

FCC Part 15 EMI TEST REPORT of

E.U.T. : 802.11b mini-pci wireless lan
card

MODEL : WM1

FCC ID. : HFSWM100

for

APPLICANT : Quanta Computer Inc.

ADDRESS : No. 188, Wen Hwa 2nd Rd., Kuei Shan Hsiang,
Tao Yuan Shien, Taiwan, R.O.C.

Test Performed by

ELECTRONICS TESTING CENTER, TAIWAN
NO. 8 LANE 29, WENMIMG ROAD,
LOSHAN TSUN, KWEISHAN HSIANG,
TAOYUAN, TAIWAN, R.O.C.

Tel:(03)3280026#570~576

Fax:(03)3276188

Report Number : ET90S-11-032

TEST REPORT CERTIFICATION

Applicant : Quanta Computer Inc.
No. 188, Wen Hwa 2nd Rd., Kuei Shan Hsiang, Tao Yuan Shien,
Taiwan, R.O.C.

Manufacturer : Quanta Computer Inc.
No. 188, Wen Hwa 2nd Rd., Kuei Shan Hsiang, Tao Yuan Shien,
Taiwan, R.O.C.

Description of EUT :

- a) Type of EUT : 802.11b mini-pci wireless lan card
- b) Trade Name : Quanta
- c) Model No. : WM1
- d) Power Supply : Adaptor:I/P:100~240Vac 50/60Hz;
O/P:3.3V, Tx:380MA, Rx:215MA,
Tx:1.245W, Rx:0.7095W

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

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

Note: 1. The result of the testing report 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 : Dec. 05, 2001

Test Engineer : Ricard Hu

Approve & Authorized Signer :



Win-Po Tsai, Manager, NVLAP Signatory
EMC Dept. I of ELECTRONICS
TESTING CENTER, TAIWAN

Table of Contents	Page
1 GENERAL INFORMATION	1
1.1 Product Description.....	1
1.2 Characteristics of Device	1
1.3 Test Methodology.....	1
1.4 Test Facility.....	1
2 PROVISIONS APPLICABLE	2
2.1 Definition	2
2.2 Requirement for Compliance	3
2.3 Restricted Bands of Operation	5
2.4 Labeling Requirement	5
2.5 User Information	6
3. SYSTEM TEST CONFIGURATION	7
3.1 Justification	7
3.2 Devices for Tested System	7
4 RADIATED EMISSION MEASUREMENT	8
4.1 Applicable Standard	8
4.2 Measurement Procedure	8
4.3 Measuring Instrument.....	10
4.4 Radiated Emission Data	11
4.4.1 RF Portion	11
4.4.2 Other Emission	14
4.5 Field Strength Calculation.....	14
4.6 Photos of Radiation Measuring Setup.....	15
5 CONDUCTED EMISSION MEASUREMENT	19
5.1 Standard Applicable	19
5.2 Measurement Procedure	19
5.3 Conducted Emission Data	20
5.4 Result Data Calculation.....	21
5.5 Conducted Measurement Equipment	22
5.6 Photos of Conduction Measuring Setup.....	23
6 ANTENNA REQUIREMENT	24
6.1 Standard Applicable	24
6.2 Antenna Construction and Directional Gain	24
7 EMISSION BANDWIDTH MEASUREMENT	25

7.1 Standard Applicable	25
7.2 Measurement Procedure	25
7.3 Measurement Equipment.....	25
7.4 Measurement Data.....	26
8 OUTPUT POWER MEASUREMENT	27
8.1 Standard Applicable	27
8.2 Measurement Procedure	27
8.3 Measurement Equipment.....	27
8.4 Measurement Data.....	28
9 100 kHz BANDWIDTH OF BAND EDGES MEASUREMENT	29
9.1 Standard Applicable	29
9.2 Measurement Procedure	29
9.3 Measurement Equipment.....	29
9.4 Measurement Data.....	30
10 POWER DENSITY MEASUREMENT	31
10.1 Standard Applicable	31
10.2 Measurement Procedure	31
10.3 Measurement Equipment.....	31
10.4 Measurement Data.....	32
11 PROCESSING GAIN MEASUREMENT	33
11.1 Standard Applicable	33
11.2 Measurement Description	33
11.3 Measurement Equipment.....	35
11.4 Measurement Data.....	35
APPENDIX 1 : PLOTTED DATAS OF POWER LINE CONDUCTED EMISSIONS	36
APPENDIX 2 : ENGINEERING GRAPH OF ANTENNA CONSTRUCTION	43
APPENDIX 3 : PLOTTED DATAS OF EMISSIONS BANDWIDTH.....	46
APPENDIX 4 : PLOTTED DATAS OF OUTPUT PEAK POWER	50
APPENDIX 5 : PLOTTED DATAS OF BAND EDGE EMISSION	54
APPENDIX 6 : PLOTTED DATAS OF POWER DENSITY	64
APPENDIX 7 : PROCESSING GAIN TESTED DATA SHEETS	68

1 GENERAL INFORMATION

1.1 Product Description

a) Type of EUT	: 802.11b mini-pci wireless lan card
b) Trade Name	: Quanta
c) Model No.	: WM1
d) Power Supply	: Adaptor:I/P:100~240Vac 50/60Hz; O/P:3.3V, Tx:380MA, Rx:215MA, Tx:1.245W, Rx:0.7095W

1.2 Characteristics of Device

- ♦ Fully IEEE 802.11b and Wi-Fi compatible
- ♦ Seamless roaming under 802.11b WLAN infrastructure
- ♦ Support 11M/5.5M/2M/1M automatically fall back functionality
- ♦ WEP 40/64/128 bits encryption provided
- ♦ User-friendly installation, just plug and play
- ♦ Provide Web-based configuration utility and window-based diagnostic tools
- ♦ Good receiving sensitivity and block free design

1.3 Test Methodology

The 802.11b mini-pci wireless lan card designed with a transmitting method of direct sequence spread spectrum is for local area network operation, which operates at 2.4 GHz ISM band and data rate up to 11 Mbps. The rated output power is 19.9 dBm (97.7 mW).

1.4 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 or industrial environment. Example of such devices that are marketed for the general public.

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

Intentional radiator:

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

2.2 Requirement for Compliance

(1) Conducted Emission Requirement

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

Frequency MHz	Emissions V	Emissions dBV
0.45 - 30.0	250	48.0

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

(2) Radiated Emission Requirement

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

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

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

(3) Antenna Requirement

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

(4) Bandwidth Requirement

For direct sequence system, according to 15.247(a)(2), the minimum 6dB bandwidth shall be at least 500 kHz.

(5) Output Power Requirement

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

(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) Power Density Requirement

According to 15.247(d), for direct sequence systems, the transmitted power density averaged over any 1 second interval shall not be greater than 8 dBm in any 3 kHz bandwidth within these bands.

(8) Processing Gain Requirement

According to 15.247(e), the processing gain of a direct sequence system shall be at least 10 dB. The processing gain shall be determined from the ratio in dB of the signal to noise ratio with the system spreading code turned off to the signal to noise ratio with the system spreading code turned on, as measured at the demodulated output of the receiver.

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 both radiated and conducted emissions, EUT was extended from notebook PC. The notebook PC put in an aluminum box and shielded it.

3.2 Devices for Tested System

Device	Manufacture	Model / FCC ID.	Cable Description
802.11b mini-pci wireless lan card *	Quanta Computer Inc.	WM1 HFSWM100	----

Remark “*” means equipment under test.

4 RADIATED EMISSION MEASUREMENT

4.1 Applicable Standard

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

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

4.2 Measurement Procedure

1. Setup the configuration per figure 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 data rate, placement of ANT. cables associated with EUT and changed ANT.1 ~ANT.4 to obtain the worse case and record the result.

Figure 1 : Frequencies measured below 1 GHz configuration

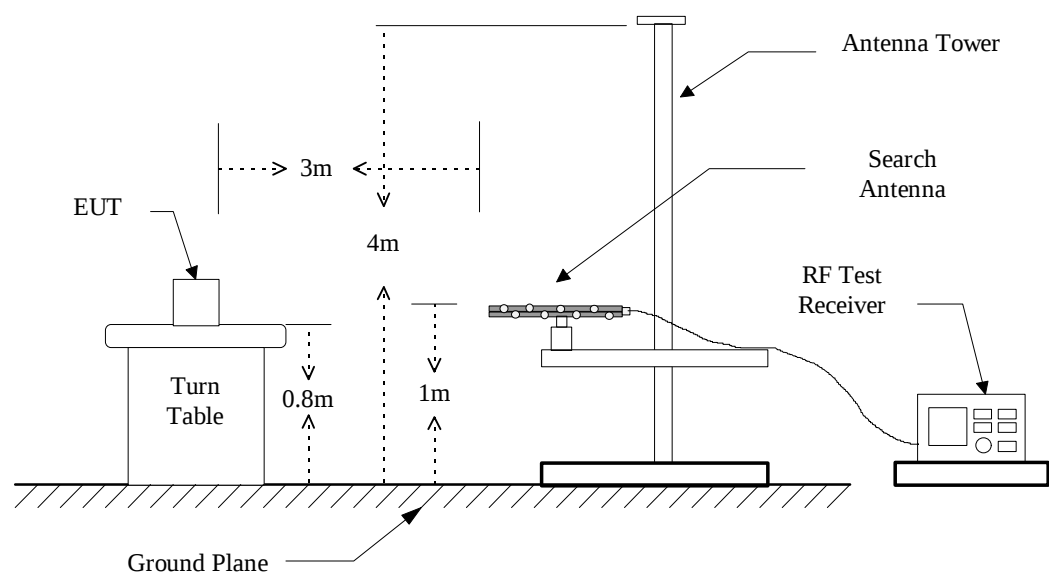
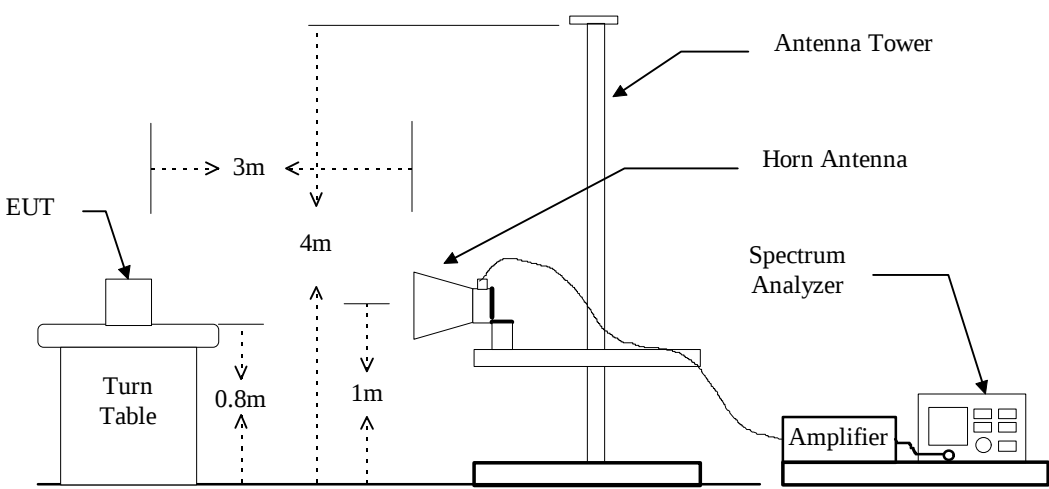


Figure 2 : Frequencies measured above 1 GHz configuration



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	01/31/2002
Horn Antenna	EMCO	3115	05/09/2002
LogBicone Antenna	Schwarzbeck	9160	10/18/2002
Horn Antenna	EMCO	3116	06/28/2002
Preamplifier	Hewlett-Packard	8449B	08/30/2002
Spectrum Analyzer	Hewlett-Packard	8564EC	09/10/2002

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

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

4.4 Radiated Emission Data

4.4.1 RF Portion

a) Channel 1

Operation Mode : Receiving /Transmitting

Fundamental Frequency : 2412 MHz (Local Frequency : 2038 MHz)

Test Date : Dec. 03, 2001

Temperature : 23

Humidity : 65 %

Frequency (MHz)	Reading (dBuV)				Factor (dB) Corr.	Result @3m (dBuV/m)		Limit @3m (dBuV/m)		Margin (dB)	Table Deg. (Deg.)	Ant. High (m)
	H Peak	V Ave	H Peak	V Ave		Peak	Ave	Peak	Ave.			
2038.000	61.2	47.2	64.5	56.5	-3.3	61.2	53.2	74.0	54.0	-0.8	305	1.0
4076.000	---	---	---	---	9.8	---	---	74.0	54.0	---	---	---
6114.000	---	---	---	---	12.5	---	---	74.0	54.0	---	---	---
8152.000	---	---	---	---	17.3	---	---	74.0	54.0	---	---	---
10190.000	---	---	---	---	18.3	---	---	74.0	54.0	---	---	---
4824.000	47.2	33.7	51.2	35.3	11.5	62.7	46.8	74.0	54.0	-7.2	78	1.3
7236.000	---	---	---	---	15.1	---	---	74.0	54.0	---	---	---
9648.000	---	---	---	---	17.7	---	---	74.0	54.0	---	---	---
12060.000	---	---	---	---	22.9	---	---	74.0	54.0	---	---	---
14472.000	---	---	---	---	25.6	---	---	74.0	54.0	---	---	---
16884.000	---	---	---	---	25.6	---	---	74.0	54.0	---	---	---
19296.000	---	---	---	---	31.0	---	---	74.0	54.0	---	---	---
21708.000	---	---	---	---	31.4	---	---	74.0	54.0	---	---	---
24120.000	---	---	---	---	30.7	---	---	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.

b) Channel 6

Operation Mode : Receiving / Transmitting

Fundamental Frequency : 2437 MHz (Local Frequency : 2063 MHz)

Test Date : Dec. 03, 2001

Temperature : 23

Humidity : 65 %

Frequency (MHz)	Reading (dBuV)				Factor (dB) Corr.	Result @3m (dBuV/m)		Limit @3m (dBuV/m)		Margin (dB)	Table Deg. (Deg.)	Ant. High (m)
	H Peak	Ave	V Peak	Ave		Peak	Ave	Peak	Ave.			
2063.000	58.8	***	63.8	56.0	-3.2	60.6	52.8	74.0	54.0	-1.2	309	1.0
4126.000	---	---	---	---	9.9	---	---	74.0	54.0	---	---	---
6189.000	---	---	---	---	12.6	---	---	74.0	54.0	---	---	---
8252.000	---	---	---	---	17.2	---	---	74.0	54.0	---	---	---
10315.000	---	---	---	---	18.5	---	---	74.0	54.0	---	---	---
4874.000	47.3	34.2	53.0	38.2	11.6	64.6	49.8	74.0	54.0	-4.2	20	1.0
7311.000	---	---	---	---	15.1	---	---	74.0	54.0	---	---	---
9748.000	---	---	---	---	17.8	---	---	74.0	54.0	---	---	---
12185.000	---	---	---	---	22.1	---	---	74.0	54.0	---	---	---
14622.000	---	---	---	---	25.6	---	---	74.0	54.0	---	---	---
17059.000	---	---	---	---	25.7	---	---	74.0	54.0	---	---	---
19496.000	---	---	---	---	31.1	---	---	74.0	54.0	---	---	---
21933.000	---	---	---	---	31.4	---	---	74.0	54.0	---	---	---
24370.000	---	---	---	---	30.5	---	---	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.

c) Channel 11

Operation Mode : Receiving / Transmitting

Fundamental Frequency : 2462 MHz (Local Frequency : 2088 MHz)

Test Date : Dec. 03, 2001

Temperature : 23

Humidity : 65 %

Frequency (MHz)	Reading (dBuV)				Factor (dB) Corr.	Result @3m (dBuV/m)		Limit @3m (dBuV/m)		Margin (dB)	Table Deg. (Deg.)	Ant. High (m)
	H Peak	V Ave	H Peak	V Ave		Peak	Ave	Peak	Ave.			
2088.000	59.3	42.0	64.0	56.0	-3.1	60.9	52.9	74.0	54.0	-1.1	310	1.0
4176.000	---	---	---	---	10.0	---	---	74.0	54.0	---	---	---
6264.000	---	---	---	---	12.8	---	---	74.0	54.0	---	---	---
8352.000	---	---	---	---	17.4	---	---	74.0	54.0	---	---	---
10440.000	---	---	---	---	18.9	---	---	74.0	54.0	---	---	---
4924.000	49.3	34.0	52.5	36.5	11.7	64.2	48.2	74.0	54.0	-5.8	285	1.0
7386.000	---	---	---	---	15.2	---	---	74.0	54.0	---	---	---
9848.000	---	---	---	---	17.9	---	---	74.0	54.0	---	---	---
12310.000	---	---	---	---	22.1	---	---	74.0	54.0	---	---	---
14772.000	---	---	---	---	25.7	---	---	74.0	54.0	---	---	---
17234.000	---	---	---	---	25.7	---	---	74.0	54.0	---	---	---
19696.000	---	---	---	---	31.2	---	---	74.0	54.0	---	---	---
22158.000	---	---	---	---	31.5	---	---	74.0	54.0	---	---	---
24620.000	---	---	---	---	31.0	---	---	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.

