FCC Part 15
EMI TEST REPORT

of

E.U.T. : Wireless LAN Access Point

MODEL : WA211P

FCC ID. : PQP-WA211P-X

for

APPLICANT : PRIME ELECTRONICS & SATELLITICS INC.

ADDRESS : 69, Tung Yuan Rd., Chung Li Industrial Park,
Chung Li City, Tao Yuan, Taiwan, R.O.C.

Test Performed by

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Report Number : ET90S-11-041

TEST REPORT CERTIFICATION

Applicant	: PRIME ELECTRONICS & SATELLITICS INC. 69, Tung Yuan Rd., Chung Li Industrial Park, Chung Li City, Tao Yuan, Taiwan, R.O.C.
Manufacturer	: PRIME ELECTRONICS & SATELLITICS INC. 69, Tung Yuan Rd., Chung Li Industrial Park, Chung Li City, Tao Yuan, Taiwan, R.O.C.
Description of EUT	:
a) Type of EUT	: Wireless LAN Access Point
b) Trade Name	: PESI
c) Model No.	: WA211P
d) Seriall No.	: 1000WA211P
e) Power Supply	: Adaptor:I/P:100~240Vac 47~63Hz; O/P:5Vdc, 2.0A, 10W
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 : Jan. 07, 2002

Test Engineer : Rick Hu

Approve & Authorized Signer : Win-Po Tsai

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

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1 GENERAL INFORMATION

1.1 Product Description

a) Type of EUT : Wireless LAN Access Point
b) Trade Name : PESI
c) Model No. : WA211P
d) Serial No. : 1000WA211P
e) Power Supply : Adaptor:I/P:100~240Vac 47~63Hz;
O/P:5Vdc, 2.0A, 10W

1.2 Characteristics of Device

The PESI-AP (IEEE 802.11b, 11Mbps WLAN Access Point) is an internetworking device for interconnecting a WLAN with other WLANs and legacy LANs, which provides a 2.4 GHz RF network and bridges to an Ethernet backbone. The Access Point is the wireless equivalent of a LAN hub. It receives, buffers and transmits data between the WLAN and the wired network, supporting a group of wireless user devices. An Access Point is typically connected with the wired backbone through a standard Ethernet cable, and communicates with wireless devices by means of an antenna. The Access Point, or the antenna connected to it, is generally mounted high on a wall or on the ceiling. Like the cells in a cellular phone network. It feature:

- Highly Efficient Dipole Antennas Provide Extensive Range of Operation
- Auto Fall-Back Data Rate for Long-Distance Communication and Noisy Environments
- High-Speed Data Transmitter Rate Up to 11 Mbps
- Interoperable with IEEE 802.11b (DSSS) 2.4GHz-Compliant Equipment
- Features Roaming, Best Access Point Selection, Load Balancing, and Network Traffic Filtering
- 40-Bit or 128-Bit (optional) Wired Equivalent Privacy
- Free Software Driver Upgrades

1.3 Test Methodology

The Wireless LAN Access Point 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 19.4 dBm (87.1 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 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	Emissions µV	Emissions dBµV
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 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) 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 below 1 GHz, the system was configured for testing in a typical fashion as a customer would normally use it. The peripherals other than EUT were connected in normally standing by situation. Measurement was performed under the condition that a computer program was exercised to simulate data communication of EUT, and the transmission rate was set allowed by EUT.

3.2 Devices for Tested System

Device	Manufacture	Model / FCC ID.	Cable Description
Wireless LAN Access Point *	PRIME ELECTRONICS & SATELLITICS INC.	WA211P PQP-WA211P-X	1.9m, Unshielded/Adaptor (VDE/DSA-0101F-05A) 1.2m, USB cable 1.7m, LAN cable
Notebook PC	ASUS	L7300	3.5m, Unshielded/Adaptor I/P:100~240VAC O/P:19VDC, 2.64A (Delta/ADP-50SB)

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 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

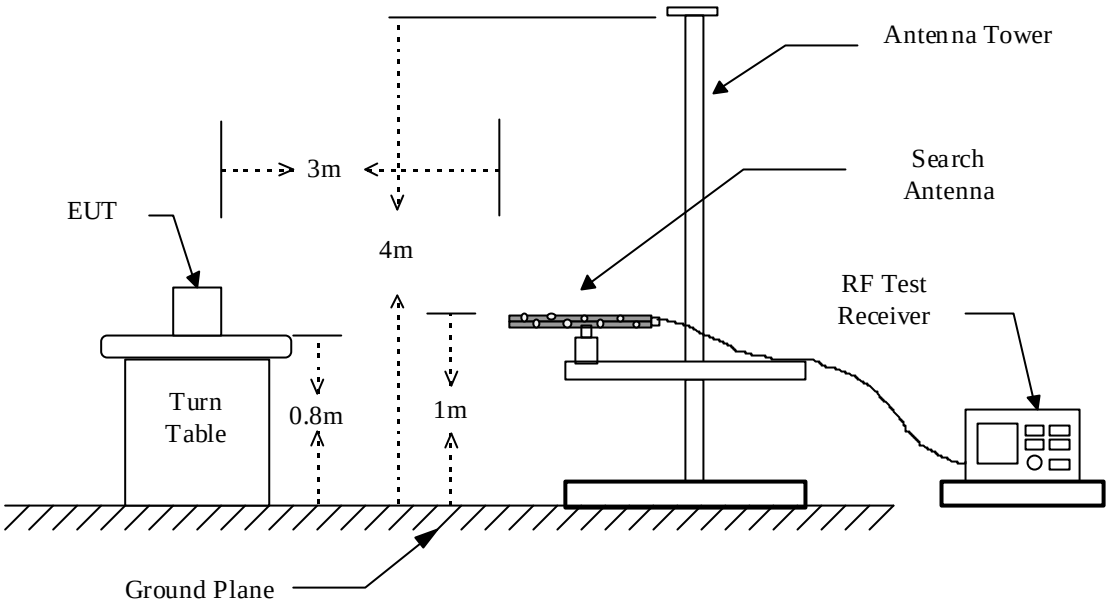
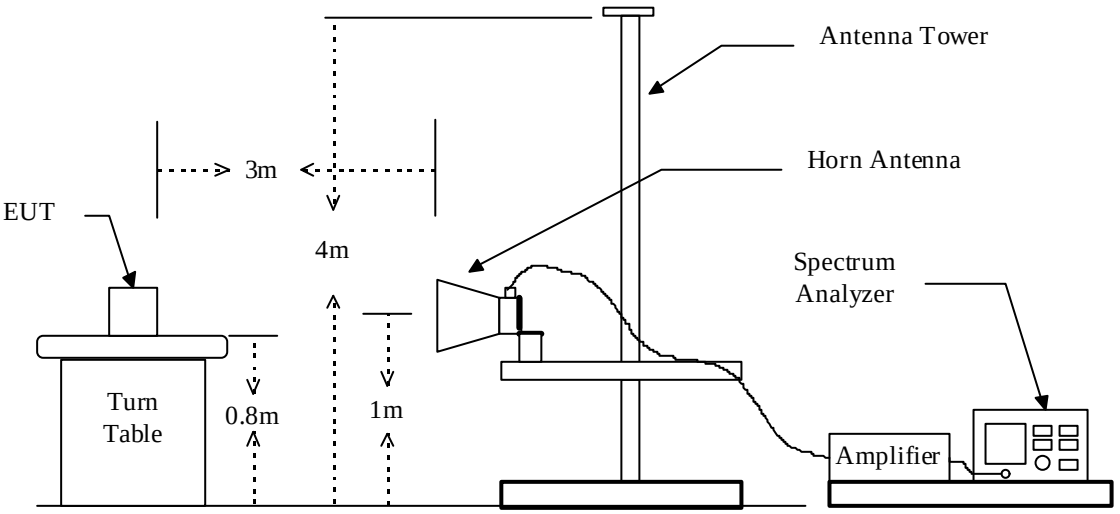


