# WLAN RF Test

## —802.11b/11g/11n

Using N4010A

# Contents

# 1. Introduction

This document presents the RF test procedure of Wi-Fi 11b/11g/11n refers to IEEE Std 802.11:1999 Edition (R2003) etc.

# 2. Revision History

| Revision | Date | Authors | Description |
|---|---|---|---|
| 1.0 | Apr.2013 | Allan. Tang | Initial release |
| | | | |
| | | | |

# 3. Environment Definition

## 3.1 Temperature

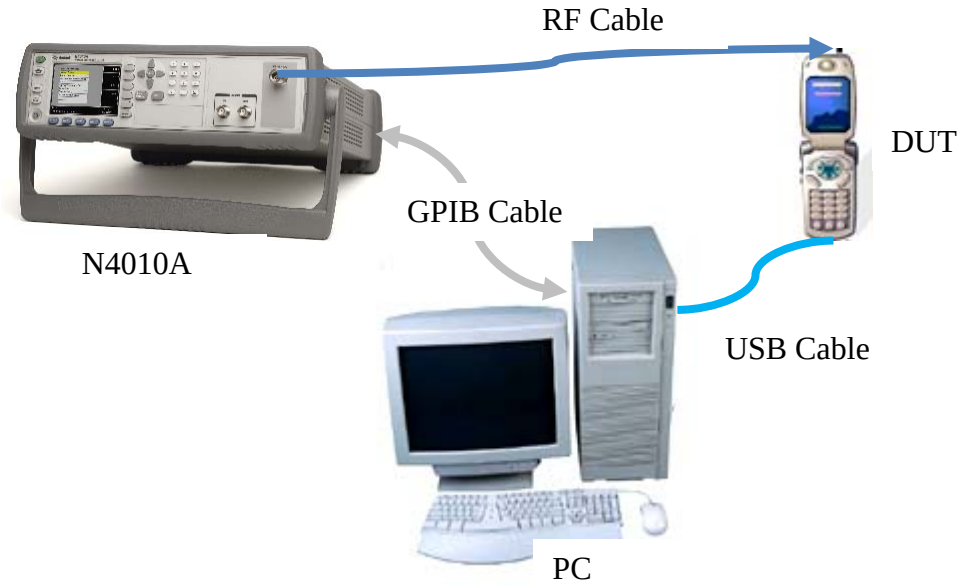
Transmit and receive operating temperature ranges are specified for full operation compliance to the High Rate PHY. Type 1 shall be defined as 0 ℃to 40 ℃, and is designated for office environments. Type 2 shall be defined as –30 ℃to+70 ℃, and is designated for industrial environments.

# 4. Instruments

The following instruments are required:

1) Wi-Fi tester (N4010A)
2) Spectrum analyzer (R&S FSP 12.75GHz)
3) RF cables, connectors

# 5. Test Block Diagram



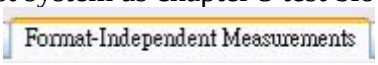
# 6. Wi-Fi 11b test

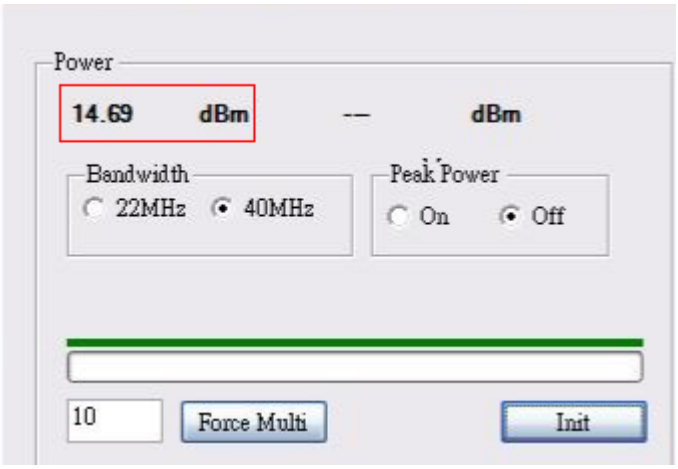
## 6.1 Transmit Power Levels (18.4.7.1)

1. Test environment: normal; see clause 3.1
2. Frequencies to be tested: Low、Middle、High
3. Data rate to be tested: 1Mbps, 11Mbps
4. Spec requirements:

| Maximum output power | Geographic location | Compliance document |
|---|---|---|
| 1000 mW | USA | FCC 15.247 |
| 100 mW (EIRP) | Europe | ETS 300–328 |
| 10 mW/MHz | Japan | MPT ordinance for Regulating Radio Equipment, Article 49-20 |

5. Test method:

Connect the test system as chapter 5 test block diagram, turn on the DUT transmit power, measure the transmit power via 


6. Test Results

| Data rate | Low (2412MHz) | Mid(2442MHz) | High(2472MHz) |
|---|---|---|---|
| 1Mbps | | | |
| 11Mbps | | | |

## 6.2 Transmit Spectrum Mask (18.4.7.3)

1. Test environment: normal; see clause 3.1

2. Frequencies to be tested: Low、Middle、High

3. Data rate to be tested: 1Mbps, 11Mbps

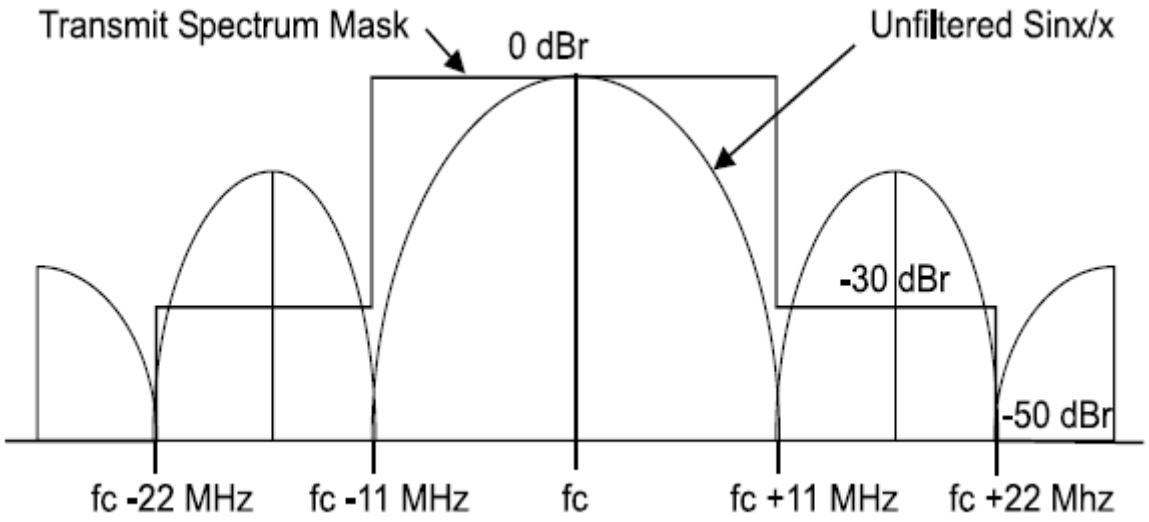
4. Spec requirements:

The transmitted spectral products shall be less than -30dBr for:

fc - 22 MHz < f < fc -11 MHz and fc + 11 MHz < f < fc + 22 MHz

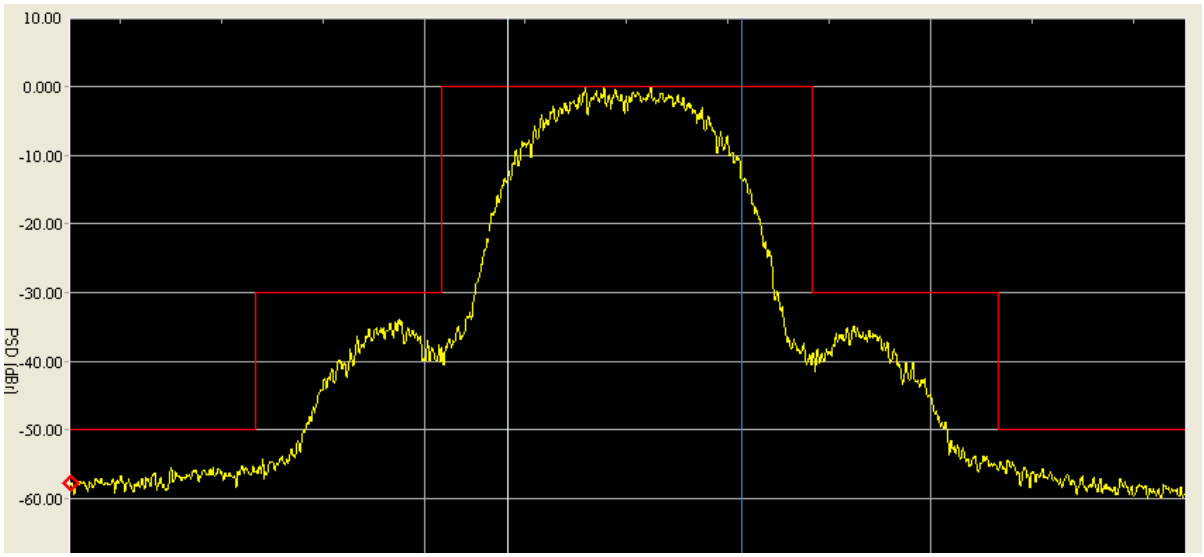
And shall be less than -50dBr for:

f < fc -22 MHz and f > fc + 22 MHz




5. Test method:

Connect the test system as chapter 5 test block diagram, turn on the DUT transmit power, measure the transmit power via Spectral Mask




6. Test Results

| Data rate | Low (2412MHz) | Mid(2442MHz) | High(2472MHz) |
|---|---|---|---|
| 1Mbps | | | |
| 11Mbps | | | |

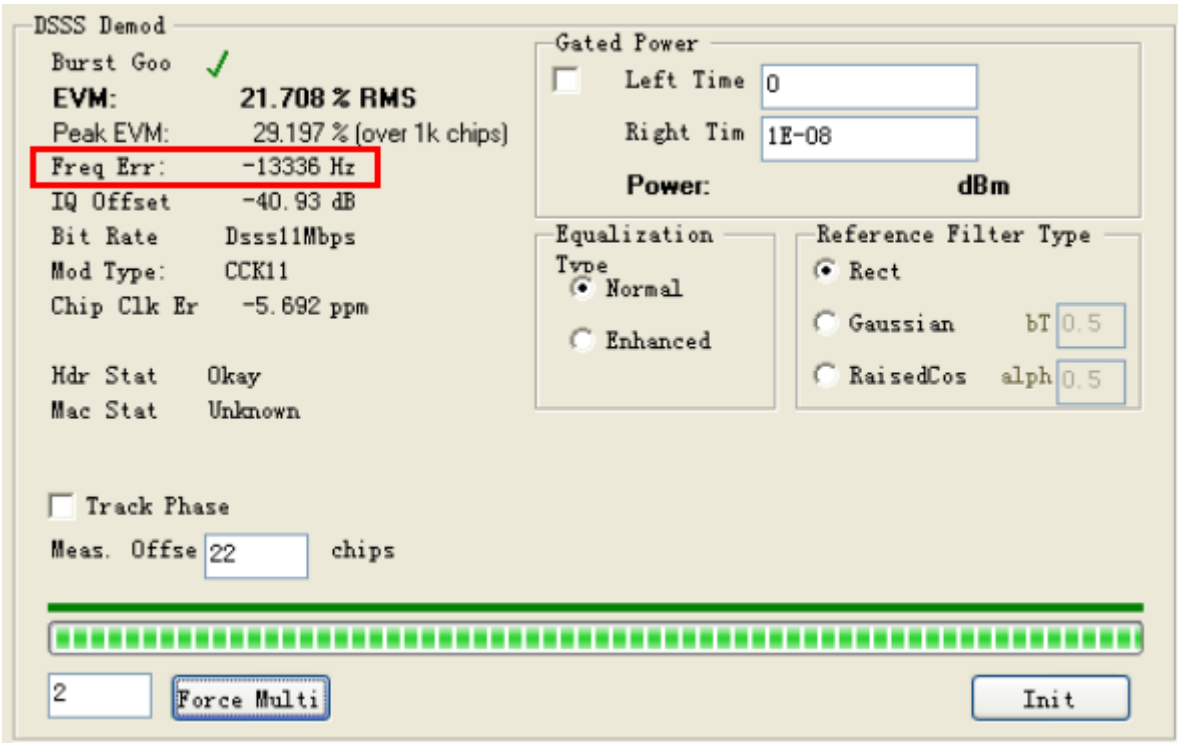
# 6.3 Transmit Center Frequency Tolerance (18.4.7.4)

1. Test environment: normal; see clause 3.1
2. Frequencies to be tested: Low、Middle、High
3. Data rate to be tested: 1Mbps, 11Mbps
4. Spec requirements:

The transmitted center frequency tolerance shall be ±25 ppm maximum.

