



**SGS-CSTC Standards  
Technical Services Ltd.**

1/F., Building No. 1 Building, Agriculture Machinery Materials Co. Wushan  
Road, Shipai, Tianhe District, Guangzhou, China  
Telephone: +86 (0) 20 3848 1001      Fax: +86 (0) 20 3848 1006  
kent\_hsu@sgs.com

**FEDERAL COMMUNICATIONS COMMISSION**  
Registration number: 282399

Report No.: GLEMO050200419ITF

Page: 1 of 36

FCC ID:SSLHS2303T

## **FCC TEST REPORT**

**Application No. :** GLEMO050200419ITF

**Applicant:** Shenzhen Hais Electronic Co., Ltd

**FCC ID:** SSLHS2303T

**Fundamental Carrier Frequency :** 2.402GHz to 2.481GHz

**Equipment Under Test (EUT):**

Name: 2.4G WIRELESS CONTROLLER

Model: HS2314, HS2320, HS2383 ♣

Band Name: HAIS

♣

Please refer to section 2 of this report which indicates which model was actually tested and which models are electrically identical.

**Standards:** FCC PART 15, SUBPART C: 2004 ( Section 15.247)

**Date of Receipt:** 24 February 2005

**Date of Test:** 24 February to 01 March 2005

**Date of Issue:** 03 March 2005

|                      |               |
|----------------------|---------------|
| <b>Test Result :</b> | <b>PASS *</b> |
|----------------------|---------------|

\* In the configuration tested, the EUT complied with the standards specified above.

Authorized Signature:

Kent Hsu  
Laboratory Manager

This report refers to the General Conditions for Inspection and Testing Services, printed overleaf

This report details the results of the testing carried out on one sample. The results contained in this test report do not relate to other samples of the same product and does not permit the use of the SGS PRODUCT CERTIFICATION MARK.. The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in this report.

This report may only be reproduced and distributed in full. If the product in this report is used in any configuration other than that detailed in the report, the manufacturer must ensure the new system complies with all relevant standards. Any mention of SGS International Electrical Approvals or testing done by SGS International Electrical Approvals in connection with, distribution or use of the product described in this report must be approved by SGS International Electrical Approvals in writing.

## 2 Test Summary

| Test                                 | Test Requirement  | Stanadard Paragraph     | Result |
|--------------------------------------|-------------------|-------------------------|--------|
| Conducted Emission (150KHz to 30MHz) | FCC PART 15 :2003 | Section 15.207          | PASS   |
| Radiated Emission (30MHz to 25GHz)   | FCC PART 15 :2003 | Section 15.209          | PASS   |
| Maximum Peak Output Power            | FCC PART 15 :2003 | Section 15.247 (b1)     | PASS   |
| Hopping Channel Number               | FCC PART 15 :2003 | Section 15.247 (b1)     | PASS   |
| Occupied Bandwidth                   | FCC PART 15 :2003 | Section 15.247 (a1)     | PASS   |
| Carrier Frequencies Separated        | FCC PART 15 :2003 | Section 15.247 (a1,iii) | PASS   |
| Band Edges Measurement               | FCC PART 15 :2003 | Section 15.247 (c)      | PASS   |
| Dell Time                            | FCC PART 15 :2003 | Section 15.247 (c)      | PASS   |
| Power Spectral Density Measurement   | FCC PART 15 :2003 | Section 15.247 (d)      | PASS   |

### Remark:

Model No.: **HS2314, HS2320, HS2383.**

The three models HS2314, HS2320, HS2383 and another 5 models: G8085, G8086, G9885, G8084, G9786. Only one model was tested as above since their electrical circuit design, layout, components used and internal wiring are identical. Only the applicant, product model no. and the outer are different. For further details please refer to the facsimile from Shengzhen Hais Co., Ltd dated 24 February 2005.

### 3 Contents

|   | Page         |
|---|--------------|
| <b>1 COVER PAGE.....</b>  | <b>1</b>     |
| <b>2 TEST SUMMARY.....</b>  | <b>2</b>     |
| <b>3 CONTENTS .....</b>   | <b>3</b>     |
| <b>4 GENERAL INFORMATION.....</b>   | <b>4</b>     |
| 4.1 CLIENT INFORMATION .....  | 4            |
| 4.2 GENERAL DESCRIPTION OF E.U.T.....                                     | 4            |
| 4.3 DESCRIPTION OF SUPPORT UNITS .....                                    | 4            |
| 4.4 STANDARDS APPLICABLE FOR TESTING.....                                 | 4            |
| 4.5 TEST LOCATION.....  | 4            |
| 4.6 OTHER INFORMATION REQUESTED BY THE CUSTOMER .....                     | 4            |
| 4.7 TEST FACILITY.....  | 5            |
| <b>5 TEST RESULTS.....</b>  | <b>6</b>     |
| 5.1 TEST INSTRUMENTS .....  | 6            |
| 5.2 E.U.T. OPERATION .....  | 6            |
| 5.3 TEST RESULT .....   | 7            |
| 5.3.1 <i>Conducted Emissions Mains Terminals, 150kHz to 30MHz .....</i>   | 7            |
| 5.3.2 <i>Radiated Emissions .....</i>                                     | 8            |
| 5.3.3 <i>Maximum Peak Output Power .....</i>                              | 15           |
| 5.3.4 <i>Hopping Channel Number .....</i>                                 | 17           |
| 5.3.5 <i>Occupied Bandwidth &amp; Carrier Frequencies Separated .....</i> | 18           |
| 5.3.6 <i>Band Edges Requirement .....</i>                                 | 23           |
| 5.3.7 <i>Dwell Time .....</i>   | 28           |
| 5.3.8 <i>Power Spectral Density .....</i>                                 | 32           |
| <b>6 TEST SETUP .....</b>   | <b>33</b>    |
| <b>7 PHOTOGRAPHS - EUT CONSTRUCTIONAL DETAILS .....</b>                   | <b>34-36</b> |

## **4 General Information**

### **4.1 Client Information**

Applicant Name: Shenzhen Hais Electronic Co., Ltd  
Applicant Address: 14 Building, Chentian Industrial Zone, Baomin 2/R, Bao'an, Shenzhen, China.

### **4.2 General Description of E.U.T.**

Product Name: 2.4G WIRELESS CONTROLLER ( Joystick Part)  
Model: HS2314, HS2320, HS2383 ♦  
Power Supply: 3.0V DC (2 x 'AA' Size Batteries)  
Power Cord: N/A-

### **4.3 Description of Support Units**

The EUT was tested with a Microsoft X-Box & a TCL 14" TV monitor.

### **4.4 Standards Applicable for Testing**

The customer requested FCC tests for a 2.4G WIRELESS CONTROLLER.  
The standard used was FCC PART 15, SUBPART C (2004) section 15.247.

### **4.5 Test Location**

All tests were performed at:-

SGS-CSTC Standards Technical Services Ltd., Guangzhou Safety & EMC Laboratory, 1/F, Building No. 1, Agriculture Machinery Materials Company Warehouse Ltd., Wushan Road Shipai, Tianhe District, Guangzhou, China. P.C. 510630.

Tel: +86 20 3848 1001

Fax: +86 20 3848 1006

### **4.6 Other Information Requested by the Customer**

None.

#### **4.7 Test Facility**

The test facility is recognized, certified, or accredited by the following organizations:

- **NVLAP – Lab Code: 200611-0**  
SGS-CSTC Standards Technical Services Co., Ltd., Guangzhou EMC Laboratory is recognized under the National Voluntary Laboratory Accreditation Program (NVLAP/NIST). NVLAP Code: 200611-0. Effective through December 31, 2004.
- **ACA**  
SGS-CSTC Standards Technical Services Co., Ltd., EMC Laboratory can also perform testing for the Australian C-Tick mark as a result of our NVLAP accreditation.
- **VCCI**  
The 3m Semi-anechoic chamber and Shielded Room (11.5m x 4m x 4m) of SGS-CSTC Standards Technical Services Co., Ltd. have been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: R-1599 and C-1706 respectively.  
Date of Registration: February 28, 2003. Valid until May 30, 2005
- **SGS UK(Certificate No.: 32), SGS-TUV SAARLAND and SGS-FINKO**  
Have approved SGS-CSTC Standards Technical Services Co., Ltd., EMC Laboratory as a supplier of EMC TESTING SERVICES and SAFETY TESTING SERVICES.
- **CNAL – LAB Code: L0141**  
SGS-CSTC Standards Technical Services Co., Ltd., EMC Laboratory has been assessed and in compliance with CNAL/AC01:2002 accreditation criteria for testing laboratories (identical to ISO/IEC 17025:1999 General Requirements) for the Competence of Testing Laboratories.
- **FCC – Registration No.: 282399**  
SGS-CSTC Standards Technical Services Co., Ltd., EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Registration 282399, May 31, 2002. With the above and NVLAP, SGS-CSTC is an authorized test laboratory for the DoC process.
- **Industry Canada (IC)**  
The 3m Semi-anechoic chamber of SGS-CSTC Standards Technical Services Co., Ltd. has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 5169.

