

# FCC Part 15

# EMI TEST REPORT

## of

E.U.T. : Bluetooth Audio Gateway for  
Corded Phones

MODEL : BAG-1000

FCC ID. : OAJBAG-1000

for

APPLICANT : J Communications Co., Ltd.

ADDRESS : No.124-4,Ojeon-Dong, Uiwang-City, Kyungki-Do,  
South Korea.

Test Performed by

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Report Number : ET92R-03-058-03

# TEST REPORT CERTIFICATION

Applicant : J Communications Co., Ltd.  
No.124-4,Ojeon-Dong, Uiwang-City, Kyungid-Do, South Korea

Manufacturer : J Communications Co., Ltd.  
No.124-4,Ojeon-Dong, Uiwang-City, Kyungid-Do, South Korea

Description of EUT :  
a) Type of EUT : Bluetooth Audio Gateway for Corded Phones  
b) Trade Name : Rhapsody AGT  
c) Model No. : BAG-1000  
d) Power Supply : I/P: 120Vac/ 60Hz ; O/P: 5Vdc, 500mA

Regulation Applied : FCC Rules and Regulations Part 15 Subpart B & C (2002)

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 relates only to the item tested.  
2. The testing report shall not be reproduced expect in full, without the written approval of ETC.

Issued Date : Apr. 28, 2003

Test Engineer : Tien Lu Liao  
(Tien-lu Liao )

Approve & Authorized Signer :

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# 1 GENERAL INFORMATION

## 1.1 Product Description

- |                 |   |
|-----------------|---|
| a) Type of EUT  | : Bluetooth Audio Gateway for Corded Phones |
| b) Trade Name   | : Rhapsody AGT                              |
| c) Model No.    | : BAG-1000                                  |
| d) Power Supply | : I/P: 120Vac/ 60Hz ; O/P: 5Vdc, 500mA      |

## 1.2 Characteristics of Device

Any device that you want to use with the Bluetooth Audio Gateway for Corded Phones has to be compatible with Bluetooth wireless technology and support the Headset Profile. To be able to use the Audio Gateway for Corded Phones together with a mobile phone, you need to have a phone with built-in Bluetooth capability, or another Bluetooth audio gateway connected to it.

## 1.3 Test Methodology

This Bluetooth Audio Gateway designed with a transmitting method of hopping spread spectrum technology. The base unit plugs into a standard analogue telephone jack and provides a digital wireless communication link with the handset using the 2400 to 2483.5 MHz ISM band.

## 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, 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 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

Except for Class A digital devices, for equipment 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 50 $\Omega$  H/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 dB $\mu$ V	Average dB $\mu$ V
0.15 - 0.5	66-56*	56-46*
0.5 - 5.0	56	46
5.0 - 30.0	60	50

\* Decreases with the logarithm of the frequency

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

### (2) Radiated Emission Requirement

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

Frequency MHz	Distance Meters	Radiated dB $\mu$ V/m	Radiated $\mu$ 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) Hopping Channel Separation**

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

**(5) Number of Hopping frequencies used**

According to 15.247(a)(1)(iii), frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 non-overlapping channels.

**(6) Hopping Channel Bandwidth**

According to 15.247(a)(1)(ii), for frequency hopping system operating in the 5725-5850 MHz band, the maximum 20dB bandwidth of the hopping channel is 1MHz.

**(7) Dwell Time of each frequency**

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

**(8) Output Power Requirement**

According to 15.247(b)(1), for frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt.

For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

**(9) 100 kHz Bandwidth of Frequency Band Edges Requirement**

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.

**(10) Out-of-Band Conducted Emission Requirement**

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) Peak Power Spectral Density Requirement**

According to 15.247(d), for digitally modulated systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

**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 11 by transmitting mode.

#### 3.2 Devices for Tested System

Device	Manufacture	Model / FCC ID.	Cable Description
Bluetooth Audio Gateway for Corded Phones* Telephone	J Communications Co., Ltd.	BAG-1000 OAJBAG-1000	2.5m unshielded AC Adaptor Power cord  0.8m unshielded Telephone 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.

Note : A high 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 placement of cables associated with EUT to obtain the worse case and record the result.

Figure 1 : Frequencies measured below 1 GHz configuration

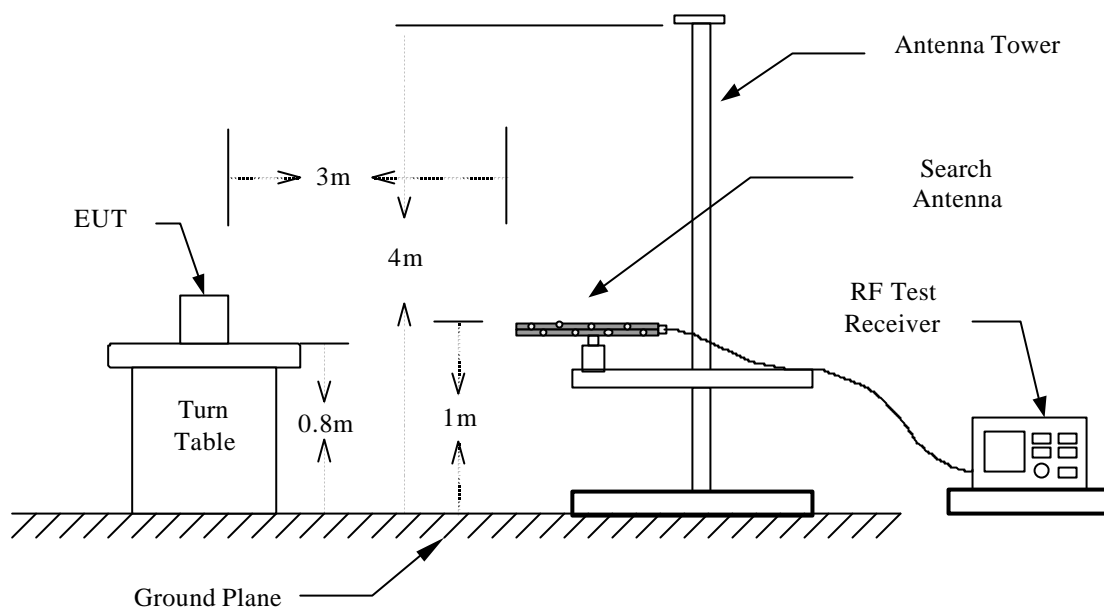
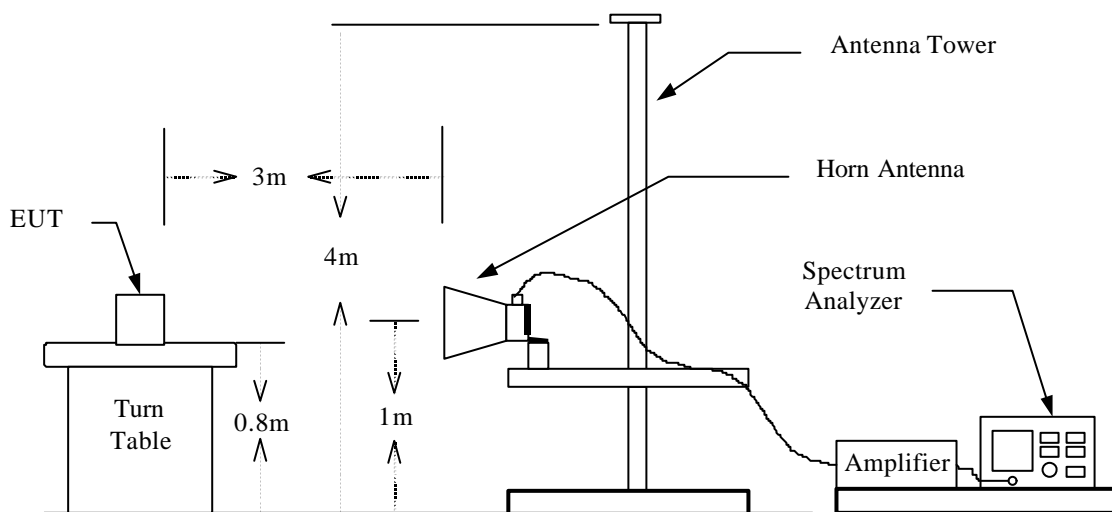


