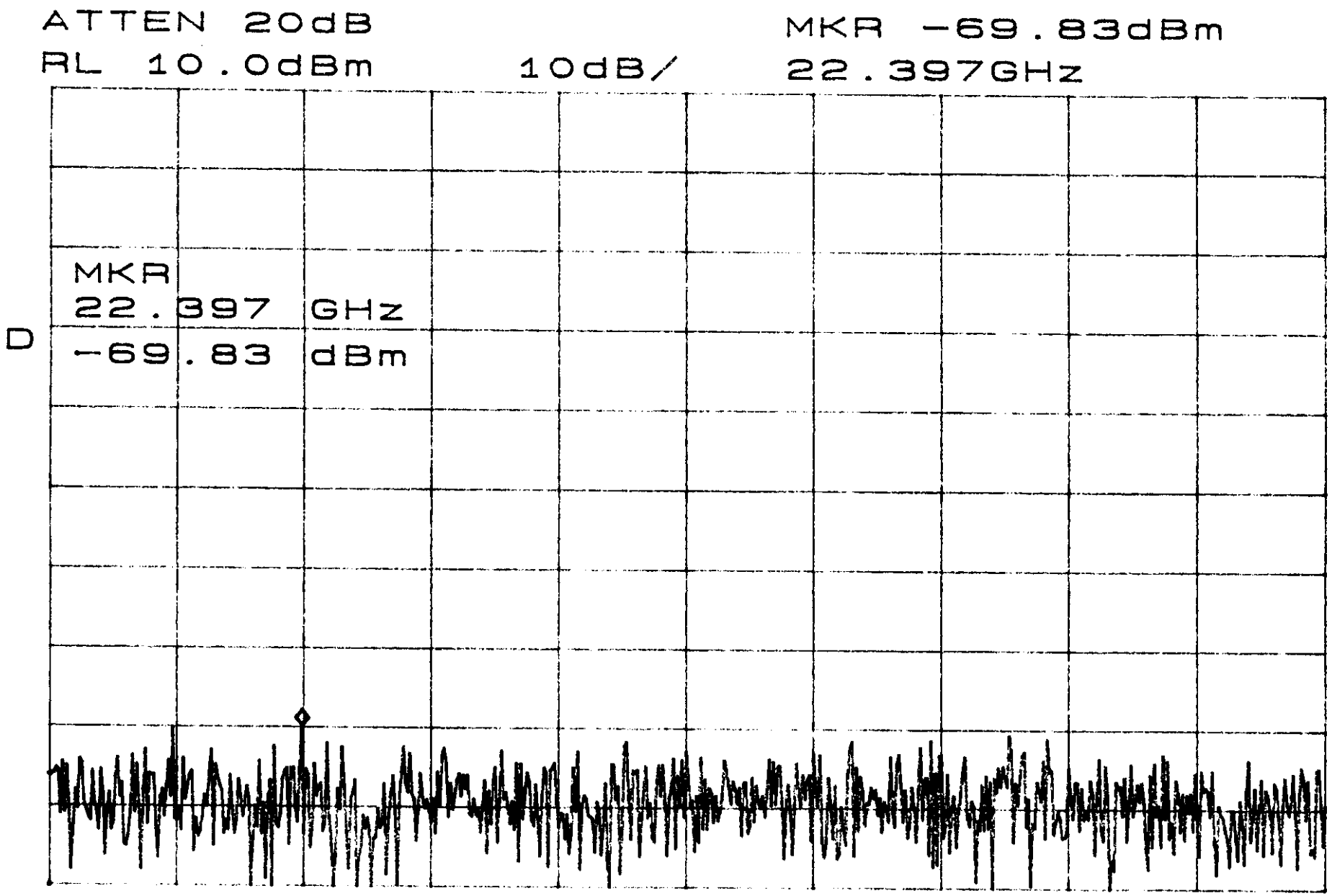
EHET 00B

12-14



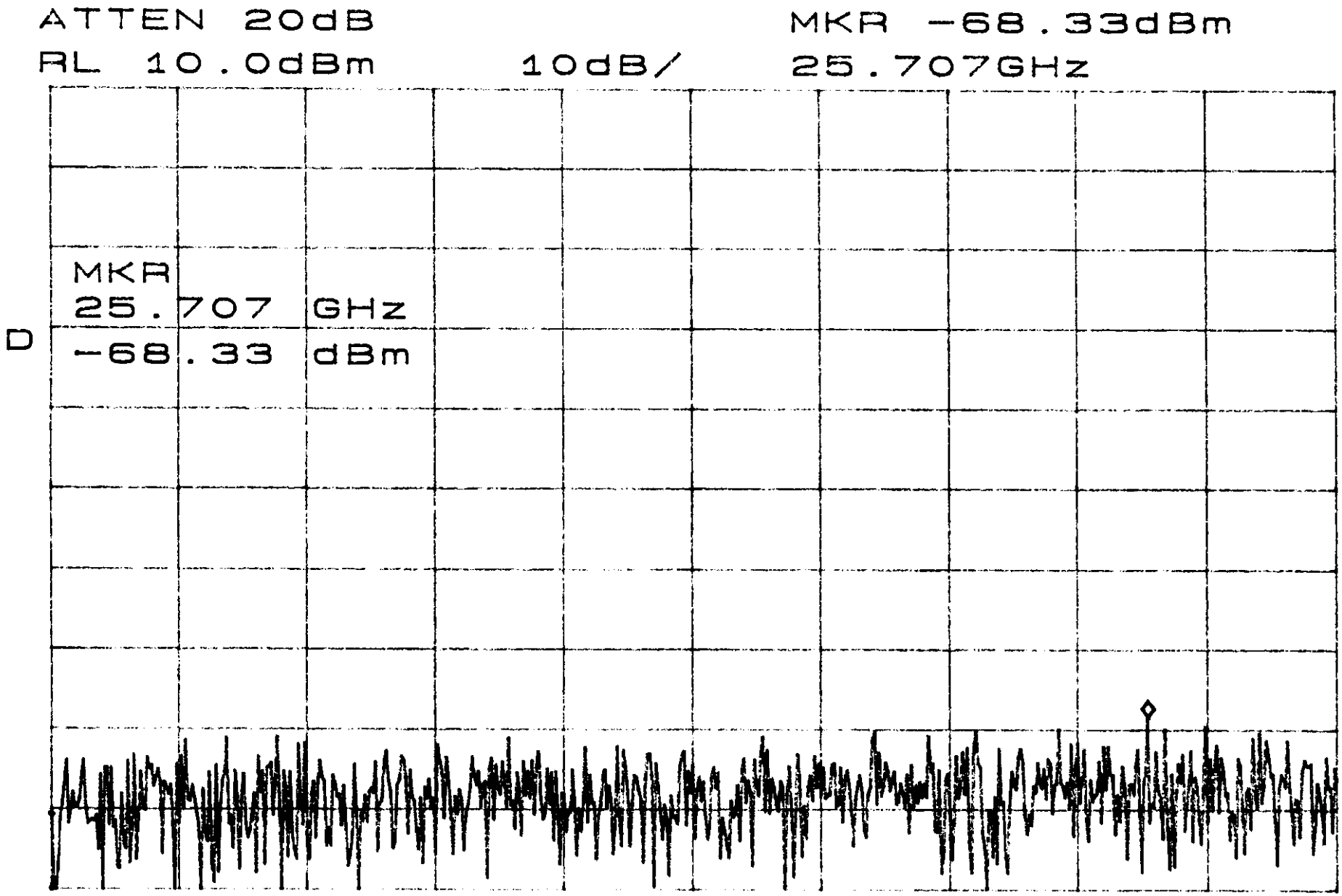