Figure 2 : Frequencies measured above 1 GHz configuration



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	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. 25, 2001 Temperature : 18 ℃ Humidity : 63 %

Frequency (MHz)	Reading (dBuV) H Peak	H Ave	V Peak	V Ave	Factor (dB) Corr.	Result @3m (dBuV/m) Peak	Ave	Limit @3m (dBuV/m) Peak	Ave.	Margin (dB)	Table Deg. (Deg.)	Ant. High (m)
2037.986	50.7	---	55.0	53.2	-3.3	51.7	49.9	74.0	54.0	-4.1	220	1.1
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	---	---	---	---	11.5	---	---	74.0	54.0	---	---	---
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. 25, 2001 Temperature : 18 ℃ Humidity : 63 %

Frequency (MHz)	Reading (dBuV) H Peak	H Ave	V Peak	V Ave	Factor (dB) Corr.	Result @3m (dBuV/m) Peak	Ave	Limit @3m (dBuV/m) Peak	Ave.	Margin (dB)	Table Deg. (Deg.)	Ant. High (m)
2062.970	50.5	---	54.7	52.5	-3.2	51.5	49.3	74.0	54.0	-4.7	220	1.1
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	---	---	---	---	11.6	---	---	74.0	54.0	---	---	---
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. 25, 2001 Temperature : 18 ℃ Humidity : 63 %

Frequency (MHz)	Reading (dBuV) H Peak	H Ave	V Peak	V Ave	Factor (dB) Corr.	Result @3m (dBuV/m) Peak	Result Ave	Limit @3m (dBuV/m) Peak	Limit Ave.	Margin (dB)	Table Deg. (Deg.)	Ant. High (m)
2087.986	51.7	---	57.2	54.3	-3.1	54.1	51.2	74.0	54.0	-2.8	220	1.1
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	---	---	---	---	11.7	---	---	74.0	54.0	---	---	---
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. 20, 2001 Temperature : 21 ℃ 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)
281.230	H	19.8	16.5	36.3	46.0	-9.7	270	1.2
284.410	V	21.1	16.5	37.6	46.0	-8.4	320	1.0
436.430	V	15.6	21.3	36.9	46.0	-9.1	270	1.0
453.890	H	19.4	21.2	40.6	46.0	-5.4	300	1.4
453.890	V	15.3	21.2	36.5	46.0	-9.5	300	1.1
484.930	H	16.6	22.3	38.9	46.0	-7.1	10	1.4
504.330	H	14.7	22.3	37.0	46.0	-9.0	270	1.5
504.330	V	13.5	22.3	35.8	46.0	-10.2	360	1.4
606.180	H	13.3	24.9	38.2	46.0	-7.8	360	1.0
706.090	H	16.0	26.6	42.6	46.0	-3.4	75	1.3
706.090	V	15.5	26.6	42.1	46.0	-3.9	15	1.1
904.940	V	6.8	35.4	42.2	46.0	-3.8	300	1.2

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

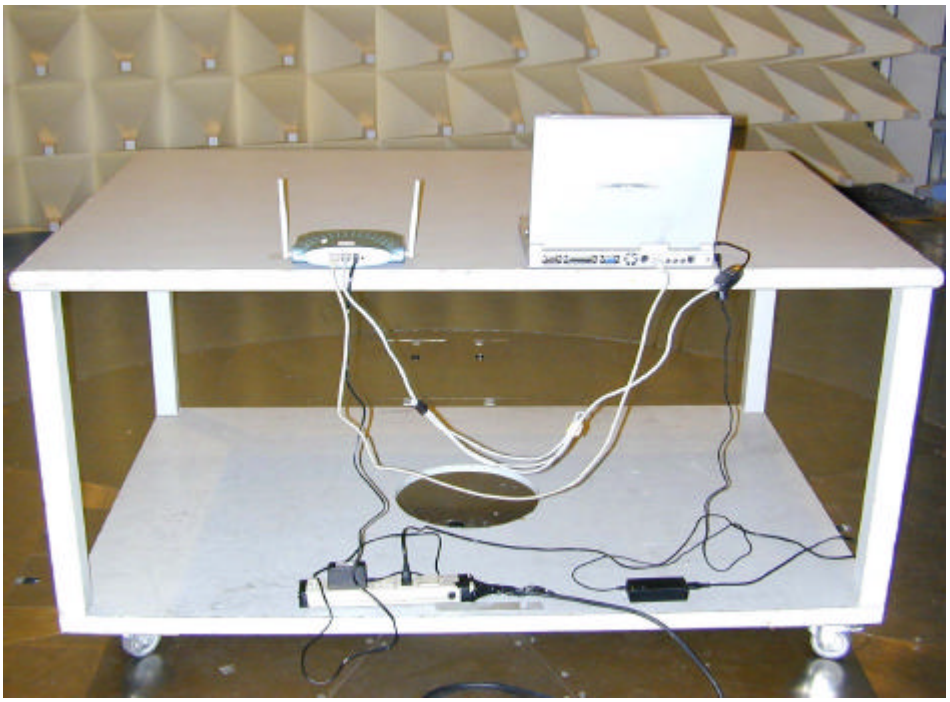
The field strength is calculated by adding the Antenna Factor, High Pass Filter Loss(if used) and Cable Loss, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation calculation is as follows:

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

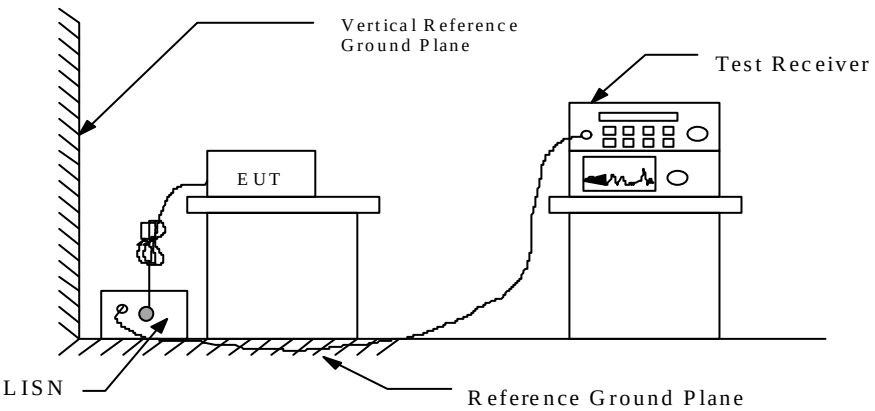
5.1 Standard Applicable

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 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. 20, 2001 Temperature : 17 ℃ Humidity: 70 %

Frequency (MHz)	Reading (dBuV) L1	Reading (dBuV) L2	Factor (dB)	Result (dBuV) L1	Result (dBuV) L2	Limit (dBuV)	Margin (dB)
0.477	42.2#	***	0.1	42.3#	***	48.0	-5.7
0.602	42.5#	***	0.1	42.6#	***	48.0	-5.4
0.731	41.3#	***	0.1	41.4#	***	48.0	-6.6
0.977	42.4#	***	0.1	42.5#	***	48.0	-5.5
1.102	43.1#	42.8#	0.2	43.3#	43.0#	48.0	-4.7
1.473	41.5#	43.6#	0.2	41.7#	43.8#	48.0	-4.2
1.594	***	42.8#	0.2	***	43.0#	48.0	-5.0
1.793	***	43.6#	0.2	***	43.8#	48.0	-4.2
1.961	***	42.5#	0.2	***	42.7#	48.0	-5.3
2.145	***	41.4#	0.2	***	41.6#	48.0	-6.4

b) Channel 6

Operation Mode : Transmitting / Receiving
Test Date : Dec. 20, 2001 Temperature : 17 ℃ Humidity: 70 %