Figure 2 : Frequencies measured above 1 GHz configuration



### 4.3 Measuring Instrument

The following instrument are used for radiated emissions measurement:

Equipment	Manufacturer	Model No.	Next Cal. Due
Spectrum Analyzer	Hewlett-Packard	8568B	01/10/2004
Pre-selector	Hewlett-Packard	85685A	01/10/2004
Quasi Peak Detector	Hewlett-Packard	85650A	01/10/2004
RF Test Receiver	Rohde & Schwarz	ESVS 30	08/06/2003
RF Test Receiver	Rohde & Schwarz	ESBI	05/26/2003
Horn Antenna	EMCO	3115	08/08/2003
Log periodic Antenna	EMCO	3146	11/04/2003
Biconical Antenna	EMCO	3110B	11/04/2003
Preamplifier	Hewlett-Packard	8449B	05/29/2003
Preamplifier	Hewlett-Packard	8447D	09/29/2003
Spectrum Analyzer	Hewlett-Packard	8564E	04/14/2004

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	300 Hz

## 4.4 Radiated Emission Data

### 4.4.1 RF Portion(Max power)

a) Operation Mode : Receiving /Transmitting

Fundamental Frequency : 2402 MHz ( Local Frequency : 2400.558 MHz )

Test Date : Mar. 17, 2003

Temperature : 22

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.			
*2400.492	---	---	---	---	-3.1	---	---	74.0	54.0	---	---	---
*4800.984	---	---	---	---	2.5	---	---	74.0	54.0	---	---	---
*7201.476	---	---	---	---	5.7	---	---	74.0	54.0	---	---	---
*9601.968	---	---	---	---	7.2	---	---	74.0	54.0	---	---	---
*12002.460	---	---	---	---	9.2	---	---	74.0	54.0	---	---	---
4803.717	55.7	37.8	56.0	38.5	2.5	58.5	41.0	74.0	54.0	-13.0	180	1.0
7205.576	---	---	---	---	5.7	---	---	74.0	54.0	---	---	---
9607.435	---	---	---	---	7.2	---	---	74.0	54.0	---	---	---
12009.294	---	---	---	---	9.2	---	---	74.0	54.0	---	---	---
14411.153	---	---	---	---	11.5	---	---	74.0	54.0	---	---	---
16813.012	---	---	---	---	11.8	---	---	74.0	54.0	---	---	---
19214.871	---	---	---	---	8.9	---	---	74.0	54.0	---	---	---
21616.730	---	---	---	---	9.7	---	---	74.0	54.0	---	---	---
24018.589	---	---	---	---	10.3	---	---	74.0	54.0	---	---	---

Note :

1. Remark “\*” means that the emission frequency is produced from local oscillator.
2. Remark “---” means that the emission level is too low to be measured (a pre-amplifier of about 35 dB is used).
3. Margins are derived from Peak or Average whichever is lower. If there is only peak value in Result field, the Margin is also referred to average limits.
4. The expanded uncertainty of the radiated emission tests is 3.53 dB.



b) Operation Mode : Receiving /Transmitting

Fundamental Frequency : 2441 MHz ( Local Frequency : 2400.492 MHz )

Test Date : Mar. 12, 2003

Temperature : 20

Humidity : 63 %

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.			
*2439.617	---	---	---	---	-2.9	---	---	74.0	54.0	---	---	---
*4879.234	---	---	---	---	2.7	---	---	74.0	54.0	---	---	---
*7318.851	---	---	---	---	5.9	---	---	74.0	54.0	---	---	---
*9758.468	---	---	---	---	7.3	---	---	74.0	54.0	---	---	---
*12198.085	---	---	---	---	9.3	---	---	74.0	54.0	---	---	---
4881.825	50.3	35.8	53.2	37.8	2.7	55.9	40.5	74.0	54.0	-13.5	175	1.0
7322.738	---	---	---	---	5.9	---	---	74.0	54.0	---	---	---
9763.651	---	---	---	---	7.3	---	---	74.0	54.0	---	---	---
12204.564	---	---	---	---	9.3	---	---	74.0	54.0	---	---	---
14645.477	---	---	---	---	11.6	---	---	74.0	54.0	---	---	---
17086.390	---	---	---	---	13.3	---	---	74.0	54.0	---	---	---
19527.303	---	---	---	---	8.5	---	---	74.0	54.0	---	---	---
21968.216	---	---	---	---	9.9	---	---	74.0	54.0	---	---	---
24409.129	---	---	---	---	10.7	---	---	74.0	54.0	---	---	---

Note :

