# TEST REPORT

**of**

FCC Part 15 Subpart B&C §15.247
FCC ID: SQMSQ-3000

| | | |
|---|---|---|
| Equipment Under Test | : | VoIP Phone |
| Model Name | : | SQ-3000 |
| Serial No. | : | N/A |
| Applicant | : | UniData Communication Systems, INC. |
| Manufacturer | : | UniData Communication Systems, INC. |
| Date of Test(s) | : | 2009-08-01 ~ 2009-08-17 |
| Date of Issue | : | 2009-08-19 |

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

**Tested By:** **Date** **2009-08-19**

**Geoffrey Do**

**Approved By** **Date** **2009-08-19**

**Charles Kim**

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# 1. General information

## 1.1. Testing laboratory

SGS Testing Korea Co., Ltd.
- Wireless Div. 2FL, 18-34, Sanbon-dong, Gunpo-si, Gyeonggi-do, Korea 435-040
- 705, Dongcheon-dong Suji-gu, Yongin-si, Gyeonggi-do, Korea.
www.electrolab.kr.sgs.com
Phone No. : +82 +31 428 5700
Fax No. : +82 +31 427 2371

## 1.2 Details of applicant

Applicant : UniData Communication System, INC.
Address : 3F, BuLim-Bldg, 837-6, Bangbae 4-dong, Seocho-gu, Seoul-si, Korea
Contact Person : Byeong-Gil Park
Phone No. : +82 +2 3443 3390
Fax No. : -

## 1.3 Description of EUT

| | |
|---|---|
| **Kind of Product** | VoIP Phone |
| **Model Name** | SQ-3000 |
| **Serial Number** | N/A |
| **Power Supply** | DC 3.7 V |
| **Frequency Range** | 2412 MHz ~ 2462 MHz (11a/g),<br>5745 MHz ~ 5825 MHz (11a)<br>5180 MHz ~ 5240 MHz (11a – Non DFS) |
| **Modulation Technique** | DSSS, OFDM |
| **Number of Channels** | 11 channel(11b/g), 5 channel(11a), 4 channel(11a – Non DFS) |
| **Operating Conditions** | -20 ~ 60℃ |
| **Antenna Type** | Fixed type |
| **Antenna Gain** | 2.85 dBi(11b/g), 1.78 dBi(11a), 1.85 dBi(11a – Non DFS) |

## 1.4. Description of test mode

IEEE 802.11 b mode:
We found out the test mode with the highest power level after we analyze all the data rates. So we choose 1 Mbps data rate (worst case) as a representative.

IEEE 802.11a/g mode:
We found out the test mode with the highest power level after we analyze all the data rates. So we choose 6 Mbps data rate (worst case) as a representative.

## 1.5. Test equipment list

| Equipment | Manufacturer | Model | Cal Due. |
|---|---|---|---|
| Signal Generator | R&S | SMR40 | Jan. 21, 2010 |
| Spectrum Analyzer | H.P | 8565E | Oct. 01, 2009 |
| Spectrum Analyzer | Agilent | E4440A | Apr. 01, 2010 |
| Spectrum Analyzer | R&S | FSP40 | Oct. 01, 2009 |
| High Pass Filter | Wainwright Instrument GmbH | WHK3.0/18G-11SS | Oct. 01, 2009 |
| High Pass Filter | Wainwright Instrument GmbH | WHK6.0/18G-11SS | Oct. 01, 2009 |
| Attenuator | Agilent | 8494B | Apr. 01, 2010 |
| DC Power Supply | Agilent | 6674A | Apr. 02, 2010 |
| Two-Lie V-network | R & S | ENV326 | Jan. 01. 2010 |
| Test Receiver | R & S | ESS | Jul. 03, 2010 |
| Test Receiver | R & S | ESU26 | Apr. 21, 2010 |
| Preamplifier | H.P | 8447F | Jul. 02, 2010 |
| Preamplifier | H.P | 8449B | Apr. 01, 2010 |
| Bilog Antenna | VULB9163 | SCHWARZBECK MESSELEKTRONIK | Jul. 22. 2010 |
| Horn Antenna | Electro-Metrics | RGA-60 | Jun. 16, 2010 |
| Horn Antenna | R&S | HF906 | Oct. 09, 2009 |
| Anechoic Chamber | SY Corporation | L x W x H (6.5 m x 3.5 m x 3.5 m) | N.C.R. |
| Anechoic Chamber | SY Corporation | L x W x H (9.6 m x 6.4 m x 6.6 m) | Jan. 31, 2010 |

### ▶ Support equipment

| Description | Manufacturer | Model | Serial Number |
|---|---|---|---|
| Notebook Computer | Sony Corporation | PCG-3AHP | 28272287 7000053 |
| Wireless Router | D-Link System | DIR-655 | F3R3291000460 |

## 1.6. Summary of test result

The EUT has been tested according to the following specifications:

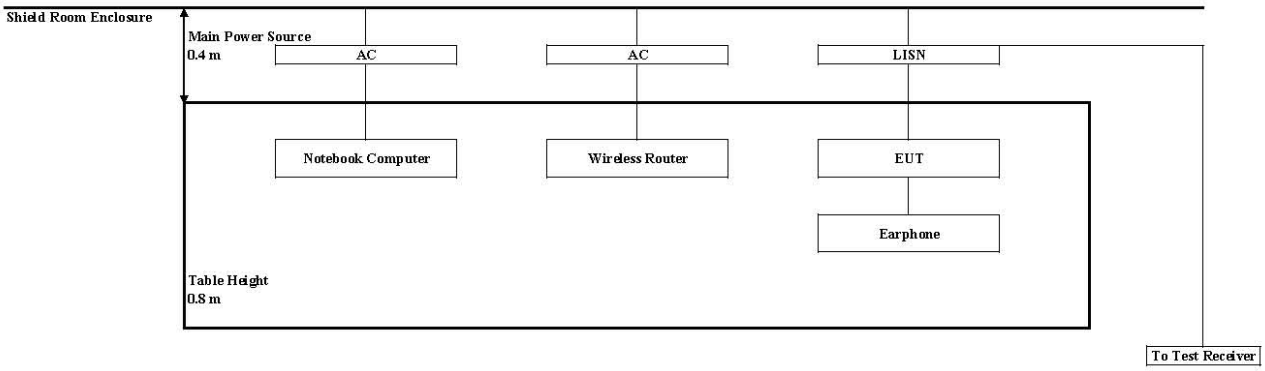
| Applied standard : FCC Part15 subpart B&C | | |
|---|---|---|
| **Standard section** | **Test Item** | **Result** |
| 15.207 | Transmitter AC power line conducted emission | Complied |
| 15.205(a)<br>15.209(a)<br>15.247(d) | Transmitter radiated spurious emissions and Conducted spurious emission | Complied |
| 15.247(a)(2) | 6 dB Bandwidth and 99 % BW | Complied |
| 15.247(b)(3) | Maximum peak output power | Complied |
| 15.247(e) | Power spectral density | Complied |

## 1.7. Test report revision

| Revision | Report number | Description |
|---|---|---|
| 0 | F690501/RF-RTL003286 | Initial |

# 2. Transmitter AC power line conducted emission

## 2.1. Test setup




## 2.2. Limit

According to §15.207(a) for an intentional radiator 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 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 uH/50 ohm line impedance stabilization network(LISN).
Compliance with the provision of this paragraph shall on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower applies at the boundary between the frequency ranges.

| Frequency of Emission (MHz) | Conducted limit (dBμV) | |
|---|---|---|
| | Quasi-peak | Average |
| 0.15 – 0.50 | 66-56* | 56-46* |
| 0.50 – 5.00 | 56 | 46 |
| 5.00 – 30.0 | 60 | 50 |

▣ *Decreases with the logarithm of the frequency.*

## 2.3. Test procedures

Radiated emissions from the EUT were measured according to the dictates of ANSI C63.4:2003

1. The test procedure is performed in a 6.5 m × 3.6 m× 3.6 m (L×W×H) shielded room. The EUT along with its peripherals were placed on a 1.0 m(W)× 1.5 m(L) and 0.8 m in height wooden table and the EUT was adjusted to maintain a 0.4 meter space from a vertical reference plane.
2. The EUT was connected to power mains through a line impedance stabilization network (LISN) which provides 50 ohm coupling impedance for measuring instrument and the chassis ground was bounded to the horizontal ground plane of shielded room.
3. All peripherals were connected to the second LISN and the chassis ground also bounded to the horizontal ground plane of shielded room.
4. The excess power cable between the EUT and the LISN was bundled. The power cables of peripherals were unbundled. All connecting cables of EUT and peripherals were moved to find the maximum emission.

## 2.4. Test result (Worst case configuration_IEEE 802.11b)

The following table shows the highest levels of conducted emissions on both phase of Hot and Neutral line.

Ambient temperature : 23 ℃
Relative humidity : 47 % R.H.

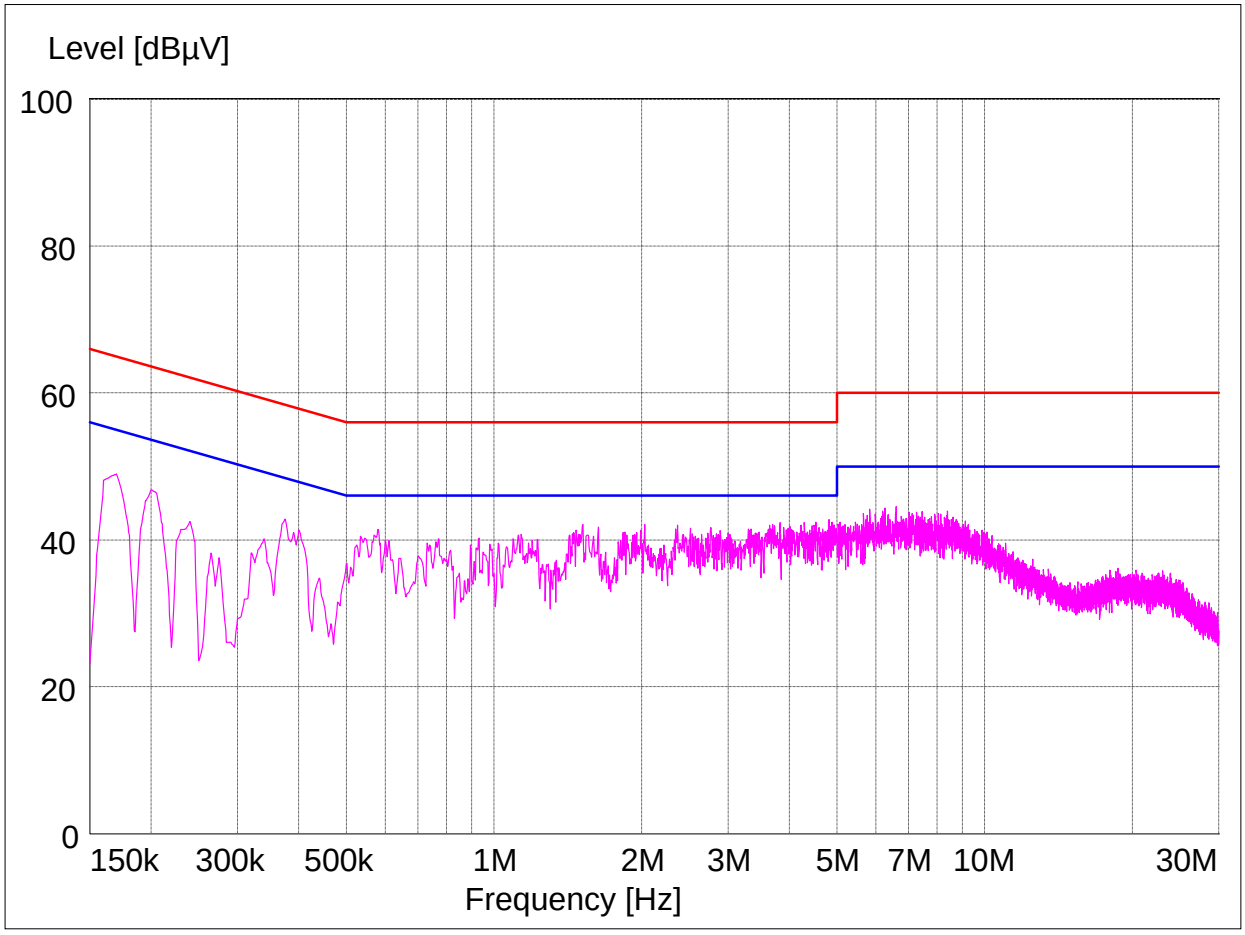
Frequency range : 0.15 MHz – 30 MHz
Measured Bandwidth : 9 kHz

| Freq. | Level (dBuV) | | Line | Limit (dBuV) | | Margin (dB) | |
|---|---|---|---|---|---|---|---|
| (MHz) | Q-Peak | Average | | Q-Peak | Average | Q-Peak | Average |
| 0.17 | 42.80 | 28.70 | H | 64.96 | 54.96 | 22.16 | 26.26 |
| 0.37 | 40.90 | 28.80 | H | 58.50 | 48.50 | 17.60 | 19.70 |
| 0.57 | 39.20 | 28.00 | H | 56.00 | 46.00 | 16.80 | 18.00 |
| 0.78 | 36.30 | 22.40 | H | 56.00 | 46.00 | 19.70 | 23.60 |
| 7.05 | 36.30 | 29.20 | H | 60.00 | 50.00 | 23.70 | 20.80 |
| 8.83 | 35.30 | 28.90 | H | 60.00 | 50.00 | 24.70 | 21.10 |
| 0.17 | 44.10 | 30.10 | N | 64.96 | 54.96 | 20.86 | 24.86 |
| 0.37 | 39.70 | 30.10 | N | 58.50 | 48.50 | 18.80 | 18.40 |
| 2.03 | 36.60 | 27.80 | N | 56.00 | 46.00 | 19.40 | 18.20 |
| 4.81 | 36.50 | 29.00 | N | 56.00 | 46.00 | 19.50 | 17.00 |
| 6.61 | 38.10 | 30.80 | N | 60.00 | 50.00 | 21.90 | 19.20 |
| 8.40 | 37.10 | 30.50 | N | 60.00 | 50.00 | 22.90 | 19.50 |

