# FCC 47 CFR PART 15 SUBPART C AND ANSI C63.4: 2003

# TEST REPORT

**For**

**AirCruiser N300 Mini Card**

**Model: GN-WS30N-RH**

**Brand: GIGA-BYTE**

**Issued for**

**GIGA-BYTE TECHNOLOGY CO., LTD.**

**No.6, Bau Chiang Road, Hsin-Tien, Taipei Hsien, Taiwan, R.O.C.**

**Issued by**

**Compliance Certification Services Inc.**
**Tainan Lab.**
**No. 8, Jiu Cheng Ling, Jiaokeng Village,Sinhua Township, Tainan Hsien 712, Taiwan R.O.C.**
**TEL: 886-6-580-2201**
**FAX: 886-6-580-2202**

NVLAP LAB CODE 200627-0

Testing Laboratory 1109



*Total Page: 173*

# Revision History

| Rev. | | Issue Date | | Revisions | Effect Page | Revised By |
|---|---|---|---|---|---|---|
| 00 | | Sep. 28, 2007 | | Initial Issue | ALL | Leah Peng |
| | | | | | | |
| | | | | | | |

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# 1. TEST REPORT CERTIFICATION

| | |
|---|---|
| **Applicant** | : GIGA-BYTE TECHNOLOGY CO., LTD. |
| **Address** | : No.6, Bau Chiang Road, Hsin-Tien, Taipei Hsien, Taiwan, R.O.C. |
| **Manufacture** | : GIGA-BYTE TECHNOLOGY CO., LTD. |
| **Address** | : No.6, Bau Chiang Road, Hsin-Tien, Taipei Hsien, Taiwan, R.O.C. |
| **Equipment Under Test** | : AirCruiser N300 Mini Card |
| **Model Number** | : GN-WS30N-RH |
| **Brand Name** | : GIGA-BYTE |
| **Date of Test** | : September 13, 2007 ~ October 26, 2007 |

| **APPLICABLE STANDARD** | |
|---|---|
| **STANDARD** | **TEST RESULT** |
| FCC Part 15 Subpart C : 2004 AND ANSI C63.4 : 2003 | No non-compliance noted |

***Approved by:***

October 17, 2007

**Jeter Wu**
Section Manager
Compliance Certification Services Inc.

***Reviewed by:***

October 17, 2007

**Eric Yang**
Engineer
Compliance Certification Services Inc.

# 2. EUT DESCRIPTION

## 2.1 DESCRIPTION OF EUT & POWER

| | |
|---|---|
| **Product Name** | AirCruiser N300 Mini Card |
| **Model Number** | GN-WS30N-RH |
| **Brand Name** | GIGA-BYTE |
| **Frequency Range** | IEEE 802.11b/g, 802.11n HT20 (DTS Band):2412MHz～2462MHz<br>IEEE 802.11n HT40 (DTS Band):2422MHz～2452MHz |
| **Transmit Power (ERP)** | IEEE 802.11b: 23.70dBm (DTS Band) (234.598mW)<br>IEEE 802.11g: 26.79dBm (DTS Band) (478.069mW)<br>IEEE 802.11n HT20: 25.65dBm (DTS Band) (367.3354mW)<br>IEEE 802.11n HT40: 25.20dBm (DTS Band) (330.984mW) |
| **Channel Spacing** | IEEE 802.11b/g, 802.11n HT20/HT40: 5MHz |
| **Channel Number** | IEEE 802.11b/g, 802.11n HT20:11 Channels<br>IEEE 802.11n HT40 :7 Channels |
| **Transmit Data Rate** | IEEE 802.11b:11, 5.5, 2, 1Mbps<br>IEEE 802.11g : 54, 48 ,36, 24, 18, 12, 11, 9, 6Mbps<br>IEEE 802.11n HT20 : 130, 117 ,104, 78, 65, 58.5, 52, 39, 26, 19.5, 13, 6.5 Mbps<br>IEEE 802.11n HT40 : 130, 117 ,104, 78, 65, 58.5, 52, 39, 26, 19.5, 13, 6.5 Mbps |
| **Type of Modulation** | IEEE 802.11b：DSSS (CCK, DQPSK, DBPSK)<br>IEEE 802.11g：OFDM (64QAM, 16QAM, QPSK, BPSK)<br>IEEE 802.11n HT20/40：OFDM (64QAM, 16QAM, QPSK, BPSK) |
| **Frequency Selection** | by software / firmware |
| **Antenna Type** | PIFA For Wireless LAN Antenna<br>Manufacture: FAVORTRON<br>M/N: X40 Gain: 2.27dBi<br>Connector Type: I-Pex MHF Plug<br>( 2TX 3RX ). |
| **Power Source** | 3.3Vdc (Powered from host device ) |

**Remark:** 1. The sample selected for test was engineering sample that approximated to production product and was provided by manufacturer.
2. This submittal(s) (test report) is intended for FCC ID: **JCK-GN-WS30N-RH** filing to comply with Section 15.207, 15.209 and 15.247 of the FCC Part 15, Subpart C Rules.

# 3. DESCRIPTION OF TEST MODES

The EUT is an 802.11n MIMO transceiver in Mini-PCI module form factor. It has two transmitter chains and three receive chains (2x3 configurations). The 2x3 configuration is implemented with three outside chains (Chain 0 and 1).

The RF chipset is manufactured by Ralink Technology, Corp.

The antenna peak gain 2.27dBi (highest gain) were chosen for full testing.

**IEEE 802.11 b, 802.11g, 802.11n HT20 mode (DTS Band)**

The EUT had been tested under operating condition.

There are three channels have been tested as following:

| Channel | Frequency (MHz) |
|---|---|
| Low | 2412 |
| Middle | 2437 |
| High | 2462 |

IEEE 802.11b mode : 11Mbps data rate (worst case) were chosen for full testing.
IEEE 802.11g mode : 6Mbps data rate (worst case) were chosen for full testing.
IEEE 802.11n HT20 mode : 6.5Mbps data rate (worst case) were chosen for full testing.

**IEEE 802.11n HT40 mode (DTS Band)**

The EUT had been tested under operating condition.

There are three channels have been tested as following:

| Channel | Frequency (MHz) |
|---|---|
| Low | 2422 |
| Middle | 2437 |
| High | 2452 |

IEEE 802.11n HT40 mode : 6.5Mbps data rate (worst case) were chosen for full testing.

The worst-case data rates are determined according to the description above, based on the investigations by measuring the PSD, peak power and average power across all the data rates, bandwidths, modulations and spatial stream modes.

The worst-case channel is determined as the channel with the highest output power. The highest measured output power was at 2437 MHz.

# 4. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.4 and FCC CFR 47 2.1046, 2046, 2.1047, 2.1049, 2.1051, 2.1053, 2.1055, 2.1057, 15.207, 15.209 and 15.247.

# 5. FACILITIES AND ACCREDITATIONS

## 5.1 FACILITIES

All measurement facilities used to collect the measurement data are located at
CCS Tainan Lab.
No. 8, Jiu Cheng Ling, Jiaokeng Village,Sinhua Township, Tainan Hsien 712, Taiwan R.O.C.
The sites are constructed in conformance with the requirements of ANSI C63.7, ANSI C63.4 and CISPR Publication 22.

## 5.2 EQUIPMENT

Radiated emissions are measured with one or more of the following types of linearly polarized antennas: tuned dipole, biconical, log periodic, bi-log, and/or ridged waveguide, horn. Spectrum analyzers with preselectors and quasi-peak detectors are used to perform radiated measurements.
Conducted emissions are measured with Line Impedance Stabilization Networks and EMI Test Receivers.
Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements.
All receiving equipment conforms to CISPR Publication 16-1, “Radio Interference Measuring Apparatus and Measurement Methods.”

## 5.3 LABORATORY ACCREDITATIONS LISTINGS

The test facilities used to perform radiated and conducted emissions tests are accredited by National Voluntary Laboratory Accreditation Program for the specific scope of accreditation under Lab Code: 200627-0 to perform Electromagnetic Interference tests according to FCC PART 15 AND CISPR 22 requirements. No part of this report may be used to claim or imply product endorsement by NVLAP or any agency of the US Government. In addition, the test facilities are listed with Federal Communications Commission (registration no: 228014).

## 5.4 TABLE OF ACCREDITATIONS AND LISTINGS

| Country | Agency | Scope of Accreditation | Logo |
|---|---|---|---|
| USA | NVLAP | EN 55014-1, AS/NZS 1044, CNS 13783-1, IEC/CISPR 14-1, IEC/CISPR 22, EN 55022, EN 61000-3-2, EN 61000-3-3, ANSI C63.4, AS/NZS CISPR 22, AS/NZS 3548, IEC 61000-4-2/3/4/5/6/8/11 | NVLAP LAB CODE 200627-0<br>200627-0 |
| USA | FCC | 3/10 meter Open Area Test Sites to perform FCC Part 15/18 measurements | 228014 |
| Japan | VCCI | 3/10 meter Open Area Test Sites and conducted test sites to perform radiated/conducted measurements | R-1989<br>C-2142 |
| Taiwan | TAF | CISPR 11 FCC METHOD-47 CFR Part 18 EN 55011 CNS 13803, CISPR 14 EN 55014 CNS 13783-1, CISPR 22 EN 55022 VCCI FCC Method-47 CFR Part 15 Subpart B CNS 13438 | Testing Laboratory 1109 |
| Taiwan | BSMI | CNS 13438, CNS 13783-1, CNS 13803, CNS13439 | SL2-IS-E-0039<br>SL2-IN-E-0039<br>SL2-R1/R2-0039<br>SL2-A1-E-0039 |
| Canada | Industry Canada | RSS210, Issue 7 | IC 6192 |

* No part of this report may be used to claim or imply product endorsement by NVLAP or any agency of the US Government.

# 6. CALIBRATION AND UNCERTAINTY

## 6.1 MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

## 6.2 MEASUREMENT UNCERTAINTY

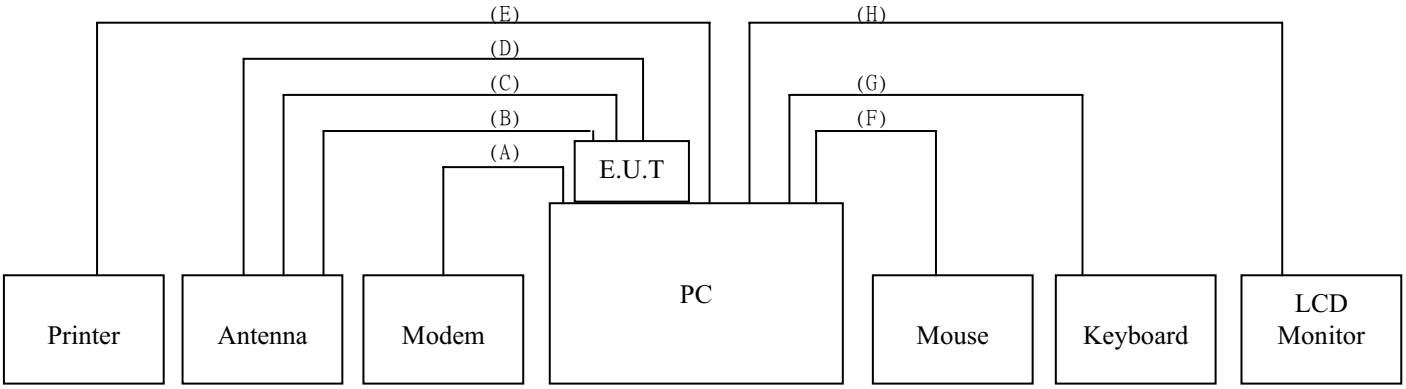
Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

| PARAMETER | UNCERTAINTY |
|---|---|
| Radiated Emission, 30 to 1000 MHz | +/- 3.2 dB |
| Radiated Emission, 1 to 26.5 GHz | +/- 3.2 dB |
| Power Line Conducted Emission | +/- 2.1 dB |

Uncertainty figures are valid to a confidence level of 95%

# 7. SETUP OF EQUIPMENT UNDER TEST

## 7.1 SETUP CONFIGURATION OF EUT




## 7.2 SUPPORT EQUIPMENT

| No. | Product | Manufacturer | Model No. | FCC ID | Signal Cable |
|---|---|---|---|---|---|
| 1 | PC | HP | d330uT | DOC | Power cable, unshd, 1.5m |
| 2 | LCD Monitor | BenQ | FP731 | DOC | VGA cable,shd,1.8m |
| 3 | Keyboard(PS2) | HP | KB-0133 | DOC | Keyboard cable, shd, 1.9m |
| 4 | Mouse(PS2) | HP | M-S69 | JNZ211443 | Mouse cable,shd,1.8m |
| 5 | Modem | LEMEL | MD-56K | DOC(3882B582) | RS232 cable,shd,1.1m |
| 6 | Printer | EPSON | EPSON C43UX | DOC | Printer cable,shd,1.8m |

| No. | Signal cable description | |
|---|---|---|
| A | RS232 cable | 1.1m, shielded, 1pcs. |
| B | Antenna cable | 0.65m, unshielded, 1pcs. |
| C | Antenna cable | 0.65m, unshielded, 1pcs. |
| D | Antenna cable | 0.65m, unshielded, 1pcs. |
| E | Printer cable | 1.8m, shielded, 1pcs. |
| F | Mouse cable | 1.8m, shielded, 1pcs. |
| G | Keyboard cable | 1.9m, shielded, 1pcs. |
| H | VGA cable | 1.8m, shielded, 1pcs. |

**Remark:**

1. All the above equipment/cables were placed in worse case positions to maximize emission signals during emission test.
2. Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.

## 7.3 EUT OPERATING CONDITION

1. Set up all computers like the setup diagram.
2. The "**Ralink QA Test Program for RT2860"** software was used for testing. The EUT driver software installed in the host support equipment during testing was Ralink QA Test Program for RT2860 Drive.

(1) **TX Mode:**

⇨ **Tx Mode:CCK 、OFDM、 HT MixMode** (Bandwidth: 20、40)

⇨ **Tx Data Rate:11Mbps long** (IEEE 802.11b mode, chain 0 TX)

**6Mbps** (IEEE 802.11g mode, chain 0 TX)

**6.5Mbps** (IEEE 802.11n HT20 mode, chain 0/1 TX)

**6.5Mbps** (IEEE 802.11n HT40 mode, chain 0/1 TX)

⇨ **Power control mode**

**Target Power:** IEEE 802.11b Channel Low (2412MHz) = **0F (Chain 0)**
IEEE 802.11b Channel Low (2412MHz) = **19 (Chain 1)**
IEEE 802.11b Channel Middle (2437MHz) = **0D (Chain 0)**
IEEE 802.11b Channel Middle (2437MHz) = **17 (Chain 1)**
IEEE 802.11b Channel High (2462MHz) = **0A (Chain 0)**
IEEE 802.11b Channel High (2462MHz) = **13 (Chain 1)**

**Target Power:** IEEE 802.11g Channel Low (2412MHz) = **0E (Chain 0)**
IEEE 802.11g Channel Low (2412MHz) = **18 (Chain 1)**
IEEE 802.11g Channel Middle (2437MHz) = **0C (Chain 0)**
IEEE 802.11g Channel Middle (2437MHz) = **16 (Chain 1)**
IEEE 802.11g Channel High (2462MHz) = **4 (Chain 0)**
IEEE 802.11g Channel High (2462MHz) = **0D (Chain 1)**

**Target Power:** IEEE 802.11n HT20 Channel Low (2412MHz) = **17 (Chain 0)**
IEEE 802.11n HT20 Channel Low (2412MHz) = **1F (Chain 1)**
IEEE 802.11n HT20 Channel Middle (2437MHz) = **14 (Chain 0)**
IEEE 802.11n HT20 Channel Middle (2437MHz) = **1E (Chain 1)**
IEEE 802.11n HT20 Channel High (2462MHz) = **0D (Chain 0)**
IEEE 802.11n HT20 Channel High (2462MHz) = **16 (Chain 1)**

**Target Power:** IEEE 802.11n HT40 Channel Low (2422MHz) = **13 (Chain 0)**
IEEE 802.11n HT40 Channel Low (2422MHz) = **1D (Chain 1)**
IEEE 802.11n HT40 Channel Middle (2437MHz) = **13 (Chain 0)**
IEEE 802.11n HT40 Channel Middle (2437MHz) = **1D (Chain 1)**
IEEE 802.11n HT40 Channel High (2452MHz) = **5 (Chain 0)**
IEEE 802.11n HT40 Channel High (2452MHz) = **0F (Chain 1)**

(2) **RX Mode：**

**MAC Address: FFFFFFFFFFFF**

**Start RX**

3. All of the function are under run.
4. Start test.

**For Normal operating :**

1. Set up all computers like the setup diagram.
2. Notebook PC (2) ping 192.168.0.10 –t to Notebook PC(1).
3. Notebook PC (1) ping 192.168.0.20 –t to Notebook PC(2).
4. Notebook PC (1) (2) ping 192.168.0.50 –t to AP.
5. All of the function are under run.
6. Start test.

# 8. APPLICABLE LIMITS AND TEST RESULTS

## 8.1 6dB BANDWIDTH

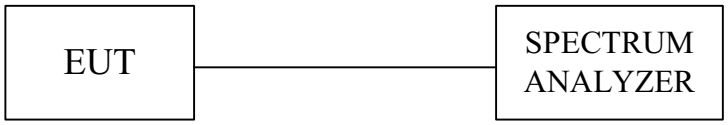
**LIMIT**

§ 15.207(a) (2) For direct sequence systems, the minimum 6dB bandwidth shall be at least 500 kHz.

**TEST EQUIPMENTS**

| Name of Equipment | Manufacturer | Model | Serial Number | Calibration Due |
|---|---|---|---|---|
| Spectrum Analyzer | R&S | FSEM | 829054/017 | MAR. 13, 2008 |

**TEST SETUP**




**TEST PROCEDURE**

The transmitter output was connected to a spectrum analyzer. The bandwidth of the fundamental frequency was measured by spectrum analyzer with 100 KHz RBW and 300 KHz VBW. The 6dB bandwidth is defined as the total spectrum the power of which is higher than peak power minus 6dB.

## TEST RESULTS

No non-compliance noted

**IEEE 802.11b mode (Two TX)**

| Channel | Channel Frequency (MHz) | 6dB Bandwidth (kHz) | | Minimum Limit (kHz) | Pass / Fail |
|---|---|---|---|---|---|
| | | Chain 0 | Chain 1 | | |
| Low | 2412 | 12424 | 12424 | 500 | PASS |
| Middle | 2437 | 12424 | 12424 | 500 | PASS |
| High | 2462 | 12424 | 12424 | 500 | PASS |

**IEEE 802.11g mode (Two TX)**

| Channel | Channel Frequency (MHz) | 6dB Bandwidth (kHz) | | Minimum Limit (kHz) | Pass / Fail |
|---|---|---|---|---|---|
| | | Chain 0 | Chain 1 | | |
| Low | 2412 | 16633 | 16633 | 500 | PASS |
| Middle | 2437 | 16633 | 16633 | 500 | PASS |
| High | 2462 | 16633 | 16633 | 500 | PASS |

**IEEE 802.11n HT20 mode (Two TX)**

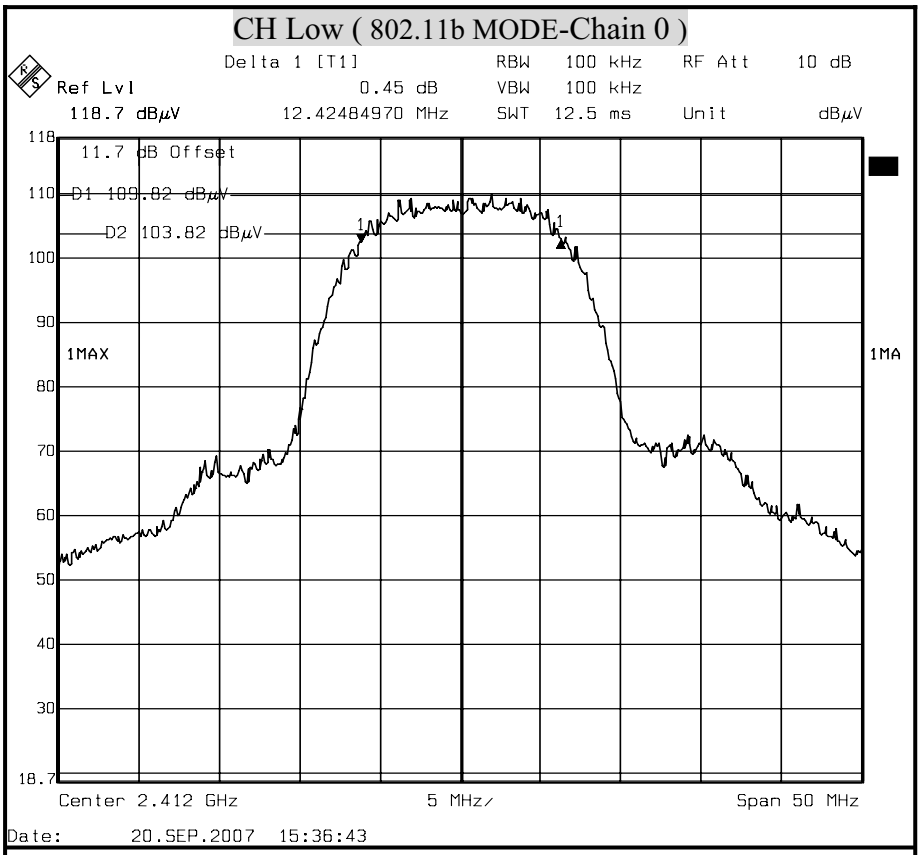
| Channel | Channel Frequency (MHz) | 6dB Bandwidth (kHz) | | Minimum Limit (kHz) | Pass / Fail |
|---|---|---|---|---|---|
| | | Chain 0 | Chain 1 | | |
| Low | 2412 | 17835 | 17835 | 500 | PASS |
| Middle | 2437 | 17835 | 17835 | 500 | PASS |
| High | 2462 | 17835 | 17835 | 500 | PASS |

**IEEE 802.11n HT40 mode (Two TX)**

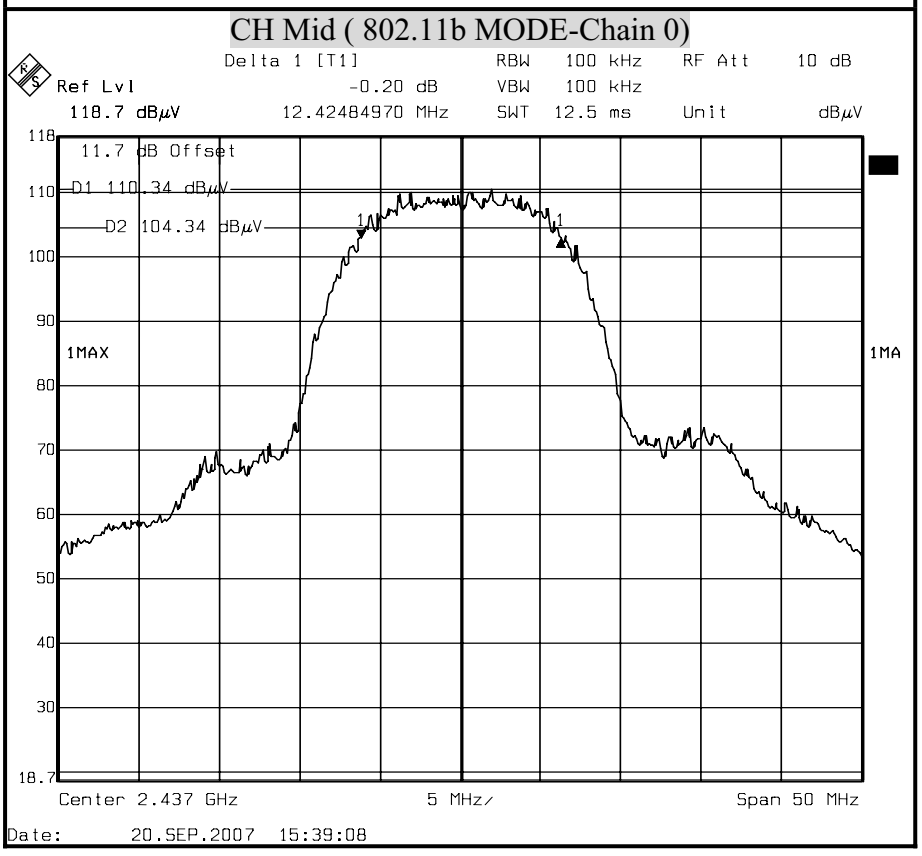
| Channel | Channel Frequency (MHz) | 6dB Bandwidth (kHz) | | Minimum Limit (kHz) | Pass / Fail |
|---|---|---|---|---|---|
| | | Chain 0 | Chain 1 | | |
| Low | 2422 | 36472 | 36472 | 500 | PASS |
| Middle | 2437 | 36472 | 36472 | 500 | PASS |
| High | 2452 | 36673 | 36472 | 500 | PASS |

**6dB BANDWIDTH ( 802.11b MODE)**

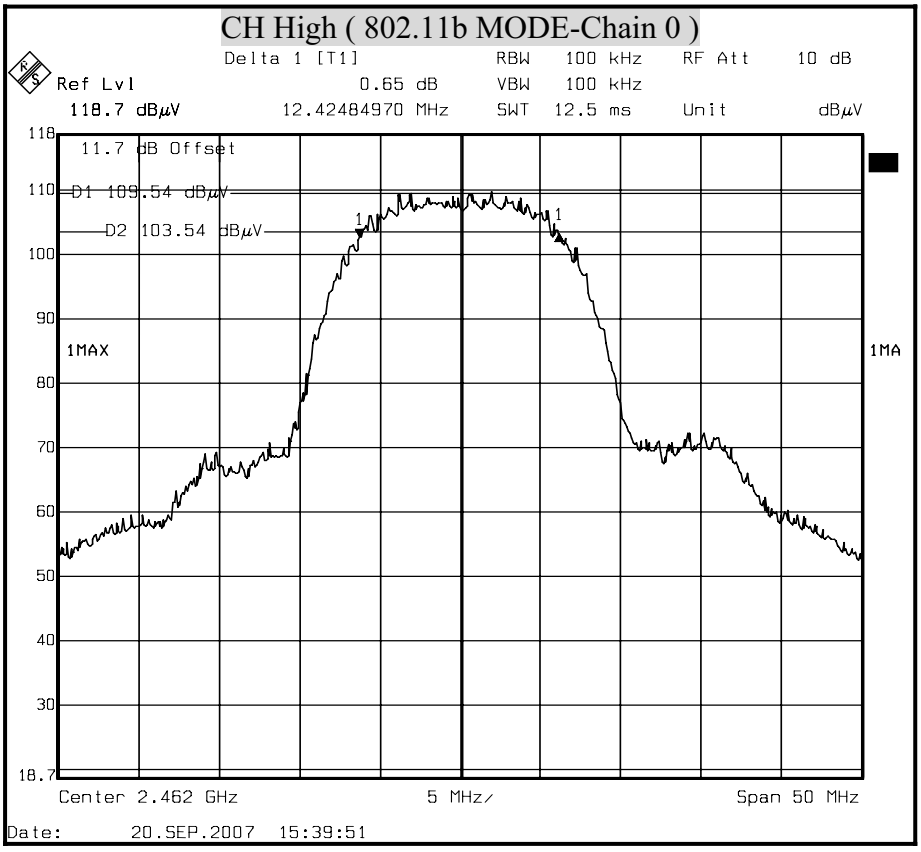
CH Low ( 802.11b MODE-Chain 0 )



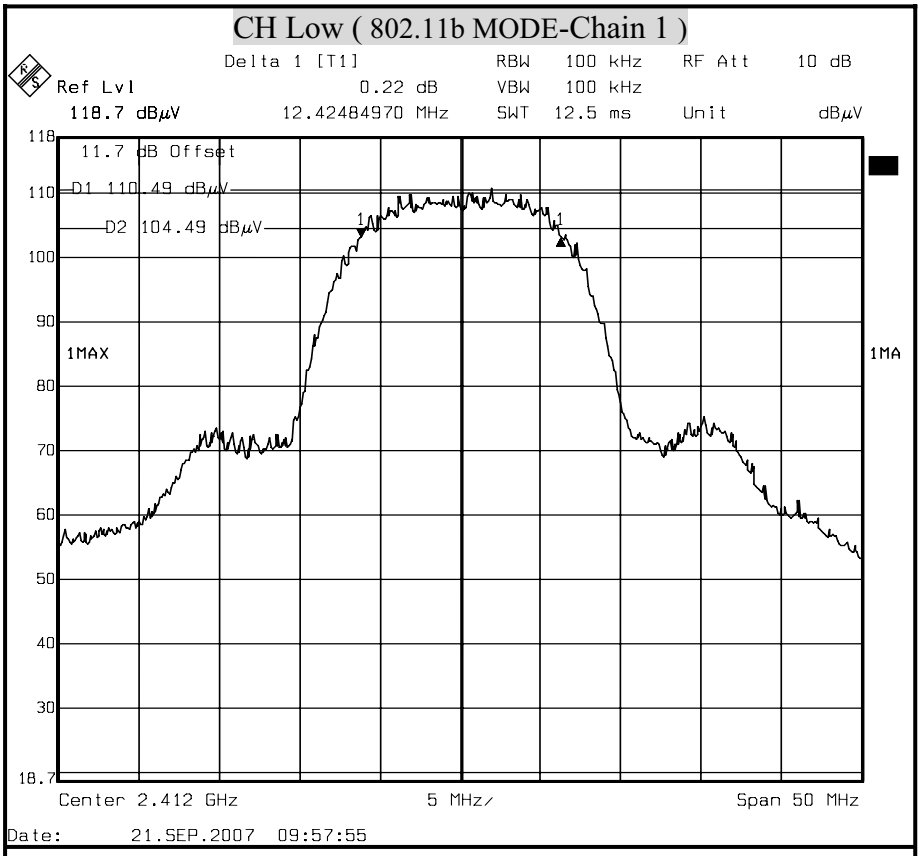

CH Mid ( 802.11b MODE-Chain 0)



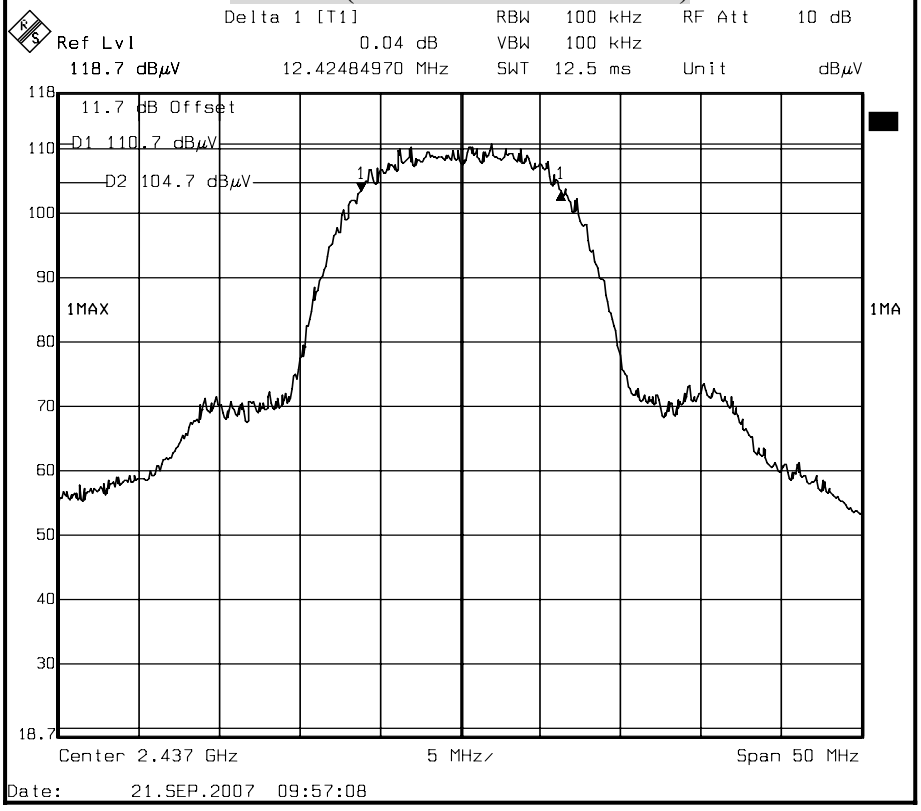
CH High ( 802.11b MODE-Chain 0 )



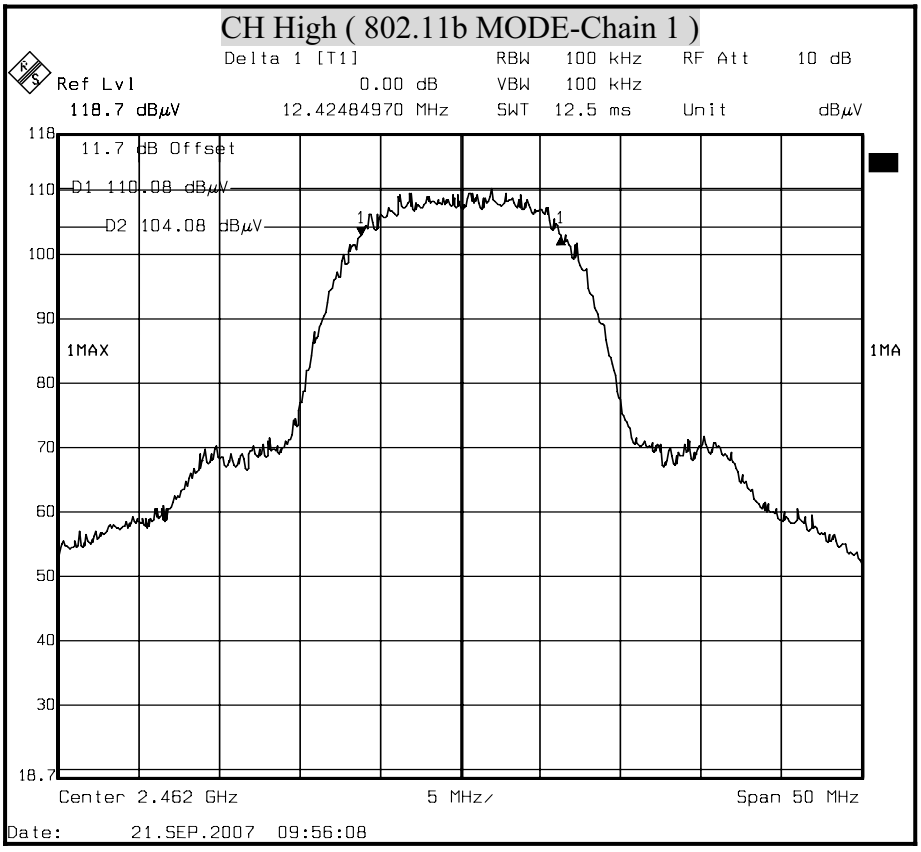
CH Low ( 802.11b MODE-Chain 1 )