5. Test method:

Connect the test system as chapter 5 test block diagram, turn on the DUT transmit power, measure the transmit power via DSSS Demod




6. Test Results

| Data rate | Low (2412MHz) | Mid(2442MHz) | High(2472MHz) |
|---|---|---|---|
| 1Mbps | | | |
| 11Mbps | | | |

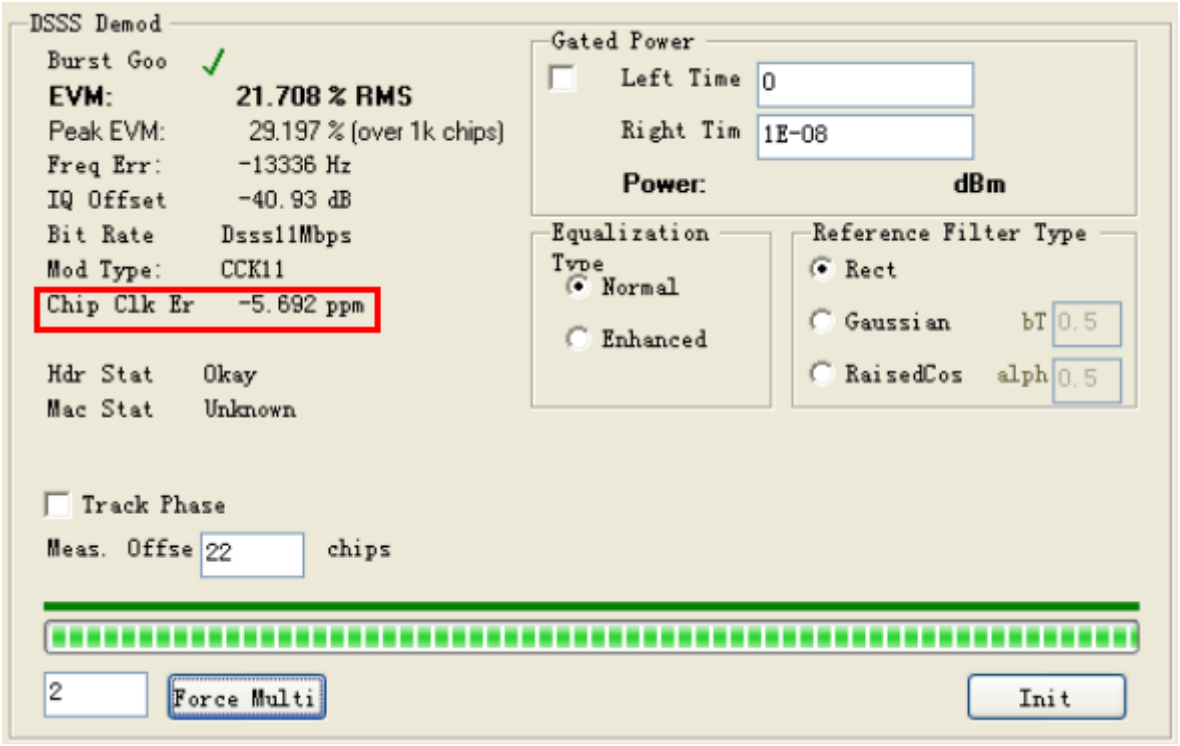
# 6.4 Chip Clock Frequency Tolerance (18.4.7.5)

1. Test environment: normal; see clause 3.1
2. Frequencies to be tested: Low、Middle、High
3. Data rate to be tested: 1Mbps, 11Mbps
4. Spec requirements:

The PN code chip clock frequency tolerance shall be better than ±25 ppm maximum.

5. Test method:

Connect the test system as chapter 5 test block diagram, turn on the DUT transmit power, measure the transmit power via DSSS Demod




6. Test Results

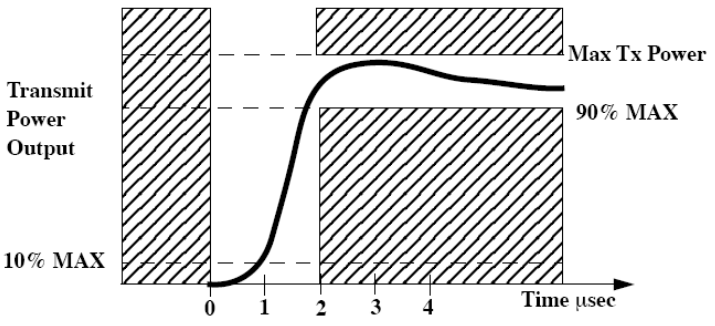
| Data rate | Low (2412MHz) | Mid(2442MHz) | High(2472MHz) |
|---|---|---|---|
| 1Mbps | | | |
| 11Mbps | | | |

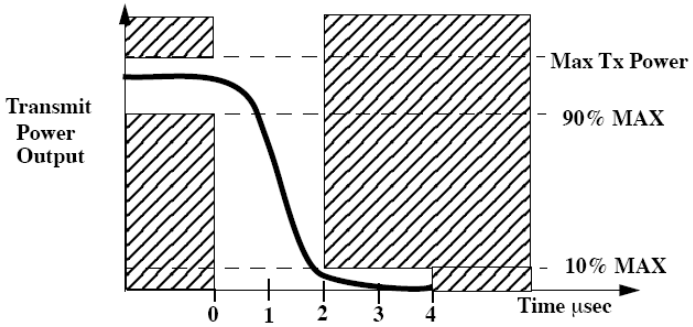
# 6.5 Transmit Power on and Power down Ramp (18.4.7.6)

1. Test environment: normal; see clause 3.1
2. Frequencies to be tested: Low、Middle、High
3. Data rate to be tested: 1Mbps, 11Mbps
4. Spec requirements:

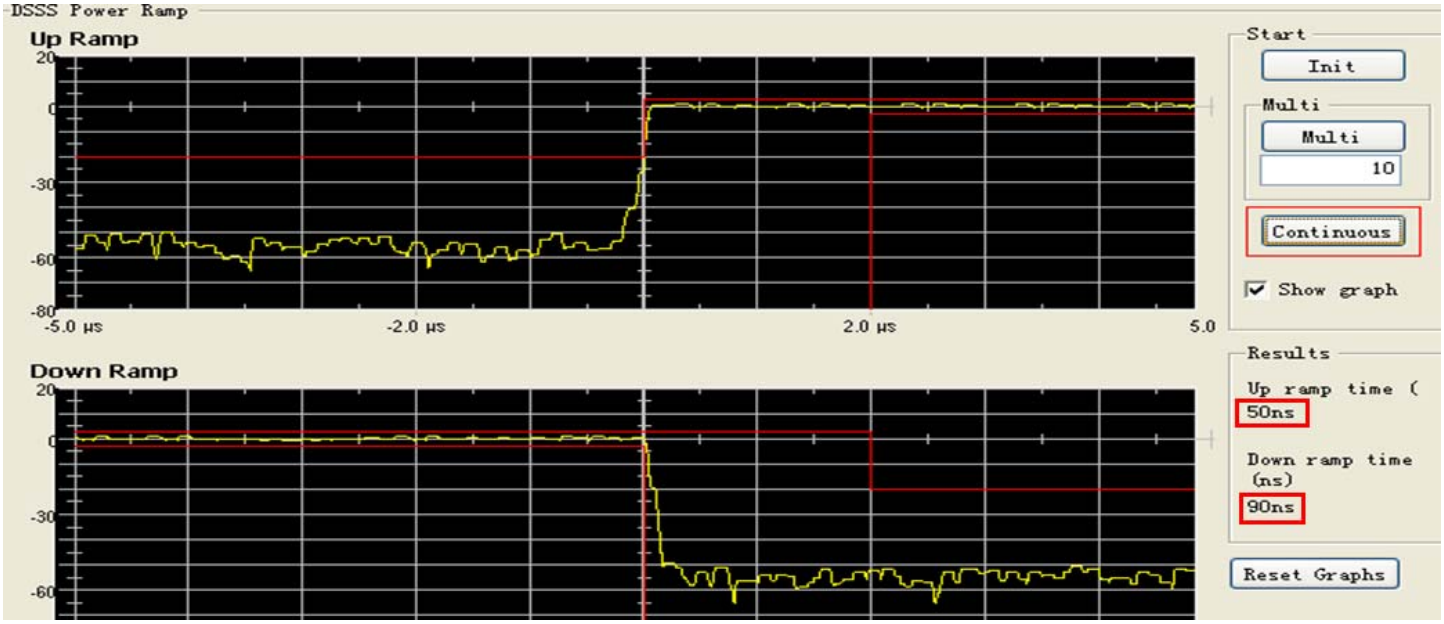
The transmit power-on ramp for 10% to 90% of maximum power shall be no greater than 2 μ s

The transmit power-down ramp for 90% to 10% maximum power shall be no greater than 2 μ s



Connect the test system as chapter 5 test block diagram, turn on the DUT transmit power, measure the transmit power via DSSS Power Ramp




6. Test Results

| Data rate | Low (2412MHz) | Mid(2442MHz) | High(2472MHz) |
|---|---|---|---|
| 1Mbps | | | |
| 11Mbps | | | |

# 6.6 RF Carrier Suppression (18.4.7.7)

1. Test environment: normal; see clause 3.1

2. Frequencies to be tested: Low、Middle、High

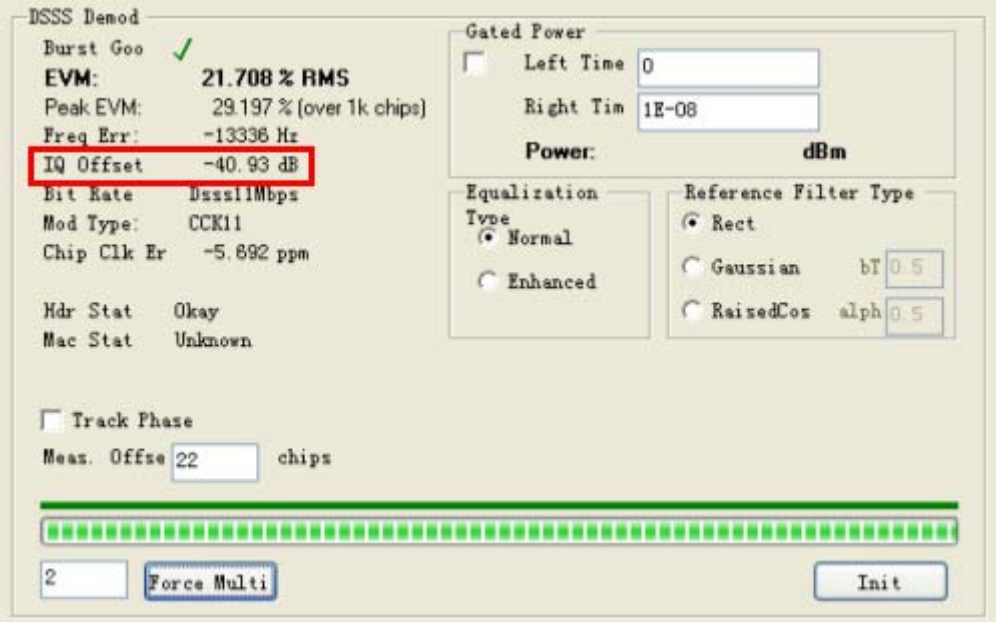
3. Data rate to be tested: 1Mbps, 11Mbps

4. Spec requirements:

The RF carrier suppression, measured at the channel center frequency, shall be at least 15dB below the peak SIN(x)/x power spectrum.

