# ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

## INTENTIONAL RADIATOR CERTIFICATION TO FCC PART 15 SUBPART C REQUIREMENT

*OF*

| | |
|---|---|
| **Product Name:** | **WIFI MODULE** |
| **Brand Name:** | **N/A** |
| **Model No.:** | **GS1011MIPS** |
| **Model Difference:** | **N/A** |
| **FCC ID:** | **YOPGS1011MIPS** |
| **Report No.:** | **ER/2012/20028-02** |
| **Issue Date:** | **May. 04, 2012** |
| **FCC Rule Part:** | **§15.247, Cat: DTS** |
| **Prepared for:** | **GainSpan Corporation**<br>**3590 North First Street, Suite 300, San Jose, CA 95134, USA** |
| **Prepared by:** | **SGS Taiwan Ltd.**<br>**Electronics & Communication Laboratory**<br>**No. 134, Wu Kung Rd., Wuku Industrial Zone, Taipei County, Taiwan.** |

Testing Laboratory
0513

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# VERIFICATION OF COMPLIANCE

| | |
|---|---|
| **Applicant:** | GainSpan Corporation<br>3590 North First Street, Suite 300, San Jose, CA 95134, USA |
| **Product Name:** | WIFI MODULE |
| **Brand Name:** | N/A |
| **FCC ID:** | YOPGS1011MIPS |
| **Model No.:** | GS1011MIPS |
| **Model Difference:** | N/A |
| **File Number:** | ER/2012/20028-02 |
| **Date of test:** | Mar. 01, 2012 ~ Apr. 11, 2012 |
| **Date of EUT Received:** | Mar. 01, 2012 |

## We hereby certify that:

The above equipment was tested by SGS Taiwan Ltd. Electronics & Communication Laboratory The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.4 (2003) and the energy emitted by the sample EUT tested as described in this report is in compliance with conducted and radiated emission limits of FCC Rules Part 15.247.

The test results of this report relate only to the tested sample identified in this report.

| | | | |
|---|---|---|---|
| ***Test By:*** | Jay Lin | ***Date*** | May. 04, 2012 |
| | ***Jay Lin / Engineer*** | | |
| ***Prepared By:*** | Tiffany Kao | ***Date*** | May. 04, 2012 |
| | ***Tiffany Kao / Clerk*** | | |
| ***Approved By:*** | Jim Chang | ***Date*** | May. 04, 2012 |
| | ***Jim Chang / Supervisor*** | | |

# Version

| Version No. | Date | Description |
|---|---|---|
| 00 | May. 04, 2012 | Initial creation of document |
| | | |

# Table of Contents

# 1 GENERAL INFORMATION

## 1.1 Product Description

**General:**

| | |
|---|---|
| Product Name: | WIFI MODULE |
| Brand Name: | N/A |
| Model No.: | GS1011MIPS |
| Model Difference: | N/A |
| Power Supply: | 3.3Vdc by DC Power Supply. |

**WLAN: 802.11 b**

| | |
|---|---|
| Frequency Range: | 2412 – 2462 MHz |
| Channel number: | 11 channels |
| Max. Output Power: | 802.11 b: 10.46 dBm (Peak) |
| Modulation Technology: | DSSS |
| Modulation type: | CCK, DQPSK, DBPSK for DSSS |
| Transition Rate: | 802.11 b: 1/2/5.5/11 Mbps; |
| Antenna Designation: | PCB antenna, Model name: GIB0x , Antenna Gain: -3.06dBi |
| Type of Emission: | 13M1G1D |

The EUT is compliance with IEEE 802.11 b Standard.
This report applies for frequency bands: 2412MHz – 2462MHz

## 1.2 Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended for **FCC ID: YOPGS1011MIPS** filing to comply with Section 15.247 of the FCC Part 15, Subpart C Rules. The composite system (digital device) is compliance with Subpart B is authorized under a Doc procedure.

## 1.3 Test Methodology

Both conducted and radiated testing was performed according to the procedures in ANSI C63.4 (2003). Radiated testing was performed at an antenna to EUT distance 3 meters.

Tested in accordance with Oct 2002 KDB558074 for compliance to FCC 47CFR 15.247 requirements.

## 1.4 Test Facility

The measurement facilities used to collect the 3m Radiated Emission and AC power line conducted data are located on the address of SGS Taiwan Ltd. Electronics & Communication Laboratory No. 134, Wu Kung Rd., Wuku Industrial Zone, Taipei Country, Taiwan which are constructed and calibrated to meet the FCC requirements in documents ANSI C63.4: 2003. FCC Registration Number are: 990257 and 236194, Canada Registration Number: 4620A-4.

The 10 m Open Area Test Sites located on the address of SGS Taiwan Ltd. Electronics & Communication Laboratory No. 29, Pau-Tou-Tsuo Valley Chia-Pau Tsuen, Linkou Hsiang, Taipei county, which is constructed and calibrated to meet the CISPR 22/EN 55022 requirements. SGS Site No. 1(3 &10 meters) and FCC Registration Number: 94644.

## 1.5 Special Accessories

Not available for this EUT intended for grant.

## 1.6 Equipment Modifications

Not available for this EUT intended for grant.

# 2 SYSTEM TEST CONFIGURATION

## 2.1 EUT Configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner which intends to maximize its emission characteristics in a continuous normal application.

## 2.2 EUT Exercise

The EUT (Transmitter) was operated in the engineering mode to fix the Tx frequency that was for the purpose of the measurements.

## 2.3 Test Procedure

### 2.3.1 Conducted Emissions

The EUT is a placed on as turn table which is 0.8 m above ground plane. According to the requirements in Section 7 and 13 of ANSI C63.4-2003.Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using CISPR Quasi-Peak and Average detector mode.

### 2.3.2 Radiated Emissions

The EUT is a placed on as turn table which is 0.8 m above ground plane. The turn table shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of this hand-held transmitter(EUT) was rotated through three orthogonal axes and measurement procedures for electric field radiated emissions above 1 GHz the EUT measurement is to be made “while keeping the antenna in the ‘cone of radiation’ from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response.” is still within the 3dB illumination BW of the measurement antenna. according to the requirements in Section 8 and 13 of ANSI C63.4-2003.

## 2.4 Configuration of Tested System

**Fig. 2-1 Configuration of Tested System**

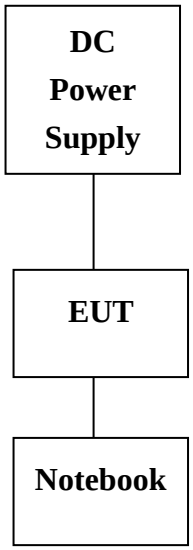



**Table 2-1 Equipment Used in Tested System**

| Item | Equipment | Mfr/Brand | Model / Type No. | Series No. |
|---|---|---|---|---|
| 1. | Notebook | DELL | E5400 | 3704625136 |
| 2. | DC Power Supply | Topward | 3303D | 981327 |
| 3. | WLAN Software | N/A | UTF-8 Tera Term Pro | Version 4.58 |

# 3 SUMMARY OF TEST RESULTS

| FCC Rules | Description Of Test | Result |
|---|---|---|
| §15.207(a) | AC Power Line Conducted Emission | N/A |
| §15.247(b) (3),(4)(c) | Peak Output Power | Compliant |
| §15.247(a)(2) | 6dB Bandwidth | Compliant |
| §15.247(d) | 100 KHz Bandwidth Of Frequency Band Edges | Compliant |
| §15.247(d) | Spurious Emission | Compliant |
| §15.247(e) | Peak Power Density | Compliant |
| §15.203 | Antenna Requirement | Compliant |

# 4 DESCRIPTION OF TEST MODES

The EUT has been tested under operating condition.
Test program used to control the EUT for staying in continuous transmitting and receiving mode is programmed.

802.11 b mode: Channel low (2412MHz)、mid (2437MHz) and high (2462MHz) with 1Mbps data rate are chosen for full testing.

# 5. MEASUREMENT UNCERTAINTY FOR FIELD STRENGTH OF SPURIOUS RADIATION

| | |
|---|---|
| Measurement uncertainty (Polarization : **Vertical**) | 30MHz - 180MHz: 3.37dB |
| | 180MHz -417MHz: 3.19dB |
| | 0.417GHz-1GHz: 3.19dB |
| | 1GHz - 18GHz: 4.04dB |
| | 18GHz - 40GHz: 4.04dB |

| | |
|---|---|
| Measurement uncertainty (Polarization : **Horizontal**) | 30MHz - 167MHz: 4.22dB |
| | 167MHz -500MHz: 3.44dB |
| | 0.5GHz-1GHz: 3.39dB |
| | 1GHz - 18GHz: 4.08dB |
| | 18GHz - 40GHz: 4.08dB |

# 6 CONDUCTED EMISSION TEST

## 6.1. Standard Applicable:

According to §15.207, frequency range within 150KHz to 30MHz shall not exceed the Limit table as below.

| Frequency range MHz | Limits dB(uV) | |
|---|---|---|
| | Quasi-peak | Average |
| 0.15 to 0.50 | 66 to 56 | 56 to 46 |
| 0.50 to 5 | 56 | 46 |
| 5 to 30 | 60 | 50 |
| Note<br>1.The lower limit shall apply at the transition frequencies<br>2.The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz. | | |

## 6.2. Measurement Equipment Used:

| AC Power Line Conducted Emission Test Site | | | | | |
|---|---|---|---|---|---|
| **EQUIPMENT TYPE** | **MFR** | **MODEL NUMBER** | **SERIAL NUMBER** | **LAST CAL.** | **CAL DUE.** |
| EMI Test Receiver | R&S | ESCI7 | 100759 | 05/20/2011 | 05/19/2013 |
| EMI Receiver | R&S | ESCS 30 | 828985/004 | 09/23/2011 | 09/22/2012 |
| LISN | Rolf-Heine | NNB-2/16Z | 99012 | 03/23/2012 | 03/22/2013 |
| LISN | FCC | FCC-LISN-50/250-25-2-01 | 04034 | 03/23/2012 | 03/22/2013 |
| Coaxial Cables | N/A | WK CE Cable | N/A | 01/04/2011 | 01/03/2013 |

## 6.3. EUT Setup:

1. The conducted emission tests were performed in the test site, using the setup in accordance with the ANSI C63.4-2003.
2. The AC/DC Power adaptor of EUT was plug-in LISN. The EUT was placed flushed with the rear of the table.
3. The LISN was connected with 120Vac/60Hz power source.

## 6.4. Measurement Procedure:

1. The EUT was placed on a table which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all frequency measured were complete.

## 6.5. Measurement Result:

The initial step in collecting conducted data is a spectrum analyzer peak scan of the measurement range. Significant peaks are then marked as shown on the following data page, and these signals are then quasi-peaked.

Note: N/A. 3.3Vdc by DC Power Supply.

# 7 PEAK OUTPUT POWER MEASUREMENT

## 7.1 Standard Applicable:

According to §15.247(a)(2), (b)

(3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 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 antennas and antenna elements. The average must not include any time 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.

(4) The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas 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 paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

(c) Operation with directional antenna gains greater than 6 dBi.

(1) Fixed point-to-point operation:

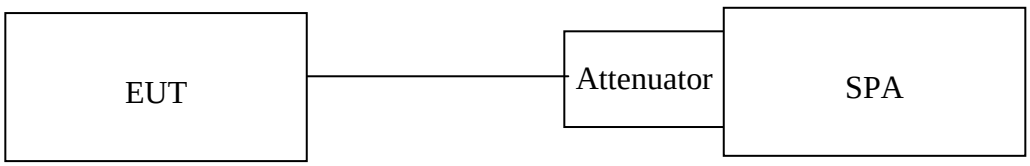
(i) Systems operating in the 2400-2483.5 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the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

(ii) Systems operating in the 5725-5850 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted output power.

## 7.2 Measurement Equipment Used:

| Conducted Emission Test Site | | | | | |
|---|---|---|---|---|---|
| **EQUIPMENT TYPE** | **MFR** | **MODEL NUMBER** | **SERIAL NUMBER** | **LAST CAL.** | **CAL DUE.** |
| Power Sensor | Anritsu | ML2495A | 1005007 | 02/08/2012 | 02/07/2014 |
| Power Meter | Anritsu | MA2411B | 917032 | 02/08/2012 | 02/07/2014 |
| Spectrum Analyzer | Agilent | E4446A | MY51100003 | 04/15/2011 | 04/14/2013 |
| Spectrum Analyzer | Agilent | E4440A | MY45304525 | 03/17/2012 | 03/16/2014 |
| DC Block | Mini-Circuits | BLK-18-S+ | 1 | 02/28/2012 | 02/27/2013 |
| Low Loss Cable | HUBER+SUHNER | SUCOFLEX 104PEA | N/A | 01/05/2012 | 01/04/2013 |
| Attenuator | Mini-Circuit | BW-S10W2+ | 002 | 02/28/2012 | 02/27/2013 |
| Splitter | Agilent | 11636B | N/A | 02/28/2012 | 02/27/2013 |
| Power Sensor | Anritsu | ML2495A | 1005007 | 02/08/2012 | 02/07/2014 |
| Power Meter | Anritsu | MA2411B | 917032 | 02/08/2012 | 02/07/2014 |

## 7.3 Test Set-up:




## 7.4 Measurement Procedure:

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the power meter.
3. Record the max. reading.
4. Repeat above procedures until all frequency measured were complete.