4.4.2 Other Emission

a) Emission frequencies below 1 GHz

Test Date : Dec. 05, 2001

Temperature : 23

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)
31.940	V	2.0	24.9	26.9	40.0	-13.1	280	1.0
96.930	H	29.8	9.4	39.2	43.5	-4.3	145	1.0
444.190	H	20.3	21.3	41.6	46.0	-4.4	200	1.2
444.190	V	12.4	21.3	33.7	46.0	-12.3	300	1.0
465.530	H	21.1	21.3	42.4	46.0	-3.6	360	1.1
478.140	H	18.8	22.3	41.1	46.0	-4.9	240	1.0
478.140	V	12.2	22.3	34.5	46.0	-11.5	270	1.1
512.090	H	19.8	22.3	42.1	46.0	-3.9	325	1.0
512.090	V	14.0	22.3	36.3	46.0	-9.7	320	1.0
521.790	H	20.9	22.3	43.2	46.0	-2.8	310	1.4
521.790	V	14.1	22.3	36.4	46.0	-9.6	230	1.0
555.740	V	11.5	23.7	35.2	46.0	-10.8	175	1.0

b) Emission frequencies above 1 GHz

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

4.5 Field Strength Calculation

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

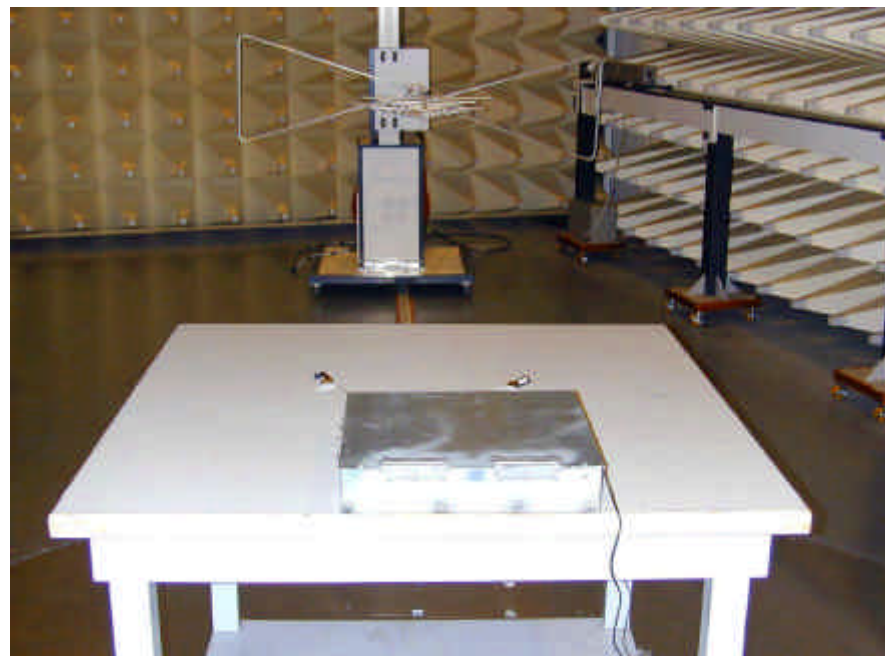
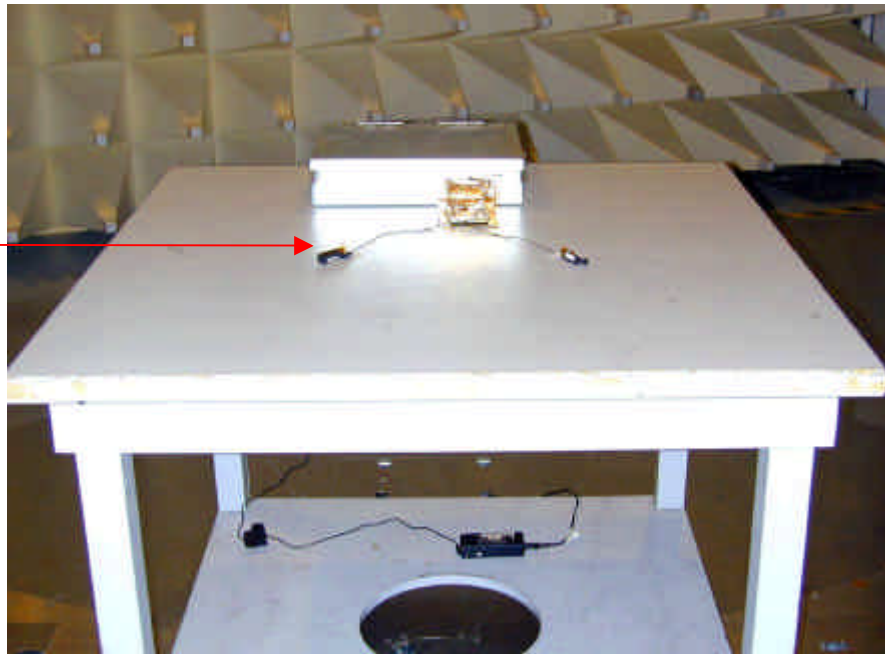
$$\text{Result} = \text{Reading} + \text{Corrected Factor}$$

where

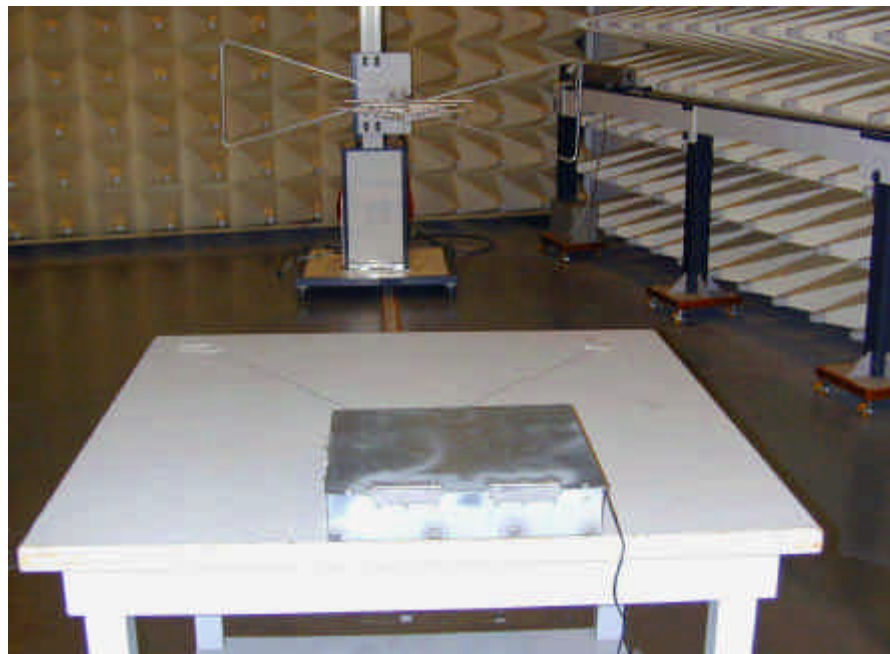
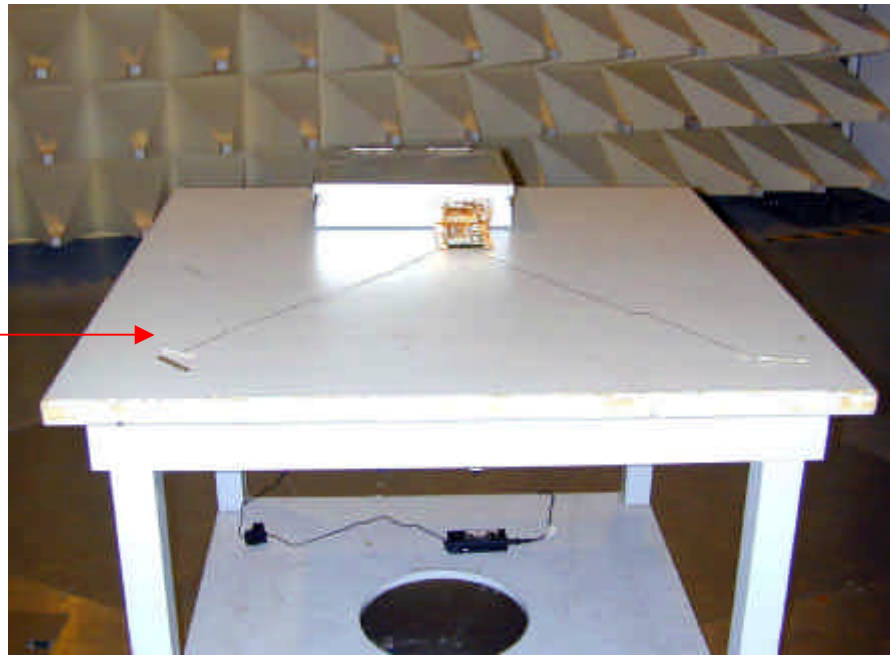
Corrected Factor = Antenna FACTOR + Cable Loss + High Pass Filter Loss - Amplifier Gain

4.6 Photos of Radiation Measuring Setup

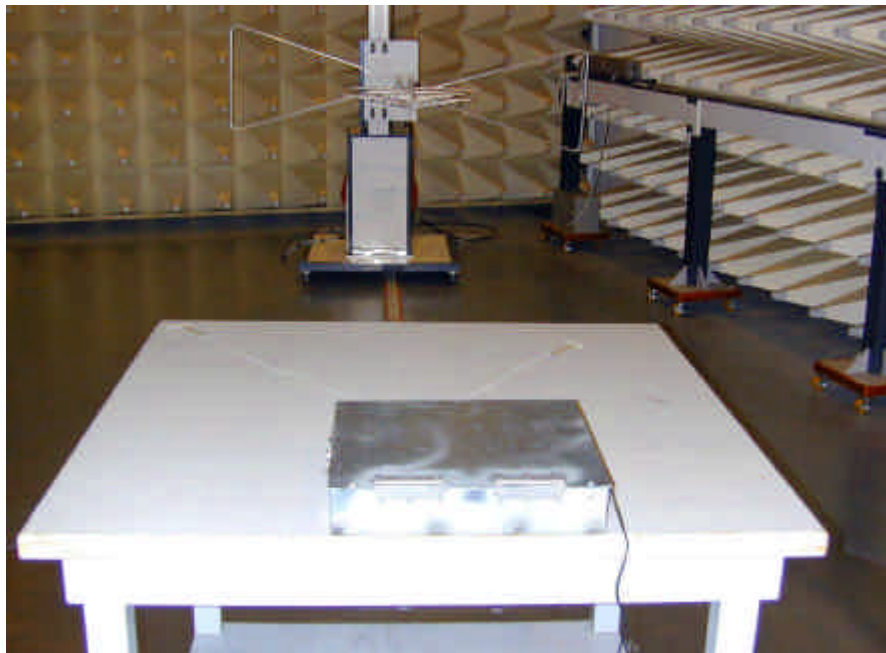
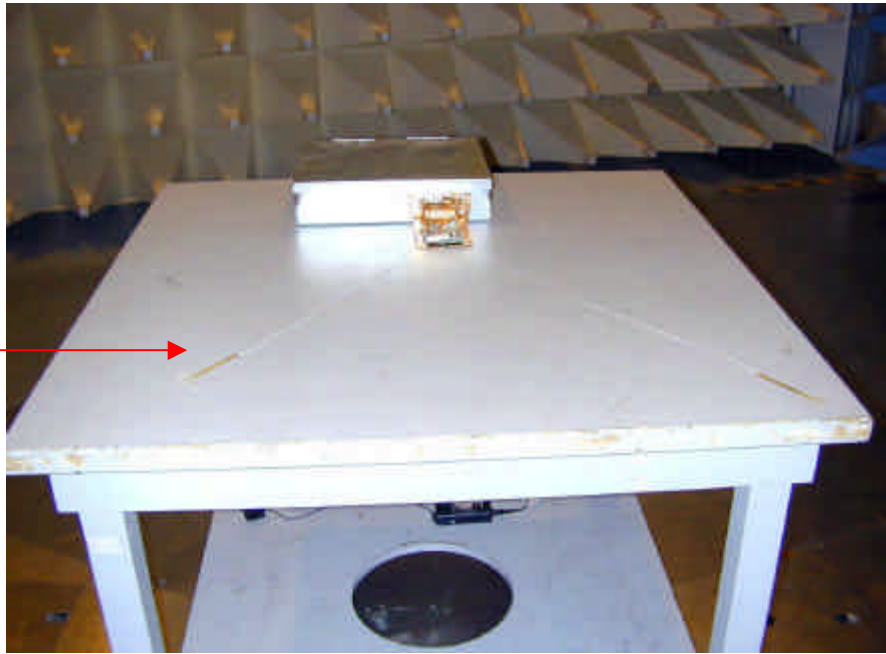
ANT. 1



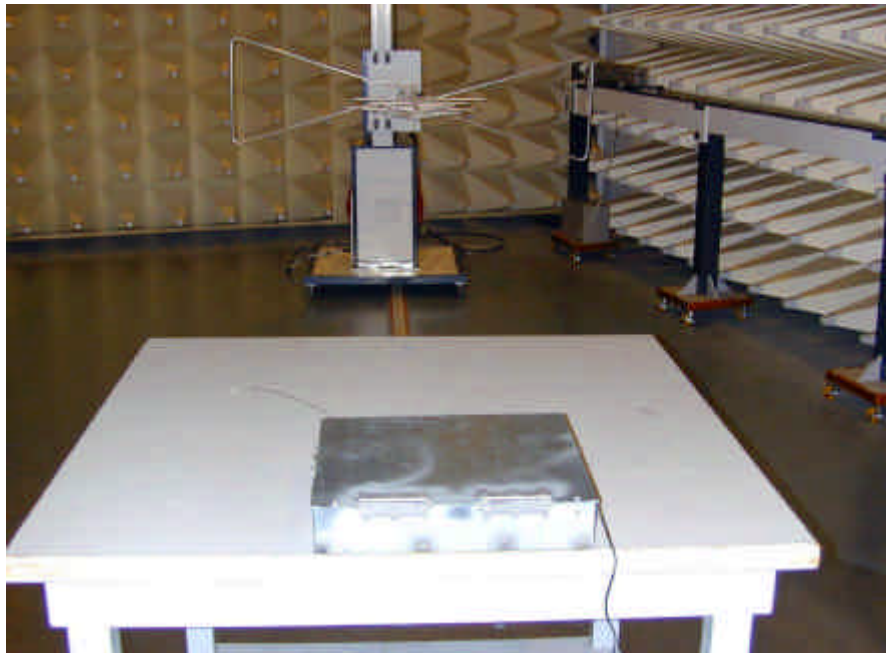
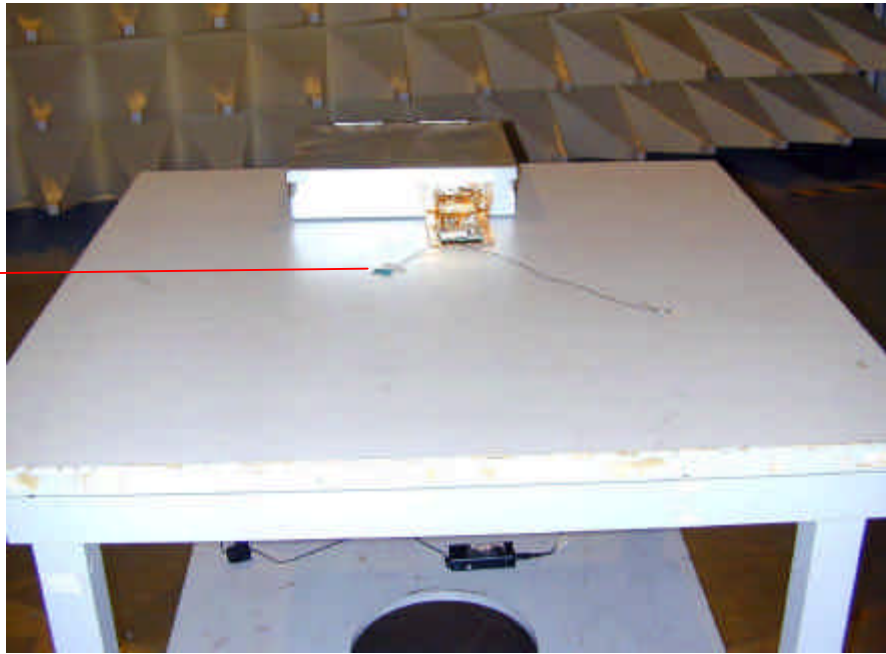
ANT. 2



ANT. 3



ANT. 4



5 CONDUCTED EMISSION MEASUREMENT

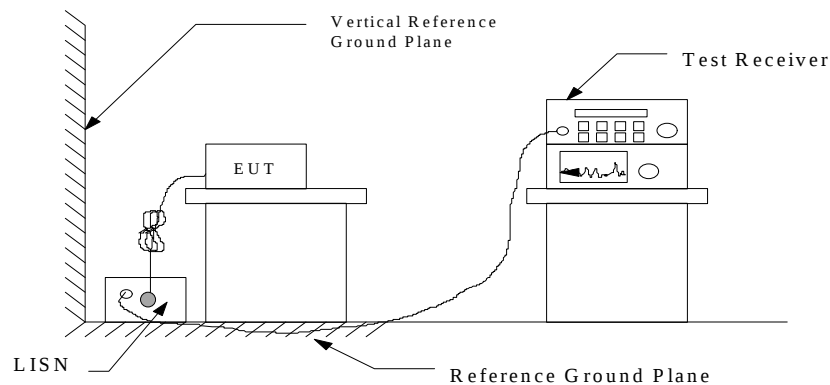
5.1 Standard Applicable

For unintentional and intentional device, Line Conducted Emission Limits are in accordance to 15.107(a) and 15.207(a) respectively. Both Limits are identical specification.