5. Test method:

Connect the test system as chapter 5 test block diagram, turn on the DUT transmit power, measure the transmit power via DSSS Demod




6. Test Results

| Data rate | Low (2412MHz) | Mid(2442MHz) | High(2472MHz) |
|---|---|---|---|
| 1Mbps | | | |
| 11Mbps | | | |

# 6.7 Transmit Modulation Accuracy (18.4.7.8)

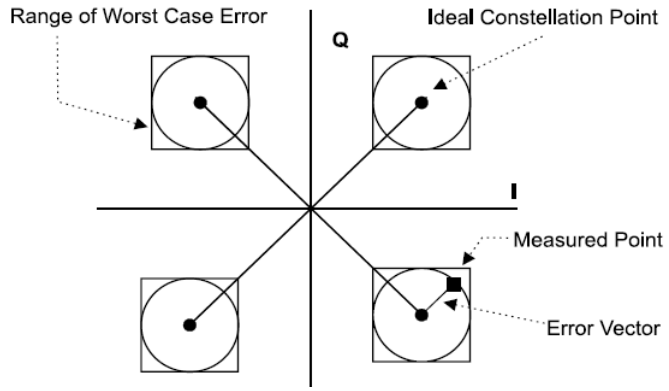
1. Test environment: normal; see clause 3.1

2. Frequencies to be tested: Low、Middle、High

3. Data rate to be tested: 1Mbps, 11Mbps

4. Spec requirements:

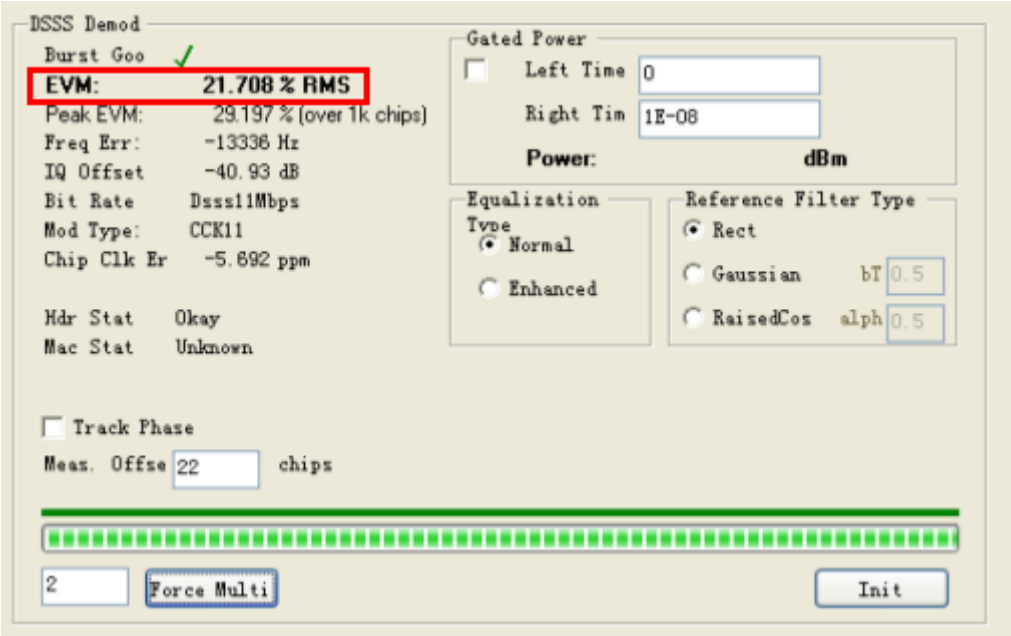
The transmit modulation accuracy requirement for the High Rate PHY shall be based on the difference between the actual transmitted waveform and the ideal signal waveform. Modulation accuracy shall be determined by measuring the peak vector error magnitude during each chip period. Worst-case vector error magnitude shall not exceeded 0.35 for the normalized sampled chip data.




5. Test method:

Connect the test system as chapter 5 test block diagram, turn on the DUT transmit power, measure the

transmit power via DSSS Demod




6. Test Results

| Data rate | Low (2412MHz) | Mid(2442MHz) | High(2472MHz) |
|---|---|---|---|
| 1Mbps | | | |
| 11Mbps | | | |

# 6.8 Receiver Minimum Input Level Sensitivity (18.4.8.1)

1. Test environment: normal; see clause 3.1

2. Frequencies to be tested: Low、Middle、High

3. Data rate to be tested: 11Mbps

4. Spec requirements:

The frame error ratio (FER) shall be less than 8×10–2 at a PSDU length of 1024 octets for an input level of –76dBm measured at the antenna connector. This FER shall be specified for 11 Mbit/s CCK modulation. The test for the minimum input level sensitivity shall be conducted with the energy detection threshold set less than or equal to –76dBm.

5. Test method:

Connect the test system as chapter 5 test block diagram, turn on the DUT receive path, transmit 1000 packets by N4010A with specific power via AWG Control, then record the packets received by DUT, calculate the FER.

6. Test Results

| Data rate | Low (2412MHz) | Mid(2442MHz) | High(2472MHz) |
|---|---|---|---|
| 11Mbps | | | |

# 6.9 Receiver Maximum Input Level Sensitivity (18.4.8.2)

1. Test environment: normal; see clause 3.1

2. Frequencies to be tested: Low、Middle、High

3. Data rate to be tested: 11Mbps

4. Spec requirements:

The receiver shall provide a maximum FER of 8×10–2 at a PSDU length of 1024 octets for a maximum input level of –10dBm measured at the antenna. This FER shall be specified for 11 Mbit/s CCK modulation.

5. Test method:

Connect the test system as chapter 5 test block diagram, turn on the DUT receive path, transmit 1000 packets by N4010A with specific power (-10dBm) via AWG Control, then record the packets received by DUT, calculate the FER.

6. Test Results

| Data rate | Low (2412MHz) | Mid(2442MHz) | High(2472MHz) |
|---|---|---|---|
| 11Mbps | | | |

# 6.10 Receiver Adjacent Channel Rejection (18.4.8.3)

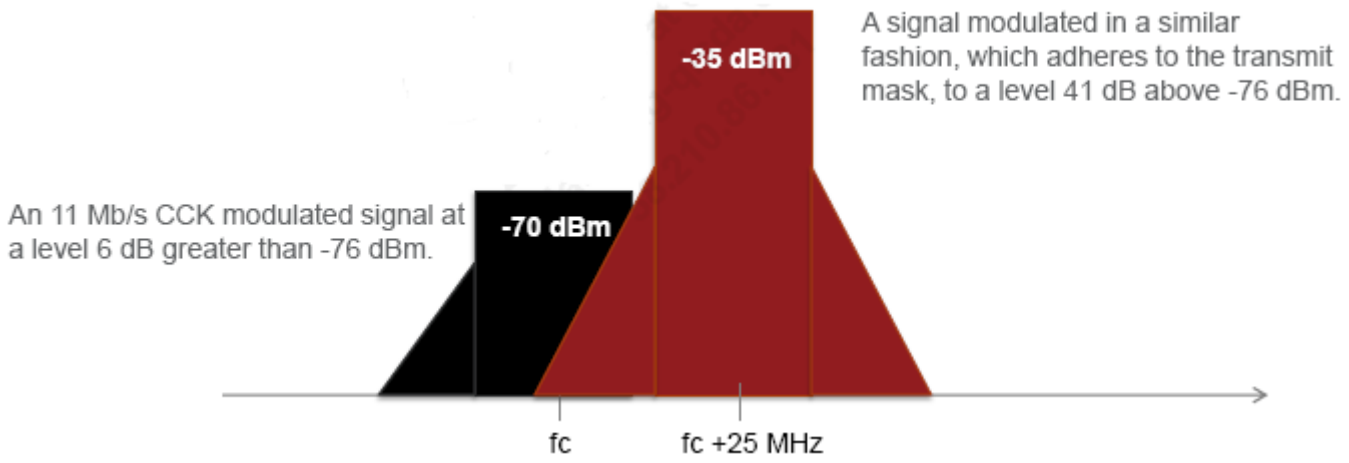
1. Test environment: normal; see clause 3.1

2. Frequencies to be tested: Middle

3. Data rate to be tested: 11Mbps

4. Spec requirements:

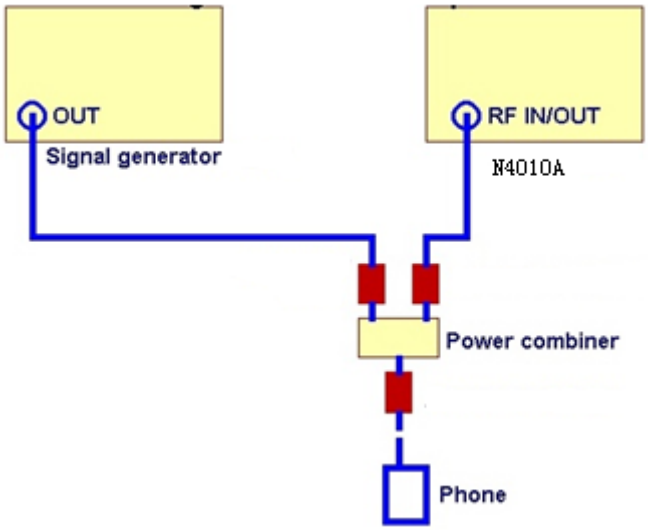
Adjacent channel rejection is defined between any two channels with >25 MHz separation in each channel Group. The adjacent channel rejection shall be equal to or better than 35dB, with an FER of 8×10–2 using 11 Mbit/s CCK modulation described in 18.4.6.3 and a PSDU length of 1024 octets.




5. Test method:

Connect the test system the following test block diagram, turn on the DUT receive path, input an 11 Mbit/s

CCK modulated signal at a level 6dB greater than specified in 18.4.8.1 via AWG Control , In an adjacent input a signal modulated in a similar fashion, which adheres to the transmit mask specified in 18.4.7.3 to a level 41dB above the level specified in 18.4.8.1. The adjacent channel signal shall be derived from a separate signal source then record the packets received by DUT, calculate the FER. Under these conditions, the FER shall be no worse than 8×10–2.