## 5 Test Results

### 5.1 Test Instruments

| Test Equipment                    | Manufacturer      | Model                     | Asset No. | Cal. Due Date |
|-----------------------------------|-------------------|---------------------------|-----------|---------------|
| 3m Semi- Anechoic Chamber         | Frankonia         | 3m method                 | EMC0501   | 15-02-2005    |
| EMI Test Receiver                 | Rohde & Schwarz   | ESCS30                    | EMC0506   | 15-02-2005    |
| Bilog Type Antenna                | Schaffner Chase   | CBL6143                   | EMC0519   | 17-01-2005    |
| Coaxial cable                     | SGS-CSTC          | 10m                       | EMC0514   | 04-11-2004    |
| Spectrum Analyzer                 | ROHDE & SCHWARZ   | FSP 30                    | EMC0521   | 01-04-2005    |
| Horn Antenna                      | ROHDE & SCHWARZ   | HF906                     | EMC0517   | 01-04-2005    |
| Temperature, Humidity & Barometer | Oregon Scientific | BA-888                    | EMC0003   | 24-07-2004    |
| Peramplifier                      | Agilent           | 8449B                     | EMC0520   | 30-06-2005    |
| Coaxial cable                     | SGS               | N/A                       | EMC0514   | 01-06-2005    |
| Shielding Room                    | Frankonia         | 12 x 4 x 4 m <sup>3</sup> | EMC0103   | N/A           |
| LISN                              | Schaffner Chase   | MNZ050D11                 | 1421      | 04-11-2004    |
| EMI Test Receiver                 | Rohde& Schwarz    | ESCS30                    | 100086    | 09-12-2004    |
| Coaxial Cable                     | SGS               | 2m                        | EMC0107   | 01-06-2005    |

### 5.2 E.U.T. Operation

Input voltage: Supplied 3.0V DC (2 x 'AA' Size Batteries)

Operating Environment:

Temperature: 24.0 °C

Humidity: 60% RH

Atmospheric Pressure: 1012 mbar

EUT Operation: Test the EUT as a product which has frequency hopping system. The total hopping channels are 80 channels (0 to 79 channel), the fundamental frequencies are from 2.402GHz to 2.481GHz.

The test procedure provided by applicant enabled the EUT to transmit and receive data at lowest (**Channel 0: 2.402GHz**), middle (**Channel 39: 2.441GHz**), and highest channel (**Channel 79: 2.481GHz**), frequencies individually.

Pre-test all the frequencies mode and their power status, compliance test in the worse case: Channel 79, Channel 39,, Channel 0. (At -10dB RF power status )

### **5.3 Test Result**

#### **5.3.1 Conducted Emissions Mains Terminals, 150kHz to 30MHz**

Not Apply.

According to 15.207 (C): Measurements to demonstrate compliance with the conducted limits are not required for devices which only employ battery power for operation and which do not operate from the AC power lines or contain provisions for operation while connected to the AC power lines.

### 5.3.2 Radiated Emissions

Test Requirement:

FCC 15.209

Test Method:

Base on ANSI 63.4.

Test Date:

25 February 2005

Measurement Distance: 3m (Semi-Anechoic Chamber)

Frequency range 30 MHz – 25GHz for transmitting mode.

Test instrumentation resolution bandwidth 120 kHz (30 MHz - 1000 MHz)  
1 MHz (1000 MHz – 25GHz)

Receive antenna scan height 1 m - 4 m, polarization Vertical / Horizontal

Limit:

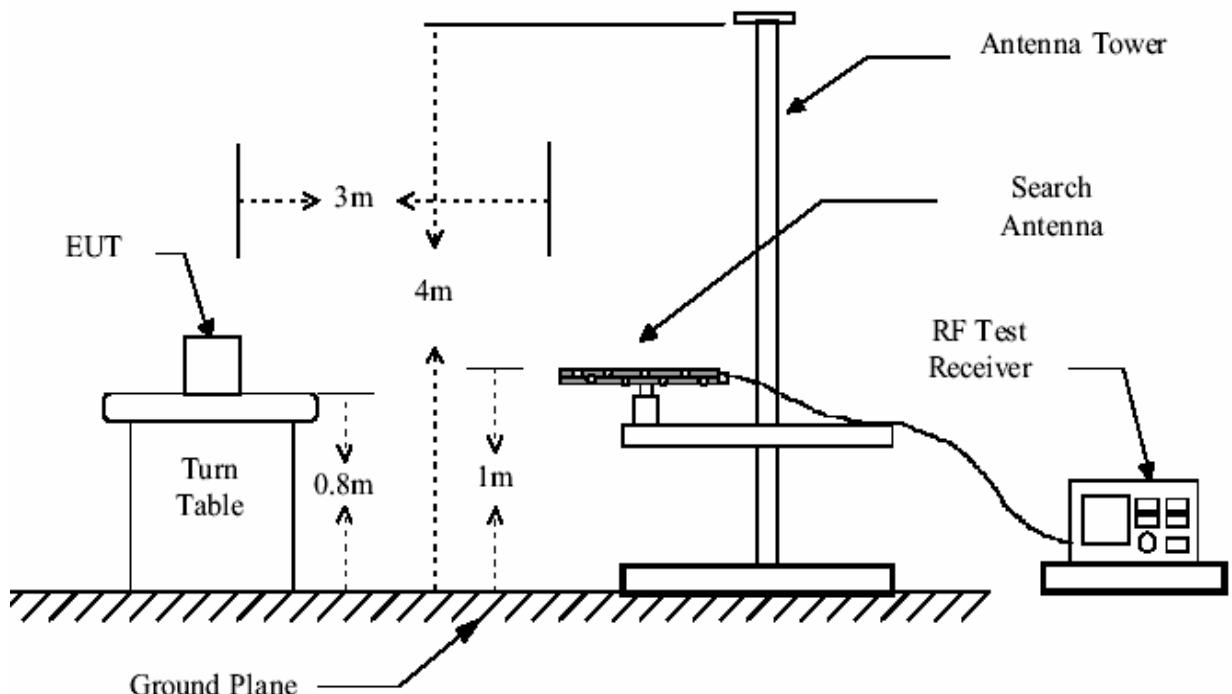
40.0 dB $\mu$ V/m between 30MHz & 88MHz

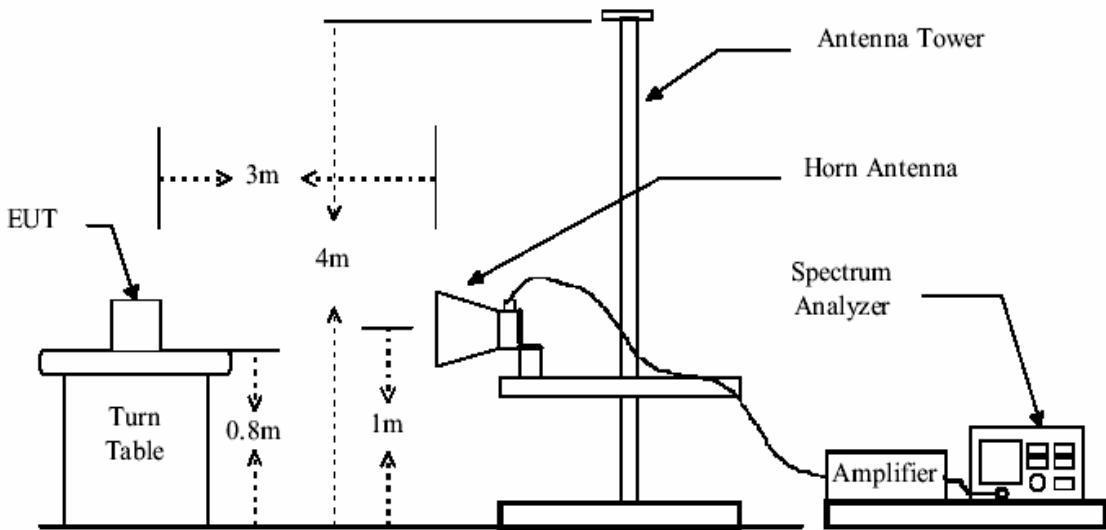
43.5 dB $\mu$ V/m between 88MHz & 216MHz

46.0 dB $\mu$ V/m between 216MHz & 960MHz

54.0 dB $\mu$ V/m above 960MHz

#### Test Configuration:





**Test Procedure:** The procedure used was ANSI Standard C63.4-2003. The receiver was scanned from 30MHz to 25GHz. When an emission was found, the table was rotated to produce the maximum signal strength. An initial pre-scan was performed for in peak detection mode using the receiver. The EUT was measured for both the Horizontal and Vertical polarities and performed a pre-test three orthogonal planes. For intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage. The worst case emissions were reported.

The field strength is calculated by adding the Antenna Factor, Cable Factor & Peramplifier. The basic equation with a sample calculation is as follows:

Final Test Level = Receiver Reading + Antenna Factor + Cable Factor - Peramplifier Factor

The following test results were performed on the EUT

**5.3.2.1 Harmonics Emissions**Test mode: **perform the test in transmitting status:****Test in Channel 0 (RF power - 10dB Status)****Harmonics & Spurious Emissions****Peak Measurement**

| <b>Test Frequency<br/>(GHz)</b> | <b>Measuring Level (dBuV/m)</b> |            | <b>Limits<br/>(dBuV/m)</b> | <b>Margin (dB)</b> |            |
|---------------------------------|---------------------------------|------------|----------------------------|--------------------|------------|
|                                 | Vertical                        | Horizontal |                            | Vertical           | Horizontal |
| 2) 4.804                        | 49.6                            | 44.8       | 74.0                       | 24.4               | 29.2       |
| 3) 7.206                        | 48.6                            | 45.3       | 74.0                       | 25.4               | 28.7       |
| 4) 9.608                        | N/A                             | N/A        | 74.0                       | N/A                | N/A        |
| 5) 12.010                       | N/A                             | N/A        | 74.0                       | N/A                | N/A        |
| 6) 14.412                       | N/A                             | N/A        | 74.0                       | N/A                | N/A        |
| 7) 16.814                       | N/A                             | N/A        | 74.0                       | N/A                | N/A        |
| 8) 19.216                       | N/A                             | N/A        | 74.0                       | N/A                | N/A        |
| 9) 21.618                       | N/A                             | N/A        | 74.0                       | N/A                | N/A        |
| 10) 24.020                      | N/A                             | N/A        | 74.0                       | N/A                | N/A        |

**Average Measurement**

|            |      |      |      |      |      |
|------------|------|------|------|------|------|
| 2) 4.804   | 36.0 | 35.5 | 54.0 | 18.0 | 18.5 |
| 3) 7.206   | 37.5 | 36.2 | 54.0 | 16.5 | 17.8 |
| 4) 9.608   | N/A  | N/A  | 54.0 | N/A  | N/A  |
| 5) 12.010  | N/A  | N/A  | 54.0 | N/A  | N/A  |
| 6) 14.412  | N/A  | N/A  | 54.0 | N/A  | N/A  |
| 7) 16.814  | N/A  | N/A  | 54.0 | N/A  | N/A  |
| 8) 19.216  | N/A  | N/A  | 54.0 | N/A  | N/A  |
| 9) 21.618  | N/A  | N/A  | 54.0 | N/A  | N/A  |
| 10) 24.020 | N/A  | N/A  | 54.0 | N/A  | N/A  |

N/A: refer to remark 1).

