FCC Part 15
EMI TEST REPORT

of

E.U.T. : Bluetooth headset

MODEL : WEP130DSE

FCC ID. : A3LWEP130DSE

for

APPLICANT : Samsung Electronics CO., Ltd.

ADDRESS : 9th F1, Samsung Main Bldg. 250, 2-Ka, Taepyung-Ro, Chung-Ku, Seoul, Korea 100-742

Test Performed by

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Report Number : ET92S-08-174-01

TEST REPORT CERTIFICATION

Applicant : Samsung Electronics CO., Ltd.
9th F1, Samsung Main Bldg. 250, 2-Ka, Taepyung-Ro, Chung-Ku, Seoul, Korea 100-742

Manufacturer : Samsung Electronics CO., Ltd.
9th F1, Samsung Main Bldg. 250, 2-Ka, Taepyung-Ro, Chung-Ku, Seoul, Korea 100-742

Description of EUT :

a) Type of EUT : Bluetooth headset

b) Trade Name : Samsung Bluetooth Headset

c) Model No. : WEP130DSE

d) Power Supply : 3.80VDC (Rechargeable Battery)
AC Adaptor (SAMSUNG/TAD037EBE)
Input: 100-240VAC, 50/60Hz ; Output: 5VDC, 0.7A

Regulation Applied : FCC Rules and Regulations Part 15 Subpart B & C (2003)

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

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

Issued Date : Sep. 13, 2003

Test Engineer : Andy Kuo

Approve & Authorized Signer : Win-Po Tsai

Signature
Win-Po Tsai
Manager of EMC Testing Department I
Electronics Testing Center, Taiwan

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1 GENERAL INFORMATION

1.1 Product Description

a) Type of EUT : Bluetooth headset
b) Trade Name : Samsung Bluetooth Headset
c) Model No. : WEP130DSE
d) Power Supply : 3.80VDC (Rechargeable Battery)
AC Adaptor (SAMSUNG/TAD039EBE)
Input: 100-240VAC, 50/60Hz ; Output: 5VDC, 0.7A

1.2 Characteristics of Device

The EUT is a Bluetooth headset.

1.3 Test Methodology

The Bluetooth headset designed with a transmitting method of Frequency Hopping spread spectrum, which operates at 2.4 GHz ISM band and data rate up to 11 Mbps. The rated output power is 1.83 dBm (1.524 mW).

1.4 Modifiction List of EUT

No modifications were required. (That is the EUT complied with the requirements as tested.)

1.5 Test Facility

The semi-anechoic chamber and conducted measurement facility used to collect the radiated and conducted data are located inside the Building at No.8, Lane 29, Wen-ming Road, Lo-shan Tsun, Kweishan Hsiang, Taoyuan, Taiwan, R.O.C.
This site has been accreditation as a FCC filing site.

2 PROVISIONS APPLICABLE

2.1 Definition

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

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

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

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

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

2.2 Requirement for Compliance

(1) Conducted Emission Requirement

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

Frequency MHz	Quasi Peak dBμV	Average dBμV
0.15 - 0.5	66-56*	56-46*
0.5 - 5.0	56	46
5.0 - 30.0	60	50

*Decreases with the logarithm of the frequency.

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

(2) Radiated Emission Requirement

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

Frequency MHz	Distance Meters	Radiated dBμV/m	Radiated μV/m
30 - 88	3	40.0	100
88 - 216	3	43.5	150
216 - 960	3	46.0	200
above 960	3	54.0	500

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

(3) Antenna Requirement

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

(4) 20dB Bandwidth Requirement

For frequency hopping systems, according to 15.247(a)(1), hopping channel carrier frequencies seperated by a minimum of 25kHz or the 20dB bandwidth of hopping channel, whichever is greater.

(5) Output Power Requirement

For frequency hopping systems, according to 15.247(1), operating in the 2400-2483.5MHz band employing at least 75 hopping channels. The maximum peak output power of the transmitter shall not exceed 1 Watt. If transmitting antennas of directional gain greater than 6 dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

(6) 100 kHz Bandwidth of Frequency Band Edges Requirement

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

(7) Number of Hopping Channels

According to 15.247(b)(1), for frequency hopping systems, operating in the 2400-2483.5MHz band employing at least 75 hopping channels.

(8) Channel Carrier Frequencies Seperation

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

(9) Dwell Time

According to 15.247(a)(1)(iii), frequency hopping system in the 2400-2483.5MHz band employing at least 15 non-overlapping channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 second multiplied by the number of hopping channels employed.

(10) RF Exposure Evaluation

According to 15.247(b)(5), system operating under the provisions of this section(15.247) shall operated in a manner that ensures that the public is not exposed to radio frequency levels in excess of the commission guidelines, 1.1307(b)(1)

2.3 Restricted Bands of Operation

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

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42-16.423	399.9-410	4.5-5.25
0.495 - 0.505 **	16.69475 - 16.69525	608-614	5.35-5.46
2.1735 - 2.1905	16.80425 - 16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475 - 156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2655-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	Above 38.6
13.36-13.41			

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

2.4 Labeling Requirement

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

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

2.5 User Information

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

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

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

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

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

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

-- Reorient or relocate the receiving antenna.

-- Increase the separation between the equipment and receiver.

-- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

-- Consult the dealer or an experienced radio / TV technician for help.

3. SYSTEM TEST CONFIGURATION

3.1 Justification

For the purposes of this test report ancillary equipment is defined as equipment which is used in conjunction with the EUT to provide operational and control features to the EUT. It is necessary to configure the system in a typical fashion, as a customer would normally use it. But never the less Ancillary Equipment can influence the test results..

3.2 Devices for Tested System

Device	Manufacture	Model	Cable Description
*Bluetooth headset	Samsung	WEP130DSE	----
Notebook PC	ASUS	L7300/L7200	1.8m, Unshielded Power Line (Adaptor) 2.0m, Unshielded RS-232 Cable
DC Power Supply	GW	GPC-3030D	1.8m, Unshielded Power Line

Remark “*” means equipment under test.

4 RADIATED EMISSION MEASUREMENT

4.1 Applicable Standard

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

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

4.2 Measurement Procedure

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

   Note : A band pass filter was used to avoid pre-amplifier saturated when measure TX operation mode in frequency band above 1 GHz.
5. Repeat step 4 until all frequencies need to be measured were complete.
6. Repeat step 5 with search antenna in vertical polarized orientations.
7. Check the three frequencies of highest emission with varying the datarate, placement of ANT. cables associated with EUT to obtain the worse case and record the result.

Figure 1 : Frequencies measured below 1 GHz configuration

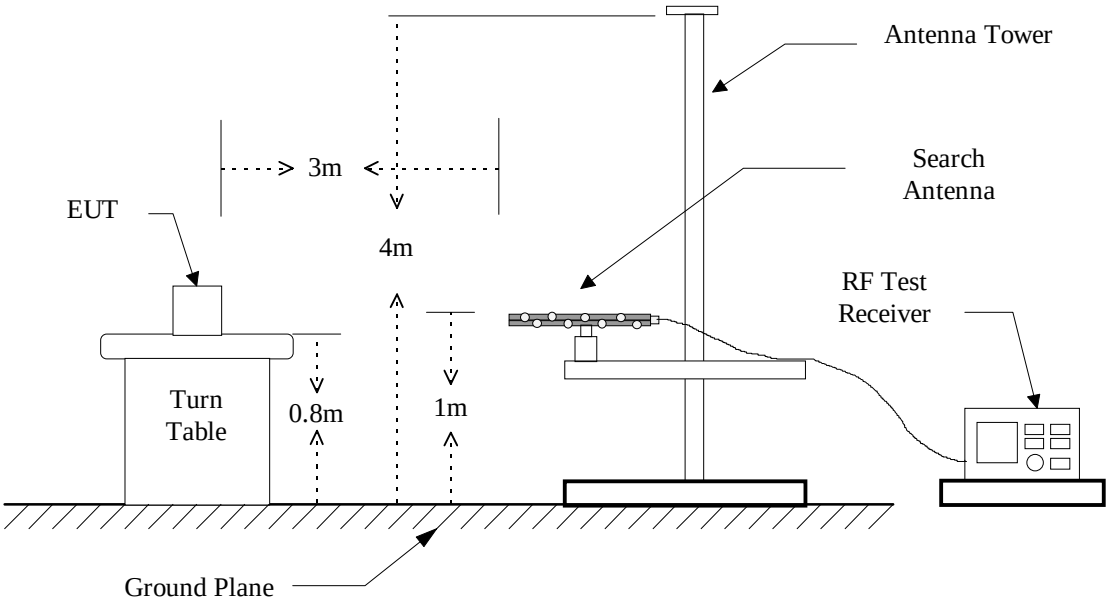
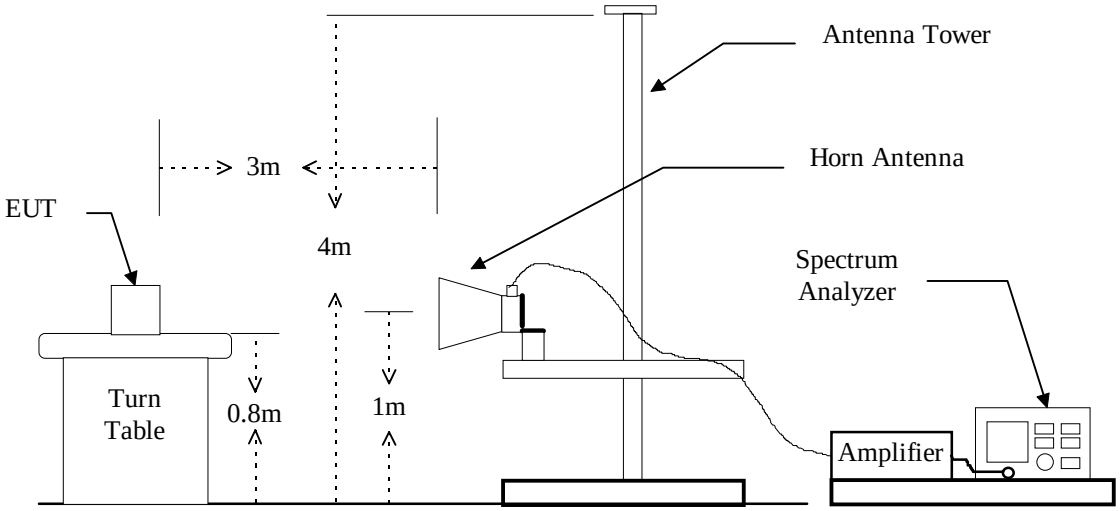


Figure 2 : Frequencies measured above 1 GHz configuration



4.3 Measuring Instrument

The following instrument are used for radiated emissions measurement :

Equipment	**Manufacturer**	**Model No.**	**Next Cal. Due**
EMI Test Receiver	Hewlett-Packard	8546A	08/27/2004
Horn Antenna	EMCO	3115	06/05/2004
LogBicone Antenna	Schwarzbeck	9160	10/28/2003
Horn Antenna	EMCO	3116	06/28/2004
Preamplifier	Hewlett-Packard	8449B	09/04/2004
Spectrum Analyzer	Hewlett-Packard	8564EC	09/10/2004

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

Frequency Band (MHz)	Instrument	Function	Resolution bandwidth	Video Bandwidth
30 to 1000	RF Test Receiver	Quasi-Peak	120 kHz	N/A
	Spectrum Analyzer	Peak	100 kHz	100 kHz
Above 1000	Spectrum Analyzer	Peak	1 MHz	1 MHz
	Spectrum Analyzer	Average	1 MHz	10 Hz

4.4 Radiated Emission Data

4.4.1 RF Portion

a) Channel 1

Operation Mode : Receiving /Transmitting

Fundamental Frequency : 2402 MHz

Test Date : Sep. 9, 2003 Temperature : 24 ℃ Humidity : 65 %

Frequency (MHz)	Reading (dBuV) H Peak	Reading (dBuV) H Ave	Reading (dBuV) V Peak	Reading (dBuV) V Ave	Factor (dB) Corr.	Result @3m (dBuV/m) Peak (H/V Max.)	Result @3m (dBuV/m) Ave (H/V Max.)	Limit @3m (dBuV/m) Peak	Limit @3m (dBuV/m) Ave.	Margin (dB)	Table Deg. (Deg.)	Ant. High (m)
4804.000	46.8	---	46.7	---	4.5	51.3	---	74.0	54.0	3.7	180	1.0
7206.000	---	---	---	---	---	---	---	74.0	54.0	---	---	---
9608.000	---	---	---	---	---	---	---	74.0	54.0	---	---	---
12010.000	---	---	---	---	---	---	---	74.0	54.0	---	---	---
14412.000	---	---	---	---	---	---	---	74.0	54.0	---	---	---
16814.000	---	---	---	---	---	---	---	74.0	54.0	---	---	---
19216.000	---	---	---	---	---	---	---	74.0	54.0	---	---	---
21618.000	---	---	---	---	---	---	---	74.0	54.0	---	---	---
24020.000	---	---	---	---	---	---	---	74.0	54.0	---	---	---

Note :

1. Item of margin shown in above table refer to average limit.
2. Remark “---” means that the emissions level is too low to be measured.
3. Item “Margin” referred to Average limit while there is only peak result.
4. The radiation emissions have been measured to beyond the tenth harmonic of the fundamenta frequency and show the significant frequencies, other means the value is too low to be detected.

b) Channel 40

Operation Mode : Receiving / Transmitting

Fundamental Frequency : 2441 MHz

Test Date : Sep. 9, 2003 Temperature : 24 ℃ Humidity : 65 %

Frequency (MHz)	Reading (dBuV) H Peak	Reading (dBuV) H Ave	Reading (dBuV) V Peak	Reading (dBuV) V Ave	Factor (dB) Corr.	Result @3m (dBuV/m) Peak (H/V Max.)	Result @3m (dBuV/m) Ave (H/V Max.)	Limit @3m (dBuV/m) Peak	Limit @3m (dBuV/m) Ave.	Margin (dB)	Table Deg. (Deg.)	Ant. High (m)
4882.000	48.0	---	47.0	---	4.5	52.5	---	74.0	54.0	1.5	180	1.0
7323.000	---	---	---	---	---	---	---	74.0	54.0	---	---	---
9764.000	---	---	---	---	---	---	---	74.0	54.0	---	---	---
12205.000	---	---	---	---	---	---	---	74.0	54.0	---	---	---
14646.000	---	---	---	---	---	---	---	74.0	54.0	---	---	---
17087.000	---	---	---	---	---	---	---	74.0	54.0	---	---	---
19528.000	---	---	---	---	---	---	---	74.0	54.0	---	---	---
21969.000	---	---	---	---	---	---	---	74.0	54.0	---	---	---
24410.000	---	---	---	---	---	---	---	74.0	54.0	---	---	---

Note :

1. Item of margin shown in above table refer to average limit.
2. Remark “---” means that the emissions level is too low to be measured.
3. Item “Margin” referred to Average limit while there is only peak result.
4. The radiation emissions have been measured to beyond the tenth harmonic of the fundamenta frequency and show the significant frequencies, other means the value is too low to be detected.

c) Channel 79

Operation Mode : Receiving / Transmitting

Fundamental Frequency : 2480 MHz

Test Date : Sep. 9, 2003 Temperature : 24 ℃ Humidity : 65 %

Frequency (MHz)	Reading (dBuV) H Peak	Reading (dBuV) H Ave	Reading (dBuV) V Peak	Reading (dBuV) V Ave	Factor (dB) Corr.	Result @3m (dBuV/m) Peak (H/V Max.)	Result @3m (dBuV/m) Ave (H/V Max.)	Limit @3m (dBuV/m) Peak	Limit @3m (dBuV/m) Ave.	Margin (dB)	Table Deg. (Deg.)	Ant. High (m)
4960.000	48.3	---	46.5	---	4.5	52.8	---	74.0	54.0	1.2	180	1.0
7440.000	---	---	---	---	---	---	---	74.0	54.0	---	---	---
9920.000	---	---	---	---	---	---	---	74.0	54.0	---	---	---
12400.000	---	---	---	---	---	---	---	74.0	54.0	---	---	---
14880.000	---	---	---	---	---	---	---	74.0	54.0	---	---	---
17360.000	---	---	---	---	---	---	---	74.0	54.0	---	---	---
19840.000	---	---	---	---	---	---	---	74.0	54.0	---	---	---
22320.000	---	---	---	---	---	---	---	74.0	54.0	---	---	---
24800.000	---	---	---	---	---	---	---	74.0	54.0	---	---	---

Note :

1. Item of margin shown in above table refer to average limit.
2. Remark “---” means that the emissions level is too low to be measured.
3. Item “Margin” referred to Average limit while there is only peak result.
4. The radiation emissions have been measured to beyond the tenth harmonic of the fundamenta frequency and show the significant frequencies, other means the value is too low to be detected.

4.4.2 Other Emission

a) Operation Mode: Receiving / Transmitting Mode

Test Date : Sep. 9, 2003 Temperature : 24 ℃ Humidity : 65 %

Frequency (MHz)	Ant-Pol H/V	Meter Reading (dBuV)	Corrected Factor (dB)	Result @3m (dBuV/m)	Limit @3m (dBuV/m)	Margin (dB)	Table Degree (Deg.)	Ant. High (m)
87.230	V	22.5	10.1	32.6	40.0	-7.4	185	1.0
286.080	V	16.3	16.5	32.8	46.0	-13.2	144	1.0
339.430	H	16.8	17.5	34.3	46.0	-11.7	186	1.0
436.430	V	15.7	20.6	36.3	46.0	-9.7	86	1.0
504.330	H	13.1	22.3	35.4	46.0	-10.6	170	1.0
706.090	V	12.9	26.6	39.5	46.0	-6.5	180	1.0
706.090	H	11.8	26.6	38.4	46.0	-7.6	180	1.0

Note :
1. Item of margin shown in above table refer to average limit.
2. Remark “---” means that the emissions level is too low to be measured.
3. Item “Margin” referred to Q.P. limit while there is only peak result.

b) Operation Mode: Charge Mode

Test Date : Sep. 9, 2003 Temperature : 24 ℃ Humidity : 65 %

Frequency (MHz)	Ant-Pol H/V	Meter Reading (dBuV)	Corrected Factor (dB)	Result @3m (dBuV/m)	Limit @3m (dBuV/m)	Margin (dB)	Table Degree (Deg.)	Ant. High (m)
No Emissions found.								

Note :

1. Item of margin shown in above table refer to average limit.
2. Remark "---" means that the emissions level is too low to be measured.
3. Item "Margin" referred to Q.P. limit while there is only peak result.

