FCC Part 15
EMI TEST REPORT

of

E.U.T. : BL3006F 2.4GHz WLAN ODU

FCC ID. : QZGBL3006F-001

MODEL : BL3006F

for

APPLICANT : K-Best Technology Inc.

ADDRESS : 2FI-1, No.185, Ko Wang Rd., Kau Yuan Tsun, Lung Tan Hsiang, Tao Yuan Hsien, Taiwan

Test Performed by

ELECTRONICS TESTING CENTER, TAIWAN
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Report Number : ET93R-02-048

TEST REPORT CERTIFICATION

Applicant : K-Best Technology Inc.
2FI, -1, No. 185, Ko Wang Rd., Kau Yuan Tsun, Lung Tan Hsiang, Tao Yuan Hsien, Taiwan

Manufacturer : K-Best Technology Inc.
2FI, -1, No. 185, Ko Wang Rd., Kau Yuan Tsun, Lung Tan Hsiang, Tao Yuan Hsien, Taiwan

Description of EUT :

a) Type of EUT : BL3006F 2.4GHz WLAN ODU

b) Trade Name : K-Best

c) Model No. : BL3006F

d) Power Supply : I/P: 100-240Vdc,50-60Hz,1.0A,60-70VA;
O/P: +12Vdc,2.0A,30W

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 : Mar. 05, 2004

Test Engineer : Tien Lu Liao
(Tien lu Liao)

Approve & Authorized Signer : Will Yauo
Will Yauo, Manager
EMC Dept. II of ELECTRONICS
TESTING CENTER, TAIWAN

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1 GENERAL INFORMATION

1.1 Product Description

a) Type of EUT : BL3006F 2.4GHz WLAN ODU
b) Trade Name : K-Best
c) Model No. : BL3006F
d) Power Supply : I/P: 100-240Vdc,50-60Hz,1.0A,60-70VA;
O/P: +12Vdc,2.0A,30W

1.2 Characteristics of Device

1. 2400~2500 MHz unlicensed ISM Band
2. IEEE 802.11 Standard
3. Provides DC Power to the ODU with PoE (Power over Ethernet).
4. 26dBm output power levels.
5. 20 dB receive gain for the ODU
6. Bi-directional TDD technology
7. Transmitter and receiver LED
8. Waterproof housing
9. The Z-Com WLAN Access Point is currently certified with FCC ID: M4Y-000325
10. Antenna used:

Antenna Model	Antenna type	Antenna Gain (dBi)
KBNT2418-16	Flat Panel	18

1.3 Test Methodology

For BL3006F 2.4GHz WLAN ODU, both conducted and radiated emissions were performed according to the procedures illustrated in ANSI C63.4 (1992) and for processing gain measurement is according to FCC Public Notice. Other required measurements were illustrated in separate sections of this test report for details.

1.4 Test Facility

The open area test site and conducted measurement facility used to collect the radiated data is located on the roof top of Building at No. 34, Lin 5, Ding Fu Tsun, Linkou Hsiang, Taipei Hsien, Taiwan 244, R.O.C.
This site has been fully described in a report submitted to your office, and accepted in a letter dated Feb. 10, 2000.

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

Except for Class A digital devices, for equpment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150kHz to 30MHz shall not exceed the limits in the following table, as measured using a 50µH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the band edges.

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

(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

According to 15.247(a)(2), systems using digital modulation techniques may operate in the 902 - 928 MHz, 2400 - 2483.5 MHz, and 5725 - 5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

(5) Output Power Requirement

For direct sequence system, according to 15.247(b)(3), the maximum peak output power of the transmitter shall not exceed 1 Watt.

According to 15.247(b)(4), except as shown in paragraphs (b)(4)(i), (ii), and (iii) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the peak output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

According to 15.247(b)(4)(i), systems operating in the 2400-2483.5 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 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.

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	4.5-5.15
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	3360-4400	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 to maximum allowed by EUT. Three highest emissions were verified with varying placement of the transmitting antenna connected to EUT to maximize the emission from EUT.

For conducted emissions, only measured on TX and RX operation, for the digital circuits portion also function normally whenever TX or RX is operated. For radiated emissions, whichever RF channel is operated, the digital circuits function identically. As the reason, measurement of radiated emissions from digital circuits is only performed with channel 7 by transmitting mode.

During the preliminary test, the worse case is the antenna with a cable, and data presented in this test report just shows the worse case.

3.2 Devices for Tested System

Device	Manufacture	Model / FCC ID.	Cable Description
BL3006F 2.4GHz WLAN ODU *	K-Best Technology Inc.	BL3006F/ QZGBL3006F-001	2.5m Unshieled AC Adaptor power cord 50m Shieled RJ-45 cable Line 1.0m Unshieled RJ-45 cable 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 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, a pre-scan is performed in a shielded chamber to determine the accurate frequencies of higher emissions will be checked on a open test site. As the same purpose, for emission frequencies measured above 1 GHz, a pre-scan also 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.
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 placement of cables associated with EUT to obtain the worse case and record the result.

Figure 1 : Frequencies measured below 1 GHz configuration

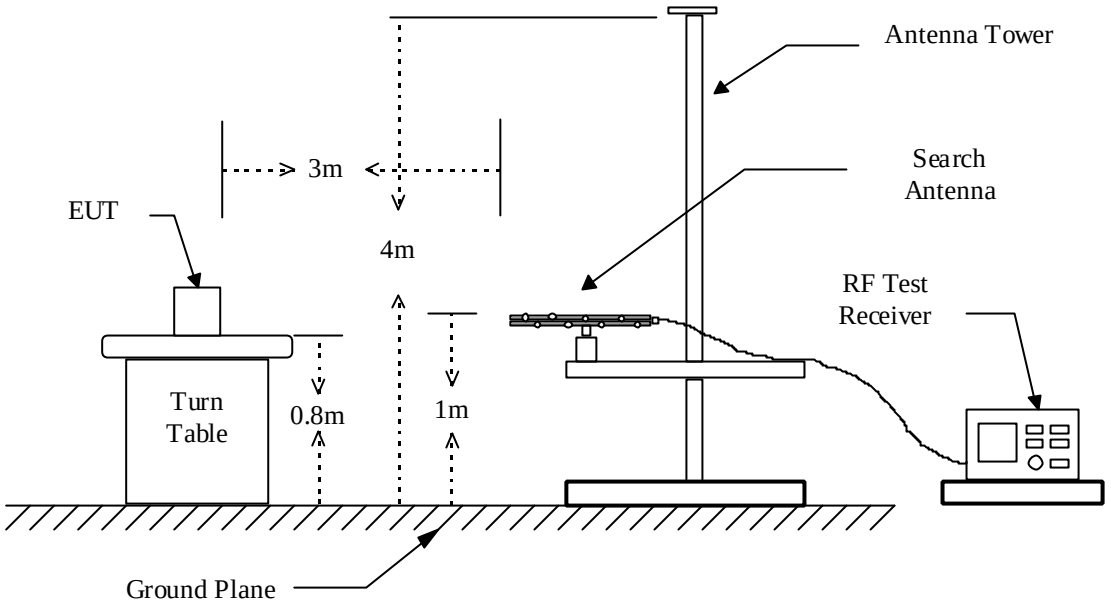
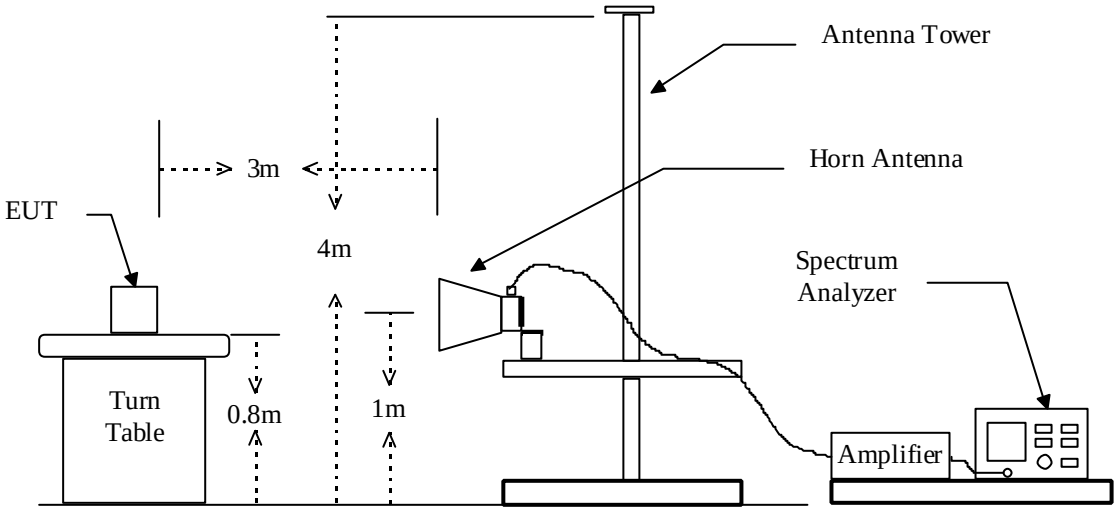


Figure 2 : Frequencies measured above 1 GHz configuration



4.3 Measuring Instrument

The following instrument are used for radiated emissions measurement:

Equipment	Manufacturer	Model No.	Next Cal. Due
Spectrum Analyzer	Adventest	R3271	11/09/2004
RF Test Receiver	Rohde & Schwarz	ESVS 30	08/09/2004
Horn Antenna	EMCO	3115	05/28/2004
Horn Antenna	EMCO	3116	03/10/2004
Log periodic Antenna	EMCO	3146	12/22/2004
Biconical Antenna	EMCO	3110B	11/05/2004
Preamplifier	Hewlett-Packard	8449B	07/22/2004
Preamplifier	Hewlett-Packard	8447D	02/19/2005
Spectrum Analyzer	Hewlett-Packard	8564E	07/23/2004