1. Remark “\*” means that the emission frequency is produced from local oscillator.
2. Remark “---” means that the emission level is too low to be measured (a pre-amplifier of about 35 dB is used).
3. Margins are derived from Peak or Average whichever is lower. If there is only peak value in Result field, the Margin is also referred to average limits.
4. The expanded uncertainty of the radiated emission tests is 3.53 dB.

c) Operation Mode : Receiving /Transmitting

Fundamental Frequency : 2480.000 MHz ( Local Frequency : 2478.483 MHz )

Test Date : Mar. 12, 2003

Temperature : 20

Humidity : 63 %

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.			
*2478.483	---	---	---	---	-2.8	---	---	74.0	54.0	---	---	---
*4956.966	---	---	---	---	2.8	---	---	74.0	54.0	---	---	---
*7435.449	---	---	---	---	6.1	---	---	74.0	54.0	---	---	---
*9913.932	---	---	---	---	7.4	---	---	74.0	54.0	---	---	---
*12392.415	---	---	---	---	9.4	---	---	74.0	54.0	---	---	---
4960.333	53.7	38.2	55.2	38.5	2.8	58.0	41.3	74.0	54.0	-12.7	185	1.0
7440.500	---	---	---	---	6.1	---	---	74.0	54.0	---	---	---
9920.667	---	---	---	---	7.4	---	---	74.0	54.0	---	---	---
12400.834	---	---	---	---	9.4	---	---	74.0	54.0	---	---	---
14881.001	---	---	---	---	11.5	---	---	74.0	54.0	---	---	---
17361.168	---	---	---	---	15.2	---	---	74.0	54.0	---	---	---
19841.335	---	---	---	---	8.6	---	---	74.0	54.0	---	---	---
22321.502	---	---	---	---	10.2	---	---	74.0	54.0	---	---	---
24801.669	---	---	---	---	11.0	---	---	74.0	54.0	---	---	---

Note :

1. Remark "\*" means that the emission frequency is produced from local oscillator.
2. Remark "---" means that the emission level is too low to be measured (a pre-amplifier of about 35 dB is used).
3. Margins are derived from Peak or Average whichever is lower. If there is only peak value in Result field, the Margin is also referred to average limits.
4. The expanded uncertainty of the radiated emission tests is 3.53 dB.

**4.4.2 Radiated Emissions in Restricted Bands**

a) Operation Mode : Receiving /Transmitting

Test Date : Mar. 12, 2003

Temperature: 20

Humidity : 63 %

Frequency  (MHz)	Reading (dBuV)				Factor (dB)  Corr.	Result @3m (dBuV/m)		Limit @3m (dBuV/m)		Margin (dB)	Table Deg. (Deg.)	Ant. High (m)
	H		V			Peak	Ave	Peak	Ave.			
	Peak	Ave	Peak	Ave								
1100.568	46.3	---	47.5	---	-9.3	38.2	---	74.0	54.0	-15.8	180	1.0
1368.795	---	---	---	---	-8.1	---	---	74.0	54.0	---	---	---
1500.168	---	---	---	---	-7.5	---	---	74.0	54.0	---	---	---
1646.030	---	---	---	---	-6.7	---	---	74.0	54.0	---	---	---
1700.687	---	---	---	---	-6.3	---	---	74.0	54.0	---	---	---
1720.650	---	---	---	---	-6.2	---	---	74.0	54.0	---	---	---
2250.785	---	---	---	---	-3.6	---	---	74.0	54.0	---	---	---
2380.150	---	---	---	---	-3.2	---	---	74.0	54.0	---	---	---
2490.750	---	---	---	---	-2.7	---	---	74.0	54.0	---	---	---
2800.100	---	---	---	---	-1.8	---	---	74.0	54.0	---	---	---
3265.250	---	---	---	---	-0.6	---	---	74.0	54.0	---	---	---
3337.685	---	---	---	---	-0.4	---	---	74.0	54.0	---	---	---
3350.980	---	---	---	---	-0.4	---	---	74.0	54.0	---	---	---
4000.675	---	---	---	---	2.0	---	---	74.0	54.0	---	---	---
4809.371	---	---	---	---	2.6	---	---	74.0	54.0	---	---	---
5400.863	---	---	---	---	4.1	---	---	74.0	54.0	---	---	---
7600.800	---	---	---	---	6.2	---	---	74.0	54.0	---	---	---
8325.300	---	---	---	---	6.7	---	---	74.0	54.0	---	---	---
9125.030	---	---	---	---	7.1	---	---	74.0	54.0	---	---	---
9358.165	---	---	---	---	7.1	---	---	74.0	54.0	---	---	---
11876.00 0	---	---	---	---	9.2	---	---	74.0	54.0	---	---	---
13356.70 0	---	---	---	---	10.8	---	---	74.0	54.0	---	---	---
14489.20 0	---	---	---	---	11.6	---	---	74.0	54.0	---	---	---
15987.10 0	---	---	---	---	7.8	---	---	74.0	54.0	---	---	---

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.

**4.4.3 Other Emissions**

Operation Mode : Receiving /Transmitting

Test Date : Mar. 12, 2003

Temperature: 20

Humidity : 63 %

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)
30.000	H/V	---	-9.8	---	40.0	---	---	---
50.000	H/V	---	-14.1	---	40.0	---	---	---
80.000	H/V	---	-15.0	---	40.0	---	---	---
150.000	H/V	---	-10.0	---	43.5	---	---	---
250.000	H/V	---	-3.9	---	46.0	---	---	---
500.000	H/V	---	-4.4	---	46.0	---	---	---
800.000	H/V	---	0.7	---	46.0	---	---	---

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.