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 6 or 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 three 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

a) Channel 1

Operation Mode : Transmitting / Receiving

Test Date : Dec. 05, 2001

Temperature : 22

Humidity: 66 %

Frequency (MHz)	Reading (dBuV)		Factor (dB)	Result (dBuV)		Limit (dBuV)	Margin (dB)
	L1	L2		L1	L2		
0.505	29.1#	29.3#	0.1	29.2#	29.4#	48.0	-18.6
0.563	27.6#	26.8#	0.1	27.7#	26.9#	48.0	-20.3
0.942	***	27.9#	0.1	***	28.0#	48.0	-20.0
1.980	29.0#	***	0.2	29.2#	***	48.0	-18.8
4.648	***	27.9#	0.2	***	28.1#	48.0	-19.9
6.691	29.3#	***	0.2	29.5#	***	48.0	-18.5
27.207	***	30.4#	0.5	***	30.9#	48.0	-17.1
27.344	30.7#	***	0.5	31.2#	***	48.0	-16.8
28.684	31.2#	***	0.5	31.7#	***	48.0	-16.3
29.345	***	31.5#	0.5	***	32.0#	48.0	-16.0

b) Channel 6

Operation Mode : Transmitting / Receiving

Test Date : Dec. 05, 2001

Temperature : 22

Humidity: 66 %

Frequency (MHz)	Reading (dBuV)		Factor (dB)	Result (dBuV)		Limit (dBuV)	Margin (dB)
	L1	L2		L1	L2		
0.505	27.5#	28.1#	0.1	27.6#	28.2#	48.0	-19.8
0.563	***	26.7#	0.1	***	26.8#	48.0	-21.2
0.692	24.3#	***	0.1	24.4#	***	48.0	-23.6
1.004	***	26.3#	0.2	***	26.5#	48.0	-21.5
1.695	25.6#	***	0.2	25.8#	***	48.0	-22.2
3.457	27.1#	***	0.2	27.3#	***	48.0	-20.7
4.715	***	28.3#	0.2	***	28.5#	48.0	-19.5
4.965	28.0#	***	0.2	28.2#	***	48.0	-19.8
27.238	***	26.4#	0.5	***	26.9#	48.0	-21.1
27.777	31.4#	***	0.5	31.9#	***	48.0	-16.1

c) Channel 11

Operation Mode : Transmitting / Receiving

Test Date : Dec. 05, 2001

Temperature : 22

Humidity: 66 %

Frequency (MHz)	Reading (dBuV)		Factor (dB)	Result (dBuV)		Limit (dBuV)	Margin (dB)
	L1	L2		L1	L2		
0.505	28.9#	26.6#	0.1	29.0#	26.7#	48.0	-19.0
0.563	26.0#	26.3#	0.1	26.1#	26.4#	48.0	-21.6
1.008	***	28.0#	0.2	***	28.2#	48.0	-19.8
2.230	***	27.4#	0.2	***	27.6#	48.0	-20.4
2.891	26.1#	***	0.2	26.3#	***	48.0	-21.7
4.652	27.8#	***	0.2	28.0#	***	48.0	-20.0
5.344	27.3#	***	0.2	27.5#	***	48.0	-20.5
27.102	***	27.4#	0.5	***	27.9#	48.0	-20.2
28.824	***	27.6#	0.5	***	28.1#	48.0	-19.9
28.953	27.0#	***	0.5	27.5#	***	48.0	-20.5

- 1)① If the data table appeared symbol of "****" means the value was too low to be measured.
 ② 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.
 ③ If the data table appeared symbol of “#” means the noise was low, so record the peak value.

Note : Please see appendix 1 for Ploted Datas**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:

$$\text{RESULT} = \text{READING} + \text{LISN FACTOR (Included Cable Loss)}$$

Assume a receiver reading of 22.5 dBV is obtained, and LISN Factor is 0.1 dB, then the total of disturbance voltage is 22.6 dBV.

$$\text{RESULT} = 22.5 + 0.1 = 22.6 \text{ dBV}$$

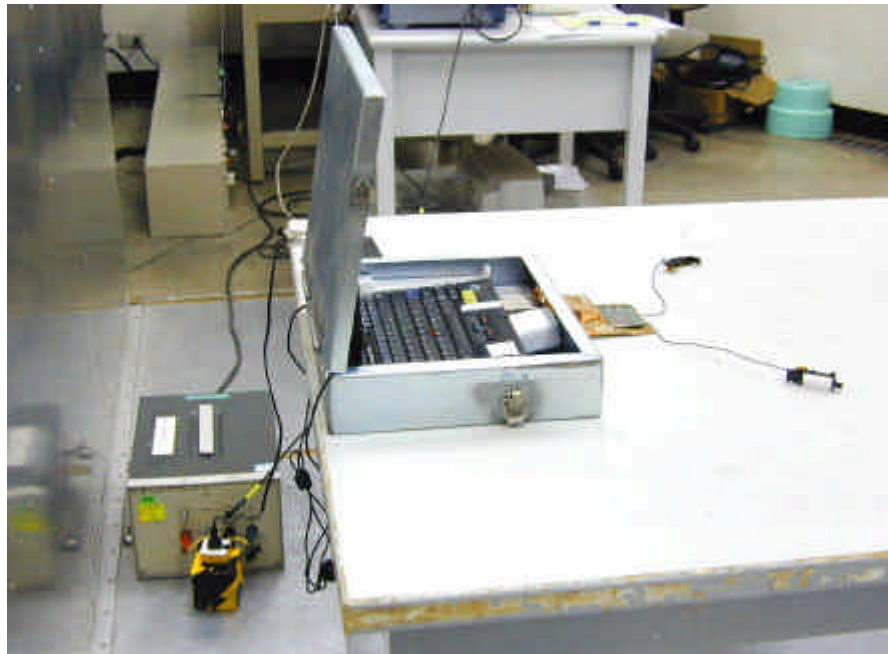
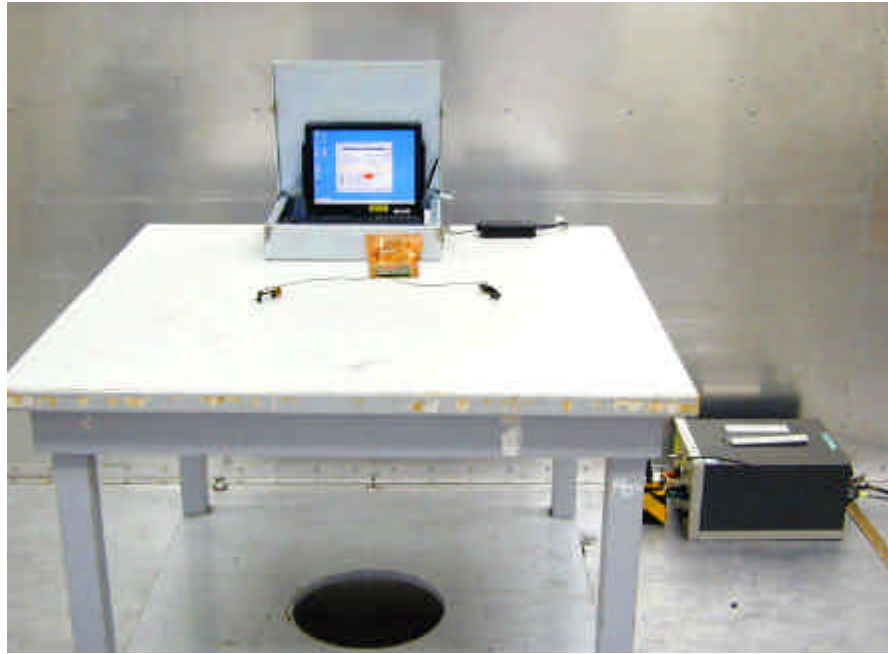
$$\begin{aligned} \text{Level in V} &= \text{Common Antilogarithm}[(22.6 \text{ dBV})/20] \\ &= 13.48 \text{ V} \end{aligned}$$

5.5 Conducted Measurement Equipment

The following test equipment are used during the conducted test .

Equipment	Manufacturer	Model No.	Next Cal. Due
RF Test Receiver	Rohde and Schwarz	ESCS30	09/18/2002
Line Impedance Stabilization network	EMCO	3825	10/27/2002

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

The antenna terminal of this unit is designed with a female HIROSE Connector. Please see construction Photos Of Exhibit B for details.

The directional gain of antenna used for transmitting is Peak 2dBi, Typical 0.5~1.5dBi and the details antenna construction please see **Appendix 2**.

7 EMISSION BANDWIDTH MEASUREMENT

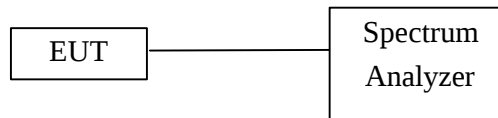
7.1 Standard Applicable

According to 15.247(a)(2), for direct sequence system, the minimum 6dB bandwidth shall be at least 500 kHz.

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 6 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	7440A	N/A
Spectrum Analyzer	Hewlett-Packard	8564EC	09/10/2002

7.4 Measurement Data

Test Date : Dec. 04, 2001 Temperature : 20 Humidity: 65 %

- a) Channel 01 : 6 dB Emission Bandwidth is 11.17 MHz
- b) Channel 06 : 6 dB Emission Bandwidth is 9.17 MHz
- c) Channel 11 : 6 dB Emission Bandwidth is 9.00 MHz

Note: Please see Appendix 3 for plotted datas

8 OUTPUT POWER MEASUREMENT

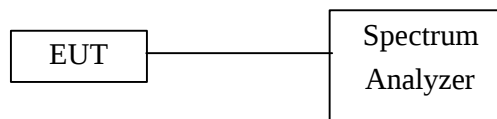
8.1 Standard Applicable

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

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 2 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	7440A	N/A
Spectrum Analyzer	Hewlett-Packard	8564EC	09/10/2002

8.4 Measurement Data

Test Date : Dec. 04, 2001 Temperature : 20 Humidity: 65 %

- a) Channel 01 : Output Peak Power is 19.9 dBm or **97.7 mW**
- b) Channel 06 : Output Peak Power is 19.8 dBm or **95.5 mW**
- c) Channel 11 : Output Peak Power is 19.3 dBm or **85.1 mW**

Note: Please see Appendix 4 for plotted datas

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	7440A	N/A
Spectrum Analyzer	Hewlett-Packard	8564EC	09/10/2002

9.4 Measurement Data

Test Date : Dec. 04, 2001 Temperature : 20 Humidity: 65 %

- a) Lower Band Edge : maximum value is -26.0 dBm that is attenuated more than 20dB
- b) Upper Band Edge : maximum value is -48.7 dBm that is attenuated more than 20dB

Note: Please see Appendix 5 for plotted datas

10 POWER DENSITY MEASUREMENT

10.1 Standard Applicable

According to 15.247(d), for direct sequence systems, the transmitted power density averaged over any 1 second interval shall not be greater than 8 dBm in any 3 kHz bandwidth within these bands.

10.2 Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT as shown in figure 5. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set EUT to any one measured frequency within its operating range and make sure the instrument is operated in its linear range.
3. Adjust the center frequency of spectrum analyzer on highest level appearing on spectral display within a 300 kHz frequency span.
4. Set the spectrum analyzer on a 3 kHz resolution bandwidth and 10 kHz video bandwidth as well as max. hold function, then record the measurement result.
5. Repeat above procedures until all measured frequencies were complete.

10.3 Measurement Equipment

Equipment	Manufacturer	Model No.	Next Cal. Due
Plotter	Hewlett-Packard	7440A	N/A
Spectrum Analyzer	Hewlett-Packard	8564EC	09/10/2002

10.4 Measurement Data

Test Date : Dec. 04, 2001 Temperature : 20 Humidity: 65 %

- a) Channel 01 : Maximun Power Density of 3 kHz Bandwidth is -8.7 dBm
- b) Channel 06 : Maximun Power Density of 3 kHz Bandwidth is -8.5 dBm
- c) Channel 11 : Maximun Power Density of 3 kHz Bandwidth is -9.3 dBm

Note: Please see Appendix 6 for plotted datas

11 PROCESSING GAIN MEASUREMENT

11.1 Standard Applicable

According to 15.247(e), the processing gain of a direct sequence system shall be at least 10 dB. The processing gain shall be determined from the ratio in dB of the signal to noise ratio with the system spreading code turned off to the signal to noise ratio with the system spreading code turned on, as measured at the demodulated output of the receiver.

11.2 Measurement Description

The processing gain measurement is based upon the CW jamming margin method suggested in the FCC document entitled “GUIDANCE ON MEASUREMENTS FOR DIRECT SEQUENCE SPREAD SPECTRUM SYSTEMS, 54597, July 12,1995”

The test consists of stepping a CW signal generator in 50KHz increment across pass band of each three channels within 2400 – 2483 MHz band. This CW signal represents the jamming signal. The selected three channels are as followings:

Channel 01: centered at 2412 MHz

Channel 06: centered at 2437 MHz

Channel 11: centered at 2462 MHz

These three channels represents the Low, Mid and High frequency bands of the EUT, respectively. And, the processing gain of the EUT determined for these bands should be representative of the entire band.

(1). Measurement Configuration

The measurement configuration (draw in next page) is according to FCC document 54797,page3.

(2) Derivation of the Processing Gain

(a) The Processing Gain (G_p) is calculated according to the following equations:

$$G_p = (S/N)_o + M_j + L_{sys} \dots (4-1) \dots \text{Refer to FCC document 54797 Page3}$$

Where M_j = J/S ratio (dB)

L_{sys} = System losses (assumed to be 2 dB)

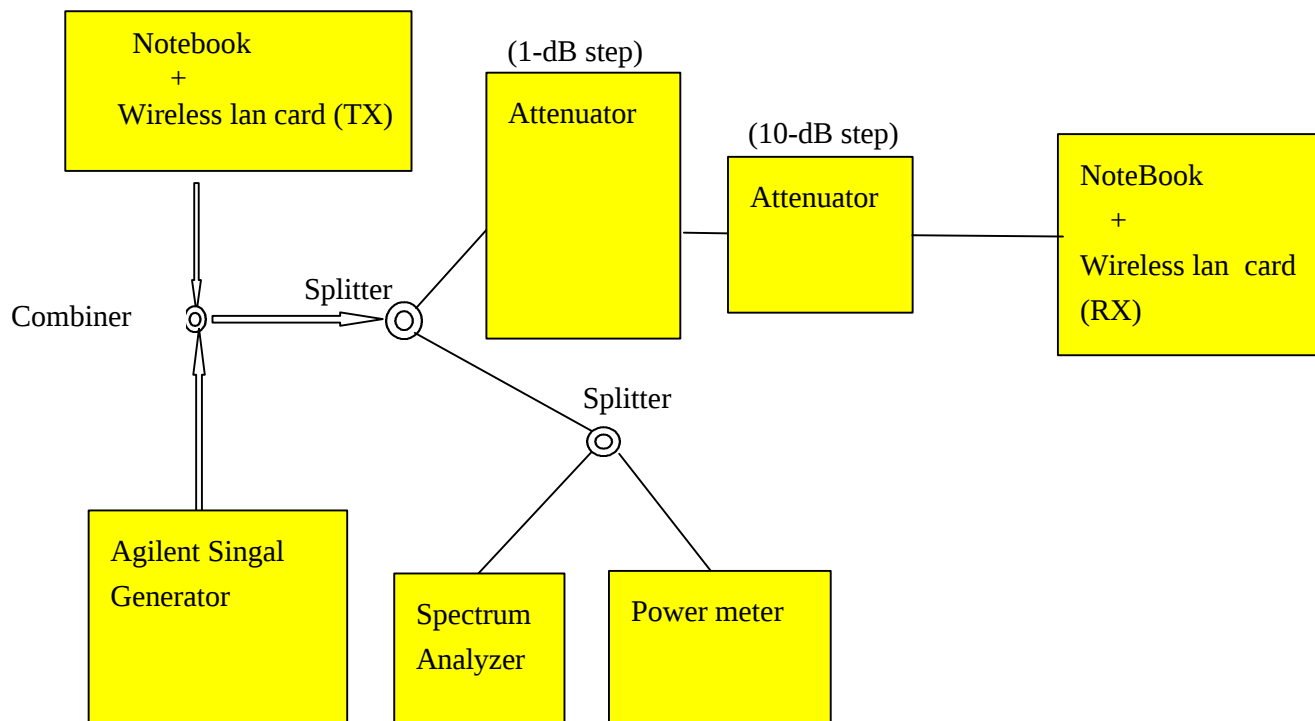
$(S/N)_o$ = the required signal to noise ratio at the receiver output for a given received signal quality

Therefore, from equation (4-1)

$$G_p = 16.4 + J/S + 2 \text{ (dB)} = 18.4 + J/S \text{ (dB)} \dots (4-2)$$

(3) Test Results

The tested data are listed in the following pages. After discarding the worst 20% of the J/S ratio data points, the lowest remaining J/S ratio is used to determine the processing gain (PG), according to the derivative equation (4/2), of each tested channel.