6. Test Results

| Data rate | Mid(2442MHz) |
|---|---|
| 11Mbps | |

# 7. Wi-Fi 11g test

## 7.1 Transmit Power Levels (19.4.7.1)

1. Test environment: normal; see clause 3.1

2. Frequencies to be tested: Low、Middle、High

3. Data rate to be tested: 6Mbps, 36Mbps, and 54Mbps

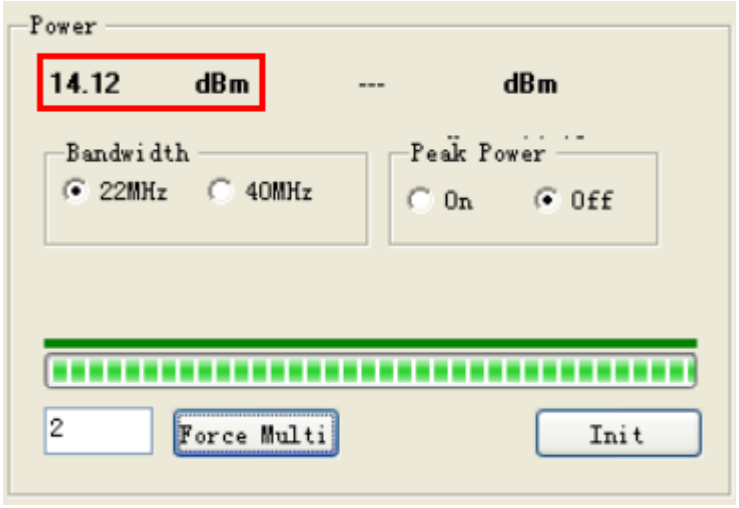
4. Spec requirements:

The maximum transmit power level shall meet the requirements of the local regulatory body.

| Maximum output power | Geographic location | Compliance document |
|---|---|---|
| 1000 mW | USA | FCC 15.247 |
| 100 mW (EIRP) | Europe | ETS 300–328 |
| 10 mW/MHz | Japan | MPT ordinance for Regulating Radio Equipment, Article 49-20 |

5. Test method:

Connect the test system as chapter 5 test block diagram, turn on the DUT transmit power, measure the transmit power via Format-Independent Measurements




6. Test Results

| Data rate | Low (2412MHz) | Mid(2442MHz) | High(2472MHz) |
|---|---|---|---|
| 6Mbps | | | |
| 36Mbps | | | |
| 54Mbps | | | |

# 7.2 Transmit Spectrum Mask (19.5.4)

1. Test environment: normal; see clause 3.1

2. Frequencies to be tested: Low、Middle、High

3. Data rate to be tested: 6Mbps, 36Mbps, and 54Mbps

4. Spec requirements:

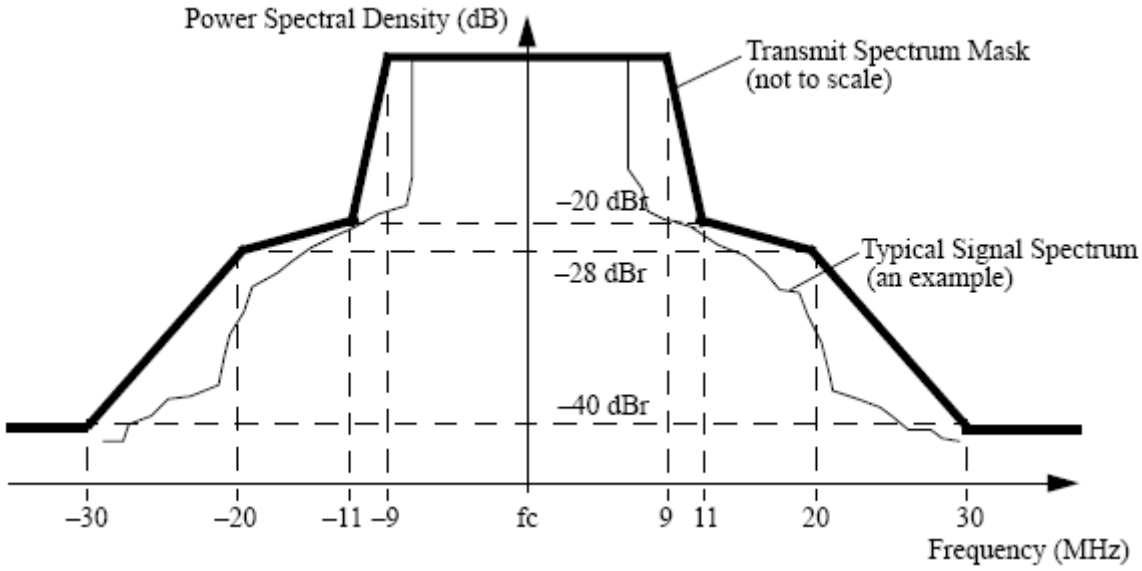
The transmitted spectrum shall have a 0dBr (dB relative to the maximum spectral density of the signal) bandwidth not exceeding 18 MHz;

And shall be less than -20dBr for: 11 MHz frequency offset;

And shall be less than -28dBr for: 20 MHz frequency offset;

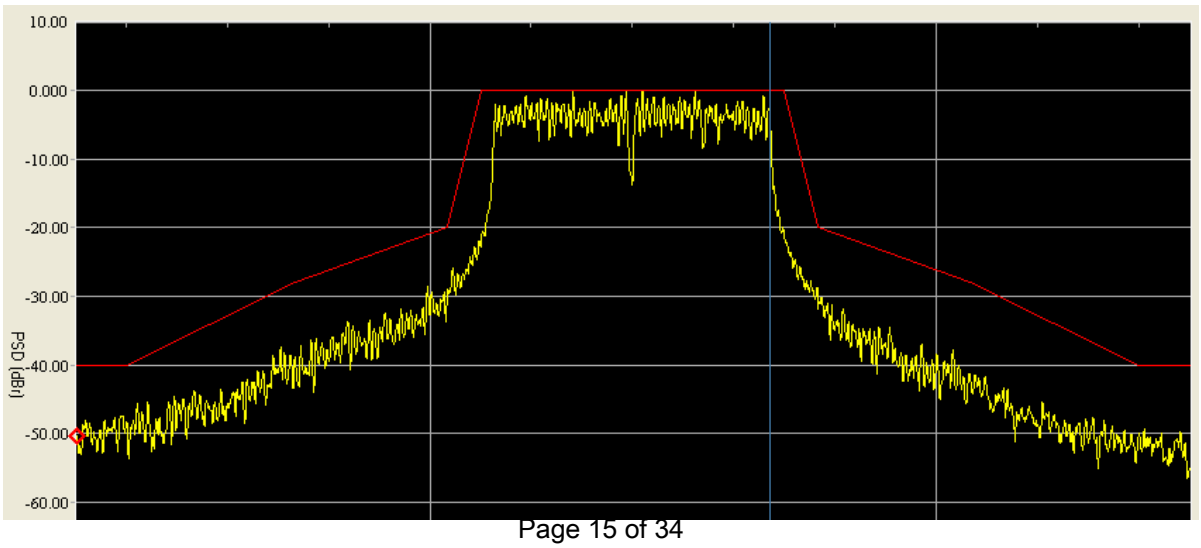
And shall be less than -40dBr for: 30 MHz frequency offset and above;

The transmitted spectral density of the transmitted signal shall fall within the spectral mask, The measurements shall be made using a 100 kHz resolution bandwidth and a 30 kHz video bandwidth.




5. Test method:

Connect the test system as chapter 5 test block diagram, turn on the DUT transmit power, measure the transmit power via



6. Test Results

| Data rate | Low (2412MHz) | Mid(2442MHz) | High(2472MHz) |
|---|---|---|---|
| 6Mbps | | | |
| 36Mbps | | | |
| 54Mbps | | | |

# 7.3 Transmit Center Frequency Tolerance (19.4.7.2)

1. Test environment: normal; see clause 3.1

2. Frequencies to be tested: Low、Middle、High

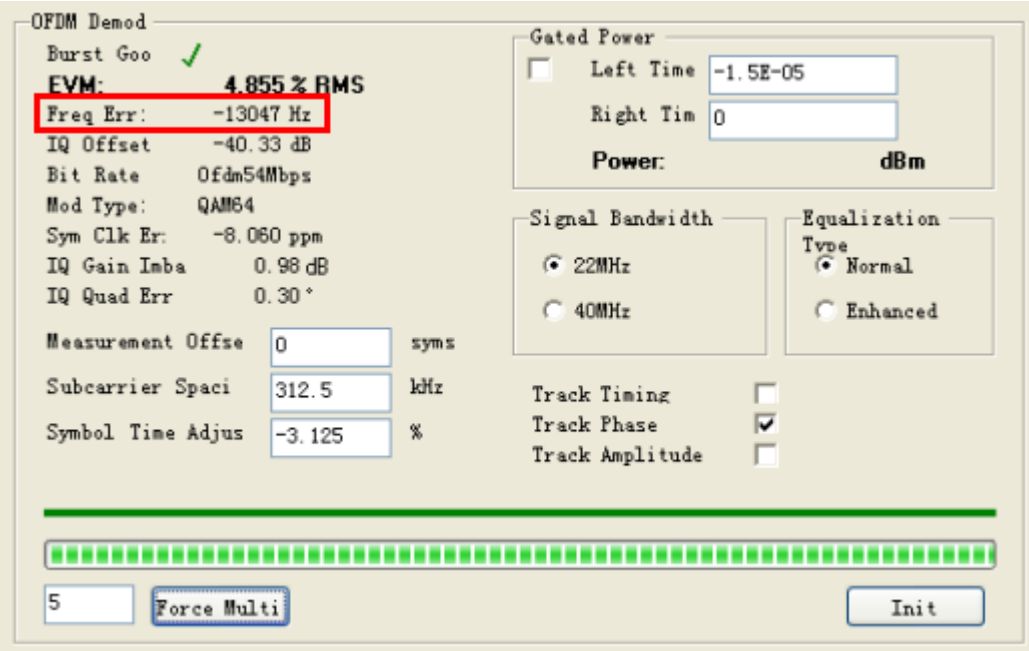
3. Data rate to be tested: 6Mbps, 36Mbps, and 54Mbps

4. Spec requirements:

The transmitted center frequency tolerance shall be ±25 ppm maximum.

5. Test method:

Connect the test system as chapter 5 test block diagram, turn on the DUT transmit power, measure the transmit power via OFDM Demod




6. Test Results

| Data rate | Low (2412MHz) | Mid(2442MHz) | High(2472MHz) |
|---|---|---|---|
| 6Mbps | | | |
| 36Mbps | | | |
| 54Mbps | | | |

# 7.4 Symbol Clock Frequency Tolerance (19.4.7.3)

1. Test environment: normal; see clause 3.1

2. Frequencies to be tested: Low、Middle、High

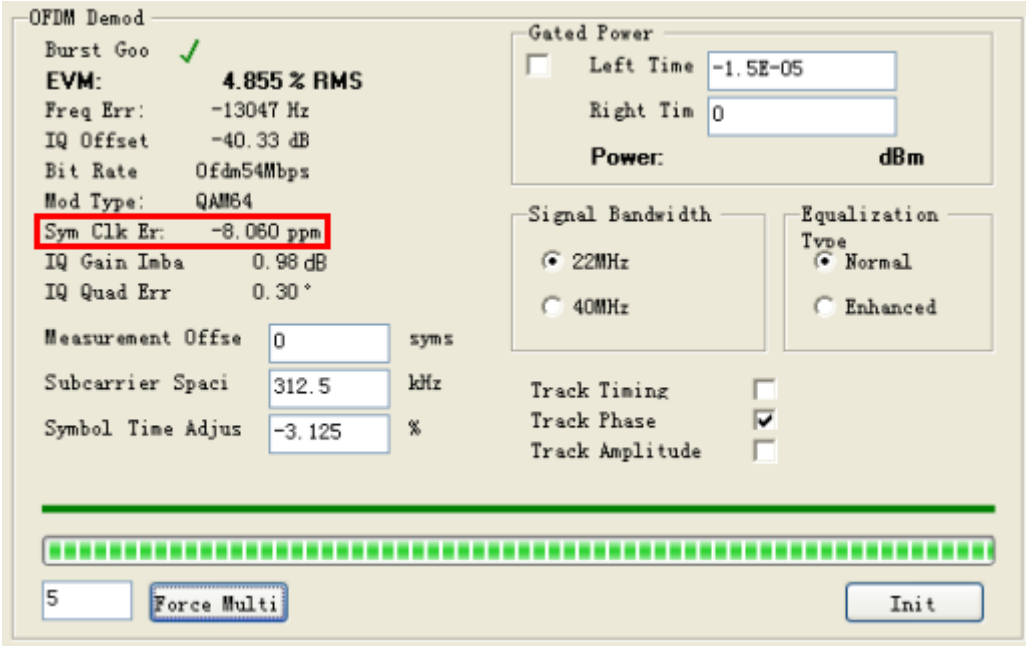
3. Data rate to be tested: 6Mbps, 36Mbps, and 54Mbps

4. Spec requirements:

The transmitted center frequency tolerance shall be ±25 ppm maximum.