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 01

Operation Mode : Receiving /Transmitting

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

Test Date : Feb. 20, 2004 Temperature : 23 ℃ Humidity : 65 %

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)
* 2038.000	---	---	---	---	-4.5	---	---	74.0	54.0	---	---	---
* 4076.000	---	---	---	---	2.0	---	---	74.0	54.0	---	---	---
* 6114.000	---	---	---	---	4.5	---	---	74.0	54.0	---	---	---
* 8152.000	---	---	---	---	6.5	---	---	74.0	54.0	---	---	---
* 10190.000	---	---	---	---	7.6	---	---	74.0	54.0	---	---	---
4824.000	53.5	48.5	50.8	48.3	2.6	56.1	51.1	74.0	54.0	-2.9	1.3	45
7236.000	---	---	---	---	5.8	---	---	74.0	54.0	---	---	---
9648.000	---	---	---	---	7.3	---	---	74.0	54.0	---	---	---
12060.000	---	---	---	---	9.2	---	---	74.0	54.0	---	---	---
14472.000	---	---	---	---	11.6	---	---	74.0	54.0	---	---	---
16884.000	---	---	---	---	12.1	---	---	74.0	54.0	---	---	---
19296.000	---	---	---	---	8.8	---	---	74.0	54.0	---	---	---
21708.000	---	---	---	---	9.8	---	---	74.0	54.0	---	---	---
24120.000	---	---	---	---	10.4	---	---	74.0	54.0	---	---	---

Note :

1. *Item of margin shown in above table refer to average limit.*
2. *It is considered that the results of average comply with average limit when measuring data with a peak function detector meet the average limit. Mark "***" means that Peak result is meet average limit.*
3. *Remark "---" means that the emissions level is too low to be measured.*
4. *Item "Margin" referred to Average limit while there is only peak result.*
5. *The expanded uncertainty of the radiated emission tests is 3.53 dB.*
6. *Remark "*" means the receiving local frequency and the harmonics.*

b) Channel 06

Operation Mode : Receiving / Transmitting

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

Test Date : Feb. 20, 2004 Temperature : 23 ℃ 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	Result @3m (dBuV/m) Ave	Limit @3m (dBuV/m) Peak	Limit @3m (dBuV/m) Ave.	Margin (dB)	Table Deg. (Deg.)	Ant. High (m)
* 2063.000	---	---	---	---	-4.4	---	---	74.0	54.0	---	---	---
* 4126.000	---	---	---	---	2.0	---	---	74.0	54.0	---	---	---
* 6189.000	---	---	---	---	4.5	---	---	74.0	54.0	---	---	---
* 8252.000	---	---	---	---	6.6	---	---	74.0	54.0	---	---	---
* 10315.000	---	---	---	---	7.7	---	---	74.0	54.0	---	---	---
4874.000	44.6	37.6	45.7	38.8	2.7	48.4	41.5	74.0	54.0	-12.5	47	1.3
7311.000	---	---	---	---	5.9	---	---	74.0	54.0	---	---	---
9748.000	---	---	---	---	7.3	---	---	74.0	54.0	---	---	---
12185.000	---	---	---	---	9.3	---	---	74.0	54.0	---	---	---
14622.000	---	---	---	---	11.6	---	---	74.0	54.0	---	---	---
17059.000	---	---	---	---	13.1	---	---	74.0	54.0	---	---	---
19496.000	---	---	---	---	8.5	---	---	74.0	54.0	---	---	---
21933.000	---	---	---	---	9.9	---	---	74.0	54.0	---	---	---
24370.000	---	---	---	---	10.7	---	---	74.0	54.0	---	---	---

Note :

1. *Item of margin shown in above table refer to average limit.*
2. *It is considered that the results of average comply with average limit when measuring data with a peak function detector meet the average limit. Mark "***" means that Peak result is meet average limit.*
3. *Remark "---" means that the emissions level is too low to be measured.*
4. *Item "Margin" referred to Average limit while there is only peak result.*
5. *The expanded uncertainty of the radiated emission tests is 3.53 dB.*
6. *Remark "*" means the receiving local frequency and the harmonics.*

c) Channel 11

Operation Mode : Receiving / Transmitting

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

Test Date : Feb. 20, 2004 Temperature : 23 ℃ 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	Result @3m (dBuV/m) Ave	Limit @3m (dBuV/m) Peak	Limit @3m (dBuV/m) Ave.	Margin (dB)	Table Deg. (Deg.)	Ant. High (m)
* 2088.000	---	---	---	---	-4.3	---	---	74.0	54.0	---	---	---
* 4176.000	---	---	---	---	2.0	---	---	74.0	54.0	---	---	---
* 6264.000	---	---	---	---	4.5	---	---	74.0	54.0	---	---	---
* 8352.000	---	---	---	---	6.7	---	---	74.0	54.0	---	---	---
* 10440.000	---	---	---	---	7.8	---	---	74.0	54.0	---	---	---
4924.000	45.2	39.0	44.8	36.8	2.8	48.0	41.8	74.0	54.0	-12.2	1.3	50
7386.000	---	---	---	---	6.0	---	---	74.0	54.0	---	---	---
9848.000	---	---	---	---	7.3	---	---	74.0	54.0	---	---	---
12310.000	---	---	---	---	9.3	---	---	74.0	54.0	---	---	---
14772.000	---	---	---	---	11.5	---	---	74.0	54.0	---	---	---
17234.000	---	---	---	---	14.3	---	---	74.0	54.0	---	---	---
19696.000	---	---	---	---	8.5	---	---	74.0	54.0	---	---	---
22158.000	---	---	---	---	10.0	---	---	74.0	54.0	---	---	---
24620.000	---	---	---	---	10.9	---	---	74.0	54.0	---	---	---

Note :

1. *Item of margin shown in above table refer to average limit.*
2. *It is considered that the results of average comply with average limit when measuring data with a peak function detector meet the average limit. Mark "***" means that Peak result is meet average limit.*
3. *Remark "---" means that the emissions level is too low to be measured.*
4. *Item "Margin" referred to Average limit while there is only peak result.*
5. *The expanded uncertainty of the radiated emission tests is 3.53 dB.*
6. *Remark "*" means the receiving local frequency and the harmonics.*

4.4.2 Radiated Eimssion of Restricted bands

Test Date : Feb. 20, 2004 Temperature : 23 ℃ Humidity : 65 %

Operation Mode : CH 01 Restricted Frequency band: 2310MHz – 2390MHz

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)
2356.785	43.4	29.8	44.7	31.1	-3.2	41.5	27.9	74.0	54.0	-26.1	180	1.0
2387.125	43.5	29.5	45.0	31.5	-3.1	41.9	28.4	74.0	54.0	-25.6	45	1.0

Operation Mode : CH 11 Restricted Frequency band: 2483.5MHz – 2500MHz

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)
2487.900	43.7	30.0	45.1	31.6	-2.7	42.4	28.9	74.0	54.0	-25.1	175	1.0
2499.675	44.1	30.5	45.8	32.1	-2.7	43.1	29.4	74.0	54.0	-24.6	15	1.0

Note :

1. *Item of margin shown in above table refer to average limit.*
2. *It is considered that the results of average comply with average limit when measuring data with a peak function detector meet the average limit. Mark "***" means that Peak result is meet average limit.*
3. *Remark "---" means that the emissions level is too low to be measured.*
4. *Item "Margin" referred to Average limit while there is only peak result.*
5. *The expanded uncertainty of the radiated emission tests is 3.53 dB.*

4.4.3 Other Emission

a) Emission frequencies below 1 GHz

Test Date : Feb. 10, 2004 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)
32.700	H	46.4	-10.3	36.1	40.0	-3.9	180	4.0
42.420	V	48.4	-12.4	36.0	40.0	-4.0	90	1.0
180.120	H	49.2	-9.1	40.1	43.5	-3.4	0	4.0
230.610	H	40.1	-5.1	35.0	46.0	-11.0	50	4.0
365.800	H	47.1	-7.6	39.5	46.0	-6.5	55	4.0
797.700	H	41.3	0.6	41.9	46.0	-4.1	180	3.0
848.100	H	39.4	2.1	41.5	46.0	-4.5	90	2.5

Note :

1. Remark "---" means that the emissions level is too low to be measured.

2. The expanded uncertainty of the radiated emission tests is 3.53 dB.

b) Emission frequencies above 1 GHz

Radiated emission frequencies above 1 GHz to 25 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

Please see Exhibit-F-Setup_Photos

5 CONDUCTED EMISSION MEASUREMENT

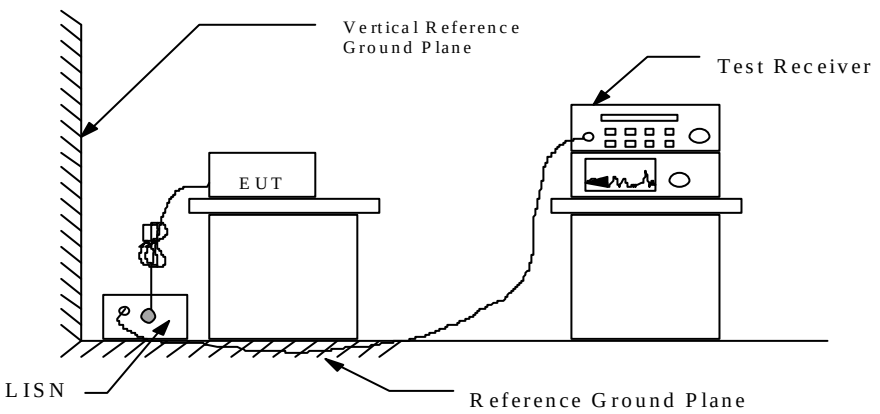
5.1 Standard Applicable

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 01

Operation Mode : Transmitting / Receiving
Test Date : Feb. 18, 2004 Temperature : 25 ℃ Humidity : 55 %