11.3 Measurement Equipment

Equipment	Manufacturer	Model No.	Next Cal. Due
Spectrum Analyzer	Agilent	E4407B	06/11/2002
Signal Generator	Agilent	E4433B	06/07/2002
Power Meter	Agilent	E4417A	06/11/2002
Attenuator	Agilent	8496A	06/08/2002
Attenuator	Agilent	8494A	06/09/2002
Combiner/Splitter	Merrimac	PMD-24M-6G	N/A

11.4 Measurement Data

Test Date : Dec. 14, 2001 Temperature : 20 Humidity: 67 %

The processing gain is greater than 10 dB, please see Appendix 7 for details.

Data Rate = 11Mbps

For channel 1, PG =12.1 (2412 MHz)

channel 6, PG =12.1 (2437 MHz)

channel 11, PG =12.1 (2462 MHz)

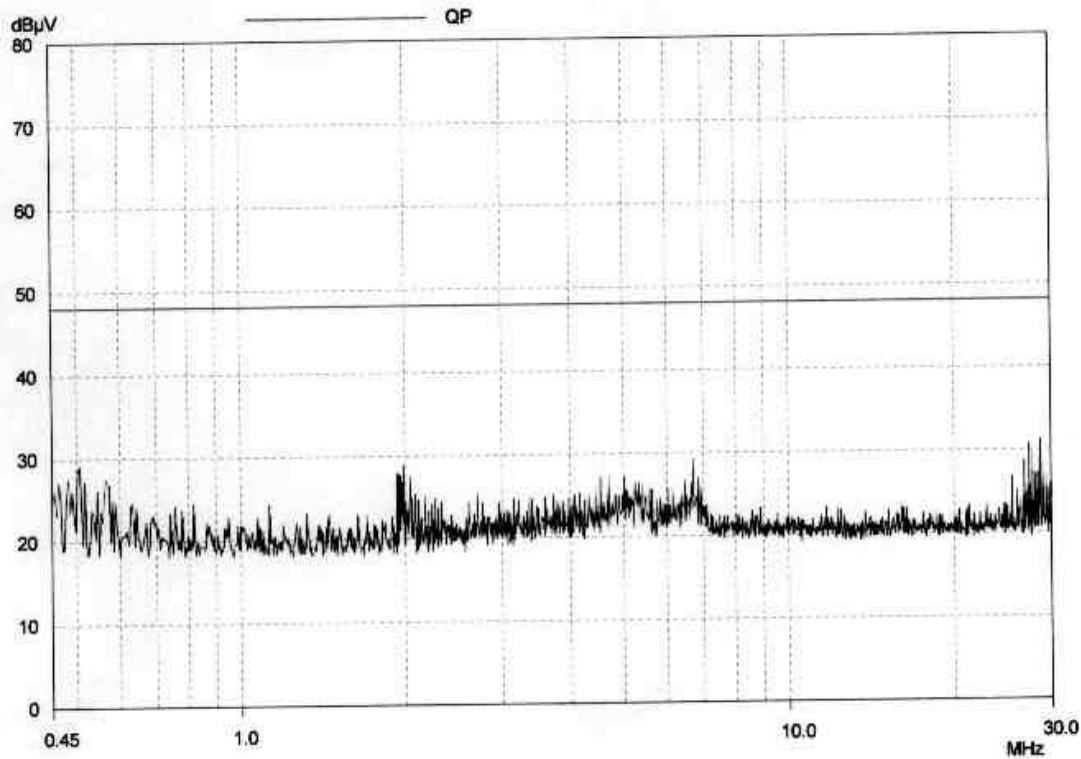
In these three channels, the processing-gain values of EUT are all greater than 10dB, which satisfies §15.247(e).

Appendix 1 : Ploted Datas of Power Line Conducted Emissions

Conducted Emission
Peak Value

EUT: Wireless LAN Mini PCI Card
Manuf:
Op Cond: CH1 Datarate 11Mbps
Operator: Rick Hu
Test Spec: FCC Class B
Comment: L1

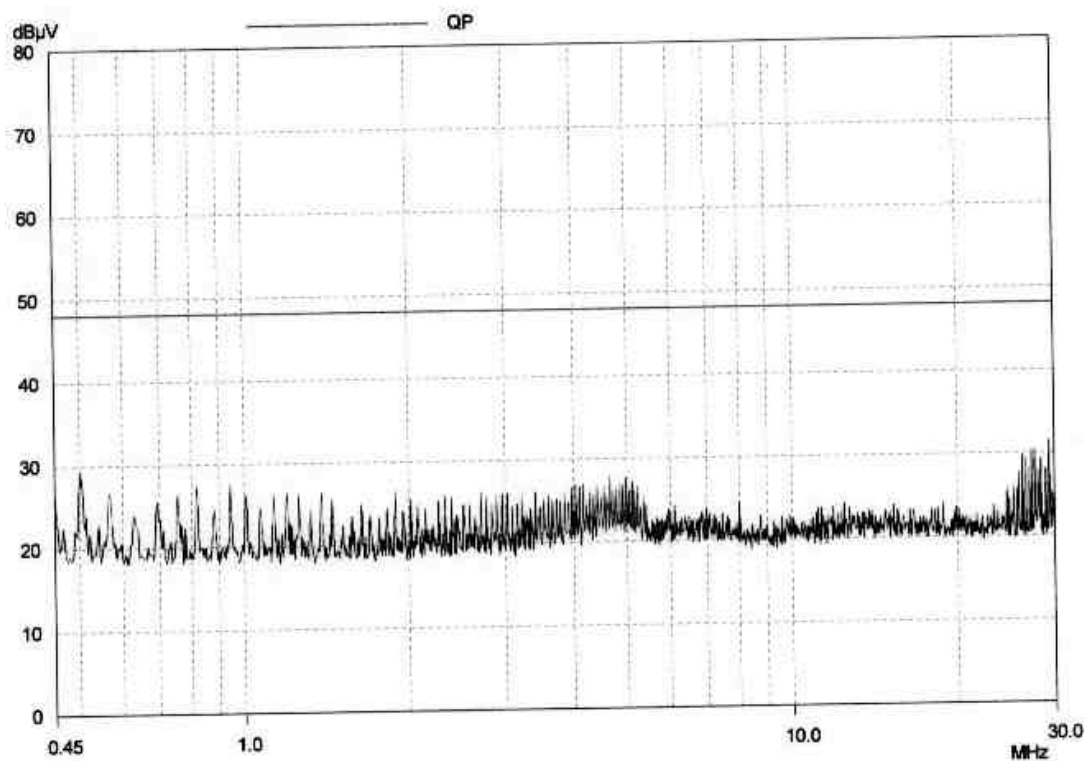
Prescan Measurement: Detector: X PK
Meas Time: see scan settings
Peaks: 8
Acc Margin: 10 dB



Conducted Emission**Peak Value**

EUT: Wireless LAN Mini PCI Card
Manuf:
Op Cond: CH1 Datarate 11Mbps
Operator: Rick Hu
Test Spec: FCC Class B
Comment: L2

Prescan Measurement: Detector: X PK
Meas Time: see scan settings
Peaks: 8
Acc Margin: 10 dB

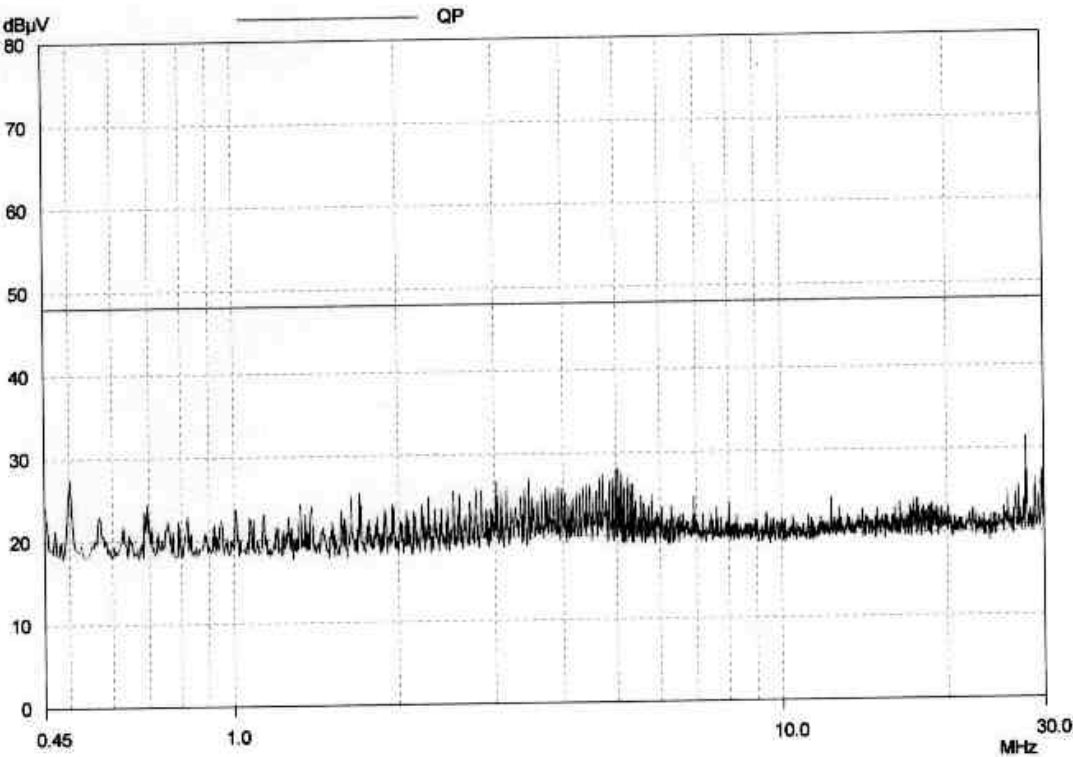


Conducted Emission

Peak Value

EUT: Wireless LAN Mini PCI Card
Manuf:
Op Cond: CH6 Datarate 11Mbps
Operator: Rick Hu
Test Spec: FCC Class B
Comment: L1

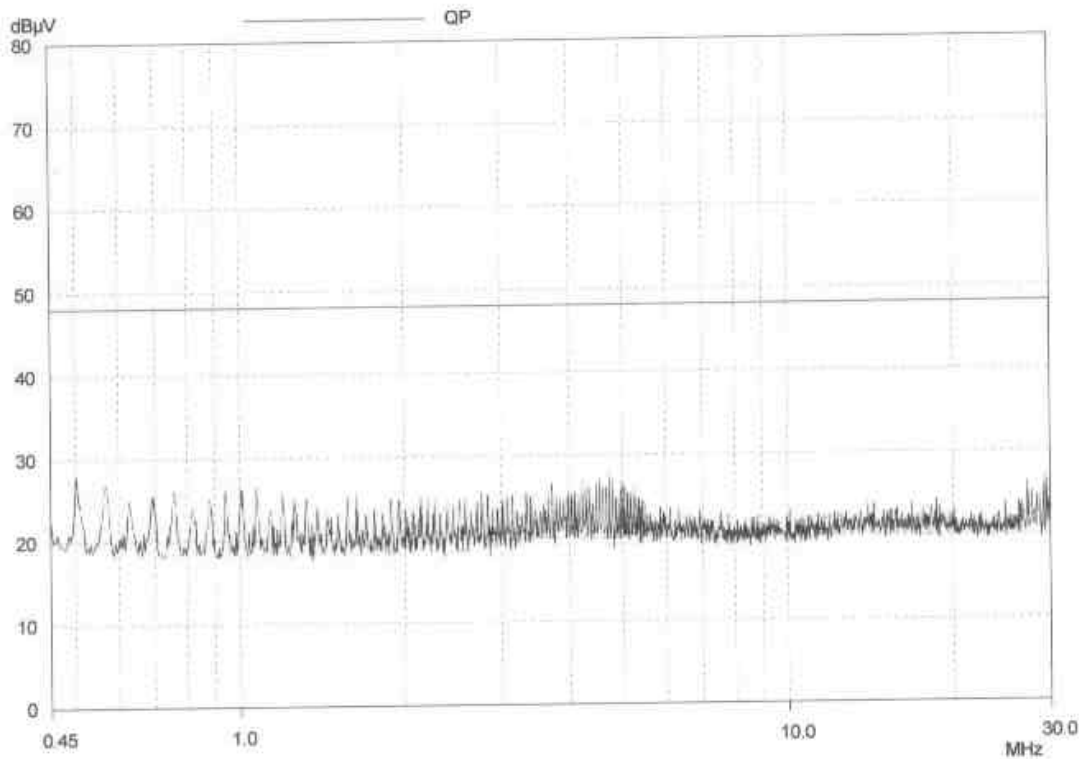
Prescan Measurement: Detector: X PK
 Meas Time: see scan settings
 Peaks: 8
 Acc Margin: 10 dB



Conducted Emission
Peak Value

EUT: Wireless LAN Mini PCI Card
Manuf:
Op Cond: CH6 Datarate 11Mbps
Operator: Rick Hu
Test Spec: FCC Class B
Comment: L2

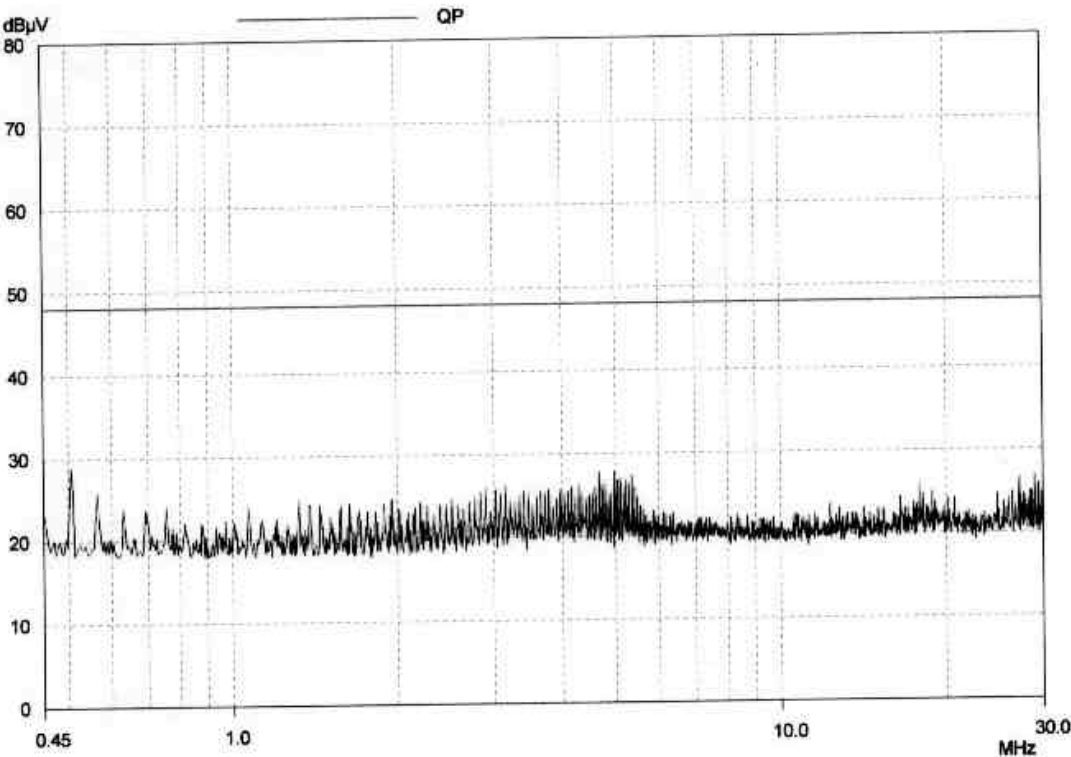
Prescan Measurement: Detector: X PK
Meas Time: see scan settings
Peaks: 8
Acc Margin: 10 dB



Conducted Emission
Peak Value

EUT: Wireless LAN Mini PCI Card
Manuf:
Op Cond: CH11 Datarate 11Mbps
Operator: Rick Hu
Test Spec: FCC Class B
Comment: L1