**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

$$\text{Corrected Factor} = \text{Antenna FACTOR} + \text{Cable Loss} + \text{High Pass Filter Loss} - \text{Amplifier}$$

## **4.6 Photos of Radiation Measuring Setup**

Please see Exhibit -F-Test Setup Photos

## 5 CONDUCTED EMISSION MEASUREMENT

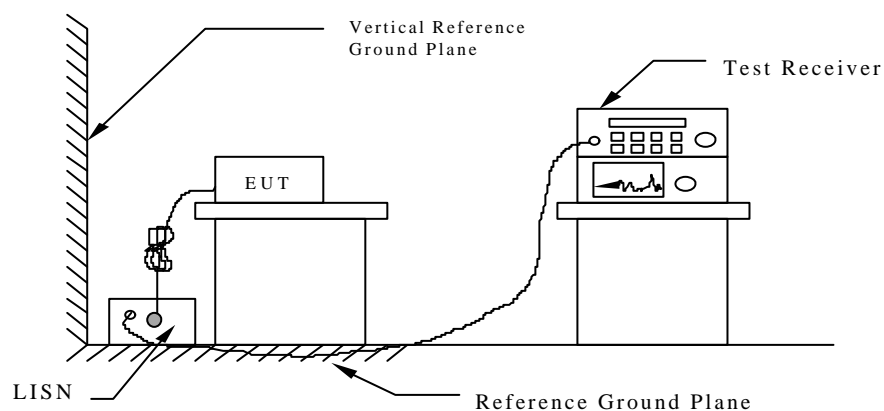
### 5.1 Standard Applicable

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

### 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**Operation Mode : 2402MHzTest Date : Mar. 12, 2003Temperature : 20Humidity: 63 %

Freq.  (MHz)	Meter Reading  (dB μ V)				Factor  (dB)	Limit  (dB μ V)		Result  (dB μ V)			
	Q.P Value		AVG. Value			Q.P	AVG.	Q.P Value		AVG. Value	
	N	L1	N	L1		Value	Value	N	L1	N	L1
0.161	12.8	12.4	----	----	0.2	65.4	55.4	13.0	12.6	----	----
0.183	13.2	12.1	----	----	0.2	64.3	54.3	13.4	12.3	----	----
0.198	12.0	11.4	----	----	0.2	63.7	53.7	12.2	11.6	----	----
0.876	10.1	10.1	----	----	0.3	56.0	46.0	10.4	10.4	----	----
7.776	11.8	11.7	----	----	0.7	60.0	50.0	12.5	12.4	----	----
27.618	15.7	14.8	----	----	1.9	60.0	50.0	17.6	16.7	----	----

Operation Mode : 2441MHzTest Date : Mar. 12, 2003Temperature : 20Humidity: 63 %

Freq.  (MHz)	Meter Reading (dB μ V)				Factor  (dB)	Limit (dB μ V)		Result (dB μ V)			
	Q.P Value		AVG. Value			Q.P	AVG.	Q.P Value		AVG. Value	
	N	L1	N	L1		Value	Value	N	L1	N	L1
0.161	13.0	12.5	----	----	0.2	65.4	55.4	13.2	12.7	----	----
0.183	13.4	12.2	----	----	0.2	64.3	54.3	13.6	12.4	----	----
0.198	12.1	11.6	----	----	0.2	63.7	53.7	12.3	11.8	----	----
0.876	10.2	10.3	----	----	0.3	56.0	46.0	10.5	10.6	----	----
7.776	11.9	11.9	----	----	0.7	60.0	50.0	12.6	12.6	----	----
27.618	15.9	14.9	----	----	1.9	60.0	50.0	17.8	16.8	----	----

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

Operation Mode : 2480MHzTest Date : Mar. 12, 2003Temperature : 20Humidity: 63 %

Freq.  (MHz)	Meter Reading  (dB μ V)				Factor  (dB)	Limit  (dB μ V)		Result  (dB μ V)			
	Q.P Value		AVG. Value			Q.P Value	AVG. Value	Q.P Value		AVG. Value	
	N	L1	N	L1				N	L1	N	L1
0.161	12.9	12.6	----	----	0.2	65.4	55.4	13.1	12.8	----	----
0.183	13.3	12.3	----	----	0.2	64.3	54.3	13.5	12.5	----	----
0.198	12.2	11.5	----	----	0.2	63.7	53.7	12.4	11.7	----	----
0.876	10.3	10.2	----	----	0.3	56.0	46.0	10.6	10.5	----	----
7.776	12.0	11.8	----	----	0.7	60.0	50.0	12.7	12.5	----	----
27.618	15.8	15.0	----	----	1.9	60.0	50.0	17.7	16.9	----	----

*Note : 1. Please see appendix I 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:

$$\text{RESULT} = \text{READING} + \text{LISN FACTOR}$$

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

$$\text{RESULT} = 22.5 + 0.1 = 22.6 \text{ dB } \mu \text{ V}$$

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



## 5.5 Conducted Measurement Equipment

The following test equipment are used during the conducted test.

<b>Equipment</b>	<b>Manufacturer</b>	<b>Model No.</b>	<b>Next Cal. Due</b>
EMI Test Receiver	Rohde and Schwarz	ESCS 30	11/27/2003
Line Impedance Stabilization network	Rohde and Schwarz	ESH2-Z5	09/03/2003
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.
EMI Test Receiver	Rohde and Schwarz	ESCS 30	11/27/2003

## **5.6 Photos of Conduction Measuring Setup**

Please see Exhibit- F- Test 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.

### **6.2 Antenna Connected Construction**

The antenna of this unit is designed to be mounted permanently on the device. No consideration of replacement. Please see construction Photos Of Exhibit B for details.

## 7 HOPPING CHANNEL SEPARATION

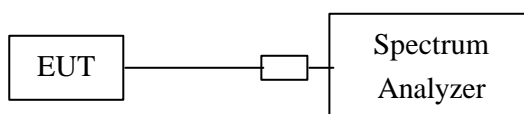
### 7.1 Standard Applicable

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

### 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. The EUT must have its hopping function enabled. Then set it to any one convenient frequency within its operating range.
3. Use the following spectrum analyzer settings:  
Span = wide enough to capture the peaks of two adjacent channels  
Resolution (or IF) Bandwidth (RBW)  $\geq 1\%$  of the span  
Video (or Average) Bandwidth (VBW)  $\geq$  RBW  
Sweep = auto  
Detector function = peak  
Trace = max hold
4. Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. Plot the result on the screen of spectrum analyzer.
5. Repeat above procedures until all frequencies measured were complete.

Figure 4 : Measurement configuration.



### 7.3 Measurement Equipment

Equipment	Manufacturer	Model No.	Next Cal. Due
Spectrum Analyzer	Hewlett-Packard	8564E	04/14/2004
Attenuator	Weinschel Engineering	1	N/A
Plotter	Hewlett-Packard	7440A	N/A

## 7.4 Measurement Data

**Model :**Test Date : Mar. 12, 2003 Temperature : 20 Humidity: 63 %

- 1) 2402MHz : Adjacent Hopping Channel Separation is 1000 kHz
- 2) 2441MHz : Adjacent Hopping Channel Separation is 1000 kHz
- 3) 2480MHz : Adjacent Hopping Channel Separation is 1000 kHz

**Note : 1. Please see appendix 2 for Plotted Data**

**2. The expanded uncertainty of the hopping channel separation tests is 1000Hz.**

## 8 NUMBER OF HOPPING FREQUENCY USED

### 8.1 Standard Applicable

According to 15.247(a)(1)(iii), frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 non-overlapping channels.