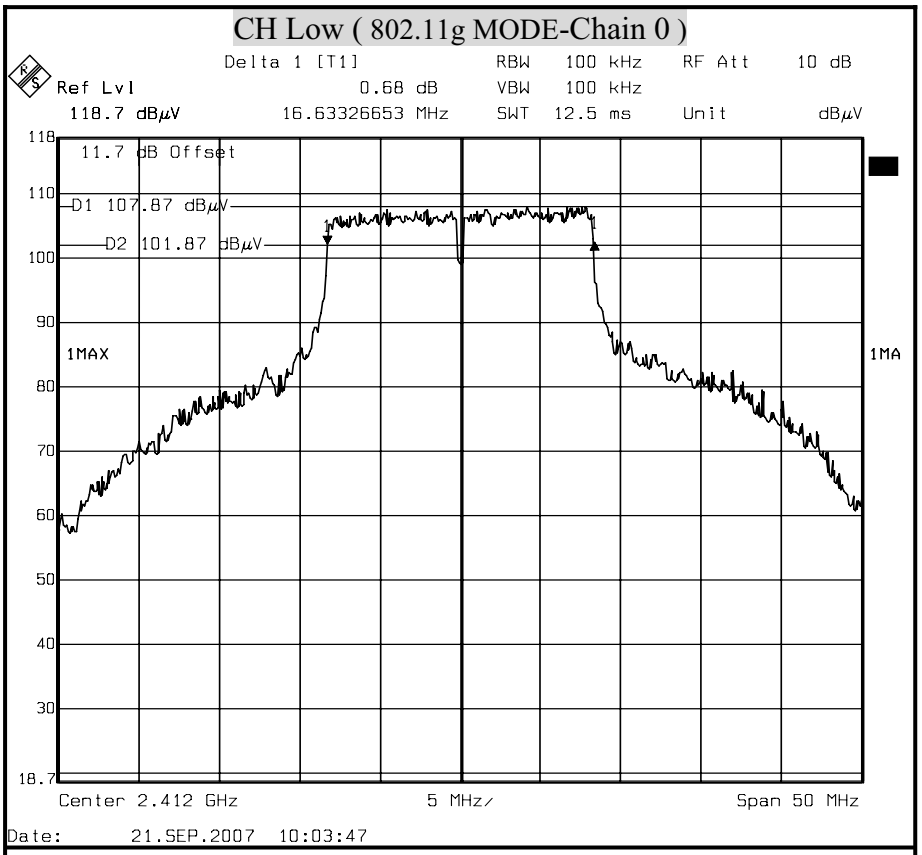

CH Mid ( 802.11b MODE-Chain 1)

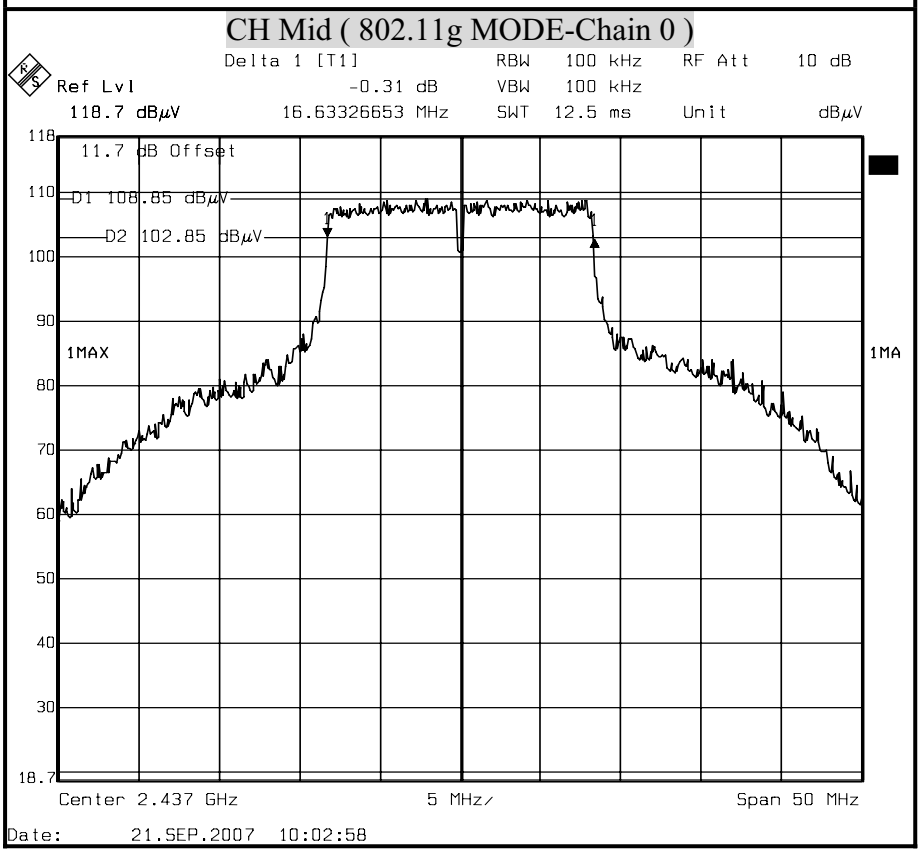


CH High ( 802.11b MODE-Chain 1 )

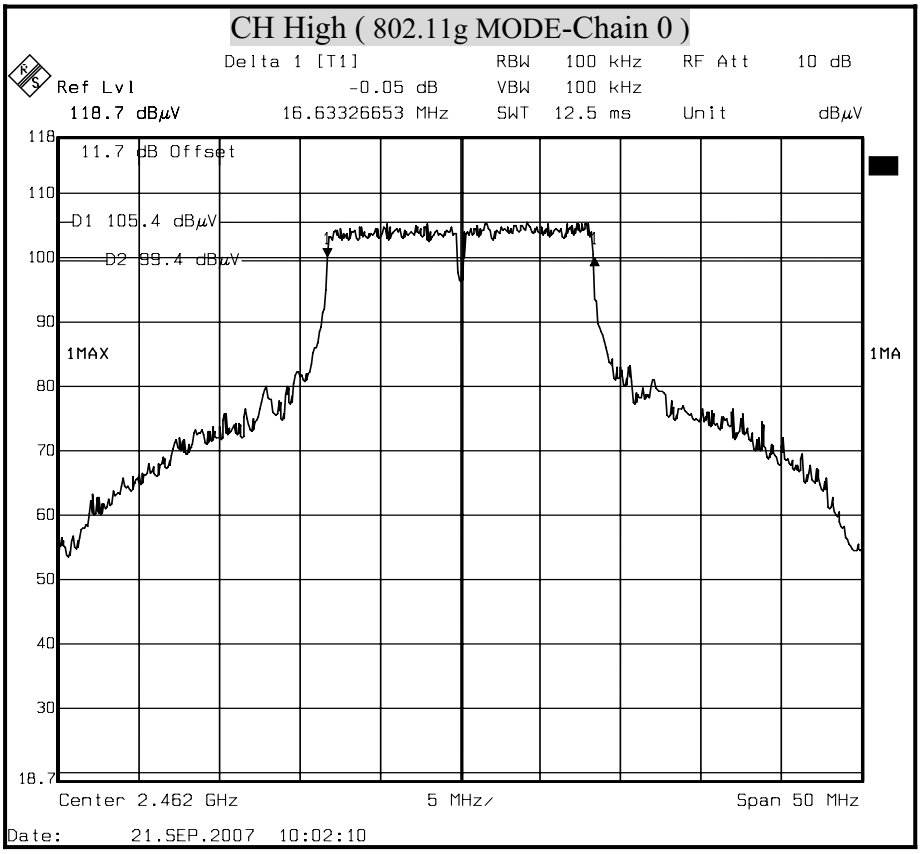


## 6dB BANDWIDTH ( 802.11g MODE)

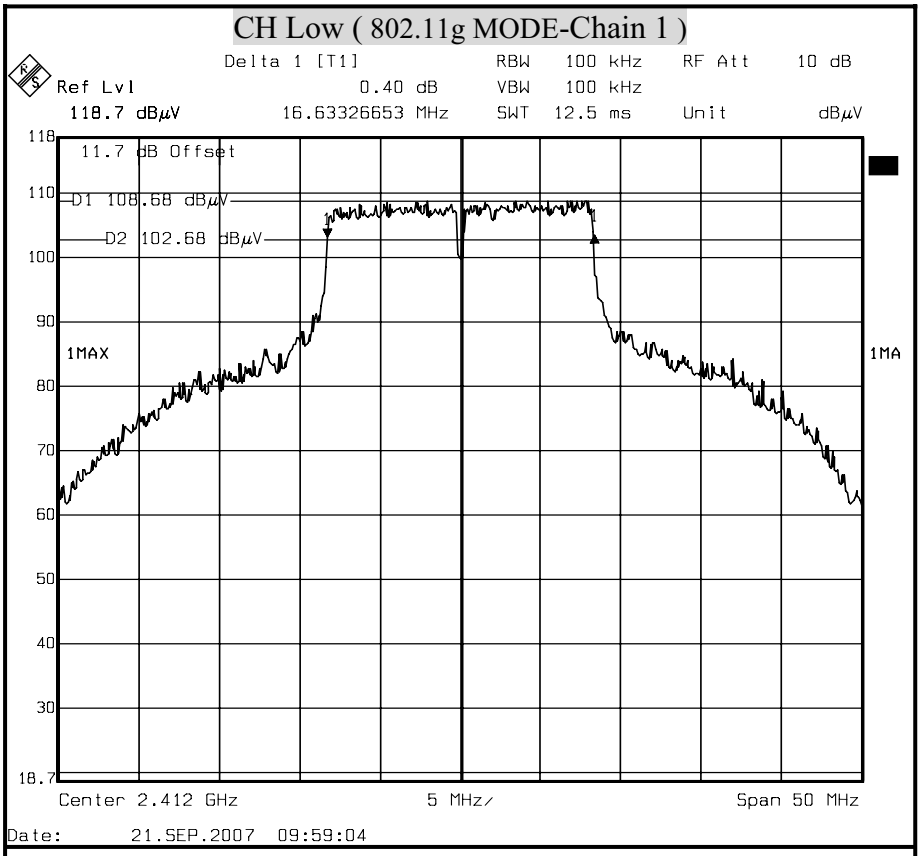


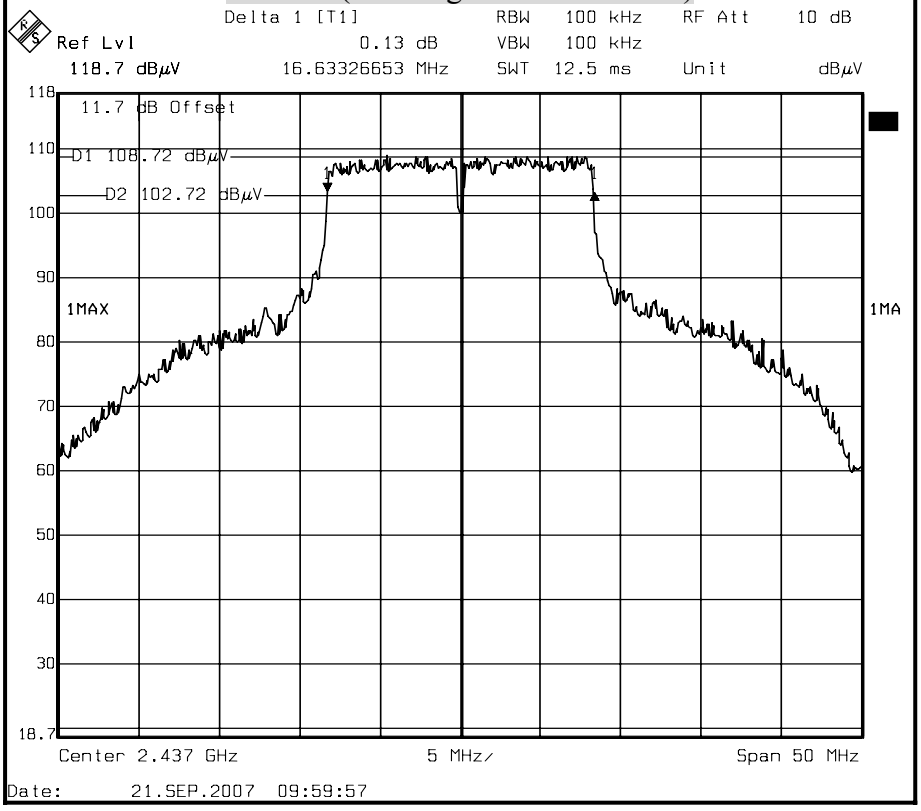
CH High ( 802.11g MODE-Chain 0 )



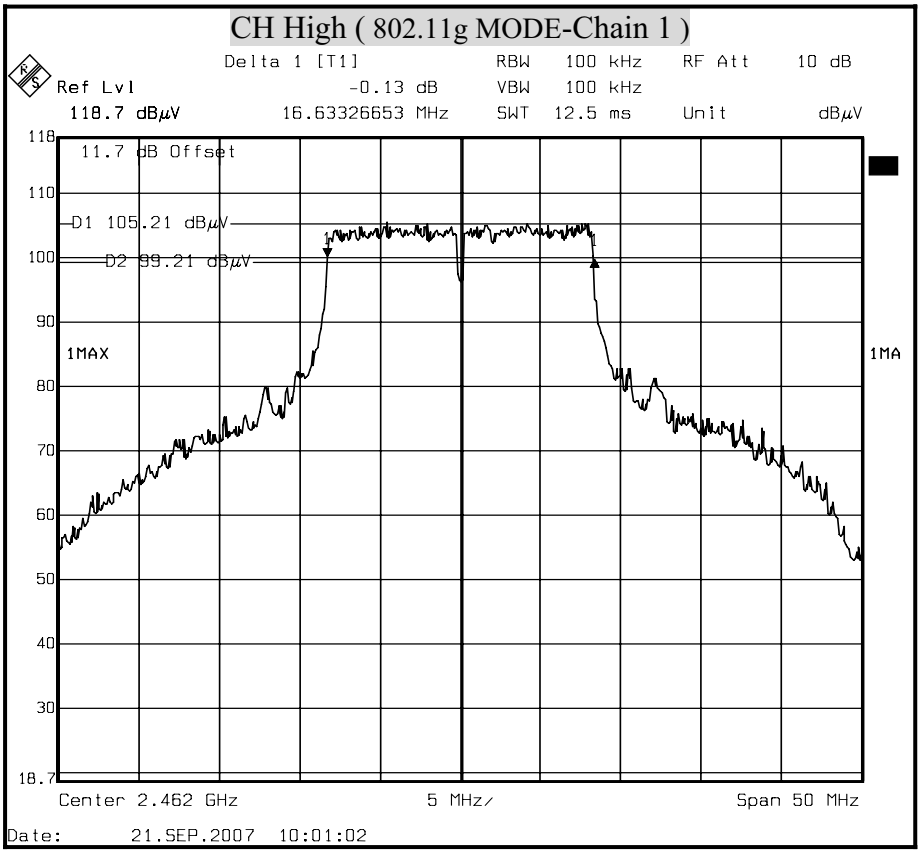
CH Low ( 802.11g MODE-Chain 1 )




CH Mid ( 802.11g MODE-Chain 1 )

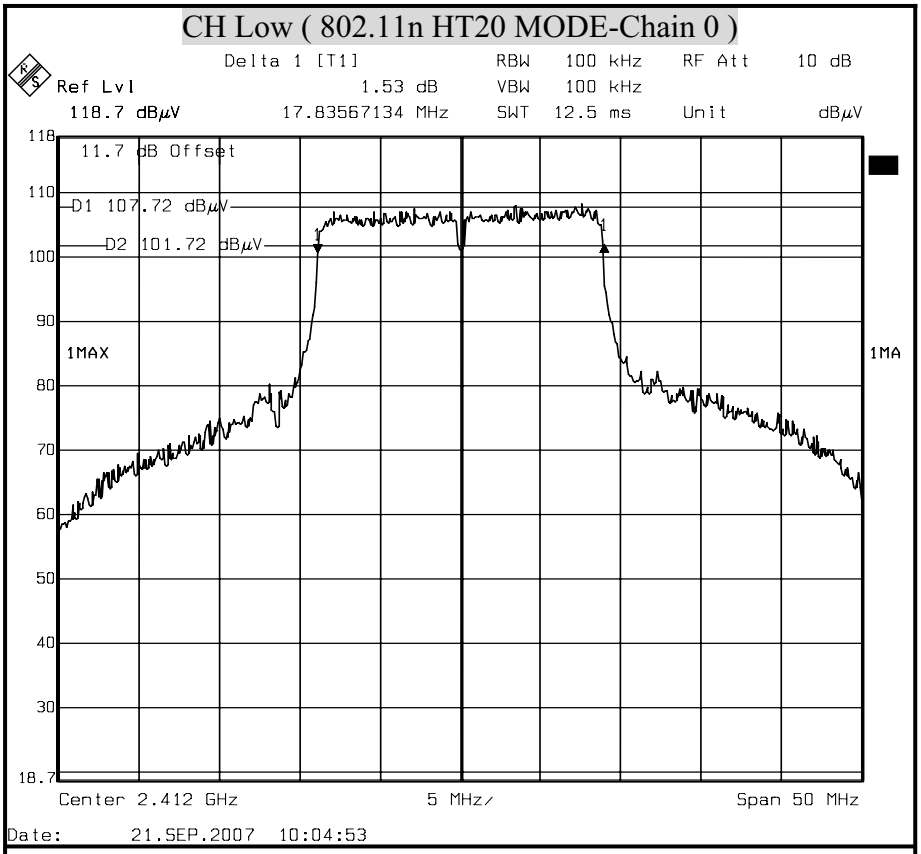


CH High ( 802.11g MODE-Chain 1 )

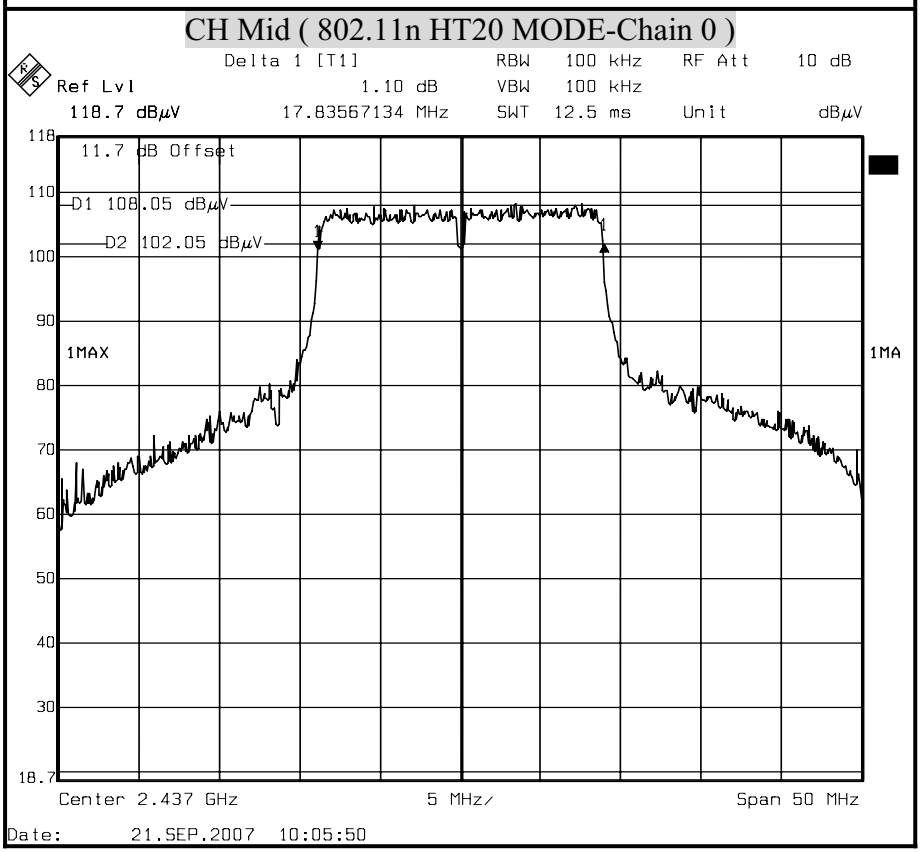


## 6dB BANDWIDTH ( 802.11n HT20 MODE)

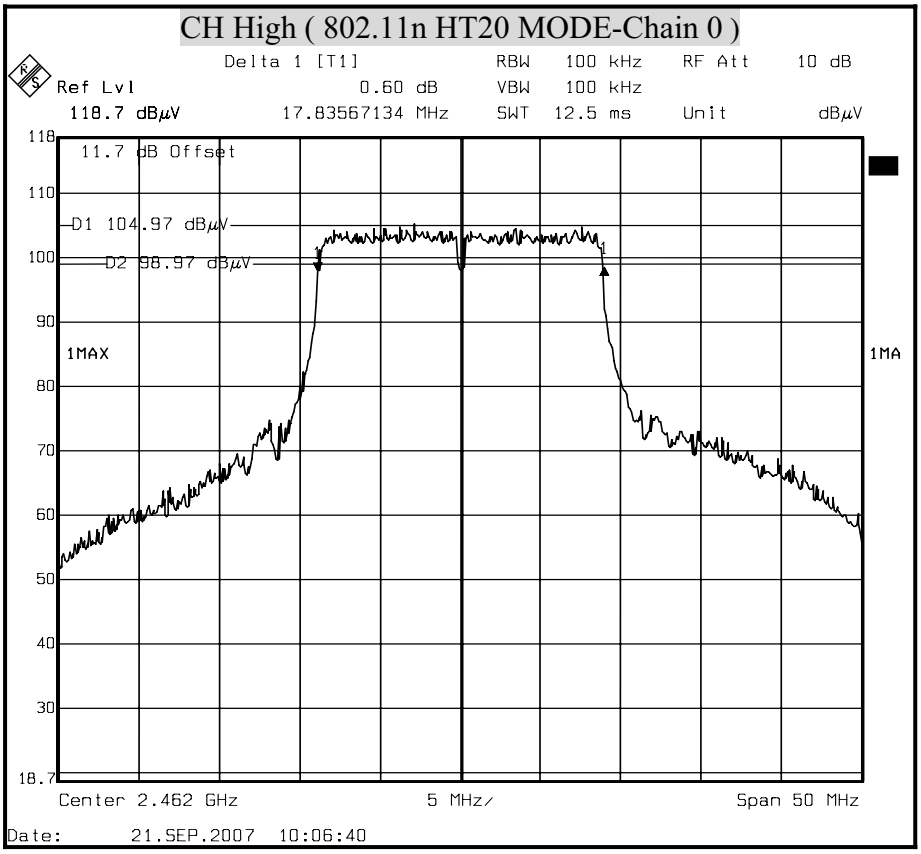
CH Low ( 802.11n HT20 MODE-Chain 0 )



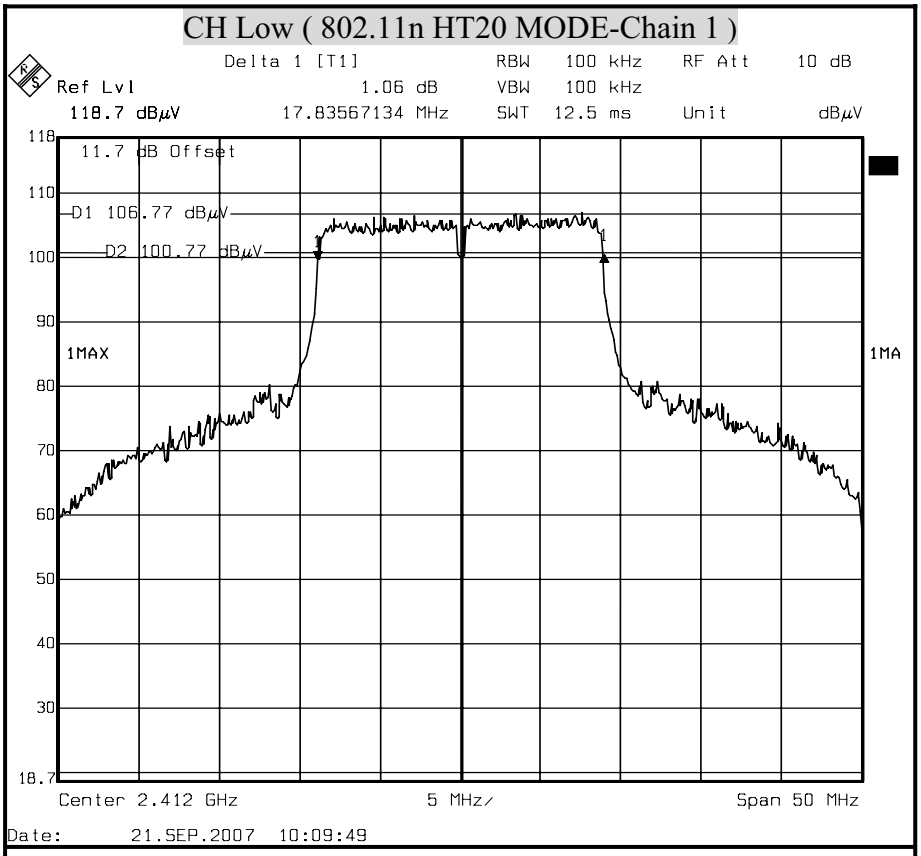

CH Mid ( 802.11n HT20 MODE-Chain 0 )



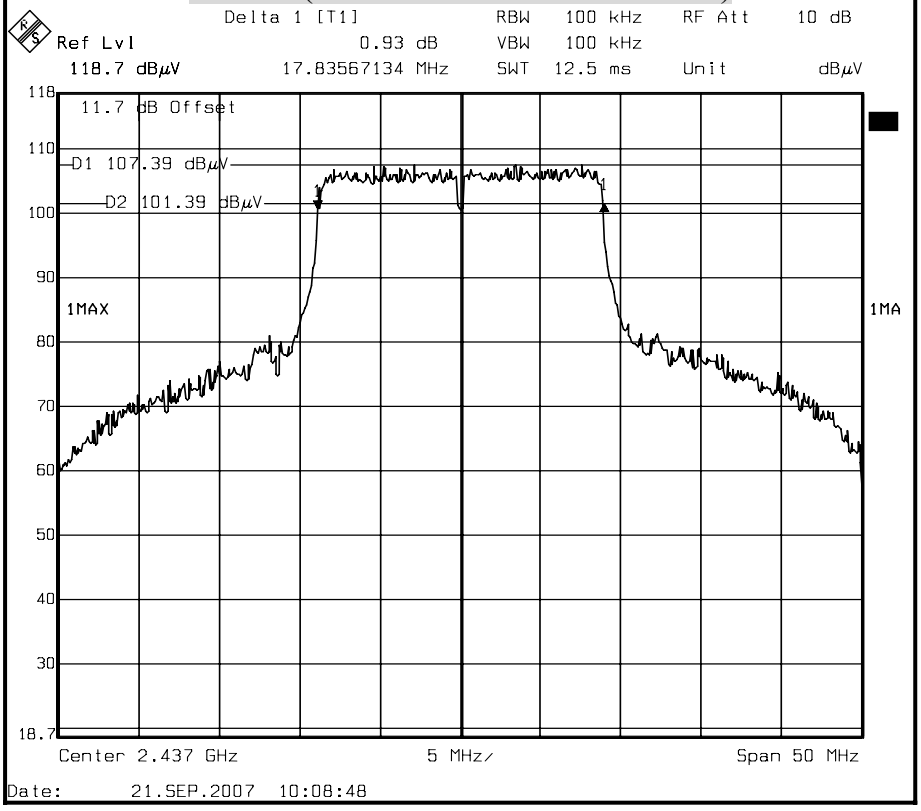
CH High ( 802.11n HT20 MODE-Chain 0 )



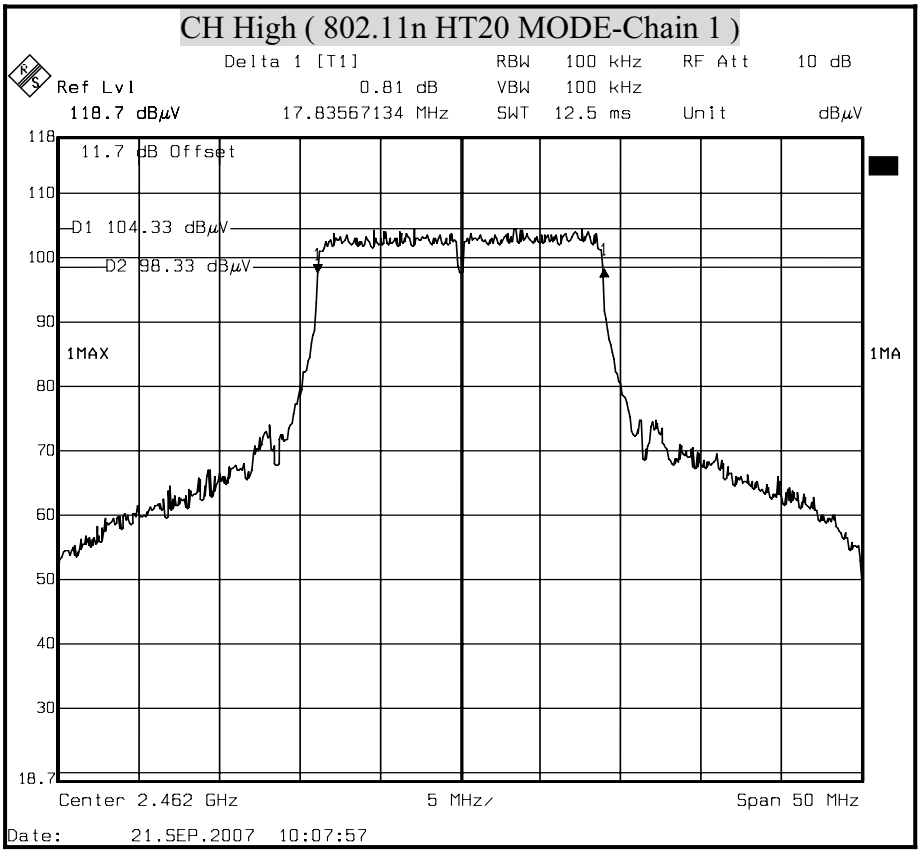
CH Low ( 802.11n HT20 MODE-Chain 1 )




CH Mid (802.11n HT20 MODE-Chain 1 )

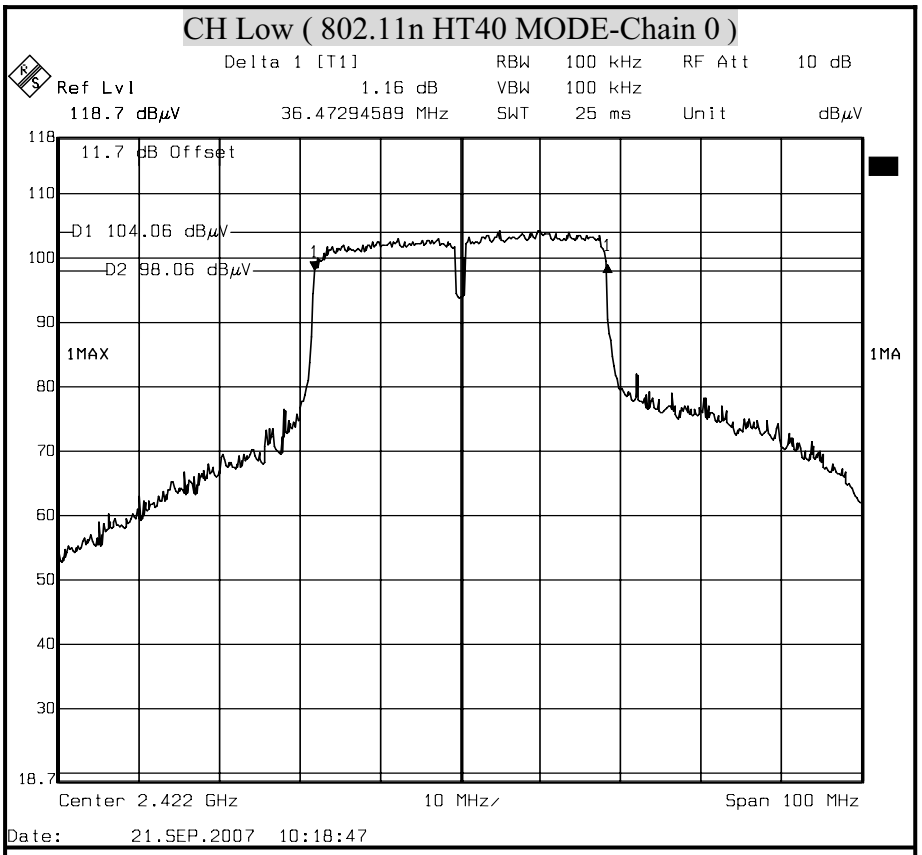


CH High ( 802.11n HT20 MODE-Chain 1 )

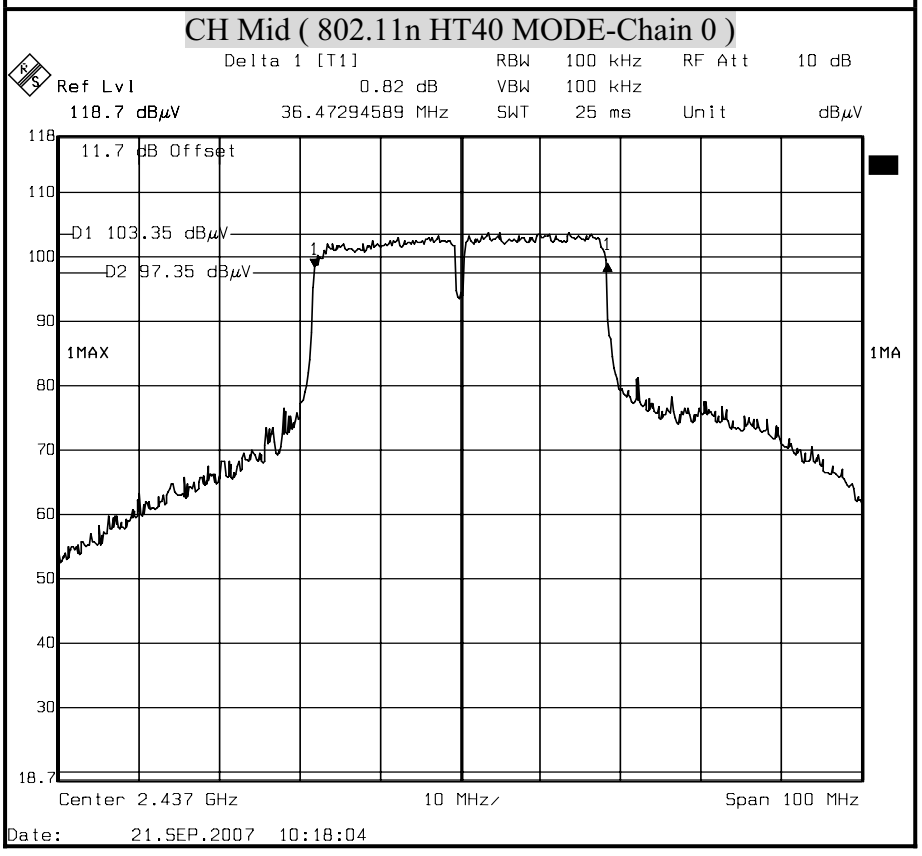


## 6dB BANDWIDTH ( 802.11n HT40 MODE)

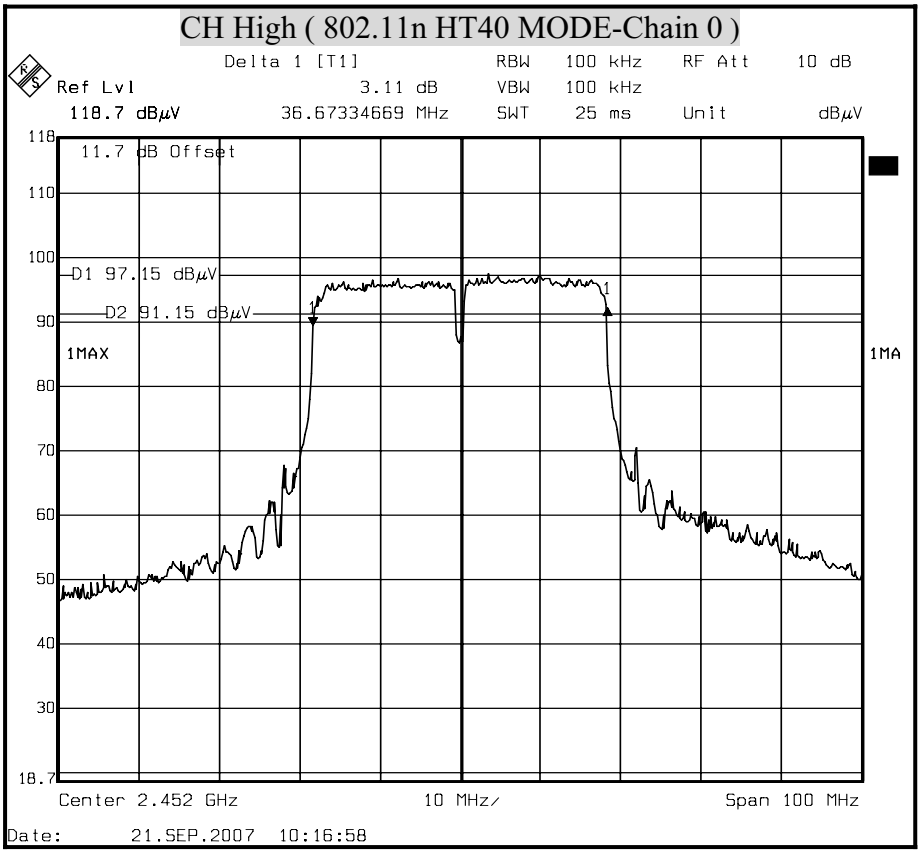
CH Low ( 802.11n HT40 MODE-Chain 0 )