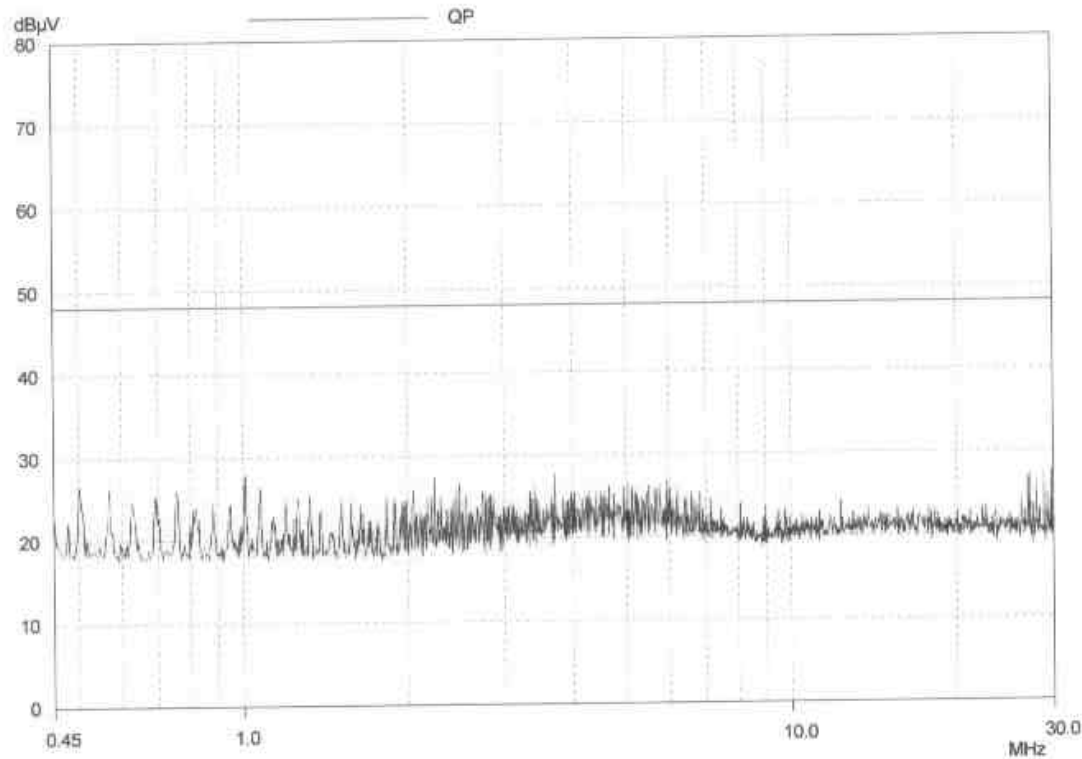
Prescan Measurement: Detector: X PK
Meas Time: see scan settings
Peaks: 8
Acc Margin: 10 dB



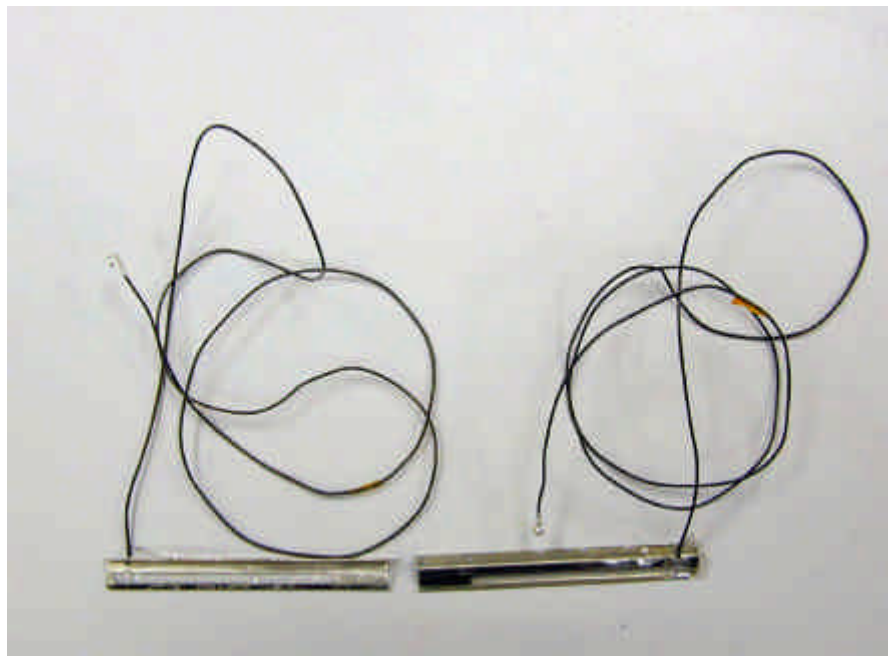
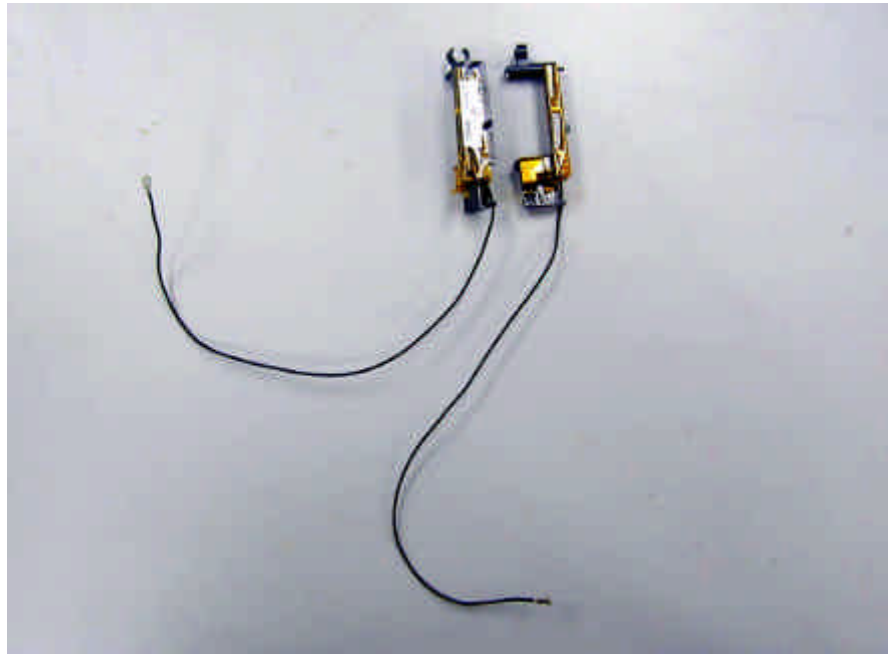
Conducted Emission
Peak Value

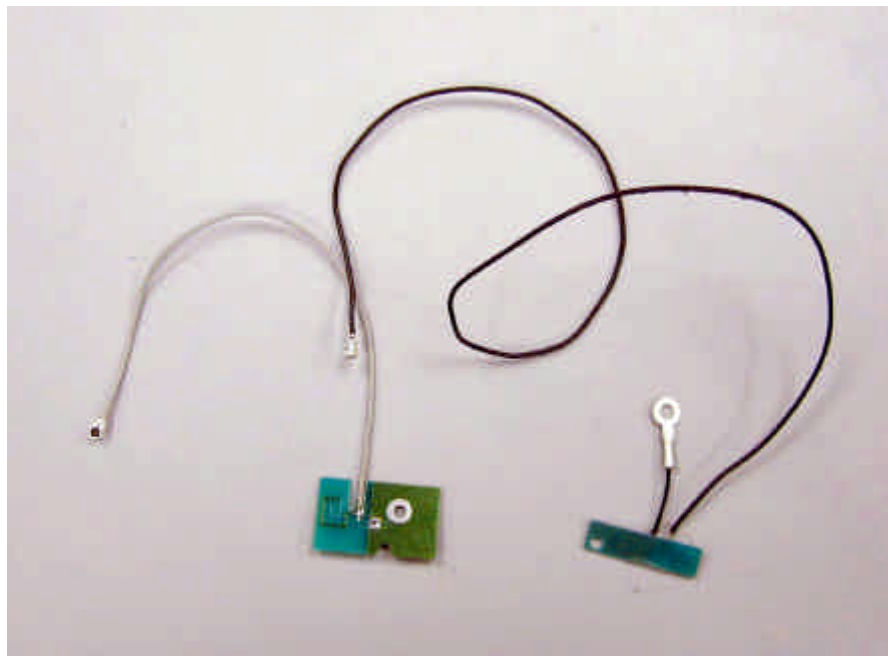
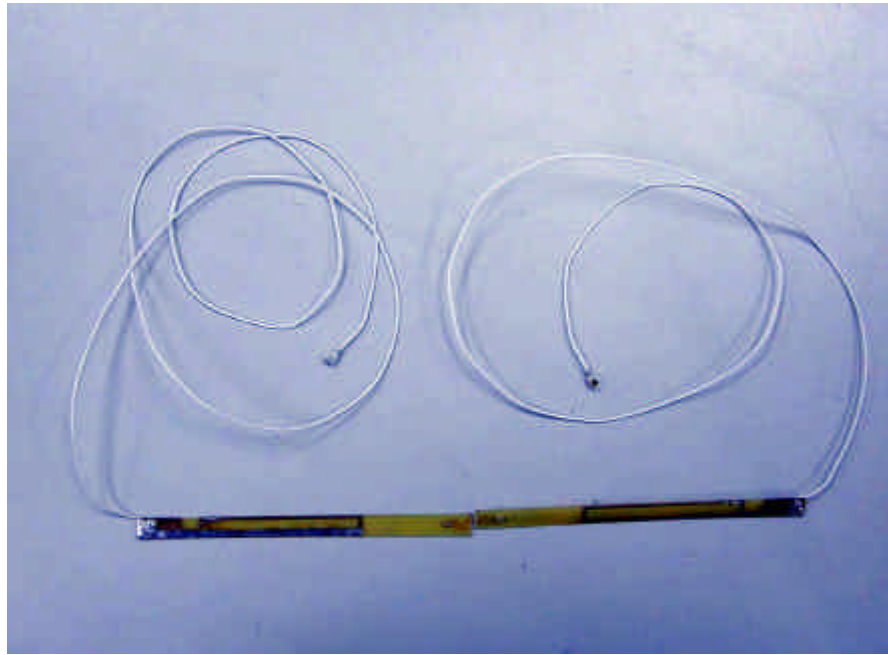
EUT: Wireless LAN Mini PCI Card
Manuf:
Op Cond: CH11 Datarate 11Mbps
Operator: Rick Hu
Test Spec: FCC Class B
Comment: L2

Prescan Measurement: Detector: X PK
Meas Time: see scan settings
Peaks: 8
Acc Margin: 10 dB

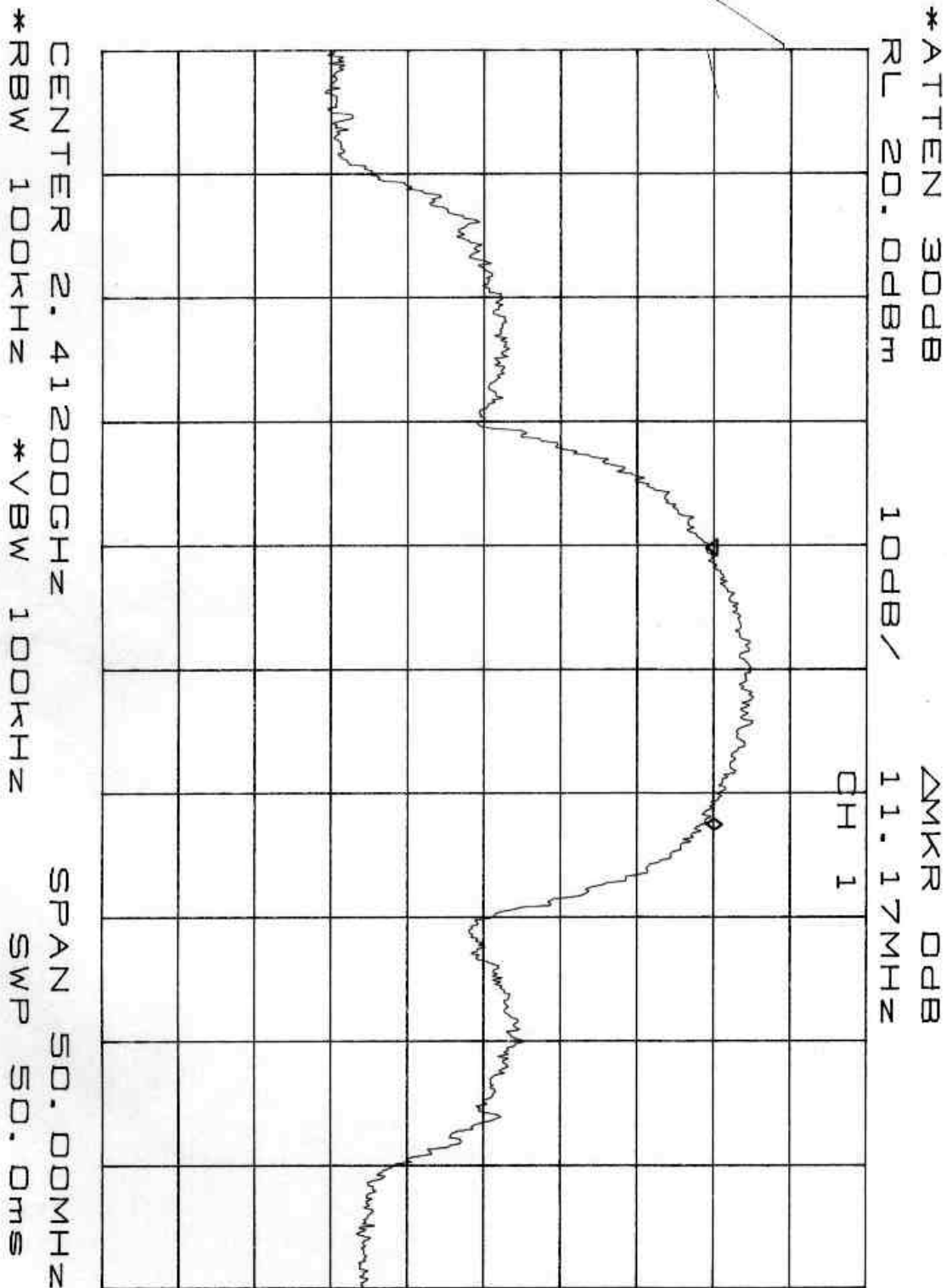


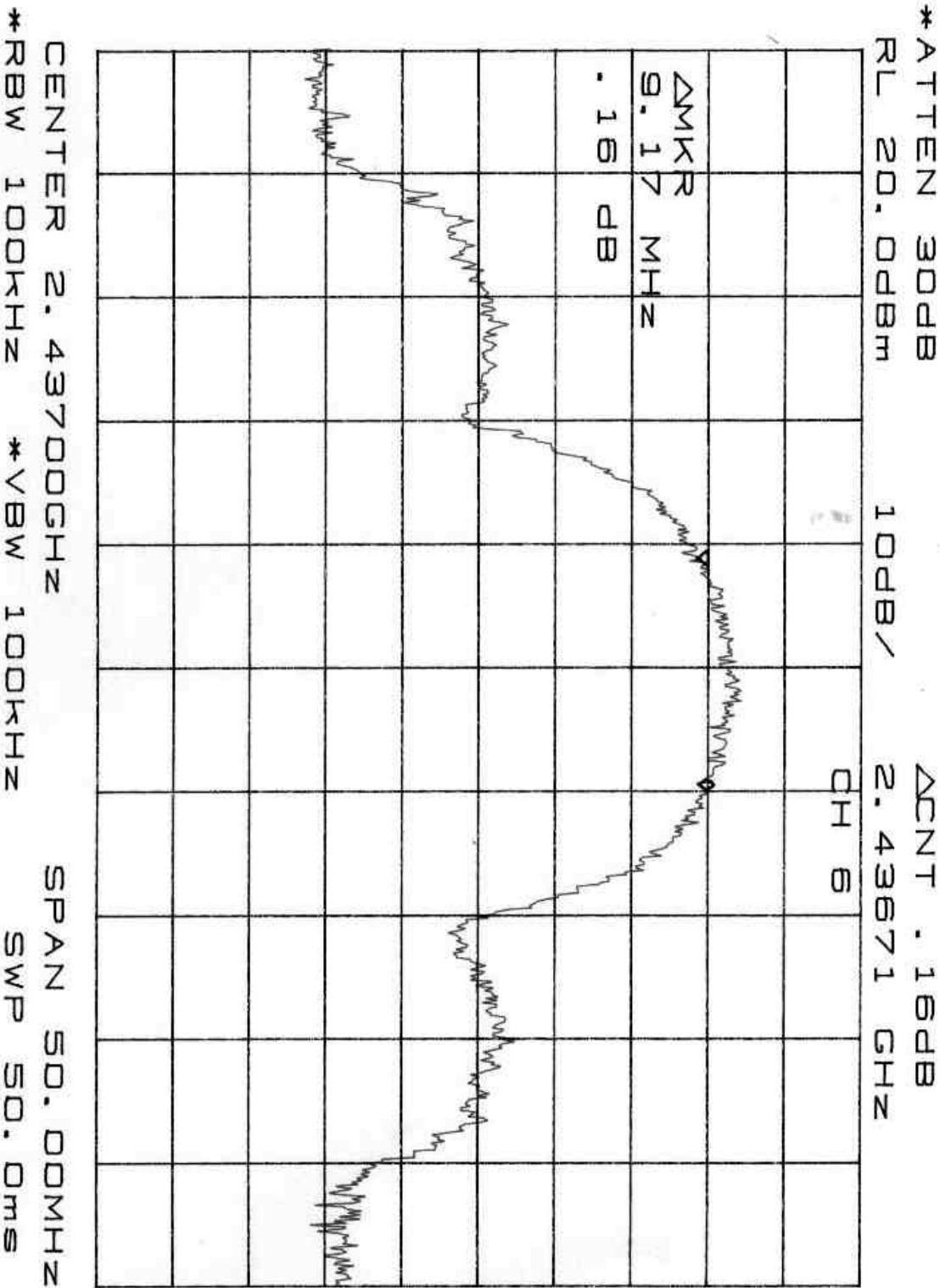
Appendix 2 : Engineering Graph of Antenna Construction