Test mode: **perform the test in transmitting status :**

**Test the racing wheel in Channel 39 (RF power - 10dB Status).**

Harmonics & Spurious Emissions:

| <b>Peak Measurement</b>     |                                 |            |                        |                    |            |
|-----------------------------|---------------------------------|------------|------------------------|--------------------|------------|
| <b>Test Frequency (GHz)</b> | <b>Measuring Level (dBuV/m)</b> |            | <b>Limits (dBuV/m)</b> | <b>Margin (dB)</b> |            |
|                             | Vertical                        | Horizontal |                        | Vertical           | Horizontal |
| 11) 4.804                   | 50.5                            | 46.6       | 74.0                   | 23.5               | 27.4       |
| 12) 7.206                   | 48.9                            | 45.8       | 74.0                   | 25.1               | 28.2       |
| 13) 9.608                   | N/A                             | N/A        | 74.0                   | N/A                | N/A        |
| 14) 12.010                  | N/A                             | N/A        | 74.0                   | N/A                | N/A        |
| 15) 14.412                  | N/A                             | N/A        | 74.0                   | N/A                | N/A        |
| 16) 16.814                  | N/A                             | N/A        | 74.0                   | N/A                | N/A        |
| 17) 19.216                  | N/A                             | N/A        | 74.0                   | N/A                | N/A        |
| 18) 21.618                  | N/A                             | N/A        | 74.0                   | N/A                | N/A        |
| 19) 24.020                  | N/A                             | N/A        | 74.0                   | N/A                | N/A        |
| <b>Average Measurement</b>  |                                 |            |                        |                    |            |
| 11) 4.804                   | 36.5                            | 35.2       | 54.0                   | 17.5               | 18.8       |
| 12) 7.206                   | 38.6                            | 36.5       | 54.0                   | 15.4               | 17.5       |
| 13) 9.608                   | N/A                             | N/A        | 54.0                   | N/A                | N/A        |
| 14) 12.010                  | N/A                             | N/A        | 54.0                   | N/A                | N/A        |
| 15) 14.646                  | N/A                             | N/A        | 54.0                   | N/A                | N/A        |
| 16) 17.087                  | N/A                             | N/A        | 54.0                   | N/A                | N/A        |
| 17) 19.528                  | N/A                             | N/A        | 54.0                   | N/A                | N/A        |
| 18) 21.969                  | N/A                             | N/A        | 54.0                   | N/A                | N/A        |
| 19) 24.410                  | N/A                             | N/A        | 54.0                   | N/A                | N/A        |

N/A: refer to remark 1).

Test mode: **perform the test in transmitting status :**

**Test in Channel 79 (RF power - 10dB Status)**

Harmonics & Spurious Emissions:

|                             |                                 | <b>Peak Measurement</b> |                        |                    |            |
|-----------------------------|---------------------------------|-------------------------|------------------------|--------------------|------------|
| <b>Test Frequency (GHz)</b> | <b>Measuring Level (dBuV/m)</b> |                         | <b>Limits (dBuV/m)</b> | <b>Margin (dB)</b> |            |
|                             | Vertical                        | Horizontal              |                        | Vertical           | Horizontal |
| 20) 4.804                   | 52.3                            | 44.5                    | 74.0                   | 21.7               | 29.5       |
| 21) 7.206                   | 48.2                            | 45.1                    | 74.0                   | 25.8               | 28.9       |
| 22) 9.608                   | N/A                             | N/A                     | 74.0                   | N/A                | N/A        |
| 23) 12.010                  | N/A                             | N/A                     | 74.0                   | N/A                | N/A        |
| 24) 14.412                  | N/A                             | N/A                     | 74.0                   | N/A                | N/A        |
| 25) 16.814                  | N/A                             | N/A                     | 74.0                   | N/A                | N/A        |
| 26) 19.216                  | N/A                             | N/A                     | 74.0                   | N/A                | N/A        |
| 27) 21.618                  | N/A                             | N/A                     | 74.0                   | N/A                | N/A        |
| 28) 24.020                  | N/A                             | N/A                     | 74.0                   | N/A                | N/A        |
| <b>Average Measurement</b>  |                                 |                         |                        |                    |            |
| 20) 4.804                   | 36.6                            | 35.2                    | 54.0                   | 17.4               | 18.8       |
| 21) 7.206                   | 37.8                            | 36.7                    | 54.0                   | 16.2               | 17.3       |
| 22) 9.608                   | N/A                             | N/A                     | 54.0                   | N/A                | N/A        |
| 23) 12.010                  | N/A                             | N/A                     | 54.0                   | N/A                | N/A        |
| 24) 14.886                  | N/A                             | N/A                     | 54.0                   | N/A                | N/A        |
| 25) 17.367                  | N/A                             | N/A                     | 54.0                   | N/A                | N/A        |
| 26) 19.848                  | N/A                             | N/A                     | 54.0                   | N/A                | N/A        |
| 27) 22.329                  | N/A                             | N/A                     | 54.0                   | N/A                | N/A        |
| 28) 24.810                  | N/A                             | N/A                     | 54.0                   | N/A                | N/A        |

N/A: refer to remark 1).

## Remark:

- 1). N/A: For this intentional radiator operates below 10 GHz, the spectrum shall be investigated to the tenth harmonic of the highest fundamental frequency. And above the fifth harmonic of this intentional radiator, the disturbance is very low. So the test result only displays to 5<sup>th</sup> harmonic.
- 2). According to 15.249 (d) As shown in Section 15.35(b), for frequencies above 1000 MHz, the above field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.
- 3). The test only perform the EUT in transmitting status since the test frequencies were over 1GHz only required transmitting status.

TEST RESULTS: The unit does meet the FCC requirements.

**5.3.2.2 Other Spurious Emissions.**

|                       |  |
|-----------------------|--|
| Test Requirement:     | FCC Part15 Section 15.209  |
| Test Method:          | Based on FCC Part15 B  |
| Measurement Distance: | 3m   |
| Limit:                | 40.0 dB $\mu$ V/m between 30MHz & 88MHz<br>43.5 dB $\mu$ V/m between 88MHz & 216MHz<br>46.0 dB $\mu$ V/m between 216MHz & 960MHz<br>54.0 dB $\mu$ V/m above 960MHz |
| Detector:             | Peak for pre-scan , 120kHz resolution bandwidth within 1GHz,<br>1MHz resolution bandwidth above 1GHz<br>Quasi-Peak if maximised peak within 6dB of limit           |

All the test modes( including with **transmitting mode and receiving mode**), the test data only was shown for the worsted case mode: **Test in Channel 39 in transmitting mode.(RF power - 10dB Status).**

The following measurement result were performed on the EUT:

| Frequency (Hz) | Antenna Polarization | Emission Level (dB $\mu$ V/m) | Limit dB $\mu$ V/m) | Margin (dB) |
|----------------|----------------------|-------------------------------|---------------------|-------------|
| 30.000M        | Vertical             | 26.5                          | 40.0                | 13.5        |
| 200.000M       | Vertical             | 23.8                          | 43.5                | 19.7        |
| 900.000M       | Vertical             | 27.0                          | 46.0                | 19.0        |
| 1.200G         | Vertical             | 31.8                          | 54.0                | 22.2        |
| 30.000M        | Horizontal           | 22.5                          | 40.0                | 17.5        |
| 200.000M       | Horizontal           | 24.9                          | 43.5                | 18.6        |
| 900.000M       | Horizontal           | 28.2                          | 46.0                | 17.8        |
| 1.200G         | Horizontal           | 30.1                          | 54.0                | 23.9        |

The field strength is calculated by adding the Antenna Factor, Cable Factor & Peramplifier . The basic equation with a sample calculation is as follows:

Final Test Level =Receiver Reading + Antenna Factor + Cable Factor – Peramplifier Factor

**TEST RESULTS: The unit does meet the FCC requirements**

### 5.3.3 Maximum Peak Output Power

Test Requirement:

FCC Part15 C

Test Method:

Base on ANSI 63.4.