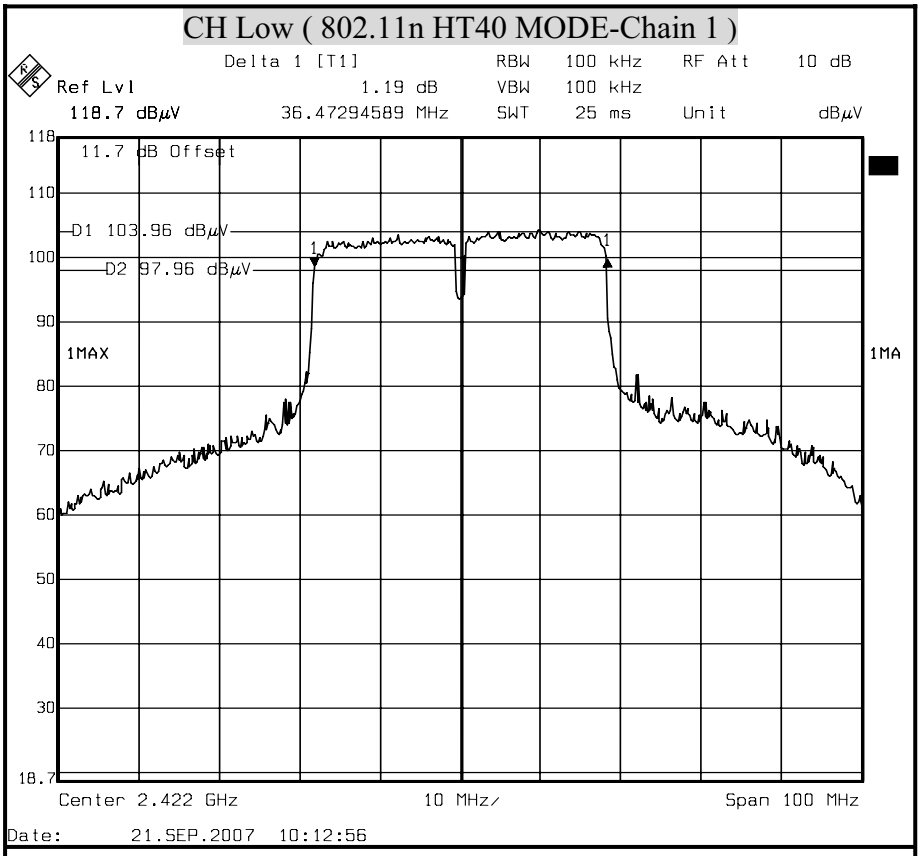

CH Mid ( 802.11n HT40 MODE-Chain 0 )



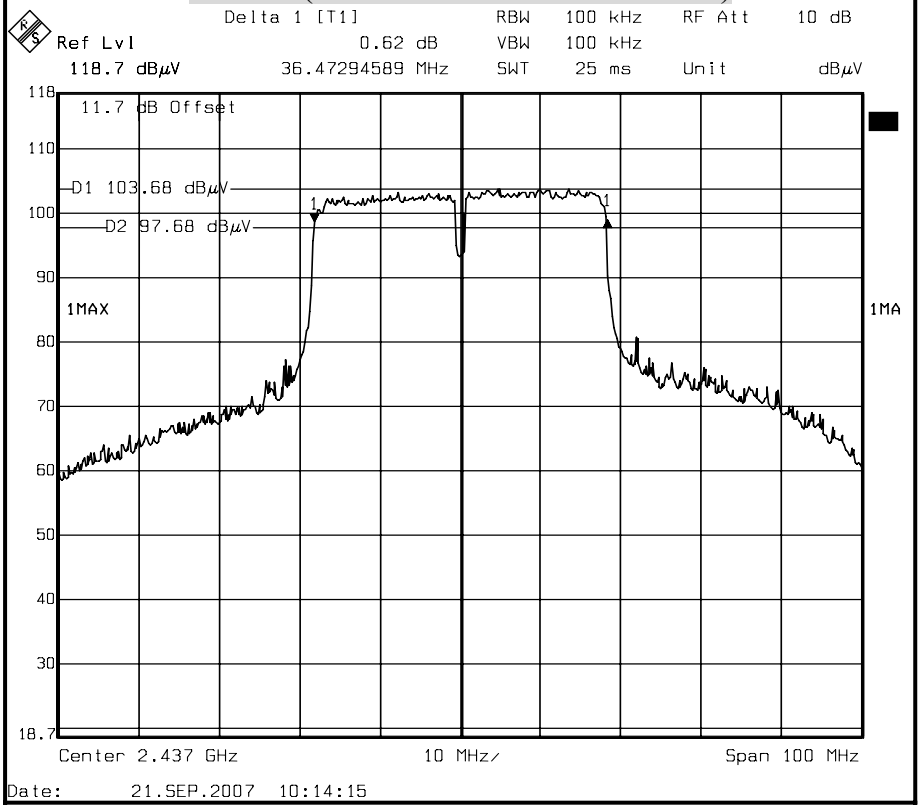
CH High ( 802.11n HT40 MODE-Chain 0 )



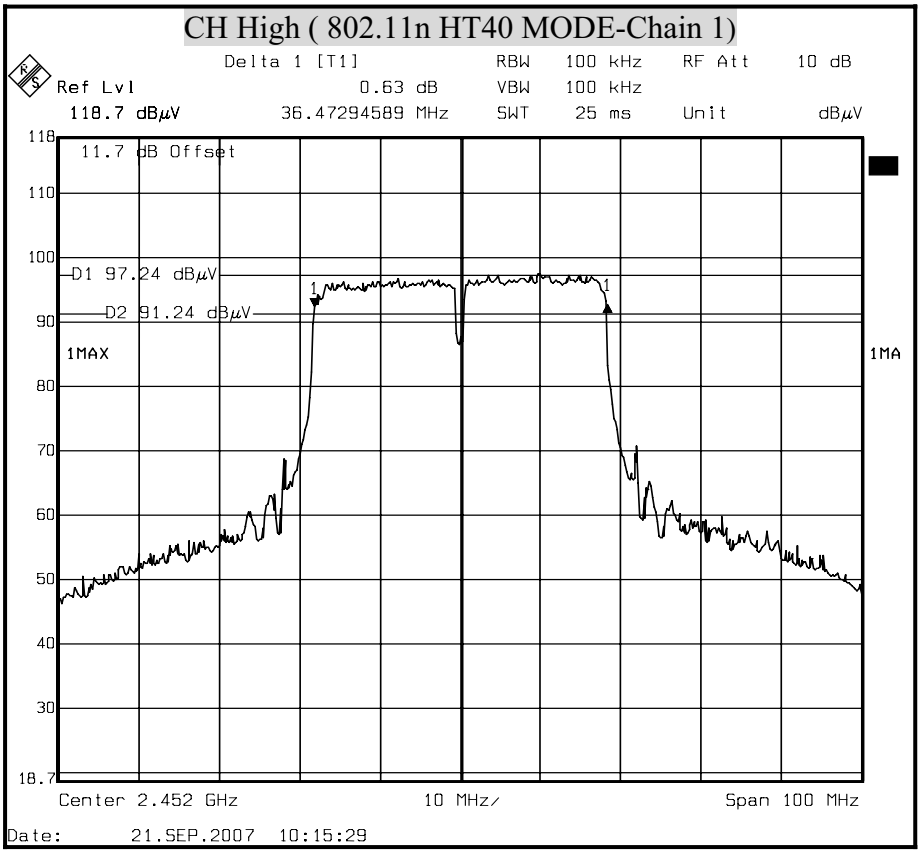
CH Low ( 802.11n HT40 MODE-Chain 1 )




CH Mid ( 802.11n HT40 MODE-Chain 1)



CH High ( 802.11n HT40 MODE-Chain 1)



## 8.2 99% BANDWIDTH

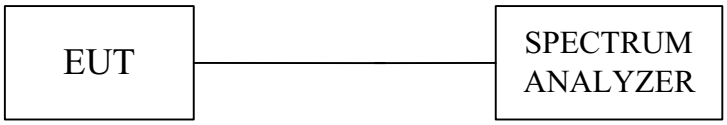
**LIMIT**

None: For reporting purposes only.

**TEST EQUIPMENTS**

| Name of Equipment | Manufacturer | Model | Serial Number | Calibration Due |
|---|---|---|---|---|
| Spectrum Analyzer | R&S | FSEM | 829054/017 | MAR. 13, 2008 |

**TEST SETUP**




**TEST PROCEDURE**

1. The spectrum shall be set as follows :
   Span : The minimum span to fully display the emission and approximately 20dB below peak level.
   RBW : The set to 1% to 3% of the approximate emission width.
2. Compute the combined power of all signal responses contained in the trace by covering all the data points.
3. For 99% occupied BW, place the markers at the frequency at which 0.5% of the power lies to the right of the right marker and 0.5% of the power lies to the left of the left marker.
4. The 99% BW is the bandwidth between the right and left markers.

## TEST RESULTS

No non-compliance noted

**IEEE 802.11b mode (Two TX)**

| Channel | Channel Frequency (MHz) | 99% Occupied power bandwidth (MHz) | |
|---|---|---|---|
| | | Chain 0 | Chain 1 |
| Low | 2412 | 15.230 | 15.230 |
| Middle | 2437 | 15.130 | 15.130 |
| High | 2462 | 15.130 | 15.230 |

**IEEE 802.11g mode (Two TX)**

| Channel | Channel Frequency (MHz) | 99% Occupied power bandwidth (MHz) | |
|---|---|---|---|
| | | Chain 0 | Chain 1 |
| Low | 2412 | 17.334 | 17.434 |
| Middle | 2437 | 17.334 | 17.334 |
| High | 2462 | 17.134 | 17.234 |

**IEEE 802.11n HT20 mode (Two TX)**

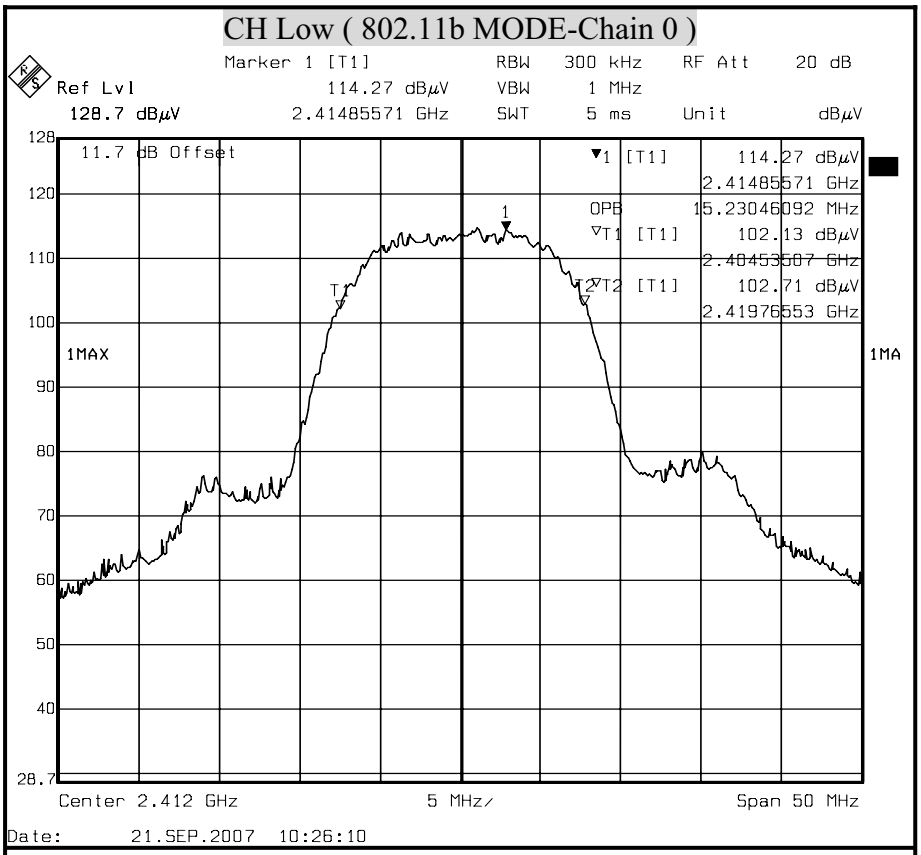
| Channel | Channel Frequency (MHz) | 99% Occupied power bandwidth (MHz) | |
|---|---|---|---|
| | | Chain 0 | Chain 1 |
| Low | 2412 | 17.935 | 17.835 |
| Middle | 2437 | 17.835 | 17.835 |
| High | 2462 | 17.735 | 17.735 |

**IEEE 802.11n HT40 mode (Two TX)**

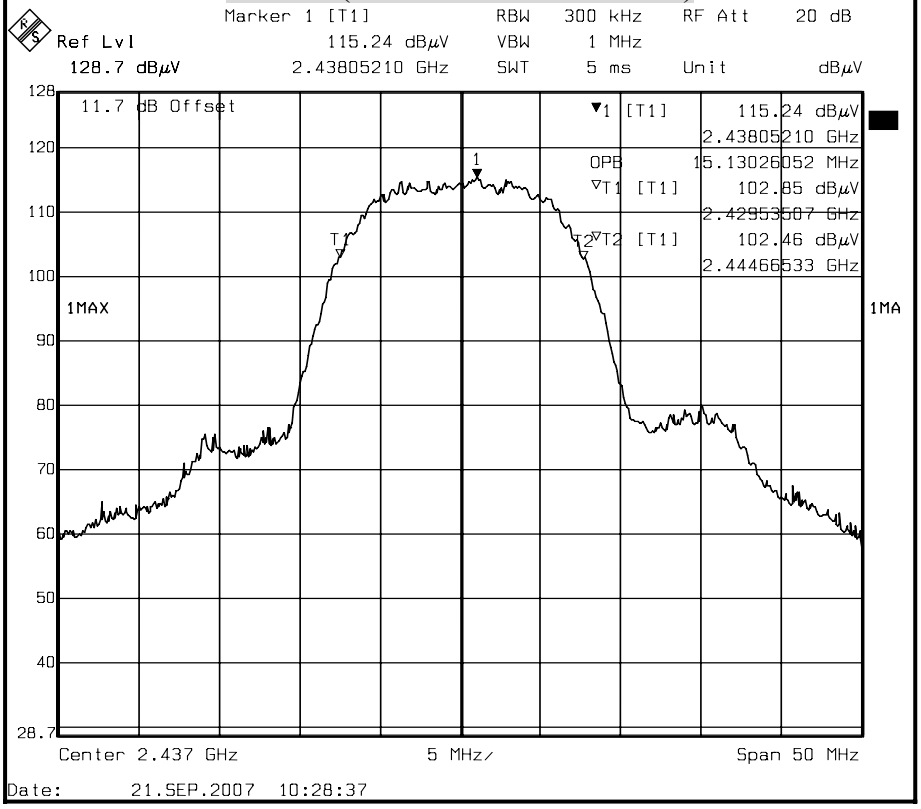
| Channel | Channel Frequency (MHz) | 99% Occupied power bandwidth (MHz) | |
|---|---|---|---|
| | | Chain 0 | Chain 1 |
| Low | 2422 | 36.072 | 36.272 |
| Middle | 2437 | 36.272 | 36.272 |
| High | 2452 | 36.072 | 36.072 |

## 99% BANDWIDTH ( 802.11b MODE)

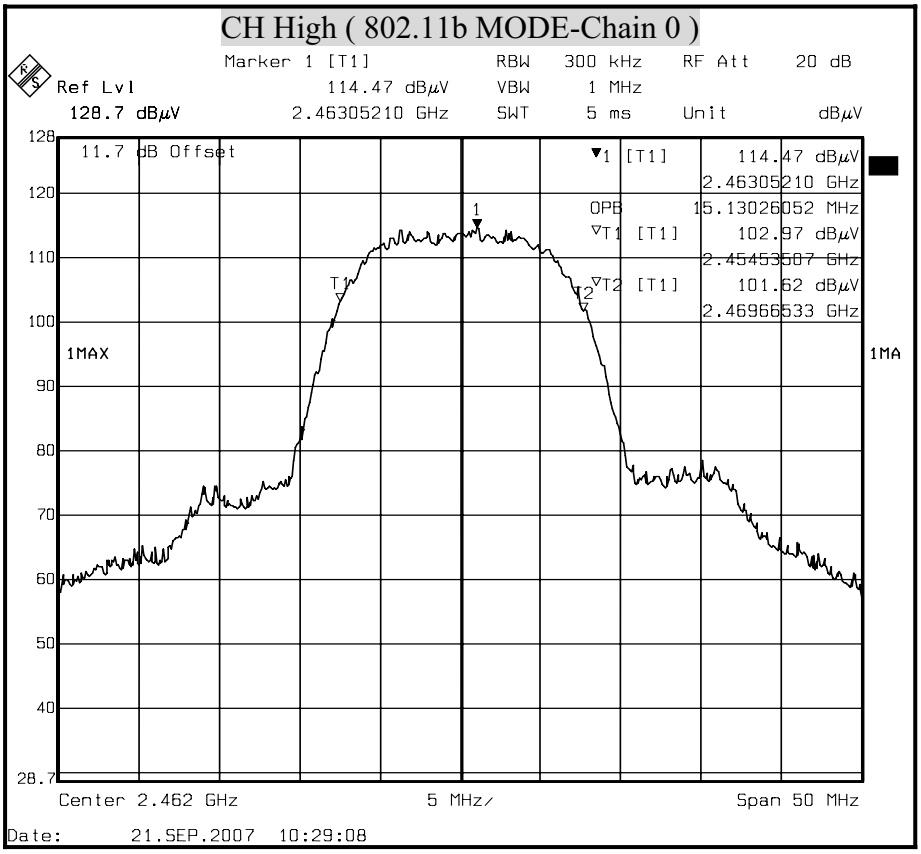
CH Low ( 802.11b MODE-Chain 0 )



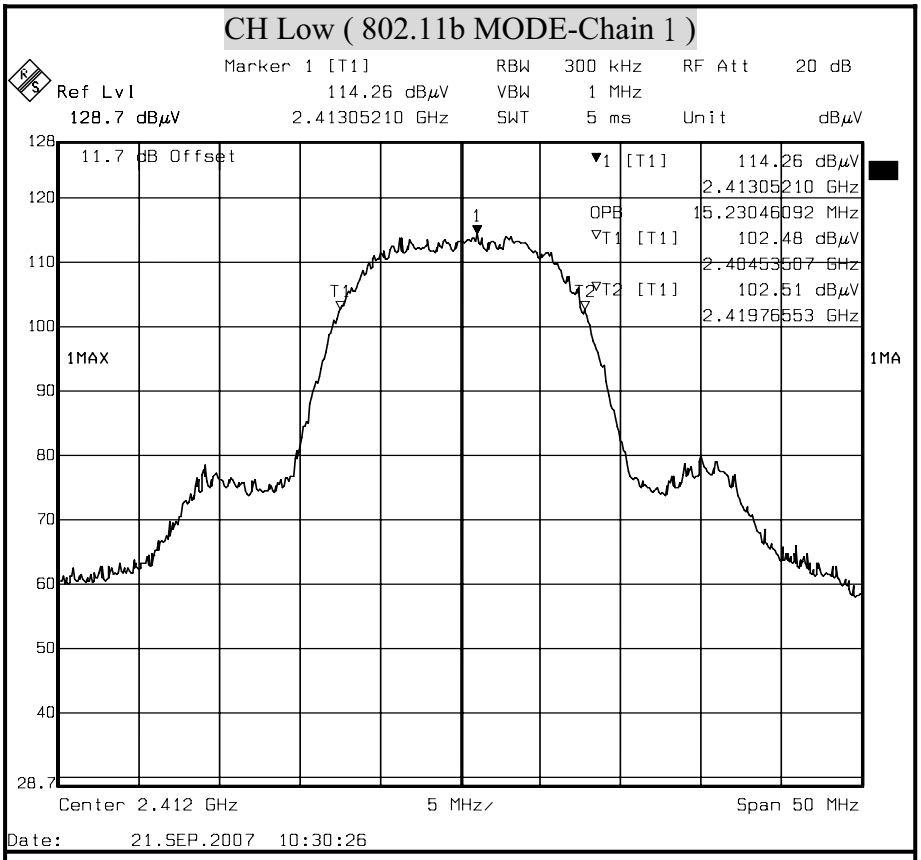

CH Mid ( 802.11b MODE-Chain 0 )



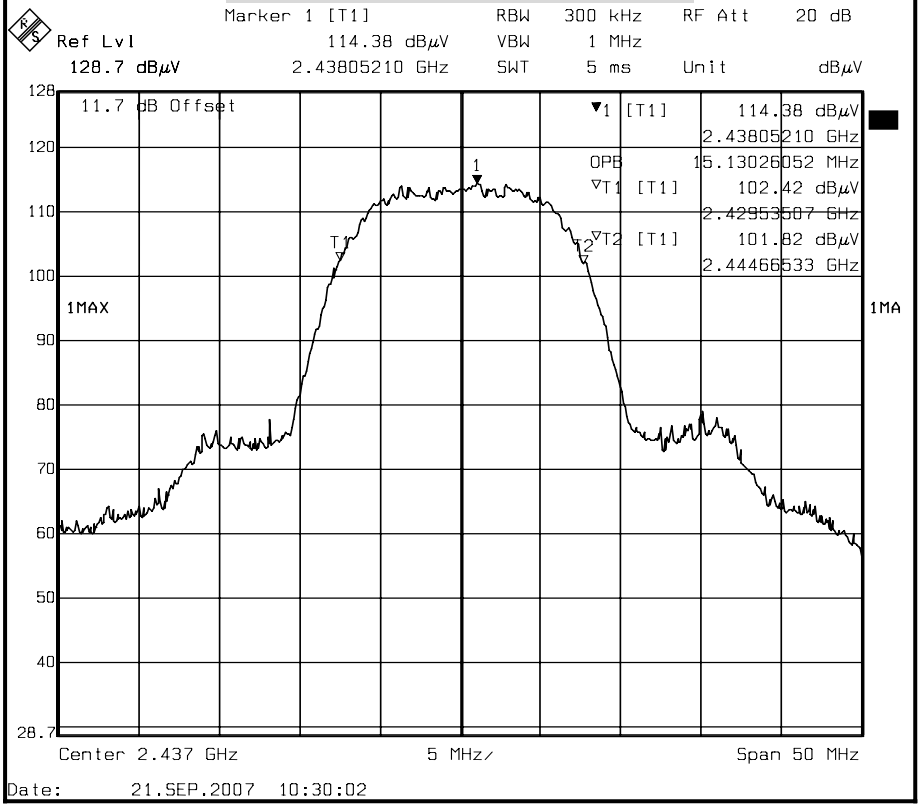
CH High ( 802.11b MODE-Chain 0 )



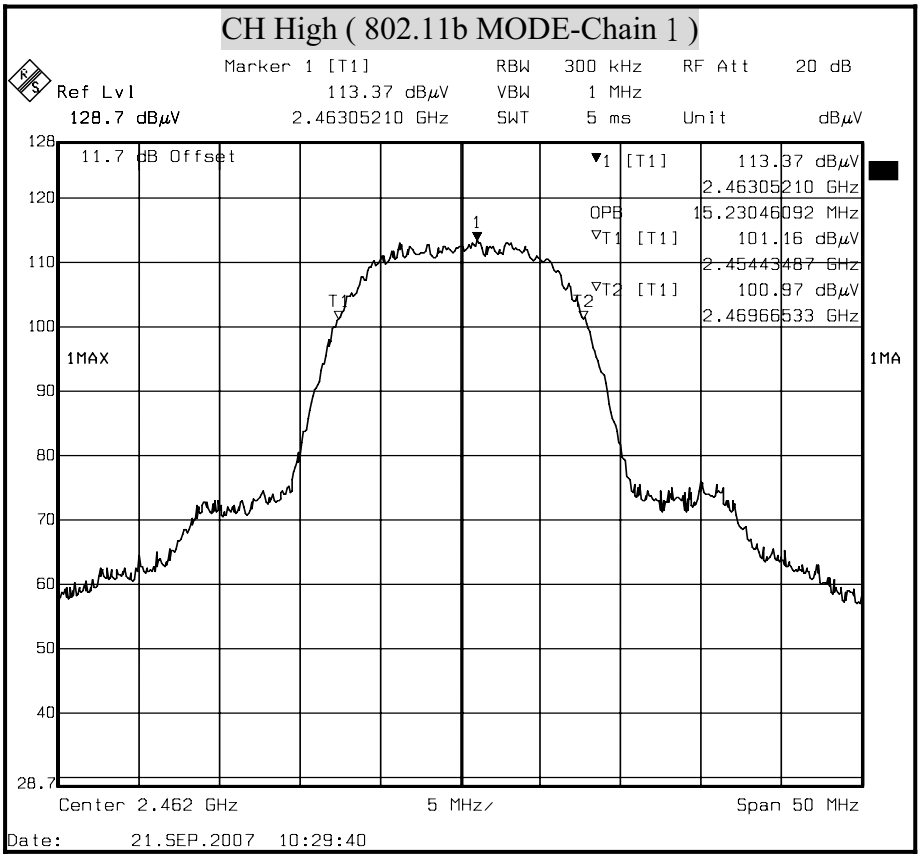
CH Low ( 802.11b MODE-Chain 1 )




CH Mid ( 802.11b MODE-Chain 1 )

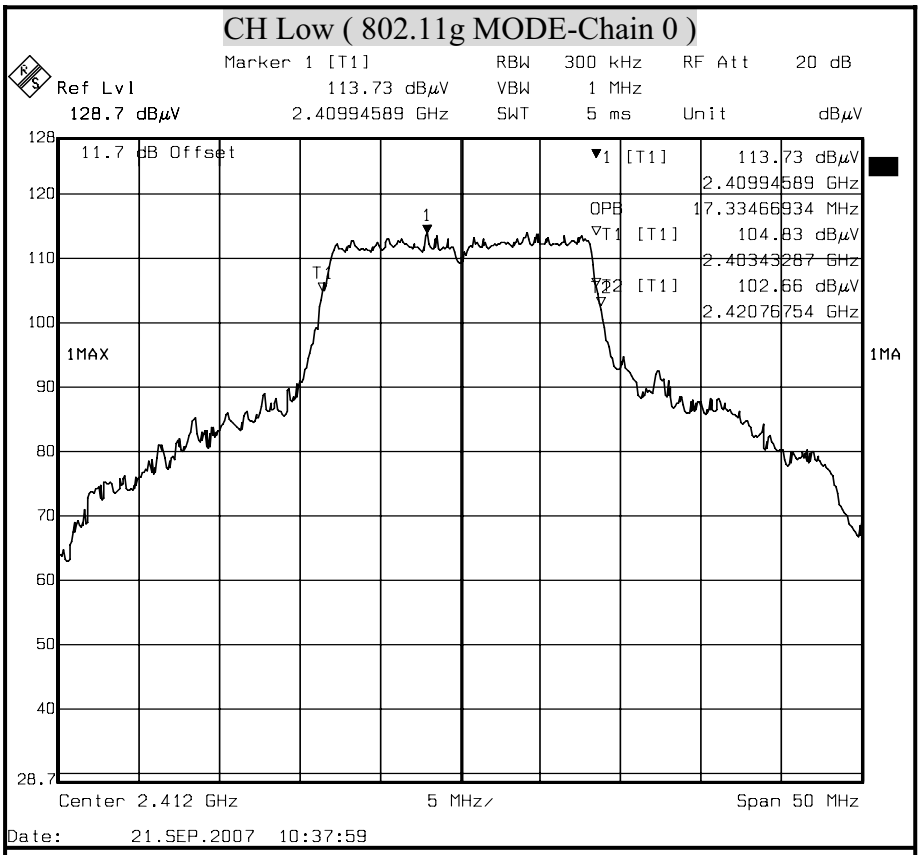


CH High ( 802.11b MODE-Chain 1 )

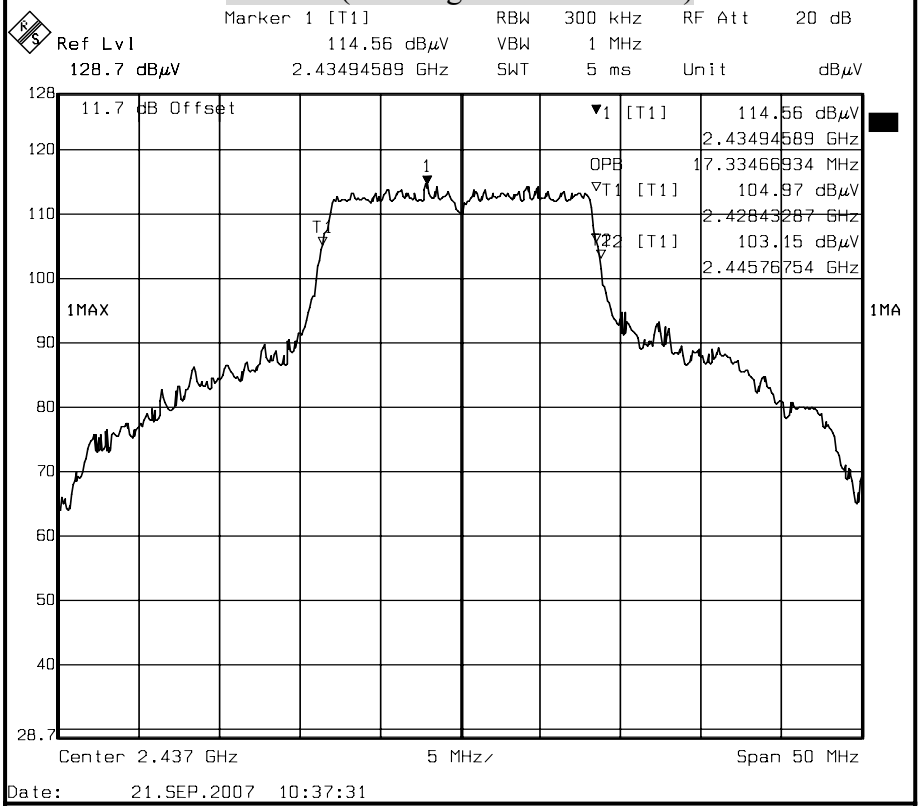


## 99% BANDWIDTH ( 802.11g MODE)

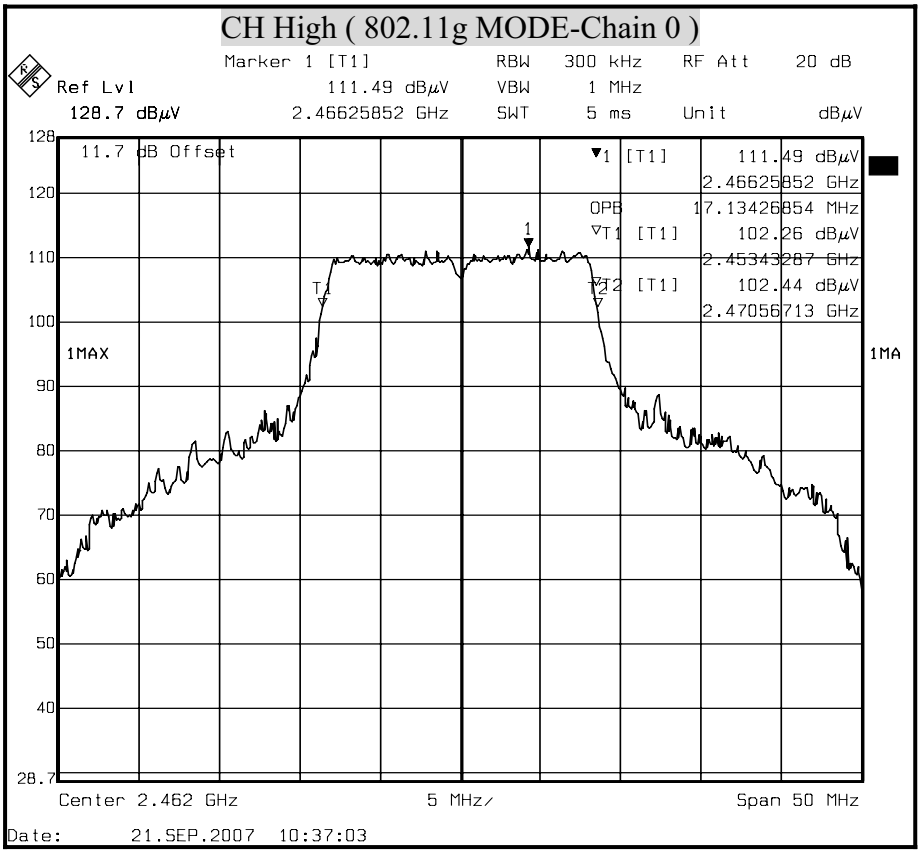
CH Low ( 802.11g MODE-Chain 0 )