4.5 Field Strength Calculation

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

Result = Reading + Corrected Factor

where

Corrected Factor = Antenna Factor + Cable Loss + High Pass Filter Loss - Amplifier Gain

4.6 Photos of Radiation Measuring Setup

5 CONDUCTED EMISSION MEASUREMENT

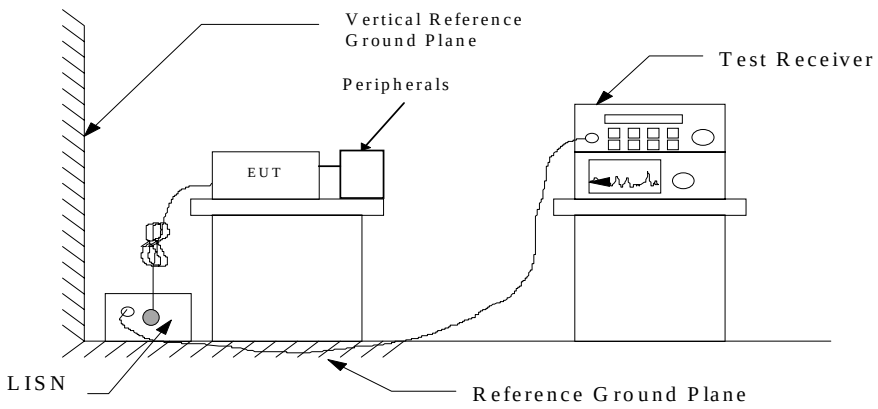
5.1 Applicable Standard

For unintentional digital devices, Line Conducted Emission Limits are in accordance to § 15.107(a) . And according to § 15.107(e), an alternative to the conducted limits is CISPR 22.

5.2 Measurement Procedure

1. Setup the configuration per figure 3.
2. A preliminary scan with a spectrum monitor is performed to identify the frequency of emission that has the highest amplitude relative to the limit by operating the EUT in selected modes of operation, typical cable positions, and with a typical system configuration.
3. Record the 4 to 8 highest emissions relative to the limit.
4. Measure each frequency obtained from step 3 by a test receiver set on quasi peak detector function, and then record the accuracy frequency and emission level. If all emissions measured in the specified band are attenuated more than 20 dB from the limit, this step would be ignored, and the peak detector function would be used.
5. Confirm the highest emissions with variation of the EUT cable configuration and record the final data.
6. Repeat all above procedures on measuring each operation mode of EUT.

Figure 3 : Conducted emissions measurement configuration



5.3 Conducted Emission Data

Temperature : 28 ℃
Humidity : 70 %
Test Date : Sep. 10, 2003
Operation Mode : Charge Mode

Freq. (MHz)	**Meter Reading** (dBuV)				**Factor** (dB)	**Result** (dBuV)				**Limit** (dBuV)		**Margins** (dB)
	Q.P Value		AVG. Value			Q.P Value		AVG. Value		Q.P Value	AVG. Value	Q.P. or AVG.
	L1	L2	L1	L2		L1	L2	L1	L2			
0.430	39.7	***	----	----	0.1	39.8	***	----	----	57.3	47.3	-17.5
0.576	40.9	38.8	----	----	0.1	41.0	38.9	----	----	56.0	46.0	-15.0
0.599	46.7	***	34.4	----	0.1	46.8	***	34.5	----	56.0	46.0	-9.2
0.607	47.2	46.7	36.2	32.8	0.1	47.3	46.8	36.3	32.9	56.0	46.0	-8.7
0.619	***	45.1	----	30.3	0.1	***	45.2	----	30.4	56.0	46.0	-10.8
1.824	36.8	37.1	----	----	0.2	37.0	37.3	----	----	56.0	46.0	-18.7

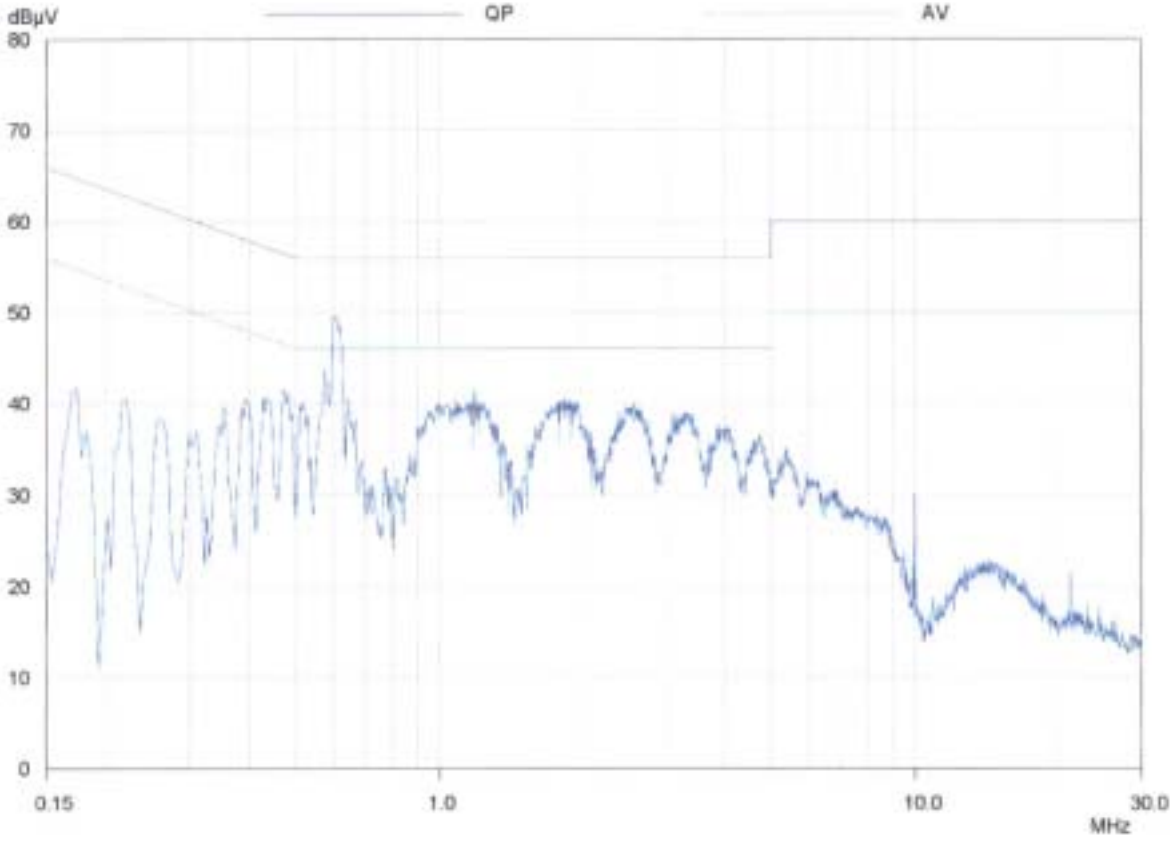
Note:

1. The full frequency range scanning test data is shown in next two pages.
2. “***” means the value was too low to be measured.
3. If the data table appeared symbol of "----" means the Q.P. value is under the limit for AVG. so, the AVG. value doesn't need to be measured.
4. The estimated measurement uncertainty of the result measurement is ± 3dB.

Conduction Emission Test
Peak Value

EUT:	BLUETOOTH HANDSET
Manuf:	
Op Cond:	CHARGING MODE
Operator:	An.
Test Spec:	FCC PART 15
Comment:	L1

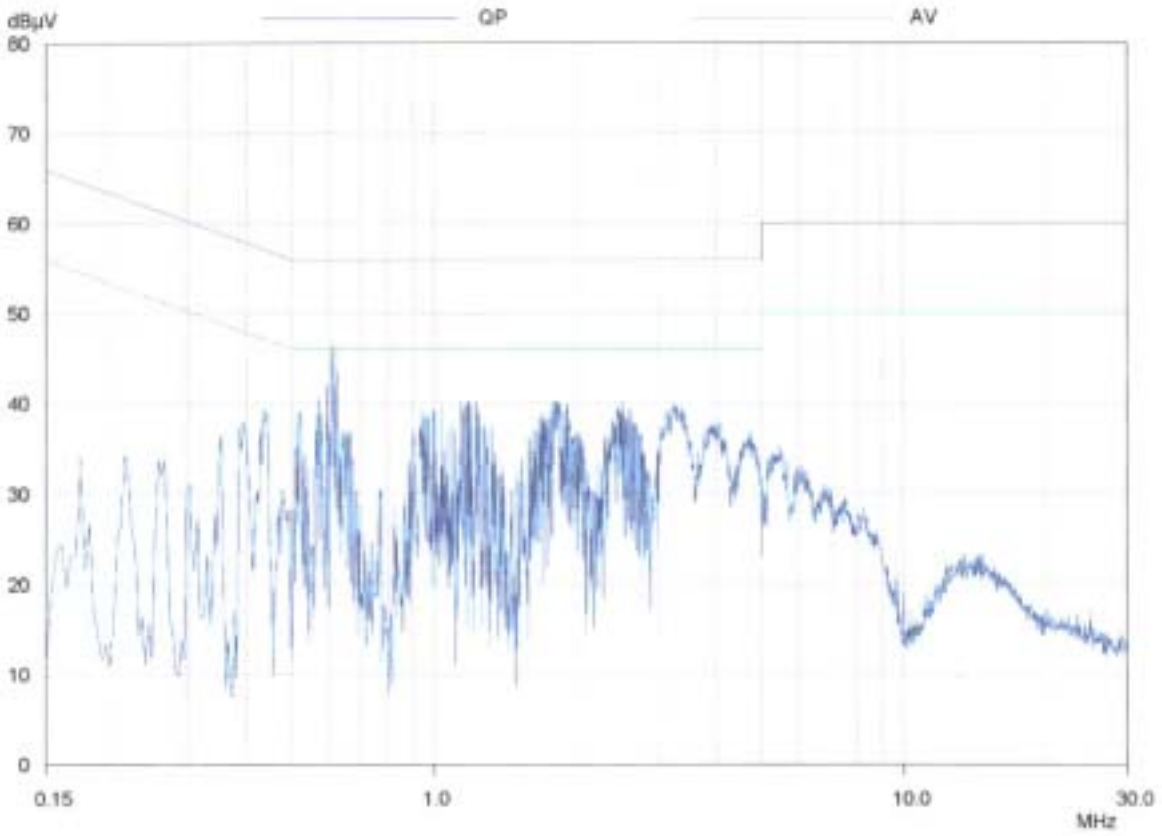
Final Measurement:	Detector:	X AV
	Meas Time:	1sec
	Peaks:	8
	Acc Margin:	30 dB



Conduction Emission Test
Peak Value

EUT:	BLUETOOTH HANDSET
Manuf:	
Op Cond:	CHARGING MODE
Operator:	An
Test Spec:	FCC PART 15
Comment:	L2

Final Measurement:	Detector:	X AV
	Meas Time:	1sec
	Peaks:	8
	Acc Margin:	30 dB



5.4 Result Data Calculation

The result data is calculated by adding the LISN Factor to the measured reading. The basic equation with a sample calculation is as follows:

RESULT = READING + LISN FACTOR

Assume a receiver reading of 22.5 dB μ V is obtained, and LISN Factor is 0.1 dB, then the total of field strength is 22.6 dB μ V.

RESULT = 22.5 + 0.1 = 22.6 dB μ V
Level in μ V = Common Antilogarithm[(22.6 dB μ V)/20]
= 13.48 μ V

5.5 Conducted Measurement Equipment

The following test equipment are used during the conducted test .

Equipment	Manufacturer	Model No.	Serial No.	Calibrated until
EMI Test Receiver	R&S	ESCS30	13054409-001	Sep. 23, 2003
LISN	EMCO	3825	13057704-001	Nov. 02, 2003

Note: The standards used to perform this calibration are traceable to NML/ROC and NIST/USA.

5.6 Photos of Conduction Measuring Setup

6 ANTENNA REQUIREMENT

6.1 Standard Applicable

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

6.2 Antenna Construction and Directional Gain

Highly efficient special antennas fix on the PCB. The directional gain of antenna used for transmitting is typical 1.5dBi.

7 20dB EMISSION BANDWIDTH MEASUREMENT

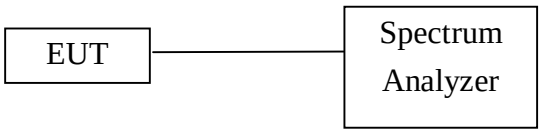
7.1 Standard Applicable

According to 15.247(a)(1), for frequency hopping systems, hopping channel carrier frequencies seperated by a minimum of 25kHz or the 20dB bandwidth of hopping channel, whichever is greater.

7.2 Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT as shown in figure 4. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
3. Measure the frequency difference of two frequencies that were attenuated 20 dB from the reference level. Record the frequency difference as the emission bandwidth.
4. Repeat above procedures until all frequencies measured were complete.

Figure 4: Emission bandwidth measurement configuration.



7.3 Measurement Equipment

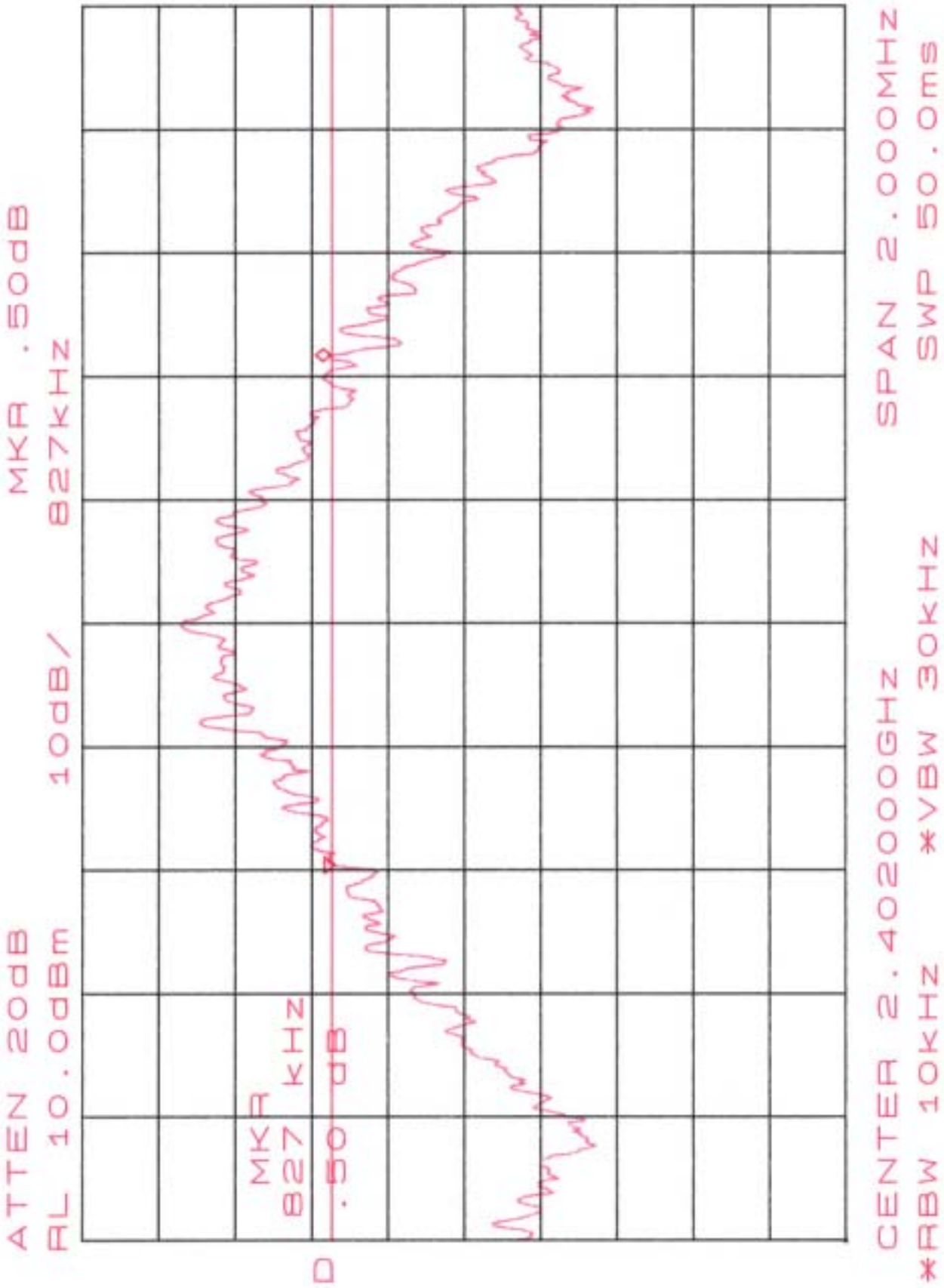
Equipment	Manufacturer	Model No.	Next Cal. Due
Plotter	Hewlett-Packard	7550A	N/A
Spectrum Analyzer	Hewlett-Packard	8564EC	09/10/2004