5. Test method:

Connect the test system as chapter 5 test block diagram, turn on the DUT transmit power, measure the transmit power via OFDM Demod




6. Test Results

| Data rate | Low (2412MHz) | Mid(2442MHz) | High(2472MHz) |
|---|---|---|---|
| 6Mbps | | | |
| 36Mbps | | | |
| 54Mbps | | | |

# 7.5 Transmitter Center Frequency Leakage (17.3.9.6.1)

1. Test environment: normal; see clause 3.1

2. Frequencies to be tested: Low、Middle、High

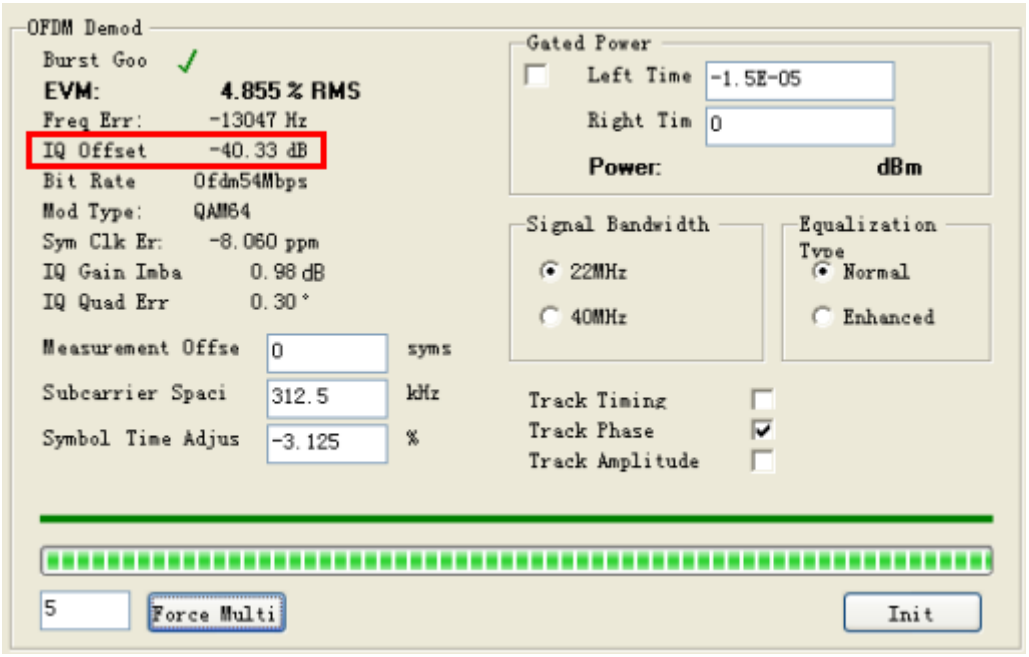
3. Data rate to be tested: 6Mbps, 36Mbps, and 54Mbps

4. Spec requirements:

Leakage shall not exceed -15dB relative to overall transmitted power or, equivalently, +2dB relative to the average energy of the rest of the subcarriers.

5. Test method:

Connect the test system as chapter 5 test block diagram, turn on the DUT transmit power, measure the transmit power via OFDM Demod



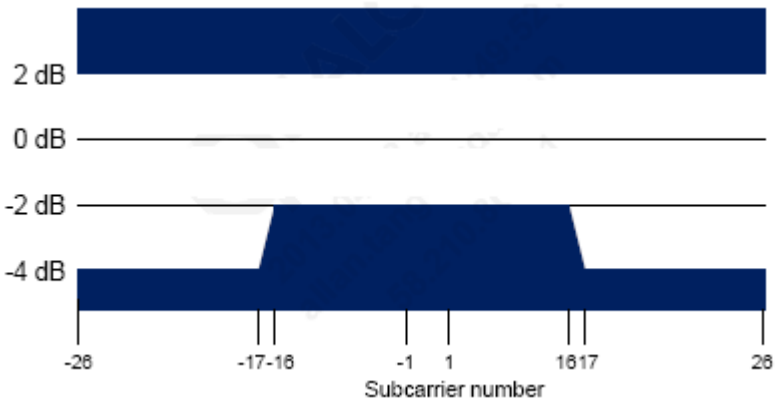

6. Test Results

| Data rate | Low (2412MHz) | Mid(2442MHz) | High(2472MHz) |
|---|---|---|---|
| 6Mbps | | | |
| 36Mbps | | | |
| 54Mbps | | | |

# 7.6 Transmitter Spectral Flatness (17.3.9.6.2)

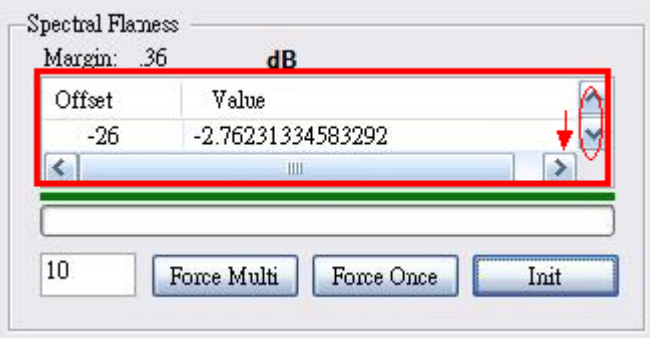
1. Test environment: normal; see clause 3.1
2. Frequencies to be tested: Low、Middle、High
3. Data rate to be tested: 6Mbps, 36Mbps, and 54Mbps
4. Spec requirements:

The average energy of the constellations in each of the spectral lines –16~ –1 and +1~ +16 will deviate no more than ± 2dB from their average energy. The average energy of the constellations in each of the spectral lines –26~ –17 and +17~ +26 will deviate no more than +2/–4dB from the average energy of spectral lines –16~ –1 and +1~ +16.




5. Test method:

Connect the test system as chapter 5 test block diagram, turn on the DUT transmit power, measure the transmit power via OFDM Standards Measurements




6. Test Results

| Data rate | Low (2412MHz) | Mid(2442MHz) | High(2472MHz) |
|---|---|---|---|
| 6Mbps | | | |
| 36Mbps | | | |
| 54Mbps | | | |

# 7.7 Transmit modulation accuracy (19.7.2.7)

1. Test environment: normal; see clause 3.1

2. Frequencies to be tested: Low、Middle、High

3. Data rate to be tested: 6Mbps, 36Mbps, and 54Mbps

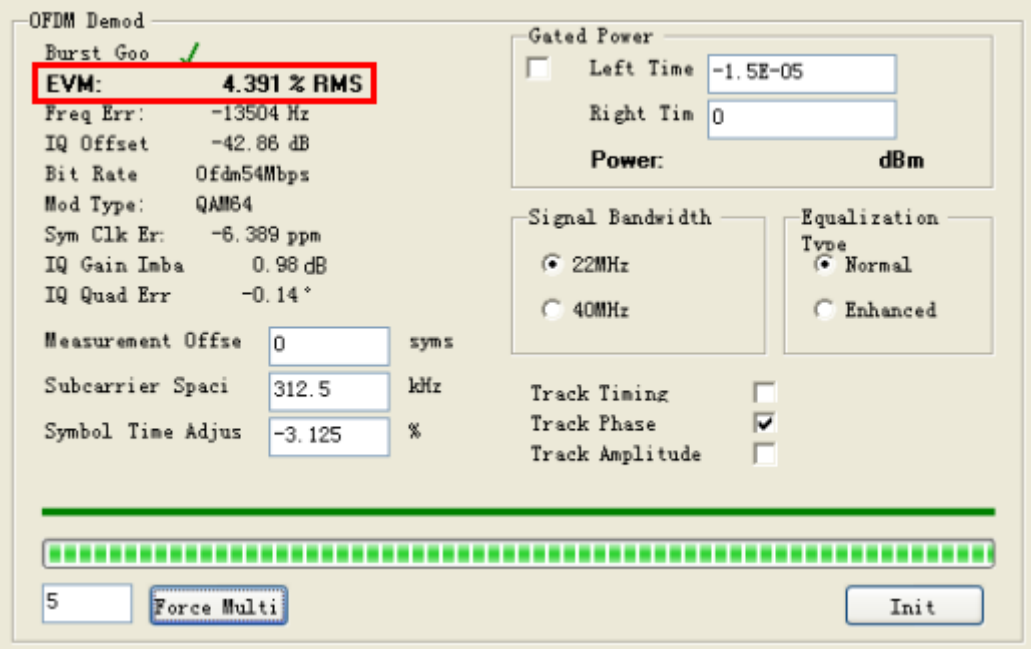
4. Spec requirements:

The relative constellation RMS error, averaged over subcarriers, OFDM frames, and packets, shall not exceed a data-rate dependent value according to the following table.

| Data rate (Mbits/s) | Relative constellation error (dB) |
|---|---|
| 6 | –5 |
| 9 | –8 |
| 12 | –10 |
| 18 | –13 |
| 24 | –16 |
| 36 | –19 |
| 48 | –22 |
| 54 | –25 |

5. Test method:

Connect the test system as chapter 5 test block diagram, turn on the DUT transmit power, measure the transmit power via OFDM Demod




6. Test Results

| Data rate | Low (2412MHz) | Mid(2442MHz) | High(2472MHz) |
|---|---|---|---|
| 6Mbps | | | |
| 36Mbps | | | |
| 54Mbps | | | |

# 7.8 Transmission Spurious (19.4.3)

1. Test environment: normal; see clause 3.1

2. Frequencies to be tested: Middle

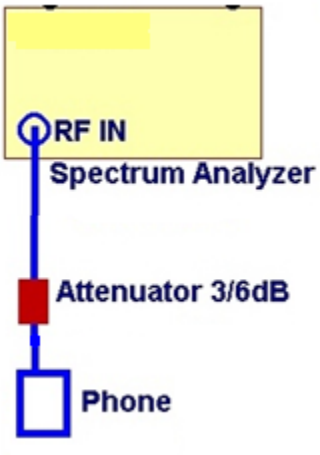
3. Data rate to be tested: 54Mbps

4. Spec requirements:

The ERP shall conform to in-band and out-of-band spurious emissions as set by the appropriate regulatory bodies for the 2.4 GHz band.

5. Test method:

Connect the test system as following block diagram, turn on the DUT transmit power, measure the transmit spurious in spectrum analyzer.



6. Test Results

# 7.9 Receiver Minimum Input Level Sensitivity (19.5.1)

1. Test environment: normal; see clause 3.1

2. Frequencies to be tested: Low、Middle、High

3. Data rate to be tested: 54Mbps

4. Spec requirements:

The packet error ratio (PER) shall be less than 10% at a PSDU length of 1000 bytes for the input levels off following table.

| Data rate (Mbits/s) | Minimum sensitivity (dBm) |
|---|---|
| 6 | –82 |
| 9 | –81 |
| 12 | –79 |
| 18 | –77 |
| 24 | –74 |
| 36 | –70 |
| 48 | –66 |
| 54 | –65 |

5. Test method:

Connect the test system as chapter 5 test block diagram, turn on the DUT receive path, transmit 1000 packets by N4010A with specific power via AWG Control, then record the packets received by DUT, calculate the PER.

6. Test Results

| Data rate | Low (2412MHz) | Mid(2442MHz) | High(2472MHz) |
|---|---|---|---|
| 54Mbps | | | |

# 7.10 Receiver Maximum Input Level (19.5.3)

1. Test environment: normal; see clause 3.1

2. Frequencies to be tested: Low、Middle、High

3. Data rate to be tested: 54Mbps

4. Spec requirements:

The PER shall be less than 10% at a PSDU length of 1000 bytes for an input level of -20dBm measured at the antenna connector for any supported modulation signal or data rate.

5. Test method:

Connect the test system as chapter 5 test block diagram, turn on the DUT receive path, transmit 1000 packets by N4010A with specific power (-20dBm) via AWG Control, then record the packets received by

DUT, calculate the FER.