EHET 003

13-14



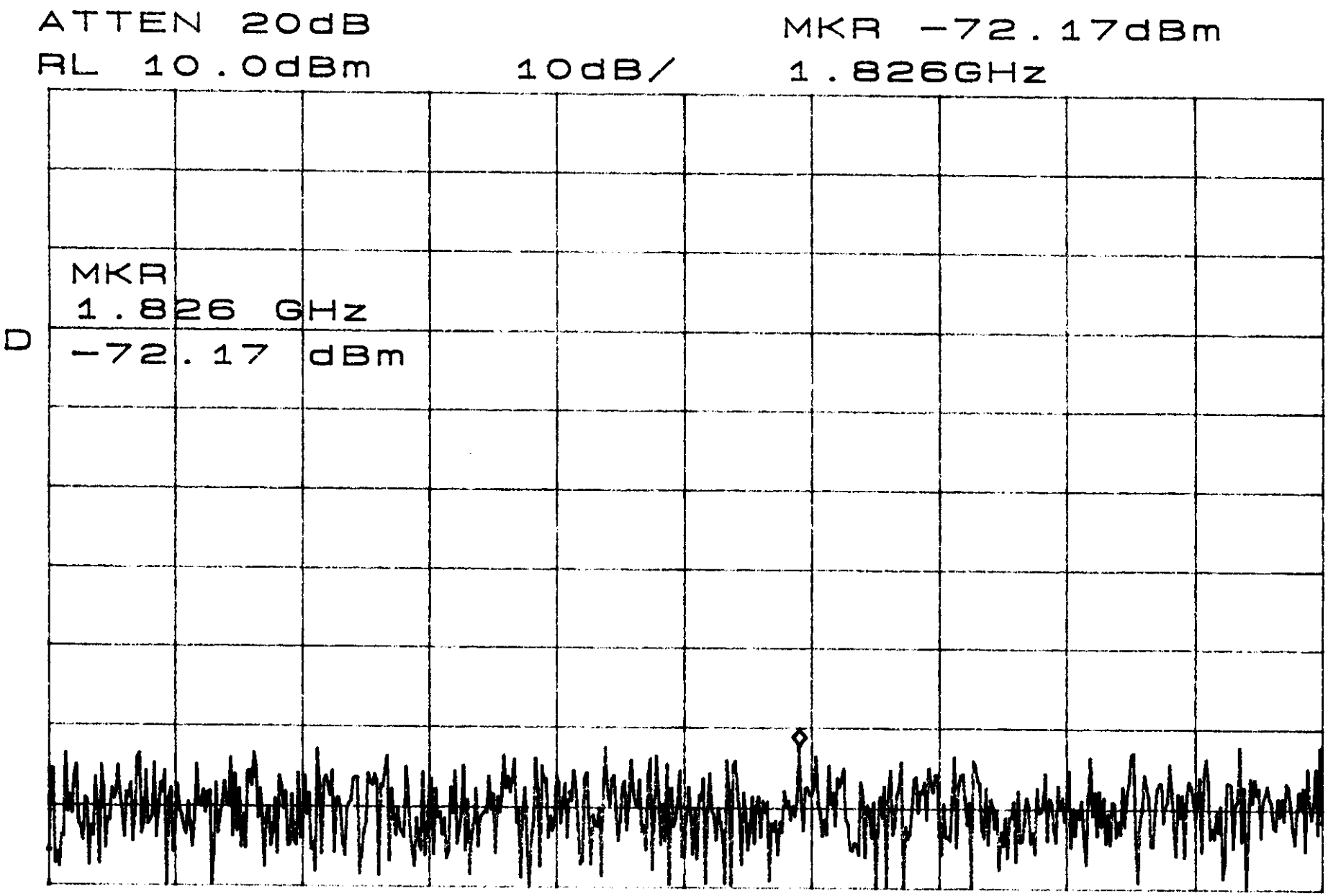
EMET 003

14-14