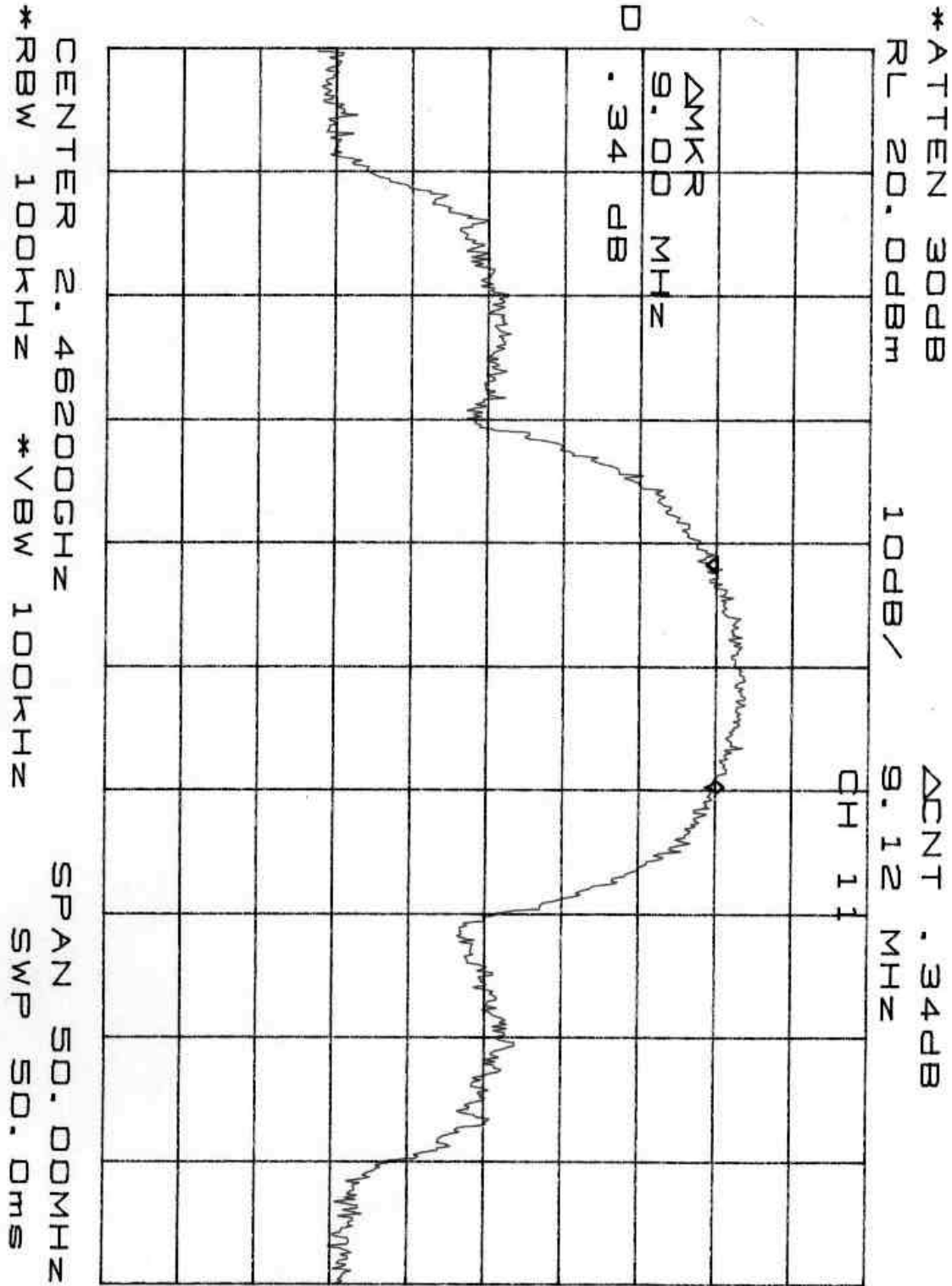




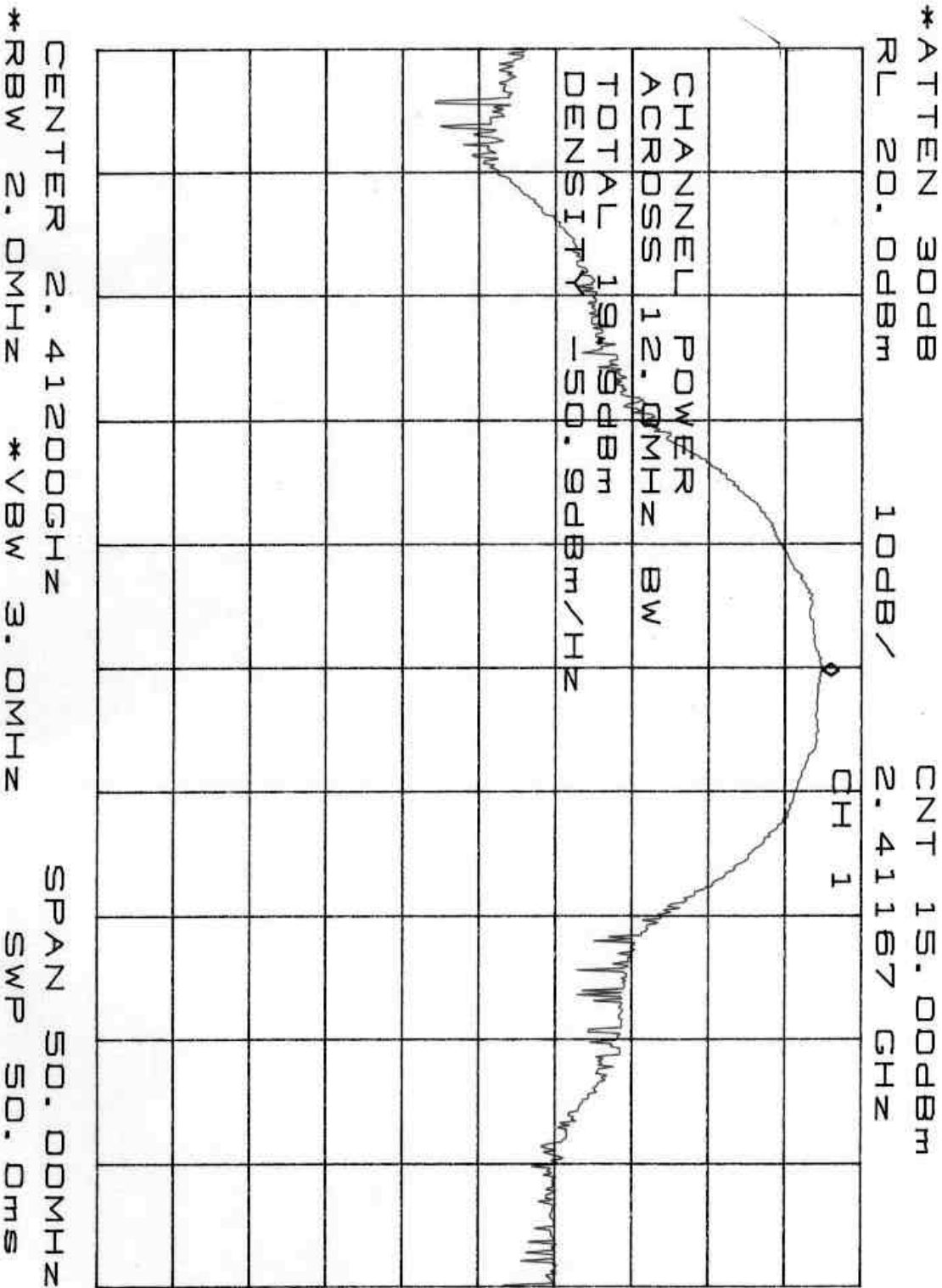
Appendix 3 : Ploted Datas of Emissions Bandwidth