6. Test Results

| Data rate | Low (2412MHz) | Mid(2442MHz) | High(2472MHz) |
|---|---|---|---|
| 54Mbps | | | |

# 7.11 Adjacent Channel Rejection (19.5.2)

1. Test environment: normal; see clause 3.1

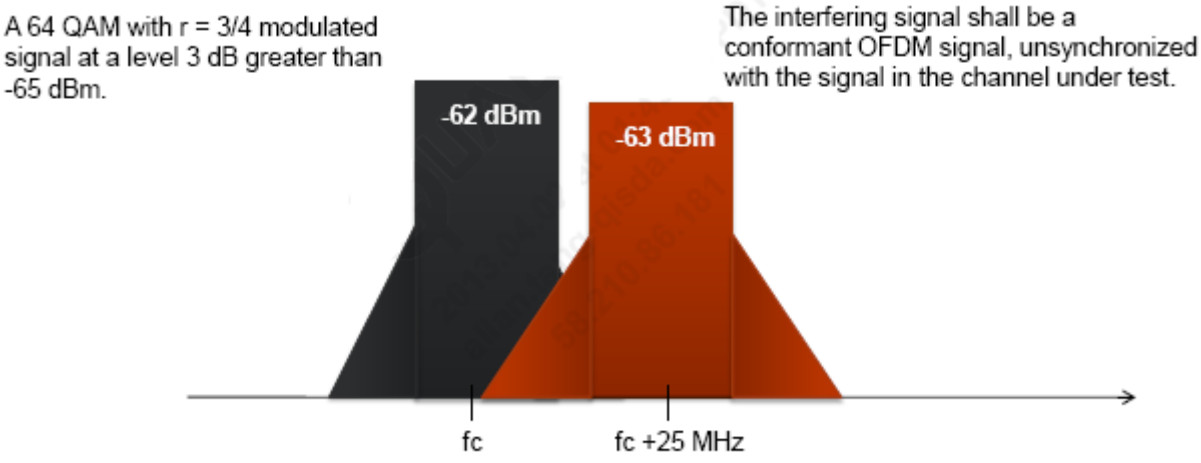
2. Frequencies to be tested: Middle

3. Data rate to be tested: 54Mbps

4. Spec requirements:

Adjacent channels at 2.4 GHz are defined to be at ±25 MHz spacing. The adjacent channel rejection shall be measured by setting the desired signal's strength 3dB above the rate-dependent sensitivity specified in following table and raising the power of the interfering signal until 10% PER is caused for a PSDU length of 1000 bytes.

| Data rate (Mbits/s) | Minimum sensitivity (dBm) | Adjacent channel rejection (dB) |
|---|---|---|
| 6 | –82 | 16 |
| 9 | –81 | 15 |
| 12 | –79 | 13 |
| 18 | –77 | 11 |
| 24 | –74 | 8 |
| 36 | –70 | 4 |
| 48 | –66 | 0 |
| 54 | –65 | –1 |

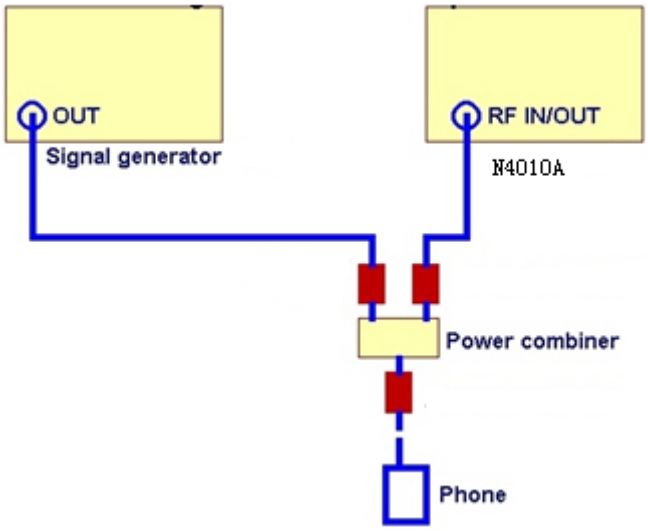



Example for 54 Mbps measurement

5. Test method:

Connect the test system the following test block diagram, turn on the DUT receive path, input an 54Mbit/s

OFDM modulated signal at a level 3dB greater than specified in 19.5.1 via AWG Control , In an adjacent input a signal modulated in a similar fashion, which adheres to the transmit mask specified in 19.5.4 to a level defined in the above table. The adjacent channel signal shall be derived from a separate signal source then record the packets received by DUT, calculate the FER. Under these conditions, the FER shall be no worse than 10%.




6. Test Results

| Data rate | Mid(2442MHz) |
|---|---|
| 54Mbps | |

# 8. Wi-Fi 11n test

## 8.1 Transmit Power (20.3.21.3)

1. Test environment: normal; see clause 3.1

2. Frequencies to be tested: Low、Middle、High

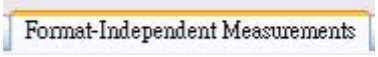
3. Data rate to be tested: MCS0, MCS7

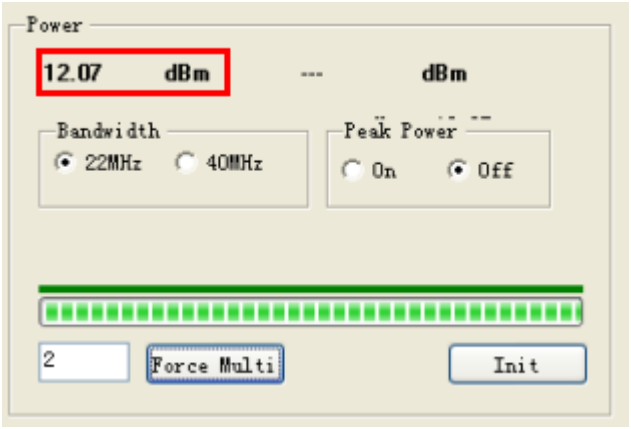
4. Spec requirements:

The maximum transmit power level shall meet the requirements of the local regulatory body.

| Maximum output power | Geographic location | Compliance document |
|---|---|---|
| 1000 mW | USA | FCC 15.247 |
| 100 mW (EIRP) | Europe | ETS 300–328 |
| 10 mW/MHz | Japan | MPT ordinance for Regulating Radio Equipment, Article 49-20 |

5. Test method:

Connect the test system as chapter 5 test block diagram, turn on the DUT transmit power, measure the transmit power via 


6. Test Results

| Data rate | Low (2412MHz) | Mid(2442MHz) | High(2472MHz) |
|---|---|---|---|
| MCS0 | | | |
| MCS7 | | | |

## 8.2 Transmit Spectrum Mask (20.3.21.1)

1. Test environment: normal; see clause 3.1

2. Frequencies to be tested: Low、Middle、High

3. Data rate to be tested: MCS0, MCS7

4. Spec requirements:

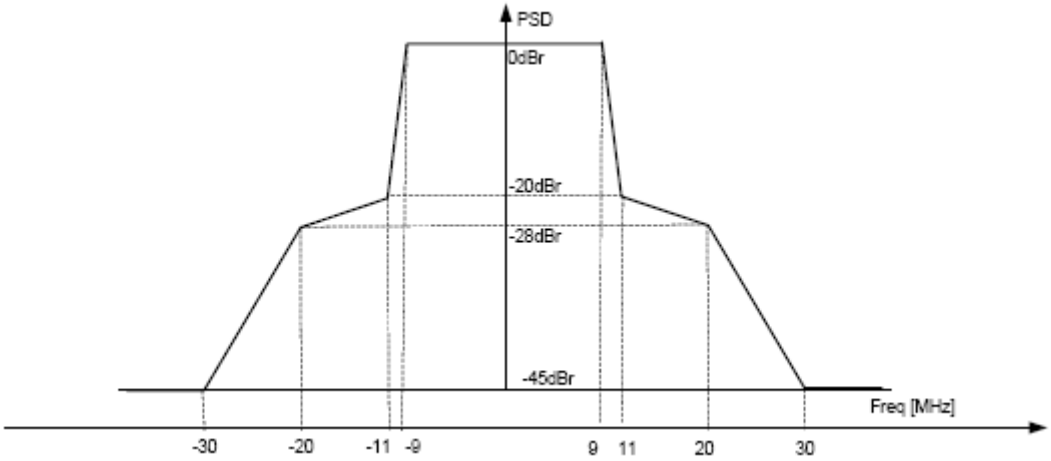
When transmitting in a 20 MHz channel, The transmitted spectrum shall have a 0dBr (dB relative to the maximum spectral density of the signal) bandwidth not exceeding 18 MHz;

And shall be less than -20dBr for: 11 MHz frequency offset;

And shall be less than -28dBr for: 20 MHz frequency offset;

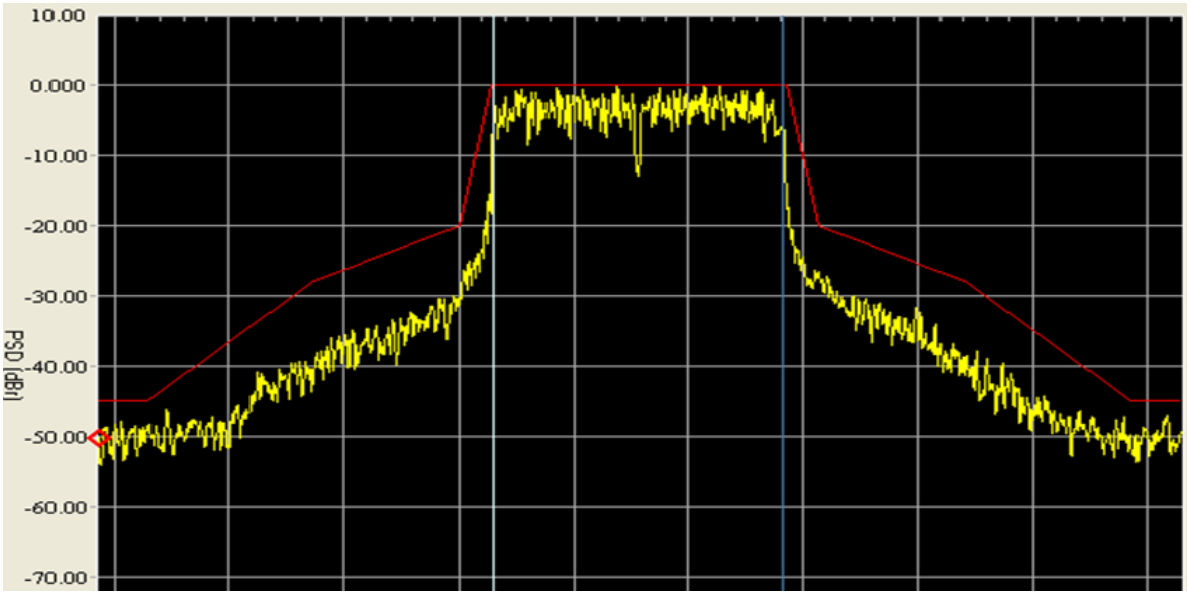
And shall be the maximum of –45dBr and –53dBm/MHz for: 30 MHz frequency offset and above;

The transmitted spectral density of the transmitted signal shall fall within the spectral mask, The measurements shall be made using a 100 kHz resolution bandwidth and a 30 kHz video bandwidth.