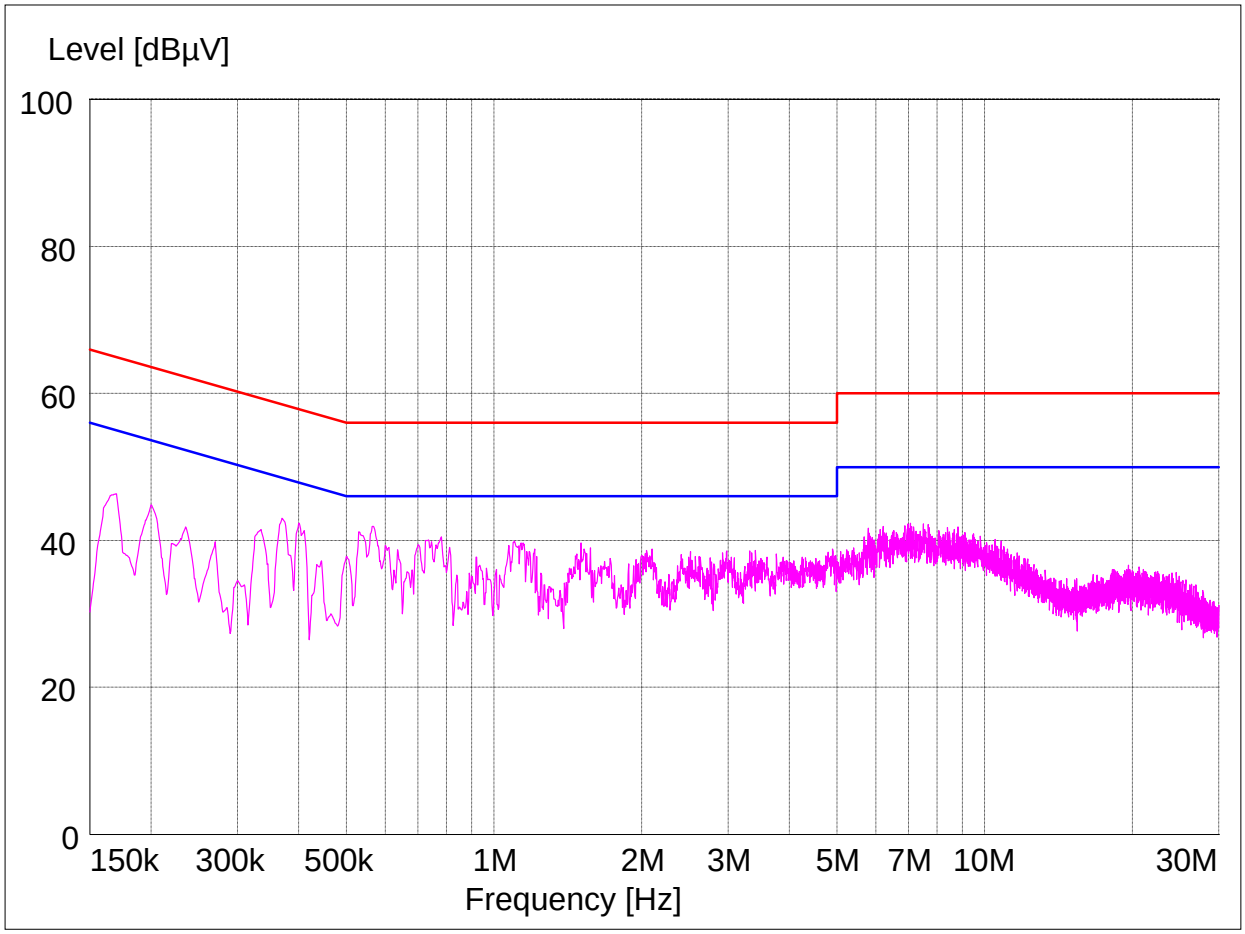
▣ Note
Line ( H ) : Hot
Line ( N ) : Neutral

**Plot of conducted power line**

Test mode: (Hot)



Test mode: (Neutral)

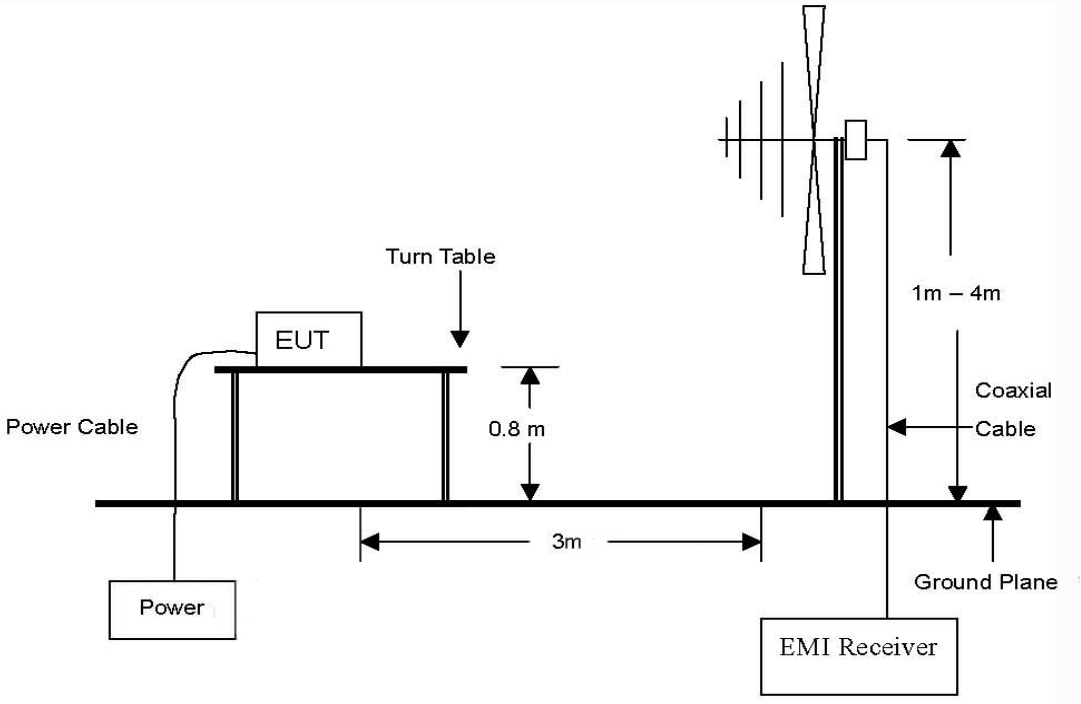


# 3. Transmitter radiated spurious emissions and conducted spurious emission

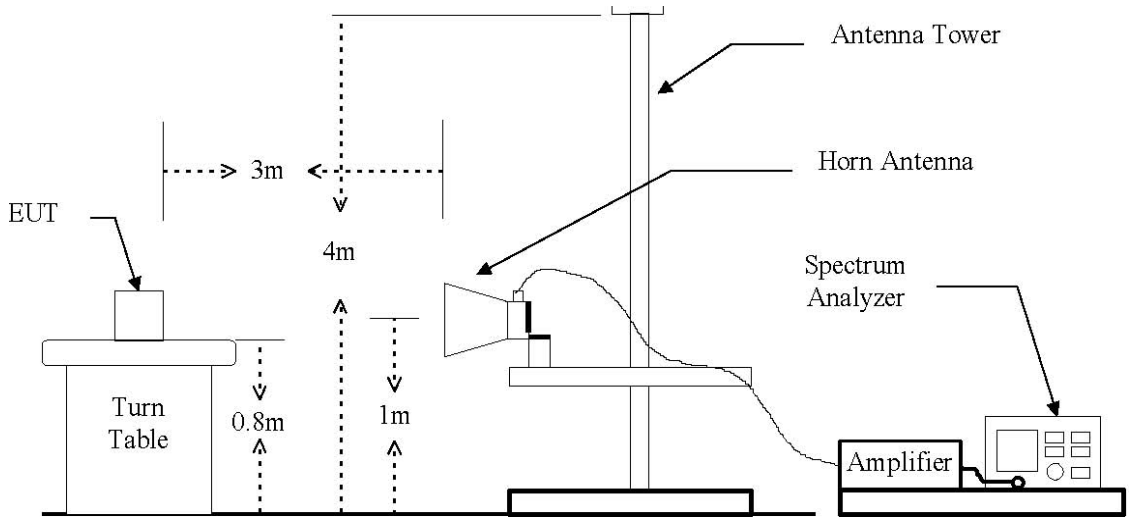
## 3.1. Test setup

### 3.1.1. Transmitter radiated spurious emissions

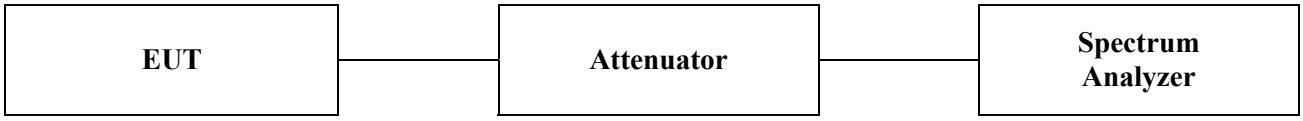
The diagram below shows the test setup that is utilized to make the measurements for emission from 30 MHz to 1 GHz Emissions.




The diagram below shows the test setup that is utilized to make the measurements for emission from 1 GHz to 24 GHz Emissions.



### 3.1.2. Conducted spurious emissions




## 3.2. Limit

According to §15.247(d), 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 , provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval , as permitted under paragraph(b)(3) of this section , the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in section §15.209(a) is not required. In addition, radiated emission which in the restricted band, as define in section §15.205(a), must also comply the radiated emission limits specified in section §15.209(a) (see section §15.205(c))
According to § 15.109(a), for an intentional radiator devices, the general required of field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values：

| Frequency (MHz) | Distance (Meters) | Radiated (dBμV/m) | Radiated (μV/m) |
|---|---|---|---|
| 30 - 88 | 3 | 40.0 | 100 |
| 88 – 216 | 3 | 43.5 | 150 |
| 216 – 960 | 3 | 46.0 | 200 |
| Above 960 | 3 | 54.0 | 500 |

## 3.3. Test procedures

Radiated emissions from the EUT were measured according to the dictates of ANSI C63.4:2003

### 3.3.1. Test procedures for radiated spurious emissions

1. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter anechoic chamber test site. The table was rotated 360 degrees to determine the position of the highest radiation.
2. During performing radiated emission below 1 GHz, the EUT was set 3 meters away from the interference receiving antenna, which was mounted on the top of a variable-height antenna tower. During performing radiated emission above 1 GHz, the EUT was set 3 meter away from the interference-receiving antenna.
3. The antenna is a broadband antenna, and its height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
4. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the table was turned from 0 degrees to 360 degrees to find the maximum reading.
5. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
6. If the emission level of the EUT in peak mode was 10 dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10 dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

▣ *Note*

1. *The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Peak detection (PK) or Quasi-peak detection (QP) at frequency below 1 GHz.*
2. *The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 1MHz for Peak detection and frequency above 1 GHz.*
3. *The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 10 Hz for Average detection (AV) at frequency above 1 GHz.*

### 3.3.2. Test procedures for conducted spurious emissions

1. The transmitter output was connected to the spectrum analyzer through an attenuator.
2. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using RBW=100 kHz, VBW=100 kHz.

### 3.4.1. Test result

Ambient temperature : 23 ℃
Relative humidity : 48 % R.H.

### 3.4.4.1. Spurious radiated emission for below 1GHz (Worst case configuration_ IEEE 802.11b)

The frequency spectrum from 30 MHz to 1000 MHz was investigated. All emissions are not reported much lower than the prescribed limits. All reading values are quasi-peak values.

| Radiated emissions | | | Ant | Correction factors | | Total | Limit | |
|---|---|---|---|---|---|---|---|---|
| Frequency (MHz) | Reading (dBuV) | Detect mode | Pol. | AF (dB/m) | Amp gain+CL (dB) | Actual (dBuV/m) | Limit (dBuV/m) | Margin (dB) |
| 398.923 | 36.60 | Q.P. | H | 15.60 | -26.13 | 26.07 | 46.00 | 19.93 |
| 664.986 | 35.40 | Q.P. | H | 19.61 | -26.28 | 28.73 | 46.00 | 17.27 |
| 764.815 | 33.50 | Q.P. | H | 20.92 | -25.88 | 28.54 | 46.00 | 17.46 |
| 797.998 | 38.60 | Q.P. | H | 21.06 | -25.70 | 33.96 | 46.00 | 12.04 |
| Above 800.00 | Not Detected | | | | | | | |

▣ *Remark:*

1. *Measuring frequencies from 30 MHz to the 1 GHz.*
2. *All spurious emission at low, middle and high channel are almost the same below 1 GHz, so the spurious emission test result of the low channel was chosen as representative in finial test.*
3. *Radiated emissions measured in frequency range from 30 MHz to 1000 MHz were made an instrument Using peak/quasi-peak detector mode.*
4. *Quasi-peak test would be performed if the peak result were greater than the quasi-peak limit or as required by the applicant.*
5. *To get a maximum emission level from the EUT, the EUT was moved throughout the XY, XZ and YZ planes. The worst case is XZ.*

### 3.4.4.2. Spurious radiated emission for above 1 GHz

**IEEE 802.11b**

A. Low Channel (2412 MHz)

| Radiated Emissions | | | Ant | Correction Factors | | Total | Limit | |
|---|---|---|---|---|---|---|---|---|
| Frequency (MHz) | Reading (dBuV) | Detect Mode | Pol. | AF (dB/m) | Amp Gain+CL (dB) | Actual (dBuV/m) | Limit (dBuV/m) | Margin (dB) |
| 2390.00* | 50.60 | P | H | 28.05 | -30.41 | 48.24 | 74.00 | 25.76 |
| 2390.00* | 39.00 | Av | H | 28.05 | -30.41 | 36.64 | 54.00 | 17.36 |
| 2390.00* | 49.50 | P | V | 28.05 | -30.41 | 47.14 | 74.00 | 26.86 |
| 2390.00* | 37.10 | Av | V | 28.05 | -30.41 | 34.74 | 54.00 | 19.26 |
| Above 2400.00 | Not Detected | | | | | | | |

B. Middle Channel (2437 MHz)

| Radiated Emissions | | | Ant | Correction Factors | | Total | Limit | |
|---|---|---|---|---|---|---|---|---|
| Frequency (MHz) | Reading (dBuV) | Detect Mode | Pol. | AF (dB/m) | Amp Gain+CL (dB) | Actual (dBuV/m) | Limit (dBuV/m) | Margin (dB) |
| Above 1000.00 | Not Detected | | | | | | | |

C. High Channel (2462 MHz)

| Radiated Emissions | | | Ant | Correction Factors | | Total | Limit | |
|---|---|---|---|---|---|---|---|---|
| Frequency (MHz) | Reading (dBuV) | Detect Mode | Pol. | AF (dB/m) | Amp Gain+CL (dB) | Actual (dBuV/m) | Limit (dBuV/m) | Margin (dB) |
| 2483.50* | 48.30 | P | H | 28.18 | -30.58 | 45.90 | 74.00 | 28.10 |
| 2483.50* | 34.90 | Av | H | 28.18 | -30.58 | 32.50 | 54.00 | 21.50 |
| 2483.50* | 47.60 | P | V | 28.18 | -30.58 | 45.20 | 74.00 | 28.80 |
| 2483.50* | 34.40 | Av | V | 28.18 | -30.58 | 32.00 | 54.00 | 22.00 |
| Above 2500.00 | Not Detected | | | | | | | |

▣ *Remarks*

1. *"*" means the restricted band.*
2. *Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental Frequency.*
3. *Radiated emissions measured in frequency above 1000 MHz were made with an instrument using peak/average detector mode.*
4. *Average test would be performed if the peak result were greater than the average limit.*
5. *To get a maximum emission level from the EUT, the EUT was moved throughout the XY, XZ and YZ planes. The worst case is XZ.*

**IEEE 802.11g**

A. Low Channel (2412 MHz)

| Radiated Emissions | | | Ant | Correction Factors | | Total | Limit | |
|---|---|---|---|---|---|---|---|---|
| Frequency (MHz) | Reading (dBuV) | Detect Mode | Pol. | AF (dB/m) | Amp Gain+CL (dB) | Actual (dBuV/m) | Limit (dBuV/m) | Margin (dB) |
| 2390.00* | 64.40 | P | H | 28.05 | -30.41 | 62.04 | 74.00 | 11.96 |
| 2390.00* | 47.70 | Av | H | 28.05 | -30.41 | 45.34 | 54.00 | 8.66 |
| 2390.00* | 61.50 | P | V | 28.05 | -30.41 | 59.14 | 74.00 | 14.86 |
| 2390.00* | 45.10 | Av | V | 28.05 | -30.41 | 42.74 | 54.00 | 11.26 |
| Above 2400.00 | Not Detected | | | | | | | |