### 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 4 without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. The EUT must have its hopping function enabled.
3. Use the following spectrum analyzer settings:  
Span = the frequency band of operation  
RBW  $\geq$  1% of the span  
VBW  $\geq$  RBW  
Sweep = auto  
Detector function = peak  
Trace = max hold
4. Allow the trace to stabilize. Plot the result on the screen of spectrum analyzer.
5. Repeat above procedures until all frequencies measured were complete.

### 8.3 Measurement Equipment

Equipment	Manufacturer	Model No.	Next Cal. Due
Spectrum Analyzer	Hewlett-Packard	8564E	04/14/2004
Attenuator	Weinschel Engineering	1	N/A
Plotter	Hewlett-Packard	7440A	N/A

## 8.4 Measurement Data

**Model :**

Test Date : Mar. 12, 2003      Temperature : 20      Humidity: 63 %

There are 79 hopping frequencies in a hopping sequence.

*Note : 1. Please see appendix 3 for Plotted Data*

*2. The expanded uncertainty of number of hopping frequency used tests is 1000Hz.*

## 9 CHANNEL BANDWIDTH

### 9.1 Standard Applicable

According to 15.247(a)(1)(ii), for frequency hopping system operating in the 5725-5850 MHz band, the maximum 20dB bandwidth of the hopping channel is 1MHz.

### 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 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.
3. Use the following spectrum analyzer settings:  
Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel  
RBW  $\geq$  1% of the 20 dB bandwidth  
VBW  $\geq$  RBW  
Sweep = auto  
Detector function = peak  
Trace = max hold
4. Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. Use the marker-delta function to measure 20 dB down one side of the emission. Reset the marker-delta function, and move the marker to the other side of the emission, until it is (as close as possible to) even with the reference marker level. The marker-delta reading at this point is the 20 dB bandwidth of the emission. Plot the result on the screen of spectrum analyzer.
5. Repeat above procedures until all frequencies measured were complete.

### 9.3 Measurement Equipment

Equipment	Manufacturer	Model No.	Next Cal. Due
Spectrum Analyzer	Hewlett-Packard	8564E	04/14/2004
Attenuator	Weinschel Engineering	1	N/A
Plotter	Hewlett-Packard	7440A	N/A



## 9.4 Measurement Data

**Model :**Test Date : Mar. 12, 2003 Temperature : 20 Humidity: 63 %

- 1) 2402MHz : Channel Bandwidth is 858 kHz
- 2) 2441MHz : Channel Bandwidth is 867 kHz
- 3) 2480MHz : Channel Bandwidth is 867 kHz

**Note : 1. Please see appendix 4 for Plotted Data**

**2. The expanded uncertainty of channel bandwidth tests is 1000Hz.**

## 10 DWELL TIME ON EACH CHANNEL

### 10.1 Standard Applicable

According to 15.247(a)(1)(iii), for frequency hopping system operating in the 2400-2483.5 band, the average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

### 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 it to measurement instrument. The EUT must have its hopping function enabled.
3. Use the following spectrum analyzer settings:  
Span = zero span, centered on a hopping channel  
RBW = 1 MHz  
VBW  $\geq$  RBW  
Sweep = as necessary to capture the entire dwell time per hopping channel  
Detector function = peak  
Trace = max hold
4. Use the marker-delta function to determine the dwell time. Plot the result on the screen of spectrum analyzer.
5. Repeat above procedures until all frequencies measured were complete.

### 10.3 Measurement Equipment

Equipment	Manufacturer	Model No.	Next Cal. Due
Spectrum Analyzer	Hewlett-Packard	8564E	04/14/2004
Attenuator	Weinschel Engineering	1	N/A
Plotter	Hewlett-Packard	7440A	N/A

## 10.4 Measurement Data

The number of hopping channels = 79.

The period of 0.4 seconds multiplied by the number of hopping channels employed = 31.6 seconds.

### Model :

Test Date : Mar. 12, 2003      Temperature : 20      Humidity: 63 %

- 1) 2402MHz : the dwell time is  $110 \times 3 \times 500 \mu s = 0.165 \text{ ms}$
- 2) 2441MHz : the dwell time is  $110 \times 3 \times 500 \mu s = 0.165 \text{ ms}$
- 3) 2480MHz : the dwell time is  $110 \times 3 \times 500 \mu s = 0.165 \text{ ms}$

The maximum time of occupancy for a particular channel is 193.39 msec within a period of 0.4 seconds multiplied by the number of hopping channels employed, which is less than the 400 msec allowed by the rules; therefore, it meets the requirements of this section.

**Note : 1. Please see appendix 5 for Plotted Data**

**2. The expanded uncertainty of dwell time on each channel tests is 1000Hz.**

## 11 OUTPUT POWER MEASUREMENT

### 11.1 Standard Applicable

According to 15.247(b)(1), for frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt.

For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

### 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 = approximately 5 times the 20 dB bandwidth, centered on a hopping channel  
 RBW > the 20 dB bandwidth of the emission being measured  
 VBW  $\geq$  RBW  
 Sweep = auto  
 Detector function = peak  
 Trace = max hold
4. Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. The indicated level is the peak output power. Plot the result on the screen of spectrum analyzer.
5. Repeat above procedures until all frequencies measured were complete.

### 11.3 Measurement Equipment

Equipment	Manufacturer	Model No.	Next Cal. Due
Spectrum Analyzer	Hewlett-Packard	8564E	04/14/2004
Attenuator	Weinschel Engineering	1	N/A
Plotter	Hewlett-Packard	7440A	N/A

## 11.4 Measurement Data

**Model :**Test Date : Mar. 12, 2003Temperature : 20Humidity: 63 %

- 1) 2402MHz : Output Peak Power is  $-2.00$  dBm = **0.63** mW
- 2) 2441MHz : Output Peak Power is  $-0.83$  dBm = **0.83** mW
- 3) 2480MHz : Output Peak Power is  $-2.17$  dBm = **0.61** mW

*Note : 1. Please see appendix 6 for Plotted Data*

*2. The expanded uncertainty of output power measurement tests is 2dB.*

## 12 100 kHz BANDWIDTH OF BAND EDGES MEASUREMENT

### 12.1 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.

### 12.2 Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT as shown in figure 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 emission operating on the channel closest to the bandedge, as well as any modulation products which fall outside of the authorized band of operation  
 RBW  $\geq$  1% of the span  
 VBW  $\geq$  RBW  
 Sweep = auto  
 Detector function = peak  
 Trace = max hold
4. Allow the trace to stabilize. Set the marker on the emission at the bandedge, or on the highest modulation product outside of the band, if this level is greater than that at the bandedge. Enable the marker-delta function, then use the marker-to-peak function to move the marker to the peak of the in-band emission. Plot the result on the screen of spectrum analyzer.
5. Repeat above procedures until all measured frequencies were complete.