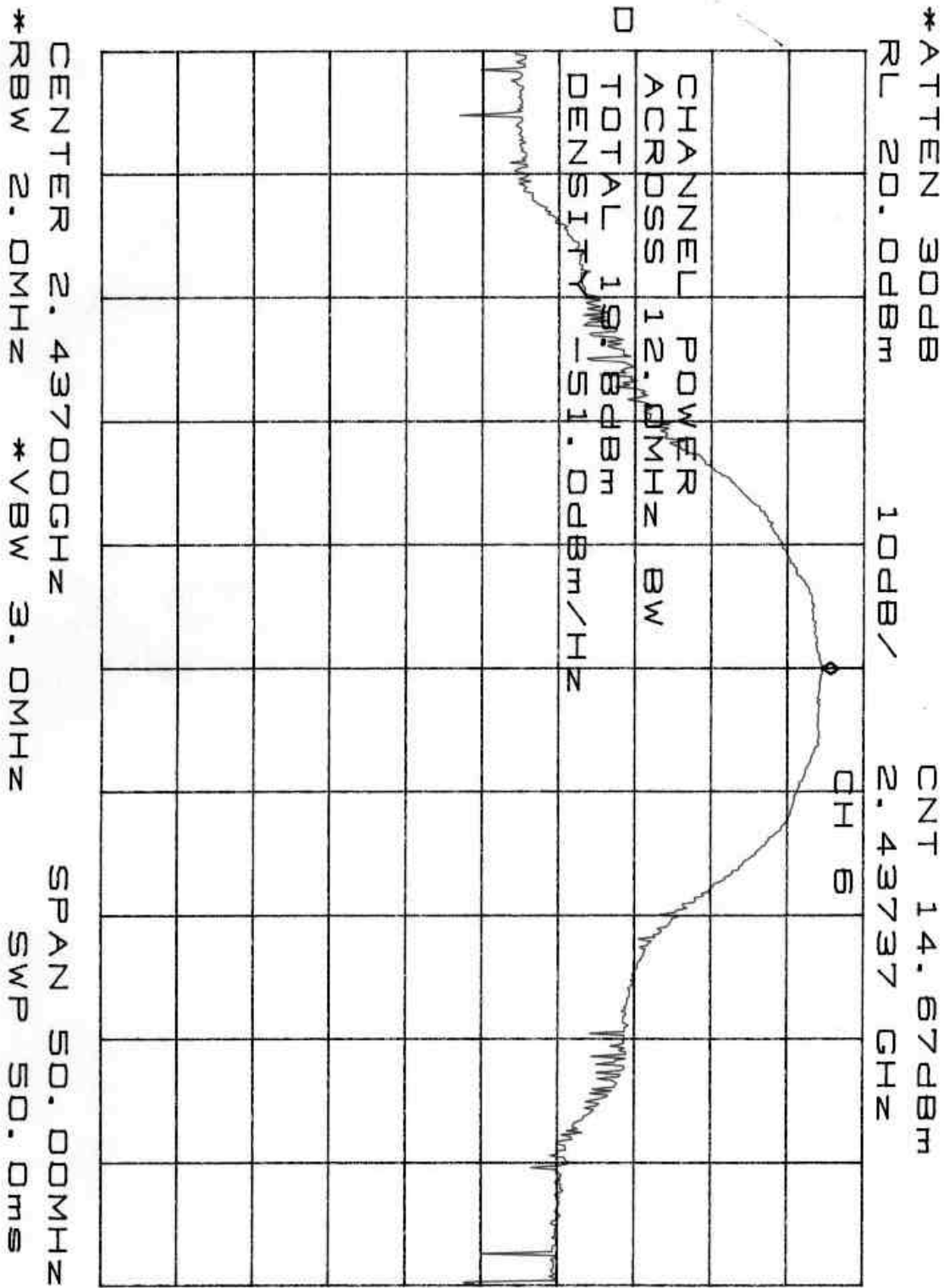


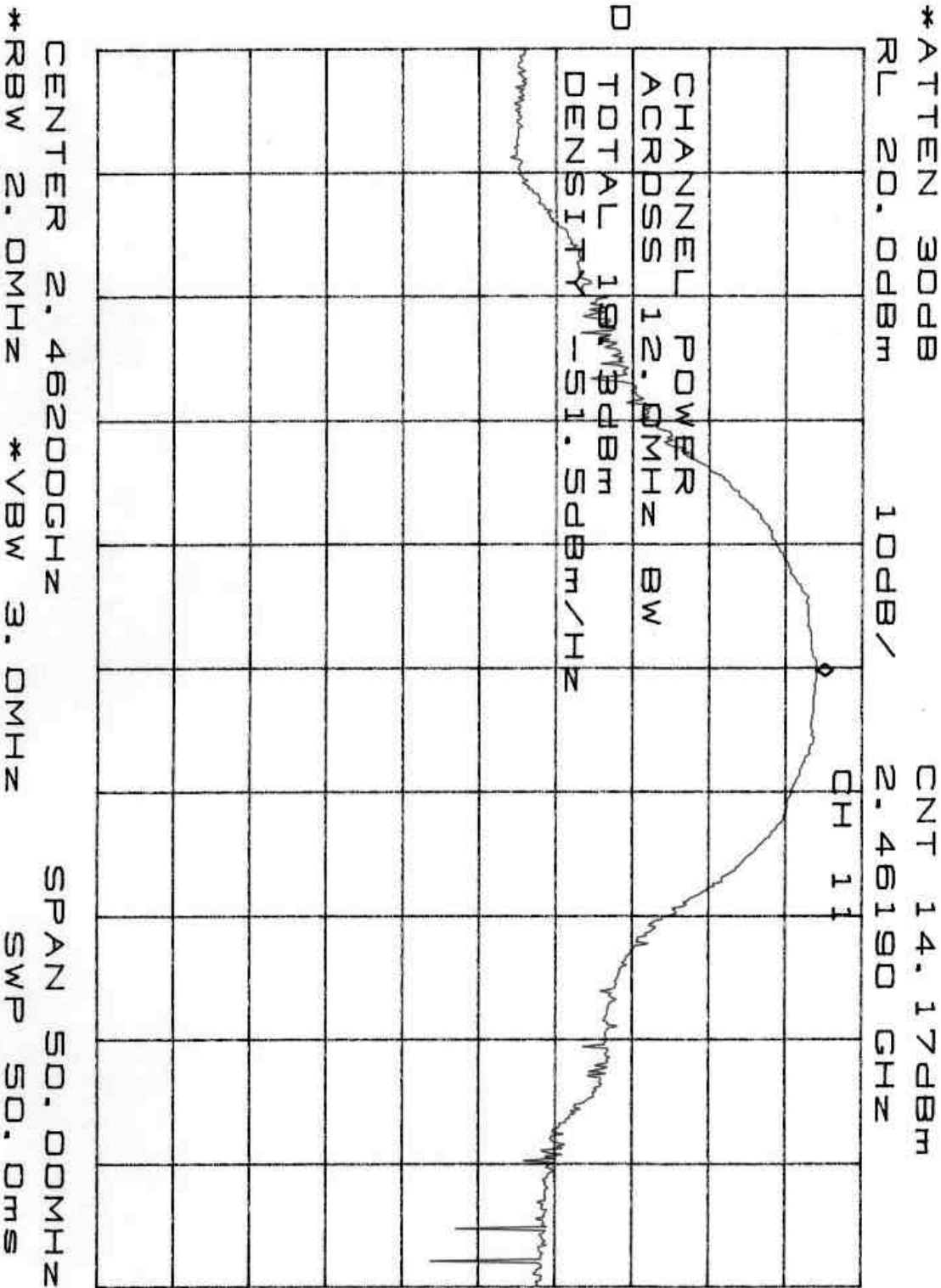




Appendix 4 : Ploted Datas of Output Peak Power







Appendix 5 : Ploted Datas of Band Edge Emission

*ATTEN 2008

RL 10. 00BM

104B/

CNT - 53. 67 DBH

11.01 MIN

011

4	Σ
0	λ
0	μ
0	
Σ	
I	
N	

153.67 dBm

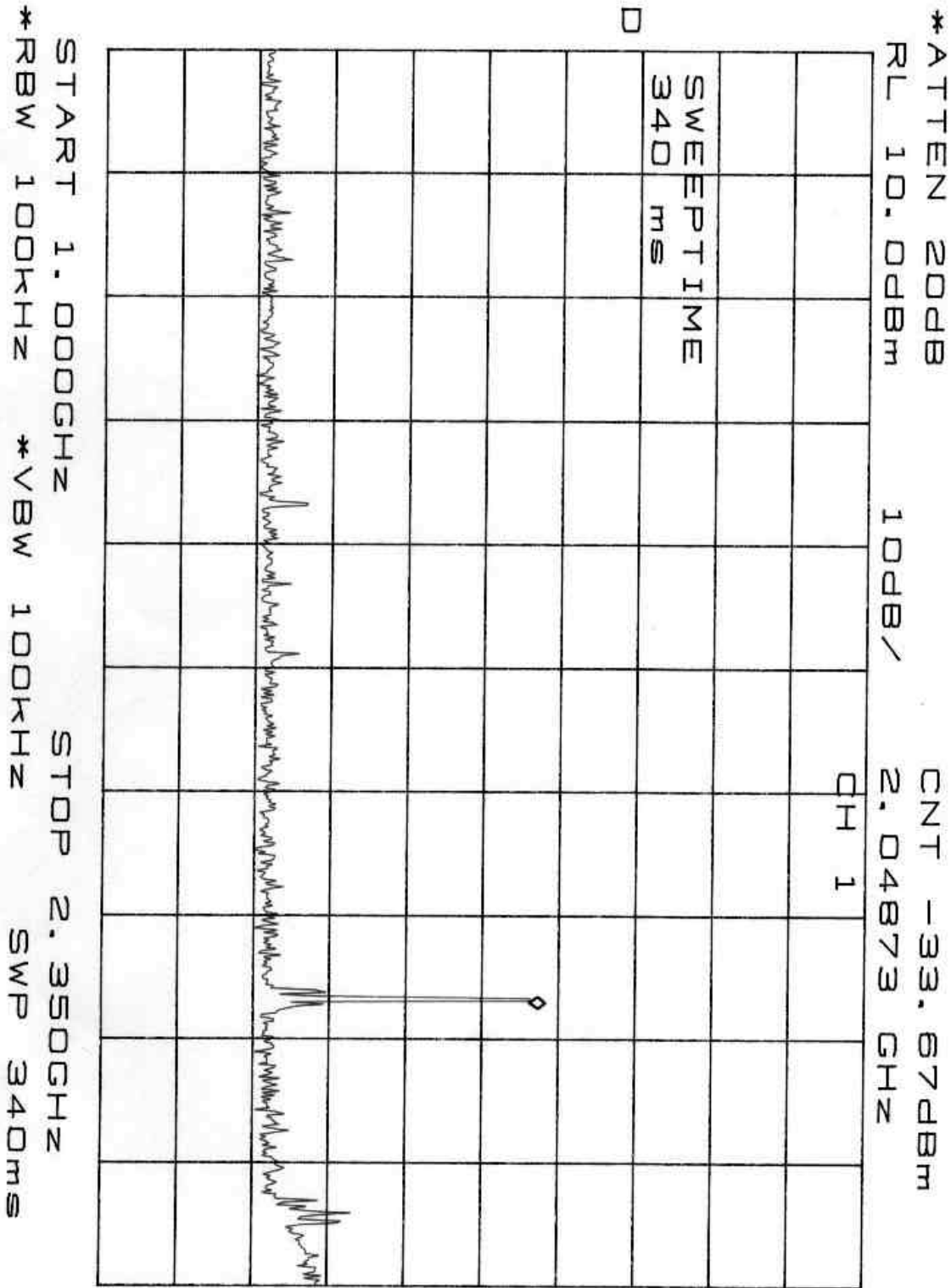
START 30. OMHN

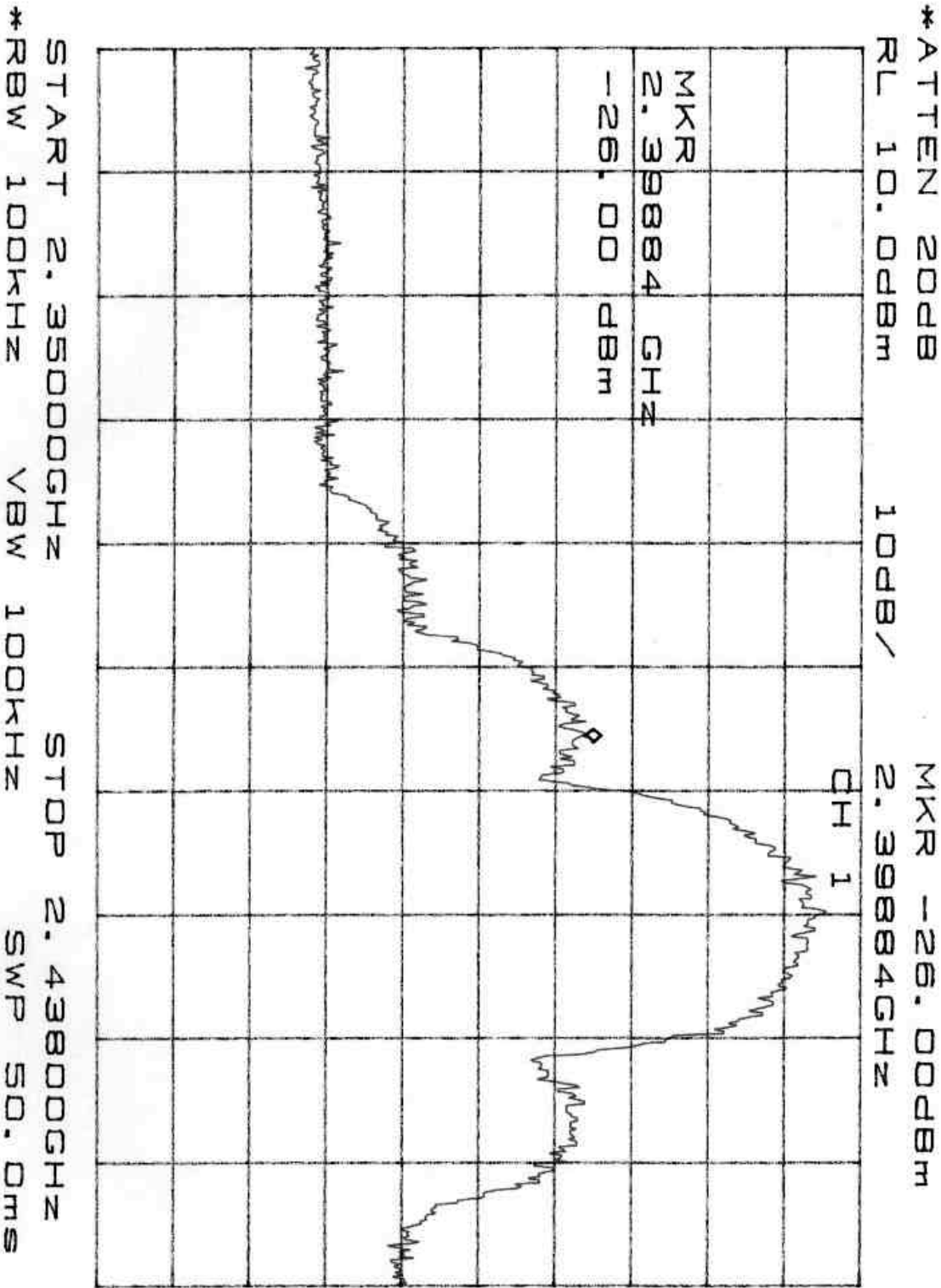
STOP 1. 0000GHN

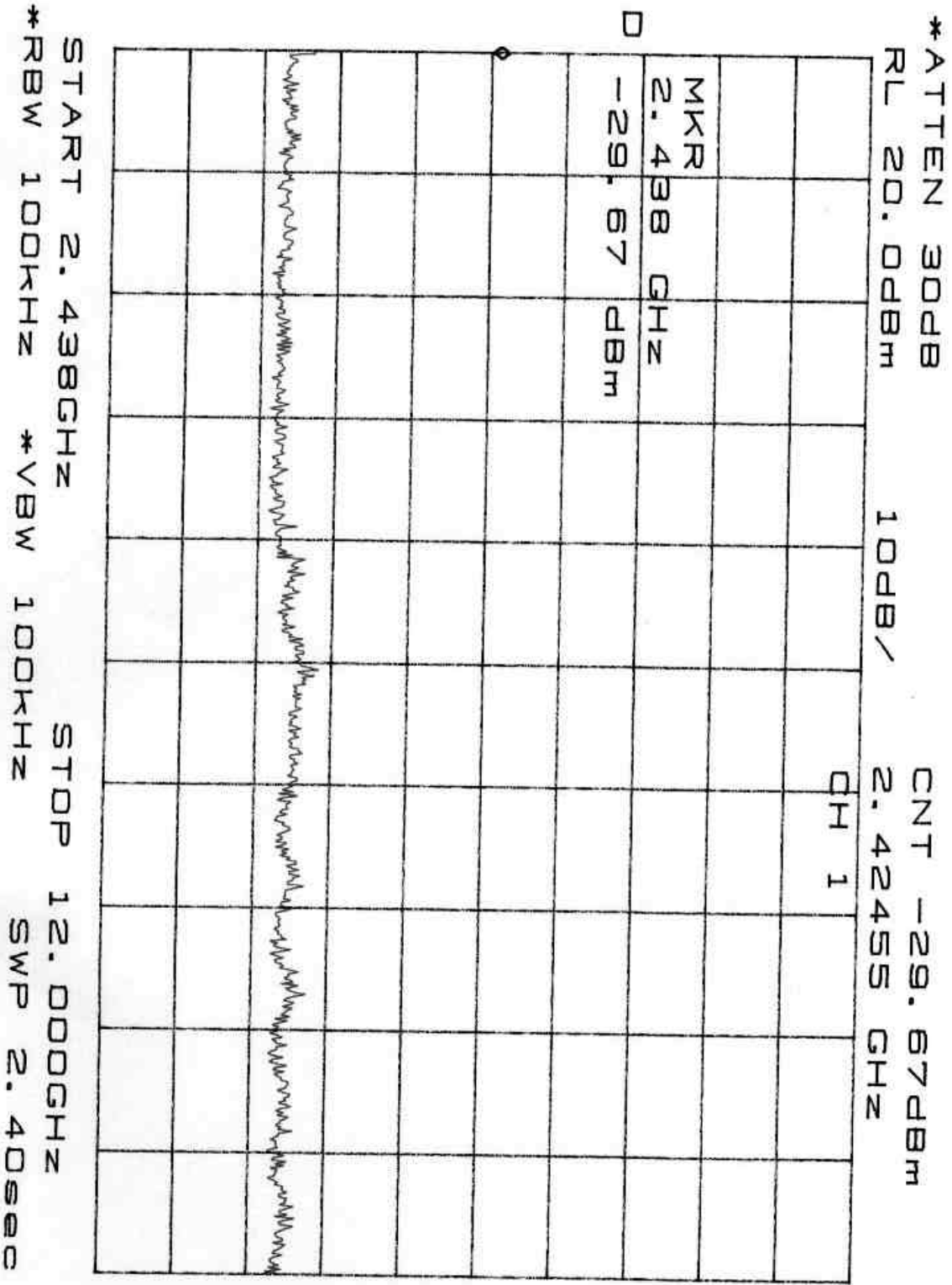
* R W M LOOKIN

*VBMW LOOK IN

SWP 250HS



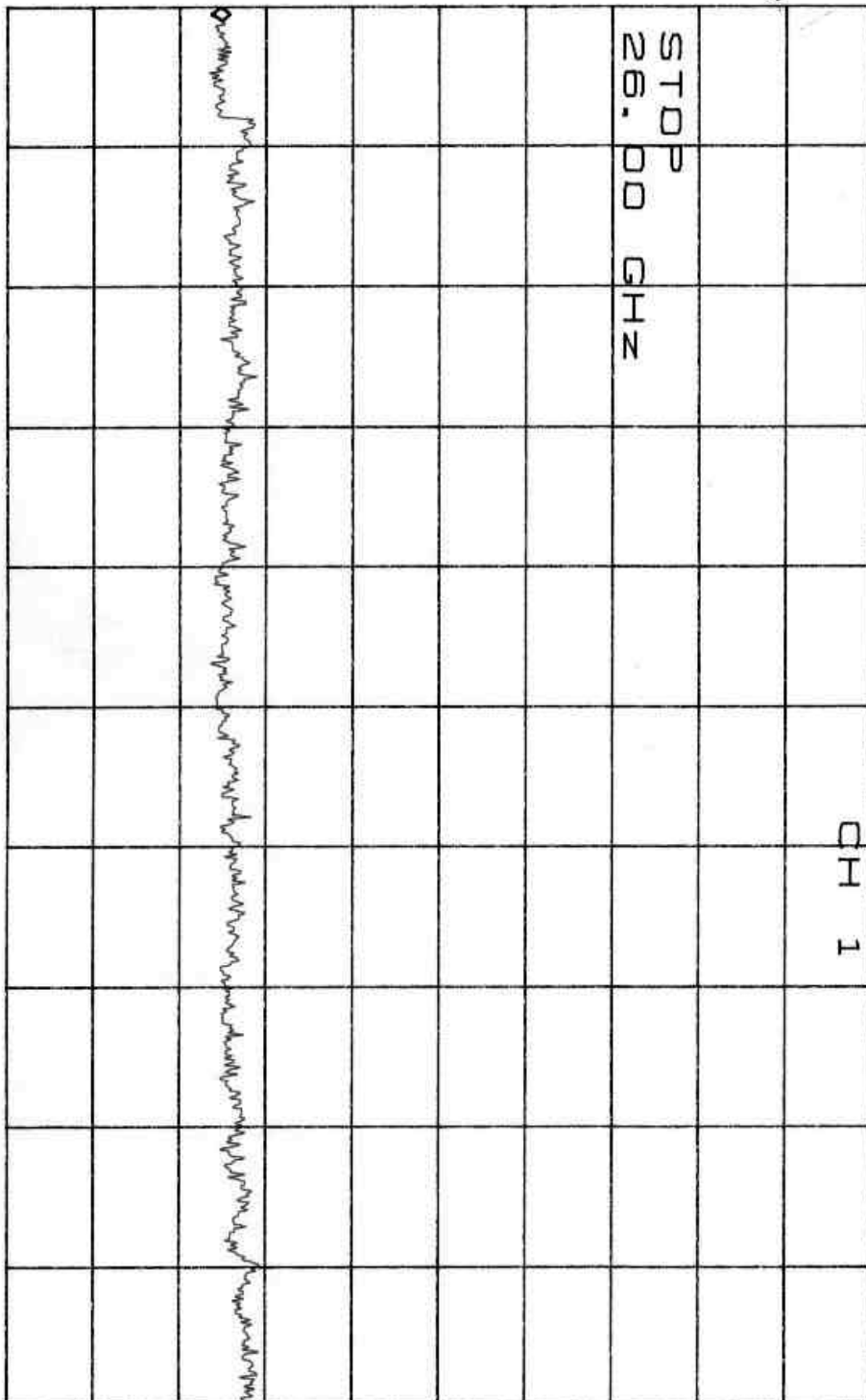




*ATTEN NORDB
RL 10. OBER