5. Test method:

Connect the test system as chapter 5 test block diagram, turn on the DUT transmit power, measure the transmit power via




6. Test Results

| Data rate | Low (2412MHz) | Mid(2442MHz) | High(2472MHz) |
|---|---|---|---|
| MCS0 | | | |
| MCS7 | | | |

# 8.3 Transmit Center Frequency Tolerance (20.3.21.4)

1. Test environment: normal; see clause 3.1

2. Frequencies to be tested: Low、Middle、High

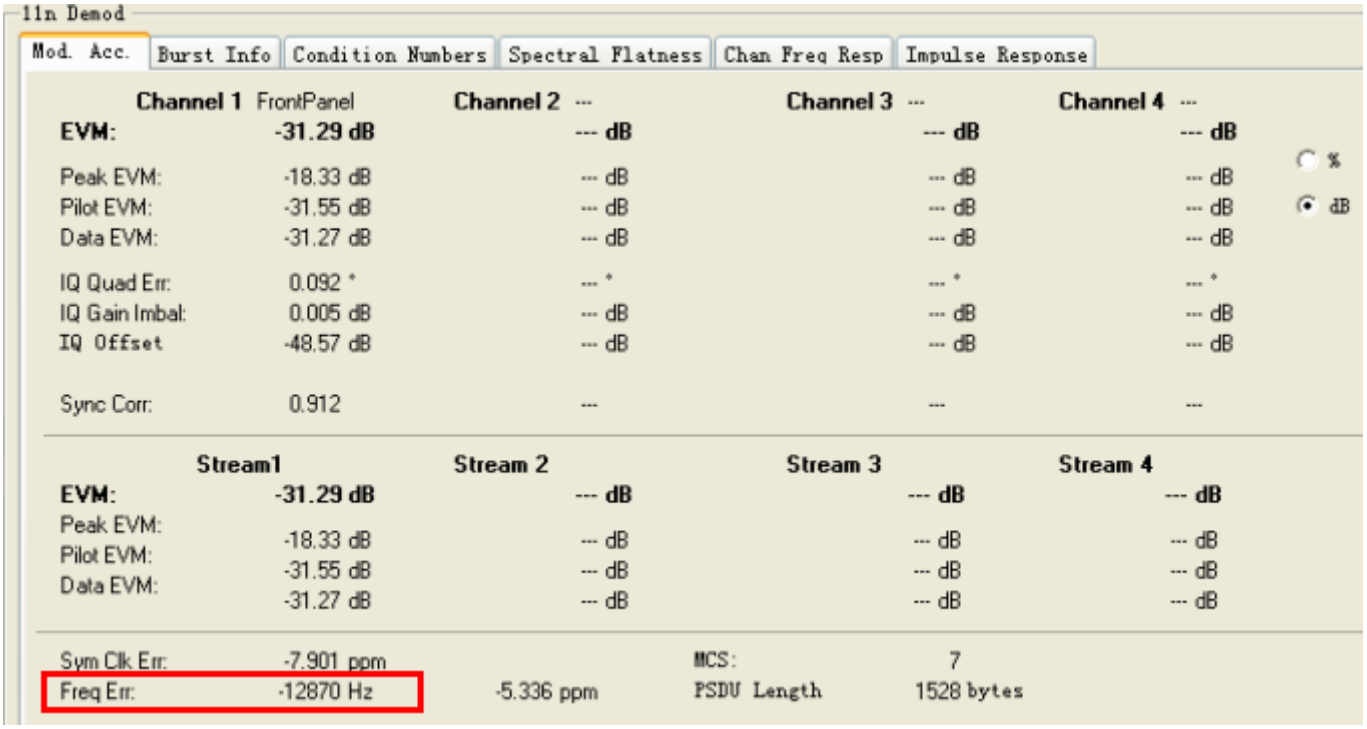
3. Data rate to be tested: MCS0, MCS7

4. Spec requirements:

The transmitter center frequency tolerance shall be ±25ppm maximum for the 2.4 GHz band and ± 20ppm maximum for the 5 GHz band.

5. Test method:

Connect the test system as chapter 5 test block diagram, turn on the DUT transmit power, measure the transmit power via 11n Demod




6. Test Results

| Data rate | Low (2412MHz) | Mid(2442MHz) | High(2472MHz) |
|---|---|---|---|
| MCS0 | | | |
| MCS7 | | | |

# 8.4 Symbol Clock Frequency tolerance (20.3.21.6)

1. Test environment: normal; see clause 3.1

2. Frequencies to be tested: Low、Middle、High

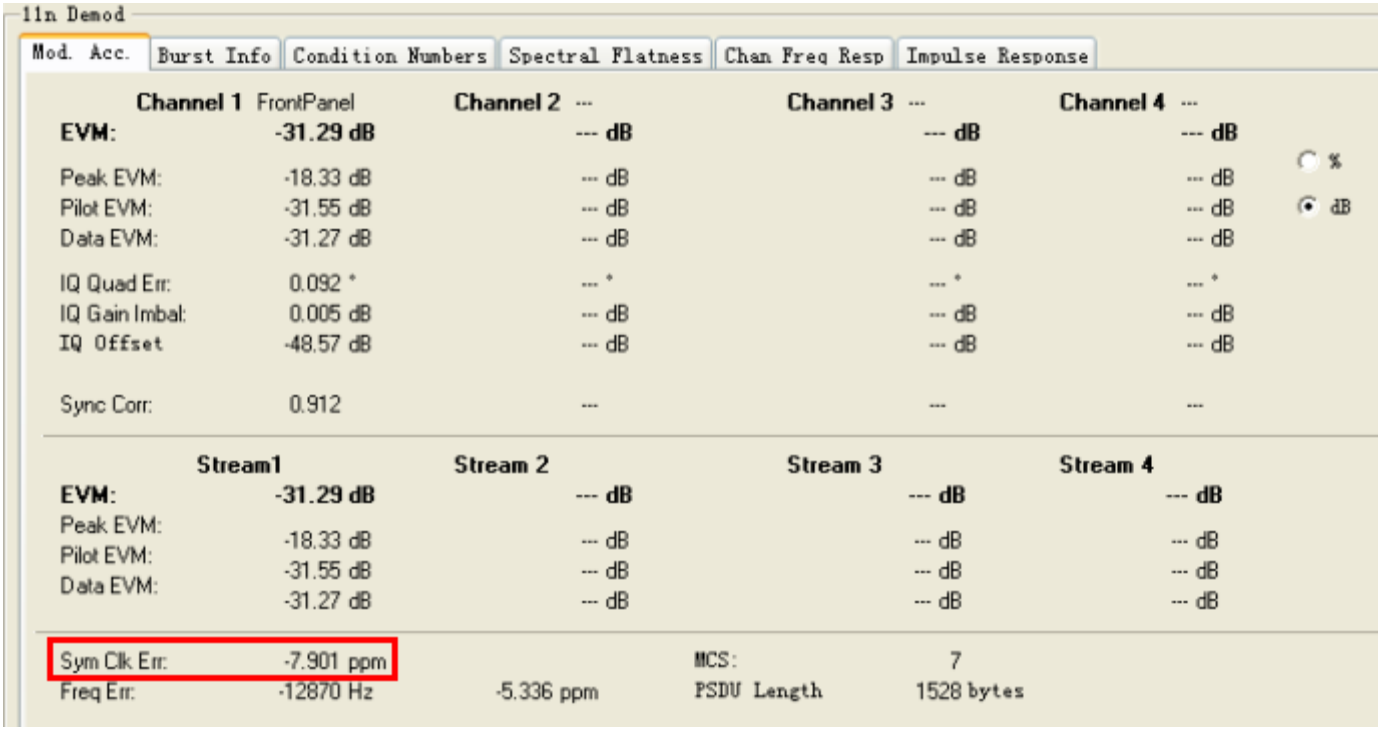
3. Data rate to be tested: MCS0, MCS7

4. Spec requirements:

The transmitter center frequency tolerance shall be ± 25ppm maximum for the 2.4 GHz band and ± 20ppm maximum for the 5 GHz band.

5. Test method:

Connect the test system as chapter 5 test block diagram, turn on the DUT transmit power, measure the transmit power via 11n Demod




6. Test Results

| Data rate | Low (2412MHz) | Mid(2442MHz) | High(2472MHz) |
|---|---|---|---|
| MCS0 | | | |
| MCS7 | | | |

# 8.5 Transmit Center Frequency Leakage (20.3.21.7.2)

1. Test environment: normal; see clause 3.1

2. Frequencies to be tested: Low、Middle、High

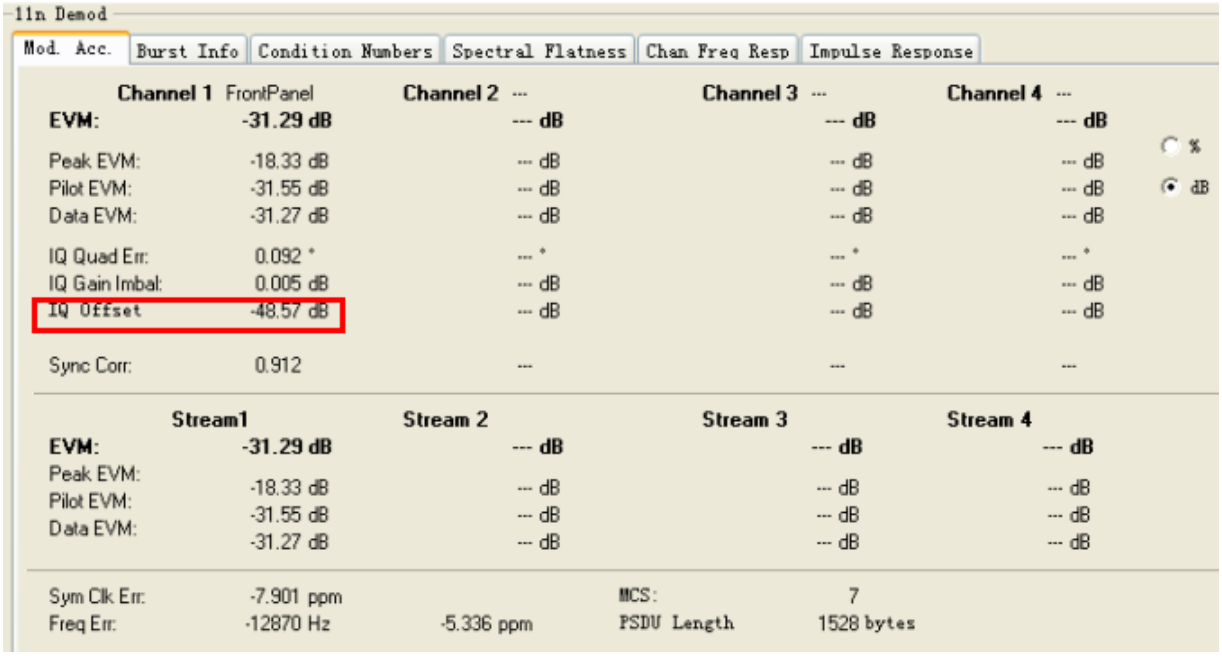
3. Data rate to be tested: MCS0, MCS7

4. Spec requirements:

The transmitter center frequency leakage shall follow 17.3.9.6.1 for all transmissions in a 20 MHz channel Width, which shall not exceed -15dB relative to overall transmitted power or, equivalently, +2 dB relative to the average energy of the rest of the subcarriers.

5. Test method:

Connect the test system as chapter 5 test block diagram, turn on the DUT transmit power, measure the transmit power via 11n Demod




6. Test Results

| Data rate | Low (2412MHz) | Mid(2442MHz) | High(2472MHz) |
|---|---|---|---|
| MCS0 | | | |
| MCS7 | | | |

# 8.6 Spectral Flatness (20.3.21.2)

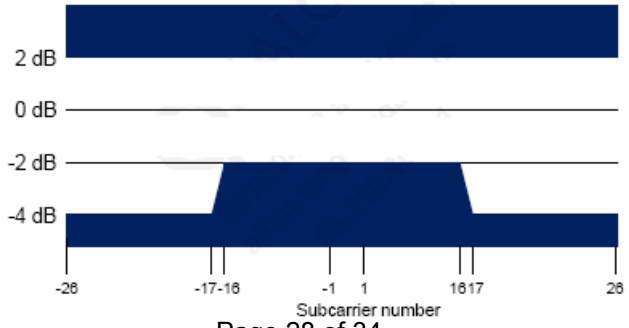
1. Test environment: normal; see clause 3.1

2. Frequencies to be tested: Low、Middle、High

3. Data rate to be tested: MCS0, MCS7

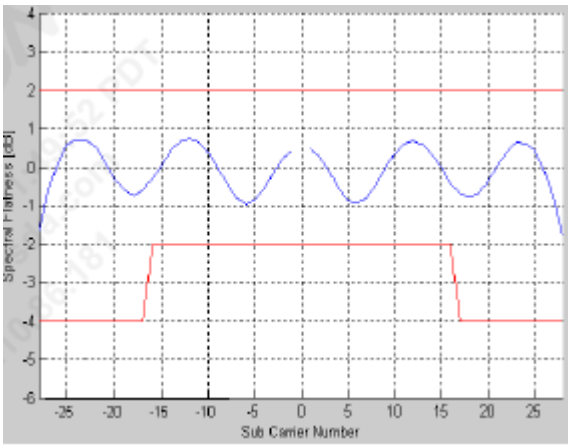
4. Spec requirements:

In a 20 MHz channel and in corresponding 20 MHz transmission in a 40 MHz channel, the average energy of the constellations in each of the subcarriers with indices –16 to –1 and +1 to +16 shall deviate no more than ± 2dB from their average energy. The average energy of the constellations in each of the subcarriers with indices –28 to –17 and +17 to +28 shall deviate no more than +2/–4 dB from the average energy of subcarriers with indices –16 to –1 and +1 to +16.