Frequency (MHz)	Reading (dBuV) L1	Reading (dBuV) L2	Factor (dB)	Result (dBuV) L1	Result (dBuV) L2	Limit (dBuV)	Margin (dB)
0.477	41.9#	***	0.1	42.0#	***	48.0	-6.0
0.602	43.1#	***	0.1	43.2#	***	48.0	-4.8
0.731	41.2#	***	0.1	41.3#	***	48.0	-6.7
0.977	42.8#	***	0.1	42.9#	***	48.0	-5.1
1.086	42.5#	42.6#	0.2	42.7#	42.8#	48.0	-5.2
1.293	***	42.3#	0.2	***	42.5#	48.0	-5.5
1.473	41.8#	43.9#	0.2	42.0#	44.1#	48.0	-3.9
1.773	***	43.6#	0.2	***	43.8#	48.0	-4.2
1.883	***	41.4#	0.2	***	41.6#	48.0	-6.4
2.125	***	42.4#	0.2	***	42.6#	48.0	-5.4

c) Channel 11

Operation Mode : Transmitting / Receiving
Test Date : Dec. 20, 2001 Temperature : 17 ℃ Humidity: 70 %

Frequency (MHz)	Reading (dBuV)		Factor (dB)	Result (dBuV)		Limit (dBuV)	Margin (dB)
	L1	L2		L1	L2		
0.477	42.4#	***	0.1	42.5#	***	48.0	-5.5
0.602	42.8#	***	0.1	42.9#	***	48.0	-5.1
0.720	41.2#	***	0.1	41.3#	***	48.0	-6.7
0.977	42.4#	***	0.1	42.5#	***	48.0	-5.5
1.086	43.5#	43.4#	0.2	43.7#	43.6#	48.0	-4.3
1.316	***	41.6#	0.2	***	41.8#	48.0	-6.2
1.430	***	44.1#	0.2	***	44.3#	48.0	-3.7
1.473	42.4#	***	0.2	42.6#	***	48.0	-5.4
1.586	***	43.1#	0.2	***	43.3#	48.0	-4.7
1.797	***	43.3#	0.2	***	43.5#	48.0	-4.5
1.938	***	41.9#	0.2	***	42.1#	69.5	-27.4

Note 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:

RESULT = READING + LISN FACTOR (Included Cable Loss)

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

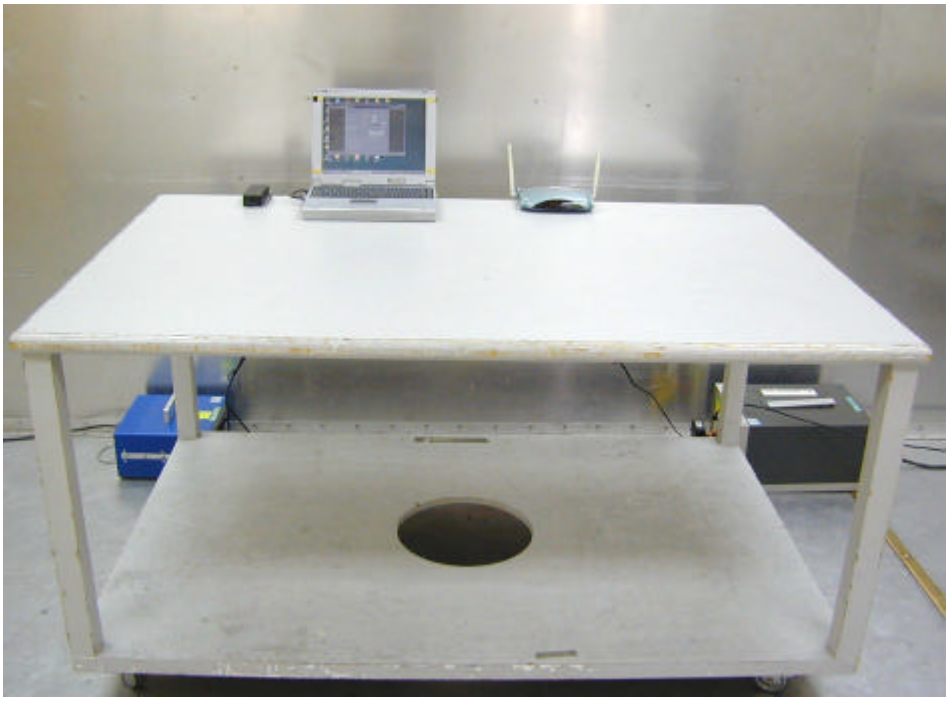
RESULT = 22.5 + 0.1 = 22.6 dBμV
Level in μV = Common Antilogarithm[(22.6 dBμV)/20]
= 13.48 μV

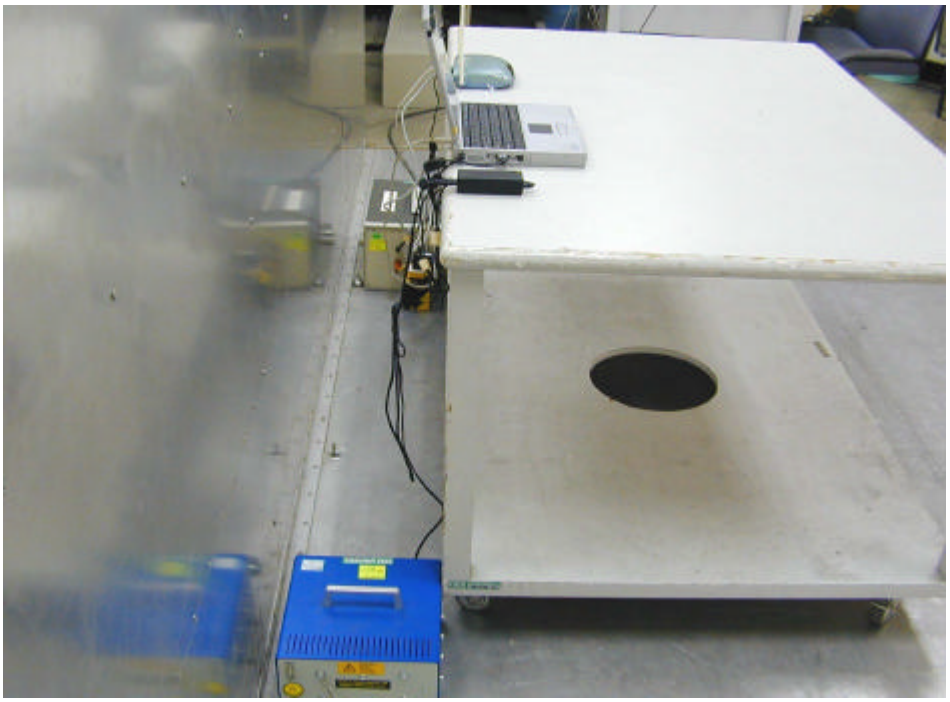
5.5 Conducted Measurement Equipment

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
Line Impedance Stabilization network	Telemeter	NNB-2/16Z	04/02/2002

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

Highly efficient dipole antennas fix on the PCB. The directional gain of antenna used for transmitting is Peak 2.73dBi, Typical 2.0dBi and the details antenna construction.