Test Date:

25 February 2005

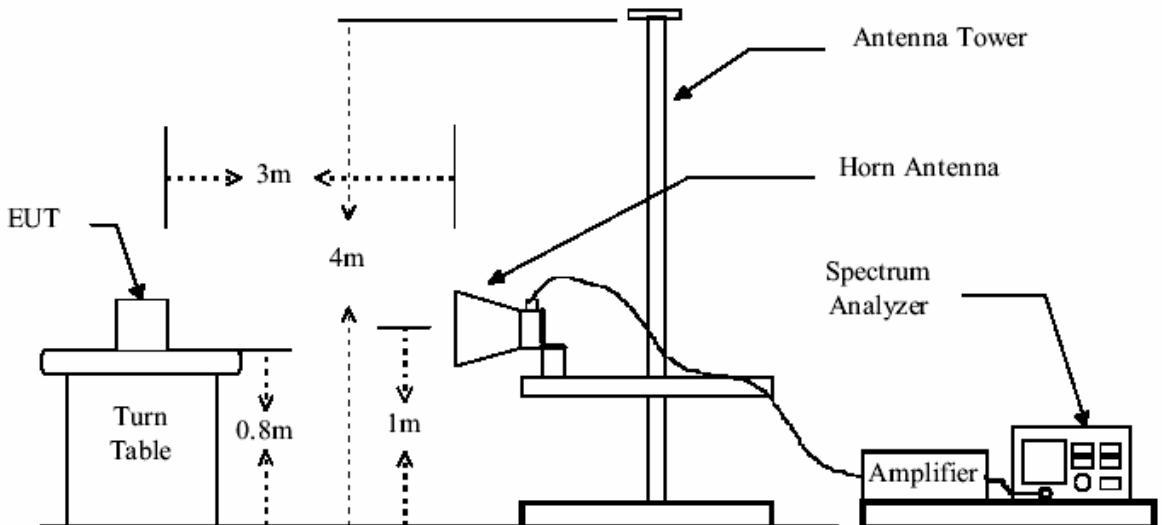
Requirements:

Regulation 15.247 (b) The Limit of Maximum Peak Output Power Measurement is 1W (30dBm).

Test mode:

Compliance test in the worse case: Channel 0, Channel 39, Channel 79. (At -4 dB RF power status).

#### Test Configuration:



**Test Procedure:**

The technique used to find the output power of the transmitter was the antenna substitution method. Substitution method was performed to determine the actual ERP emission levels of the EUT. The following test procedure as below:

1. The EUT was powered ON and placed on a table in the chamber. The antenna of the transmitter was extended to its maximum length.
2. The fundamental frequency of the transmitter was maximized on the test receiver display by raising and lowering the receive antenna and by rotating the turntable. After the fundamental emission was maximized, a field strength measurement was made.
3. Steps 1 and 2 were performed with the EUT and the receive antenna in both vertical and horizontal polarization.
4. Calculate the transmitter's peak power using the following equation:  
Power=  $(E \times d)^2 / (30 \times G)$   
Where: E= the measured maximum field strength in V/m.  
Set the RBW > 6dB bandwidth of the emission or use a peak power meter..  
.G= the numeric gain of the transmitting antenna over an isotropic radiator.  
.d= the distance in meters from which the field strength was measured.  
.P= the power in watts is the final Maximum Peak Output Power .

**Test Result:**

| Test Channel | Fundamental Frequency (GHz) | Filed Strength (dBuV/m) | Gain (dBi) | Output Power (dBm) | Limit (dBm) | PASS/FAIL |
|--------------|-----------------------------|-------------------------|------------|--------------------|-------------|-----------|
| 0            | 2.402                       | 84.4                    | -10        | -5.83              | 30.0        | Pass      |
| 39           | 2.441                       | 86.8                    | -10        | -3.43              | 30.0        | Pass      |
| 79           | 2.481                       | 86.2                    | -10        | -4.03              | 30.0        | Pass      |

**Remark:** The manufacturer for the antenna gain specification is -10 dBi ( if test in -10dB RF output power mode).

**TEST RESULTS: The unit does meet the FCC requirements.**

### 5.3.4 Hopping Channel Number

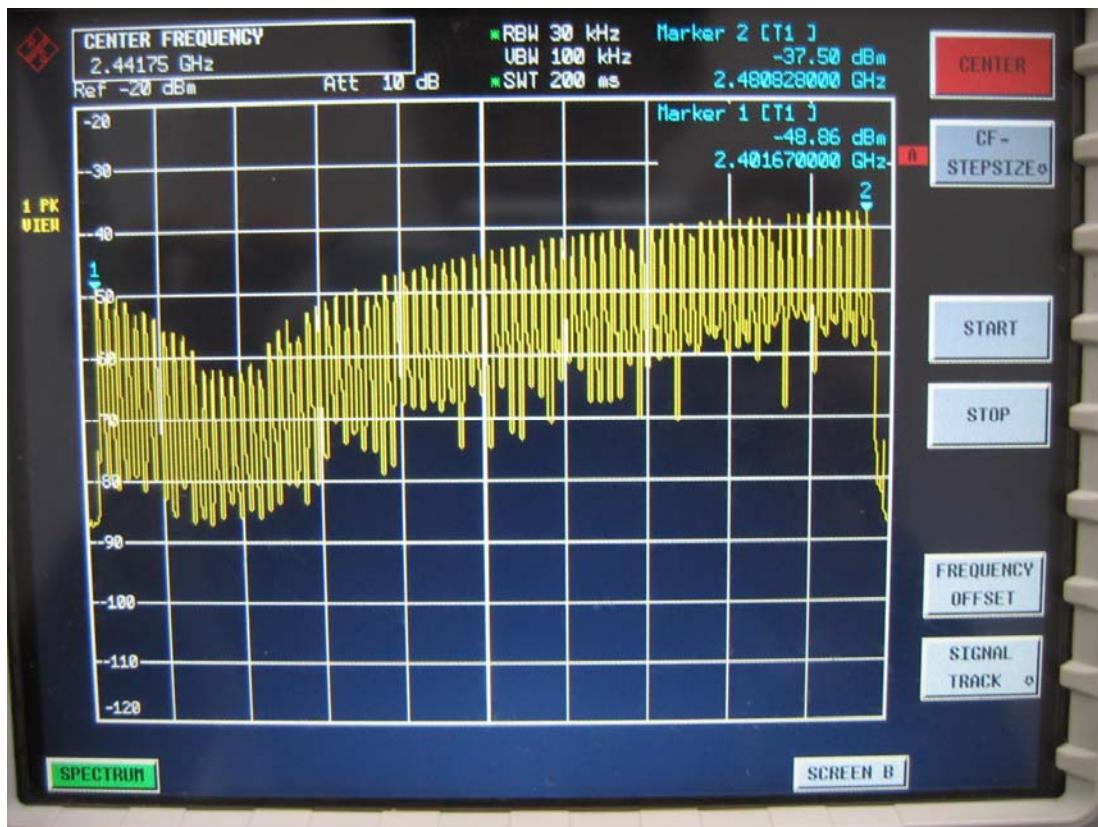
Test Requirement: FCC Part15 C

Test Method: Based on FCC Part15 C Section 15.247

Test Date: 28 February 2004

Requirements: Regulation 15.247 (b) (1) For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 hopping channels.

Test result: Total channels are 80 channels, channel 0 to channel 79.  
The unit does meet the FCC requirements  
Please refer the graph as below:



**5.3.5 Occupied Bandwidth & Carrier Frequencies Separated**

Test Requirement: FCC Part 15 C

Test Method: Based on FCC Part 15 C Section 15.247:

Test Date: 28 February 2004

Requirements: (a) Operation under the provisions of this Section is limited to frequency hopping and direct sequence spread spectrum intentional radiators that comply with the following provisions: (1) Frequency hopping systems 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.

**5.3.5.1 Occupied Bandwidth:**

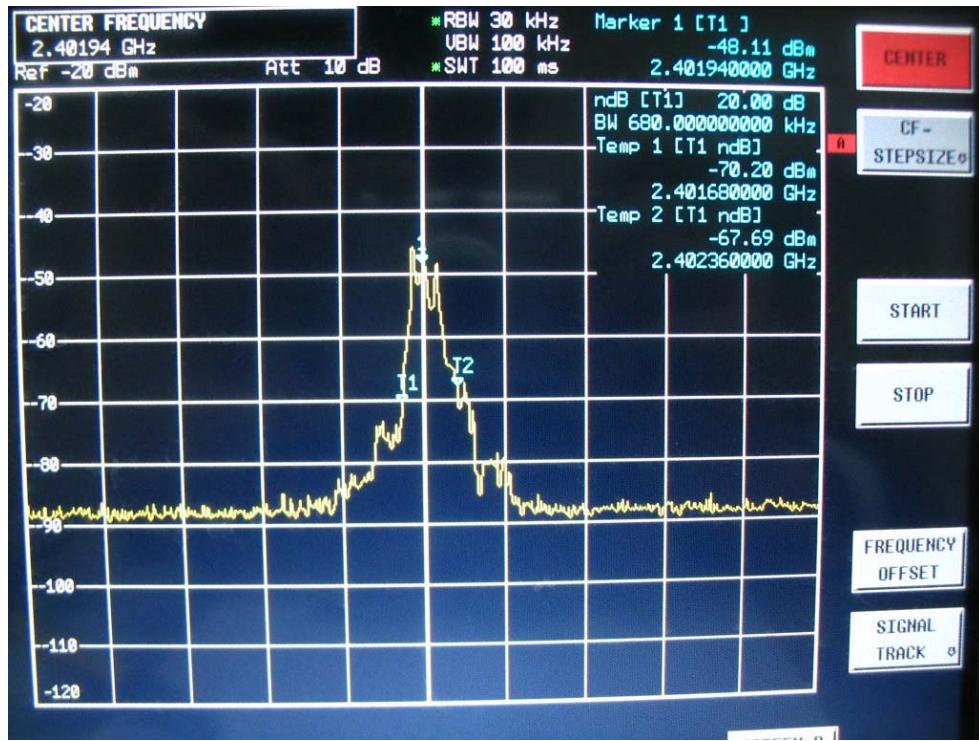
Test Procedure: The transmitter output was connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured by spectrum analyzer with 3 MHz RBW and 10 MHz VBW, established the resolution bandwidth that exceeds the signal bandwidth. The resolution bandwidth is then reduced to 1% of the estimated emission bandwidth and the video bandwidth is set to 3 times the resolution bandwidth. The bandwidth of the fundamental frequency was measured by spectrum analyzer with 30 KHz RBW and 100KHz VBW. The 20 dB bandwidth is defined as the total spectrum the power of which is higher than peak power minus 20 dB. Analyzer and the attached plot was taken. The output power please refer the section 5.3.3 of this report.