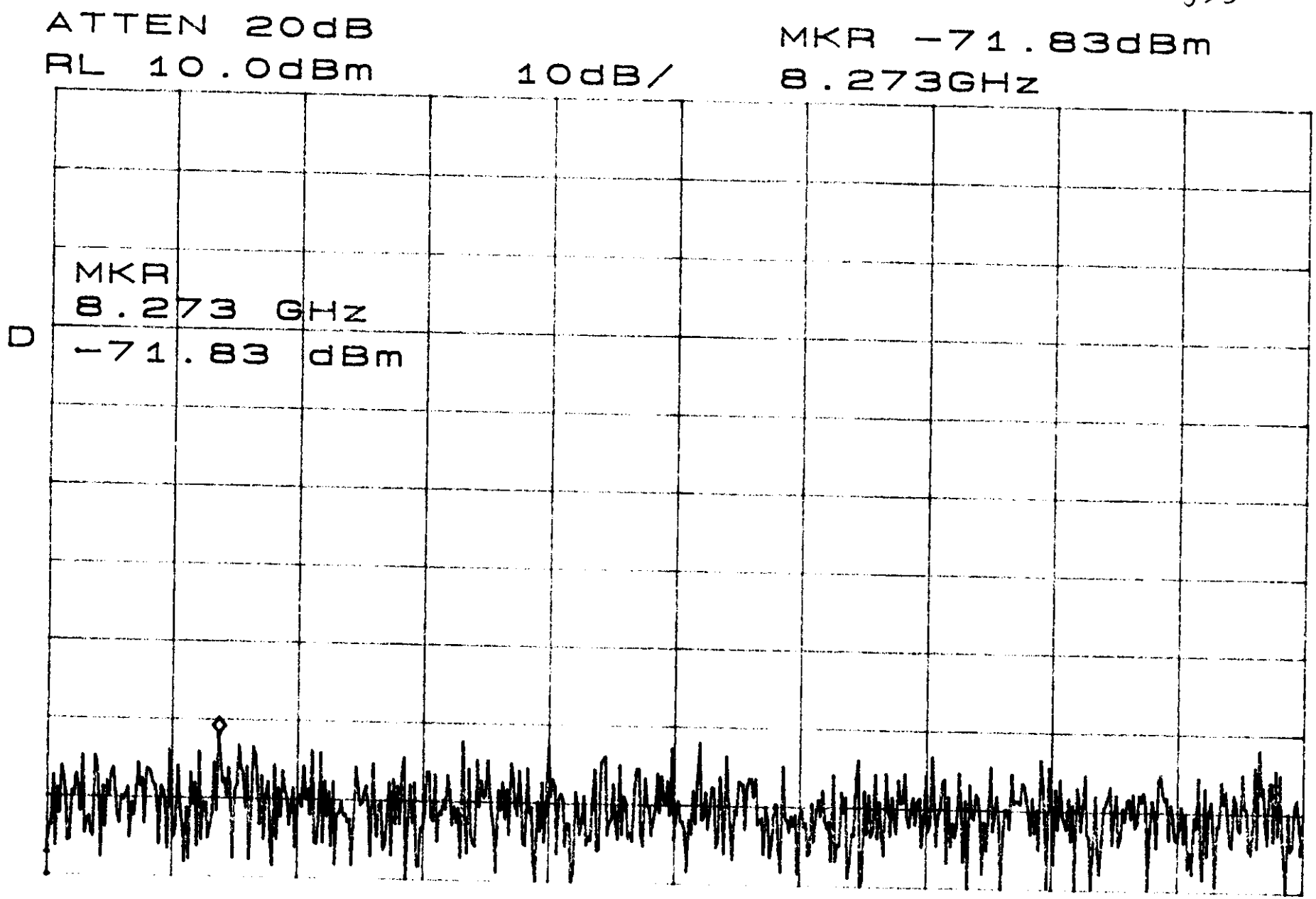
EMET 003

1-5

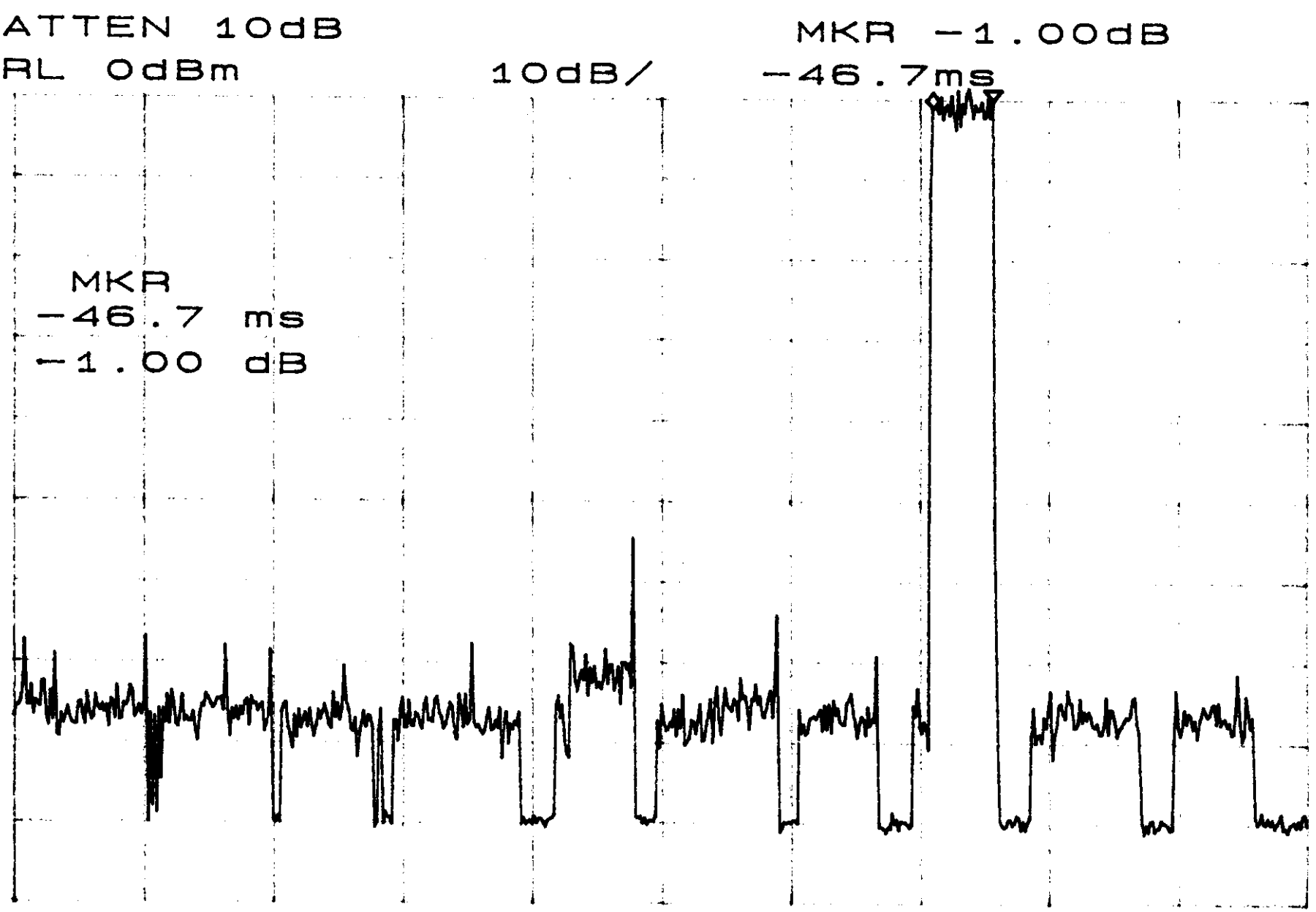

ATTEN 20dB
RL 10.0dBm
10dB/
MKR -72.17dBm
1.826GHz
MKR
1.826 GHz
-72.17 dBm
D
START 1.000GHz
STOP 2.400GHz