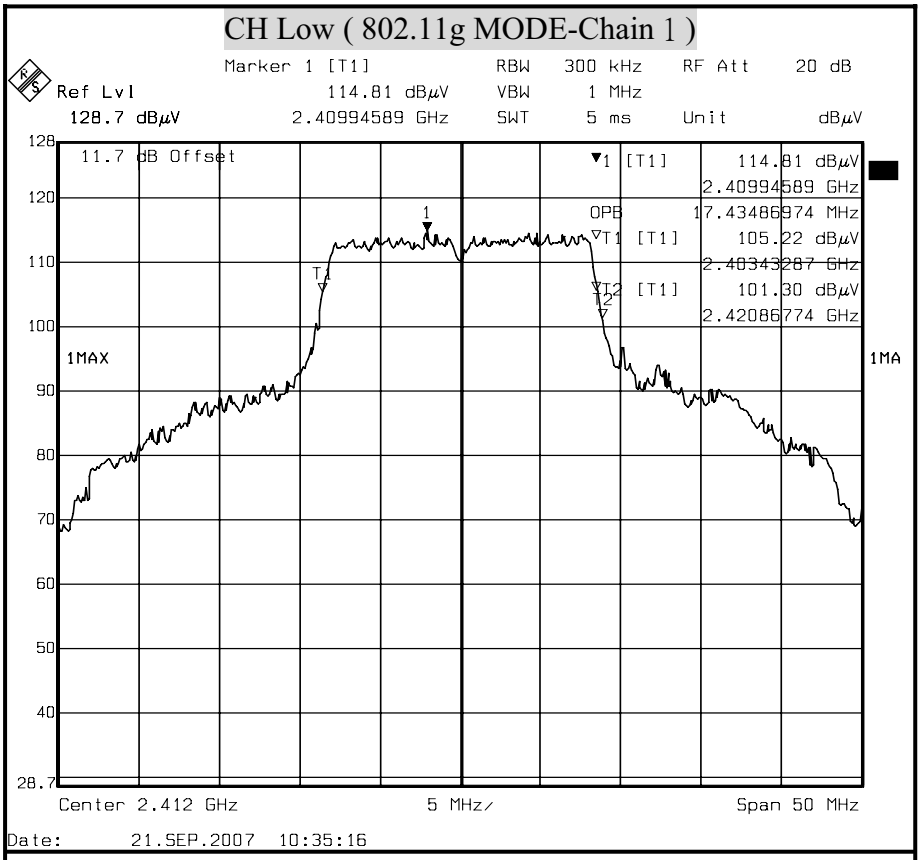

CH Mid ( 802.11g MODE-Chain 0 )



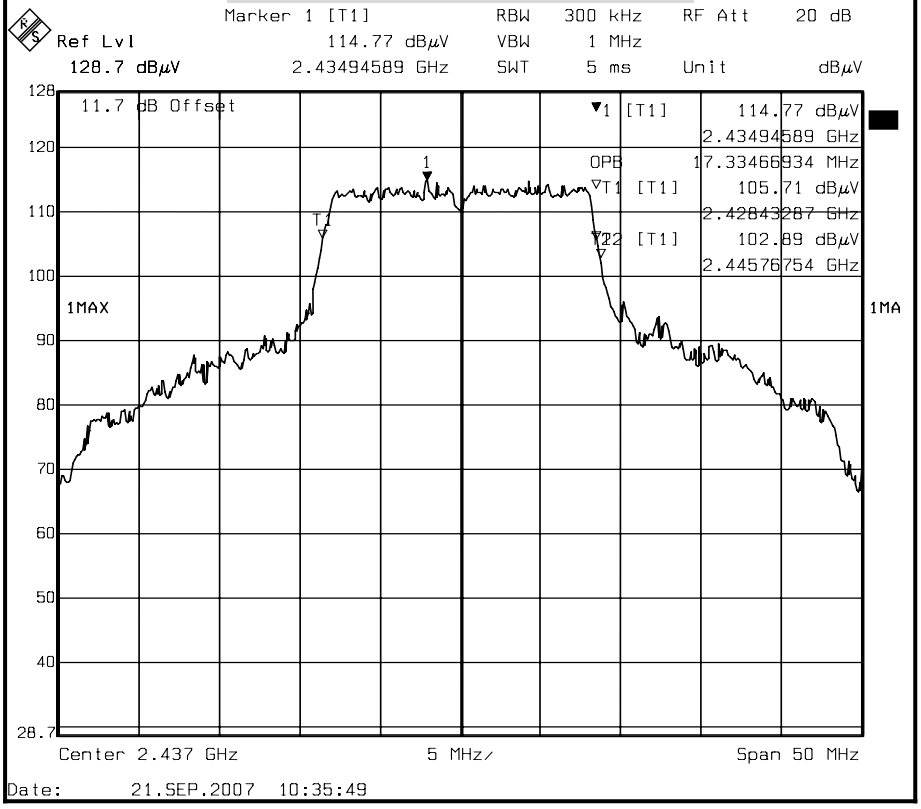
CH High ( 802.11g MODE-Chain 0 )



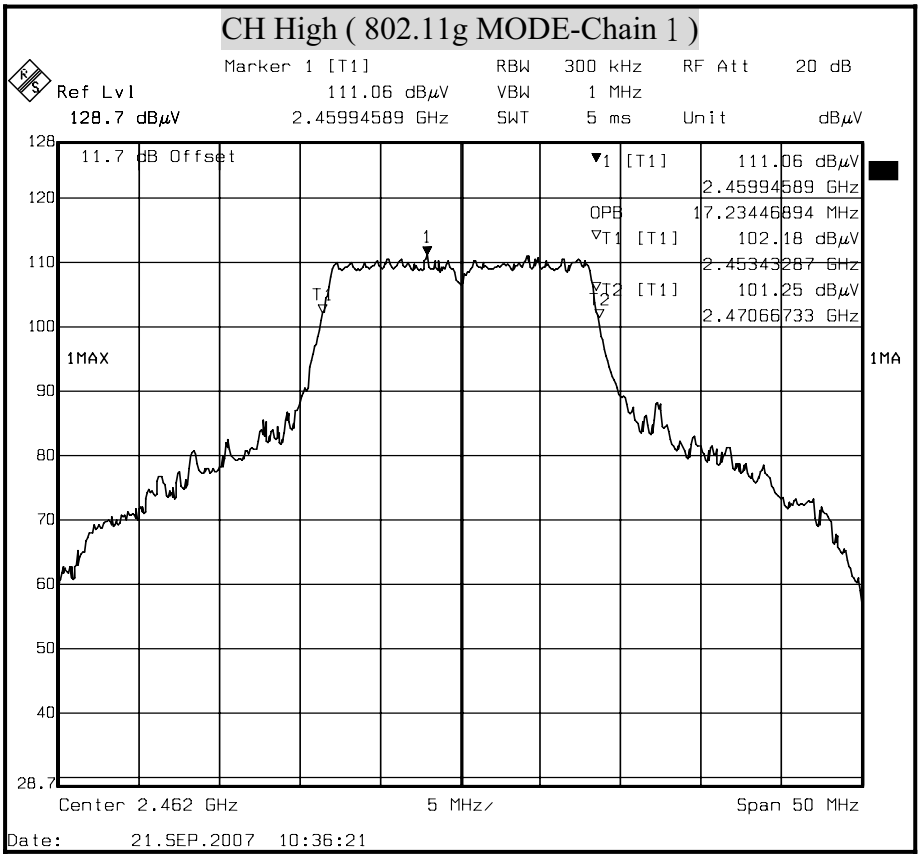
CH Low ( 802.11g MODE-Chain 1 )




CH Mid ( 802.11g MODE-Chain 1 )

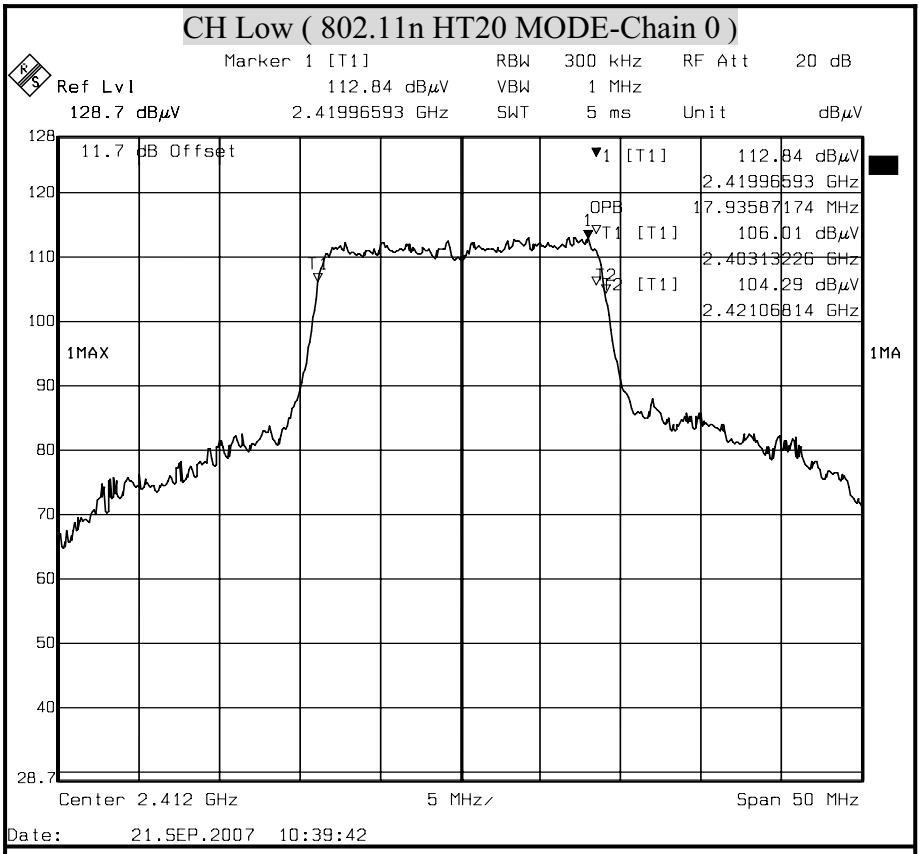


CH High ( 802.11g MODE-Chain 1 )

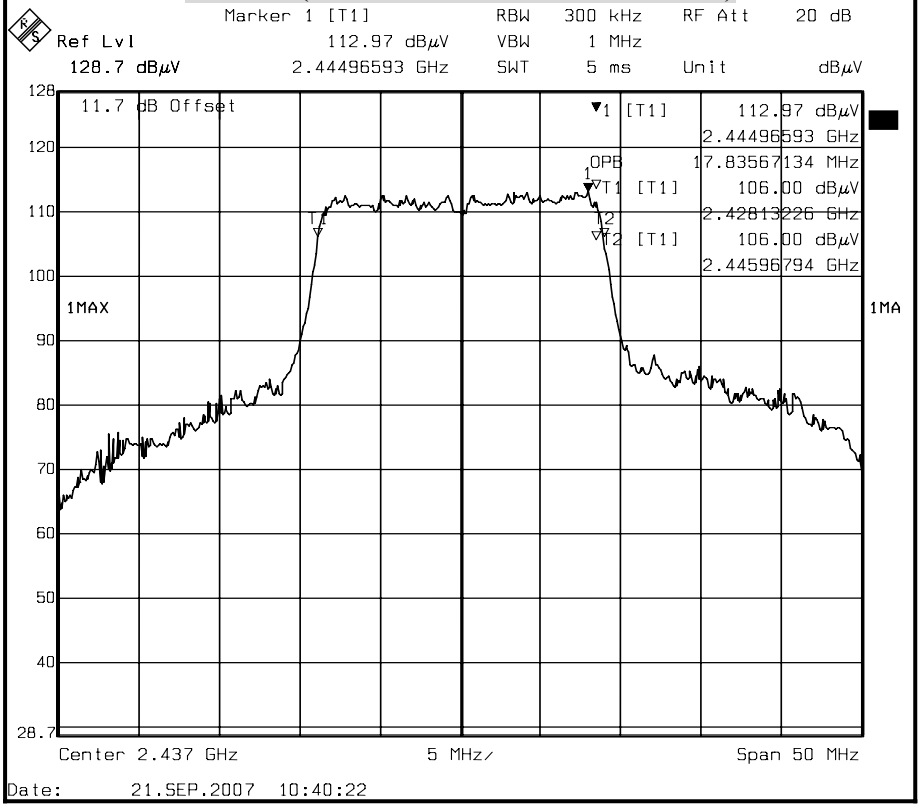


## 99% BANDWIDTH ( 802.11n HT20 MODE )

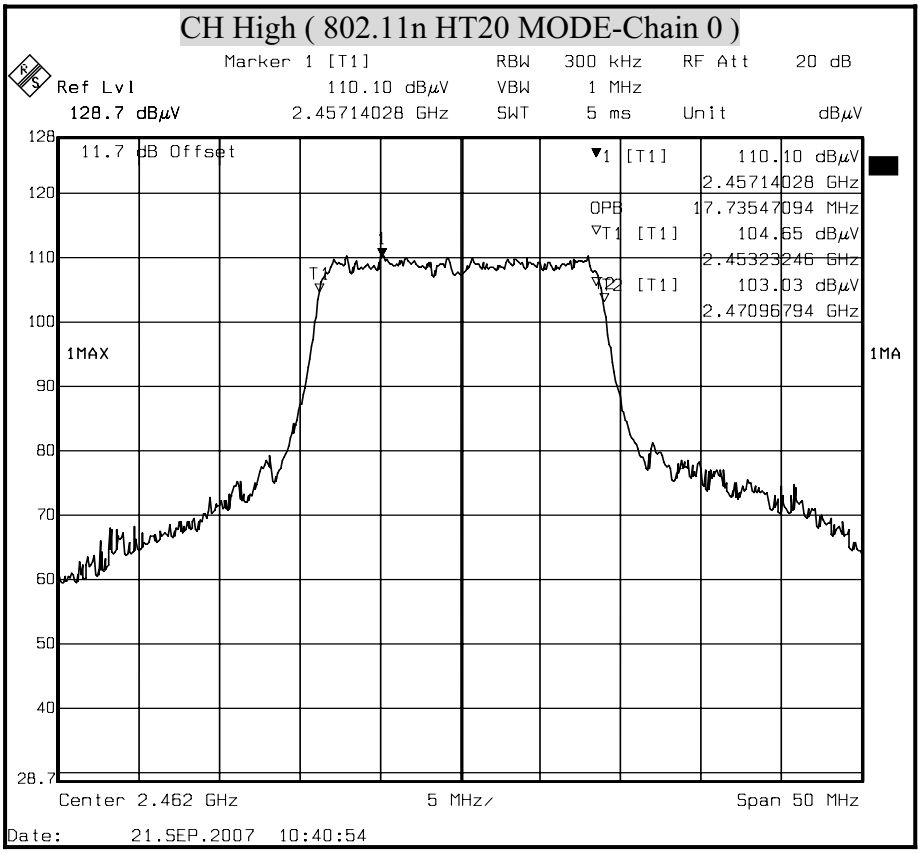
CH Low ( 802.11n HT20 MODE-Chain 0 )



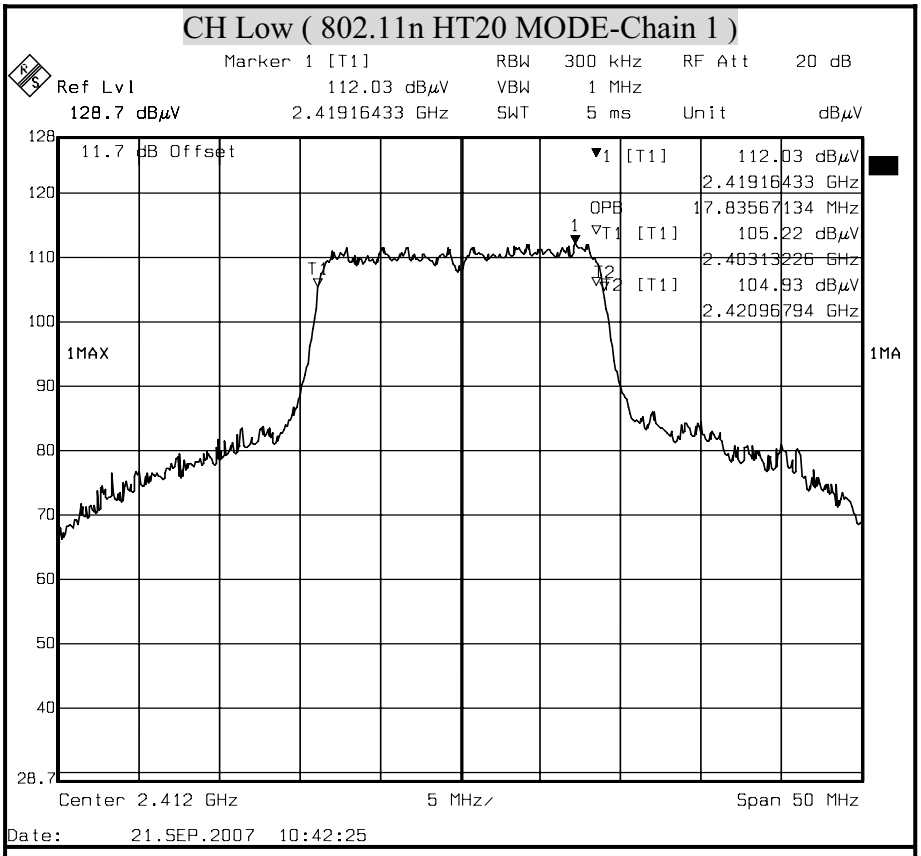

CH Mid ( 802.11n HT20 MODE-Chain 0 )



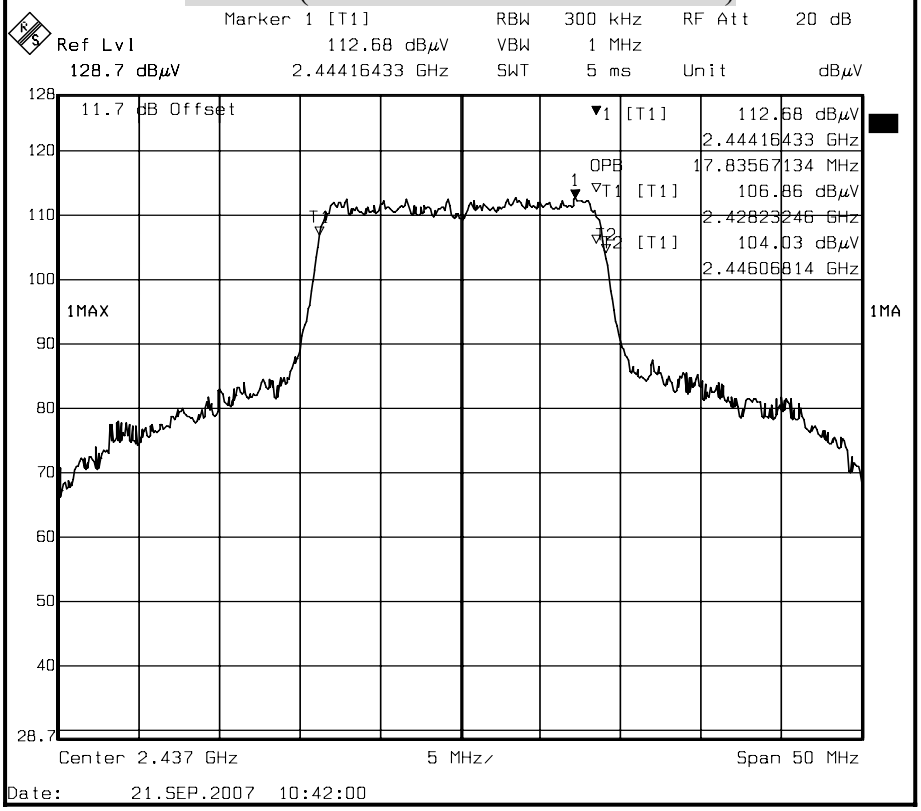
CH High ( 802.11n HT20 MODE-Chain 0 )



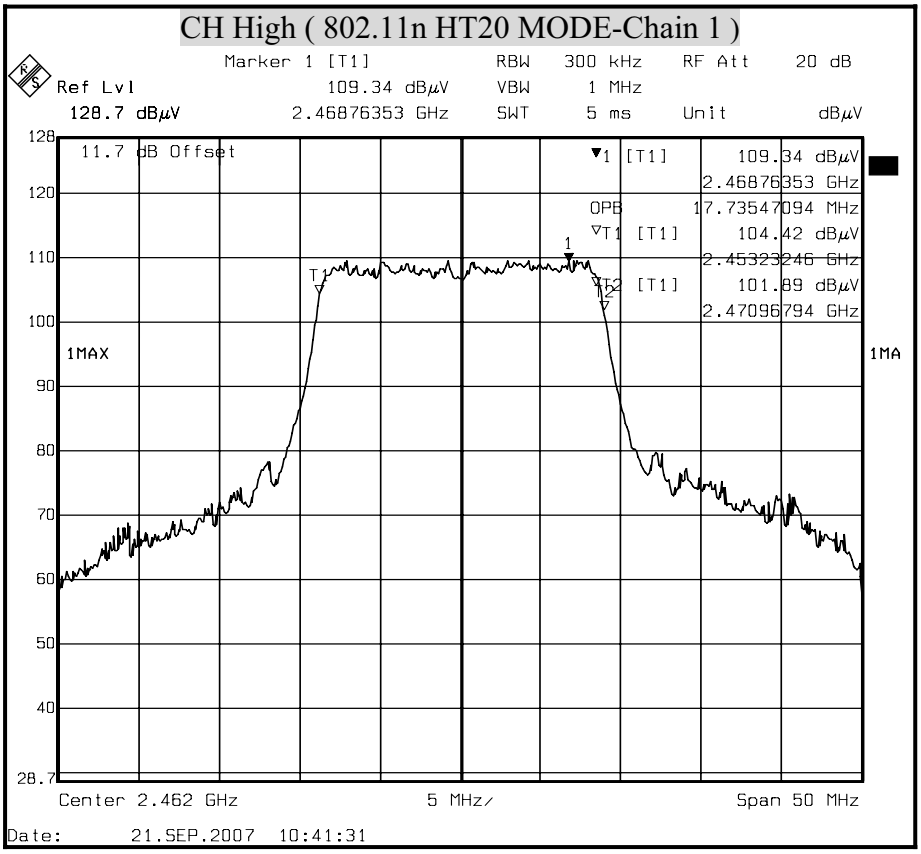
CH Low ( 802.11n HT20 MODE-Chain 1 )




CH Mid ( 802.11n HT20 MODE-Chain 1 )

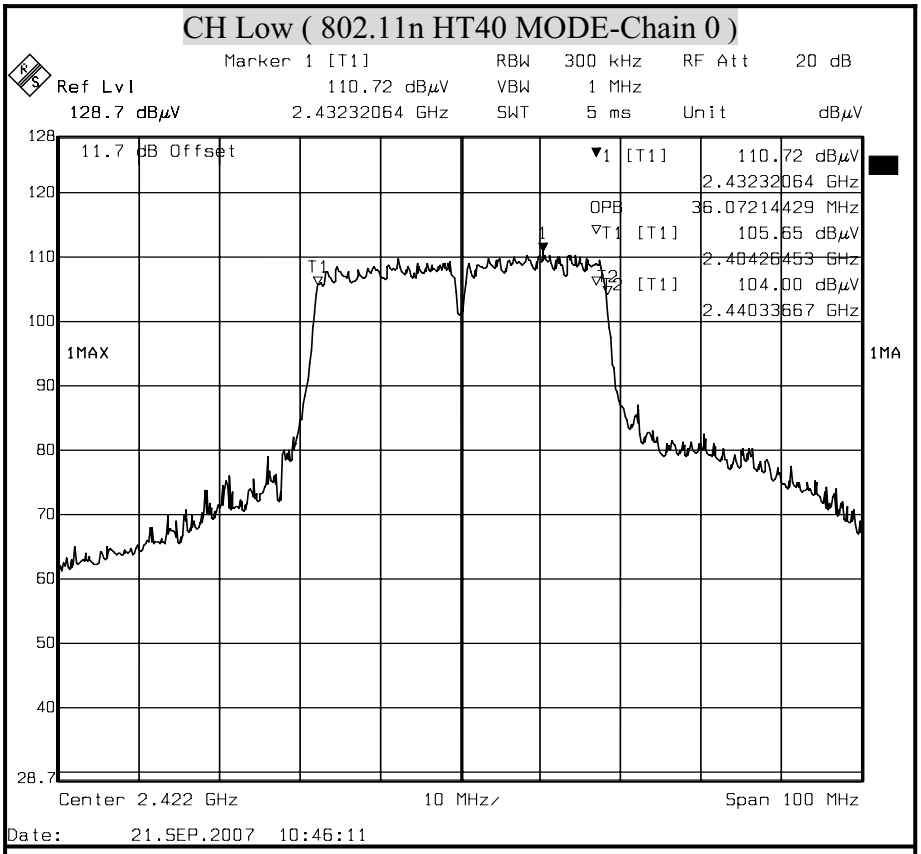


CH High ( 802.11n HT20 MODE-Chain 1 )

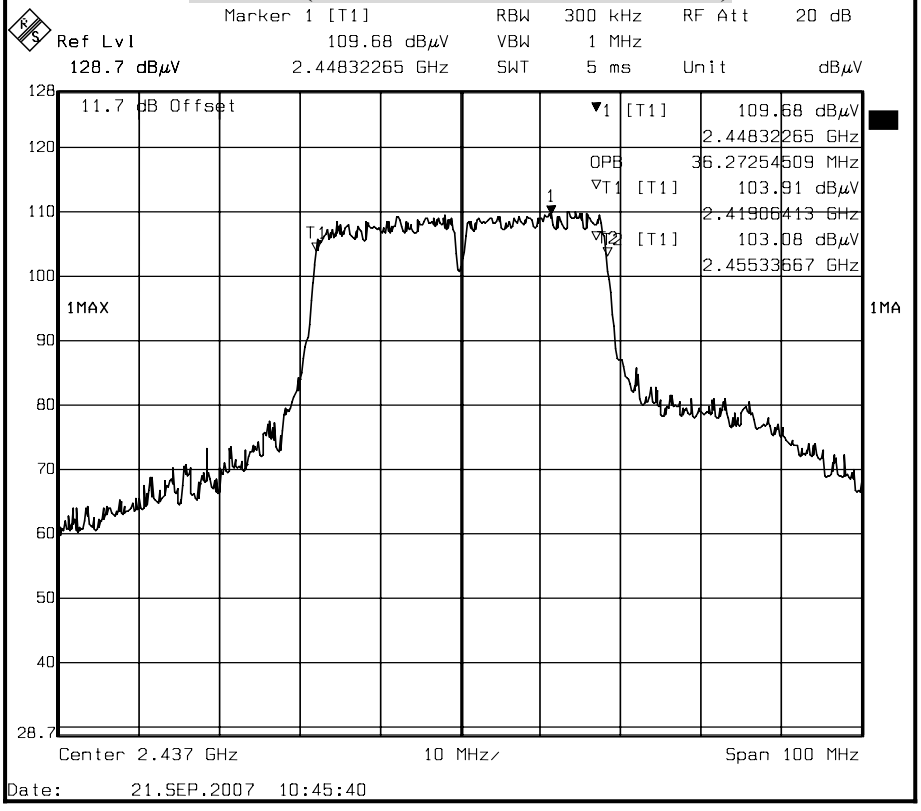


## 99% BANDWIDTH ( 802.11n HT40 MODE )

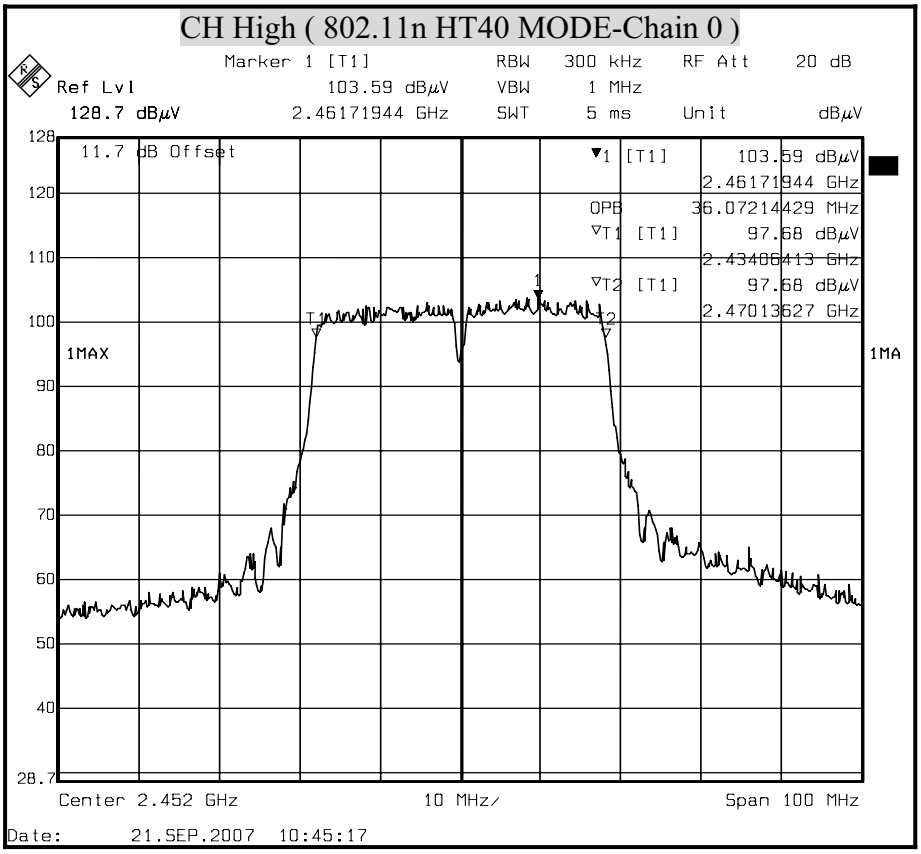
CH Low ( 802.11n HT40 MODE-Chain 0 )



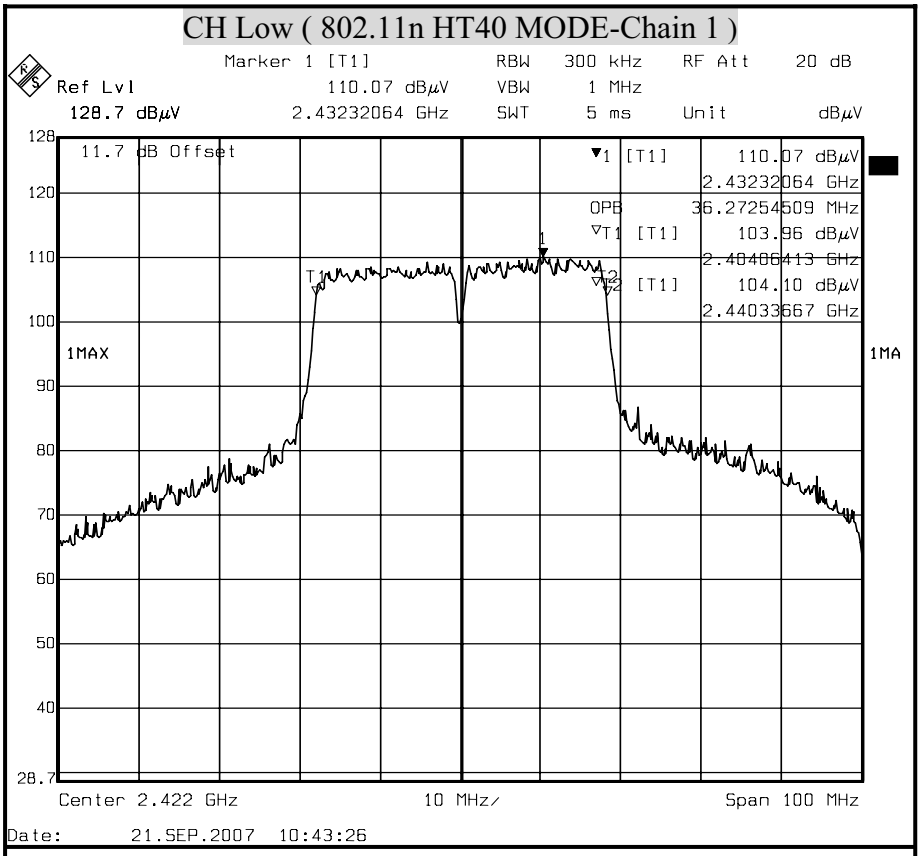

CH Mid ( 802.11n HT40 MODE-Chain 0)



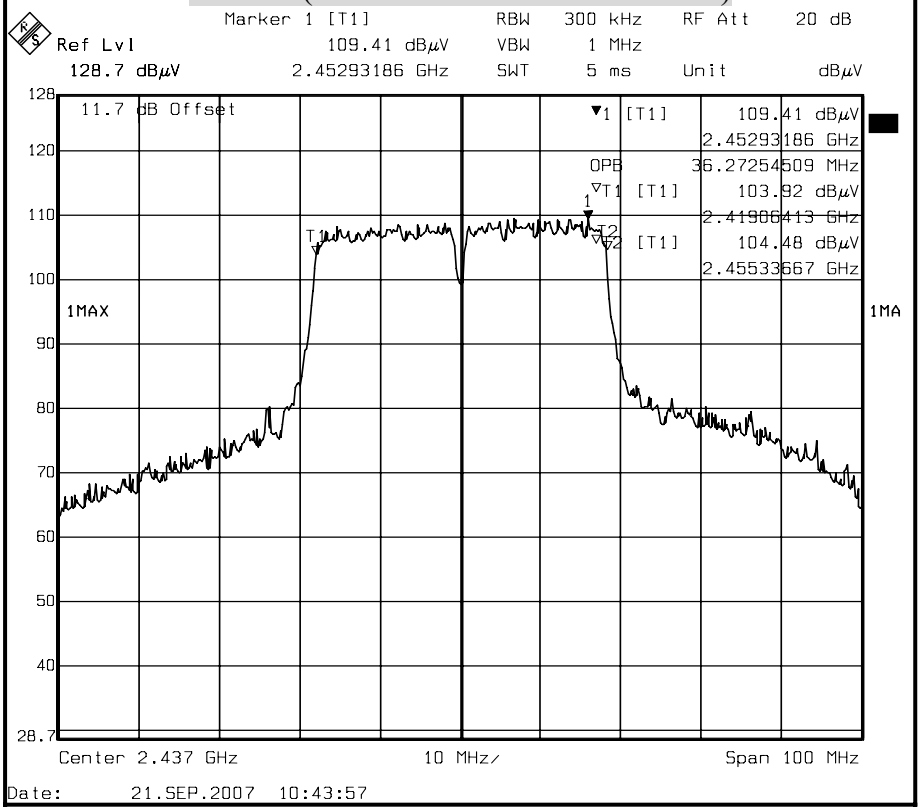
CH High ( 802.11n HT40 MODE-Chain 0 )



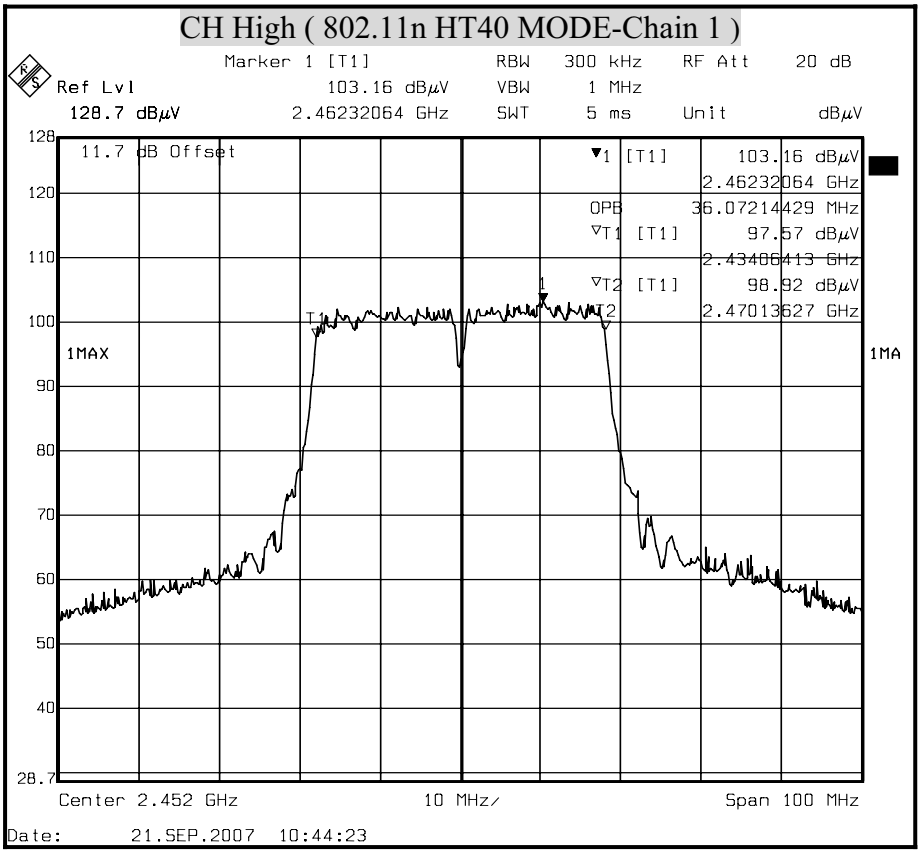
CH Low ( 802.11n HT40 MODE-Chain 1 )




CH Mid ( 802.11n HT40 MODE-Chain 1)



CH High ( 802.11n HT40 MODE-Chain 1 )



## 8.3 MAXIMUM PEAK OUTPUT POWER

**LIMIT**

§ 15.247(b) The maximum peak output power of the intentional radiator shall not exceed the following:

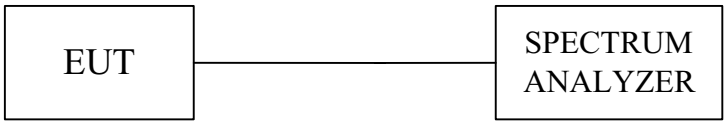
§ 15.247(b) (3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 watt.