CNT -66.17DBF
11.70789 GHz
10dB/

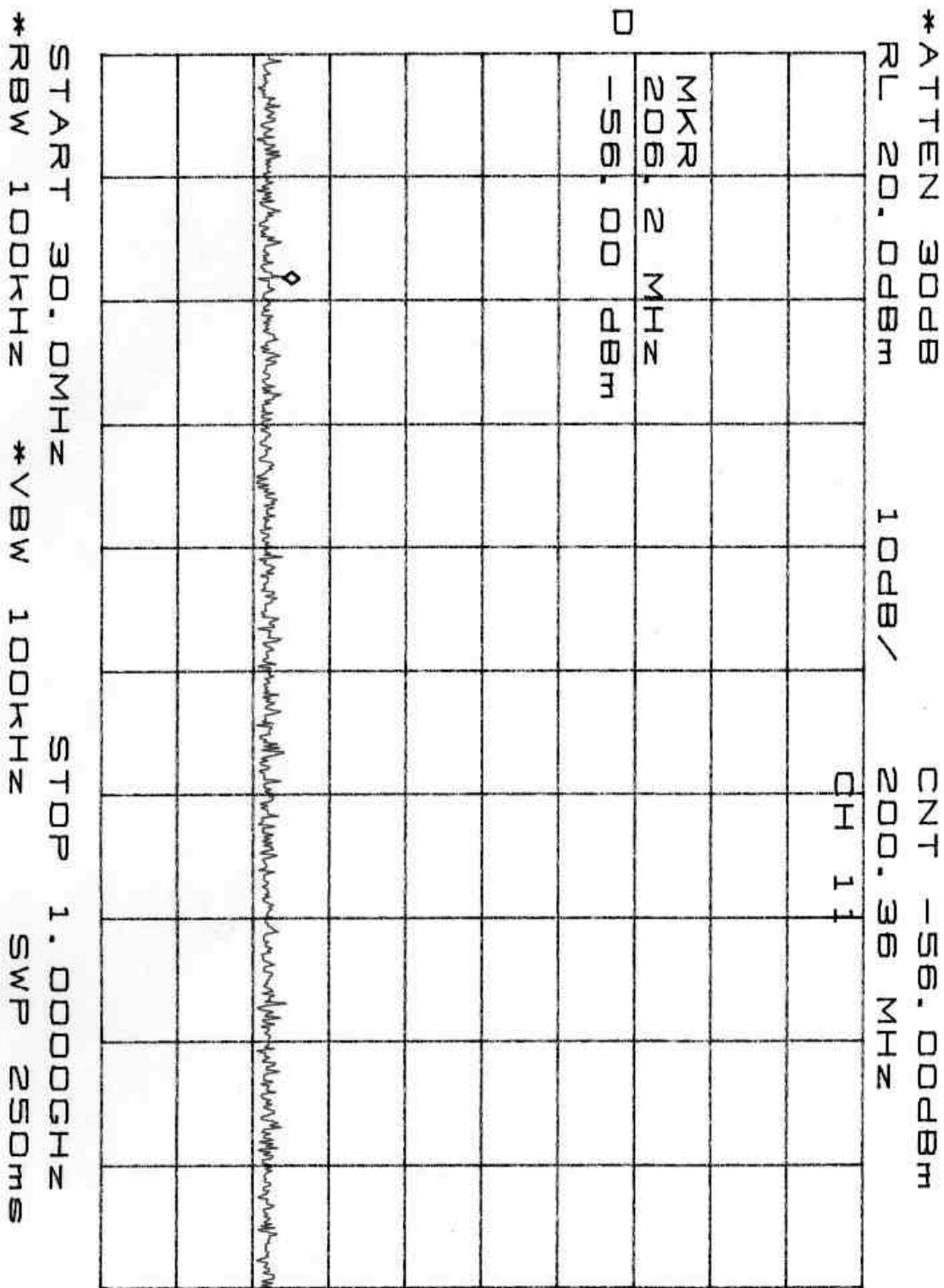
□	NS
	01
	00
	00
	00
	IN

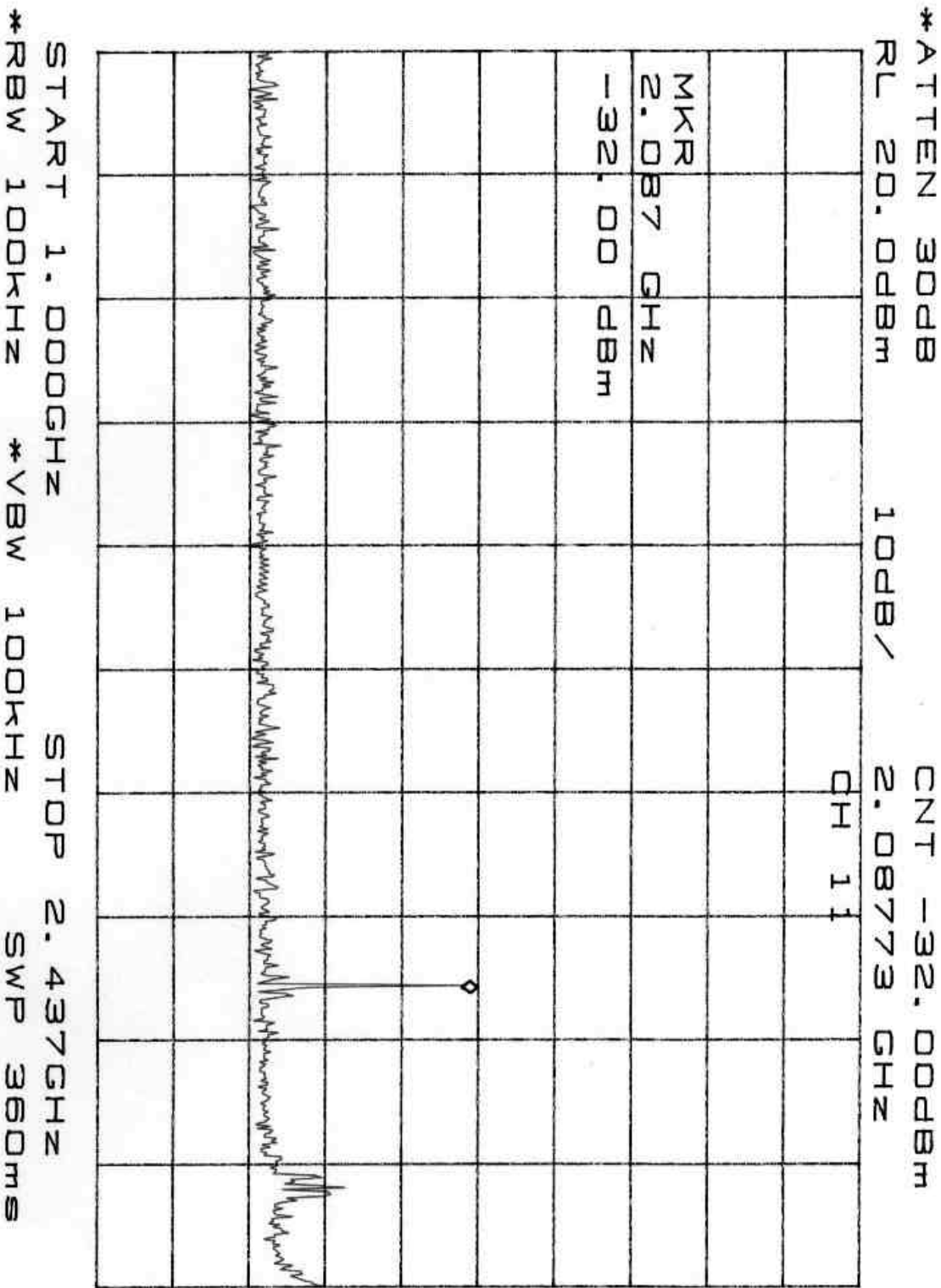


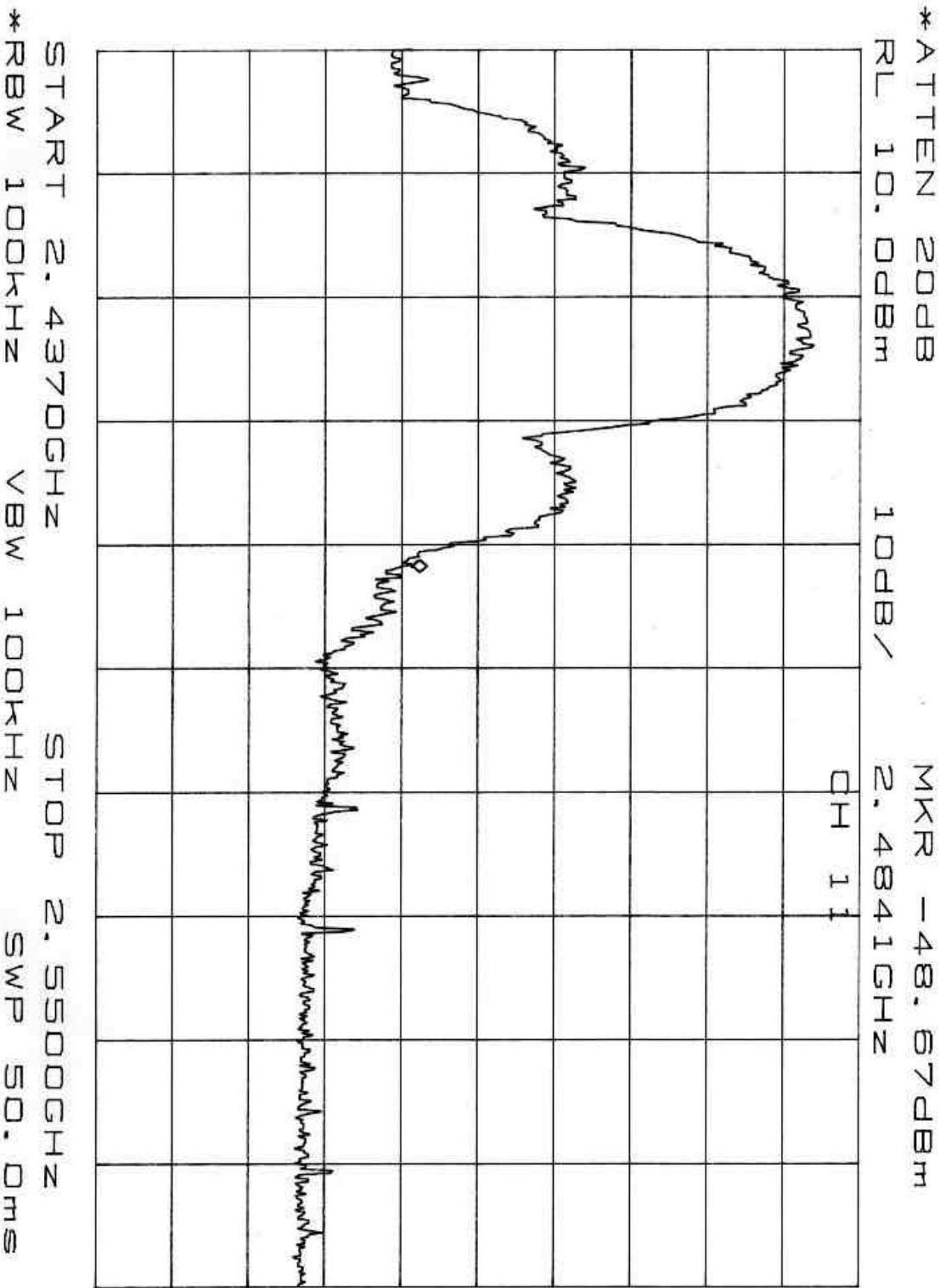
```

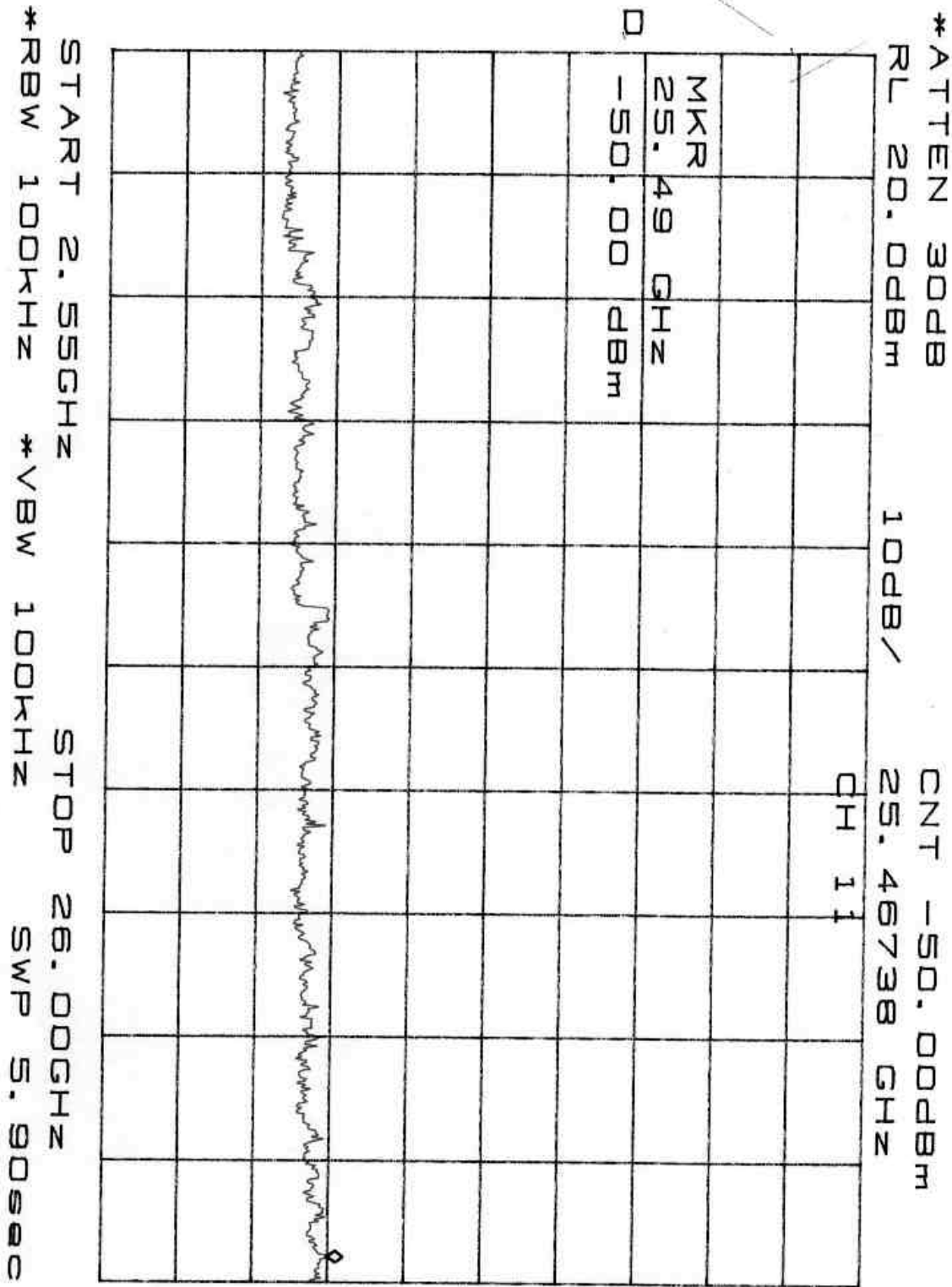
START 12. DOGIN      STOP 26. DOGIN
*RBW 100KIN          *VBW 100KIN      SWP 3.500000

```









Appendix 6 : Ploted Datas of Power Density

*ATTEN 2000B

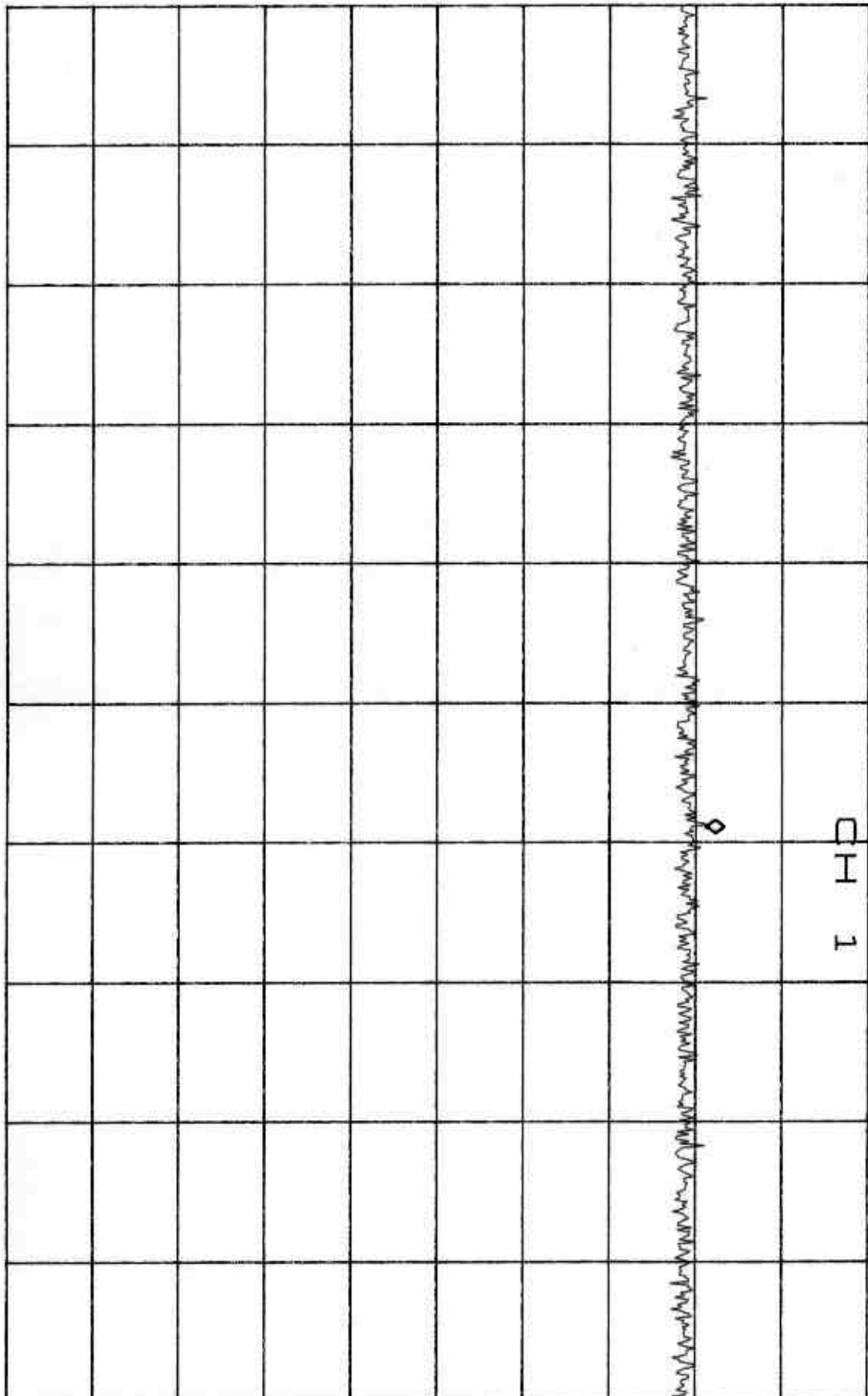
10. OCTBER 1941

10dB/

CNT - 8.67 dBm

2. 41200 GIN

CH 1



CENTER N. 4120000GHIN

SPAN 300. OKIN

*RBM W. OKIN *VBM 1OKIN

*SWP 100SEC