Freq.	Meter Reading (dBµV)				Factor	Limit (dBµV)		Result (dBµV)			
	Q.P Value		AVG. Value			Q.P	AVG.	Q.P Value		AVG. Value	
(MHz)	N	L1	N	L1	(dB)	Value	Value	N	L1	N	L1
3.191	40.7	41.0	----	----	0.6	56.0	46.0	41.3	41.6	----	----
3.441	43.6	43.4	----	----	0.6	56.0	46.0	44.2	44.0	----	----
3.531	42.9	41.3	----	----	0.6	56.0	46.0	43.5	41.9	----	----
3.746	43.7	42.4	----	----	0.6	56.0	46.0	44.3	43.0	----	----
3.781	41.3	42.7	----	----	0.6	56.0	46.0	41.9	43.3	----	----
3.836	42.9	41.4	----	----	0.6	56.0	46.0	43.5	42.0	----	----

b) Channel 06

Operation Mode : Transmitting / Receiving
Test Date : Feb. 18, 2004 Temperature : 25 ℃ Humidity : 55 %

Freq.	Meter Reading (dBµV)				Factor	Limit (dBµV)		Result (dBµV)			
	Q.P Value		AVG. Value			Q.P	AVG.	Q.P Value		AVG. Value	
(MHz)	N	L1	N	L1	(dB)	Value	Value	N	L1	N	L1
0.216	46.3	48.3	----	----	0.2	63.0	53.0	46.5	48.5	----	----
2.473	34.5	37.2	----	----	0.5	56.0	46.0	35.0	37.7	----	----
3.375	40.2	41.3	----	----	0.6	56.0	46.0	40.8	41.9	----	----
3.465	42.2	42.8	----	----	0.6	56.0	46.0	42.8	43.4	----	----
3.652	44.6	43.5	----	----	0.6	56.0	46.0	45.2	44.1	----	----
3.688	42.5	41.2	----	----	0.6	56.0	46.0	43.1	41.8	----	----

Note : 1. Please see appendix 1 for Plotted Data
2. The expanded uncertainty of the conducted emission tests is 2.45 dB.

c) Channel 11

Operation Mode : Transmitting / Receiving
Test Date : Feb. 18, 2004 Temperature : 25 ℃ Humidity : 55 %

Freq.	**Meter Reading** (dBμV)				**Factor**	**Limit** (dBμV)		**Result** (dBμV)			
	Q.P Value		AVG. Value			Q.P	AVG.	Q.P Value		AVG. Value	
(MHz)	N	L1	N	L1	(dB)	Value	Value	N	L1	N	L1
0.189	50.5	50.3	----	----	0.2	64.1	54.1	50.7	50.5	----	----
2.996	38.8	39.9	----	----	0.5	56.0	46.0	39.3	40.4	----	----
3.359	42.3	42.7	----	----	0.6	56.0	46.0	42.9	43.3	----	----
3.660	43.9	43.3	----	----	0.6	56.0	46.0	44.5	43.9	----	----
3.703	43.9	42.5	----	----	0.6	56.0	46.0	44.5	43.1	----	----
3.836	43.5	42.9	----	----	0.6	56.0	46.0	44.1	43.5	----	----

Note : 1. Please see appendix 1 for Plotted Data
2. The expanded uncertainty of the conducted emission tests is 2.45 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 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
EMI Test Receiver	Rohde and Schwarz	ESCS 30	12/01/2004
Line Impedance Stabilization network	Rohde and Schwarz	ESH2-Z5	09/20/2004
Monitor	IBM	E54	N.C.R.
Printer	HP	LaserJet 1000	N.C.R.
Shielded Room	Riken	----	N.C.R.
Computer	Acer	Veriton	N.C.R.

5.6 Photos of Conduction Measuring Setup

Please see Exhibit-F-Setup_Photos

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.

According to 15.247(b)(4), except as shown in paragraphs (b)(4)(i), (ii), and (iii) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the peak output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

According to 15.247(b)(4)(i), systems operating in the 2400-2483.5 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 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 Male MMCX Connector. Please see constraction Photos Of Exhibit B for details.

Antenna Model	Antenna type	Antenna Gain (dBi)
KBNT2418-16	Flat Panel	18

7 EMISSION BANDWIDTH MEASUREMENT

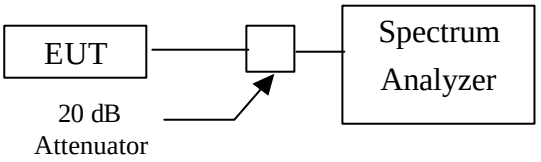
7.1 Standard Applicable

According to 15.247(a)(2), systems using digital modulation techniques may operate in the 902 - 928 MHz, 2400 - 2483.5 MHz, and 5725 - 5850 MHz bands. The minimum 6 dB 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 without connection to measurement instrument. 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
Spectrum Analyzer	Hewlett-Packard	8564E	07/23/2004
Attenuator	Weinschel Engineering	1	N/A
Plotter	Hewlett-Packard	7440A	N/A

7.4 Measurement Data

Test Date : Feb. 20, 2004 Temperature : 23℃ Humidity: 65 %

a) Channel 01 : 6 dB Emission Bandwidth is 11.33 MHz
b) Channel 06 : 6 dB Emission Bandwidth is 11.33 MHz
c) Channel 11 : 6 dB Emission Bandwidth is 11.33 MHz

Note : 1. Please see appendix 2 for Plotted Data
2. The expanded uncertainty of the emission bandwidth tests is 1500Hz.

8 OUTPUT POWER MEASUREMENT

8.1 Standard Applicable

For direct sequence system, according to 15.247(b)(3), the maximum peak output power of the transmitter shall not exceed 1 Watt.

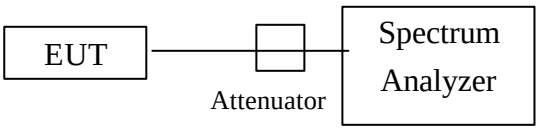
According to 15.247(b)(4), except as shown in paragraphs (b)(4)(i), (ii), and (iii) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the peak output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

According to 15.247(b)(4)(i), systems operating in the 2400-2483.5 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 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 without connection to measurement instrument. 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 = RBW.
4. Use channel power function and record the level displayed.
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
Spectrum Analyzer	Hewlett-Packard	8564E	07/23/2004
Attenuator	Weinschel Engineering	1	N/A
Plotter	Hewlett-Packard	7440A	N/A

8.4 Measurement Data

The directional gain of the antenna used is 18.0 dBi. According to 15.247(b)(4)(i), the maximum peak output power is redused by (18-6) / 3 = 4 dB. Hence the maximum peak output power of the transmitter shall not exceed 30 dBm (1 Watt) – 4 dB = 26 dBm.

Test Date : Feb. 20, 2004 Temperature : 23℃ Humidity: 65 %

a) Channel 01 : Output Peak Power is 25.8 dBm or **380.19**mW
b) Channel 06 : Output Peak Power is 25.9 dBm or **389.05**mW
c) Channel 11 : Output Peak Power is 25.3 dBm or **338.84**mW

Note : 1. Please see appendix 3 for Plotted Data
2. The expanded uncertainty of the output power tests is 2dB.

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 without connection to measurement instrument. 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 of spectrum analyzer to 100kHz and VBW = RBW 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
Spectrum Analyzer	Hewlett-Packard	8564E	07/23/2004
Attenuator	Weinschel Engineering	1	N/A
Plotter	Hewlett-Packard	7440A	N/A

9.4 Measurement Data

Test Date : Feb. 20, 2004 Temperature : 23℃ Humidity: 65 %

a) Lower Band Edge : maximum value is –32.83 dBm that is attenuated more than 20 dB
b) Upper Band Edge : maximum value is –40.50 dBm that is attenuated more than 20 dB

Note : 1. Please see appendix 4 for Plotted Data
2. The expanded uncertainty of the 100 khz bandwidth of band edges tests is 2dB.

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 4 without connection to measurement instrument. 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 100 kHz video bandwidth as well as max hold function.
5. Repeat above procedures until all measured frequencies were complete.

10.3 Measurement Equipment

Equipment	Manufacturer	Model No.	Next Cal. Due
Spectrum Analyzer	Hewlett-Packard	8564E	07/23/2004
Attenuator	Weinschel Engineering	1	N/A
Plotter	Hewlett-Packard	7440A	N/A

10.4 Measurement Data

Test Date : Feb. 20, 2004 Temperature : 23℃ Humidity: 65 %

a) Channel 01 : Maximun Power Density of 3 kHz Bandwidth is –0.03 dBm
b) Channel 06 : Maximun Power Density of 3 kHz Bandwidth is –0.30 dBm
c) Channel 11 : Maximun Power Density of 3 kHz Bandwidth is –0.20 dBm

Note : 1. Please see appendix 5 for Plotted Data
2. The expanded uncertainty of the power density tests is 2dB.

11. OUT-OF-BAND CONDUCTED EMISSION MEASUREMENT

11.1 Standard Applicable

According to 15.247(c), in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required.

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 4 without connection to measurement instrument. 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. Use the following spectrum analyzer settings:

   Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic. Typically, several plots are required to cover this entire span.

   RBW = 100 kHz

   VBW ≥ RBW

   Sweep = auto

   Detector function = peak

   Trace = max hold.
4. Allow the trace to stabilize. Set the marker on the peak of any spurious emission recorded. Plot the result on the screen of spectrum analyzer.
5. Repeat above procedures until all measured frequencies were complete.

11.3 Measurement Equipment

Equipment	Manufacturer	Model No.	Next Cal. Due
Spectrum Analyzer	Hewlett-Packard	8564E	07/23/2004
Attenuator	Weinschel Engineering	1	N/A
Plotter	Hewlett-Packard	7440A	N/A

11.4 Measurement Data

Model : CH Low

Test Date : Feb. 20, 2004 Temperature : 23℃ Humidity: 65 %

a) 1 GHz to 5 GHz frequency band: All emissions are attenuated more than 20dB from the carrier.
b) 5 GHz to 25 GHz frequency band: All emissions are attenuated more than 20dB from the carrier.