### 12.3 Measurement Equipment

Equipment	Manufacturer	Model No.	Next Cal. Due
Spectrum Analyzer	Hewlett-Packard	8564E	04/14/2004
Attenuator	Weinschel Engineering	1	N/A
Plotter	Hewlett-Packard	7440A	N/A

## 12.4 Measurement Data

**Model :**

Test Date : Mar. 12, 2003

Temperature : 20

Humidity: 63 %

- a) Lower Band Edge : All emissions are attenuated more than 20dB from the carrier.
- b) Upper Band Edge : All emissions are attenuated more than 20dB from the carrier.

**Note : 1. Please see appendix 7 for Plotted Data**

**2. The expanded uncertainty of the out-of-band conducted emission tests is 2dB.**

## 13 OUT-OF-BAND CONDUCTED EMISSION MEASUREMENT

### 13.1 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.

### 13.2 Measurement Procedure

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

### 13.3 Measurement Equipment

Equipment	Manufacturer	Model No.	Next Cal. Due
Spectrum Analyzer	Hewlett-Packard	8564E	04/14/2004
Attenuator	Weinschel Engineering	1	N/A
Plotter	Hewlett-Packard	7440A	N/A



## 13.4 Measurement Data

**Model :**

Test Date : Mar. 12, 2003      Temperature : 20      Humidity: 63 %

- 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.

**Note : 1. Please see appendix 8 for Plotted Data**

**2. The expanded uncertainty of the out-of-band conducted emission tests is 2dB.**

## 14 PEAK POWER SPECTRAL DENSITY MEASUREMENT

### 14.1 Standard Applicable

According to 15.247(d), for digitally modulated systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

### 14.2 Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT as shown in figure 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. Use the following spectrum analyzer settings:  
Span = 300 kHz, centered on highest level appearing on spectral display  
RBW = 3 kHz  
VBW  $\geq$  RBW  
Sweep = 100 s  
Detector function = peak  
Trace = max hold
4. Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. Plot the result on the screen of spectrum analyzer.
5. Repeat above procedures until all measured frequencies were complete.

### 14.3 Measurement Equipment

Equipment	Manufacturer	Model No.	Next Cal. Due
Spectrum Analyzer	Hewlett-Packard	8564E	04/14/2004
Attenuator	Weinschel Engineering	1	N/A
Plotter	Hewlett-Packard	7440A	N/A

## 14.4 Measurement Data

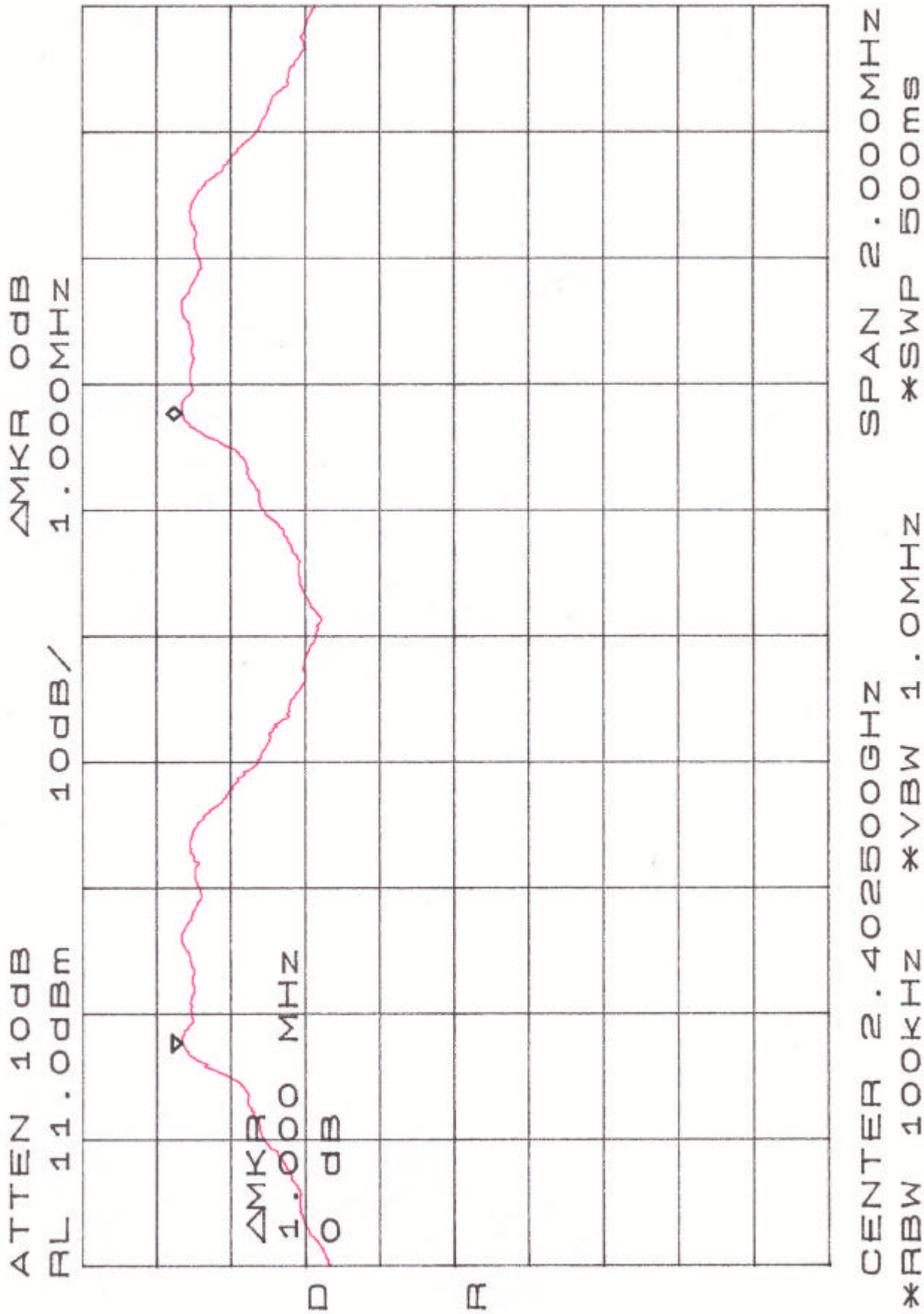
**Model :**Test Date : May 12, 2003Temperature : 20Humidity: 63 %