Test result:

| Test Channel | 20 dB bandwidth | PASS/FAIL |
|--------------|-----------------|-----------|
| 0            | 680KHz          | Pass      |
| 39           | 840KHz          | Pass      |
| 79           | 640KHz          | Pass      |

The unit does meet the FCC requirements. Please refer the graph as below:

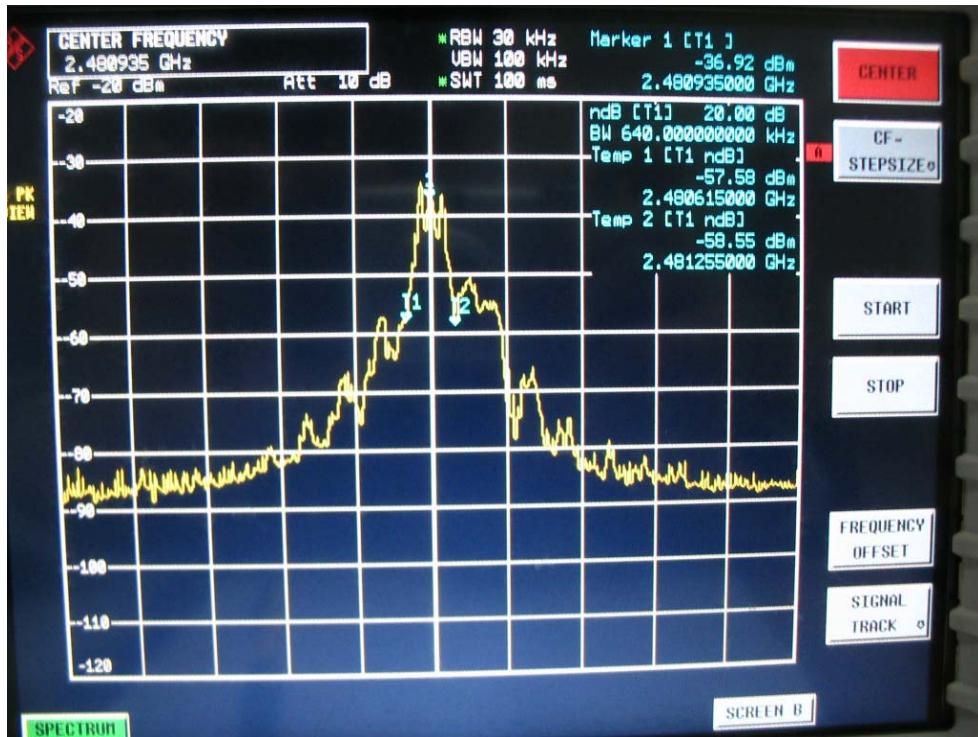
## 1. Channel 0: 20dB Bandwidth



## 2. Channel 39: 20dB Bandwidth



### 3. Channel 79: 20dB Bandwidth



### 5.3.5.2 Carrier Frequencies Separated

**Test Procedure:** The transmitter output was connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured by spectrum analyzer with 3 kHz RBW and 10 kHz VBW. The 20 dB bandwidth is defined as the total spectrum the power of which is higher than peak power minus 20 dB. Analyzer and the attached plot was taken.

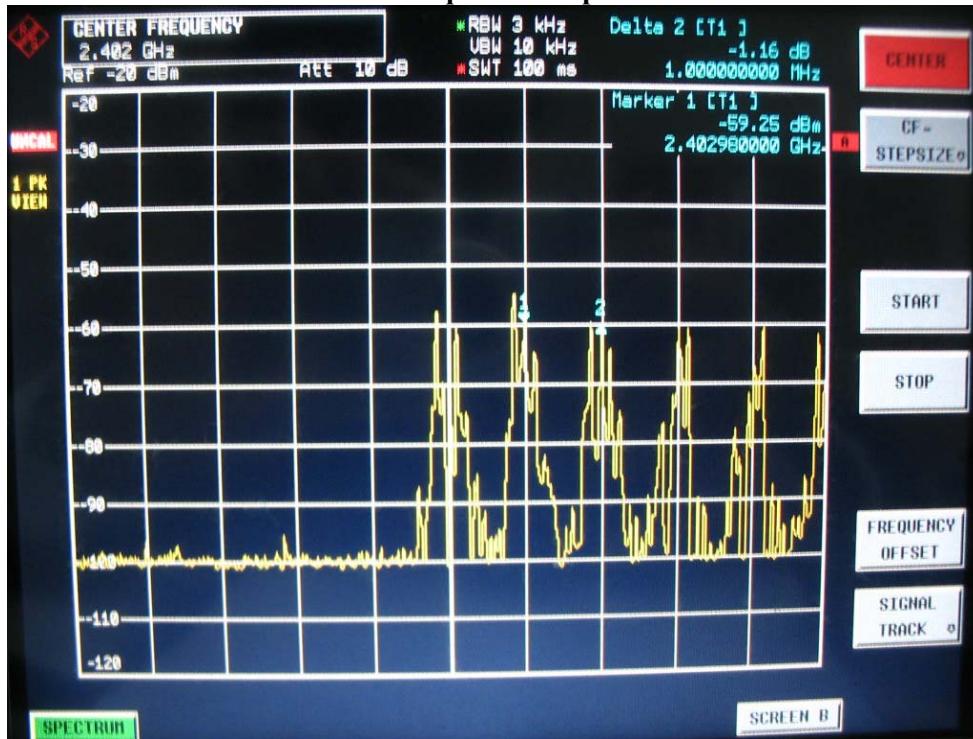
Test result:

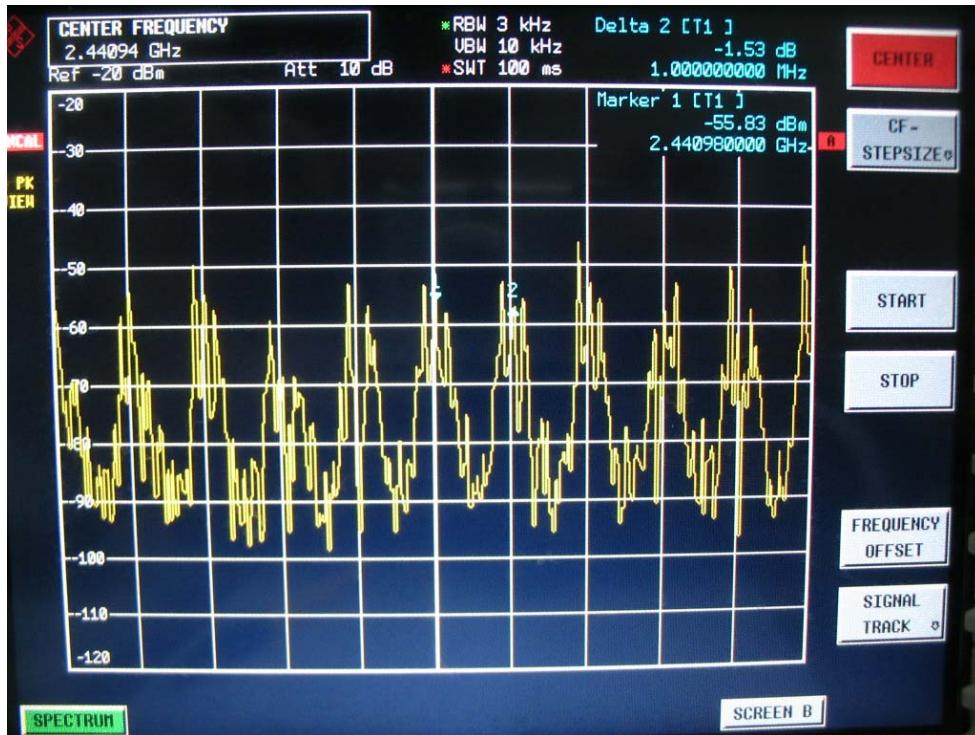
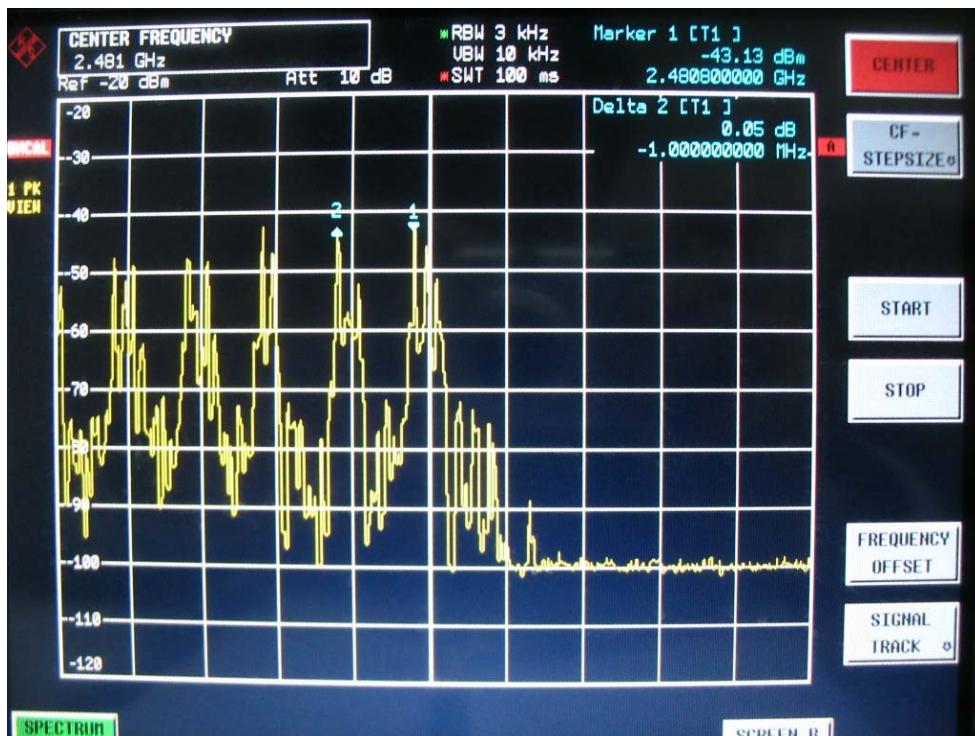
| Test Channel                                   | Carrier Frequencies Separated | PASS/FAIL |
|--|-------------------------------|-----------|
| Lower Channels<br>(channel 0 and channel 1)    | 1.0MHz                        | Pass      |
| Middle Channels<br>(channel 39 and channel 40) | 1.0MHz                        | Pass      |
| Upper Channels<br>(channel 78 and channel 79)  | 1.0MHz                        | Pass      |