## 7.5 Measurement Result:

**802.11b**

| Cable loss = 0 | | Peak Power Output | | | | |
|---|---|---|---|---|---|---|
| CH | Frequency (MHz) | Data Rate | | | | Required Limit |
| | | 1 | 2 | 5.5 | 11 | |
| 1 | 2412 | 10.46 | 10.15 | 9.99 | 9.76 | 1 Watt = 30 dBm |
| 6 | 2437 | 10.20 | 10.10 | 9.85 | 9.79 | 1 Watt = 30 dBm |
| 11 | 2462 | 10.42 | 10.11 | 9.95 | 9.91 | 1 Watt = 30 dBm |
| Cable loss = 0 | | Average Power Output | | | | |
| CH | Frequency (MHz) | Data Rate | | | | Required Limit |
| | | 1 | 2 | 5.5 | 11 | |
| 1 | 2412 | 7.98 | 7.86 | 7.56 | 7.45 | 1 Watt = 30 dBm |
| 6 | 2437 | 7.69 | 7.45 | 7.26 | 7.36 | 1 Watt = 30 dBm |
| 11 | 2462 | 7.88 | 7.65 | 7.49 | 7.41 | 1 Watt = 30 dBm |

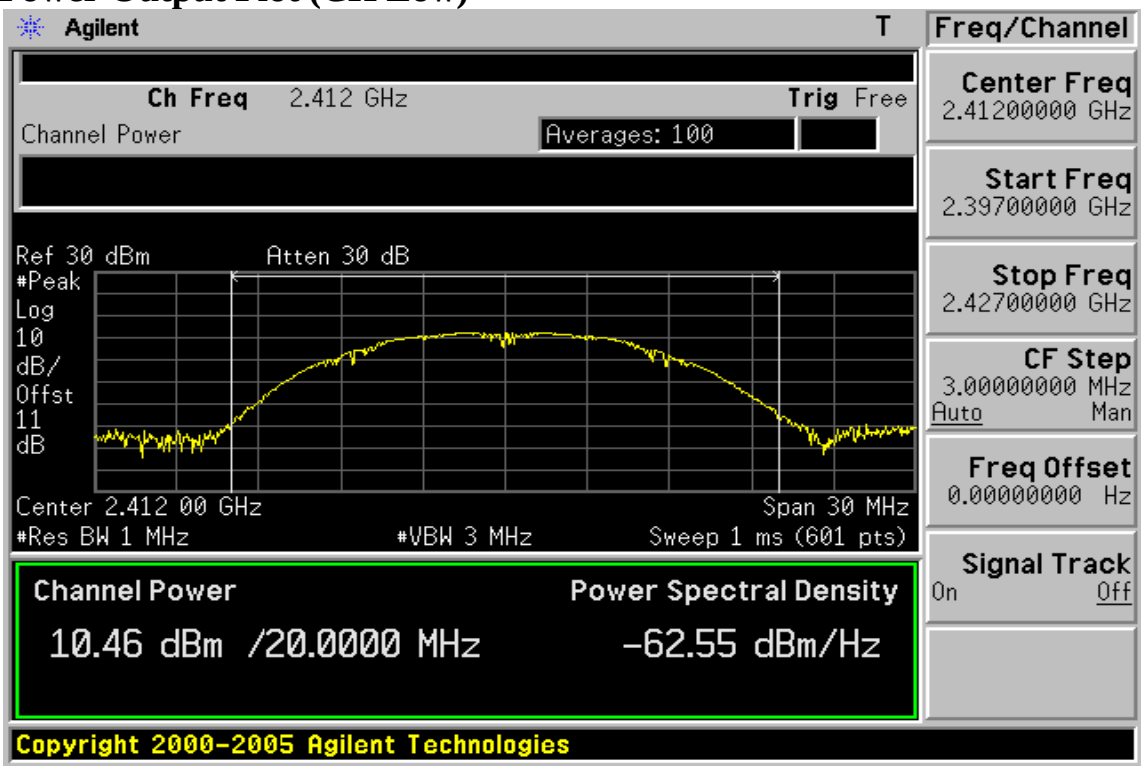
**Note: Offset 11dB*

** Read Power = Output Power + Cable Loss*

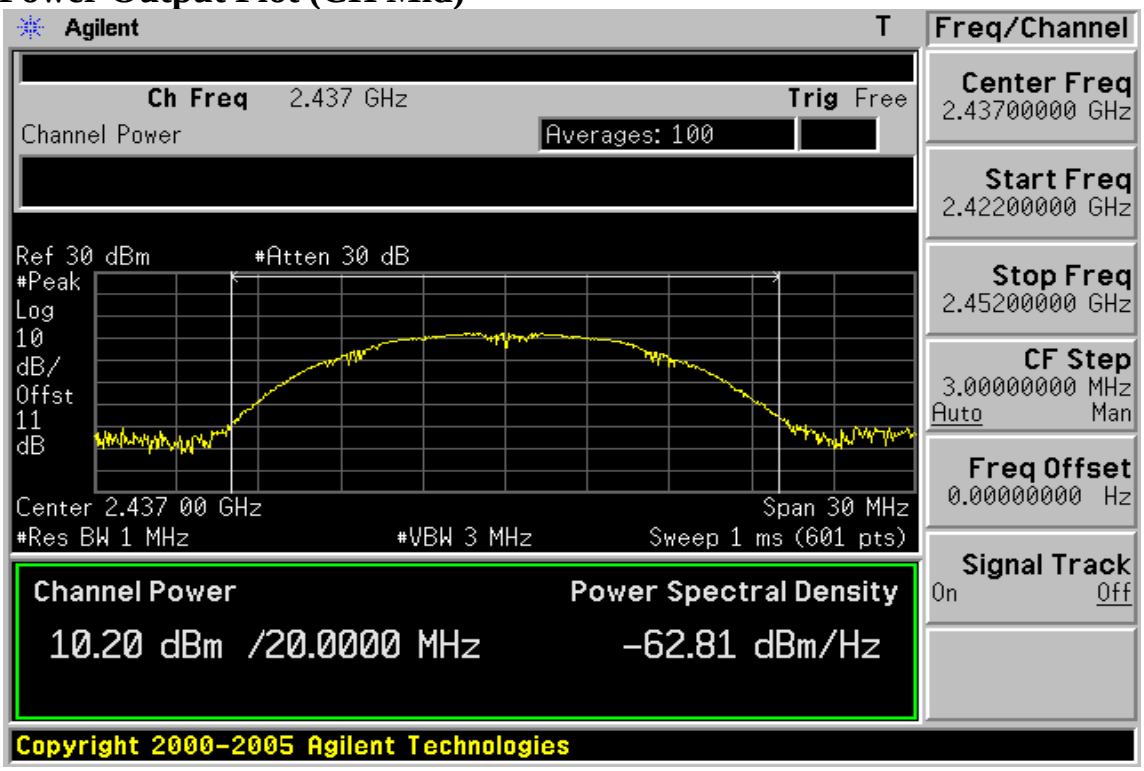
Note: Refer to next page for plots.

## 802.11b, 1Mbps

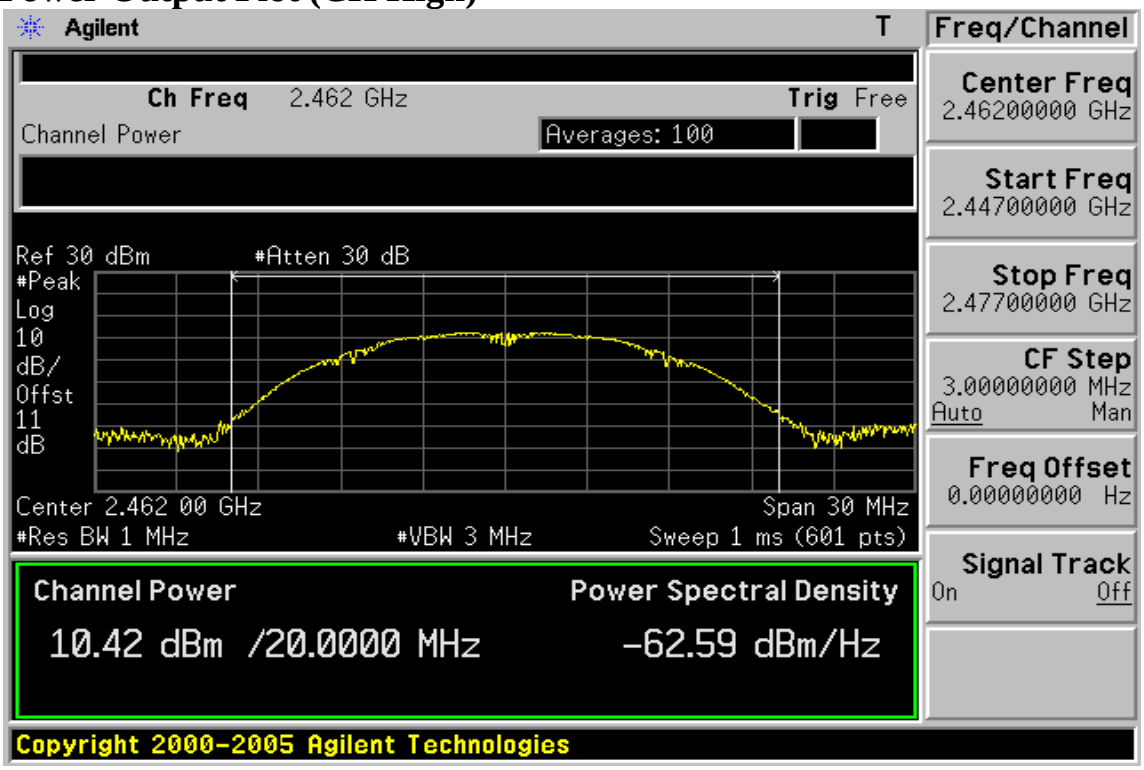
## Peak Power Output Plot (CH Low)