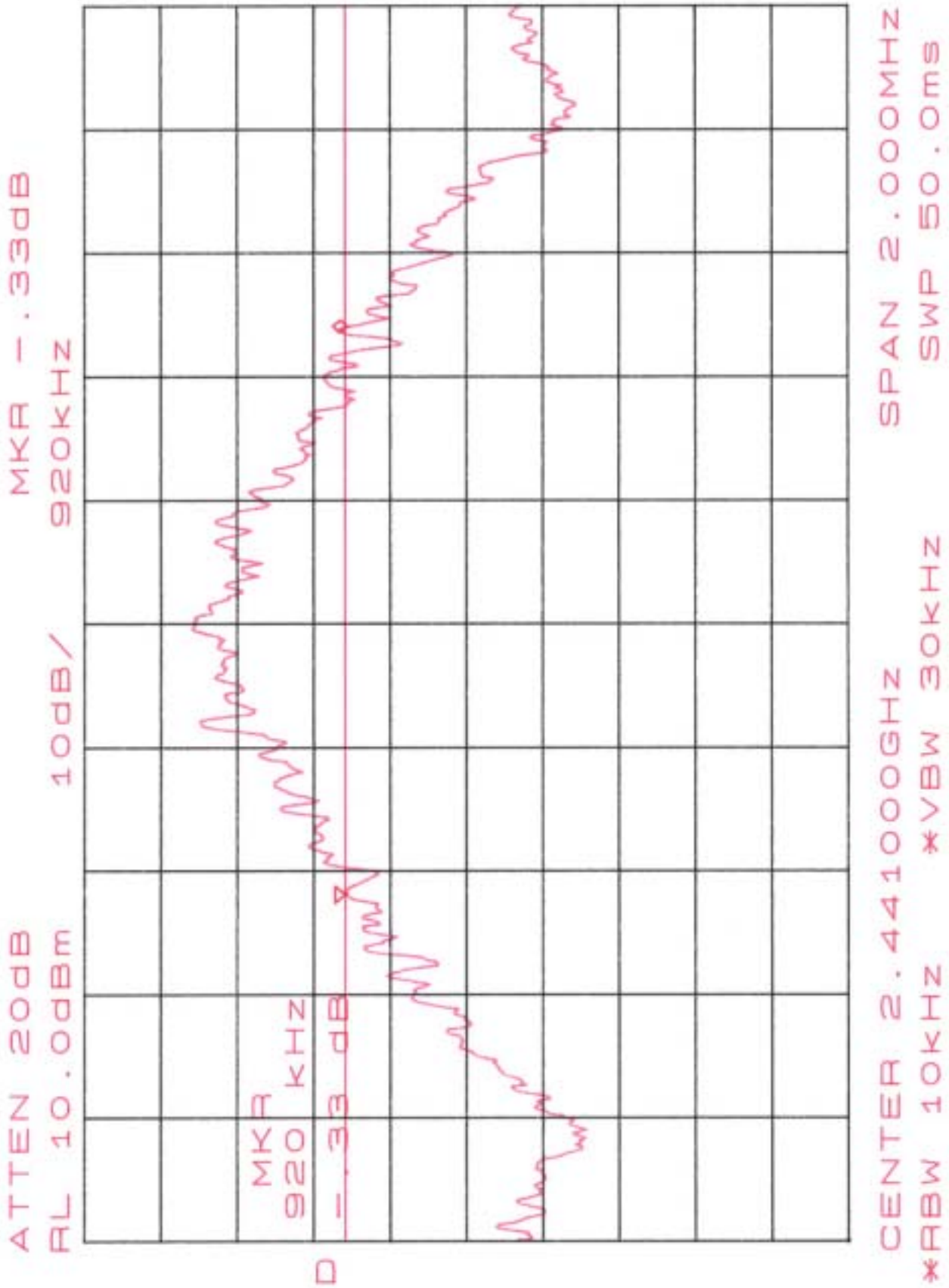
7.4 Measurement Data

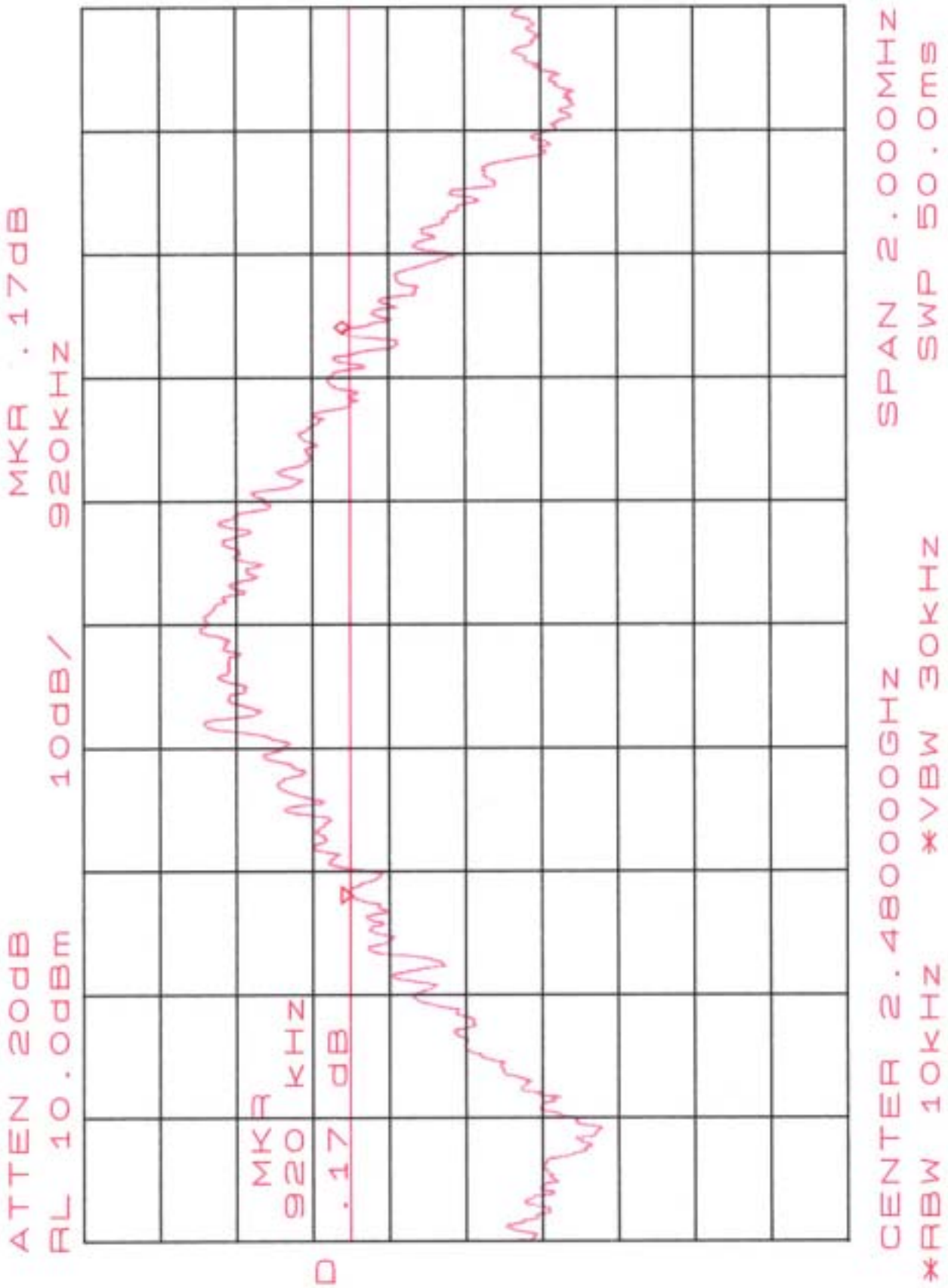
Test Date : Sep. 8, 2003 Temperature : 25 ℃ Humidity: 70%

a) Channel 01 : 20 dB Emission Bandwidth is 827 KHz
b) Channel 40 : 20 dB Emission Bandwidth is 920 KHz
c) Channel 79 : 20 dB Emission Bandwidth is 920 KHz

Note: Please see Appendix 1 for ploted datas


ATTEN 20dB
RL 10.0dBm
10dB/
MKR .50dB
827kHz
MKR
827 kHz
.50 dB
CENTER 2.40200GHz
*RBW 10kHz
*VBW 30kHz
SPAN 2.000MHz
SWP 50.0ms


ATTEN 20dB
RL 10.0dBm
10dB/
MKR -.33dB
920kHz
MKR
920
kHz
-.33 dB
D
CENTER 2.441000GHz
*RBW 10kHz
*VBW 30kHz
SPAN 2.000MHz
SWP 50.0ms


ATTEN 20dB
RL 10.0dBm
10dB/
MKR .17dB
920kHz
MKR
920
kHz
.17 dB
D
CENTER 2.48000GHz
*RBW 10kHz
*VBW 30kHz
SPAN 2.000MHz
SWP 50.0ms

8 OUTPUT POWER MEASUREMENT

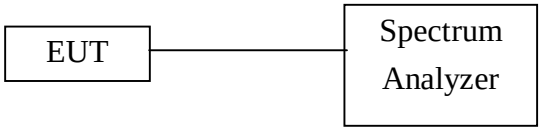
8.1 Standard Applicable

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

8.2 Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT as shown in figure 5. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range and make sure the instrument is operated in its linear range.
3. Set RBW of spectrum analyzer to 1 MHz and VBW to 3 MHz.
4. Measure the highest amplitude appearing on spectral display and record the level to calculate result data.
5. Repeat above procedures until all frequencies measured were complete.

Figure 5: Output power and measurement configuration.



8.3 Measurement Equipment

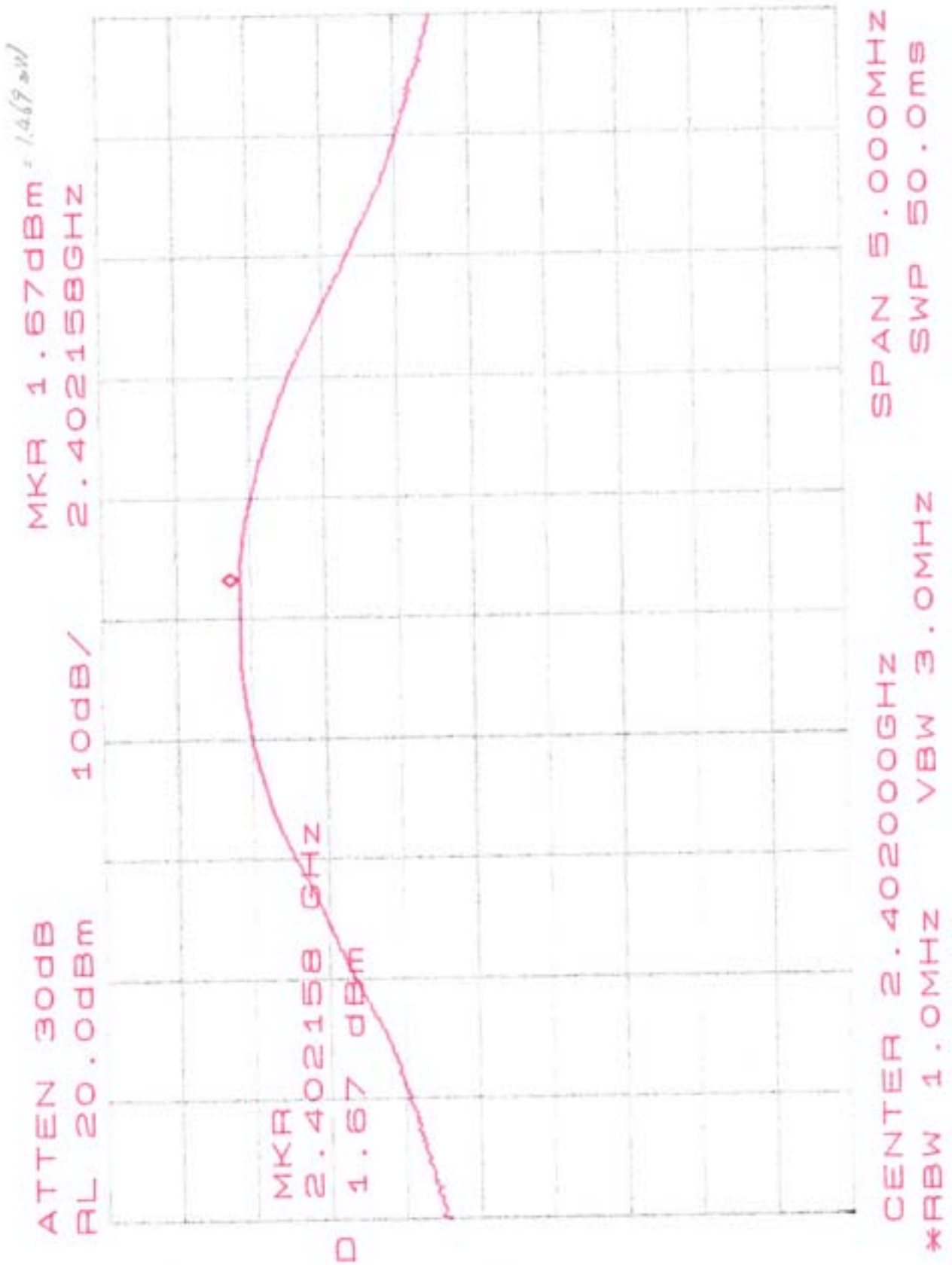
Equipment	Manufacturer	Model No.	Next Cal. Due
Plotter	Hewlett-Packard	7550A	N/A
Spectrum Analyzer	Hewlett-Packard	8564EC	09/10/2004

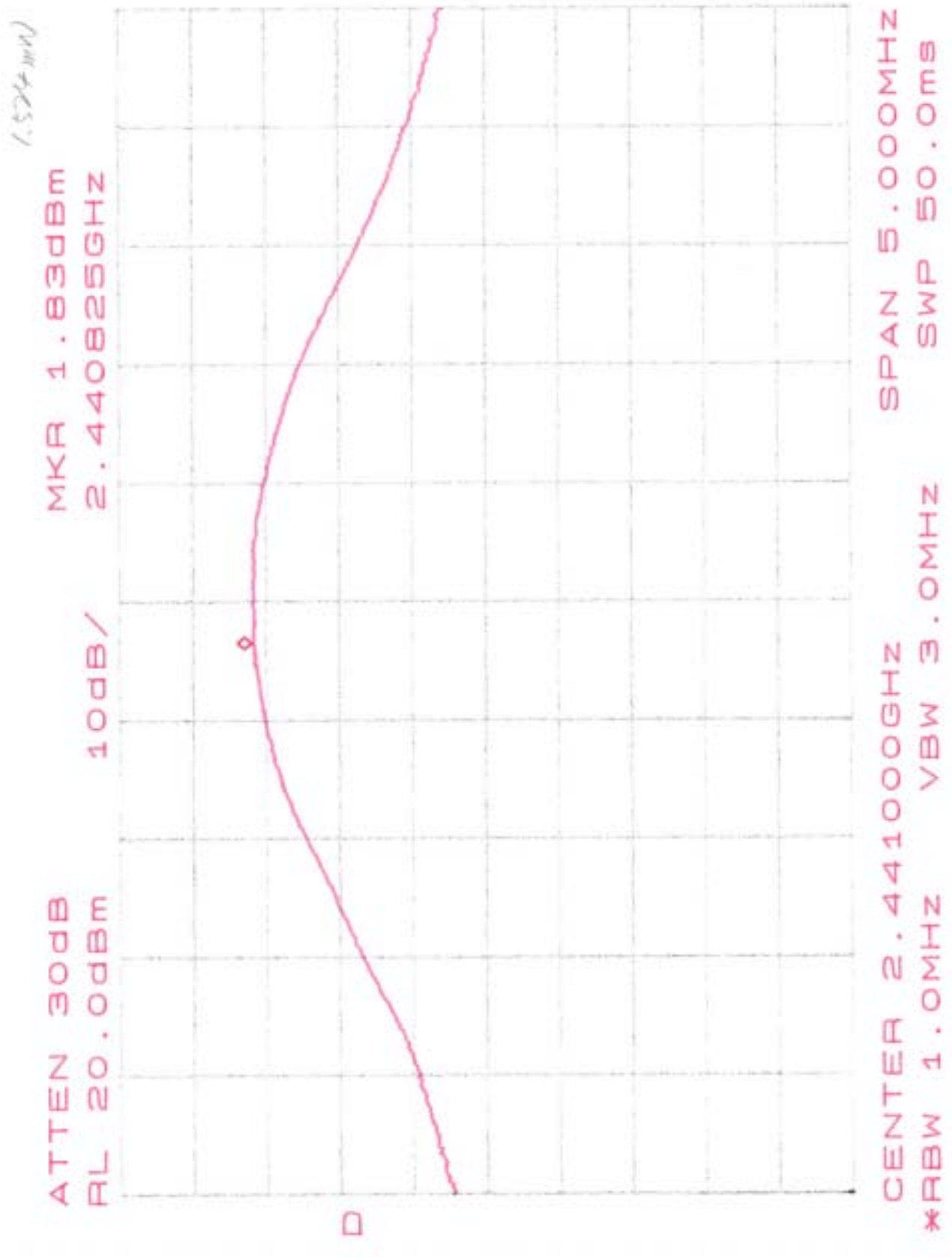
8.4 Measurement Data

Test Date : Sep. 8, 2003 Temperature : 25 ℃ Humidity: 78 %

a) Channel 01 : Output Peak Power is 1.67 dBm or 1.469 mW
b) Channel 40 : Output Peak Power is 1.83 dBm or 1.524 mW
c) Channel 79 : Output Peak Power is 1.33 dBm or 1.358 mW

Note: Please see Appendix 2 for ploted datas


ATTEN 30dB
RL 20.0dBm
10dB/
MKR 1.67dBm = 1.467mW
2.402158GHz
MKR
2.402158 GHz
1.67 dBm
D
CENTER 2.402000GHz
*RBW 1.0MHz
VBW 3.0MHz
SPAN 5.000MHz
SWP 50.0ms


ATTEN 30dB
RL 20.0dBm
10dB/
MKR 1.83dBm
2.440825GHz
D
CENTER 2.441000GHz
*RBW 1.0MHz
VBW 3.0MHz
SPAN 5.000MHz
SWP 50.0ms

ATTEN 30dB
RL 20.0dBm
10dB/
MKR 1.33dBm
2.479792GHz
MKR
2.479792 GHz
1.33 dBm
D
CENTER 2.480000GHz
*RBW 1.0MHz
VBW 3.0MHz
SPAN 5.000MHz
SWP 50.0ms

9 100 kHz BANDWIDTH OF BAND EDGES MEASUREMENT

9.1 Standard Applicable

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

9.2 Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT as shown in figure 5. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range and make sure the instrument is operated in its linear range.
3. Set both RBW and VBW of spectrum analyzer to 100 kHz with a convenient frequency span including 100kHz bandwidth from band edge.
4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete.