**The unit does meet the FCC requirements.**

Please refer the graph as below:

#### 1. Lower Channels: Carrier Frequencies Separated



**2. Middle Channels: Carrier Frequencies Separated****3. Upper Channels: Carrier Frequencies Separated**

**5.3.6 Band Edges Requirement**

Test Requirement: FCC Part 15 C

Test Method: Based on FCC Part15 C Section 15.247:

Operation within the band 2400 – 2483.5 MHz

Test Date: 28 February 2004

Requirements: Section 15.247 (c) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum 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. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

**5.3.6.1 100 kHz Bandwidth Outside the Frequency Band**

Method of Measurement: Set RBW of spectrum analyzer to 100 kHz and VBW of spectrum analyzer to 300 kHz with suitable frequency span including 100 kHz bandwidth from band edge.

The band edges was measured and recorded.

Test Result:

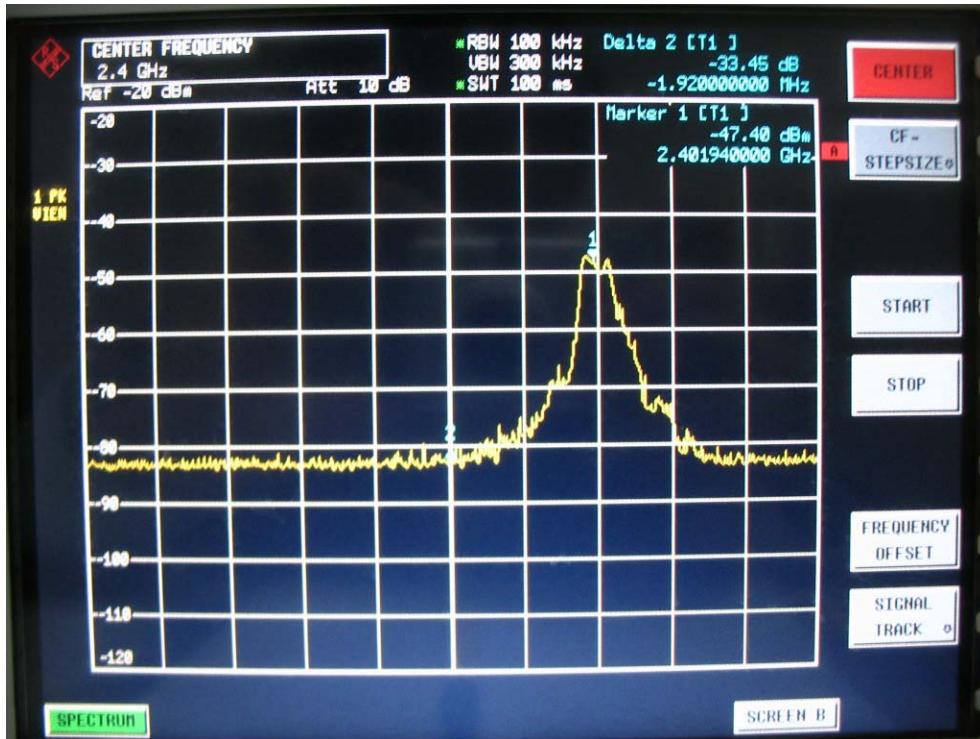
The Lower Edges: the value is -33.45dBm that is attenuated more than 20dB.

The Upper Edges: the value is -36.43dBm that is attenuated more than 20dB.

**The unit does meet the FCC requirements**

The graph as below, represents the emissions take for this device.

1. For Lower Channel: the fundamental frequency is **2.402G Hz**.



2. For Upper Channel: the fundamental frequency is **2.481GHz**.



**5.3.6.2 Radiated Emissions which fall in the restricted bands**

Test Requirement: Section 15.247 (c) In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

Test Method: Base on ANSI 63.4.

Test Date: 28 February 2004

Measurement Distance: 3m (Semi-Anechoic Chamber)

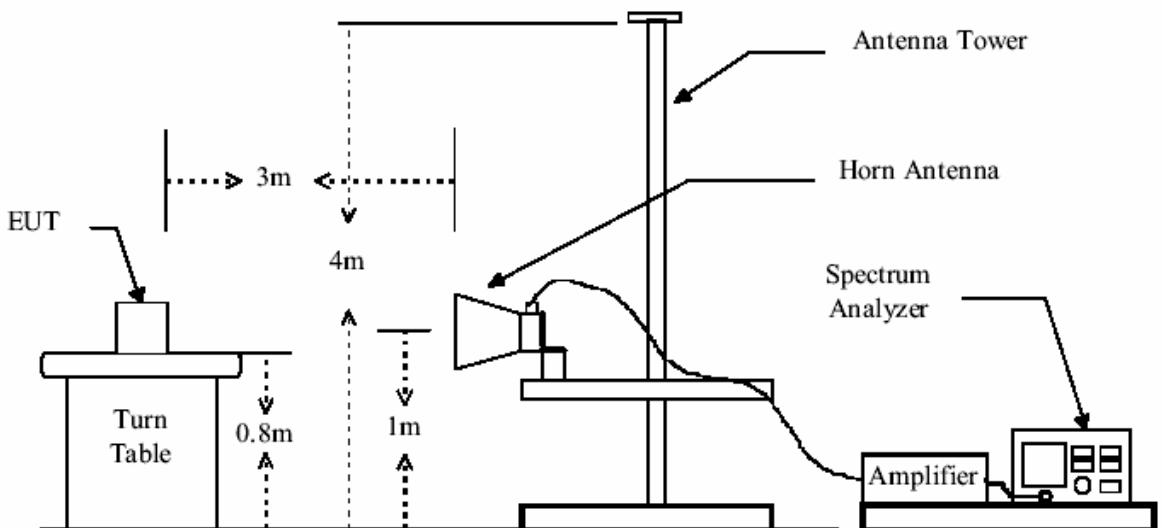
Limit: 40.0 dB $\mu$ V/m between 30MHz & 88MHz

43.5 dB $\mu$ V/m between 88MHz & 216MHz

46.0 dB $\mu$ V/m between 216MHz & 960MHz

54.0 dB $\mu$ V/m above 960MHz

Detector: Peak for pre-scan , 120kHz resolution bandwidth within 1GHz,  
1MHz resolution bandwidth above 1GHz

**Test Configuration:**

**Test Procedure:** The procedure used was ANSI Standard C63.4-2000. The receiver was scanned from 30MHz to 25GHz. When an emission was found, the table was rotated to produce the maximum signal strength. An initial pre-scan was performed for in peak detection mode using the receiver. The EUT was measured for both the Horizontal and Vertical polarities and performed a pre-test three orthogonal planes. For intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage. The worst case emissions were reported.

The field strength is calculated by adding the Antenna Factor, Cable Factor & Peramplifier. The basic equation with a sample calculation is as follows:

Final Test Level = Receiver Reading + Antenna Factor + Cable Factor – Peramplifier Factor

**Test Result:****1. Channel 0 ( 2.402GHz)**

| Test Frequency<br>(MHz) | Peak Level<br>(dBuV/m) | Average Level<br>(dBuV/m) | Peak Limit<br>(dBuV/m) | Average Limit<br>(dBuV/m) | Margin (dB) |      |
|-------------------------|------------------------|---------------------------|------------------------|---------------------------|-------------|------|
|                         |                        |                           |                        |                           | Peak        | AV   |
| 2390.000                | 43.2                   | 35.5                      | 74.0                   | 54.0                      | 30.8        | 18.5 |
| 2483.500                | 44.1                   | 36.1                      | 74.0                   | 54.0                      | 29.9        | 17.9 |

**2. Channel 39 ( 2.441GHz)**

| Test Frequency<br>(MHz) | Peak Level<br>(dBuV/m) | Average Level<br>(dBuV/m) | Peak Limit<br>(dBuV/m) | Average Limit<br>(dBuV/m) | Margin (dB) |      |
|-------------------------|------------------------|---------------------------|------------------------|---------------------------|-------------|------|
|                         |                        |                           |                        |                           | Peak        | AV   |
| 2390.000                | 44.1                   | 36.2                      | 74.0                   | 54.0                      | 29.9        | 17.8 |
| 2483.500                | 45.2                   | 37.0                      | 74.0                   | 54.0                      | 28.8        | 17.0 |