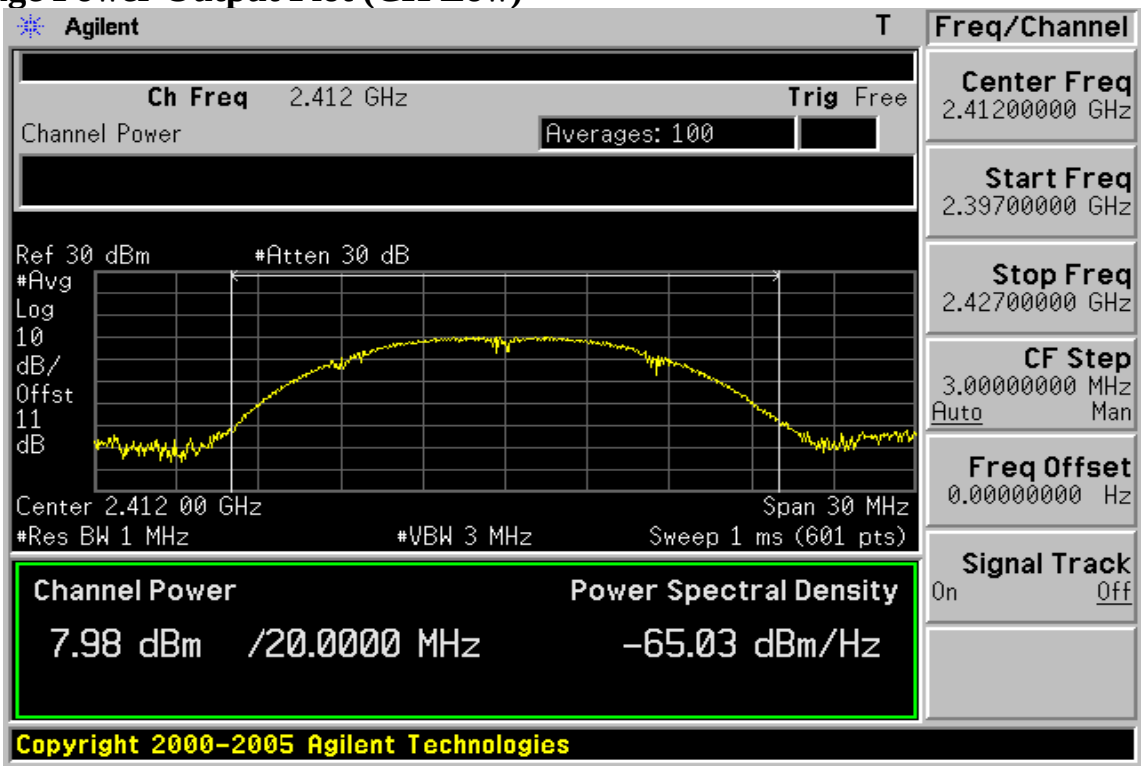

## Peak Power Output Plot (CH Mid)



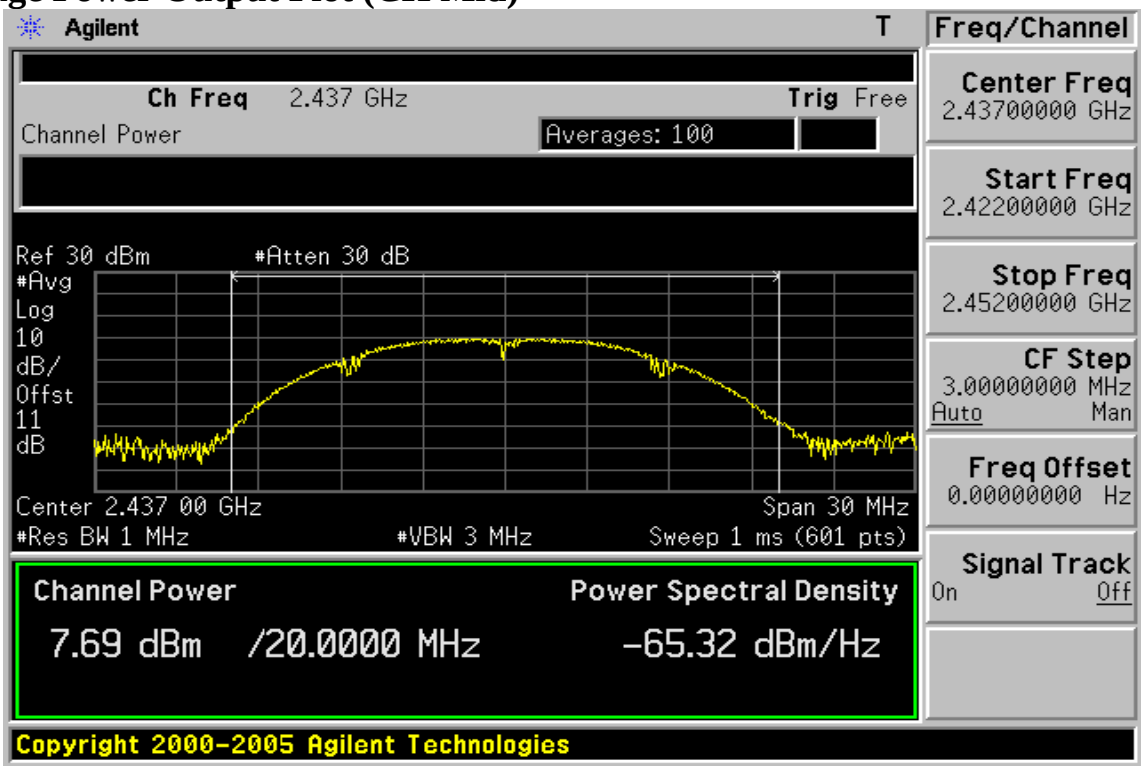
## Peak Power Output Plot (CH High)



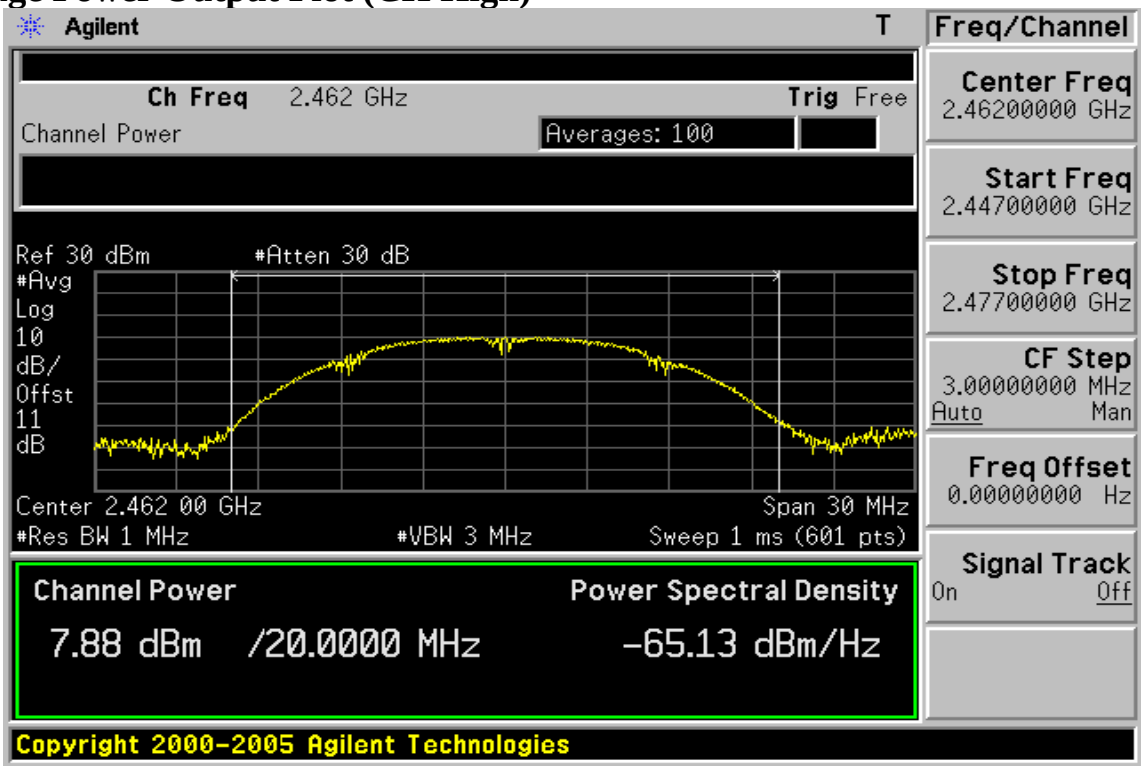

## Average Power Output Plot (CH Low)



## Average Power Output Plot (CH Mid)




## Average Power Output Plot (CH High)



# 8 6dB BANDWIDTH

## 8.1 Standard Applicable:

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

## 8.2 Measurement Equipment Used:

Refer to section 7.2 for details.

## 8.3 Test Set-up:

Refer to section 7.3 for details.

## 8.4 Measurement Procedure:

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the 3.antenna port to the spectrum analyzer.
3. Set the spectrum analyzer as RBW=100KHz, VBW = 3*RBW, Span= 30M/50MHz, Sweep=auto
4. Mark the peak frequency and –6dB (upper and lower) frequency.
5. Repeat above procedures until all frequency measured were complete.

## 8.5 Measurement Result:

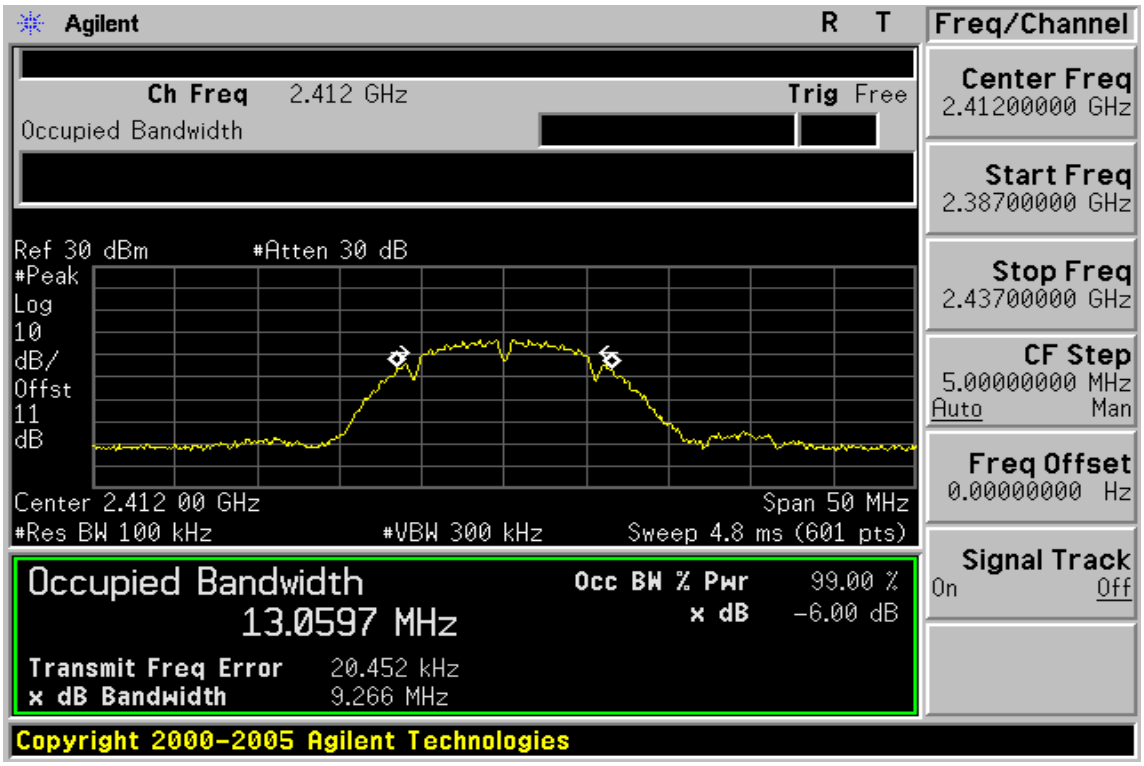
**802.11b**

| Frequency (MHz) | Bandwidth (MHz) | Bandwidth (KHz) | Result |
|---|---|---|---|
| 2412 | 9.266 | > 500 | PASS |
| 2437 | 9.265 | > 500 | PASS |
| 2462 | 9.271 | > 500 | PASS |