9.3 Measurement Equipment

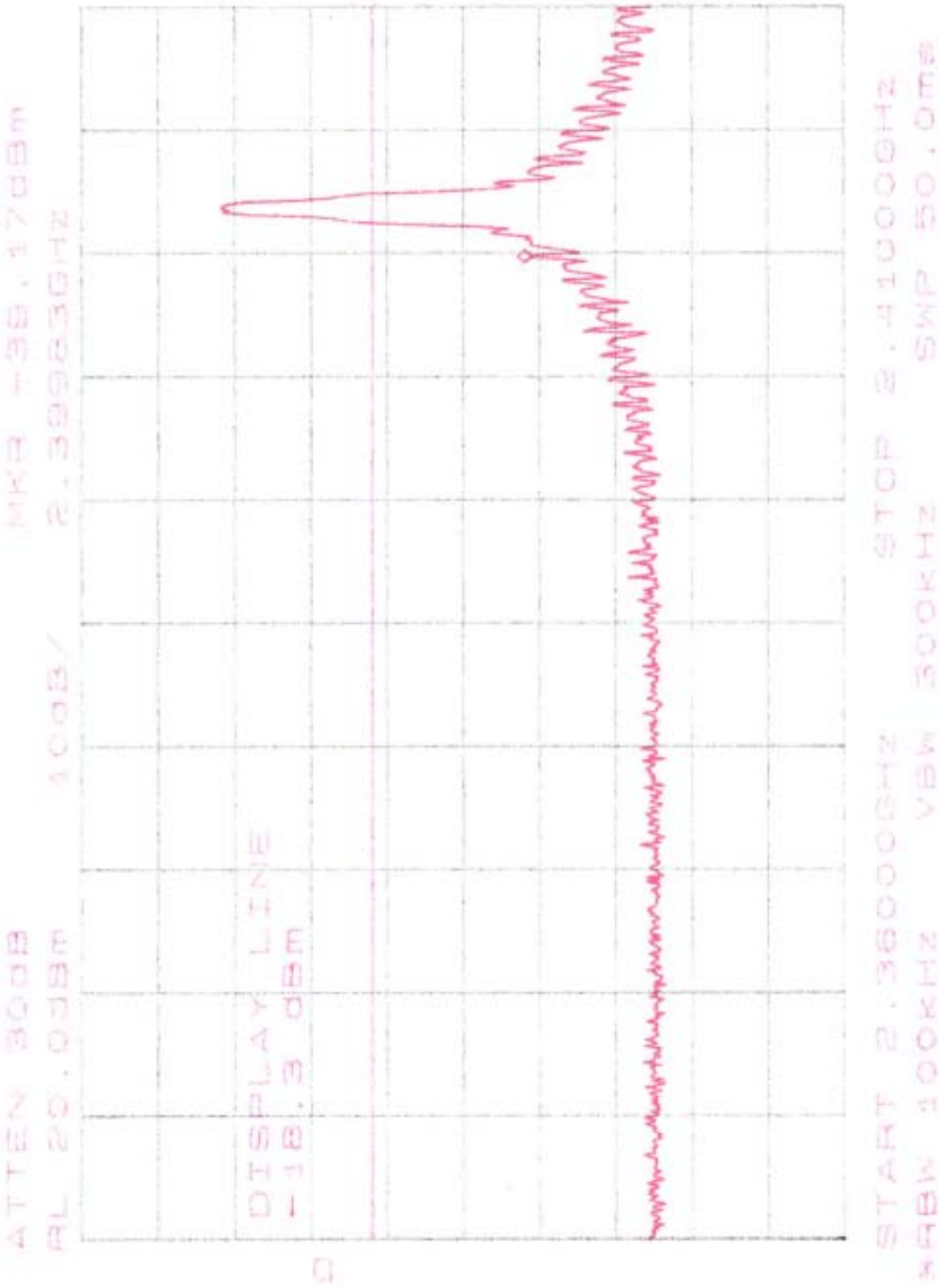
Equipment	Manufacturer	Model No.	Next Cal. Due
Plotter	Hewlett-Packard	7550A	N/A
Spectrum Analyzer	Hewlett-Packard	8564EC	09/10/2004

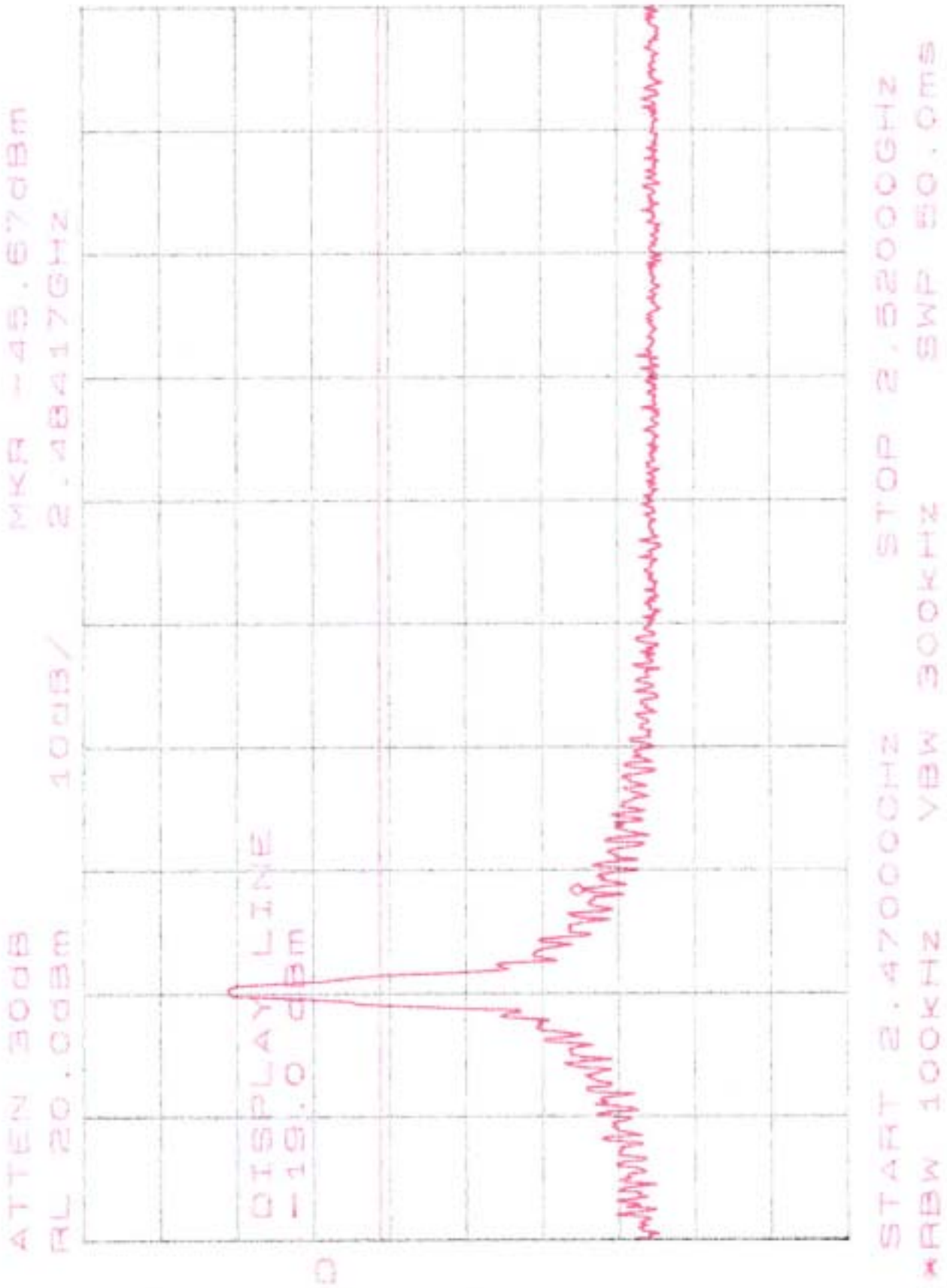
9.4 Measurement Data

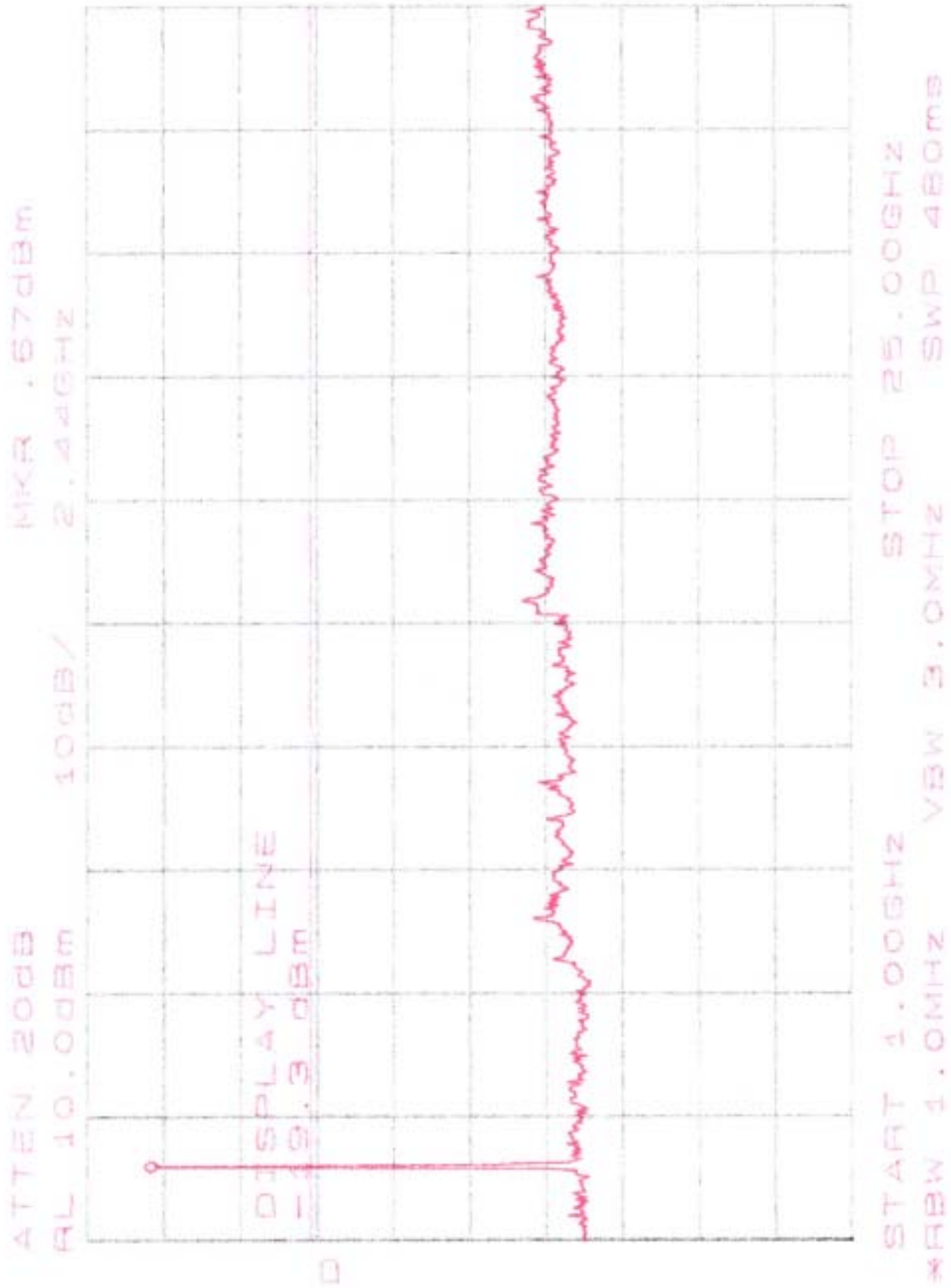
Test Date : Sep. 8, 2003 Temperature : 25 ℃ Humidity: 70%

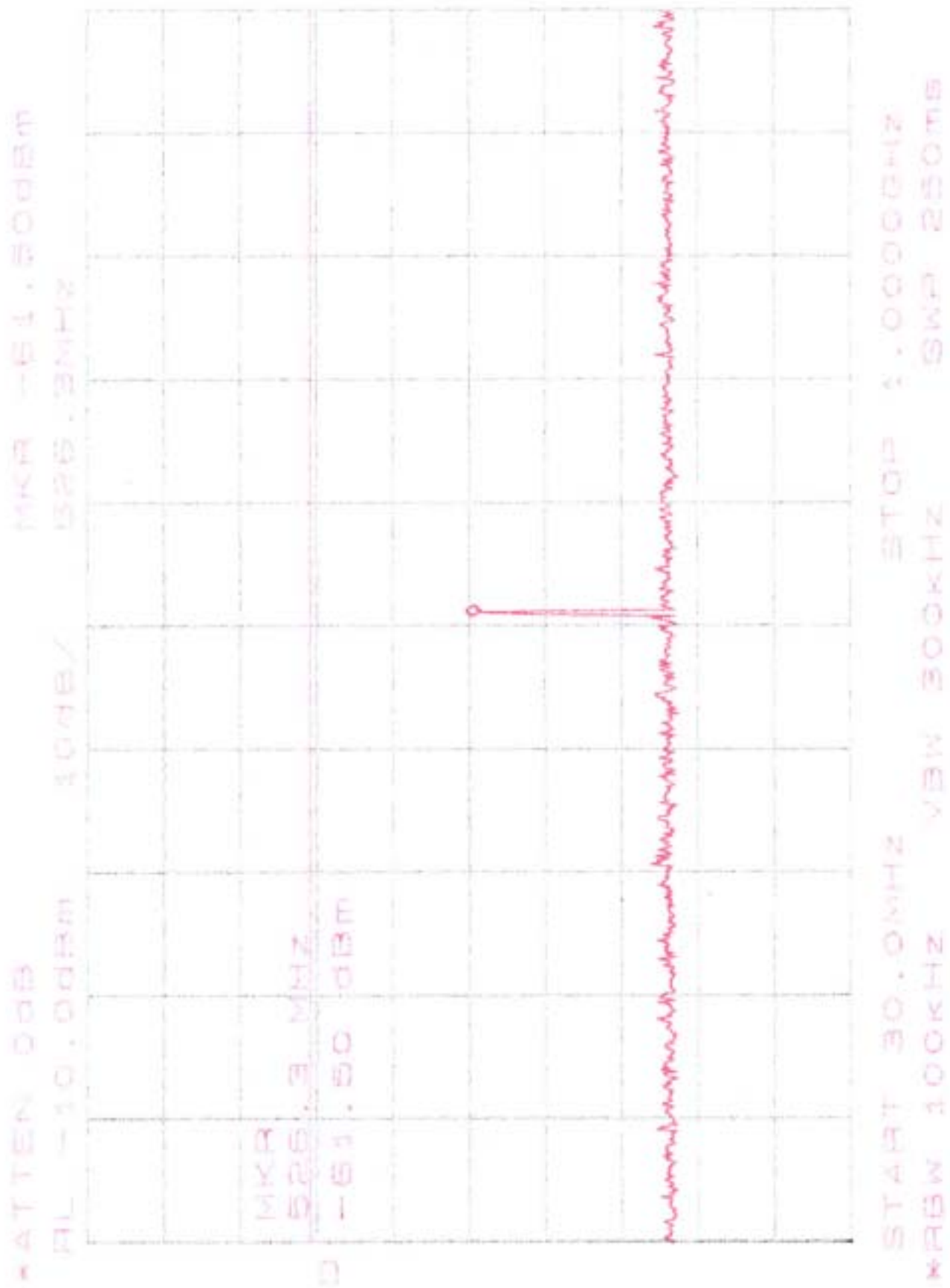
a) Lower Band Edge : maximum value is –39.17 dBm that is attenuated more than 20dB
b) Upper Band Edge : maximum value is –45.67 dBm that is attenuated more than 20dB

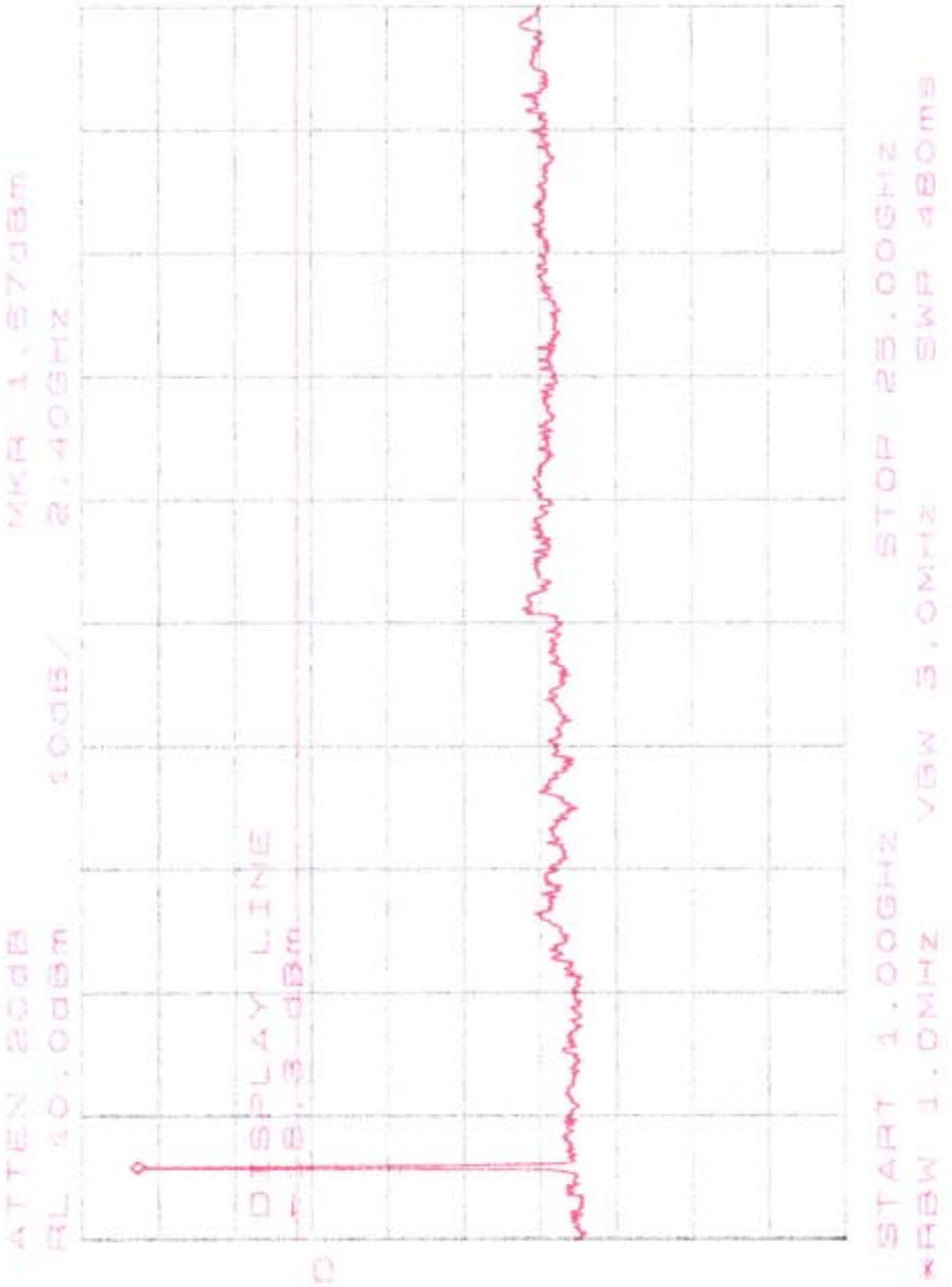
Note: Please see Appendix 3 for ploted datas