Model : CH Middle

Test Date : Feb. 20, 2004 Temperature : 23℃ Humidity: 65 %

a) 1 GHz to 5 GHz frequency band: All emissions are attenuated more than 20dB from the carrier.
b) 5 GHz to 25 GHz frequency band: All emissions are attenuated more than 20dB from the carrier.

Model : CH High

Test Date : Feb. 20, 2004 Temperature : 23℃ Humidity: 65 %

c) 1 GHz to 5 GHz frequency band: All emissions are attenuated more than 20dB from the carrier.
d) 5 GHz to 25 GHz frequency band: All emissions are attenuated more than 20dB from the carrier

Note : 1. Please see appendix 6 for Plotted Data
2. The expanded uncertainty of the out-of-band conducted emission tests is 2dB.

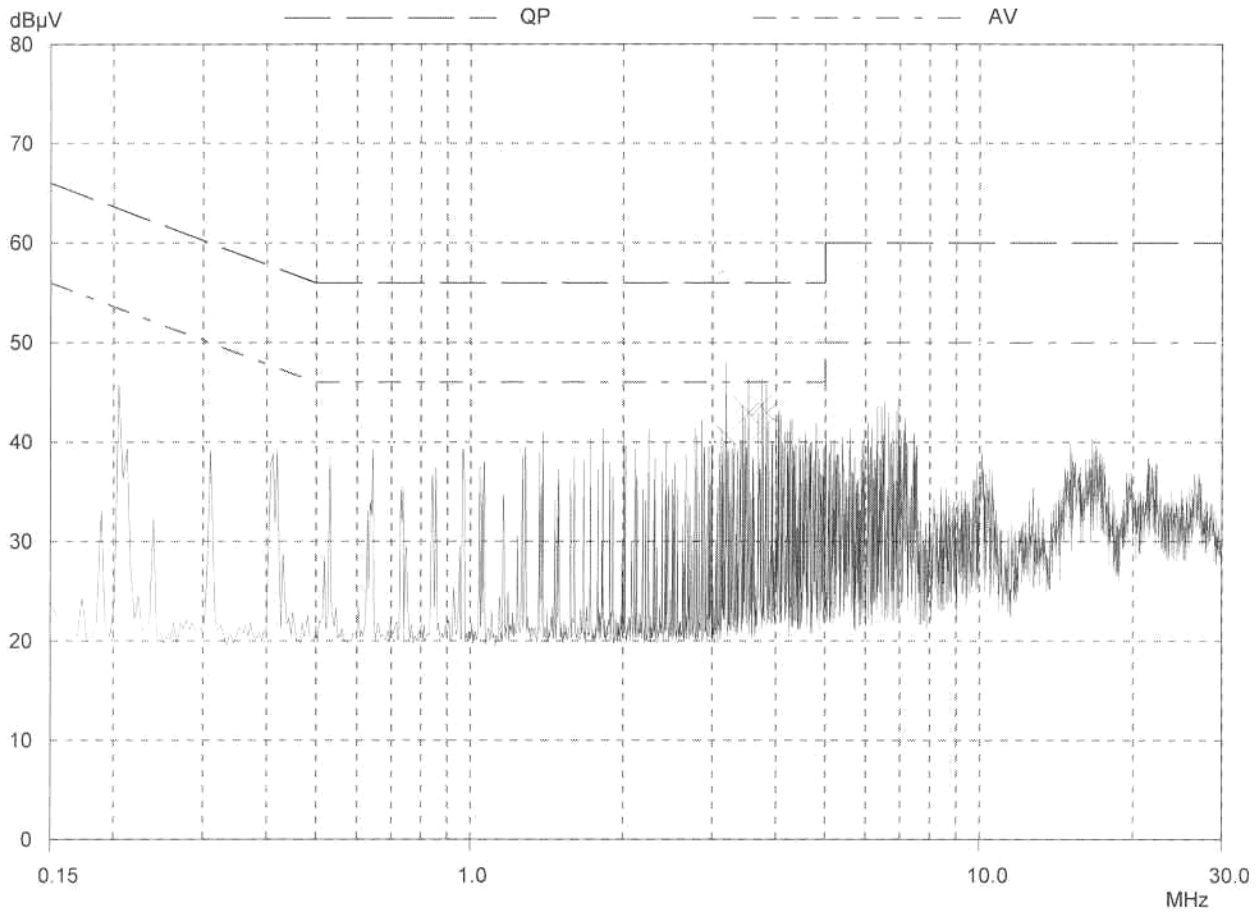
Appendix 1 : Ploted Datas of Power Line Conducted Emissions