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

**TEST EQUIPMENTS**

| Name of Equipment | Manufacturer | Model | Serial Number | Calibration Due |
|---|---|---|---|---|
| Spectrum Analyzer | R&S | FSEM | 829054/017 | MAR. 13, 2008 |

**TEST SETUP**




**TEST PROCEDURE**

1. The spectrum shall be set as follows:
   Span: 1.5 times channel integration bandwidth.
   RBW: 1MHz
   VBW: 3MHz
   Detector: Peak
   Sweep: Single trace
2. Compute the combined power of all signal responses contained in the trace by covering all the data points.
3. For 99% occupied BW, place the markers at the frequency at which 0.5% of the power lies to the right of the right marker and 0.5% of the power lies to the left of the left marker.
4. The peak output power is the channel power integrated over 99% bandwidth.

## TEST RESULTS

No non-compliance noted

Total peak power calculation formula:
10 log (10^ (Chain 0 Power / 10) + 10^ (Chain1 Power / 10) ).

The maximum antenna gain is 2.27dBi for other than fixed, point-to-point operations, therefore the limit is 30dBm. In the legacy mode, the effective antenna gain is 2.27 + 10 x Log (2) =5.28dBi. 5.28dBi-6dBi=-0.72dB (<0dBi); Peak power limit= 30-0=30dBm

**IEEE 802.11b mode (Two TX)**

| Channel | Channel Frequency (MHz) | Peak Power (dBm) | | Peak Power Total (dBm) | Peak Power Limit (dBm) | Pass / Fail |
|---|---|---|---|---|---|---|
| | | Chain 0 | Chain 1 | | | |
| Low | 2412 | 20.96 | 20.16 | 23.59 | 30.00 | PASS |
| Middle | 2437 | 21.07 | 20.28 | 23.70 | 30.00 | PASS |
| High | 2462 | 20.68 | 19.31 | 23.03 | 30.00 | PASS |

Note : 1. At finial test to get the worst-case emission at 11Mbps.
2. The cable assembly insertion loss of 11.7dB (including 10 dB pad and 1.7 dB cable) was Entered as an offset in the spectrum analyzer to allow for direct reading of power.

**IEEE 802.11g mode (Two TX)**

| Channel | Channel Frequency (MHz) | Peak Power (dBm) | | Peak Power Total (dBm) | Peak Power Limit (dBm) | Pass / Fail |
|---|---|---|---|---|---|---|
| | | Chain 0 | Chain 1 | | | |
| Low | 2412 | 23.32 | 23.35 | 26.35 | 30.00 | PASS |
| Middle | 2437 | 23.98 | 23.58 | 26.79 | 30.00 | PASS |
| High | 2462 | 21.00 | 19.95 | 23.52 | 30.00 | PASS |

Note : 1.At finial test to get the worst-case emission at 6Mbps.
2. The cable assembly insertion loss of 11.7dB (including 10 dB pad and 1.7 dB cable) was Entered as an offset in the spectrum analyzer to allow for direct reading of power.

**IEEE 802.11n HT20 mode (Two TX)**

| Channel | Channel Frequency (MHz) | Peak Power (dBm) | | Peak Power Total (dBm) | Peak Power Limit (dBm) | Pass / Fail |
|---|---|---|---|---|---|---|
| | | Chain 0 | Chain 1 | | | |
| Low | 2412 | 22.88 | 21.37 | 25.20 | 30.00 | PASS |
| Middle | 2437 | 22.99 | 22.26 | 25.65 | 30.00 | PASS |
| High | 2462 | 20.45 | 19.39 | 22.96 | 30.00 | PASS |

Note : 1.At finial test to get the worst-case emission at 6.5Mbps.
2. The cable assembly insertion loss of 11.7dB (including 10 dB pad and 1.7 dB cable) was Entered as an offset in the spectrum analyzer to allow for direct reading of power.

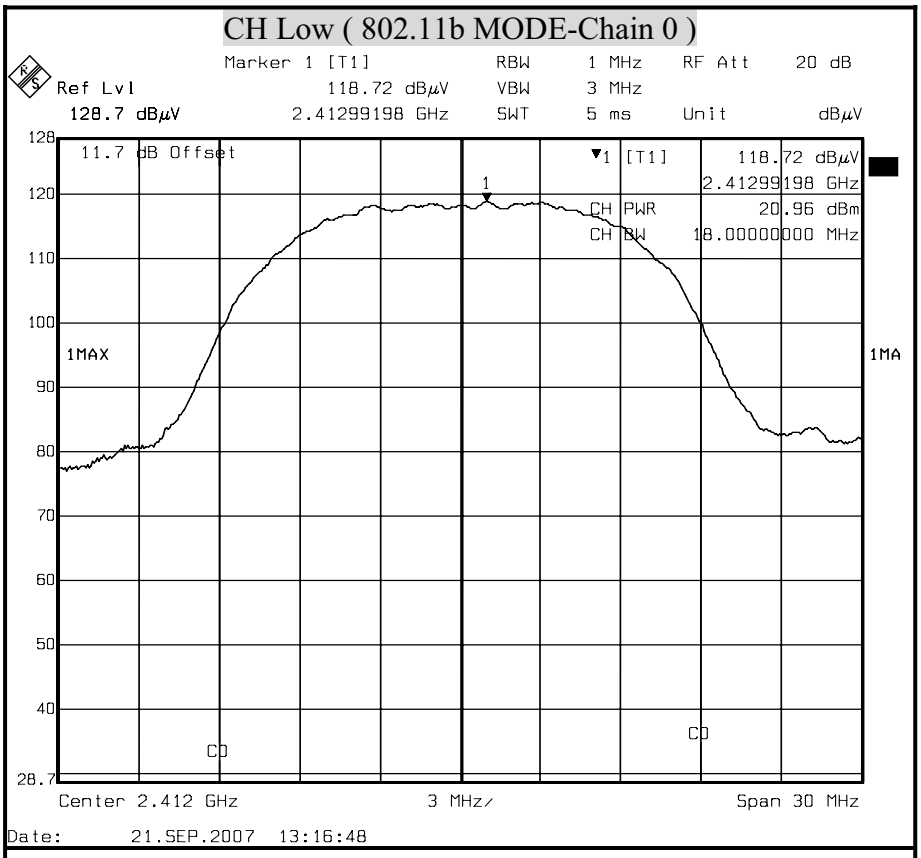
**IEEE 802.11n HT40 mode (Two TX)**

| Channel | Channel Frequency (MHz) | Peak Power (dBm) | | Peak Power Total (dBm) | Peak Power Limit (dBm) | Pass / Fail |
|---|---|---|---|---|---|---|
| | | Chain 0 | Chain 1 | | | |
| Low | 2422 | 22.34 | 22.03 | 25.20 | 30.00 | PASS |
| Middle | 2437 | 22.23 | 21.74 | 25.00 | 30.00 | PASS |
| High | 2452 | 15.86 | 15.37 | 18.63 | 30.00 | PASS |

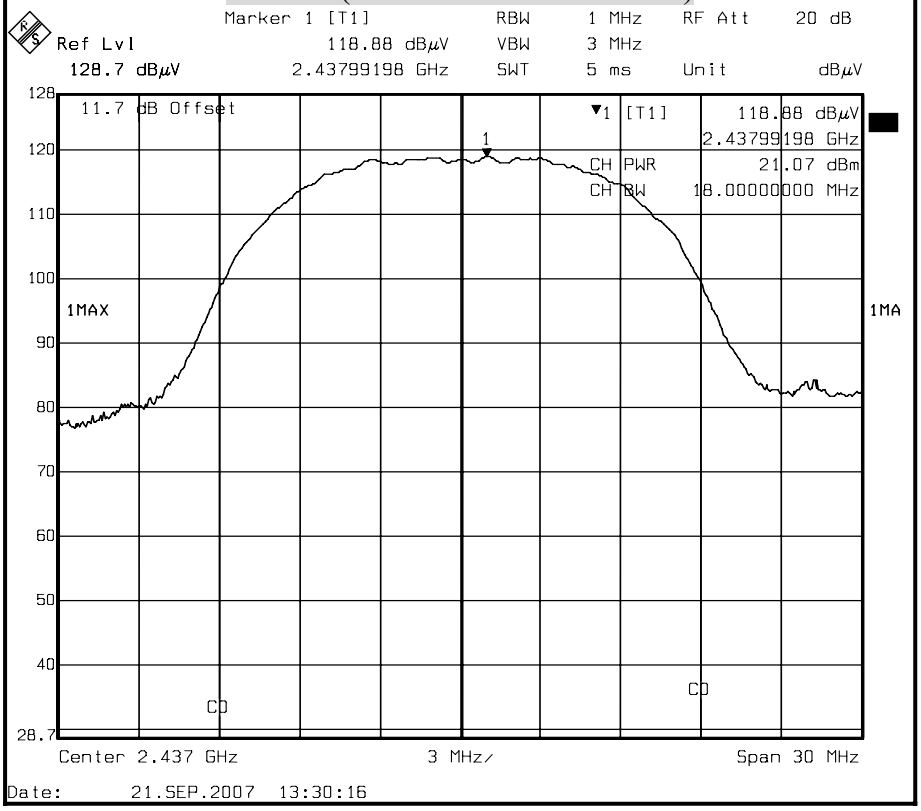
Note : 1.At finial test to get the worst-case emission at 6.5Mbps.
2. The cable assembly insertion loss of 11.7dB (including 10 dB pad and 1.7 dB cable) was Entered as an offset in the spectrum analyzer to allow for direct reading of power.

## MAXIMUM PEAK OUTPUT POWER ( 802.11b MODE)

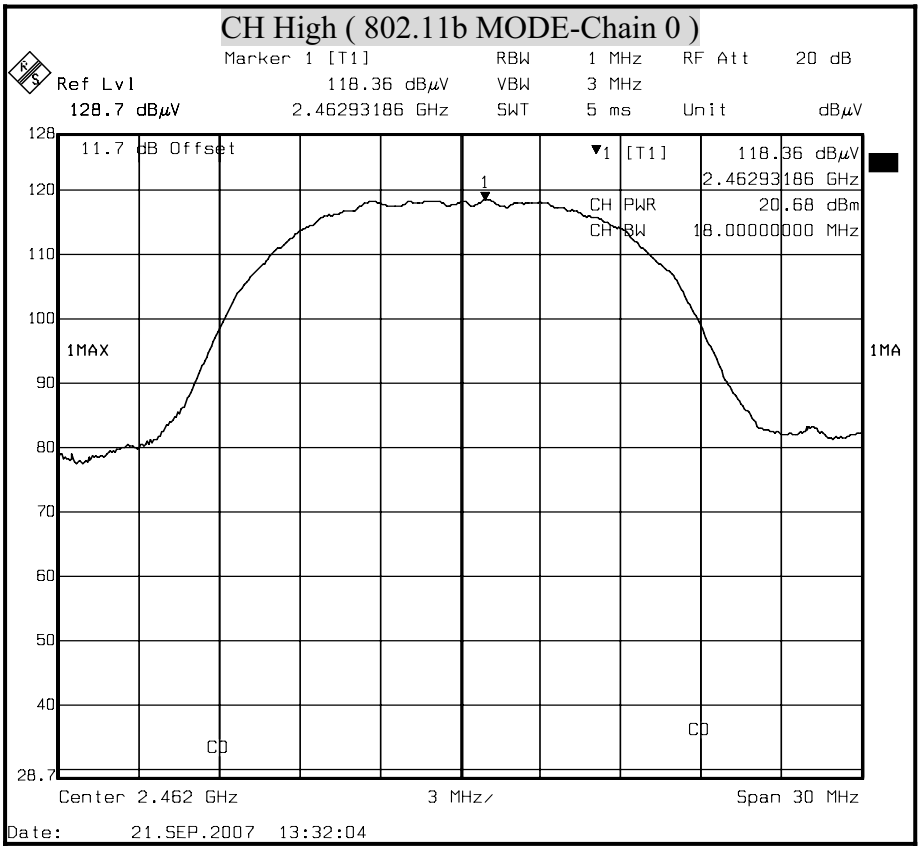
CH Low ( 802.11b MODE-Chain 0 )




CH Mid ( 802.11b MODE-Chain 0 )

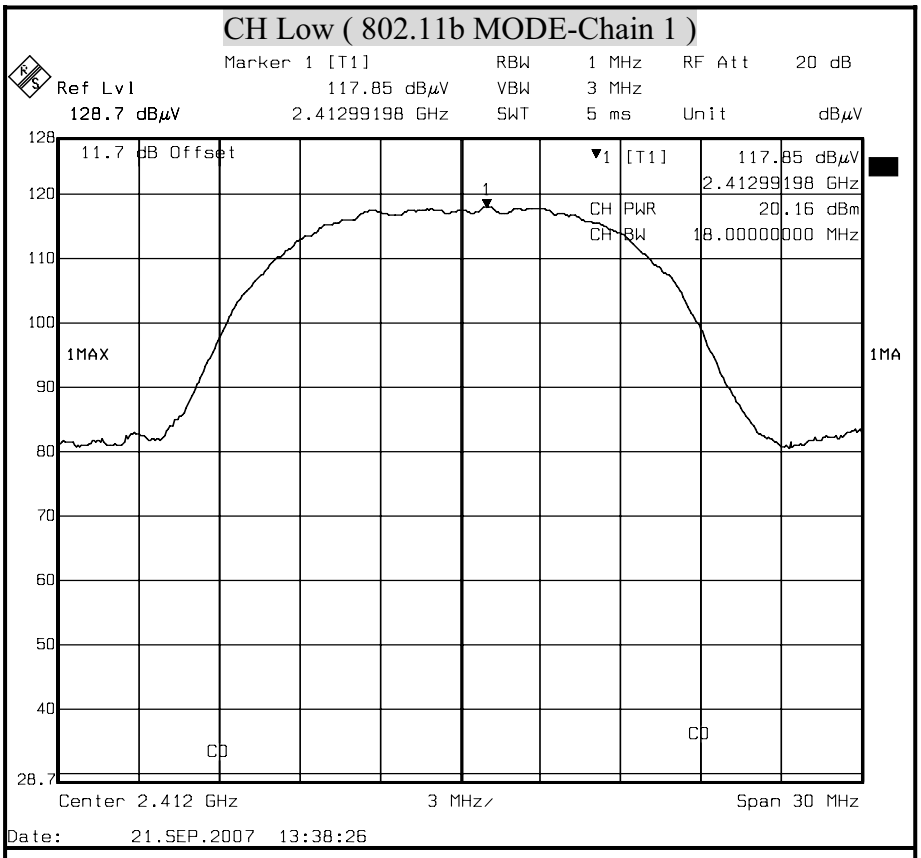


CH High ( 802.11b MODE-Chain 0 )

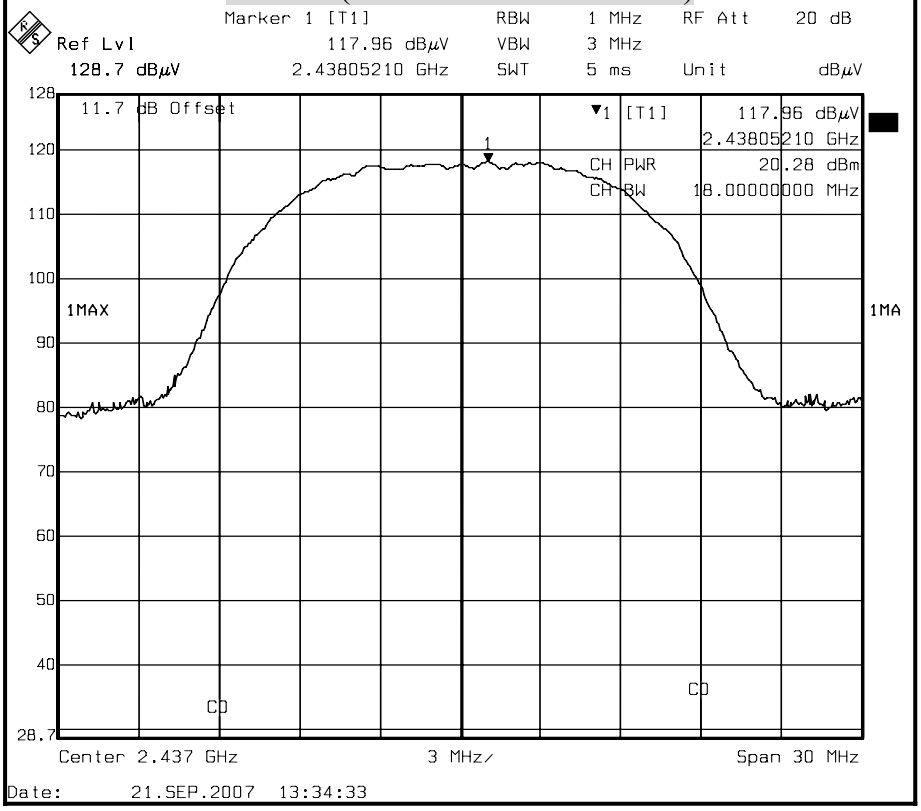


## MAXIMUM PEAK OUTPUT POWER ( 802.11b MODE)

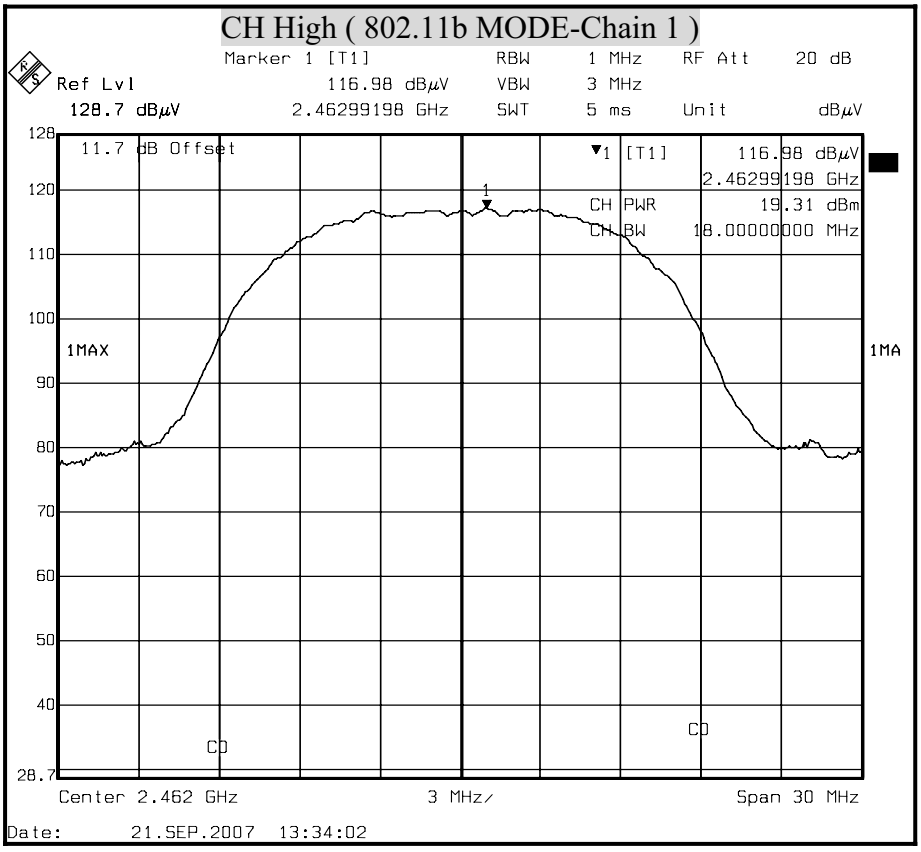
CH Low ( 802.11b MODE-Chain 1 )




CH Mid ( 802.11b MODE-Chain 1 )

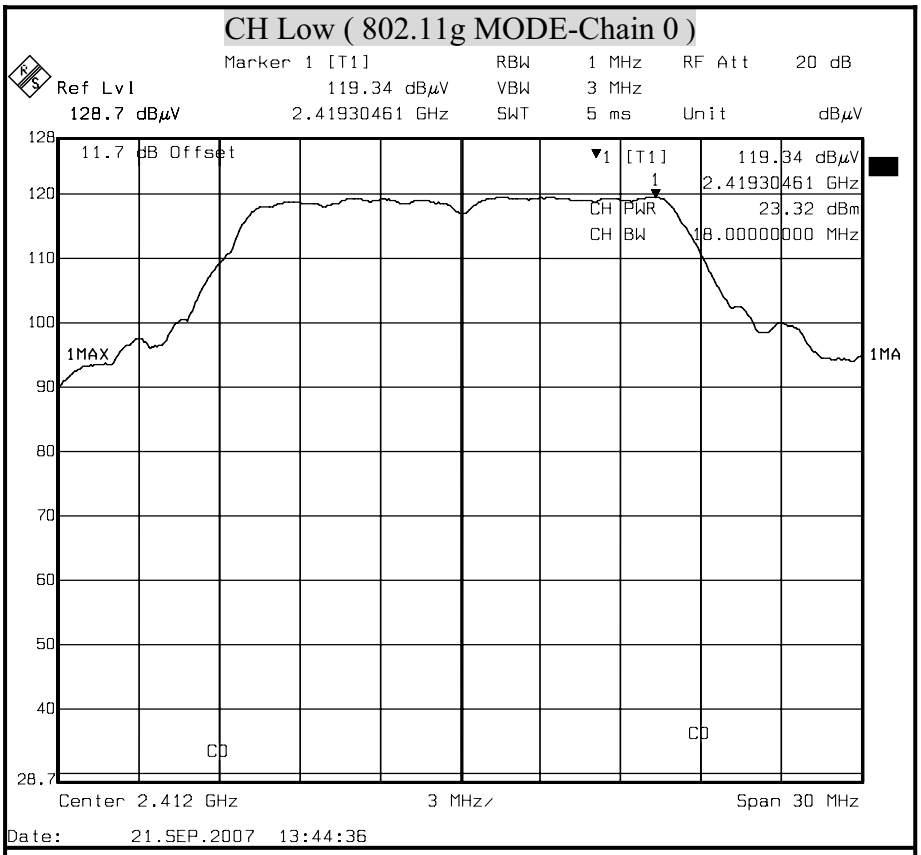


CH High ( 802.11b MODE-Chain 1 )

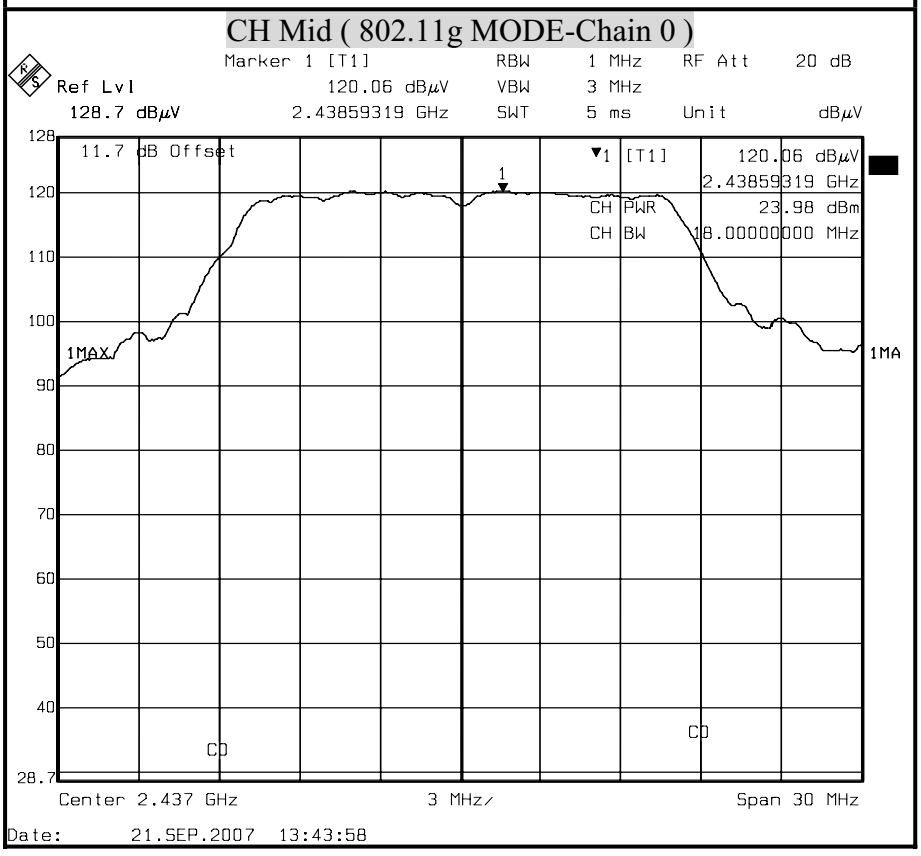


## MAXIMUM PEAK OUTPUT POWER ( 802.11g MODE )

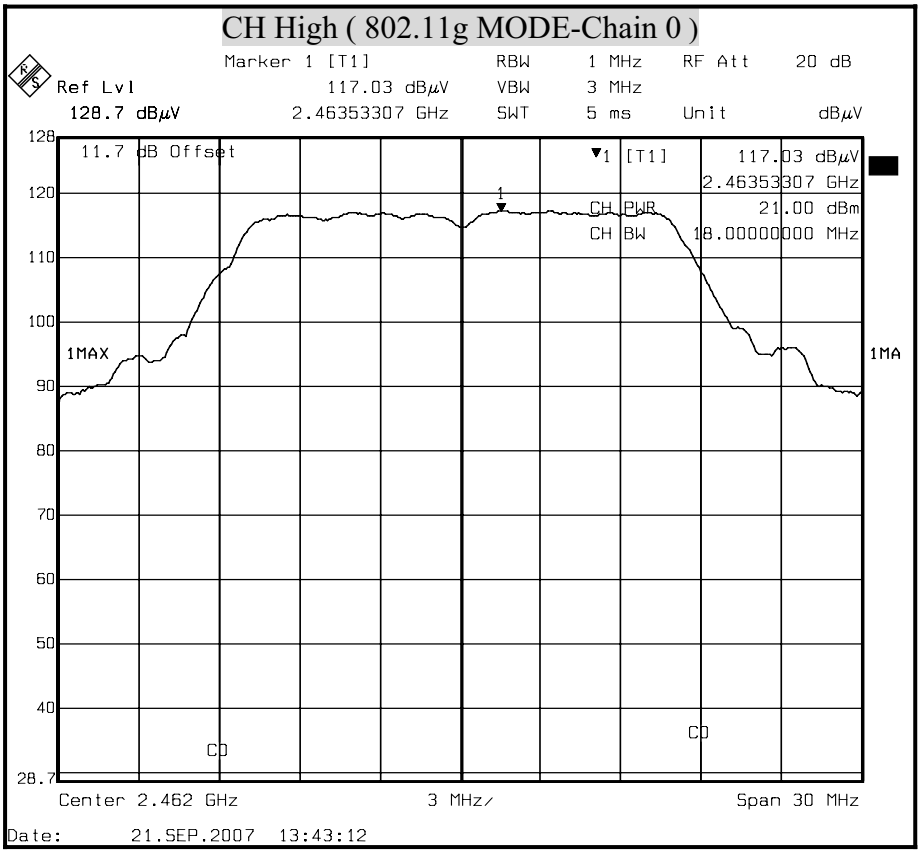
CH Low ( 802.11g MODE-Chain 0 )




CH Mid ( 802.11g MODE-Chain 0 )

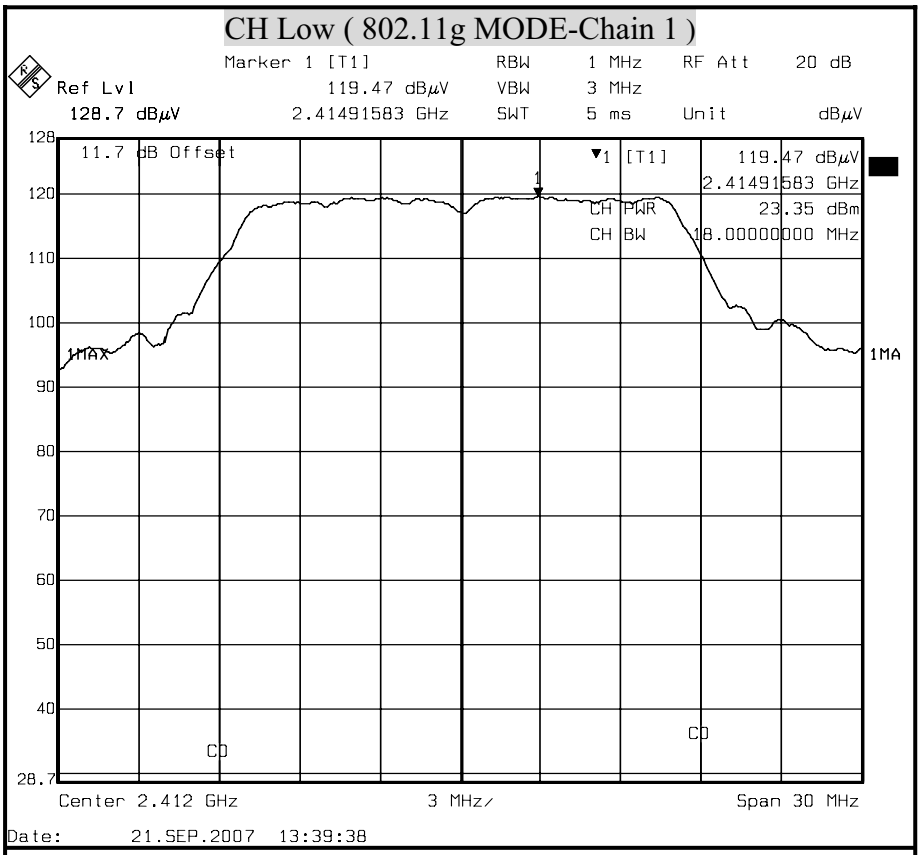


CH High ( 802.11g MODE-Chain 0 )