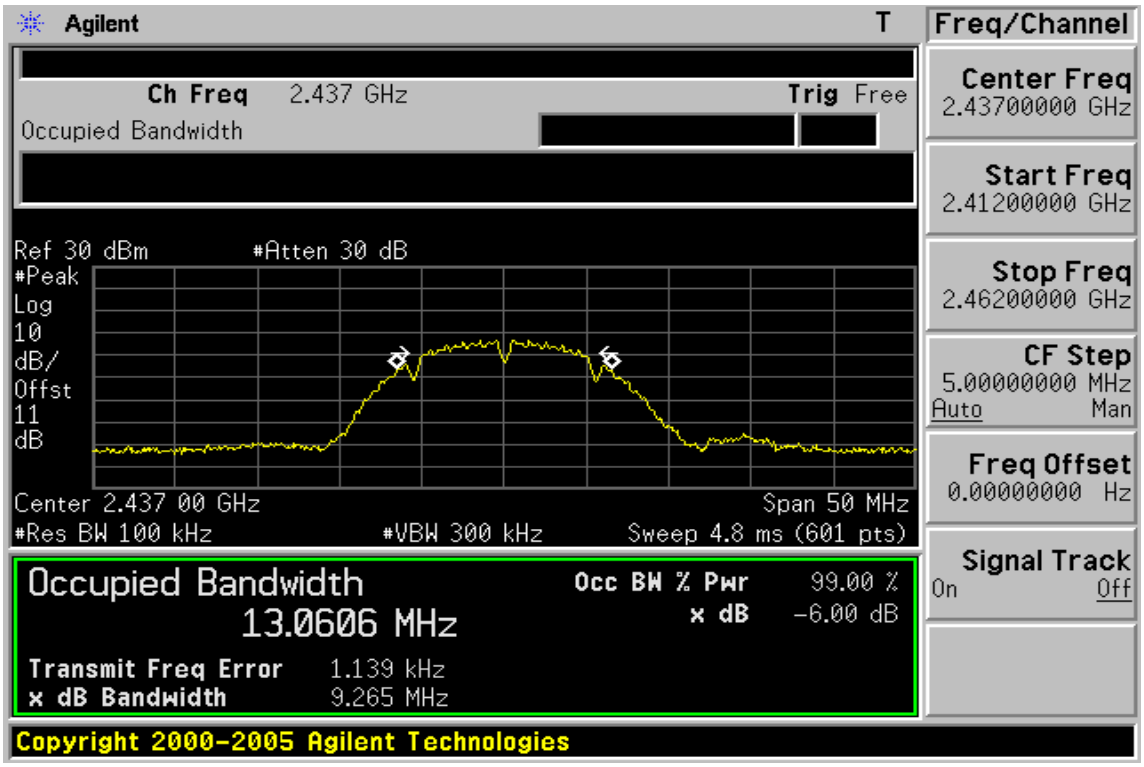
*offset: 11.0 dB*

## 802.11b

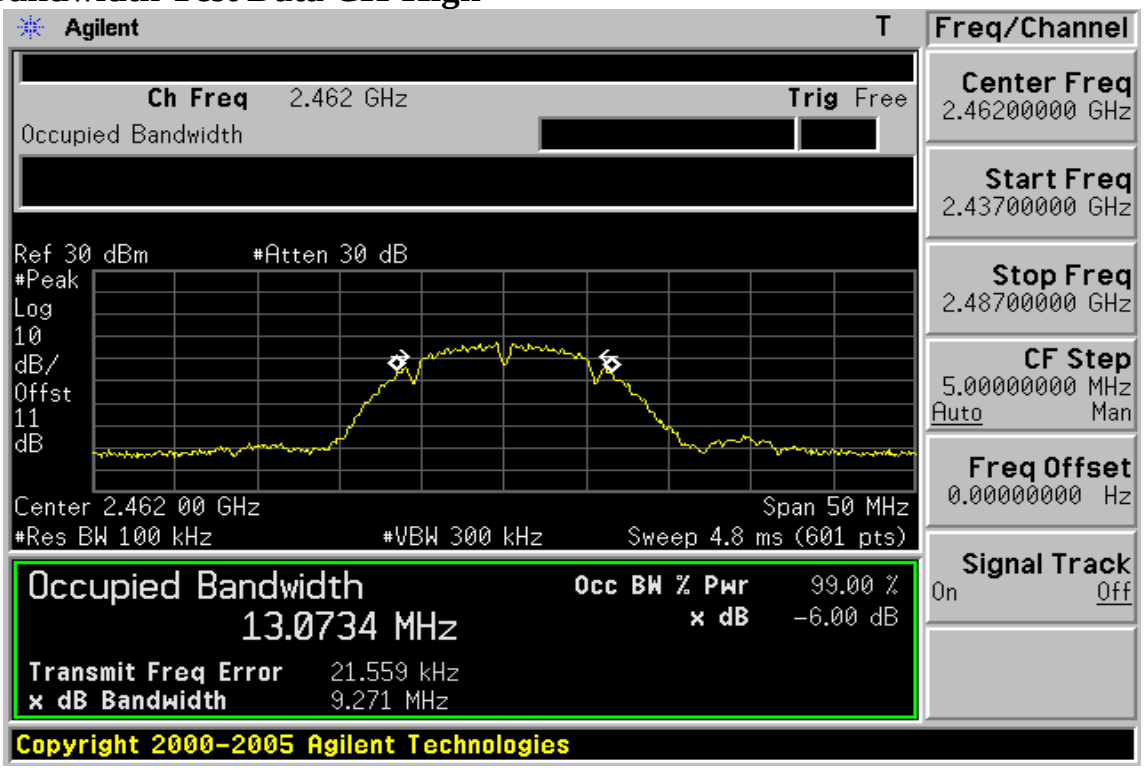
## 6dB Bandwidth Test Data CH-Low




## 6dB Bandwidth Test Data CH-Mid



# 6dB Bandwidth Test Data CH-High



# 9 100KHz BANDWIDTH OF BAND EDGES MEASUREMENT

## 9.1. Standard Applicable:

According to §15.247(c), in any 100 KHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator in operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100KHz bandwidth within the band that contains the highest level of the desired power, In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in15.209(a).

## 9.2. Measurement Equipment Used:

### 9.2.1. Conducted Emission at antenna port:

Refer to section 7.2 for details.

### 9.2.2. Radiated emission:

| 966 Chamber | | | | | |
|---|---|---|---|---|---|
| **EQUIPMENT TYPE** | **MFR** | **MODEL NUMBER** | **SERIAL NUMBER** | **LAST CAL.** | **CAL DUE.** |
| EMI Test Receiver | R&S | ESCI7 | 100759 | 05/20/2011 | 05/19/2012 |
| Spectrum Analyzer | Agilent | E4446A | MY51100003 | 04/15/2011 | 04/14/2013 |
| EXA Spectrum Analyzer | Agilent | N9010A | MY50420195 | 02/15/2011 | 02/14/2013 |
| Spectrum Analyzer | R&S | FSV-30 | 101398 | 10/18/2011 | 10/17/2013 |
| Bilog Antenna | SCHWAZBECK | VULB9168 | 378 | 01/10/2012 | 01/09/2014 |
| Horn antenna | ETS.LINDGREN | 3117 | 123995 | 05/19/2011 | 05/18/2013 |
| Horn Antenna | Schwarzbeck | BBHA9170 | 185 | 07/11/2011 | 07/10/2013 |
| Pre-Amplifier | Agilent | 8447D | 2944A07676 | 01/04/2012 | 01/03/2013 |
| Pre-Amplifier | EMC Instruments Corp. | EMC0126530 | 980038 | 01/04/2012 | 01/03/2013 |
| Filter 2400-2483.5 MHz | EWT | EWT-14-0166 | M2 | 05/25/2011 | 05/24/2012 |
| Attenuator | Mini-Circuit | BW-S10W2+ | 004 | 02/28/2012 | 02/27/2013 |
| Turn Table | HD | DT420 | N/A | N.C.R | N.C.R |
| Antenna Tower | HD | MA240-N | 240/657 | N.C.R | N.C.R |
| Controller | HD | HD100 | N/A | N.C.R | N.C.R |
| Low Loss Cable | Huber Suhner | 966_Rx | 9 | 01/04/2012 | 01/03/2013 |
| 3m Site NSA | SGS | 966 chamber | N/A | 07/15/2011 | 07/14/2012 |

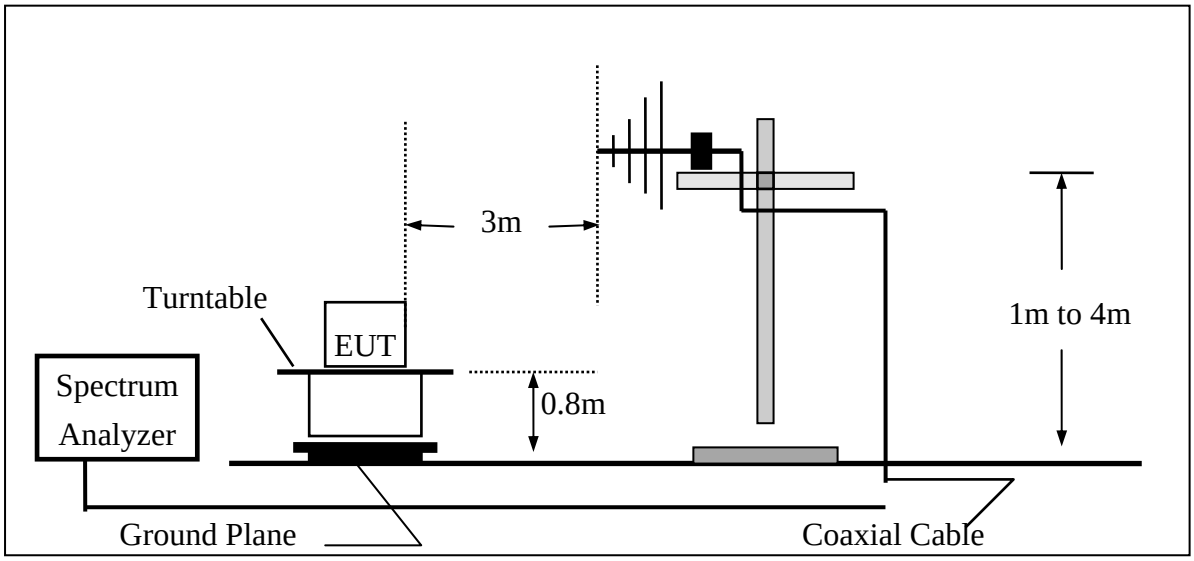
## 9.3. Test SET-UP:

### 9.3.1. Conducted Emission at antenna port:

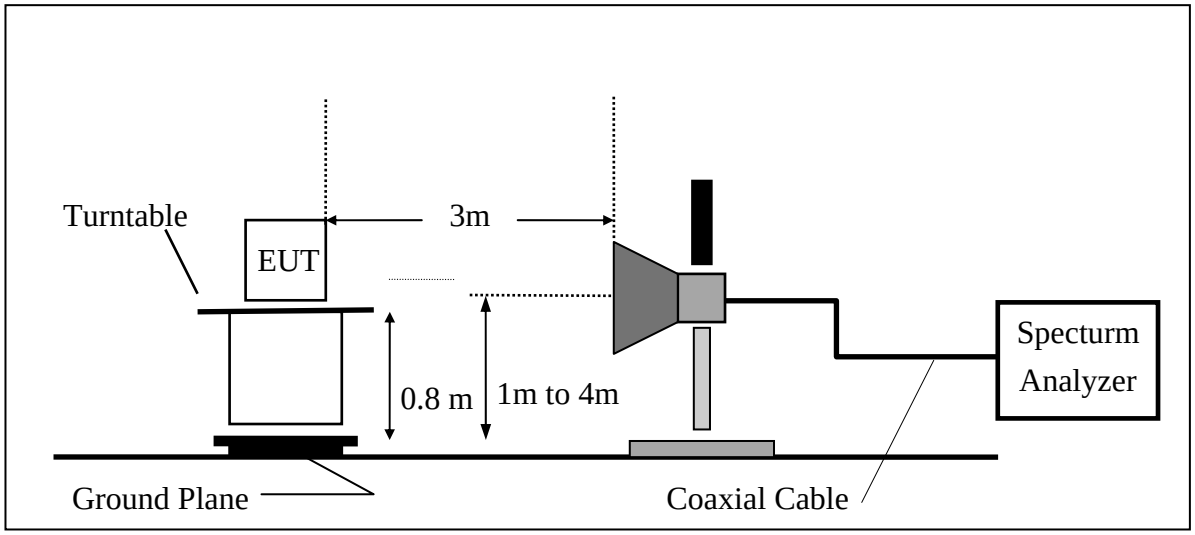
Refer to section 7.3 for details.

### 9.3.2. Radiated emission:

(A) Radiated Emission Test Set-Up, Frequency Below 1000MHz




(B) Radiated Emission Test Set-UP Frequency Over 1 GHz



## 9.4. Measurement Procedure:

1. Place the EUT on the table and set it in 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 center frequency of spectrum analyzer = operating frequency.
4. Set the spectrum analyzer as RBW, VBW=100KHz, Span=25MHz, Sweep = auto
5. Mark Peak, 2.310GHz – 2.390GHz and 2.4835GHz – 2.500GHz and record the max. level.
6. Repeat above procedures until all frequency measured were complete.

## 9.5. Field Strength Calculation:

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor(if any) from the measured reading. The basic equation with a sample calculation is as follows:

**FS = RA + AF + CL - AG**

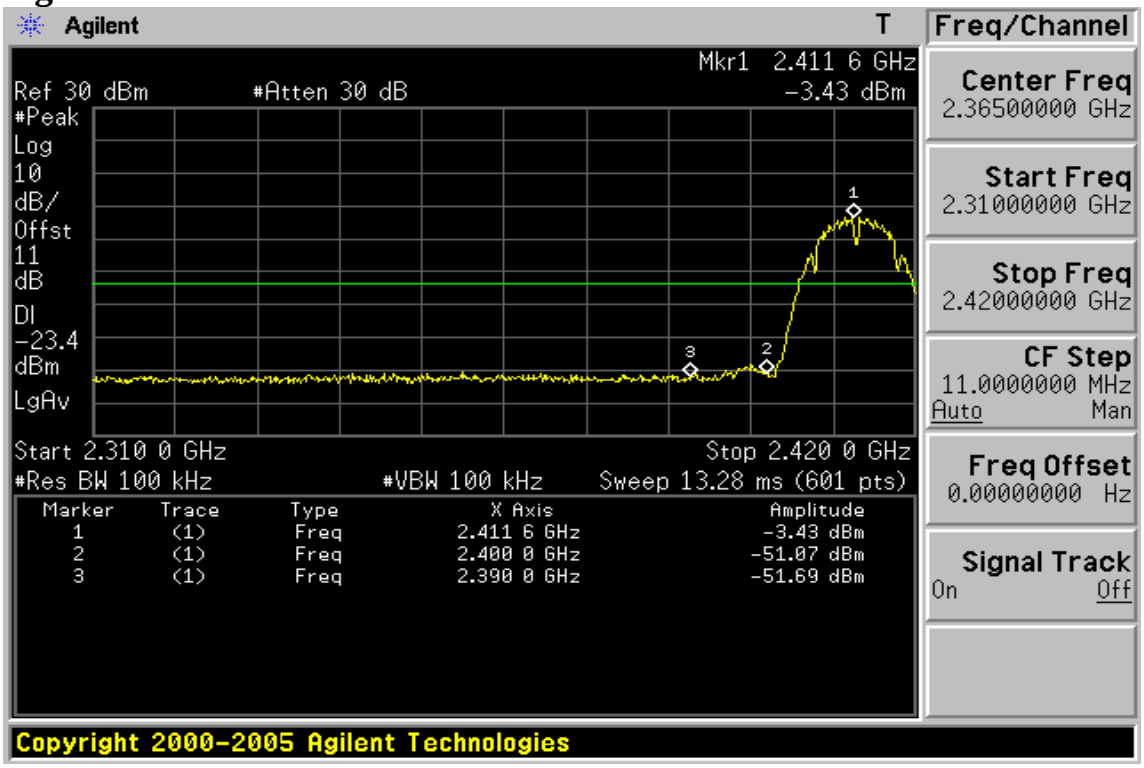
| | | |
|---|---|---|
| Where | FS = Field Strength | CL = Cable Attenuation Factor (Cable Loss) |
| | RA = Reading Amplitude | AG = Amplifier Gain |
| | AF = Antenna Factor | |