CONDUCTION EMISSION TEST

Peak Value

EUT:	2.4G
Manuf:	
Op Cond:	CH 1
Operator:	
Test Spec:	
Comment:	
	N

Final Measurement:	Detector:	X QP
	Meas Time:	1sec
	Peaks:	8
	Acc Margin:	25 dB

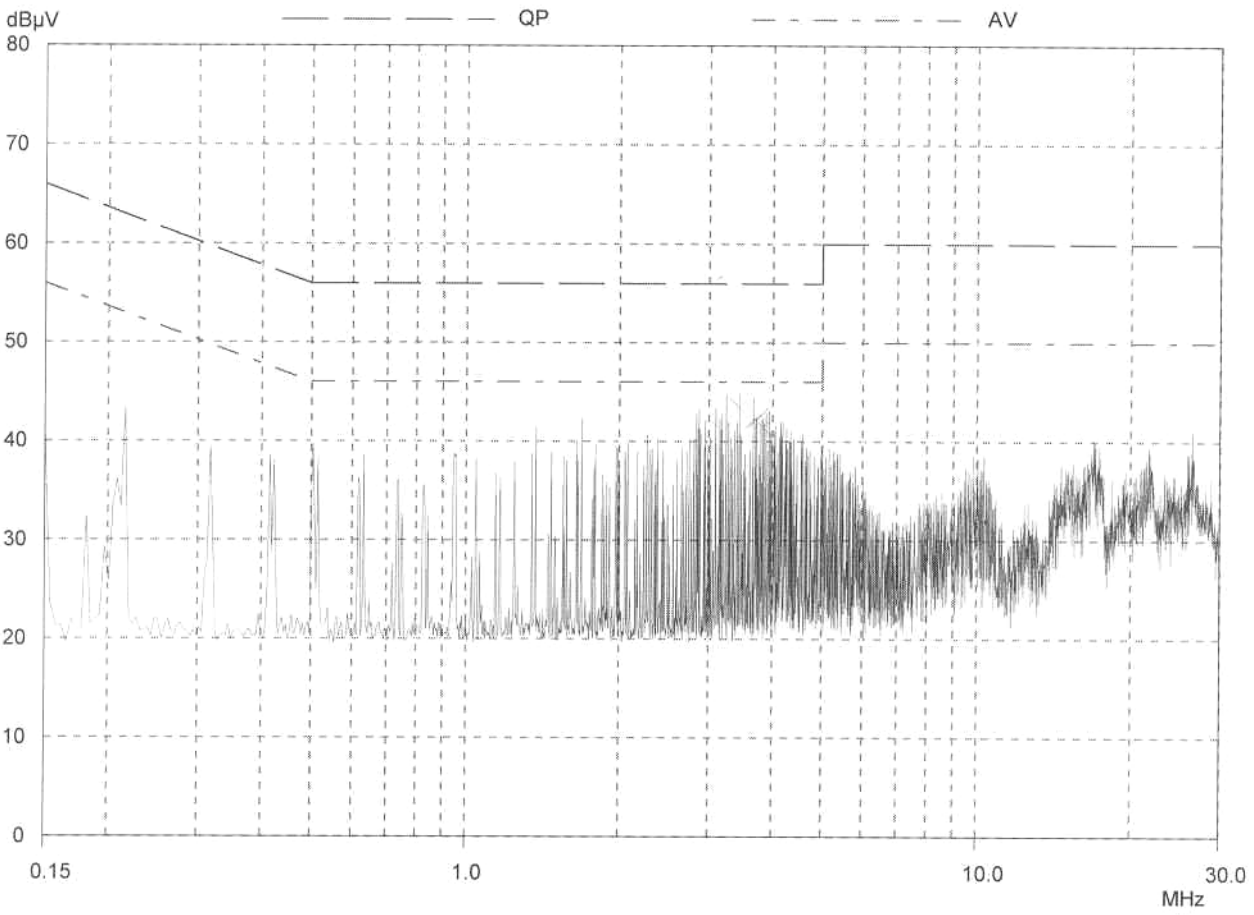


CONDUCTION EMISSION TEST

Peak Value

EUT:	2.4G
Manuf:	
Op Cond:	CH 1
Operator:	
Test Spec:	
Comment:	
	L1

Final Measurement:	Detector:	X QP
	Meas Time:	1sec
	Peaks:	8
	Acc Margin:	25 dB

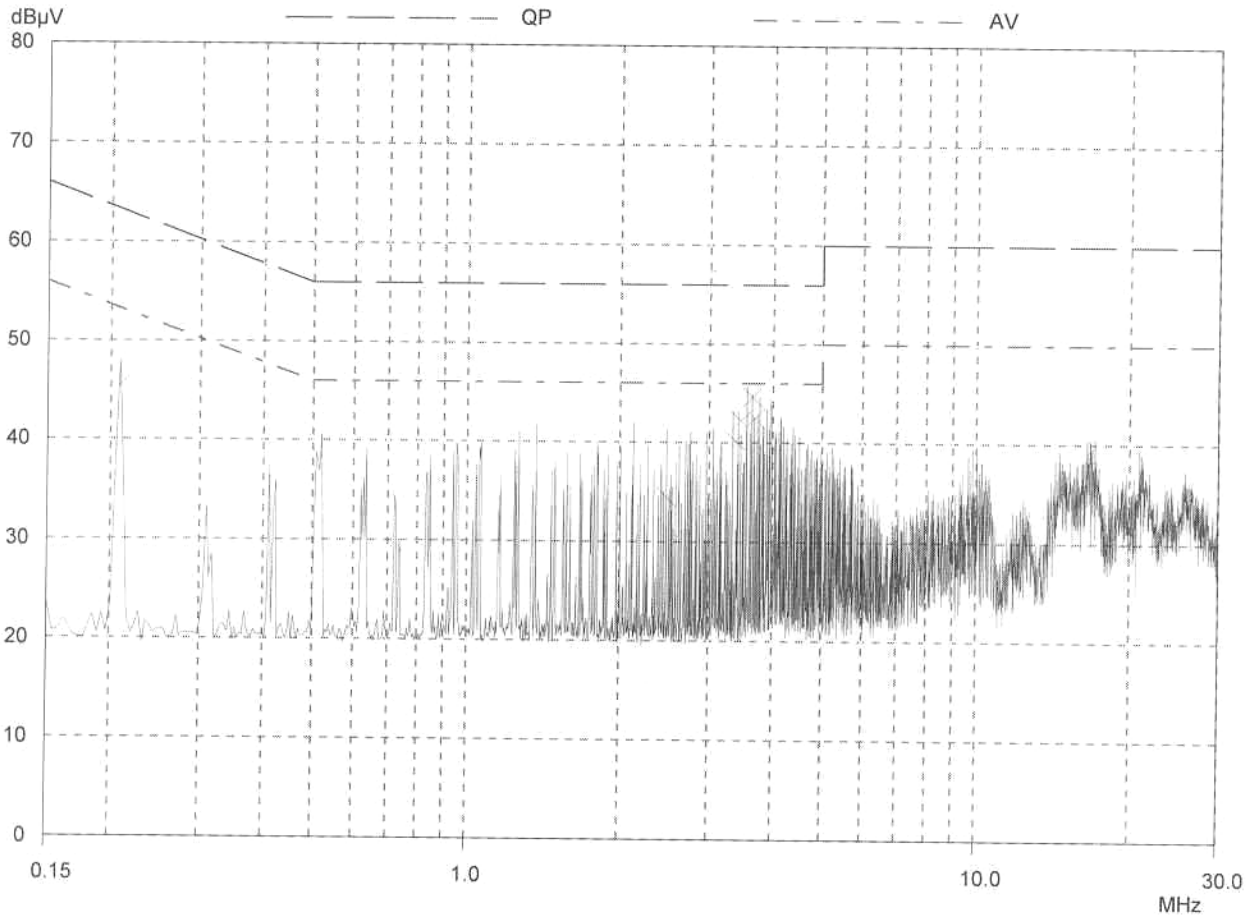


CONDUCTION EMISSION TEST

Peak Value

EUT:	2.4G
Manuf:	