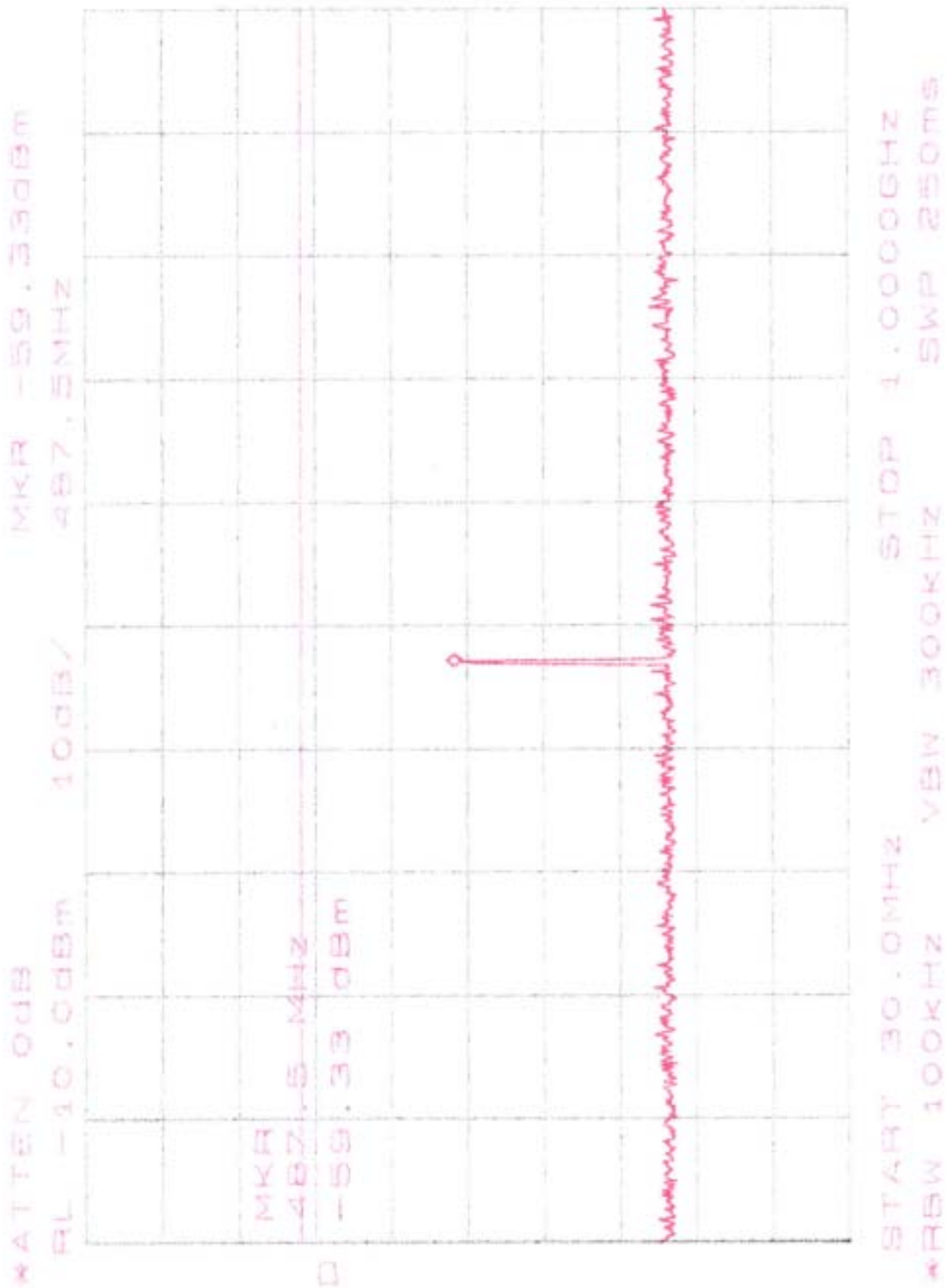

ATTEN 30dB
RL 20.0dBm
10dB/
MKR -39.17dBm
2.39983GHz
DISPLAY LINE
-18.3 dBm
START 2.36000GHz
RBW 100kHz
VBW 300kHz
STOP 2.41000GHz
SWP 50.0ms

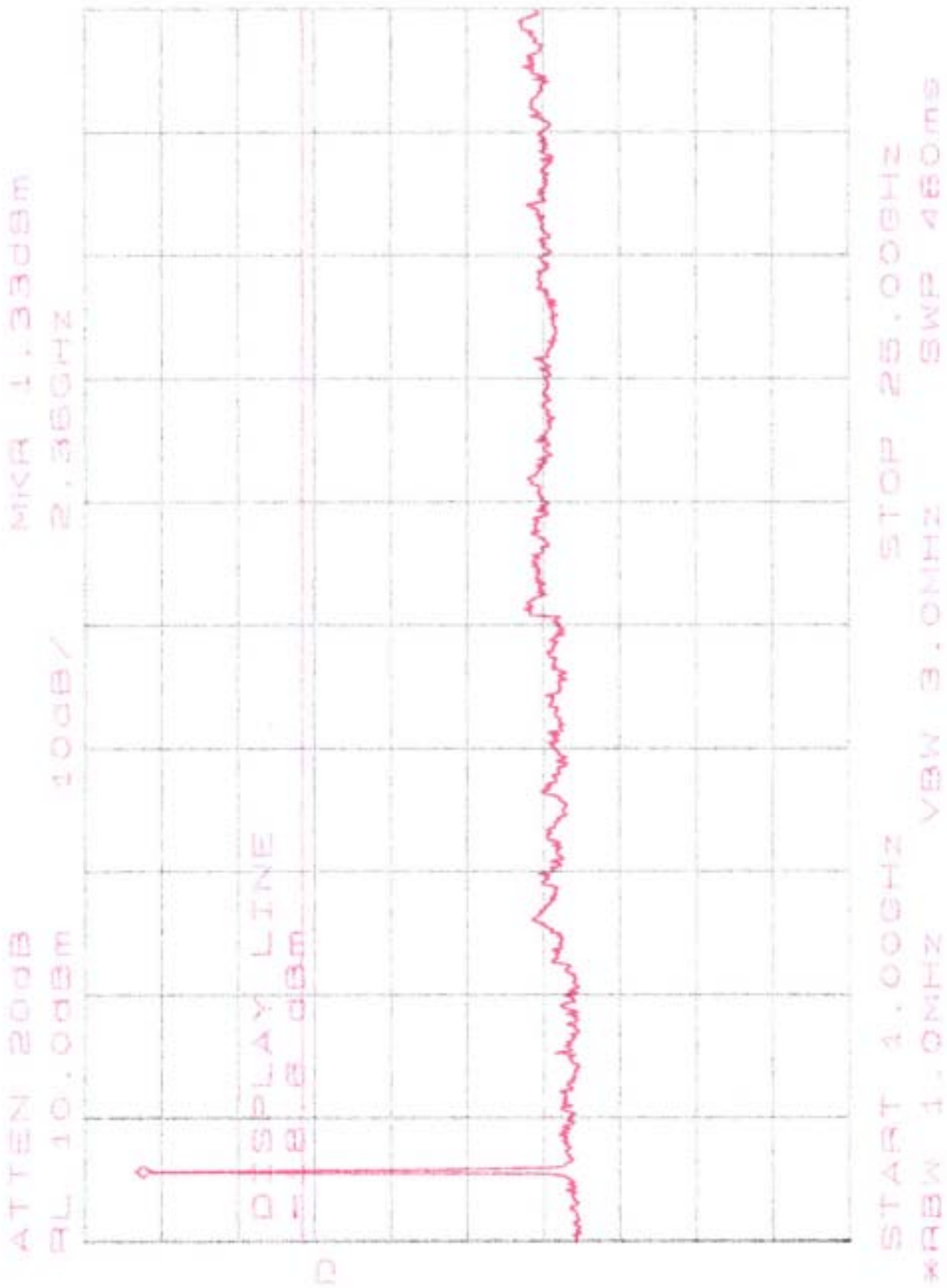

ATTEN 30dB
RL 20.0dBm
10dB/
MKR -45.67dBm
2.48417GHz
DISPLAY LINE
-19.0 dBm
START 2.47000GHz
STOP 2.52000GHz
*RBW 100kHz
VBW 300kHz
SWP 50.0ms

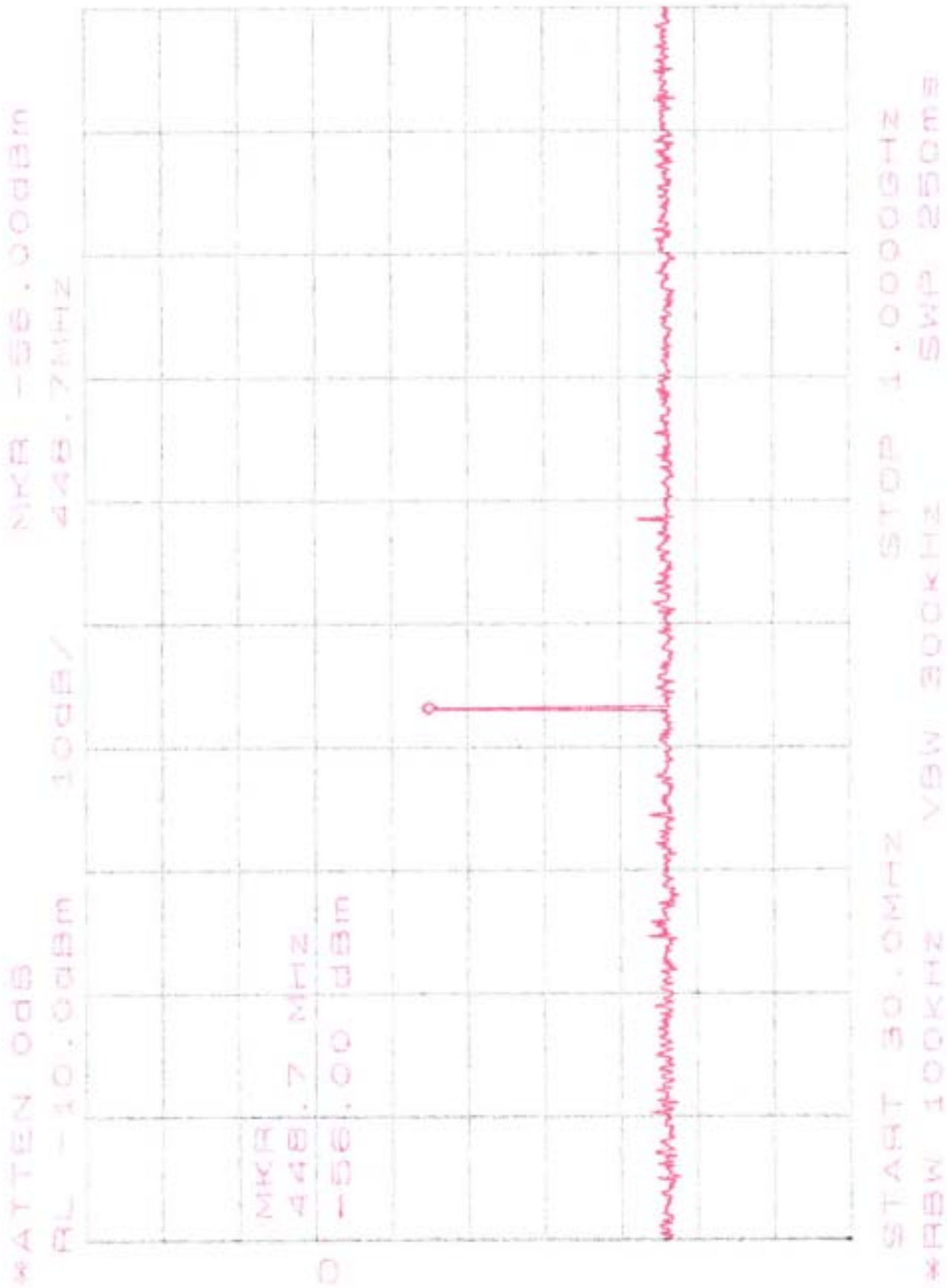

ATTEN 20dB
RL 10.0dBm
10dB/
MKR .67dBm
2.446GHz
DISPLAY LINE
-16.3 dBm
START 1.00GHz
RBW 1.0MHz
VBW 3.0MHz
STOP 25.00GHz
SWP 480ms


*ATTEN 0dB
RL -10.0dBm
10dB/
MKR -61.50dBm
526.3MHz
MKR
526.3 MHz
-61.50 dBm
START 30.0MHz
*RBW 100kHz
VBW 300kHz
STOP 1.0000GHz
SWP 250ms


ATTEN 20dB
RL 10.00dBm
10dB/
MKR 1.87dBm
2.40GHz
DISPLAY LINE
-3.0dBm
0
START 1.00GHz
RBW 1.0MHz
VBW 3.0MHz
STOP 25.00GHz
SWP 480ms


*ATTEN 0dB
MKR -59.33dBm
RL -10.0dBm
10dB/
487.5MHz
MKR
487.5 MHz
-59.33 dBm
STOP 1.000GHz
SWP 250ms
START 30.0MHz
VBW 300kHz
*RBW 100kHz


ATTEN 20dB
RL 10.0dBm
10dB/
MKR 1.33dBm
2.36GHz
DISPLAY LINE
-18.8 dBm
START 1.00GHz
*RBW 1.0MHz
VBW 3.0MHz
STOP 25.00GHz
SWP 480ms


ATTEN 0dB
RL -10.00dBm
10dB/
MKR -56.00dBm
448.7MHz
MKR
448.7 MHz
-56.00 dBm
0
START 30.0MHz
RBW 100kHz
VBW 300kHz
STOP 1.0000GHz
SWP 250ms

10 RADIATED MEASUREMENT AT BANDEDGE WITH FUNDAMENTAL FREQUENCIES

10.1 Standard Applicable

According to 15.247(c), 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).

10.2 Measurement Procedure

1. Setup the configuration per figure 2 for 2.39GHz and 2.4835GHz measured.
2. Set the spectrum analyzer on 1MHz resolution bandwidth for each frequency measured.
3. The search antenna is to be raised and lowered over a range from 1 to 4 meters in horizontally polarized orientation. Position th highness when the highest value is indicated on spectrum analyzer, then change the orientation of EUT on test table over a range from 0º to 360º with a speed as slow as possible, and keep the azimuth that highest emission is indicated on the spectrum analyzer. Vary the antenna position again and record the highest value as a final reading. A RF test receiver is also used to confirm emissions measured.
4. Repeat step 3 until all frequencies need to be measured were complete.
5. Repeat step 4 with search antenna in vertical polarized orientations.
6. Measurement applied to channel 1、40、79, recorded the result.

10.3 Measuring Instrument

The following instrument are used for radiated emissions measurement :

Equipment	**Manufacturer**	**Model No.**	**Next Cal. Due**
EMI Test Receiver	Hewlett-Packard	8546A	08/27/2004
Horn Antenna	EMCO	3115	06/05/2004
LogBicone Antenna	Schwarzbeck	9160	10/28/2003
Horn Antenna	EMCO	3116	06/28/2004
Preamplifier	Hewlett-Packard	8449B	09/04/2004
Spectrum Analyzer	Hewlett-Packard	8564EC	09/10/2004

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

Frequency Band (MHz)	Instrument	Function	Resolution bandwidth	Video Bandwidth
2390 & 2483.5	Spectrum Analyzer	Peak	1 MHz	1 MHz
	Spectrum Analyzer	Average	1 MHz	10 Hz

10.4 Radiated Emission Data

a) Channel 1

Operation Mode : Receiving /Transmitting

Fundamental Frequency : 2402 MHz

Test Date : Sep. 9, 2003 Temperature : 24 ℃ Humidity : 65 %

Frequency (MHz)	Reading (dBuV) H Peak	H Ave	V Peak	V Ave	Factor (dB) Corr.	Result @3m (dBuV/m) Peak (H/V Max.)	Result @3m (dBuV/m) Ave (H/V Max.)	Limit @3m (dBuV/m) Peak	Limit @3m (dBuV/m) Ave.	Margin (dB)	Table Deg. (Deg.)	Ant. High (m)
2390.000	48.8	---	50.2	---	-4.0	46.2	---	74.0	54.0	-7.8	180	1.0
2483.500	47.7	---	47.0	---	-3.3	44.4	---	74.0	54.0	-9.6	180	1.0

b) Channel 40

Operation Mode : Receiving / Transmitting

Fundamental Frequency : 2441MHz

Test Date : Sep. 9, 2003 Temperature : 24 ℃ Humidity : 65 %

Frequency (MHz)	Reading (dBuV) H Peak	H Ave	V Peak	V Ave	Factor (dB) Corr.	Result @3m (dBuV/m) Peak (H/V Max.)	Result @3m (dBuV/m) Ave (H/V Max.)	Limit @3m (dBuV/m) Peak	Limit @3m (dBuV/m) Ave.	Margin (dB)	Table Deg. (Deg.)	Ant. High (m)
2384.000	48.5	---	49.0	---	-4.0	45.0	---	74.0	54.0	-9.0	180	1.0
2483.500	49.3	---	47.3	---	-3.3	46.0	---	74.0	54.0	-8.0	180	1.0

c) Channel 79

Operation Mode : Receiving / Transmitting

Fundamental Frequency : 2480 MHz

Test Date : Sep. 8, 2003 Temperature : 24 ℃ Humidity : 65 %

Frequency (MHz)	Reading (dBuV) H Peak	H Ave	V Peak	V Ave	Factor (dB) Corr.	Result @3m (dBuV/m) Peak (H/V Max.)	Result @3m (dBuV/m) Ave (H/V Max.)	Limit @3m (dBuV/m) Peak	Limit @3m (dBuV/m) Ave.	Margin (dB)	Table Deg. (Deg.)	Ant. High (m)
2383.500	46.3	---	50.5	---	-4.0	46.5	---	74.0	54.0	-7.5	180	1.0
2483.500	58.3	38.0	61.0	38.2	-3.3	57.7	34.9	74.0	54.0	-16.3	180	1.0

11 Number of Hopping Channels

11.1 Standard Applicable

According to 15.247(b)(1), for frequency hopping systems, operating in the 2400-2483.5MHz band employing at least 75 hopping channels

11.2 Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT as shown in figure 5. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set EUT to hopping operating mode and set spectrum analyzer miximum to measure the number of hopping channels.