5. Test method:

Connect the test system as chapter 5 test block diagram, turn on the DUT transmit power, measure the transmit power via 11n Demod / Spectral Flatness




6. Test Results

| Data rate | Low (2412MHz) | Mid(2442MHz) | High(2472MHz) |
|---|---|---|---|
| MCS0 | | | |
| MCS7 | | | |

# 8.7 Transmitter Constellation Error (20.3.21.7.3)

1. Test environment: normal; see clause 3.1

2. Frequencies to be tested: Low、Middle、High

3. Data rate to be tested: MCS0, MCS7

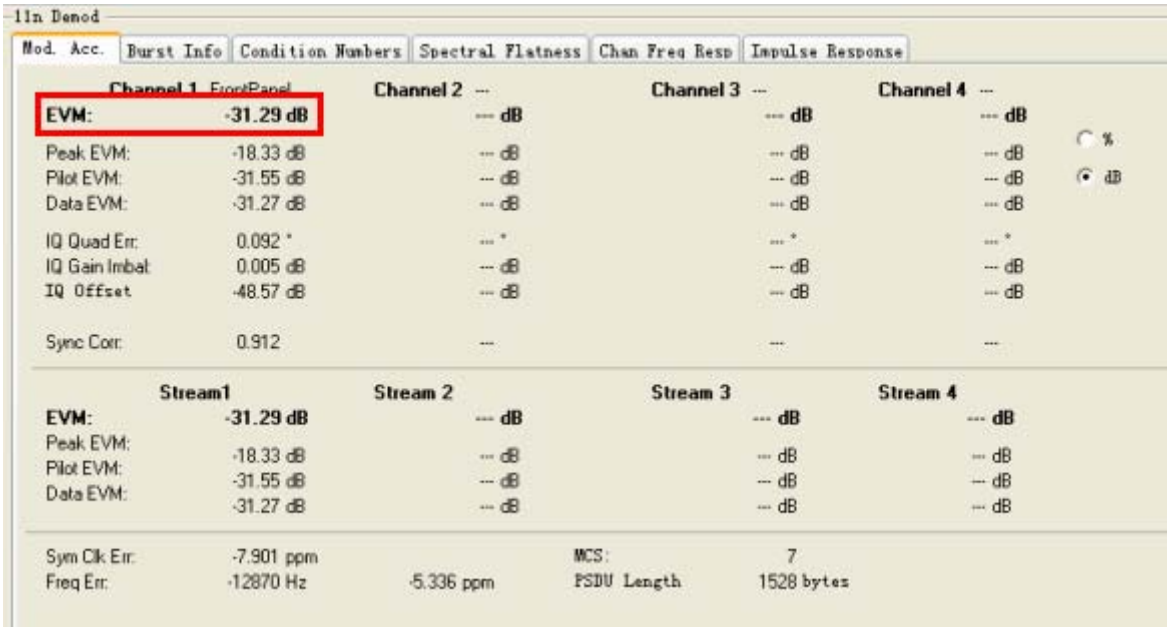
4. Spec requirements:

The relative constellation frame-averaged RMS error, calculated first by averaging over subcarriers, OFDM frames, and spatial streams, shall not exceed a data-rate-dependent value according to table below.

| Modulation | Coding rate | Relative constellation error (dB) |
|---|---|---|
| BPSK | 1/2 | –5 |
| QPSK | 1/2 | –10 |
| QPSK | 3/4 | –13 |
| 16-QAM | 1/2 | –16 |
| 16-QAM | 3/4 | –19 |
| 64-QAM | 2/3 | –22 |
| 64-QAM | 3/4 | –25 |
| 64-QAM | 5/6 | –28 |

5. Test method:

Connect the test system as chapter 5 test block diagram, turn on the DUT transmit power, measure the transmit power via 11n Demod




6. Test Results

| Data rate | Low (2412MHz) | Mid(2442MHz) | High(2472MHz) |
|---|---|---|---|
| MCS0 | | | |
| MCS7 | | | |

# 8.8 Receiver Minimum Input Sensitivity (20.3.22.1)

1. Test environment: normal; see clause 3.1

2. Frequencies to be tested: Low、Middle、High

3. Data rate to be tested: MCS7

4. Spec requirements:

The packet error ratio (PER) shall be less than 10% at a PSDU length of 4096 octets with the rate-dependent input levels listed in Table below.

| Modulation | Rate (R) | Minimum sensitivity (20 MHz channel spacing) (dBm) |
|---|---|---|
| BPSK | 1/2 | –82 |
| QPSK | 1/2 | –79 |
| QPSK | 3/4 | –77 |
| 16-QAM | 1/2 | –74 |
| 16-QAM | 3/4 | –70 |
| 64-QAM | 2/3 | –66 |
| 64-QAM | 3/4 | –65 |
| 64-QAM | 5/6 | –64 |

5. Test method:

Connect the test system as chapter 5 test block diagram, turn on the DUT receive path, transmit 1000

packets by N4010A with specific power via AWG Control , then record the packets received by DUT, calculate the PER.

6. Test Results

| Data rate | Low (2412MHz) | Mid(2442MHz) | High(2472MHz) |
|---|---|---|---|
| MCS7 | | | |

# 8.9 Receiver Maximum Input Level (20.3.22.4)

1. Test environment: normal; see clause 3.1

2. Frequencies to be tested: Low、Middle、High

3. Data rate to be tested: MCS7

4. Spec requirements:

The receiver shall provide a maximum PER of 10% at a PSDU length of 4096 octets, for a maximum input level of -30dBm in the 5 GHz band and -20dBm in the 2.4 GHz band, measured at each antenna for any baseband modulation.

5. Test method:

Connect the test system as chapter 5 test block diagram, turn on the DUT receive path, transmit 1000 packets by N4010A with specific power (-20dBm) via AWG Control , then record the packets received by DUT, calculate the FER.

6. Test Results

| Data rate | Low (2412MHz) | Mid(2442MHz) | High(2472MHz) |
|---|---|---|---|
| MCS7 | | | |

# 8.10 Adjacent Channel Rejection (20.3.22.2)

1. Test environment: normal; see clause 3.1

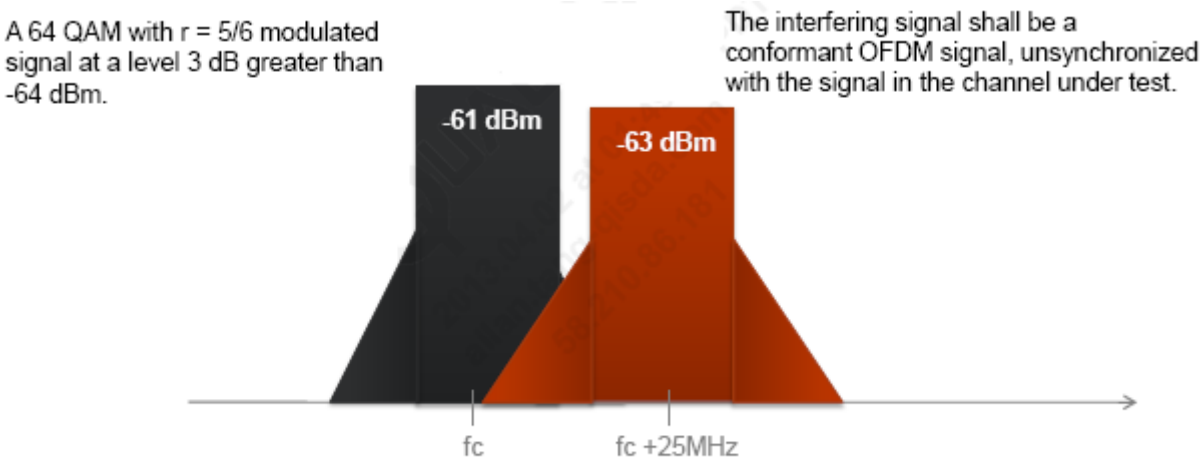
2. Frequencies to be tested: Middle

3. Data rate to be tested: MCS7

4. Spec requirements:

For all transmissions in a 20 MHz channel width, the adjacent channel rejection shall be measured by setting the desired signal’s strength 3dB above the rate-dependent sensitivity specified in following table and raising the power of the interfering signal until 10% PER is caused for a PSDU length of 4096 octets.

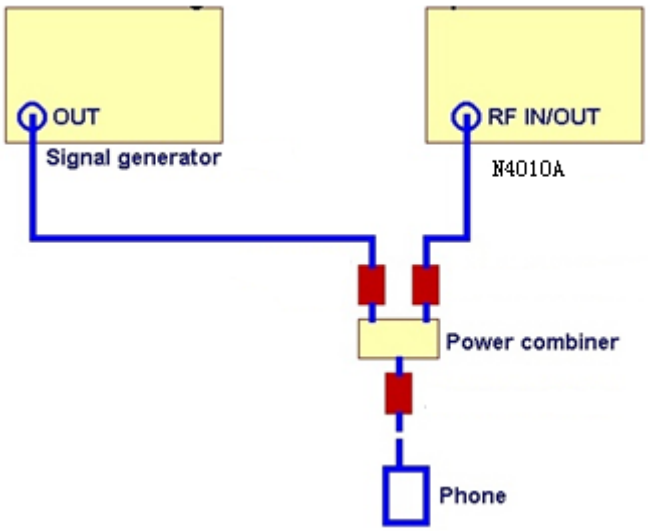
| Modulation | Rate (R) | Minimum sensitivity (20 MHz channel spacing) (dBm) | Adjacent channel rejection (dB) |
|---|---|---|---|
| BPSK | 1/2 | –82 | 16 |
| QPSK | 1/2 | –79 | 13 |
| QPSK | 3/4 | –77 | 11 |
| 16-QAM | 1/2 | –74 | 8 |
| 16-QAM | 3/4 | –70 | 4 |
| 64-QAM | 2/3 | –66 | 0 |
| 64-QAM | 3/4 | –65 | –1 |
| 64-QAM | 5/6 | –64 | –2 |




Example for MCS7 measurement in 20 MHz channels.

5. Test method:

Connect the test system the following test block diagram, turn on the DUT receive path, input an MCS7 OFDM modulated signal at a level 3dB greater than specified in 20.3.22.1 via AWG Control , In an adjacent input a signal modulated in a similar fashion, which adheres to the transmit mask specified in 20.3.21.1 to a level defined in the above table. The adjacent channel signal shall be derived from a separate signal source then record the packets received by DUT, calculate the FER. Under these conditions, the FER shall be no worse than 10%.




6. Test Results

| Data rate | Mid(2442MHz) |
|---|---|
| MCS7 | |

# 9. Reference

1. IEEE Std 802.11_1999 Edition (R2007)
2. IEEE Std 802.11b-1999 Supplement to IEEE Std 802.11_1999 Edition
3. IEEE Std 802.11a-1999 Supplement to IEEE Std 802.11_1999 Edition
4. IEEE Std 802.11g-2003 Amendment to IEEE Std 802.11_1999 Edition
5. IEEE Std 802.11n-2009 Amendment to IEEE Std 802.11_2007 Edition