B. Middle Channel (2437 MHz)

| Radiated Emissions | | | Ant | Correction Factors | | Total | Limit | |
|---|---|---|---|---|---|---|---|---|
| Frequency (MHz) | Reading (dBuV) | Detect Mode | Pol. | AF (dB/m) | Amp Gain+CL (dB) | Actual (dBuV/m) | Limit (dBuV/m) | Margin (dB) |
| Above 1000.00 | Not Detected | | | | | | | |

C. High Channel (2462 MHz)

| Radiated Emissions | | | Ant | Correction Factors | | Total | Limit | |
|---|---|---|---|---|---|---|---|---|
| Frequency (MHz) | Reading (dBuV) | Detect Mode | Pol. | AF (dB/m) | Amp Gain+CL (dB) | Actual (dBuV/m) | Limit (dBuV/m) | Margin (dB) |
| 2483.50* | 57.80 | P | H | 28.18 | -30.58 | 55.40 | 74.00 | 18.60 |
| 2483.50* | 42.20 | Av | H | 28.18 | -30.58 | 39.80 | 54.00 | 14.20 |
| 2483.50* | 58.20 | P | V | 28.18 | -30.58 | 55.80 | 74.00 | 18.20 |
| 2483.50* | 42.20 | Av | V | 28.18 | -30.58 | 39.80 | 54.00 | 14.20 |
| Above 2500.00 | Not Detected | | | | | | | |

◙ *Remarks*

1. *"*" means the restricted band.*
2. *Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental Frequency.*
3. *Radiated emissions measured in frequency above 1000 MHz were made with an instrument using peak/average detector mode.*
4. *Average test would be performed if the peak result were greater than the average limit.*
5. *To get a maximum emission level from the EUT, the EUT was moved throughout the XY, XZ and YZ planes. The worst case is XZ.*

**IEEE 802.11a**

A. Low Channel (5745 MHz)

| Radiated Emissions | | | Ant | Correction Factors | | Total | Limit | |
|---|---|---|---|---|---|---|---|---|
| Frequency (MHz) | Reading (dBuV) | Detect Mode | Pol. | AF (dB/m) | CL (dB) | Actual (dBuV/m) | Limit (dBuV/m) | Margin (dB) |
| 5745.00* | 67.52 | P | H | 34.29 | 7.82 | 109.63 | - | - |
| 5745.00* | 54.52 | Av | H | 34.29 | 7.82 | 96.63 | - | - |
| 5745.00* | 69.37 | P | V | 34.29 | 7.82 | 111.48 | - | - |
| 5745.00* | 56.60 | Av | V | 34.29 | 7.82 | 98.71 | - | - |
| **Frequency (MHz)** | **Reading (dBuV)** | **Detect Mode** | **Pol.** | **AF (dB/m)** | **Amp Gain+CL (dB)** | **Actual (dBuV/m)** | **Limit (dBuV/m)** | **Margin (dB)** |
| Above 1000.00 | Not Detected | | | | | | | |

B. Middle Channel (5785 MHz)

| Radiated Emissions | | | Ant | Correction Factors | | Total | Limit | |
|---|---|---|---|---|---|---|---|---|
| Frequency (MHz) | Reading (dBuV) | Detect Mode | Pol. | AF (dB/m) | CL (dB) | Actual (dBuV/m) | Limit (dBuV/m) | Margin (dB) |
| 5785.00* | 65.85 | P | H | 34.34 | 7.92 | 108.11 | - | - |
| 5785.00* | 53.79 | Av | H | 34.34 | 7.92 | 96.05 | - | - |
| 5785.00* | 70.52 | P | V | 34.34 | 7.92 | 112.78 | - | - |
| 5785.00* | 58.01 | Av | V | 34.34 | 7.92 | 100.27 | - | - |
| **Frequency (MHz)** | **Reading (dBuV)** | **Detect Mode** | **Pol.** | **AF (dB/m)** | **Amp Gain+CL (dB)** | **Actual (dBuV/m)** | **Limit (dBuV/m)** | **Margin (dB)** |
| Above 1000.00 | Not Detected | | | | | | | |

C. High Channel (5825 MHz)

| Radiated Emissions | | | Ant | Correction Factors | | Total | Limit | |
|---|---|---|---|---|---|---|---|---|
| Frequency (MHz) | Reading (dBuV) | Detect Mode | Pol. | AF (dB/m) | Amp Gain+CL (dB) | Actual (dBuV/m) | Limit (dBuV/m) | Margin (dB) |
| 5825.00* | 65.17 | P | H | 34.39 | 8.04 | 107.60 | - | - |
| 5825.00* | 52.61 | Av | H | 34.39 | 8.04 | 95.04 | - | - |
| 5825.00* | 69.80 | P | V | 34.39 | 8.04 | 112.23 | - | - |
| 5825.00* | 57.91 | Av | V | 34.39 | 8.04 | 100.34 | - | - |
| **Frequency (MHz)** | **Reading (dBuV)** | **Detect Mode** | **Pol.** | **AF (dB/m)** | **Amp Gain+CL (dB)** | **Actual (dBuV/m)** | **Limit (dBuV/m)** | **Margin (dB)** |
| Above 1000.00 | Not Detected | | | | | | | |

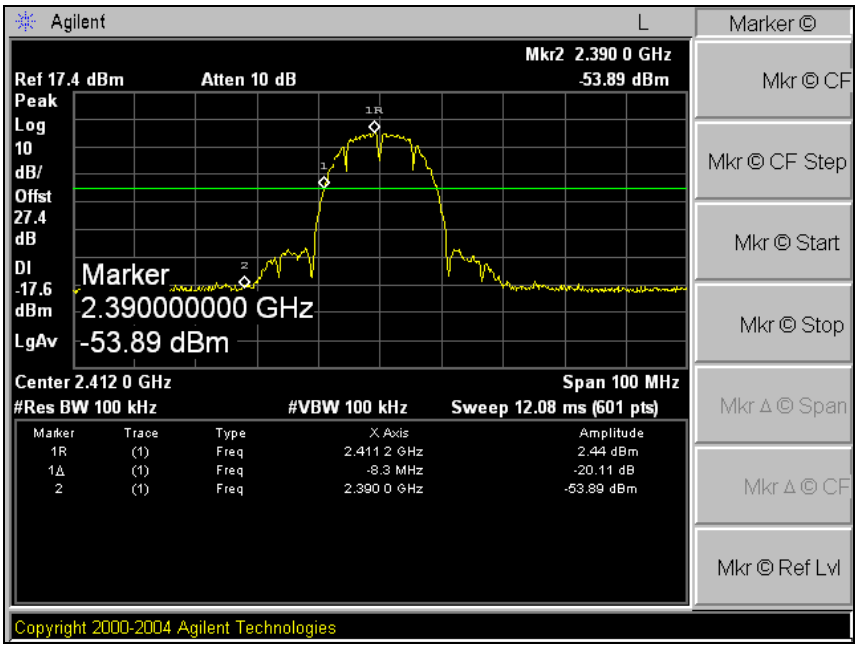
▣ *Remarks*

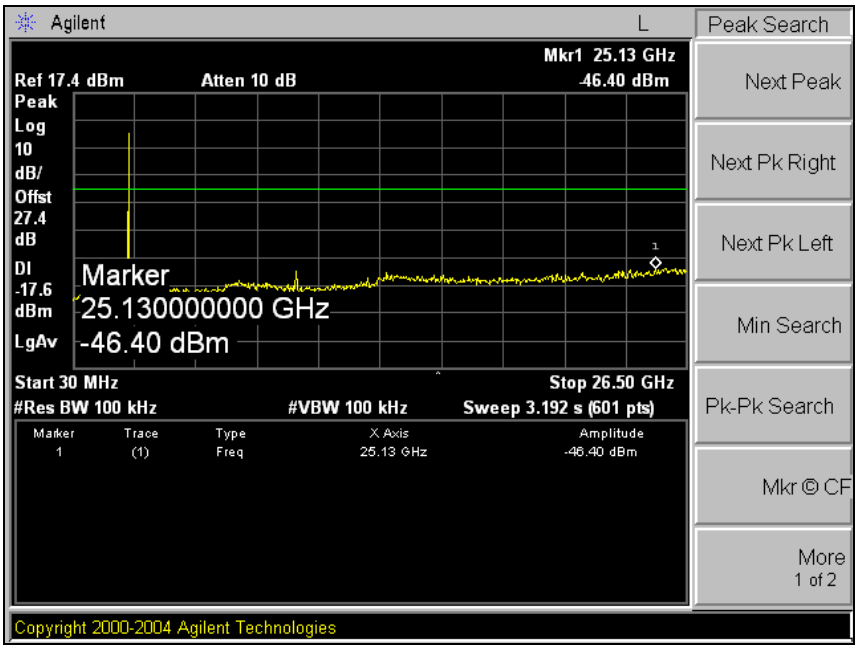
1. *"*" means fundamental frequency.*
2. *Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental Frequency.*
3. *Radiated emissions measured in frequency above 1000 MHz were made with an instrument using peak/average detector mode.*
4. *Average test would be performed if the peak result were greater than the average limit.*
5. *To get a maximum emission level from the EUT, the EUT was moved throughout the XY, XZ and YZ planes. The worst case is XZ.*