ENET 0013

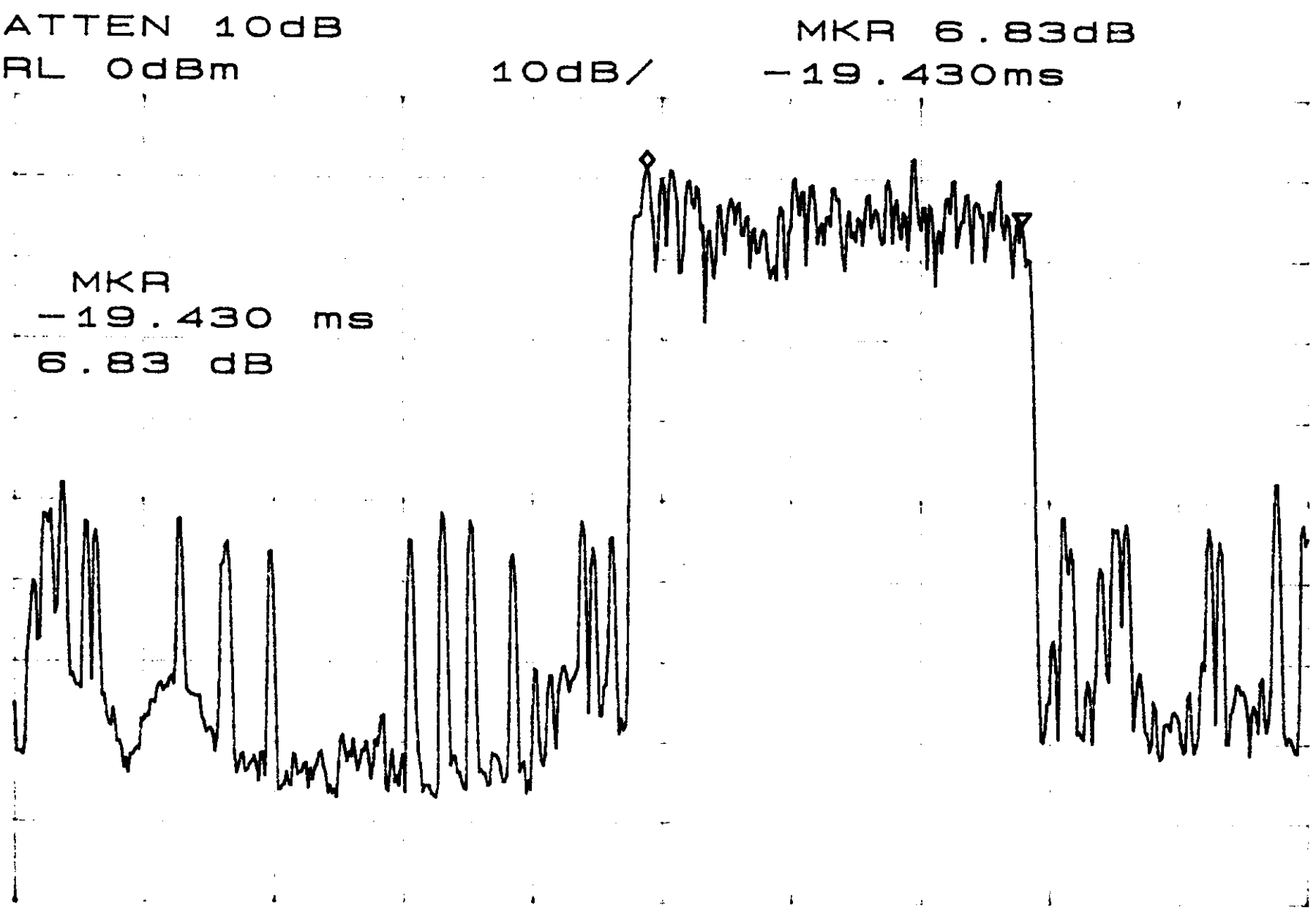
5.5


ATTEN 20dB
RL 10.0dBm
10dB/
MKR -71.83dBm
8.273GHz
MKR
8.273 GHz
-71.83 dBm
D
START 8.000GHz
STOP 10.000GHz
*RBW 30KHz
VBW 30KHz