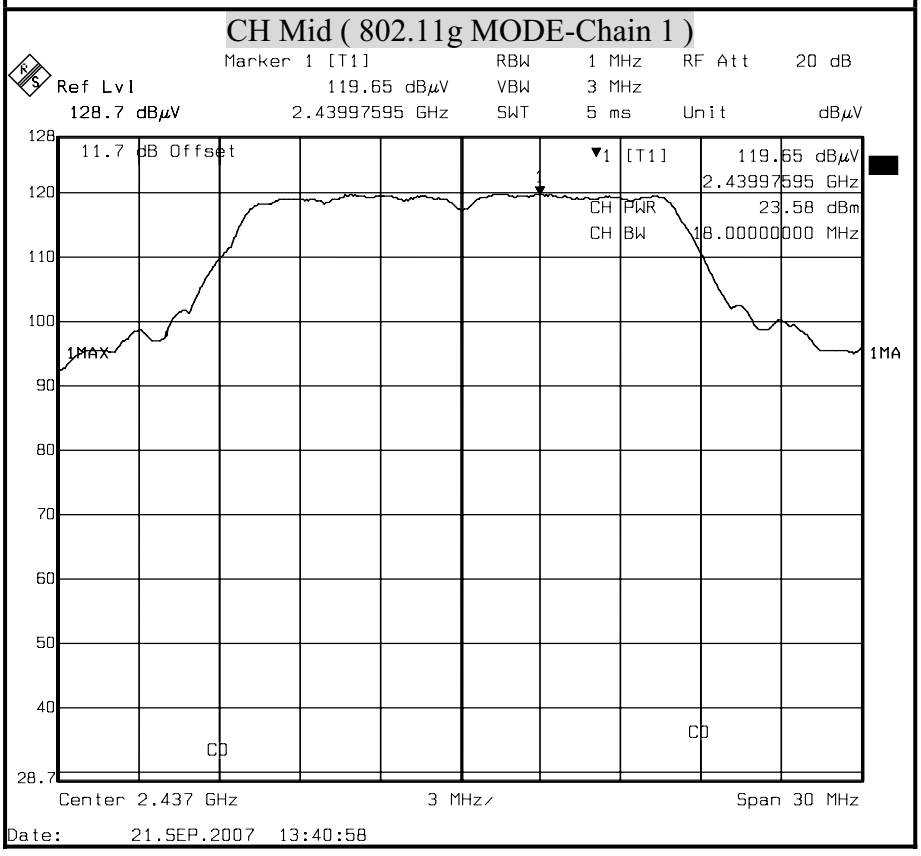


## MAXIMUM PEAK OUTPUT POWER ( 802.11g MODE )

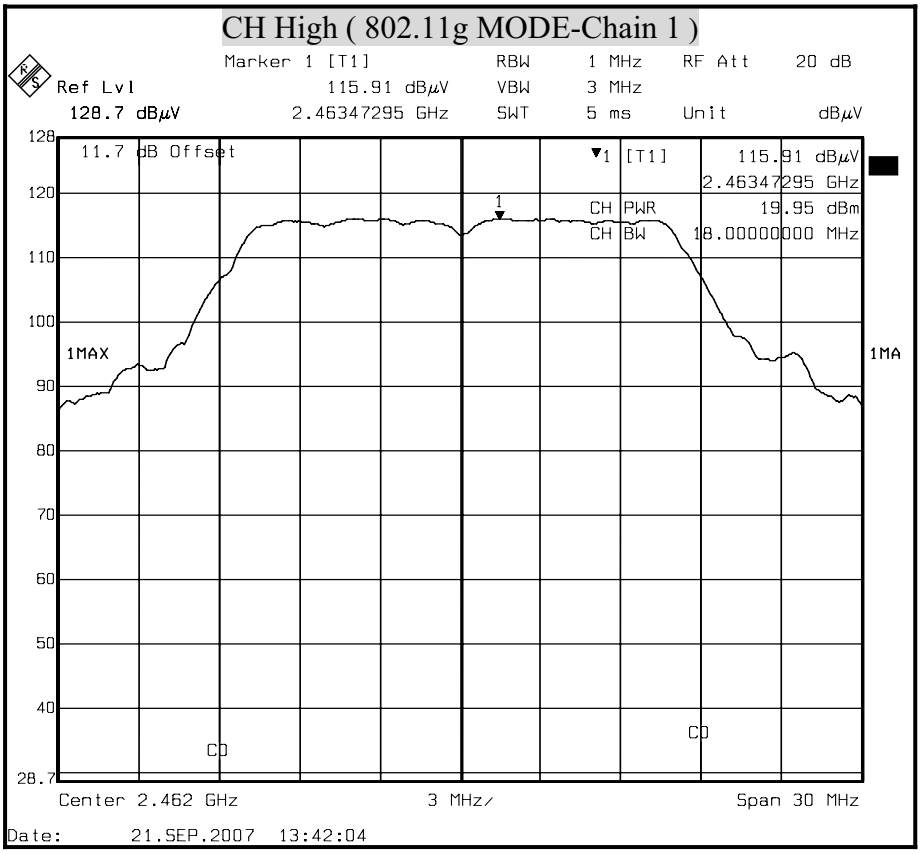
CH Low ( 802.11g MODE-Chain 1 )




CH Mid ( 802.11g MODE-Chain 1 )

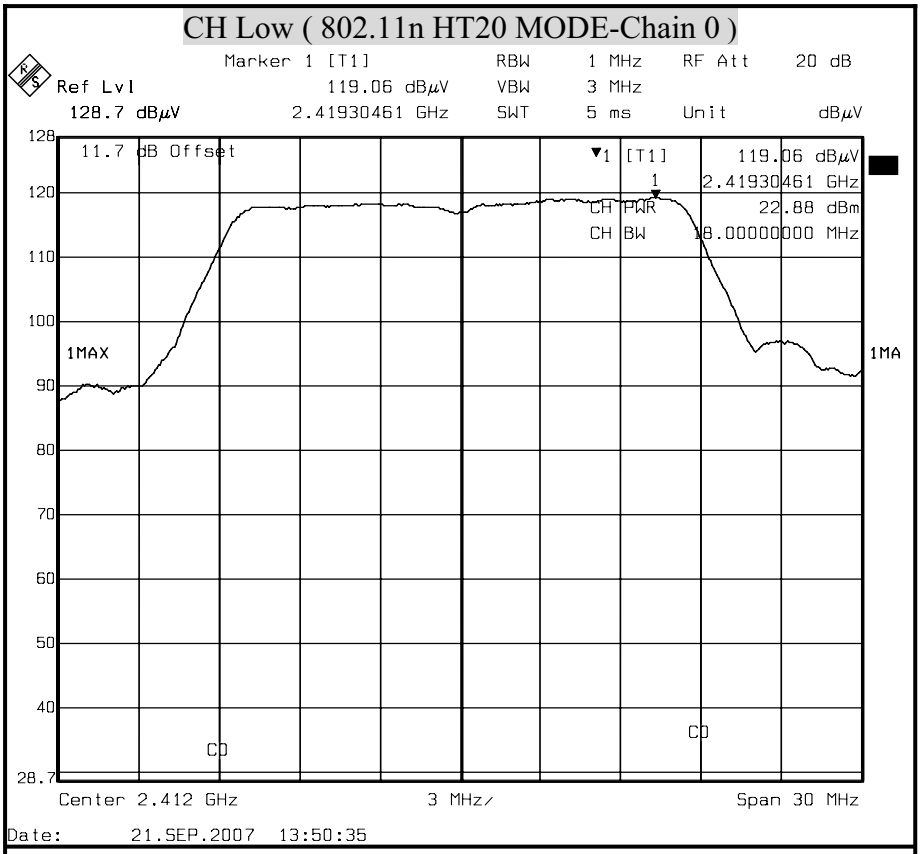


CH High ( 802.11g MODE-Chain 1 )

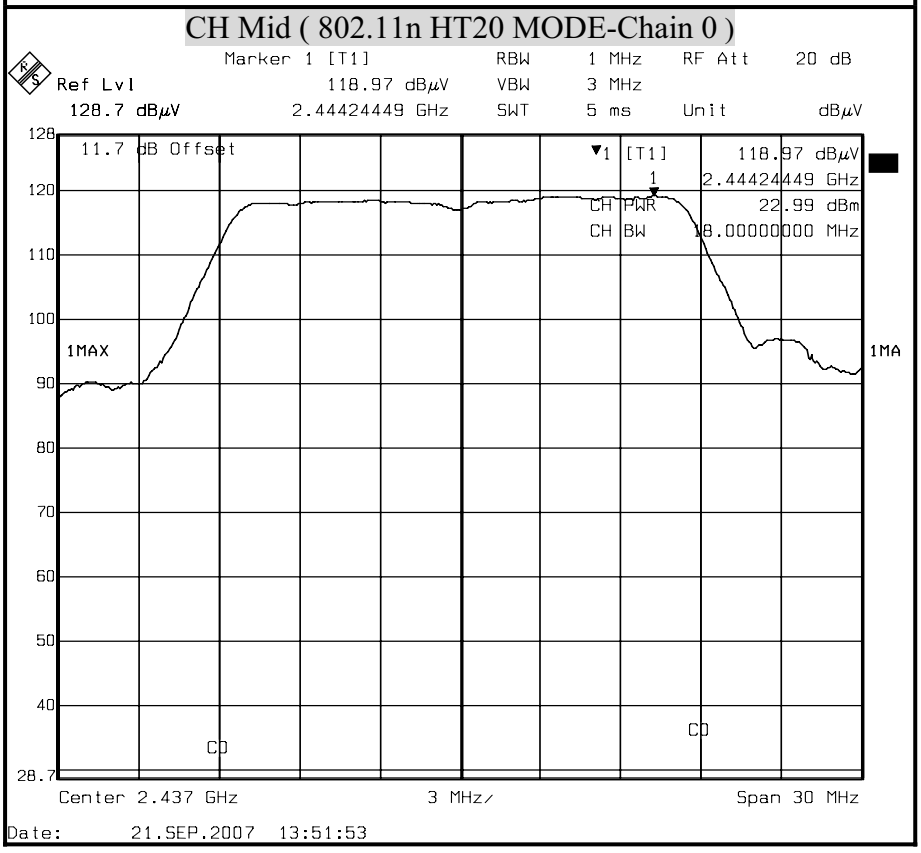


## MAXIMUM PEAK OUTPUT POWER ( 802.11n HT20 MODE )

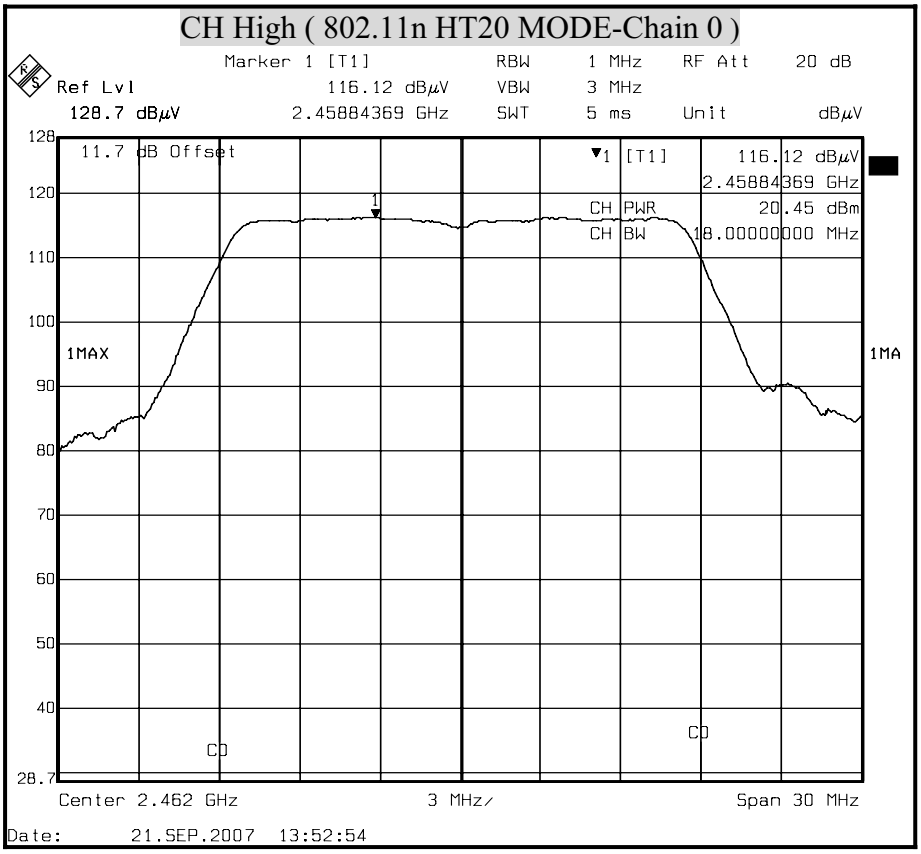
CH Low ( 802.11n HT20 MODE-Chain 0 )



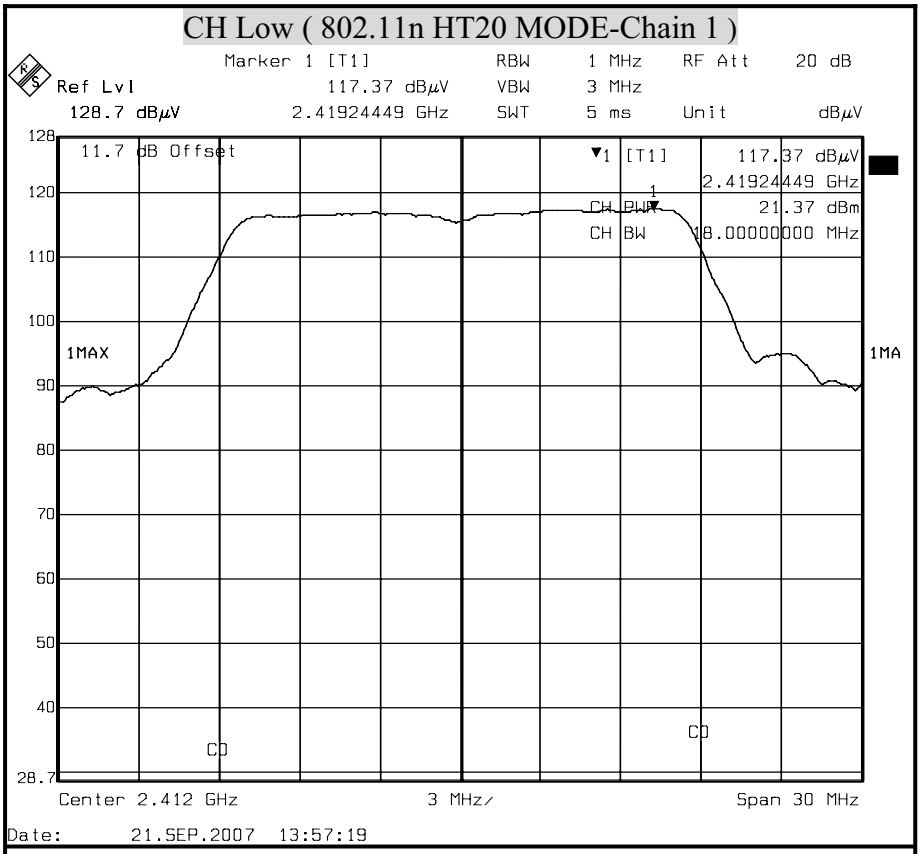

CH Mid ( 802.11n HT20 MODE-Chain 0 )



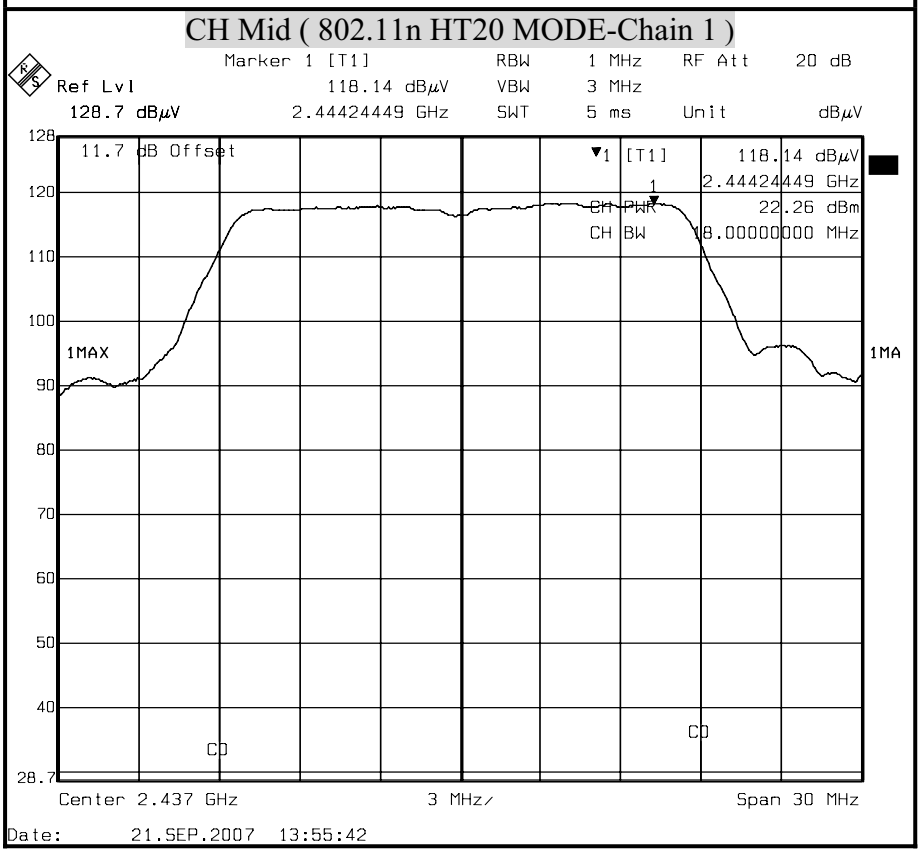
CH High ( 802.11n HT20 MODE-Chain 0 )



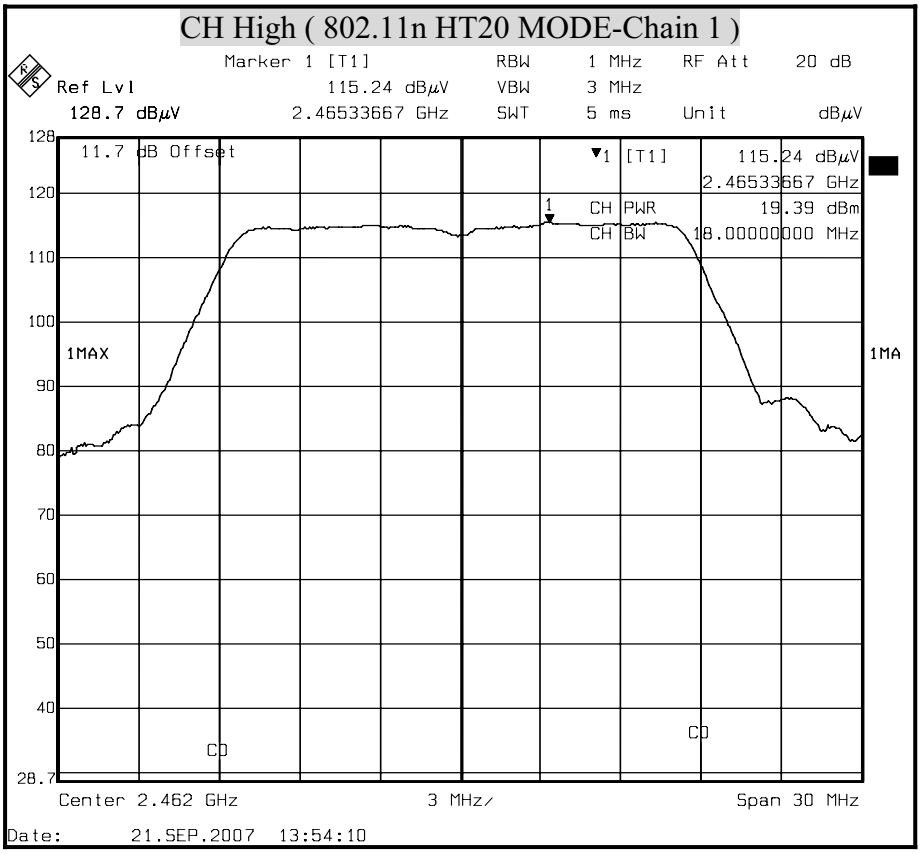
CH Low ( 802.11n HT20 MODE-Chain 1 )




CH Mid ( 802.11n HT20 MODE-Chain 1 )

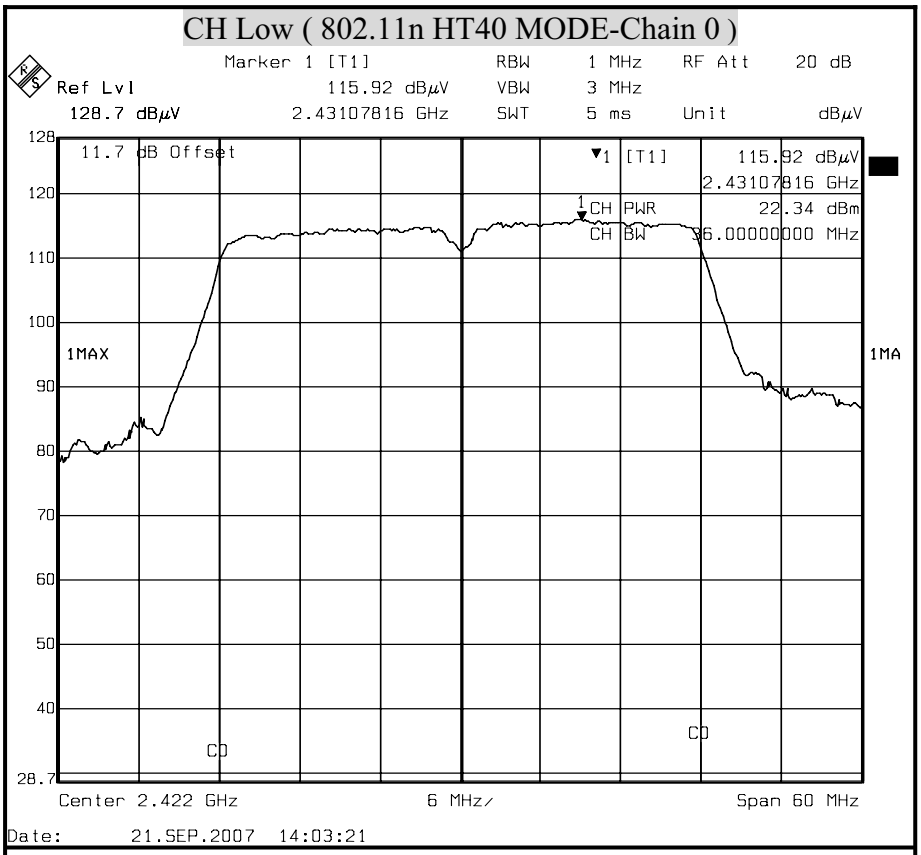


CH High ( 802.11n HT20 MODE-Chain 1 )

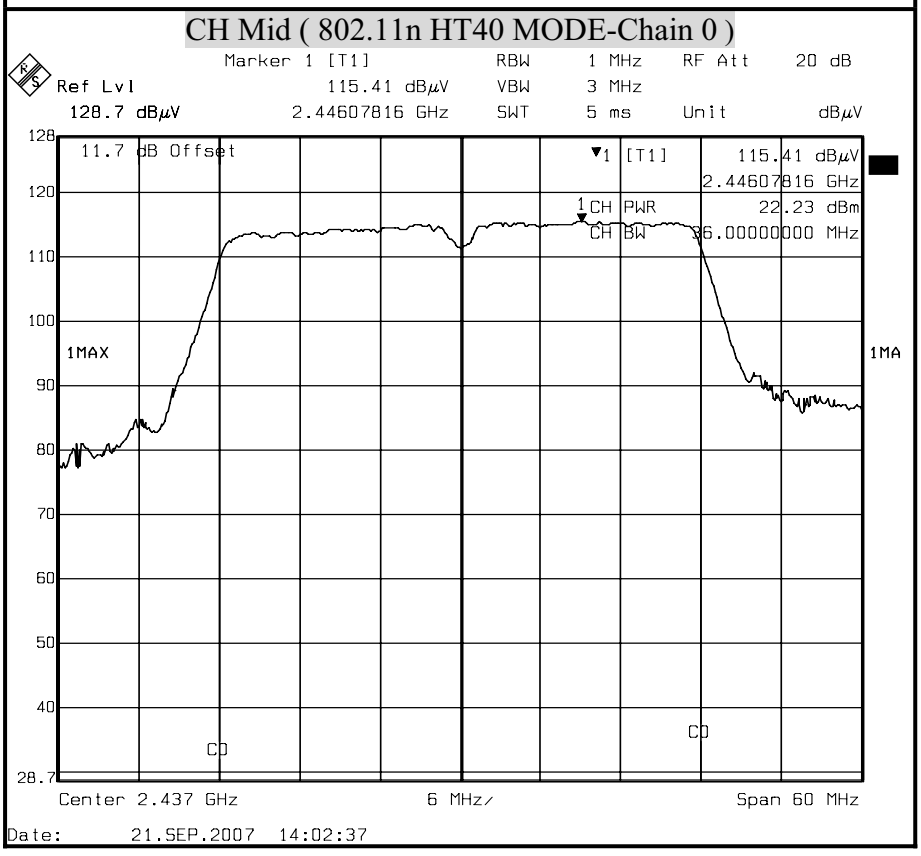


## MAXIMUM PEAK OUTPUT POWER ( 802.11n HT40 MODE )

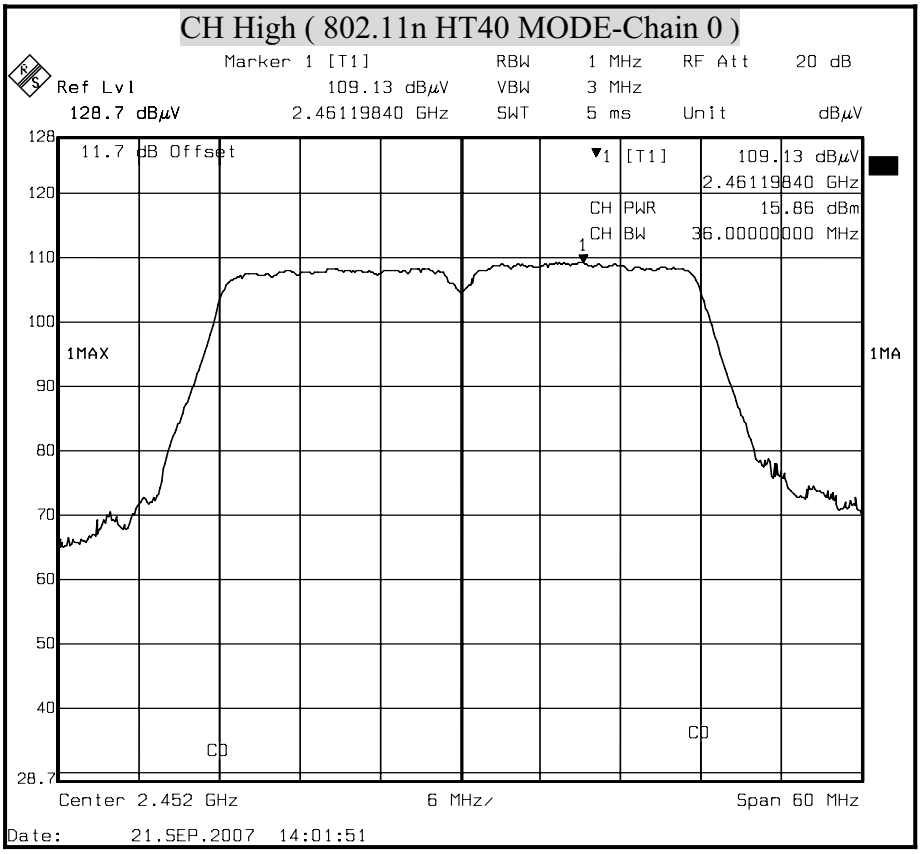
CH Low ( 802.11n HT40 MODE-Chain 0 )



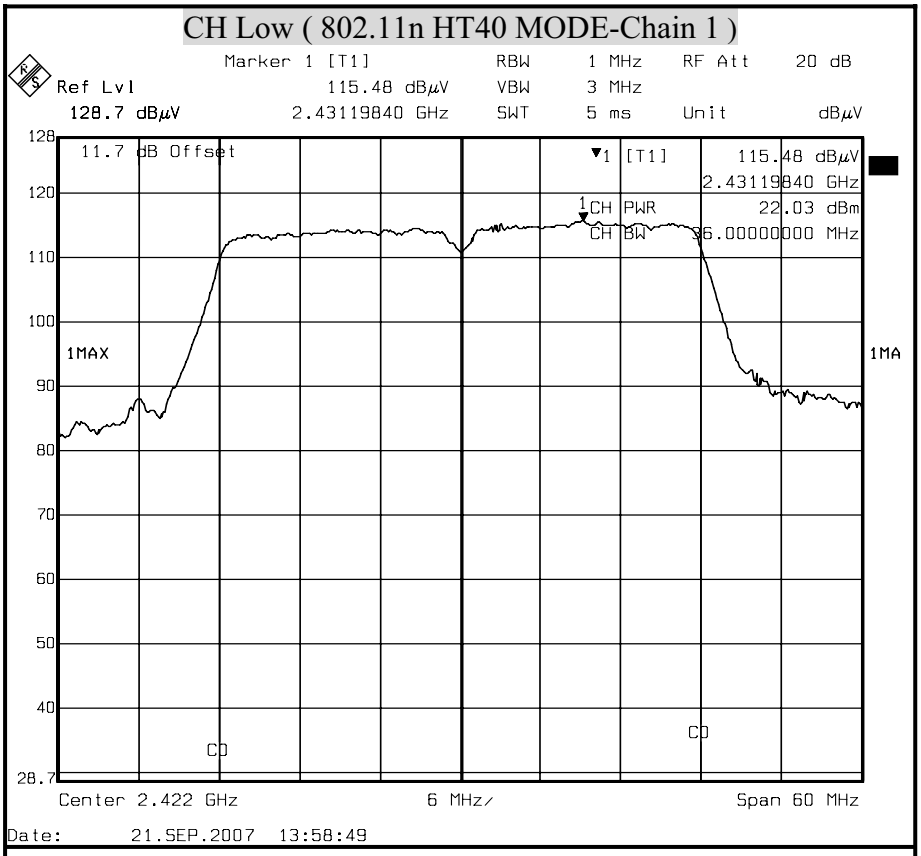

CH Mid ( 802.11n HT40 MODE-Chain 0 )



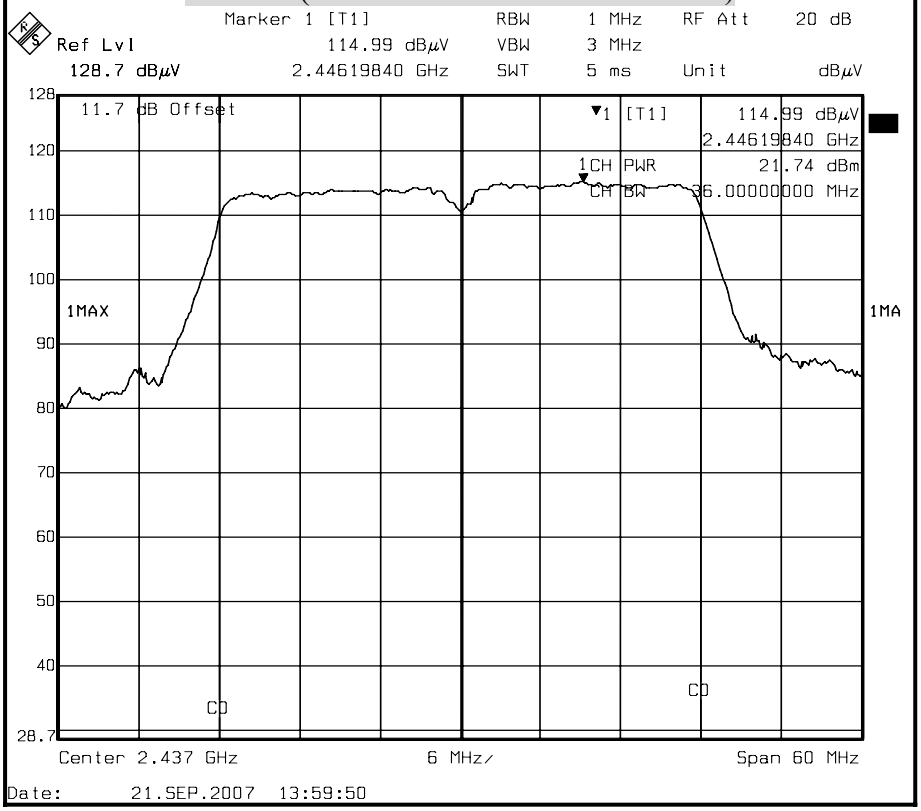
CH High ( 802.11n HT40 MODE-Chain 0 )



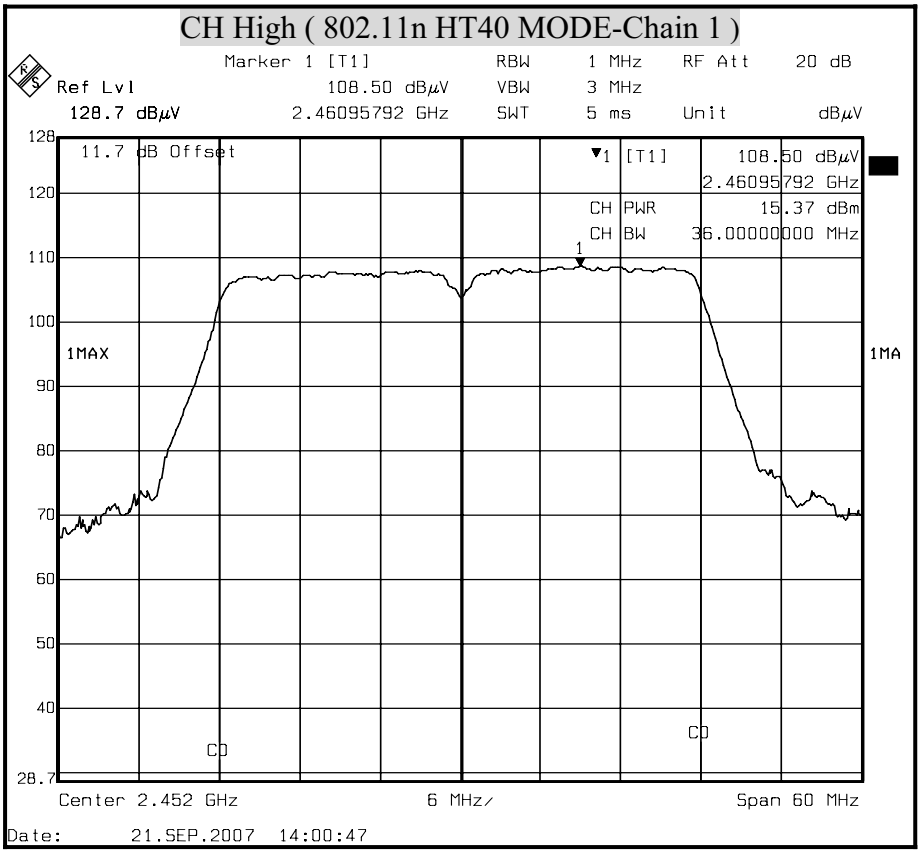
CH Low ( 802.11n HT40 MODE-Chain 1 )




CH Mid ( 802.11n HT40 MODE-Chain 1 )



CH High ( 802.11n HT40 MODE-Chain 1 )



## 8.4 MAXIMUM PERMISSIBLE EXPOSURE

According to FCC 1.1310 : The criteria listed in the following table shall be used to evaluate the environment impact of human exposure to radio frequency (RF) radiation as specified in 1.1307(b)LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

| Frequency Range (MHz) | Electric Field Strength (V/m) | Magnetic Field Strength (A/m) | Power Density ($mW/cm^2$) | Average Time |
|---|---|---|---|---|
| (A) Limits for Occupational / Control Exposures | | | | |
| 300-1,500 | -- | -- | F/300 | 6 |
| 1,500-100,000 | -- | -- | 5 | 6 |
| (B) Limits for General Population / Uncontrol Exposures | | | | |
| 300-1,500 | -- | -- | F/1500 | 6 |
| 1,500-100,000 | -- | -- | 1 | 30 |

**CALCULATIONS**

Given $E = \frac{\sqrt{30 \times P \times G}}{d}$ & $S = \frac{E^2}{3770}$

*Where* $E$ = *Field strength in Volts / meter*

$P$ = *Power in Watts*

$G$ = *Numeric antenna gain*

$d$ = *Distance in meters*

$S$ = *Power density in milliwatts / square centimeter*

Combining equations and re-arranging the terms to express the distance as a function of the remaining variables yields:

$$S = \frac{30 \times P \times G}{3770 d^2}$$

Changing to units of mW and cm, using:

*P (mW) = P (W) / 1000 and*

*d (cm) = d(m) / 100*

Yields

$$S = \frac{30 \times (P/1000) \times G}{3770 \times (d/100)^2} = 0.0796 \times \frac{P \times G}{d^2}$$

*Where* $d$ = *Distance in cm*

$P$ = *Power in mW*

$G$ = *Numeric antenna gain*

$S$ = *Power density in* $mW / cm^2$

**LIMIT**

Power Density Limit, S=1.0mW/cm$^2$

**TEST RESULTS**

No non-compliance noted

| Mode | Minimum separation distance (cm) | Output Power (dBm) | Antenna Gain (dBi) | Power Density Limit (mW/cm$^2$) | Power Density at 20cm (mW/cm$^2$) |
|---|---|---|---|---|---|
| IEEE 802.11b | 20 | 23.70 | 2.58 | 1.00 | 0.08 |
| IEEE 802.11g | 20 | 26.79 | 2.58 | 1.00 | 0.17 |
| IEEE 802.11n HT20 | 20 | 25.65 | 2.58 | 1.00 | 0.13 |
| IEEE 802.11n HT40 | 20 | 25.20 | 2.58 | 1.00 | 0.12 |

***Remark:*** *For mobile or fixed location transmitters, the maximum power density is 1.0 mW/cm$^2$ even if the calculation indicates that the power density would be larger.*

## 8.5 AVERAGE POWER

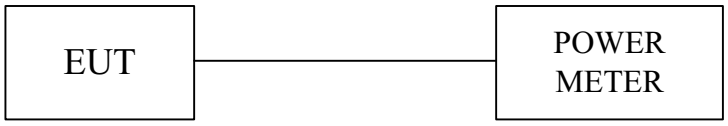
### LIMIT

None, for reporting purposes only.