### 3.4.3. Spurious RF Conducted Emissions: Plot of Spurious RF Conducted Emission

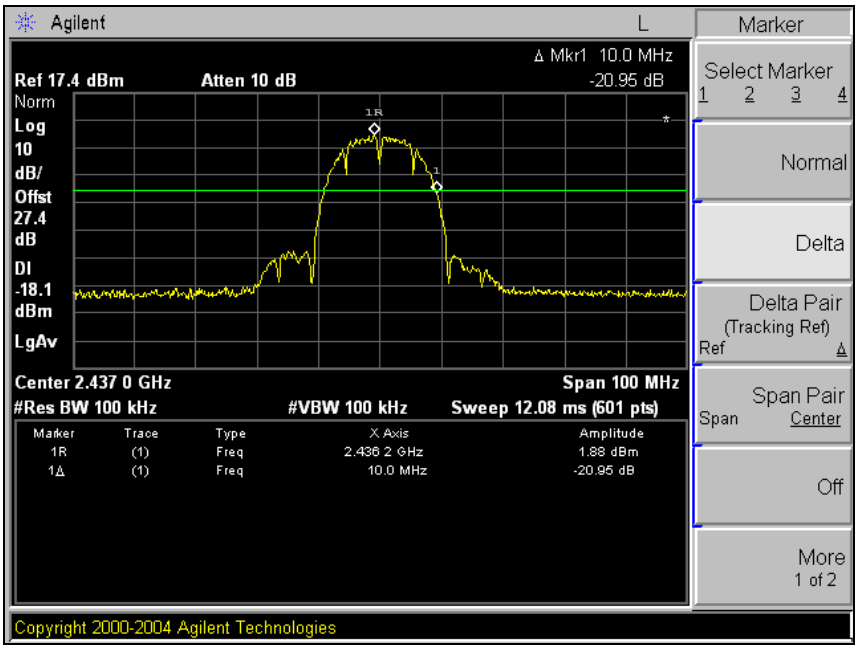
**IEEE 802.11b**

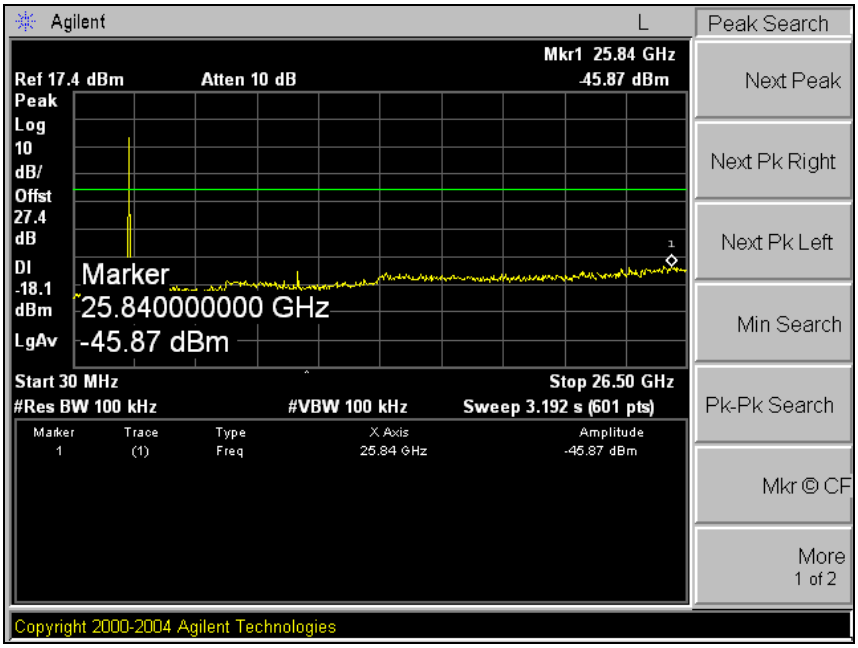
Low Channel



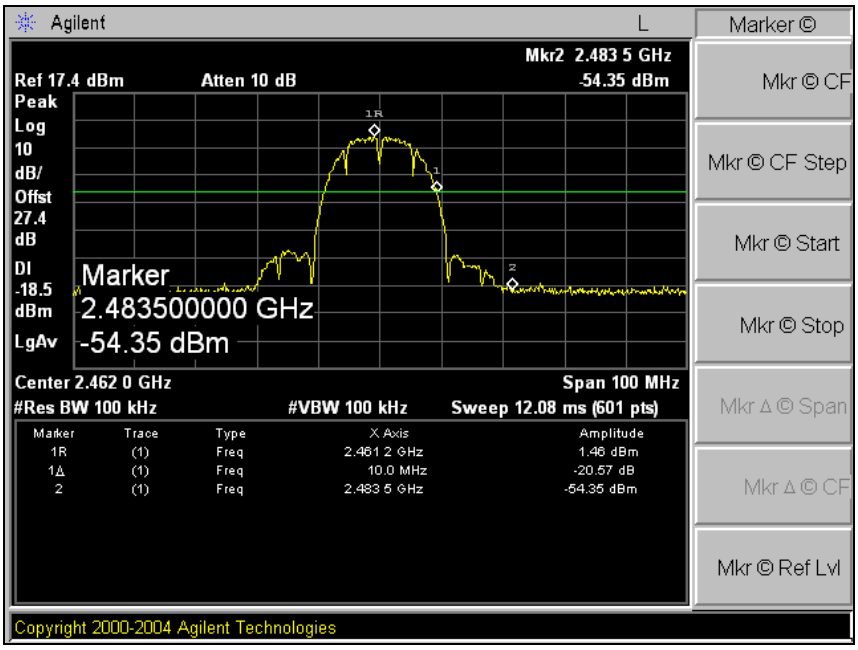



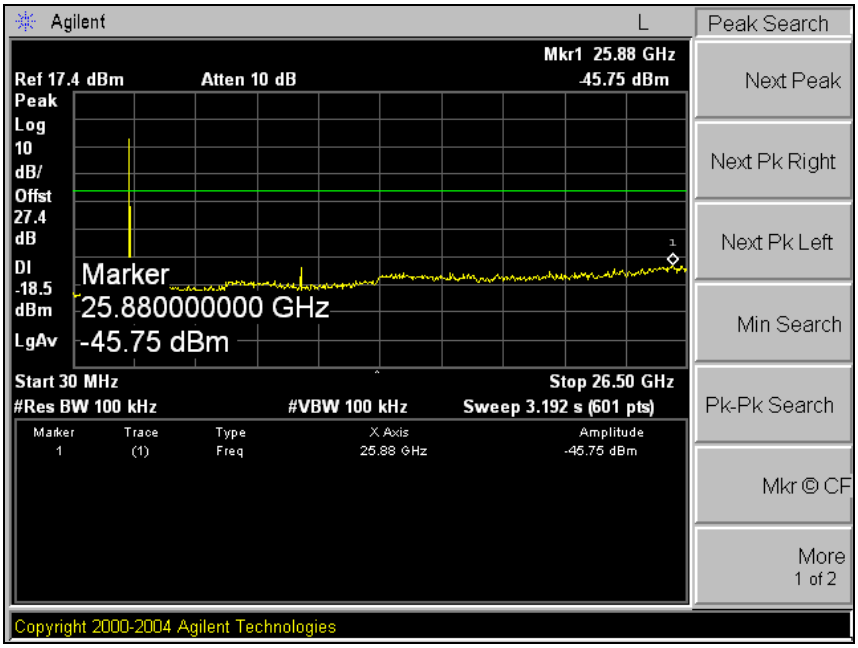
Middle Channel



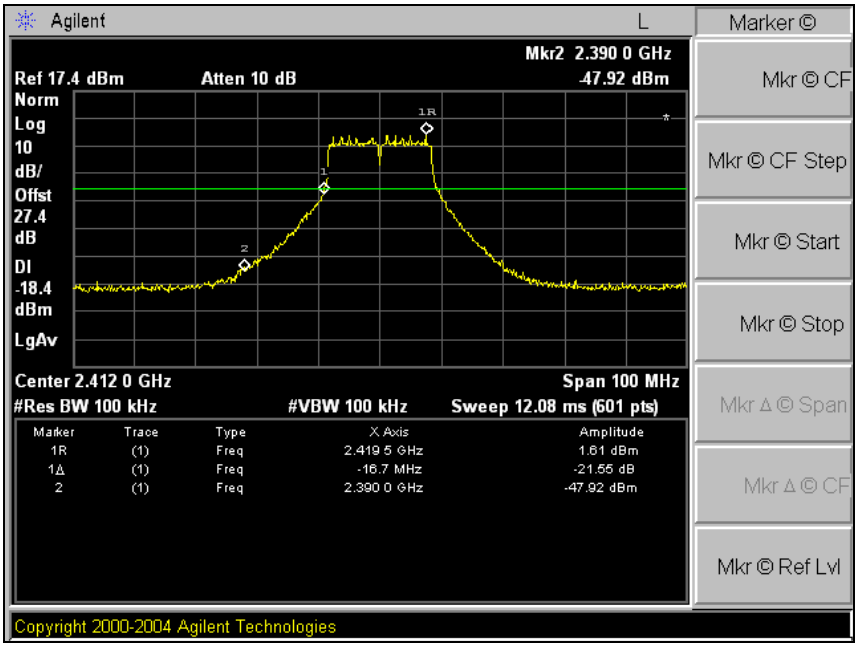
High Channel

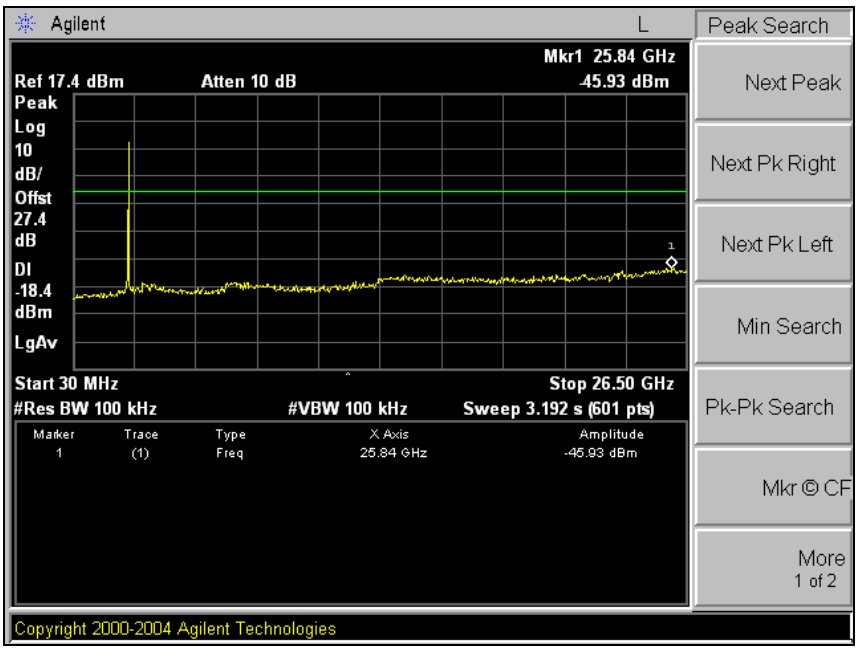


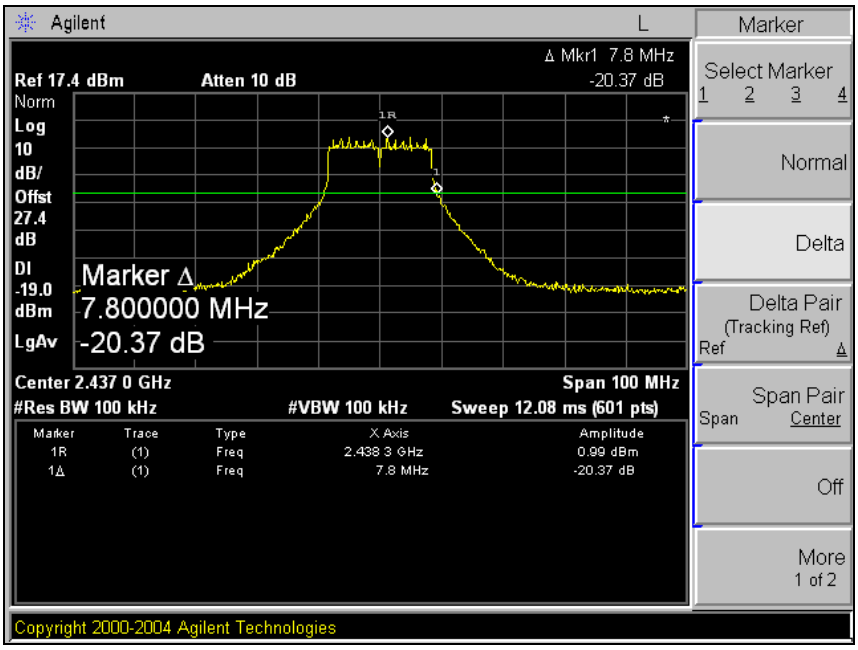
**IEEE 802.11g**

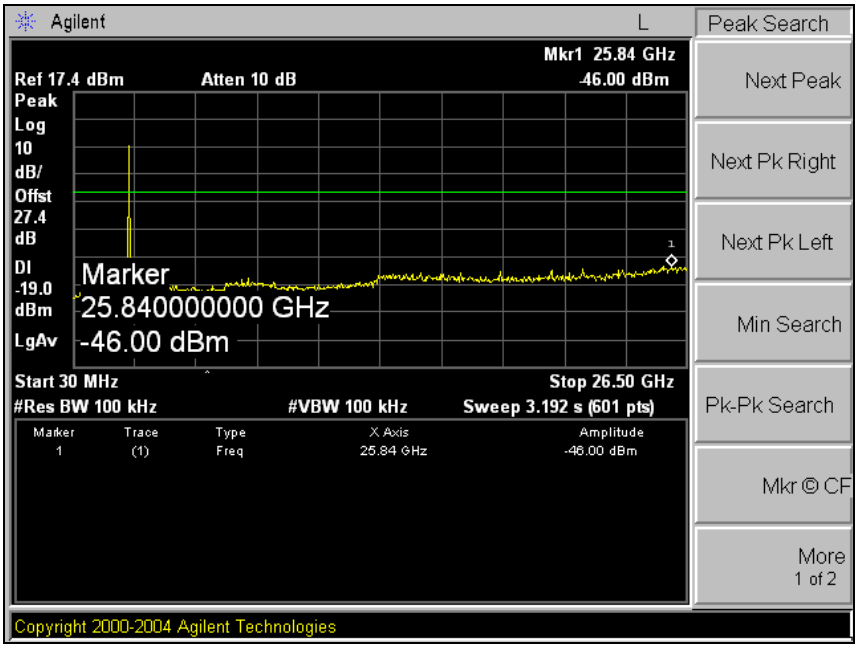
Low Channel



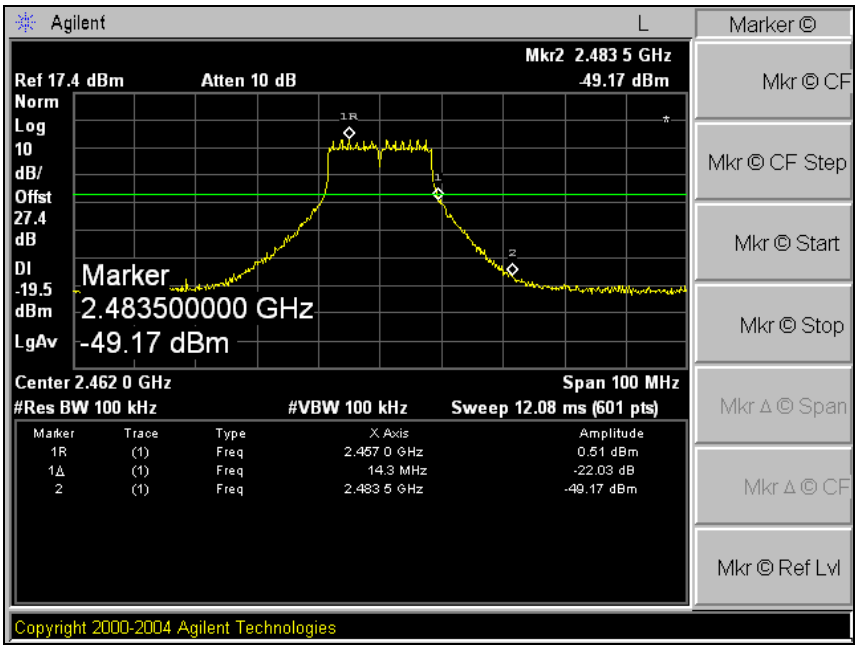



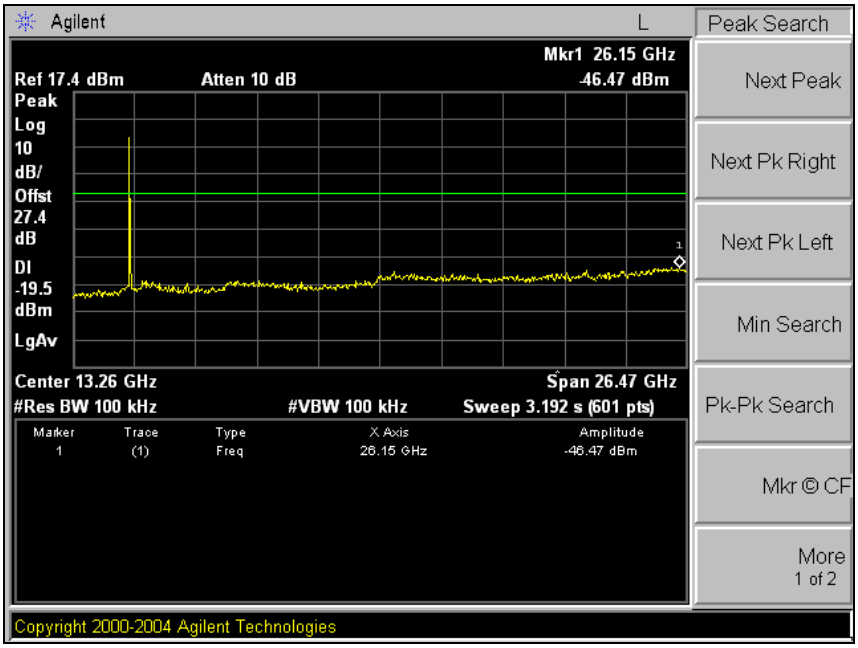
Middle Channel



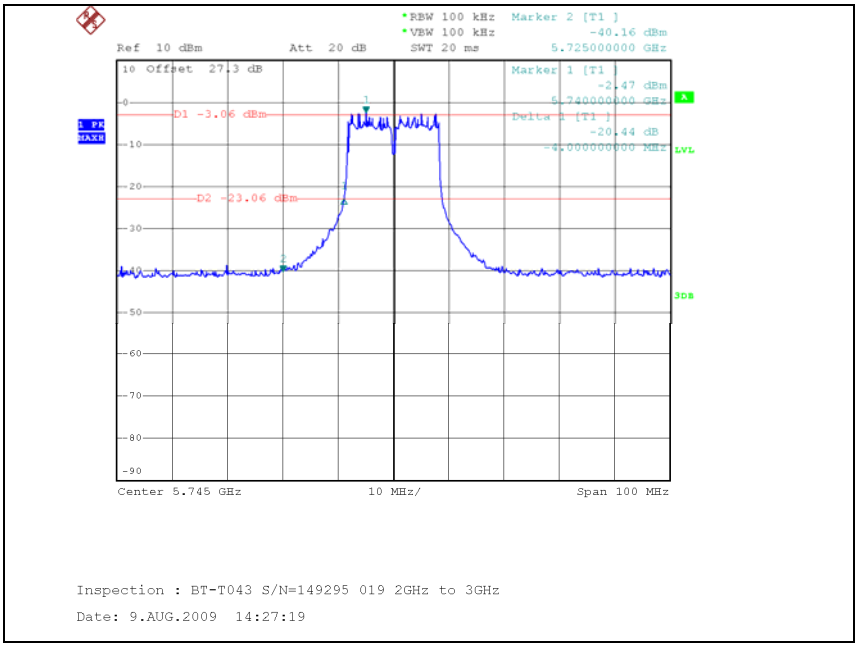
High Channel

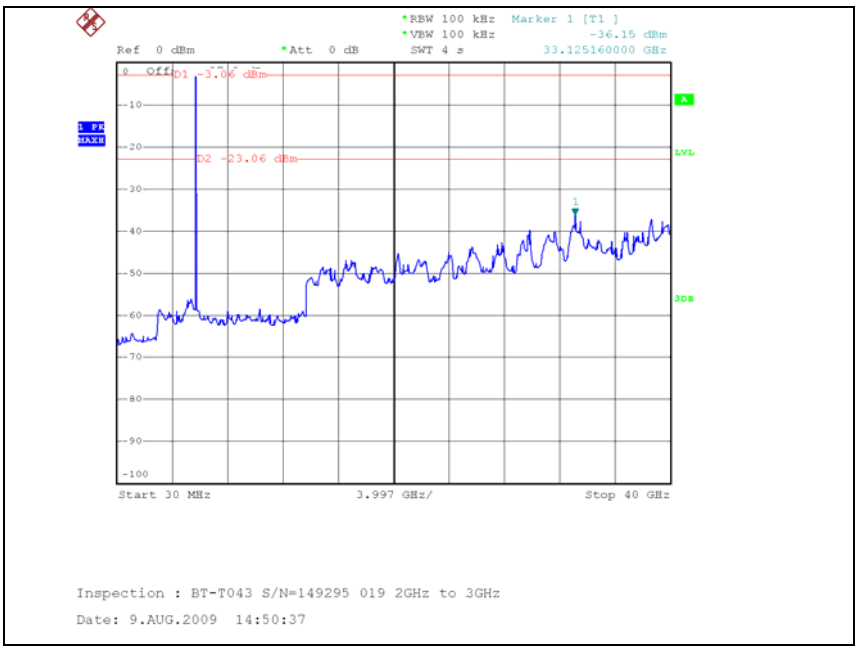


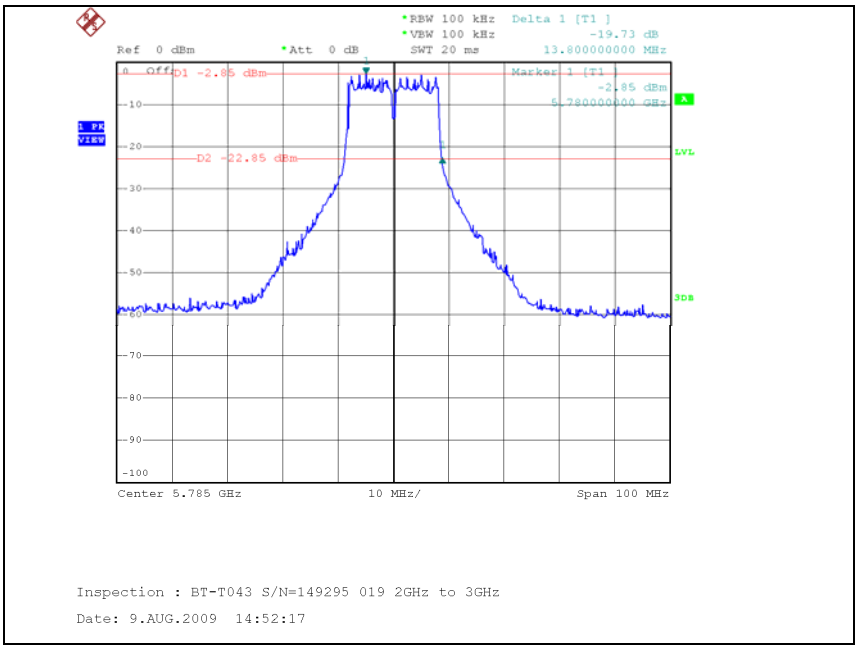
**IEEE 802.11a**

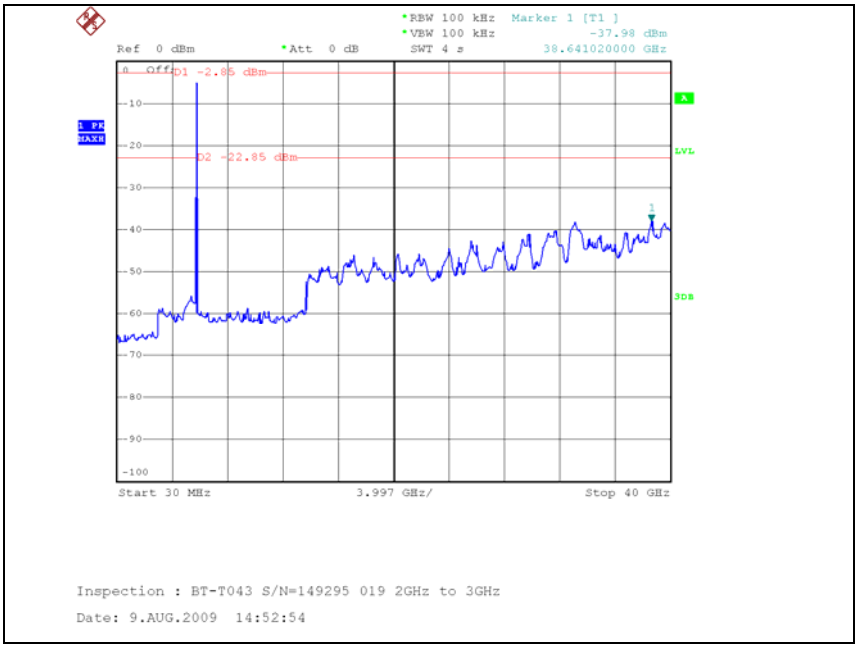
Low Channel



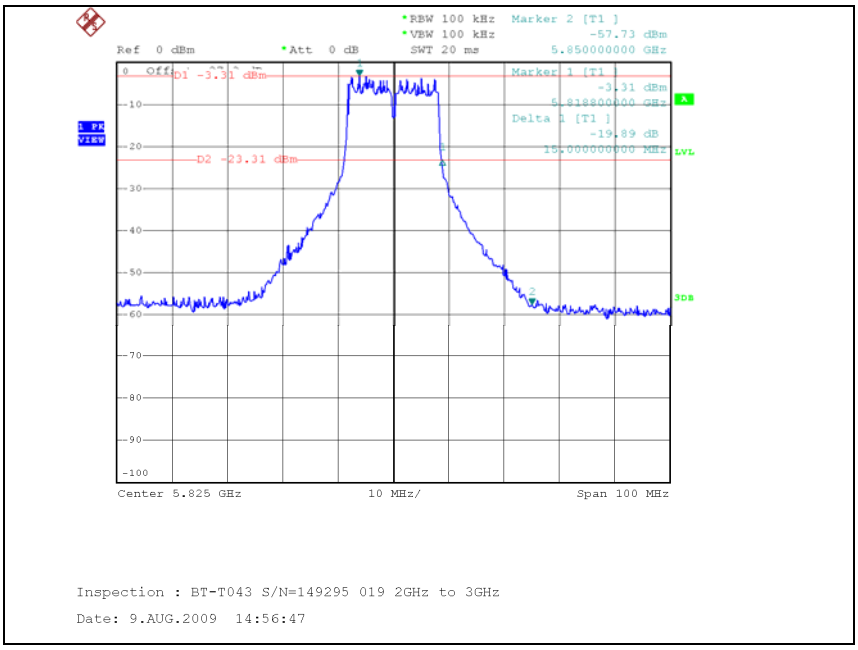



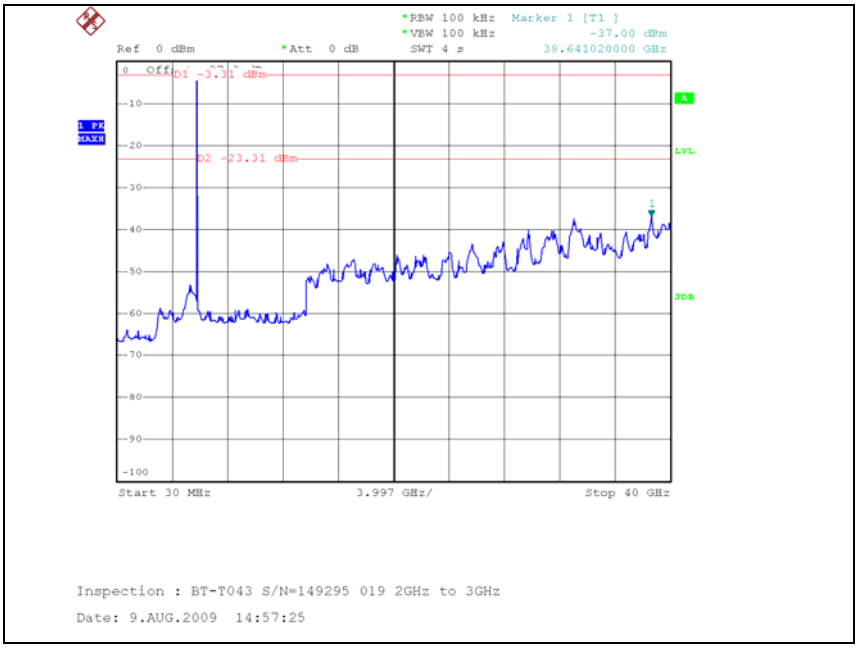
Middle Channel



High Channel



# 4. 6 dB Bandwidth measurement and 99 % BW

## 4.1. Test setup


## 4.2. Limit

According to §15.247(a)(2), systems using digital modulation techniques may operate in the 902 ~928 MHz , 2400 ~ 2483.5 MHz, and 5725 ~ 5825 MHz bands. The minimum of 6 dB Bandwidth shall be at least 500 kHz