11.3 Measurement Equipment

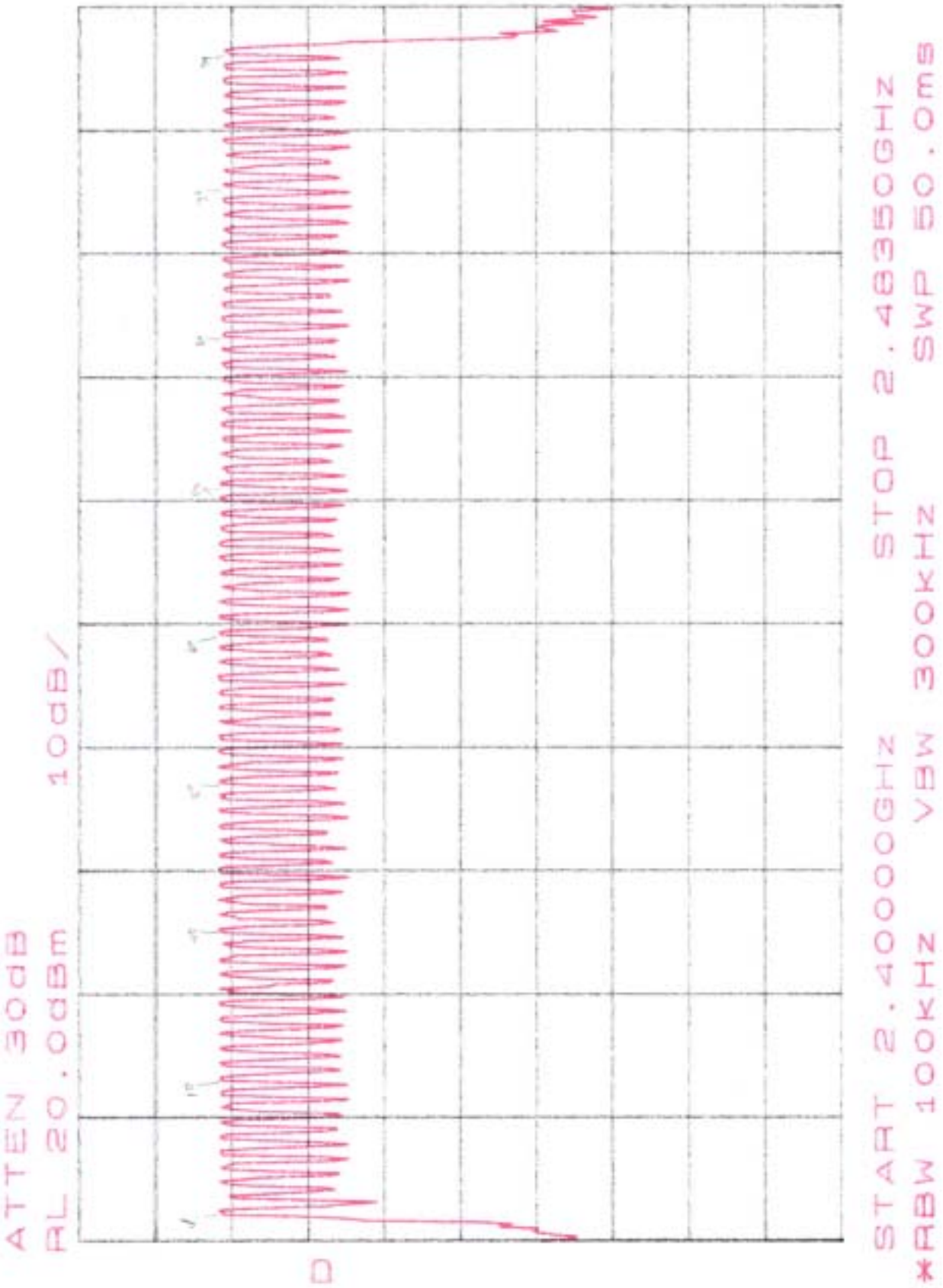
Equipment	Manufacturer	Model No.	Next Cal. Due
Plotter	Hewlett-Packard	7440A	N/A
Spectrum Analyzer	Hewlett-Packard	8564EC	09/10/2004

11.4 Measurement Data

Test Date : Sep. 8, 2003 Temperature : 25℃ Humidity: 70 %

Number of hopping channels = 79 channels

Note: Please see Appendix 4 for ploted datas


ATTEN 30dB
RL 20.0dBm
10dB/
D
START 2.40000GHz
*RBW 100kHz
VBW 300kHz
STOP 2.48350GHz
SWP 50.0ms

12 Channel Carrier Frequencies Seperation

12.1 Standard Applicable

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

12.2 Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT as shown in figure 5. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measurement frequency within its operating ragne and make sure the instrument is operated in its linear range.
3. Set spectrum analyzer maximum hold to measure channel carrier frequency , then adjust channel carrier frequency to adjacent channel.
4. Repeat above procedure until all measured frequencies were complete.

12.3 Measurement Equipment

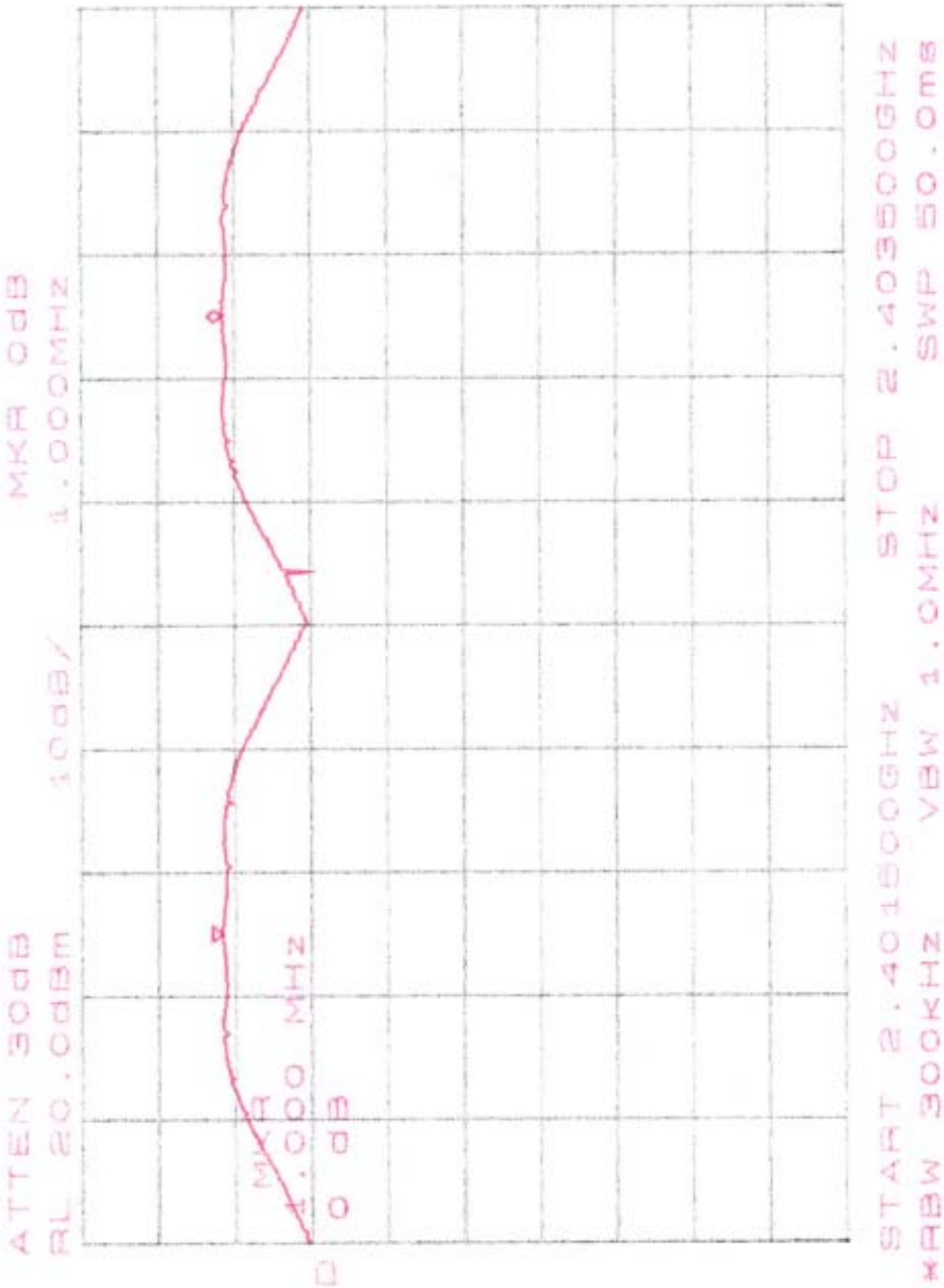
Equipment	Manufacturer	Model No.	Next Cal. Due
Plotter	Hewlett-Packard	7550A	N/A
Spectrum Analyzer	Hewlett-Packard	8564EC	09/10/2004

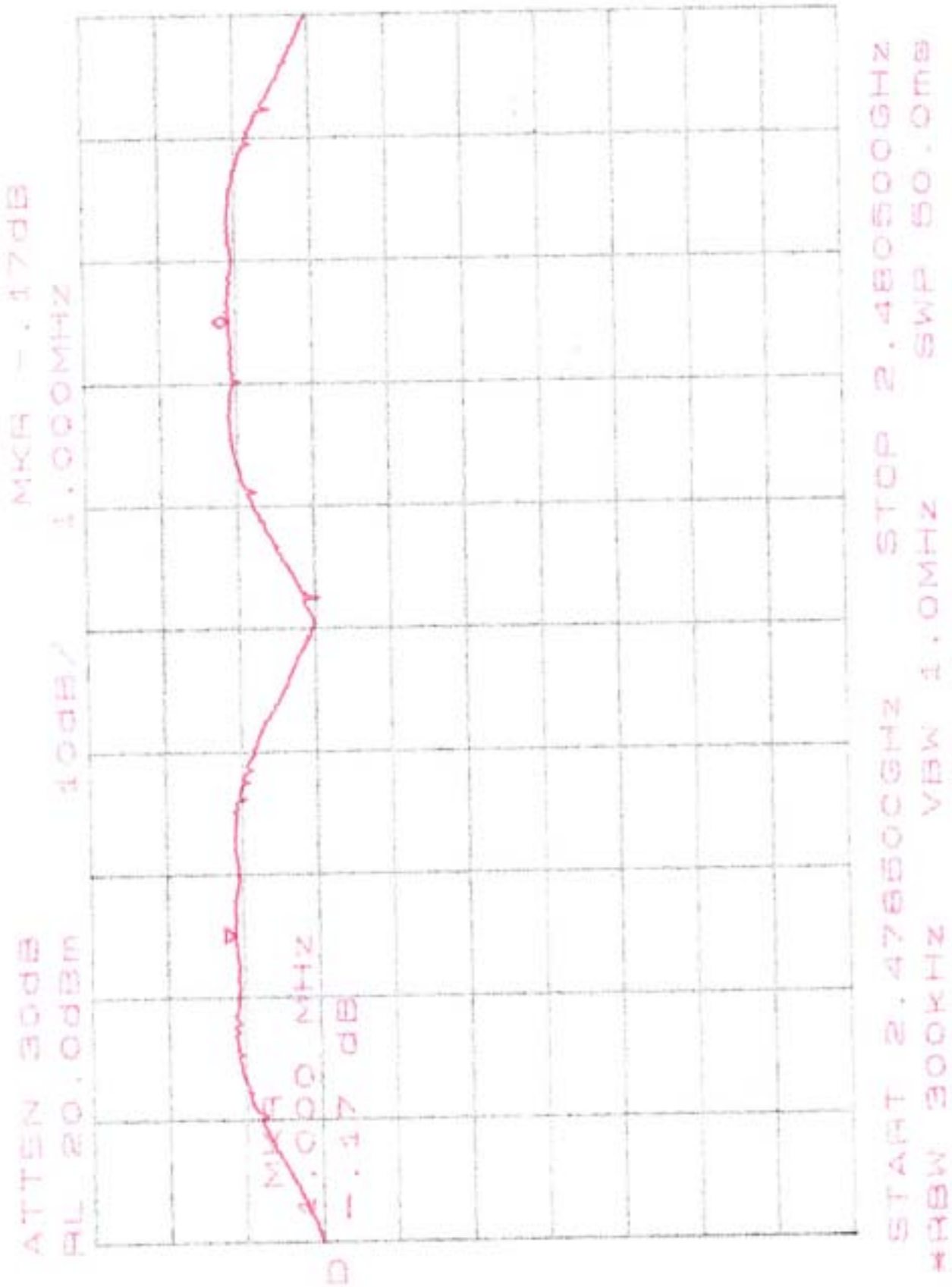
12.4 Measurement Data

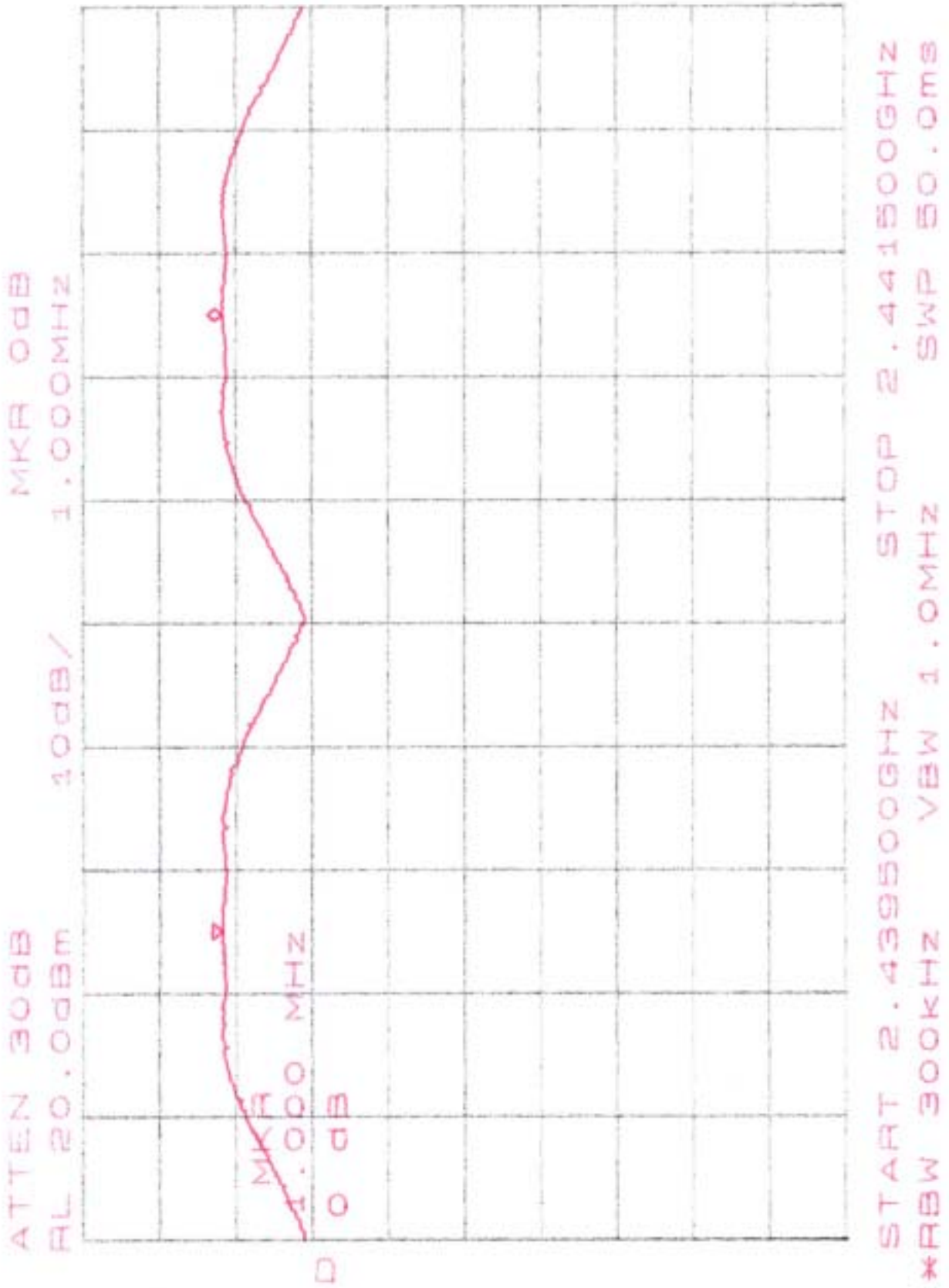
Test Date : Sep. 9, 2003 Temperature : 25℃ Humidity: 70 %

a) 2402MHz channel seperation is 1MHz
b) 2441MHz channel seperation is 1MHz
c) 2480MHz channel seperation is 1MHz

Note: Please see Appendix 5 for ploted datas


ATTEN 30dB
RL 20.0dBm
10dB/
MKR 0dB
1.000MHz
MKR
1.000 MHz
0 dB
START 2.401500GHz
STOP 2.403500GHz
*RBW 300kHz
VBW 1.0MHz
SWP 50.0ms


ATTEN 30dB
RL 20.0dBm
10dB/
MKR -.17dB
1.000MHz
MKR
1.000 MHz
-.17 dB
D
START 2.478500GHz
STOP 2.480500GHz
*RBW 300kHz
VBW 1.0MHz
SWP 50.0ms


ATTEN 30dB
RL 20.0dBm
10dB/
MKR 0dB
1.000MHz
MKR
1.000 MHz
0 dB
D
START 2.439500GHz
*RBW 300kHz
VBW 1.0MHz
STOP 2.441500GHz
SWP 50.0ms

13 POWER SPECTRAL DENSITY

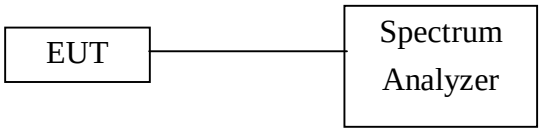
13.1 Standard Applicable

For frequency hopping system, according to 15.247(d), for digitally modulated, the peak power speceral density conducted from the intentional radiator to the antenna shall not be greater them 8dBm in any 3kHz band furing any time interral of continuous transmission.

13.2 Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT as shown in figure 5. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range and make sure the instrument is operated in its linear range.
3. Set RBW of spectrum analyzer to 3kHz, VBW to 30 kHz, sweep 300kHz and sweep time 100 sec.
4. Measure the highest amplitude appearing on spectral display and record the level to calculate result data.
5. Repeat above procedures until all frequencies measured were complete.

Figure 5: Output power and measurement configuration.