**3. Channel 79 ( 2.481GHz)**

| Test Frequency<br>(MHz) | Peak Level<br>(dBuV/m) | Average Level<br>(dBuV/m) | Peak Limit<br>(dBuV/m) | Average Limit<br>(dBuV/m) | Margin (dB) |      |
|-------------------------|------------------------|---------------------------|------------------------|---------------------------|-------------|------|
|                         |                        |                           |                        |                           | Peak        | AV   |
| 2390.000                | 44.8                   | 35.2                      | 74.0                   | 54.0                      | 29.2        | 18.8 |
| 2483.500                | 45.6                   | 37.5                      | 74.0                   | 54.0                      | 28.4        | 16.5 |

**The unit does meet the FCC requirements.**

## Section 15.205 Restricted bands of operation.

(a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

| <b>MHz</b>                 | <b>MHz</b>            | <b>MHz</b>      | <b>GHz</b>       |
|----------------------------|-----------------------|-----------------|------------------|
| 0.090 - 0.110              | 16.42 - 16.423        | 399.9 - 410     | 4.5 - 5.15       |
| <sup>1</sup> 0.495 - 0.505 | 16.69475 - 16.69525   | 608 - 614       | 5.35 - 5.46      |
| 2.1735 - 2.1905            | 16.80425 - 16.80475   | 960 - 1240      | 7.25 - 7.75      |
| 4.125 - 4.128              | 25.5 - 25.67          | 1300 - 1427     | 8.025 - 8.5      |
| 4.17725 - 4.17775          | 37.5 - 38.25          | 1435 - 1626.5   | 9.0 - 9.2        |
| 4.20725 - 4.20775          | 73 - 74.6             | 1645.5 - 1646.5 | 9.3 - 9.5        |
| 6.215 - 6.218              | 74.8 - 75.2           | 1660 - 1710     | 10.6 - 12.7      |
| 6.26775 - 6.26825          | 108 - 121.94          | 1718.8 - 1722.2 | 13.25 - 13.4     |
| 6.31175 - 6.31225          | 123 - 138             | 2200 - 2300     | 14.47 - 14.5     |
| 8.291 - 8.294              | 149.9 - 150.05        | 2310 - 2390     | 15.35 - 16.2     |
| 8.362 - 8.366              | 156.52475 - 156.52525 | 2483.5 - 2500   | 17.7 - 21.4      |
| 8.37625 - 8.38675          | 156.7 - 156.9         | 2655 - 2900     | 22.01 - 23.12    |
| 8.41425 - 8.41475          | 162.0125 - 167.17     | 3260 - 3267     | 23.6 - 24.0      |
| 12.29 - 12.293             | 167.72 - 173.2        | 3332 - 3339     | 31.2 - 31.8      |
| 12.51975 - 12.52025        | 240 - 285             | 3345.8 - 3358   | 36.43 - 36.5     |
| 12.57675 - 12.57725        | 322 - 335.4           | 3600 - 4400     | ( <sup>2</sup> ) |
| 13.36 - 13.41              |                       |                 |                  |

### 5.3.7 Dwell Time

Test Requirement: FCC Part 15 C

Test Method: Based on FCC Part15 C Section 15.247:

Test Date: 28 February 2004

Requirements: 15.247 a (1)(iii) Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 non-overlapping channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

Test Procedure:

1. Set RBW of spectrum analyzer to 1MHz and VBW of spectrum analyzer to 1MHz , Set the test channel frequency span to 0.
2. Set the sweep time of spectrum analyzer to 5ms, measure the single pulse during time.
3. Set the sweep time of spectrum analyzer to 500ms, measure the pulses number of the measurement time.

Test Result:

The test period:  $T = 0.4 \text{ Second/Channel} \times 80 \text{ Channel} = 32\text{s}$

1. **Channel 0: 2.402GHz**

The Average Occupany time =  $1.630\text{ms} \times (42/500\text{ms} \times 32\text{s}) / 80 = 52.160\text{ms}$

2. **Channel 39: 2.441GHz**

The Average Occupany time =  $1.620\text{ms} \times (42/500\text{ms} \times 32\text{s}) / 80 = 51.840\text{ms}$

3. **Channel 79: 2.4835GHz**

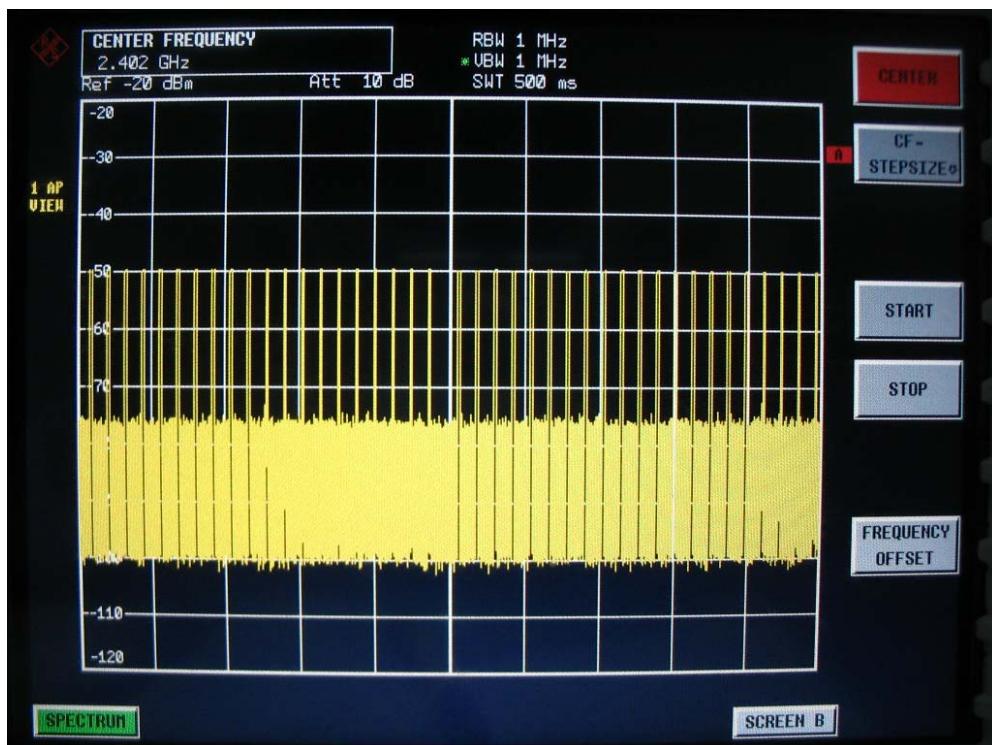
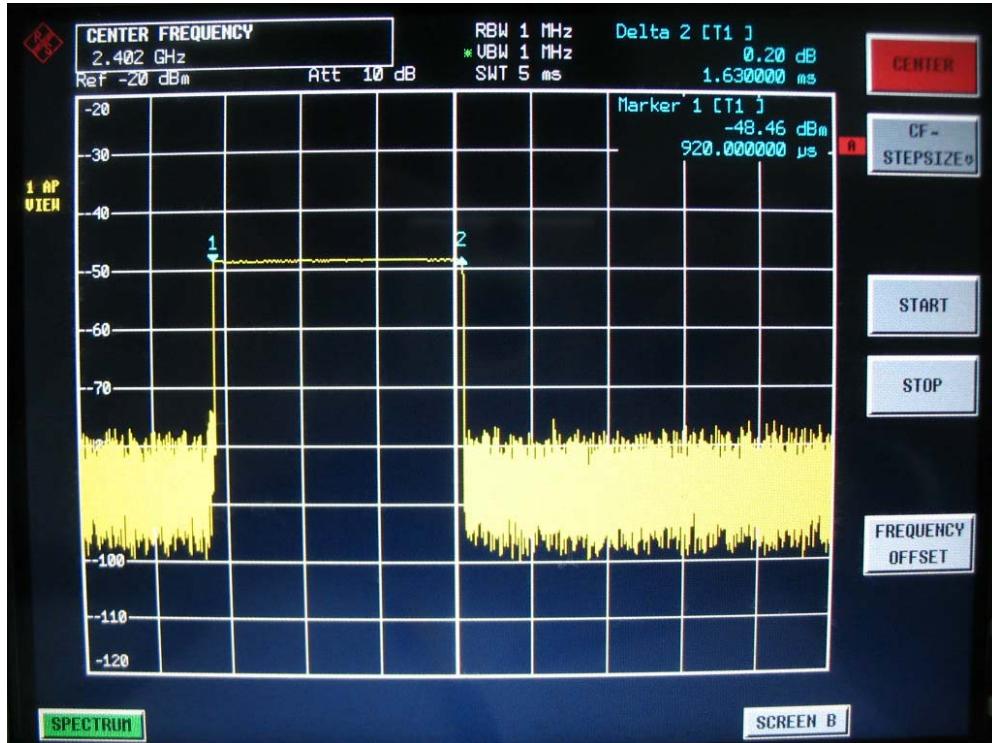
The Average Occupany time =  $1.600\text{ms} \times (42/500\text{ms} \times 32\text{s}) / 80 = 51.200\text{ms}$

The results are not be greater than 0.4 seconds.