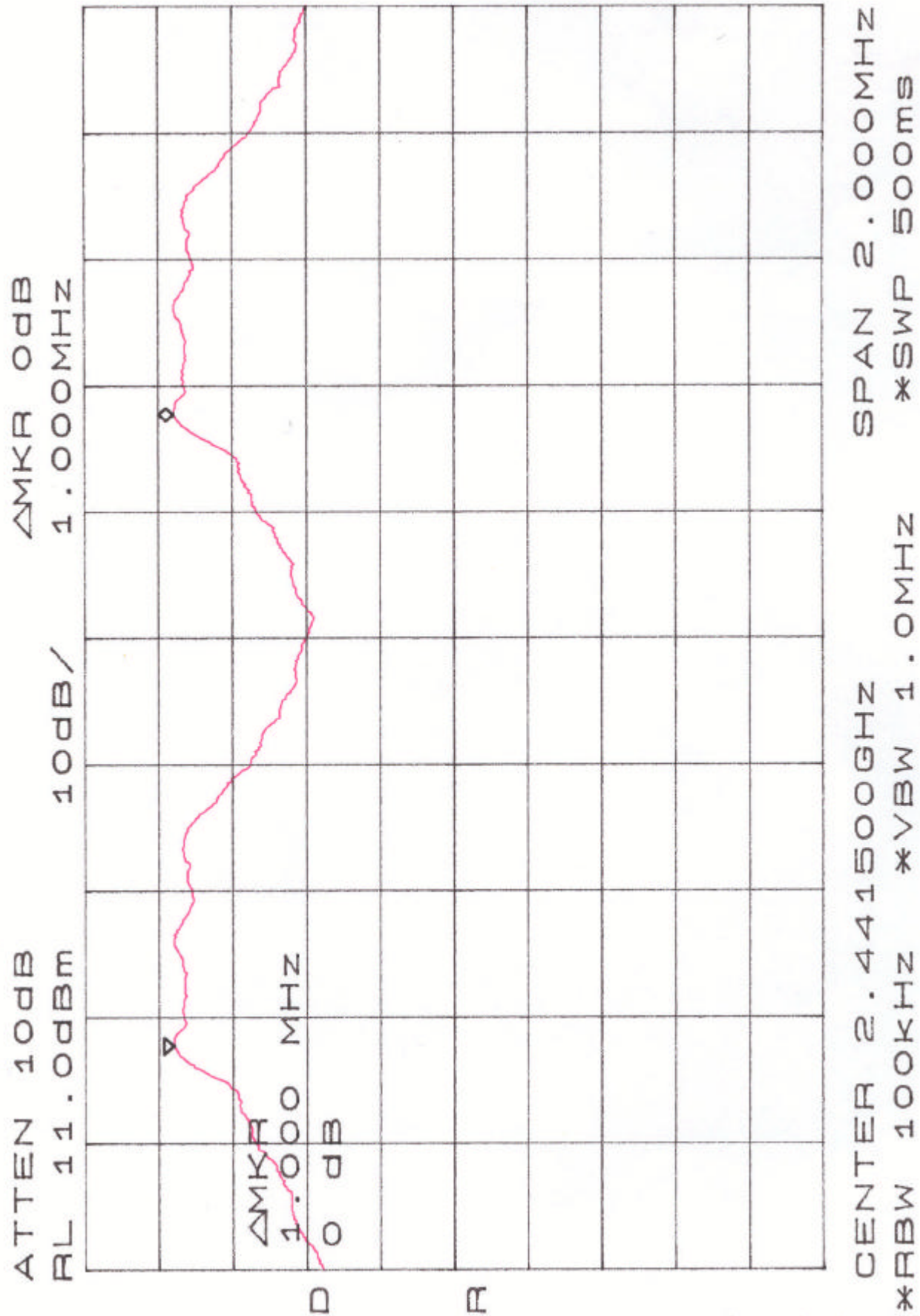
- a) 2402MHz : Maximun Power Density of 3 kHz Bandwidth is -12.33 dBm
- b) 2441MHz : Maximun Power Density of 3 kHz Bandwidth is -11.33 dBm
- c) 2480MHz : Maximun Power Density of 3 kHz Bandwidth is -12.50 dBm