7 EMISSION BANDWIDTH MEASUREMENT

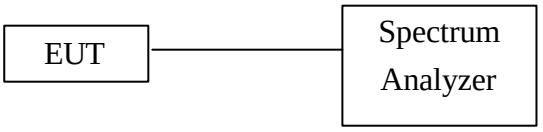
7.1 Standard Applicable

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. 25, 2001 Temperature : 18 ℃ Humidity: 63 %

a) Channel 01 : 6 dB Emission Bandwidth is 7.25 MHz
b) Channel 06 : 6 dB Emission Bandwidth is 7.58 MHz
c) Channel 11 : 6 dB Emission Bandwidth is 7.33 MHz

Note: Please see Appendix 2 for ploted datas

8 OUTPUT POWER MEASUREMENT

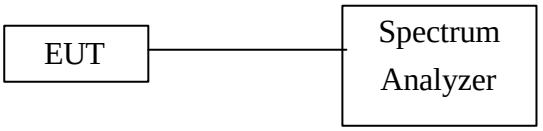
8.1 Standard Applicable

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. 25, 2001 Temperature : 18 ℃ Humidity: 63 %

a) Channel 01 : Output Peak Power is 20.8 dBm or **120.2** mW
b) Channel 06 : Output Peak Power is 20.5 dBm or **112.2** mW
c) Channel 11 : Output Peak Power is 19.6 dBm or **91.2** mW

Note: 1. Please see Appendix 3 for ploted datas

2. Output peak power=reading + 10 log $\frac{6dB(BW)}{measure(BW)}$

(a) $15.2 + 10 \log\frac{7.25}{2} = 15.2+5.6=20.8$

(b) $14.7 + 10 \log\frac{7.58}{2} = 14.7+5.8=20.5$

(c) $14.0 + 10 \log\frac{7.33}{2} = 14.0+5.6=19.6$

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. 25, 2001 Temperature : 18 ℃ Humidity: 63 %

a) Lower Band Edge : maximum value is –25.8 dBm that is attenuated more than 20dB
b) Upper Band Edge : maximum value is –42.0 dBm that is attenuated more than 20dB

Note: Please see Appendix 4 for ploted datas

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、6、11, 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	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
2390 & 2483.5	Spectrum Analyzer	Peak	1 MHz	1 MHz
	Spectrum Analyzer	Average	1 MHz	300 Hz

10.4 Radiated Emission Data

a) Channel 1

Operation Mode : Receiving /Transmitting

Fundamental Frequency : 2412 MHz

Test Date : Jan. 07, 2002 Temperature : 18 ℃ Humidity : 58 %

Frequency (MHz)	Reading (dBuV) H Peak	H Ave	V Peak	V Ave	Factor (dB) Corr.	Result @3m (dBuV/m) Peak	Result Ave	Limit @3m (dBuV/m) Peak	Limit Ave.	Margin (dB)	Table Deg. (Deg.)	Ant. High (m)
2390.000	49.7	---	54.2	43.2	-1.7	52.5	41.5	74.0	54.0	-12.5	200	1.4
2483.500	47.6	---	50.7	---	-1.1	49.6	---	74.0	54.0	-5.4	120	1.4

b) Channel 6

Operation Mode : Receiving / Transmitting

Fundamental Frequency : 2437 MHz

Test Date : Jan. 07, 2002 Temperature : 18 ℃ Humidity : 58 %

Frequency (MHz)	Reading (dBuV) H Peak	H Ave	V Peak	V Ave	Factor (dB) Corr.	Result @3m (dBuV/m) Peak	Result Ave	Limit @3m (dBuV/m) Peak	Limit Ave.	Margin (dB)	Table Deg. (Deg.)	Ant. High (m)
2390.000	49.2	---	51.6	---	-1.7	49.9	---	74.0	54.0	-4.1	60	1.0
2483.500	46.8	---	50.6	---	-1.1	49.5	---	74.0	54.0	-4.5	260	1.0

c) Channel 11

Operation Mode : Receiving / Transmitting

Fundamental Frequency : 2462 MHz

Test Date : Jan. 07, 2002 Temperature : 18 ℃ Humidity : 58 %

Frequency (MHz)	Reading (dBuV) H Peak	H Ave	V Peak	V Ave	Factor (dB) Corr.	Result @3m (dBuV/m) Peak	Result Ave	Limit @3m (dBuV/m) Peak	Limit Ave.	Margin (dB)	Table Deg. (Deg.)	Ant. High (m)
2390.000	50.8	---	51.2	---	-1.7	49.5	---	74.0	54.0	-5.5	65	1.0
2483.500	51.3	---	57.0	47.8	-1.1	55.9	46.7	74.0	54.0	-7.3	40	1.1

11 POWER DENSITY MEASUREMENT

11.1 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.

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 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.

11.3 Measurement Equipment

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

11.4 Measurement Data

Test Date : Dec. 25, 2001 Temperature : 18℃ Humidity: 63 %

a) Channel 01 : Maximun Power Density of 3 kHz Bandwidth is –9.3 dBm
b) Channel 06 : Maximun Power Density of 3 kHz Bandwidth is –10.0 dBm
c) Channel 11 : Maximun Power Density of 3 kHz Bandwidth is –10.3 dBm

Note: Please see Appendix 5 for ploted datas

12 PROCESSING GAIN MEASUREMENT

12.1 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.

12.2 Measurement Description

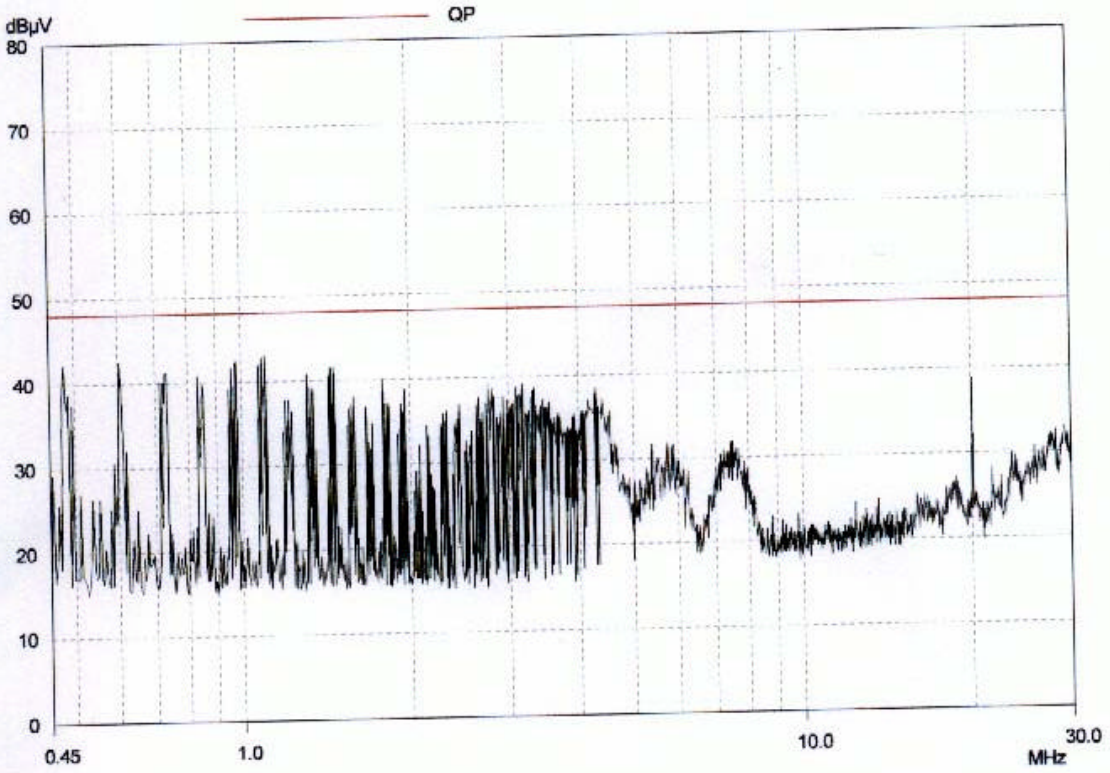
The processing gain measurement provided by PRIME ELECTRONICS & SATELLITICS INC., please see Attachment

Appendix 1 : Ploted Datas of Power Line Conducted Emissions

Conducted Emission
Peak Value

EUT:	Wireless LAN
Manuf:	
Op Cond:	Tx (CH 1)
Operator:	Rick Hu
Test Spec:	FCC Class B
Comment:	L1