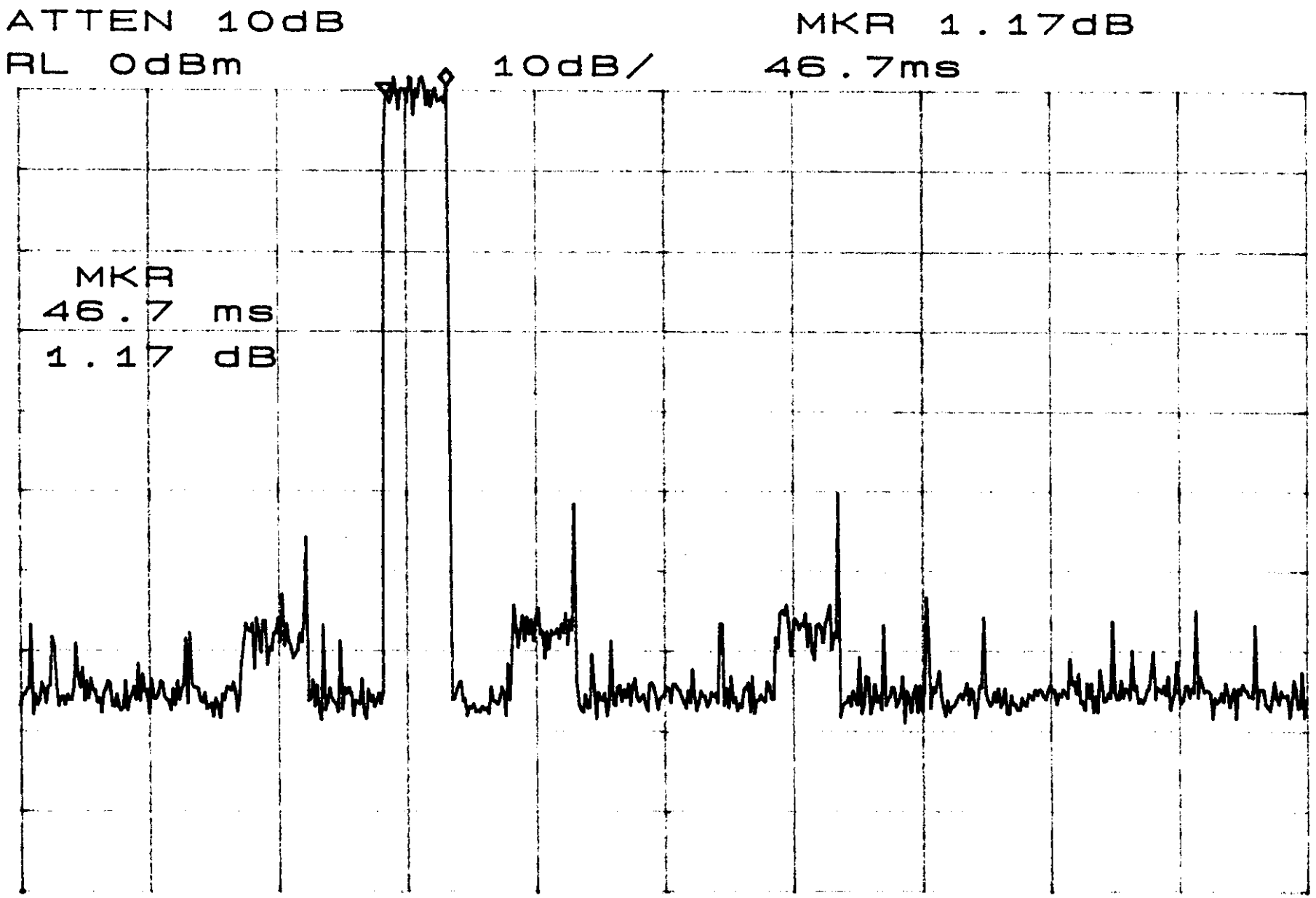
TRANSMISSION TIME
ENET → POLETOP



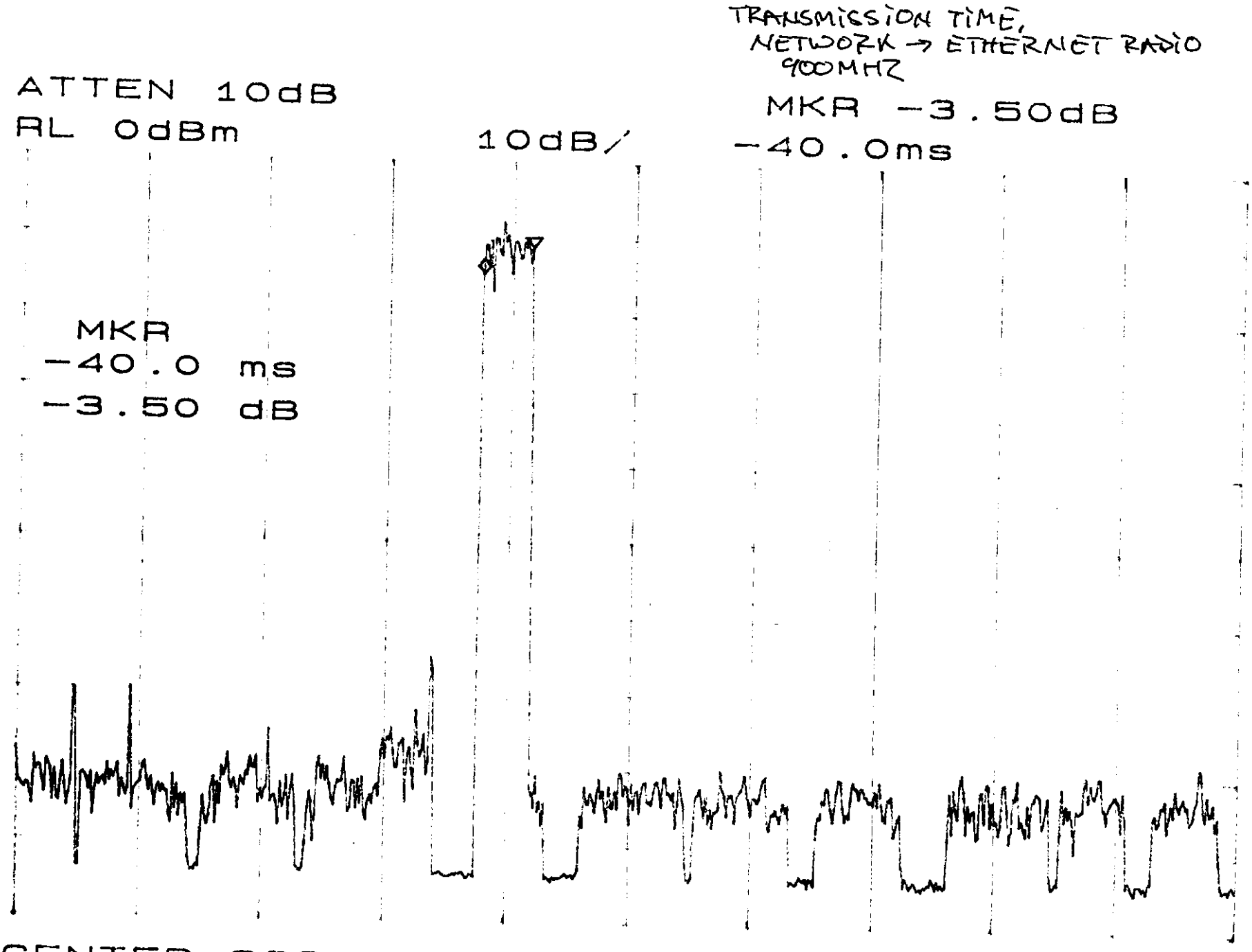
TRANSMISSION TIME