### TEST EQUIPMENTS

| Name of Equipment | Manufacturer | Model | Serial Number | Calibration Due |
|---|---|---|---|---|
| Power Meter | Anritsu | ML2487A | 6K00003888 | MAR. 13, 2008 |

### TEST SETUP




### TEST PROCEDURE

The transmitter output is connected to a power meter.

### TEST RESULTS

Total peak power calculation formula:
10 log (10^ (Chain 0 Power / 10) + 10^ (Chain1 Power / 10) ).

No non-compliance noted

**IEEE 802.11b mode**

| Channel | Channel Frequency (MHz) | Average Power (dBm) | |
|---|---|---|---|
| | | Chain 0 | Chain 1 |
| Low | 2412 | 16.92 | 15.96 |
| Middle | 2437 | 17.13 | 16.47 |
| High | 2462 | 16.68 | 15.30 |

Note : 1.At finial test to get the worst-case emission at 11Mbps.
2. The cable assembly insertion loss of 11.7dB (including 10 dB pad and 1.7 dB cable) was Entered as an offset in the spectrum analyzer to allow for direct reading of power.

**IEEE 802.11g mode**

| Channel | Channel Frequency (MHz) | Average Power (dBm) | |
|---|---|---|---|
| | | Chain 0 | Chain 1 |
| Low | 2412 | 17.18 | 16.35 |
| Middle | 2437 | 17.69 | 16.63 |
| High | 2462 | 14.14 | 12.50 |

Note : 1.At finial test to get the worst-case emission at 6Mbps.
2. The cable assembly insertion loss of 11.7dB (including 10 dB pad and 1.7 dB cable) was Entered as an offset in the spectrum analyzer to allow for direct reading of power.

**IEEE 802.11n HT20 mode**

| Channel | Channel Frequency (MHz) | Average Power (dBm) | |
|---|---|---|---|
| | | Chain 0 | Chain 1 |
| Low | 2412 | 15.25 | 14.37 |
| Middle | 2437 | 14.53 | 14.92 |
| High | 2462 | 13.74 | 12.27 |

Note : 1.At finial test to get the worst-case emission at 6.5Mbps.
2. The cable assembly insertion loss of 11.7dB (including 10 dB pad and 1.7 dB cable) was Entered as an offset in the spectrum analyzer to allow for direct reading of power.

**IEEE 802.11n HT40 mode**

| Channel | Channel Frequency (MHz) | Average Power (dBm) | |
|---|---|---|---|
| | | Chain 0 | Chain 1 |
| Low | 2422 | 16.22 | 15.11 |
| Middle | 2437 | 15.48 | 14.85 |
| High | 2452 | 9.09 | 8.15 |

Note : 1.At finial test to get the worst-case emission at 6.5Mbps.
2. The cable assembly insertion loss of 11.7dB (including 10 dB pad and 1.7 dB cable) was Entered as an offset in the spectrum analyzer to allow for direct reading of power.

## 8.6 POWER SPECTRAL DENSITY

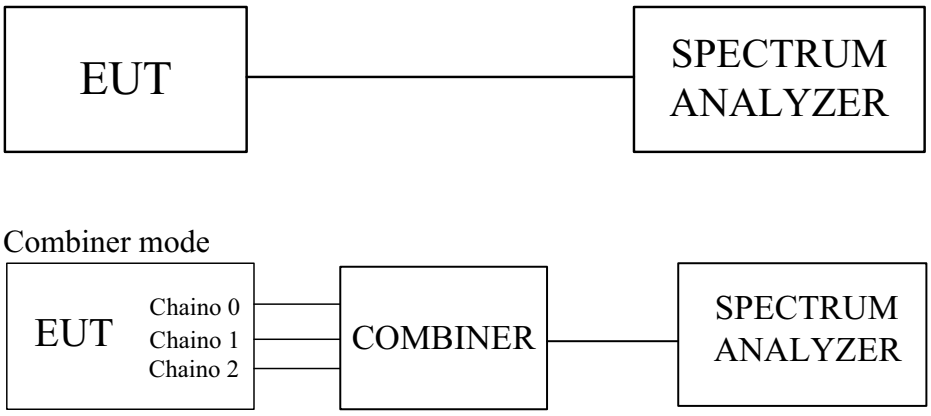
**LIMIT**

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

**TEST EQUIPMENTS**

| Name of Equipment | Manufacturer | Model | Serial Number | Calibration Due |
|---|---|---|---|---|
| Spectrum Analyzer | R&S | FSEM | 829054/017 | MAR. 13, 2008 |

**TEST SETUP**




**TEST PROCEDURE**

The transmitter output was connected to the spectrum analyzer, the bandwidth of the fundamental frequency was measured with the spectrum analyzer using RBW=3KHz and VBW≧RBW, set sweep time=span / 3KHz.
The power spectral density was measured and recorded.
The sweep time is allowed to be longer than span / 3KHz for a full response of the mixer in the spectrum analyzer.

**TEST RESULTS**

Total peak power calculation formula:
10 log (10^ (Chain 0 PPSD / 10) + 10^ (Chain1 PPSD / 10) ).

No non-compliance noted.

**IEEE 802.11b mode**

| Channel | Channel Frequency (MHz) | Final RF Power Level in 3KHz BW (dBm) | | PPSD Total (dBm) | Maximum Limit (dBm) | Pass / Fail |
|---|---|---|---|---|---|---|
| | | Chain 0 | Chain 1 | | | |
| Low | 2412 | -9.75 | -12.39 | -7.86 | 8 | PASS |
| Middle | 2437 | -11.17 | -10.97 | -8.06 | 8 | PASS |
| High | 2462 | -10.64 | -9.85 | -7.22 | 8 | PASS |

Note : 1.At finial test to get the worst-case emission at 11Mbps.
2. The cable assembly insertion loss of 11.7dB (including 10 dB pad and 1.7 dB cable) was Entered as an offset in the spectrum analyzer to allow for direct reading of power.

**IEEE 802.11b Combined mode**

| Channel | Channel Frequency (MHz) | Final RF Power Level in 3KHz BW (dBm) | Maximum Limit (dBm) | Pass / Fail |
|---|---|---|---|---|
| Low | 2412 | -6.82 | 8 | PASS |
| Middle | 2437 | -4.82 | 8 | PASS |
| High | 2462 | -7.23 | 8 | PASS |

Note : 1.At finial test to get the worst-case emission at 11Mbps.
2. The cable assembly insertion loss of 15.2dB (including 10 dB pad and 5.2 dB cable) was Entered as an offset in the spectrum analyzer to allow for direct reading of power.

**IEEE 802.11g mode**

| Channel | Channel Frequency (MHz) | Final RF Power Level in 3KHz BW (dBm) | | PPSD Total (dBm) | Maximum Limit (dBm) | Pass / Fail |
|---|---|---|---|---|---|---|
| | | Chain 0 | Chain 1 | | | |
| Low | 2412 | -12.21 | -12.63 | -9.40 | 8 | PASS |
| Middle | 2437 | -11.94 | -12.49 | -9.20 | 8 | PASS |
| High | 2462 | -14.44 | -17.25 | -12.61 | 8 | PASS |

Note : 1.At finial test to get the worst-case emission at 6Mbps.
2. The cable assembly insertion loss of 11.7dB (including 10 dB pad and 1.7 dB cable) was Entered as an offset in the spectrum analyzer to allow for direct reading of power.

**IEEE 802.11g Combined mode**

| Channel | Channel Frequency (MHz) | Final RF Power Level in 3KHz BW (dBm) | Maximum Limit (dBm) | Pass / Fail |
|---|---|---|---|---|
| Low | 2412 | -8.18 | 8 | PASS |
| Middle | 2437 | -8.93 | 8 | PASS |
| High | 2462 | -12.14 | 8 | PASS |

Note : 1.At finial test to get the worst-case emission at 6.0Mbps.
2. The cable assembly insertion loss of 15.2dB (including 10 dB pad and 5.2 dB cable) was Entered as an offset in the spectrum analyzer to allow for direct reading of power.

**IEEE 802.11n HT20 mode**

| Channel | Channel Frequency (MHz) | Final RF Power Level in 3KHz BW (dBm) | | PPSD Total (dBm) | Maximum Limit (dBm) | Pass / Fail |
|---|---|---|---|---|---|---|
| | | Chain 0 | Chain 1 | | | |
| Low | 2412 | -13.68 | -13.80 | -10.19 | 8 | PASS |
| Middle | 2437 | -11.92 | -12.37 | -9.13 | 8 | PASS |
| High | 2462 | -15.27 | -15.54 | -12.39 | 8 | PASS |

Note : 1.At finial test to get the worst-case emission at 6.5Mbps.
2. The cable assembly insertion loss of 11.7dB (including 10 dB pad and 1.7 dB cable) was Entered as an offset in the spectrum analyzer to allow for direct reading of power.

**IEEE 802.11n HT20 Combined mode**

| Channel | Channel Frequency (MHz) | Final RF Power Level in 3KHz BW (dBm) | Maximum Limit (dBm) | Pass / Fail |
|---|---|---|---|---|
| Low | 2412 | -10.62 | 8 | PASS |
| Middle | 2437 | -8.56 | 8 | PASS |
| High | 2462 | -12.67 | 8 | PASS |

Note : 1.At finial test to get the worst-case emission at 6.5Mbps.
2. The cable assembly insertion loss of 15.2dB (including 10 dB pad and 5.2 dB cable) was Entered as an offset in the spectrum analyzer to allow for direct reading of power.

**IEEE 802.11n HT40 mode**

| Channel | Channel Frequency (MHz) | Final RF Power Level in 3KHz BW (dBm) | | PPSD Total (dBm) | Maximum Limit (dBm) | Pass / Fail |
|---|---|---|---|---|---|---|
| | | Chain 0 | Chain 1 | | | |
| Low | 2422 | -15.72 | -16.30 | -12.99 | 8 | PASS |
| Middle | 2437 | -14.54 | -14.34 | -11.43 | 8 | PASS |
| High | 2452 | -19.81 | -22.38 | -17.90 | 8 | PASS |

Note : 1.At finial test to get the worst-case emission at 6.5Mbps.
2. The cable assembly insertion loss of 11.7dB (including 10 dB pad and 1.7 dB cable) was Entered as an offset in the spectrum analyzer to allow for direct reading of power.

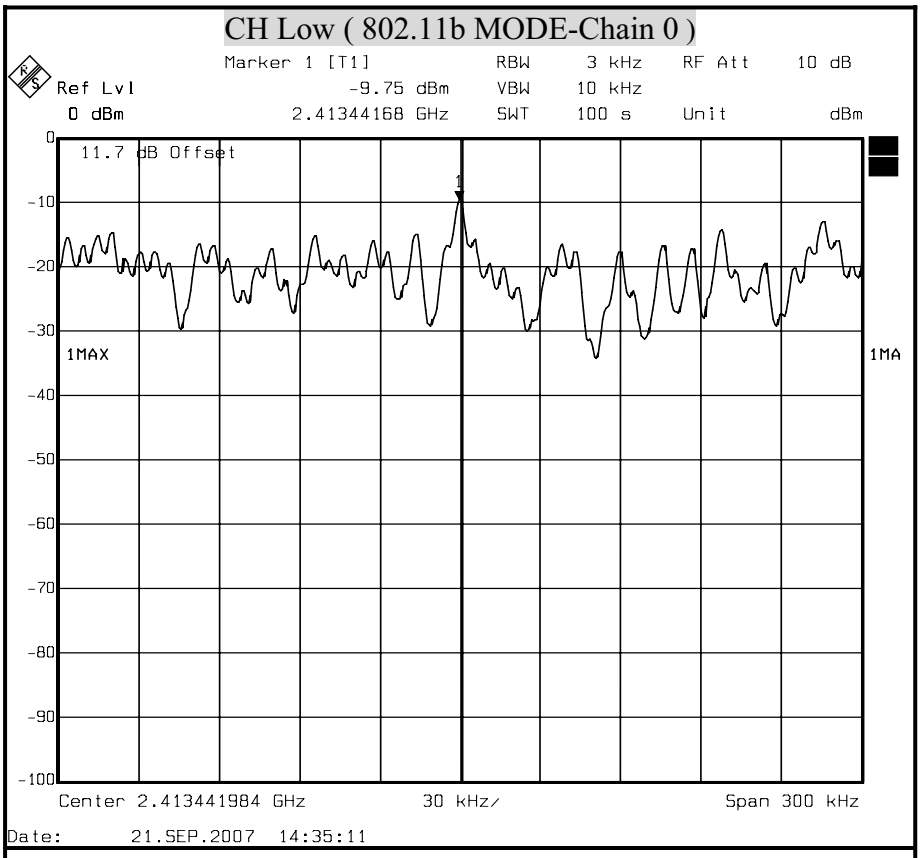
**IEEE 802.11n HT40 Combined mode**

| Channel | Channel Frequency (MHz) | Final RF Power Level in 3KHz BW (dBm) | Maximum Limit (dBm) | Pass / Fail |
|---|---|---|---|---|
| Low | 2422 | -11.00 | 8 | PASS |
| Middle | 2437 | -12.05 | 8 | PASS |
| High | 2452 | -17.64 | 8 | PASS |

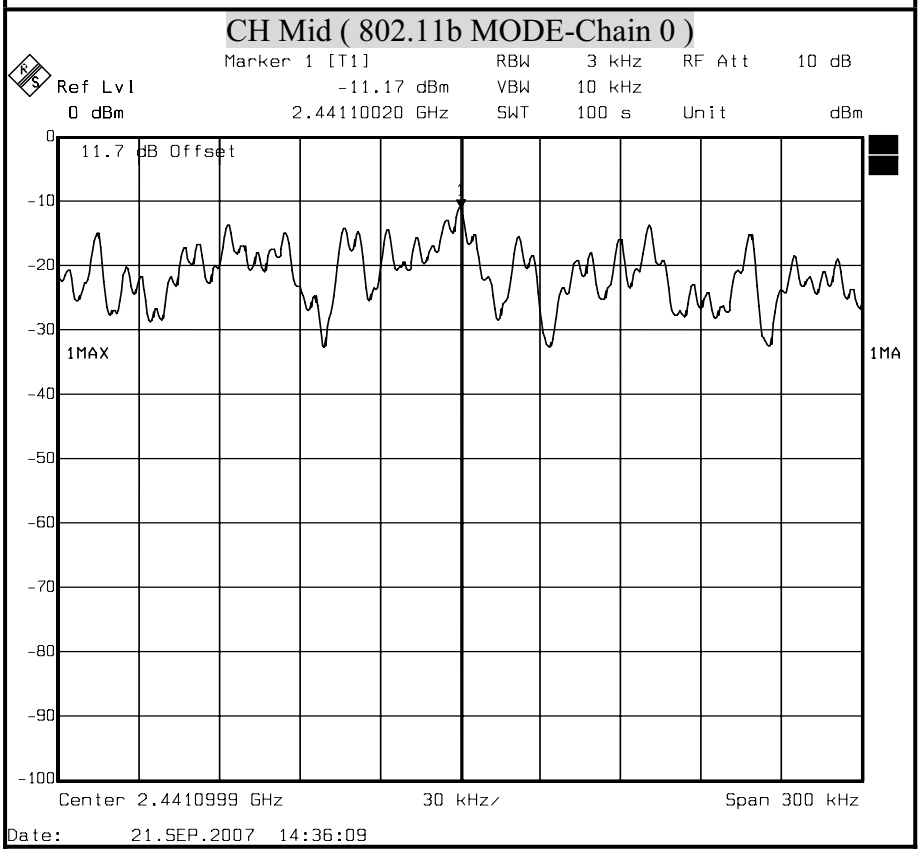
Note : 1.At finial test to get the worst-case emission at 6.5Mbps.
2. The cable assembly insertion loss of 15.2dB (including 10 dB pad and 5.2 dB cable) was Entered as an offset in the spectrum analyzer to allow for direct reading of power.

## POWER SPECTRAL DENSITY (IEEE 802.11b MODE)

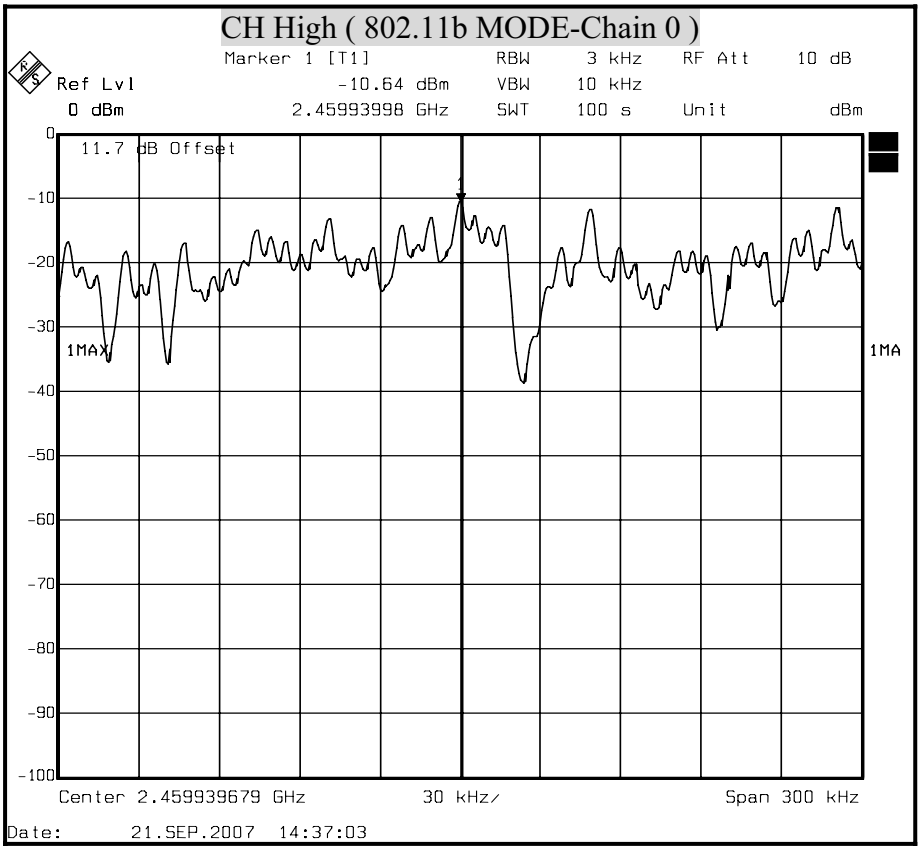
CH Low ( 802.11b MODE-Chain 0 )



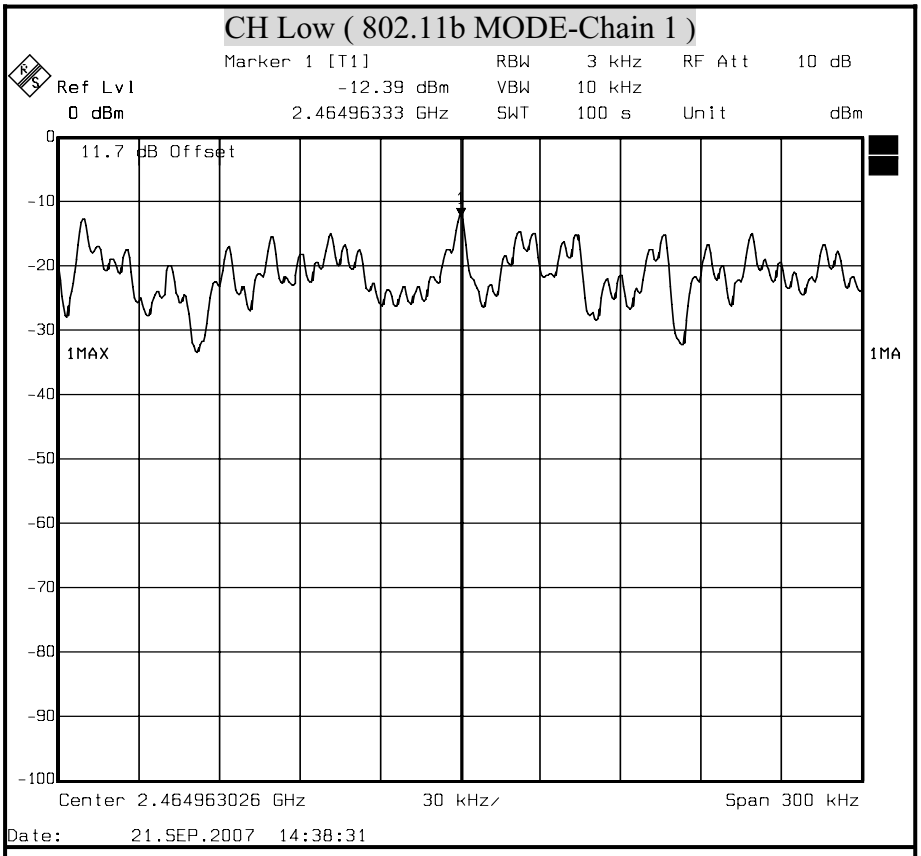

CH Mid ( 802.11b MODE-Chain 0 )



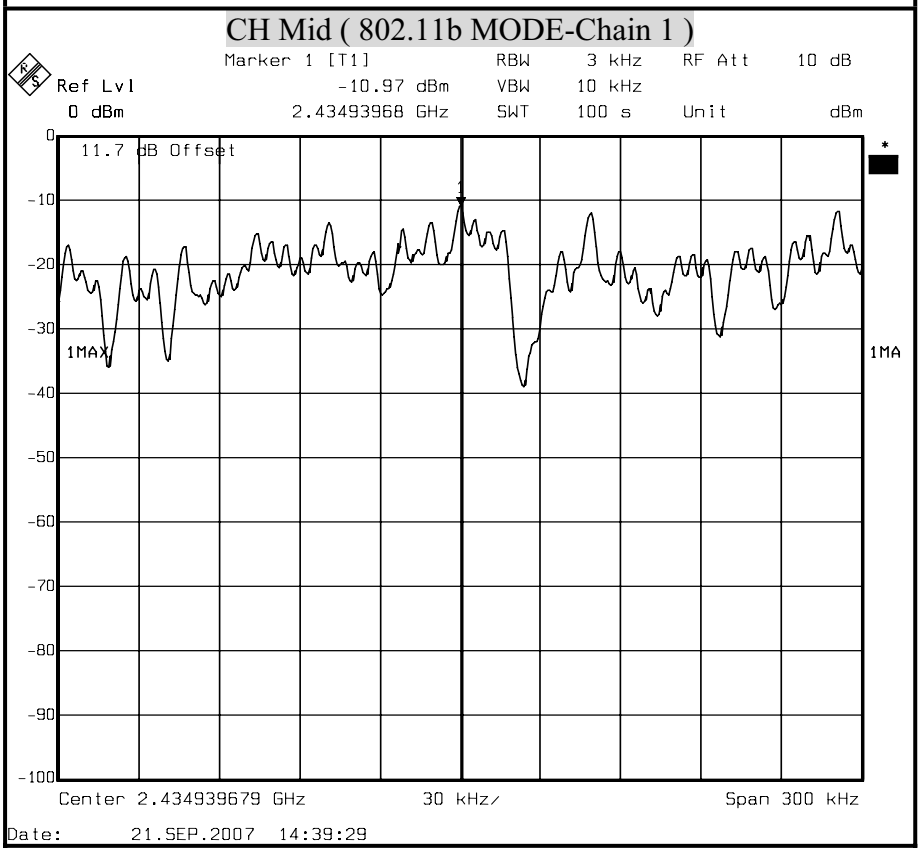
CH High ( 802.11b MODE-Chain 0 )



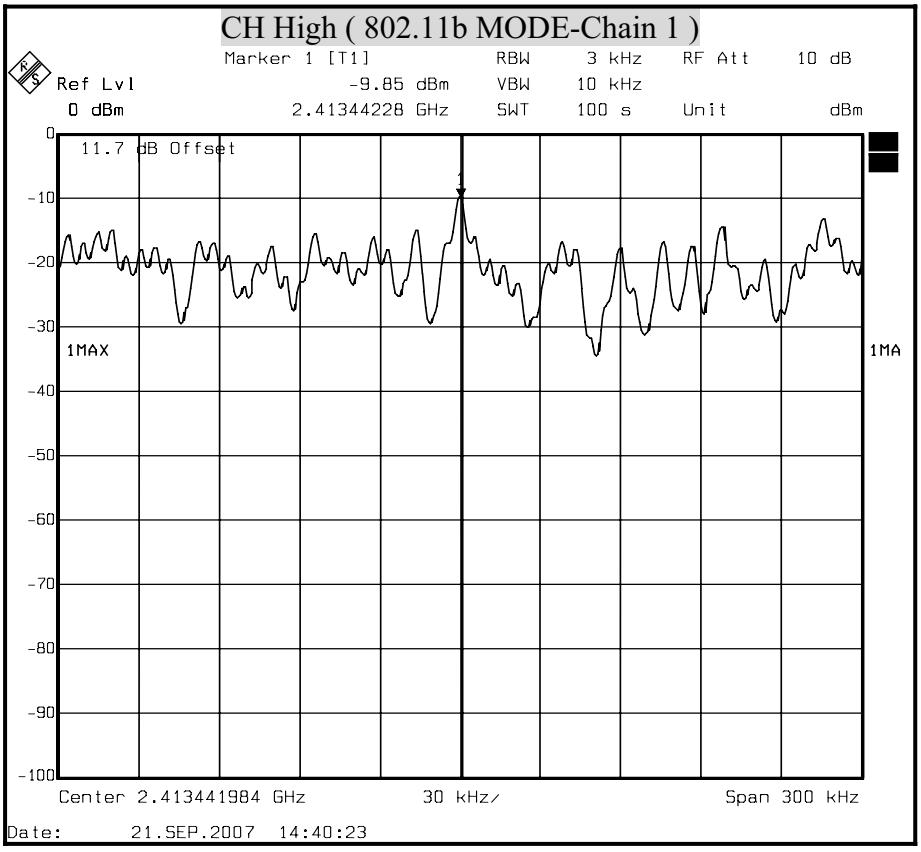
CH Low ( 802.11b MODE-Chain 1 )




CH Mid ( 802.11b MODE-Chain 1 )

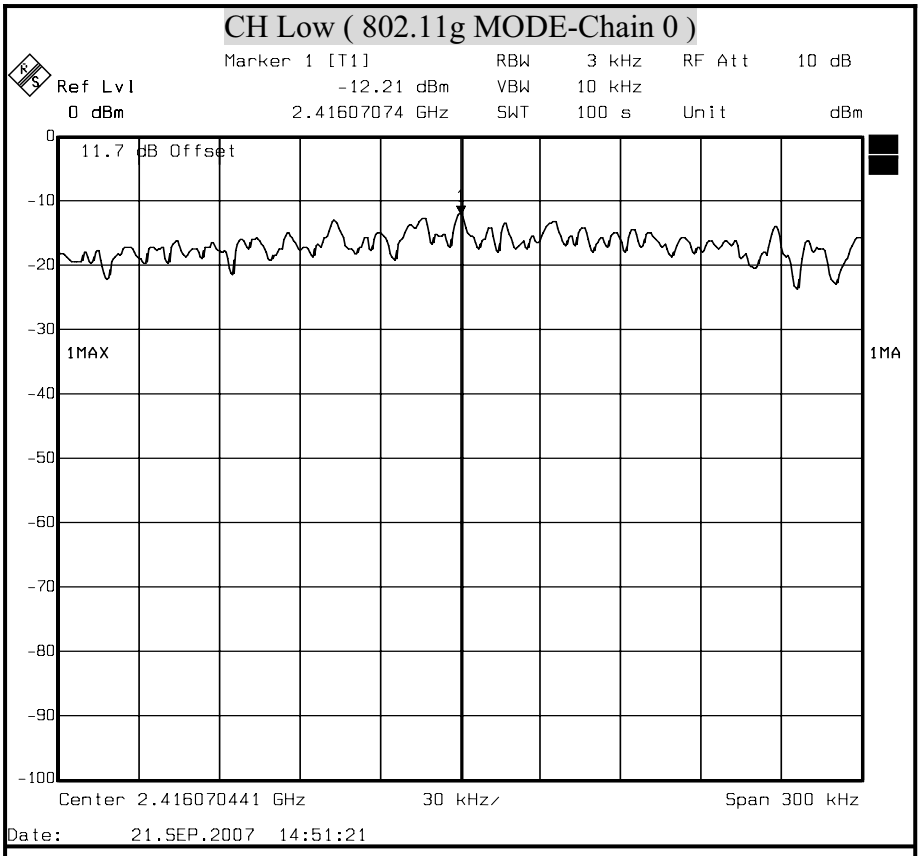


CH High ( 802.11b MODE-Chain 1 )

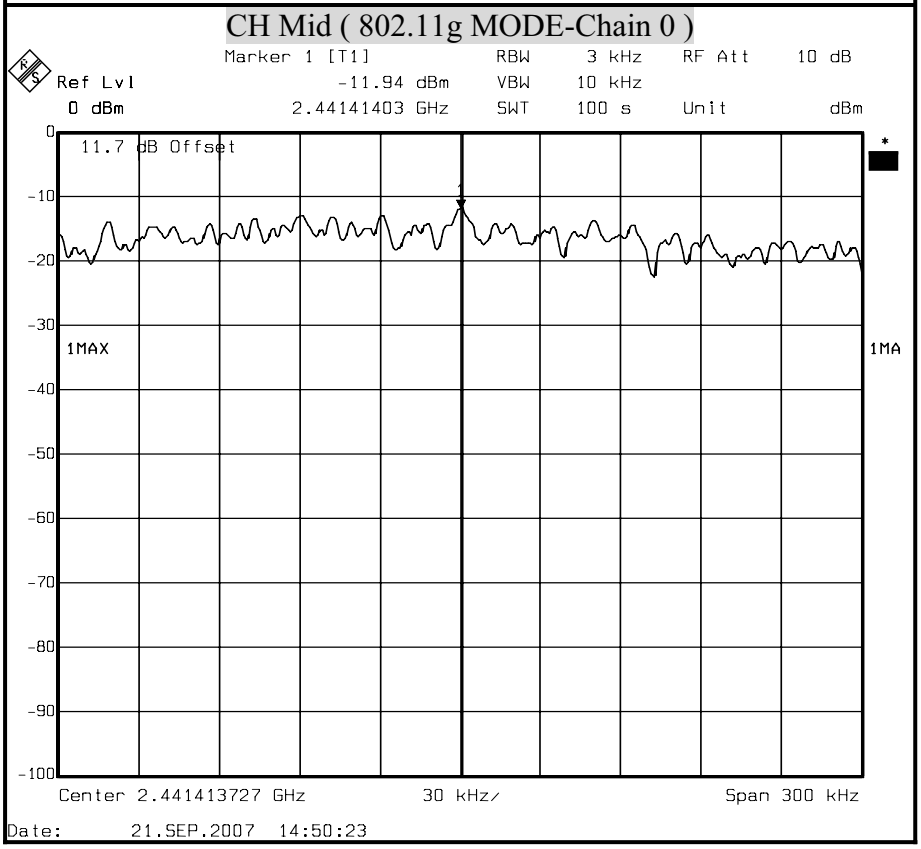


## POWER SPECTRAL DENSITY (IEEE 802.11g MODE )

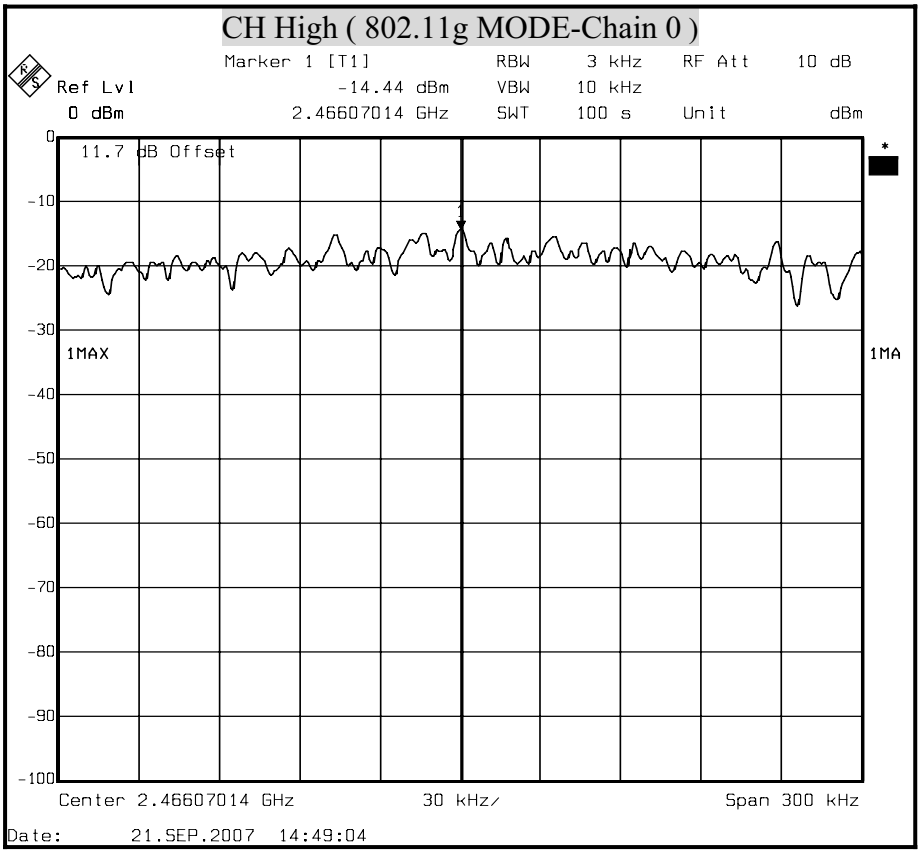
CH Low ( 802.11g MODE-Chain 0 )