## 4.3. Test procedure

1. Place the EUT on the table and set it in the transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set the spectrum analyzer as;
   2 GHz: RBW = 100 kHz, VBW = 100 kHz, Span = 100 MHz, Sweep = auto.
   5 GHz: RBW = 1 MHz, VBW = 3 MHz, Span = 100 MHz, Sweep = auto.
4. Mark the peak frequency and –6dB (upper and lower) frequency.
5. Repeat until all the rest channels are investigated.

## 4.4. Test result

Ambient temperature : 22 ℃
Relative humidity : 49 % R.H.

**IEEE 802.11b**

| Frequency (MHz) | 6 dB Bandwidth (MHz) | 99% Bandwidth (MHz) |
|---|---|---|
| 2412 | 12.48 | 15.78 |
| 2437 | 12.60 | 15.80 |
| 2462 | 12.58 | 15.74 |

**IEEE 802.11g**

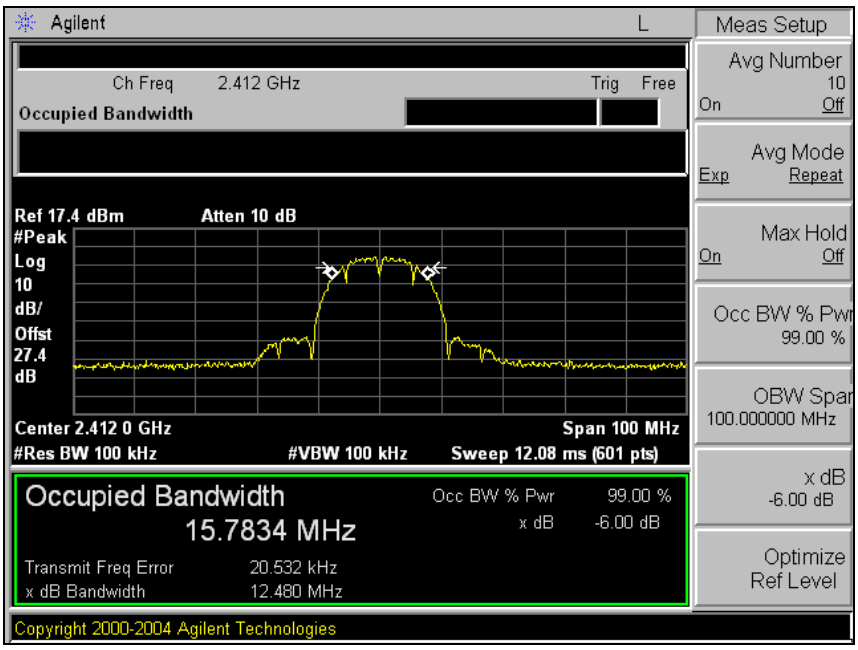
| Frequency (MHz) | 6 dB Bandwidth (MHz) | 99% Bandwidth (MHz) |
|---|---|---|
| 2412 | 16.59 | 16.64 |
| 2437 | 16.56 | 16.64 |
| 2462 | 16.54 | 16.62 |

**IEEE 802.11a**

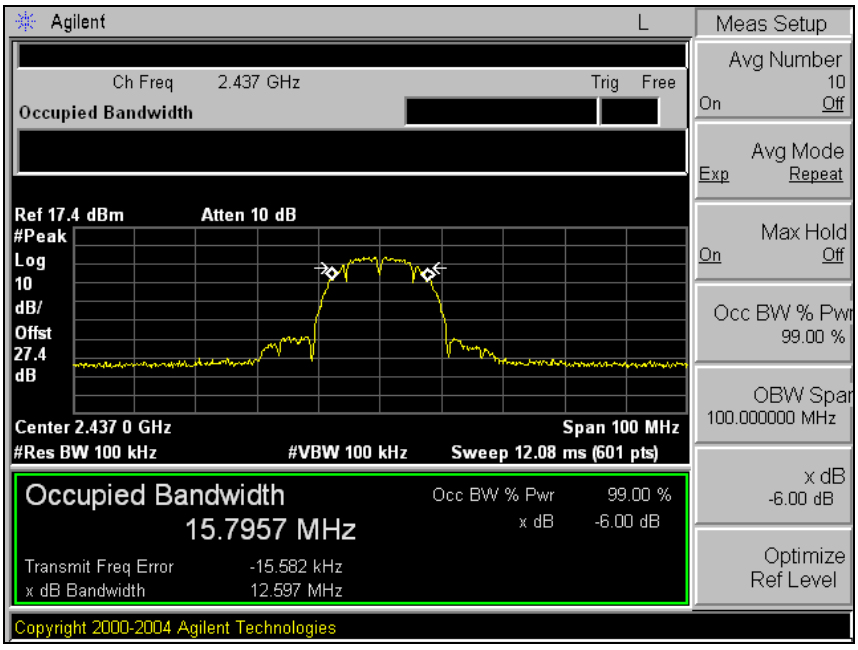
| Frequency (MHz) | 6 dB Bandwidth (MHz) | 99% Bandwidth (MHz) |
|---|---|---|
| 5745 | 16.78 | 18.28 |
| 5785 | 16.75 | 18.28 |
| 5825 | 16.67 | 18.33 |