13.3 Measurement Equipment

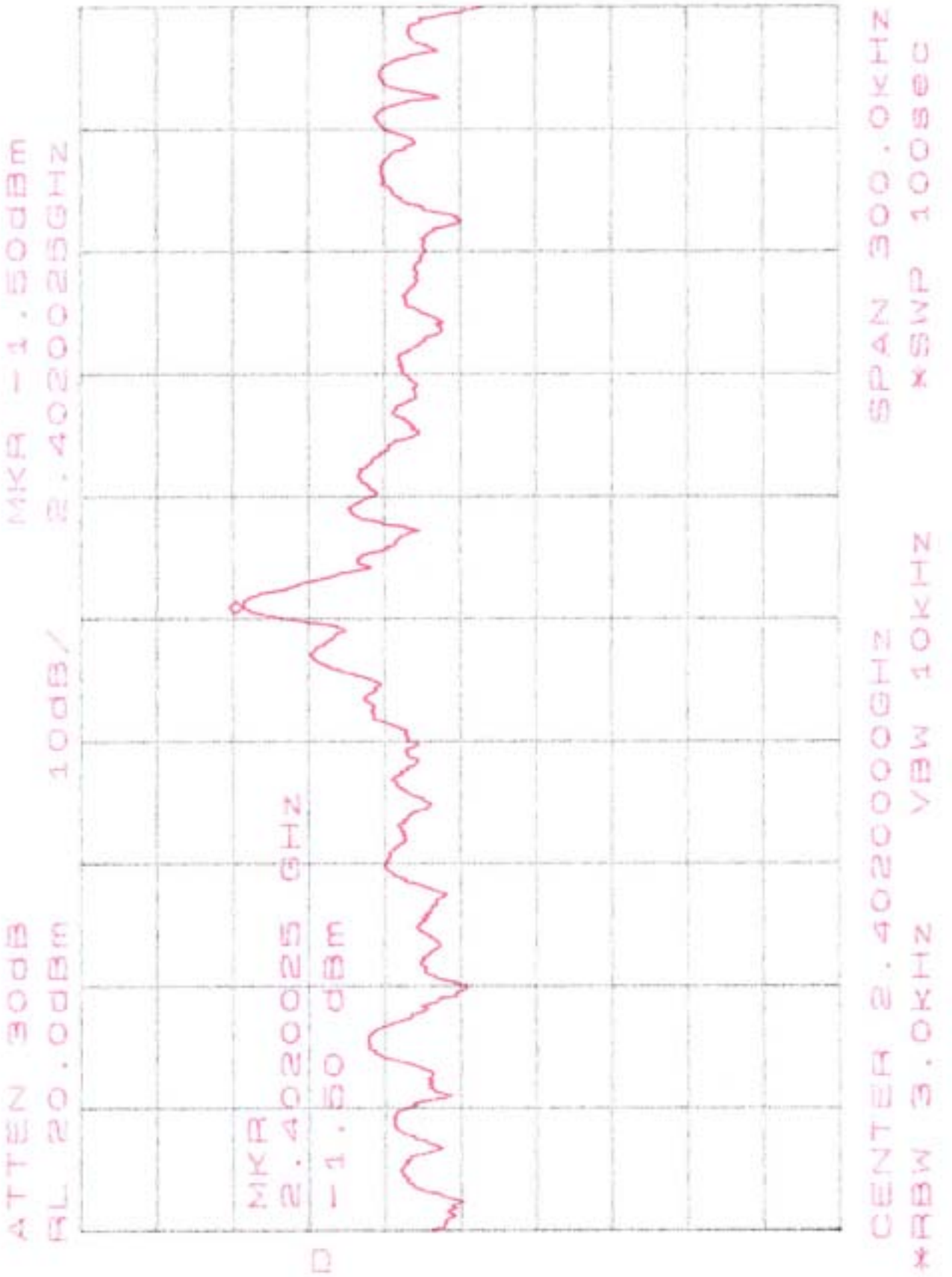
Equipment	Manufacturer	Model No.	Next Cal. Due
Plotter	Hewlett-Packard	7550A	N/A
Spectrum Analyzer	Hewlett-Packard	8564EC	09/10/2004

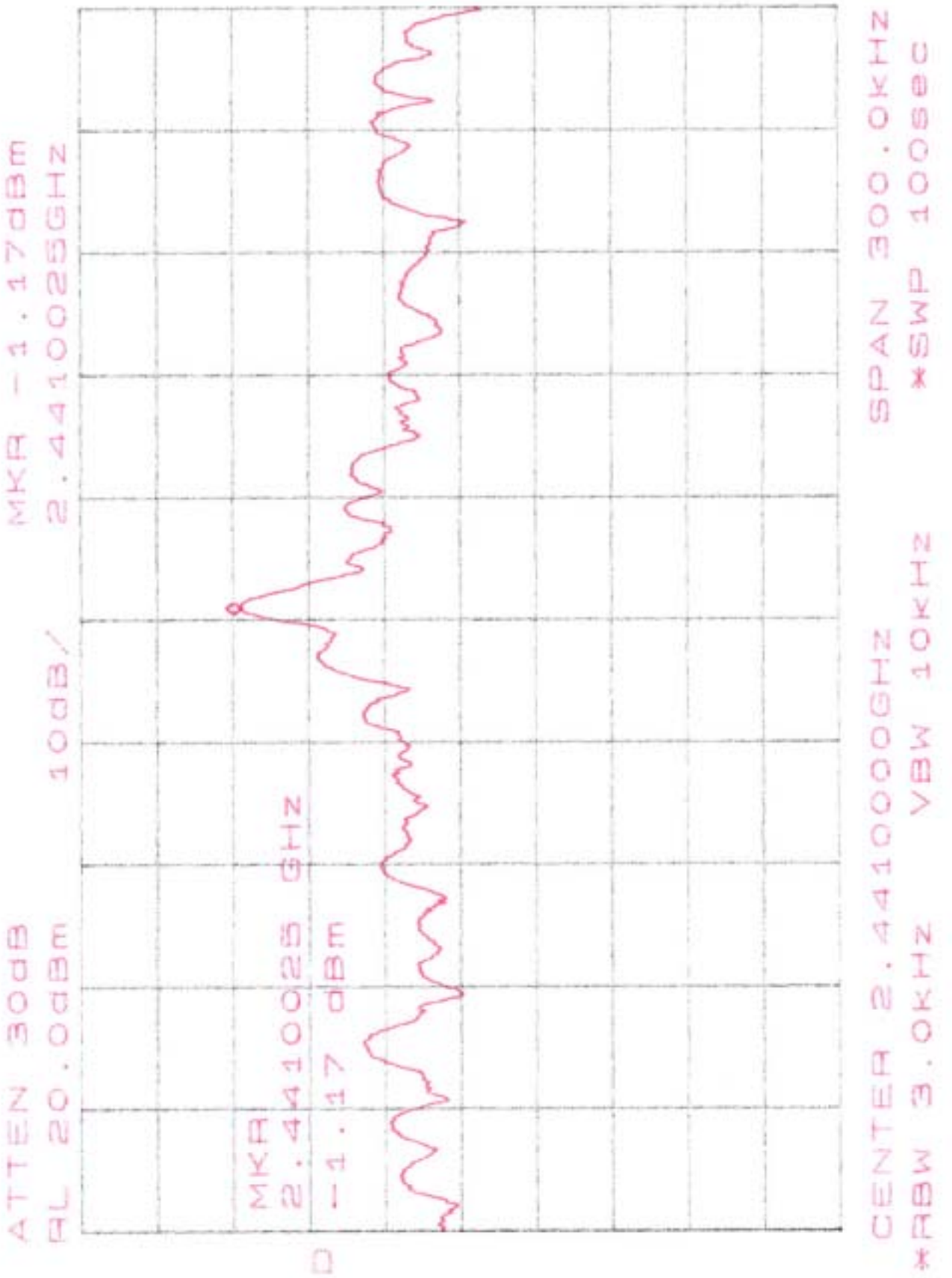
13.4 Measurement Data

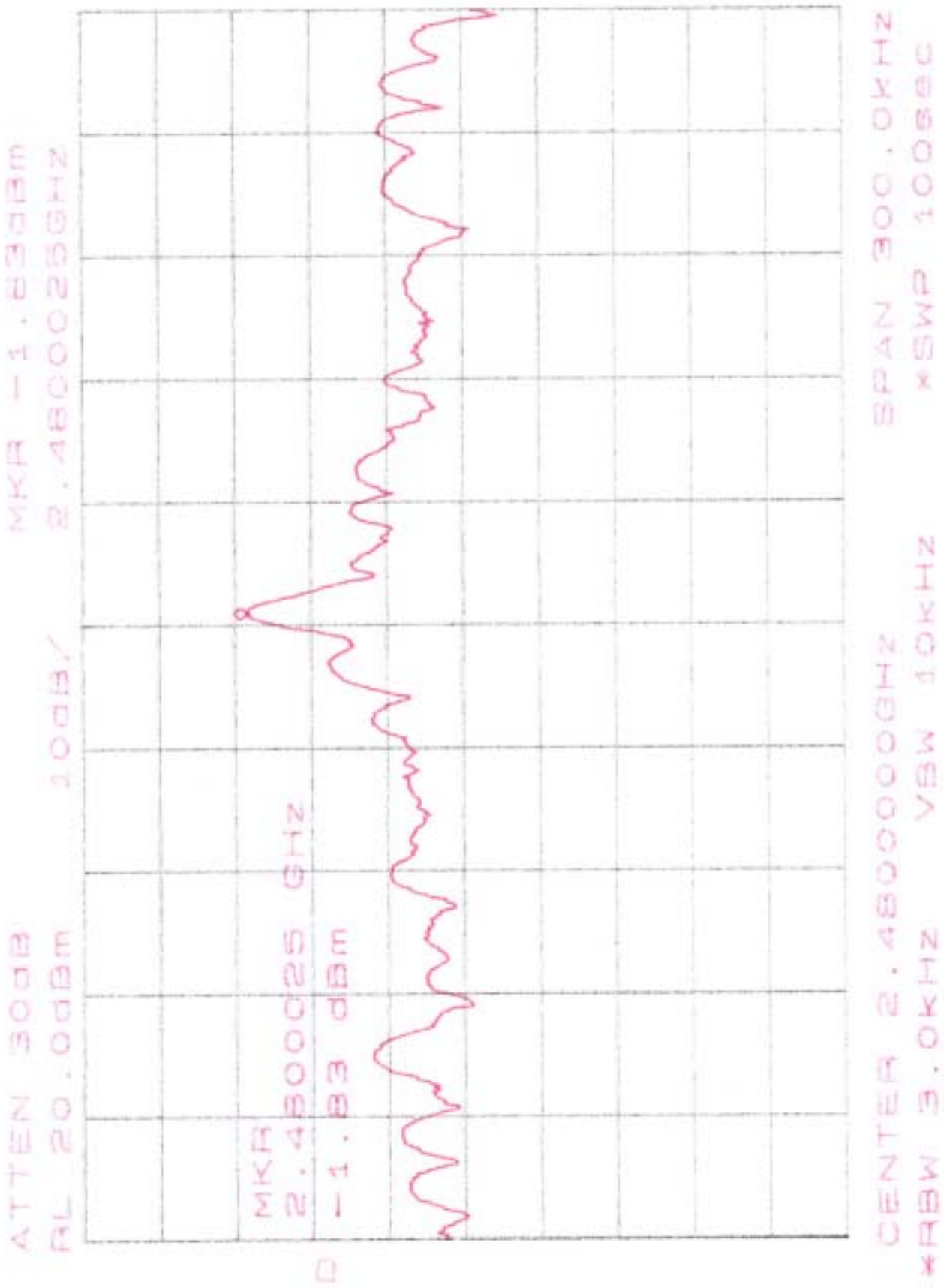
Test Date : Sep. 9, 2003 Temperature : 25 ℃ Humidity: 70 %

a) Channel 01 : Power Spectral Density is –1.50 dBm
b) Channel 40 : Power Spectral Density is –1.17 dBm
c) Channel 79 : Power Spectral Density is –1.83 dBm

Note: Please see next pages for ploted datas


ATTEN 30dB
RL 20.0dBm
10dB/
MKR -1.50dBm
2.4020025GHz
MKR
2.4020025 GHz
-1.50 dBm
CENTER 2.4020000GHz
*RBW 3.0KHz
VBW 10KHz
SPAN 300.0KHz
*SWP 100sec


ATTEN 30dB
RL 20.0dBm
10dB/
MKR -1.17dBm
2.441002GHz
MKR
2.441025 GHz
-1.17 dBm
CENTER 2.441000GHz
*RBW 3.0kHz
VBW 10kHz
SPAN 300.0kHz
*SWP 100sec


ATTEN 30dB
RL 20.00dBm
10dB/
MKR -1.83dBm
2.4800025GHz
MKR
2.4800025 GHz
-1.83 dBm
CENTER 2.4800000GHz
*RBW 3.0kHz
VBW 10kHz
SPAN 300.0kHz
*SWP 100sec

14 Dwell Time

14.1 Standard Applicable

According to 15.247(a)(1)(iii), frequency hopping system in the 2400-2483.5MHz band employing at least 15 non-overlapping channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 second multiplied by the number of hopping channels employed.

14.2 Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT as shown in figure 5.

14.3 Measurement Equipment

Equipment	Manufacturer	Model No.	Next Cal. Due
Plotter	Hewlett-Packard	7550A	N/A
Spectrum Analyzer	Hewlett-Packard	8564EC	09/10/2004

14.4 Measurement Data

Test Date : Sep. 9, 2003 Temperature : 25℃ Humidity: 70 %

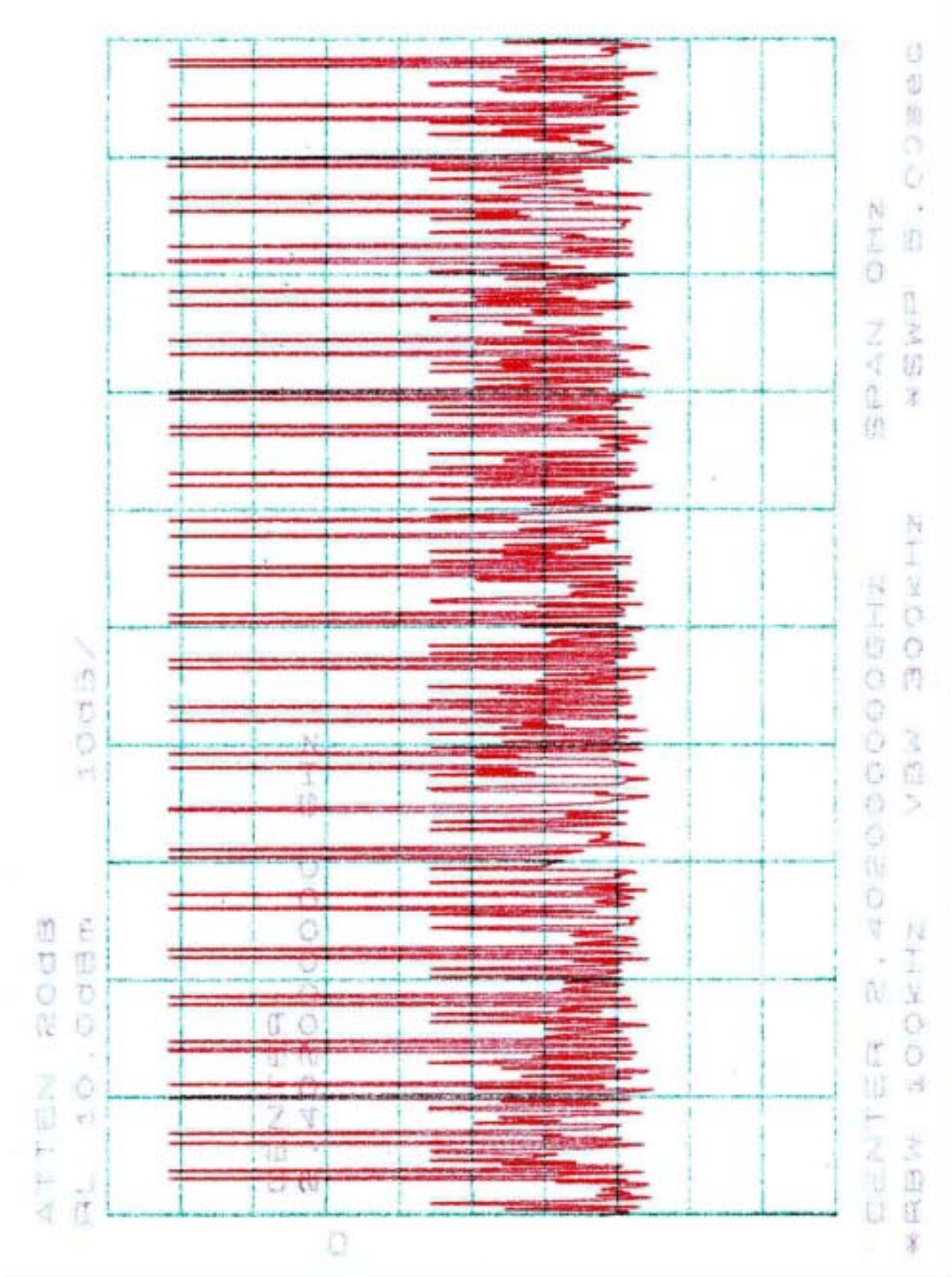
Test period=0.4(second/channel)$\times$79 channel=31.6sec

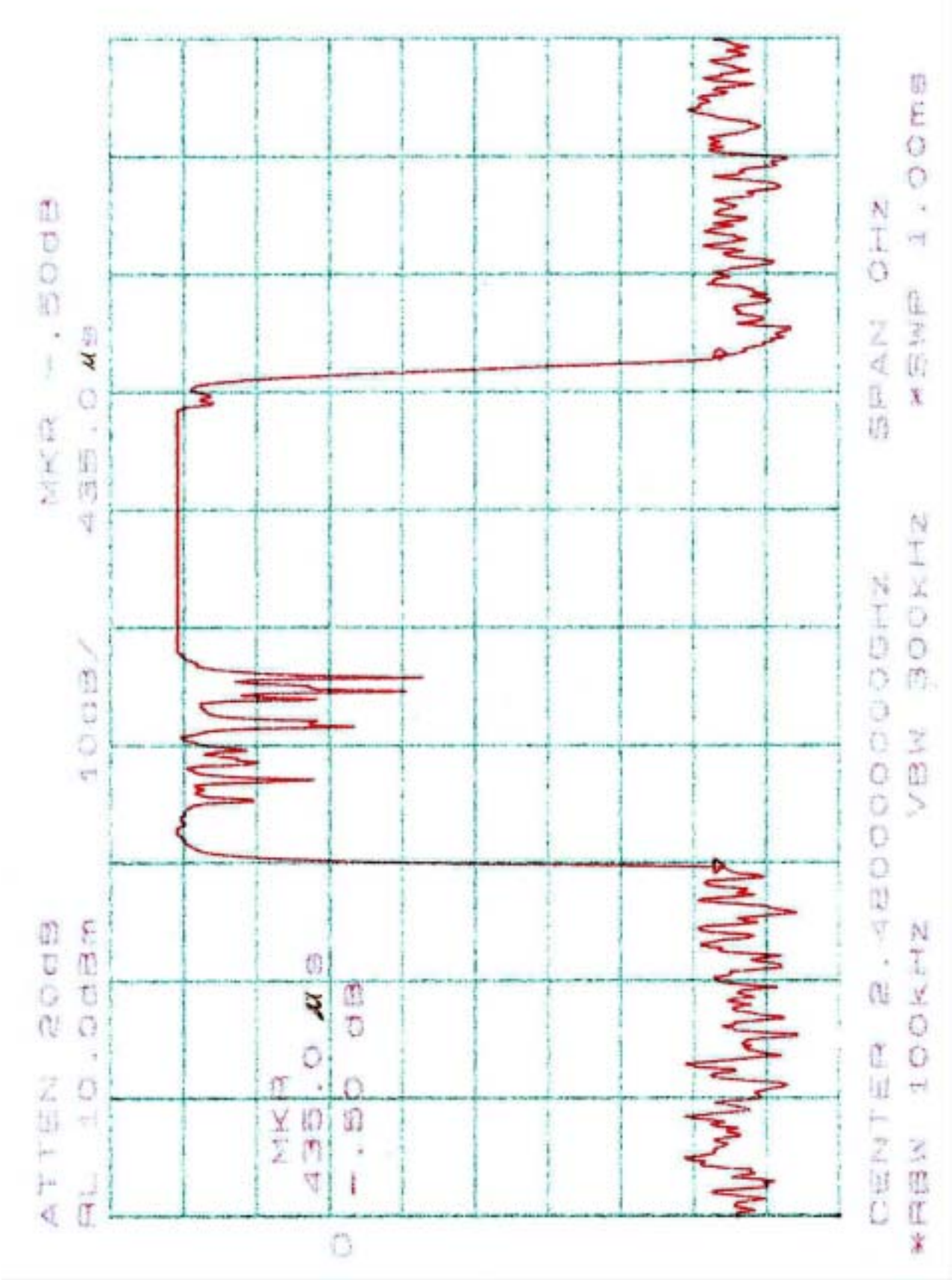
a) 2402MHz dwell time= $0.4350\text{ms} \times \frac{49}{5} \times 31.6 = 134.71\text{ms}$