## 9.6. Measurement Result:

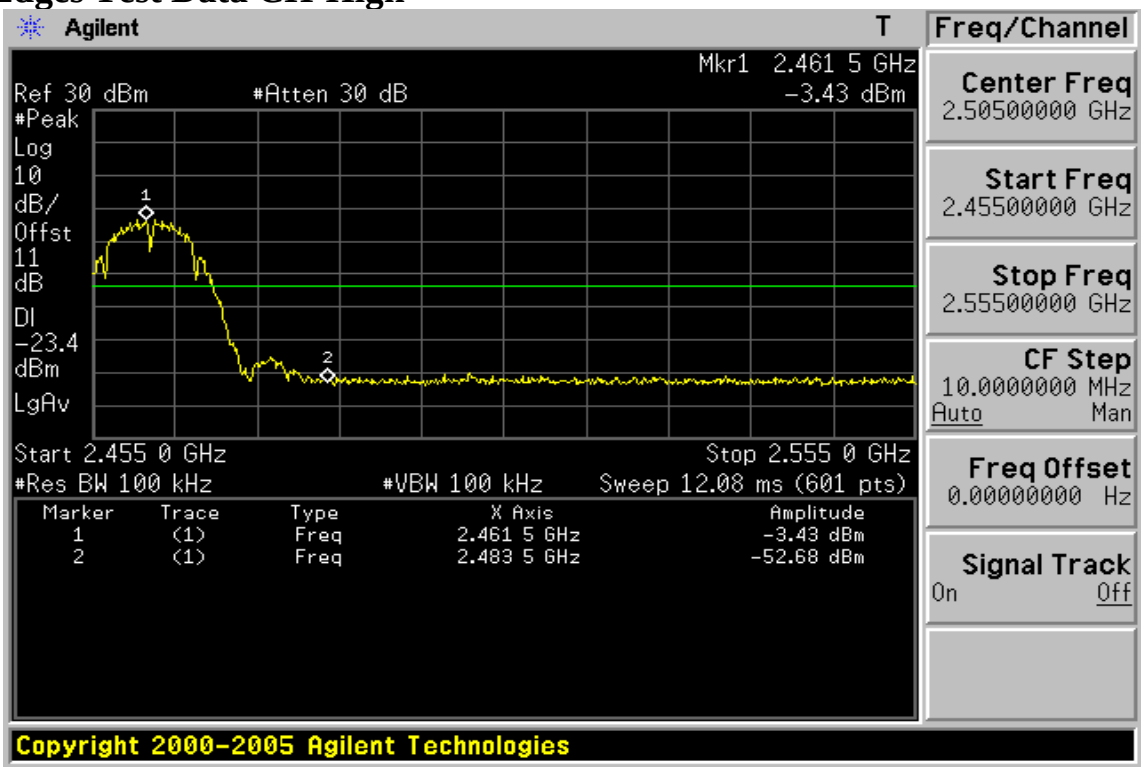
Note: Refer to next page spectrum analyzer data chart and tabular data sheets.

# 802.11b

## Band Edges Test Data CH-Low




## Band Edges Test Data CH-High



**Radiated Emission: 802.11 b mode**

| | | | |
|---|---|---|---|
| Operation Band | :802.11b | Test Date | :2012-04-09 |
| Fundamental Frequency | :2412 MHz | Temp./Humi. | :27 deg_C / 66 RH |
| Operation Mode | :TX LOW Bandedge | Engineer | :Jay |
| EUT Pol. | :E2 Plan | Measurement Antenna Pol. | :VERTICAL |

Actual FS(dBμV / m) = SPA. Reading level(dBμV) + Factor(dB)

Factor(dB) = Antenna Factor(dBμV / m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

Note : "F" : denotes Fundamental Frequency. ; "H" : denotes Harmonic Frequency.
"E" : denotes Band Edge Frequency. ; "S" : denotes Spurious Frequency.
"---" : denotes Noise Floor.

| Freq. | Note | Detector Mode | Spectrum Reading Level | Factor | Actual FS | Limit @3m | Safe Margin |
|---|---|---|---|---|---|---|---|
| MHz | F/H/E/S | PK/QP/AV | dBμV | dB | dBμV / m | dBμV / m | dB |
| 2390.00 | E | Average | 33.28 | 4.68 | 37.96 | 54.00 | -16.04 |
| 2390.00 | E | Peak | 47.08 | 4.68 | 51.76 | 74.00 | -22.24 |

| | | | |
|---|---|---|---|
| Operation Band | :802.11b | Test Date | :2012-04-09 |
| Fundamental Frequency | :2412 MHz | Temp./Humi. | :27 deg_C / 66 RH |
| Operation Mode | :TX LOW Bandedge | Engineer | :Jay |
| EUT Pol. | :E2 Plan | Measurement Antenna Pol. | :HORIZONTAL |

Actual FS(dBμV / m) = SPA. Reading level(dBμV) + Factor(dB)

Factor(dB) = Antenna Factor(dBμV / m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

Note : "F" : denotes Fundamental Frequency. ; "H" : denotes Harmonic Frequency.
"E" : denotes Band Edge Frequency. ; "S" : denotes Spurious Frequency.
"---" : denotes Noise Floor.

| Freq. | Note | Detector Mode | Spectrum Reading Level | Factor | Actual FS | Limit @3m | Safe Margin |
|---|---|---|---|---|---|---|---|
| MHz | F/H/E/S | PK/QP/AV | dBμV | dB | dBμV / m | dBμV / m | dB |
| 2390.00 | E | Average | 33.69 | 5.30 | 38.99 | 54.00 | -15.01 |
| 2390.00 | E | Peak | 46.64 | 5.30 | 51.94 | 74.00 | -22.06 |

| | | | |
|---|---|---|---|
| Operation Band | :802.11b | Test Date | :2012-04-09 |
| Fundamental Frequency | :2462 MHz | Temp./Humi. | :27 deg_C / 66 RH |
| Operation Mode | :TX HIGH Bandedge | Engineer | :Jay |
| EUT Pol. | :E2 Plan | Measurement Antenna Pol. | :VERTICAL |

Actual FS(dBμV / m) = SPA. Reading level(dBμV) + Factor(dB)

Factor(dB) = Antenna Factor(dBμV / m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

Note : "F" : denotes Fundamental Frequency. ; "H" : denotes Harmonic Frequency.
"E" : denotes Band Edge Frequency. ; "S" : denotes Spurious Frequency.
"---" : denotes Noise Floor.

| Freq. | Note | Detector Mode | Spectrum Reading Level | Factor | Actual FS | Limit @3m | Safe Margin |
|---|---|---|---|---|---|---|---|
| MHz | F/H/E/S | PK/QP/AV | dBμV | dB | dBμV / m | dBμV / m | dB |
| 2483.50 | E | Average | 33.05 | 5.26 | 38.31 | 54.00 | -15.69 |
| 2483.50 | E | Peak | 46.01 | 5.26 | 51.27 | 74.00 | -22.73 |

| | | | |
|---|---|---|---|
| Operation Band | :802.11b | Test Date | :2012-04-09 |
| Fundamental Frequency | :2462 MHz | Temp./Humi. | :27 deg_C / 66 RH |
| Operation Mode | :TX HIGH Bandedge | Engineer | :Jay |
| EUT Pol. | :E2 Plan | Measurement Antenna Pol. | :HORIZONTAL |

Actual FS(dBμV / m) = SPA. Reading level(dBμV) + Factor(dB)

Factor(dB) = Antenna Factor(dBμV / m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

Note : "F" : denotes Fundamental Frequency. ; "H" : denotes Harmonic Frequency.
"E" : denotes Band Edge Frequency. ; "S" : denotes Spurious Frequency.
"---" : denotes Noise Floor.

| Freq. | Note | Detector Mode | Spectrum Reading Level | Factor | Actual FS | Limit @3m | Safe Margin |
|---|---|---|---|---|---|---|---|
| MHz | F/H/E/S | PK/QP/AV | dBμV | dB | dBμV / m | dBμV / m | dB |
| 2483.50 | E | Average | 33.02 | 6.29 | 39.31 | 54.00 | -14.69 |
| 2483.50 | E | Peak | 45.69 | 6.29 | 51.98 | 74.00 | -22.02 |

# 10 SPURIOUS RADIATED EMISSION TEST

## 10.1 Standard Applicable

According to §15.247(c), all other emissions outside these bands shall not exceed the general radiated emission limits specified in §15.209(a). And according to §15.33(a)(1), for an intentional radiator operates below 10GHz, the frequency range of measurements: to the tenth harmonic of the highest fundamental frequency or to 40GHz, whichever is lower.

## 10.2 Measurement Equipment Used:

### 10.2.1. Conducted Emission at antenna port:

Refer to section 7.2 for details.

### 10.2.2. Radiated emission:

Refer to section 9.2.2 for details.

## 10.3 Test SET-UP:

### 10.3.1. Conducted Emission at antenna port:

Refer to section 7.3 for details.

### 10.3.2. Radiated emission:

Refer to section 9.3.2 for details.

## 10.4 Measurement Procedure:

**Radiated Emission:**

1. The EUT was placed on a turn table which is 0.8m above ground plane.
2. The turn table shall rotate 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emissions.
4. When measurement procedures for electric field radiated emissions above 1 GHz the EUT measurement is to be made "while keeping the antenna in the 'cone of radiation' from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response." is still within the 3dB illumination BW of the measurement antenna.
5. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
6. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
7. Repeat above procedures until all frequency measured were complete.

**Conducted Emission:**

1. To connect Antenna Port of EUT to Spectrum.
2. Set RBW = 100K & VBW = 100K on Spectrum.
3. Sweep the frequency to determine spurious emission as seen on spectrum from span of 30M to 3G and 3G to 26.5G for 2.4G, 30M to 6G, 6G to 18G and 18G to 40G for 5G.
4. Via Software, combine 5 spans of frequency range into one plot

## 10.5 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor(if any) from the measured reading. The basic equation with a sample calculation is as follows:

**FS = RA + AF + CL - AG**

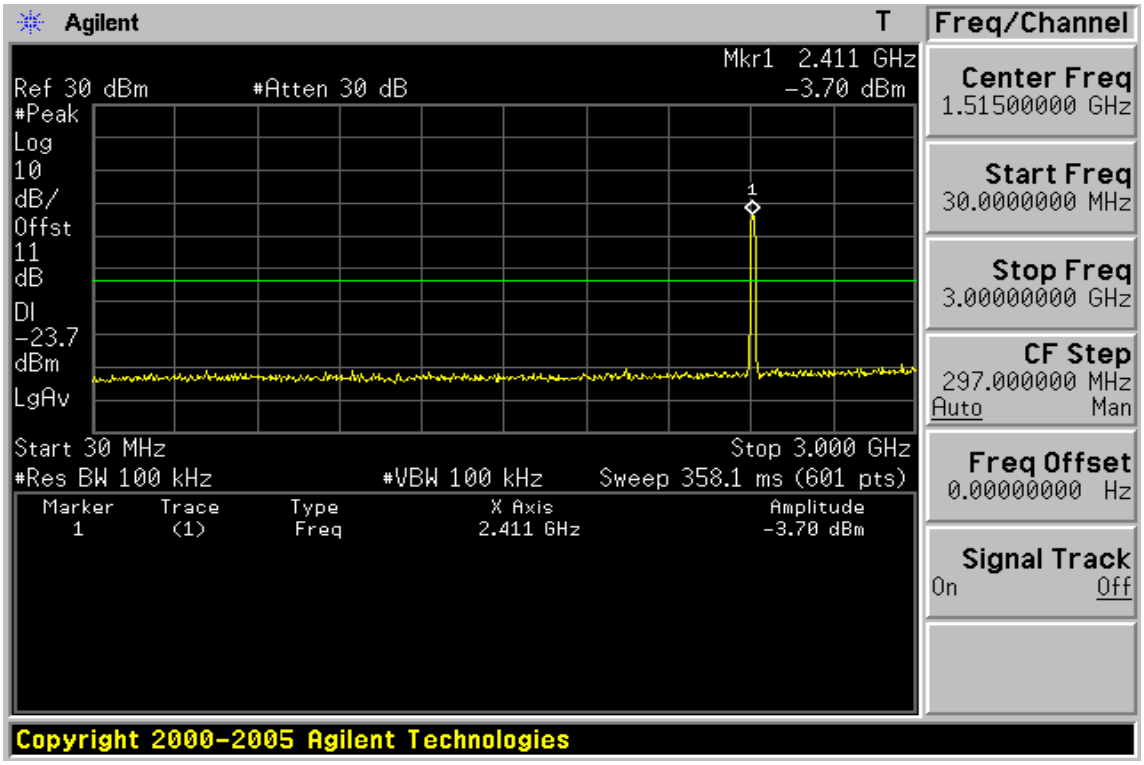
| | | |
|---|---|---|
| Where | FS = Field Strength | CL = Cable Attenuation Factor (Cable Loss) |
| | RA = Reading Amplitude | AG = Amplifier Gain |
| | AF = Antenna Factor | |