**IEEE 802.11b**

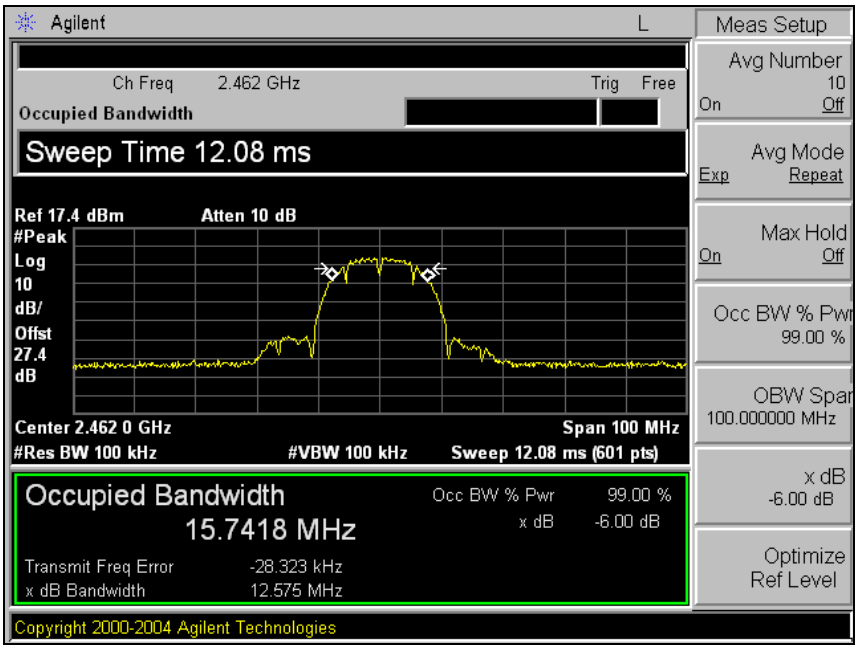
Low channel




Middle channel

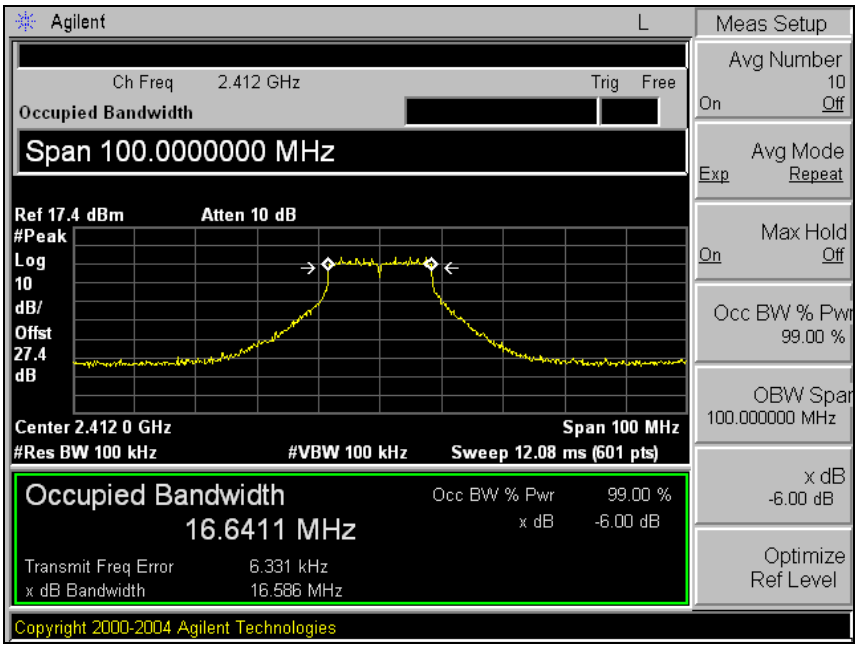


High channel

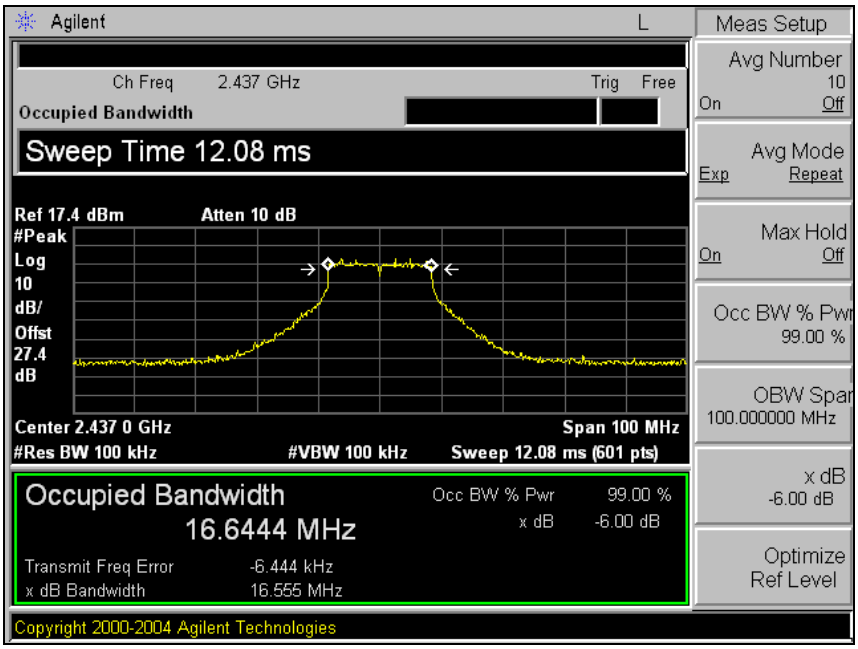


**IEEE 802.11g**

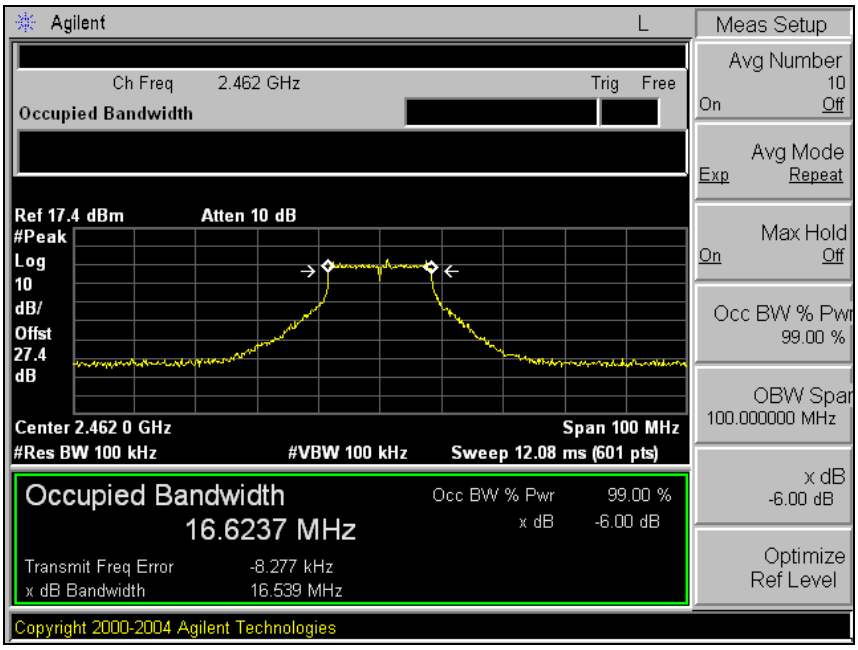
Low channel




Middle channel

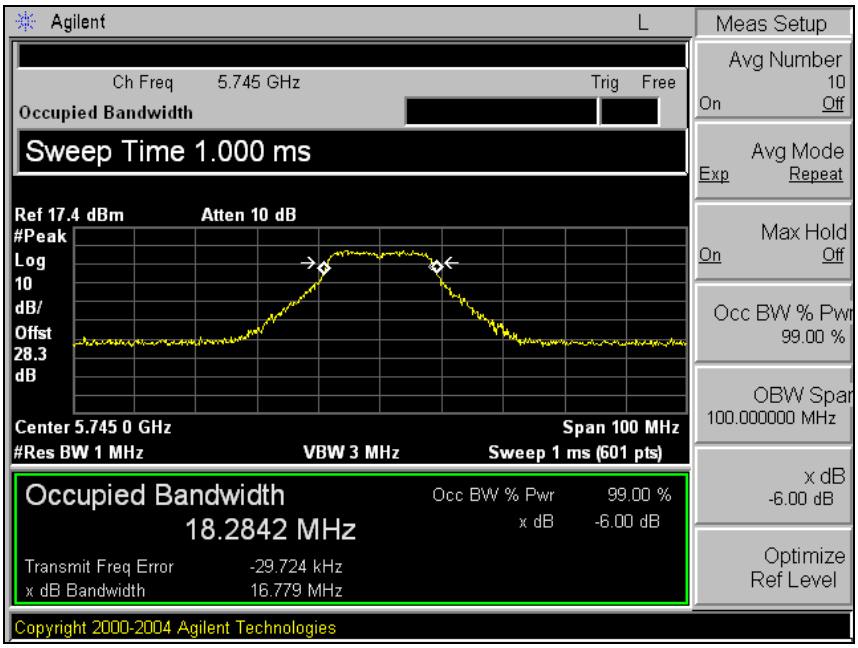


High channel

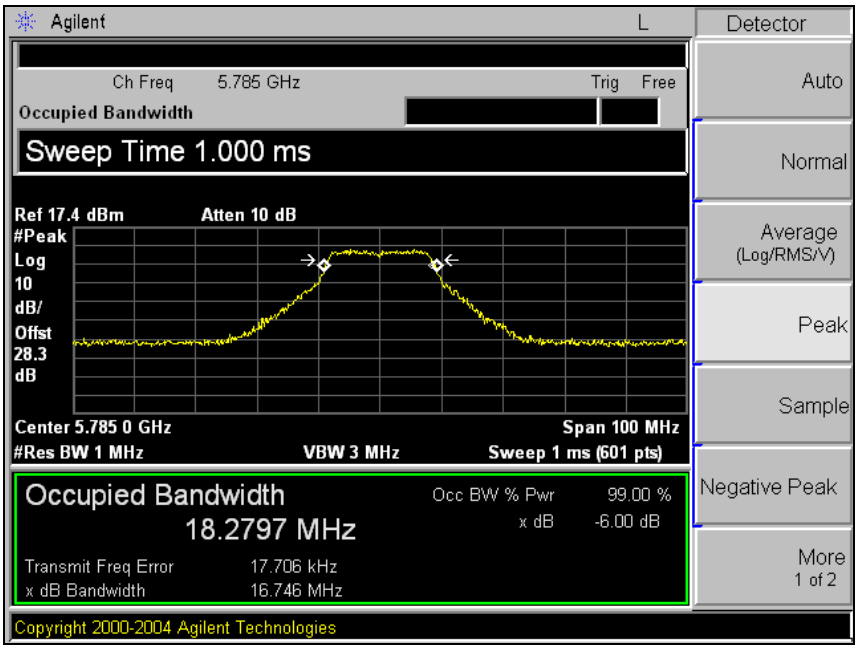


**IEEE 802.11a**

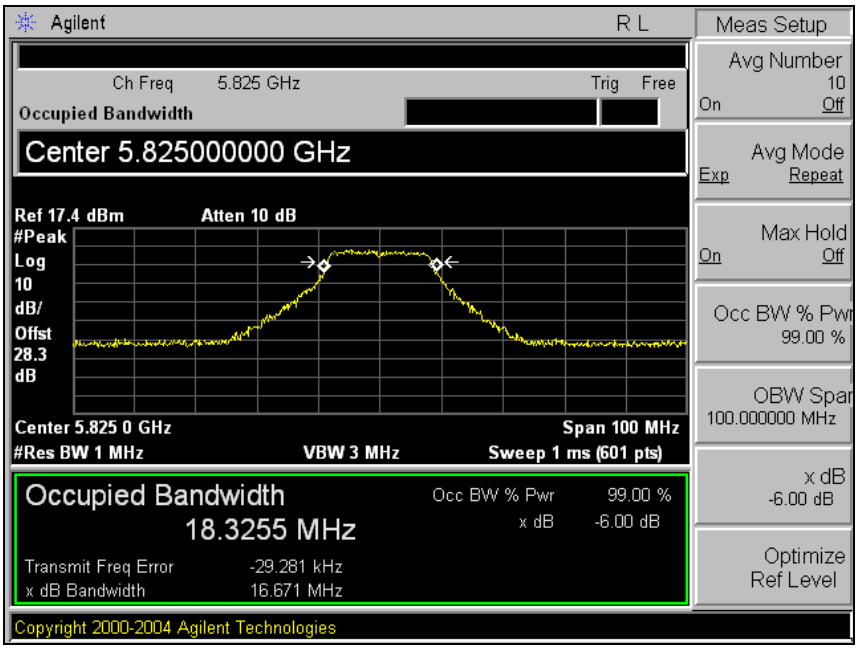
Low channel




Middle channel



High channel



# 5. Maximum peak output power measurement

## 5.1. Test setup


## 5.2. Limit

According to §15.247(b)(3), for systems using digital modulation in the 902 ~ 928 MHz, 2400 ~2483.5 MHz, and 5725 ~ 5850 MHz band: 1 Watt. As an alternative to a peak power measurement, compliance with the one watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antenna elements. The average must not include any intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.
According to §15.247(b)(4), the conducted output power limit specified in paragraph(b) of this section is based on the use of antenna with directional gains that do not exceed 6 dBi. Except as shown in paragraph(c) of this section, if transmitting antenna of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraph (b)(1), (b)(2), and (b)(3) of this section , as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6dBi.

## 5.3. Test procedure

1. Place the EUT on the table and set it in the transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set the Spectrum analyzer as RBW = 1 MHz, VBW = 3 MHz, Span = Auto, Channel BW = 99%.

## 5.4. Test result

Ambient temperature : 22 ℃
Relative humidity : 49 % R.H.

**IEEE 802.11b**

| Frequency (MHz) | Output power (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|
| 2412 | 16.78 | 30 | 13.22 |
| 2437 | 16.12 | | 13.88 |
| 2462 | 15.70 | | 14.30 |

**IEEE 802.11g**

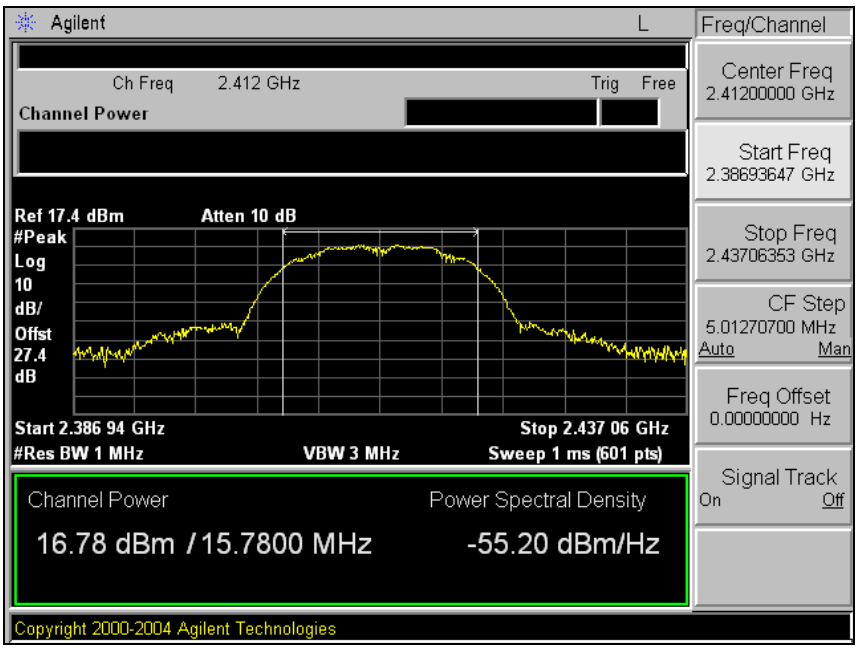
| Frequency (MHz) | Output power (dBm) | Peak Power Limit (dBm) | Margin (dB) |
|---|---|---|---|
| 2412 | 16.71 | 30 | 13.29 |
| 2437 | 16.49 | | 13.51 |
| 2462 | 16.24 | | 13.76 |

**IEEE 802.11a**

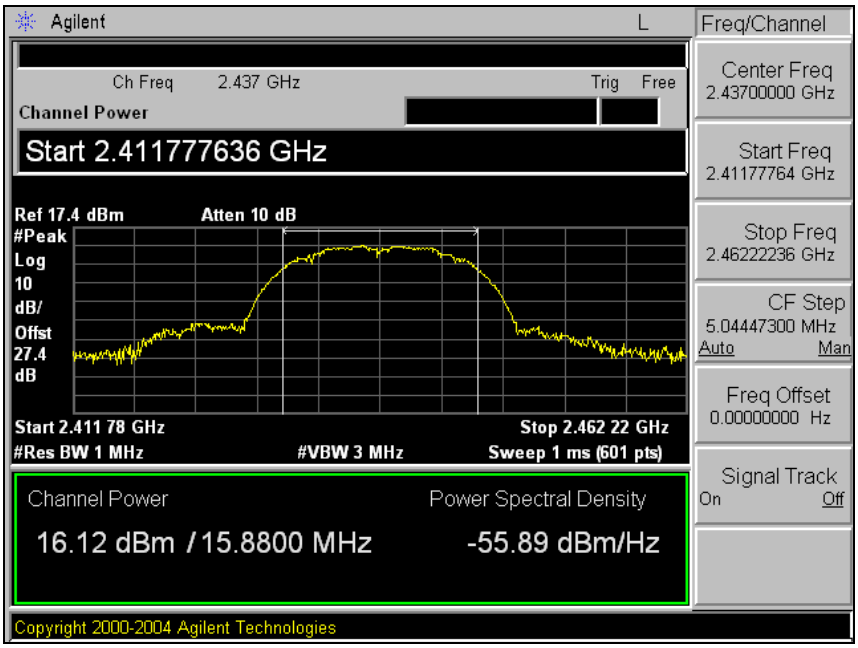
| Frequency (MHz) | Output power (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|
| 5745 | 11.37 | 30 | 18.63 |
| 5785 | 13.14 | | 16.86 |
| 5825 | 12.71 | | 17.29 |