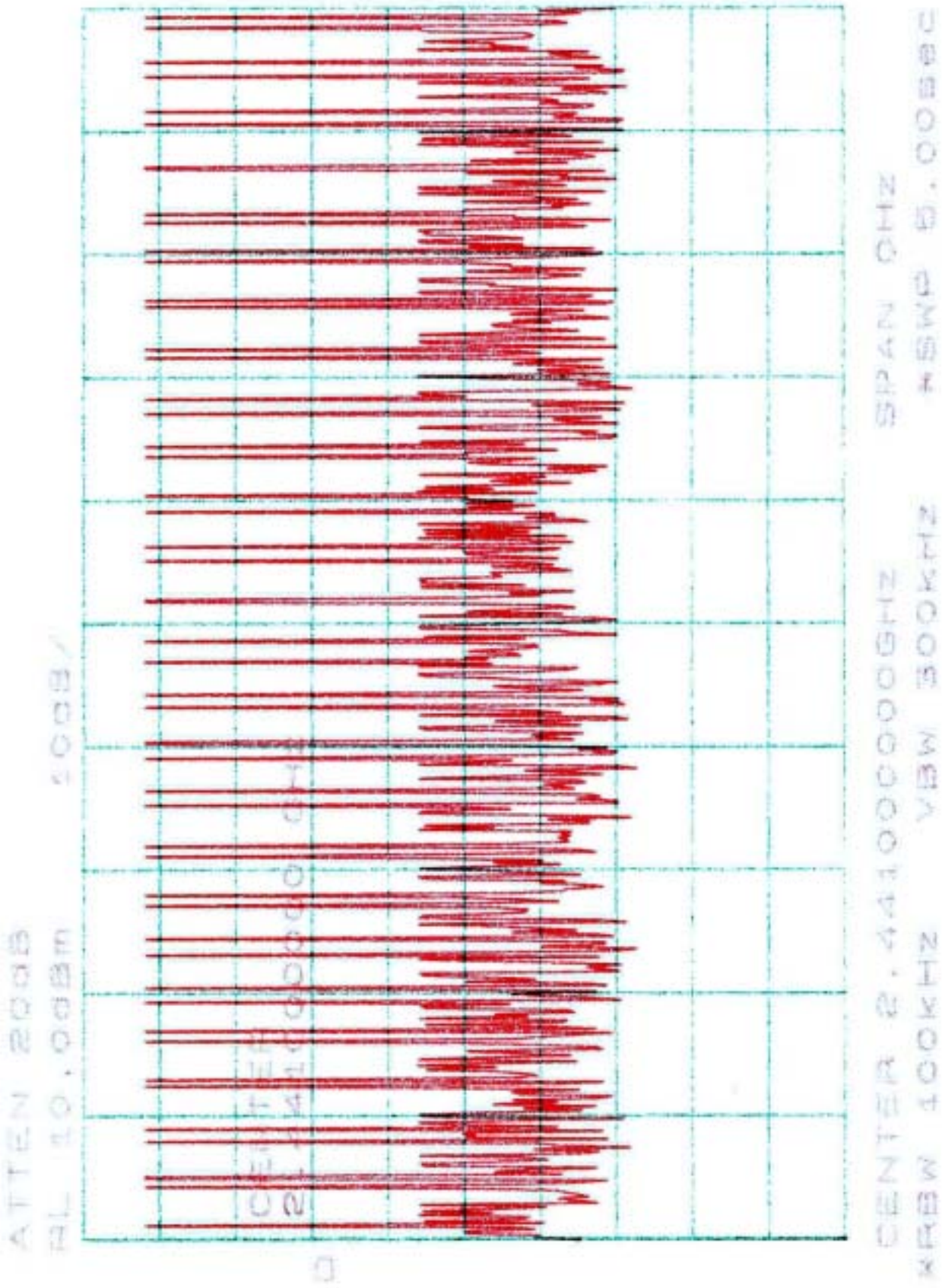
b) 2441MHz dwell time= $0.4333\text{ms} \times \frac{49}{5} \times 31.6 = 134.18\text{ms}$

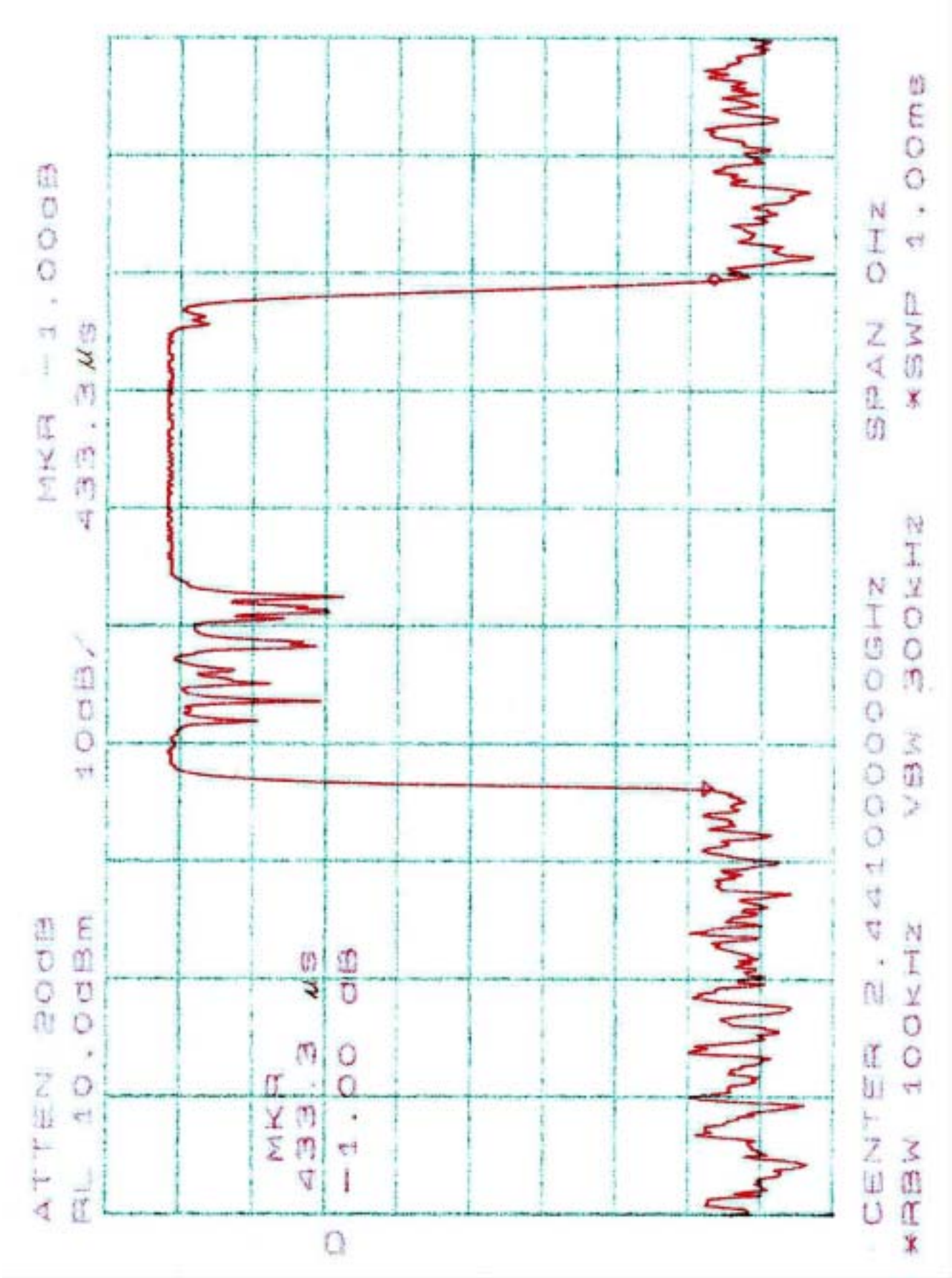
c) 2480MHz dwell time= $0.4333\text{ms} \times \frac{48}{5} \times 31.6 = 131.45\text{ms}$

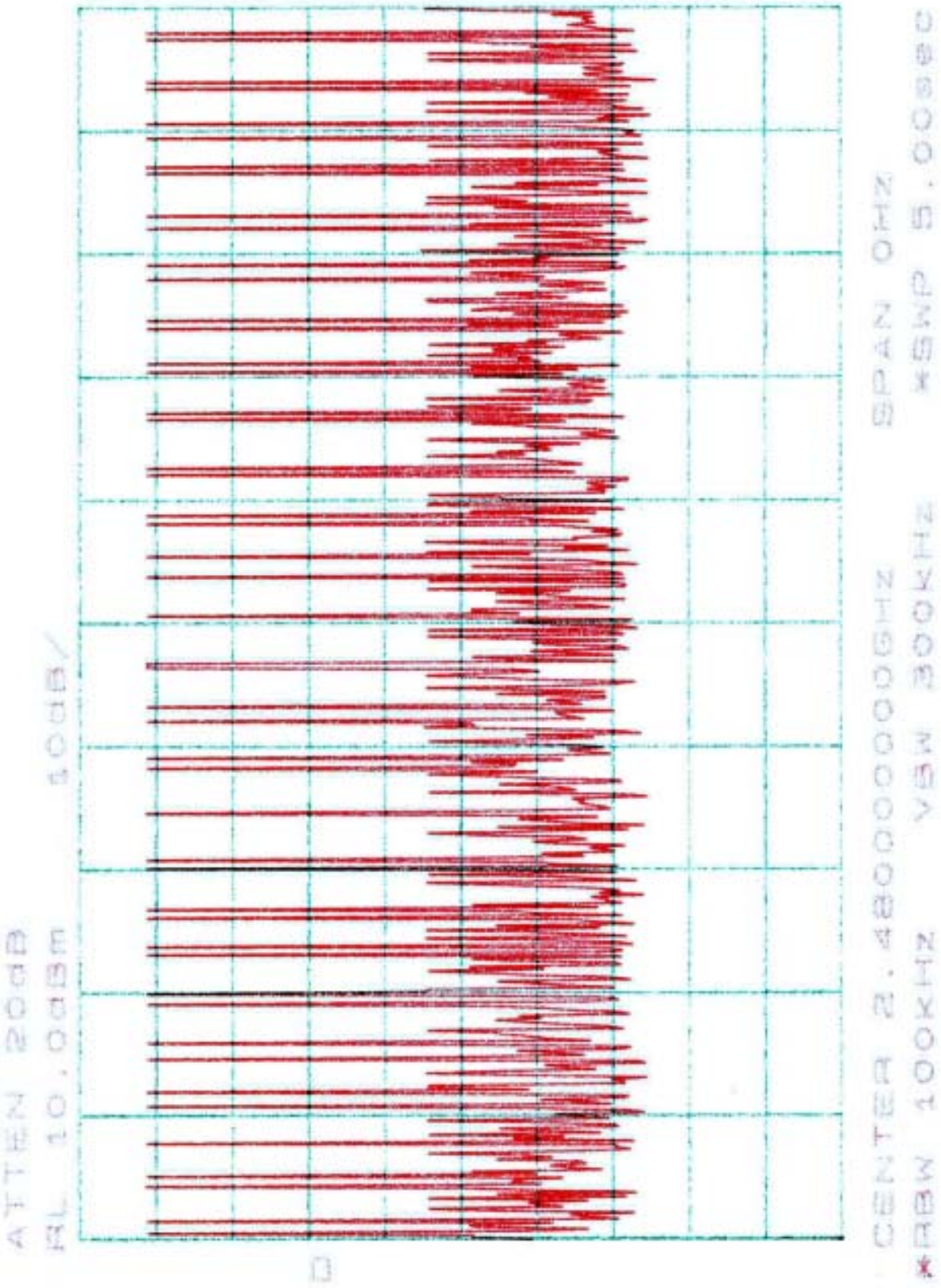
Note: Please see Appendix 6 for ploted datas

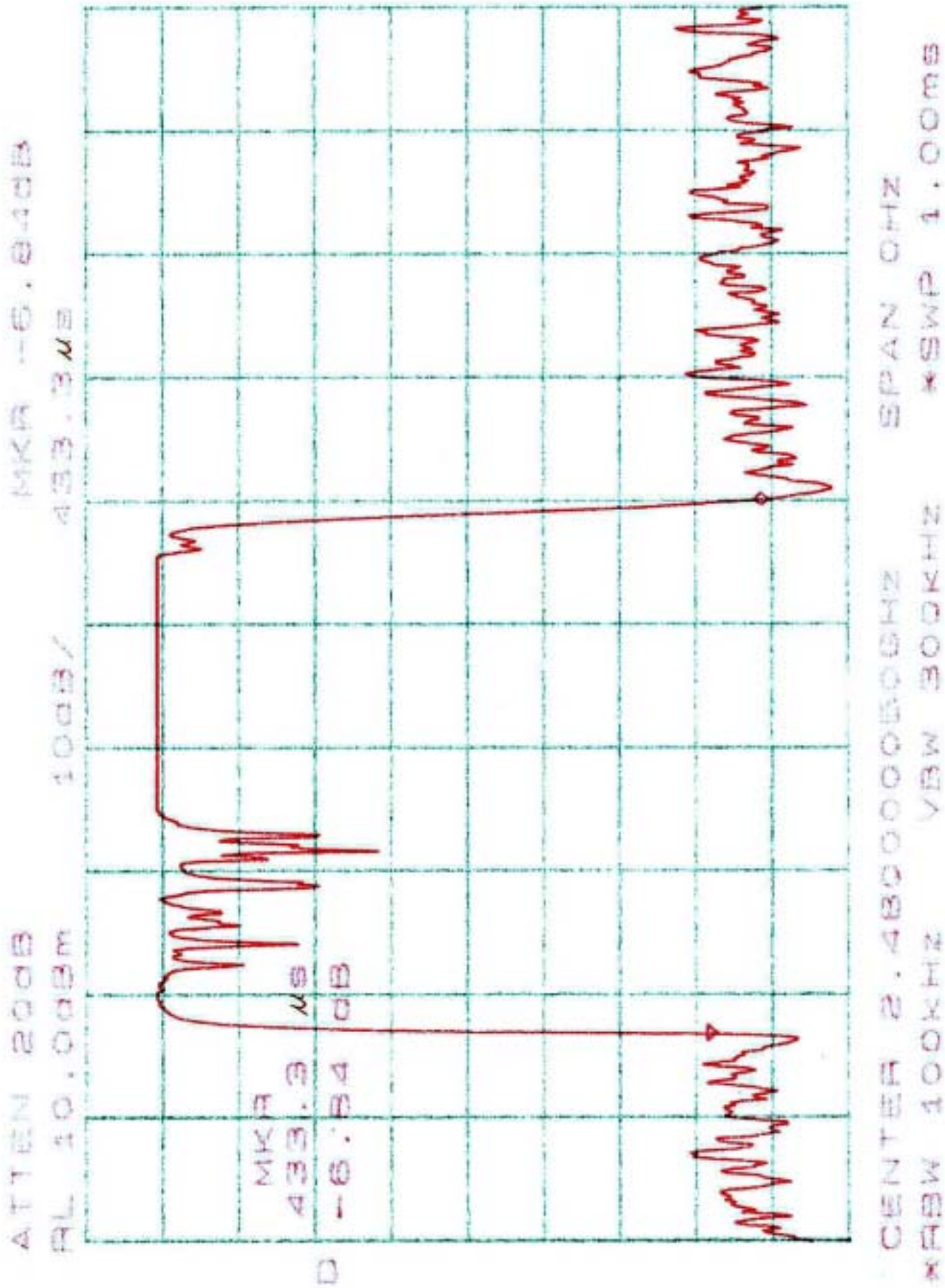

ATTEN 20dB
RL 10.0dBm
10dB/
CENTER 2.402000000GHz
SPAN 0Hz
*RBW 100kHz
VBW 300kHz
*SWP 5.00sec


ATTEN 20dB
RL 10.00dBm
10dB/
MKR 435.0 µs
-.50dB
MKR
435.0 µs
-.50 dB
CENTER 2.420000000GHz
SPAN 0Hz
*RBW 100kHz
VBW 300kHz
*SWP 1.00ms
0


ATTEN 20dB
RL 10.0dBm
10dB/
CENTER 2.441000000 GHz
CENTER 2.441000000GHz
SPAN 0Hz
*RBW 100kHz
VBW 300kHz
*SWP 5.00sec


ATTEN 20dB
RL 10.00dBm
10dB/
MKR -1.00dB
433.3µs
MKR
Δ433.3 µs
-1.00 dB
CENTER 2.441000000GHz
SPAN 0Hz
*RBW 100kHz
VBW 300kHz
*SWP 1.00ms


ATTEN 20dB
RL 10.0dBm
10dB/
D
CENTER 2.480000000GHz
SPAN 0Hz
*RBW 100kHz
VBW 300kHz
*SWP 5.00sec


ATTEN 20dB
RL 10.00dBm
10dB/
MKR -6.84dB
433.3μs
MKR
433.3μs
-6.84 dB
CENTER 2.480000000GHz
SPAN 0Hz
*RBW 100kHz
VBW 300kHz
*SWP 1.00ms