## 10.6 Measurement Result:

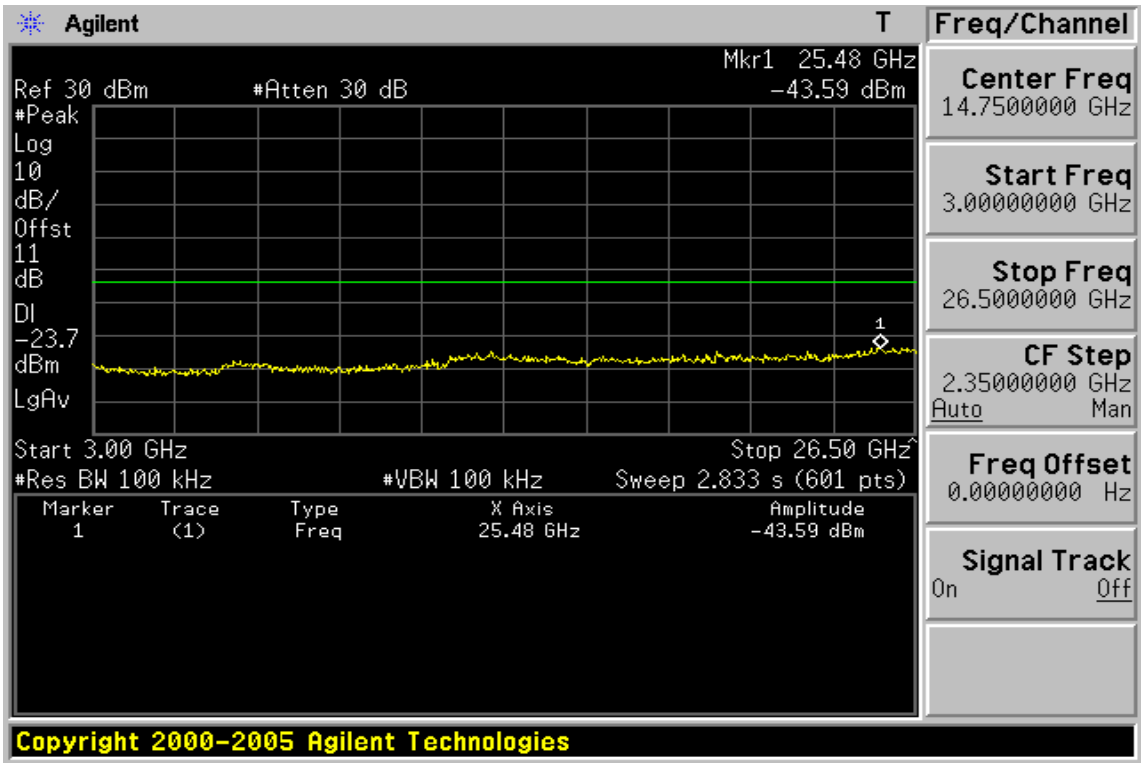
Note: Refer to next page spectrum analyzer data chart and tabular data sheets.