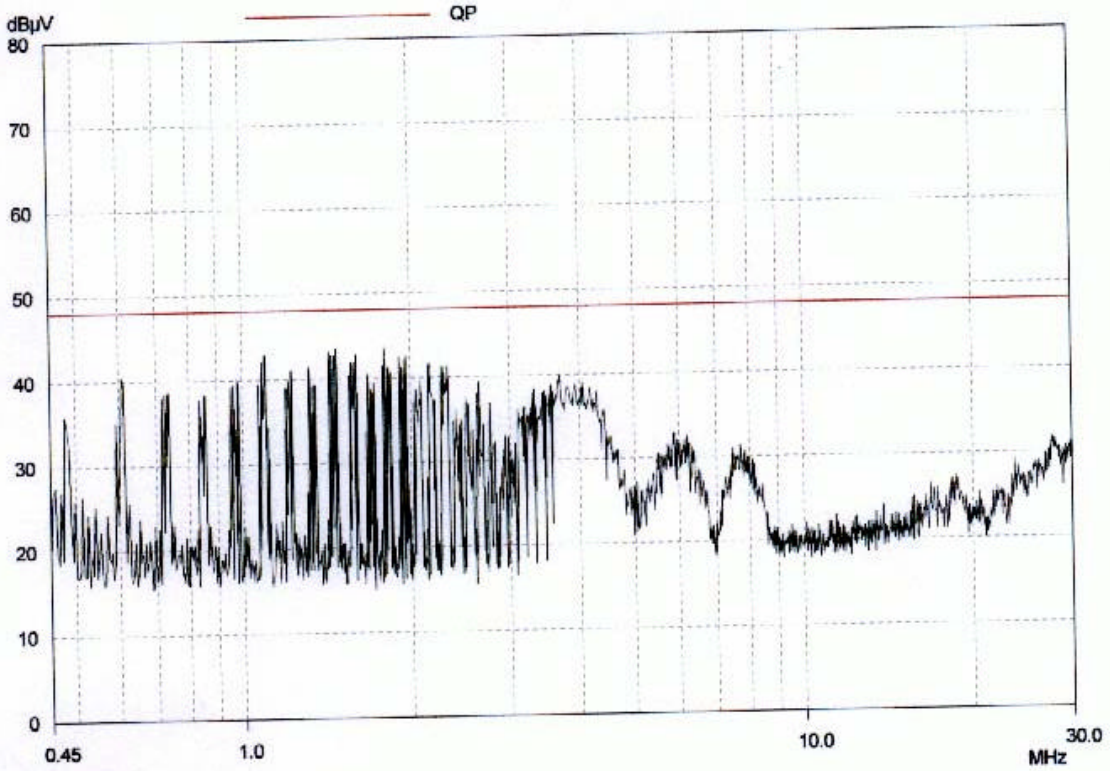
Prescan Measurement:	Detector:	X PK
	Meas Time:	see scan settings
	Peaks:	8
	Acc Margin:	10 dB



Conducted Emission
Peak Value

EUT:	Wireless LAN
Manuf:	
Op Cond:	Tx (CH 1)
Operator:	Rick Hu
Test Spec:	FCC Class B
Comment:	L2

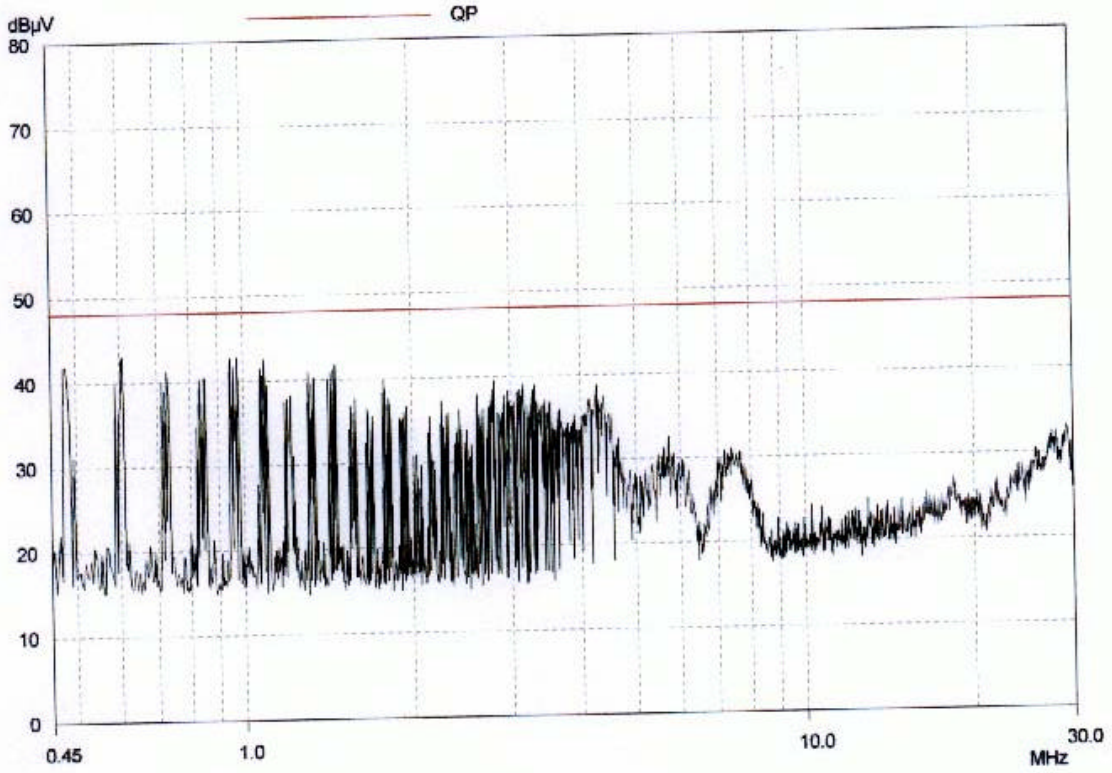
Prescan Measurement:	Detector:	X PK
	Meas Time:	see scan settings
	Peaks:	8
	Acc Margin:	10 dB



Conducted Emission
Peak Value

EUT:	Wireless LAN
Manuf:	
Op Cond:	Tx (CH 6)
Operator:	Rick Hu
Test Spec:	FCC Class B
Comment:	L1

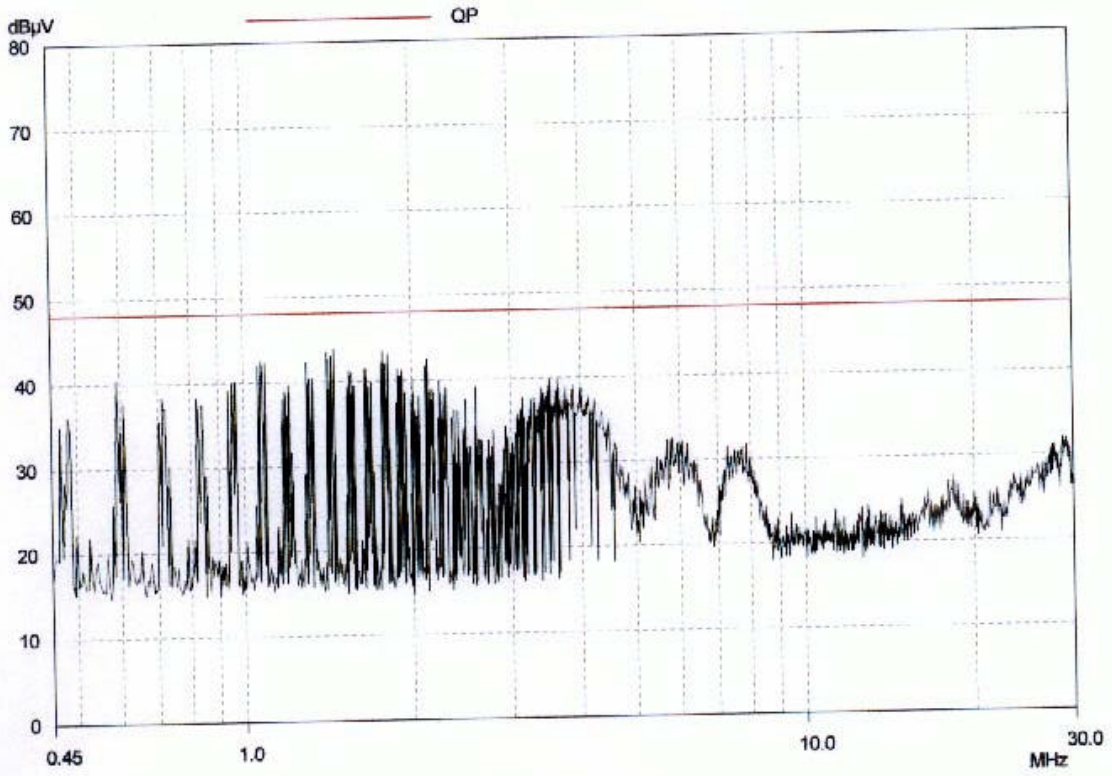
Prescan Measurement:	Detector:	X PK
	Meas Time:	see scan settings
	Peaks:	8
	Acc Margin:	10 dB