**IEEE 802.11b**

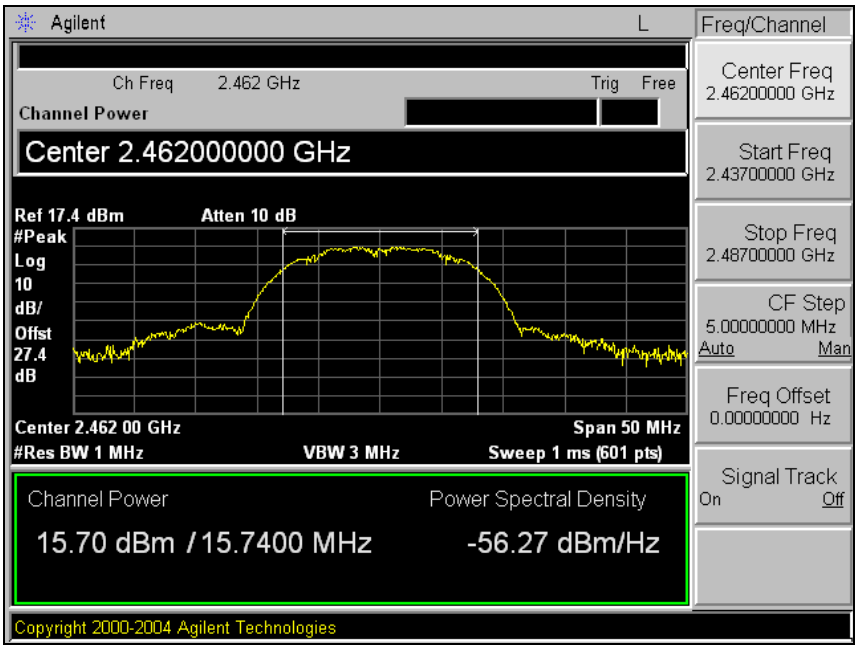
Low channel




Middle channel

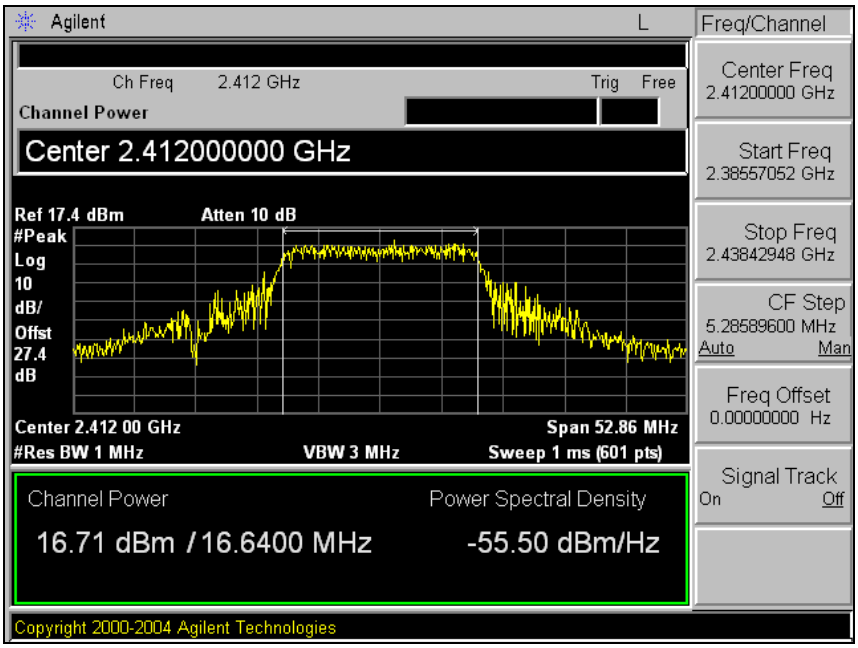


High channel

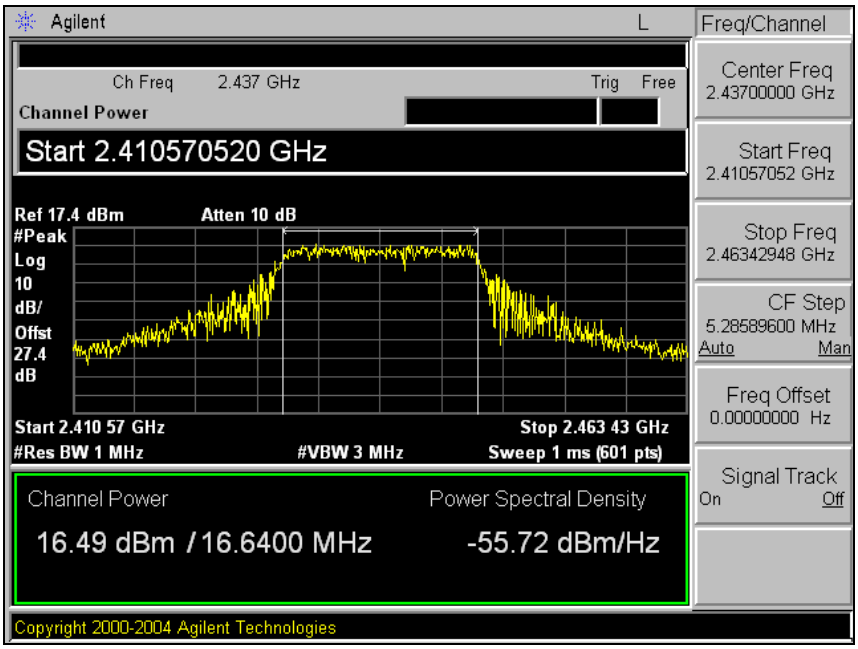


**IEEE 802.11g**

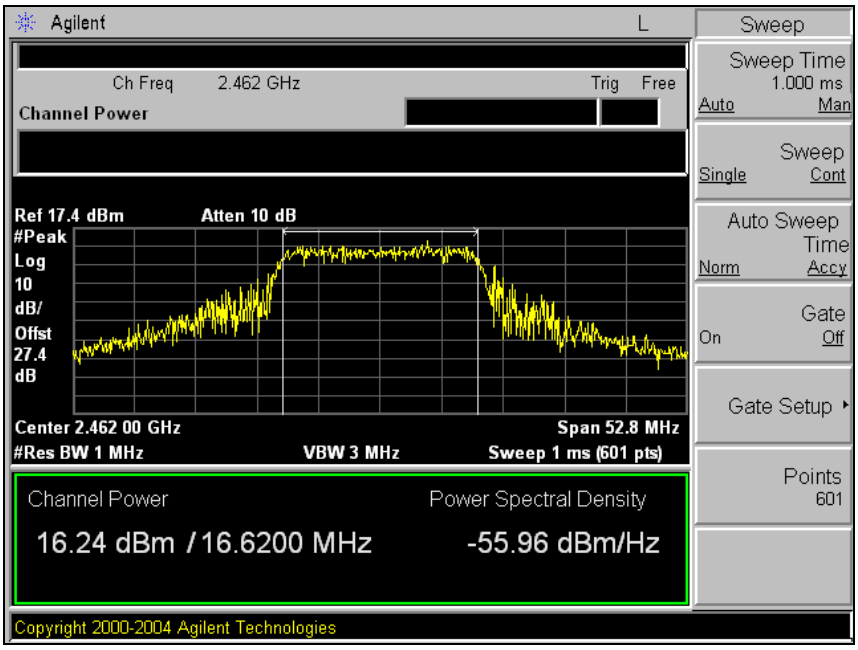
Low channel




Middle channel

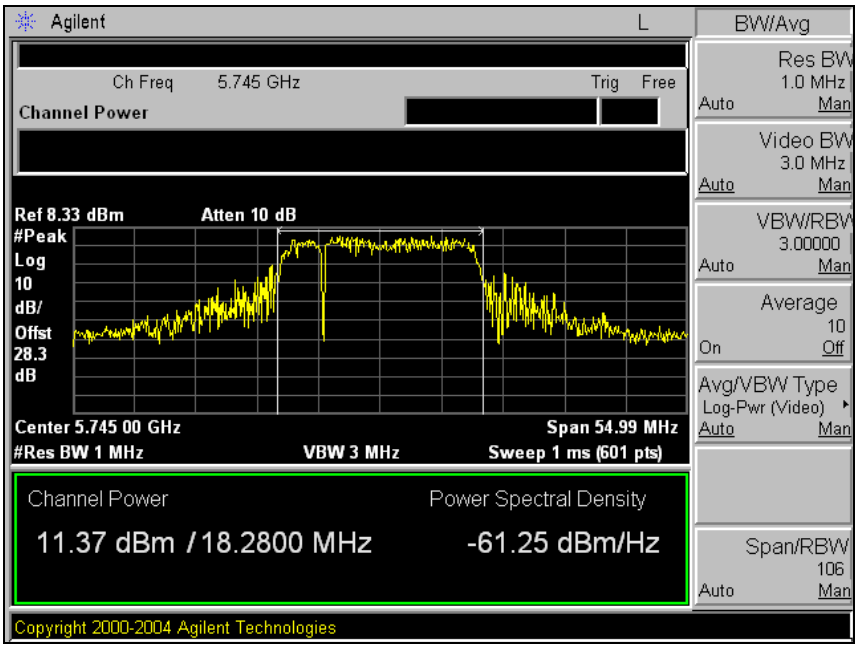


High channel

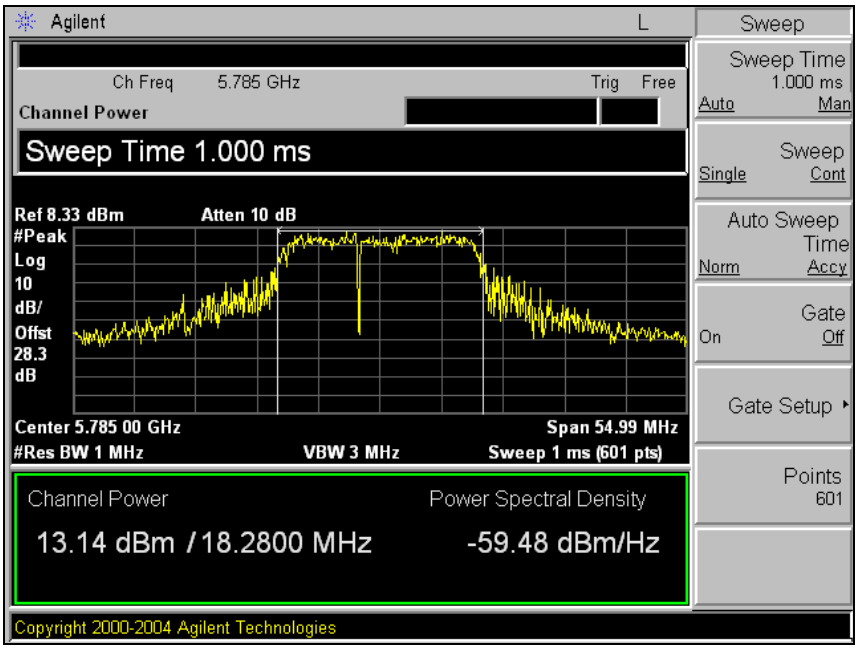


**IEEE 802.11a**

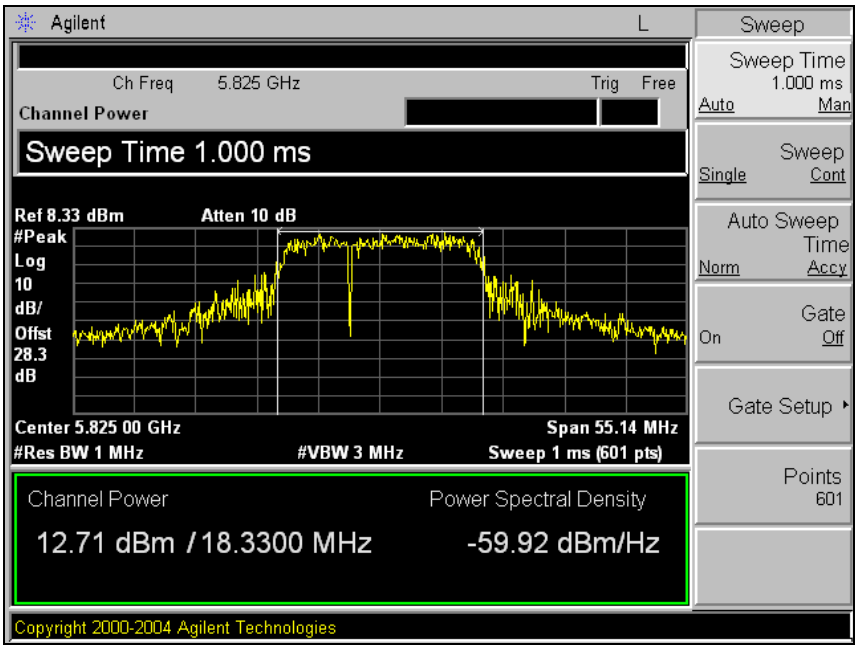
Low channel




Middle channel



High channel



# 6. Power spectral density measurement

## 6.1. Test setup


## 6.2. Limit

According to §15.247(e), For digitally modulated system, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph(b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density

## 6.3. Test procedure

1. Place the EUT on the table and set it in transmitting mode
   Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
2. Set the spectrum analyzer as RBW = 3 kHz, VBW = 10 kHz, Span = 300 kHz, Sweep = 100 s
3. Record the max reading.
4. Repeat the above procedure until the measurements for all frequencies are completed.

## 6.4. Test result

Ambient temperature : 22 ℃
Relative humidity : 49 % R.H.