Op Cond:	CH 6
Operator:	
Test Spec:	
Comment:	
	N

Final Measurement:	Detector:	X QP
	Meas Time:	1sec
	Peaks:	8
	Acc Margin:	25 dB

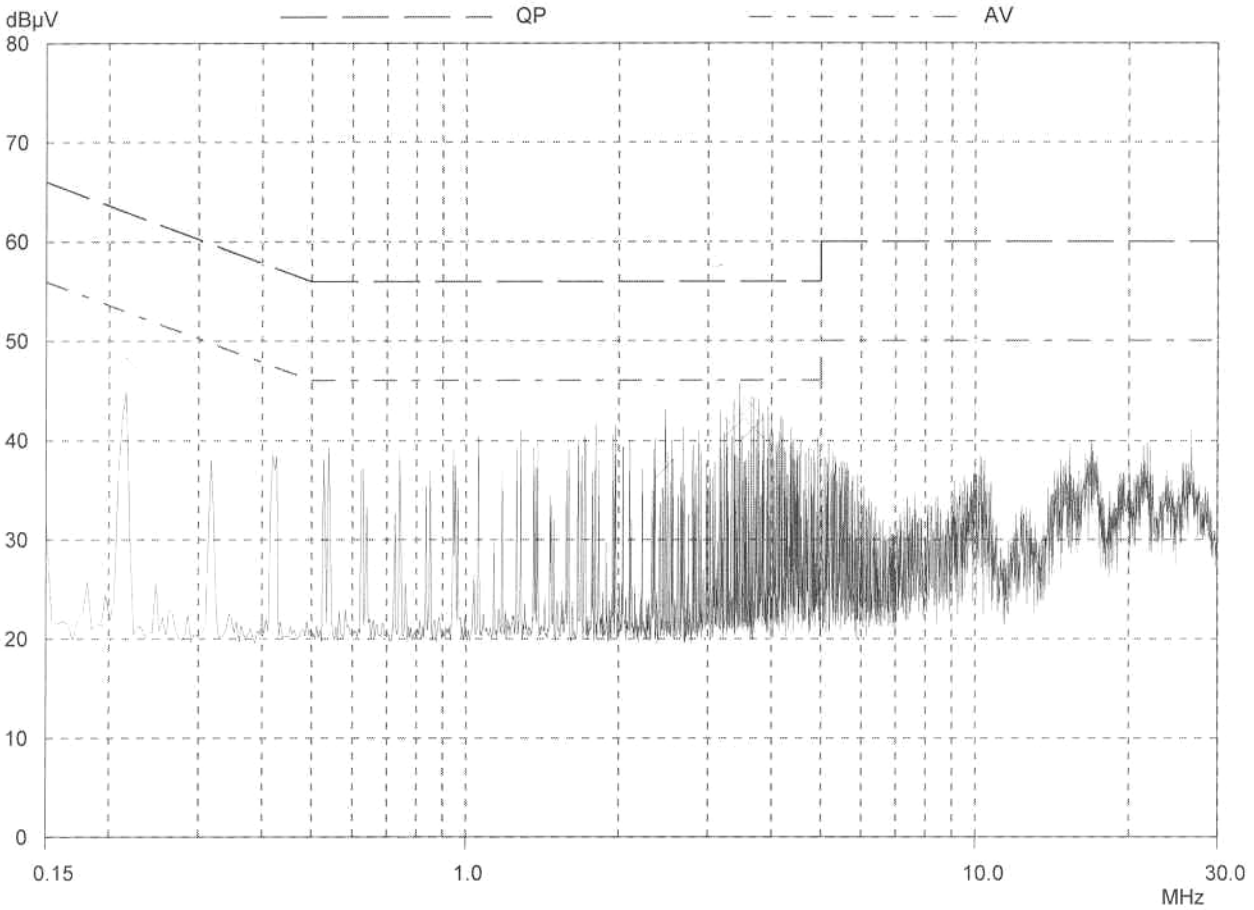


CONDUCTION EMISSION TEST

Peak Value

EUT:	2.4G
Manuf:	
Op Cond:	CH 6
Operator:	
Test Spec:	
Comment:	
	L1

Final Measurement:	Detector:	X QP
	Meas Time:	1sec
	Peaks:	8
	Acc Margin:	25 dB

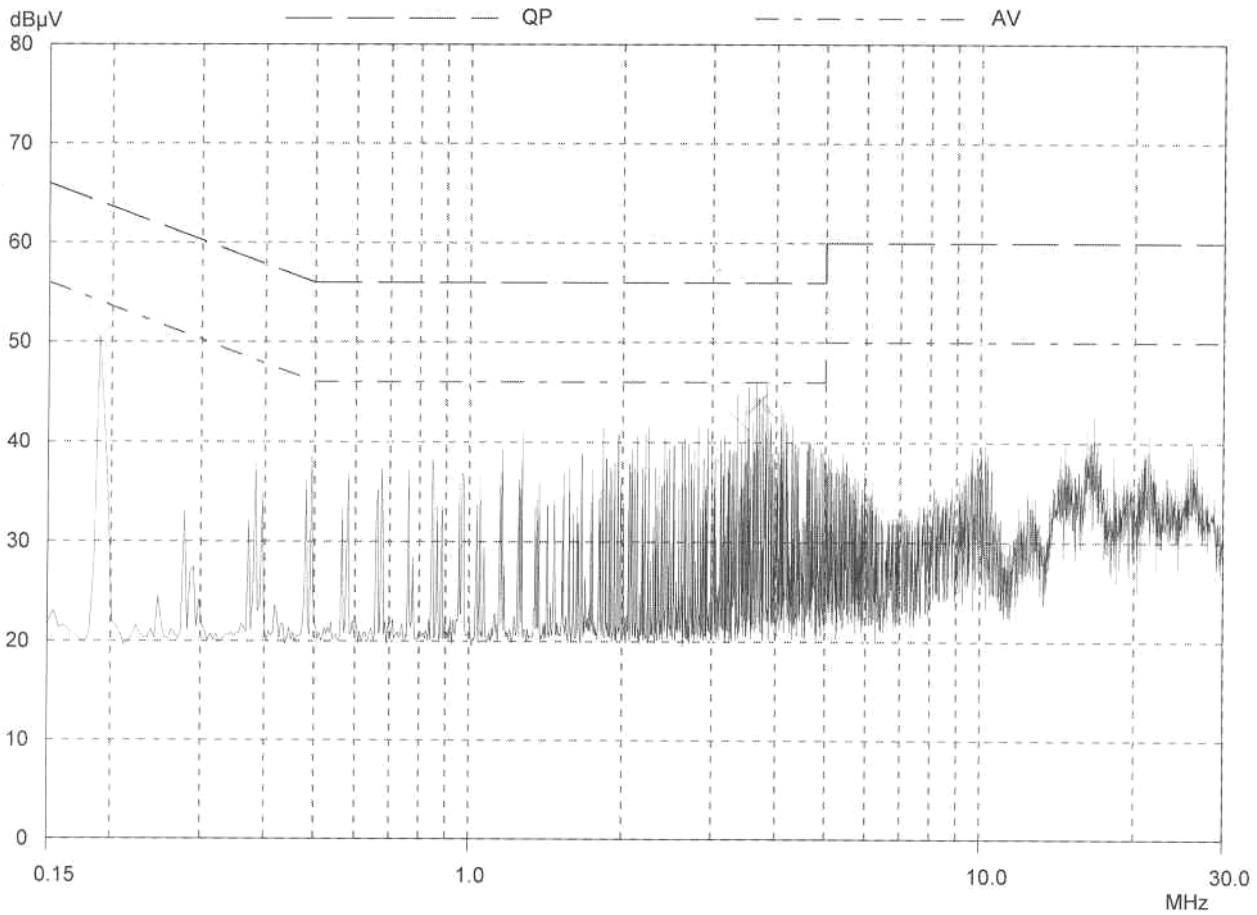


CONDUCTION EMISSION TEST

Peak Value

EUT:	2.4G
Manuf:	
Op Cond:	CH 11
Operator:	
Test Spec:	
Comment:	
	N