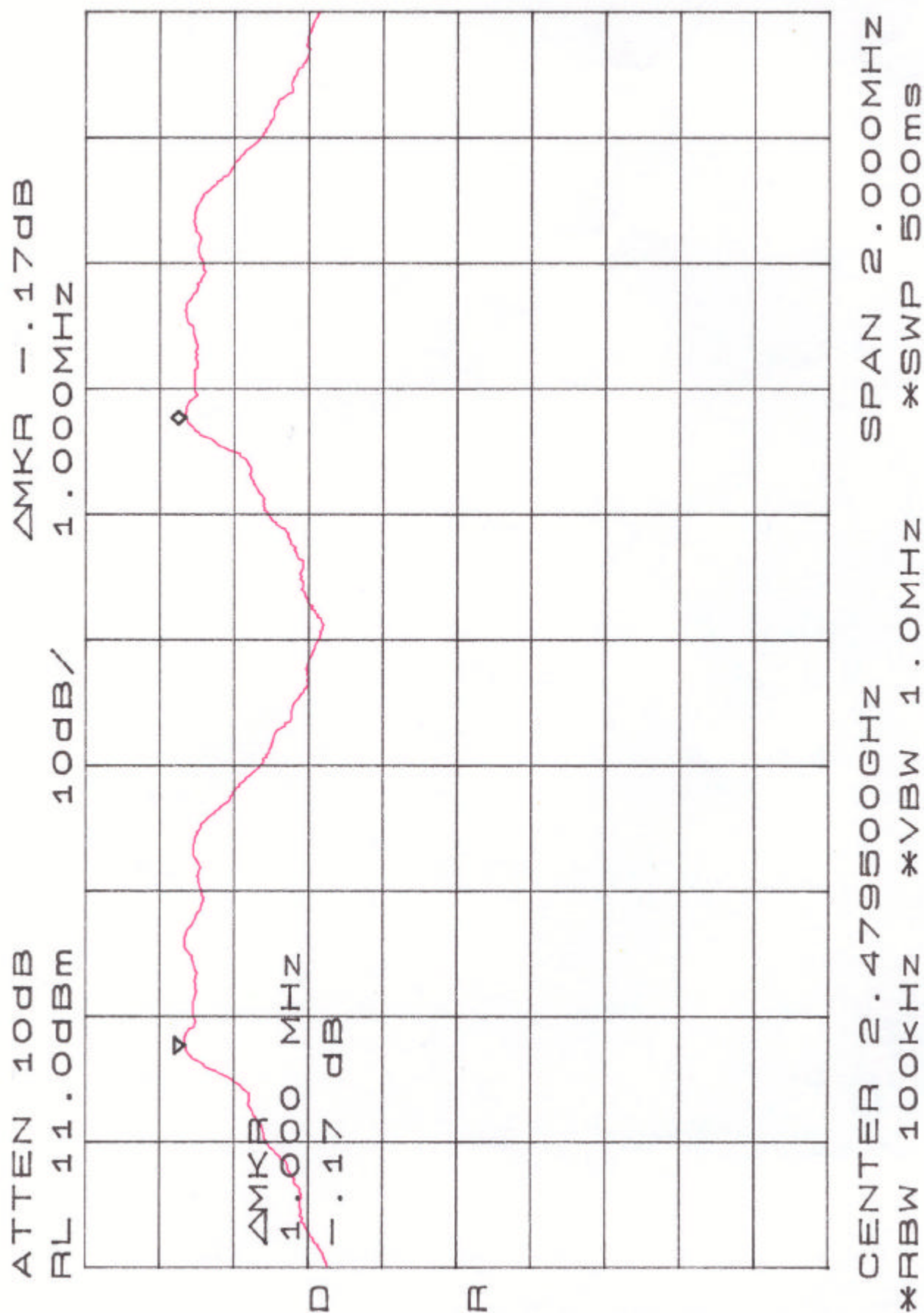
***Note : 1. Please see appendix 9 for Plotted Data***

***2. The expanded uncertainty of the power density tests is 2dB.***

## **Appendix 1 : Plotted Data for Separation of Adjacent Channel**

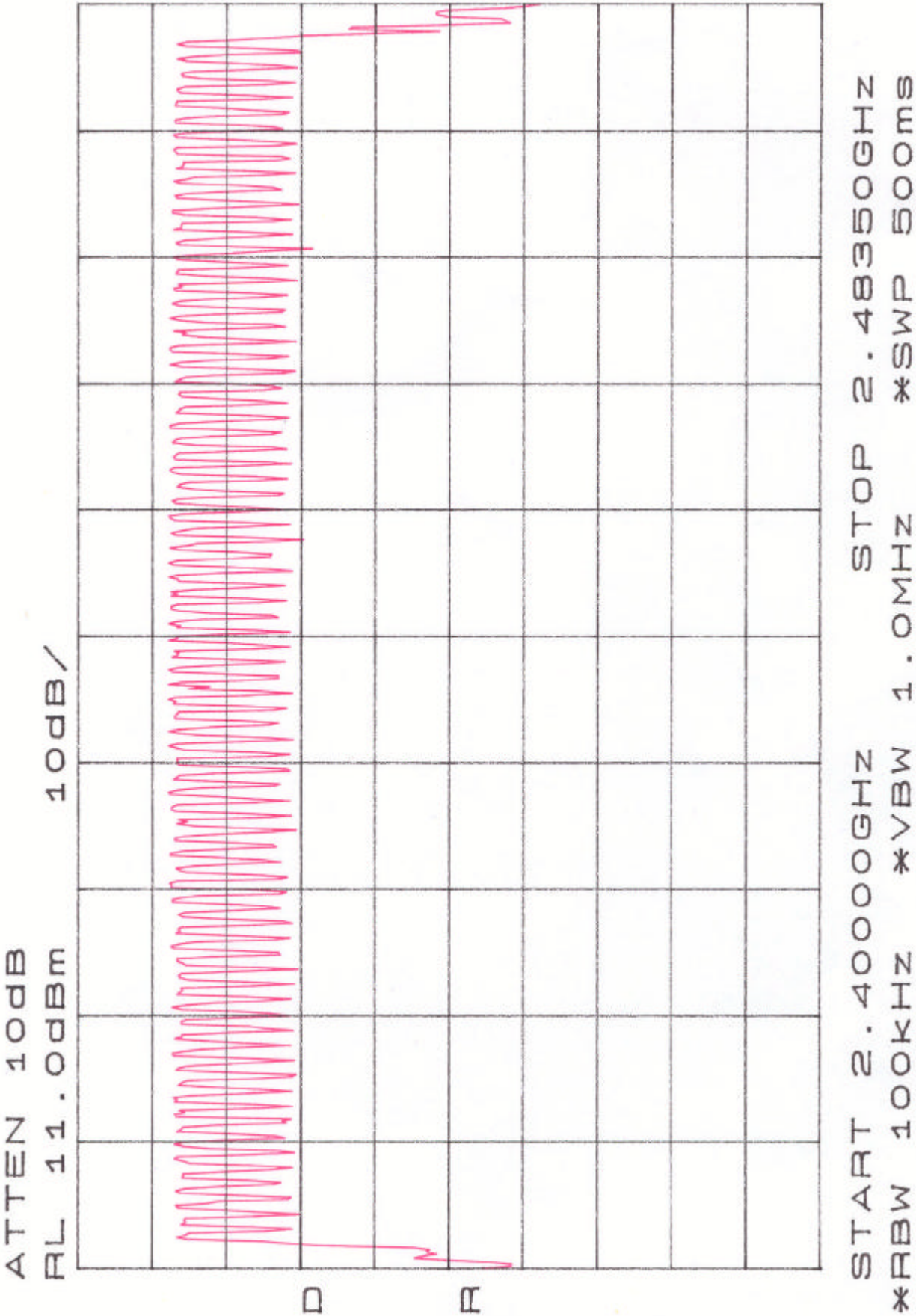






## **Appendix 2 : Plotted Data for Total Used Hopping Frequencies**





## **Appendix 3 : Plotted Data for Channel Bandwidth**