Conducted Emission
Peak Value

EUT:	Wireless LAN
Manuf:	
Op Cond:	Tx (CH 6)
Operator:	Rick Hu
Test Spec:	FCC Class B
Comment:	L2

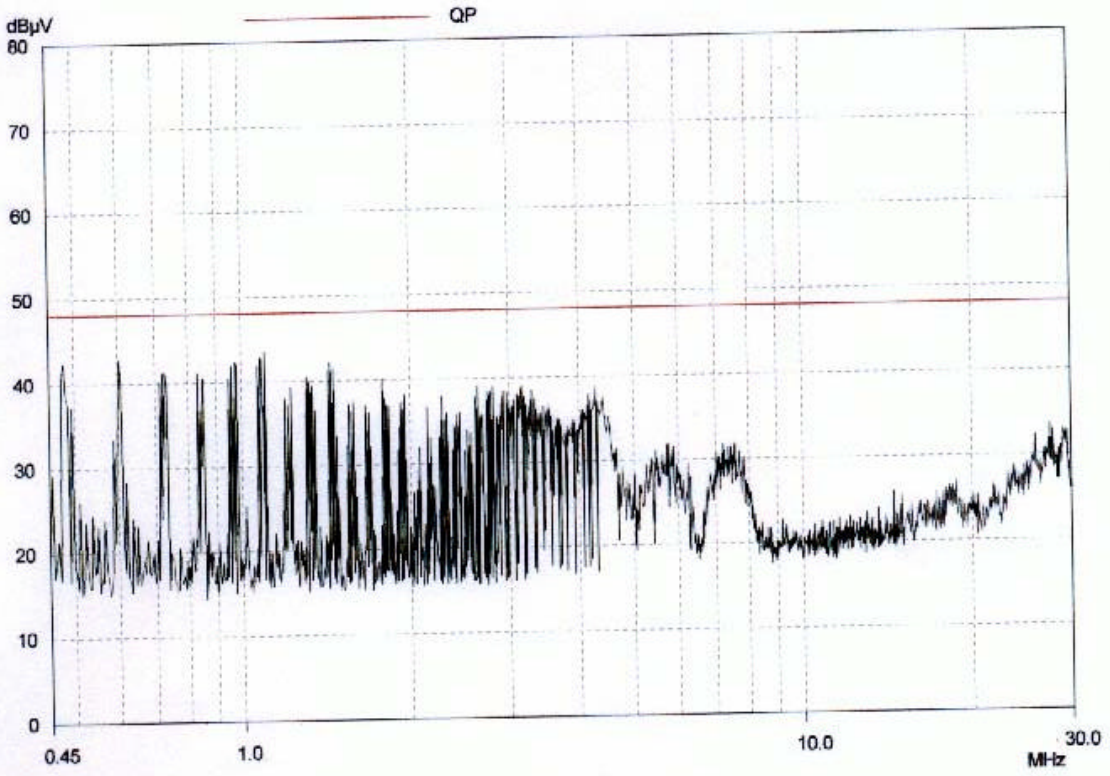
Prescan Measurement:	Detector:	X PK
	Meas Time:	see scan settings
	Peaks:	8
	Acc Margin:	10 dB



Conducted Emission
Peak Value

EUT:	Wireless LAN
Manuf:	
Op Cond:	Tx (CH 11)
Operator:	Rick Hu
Test Spec:	FCC Class B
Comment:	L1

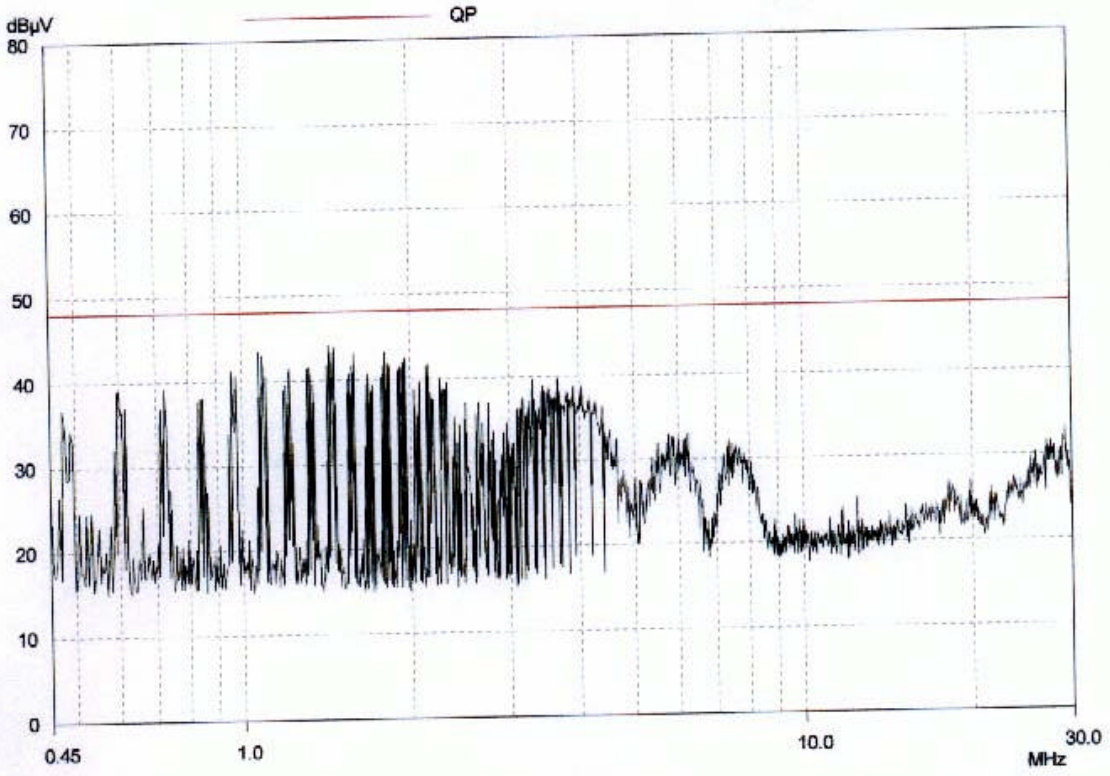
Prescan Measurement:	Detector:	X PK
	Meas Time:	see scan settings
	Peaks:	8
	Acc Margin:	10 dB