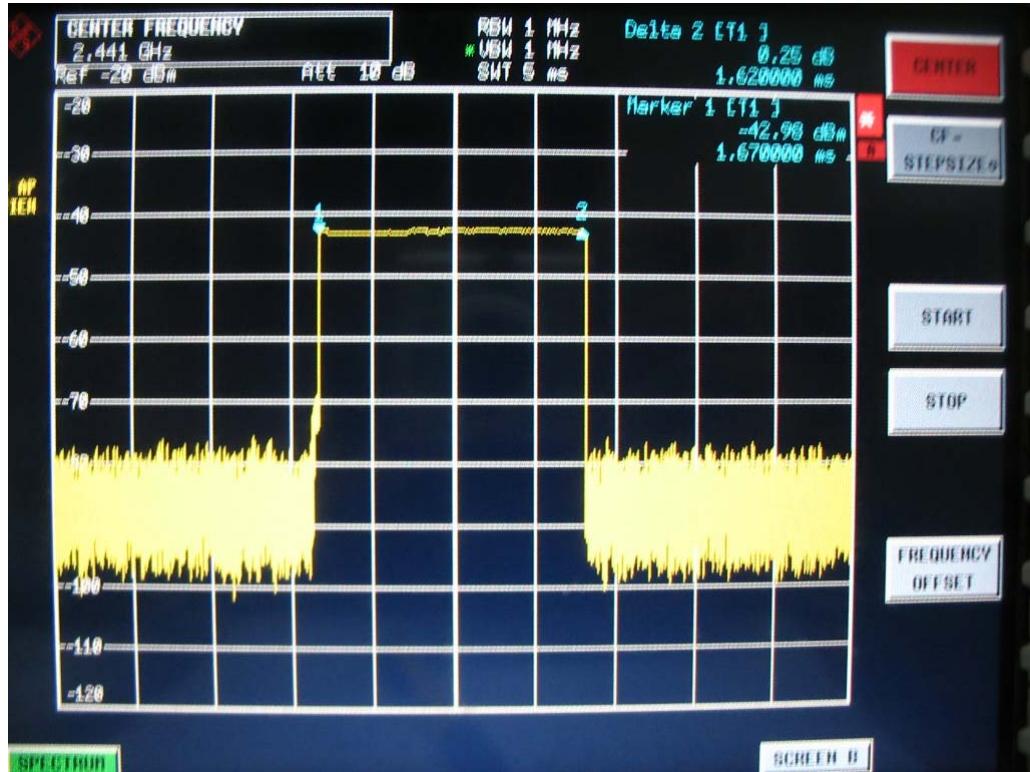
**The unit does meet the FCC requirements.**

The graph as below, represents the emissions take for this device.

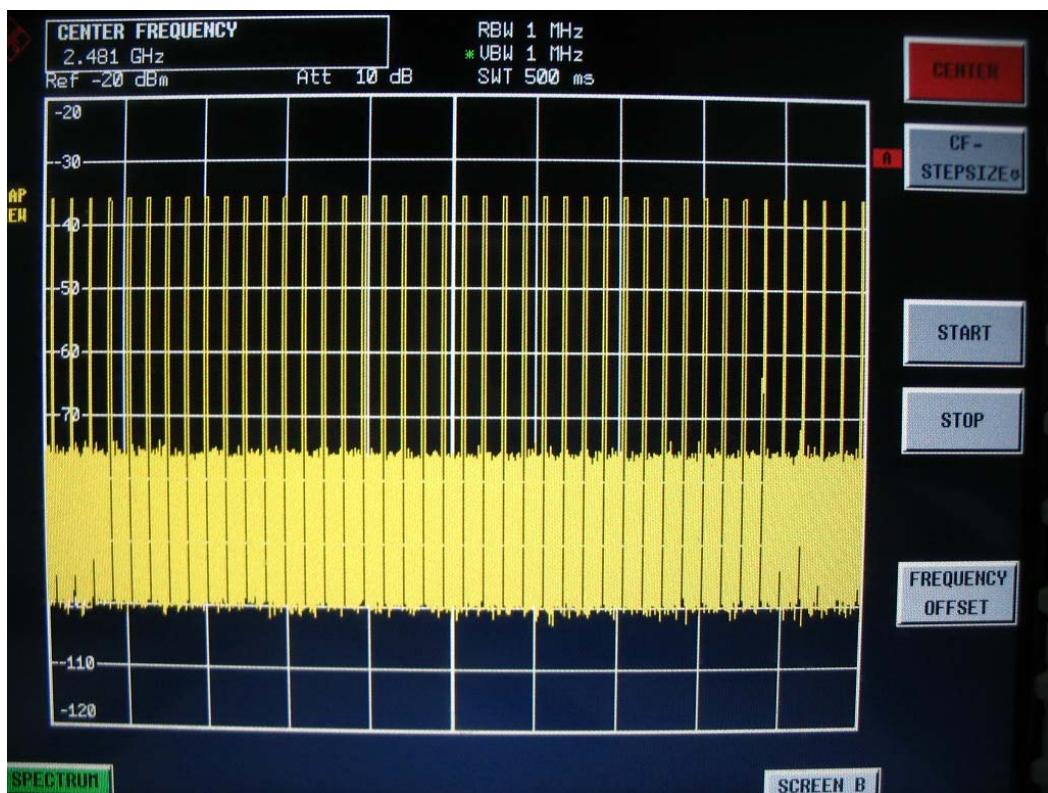
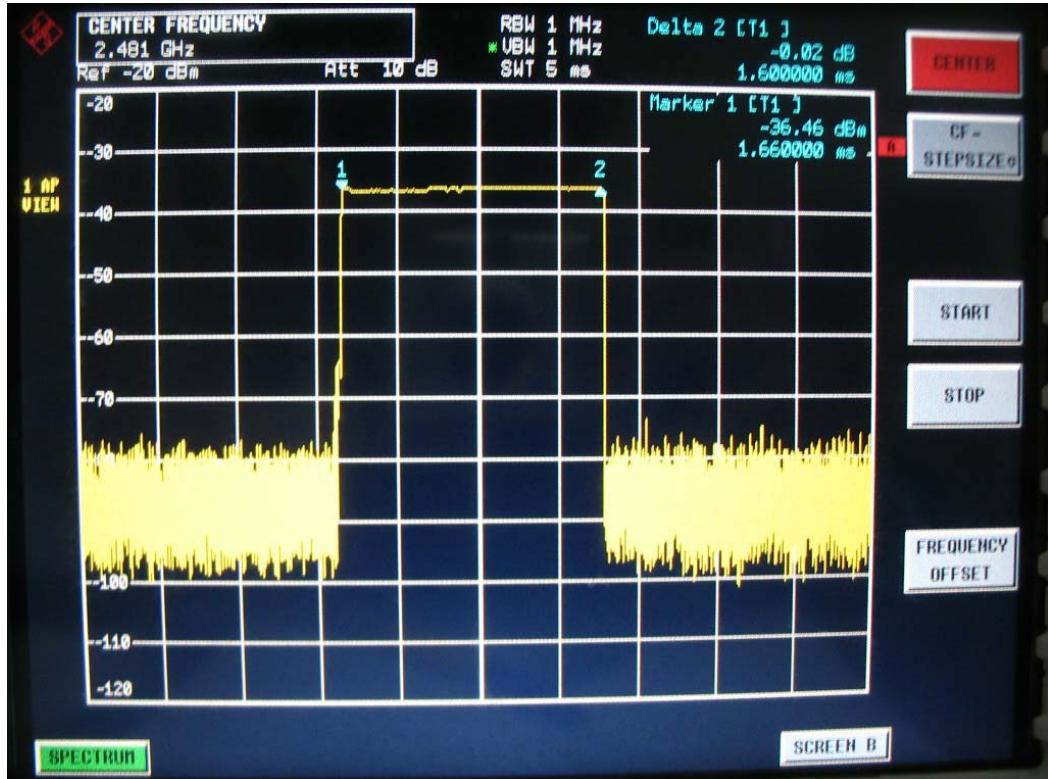
## Channel 0: 2.402GHz



### Channel 39: 2.441GHz



Channel 79: 2.481GHz



### 5.3.8 Power Spectral Density

|                   |  |
|-------------------|--|
| Test Requirement: | FCC Part15 C   |
| Test Method:      | Base on ANSI 63.4..  |
| Test Date:        | 28 February 2004   |
| Requirements:     | <b>Regulation 15.247 (d)</b> For direct sequence 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 . |

#### Test Procedures:

The tests below are running with the EUT transmitter set at high power mode. The EUT is needed to force selection of output power level and channel number. While testing, EUT was set to transmit continuously. A horn antenna was connected with the spectrum analyzer.

The EUT is tested in Chamber. Put EUT on the middle of a wooden table. Set spectrum analyzer RBW = 3 KHz, VBW > RBW (e.g. VBW = 10 KHz), Span = 2 MHz. Turn around the table to find maximum emission.

1. Then set the Span = 300 KHz and sweep time = 100 sec. Peak the maximum emission again. Record the test field strength.

2. Calculate the transmitter's peak power using the following equation:

$$\text{Power} = (E \times d)^2 / (30 \times G)$$

Where: E= the measured maximum field strength in V/m.

Set the RBW > 6dB bandwidth of the emission or use a peak power meter..

.G= the numeric gain of the transmitting antenna over an isotropic radiator.

.d= the distance in meters from which the field strength was measured.

.P= the power in watts is the final Maximum Peak Output Power .

The EUT was set transmitting continuously and force selection of output power level and channel number. We'd observed that the peak levels aren't greater than +8dBm limit.

#### Test Result:

| Test Channel | Fundamental Frequency (GHz) | RF POWER LEVEL IN 3 KHz BW Filed Strength (dBuV/m) | Gain (dBi) | RF POWER LEVEL IN 3 KHz BW (dBm) | MAXIMUM Limit (dBm) | PASS/ FAIL |
|--------------|-----------------------------|--|------------|----------------------------------|---------------------|------------|
| 0            | 2.402                       | 71.0   | -10        | -19.23                           | 8.0                 | Pass       |
| 39           | 2.441                       | 72.3   | -10        | -17.93                           | 8.0                 | Pass       |
| 79           | 2.481                       | 72.0   | -10        | -18.23                           | 8.0                 | Pass       |

**Remark:** The manufacturer for the antenna gain specification is -10 dBi ( if test in -10dB RF output power mode.)

**The EUT meets the requirements of this section.**