Final Measurement:	Detector:	X QP
	Meas Time:	1sec
	Peaks:	8
	Acc Margin:	25 dB

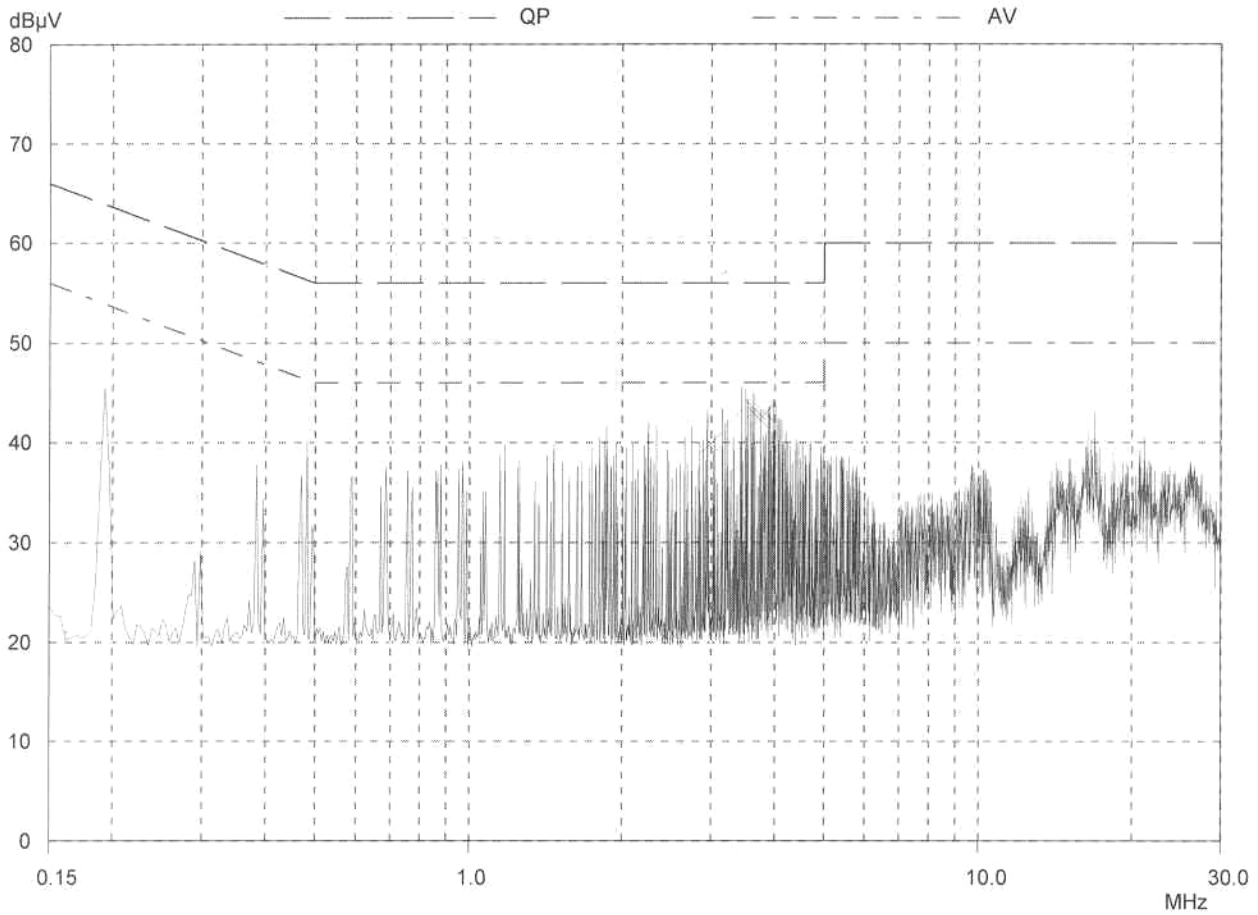


CONDUCTION EMISSION TEST

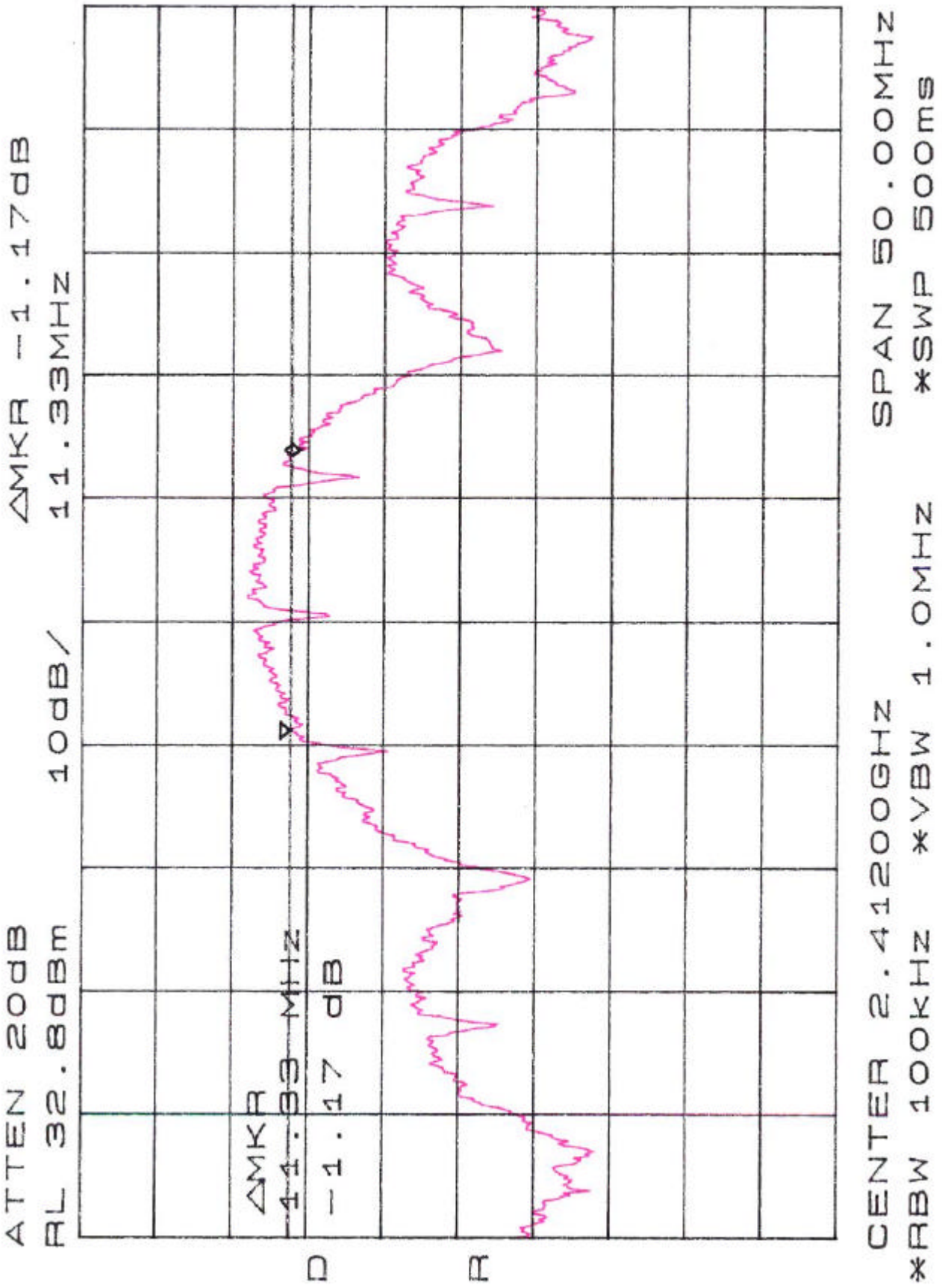
Peak Value

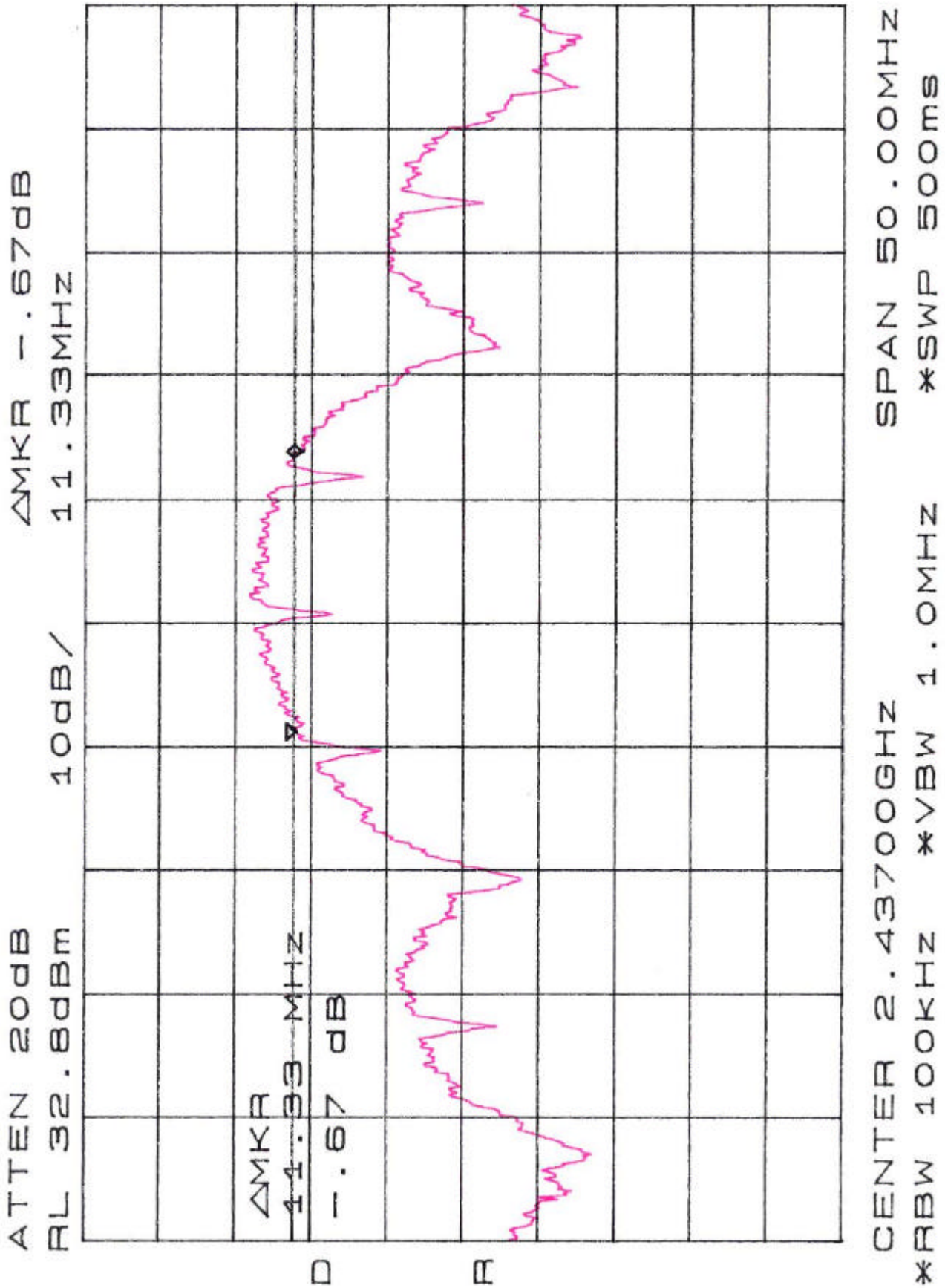
EUT:	2.4G
Manuf:	
Op Cond:	CH 11
Operator:	
Test Spec:	
Comment:	
	L1

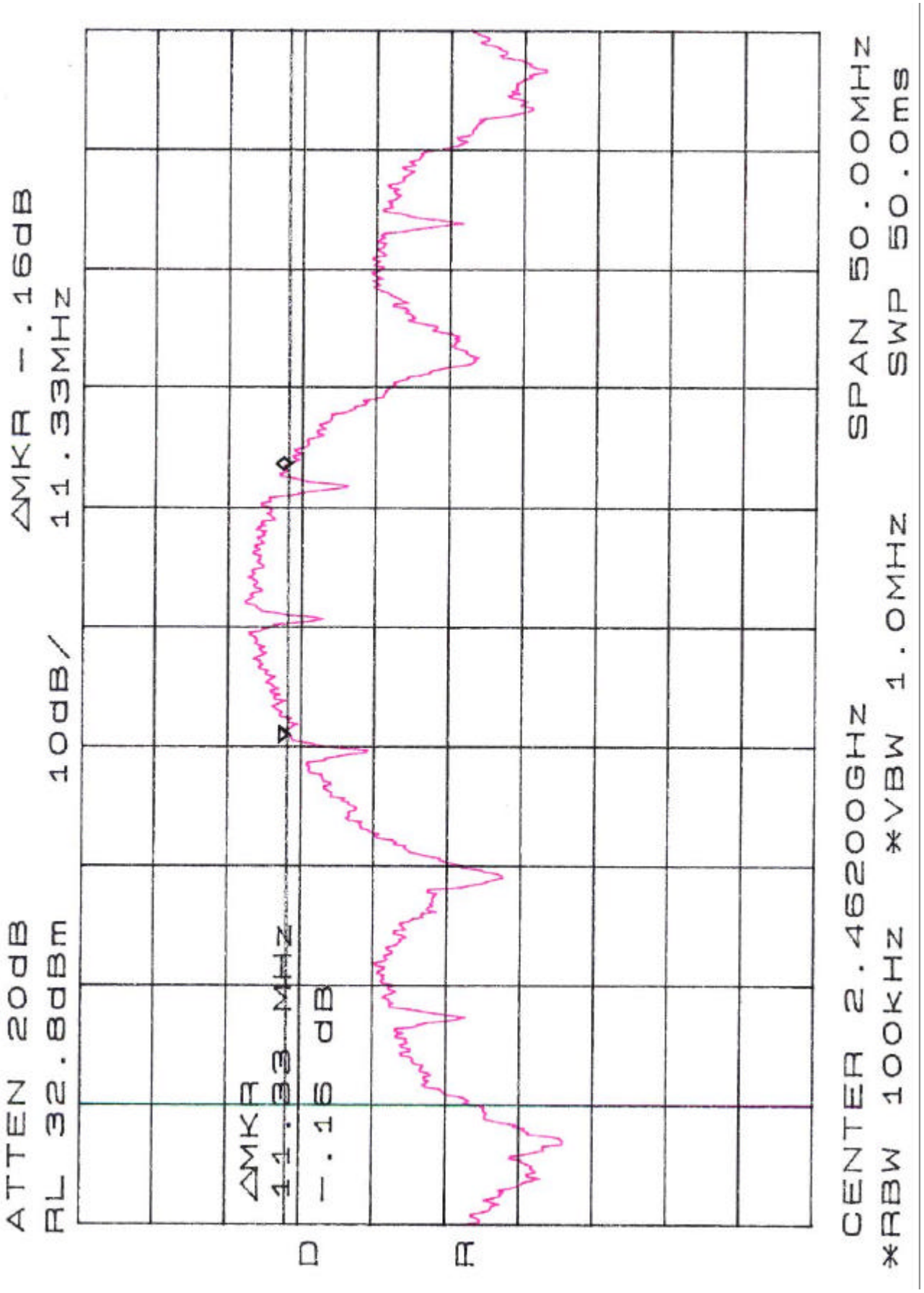
Final Measurement:	Detector:	X QP
	Meas Time:	1sec
	Peaks:	8
	Acc Margin:	25 dB



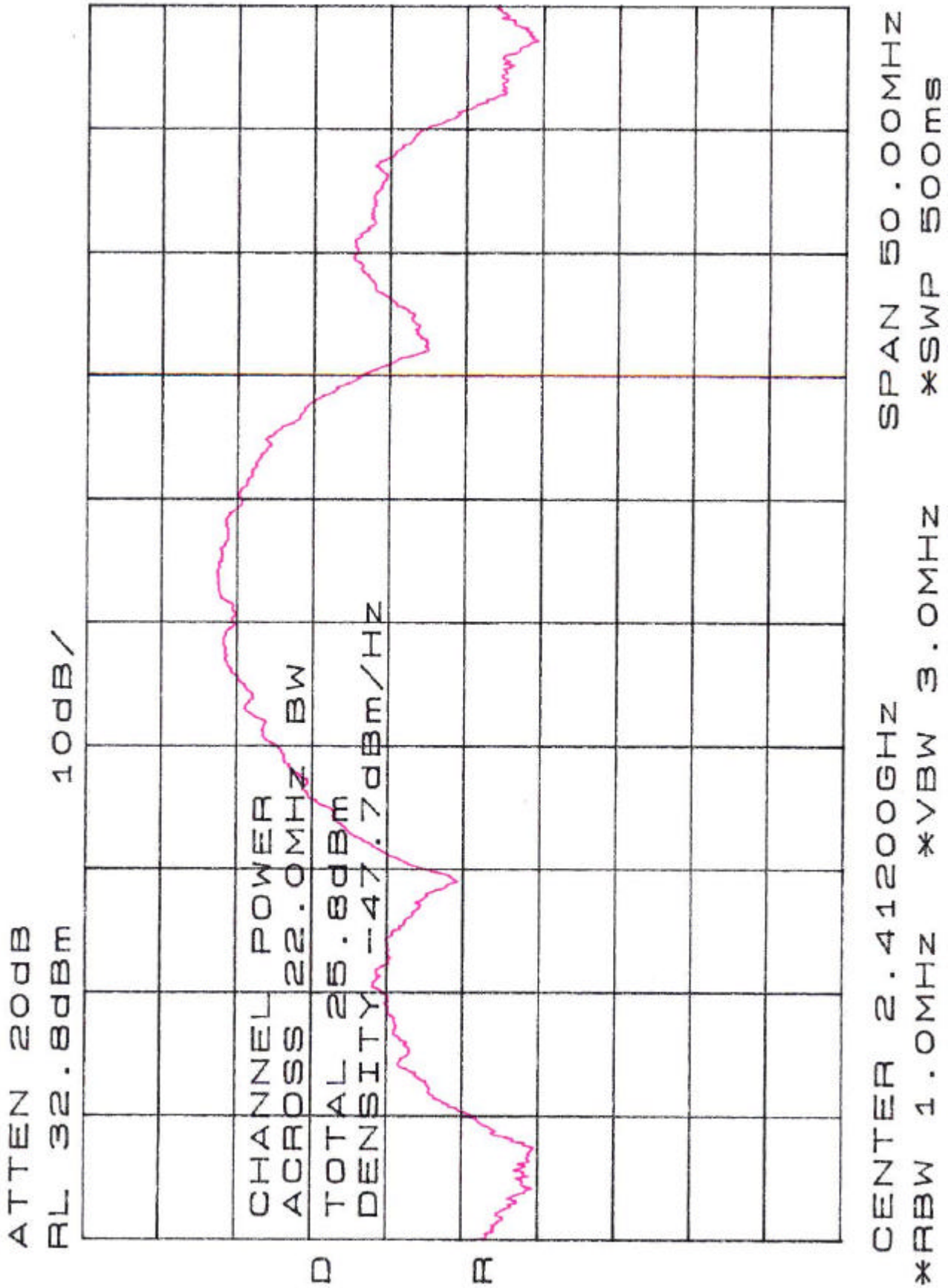
Appendix 2 : Ploted Datas of Emissions Bandwidth