**IEEE 802.11b**

| Frequency (MHz) | Final RF Power Level in 3 kHz BW (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|
| 2412 | -20.08 | 8 | 28.08 |
| 2437 | -20.15 | | 28.15 |
| 2462 | -20.56 | | 28.56 |

**IEEE 802.11g**

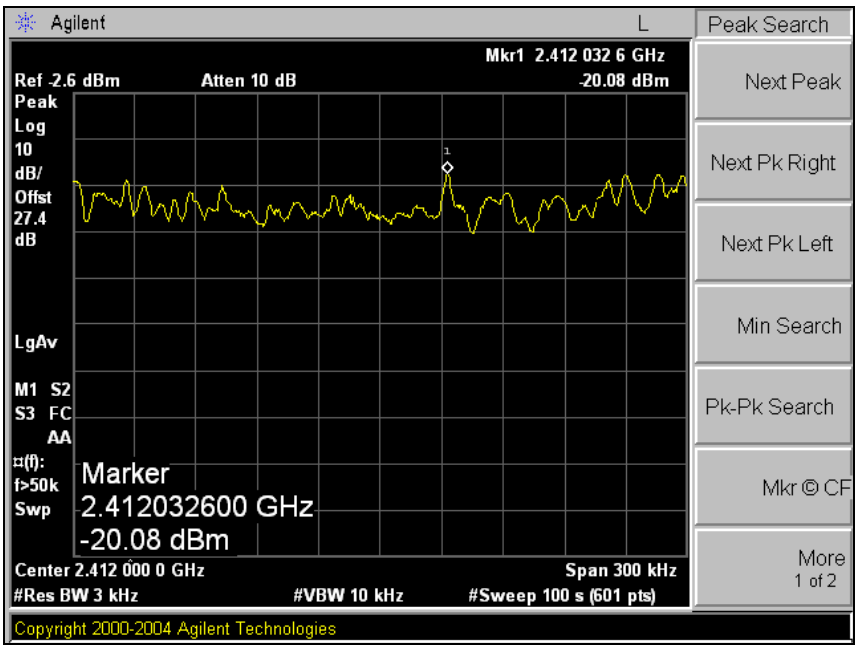
| Frequency (MHz) | Final RF Power Level in 3 kHz BW (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|
| 2412 | -21.06 | 8 | 29.06 |
| 2437 | -21.33 | | 29.33 |
| 2462 | -21.05 | | 29.05 |

**IEEE 802.11g**

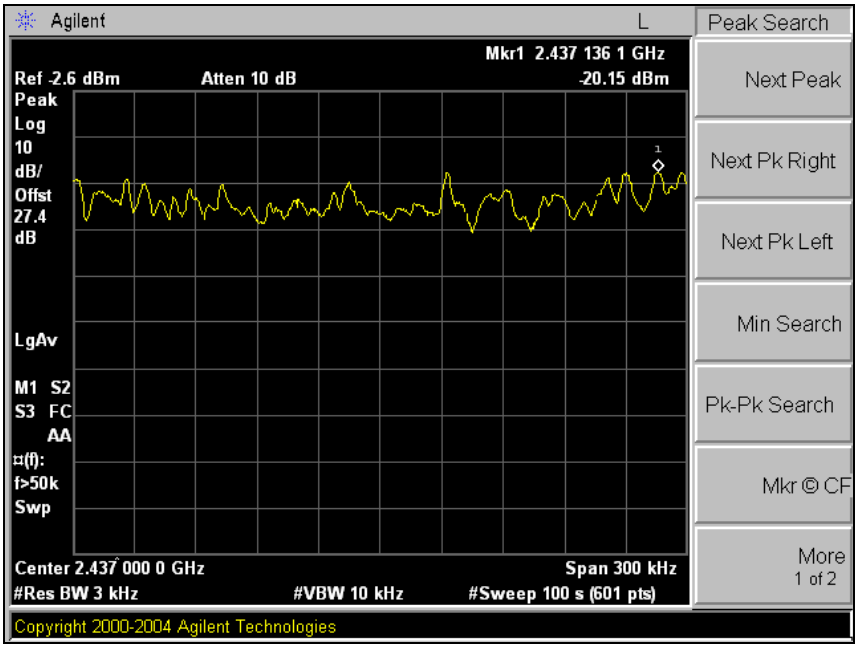
| Frequency (MHz) | Final RF Power Level in 3 kHz BW (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|
| 2412 | -20.51 | 8 | 28.51 |
| 2437 | -17.40 | | 25.40 |
| 2462 | -18.07 | | 26.07 |

**IEEE 802.11b**

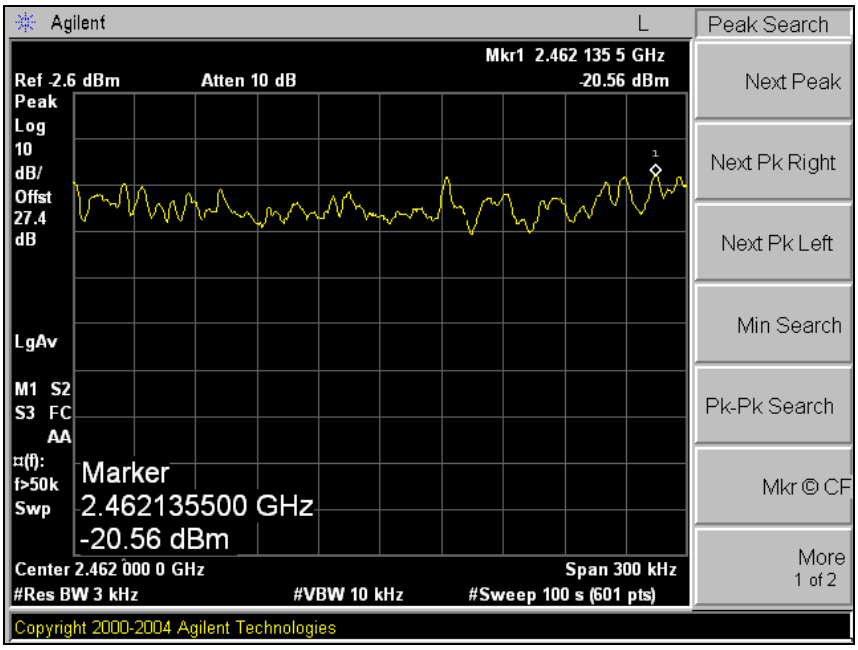
Low channel




Middle channel

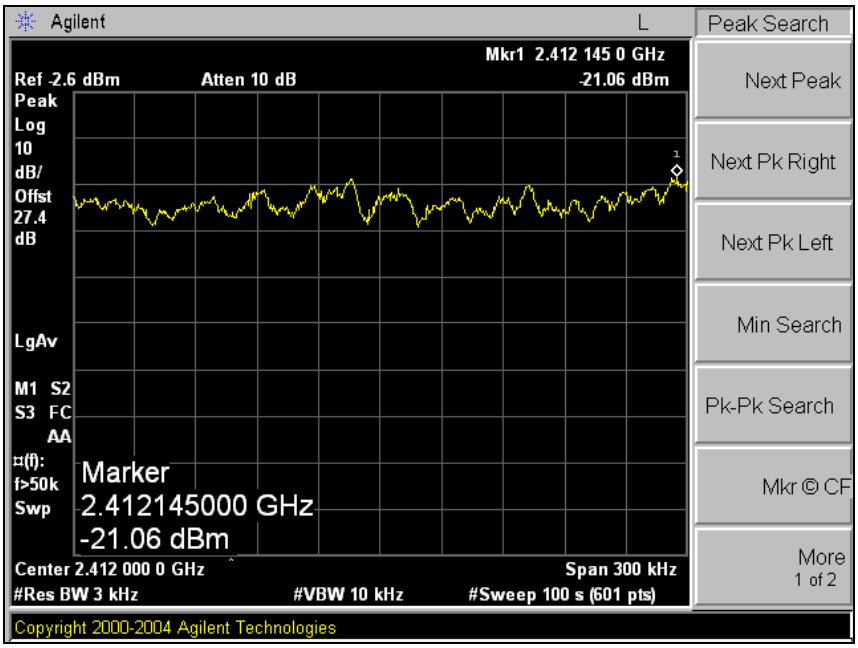


High channel

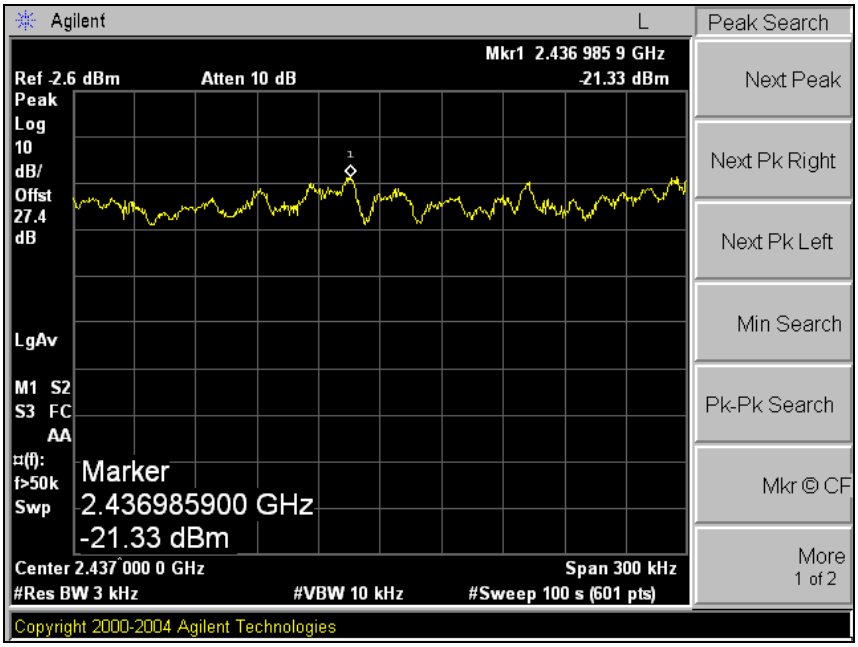


**IEEE 802.11g**

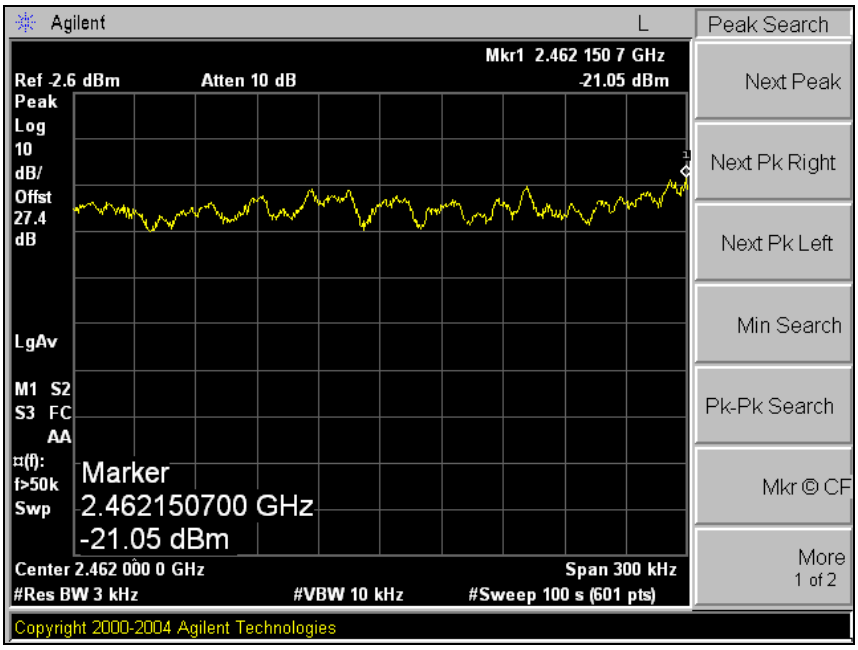
Low channel




Middle channel

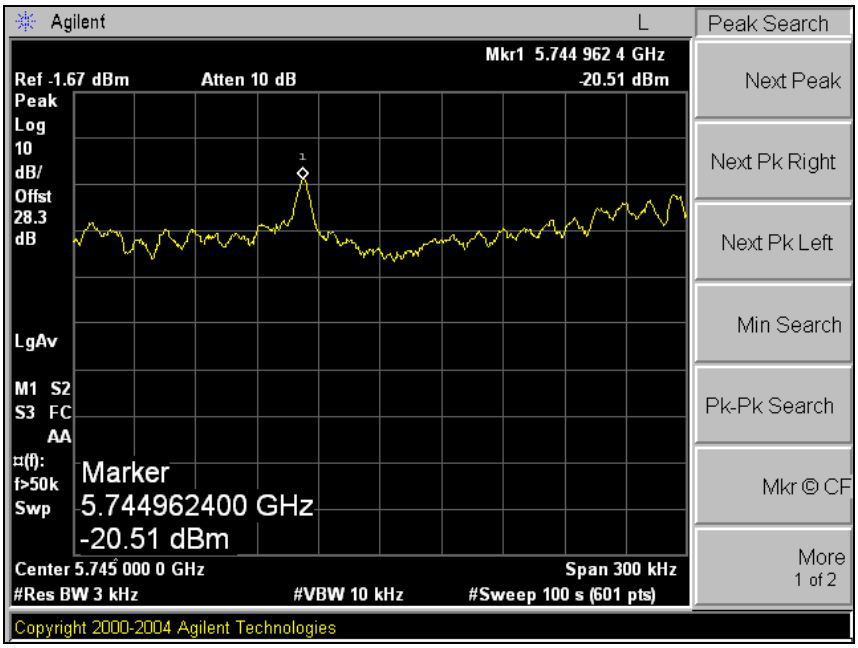


High channel

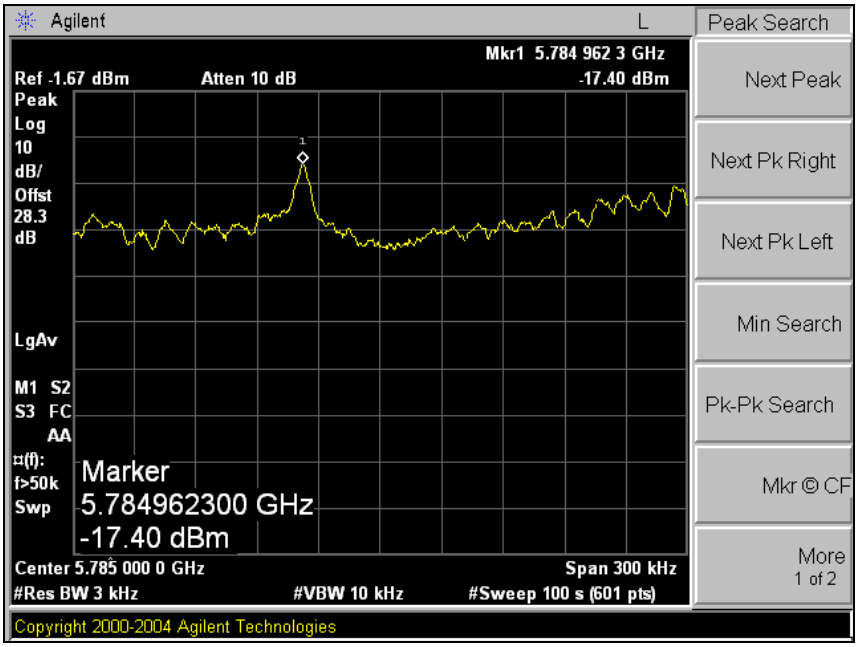


**IEEE 802.11a**

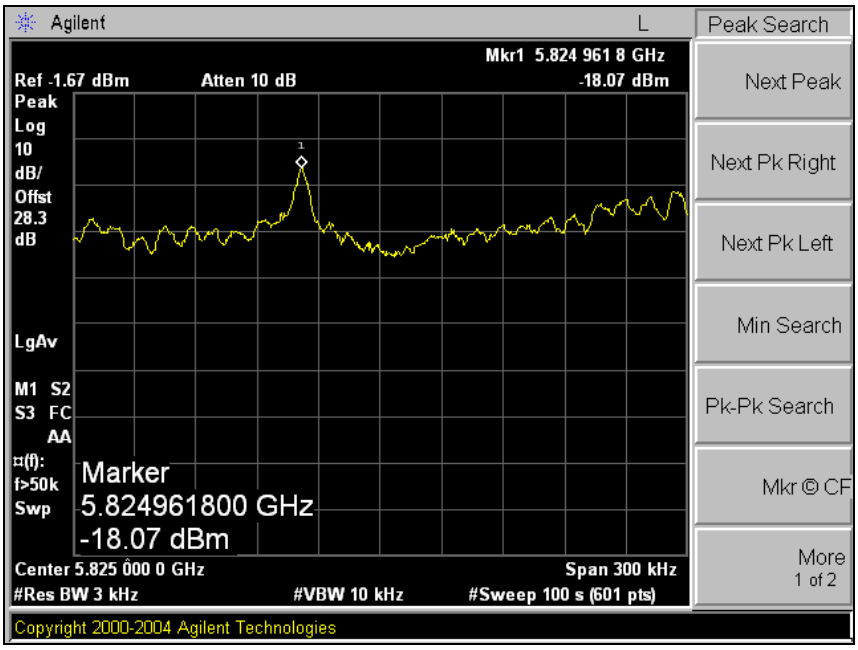
Low channel




Middle channel



High channel



# 7. Antenna Requirement

## 7.1. Standard Applicable

For intentional device, according to FCC 47 CFR Section §15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. And according to FCC 47 CFR Section § 15.247 (b), if transmitting antennas of directional gain greater than 6 dBi are used, the power shall be reduced by the amount in dB that the gain of the antenna exceeds 6 dBi.

## 7.2. Antenna Connected Construction

The antenna used of this product is inverter F type antenna.
The peak max gain of this antenna is 2.85 dBi(2.4 GHz) & 1.78 dBi(5.7 GHz)