ETHERNET TO NETWORK



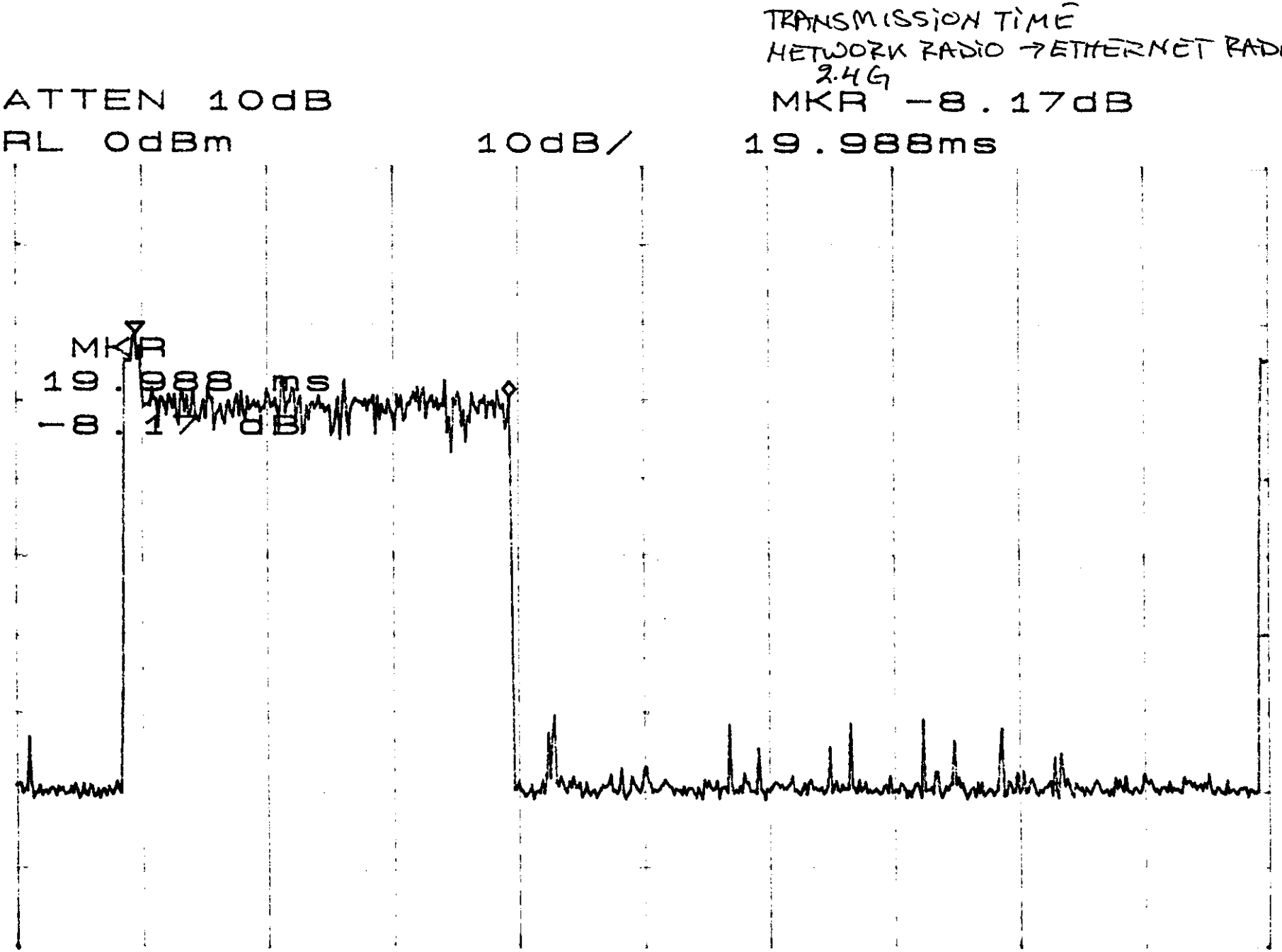
TRANSMISSION TIME
ETHERNET → MODEM



TRANSMISSION TIME,
NETWORK → ETHERNET RADIO
900MHZ



TRANSMISSION TIME
NETWORK RADIO → ETHERNET RADIO
2.4G



TRANSMISSION TIME
POLETOP TO MODEM
900 MHZ