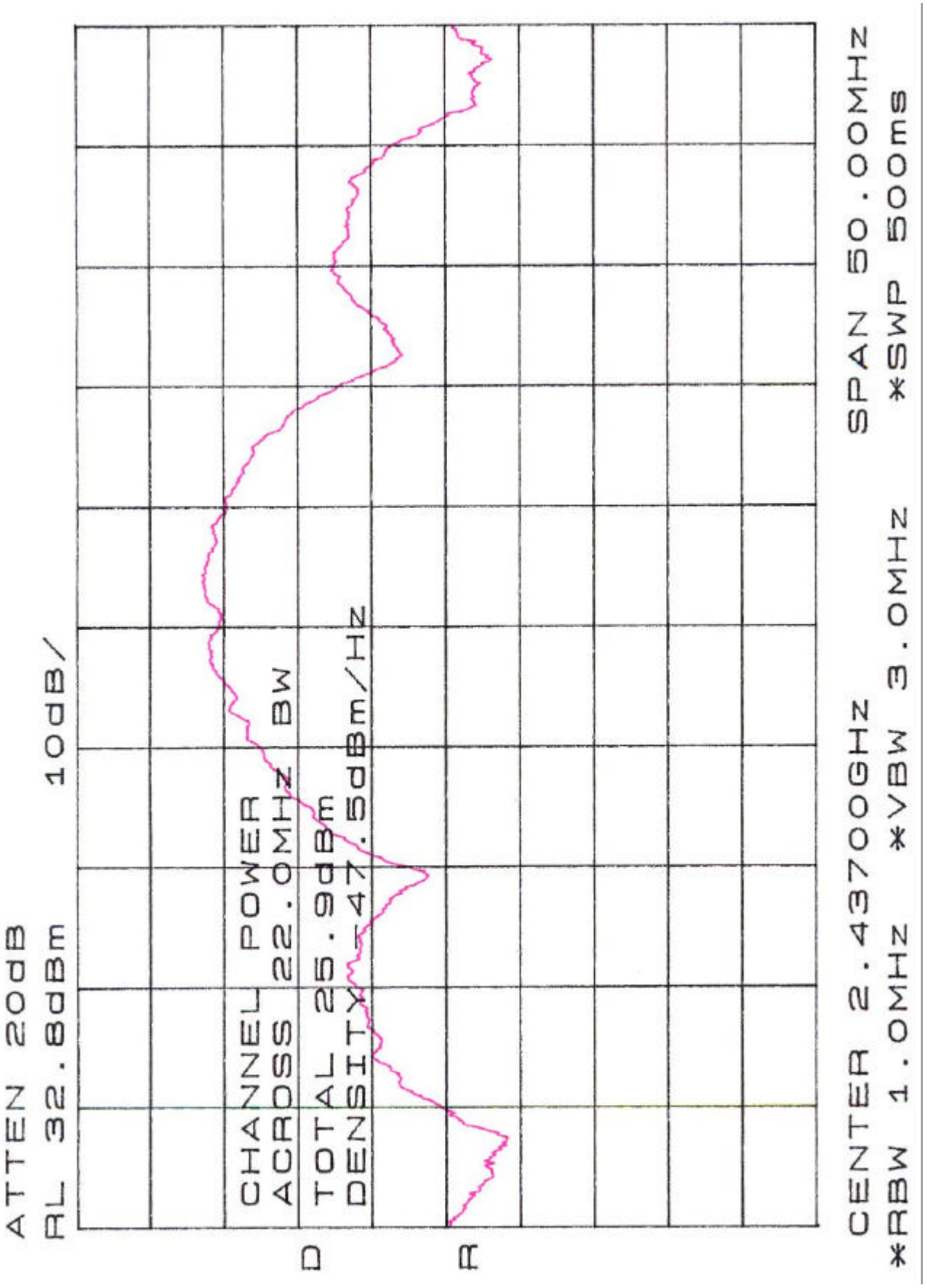

ATTEN 20dB
RL 32.8dBm
10dB/
ΔMKR -1.17dB
11.33MHz
ΔMKR
11.33 MHz
-1.17 dB
D
R
CENTER 2.4120GHz
*RBW 100kHz
*VBW 1.0MHz
SPAN 50.00MHz
*SWP 500ms

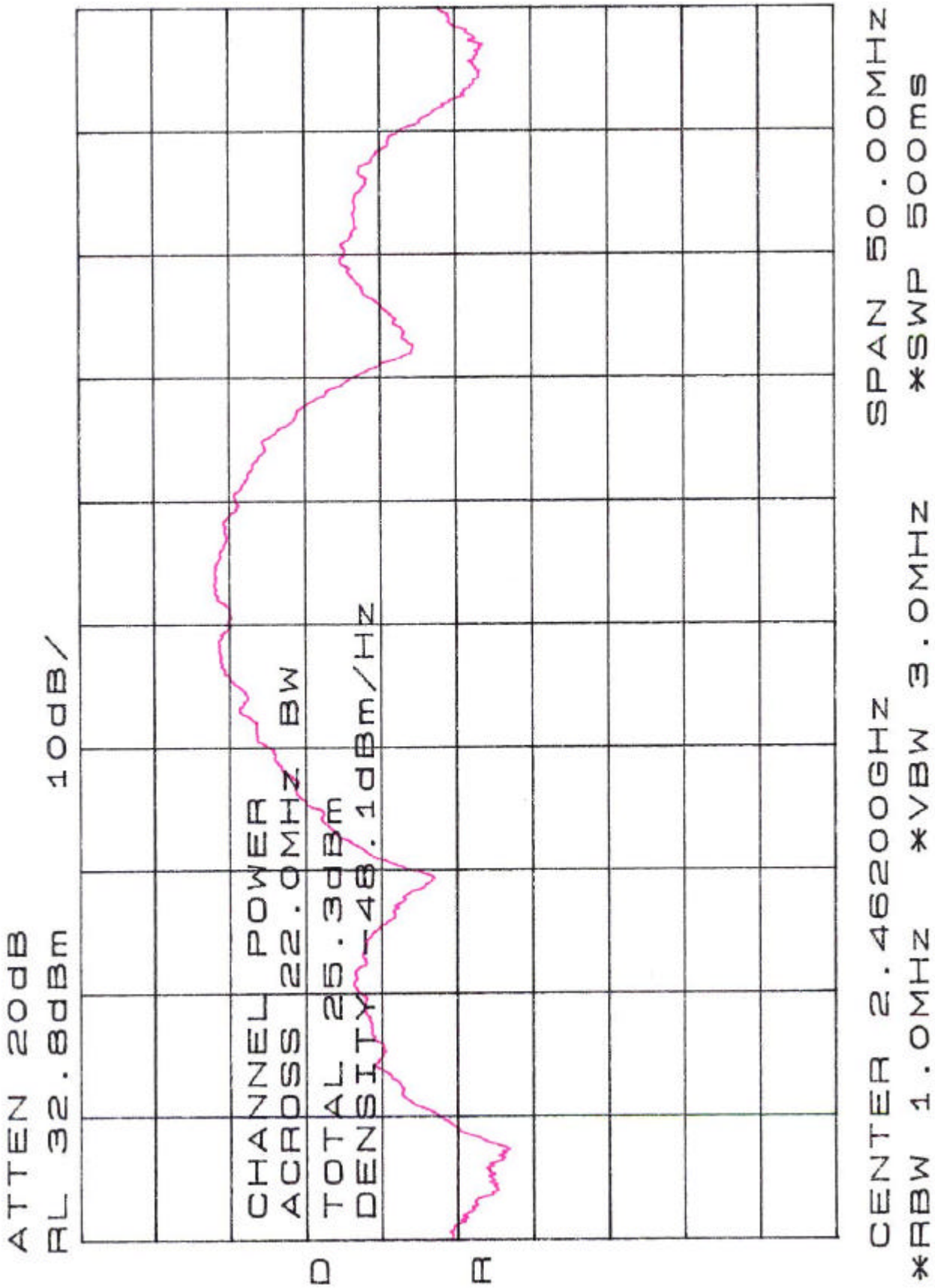

ATTEN 20dB
RL 32.8dBm
10dB/
ΔMKR -.67dB
11.33MHz
ΔMKR
11.33 MHz
-.67 dB
D
R
CENTER 2.43700GHz
*RBW 100kHz
*VBW 1.0MHz
SPAN 50.00MHz
*SWP 500ms


ATTEN 20dB
RL 32.8dBm
10dB/
ΔMKR -.16dB
11.33MHz
ΔMKR
11.33 MHz
-.16 dB
D
R
CENTER 2.46200GHz
*RBW 100kHz
*VBW 1.0MHz
SPAN 50.00MHz
SWP 50.0ms

Appendix 3 : Ploted Datas of Output Peak Power


ATTEN 20dB
RL 32.8dBm
10dB/
CHANNEL POWER
ACROSS 22.0MHZ BW
TOTAL 25.8dBm
DENSITY -47.7dBm/HZ
D
R
CENTER 2.4120GHZ
*RBW 1.0MHZ
*VBW 3.0MHZ
SPAN 50.00MHZ
*SWP 500ms


ATTEN 20dB
RL 32.8dBm 10dB/
CHANNEL POWER
ACROSS 22.0MHz BW
TOTAL 25.9dBm
DENSITY -47.5dBm/Hz
D
R
CENTER 2.437000GHz
*RBW 1.0MHz *VBW 3.0MHz
SPAN 50.00MHz
*SWP 500ms


ATTEN 20dB
RL 32.8dBm
10dB/
CHANNEL POWER
ACROSS 22.0MHZ BW
TOTAL 25.3dBm
DENSITY -46.1dBm/HZ
D
R
CENTER 2.46200GHZ
*RBW 1.0MHZ
*VBW 3.0MHZ
SPAN 50.00MHZ
*SWP 50ms