# Conducted Spurious Emission Measurement Result (802.11b)

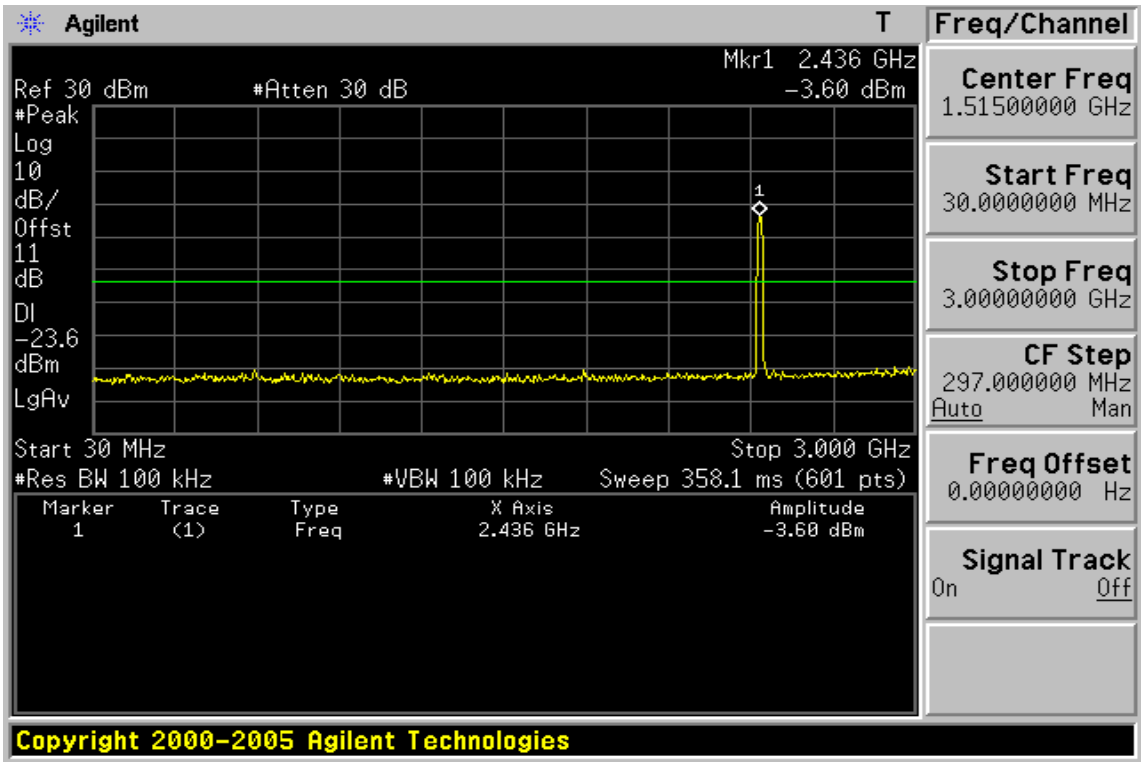
## Ch Low 30MHz – 3GHz



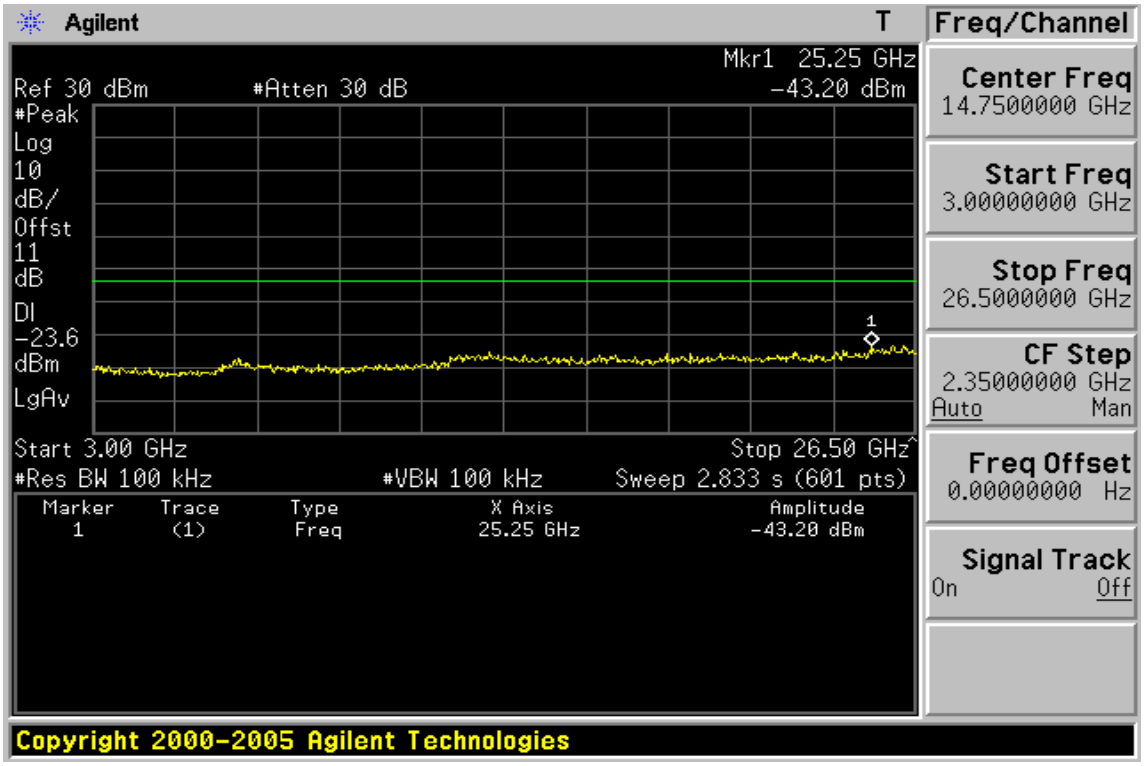

## Ch Low 3GHz – 26.5GHz



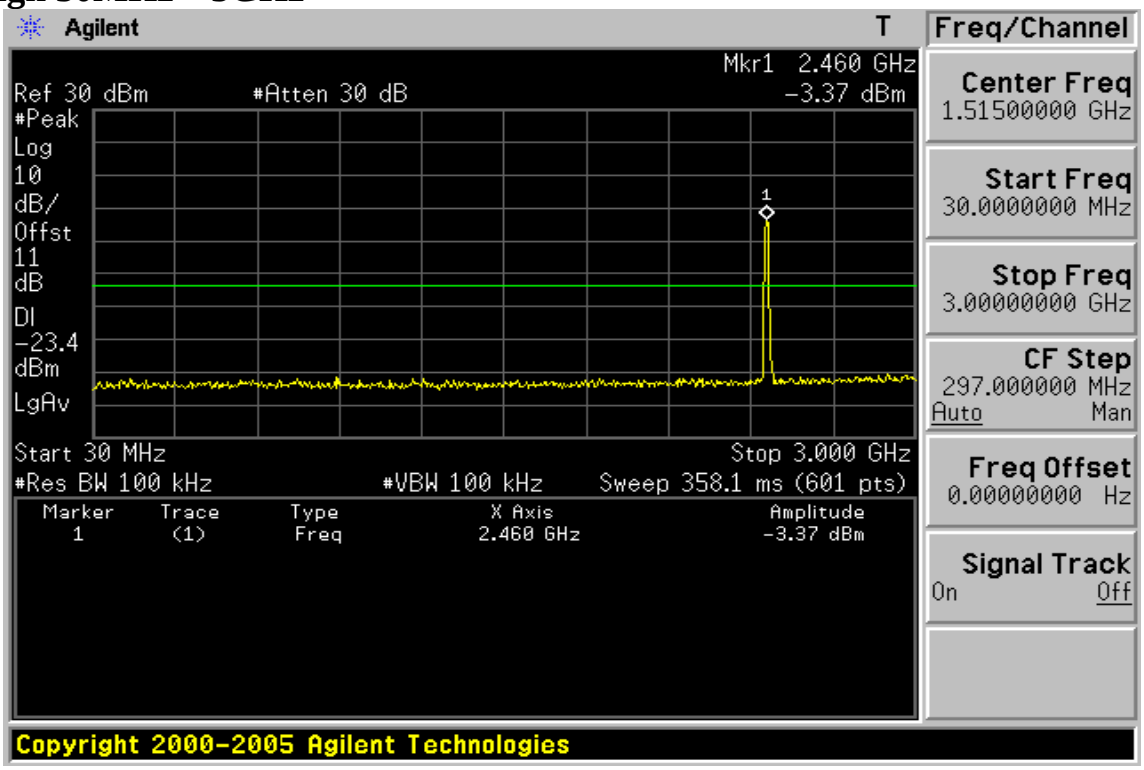
## Ch Mid 30MHz – 3GHz



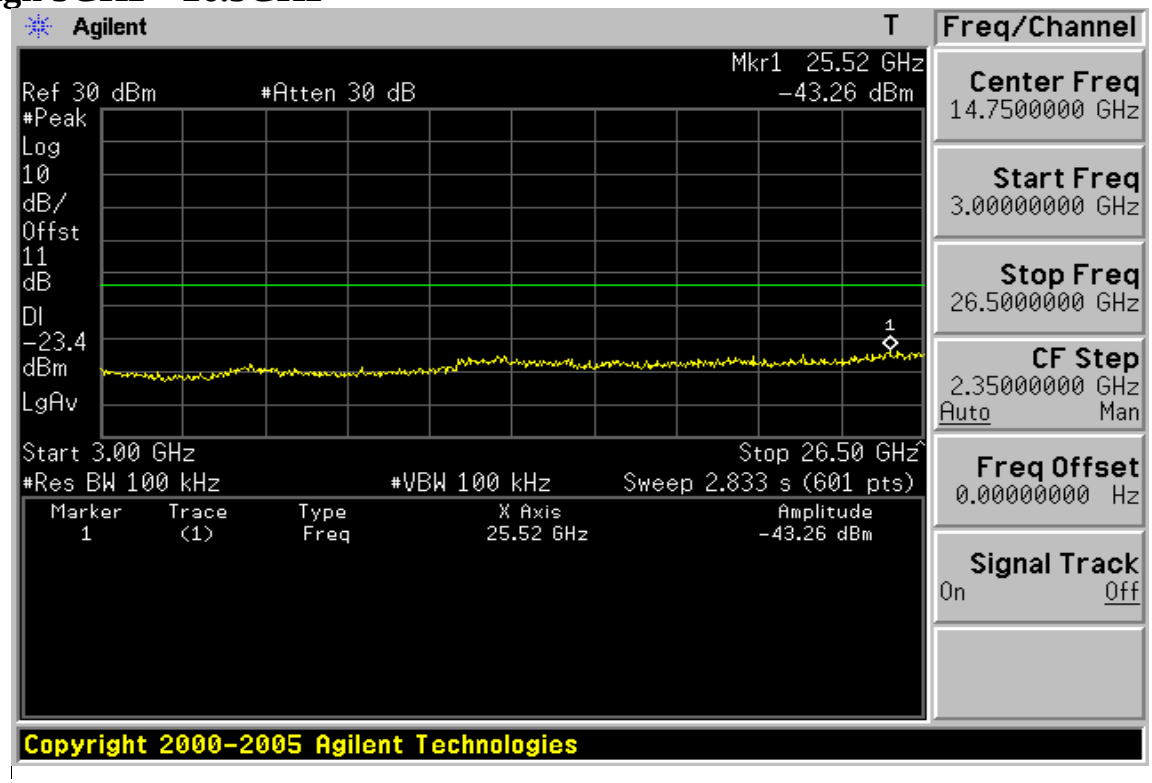

## Ch Mid 3GHz – 26.5GHz



## Ch High 30MHz – 3GHz




## Ch High 3GHz – 26.5GHz



## Radiated Spurious Emission Measurement Result

| | | | |
|---|---|---|---|
| Operation Band | :802.11b | Test Date | :2012-04-09 |
| Fundamental Frequency | :2412 MHz | Temp./Humi. | :27 deg_C / 66 RH |
| Operation Mode | :TX LOW | Engineer | :Jay |
| EUT Pol. | :E2 Plan | Measurement Antenna Pol. | :VERTICAL |

Actual FS(dBμV / m) = SPA. Reading level(dBμV) + Factor(dB)

Factor(dB) = Antenna Factor(dBμV / m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

Note : "F" : denotes Fundamental Frequency. ; "H" : denotes Harmonic Frequency.
"E" : denotes Band Edge Frequency. ; "S" : denotes Spurious Frequency.
"---" : denotes Noise Floor.

| Freq. | Note | Detector Mode | Spectrum Reading Level | Factor | Actual FS | Limit @3m | Safe Margin |
|---|---|---|---|---|---|---|---|
| MHz | F/H/E/S | PK/QP/AV | dBμV | dB | dBμV / m | dBμV / m | dB |
| 143.49 | S | Peak | 41.63 | -12.82 | 28.81 | 43.50 | -14.69 |
| 283.17 | S | Peak | 39.70 | -12.97 | 26.73 | 46.00 | -19.27 |
| 335.55 | S | Peak | 38.66 | -11.86 | 26.80 | 46.00 | -19.20 |
| 495.60 | S | Peak | 37.63 | -9.63 | 28.00 | 46.00 | -18.00 |
| 724.52 | S | Peak | 35.97 | -5.37 | 30.60 | 46.00 | -15.40 |
| 799.21 | S | Peak | 39.94 | -4.21 | 35.73 | 46.00 | -10.27 |
| 4824.00 | H | Peak | 34.64 | 9.56 | 44.20 | 74.00 | -29.80 |
| 7236.00 | H | --- | | | | | |
| 9648.00 | H | --- | | | | | |
| 12060.00 | H | --- | | | | | |
| 14472.00 | H | --- | | | | | |
| 16884.00 | H | --- | | | | | |
| 19296.00 | H | --- | | | | | |
| 21708.00 | H | --- | | | | | |
| 24120.00 | H | --- | | | | | |

| | | | |
|---|---|---|---|
| Operation Band | :802.11b | Test Date | :2012-04-09 |
| Fundamental Frequency | :2412 MHz | Temp./Humi. | :27 deg_C / 66 RH |
| Operation Mode | :TX LOW | Engineer | :Jay |
| EUT Pol. | :E2 Plan | Measurement Antenna Pol. | :HORIZONTAL |

Actual FS(dBμV / m) = SPA. Reading level(dBμV) + Factor(dB)

Factor(dB) = Antenna Factor(dBμV / m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

Note : "F" : denotes Fundamental Frequency. ; "H" : denotes Harmonic Frequency.
"E" : denotes Band Edge Frequency. ; "S" : denotes Spurious Frequency.
"---" : denotes Noise Floor.

| Freq. | Note | Detector Mode | Spectrum Reading Level | Factor | Actual FS | Limit @3m | Safe Margin |
|---|---|---|---|---|---|---|---|
| MHz | F/H/E/S | PK/QP/AV | dBμV | dB | dBμV / m | dBμV / m | dB |
| 165.80 | S | Peak | 39.23 | -12.77 | 26.46 | 43.50 | -17.04 |
| 277.35 | S | Peak | 42.34 | -13.13 | 29.21 | 46.00 | -16.79 |
| 408.30 | S | Peak | 38.92 | -10.88 | 28.04 | 46.00 | -17.96 |
| 600.36 | S | Peak | 31.81 | -7.55 | 24.26 | 46.00 | -21.74 |
| 724.52 | S | Peak | 39.92 | -5.37 | 34.55 | 46.00 | -11.45 |
| 773.02 | S | Peak | 40.32 | -4.56 | 35.76 | 46.00 | -10.24 |
| 4824.00 | H | Peak | 34.29 | 9.57 | 43.86 | 74.00 | -30.14 |
| 7236.00 | H | --- | | | | | |
| 9648.00 | H | --- | | | | | |
| 12060.00 | H | --- | | | | | |
| 14472.00 | H | --- | | | | | |
| 16884.00 | H | --- | | | | | |
| 19296.00 | H | --- | | | | | |
| 21708.00 | H | --- | | | | | |
| 24120.00 | H | --- | | | | | |

| | | | |
|---|---|---|---|
| Operation Band | :802.11b | Test Date | :2012-04-09 |
| Fundamental Frequency | :2437 MHz | Temp./Humi. | :27 deg_C / 66 RH |
| Operation Mode | :TX MID | Engineer | :Jay |
| EUT Pol. | :E2 Plan | Measurement Antenna Pol. | :VERTICAL |

Actual FS(dBμV / m) = SPA. Reading level(dBμV) + Factor(dB)

Factor(dB) = Antenna Factor(dBμV / m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

Note : "F" : denotes Fundamental Frequency. ; "H" : denotes Harmonic Frequency.
"E" : denotes Band Edge Frequency. ; "S" : denotes Spurious Frequency.
"---" : denotes Noise Floor.

| Freq. | Note | Detector Mode | Spectrum Reading Level | Factor | Actual FS | Limit @3m | Safe Margin |
|---|---|---|---|---|---|---|---|
| MHz | F/H/E/S | PK/QP/AV | dBμV | dB | dBμV / m | dBμV / m | dB |
| 151.25 | S | Peak | 40.96 | -12.34 | 28.62 | 43.50 | -14.88 |
| 284.14 | S | Peak | 38.98 | -12.94 | 26.04 | 46.00 | -19.96 |
| 354.95 | S | Peak | 36.41 | -11.61 | 24.80 | 46.00 | -21.20 |
| 495.60 | S | Peak | 38.33 | -9.63 | 28.70 | 46.00 | -17.30 |
| 724.52 | S | Peak | 36.20 | -5.37 | 30.83 | 46.00 | -15.17 |
| 796.30 | S | Peak | 40.43 | -4.24 | 36.19 | 46.00 | -9.81 |
| 4874.00 | H | Peak | 34.16 | 10.12 | 44.28 | 74.00 | -29.72 |
| 7311.00 | H | --- | | | | | |
| 9748.00 | H | --- | | | | | |
| 12185.00 | H | --- | | | | | |
| 14622.00 | H | --- | | | | | |
| 17059.00 | H | --- | | | | | |
| 19496.00 | H | --- | | | | | |
| 21933.00 | H | --- | | | | | |
| 24370.00 | H | --- | | | | | |

| | | | |
|---|---|---|---|
| Operation Band | :802.11b | Test Date | :2012-04-09 |
| Fundamental Frequency | :2437 MHz | Temp./Humi. | :27 deg_C / 66 RH |
| Operation Mode | :TX MID | Engineer | :Jay |
| EUT Pol. | :E2 Plan | Measurement Antenna Pol. | :HORIZONTAL |

Actual FS(dBμV / m) = SPA. Reading level(dBμV) + Factor(dB)

Factor(dB) = Antenna Factor(dBμV / m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

Note : "F" : denotes Fundamental Frequency. ; "H" : denotes Harmonic Frequency.
"E" : denotes Band Edge Frequency. ; "S" : denotes Spurious Frequency.
"---" : denotes Noise Floor.

| Freq. | Note | Detector Mode | Spectrum Reading Level | Factor | Actual FS | Limit @3m | Safe Margin |
|---|---|---|---|---|---|---|---|
| MHz | F/H/E/S | PK/QP/AV | dBμV | dB | dBμV / m | dBμV / m | dB |
| 165.80 | S | Peak | 40.49 | -12.77 | 27.72 | 43.50 | -15.78 |
| 280.26 | S | Peak | 42.74 | -13.04 | 29.70 | 46.00 | -16.30 |
| 321.00 | S | Peak | 39.81 | -12.08 | 27.73 | 46.00 | -18.27 |
| 499.48 | S | Peak | 32.79 | -9.60 | 23.19 | 46.00 | -22.81 |
| 700.27 | S | Peak | 34.81 | -5.75 | 29.06 | 46.00 | -16.94 |
| 773.02 | S | Peak | 40.55 | -4.56 | 35.99 | 46.00 | -10.01 |
| 4874.00 | H | Peak | 34.40 | 10.07 | 44.47 | 74.00 | -29.53 |
| 7311.00 | H | --- | | | | | |
| 9748.00 | H | --- | | | | | |
| 12185.00 | H | --- | | | | | |
| 14622.00 | H | --- | | | | | |
| 17059.00 | H | --- | | | | | |
| 19496.00 | H | --- | | | | | |
| 21933.00 | H | --- | | | | | |
| 24370.00 | H | --- | | | | | |

| | | | |
|---|---|---|---|
| Operation Band | :802.11b | Test Date | :2012-04-09 |
| Fundamental Frequency | :2462 MHz | Temp./Humi. | :27 deg_C / 66 RH |
| Operation Mode | :TX HIGH | Engineer | :Jay |
| EUT Pol. | :E2 Plan | Measurement Antenna Pol. | :VERTICAL |

Actual FS(dBμV / m) = SPA. Reading level(dBμV) + Factor(dB)

Factor(dB) = Antenna Factor(dBμV / m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

Note : "F" : denotes Fundamental Frequency. ; "H" : denotes Harmonic Frequency.
"E" : denotes Band Edge Frequency. ; "S" : denotes Spurious Frequency.
"---" : denotes Noise Floor.