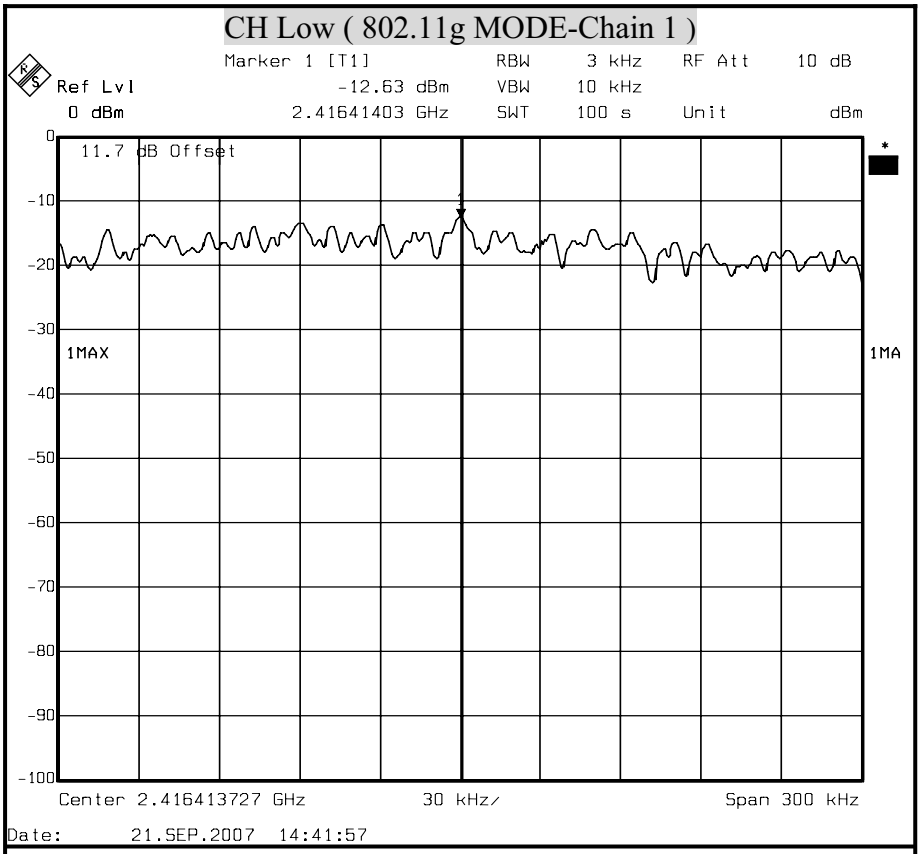

CH Mid ( 802.11g MODE-Chain 0 )



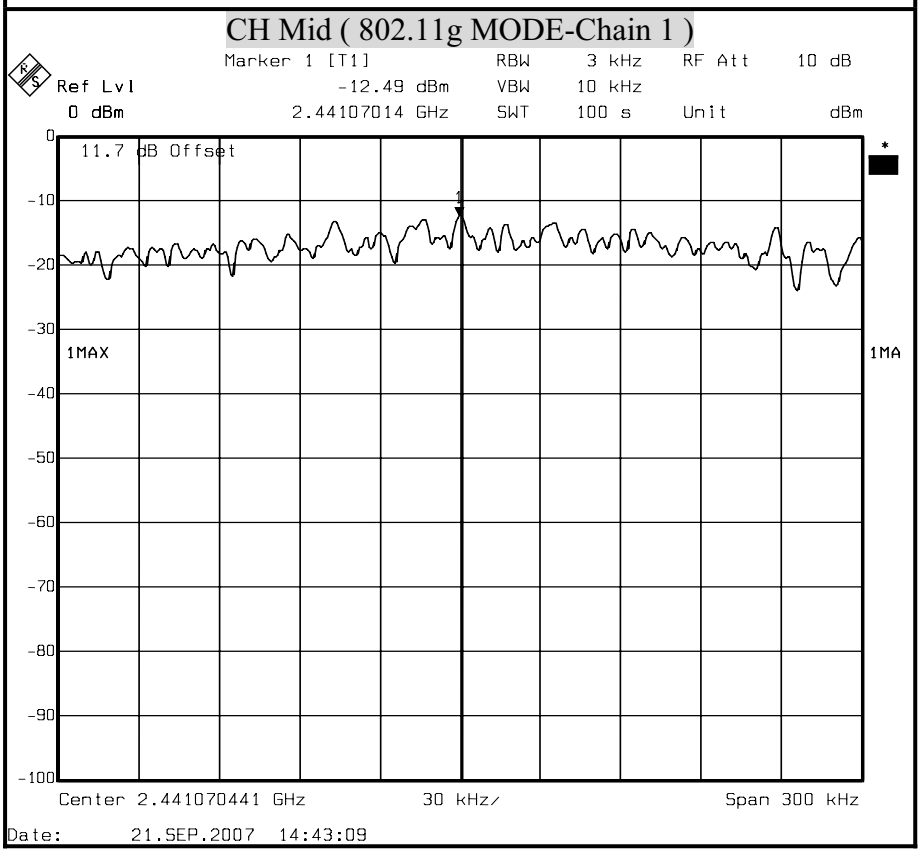
CH High ( 802.11g MODE-Chain 0 )



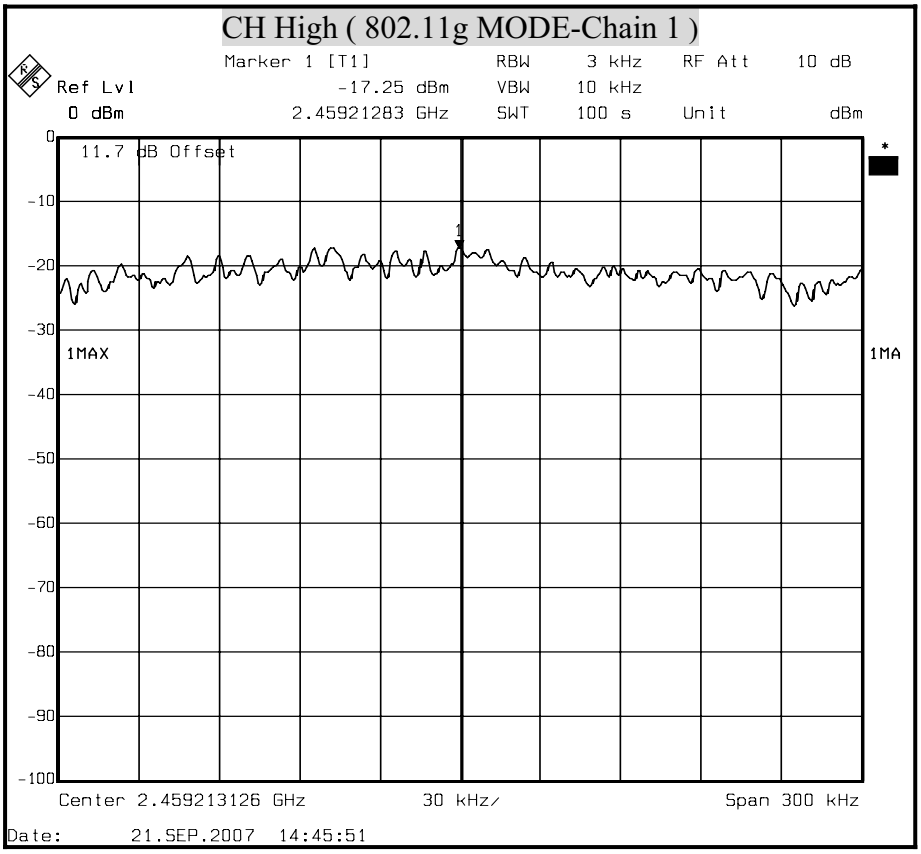
CH Low ( 802.11g MODE-Chain 1 )




CH Mid ( 802.11g MODE-Chain 1 )

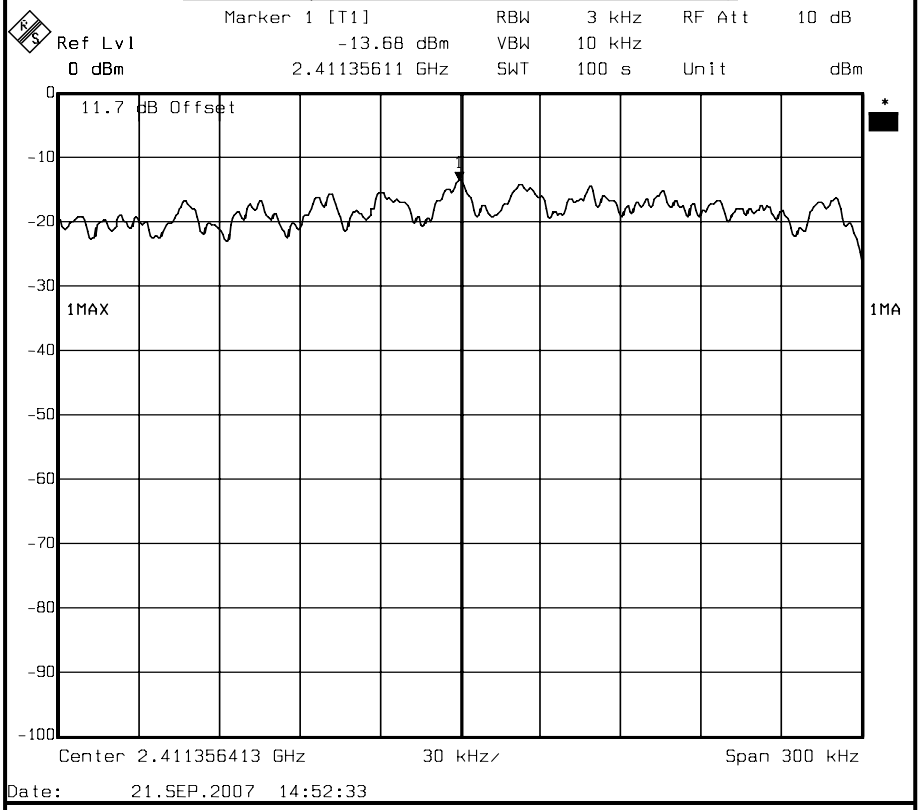


CH High ( 802.11g MODE-Chain 1 )

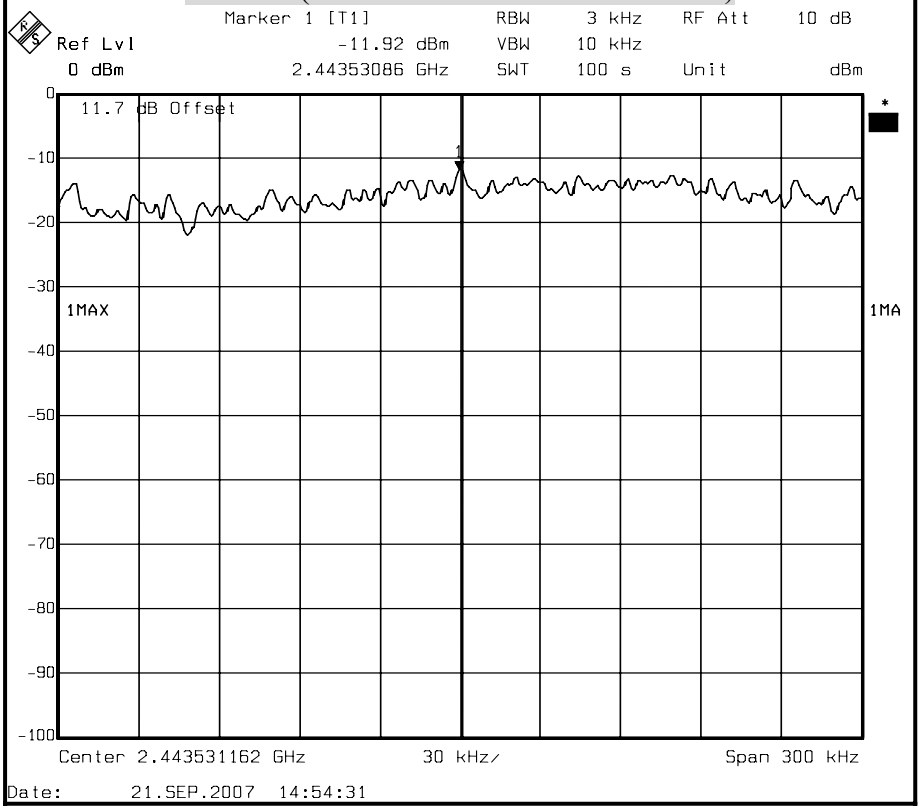


## POWER SPECTRAL DENSITY (IEEE 802.11n HT20 MODE )

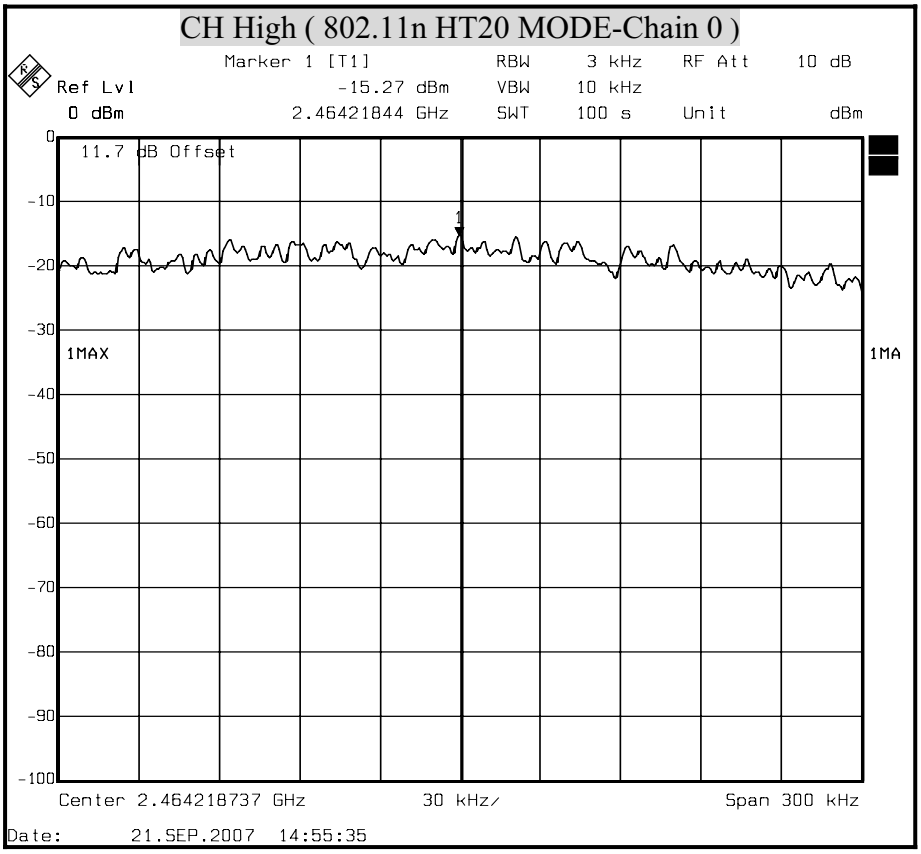
CH Low ( 802.11n HT20 MODE-Chain 0 )



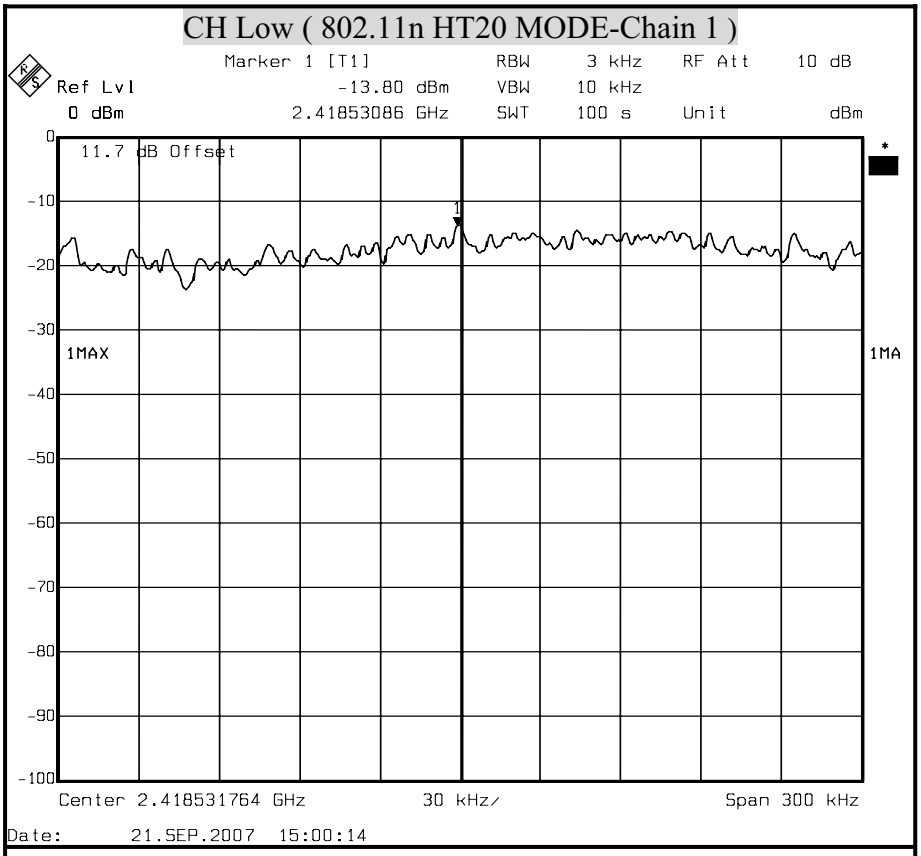

CH Mid ( 802.11n HT20 MODE-Chain 0 )



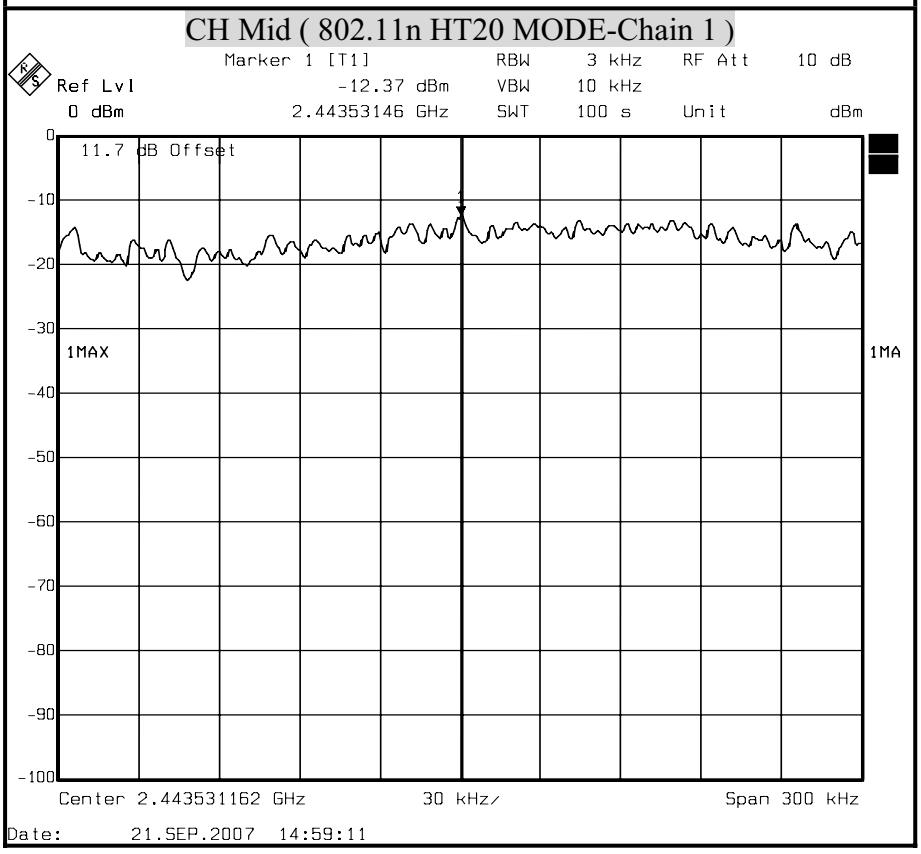
CH High ( 802.11n HT20 MODE-Chain 0 )



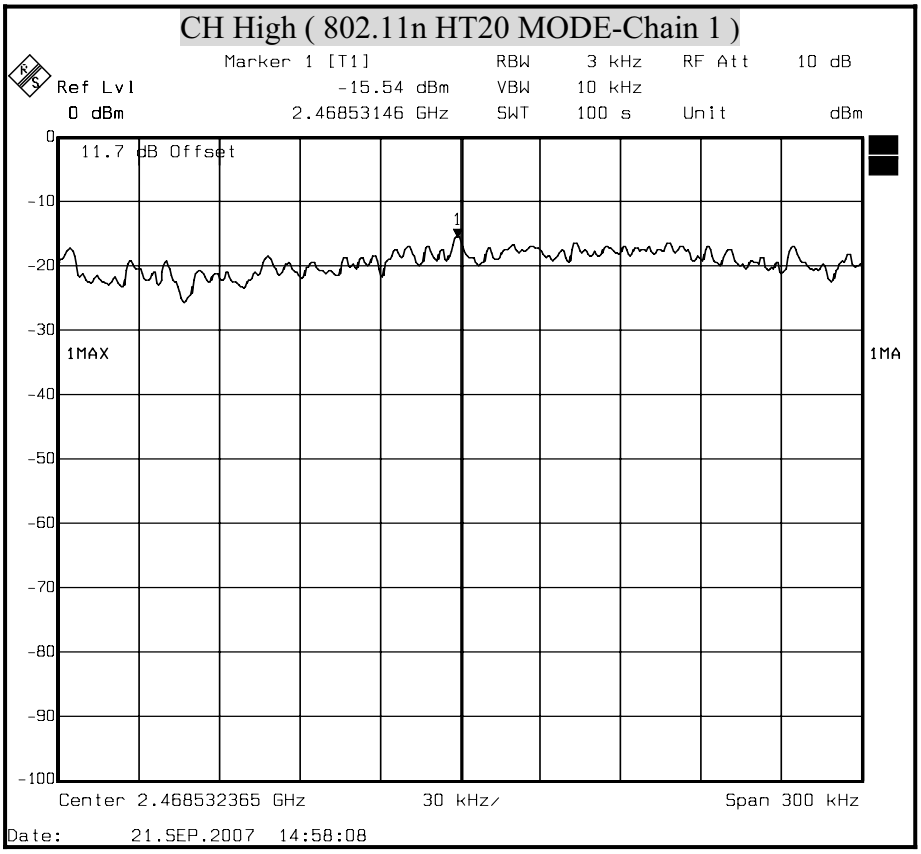
CH Low ( 802.11n HT20 MODE-Chain 1 )



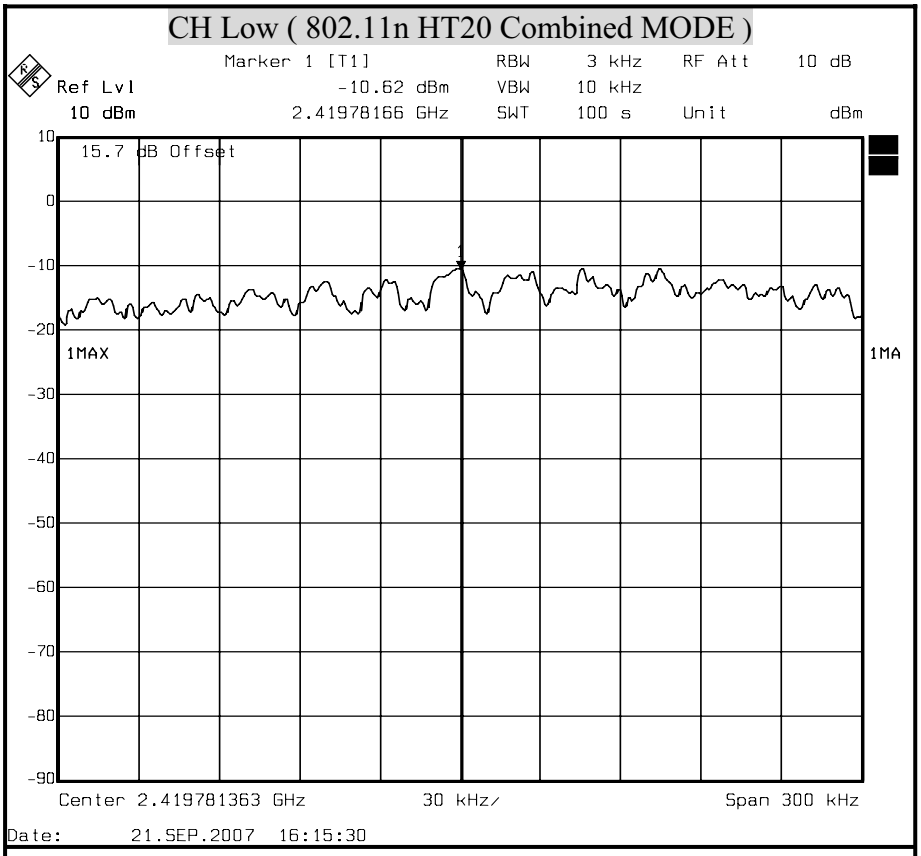

CH Mid ( 802.11n HT20 MODE-Chain 1 )



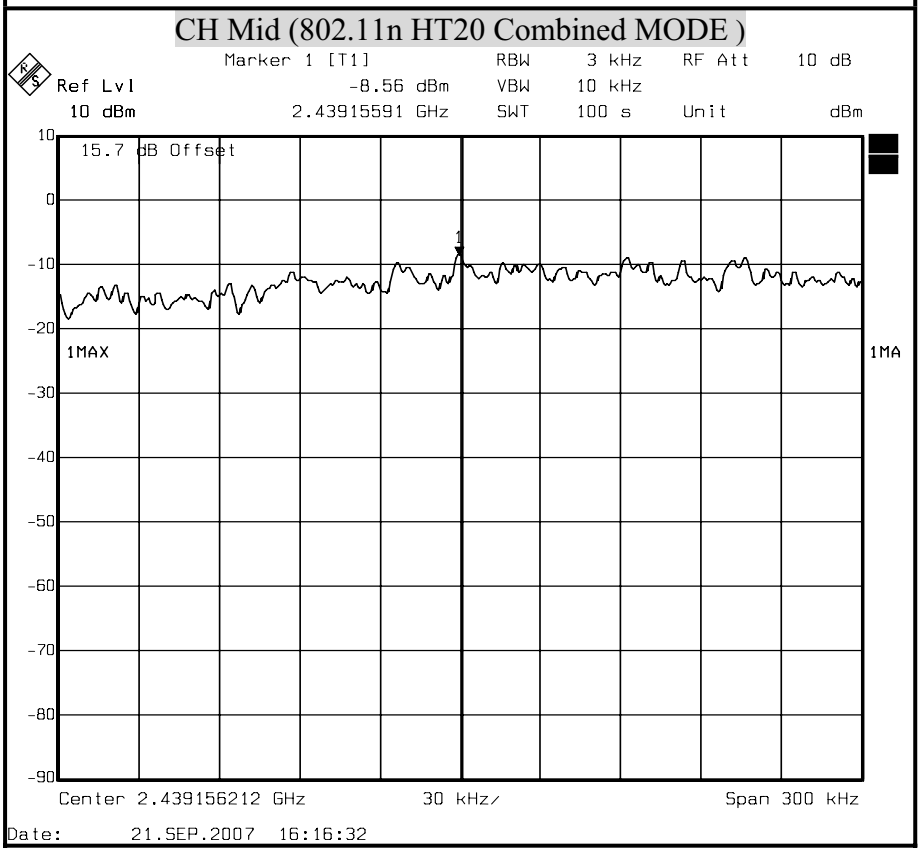
CH High ( 802.11n HT20 MODE-Chain 1 )



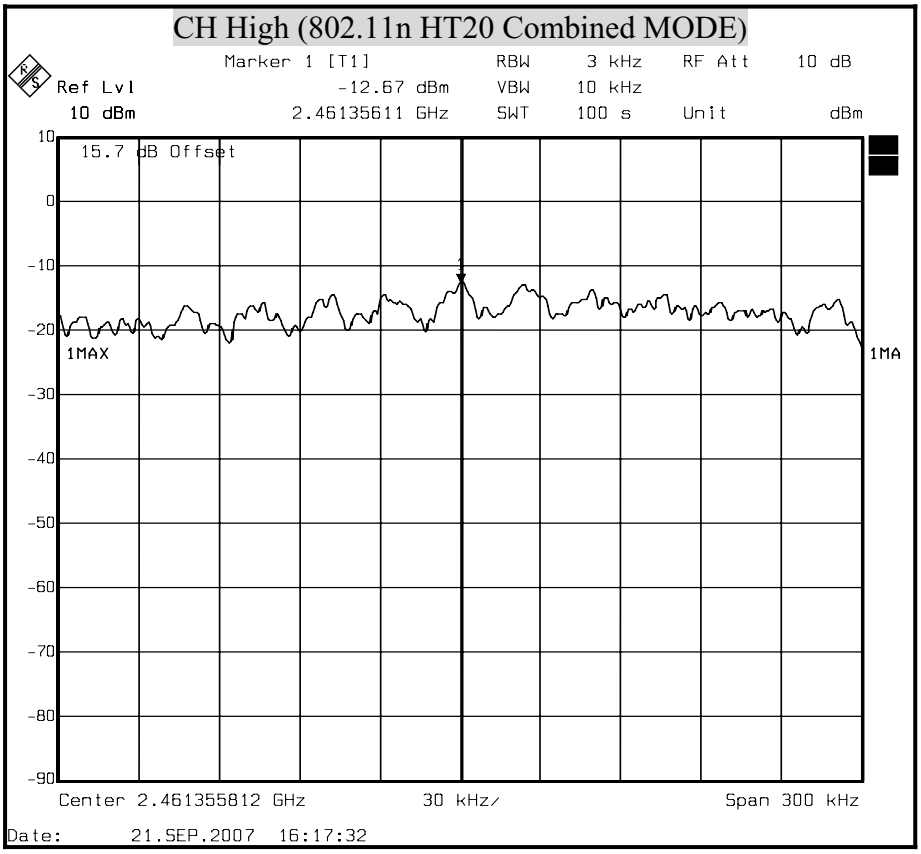
CH Low ( 802.11n HT20 Combined MODE )




CH Mid (802.11n HT20 Combined MODE )

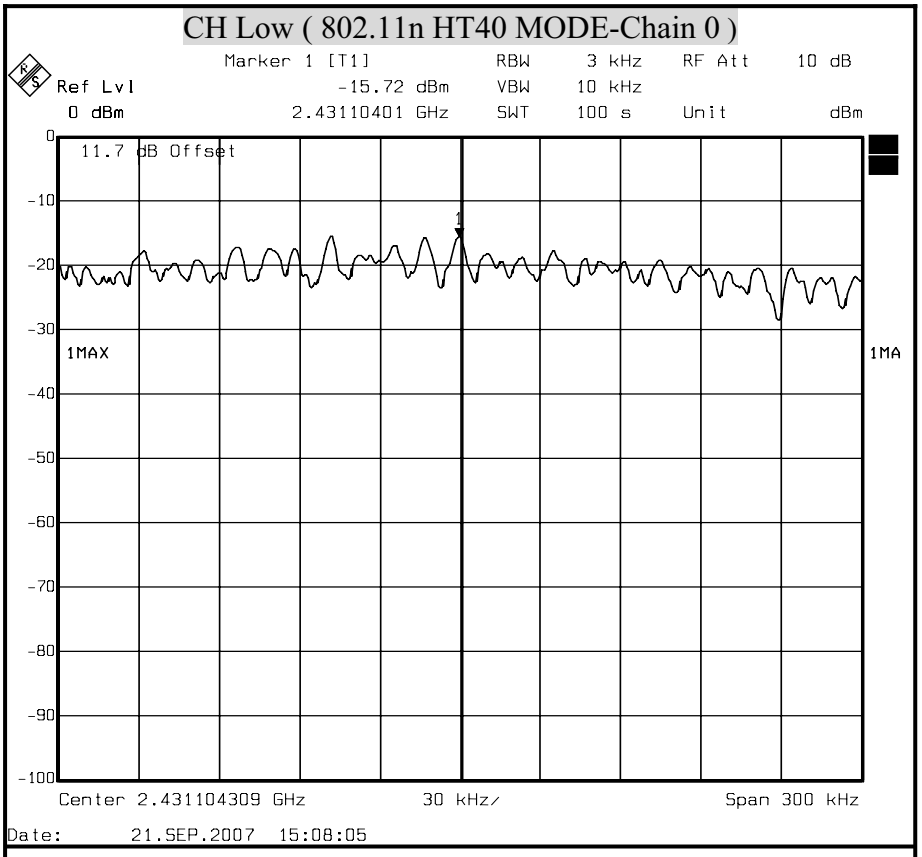


CH High (802.11n HT20 Combined MODE)

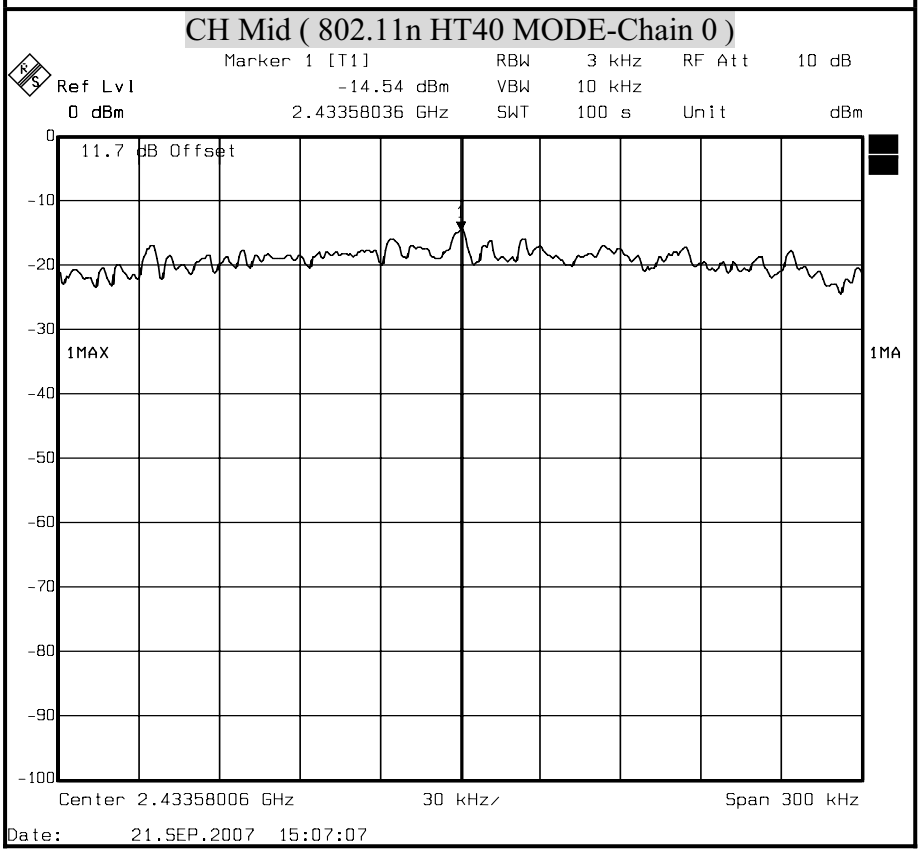


## POWER SPECTRAL DENSITY (IEEE 802.11n HT40 MODE )

CH Low ( 802.11n HT40 MODE-Chain 0 )




CH Mid ( 802.11n HT40 MODE-Chain 0 )



CH High ( 802.11n HT40 MODE-Chain 0 )