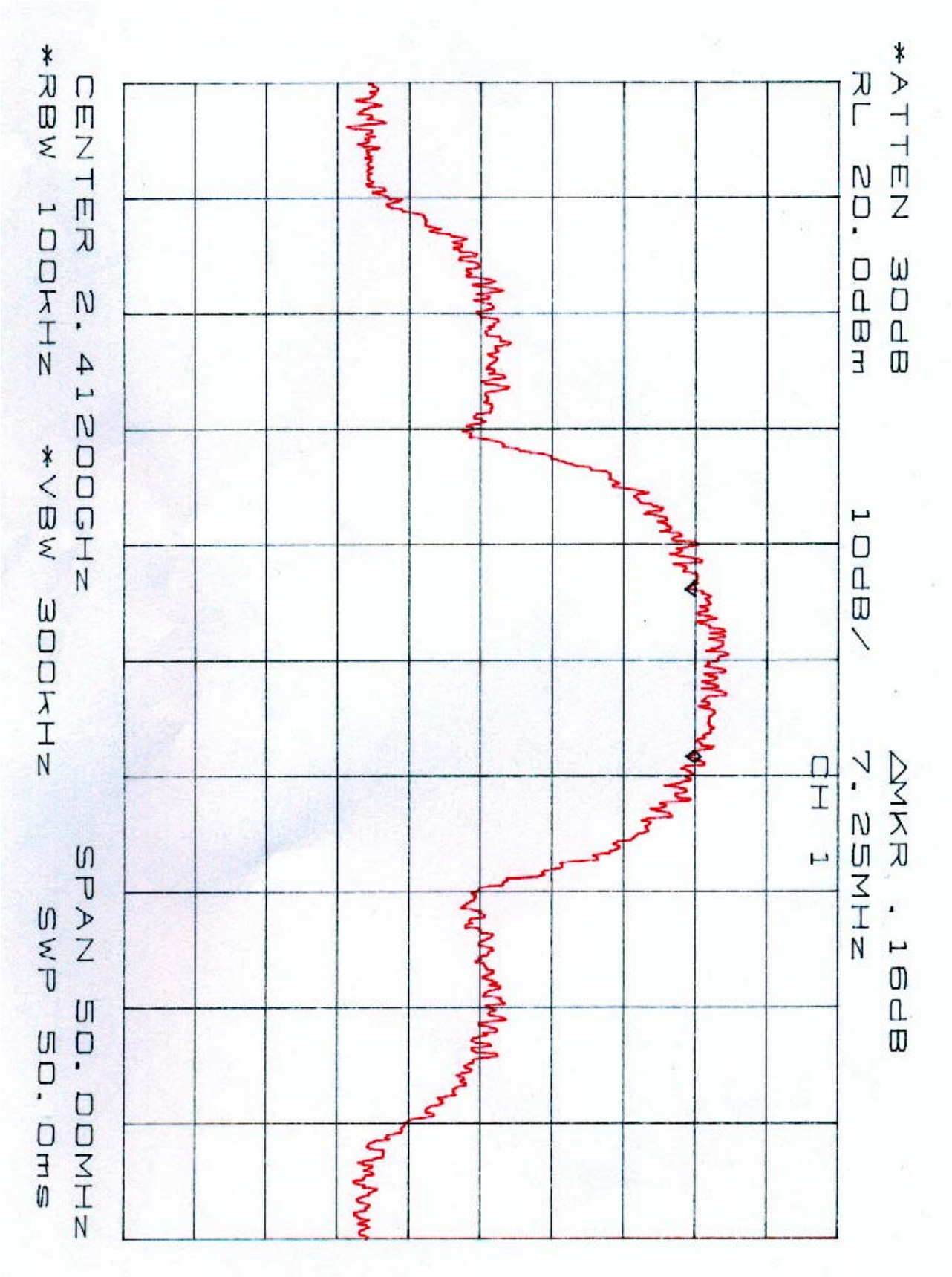
Conducted Emission
Peak Value

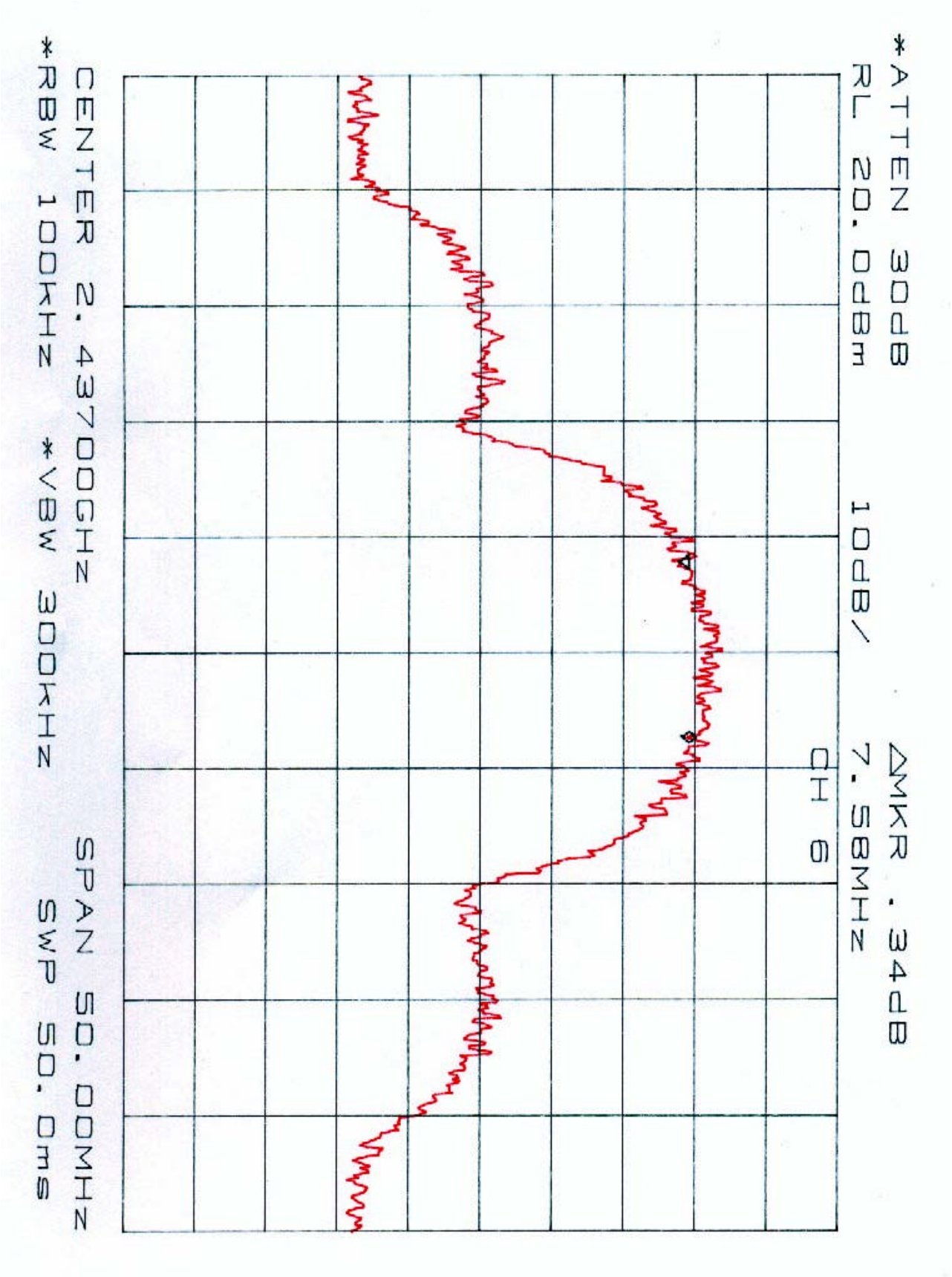
EUT:	Wireless LAN
Manuf:	
Op Cond:	Tx (CH 11)
Operator:	Rick Hu
Test Spec:	FCC Class B
Comment:	L2