| Freq. | Note | Detector Mode | Spectrum Reading Level | Factor | Actual FS | Limit @3m | Safe Margin |
|---|---|---|---|---|---|---|---|
| MHz | F/H/E/S | PK/QP/AV | dBμV | dB | dBμV / m | dBμV / m | dB |
| 148.34 | S | Peak | 41.33 | -12.45 | 28.88 | 43.50 | -14.62 |
| 344.28 | S | Peak | 37.65 | -11.76 | 25.89 | 46.00 | -20.11 |
| 495.60 | S | Peak | 37.75 | -9.63 | 28.12 | 46.00 | -17.88 |
| 533.43 | S | Peak | 35.35 | -8.92 | 26.43 | 46.00 | -19.57 |
| 627.52 | S | Peak | 32.27 | -6.97 | 25.30 | 46.00 | -20.70 |
| 796.30 | S | Peak | 39.16 | -4.24 | 34.92 | 46.00 | -11.08 |
| 4924.00 | H | Peak | 34.47 | 9.95 | 44.42 | 74.00 | -29.58 |
| 7386.00 | H | --- | | | | | |
| 9848.00 | H | --- | | | | | |
| 12310.00 | H | --- | | | | | |
| 14772.00 | H | --- | | | | | |
| 17234.00 | H | --- | | | | | |
| 19696.00 | H | --- | | | | | |
| 22158.00 | H | --- | | | | | |
| 24620.00 | H | --- | | | | | |

| | | | |
|---|---|---|---|
| Operation Band | :802.11b | Test Date | :2012-04-09 |
| Fundamental Frequency | :2462 MHz | Temp./Humi. | :27 deg_C / 66 RH |
| Operation Mode | :TX HIGH | Engineer | :Jay |
| EUT Pol. | :E2 Plan | Measurement Antenna Pol. | :HORIZONTAL |

Actual FS(dBμV / m) = SPA. Reading level(dBμV) + Factor(dB)

Factor(dB) = Antenna Factor(dBμV / m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

Note : "F" : denotes Fundamental Frequency. ; "H" : denotes Harmonic Frequency.
"E" : denotes Band Edge Frequency. ; "S" : denotes Spurious Frequency.
"---" : denotes Noise Floor.

| Freq. | Note | Detector Mode | Spectrum Reading Level | Factor | Actual FS | Limit @3m | Safe Margin |
|---|---|---|---|---|---|---|---|
| MHz | F/H/E/S | PK/QP/AV | dBμV | dB | dBμV / m | dBμV / m | dB |
| 166.77 | S | Peak | 39.89 | -12.87 | 27.02 | 43.50 | -16.48 |
| 239.52 | S | Peak | 40.96 | -14.21 | 26.75 | 46.00 | -19.25 |
| 294.81 | S | Peak | 40.94 | -12.69 | 28.25 | 46.00 | -17.75 |
| 408.30 | S | Peak | 37.25 | -10.88 | 26.37 | 46.00 | -19.63 |
| 724.52 | S | Peak | 40.01 | -5.37 | 34.64 | 46.00 | -11.36 |
| 772.05 | S | Peak | 40.80 | -4.57 | 36.23 | 46.00 | -9.77 |
| 4924.00 | H | Peak | 33.60 | 9.84 | 43.44 | 74.00 | -30.56 |
| 7386.00 | H | --- | | | | | |
| 9848.00 | H | --- | | | | | |
| 12310.00 | H | --- | | | | | |
| 14772.00 | H | --- | | | | | |
| 17234.00 | H | --- | | | | | |
| 19696.00 | H | --- | | | | | |
| 22158.00 | H | --- | | | | | |
| 24620.00 | H | --- | | | | | |

# 11 PEAK POWER SPECTRAL DENSITY

## 11.1 Standard Applicable:

According to §15.247(e) For digitally modulated systems, the 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. 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.

## 11.2 Measurement Equipment Used:

Refer to section 7.2 for details.

## 11.3 Test Set-up:

Refer to section 7.3 for details.

## 11.4 Measurement Procedure:

1. Place the EUT on the table and set it in 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 = 3KHz, VBW = 10KHz, Span = 300KHz, Sweep=100s
4. Record the max. reading.
5. Repeat above procedures until all frequency measured were complete.

## 11.5 Measurement Result:

**802.11b**

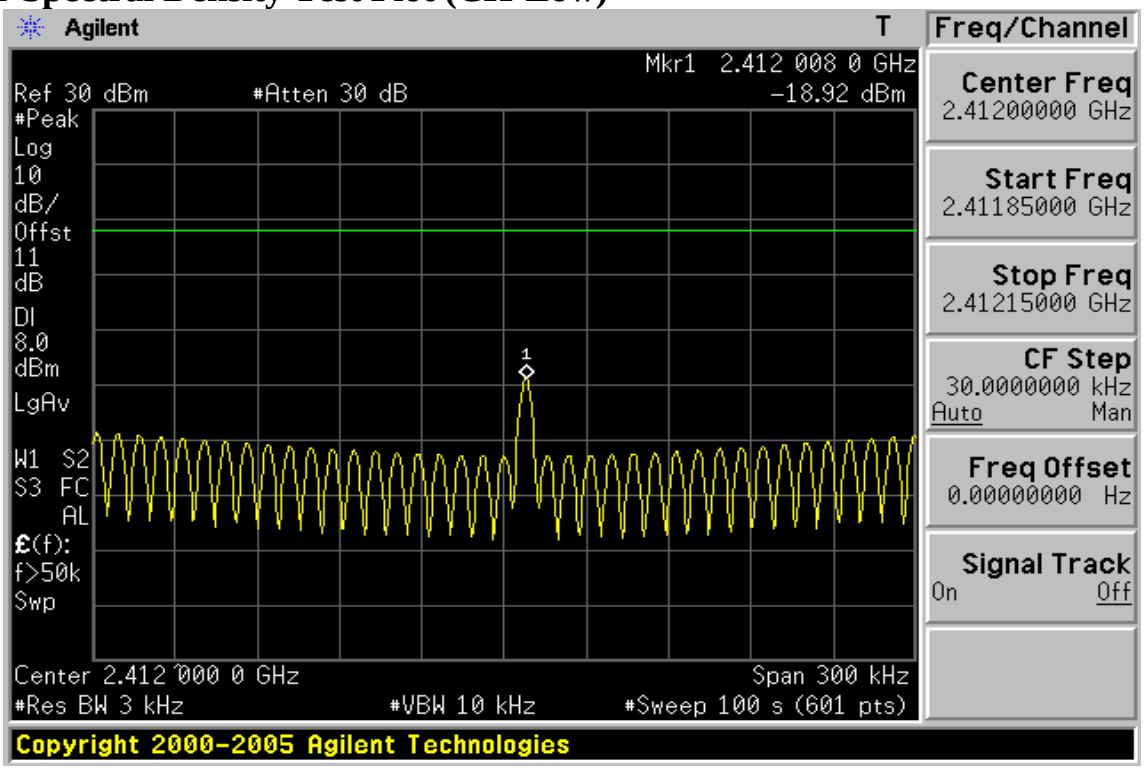
| Frequency MHz | RF Power Density Reading (dBm) | RF Power Density Level (dBm) | Maximum Limit (dBm) |
|---|---|---|---|
| 2412 | -18.92 | -18.92 | 8 |
| 2437 | -19.26 | -19.26 | 8 |
| 2462 | -19.19 | -19.19 | 8 |

**Note: Offset: 11 dB*

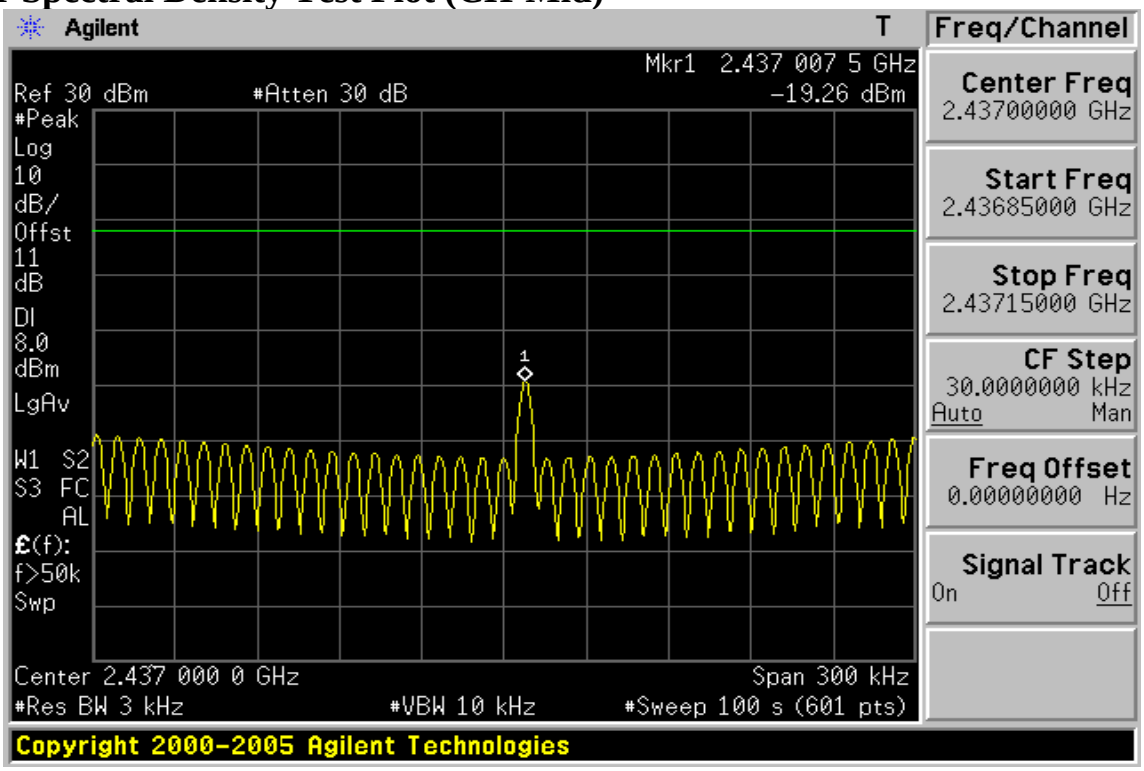
Note: Refer to next page for plots.

## 802.11b

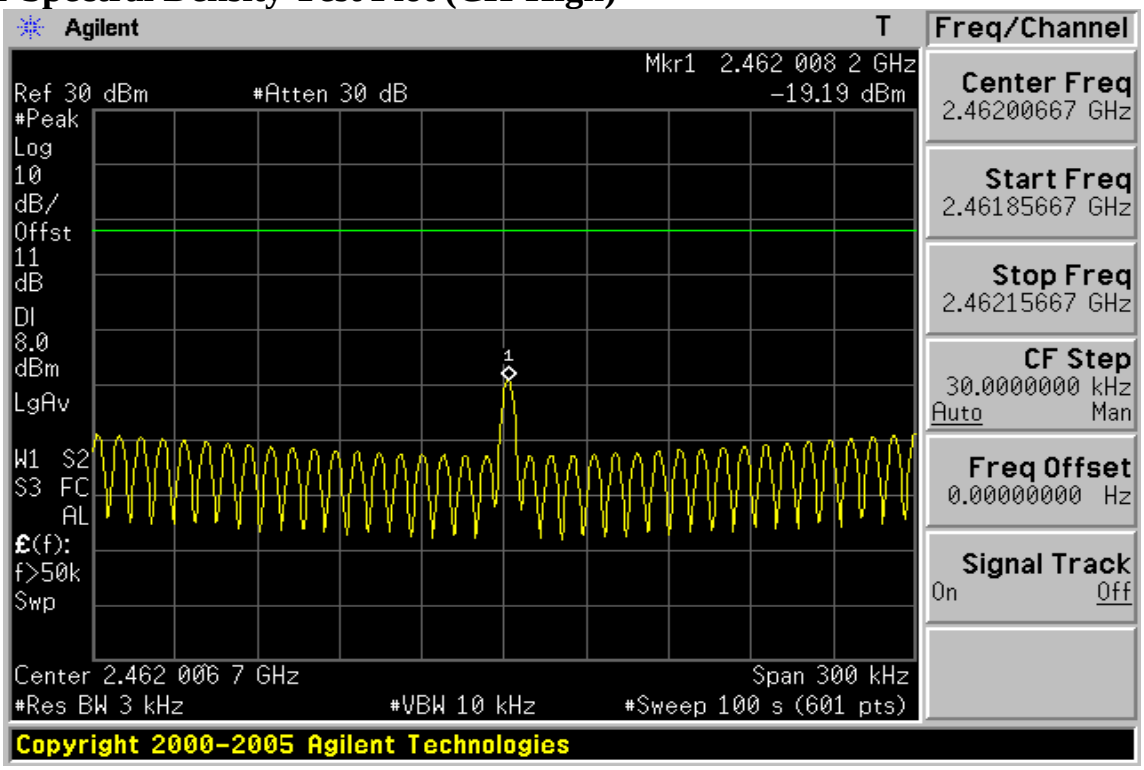
## Power Spectral Density Test Plot (CH-Low)




## Power Spectral Density Test Plot (CH-Mid)



# Power Spectral Density Test Plot (CH-High)



# 12 ANTENNA REQUIREMENT

## 12.1. Standard Applicable:

According to §15.203, Antenna requirement.

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. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of Sections 15.211, 15.213, 15.217, 15.219, or 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with Section 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded.

## 12.2. Antenna Connected Construction:

The directional gains of antenna used for transmitting is -3.06dBi and the antenna connector is designed with permanent attachment and no consideration of replacement. Please see EUT photo for details.