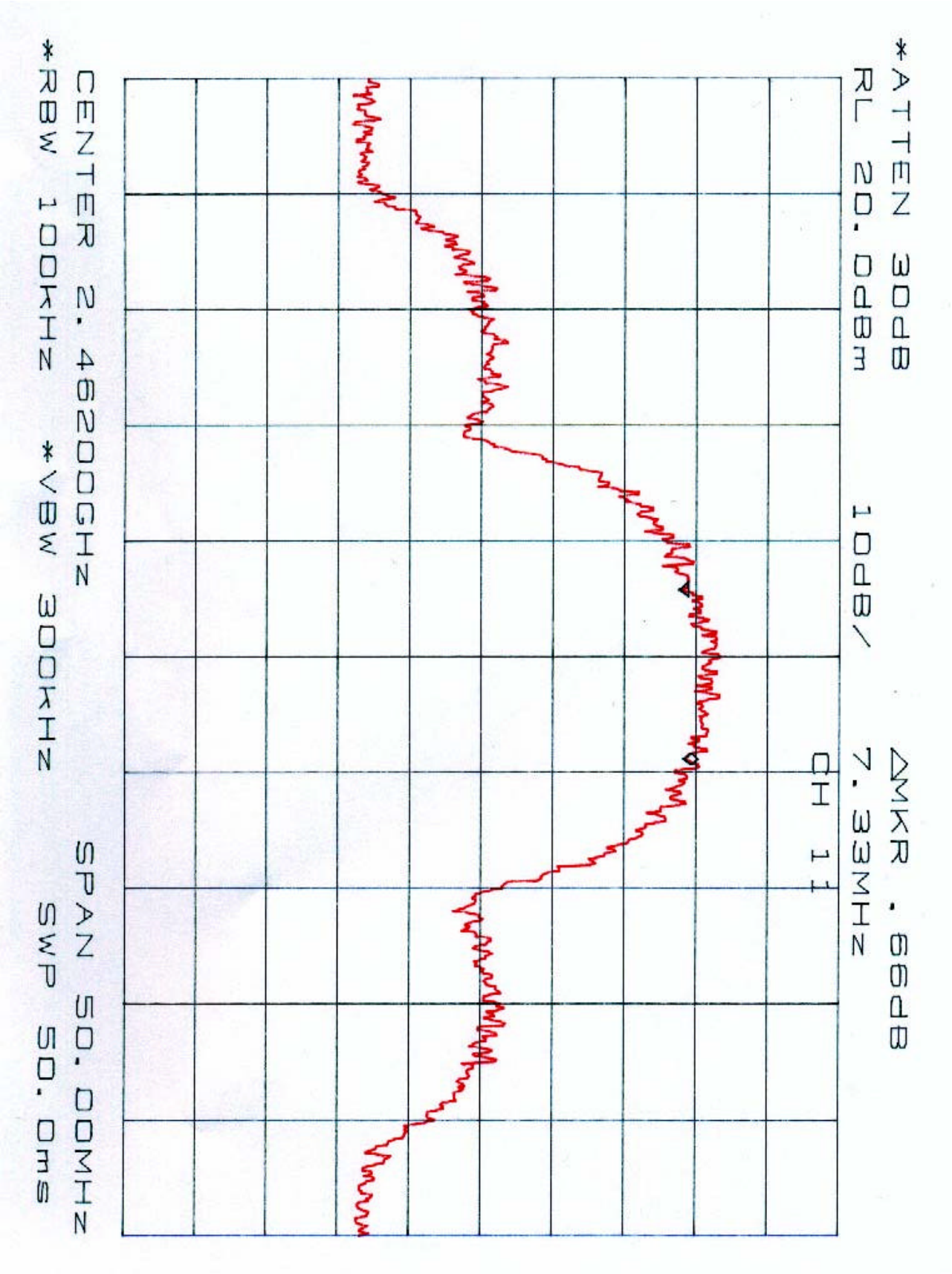
Prescan Measurement:	Detector:	X PK
	Meas Time:	see scan settings
	Peaks:	8
	Acc Margin:	10 dB



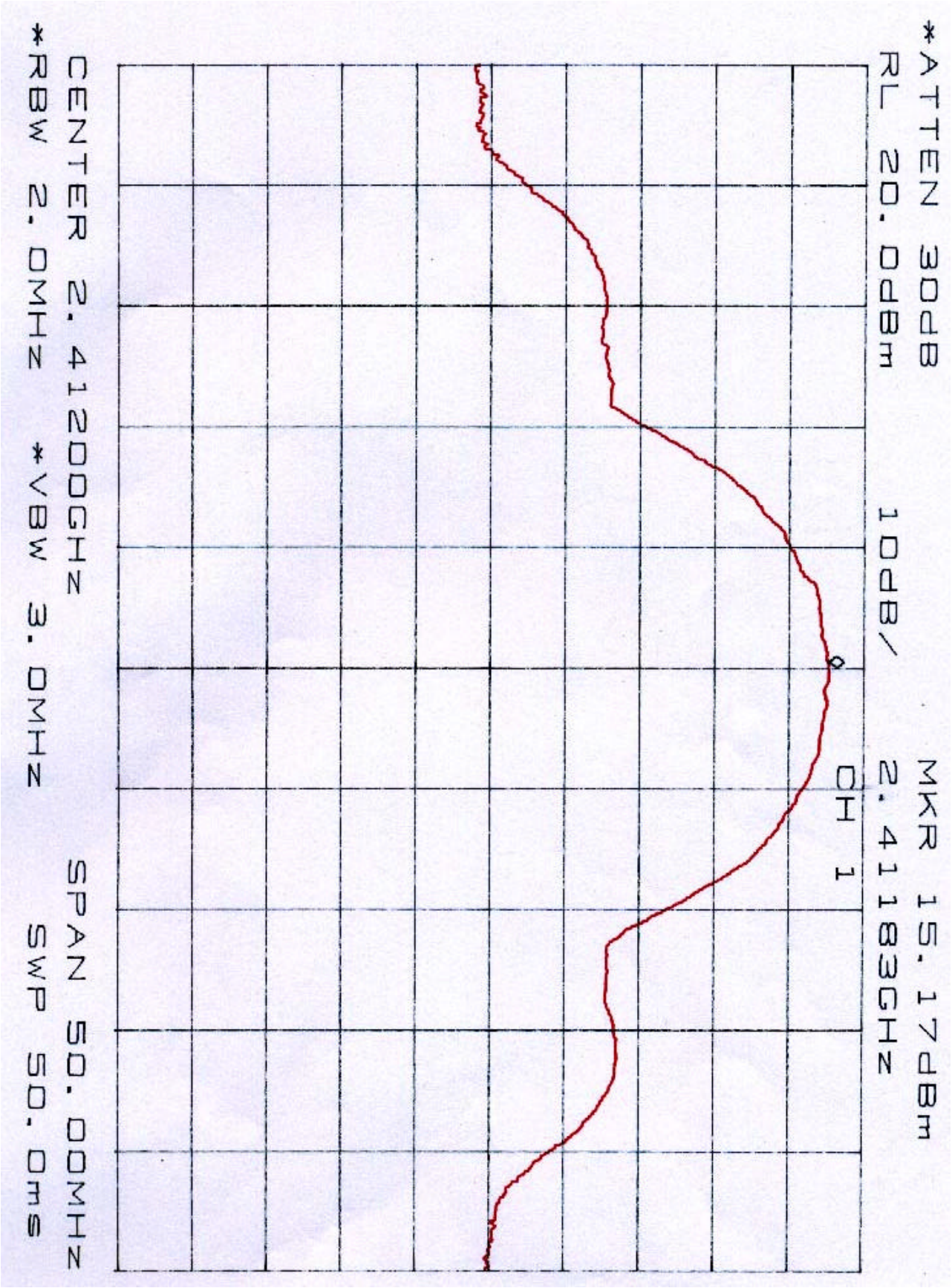
Appendix 2 : Ploted Datas of Emissions Bandwidth


*ATTEN 30dB
RL 20.0dBm
10dB/
ΔMKR .16dB
7.25MHz
CH 1
CENTER 2.412000GHz
*RBW 100kHz
*VBW 300kHz
SPAN 50.00MHz
SWP 50.0ms


*ATTEN 30dB
RL 20.0dBm
10dB/
ΔMKR .34dB
7.58MHz
CH 6
CENTER 2.437000GHz
SPAN 50.00MHz
*RBW 100kHz
*VBW 300kHz
SWP 50.0ms


*ATTEN 30dB
RL 20. 0dBm
10dB/
ΔMKR . 66dB
7. 33MHz
CH 11
CENTER 2. 462000GHz
SPAN 50. 00MHz
*RBW 100kHz
*VBW 300kHz
SWP 50. 0ms

Appendix 3 : Ploted Datas of Output Peak Power


*ATTEN 30dB
MKR 15.17dBm
RL 20.0dBm
10dB/
2.41183GHz
OH 1
CENTER 2.41200GHz
SPAN 50.00MHz
*RBW 2.0MHz
*VBW 3.0MHz
SWP 50.0ms